RFSA3413

5 MHz to 6000 MHz Digial Step Attenuator

Product Overview

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.

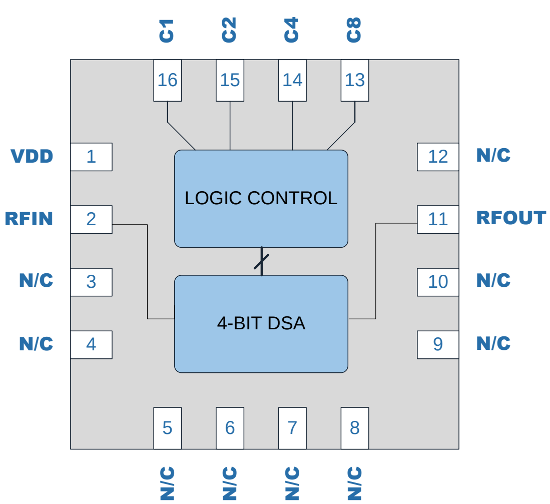
The RFSA3413 is available in a 3mm x 3mm QFN package.

16 Pad 3.0 x 3.0 x 0.85 mm QFN Package

Key Features

- 4-Bit, 15 dB Range, 1.0 dB Step
- Patented Circuit Architecture
- Overshoot-free Transient Switching Performance
- Frequency Range 5 MHz to 6000 MHz
- High Linearity, IIP3 > +55 dBm
- Parallel Control Interface
- Fast Switching, 120 ns Typical
- Single Supply 3 V to 5 V Operation
- 3V CMOS Logic Compatible
- RF Oins have No DC Voltage present, Can be DC Grounded Externally

Functional Block Diagram



Top View

Applications

- 2G through 4G Base Stations
- Point-to-Point
- WiMax / Wi-Fi
- Test Equipment

Ordering Information

Part No.	Description
RFSA3413SQ	Sample bag with 25 pieces
RFSA3413SR	7" Reel with 100 pieces
RFSA3413TR13	7" Reel with 2500 pieces
RFSA3413PCK-410	5 MHz to 6000 MHz PCBA with 5-piece sample bag

Absolute Maximum Ratings

Parameter	Rating
Storage Temperature	−40 to +150 °C
RF Input Power at RFIN, T_C=85°C	+30 dBm
RF Input Power at RFOUT, T_C=85°C	+27 dBm
Device Supply Voltage (V_{DD})	-0.5 to +6 V
All Other DC and Logic Pins, V_{DD} Appplied Prior to Any Other Pin Voltages	-0.5 to +6 V

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.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Device Supply Voltage (V_{DD}) (1)	+2.7		+5.5	V
Digital Logic High	+1.6		V_{DD}	V
Digital Logic Low	-0.2		+0.9	
Operating Temperature (2)	−40		+105	°C
Operating Junction Temperature			+125	°C

(1) Device performance is constant over this range; LDO on chip
(2) Derate RF Input Handing about 85°C

Electrical Specifications

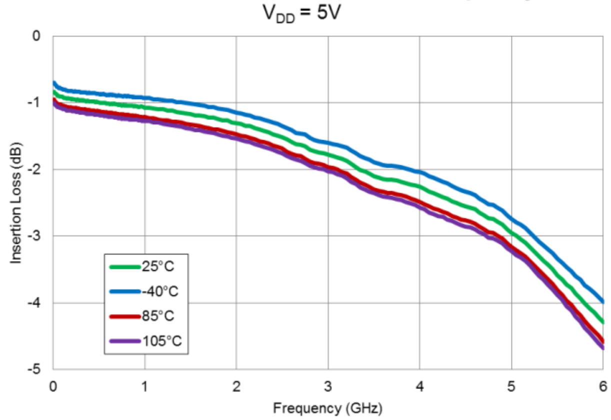
Parameter	Conditions (1)	Min	Typ	Max	Units
Operational Frequency Range		5		6000	MHz
Insertion Loss	2000MHz, 0 dB attenuation		1.4	2.8	dB
Attenuation Range	1.0 dB step size		15		dB
Absolute Attenuation Error			0.2 ±4%		dB
Input IP3			+55		dBm
Input P0.1dB			+30		dBm
Input/Output Return Loss			15		dB
Input and Output Impedance			50		Ω
Attenuation Step Time	50% control signal level to 10% / 90% RF		120		nsec
Successive Step Phase Delta	2000MHz		2		Deg
Supply Current, I_{DD}	Steady state, transient between states higher		180	300	µA
RF Input Power at RFIN	Continuous operation at +85°C case temperature			+27	dBm
RF Input Power at RFOUT	Continuous operation at +85°C case temperature			+20	dBm
Thermal Resistance, θ_{jc}	At maximum attenuation state with RF power		55		°C/W

Notes:
1. Test conditions unless otherwise noted: V_{DD} = +5.0 V, Temp = +25 °C, 2000MHz, 50 Ω system.

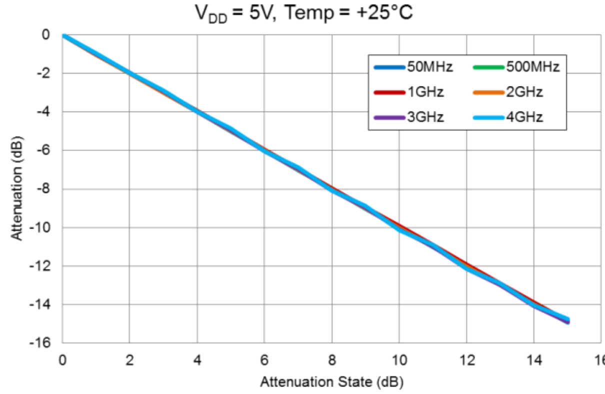
RF Typical Performance Plots

T = 25°C, V_{DD} = 5V unless otherwise noted

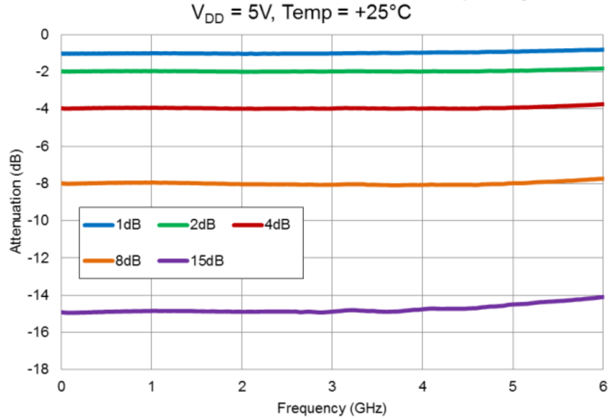
Minimum Insertion Loss versus Frequency
V_{DD} = 5V



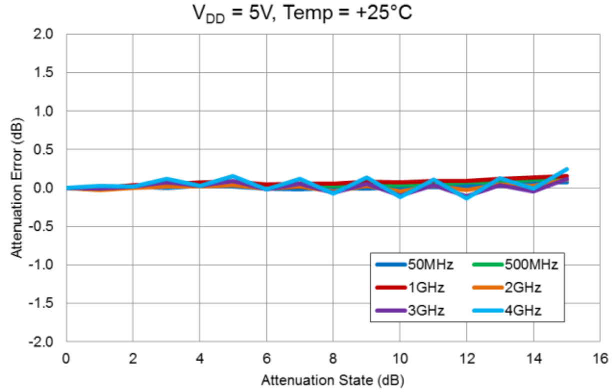
Normalized Attenuation versus Attenuation State
V_{DD} = 5V, Temp = +25°C



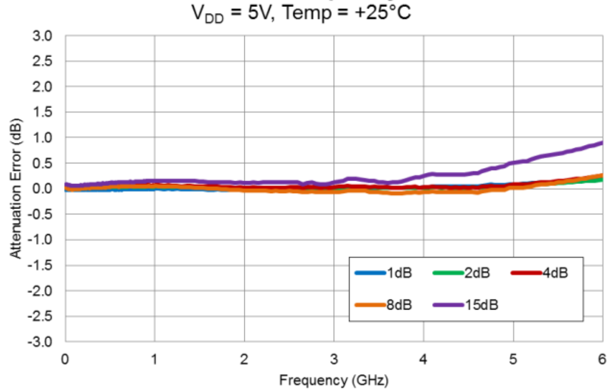
Normalized Attenuation versus Frequency
V_{DD} = 5V, Temp = +25°C



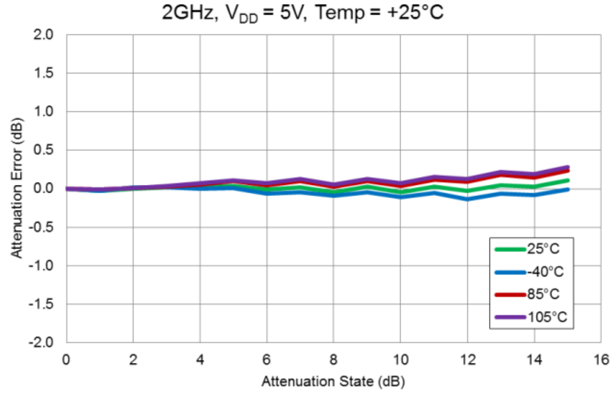
Absolute Attenuation Error versus Attenuation State
V_{DD} = 5V, Temp = +25°C



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



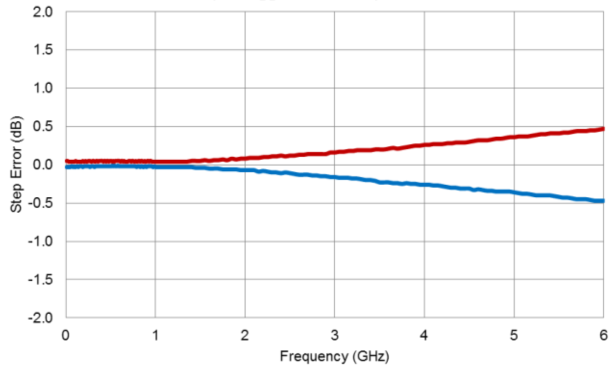
Absolute Attenuation Error versus Attenuation State
2GHz, V_{DD} = 5V, Temp = +25°C



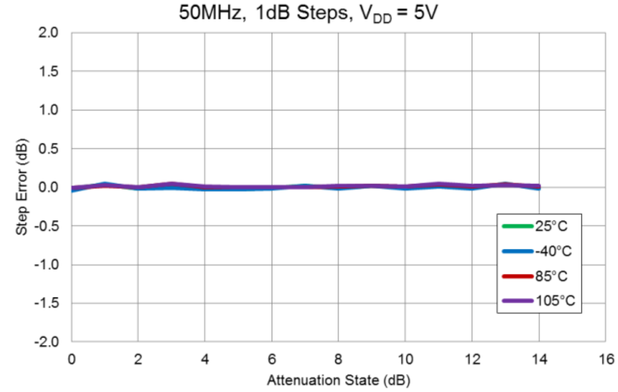
RF Typical Performance Plots (continune)

T = 25°C, V_{DD} = 5V unless otherwise noted

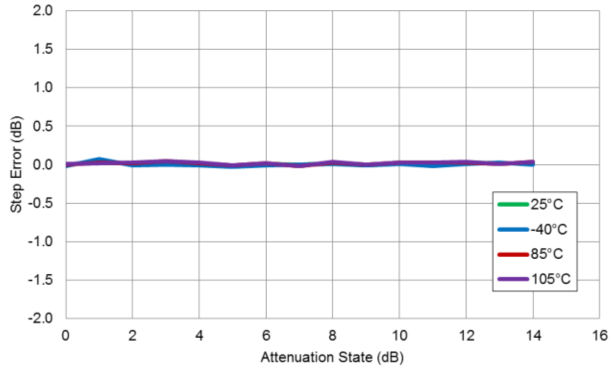
Worst Case Successive Step Error versus Frequency
1dB Steps, V_{DD} = 5V, Temp = +25°C



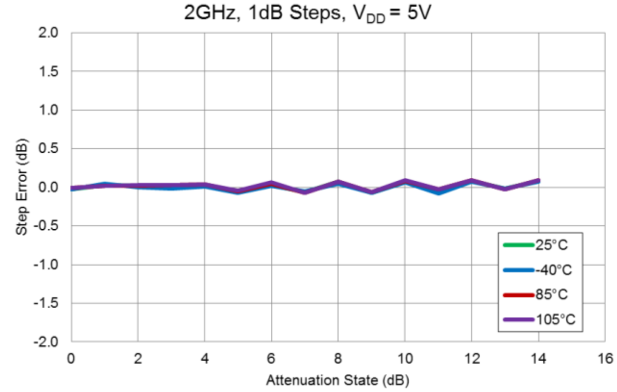
Successive Step Error versus Attenuation State
50MHz, 1dB Steps, V_{DD} = 5V



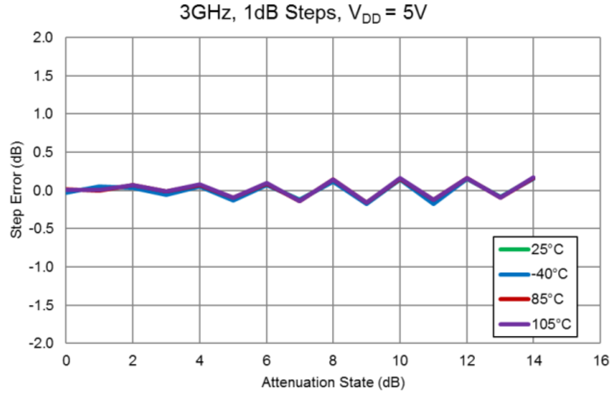
Successive Step Error versus Attenuation State
1GHz, 1dB Steps, V_{DD} = 5V



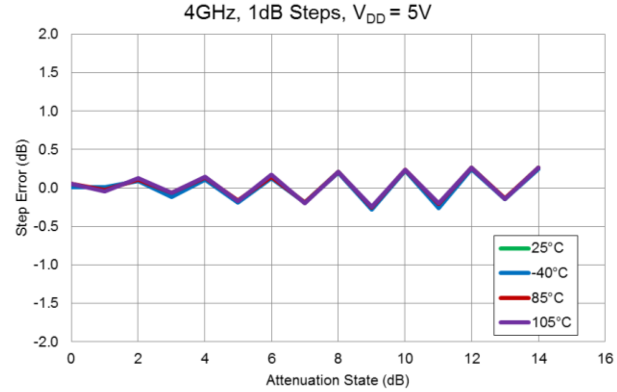
Successive Step Error versus Attenuation State
2GHz, 1dB Steps, V_{DD} = 5V



Successive Step Error versus Attenuation State
3GHz, 1dB Steps, V_{DD} = 5V

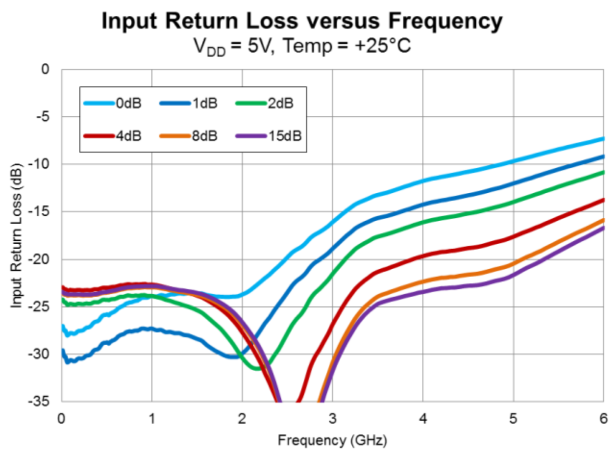


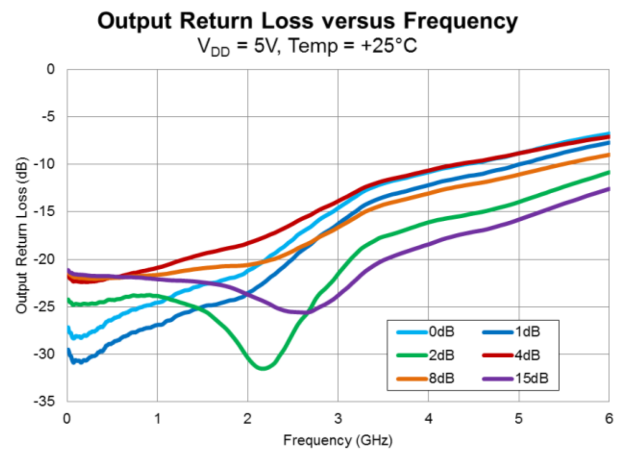
Successive Step Error versus Attenuation State
4GHz, 1dB Steps, V_{DD} = 5V

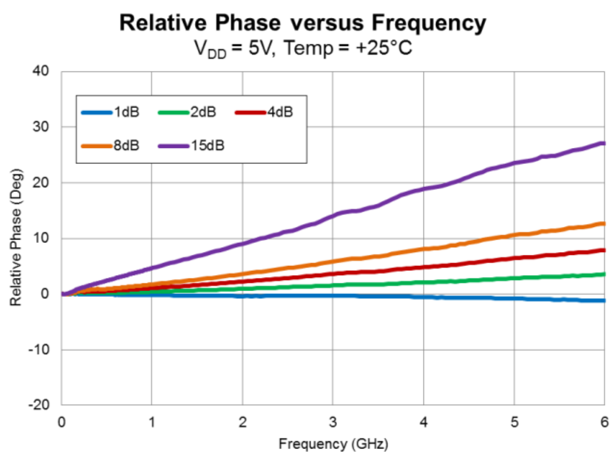


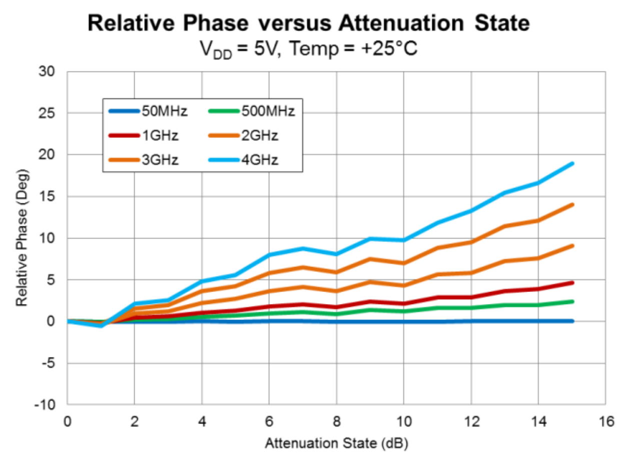
RF Typical Performance Plots (continune)

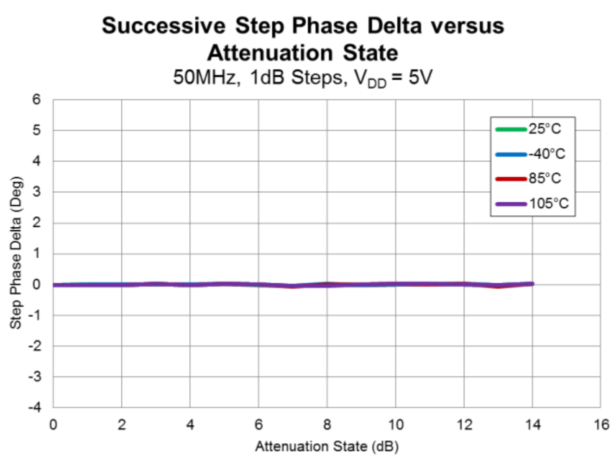
T = 25°C, V_{DD} = 5V unless otherwise noted

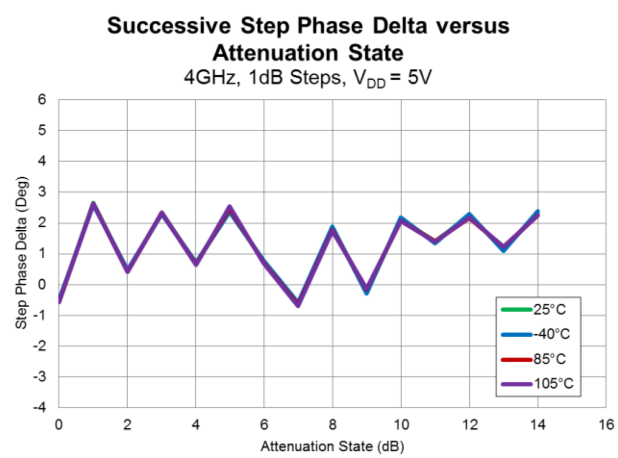








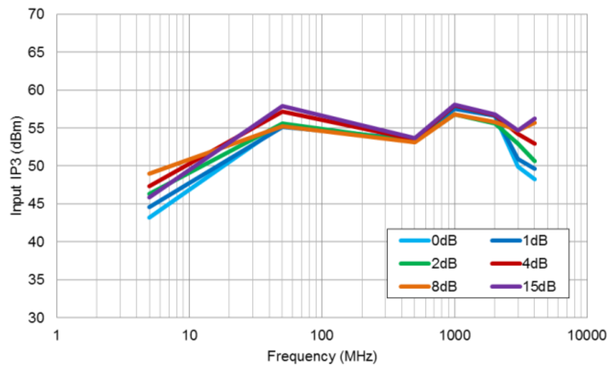




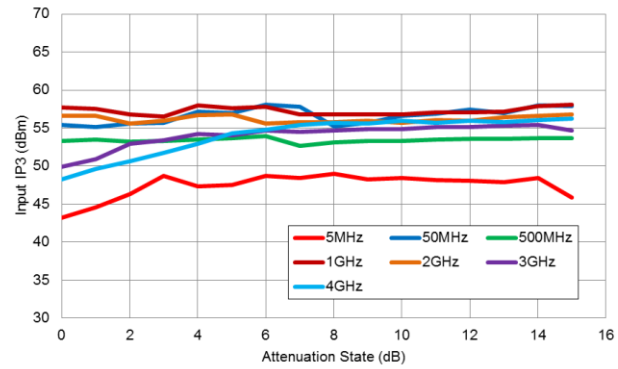
RF Typical Performance Plots (continune)

T = 25°C, V_{DD} = 5V unless otherwise noted

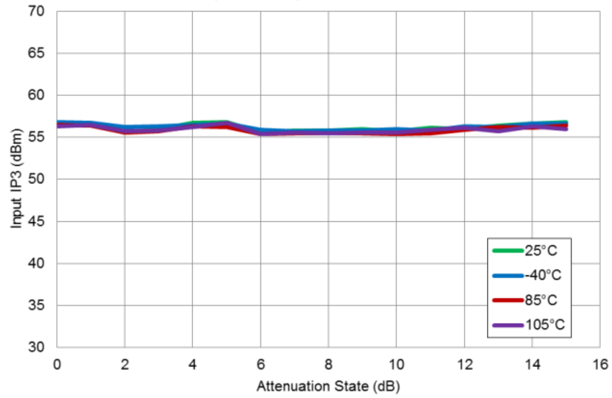
Input IP3 versus Frequency
V_{DD} = 5V, RF 50MHz to 4000MHz Pin = +18dBm/Tone,
RF 5MHz Pin = +15dBm/Tone, Temp = +25°C



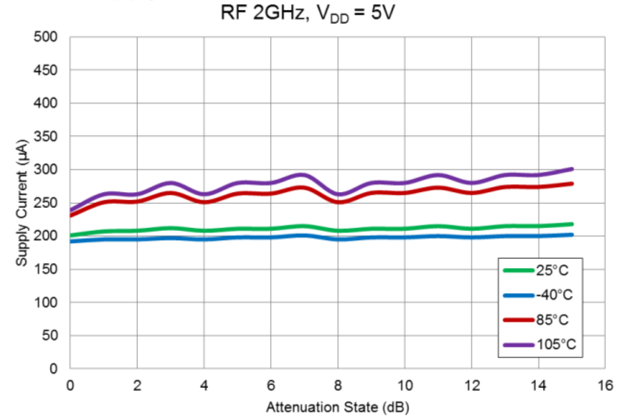
Input IP3 versus Attenuation State
V_{DD} = 5V, RF 50MHz to 4000MHz Pin = +18dBm/Tone,
RF 5MHz Pin = +15dBm/Tone, Temp = +25°C



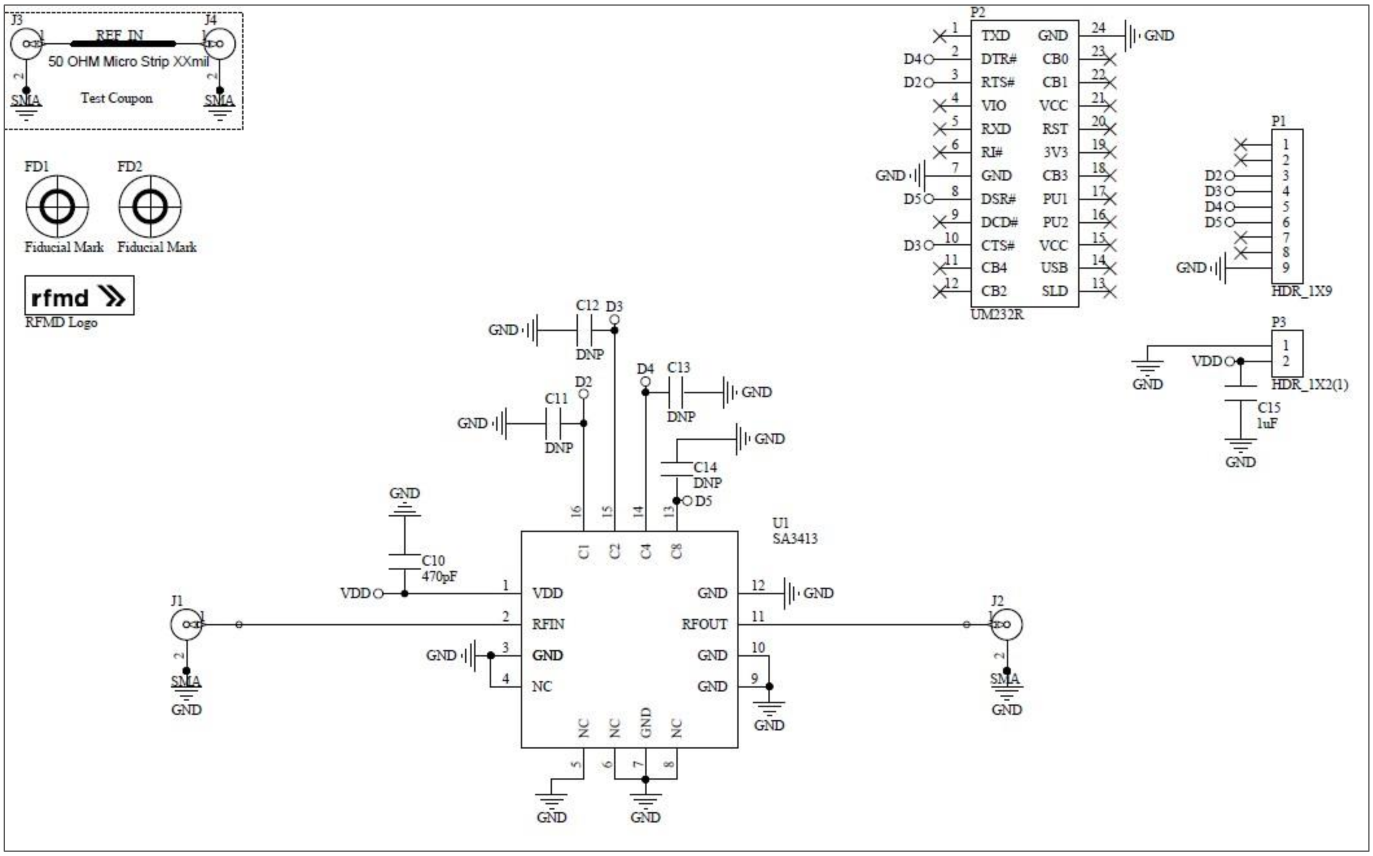
Input IP3 versus Attenuation State
RF 2GHz, Vdd=5V, Pin=+18dBm/Tone



Supply Current versus Attenuation State
RF 2GHz, V_{DD} = 5V



Evaluation Board Schematic, RFSA2534PCK-410 5MHz to 6000MHz



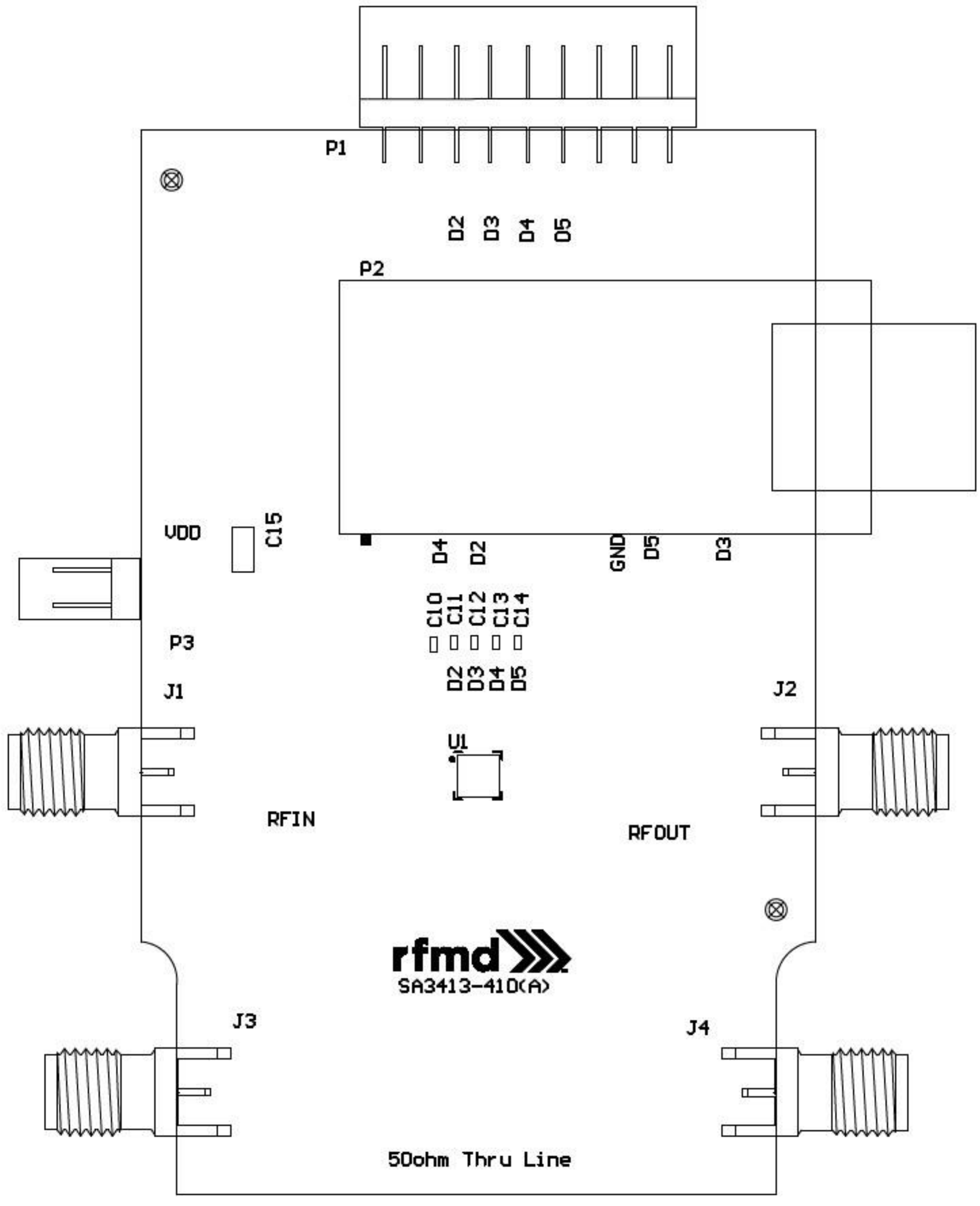
Bill of Material – RFSA3413PCK-410

Reference Des.	Value	Description	Manuf.	Part Number
n/a	n/a	Printed Circuit Board	Qorvo	SA3413-410(A)
U1	n/a	Module, Digital Step Attenuator, 5-6000MHz	Qorvo	RFSA3413
C10	470 pF	CAP, 470pF, 5%, 50V, C0G, 0402	Murata Electronics	GRM1555C1H471JA01D
C15	1 µF	CAP, 1 µF, 10%, 25V, X7R, 1206	Taiyo Yuden (USA), Inc.	CE TMK316BJ105KL-T
J1, J2, J3, J4	n/a	CONN, SMA, END LNCH, UNIV, HYB MNT, FLT	Molex	SD-73251-4000
P1	n/a	CONN, HDR, ST, 9-PIN, 0.100"	SAMTEC	TSW-109-07-G-S
P2	n/a	CONN, SKT, 24-PIN DIP, 0.600", T/H	Aries Electronics Inc.	24-6518-10
P3	n/a	CONN, HDR, ST, PLRZD, 2-PIN, 0.100"	ITW Pancon	MPSS100-2-C
M1	n/a	Module, USB to Serial Uart, SSOP-28	Future Technology Devices	UM232R

Notes:

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

Evaluation Board Assembly, RFSA3413PCK-410 5MHz to 6000MHz



RFSA3413 Programming by Using USB Interface

Refer to Qorvo 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 Qorvo Parts List of the CBG user interface. Set the attenuation value using the CBG Graphic User Interface (GUI). The attenuator is set to the desired state and measurements can be taken.

RFSA3413 Programming by Using Its Parallel Bus

This configuration allows the user to control the attenuator through the P1 connector using an external harness. Remove the USB interface board 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.

Power-up State

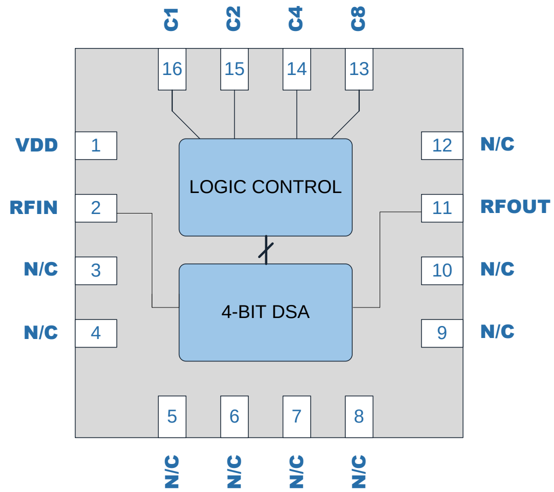
The default state is minimum attenuation (0dB) when supply voltage is applied to the attenuator. If a different attenuation state is desired during power up, this can be accomplished by applying signals according to the Parallel Interface Attenuation Truth Table. The attenuator will power up to the state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

Control Bit Truth Table (Major

D5 (C8)	D4 (C4)	D3 (C2)	D2 (C1)	Attenuation State
H	H	H	H	0 dB *
H	H	H	L	1 dB
H	H	L	H	2 dB
H	L	H	H	4 dB
L	H	H	H	8 dB
H	H	H	H	15 dB

*0 dB Reference State with the Insertion Loss as specified

Pad Configuration and Description

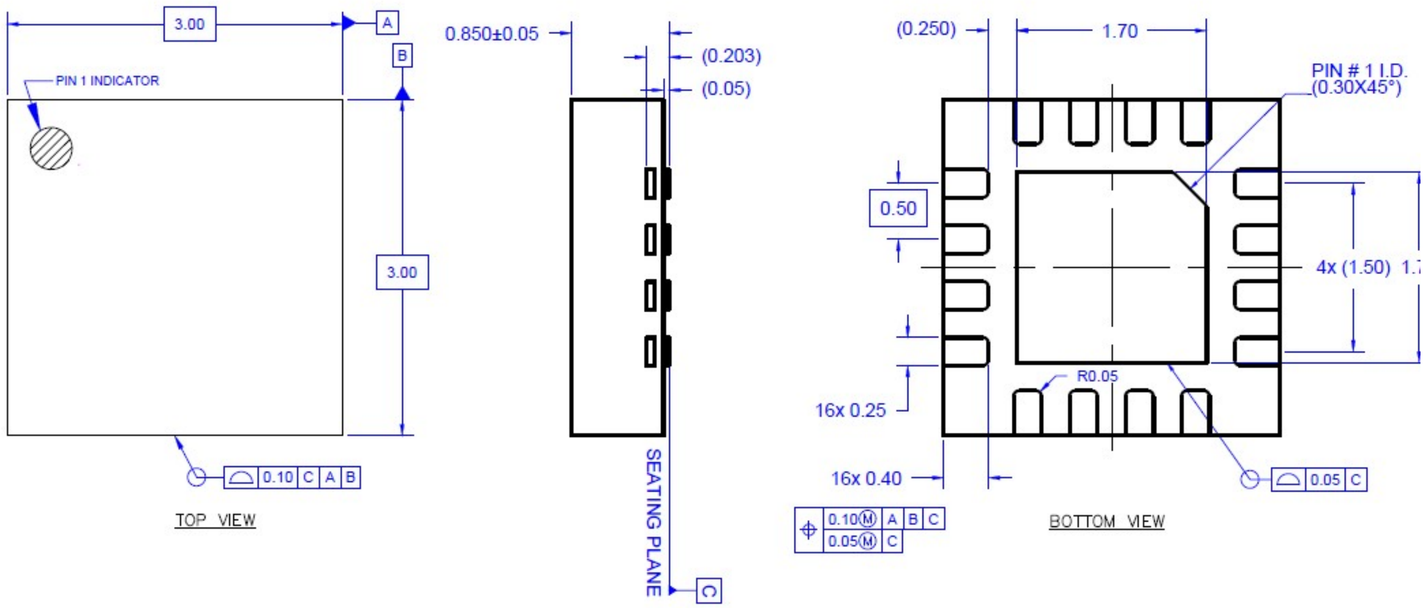


Top View

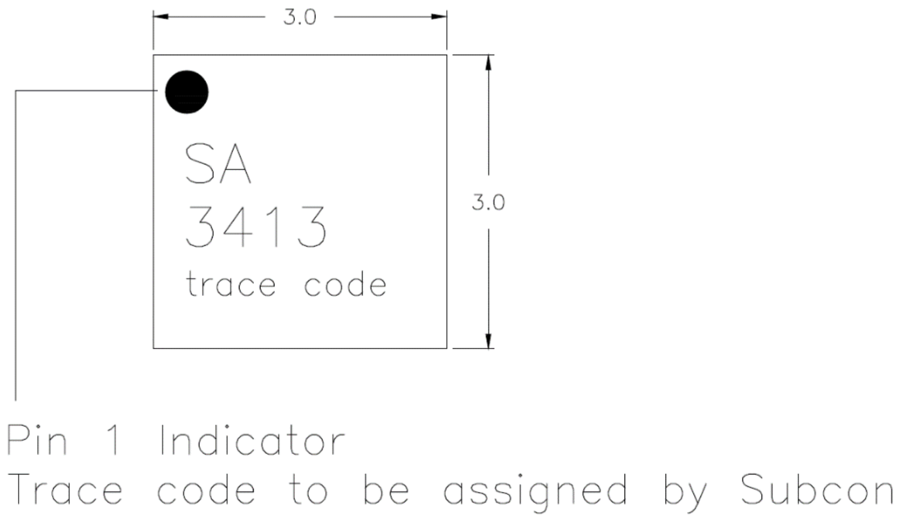
Pad No.	Label	Description
1	VDD	Supply Voltage
2	RFIN	RF Input: Incident RF power must enter this pin for rated thermal performance and reliability. Do not apply DC power to this pin. Pin may be DC grounded externally and is grounded thru resistors internal to the part.
3, 4, 5, 6, 7, 8, 9, 10, 12	NC	No Internal Connection. Land pads should be provided on PCB for mounting integrity.
11	RFOUT	RF Output Pin; Pin may be DC grounded externally and is grounded thru resistors internal to the part.
13	C8	8 dB Bit, Parallel Control Input; 3V CMOS compatible logic.
14	C4	4 dB Bit, Parallel Control Input; 3V CMOS compatible logic.
15	C2	2 dB Bit, Parallel Control Input; 3V CMOS compatible logic.
16	C1	1 dB Bit, Parallel Control Input; 3V CMOS compatible logic.
Backside Paddle	GND	RF/DC ground. Quantity 9 Ground via holes recommended.

Package Outline

(Dimensions in Millimeters)



Package Marking



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C	ESDA / JEDEC JS-001-2012
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	Level 1	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

Solderability

Compatible with both lead-free (260°C max. reflow temp.) and tin/lead (245°C max. reflow temp.) soldering processes.
Solder profiles available upon request.

Contact plating: Matte Sn

RoHS Compliance

This part is compliant with 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.

This product also has the following attributes:

- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_{4}0_{2}$) Free
- PFOS Free
- SVHC Free

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

Web: **www.qorvo.com** **Tel: 1-844-890-8163**

Email: **customer.support@qorvo.com**

For technical questions and application information:

Email: **appsupport@qorvo.com**

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