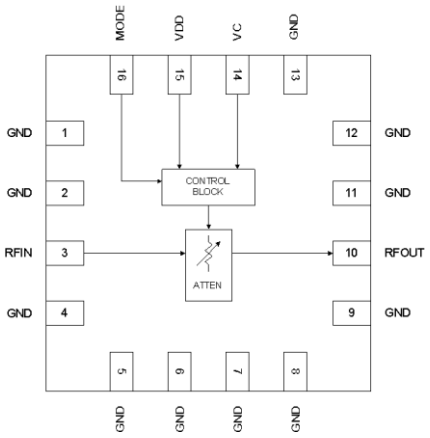
RFSA3043

75Ω Voltage Controlled Attenuator (5 – 3000 MHz)

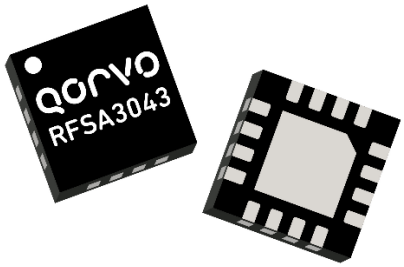
Product Overview

The RFSA3043 is a fully monolithic analog voltage-controlled attenuator (VCA) featuring exceptional linearity over a typical temperature compensated 30 dB gain control range. It incorporates a revolutionary new circuit architecture to solve a long–standing industry problem: high IP3, high attenuation range, low DC current, broad bandwidth and temperature compensated linear in dB control voltage characteristic. This voltage–controlled attenuator is controlled by a single positive control voltage with on–chip DC conditioning circuitry. The slope of the control voltage versus gain is selectable. The RFSA3043 draws a very low 2 mA current and is packaged in a small 3 mm x 3 mm QFN. This attenuator is matched to 75 Ω over its rated control range and frequency with no external matching components required.

Functional Block Diagram



Top View



QFN, 16–pin, 3.0 mm x 3.0 mm

Key Features

- Broadband 5 – 3000 MHz frequency range
- 30 dB attenuation range
- +50 dBm Input IP3 (typical)
- +80 dBm Input IP2 (typical)
- Low Distortion: -80 dBc CSO and -75 dBc CTB for 132 channel 38 dBmV input
- High 1 dB compression point (> +30 dBm)
- Low supply current: 2 mA (typical)
- 3 V to 5 V power supply
- Linear in dB control characteristic

Applications

- Cable Modems
- CATV
- High Linearity Power Control

Ordering Information

Part Number	Description
RFSA3043SQ	Sample Bag with 25 Pieces
RFSA3043TR7	7" Reel with 2500 Pieces
RFSA3043PCK-410	EVB with 5 Piece Sample Bag

Absolute Maximum Ratings

Parameter	Rating
Control Voltage (V_C)	−0.5 to +6.0 V
Supply Voltage (V_{DD})	−0.5 to +6.0 V
Mode Pin Voltage (MODE)	−0.5 to +6.0 V
Storage Temperature Range	−65 to +150 °C

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
Operating Temperature	−40		+105	°C
Junction Temperature			+125	°C
RF Power Supply Voltage	3	5	5.5	V

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

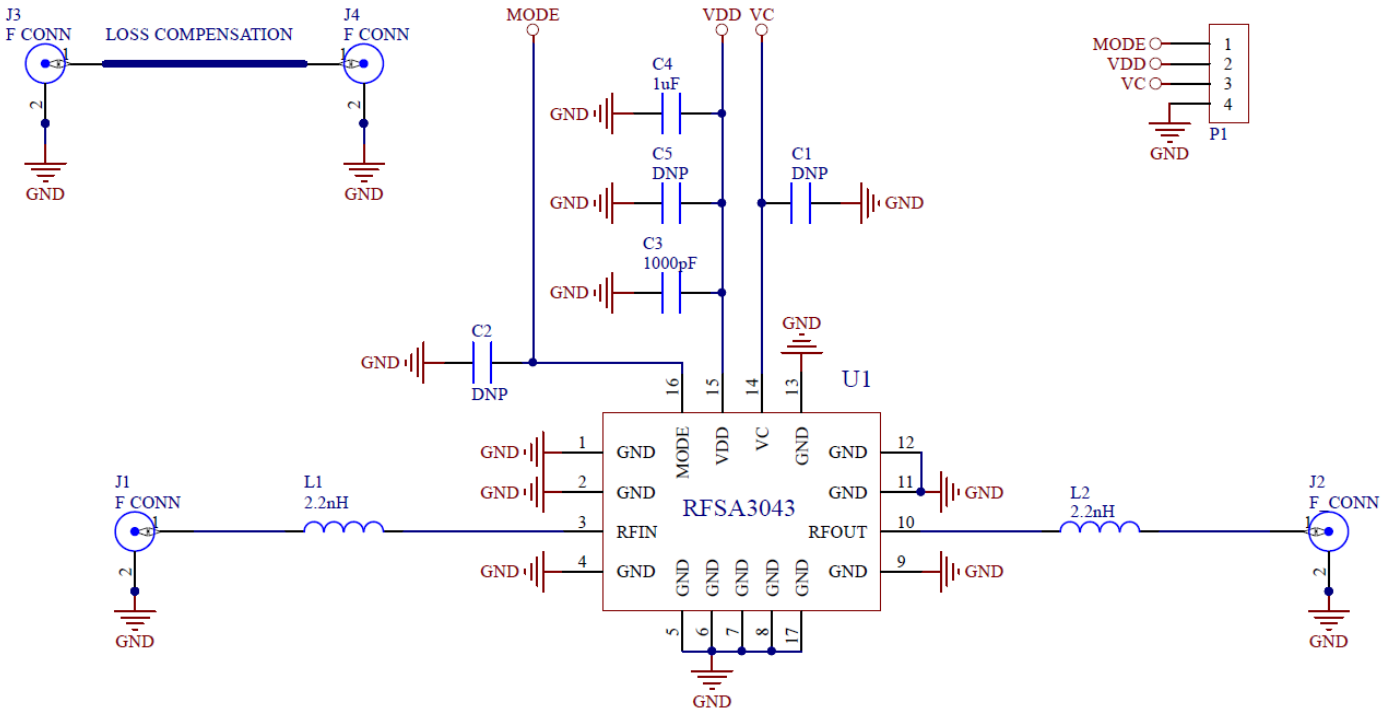
Electrical Specifications

Parameter	Condition (1)	Min	Typ	Max	Unit
Supply Current (I_{SS})	Steady state operation, current draw during attenuation state transitions is higher.		2		mA
Thermal Resistance	T_{REF} taken at +85 °C from backside of PCB		35		°C / W
RF Input Power				27	dBm
Frequency Range		5		3000	MHz
Minimum Insertion Loss			1.5	2.0	dB
Gain Control Range		30	35		dB
Gain v Temperature	Peak to peak gain variation over temperature for fixed control voltage		1.5		dB
Return Loss			15		dB
Relative Phase	Insertion phase at 15 dB attenuation relative to Minimum attenuation		5		degree
Input 1 dB Compression Point			30		dBm
Input IP3	P_{IN} + ($IM3_{dBc}$ / 2)		50		dBm
Input IP2	P_{IN} + ($IM2_{dBc}$) IM2 is f1 + f2		80		dBm
Input IH2	P_{IN} + $H2_{dBc}$ H2 is second harmonic		85		dBm
Input IH3	P_{IN} + ($H3_{dBc}$ / 2) H3 is third harmonic		55		dBm
CSO	55.25 MHz to 865.25 MHz, 132 channel, +38 dBmV Input, flat tilt		-80		dBc
CTB			-75		dBc
XMOD			-70		dBc
Voltage Control Range Positive Attenuation Slope	5 V control voltage is lowest insertion loss MODE pin high	0		5	V
Voltage Control Range Negative Attenuation Slope	0 V control voltage is lowest insertion loss MODE pin low	0		5	V
Voltage Control Pin Current	V_C pin at 5 V MODE pin high		37		µA
Voltage Control Pin Current	V_C pin at 5 V MODE pin low		37		µA
MODE Pin Logic Low				0.4	V
MODE Pin Logic High		1			V
Setting Time	1 dB attenuation change settling with 0.1 dB		10		µSec

Notes:

1. Typical performance at these conditions: Temp. = +25 °C, V_{DD} = +5 V, 1000 MHz

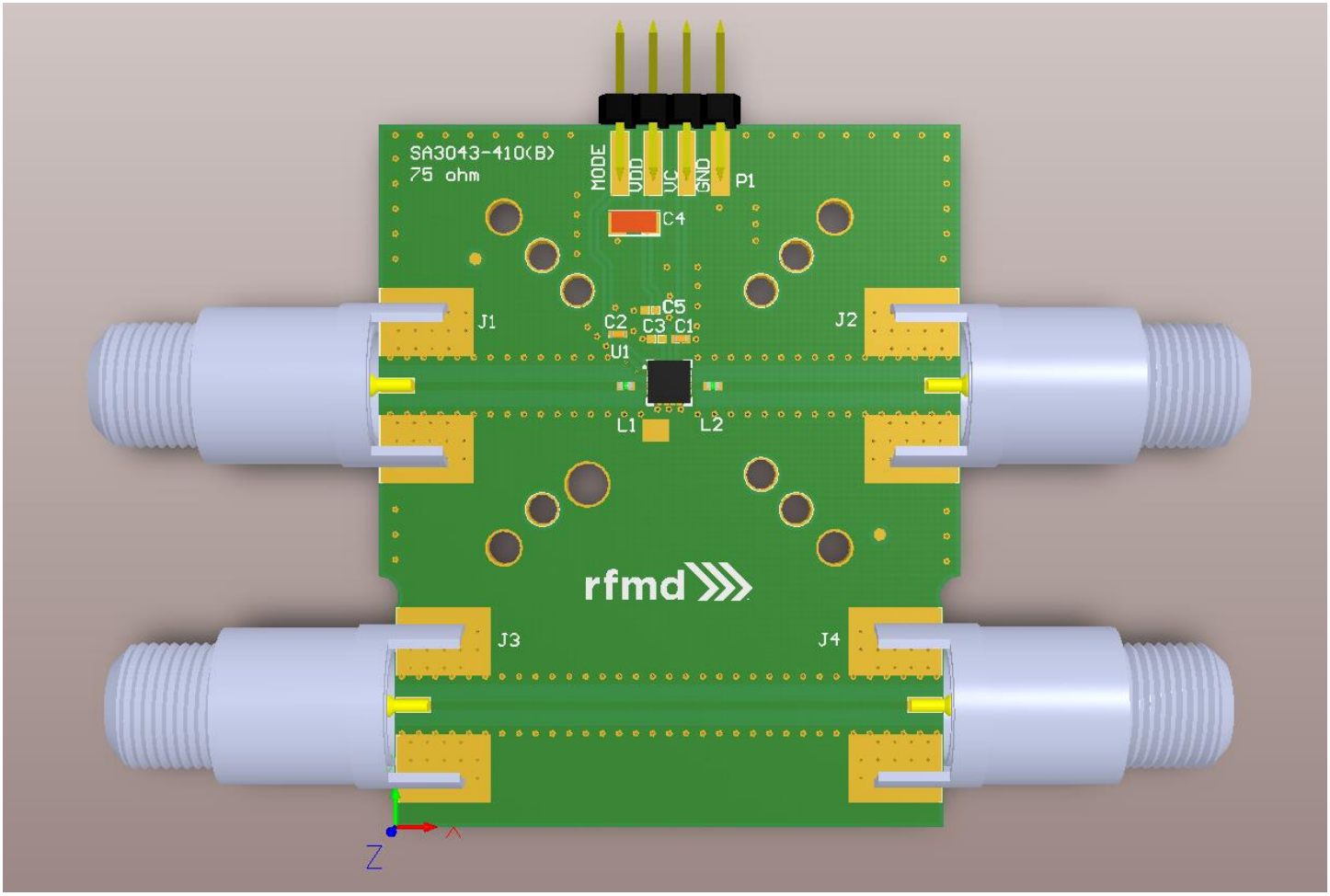
Evaluation Board Schematic



Bill of Materials

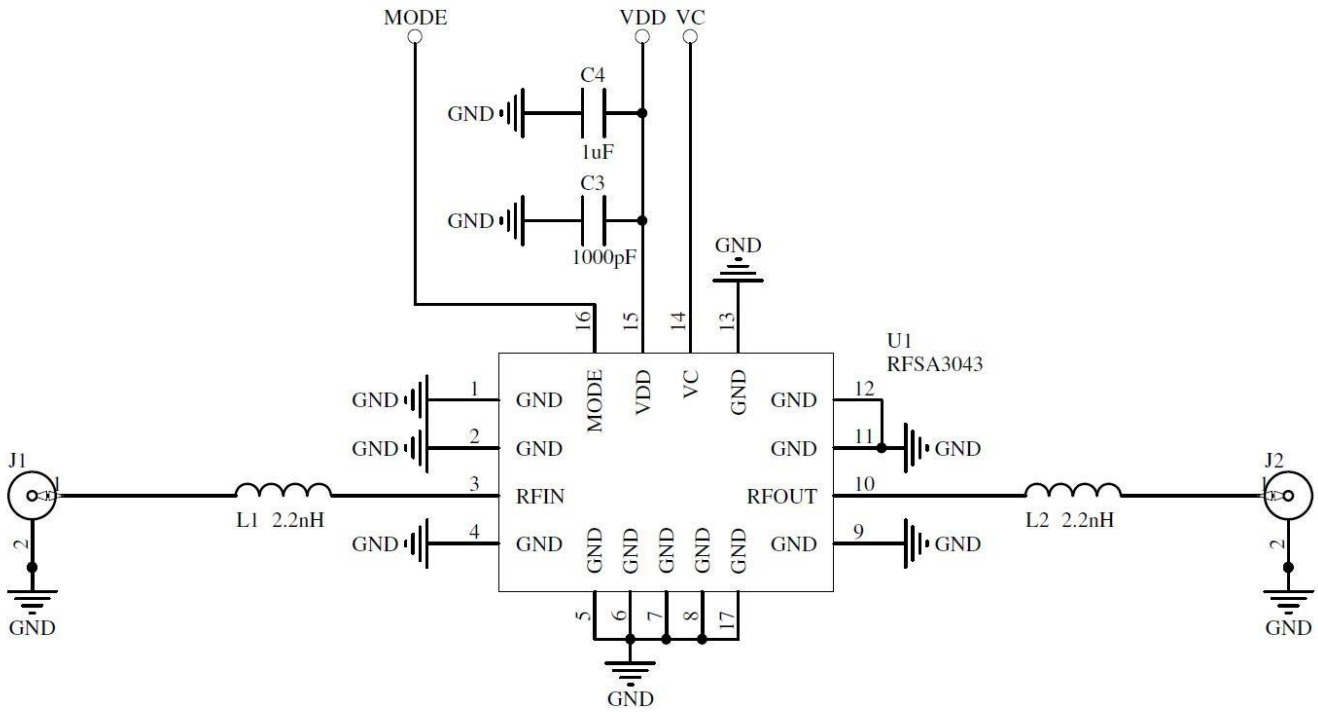
Ref Des	Description	Manufacturer	Manufacturer Part #
U1	CATV Voltage Controlled Attenuator	Qorvo	RFSA3043
PCB	SA3043-410 Evaluation Board	DDI	SA3043-410(B)
J1-J4	CONN, F FEM EDGE MOUNT, 75Ω, 0.065”	Genesis Technology USA	GT20-300204
P1	CONN, HDR, ST, 4-PIN, 0.100”	Samtec, Inc.	TSW-104-08-S-S
C3	CAP, 1000 pF, 10%, 25 V, X7R, 0402	Murata Electronics	GRM155R71H102KA01D
C4	CAP, 1 µF, 10%, 16 V, X7R, 1206	Murata Electronics	500R07S0R8AV4T
L1, L2	IND, 2.2 nH, +/-0.1 nH, T/F, 0402	Murata Electronics	LQP15MN2N2B02D
C1, C2, C5	DNP	N/A	N/A

Evaluation Board Assembly Drawing



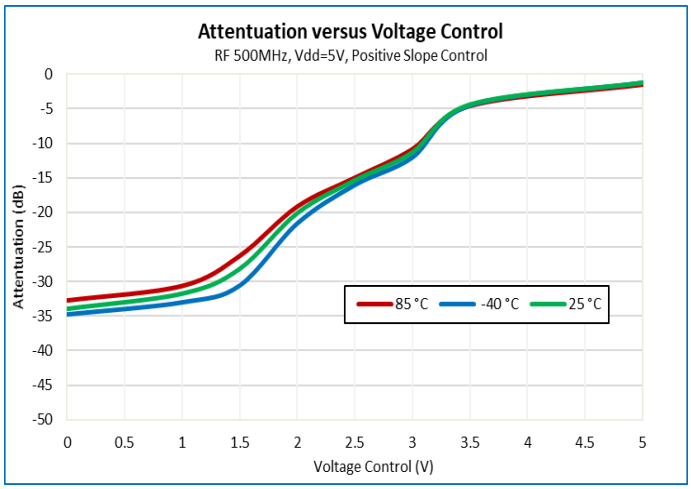
Note: J3-J4 used for loss compensation

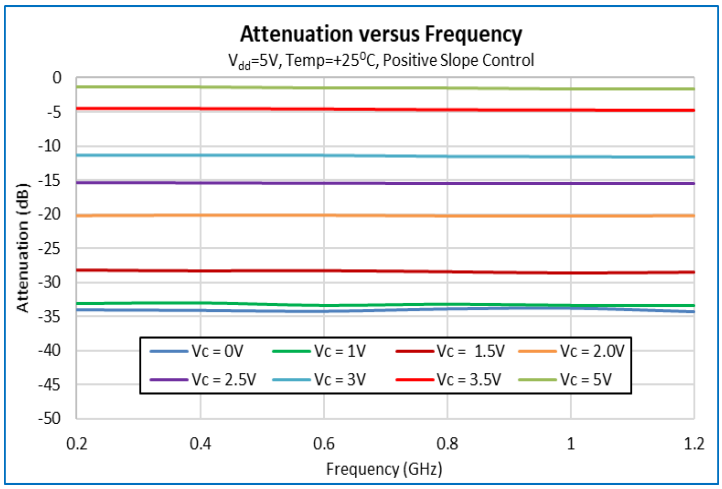
Application Schematic

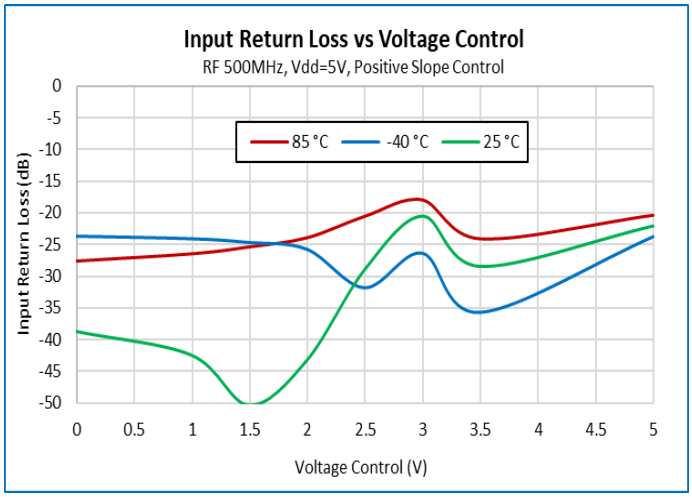


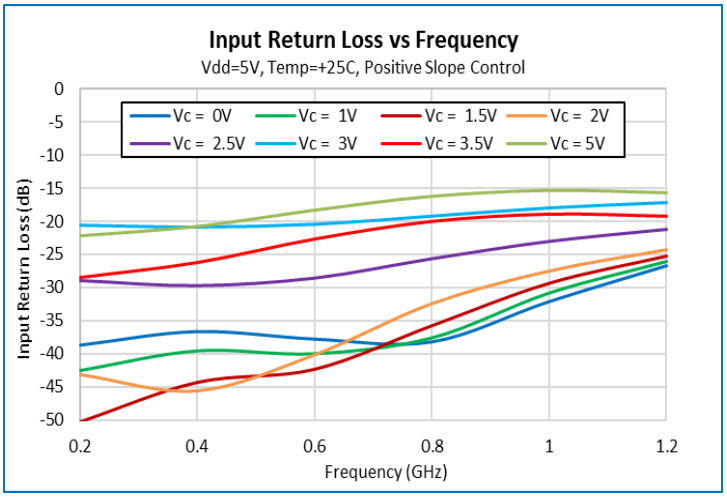
Performance Data

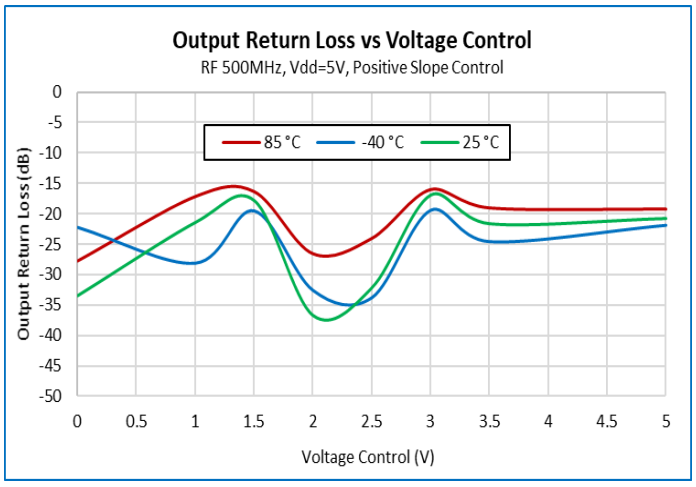
Test conditions unless otherwise stated: Temp.= + 25 °C, V_{DD} = + 5 V, Frequency = 2000 MHz

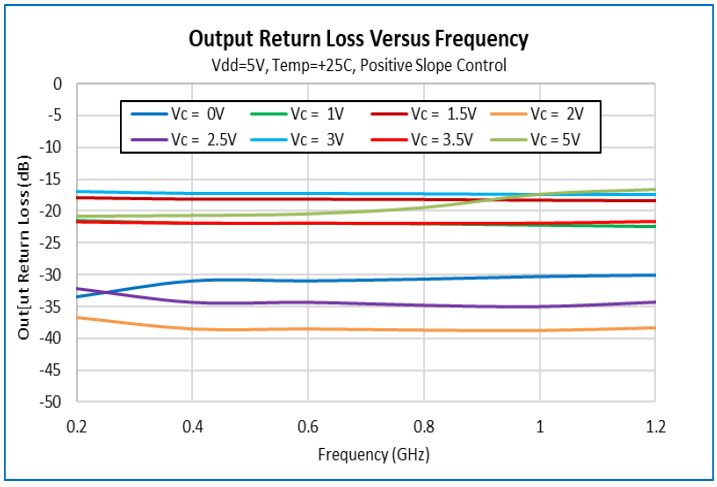










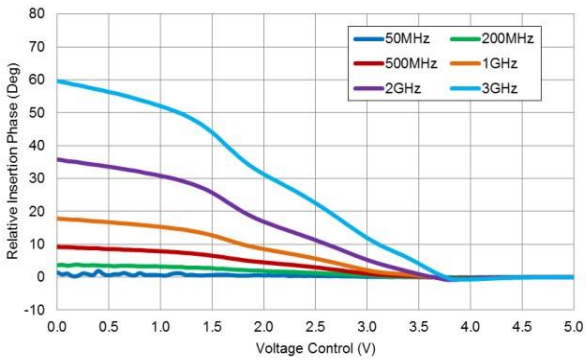


Performance Data (continued)

Test conditions unless otherwise stated: Temp.= + 25 °C, V_{DD} = + 5 V, Frequency = 2000 MHz

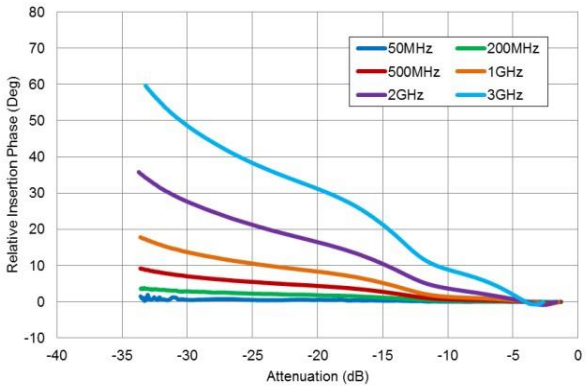
Relative Insertion Phase versus Voltage Control

V_{DD}=5V, Temp=+25°C, Positive Slope Control



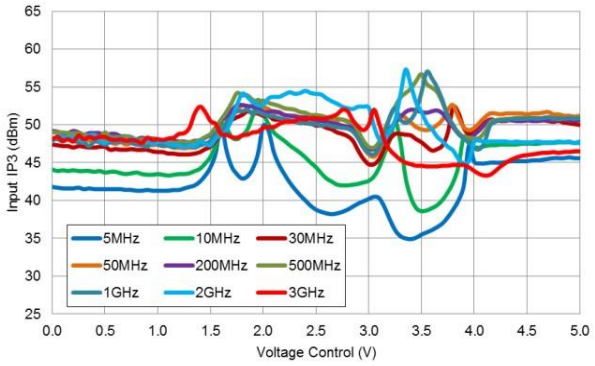
Relative Insertion Phase versus Attenuation

V_{DD}=5V, Temp=+25°C, Positive Slope Control



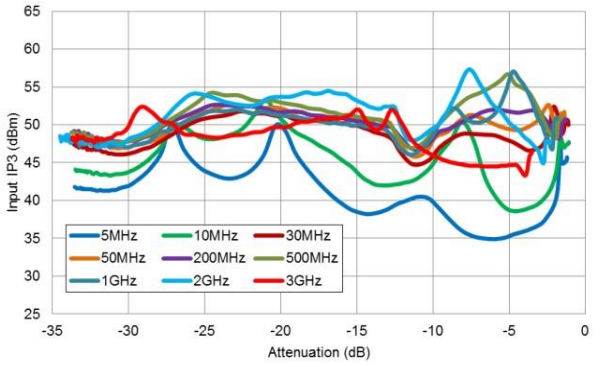
Input IP3 versus Voltage Control

V_{DD}=5V, Pin=+15dBm/Tone, Temp=+25°C, Positive Slope Control



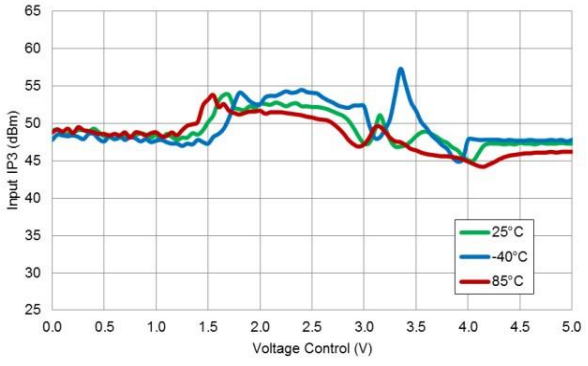
Input IP3 versus Attenuation

V_{DD}=5V, Pin=+15dBm/Tone, Temp=+25°C, Positive Slope Control



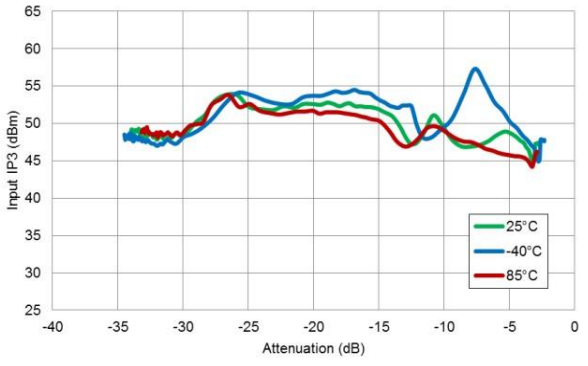
Input IP3 versus Voltage Control

RF 2GHz, V_{DD}=5V, Pin=+15dBm/Tone, Positive Slope Control



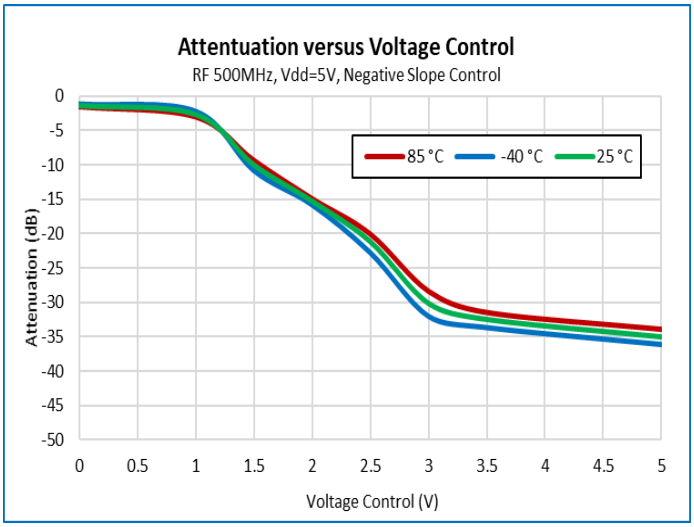
Input IP3 versus Attenuation

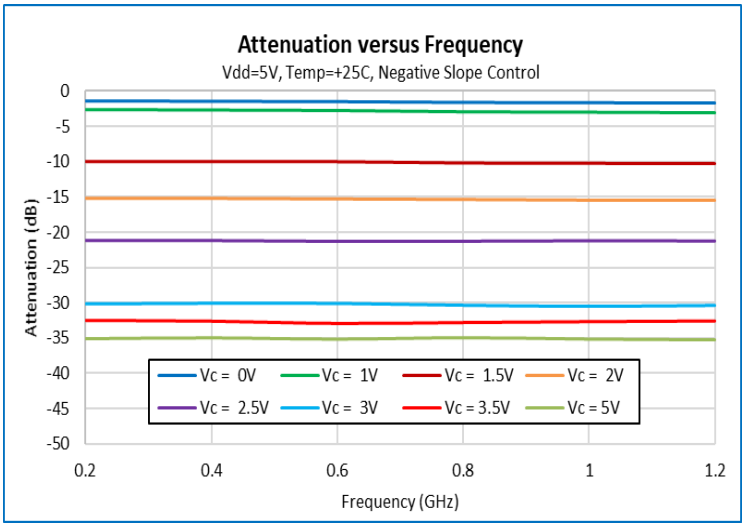
RF 2GHz, V_{DD}=5V, Pin=+15dBm/Tone, Positive Slope Control

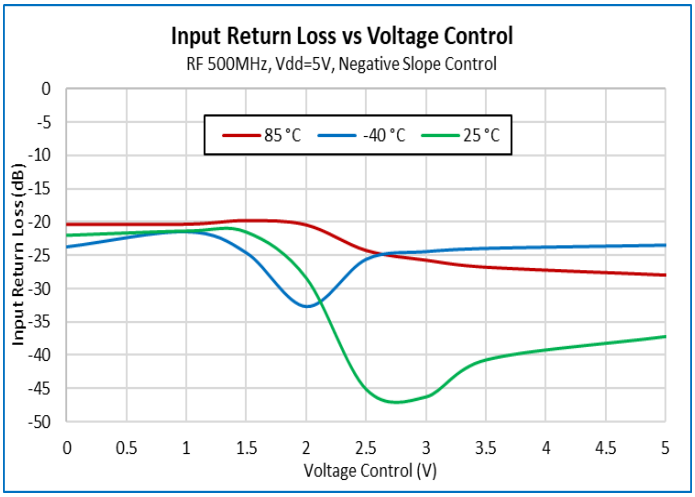


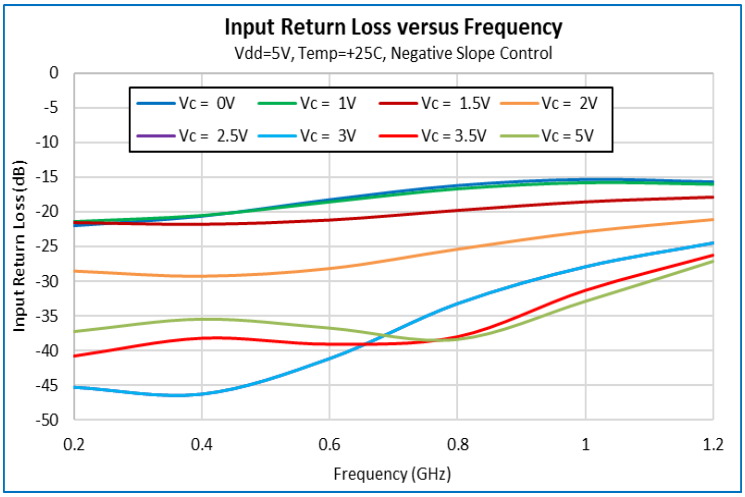
Performance Data (continued)

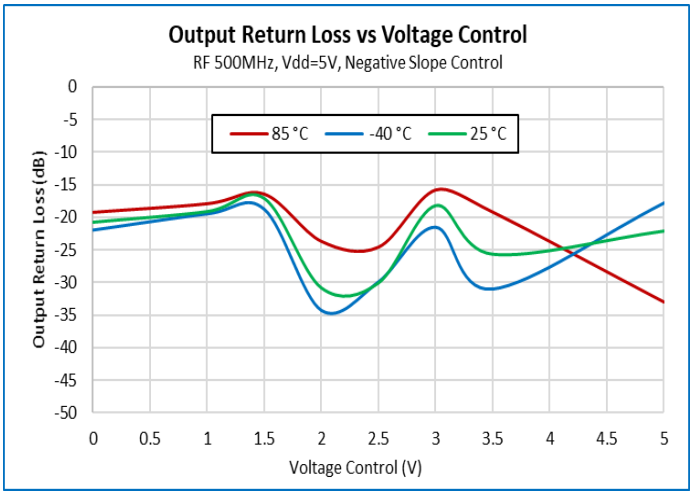
Test conditions unless otherwise stated: Temp.= + 25 °C, V_{DD} = + 5 V, Frequency = 2000 MHz

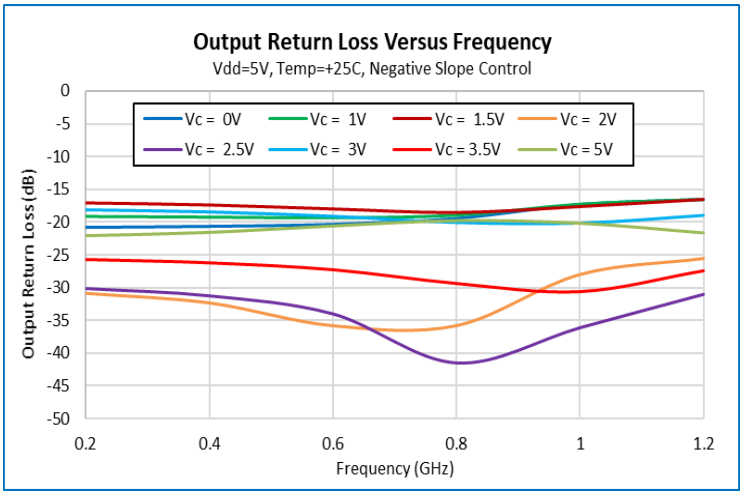






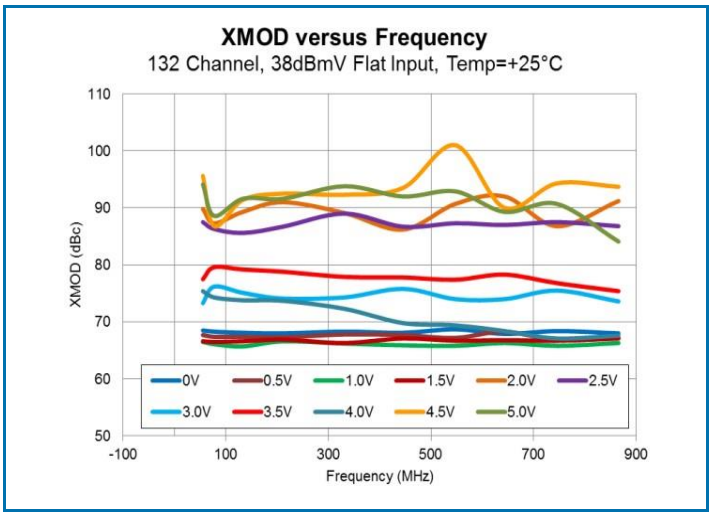


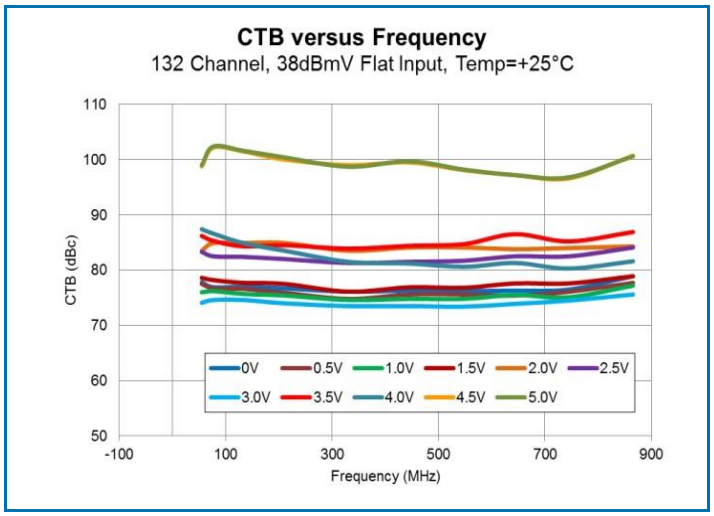


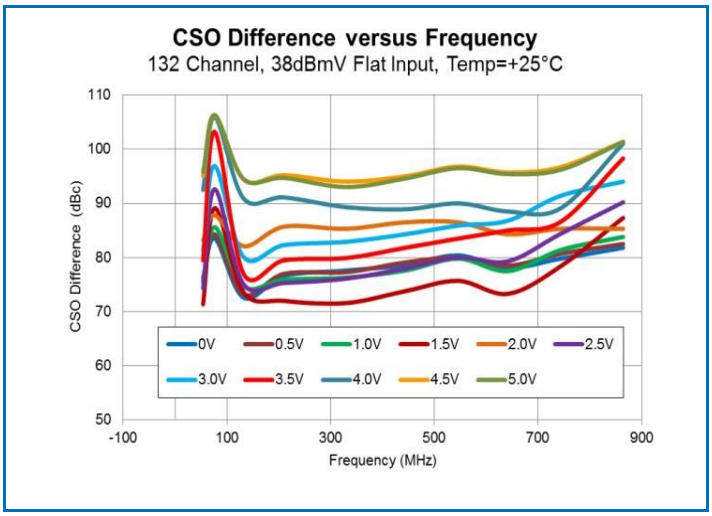


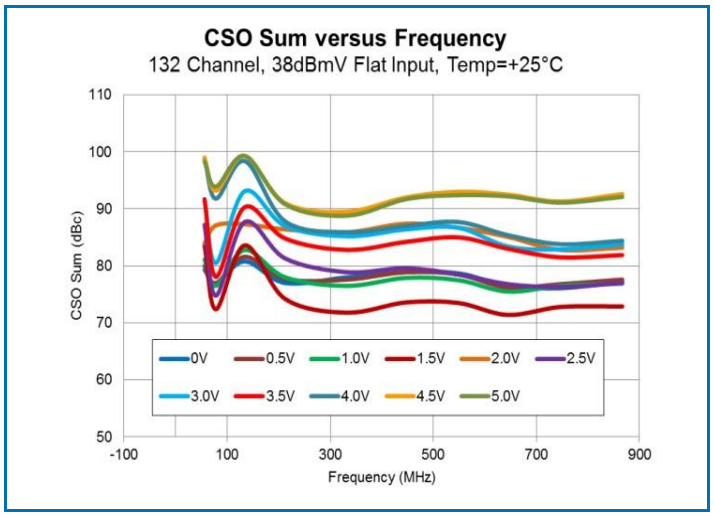
Performance Data (continued)

Test conditions unless otherwise stated: Temp.= + 25 °C, V_{DD} = + 5 V, Frequency = 500 MHz



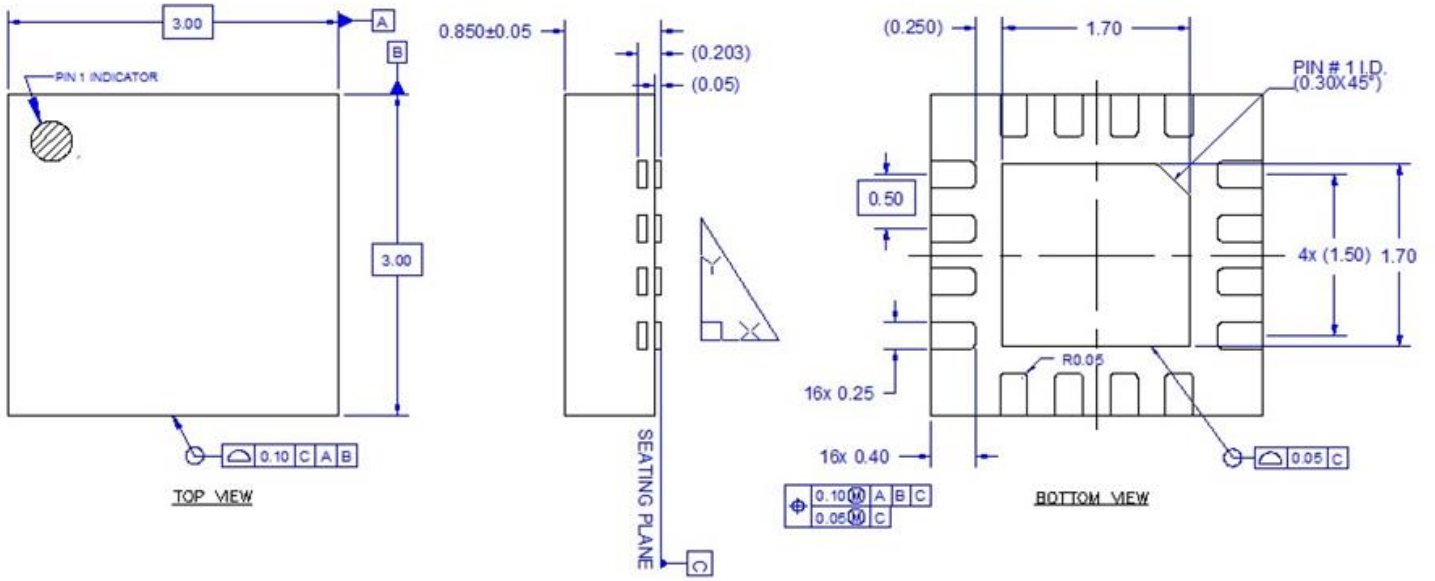






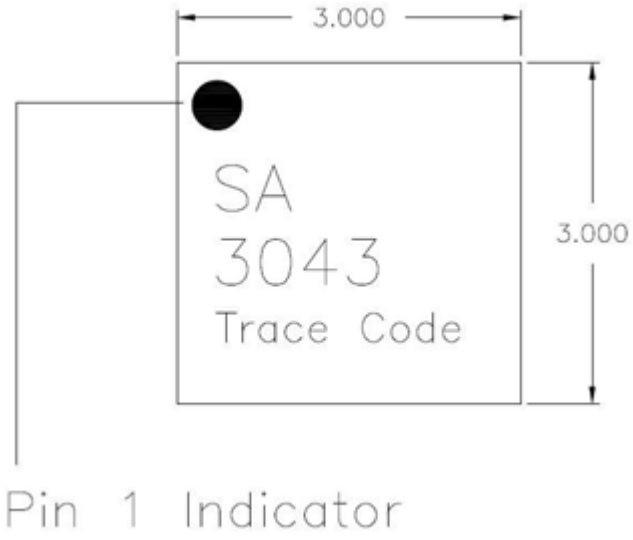
Notes: L1 and L2 = 0 Ω

Package Dimensions



Notes:
1. Dimensions in millimeters

Package Marking



Pin Configuration and Description

Pin	Name	Description
1	GND	Ground Pin
2	GND	Ground Pin
3	RF IN	RF Input, use external DC block. RF input must be this pin to insure linearity and thermal resistance specifications.
4	GND	Ground Pin
5	GND	Ground Pin
6	GND	Ground Pin
7	GND	Ground Pin
8	GND	Ground Pin
9	GND	Ground Pin
10	RF OUT	RF Output, use external DC block. RF output must be this pin to insure linearity and thermal resistance specifications.
11	GND	Ground Pin
12	GND	Ground Pin
13	GND	Ground Pin
14	V_C	Attenuator Control Voltage
15	V_{DD}	Supply Voltage
16	MODE	Attenuation Slope Control Set logic LOW to enable negative attenuation slope Set logic HIGH to enable positive attenuation slope

Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 2 (2000 V)	ESDA / JEDEC JS-001-2010
ESD – Charged Device Model (CDM)	Class C3 (1000 V)	JEDEC JESD22-C101
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:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) Free
- SVHC Free
- PFOS 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

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