

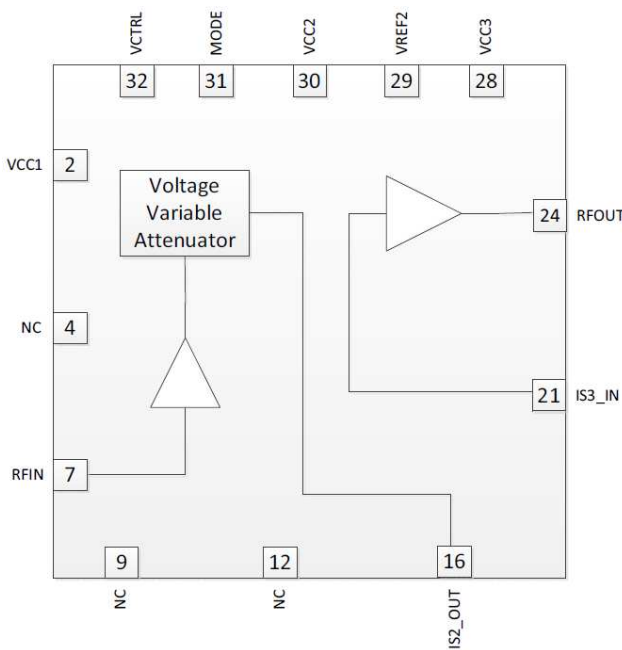
### General Description

Qorvo's RFVA0016 is an integrated analog controlled variable gain amplifier for broadband applications with external matching to allow for configurations in different bands with a single module. It features exceptional linearity over a greater than 30dB gain control range. This variable gain amplifier is controlled by a single 0V to 3.3V positive supply voltage when mode pin is 0V or 5V to 0V positive supply voltage when mode pin is 5V. The RFVA0016 is packaged in a small 5.2mm x 5.2mm leadless laminate MCM which contains thermal vias for ultra-low thermal resistance. This module is external matched to 50 Ω at each individual band.



MCM, 32-Pin, 5.2mm x 5.2mm

### Functional Block Diagram



Top View

### Product Features

- Frequency Range 400MHz to 2810MHz
- Mode Pin to Switch the Attenuation Slope
- Gain = 25dB Typical
- Gain Control Range = >30dB
- ACPR > -60dBc Typical at
- +10dBm POUT (Dual Carrier WCDMA)
- Small 5.2mm x 5.2mm, Multi-Chip Module
- +5V Supply

### Applications

- Cellular, 3G Infrastructure
- WiBro, WiMax, LTE
- Microwave Radio
- High Linearity Power Control

### Ordering Information

Part No.	Description
RFVA0016SQ	Sample bag with 25 pieces
RFVA0016SR	7" Reel with 100 pieces
RFVA0016TR7	7" Reel with 750 pieces
RFVA0016TR13	13" Reel with 2500 pieces
RFVA0016PCK-410	2110MHz to 2170MHz PCBA with 5-piece sample bag

## Absolute Maximum Ratings

Parameter	Rating
Supply Voltage	5.5 V
Control Voltage	5.5 V
DC Supply Current	270 mA
RF Input	+24 dBm
Operating Junction Temperature	170 °C
Storage Temperature	-40 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 Range	-40		+105	°C
Tj for >10 <sup>6</sup> hours MTTF			+170	°C

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

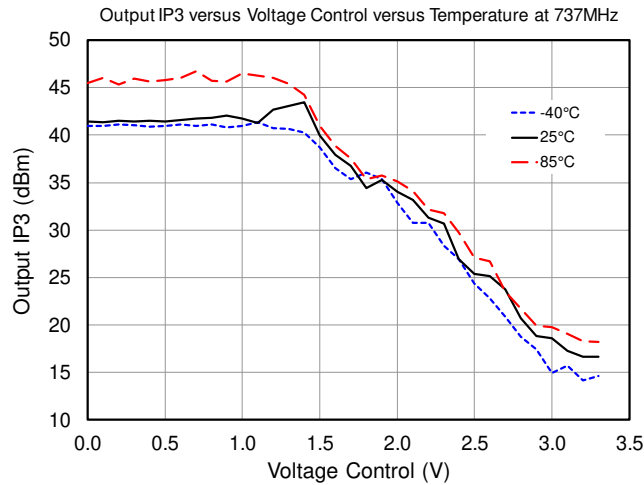
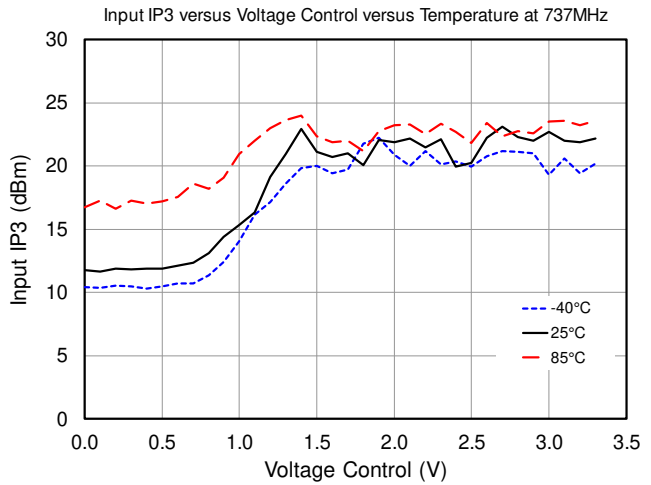
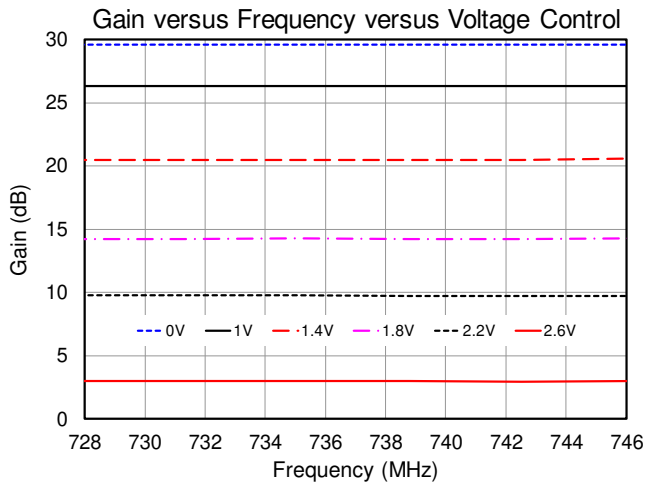
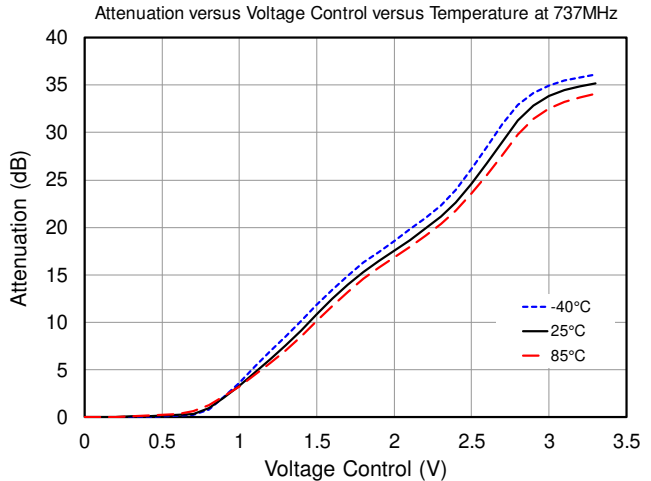
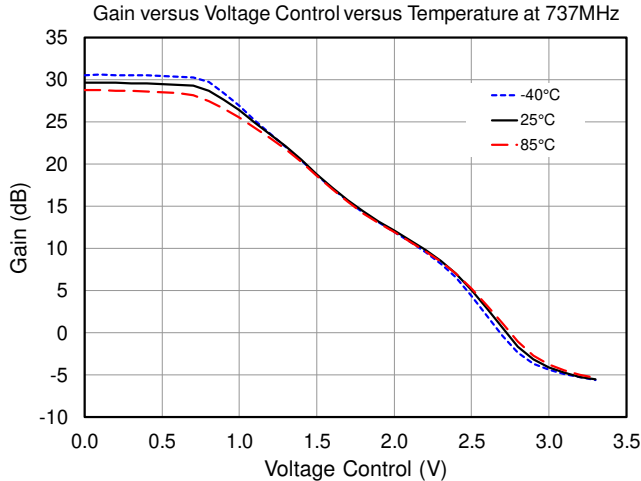
## Electrical Specifications

Parameter	Conditions	Min	Typ	Max	Units
<b>728MHz to 746MHz Frequency Band</b>	<b>All specifications for 25 °C, 5V, unless otherwise stated.</b>				
Gain		24	29		dB
Adjustment Range		30	35		dB
Output IP3	Max gain		+41		dBm
Output P1dB	Max gain		+25		dBm
ACPR	Dual carrier WCDMA, 7.5dB CF at nominal operating output power of +10dBm		-65	-62	dBc
Gain Flatness	Over 50MHz BW		0.3		dB
Control Voltage	Mode Pin = 0V	0		3.3	V
Noise Figure	Min attenuator setting		5		dB
Impedance			50		Ω
Input Return Loss			18		dB
Output Return Loss			12.5		dB
<b>2110MHz to 2170MHz Frequency Band</b>	<b>All specifications for 25 °C, 5V, unless otherwise stated.</b>				
Gain		24	26		dB
Adjustment Range		35	40		dB
Output IP3	Max gain		+40		dBm
Output P1dB	Max gain		+24		dBm
ACPR	Dual carrier WCDMA, 7.5dB CF at nominal operating output power of +10dBm		-65	-62	dBc
Gain Flatness	Over 50MHz BW		0.3		dB
Control Voltage	Mode Pin = 0V	0		3.3	V
Noise Figure	Min attenuator setting		5		dB
Impedance			50		Ω
Input Return Loss			21		dB
Output Return Loss			16		dB

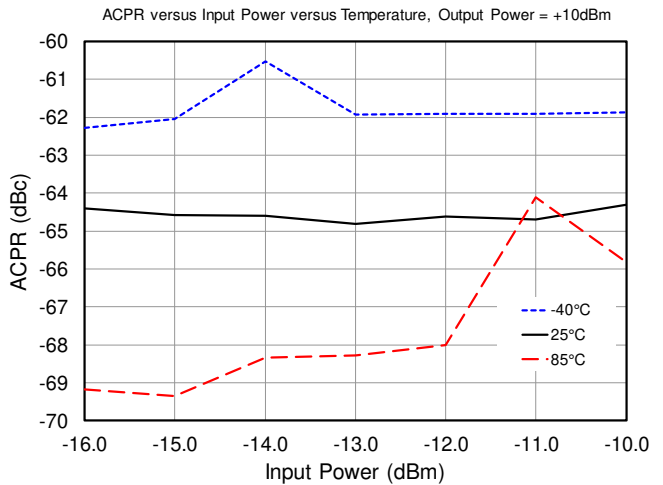
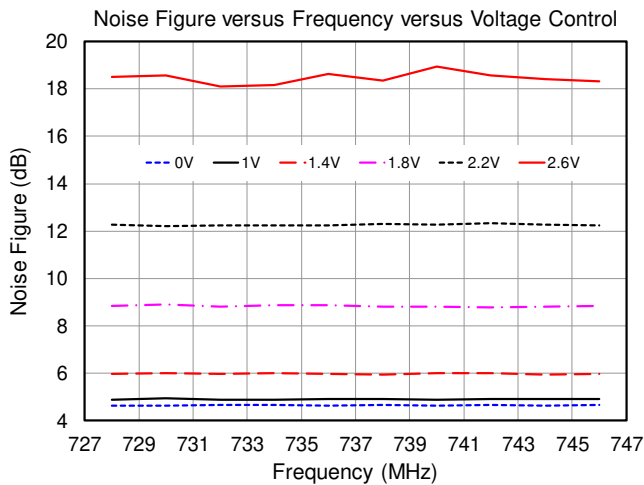
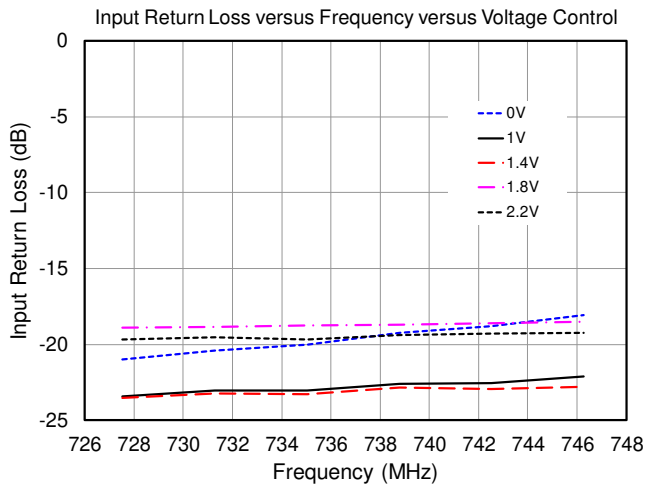
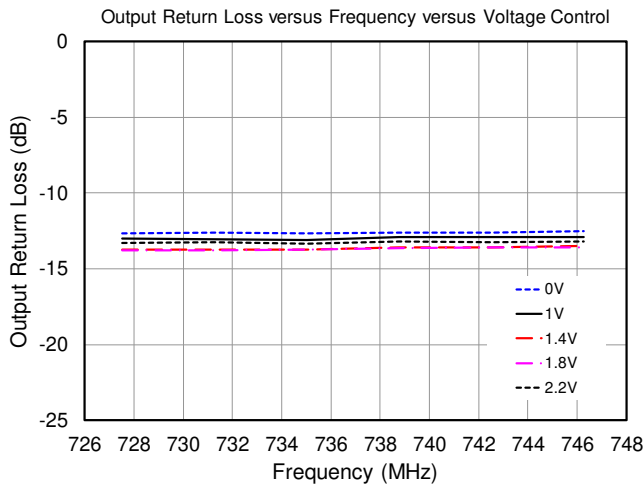
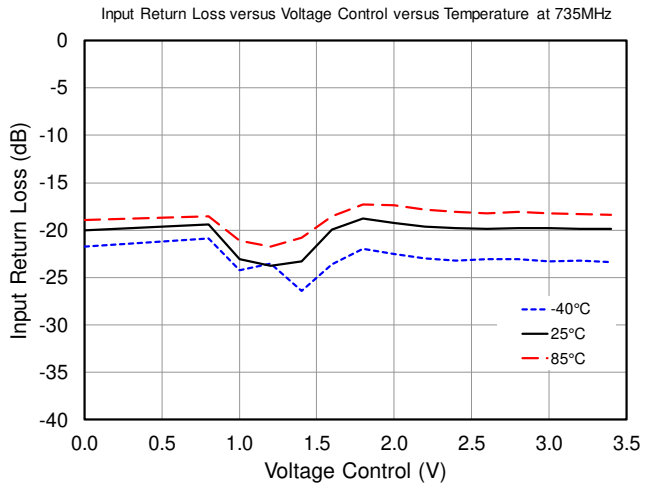
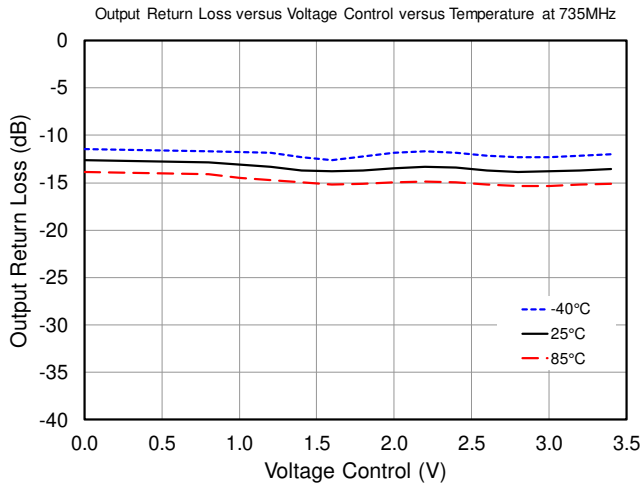
## Electrical Specifications

Parameter	Conditions	Min	Typ	Max	Units
<b>2620MHz to 2690MHz Frequency Band</b>	<b>All specifications for 25 °C, 5V, unless otherwise stated.</b>				
Gain		22	24		dB
Adjustment Range		37	45		dB
Output IP3	Max gain		+40		dBm
Output P1dB	Max gain		+24		dBm
ACPR	Dual carrier WCDMA, 7.5dB CF at nominal operating output power of +10dBm		-65	-62	dBc
Gain Flatness	Over 50MHz BW		0.25		dB
Control Voltage	Mode Pin = 0V	0		3.3	V
Noise Figure	Min attenuator setting		4.9		dB
Impedance			50		Ω
Input Return Loss			21		dB
Output Return Loss			18		dB
<b>Power Supply</b>	<b>All specifications for 25 °C, 5V, unless otherwise stated.</b>				
Supply Voltage		4.75	5	5.25	V
Gain Control Voltage	Mode Pin = 0V	0		3.3	V
	Mode Pin = 5V	5		0	V
Current		140	185	218	mA
Thermal Resistance (R <sub>TH</sub> )			57		°C/W

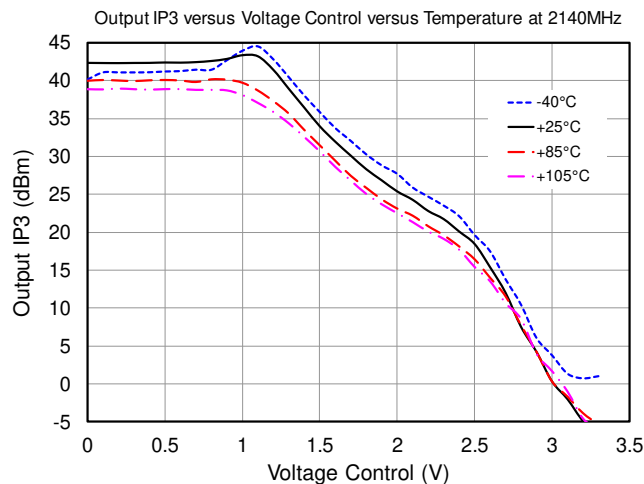
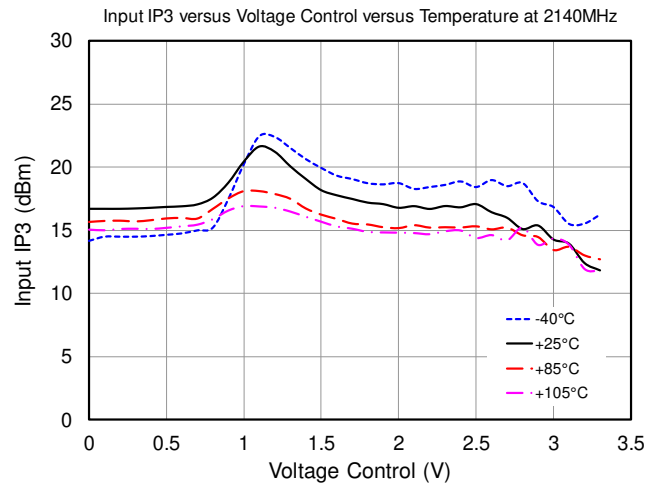
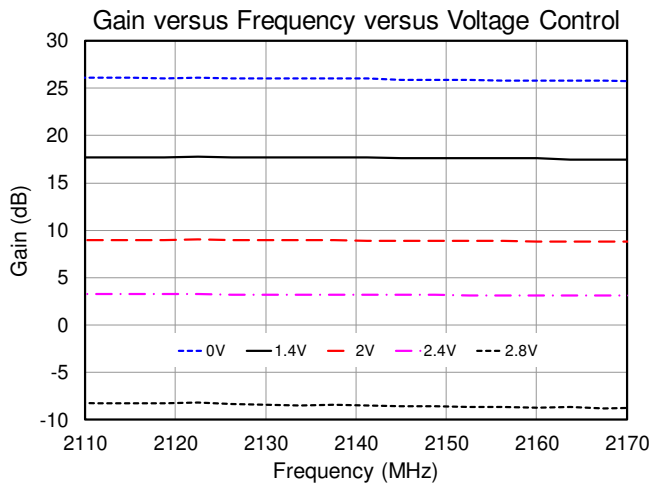
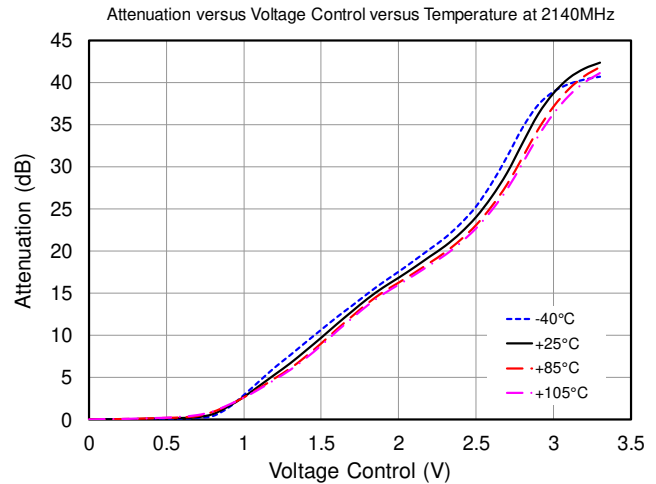
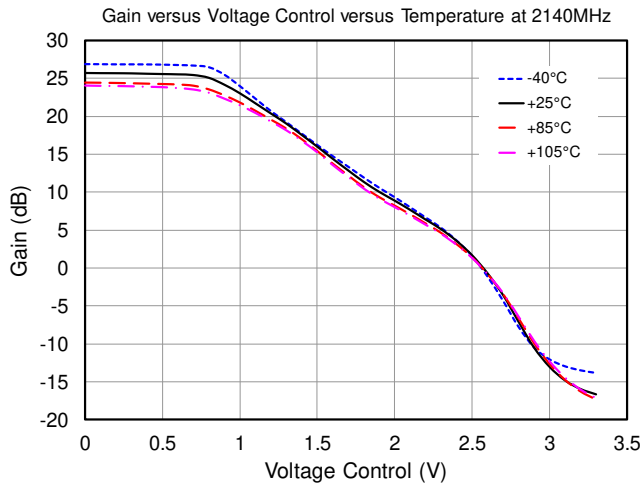
Typical Performance – 724MHz to 746MHz Application Circuit



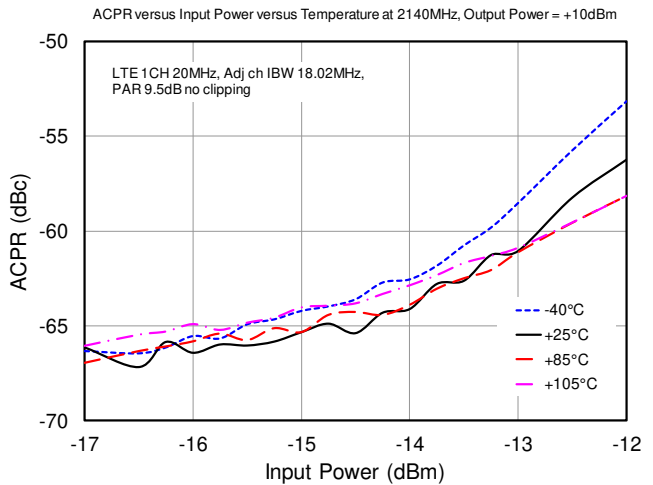
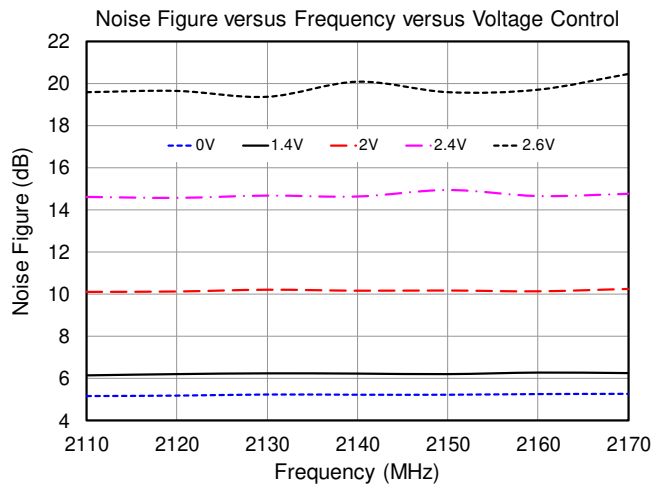
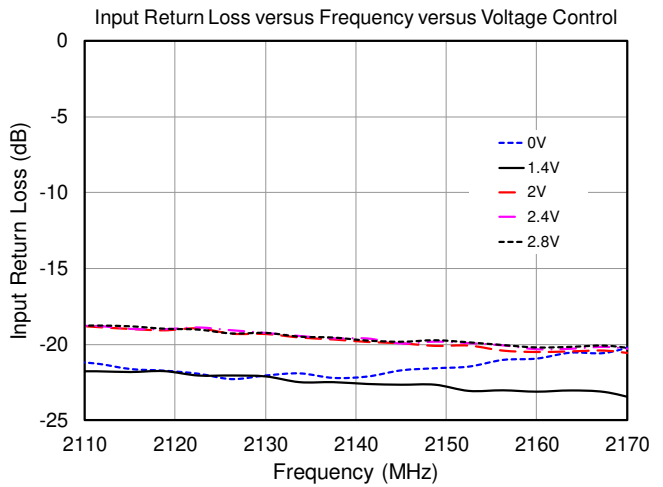
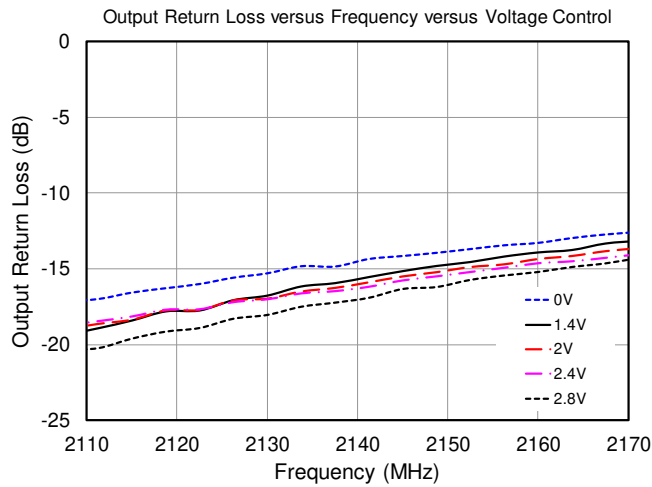
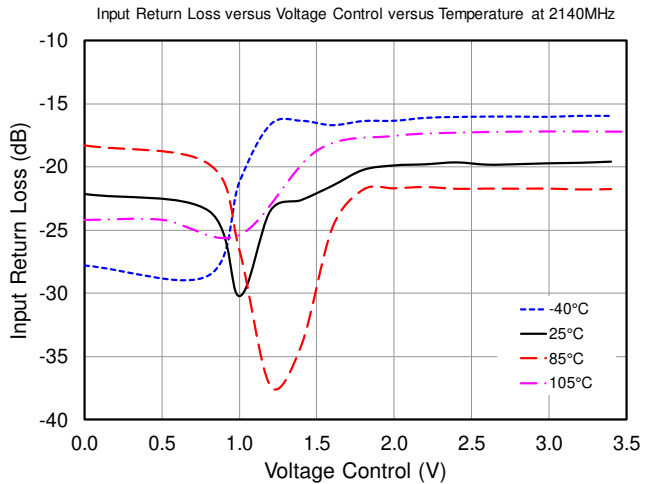
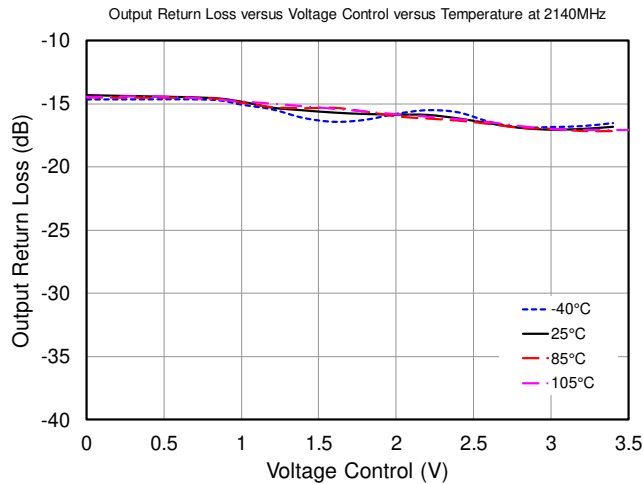
Typical Performance – 724MHz to 746MHz Application Circuit



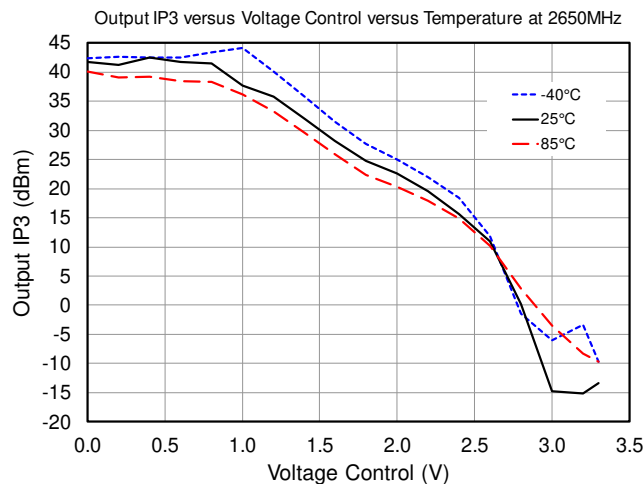
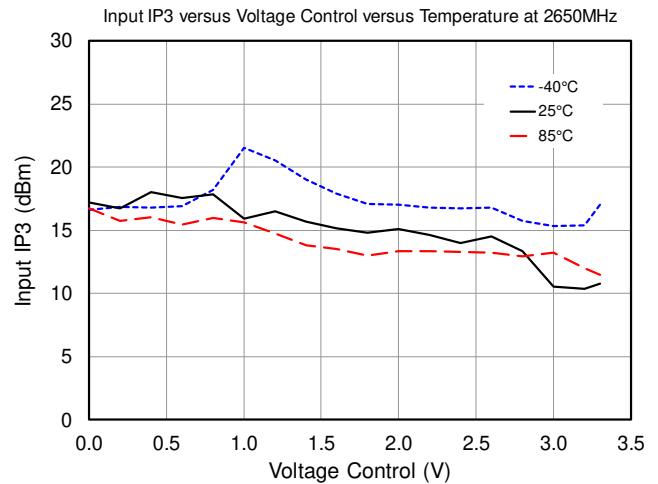
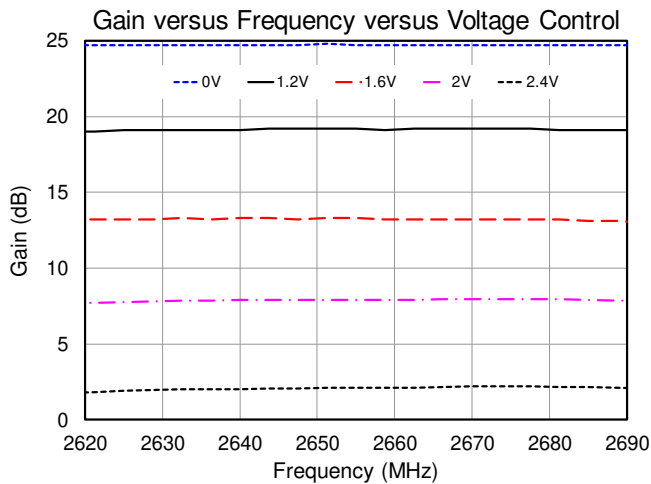
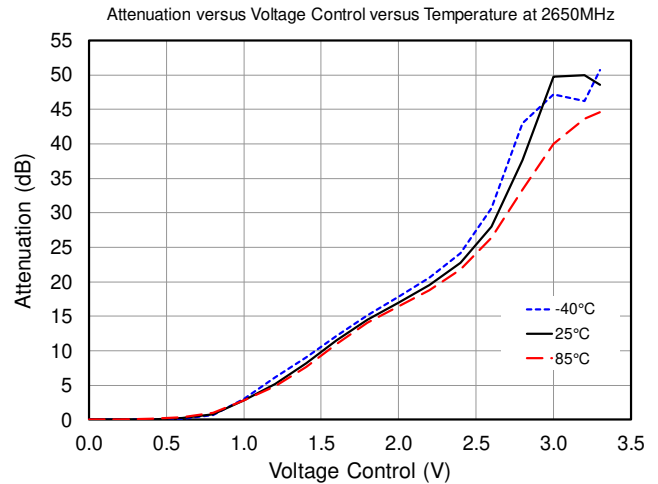
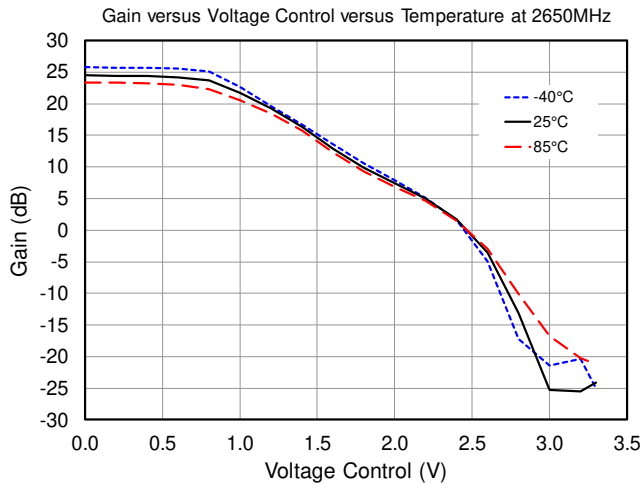
Typical Performance – 2110MHz to 2170MHz Application Circuit



Typical Performance – 2110MHz to 2170MHz Application Circuit

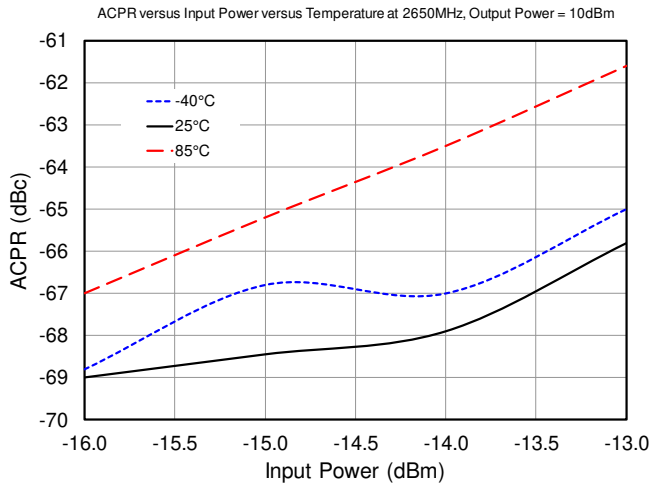
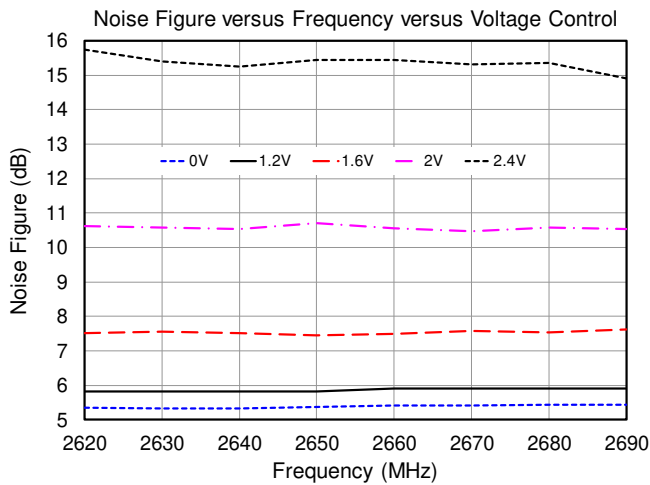
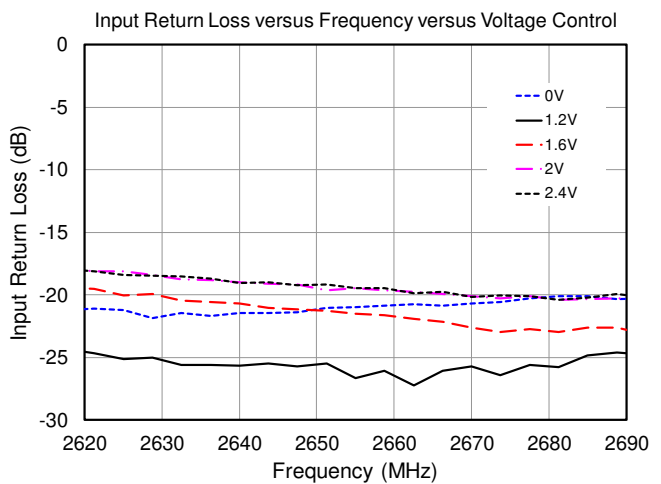
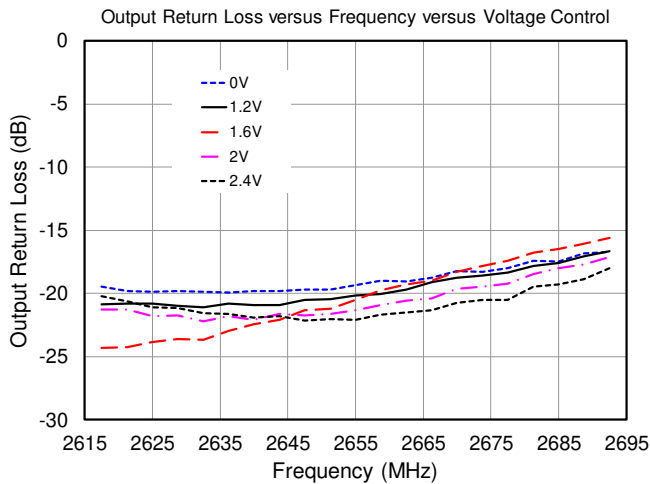
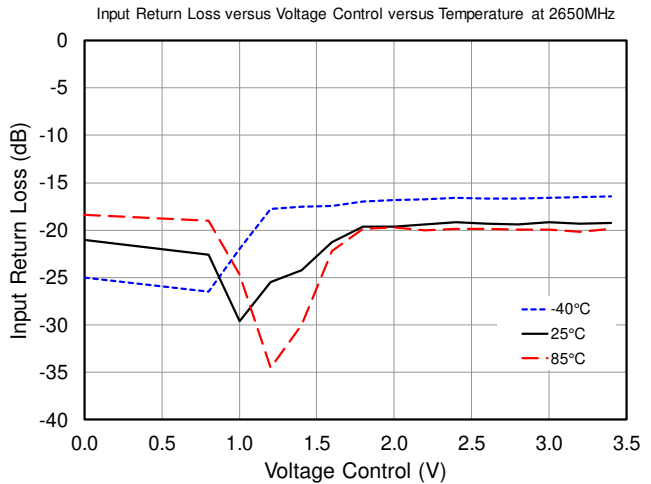
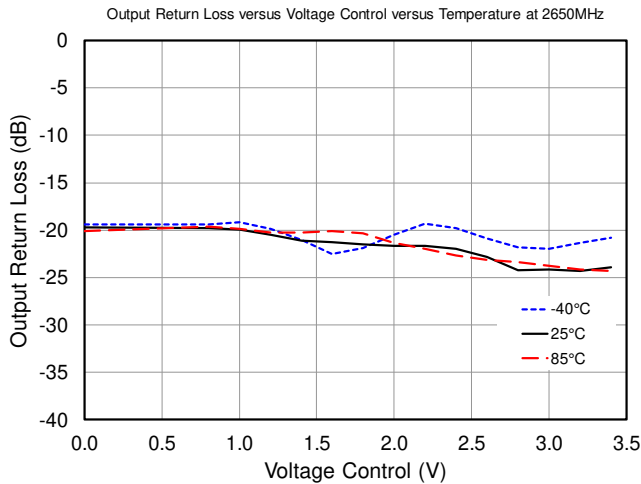


Typical Performance – 2620MHz to 2690MHz Application Circuit





Typical Performance – 2620MHz to 2690MHz Application Circuit

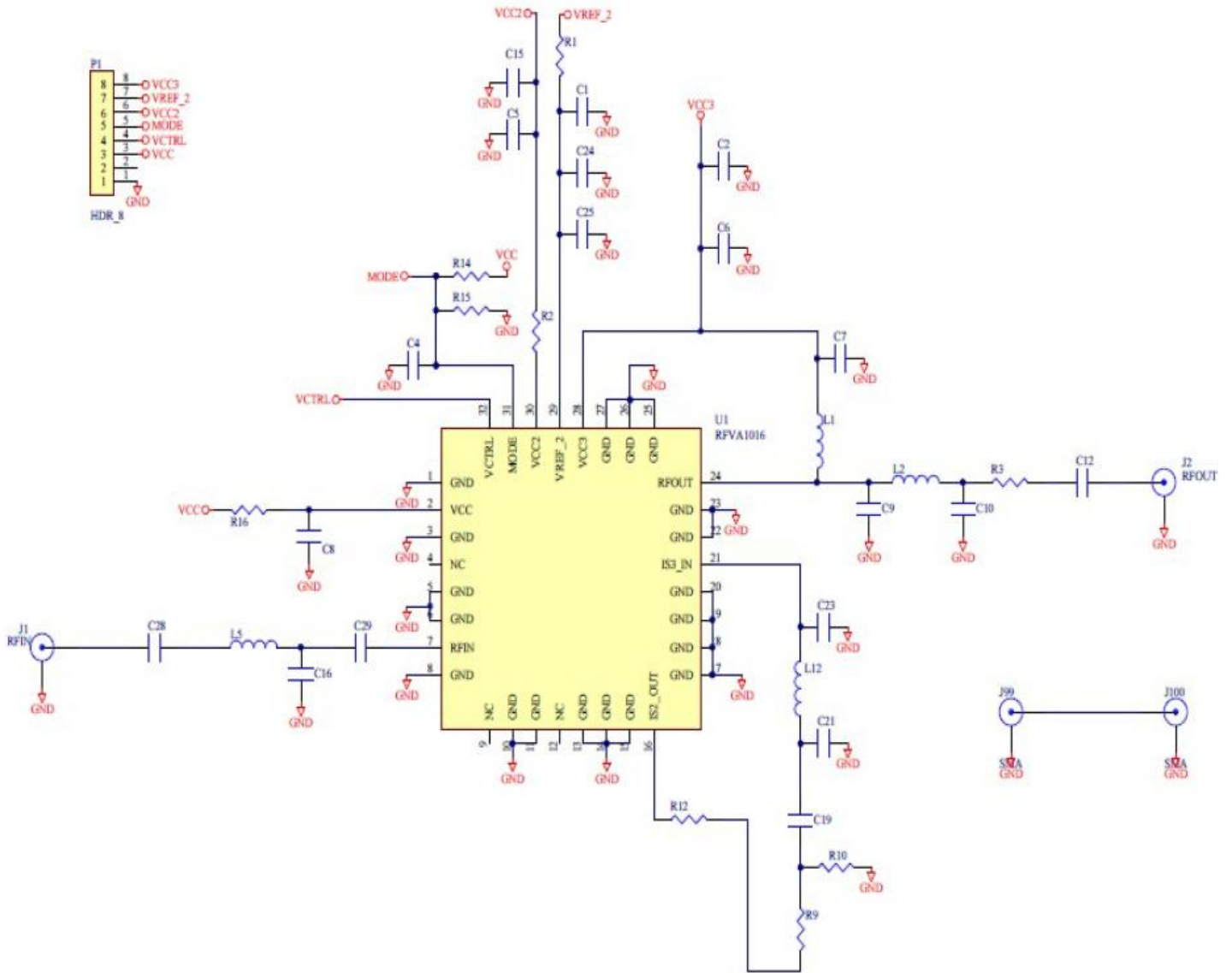




**Evaluation Board Bill of Materials (BOM) – 728MHz to 746MHz Application Circuit**

Reference	Value	Description	Manuf.	Part Number
		VA0016410(A)	DDI	VA0016410(A)
C1, C2, C15	0.1uF	CAP, 10%, 16V, X7R, 0402	Murata Electronics	GRM155R71C104KA88D
C24	100pF	CAP, 5%, 50V, C0G, 0402	Murata Electronics	GRM1555C1H101JA01D
C5, C6, C8	1000pF	CAP, 10%, 50V, X7R, 0402	Murata Electronics	GRM155R71H102KA01D
C7, C25	10pF	CAP, 5%, 50V, C0G, 0402	Murata Electronics	GRM1555C1H100JZ01E
C12, C28	100pF	CAP, 5%, 25V, C0G, 0201	Murata Electronics	GRM0335C1E101JD01D
C10	3.9pF	CAP, +/-0.25pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E3R9CD01E
C19	12pF	CAP, 1%, 25V, C0G, 0201	Murata Electronics	GRM0335C1E120FD01E
C21	4.2pF	CAP, +/-0.05pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E4R2WD01
L1	47nH	IND, 5%, M/L, 0402	Murata Electronics	LQG15HN47NJ02D
L5	2.2nH	IND, +/-0.1nH, T/F, HI-Q, 0201	Murata Electronics	LQP03TN2N2B02D
L12	10nH	IND, 3%, T/F, HI-Q, 0201	Murata Electronics	LQP03TN10NH02D
L2	6.2nH	IND, 3%, T/F, HI-Q, 0201	Murata Electronics	LQP03TN6N2H02D
R1	1.5K	RES, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-152JPA15
R2	100	RES, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-101JPA15
R3, R9, R12	0 OHM	RES, 0201	Kamaya, Inc	RMC1/20JPPA15
R10	2.2K	RES, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-222JPA15
R16	0 OHM	RES, 0402	Kamaya, Inc	RMC1/16SJPTH
J1, J2, J3, J4		CONN, SMA, END LNCH, UNIV, HYB MNT, FLT	HEILIND	PER MAT-21-1038
P1		CONN, HDR, ST, PLRZD, 8-PIN	ITW Pancon	MPSS100-8-C
C3, C4, C9, C11, C13, C14, C16- C18, C20, C22, C23, C26, C27, C30-C32, R4- R8, R11, R13-R15, L7,		DNP		
U1		DUT	Qorvo	RFVA0016

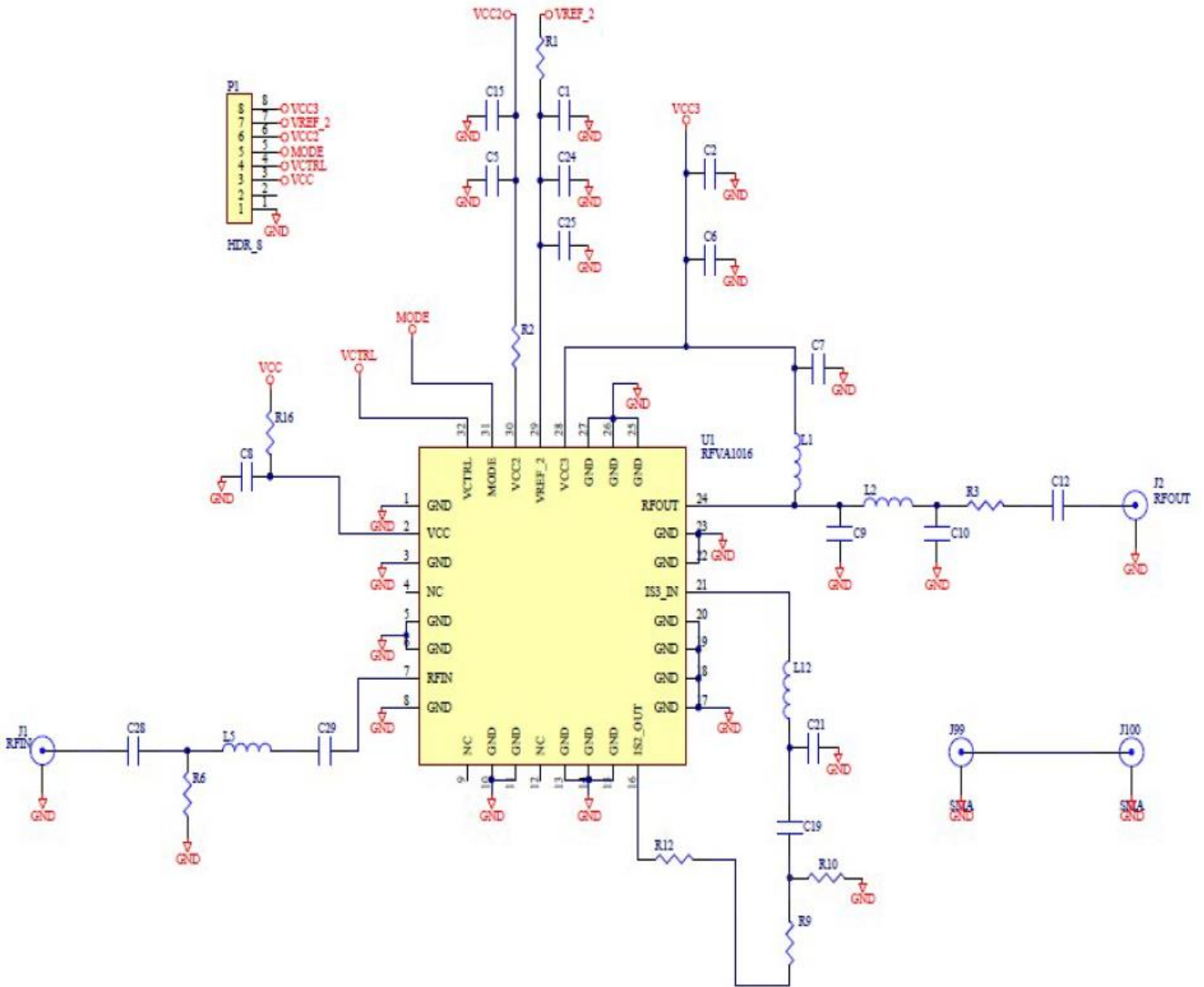
Evaluation Board Schematic – 2110MHz to 2170MHz Application Circuit



**Evaluation Board Bill of Materials – 2110MHz to 2170MHz Application Circuit**

Reference	Value	Description	Manuf.	Part Number
		VA0016410(A)	DDI	VA0016410(A)
C1, C2, C15	0.1uF	CAP, 10%, 16V, X7R, 0402	Murata Electronics	GRM155R71C104KA8
C24	100pF	CAP, 5%, 50V, C0G, 0402	Murata Electronics	GRM1555C1H101JA0
C5, C6, C8	1000pF	CAP, 10%, 50V, X7R, 0402	Murata Electronics	GRM155R71H102KA0
C7, C25	10pF	CAP, 5%, 50V, C0G, 0402	Murata Electronics	GRM1555C1H100JZ01
C12, C28	100pF	CAP, 5%, 25V, C0G, 0201	Murata Electronics	GRM0335C1E101JD0
C16	0.1pF	CAP, +/-0.05pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1ER10WZ0
C29, C10	2pF	CAP, +/-0.1pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E2R0BD0
C9	1.5pF	CAP, +/-0.1pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E1R5BD0
C19	2.1pF	CAP, +/-0.1pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E2R1BD0
C21	2.2pF	CAP, +/-0.1pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E2R2BD0
L1	27nH	IND, 5%, M/L, 0402	Murata Electronics	LQG15HN27NJ02D
L5	5.1nH	IND, 3%, T/F, HI-Q, 0201	Murata Electronics	LQP03TN5N1H02D
L12	0.6nH	IND, +/-0.1nH, T/F, HI-Q, 0201	Murata Electronics	LQP03TN0N6B02D
L2	1.8nH	IND, +/-0.1nH, T/F, HI-Q, 0201	Murata Electronics	LQP03TN1N8B02D
R1	1.5K	RES, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-152JPA15
R2	100 OHM	RES, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-101JPA15
R3, R9, R12	0 OHM	RES, 0201	Kamaya, Inc	RMC1/20JPPA15
R10	2.2K	RES, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-222JPA15
R16	0 OHM	RES, 0402	Kamaya, Inc	RMC1/16SJPTH
J1, J2, J3, J4		CONN, SMA, END LNCH, UNIV, HYB MNT, FLT	HEILIND	PER MAT-21-1038
P1		CONN, HDR, ST, PLRZD, 8-PIN	ITW Pancon	MPSS100-8-C
C3, C4, C11, C13, C14, C17, C18, C20, C22, C23, C26, C27, C30- C32, R4-R8, R11, R13- R15, L7, L9,		DNP		
U1		DUT	Qorvo	RFVA0016

Evaluation Board Schematic – 2620MHz to 2690MHz Application Circuit



**Evaluation Board Bill of Materials – 2620MHz to 2690MHz Application Circuit**

Reference	Value	Description	Manuf.	Part Number
		VA0016410(A)	DDI	VA0016410(A)
C1, C2, C15	0.1uF	CAP, 10%, 16V, X7R, 0402	Murata Electronics	GRM155R71C104KA8
C24	100pF	CAP, 5%, 50V, C0G, 0402	Murata Electronics	GRM1555C1H101JA0
C5, C6, C8	1000pF	CAP, 10%, 50V, X7R, 0402	Murata Electronics	GRM155R71H102KA0
C7, C25	10pF	CAP, 5%, 50V, C0G, 0402	Murata Electronics	GRM1555C1H100JZ01
C12, C28	100pF	CAP, 5%, 25V, C0G, 0201	Murata Electronics	GRM0335C1E101JD0
C10	1.4pF	CAP, +/-0.05pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E1R4WD
C9	1pF	CAP, +/-0.1pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E1R0BD0
C19	2.1pF	CAP, +/-0.1pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E2R1BD0
C21	2.2pF	CAP, +/-0.1pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E2R2BD0
L1	27nH	IND, 5%, M/L, 0402	Murata Electronics	LQG15HN27NJ02D
L2	0.9nH	IND, +/-0.1nH, T/F, HI-Q, 0201	Murata Electronics	LQP03TN0N9B02D
L5	3.3nH	IND, +/-0.1nH, T/F, HI-Q, 0201	Murata Electronics	LQP03TN3N3B02D
L12	4.0pF	CAP, +/-0.05pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1E4R0WD
R1	1.5K	RES, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-152JPA15
R2	100 OHM	RES, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-101JPA15
R6	0.2pF	CAP, +/-0.05pF, 25V, C0G, 0201	Murata Electronics	GRM0335C1ER20WZ
R3, R9, R12, C29	0 OHM	RES, 0201	Kamaya, Inc	RMC1/20JPPA15
R10	2.2K	RES, 5%, 1/20W, 0201	Kamaya, Inc	RMC1/20-222JPA15
R16	0 OHM	RES, 0402	Kamaya, Inc	RMC1/16SJPTH
J1, J2, J3, J4		CONN, SMA, END LNCH, UNIV, HYB MNT, FLT	HEILIND	PER MAT-21-1038
P1		CONN, HDR, ST, PLRZD, 8-PIN	ITW Pancon	MPSS100-8-C
C3, C4, C11, C13, C14, C16, C17, C18, C20, C22, C23, C26, C27, C30-C32, R4, R5, R7, R8, R11, R13-R15, L7, L9, L11, L13		DNP		
U1		DUT	Qorvo	RFVA0016

## Mode Pin Truth Table

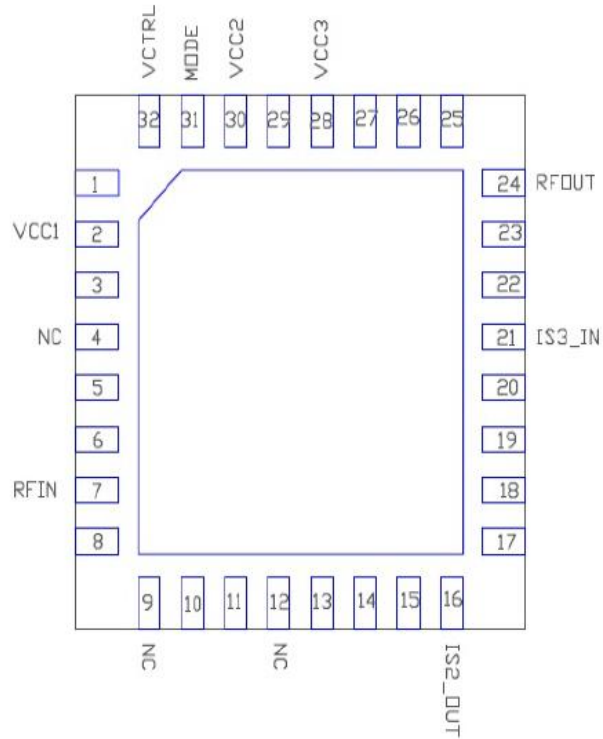
Mode	Min Attenuation	Max Attenuation
Low or 0V	0V	3.3V
High or 5V	5V	0V

## Pin Names and Description

Pin No.	Label	Description
1	GND	Low inductive path to ground
2	VCC1	V <sub>CC</sub> Supply
3	GND	Low inductive path to ground
4	NC	No Connect
5	GND	Low inductive path to ground
6	GND	Low inductive path to ground
7	RFIN	RF Input (externally matched to 50Ω)
8	GND	Low inductive path to ground
9	NC	No Connect
10	GND	Low Inductive path to ground
11	GND	Low inductive path to ground
12	NC	No Connect
13	GND	Low Inductive path to ground
14	GND	Low Inductive path to ground
15	GND	Low Inductive path to ground
16	IS2_OUT	Interstage RF Output to allow matching to last stage amplifier
17	GND	Low Inductive path to ground
18	GND	Low inductive path to ground
19	GND	Low inductive path to ground
20	GND	Low inductive path to ground
21	IS3_IN	Interstage RF IN to allow matching to last stage amplifier
22	GND	Low inductive path to ground
23	GND	Low inductive path to ground
24	RFOUT	RF Output (externally matched to 50Ω)
25	GND	Low Inductive path to ground
26	GND	Low inductive path to ground
27	GND	Low inductive path to ground
28	VCC3	Supply Voltage
29	VREF2	Reference Voltage to set current of last stage device
30	VCC2	Supply Voltage
31	MODE	Mode select pin to select positive or negative slope of the V <sub>CTRL</sub> voltage, see Mode Pin Truth table.
32	VCTRL	Voltage Variable Amplifier Control Voltage.

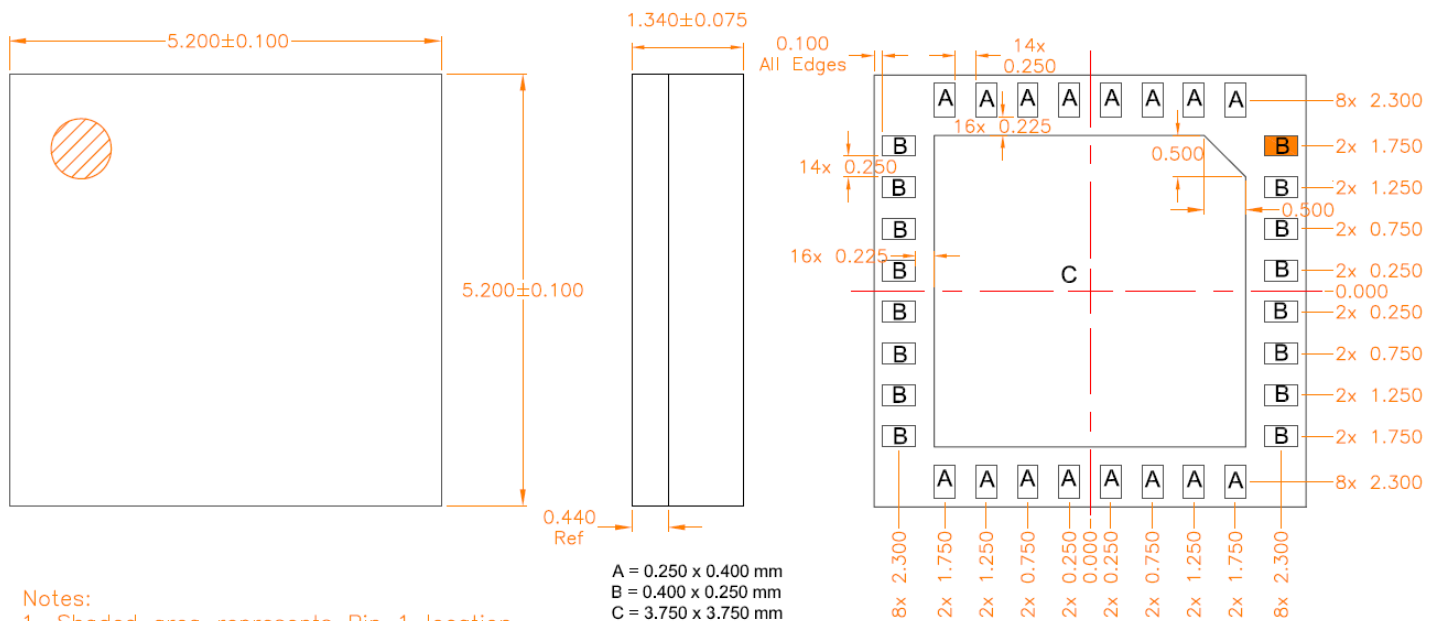


IO Pattern



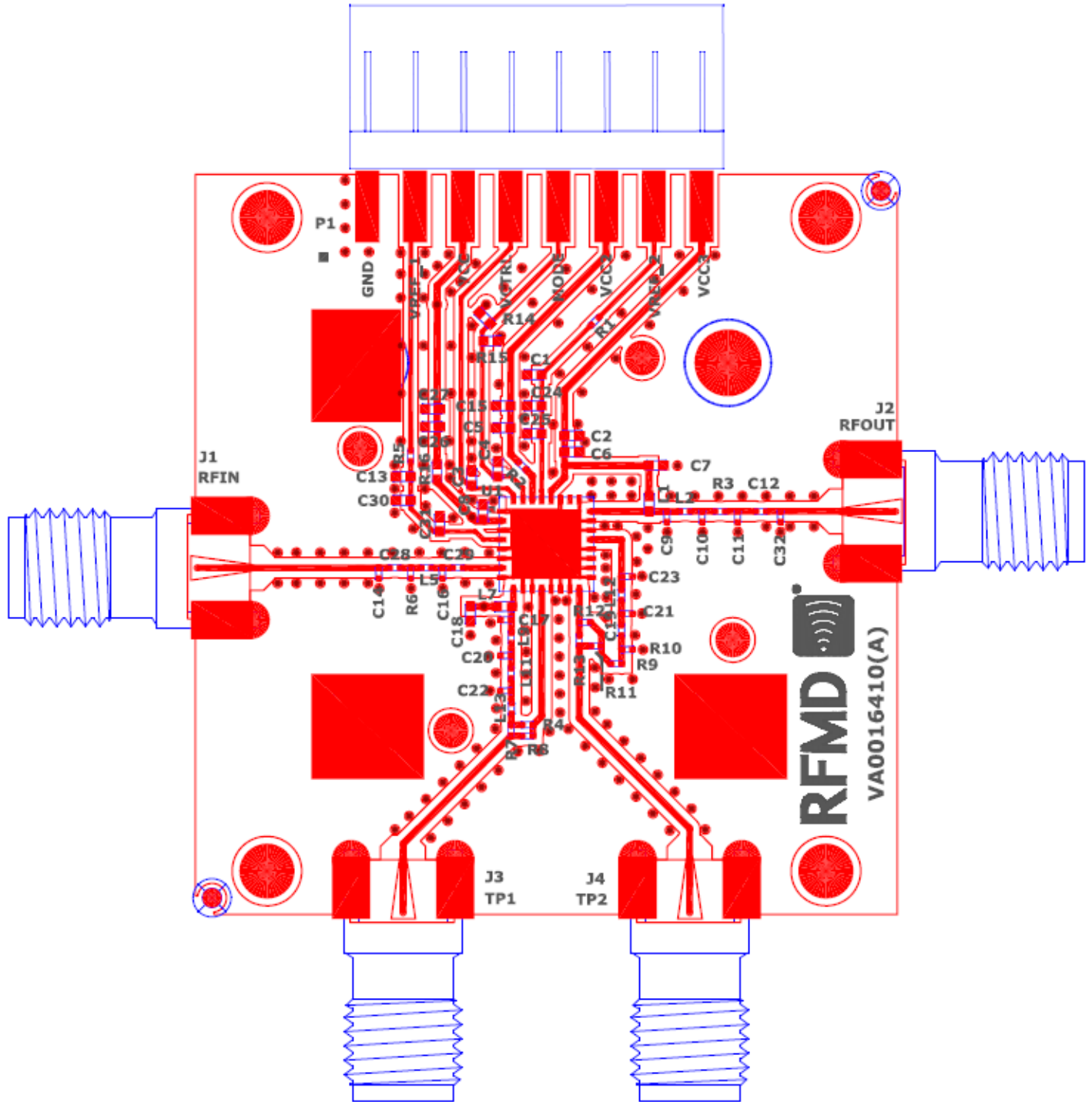
Note: All other pins are grounded.

Package Outline Drawing



Notes:  
1. Shaded area represents Pin 1 location.

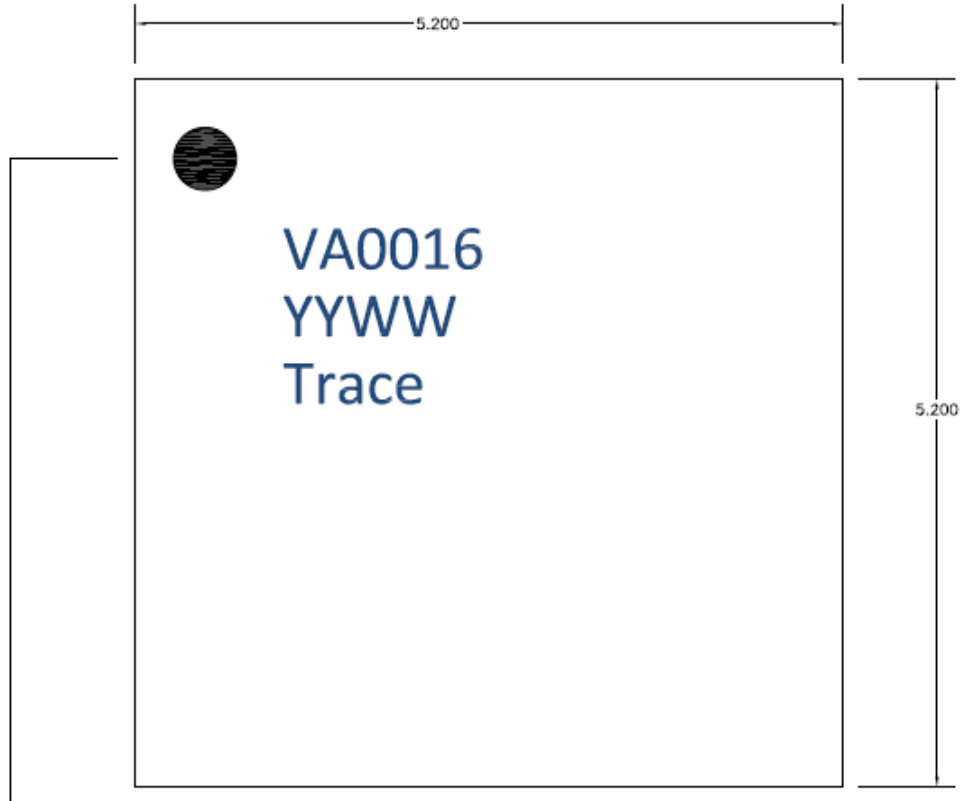
Evaluation Board Assembly Drawing



Note: TP1 and TP2 are test ports for interstage tuning.

Branding Diagram

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Pin 1 Indicator  
YY = Year  
WW = Week

## Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1C	ESDA / JEDEC JS-001-2014
ESD – Charged Device Model (CDM)	Class C3	JEDEC JESD22-C101F
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020



Caution!  
ESD-Sensitive Device

## Solderability

Compatible with lead-free (260°C max. reflow temp.) soldering process.

Solder profiles available upon request.

Contact plating: Electrolytic NiAu

## 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<sub>15</sub>H<sub>12</sub>Br<sub>4</sub>O<sub>2</sub>) Free
- PFOS Free
- SVHC Free



## Contact Information

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

**Web:** [www.qorvo.com](http://www.qorvo.com)

**Tel:** 1-844-890-8163

**Email:** [customer.support@qorvo.com](mailto:customer.support@qorvo.com)

For technical questions and application information: **Email:** [appsupport@qorvo.com](mailto:appsupport@qorvo.com)

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