

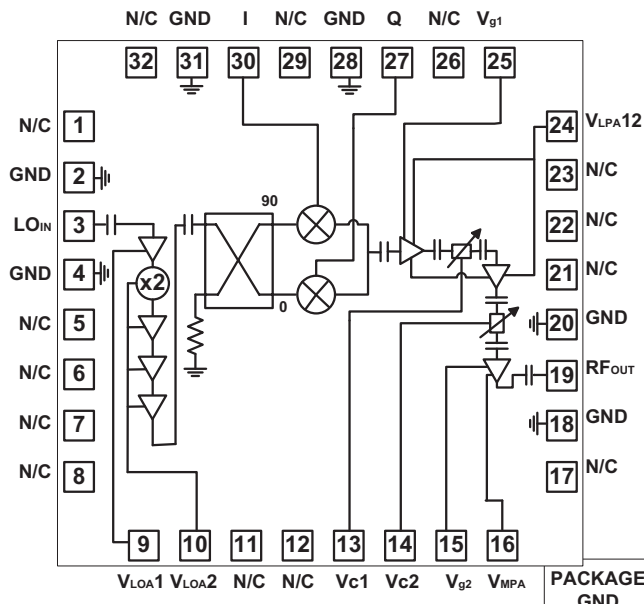


Features

- RF Frequency: 21GHz to 26.5GHz
- LO Frequency (LSB): 10.5GHz to 15.2GHz
- LO Frequency (USB): 8.5GHz to 13.25GHz
- IF Frequency: DC to 4GHz
- Conversion Gain (Max): 21dB
- Conversion Gain (Min): -10dB
- NF (Max. Gain): 12dB
- OIP3 (Max. Gain): +27dBm
- Image Rejection: 15dBc

Applications

- Point-to-Point
- VSAT



Functional Block Diagram

Product Description

RFMD's RFUV1703 is a 21GHz to 26.5GHz GaAs pHEMT upconverter, incorporating an integrated doubler, LO buffer amplifier, a balanced single sideband (image rejection) mixer followed by Variable Gain Amplifier, DC decoupling capacitors. The combination of high performance part and low-cost packaging makes the RFUV1703 a cost effective solution, ideally suited to both current and next generation point-to-point and VSAT applications. RFUV1703 is packaged in a 5mm x 5mm QFN to simplify both system level board design and volume assembly.

Ordering Information

RFUV1703S2	2-Piece Sample Bag
RFUV1703SB	5-Piece Bag
RFUV1703SQ	25-Piece Bag
RFUV1703SR	100 Pieces on 7" reel
RFUV1703TR7	750 Pieces on 7" reel
RFUV1703PCBA-410	Evaluation Board

Absolute Maximum Ratings

Parameter	Rating	Unit
LPA Drain Voltage V_D	6	V
LOA Drain Voltage	6	V
IF Input Power	15	dBm
LO Input Power	15	dBm
T_{OPER}	-55 to +85	°C
T_{STOR}	-65 to +150	°C
ESD Human Body Model	Class 1A	

**Caution!** ESD sensitive device.

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.

The information in this publication is believed to be accurate and reliable. However, no responsibility is assumed by RF Micro Devices, Inc. ("RFMD") for its use, nor for any infringement of patents, or other rights of third parties, resulting from its use. No license is granted by implication or otherwise under any patent or patent rights of RFMD. RFMD reserves the right to change component circuitry, recommended application circuitry and specifications at any time without prior notice.



RFMD Green: RoHS compliant per EU Directive 2002/95/EC, 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.

Nominal Operating Parameters

Parameter	Specification			Unit	Condition
	Min.	Typ.	Max.		
RF Frequency	21		26.5	GHz	
LO Frequency: LSB	10.5		15.25	GHz	
LO Frequency: USB	8.5		13.25	GHz	
IF Frequency	DC	2.5	4.0	GHz	
LO input Drive		0		dBm	
Conversion Gain (Max.) (USB)	19	21		dB	LO=9.95 GHz & 11.5 GHz
Conversion Gain (Min.) (USB)	-5.5	-5		dB	LO=9.95 GHz & 11.5 GHz
OIP3 (max. Gain) (USB)	23.5	29		dBm	LO=9.95 GHz
OIP3 (-5dB Gain) (USB)	0.5	6.5		dBm	LO=9.95 GHz
OIP3 (max. Gain) (USB)	20.5	27		dBm	LO=11.5 GHz
OIP3 (-5dB Gain) (USB)	4	9		dBm	LO=11.5 GHz
Image Rejection (max. Gain) (USB)	15	20		dBc	LO=9.95 GHz
Image Rejection (max. Gain) (USB)	14	20		dBc	LO=11.5 GHz
LO Leakage @ RF-Port (max. Gain) (USB)		-10	5	dBm	LO=9.95 GHz
LO Leakage @ RF-Port (max. Gain) (USB)		1	7.5	dBm	LO=11.5 GHz
NF (max. Gain)		12		dB	
LO Return Loss		10		dB	
RF Return Loss		10		dB	
V_{LOA}		4		V	
V_{LPA}		3.5		V	
V_{MOA}		4.5		V	
I_{LOA}		205		mA	
I_{LOA12}		120		mA	
I_{MPA}		120		mA	
I_{TOTAL}		445		mA	
V_{C1}, V_{C2}	-4		0	V	

Test Conditions and Bias Sequence

Measurements performed with I and Q (IF) ports connected to an external 90° Hybrid, LO Power = 0dBm and IF = 2.5GHz, -10dBm, unless otherwise stated.

$V_{LOA1} = V_{LOA2} = 4V$, $I_{LOA1,2} = 205mA$; $V_{LPA12} = 3.5V$, Adjust V_{G1} around -0.4V to get $I_{LPA12} = 120mA$;
 $V_{MPA} = 4.5V$, Adjust V_{G2} to get $I_{MPA} = 120mA$; $I_{TOTAL} = 445mA$, $V_{C1} = V_{C2} = -4V$

Typical Bias Sequence							
	G_{MAX}						G_{MIN}
V_{C1} (V)	-4	-2	-1	0	0	0	0
V_{C2} (V)	-4	-4	-4	-4	-2	-1	0

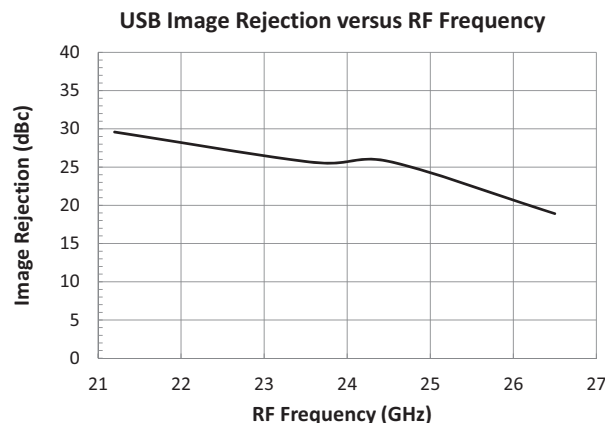
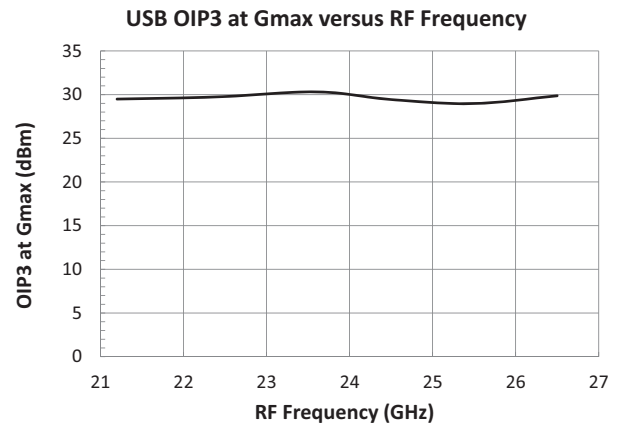
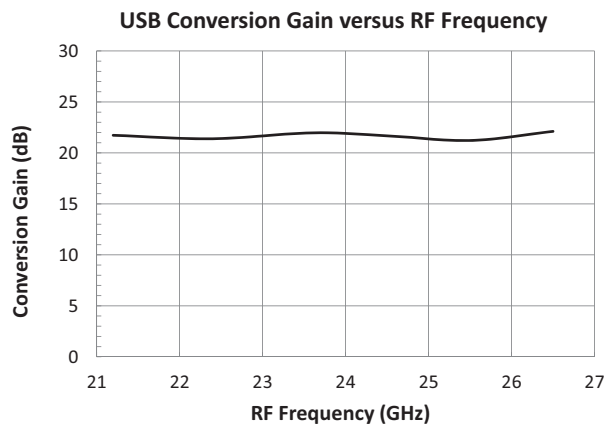
More dynamic range can be achieved using V_{G2} over (-0.4 to -1V) and V_{G1} over (-0.4 to -1V)

Typical Electrical Performance

Measurements performed with I and Q (IF) ports connected to an external 90° Hybrid, LO Power = 0dBm and IF = 2.5GHz, -10dBm, unless otherwise stated.

USB Conversion Gain, Image Rejection and OIP3

$V_{LOA1} = V_{LOA2} = 4V$, $I_{LOA1,2} = 205mA$; $V_{LPA12} = 3.5V$, Adjust V_{G1} around -0.4V to get $I_{LPA12} = 120mA$;
 $V_{MPA} = 4.5V$, Adjust V_{G2} to get $I_{MPA} = 120mA$; $I_{TOTAL} = 445mA$, $V_{C1} = V_{C2} = -4V$

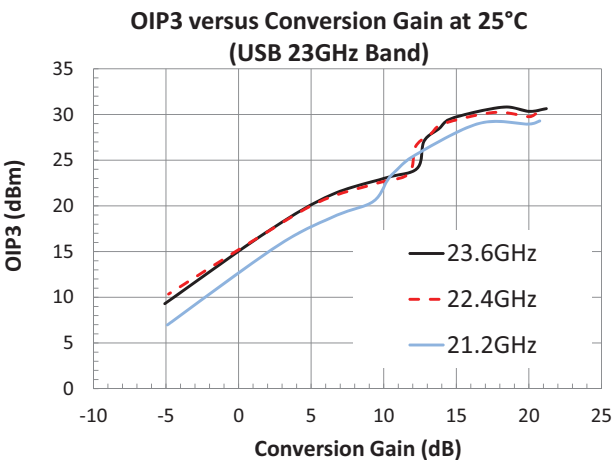
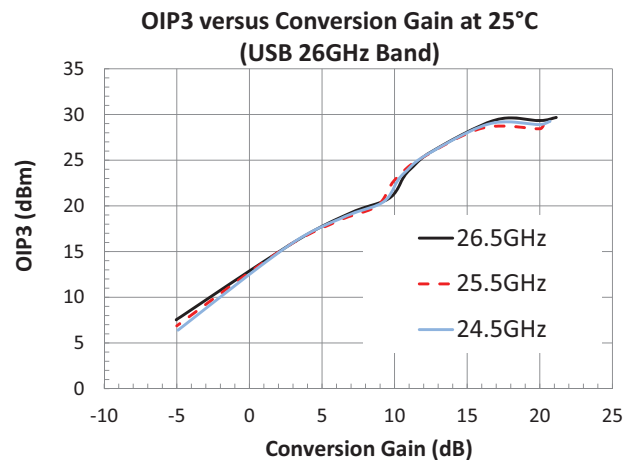


USB OIP3 versus Conversion Gain

$V_{LOA1} = V_{LOA2} = 4V$, $I_{LOA1,2} = 205mA$; $V_{LPA12} = 3.5V$, Adjust V_{G1} around $-0.4V$ to get $I_{LPA12} = 120mA$;
 $V_{MPA} = 4.5V$, Adjust V_{G2} to get $I_{MPA} = 120mA$; $I_{TOTAL} = 445mA$, $V_{C1} = V_{C2} = -4V$

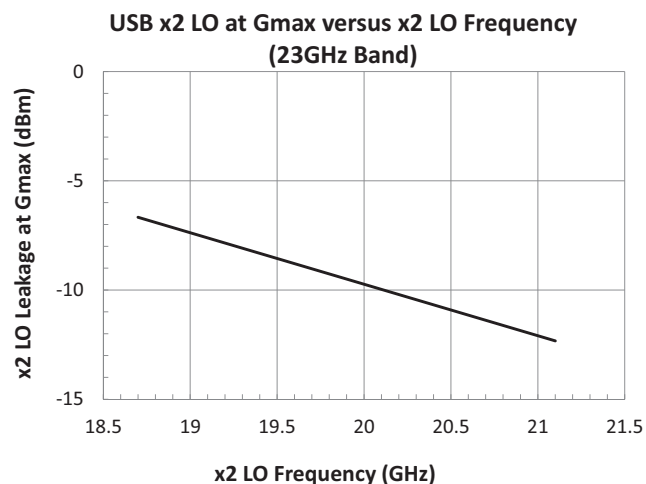
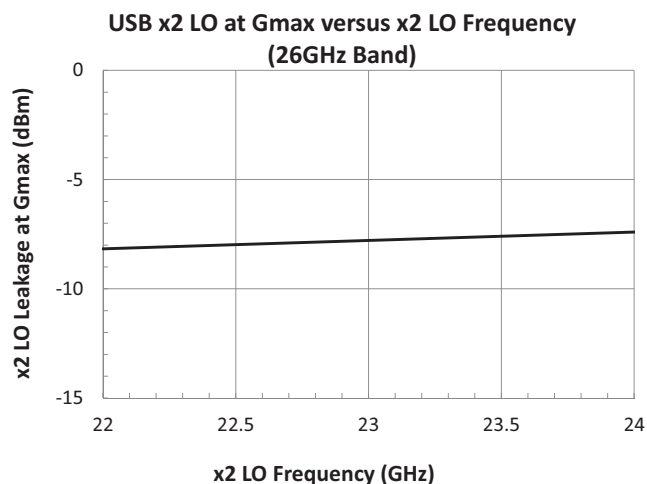
Typical Bias Sequence							
	G _{MAX}						G _{MIN}
V _{C1} (V)	-4	-2	-1	0	0	0	0
V _{C2} (V)	-4	-4	-4	-4	-2	-1	0

More dynamic range can be achieved using V_{G2} over $(-0.4$ to $-1V)$



USB LO Leakage

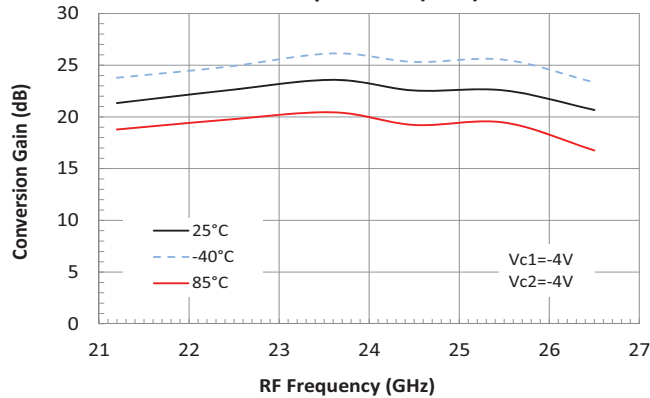
$V_{LOA1} = V_{LOA2} = 4V$, $I_{LOA1,2} = 205mA$; $V_{LPA12} = 3.5V$, Adjust V_{G1} around $-0.4V$ to get $I_{LPA12} = 120mA$;
 $V_{MPA} = 4.5V$, Adjust V_{G2} to get $I_{MPA} = 120mA$; $I_{TOTAL} = 445mA$, $V_{C1} = V_{C2} = -4V$



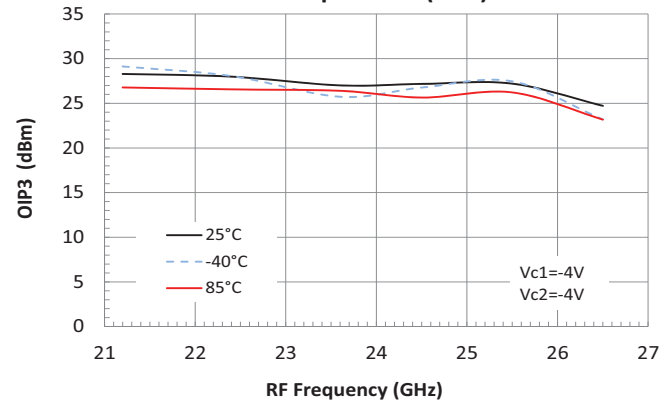
Over Temperature Performance (USB)

$V_{LOA1} = V_{LOA2} = 4V$, $I_{LOA1,2} = 205mA$; $V_{LPA12} = 3.5V$, Adjust V_{G1} around $-0.4V$ to get $I_{LPA12} = 120mA$;
 $V_{MPA} = 4.5V$, Adjust V_{G2} to get $I_{MPA} = 120mA$; $I_{TOTAL} = 445mA$

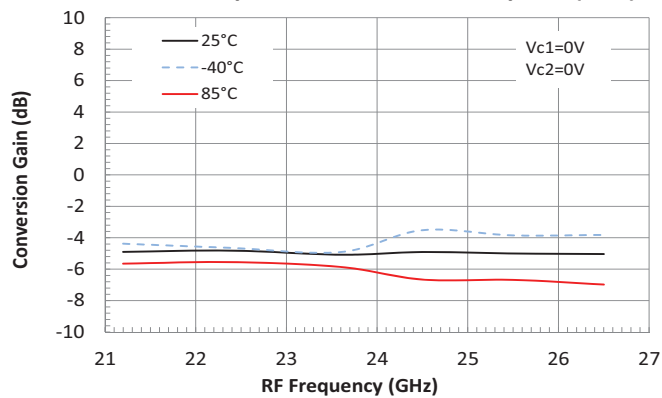
Max Conversion Gain versus RF Frequency Over Temperature (USB)



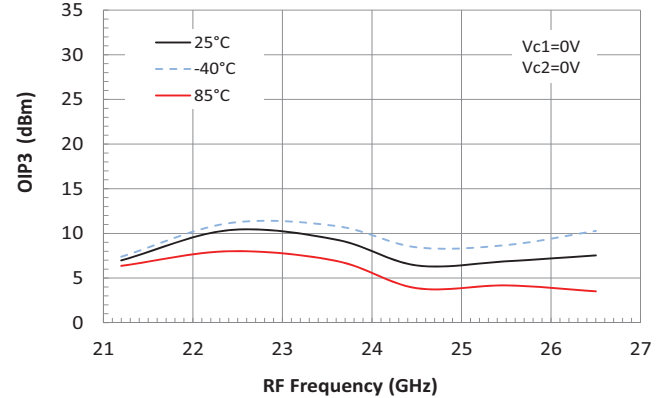
OIP3 at Gmax versus RF Frequency Over Temperature (USB)



Conversion Gain versus RF Frequency Over Temperature at -5dB CG set point (USB)



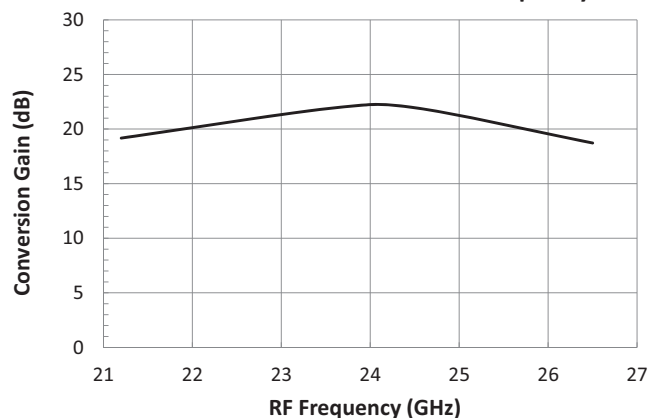
OIP3 at -5dB CG versus RF Frequency Over Temperature (USB)



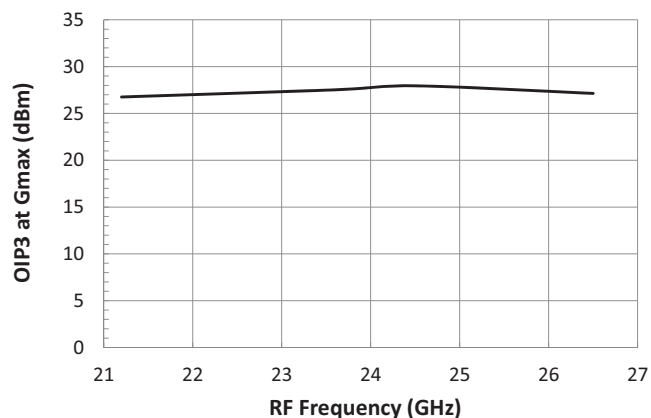
LSB Conversion Gain, Image Rejection, and OIP3

$V_{LOA1} = V_{LOA2} = 4V$, $I_{LOA1,2} = 205mA$; $V_{LPA12} = 3.5V$, Adjust V_{G1} around $-0.4V$ to get $I_{LPA12} = 120mA$;
 $V_{MPA} = 4.5V$, Adjust V_{G2} to get $I_{MPA} = 120mA$; $I_{TOTAL} = 445mA$, $V_{C1} = V_{C2} = -4V$

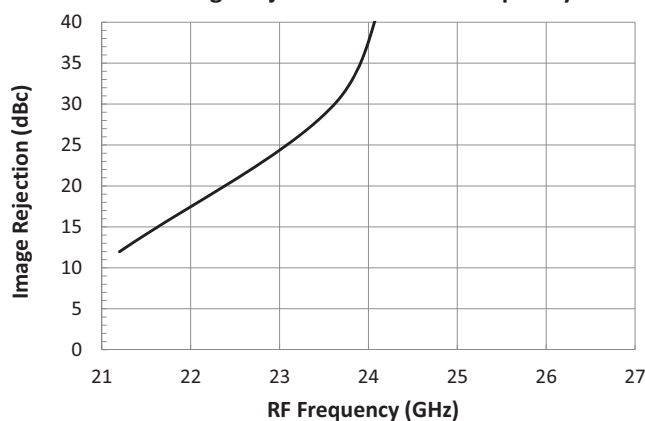
LSB Conversion Gain versus RF Frequency



LSB OIP3 at Gmax versus RF Frequency



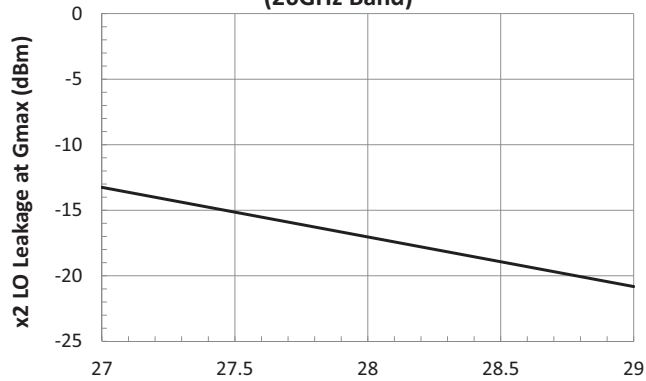
LSB Image Rejection versus RF Frequency



LSB LO Leakage

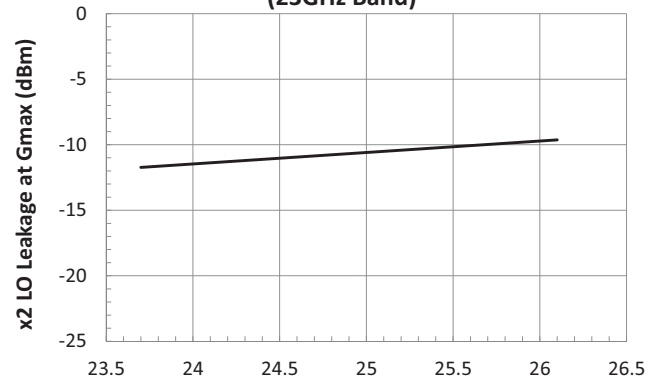
$V_{LOA1} = V_{LOA2} = 4V$, $I_{LOA1,2} = 205mA$; $V_{LPA12} = 3.5V$, Adjust V_{G1} around $-0.4V$ to get $I_{LPA12} = 120mA$;
 $V_{MPA} = 4.5V$, Adjust V_{G2} to get $I_{MPA} = 120mA$; $I_{TOTAL} = 445mA$, $V_{C1} = V_{C2} = -4V$

LSB x2 LO at Gmax versus x2 LO Frequency
(26GHz Band)



x2 LO Frequency (GHz)
 $I_{BIAS} = -42mV$ $Q_{BIAS} = 0mV$

LSB x2 LO at Gmax versus x2 LO Frequency
(23GHz Band)

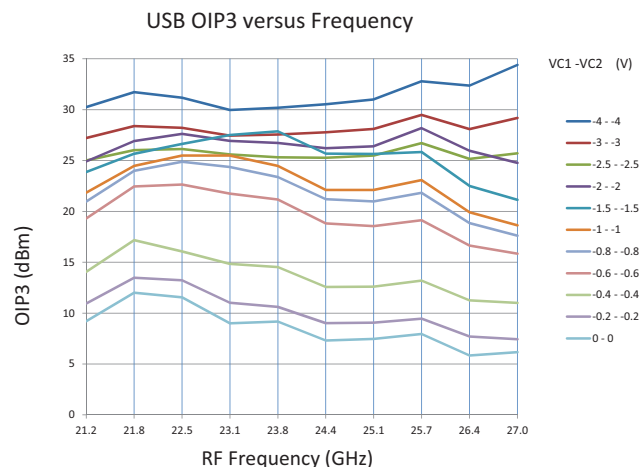
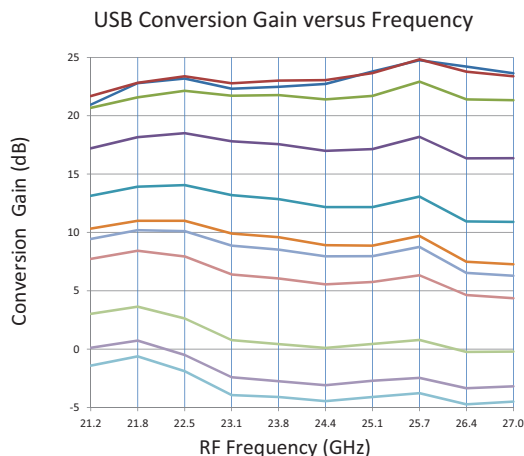


x2 LO Frequency (GHz)
 $I_{BIAS} = -56mV$ $Q_{BIAS} = 0mV$

Performance Using Single Control Line (without IQ bias)_1

$V_{MPA} = 4.5V$, $V_{LPA12} = 3.5V$, $V_{LOA1} = V_{LOA2} = 4V$, $I_{total} = 445mA$, $V_{G1} = V_{G2} = -0.4V$

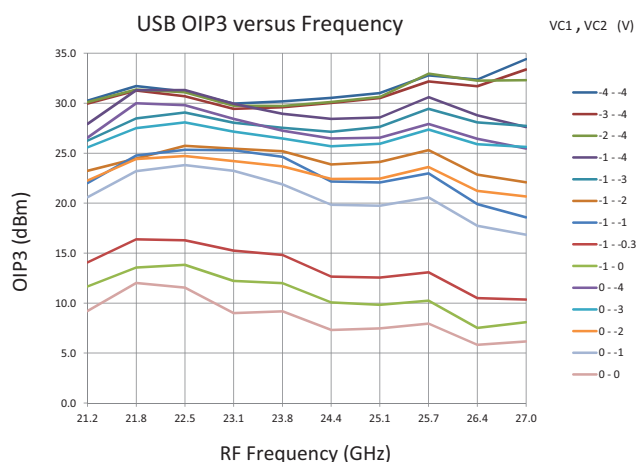
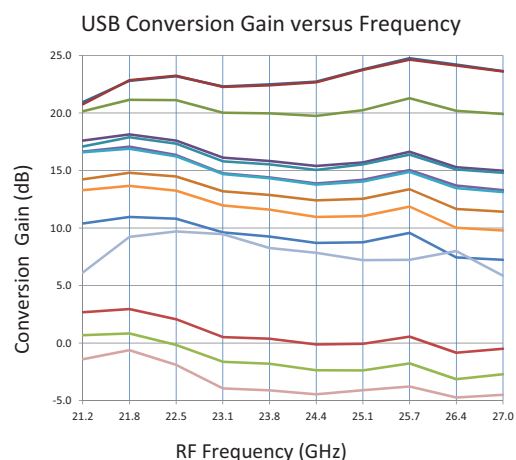
V_{C1} and V_{C2} are connected together off chip and changes over (-4V to 0V)



Performance Using Double Control Line (without IQ bias)_2

$V_{MPA} = 4.5V$, $V_{LPA12} = 3.5V$, $V_{LOA1} = V_{LOA2} = 4V$, $I_{total} = 445mA$, $V_{G1} = V_{G2} = -0.4V$

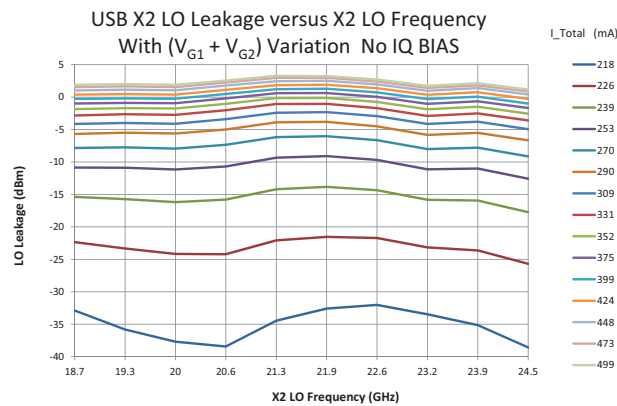
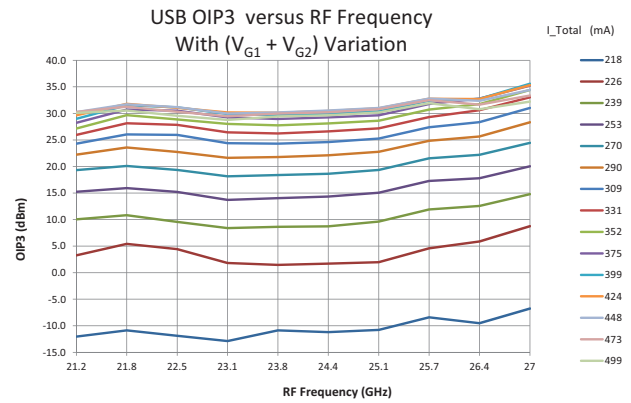
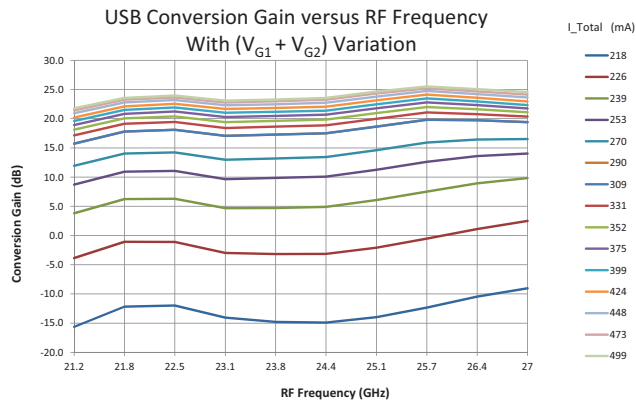
V_{C1} and V_{C2} are separately controlled and changes over (-4V to 0V)



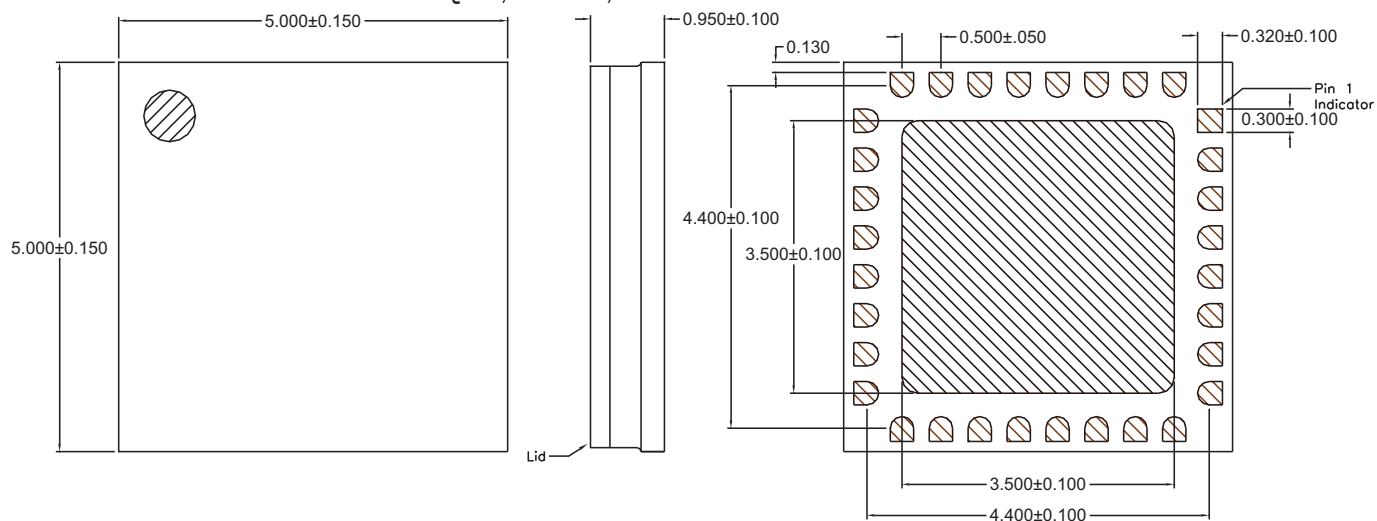
Performance Using Single Control on $V_{G1} = V_{G2}$ (without IQ bias)_3

$V_{MPA} = 4.5V$, $V_{LPA12} = 3.5V$, $V_{LOA1} = V_{LOA2} = 4V$, $V_{C1} = V_{C2} = -4V$

V_{G1} and V_{G2} are connected together off chip and changes over (-0.3V to -1V)



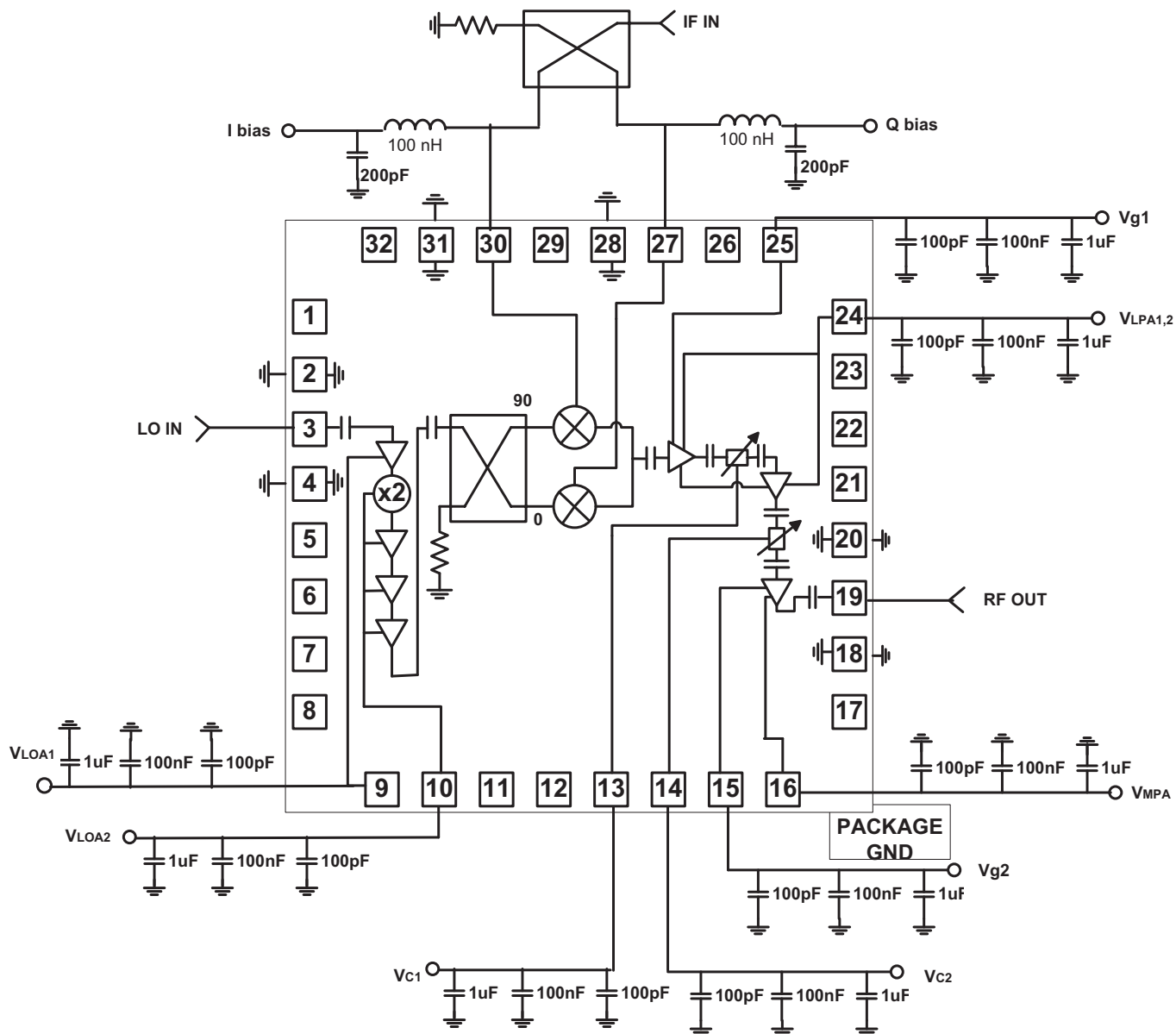
Package Outline Drawing
QFN, 32-Pin, 5mm x 5mm x 0.95mm



Pin Names and Description

Pin	Name	Description
1	N/C	Not Connected
2	GND	Ground
3	LO	Local Oscillator Input. AC Coupled and Matched to 50Ω
4	GND	Ground
5	N/C	Not Connected
6	N/C	Not Connected
7	N/C	Not Connected
8	N/C	Not Connected
9	VLOA1	LOA Stage1 Drain Bias
10	VLOA2	LOA Stage2 Drain Bias
11	N/C	Not Connected
12	N/C	Not Connected
13	VC1	Control Line Number 1 (See Bias Sequence Description)
14	VC2	Control Line Number 2 (See Bias Sequence Description)
15	VG2	MPA Gate Bias
16	VMPA	MPA Drain Bias
17	N/C	Not Connected
18	GND	Ground
19	RFOUT	RF Output. AC Coupled and Matched to 50Ω
20	GND	Ground
21	N/C	Not Connected
22	N/C	Not Connected
23	N/C	Not Connected
24	VLPA1, VLPA2	LPA Stage 1, 2 Drain Bias
25	VG1	LPA Stage 1, 2 Gate Bias
26	N/C	Not Connected
27	Q	IF Q Input
28	GND	Ground
29	N/C	Not Connected
30	I	IF I Input
31	GND	Ground
32	N/C	Not Connected

Application Circuit Block Diagram

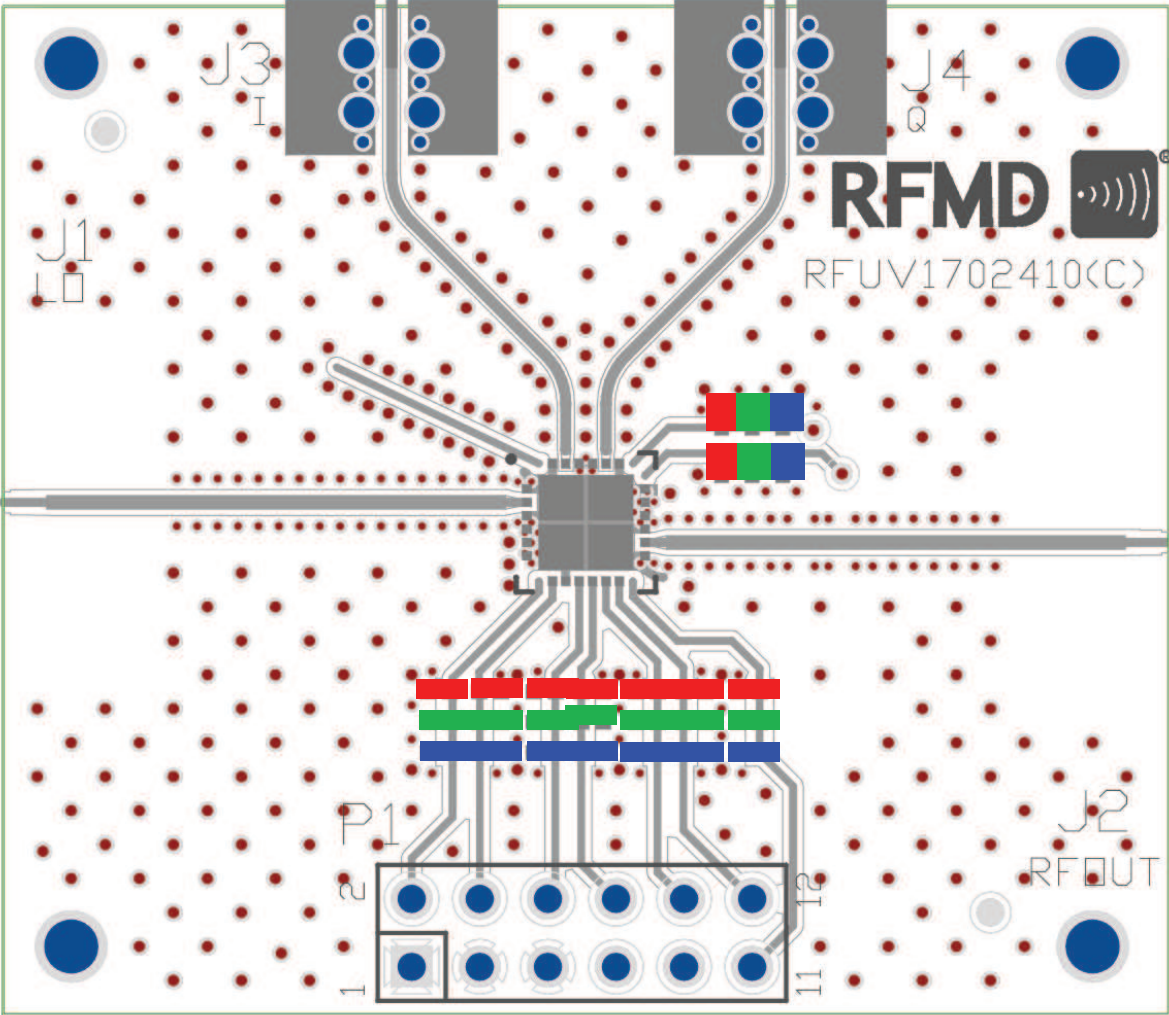


$2 * LO - IF = RF$ (LSB), $LO = 10.5$ to 15.25 GHz
 $2 * LO + IF = RF$ (USB), $LO = 8.5$ GHz to 13.25 GHz

Notes:

1. External components for IQ biases are required.
2. External hybrid coupler is required.

Evaluation Board Layout



- Legend:
- 100pF (0402)
 - 100nF (0402)
 - 1uF (0402)
- Component Labels:
- VLOA1 VLOA2 NC VC1 VC2 VG2
GND GND GND VG1 VLP2 VMPA

Sub-Band Frequency Ranges

Band	Frequency Range
23GHz	21.2GHz to 23.6GHz
26GHz	24.5GHz to 26.5GHz