# RFUV1003

## 12GHZ TO 16GHZ GAAS MMIC IQ UPCONVERTER

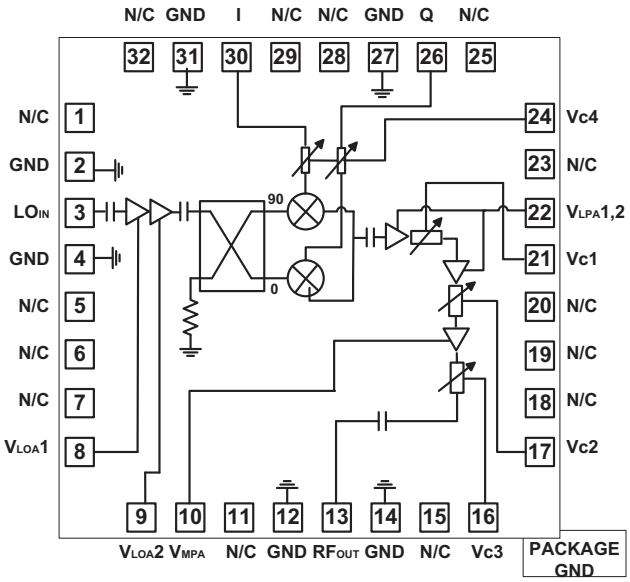
Package: QFN, 32-Pin, 5mm x 5mm x 0.95mm

## Features

- RF Frequency: 12GHz to16GHz
- LO Frequency: 8GHz to 20GHz
- IF Frequency: DC to 4GHz
- Conversion Gain (Max): 23dB
- Conversion Gain (Min): -10dB
- NF (Max. Gain): 11dB
- NF (Min. Gain): 17dB
- OIP3 (Max. Gain): +28dBm
- OIP3 (Min. Gain): +12dBm
- Image Rejection: 20dBc

## Applications

- Point to point
- VSAT




Functional Block Diagram

## Product Description

RFMD's RFUV1003 is a 12GHz to 16GHz GaAs pHEMT upconverter, incorporating an integrated LO buffer amplifier, a Balanced Single Side Band (Image rejection) mixer followed by Variable Gain Amplifier, DC decoupling capacitors. The combination of high performance part and low cost packaging makes the RFUV1003 a cost effective solution, ideally suited to both current and next generation Point-to-Point and VSAT applications. RFUV1003 is packaged in a 5mm x 5mm QFN to simplify both system level board design and volume assembly.

### Ordering Information

| | |
|---|---|
| RFUV1003S2 | 2-piece sample bag |
| RFUV1003SB | 5-piece bag |
| RFUV1003SQ | 25-piece bag |
| RFUV1003SR | 100 pieces on 7” reel |
| RFUV1003TR7 | 750 pieces on 7” reel |
| RFUV1003TR13 | 2500 pieces on 13” reel |
| RFUV1003PCK-410 | Evaluation board with 2-piece sample bag |

### Optimum Technology Matching® Applied

| | | | |
|---|---|---|---|
| ☐ GaAs HBT | ☐ SiGe BiCMOS | ☑ GaAs pHEMT | ☐ GaN HEMT |
| ☐ GaAs MESFET | ☐ Si BiCMOS | ☐ Si CMOS | ☐ BiFET HBT |
| ☐ InGaP HBT | ☐ SiGe HBT | ☐ Si BJT | ☐ LDMOS |





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## Absolute Maximum Ratings

| Parameter | Rating | Unit |
|---|---|---|
| LPA Drain Voltage Vd | 6 | V |
| LOA Drain Voltage | 6 | V |
| RF Input Power | 15 | dBm |
| LO Input Power | 15 | dBm |
| $T_{OPER}$ | -40 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.



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.

| Parameter | Specification | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min. | Typ. | Max. | | |
| | | | | | |
| RF Frequency | 12 | | 16 | GHz | |
| LO Frequency | 8 | | 20 | GHz | |
| IF Frequency | DC | | 4 | GHz | |
| LO input Drive | | 0 | | dBm | |
| Conversion Gain (Max.) | 20 | 23 | | dB | |
| Conversion Gain (Min.) | | -10 | | dB | |
| NF (max. Gain) | | 11 | | dB | |
| NF (min. Gain) | | 17 | | dB | |
| OIP3 (max. Gain) | 25 | 28 | | dBm | |
| OIP3 (min. Gain) | 9 | 12 | | dBm | |
| Image Rejection | 15 | 20 | | dBc | |
| LO Leakage at RF-Port (Maximum Gain) | | -5 | 5 | dBm | With IQ bias |
| LO Return Loss | | 10 | | dB | |
| RF Return Loss | | 10 | | dB | |
| $V_D$ | | 5 | | V | |
| $I_D$ | | 380 | 500 | mA | |
| VVA | -3 | | 0 | V | |



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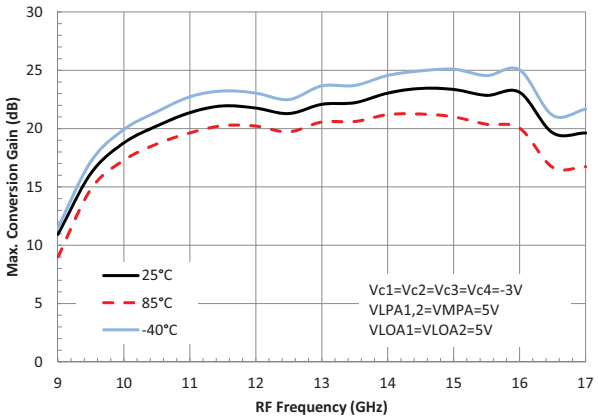
## Typical Electrical Performance

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.

Max. Conversion Gain vs. RF Frequency
Over Temperature (USB)




Min. Conversion Gain vs. RF Frequency
Over Temperature (USB)

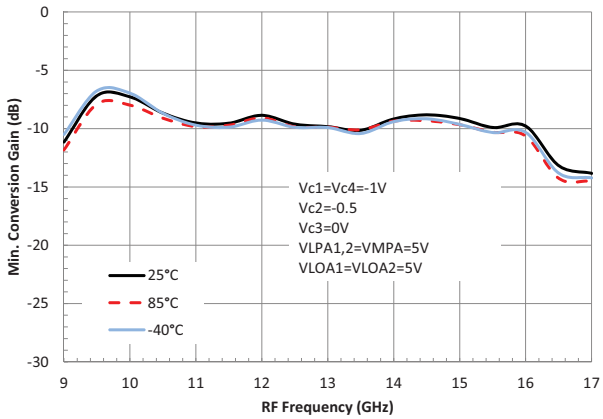
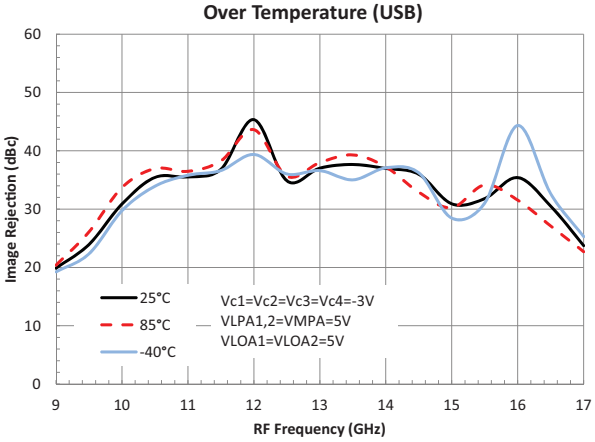


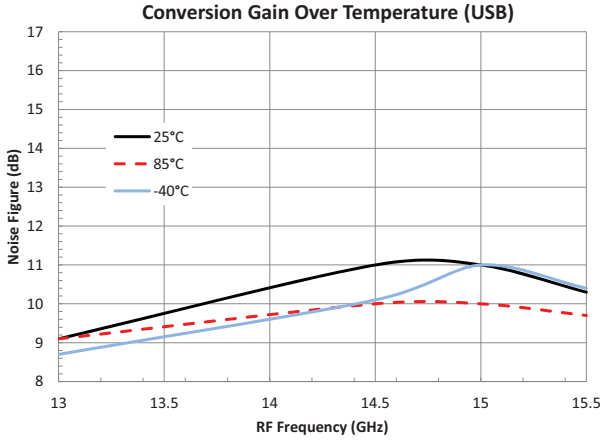

Image Rejection vs. RF Frequency
Over Temperature (USB)



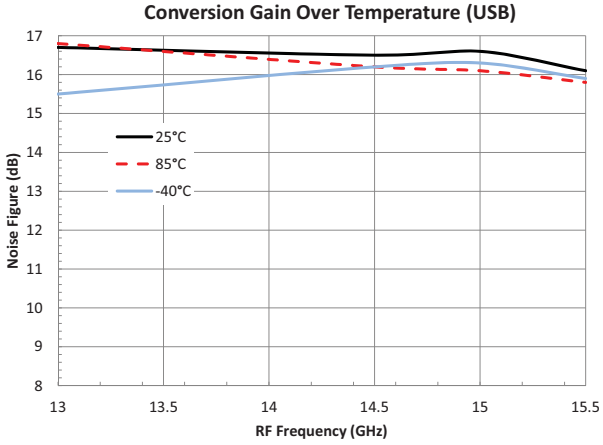
## Typical Electrical Performance

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.

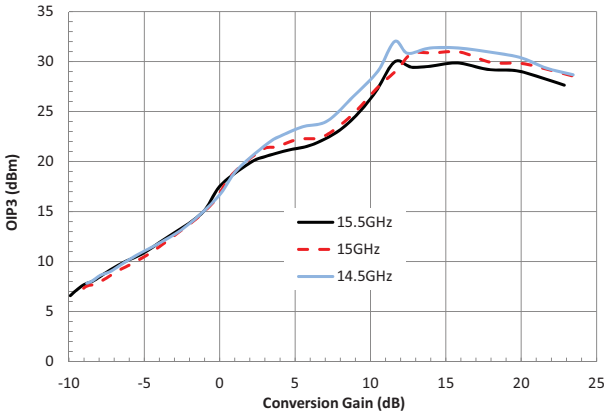
Noise Figure vs. RF Frequency at 20dB Conversion Gain Over Temperature (USB)



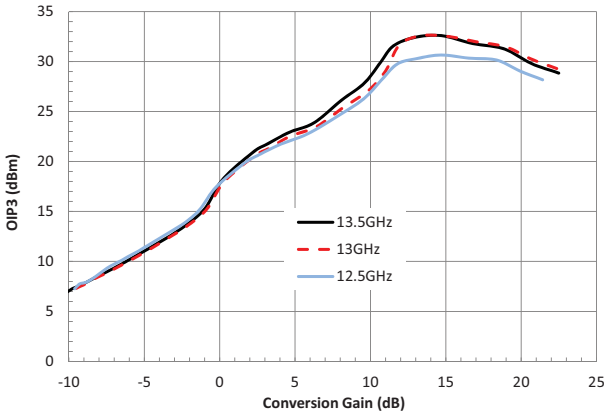

Noise Figure vs. RF Frequency at -5dB Conversion Gain Over Temperature (USB)




OIP3 vs. Conversion Gain at 25°C (USB 15GHz Band)




OIP3 vs. Conversion Gain at 25°C (USB 13GHz Band)



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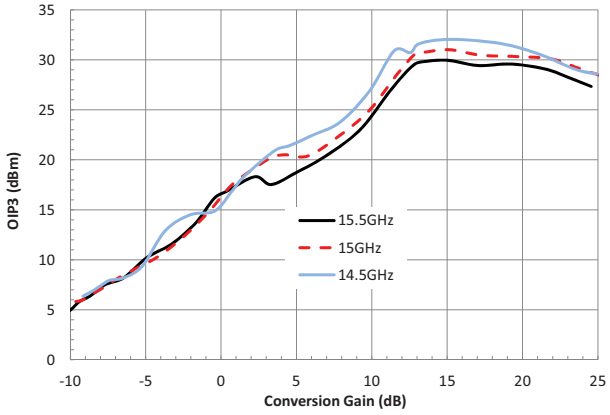
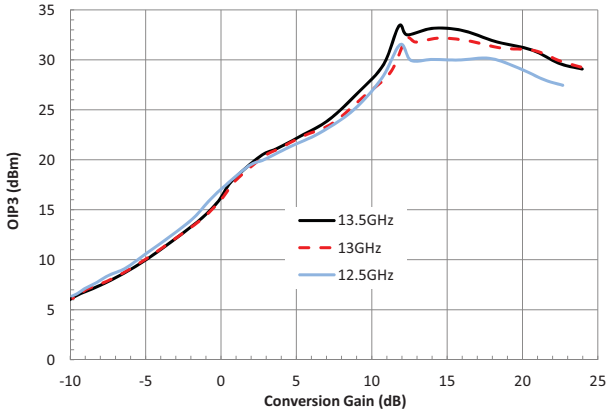
## Typical Electrical Performance

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.

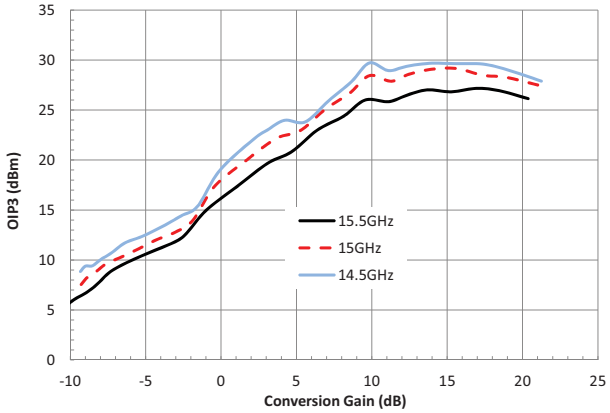
OIP3 vs. Conversion Gain at -40°C
(USB 15GHz Band)



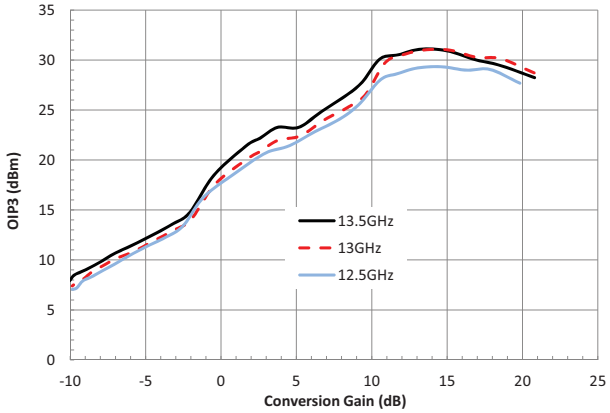

OIP3 vs. Conversion Gain at -40°C
(USB 13GHz Band)




OIP3 vs. Conversion Gain at 85°C
(USB 15GHz Band)



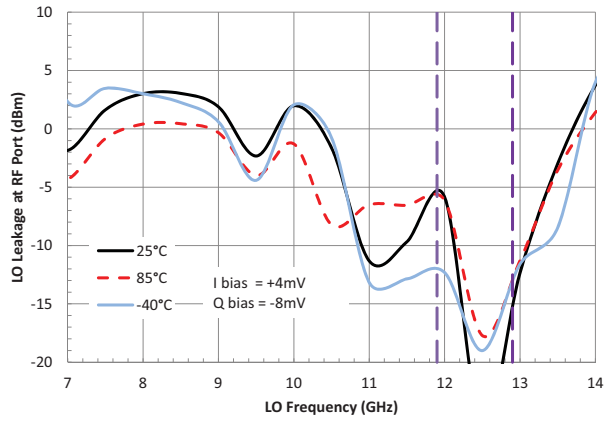

OIP3 vs. Conversion Gain at 85°C
(USB 13GHz Band)



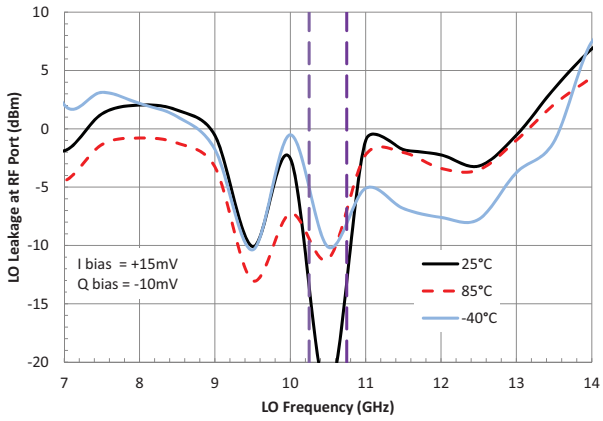
## Typical Electrical Performance

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.

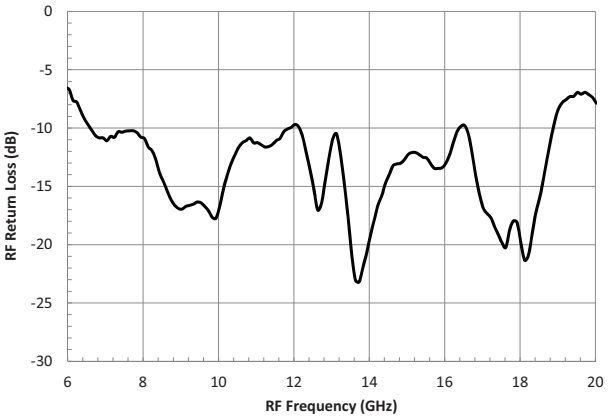
LO Leakage vs. LO Frequency
Over Temperature (USB 15GHz Band)



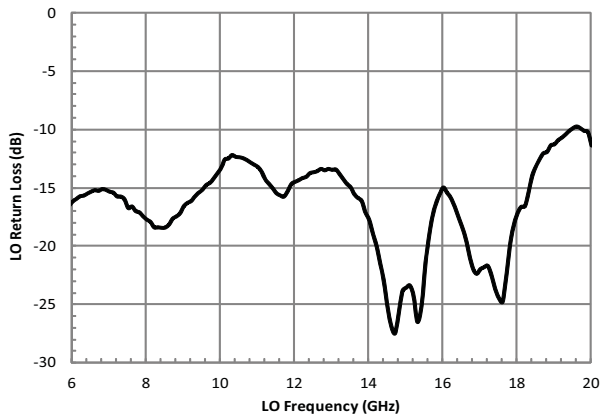

LO Leakage vs. LO Frequency
Over Temperature (USB 13GHz Band)




RF Return Loss vs. RF Frequency




LO Return Loss vs. LO Frequency



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## Bias Sequence and Gain Control

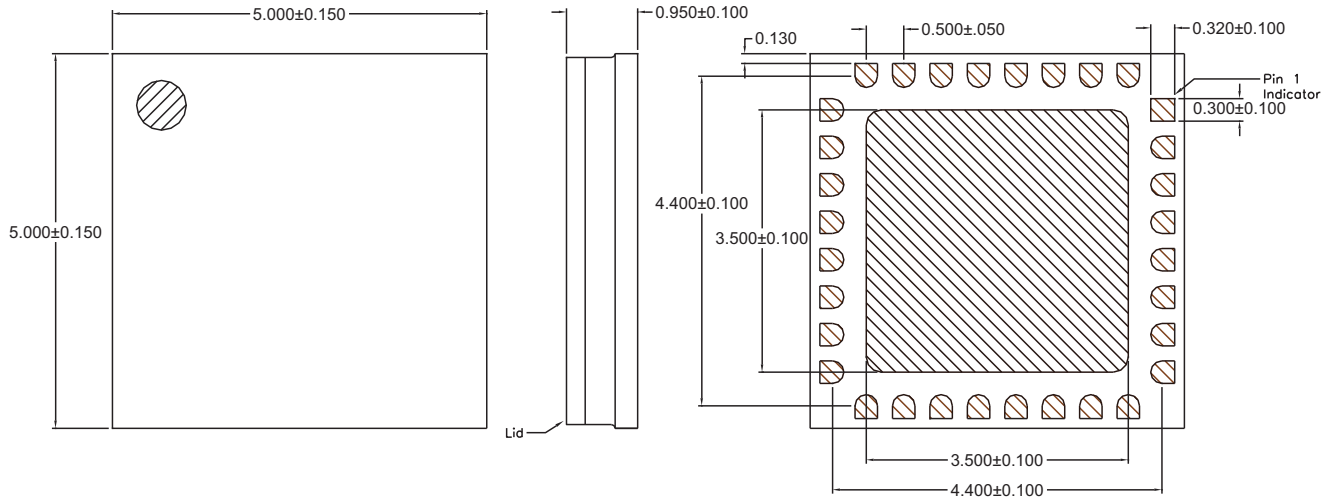
Optimum performance is achieved using sequential bias. At maximum gain ($V_C1$ ,$V_C4$), $V_C2$ and $V_C3$ are set at -3V. ($V_C1$ ,$V_C4$), $V_C2$ and $V_C3$ are biased in sequence. The first dynamic range is achieved by setting $V_C2$ and $V_C3$ at -3V and varying ($V_C1$ ,$V_C4$) over the (-3V to -1V) range as shown in the table below. Similarly second dynamic range is achieved by setting ($V_C1$ ,$V_C4$) at -1V, $V_C3$ at -3V and varying $V_C2$ over the (-3V to -0.5V) range. Finally third dynamic range is achieved by setting ($V_C1$ ,$V_C4$) at -1V, $V_C2$ at -0.5V and varying $V_C3$ over the (-3V to 0V) range.

Bias Sequence 1 (Typical)

| | Gmax | | | | | | | | | | | | | | Gmin |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VC1, VC4 | -3 | -2.5 | -2 | -1.5 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| VC2 | -3 | -3 | -3 | -3 | -3 | -2.5 | -2 | -1.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| VC3 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -3 | -2.5 | -2 | -1.5 | -1 | -0.5 | 0 |

## Package Outline Drawing

QFN, 32-Pin, 5mm x 5mm x 0.95mm





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## Pin Names and Description

| Pin | Function | Description |
|---|---|---|
| 1 | N/C | |
| 2 | GND | Ground |
| 3 | LO | Local Oscillator Input. AC Coupled and Matched to 50Ω |
| 4 | GND | Ground |
| 5 | N/C | |
| 6 | N/C | |
| 7 | N/C | |
| 8 | VLOA1 | LOA Stage1 Drain Bias |
| 9 | VLOA2 | LOA Stage2 Drain Bias |
| 10 | VMPA | MPA Drain Bias |
| 11 | N/C | |
| 12 | GND | Ground |
| 13 | RFOUT | RF Output. AC Coupled and Matched to 50W |
| 14 | GND | Ground |
| 15 | N/C | |
| 16 | VC3 | Control Line number3 (See Bias Sequence description) |
| 17 | VC2 | Control Line number2 (See Bias Sequence description) |
| 18 | N/C | |
| 19 | N/C | |
| 20 | N/C | |
| 21 | VC1 | Control Line number1 (See Bias Sequence description) |
| 22 | VLPA1, VLPA2 | LPA Stage1,2 Drain Bias |
| 23 | N/C | |
| 24 | VC4 | Control Line number4 (See Bias Sequence description) |
| 25 | N/C | |
| 26 | Q | IF Q Input |
| 27 | GND | Ground |
| 28 | N/C | |
| 29 | N/C | |
| 30 | I | IF I Input |
| 31 | GND | Ground |
| 32 | N/C | |


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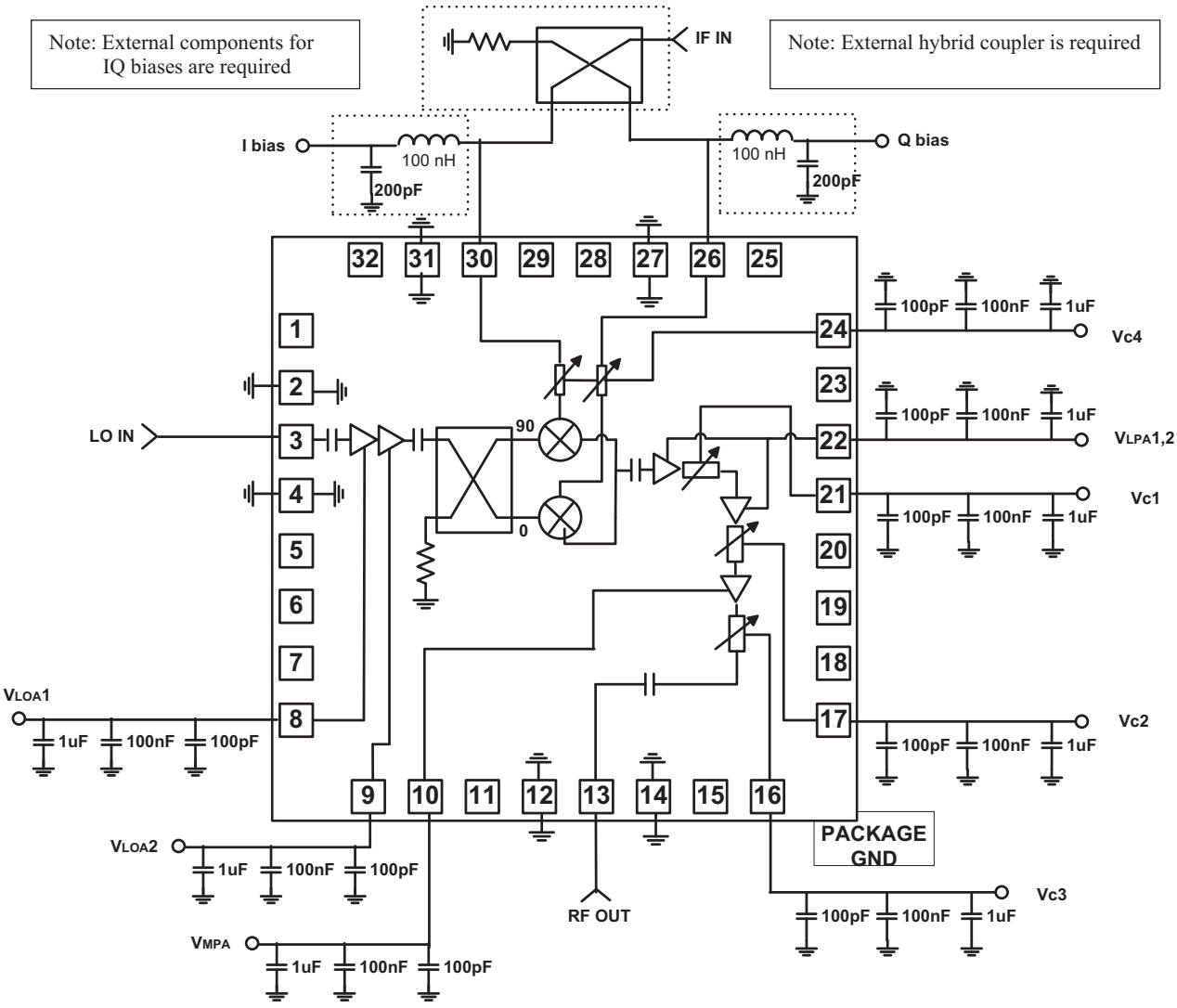
## Application Circuit Block Diagram





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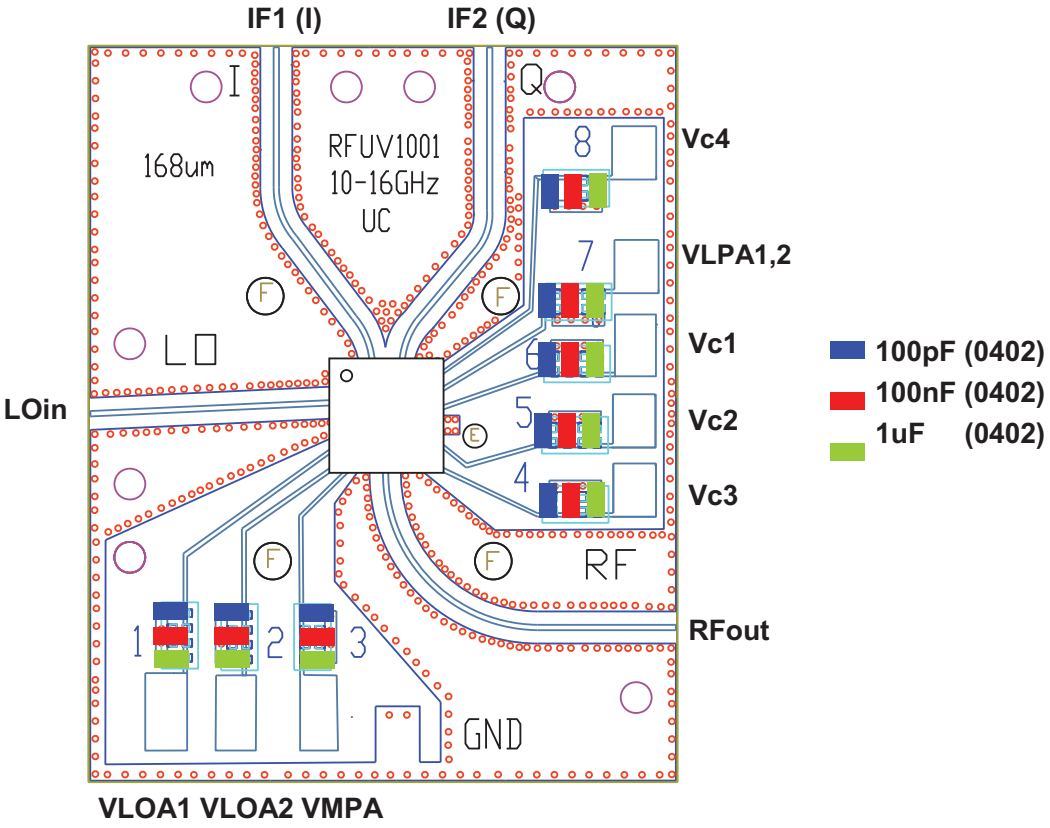
## Evaluation Board Layout




**Test Condition**

| | |
|---|---|
| LO Power | 0dBm |
| IF Power | -10dBm |
| VLOA1, VLOA2 | 5V |
| VLPA1, VLPA2, VMPA | 5V |
| ($V_C1$, $V_C4$), $V_C2$, $V_C3$ | -3V to 0V |

**Sub-Band Frequency Ranges**

| Band | Frequency Range |
|---|---|
| 10GHz | 10GHz to 10.5GHz |
| 11GHz | 10.7GHz to 11.7GHz |
| 13GHz | 12.75GHz to 13.25GHz |
| 15GHz | 14.4GHz to 15.4GHz |



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