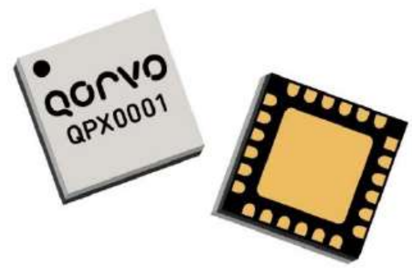
QPX0001

6-26 GHz I/Q Mixer

Product Overview

Qorvo's QPX0001 is a compact, wideband I/Q GaAs mixer housed in a 3.9 x 3.9 mm air cavity surface mount ceramic package. Operating over the 6 to 26 GHz bandwidth, the mixer can be configured as an image reject mixer, a single sideband upconverter, or a QPSK modulator/demodulator. The QPX0001 utilizes two double balanced mixer cells and a 90º hybrid internal to the MMIC. An external 90º IF hybrid is required to complete the image rejection or sideband suppression. The QPX0001 is a much smaller alternative to higher cost hybrid I/Q Mixers and single sideband upconverter assemblies.

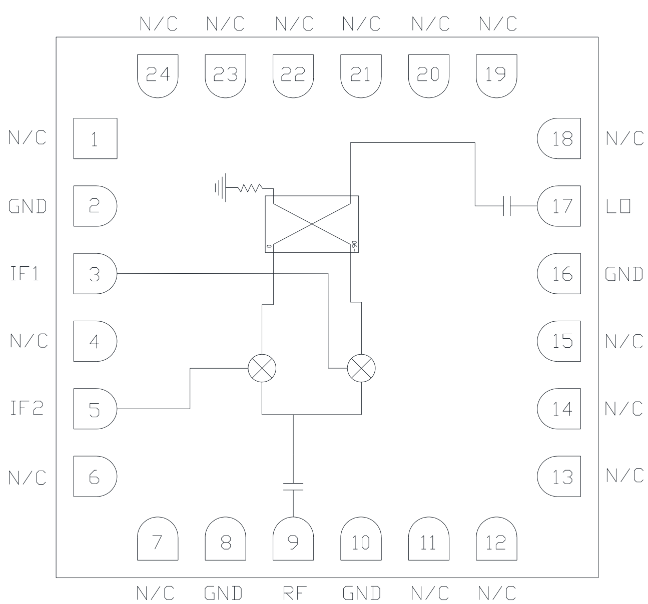


Key Features

- I, Q outputs
- RF, LO Frequency Range: 6 – 26 GHz
- IF Frequency Range: DC – 3 GHz
- Low conversion loss of 8 dB at 14 GHz
- High image rejection of 25 dB
- High LO/RF isolation > 45 dB at 14 GHz
- Wide operating bandwidth
- Package Dimensions: 3.9 x 3.9 x 0.9 mm

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Functional Block Diagram



Applications

- Image reject downconversion
- Single-sideband modulation
- Low noise receiver systems
- Phase detection
- Electronic Warfare (EW)
- QPSK modulation/demodulation

Ordering Information

Part No.	Description
QPX0001EVB1	Evaluation Board, Qty=1
QPX0001SR	Tape and Reel, Qty=100

ES France - Département RF & Hyperfréquences - 127 rue de Buzenval BP 26 - 92380 Garches
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Absolute Maximum Ratings

Parameter	Rating
LO, RF, or IF power, CW, 25 ºC	+25 dBm
Channel Temperature, Tch	150 °C
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Mounting Temperature (30 sec)	260 °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
LO Drive Power	+13	+17	+21	dBm
RF input Power (downconversion)			+17	dBm
IF Input Power (upconversion)			+17	dBm
Temperature Range	-40	+25	+85	°C

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

Electrical Specifications

Test conditions unless otherwise noted: 25 °C, IF = 100 MHz USB, LO = +17 dBm

Parameter	Min	Typ.	Max	Units
RF, LO Operational Frequency Range	6	–	26	GHz
IF Frequency Range	DC	–	3	GHz
Conversion Gain (with external 90º IF hybrid)	-13	-8	–	dB
Image Rejection (with external 90º IF hybrid)	–	25	–	dB
LO to RF Isolation	–	40	–	dB
LO to IF Isolation	–	27	–	dB
Input Power (P_{1dB})	–	+14	–	dBm
Input IP3	–	+21	–	dBm

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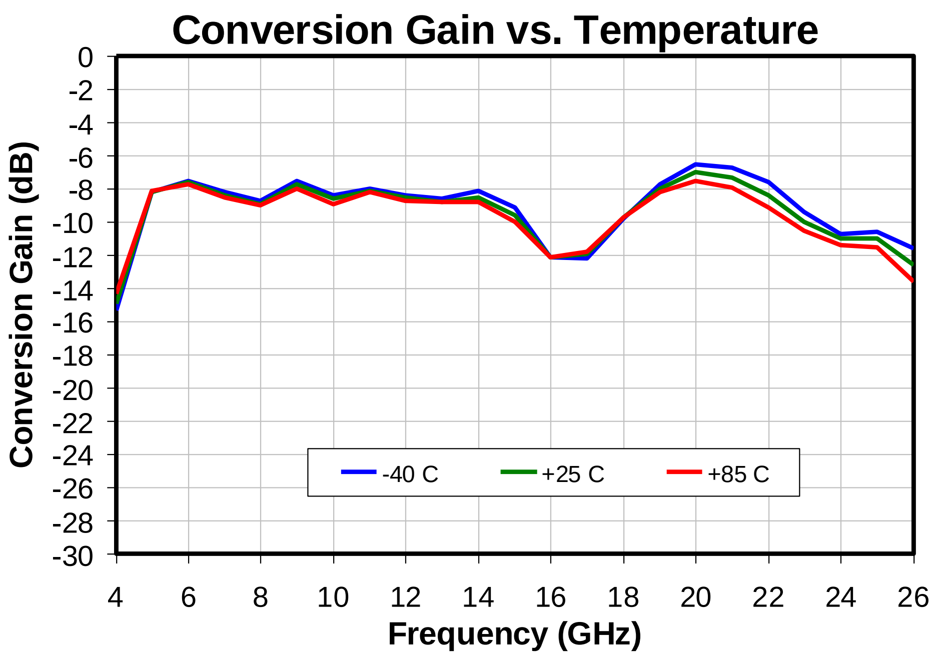
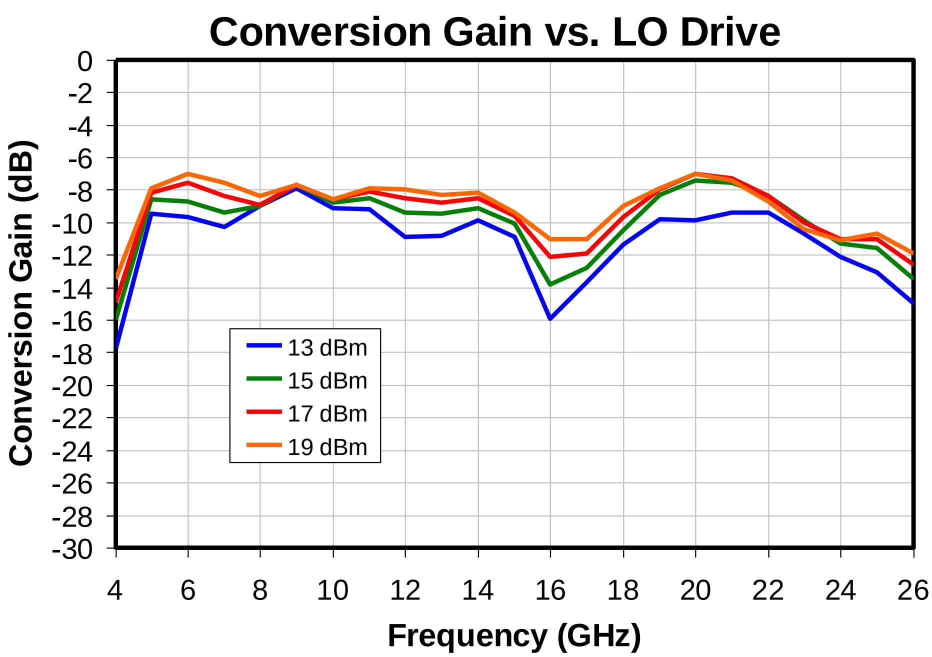
Typical Performance – Data Taken as IRM with External IF Hybrid, IF=100 MHz USB





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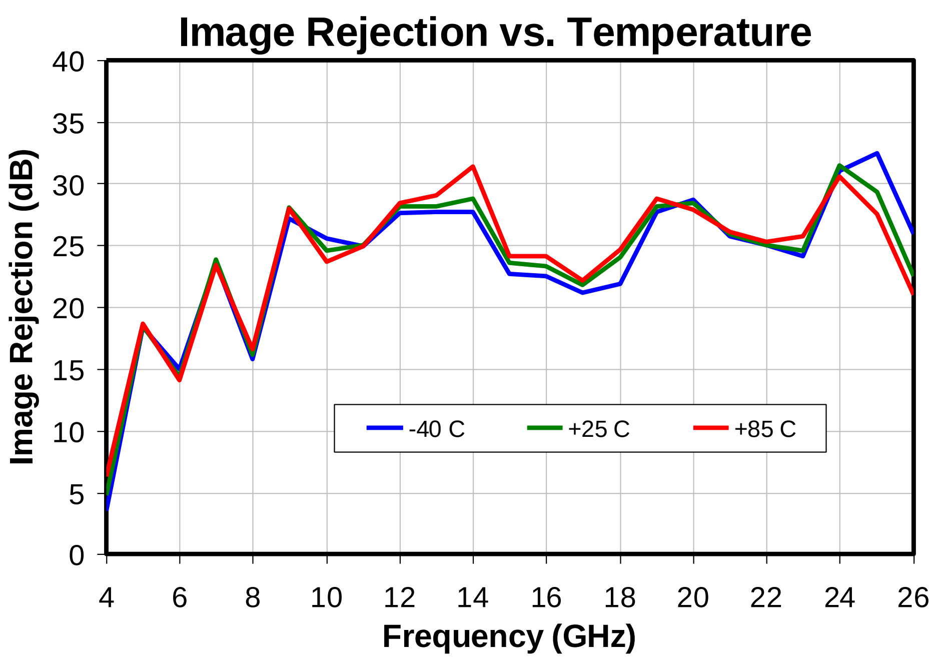

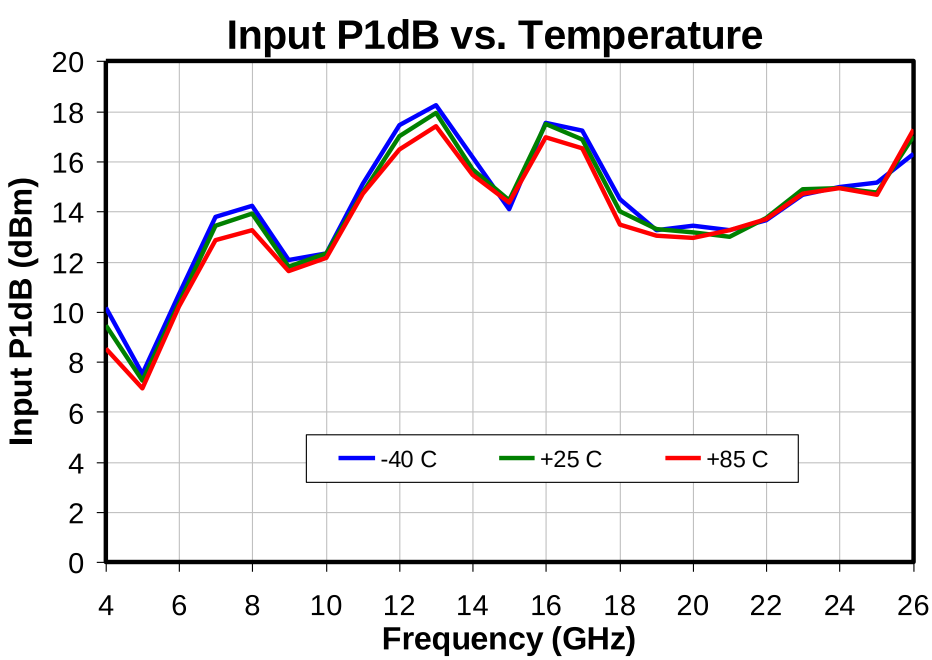

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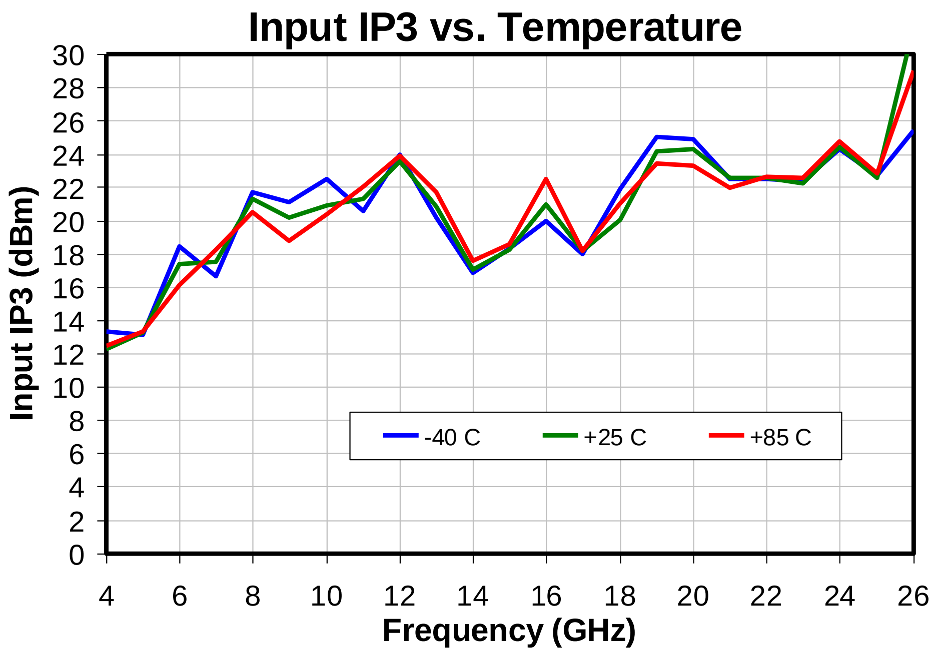

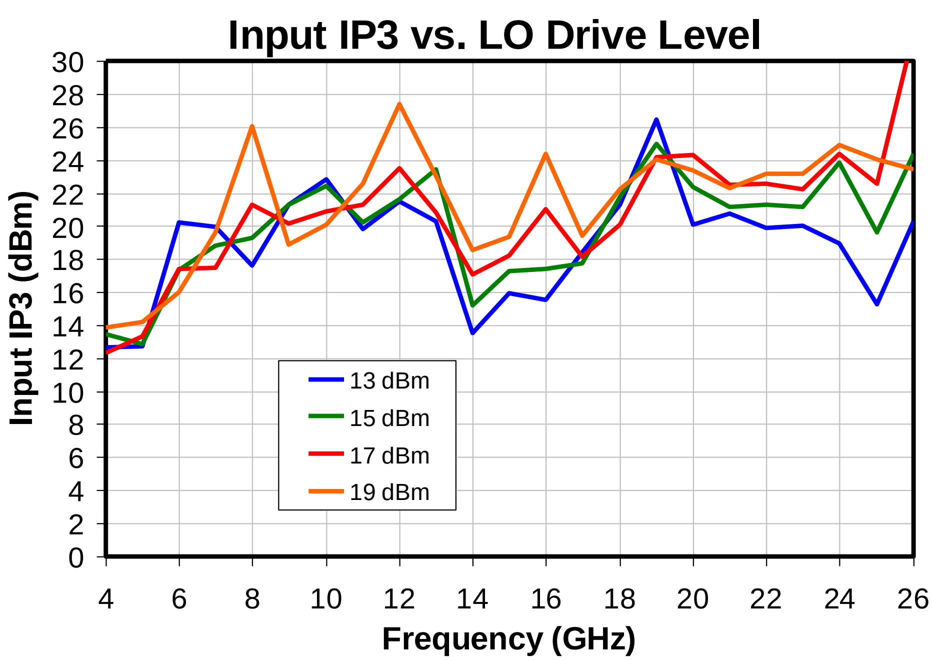

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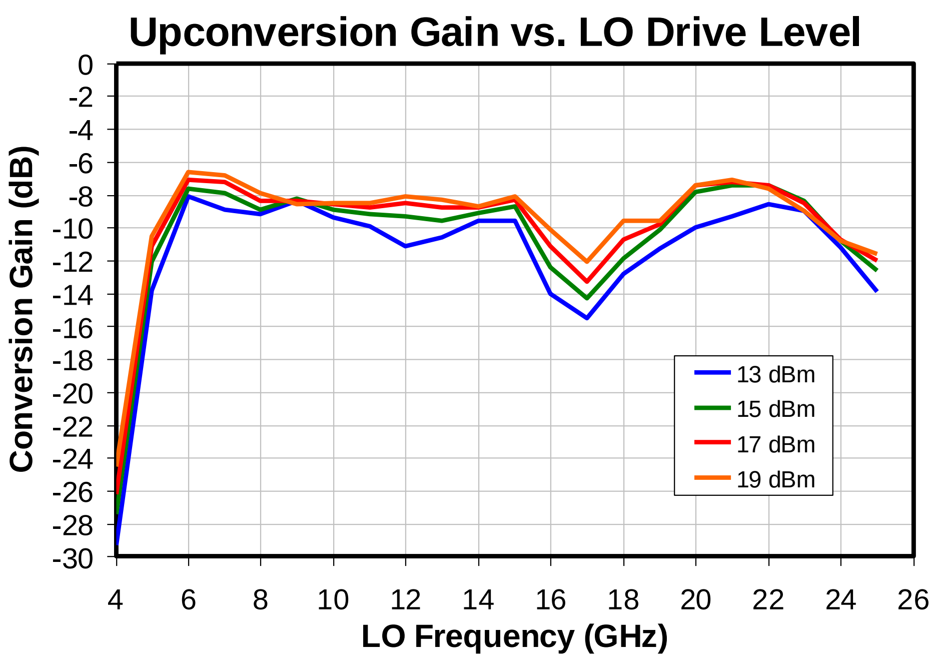
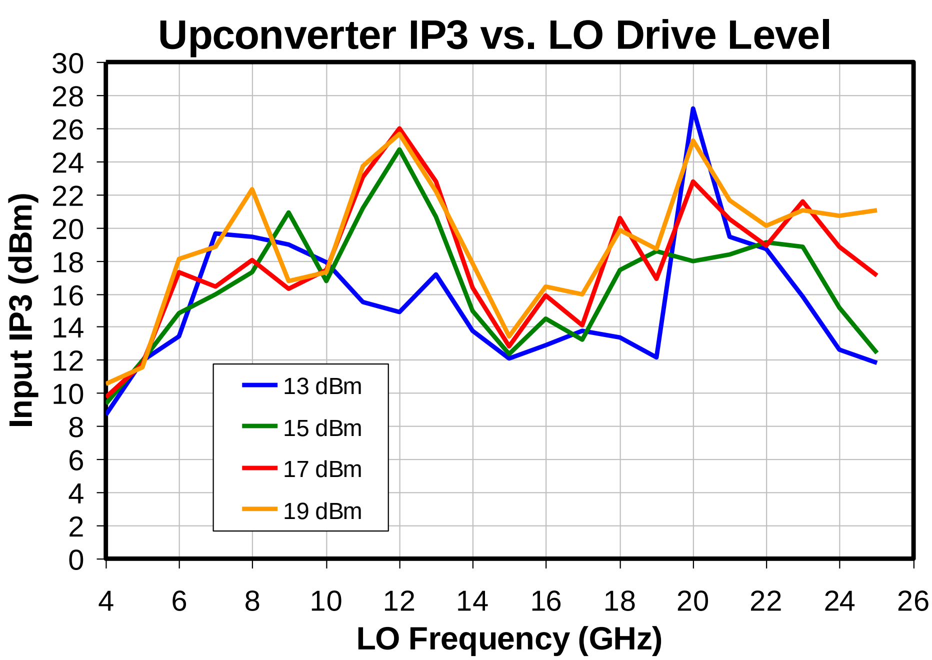
Typical Performance – Data Taken as Upconverter with External IF Hybrid, IF=950 MHz USB





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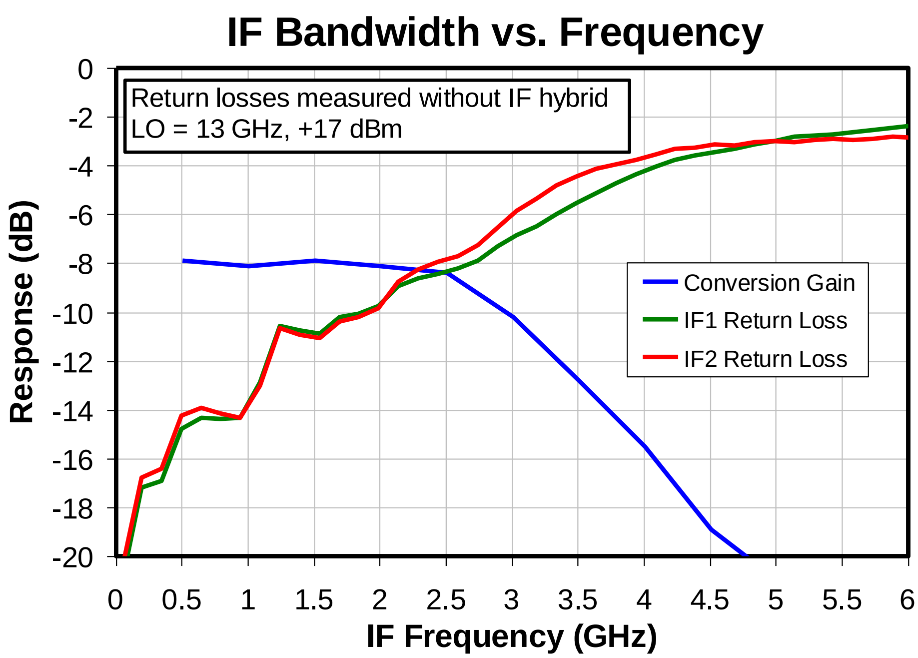
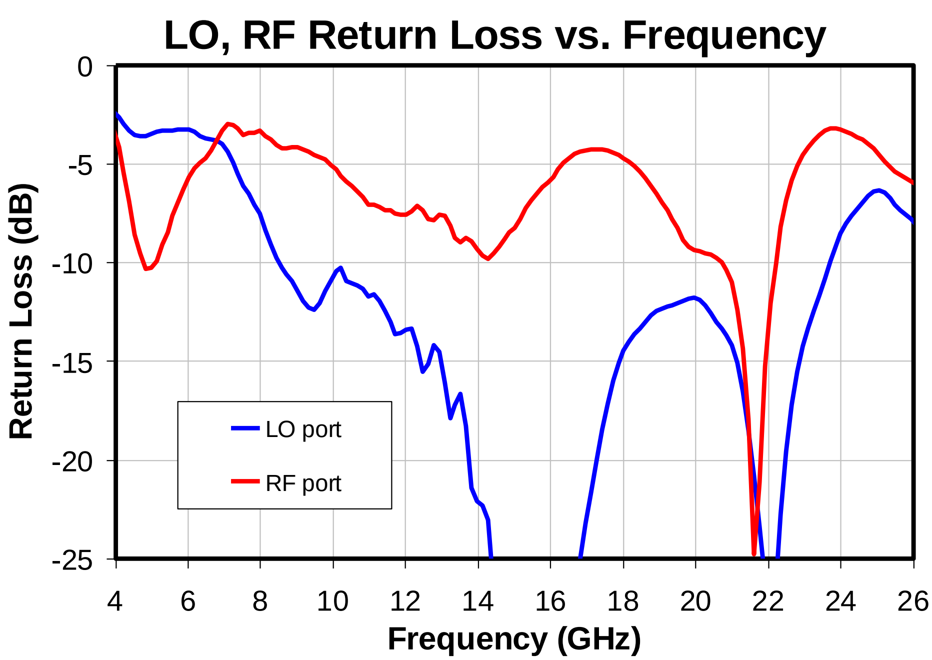
Typical Performance





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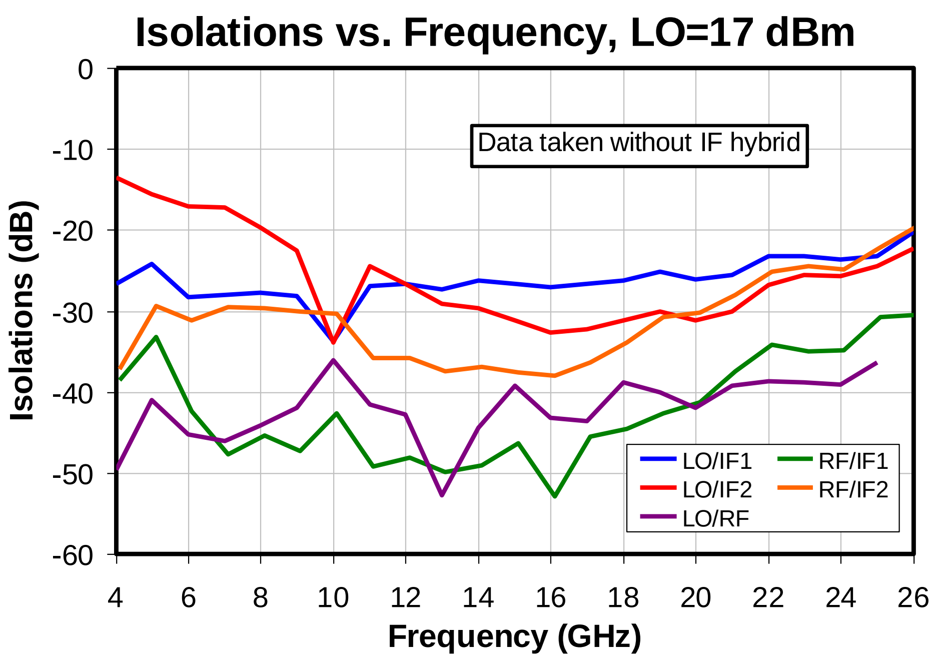
Typical Performance



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Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) [1]	T_{BASE} = 85 °C, CW, LO P_{IN} = 17 dBm (0.05 W), P_{DISS} = 0.05 W	400	ºC/W
Channel Temperature (T_{CH}) [1]		105	°C
Median Lifetime (T_M)		4.0E6	Hrs

Notes:
1. Measured to the back of the package.

Spur Performance

	nLO				
mRF	0	1	2	3	4
0	x	-11	26		
1	46	0	54	44	
2			53	64	
3				66	
4					

	nLO				
mRF	0	1	2	3	4
0	x	-8	11		
1	27	0	41	36	
2	61	67	48	66	65
3		68		62	
4					

RF = 14.1 GHz, -10 dBm
LO = 14 GHz, +17 dBm
All values in dBc below IF output power level (1RF – 1LO)
Data taken as downconverter with no IF hybrid
IF1 response in top table, IF2 response in bottom table.

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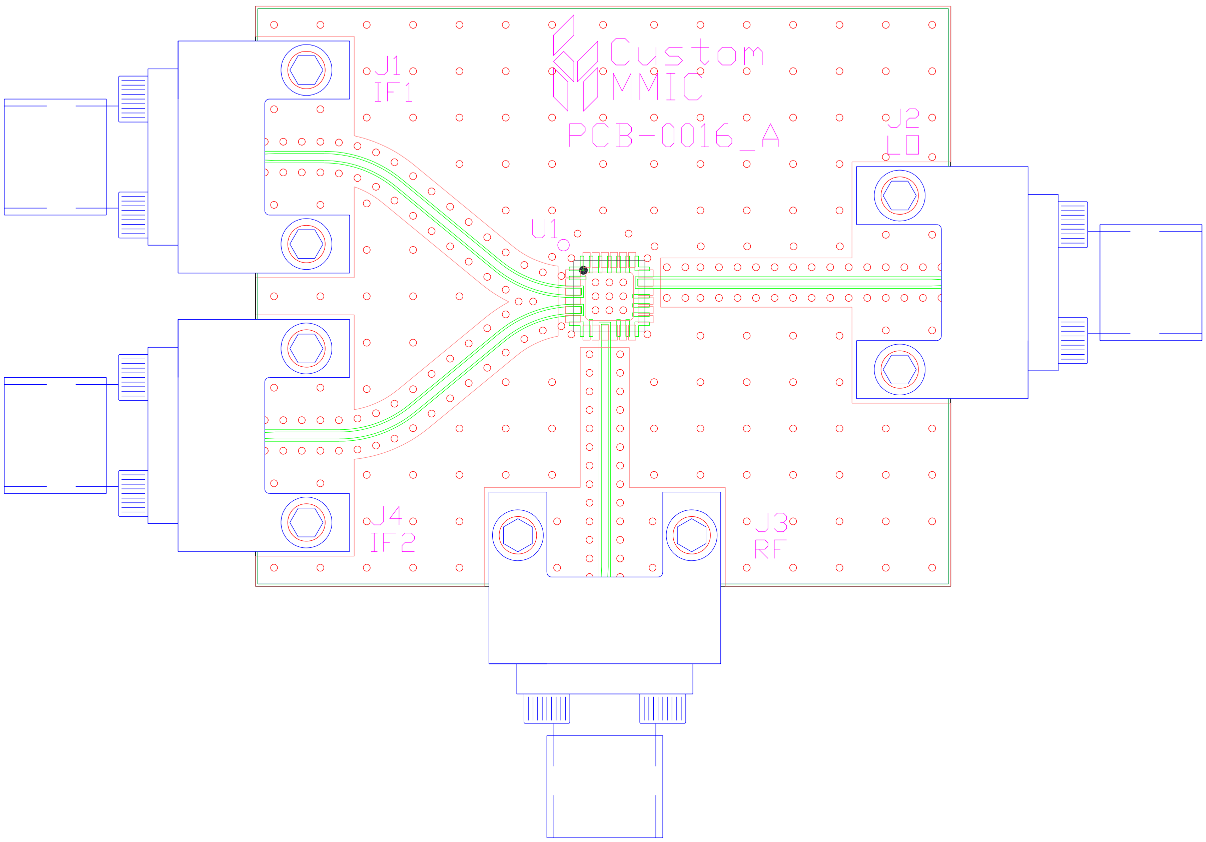
Evaluation Board (EVB) Assembly Layout



Bill of Materials for QPX0001EVB1

Reference Des.	Value	Description	Manuf.	Part Number
J1, J2, J3, J4		End Launch Connector		
U1		QPX0001 I/Q Mixer	Qorvo	
PCB		PCB-0016 Evaluation PCB		

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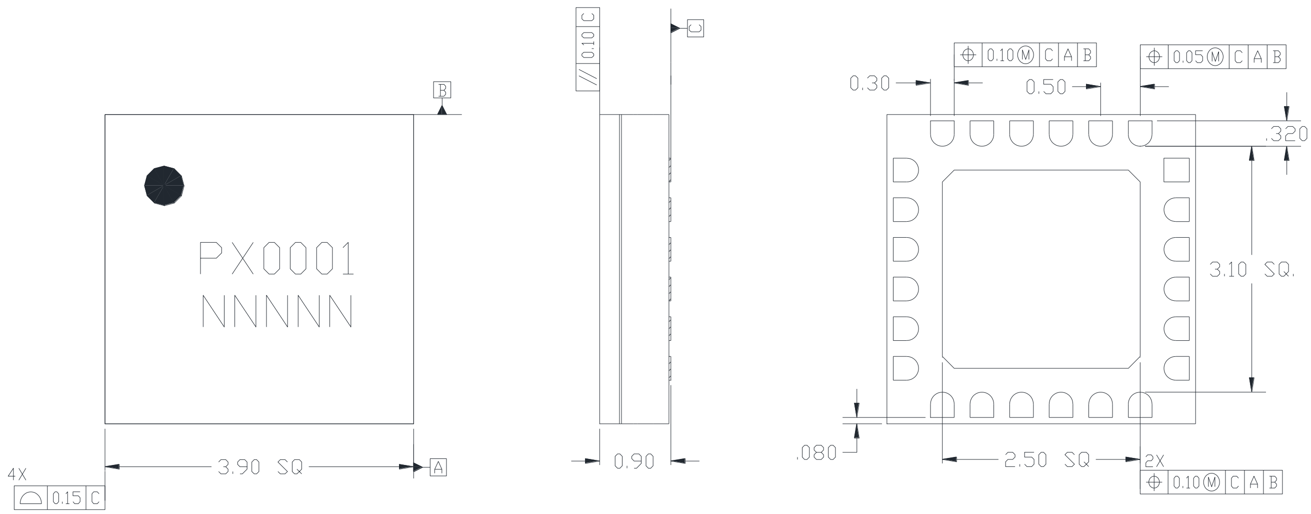
Mechanical Information



NOTES:
1. ALL DIMENSIONS AND TOLERANCES ARE WITHIN THOSE INDICATED IN JEDEC MO-220 WITH EXCEPTION OF TOTAL THICKNESS. ALL DIMENSION SHOWN AS mm. CONTROLLING DIMENSION ARE IN mm.
2. LEAD FINISH: ELECTROLESS NICKEL ELECTROLESS PALLADIUM IMMERSION GOLD (ENEPIG) PLATING IN ACCORDANCE WITH IPC-4556
3. MARKING: ALL MARKING SHALL BE PERMANENT AND LEGIBLE
   LINE 1: PART NUMBER AS INDICATED
   LINE 2: REPRESENTED A 5 DIGITS NNNNN UNIQUE ALPHANUMERIC LOT NUMBER OR LAST 4 DIGITS OF THE CUSTOM MMIC PO NUMBER
4. INDICATED DIMENSION/TOLERANCE APPLIES TO LEADS AND EXPOSED PAD.
5. REFERENCE ASSEMBLY DRAWING DRAW-AD-0046 FOR ASSEMBLY INFORMATION.
6. ALTERNATE PIN #1 IDENTIFIER WITH CORNER CHAMFER ON GROUND PADDLE IS ACCEPTABLE.

Recommended PCB Land Pattern

Qorvo recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Qorvo Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Qorvo recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Qorvo Application Note AN 102 for a recommended solder reflow profile.

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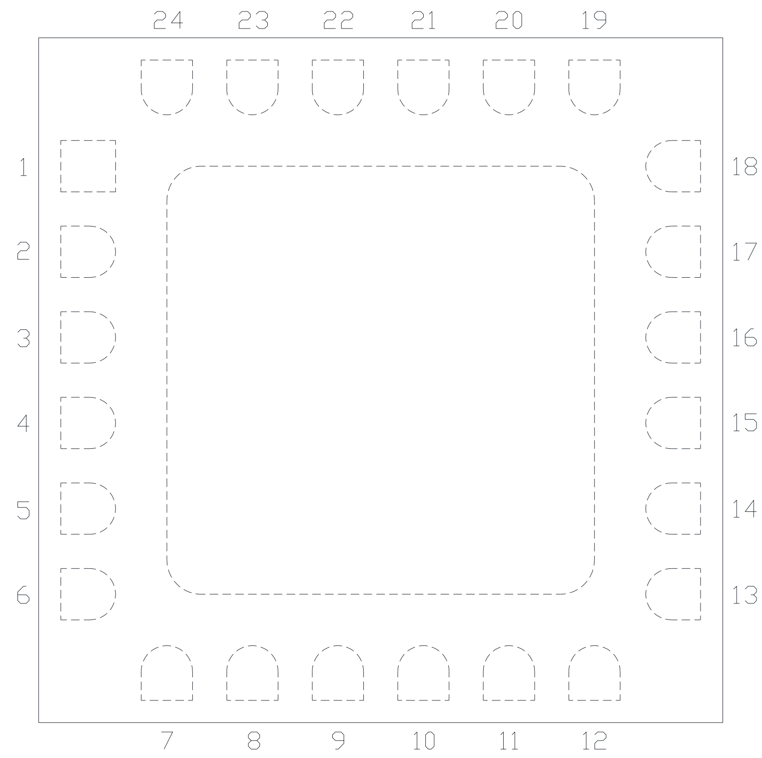
Pin Diagram



Pin Description

Pad No.	Symbol	Description
1, 4, 6, 7, 11-15, 18-24	N/C	No connection required. These pins may be connected to RF/DC ground.
3, 5	IF1, IF2	These pins are DC coupled. For applications not requiring operation to DC, these ports should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, these pins must not source or sink more than 16 mA of current or part non-function or part failure may result.
9	RF	This pin is AC coupled and matched to 50 Ohms.
17	LO	This pin is AC coupled and matched to 50 Ohms.
2, 8, 10, 16, and die paddle	Ground	Connect to RF / DC ground

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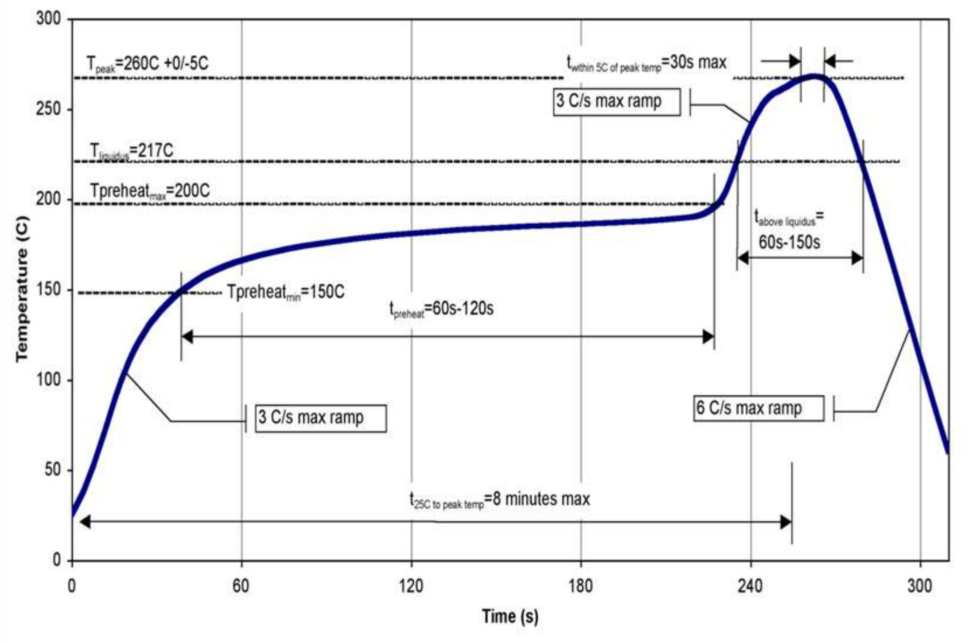
Assembly Notes

1. Compatible with lead-free soldering processes with 260°C peak reflow temperature.
2. Contact plating: ENEPIG
3. Solder rework not recommended.
4. See Application Note AN102 for further information regarding soldering.

Recommended Soldering Temperature Profile



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Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1A	ESDA / JEDEC JS-001-2012
MSL – Moisture Sensitivity Level	Level 1	JEDEC standard IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

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 ($C_{15}H_{12}Br_{4}0_{2}$) 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**

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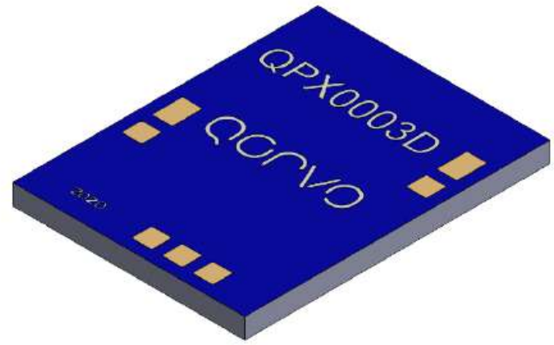
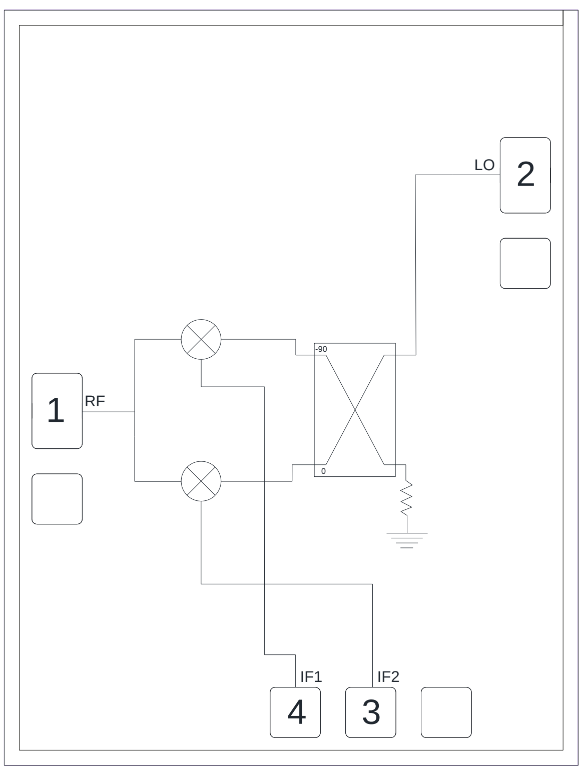
QPX0003D
30-40 GHz I/Q Mixer

Product Overview

Qorvo's QPX0003D is a compact I/Q mixer in die form operating over the 30 to 40 GHz bandwidth that can be configured as an image reject mixer, a single sideband upconverter, or a QPSK modulator/demodulator. The QPX0003D utilizes two double balanced mixer cells and a 90º hybrid on the LO port. An external 90º hybrid on the IF port is required to complete the image rejection or sideband suppression. The QPX0003D is a smaller alternative to higher cost hybrid I/Q Mixers and single sideband upconverter assemblies.



Functional Block Diagram



Key Features

- I, Q outputs/inputs
- RF, LO Frequency Range: 30 to 40 GHz
- IF Frequency Range: DC – 5 GHz
- Low conversion loss of 7 dB at 35 GHz
- High image rejection of 25 dB
- High LO/RF isolation > 35 dB at 35 GHz
- Small die size

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Applications

- Image reject downconversion
- Single-sideband modulation
- Low noise receiver systems
- Phase detection
- QPSK modulation/demodulation

Ordering Information

Part No.	Description
QPX0003D	30 to 40 GHz I/Q mixer die
QPX0003DS2	Sample, 2 pieces

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Absolute Maximum Ratings

Parameter	Rating
LO, RF, or IF power, CW, 25 ºC	+25 dBm
Channel Temperate, Tch	150 °C
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 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
LO Drive Power	+11	+15	+21	dBm
RF input Power (downconversion)			+17	dBm
IF Input Power (upconversion)			+17	dBm
Temperature Range	-55	+25	+85	°C

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

Electrical Specifications

Test conditions unless otherwise noted: 25 °C, IF = 100 MHz USB, LO = +15 dBm

Parameter		Min	Typ.	Max	Units
RF, LO Operational Frequency Range		30	–	40	GHz
IF Frequency Range		DC	–	5	GHz
Conversion Gain (with external hybrid)	RF, LO Frequency = 30 – 36 GHz	-11	-7	–	dB
	RF, LO Frequency = 36 – 40 GHz	-11	-9	–	dB
Image Rejection (with external hybrid)	RF, LO Frequency = 30 – 36 GHz	20	25	–	dB
	RF, LO Frequency = 36 – 40 GHz	15	17.5	–	dB
LO to RF Isolation	RF, LO Frequency = 30 – 36 GHz	–	35	–	dB
	RF, LO Frequency = 36 – 40 GHz	–	35	–	dB
LO to IF Isolation	RF, LO Frequency = 30 – 36 GHz	–	25	–	dB
	RF, LO Frequency = 36 – 40 GHz	–	22	–	dB
Input Power (P_{1dB})		–	+10	–	dBm
Input IP3		–	+18	–	dBm

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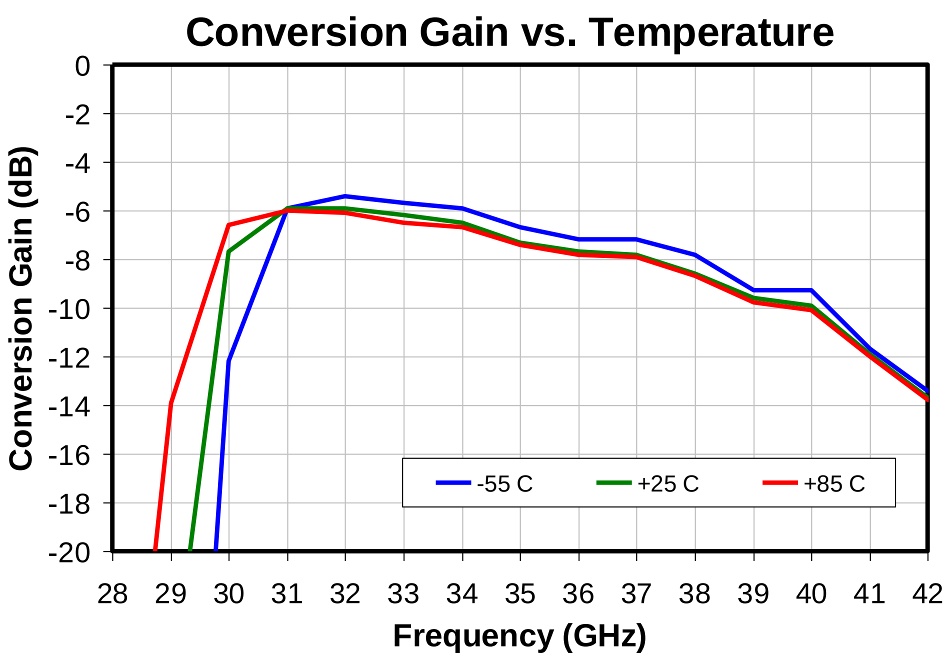
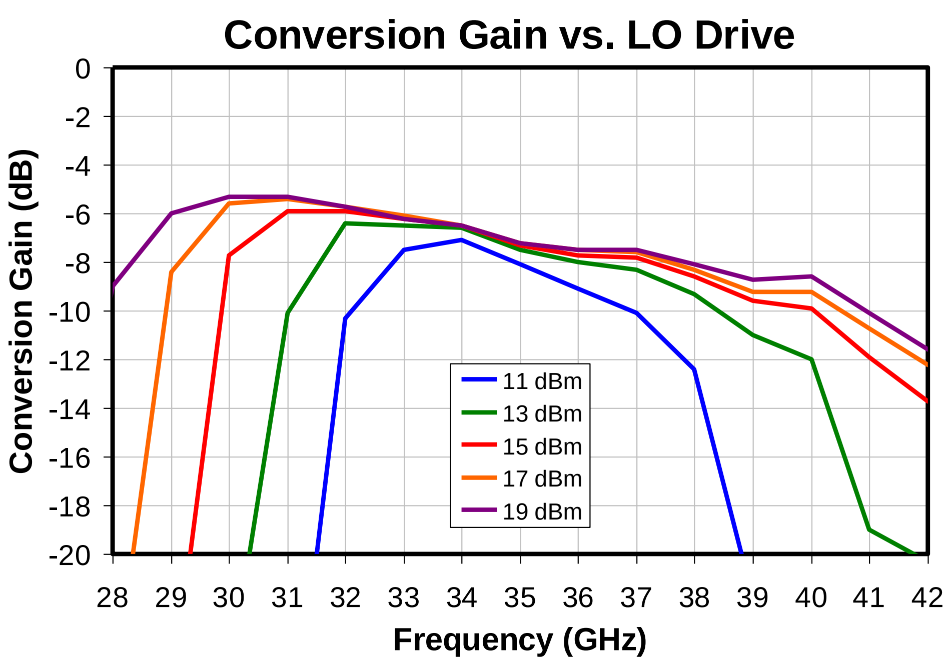
Typical Performance – Data Taken as IRM with External IF Hybrid, IF=100 MHz USB





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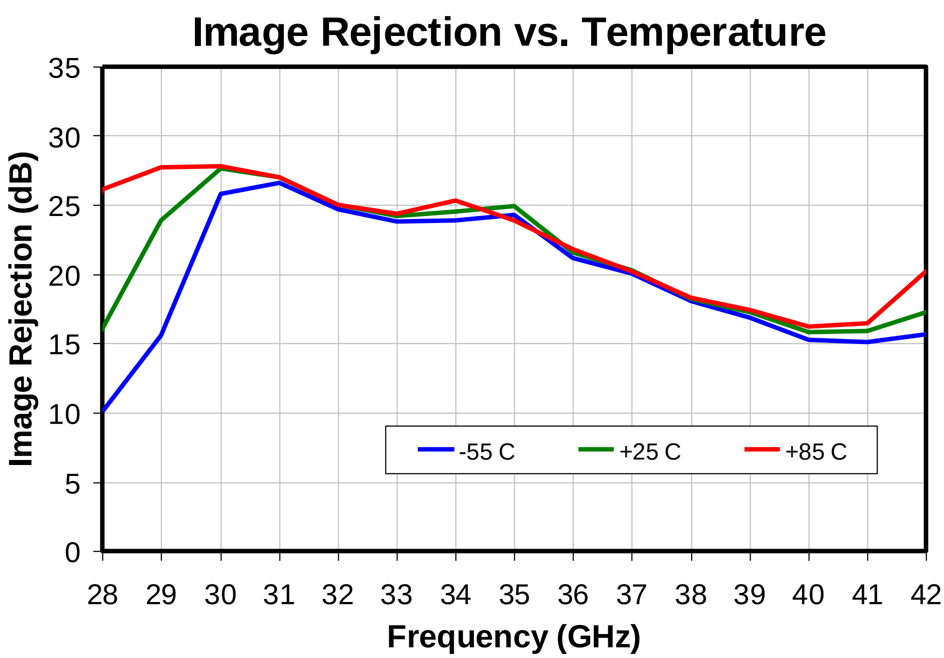

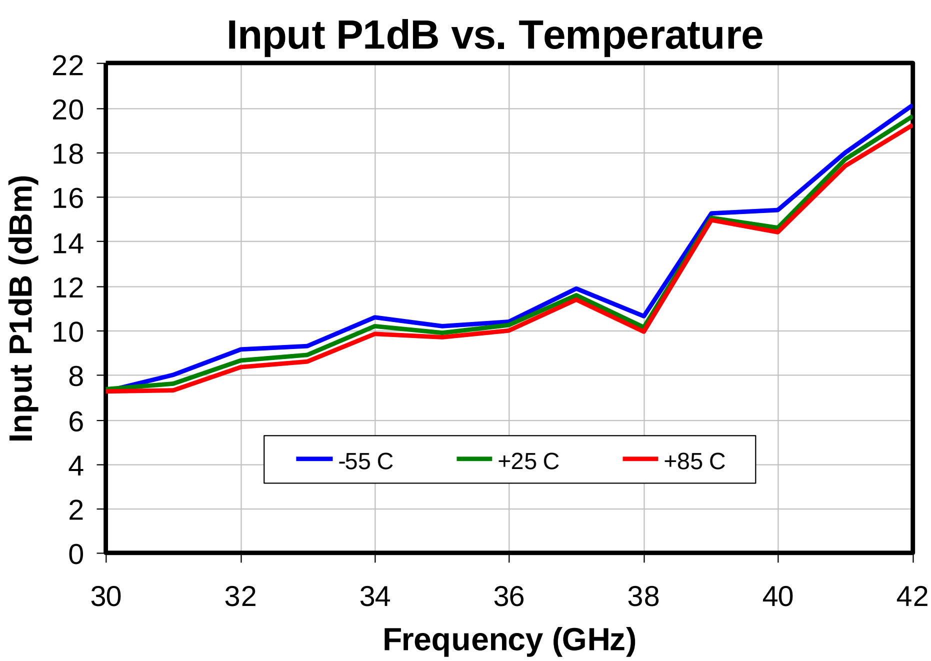

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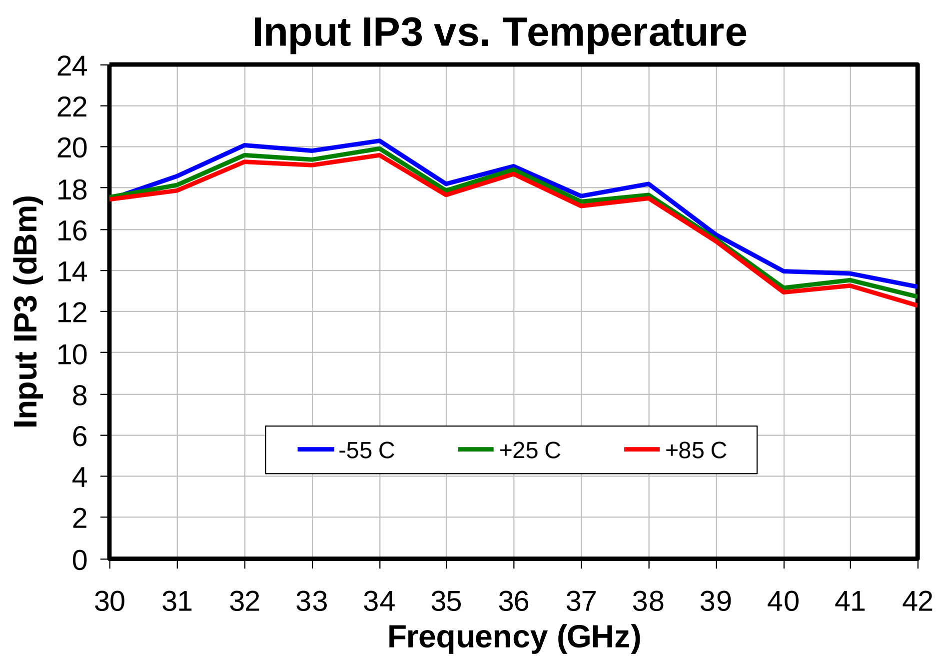
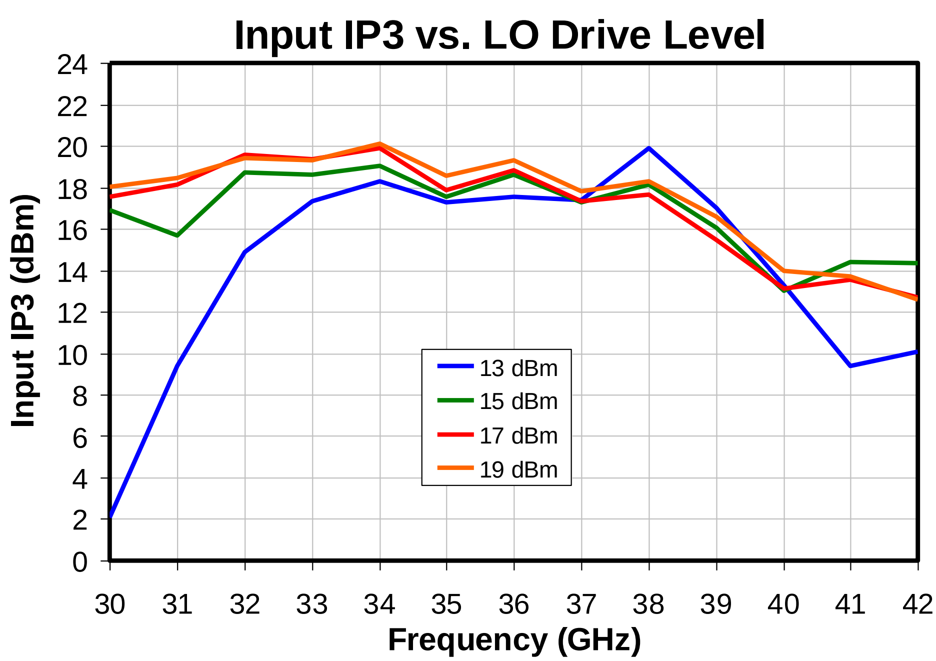
Typical Performance – Data Taken as IRM with External IF Hybrid, IF=100 MHz USB





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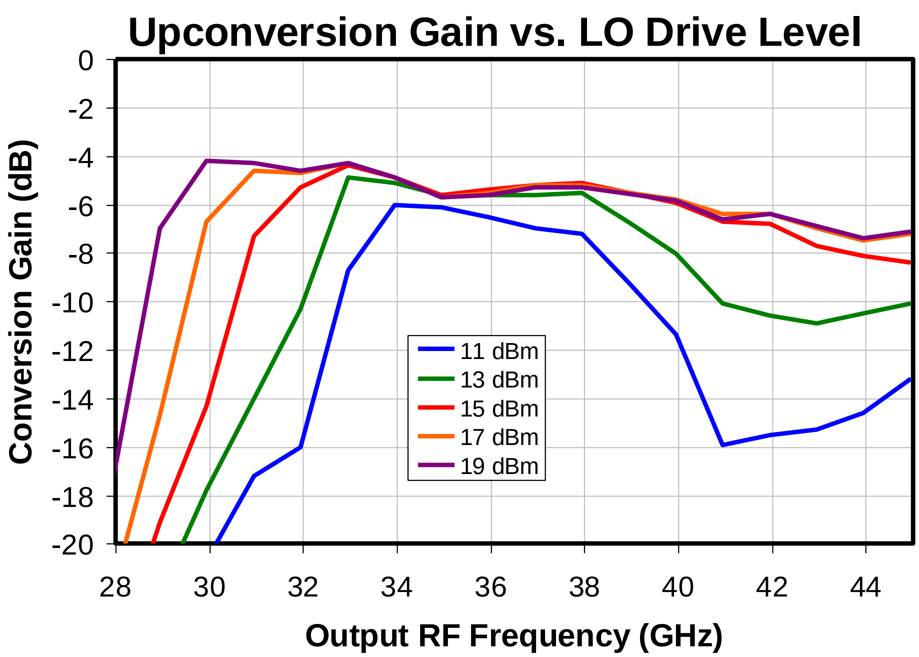
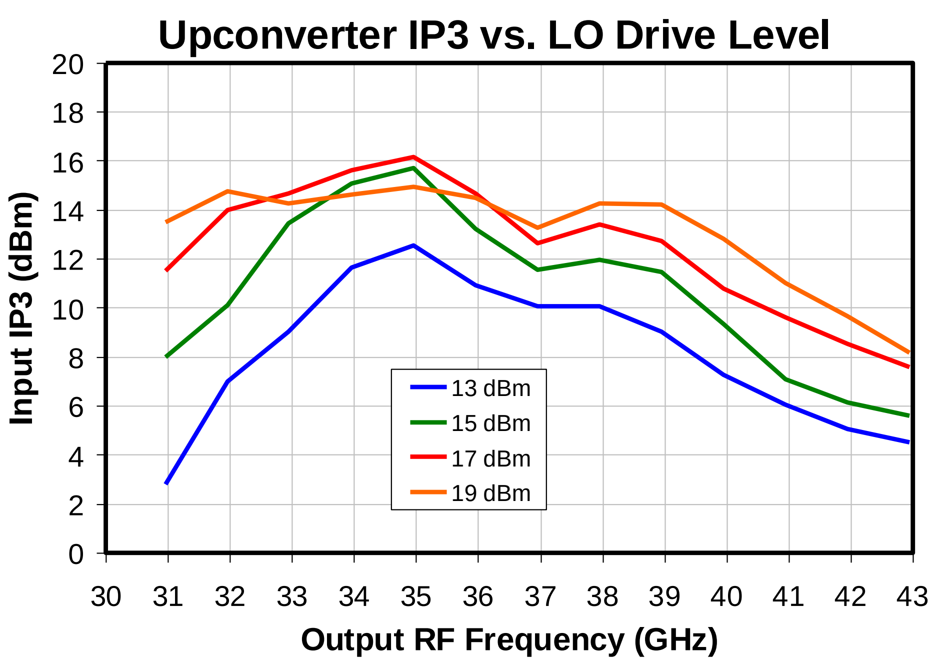
Typical Performance – Data Taken as Upconverter with External IF Hybrid, IF=950 MHz USB





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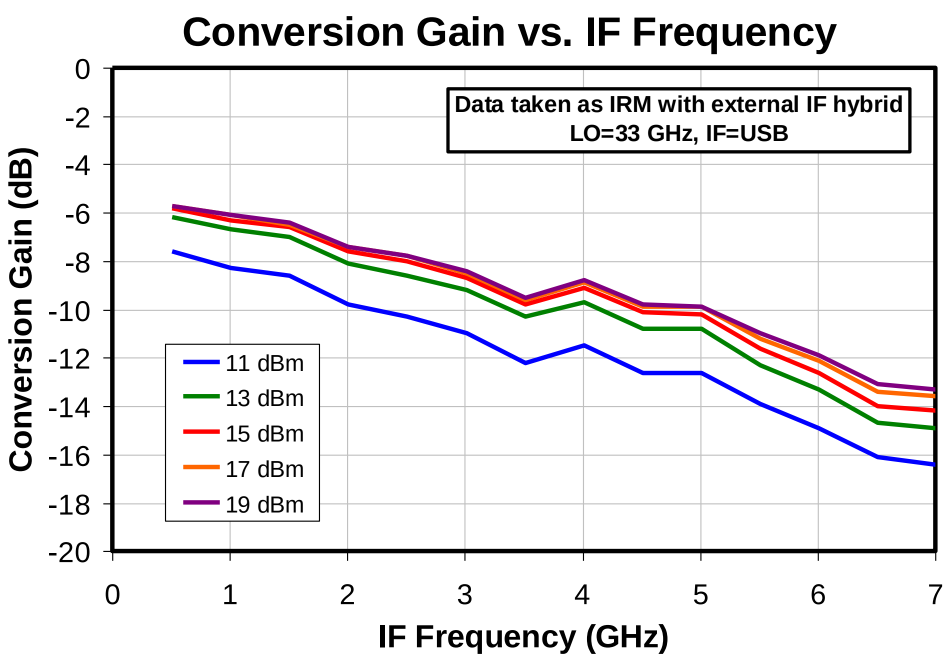
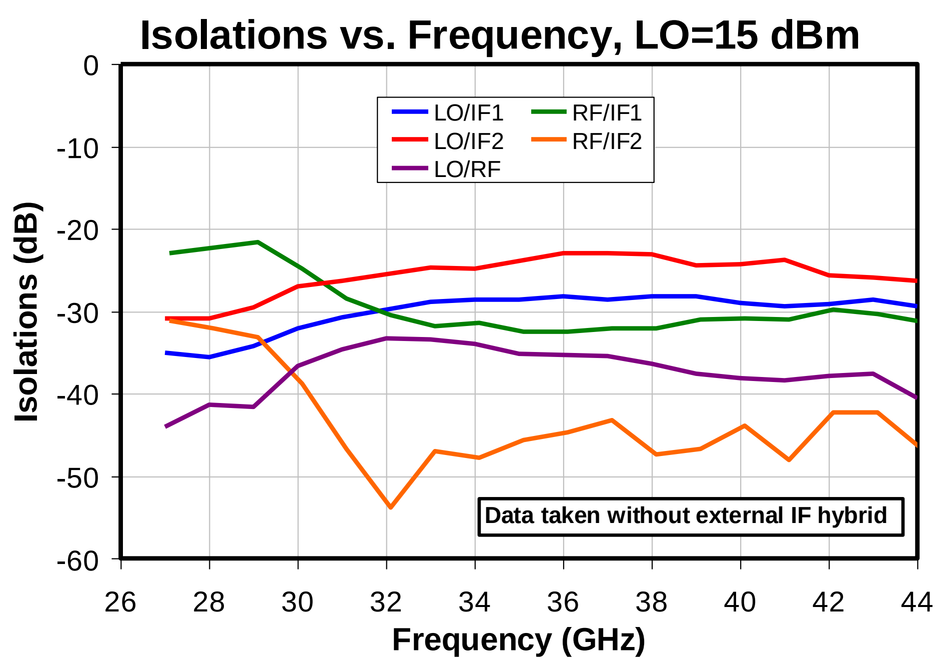
Typical Performance





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Channel Temperature (T_{CH}) (1)		105	°C
Median Lifetime (T_M)		4.0E6	Hrs

Notes:
1. Measured to the back of the die.

Spur Performance

	nLO				
mRF	0	1	2	3	4
0	x	0			
1	27	0	37		
2		63	47	59	
3				64	
4					

	nLO				
mRF	0	1	2	3	4
0	x	-3			
1	50	0	59		
2		56	48	55	
3				61	
4					

RF = 34.1 GHz, -10 dBm
LO = 34 GHz, +15 dBm
All values in dBc below IF output power level (1RF – 1LO)
Response to IF1 port shown in top table, IF2 port in bottom table
Data taken as downconverter with no IF hybrid

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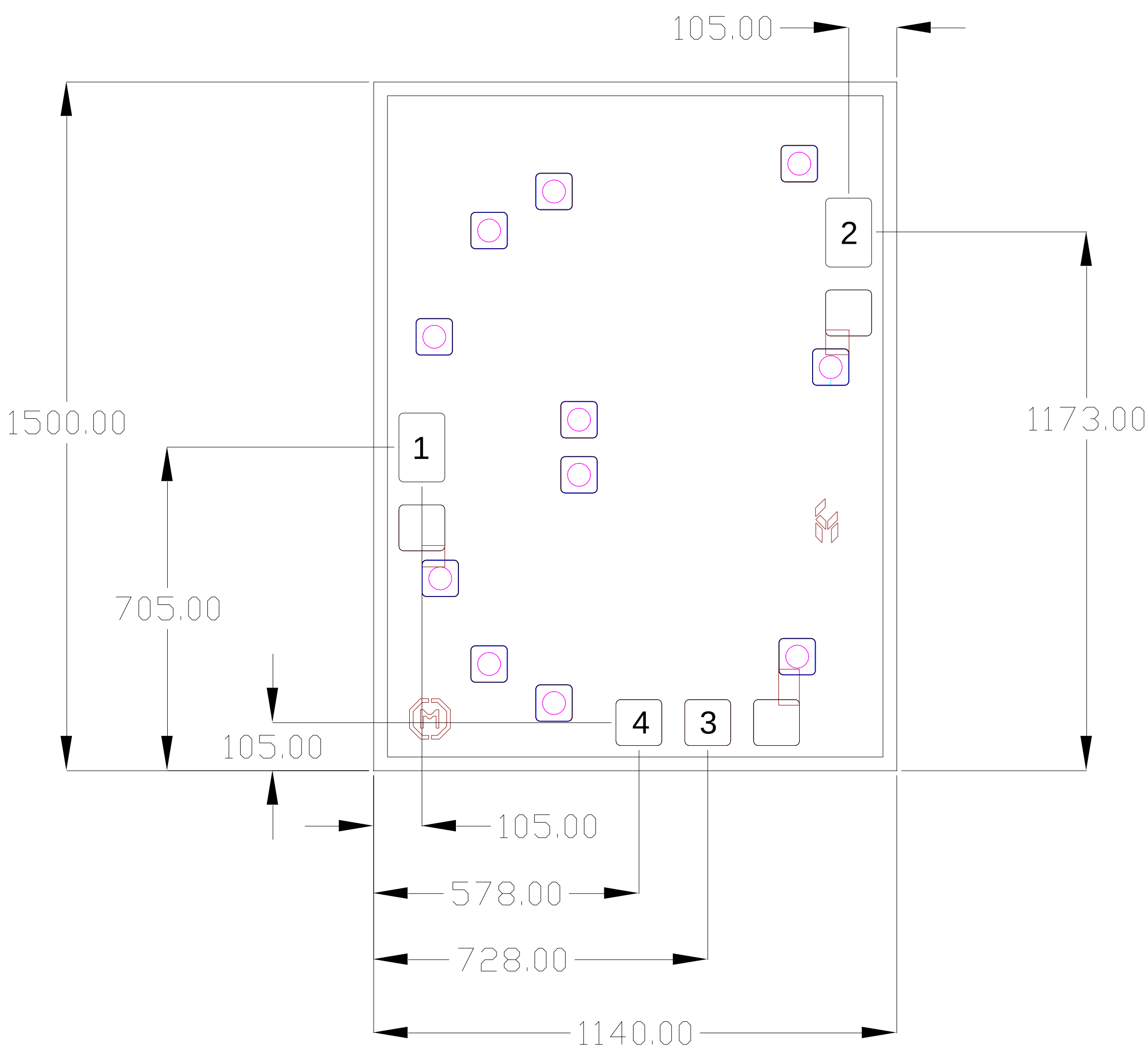
Mechanical Information



Notes:

1. All dimensions in microns.
2. No connection required for unlabeled grounds.
3. Backside is RF and DC ground.
4. Backside and bond pad metal: Gold.
5. Die is 100 um thick.
6. Bond pads (1) and (2) are 100 x 150 um, bond pads (3) and (4) are 100 x 100 um.

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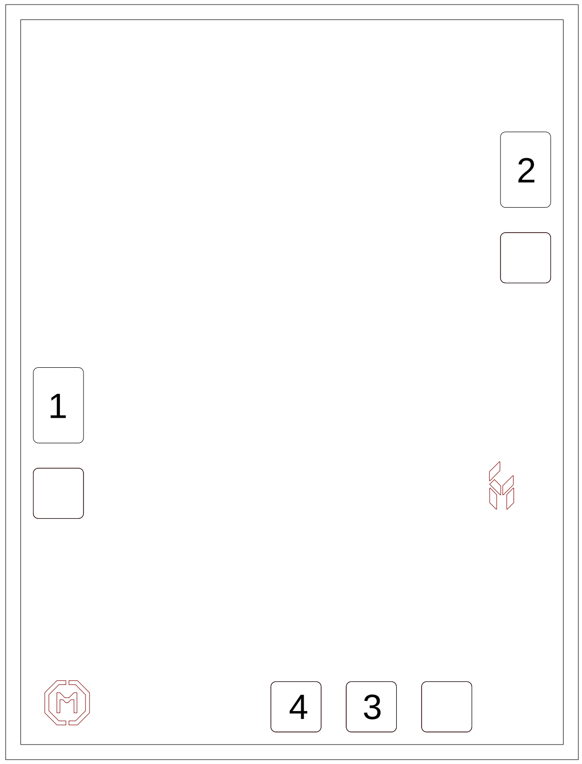
Pin Diagram



Bond Pad Description

Pad No.	Symbol	Pad Size (um)	Description
1	RF	100 x 150	This pin is DC coupled and matched to 50 Ohms.
2	LO	100 x 150	This pin is DC coupled and matched to 50 Ohms.
3, 4	IF2, IF1	100 x 100	These pins are DC coupled. For applications not requiring operation to DC, these ports should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, these pins must not source or sink more than 16 mA of current or part non-function or part failure may result.
Backside	Ground		Connect to RF / DC ground

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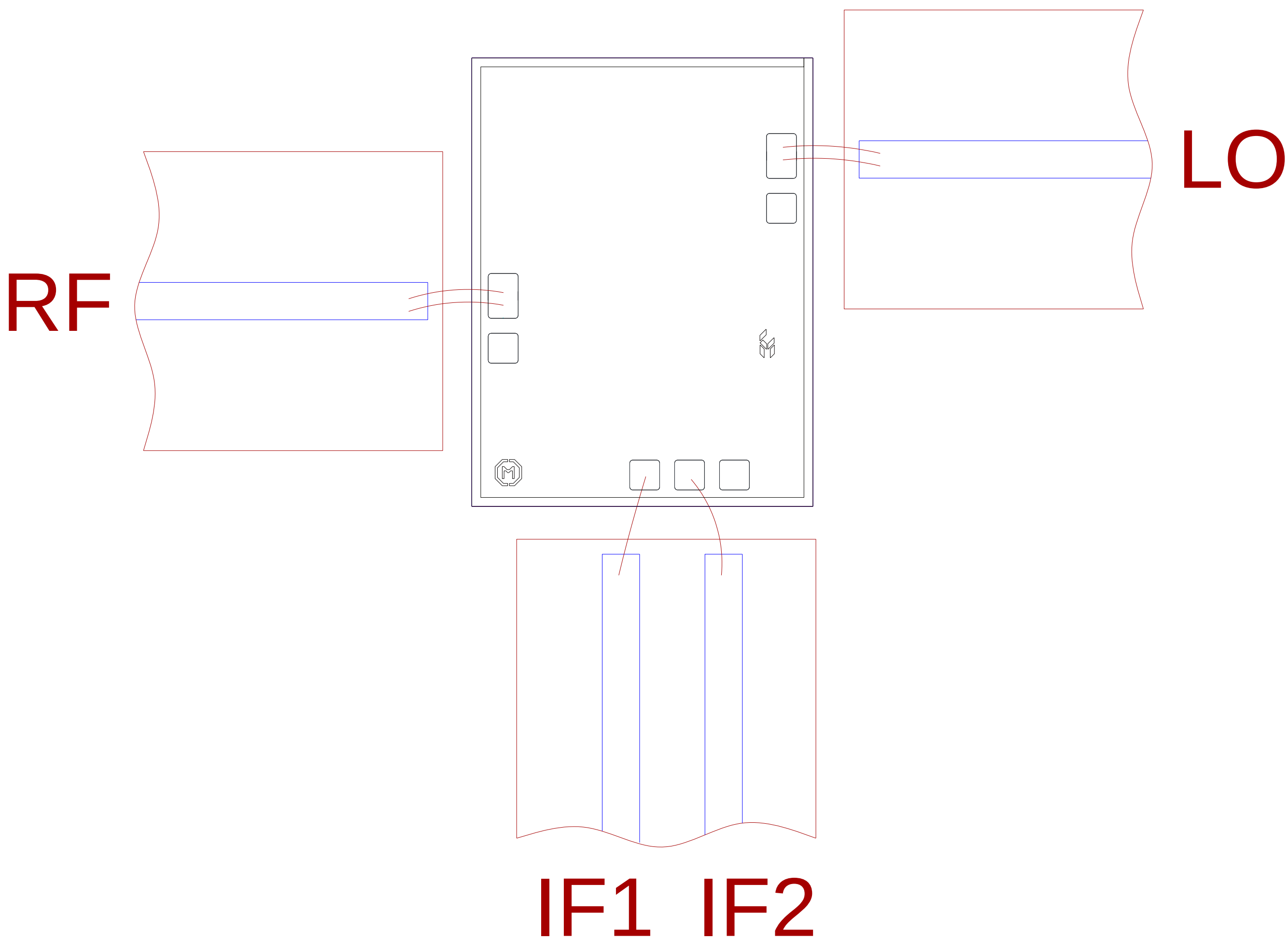
Assembly Guidelines

The backside of the QPX0003D is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 µm thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



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Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1A	ESDA / JEDEC JS-001-2012
MSL – Convection Reflow 235 °C	N/A	JEDEC standard IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

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 ($C_{15}H_{12}Br_{4}0_{2}$) 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**

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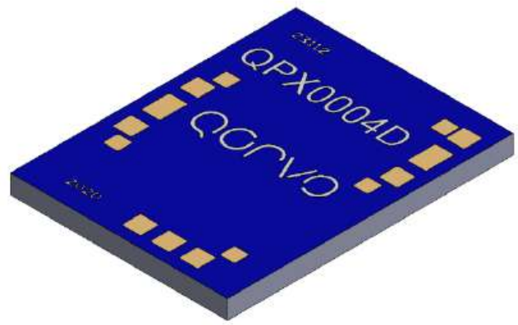
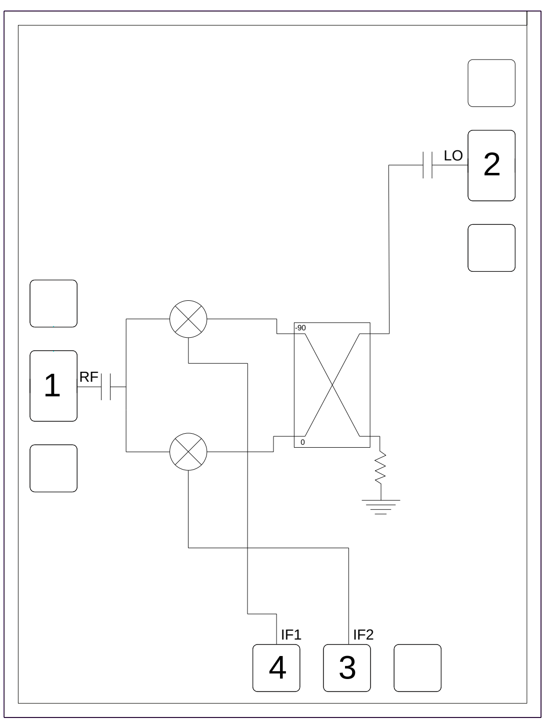
Product Overview

Qorvo's QPX0004D is a compact I/Q mixer in die form operating over the 24 to 34 GHz bandwidth that can be configured as an image reject mixer, a single sideband upconverter, or a QPSK modulator/demodulator. The QPX0004D utilizes two double balanced mixer cells and a 90º hybrid on the LO port. An external 90º hybrid on the IF port is required to complete the image rejection or sideband suppression. The QPX0004D is a much smaller alternative to higher cost hybrid I/Q Mixers and single sideband upconverter assemblies.



Functional Block Diagram



Key Features

- I, Q outputs
- RF, LO Frequency Range: 24 to 34 GHz
- IF Frequency Range: DC – 7 GHz
- Low conversion loss of 9 dB at 28 GHz
- High image rejection of 25 dB
- High LO/RF isolation > 40 dB at 28 GHz
- Small die size

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Applications

- Image reject downconversion
- Single-sideband modulation
- Low noise receiver systems
- Phase detection
- QPSK modulation/demodulation

Ordering Information

Part No.	Description
QPX0004D	24-34 GHz I/Q mixer die
QPX0004DS2	Sample, 2 pieces

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Absolute Maximum Ratings

Parameter	Rating
LO, RF, or IF power, CW, 25 ºC	+25 dBm
Channel Temperate, Tch	150 °C
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 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
LO Drive Power	+11	+15	+21	dBm
RF input Power (downconversion)			+17	dBm
IF Input Power (upconversion)			+17	dBm
Temperature Range	-55	+25	+85	°C

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

Electrical Specifications

Test conditions unless otherwise noted: 25 °C, IF = 100 MHz USB, LO = +15 dBm

Parameter	Min	Typ.	Max	Units
RF, LO Operational Frequency Range	24	–	34	GHz
IF Frequency Range	DC	–	7	GHz
Conversion Gain (with external 90º hybrid)	-10.7	-9	–	dB
Image Rejection (with external 90º hybrid)	–	-15	–	dB
LO to RF Isolation	–	-30	–	dB
LO to IF Isolation	–	-24	–	dB
Input Power (P_{1dB})	–	+11	–	dBm
Input IP3	–	+19	–	dBm

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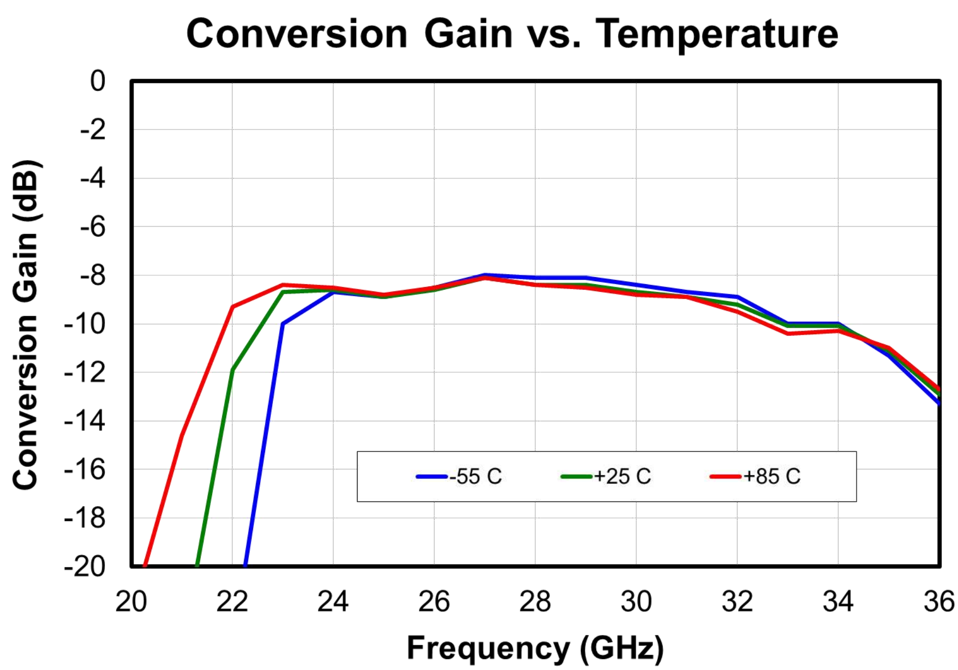
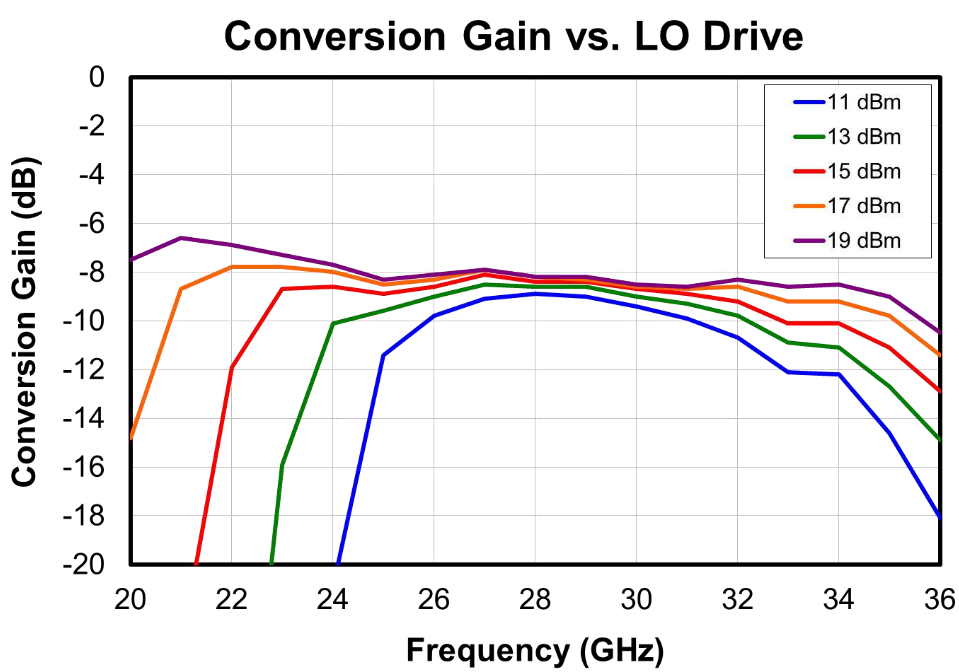
Typical Performance – Data Taken as IRM with External IF Hybrid, IF=100 MHz USB





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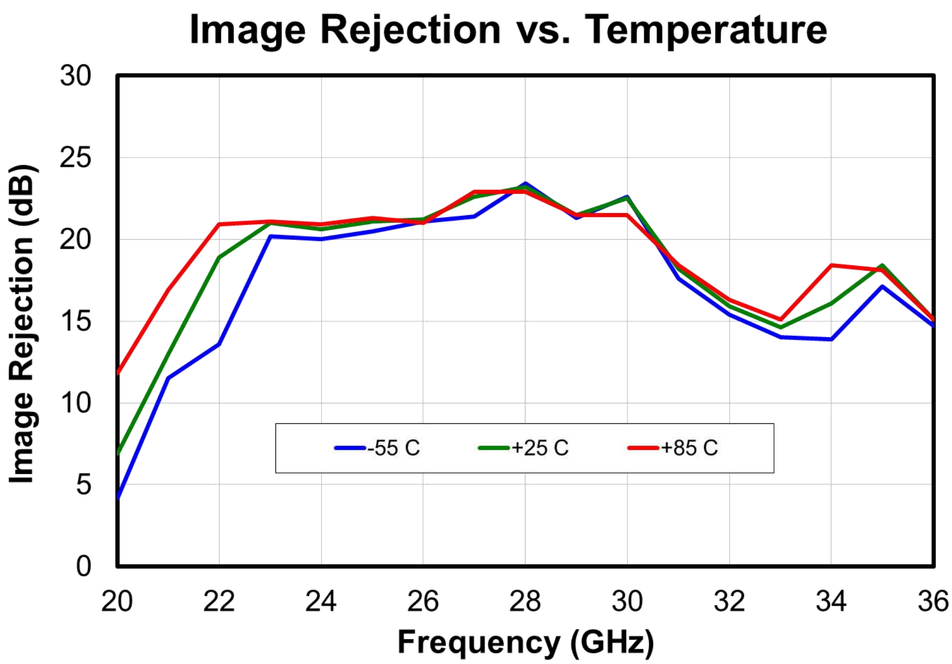
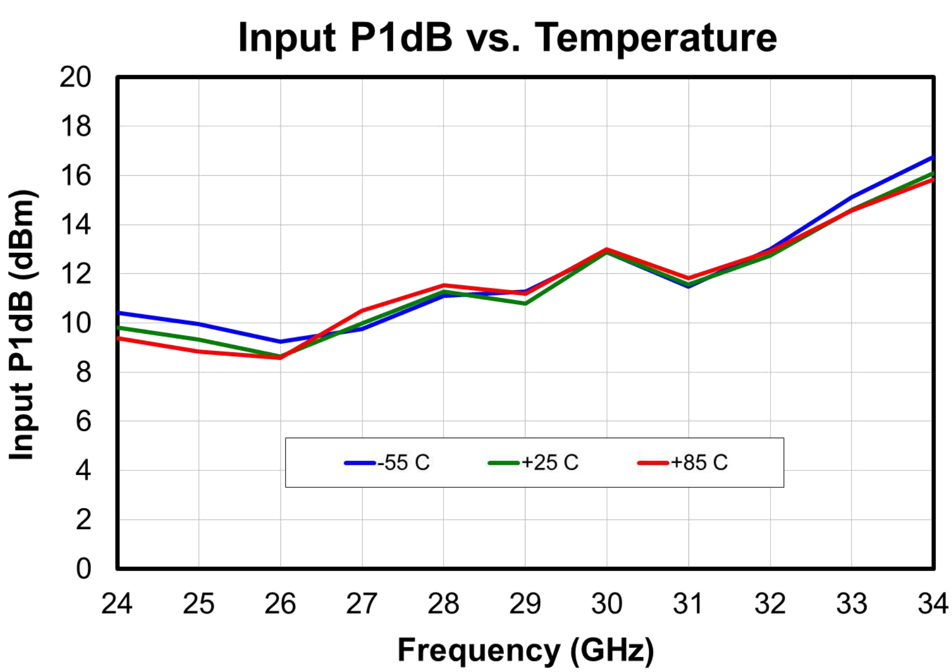
Typical Performance – Data Taken as IRM with External IF Hybrid, IF=100 MHz USB





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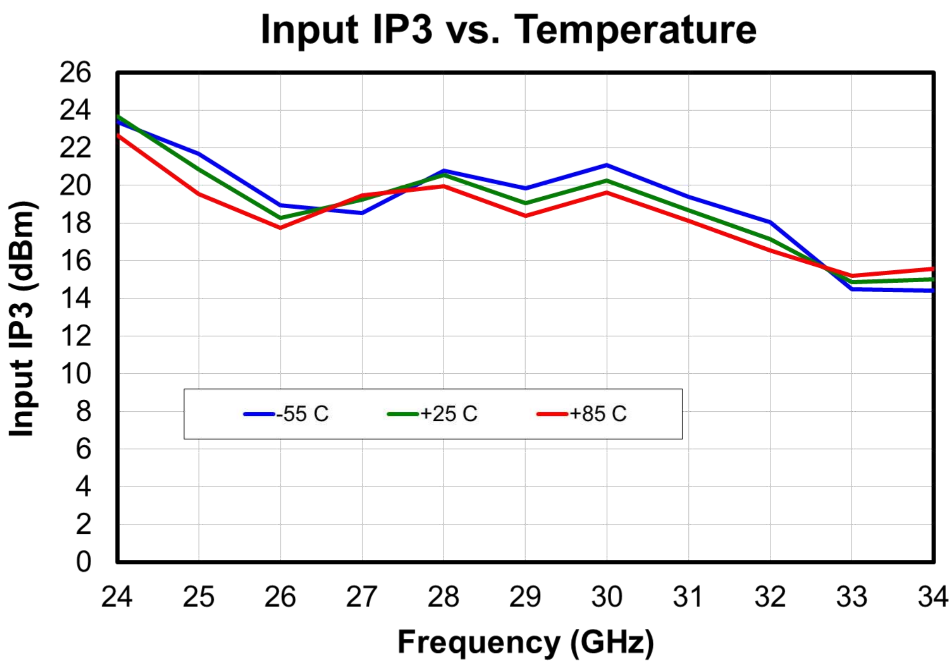
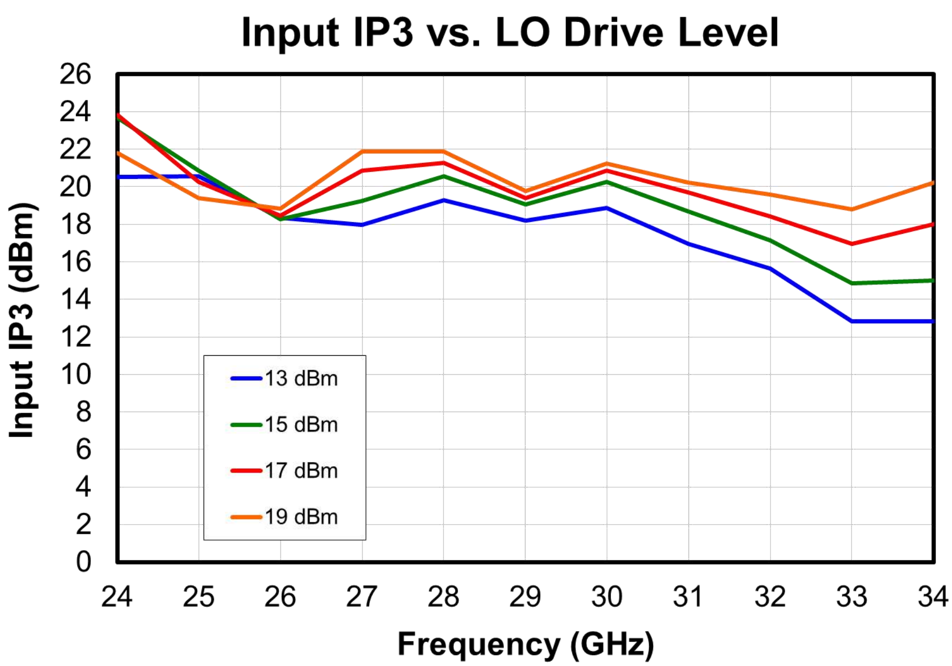
Typical Performance – Data Taken as IRM with External IF Hybrid, IF=100 MHz USB





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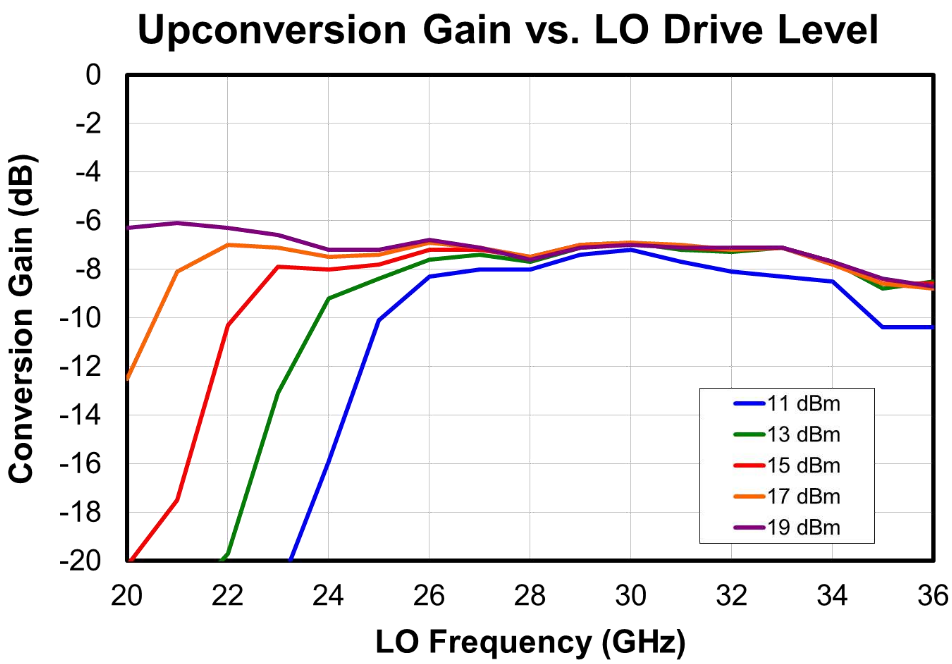
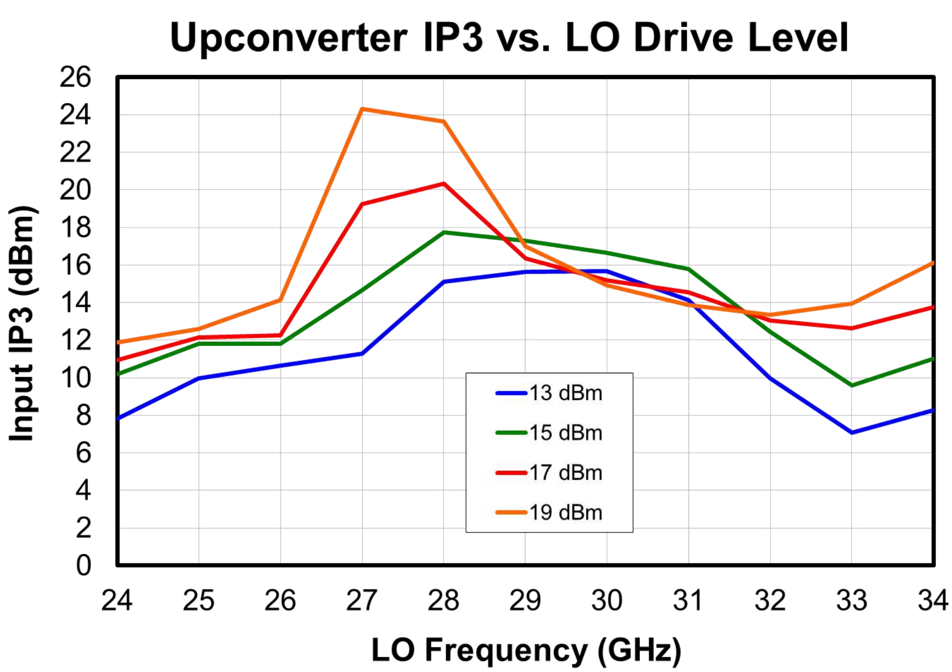
Typical Performance – Data Taken as Upconverter with External IF Hybrid, IF=950 MHz USB





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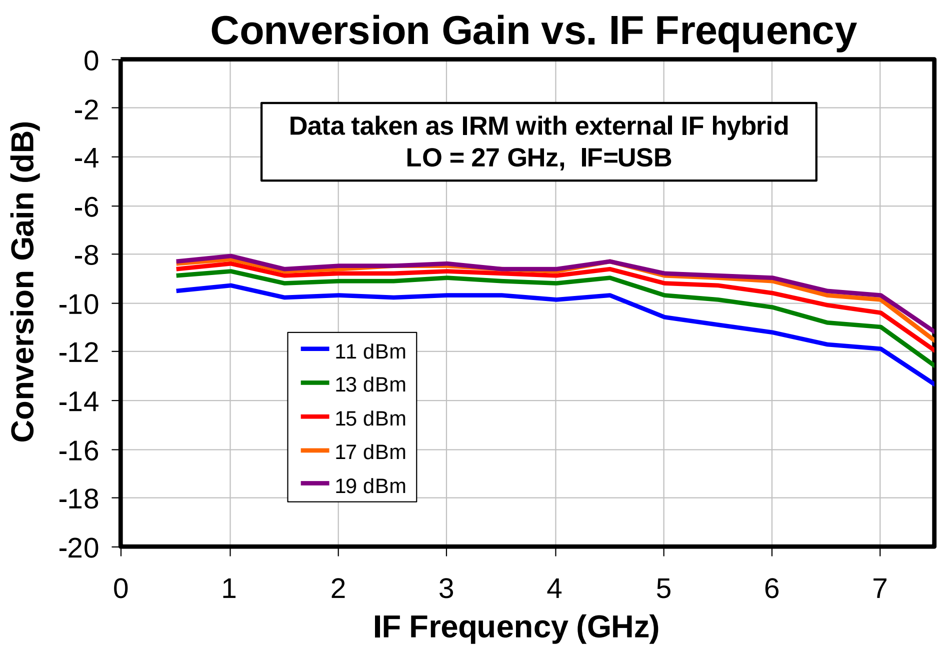
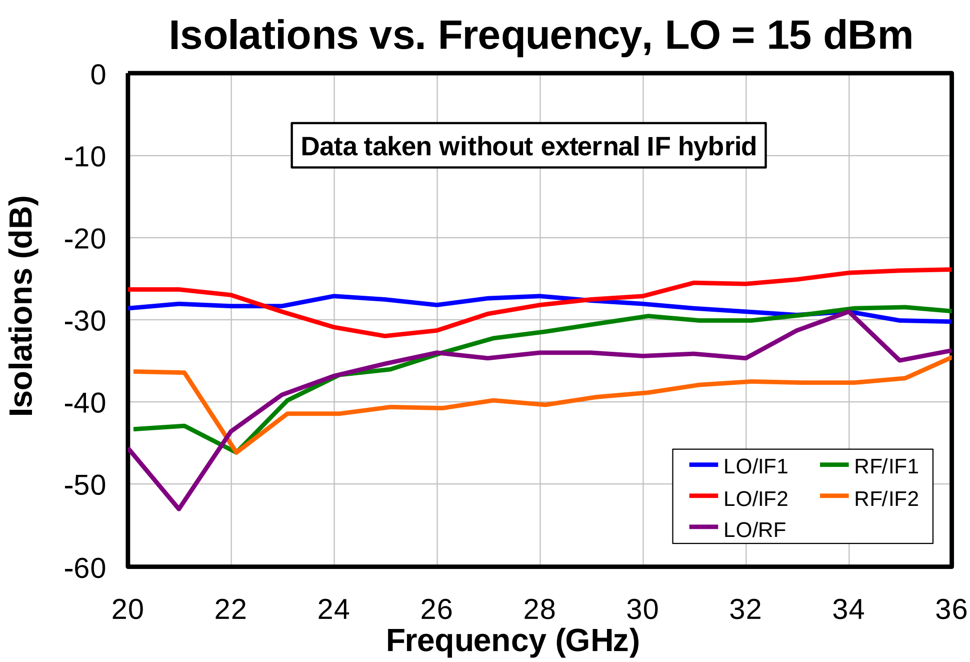
Typical Performance





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Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) [1]	T_{BASE} = 85 °C, CW, Frequency = 28 GHz, LO P_{IN} = 17 dBm (0.05 W), P_{DISS} = 0.05 W	400	ºC/W
Channel Temperature (T_{CH}) [1]		105	°C
Median Lifetime (T_M)		4.0E6	Hrs

Notes:
1. Measured to the back of the die.

Spur Performance

	nLO				
mRF	0	1	2	3	4
0	x	-5			
1	23	0	37		
2		55	47	57	
3				62	
4					

RF = 28.1 GHz, -10 dBm
LO = 28 GHz, +15 dBm
All values in dBc below IF output power level (1RF – 1LO)
Data taken as downconverter with no IF hybrid

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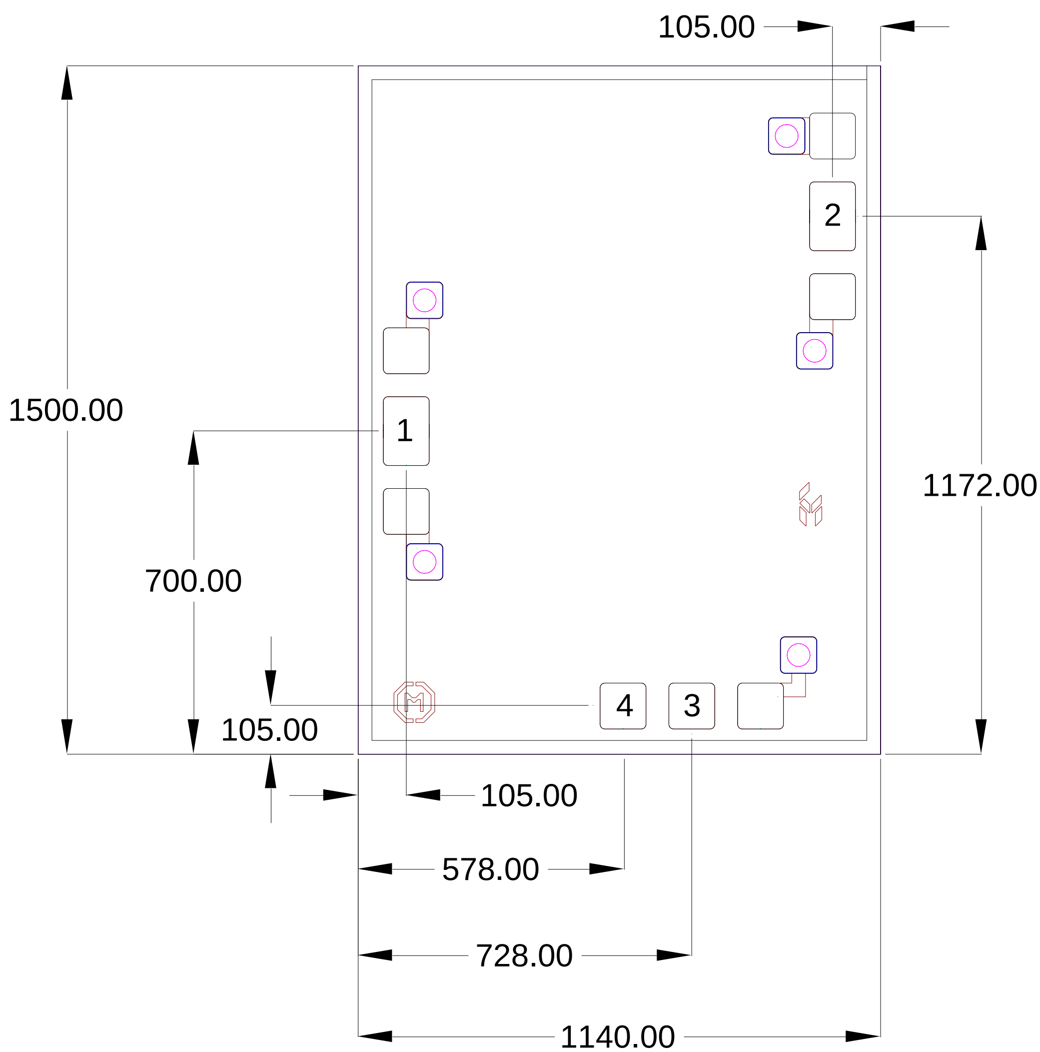
Mechanical Information



Notes:

1. All dimensions in microns.
2. No connection required for unlabeled grounds
3. Backside is RF and DC ground.
4. Backside and bond pad metal: Gold.
5. Die is 100 um thick.
6. Bond pads (1) and (2) are 100 x 150 um, bond pads (3) and (4) are 100 x 100 um.

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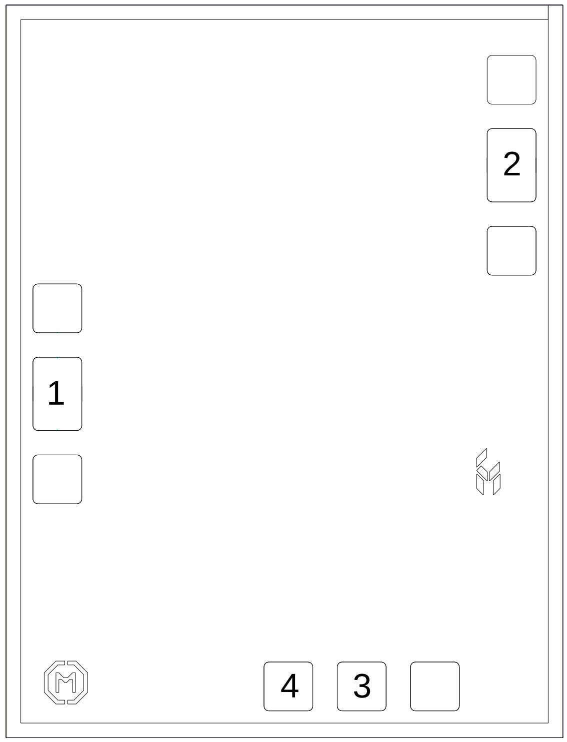
Pin Diagram



Bond Pad Description

Pad No.	Symbol	Pad Size (um)	Description
1	RF	100 x 150	This pin is AC coupled and matched to 50 Ohms.
2	LO	100 x 150	This pin is AC coupled and matched to 50 Ohms.
3, 4	IF2, IF1	100 x 100	These pins are DC coupled. For applications not requiring operation to DC, these ports should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, these pins must not source or sink more than 16 mA of current or part non-function or part failure may result.
Backside	Ground		Connect to RF / DC ground

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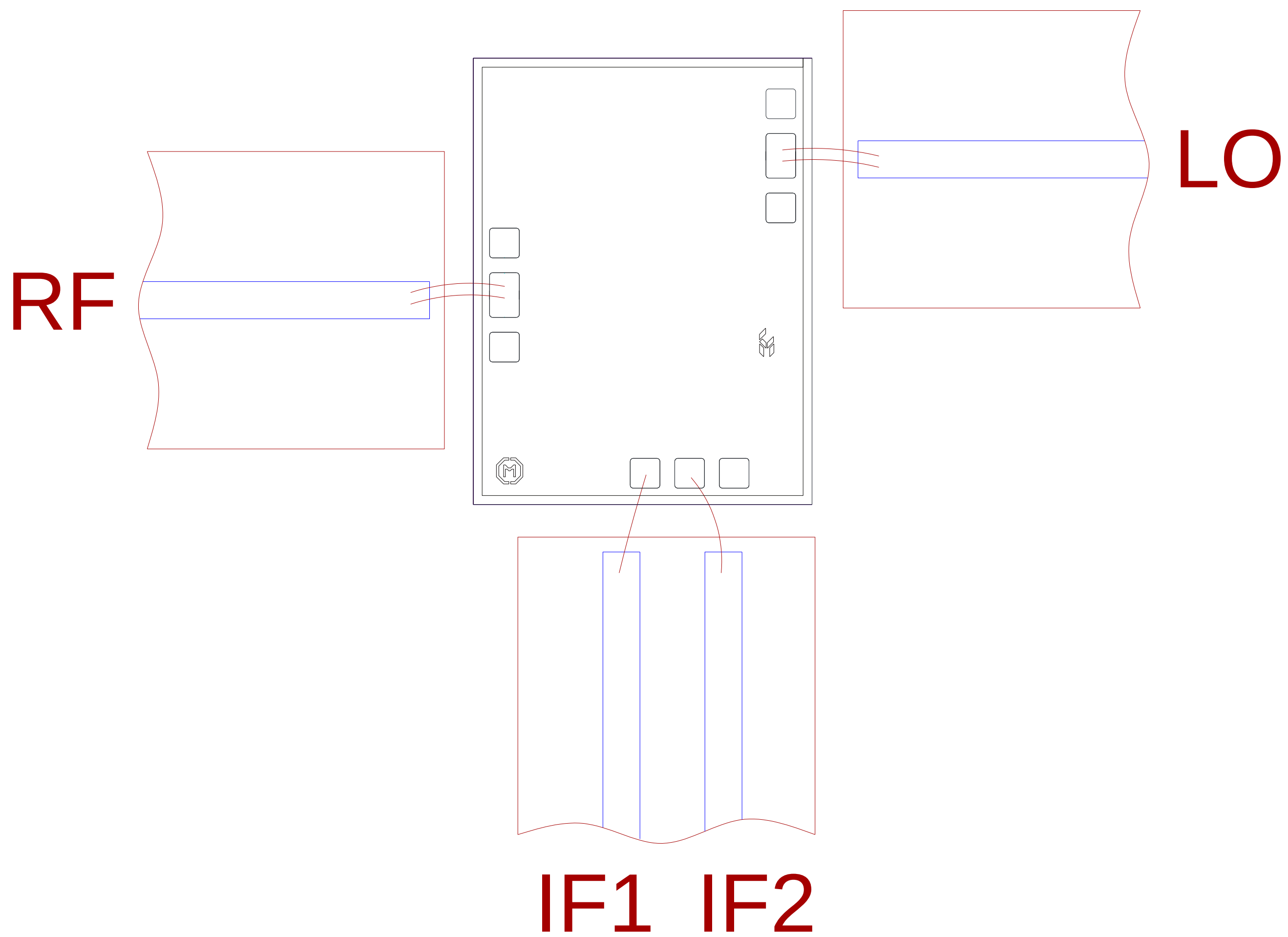
Assembly Guidelines

The backside of the QPX0004D is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 µm thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



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Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1A	ESDA / JEDEC JS-001-2012
MSL – Convection Reflow 235 °C	N/A	JEDEC standard IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

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 ($C_{15}H_{12}Br_40_2$) 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

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TGC2510-SM

Ku - Band Upconverter

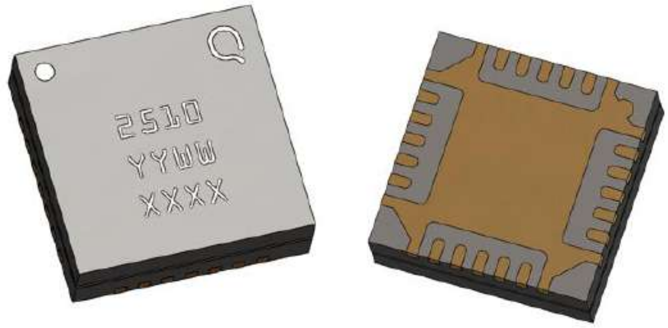
Product Description

The QORVO TGC2510-SM is a Ku-Band image reject upconverter with integrated LO buffer amplifier and output variable gain amplifier. The TGC2510-SM operates from an RF of 10 to 16 GHz and LO from 6.5 to 19 GHz with IF inputs from DC to 3.5GHz and is designed using QORVO's 3MI DR 0.15 um pHEMT production process.

The TGC2510-SM typically provides 33 dBm of output TOI at –10 dBm input power per tone and has a conversion gain of 17 dB.

The TGC2510-SM is available in a low-cost, surface mount 28 lead 5x5mm QFN package and is ideally suited for Point-to-Point Radio, and Ku-Band VSAT Ground Terminal.

Lead-free and RoHS compliant.



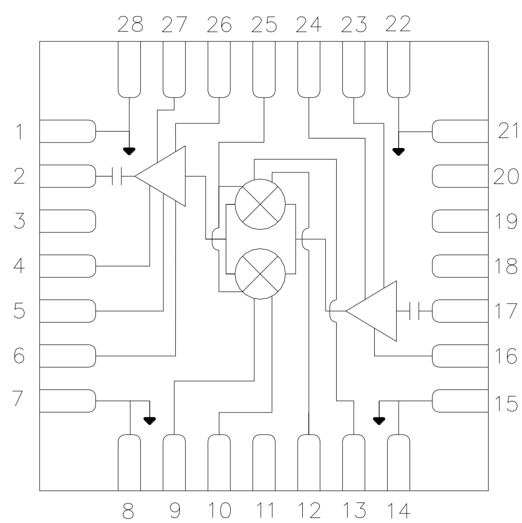
28-pin 5x5 mm QFN package

Product Features

- RF Frequency Range: 10 - 16 GHz
- IF Frequency: DC – 3.5 GHz
- LO Frequency: 6.5 – 19 GHz
- LO Input Power: 0 to 6 dBm
- Conversion Gain: 17 dB
- OTOI: 33 dBm at max gain
- Attenuation Range: 15 dB typical
- Package Dimensions: 5.0 x 5.0 x 1.3 mm

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Function Block Diagram



Ordering Information

Part No.	Description
TGC2510-SM	Ku-Band Upconverter
TGC2510-SMEVBLL	TGC2510-SM EVB LSB, Low IF Band, 1.3 to 2.45 GHz
TGC2510-SMEVBLH	TGC2510-SM EVB LSB, High IF Band, 2.5 to 4.0 GH
TGC2510-SMEVBUL	TGC2510-SM EVB USB, Low IF Band, 1.3 to 2.45 GHz
TGC2510-SMEVBUH	TGC2510-SM EVB USB, High IF Band, 2.5 to 4.0 GHz

Applications

- VSAT
- Point-to-Point Radio
- Test Equipment & Sensors

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Absolute Maximum Ratings

Parameter	Rating
VDRF	6 V
VDLO	6 V
IDRF	350 mA
IDLO	100 mA
VREF	3 V
VGRF, VGLO, VGX	-2 to +1.5 V
VCTRL	3 V
IF1, IF2	-2 to +2 V
IF Input Power, 50Ω, T = 25°C	10 dBm
Channel Temperature, Tch	200 °C
Storage Temperature	-65 to 125°C

These are stress ratings only, functional operation of the device at these conditions is not implied. Extended application of Absolute Maximum Rating conditions may reduce device reliability. Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

Parameter	Min	Typ.	Max	Units
Operating Temp. Range	-40	+25	+85	°C
VDRF		5		V
IDRF		240		mA
VGRF		-0.70		V
VDLO		5		V
IDLO		60		mA
VGLO		-0.63		V
VREF		2		V
VGX		-1.2		V
VCTRL		0		V
LO Input Power	0		6	dBm

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

Electrical Specifications

Test conditions unless otherwise noted: IF Input Power = -10 dBm, VGX = -1.2 V, VREF = 2 V, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA. VCTRL = 0 V for maximum gain.

Parameter	Conditions	Min	Typ	Max	Units
RF Frequency Range		10		16	GHz
LO Frequency Range		6.5		19	GHz
IF Frequency Range		DC		3.5	GHz
LO Input Power		0		6	dBm
Conversion Gain	IF=2GHz	15	17		dBm
Third Order Output Intercept Point, OIP3	RF = 10 to 11.7GHz, IF=2GHz	24	33		dBm
Third Order Output Intercept Point, OIP3	RF = 12.7 to 15.4GHz, IF=2GHz	26	33		dBm
Image Rejection			25		dB
P1dB Output Power			22		dBm

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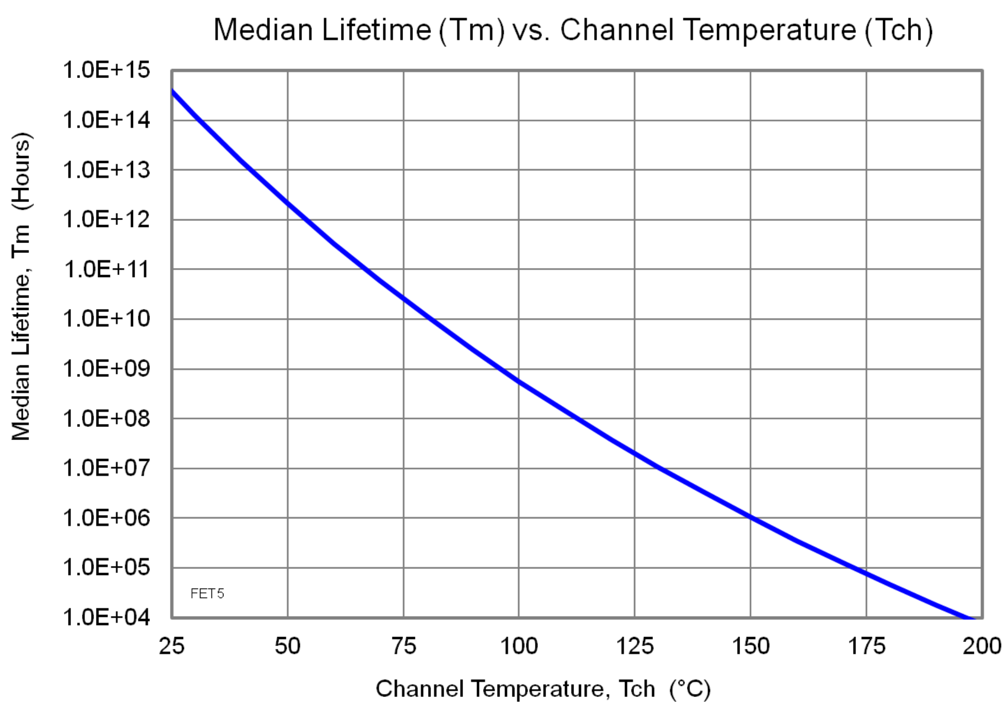
Thermal and Reliability Information

Parameter	Conditions	Rating
Thermal Resistance, θ_{JC}, measured to back of package	Tbase = 85 °C	θ_{JC} = 26.1 °C/W
Channel Temperature (Tch), and Median Lifetime (Tm)	Tbase = 85 °C, VDRF = 5 V, IDRF = 240 mA VDLO = 5 V, IDLO = 60 mA Pdiss = 1.5 W	Tch = 124 °C Tm = 2.3 E+7 Hours
Channel Temperature (Tch), and Median Lifetime (Tm) Under RF Drive	Tbase = 85 °C VDRF = 5 V, IDRF = 240 mA VDLO = 5 V, IDLO = 85 mA Pin = -10 dBm Pdiss = 1.63 W	Tch = 128 °C Tm = 1.4 E+7 Hours



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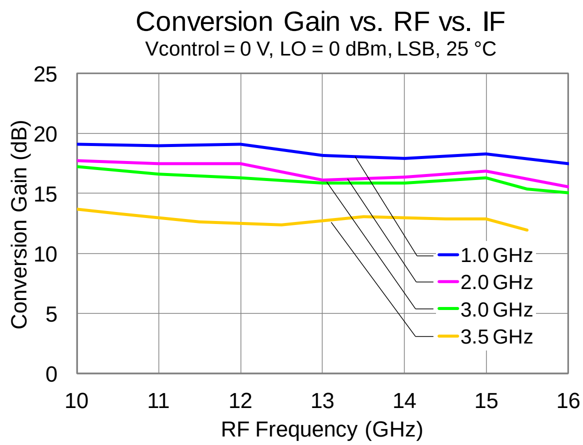
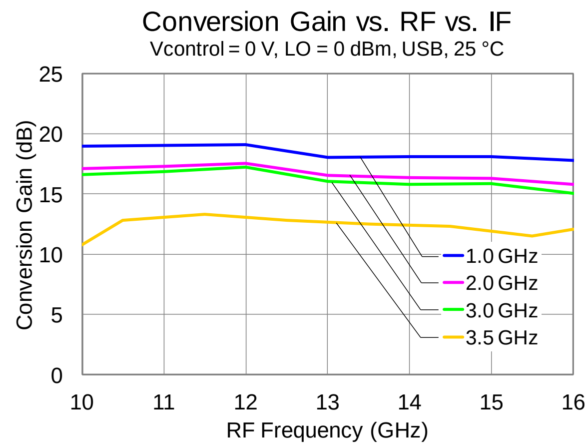
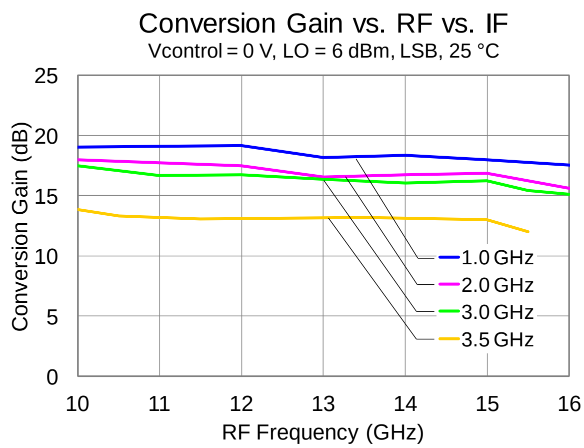
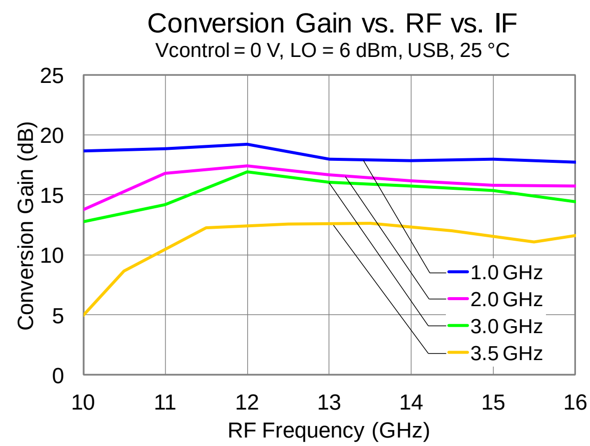
Performance Plots

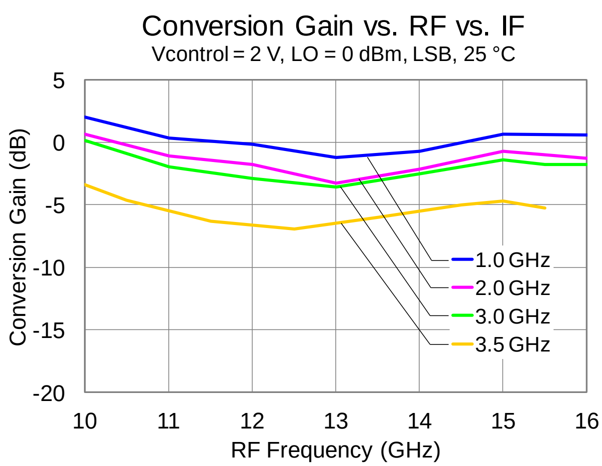
IF Input Power = -10 dBm, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA. VGX = -1.2 V, VREF = 2 V.
Data taken with external IF hybrid and LO nulling applied.

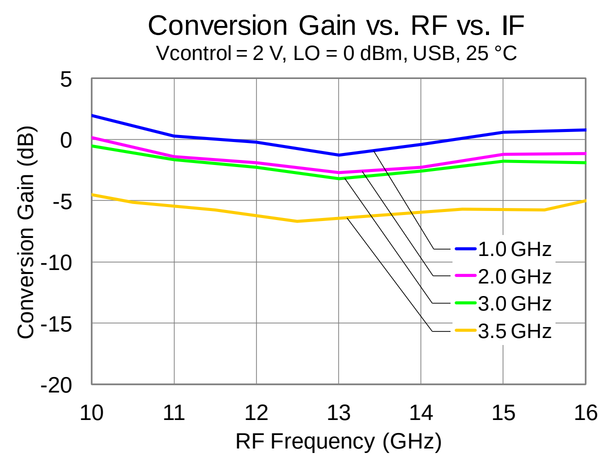












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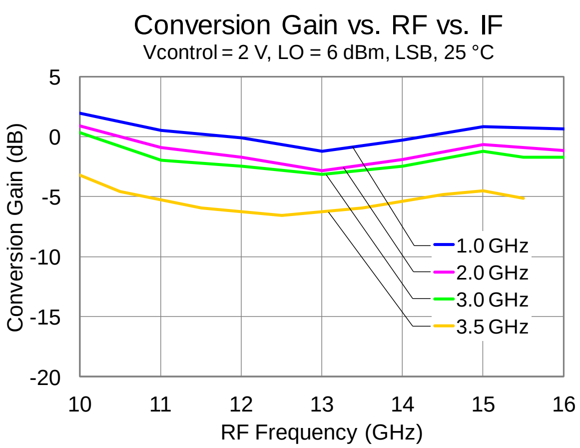
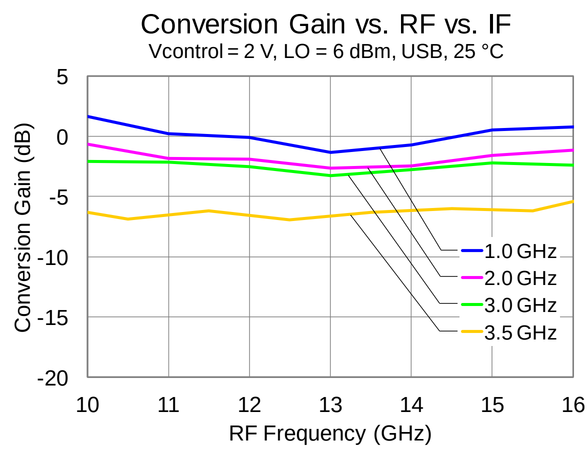
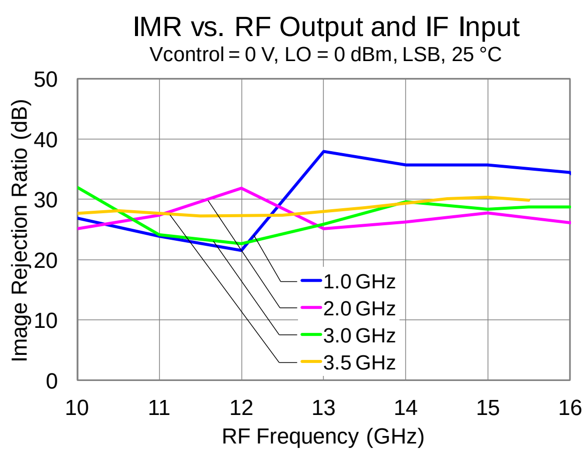
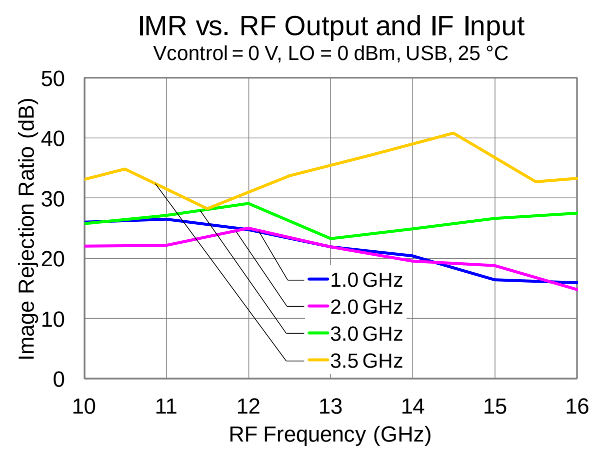
Performance Plots

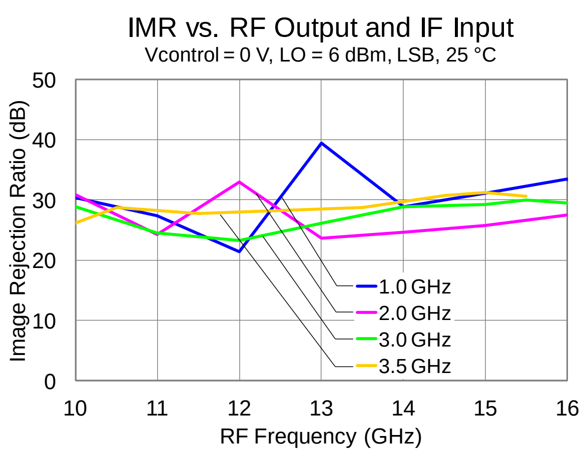
IF Input Power = -10 dBm, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA, VGX = -1.2 V, VREF = 2 V.
Data taken with external IF hybrid and LO nulling applied.

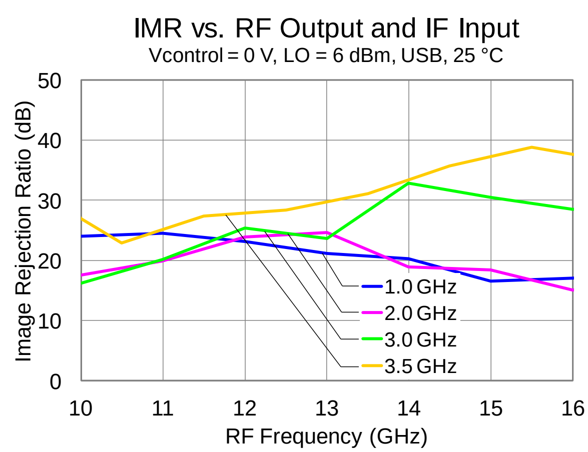












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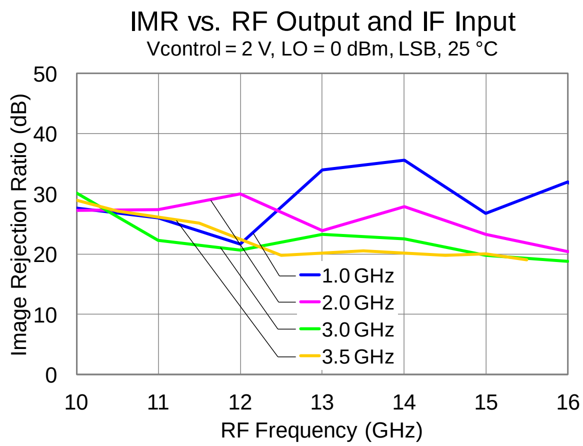
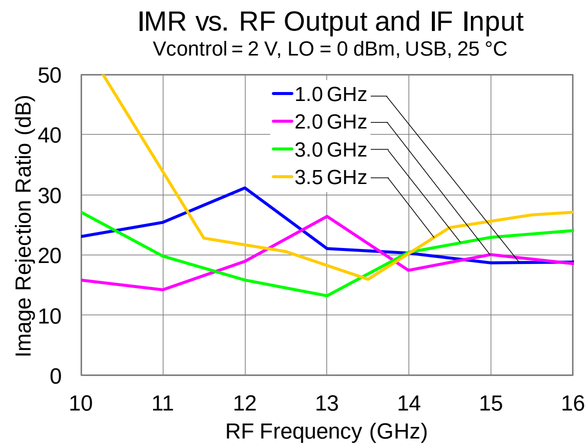
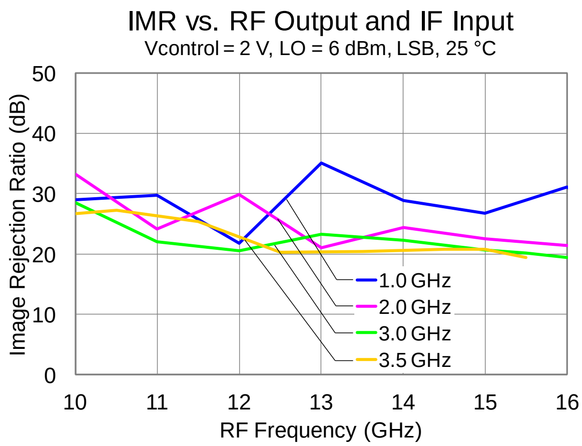
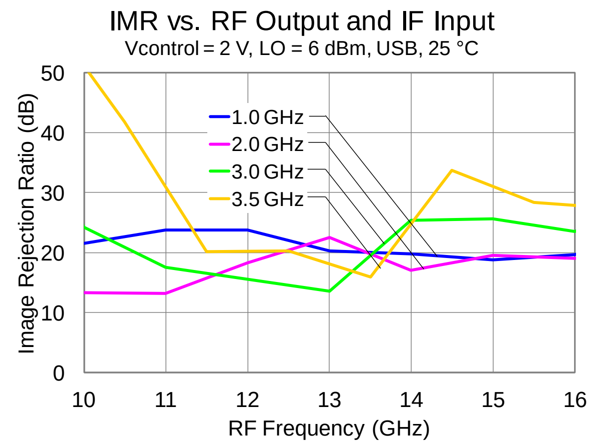
Performance Plots

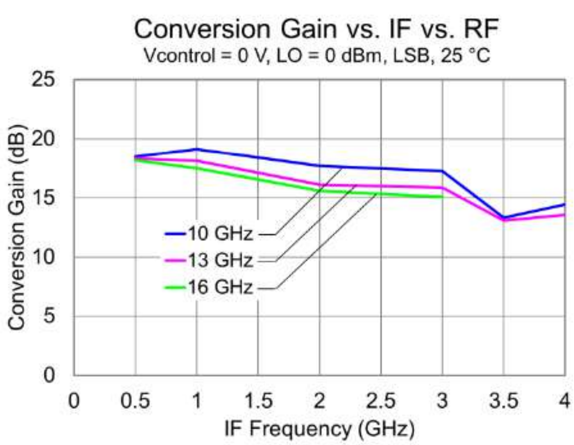
IF Input Power = -10 dBm, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA, VGX = -1.2 V, VREF = 2 V.
Data taken with external IF hybrid and LO nulling applied.

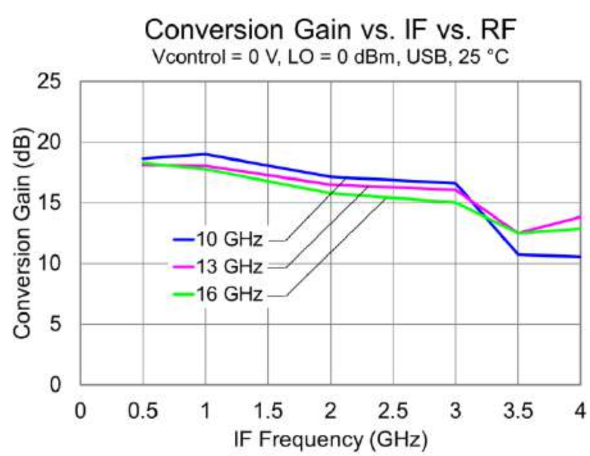












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Performance Plots

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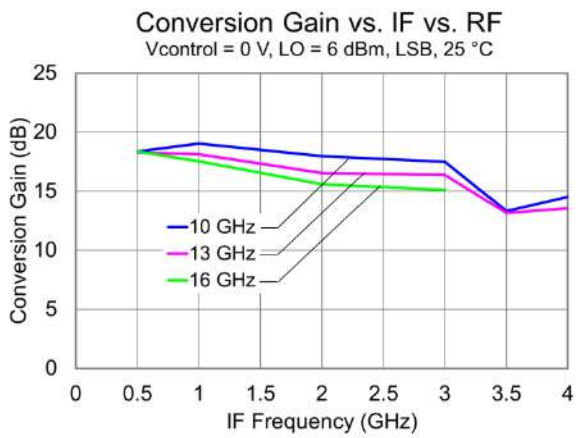
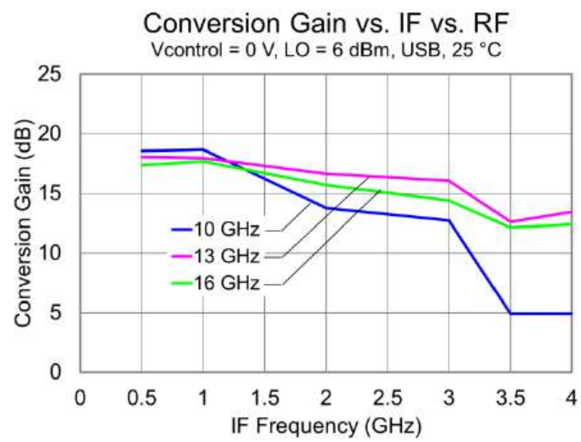
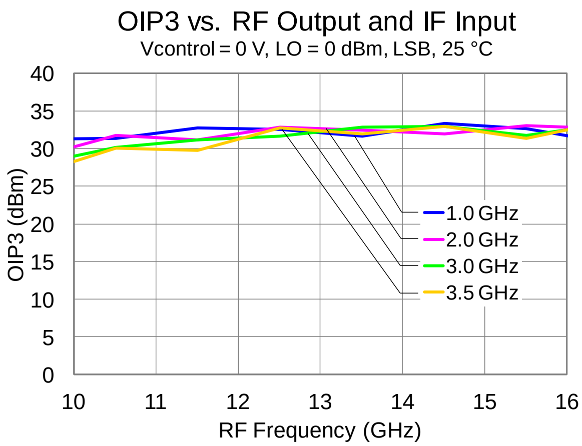
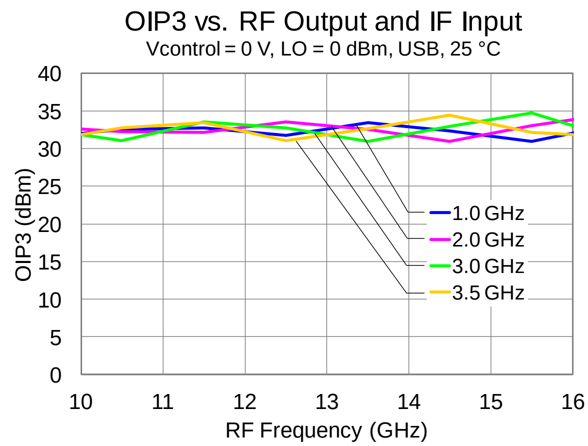
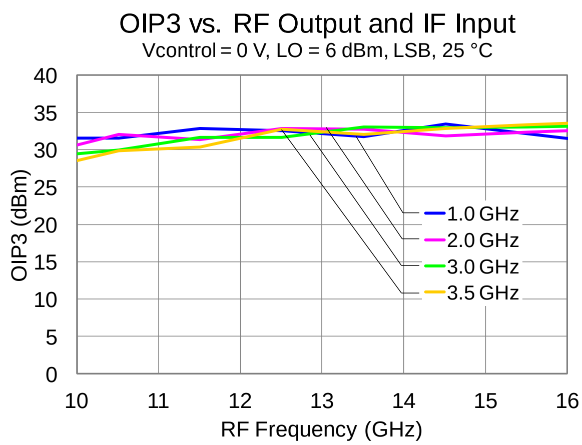
Data taken with external IF hybrid and LO nulling applied.

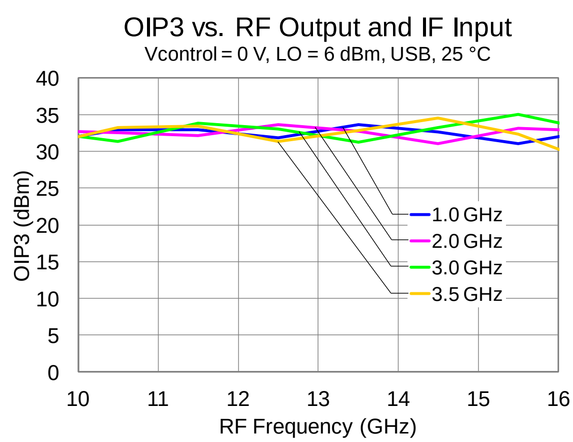












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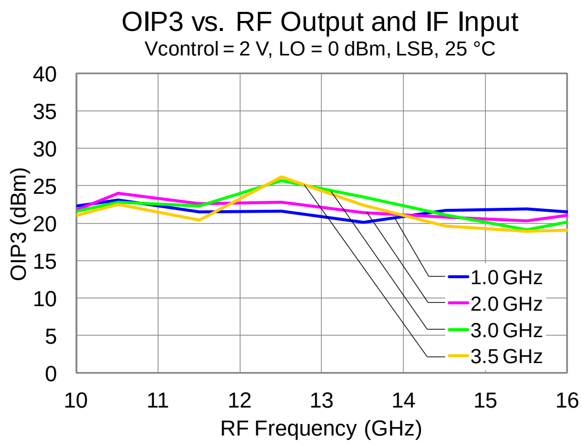
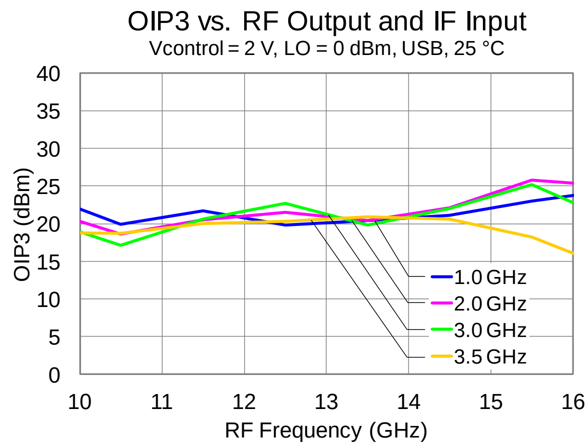
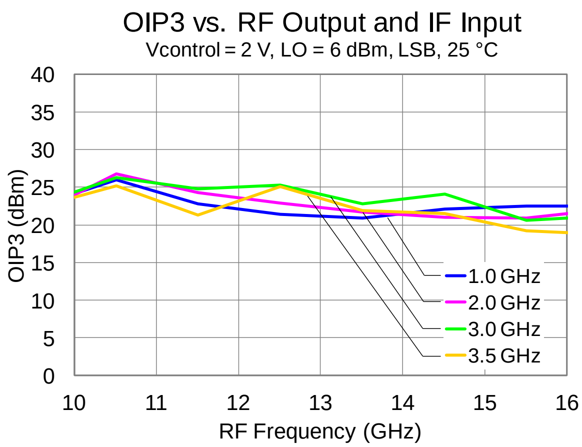
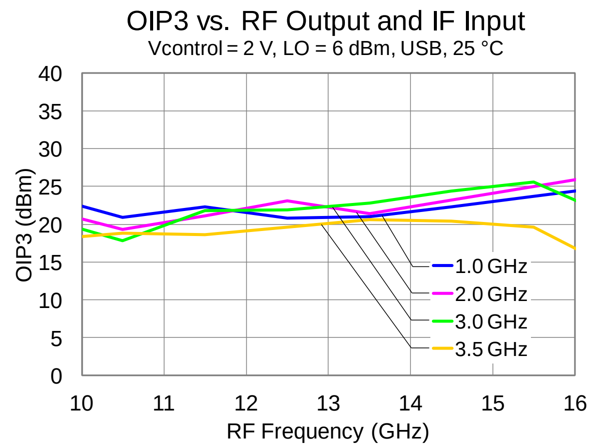
Performance Plots

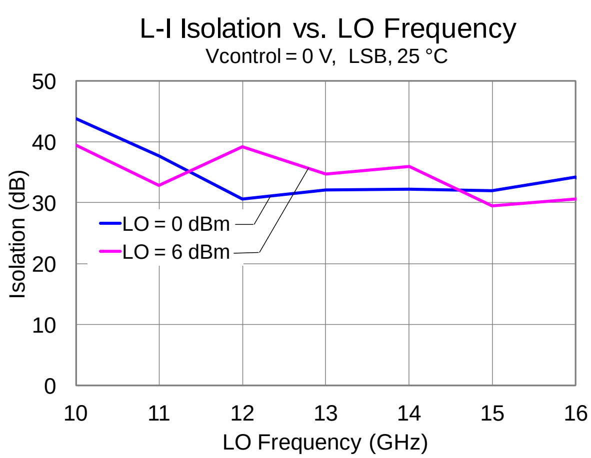
IF Input Power = -10 dBm, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA, VGX = -1.2 V, VREF = 2 V.
Data taken with external IF hybrid and LO nulling applied.

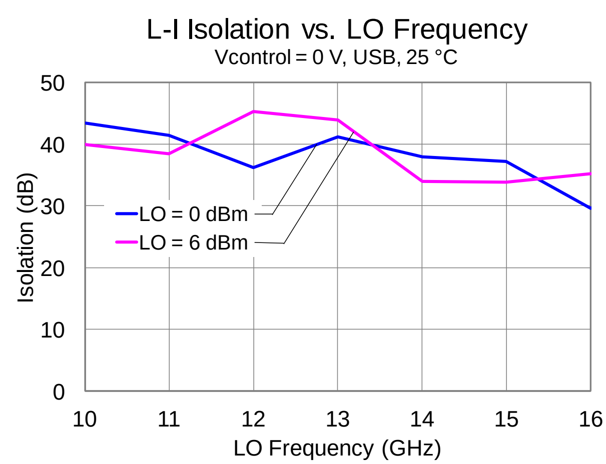












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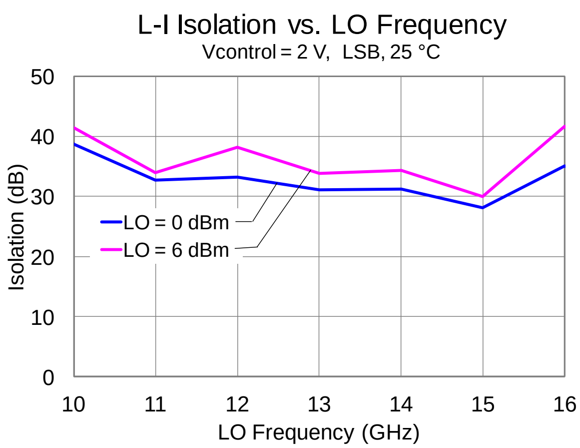
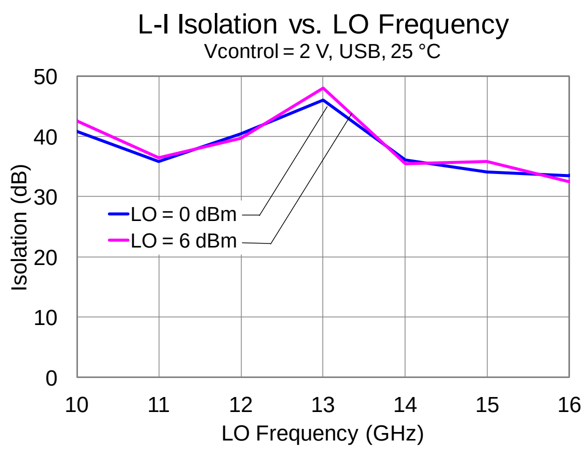
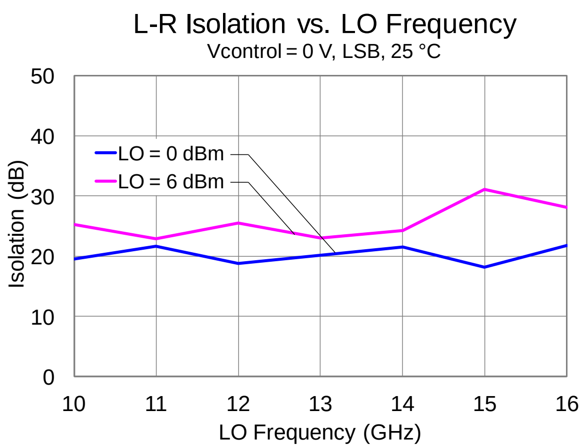
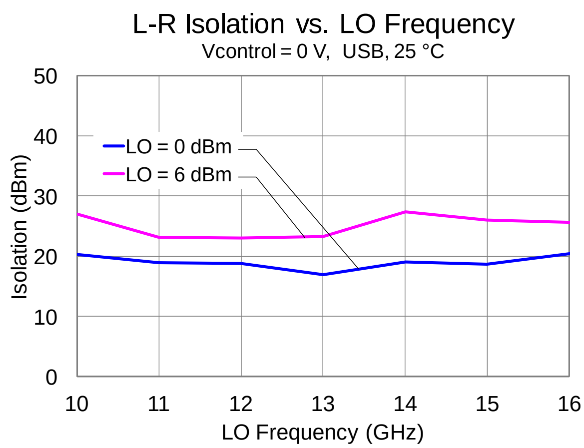
Performance Plots

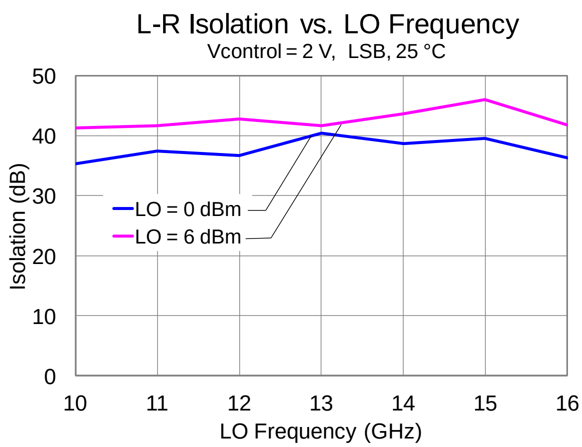
IF Input Power = -10 dBm, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA, VGX = -1.2 V, VREF = 2 V.
Data taken with external IF hybrid and LO nulling applied.

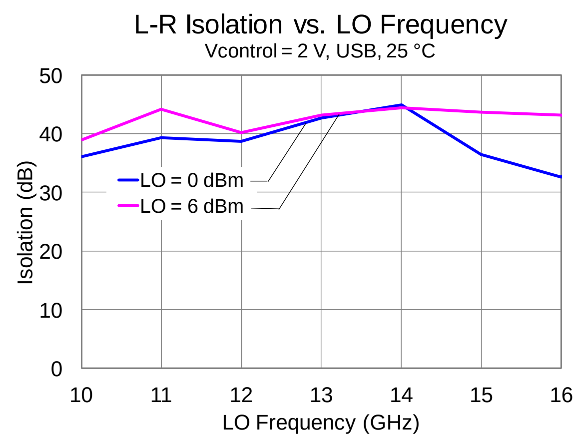












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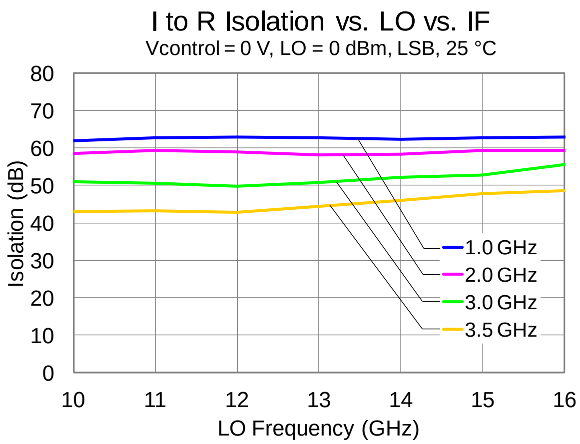
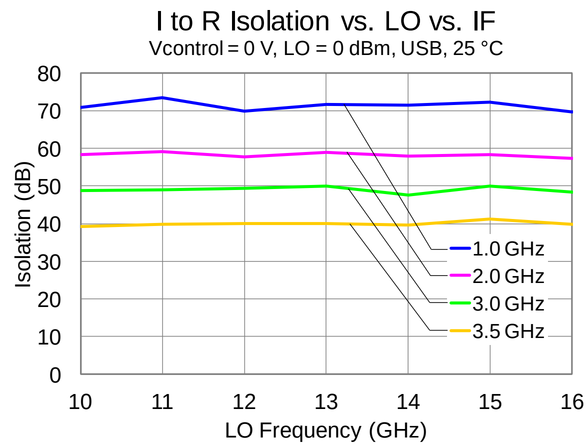
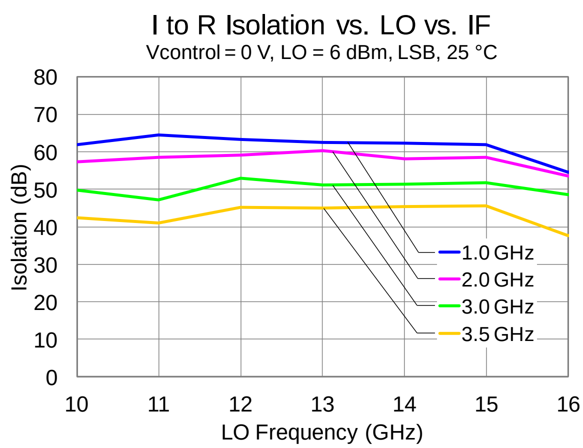
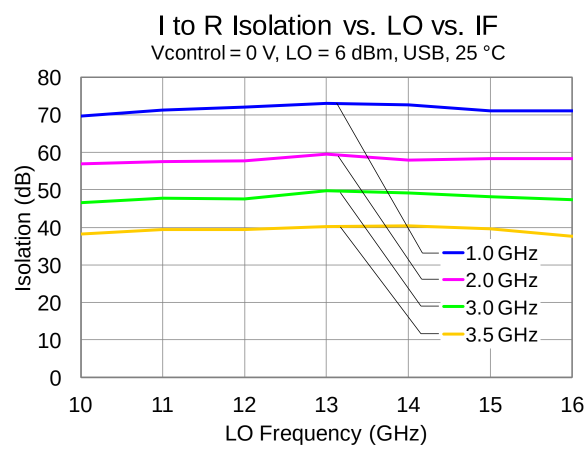
Performance Plots

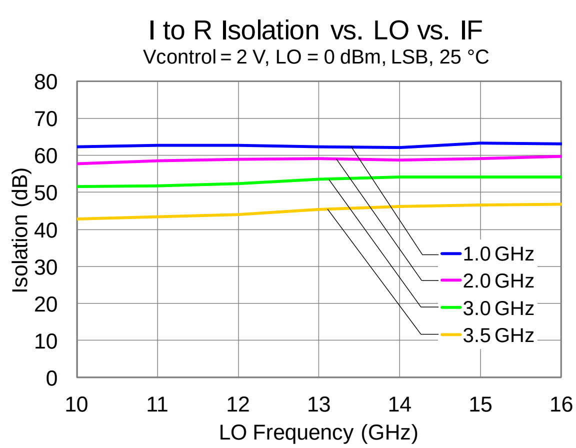
IF Input Power = -10 dBm, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA, VGX = -1.2 V, VREF = 2 V.
Data taken with external IF hybrid and LO nulling applied.

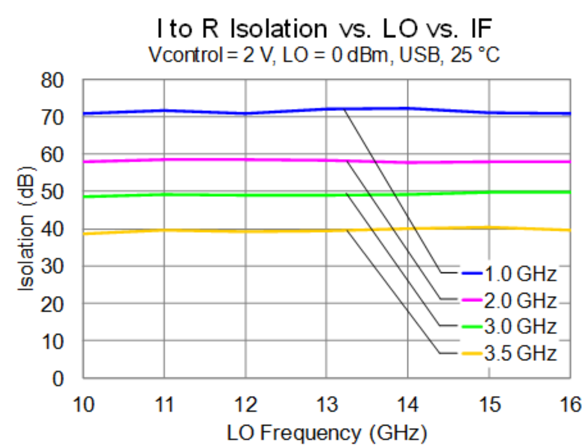












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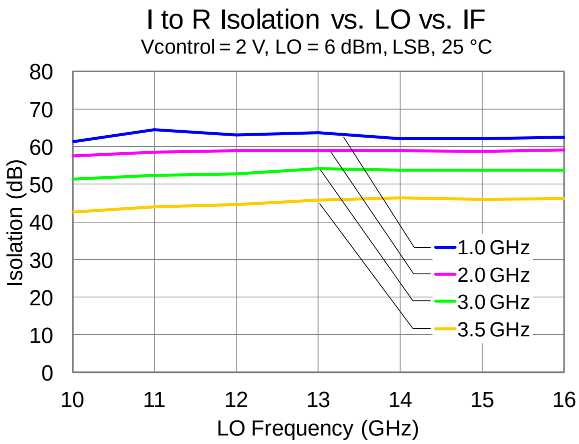
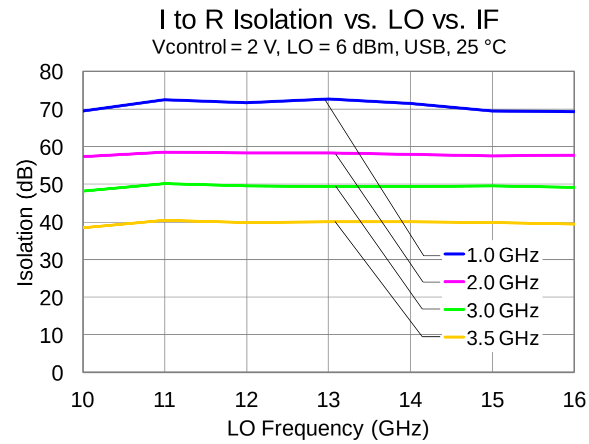
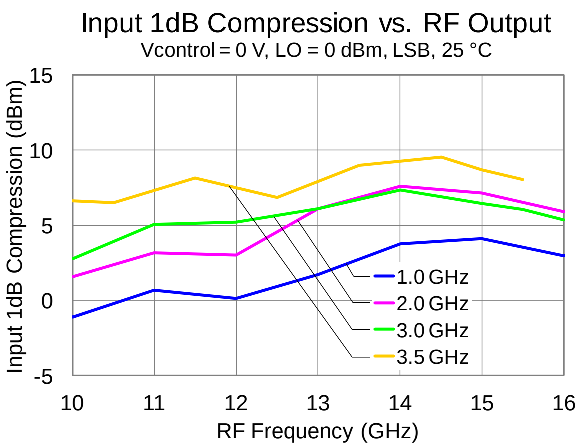
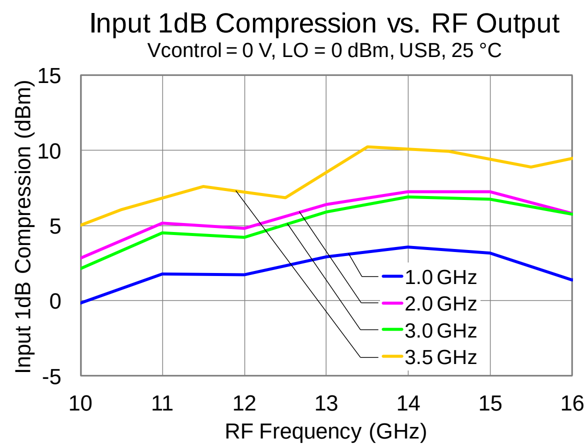
Performance Plots

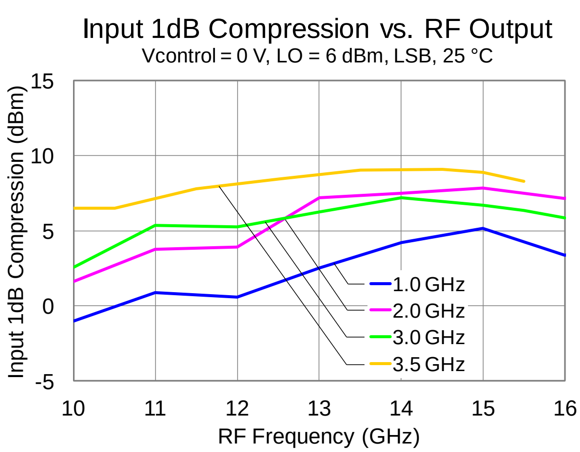
IF Input Power = -10 dBm, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA, VGX = -1.2 V, VREF = 2 V.
Data taken with external IF hybrid and LO nulling applied.

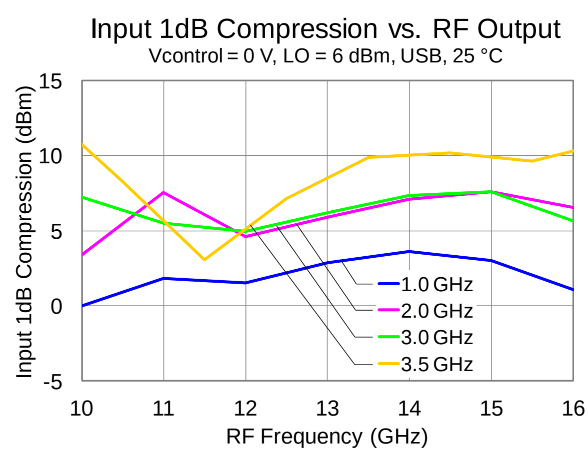












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Performance Plots

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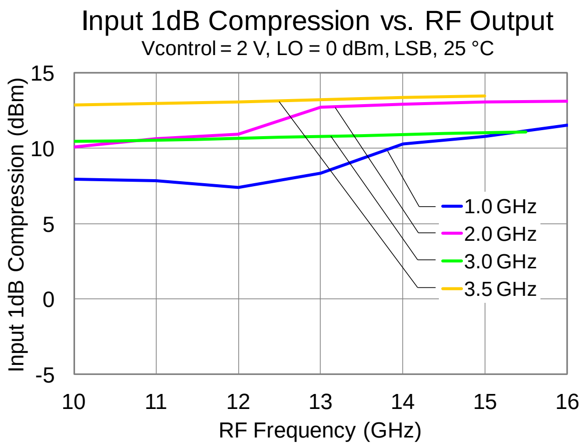
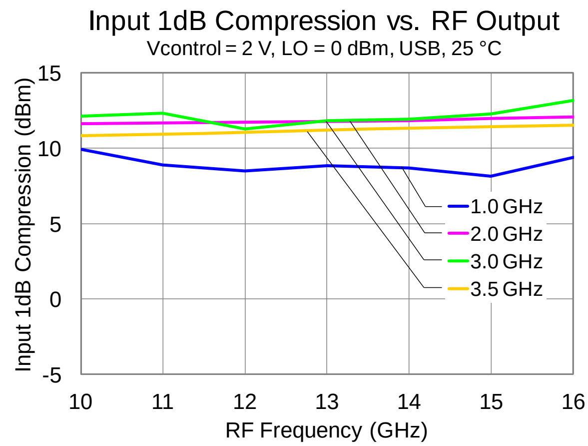
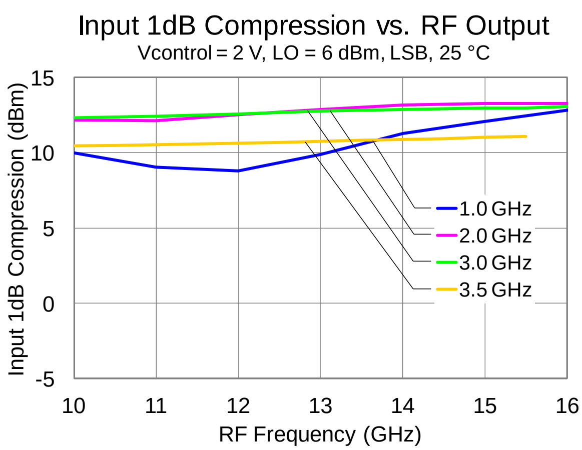
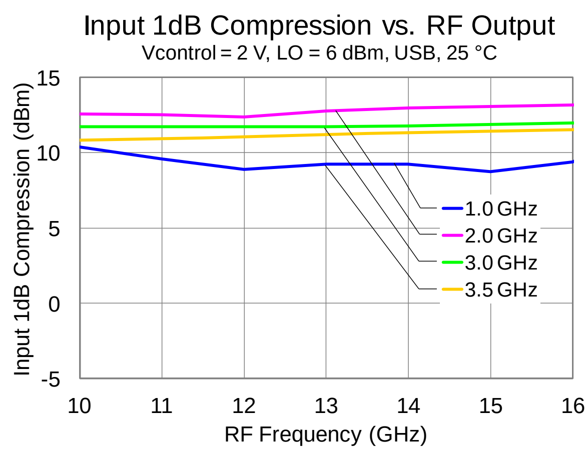
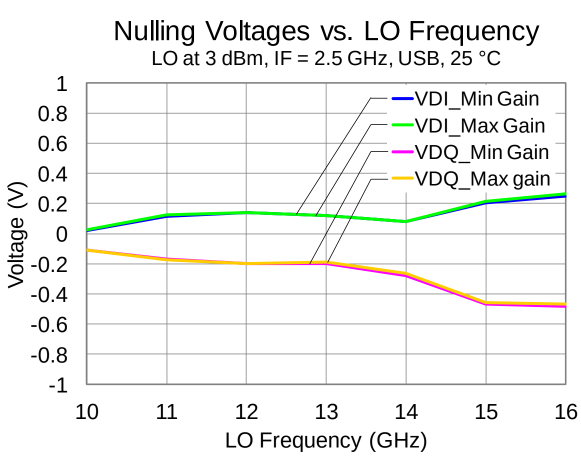
Data taken with external IF hybrid and LO nulling applied.

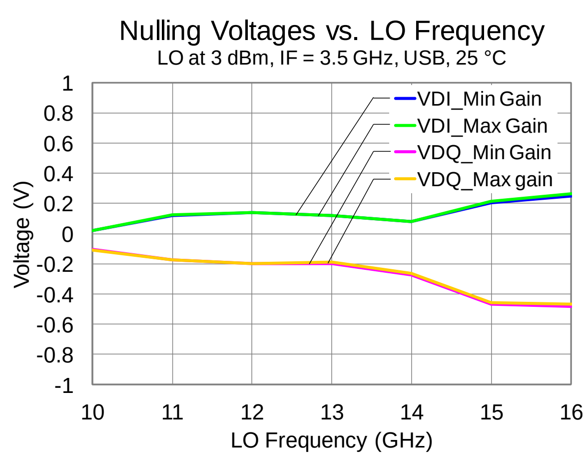












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Performance Plots

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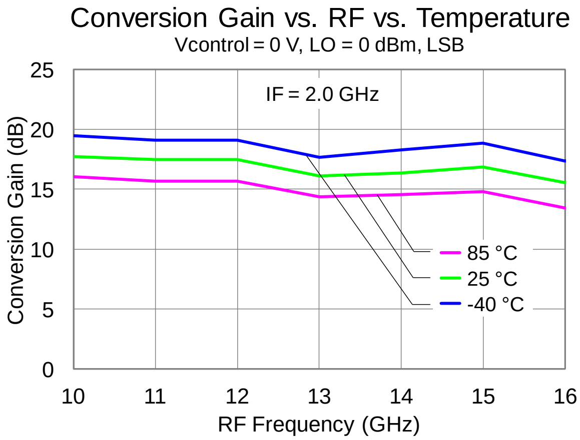
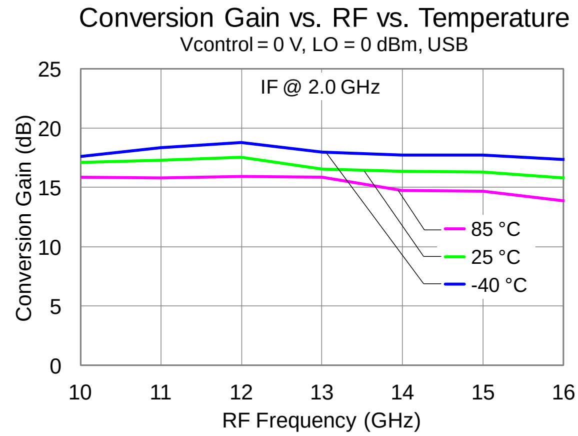
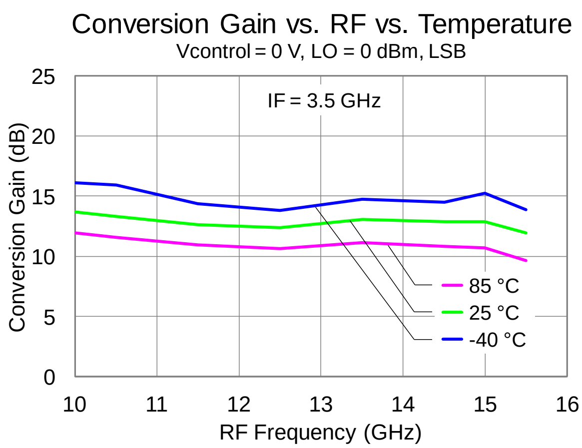
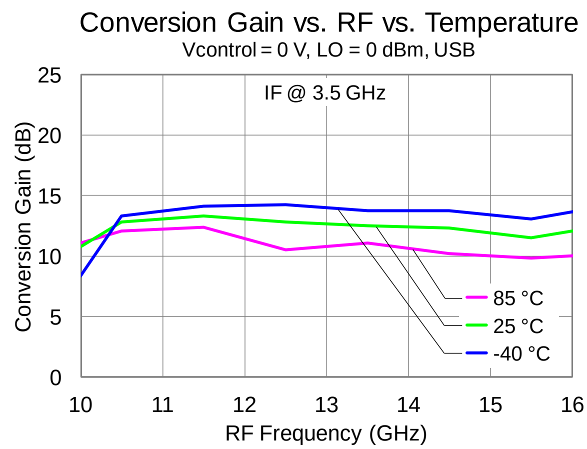
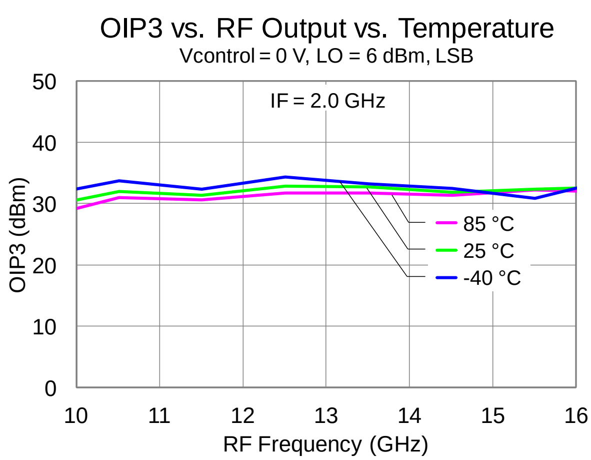
Data taken with external IF hybrid and LO nulling applied.

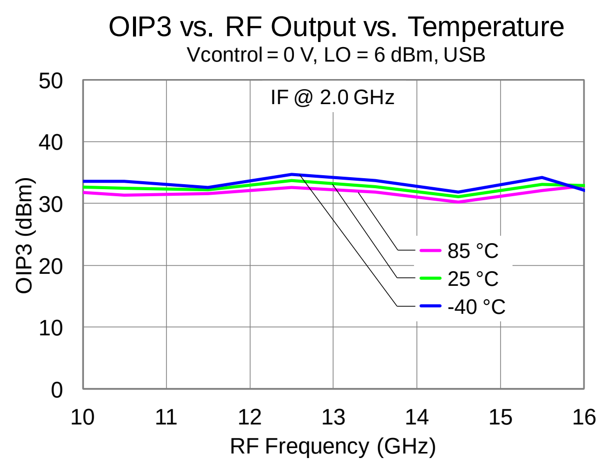












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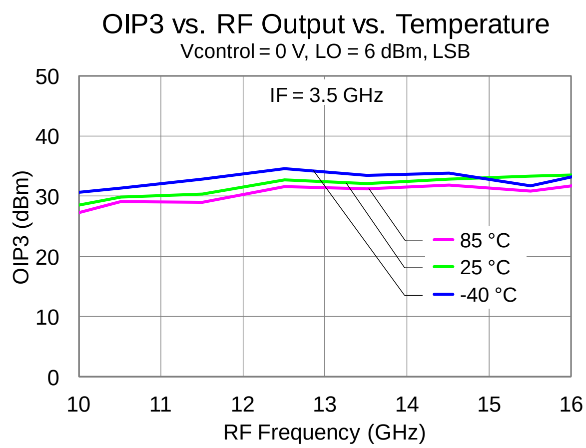
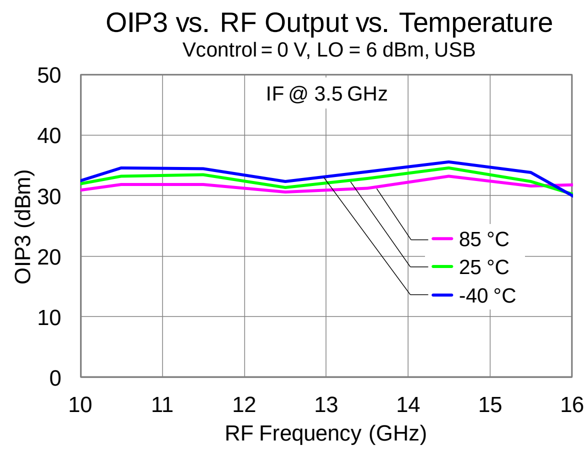
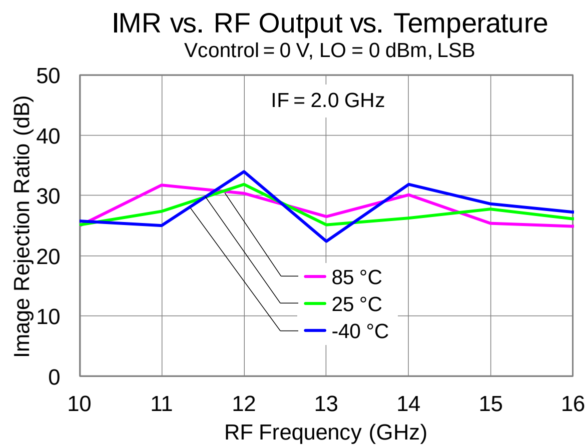
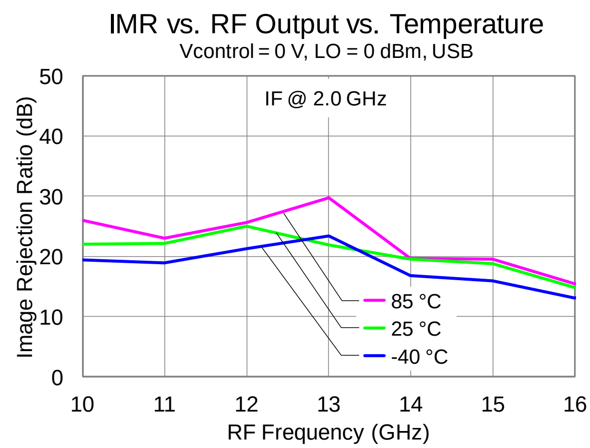
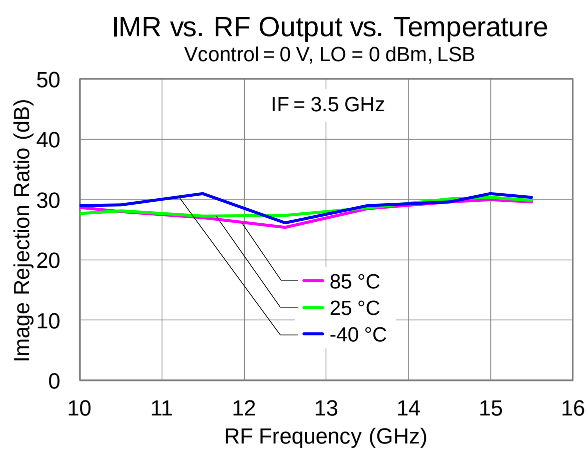
IF Input Power = -10 dBm, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA, VGX = -1.2 V, VREF = 2 V.
Data taken with external IF hybrid and LO nulling applied.

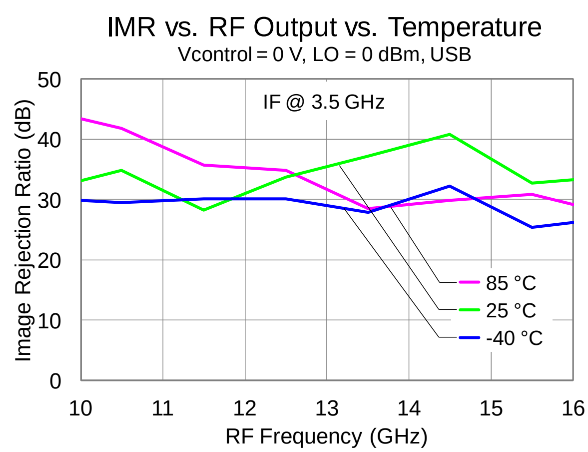












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Mixing Products

IF Input Power = -10 dBm, VDLO = 5 V, IDLO = 60 mA, VDRF = 5 V, IDRF = 240 mA. VGX = -1.2 V, VREF = 2 V.
Data taken with external IF hybrid and LO nulling applied.

M x N Spurious Outputs for LSB

LO = 0 – 6 dBm, 25 °C; All values are in dBc.
For LSB IF = 2.0 GHz: LO = 12.0 GHz to 18.0 GHz; IF = 3.5 GHz: LO = 13.5 GHz to 19.0 GHz.

Spurious Suppresion (dBc) for IF = 2.0 GHz				
RF/LO	0	1	2	3
-3	---	70	79	76
-2	---	44	40	75
-1	---	0	38	69
0	---	24	30	38
1	61	24	69	68
2	62	44	79	75
3	72	78	78	76

Spurious Suppresion (dBc) for IF = 3.5 GHz				
RF/LO	0	1	2	3
-3	---	84	75	73
-2	---	50	45	71
-1	---	0	59	63
0	---	21	28	34
1	51	27	64	69
2	49	64	74	74
3	85	77	70	---

M x N Spurious Outputs for USB

LO = 0 – 6 dBm, 25 °C; All values are in dBc.
For USB IF = 2.0 GHz: LO = 8.0 GHz to 14.0 GHz; IF = 3.5 GHz: LO = 6.5 GHz to 12.5 GHz.

Spurious Suppresion (dBc) for IF = 2.0 GHz				
RF/LO	0	1	2	3
-3	---	70	46	44
-2	---	46	29	54
-1	---	17	20	15
0	---	23	-17	25
1	56	0	8	26
2	28	33	32	62
3	48	43	66	71

Spurious Suppresion (dBc) for IF = 3.5 GHz				
RF/LO	0	1	2	3
-3	---	62	66	49
-2	---	70	33	41
-1	---	23	8	14
0	---	19	-29	-17
1	23	0	4	11
2	27	30	38	41
3	56	58	64	72

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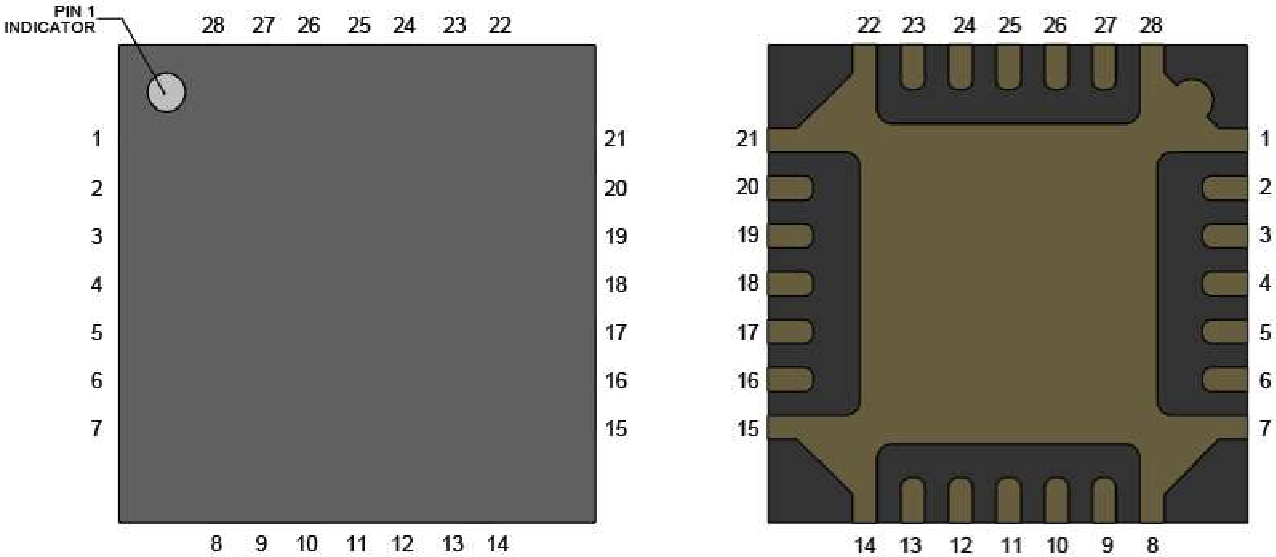
Pin Configuration and Description



Pin No.	Label	Description
1, 7, 8, 9, 13, 14, 15, 16, 21, 22, 26, 28	GND	Internal Grounding; must be grounded on PCB.
2	RF OUT	RF Output matched to 50 ohms, AC Coupled.
3, 11, 18, 19, 20	NC	No internal connection; must be grounded on PCB.
4	VCTRL	Control Voltage. Bias network is required; see Application Circuit on page 17 as an example.
5	VREF	Reference Voltage. Bias network is required; see Application Circuit on page 17 as an example.
6	VGRF	RF Gate Voltage. Bias network is required; see Application Circuit on page 17 as an example.
10	IF1	IF Input matched to 50 ohms, DC coupled.
12	IF2	IF Input matched to 50 ohms, DC coupled.
17	LO IN	LO Input, matched to 50 ohms, AC coupled.
23	VGLO	LO Gate Voltage. Bias network is required; see Application Circuit on page 17 as an example.
24	VDLO	LO Drain Voltage. Bias network is required; see Application Circuit on page 17 as an example.
25	VGX	Mixer Voltage. Bias network is required; see Application Circuit on page 17 as an example.
27	VDRF	RF Drain Voltage. Bias network is required; see Application Circuit on page 17 as an example.
29	GND	Backside Paddle. Multiple vias should be employed to minimize inductance and thermal resistance; see Mounting Configuration on page 20 for suggested footprint.

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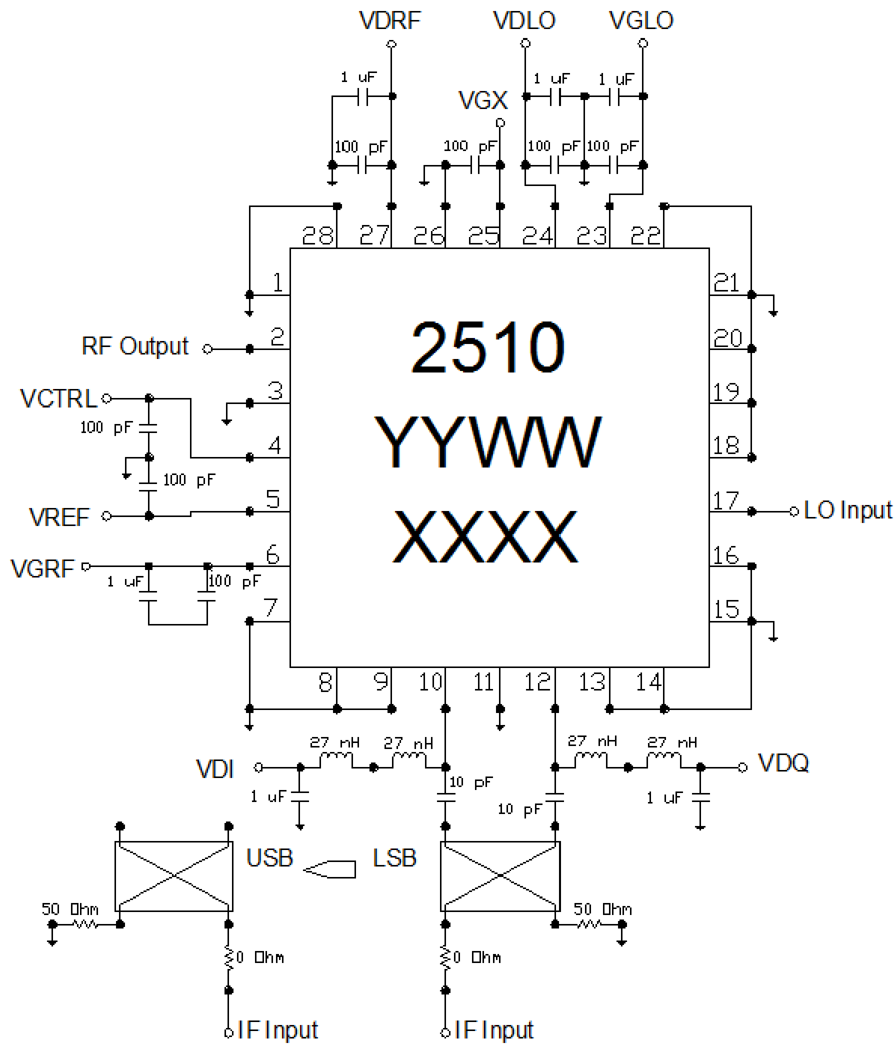
Applications Circuit



Bias-up Procedure	Bias-down Procedure
Set VGX = -1.2 V, Set VREF = 2.0 V, Set VCTRL = 0 V Set VGLO = -1.5 V, Set VDLO = 5.0 V	Turn off RF and LO signals
Set VGX, VREF, VCTRL, VGLO, VGRF, VDI, VDQ current limits to 10 mA	Reduced VDLO = 0 V
Set IDLO limit to 100 mA, Set IDRF limit to 350 mA	Reduce VDRF = 0 V
Increase VGLO to get IDLO = 60 mA	Set VDI = 0 V, if used for LO nulling
Set VGRF = -1.5 V, Set VDRF = 5.0 V	Set VDQ = 0 V, if used for LO nulling
Increase VGRF to get IDRF = 240 mA	Reduced VGLO = 0V, VGRF = 0 V, VREF = 0 V
Set VDI, VDQ to 0V; or no connection	Reduce VCTRL = 0 V
Apply LO and RF signals	Reduced VGX = 0 V

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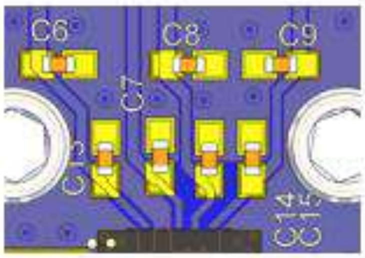
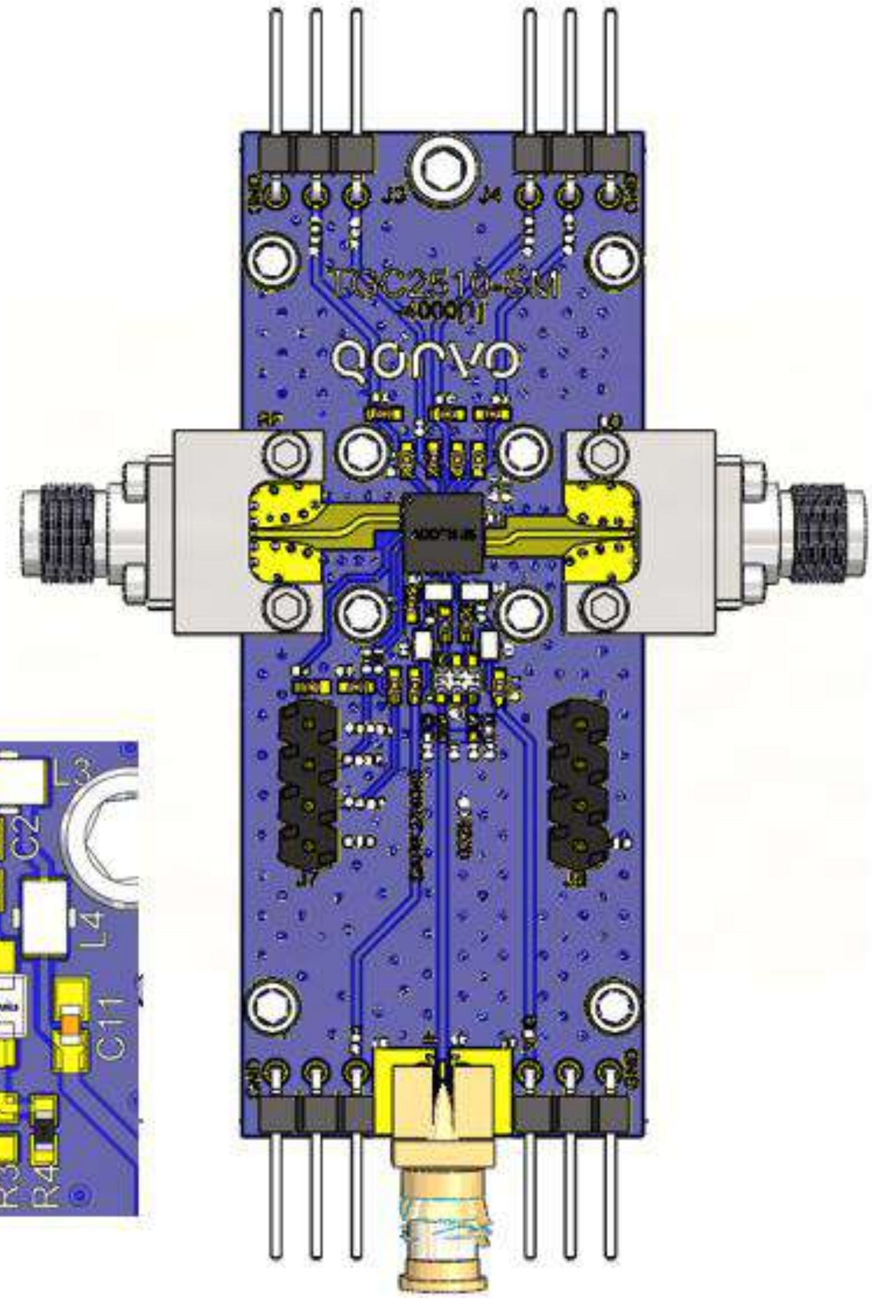
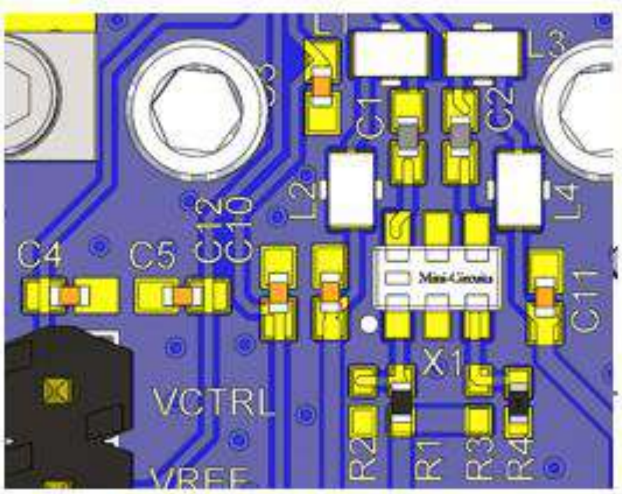
Evaluation Board (EVB) Assembly Layout

Board material is RO4003 0.008" thickness with ½ oz copper cladding.







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Application Circuit Component

Bill of Material

Ref Des	Value	Description	Manufacturer	Part Number
C1 – C2	10 pF	Cap, 0402, 50V, 5%, NPO	various	
C3 - C5, C7, C13 - C15	100 pF	Cap, 0402, 50V, 5%, NPO	various	
C10 – C12, C6, C8, C9	1 µF	Cap, 0805, 25V, 5%, X5R	various	
L1 – L4	27 nH	Ind, 0201, 100 mA, 5%, SMD	various	
Q1		Ku-Band Up-Converter	QORVO	TGC2510-SM

LSB Configuration

Ref Des	Value	Description	Manufacturer	Part Number
X1		IF Quad Coupler, 1.35 to 2.45 GHz	Mini-Circuits	QCN-25+
X1		IF Quad Coupler, 2.5 to 4.0 GHz	Mini-Circuits	QCN-45+
R1	0 Ω	Res, 0402, 0.01W, SMD	various	
R4	50 Ω	Res, 0402, 0.05W, 0.1%, SMD	various	
R2, R3		DNP		

USB Configuration

Ref Des	Value	Description	Manufacturer	Part Number
X1		IF Quad Coupler, 1.35 to 2.45 GHz	Mini-Circuits	QCN-25+
X1		IF Quad Coupler, 2.5 to 4.0 GHz	Mini-Circuits	QCN-45+
R3	0 Ω	Res, 0402, 0.01W, SMD	various	
R2	50 Ω	Res, 0402, 0.05W, 0.1%, SMD	various	
R1, R4		DNP		

Note: Due to bandwidth limitations of IF quad coupler, two versions of coupler were used on EVBs, users need to choose low or high band of IF to be used, in addition to LSB and USB selection. Refer to ordering information section for details.

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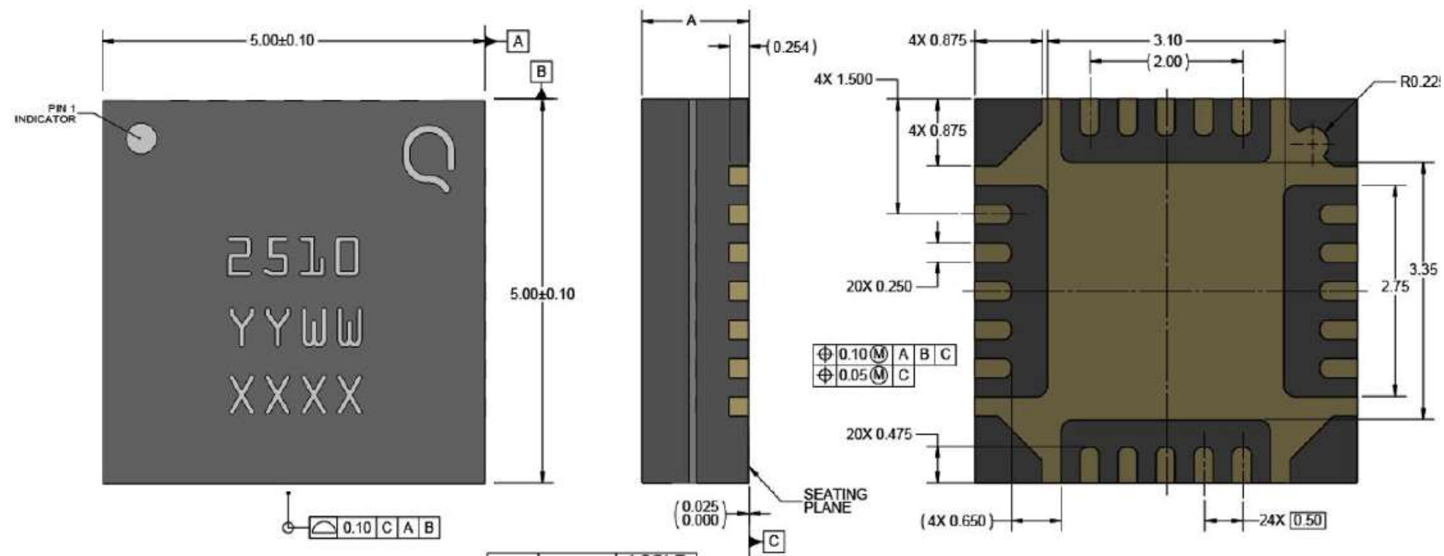
Package Marking and Dimensions



		ACSLP
A	MAX.	1.400
	NOM	1.300
	MIN.	1.200

The TGC2510-SM will be marked with the “2510” designator. The “YY” represents the last two digits of the year the part was manufactured, the “WW” is the work week, and the “XXXX” is batch ID.

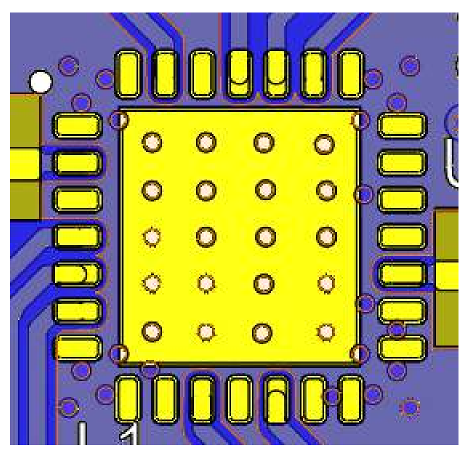
This package is lead-free/RoHS-compliant with a copper alloy base (CDA194), and the plating material on the leads is NiPdAu. It is compatible with a lead-free (maximum 260 °C reflow temperature) soldering process.

PCB Mounting Pattern

Notes:

1. The pad pattern shown has been developed and tested for optimized assembly at TriQuint Semiconductor. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.

2. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35mm diameter drill and have a final plated thru diameter of .25 mm.



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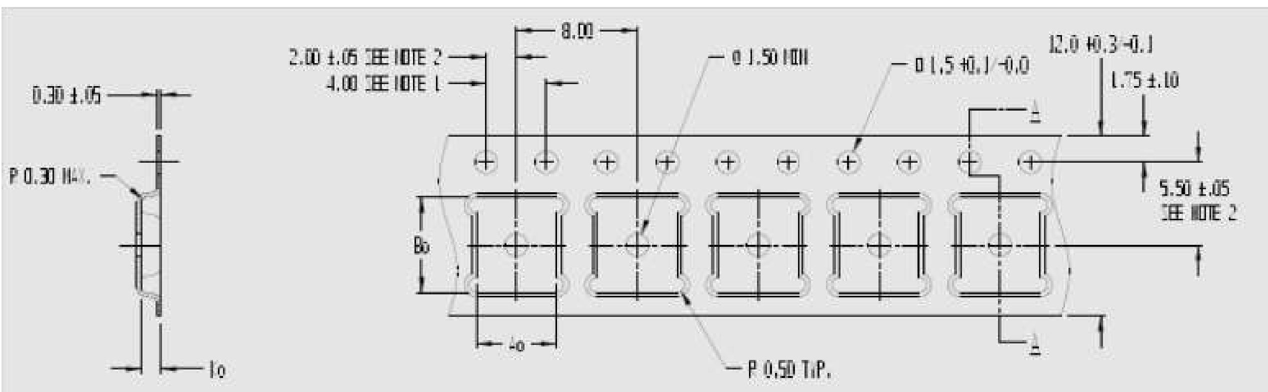
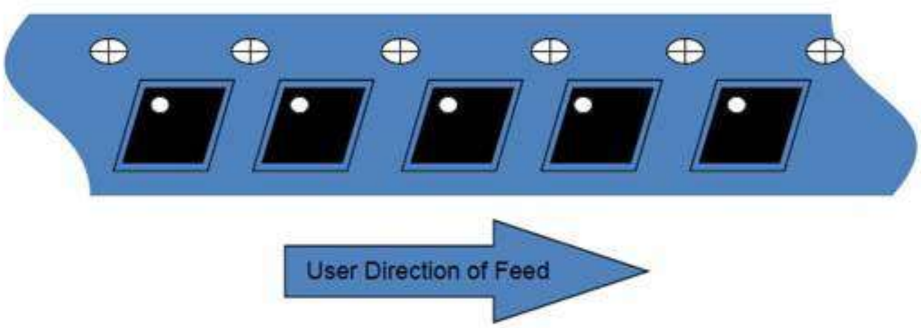
Tape and Reel Information

Standard T/R size = 500 pieces on a 7” reel.

Material		Cavity (mm)				Distance Between Centerline (mm)		Carrier Tape (mm)	Cover Carrier (mm)
Vendor	Vendor P/N	Length (A0)	Width (B0)	Depth (K0)	Pitch (P1)	Length direction (P2)	Width Direction (F)	Width (W)	Width (W)
Tek-Pak	QFN0500X0 500F-L500	5.3	5.3	1.65	8.0	2.00	5.50	12.0	9.20





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Assembly Notes

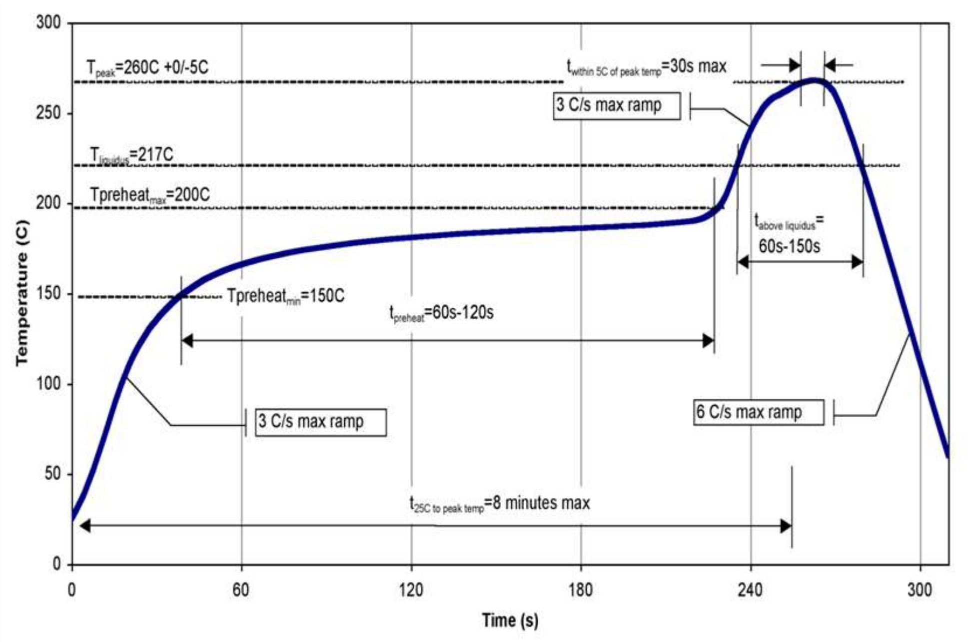
Compatible with lead-free soldering processes with 260°C peak reflow temperature.

This package is air-cavity and non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing after soldering is highly recommended.

Contact plating: Ni-Pd-Au.

Solder rework not recommended.

Recommended Soldering Temperature Profile



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Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 0	ESDA / JEDEC JS-001-2012
MSL – Moisture Sensitivity Level	Level 1	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

RoHS Compliance

This product is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances 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 ($C_{15}H_{12}Br_{4}0_{2}$) Free
- PFOS Free
- SVHC Free

Contact Information

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

Tel: 1-844-890-8163

Web: www.qorvo.com

Email: customer.support@qorvo.com

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TGC4510-SM

K - Band Upconverter

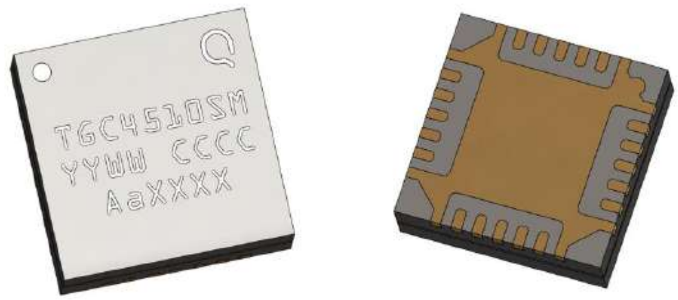
Product Description

The QORVO TGC4510-SM is a K-Band image reject upconverter mixer with integrated x2 LO buffer amplifier and output variable gain amplifier. The TGC4510-SM outputs an RF frequency from 17.7 to 26.5 GHz using IF inputs from DC to 4.0 GHz and a corresponding LO frequency. It is designed using QORVO's pHEMT production process.

The TGC4510-SM typically provides 32 dBm of output TOI at –10 dBm input power per tone and has a conversion gain of 13 dB. Optional nulling of the LO can improve LO Isolation by 30 dB.

The TGC4510-SM is available in a low-cost, surface mount 28 lead 5x5mm QFN package and is ideally suited for Point-to-Point Radio, and K-Band VSAT Ground Terminal.

Lead-free and RoHS compliant.



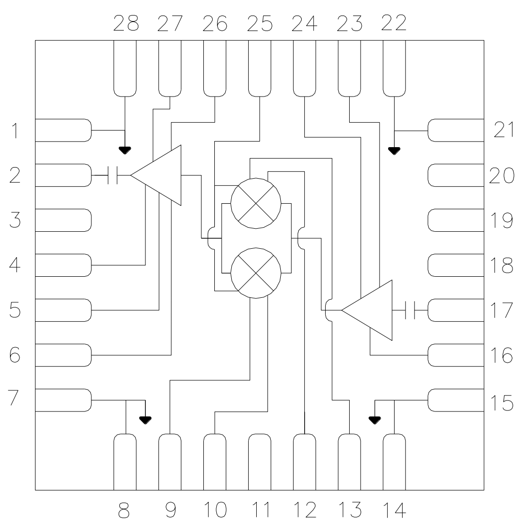
28-pin 5x5 mm QFN package

Product Features

- RF Frequency Range: 17.7 – 26.5 GHz
- IF Frequency: DC – 4.0 GHz
- LO Frequency: 6.85 – 15.25 GHz
- LO Input Power: 2 to 10 dBm
- Conversion Gain: 13 dB
- OTOI: 32 dBm at max gain
- Attenuation Range: 30 dB typical
- Bias 5.0 V, 360 mA, 3.3 V, 180 mA
- Package Dimensions: 5.0 x 5.0 x 1.3 mm

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Function Block Diagram



Applications

- VSAT Ground Terminal
- Point-to-Point Radio
- Millimeter Wave Communications

Ordering Information

Part No.	Description
TGC4510-SM	Ku-Band Upconverter
1119047	Shipping Tray, Qty 50
1098636	Tape and Reel, Qty 500
TGC4510-SMEVBLL	TGC4510-SM EVB LSB, Low IF Band, 1.3 to 2.45 GHz
TGC4510-SMEVBLH	TGC4510-SM EVB LSB, High IF Band, 2.5 to 4.0 GH
TGC4510-SMEVBUL	TGC4510-SM EVB USB, Low IF Band, 1.3 to 2.45 GHz
TGC4510-SMEVBUH	TGC4510-SM EVB USB, High IF Band, 2.5 to 4.0 GHz

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Absolute Maximum Ratings

Parameter	Rating	Parameter	Rating
VDRF, VDLO1, VDLO23	+ 6 V	LO Nulling DC Voltage at IF1, IF2	-2 to +2 V
IDRF	390 mA	Input Power at LO Port, 50Ω, T = 25°C	15 dBm
IDLO1	190 mA	Input Power at IF Port, 50Ω, T = 25°C	18 dBm
IDLO23	300 mA	Power Dissipation, Pdiss	2 W
VGRF, VGLO, VGX	-3 to +1.5 V	Channel Temperature, Tch	200 °C
VCTRL1, VCTRL2	+ 3 to 0 V	Storage Temperature	-65 to 125°C

These are stress ratings only, functional operation of the device at these conditions is not implied. Extended application of Absolute Maximum Rating conditions may reduce device reliability. Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

Parameter [1]	Min	Typ	Max	Units	Parameter [1]	Min	Typ.	Max	Units
Operating Temp. Range	-40	+25	+85	°C	VGLO [3]		-0.7		V
VDRF		5		V	VCTRL1, VCTRL2 (max gain) [4]	-2		0	V
VGRF [2]		-0.75		V	VCTRL1, VCTRL2 (min gain) [4]	0		-2	V
IDRF		360		mA	Vi, Vq [5]	-1		1	V
VDLO1, VDLO23		3.3		V	VGX		-1.2		V
IDLO1 + IDLO23	140	180	200	mA	LO Input Power	3	6	9	dBm

1 Electrical specification are measured at specified test conditions. Specifications are not guaranteed over all recommended operating conditions.
2 VGRF value is typical, can be adjusted to get required IDRF.
3 VGLO value is typical, can be adjusted to get required IDLO1+IDLO23.
4 VCTRL1 and VCTRL2 can be adjusted to achieve required conversion gain.
5 Vi and Vq can be adjusted to achieve required LO isolations, optional.

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Electrical Specifications

Test conditions unless otherwise noted: VDLO1, VDLO23 = + 3.3 V, VGLO = -0.7 V, IDLO1 + IDLO23 = 140 to 200 mA, VDRF = 5.0 V, VGRF = - 0.75 V, IDRF = 340 to 380 mA, VGX = -1.2 V, T = 25 ˚C

Parameter		Conditions	Min	Typ	Max	Units
RF Frequency Range			17.7		26.5	GHz
LO Frequency Range			6.85		15.25	GHz
IF Frequency Range			0		4	GHz
Conversion Gain	1/	17.7 GHz to 26.5 GHz		13		dB
Conversion Gain	1/	17.7 GHz to 23.6 GHz	9.5	13	17.5	dB
Attenuation Range	2/			34		dB
SSB Noise Figure				15		dB
OIP3		17.7 GHz to 26.5 GHz	27.5	32		dBm
OIP3		17.7 GHz to 23.6 GHz	27.5	32		dBm
IIP3 at Minimum Gain				13		dBm
Image Rejection				15		dB
LO Isolation at RF Port	3/	Without external LO nulling voltage		-5		dB
LO Isolation at RF Port	3/	With external LO nulling voltage		25		dB
LO Return Loss				12		dB
RF Return Loss				11		dB

Notes:

1/ At Maximum gain.
2/ Maximum gain at VCTL1 = -2 V, VCTL2 = 0 V; Minimum gain at VCTL1 = 0 V, VCTL2 = -2 V
3/ LO Isolation = (Input Power at LO Port at LO Frequency) – (Output Power at RF port at 2xLO frequency)

Frequency Mapping

Lower Side Band Frequency Ranges

IF Freq GHz	LO Freq GHz	RF Freq GHz
0.5	9-14	17.5-27.5
1.0	9-14	17-27
2.0	9-14	16-26
3.0	10-15	17-27
3.3	10-15.5	16.7-27.7
4.0	10-16	16-28

Upper Side Band Frequency Ranges

IF Freq GHz	LO Freq GHz	RF Freq GHz
0.5	8-14	16.5-28.5
1.0	8-13	17-28
2.0	7-13	16-28
3.0	6.5-12	16-27
3.3	6.5-12	16.3-27.3
4.0	6.5-11	17-26

State	VCTRL1 V	VCTRL2 V
Max Gain	-2	0
Reduced Gain	-1.0	-1.0
Min Gain	0	-2

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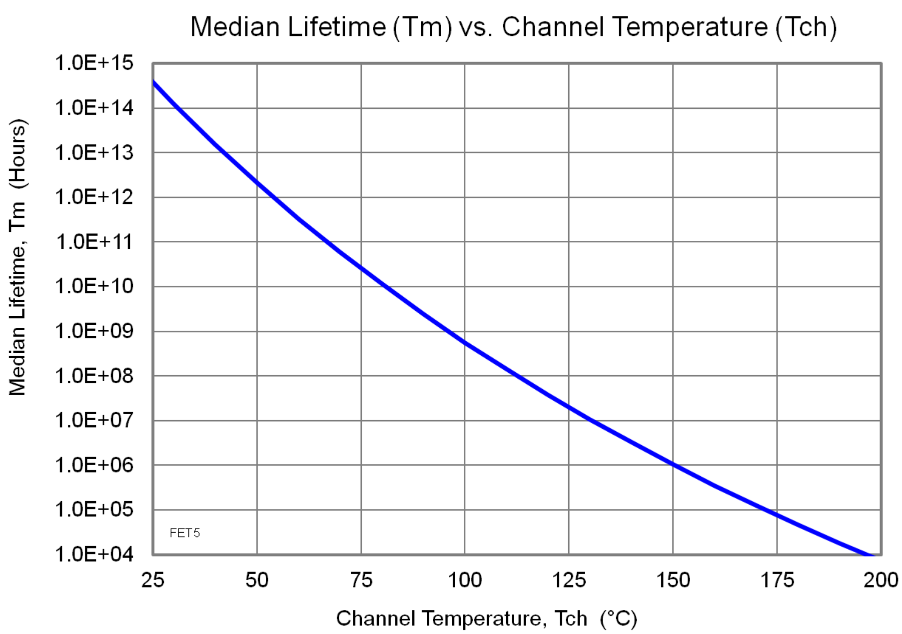
Thermal and Reliability Information

Parameter	Conditions	Rating
Thermal Resistance, θ_{JC}, measured to back of package	Tbase = 85 °C	θ_{JC} = 19.6 °C/W
Channel Temperature (Tch), and Median Lifetime (Tm)	Tbase = 85 °C, VDLO = 3.0 V, IDLO=260 mA, VDRF = 5.0 V, IDRF=360 mA, Pdiss = 2.6 W	Tch = 136 °C Tm = 5.2 E+06 Hours



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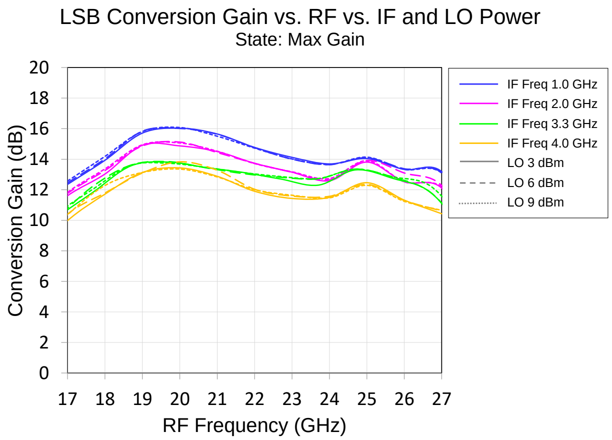
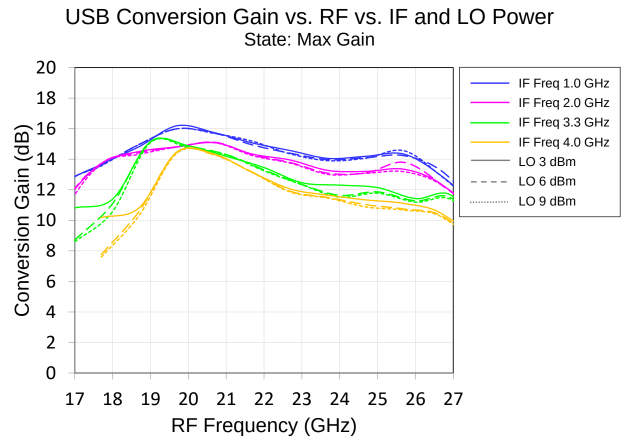
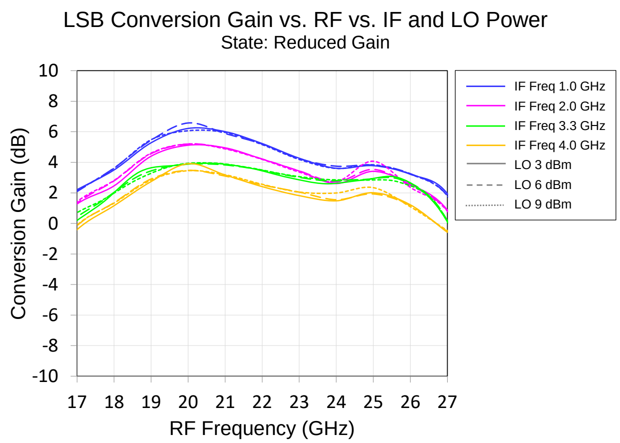
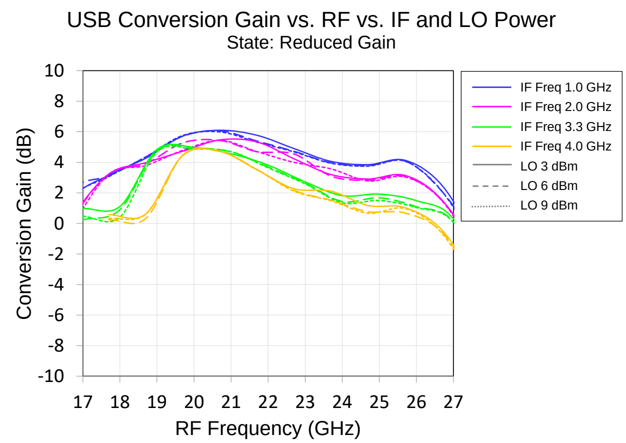
Performance Plots

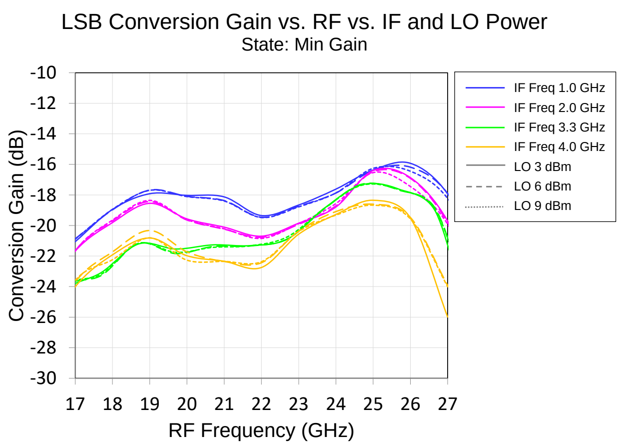
Test conditions unless otherwise noted: VDLO1, VDLO23 = 3.3 V, VGLO = - 0.7 V, IDLO1+IDLO23 = 140 to 200 mA, VDRF = 5.0 V VGRF = - 0.75 V, IDRF = 340 to 380 mA, VGX = - 1.2 V, 25 °C. Data taken with external IF hybrid and LO nulling applied

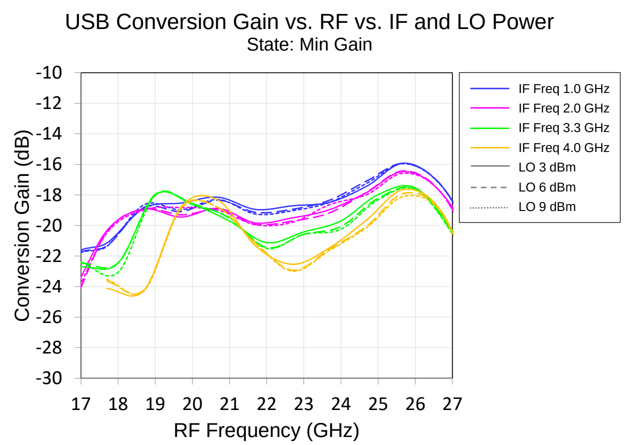












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Performance Plots

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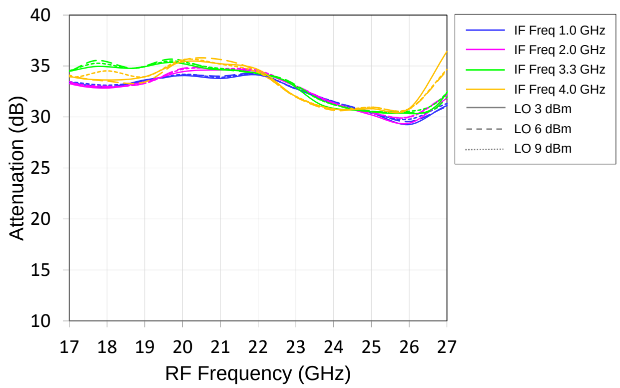
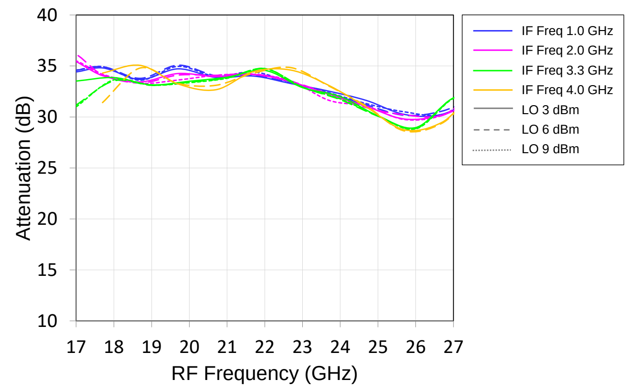
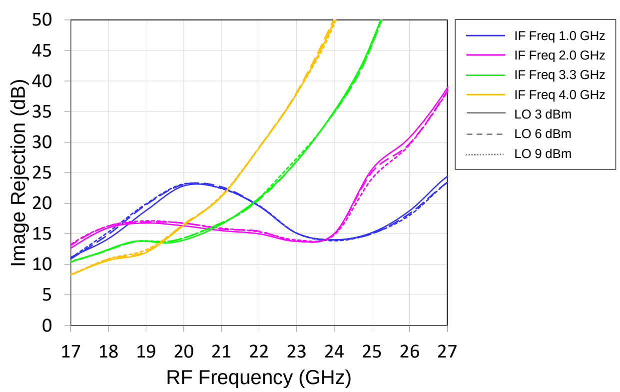
LSB Attenuation vs. RF vs. IF and LO Power
Min to Max Gain State



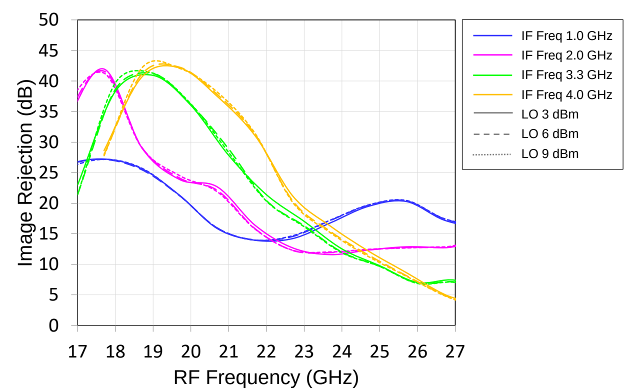
USB Attenuation vs. RF vs. IF and LO Power
Min to Max Gain State



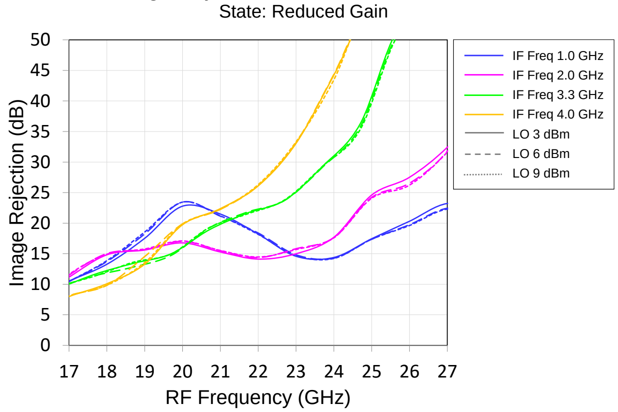
LSB Image Rejection vs. RF vs. IF and LO Power
State: Max Gain



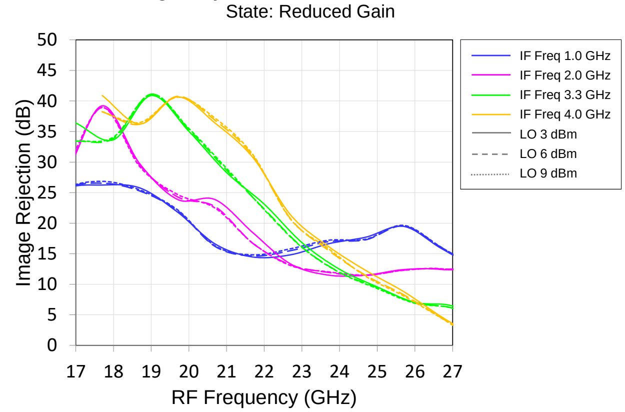
USB Image Rejection vs. RF vs. IF and LO Power
State: Max Gain



LSB Image Rejection vs. RF vs. IF and LO Power
State: Reduced Gain



USB Image Rejection vs. RF vs. IF and LO Power
State: Reduced Gain



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Performance Plots

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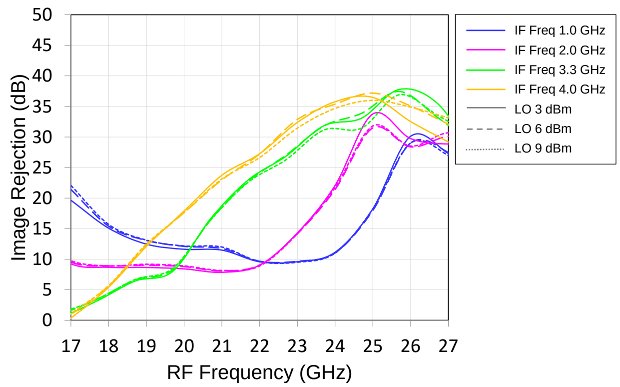
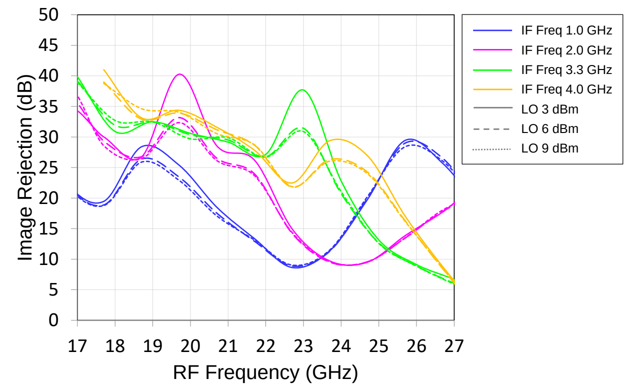
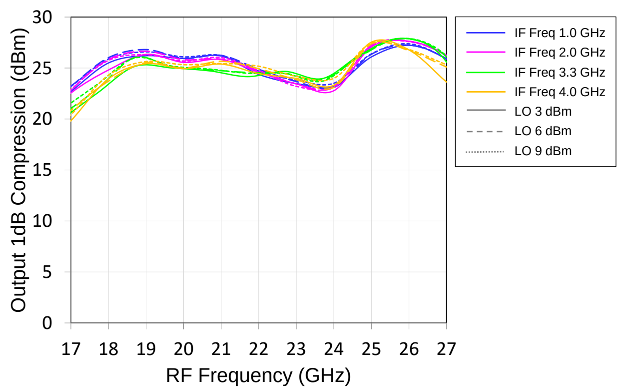
LSB Image Rejection vs. RF vs. IF and LO Power
State: Min Gain



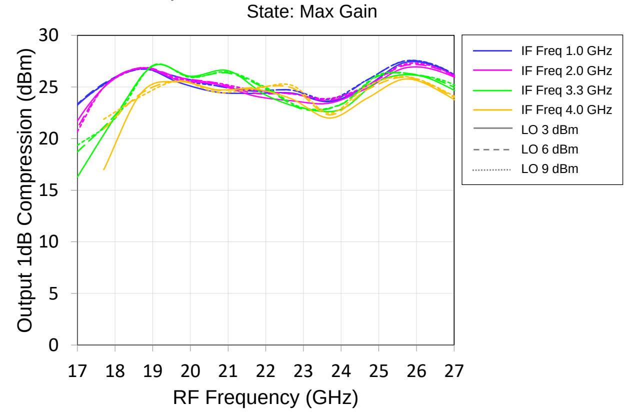
USB Image Rejection vs. RF vs. IF and LO Power
State: Min Gain



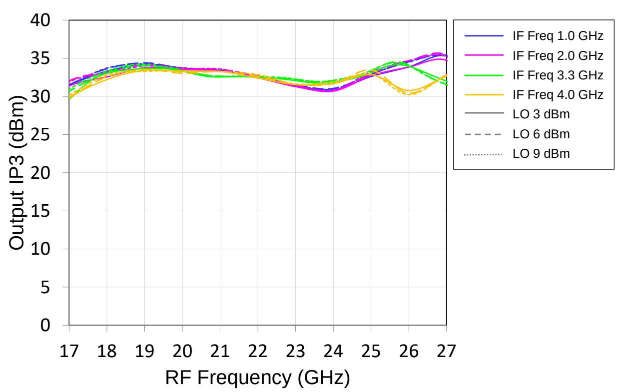
LSB Output P1dB vs. RF vs. IF and LO Power
State: Max Gain



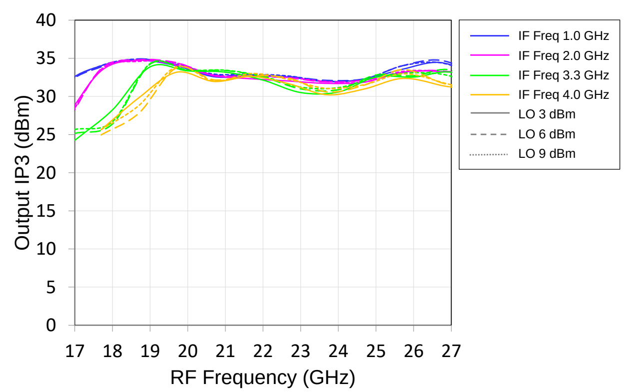
USB Output P1dB vs. RF vs. IF and LO Power
State: Max Gain



LSB Output IP3 vs. RF vs. IF and LO Power
State: Max Gain



USB Output IP3 vs. RF vs. IF and LO Power
State: Max Gain



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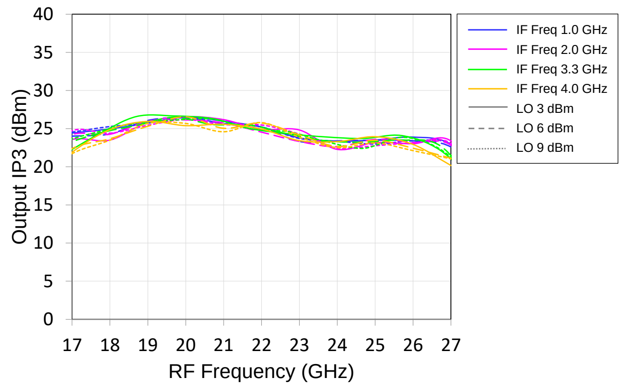
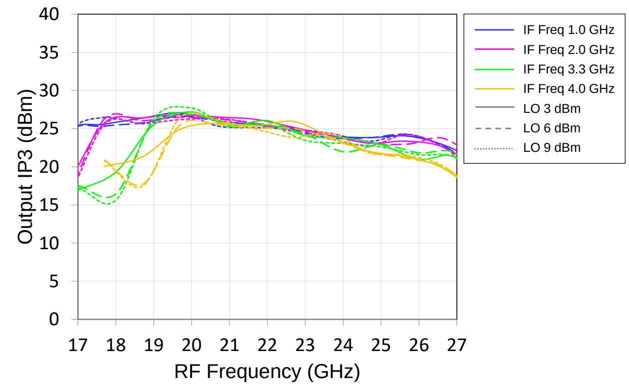
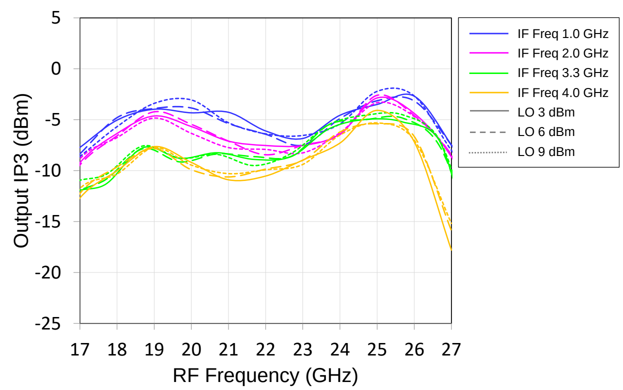
LSB Output IP3 vs. RF vs. IF and LO Power
State: Reduced Gain



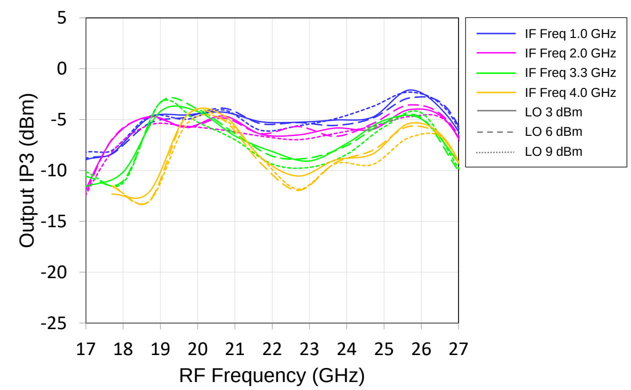
USB Output IP3 vs. RF vs. IF and LO Power
State: Reduced Gain



LSB Output IP3 vs. RF vs. IF and LO Power
State: Min Gain



USB Output IP3 vs. RF vs. IF and LO Power
State: Min Gain



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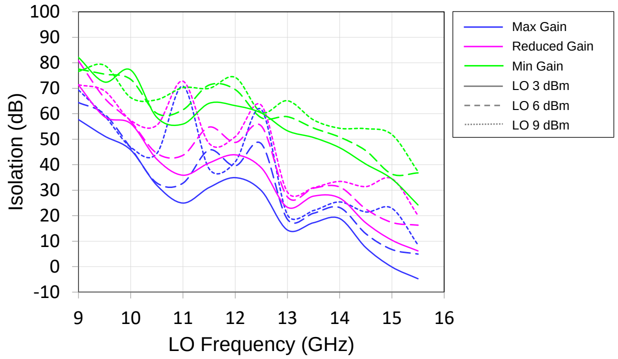
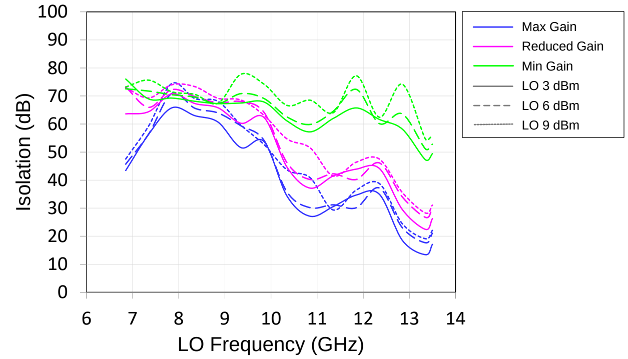
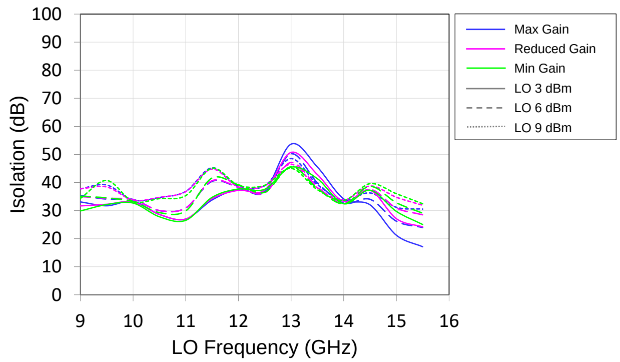
LSB LO-to-RF Isolation vs. LO Freq vs. LO Power and State



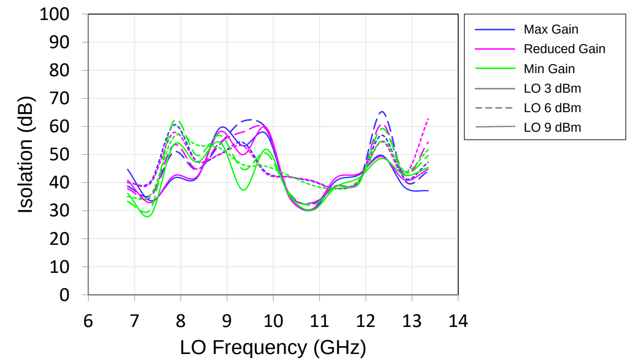
USB LO-to-RF Isolation vs. LO Freq vs. LO Power and State



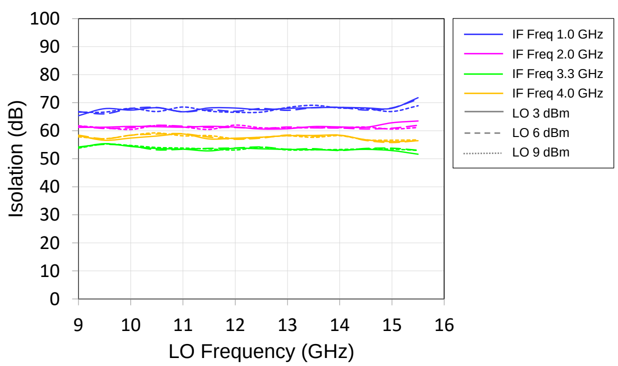
LSB LO-to-IF Isolation vs. LO Freq vs. LO Power and State



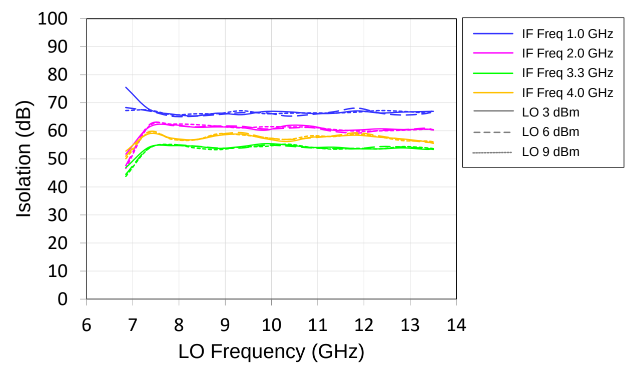
USB LO-to-IF Isolation vs. LO Freq vs. LO Power and State



LSB IF-to-RF Isolation vs. LO Freq vs. IF and LO Power
State: Max Gain



USB IF-to-RF Isolation vs. LO Freq vs. IF and LO Power
State: Max Gain



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Performance Plots

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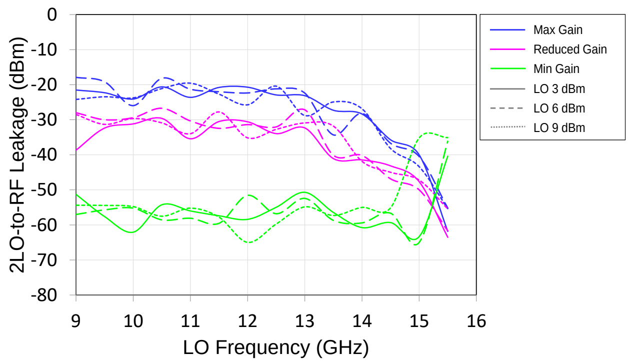
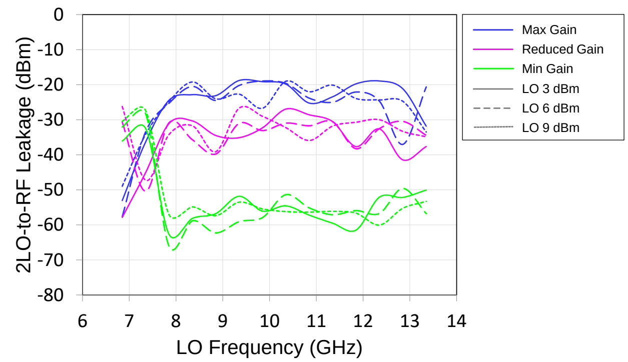
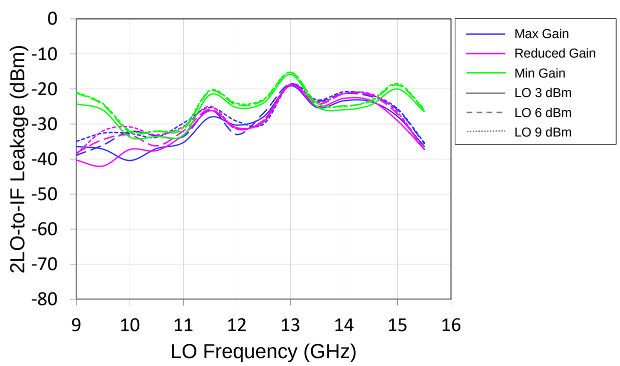
LSB 2LO-to-RF Leakage vs. LO Freq vs. LO Power and State



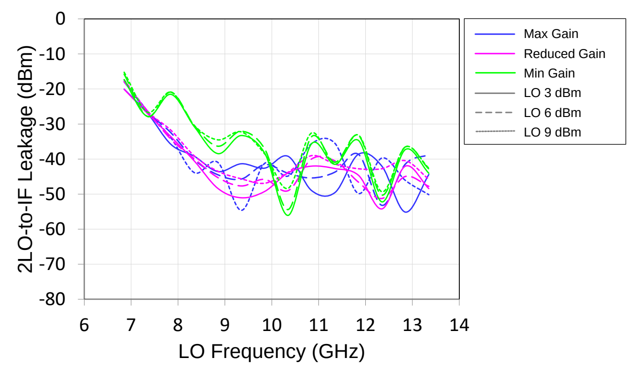
USB 2LO-to-RF Leakage vs. LO Freq vs. LO Power and State



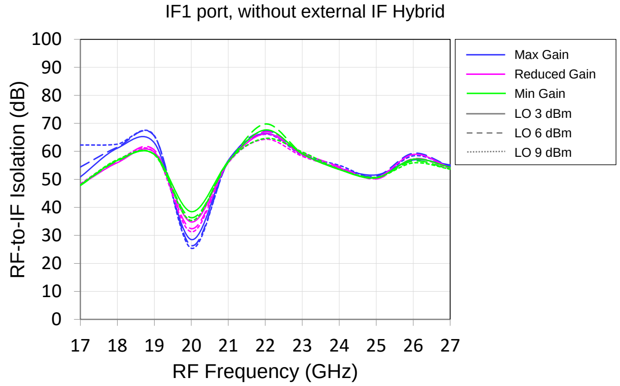
LSB 2LO-to-IF Leakage vs. LO Freq vs. LO Power and State



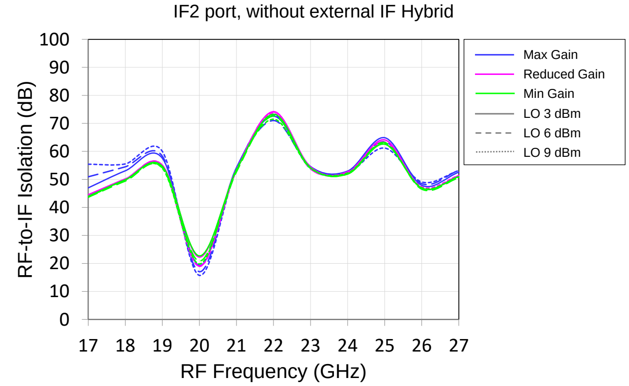
USB 2LO-to-IF Leakage vs. LO Freq vs. LO Power and State



RF-to-IF Isolation vs. RF Freq vs. LO Power and State
IF1 port, without external IF Hybrid



RF-to-IF Isolation vs. RF Freq vs. LO Power and State
IF2 port, without external IF Hybrid



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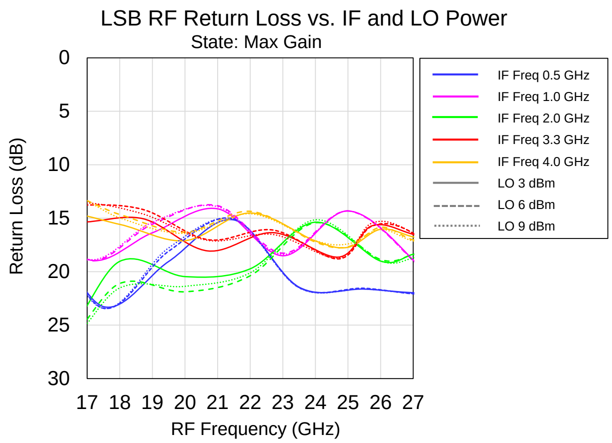
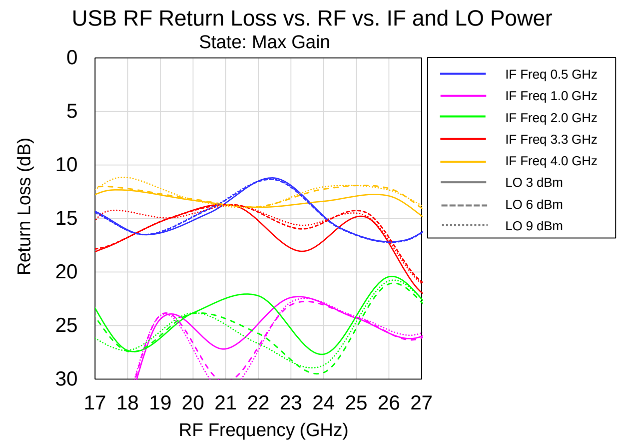
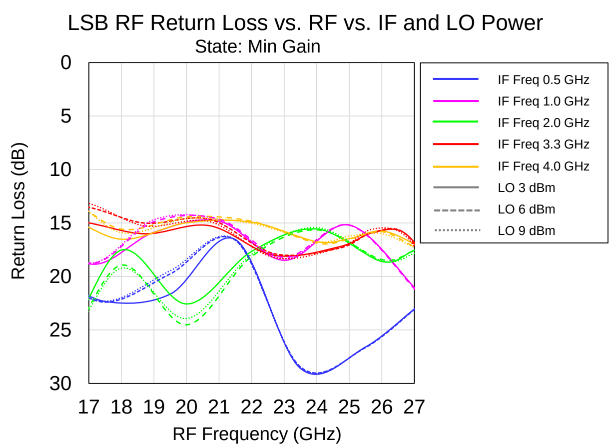
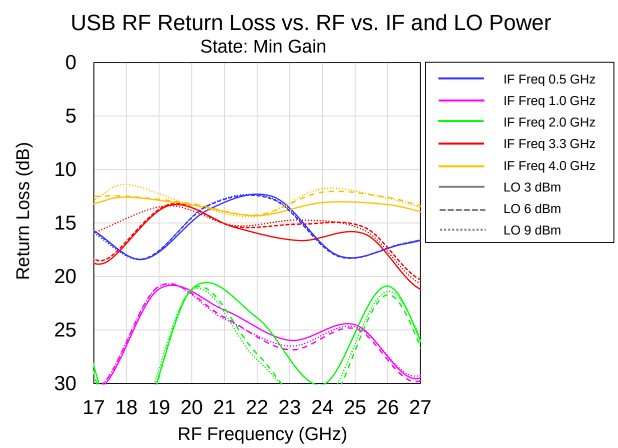
Performance Plots – Return Loss

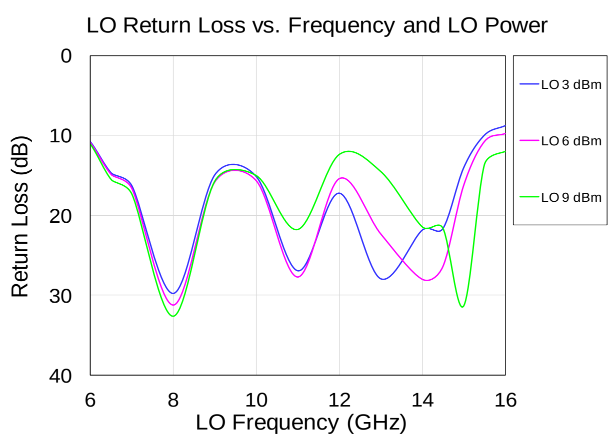
Test conditions unless otherwise noted: VDLO1, VDLO23 = 3.3 V, VGLO = - 0.7 V, IDLO1+IDLO23 = 140 to 200 mA, VDRF = 5.0 V, VGRF = - 0.75 V, IDRF = 340 to 380 mA, VGX = - 1.2 V, 25 °C











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Performance Plots - External LO Nulling

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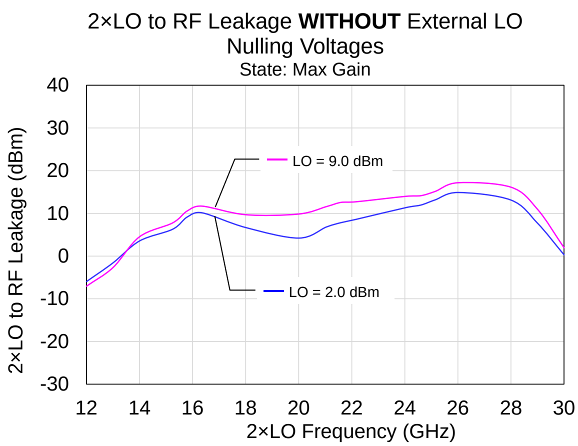

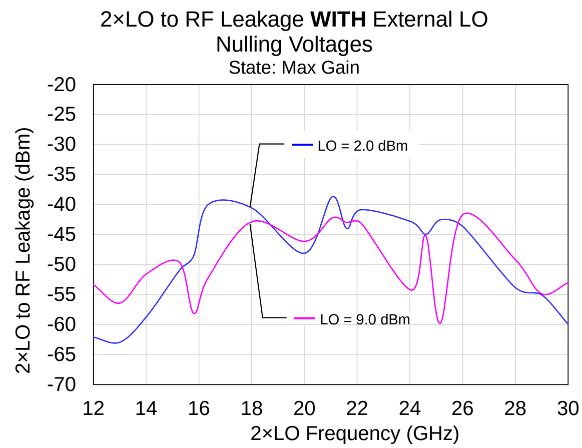

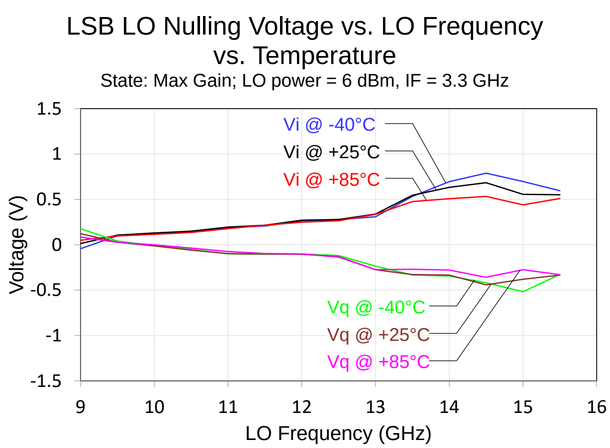

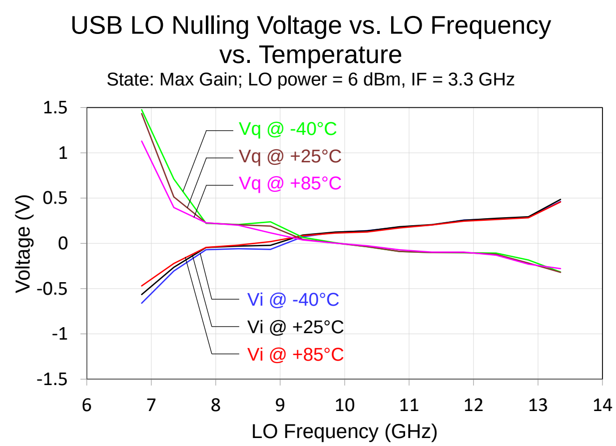

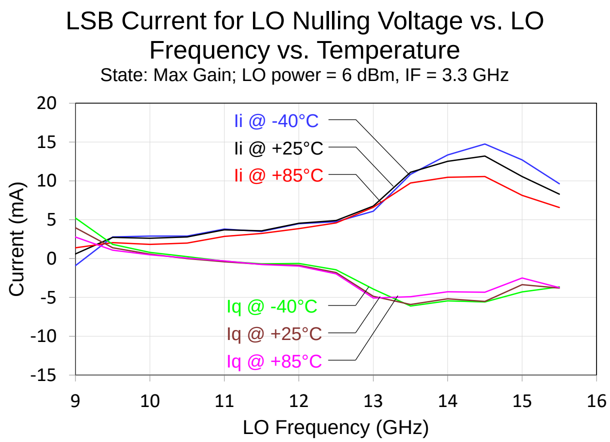

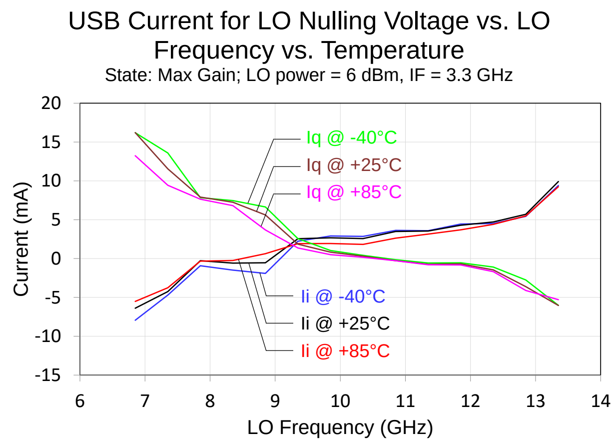

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Performance Plots – Conversion Gain vs. Temperature

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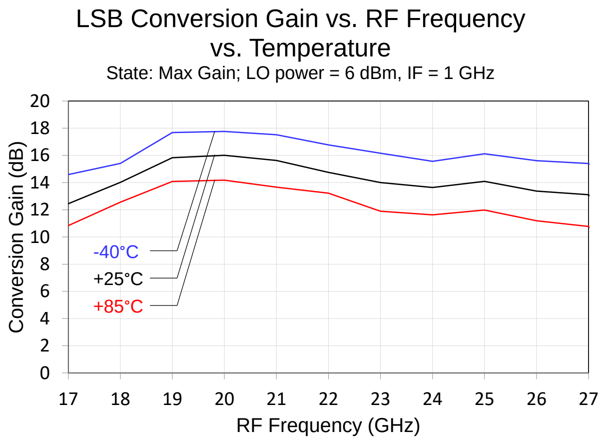

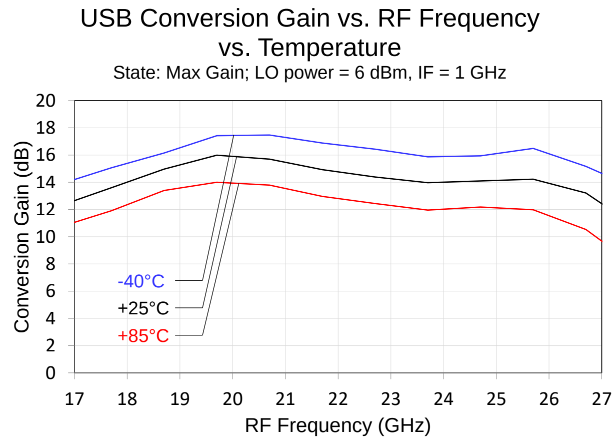

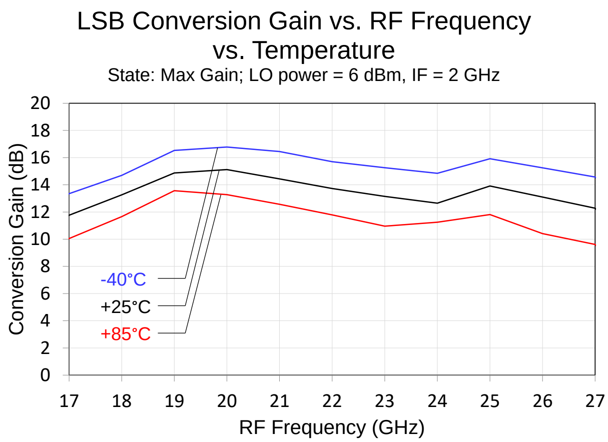

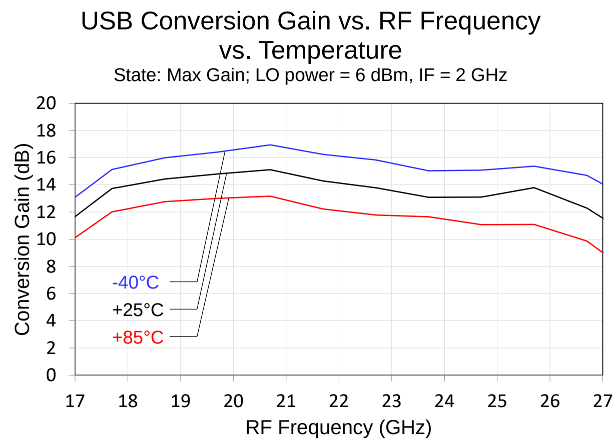

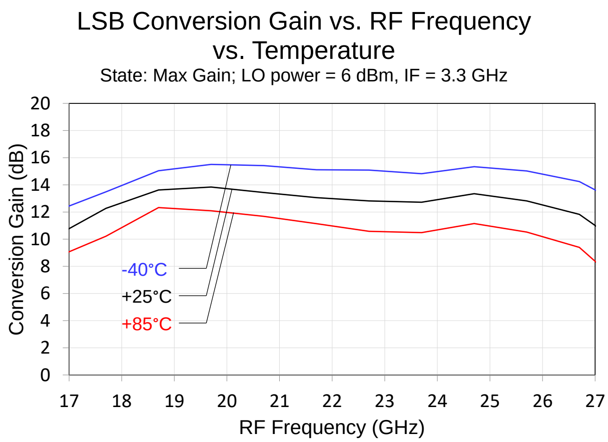

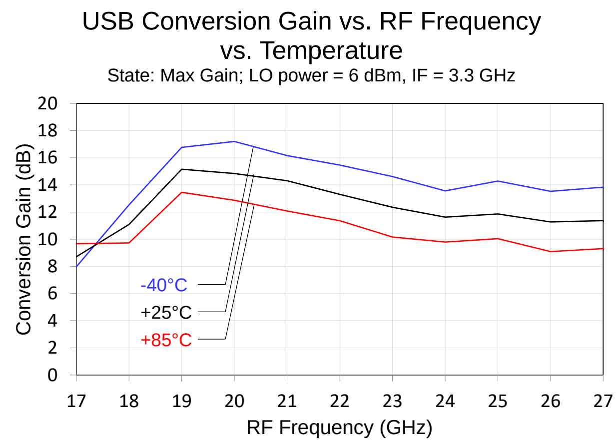

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Performance Plots – Image Rejection vs. Temperature

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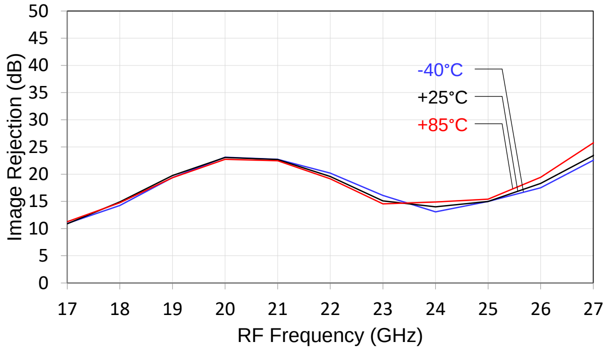
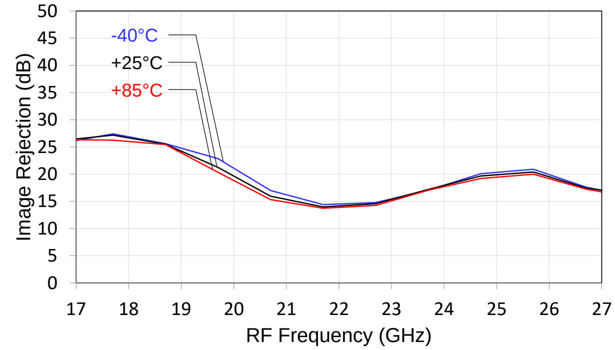
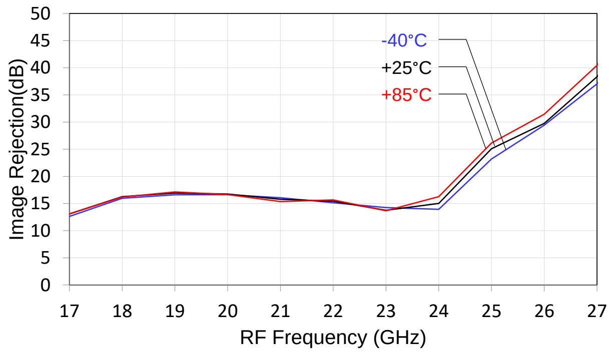
LSB Image Rejection vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 1 GHz



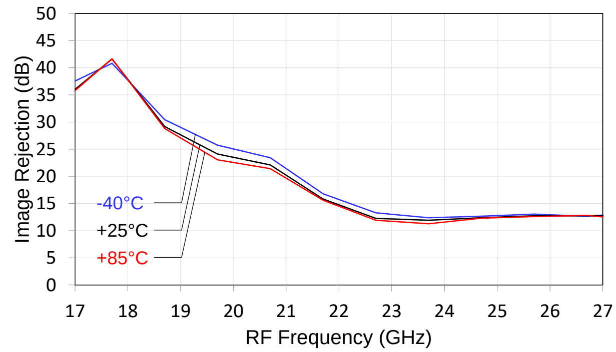
USB Image Rejection vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 1 GHz



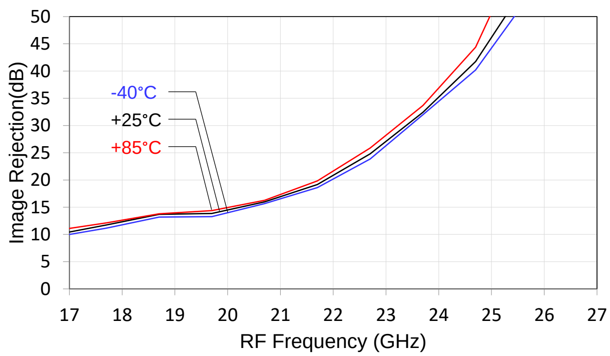
LSB Image Rejection vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 2 GHz



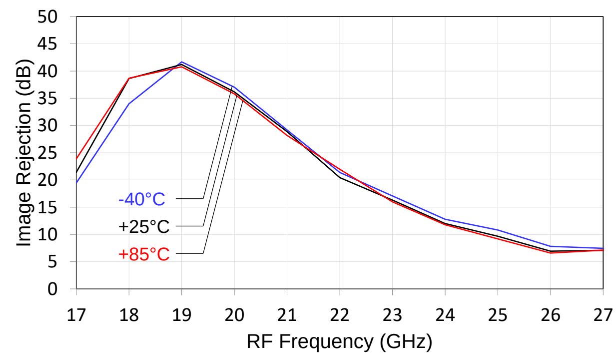
USB Image Rejection vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 2 GHz



LSB Image Rejection vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 3.3 GHz



USB Image Rejection vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 3.3 GHz



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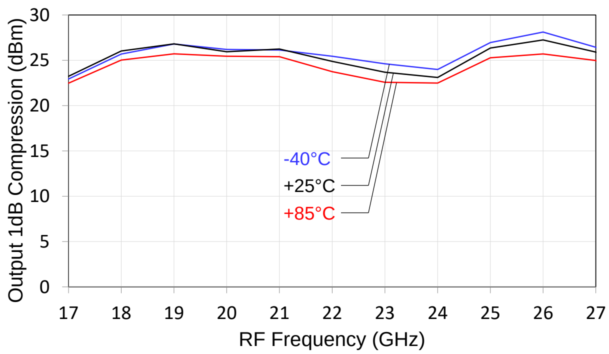
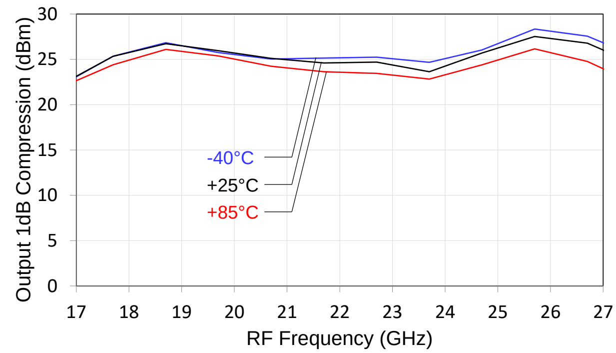
Performance Plots – 1dB Compression vs. Temperature

Test conditions unless otherwise noted: VDLO1, VDLO23 = 3.3 V, VGLO = - 0.7 V, IDLO1+IDLO23 = 140 to 200 mA, VDRF = 5.0 V, VGRF = - 0.75 V, IDRF = 340 to 380 mA, VGX = - 1.2 V, 25 °C. Data taken with external IF hybrid and LO nulling applied.

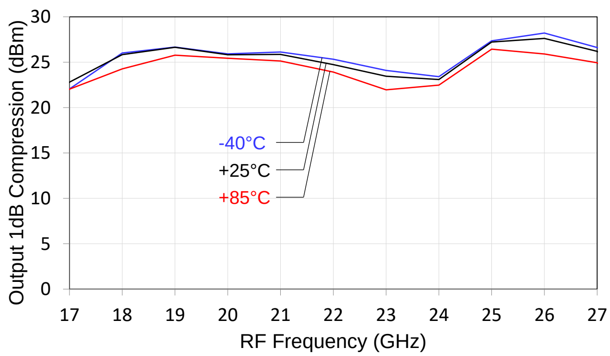
LSB Output P1dB vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 1 GHz



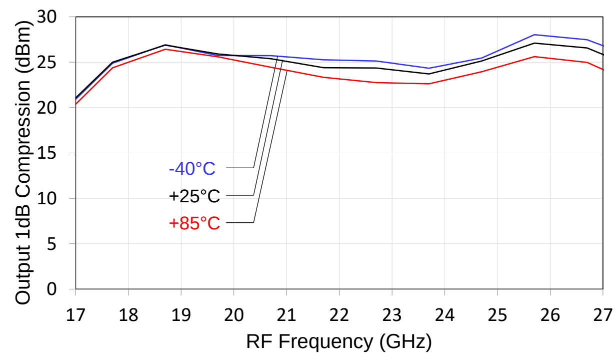
USB Output P1dB vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 1 GHz



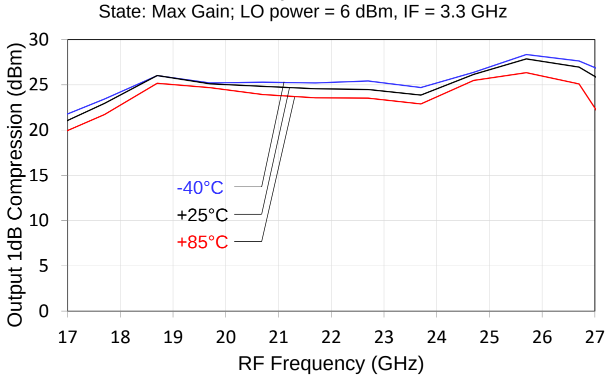
LSB Output P1dB vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 2 GHz



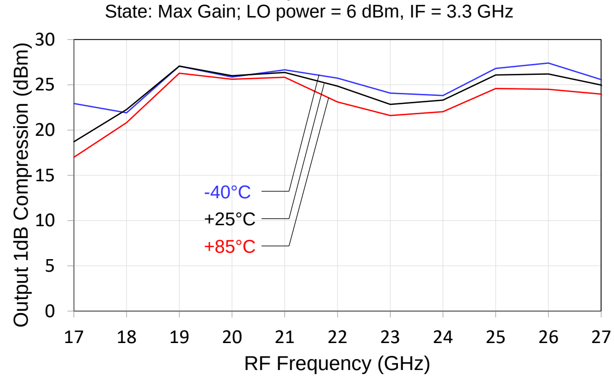
USB Output P1dB vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 2 GHz



LSB Output P1dB vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 3.3 GHz



USB Output P1dB vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 3.3 GHz



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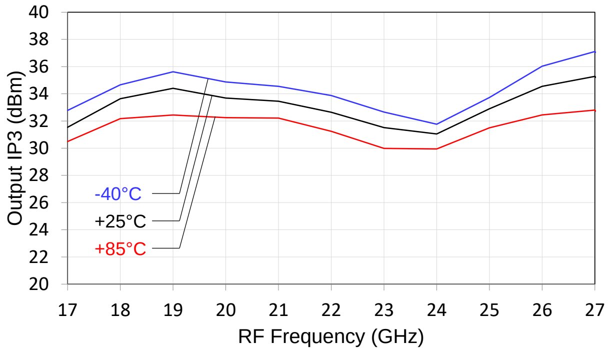
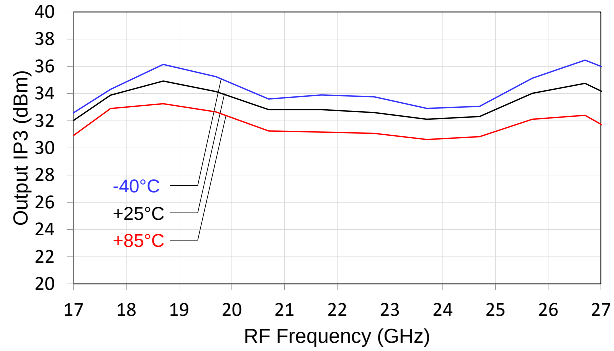
Performance Plots – Output IP3 vs. Temperature

Test conditions unless otherwise noted: VDLO1, VDLO23 = 3.3 V, VGLO = - 0.5 V, IDLO1+IDLO23 = 140 to 200 mA, VDRF = 5.0 V, VGRF = - 0.75 V, IDRF = 340 to 380 mA, VGX = - 1.2 V, 25 °C. Data taken with external IF hybrid and LO nulling applied.

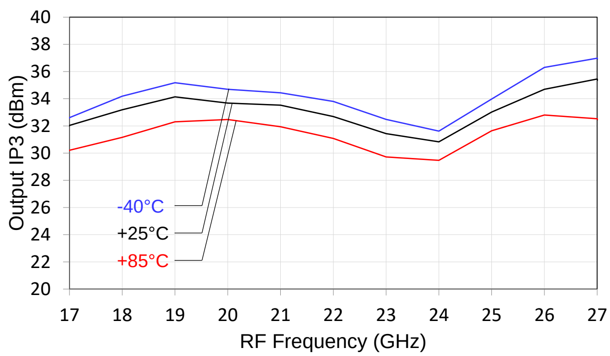
LSB Output IP3 vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 1 GHz



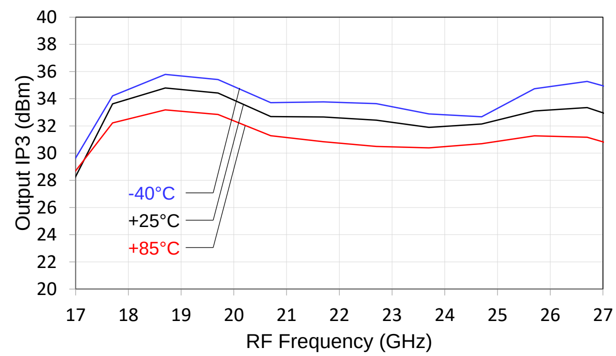
USB Output IP3 vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 1 GHz



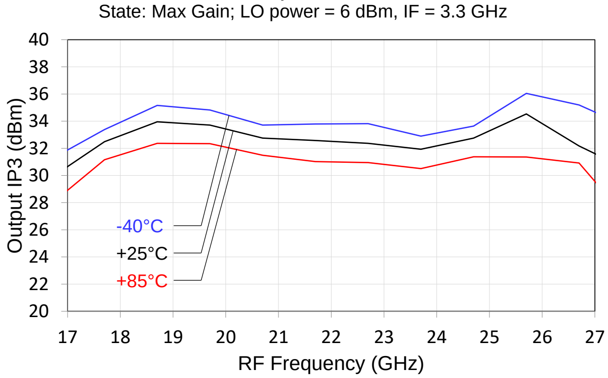
LSB Output IP3 vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 2 GHz



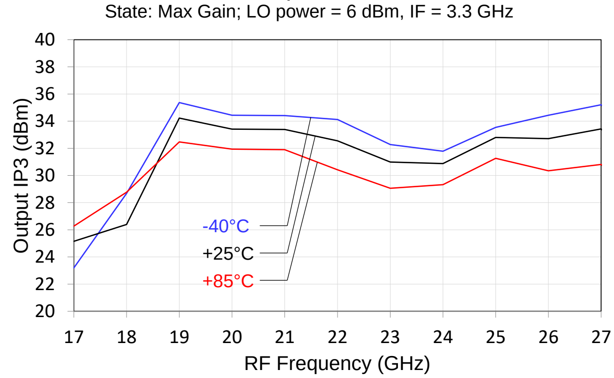
USB Output IP3 vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 2 GHz



LSB Output IP3 vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 3.3 GHz



USB Output IP3 vs. RF Frequency vs. Temperature
State: Max Gain; LO power = 6 dBm, IF = 3.3 GHz



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Mixing Products

Test conditions unless otherwise noted: VDLO1, VDLO23 = 3.3 V, VGLO = - 0.7 V, IDLO1+IDLO23 = 140 to 200 mA, VDRF = 5.0 V, VGRF = - 0.75 V, IDRF = 340 to 380 mA, VGX = - 1.2 V, 25 °C. Data taken with external IF hybrid and LO nulling applied, 25 °C.

M x N Spurious Outputs for LSB

Spur tables are $N \times f_{IF} - M \times f_{LO}$ mixer spurious products. RF frequency is at 2 x LO – IF.
All values are in dBc below the RF output power level. IF input power = -10 dBm, LO Power = 3 to 9 dBm.

N x f_{IF} \ M x f_{LO}	0	1	2	3	4	5
-5	--	86	79	70	60	63
-4	--	85	76	74	63	61
-3	--	84	77	70	59	60
-2	--	82	74	66	64	61
-1	--	81	0	63	58	61
0	--	12	19	4	33	53
1	89	75	12	63	57	60
2	83	75	73	61	61	57
3	82	74	67	60	60	--
4	79	76	69	63	60	--
5	84	77	67	59	58	--

If = 2.0 GHz, LO = 9.0 GHz to 13.0 GHz

N x f_{IF} \ M x f_{LO}	0	1	2	3	4	5
-5	--	84	80	73	64	62
-4	--	86	79	68	61	64
-3	--	87	78	70	64	61
-2	--	83	71	63	61	66
-1	--	49	0	38	63	65
0	--	-3	20	27	37	53
1	75	37	11	61	62	--
2	84	77	64	63	63	--
3	83	75	62	60	58	--
4	79	74	59	60	--	--
5	76	69	62	64	--	--

IF = 3.3 GHz, LO = 10.0 GHz to 15.0 GHz

M x N Spurious Outputs for USB

Spur tables are $N \times f_{IF} - M \times f_{LO}$ mixer spurious products. RF frequency is at 2 x LO + IF.
All values are in dBc below the RF output power level. IF input power = -10 dBm, LO Power = 3 to 9 dBm.

N x f_{IF} \ M x f_{LO}	0	1	2	3	4	5
-5	--	89	77	76	65	62
-4	--	88	76	78	65	62
-3	--	88	79	73	64	64
-2	--	84	68	72	61	62
-1	--	76	14	53	54	65
0	--	26	-13	6	32	55
1	69	59	0	42	61	63
2	88	77	66	61	63	64
3	85	79	74	64	59	66
4	85	79	71	66	65	65
5	85	79	69	62	63	61

If = 2.0 GHz, LO = 8.0 GHz to 12.0 GHz

N x f_{IF} \ M x f_{LO}	0	1	2	3	4	5
-5	--	84	87	77	74	61
-4	--	85	82	77	74	66
-3	--	88	79	79	69	63
-2	--	86	72	74	55	63
-1	--	78	10	43	21	51
0	--	25	-14	1	-24	49
1	59	52	0	35	33	63
2	86	77	60	64	63	62
3	85	78	69	63	61	62
4	80	78	68	61	61	61
5	77	71	62	60	63	60

IF = 3.3 GHz, LO = 11.0 GHz to 15.5 GHz

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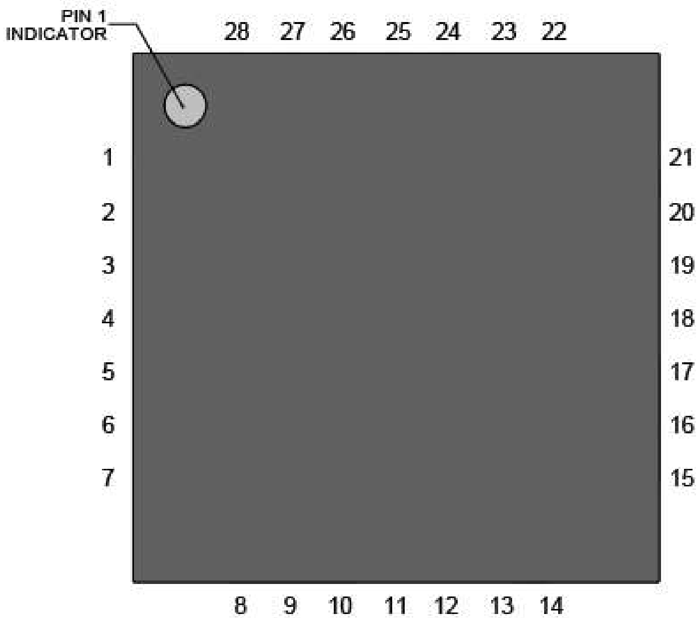
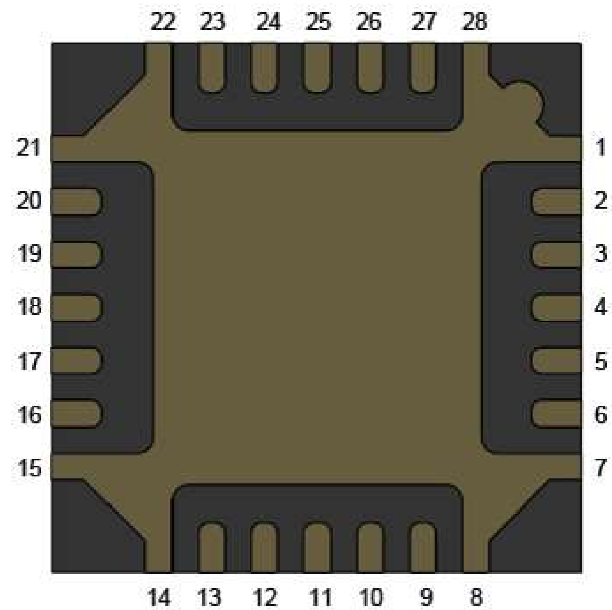
Pin Configuration and Description





Pin No.	Label	Description
1, 7, 8, 9, 13, 14, 15, 21, 22, 27, 28	GND	Internal grounding; must be grounded on PCB.
2	RF OUT	RF Output matched to 50 ohms, AC Coupled.
3, 11, 19, 20, 24	NC	No internal connection; must be grounded on PCB.
4	VCTRL2	Variable gain control for RF amplifier
5	VCTRL1	Variable gain control for RF amplifier
6	VGRF	Gate voltage for RF amplifier
10	IF2	IF input for upconverter
12	IF1	IF input for upconverter
16	LO IN	LO input for upconverter.
17	VDLO1	Drain voltage for the first stage of the LO doubler
18	VGLO	Gate bias for VDLO1 and VDLO23.
23	VDLO23	Drain voltage for stages 2 and 3 of LO doubler
25	VGX	Mixer bias voltage
26	VDRF	Drain voltage for the RF amplifier
29	GND	Backside Paddle

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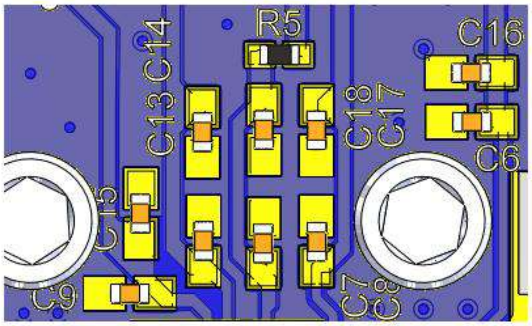
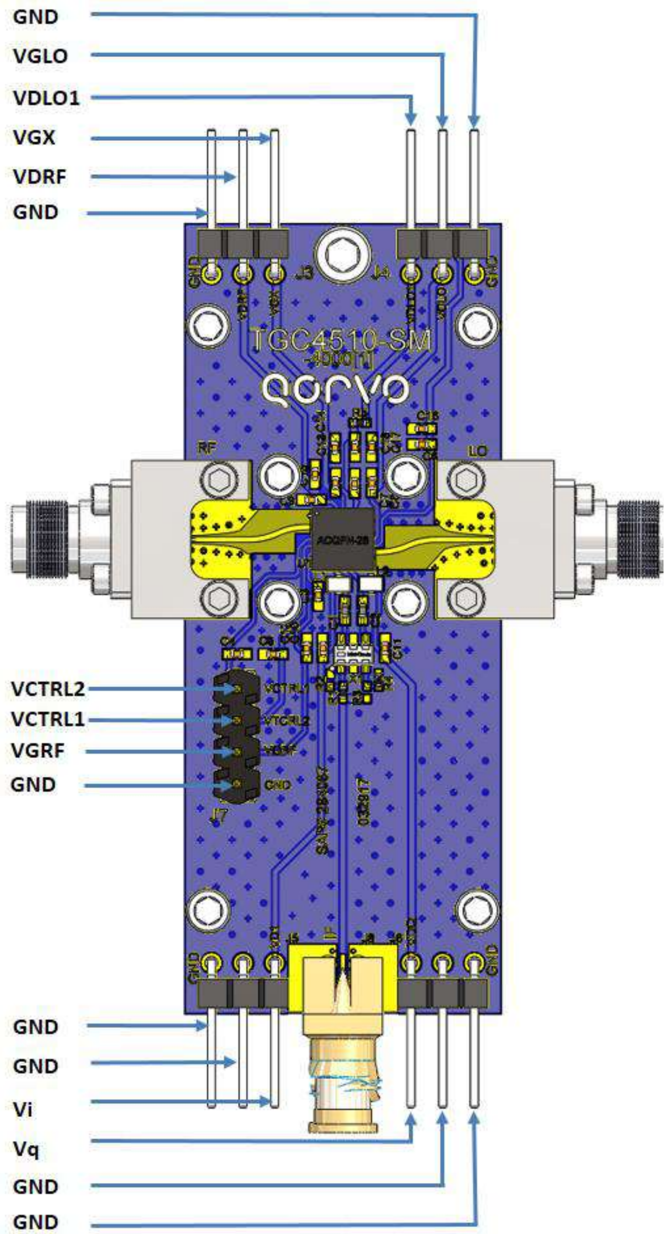
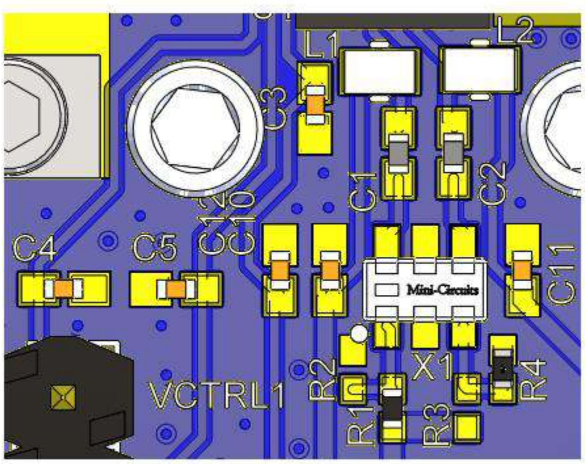
Evaluation Board (EVB) Assembly Layout

Board material is single core layer using 0.008” thick Rogers RO4003, Єr = 3.38. Metal layer is 0.5-oz copper cladding.







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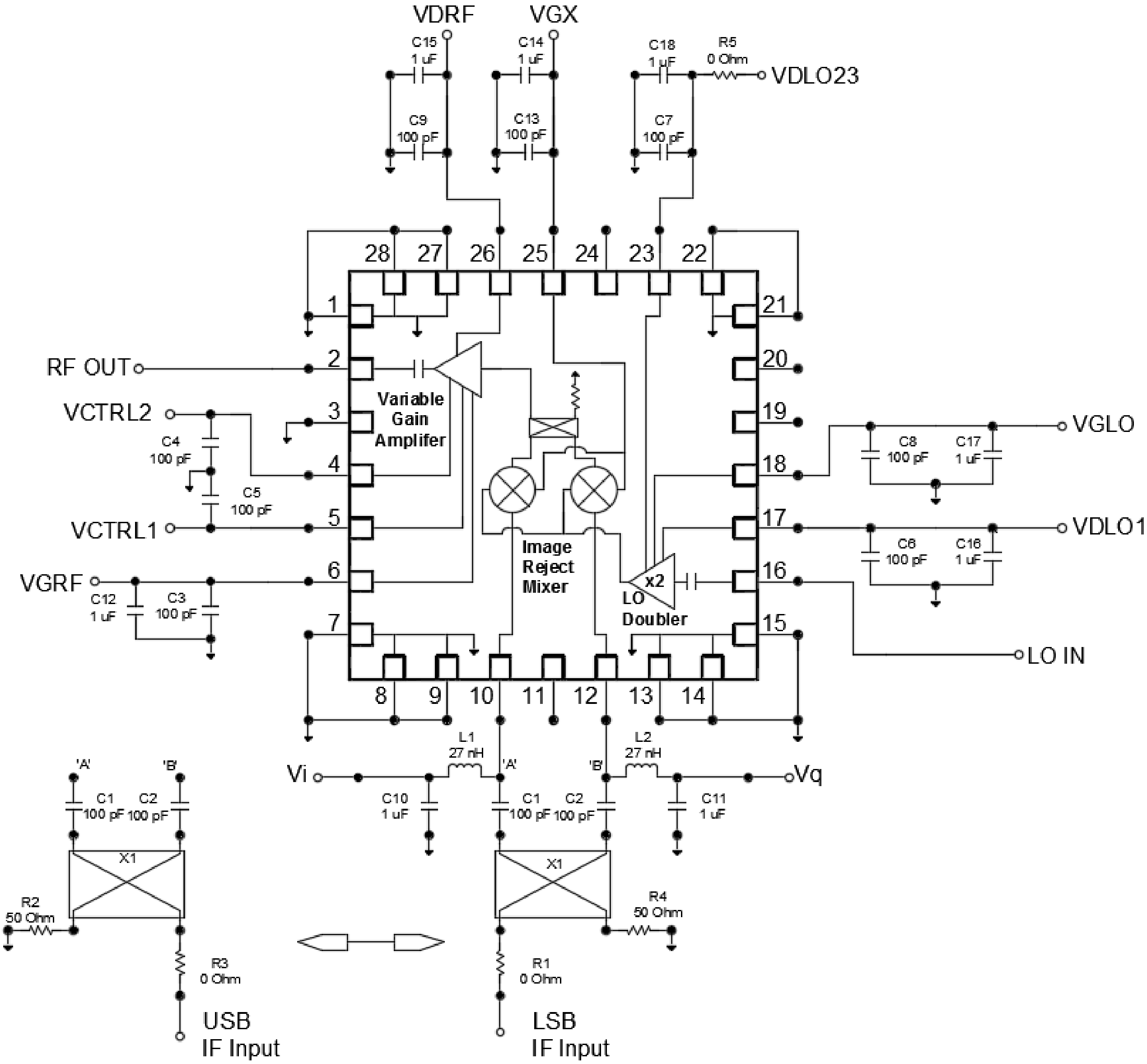
Applications Circuit



Bias-up Procedure	Bias-down Procedure
Set VGX = -1.2 V, VCTRL1 = - 2.0 V, VCTRL2 = 0 V, VGLO = -1.2 V, VGRF = -1.2 V. Set limit for each to 10mA.	Turn off IF and LO signals.
Set VDRF = 5.0 V, limit 390 mA, VDLO1 and VDLO23 = 3.3 V. Set VDLO1 limit to 150 mA and VDLO23 limit to 200 mA or VDLO1+VDLO23 = 350 mA	Set VDLO1, VDLO23 to 0 V.
Adjust VGLO to get IDLO1+IDLO23 to 180 mA.	Set VDRF to 0 V.
Adjust VGRF to get RF amplifier current (VDRF) of 360 mA.	Set Vi, Vq to 0 V if used LO nulling.
Apply LO and IF signals.	Set VGLO, VGRF, VGX to 0 V.
If using external control for LO nulling, adjust Vi and Vq for optimum LO suppression, adjust VCTRl1 and VCTRL2 to get required conversion gain.	Set VCTRL1, VCTRL2 to 0 V.

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Application Circuit Components

Bill of Material

Ref Des	Value	Description	Manufacturer	Part Number
C1 – C9, C13	100 pF	Cap, 0603, 25 V, +/- 5%, NPO	various	
C10 – C12, C14 – C18	1 µF	Cap, 0603, 25 V, 10%, X7R	various	
L1 – L2	27 nH	Ind, 0603, 2%, 0.6A, SMD	various	
R5	0 Ω	Res, 0402, 1/10 W, 5%, SMD	various	
Q1		Ku-Band Up-Converter	QORVO	TGC4510-SM

LSB Configuration

Ref Des	Value	Description	Manufacturer	Part Number
X1 (For Low IF)		IF Quad Coupler, 1.35 to 2.45 GHz	Mini-Circuits	QCN-25+
X1 (For High IF)		IF Quad Coupler, 2.5 to 4.0 GHz	Mini-Circuits	QCN-45+
R1	0 Ω	Res, 0402, 1/10 W, 5%, SMD	various	
R4	50 Ω	Res, 0402, 1/8 W, 1%, SMD	various	
R2, R3		DNP		

USB Configuration

Ref Des	Value	Description	Manufacturer	Part Number
X1 (For Low IF)		IF Quad Coupler, 1.35 to 2.45 GHz	Mini-Circuits	QCN-25+
X1 (For High IF)		IF Quad Coupler, 2.5 to 4.0 GHz	Mini-Circuits	QCN-45+
R3	0 Ω	Res, 0402, 1/10 W, 5%, SMD	various	
R2	50 Ω	Res, 0402, 1/8 W, 1%, SMD	various	
R1, R4		DNP		

Note: Due to bandwidth limitations of IF quad coupler, two versions of coupler were used on EVBs, users need to choose low or high band of IF to be used, in addition to LSB and USB selection. Refer to ordering information section for details.

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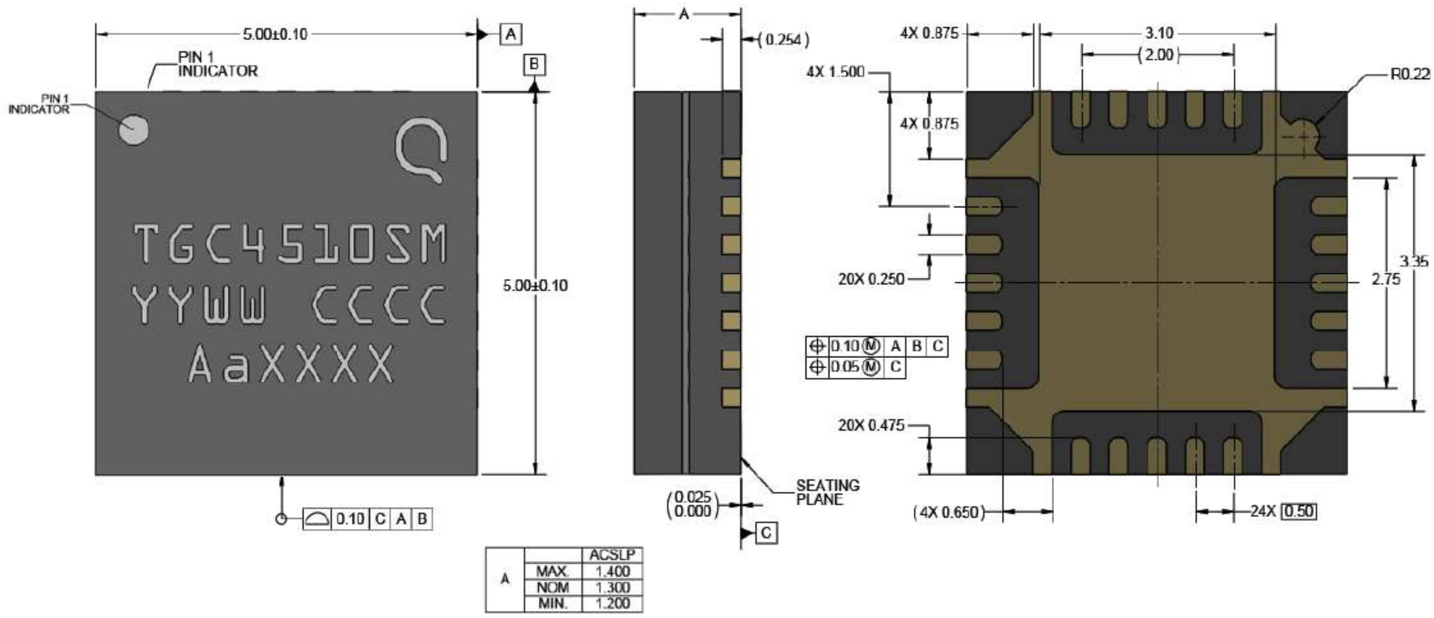
Package Marking and Dimensions



All dimensions are in millimeters. Top marking: “YY” represents the last two digits of the year the part was manufactured, the “WW” is the work week, CCCC is country code and the “XXXX” is batch ID.

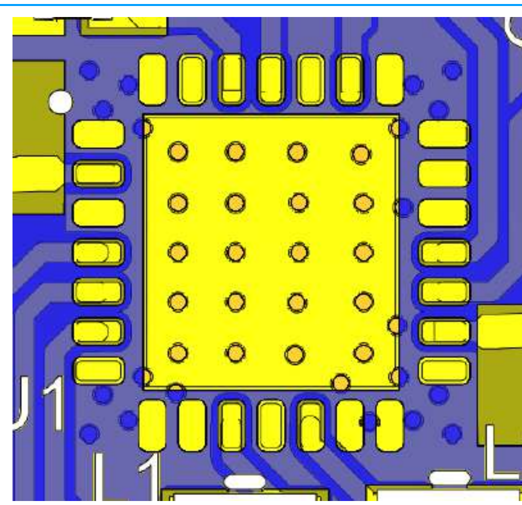
This package is lead-free/RoHS-compliant with a copper alloy base (CDA194), and the plating material on the leads is NiPdAu. It is compatible with a lead-free (maximum 260 °C reflow temperature) soldering process.

PCB Mounting Pattern

Notes:

1. The pad pattern shown has been developed and tested for optimized assembly at Qorvo. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.

2. Ground / thermal vias are critical for the proper performance of this device. Vias should use a .35mm diameter drill and have a final plated thru diameter of .25 mm.



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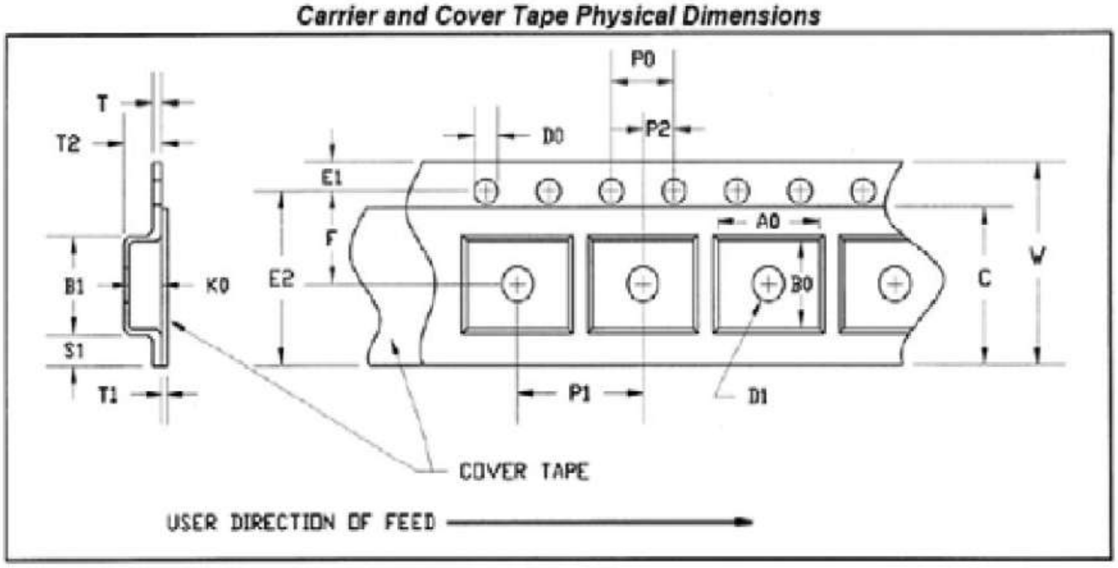
Tape and Reel Information

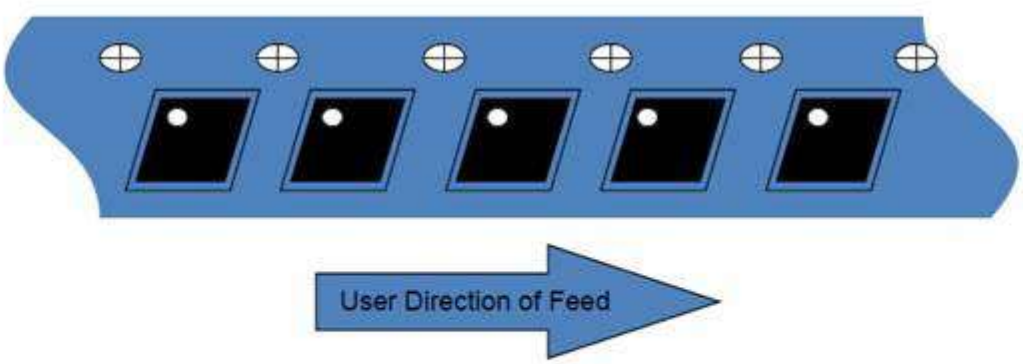
Standard T/R size = 500 pieces on a 7” reel. Tape and reel specifications for this part are also available on the QORVO website in the “Application Notes” section.

Carrier and Cover Tape Dimensions:

Part	Feature	Symbol	Size (in)	Size (mm)
Cavity	Length	A0	0.209	5.3
	Width	B0	0.209	5.3
	Depth	K0	0.064	1.65
	Pitch	P1	0.315	8.00
Cover Tape	Width	C	0.362	9.2
Carrier Tape	Width	W	0.472	12.00

Carrier and Cover Tape Physical Dimensions





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Assembly Notes

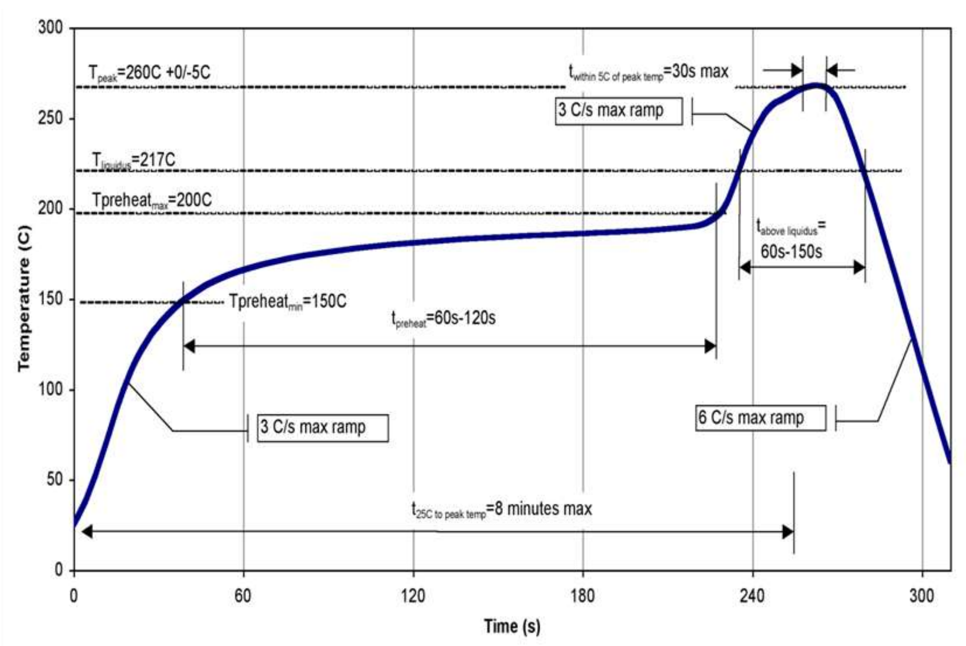
Compatible with lead-free soldering processes with 260°C peak reflow temperature.

This package is air-cavity and non-hermetic, and therefore cannot be subjected to aqueous washing. The use of no-clean solder to avoid washing after soldering is highly recommended.

Contact plating: Ni-Pd-Au.

Solder rework not recommended.

Recommended Soldering Temperature Profile



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Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1A	ESDA / JEDEC JS-001-2012
MSL – Moisture Sensitivity Level	Level 1	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

RoHS Compliance

This product is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances 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 ($C_{15}H_{12}Br_{4}0_{2}$) Free
- PFOS Free
- SVHC Free

Contact Information

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

Tel: 1-844-890-8163

Web: www.qorvo.com

Email: customer.support@qorvo.com

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CMD177

6-14 GHz Fundamental Mixer

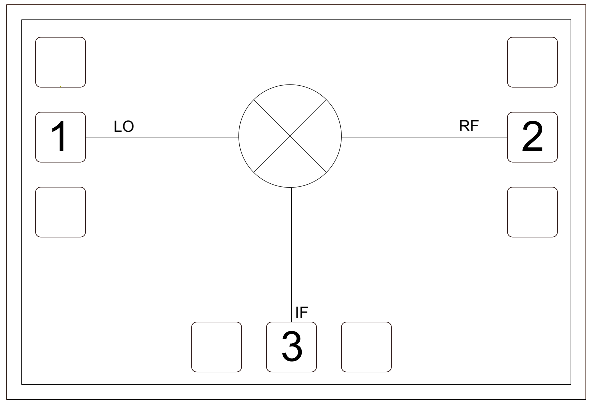
Features

- ► Low conversion loss
- ► High isolation
- ► Wide IF bandwidth
- ► Passive double balanced topology
- ► Small die size

Description

The CMD177 is a general purpose double balanced mixer die that can be used for up- and downconverting applications between 6 and 14 GHz. The CMD177 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +9 dBm. The CMD177 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Functional Block Diagram



Electrical Performance – IF = 100 MHz, LO = +13 dBm , T_A = 25 °C, F = 10 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		6 – 14		GHz
Frequency Range, IF	DC		5	GHz
Conversion Loss		6.5		dB
LO to RF Isolation		43		dB
LO to IF Isolation		37		dB
RF to IF Isolation		22		dB
Input P1dB		9.5		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

Custom MMIC
300 Apollo Drive Chelmsford, MA 01824 Phone (978) 467-4290 Fax (978) 467-4294

ES France - Département RF & Hyperfréquences - 127 rue de Buzenval BP 26 - 92380 Garches
Tél. 01 47 95 99 60 - Fax. 01 47 01 16 22 - e-mail: hyper@es-france.com - Site Web: www.es-france.com

Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal resistance, Θ_{JC}	331.4 ºC / W

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications – IF = 100 MHz, LO = +13 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		8 – 12			6 – 14		GHz
Frequency Range, IF	DC		5	DC		5	GHz
Conversion Loss		6.5	8		7	10	dB
Noise Figure (SSB)		6.5	8		7	10	dB
LO to RF Isolation	37	43		34	43		dB
LO to IF Isolation	28	37		28	37		dB
RF to IF Isolation	15	22		12	22		dB
Input P1dB		9.5			9.5		dBm
Input IP3		16			16		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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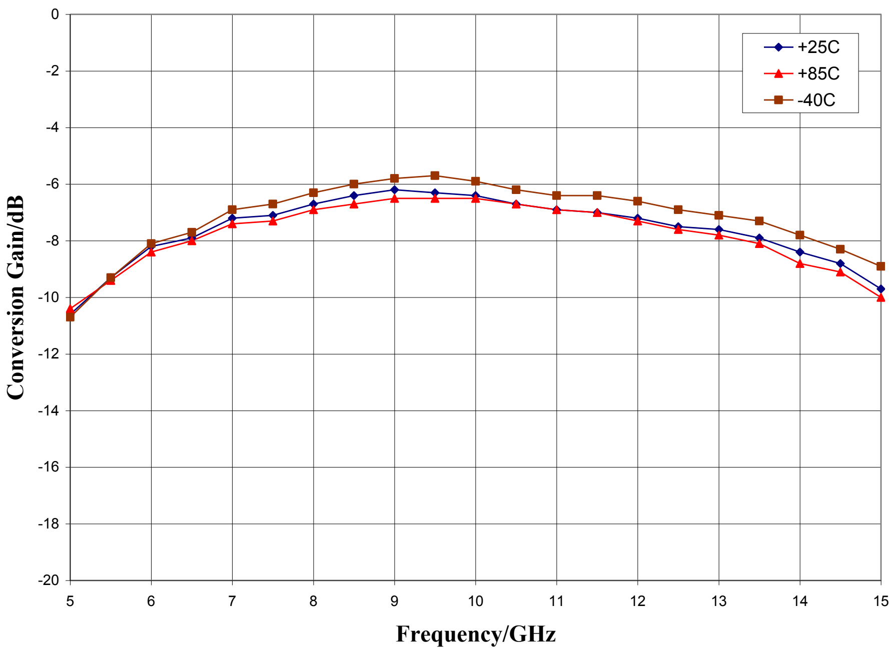
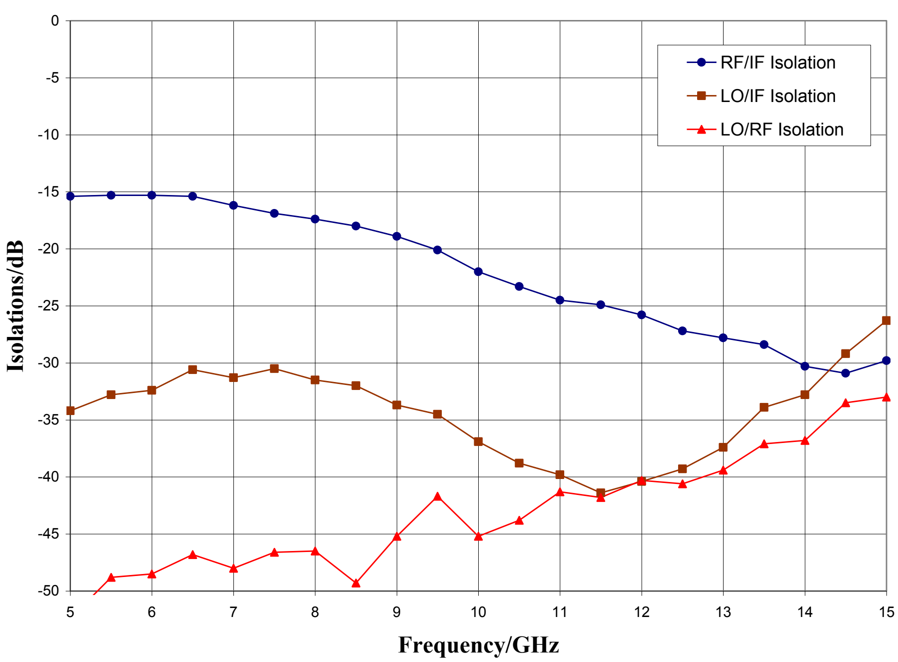
Typical Performance

Conversion Gain vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



Isolation, LO = +13 dBm



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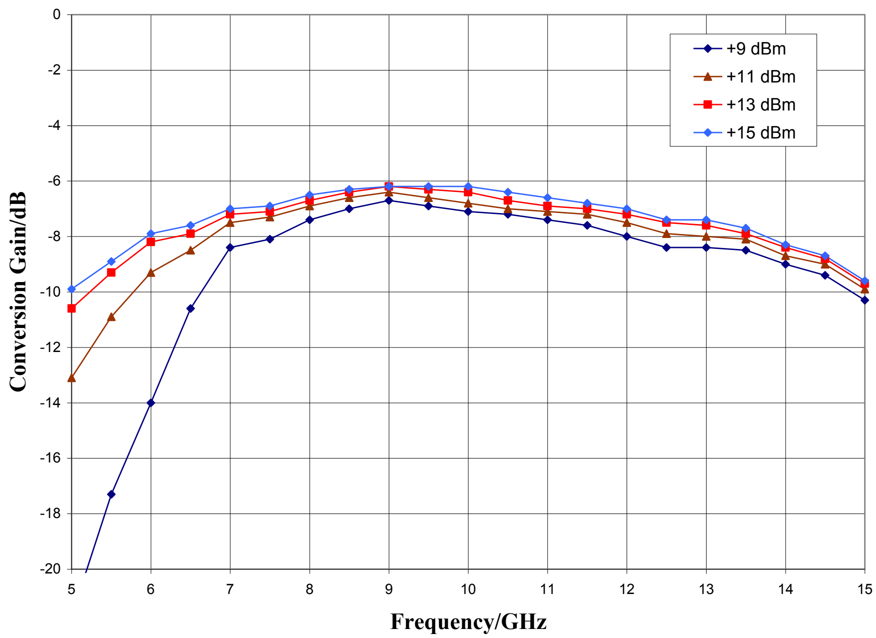
Custom MMIC

CMD177

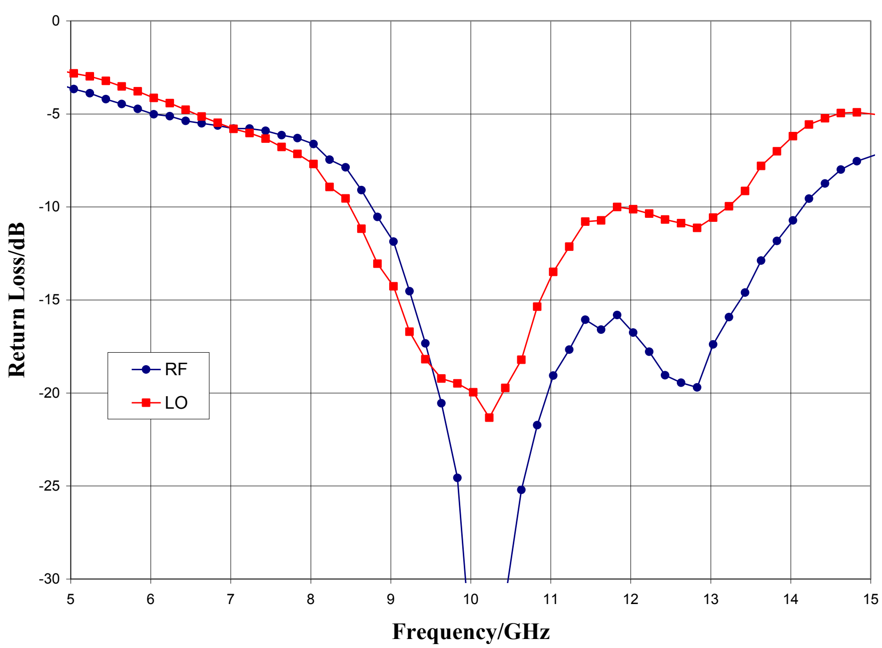
6-14 GHz Fundamental Mixer

Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 13 dBm



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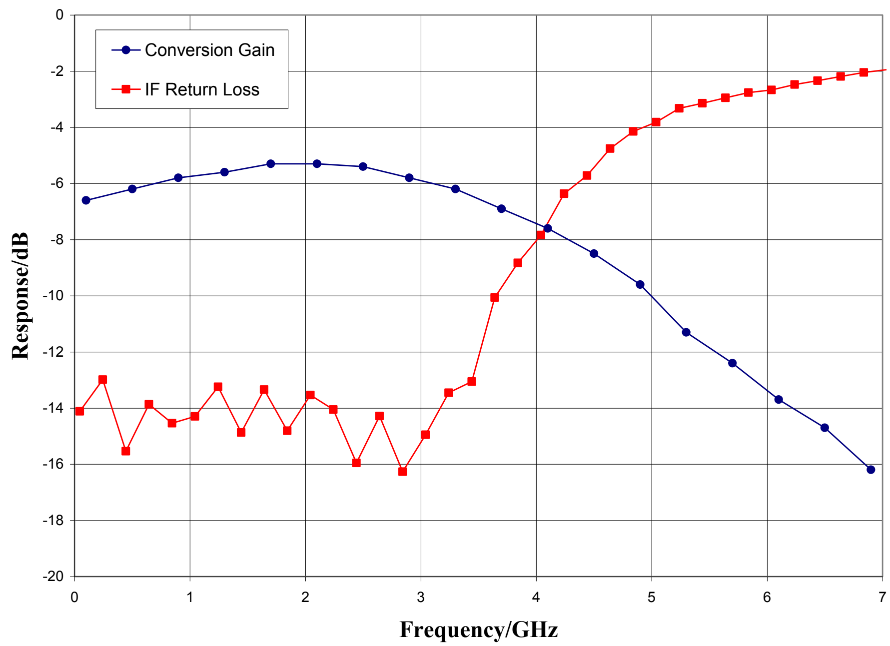
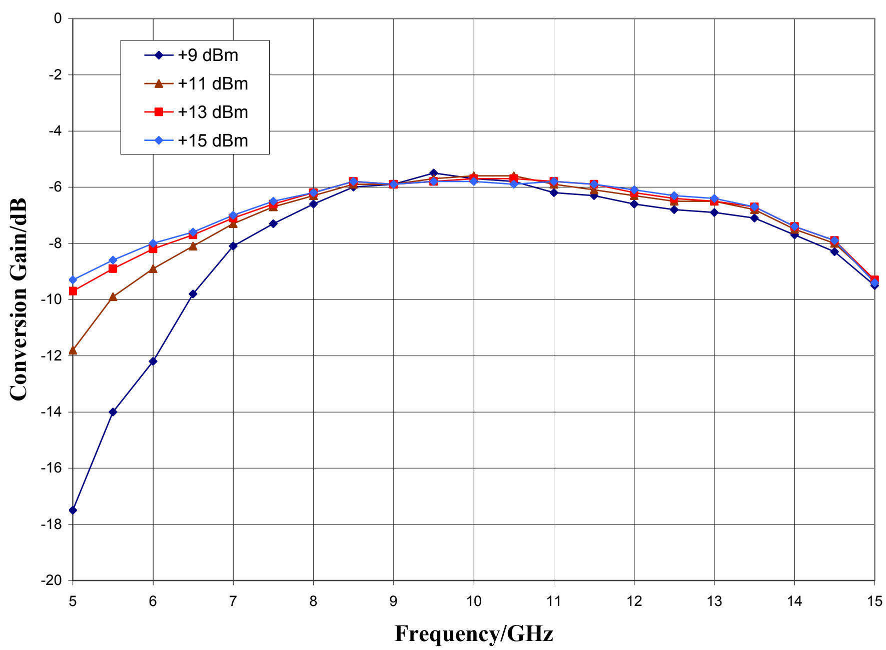
Typical Performance

IF Bandwidth, LO = +13 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 100 MHz



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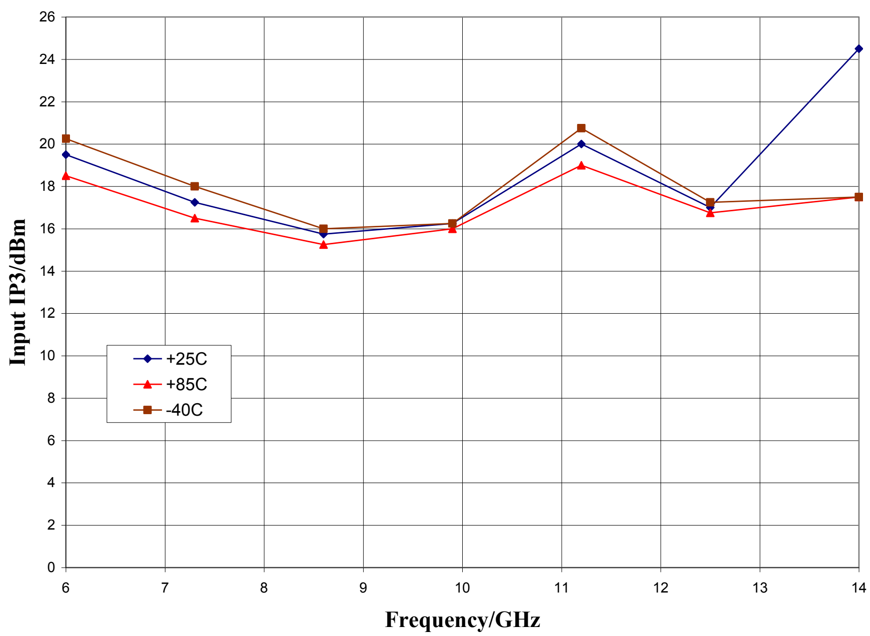
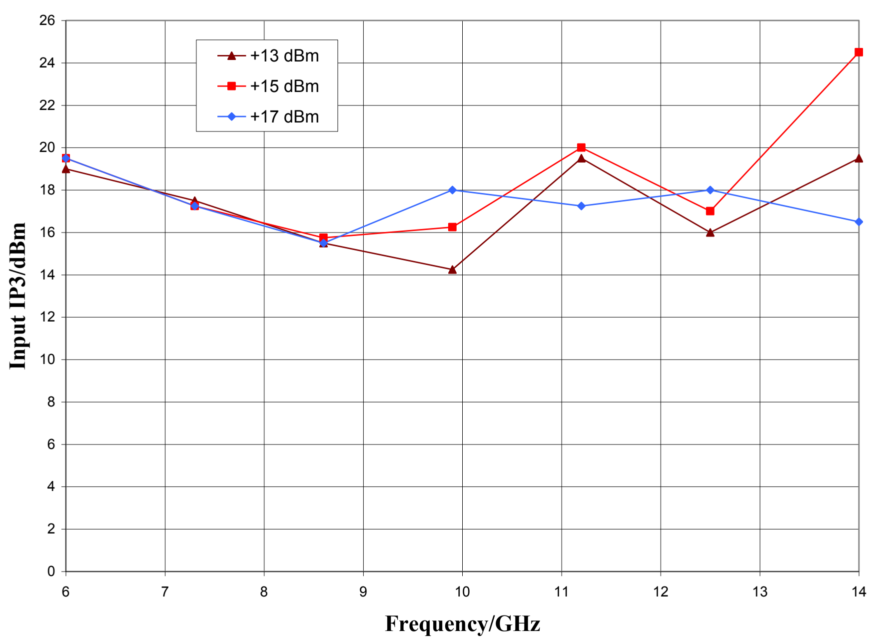
Typical Performance

Input IP3 vs. Temperature, LO = +15 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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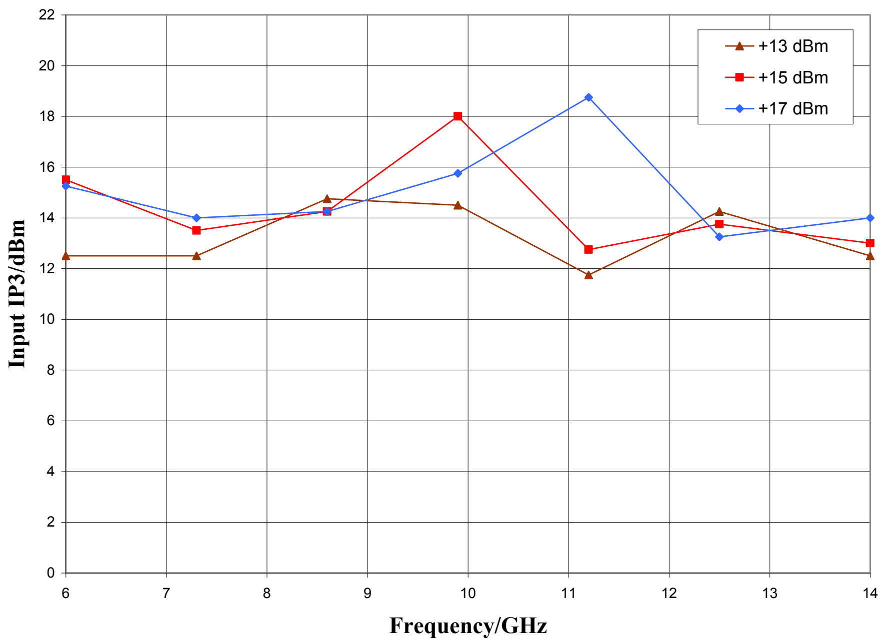
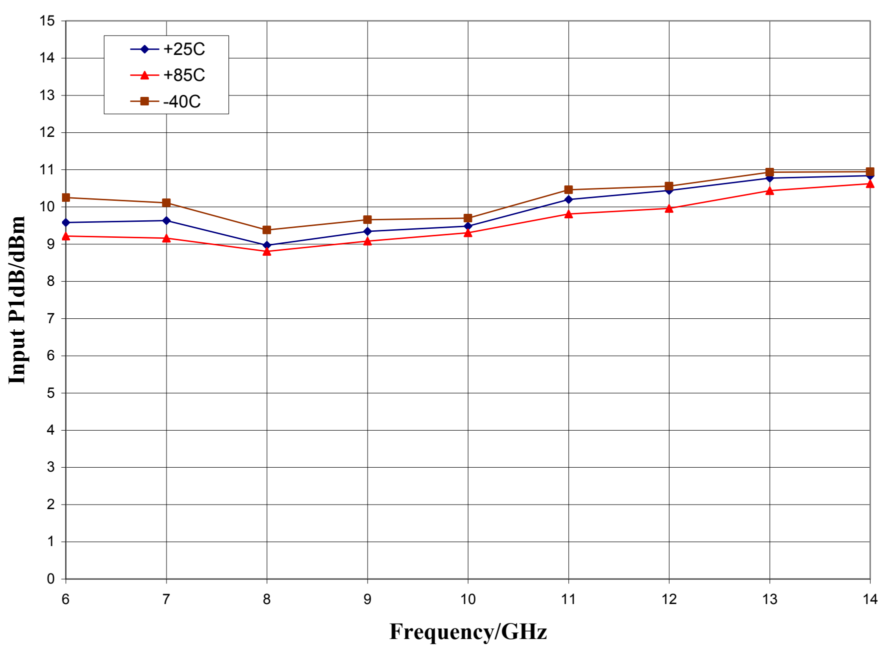
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



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Typical Performance

MxN Spurious Outputs

	nLO				
mRF	0	1	2	3	4
0	xx	6.5	33.5	30.5	29.5
1	17.5	0	37.5	38.5	57.5
2	>75	69.5	66.5	66.5	> 75
3	> 75	> 75	> 75	62.5	> 75
4	> 75	> 75	> 75	> 75	> 75

RF = 10.1 GHz @ -10 dBm
LO = 10.0 GHz @ +13 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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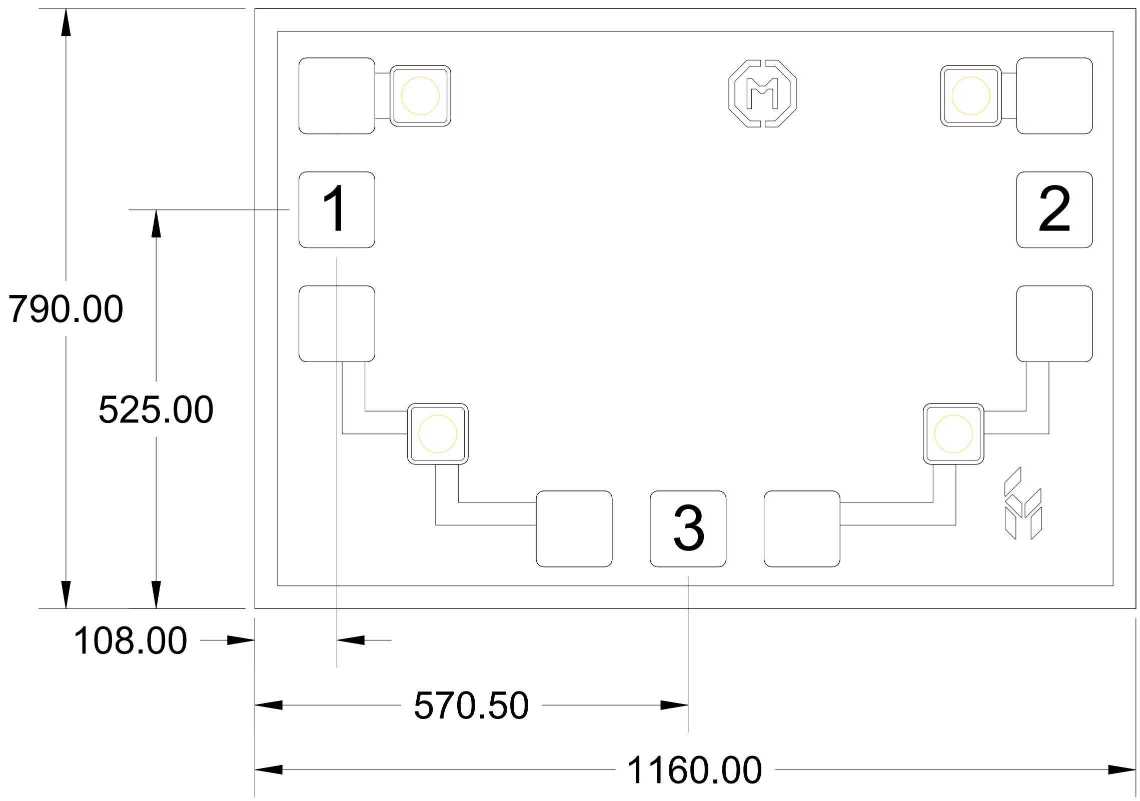
Mechanical Information

Die Outline (all dimensions in microns)



Notes:

1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 100 microns thick
5. All bond pads are 100 x 100 microns square

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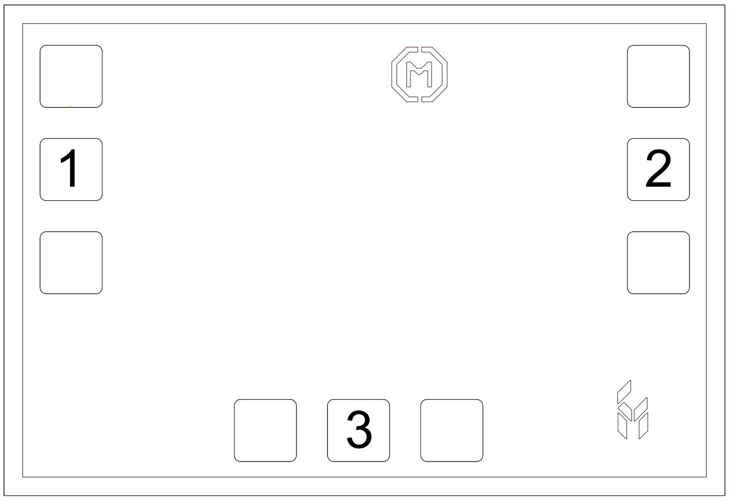
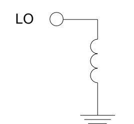
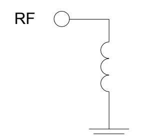
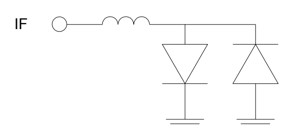
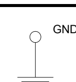
Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	LO	This pin is DC coupled and matched to 50 ohms.	
2	RF	This pin is DC coupled and matched to 50 ohms.	
3	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
Backside	Ground	Connect to RF / DC ground.	

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Applications Information

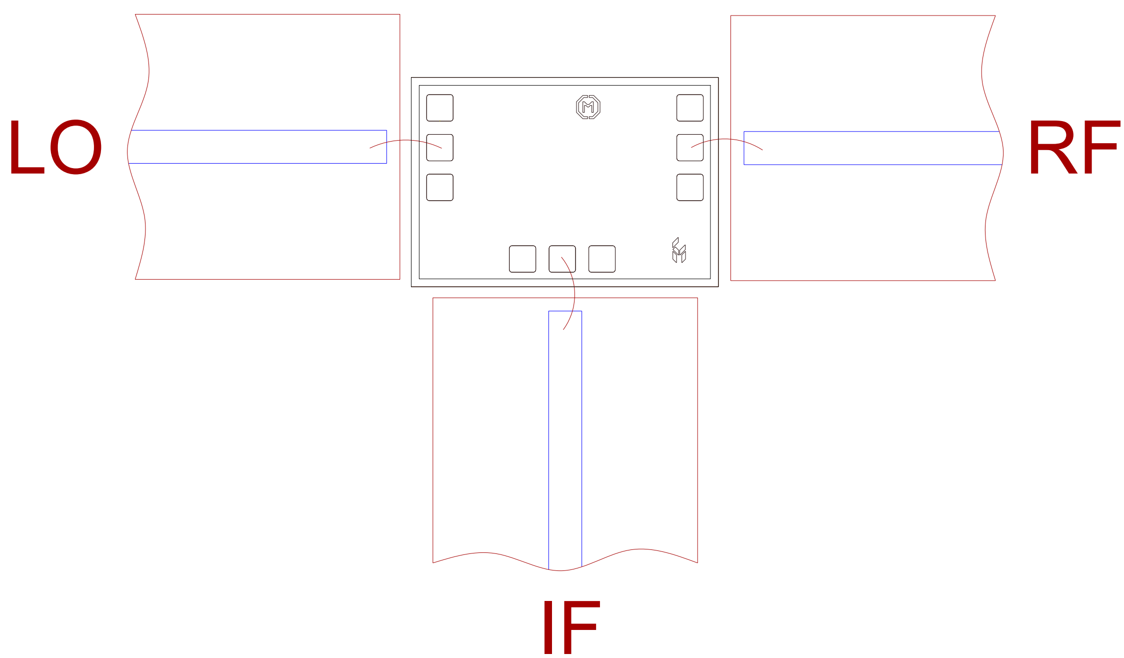
Assembly Guidelines

The backside of the CMD177 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD177C3

6-14 GHz Fundamental Mixer

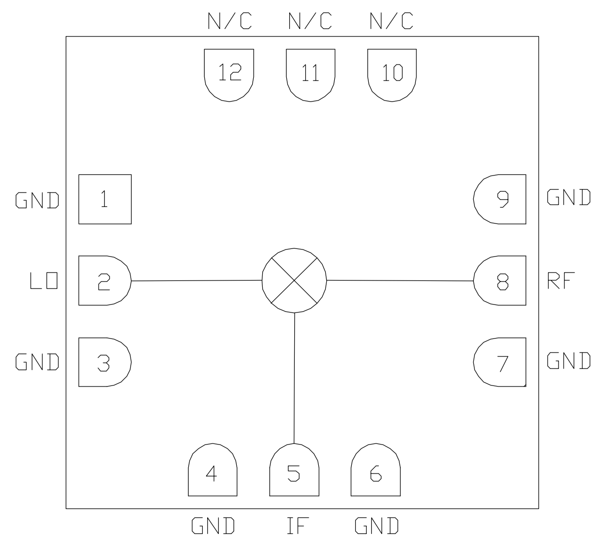
Features

- ► Low conversion loss
- ► High isolation
- ► Wide IF bandwidth
- ► Passive double balanced topology
- ► Pb-free RoHs compliant 3x3 mm SMT package

Description

The CMD177C3 is a general purpose double balanced mixer in a leadless surface mount package that can be used for up- and downconverting applications between 6 and 14 GHz. The CMD177C3 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +9 dBm. The CMD177C3 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Functional Block Diagram



Electrical Performance - IF = 100 MHz, LO = +13 dBm , T_A = 25 °C, F = 10 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		6 - 14		GHz
Frequency Range, IF	DC		5	GHz
Conversion Loss		6.5		dB
LO to RF Isolation		43		dB
LO to IF Isolation		37		dB
RF to IF Isolation		22		dB
Input P1dB		9.5		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications - IF = 100 MHz, LO = +13 dBm, T_A = 25 ^oC

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		8 - 12			6 - 14		GHz
Frequency Range, IF	DC		5	DC		5	GHz
Conversion Loss		6.5	8		7	10	dB
Noise Figure (SSB)		6.5	8		7	10	dB
LO to RF Isolation	37	43		34	43		dB
LO to IF Isolation	28	37		28	37		dB
RF to IF Isolation	15	22		12	22		dB
Input P1dB		9.5			9.5		dBm
Input IP3		16			16		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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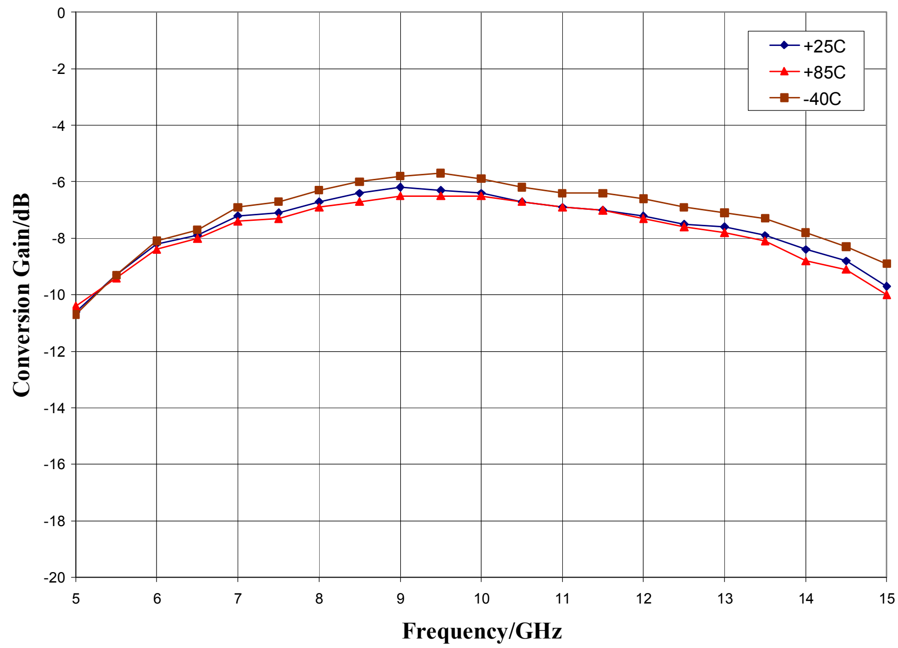
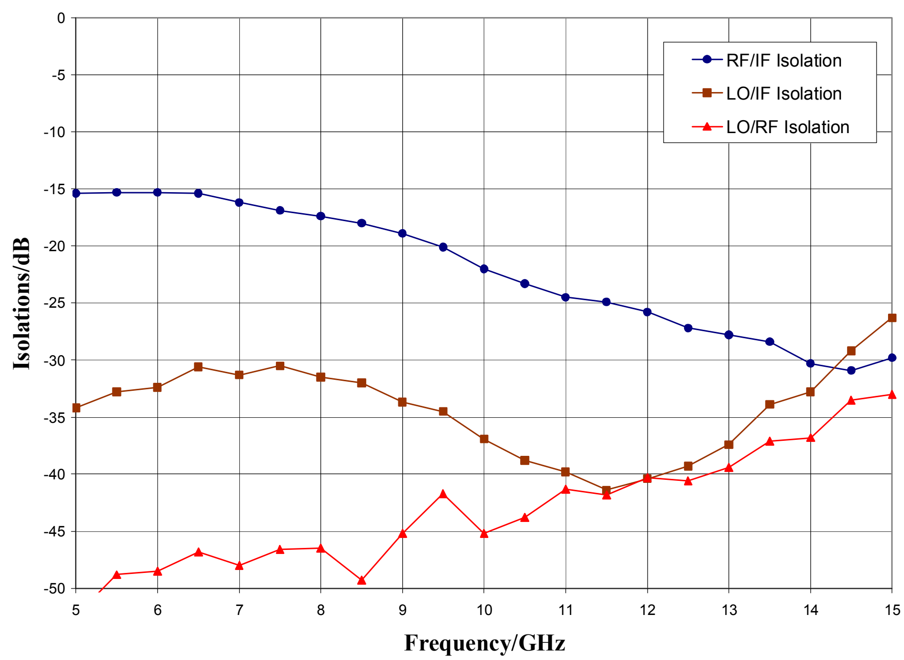
Typical Performance

Conversion Gain vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



Isolation, LO = +13 dBm



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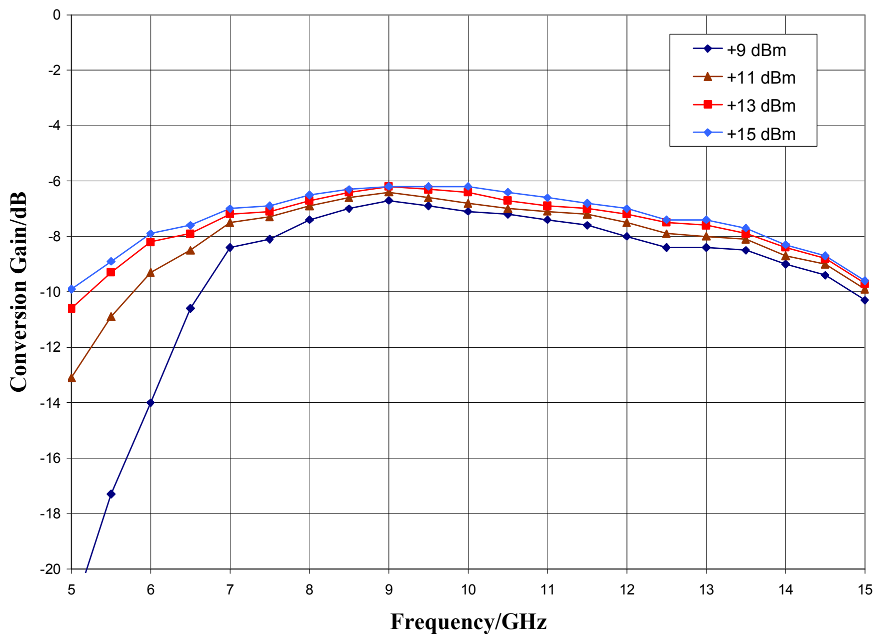
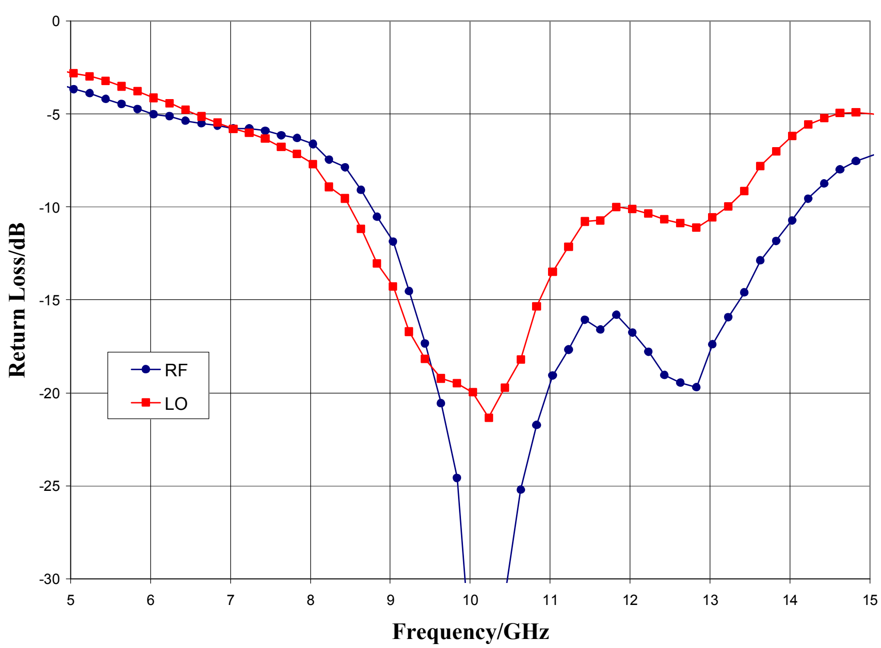
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 13 dBm



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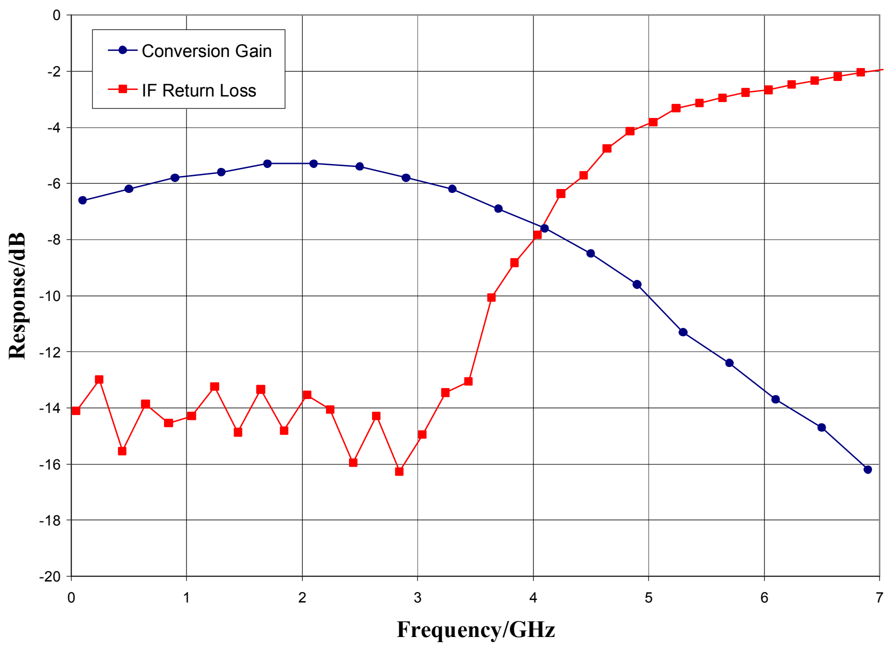
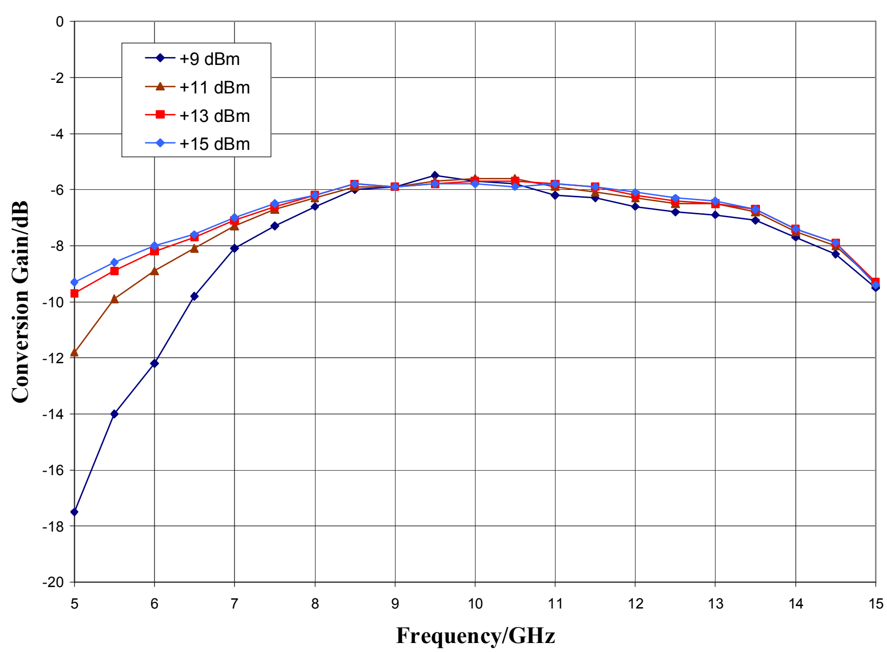
Typical Performance

IF Bandwidth, LO = +13 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 100 MHz



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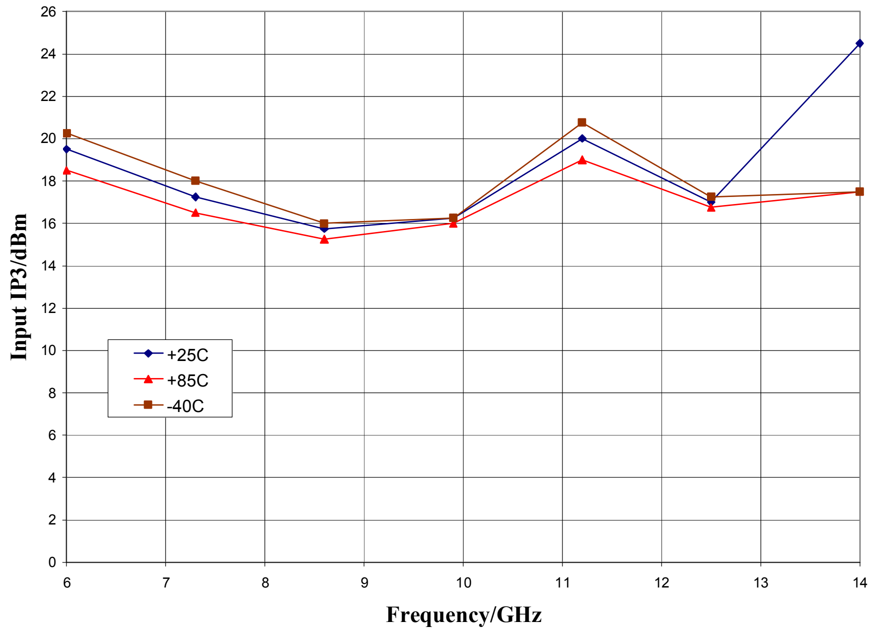
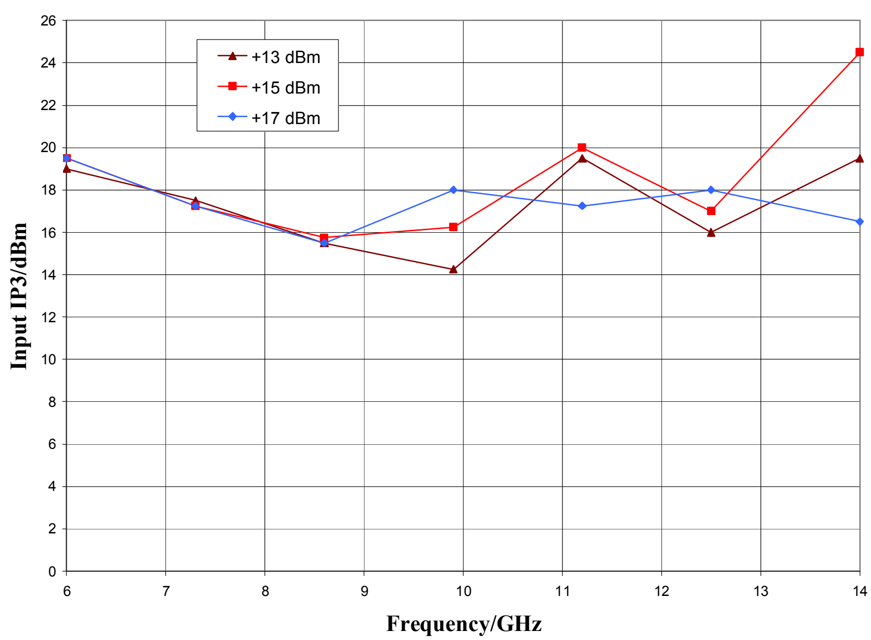
Typical Performance

Input IP3 vs. Temperature, LO = +15 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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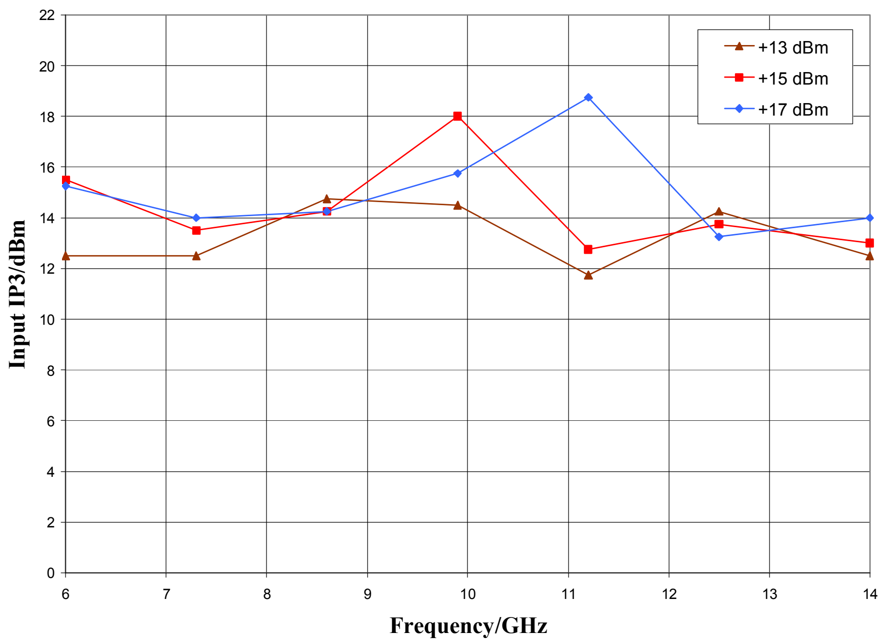
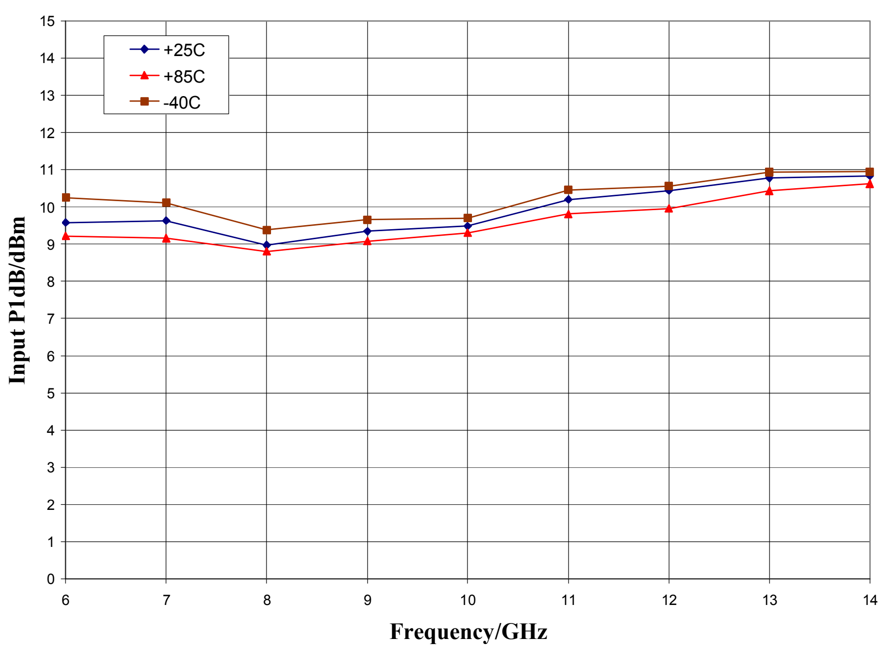
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



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Typical Performance

MxN Spurious Outputs

	nLO				
mRF	0	1	2	3	4
0	xx	6.5	33.5	30.5	29.5
1	17.5	0	37.5	38.5	57.5
2	>75	69.5	66.5	66.5	> 75
3	> 75	> 75	> 75	62.5	> 75
4	> 75	> 75	> 75	> 75	> 75

RF = 10.1 GHz @ -10 dBm
LO = 10.0 GHz @ +13 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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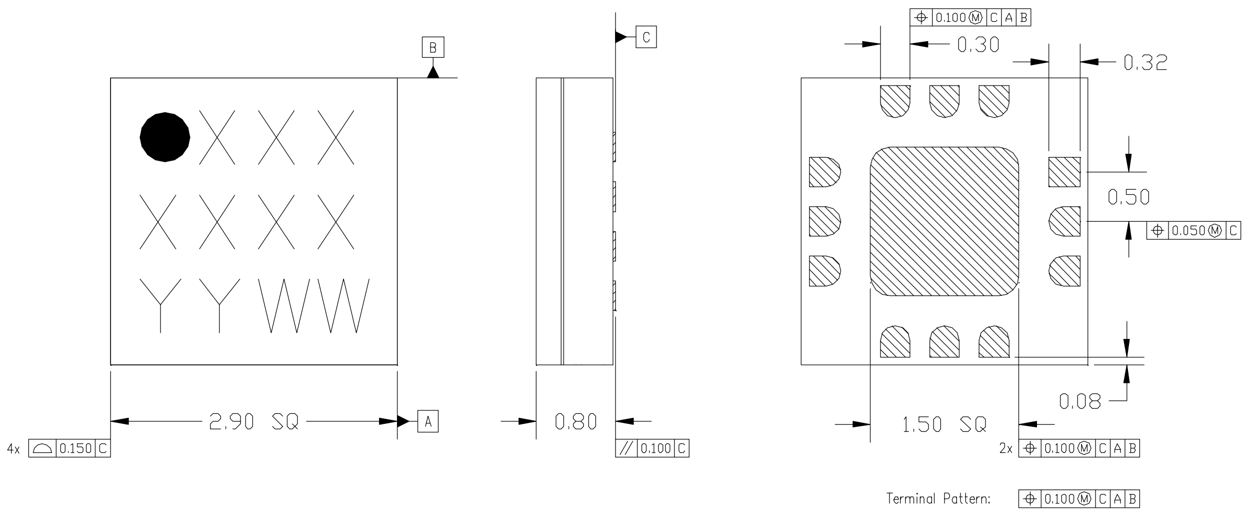
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   4.1. LINE 1: PART NUMBER
      4.1.1. EXAMPLE: CMD177C3 SHALL BE MARKED AS 177
   4.2. LINE 2: LOT NUMBER
   4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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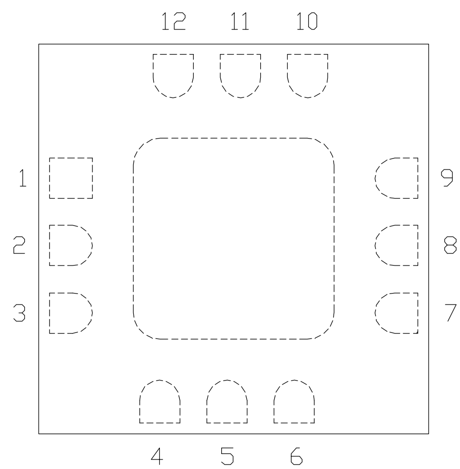
CMD177C3

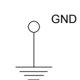
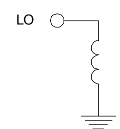
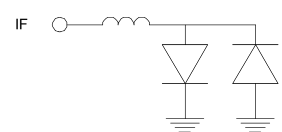
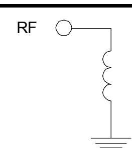
6-14 GHz Fundamental Mixer

Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1,3,4,6,7,9 and die paddle	Ground	Connect to RF / DC ground.	
2	LO	This pin is DC coupled and matched to 50 ohms.	
5	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
8	RF	This pin is DC coupled and matched to 50 ohms.	
10-12	N/C	No connection required. These pins may be connected to RF/DC ground	

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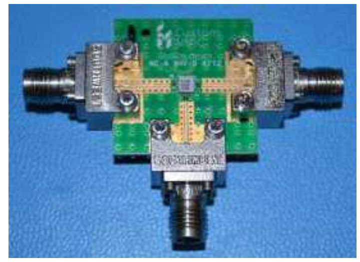
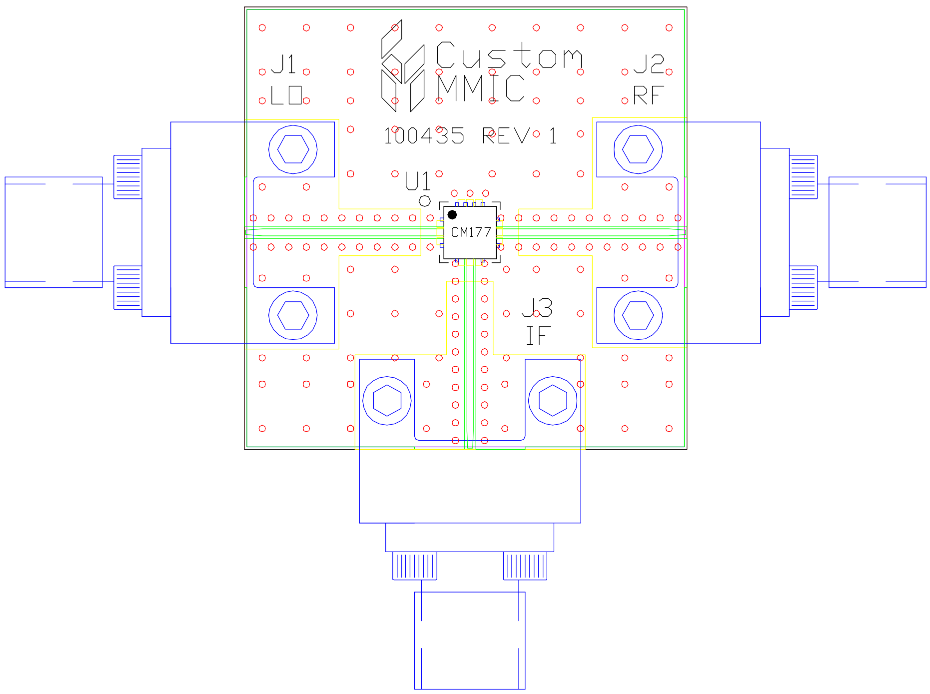
Applications Information

Evaluation Board



The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J3		SMA End Launch Connector
U1		CMD177C3 Fundamental Mixer
PCB		100435 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD178C3

11-21 GHz Fundamental Mixer

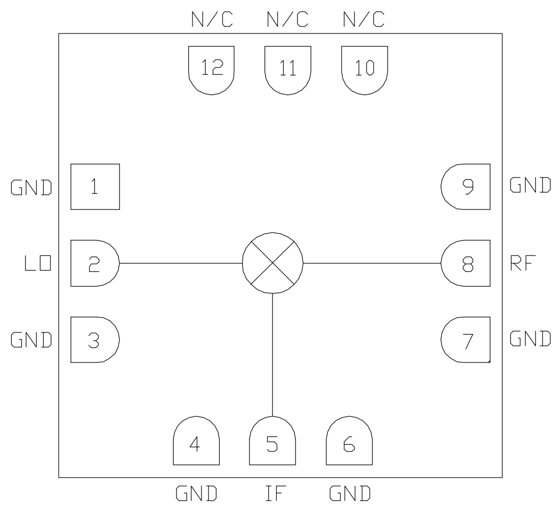
Features

- ► Low conversion loss
- ► High isolation
- ► Wide IF bandwidth
- ► Passive double balanced topology
- ► Pb-free RoHs compliant 3x3 mm SMT package

Description

The CMD178C3 is a general purpose double balanced mixer in a leadless surface mount package that can be used for up- and downconverting applications between 11 and 20 GHz. The CMD178C3 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +9 dBm. The CMD178C3 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Functional Block Diagram



Electrical Performance - IF = 100 MHz, LO = +13 dBm , T_A = 25 °C, F = 15 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		11 - 21		GHz
Frequency Range, IF	DC		6	GHz
Conversion Loss		6		dB
LO to RF Isolation		45		dB
LO to IF Isolation		45		dB
RF to IF Isolation		26		dB
Input P1dB		9		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications - IF = 100 MHz, LO = +13 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		13 - 17			11 - 21		GHz
Frequency Range, IF	DC		6	DC		6	GHz
Conversion Loss		6	8		7	10	dB
Noise Figure (SSB)		6	8		7	10	dB
LO to RF Isolation	35	43		31	43		dB
LO to IF Isolation	33	48		30	38		dB
RF to IF Isolation	17	25		15	25		dB
Input P1dB		9			9		dBm
Input IP3		16			16		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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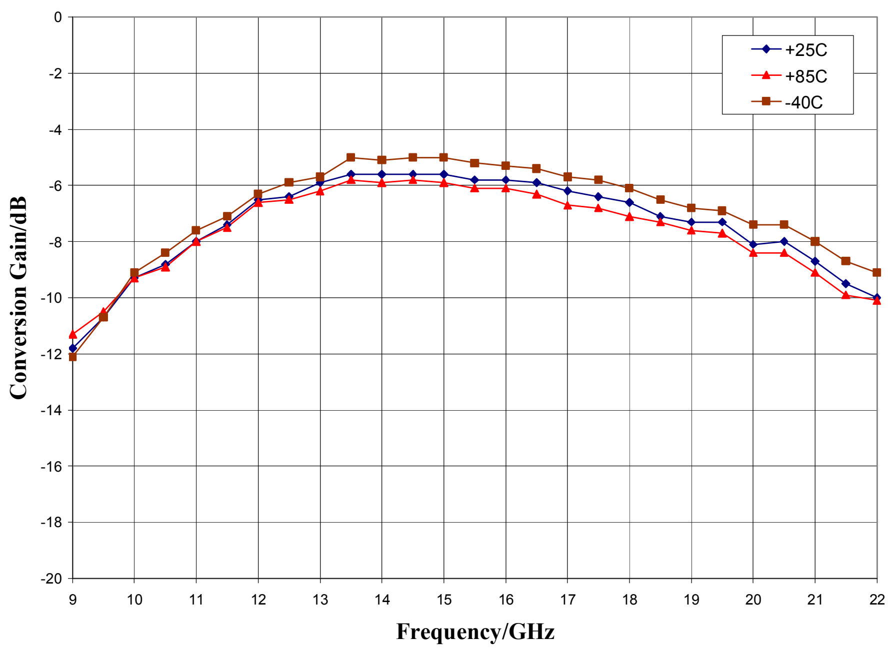
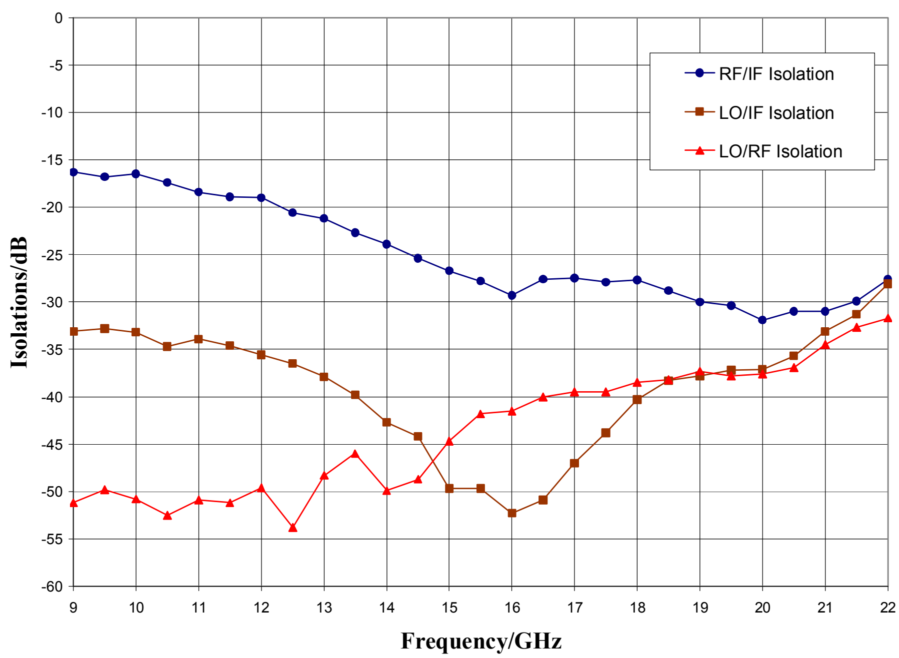
Typical Performance

Conversion Gain vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



Isolation, LO = +13 dBm



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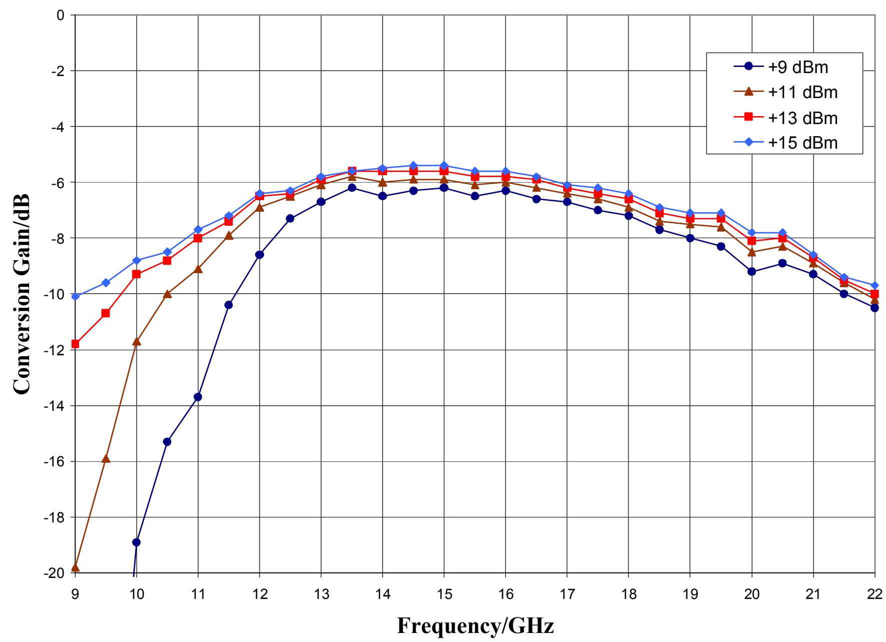
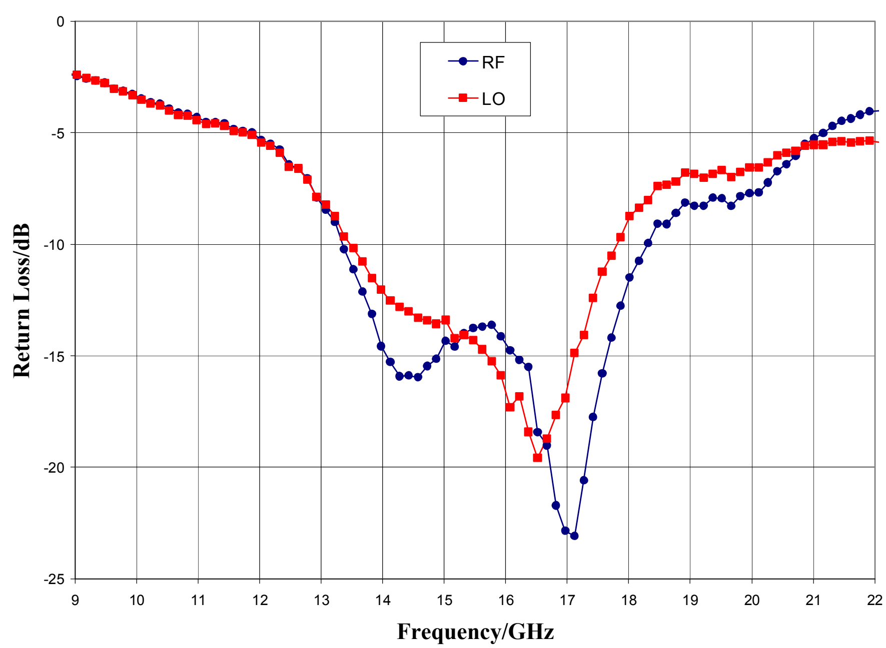
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 13 dBm



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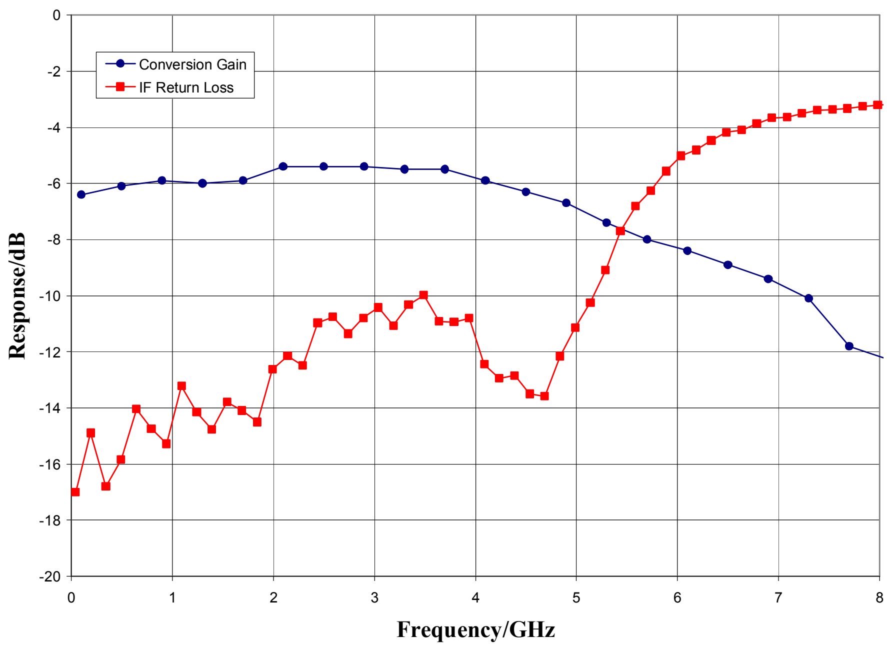
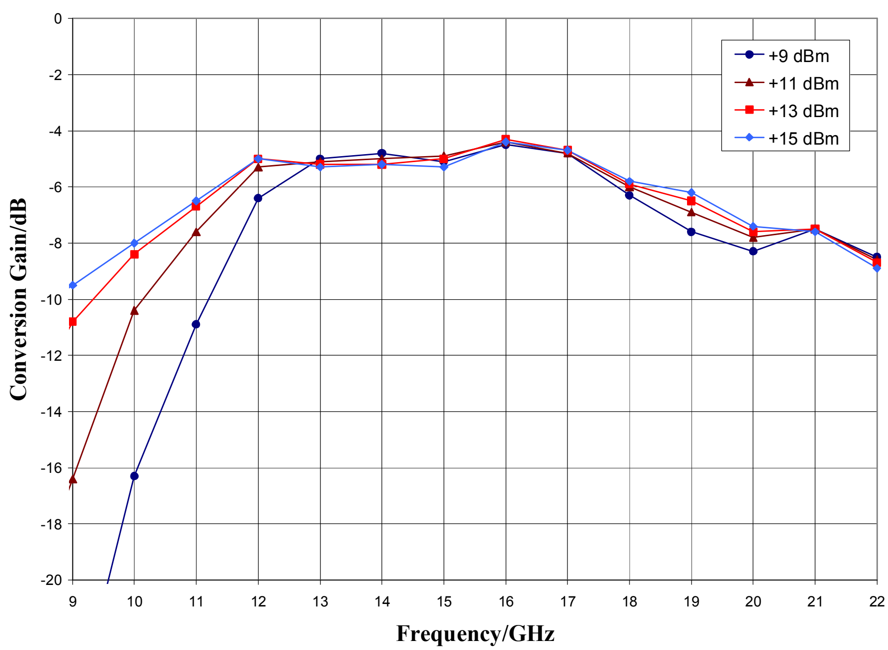
Typical Performance

IF Bandwidth, LO = +13 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 100 MHz



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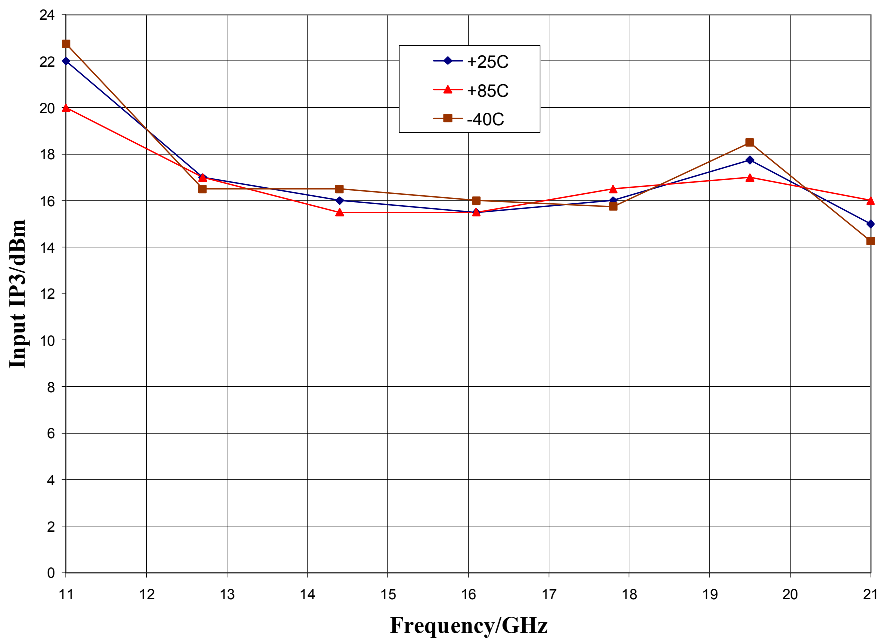
CMD178C3

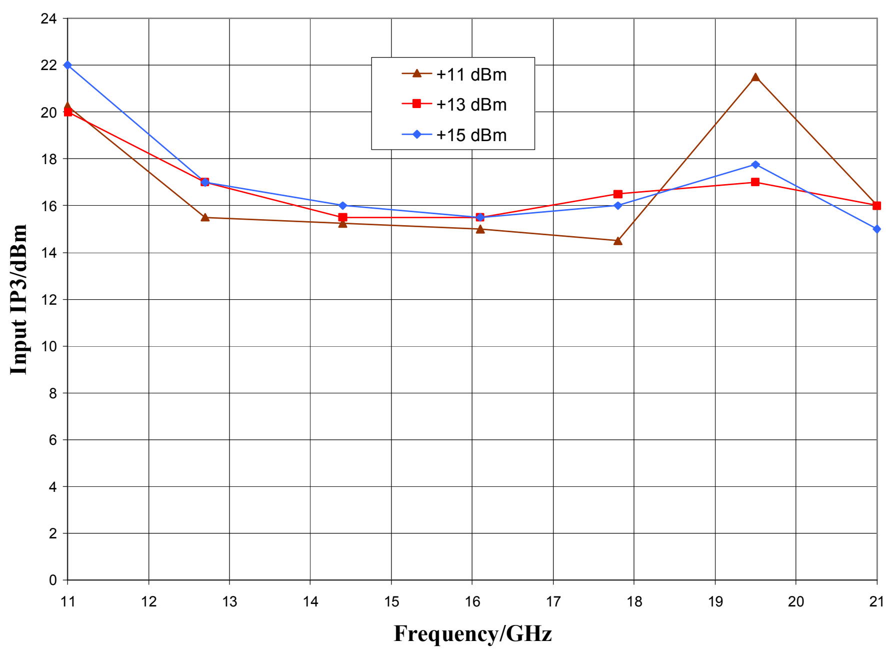
11-21 GHz Fundamental Mixer

Typical Performance

Input IP3 vs. Temperature, LO = +13 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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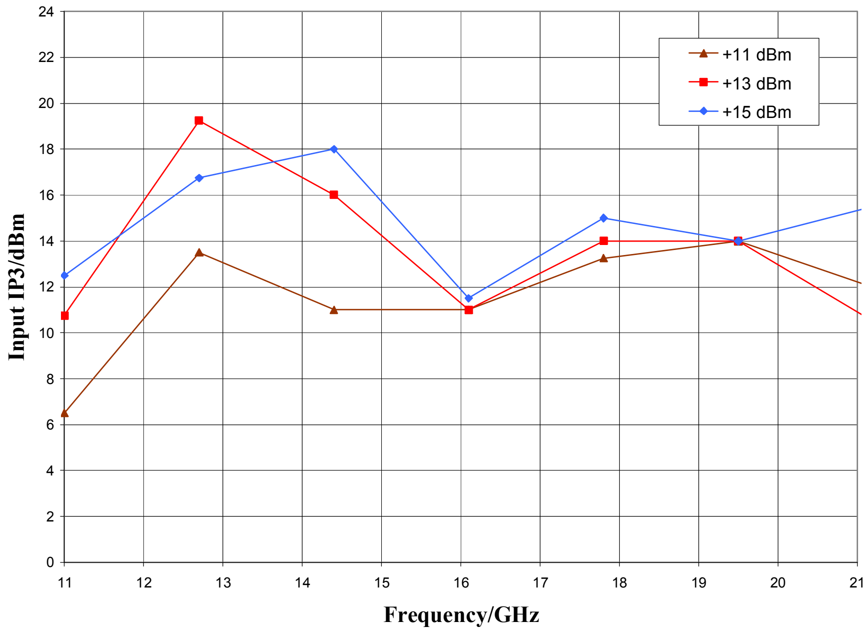
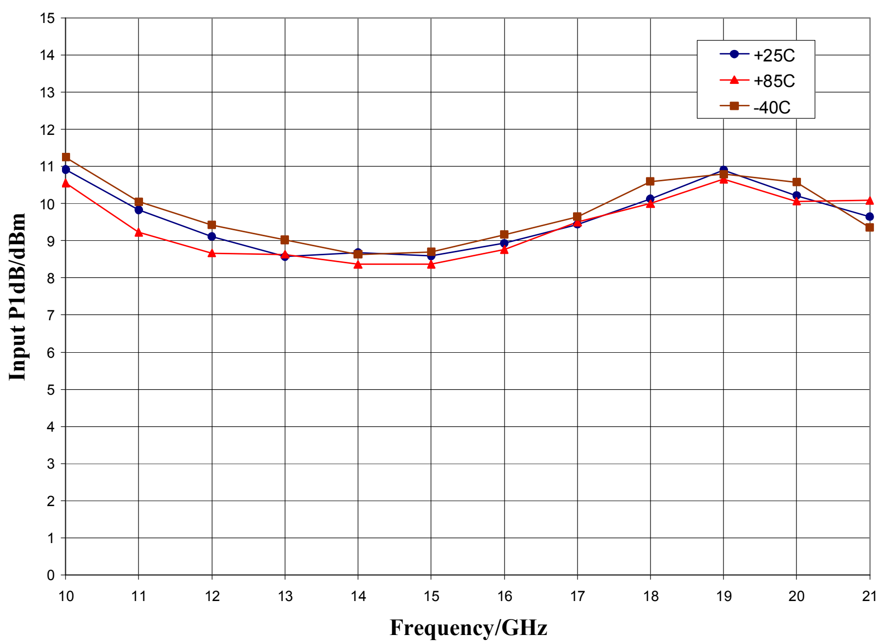
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 500 MHz



Input P1dB vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



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Typical Performance

MxN Spurious Outputs

	nLO				
mRF	0	1	2	3	4
0	xx	25	33	> 90	> 90
1	28	0	47	40	> 90
2	72	64	64	67	75
3	> 90	> 90	> 90	64	> 90
4	> 90	> 90	> 90	> 90	> 90
RF = 15.1 GHz @ -10 dBm LO = 15.0 GHz @ +13 dBm All values in dBc below the IF output power level (1RF - 1LO)					

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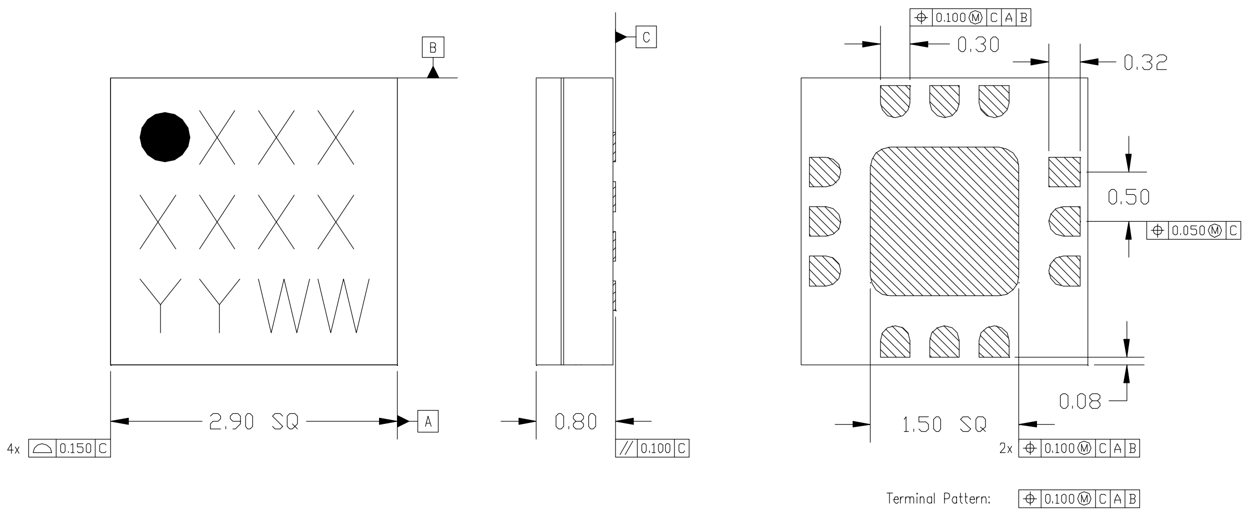
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   4.1. LINE 1: PART NUMBER
      4.1.1. EXAMPLE: CMD177C3 SHALL BE MARKED AS 177
   4.2. LINE 2: LOT NUMBER
   4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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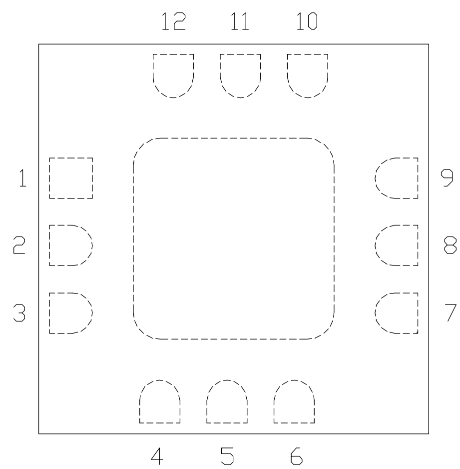
CMD178C3

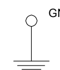
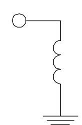
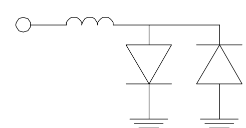
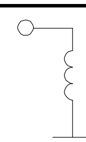
11-21 GHz Fundamental Mixer

Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1,3,4,6,7,9 and die paddle	Ground	Connect to RF / DC ground.	
2	LO	This pin is DC coupled and matched to 50 ohms.	
5	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
8	RF	This pin is DC coupled and matched to 50 ohms.	
10-12	N/C	No connection required. These pins may be connected to RF/DC ground	

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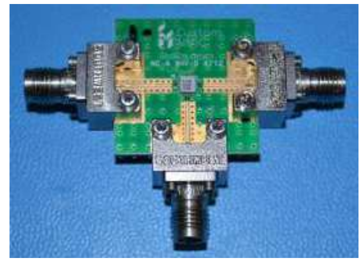
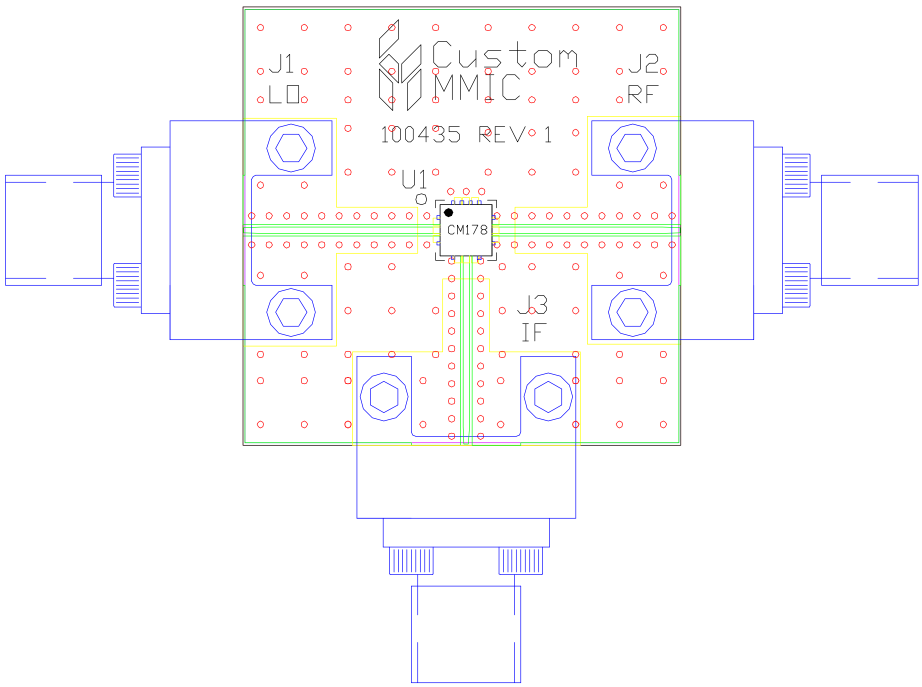
Applications Information

Evaluation Board



The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J3		SMA End Launch Connector
U1		CMD178C3 Fundamental Mixer
PCB		100435 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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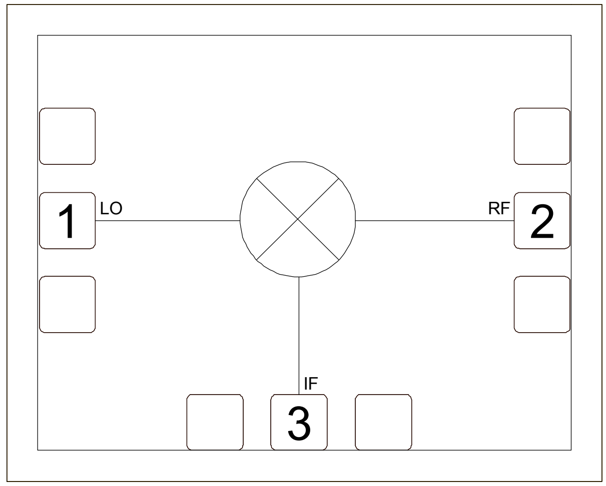
CMD179

16-26 GHz Fundamental Mixer

Features

- ► Low conversion loss
- ► High isolation
- ► Wide IF bandwidth
- ► Passive double balanced topology
- ► Small die size

Functional Block Diagram



Description

The CMD179 is a general purpose double balanced mixer die that can be used for up- and downconverting applications between 16 and 26 GHz. The CMD179 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +9 dBm. The CMD179 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Electrical Performance **- IF = 100 MHz, LO = +13 dBm , T_A = 25 ^{o}C, F = 21 GHz**

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		16 - 26		GHz
Frequency Range, IF	DC		9	GHz
Conversion Loss		6.5		dB
LO to RF Isolation		40		dB
LO to IF Isolation		48		dB
RF to IF Isolation		26		dB
Input P1dB		10		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 to 150 °C

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications - IF = 100 MHz, LO = +13 dBm, T_A = 25 ^{o}C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		18 - 24			16 - 26		GHz
Frequency Range, IF	DC		9	DC		9	GHz
Conversion Loss		6.5	8		7	10	dB
Noise Figure (SSB)		6.5	8		7	10	dB
LO to RF Isolation	37	43		36	43		dB
LO to IF Isolation	38	48		29	43		dB
RF to IF Isolation	18	25		15	25		dB
Input P1dB		10			10		dBm
Input IP3		17			17		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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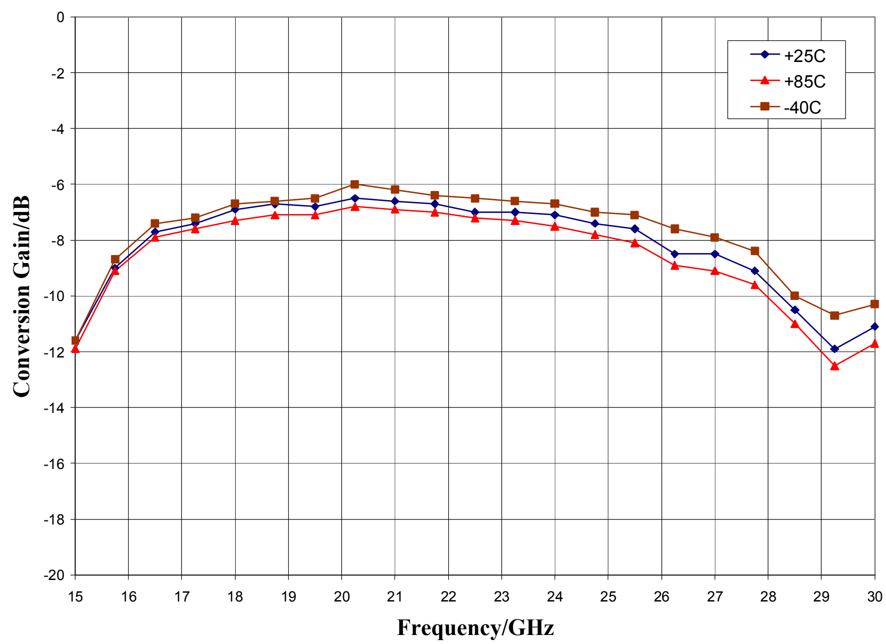
CMD179

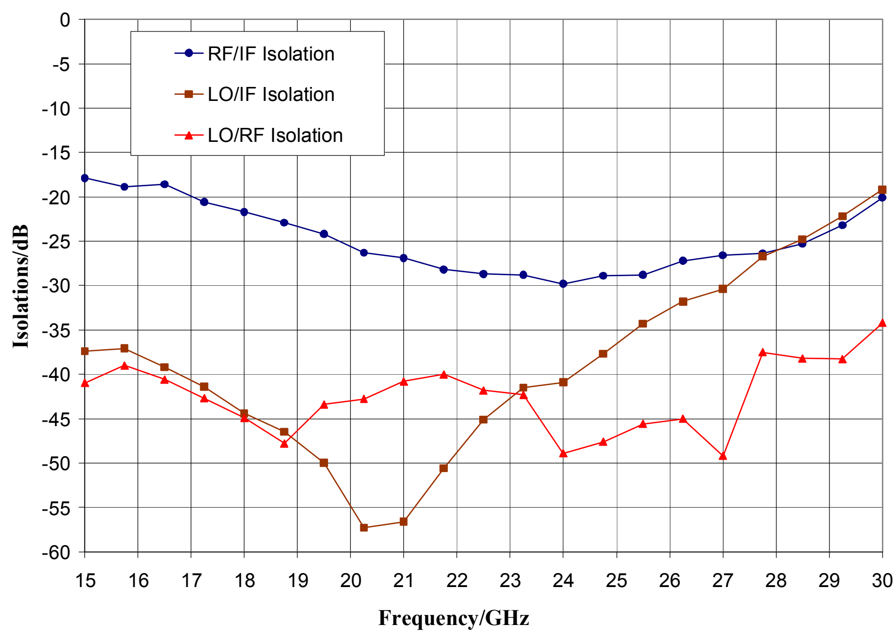
16-26 GHz Fundamental Mixer

Typical Performance

Conversion Gain vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



Isolation, LO = +13 dBm



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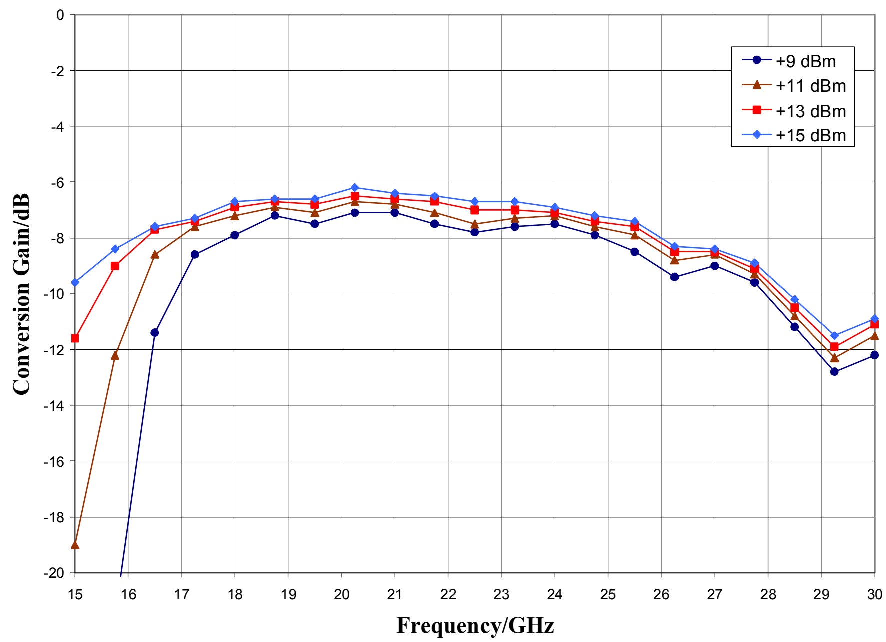
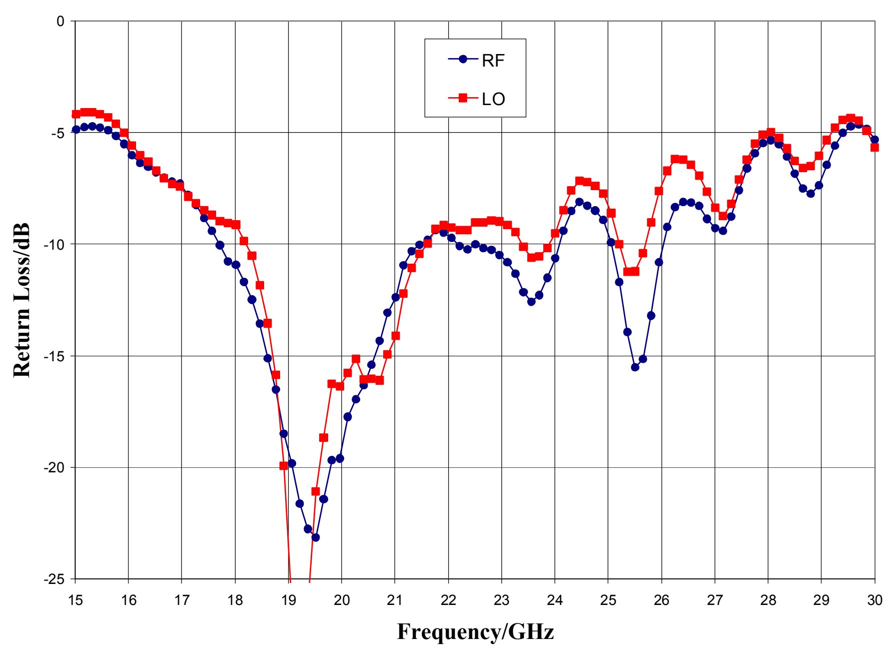
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 13 dBm



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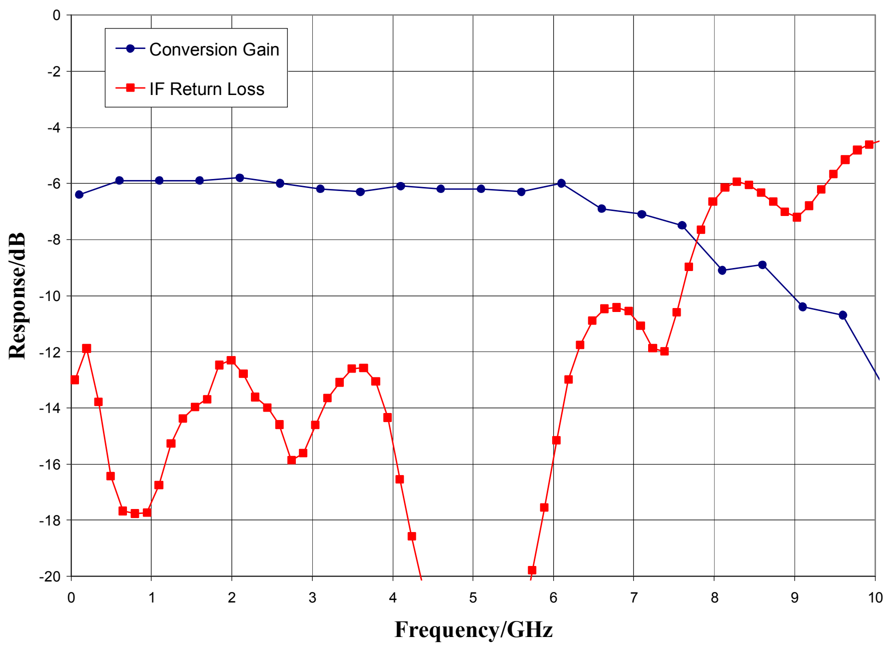
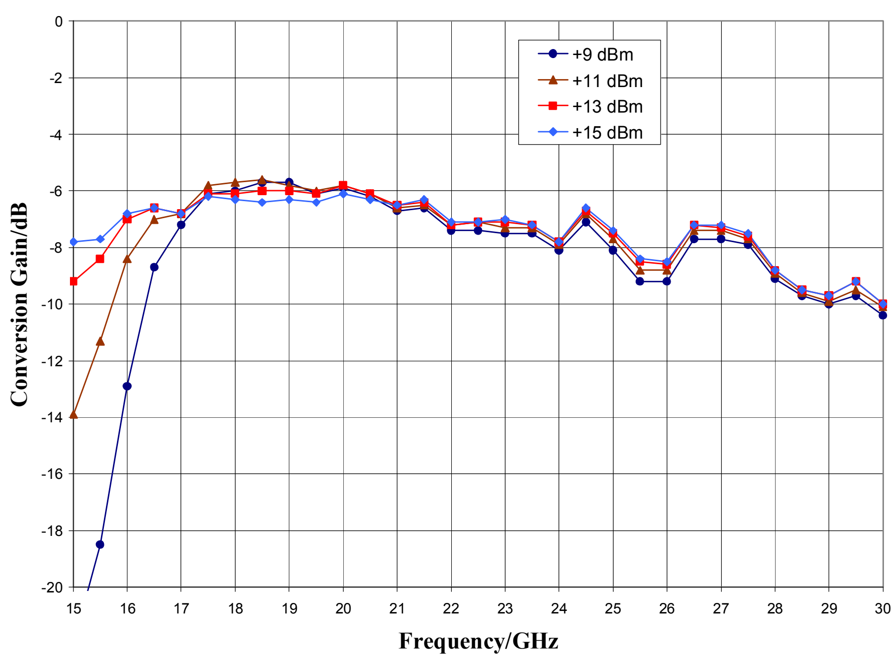
Typical Performance

IF Bandwidth, LO = +13 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 100 MHz



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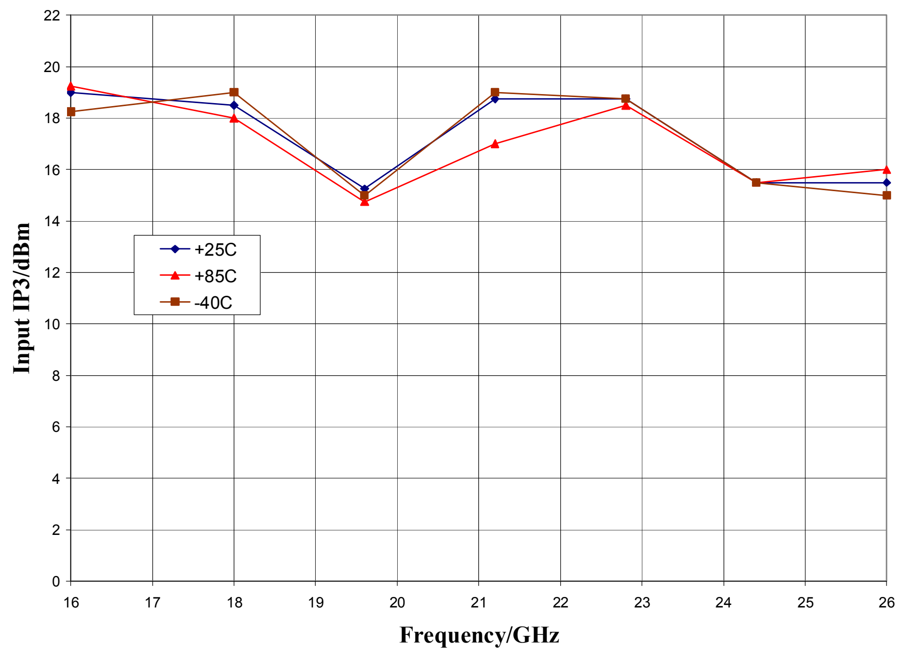
CMD179

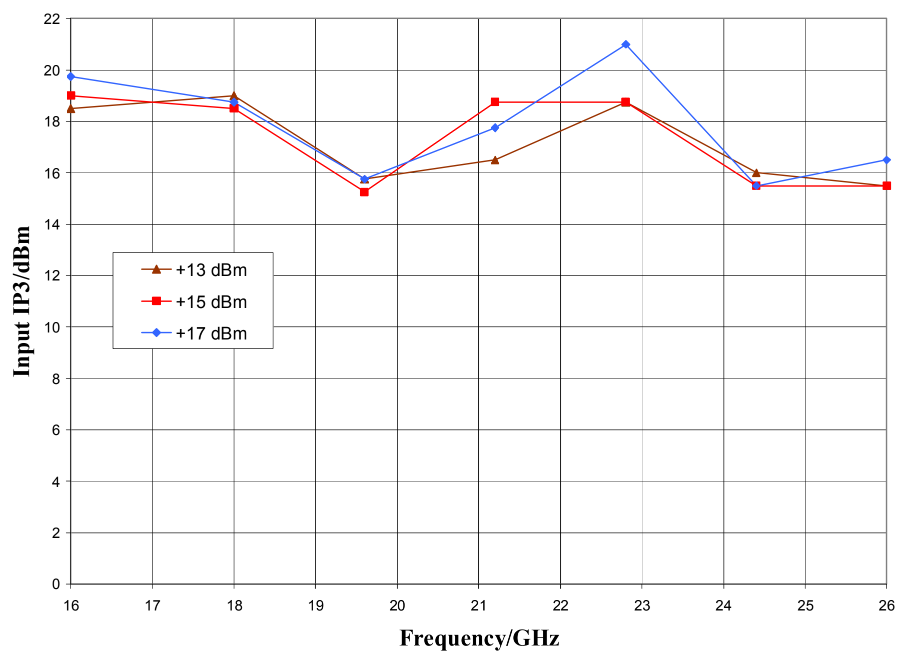
16-26 GHz Fundamental Mixer

Typical Performance

Input IP3 vs. Temperature, LO = +15 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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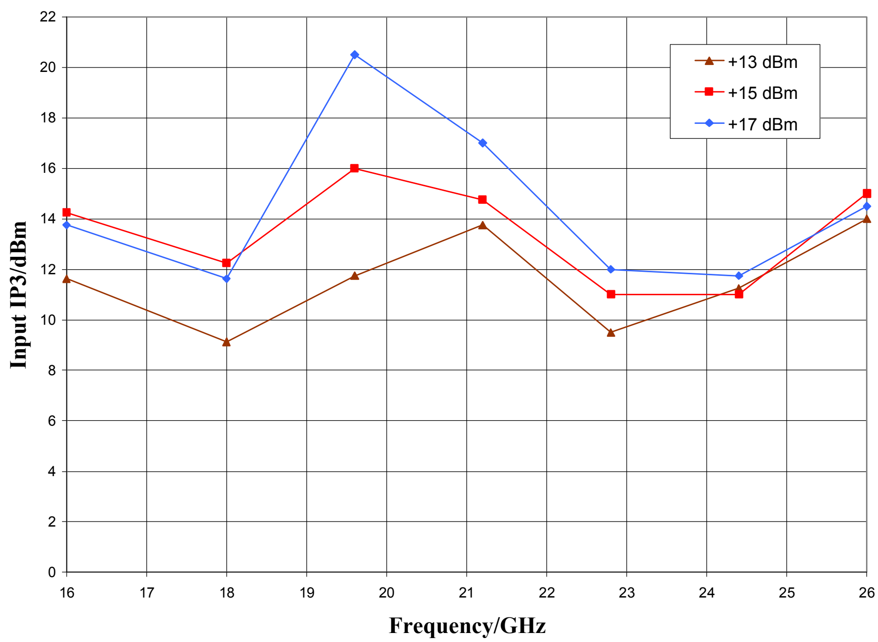
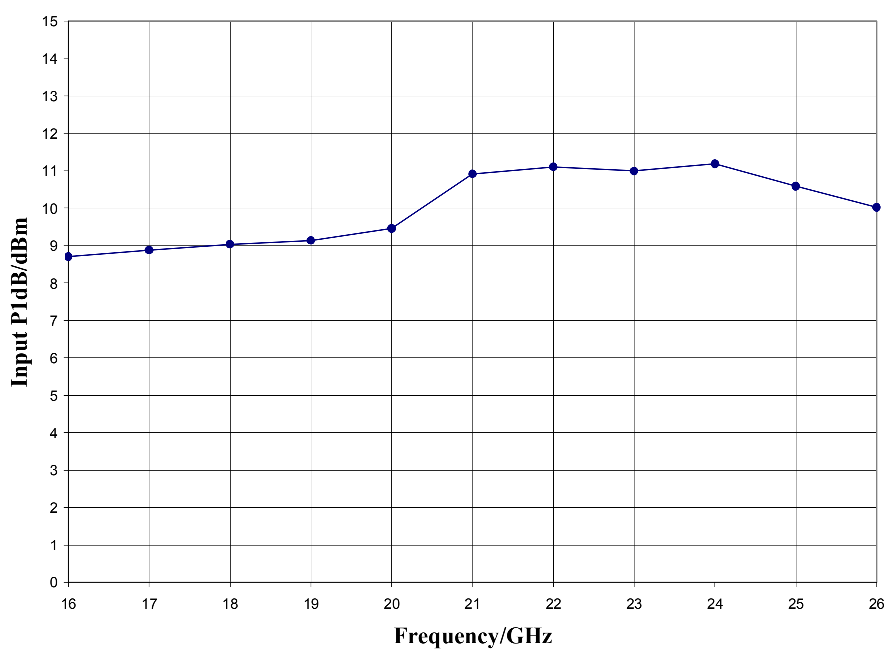
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB, LO = +13 dBm, IF = 100 MHz USB



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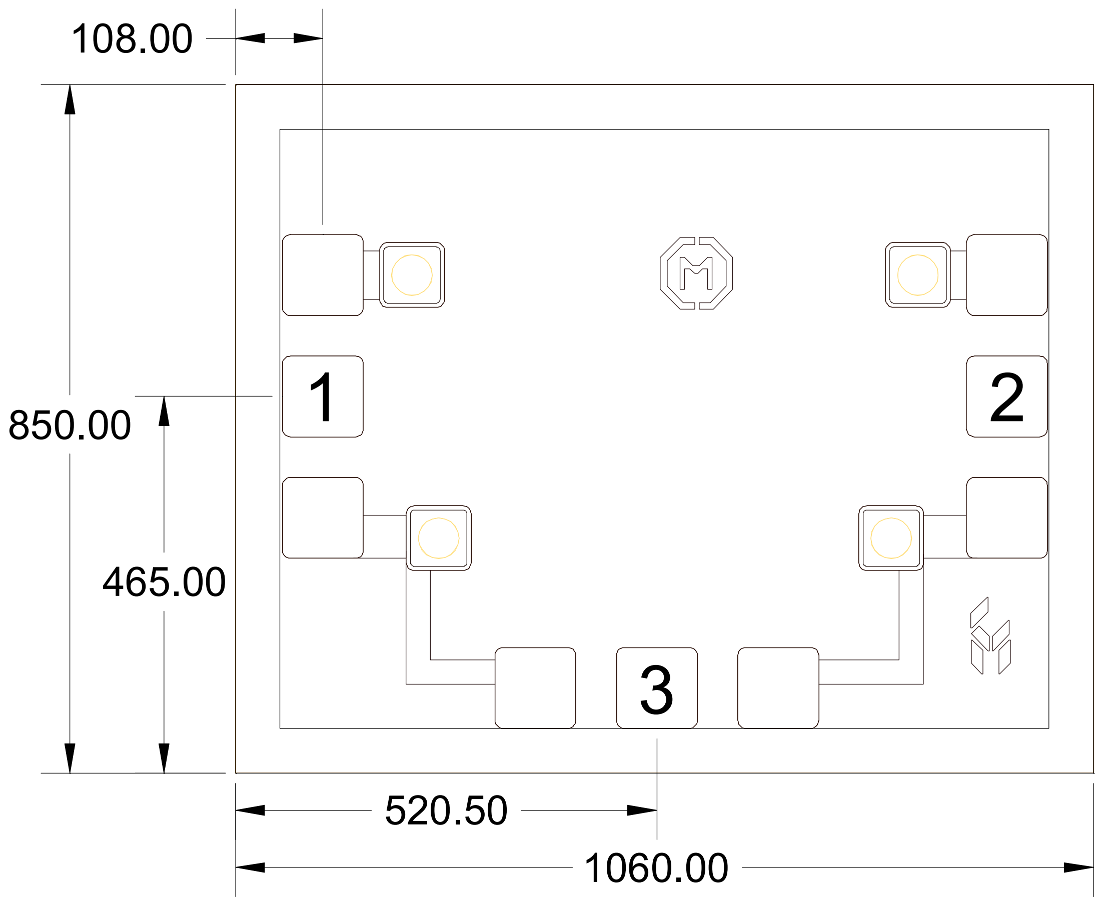
Mechanical Information

Die Outline (all dimensions in microns)



Notes:
1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 85 microns thick
5. DC bond pads are 100 microns square

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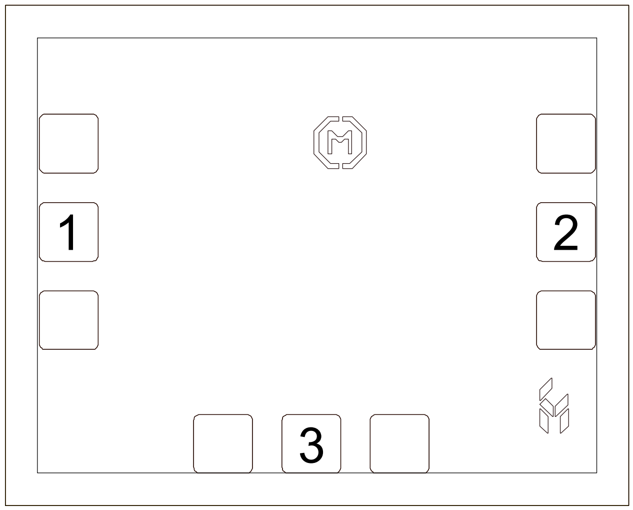
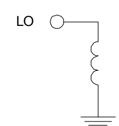
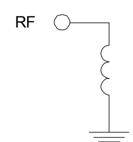
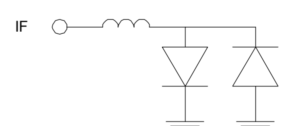
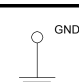
Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	LO	This pin is DC coupled and matched to 50 ohms.	
2	RF	This pin is DC coupled and matched to 50 ohms.	
3	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
Backside	Ground	Connect to RF / DC ground.	

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CMD179

16-26 GHz Fundamental Mixer

Applications Information

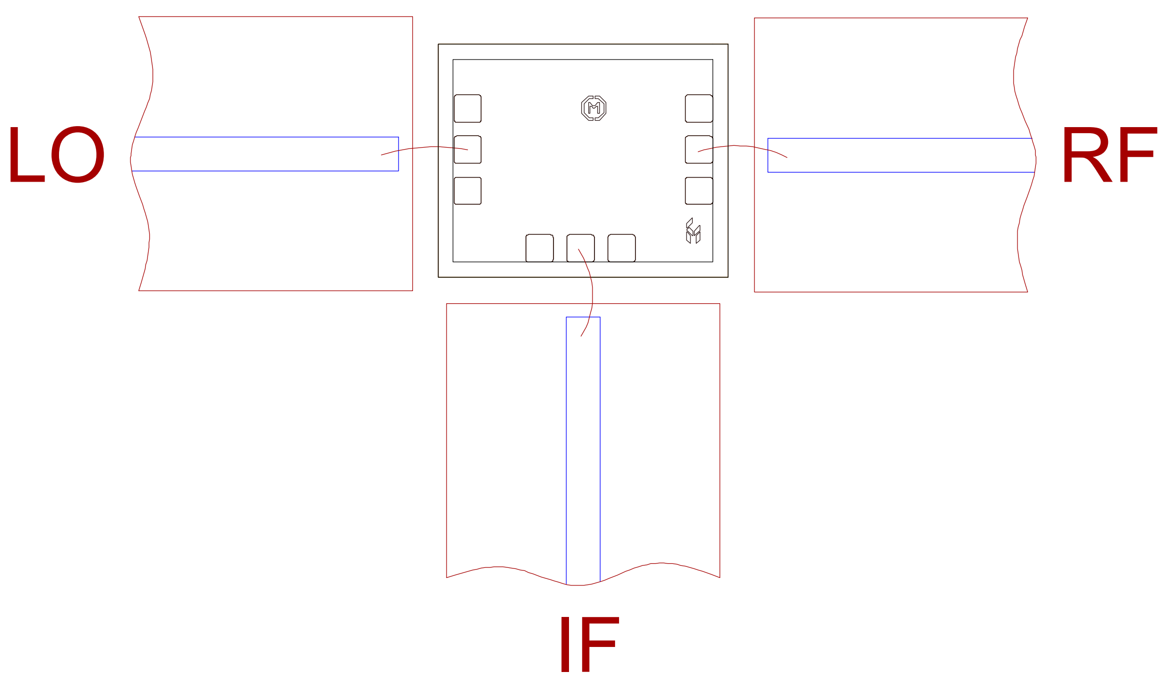
Assembly Guidelines

The backside of the CMD179 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 85 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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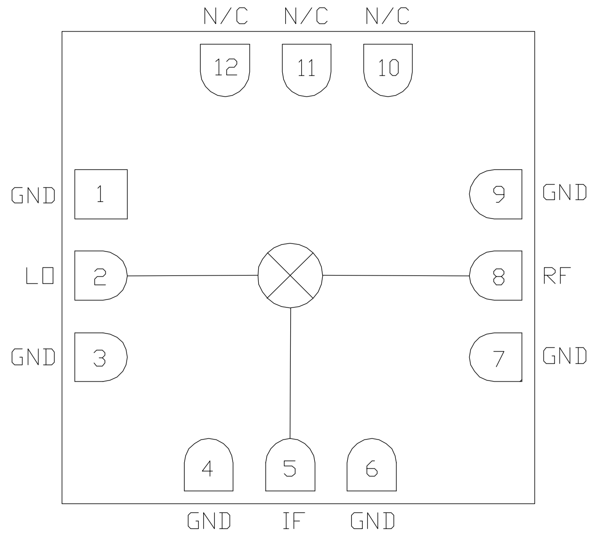
CMD179C3

16-26 GHz Fundamental Mixer

Features

- ► Low conversion loss
- ► High isolation
- ► Wide IF bandwidth
- ► Passive double balanced topology
- ► Pb-free RoHs compliant 3x3 mm SMT package

Functional Block Diagram



Description

The CMD179C3 is a general purpose double balanced mixer in a leadless surface mount package that can be used for up- and downconverting applications between 16 and 26 GHz. The CMD179C3 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +9 dBm. The CMD179C3 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Electrical Performance **- IF = 100 MHz, LO = +13 dBm , T_A = 25 °C, F = 21 GHz**

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		16 - 26		GHz
Frequency Range, IF	DC		9	GHz
Conversion Loss		6.5		dB
LO to RF Isolation		40		dB
LO to IF Isolation		48		dB
RF to IF Isolation		26		dB
Input P1dB		10		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications - IF = 100 MHz, LO = +13 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		18 - 24			16 - 26		GHz
Frequency Range, IF	DC		9	DC		9	GHz
Conversion Loss		6.5	8		7	10	dB
Noise Figure (SSB)		6.5	8		7	10	dB
LO to RF Isolation	37	43		36	43		dB
LO to IF Isolation	38	48		29	43		dB
RF to IF Isolation	18	25		15	25		dB
Input P1dB		10			10		dBm
Input IP3		17			17		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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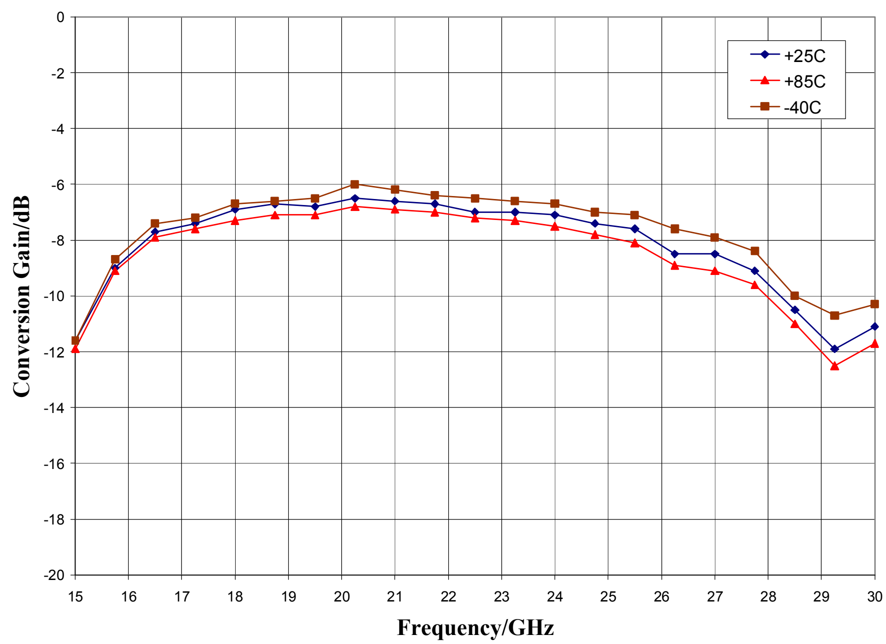
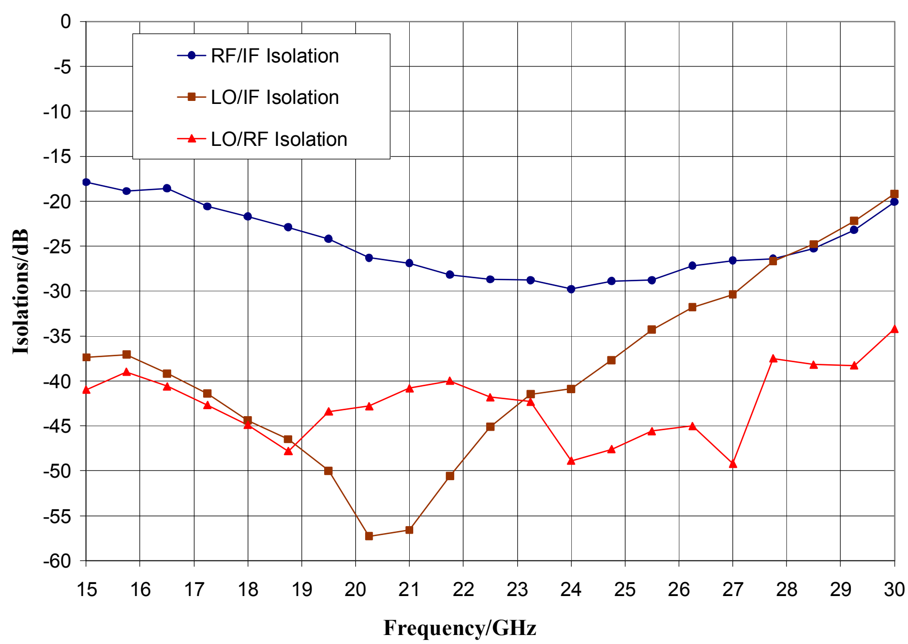
Typical Performance

Conversion Gain vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



Isolation, LO = +13 dBm



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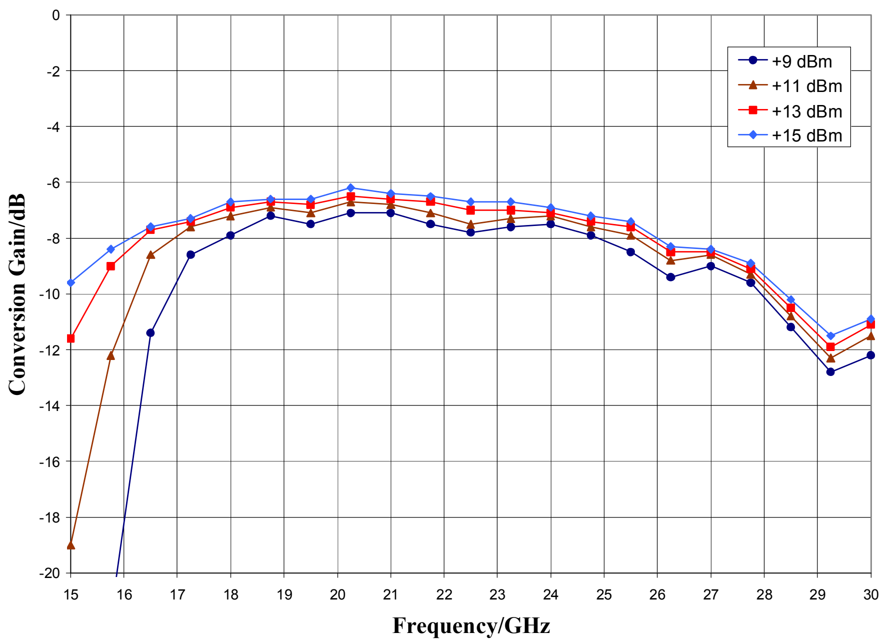
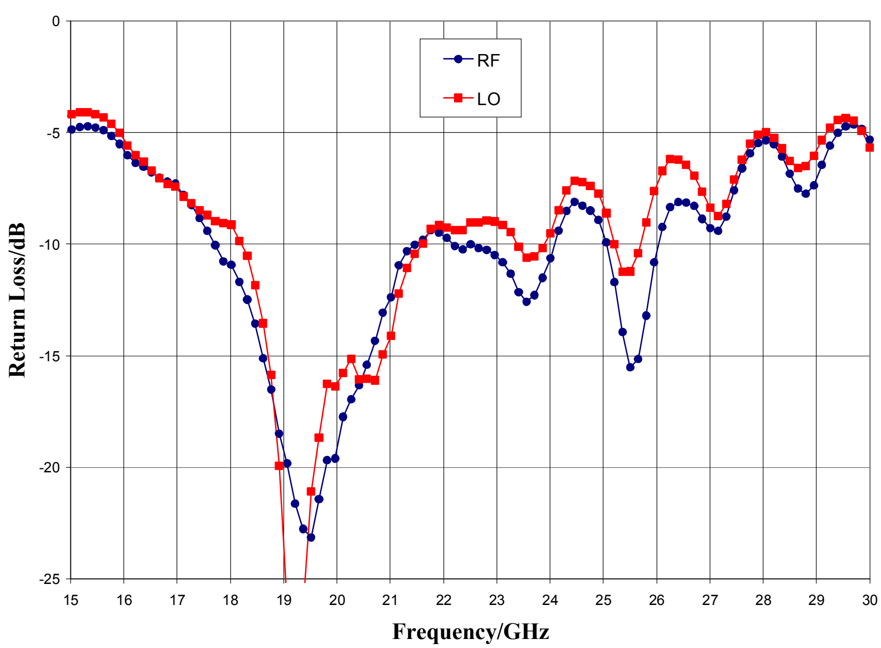
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 13 dBm



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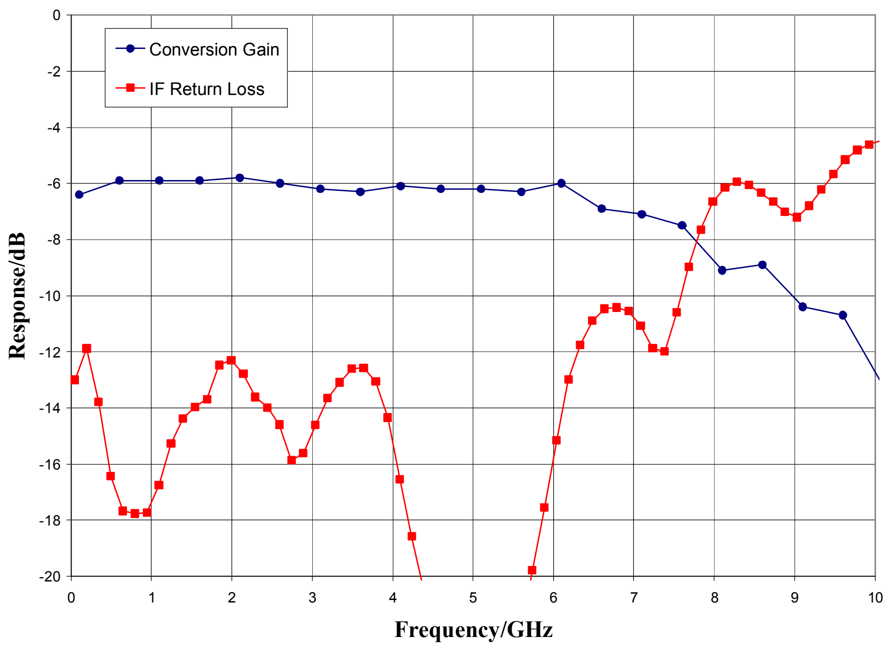
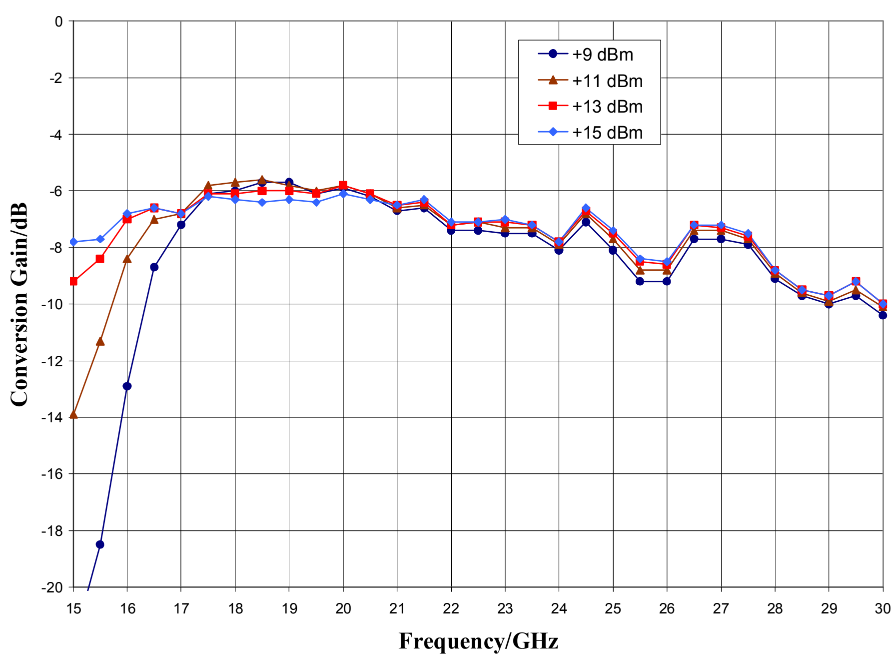
Typical Performance

IF Bandwidth, LO = +13 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 100 MHz



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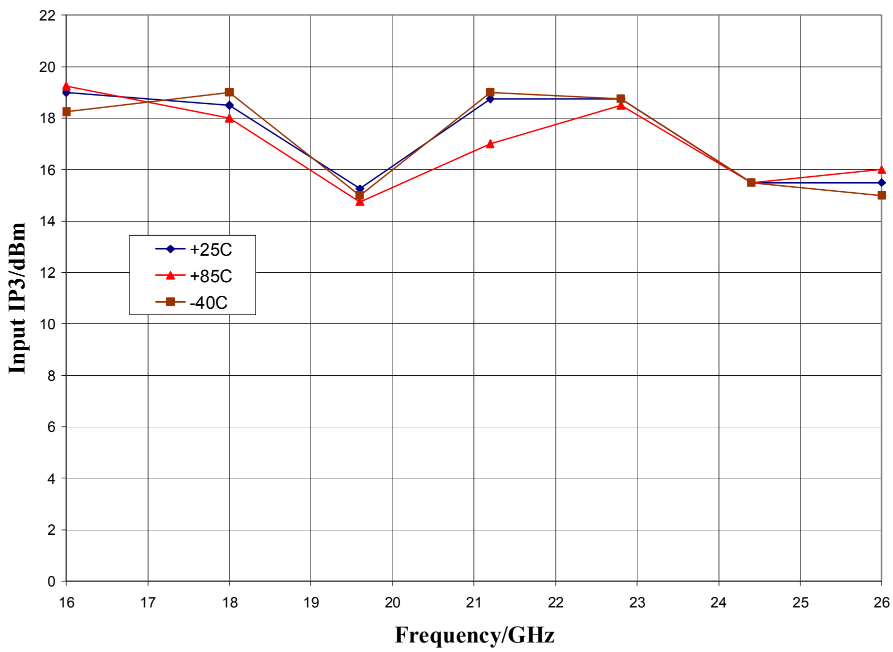
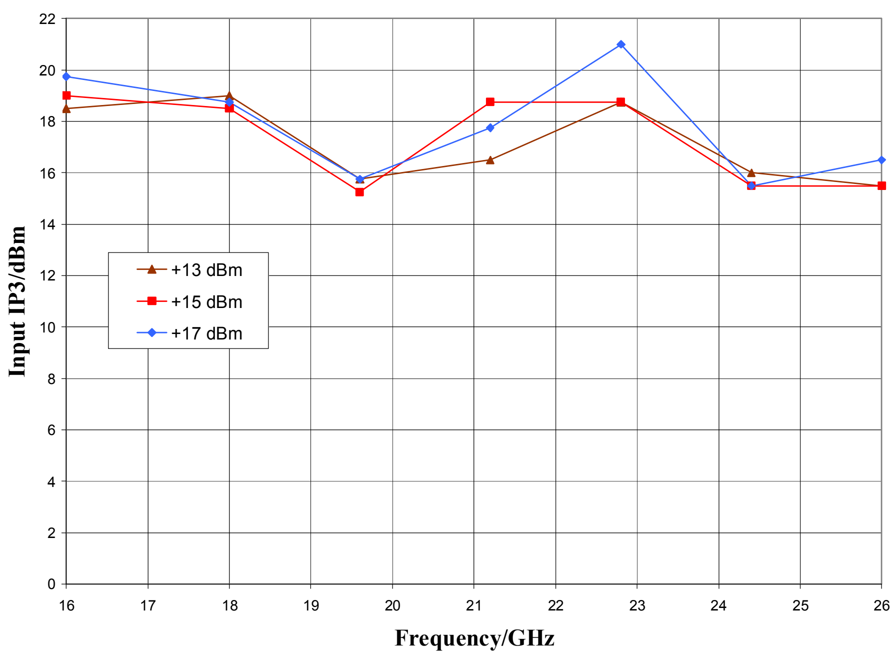
Typical Performance

Input IP3 vs. Temperature, LO = +15 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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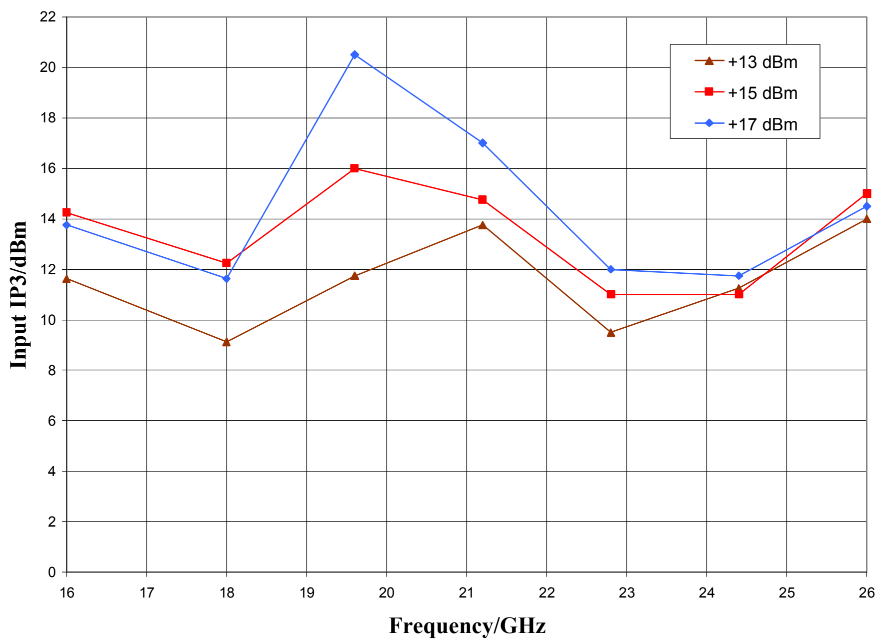
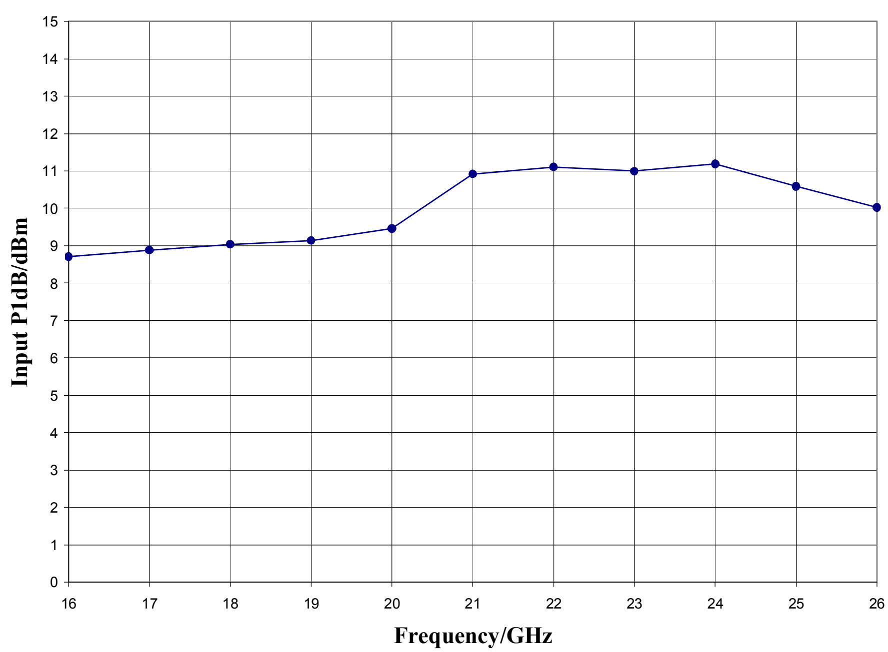
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB, LO = +13 dBm, IF = 100 MHz USB



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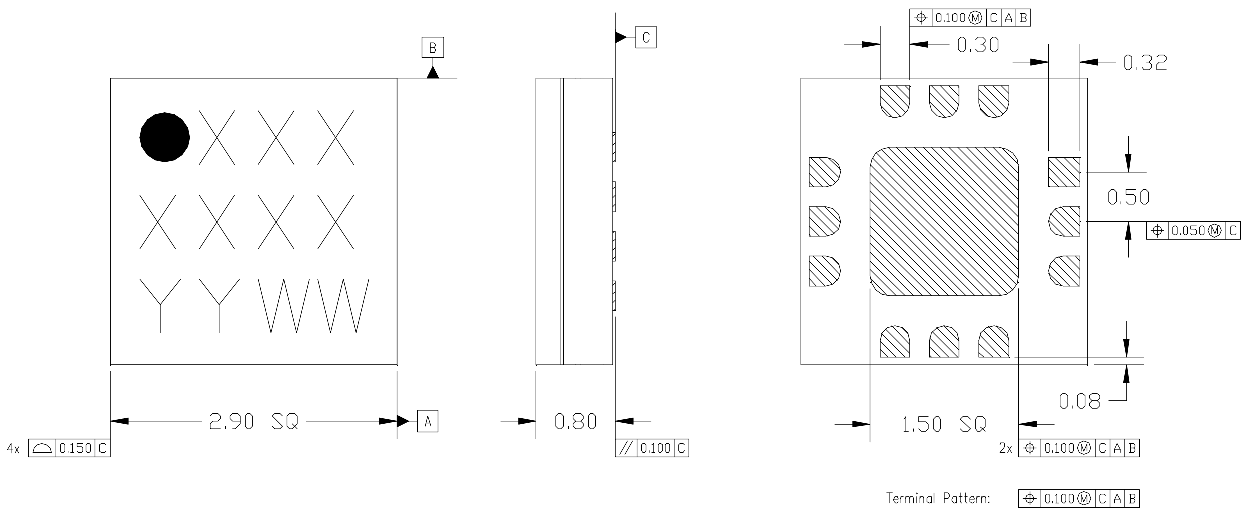
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   - 3.1. Ni: 8.89um MAX, 1.27um MIN
   - 3.2. Pd: 0.17um MAX, 0.07um MIN
   - 3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   - 4.1. LINE 1: PART NUMBER
     - 4.1.1. EXAMPLE: CMD177C3 SHALL BE MARKED AS 177
   - 4.2. LINE 2: LOT NUMBER
   - 4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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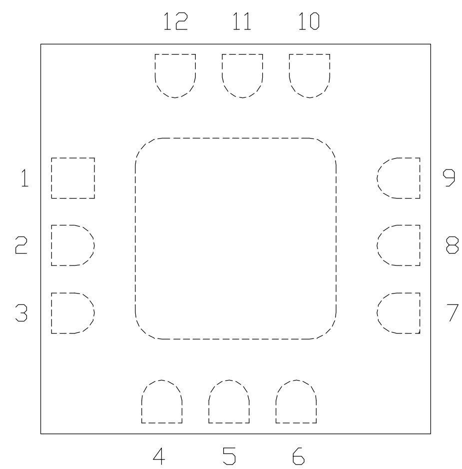
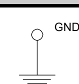
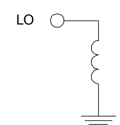
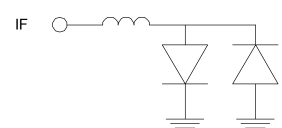
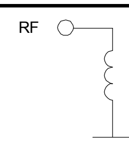
Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1,3,4,6,7,9 and die paddle	Ground	Connect to RF / DC ground.	
2	LO	This pin is DC coupled and matched to 50 ohms.	
5	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
8	RF	This pin is DC coupled and matched to 50 ohms.	
10-12	N/C	No connection required. These pins may be connected to RF/DC ground	

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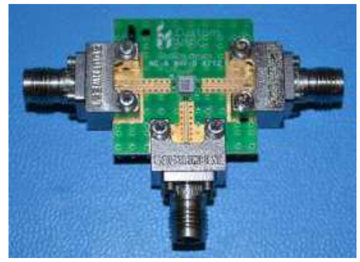
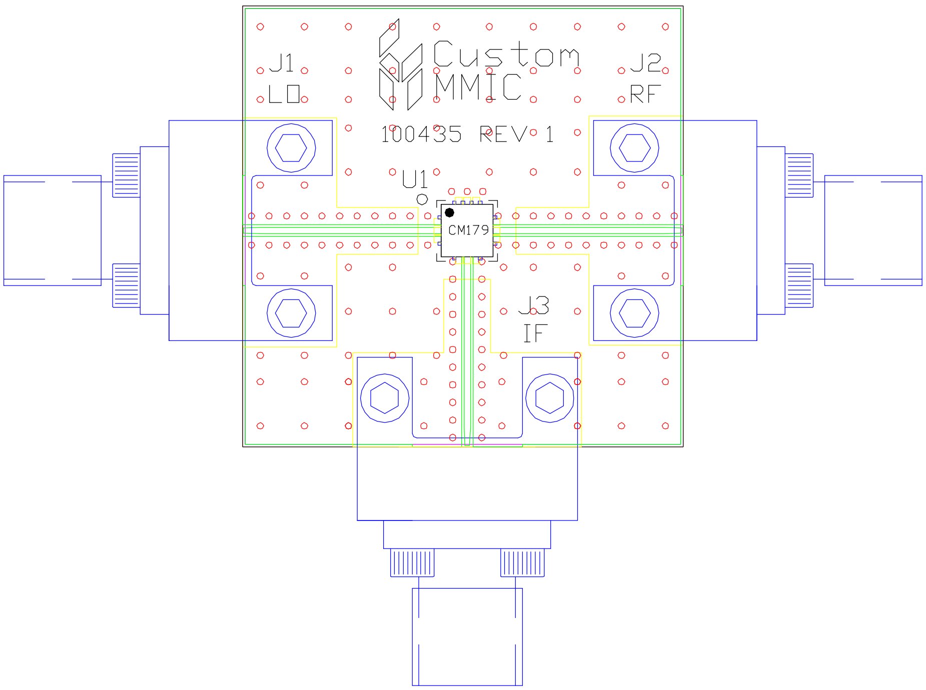
Applications Information

Evaluation Board



The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J3		SMA End Launch Connector
U1		CMD179C3 Fundamental Mixer
PCB		100435 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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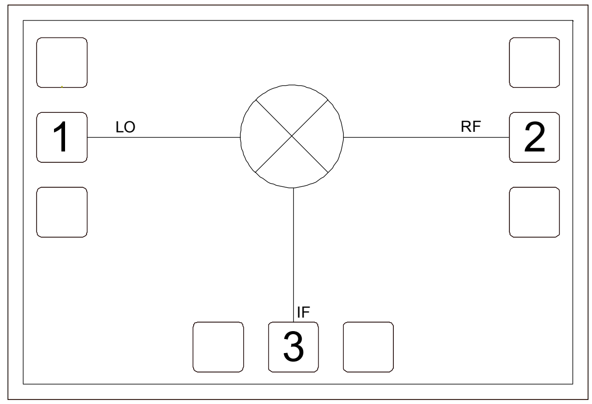
CMD180

20-32 GHz Fundamental Mixer

Features

- ► Low conversion loss
- ► High isolation
- ► Wide IF bandwidth
- ► Passive double balanced topology
- ► Small die size

Functional Block Diagram



Description

The CMD180 is a general purpose double balanced mixer die that can be used for up- and down converting applications between 20 and 32 GHz. The CMD180 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +9 dBm. The CMD180 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Electrical Performance – IF = 100 MHz, LO = +13 dBm , T_A = 25 °C, F = 26 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		20 – 32		GHz
Frequency Range, IF	DC		10	GHz
Conversion Loss		7		dB
LO to RF Isolation		36		dB
LO to IF Isolation		36		dB
RF to IF Isolation		26		dB
Input P1dB		10		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+21 dBm
LO Drive	+21 dBm
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal resistance, Θ_{JC}	672 ºC / W
Power Dissipation, Pdiss	96.7 mW

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications – IF = 100 MHz, LO = +13 dBm, T_A = 25 ºC

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		22 – 28			20 – 32		GHz
Frequency Range, IF	DC		10	DC		10	GHz
Conversion Loss		7	9		7	11	dB
Noise Figure (SSB)		7	9		7	11	dB
LO to RF Isolation	31	36		27	36		dB
LO to IF Isolation	30	38		27	38		dB
RF to IF Isolation	19	26		16	26		dB
Input P1dB		10			9		dBm
Input IP3		18			18		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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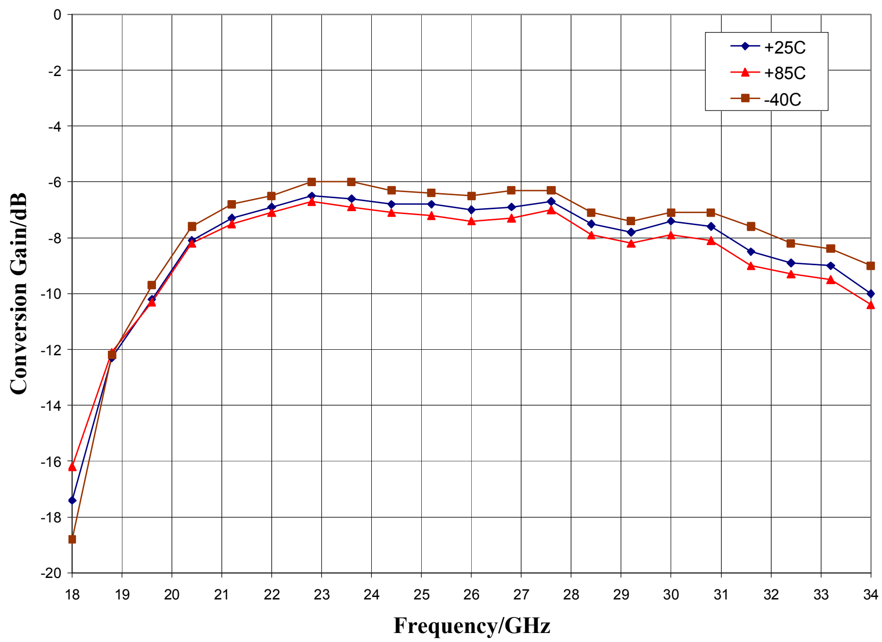
CMD180

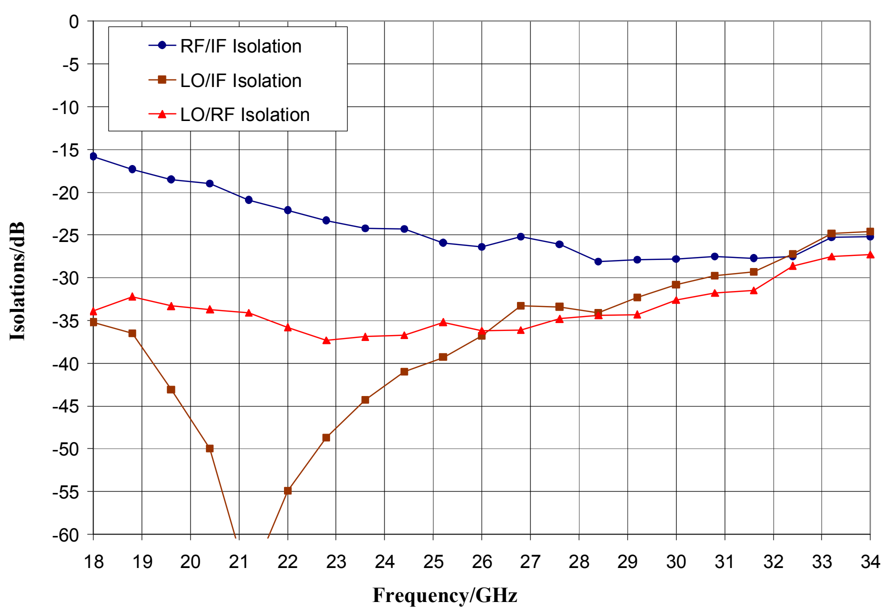
20-32 GHz Fundamental Mixer

Typical Performance

Conversion Gain vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



Isolation, LO = +13 dBm



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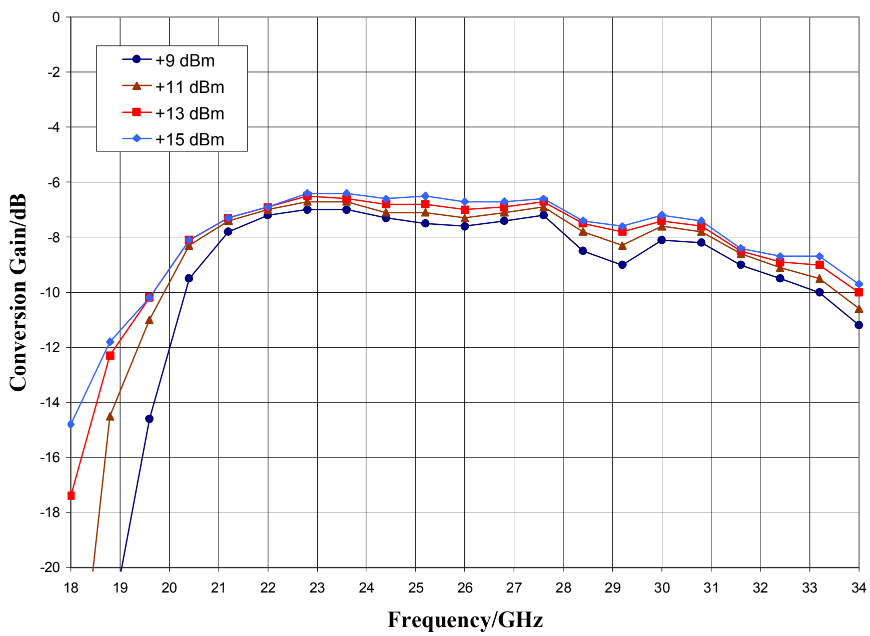
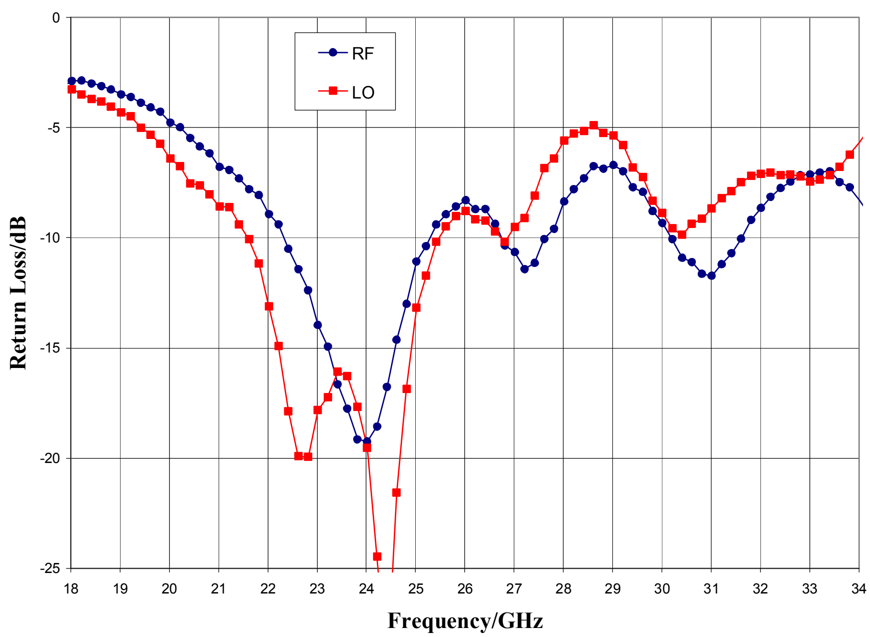
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 13 dBm



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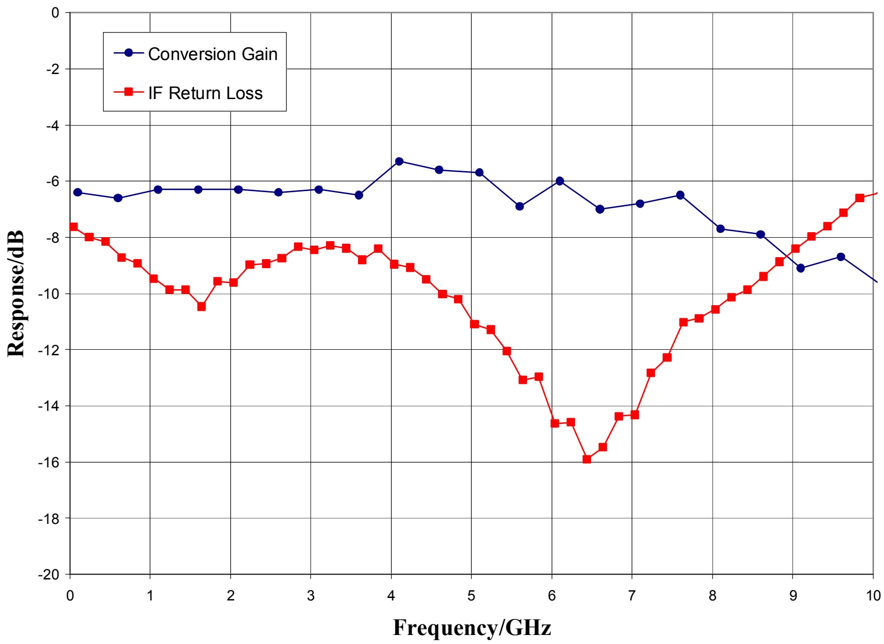
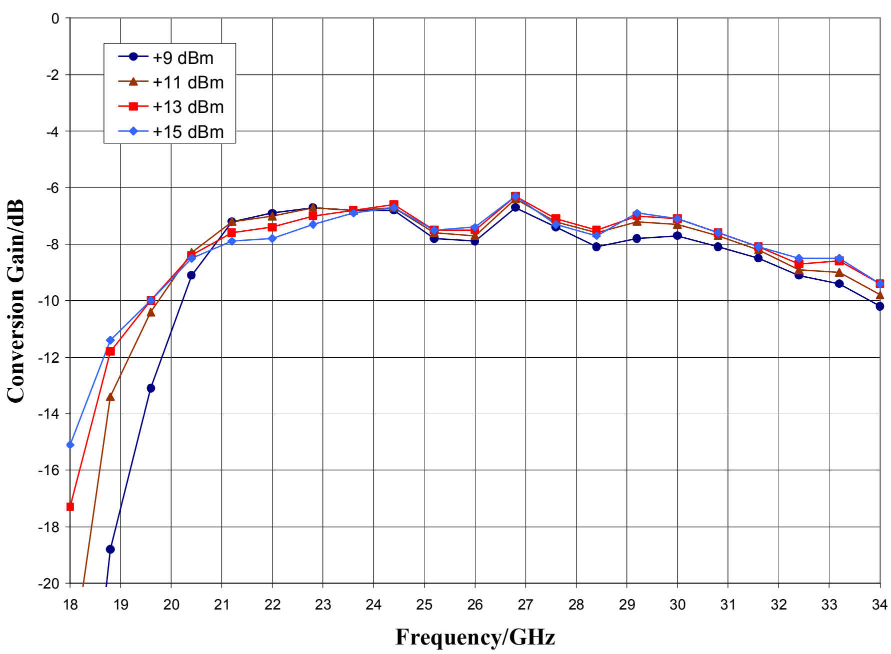
Typical Performance

IF Bandwidth, LO = +13 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 100 MHz



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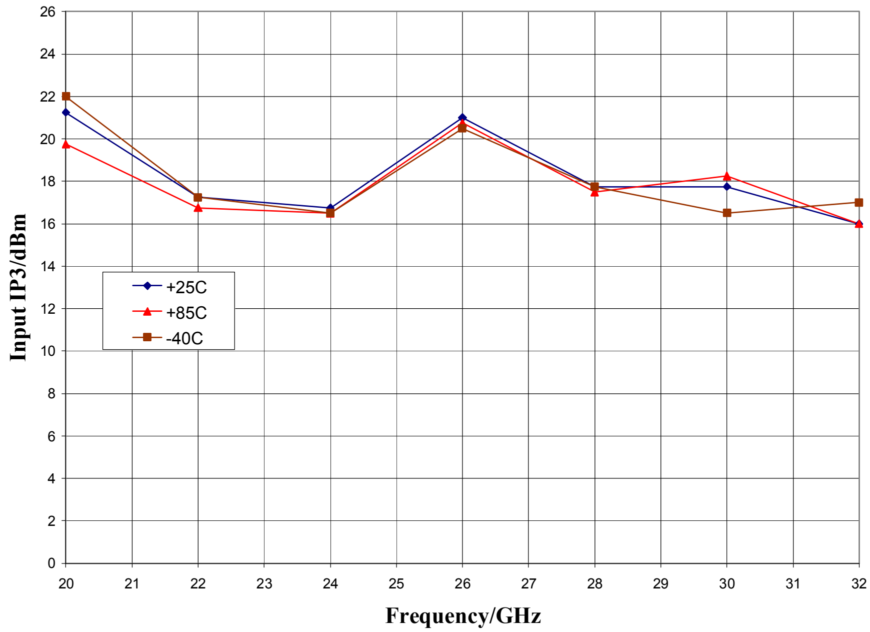
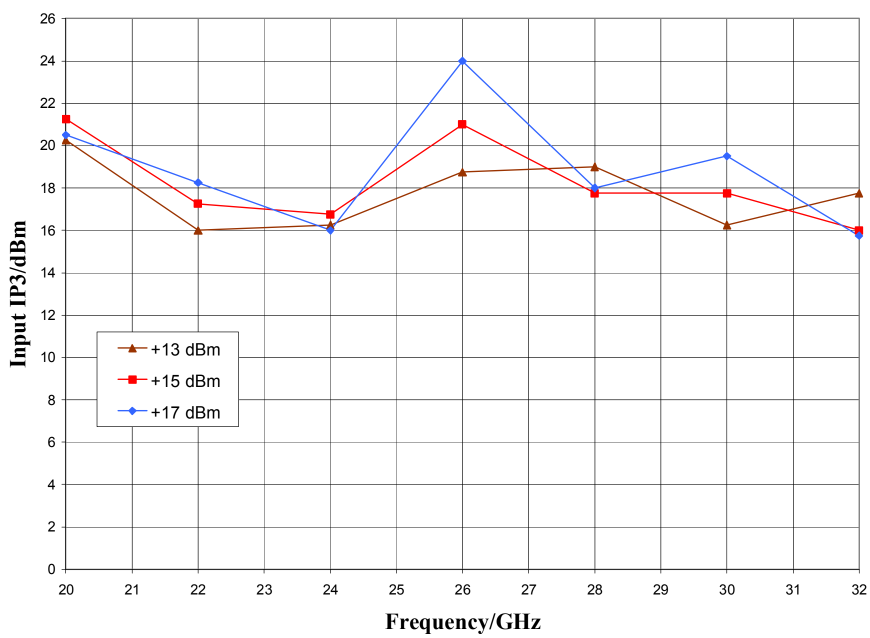
Typical Performance

Input IP3 vs. Temperature, LO = +15 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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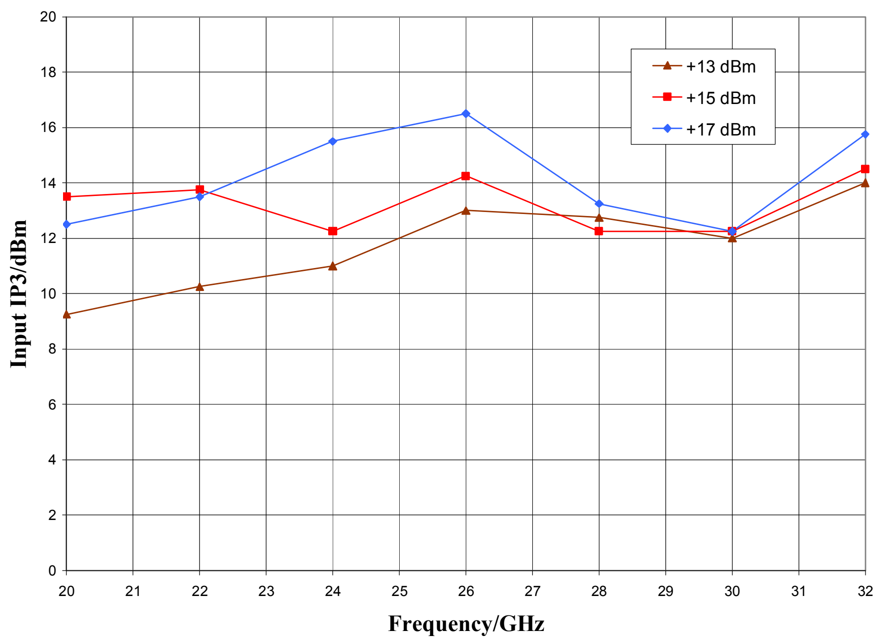
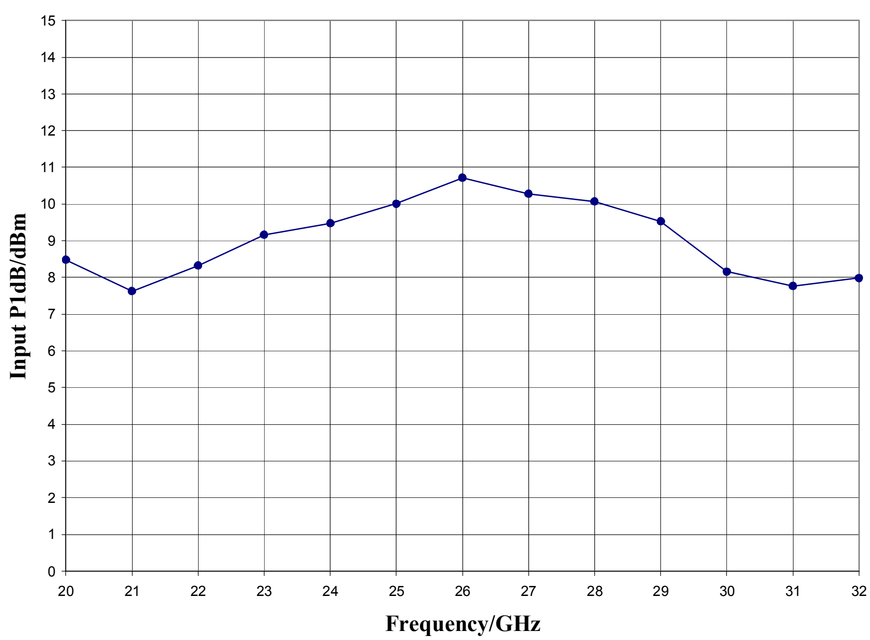
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB, LO = +13 dBm, IF = 100 MHz USB



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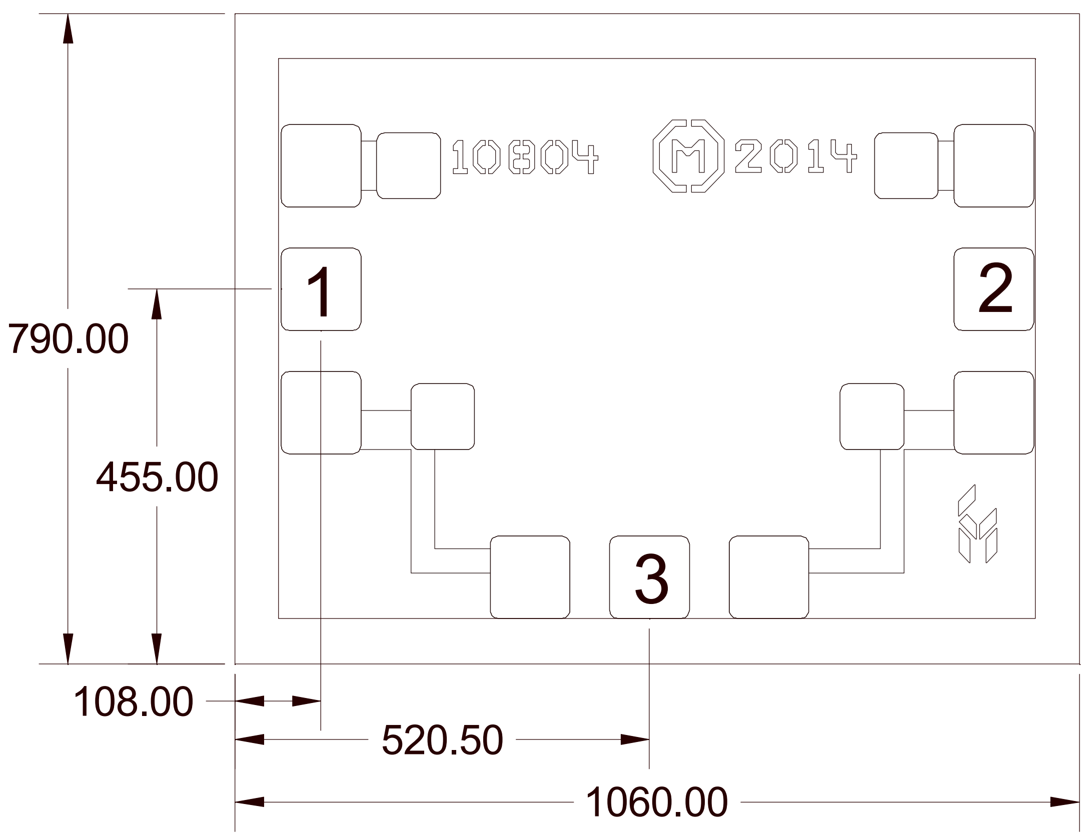
Mechanical Information

Die Outline (all dimensions in microns)



Notes:

1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 100 microns thick
5. All bond pads (1, 2, 3) are 100 x 100 microns

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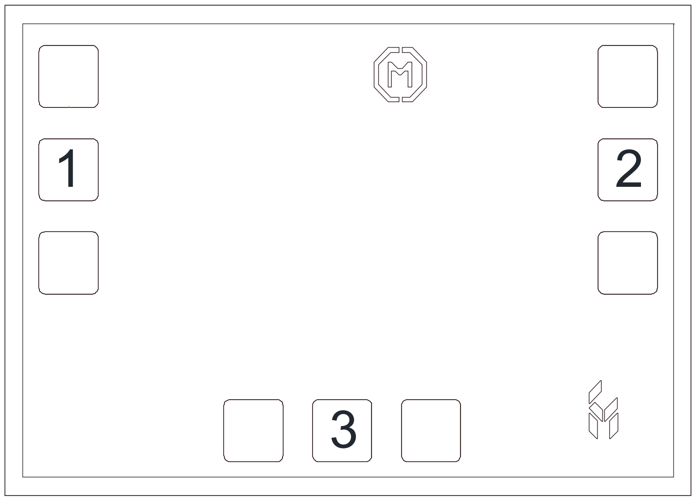
CMD180

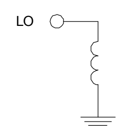
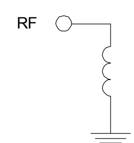
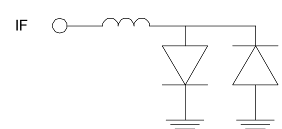
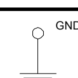
20-32 GHz Fundamental Mixer

Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	LO	This pin is DC coupled and matched to 50 ohms.	
2	RF	This pin is DC coupled and matched to 50 ohms.	
3	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
Backside	Ground	Connect to RF / DC ground.	

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CMD180

20-32 GHz Fundamental Mixer

Applications Information

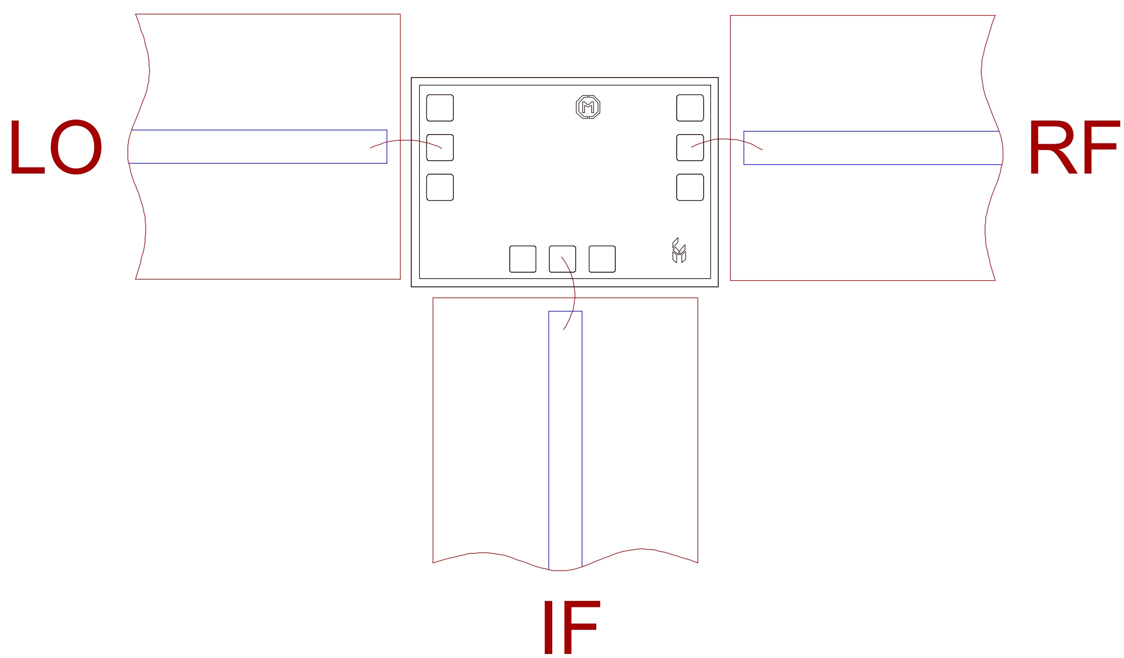
Assembly Guidelines

The backside of the CMD180 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD180C3

20-32 GHz Fundamental Mixer

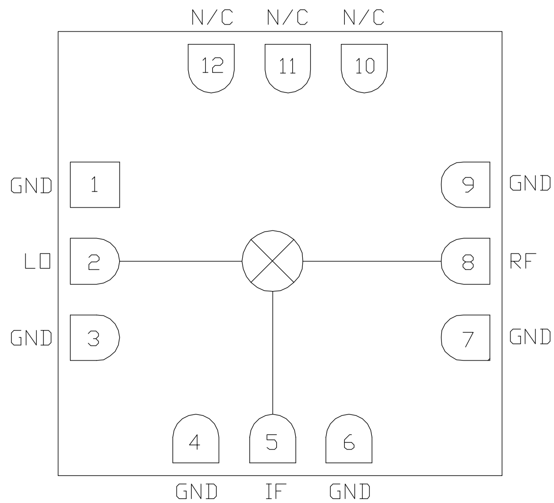
Features

- ► Low conversion loss
- ► High isolation
- ► Wide IF bandwidth
- ► Passive double balanced topology
- ► Pb-free RoHs compliant 3x3 mm SMT package

Description

The CMD180C3 is a general purpose double balanced mixer in a leadless surface mount package that can be used for up- and downconverting applications between 20 and 32 GHz. The CMD180C3 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +9 dBm. The CMD180C3 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Functional Block Diagram



Electrical Performance - IF = 100 MHz, LO = +13 dBm , T_A = 25 °C, F = 26 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		20 - 32		GHz
Frequency Range, IF	DC		10	GHz
Conversion Loss		7		dB
LO to RF Isolation		36		dB
LO to IF Isolation		36		dB
RF to IF Isolation		26		dB
Input P1dB		10		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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CMD180C3

20-32 GHz Fundamental Mixer

Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+21 dBm
LO Drive	+21 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	651.2 °C / W
Power Dissipation, Pdiss	99.8 mW

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications - IF = 100 MHz, LO = +13 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		22 - 28			20 - 32		GHz
Frequency Range, IF	DC		10	DC		10	GHz
Conversion Loss		7	9		7	11	dB
Noise Figure (SSB)		7	9		7	11	dB
LO to RF Isolation	31	36		27	36		dB
LO to IF Isolation	30	38		27	38		dB
RF to IF Isolation	19	26		16	26		dB
Input P1dB		10			9		dBm
Input IP3		18			18		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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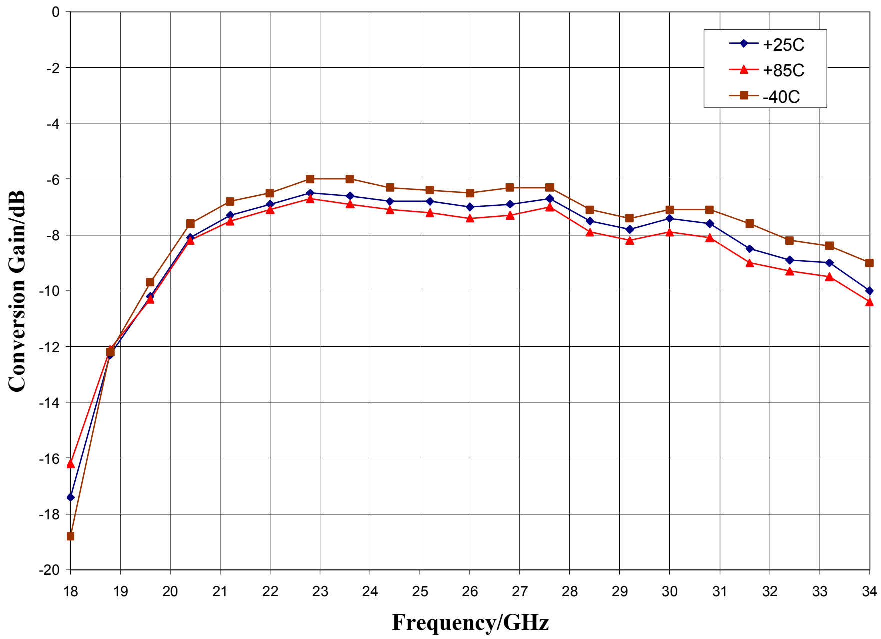
CMD180C3

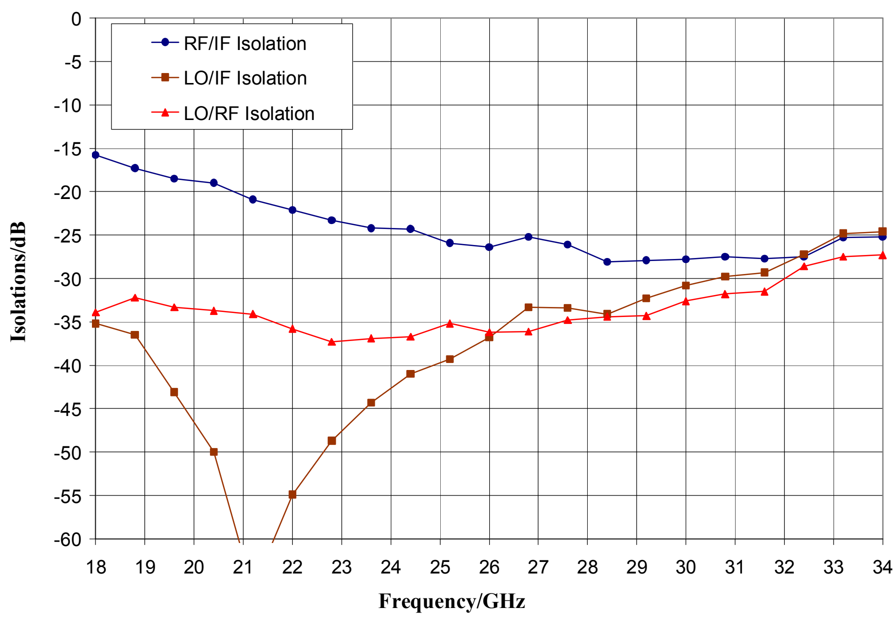
20-32 GHz Fundamental Mixer

Typical Performance

Conversion Gain vs. Temperature, LO = +13 dBm, IF = 100 MHz USB



Isolation, LO = +13 dBm



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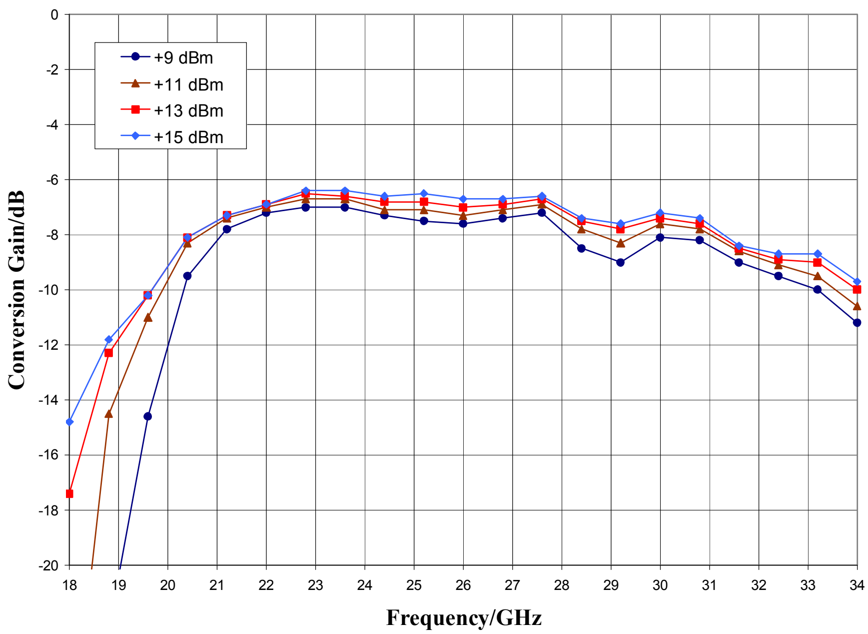
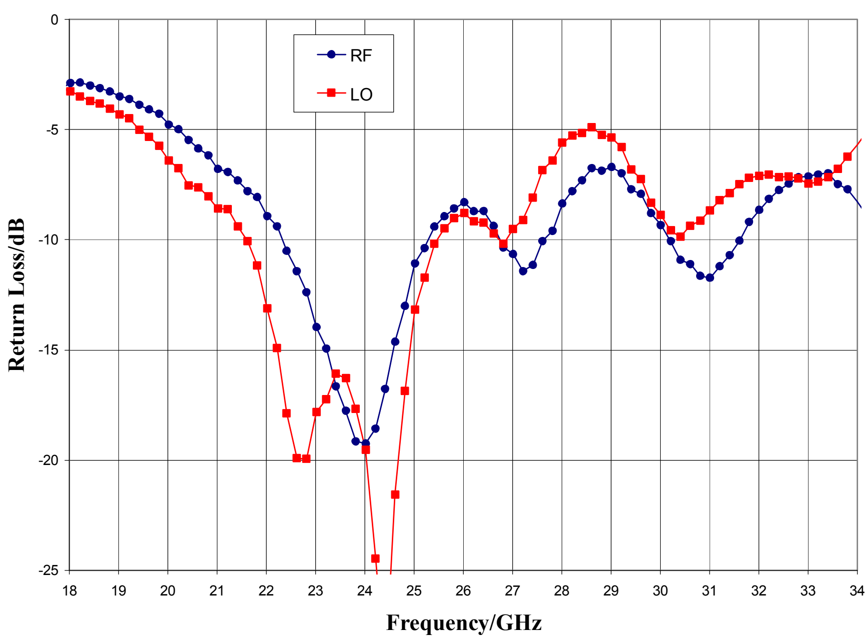
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 13 dBm



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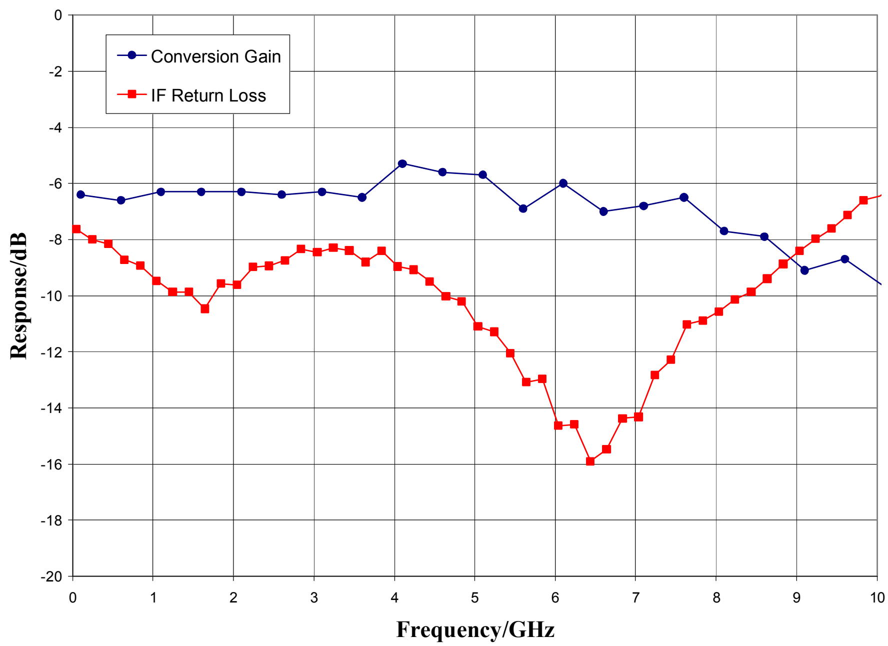
CMD180C3

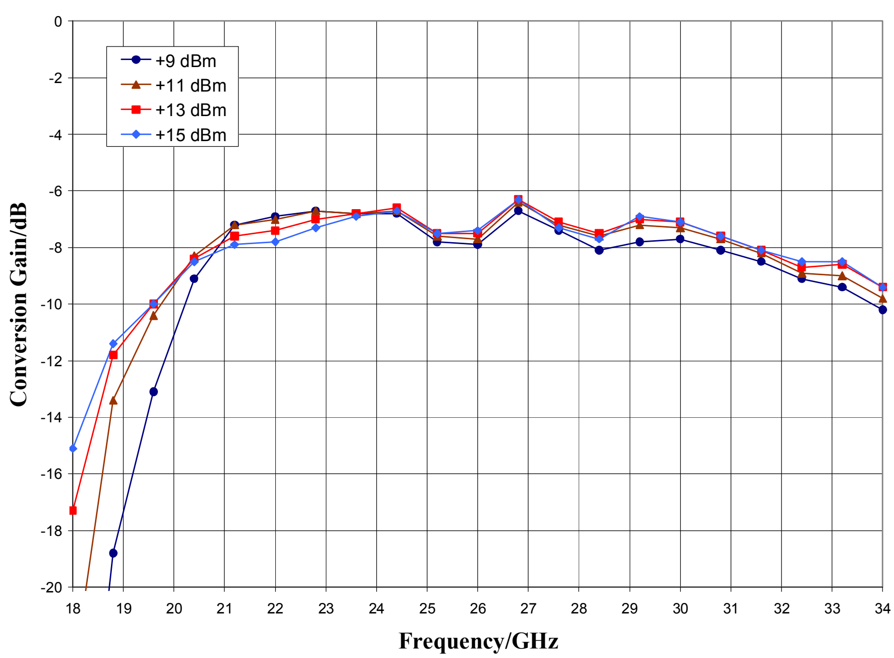
20-32 GHz Fundamental Mixer

Typical Performance

IF Bandwidth, LO = +13 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 100 MHz



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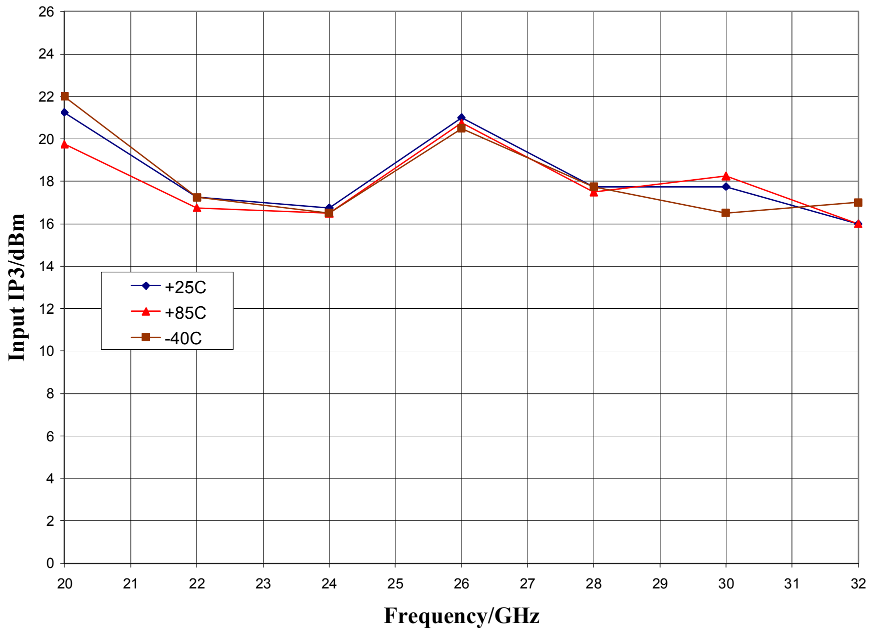
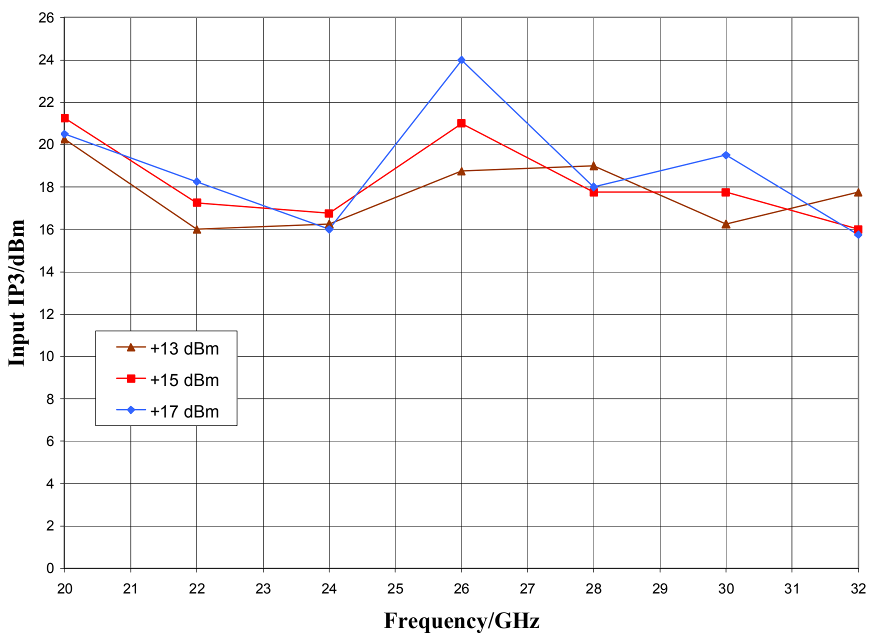
Typical Performance

Input IP3 vs. Temperature, LO = +15 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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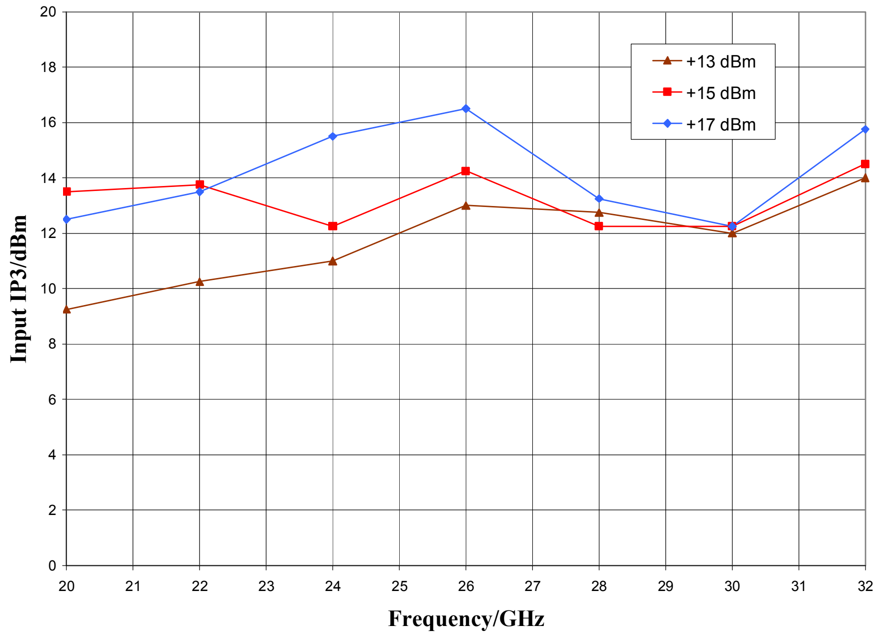
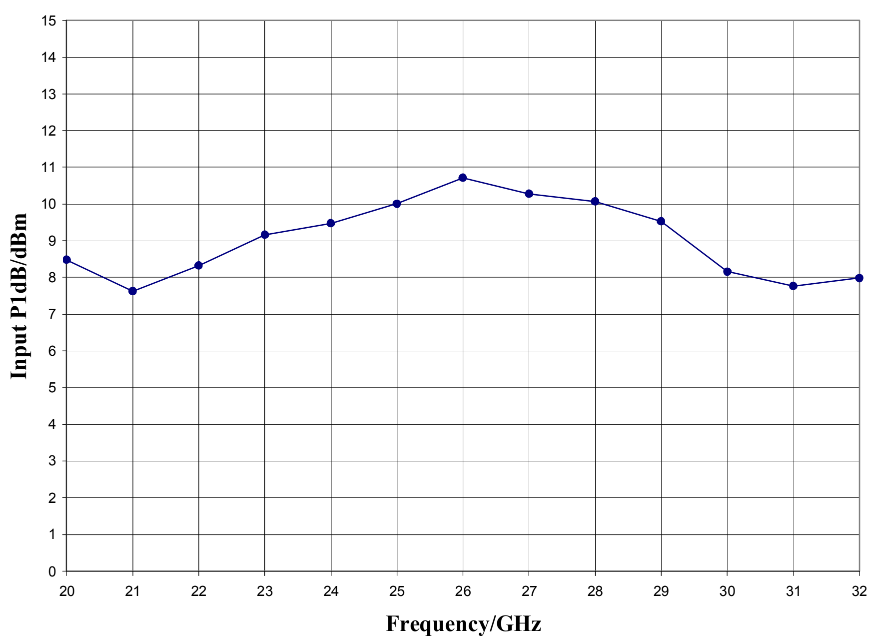
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB, LO = +13 dBm, IF = 100 MHz USB



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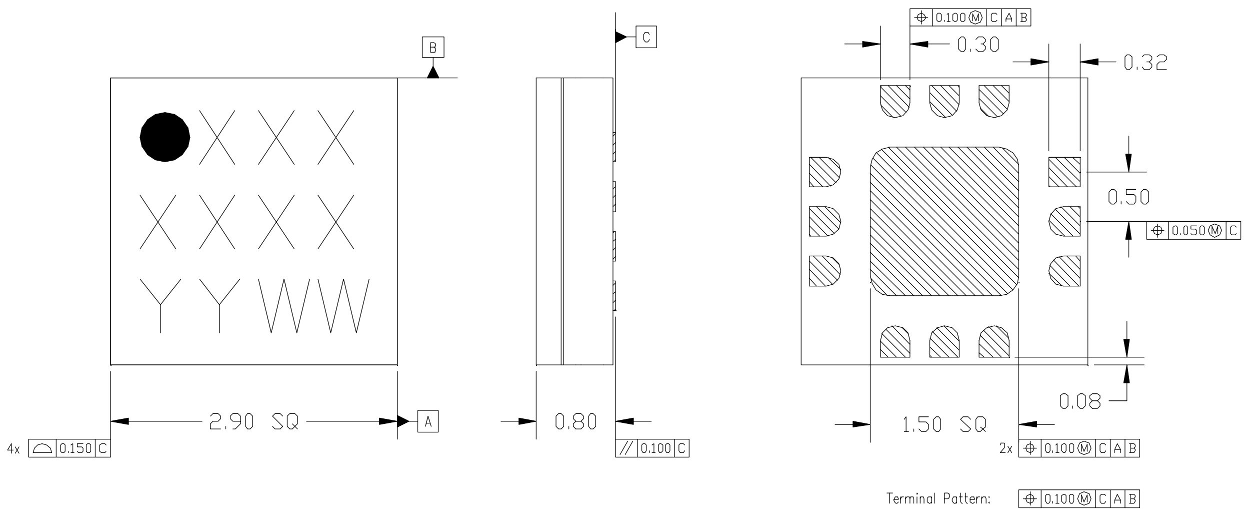
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   4.1. LINE 1: PART NUMBER
      4.1.1. EXAMPLE: CMD177C3 SHALL BE MARKED AS 177
   4.2. LINE 2: LOT NUMBER
   4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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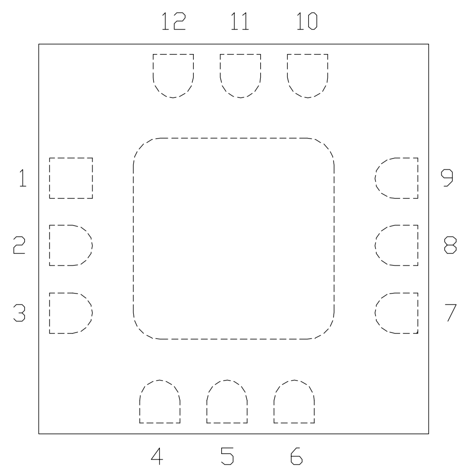
CMD180C3

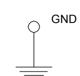
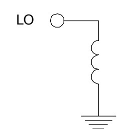
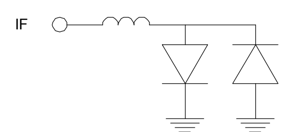
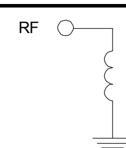
20-32 GHz Fundamental Mixer

Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1,3,4,6,7,9 and die paddle	Ground	Connect to RF / DC ground.	
2	LO	This pin is DC coupled and matched to 50 ohms.	
5	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
8	RF	This pin is DC coupled and matched to 50 ohms.	
10-12	N/C	No connection required. These pins may be connected to RF/DC ground	

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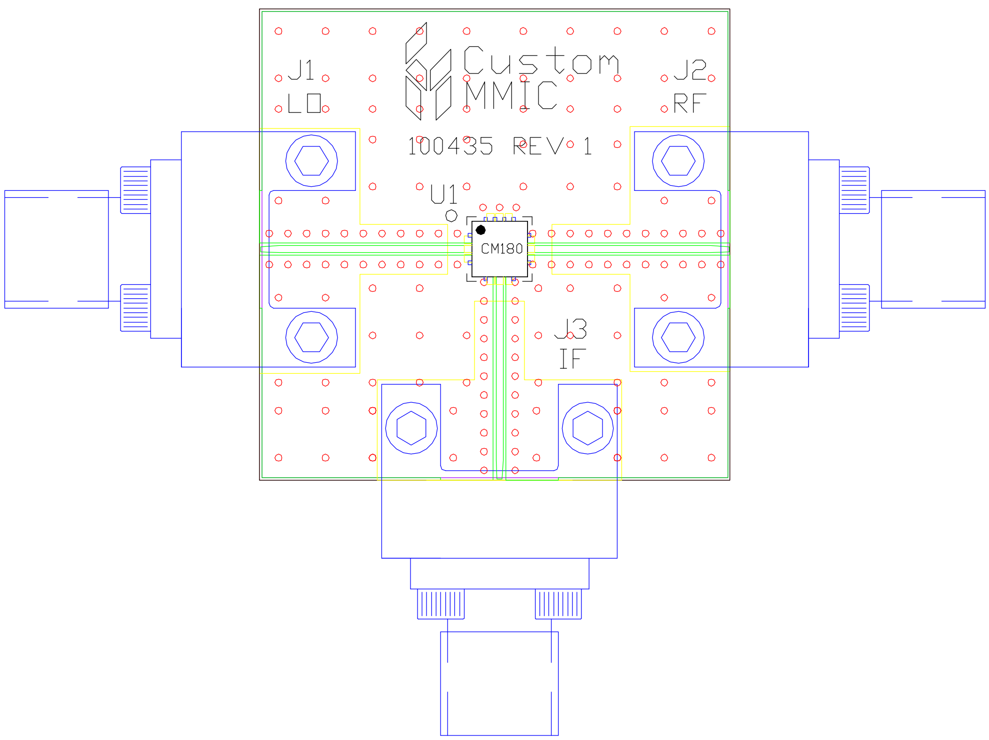
Applications Information

Evaluation Board

The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J3		2.92 mm End Launch Connector
U1		CMD180C3 Fundamental Mixer
PCB		100435 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD181

26-45 GHz Fundamental Mixer

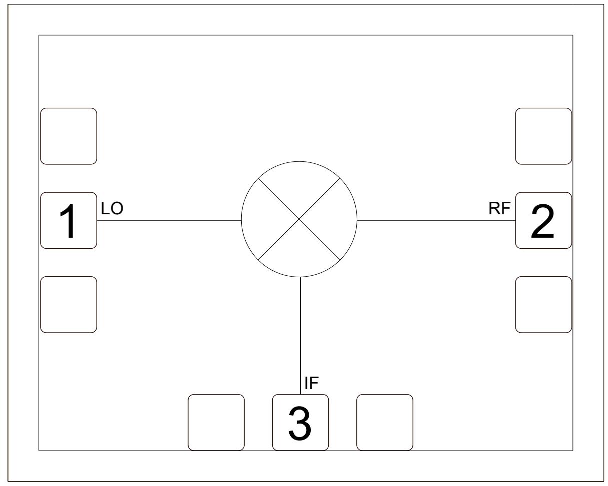
Features

- ► Low conversion loss
- ► High isolation
- ► Wide IF bandwidth
- ► Passive double balanced topology
- ► Small die size

Description

The CMD181 is a general purpose double balanced mixer die that can be used for up- and downconverting applications between 26 and 45 GHz. The CMD181 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +15 dBm. The CMD181 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Functional Block Diagram



Electrical Performance – IF = 5 GHz USB, LO = +17 dBm , T_A = 25 °C, LO = 34 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		26 – 45		GHz
Frequency Range, IF	DC		12	GHz
Conversion Loss		6.5		dB
LO to RF Isolation		37		dB
LO to IF Isolation		29		dB
RF to IF Isolation		35		dB
Input IP3		+22		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 5 GHz USB

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+23 dBm
LO Drive	+23 dBm
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	302.8 ºC / W
Power Dissipation, Pdiss	215 mW

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications – IF = 5 GHz, LO = +17 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		26 – 45		GHz
Frequency Range, IF	DC		12	GHz
Conversion Loss		6.5	9	dB
Noise Figure (SSB)		6.5	9	dB
LO to RF Isolation	32	37		dB
LO to IF Isolation	22	30		dB
RF to IF Isolation	30	35		dB
Input IP3	20	23		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 5 GHz

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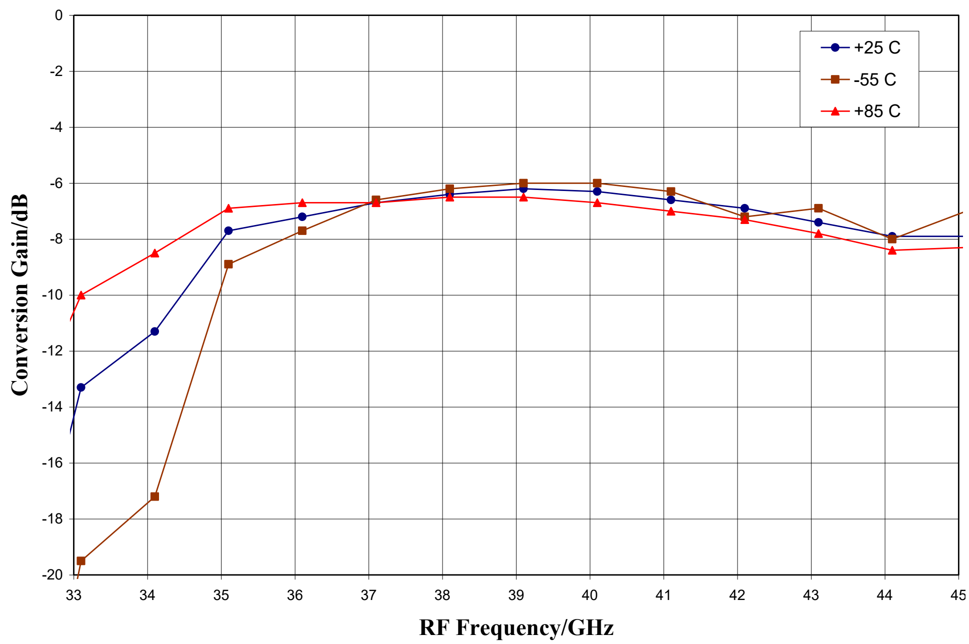
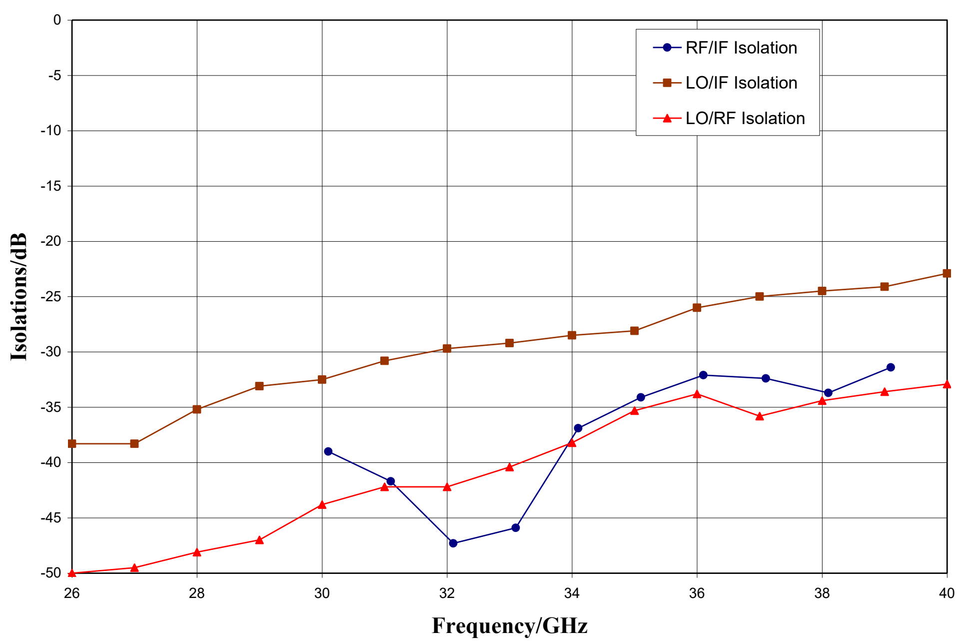
Typical Performance

Conversion Gain vs. Temperature, LO = +17 dBm, IF = 5 GHz USB



Isolation, LO = +17 dBm



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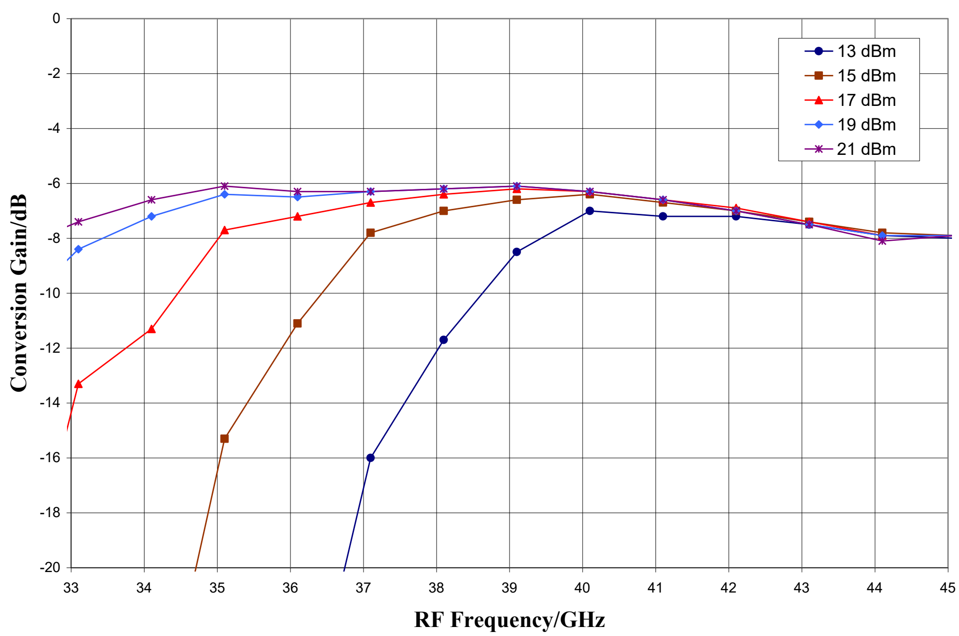
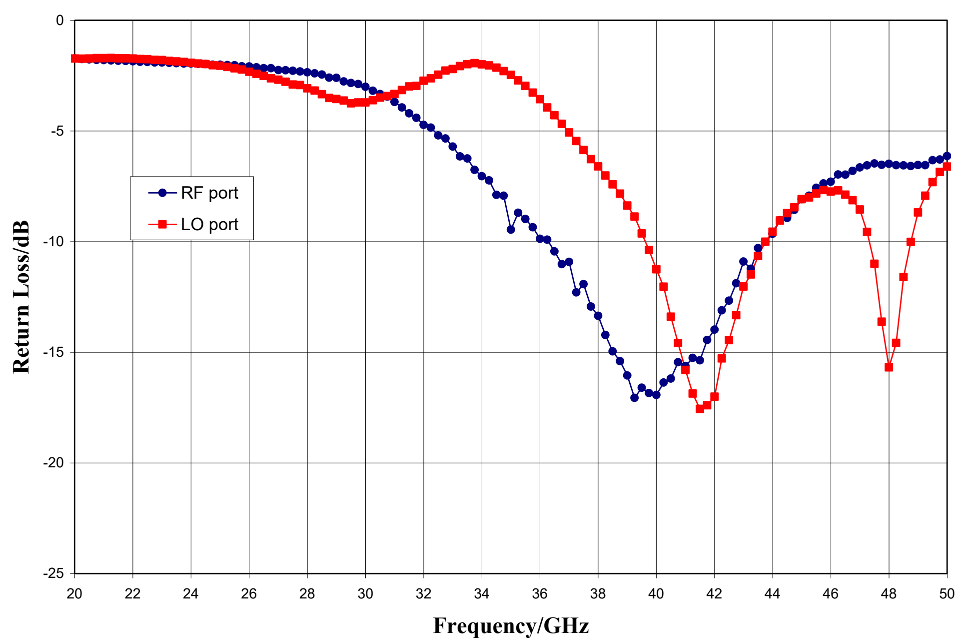
Typical Performance

Conversion Gain vs. LO Drive, IF = 5 GHz USB



Return Loss, LO = + 17 dBm



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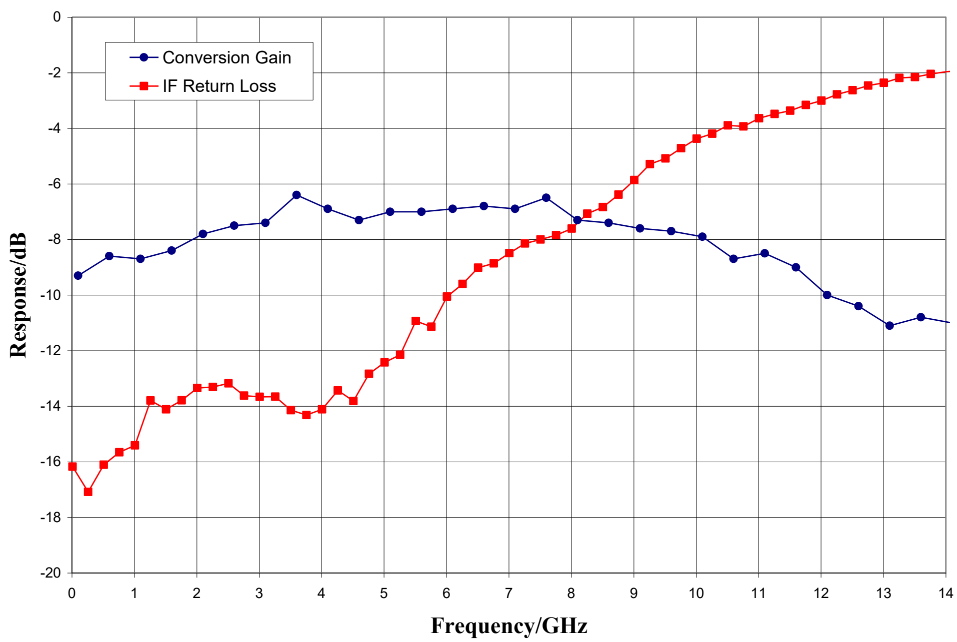
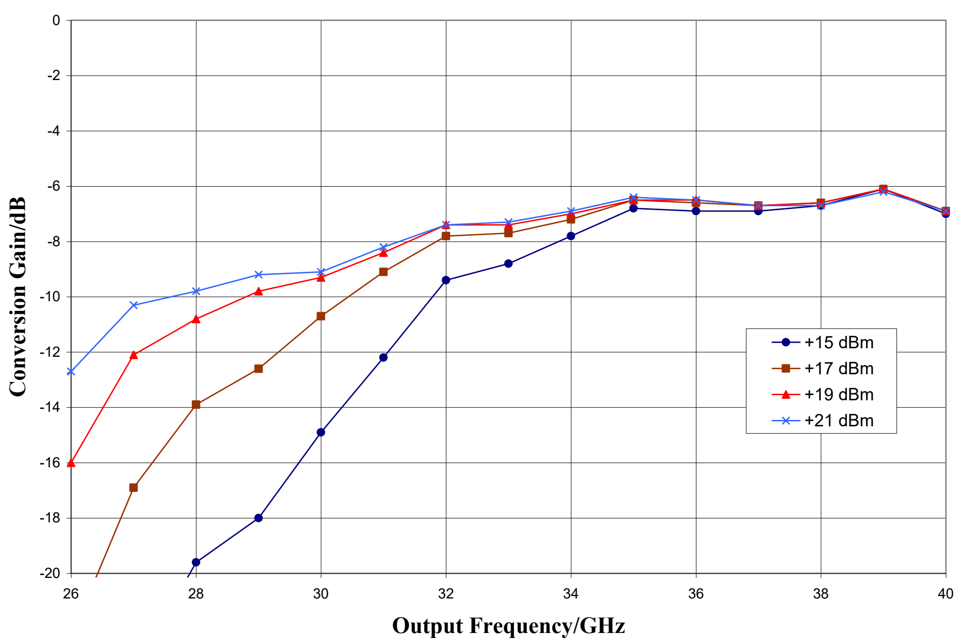
Typical Performance

IF Bandwidth, LO = +17 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 600 MHz



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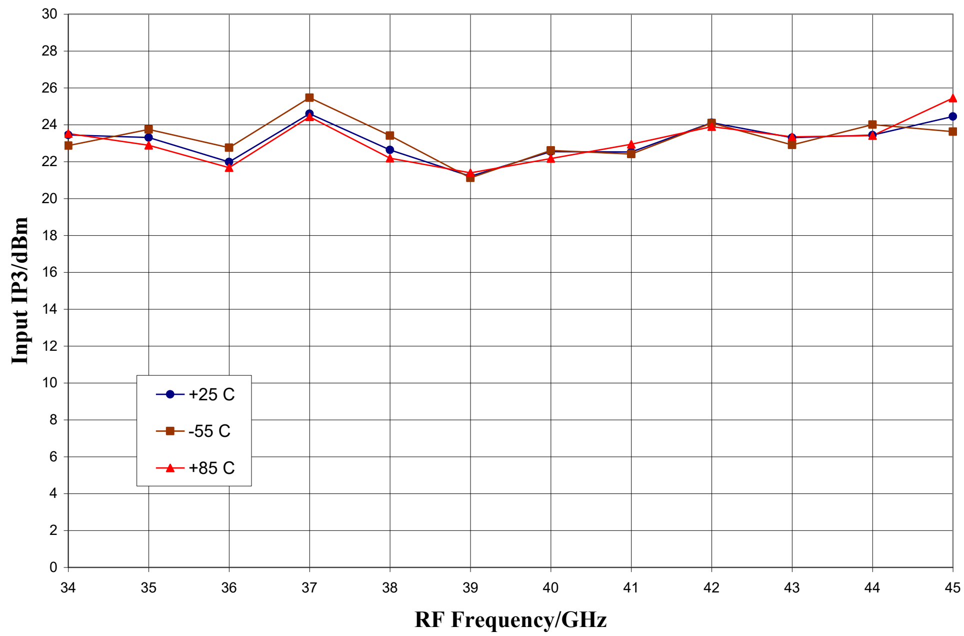
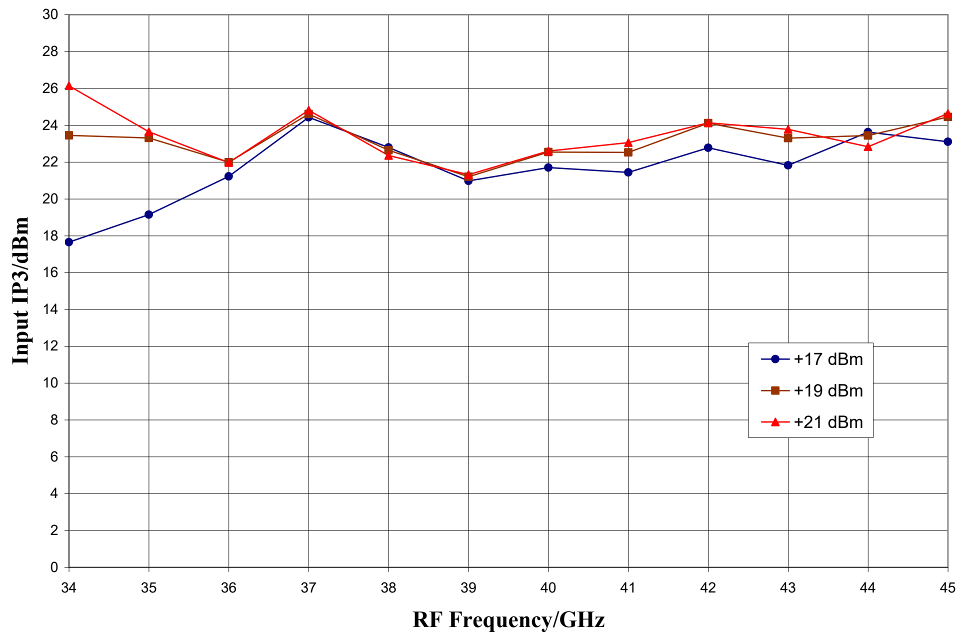
Typical Performance

Input IP3 vs. Temperature, LO = +19 dBm, IF = 5 GHz USB



Input IP3 vs. LO Drive, IF = 5 GHz USB



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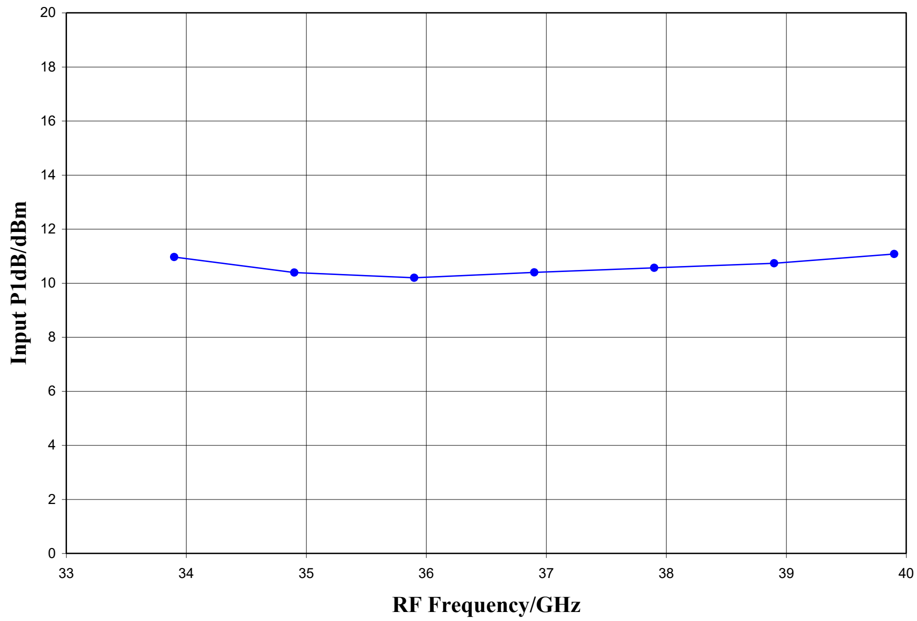
Typical Performance

Input P1dB, LO=+17 dBm, IF = 5 GHz USB



M x N Spur Table

	nLO				
mRF	0	1	2	3	4
0	xx	-3			
1	27	0	50		
2			59	64	
3				74	> 80
4					> 80

RF = 39.1 GHz @ -10 dBm
LO = 34.0 GHz @ +17 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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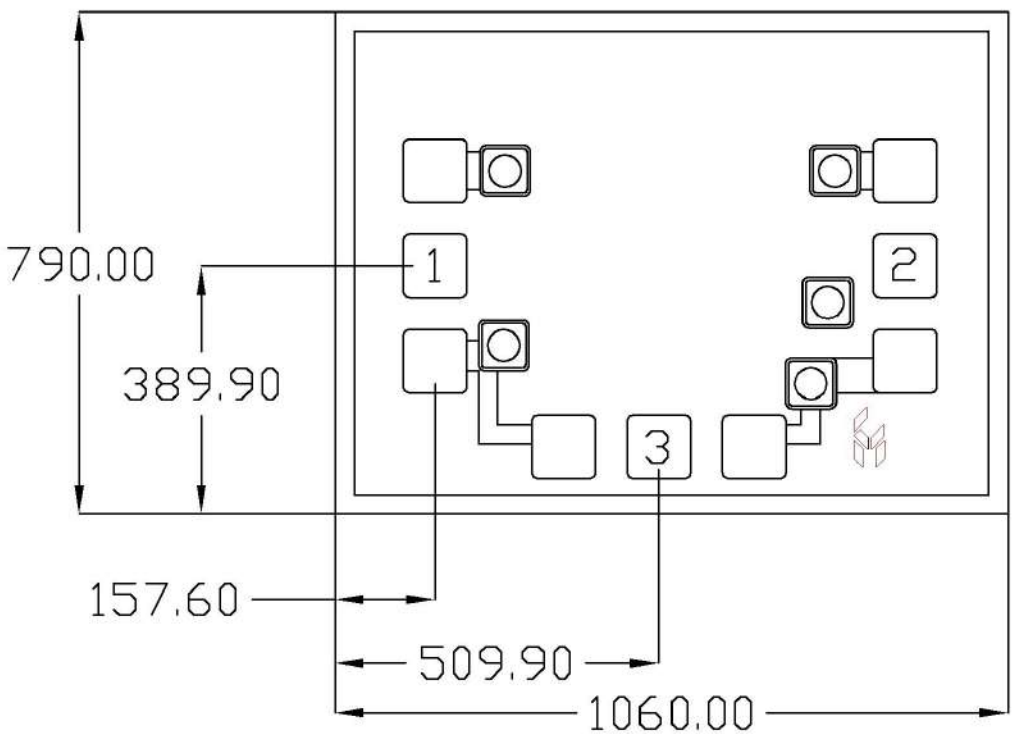
Mechanical Information

Die Outline (all dimensions in microns)



Notes:
1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 100 microns thick
5. All bond pads (1, 2, 3) are 100 microns square

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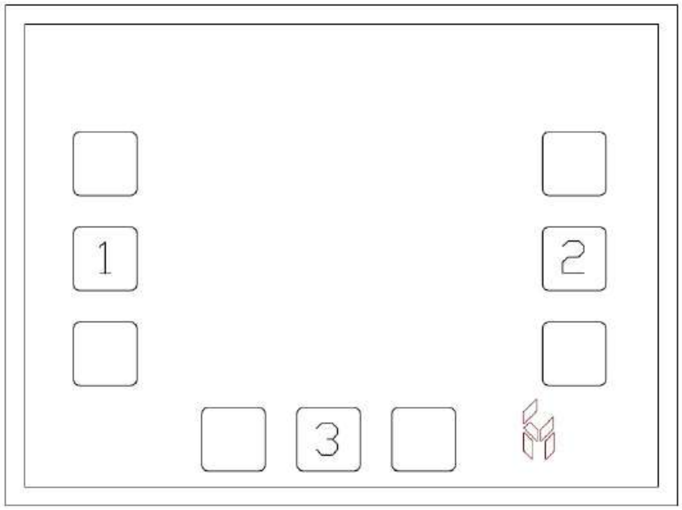
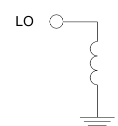
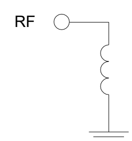
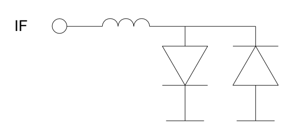
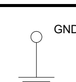
Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	LO	This pin is DC coupled and matched to 50 ohms.	
2	RF	This pin is DC coupled and matched to 50 ohms.	
3	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
Backside	Ground	Connect to RF / DC ground.	

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Applications Information

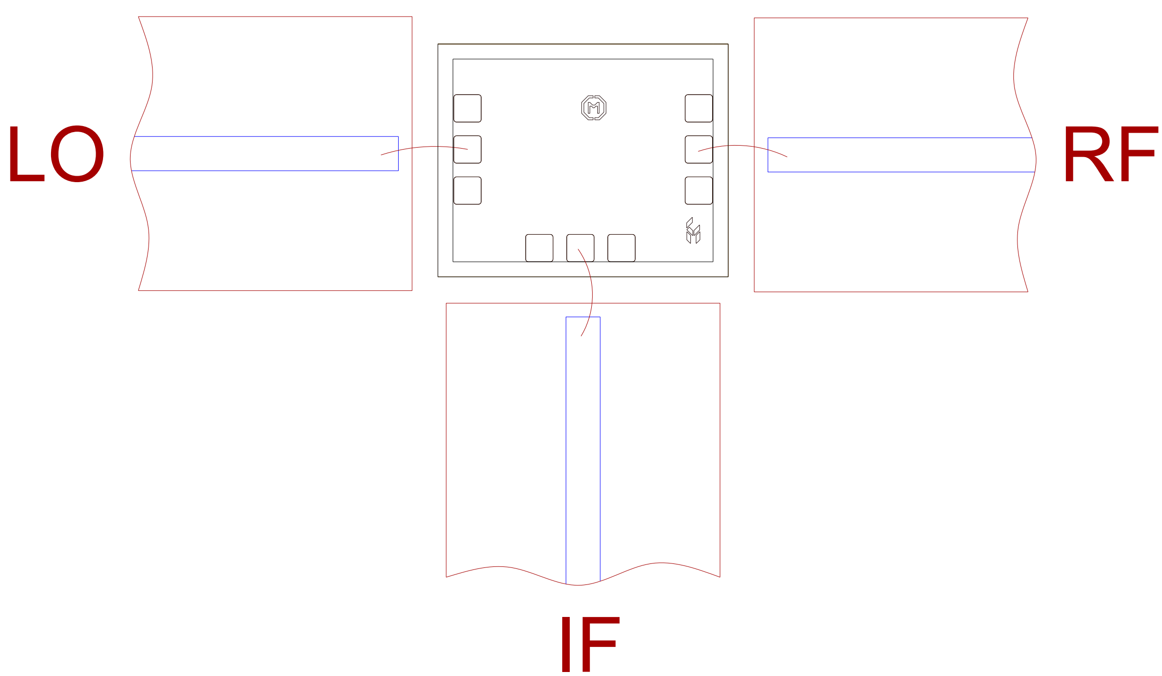
Assembly Guidelines

The backside of the CMD181 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

Please note, all information contained in this data sheet is subject to change without notice. ver 1.1 0518

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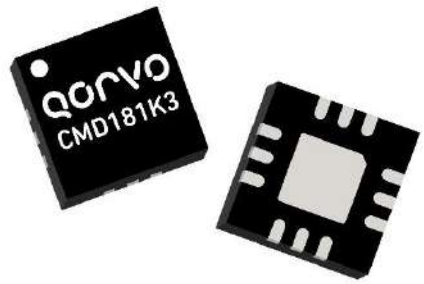
CMD181K3

26-44 GHz Mixer

Product Overview

Qorvo's CMD181K3 is a general purpose, double balanced mixer in a leadless 3 x 3 mm air cavity surface mount package. Operating over the RF bandwidth of 26 to 44 GHz, the mixer has very low conversion loss and high isolations to both the RF and IF ports due to the optimized balun structures. The mixer can also be configured as either an image reject mixer or a single sideband upconverter with external hybrids and power splitters. The CMD181K3 is a much smaller alternative to higher cost hybrid mixer assemblies.

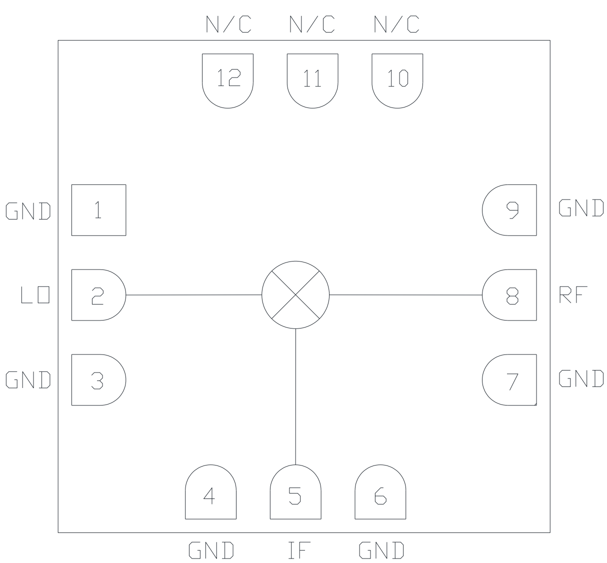


Key Features

- Single ended output
- RF, LO Frequency Range: 26 – 44 GHz
- IF Frequency Range: DC – 10 GHz
- Low conversion loss of 10 dB at 38 GHz
- High LO/RF isolation > 50 dB at 38 GHz
- Wide operating bandwidth
- Package dimensions: 3 x 3 x 1.2 mm

Performance is typical across frequency. Please reference electrical specification table and data plots for more details.

Functional Block Diagram



Applications

- Downconversion
- Upconversion
- Bi-phase modulation
- Low noise receiver systems
- Electronic Warfare (EW)

Ordering Information

Part No.	Description
CMD181K3	Tape & Reel Qty=100, MOQ=100
CMD181K3EVB	Evaluation Board, Qty=1

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Absolute Maximum Ratings

Parameter	Rating
LO, RF, or IF power, CW, 25 °C	+25 dBm
Channel Temperate, Tch	150 °C
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Mounting Temperature (30 sec)	260 °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
LO Drive Power	+13	+17	+23	dBm
RF input Power (downconversion)			+19	dBm
IF Input Power (upconversion)			+19	dBm
Temperature Range	-40	+25	+85	°C

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

Electrical Specifications

Test conditions unless otherwise noted: 25 °C, IF = 5 GHz USB, LO = +17 dBm

Parameter	Min	Typ.	Max	Units
RF, LO Operational Frequency Range	26	–	44	GHz
IF Frequency Range	DC	–	10	GHz
Conversion Gain	-13.5	-10	–	dB
LO to RF Isolation	–	40	–	dB
LO to IF Isolation	–	32	–	dB
Input Power (P_{1dB})	–	+14	–	dBm
Input IP3	–	+27	–	dBm

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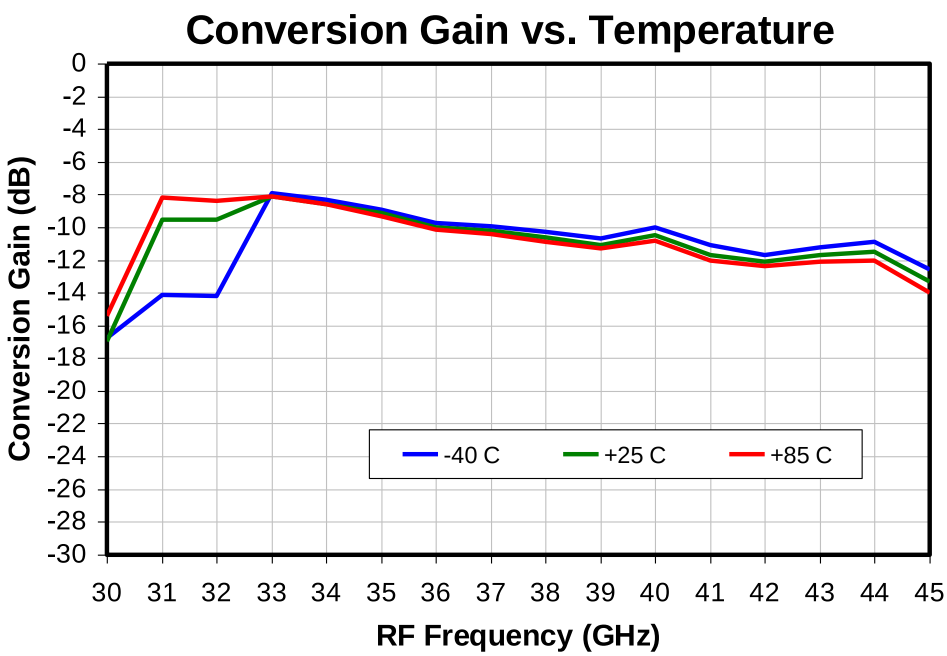
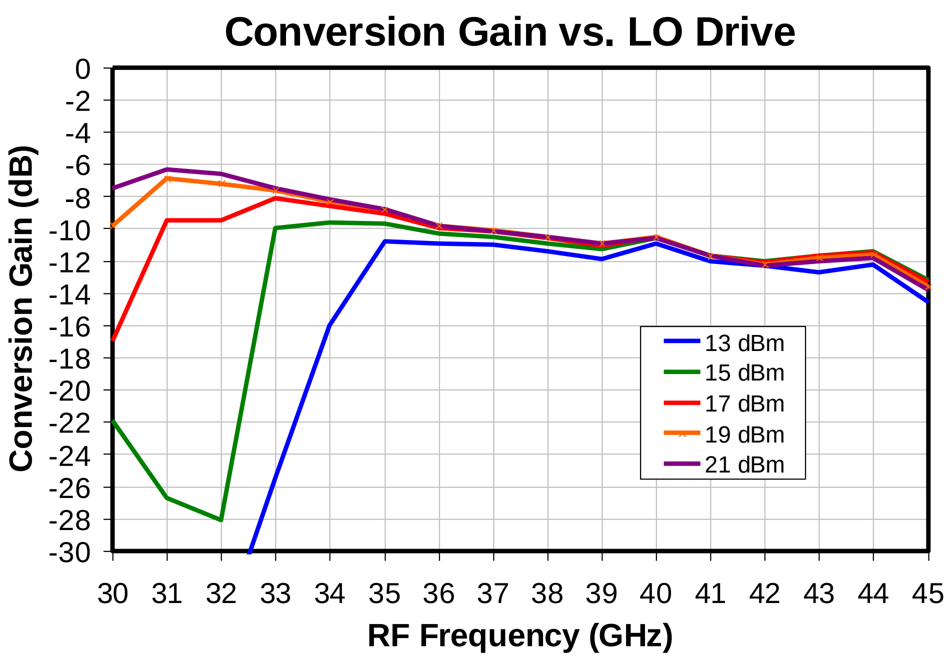
Typical Performance – Data Taken as Downconverter, IF=5 GHz USB





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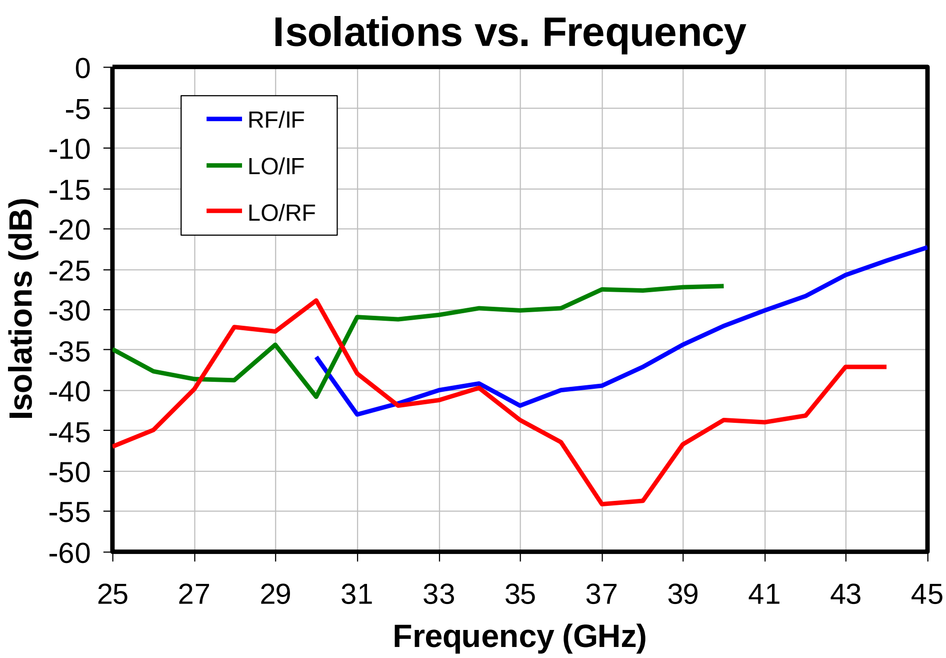
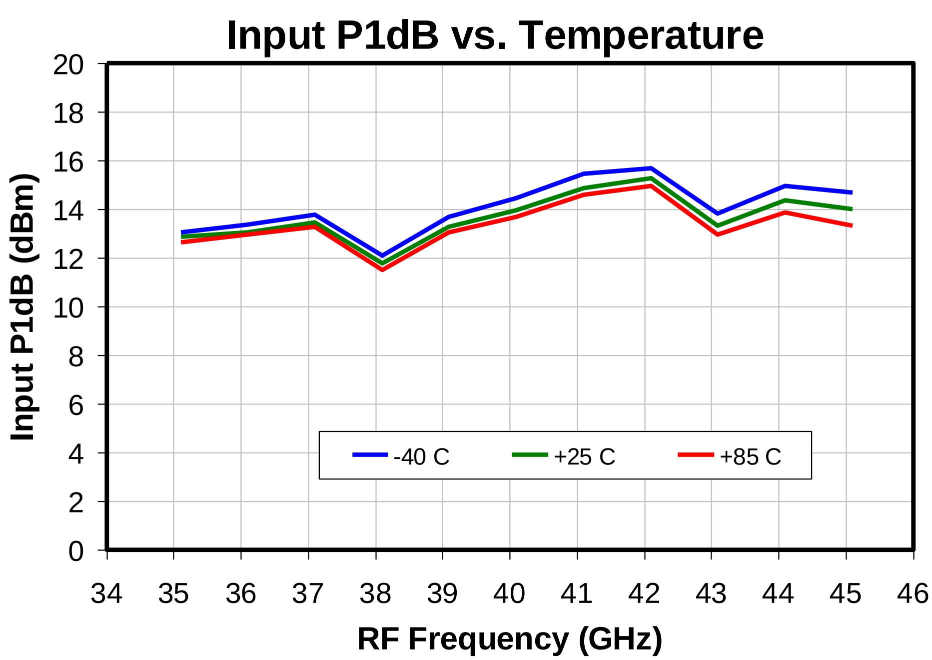
Typical Performance – Data Taken as Downconverter, IF=5 GHz USB





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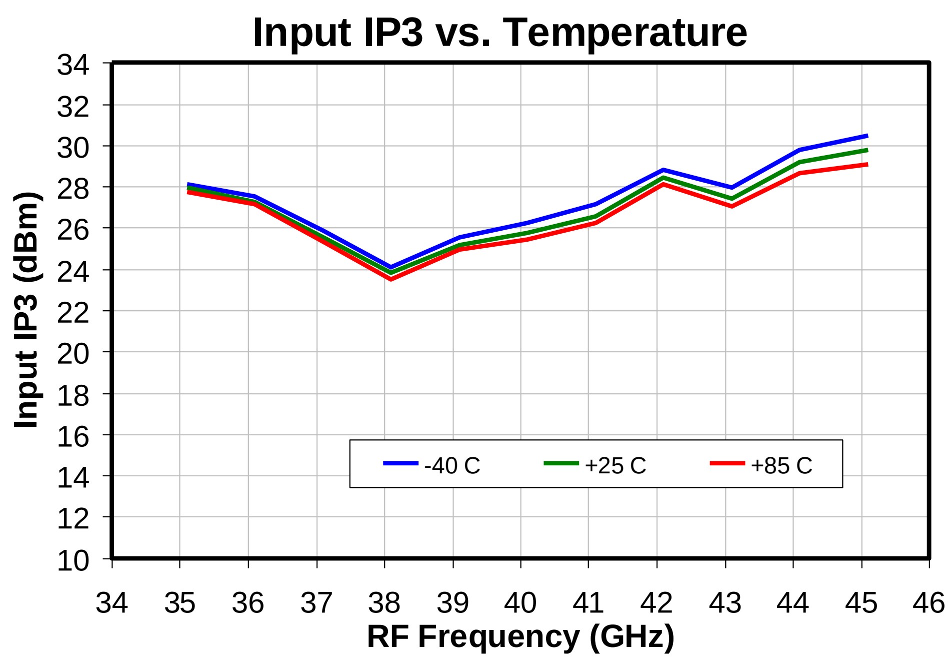
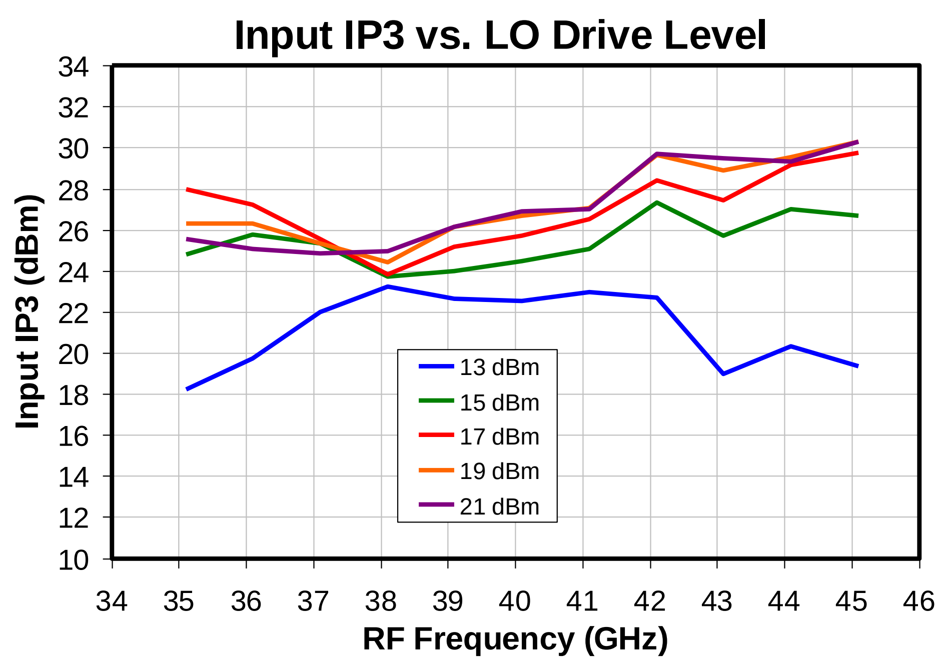
Typical Performance – Data Taken as Downconverter, IF=5 MHz USB





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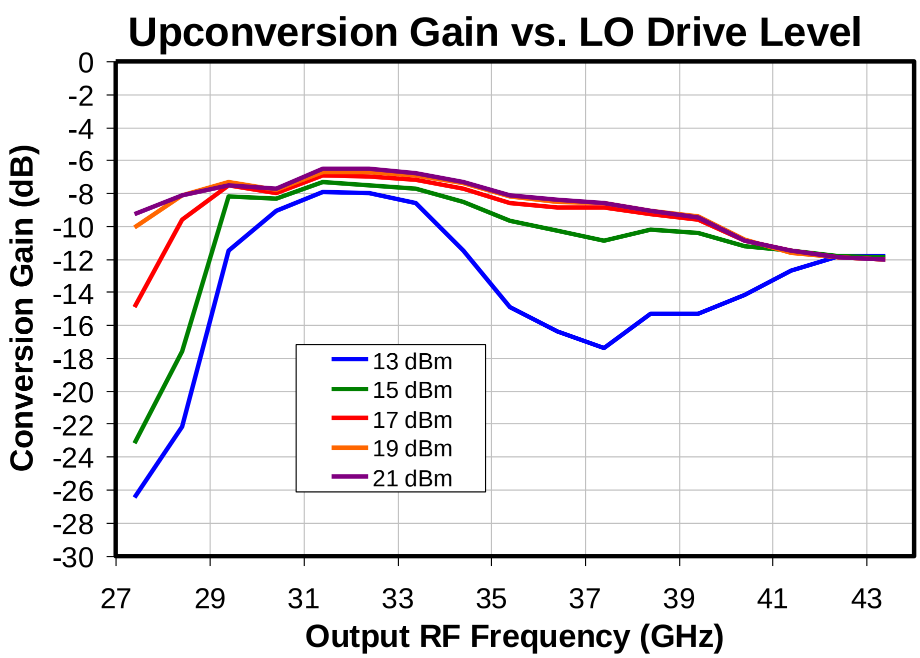
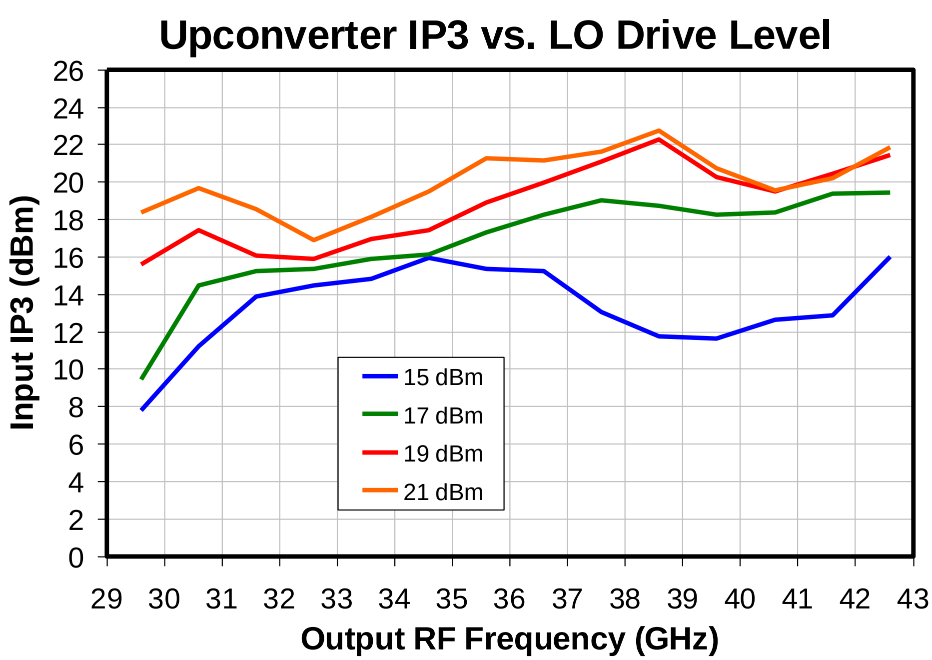
Typical Performance – Data Taken as Upconverter, IF=600 MHz USB





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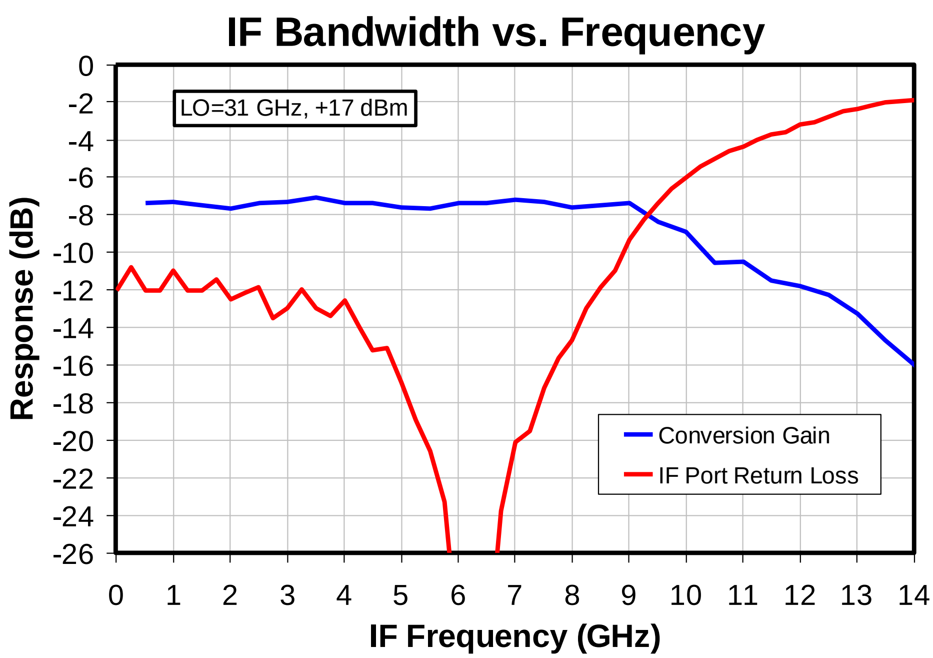
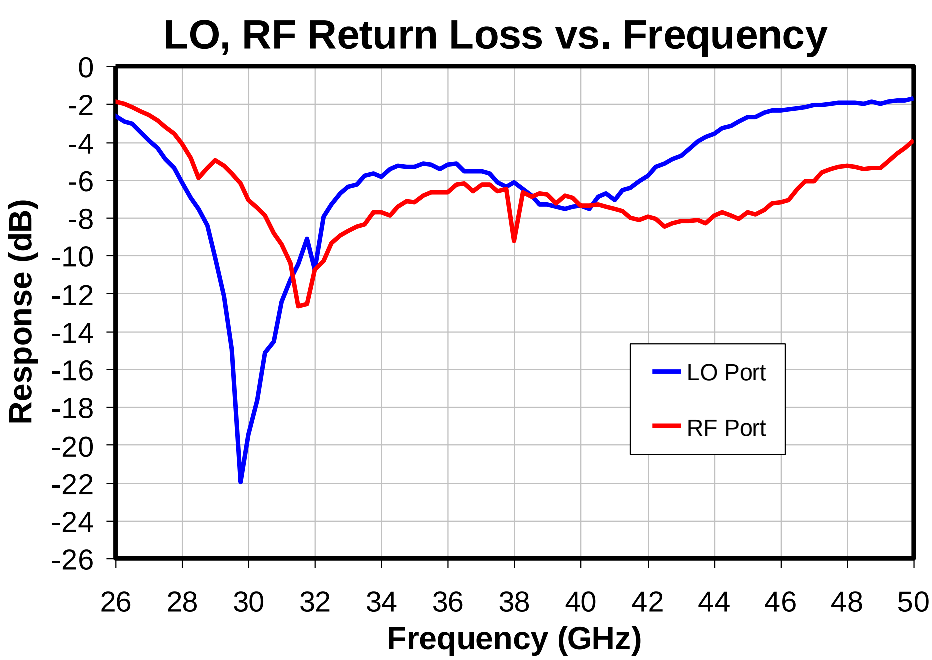
Typical Performance





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Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) [1]	T_{BASE} = 85 °C, CW, LO P_{IN} = 17 dBm (0.05 W), P_{DISS} = 0.05 W	302.8	ºC/W
Channel Temperature (T_{CH}) [1]		100.14	°C
Median Lifetime (T_M)		6.0E6	Hrs

Notes:
1. Measured to the back of the package.

Spur Performance

	nLO				
mRF	0	1	2	3	4
0	x	-3			
1	28	0	52		
2		61	58	65	
3				68	
4					

RF = 39.1 GHz, -10 dBm
LO = 34 GHz, +17 dBm
All values in dBc below IF output power level (1RF – 1LO)
Data taken as downconverter

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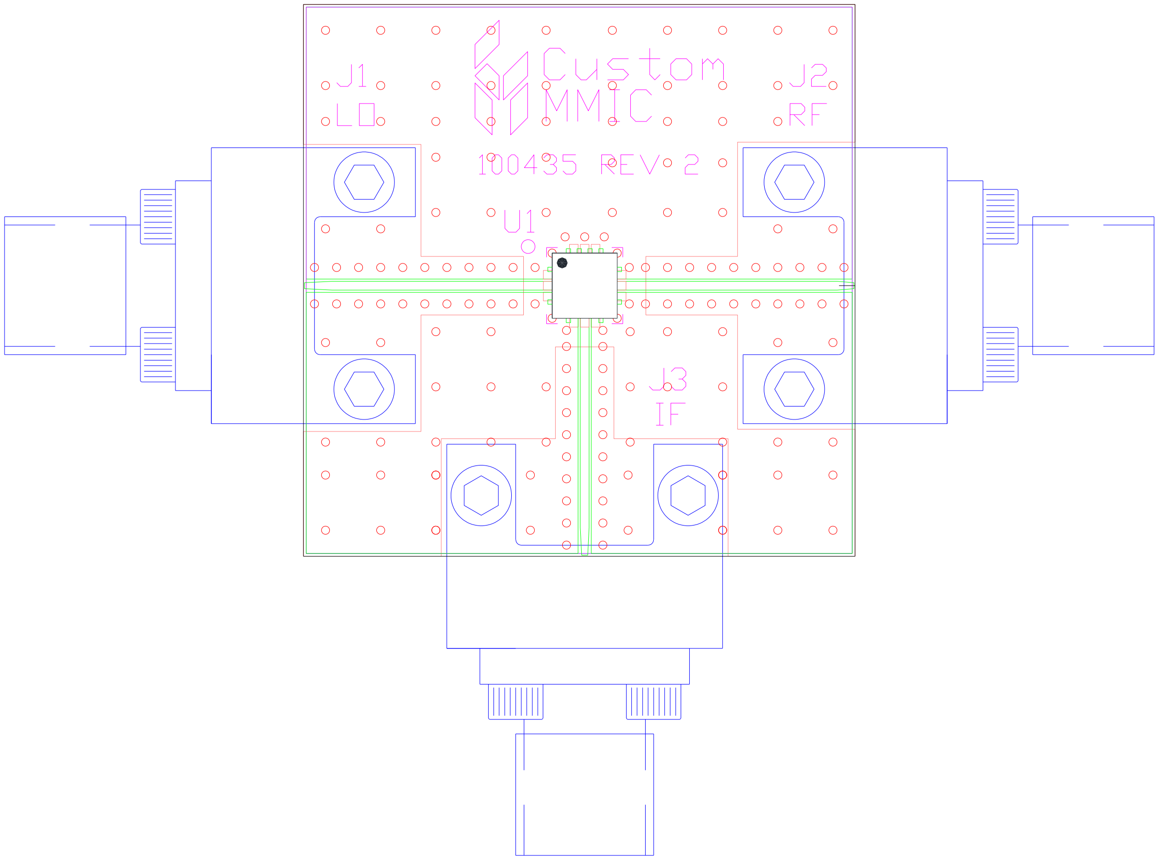
Evaluation Board (EVB) Assembly Layout



Bill of Materials for CMD181K3-EVB

Reference Des.	Value	Description	Manuf.	Part Number
J1, J2, J3		2.4 mm End Launch "V" Connector		
U1		CMD181K3 I/Q Mixer	Qorvo	
PCB		100435 Evaluation PCB		

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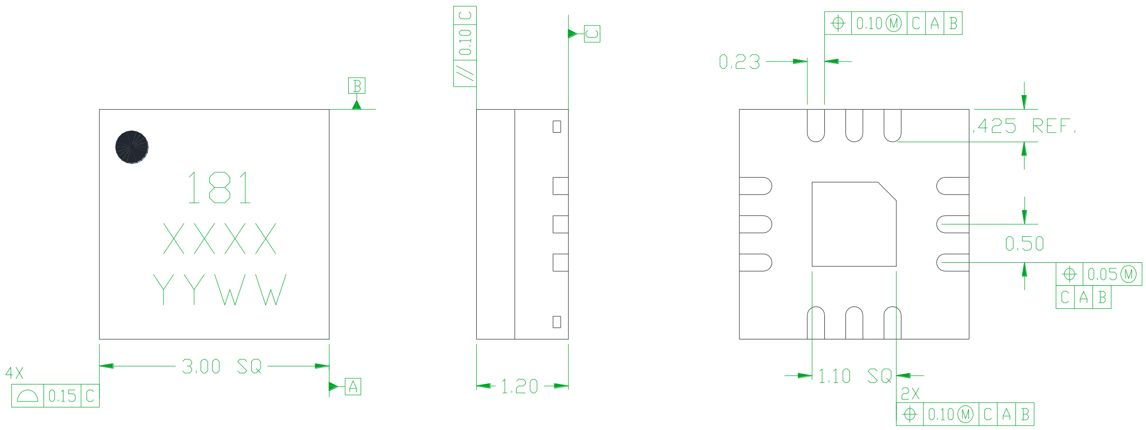
Mechanical Information



NOTES:
1. ALL DIMENSIONS AND TOLERANCES ARE WITHIN THOSE INDICATED IN JEDEC MO-220 WITH EXCEPTION OF TOTAL THICKNESS. ALL DIMENSION SHOWN AS mm. CONTROLLING DIMENSION ARE IN mm.
2. LEAD FINISH: ELECTROLESS NICKEL ELECTROLESS PALLADIUM IMMERSION GOLD (ENEPIG) PLATING IN ACCORDANCE WITH IPC-4556
3. MARKING: ALL MARKING SHALL BE PERMANENT AND LEGIBLE
   LINE 1: PART NUMBER AS INDICATED
   LINE 2: LOT NUMBER SHALL CONSIST OF THE LAST 4 DIGITS OF THE PO NUMBER
   LINE 3: DATE CODE SHALL CONSIST OF THE LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2-DIGIT WEEK CODE.
4. INDICATED DIMENSION/TOLERANCE APPLIES TO LEADS AND EXPOSED PAD.
5. REFERENCE ASSEMBLY DRAWING 102712 FOR ASSEMBLY INFORMATION.
6. ALTERNATE PIN #1 IDENTIFIER WITH CORNER CHAMFER ON GROUND PADDLE IS ACCEPTABLE.

Recommended PCB Land Pattern

Qorvo recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Qorvo Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Qorvo recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Qorvo Application Note AN 102 for a recommended solder reflow profile.

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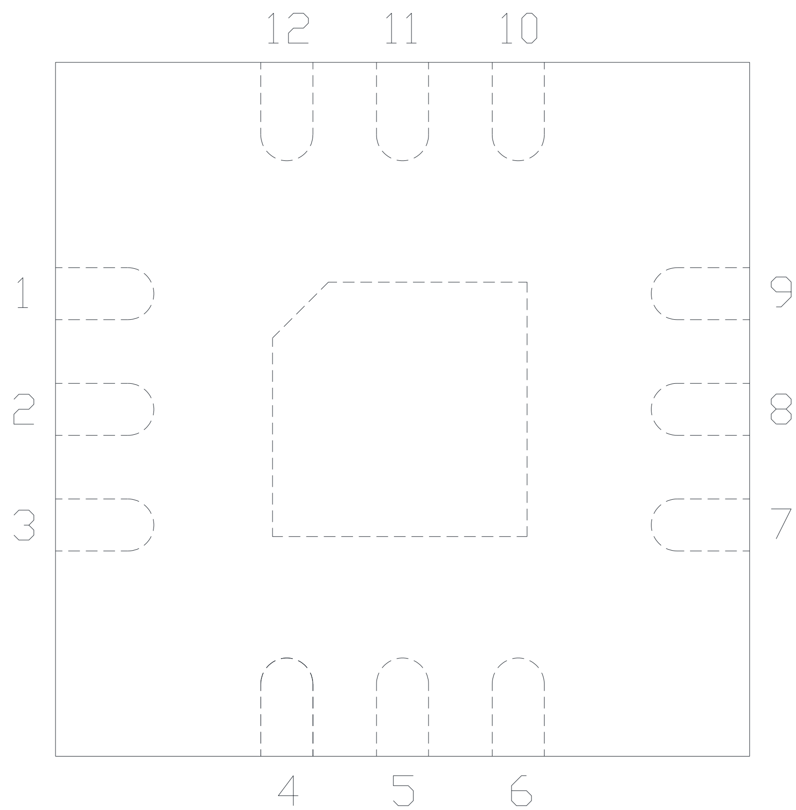
Pin Diagram



Pin Description

Pad No.	Symbol	Description
1, 3, 4, 6, 7, 9, and die paddle	Ground	Connect to RF / DC ground.
2	LO	This pin is DC coupled and matched to 50 Ohms.
5	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.
8	RF	This pin is DC coupled and matched to 50 Ohms.
10-12	N/C	No connection required. These pins may be connected to RF/DC ground.

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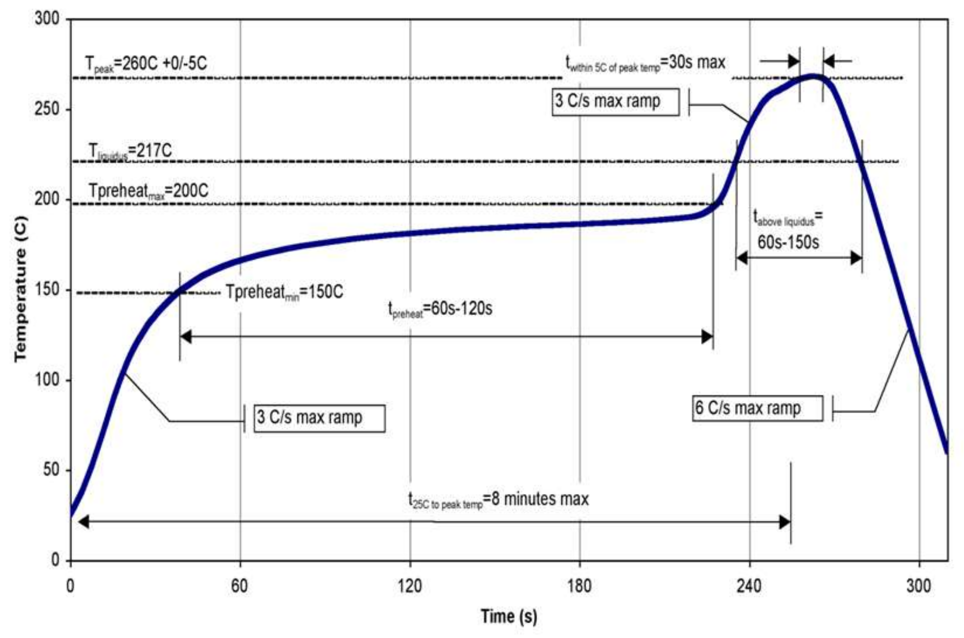
Assembly Notes

1. Compatible with lead-free soldering processes with 260°C peak reflow temperature.
2. Contact plating: ENEPIG
3. Solder rework not recommended.
4. See Application Note AN102 for further information regarding soldering.

Recommended Soldering Temperature Profile



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Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1A	ESDA / JEDEC JS-001-2012
MSL – Moisture Sensitivity Level	Level 1	JEDEC standard IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

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 ($C_{15}H_{12}Br_{4}0_{2}$) 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**

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CMD182

6-10 GHz I/Q Mixer

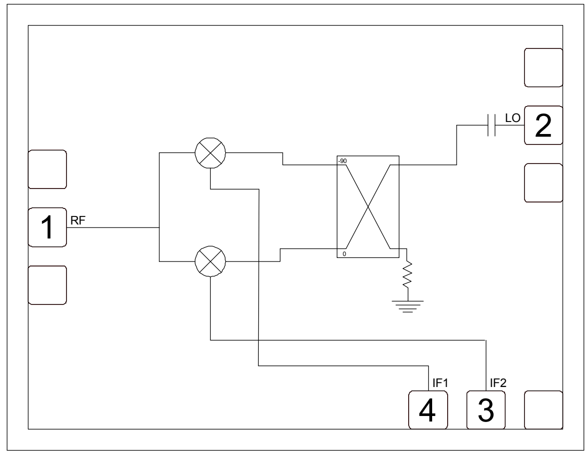
Features

- ► Low conversion loss
- ► High isolation
- ► Image rejection: 30 dB
- ► Wide IF bandwidth
- ► Small die size

Description

The CMD182 is a compact I/Q mixer die that can be used as either an image reject mixer or a single sideband upconverter. The CMD182 utilizes two double balanced mixer cells and a 90 degree hybrid. An external IF hybrid is needed to complete the image rejection. The CMD182 offers full passivation for increased reliability and moisture protection.

Functional Block Diagram



Electrical Performance - IF = 100 MHz, LO = +15 dBm , T_A = 25 ^oC, F = 8 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		6 - 10		GHz
Frequency Range, IF	DC		3.5	GHz
Conversion Loss (as IRM)		6		dB
Image Rejection		30		dB
LO to RF Isolation		46		dB
LO to IF Isolation		20		dB
Input P1dB		9		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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CMD182

6-10 GHz I/Q Mixer

Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	124.25 °C/W
Power Dissipation, Pdiss	347 mW

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications - IF = 100 MHz, LO = +15 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		6 - 10			7.1 - 8.5		GHz
Frequency Range, IF	DC		3.5	DC		3.5	GHz
Conversion Loss (as IRM)		6	9		5.5	8	dB
Image Rejection	20	28		25	30		dB
LO to RF Isolation	39	50		39	50		dB
LO to IF Isolation	15	20		15	20		dB
Input P1dB		9			9		dBm
Input IP3		18			17.5		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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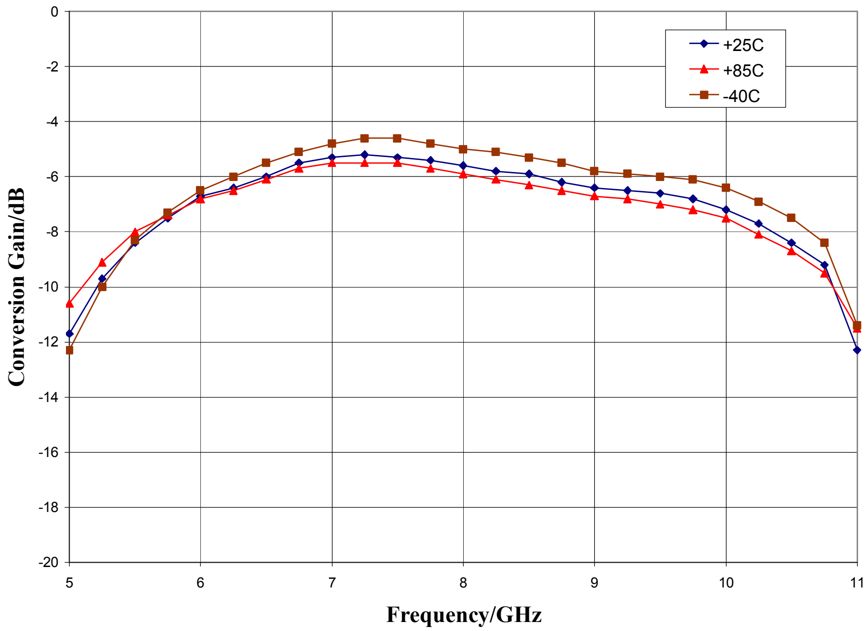
CMD182

6-10 GHz I/Q Mixer

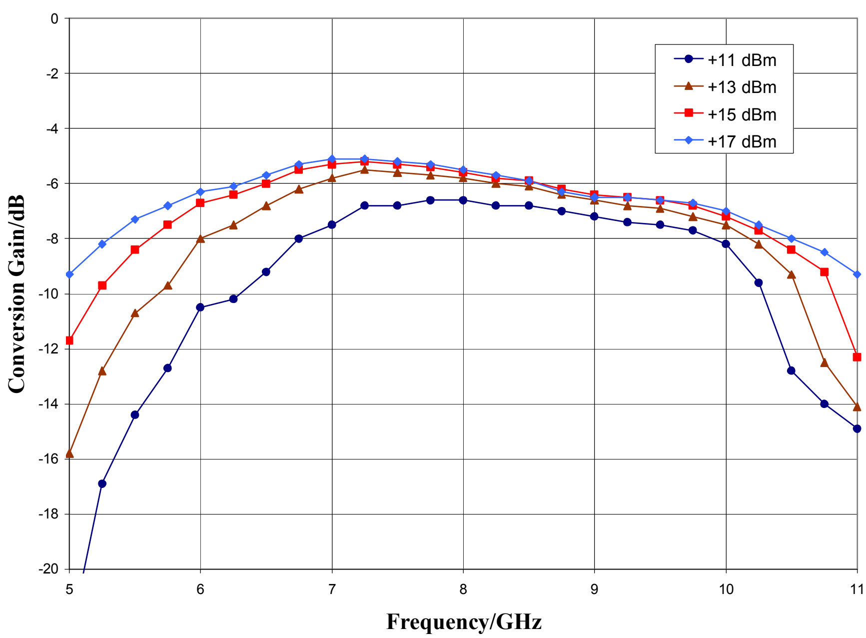
Typical Performance

Data Taken As IRM With External IF Hybrid

Conversion Gain vs. Temperature, LO = +15 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB



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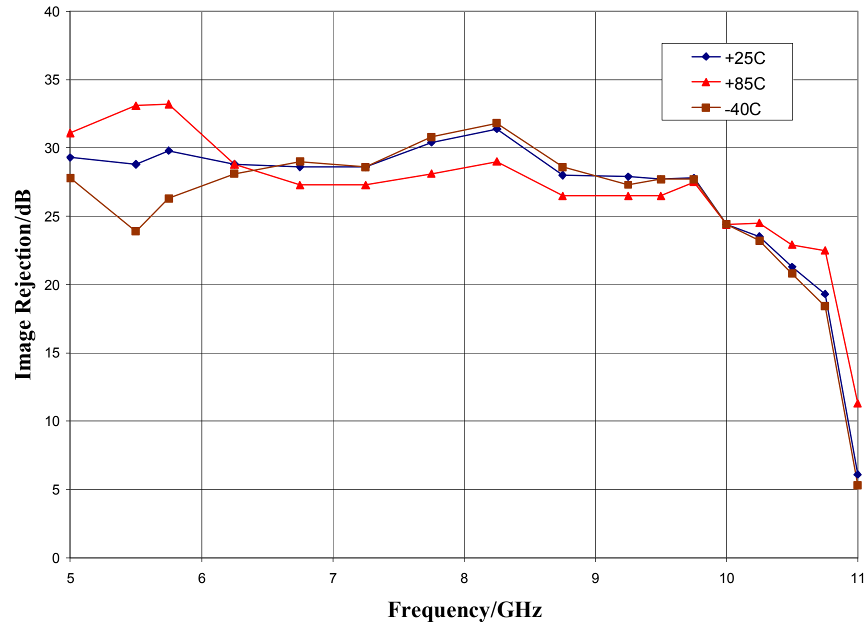
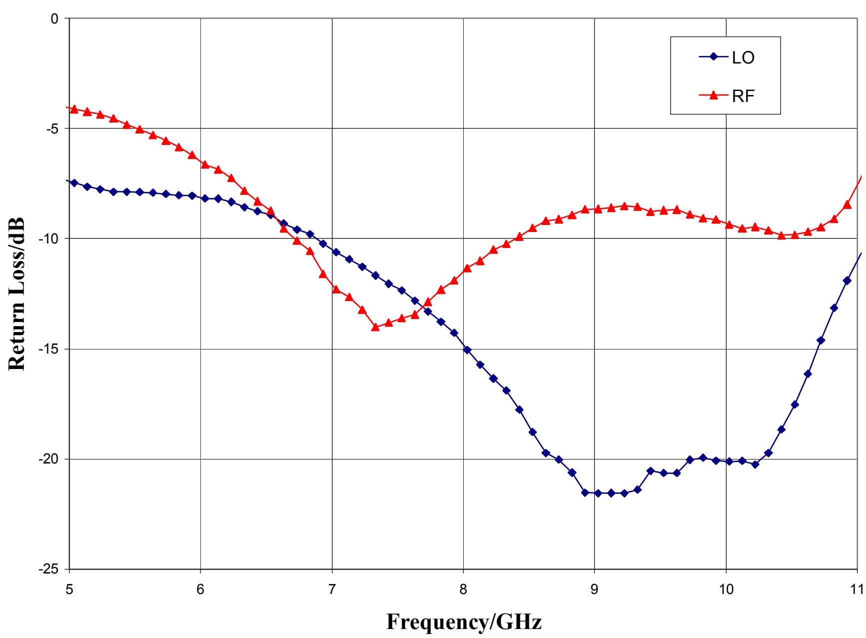
Typical Performance

Data Taken As IRM With External IF Hybrid

Image Rejection, LO = +15 dBm, IF = 100 MHz USB



Return Loss, LO = +15 dBm



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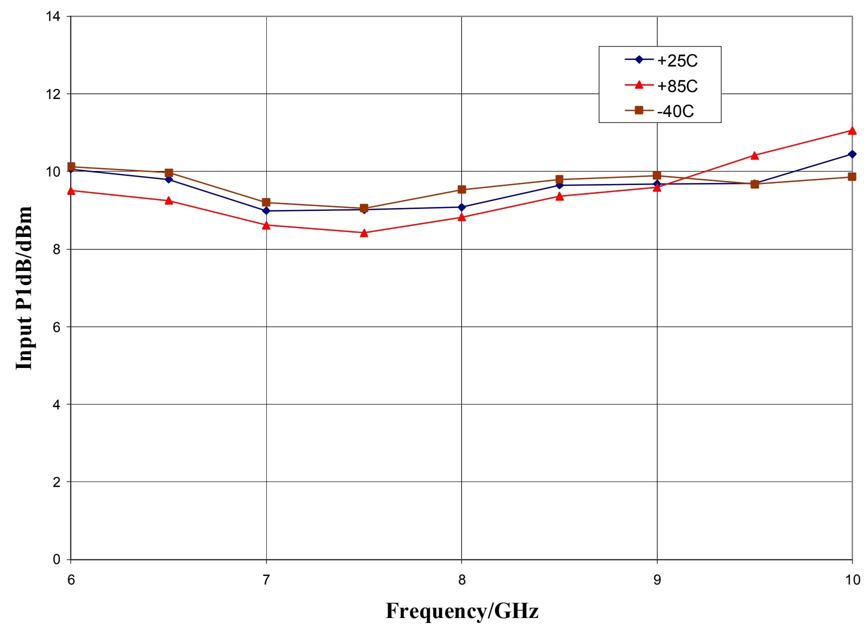
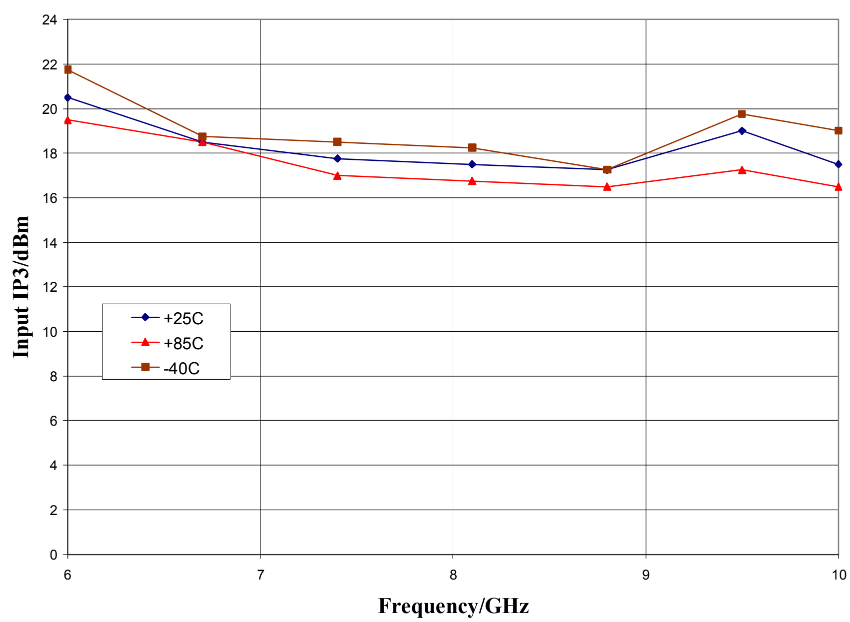
Typical Performance

Data Taken As IRM With External IF Hybrid

Input P1dB vs. Temperature, LO = +15 dBm, IF = 100 MHz USB



Input IP3 vs. Temperature, LO = +15 dBm, IF = 100 MHz USB



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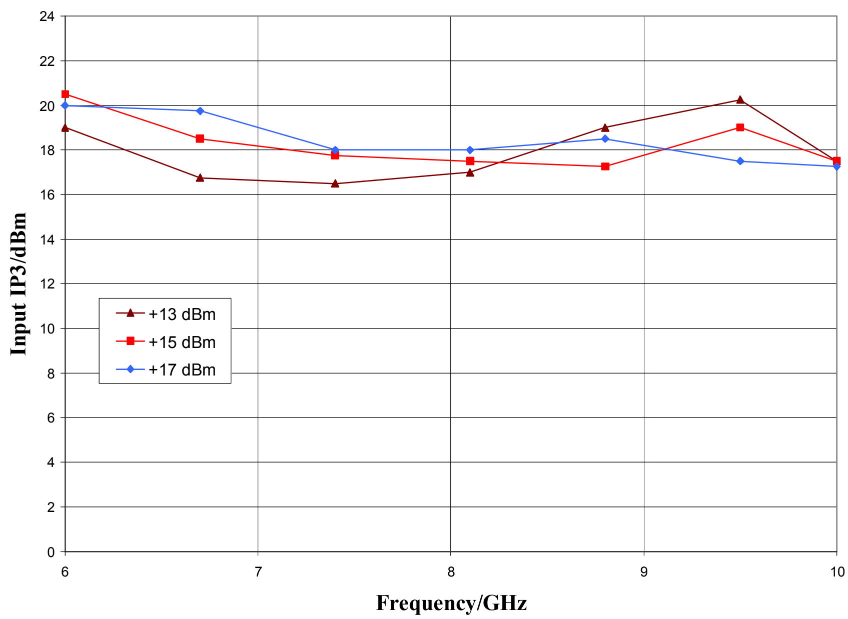
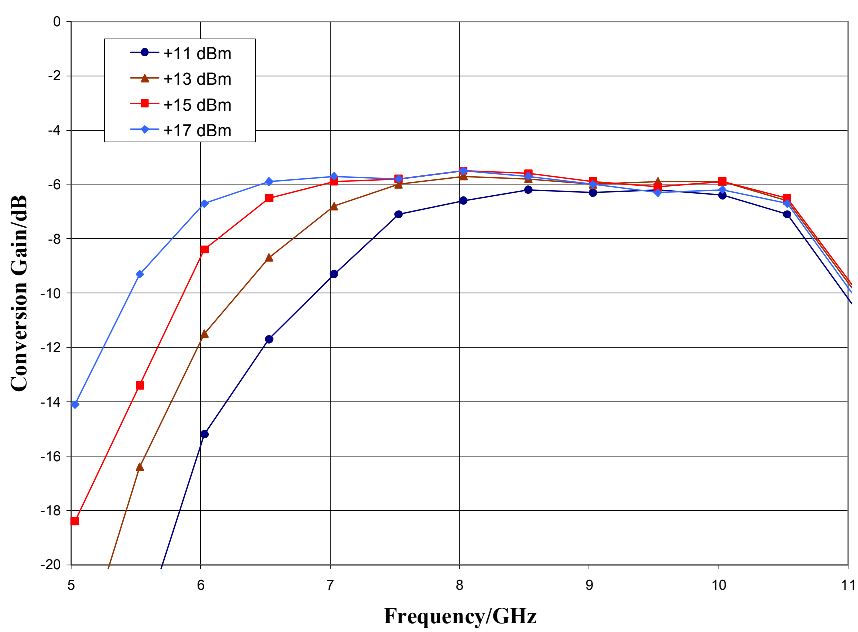
Typical Performance

Data Taken As IRM With External IF Hybrid

Input IP3 vs. LO Drive, IF = 100 MHz USB



Upconverter Performance, Conversion Gain vs. LO Drive, IF = 1 GHz



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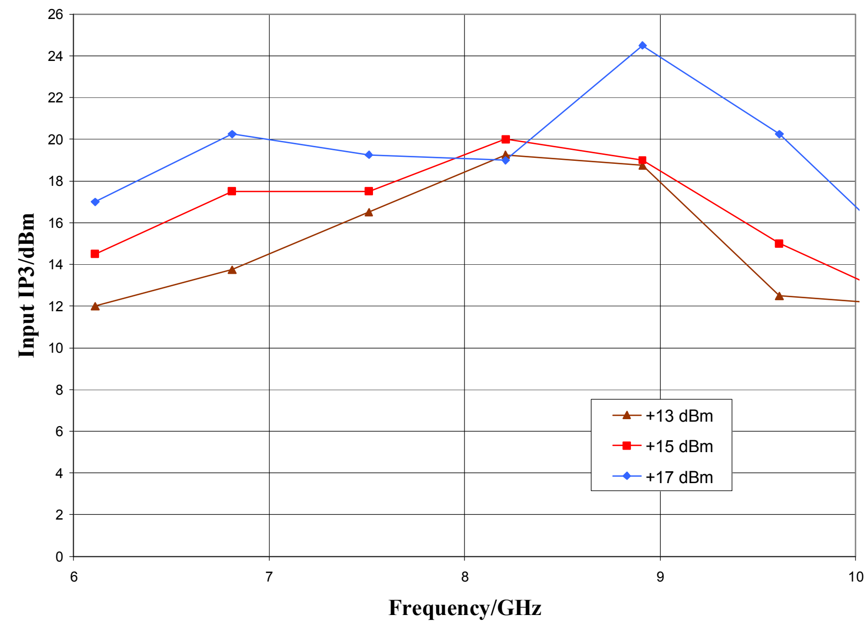
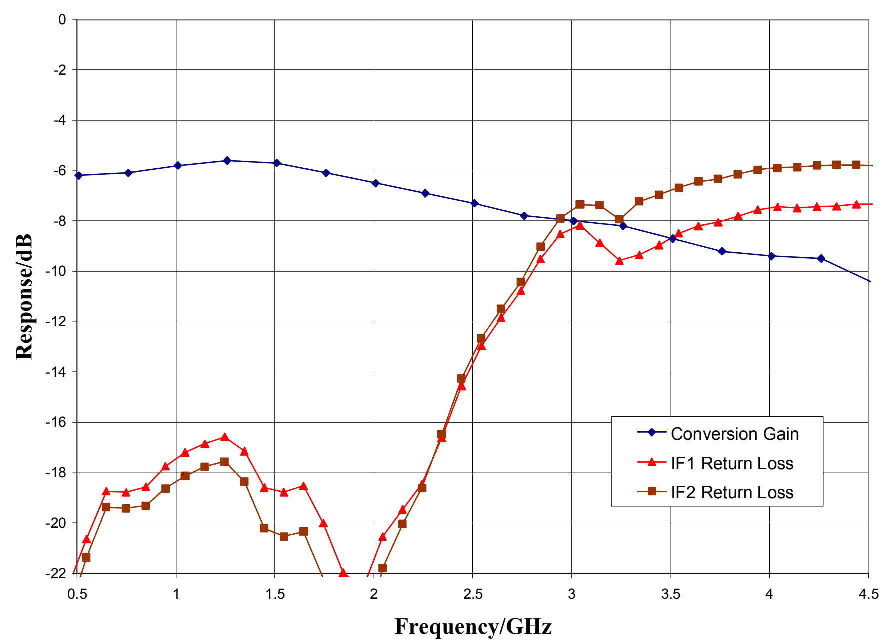
Typical Performance

Data Taken As IRM With External IF Hybrid

Upconverter Performance, Input IP3 vs. LO Drive, IF = 500 MHz



IF Bandwidth, LO = +15 dBm, Return Loss Data Taken Without IF Hybrid



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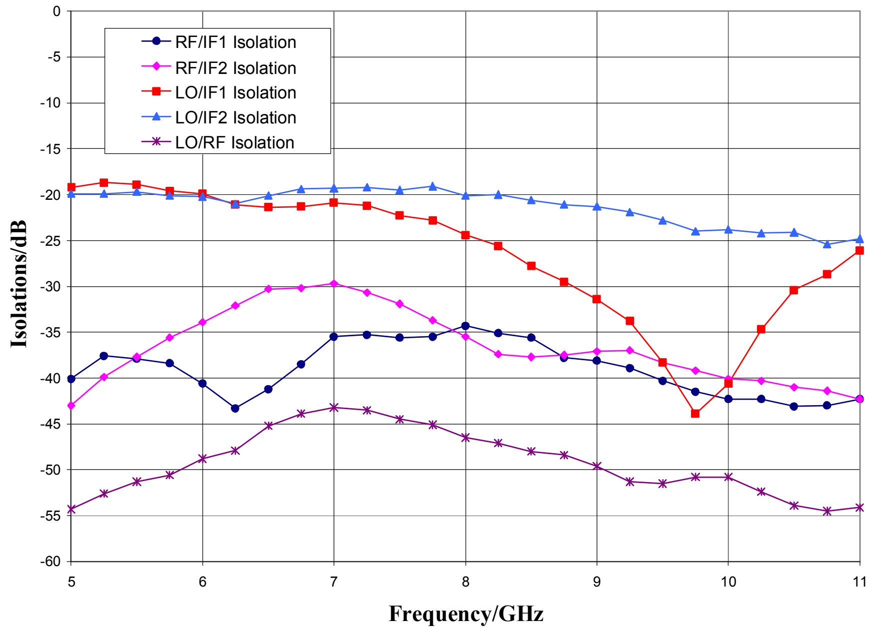
Typical Performance

Isolation, LO = +15 dBm. Data Taken Without IF Hybrid



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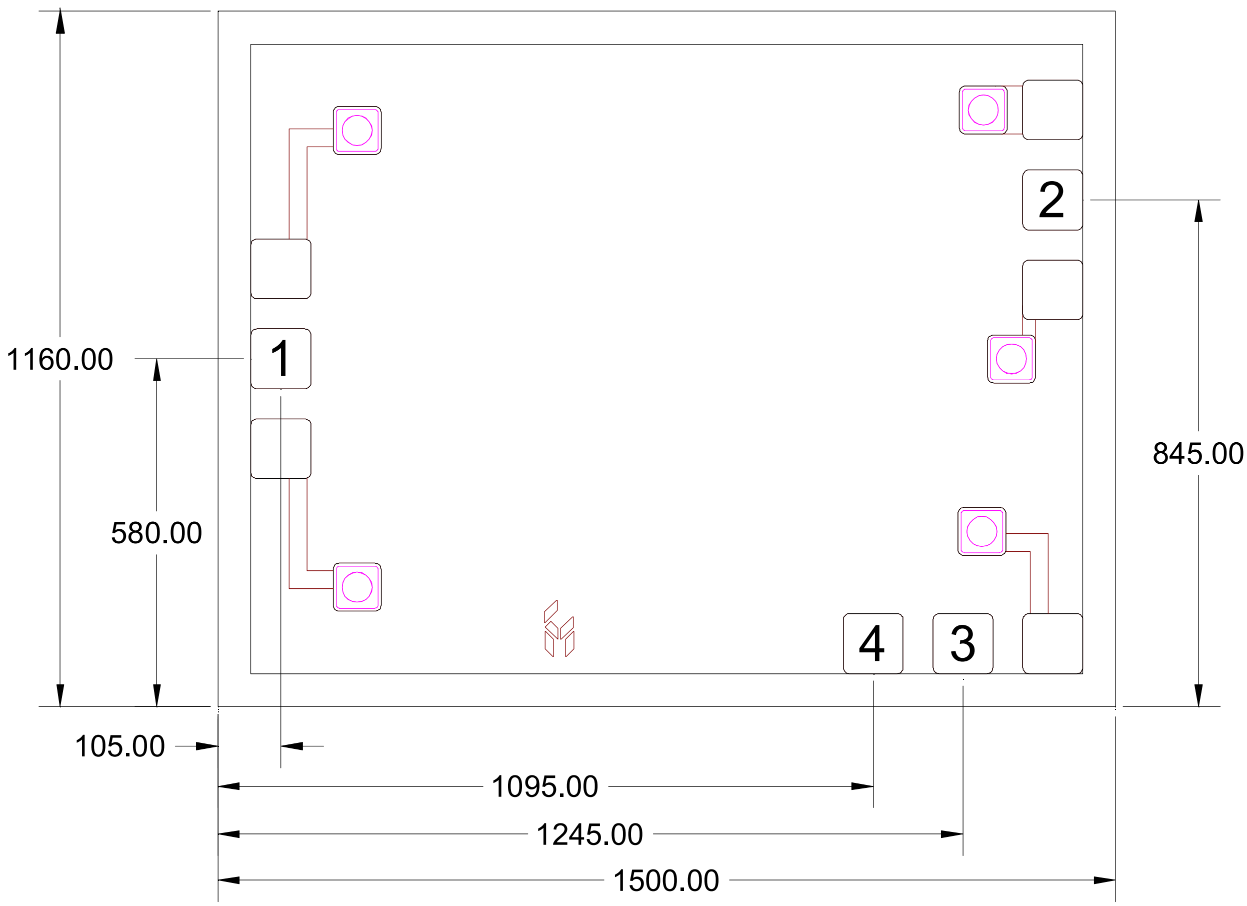
Mechanical Information

Die Outline (all dimensions in microns)



Notes:
1.No connection required for unlabeled pads
2.Backside is RF and DC ground
3.Backside and bond pad metal: Gold
4.Die is 100 microns thick
5.All bond pads (1-4) are 100 microns square

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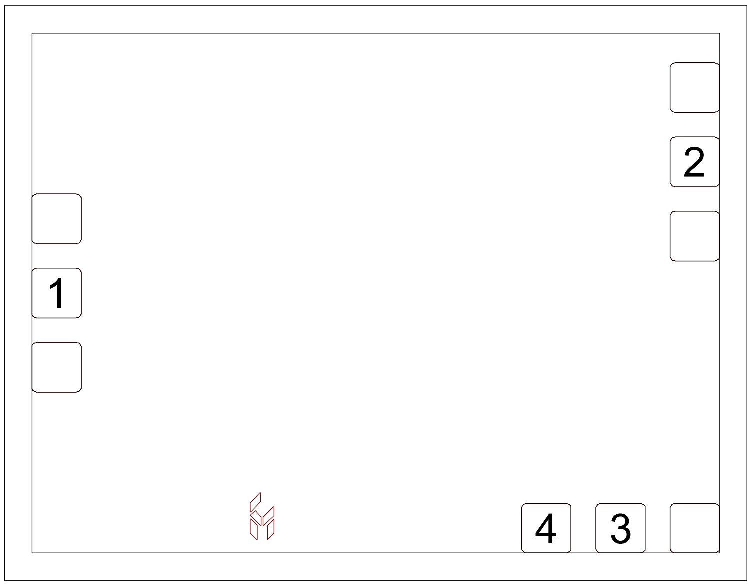
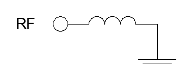
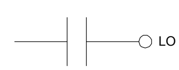
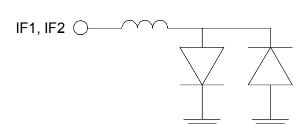
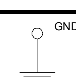
Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	RF	This pin is DC coupled and matched to 50 ohms.	
2	LO	This pin is AC coupled and matched to 50 ohms.	
3	IF2	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
4	IF1		
Backside	Ground	Connect to RF / DC ground.	

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Applications Information

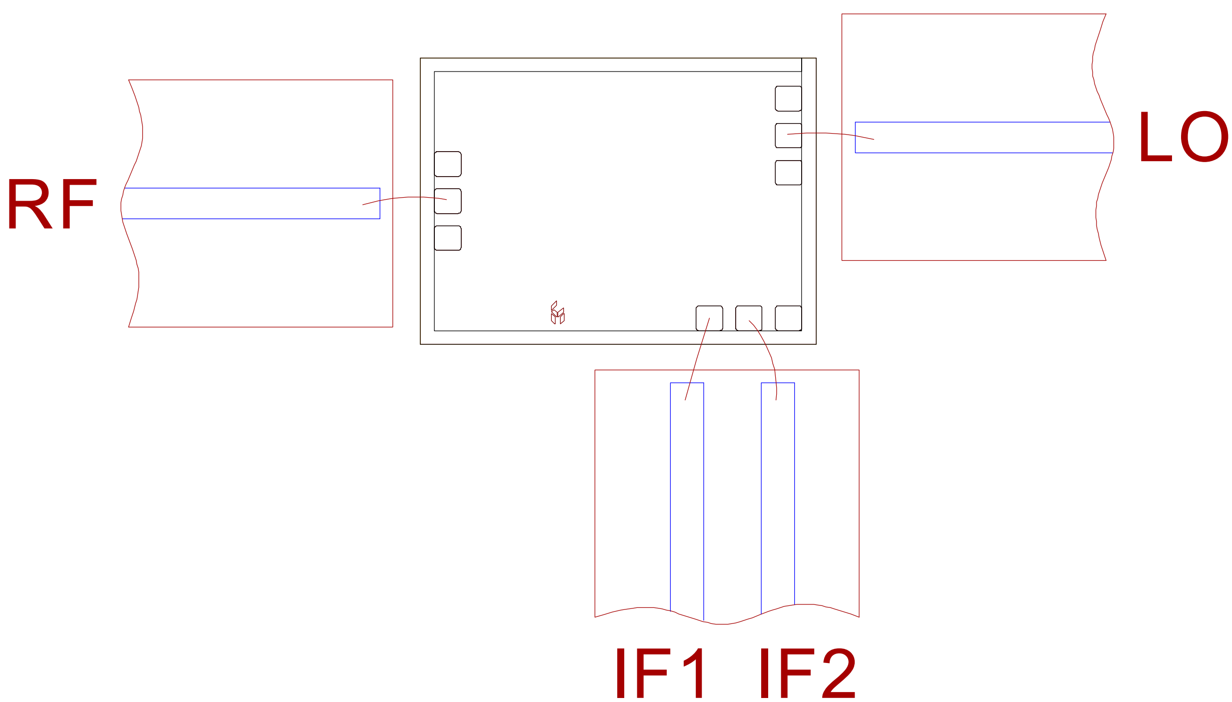
Assembly Guidelines

The backside of the CMD182 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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Custom MMIC

CMD182C4

6-10 GHz I/Q Mixer

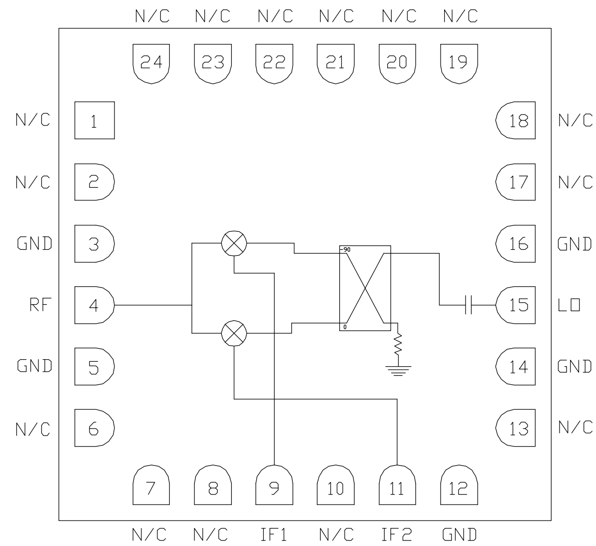
Features

- ► Low conversion loss
- ► High isolation
- ► Image rejection: 30 dB
- ► Wide IF bandwidth
- ► Pb-free RoHs compliant 4x4 mm SMT package

Description

The CMD182C4 is a compact I/Q mixer in a leadless surface mount package that can be used as either an image reject mixer or a single sideband upconverter. The CMD182C4 utilizes two double balanced mixer cells and a 90 degree hybrid. An external IF hybrid is needed to complete the image rejection. The CMD182C4 is a much smaller alternative to higher cost hybrid image reject mixers and single sideband upconverter assemblies.

Functional Block Diagram



Electrical Performance **- IF = 100 MHz, LO = +15 dBm , T_A = 25 °C, F = 8 GHz**				
Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		6 - 10		GHz
Frequency Range, IF	DC		3.5	GHz
Conversion Loss (as IRM)		6		dB
Image Rejection		30		dB
LO to RF Isolation		46		dB
LO to IF Isolation		20		dB
Input P1dB		9		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications - IF = 100 MHz, LO = +15 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		6 - 10			7.1 - 8.5		GHz
Frequency Range, IF	DC		3.5	DC		3.5	GHz
Conversion Loss (as IRM)		6	9		5.5	8	dB
Image Rejection	20	28		25	30		dB
LO to RF Isolation	39	50		39	50		dB
LO to IF Isolation	15	20		15	20		dB
Input P1dB		9			9		dBm
Input IP3		18			17.5		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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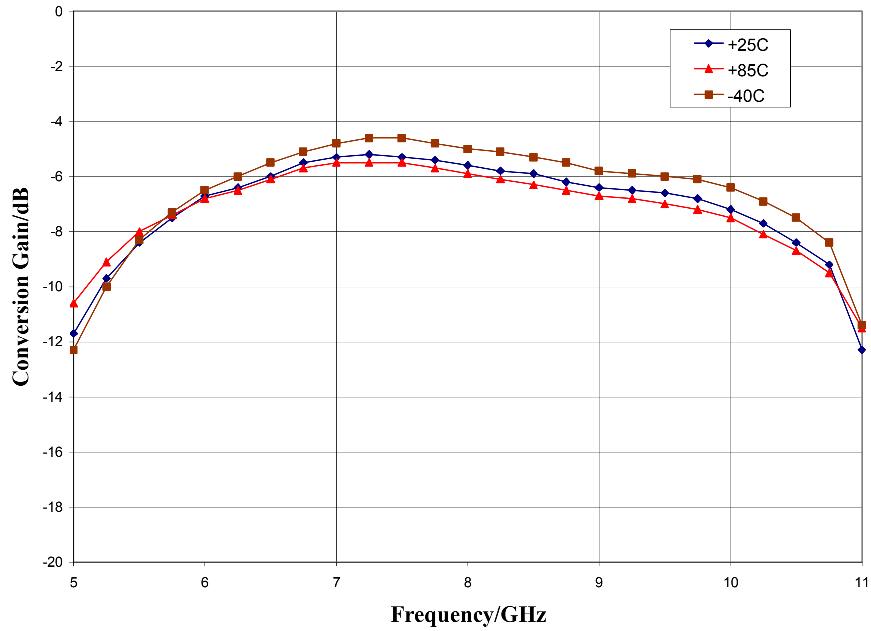
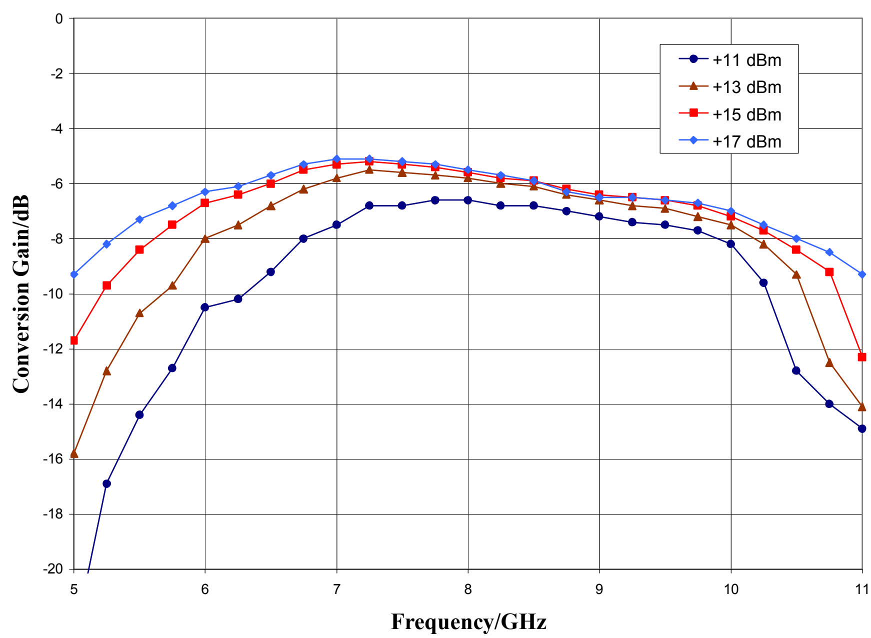
Typical Performance

Data Taken As IRM With External IF Hybrid

Conversion Gain vs. Temperature, LO = +15 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB



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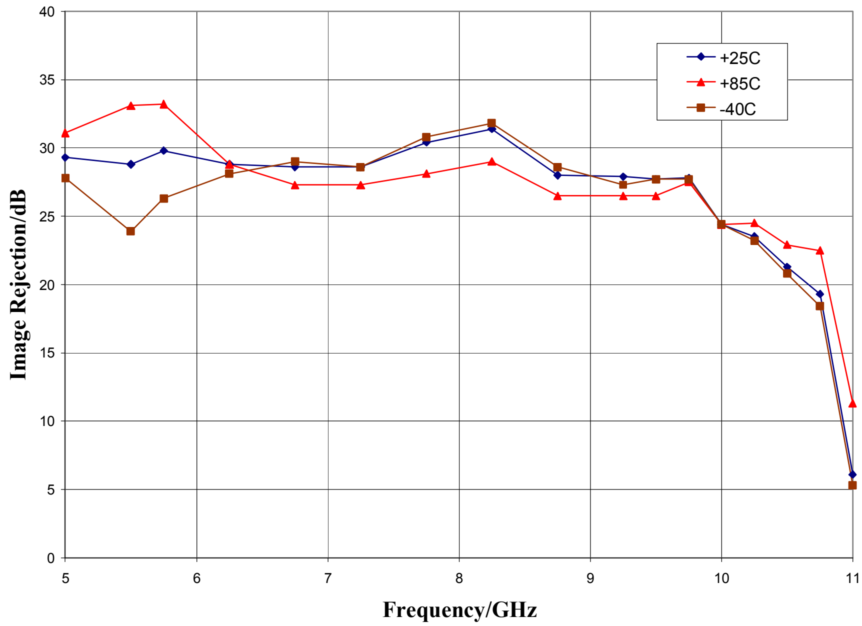
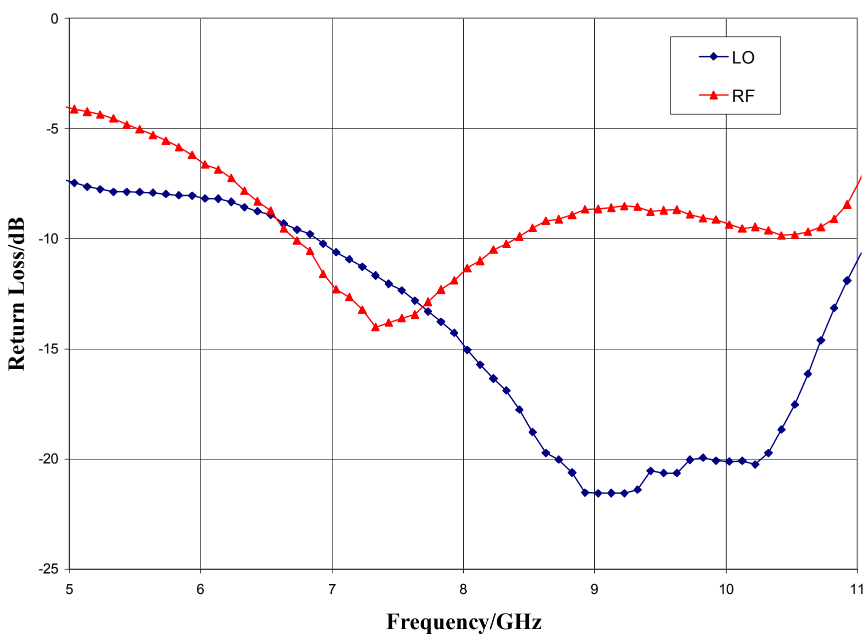
Typical Performance

Data Taken As IRM With External IF Hybrid

Image Rejection, LO = +15 dBm, IF = 100 MHz USB



Return Loss, LO = +15 dBm



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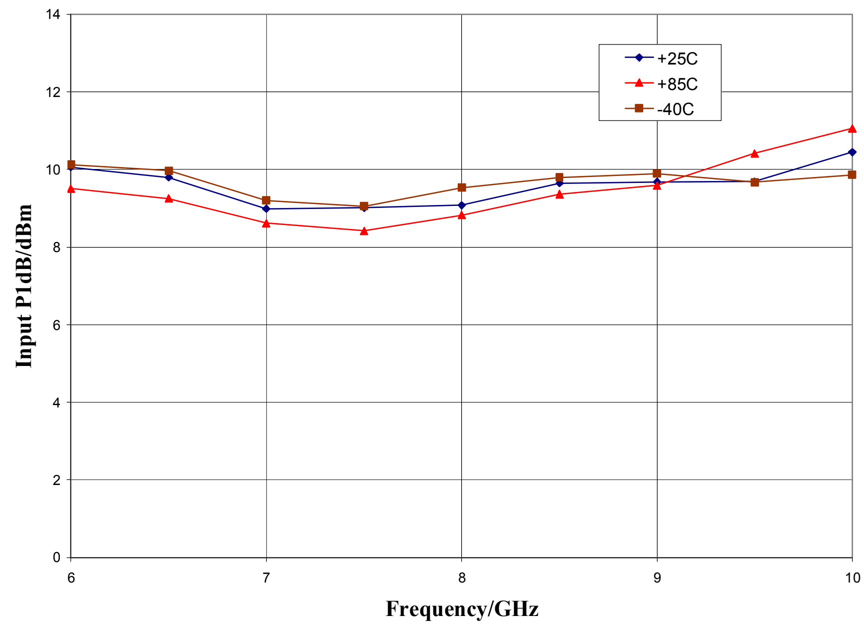
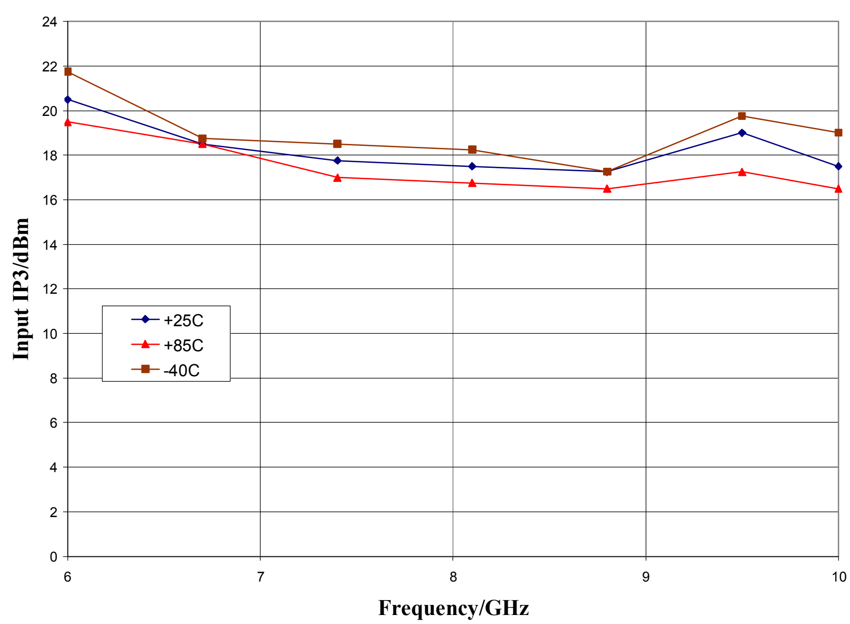
Typical Performance

Data Taken As IRM With External IF Hybrid

Input P1dB vs. Temperature, LO = +15 dBm, IF = 100 MHz USB



Input IP3 vs. Temperature, LO = +15 dBm, IF = 100 MHz USB



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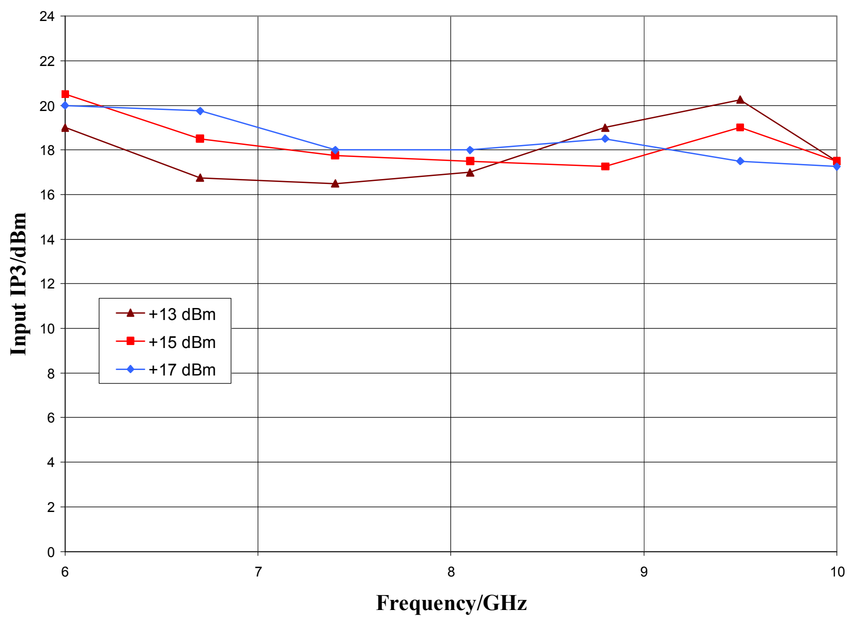
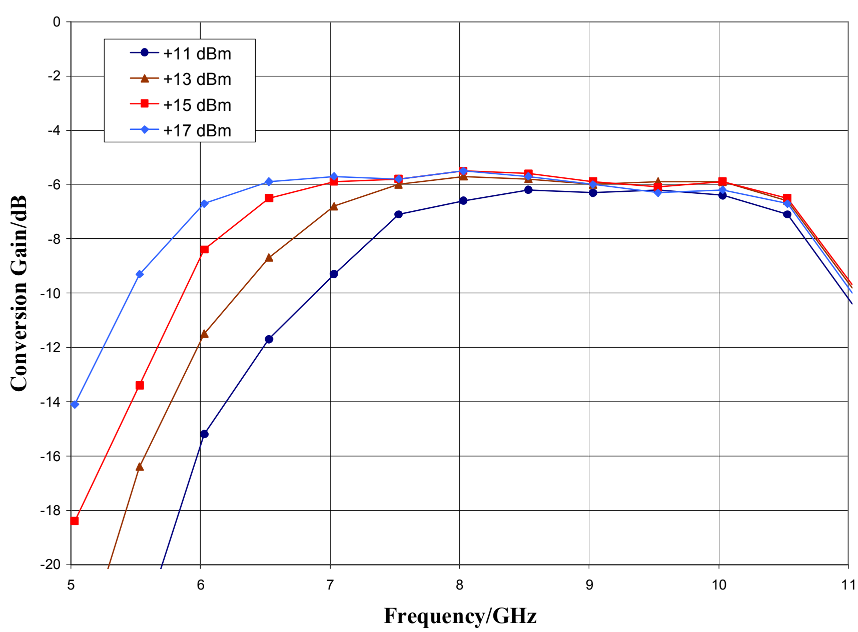
Typical Performance

Data Taken As IRM With External IF Hybrid

Input IP3 vs. LO Drive, IF = 100 MHz USB



Upconverter Performance, Conversion Gain vs. LO Drive, IF = 1 GHz



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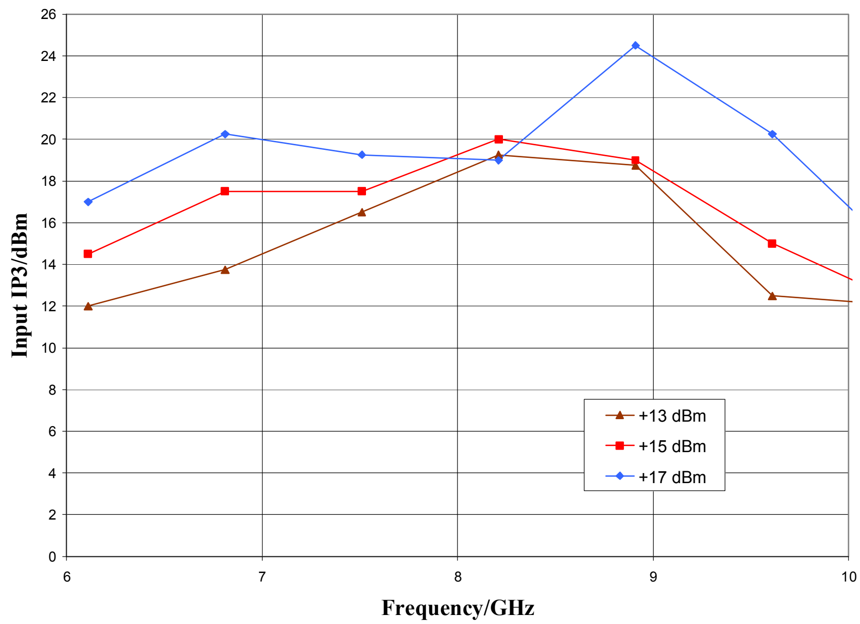
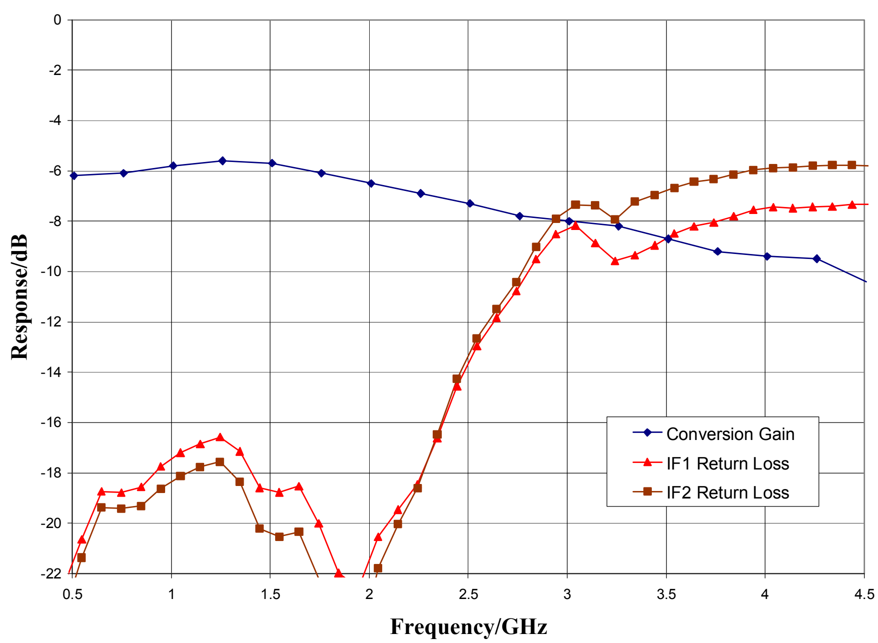
Typical Performance

Data Taken As IRM With External IF Hybrid

Upconverter Performance, Input IP3 vs. LO Drive, IF = 500 MHz



IF Bandwidth, LO = +15 dBm, Return Loss Data Taken Without IF Hybrid



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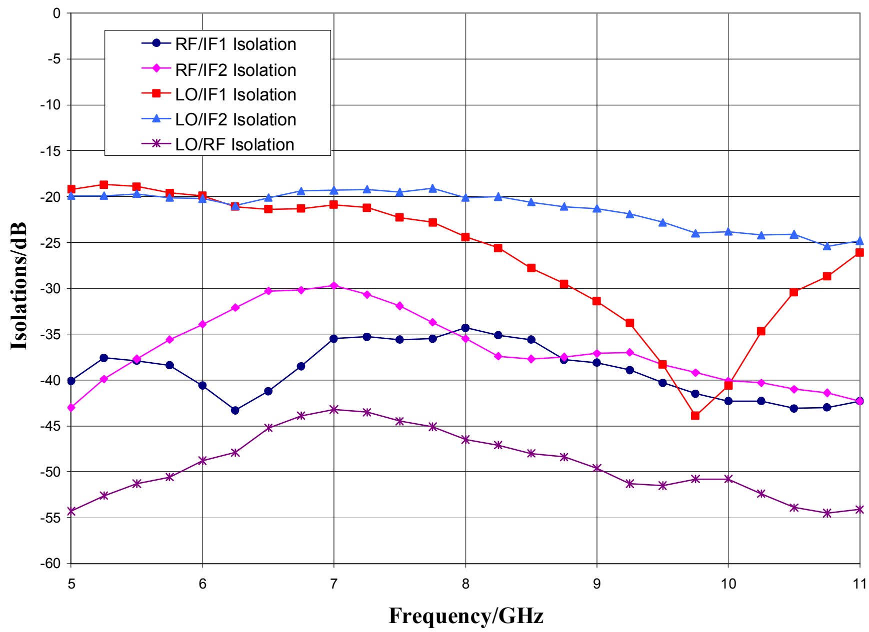
Typical Performance

Isolation, LO = +15 dBm. Data Taken Without IF Hybrid



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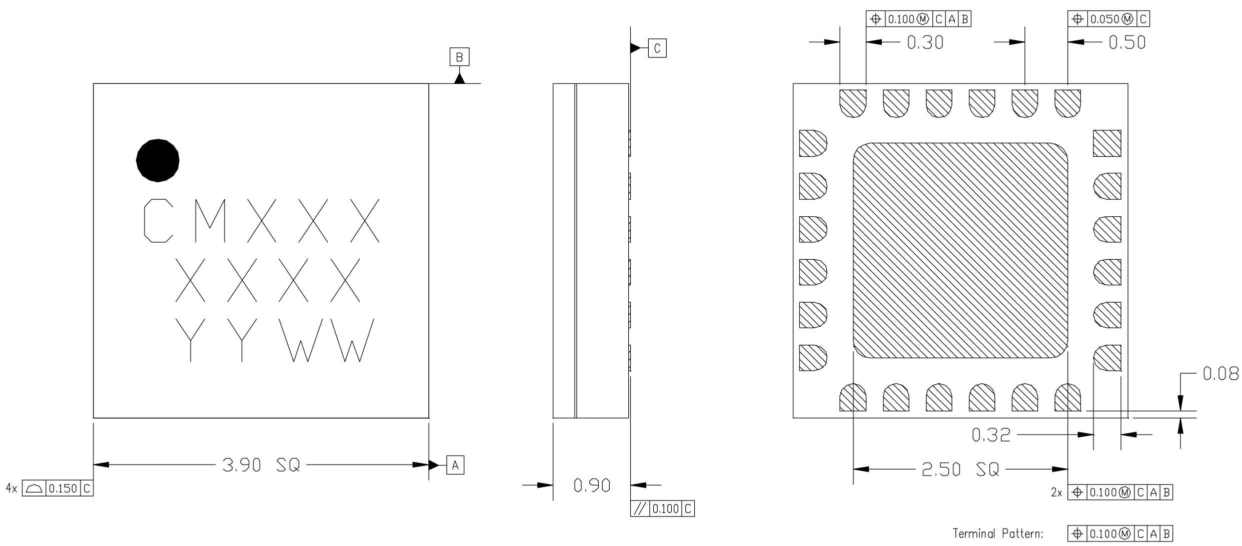
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   4.1. LINE 1: PART NUMBER
      4.1.1. EXAMPLE: CMD191C4 SHALL BE MARKED AS CM191
   4.2. LINE 2: LOT NUMBER
   4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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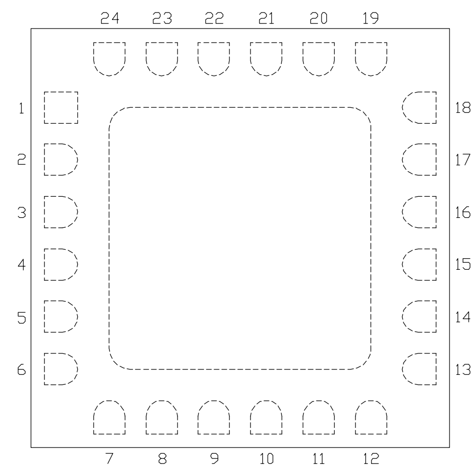
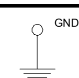
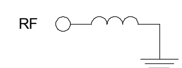
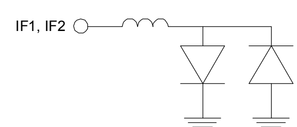
Tél. 01 47 95 99 60 - Fax. 01 47 01 16 22 - e-mail: hyper@es-france.com - Site Web: www.es-france.com

Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1, 2, 6-8, 10, 13, 17-24	N/C	No connection required. These pins may be connected to RF/DC ground.	
3, 5, 12, 14, 16 and die paddle	Ground	Connect to RF / DC ground.	
4	RF	This pin is DC coupled and matched to 50 ohms.	
9	IF1	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
11	IF2		
15	LO	This pin is AC coupled and matched to 50 ohms.	

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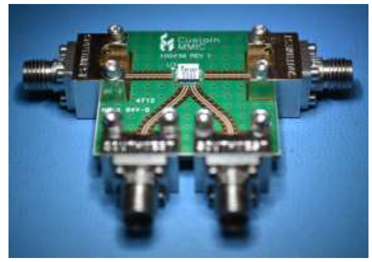
CMD182C4

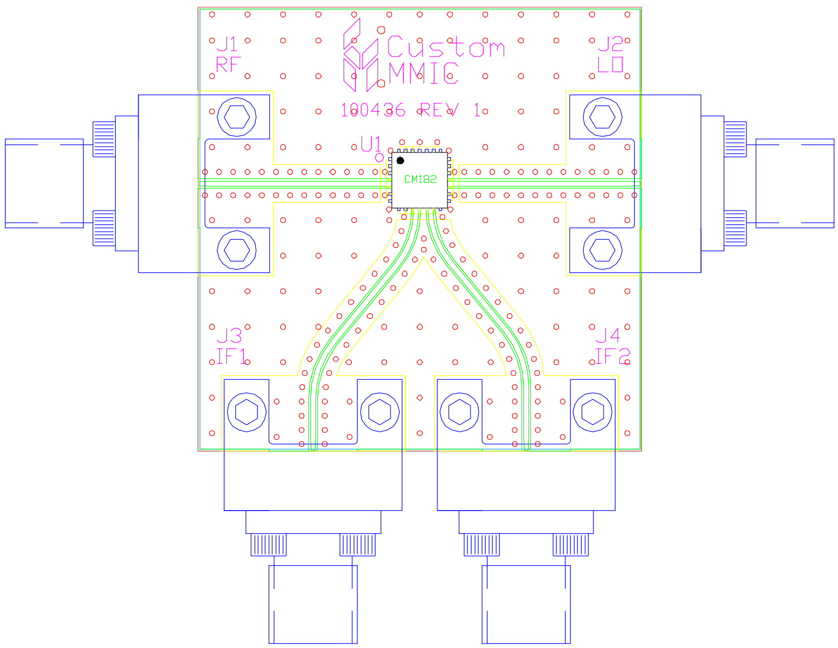
6-10 GHz I/Q Mixer

Applications Information

Evaluation Board



The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J4		SMA End Launch Connector
U1		CMD182C4 I/Q Mixer
PCB		100436 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD183C4

7.5-13 GHz I/Q Mixer

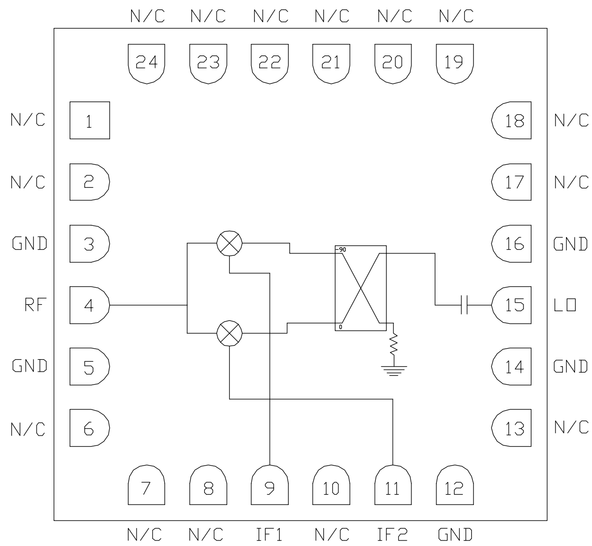
Features

- ► Low conversion loss
- ► High isolation
- ► Image rejection: 26 dB
- ► Wide IF bandwidth
- ► Pb-free RoHs compliant 4x4 mm SMT package

Description

The CMD183C4 is a compact I/Q mixer in a leadless surface mount package that can be used as either an image reject mixer or a single sideband upconverter. The CMD183C4 utilizes two double balanced mixer cells and a 90 degree hybrid. An external IF hybrid is needed to complete the image rejection. The CMD183C4 is a much smaller alternative to higher cost hybrid image reject mixers and single sideband upconverter assemblies.

Functional Block Diagram



Electrical Performance - IF = 100 MHz, LO = +15 dBm , T_A = 25 °C, F = 10 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		7.5 - 13		GHz
Frequency Range, IF	DC		4.5	GHz
Conversion Loss (as IRM)		5.5		dB
Image Rejection		26		dB
LO to RF Isolation		43		dB
LO to IF Isolation		23		dB
Input P1dB		9		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications - IF = 100 MHz, LO = +15 dBm, T_A = 25 ^{o}C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		9 - 11			7.5 - 13		GHz
Frequency Range, IF	DC		4.5	DC		4.5	GHz
Conversion Loss (as IRM)		5.5	7		6	10	dB
Image Rejection	21	25		19	25		dB
LO to RF Isolation	37	45		37	45		dB
LO to IF Isolation	15	23		15	23		dB
Input P1dB		9			9		dBm
Input IP3		19			18		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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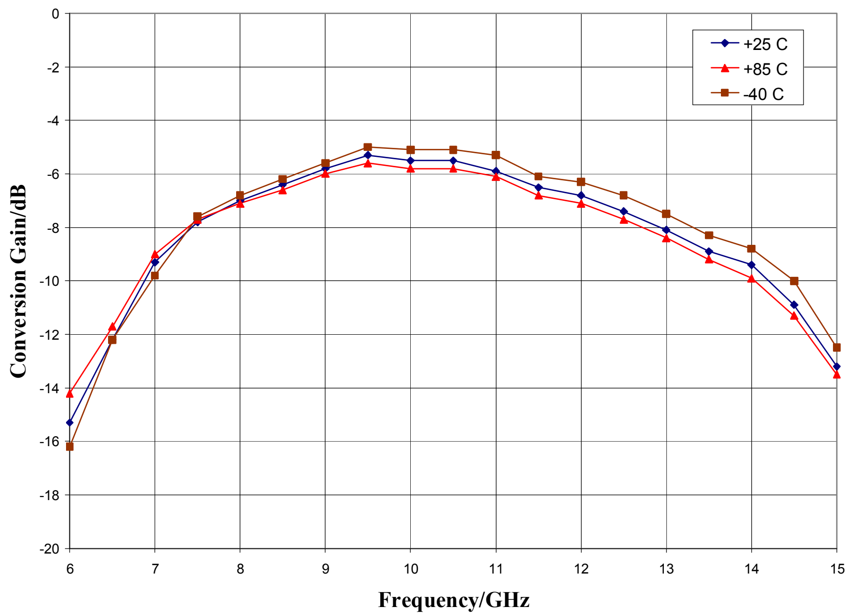
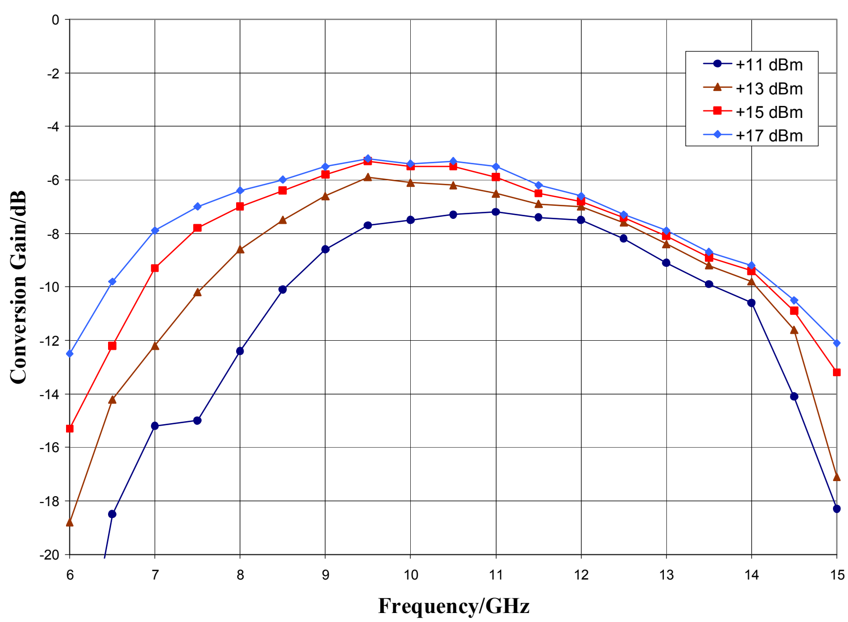
Typical Performance

Data Taken As IRM With External IF Hybrid

Conversion Gain vs. Temperature, LO = +15 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB



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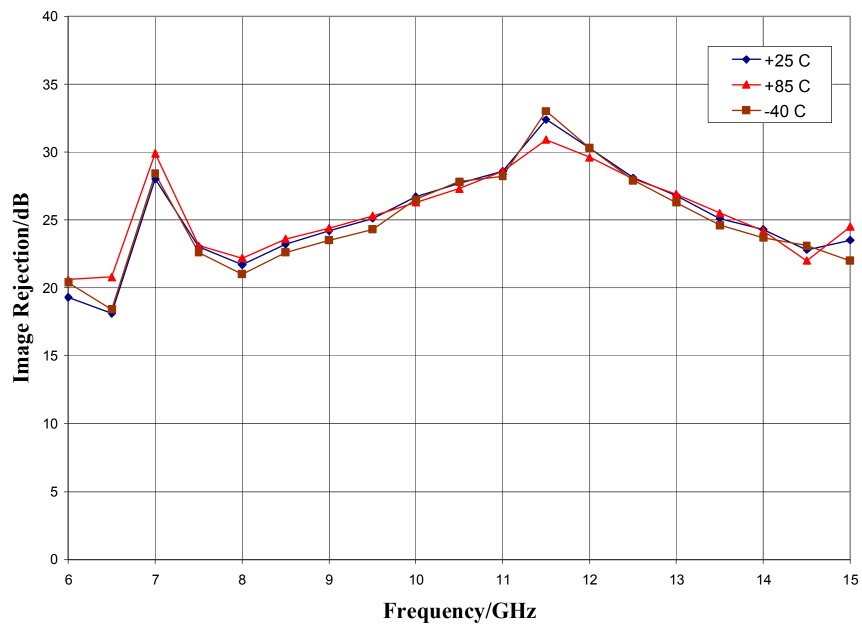
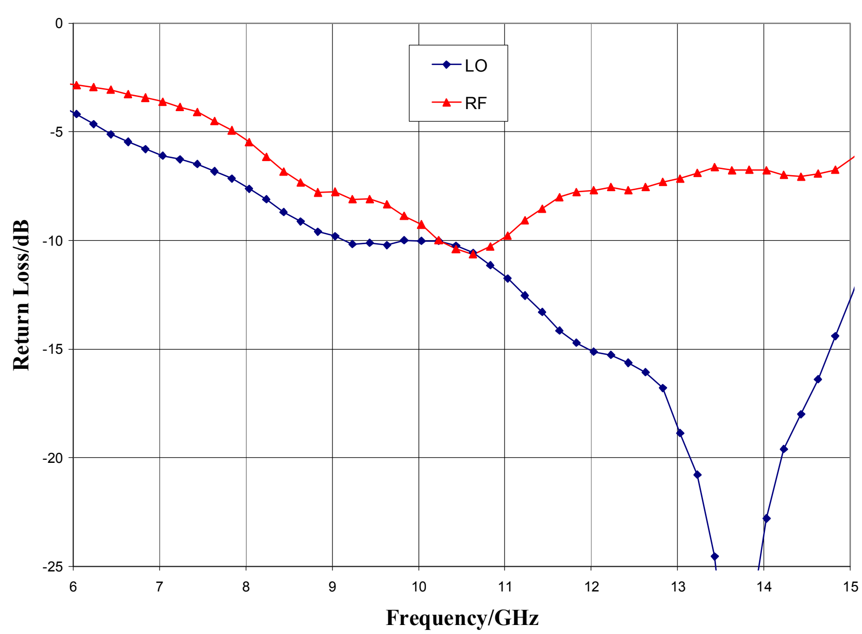
Typical Performance

Data Taken As IRM With External IF Hybrid

Image Rejection, LO = +15 dBm, IF = 100 MHz USB



Return Loss, LO = +15 dBm



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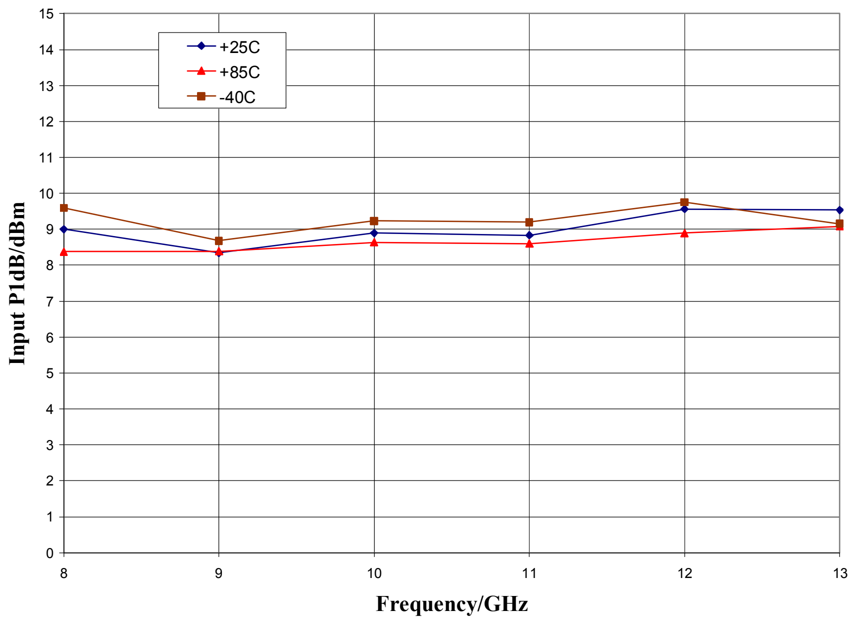
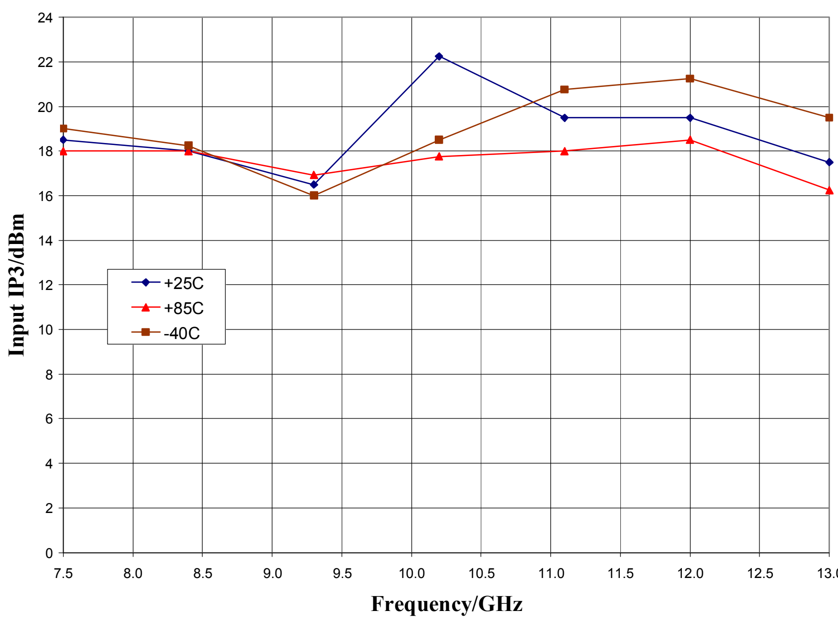
Typical Performance

Data Taken As IRM With External IF Hybrid

Input P1dB vs. Temperature, LO = +15 dBm, IF = 100 MHz USB



Input IP3 vs. Temperature, LO = +15 dBm, IF = 100 MHz USB



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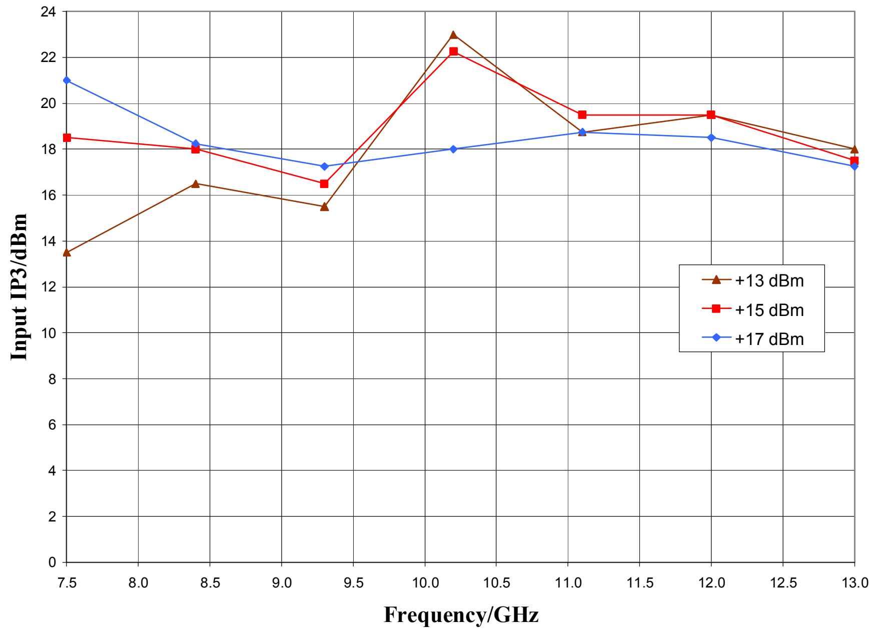
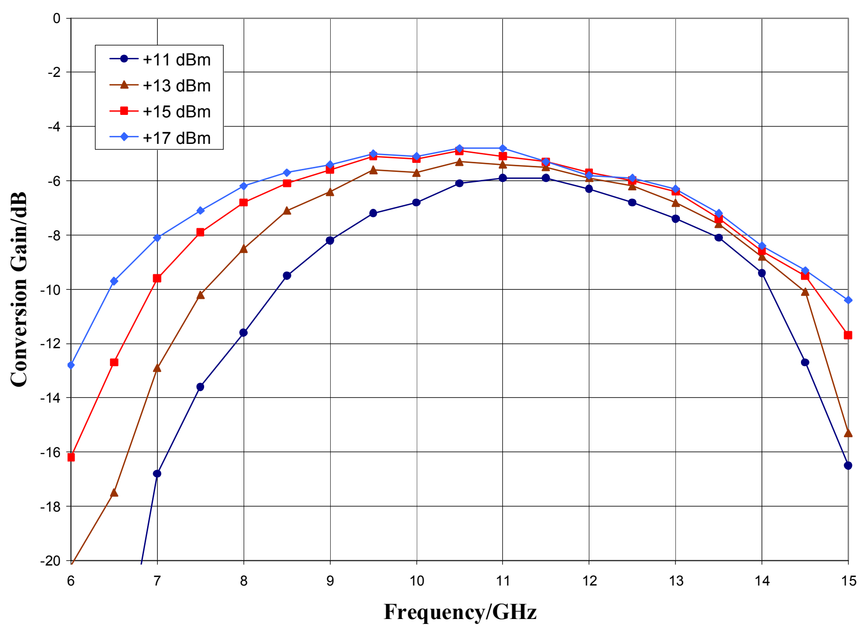
Typical Performance

Data Taken As IRM With External IF Hybrid

Input IP3 vs. LO Drive, IF = 100 MHz USB



Upconverter Performance, Conversion Gain vs. LO Drive, IF = 100 MHz



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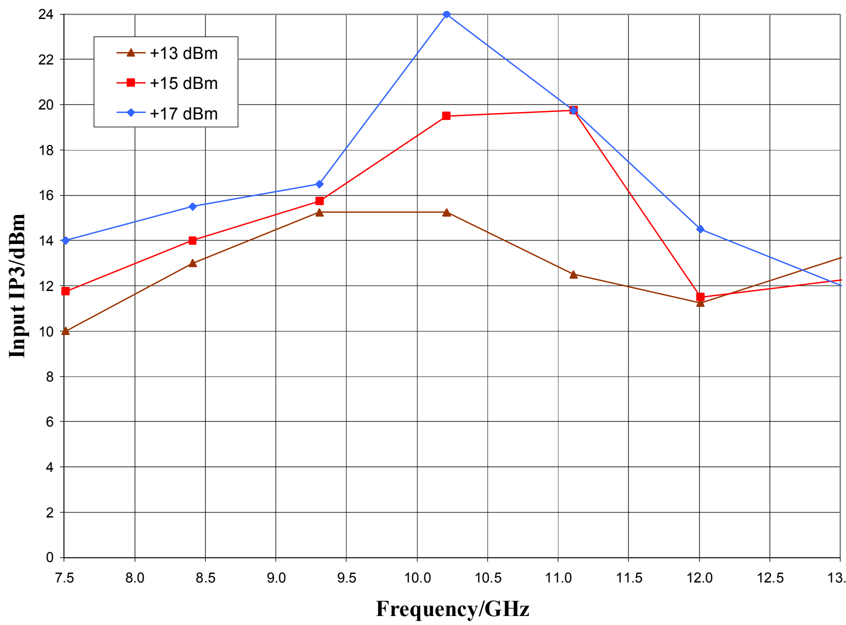
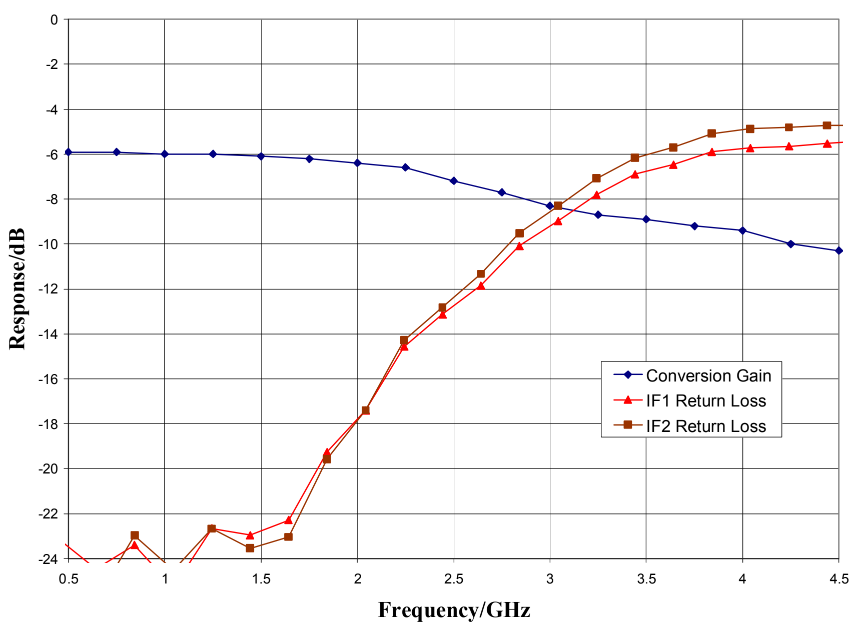
Typical Performance

Data Taken As IRM With External IF Hybrid

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



IF Bandwidth, LO = +15 dBm, Return Loss Data Taken Without IF Hybrid



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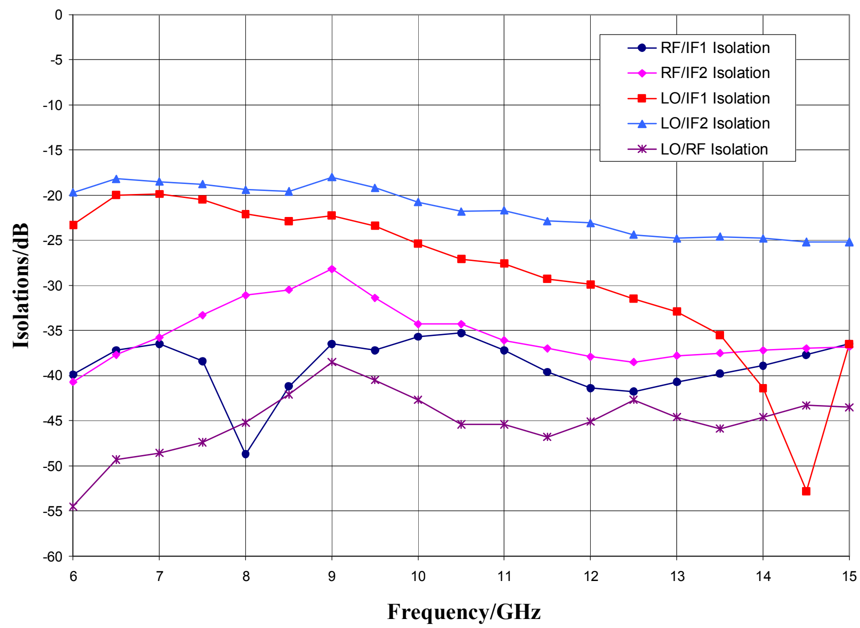
Typical Performance

Isolation, LO = +15 dBm. Data Taken Without IF Hybrid



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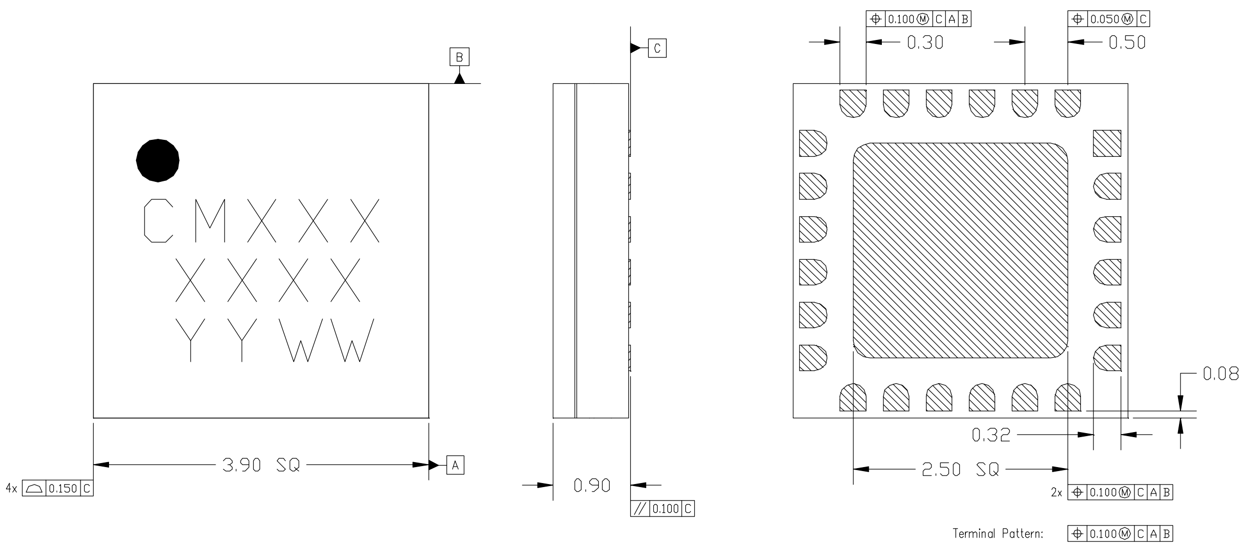
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   4.1. LINE 1: PART NUMBER
      4.1.1. EXAMPLE: CMD191C4 SHALL BE MARKED AS CM191
   4.2. LINE 2: LOT NUMBER
   4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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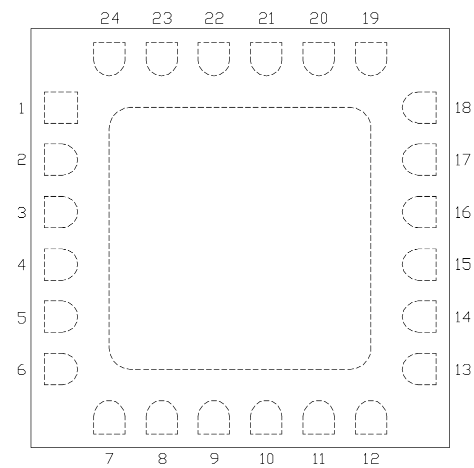
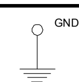
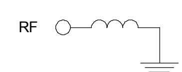
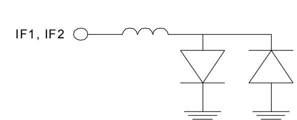
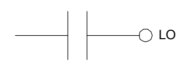
Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1, 2, 6-8, 10, 13, 17-24	N/C	No connection required. These pins may be connected to RF/DC ground.	
3, 5, 12, 14, 16 and die paddle	Ground	Connect to RF / DC ground.	
4	RF	This pin is DC coupled and matched to 50 ohms.	
9	IF1	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
11	IF2		
15	LO	This pin is AC coupled and matched to 50 ohms.	

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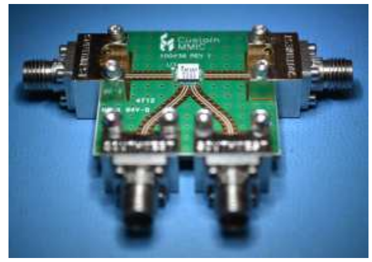
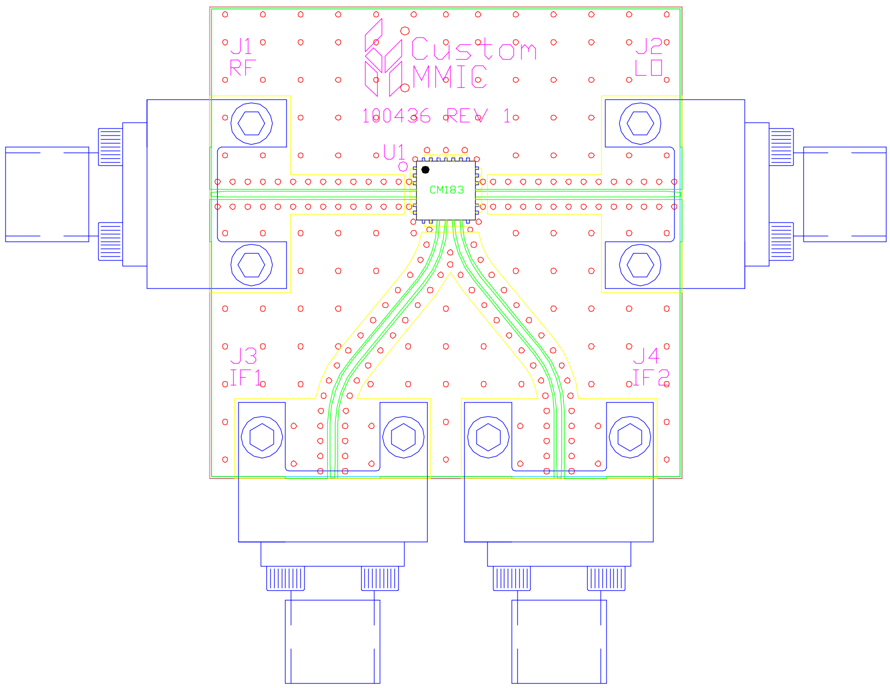
Applications Information

Evaluation Board

The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.





Bill of Material

Designator	Value	Description
J1 - J4		SMA End Launch Connector
U1		CMD183C4 I/Q Mixer
PCB		100436 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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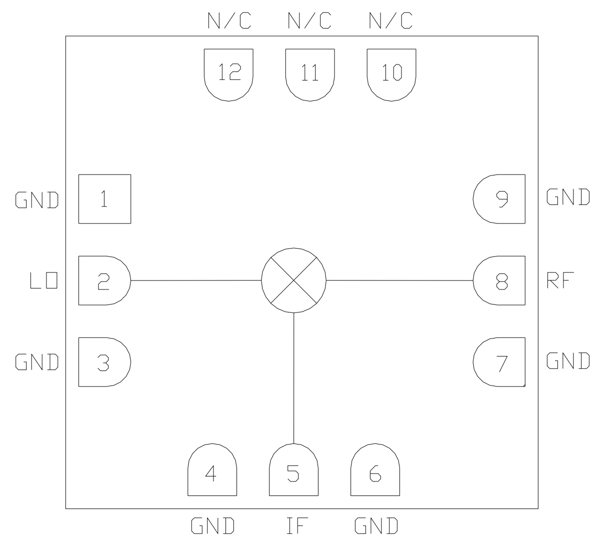
CMD251C3

4-8.5 GHz Fundamental Mixer

Features

- ► Low conversion loss
- ► High isolation
- ► Wide IF bandwidth
- ► Passive double balanced topology
- ► Pb-free RoHs compliant 3x3 mm SMT package

Functional Block Diagram



Description

The CMD251C3 is a general purpose double balanced mixer in a leadless surface mount package that can be used for up- and downconverting applications between 4 and 8.5 GHz. The CMD251C3 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +15 dBm. The CMD251C3 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Electrical Performance – IF = 100 MHz, LO = +17 dBm , T_A = 25 °C, F = 6 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		4 – 8.5		GHz
Frequency Range, IF	DC		2.2	GHz
Conversion Loss		7		dB
LO to RF Isolation		45		dB
LO to IF Isolation		36		dB
RF to IF Isolation		25		dB
Input IP3		21		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal resistance, Θ_{JC}	280.4 ºC/ W

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications – IF = 100 MHz, LO = +17 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		4 – 7			7 – 8.5		GHz
Frequency Range, IF	DC		2.2	DC		2.2	GHz
Conversion Loss		7	8.5		8.5	10	dB
Noise Figure (SSB)		7	8.5		8.5	10	dB
LO to RF Isolation	40	45		40	45		dB
LO to IF Isolation	30	40		42	50		dB
RF to IF Isolation	15	25		30	35		dB
Input P1dB		16			17		dBm
Input IP3		22			25		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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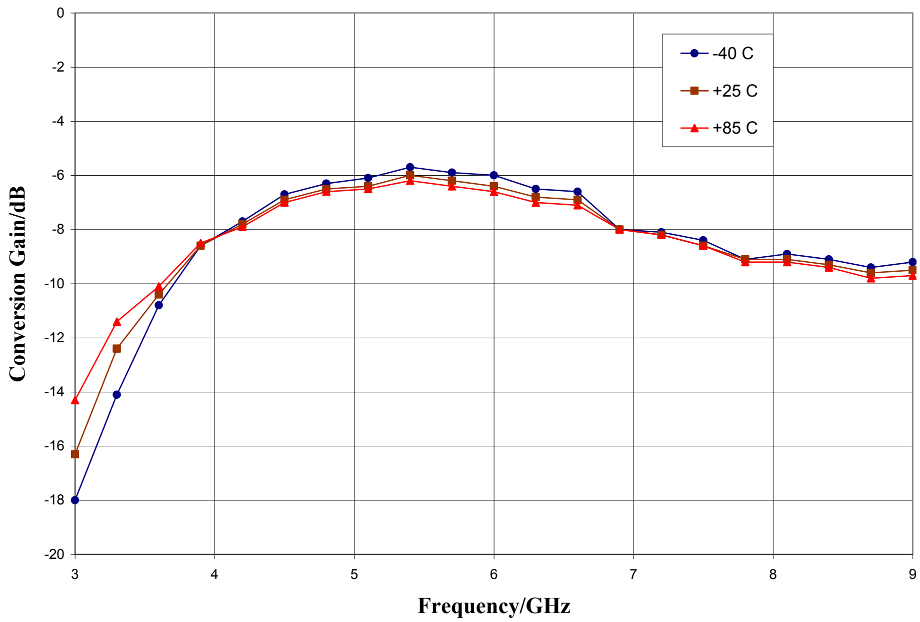
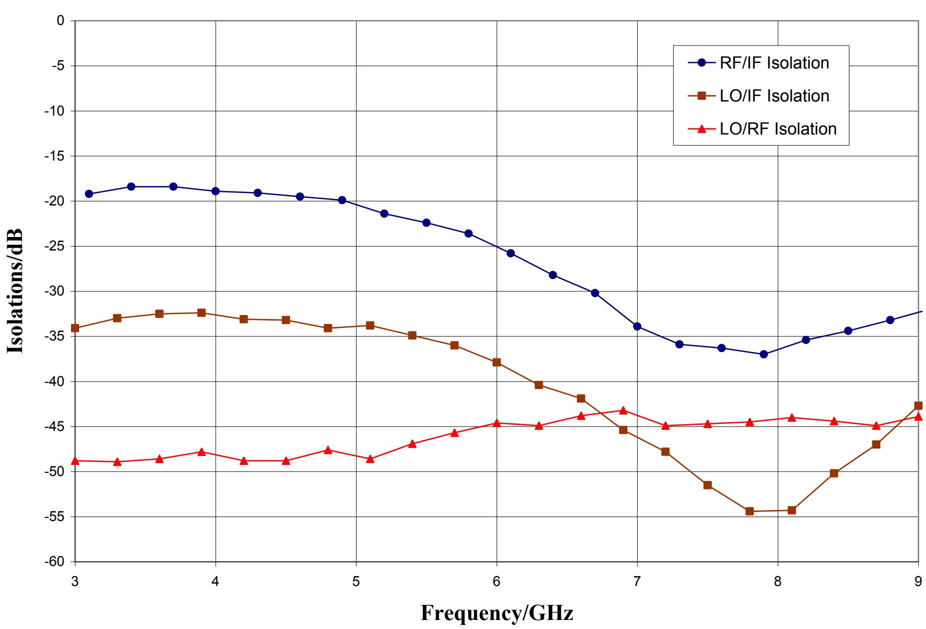
Typical Performance

Conversion Gain vs. Temperature, LO = +17 dBm, IF = 100 MHz USB



Isolations, LO = +17 dBm



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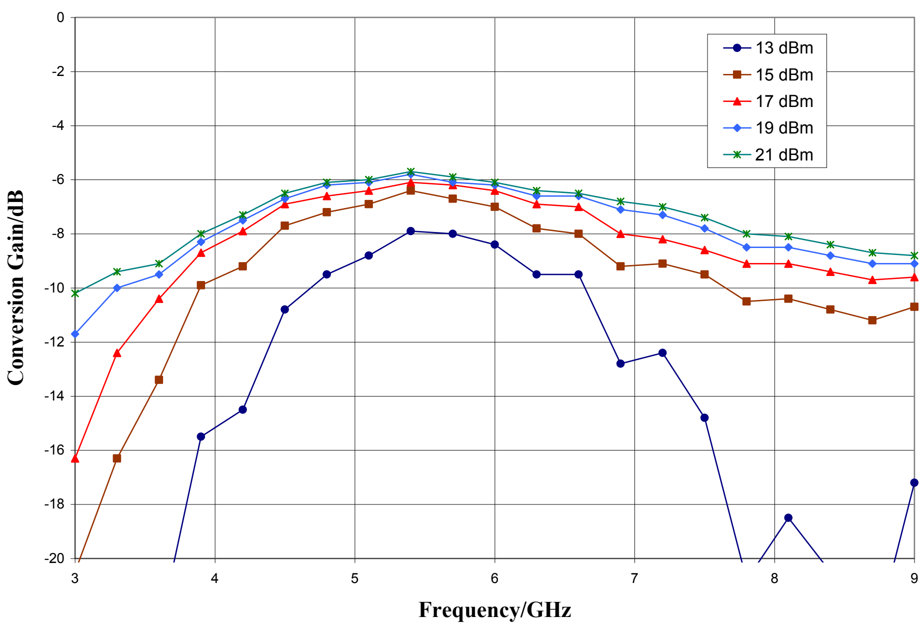
CMD251C3

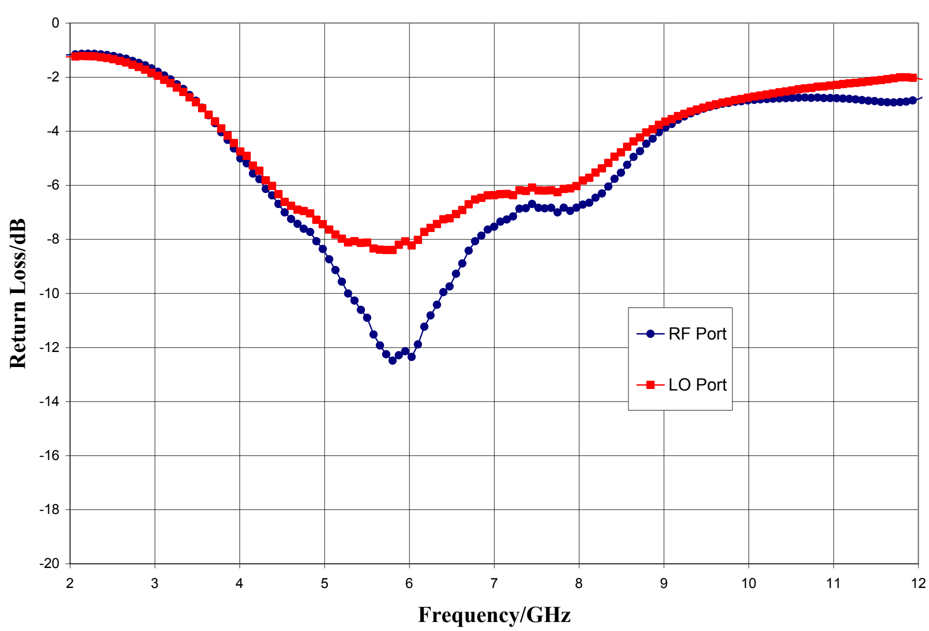
4-8.5 GHz Fundamental Mixer

Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 17 dBm



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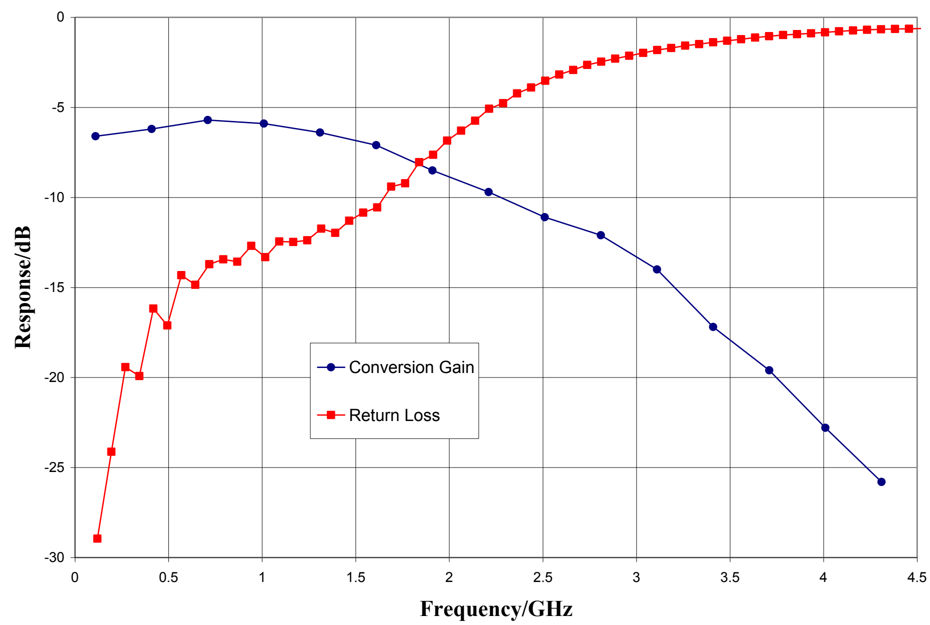
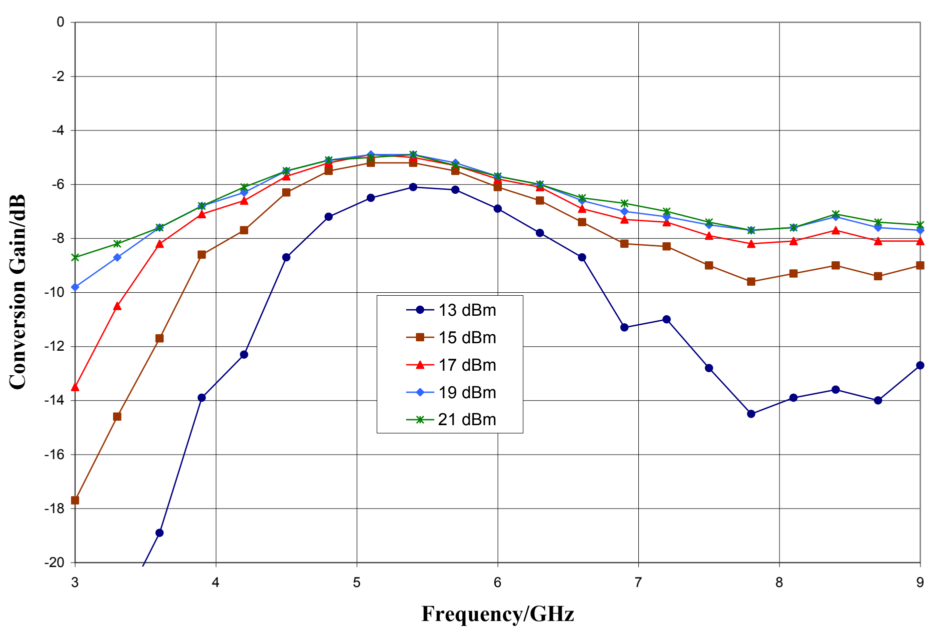
Typical Performance

IF Bandwidth, LO = +17 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 100 MHz



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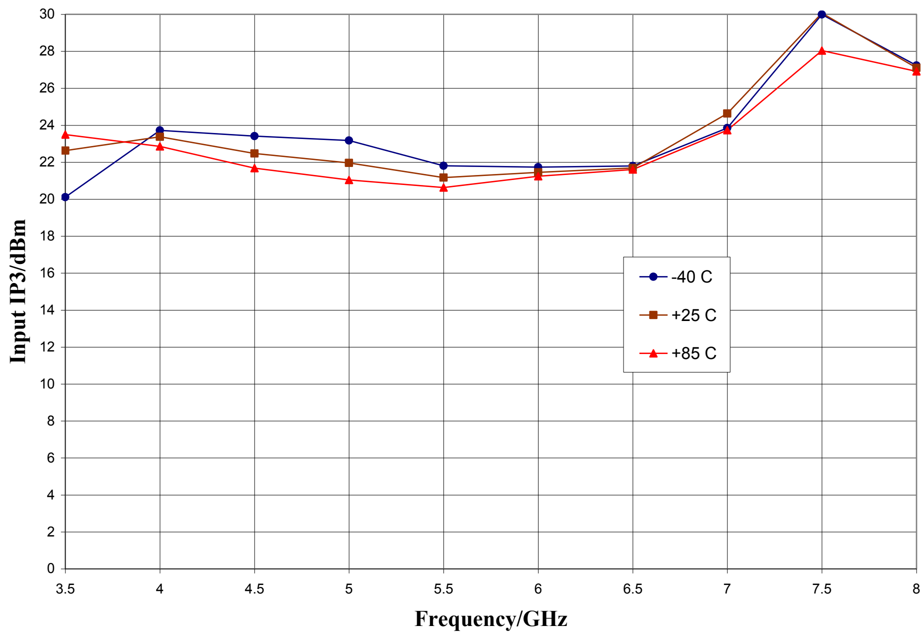
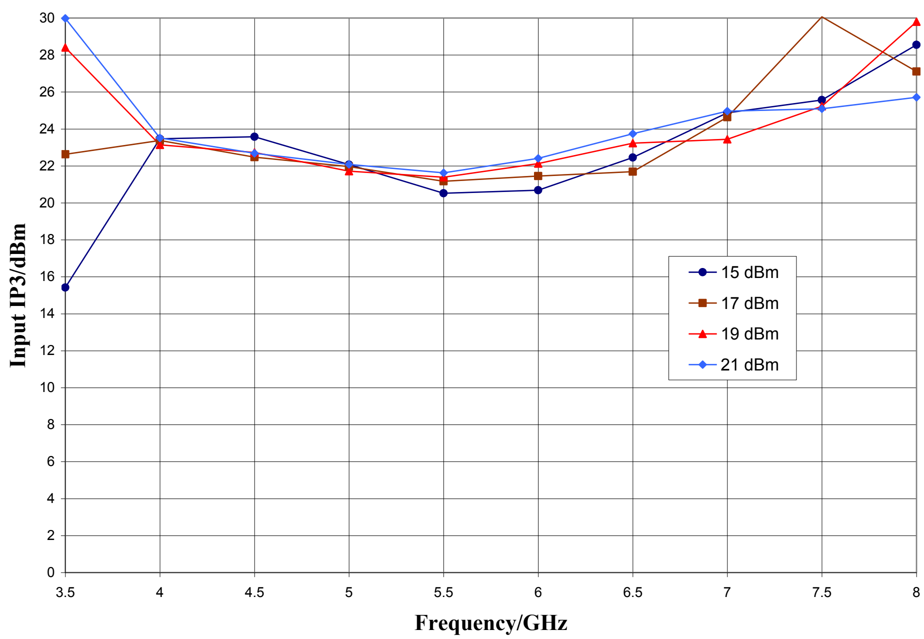
Typical Performance

Input IP3 vs. Temperature, LO = +17 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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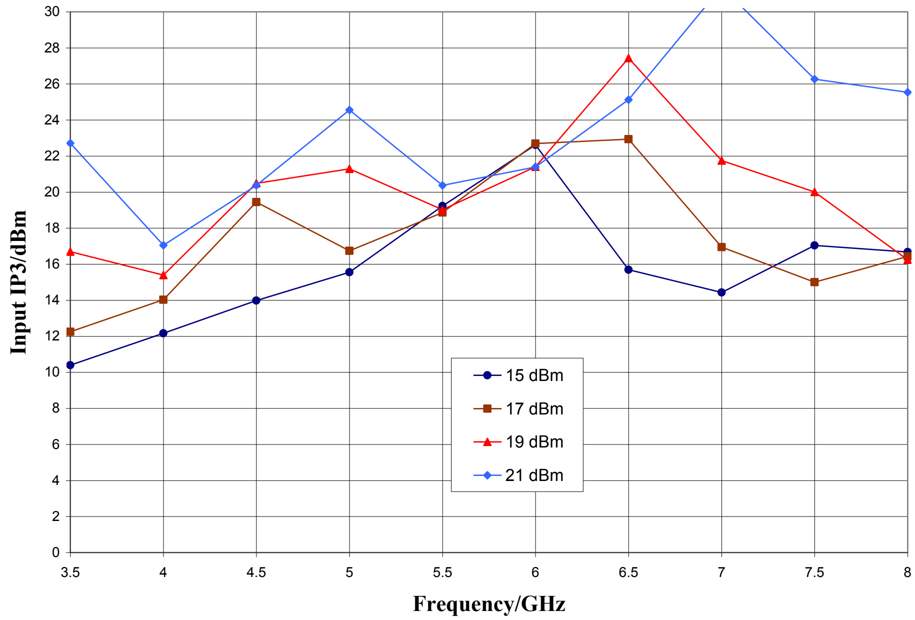
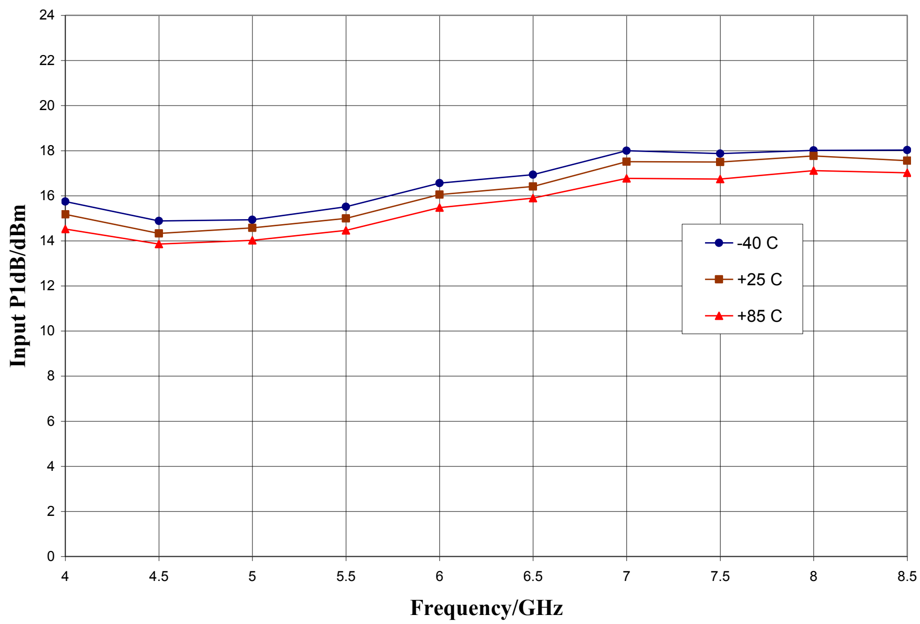
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB vs. Temperature, LO = +17 dBm, IF = 100 MHz USB



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Typical Performance

MxN Spurious Outputs

	nLO				
mRF	0	1	2	3	4
0	xx	7	9	22	35
1	21	0	35	36	39
2	67	> 80	70	71	68
3	> 80	> 80	> 80	> 80	> 80
4	> 80	> 80	> 80	> 80	> 80

RF = 6.1 GHz @ -10 dBm
LO = 6.0 GHz @ +17 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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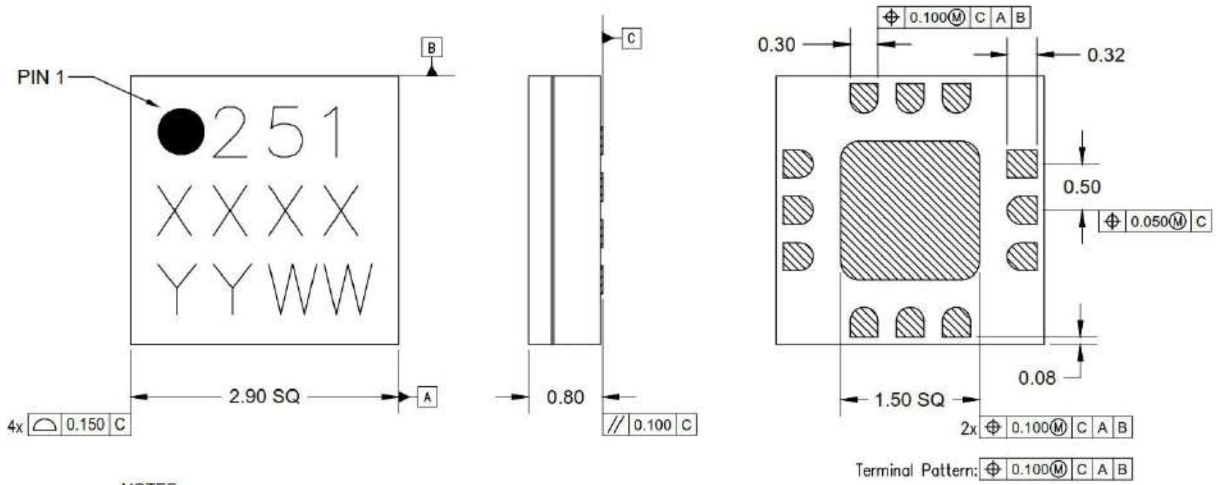
Mechanical Information

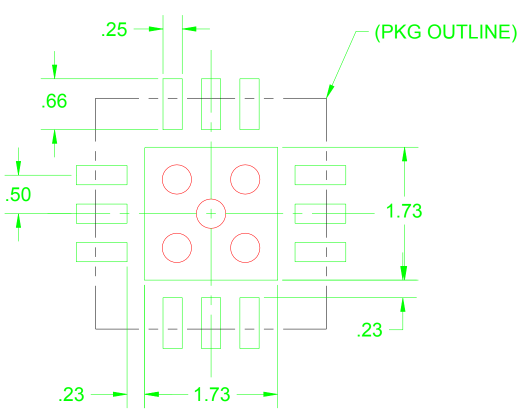
Package Information and Dimensions



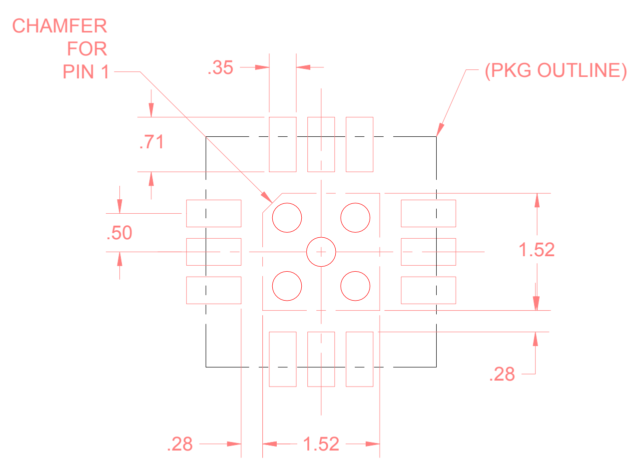
NOTES:

1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   - 3.1. Ni: 8.89um MAX, 1.27um MIN
   - 3.2. Pd: 0.17um MAX, 0.07um MIN
   - 3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING: ALL MARKING SHALL BE PERMANENT AND LEGIBLE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD

Recommended PCB Land Pattern



METALIZATION



SOLDER MASK

Custom MMIC

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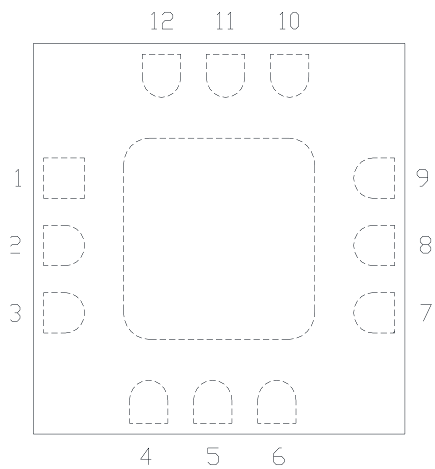
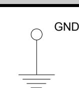
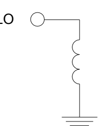
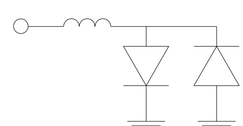
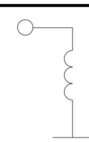
Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1,3,4,6,7,9 and die paddle	Ground	Connect to RF / DC ground.	 GND
2	LO	This pin is DC coupled and matched to 50 ohms.	 LO
5	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	 IF
8	RF	This pin is DC coupled and matched to 50 ohms.	 RF
10-12	N/C	No connection required. These pins may be connected to RF/DC ground	

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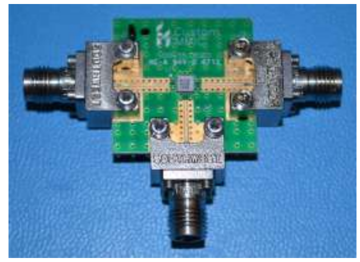
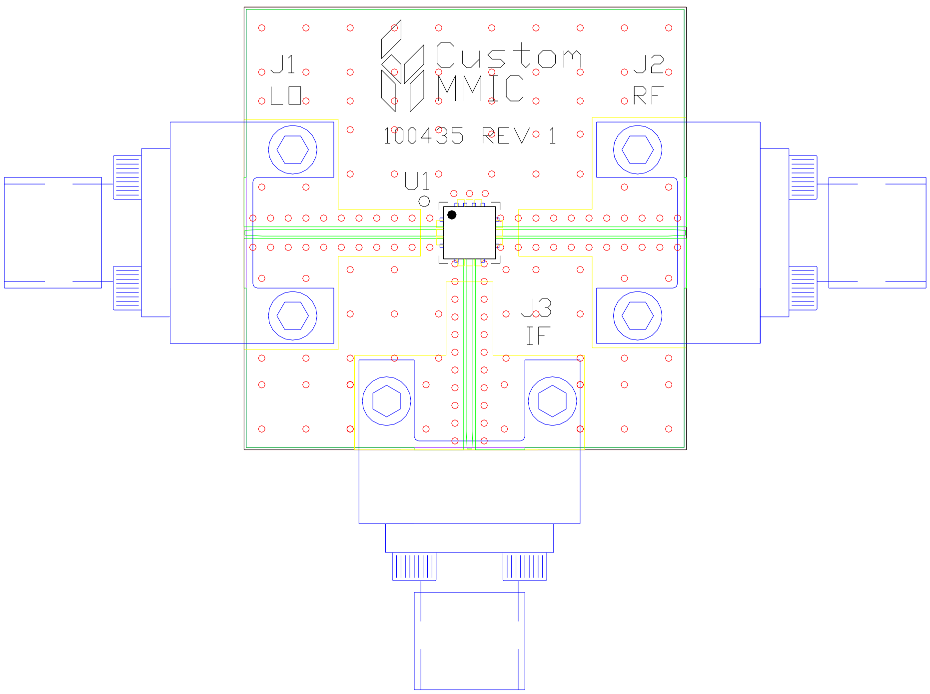
Applications Information

Evaluation Board



The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J3		SMA End Launch Connector
U1		CMD251C3 Fundamental Mixer
PCB		100435 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD252C4

4-8 GHz I/Q Mixer

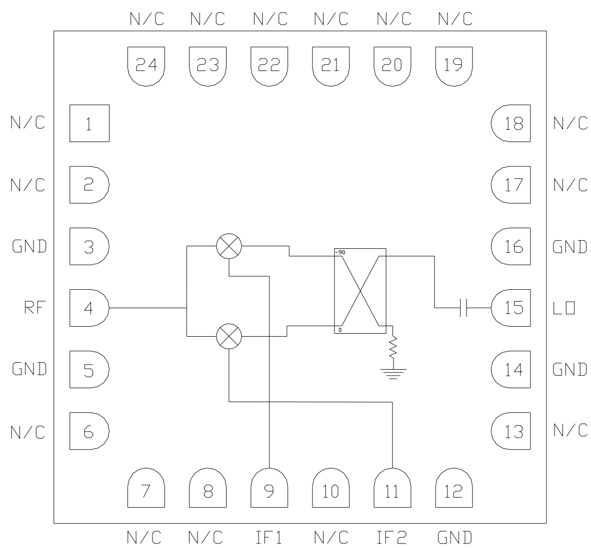
Features

- ► Low conversion loss
- ► High isolation
- ► Image rejection: 30 dB
- ► Wide IF bandwidth
- ► Pb-free RoHs compliant 4x4 mm SMT package

Description

The CMD252C4 is a compact I/Q mixer in a leadless surface mount package that can be used as either an image reject mixer or a single sideband upconverter. The CMD252C4 utilizes two double balanced mixer cells and a 90 degree hybrid. An external IF hybrid is needed to complete the image rejection. The CMD252C4 is a much smaller alternative to higher cost hybrid image reject mixers and single sideband upconverter assemblies.

Functional Block Diagram



Electrical Performance – IF = 100 MHz, LO = +20 dBm , T_A = 25 °C, F = 6 GHz				
Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		4 – 8		GHz
Frequency Range, IF	DC		2.4	GHz
Conversion Loss (as IRM)		6.5		dB
Image Rejection		30		dB
LO to RF Isolation		52		dB
LO to IF Isolation		27		dB
Input IP3		25		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal resistance, Θ_{JC}	70.9 ºC / W

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications – IF = 100 MHz, LO = +20 dBm, T_A = 25 ºC

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		4 – 7			7 – 8		GHz
Frequency Range, IF	DC		2.4	DC		2.4	GHz
Conversion Loss (as IRM)		7	9		8.5	10	dB
Image Rejection	20	25		15	18		dB
LO to RF Isolation	40	50		50	55		dB
LO to IF Isolation	16	25		22	30		dB
Input P1dB		15			17		dBm
Input IP3		25			26		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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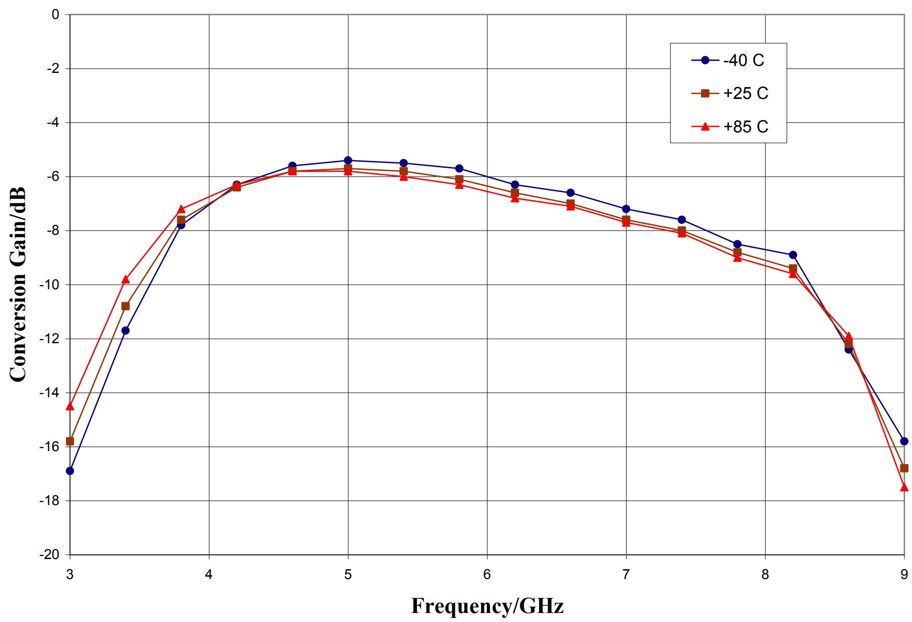
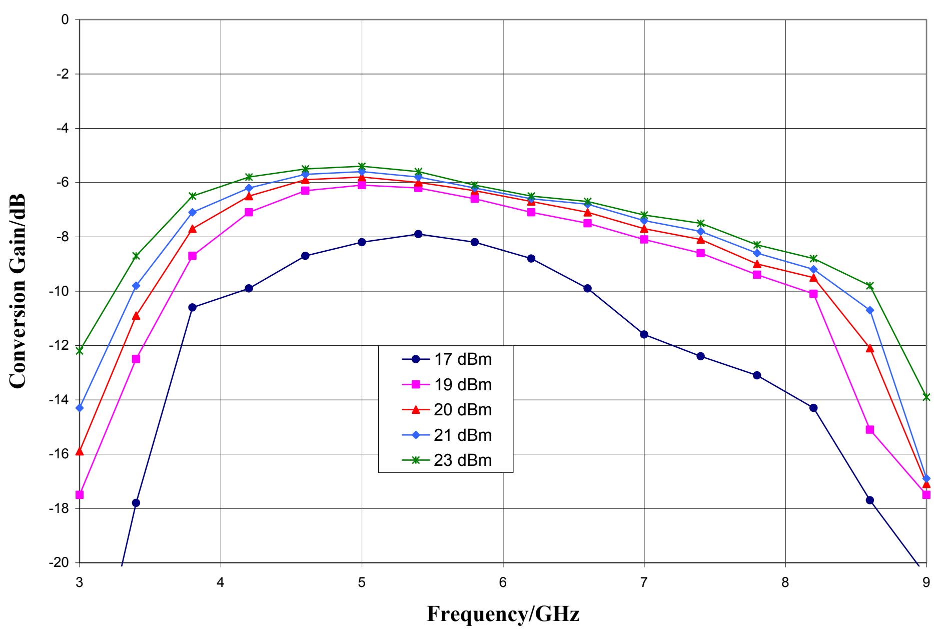
Typical Performance

Data Taken As IRM With External IF Hybrid

Conversion Gain vs. Temperature, LO = +20 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB



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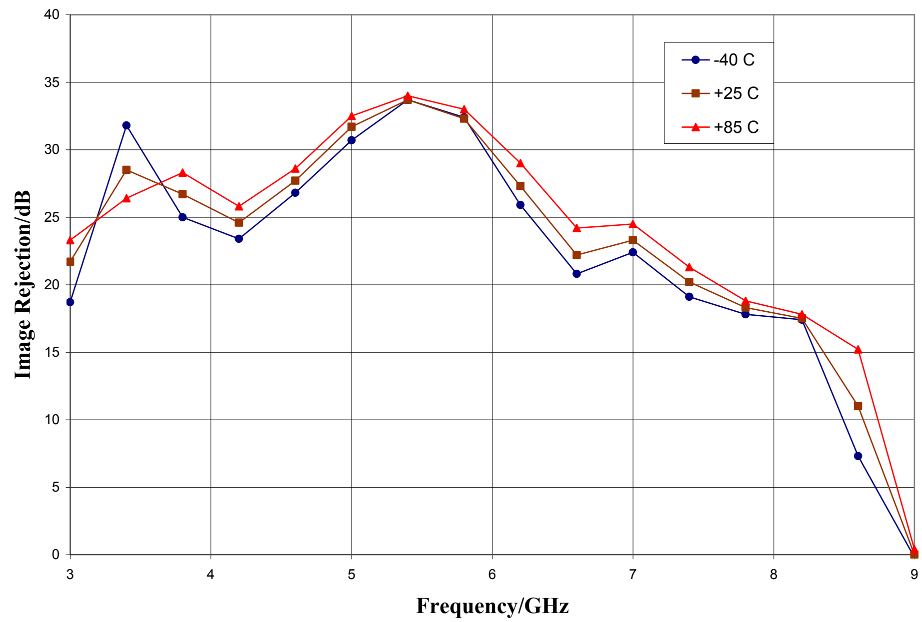
CMD252C4

4-8 GHz I/Q Mixer

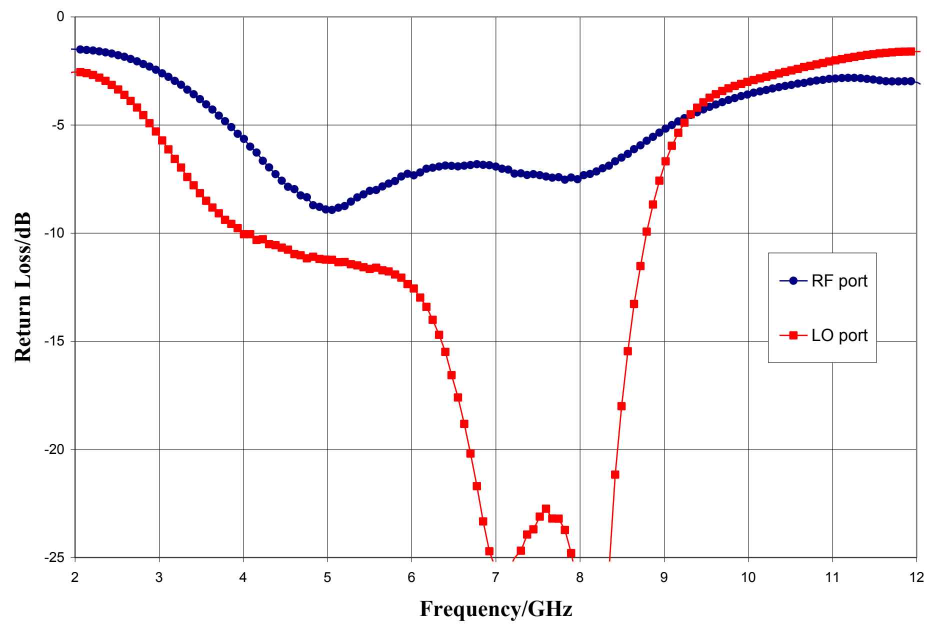
Typical Performance

Data Taken As IRM With External IF Hybrid

Image Rejection, LO = +20 dBm, IF = 100 MHz USB



Return Loss, LO = +20 dBm



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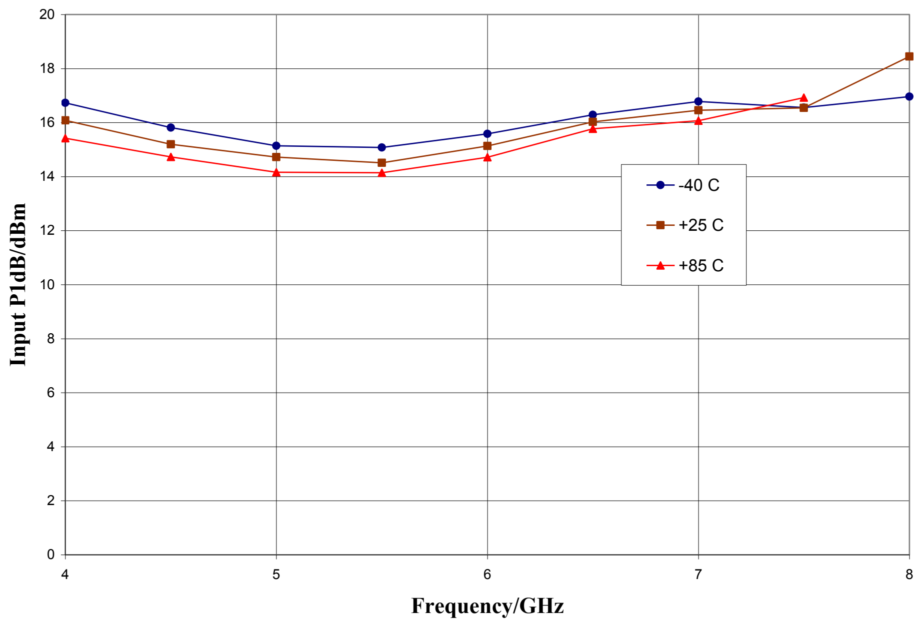
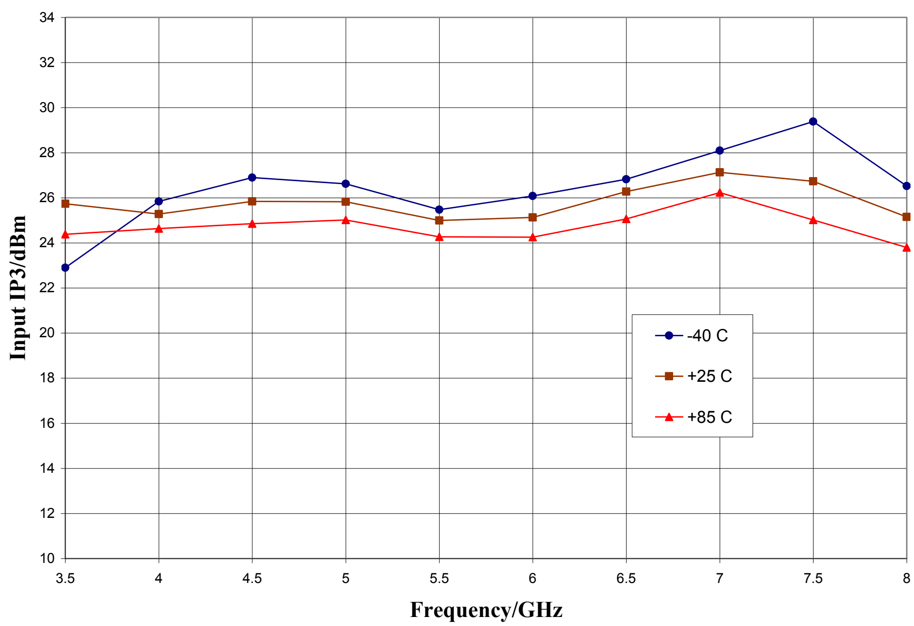
Typical Performance

Data Taken As IRM With External IF Hybrid

Input P1dB vs. Temperature, LO = +20 dBm, IF = 100 MHz USB



Input IP3 vs. Temperature, LO = +20 dBm, IF = 100 MHz USB



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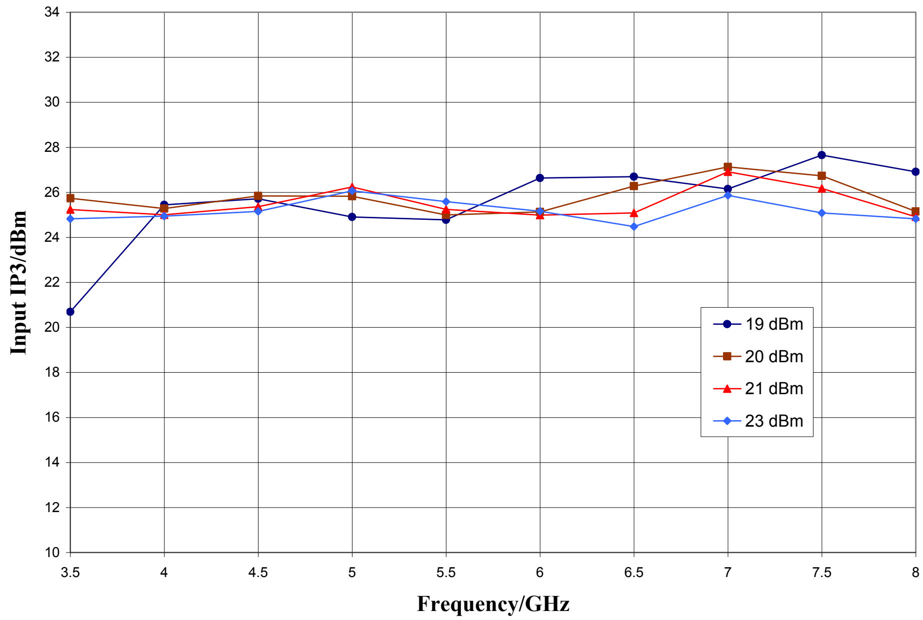
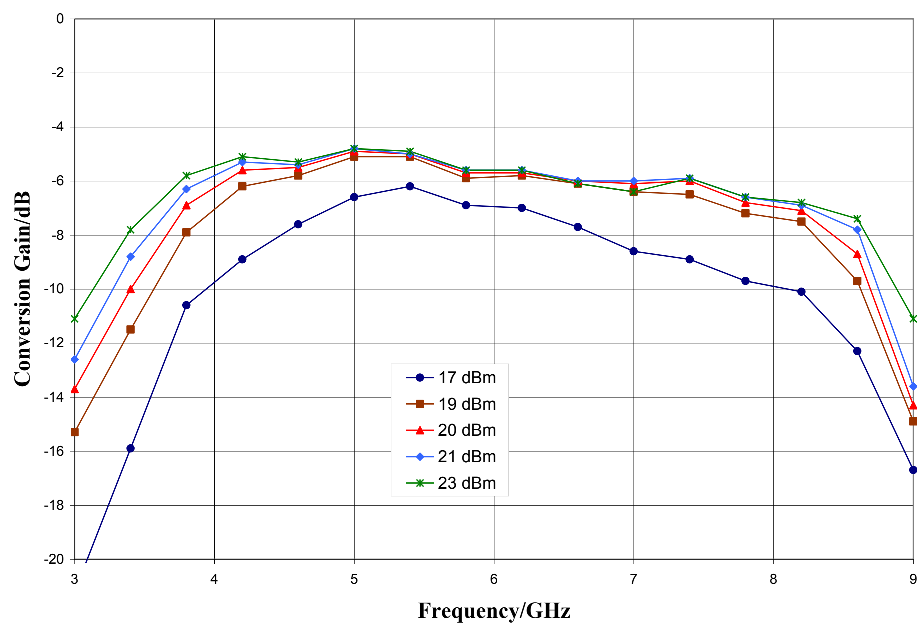
Typical Performance

Data Taken As IRM With External IF Hybrid

Input IP3 vs. LO Drive, IF = 100 MHz USB



Upconverter Performance, Conversion Gain vs. LO Drive, IF = 100 MHz



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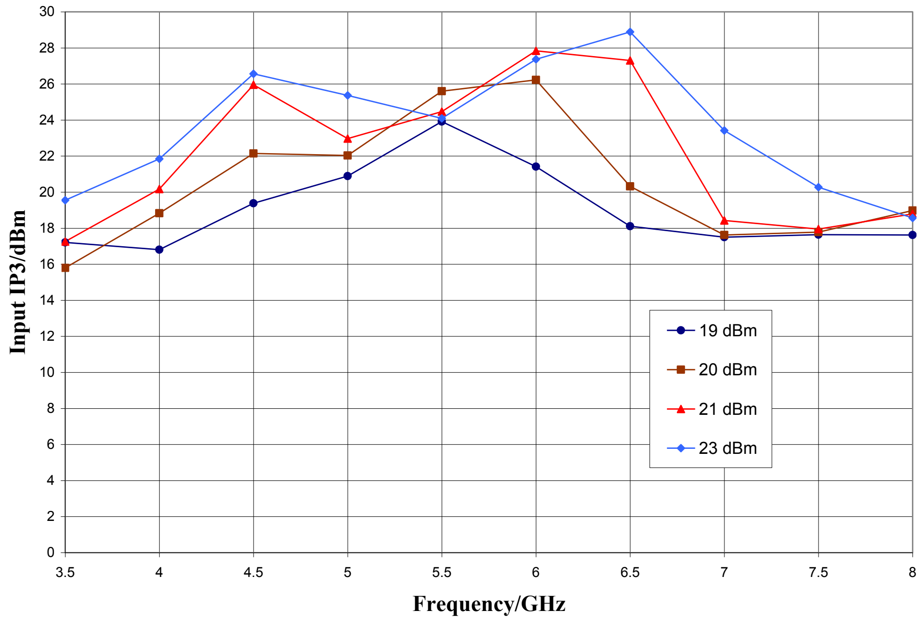
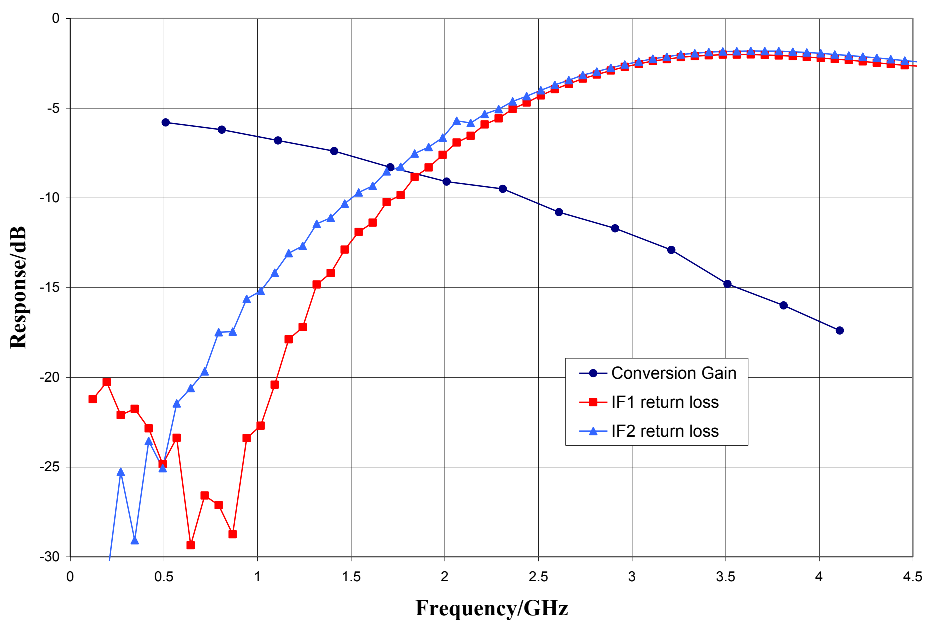
Typical Performance

Data Taken As IRM With External IF Hybrid

Upconverter Performance, Input IP3 vs. LO Drive, IF = 500 MHz



IF Bandwidth, LO = +20 dBm, Return Loss Data Taken Without IF Hybrid



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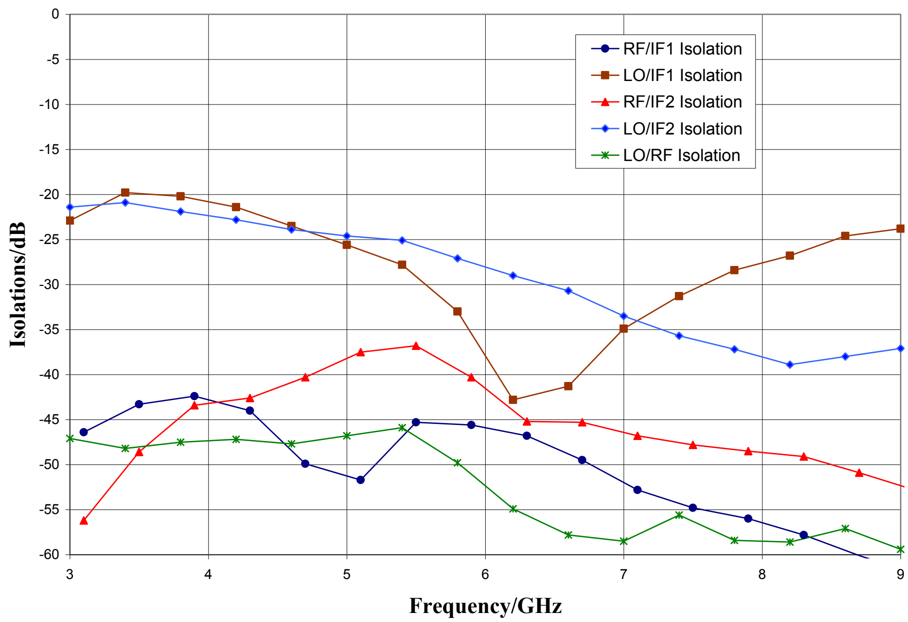
Typical Performance

Isolations, LO = +20 dBm. Data Taken Without IF Hybrid



MxN Spurious Outputs to IF1, IF2

	nLO				
mRF	0	1	2	3	4
0	xx	-1 / -10	36 / 30	10 / 14	50 / 61
1	38 / 38	0	42 / 44	50 / 48	62 / 64
2	> 80	65 / 62	69 / > 80	> 80 / 66	> 80
3	> 80	> 80	> 80	> 80	68 / > 80
4	> 80	> 80	> 80	> 80	> 80

RF = 6.1 GHz @ -10 dBm
LO = 6.0 GHz @ +20 dBm
All values in dBc below the IF1 / IF2 output power level (1RF - 1LO)
Measurement performed without IF hybrid
Where two numbers are listed, they are the spur levels for the IF1 / IF2 ports

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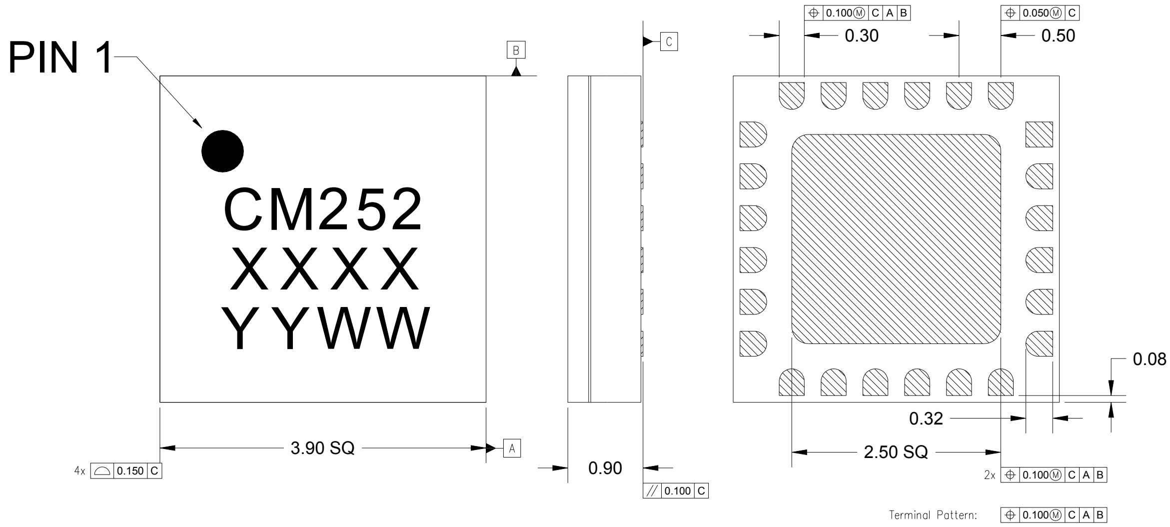
Mechanical Information

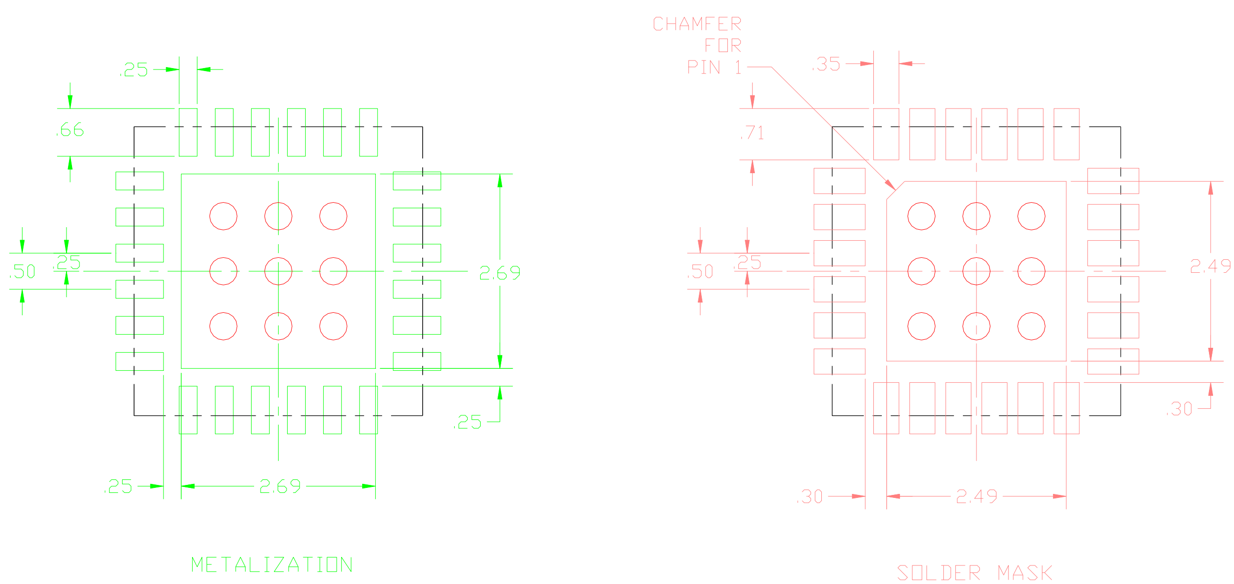
Package Information and Dimensions



NOTES:

1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING: ALL MARKING SHALL BE PERMANENT AND LEGIBLE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD

Recommended PCB Land Pattern



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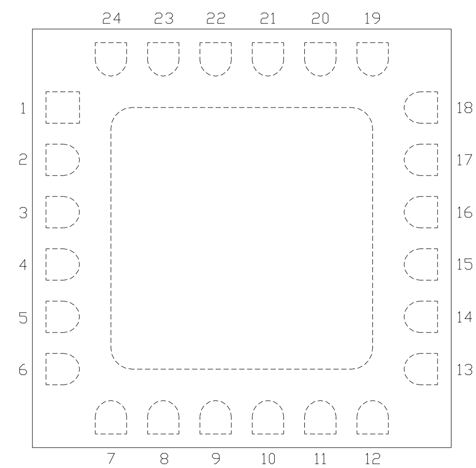
Custom MMIC

CMD252C4

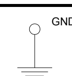
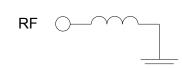
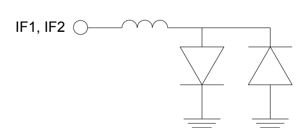
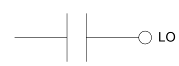
4-8 GHz I/Q Mixer

Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1, 2, 6-8, 10, 13, 17-24	N/C	No connection required. These pins may be connected to RF/DC ground.	
3, 5, 12, 14, 16 and die paddle	Ground	Connect to RF / DC ground.	
4	RF	This pin is DC coupled and matched to 50 ohms.	
9	IF1	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
11	IF2		
15	LO	This pin is AC coupled and matched to 50 ohms.	

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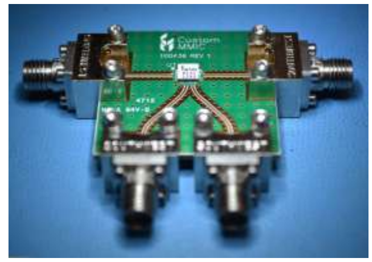
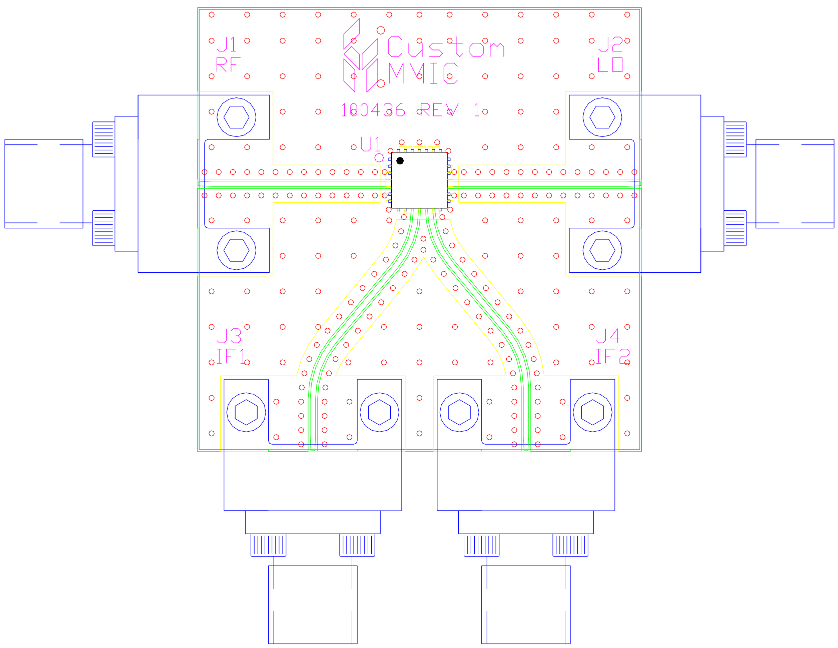
Applications Information

Evaluation Board



The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J4		SMA End Launch Connector
U1		CMD252C4 I/Q Mixer
PCB		100436 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

Please note, all information contained in this data sheet is subject to change without notice. ver 1.0 0717

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Tél. 01 47 95 99 60 - Fax. 01 47 01 16 22 - e-mail: hyper@es-france.com - Site Web: www.es-france.com

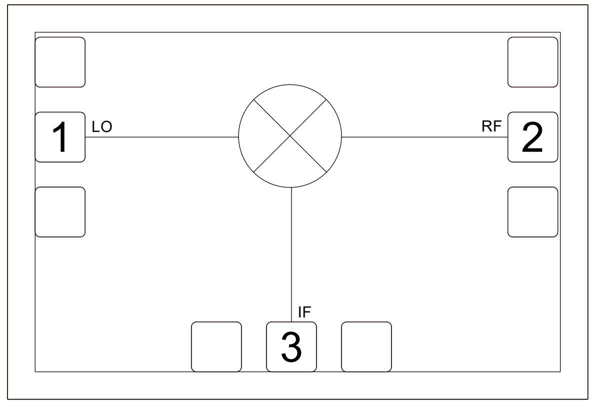
CMD253

6-14 GHz High IP3 Fundamental Mixer

Features

- ► Low conversion loss
- ► High IP3
- ► High Isolation
- ► Wide IF bandwidth
- ► Small die size

Functional Block Diagram



Description

The CMD253 is a high IP3 double balanced mixer die that can be used for up- and downconverting applications between 6 and 14 GHz. The CMD253 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +15 dBm. The CMD253 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

***Electrical Performance* - IF = 100 MHz, LO = +19 dBm , T_A = 25 ^{o}C, F = 10 GHz**

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		6 - 14		GHz
Frequency Range, IF	DC		5	GHz
Conversion Loss		6		dB
LO to RF Isolation		43		dB
LO to IF Isolation		39		dB
RF to IF Isolation		23		dB
Input P1dB		15		dBm
Input IP3		23		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	156 °C/W
Power Dissipation, Pdiss	417 mW

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications - IF = 100 MHz, LO = +19 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		8 - 12			6 - 14		GHz
Frequency Range, IF	DC		5	DC		5	GHz
Conversion Loss		6.5	8		7	11	dB
Noise Figure (SSB)		6.5			7		dB
LO to RF Isolation	35	43		32	43		dB
LO to IF Isolation	29	39		25	39		dB
RF to IF Isolation	15	23		12	23		dB
Input P1dB		15			15		dBm
Input IP3		23			23		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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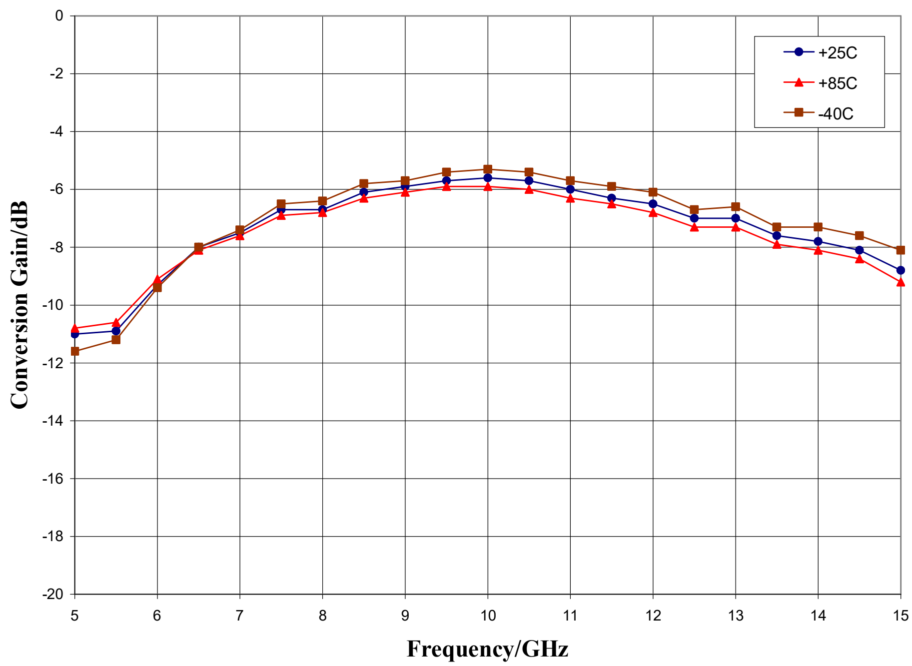
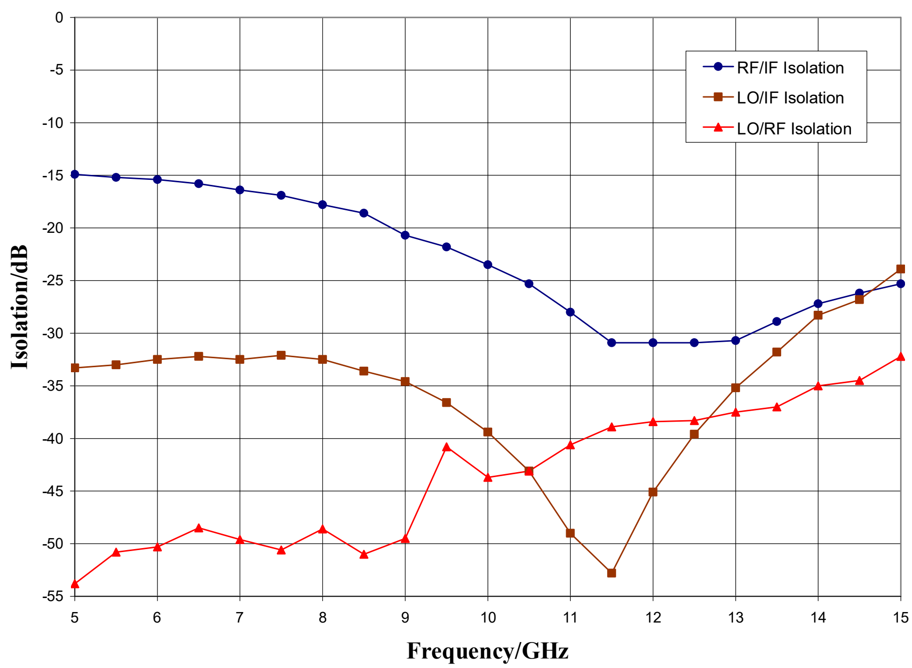
Typical Performance

Conversion Gain vs. Temperature, LO = +19 dBm, IF = 100 MHz USB



Isolation, LO = +19 dBm



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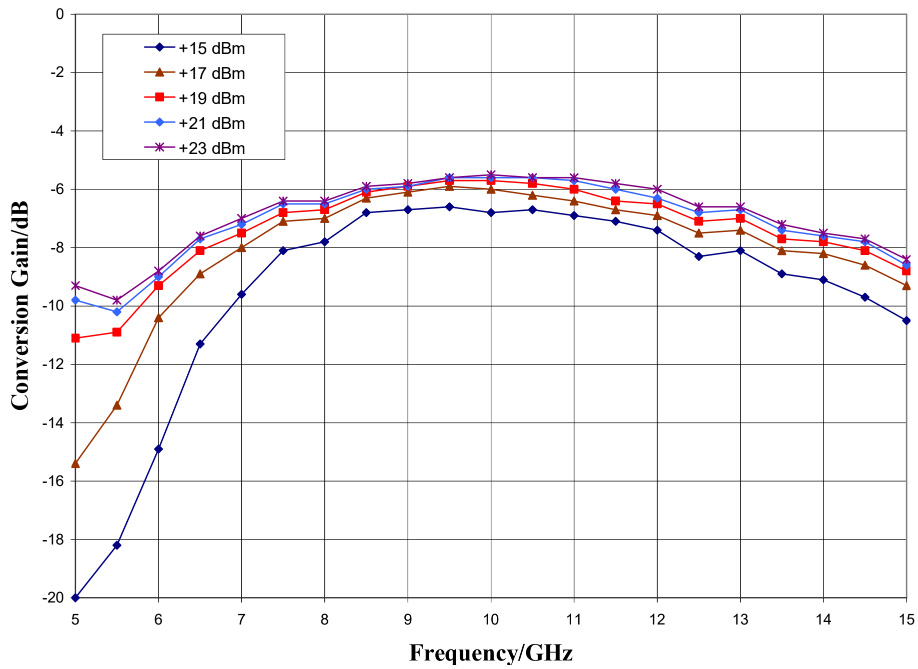
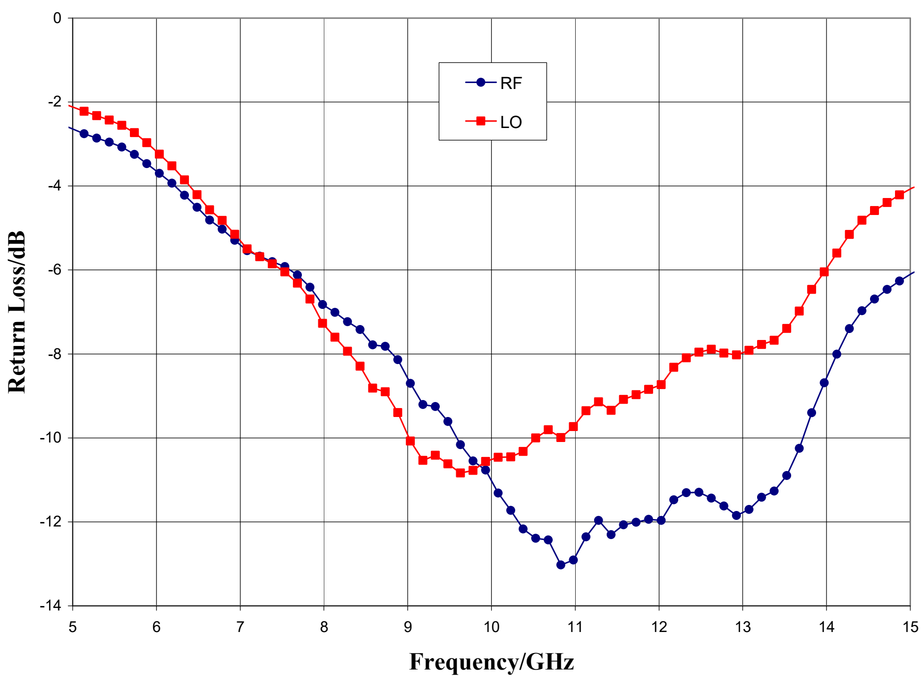
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 19 dBm



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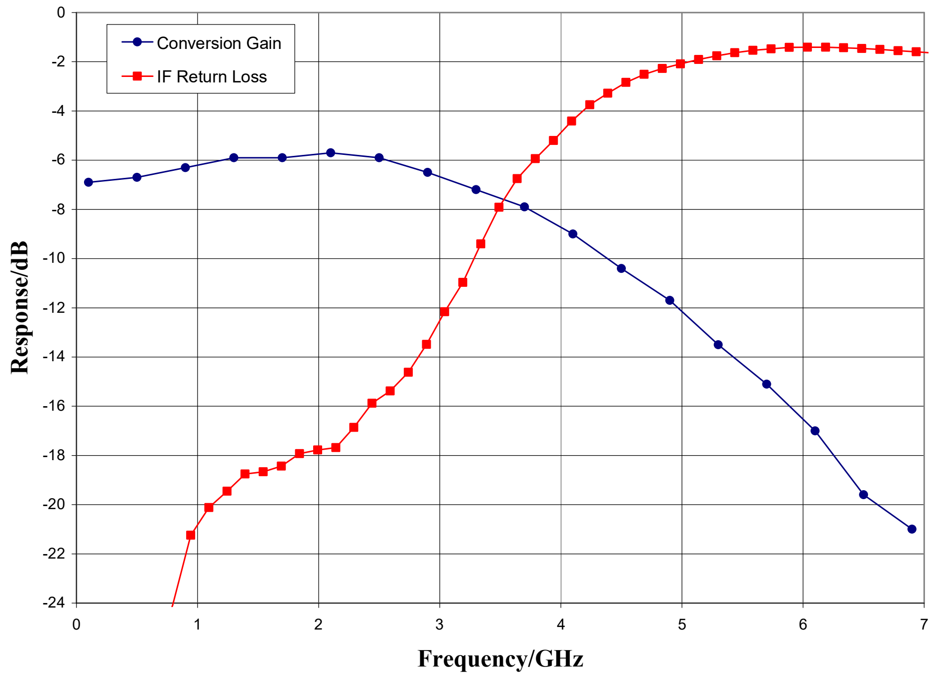
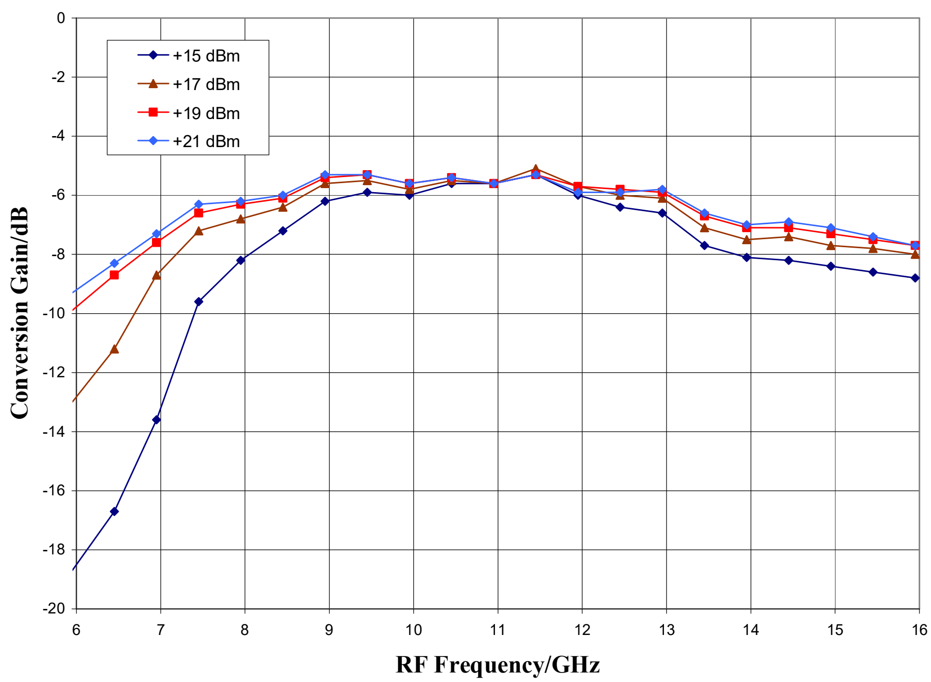
Typical Performance

IF Bandwidth, LO = +19 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 950 MHz



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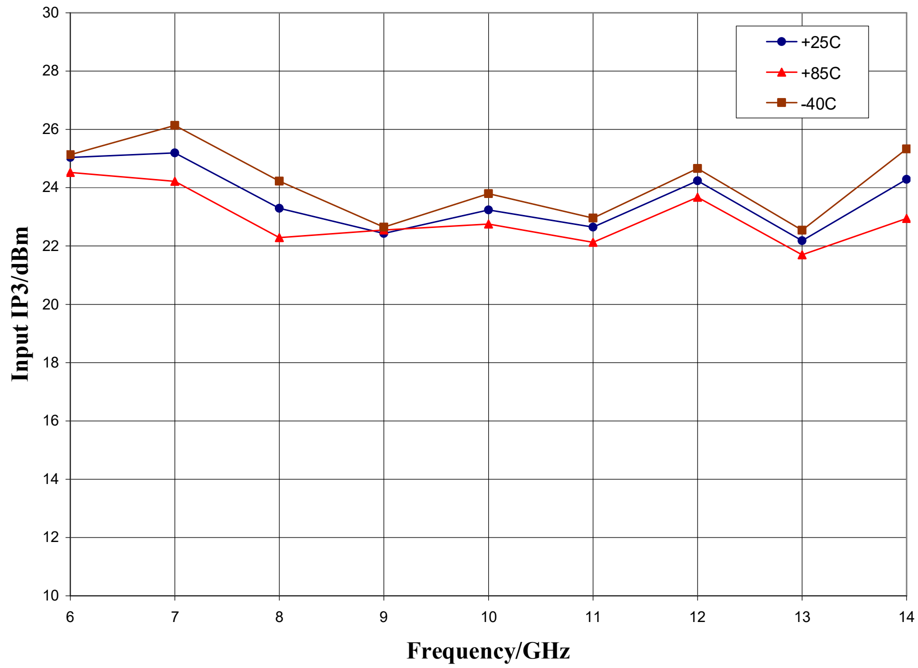
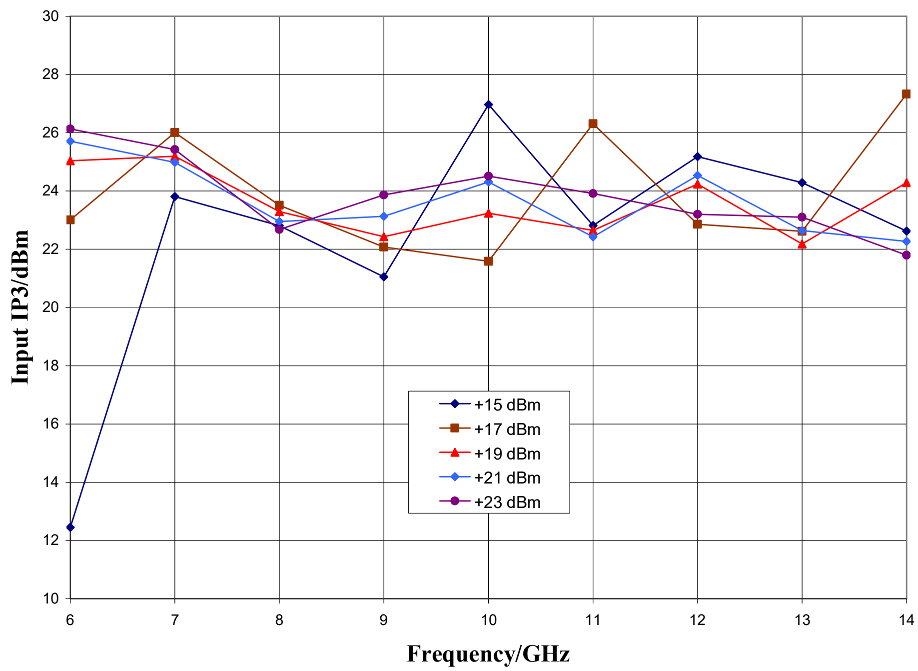
Typical Performance

Input IP3 vs. Temperature, LO = +19 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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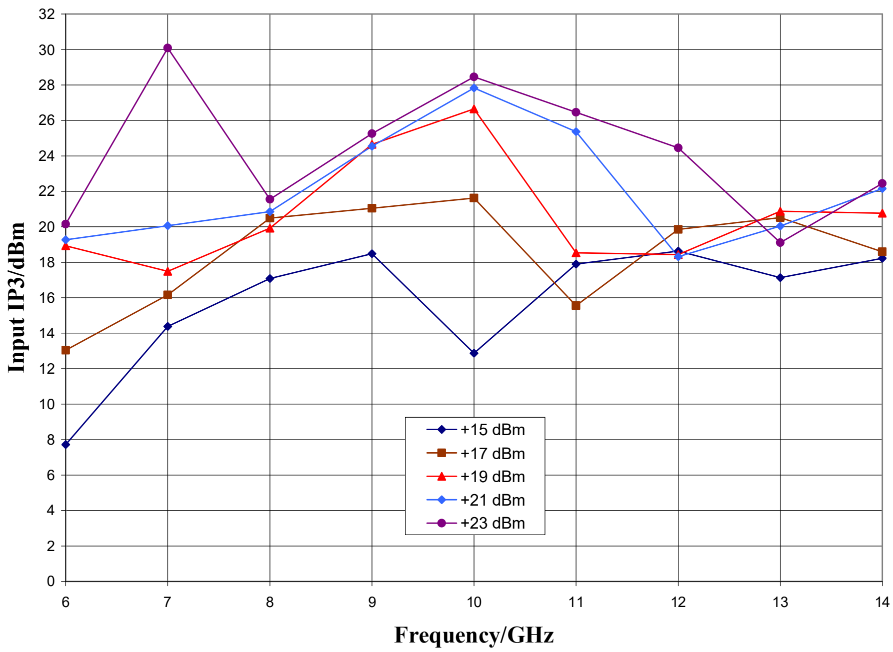
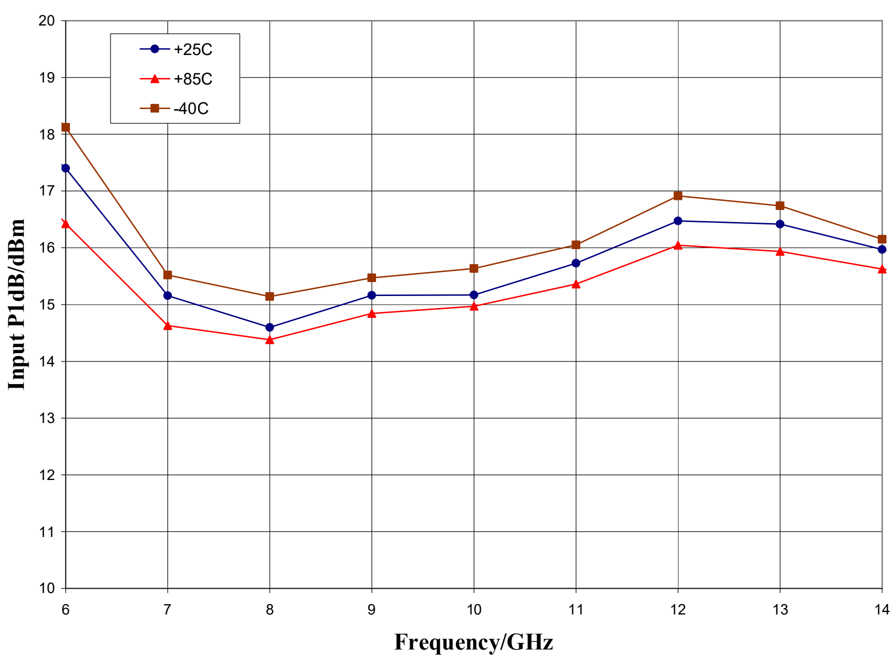
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB vs. Temperature, LO = +19 dBm, IF = 100 MHz USB



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Typical Performance

MxN Spurious Outputs

	nLO				
mRF	0	1	2	3	4
0	xx	4	21	31	21
1	18	0	40	37	62
2	>64	>64	>64	>64	>64
3	>64	>64	>64	>64	>64
4		>64	>64	>64	>64

RF = 10.1 GHz @ -10 dBm
LO = 10.0 GHz @ +19 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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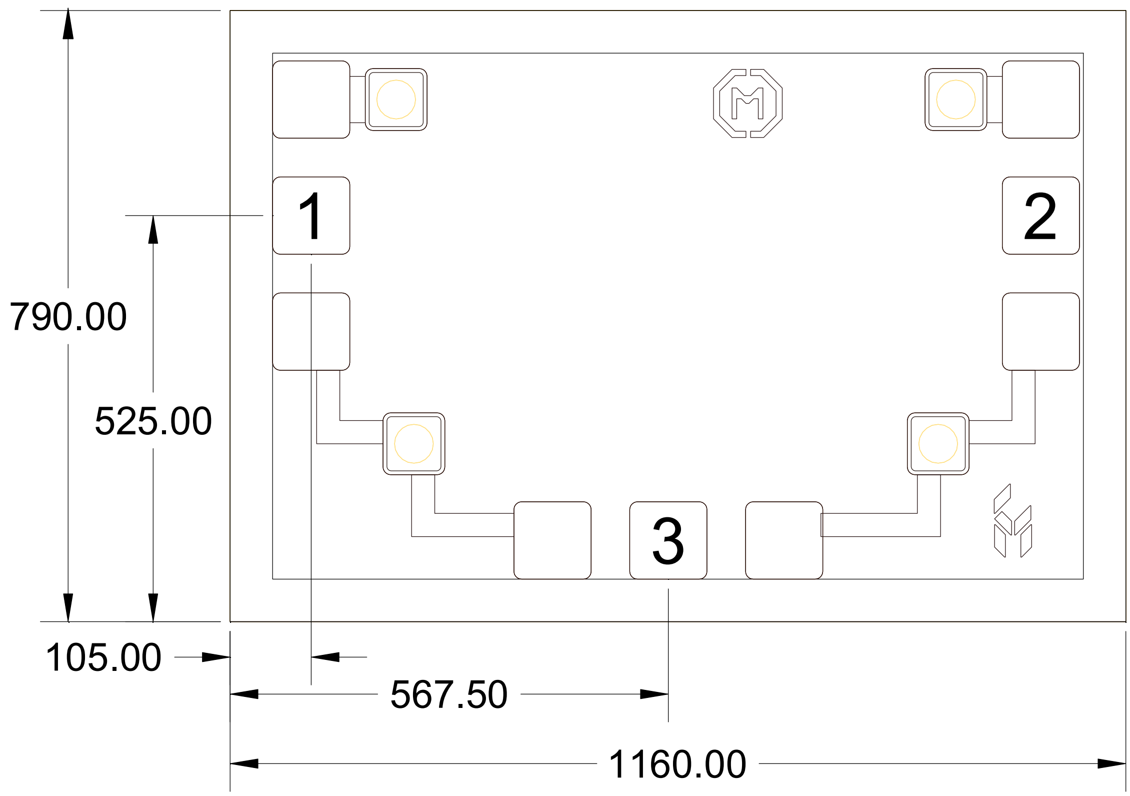
Mechanical Information

Die Outline (all dimensions in microns)



Notes:

1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 100 microns thick
5. All bond pads (1, 2, 3) are 100 x 100 microns square

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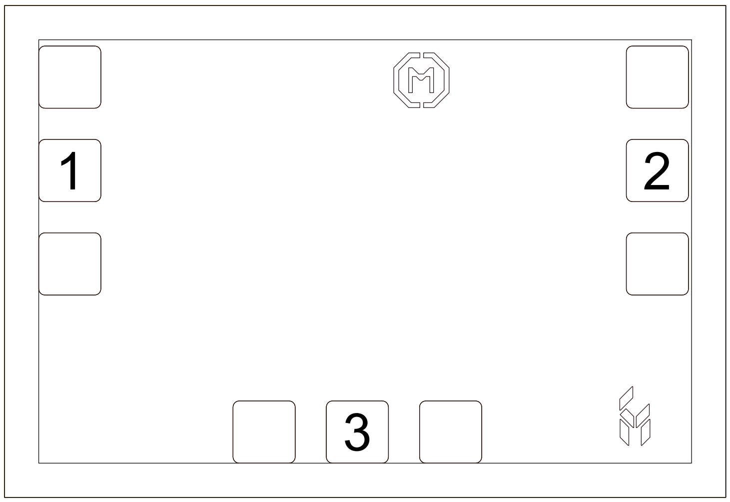
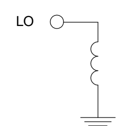
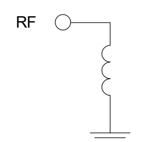
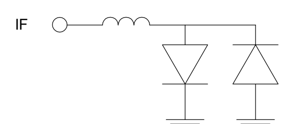
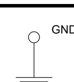
Pad Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	LO	This pin is DC coupled and matched to 50 ohms.	
2	RF	This pin is DC coupled and matched to 50 ohms.	
3	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
Backside	Ground	Connect to RF / DC ground.	

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Applications Information

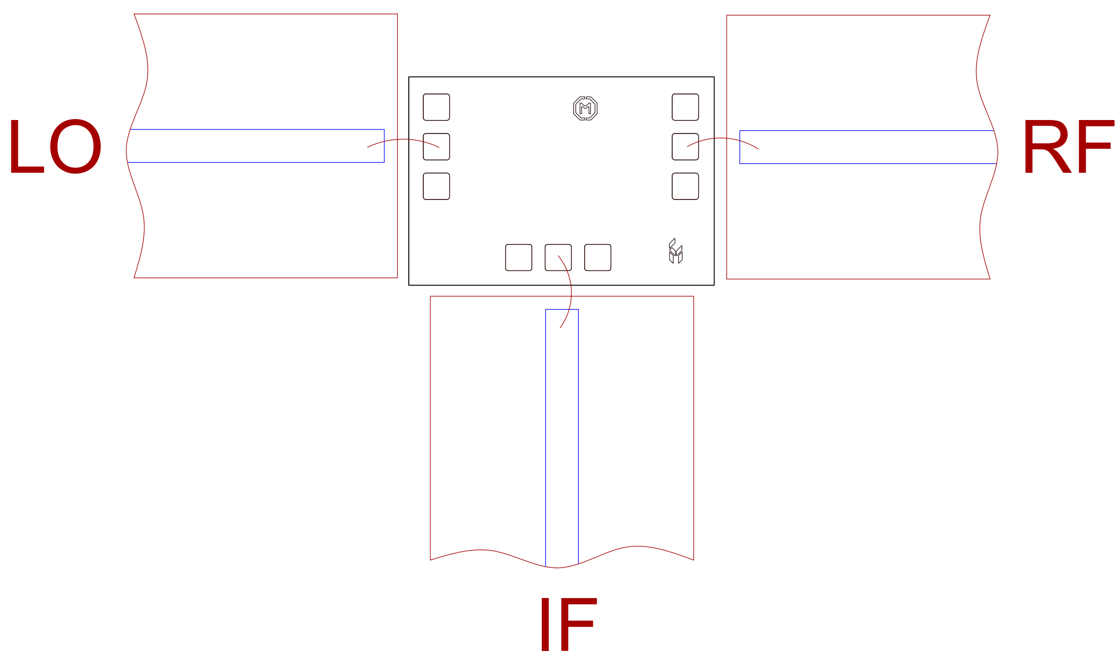
Assembly Guidelines

The backside of the CMD253 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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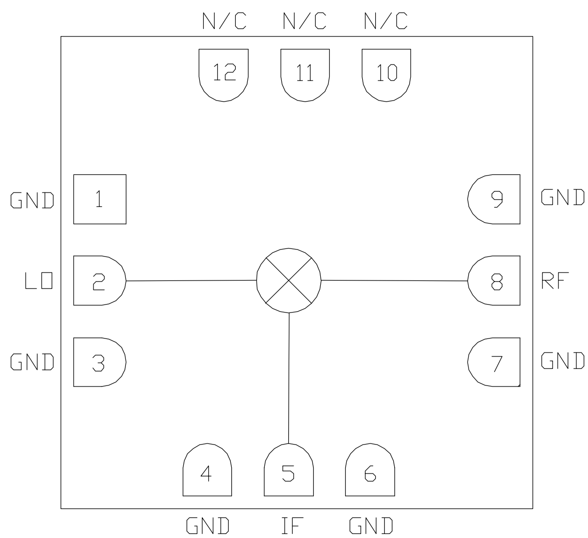
CMD253C3

6-14 GHz High IP3 Fundamental Mixer

Features

- ► Low conversion loss
- ► High IP3
- ► High Isolation
- ► Wide IF bandwidth
- ► Pb-free RoHs compliant 3x3 mm SMT package

Functional Block Diagram



Description

The CMD253C3 is a high IP3 double balanced mixer in a leadless surface mount package that can be used for up- and downconverting applications between 6 and 14 GHz. The CMD253C3 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +15 dBm. The CMD253C3 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Electrical Performance **- IF = 100 MHz, LO = +19 dBm , T_A = 25 °C, F = 10 GHz**

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		6 - 14		GHz
Frequency Range, IF	DC		5	GHz
Conversion Loss		6		dB
LO to RF Isolation		43		dB
LO to IF Isolation		39		dB
RF to IF Isolation		23		dB
Input P1dB		15		dBm
Input IP3		23		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	156 °C/W

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications - IF = 100 MHz, LO = +19 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		8 - 12			6 - 14		GHz
Frequency Range, IF	DC		5	DC		5	GHz
Conversion Loss		6.5	8		7	11	dB
Noise Figure (SSB)		6.5			7		dB
LO to RF Isolation	35	43		32	43		dB
LO to IF Isolation	29	39		25	39		dB
RF to IF Isolation	15	23		12	23		dB
Input P1dB		15			15		dBm
Input IP3		23			23		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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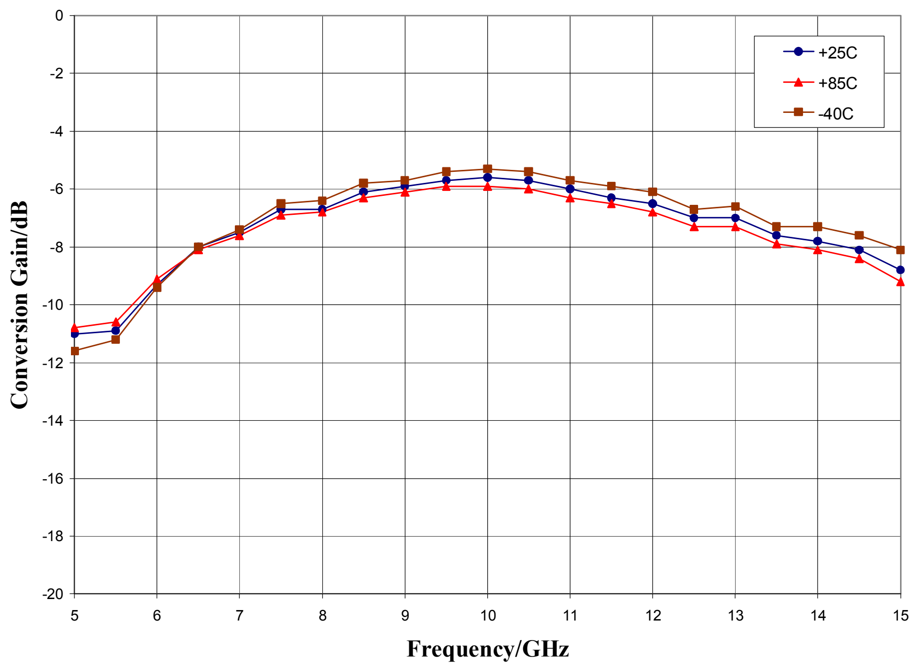
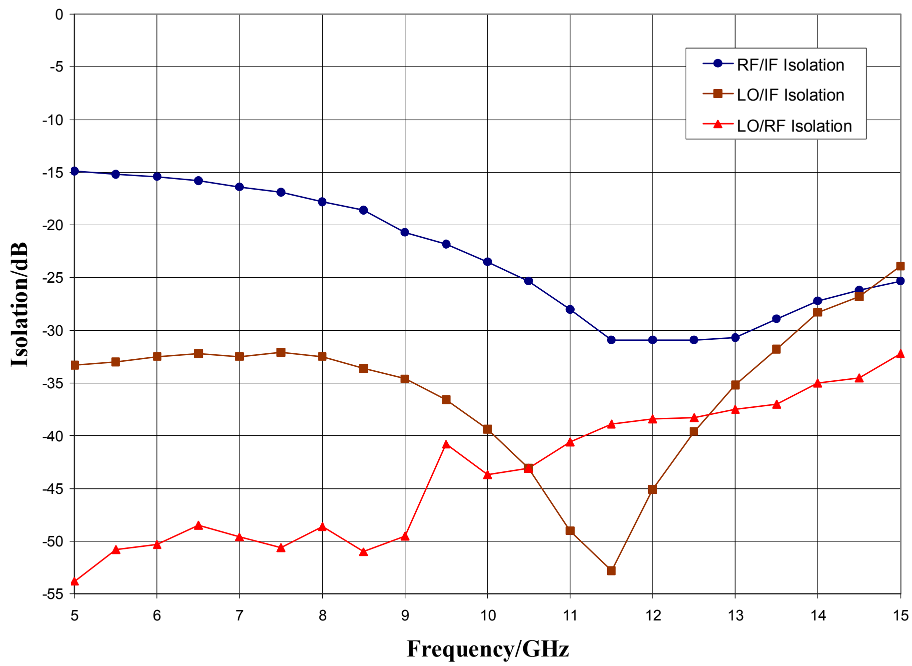
Typical Performance

Conversion Gain vs. Temperature, LO = +19 dBm, IF = 100 MHz USB



Isolation, LO = +19 dBm



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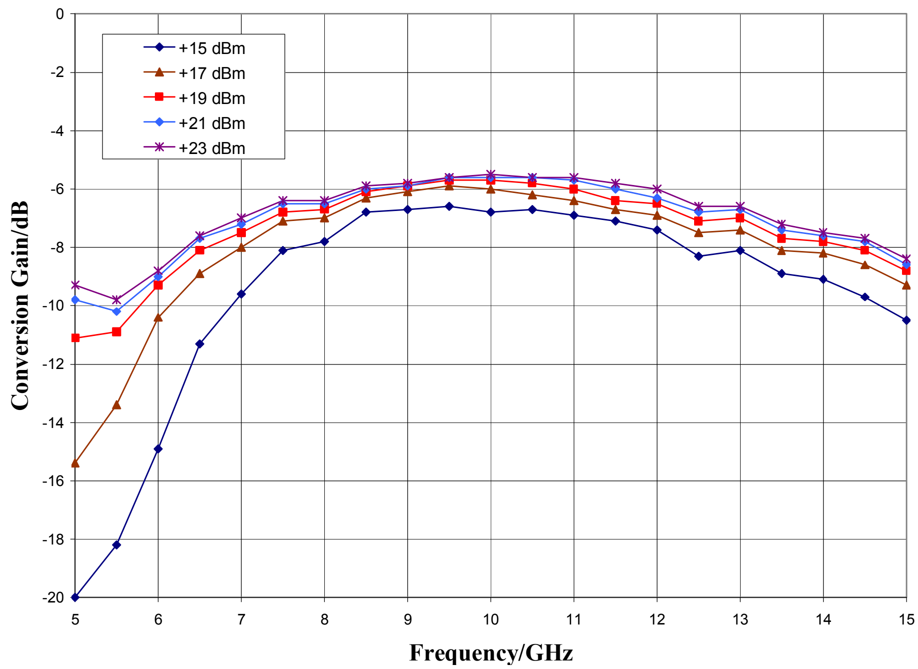
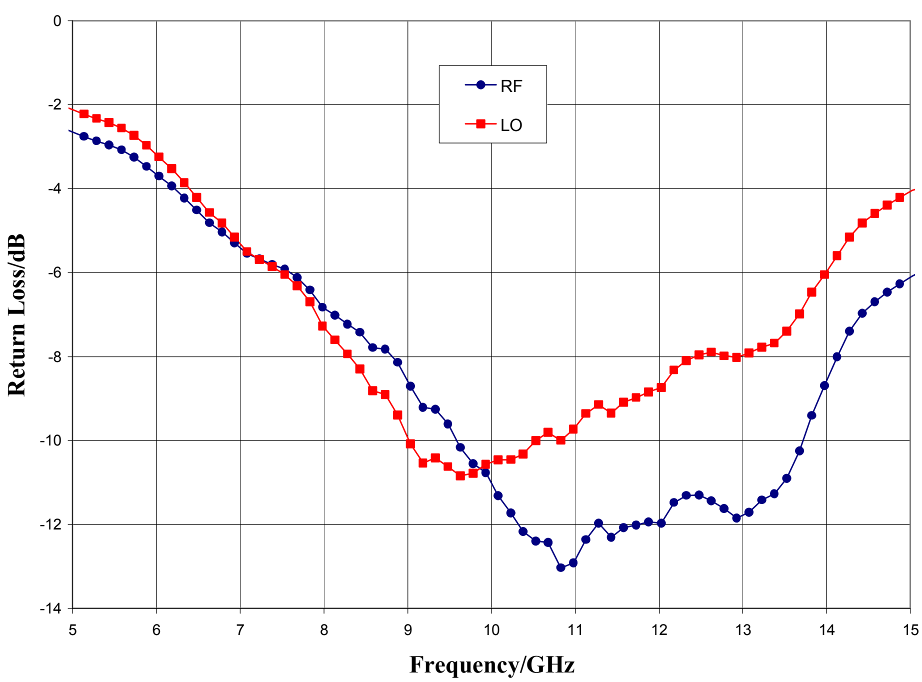
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 19 dBm



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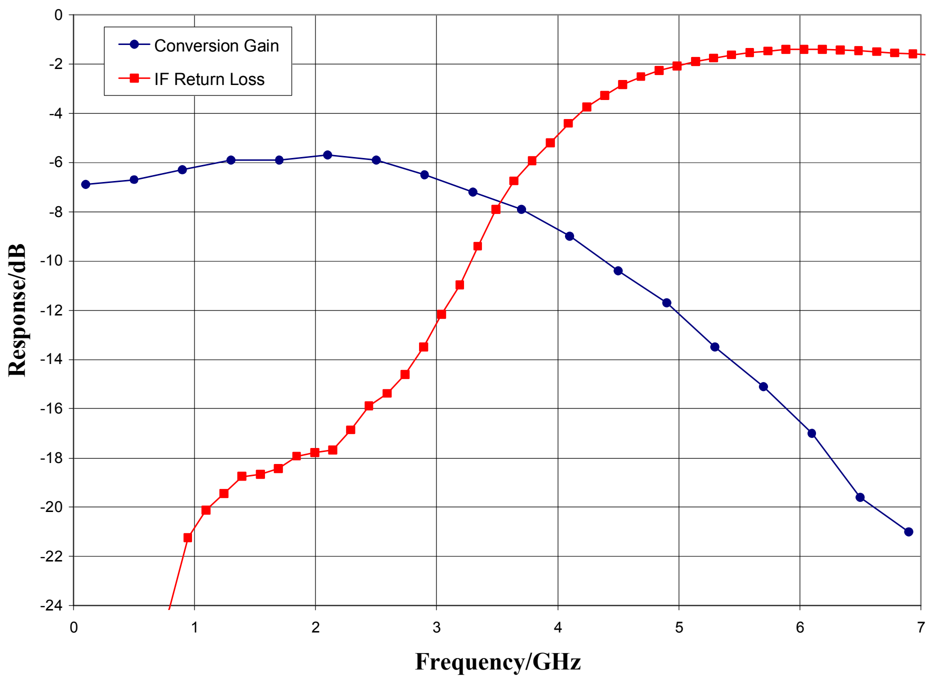
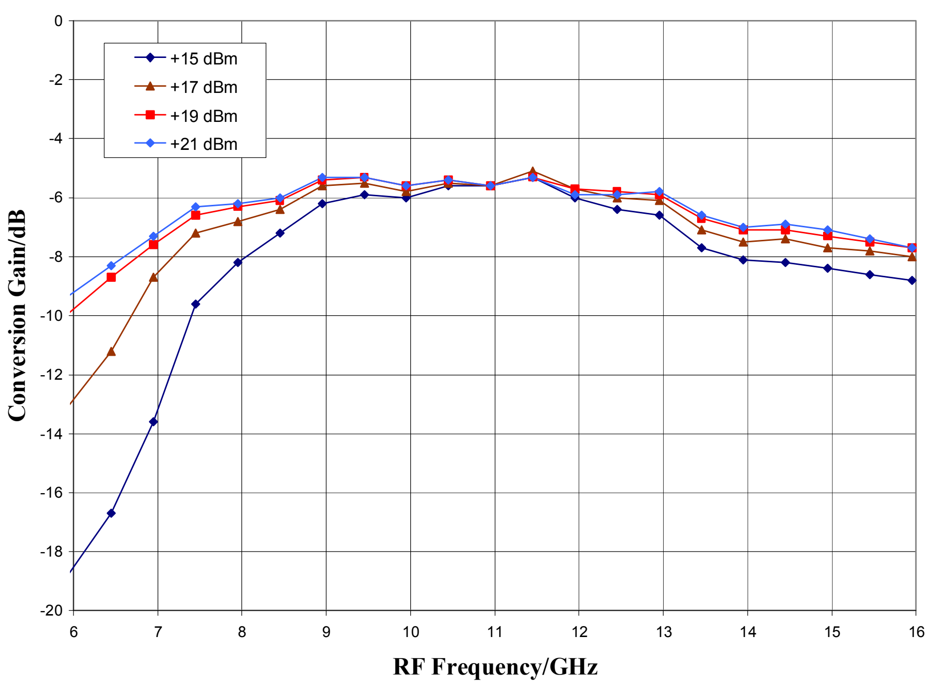
Typical Performance

IF Bandwidth, LO = +19 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 950 MHz



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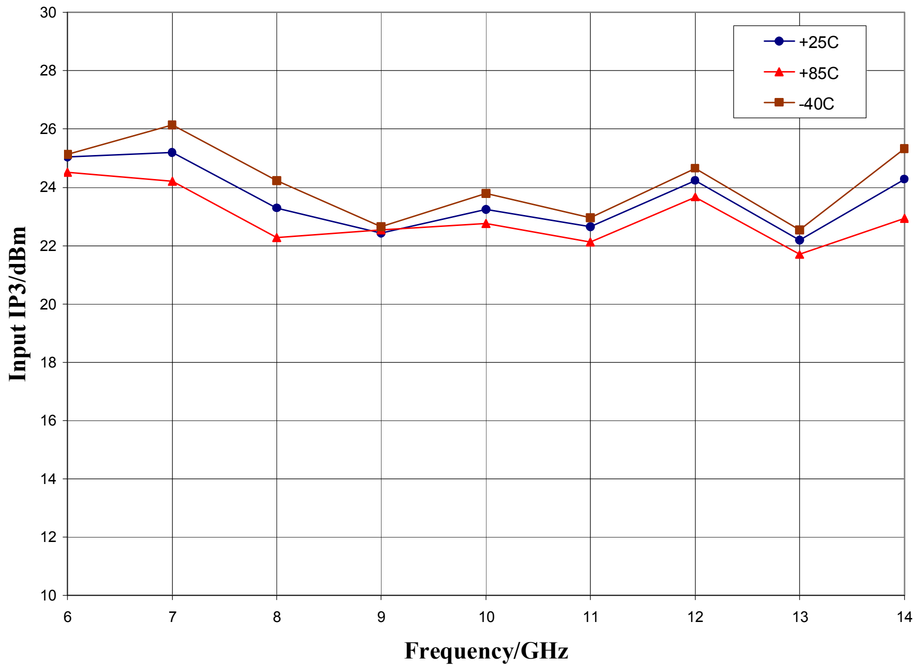
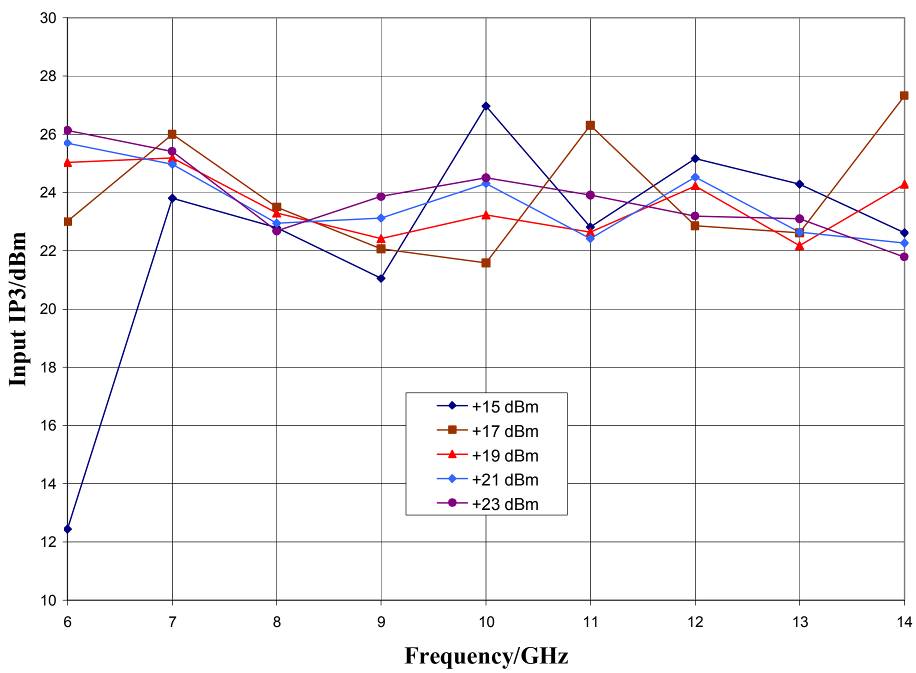
Typical Performance

Input IP3 vs. Temperature, LO = +19 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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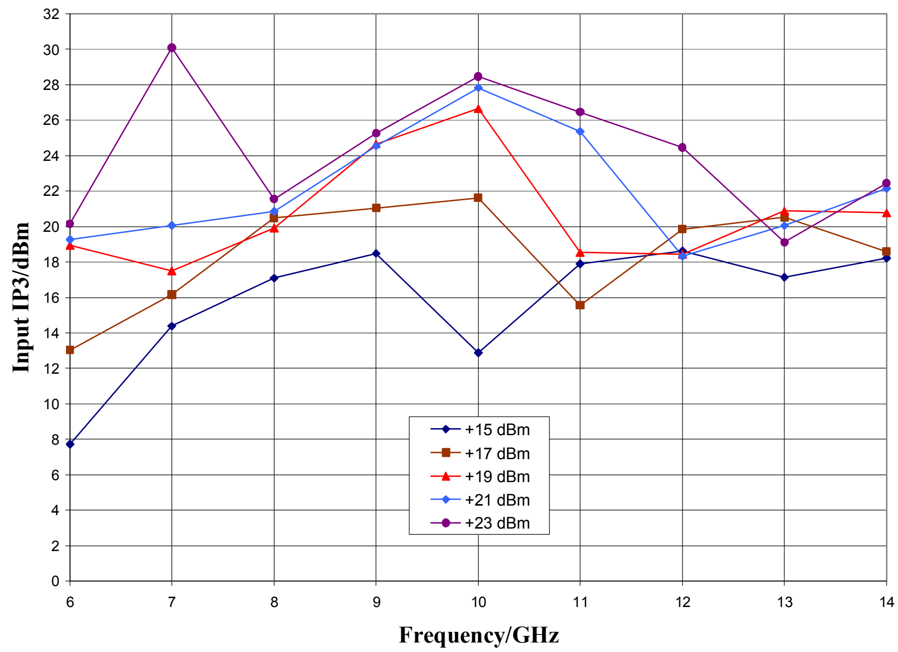
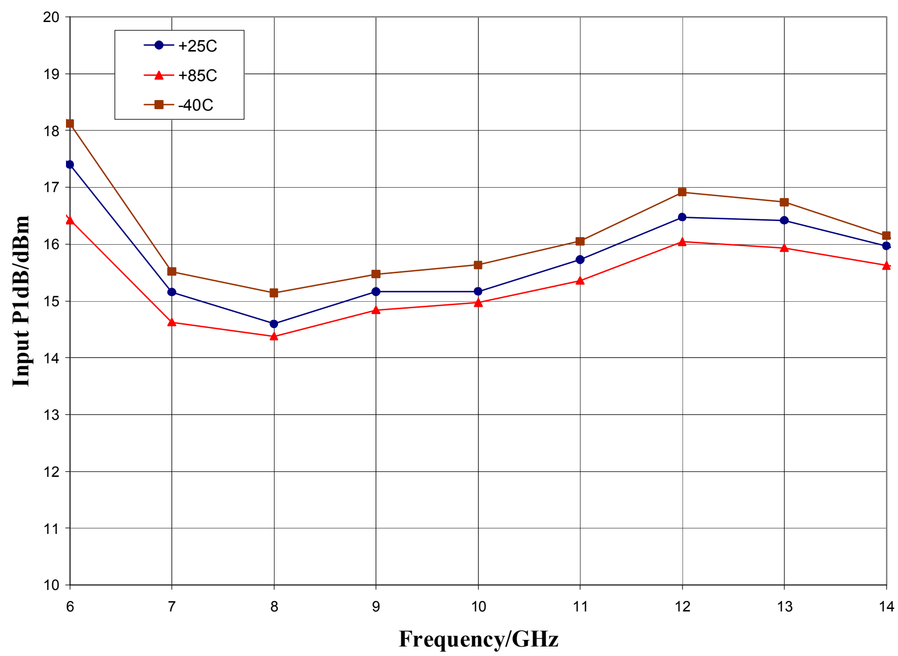
Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB vs. Temperature, LO = +19 dBm, IF = 100 MHz USB



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Typical Performance

MxN Spurious Outputs

	nLO				
mRF	0	1	2	3	4
0	xx	4	21	31	21
1	18	0	40	37	62
2	>64	>64	>64	>64	>64
3	>64	>64	>64	>64	>64
4		>64	>64	>64	>64

RF = 10.1 GHz @ -10 dBm
LO = 10.0 GHz @ +19 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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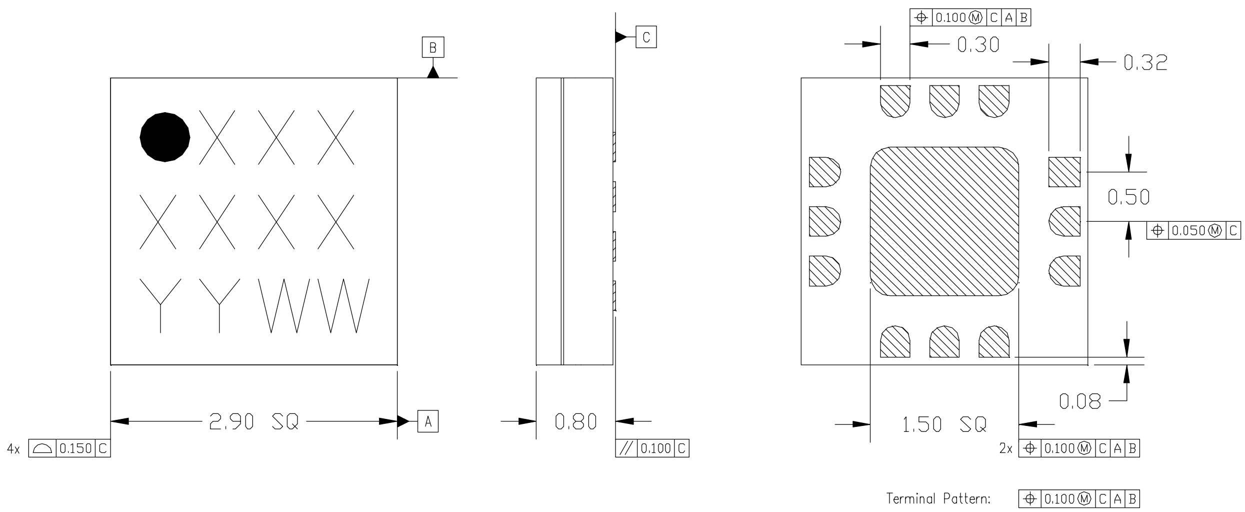
CMD253C3

6-14 GHz High IP3 Fundamental Mixer

Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   - 3.1. Ni: 8.89um MAX, 1.27um MIN
   - 3.2. Pd: 0.17um MAX, 0.07um MIN
   - 3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   - 4.1. LINE 1: PART NUMBER
     - 4.1.1. EXAMPLE: CMD177C3 SHALL BE MARKED AS 177
   - 4.2. LINE 2: LOT NUMBER
   - 4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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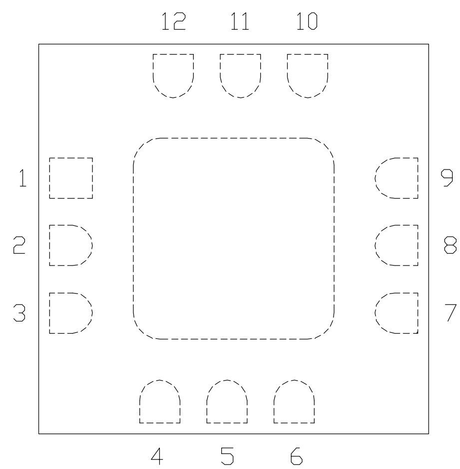
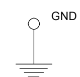
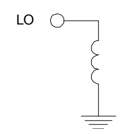
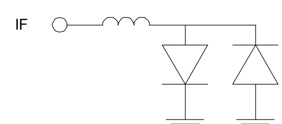
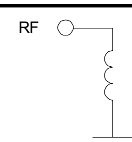
Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1,3,4,6,7,9 and die paddle	Ground	Connect to RF / DC ground.	
2	LO	This pin is DC coupled and matched to 50 ohms.	
5	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
8	RF	This pin is DC coupled and matched to 50 ohms.	
10-12	N/C	No connection required. These pins may be connected to RF/DC ground	

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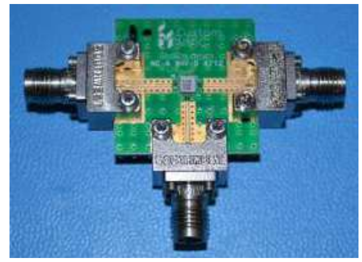
CMD253C3

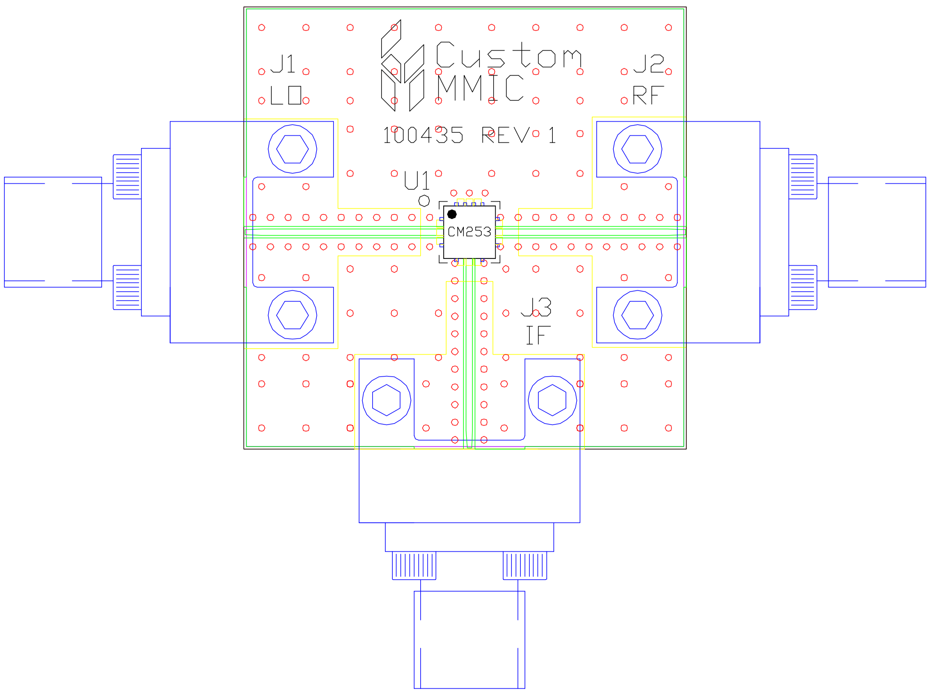
6-14 GHz High IP3 Fundamental Mixer

Applications Information

Evaluation Board



The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J3		SMA End Launch Connector
U1		CMD253C3 Fundamental Mixer
PCB		100435 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD254C3

11-21 GHz High IP3 Fundamental Mixer

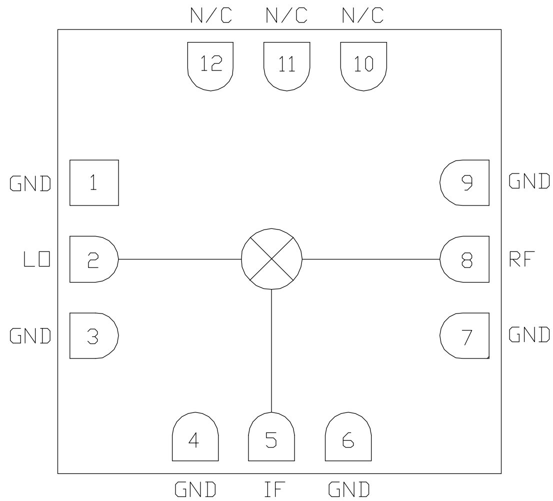
Features

- ► Low conversion loss
- ► High IP3
- ► High isolation
- ► Wide IF bandwidth
- ► Pb-free RoHs compliant 3x3 mm SMT package

Description

The CMD254C3 is a high IP3 double balanced mixer in a leadless surface mount package that can be used for up- and downconverting applications between 11 and 20 GHz. The CMD254C3 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +15 dBm. The CMD254C3 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Functional Block Diagram



Electrical Performance - IF = 100 MHz, LO = +19 dBm , T_A = 25 °C, F = 15 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		11 - 21		GHz
Frequency Range, IF	DC		6	GHz
Conversion Loss		6		dB
LO to RF Isolation		48		dB
LO to IF Isolation		44		dB
RF to IF Isolation		24		dB
Input P1dB		15		dBm
Input IP3		22		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	185 °C/W

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications - IF = 100 MHz, LO = +19 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		13 - 17			11 - 21		GHz
Frequency Range, IF	DC		6	DC		6	GHz
Conversion Loss		6	8		7	10	dB
Noise Figure (SSB)		6			7		dB
LO to RF Isolation	33	45		28	40		dB
LO to IF Isolation	33	45		26	35		dB
RF to IF Isolation	16	24		12	24		dB
Input P1dB		15			15		dBm
Input IP3		23			23		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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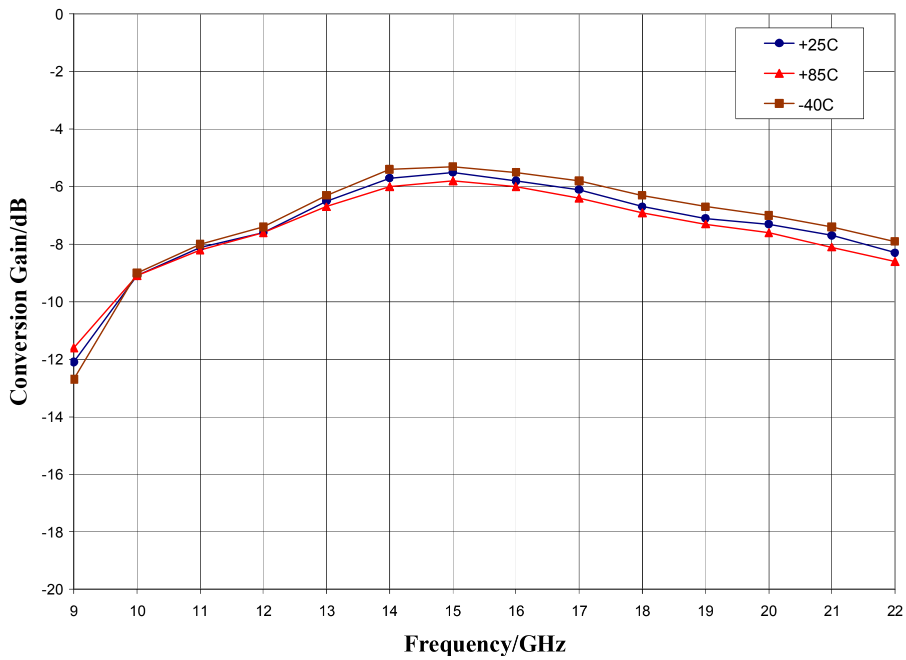
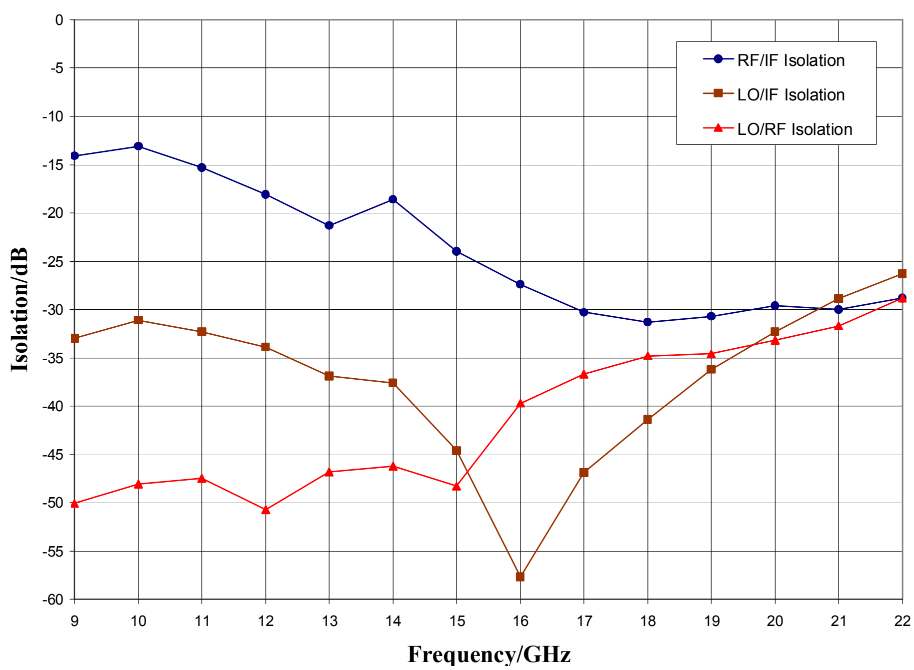
Typical Performance

Conversion Gain vs. Temperature, LO = +19 dBm, IF = 100 MHz USB



Isolation, LO = +19 dBm



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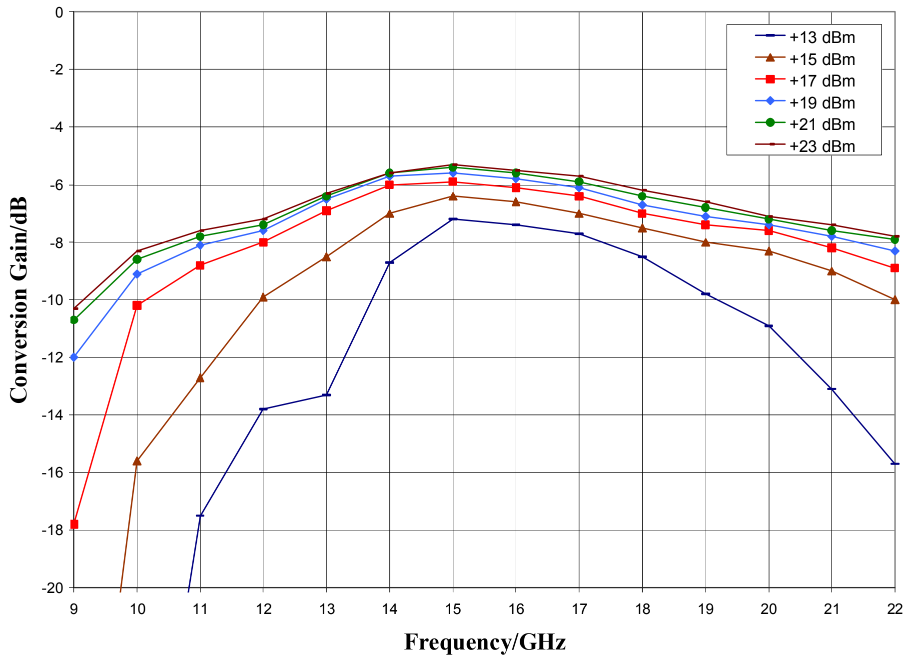
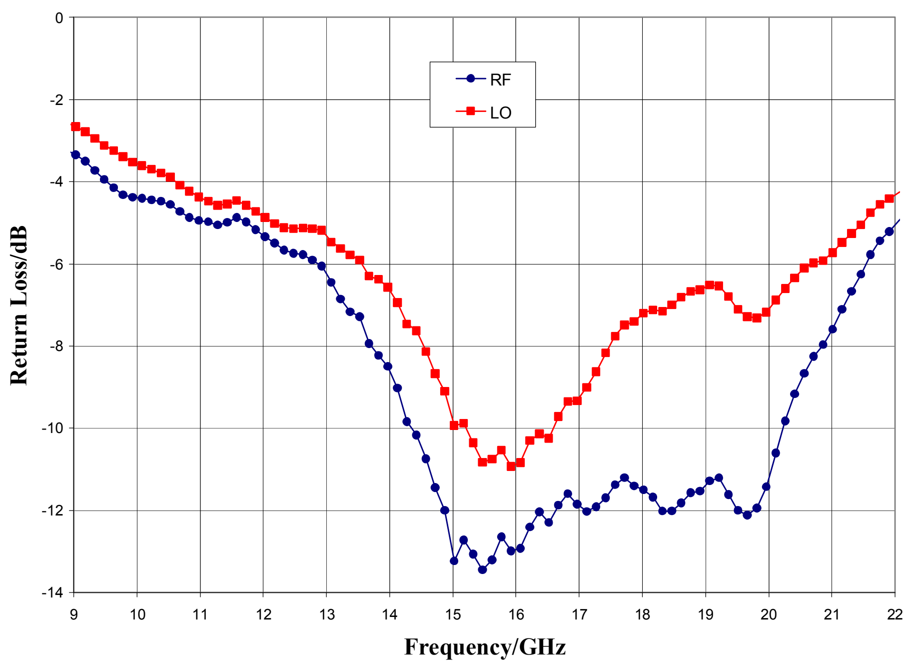
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 19 dBm



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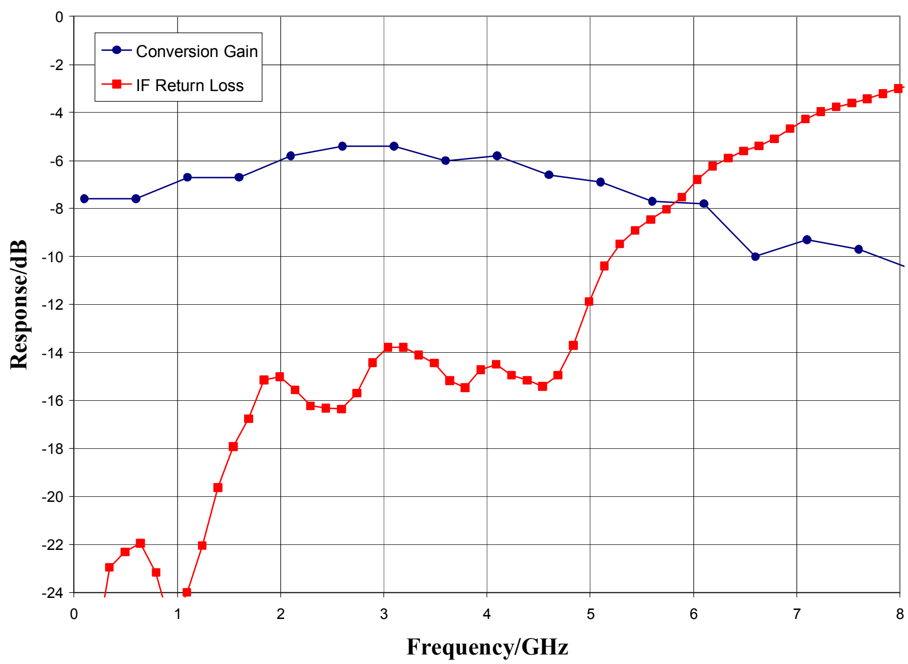
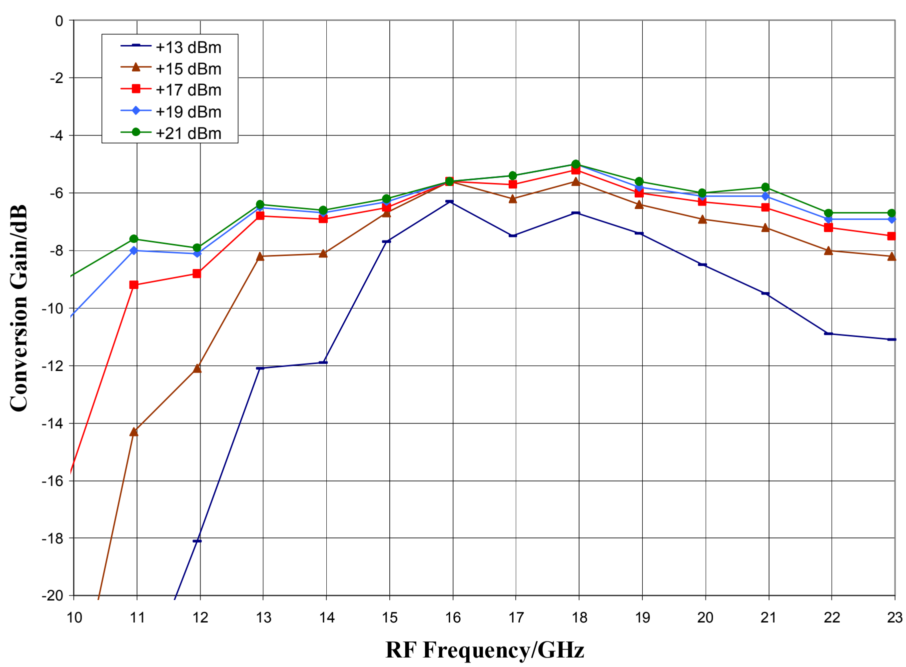
Typical Performance

IF Bandwidth, LO = +19 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 950 MHz



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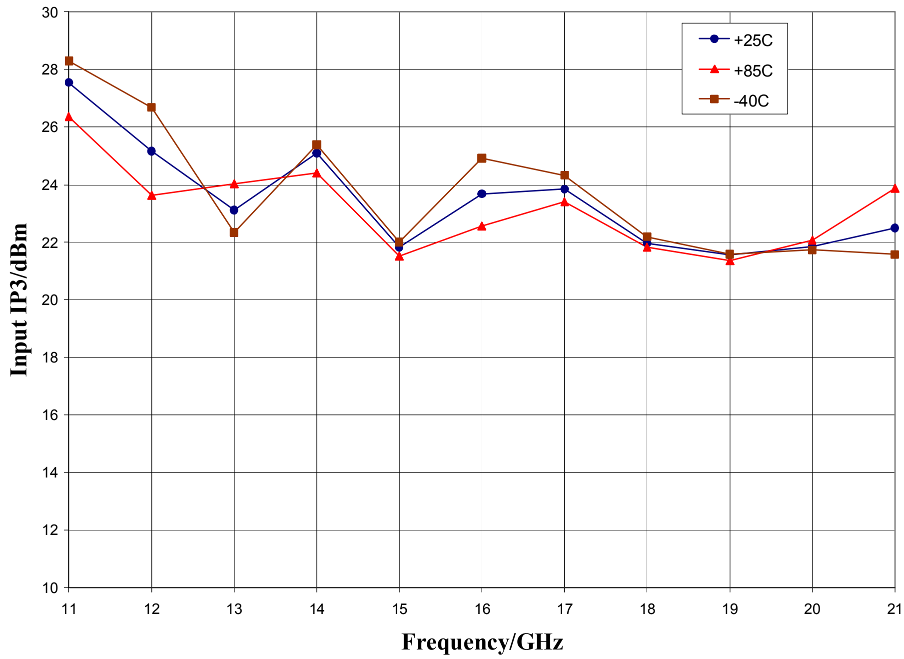
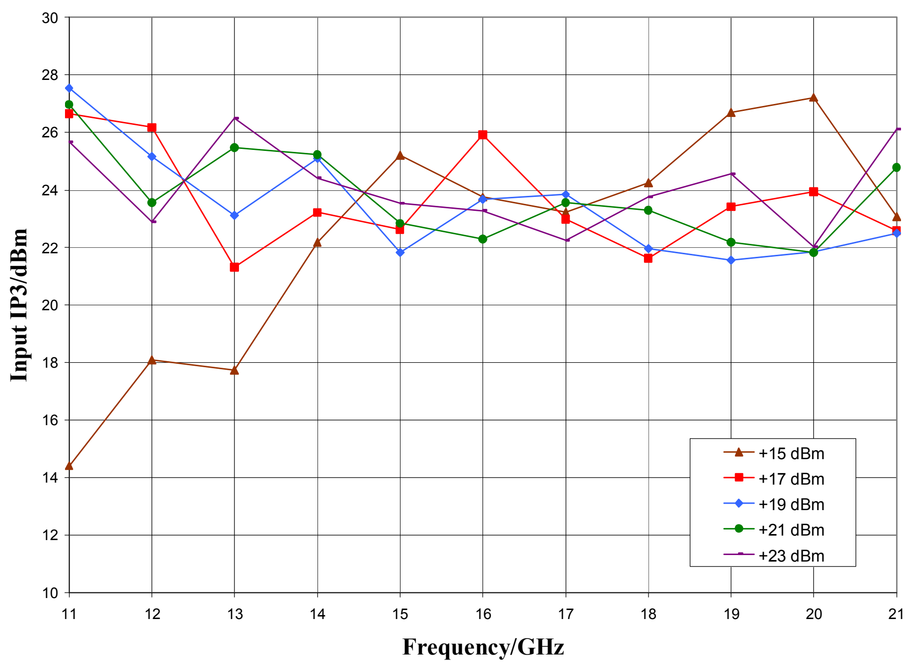
Typical Performance

Input IP3 vs. Temperature, LO = +19 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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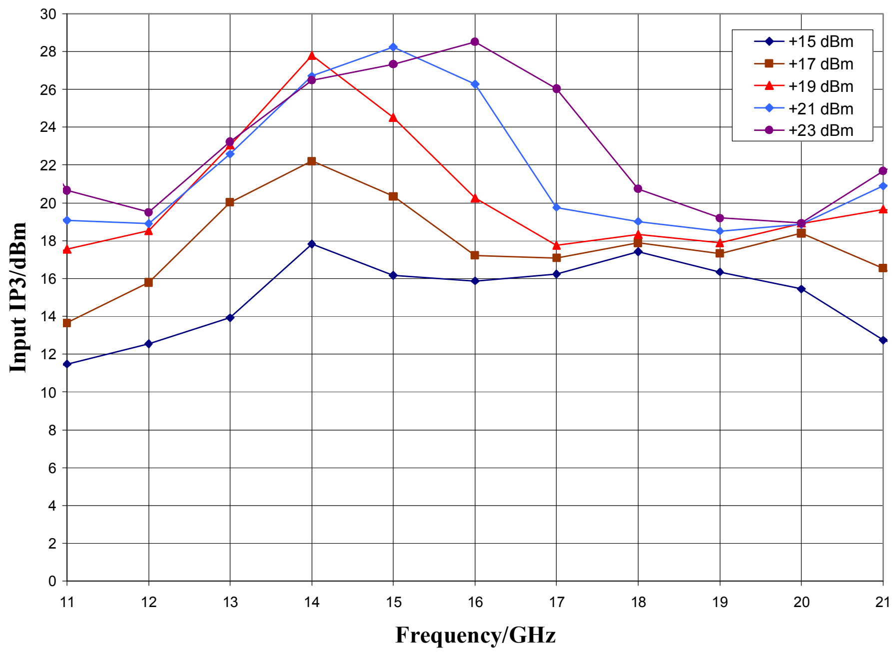
CMD254C3

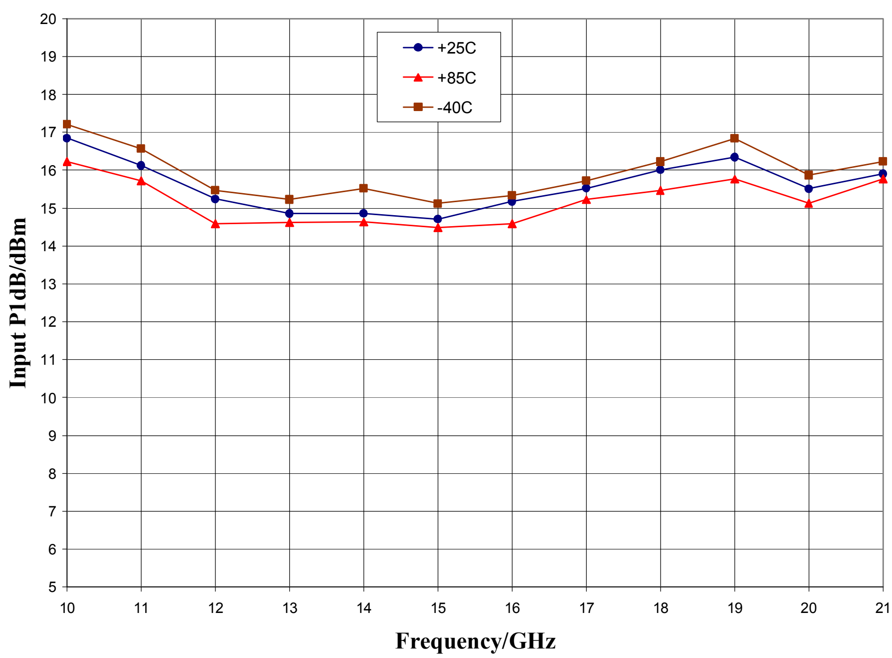
11-21 GHz High IP3 Fundamental Mixer

Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB vs. Temperature, LO = +19 dBm, IF = 100 MHz USB



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Typical Performance

MxN Spurious Outputs

	nLO				
mRF	0	1	2	3	4
0	xx	10	20		
1	18	0	39	34	
2	> 64	> 64	> 64	> 64	> 64
3		> 64	> 64	> 64	> 64
4			> 64	> 64	> 64

RF = 15.1 GHz @ -10 dBm
LO = 15.0 GHz @ +19 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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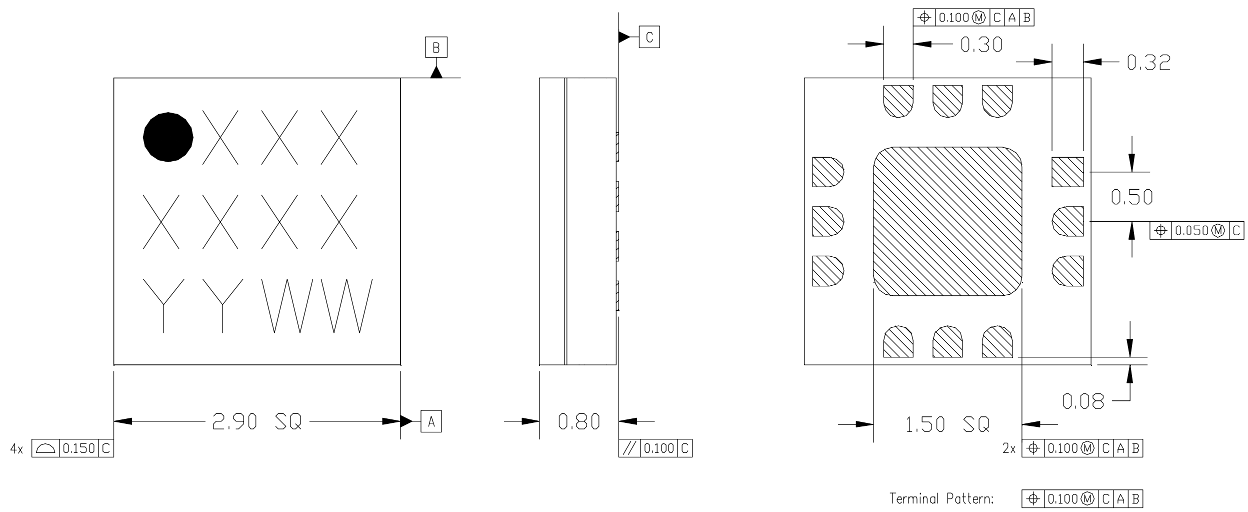
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   4.1. LINE 1: PART NUMBER
      4.1.1. EXAMPLE: CMD177C3 SHALL BE MARKED AS 177
   4.2. LINE 2: LOT NUMBER
   4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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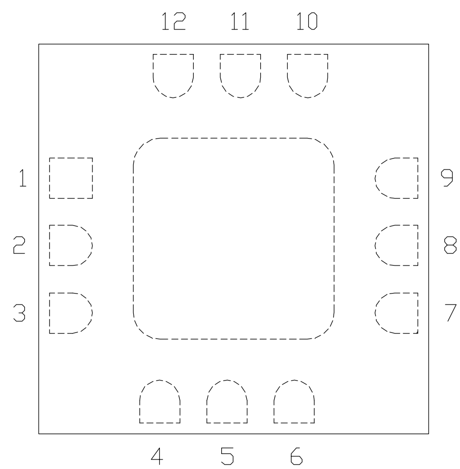
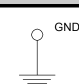
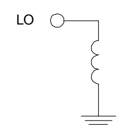
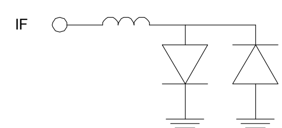
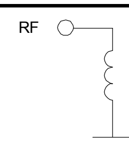
Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1,3,4,6,7,9 and die paddle	Ground	Connect to RF / DC ground.	
2	LO	This pin is DC coupled and matched to 50 ohms.	
5	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
8	RF	This pin is DC coupled and matched to 50 ohms.	
10-12	N/C	No connection required. These pins may be connected to RF/DC ground	

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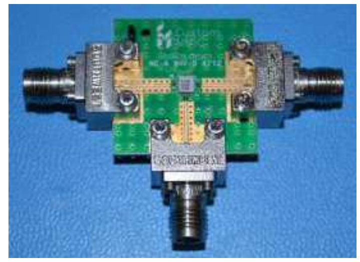
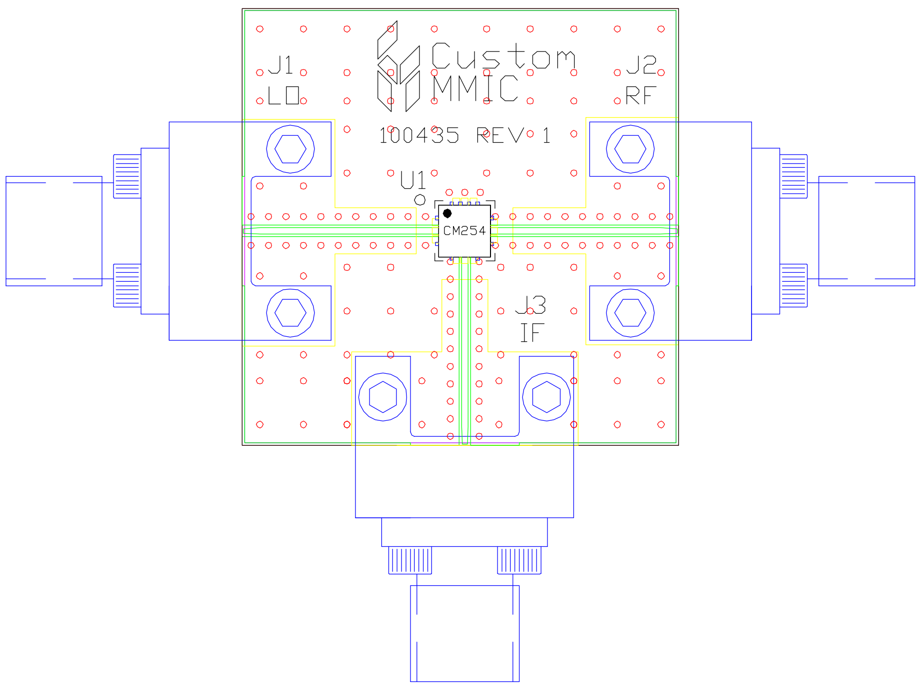
Applications Information

Evaluation Board

The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.





Bill of Material

Designator	Value	Description
J1 - J3		SMA End Launch Connector
U1		CMD254C3 Fundamental Mixer
PCB		100435 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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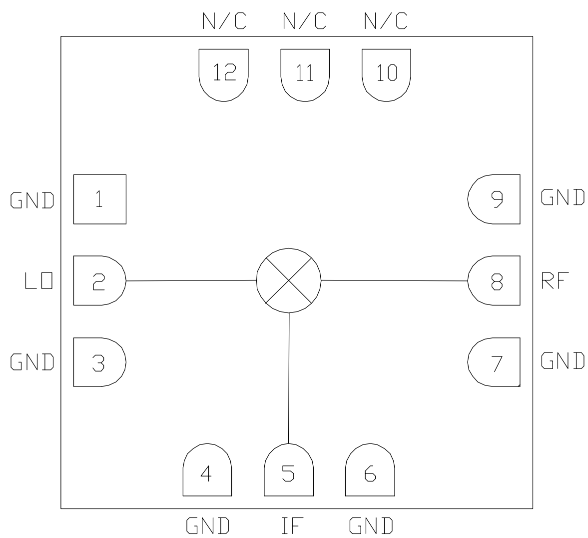
CMD255C3

16-26 GHz High IP3 Fundamental Mixer

Features

- ► Low conversion loss
- ► High IP3
- ► High isolation
- ► Wide IF bandwidth
- ► Pb-free RoHs compliant 3x3 mm SMT package

Functional Block Diagram



Description

The CMD255C3 is a general purpose double balanced mixer in a leadless surface mount package that can be used for up- and downconverting applications between 16 and 26 GHz. The CMD255C3 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +15 dBm. The CMD255C3 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

***Electrical Performance* - IF = 100 MHz, LO = +19 dBm , T_A = 25 °C, F = 21 GHz**

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		16 - 26		GHz
Frequency Range, IF	DC		9	GHz
Conversion Loss		6.5		dB
LO to RF Isolation		40		dB
LO to IF Isolation		33		dB
RF to IF Isolation		30		dB
Input P1dB		14.5		dBm
Input IP3		24		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+25 dBm
LO Drive	+25 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	268 °C/W

Operation of this device outside the maximum ratings may cause permanent damage.

Electrical Specifications - IF = 100 MHz, LO = +19 dBm, T_A = 25 ^oC

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		18 - 24			16 - 26		GHz
Frequency Range, IF	DC		9	DC		9	GHz
Conversion Loss		6.5	8.5		7	10	dB
Noise Figure (SSB)		6.5			7		dB
LO to RF Isolation	32	40		32	40		dB
LO to IF Isolation	26	33		25	33		dB
RF to IF Isolation	20	30		18	30		dB
Input P1dB		14.5			14.5		dBm
Input IP3		23			23		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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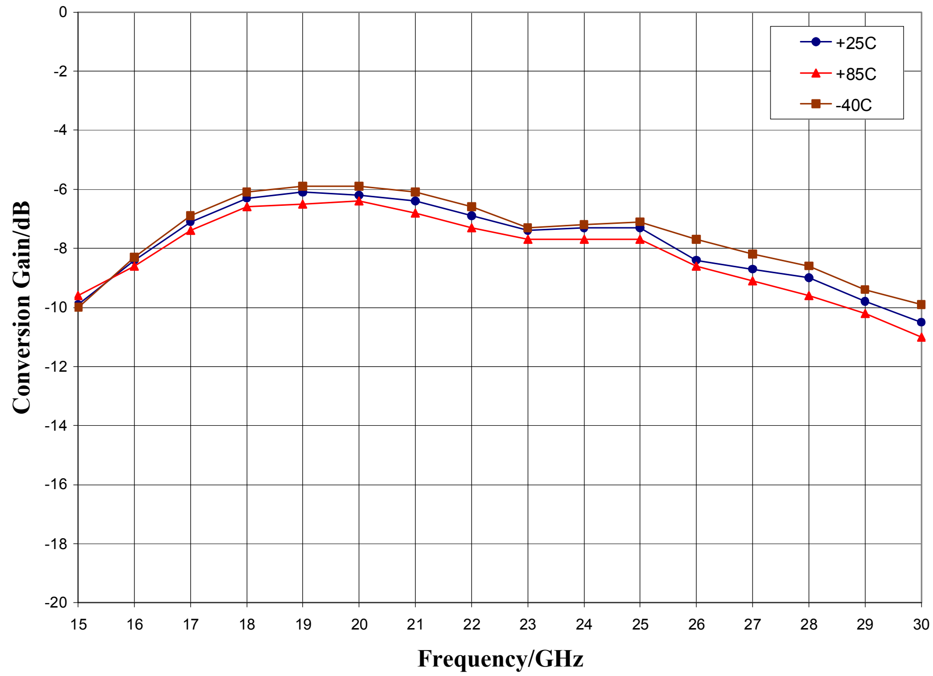
CMD255C3

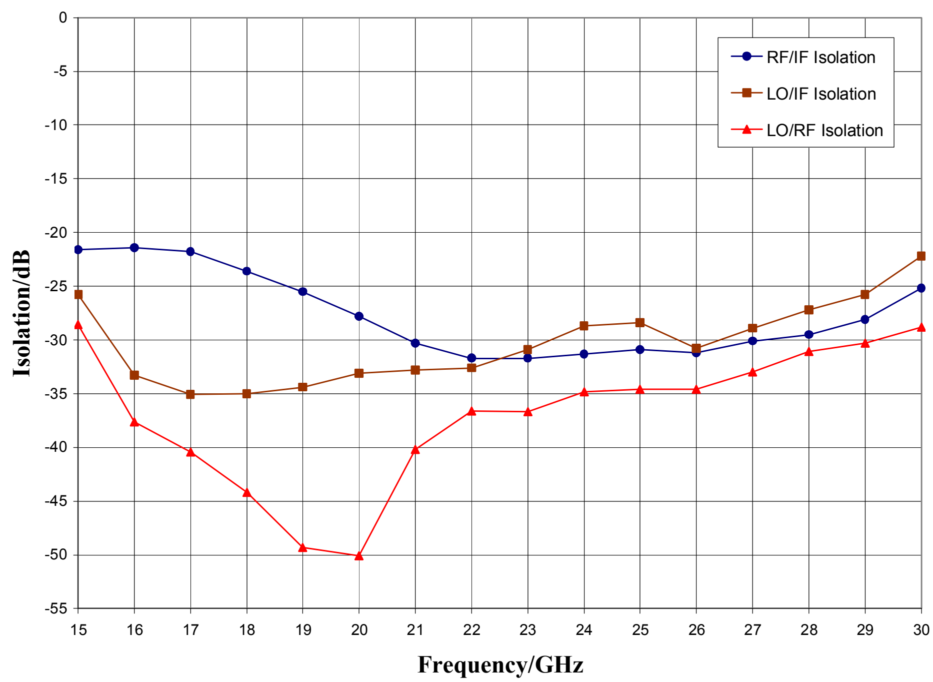
16-26 GHz High IP3 Fundamental Mixer

Typical Performance

Conversion Gain vs. Temperature, LO = +19 dBm, IF = 100 MHz USB



Isolation, LO = +19 dBm



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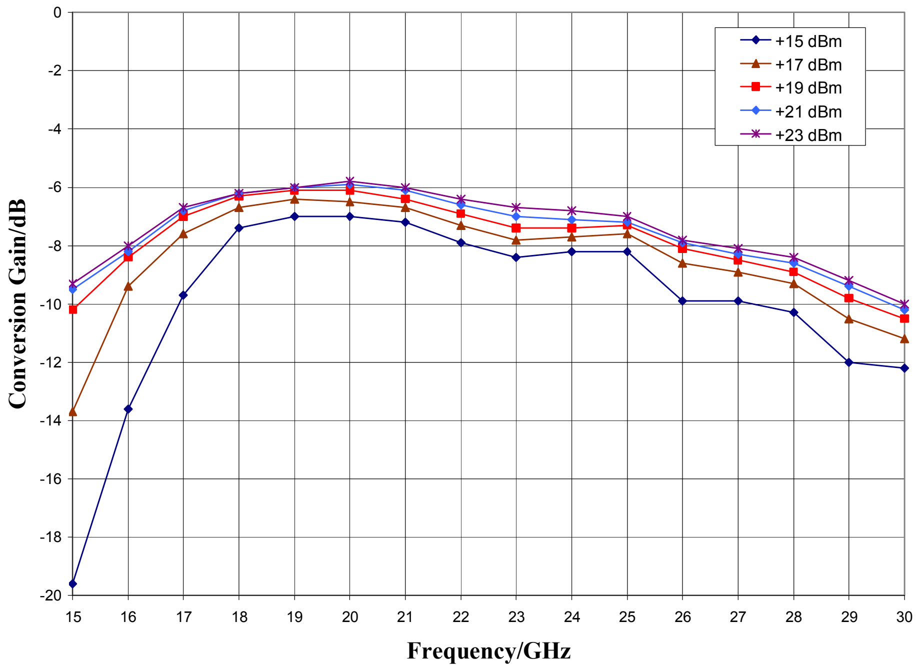
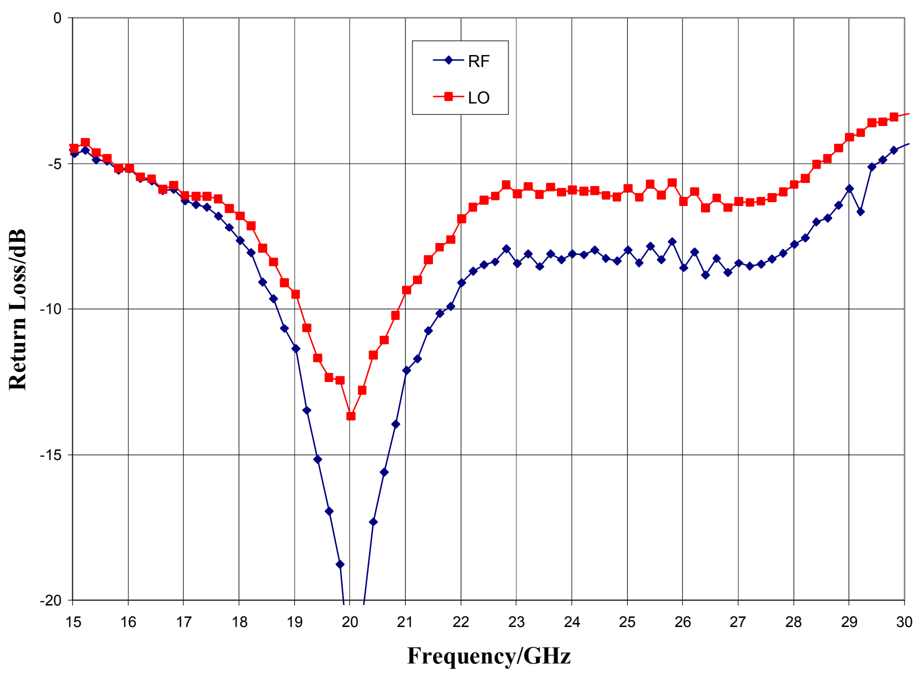
Typical Performance

Conversion Gain vs. LO Drive, IF = 100 MHz USB



Return Loss, LO = + 19 dBm



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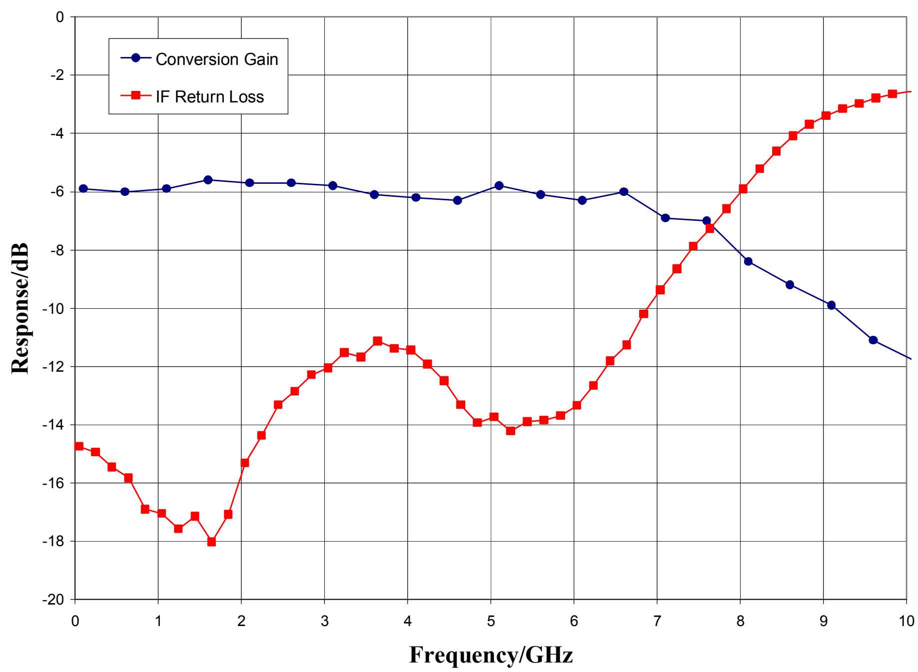
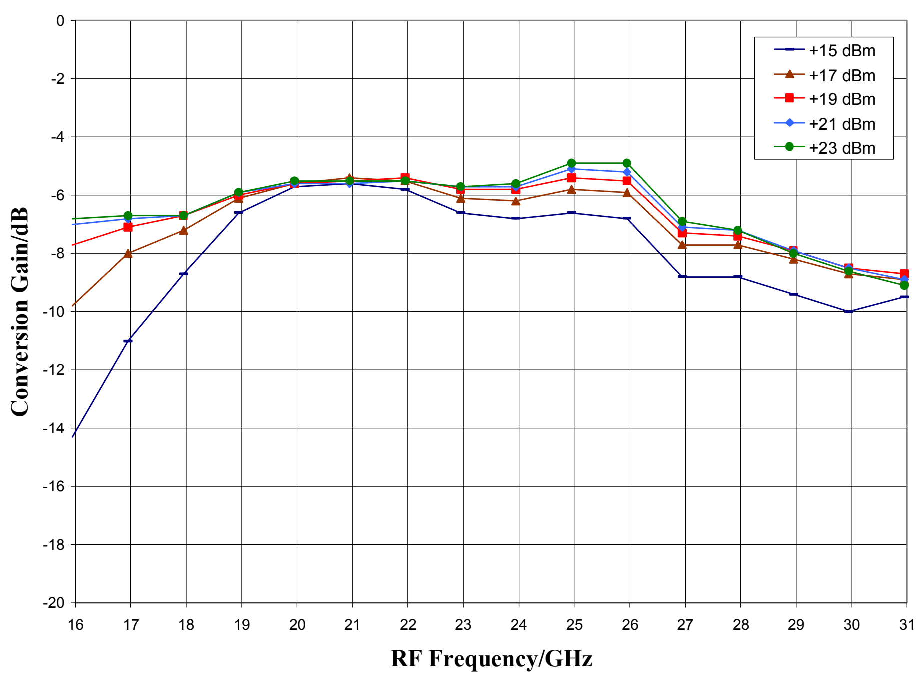
Typical Performance

IF Bandwidth, LO = +19 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 950 MHz



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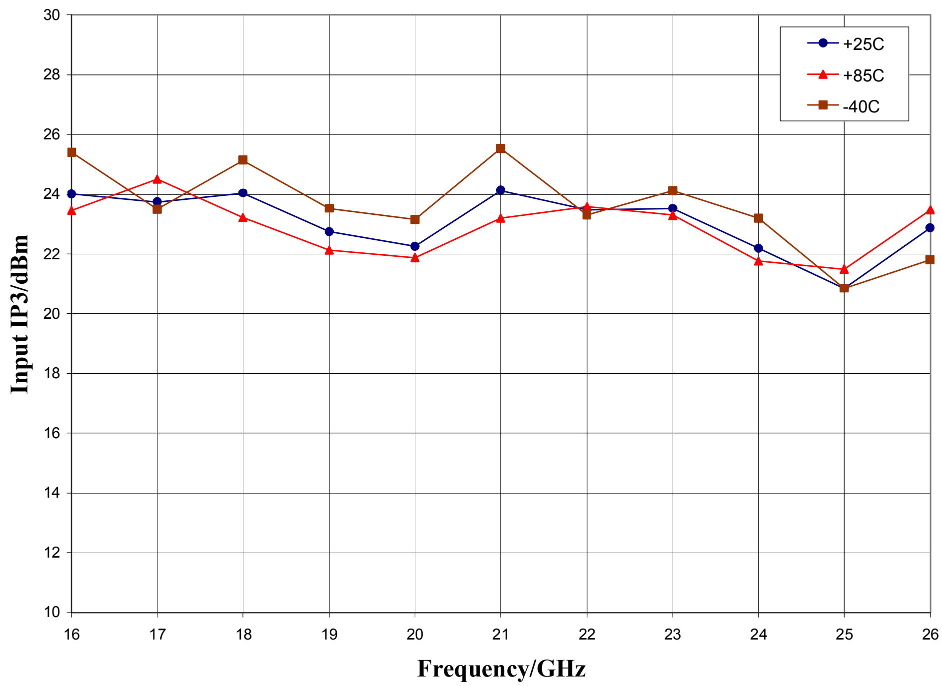
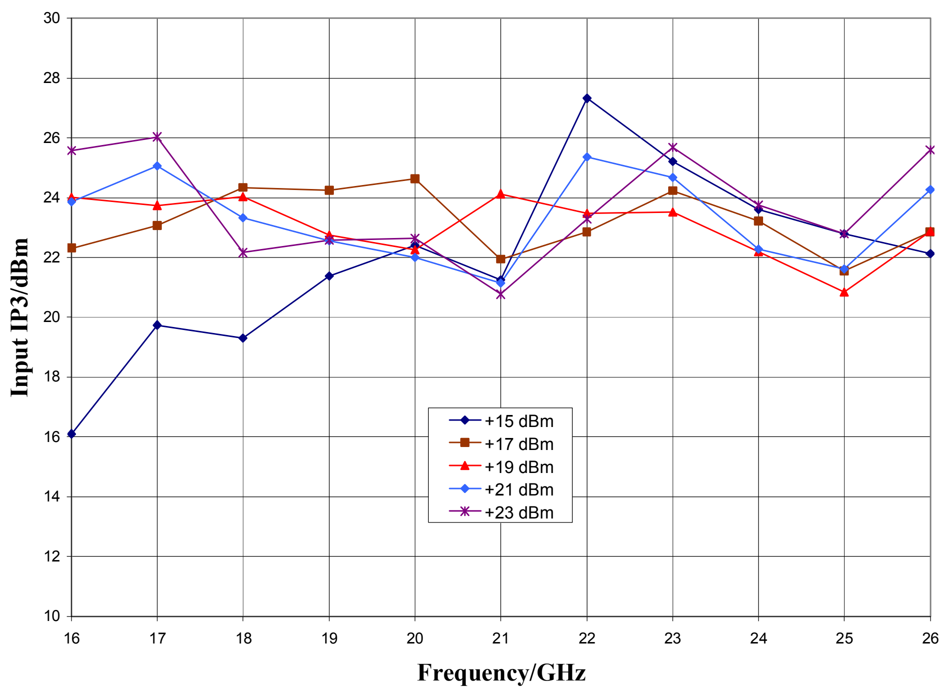
Typical Performance

Input IP3 vs. Temperature, LO = +19 dBm, IF = 100 MHz



Input IP3 vs. LO Drive, IF = 100 MHz



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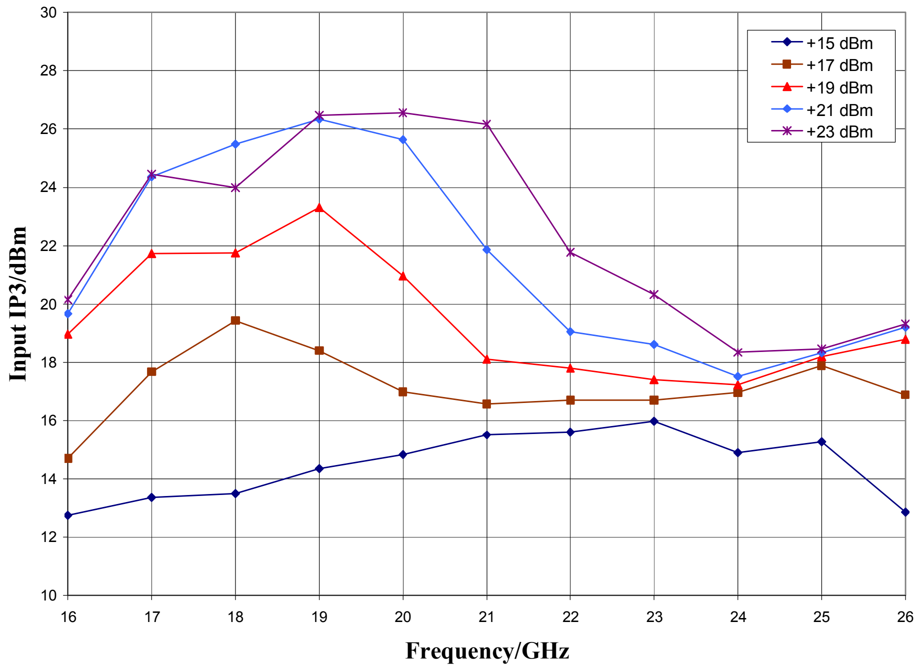
Custom MMIC

CMD255C3

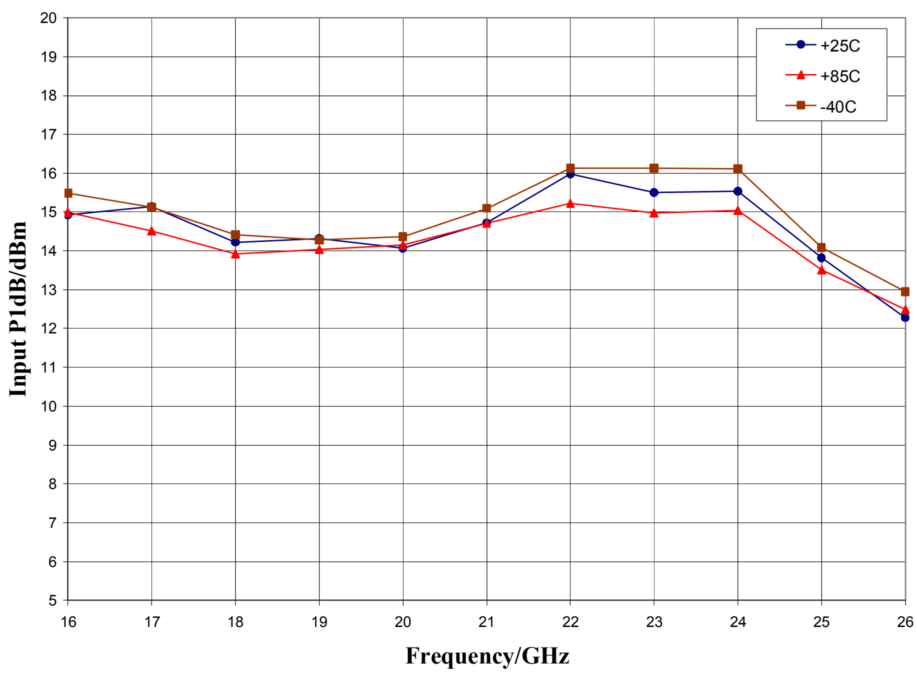
16-26 GHz High IP3 Fundamental Mixer

Typical Performance

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



Input P1dB vs. Temperature, LO = +19 dBm, IF = 100 MHz USB



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Typical Performance

MxN Spurious Outputs

	nLO				
mRF	0	1	2	3	4
0	xx	6			
1	23	0	41		
2		59	54	59	
3			> 64	> 64	> 64
4				> 64	> 64

RF = 21.1 GHz @ -10 dBm
LO = 21.0 GHz @ +19 dBm

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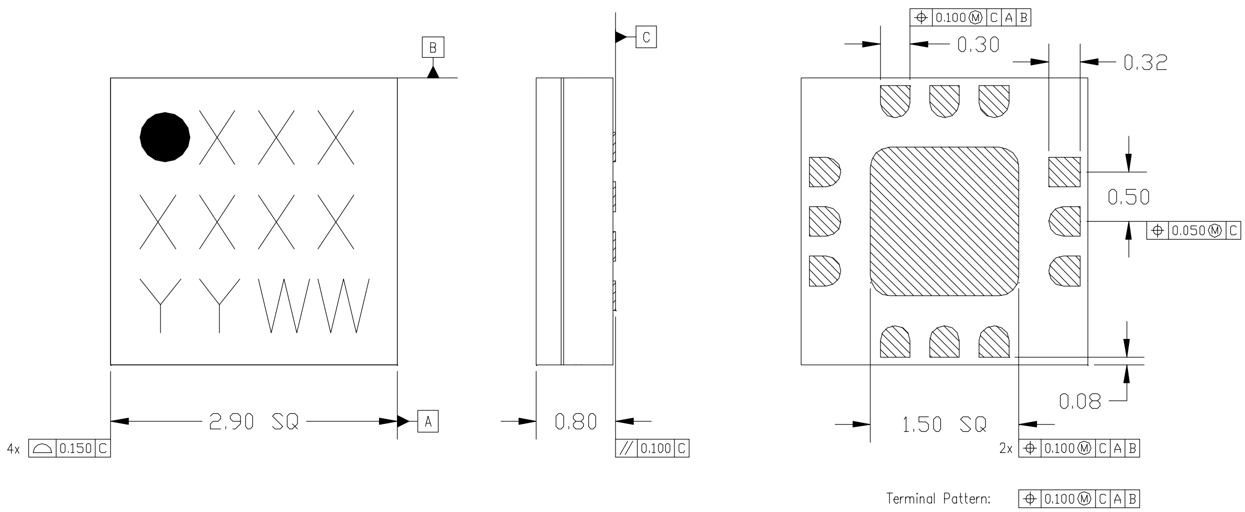
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   - 3.1. Ni: 8.89um MAX, 1.27um MIN
   - 3.2. Pd: 0.17um MAX, 0.07um MIN
   - 3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   - 4.1. LINE 1: PART NUMBER
     - 4.1.1. EXAMPLE: CMD177C3 SHALL BE MARKED AS 177
   - 4.2. LINE 2: LOT NUMBER
   - 4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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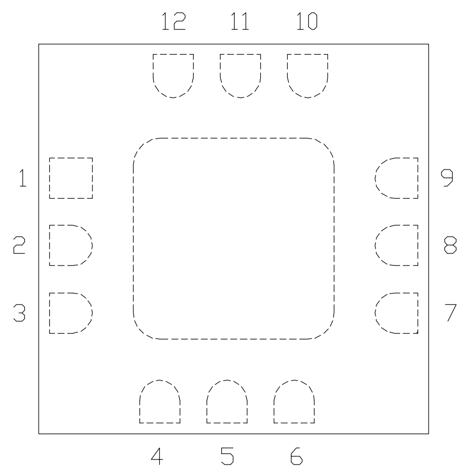
CMD255C3

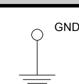
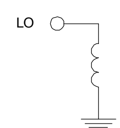
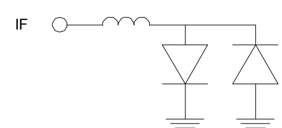
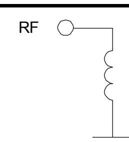
16-26 GHz High IP3 Fundamental Mixer

Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1,3,4,6,7,9 and die paddle	Ground	Connect to RF / DC ground.	
2	LO	This pin is DC coupled and matched to 50 ohms.	
5	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
8	RF	This pin is DC coupled and matched to 50 ohms.	
10-12	N/C	No connection required. These pins may be connected to RF/DC ground	

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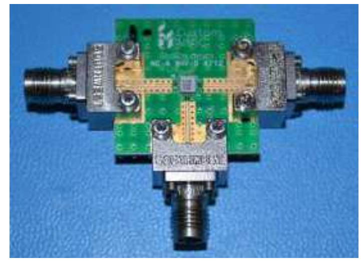
CMD255C3

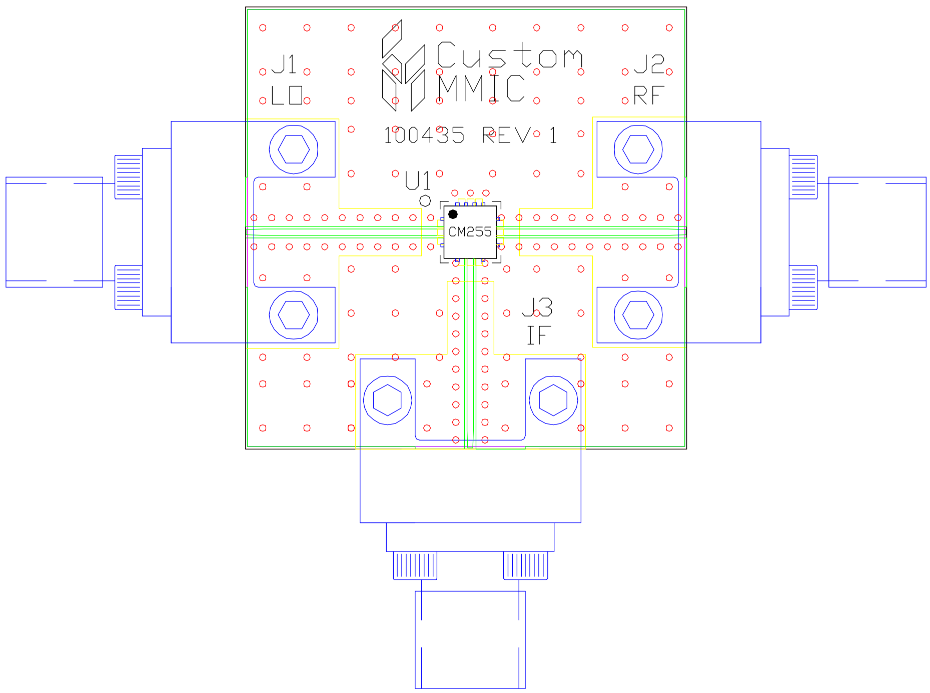
16-26 GHz High IP3 Fundamental Mixer

Applications Information

Evaluation Board

The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.





Bill of Material

Designator	Value	Description
J1 - J3		SMA End Launch Connector
U1		CMD255C3 Fundamental Mixer
PCB		100435 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

Please note, all information contained in this data sheet is subject to change without notice. ver 1.0 1017

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CMD257C4

6-10 GHz High IP3 I/Q Mixer

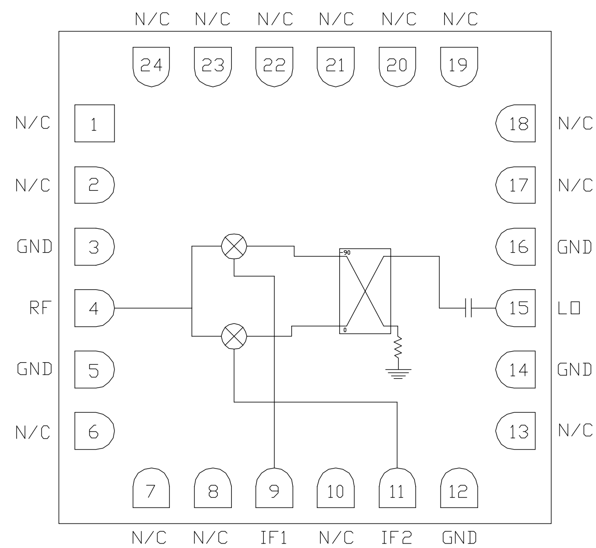
Features

- ► Low conversion loss
- ► High IP3
- ► Image rejection: 30 dB
- ► Wide IF bandwidth
- ► Pb-free RoHs compliant 4x4 mm SMT package

Description

The CMD257C4 is a high IP3 I/Q mixer in a leadless surface mount package that can be used as either an image reject mixer or a single sideband upconverter. The CMD257C4 utilizes two double balanced mixer cells and a 90 degree hybrid. An external IF hybrid is needed to complete the image rejection. The CMD257C4 is a much smaller alternative to higher cost hybrid image reject mixers and single sideband upconverter assemblies.

Functional Block Diagram



Electrical Performance - IF = 100 MHz, LO = +21 dBm , T_A = 25 °C, F = 8 GHz				
Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		6 - 10		GHz
Frequency Range, IF	DC		3.5	GHz
Conversion Loss (as IRM)		5.2		dB
Image Rejection		31		dB
LO to RF Isolation		37		dB
LO to IF Isolation		17		dB
Input P1dB		15		dBm
Input IP3		24		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+27 dBm
LO Drive	+27 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	88.5 °C/W

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications - IF = 100 MHz, LO = +21 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		6 - 10			7.1 - 8.5		GHz
Frequency Range, IF	DC		3.5	DC		3.5	GHz
Conversion Loss (as IRM)		6	9		5.5	7.5	dB
Image Rejection	22	31		24	31		dB
LO to RF Isolation	34	45		34	40		dB
LO to IF Isolation	13	18		14	18		dB
Input P1dB		15			15		dBm
Input IP3		25.5			25		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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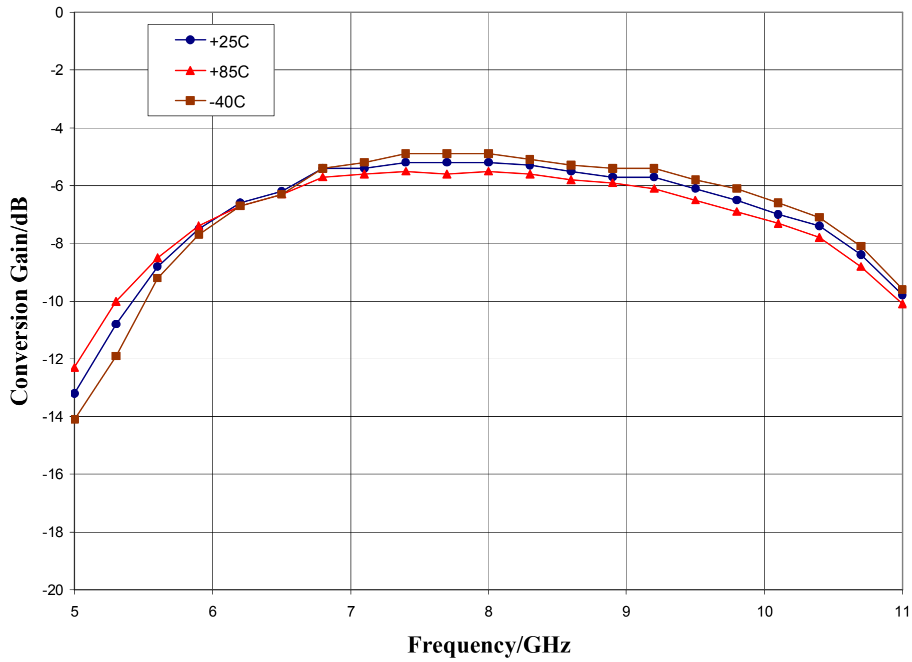
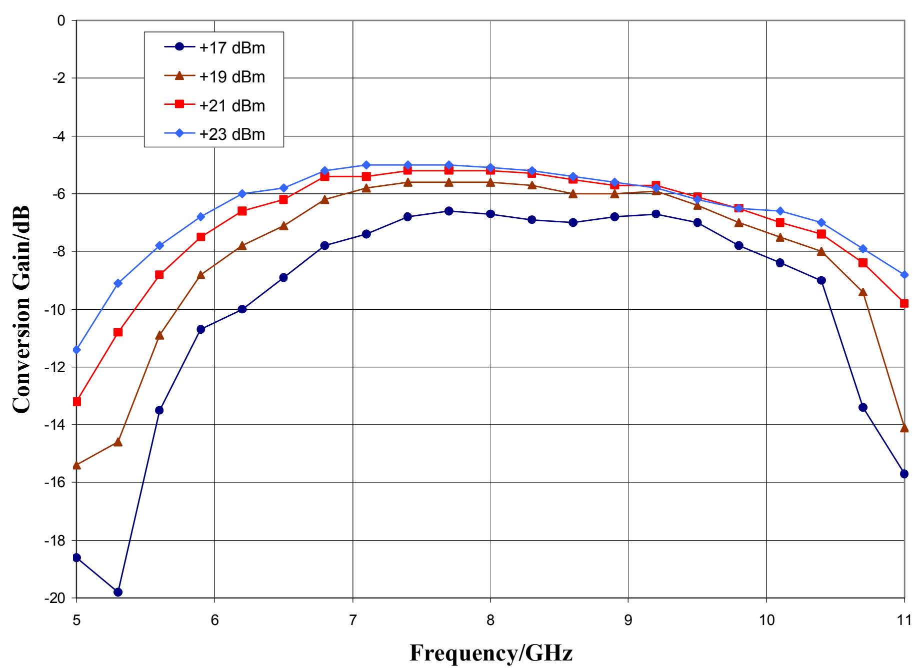
Typical Performance

Data Taken As IRM With External IF Hybrid

Conversion Gain vs. Temperature, LO = +21 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB



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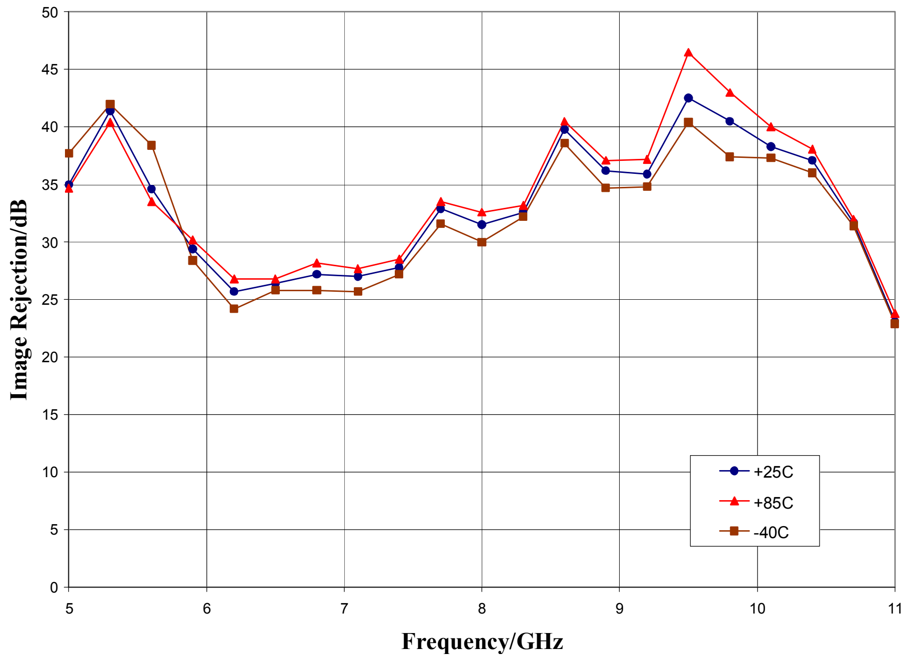
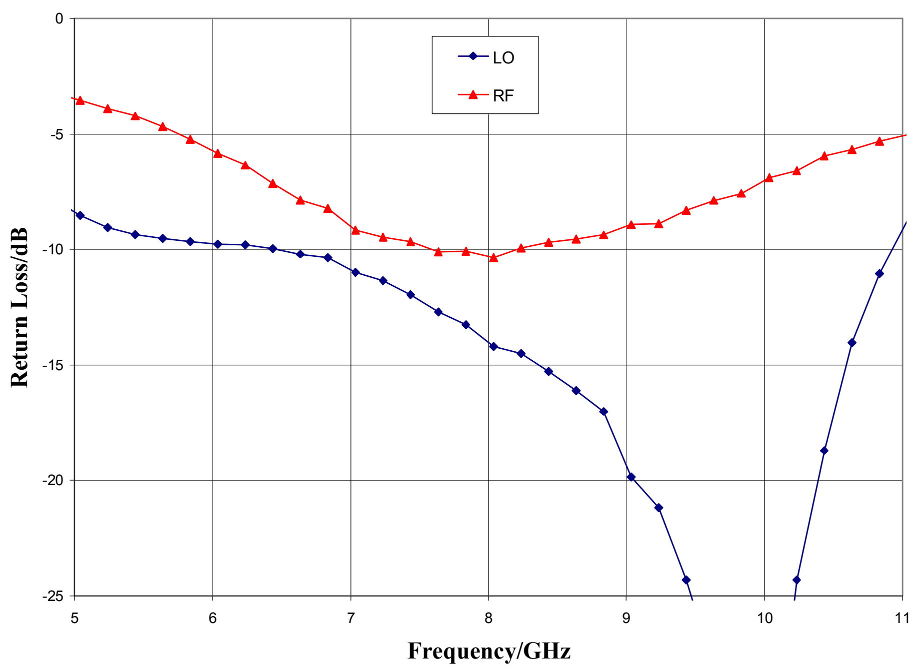
Typical Performance

Data Taken As IRM With External IF Hybrid

Image Rejection, LO = +21 dBm, IF = 100 MHz USB



Return Loss, LO = +21 dBm



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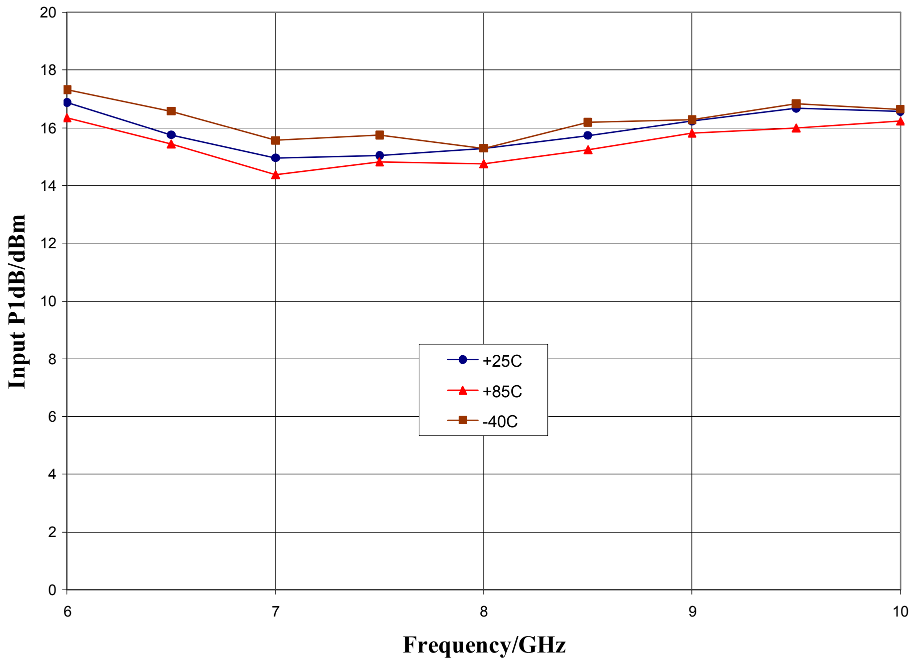
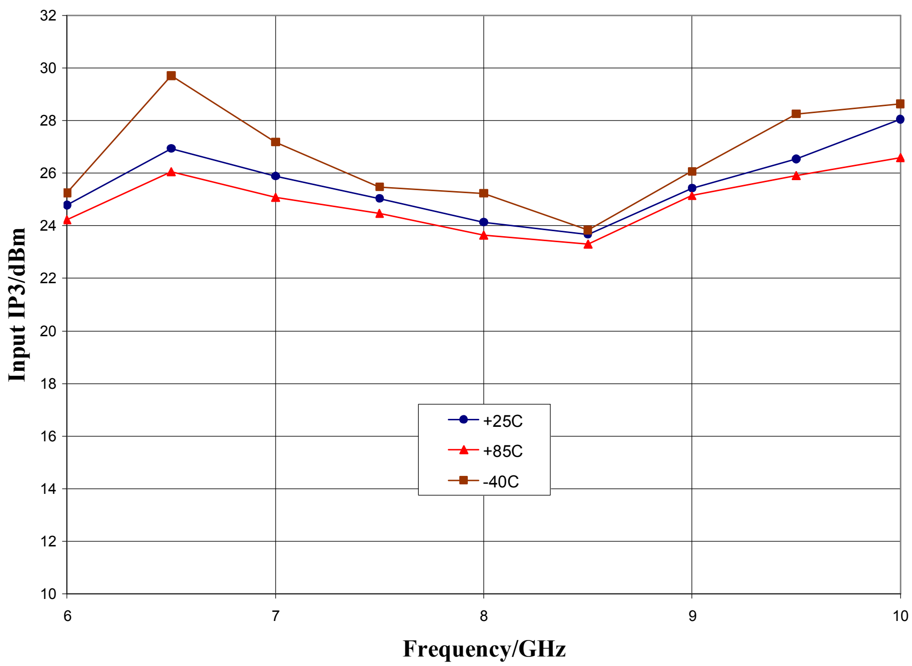
Typical Performance

Data Taken As IRM With External IF Hybrid

Input P1dB vs. Temperature, LO = +21 dBm, IF = 100 MHz USB



Input IP3 vs. Temperature, LO = +21 dBm, IF = 100 MHz USB



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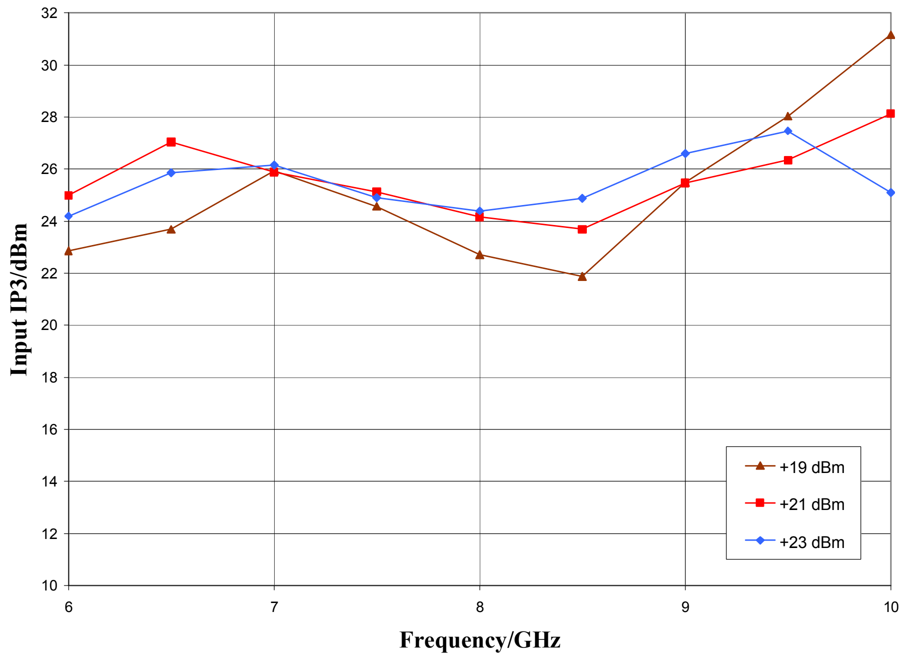
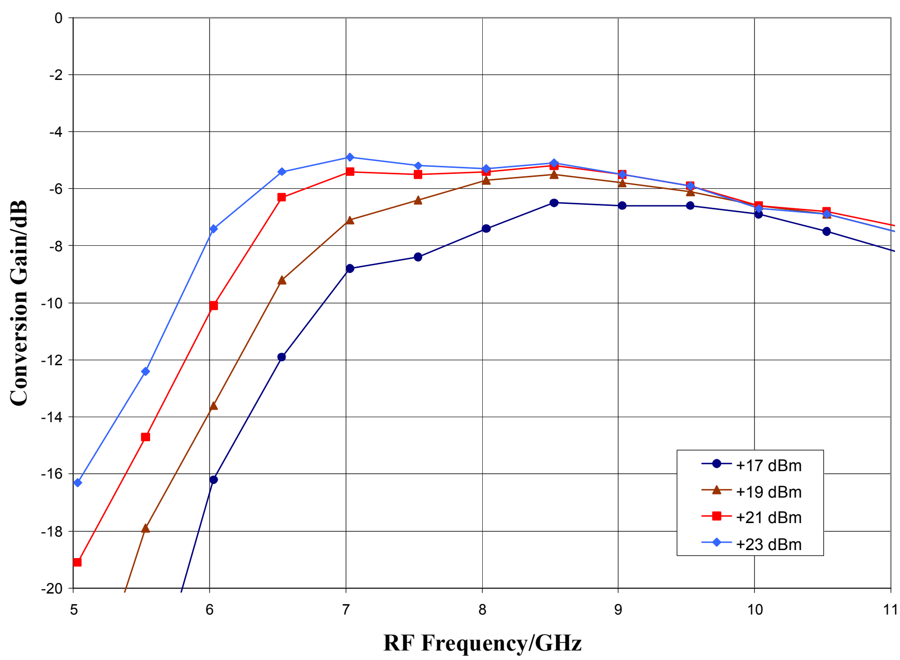
Typical Performance

Data Taken As IRM With External IF Hybrid

Input IP3 vs. LO Drive, IF = 100 MHz USB



Upconverter Performance, Conversion Gain vs. LO Drive, IF = 930 MHz



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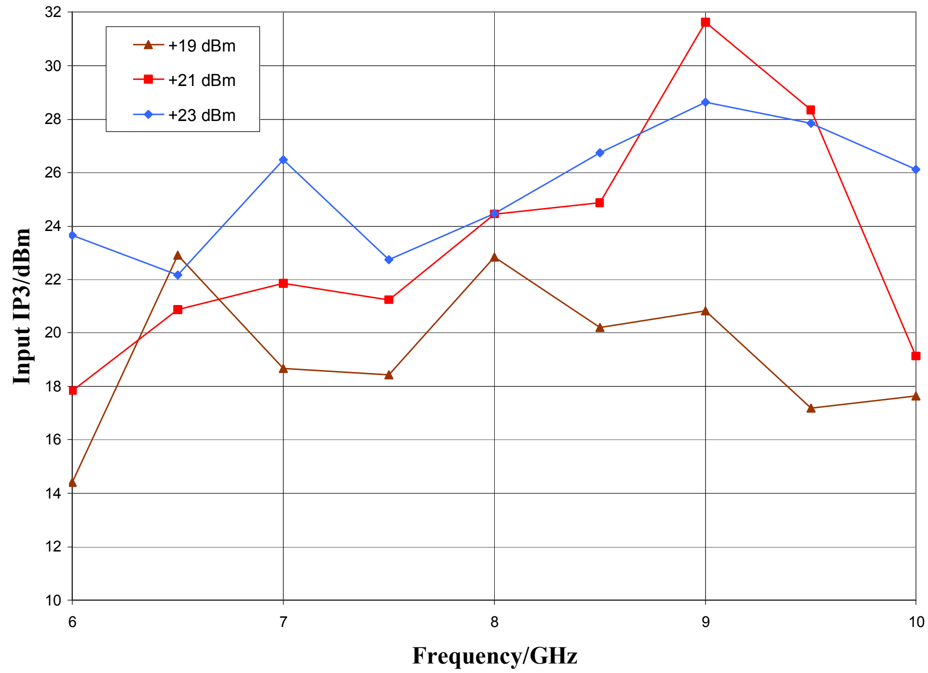
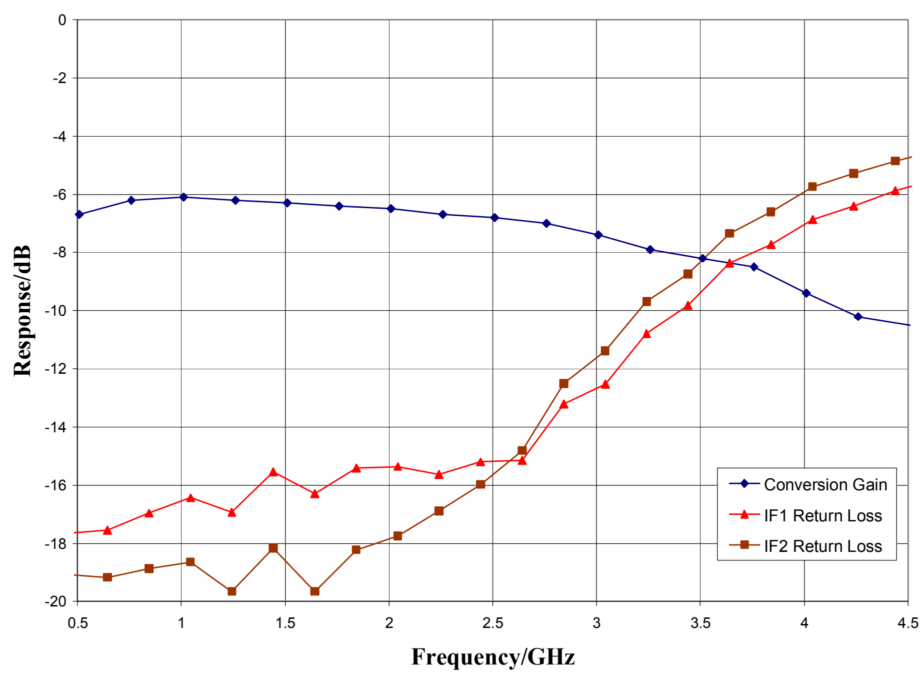
Typical Performance

Data Taken As IRM With External IF Hybrid

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



IF Bandwidth, LO = +21 dBm, Return Loss Data Taken Without IF Hybrid



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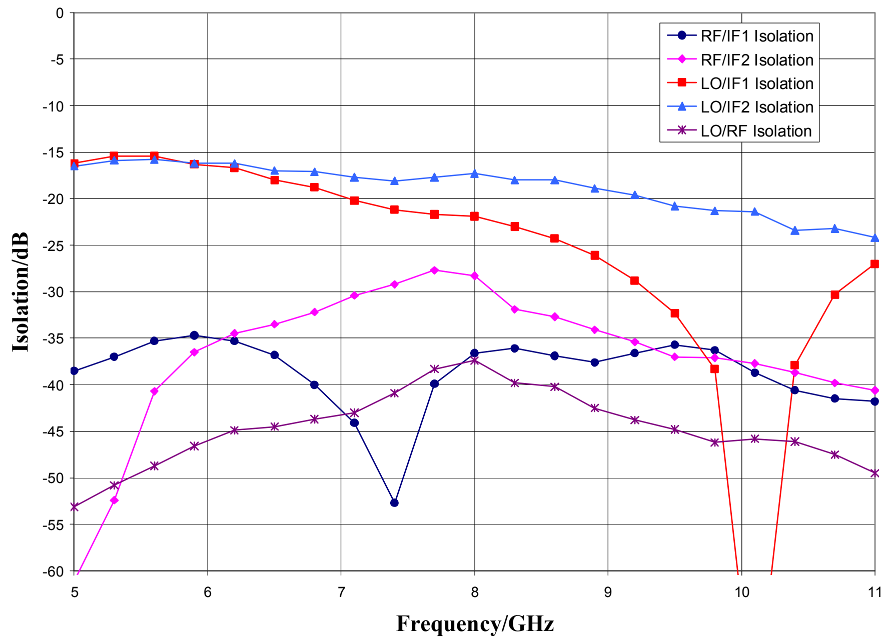
Typical Performance

Isolation, LO = +21 dBm. Data Taken Without IF Hybrid



MxN Spurious Outputs

	nLO				
mRF	0	1	2	3	4
0	xx	-17	3	5	42
1	23	0	30	43	>71
2	>71	58	>71	>71	>71
3	>71	>71	>71	>71	>71
4	>71	>71	>71	>71	>71

RF = 8.1 GHz @ -10 dBm
LO = 8.0 GHz @ +21 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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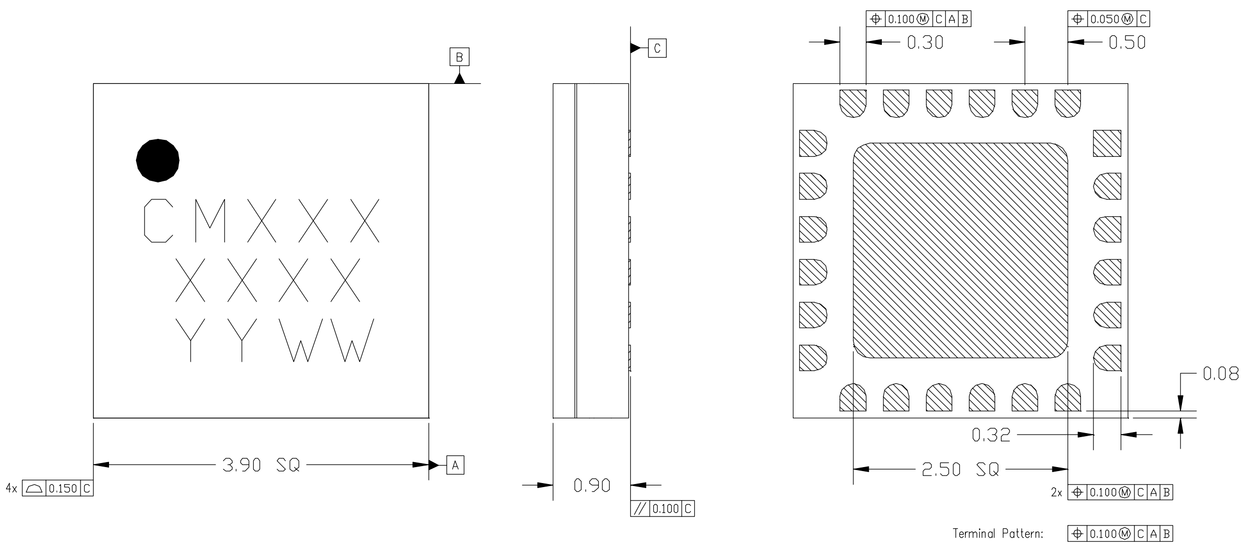
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   4.1. LINE 1: PART NUMBER
      4.1.1. EXAMPLE: CMD191C4 SHALL BE MARKED AS CM191
   4.2. LINE 2: LOT NUMBER
   4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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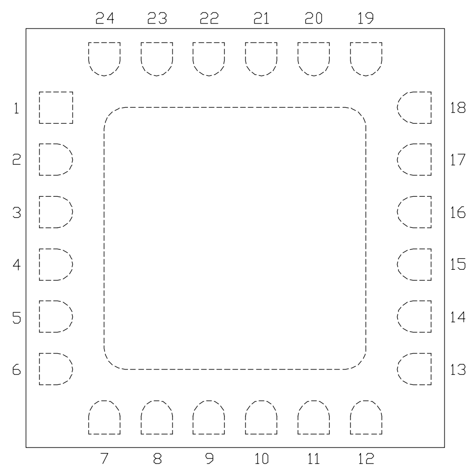
CMD257C4

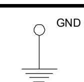
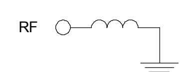
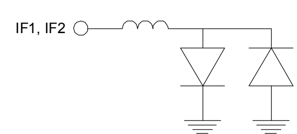
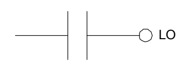
6-10 GHz High IP3 I/Q Mixer

Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1, 2, 6-8, 10, 13, 17-24	N/C	No connection required. These pins may be connected to RF/DC ground.	
3, 5, 12, 14, 16 and die paddle	Ground	Connect to RF / DC ground.	
4	RF	This pin is DC coupled and matched to 50 ohms.	
9	IF1	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
11	IF2		
15	LO	This pin is AC coupled and matched to 50 ohms.	

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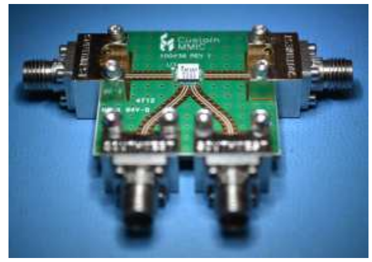
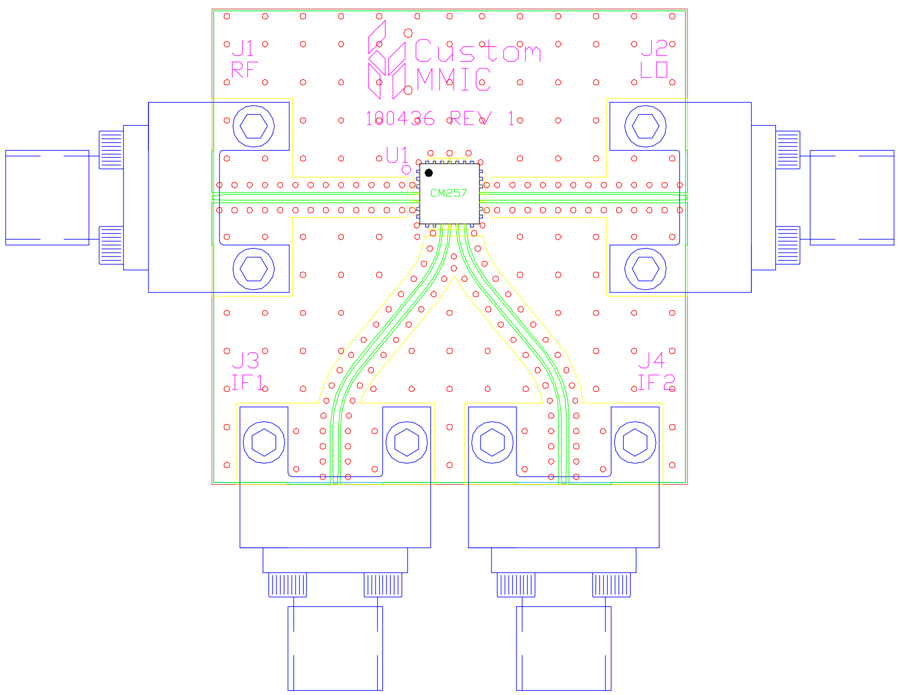
Applications Information

Evaluation Board



The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J4		SMA End Launch Connector
U1		CMD257C4 I/Q Mixer
PCB		100436 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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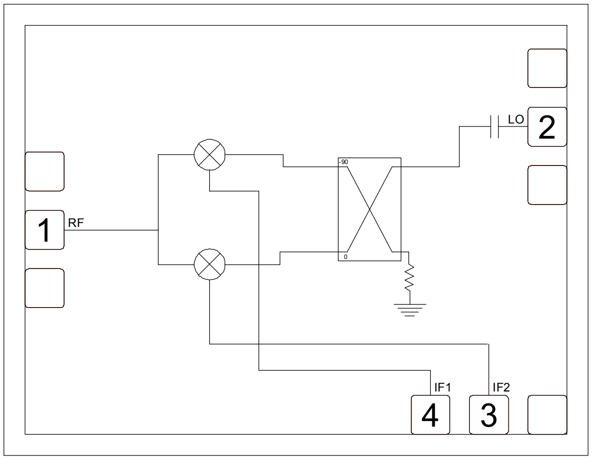
CMD258

7.5-13 GHz High IP3 I/Q Mixer

Features

- ► Low conversion loss
- ► High IP3
- ► Image rejection: 29 dB
- ► Wide IF bandwidth
- ► Small die size

Functional Block Diagram



Description

The CMD258 is a high IP3 I/Q mixer die that can be used as either an image reject mixer or a single sideband upconverter. The CMD258 utilizes two double balanced mixer cells and a 90 degree hybrid. An external IF hybrid is needed to complete the image rejection. The CMD258 offers full passivation for increased reliability and moisture protection.

Electrical Performance - IF = 100 MHz, LO = +21 dBm , T_A = 25 ^{o}C, F = 10 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		7.5 - 13		GHz
Frequency Range, IF	DC		3.5	GHz
Conversion Loss (as IRM)		5.5		dB
Image Rejection		29		dB
LO to RF Isolation		38		dB
LO to IF Isolation		20		dB
Input P1dB		14.5		dBm
Input IP3		25		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+27 dBm
LO Drive	+27 dBm
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	135.5 °C/W
Power Dissipation, Pdiss	477 mW

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications - IF = 100 MHz, LO = +21 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		9 - 11			7.5 - 13		GHz
Frequency Range, IF	DC		3.5	DC		3.5	GHz
Conversion Loss (as IRM)		5.5	7.5		7	10	dB
Image Rejection	23	28		23	30		dB
LO to RF Isolation	34	38		34	42		dB
LO to IF Isolation	15	19		14	20		dB
Input P1dB		15			16		dBm
Input IP3		24			24		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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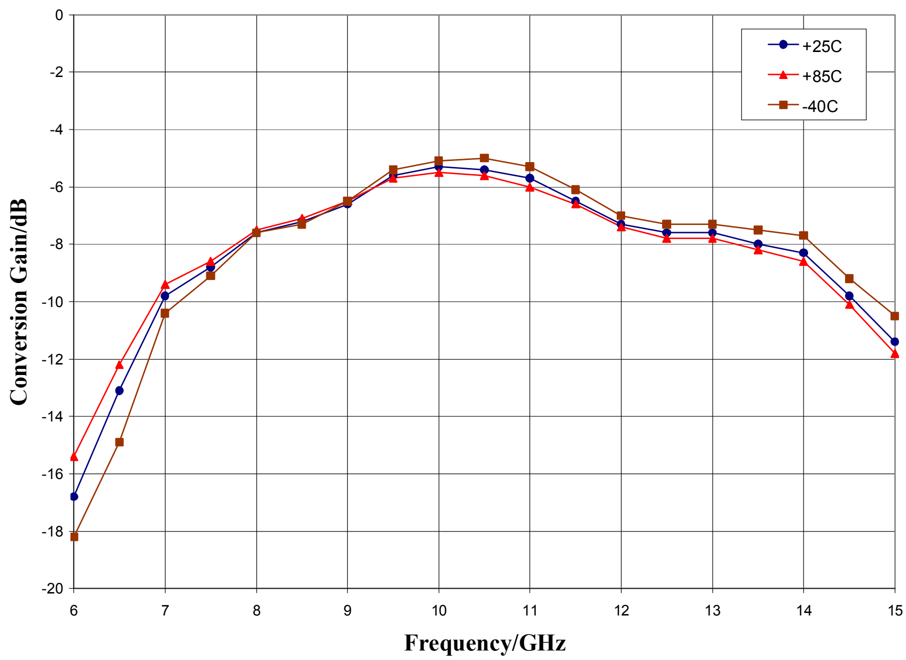
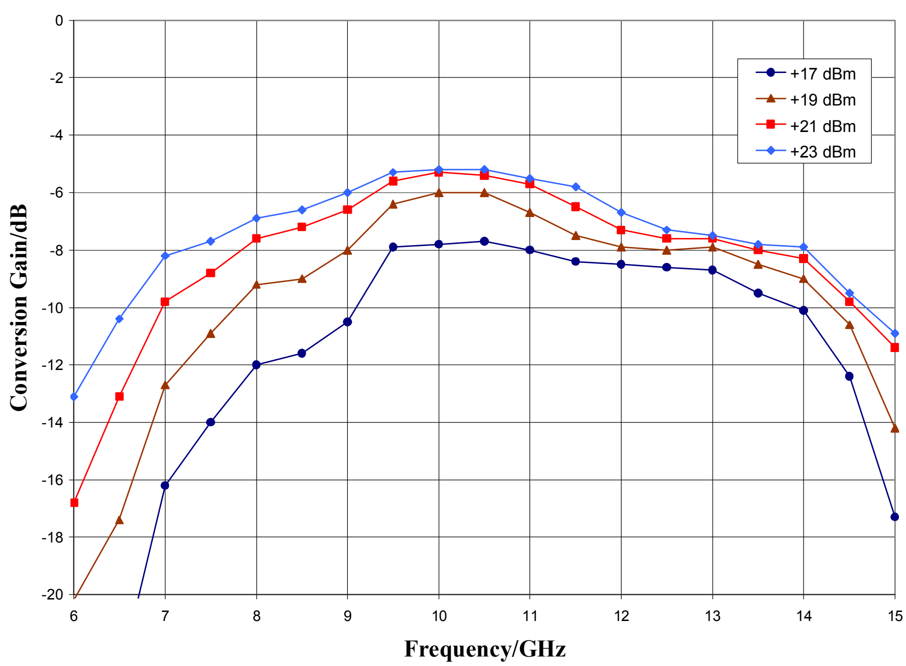
Typical Performance

Data Taken As IRM With External IF Hybrid

Conversion Gain vs. Temperature, LO = +21 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB



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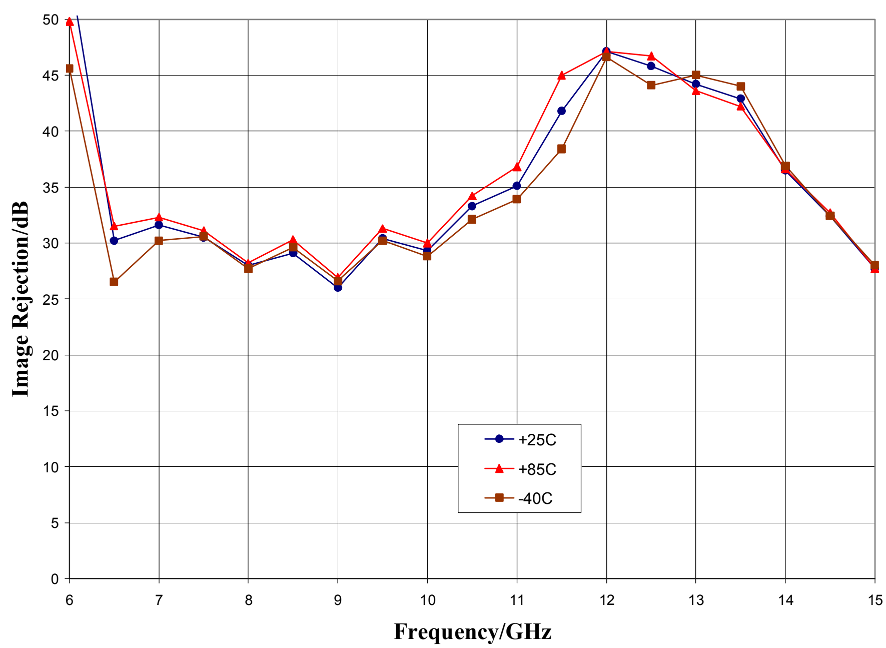
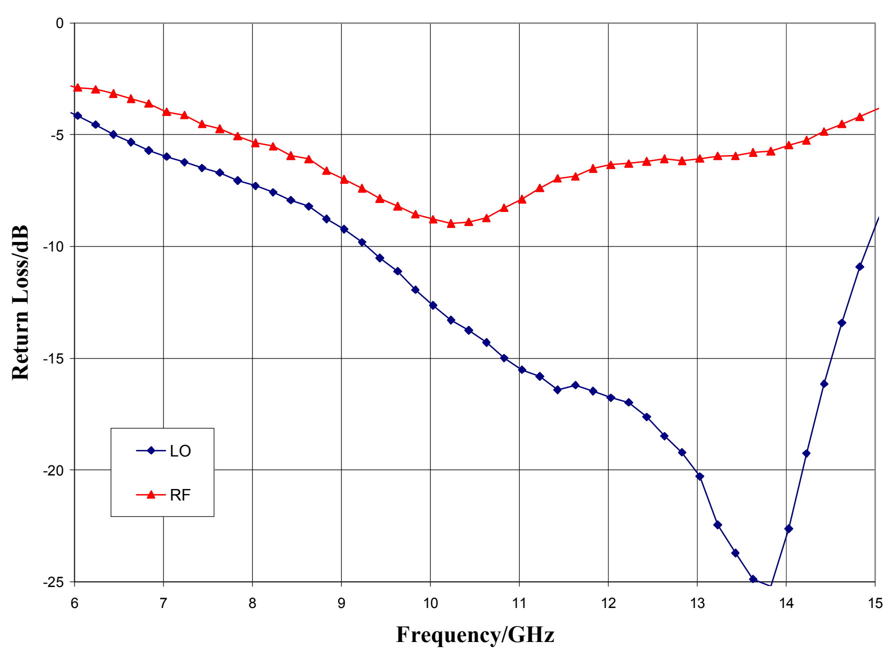
Typical Performance

Data Taken As IRM With External IF Hybrid

Image Rejection, LO = +21 dBm, IF = 100 MHz USB



Return Loss, LO = +21 dBm



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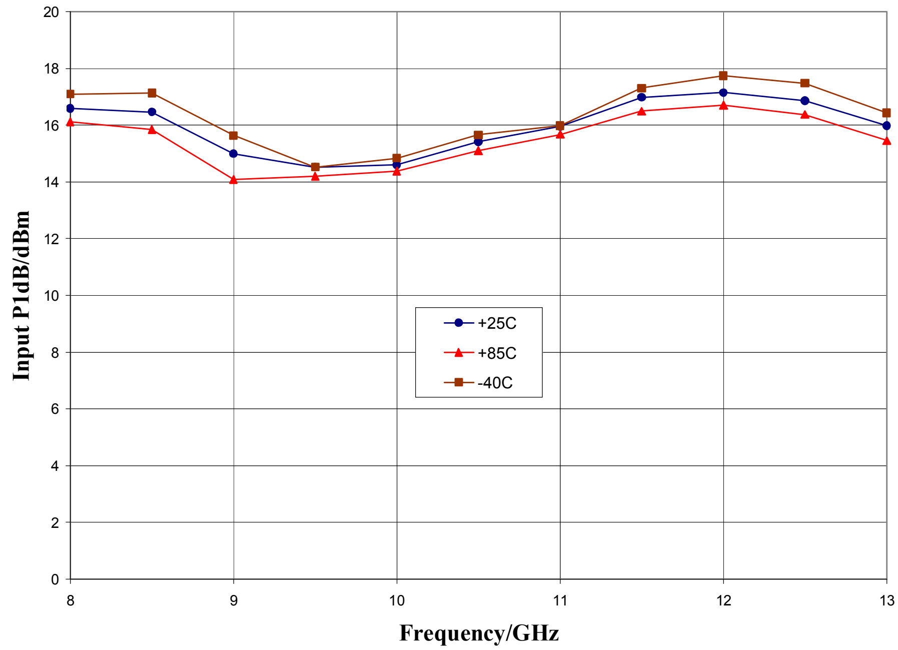
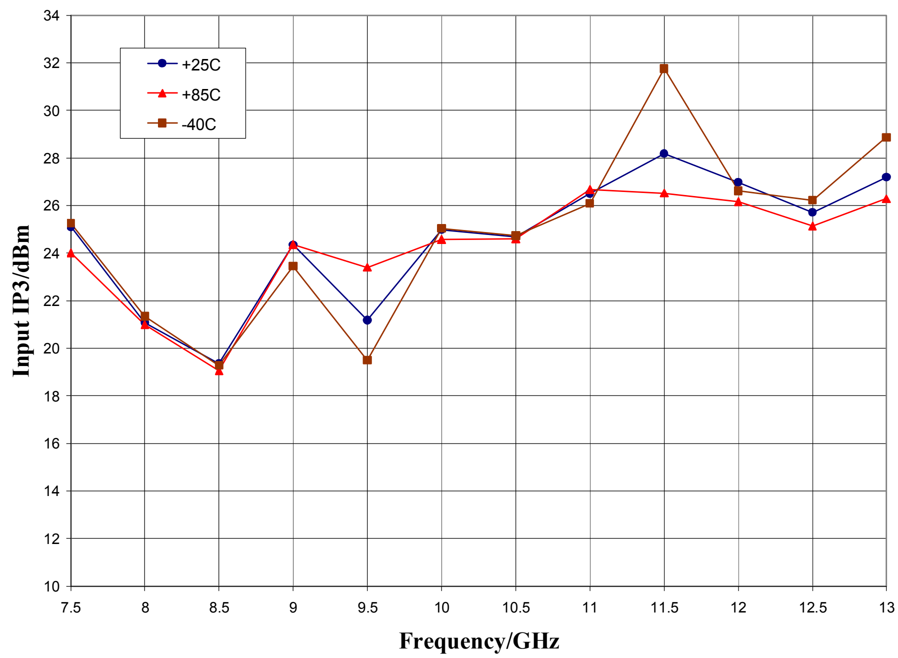
Typical Performance

Data Taken As IRM With External IF Hybrid

Input P1dB vs. Temperature, LO = +21 dBm, IF = 100 MHz USB



Input IP3 vs. Temperature, LO = +21 dBm, IF = 100 MHz USB



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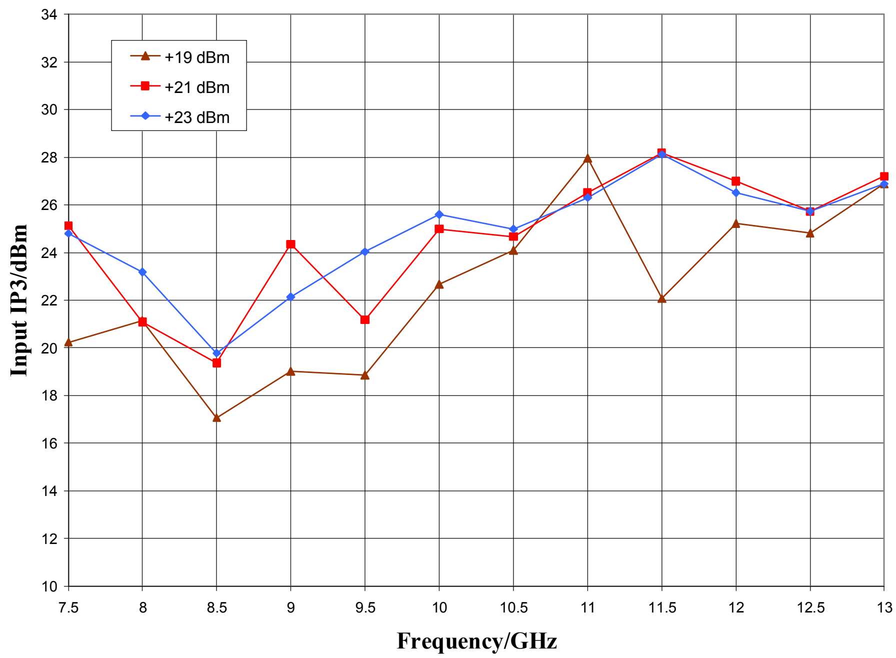
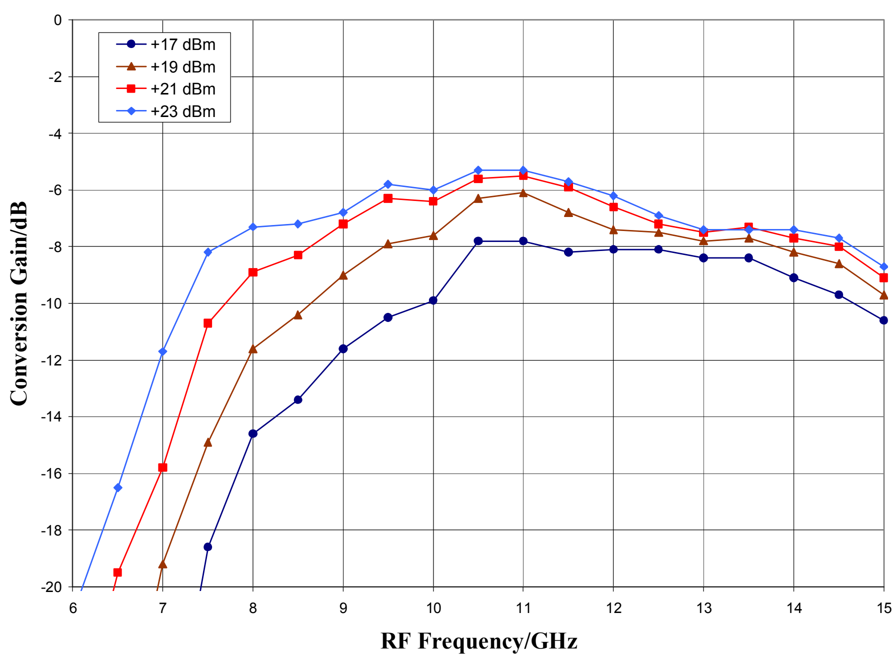
Typical Performance

Data Taken As IRM With External IF Hybrid

Input IP3 vs. LO Drive, IF = 100 MHz USB



Upconverter Performance, Conversion Gain vs. LO Drive, IF = 950 MHz



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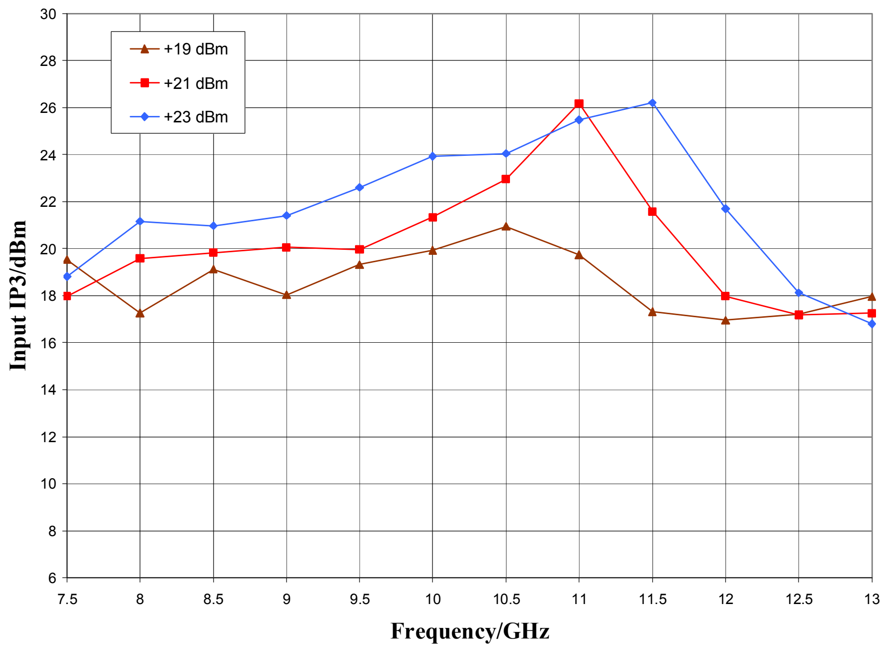
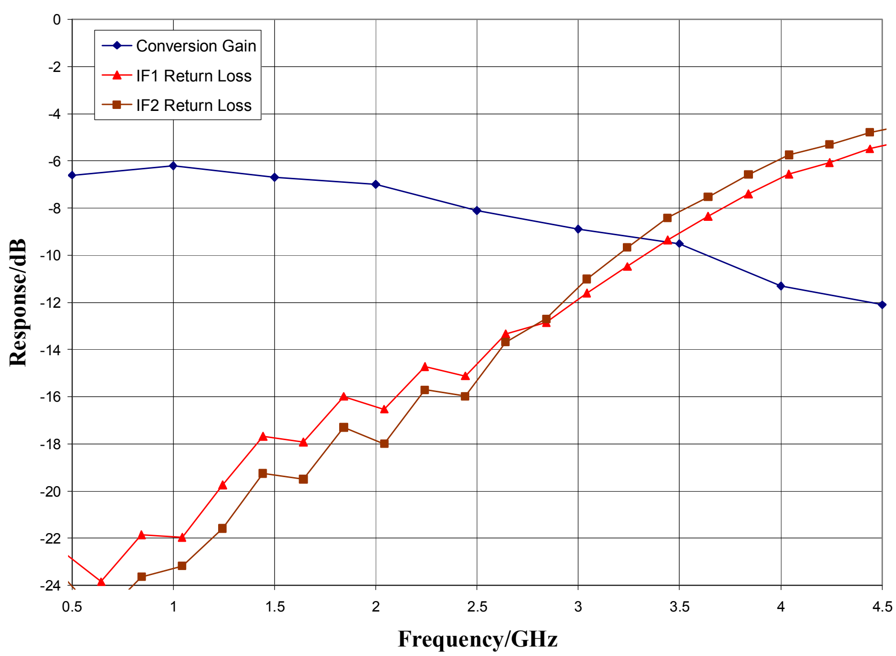
Typical Performance

Data Taken As IRM With External IF Hybrid

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



IF Bandwidth, LO = +21 dBm, Return Loss Data Taken Without IF Hybrid



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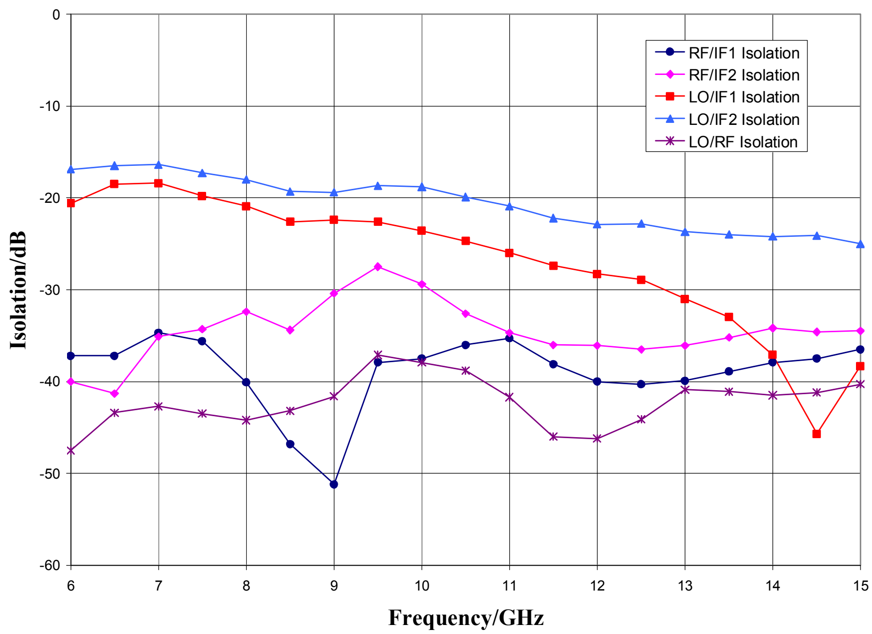
Typical Performance

Isolation, LO = +21 dBm. Data Taken Without IF Hybrid



MxN Spurious Outputs to IF1, IF2

	nLO				
mRF	0	1	2	3	4
0	xx	-13 / -17	35 / 29	-7 / 5	
1	28 / 27	0	31 / 34	51 / 56	51 / 59
2	> 71	60 / 59	> 71	> 71	> 71
3	> 71	> 71	> 71	> 71	> 71
4		> 71	> 71	> 71	> 71

RF = 10.6 GHz @ -10 dBm
LO = 10.5 GHz @ +21 dBm
All values in dBc below the IF1 / IF2 output power level (1RF - 1LO)
Measurement performed without IF hybrid
Where two numbers are listed, they are the spur levels for the IF1 / IF2 ports

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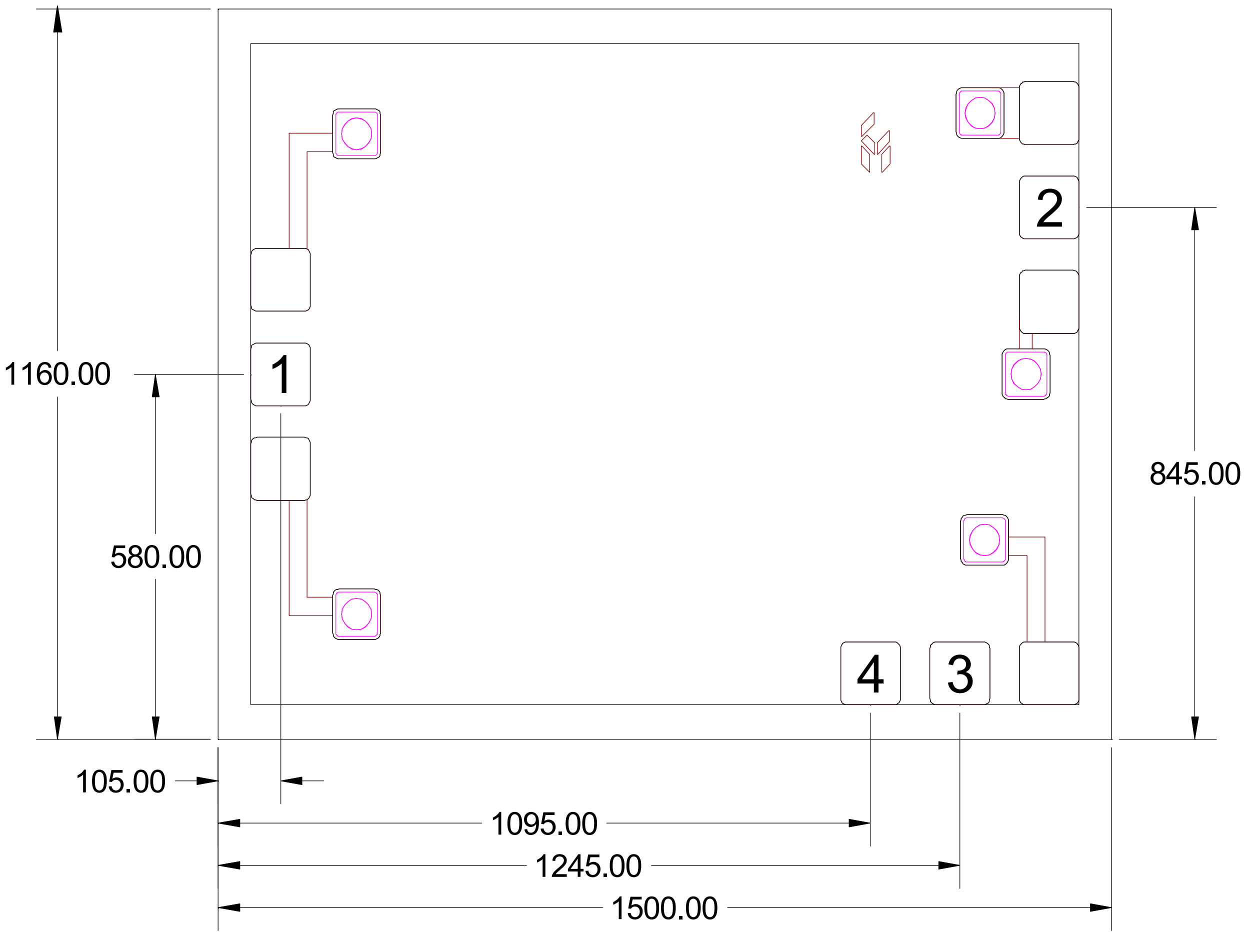
Mechanical Information

Die Outline (all dimensions in microns)



Notes:
1.No connection required for unlabeled pads
2.Backside is RF and DC ground
3.Backside and bond pad metal: Gold
4.Die is 100 microns thick
5.All bond pads (1-4) are 100 microns square

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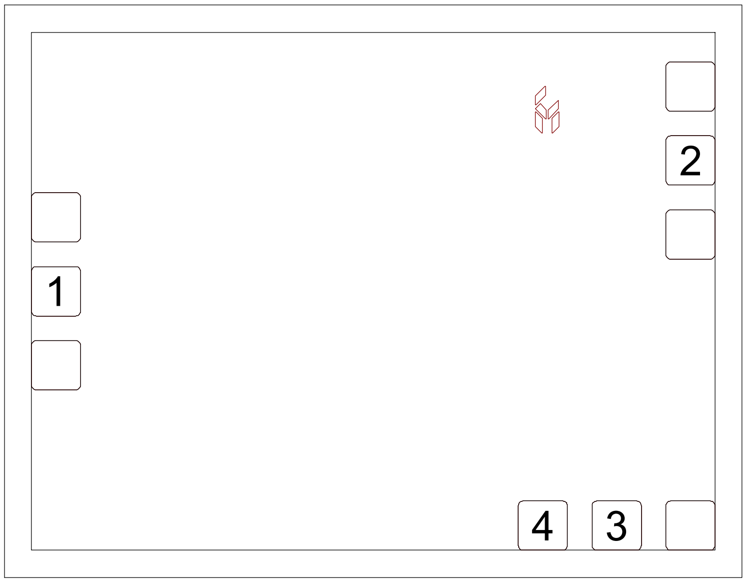
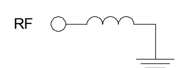
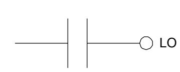
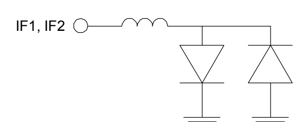
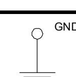
Pad Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	RF	This pin is DC coupled and matched to 50 ohms.	
2	LO	This pin is AC coupled and matched to 50 ohms.	
3	IF2	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
4	IF1		
Backside	Ground	Connect to RF / DC ground.	

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Applications Information

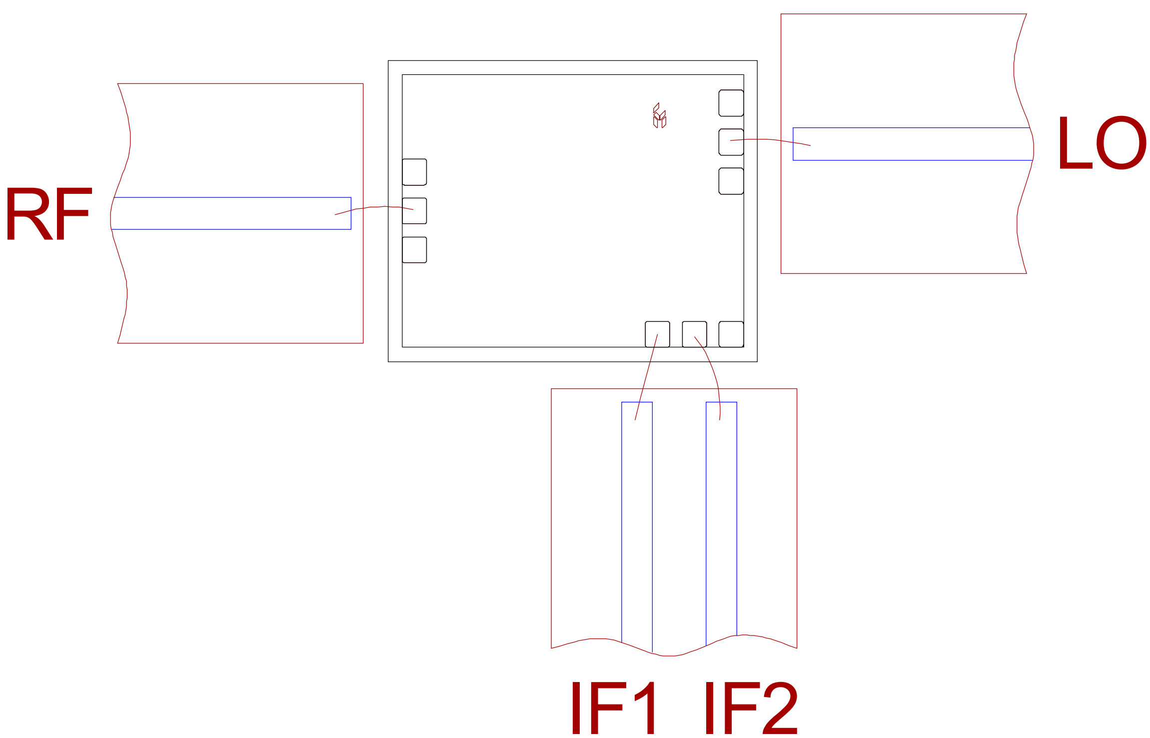
Assembly Guidelines

The backside of the CMD258 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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Custom MMIC

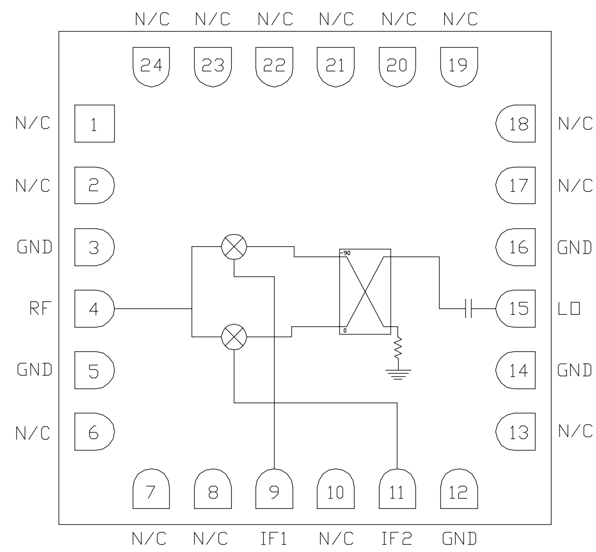
CMD258C4

7.5-13 GHz High IP3 I/Q Mixer

Features

- ► Low conversion loss
- ► High IP3
- ► Image rejection: 29 dB
- ► Wide IF bandwidth
- ► Pb-free RoHs compliant 4x4 mm SMT package

Functional Block Diagram



Description

The CMD258C4 is a high IP3 I/Q mixer in a leadless surface mount package that can be used as either an image reject mixer or a single sideband upconverter. The CMD258C4 utilizes two double balanced mixer cells and a 90 degree hybrid. An external IF hybrid is needed to complete the image rejection. The CMD258C4 is a much smaller alternative to higher cost hybrid image reject mixers and single sideband upconverter assemblies.

Electrical Performance **- IF = 100 MHz, LO = +21 dBm , T_A = 25 °C, F = 10 GHz**

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		7.5 - 13		GHz
Frequency Range, IF	DC		3.5	GHz
Conversion Loss (as IRM)		5.5		dB
Image Rejection		29		dB
LO to RF Isolation		38		dB
LO to IF Isolation		20		dB
Input P1dB		14.5		dBm
Input IP3		25		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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CMD258C4

7.5-13 GHz High IP3 I/Q Mixer

Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+27 dBm
LO Drive	+27 dBm
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	135.5 °C/W

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications - IF = 100 MHz, LO = +21 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		9 - 11			7.5 - 13		GHz
Frequency Range, IF	DC		3.5	DC		3.5	GHz
Conversion Loss (as IRM)		5.5	7.5		7	10	dB
Image Rejection	23	28		23	30		dB
LO to RF Isolation	34	38		34	42		dB
LO to IF Isolation	15	19		14	20		dB
Input P1dB		15			16		dBm
Input IP3		24			24		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz

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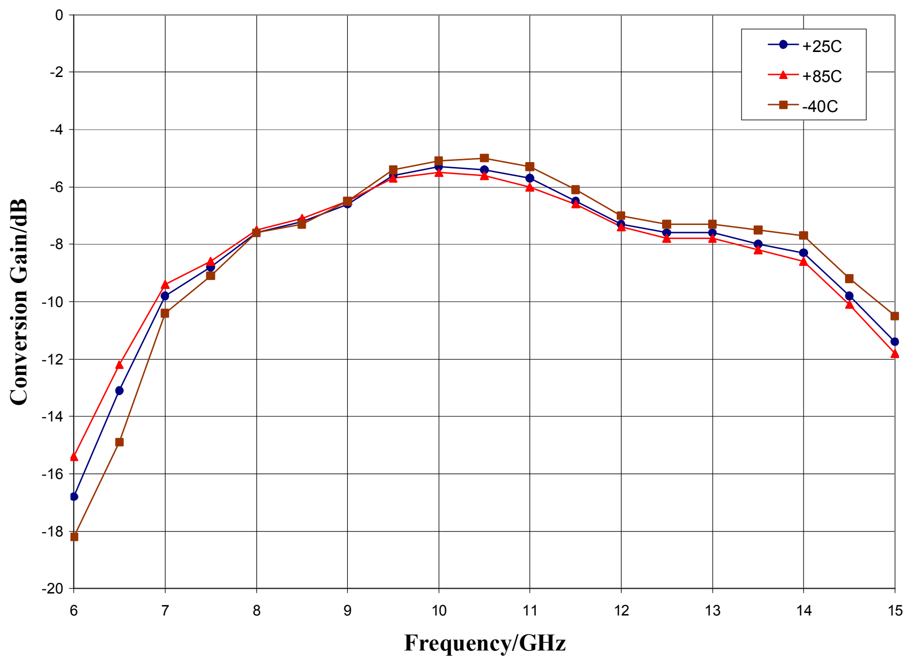
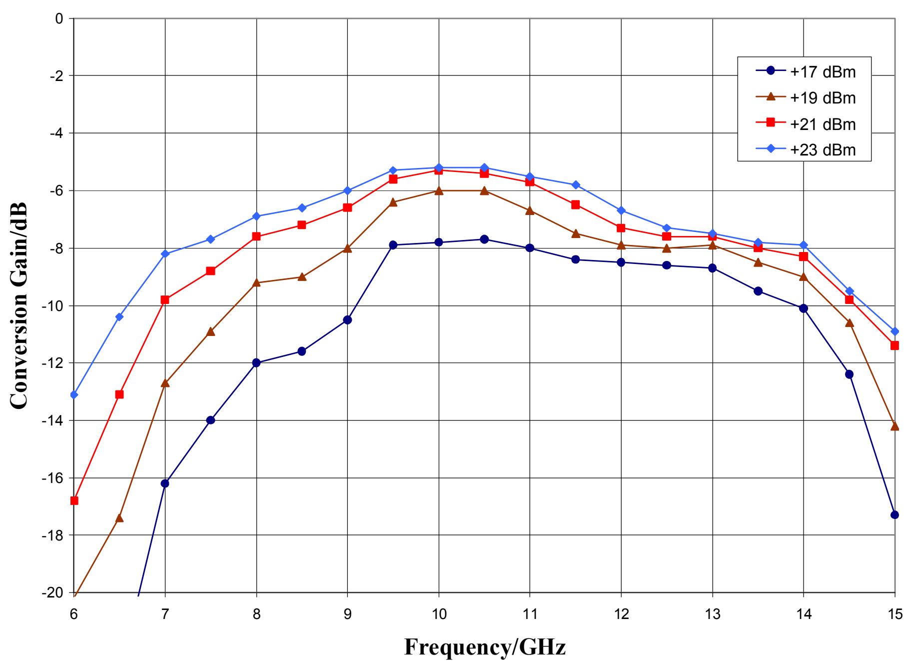
Typical Performance

Data Taken As IRM With External IF Hybrid

Conversion Gain vs. Temperature, LO = +21 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB



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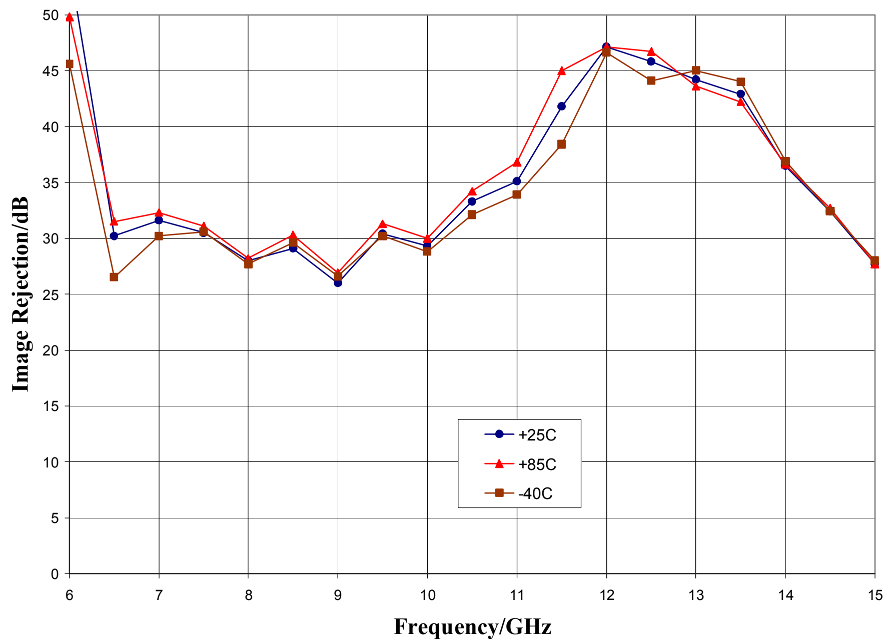
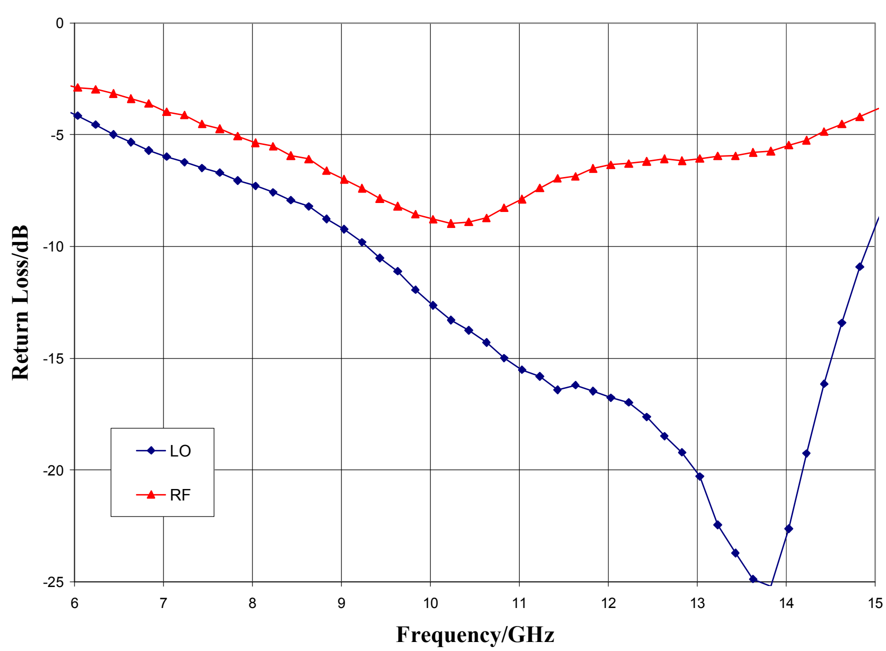
Typical Performance

Data Taken As IRM With External IF Hybrid

Image Rejection, LO = +21 dBm, IF = 100 MHz USB



Return Loss, LO = +21 dBm



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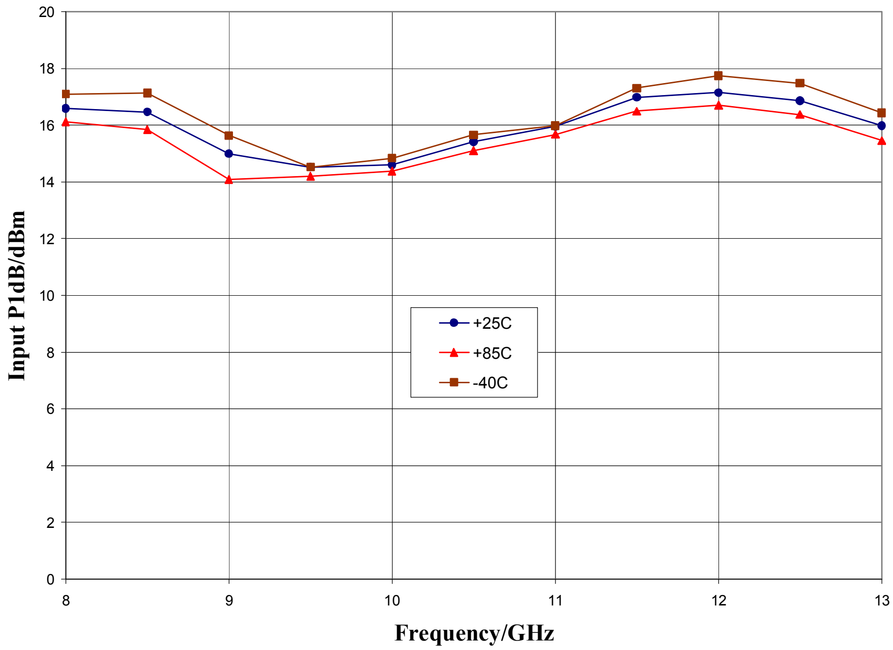
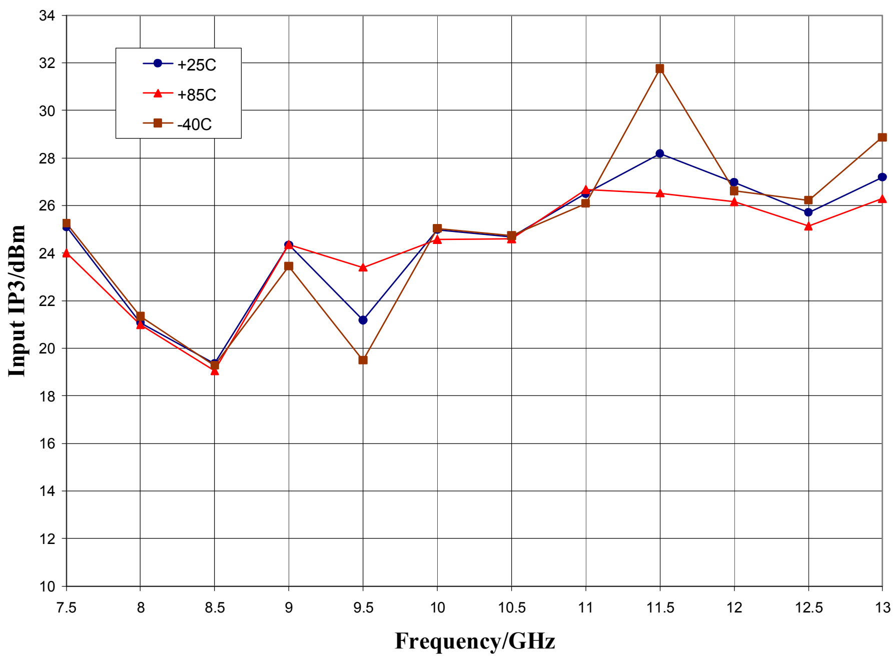
Typical Performance

Data Taken As IRM With External IF Hybrid

Input P1dB vs. Temperature, LO = +21 dBm, IF = 100 MHz USB



Input IP3 vs. Temperature, LO = +21 dBm, IF = 100 MHz USB



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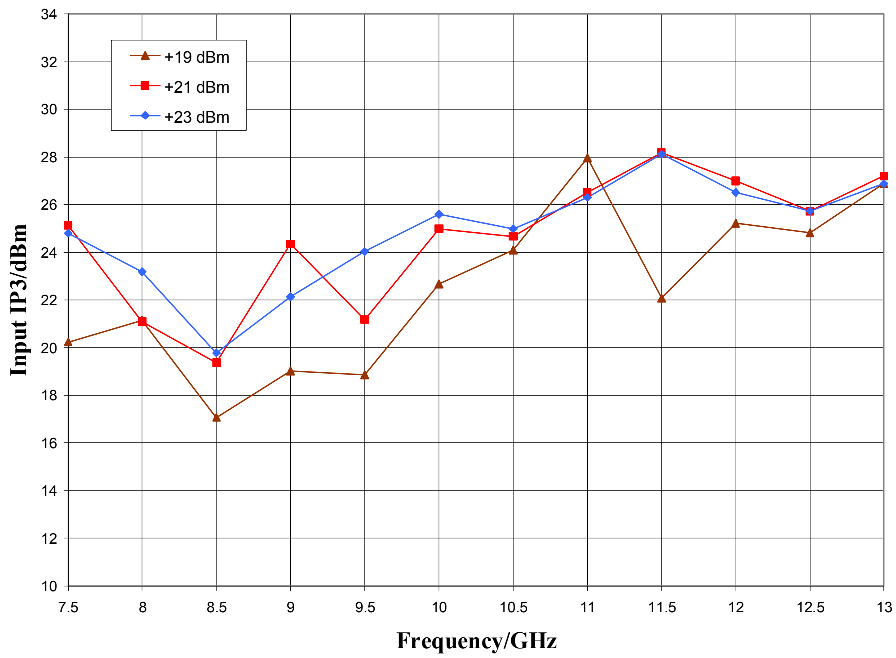
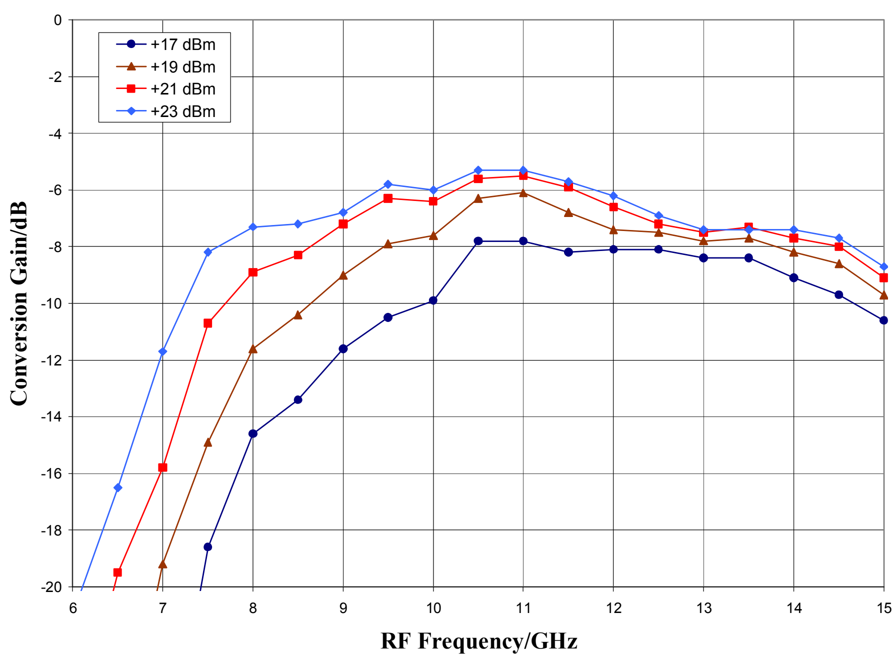
Typical Performance

Data Taken As IRM With External IF Hybrid

Input IP3 vs. LO Drive, IF = 100 MHz USB



Upconverter Performance, Conversion Gain vs. LO Drive, IF = 950 MHz



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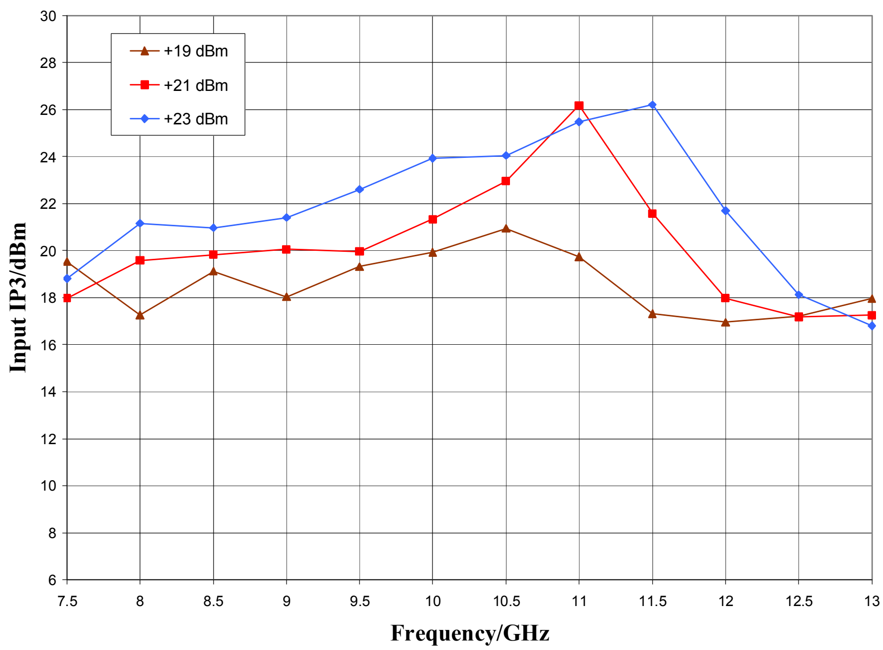
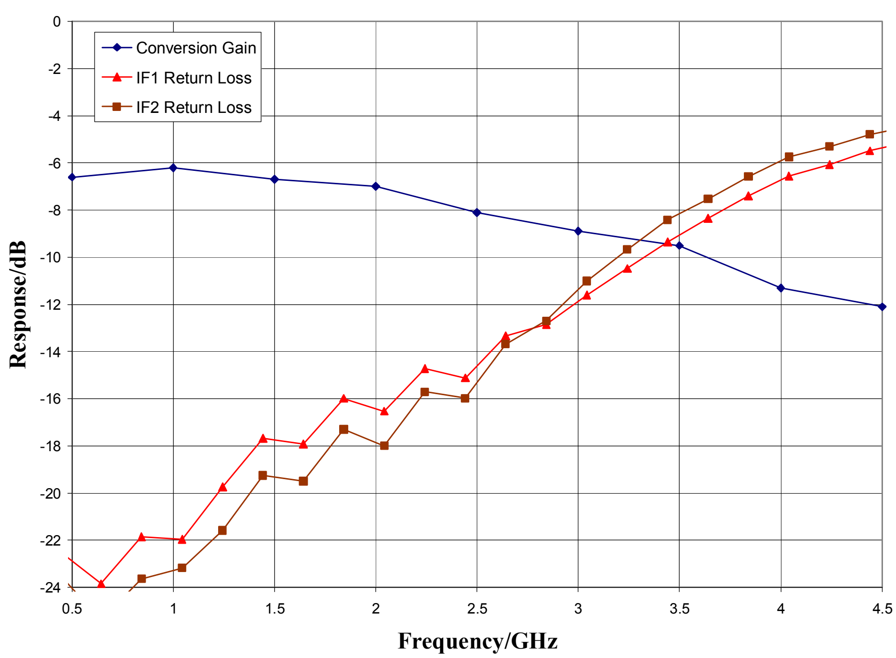
Typical Performance

Data Taken As IRM With External IF Hybrid

Upconverter Performance, Input IP3 vs. LO Drive, IF = 100 MHz



IF Bandwidth, LO = +21 dBm, Return Loss Data Taken Without IF Hybrid



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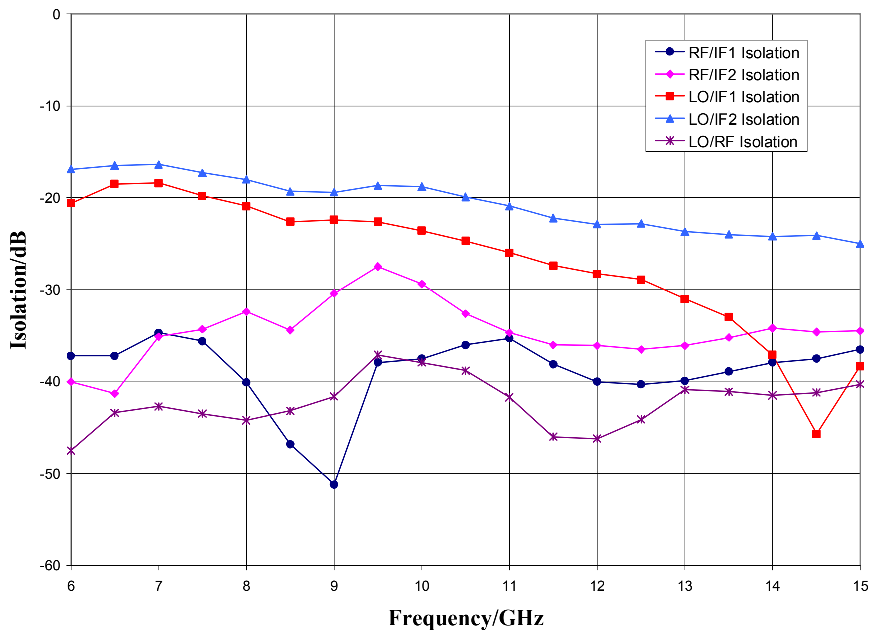
Typical Performance

Isolation, LO = +21 dBm. Data Taken Without IF Hybrid



MxN Spurious Outputs to IF1, IF2

	nLO				
mRF	0	1	2	3	4
0	xx	-13 / -17	35 / 29	-7 / 5	
1	28 / 27	0	31 / 34	51 / 56	51 / 59
2	> 71	60 / 59	> 71	> 71	> 71
3	> 71	> 71	> 71	> 71	> 71
4		> 71	> 71	> 71	> 71

RF = 10.6 GHz @ -10 dBm
LO = 10.5 GHz @ +21 dBm
All values in dBc below the IF1 / IF2 output power level (1RF - 1LO)
Measurement performed without IF hybrid
Where two numbers are listed, they are the spur levels for the IF1 / IF2 ports

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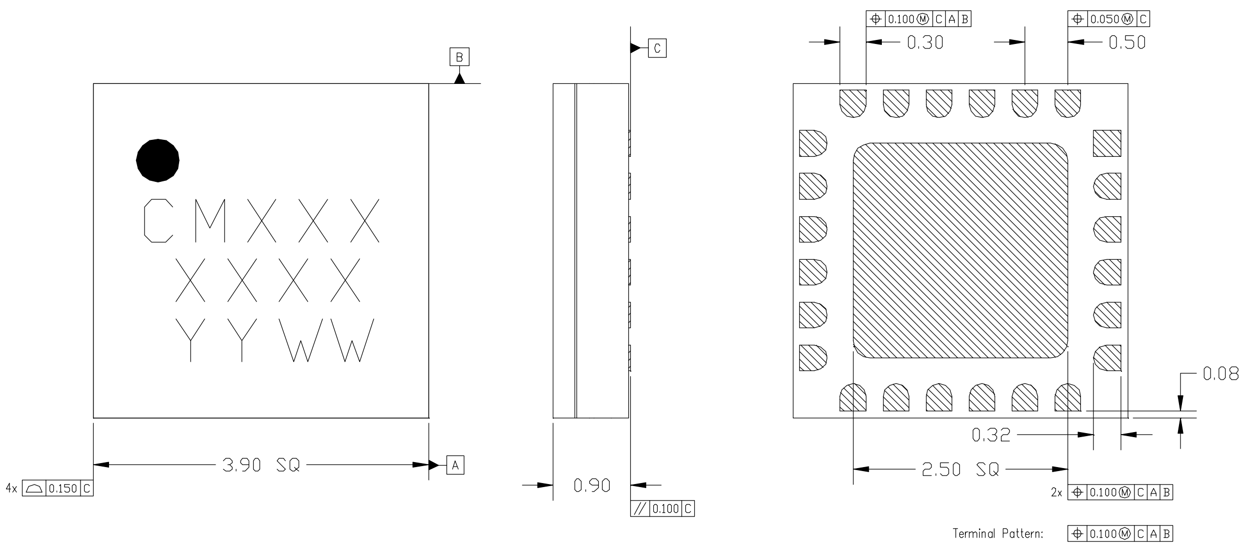
Mechanical Information

Package Information and Dimensions



NOTES:
1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   4.1. LINE 1: PART NUMBER
      4.1.1. EXAMPLE: CMD191C4 SHALL BE MARKED AS CM191
   4.2. LINE 2: LOT NUMBER
   4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC Design Services recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC Design Services recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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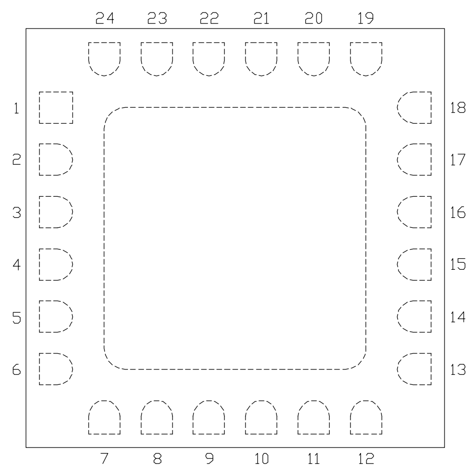
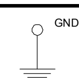
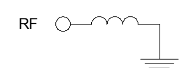
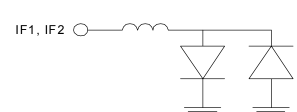
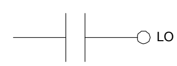
Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1, 2, 6-8, 10, 13, 17-24	N/C	No connection required. These pins may be connected to RF/DC ground.	
3, 5, 12, 14, 16 and die paddle	Ground	Connect to RF / DC ground.	
4	RF	This pin is DC coupled and matched to 50 ohms.	
9	IF1	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
11	IF2		
15	LO	This pin is AC coupled and matched to 50 ohms.	

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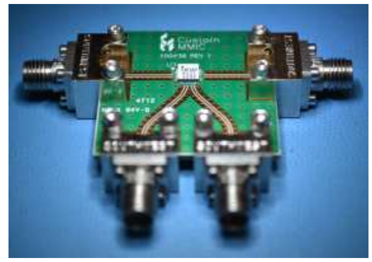
CMD258C4

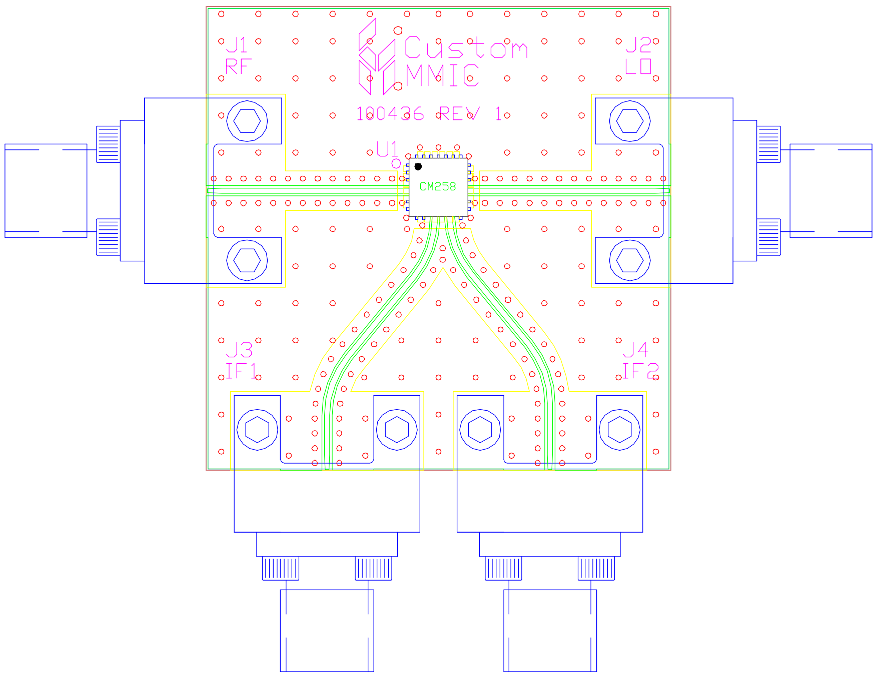
7.5-13 GHz High IP3 I/Q Mixer

Applications Information

Evaluation Board



The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



Bill of Material

Designator	Value	Description
J1 - J4		SMA End Launch Connector
U1		CMD258C4 I/Q Mixer
PCB		100436 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

Please note, all information contained in this data sheet is subject to change without notice. ver 1.0 1017

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CMD261

High IF Bandwidth Mixer

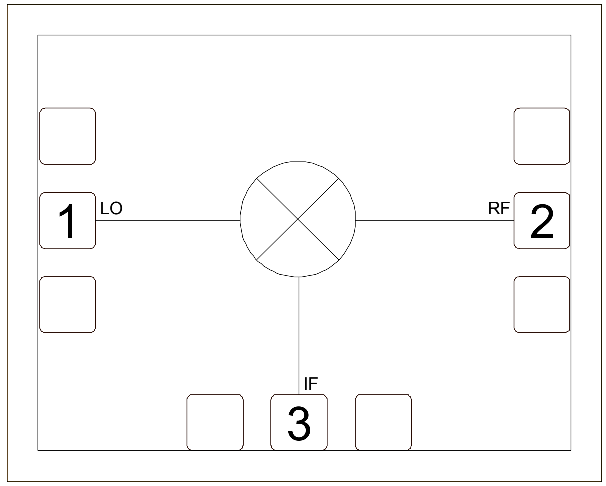
Features

- ► Low conversion loss
- ► High isolation
- ► Ultra wide IF bandwidth
- ► Passive double balanced topology
- ► Small die size

Description

The CMD261 is a general purpose double balanced mixer die with ultra wide IF bandwidth that can be used for up- and downconverting applications between 30 and 46 GHz. The CMD261 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +15 dBm. The CMD261 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Functional Block Diagram



Electrical Performance – IF = 12 GHz USB, LO = +19 dBm , T_A = 25 ^oC, RF = 36 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF		30 – 46		GHz
Frequency Range, LO		16 – 31		GHz
Frequency Range, IF	5		20	GHz
Conversion Loss		8		dB
LO to RF Isolation		30		dB
LO to IF Isolation		20		dB
RF to IF Isolation		23		dB
Input IP3		+21		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 12 GHz USB

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+24 dBm
LO Drive	+24 dBm
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	271.9 ºC / W
Power Dissipation, Pdiss	240 mW

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications – IF = 12 GHz, LO = +19 dBm, T_A = 25 ^{o}C

Parameter	Min	Typ	Max	Units
Frequency Range, RF	30 – 46			GHz
Frequency Range, LO	16 – 31			GHz
Frequency Range, IF	5		20	GHz
Conversion Loss		8	11	dB
Noise Figure (SSB)		8	11	dB
LO to RF Isolation	30	35		dB
LO to IF Isolation	13	20		dB
RF to IF Isolation	17	25		dB
Input IP3	17	21		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 12 GHz

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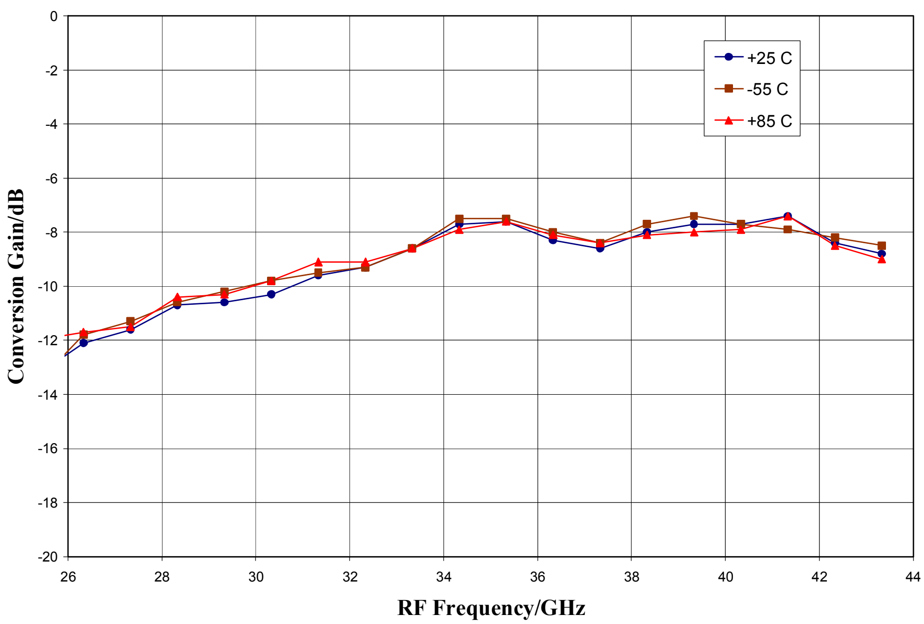
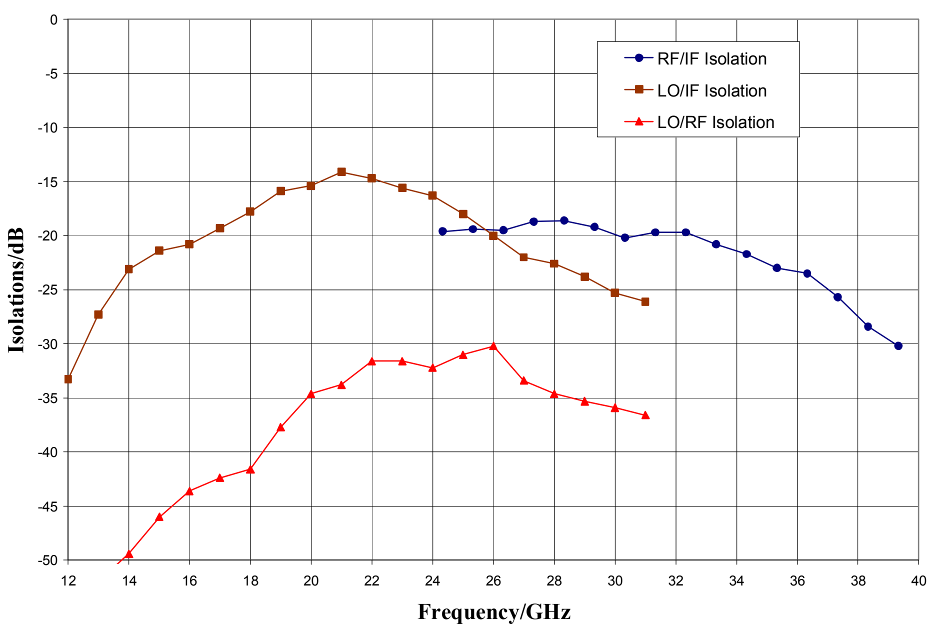
Typical Performance

Conversion Gain vs. Temperature, LO = +19 dBm, IF = 12 GHz USB



Isolations, LO = +19 dBm



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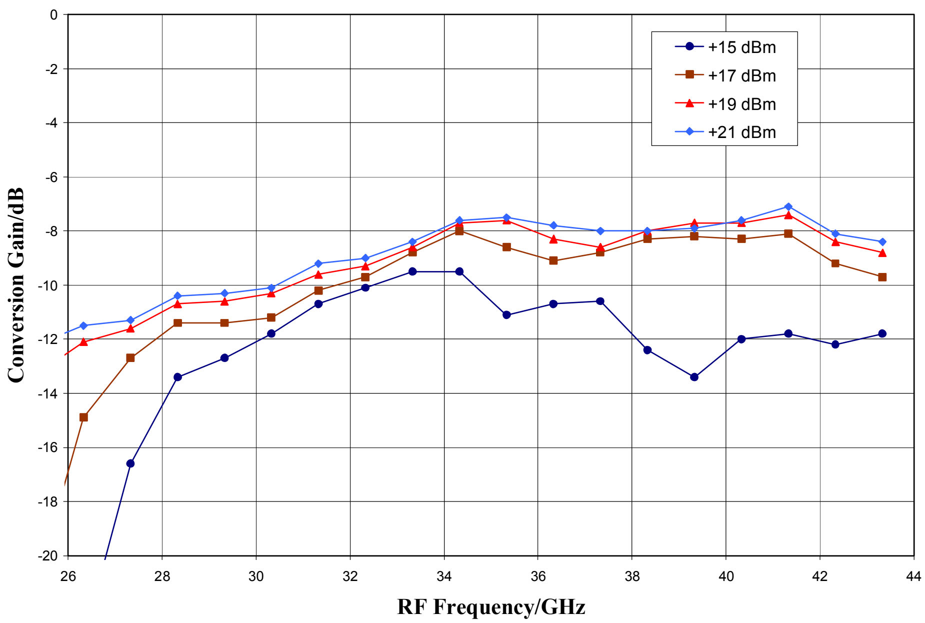
CMD261

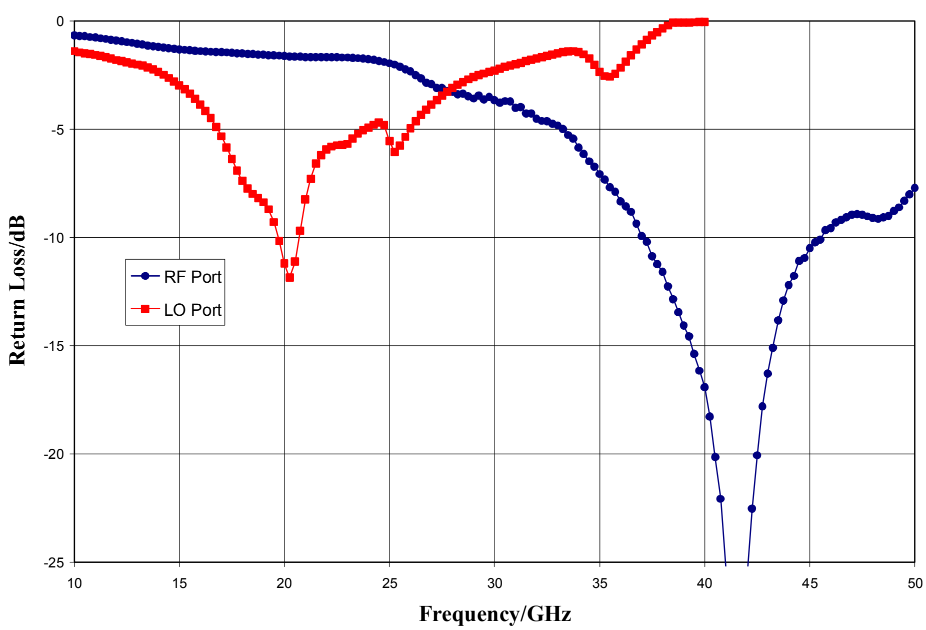
High IF Bandwidth Mixer

Typical Performance

Conversion Gain vs. LO Drive, IF = 12 GHz USB



Return Loss, LO = + 21 dBm



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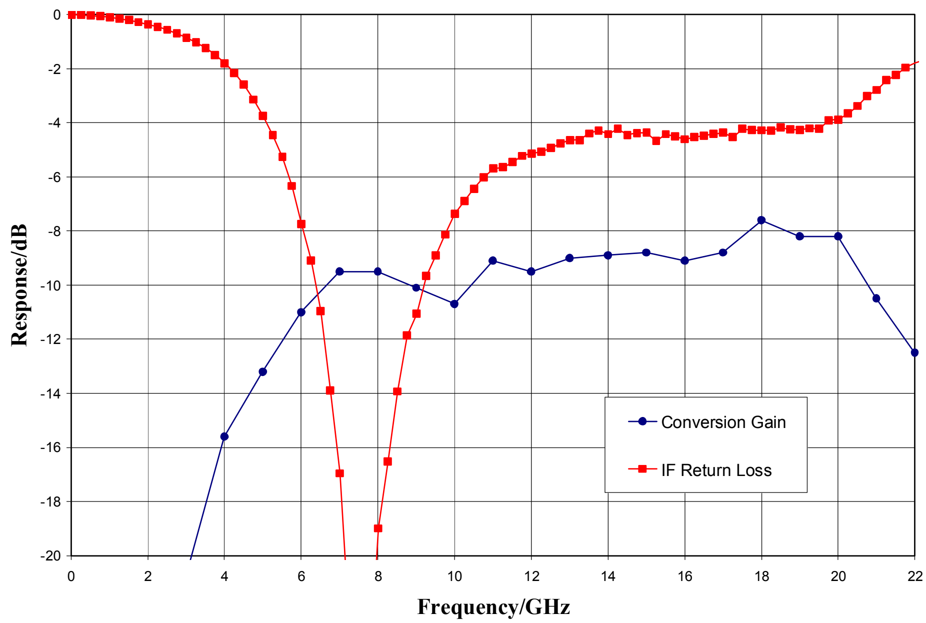
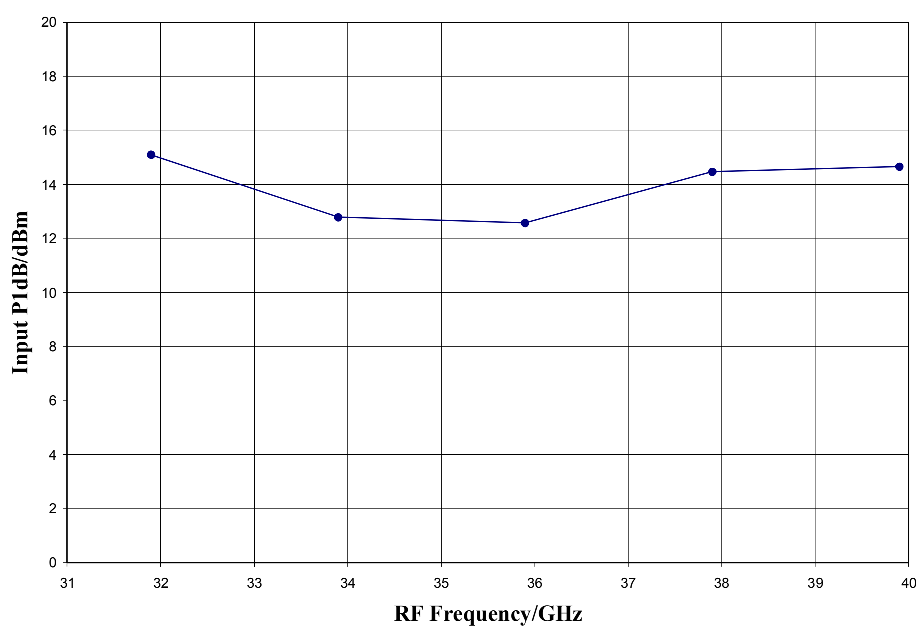
Typical Performance

IF Bandwidth, LO = +17 dBm



Input P1dB, LO=+19 dBm, IF = 12 GHz USB



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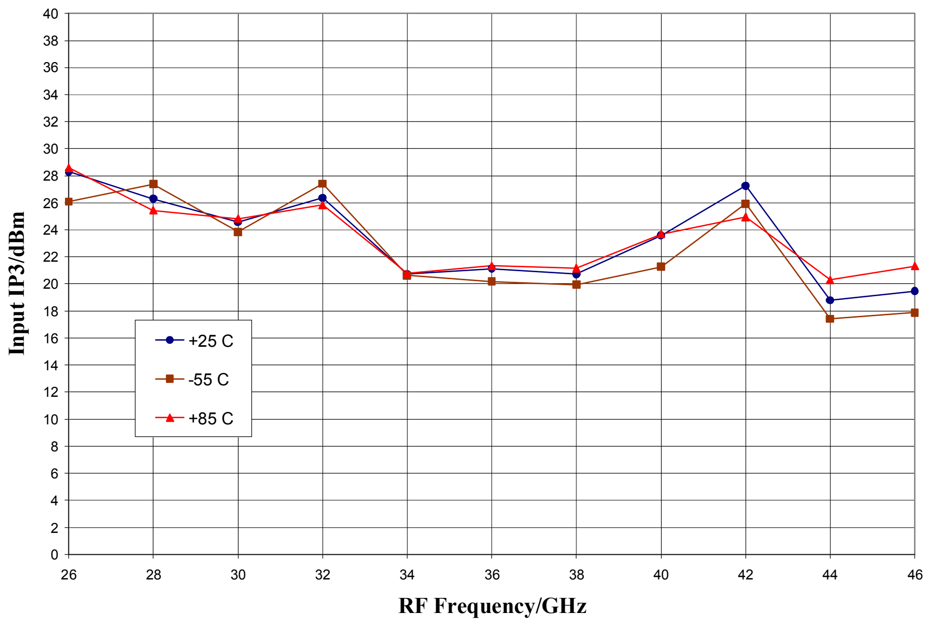
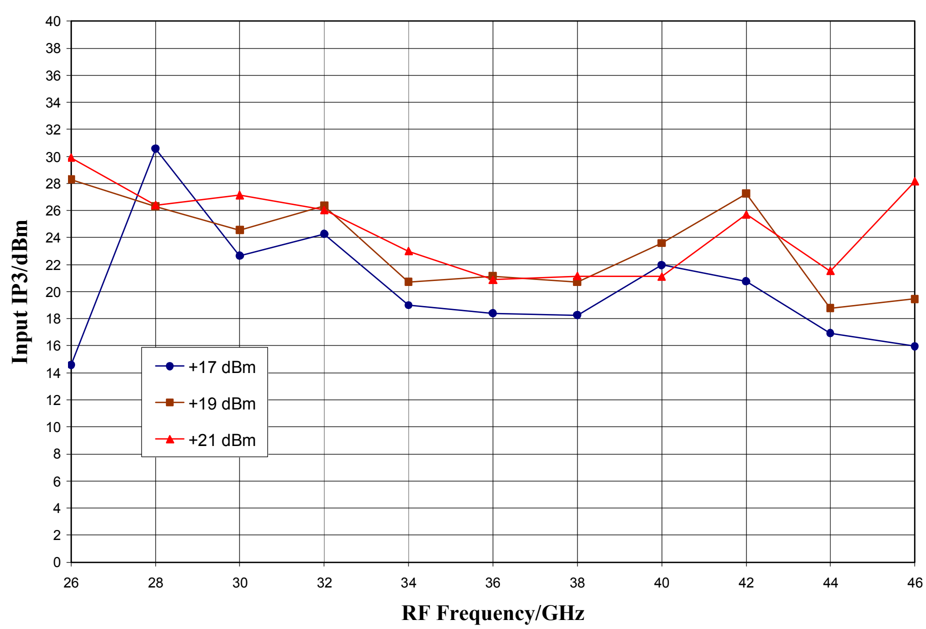
Typical Performance

Input IP3 vs. Temperature, LO = +19 dBm, IF = 12 GHz USB



Input IP3 vs. LO Drive, IF = 12 GHz USB



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Typical Performance

M x N Spur Table

	nLO				
mRF	0	1	2	3	4
0	xx	-20			
1	17	0	31	48	
2			68	66	64
3				> 80	> 80
4					

RF = 36.1 GHz @ -10 dBm
LO = 24.0 GHz @ +21 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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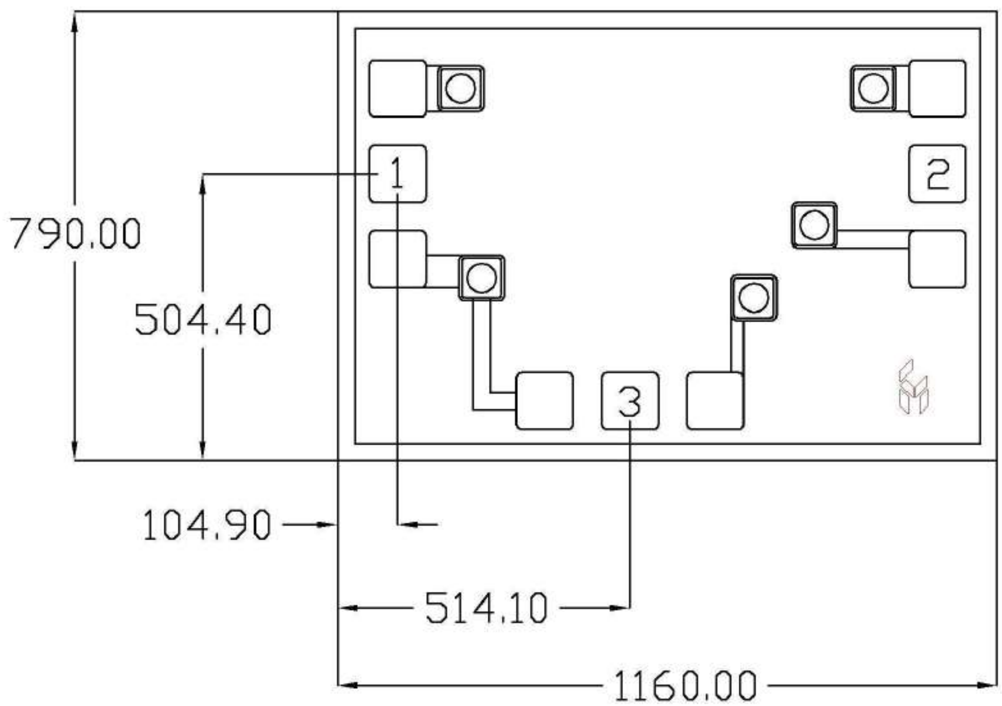
Mechanical Information

Die Outline (all dimensions in microns)



Notes:

1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 100 microns thick
5. All bond pads (1, 2, and 3) are 100 x 100 microns square

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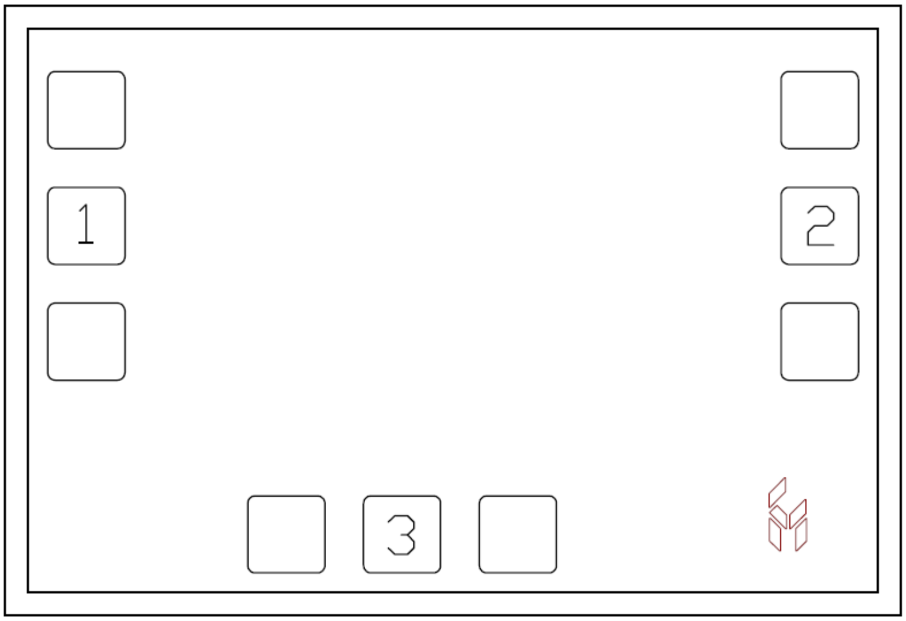
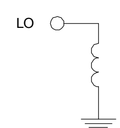
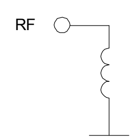
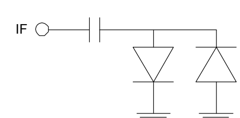
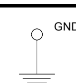
Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	LO	This pin is DC coupled and matched to 50 ohms.	
2	RF	This pin is DC coupled and matched to 50 ohms.	
3	IF	This pin is AC coupled and matched to 50 Ohms. Operation to DC is not possible.	
Backside	Ground	Connect to RF / DC ground.	

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Applications Information

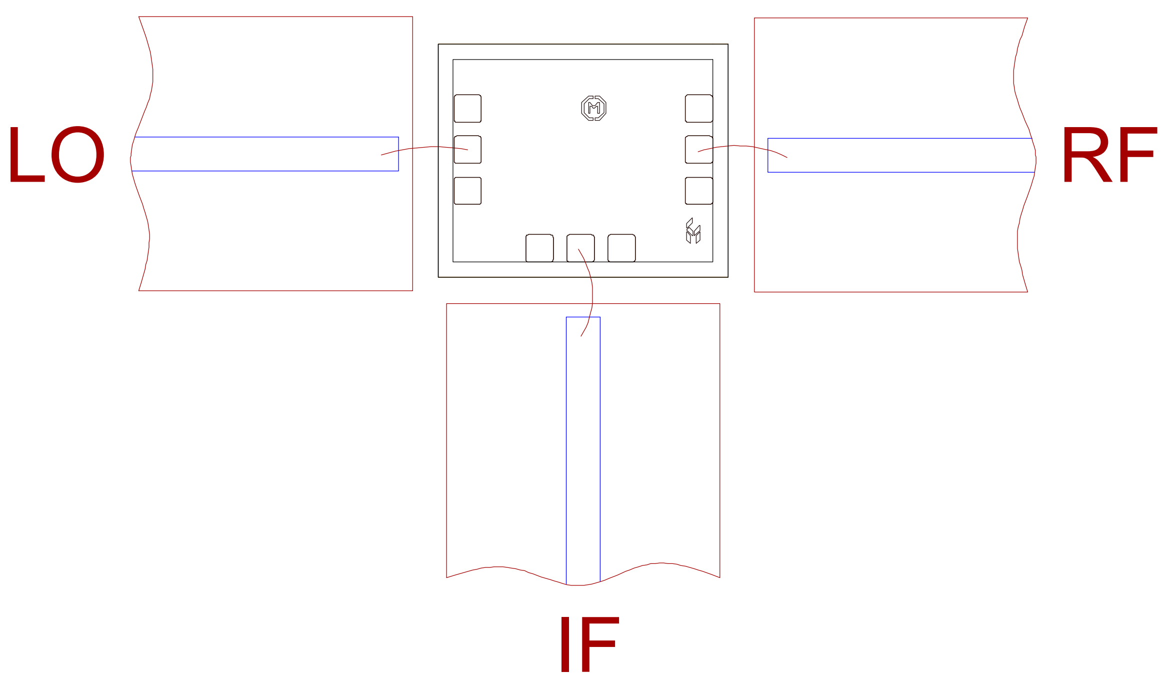
Assembly Guidelines

The backside of the CMD261 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD303

13-21 GHz Sub-harmonic ×2 Mixer

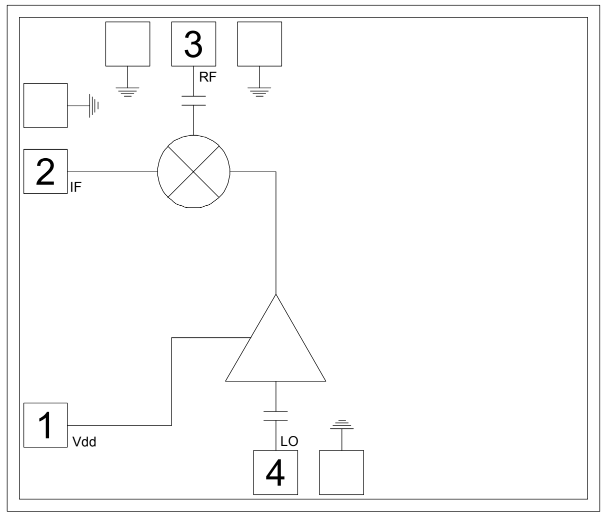
Features

- ► Integrated LO amplifier
- ► High isolations
- ► Sub-harmonic ×2 LO
- ► Single positive supply voltage
- ► HMC258 replacement

Description

The CMD303 is a sub-harmonically pumped mixer die with an integrated LO amplifier which can be used as an upconverter or downconverter. The device has low conversion loss and excellent 2LO to RF isolation eliminating the need for additional filtering. The CMD303 requires as low as 0 dBm LO drive and operates on a single positive supply voltage. The sub-harmonic design and low LO drive level allows for less stringent oscillator requirements.

Functional Block Diagram



Electrical Performance – V_{dd}=3 V, IF = 100 MHz, LO = +2 dBm, RF = 18 GHz, T_A = 25 °C

Parameter	Min	Typ	Max	Units
Frequency Range, RF		13 – 21		GHz
Frequency Range, LO		6.5 – 10.5		GHz
Frequency Range, IF	DC		3	GHz
Conversion Loss		8.5		dB
Noise Figure (SSB)		8.5		dB
2LO to RF Isolation		28		dB
2LO to IF Isolation		48		dB
Input IP3		12		dBm
Input P1dB		4		dBm
Supply Current	22	32	42	mA

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz USB

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CMD303

13-21 GHz Sub-harmonic ×2 Mixer

Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+13 dBm
LO Drive	+13 dBm
Drain Voltage, Vdd	5.5 V
Channel Temperature, Tch	150 ºC
Power Dissipation, Pdiss	0.67 W
Thermal Resistance, Θ_{JC}	97.2 ºC /W
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 to 150 °C

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Vdd	2	3	5	V
Idd		32		mA

Electrical performance is measured at specific test conditions. Electrical specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications – Vdd = 3 V, IF = 100 MHz, LO = +2 dBm, T_A = 25 ºC

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF		13 - 17			17 - 21		GHz
Frequency Range, LO		6.5 - 8.5			8.5 - 10.5		GHz
Frequency Range, IF		DC - 3			DC - 3		GHz
Conversion Loss		8.5	12		9	12.5	dB
Noise Figure (SSB)		8.5	12		9	12.5	dB
2LO to RF Isolation	17	24		22	28		dB
2LO to IF Isolation	36	43		42	50		dB
Input IP3		13			9		dBm
Input P1dB		3			3		dBm
Supply Current	22	32	42	22	32	42	mA

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz USB

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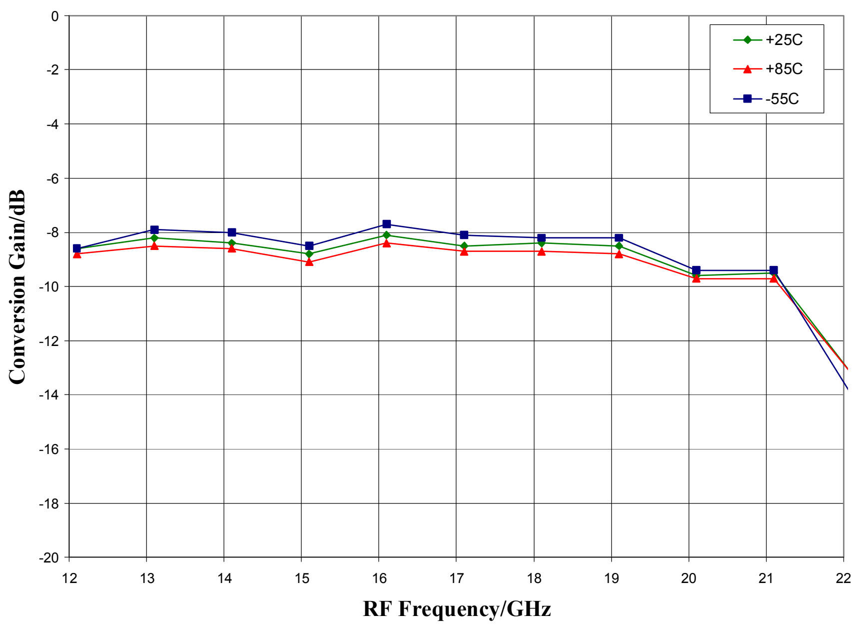
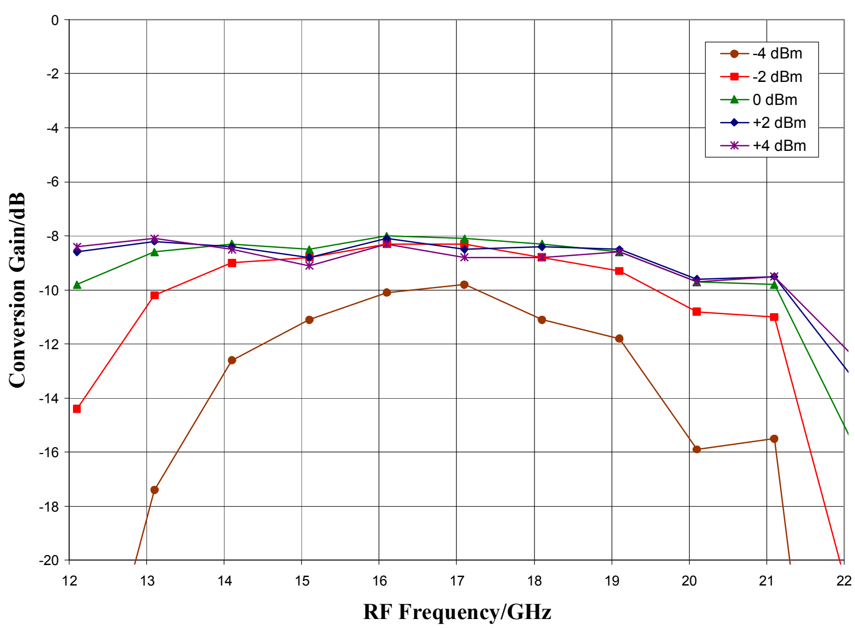
Typical Performance

Conversion Gain vs. Temperature, LO = +2 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB, $T_A = 25$ °C



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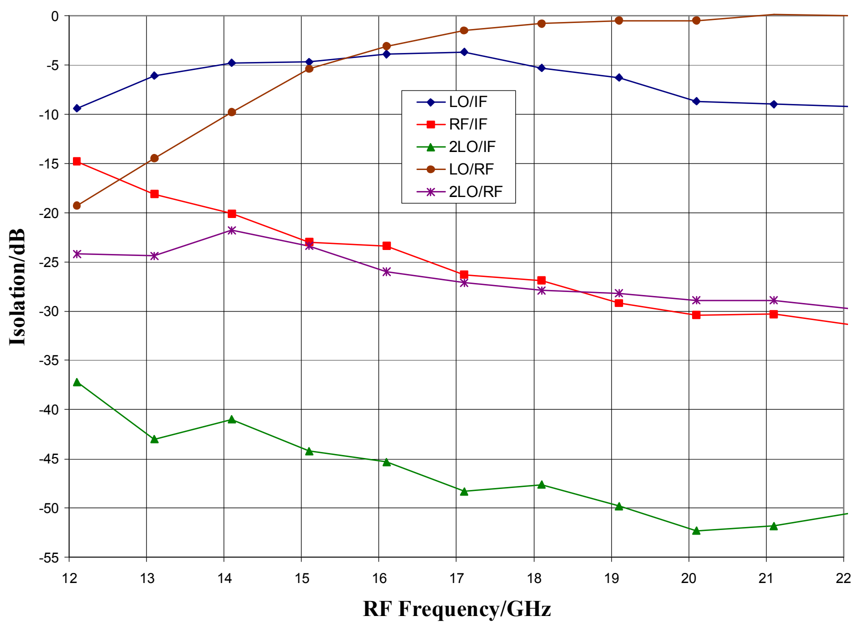
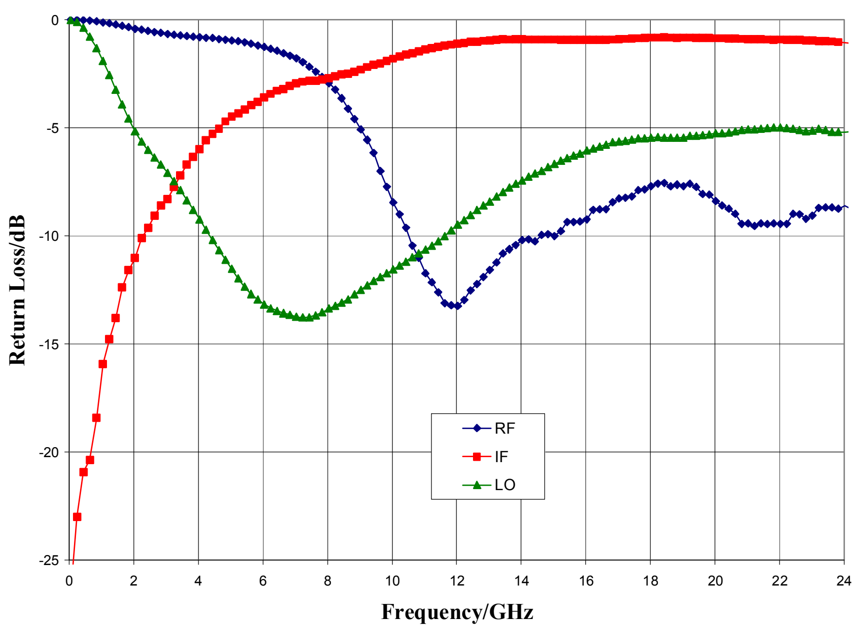
Typical Performance

Isolations, LO = +2 dBm, T_A = 25 °C



Return Loss, LO = + 2 dBm, T_A = 25 °C



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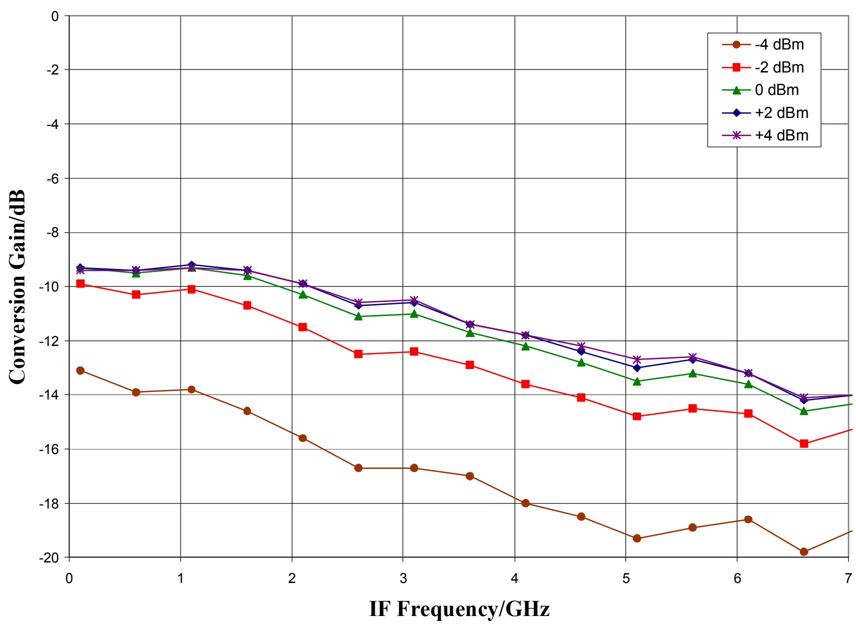
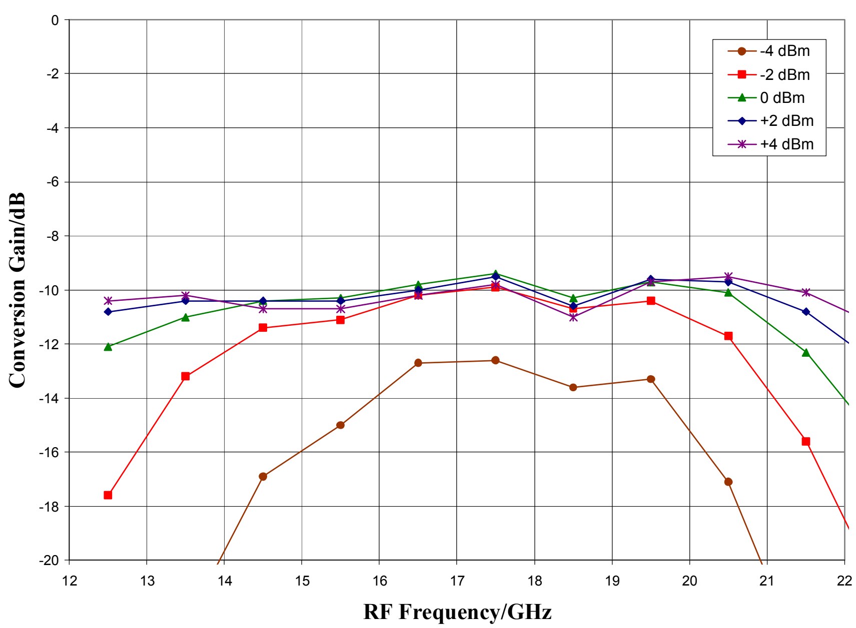
Typical Performance

IF Bandwidth, LO = +2 dBm, T_A = 25 °C



Upconverter Performance, Conversion Gain vs. LO Drive, T_A = 25 °C



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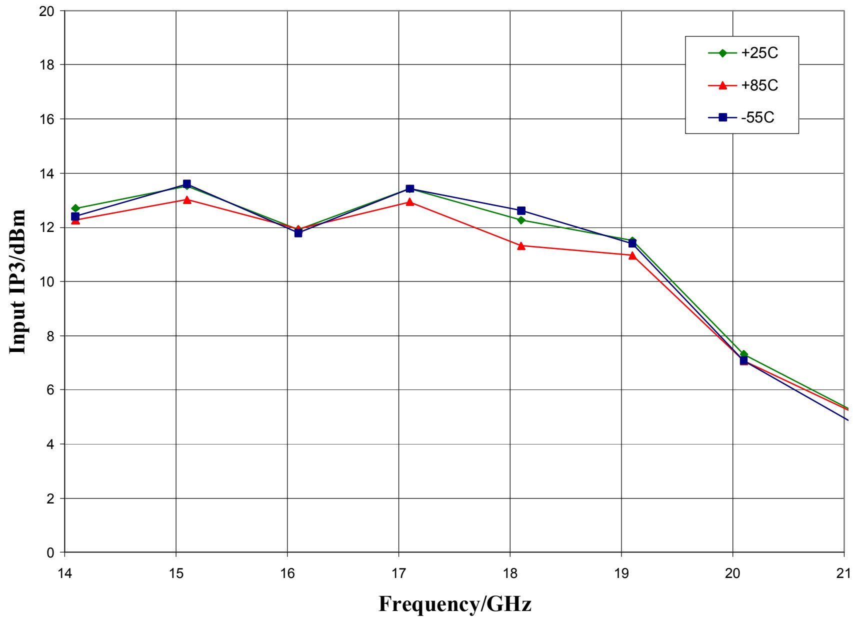
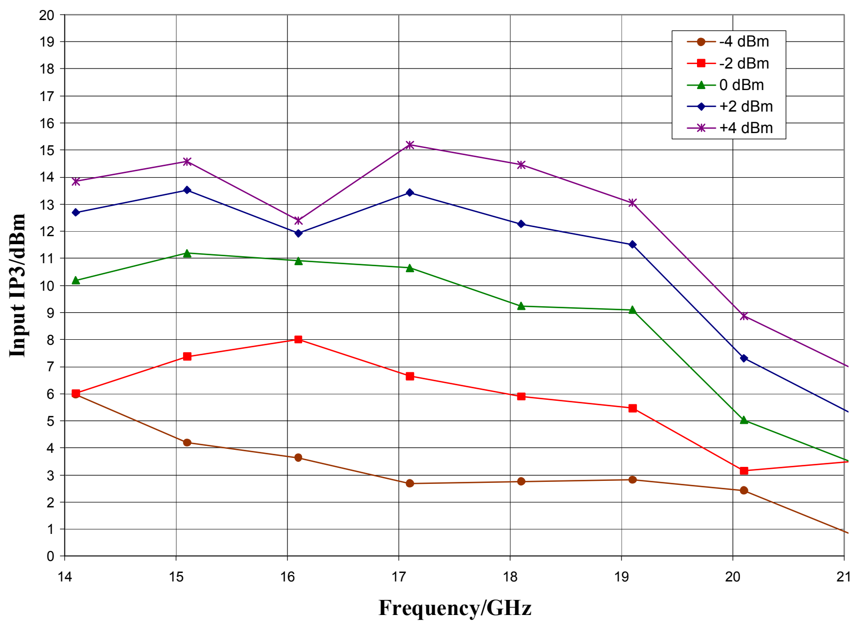
Typical Performance

Input IP3 vs. Temperature, LO = +2 dBm



Input IP3 vs. LO Drive, $T_A = 25$ °C



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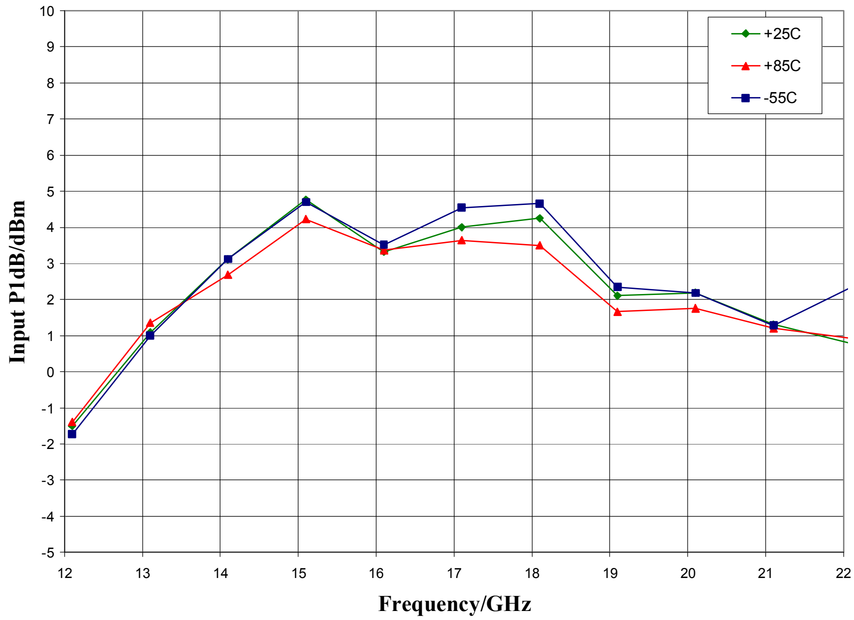
CMD303

13-21 GHz Sub-harmonic ×2 Mixer

Typical Performance

Input P1dB vs. Temperature, LO = +2 dBm



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Typical Performance

M x N Spur Table

	nLO				
mRF	0	1	2	3	4
0	X	-9	38	31	61
1	18	31	0	35	41
2	76	60	60	32	45
3	76	76	76	76	68
4	-14	76	76	76	76

RF = 18 GHz @ -10 dBm
LO = 8.55 GHz @ 0 dBm
All values in dBc below the IF output power level (1RF - 2LO)

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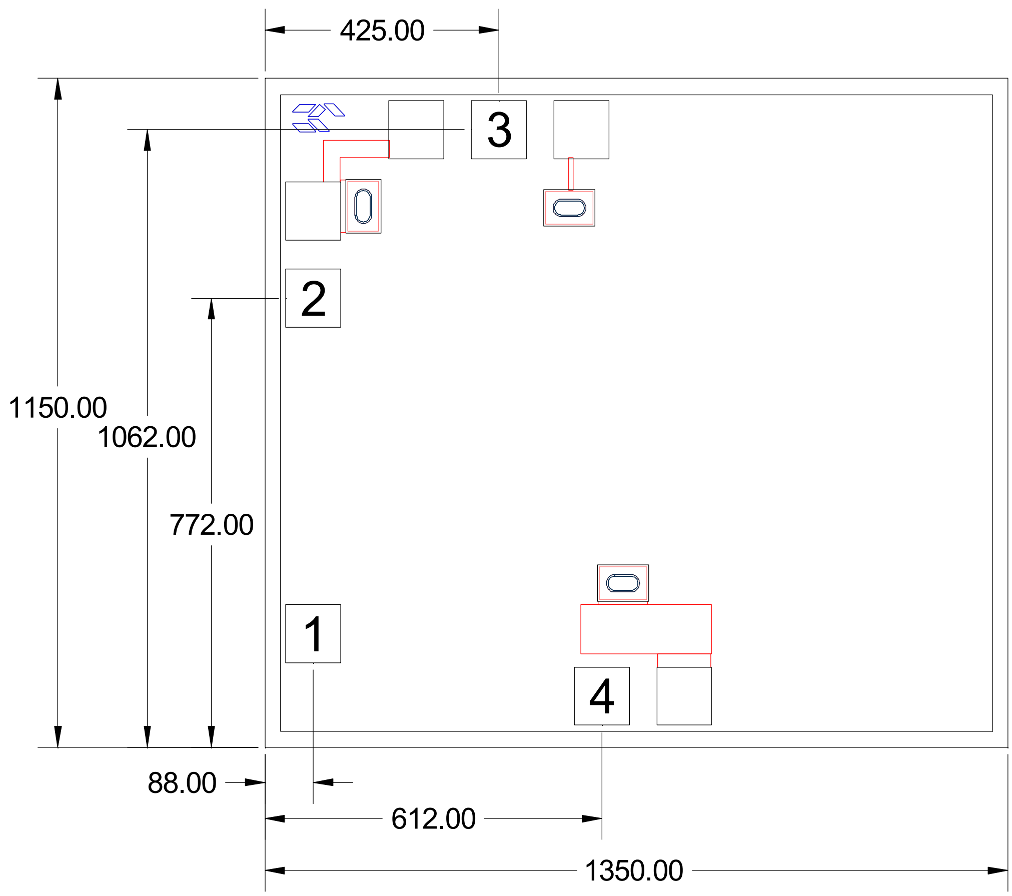
Mechanical Information

Die Outline (all dimensions in microns)



Notes:
1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 100 microns thick
5. All bond pads are 100 x 100 microns square

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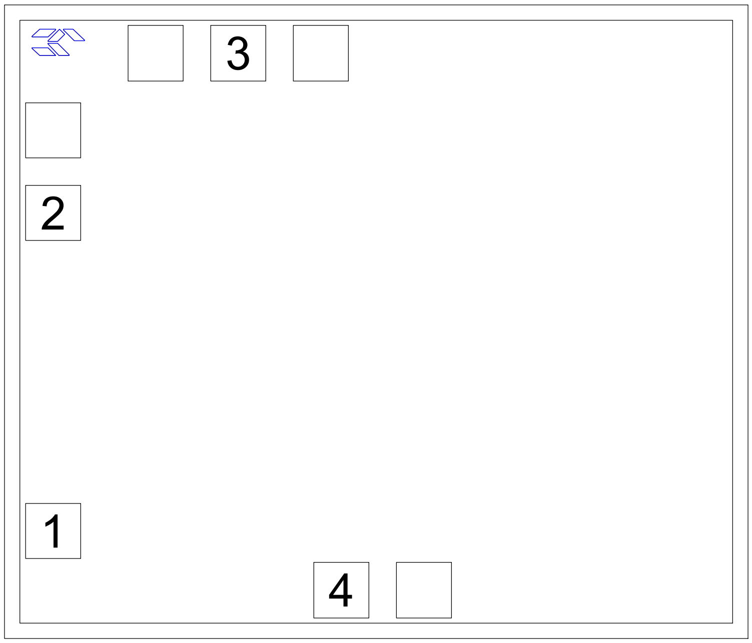
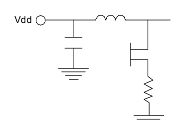
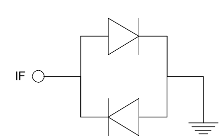
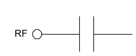
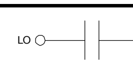
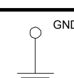
Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	Vdd	Power supply voltage Decoupling and bypass caps required	
2	IF	This pin is DC coupled and should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency. Any applied DC voltage to this pin will result in die non-function and possible die failure	
3	RF	DC blocked and 50 Ohm matched	
4	LO	DC blocked and 50 Ohm matched	
Backside	Ground	Connect to RF / DC ground.	

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Applications Information

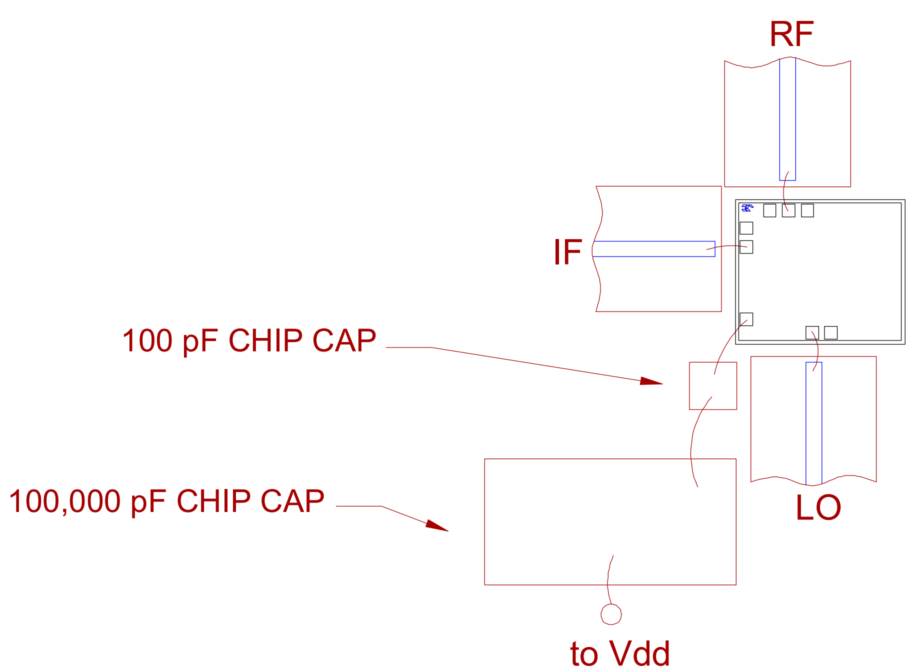
Assembly Guidelines

The backside of the CMD303 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD303C3

13-21 GHz Sub-harmonic ×2 Mixer

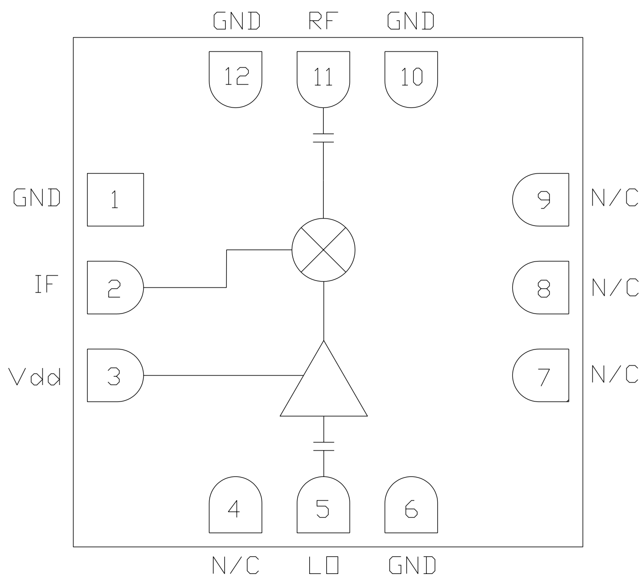
Features

- ► Integrated LO amplifier
- ► High isolations
- ► Sub-harmonic ×2 LO
- ► Single positive supply voltage
- ► HMC258LC3B replacement

Description

The CMD303C3 is a sub-harmonically pumped mixer with an integrated LO amplifier housed in a leadless 3x3 mm surface mount QFN package. The CMD303C3 can be used as an upconverter or downconverter. The device has low conversion loss and excellent 2LO to RF isolation eliminating the need for additional filtering. The CMD303C3 requires as low as 0 dBm LO drive and operates on a single positive supply voltage. The sub-harmonic design and low LO drive level allows for less stringent oscillator requirements.

Functional Block Diagram



Electrical Performance – V_{dd}=3 V, IF = 100 MHz, LO = +2 dBm, RF = 18 GHz, T_A = 25 °C

Parameter	Min	Typ	Max	Units
Frequency Range, RF		13 – 21		GHz
Frequency Range, LO		6.5 – 10.5		GHz
Frequency Range, IF	DC		4	GHz
Conversion Loss		10		dB
Noise Figure (SSB)		10		dB
2LO to RF Isolation		22		dB
2LO to IF Isolation		43		dB
Input IP3		13		dBm
Input P1dB		4		dBm
Supply Current	22	32	42	mA

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz USB

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+13 dBm
LO Drive	+8 dBm
Drain Voltage, Vdd	5.5 V
Channel Temperature, Tch	150 ºC
Power Dissipation, Pdiss	0.67 W
Thermal Resistance, Q $_{JC}$	97.2 ºC /W
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Vdd	2	3	5	V
Idd		32		mA

Electrical performance is measured at specific test conditions. Electrical specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications – Vdd = 3 V, IF = 100 MHz, LO = +2 dBm, T_A = 25 ºC

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF	13 - 17			17 - 21			GHz
Frequency Range, LO	6.5 - 8.5			8.5 - 10.5			GHz
Frequency Range, IF	DC - 4			DC - 4			GHz
Conversion Loss		9.5	13		10	13.5	dB
Noise Figure (SSB)		9.5			10		dB
2LO to RF Isolation	14	20		19	22		dB
2LO to IF Isolation	33	43		39	47		dB
Input IP3		13			9		dBm
Input P1dB		3			3		dBm
Supply Current	22	32	42	22	32	42	mA

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz USB

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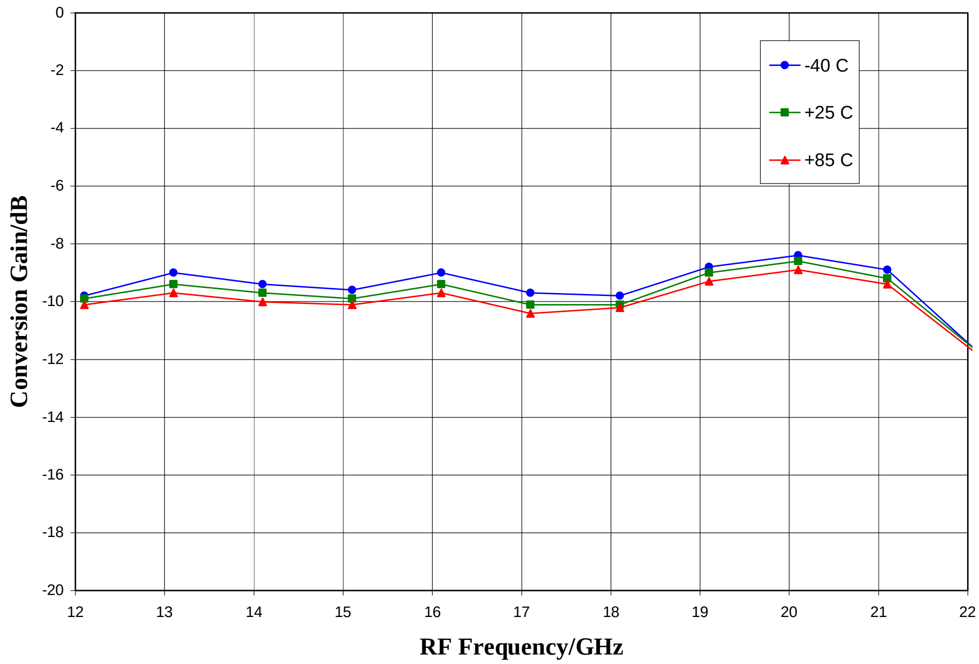
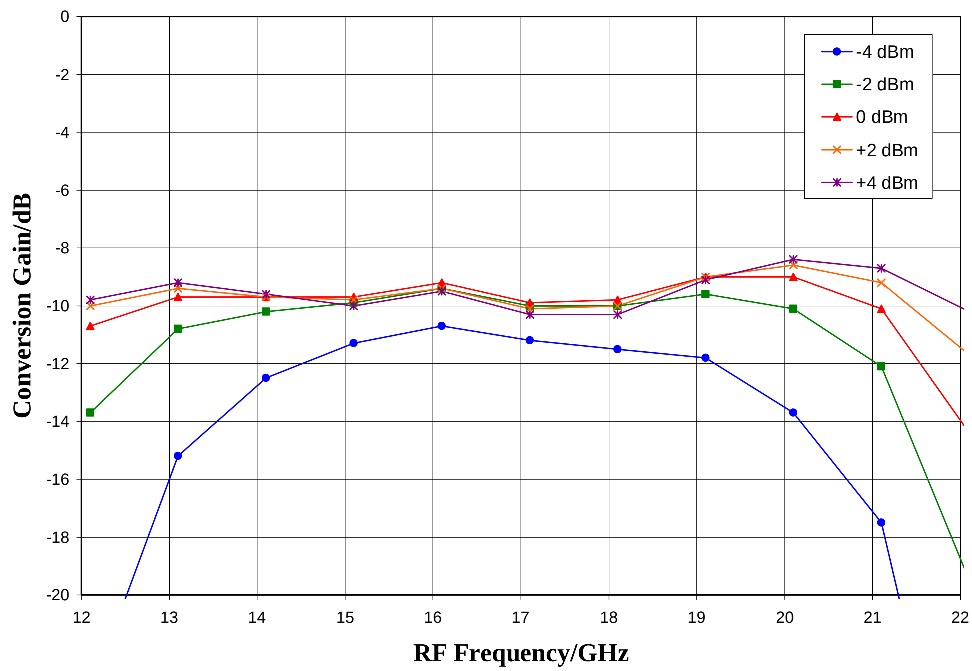
Typical Performance

Conversion Gain vs. Temperature, LO = +2 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB, $T_A = 25$ °C



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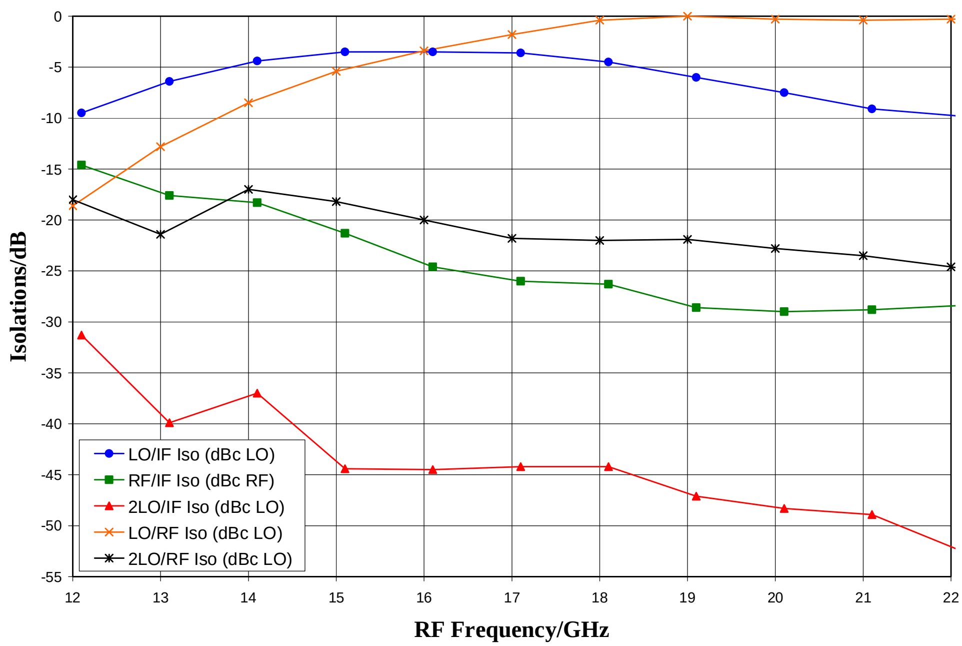
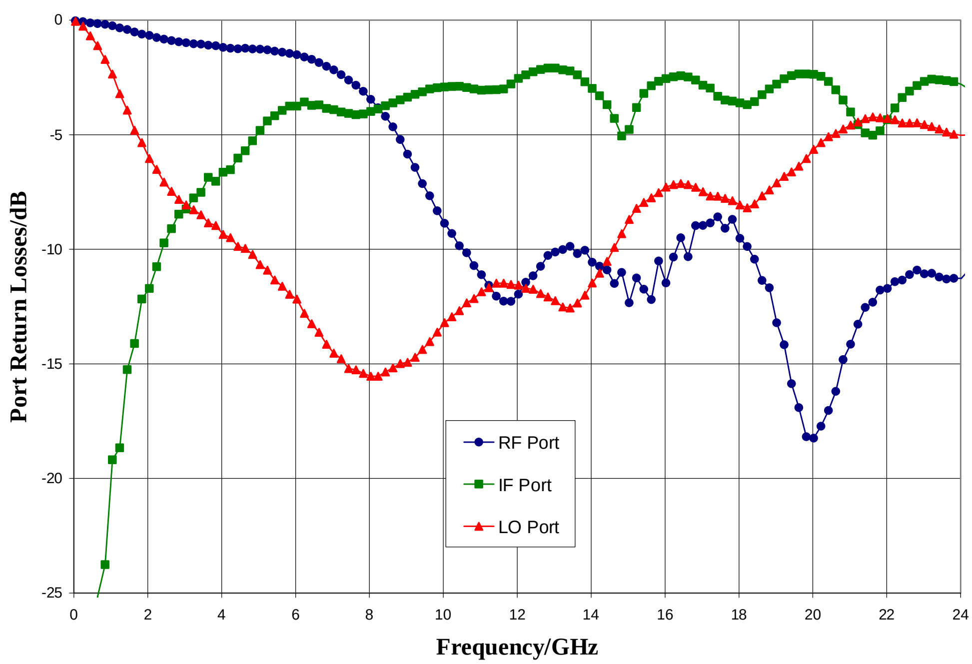
Typical Performance

Isolations, LO = +2 dBm, RF = -10 dBm, T_A = 25 °C



Return Loss, LO = + 2 dBm, T_A = 25 °C



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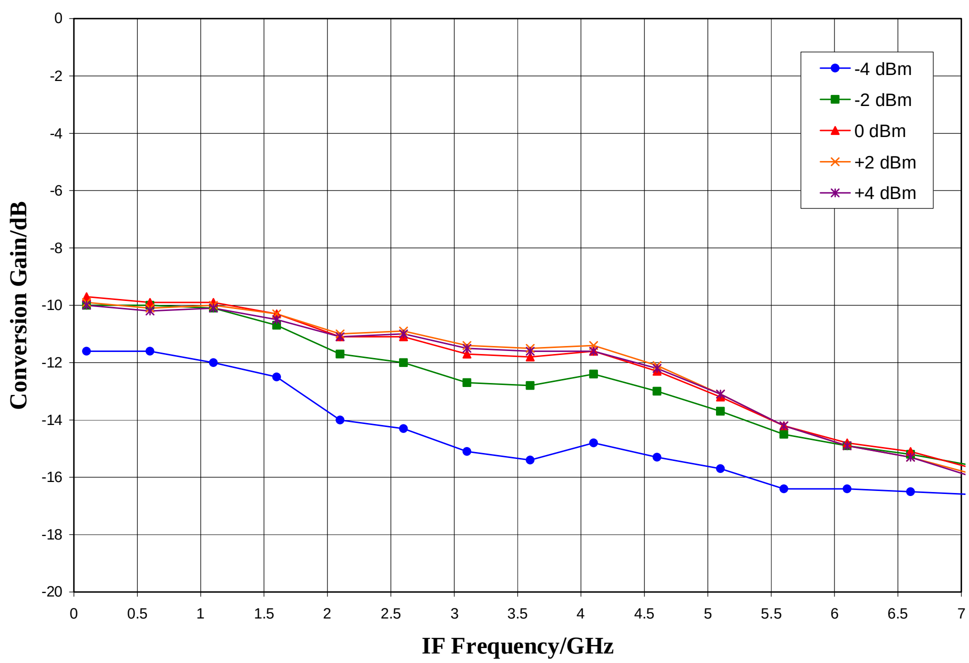
CMD303C3

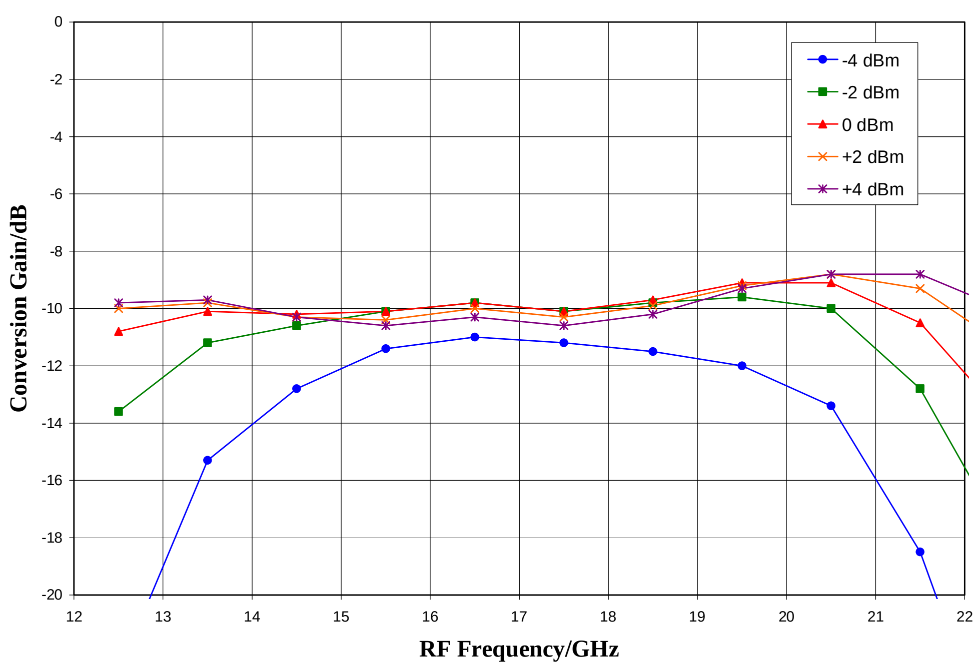
13-21 GHz Sub-harmonic ×2 Mixer

Typical Performance

IF Bandwidth, LO = +2 dBm, T_A = 25 °C



Upconverter Performance, Conversion Gain vs. LO Drive, T_A = 25 °C



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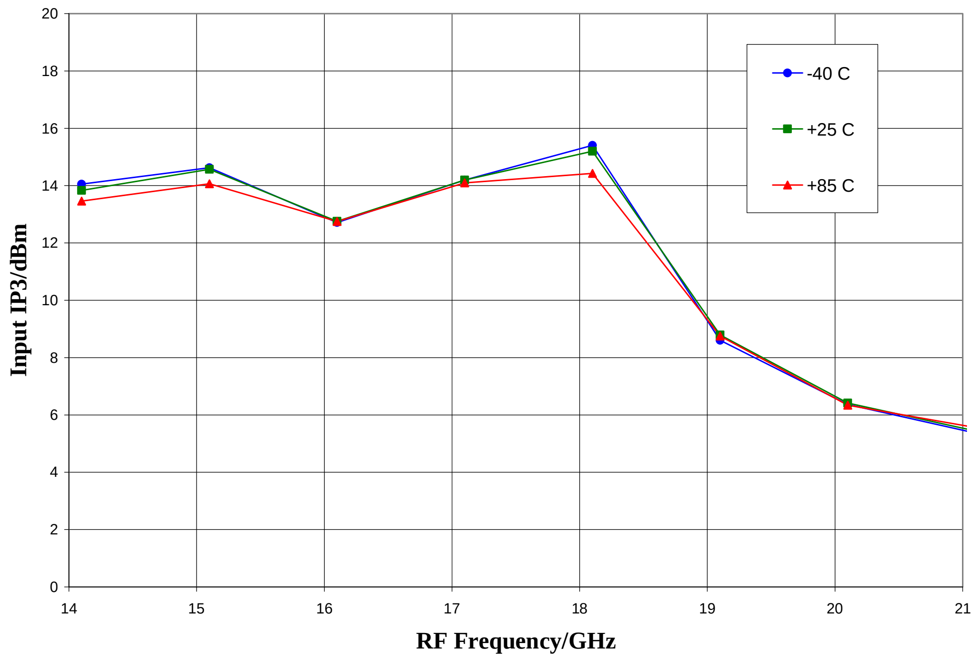
CMD303C3

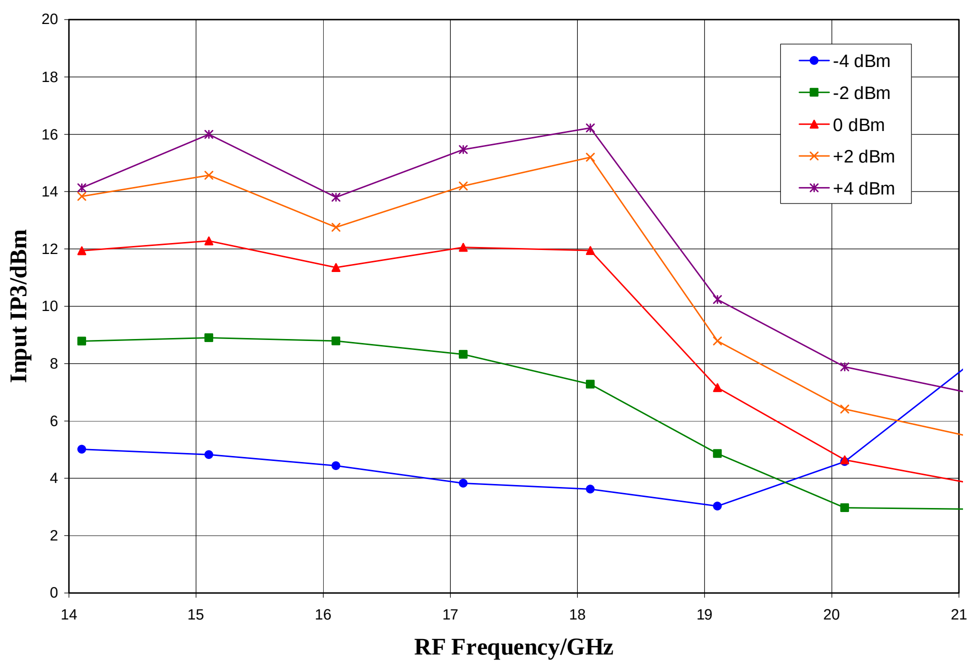
13-21 GHz Sub-harmonic ×2 Mixer

Typical Performance

Input IP3 vs. Temperature, LO = +2 dBm



Input IP3 vs. LO Drive, $T_A = 25$ °C



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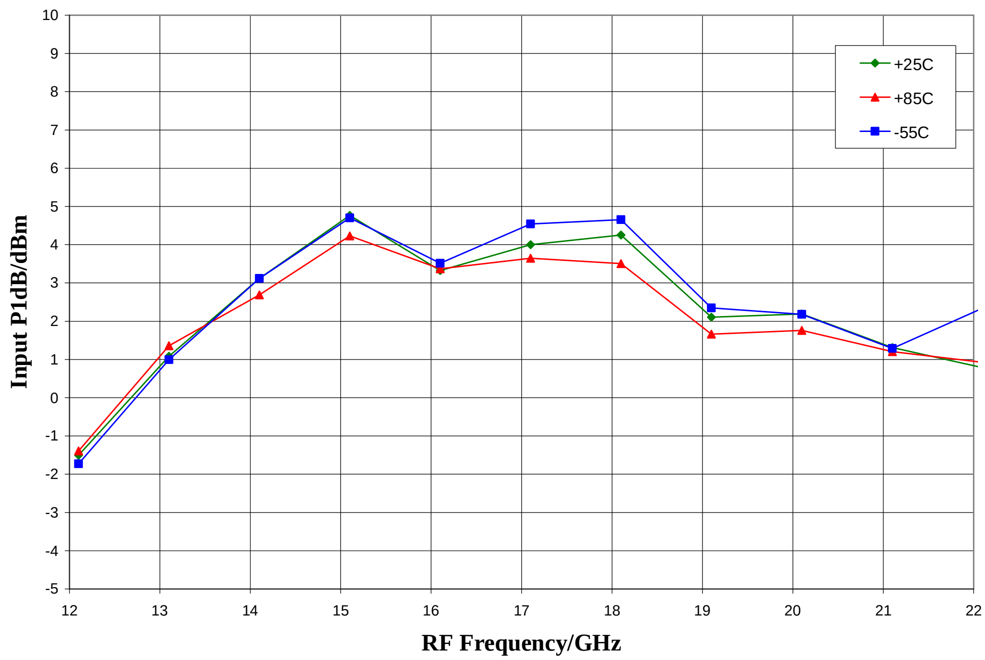
Typical Performance

Input P1dB vs. Temperature, LO = +2 dBm



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Typical Performance

M x N Spur Table

	nLO				
mRF	0	1	2	3	4
0	X	-9	38	31	61
1	18	31	0	35	41
2	76	60	60	32	45
3	76	76	76	76	68
4	-14	76	76	76	76

RF = 18 GHz @ -10 dBm
LO = 8.55 GHz @ 0 dBm
All values in dBc below the IF output power level (1RF - 2LO)

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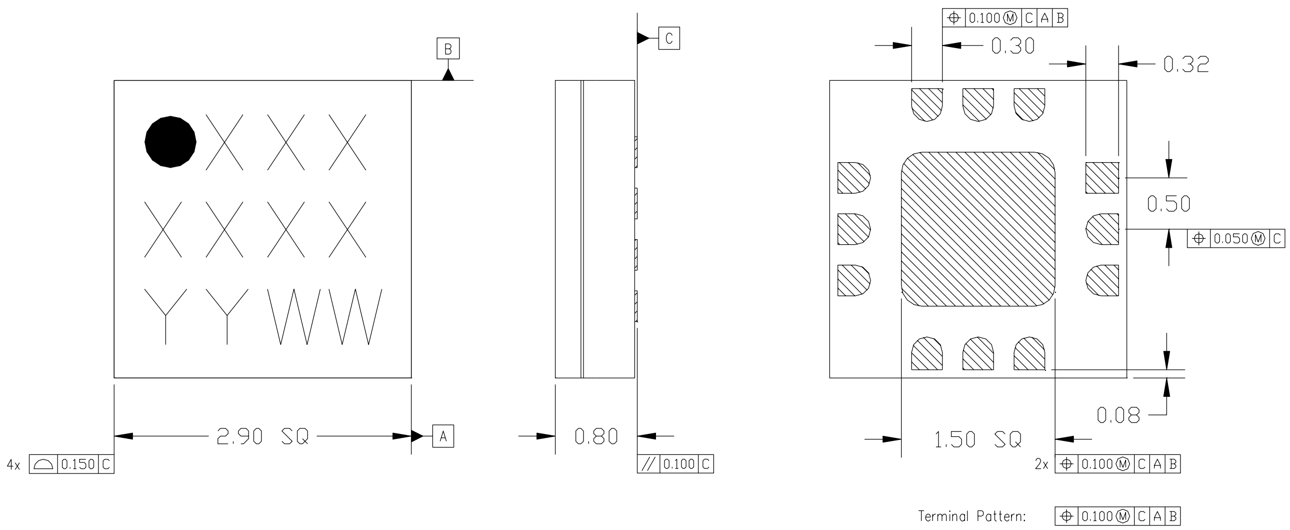
Mechanical Information

Package Information and Dimensions



NOTES:

1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   3.1. Ni: 8.89um MAX, 1.27um MIN
   3.2. Pd: 0.17um MAX, 0.07um MIN
   3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   4.1. LINE 1: PART NUMBER
      4.1.1. EXAMPLE: CMD177C3 SHALL BE MARKED AS 177
   4.2. LINE 2: LOT NUMBER
   4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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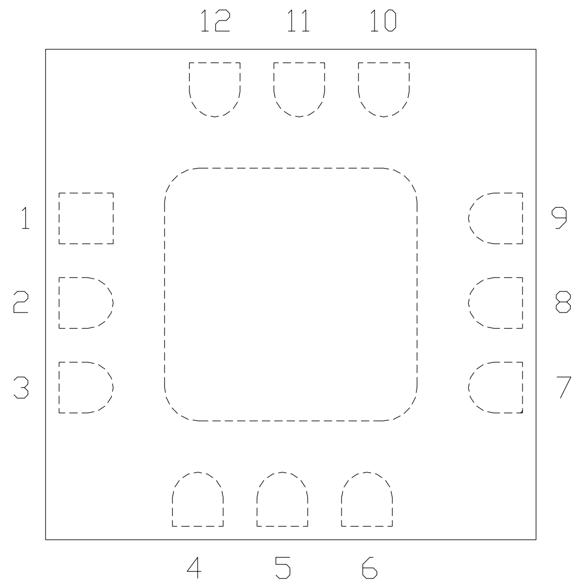
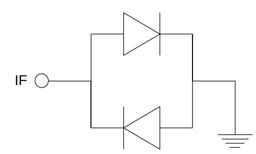
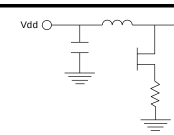
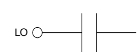
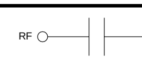
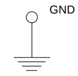
Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
2	IF	This pin is DC coupled and should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency. Any applied DC voltage to this pin will result in die non-function and possible die failure	
3	Vdd	Power supply voltage. Decoupling and bypass caps required	
4, 7-9	N/C	No connection required. These pins may be connected to RF/DC ground	
5	LO	DC blocked and 50 Ohm matched	
11	RF	DC blocked and 50 Ohm matched	
1, 6, 10, 12 and die paddle	Ground	Connect to RF / DC ground.	

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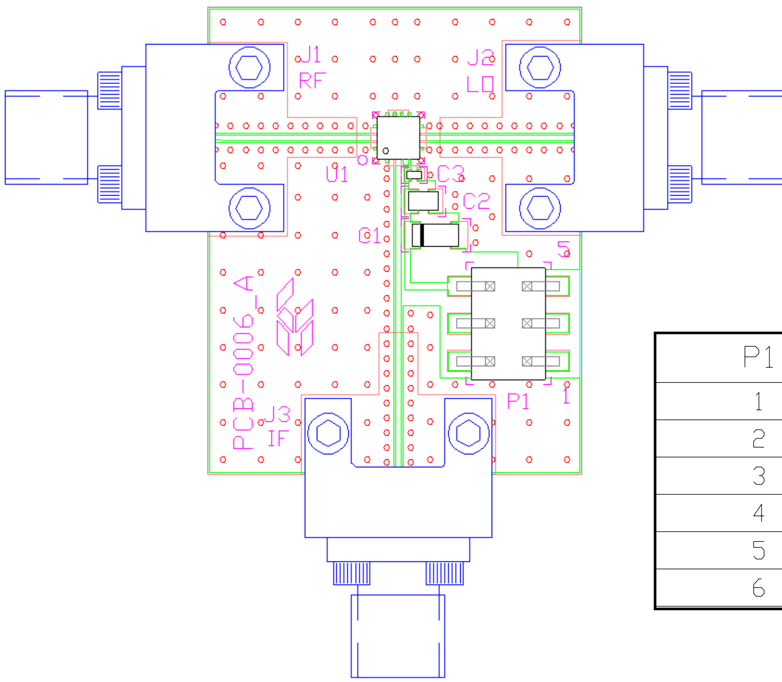
Applications Information

Evaluation Board

The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



P1	DESCRIPTION
1	GND
2	N/C
3	N/C
4	N/C
5	GND
6	Vdd

Designator	Value	Description
J1 - J3		2.92 mm End Launch Connector
P1		6 Pin Header
C1	0.33 µF	Capacitor, Tantalum
C2	1000 pF	Capacitor, 0603
C3	100 pF	Capacitor, 0402
U1		CMD303C3 Sub-harmonic x2 Mixer
PCB		DRAW-PCB-0006 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD310

20-32 GHz Sub-harmonic ×2 Mixer

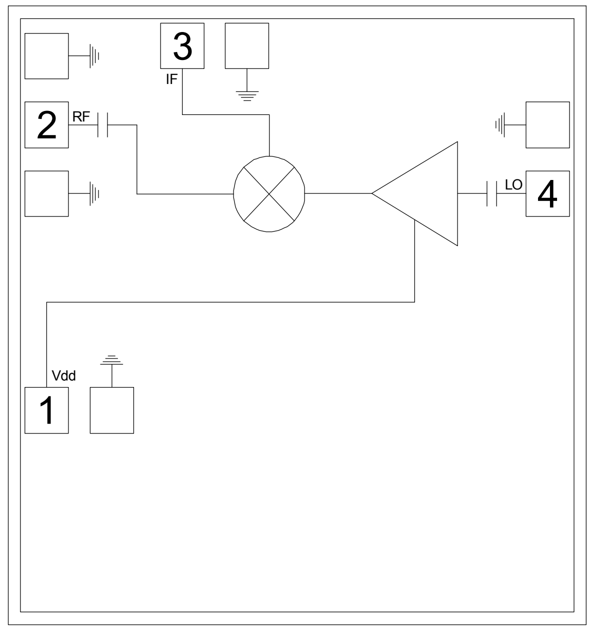
Features

- ► Integrated LO amplifier
- ► High isolations
- ► Sub-harmonic ×2 LO
- ► Single positive supply voltage
- ► HMC264 replacement

Description

The CMD310 is a sub-harmonically pumped mixer die with an integrated LO amplifier which can be used as an upconverter or downconverter. The device has low conversion loss and excellent 2LO to RF isolation eliminating the need for additional filtering. The CMD310 requires only -4 dBm LO drive and operates on a single positive supply voltage. The sub-harmonic design and low LO drive level allows for less stringent oscillator requirements.

Functional Block Diagram



Electrical Performance – V_{dd}=4 V, IF = 100 MHz, LO = -4 dBm, RF = 26 GHz, T_A = 25 °C

Parameter	Min	Typ	Max	Units
Frequency Range, RF		20 – 32		GHz
Frequency Range, LO		10 – 16		GHz
Frequency Range, IF	DC		7	GHz
Conversion Loss		9.5		dB
Noise Figure (SSB)		9.5		dB
2LO to RF Isolation		36		dB
2LO to IF Isolation		53		dB
Input IP3		10		dBm
Input P1dB		4.5		dBm
Supply Current	19	27	35	mA

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz USB

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CMD310

20-32 GHz Sub-harmonic ×2 Mixer

Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+13 dBm
LO Drive	+13 dBm
Drain Voltage, Vdd	5.5 V
Channel Temperature, Tch	150 ºC
Power Dissipation, Pdiss	0.33 W
Thermal Resistance, Θ_{JC}	199.4 ºC/W
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 to 150 °C

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Vdd	2	4	5	V
Idd		27		mA

Electrical performance is measured at specific test conditions. Electrical specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications – Vdd = 4 V, IF = 100 MHz, LO = -4 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF		20 - 26			26 - 32		GHz
Frequency Range, LO		10 - 13			13 - 16		GHz
Frequency Range, IF		DC - 7			DC - 7		GHz
Conversion Loss		9.5	12.5		10	13	dB
Noise Figure (SSB)		9.5	12.5		10	13	dB
2LO to RF Isolation	25	34		30	40		dB
2LO to IF Isolation	41	52		47	55		dB
Input IP3		8			10		dBm
Input P1dB		3			5		dBm
Supply Current	19	27	35	19	27	35	mA

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz USB

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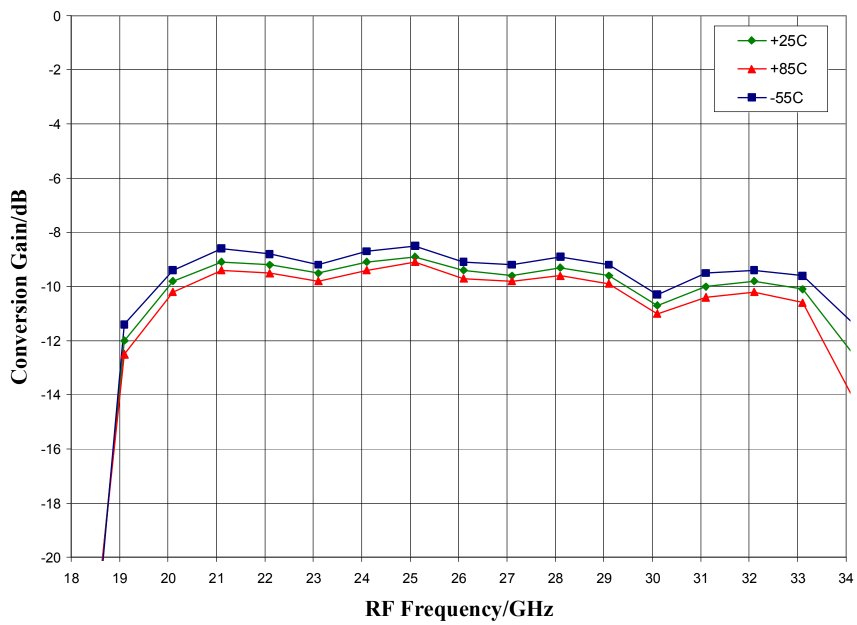
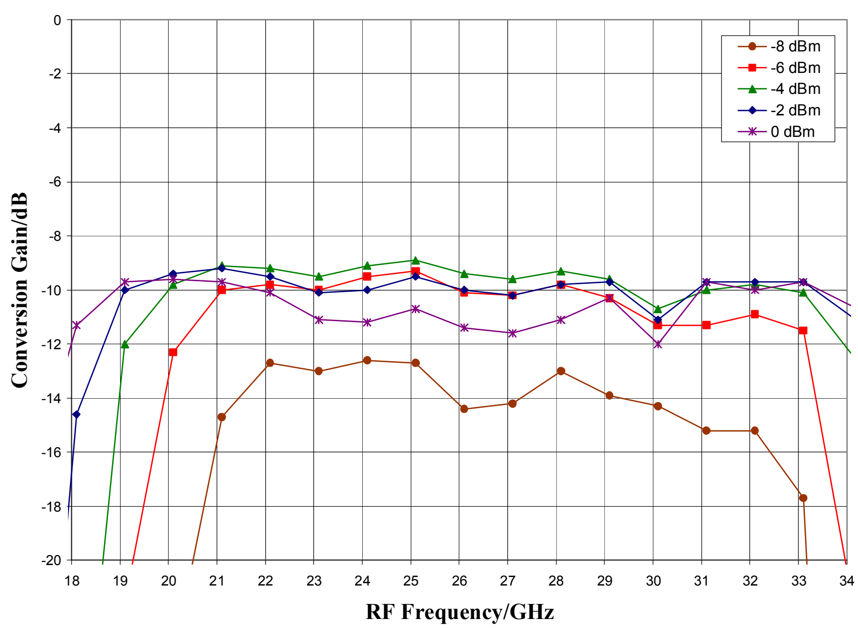
Typical Performance

Conversion Gain vs. Temperature, LO = -4 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB, T_A = 25 °C



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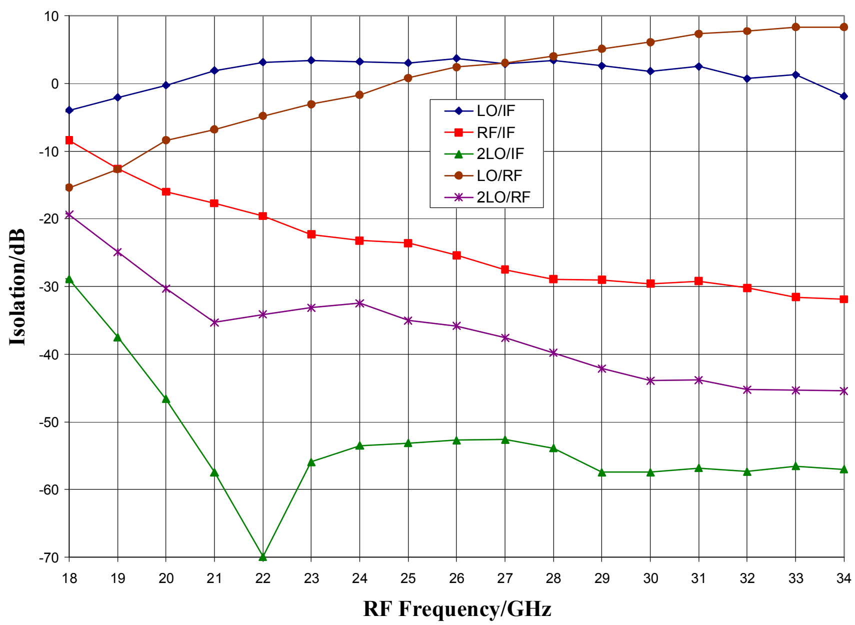
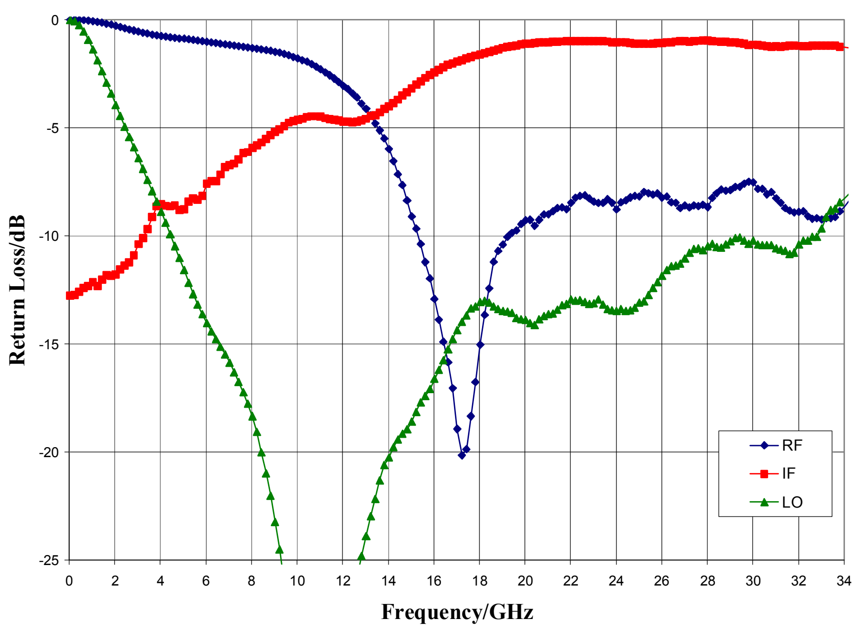
Typical Performance

Isolations, LO = -4 dBm, T_A = 25 °C



Return Loss, LO = -4 dBm, T_A = 25 °C



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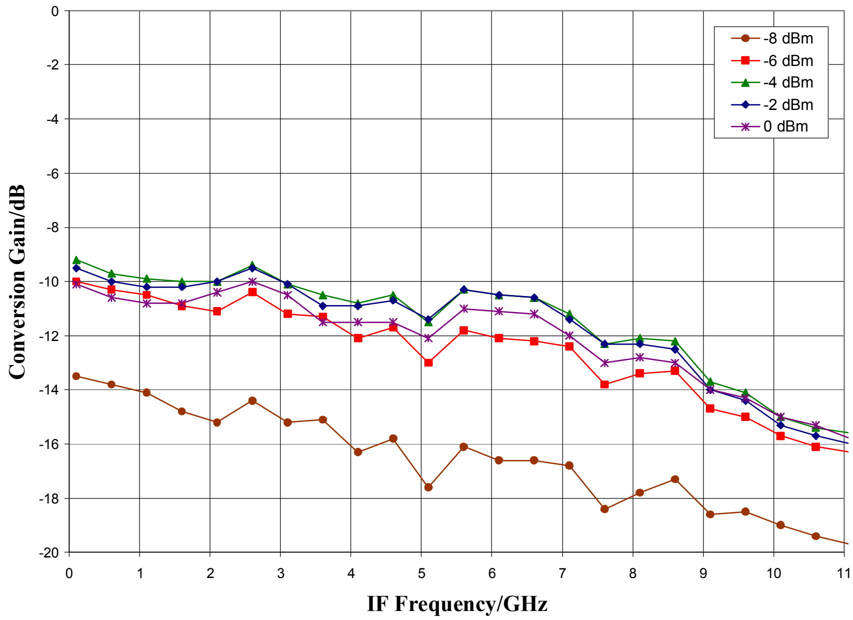
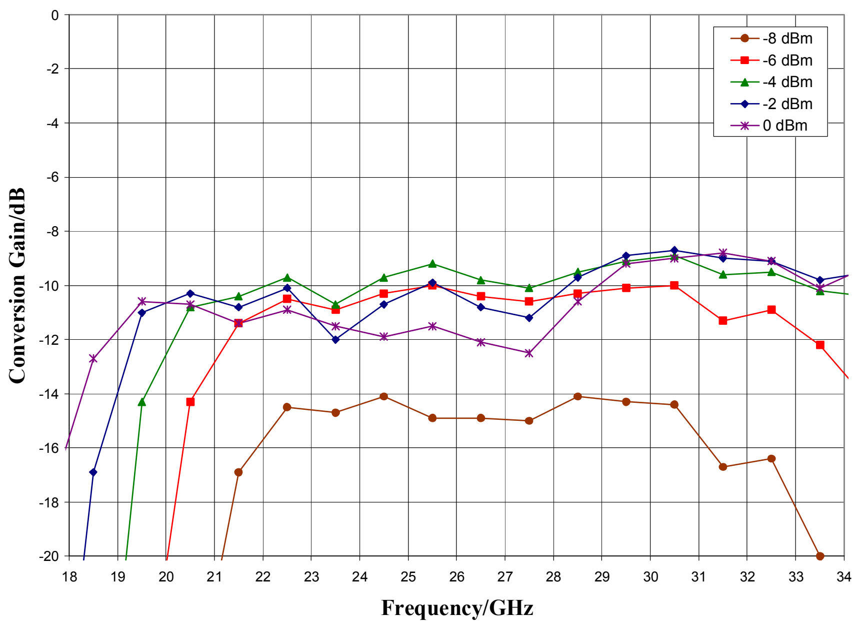
Typical Performance

IF Bandwidth, LO = -4 dBm, T_A = 25 °C



Upconverter Performance, Conversion Gain vs. LO Drive, T_A = 25 °C



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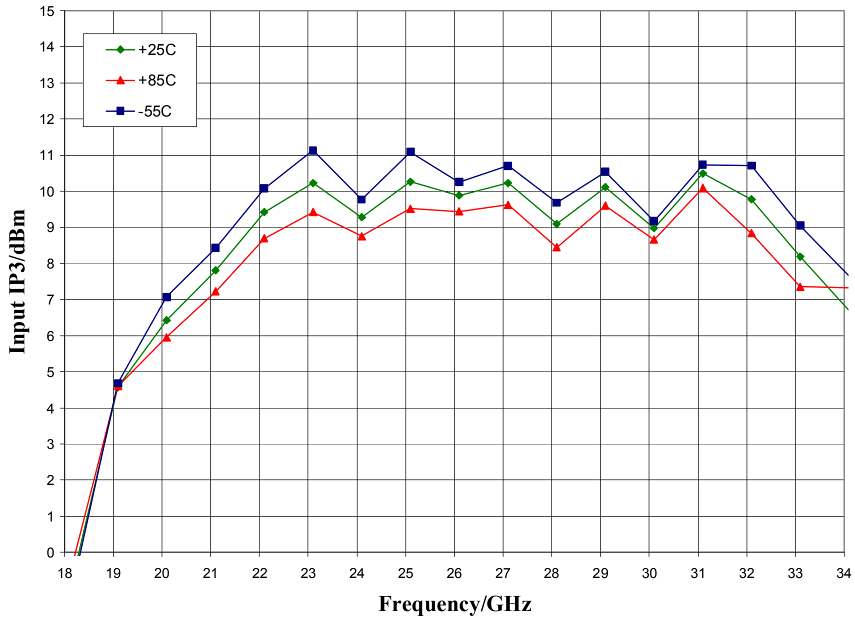
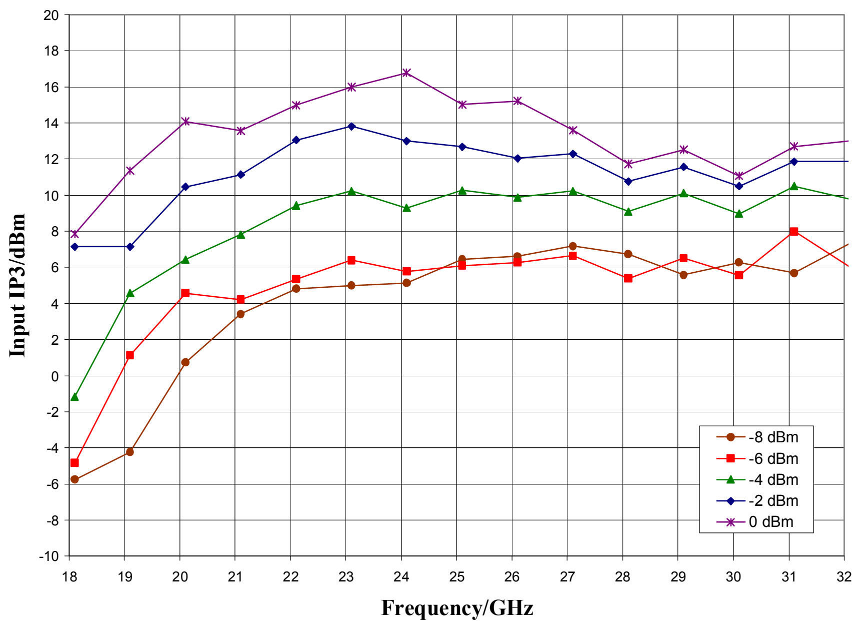
Typical Performance

Input IP3 vs. Temperature, LO = -4 dBm



Input IP3 vs. LO Drive, T_A = 25 °C



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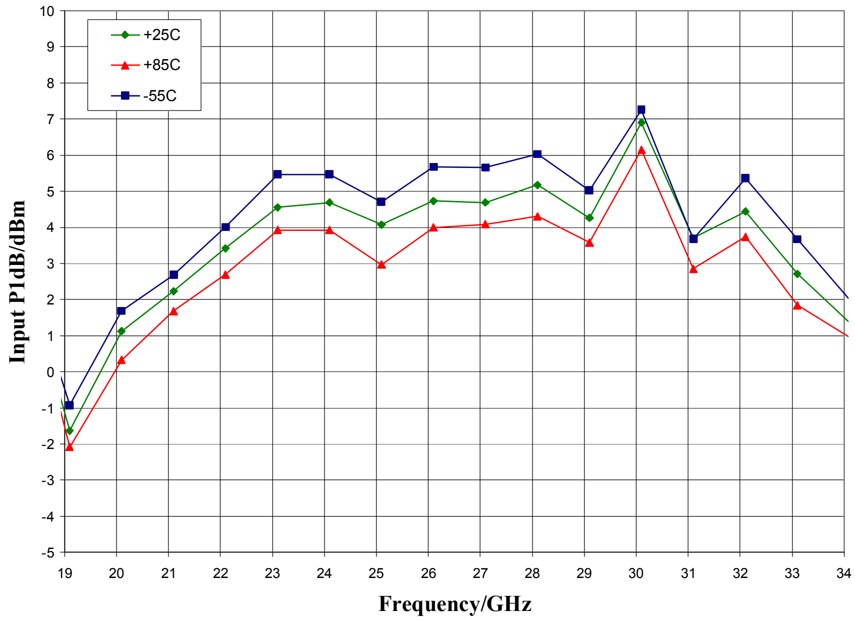
Typical Performance

Input P1dB vs. Temperature, LO = -4 dBm, T_A = 25 °C



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Typical Performance

M x N Spur Table

	nLO				
mRF	0	1	2	3	4
0	X	-16	43	29	55
1	21	53	0	55	50
2	71	63	71	44	58
3			71	71	71
4					71

RF = 30 GHz @ -10 dBm
LO = 13.6 GHz @ -4 dBm
All values in dBc below the IF output power level (1RF - 2LO)

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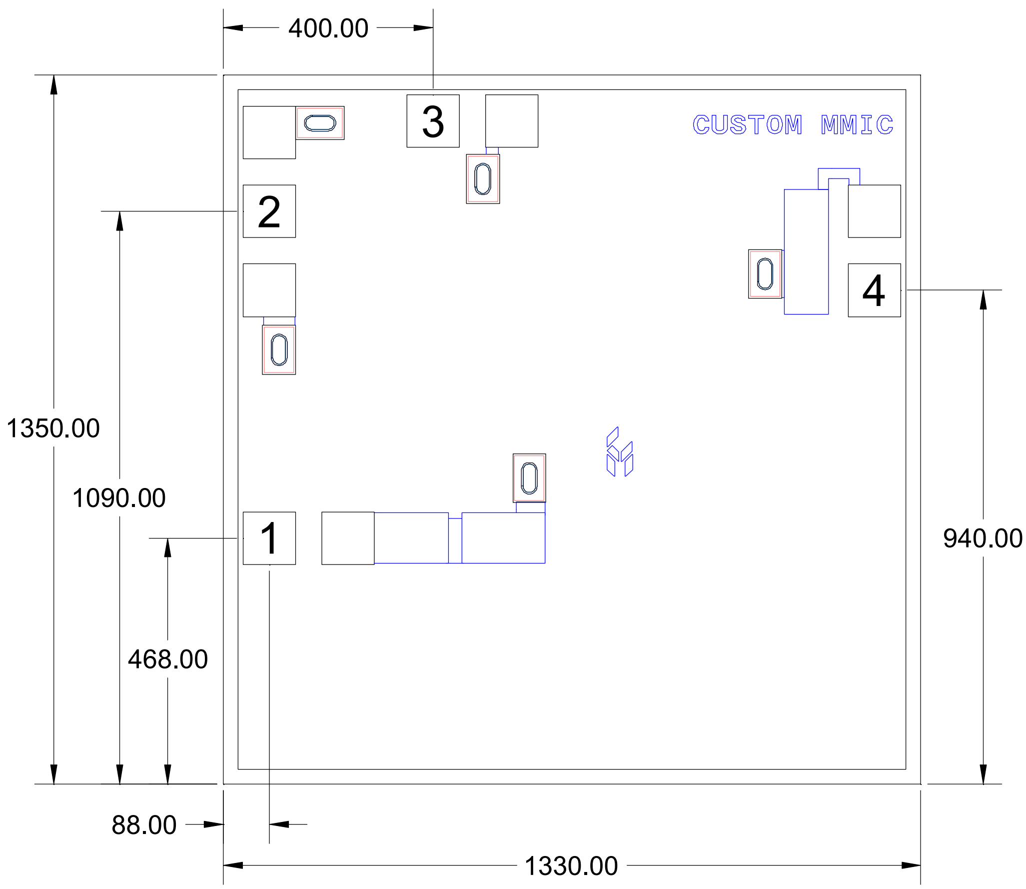
CMD310

20-32 GHz Sub-harmonic ×2 Mixer

Mechanical Information

Die Outline (all dimensions in microns)



Notes:

1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 100 microns thick
5. All bond pads are 100 x 100 microns square

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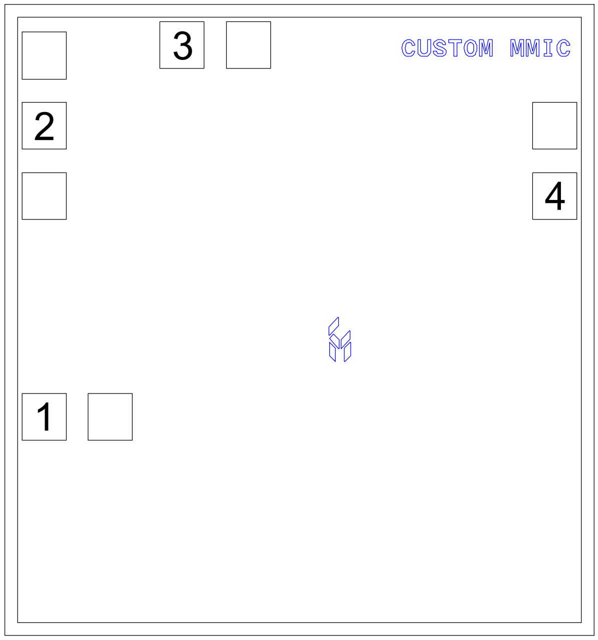
CMD310

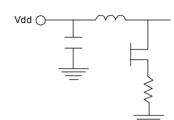
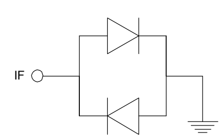
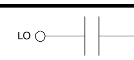
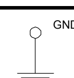
20-32 GHz Sub-harmonic ×2 Mixer

Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	Vdd	Power supply voltage Decoupling and bypass caps required	
2	RF	DC blocked and 50 Ohm matched	
3	IF	This pin is DC coupled and should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency. Any applied DC voltage to this pin will result in die non-function and possible die failure	
4	LO	DC blocked and 50 Ohm matched	
Backside	Ground	Connect to RF / DC ground.	

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Applications Information

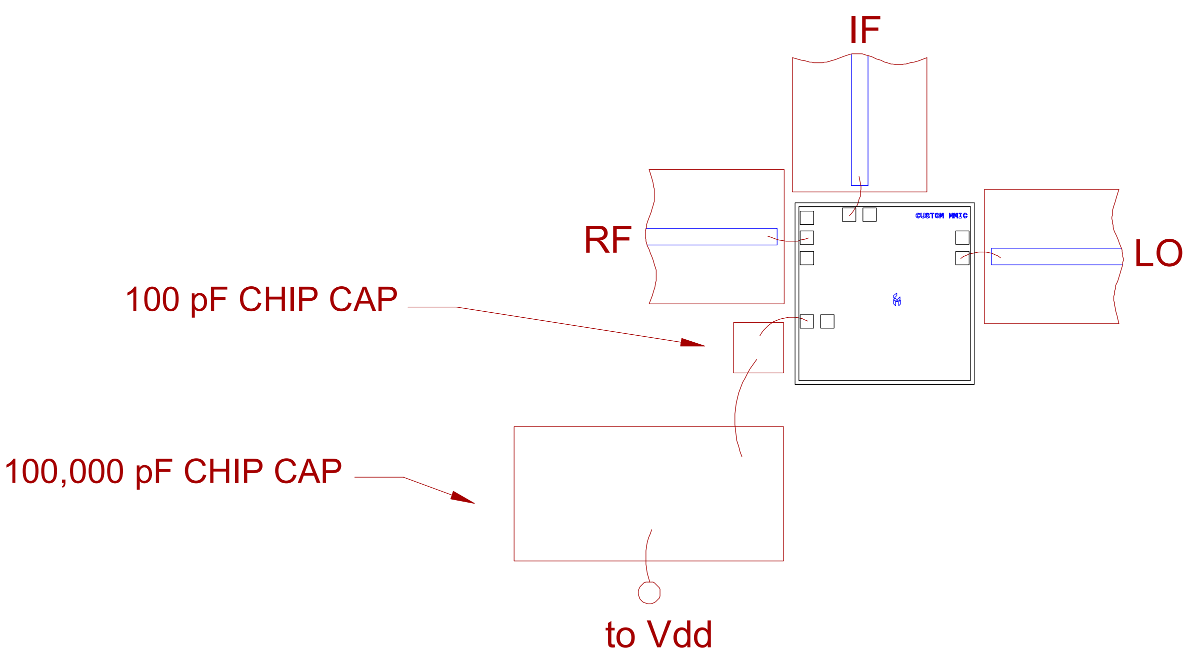
Assembly Guidelines

The backside of the CMD310 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD310C3

20-32 GHz Sub-harmonic ×2 Mixer

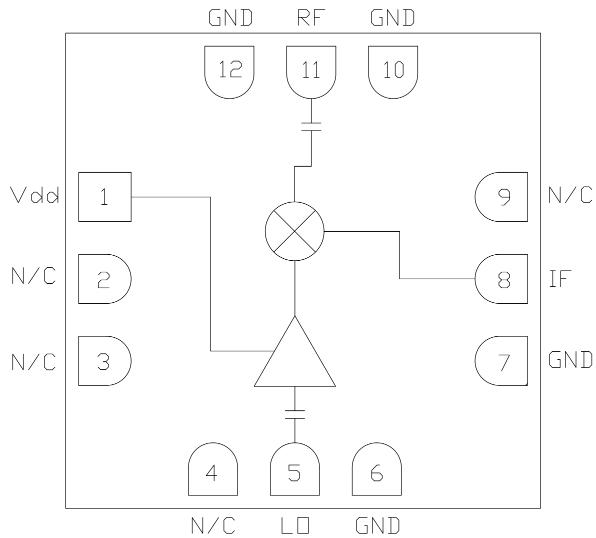
Features

- ► Integrated LO amplifier
- ► High isolations
- ► Sub-harmonic ×2 LO
- ► Single positive supply voltage
- ► HMC264LC3B replacement

Description

The CMD310C3 is a sub-harmonically pumped mixer die with an integrated LO amplifier housed in a leadless 3x3 mm surface mount QFN package. The CMD310C3 can be used as an upconverter or downconverter. The device has low conversion loss and excellent 2LO to RF isolation eliminating the need for additional filtering. The CMD310C3 requires only –2 dBm LO drive and operates on a single positive supply voltage. The sub-harmonic design and low LO drive level allows for less stringent oscillator requirements.

Functional Block Diagram



Electrical Performance – V_{dd}=4 V, IF = 100 MHz, LO = -2 dBm, RF = 26 GHz, T_A = 25 °C

Parameter	Min	Typ	Max	Units
Frequency Range, RF		20 – 32		GHz
Frequency Range, LO		10 – 16		GHz
Frequency Range, IF	DC		6	GHz
Conversion Loss		8.5		dB
Noise Figure (SSB)		8.5		dB
2LO to RF Isolation		33		dB
2LO to IF Isolation		60		dB
Input IP3		11		dBm
Input P1dB		3		dBm
Supply Current	19	27	35	mA

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz USB

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CMD310C3

20-32 GHz Sub-harmonic ×2 Mixer

Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+13 dBm
LO Drive	+13 dBm
Drain Voltage, Vdd	5.5 V
Channel Temperature, Tch	150 ºC
Power Dissipation, Pdiss	0.33 W
Thermal Resistance, Θ_{JC}	199.4 ºC/W
Operating Temperature	-40 to 85 °C
Storage Temperature	-55 to 150 °C

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Vdd	2	4	5	V
Idd		27		mA

Electrical performance is measured at specific test conditions. Electrical specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications – Vdd = 4 V, IF = 100 MHz, LO = -2 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF		20 - 26			26 - 32		GHz
Frequency Range, LO		10 - 13			13 - 16		GHz
Frequency Range, IF		DC - 6			DC - 6		GHz
Conversion Loss		9	12		11	14	dB
Noise Figure (SSB)		9	12		11	14	dB
2LO to RF Isolation	23	32		28	37		dB
2LO to IF Isolation	44	55		55	65		dB
Input IP3		12			12		dBm
Input P1dB		2			4		dBm
Supply Current	19	27	35	19	27	35	mA

Unless otherwise noted, all measurements performed as a downconverter, IF = 100 MHz USB

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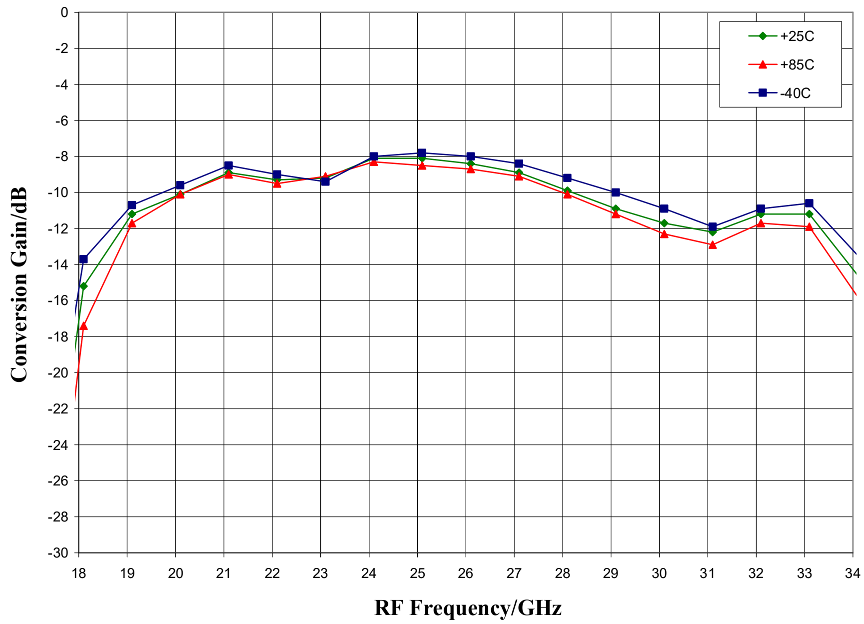
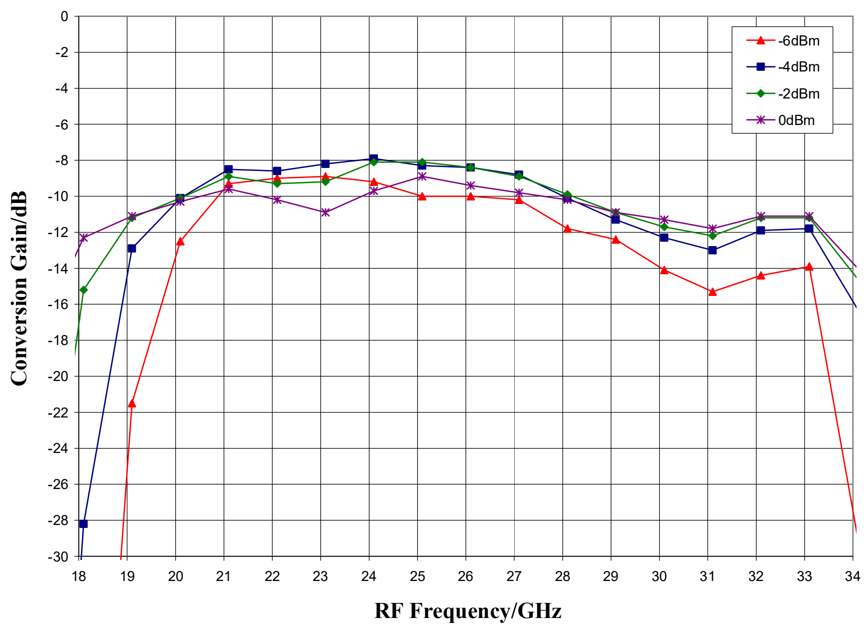
Typical Performance

Conversion Gain vs. Temperature, LO = -2 dBm, IF = 100 MHz USB



Conversion Gain vs. LO Drive, IF = 100 MHz USB, T_A = 25 °C



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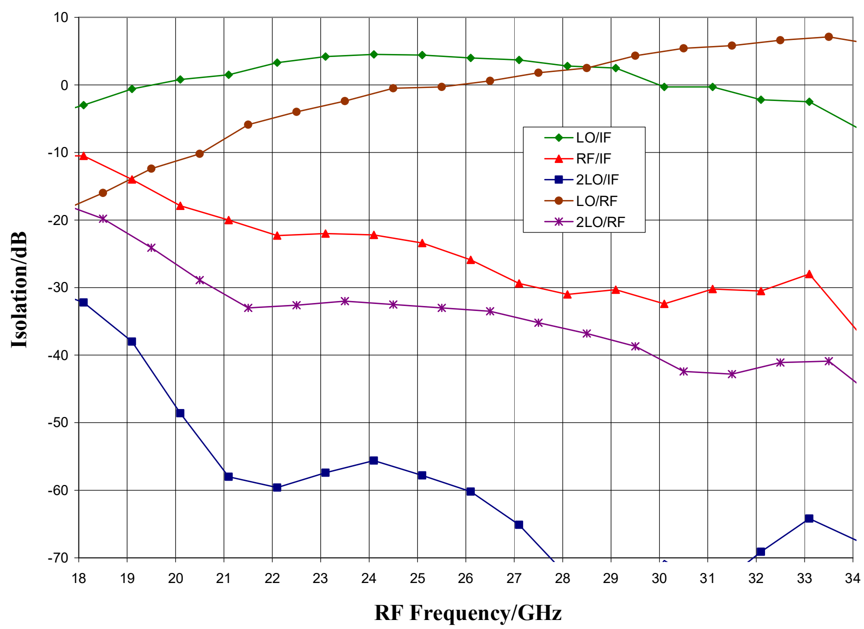
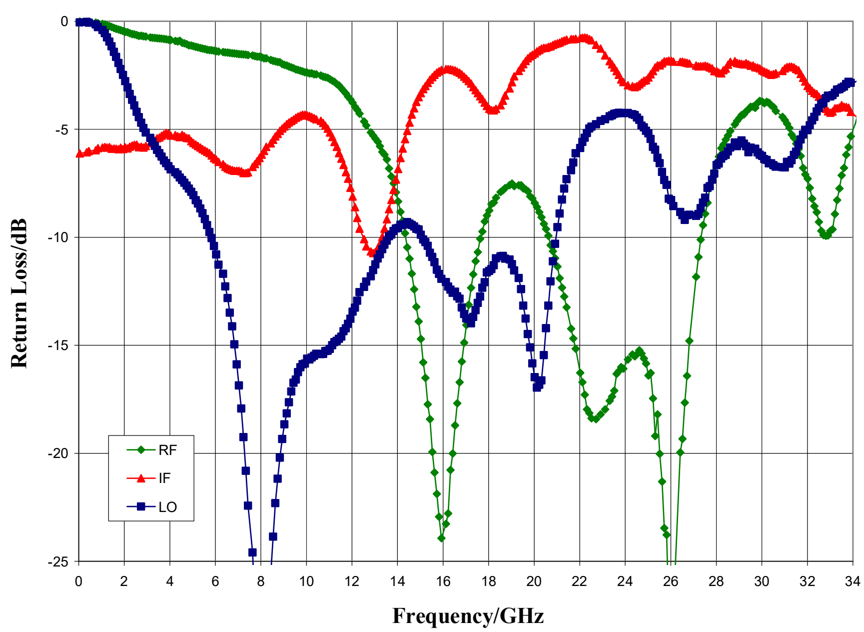
Typical Performance

Isolations, LO = -2 dBm, T_A = 25 °C



Return Loss, LO = -2 dBm, T_A = 25 °C



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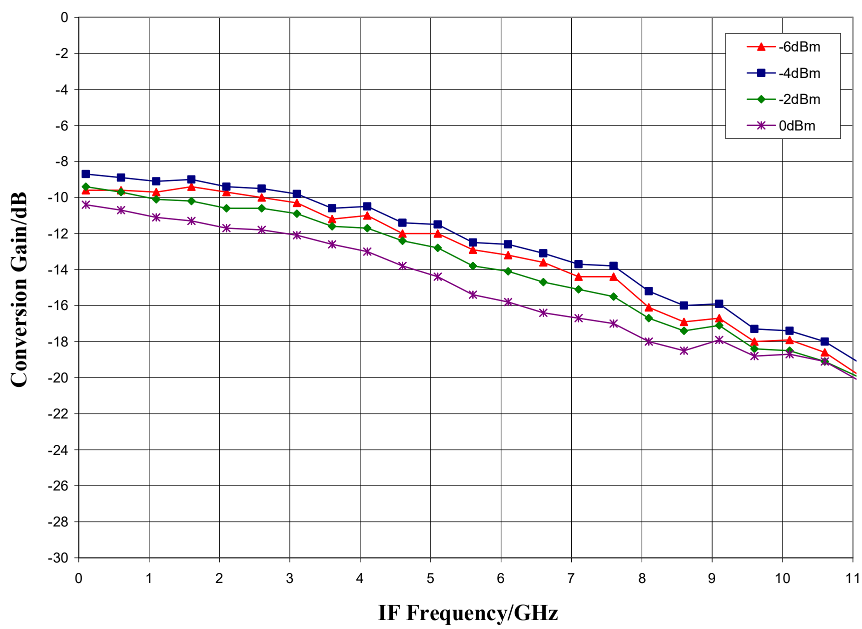
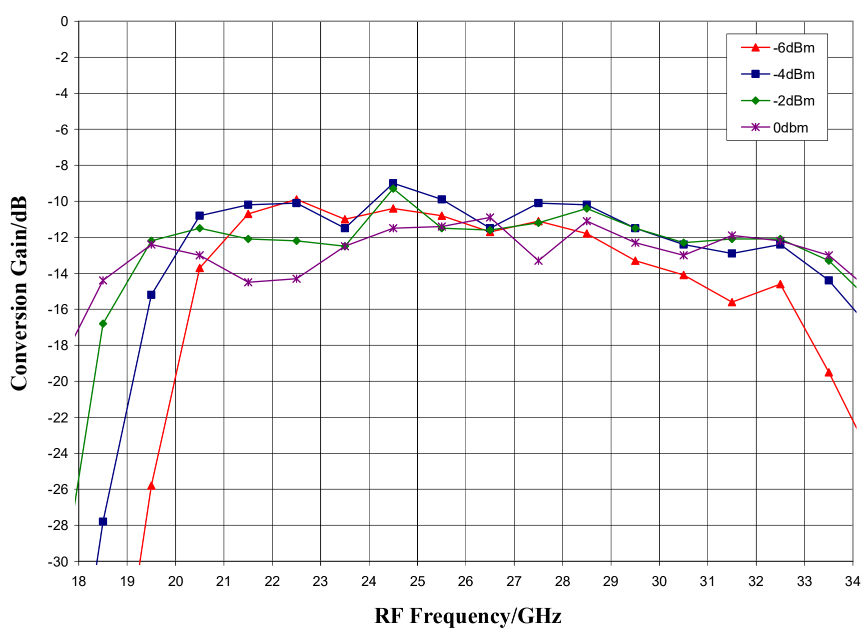
Typical Performance

IF Bandwidth vs. LO Drive, T_A = 25 °C



Upconverter Performance, Conversion Gain vs. LO Drive, T_A = 25 °C



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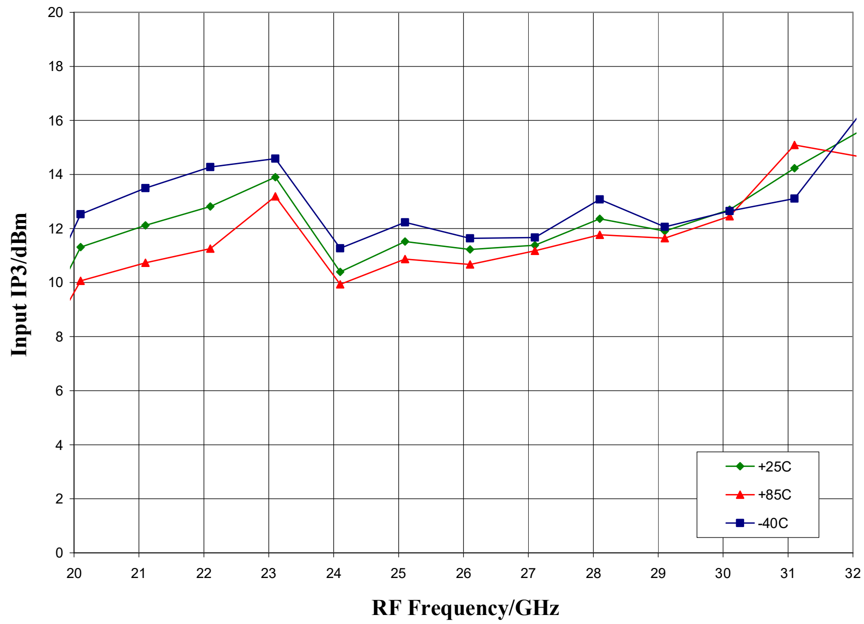
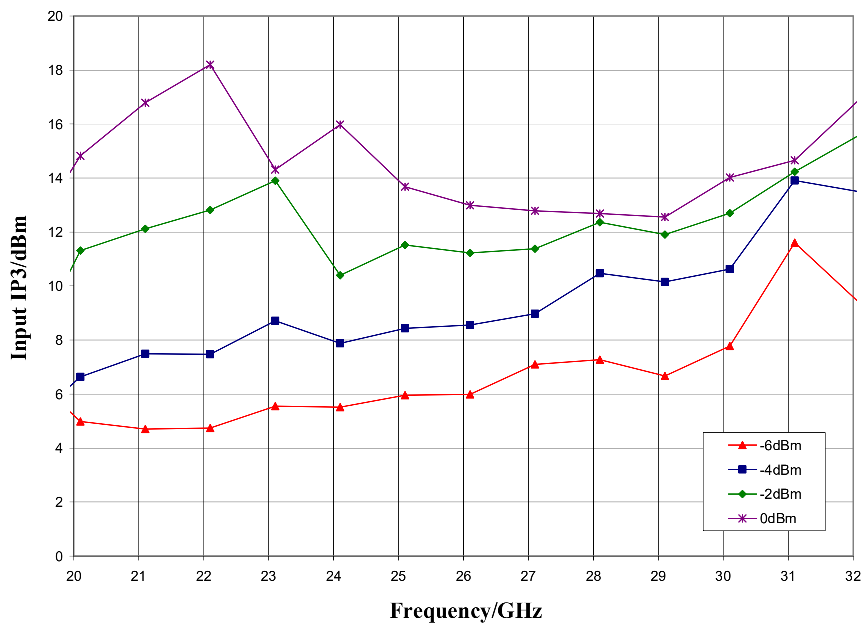
Typical Performance

Input IP3 vs. Temperature, LO = -2 dBm



Input IP3 vs. LO Drive, T_A = 25 °C



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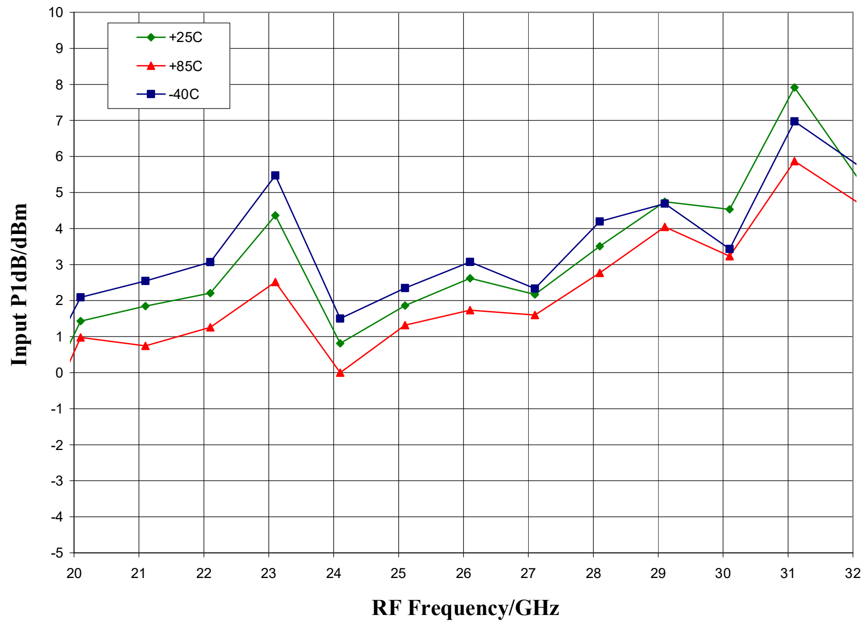
Typical Performance

Input P1dB vs. Temperature, LO = -2 dBm, T_A = 25 °C



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Typical Performance

M x N Spur Table

	nLO				
mRF	0	1	2	3	4
0	X	-16	43	29	55
1	21	53	0	55	50
2	71	63	71	44	58
3			71	71	71
4					71

RF = 30 GHz @ -10 dBm
LO = 13.6 GHz @ -4 dBm
All values in dBc below the IF output power level (1RF - 2LO)

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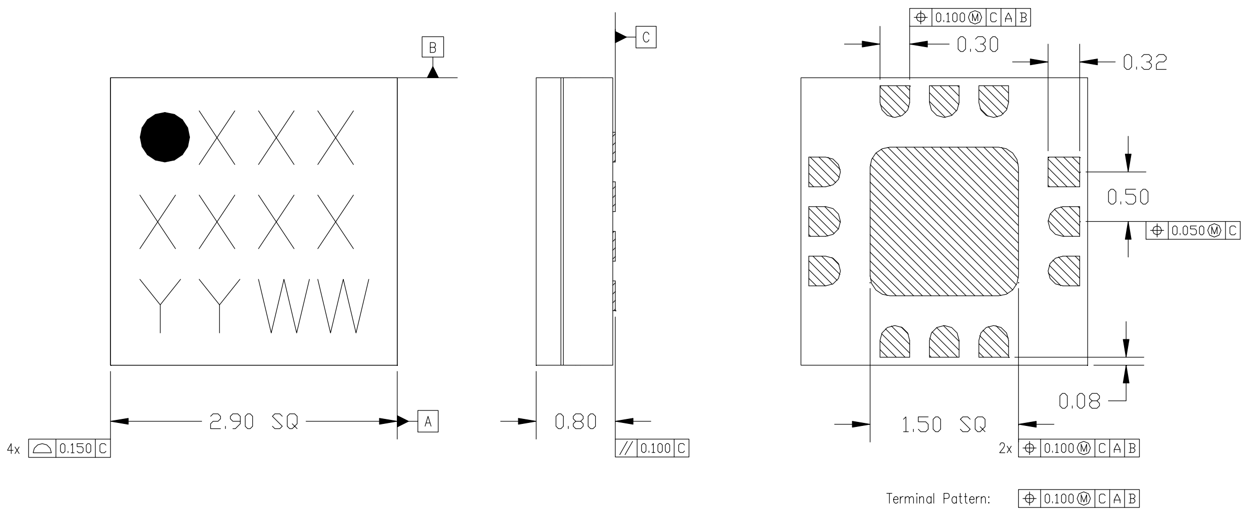
Mechanical Information

Package Information and Dimensions



NOTES:

1. ALL DIMENSIONS SHOWN IN mm.
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH:
   - 3.1. Ni: 8.89um MAX, 1.27um MIN
   - 3.2. Pd: 0.17um MAX, 0.07um MIN
   - 3.3. Au: 0.254um MAX, 0.03um MIN
4. MARKING
   - 4.1. LINE 1: PART NUMBER
     - 4.1.1. EXAMPLE: CMD177C3 SHALL BE MARKED AS 177
   - 4.2. LINE 2: LOT NUMBER
   - 4.3. LINE 3: DATE CODE - LAST 2 DIGITS OF THE YEAR OF MANUFACTURE FOLLOWED BY A 2 DIGIT WEEK CODE
5. ALTERNATE PIN #1 IDENTIFIER IS A SINGLE SQUARE PAD
6. ALTERNATE DIE PADDLE MAY HAVE CHAMFERED CORNERS

Recommended PCB Land Pattern

Custom MMIC recommends that the user develop the land pattern that will provide the best design for proper solder reflow and device attach for their specific application. Please review Custom MMIC Application Note AN 105 for a recommended land pattern approach.

Recommended Solder Reflow Profile

Custom MMIC recommends screen printing with belt furnace reflow to ensure proper solder reflow and device attach. Please review Custom MMIC Application Note AN 102 for a recommended solder reflow profile.

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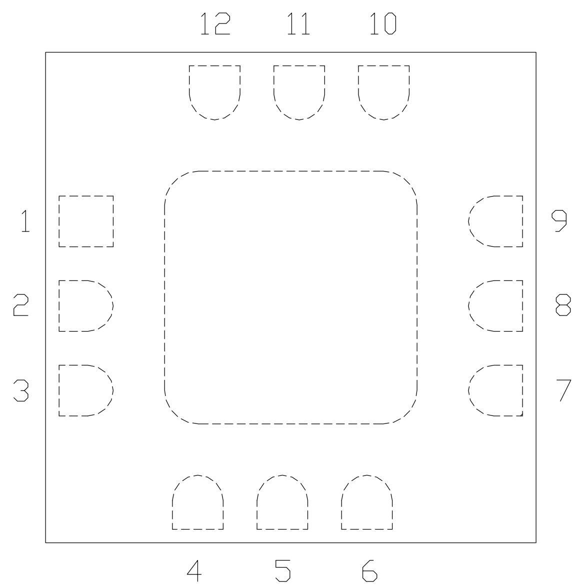
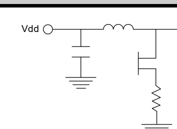
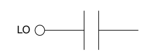
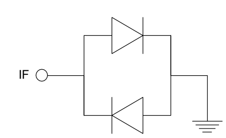
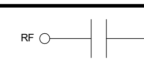
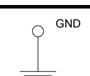
Pin Description

Pin Diagram



Functional Description

Pin	Function	Description	Schematic
1	Vdd	Power supply voltage Decoupling and bypass caps required	
2-4, 9	N/C	No connection required. These pins may be connected to RF/DC ground	
5	LO	DC blocked and 50 Ohm matched	
8	IF	This pin is DC coupled and should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency. Any applied DC voltage to this pin will result in die non-function and possible die failure	
11	RF	DC blocked and 50 Ohm matched	
6, 7, 10, 12 and die paddle	Ground	Connect to RF / DC ground.	

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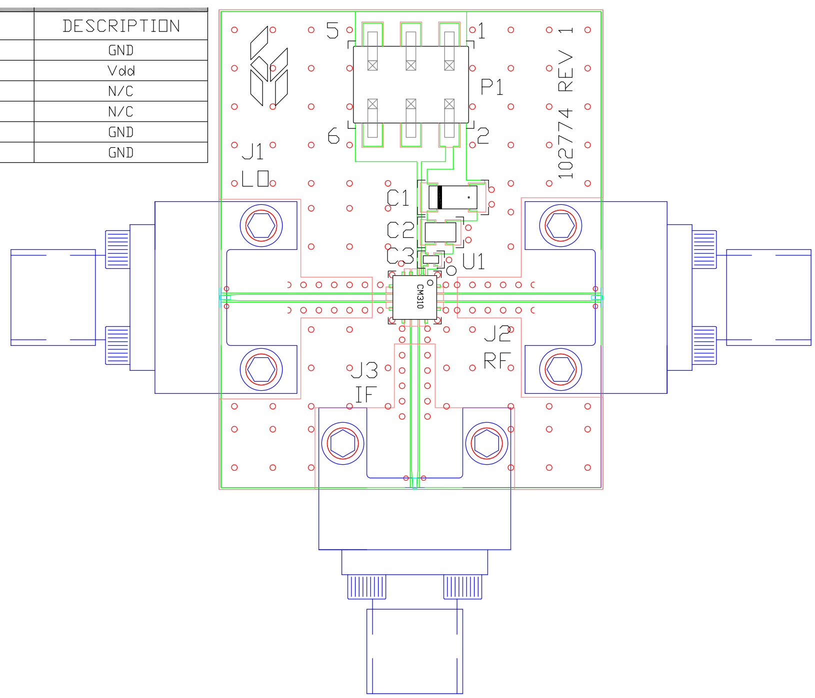
Applications Information

Evaluation Board

The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.

P2	DESCRIPTION
1	GND
2	Vdd
3	N/C
4	N/C
5	GND
6	GND



Designator	Value	Description
J1 - J3		2.92 mm End Launch Connector
P1		6 Pin Header
C1	0.33 µF	Capacitor, Tantalum
C2	1000 pF	Capacitor, 0603
C3	100 pF	Capacitor, 0402
U1		CMD310C3 Sub-harmonic x2 Mixer
PCB		102774 Evaluation PCB

GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

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CMD312

4-28 GHz Fundamental Mixer

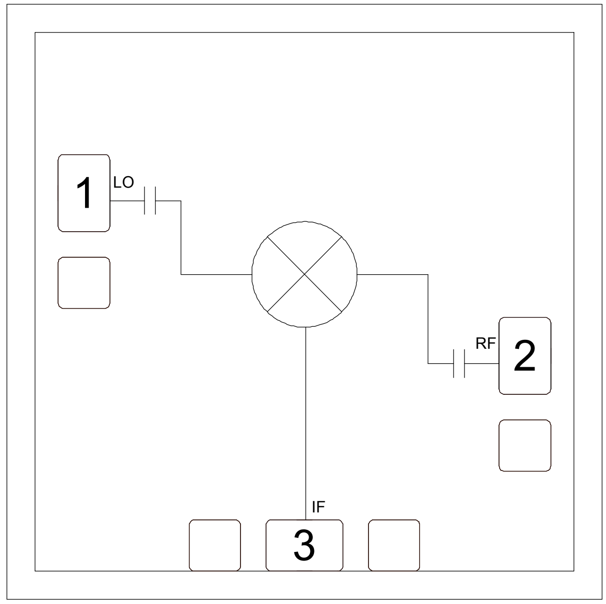
Features

- ► Low conversion loss
- ► High isolation
- ► Wide bandwidth
- ► Passive double balanced topology
- ► Small die size

Description

The CMD312 is a general purpose double balanced mixer die that can be used for up- and downconverting applications between 4 and 28 GHz. The CMD312 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +13 dBm. The CMD312 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Functional Block Diagram



Electrical Performance – IF = 900 MHz, USB, LO = +17 dBm , T_A = 25 °C, LO = 16 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		4 – 28		GHz
Frequency Range, IF	DC		3	GHz
Conversion Loss		8		dB
LO to RF Isolation		43		dB
LO to IF Isolation		50		dB
RF to IF Isolation		30		dB
Input IP3		20		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 900 MHz USB

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+21.5 dBm
LO Drive	+21.5 dBm
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	459 °C/W
Power Dissipation, Pdiss	141 mW

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications – IF = 900 MHz, LO = +17 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		4 – 17			17 – 28		GHz
Frequency Range, IF	DC		3	DC		3	GHz
Conversion Loss		8.5	10		8	10.5	dB
Noise Figure (SSB)		8.5	10		8	10.5	dB
LO to RF Isolation	29	40		22	32		dB
LO to IF Isolation	28	42		45	50		dB
RF to IF Isolation	7	20		27	40		dB
Input IP3		20			20		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 900 MHz

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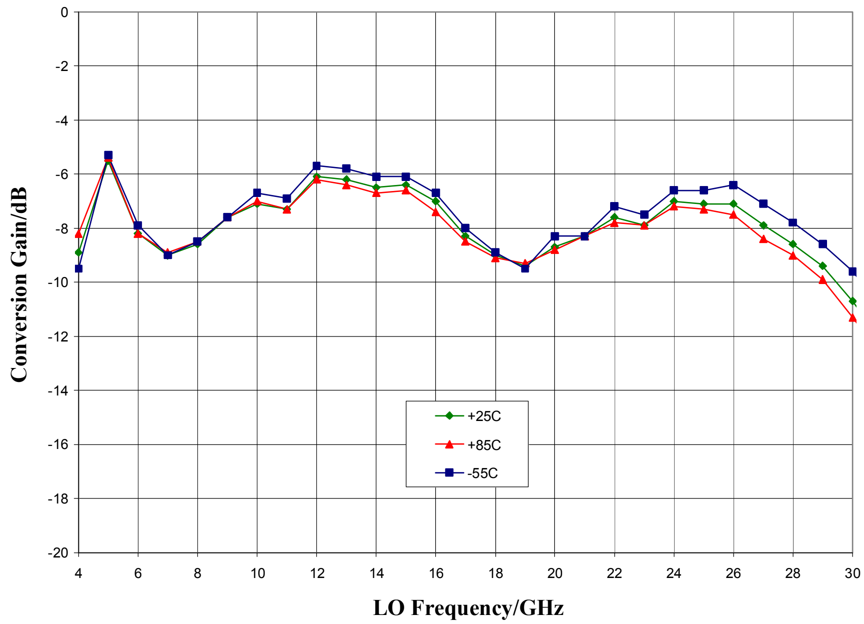
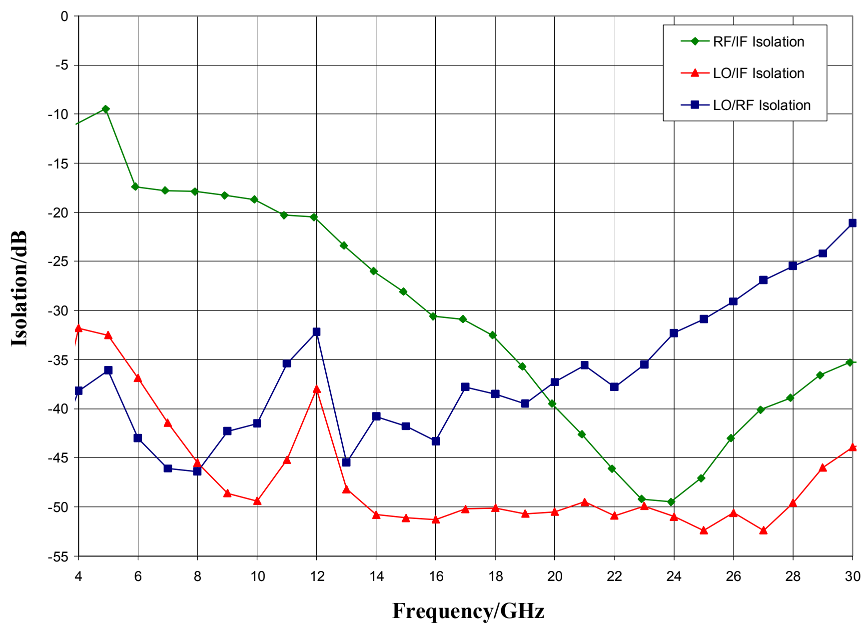
Typical Performance

Conversion Gain vs. Temperature, LO = +17 dBm, IF = 900 MHz USB



Isolation, LO = +17 dBm



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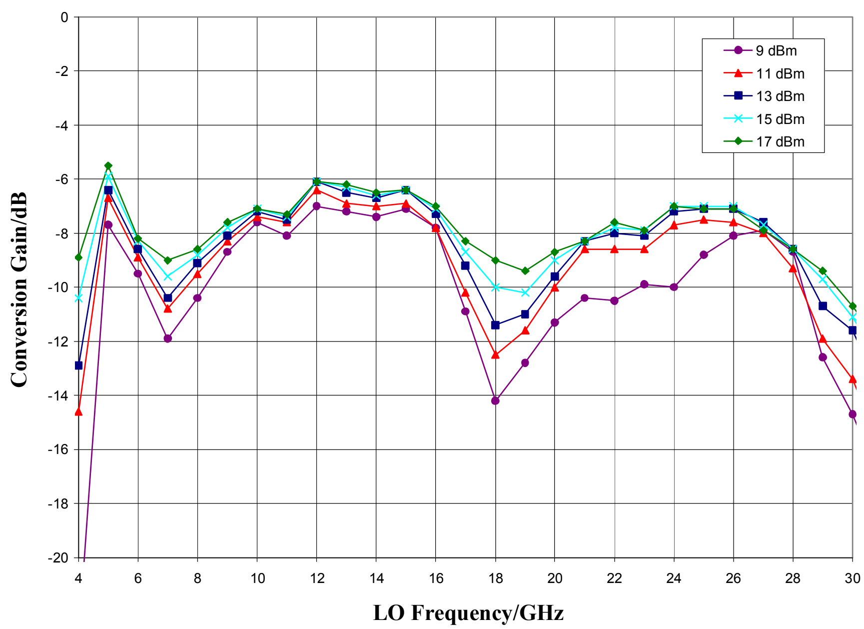
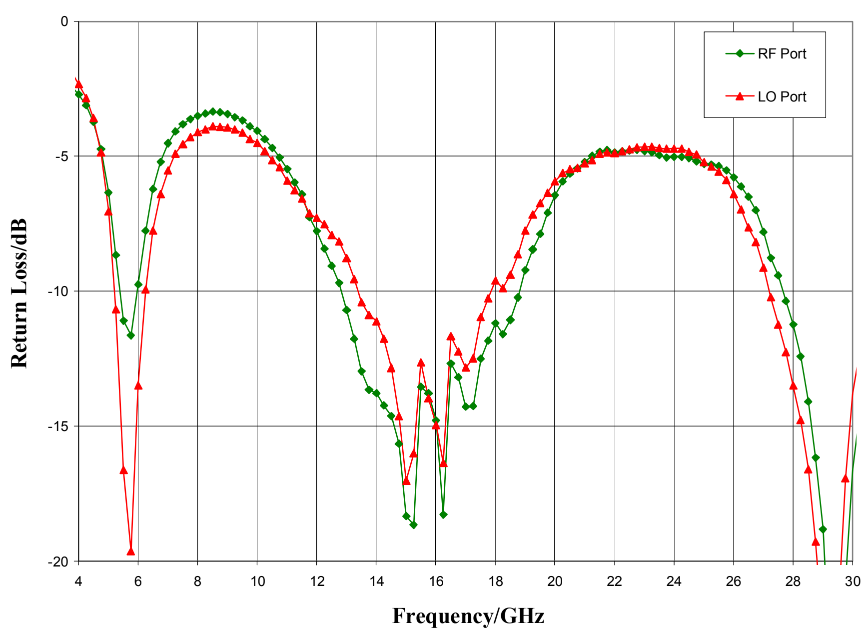
Typical Performance

Conversion Gain vs. LO Drive, IF = 900 MHz USB



Return Loss, LO = + 17 dBm



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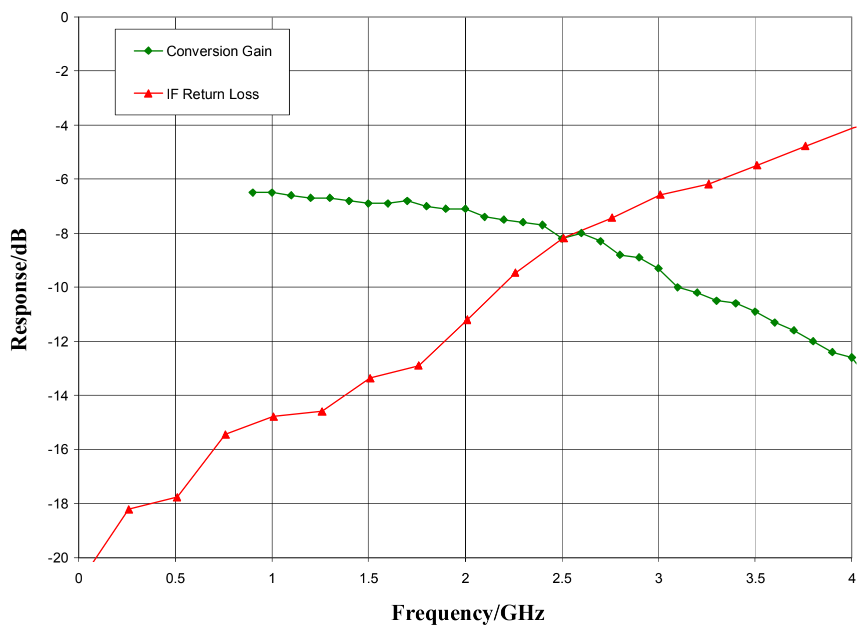
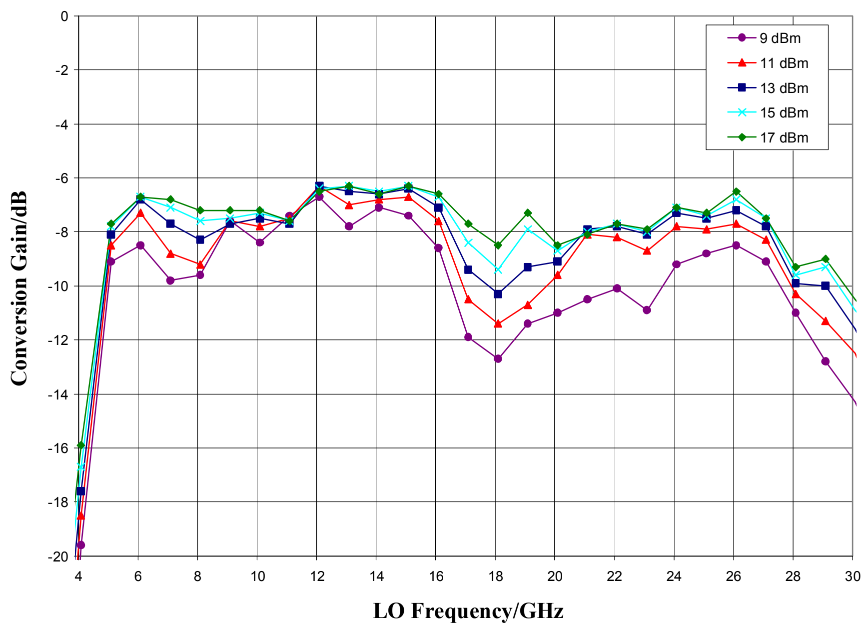
Typical Performance

IF Bandwidth, LO = +17 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 900 MHz



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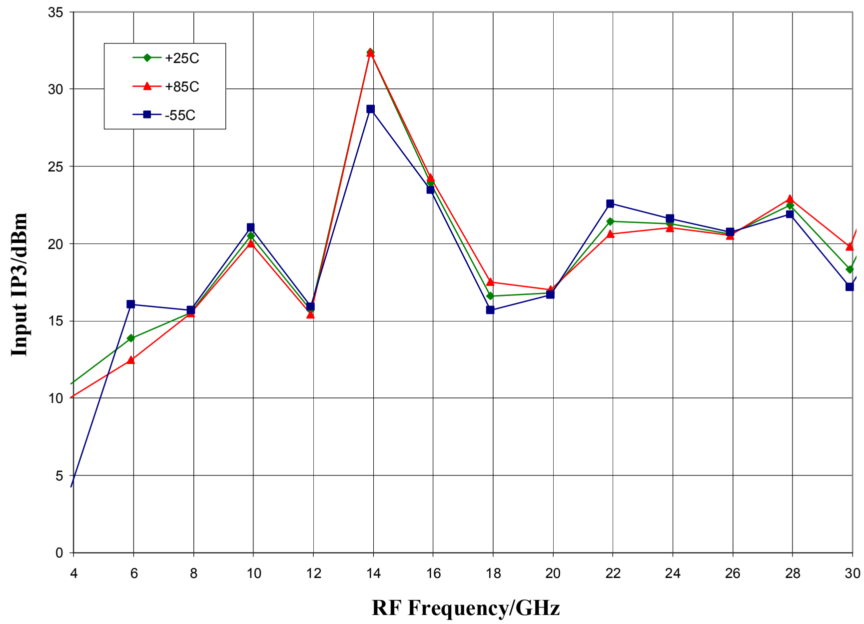
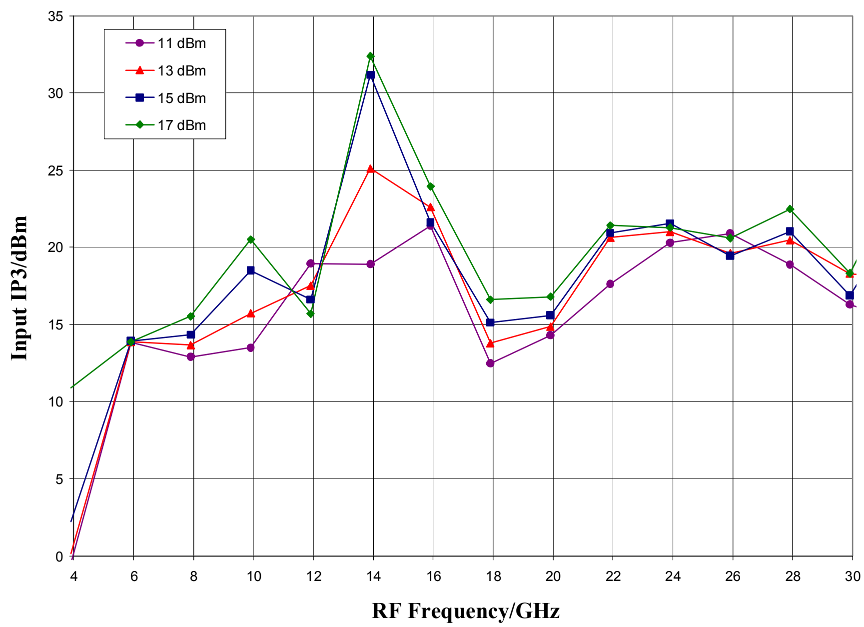
Typical Performance

Input IP3 vs. Temperature, LO = +17 dBm, IF = 900 MHz USB



Input IP3 vs. LO Drive, IF = 900 MHz USB



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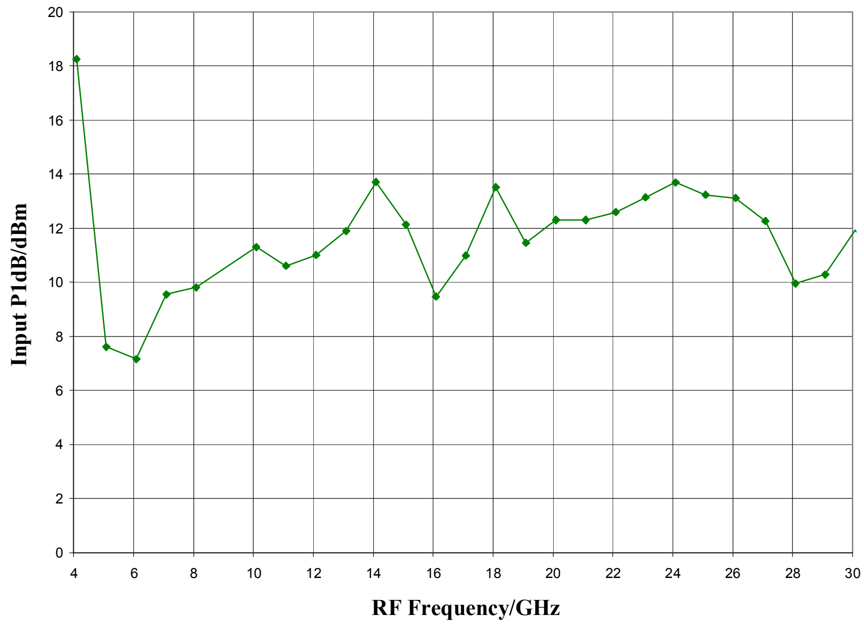
Typical Performance

Input P1dB, LO=+17 dBm, IF = 900 MHz USB



M x N Spur Table

	nLO				
mRF	0	1	2	3	4
0	xx	21	57		
1	25	0	50	45	
2	> 64	> 64	62	> 64	> 64
3		> 64	> 64	> 64	> 64
4			> 64	> 64	> 64

RF = 15.1 GHz @ -10 dBm
LO = 15.0 GHz @ +17 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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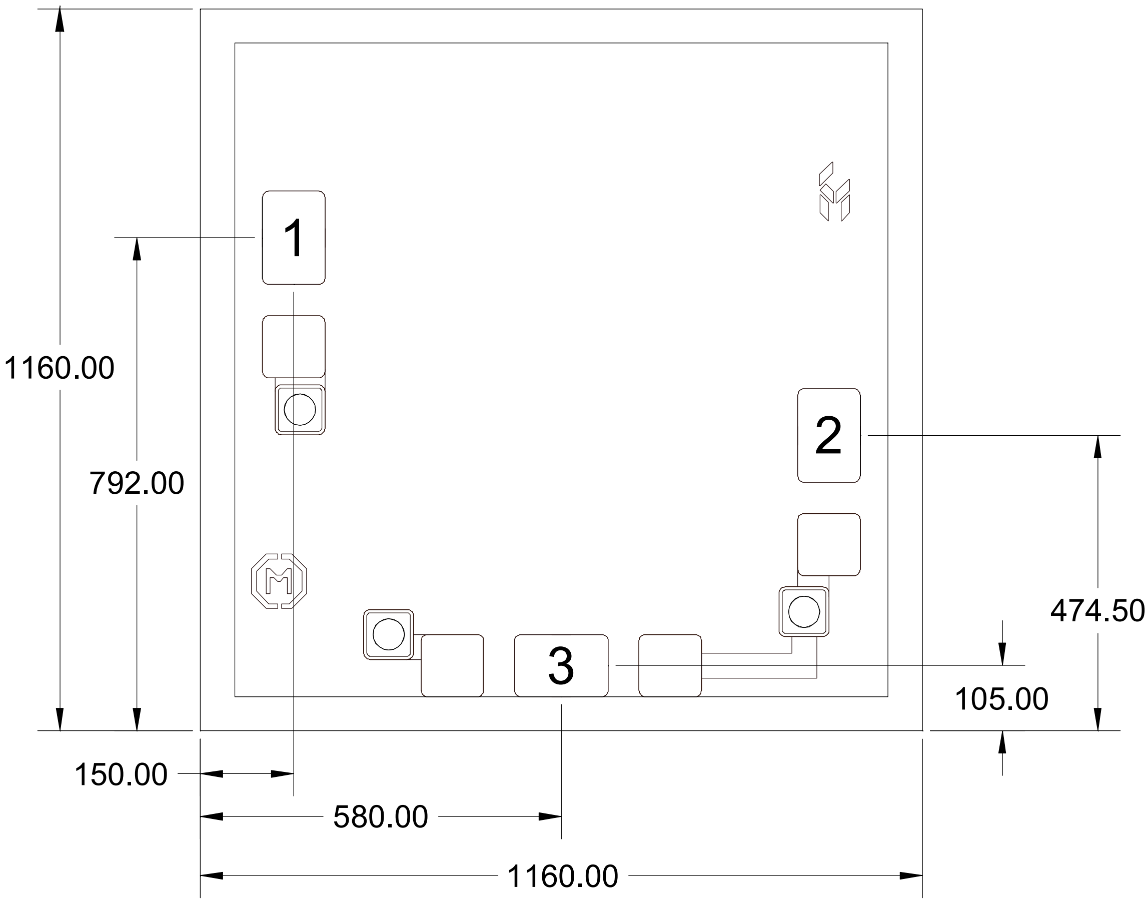
CMD312

4-28 GHz Fundamental Mixer

Mechanical Information

Die Outline (all dimensions in microns)



Notes:
1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 100 microns thick
5. All bond pads (1, 2, 3) are 100 x 150 microns square

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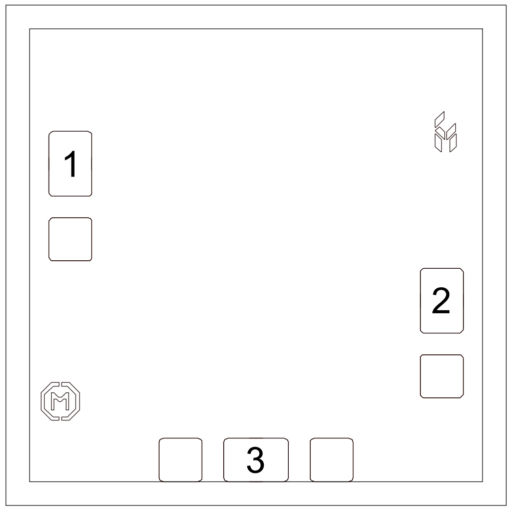
CMD312

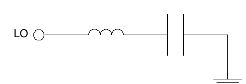
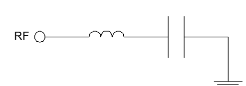
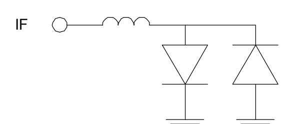
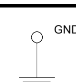
4-28 GHz Fundamental Mixer

Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	LO	This pin is AC coupled and matched to 50 ohms.	
2	RF	This pin is AC coupled and matched to 50 ohms.	
3	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
Backside	Ground	Connect to RF / DC ground.	

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Applications Information

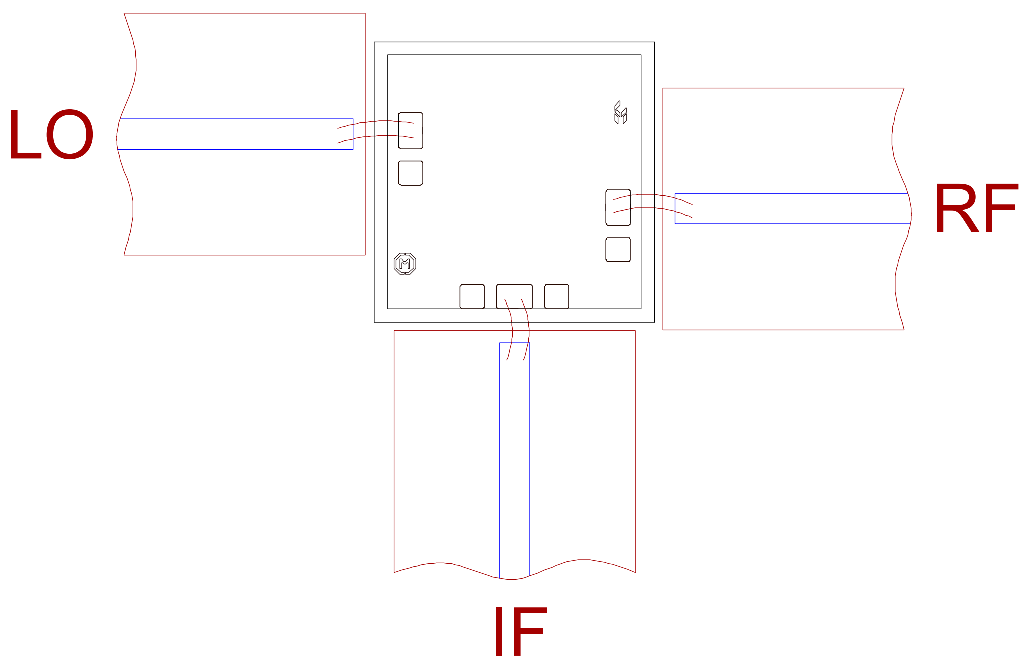
Assembly Guidelines

The backside of the CMD312 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

Please note, all information contained in this data sheet is subject to change without notice. ver 1.0 0919

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CMD313

6-45 GHz Fundamental Mixer

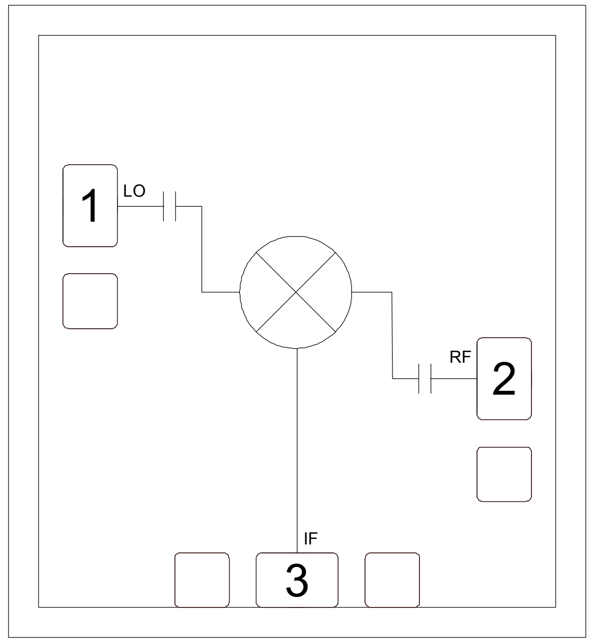
Features

- ► Low conversion loss
- ► High isolation
- ► Wide bandwidth
- ► Passive double balanced topology
- ► Small die size

Description

The CMD313 is a general purpose double balanced mixer die that can be used for up- and downconverting applications between 6 and 45 GHz. The CMD313 has very high isolation to both the RF and IF ports due to the optimized balun structures, and can operate with an LO drive level as low as +13 dBm. The CMD313 can easily be configured as an image reject mixer or single sideband modulator with external hybrids and power splitters.

Functional Block Diagram



Electrical Performance – IF = 900 MHz, USB, LO = +17 dBm , T_A = 25 °C, LO = 26 GHz

Parameter	Min	Typ	Max	Units
Frequency Range, RF & LO		6 – 45		GHz
Frequency Range, IF	DC		3	GHz
Conversion Loss		9		dB
LO to RF Isolation		41		dB
LO to IF Isolation		42		dB
RF to IF Isolation		29		dB
Input IP3		20		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 900 MHz USB

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Specifications

Absolute Maximum Ratings

Parameter	Rating
RF / IF Input Power	+21.5 dBm
LO Drive	+21.53 dBm
Operating Temperature	-55 to 85 °C
Storage Temperature	-55 to 150 °C
Thermal Resistance, Θ_{JC}	459 °C/W
Power Dissipation, Pdiss	141 mW

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

Electrical Specifications – IF = 900 MHz, LO = +17 dBm, T_A = 25 °C

Parameter	Min	Typ	Max	Min	Typ	Max	Units
Frequency Range, RF & LO		6 – 25			25 – 45		GHz
Frequency Range, IF	DC		3	DC		3	GHz
Conversion Loss		9	13		8	11	dB
Noise Figure (SSB)		9	13		8	11	dB
LO to RF Isolation	22	35			30		dB
LO to IF Isolation	21	35			42		dB
RF to IF Isolation		15			32		dB
Input IP3		20			22		dBm

Unless otherwise noted, all measurements performed as a downconverter, IF = 900 MHz

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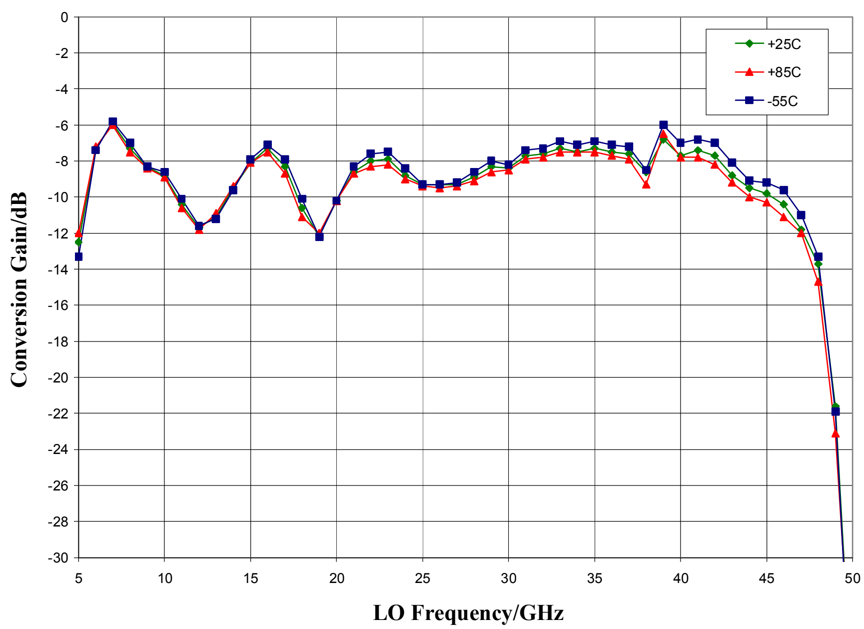
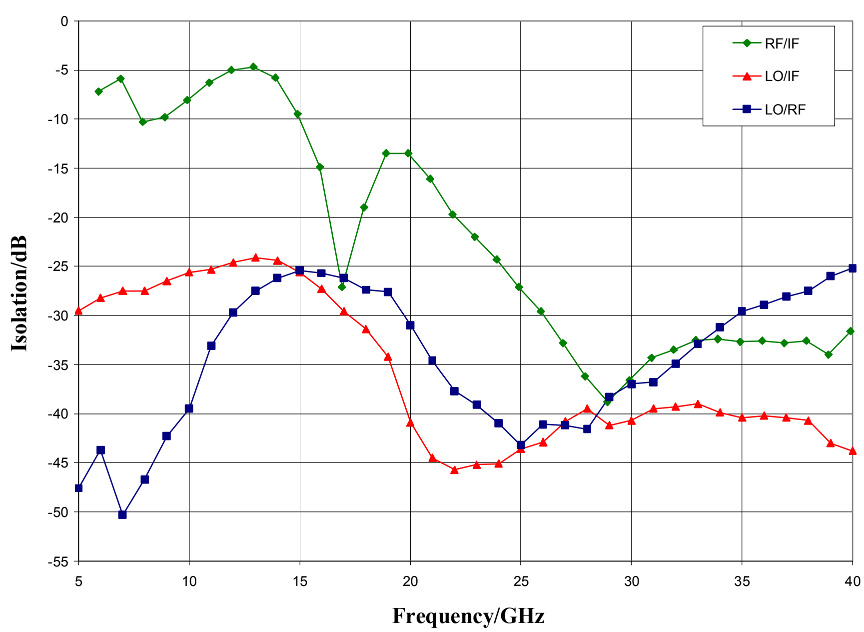
Typical Performance

Conversion Gain vs. Temperature, LO = +17 dBm, IF = 900 MHz USB



Isolation, LO = +17 dBm



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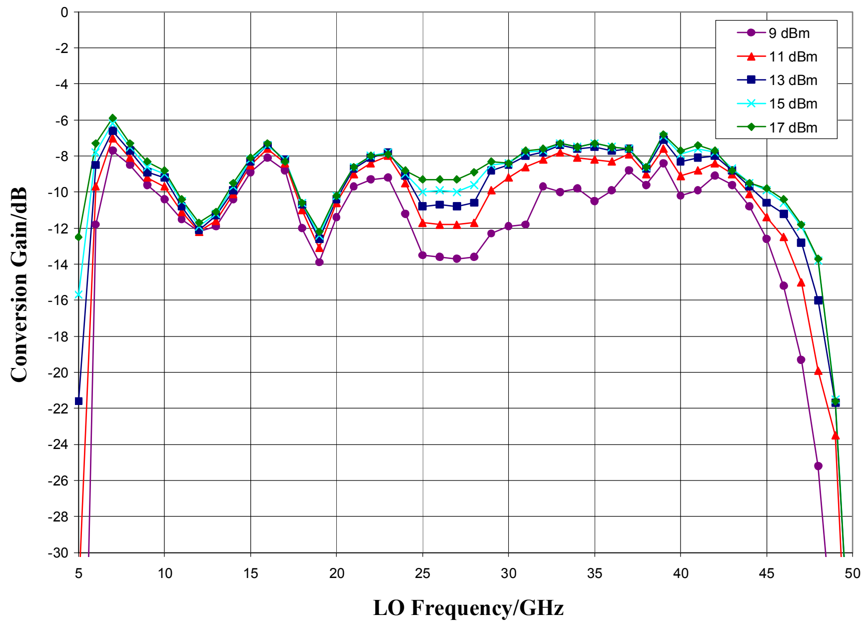
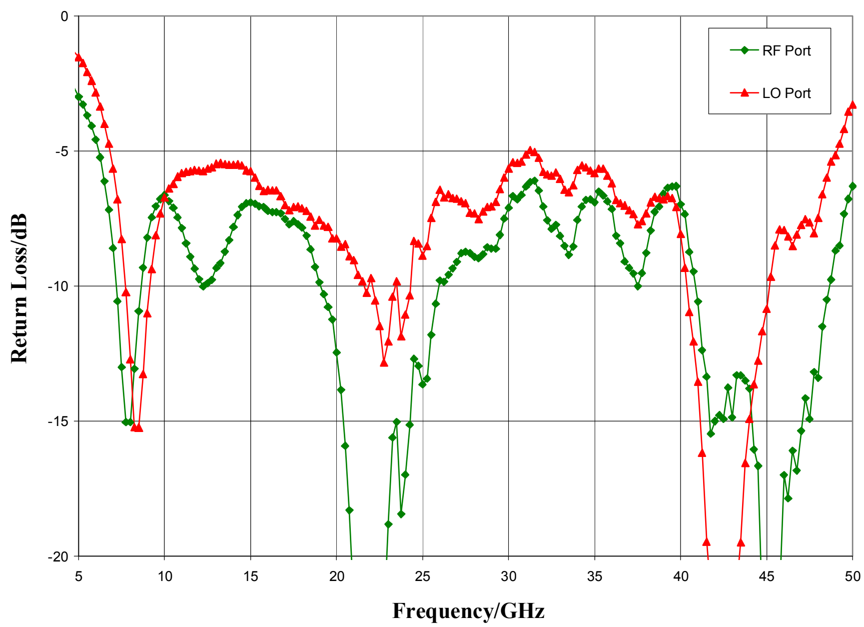
Typical Performance

Conversion Gain vs. LO Drive, IF = 900 MHz USB



Return Loss, LO = + 17 dBm



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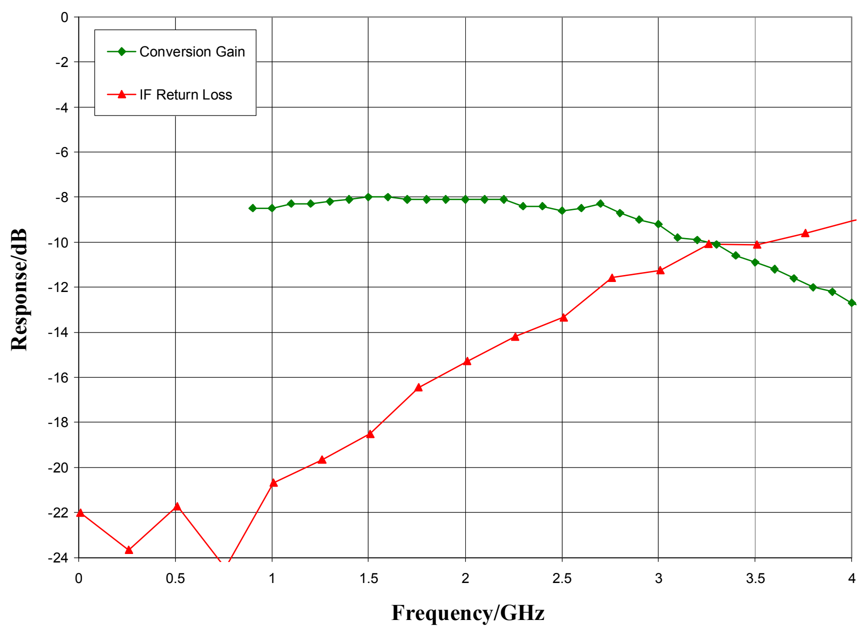
CMD313

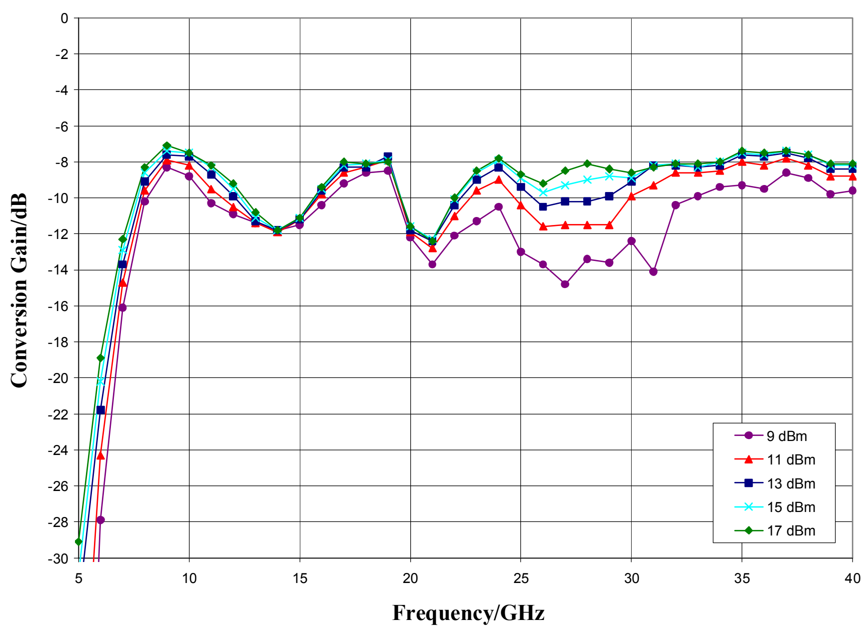
6-45 GHz Fundamental Mixer

Typical Performance

IF Bandwidth, LO = +17 dBm



Upconverter Performance, Conversion Gain vs. LO Drive, IF input = 900 MHz



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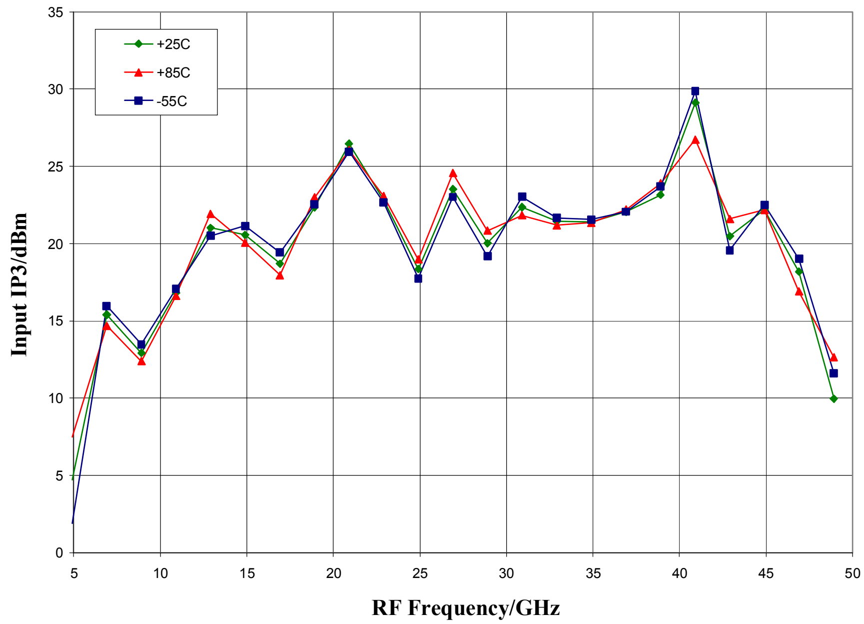
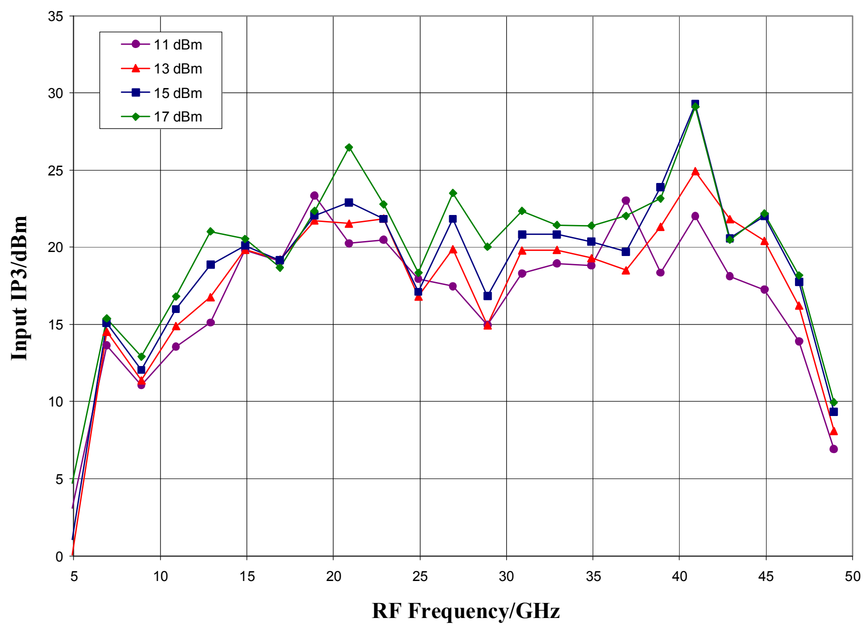
Typical Performance

Input IP3 vs. Temperature, LO = +19 dBm, IF = 900 MHz USB



Input IP3 vs. LO Drive, IF = 900 MHz USB



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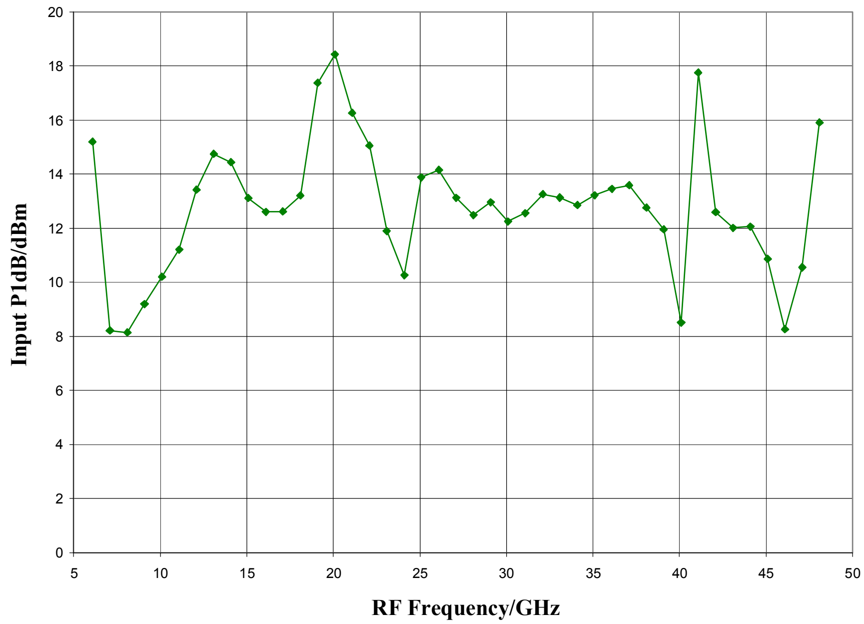
Typical Performance

Input P1dB, LO=+17 dBm, IF = 900 MHz USB



M x N Spur Table

	nLO				
mRF	0	1	2	3	4
0	xx	17			
1	20	0	46		
2		> 64	61	> 64	
3			> 64	> 64	> 64
4				> 64	> 64

RF = 23.1 GHz @ -10 dBm
LO = 23.0 GHz @ +17 dBm
All values in dBc below the IF output power level (1RF - 1LO)

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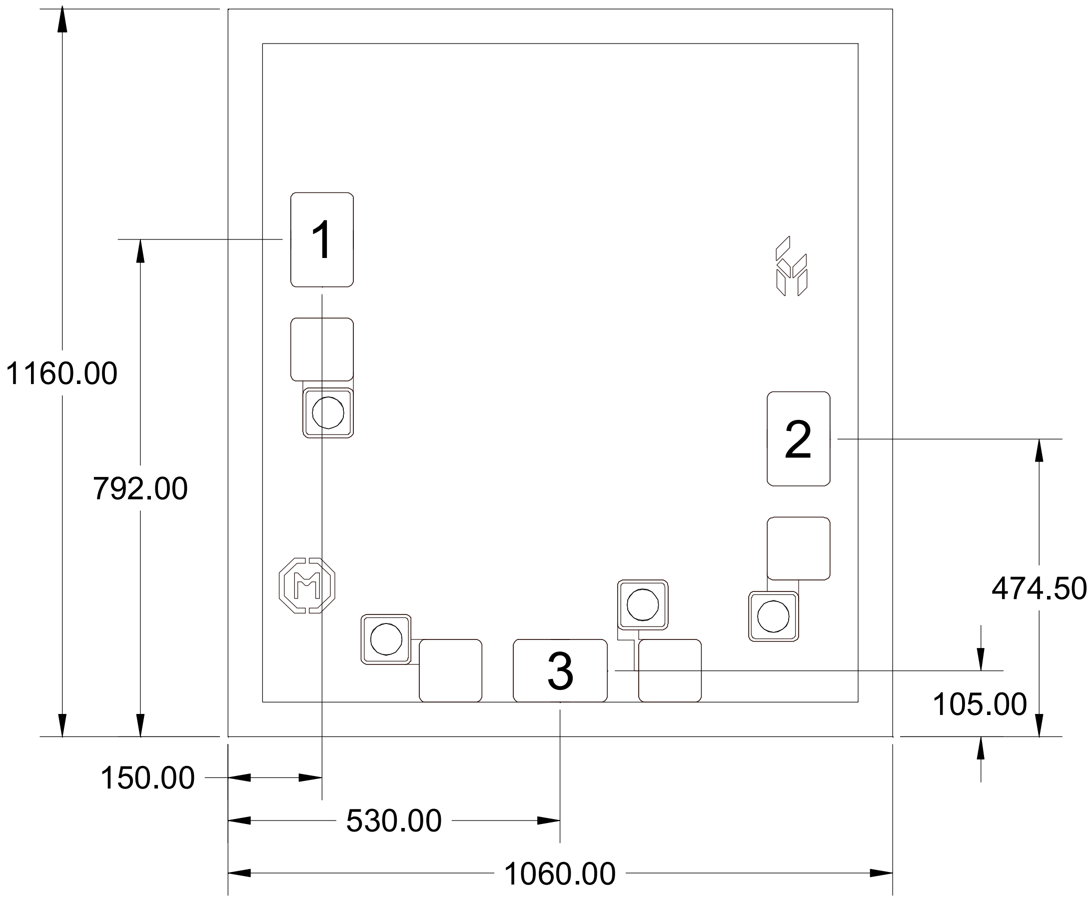
Mechanical Information

Die Outline (all dimensions in microns)



Notes:

1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 100 microns thick
5. All bond pads (1, 2, 3) are 100 x 150 microns square

Custom MMIC

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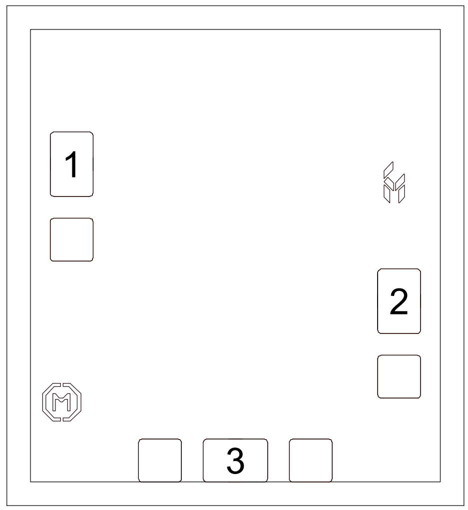
ES France - Département RF & Hyperfréquences - 127 rue de Buzenval BP 26 - 92380 Garches

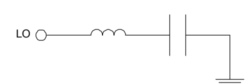
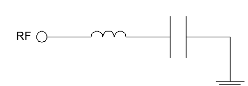
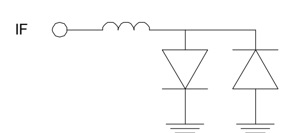
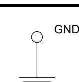
Tél. 01 47 95 99 60 - Fax. 01 47 01 16 22 - e-mail: hyper@es-france.com - Site Web: www.es-france.com

Pin Description

Pad Diagram



Functional Description

Pin	Function	Description	Schematic
1	LO	This pin is AC coupled and matched to 50 ohms.	
2	RF	This pin is AC coupled and matched to 50 ohms.	
3	IF	This pin is DC coupled. For applications not requiring operation to DC, this port should be DC blocked externally using a series capacitor whose value has been chosen to pass the necessary IF frequency range. For operation to DC, this pin must not source or sink more than 16 mA of current or part non-function or part failure may result.	
Backside	Ground	Connect to RF / DC ground.	

ver 1.0 0919

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Applications Information

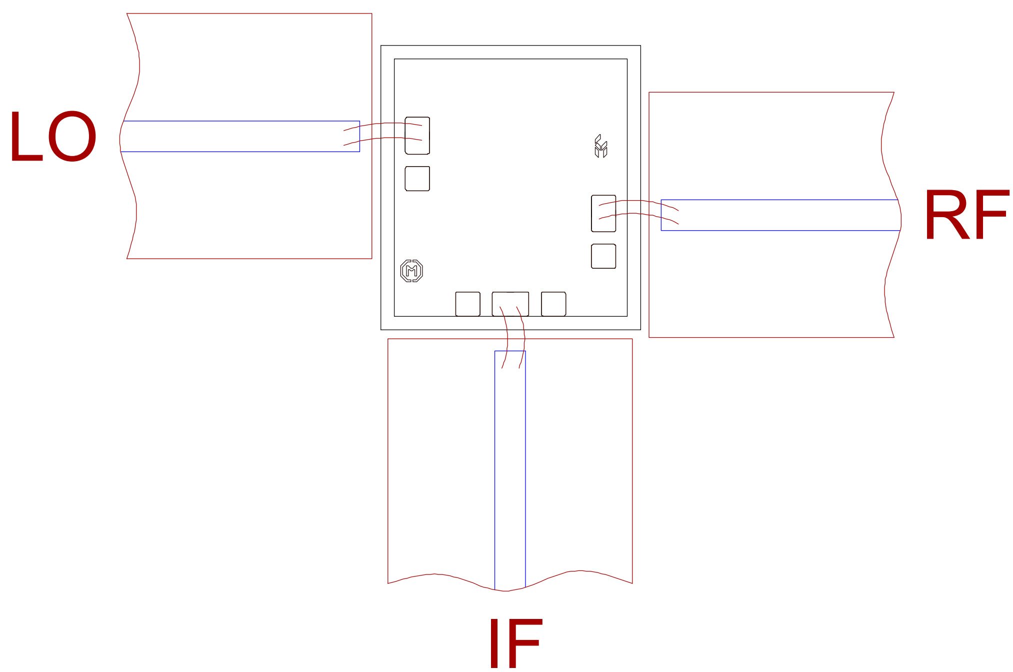
Assembly Guidelines

The backside of the CMD313 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized.

The semiconductor is 100 um thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

Assembly Diagram



GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.

Please note, all information contained in this data sheet is subject to change without notice. ver 1.0 0919

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