

GENERAL DESCRIPTION

This document describes the specifications for the IDTF1192 Dual Wideband, Gain-Settable, Zero-Distortion™ Flat-Noise™, RF to IF Downconverting Mixer.

The F1192 offers very low power consumption with excellent linearity. In addition to this and the four dynamically adjustable gain settings, the F1192 performance is exceptional across an extremely broad range of RF and IF frequencies. All of this makes it ideal for myriad applications including:

- 2G/3G/4G/5G/Multimode Remote Radio Units
- High order MIMO systems, μ cells, picocells, DAS
- Point to Point μ Wave Backhaul systems
- Broadband Repeaters
- Public Safety Infrastructure
- Any radio system operating between 400 MHz and 4000 MHz

COMPETITIVE ADVANTAGE

F1192 offers maximum performance and flexibility at minimum power consumption. The unique and patented settable-gain feature allows it to be used in a very wide variety of radiocard applications, even allowing for dynamic adjustment of gain to maximize performance on the fly. The extremely wide RF and IF bandwidths are achieved with a fixed BOM with all internal matching. The device can function with as little as -6 dBm LO power and with independent channel shutdown modes for ease of integration into high order TDD MIMO systems.

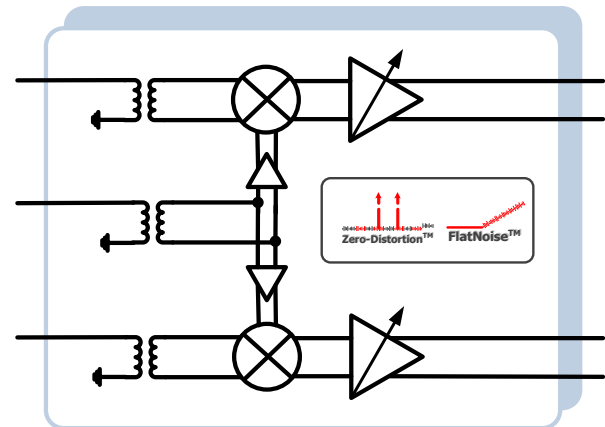
BAND PERFORMANCE SUMMARY

| RF Frequency (MHz) | 900 | 1900 | 2600 | 3500 |
|-----------------------------|------|------|------|------|
| Gain (max G_{11} setting) | 11.0 | 10.8 | 10.3 | 9.0 |
| Gain (min G_2 setting) | 2.5 | 2.3 | 1.8 | 0.5 |
| NF @ max gain (dB) | 8.9 | 8.7 | 10.0 | 10.9 |
| IIP3 @ min gain (dBm) | 28 | 27 | 29 | 30 |
| OIP3 @ G_8 (dBm) | 37 | 34 | 35 | 35 |
| IP1dB @ min gain (dBm) | 13.6 | 14.7 | 14.6 | 15.8 |
| 2x2 @ min gain (dBc) | -75 | -82 | -73 | -68 |
| Channel Isolation (dB) | 48 | 47 | 48 | 45 |
| Pdiss (mW) | 792 | 835 | 875 | 935 |

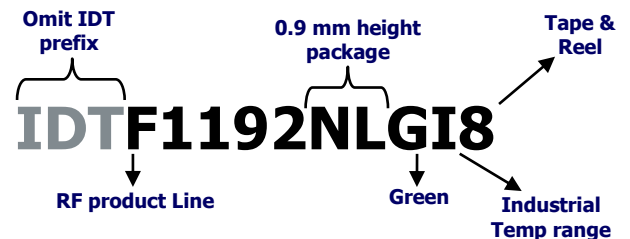
FEATURES

- RF range: 400MHz to 3800MHz
- LO range: 400MHz to 3600MHz
- IF Range: 50MHz to 600MHz
- Dual Path for MIMO
- 4 Gain Settings; 11dB, 8dB, 5dB, 2dB
- 2 bit gain step control
- Ideal for Multi-Carrier Systems
- +35dBm OIP3
- Low Noise Figure at any gain setting via IDT's FlatNoise™ technology
- $Z = 200 \Omega$ IF balanced, 50Ω RF, 50Ω LO single ended
- All internally matched. Single BOM for all RF, LO and IF frequencies
- 4 mm x 4 mm, 24-pin TQFN package
- Independent Path Standby mode
- 75 nsec settling for gain adjustment
- $VCC = 3.3V$, 835 mW, 620 mW (low power mode)

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION



ABSOLUTE MAXIMUM RATINGS

| Parameter | Symbol | Min | Max | Units |
|--|--------------------|------|-----------------------|-------|
| VCC to GND | V _{CC} | -0.5 | +3.6 | V |
| STBY_A, STBY_B, Gain_Select1, Gain_Select2, RF_A, RF_B, LO1_ADJ, LO2_ADJ | V _{CTRL} | -0.5 | V _{CC} + 0.5 | V |
| IF_A+, IF_A-, IF_B+, IF_B- | IF _{OUT} | 2.4 | V _{CC} + 0.5 | V |
| LO_IN | LO _{IN} | -0.5 | +0.5 | V |
| IF_BiasA, IF_BiasB | IF _{BIAS} | | 50 | ohms |
| IF_Ref_Bias | IF _{REF} | | 500 | ohms |
| RF Input Power (RF_A, RF_B) continuous | RF _{MAX} | | +20 | dBm |
| LO Input Power (LO_IN) continuous | LO _{MAX} | | +20 | dBm |
| Continuous Power Dissipation | P _{DISS} | | 1.5 | W |
| Junction Temperature | T _j | | 150 | °C |
| Storage Temperature Range | T _{ST} | -65 | 150 | °C |
| Lead Temperature (soldering, 10s) | T _{LEAD} | | 260 | °C |
| ElectroStatic Discharge – HBM (JEDEC/ESDA JS-001-2012) | | | Class 2 (2500 V) | |
| ElectroStatic Discharge – CDM (JEDEC 22-C101F) | | | Class C3 (1000 V) | |

Stresses above those listed above may cause permanent damage to the device. Functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

PACKAGE THERMAL AND MOISTURE CHARACTERISTICS

| | |
|---|----------|
| θ_{JA} (Junction – Ambient) | 45 °C/W |
| θ_{JC} (Junction – Case) [The Case is defined as the exposed paddle] | 2.1 °C/W |
| Moisture Sensitivity Rating (Per J-STD-020) | MSL1 |

F1192 RECOMMENDED OPERATING CONDITIONS

| Parameter | Symbol | Comment | min | typ | max | Units |
|-----------------------------|------------|-------------------|------|-----|------|-------|
| Supply Voltage(s) | V_{CC} | All V_{CC} pins | 3.15 | | 3.45 | V |
| Operating Temperature Range | T_{CASE} | Case Temperature | -40 | | +105 | deg C |
| RF Freq Range | F_{RF} | | 400 | | 3800 | MHz |
| LO Freq Range | F_{LO} | | 400 | | 3600 | |
| IF Range | F_{IF} | | 50 | | 600 | |
| LO Power | P_{LO} | Operating Range | -6 | | +6 | dBm |

IDTF1192 SPECIFICATION (GENERAL)

Typical Application Circuit, $V_{CC} = +3.3V$, $T_C = +25^\circ C$, $F_{RF} = 900MHz$, $F_{IF} = 199MHz$, $F_{LO} = 1100MHz$, $P_{LO} = 0\text{ dBm}$, $P_{IN} = -10dBm$ per tone for all gain settings unless otherwise stated, $STBY_A = STBY_B = LOW$. EVkit IF transformer losses are de-embedded unless otherwise noted.

| Parameter | Symbol | Comment | min | typ | max | units |
|------------------------------------|------------------|---|--------------------------------|-----|--------------------|----------|
| Logic Input High ³ | V_{IH} | For all control pins | <i>1.1</i> ¹ | | | V |
| Logic Input Low ³ | V_{IL} | For all control pins | | | <i>0.65</i> | V |
| Logic Current | I_{IH}, I_{IL} | For all control pins | <i>-5</i> | | <i>+100</i> | μA |
| Supply Current | $I_{1CHA\ LB}$ | Single channel - low band LO | | 134 | <i>154</i> | mA |
| | $I_{1CHA\ MB}$ | Single channel - mid band LO | | 140 | <i>160</i> | |
| | $I_{1CHA\ HB}$ | Single channel - high band LO | | 147 | <i>166</i> | |
| | $I_{2CHA\ LB}$ | Dual channel - low band LO | | 240 | <i>275</i> | |
| | $I_{2CHA\ MB}$ | Dual channel - mid band LO | | 253 | <i>287</i> | |
| | $I_{2CHA\ HB}$ | Dual channel - high band LO | | 265 | <i>299</i> | |
| Supply Current – reduced linearity | | <ul style="list-style-type: none"> Dual channel $F_{RF} = 2.2GHz$, $F_{LO} = 2GHz$ OIP3 = +20dBm max gain IFRef_Bias resistor = 3.9Kohm | | 194 | <i>220</i> | |
| Shutdown current | $I_{SD\ 2CHA}$ | Both Channels | | 3 | <i>6</i> | |
| Settling Time | T_{SETT} | <ul style="list-style-type: none"> Pin = -13 dBm Gate STBY pins per Independent Channel Standby table Time for IF Signal to settle from 50% CTRL to within 90% of final value | | 340 | | nsec |
| | | <ul style="list-style-type: none"> Pin = -13 dBm Gate STBY pins per Independent Channel Standby table Time for IF Signal to settle from 50% CTRL to within 0.1 dB of final value | | 920 | | |
| | | <ul style="list-style-type: none"> Pin = -13 dBm Gate Gain Select pins per Gain Control table Time for IF Signal to settle from 50% Gain Select to within 90% of final value | | 75 | | |
| RFIN Impedance | Z_{RFIN} | Single Ended | | 50 | | Ω |
| LO Port Impedance | Z_{LO} | Single Ended | | 50 | | |
| IF Output Impedance | Z_{IF} | Differential | | 200 | | |
| IF Return Loss | RL_{IF} | Differential 200 ohm with 4:1 Balun | | -15 | | dB |
| LO Return Loss | RL_{LO} | Single Ended 50 ohm | | -15 | | dB |

Note 1: Items in min/max columns in ***bold italics*** are Guaranteed by Test.

Note 2: Items in min/max columns that are not bold/italics are Guaranteed by Design Characterization.

Note 3: JEDEC 3.3V and JEDEC 1.8V logic

IDTF1192 SPECIFICATION (LOW BAND)

Typical Application Circuit, $V_{CC} = +3.3V$, $T_C = +25^\circ C$, $F_{RF} = 900MHz$, $F_{IF} = 199MHz$, $F_{LO} = 1100MHz$, $P_{LO} = 0\text{ dBm}$, $P_{IN} = -10\text{dBm}$ per tone for all gain settings unless otherwise stated, $STBY_A = STBY_B = LOW$. EVkit IF transformer losses are de-embedded unless otherwise noted. Gain Setting = G_5 ($\sim 5\text{ dB gain}$).

| Parameter | Symbol | Comment | min | typ | max | units |
|--------------------------|----------------------|---|-------------|---------------|-------------|--------|
| Power Gain | G_{11} | Gain setting = G_{11} | | 11.1 | | dB |
| | G_8 | Gain setting = G_8 | | 8.3 | | |
| | G_5 | Gain setting = G_5 | 4.05 | 5.4 | 6.75 | |
| | G_2 | Gain setting = G_2 | | 2.5 | | |
| G5 Gain Change over temp | $G5_{TempDrift}$ | Tcase -40C to +105C referenced to +25C | | +0.7 -0.7 | | dB |
| Gain Slope | $Gain_{SLOPE}$ | <ul style="list-style-type: none"> IF center 200MHz 100MHz BW | | + 0.006 | | dB/MHz |
| Noise Figure | NF_{G11} | Gain setting = G_{11} | | 8.9 | | dB |
| | NF_{G8} | Gain setting = G_8 | | 9.4 | | |
| | $NF_{G5}^{4,5}$ | Gain setting = G_5 | | 10.1 | 11.7 | |
| | NF_{G2} | Gain setting = G_2 | | 10.7 | | |
| Input IP3 | $IIP3_{G11}$ | Gain setting = G_{11} 800 kHz tone separation | | 24 | | dBm |
| | $IIP3_{G8}$ | Gain setting = G_8 800 kHz tone separation | | 29 | | |
| | $IIP3_{G5}^4$ | Gain setting = G_5 800 kHz tone separation | 26 | 28 | | |
| | $IIP3_{G2}$ | Gain setting = G_2 800 kHz tone separation | | 28 | | |
| G3 IIP3 change over temp | $IIP3_{G3TempDrift}$ | Tcase -40C / +105C referenced to +25C | | -2.6/ +0.6 | | dB |
| Output IP3 | $OIP3_{G11}$ | Gain setting = G_{11} 800 kHz tone separation | | 35 | | dBm |
| | $OIP3_{G8}$ | Gain setting = G_8 800 kHz tone separation | | 37 | | |
| | $OIP3_{G5}$ | Gain setting = G_5 800 kHz tone separation | | 32 | | |
| | | <ul style="list-style-type: none"> Gain setting = G_5 $T_c = +105^\circ C$ LO power = -3dBm $V_{cc} = 3.15V$ | 33 | 34 | | |
| | $OIP3_{G2}$ | Gain setting = G_2 800 kHz tone separation | | 30 | | |

IDTF1192 SPECIFICATION (LOW BAND) CONTINUED

Typical Application Circuit, $V_{CC} = +3.3V$, $T_C = +25^\circ C$, $F_{RF} = 900MHz$, $F_{IF} = 199MHz$, $F_{LO} = 1100MHz$, $P_{LO} = 0\text{ dBm}$, $P_{IN} = -10dBm$ per tone for all gain settings unless otherwise stated, $STBY_A = STBY_B = LOW$. EVkit IF transformer losses are de-embedded unless otherwise noted. Gain Setting = G_5 ($\sim 5\text{ dB gain}$).

| Parameter | Symbol | Comment | min | typ | max | units |
|--------------------------------|----------------------------------|---|------|------|-----|-------|
| Input P1dB | IP1dB _{G11} | Gain setting = G_{11} | | 7.0 | | dBm |
| | IP1dB _{G8} | Gain setting = G_8 | | 9.2 | | |
| | IP1dB _{G5} ⁴ | Gain setting = G_5 | 10.4 | 11.8 | | |
| | IP1dB _{G2} | Gain setting = G_2 | | 13.6 | | |
| Maximum saturated output power | Psat | Pin up to +20dBm | | 17 | | dBm |
| 2RF – 2LO rejection | 2x2 ⁶ | <ul style="list-style-type: none"> ▪ $P_{RF} = -10\text{ dBm}$ ▪ $F_{RFspur} = F_{LO} - F_{IF}/2$ | | -75 | -73 | dBc |
| 3RF – 3LO rejection | 3x3 | <ul style="list-style-type: none"> ▪ $P_{RF} = -10\text{ dBm}$ ▪ $F_{RFspur} = F_{LO} - F_{IF}/3$ | | -75 | | dBc |
| Channel Isolation | ISO _C | IF_B Pout versus IF_A w/ RF_A input | 47 | 48 | | dB |
| LO to IF leakage | ISO _{LI} | | | -38 | -35 | dBm |
| 2LO to IF leakage | ISO _{LI2} | | | -25 | | dBm |
| 3LO to IF leakage | ISO _{LI3} | | | -49 | | dBm |
| 4LO to IF leakage | ISO _{LI4} | | | -45 | | dBm |
| RF to IF leakage | ISO _{RI} | RF output power compared to measured IF output power | | -25 | -23 | dBc |
| LO to RF leakage | ISO _{LR} | | | -52 | | dBm |
| RF Return Loss | RL _{RF} | Single Ended 50 ohm | | -12 | | dB |

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- 3 – JEDEC 3.3V and JEDEC 1.8V logic
- 4 – Specification limits over voltage and temperature
- 5 – Max limit at Tcase = +105C
- 6 – Max limit over temperature extremes

IDTF1192 SPECIFICATION (MID BAND)

Typical Application Circuit, $V_{CC} = +3.3V$, $T_C = +25^\circ C$, $F_{RF} = 1900\text{ MHz}$, $F_{IF} = 199\text{ MHz}$, $F_{LO} = 1700\text{ MHz}$, $P_{LO} = 0\text{ dBm}$, $P_{IN} = -10\text{ dBm}$ per tone for all gain settings unless otherwise stated, $STBY_A = STBY_B = \text{LOW}$. EVkit IF transformer losses are de-embedded unless otherwise noted. Gain Setting = G_5 (~ 5 dB gain)

| Parameter | Symbol | Comment | min | typ | max | units | |
|--------------------------|----------------------|---|-------------|--------------|-------------|--------|--|
| Power Gain | G_{11} | Gain setting = G_{11} | | 10.8 | | dB | |
| | G_8 | Gain setting = G_8 | | 8.1 | | | |
| | G_5 | Gain setting = G_5 | 3.75 | 5.1 | 6.45 | | |
| | G_2 | Gain setting = G_2 | | 2.3 | | | |
| G5 Gain Change over temp | $G5_{TempDrift}$ | Tcase -40C to +105C referenced to +25C | | +0.7 -0.6 | | dB | |
| Gain Slope | $Gain_{SLOPE}$ | <ul style="list-style-type: none"> IF center 200MHz 100MHz BW | | +0.006 | | dB/MHz | |
| Noise Figure | NF_{G11} | Gain setting = G_{11} | | 8.7 | | dB | |
| | NF_{G8} | Gain setting = G_8 | | 9.1 | | | |
| | $NF_{G5}^{4, 5}$ | Gain setting = G_5 | | 9.8 | 11.4 | | |
| | NF_{G2} | Gain setting = G_2 | | 10.7 | | | |
| Blocking NF | NF_{BLK} | <ul style="list-style-type: none"> Gain Setting = G_{11} +100MHz offset blocker Pin = +4dBm | | 17 | | dB | |
| Input IP3 | $IIP3_{G11}$ | Gain setting = G_{11} 800 kHz tone separation | | 23 | | dBm | |
| | $IIP3_{G8}$ | Gain setting = G_8 800 kHz tone separation | | 25 | | | |
| | $IIP3_{G5}^4$ | Gain setting = G_5 800 kHz tone separation | 25 | 26 | | | |
| | $IIP3_{G2}$ | Gain setting = G_2 800 kHz tone separation | | 27 | | | |
| G3 IIP3 change over temp | $IIP3_{G3TempDrift}$ | Tcase -40C / +105C referenced to +25C | | -0.2/ +5 | | dB | |
| Output IP3 | $OIP3_{G11}$ | Gain setting = G_{11} 800 kHz tone separation | | 33.6 | | dBm | |
| | $OIP3_{G8}$ | Gain setting = G_8 800 kHz tone separation | | 33.6 | | | |
| | $OIP3_{G5}$ | Gain setting = G_5 800 kHz tone separation | | 29 | 31.0 | | |
| | | <ul style="list-style-type: none"> Gain setting = G_5 $T_c = +105^\circ C$ LO power = -3dBm $V_{cc} = 3.15V$ | 28.8 | 29.5 | | | |
| | $OIP3_{G2}$ | Gain setting = G_2 800 kHz tone separation | | | 29.0 | | |

IDTF1192 SPECIFICATION (MID BAND) CONTINUED

Typical Application Circuit, $V_{CC} = +3.3V$, $T_C = +25^\circ C$, $F_{RF} = 1900\text{ MHz}$, $F_{IF} = 199\text{ MHz}$, $F_{LO} = 1700\text{ MHz}$, $P_{LO} = 0\text{ dBm}$, $P_{IN} = -10\text{ dBm}$ per tone for all gain settings unless otherwise stated, $STBY_A = STBY_B = \text{LOW}$. EVkit IF transformer losses are de-embedded unless otherwise noted. Gain Setting = G_5 ($\sim 5\text{ dB gain}$)

| Parameter | Symbol | Comment | min | typ | max | units |
|--------------------------------|----------------|---|------------|------|------------|-------|
| Input P1dB | $IP1dB_{G11}$ | Gain setting = G_{11} | 6.0 | 7.7 | | dBm |
| | $IP1dB_{G8}$ | Gain setting = G_8 | | 10.1 | | |
| | $IP1dB_{G5}^4$ | Gain setting = G_5 | 11.3 | 12.7 | | |
| | $IP1dB_{G2}$ | Gain setting = G_2 | | 14.7 | | |
| Maximum saturated output power | $Psat$ | Pin up to +20dBm | | 17 | | dBm |
| 2RF – 2LO rejection | 2×2^6 | <ul style="list-style-type: none"> ▪ $P_{RF} = -10\text{ dBm}$ ▪ $F_{RFspur} = F_{LO} + F_{IF}/2$ | | -82 | -71 | dBc |
| 3RF – 3LO rejection | 3×3 | <ul style="list-style-type: none"> ▪ $P_{RF} = -10\text{ dBm}$ ▪ $F_{RFspur} = F_{LO} + F_{IF}/3$ | | -76 | | dBc |
| Channel Isolation | ISO_C | IF_B Pout versus IF_A w/ RF_A input | 40 | 47 | | dB |
| LO to IF leakage | ISO_{LI} | | | -31 | -22 | dBm |
| 2LO to IF leakage | ISO_{LI2} | | | -20 | | dBm |
| 3LO to IF leakage | ISO_{LI3} | | | -59 | | dBm |
| 4LO to IF leakage | ISO_{LI4} | | | -44 | | dBm |
| RF to IF leakage | ISO_{RI} | RF output power compared to measured IF output power | | -25 | -20 | dBc |
| LO to RF leakage | ISO_{LR} | | | -46 | | dBm |
| RF Return Loss | RL_{RF} | Single Ended 50 ohm | | -13 | | dB |

- 1 – Items in min/max columns in **bold italics** are Guaranteed by Test
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- 3 – JEDEC 3.3V and JEDEC 1.8V logic
- 4 – Specification limits over voltage and temperature
- 5 – Max limit at $T_{case} = +105^\circ C$
- 6 – Max limit over temperature extremes

IDTF1192 SPECIFICATION (HIGH BAND)

Typical Application Circuit, $V_{CC} = +3.3V$, $T_C = +25^\circ C$, $F_{RF} = 2600MHz$, $F_{IF} = 199MHz$, $F_{LO} = 2400MHz$, $P_{LO} = 0\text{ dBm}$, $P_{IN} = -10dBm$ per tone for all gain settings unless otherwise stated, $STBY_A = STBY_B = LOW$. EVkit IF transformer losses are de-embedded unless otherwise noted. Gain Setting = G_5 ($\sim 5\text{ dB gain}$)

| Parameter | Symbol | Comment | min | typ | max | units |
|--------------------------|------------------------|--|-------------|---------------|-------------|--------|
| Power Gain | G_{11} | Gain setting = G_{11} | | 10.3 | | dB |
| | G_8 | Gain setting = G_8 | | 7.5 | | |
| | G_5 | Gain setting = G_5 | 3.25 | 4.6 | 5.95 | |
| | | <ul style="list-style-type: none"> Gain setting = G_5 $F_{IF} = 469MHz$ $F_{LO} = 2130MHz$ | 2.4 | 4.0 | 5.6 | |
| G_2 | Gain setting = G_2 | | 1.8 | | | |
| G5 Gain Change over temp | $G5_{TempDrift}$ | Tcase -40C to +105C referenced to +25C | | +0.7 -0.7 | | dB |
| Gain Slope | Gain _{SLOPE1} | <ul style="list-style-type: none"> IF center 200MHz 100MHz BW | | +0.006 | | dB/MHz |
| | Gain _{SLOPE2} | <ul style="list-style-type: none"> IF center 370MHz 200MHz BW | | +0.008 | | dB/MHz |
| Noise Figure | NF_{G11} | Gain setting = G_{11} | | 10.0 | | dB |
| | NF_{G8} | Gain setting = G_8 | | 10.4 | | |
| | $NF_{G5}^{4,5}$ | Gain setting = G_5 | | 11.1 | 13 | |
| | | <ul style="list-style-type: none"> Gain setting = G_5 $F_{IF} = 469MHz$ $F_{LO} = 2130MHz$ | | 11.8 | | |
| NF_{G2} | Gain setting = G_2 | | 11.9 | | | |
| Input IP3 | $IIP3_{G11}$ | Gain setting = G_{11} 800 kHz tone separation | | 24 | | dBm |
| | $IIP3_{G8}$ | Gain setting = G_8 800 kHz tone separation | | 28 | | |
| | $IIP3_{G5}^4$ | Gain setting = G_5 800 kHz tone separation | 25 | 28 | | |
| | $IIP3_{G2}$ | Gain setting = G_2 800 kHz tone separation | | 29 | | |
| G3 IIP3 change over temp | $IIP3_{G3TempDrift}$ | Tcase -40C / +105C referenced to +25C | | -0.8/ +1.8 | | dB |

IDTF1192 SPECIFICATION (HIGH BAND) CONTINUED

Typical Application Circuit, $V_{CC} = +3.3V$, $T_C = +25^\circ C$, $F_{RF} = 2600MHz$, $F_{IF} = 199MHz$, $F_{LO} = 2400MHz$, $P_{LO} = 0\text{ dBm}$, $P_{IN} = -10\text{dBm}$ per tone for all gain settings unless otherwise stated, $STBY_A = STBY_B = LOW$. EVkit IF transformer losses are de-embedded unless otherwise noted. Gain Setting = G_5 ($\sim 5\text{ dB gain}$)

| Parameter | Symbol | Comment | min | typ | max | units | |
|--------------------------------|---|--|------|--|------|-------|--|
| Output IP3 | OIP3 _{G11} | Gain setting = G_{11} 800 kHz tone separation | | 34.7 | | dBm | |
| | OIP3 _{G8} | Gain setting = G_8 800 kHz tone separation | | 35.4 | | | |
| | OIP3 _{G5} | Gain setting = G_5 800 kHz tone separation <ul style="list-style-type: none"> • Gain setting = G_5 • $T_C = +105^\circ C$ • LO power = -3dBm • $V_{CC} = 3.15V$ | 28.4 | 32.5 | | | |
| | | | | <ul style="list-style-type: none"> • Gain setting = G_5 • $F_{IF} = 469MHz$ • $F_{LO} = 2130MHz$ | 29.3 | | |
| | | | | 31.0 | | | |
| OIP3 _{G2} | Gain setting = G_2 800 kHz tone separation | | 30.5 | | | | |
| Input P1dB | IP1dB _{G11} | Gain setting = G_{11} | | 8.3 | | dBm | |
| | IP1dB _{G8} | Gain setting = G_8 | | 10.8 | | | |
| | IP1dB _{G5} ⁴ | Gain setting = G_5 <ul style="list-style-type: none"> • Gain setting = G_5 • $F_{IF} = 469MHz$ • $F_{LO} = 2130MHz$ | 11.8 | 13.2 | | | |
| | | | | 13.1 | | | |
| IP1dB _{G2} | Gain setting = G_2 | | 14.6 | | | | |
| Maximum saturated output power | Psat | Pin up to +20dBm | | 17 | | dBm | |
| 2RF – 2LO rejection | 2x2 ⁶ | <ul style="list-style-type: none"> ▪ $P_{RF} = -10\text{ dBm}$ ▪ $F_{RFSDUR} = F_{LO} + F_{IF}/2$ | | -73 | -69 | dBc | |
| 3RF – 3LO rejection | 3x3 | <ul style="list-style-type: none"> ▪ $P_{RF} = -10\text{ dBm}$ ▪ $F_{RFSDUR} = F_{LO} + F_{IF}/2$ | | -76 | | dBc | |
| Channel Isolation | ISO _C | IF_B Pout versus IF_A w/ RF_A input | 46 | 48 | | dB | |
| LO to IF leakage | ISO _{LI} | | | -40 | -38 | dBm | |
| 2LO to IF leakage | ISO _{LI2} | | | -44 | | dBm | |
| 3LO to IF leakage | ISO _{LI3} | | | -68 | | dBm | |
| 4LO to IF leakage | ISO _{LI4} | | | -71 | | dBm | |
| RF to IF leakage | ISO _{RI} | RF output power compared to measured IF output power | | -32 | -30 | dBc | |
| LO to RF leakage | ISO _{LR} | | | -51 | | dBm | |
| RF Return Loss | RL _{RF} | Single Ended 50 ohm | | -17 | | dB | |

- 1 – Items in min/max columns in ***bold italics*** are Guaranteed by Test
- 2 – All other Items in min/max columns are Guaranteed by Design Characterization
- 3 – JEDEC 3.3V and JEDEC 1.8V logic
- 4 – Specification limits over voltage and temperature
- 5 – Max limit at Tcase = +105C
- 6 – Max limit over temperature extremes

SPUR MEASUREMENTS

| NxM (dBc, Gset=5 dB, LO=1700 MHz, IF=200 MHz, RFund=0 dBm at 1900 MHz, RFspur(MHz)=(N*LO(MHz)+IF(MHz))/M) | | | | | | | | | | | |
|---|----|--------|------|------|------|------|------|------|------|------|------|
| | | N (LO) | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| M (RF) | 1 | 0.0 | 37.7 | 22.0 | 64.3 | 39.4 | 73.3 | 52.4 | | | |
| | 2 | 54.3 | 69.5 | 53.7 | 64.2 | 50.4 | 57.0 | 61.3 | 71.8 | 62.1 | 88.7 |
| | 3 | 61.8 | 73.1 | 56.0 | 78.6 | 60.0 | 79.1 | 69.2 | 83.8 | 82.2 | 96.4 |
| | 4 | 68.0 | 88.8 | 94.4 | 91.5 | 97.2 | 96.7 | 87.7 | 94.1 | 87.1 | 98.7 |
| | 5 | >99 | >99 | 81.1 | 95.7 | 94.9 | 97.8 | 94.9 | >99 | 86.6 | 97.3 |
| | 6 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 |
| | 7 | >99 | >99 | >99 | >99 | >99 | >99 | 93.3 | >99 | >99 | >99 |
| | 8 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 |
| | 9 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 |
| | 10 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 |

| NxM (dBc, Gset=5 dB, LO=1700 MHz, IF=200 MHz, RFund=0 dBm at 1500MHz, RFspur(MHz)=(N*LO(MHz)-IF(MHz))/M) | | | | | | | | | | | |
|--|----|--------|------|------|------|------|------|------|------|------|------|
| | | N (LO) | | | | | | | | | |
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| M (RF) | 1 | 0.0 | 42.1 | 19.0 | 61.0 | 36.5 | 77.2 | 50.1 | | | |
| | 2 | 49.0 | 72.4 | 57.0 | 60.0 | 53.9 | 57.1 | 63.1 | 68.0 | 62.5 | 85.7 |
| | 3 | 69.8 | 78.6 | 51.5 | 75.9 | 62.1 | 75.3 | 66.0 | 84.5 | 76.2 | 91.4 |
| | 4 | 72.9 | 86.3 | 98.3 | 91.1 | 97.5 | >99 | 88.2 | 95.8 | 93.2 | >99 |
| | 5 | >99 | >99 | 85.2 | 96.9 | 86.7 | >99 | 93.2 | 98.2 | 88.6 | 98.3 |
| | 6 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 |
| | 7 | >99 | >99 | >99 | >99 | >99 | >99 | 89.5 | >99 | >99 | >99 |
| | 8 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 |
| | 9 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 |
| | 10 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | >99 | 98.2 |

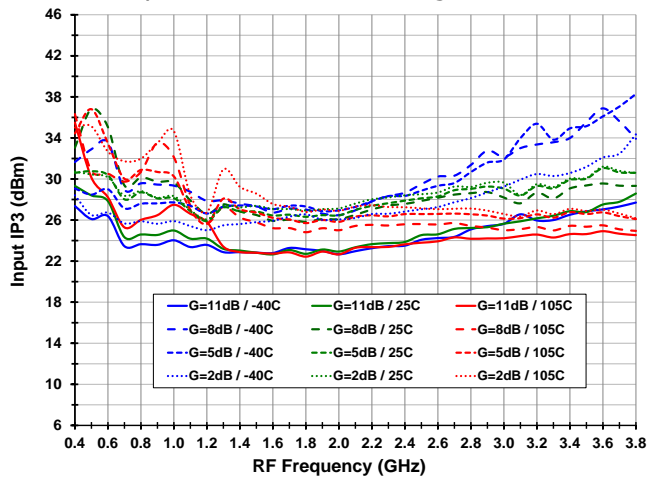
TYPICAL OPERATING CONDITIONS (TOC)

Unless otherwise Noted, the following Apply to the Typ Ops Graphs

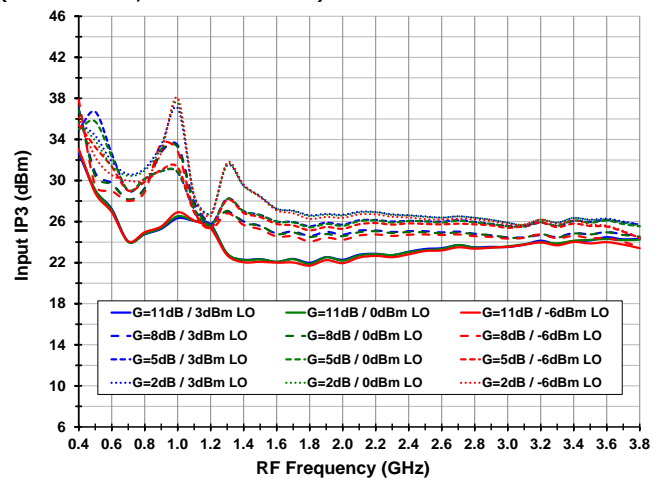
- High Side Injection for RF frequencies below 1.2 GHz
- Low Side Injection for RF frequencies from 1.3 to 2.7 GHz
- 199MHz IF
- 800KHz Tone Spacing
- All measurements fully de-embedded for trace, connector, transformer losses
- Pin = -10dBm for 2x2, 3x3, Gain
- Pout = 0 dBm/Tone for IP3
- LO level = 0 dBm, V_{CC} = 3.30 V
- Listed Temperatures are Case Temperature (TC = Case Temperature)
- Where noted, TA or TAMB = Ambient Temperature

TOCs (-) Fixed IF = 199 MHz - IIP3, OIP3, and Gain

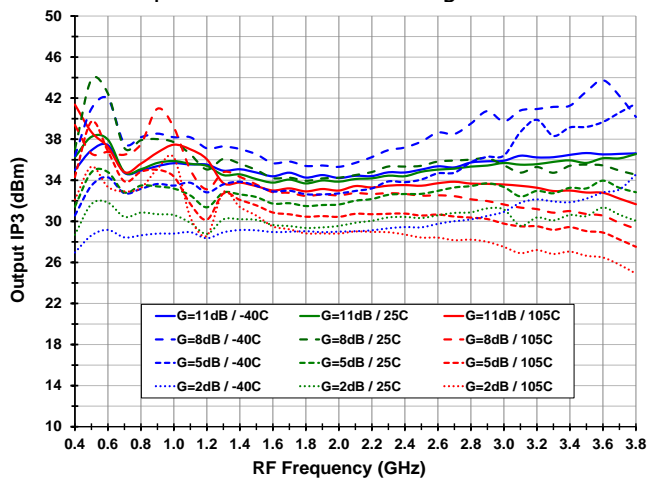
IIP3 vs. Temperature and Gain Setting



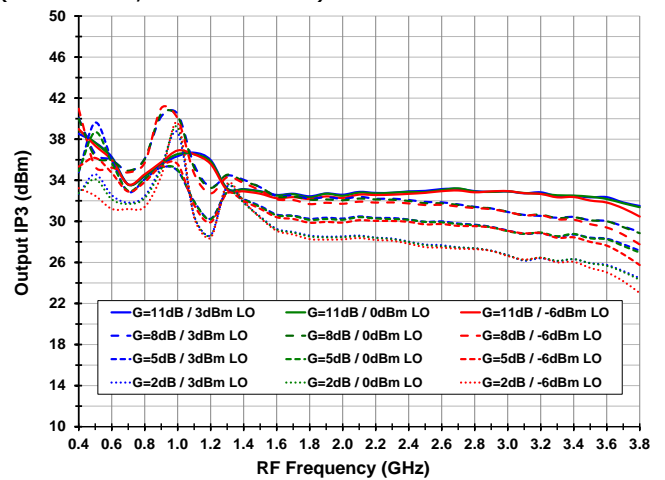
IIP3 vs. LO Power and Gain Setting (Vcc = 3.15, Tcase = 105C)



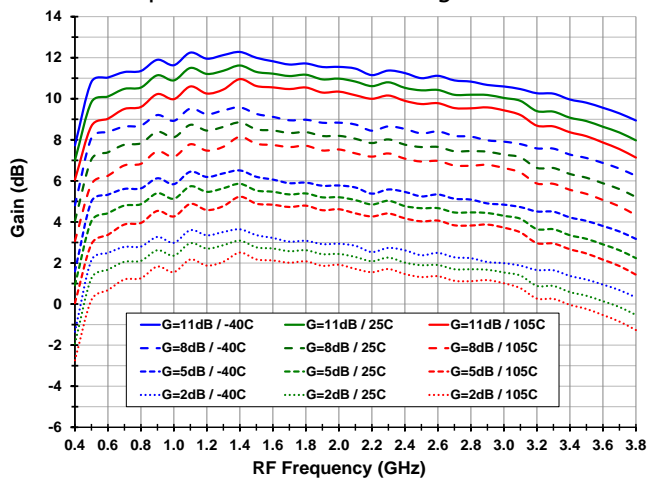
OIP3 vs. Temperature and Gain Setting



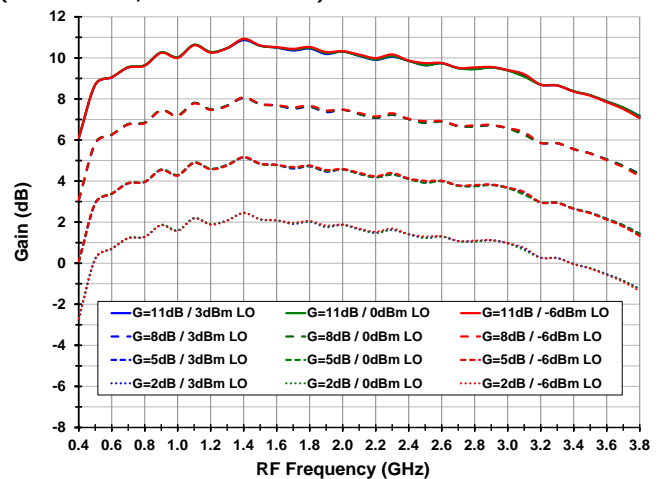
OIP3 vs. LO Power and Gain Setting (Vcc = 3.15, Tcase = 105C)



Gain vs. Temperature and Gain Setting

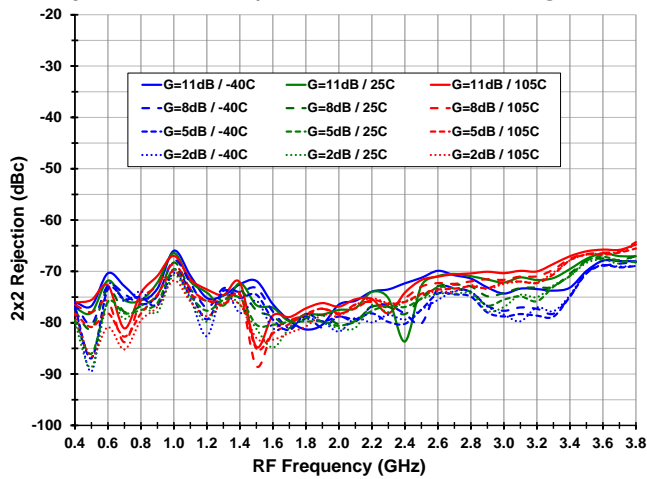


Gain vs. LO Power and Gain Setting (Vcc = 3.15, Tcase = 105C)

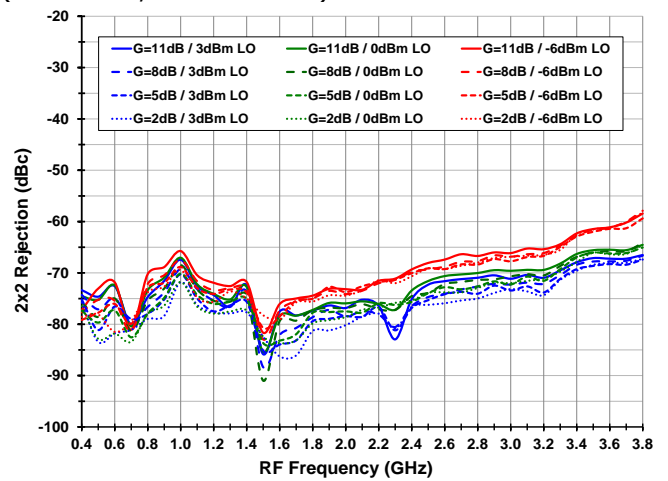


TOCs (-2-) Fixed IF = 199 MHz - 2x2 Rejection, 3x3 Rejection, and P1dB

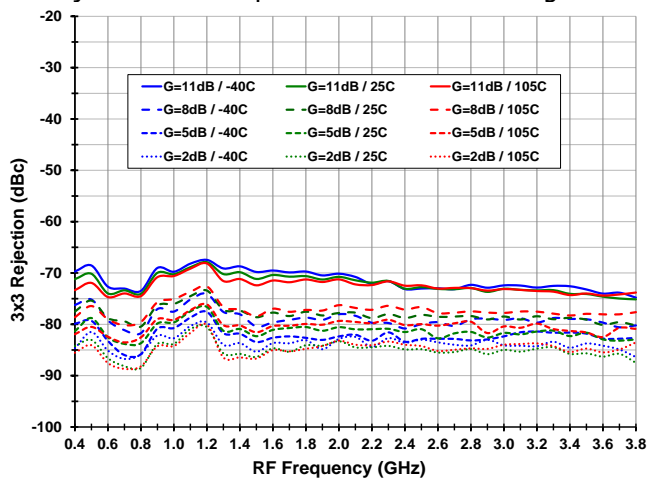
2x2 Rejection vs. Temperature and Gain Setting



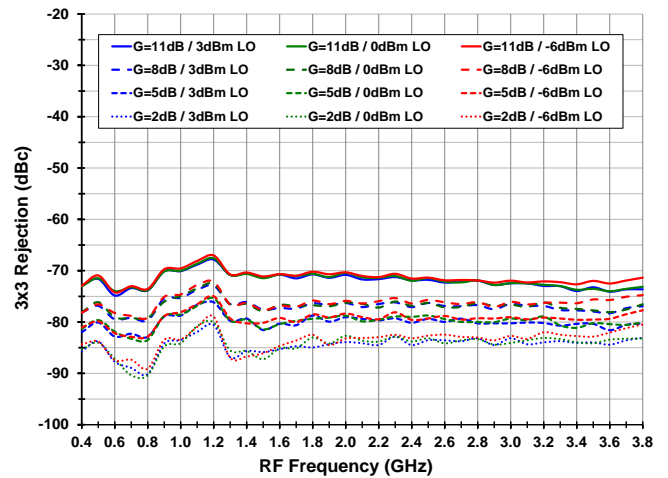
2x2 Rejection vs. LO Power and Gain Setting (Vcc = 3.15, Tcase = 105C)



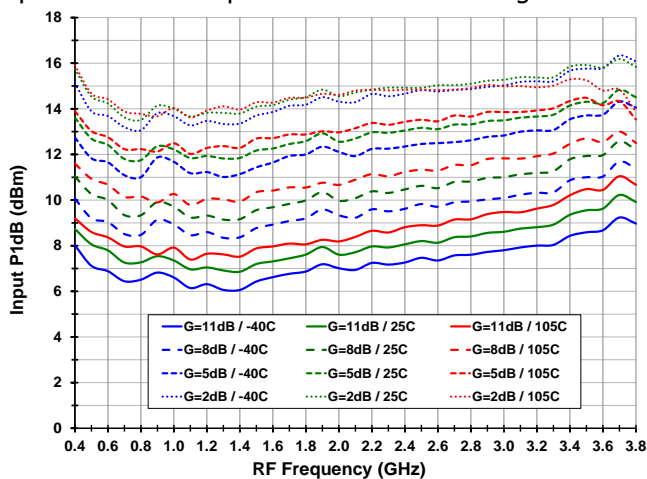
3x3 Rejection vs. Temperature and Gain Setting



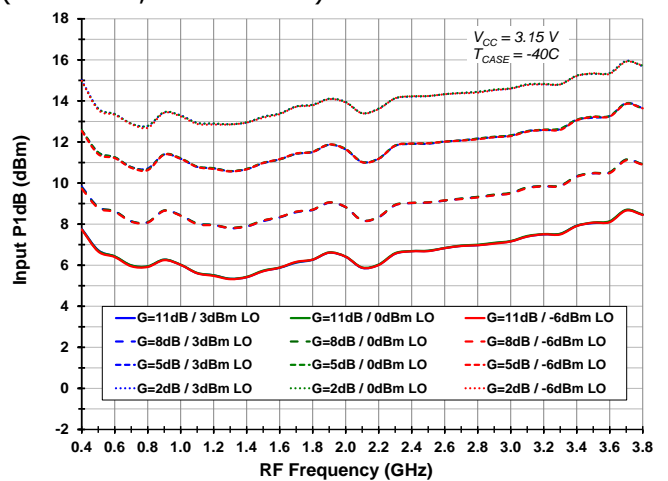
3x3 Rejection vs. LO Power and Gain Setting (Vcc = 3.15, Tcase = 105C)



Input P1dB vs. Temperature and Gain Setting

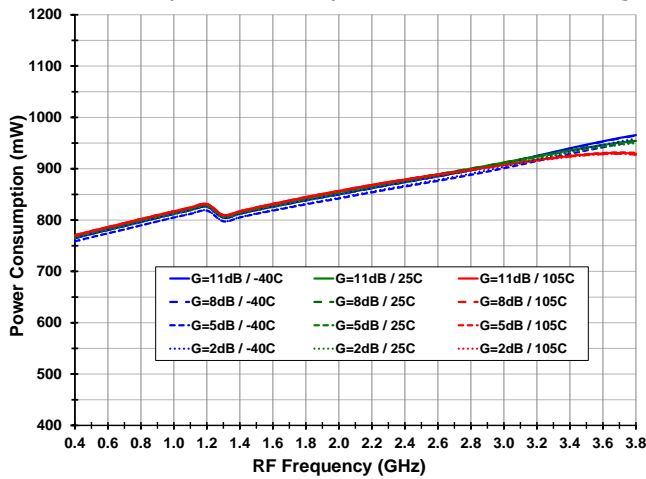


Input P1dB vs. LO Level and Gain Setting (Vcc = 3.15, Tcase = -40C)

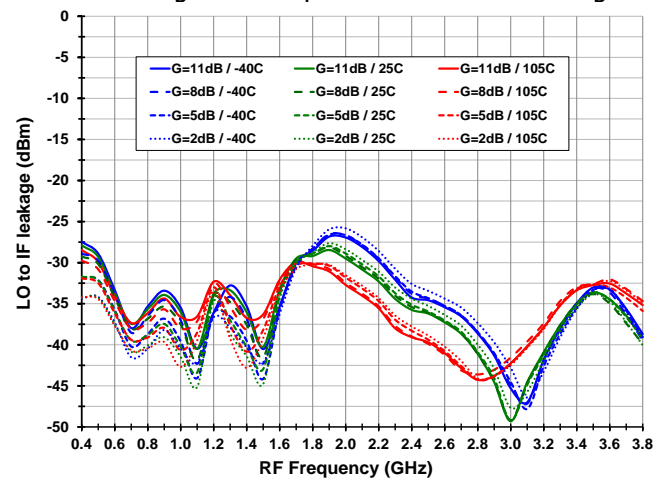


TOCs (-3-) Fixed IF = 199 MHz – Power Consumption, LO to IF Leakage, and RF to IF

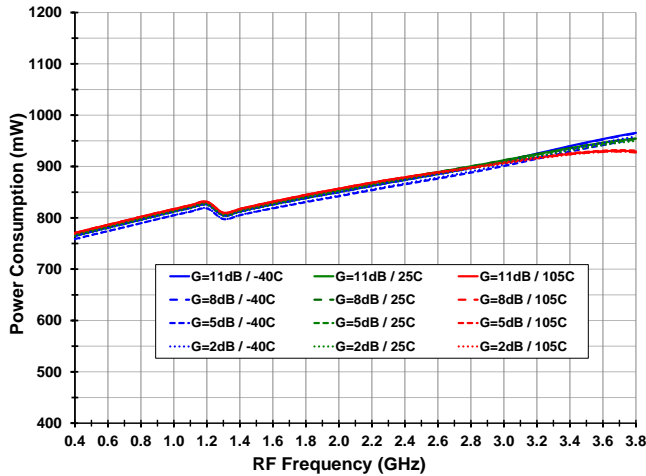
Power Consumption vs. Temperature and Gain Setting



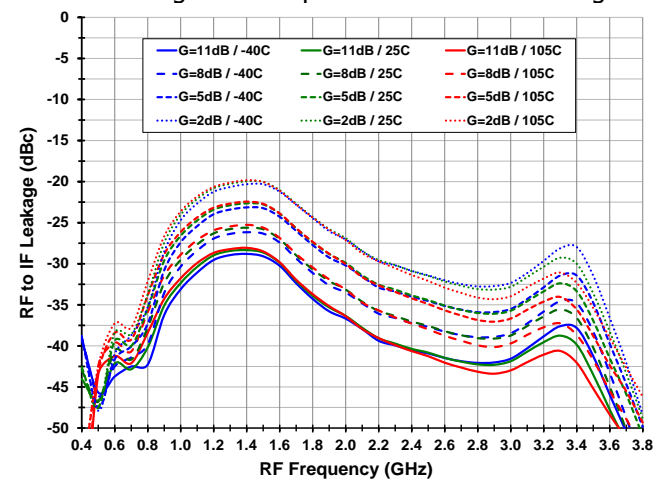
LO to IF Leakage vs. Temperature and Gain Setting



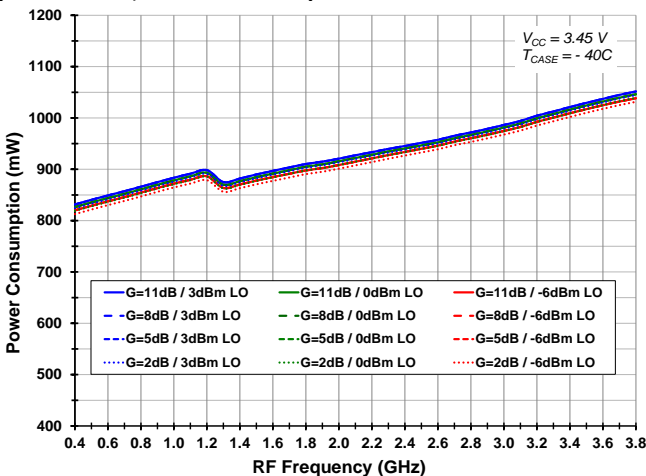
Power Consumption vs. Temperature and Gain Setting (Vcc = 3.15, Tcase = 105C)



RF to IF Leakage vs. Temperature and Gain Setting

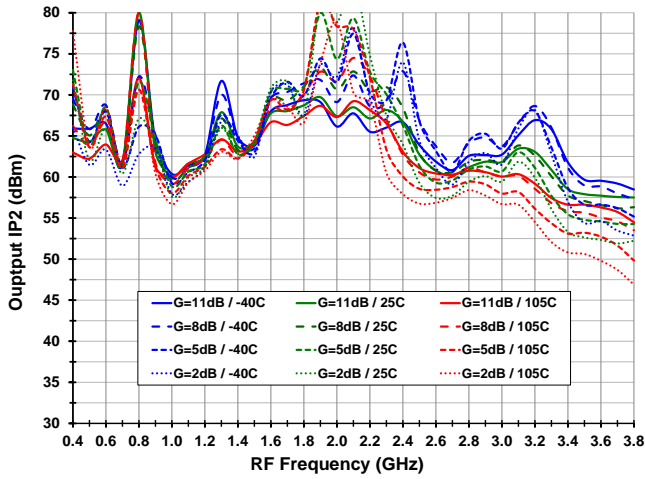


Power Consumption vs. Temperature and Gain Setting (Vcc = 3.45, Tcase = -45C)

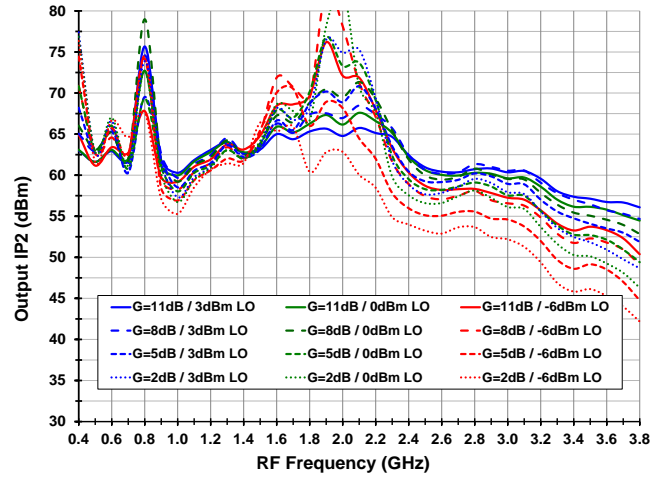


TOCs (-4-) Fixed IF = 199 MHz – Output IP2, Channel Isolation, Noise Figure

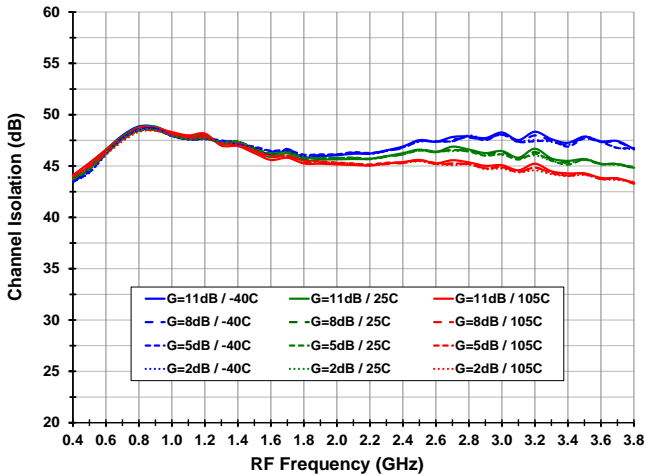
Output IP2 vs. Temperature and Gain Setting



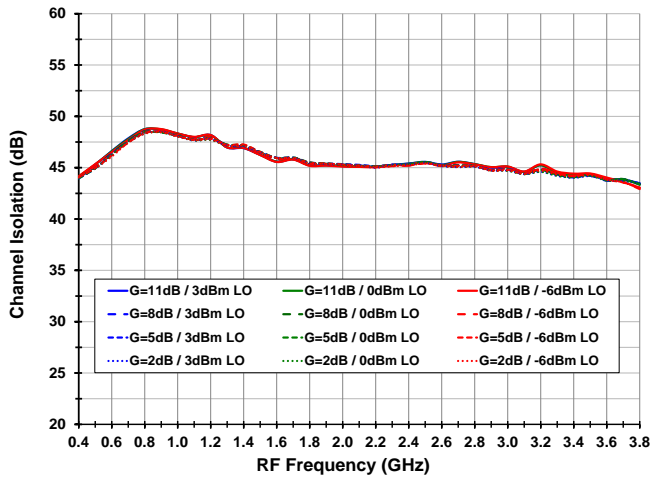
Output IP2 vs. Temperature and Gain Setting (Vcc = 3.15, Tcase = 105C)



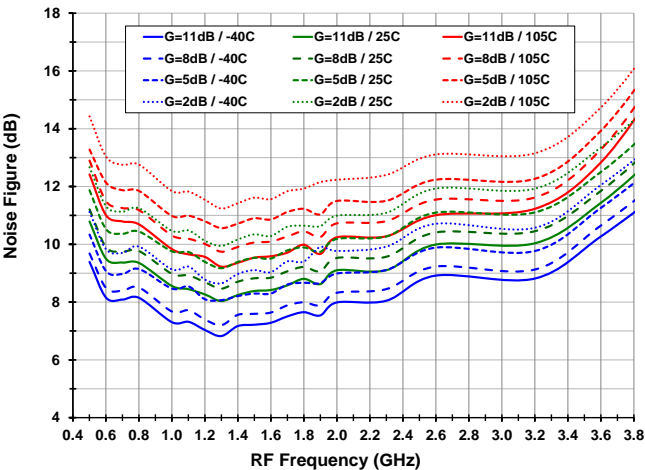
Channel Isolation vs. Temperature and Gain Setting



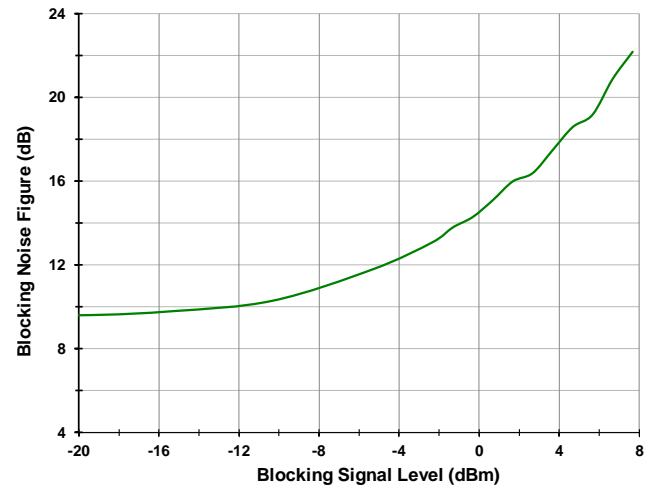
Channel Isolation vs. LO Power and Gain Setting (Vcc = 3.15, Tcase = 105C)



Noise Figure vs. Temperature and Gain Setting

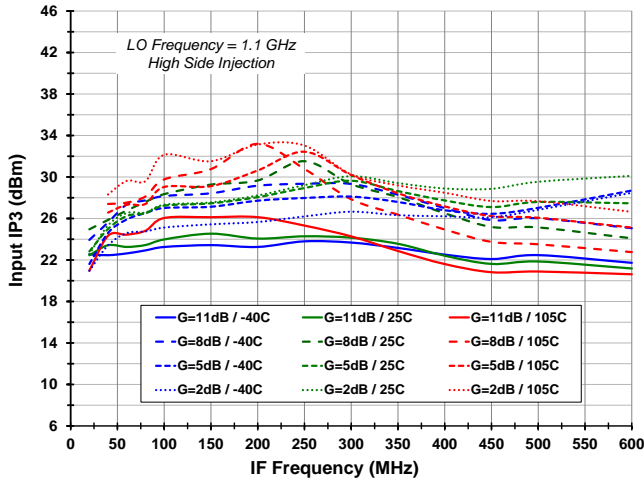


Blocking Noise Figure (Max Gain, LO=1700MHz, RF=1899MHz, Blocker=1999MHz, 25C ambient)

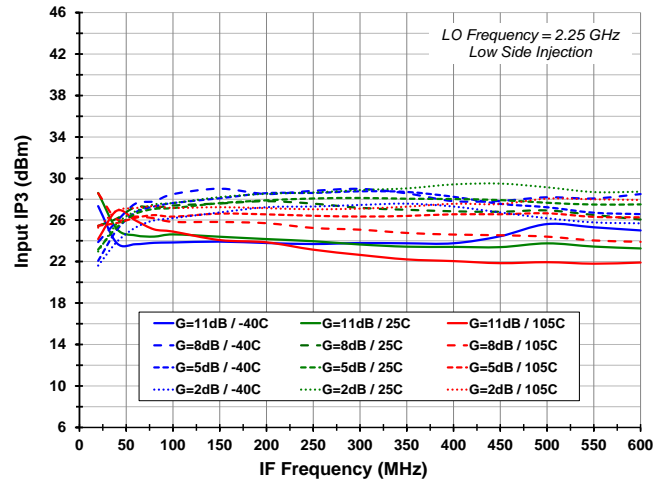


TOCs (-5-) Fixed LO = 1.1 GHz, 1.7 GHz, 2.25 GHz, 3.13 GHz – Input IP3

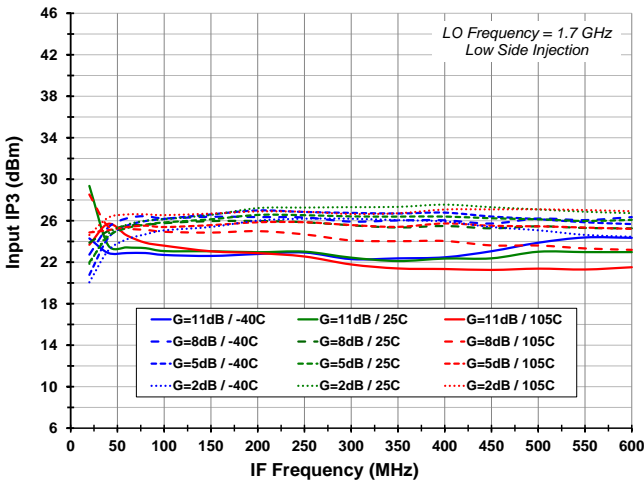
Input IP3 vs. Temperature and Gain Setting
(LO=1.1 GHz)



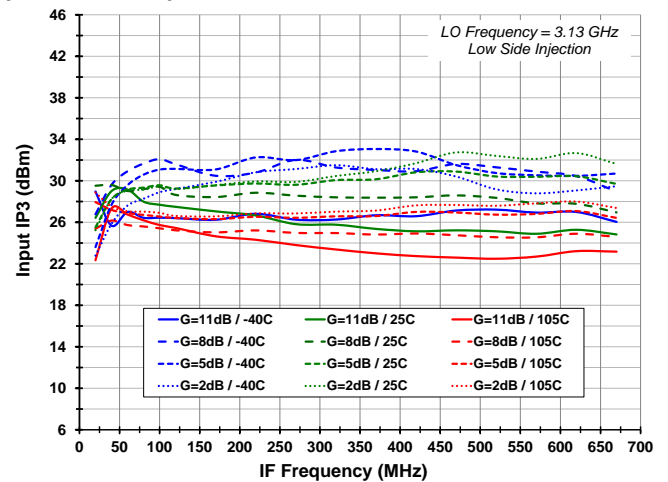
Input IP3 vs. Temperature and Gain Setting
(LO=2.25 GHz)



Input IP3 vs. Temperature and Gain Setting
(LO=1.7 GHz)

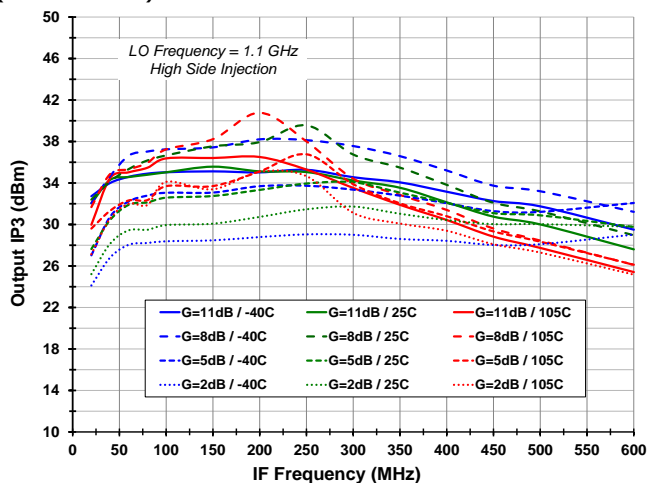


Input IP3 vs. Temperature and Gain Setting
(LO=3.13 GHz)

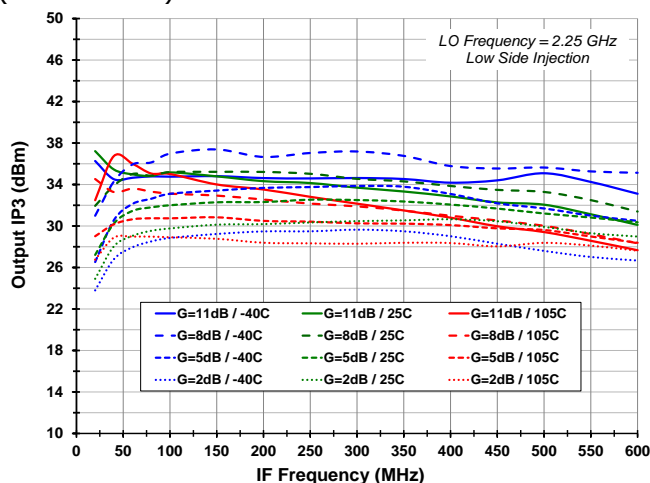


TOCs (-6-) Fixed LO = 1.1 GHz, 1.7 GHz, 2.25 GHz, 3.13 GHz – Output IP3

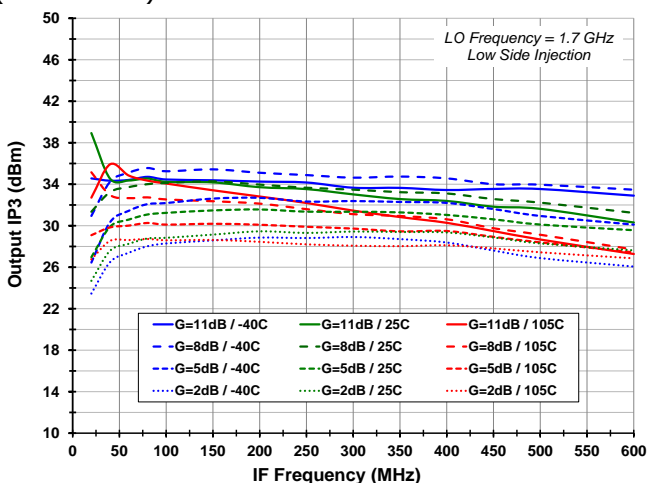
Output IP3 vs. Temperature and Gain Setting (LO=1.1 GHz)



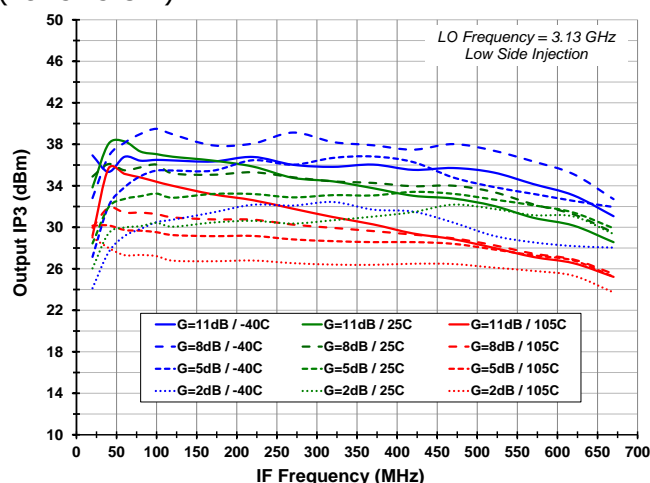
Output IP3 vs. Temperature and Gain Setting (LO=2.25 GHz)



Output IP3 vs. Temperature and Gain Setting (LO=1.7 GHz)

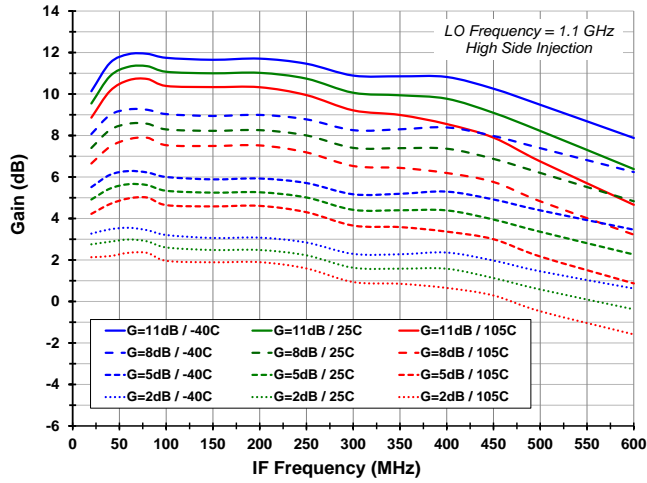


Output IP3 vs. Temperature and Gain Setting (LO=3.13 GHz)

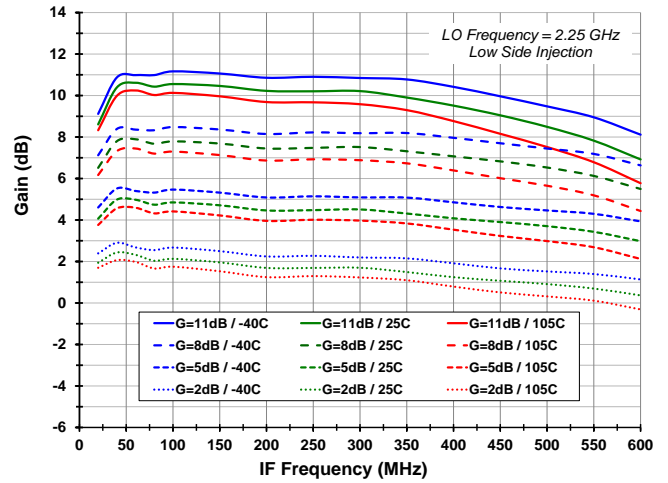


TOCs (-7-) Fixed LO = 1.1 GHz, 1.7 GHz, 2.25 GHz, 3.13 GHz – Gain

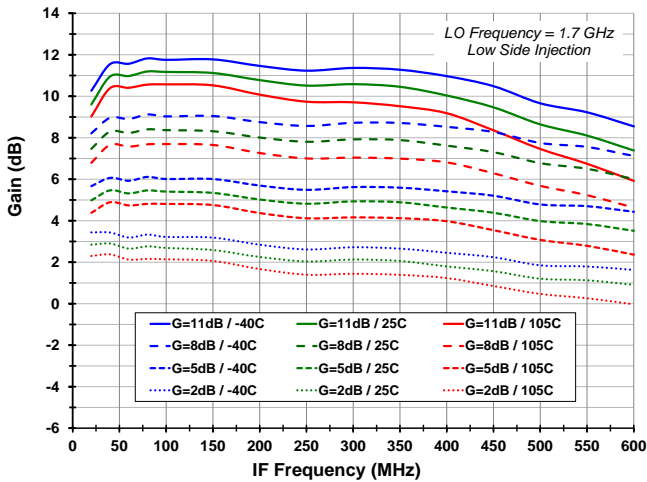
Gain vs. Temperature and Gain Setting
(LO=1.1 GHz)



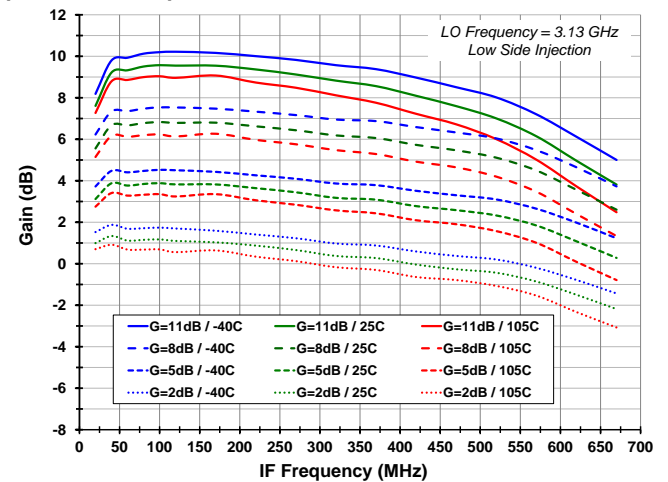
Gain vs. Temperature and Gain Setting
(LO=2.25 GHz)



Gain vs. Temperature and Gain Setting
(LO=1.7 GHz)

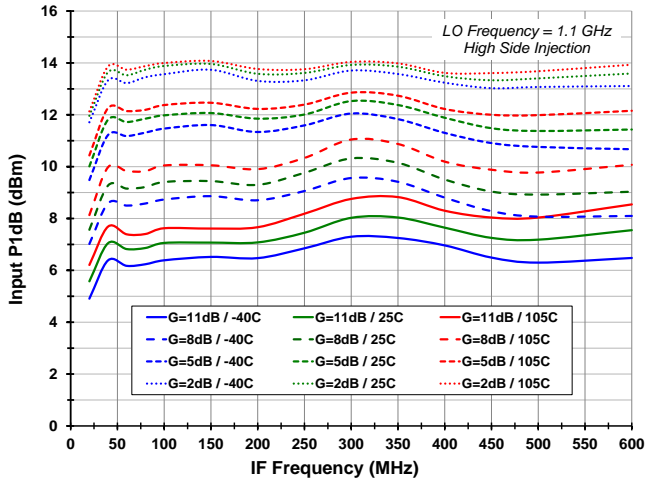


Gain vs. Temperature and Gain Setting
(LO=3.13 GHz)

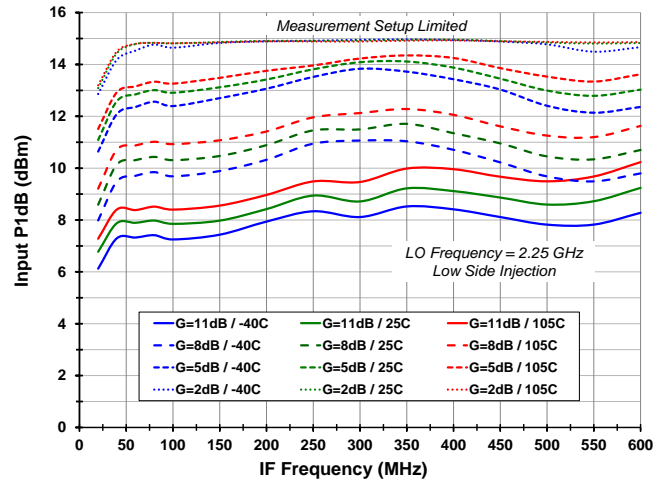


TOCs (-8-) Fixed LO = 1.1 GHz, 1.7 GHz, 2.25 GHz, 3.13 GHz – Input P1dB

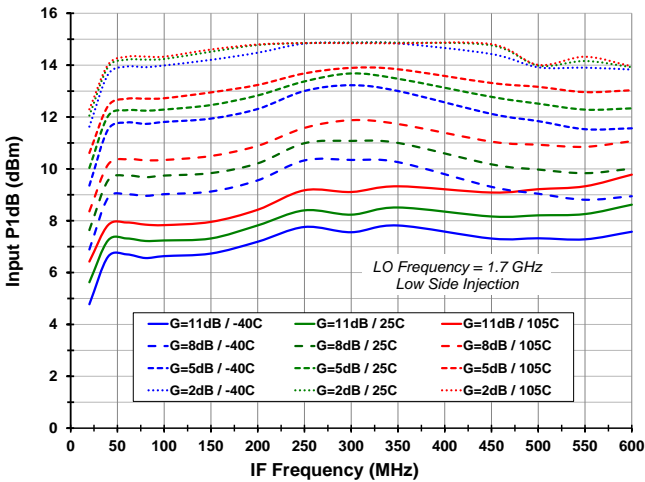
Input P1dB vs. Temperature and Gain Setting (LO=1.1 GHz)



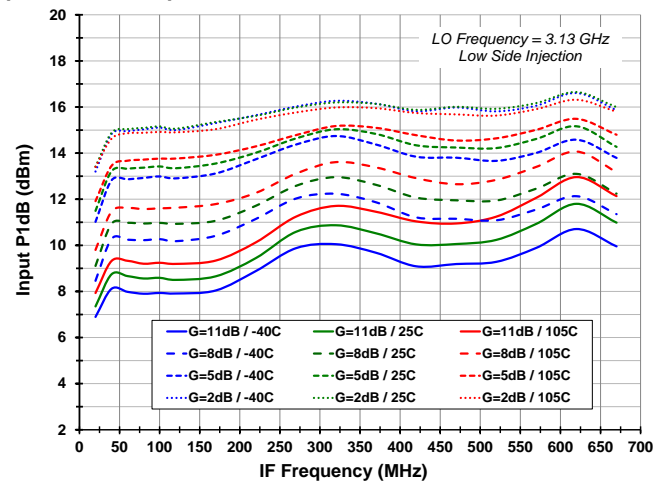
Input P1dB vs. Temperature and Gain Setting (LO=2.25 GHz)



Input P1dB vs. Temperature and Gain Setting (LO=1.7 GHz)

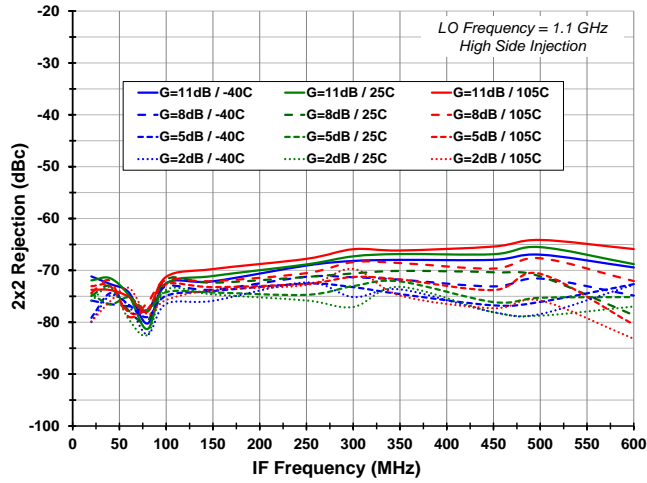


Input P1dB vs. Temperature and Gain Setting (LO=3.13 GHz)

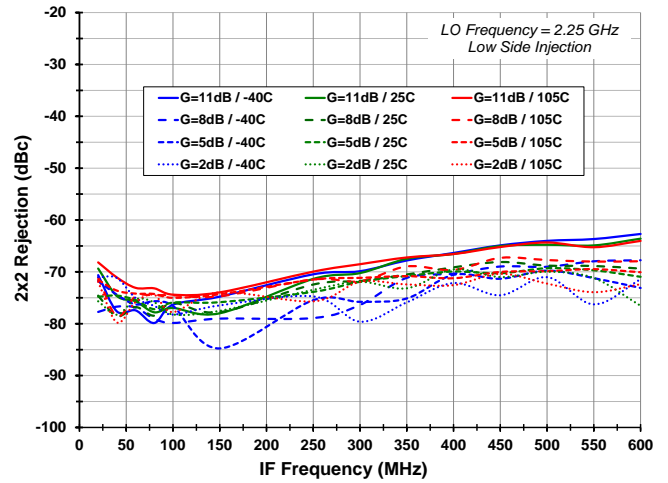


TOCs (-9-) Fixed LO = 1.1 GHz, 1.7 GHz, 2.25 GHz, 3.13 GHz – 2x2 Rejection

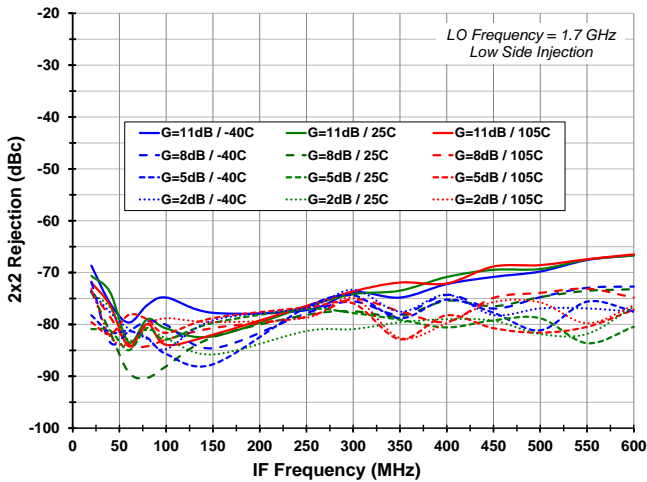
2x2 Rejection vs. Temperature and Gain Setting (LO=1.1 GHz)



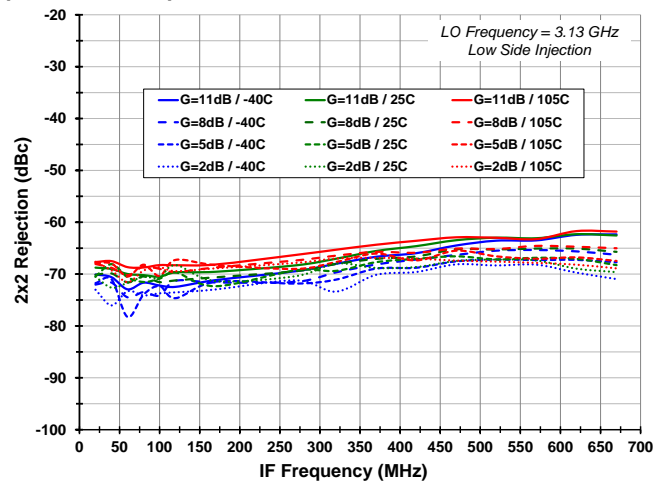
2x2 Rejection vs. Temperature and Gain Setting (LO=2.25 GHz)



2x2 Rejection vs. Temperature and Gain Setting (LO=1.7 GHz)

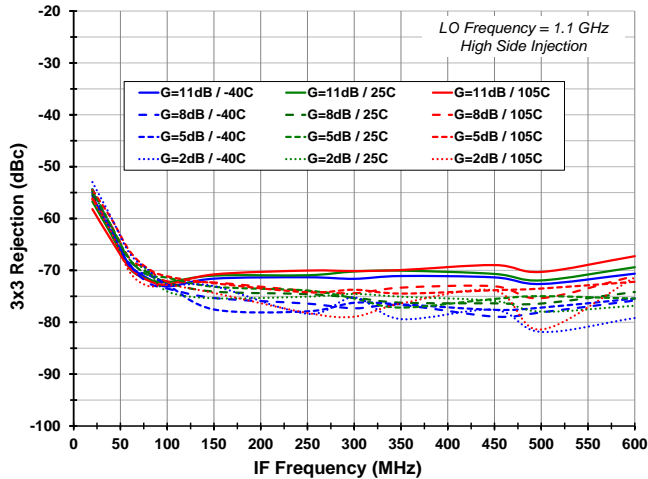


2x2 Rejection vs. Temperature and Gain Setting (LO=3.13 GHz)

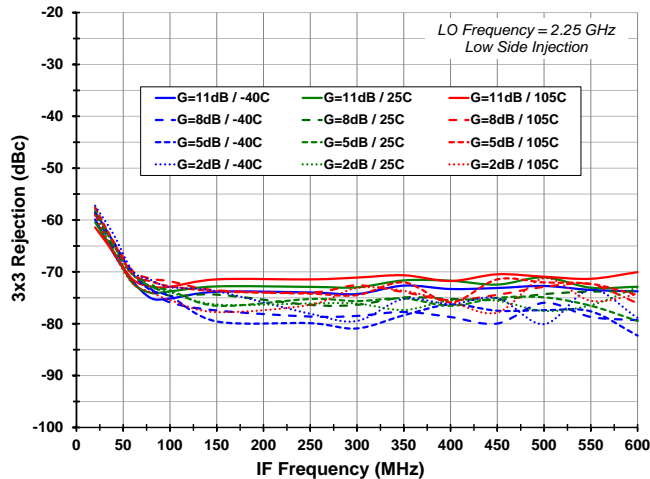


TOCs (-10-) Fixed LO = 1.1 GHz, 1.7 GHz, 2.25 GHz, 3.13 GHz – 3x3 Rejection

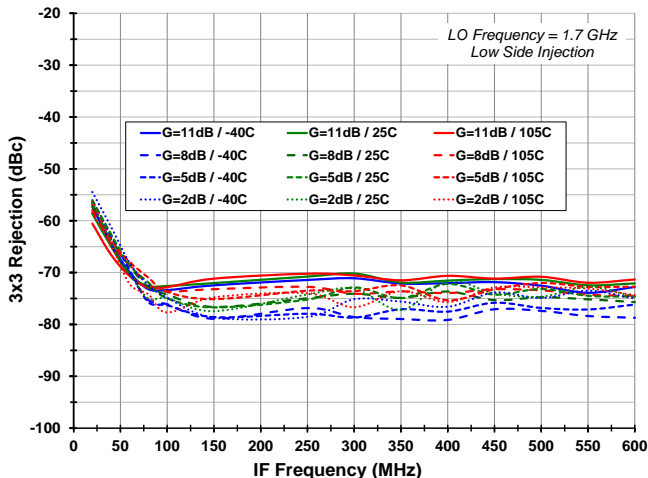
3x3 Rejection vs. Temperature and Gain Setting (LO=1.1 GHz)



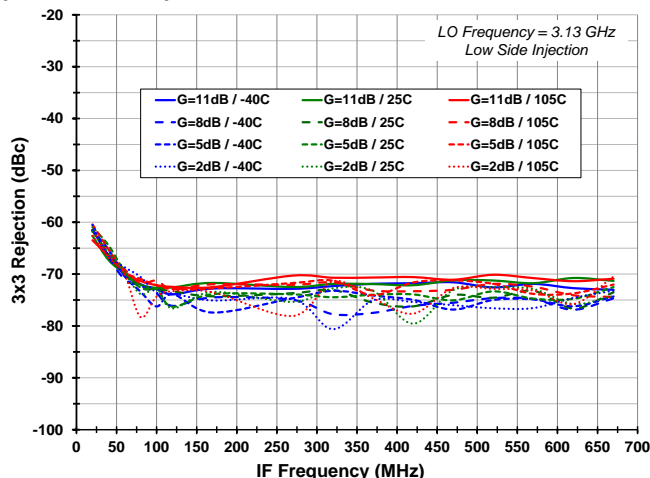
3x3 Rejection vs. Temperature and Gain Setting (LO=2.25 GHz)



3x3 Rejection vs. Temperature and Gain Setting (LO=1.7 GHz)

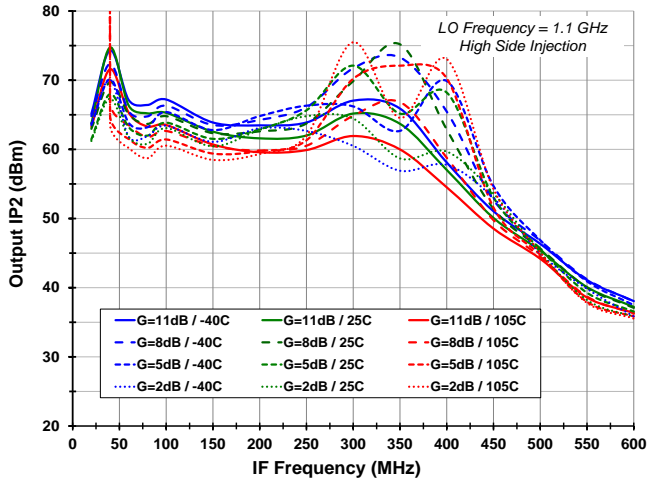


3x3 Rejection vs. Temperature and Gain Setting (LO=3.13 GHz)

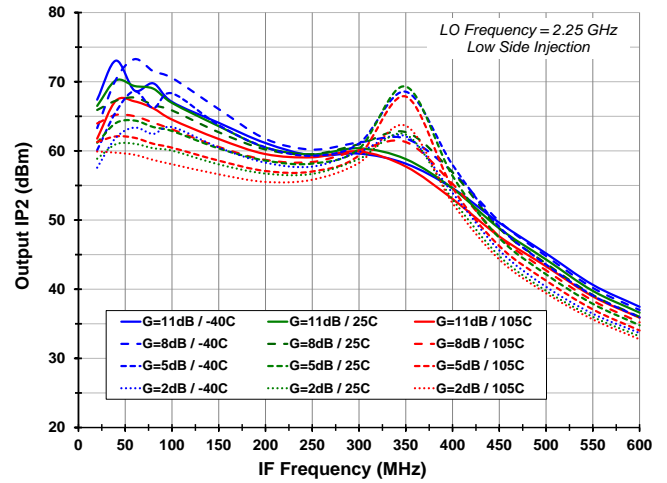


TOCs (-11-) Fixed LO = 1.1 GHz, 1.7 GHz, 2.25 GHz, 3.13 GHz – Output IP2

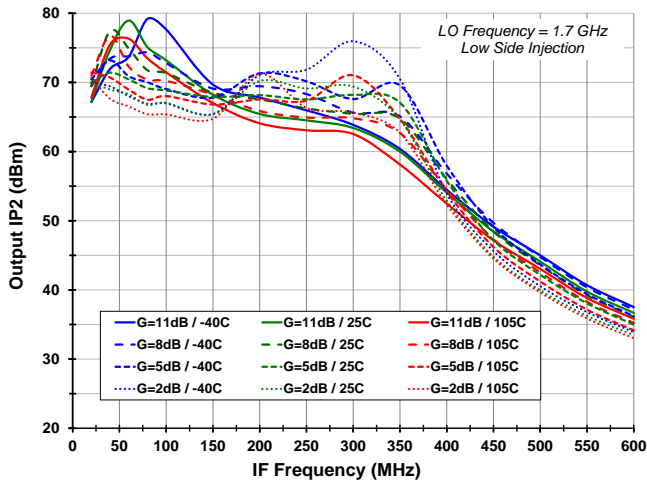
Output IP2 vs. Temperature and Gain Setting (LO=1.1 GHz)



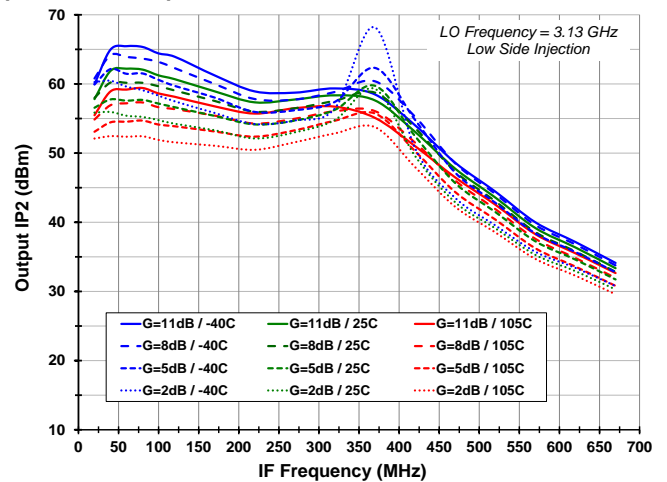
Output IP2 vs. Temperature and Gain Setting (LO=2.25 GHz)



Output IP2 vs. Temperature and Gain Setting (LO=1.7 GHz)

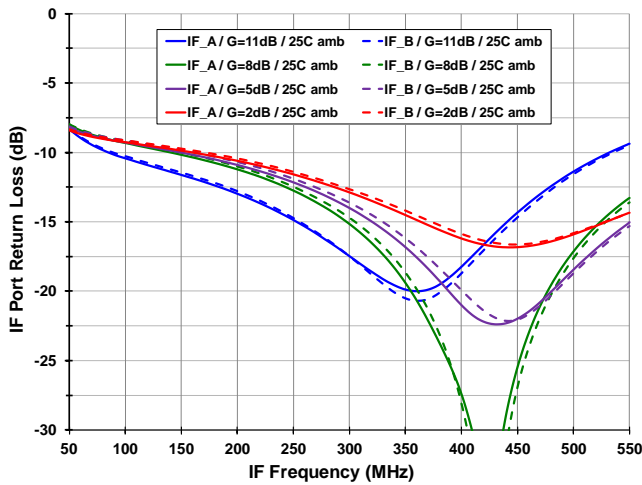


Output IP2 vs. Temperature and Gain Setting (LO=3.13 GHz)

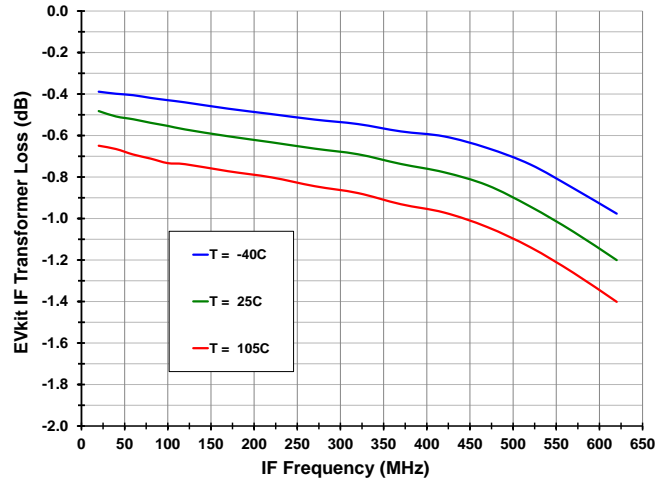


TOCs (-12-) Return Losses, Evaluation Kit Losses, STBY Settling Time

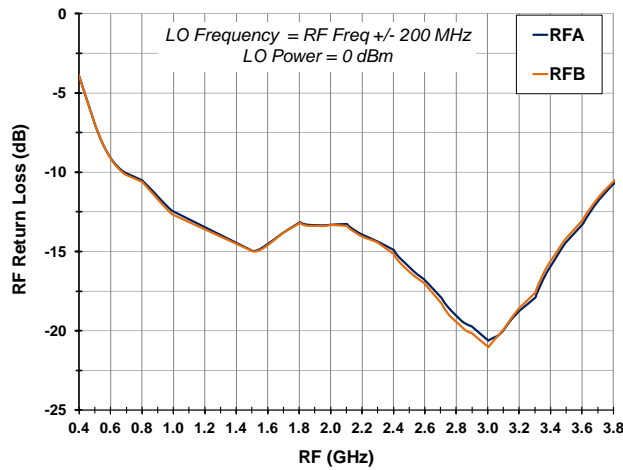
IF Port Return Loss vs. Gain Setting



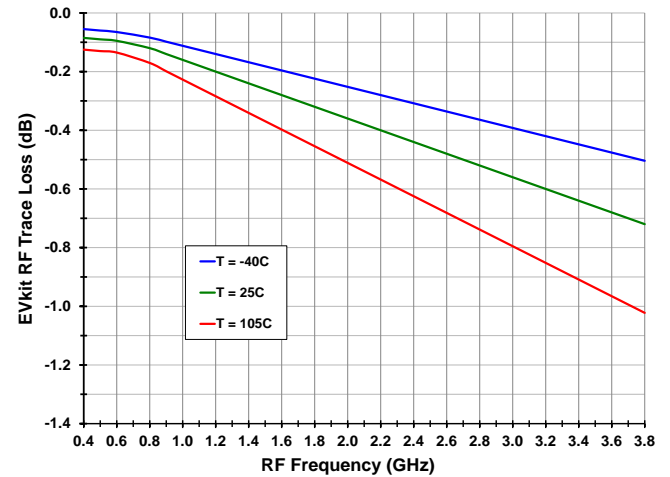
Evaluation Kit IF Transformer Loss vs. Temperature



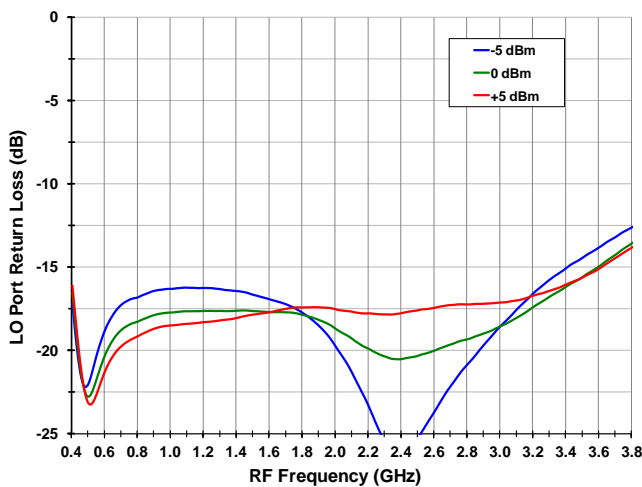
RF Port Return Loss vs. LO Frequency



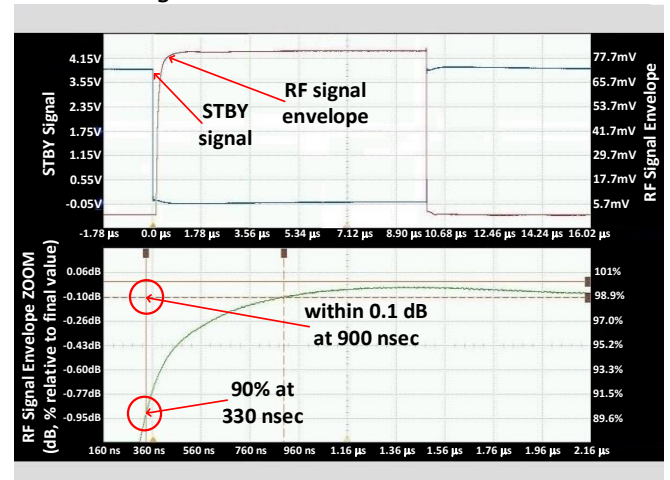
Evaluation Kit RF Trace Loss vs. Temperature



LO Port Return Loss vs. LO Power Level

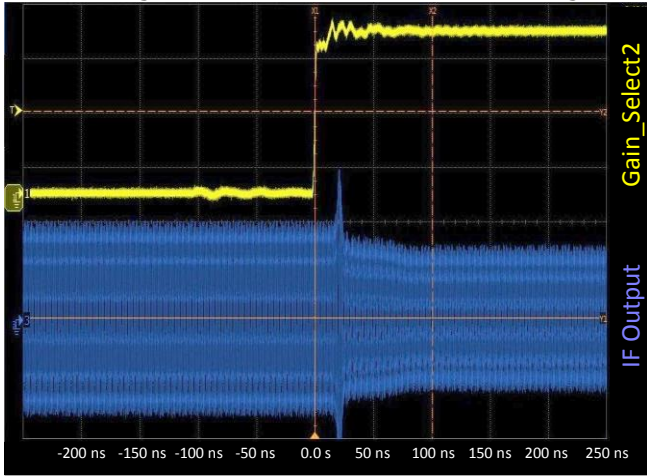


STBY Settling Time

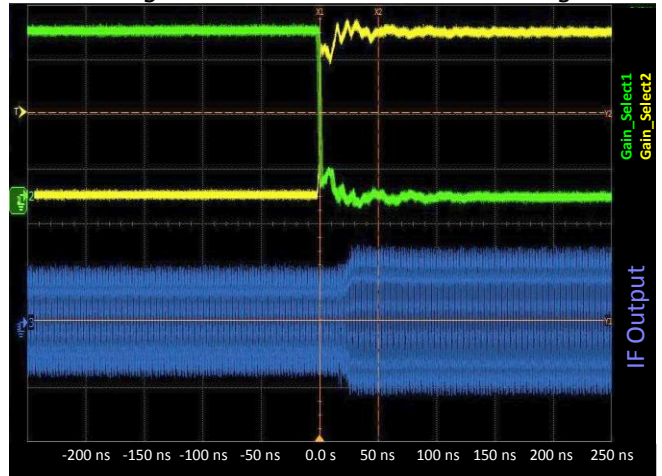


TOCs (-13-) Gain Settling Time

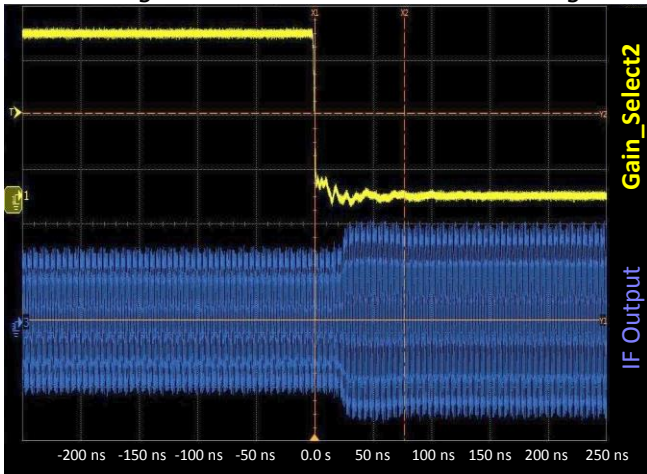
Gain Settling Time for 11 dB to 8 dB Gain Setting



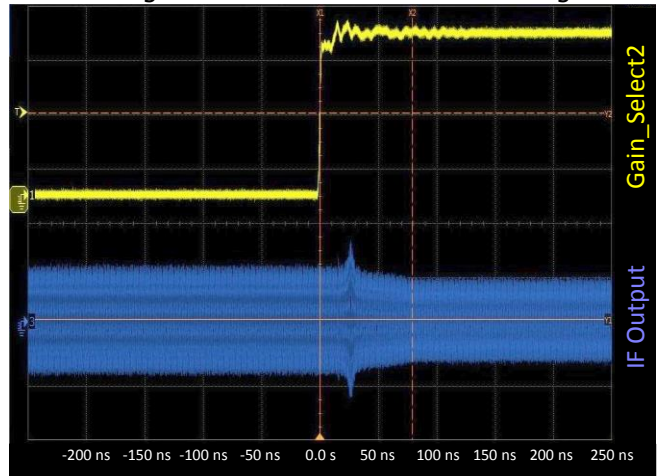
Gain Settling Time for 5 dB to 8 dB Gain Setting



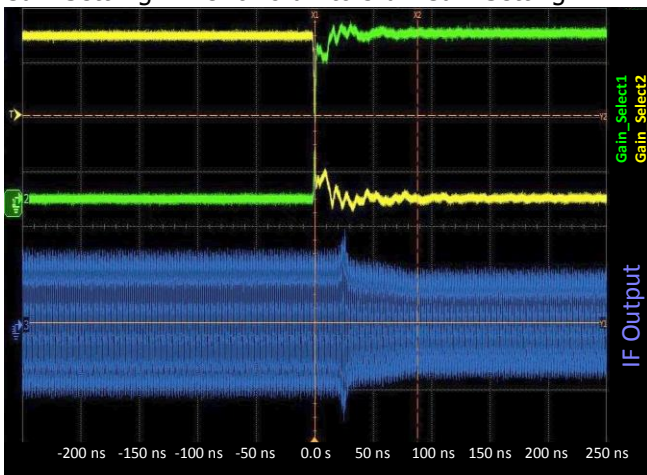
Gain Settling Time for 8 dB to 11 dB Gain Setting



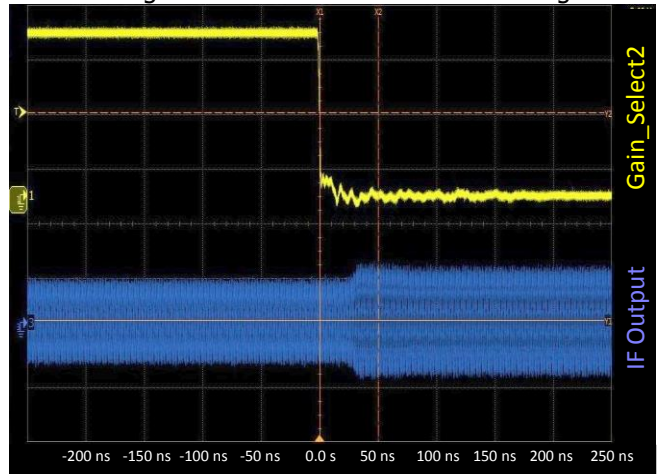
Gain Settling Time for 5 dB to 2 dB Gain Setting



Gain Settling Time for 8 dB to 5 dB Gain Setting

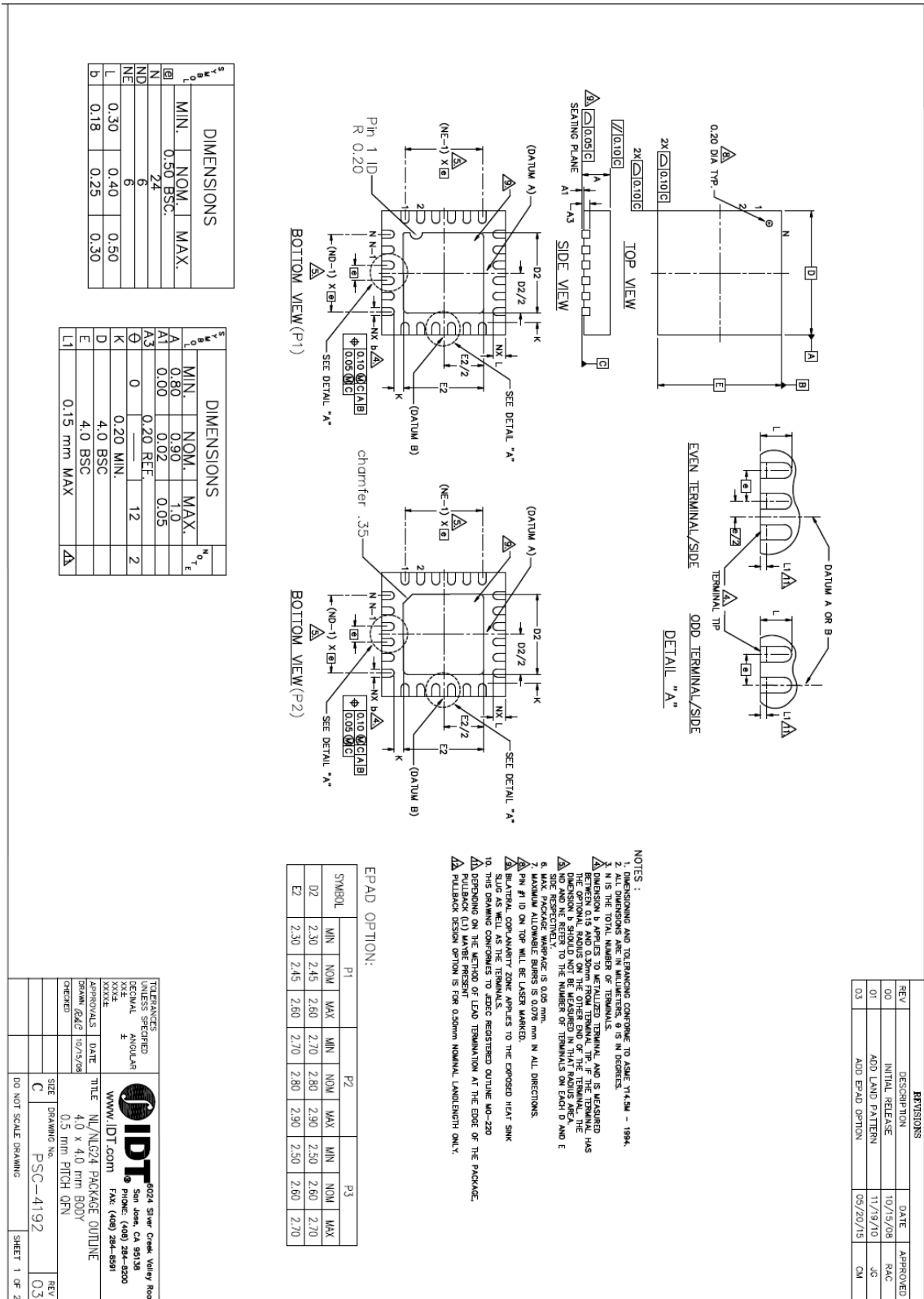


Gain Settling Time for 2 dB to 5 dB Gain Setting

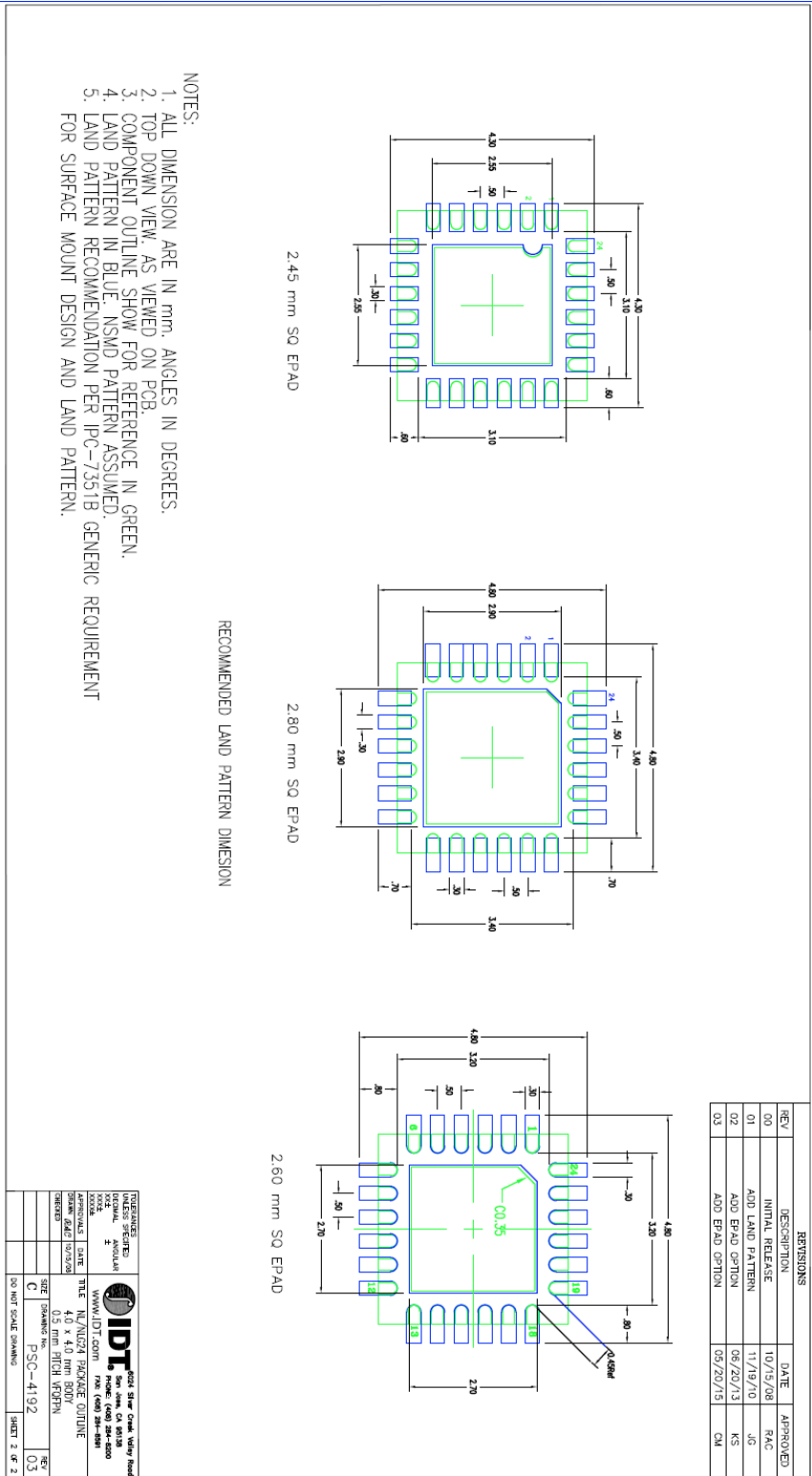


PACKAGE DRAWING

(4mm x 4mm 24-pin TQFN) with EPAD Option P1

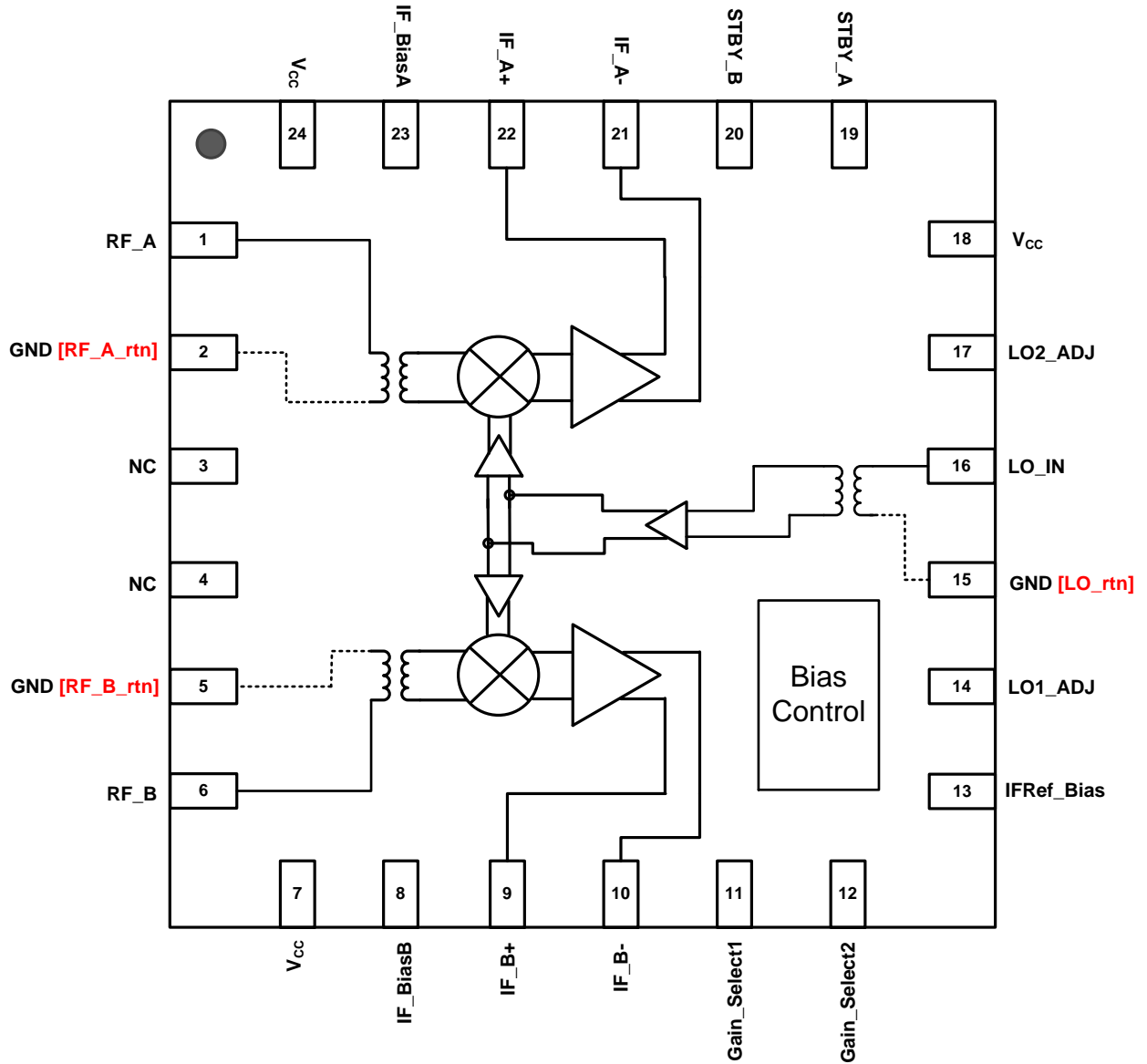


LAND PATTERN



PIN DIAGRAM

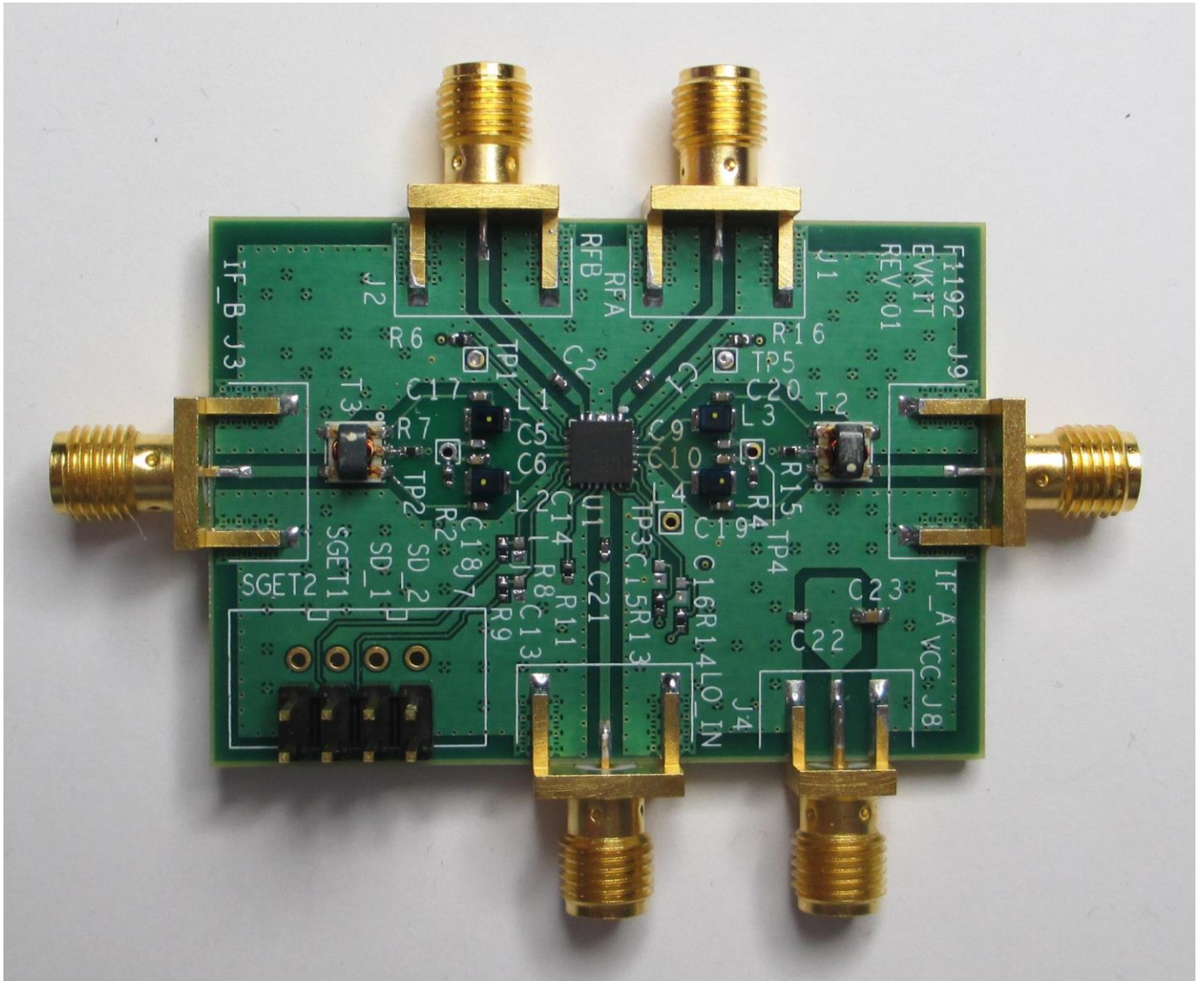
Red denotes internal connection



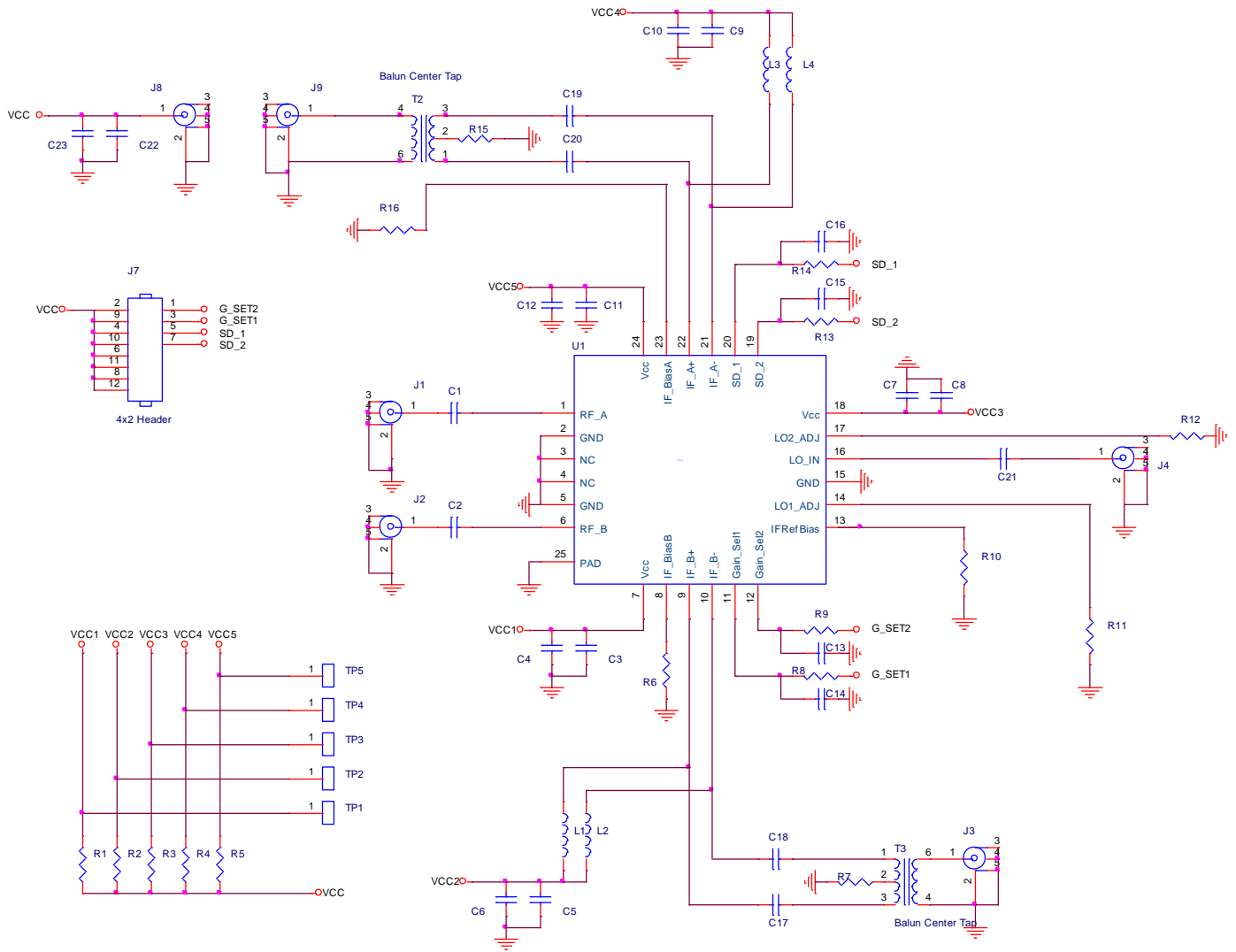
PIN DESCRIPTION

| Pin | Name | Function |
|-----------|----------------------------------|--|
| 1 | RF_A | Main Channel RF Input. Matched to 50 ohms. DO NOT apply DC to this pin. |
| 2, 5, 15 | RF_A_rtn, RF_B_rtn, LO_rtn | Transformer Ground Returns. Ground these pins. |
| 3, 4 | N.C. | Not Connected |
| 6 | RF_B | Diversity Channel RF Input. Matched to 50 ohms. DO NOT apply DC to this pin. |
| 7, 18, 24 | VCC | Power Supply. Bypass to GND with capacitors shown in the Typical Application Circuit as close as possible to pin. |
| 8 | IF_BiasB | Connect the specified resistor from this pin to ground to set the bias for the Diversity IF amplifier. |
| 9, 10 | IFB+, IFB- | Diversity Mixer Differential IF Output. Connect pullup inductors from each of these pins to VCC (see the Typical Application Circuit). |
| 11 | Gain_Select1 | Gain select control pin logic includes internal pull-down resistor. See gain select truth table for desired setting |
| 12 | Gain_Select2 | Gain select control pin logic includes internal pull-down resistor. See gain select truth table for desired setting |
| 13 | IFRef_Bias | Connect the specified resistor from this pin to ground to set the IF amplifier reference current. |
| 14 | LO1_ADJ | Connect 0 ohm resistor to GND for best performance. |
| 16 | LO_IN | Local Oscillator Input. DO NOT apply DC to this pin. |
| 17 | LO2_ADJ | Connect 0 ohm resistor to GND for best performance. |
| 19 | STBY_A | Standby Channel A (Low/Open = Channel A power ON, High = Channel A power OFF). Includes internal pull-down resistor. |
| 20 | STBY_B | Standby Channel B (Low/Open = Channel B power ON, High = Channel B power OFF). Includes internal pull-down resistor. |
| 21, 22 | IFA-, IFA+ | Main Mixer Differential IF Output. Connect pullup inductors from each of these pins to VCC (see the Typical Application Circuit). |
| 23 | IF_BiasA | Connect the specified resistor from this pin to ground to set the bias for the Main IF amplifier. |
| | — EP | Exposed Pad. Internally connected to GND. Solder this exposed pad to a PCB pad that uses multiple ground vias to provide heat transfer out of the device into the PCB ground planes. These multiple via grounds are also required to achieve the specified RF performance. |

EVKIT PICTURE



EVKIT / APPLICATIONS CIRCUIT



EVKIT BOM

| Part Reference | QTY | DESCRIPTION | Mfr. Part # | Mfr. |
|--|-----|--|--------------------|-----------------|
| C3, C5, C7, C9, C11, C22 | 6 | 1000pF ±5%, 50V, C0G Ceramic Capacitor (0402) | GRM1555C1H102J | Murata |
| C4, C6, C8, C10, C12, C17-C20, C23 | 10 | 10,000pF ±10%, 50V, X7R Ceramic Capacitor (0603) | GRM188R71H103KA01D | Murata |
| C21 | 1 | 1000pF ±5%, 50V, C0G Ceramic Capacitor (0402) | GRM1555C1H102J | Murata |
| C1, C2 | 2 | 39pF ±5%, 5V, C0G Ceramic Capacitor (0402) | GRM1555C1H390J | Murata |
| R1-R5, R7, R8, R9, R11, R12, R13, R14, R15 | 13 | 0 Ohm, 1/10W, Resistor (0402) | ERJ-2GE0R00X | Panasonic |
| R6, R16 | 2 | 390 Ohm ±1%, 1/10W, Resistor (0402) | ERJ-2RKF3900X | Panasonic |
| R10 | 1 | 1.74 kOhm ±1%, 1/10W, Resistor (0402) | ERJ-2RKF1741X | Panasonic |
| L1-4 | 4 | 390nH ±5%, 0.29 A, Ceramic Chip Inductor (0805) | 0805CS-391XJL | Coilcraft |
| T1-T2 | 2 | 4:1 Center Tap Balun | TC4-6TG2+ | Mini-Circuits |
| J7 | 1 | CONN HEADER VERT DBL 4POS GOLD | 67997-108HLF | FCI |
| J2-J6 | 3 | Edge Launch SMA Connector (Big) | 142-0701-851 | Emerson Johnson |
| J1 | 1 | Edge Launch SMA Connector (Small) | 142-0711-821 | Emerson Johnson |
| U1 | 1 | RF Dual Wideband Gain-Settable Downconverting Mixer 4x4 TQFN24 | F1192NLGI | IDT |
| | 1 | Printed Circuit Board | F1192 EVKIT REV 01 | IDT |

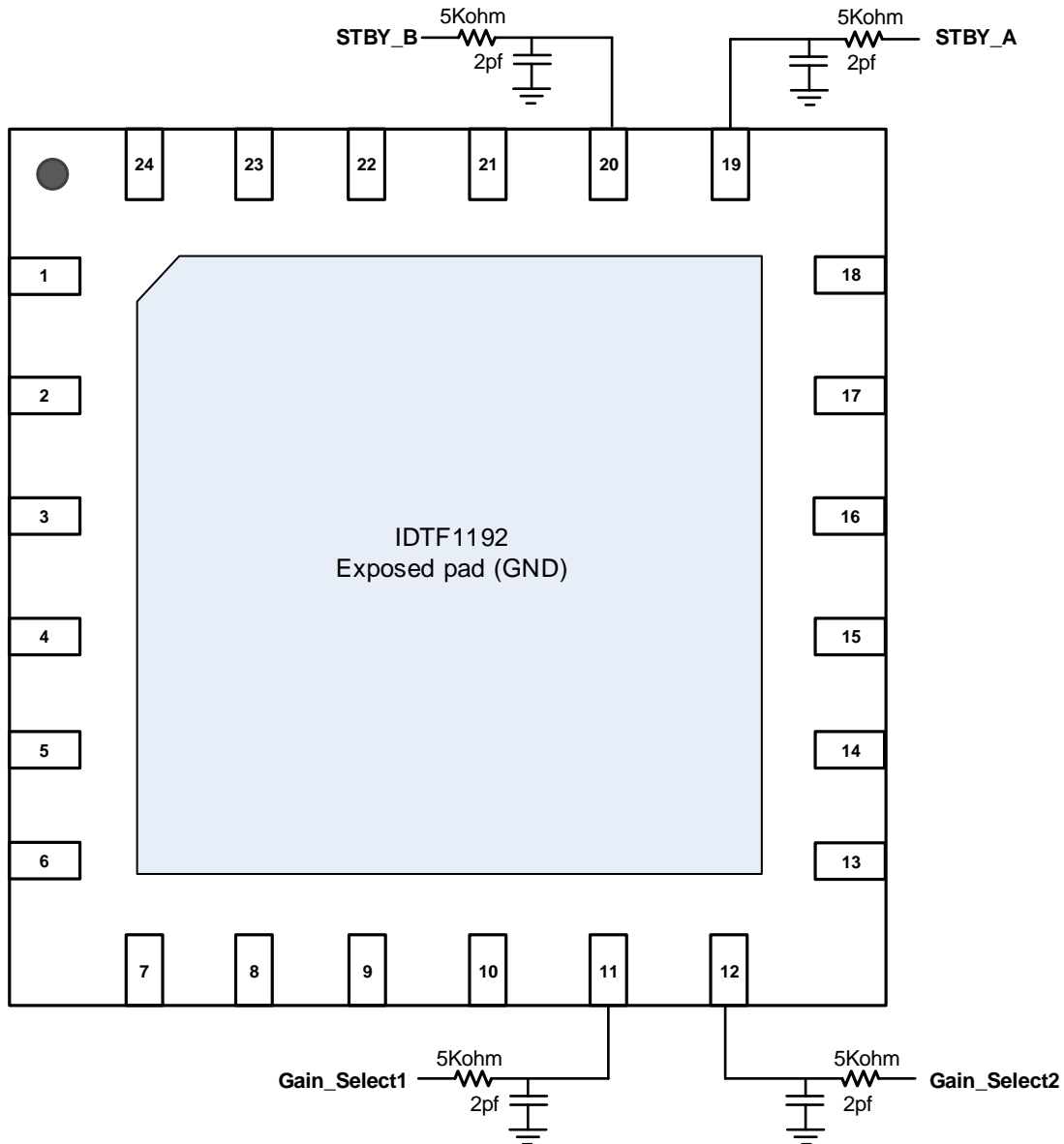
APPLICATIONS INFORMATION

Power Supplies

A common VCC power supply should be used for all pins requiring DC power. All supply pins should be bypassed with external capacitors to minimize noise and fast transients. Supply noise can degrade noise figure and fast transients can trigger ESD clamps and cause them to fail. Supply voltage change or transients should have a slew rate smaller than 1V/20uS. In addition, all control pins should remain at 0V (+/-0.3V) while the supply voltage ramps or while it returns to zero.

Control Pin Interface

If control signal integrity is a concern and clean signals cannot be guaranteed due to overshoot, undershoot, ringing, etc., provisions for an R-C circuit at the input of each control pin is recommended. This applies to pins 11, 12, 19, and 20 as shown below.



INDEPENDENT CHANNEL STANDBY

F1192 provides an independent path standby feature to reduce power consumption with a dedicated pin for each path. The following table summarizes the required pin logic to achieve the desired standby setting. Internal pull down resistors are included requiring no control to enable both channels.

| Channel A | STBY_A Pin 19 |
|-----------|---------------|
| ON | 0 |
| OFF | 1 |
| Channel B | STBY_B Pin 20 |
| ON | 0 |
| OFF | 1 |

GAIN SELECT

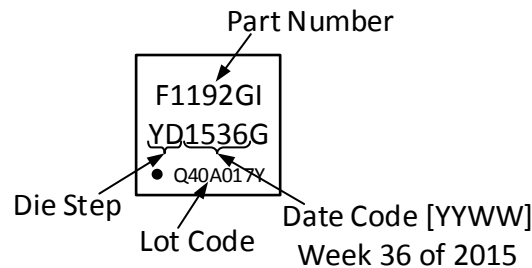
F1192 provides a gain select feature requiring 2 pins for logic control. The following table summarizes the required pin logic to achieve the desired gain setting. Internal pull down resistors are included requiring no control to set both channels to maximum gain.

| Desired Power Gain (dB) | Gain Select1 Pin 11 | Gain Select2 Pin 12 |
|-------------------------|---------------------|---------------------|
| 11 | 0 | 0 |
| 8 | 0 | 1 |
| 5 | 1 | 0 |
| 2 | 1 | 1 |

DEFAULT START-UP

Upon start-up, the device gain will be whatever the gain select pins are set for as defined in the table above.

TOP MARKINGS



REVISION HISTORY SHEET

| Rev | Date | Page | Description of Change |
|------------|-------------------|-------------|--|
| 0 | February 19, 2016 | | This is the first release of the F1192 datasheet |

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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

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