## DESCRIPTION

This document describes the specifications for the F0562 2300MHz to 2700MHz dual path Sampling IF (SIF) Receiver used in Multi-mode, Multi-carrier BaseStation Receivers. Refer to the Part # Matrix below describing the frequency coverage of the complete series. This series is offered with high side or low side LO injection options for all UTRA bands and offers significantly better Noise and Distortion performance than currently available solutions. IF frequencies from 60MHz to 450MHz are supported.

The F0562 SIF provides 29dB gain and offers 47dB gain adjustment in 1dB steps designed to operate with a single 5V supply. Nominally, the device offers +44 dBm Output IP3 using 480mA of $I_{CC}$. Alternately one can configure the device in low current (LC) mode to reduce power consumption to < 2 Watts.

This device is packaged in a 10 x 10 mm 68-pin Thin QFN with 50 ohm single-ended RF input and 200 ohm differential IF output impedances for ease of integration into the receiver lineup. The 200 ohm differential IF output can easily be matched to 100 ohms differential per the application drawing.

## COMPETITIVE ADVANTAGE

Renesas' Zero-Distortion™ mixer in combination with interstage filtering and Renesas' proprietary FlatNoise™ DVGA improves system SNR to the point where the external SAW filter can be eliminated. Both $IP3_O$ & NF are kept virtually flat while gain is backed off, enhancing SNR significantly under high level interferer conditions, and greatly benefiting 2G/3G/4G Multi-Carrier IF sampling receivers. In addition, total power consumption is reduced by 35% compared to conventional solutions.

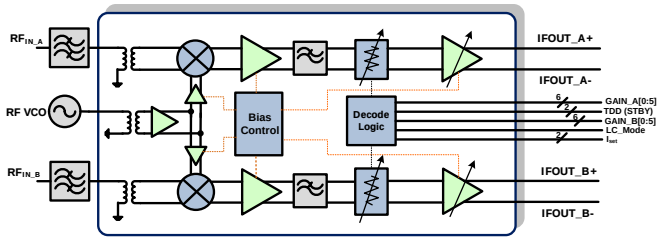
- ✓ No external SAW is needed
- ✓ Reduced Power Consumption by 35%
- ✓ NF and OIP3 virtually flat for first 13dB gain reduction

The fast-settling, parallel mode gain step of 1.0dB coupled with the excellent differential non-linearity allow for SNR to be maximized further by targeting the minimum necessary gain in small, accurate increments. The matched output does not require a terminating resistor, thus the gain and distortion performance are preserved when driving Bandpass Anti-Alias filters.

## FEATURES

- Dual Path for Diversity Systems
- Combines FlatNoise™ and Zero-Distortion technologies
- 29dB Total Power Gain
- Ultra linear +44dBm $IP3_O$
- Low NF: 9.9dB at $G_{MAX}$
- 50 Ω input impedance
- Matched 100Ω differential output impedance
- Ultra high +19.8dBm P1dBo
- Independent path standby mode
- Constant LO impedance in STBY mode
- 47dB gain control range
- 6-bit parallel control
- 1dB Gain Steps
- 60MHz – 450MHz IF frequency range
- Excellent 2nd Harmonic Rejection
- $I_{CC}$ = 390mA LC Mode
- 10 x 10 mm 68-pin VFQFPN package

## DEVICE BLOCK DIAGRAM




## PART# MATRIX

| Part# | RF freq range | UTRA bands | IF freq range | Typ. Gain | Injection |
|---|---|---|---|---|---|
| F0502 | 698 - 915 | 5,6,8,12,13,14,17 18,19,20 | 60 – 250 | 29 | High Side |
| F0552 | 1710 - 2050 | 1,2,3,4,9,10,23, 25,33,34,35,36, 37,39 | 60 – 450 | 29 | Low & High Side |
| **F0562** | **2300 – 2700** | **7,38,40,41** | **60 – 450** | **29** | **Low & High Side** |

# Contents

## ABSOLUTE MAXIMUM RATINGS

| | |
|---|---|
| VCC to GND | -0.3V to +5.5V |
| A[5:0], B[5:0], TDD_A, TDD_B (STBY), LCMode | -0.3V to (VCC + 0.25V) |
| MX_IFA+, MX_IFA-, MX_IFB+, MX_IFB- | -0.3V to (VCC + 0.25V) |
| IFOUT_A+, IFOUT_A-, IFOUT_B+, IFOUT_B- | 1V to (Vcc + 0.3V) |
| LO1_ADJ | +1V to +3V |
| LO2_ADJ | +2.1V to +4V |
| MX_IF_BiasA, MX_IF_BiasB | -0.3V to +0.3V |
| LO_IN, RFIN_A, RFIN_B | -0.3V to +0.3V |
| RF Input Power (RFIN_A, RFIN_B) | +20dBm |
| ISET_A, ISET_B to GND | -0.3V to +2.2V |
| Continuous Power Dissipation | 2.5W |
| $\theta_{JA}$ (Junction – Ambient) | +25°C/W |
| $\theta_{JC}$ (Junction – Case) The Case is defined as the exposed paddle | +3°C/W |
| Operating Temperature Range (Case Temperature) | $T_C$ = -40°C to +105°C |
| Maximum Junction Temperature | 150°C |
| Storage Temperature Range | -65°C to +150°C |
| Lead Temperature (soldering, 10s) | +260°C |

*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.*

## TRUTH TABLE – CHANNEL A AND B

| Gain Set Target | Gain CodeWord | Code Name | Gain Set Target | Gain CodeWord | Code Name | Gain Set Target | Gain CodeWord | Code Name |
|---|---|---|---|---|---|---|---|---|
| 27 | 000000 | $G_{27}$ | 5 | 010110 | $G_{5}$ | -17 | 101100 | $G_{-17}$ |
| 26 | 000001 | $G_{26}$ | 4 | 010111 | $G_{4}$ | -18 | 101101 | $G_{-18}$ |
| 25 | 000010 | $G_{25}$ | 3 | 011000 | $G_{3}$ | -19 | 101110 | $G_{-19}$ |
| 24 | 000011 | $G_{24}$ | 2 | 011001 | $G_{2}$ | -20 | 101111 | $G_{-20}$ |
| 23 | 000100 | $G_{23}$ | 1 | 011010 | $G_{1}$ | -20 | 110000 | $G_{-20}$ |
| 22 | 000101 | $G_{22}$ | 0 | 011011 | $G_{0}$ | -20 | 110001 | $G_{-20}$ |
| 21 | 000110 | $G_{21}$ | -1 | 011100 | $G_{-1}$ | -20 | 110010 | $G_{-20}$ |
| 20 | 000111 | $G_{20}$ | -2 | 011101 | $G_{-2}$ | -20 | 110011 | $G_{-20}$ |
| 19 | 001000 | $G_{19}$ | -3 | 011110 | $G_{-3}$ | -20 | 110100 | $G_{-20}$ |
| 18 | 001001 | $G_{18}$ | -4 | 011111 | $G_{-4}$ | -20 | 110101 | $G_{-20}$ |
| 17 | 001010 | $G_{17}$ | -5 | 100000 | $G_{-5}$ | -20 | 110110 | $G_{-20}$ |
| 16 | 001011 | $G_{16}$ | -6 | 100001 | $G_{-6}$ | -20 | 110111 | $G_{-20}$ |
| 15 | 001100 | $G_{15}$ | -7 | 100010 | $G_{-7}$ | -20 | 111000 | $G_{-20}$ |
| 14 | 001101 | $G_{14}$ | -8 | 100011 | $G_{-8}$ | -20 | 111001 | $G_{-20}$ |
| 13 | 001110 | $G_{13}$ | -9 | 100100 | $G_{-9}$ | -20 | 111010 | $G_{-20}$ |
| 12 | 001111 | $G_{12}$ | -10 | 100101 | $G_{-10}$ | -20 | 111011 | $G_{-20}$ |
| 11 | 010000 | $G_{11}$ | -11 | 100110 | $G_{-11}$ | -20 | 111100 | $G_{-20}$ |
| 10 | 010001 | $G_{10}$ | -12 | 100111 | $G_{-12}$ | -20 | 111101 | $G_{-20}$ |
| 9 | 010010 | $G_{9}$ | -13 | 101000 | $G_{-13}$ | -20 | 111110 | $G_{-20}$ |
| 8 | 010011 | $G_{8}$ | -14 | 101001 | $G_{-14}$ | -20 | 111111 | $G_{-20}$ |
| 7 | 010100 | $G_{7}$ | -15 | 101010 | $G_{-15}$ | | | |
| 6 | 010101 | $G_{6}$ | -16 | 101011 | $G_{-16}$ | | | |

## F0562 RECOMMENDED OPERATING CONDITIONS

| Parameter | Comment | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Supply Voltage(s) | All $V_{CC}$ pins | $V_{CC}$ | 4.75 | | 5.25 | V |
| LO Power | | $P_{LO}$ | -3 | | +3 | dBm |
| Operating Temperature Range | Case Temperature | $T_{CASE}$ | -40 | | +105 | °C |
| RF Freq Range | | $F_{RF}$ | 2300 | | 2700 | MHz |
| LO Freq Range | | $F_{LO}$ | 1900 | | 2800 | |
| IF Range | | $F_{IF}$ | 60 | | 450 | |

## F0562 SPECIFICATION

IDTF0562 Typical Application Circuit, when operated as a Sampling IF Receiver, $V_{CC}$ = +5.00V, $T_C$ = +25°C, $F_{RF}$ = 2500MHz, $F_{IF}$ = 184MHz, $F_{LO}$ = 2316MHz, $P_{LO}$ = 0 dBm, Max gain output power = +3dBm per tone unless otherwise stated, TDD = LOW. EVkit IF transformer losses are de-embedded unless otherwise noted.

| Parameter | Comment | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Logic Input High | For all control pins | $V_{IH}$ | ***1.07*** | | | V |
| Logic Input Low | For all control pins | $V_{IL}$ | | | ***0.68*** | V |
| Logic Current | For all control pins | $I_{IH}$, $I_{IL}$ | ***-150*** | | ***10*** | µA |
| Supply Current | Total $V_{CC}$, STD Mode | $I_{STD}$ | | ***480*** | ***540*** | mA |
| Supply Current | Total $V_{CC}$, LC Mode | $I_{LC}$ | | ***390*** | ***435*** | mA |
| Supply Current | ▪ Standby Mode<br>▪ STBY = $V_{IH}$<br>▪ Total Both Channels | $I_{STBY}$ | | ***27.5*** | ***37*** | mA |
| Gain STD Mode | Conversion Power Gain | $G_{STDMAX}$ | ***27***[1] | ***29*** | ***31*** | dB |
| Gain LC Mode | Conversion Power Gain | $G_{LC}$ | ***26.9*** | ***28.9*** | ***30.9*** | dB |
| Gain control range | | $G_{RANGE}$ | | 47 | | dB |
| Gain STD mode min gain setting | Maximum attenuation | $G_{STDMIN}$ | | -18 | | dB |
| Step size | | $G_{STEP}$ | | 1 | | dB |
| Differential Gain Error | Between any two adjacent 1dB steps | DNL | | 0.1 | 0.2[2] | dB |
| Integral Gain Error | Error vs. line ($G_{27}$ Ref) | INL | | ***0.2*** | ***0.8*** | dB |
| Phase Error | Maximum phase change between $G_{MAX}$ and any state down to $G_{-14}$ | IPE | | 2.2 | 4 | degree |
| NF STD Mode | Noise Figure (@ +25C) | $NF_{STD}$ | | 9.9 | 10.9 | dB |
| NF STD Mode 10dB reduced gain | | $NF_{STD\_G-10}$ | | 9.9 | 10.9 | dB |
| NF LC Mode | Noise Figure (@ +25C) | $NF_{LC}$ | | 9.6 | 10.6 | dB |
| NF LC Mode 10dB reduced gain | | $NF_{LC\_G-10}$ | | 9.6 | 10.6 | dB |
| NF w/Blocker | ▪ +100 MHz offset blocker<br>▪ $P_{IN}$ = +4 dBm<br>▪ 28dB gain reduced | $NF_{BLK}$ | | 17.6 | 19 | dB |

## F0562 SPECIFICATION (CONTINUED)

IDTF0562 Typical Application Circuit, when operated as a Sampling IF Receiver, $V_{CC}$ = +5.00V, $T_C$ = +25°C, $F_{RF}$ = 2500MHz, $F_{IF}$ = 184MHz, $F_{LO}$ = 2316MHz, $P_{LO}$ = 0 dBm, Max gain output power = +3dBm per tone unless otherwise stated, TDD = LOW. EVkit IF transformer losses are de-embedded unless otherwise noted.

| Parameter | Comment | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Turn-on time | ▪ Gate STBY from $V_{IH}$ to $V_{IL}$<br>▪ Time for IF Signal to settle to within 0.1 dB of final value | $T_{SETTL}$ | | 0.17 | 0.20 | µsec |
| Attenuator adjustment settling time | ▪ Any two Adjacent 1dB Steps<br>▪ +/-0.10 dB Pout settling | $T_{1dB}$ | | 17.5 | 25 | nsec |
| Output IP3 Max Gain, $STD_{MODE}$ | ▪ Set $G_{MAX,}$<br>▪ 800 KHz Tone Separation | $IP3_{O1}$ | ***40*** | ***44*** | | dBm |
| Output IP3 10dB reduced gain, $STD_{MODE}$ | ▪ From $G_{MAX\ to}$ $G_{MAX-10,}$<br>▪ Pout = +1dBm per tone<br>▪ 800 KHz Tone Separation | $IP3_{O2}$ | 40 | 44 | | dBm |
| Output IP3 10dB reduced gain, $STD_{MODE}$ | ▪ From $G_{MAX\ to}$ $G_{MAX-10,}$<br>▪ Pout = +1dBm per tone<br>▪ 800 KHz Tone Separation<br>▪ -40C ≤ Tcase ≤ +105C<br>▪ IF = 138MHz, LO = 2362MHz<br>▪ IF = 184MHz, LO = 2316MHz<br>▪ IF = 276MHz[3], LO = 2224MHz | $IP3_{O3}$ | | 43 | | dBm |
| Output IP3 Max Gain, $LC_{MODE}$ | ▪ Set $G_{MAX,}$<br>▪ 800 KHz Tone Separation | $IP3_{O4}$ | 40 | 44 | | dBm |
| Input IP3 22dB reduced gain, $STD_{MODE}$ | ▪ Set $G_{MAX-22dB,}$<br>▪ Pin = -5dBm per tone<br>▪ 800 KHz Tone Separation | $IP3_{ISTD}$ | 26.5 | 31 | | dBm |
| Input IP3 22dB reduced gain, $LC_{MODE}$ | ▪ Set $G_{MAX-22dB,}$<br>▪ Pin = -15dBm per tone<br>▪ 800 KHz Tone Separation | $IP3_{ILC}$ | | 25 | | dBm |
| 1 dB Compression Max Gain, $STD_{MODE}$ | Output referred | $P1dB_{O1}$ | ***17*** | 19.8 | | dBm |
| 1 dB Compression 30dB reduced gain, $STD_{MODE}$ | ▪ Input referred<br>▪ Set $G_{MAX-30dB}$ | $P1dB_{I1}$ | 8.2 | 9.2 | | dBm |
| 1 dB Compression Max Gain, $LC_{MODE}$ | Output referred | $P1dB_{O2}$ | ***17*** | 19.8 | | dBm |
| 1 dB Compression 30dB reduced gain, $LC_{MODE}$ | ▪ Input referred<br>▪ Set $G_{MAX-30dB}$ | $P1dB_{I2}$ | 6.5 | 7 | | dBm |
| 2RF – 2LO rejection Max Gain, $STD_{MODE}$ | ▪ Frequency = $F_{RF}$ - ½ $F_{IF}$<br>▪ $P_{RF}$ = -27dBm | $2x2_1$ | | -79 | -69 | dBc |
| 2RF – 2LO rejection 17dB reduced gain, $STD_{MODE}$ | ▪ Frequency = $F_{RF}$ - ½ $F_{IF}$<br>▪ $P_{RF}$ = -10dBm | $2x2_2$ | | -67 | -60 | dBc |

## F0562 SPECIFICATION (CONTINUED)

IDTF0562 Typical Application Circuit, when operated as a Sampling IF Receiver, $V_{CC}$ = +5.00V, $T_C$ = +25°C, $F_{RF}$ = 2500 MHz, $F_{IF}$ = 184MHz, $F_{LO}$ = 2316MHz, $P_{LO}$ = 0 dBm, Max gain output power = +3dBm per tone unless otherwise stated, TDD = LOW.) EVkit IF transformer losses are de-embedded unless otherwise noted.

| Parameter | Comment | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| 2RF – 2LO rejection Max Gain, $LC_{MODE}$ | ▪ Frequency = $F_{RF}$ - ½ $F_{IF}$<br>▪ $P_{RF}$ = -27dBm | $2x2_3$ | | -76 | -66 | dBc |
| 2RF – 2LO rejection 17dB reduced gain, $LC_{MODE}$ | ▪ Frequency = $F_{RF}$ - ½ $F_{IF}$<br>▪ $P_{RF}$ = -10dBm | $2x2_4$ | | -69 | -60 | dBc |
| 2nd Harmonic Max Gain, $STD_{MODE}$ | $P_{RF}$ = -27 dBm | $HD2_1$ | | -80 | -70 | dBc |
| 2nd Harmonic Max Gain, $LC_{MODE}$ | $P_{RF}$ = -27 dBm | $HD2_3$ | | -76 | -66 | dBc |
| 3rd Harmonic Max Gain, $STD_{MODE}$ | $P_{RF}$ = -27 dBm | $HD3_1$ | | -93 | -80 | dBc |
| 3rd Harmonic Max Gain, $LC_{MODE}$ | $P_{RF}$ = -27 dBm | $HD3_3$ | | -93 | -80 | dBc |
| Channel Isolation Max Gain, $STD_{MODE}$ | IF_B Pout vs. IF_A w/ RF_A input | $ISO_{C\_STD}$ | 41 | 44.5 | | dB |
| Channel Isolation Max Gain, $LC_{MODE}$ | IF_B Pout vs. IF_A w/ RF_A input | $ISO_{C\_LC}$ | 41 | 44.5 | | dB |
| LO to IF leakage Max Gain, $STD_{MODE}$ | | $ISO_{LI-1}$ | | -45 | -39 | dBm |
| LO to IF leakage Max Gain, $LC_{MODE}$ | | $ISO_{LI-3}$ | | -47 | -40 | dBm |
| RF to IF leakage Max Gain, $STD_{MODE}$ | $P_{RF}$ = -27 dBm | $ISO_{RI-1}$ | | -83 | -73 | dBc |
| RF to IF leakage Max Gain, $LC_{MODE}$ | $P_{RF}$ = -27 dBm | $ISO_{RI-2}$ | | -83 | -73 | dBc |
| LO to RF leakage | | $ISO_{LR}$ | | -37 | | dBm |
| RFIN Impedance | Single Ended | $Z_{RFIN}$ | | 50 | | Ω |
| LO Port Impedance | Single Ended | $Z_{LO}$ | | 50 | | |
| IF Output Impedance | Differential | $Z_{IF}$ | | 200 | | |

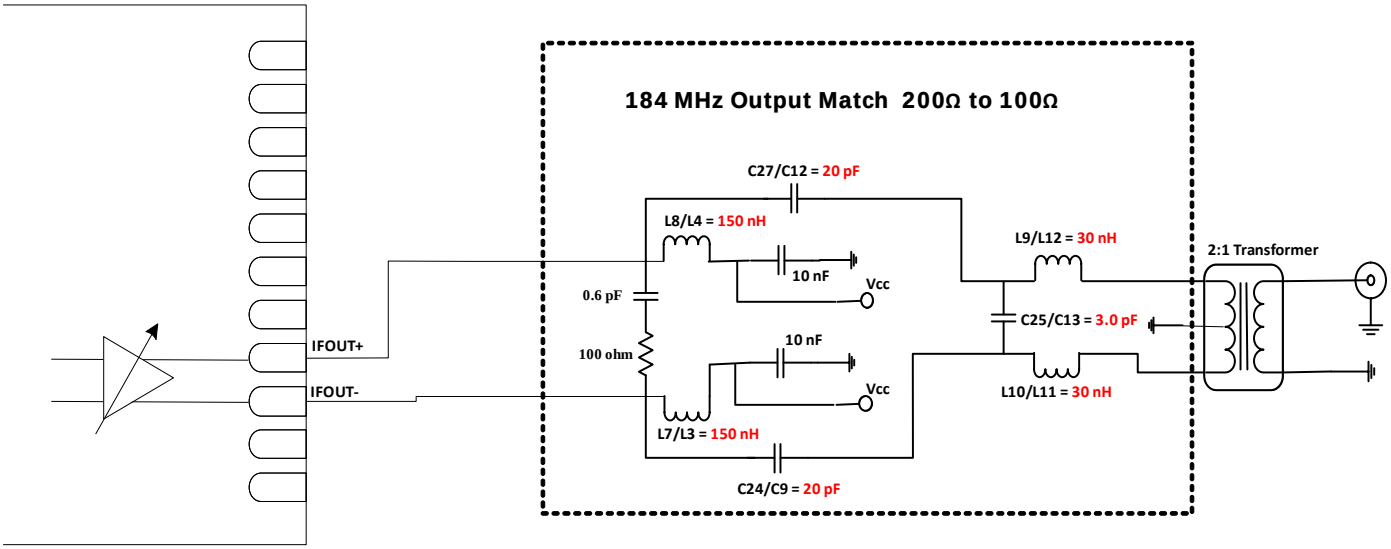
## SPECIFICATION NOTES:

1 – Items in min/max columns in ***bold italics*** are confirmed by Test using BOM1 components supporting 4:1 output impedance transformation to 50 ohms.
2 – All other Items in min/max columns are confirmed by Design Characterization using BOM2 components supporting 2:1 output impedance transformation to 100 ohms.
3 – Matching network changed for 276MHz IF per BOM table values.

## TYPICAL OPERATING CONDITIONS (184 MHZ IF CENTER)

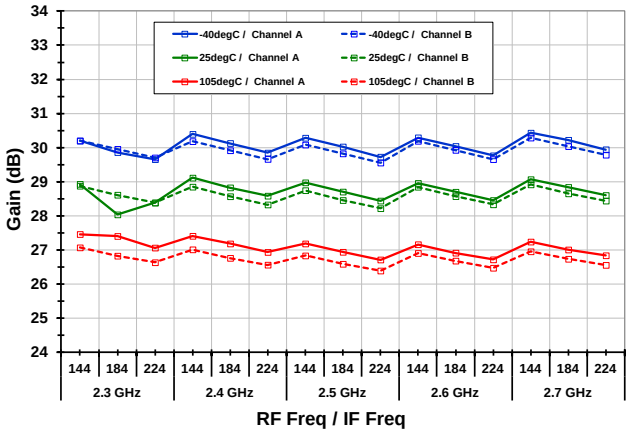
### Unless otherwise noted, the following conditions apply:

- Applications circuit for 100ohm differential load with 184MHz +/- 40MHz BW into 2:1 Transformer. See schematic Below
- Pout ~ +1dBm
- Measurement on Channel A
- $P_{IN}$ from -27dBm to -3dBm per Tone (Gain Setting Adjusted to yield Pout ~ +1dBm)
- Tone Spacing = 800kHz
- Device configured in Standard Mode with Low Side Injection
- $T_{CASE}$ = 25C, $V_{CC}$ = 5.00V, LO Power = 0dBm
- RF Frequency: 2.6GHz
- IF Frequency: 184MHz
- IF Transformer Losses are de-embedded
- Input RF trace Losses are de-embedded

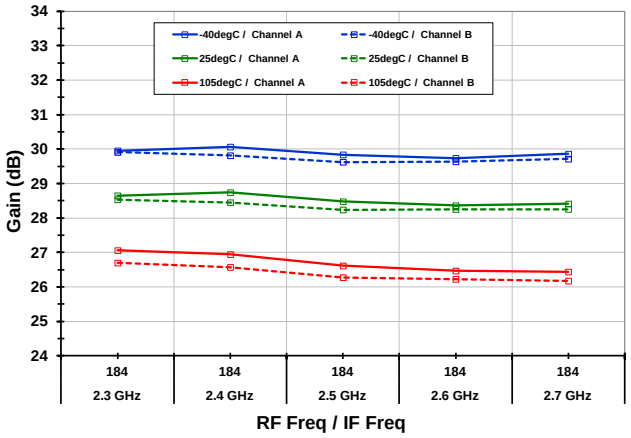


## TOCs [MAX GAIN, STD MODE, IF = 184MHz] GAIN, OIP3, OIP2 (-1-)

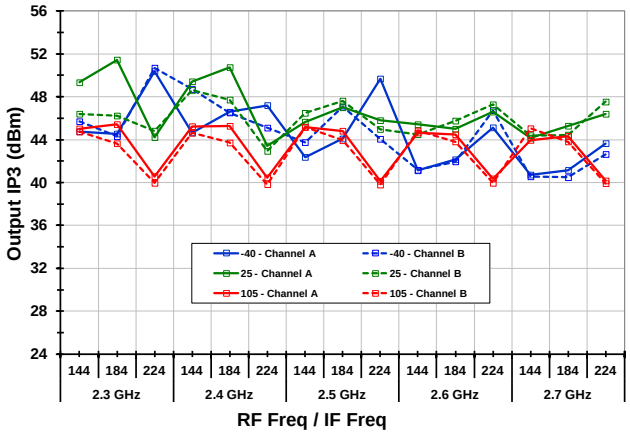
### Gain vs. $T_{CASE}$ [low side inj.]



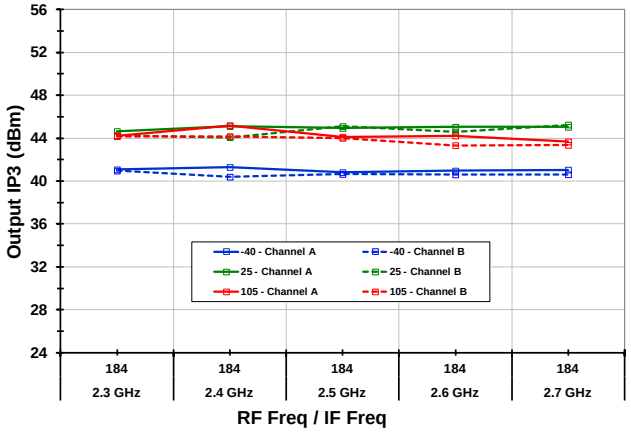

### Gain vs. $T_{CASE}$ [high side inj.]



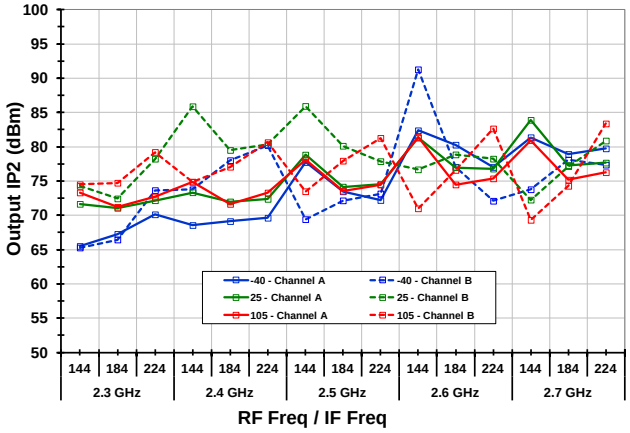

### Output IP3 vs. $T_{CASE}$ [low side inj.]



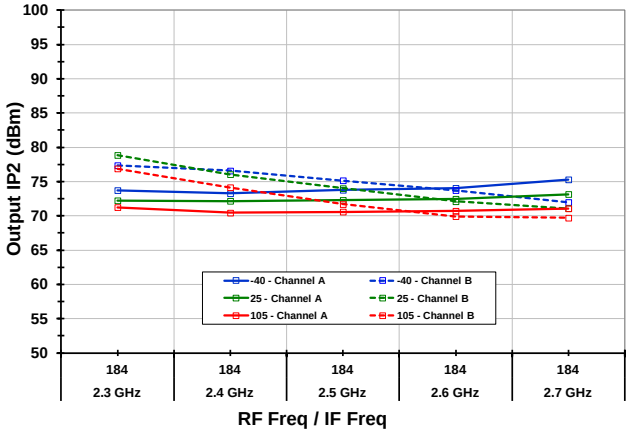

### Output IP3 vs. $T_{CASE}$ [high side inj.]




### Output IP2 vs. $T_{CASE}$ [low side inj.]

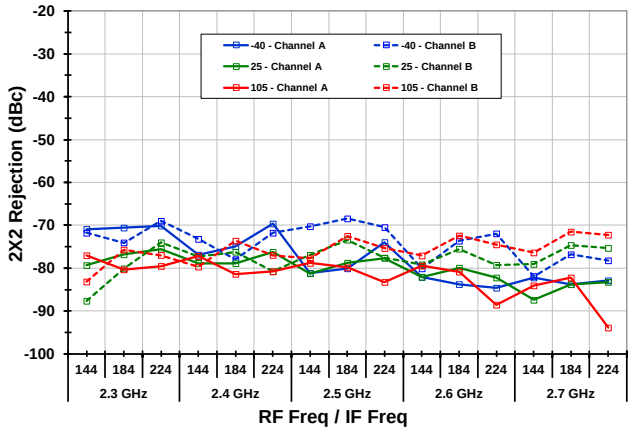



### Output IP2 vs. $T_{CASE}$ [high side inj.]

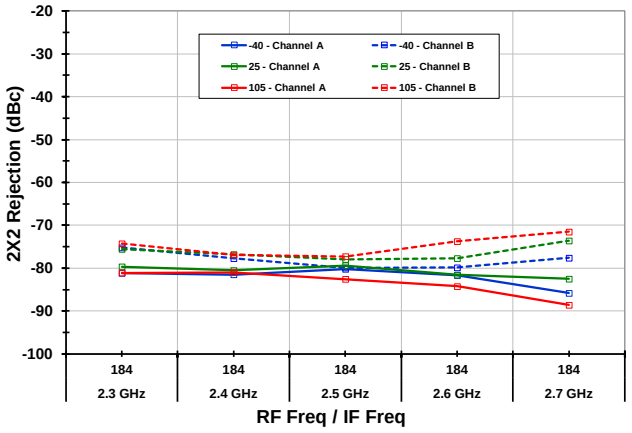


## TOCs [MAX GAIN, STD MODE, IF = 184MHz] 2x2, L-I, DC CURRENT (-2-)

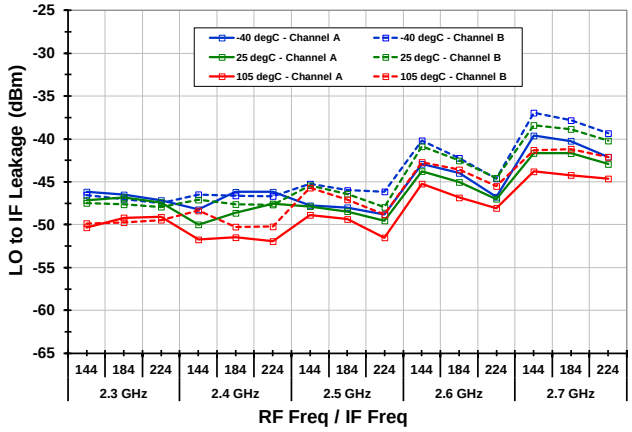
### 2 X 2 vs. $T_{CASE}$ [low side inj.]



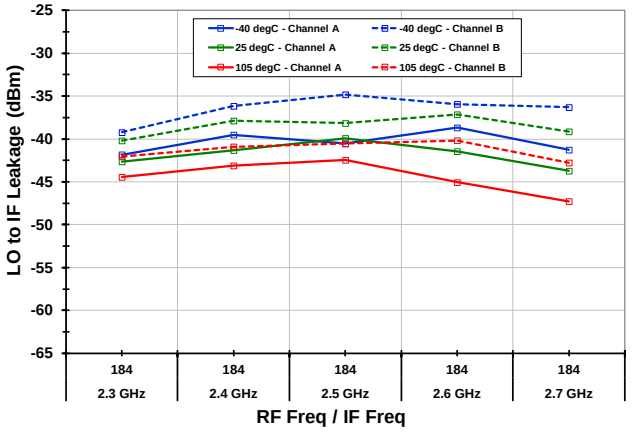

### 2 x 2 vs. $T_{CASE}$ [high side inj.]



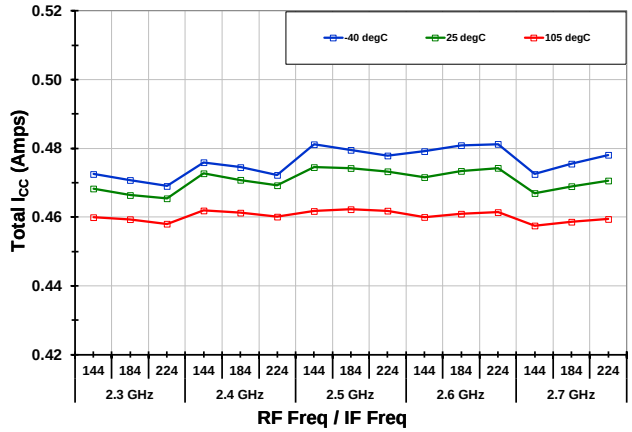

### LO to IF Leakage [low side inj.]



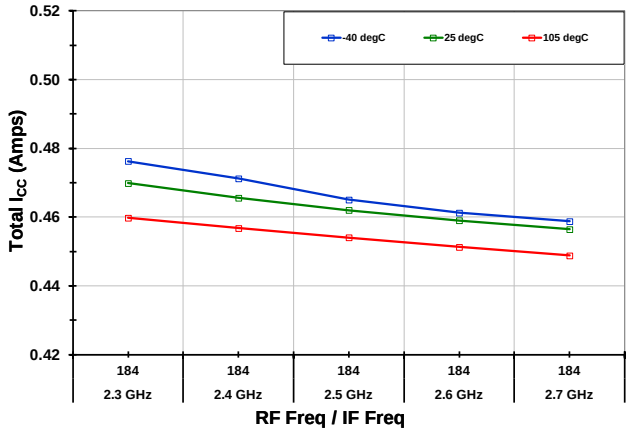

### LO to IF Leakage [high side inj.]




### Total Current Drain [low side inj.]

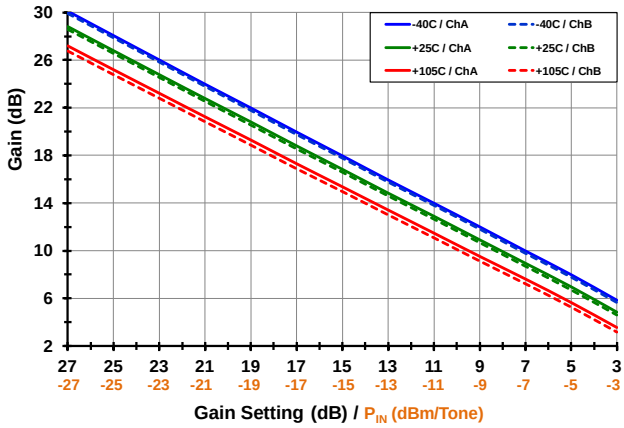



### Total Current Drain [high side inj.]

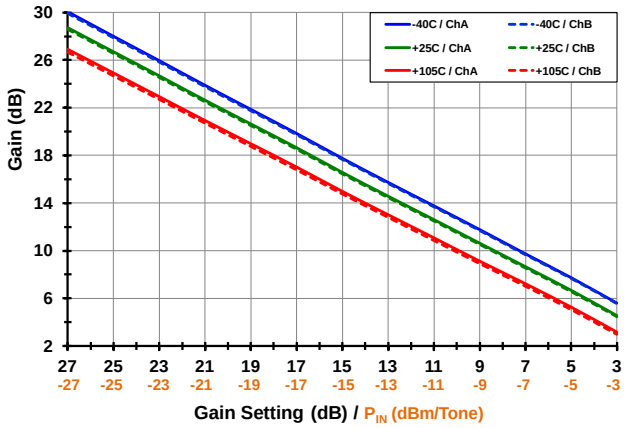


## TOCs [Swept Gain, STD Mode, IF = 184MHz, LS Injection] Gain, OIP3, IIP3 (-3-)

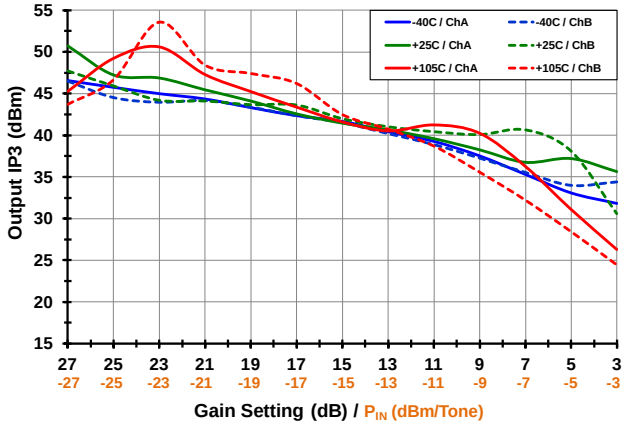
### Gain [2.4 GHz]



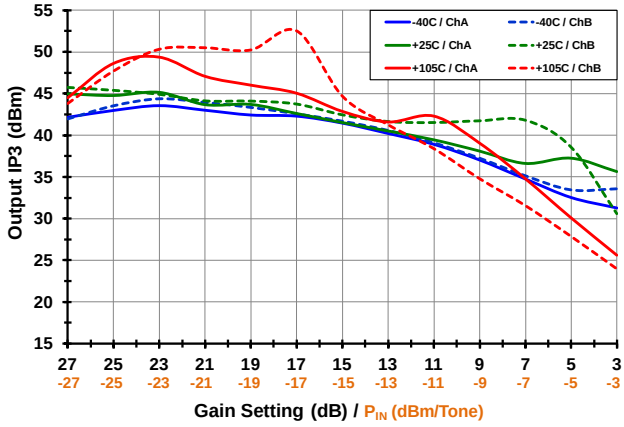

### Gain [2.6 GHz]



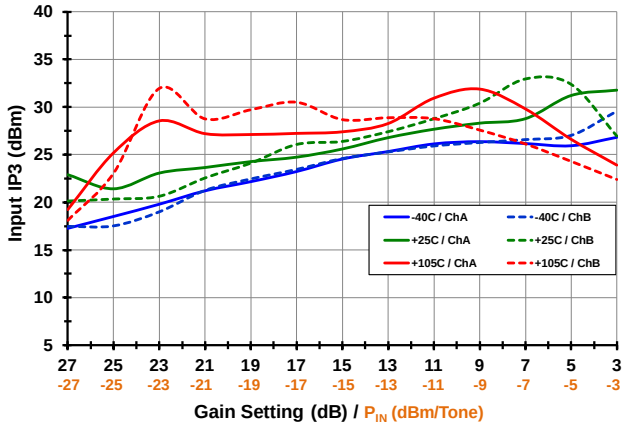

### Output IP3 [2.4 GHz]



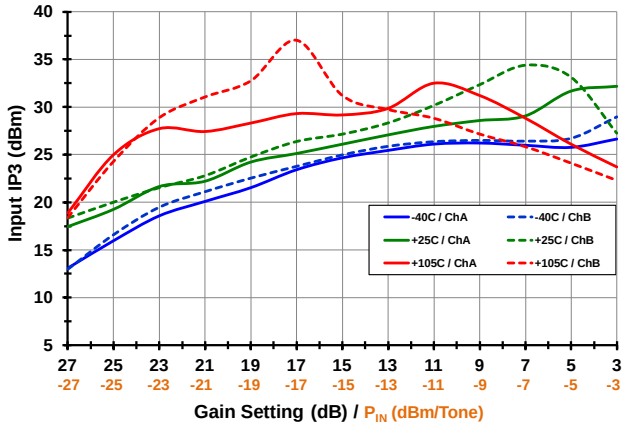

### Output IP3 [2.6 GHz]




### Input IP3 [2.4 GHz]

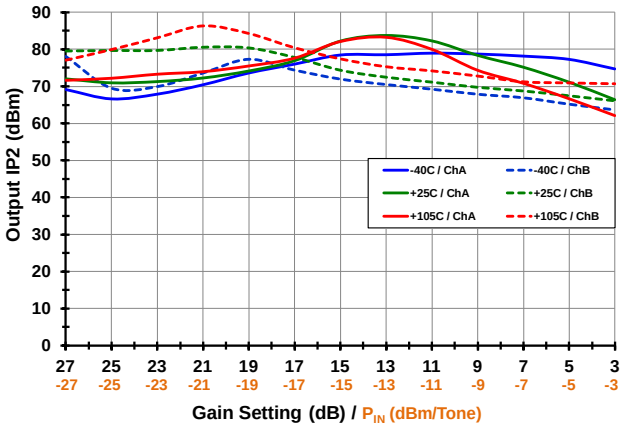



### Input IP3 [2.6 GHz]

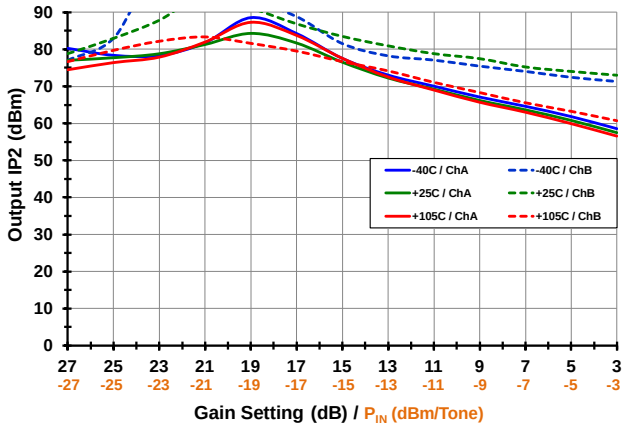


## TOCs [Swept Gain, STD Mode, IF = 184MHz, LS Injection] OIP2, IIP2, 2x2 (-4-)

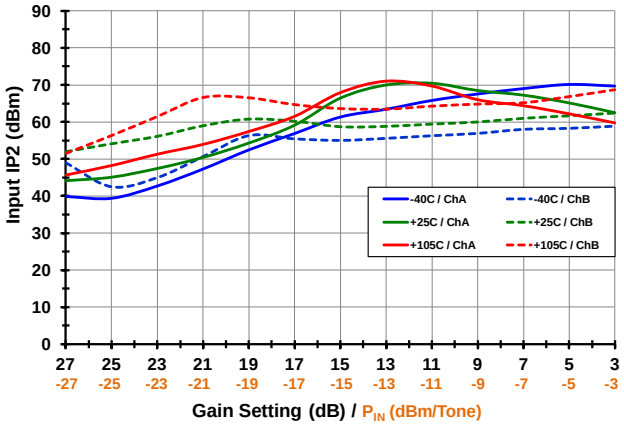
### Output IP2 [2.4 GHz]



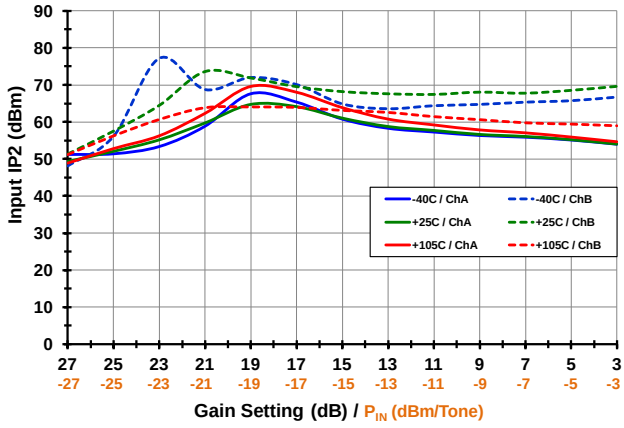

### Output IP2 [2.6 GHz]



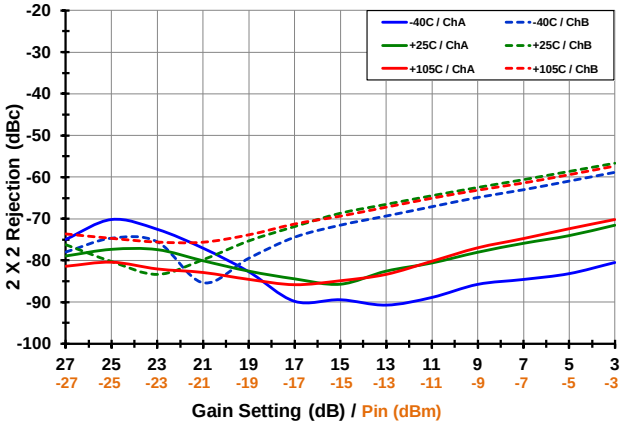

### Input IP2 [2.4 GHz]



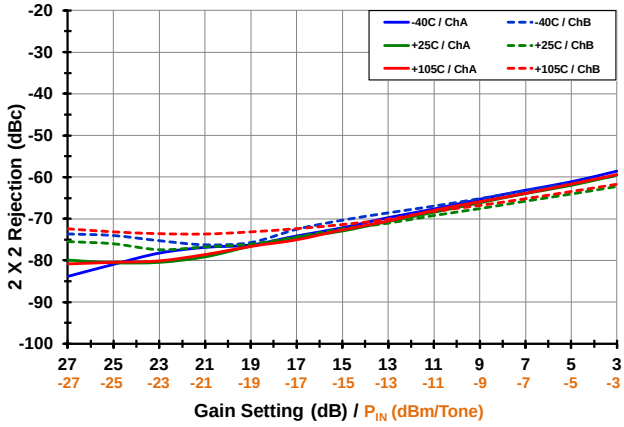

### Input IP2 [2.6 GHz]




### 2x2 Rejection [2.4 GHz]

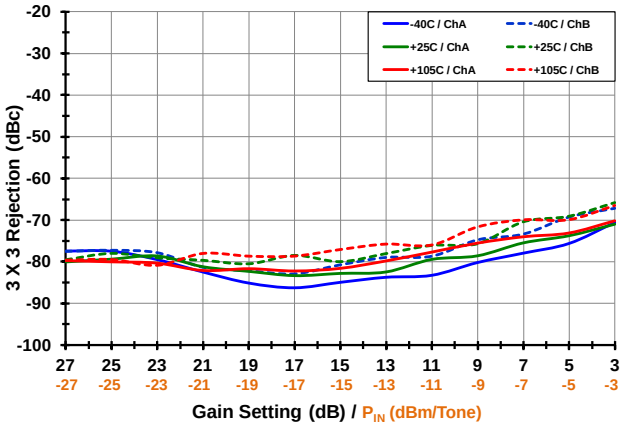



### 2x2 Rejection [2.6 GHz]

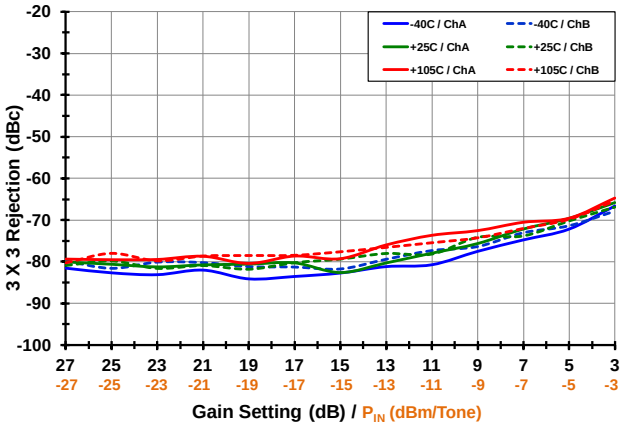


## TOCs [Swept Gain, STD Mode, IF = 184MHz, LS Injection] 3x3, L-I, R-I (-5-)

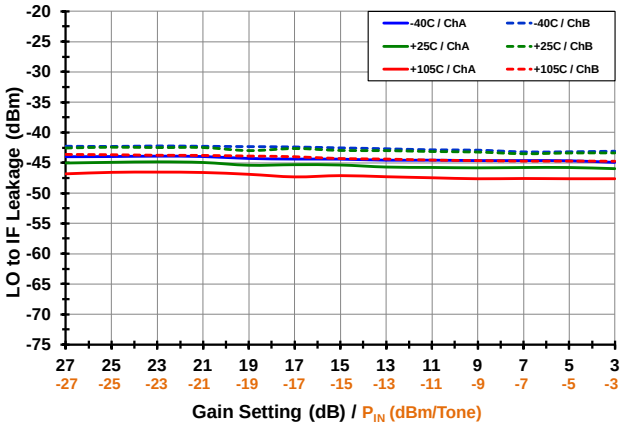
### 3x3 Rejection [2.4 GHz]



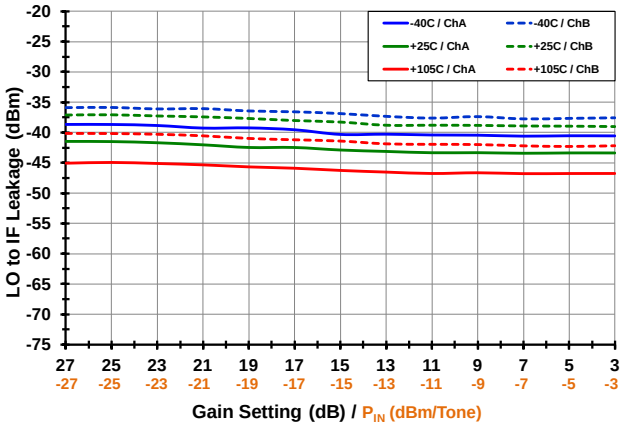

### 3x3 Rejection [2.6 GHz]



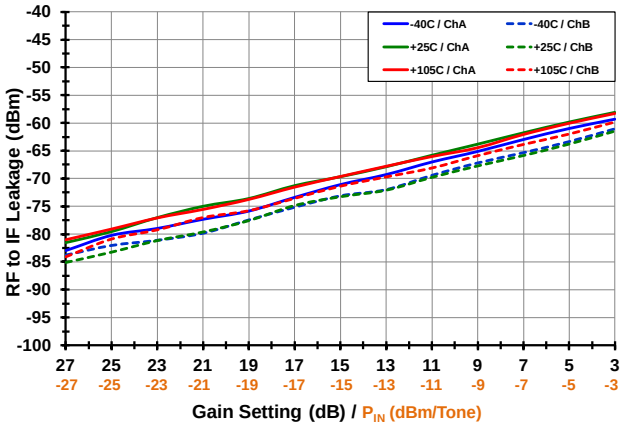

### LO to IF Leakage [low side inj, 2.6 GHz]



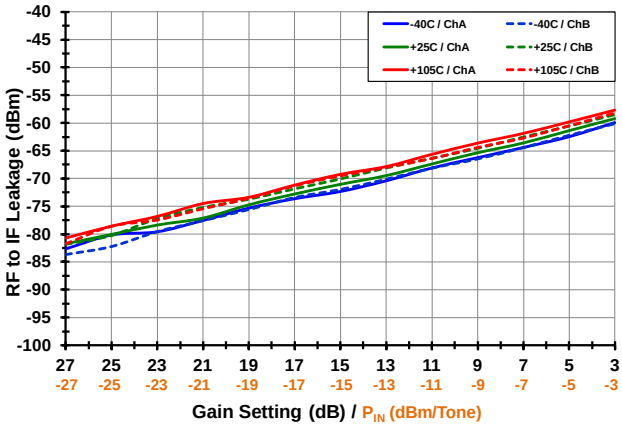

### LO to IF Leakage [high side inj., 2.6 GHz]




### RF to IF Leakage [2.4 GHz]

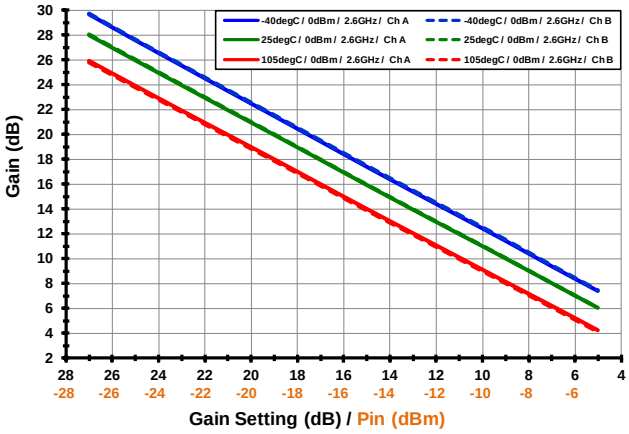



### RF to IF Leakage [2.6 GHz]

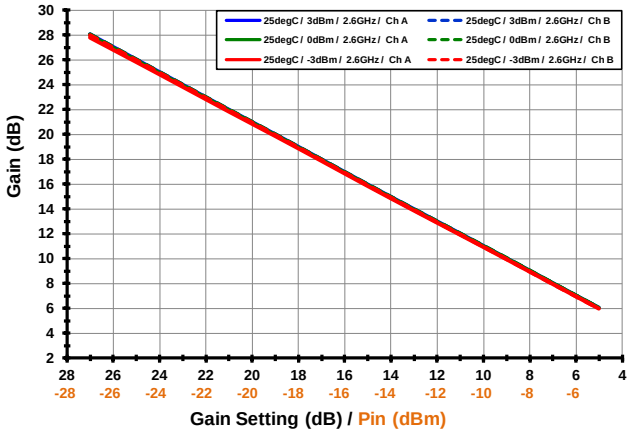


## TOCs [Swept Gain, LC Mode, IF = 184MHz, LS Injection] Gain, OIP3, IIP3 (-6-)

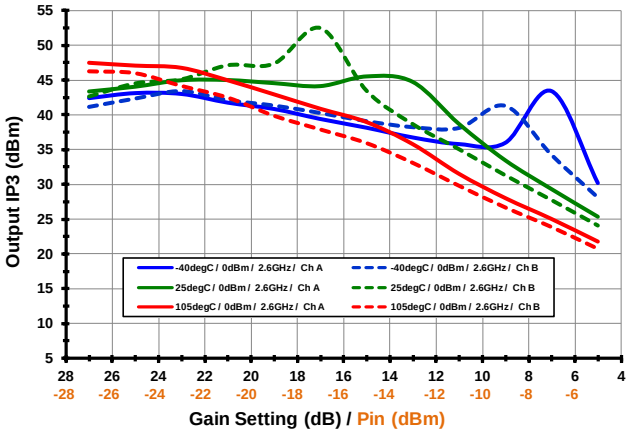
### Gain [v Temp]



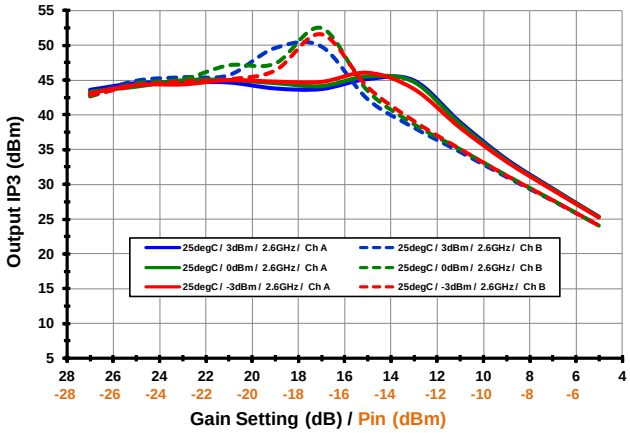

### Gain [v LO Power]



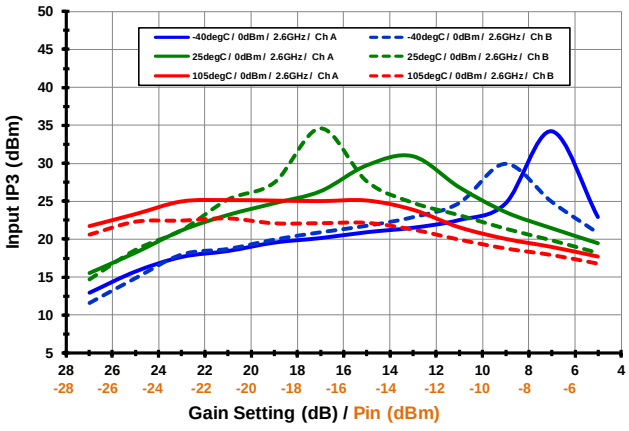

### Output IP3 [v Temp]



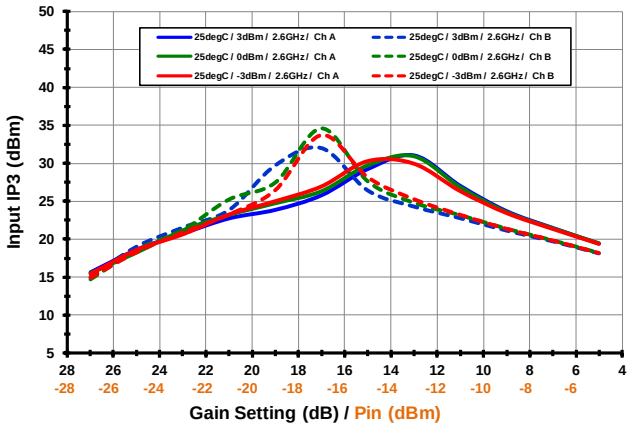

### Output IP3 [v LO Power]




### Input IP3 [v Temp]

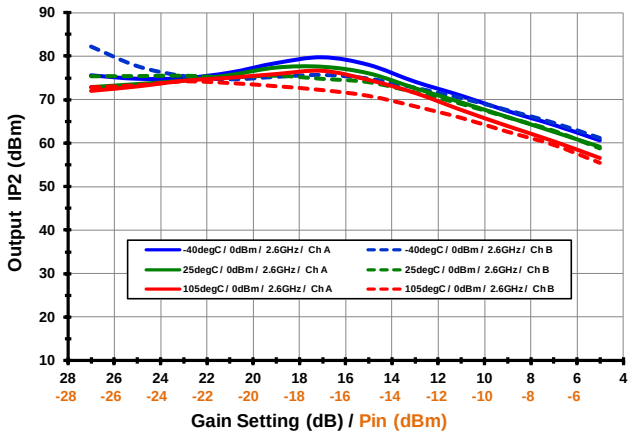



### Input IP3 [v LO Power]

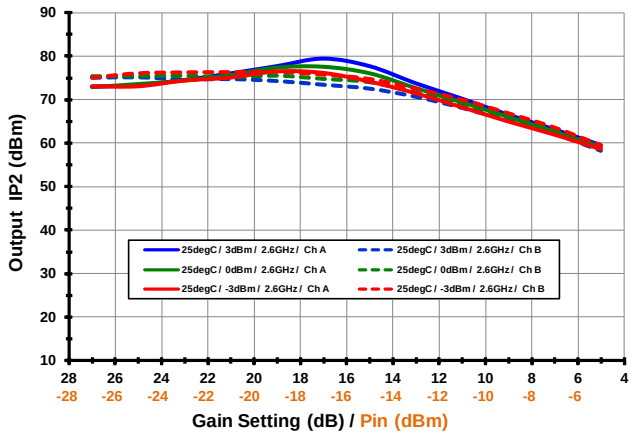


## TOCs [Swept Gain, LC Mode, IF = 184MHz, LS Injection] OIP2, Chan Iso, 2x2 (-7-)

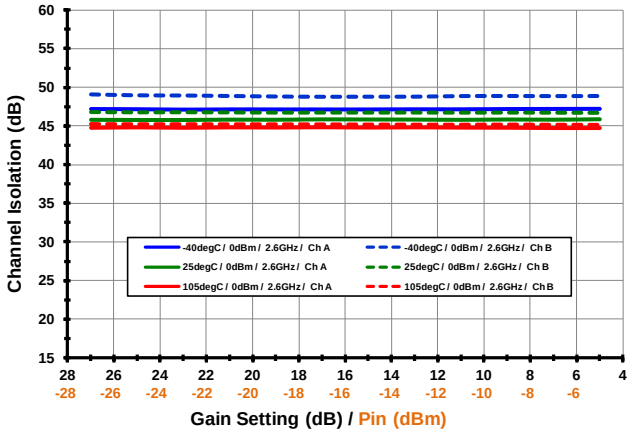
### Output IP2 [v Temp]



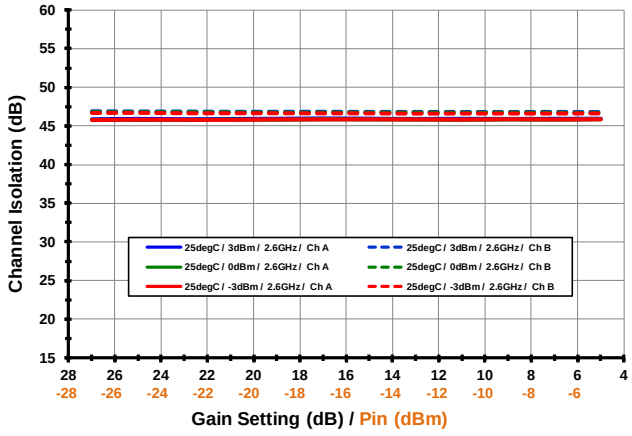

### Output IP2 [v LO Power]



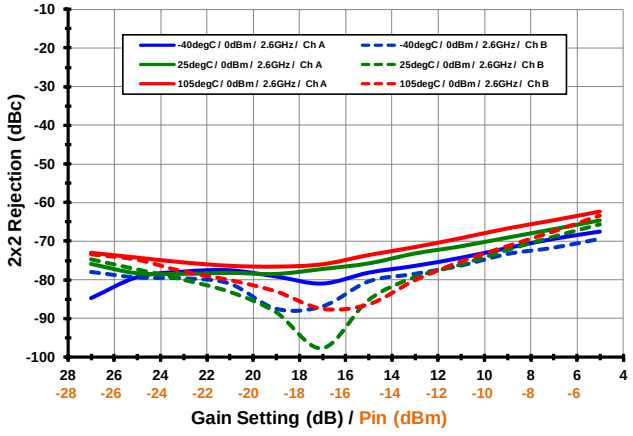

### Channel Isolation [v Temp]



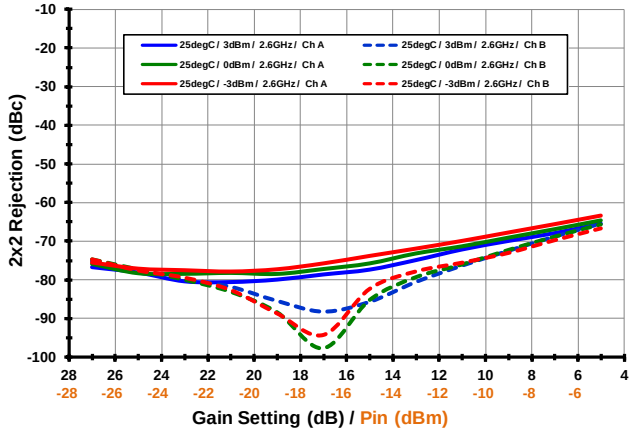

### Channel Isolation [v LO Power]




### 2x2 Rejection [v Temp]

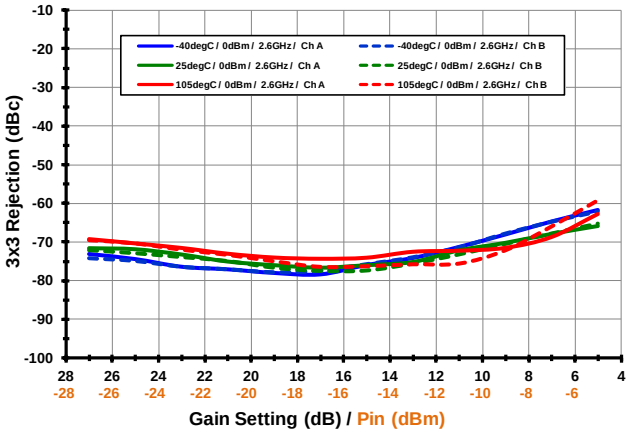



### 2x2 Rejection [v LO Power]

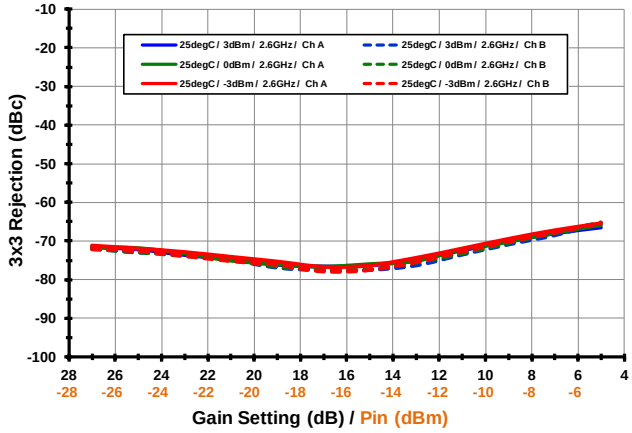


## TOCs [Swept Gain, LC Mode, IF = 184MHz, LS Injection] 3x3, L-I, DC Current, R-I (-8-)

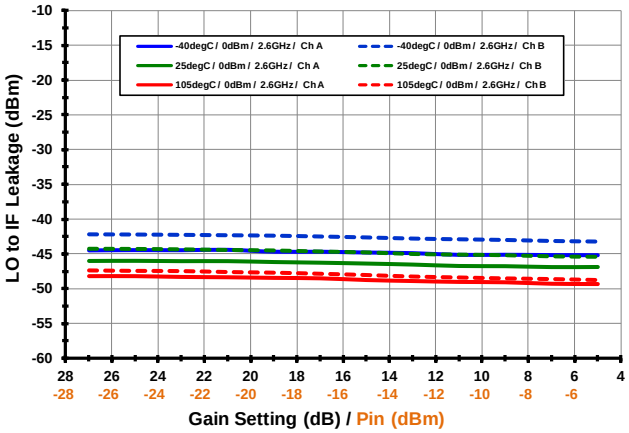
### 3x3 Rejection [v Temp]



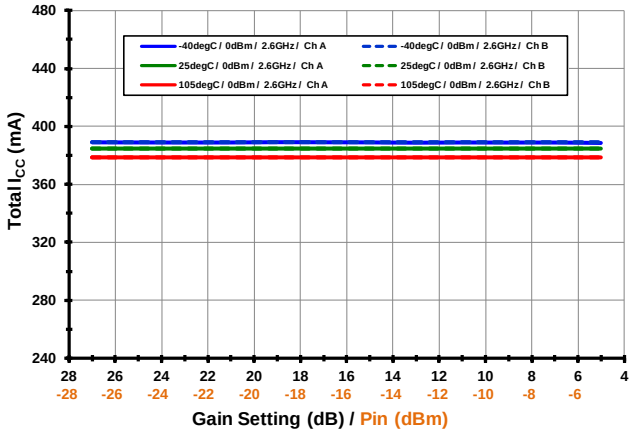

### 3x3 Rejection [v LO Power]



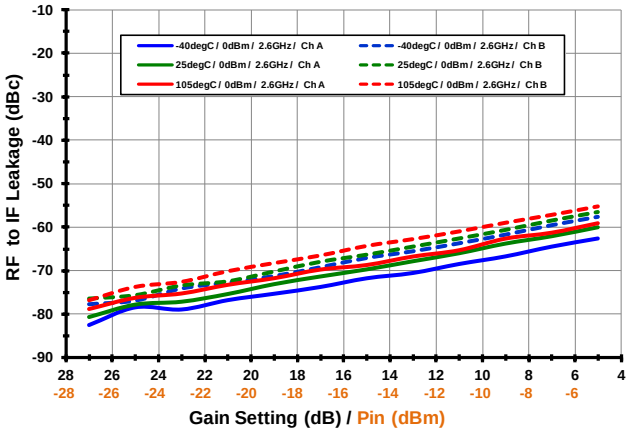

### LO to IF Leakage [v Temp]



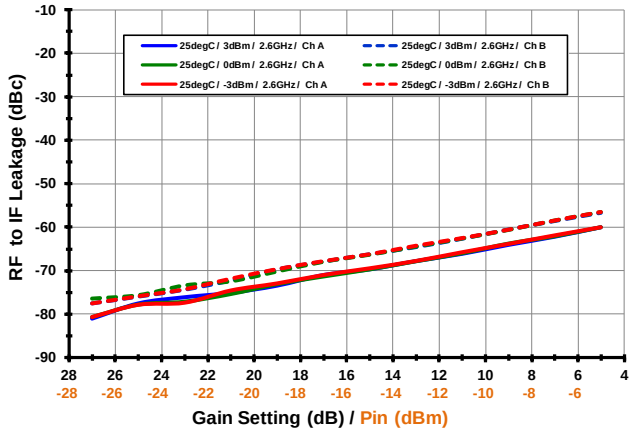

### Total $I_{CC}$ [v Temp]




### RF to IF Leakage [v Temp]



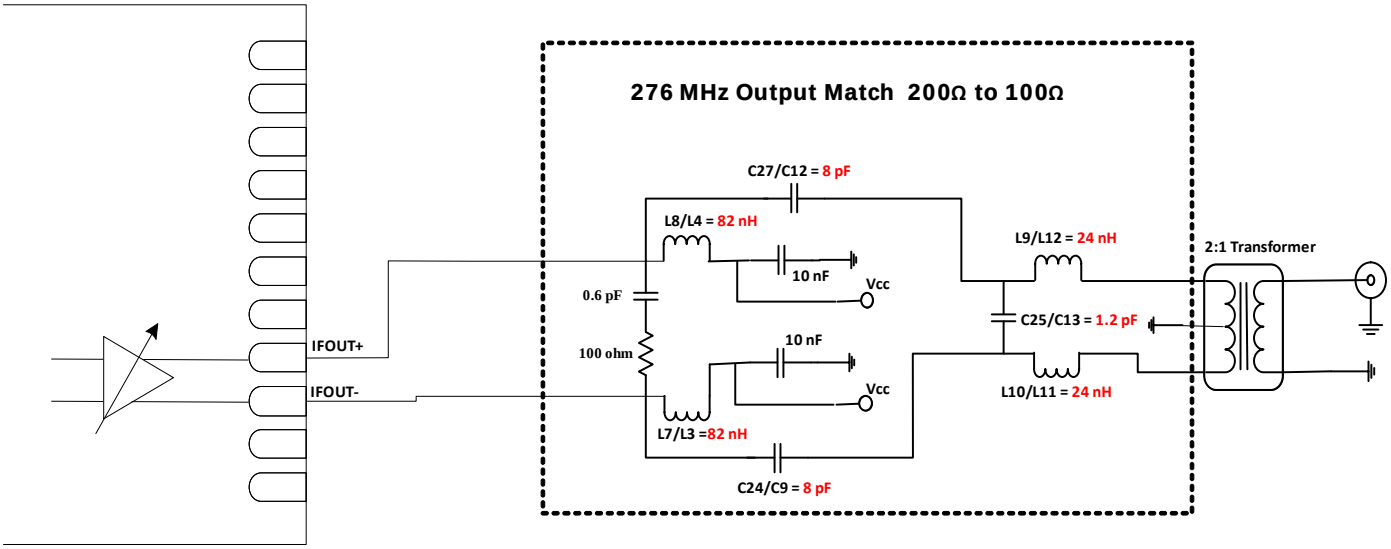

### RF to IF Leakage [v LO Power]



## TYPICAL OPERATING CONDITIONS [276MHZ IF CENTER]

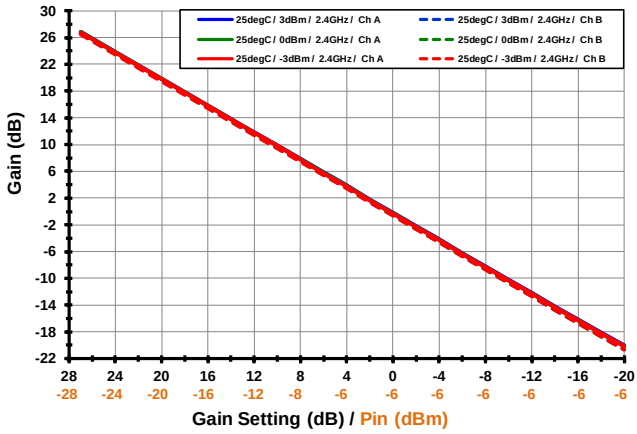
### Unless otherwise noted, the following conditions apply:

- Applications circuit for 100ohm differential load with 276MHz +/- 40 MHzBW into 2:1 Transformer. See schematic Below
- Pout ~ +1dBm (for Gain Setting > 5dB)
- Measurement on Channel A
- $P_{IN}$ from -27dBm to -6dBm per Tone (Gain Setting Adjusted to yield Pout ~ +1dBm)
- Tone Spacing = 800kHz
- Device configured in Standard Mode with Low Side Injection
- $T_{CASE}$ = 25°C, $V_{CC}$ = 5.00V, LO Power = 0dBm
- RF Frequency: 2.4GHz, 2.6GHz
- IF Frequency: 276MHz
- IF Transformer Losses are de-embedded
- Input RF trace Losses are de-embedded

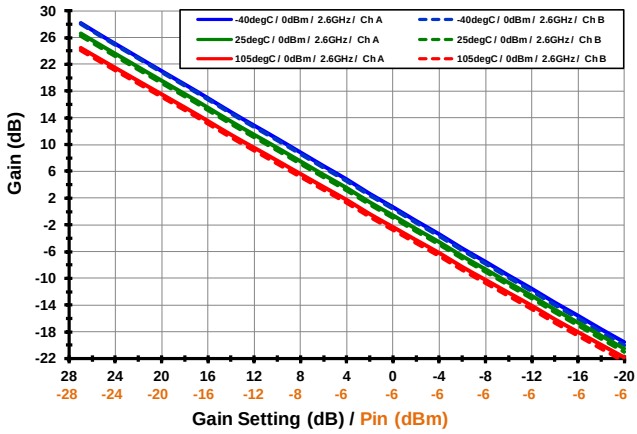


## TOCs [Swept Gain, STD Mode, IF = 276MHz, LS Injection] Gain, OIP3, OIP2 (-9-)

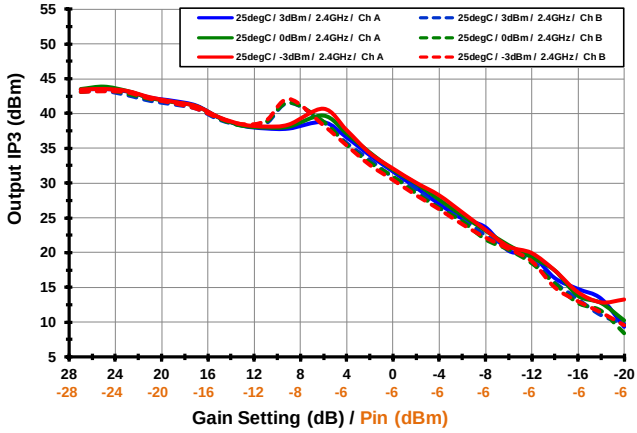
### Gain [2.4 GHz]



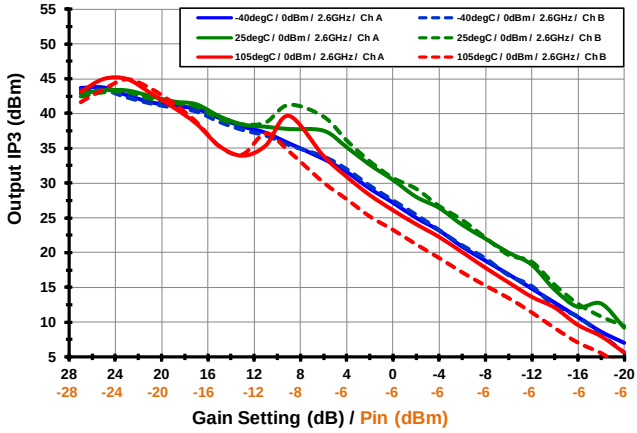

### Gain [2.6 GHz]



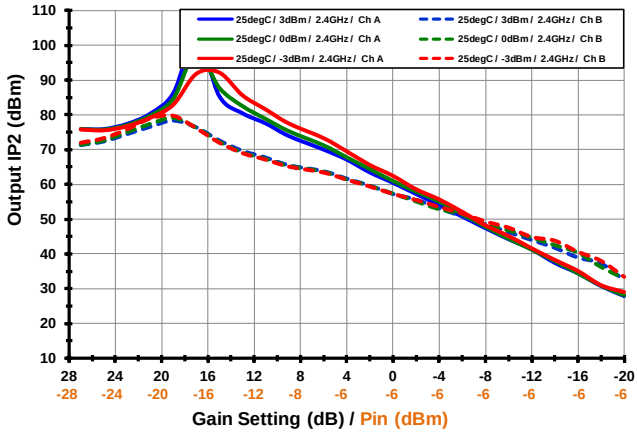

### Output IP3 [2.4 GHz]



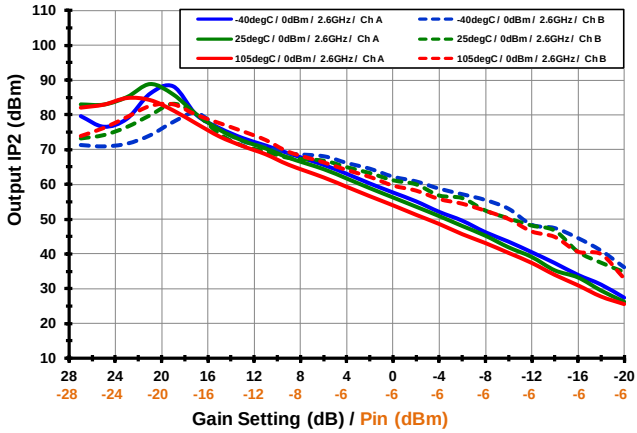

### Output IP3 [2.6 GHz]




### Output IP2 [2.4 GHz]

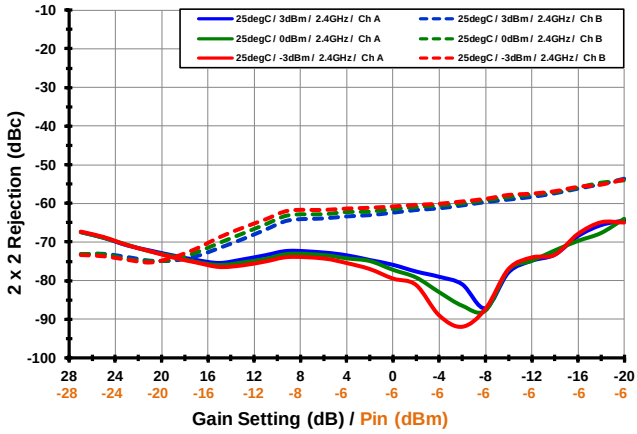



### Output IP2 [2.6 GHz]

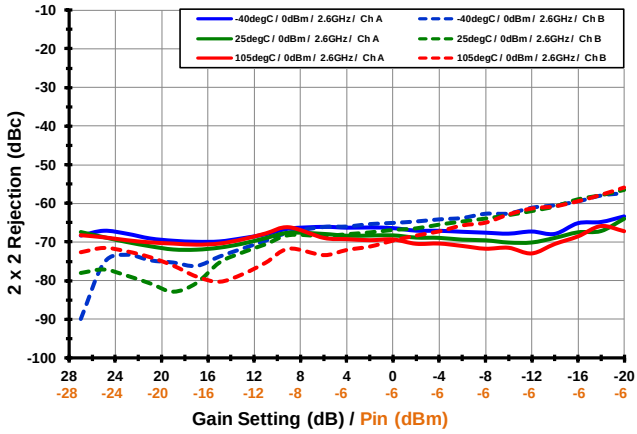


## TOCs [SWEPT GAIN, STD MODE, IF = 276MHz, LS INJECTION] 2X2, 3X3, CURRENT, R-I, ISO (-10-)

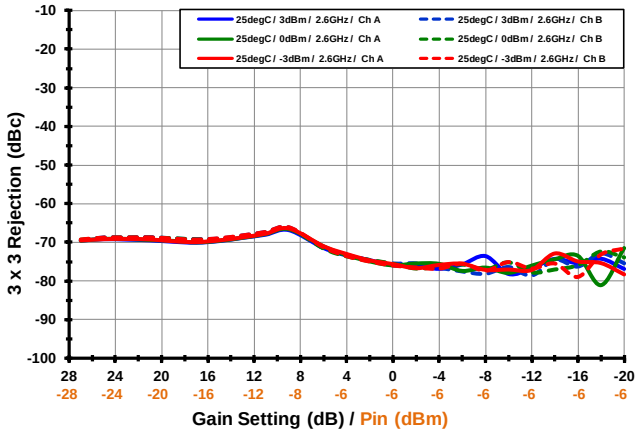
### 2x2 Rejection [2.4 GHz]



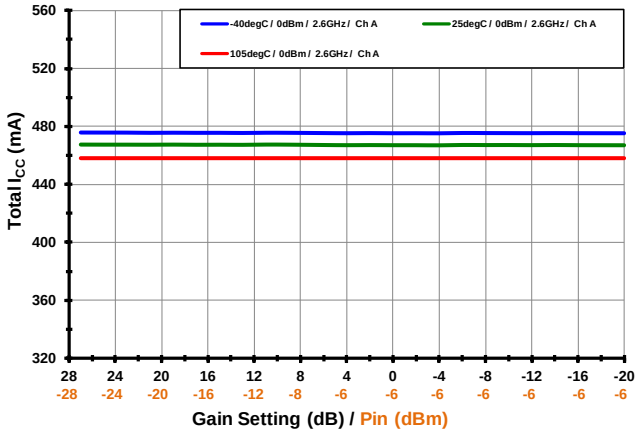

### 2x2 Rejection [2.6 GHz]



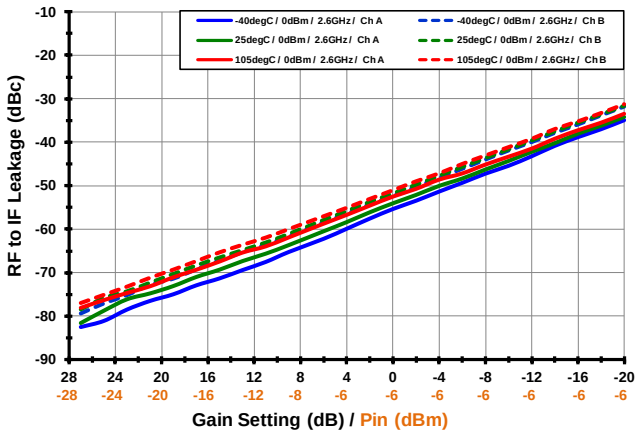

### 3x3 Rejection [2.6 GHz]



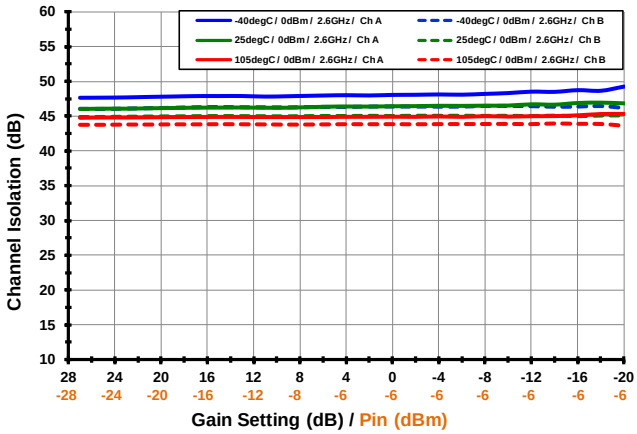

### Total $I_{CC}$ [2.6 GHz]




### RF to IF Leakage [2.6 GHz]

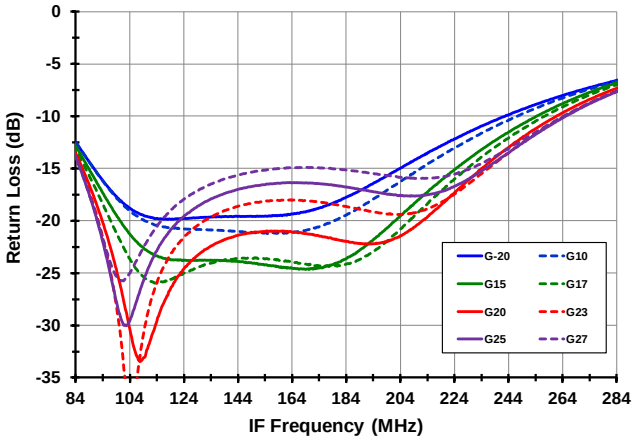



### Channel Isolation [2.6 GHz]

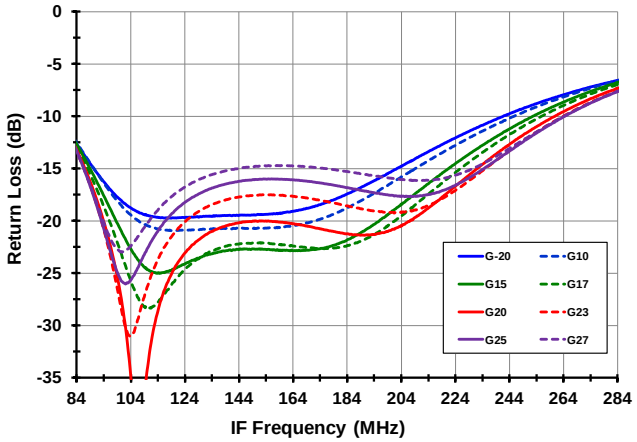


## TOCs Return Loss [STD Mode] (-11-)

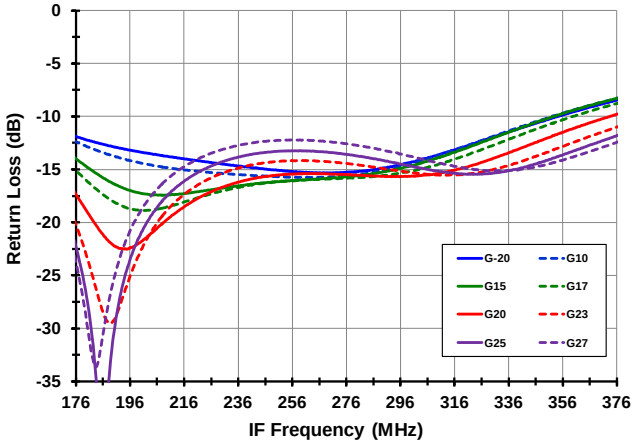
### IF_A Output Return Loss 184MHz match



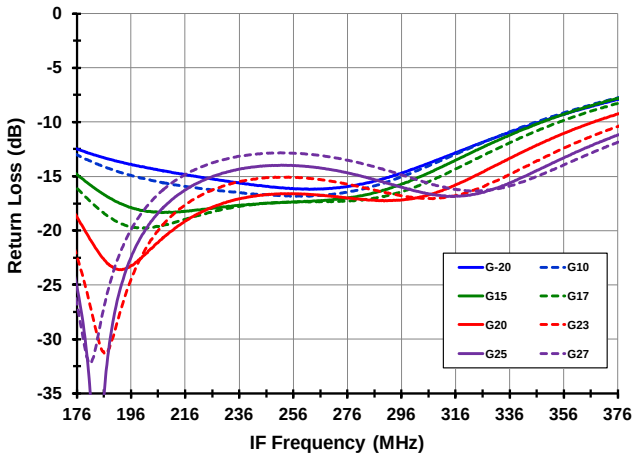

### IF_B Output Return Loss 184MHz match



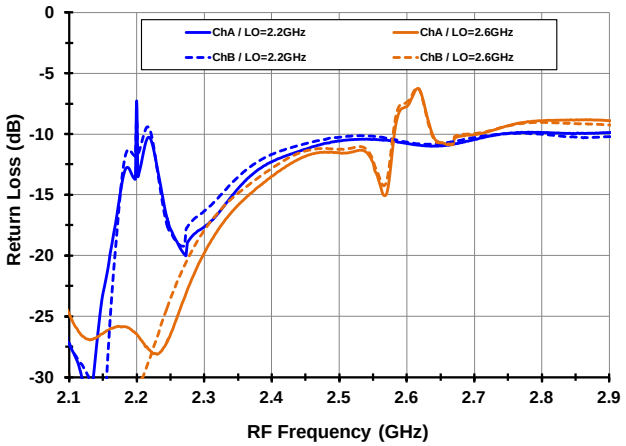

### IF_A Output Return Loss 276MHz match



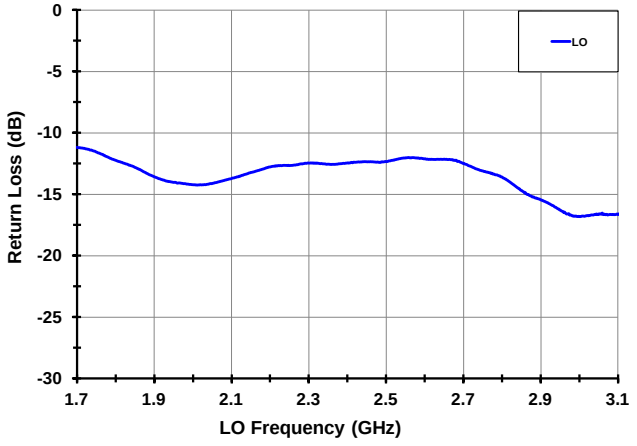

### IF_B Output Return Loss 276MHz match




### RF Port Return Loss

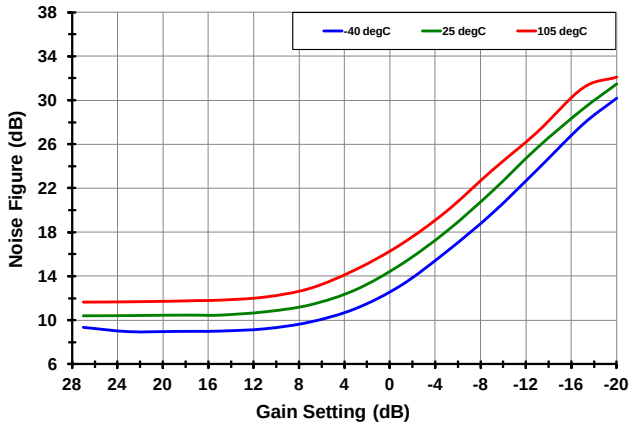



### LO Port Return Loss

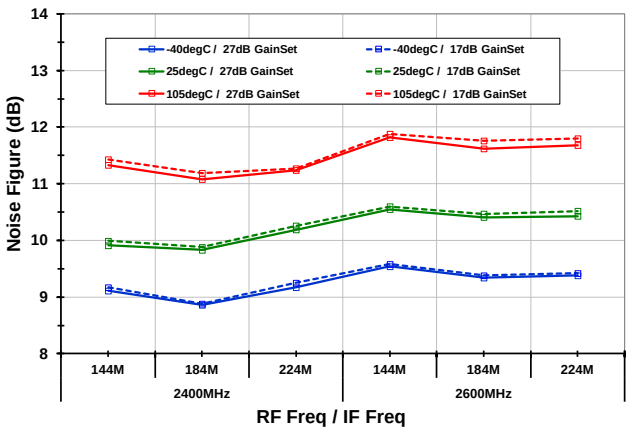


## TOCs Noise Figure, Gain Accuracy, P1dB [STD Mode] (-12-)

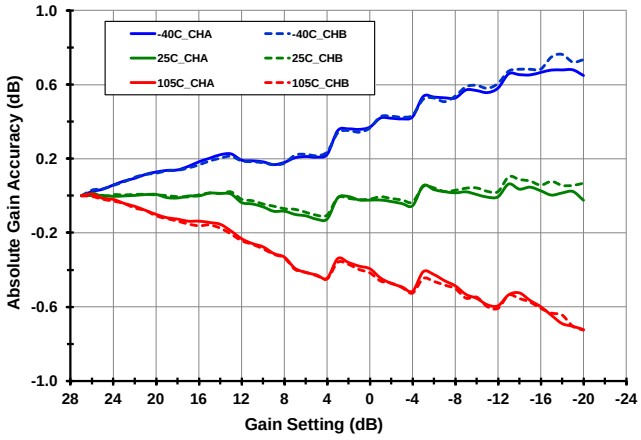
### NF v Gain [RF=2.6G, IF=184M, ChA, LS Injection]



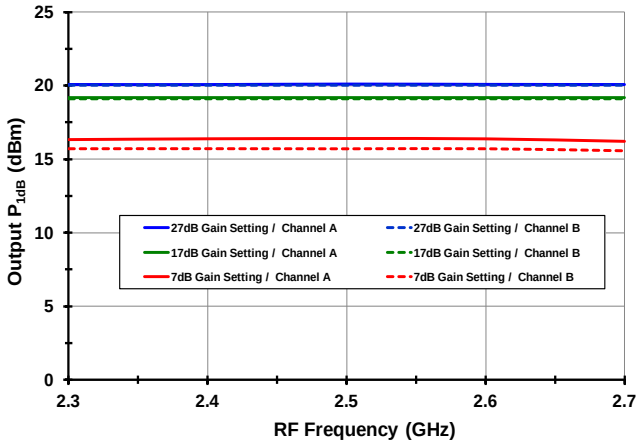

### NF v RF/IF Frequency [ChA, LS Injection]



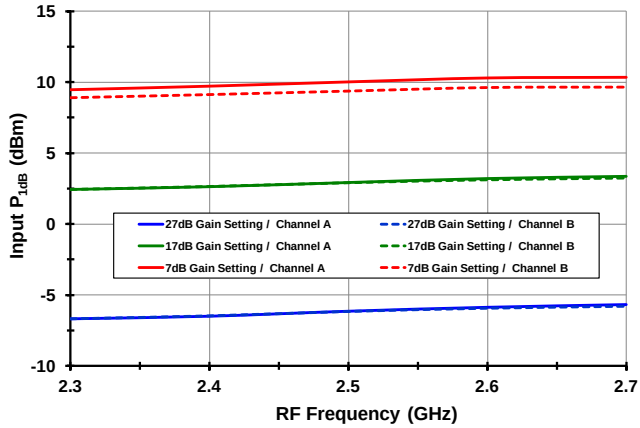

### Gain Accuracy [RF =2.6G, IF=184M, LS Injection]



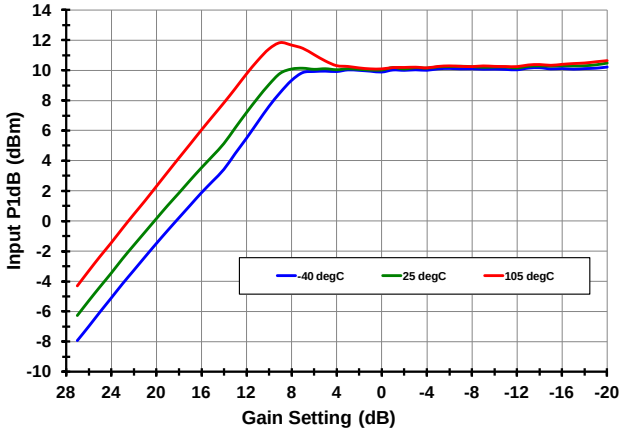

### Output P1dB [IF = 184 MHz, Low Side Injection]




### Input P1dB [IF =184 MHz, Low Side Injection]

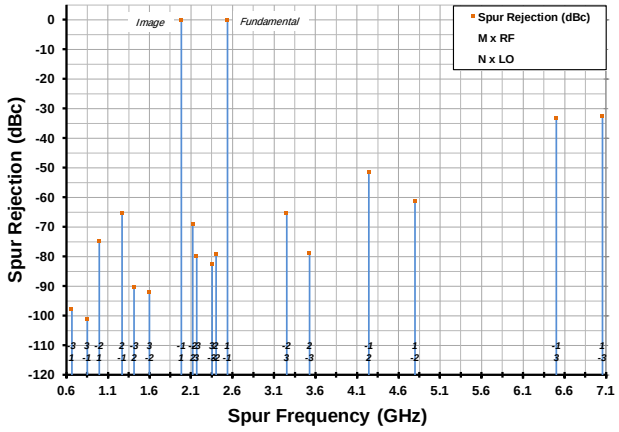



### Input P1dB [IF = 184 MHz, Low Side Injection]

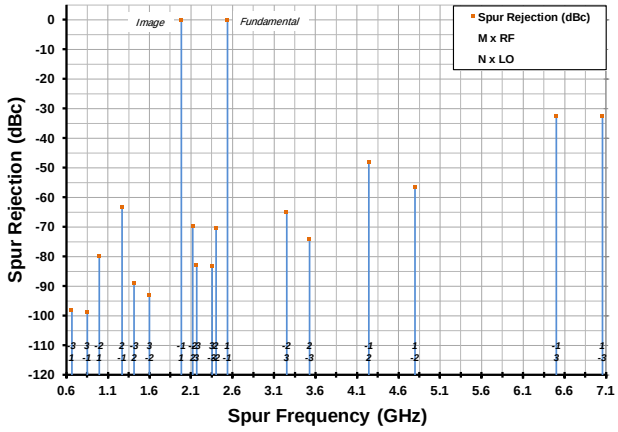


## TOCs M x N Spurs [IF = 276 MHz, LO = 2.2586 GHz, TCASE = 25C] (-13-)

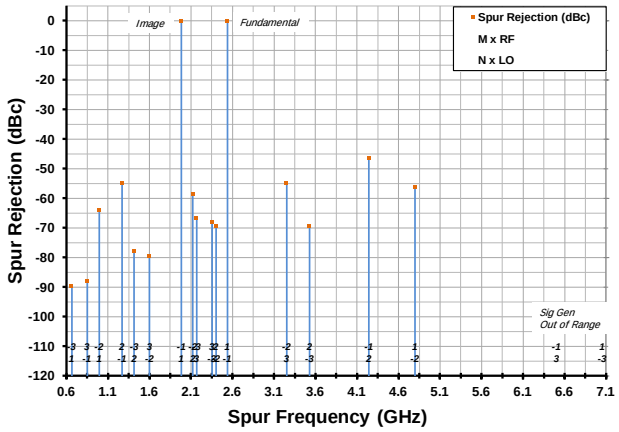
### Spur Rejection [ChA, Spur $P_{IN}$ = -5 dBm]



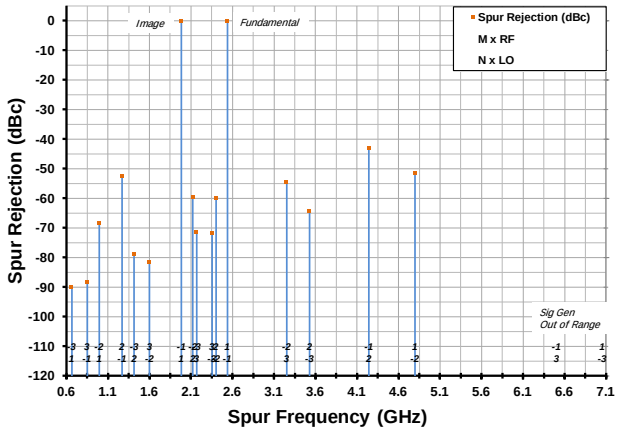

### Spur Rejection [ChB, Spur $P_{IN}$ = -5 dBm]



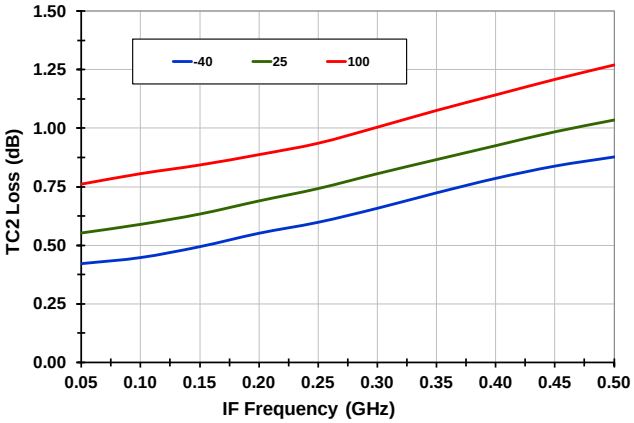

### Spur Rejection [ChA, Spur $P_{IN}$ = 0 dBm]




### Spur Rejection [ChB, Spur $P_{IN}$ = 0 dBm]

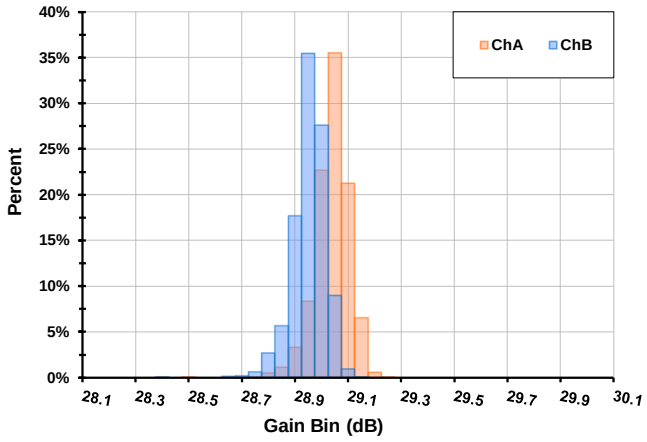



### Transformer TC2-7T Loss vs. Temperature

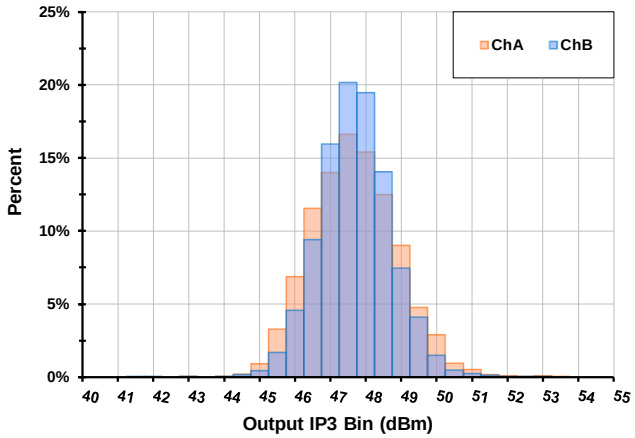


## TOCs HISTOGRAMS [N= 4584, $T_{CASE}$ = 25C] (-14-)

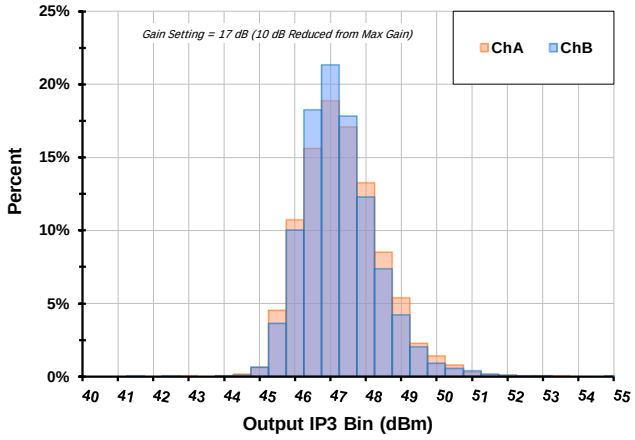
### Gain [RF = 2500M, LO = 2316M, $G_{MAX}$]



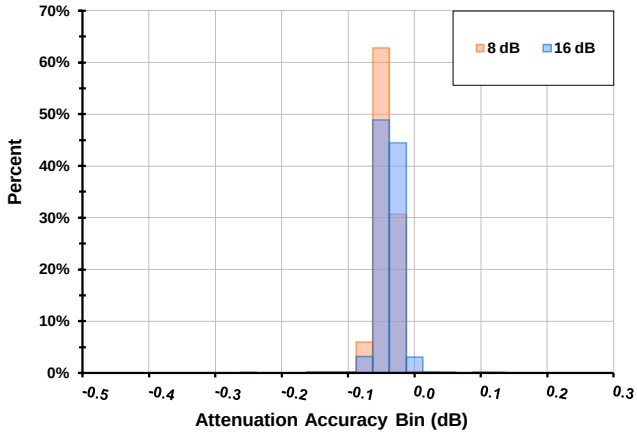

### Output IP3 [RF = 2500M, LO = 2316M, $G_{MAX}$]



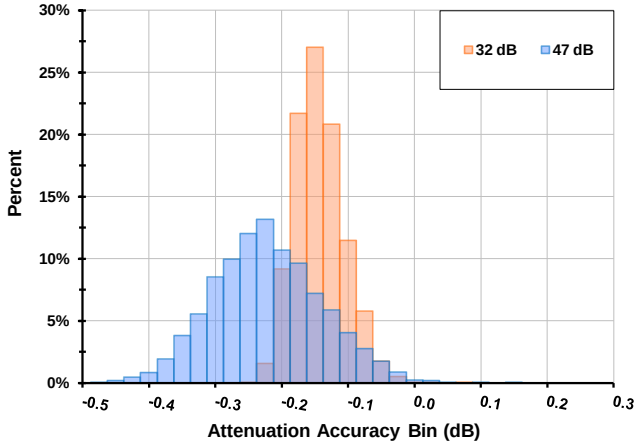

### Output IP3 [RF = 2500M, LO = 2316M, $G_{17}$]



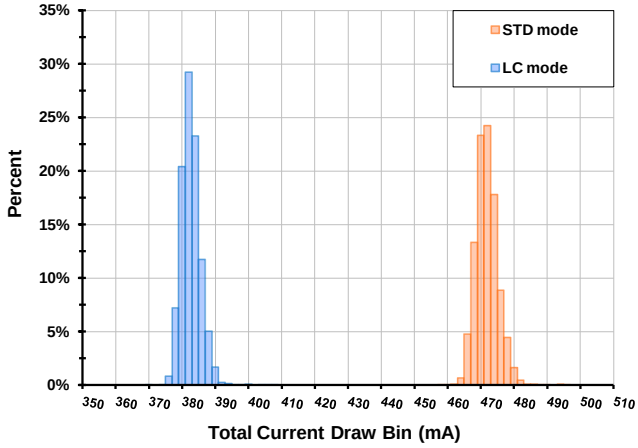

### ATTN Accuracy1 [RF = 2500M, LO = 2316, ChA]




### ATTN Accuracy2 [RF = 2500M, LO = 2316, ChA]



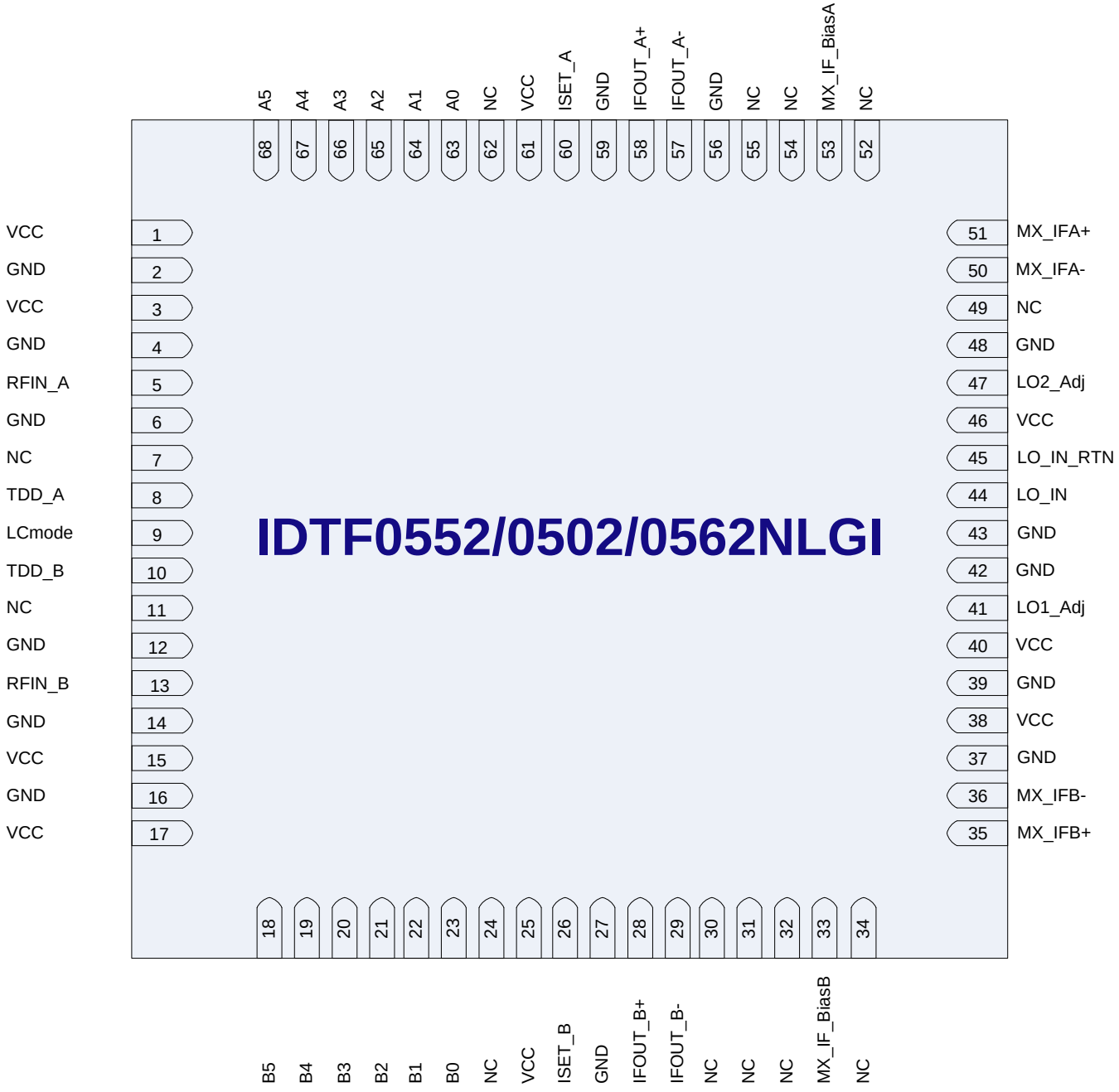

### Total $I_{CC}$ [LO = 2316M, $V_{CC}$ = 5.00 V]



## PACKAGE OUTLINE DRAWINGS

The package outline drawings are located at the end of this document and are accessible from the Renesas website (see Ordering Information for POD links). The package information is the most current data available and is subject to change without revision of this document.

## F0562 PINOUT:



## F0562 PIN DESCRIPTION TABLE

| Pin | Name | Function |
|---|---|---|
| 1, 3, 15, 17, 25, 38, 40, 46, 61 | VCC | Power Supply. Bypass to GND with capacitors shown in the Typical Application Circuit as close as possible to pin. |
| 2, 4, 6, 12, 14, 16, 27, 37, 39, 42, 43, 48, 56, 59 | GND | Ground these pins. |
| 5 | RFIN_A | Main Channel RF Input. Internally matched to 50Ω. DO NOT apply DC to these pins |
| 7, 11, 24, 30, 31, 32, 34, 49, 52, 54, 55, 62 | NC | No Connection. Not internally connected. OK to connect to VCC, OK to connect to GND |
| 8 | TDD_A | Standby control for Channel A. Includes an internal pull-up resistor so leave as NC for Standby mode. Set this pin to low or GND for normal operation. |
| 9 | LCmode | Low_Current Mode. Includes an internal pull-up resistor so leave as NC for LC mode. Set this pin to low or GND for STD mode. |
| 10 | TDD_B | Standby control for Channel B. Includes an internal pull-up resistor so leave as NC for Standby mode. Set this pin to low or GND for normal operation. |
| 13 | RFIN_B | Diversity Channel RF Input. Internally matched to 50Ω |
| 18 | B5 | Parallel Gain Control Input - MSB |
| 19 | B4 | Parallel Gain Control Input |
| 20 | B3 | Parallel Gain Control Input |
| 21 | B2 | Parallel Gain Control Input |
| 22 | B1 | Parallel Gain Control Input |
| 23 | B0 | Parallel Gain Control Input – LSB (1 dB step) |
| 26 | ISET_B | ChB VGA Icc set: Recommended resistor value = 3.83K |
| 28 | IFOUT_B+ | Channel B Differential Output +. Pull up to Vcc through an inductor |
| 29 | IFOUT_B- | Channel B Differential Output -. Pull up to Vcc through an inductor |
| 33 | MX_IF_BiasB | Connect the specified resistor for either Standard mode (41ohm) or LC mode (62ohm) from this pin to ground to set the bias for the Diversity IF amplifier. This is NOT a current set resistor. |
| 35 | MX_IFB+ | Diversity Mixer Differential IF (+) Output. Connect a pullup inductor from this pin to VCC. |
| 36 | MX_IFB- | Diversity Mixer Differential IF (-) Output. Connect a pullup inductor from this pin to VCC. |

## F0562 PIN DESCRIPTION TABLE (CONTINUED)

| | | |
|---|---|---|
| 41 | LO1_ADJ | Connect the specified resistor for either Standard mode (220ohm) or LC mode (240ohm) from this pin to ground to set the LO common buffer Icc. |
| 44 | LO_IN | Local Oscillator Input. Connect the LO to this port through the recommended coupling capacitor. |
| 45 | LO_IN_RTN | Transformer ground return. Ground this pin. |
| 47 | LO2_ADJ | Connect the specified resistor for either Standard mode (1.3K) or LC mode (2.15K) from this pin to ground to set the LO drive buffers Icc. |
| 50 | MX_IFA- | Diversity Mixer Differential IF (-) Output. Connect a pullup inductor from this pin to VCC. |
| 51 | MX_IFA+ | Diversity Mixer Differential IF (+) Output. Connect a pullup inductor from this pin to VCC. |
| 53 | MX_IF_BiasA | Connect the specified resistor for either Standard mode (41ohm) or LC mode (62ohm) from this pin to ground to set the bias for the Diversity IF amplifier. This is NOT a current set resistor. |
| 57 | IFOUT_A- | Channel A Differential Output -. Pull up to Vcc through an inductor |
| 58 | IFOUT_A+ | Channel A Differential Output +. Pull up to Vcc through an inductor |
| 60 | ISET_A | ChA VGA Icc set: Recommended resistor value = 3.83K |
| 63 | A0 | Parallel Gain Control Input – LSB (1dB step) |
| 64 | A1 | Parallel Gain Control Input |
| 65 | A2 | Parallel Gain Control Input |
| 66 | A3 | Parallel Gain Control Input |
| 67 | A4 | Parallel Gain Control Input |
| 68 | A5 | Parallel Gain Control Input - MSB |
| | — 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 noted RF performance. |

## F0562 Digital Pin Voltage and Resistance Values

The following table provides open-circuit DC voltage and resistance values referenced to ground for each of the control pins listed.

| Pin | Name | DC Voltage (volts) | Resistance (ohms) |
|---|---|---|---|
| 8 | TDD_A | 5 | 50k |
| 9 | LC_MODE | 5 | 50k |
| 10 | TDD_B | 5 | 50k |
| 18 – 23 | B0-B5 | 5 | 50k |
| 63 - 68 | A0-A5 | 5 | 50k |

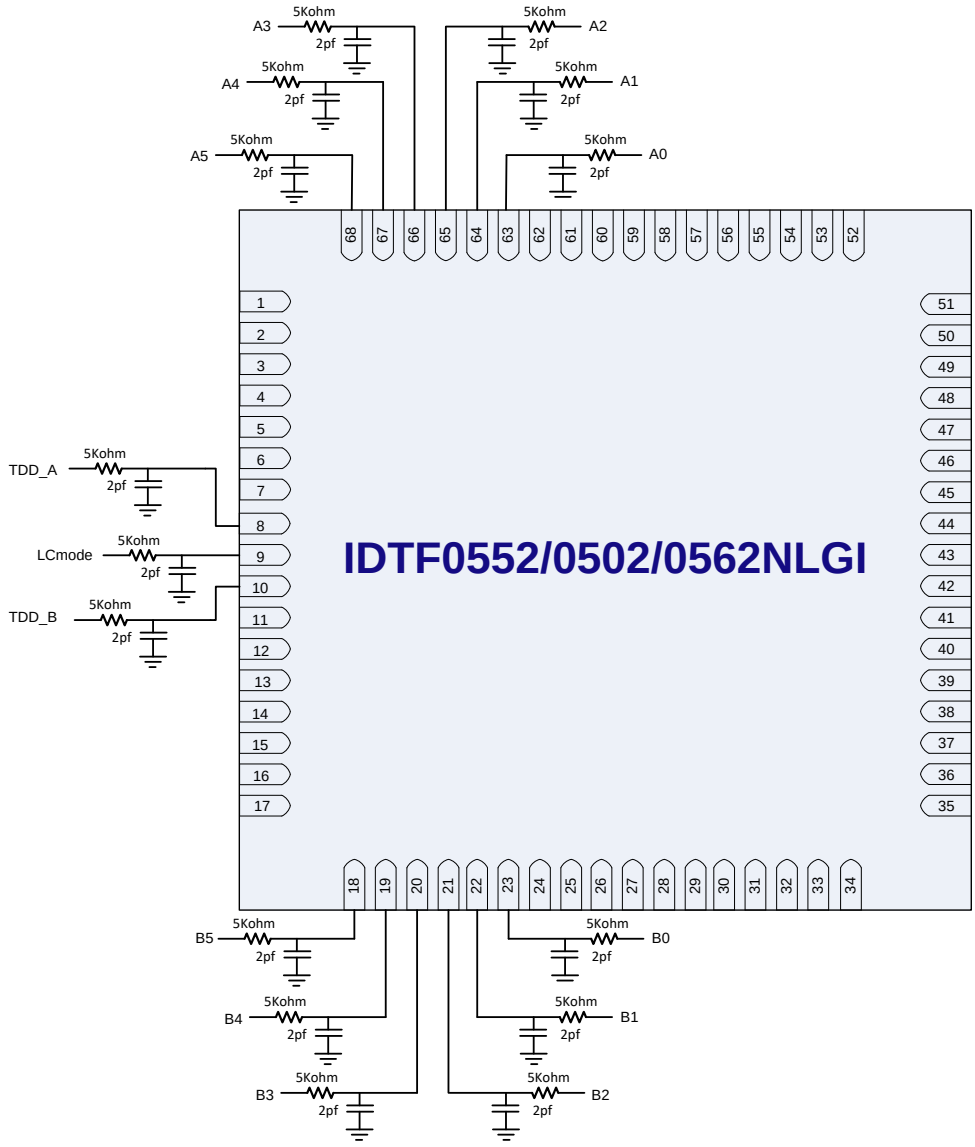
## APPLICATIONS INFORMATION

### 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.

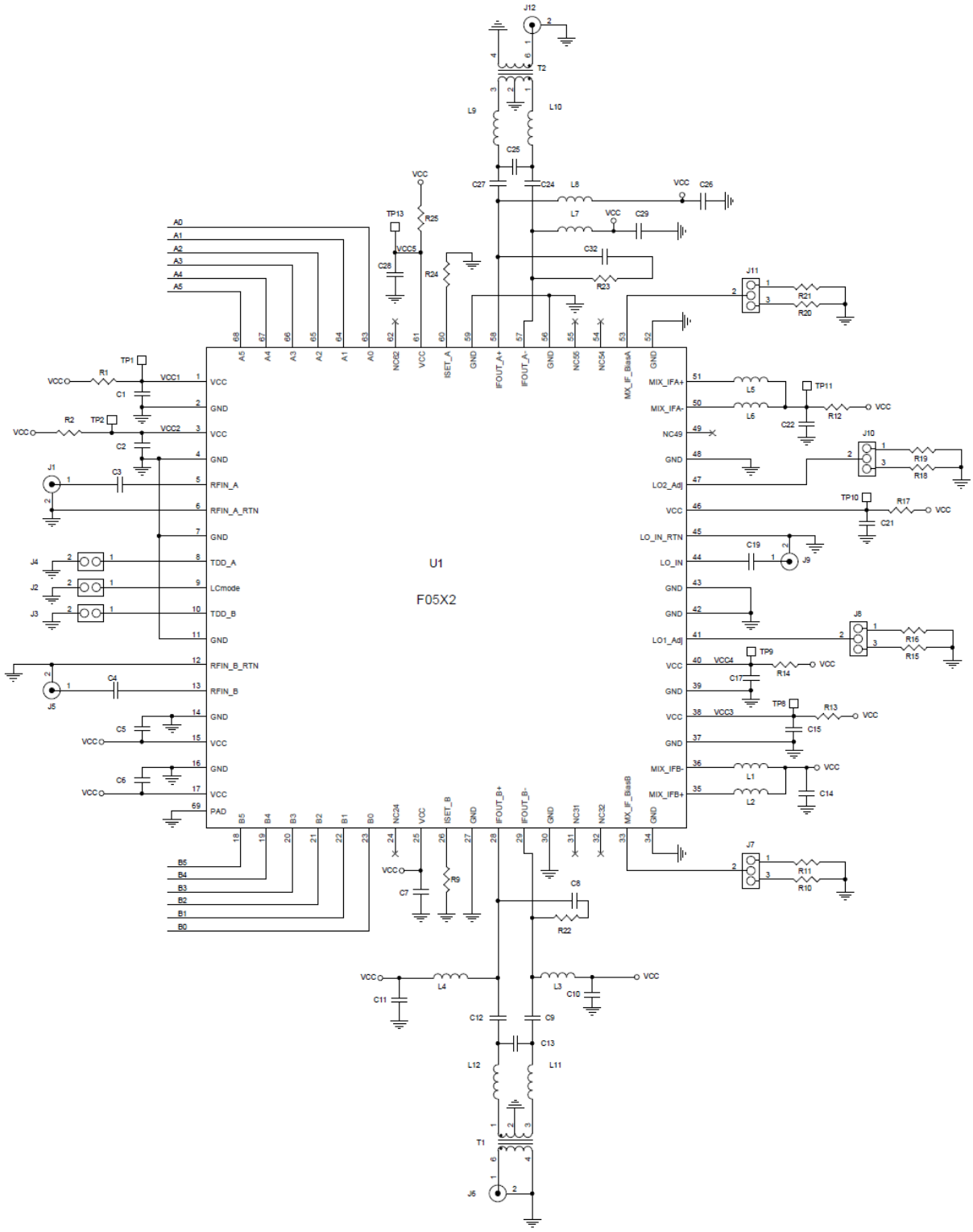
### Control Pin Interface

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 and data pin is recommended. This applies to pins 8, 9, 10, 18 - 23, and 63 - 68 as shown below.

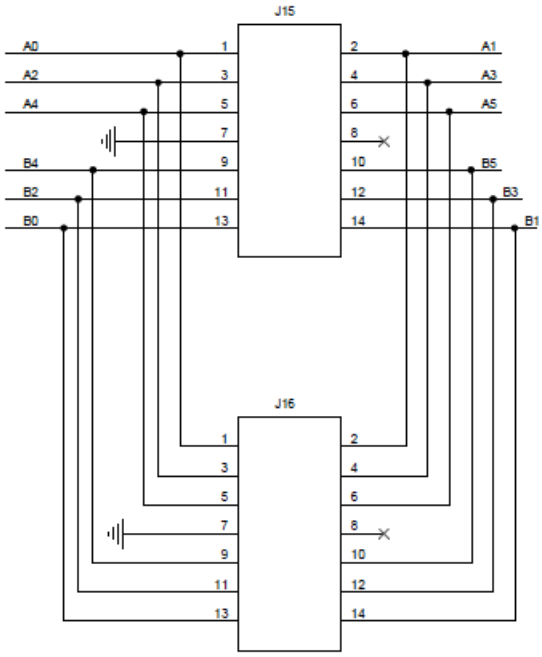


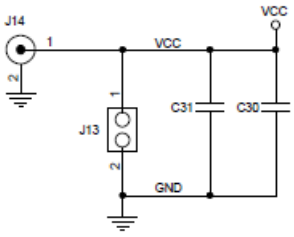
## EVKIT AND TYPICAL APPLICATION SCHEMATIC:

The following schematic describes the recommended EVkit and applications circuit.

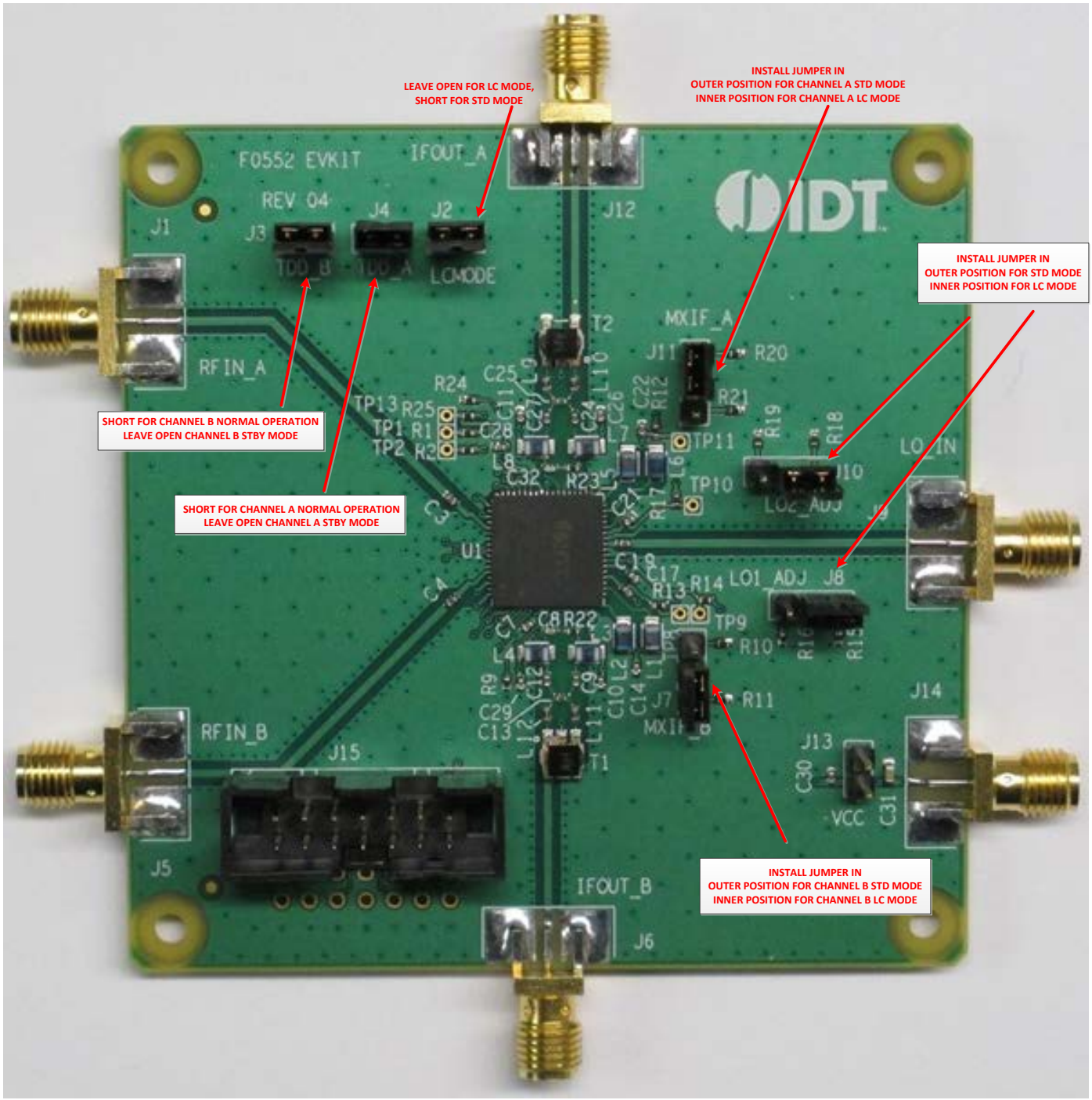


**SCHEMATIC CONTINUED FROM PREVIOUS PAGE**



## EVKIT PICTURE



## F0562 BOM 1 AND 2

Two BOMs are included: BOM1 supports the 4:1 output transformation from 200ohms to 50ohms used for production test and BOM2 supports the 2:1 output transformation from 200ohms to 100ohms used to generate the typical operating curve graphs.

**BOM1** includes components for 4:1 output transformation supporting production test (IF center frequency 184MHz)

F0562 BOM 4:1 IF=184Mhz
1/14/2013

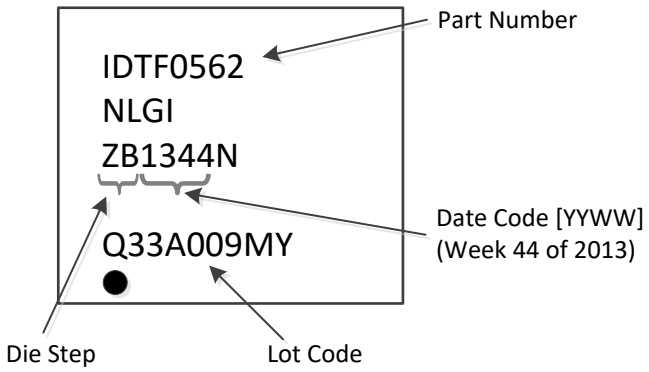
| Item # | Value | Size/Rev | Desc | Mfr. Part # | Mfr. | Supplier Part # | Supplier | Part Reference | Qty |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 39pF | 0402 | CAP CER 39PF 50V 5% C0G 0402 | GRM1555C1H390JZ01 | MURATA | 490-1286-1-ND | Digikey | C3,4,19 | 3 |
| 2 | 10nF | 0402 | CAP CER 10000PF 16V 10% X7R 0402 | GRM155R71C103KA01 | MURATA | 490-1313-1-ND | Digikey | C1,2,5,6,7,10,11,14,15, 17, 21,22,26,28,29,30 | 16 |
| 3 | 1000pF | 0402 | CAP CER 1000PF 50V C0G 0402 | GRM1555C1H102JA01 | MURATA | 490-3244-1-ND | Digikey | C9,12,24,27 | 4 |
| 4 | 0.6pF | 0402 | CAP CER 0.6pF 50V C0G +/-0.1pF 0402 | GJM1555C1HR60BB01 | MURATA | 81-GJM1555C1HR60BB0 | Mouser | C8,32 | 2 |
| 5 | 10uF | 0603 | CAP CER 10UF 6.3V X5R 0603 | GRM188R60J106ME47 | MURATA | 490-3896-1-ND | Digikey | C31 | 1 |
| 6 | 91 | 0402 | RES 91.0 OHM 1/10W 1% 0402 SMD | ERJ-2RKF91R0X | Panasonic | P91.0LCT-ND | Digikey | R15 | 1 |
| 7 | 180 | 0402 | RES 180 OHM 1/10W 1% 0402 SMD | ERJ-2RKF1800X | Panasonic | P180LCT-ND | Digikey | R16 | 1 |
| 8 | 100 | 0402 | RES 100 OHM 1/10W 1% 0402 SMD | ERJ-2RKF1000X | Panasonic | P100LCT-ND | Digikey | R22, 23 | 2 |
| 9 | 1.21K | 0402 | RES 1.21K OHM 1/10W 1% 0402 SMD | ERJ-2RKF1211X | Panasonic | P1.21KLCT-ND | Digikey | R18 | 1 |
| 10 | 1.91k | 0402 | RES 1.91K OHM 1/10W 1% 0402 SMD | ERJ-2RKF1911X | Panasonic | P1.91KLCT-ND | Digikey | R19 | 1 |
| 11 | 110 | 0402 | RES 110 OHM 1/10W 1% 0402 SMD | ERJ-2RKF1100X | Panasonic | P110LCT-ND | Digikey | R10,21 | 2 |
| 12 | 3.48K | 0402 | RES 3.48K OHM 1/10W 1% 0402 SMD | ERJ-2RKF3481X | Panasonic | P3.48KLCT-ND | Digikey | R9,24 | 2 |
| 13 | 40.2 | 0402 | RES 40.2 OHM 1/10W 1% 0402 SMD | ERJ-2RKF40R2X | Panasonic | P40.2LCT-ND | Digikey | R11,20 | 2 |
| 14 | 0 | 0402 | RES 0.0 OHM 1/10W 0402 SMD | ERJ-2GE0R00X | Panasonic | P0.0JCT-ND | Digikey | R1,2,12,13,14,17,25,L9- | 11 |
| 15 | SMA_END_LAUNCH | .062 | SMA_END_LAUNCH (Big) | 142-0701-851 | Emerson Johnson | 530-142-0701-851 | Mouser | J1,5,9 | 3 |
| 16 | SMA_END_LAUNCH | .062 | SMA_END_LAUNCH (small) | 142-0711-821 | Emerson Johnson | 530-142-0711-821 | Mouser | J6,12,14 | 3 |
| 17 | Header 14 Pin | TH 14 | CONN HEADER VERT SGL 14POS GOLD | N2514-6002-RB | 3M | MHC14K-ND | Digikey | J15 | 1 |
| 18 | Header 2 Pin | TH 2 | CONN HEADER VERT SGL 2POS GOLD | 961102-6404-AR | 3M | 3M9447-ND | Digikey | J2,3,4,13 | 4 |
| 19 | Header 3 Pin | TH 3 | CONN HEADER VERT SGL 3POS GOLD | 961103-6404-AR | 3M | 3M9448-ND | Digikey | J7,8,10,11 | 4 |
| 20 | 1:4 Balun | SM-22 | 4:1 Center Tap Balun | TC4-1WG2+ | Mini Circuits | TC4-1WG2+ | Mini Circuits | T1,2 | 2 |
| 21 | 390 nH | 0805 | 0805CS (2012) Ceramic Chip Inductor | 0805CS-391XJLB | COILCRAFT | 0805CS-391XJLB | COILCRAFT | L1-L8 | 8 |
| 22 | F0562 | TQFN-68 | Sampling IF receiver | F0562 | IDT | F0562 | IDT | U1 | 1 |
| 23 | PCB | 04 | Printed Circuit Board | F0552 EV Kit Rev 04 | | | CC | | 1 |
| 24 | DNP | | Do Not Populate | | | | | C13,25 | |
| 25 | BOM | 01 | Bill Of Material | | | | | | |
| | | | | | | | | Total | 76 |

**BOM2** includes components for 2:1 output transformation used for TOCs (IF center frequency 184MHz +/ - 40MHz)

F0562 BOM 2:1 IF=184Mhz
1/14/2013

| Item # | Value | Size/Rev | Desc | Mfr. Part # | Mfr. | Supplier Part # | Supplier | Part Reference | Qty |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 39pF | 0402 | CAP CER 39PF 50V 5% C0G 0402 | GRM1555C1H390JZ01 | MURATA | 490-1286-1-ND | Digikey | C3,4,19 | 3 |
| 2 | 10nF | 0402 | CAP CER 10000PF 16V 10% X7R 0402 | GRM155R71C103KA01 | MURATA | 490-1313-1-ND | Digikey | C1,2,5,6,7,10,11,14, 15,17, | 16 |
| 3 | 20pF | 0402 | CAP CER 20pF 50V C0G 0402 | GRM1555C1H200JZ01 | MURATA | 490-1282-1-ND | Digikey | C9,12,24,27 | 4 |
| 4 | 3pF | 0402 | CAP CER 3pF 50V C0G 0402 | GRM1555C1H3R0CZ01 | MURATA | 490-3205-1-ND | Digikey | C13,25 | 2 |
| 5 | 0.6pF | 0402 | CAP CER 0.6pF 50V C0G +/-0.1pF | GJM1555C1HR60BB01 | MURATA | 81-GJM1555C1HR60BB0 | Mouser | C8, 32 | 2 |
| 6 | 10uF | 0603 | CAP CER 10UF 6.3V X5R 0603 | GRM188R60J106ME47 | MURATA | 490-3896-1-ND | Digikey | C31 | 1 |
| 7 | 91 | 0402 | RES 91.0 OHM 1/10W 1% 0402 SMD | ERJ-2RKF91R0X | Panasonic | P91.0LCT-ND | Digikey | R15 | 1 |
| 8 | 180 | 0402 | RES 180 OHM 1/10W 1% 0402 SMD | ERJ-2RKF1800X | Panasonic | P180LCT-ND | Digikey | R16 | 1 |
| 9 | 100 | 0402 | RES 100 OHM 1/10W 1% 0402 SMD | ERJ-2RKF1000X | Panasonic | P100LCT-ND | Digikey | R22, 23 | 2 |
| 10 | 1.21K | 0402 | RES 1.21K OHM 1/10W 1% 0402 SMD | ERJ-2RKF1211X | Panasonic | P1.21KLCT-ND | Digikey | R18 | 1 |
| 11 | 1.91k | 0402 | RES 1.91K OHM 1/10W 1% 0402 SMD | ERJ-2RKF1911X | Panasonic | P1.91KLCT-ND | Digikey | R19 | 1 |
| 12 | 110 | 0402 | RES 110 OHM 1/10W 1% 0402 SMD | ERJ-2RKF1100X | Panasonic | P110LCT-ND | Digikey | R10,21 | 2 |
| 13 | 3.48K | 0402 | RES 3.48K OHM 1/10W 1% 0402 SMD | ERJ-2RKF3481X | Panasonic | P3.48KLCT-ND | Digikey | R9,24 | 2 |
| 14 | 40.2 | 0402 | RES 40.2 OHM 1/10W 1% 0402 SMD | ERJ-2RKF40R2X | Panasonic | P40.2LCT-ND | Digikey | R11,20 | 2 |
| 15 | 0 | 0402 | RES 0.0 OHM 1/10W 0402 SMD | ERJ-2GE0R00X | Panasonic | P0.0JCT-ND | Digikey | R1,2,12,13,14,17,25 | 7 |
| 16 | SMA_END_LAUNCH | .062 | SMA_END_LAUNCH (Big) | 142-0701-851 | Emerson Johnson | 530-142-0701-851 | Mouser | J1,5,9 | 3 |
| 17 | SMA_END_LAUNCH | .062 | SMA_END_LAUNCH (small) | 142-0711-821 | Emerson Johnson | 530-142-0711-821 | Mouser | J6,12,14 | 3 |
| 18 | Header 14 Pin | TH 14 | CONN HEADER VERT SGL 14POS GOL | N2514-6002-RB | 3M | MHC14K-ND | Digikey | J15 | 1 |
| 19 | Header 2 Pin | TH 2 | CONN HEADER VERT SGL 2POS | 961102-6404-AR | 3M | 3M9447-ND | Digikey | J2,3,4,13 | 4 |
| 20 | Header 3 Pin | TH 3 | CONN HEADER VERT SGL 3POS | 961103-6404-AR | 3M | 3M9448-ND | Digikey | J7,8,10,11 | 4 |
| 21 | 2:1 Balun | SM-22 | 2:1 Center Tap Balun | TC2-72T+ | Mini Circuits | TC2-72T+ | Mini Circuits | T1,2 | 2 |
| 22 | 390 nH | 0805 | 0805CS (2012) Ceramic Chip Inductor | 0805CS-391XJLB | COILCRAFT | 0805CS-391XJLB | COILCRAFT | L1,2,5,6, | 4 |
| 23 | 150nH | 0805 | 0805CS (2012) Ceramic Chip Inductor | 0805CS-151XJLB | COILCRAFT | 0805CS-151XJLB | COILCRAFT | L3,4,7,8 | 4 |
| 24 | 30nH | 0402 | 0402CS Ceramic Chip Inductor | 0402CS-30NXJLU | COILCRAFT | 0402CS-30NXJLU | COILCRAFT | L9-12 | 4 |
| 25 | F0562 | TQFN-68 | Sampling IF receiver | F0562 | IDT | F0562 | IDT | U1 | 1 |
| 26 | PCB | 04 | Printed Circuit Board | F0552 EV Kit Rev 04 | | | CC | | 1 |
| 27 | BOM | 02 | Bill Of Material | | | | | | |
| | | | | | | | | Total | 78 |

## TOP MARKINGS




## ORDERING INFORMATION

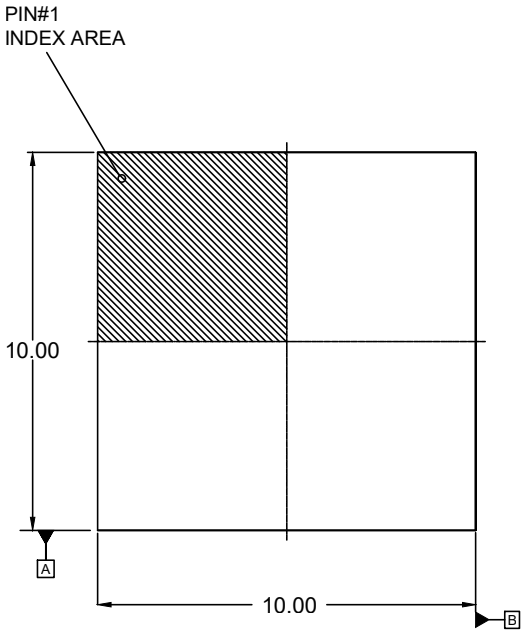
| Part Number | Package Description | Carrier Type | Temperature Range |
|---|---|---|---|
| F0562NLGI | 68-VFQFPN, 10 × 10 mm | Tape and Reel | -40°C to +85°C |
| F0562NLGI8 | | Tray | |

## REVISION HISTORY

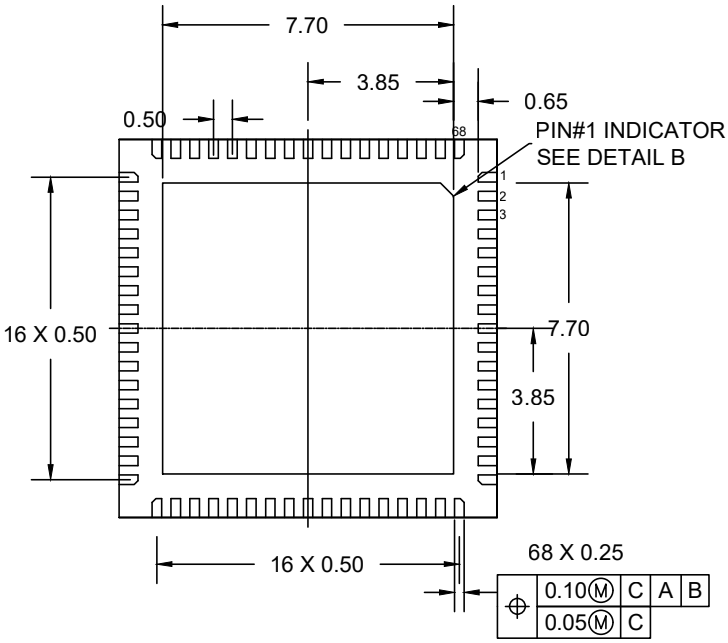
| Revision Date | Description |
|---|---|
| February 9, 2022 | Rebranded to Renesas. |
| April 16, 2014 | Initial release. |

# Package Outline Drawing

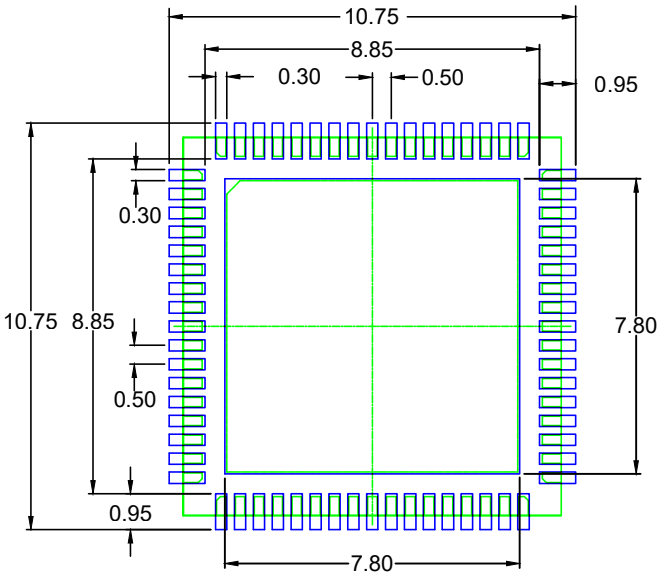
Package Code:NLG68P1
68-VFQFPN 10.0 x 10.0 x 0.90 mm Body, 0.5mm Pitch
PSC-4111-01, Revision: 01, Date Created: Feb 15, 2022



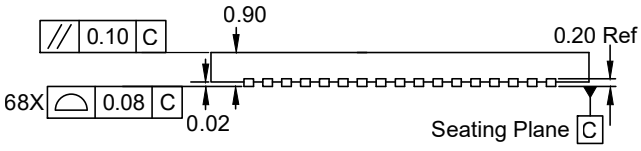

TOP VIEW




BOTTOM VIEW




RECOMMENDED LAND PATTERN DIMENSION




SIDE VIEW

NOTES:

1. All dimension are in mm, angles in degrees.
2. Top down view, as viewed on PC.
3. Land pattern in blue. NSMD land pattern assumed.
4. Land pattern recommendation as per IPC-7351B generic requirement for surface mount design and land pattern.

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### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan

www.renesas.com

### Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:

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