

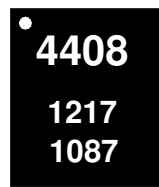
TGC4408-SM

18 - 20 GHz Block Downconverter



Applications

- VSAT Ground Terminal
- Millimeter wave Communications

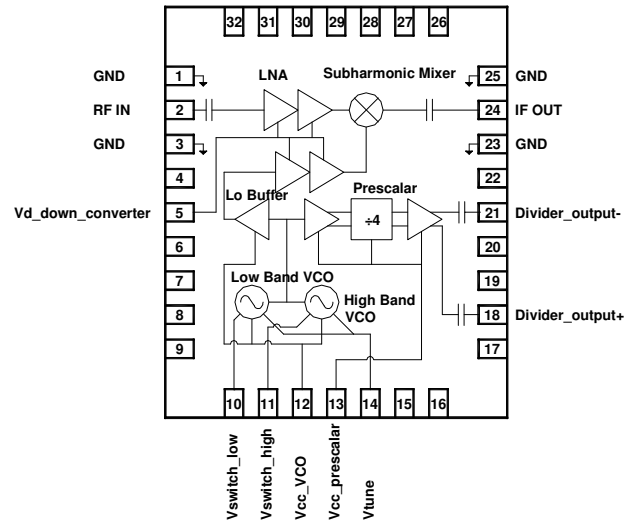


32-pin 5x6mm QFN package

Product Features

- RF Frequency: 18.3 to 20.2 GHz
- Internal dual band LO Sources
- 7.9 to 9.1 GHz and 9.9 to 11.1 GHz
- IF Frequency: 950 to 1950 MHz
- Conversion Gain: 8.5 dB
- Single Side Band Noise Figure: 6.5 dB
- Input IP3: -8 dBm
- Differential ÷4 VCO output for use by external PLL
- Single +5V supply operation
- Bias 5.0 V, 305 mA
- Package Dimensions: 5.0 x 6.0 x 0.85mm

Functional Block Diagram



General Description

The TriQuint TGC4408-SM is a low cost Ku band downconverter. It provides in a single package a dual band VCO, a subharmonic mixer, and all the associated gain stages required to integrate the VCO and the mixer.

The TGC4408-SM provides a differential signal at 1/4th the VCO frequency for use in a phase-locked loop.

The subharmonic mixer is manufactured using TriQuint's pHEMT process; the VCO and the prescaler are manufactured using TriQuint's HBT process.

The TGC4408-SM is available as a single surface mount 32 lead 5x6 QFN package and is ideally suited for VSAT ground terminals and millimeter wave communication receivers.

Lead-free and RoHS compliant.

Evaluation Boards are available upon request.

Pin Configuration

| Pin # | Function Label |
|---|------------------------|
| 1,3,23,25 | GND |
| 2 | RF IN |
| 5 | Vd down converter |
| 10 | Vswitch_low |
| 11 | Vswitch_high |
| 12 | Vcc_VCO |
| 13 | Vcc_prescaler |
| 14 | V tune |
| 18 | Divider output+ (LO/4) |
| 21 | Divider output- (LO/4) |
| 24 | IF OUT |
| 4,6,7,8,9,15,16,17,19, 20,22,26 thru 32 thru 32 | N/C |

Ordering Information

| Part No. | ECCN | Description |
|------------|-------|----------------------------------|
| TGC4408-SM | EAR99 | 18 to 20 GHz Block Downconverter |

Standard T/R size = 500 pieces on a 13" reel

Specifications

Absolute Maximum Ratings

| Parameter | Rating |
|---|-------------------------|
| Storage Temperature | -40 to 125°C |
| Mounting Temperature (30 Seconds) | 260 °C |
| Channel Temperature, T _{ch} | 200 °C |
| RF Input Power, 50Ω, T = 25°C | 10 dBm |
| V _{cc_VCO} | +5.5V |
| V _{cc_Prescaler} | +5.5 V |
| V _{tune} | +5.5 V |
| V _{switch_low} , V _{switch_high} | V _{cc} + 0.5 V |
| Current, V _{cc_VCO} | 120 mA |
| Current, V _{cc_Prescaler} | 140 mA |
| Current, V _{d_down_converter} | 155 mA |
| Current, V _{tune} | 0.5 mA |
| Current, V _{switch_low} , V _{switch_high} | 4 mA |
| Power Dissipation, P _{diss} | 2.28 W |

Operation of this device outside the parameter ranges given above may cause permanent damage.

Recommended Operating Conditions

| Parameter | Min | Typ | Max | Units |
|--|-----|-----|-----|-------|
| Operating Temp. Range | -40 | | +85 | °C |
| V _{cc_VCO} | | 5.0 | | V |
| V _{cc_Prescaler} | | 5.0 | | V |
| V _{tune} | 1 | 2.1 | 4.0 | V |
| V _{d_down_converter} | | 5.0 | | V |
| Current, V _{cc_VCO} | | 100 | | mA |
| Current, V _{cc_Prescaler} | | 105 | | mA |
| Current, V _{cc_VCO} + V _{cc_prescaler} | | 205 | 240 | mA |
| Current, V _{d_down_converter} | | 100 | 135 | mA |
| T _j (for >10 ⁵ hours MTTF) | | | 175 | °C |

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

TGC4408-SM

18 - 20 GHz Block Downconverter



Specifications

Electrical Specifications

Test conditions unless otherwise noted: V_{cc_VCO} , $V_{dd_downconverter}$, $V_{dd_prescaler} = 5.0V$, $25^{\circ}C$.

| Parameter | Conditions | Min | Typ | Max | Units |
|-------------------------------------|------------------|-------|-------|-------|--------|
| Supply Voltage | | 4.8 | 5 | 5.2 | V |
| Supply Current | | | 305 | | mA |
| Input Frequency | | 18.3 | | 20.2 | GHz |
| Output Frequency | | 950 | | 1950 | MHz |
| Return Loss @ RF IN (17.5 – 21 GHz) | | 7 | 10 | | dB |
| VCO Frequency – Low Band | Vtune +1V to +4V | 8.55 | 8.67 | 8.76 | GHz |
| VCO Frequency – High Band | Vtune +1V to +4V | 10.45 | 10.57 | 10.66 | GHz |
| VCO Tune Voltage (Vtune) | | 1 | 2.1 | 4 | V |
| VCO Tuning Sensitivity -Low Band | | 125 | 260 | 375 | MHz/V |
| VCO Tuning Sensitivity - High Band | | 125 | 260 | 375 | MHz/V |
| Pushing | | | 45 | 70 | MHz/V |
| VCO Select 1,2 | | 0 | | 5 | V |
| LO/4 Prescaler Range | | 2.09 | | 2.72 | GHz |
| LO/4 Output Power | | | -4 | | dBm |
| Phase Noise @ 10 KHz offset | | | -73 | | dBc/Hz |
| Phase Noise @ 100 KHz offset | | | -99 | | dBc/Hz |
| Phase Noise @ 1 MHz offset | | | -126 | | dBc/Hz |
| Phase Noise @ 10 MHz offset | | | -136 | | dBc/Hz |

TGC4408-SM

18 - 20 GHz Block Downconverter



Specifications

Electrical Specifications

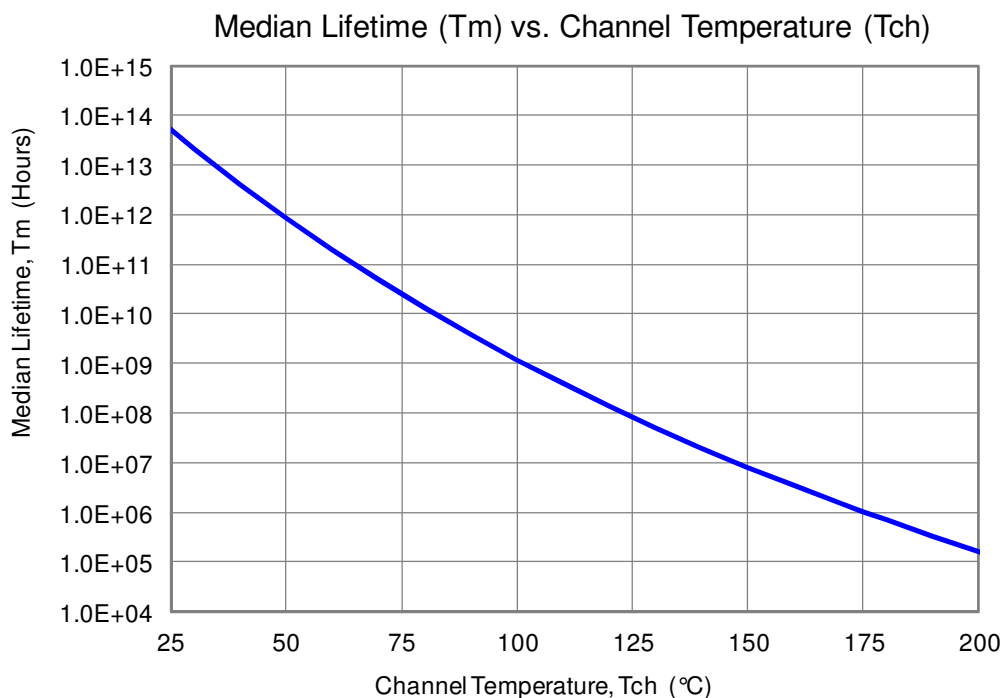
Test conditions unless otherwise noted: Vcc_VCO, Vdd_downconverter, Vdd_prescaler = 5.0V, 25 °C

| Parameter | Conditions | Min | Typ | Max | Units |
|--|---------------------------|-----|-------------------|-----|-------------------|
| Return Loss @ IF OUT (950 – 1950 MHz) | Using application circuit | 10 | 13 | | dB |
| Conversion Gain | | 6.5 | 8.5 | 9.5 | dB |
| SSB Noise Figure | | | 6.5 | 8 | dB |
| Out of Band Spurious: (2LO @ RF) (2LO @ IF) (LO/4 @ IF) | | | -35 -45 -60 | | dBm dBm dBm |
| Isolation: (LO @ IF) | | | -7 | | dBm |
| P1dB Compression Point | | -17 | -14 | | dBm |
| Third Order Input Intercept Point (IIP3) | | -10 | -6 | | dBm |

Specifications

Thermal and Reliability Information

| Parameter | Conditions | Rating |
|---|--|--|
| Thermal Resistance, θ_{JC} , measured to back of package | Tbase = 70 °C | $\theta_{JC} = 41.2 \text{ } ^\circ\text{C/W}$ |
| Channel Temperature (Tch), and Median Lifetime (Tm) | Tbase = 70 °C, Vd = 5V, Id = 305 mA, Pdiss = 1.5 W | Tch = 133 °C Tm = 3.9E+7 Hours |



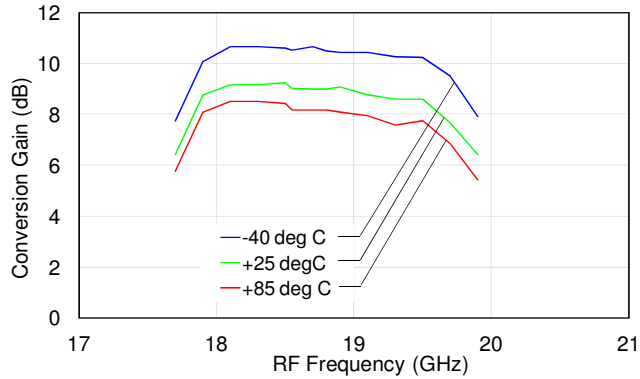
TGC4408-SM

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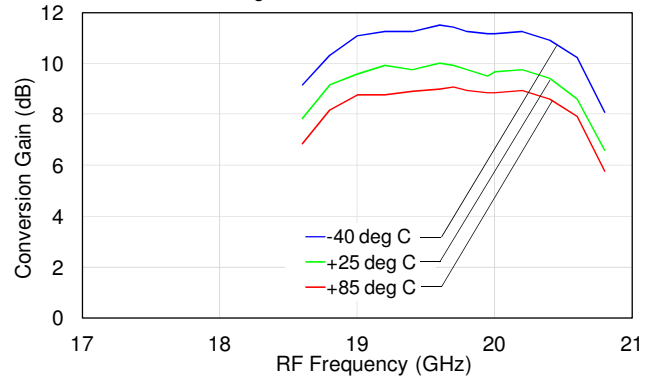


Typical Performance

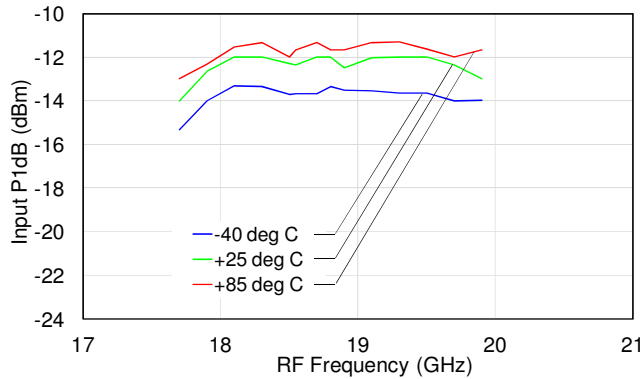
CG vs. Frequency vs. Temperature
Low Band LO: 8.67 GHz



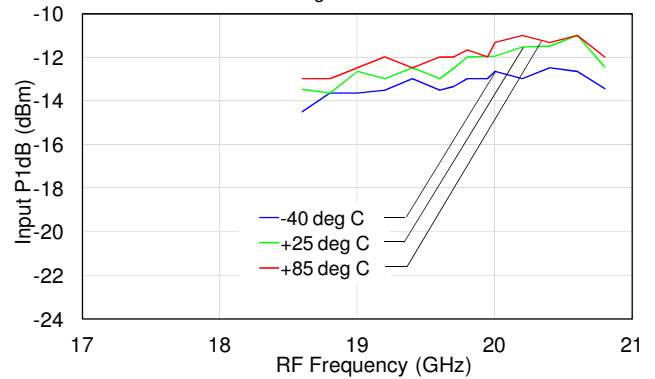
CG vs. Frequency vs. Temperature
High Band LO: 10.57 GHz



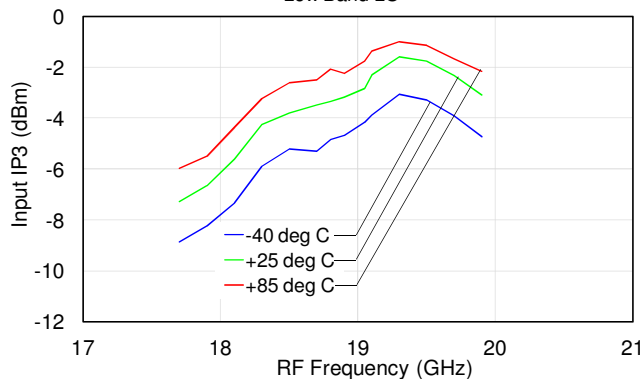
Input P1dB vs. Frequency vs. Temperature
Low Band LO



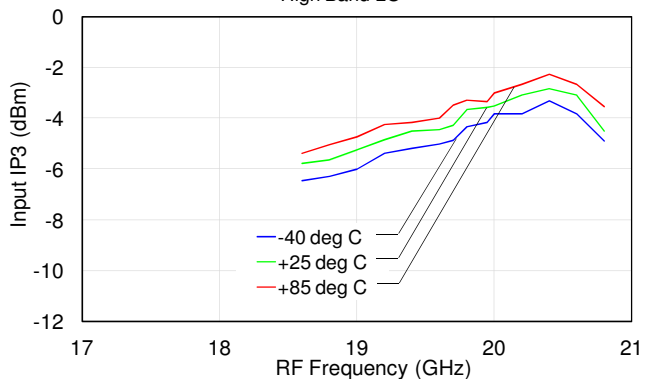
Input P1dB vs. Frequency vs. Temperature
High Band LO



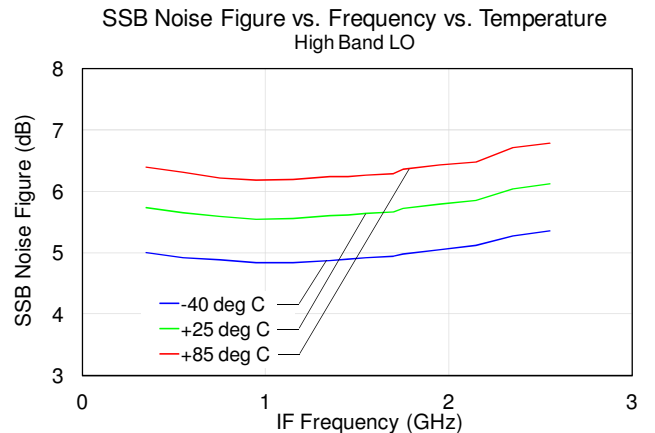
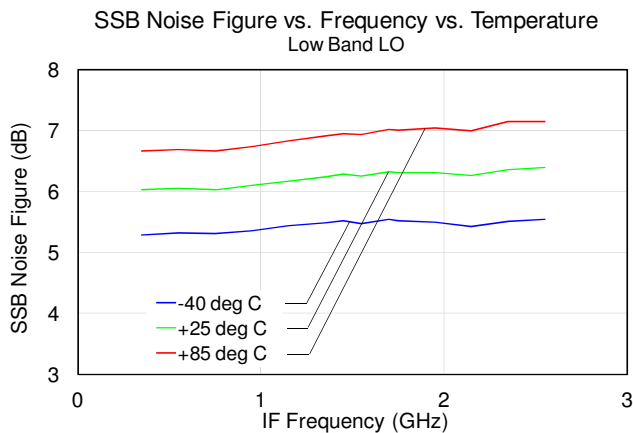
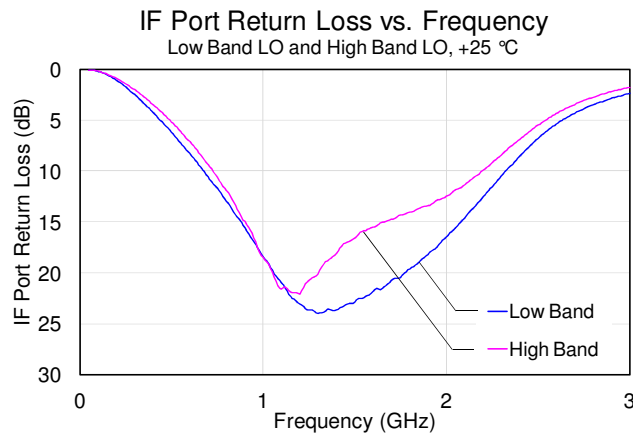
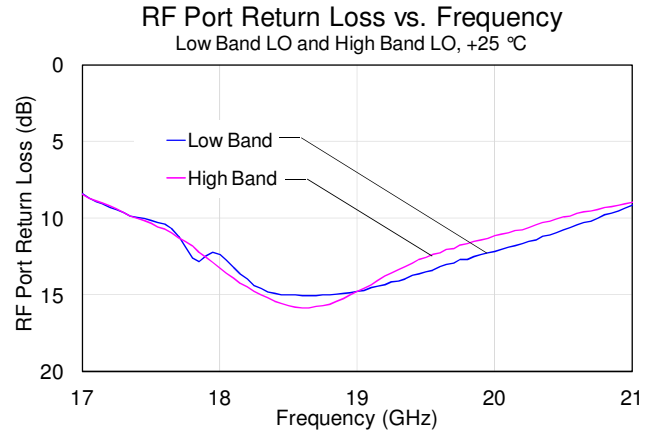
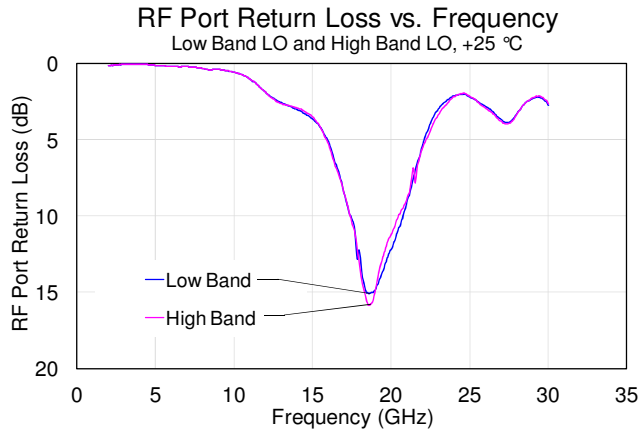
Input IP3 vs. Frequency vs. Temperature
Low Band LO



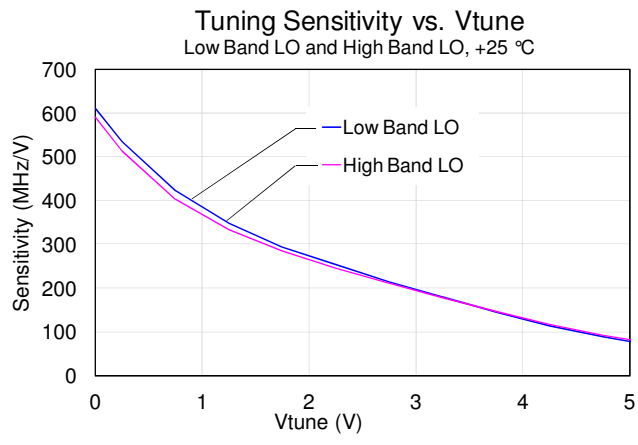
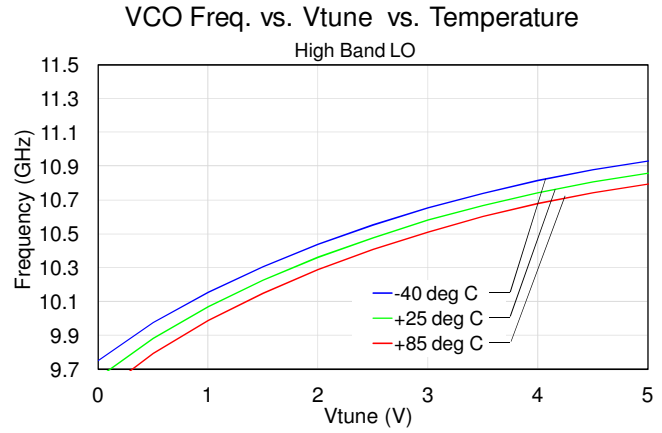
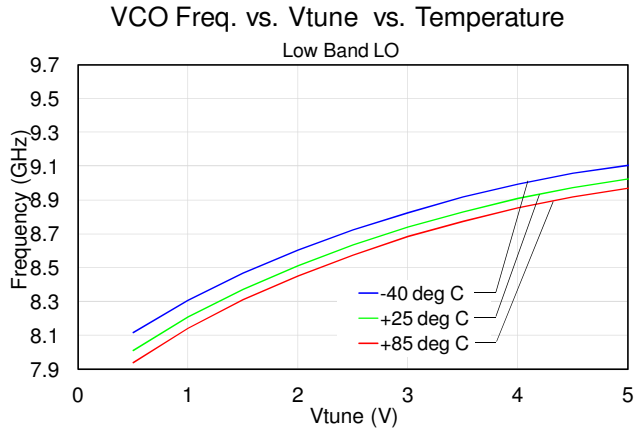
Input IP3 vs. Frequency vs. Temperature
High Band LO



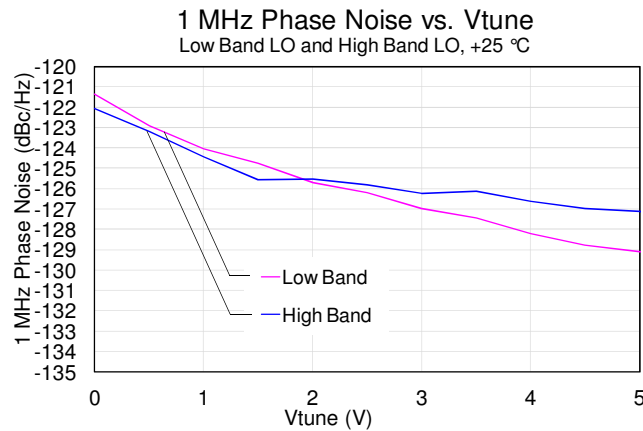
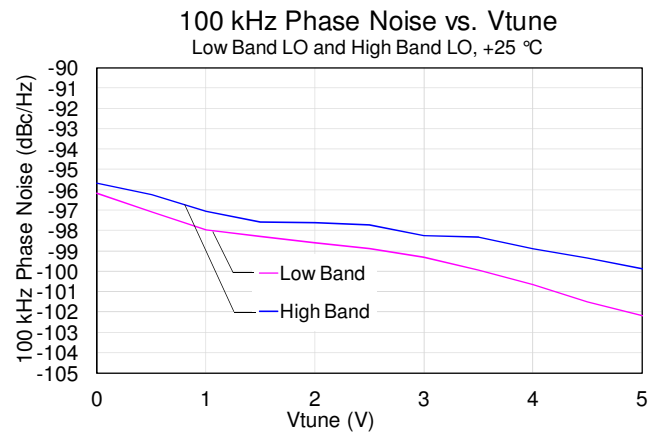
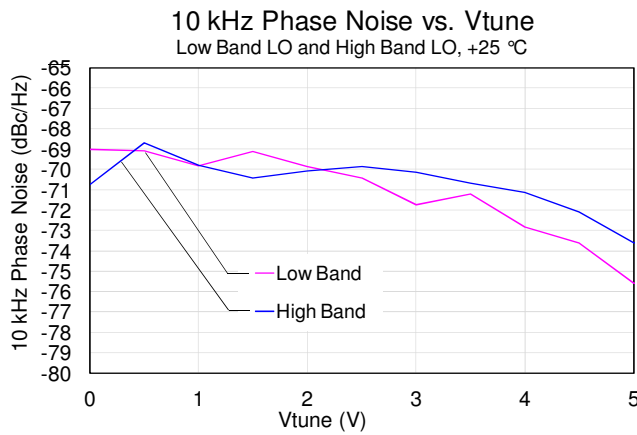
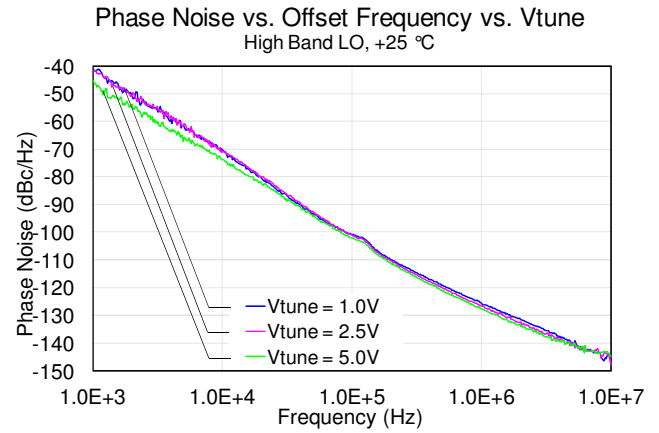
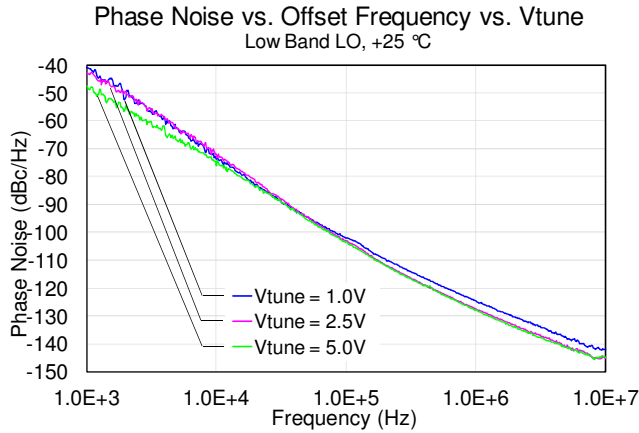
Typical Performance



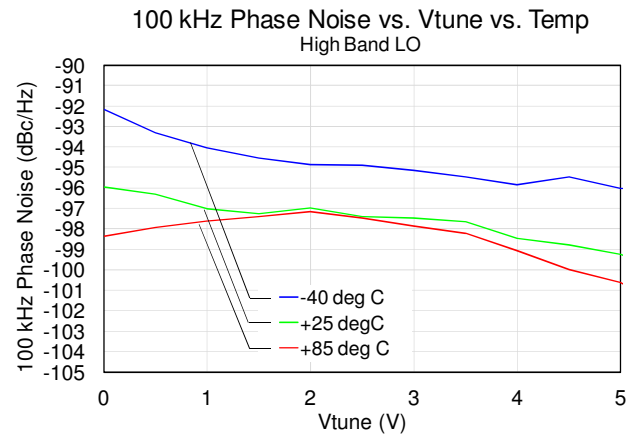
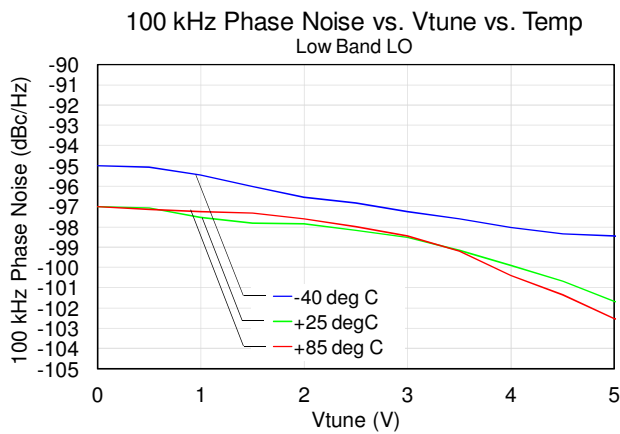
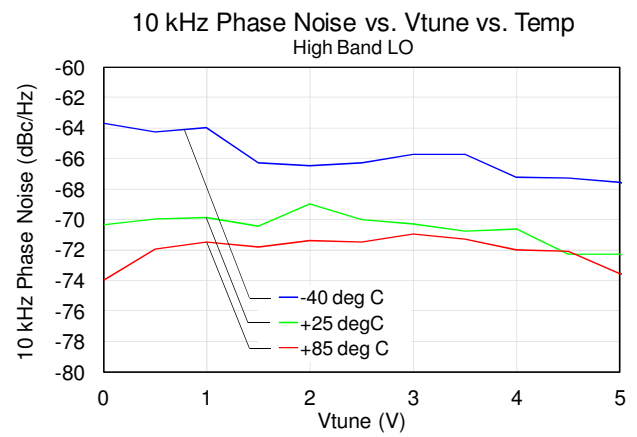
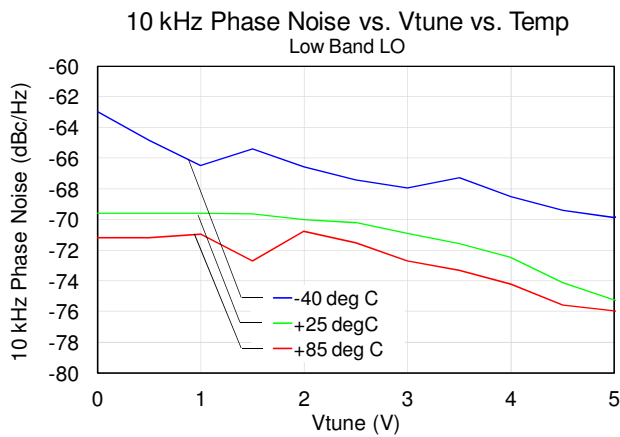
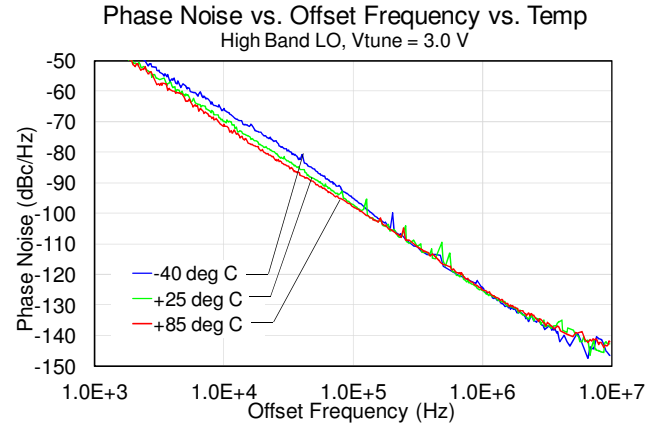
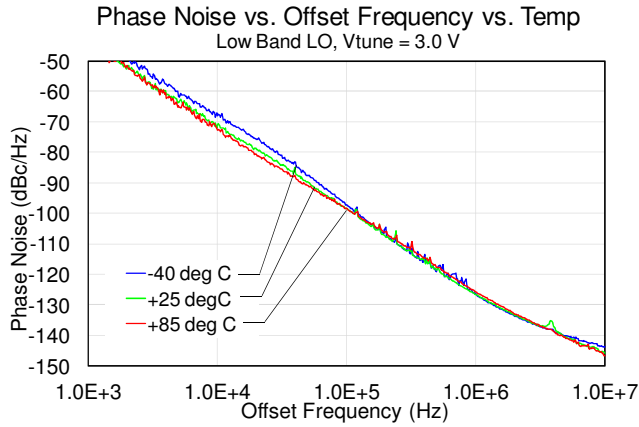
Typical Performance



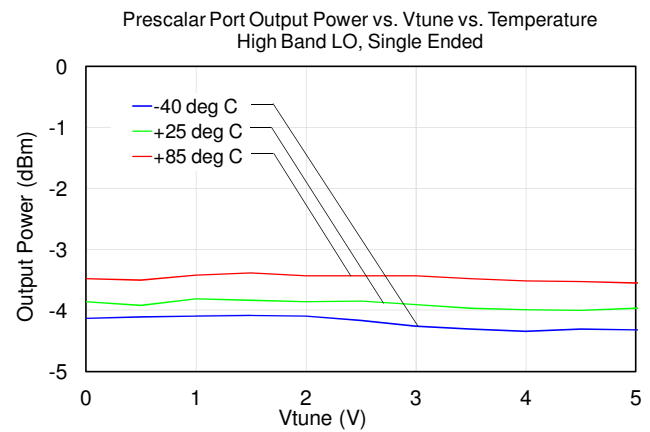
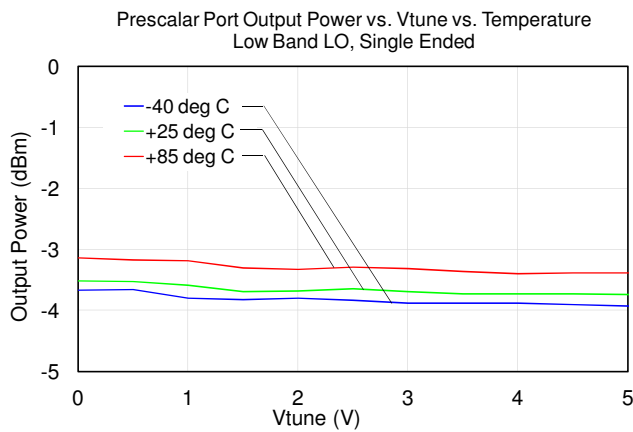
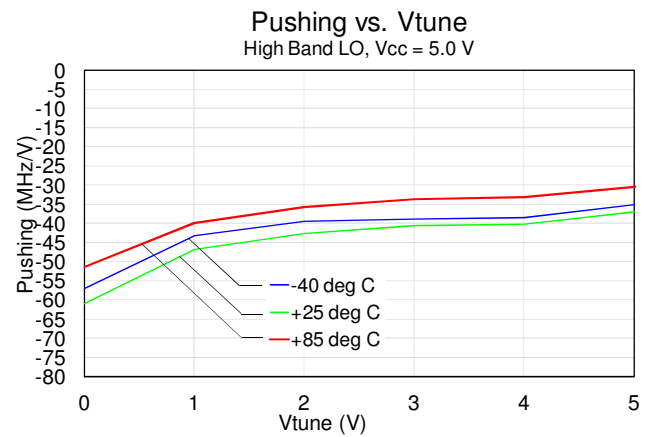
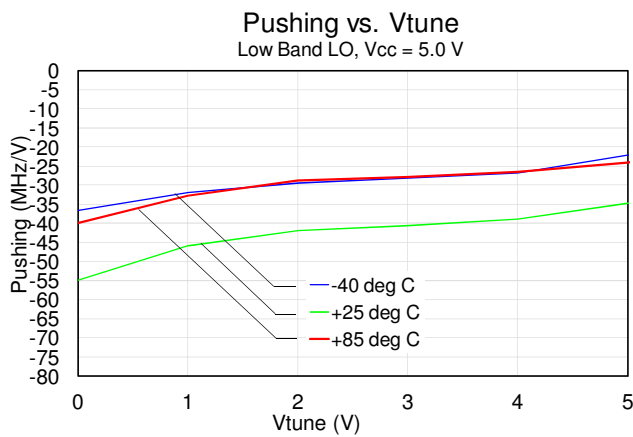
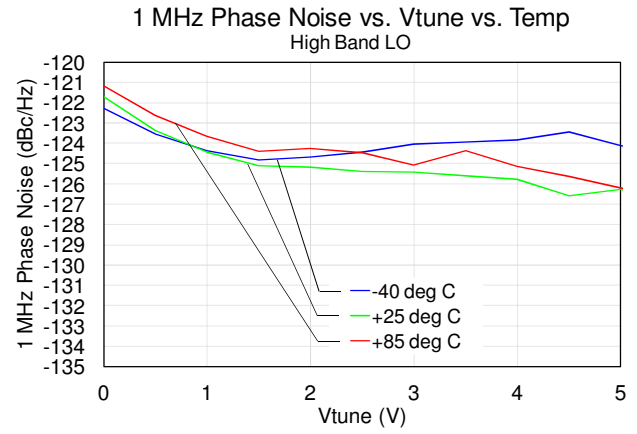
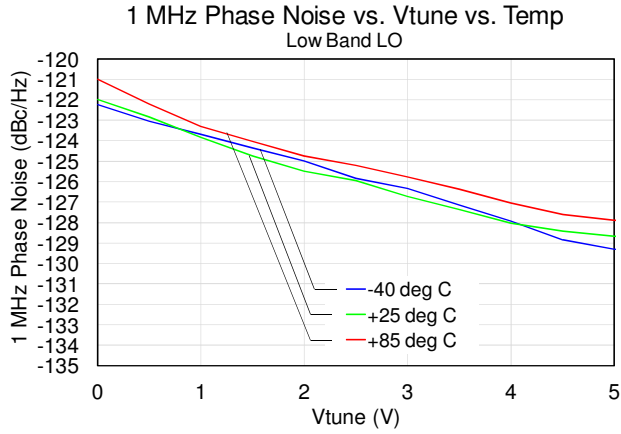
Typical Performance



Typical Performance



Typical Performance



TGC4408-SM

18 - 20 GHz Block Downconverter



Typical Performance

Spur Tables

Spur tables are $N \times f_{RF} - M \times f_{LO}$ mixer spurious products for -36 dBm RF input power.

(Subharmonic mixer, IF is at $1RF \times 2LO$)

RF = 18.3 GHz @ -36 dBm

LO = 8.67 GHz

All values in dBc below the IF output power level.

| | | $M \times f_{LO}$ | | | | | |
|---|---|-------------------|-----|----|----|----|----|
| | | 0 | 1 | 2 | 3 | 4 | 5 |
| N | 0 | -- | -19 | 34 | 4 | 10 | 22 |
| | 1 | 30 | 41 | 0 | 40 | 44 | -- |
| | 2 | -- | -- | -- | -- | -- | -- |
| | 3 | -- | -- | -- | -- | -- | -- |

RF = 18.3 GHz @ -36 dBm

LO = 8.67 GHz

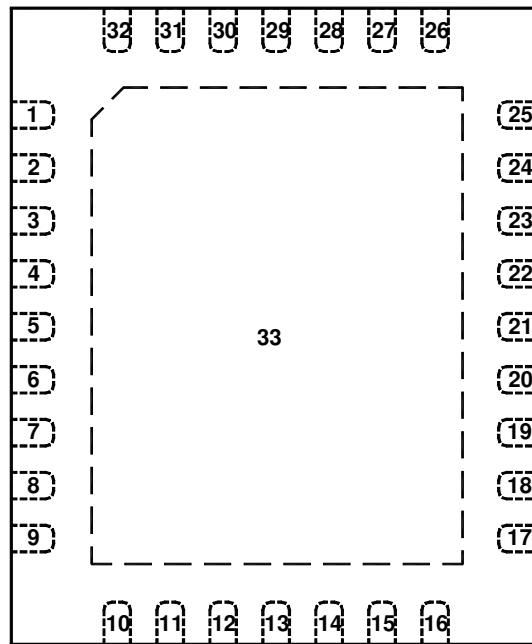
All values in dBc below the IF output power level.

| | | $M \times f_{LO}/4$ | | | | | | | | | | |
|---|---|---------------------|----|----|-----|----|----|----|----|----|----|----|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| N | 0 | 14 | 57 | 34 | -19 | 52 | 50 | 34 | 34 | 50 | 44 | 46 |
| | 1 | -- | -- | -- | -- | -- | -- | -- | 0 | -- | -- | -- |

TGC4408-SM

18 - 20 GHz Block Downconverter

Pin Description

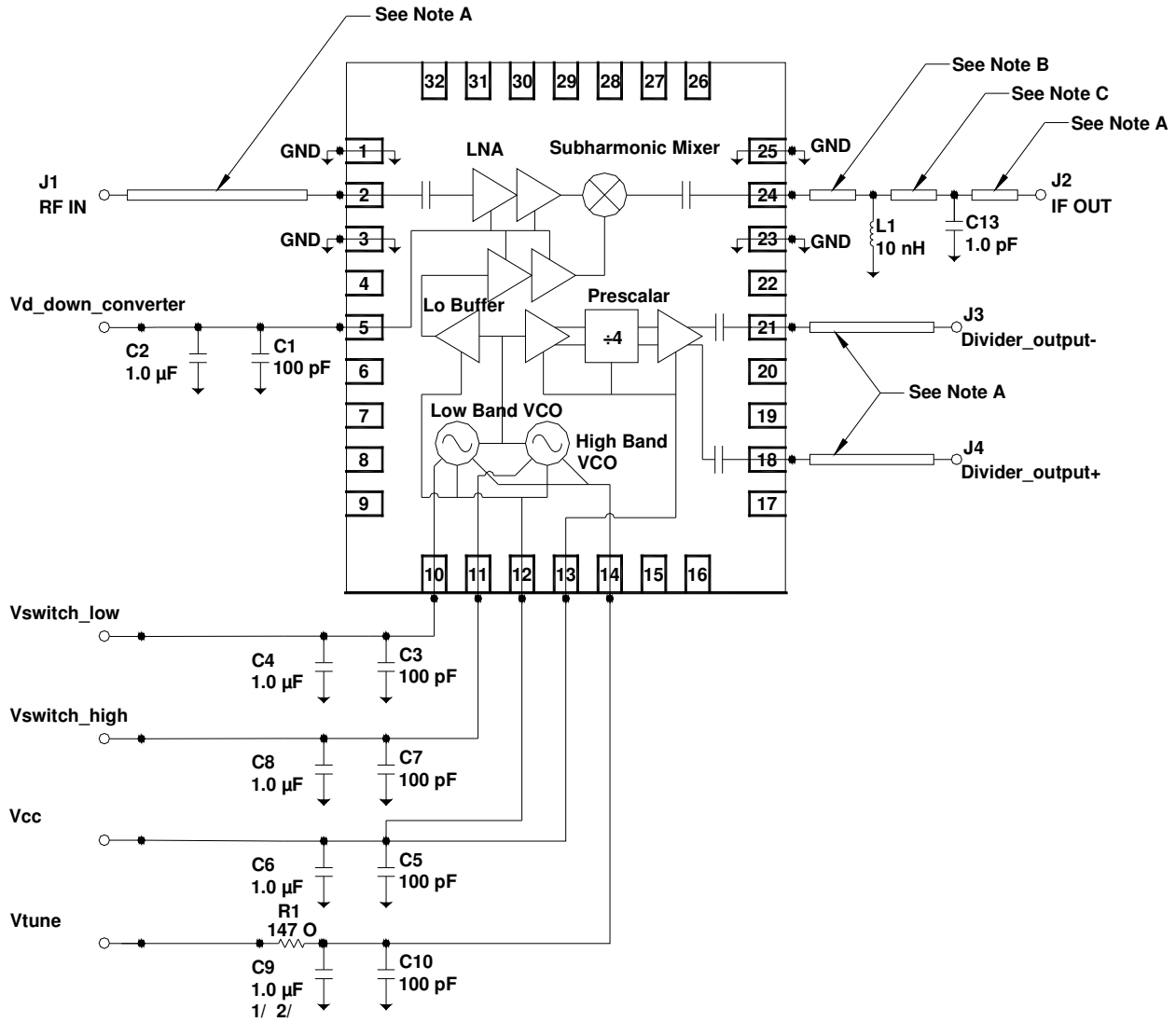


| Pin | Symbol | Description |
|--|------------------------|---|
| 1,3,23,25 | GND | GND |
| 2 | RF IN | RF Input, matched to 50 ohms |
| 5 | Vd_down_converter | +5V supply for mixer |
| 10 | Vswitch_low | +5V on pin 10 and 0 V on pin 11 enables the 8.675 GHz VCO |
| 11 | Vswitch_high | +5V on pin 11 and 0 V on pin 10 enables the 10.575 GHz VCO |
| 12 | Vcc_VCO | +5V supply for VCO |
| 13 | Vcc_prescaler | +5V supply for prescaler |
| 14 | V_tune | Adjustment voltage for the LO frequency. Vtune is common to both VCOs. |
| 18 | Divider_output+ (LO/4) | Divider_output+ (LO/4). 50 Ohm impedance. Differential output of the VCO frequency divided by 4 for use by an external phase locked loop. May be left unterminated for single ended applications. |
| 21 | Divider_output- (LO/4) | Divider_output- (LO/4). 50 Ohm impedance. Differential output of the VCO frequency divided by 4 for use by an external phase locked loop. May be left unterminated for single ended applications. |
| 24 | IF OUT | IF Output, requires external matching to 50 ohm impedance. See 'Application Circuit'. |
| 4,6,7,8,9,15, 16,17,19,20,22, 26 thru 32 | N/C | No internal connection; can be grounded on PCB or left open |
| 33 | GND | Backside Paddle. Multiple vias should be employed to minimize inductance and thermal resistance; see Mounting Configuration on page 17 for suggested footprint. |

TGC4408-SM

18 - 20 GHz Block Downconverter

Application Circuit

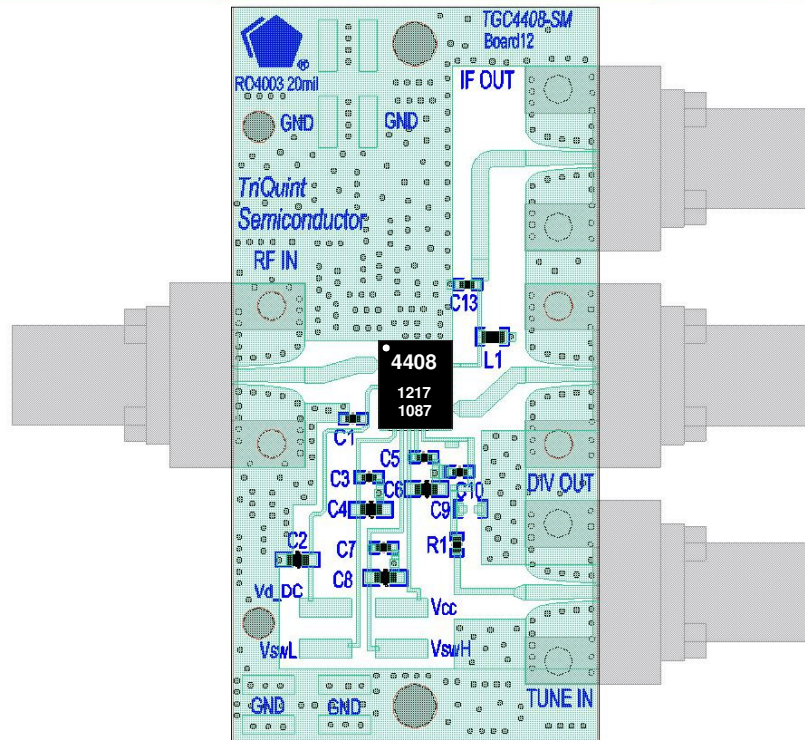


Note A: 50 Ω microstrip transmission line
 Note B: 104 Ω microstrip transmission line, 6.0° at 950 MHz
 Note C: 104 Ω microstrip transmission line, 5.1° at 950 MHz

Application Circuit

PC Board Layout

Single core layer board using 0.020" thick Rogers RO4003, $\epsilon_r = 3.38$. Metal layers are 0.5-oz copper with patterning on top layer as shown. Bottom layer is unpatterned and is the RF and DC ground. For further technical information, refer to the [TGC4408-SM](#) Product Information page.



Bill of Material

| Ref Des | Value | Description | Manufacturer | Part Number |
|---------------------------------|----------------------------|---|---------------------|-------------------------|
| C1, C3, C5, C7, C10 | 100 pF | Cap, 0402, 50 V, 5%, C0G SMD | various | |
| C2, C4, C6, C8 | 1.0 μ F | Cap, 0603, 25 V, 10%, X5R SMD | various | |
| C9 1/ | 1.0 μ F | Cap, 0603, 25 V, 10%, X5R SMD 1/ | various | |
| C9 2/ | | NO POP 2/ | | |
| C13 | 1.0 pF | Cap, 0402, 25 V, ± 0.25 pF, C0G SMD | various | |
| R1 | 147 Ω | Res, 0402, 0.06 W, 5%, SMD | various | |
| L1 | 10 nH | Ind, 0603, SMD | Coilcraft | 0603CS-10NXJ |
| RF IN, IF OUT, DIV OUT, TUNE IN | 2.92mm or SMA RF connector | End Launch Connector | Southwest Microwave | 1092-02A-5 or 292-05A-5 |
| | 100 pF | Cap, 0402, 50 V, 5%, C0G SMD | Various | |

1/ When using fixed voltage for Vtune

2/ When using PLL to set Vtune

TGC4408-SM

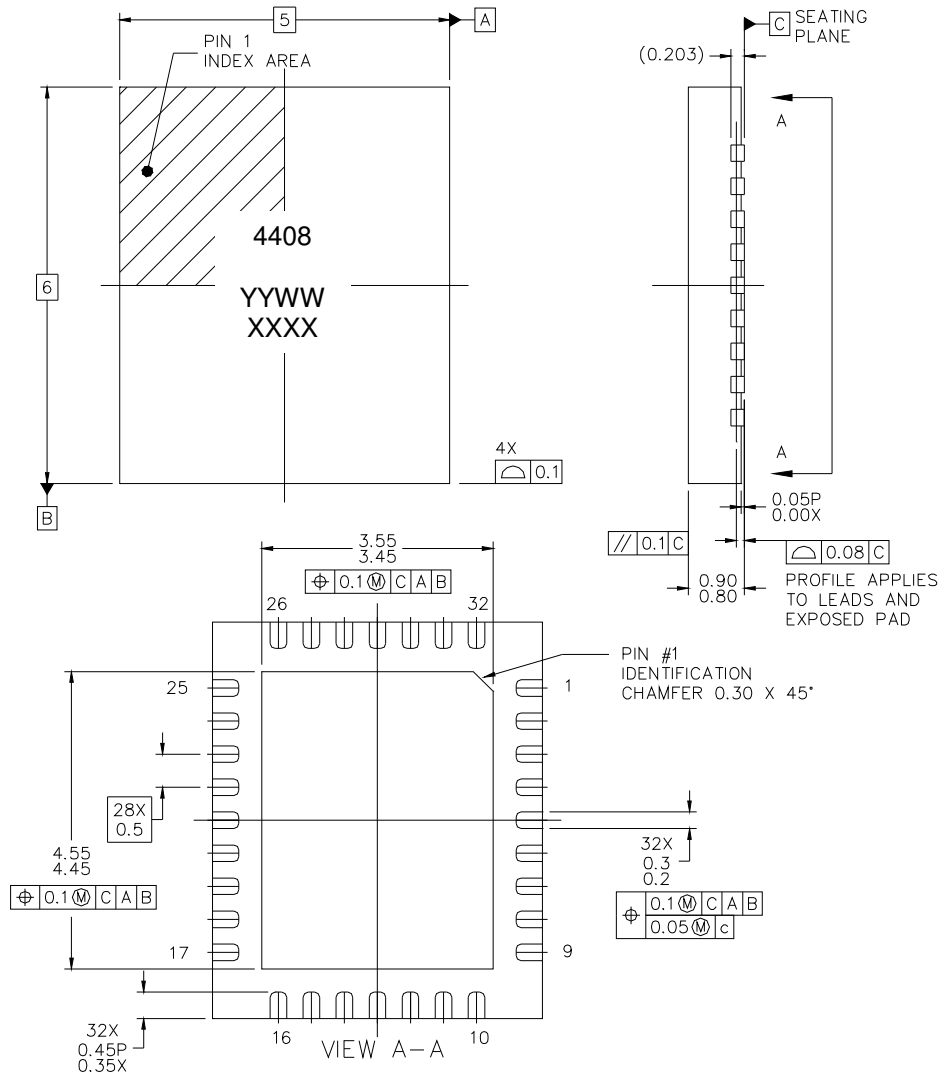
18 - 20 GHz Block Downconverter



Mechanical Information

Package Marking and Dimensions

All dimensions are in millimeters.

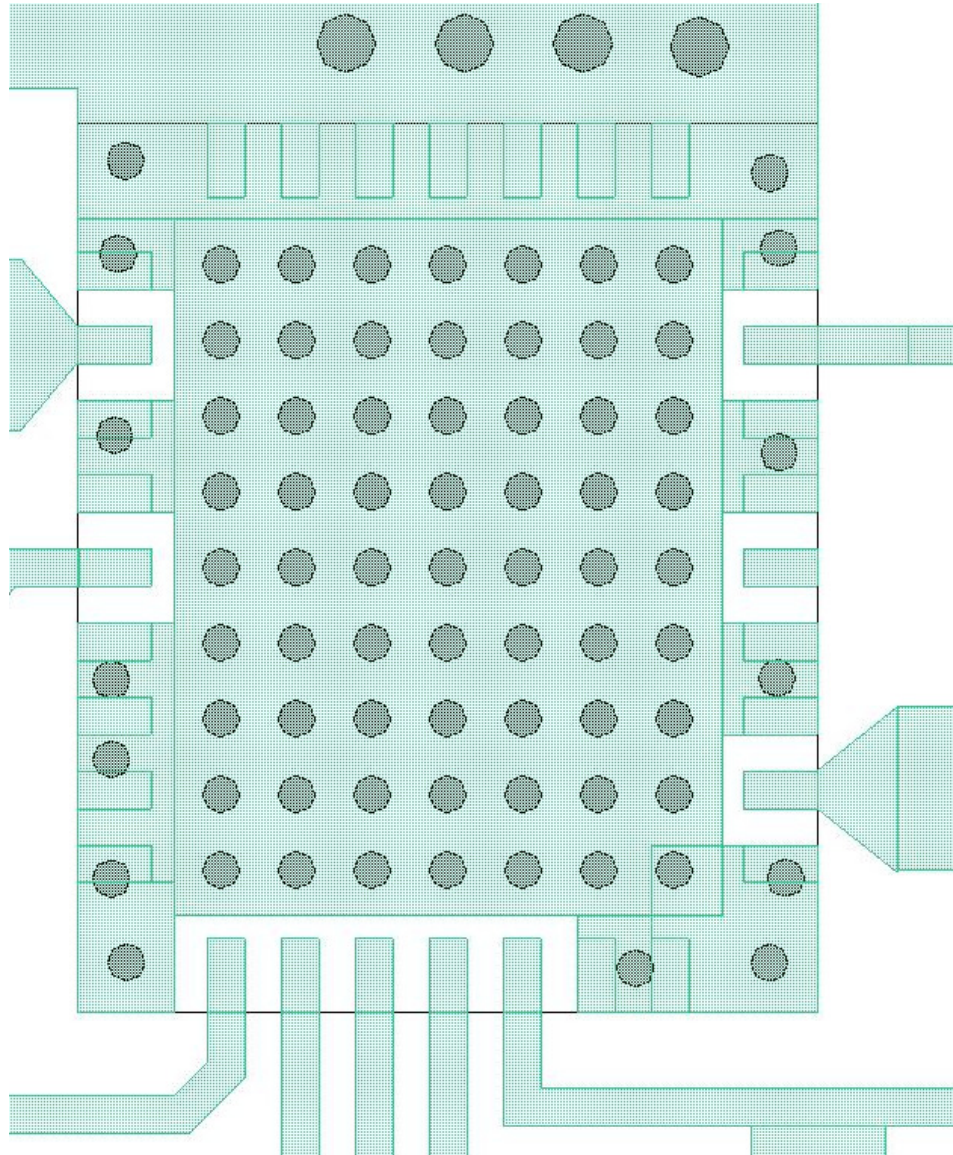


This package is lead-free/RoHS-compliant with a copper alloy base (CDA194), and the plating material on the leads is Sn. It is compatible with both lead-free (maximum 260 °C reflow temperature) and tin-lead (maximum 245 °C reflow temperature) soldering processes.

The TGC4408-SM will be marked with the “4408” designator and a lot code marked below the part designator. The “YY” represents the last two digits of the year the part was manufactured, the “WW” is the work week, and the “XXXX” is an auto-generated number

Mechanical Information

PCB Mounting Pattern



Notes:

1. The pad pattern shown has been developed and tested for optimized assembly at TriQuint Semiconductor. The PCB land pattern has been developed to accommodate lead and package tolerances. Since surface mount processes vary from company to company, careful process development is recommended.
2. Ground vias are critical for the proper performance of this device. Vias should use a .35mm (#80 / .0135") diameter drill and have a final plated thru diameter of .25 mm (.010").

TGC4408-SM

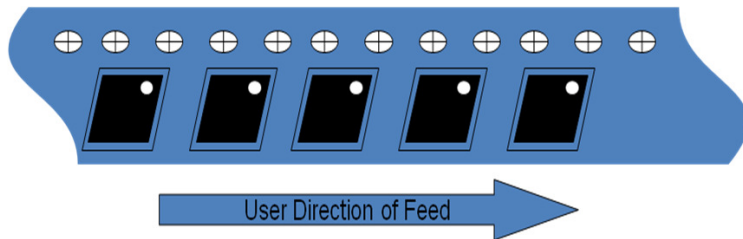
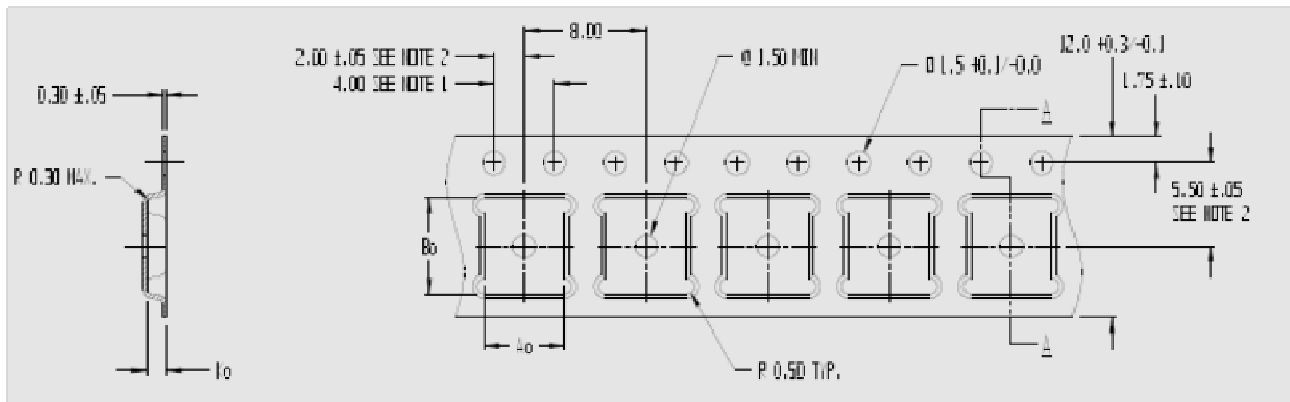
18 - 20 GHz Block Downconverter

Tape and Reel Information

Tape and reel specifications for this part are also available on the TriQuint website in the "Application Notes" section.

Standard T/R size = 500 pieces on a 13" reel.

| MATERIAL | | CAVITY (mm) | | | | DISTANCE BETWEEN CENTERLINE (mm) | | CARRIER TAPE (mm) | COVER TAPE (mm) |
|----------|------------|-------------|------------|------------|------------|----------------------------------|---------------------|-------------------|-----------------|
| Vendor | Vendor P/N | Length (A0) | Width (B0) | Depth (K0) | Pitch (P1) | Length direction (P2) | Width Direction (F) | Width (W) | Width (W) |
| Advantek | ML0506-D | 5.30 | 6.30 | 1.30 | 8.0 | 2.00 | 5.50 | 12.0 | 9.20 |



Product Compliance Information

ESD Information



Caution! ESD-Sensitive Device

ESD Rating: 1B
 Value: Passes ≥ 600 V and < 700 V min.
 Test: Human Body Model (HBM)
 Standard: JEDEC Standard JESD22-A114

ESD Rating: C4
 Value: Passes ≥ 500 V and < 700 V min.
 Test: Charged Device Model (CDM)
 Standard: JEDEC Standard JESD22-C101

ESD Rating: M2
 Value: Passes ≥ 100 V and < 200 V min.
 Test: Machine Model (MM)
 Standard: JEDEC Standard JESD22-A115

MSL Rating

Moisture Sensitivity Level (MSL) 3 at 260 °C convection reflow per JEDEC standard IPC/JEDEC J-STD-020.

Solderability

Compatible with both lead-free (260 °C max. reflow temp.) and tin/lead (245 °C max. reflow temp.) soldering processes.

Package lead plating: Sn

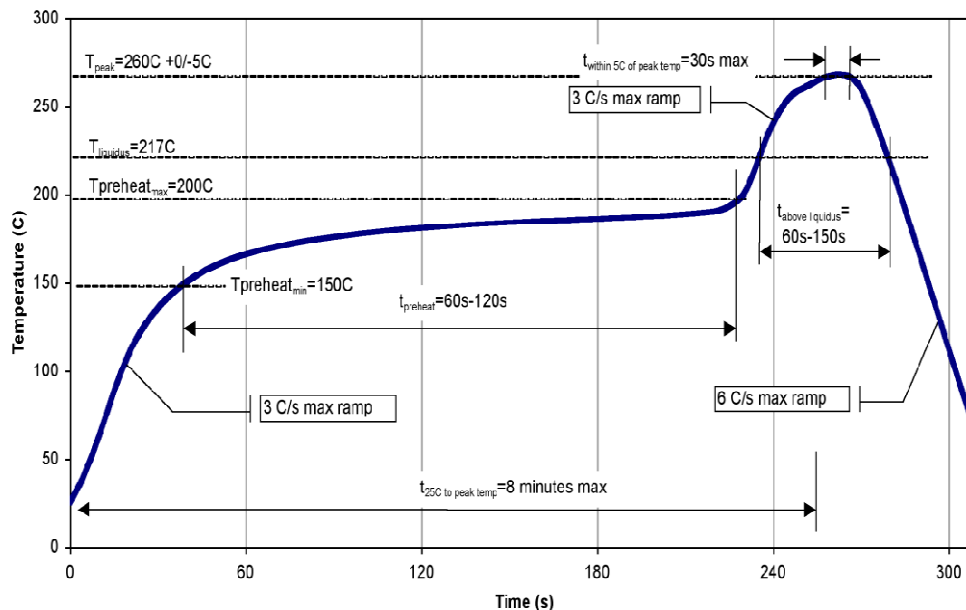
RoHS Compliance

This part is compliant with EU 2002/95/EC RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Recommended Soldering Temperature Profile



TGC4408-SM

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Contact Information

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

Web: www.triquint.com
Email: info-sales@tqs.com

Tel: +1.972.994.8465
Fax: +1.972.994.8504

For technical questions and application information:

Email: info-networks@tqs.com

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