TGC4403-SM 8 GHz – 15 GHz Packaged Doubler with Amplifier

Product Description

The Qorvo TGC4403-SM packaged MMIC combines a frequency doubler with a 3-stage amplifier, operating at input frequencies of 8 – 15 GHz. With greater than 30 dBc isolation between the input and doubler frequency, the TGC4403-SM achieves 20 dBm output power, with 2 dBm input power. This performance makes this doubler ideally suited for Point to Point Radios and Ka-Band satellite ground terminal applications. The TGC4403-SM provides the frequency doubling function in a compact 4 mm x 4 mm package foot print.

Lead-free and RoHS compliant.



16-pin 4x4 mm QFN package

Function Block Diagram



Product Features

- RF Output Frequency Range: 16 30 GHz
- Input Frequency Range: 8 15 GHz
- Output Power: 20 dBm Nominal
- Gain Power: 18 dBm
- Input Frequency Isolation: 30 dBc
- Bias: $V_D = 5 V$, $I_{DQ} = 150 \text{ mA}$, $V_{DBL} = -0.8 V$, $V_G = -0.5 V$ Typical.
- Package Dimensions: 4.0 x 4.0 x 0.9 mm

Applications

- Point-to-Point Radio
- Ka Band Sat-Com

Ordering Information

| Part No. | Description |
|------------|---|
| TGC4403-SM | 8 – 15 GHz Packaged Doubler with Amplifier |

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Absolute Maximum Ratings

| Parameter | Rating |
|---|-----------------|
| Drain to Gate Voltage (V_D - V_G) | 12 V |
| Drain Voltage (V _D) | 8 V |
| Doubler Voltage Range (VDBL) | -5 to 0 V |
| Gate Voltage Range (V _G) | −5 to 0 V |
| Drain Current (I _D) | 280 mA |
| Gate Current Range (I _G) | -1 to 23 mA |
| Doubler Current Range (IDBL) | -0.6 to 16.8 mA |
| RF Input Power, CW, T = 25 °C | 18.2 dBm |
| Power Dissipation (PDISS), 70 °C | 1.42 W |
| Channel Temperature, Tch | 150 °C |
| Mounting Temperature (30 sec) | 260 °C |
| Storage Temperature | -65 to 150 °C |

Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratir only, and functional operation of the device at these condition is not implied.

Recommended Operating Conditions

TGC4403-SM

| Parameter | Min | Тур | Max | Units |
|--|-----|------|-----|-------|
| Operating Temperature Range | -40 | +25 | +85 | °C |
| V _D | | 5 | | V |
| I _{DQ} | | 150 | | mA |
| I _{D_Drive} @ RF Input = 2dBm | | 170 | | mA |
| V _G | | -0.5 | | V |
| V _{DBL} | | -0.8 | | mA |

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

Electrical Specifications

Test conditions unless otherwise noted: $25 \degree$ C, $V_D = 5 V$, $I_{DQ} = 150 \text{ mA}$, $V_G = -0.5 \text{ V}$ Typical, $V_{DBL} = -0.8 \text{ V}$ Fixed.

| Parameter | Conditions | Min | Тур | Max | Units |
|---|--|-----|-----|-----|-------|
| Input RF Frequency Range | | 8 | | 15 | GHz |
| Conversion Gain (CG) @ RF In = 2 dBm | Input Freq.= 8 – 14.5 GHz Output Freq.= 16 – 29 GHz | 14 | 18 | | dB |
| | Input Freq. = 15 GHz Output Freq. = 30 GHz | 12 | 16 | | dB |
| Input Return Loss (IRL) | Freq. = 8 – 15 GHz | | 6 | | dB |
| Output Return Loss (ORL) | Freq. = 16 – 30 GHz | | 4 | | dB |
| Output Power @ RF In = 2 dBm | Freq. = 16 – 30 GHz | 16 | 20 | | dBm |
| Isolation, Fundamental (Isol_1x) | Input Freq.= 8 – 14.5 GHz Output Freq.= 8 – 14.5 GHz | 11 | 30 | | dBc |
| Isolation, 3 rd Harmonic (Isol_3x) | Input Freq.= 8 – 10.5 GHz Output Freq.= 24 – 31.5 GHz | 1 | 10 | | dBc |

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Thermal and Reliability Information

| Parameter | Conditions | Rating |
|--|--|------------------------------------|
| Thermal Resistance, θ_{JC} ⁽¹⁾ | Tbase = 70 °C | θ _{JC} = 56.3 °C/W |
| Channel Temperature (Т _{СН}), (No RF drive) Median Lifetime (Tm) | $V_D = 5 V$, $I_{DQ} = 150 mA$ $P_{DISS} = 0.75 W$ | Tch = 112 °C Tm = 3.47E+7 Hours |
| Channel Temperature (T _{CH}), (Under RF Drive) Median Lifetime (Tm) | $V_D = 5 V, I_{D_Drive} = 170 mA$ $P_{OUT} = 22 dBm$ $P_{DISS} = 0.69 W$ | Tch = 109 °C Tm = 4.6E+7 Hours |

Notes:

1. Thermal resistance measured to back of package.



Median Lifetime (Tm) vs. Channel Temperature (Tch)

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Performance Plots

Bias Conditions: V_D = 5 V, I_{DQ} = 150 mA, V_{DBL} = -0.8 V Typical, Temp. = 25 °C





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Pin Configuration and Description



| Pin No. | Label | Description |
|--------------------------------------|--------|--|
| 1, 2, 4, 7, 8, 9, 11, 12, 13, 15, 16 | N/C | No internal connection; must be grounded on PCB. |
| 3 | RF IN | RF Input matched to 50 ohms, AC Coupled. |
| 5 | VDBL | Doubler Gate Voltage. Bias network is required; see Application Circuit on page 6 as an example. |
| 6 | VG | Gate Voltage. Bias network is required; see Application Circuit on page 6 as an example. |
| 10 | RF OUT | RF Output, matched to 50 ohms, AC coupled. |
| 14 | VD | Drain Voltage. Bias network is required; see Application Circuit on page 6 as an example. |
| 17 | GND | Internal Grounding; must be grounded on PCB. |

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| Bias-up Procedure | Bias-down Procedure |
|---|--|
| Set V _G to -5.0 V | Turn off RF signal |
| Set V_D to +5 V | Reduce V _G to $-5.0V$. Ensure I _{DQ} ~ 0 mA |
| Set V _{DBL} to -0.8 V | Turn VDBL to 0 V |
| Adjust V _G more positive until I_{DQ} = 150 mA (V _G ~ -0.5 V Typical) | Turn V_D to 0 V |
| Apply RF Signal | Turn V_G to 0 V |

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Evaluation Board (EVB) Assembly Layout



Bill of Material

| Ref Des | Value | Description | Manufacturer | Part Number |
|------------|--------|----------------------|--------------|-------------|
| C1, C2, C3 | 1 µF | Cap, 0402, 25V, 5%, | Various | |
| C7, C8, C9 | 100 pF | Cap, 0402, 25V, 5% | Various | |
| R1, R2 | 15 ohm | Res, 0402, 1%, 0.05W | Various | |

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Package Marking and Dimensions

All dimensions are in millimeters.



Solderability

- 1. Compatible with the latest version of J-STD-020, Lead-free solder, 260 °C
- 2. The use of no-clean solder to avoid washing after soldering is recommended.
- 3. Do not expose the package lid to temperatures > 280 °C

Recommended Soldering Temperature Profile



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Handling Precautions

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

RoHS Compliance

This product is compliant with the 2011/65/EU RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment), as amended by Directive 2015/863/EU. This product also has the following attributes:

- Lead Free
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄0₂) Free
- PFOS Free
- SVHC Free

Contact Information

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