



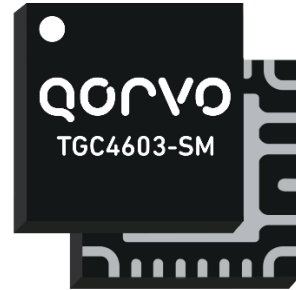
TGC4603-SM

Ka-band Doubler with 1 Watt Amplifier

General Description

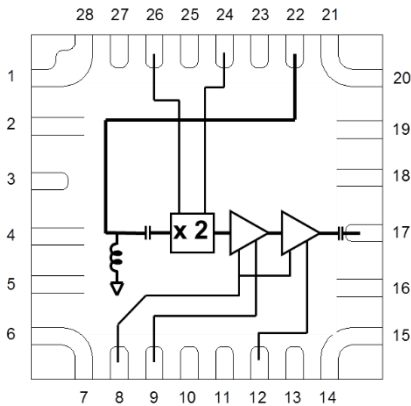
The Qorvo TGC4603-SM packaged MMIC combines a frequency doubler with a multi-stage amplifier, operating at input frequencies of 13.5 - 16 GHz. With greater than 70 dBc isolation between the input and the doubled output frequency, the TGC4603-SM achieves more than 1 Watt output power, with only 3 dBm input power. This performance makes this doubler ideally suited for Ka-Band satellite ground terminal applications. The TGC4603-SM provides the frequency doubling function in a compact 5 mm x 5 mm package footprint.

The TGC4603-SM is RoHS compliant.



28 - pin 5 x 5 mm QFN package

Functional Block Diagram



Product Features

- RF Output Frequency Range: 27 – 32 GHz
- Input Frequency Range: 13.5 – 16 GHz
- 31.5 dBm Pout
- 70 dBc Input Frequency Isolation
- Bias: VD1 = VD2 = 6 V, ID1 + ID2 = 1100 mA, VDX2 = 6 V, IDX2 = 100 mA, VGX2 = -1.2 V, VGPA = -0.6 V Typical
- Package Dimensions: 5 x 5 x 1.3 mm

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

Applications

- Ka-band VSAT

Ordering Information

Part	Description
1094294	TGC4603-SM T/R, Ka 1W X2PA, 2500 Piece
1129583	TGC4603-SM EVB

Absolute Maximum Ratings

Parameter	Value/Range
Drain Voltage, VD1, VD2, VDX2	6.5 V
Gate Voltage, VGPA, VGX2	-2.5 to 0.5 V
Drain to Gate Voltage	12 V
Drain Current, ID1	500 mA
Drain Current, ID2	1400 mA
Gate Current, IGPA	-5 to +20
Gate Current, IGX2	-5 to +20
RF CW Input Power	18 dBm
Channel Temperature, Tch	200 °C
Mounting Temperature (30 sec)	260 °C
Storage Temperature	-40 to 150 °C

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability.

Recommended Operating Conditions

Parameter	Min	Typ.	Max	Units
VD1, VD2, VDX2		6	6.5	V
ID1+ID2 (P _{IN} = 3 dBm)		1100		mA
IDX2		125		mA
VGPA		-0.6		V
VGX2		-1.2		V
IGPA		6		mA
IGX2		0.1		mA

Electrical performance is measured under conditions noted in the electrical specifications table. Specifications are not guaranteed over all recommended operating conditions.

Electrical Specifications

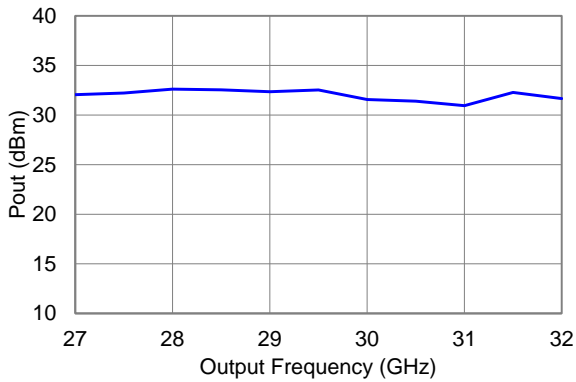
Test conditions unless otherwise noted: 25 °C, VD1 = VD2 = VDX2 = 6 V, ID1 + ID2 = 1100 mA, IDX2 = 125 mA, VGX2 = -1.2 V, VGPA = -0.6 V typical.

Parameter	Min	Typical	Max	Units
Input Frequency	13.5		16	GHz
Output Frequency	27		32	GHz
Output Power, P _{IN} = 3 dBm		31.5		dBm
Fundamental Output Rejection		75		dBc
Third Harmonic Output Rejection		70		dBc
Input Return Loss		-10		dB
Output Return Loss		-10		dB

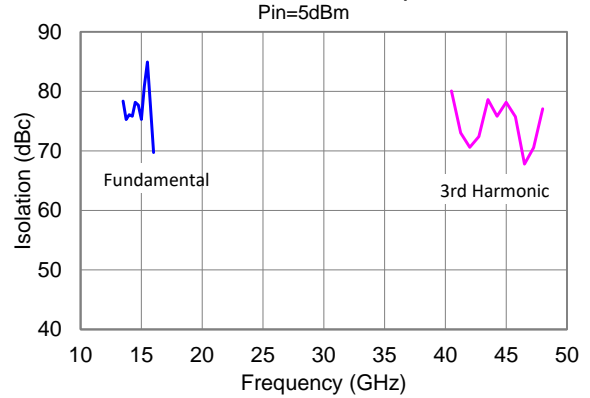
Typical Performance

Test conditions unless otherwise noted: 25 °C, VD1 = VD2 = VDX2 = 6 V, ID1 + ID2 = 1100 mA, IDX2 = 125 mA, VGX2 = -1.2 V, VGPA = -0.6 V typical.

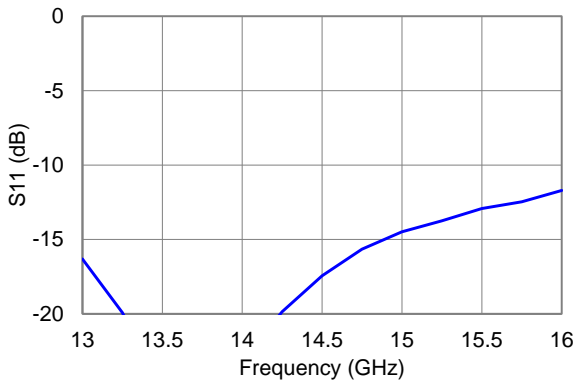
Output Power vs. Freq



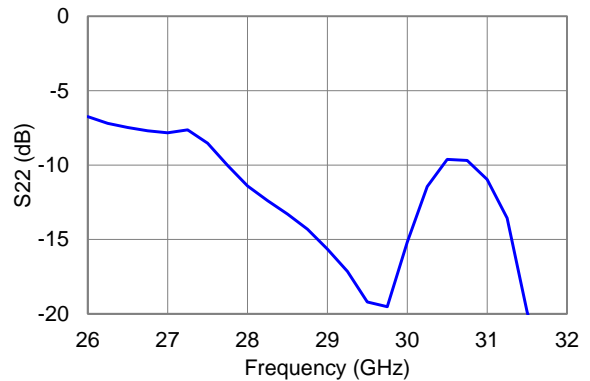
Isolation vs. Freq



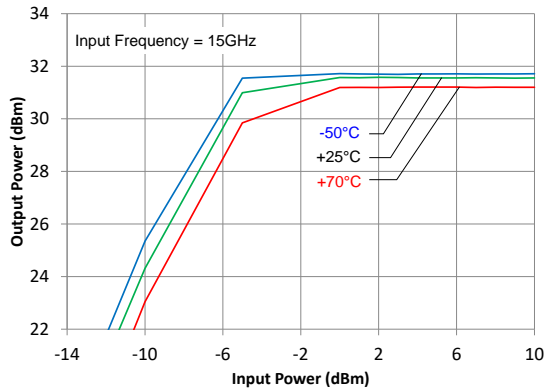
Input Return Loss vs. Freq



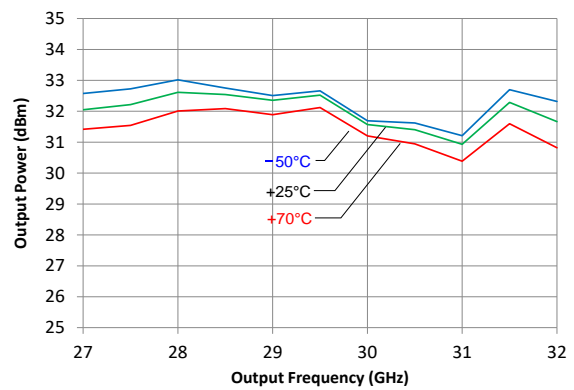
Output Return Loss vs. Freq



Pin vs. Pout over Temperature



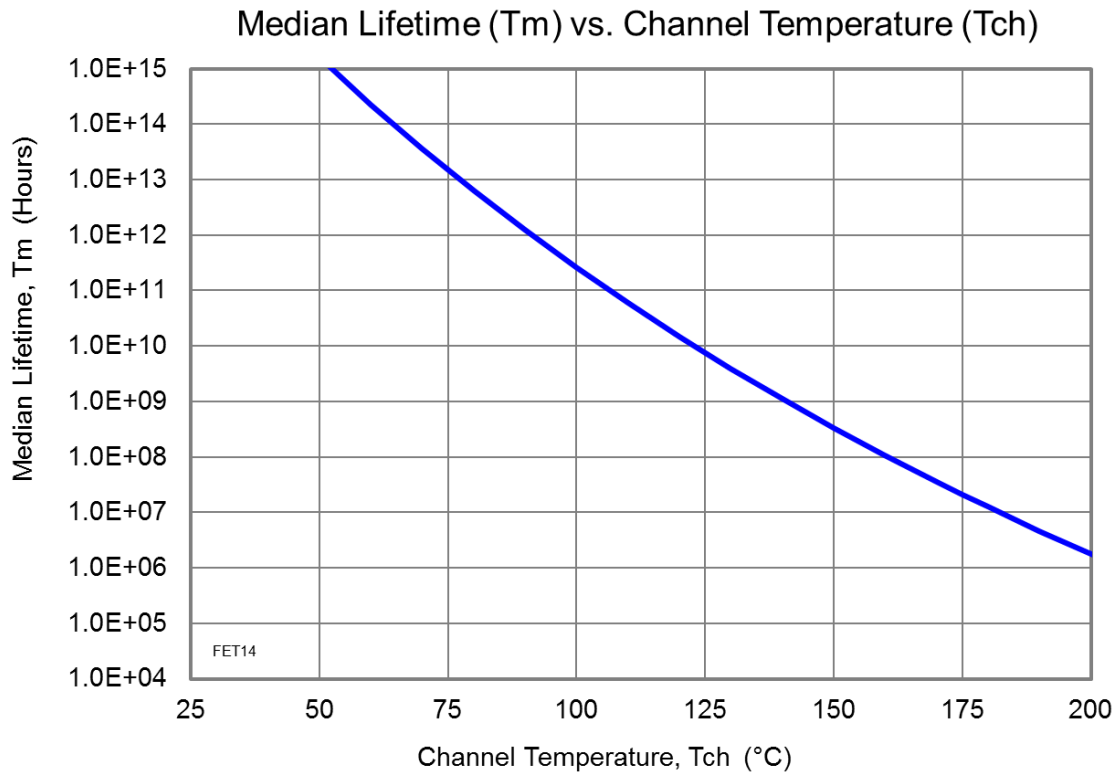
Output Power vs. Freq over Temperature



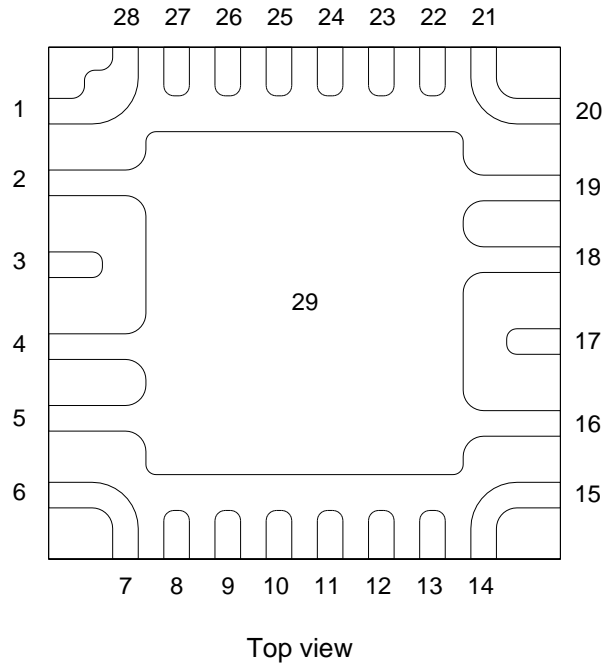
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance, θ_{JC} (1)	$T_{BASE} = 85\text{ }^{\circ}\text{C}$	14	$^{\circ}\text{C}/\text{W}$
Channel Temperature, T_{CH} (Under RF Drive)	$T_{BASE} = 85\text{ }^{\circ}\text{C}$, $VD1 = VD2 = VDX2 = 6\text{ V}$, $ID = 1430\text{ mA}$, $P_{DISS} = 8.58\text{ W}$	190	$^{\circ}\text{C}$
Median Lifetime, T_M (Under RF Drive)		4.6×10^6	Hrs

Notes: (1) Thermal resistance measured to back of package.

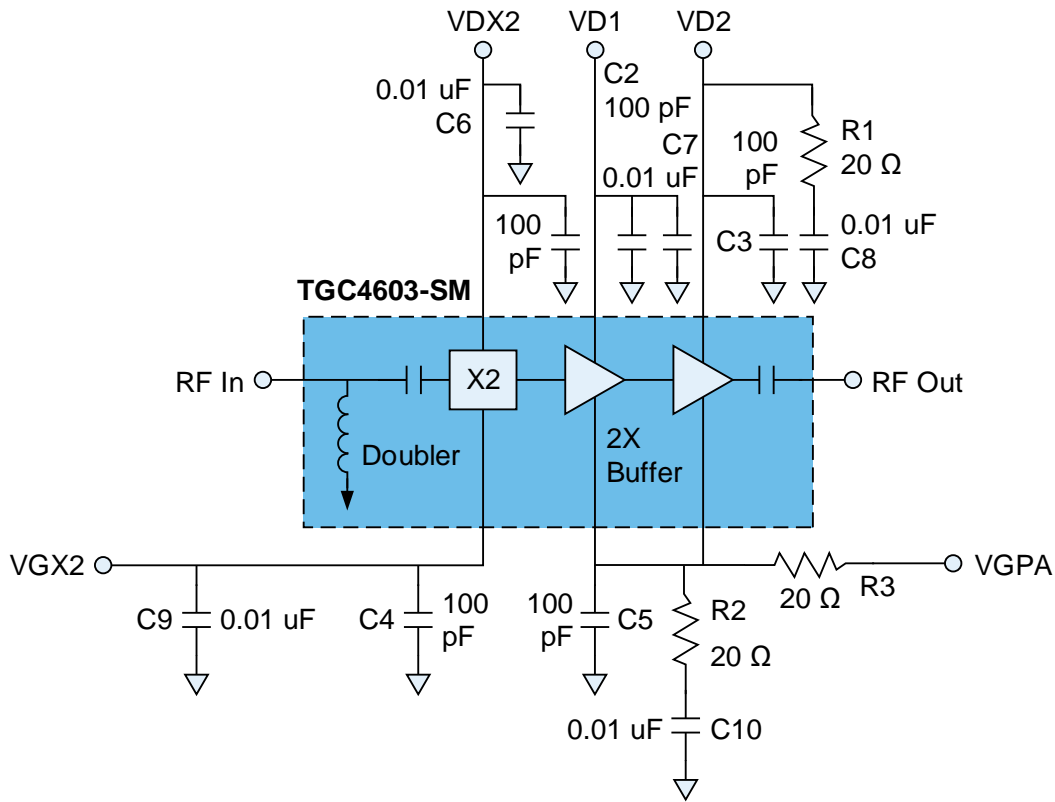


Pin Description



Pin	Symbol	Description
1-7, 14-16, 18- 21, 23, 28	GND	Ground. Must be grounded on PCB.
8	VGPA	Gate voltage for Power Amplifier. See Application Circuit on page 6.
9	VD1	Drain voltage for Power Amplifier. See Application Circuit on page 6.
10, 11, 13, 25, 27	N/C	No internal connection. May be left open on the PCB.
12	VD2	Drain voltage for Power Amplifier. See Application Circuit on page 6.
17	RFOUT	RF Output matched to 50 ohms.
22	RFIN	RF Input matched to 50 ohms.
24	VDX2	Drain voltage for Doubler circuit. See Application Circuit on page 6.
26	VGX2	Gate voltage for Doubler circuit. See Application Circuit on page 6.
29	GND	Backside Paddle Ground. Multiple vias should be employed to minimize inductance and thermal resistance; see Mounting Configuration on page 8 for suggested footprint.

Application Circuit



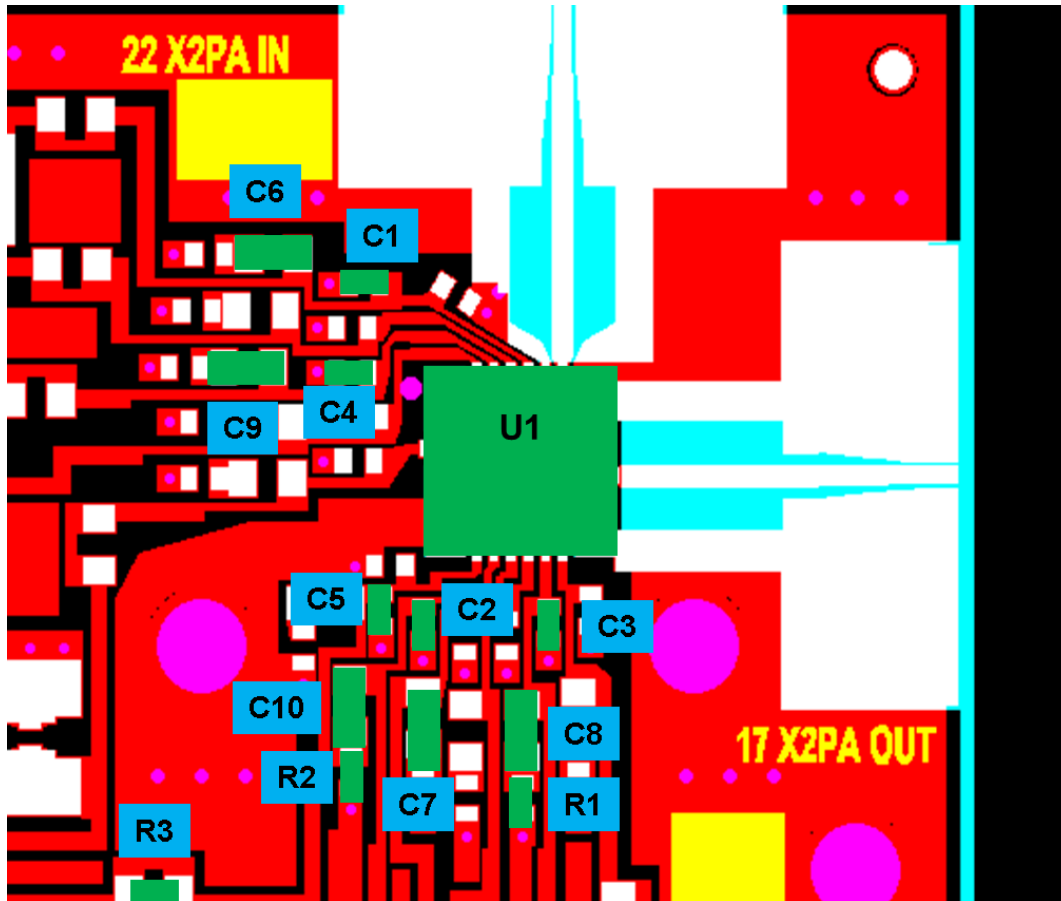
Bill of Materials

Reference Design	Description	Value	Size	Source
C1 – C5	Capacitor	100 pF	0402	Various
C6 – C10	Capacitor	0.01uF	0402	Various
R1 – R3	Resistor	20 ohm	0402	Various
U1	TGC4603-SM		5 x 5 mm	Qorvo

Application Circuit

PC Board Layout: Evaluation Board

Top RF layer is 0.010" thick Rogers RO3203, $\epsilon_r = 3.0$. Metal layers are 0.5 - oz copper. Microstrip 50 Ω line detail: width = 0.025"



Application Circuit

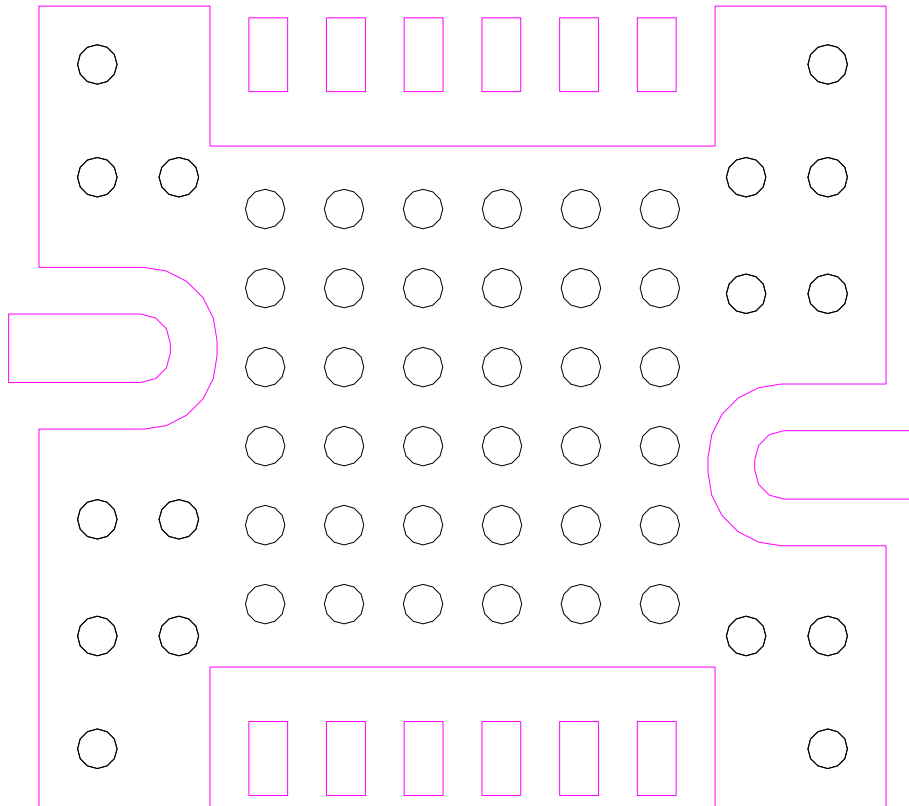
Evaluation Board Bias Procedures

Laboratory Bias-up Procedure	Laboratory Bias-down Procedure
Set VGX2 to -1.2 V	Turn off RF supply
Set VGPA to -1.5 V (pinch-off)	Set VGPA to -1.5
Set VD1, VD2 and VDX2 to 6 V	Turn VD1, VD2, and VDX2 to 0 V
Adjust VGPA more positive until target $ID1q + ID2q$ quiescent current reaches 590 mA.	Turn VGX2 to 0 V
Apply RF signal to RF Input.	Turn VGPA to 0 V

Mechanical Information

PCB Mounting Pattern

All dimensions are in millimeters

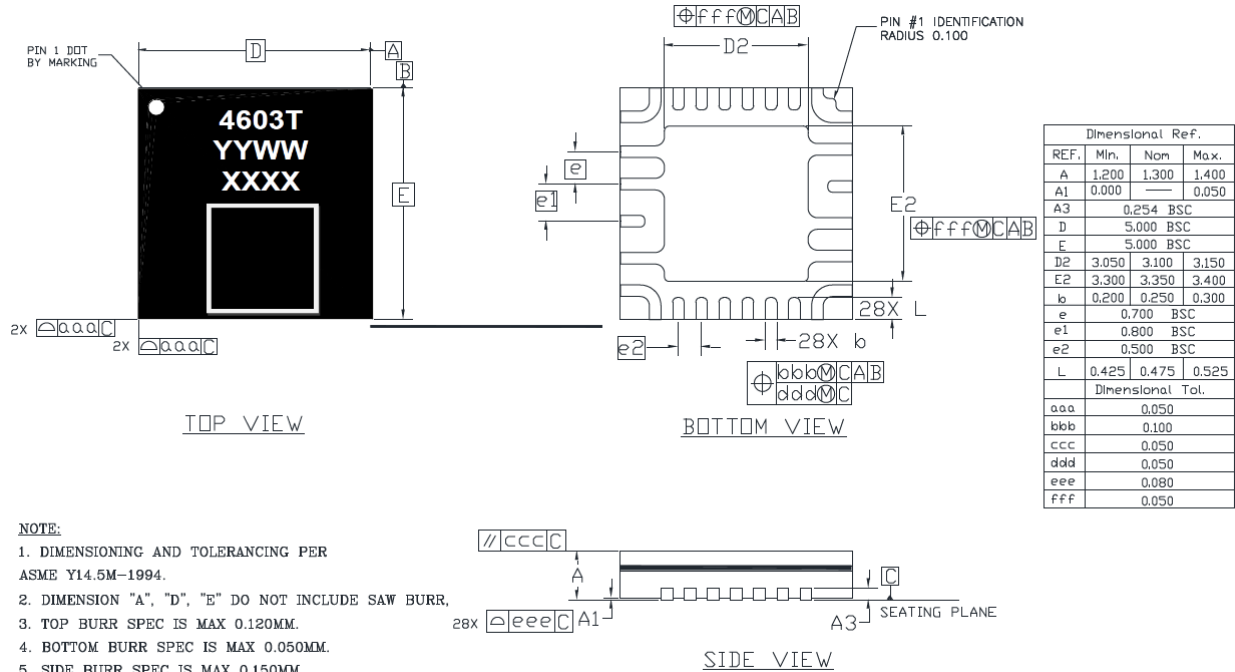


Notes:

1. A heatsink underneath the area of the PCB for the mounted device is recommended for proper thermal operation.
2. One ounce Cu plating inside vias is recommended. Vias shown are 0.254 mm (0.010") diameter on 0.5 mm (0.020") centers.
3. Ground / thermal vias are critical for the proper performance of this device. Vias have a final plated thru diameter of approximately 0.2 mm (0.008").

Mechanical Drawing

Package Marking Information and Dimensions



Notes:

1. Dimensions are in mm.

Marking:

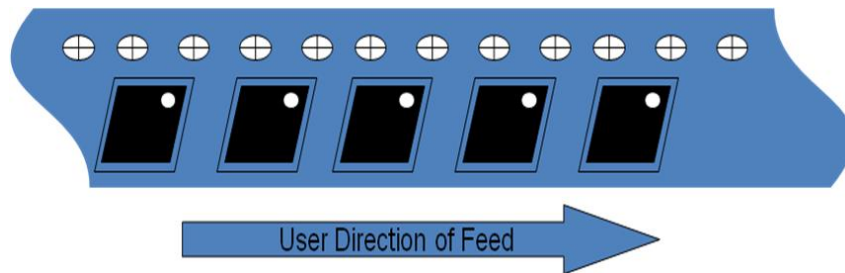
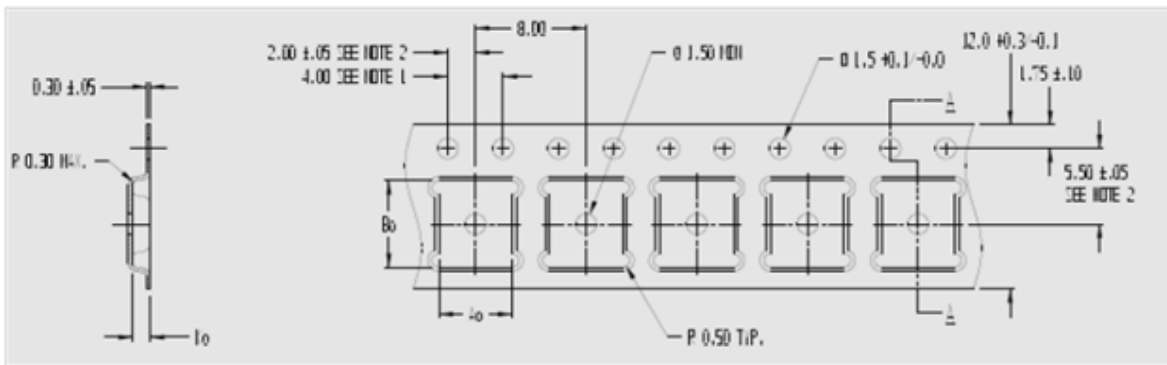
- 4603T: Part Number
- YYWW: Last 2 digits of the year and the work week.
- XXXX: 4 digits serial number by the order
- Bar Code: 2D Code - XXXX

The package is with a copper alloy base (CDA194), and the plating material on the leads is Ni-Pd-Au.

Tape and Reel Information

Standard T/R size = 2500 pieces on a 7" reel.

Material		Cavity (mm)				Distance Between Centerline (mm)		Carrier Tape (mm)	Cover Carrier (mm)
Vendor	Vendor P/N	Length (A0)	Width (B0)	Depth (K0)	Pitch (P1)	Length direction (P2)	Width Direction (F)	Width (W)	Width (W)
Tek-Pak	QFN0500 X 0500F-L500	5.3	5.3	1.65	8.0	2.00	5.50	12.0	9.20



Assembly Notes

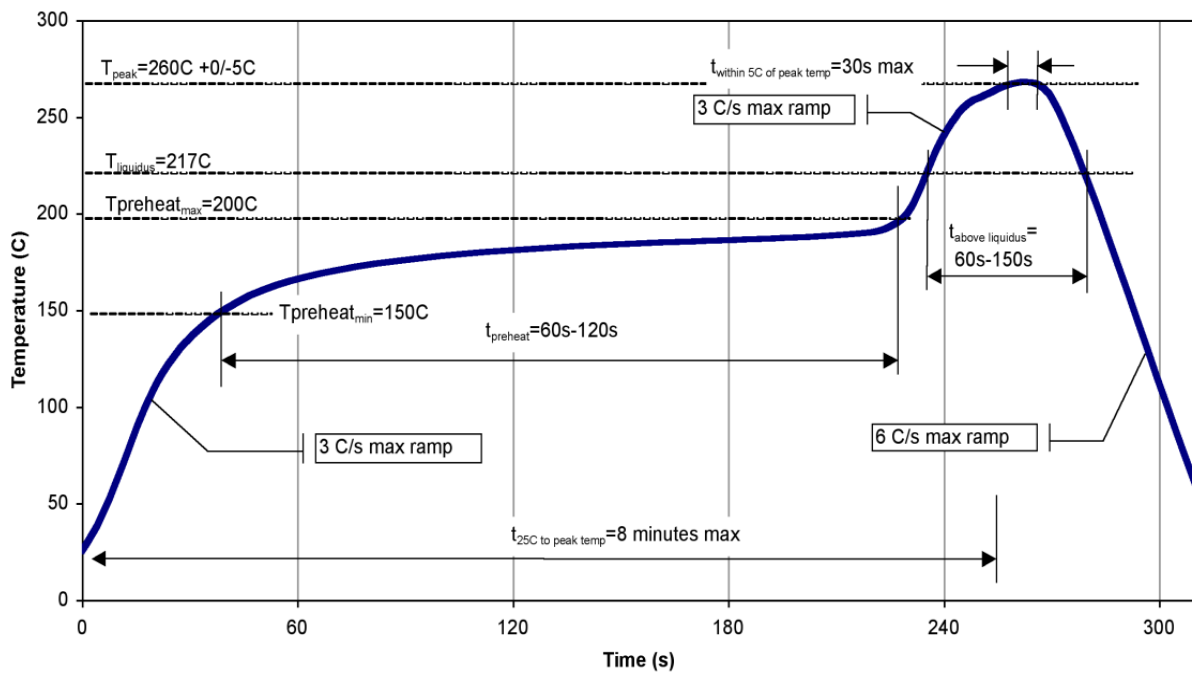
Compatible with lead-free soldering processes with 260°C peak reflow temperature.

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

Contact plating: Ni-Pd-Au.

Solder rework not recommended.

Recommended Solder Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1A	ANSI/ESD/JEDEC JS-001
ESD – Charge Device Model (CDM)	Class C2	ANSI /ESD/JEDEC JS-002
MSL – Moisture Sensitivity Level	Level 1	IPC/JEDEC J-STD-020



Caution!
 ESD-Sensitive Device

RoHS Compliance

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

This product also has the following attributes:

- Lead Free
- Antimony Free
- TBBP-A (C₁₅H₁₂Br₄O₂) Free
- PFOS Free
- SVHC Free

Contact Information

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

Web: www.qorvo.com

Tel: 1-844-890-8163

Email: customer.support@qorvo.com

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