TGA4906-SM

4 Watt Ka-Band Power Amplifier

Applications

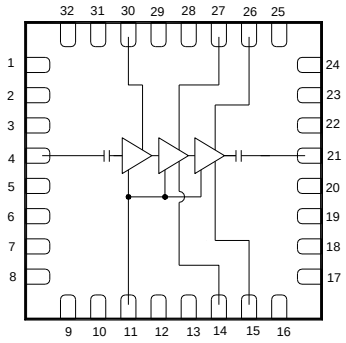
- Ka-Band Sat-Com
- VSAT

QFN 5x5 mm 32L

Product Features

- Frequency Range: 28 – 31 GHz
- Power: 36 dBm Psat
- Gain: 22 dB
- Bias: Vd = 6 V, Idq = 1.6 A, Vg = -0.7 V Typical
- Package Dimensions: 5.0 x 5.0 x 1.4 mm

Functional Block Diagram



General Description

The TriQuint TGA4906-SM is a compact 4 Watt High Power Amplifier for Ka-band applications. The part is designed using TriQuint's power pHEMT production process. The TGA4906-SM provides a nominal 36 dBm of output power at an input power level of 14 dBm with a small signal gain of 22 dB.

The TGA4906-SM is a QFN 5x5 mm surface mount packaged. It is ideally suited for low cost emerging markets such as base station transmitters for satellite ground terminals and point to point radio.

Lead-free and RoHS compliant

Evaluation Boards are available upon request.

Pin Configuration

Pin No.	Label
1,2, 3, 5 thru 10, 12, 13, 16 thru 20, 22 thru 25, 28, 29, 31, 32	N/C
4	RF IN
11	Vg
21	RF OUT
14, 15, 26, 27, 30	Vd

Ordering Information

Part No.	ECCN	Description
TGA4906-SM	3A001.b.2.c	Ka-Band Power Amplifier

Standard T/R size = 500 pieces on a 7" reel

Absolute Maximum Ratings

Parameter	Rating
Drain Voltage,Vd	+6.5 V
Gate Voltage,Vg	-5 to 0 V
Drain to Gate Voltage, Vd – Vg	11 V
Drain Current, Id	3.7 A
Gate Current, Ig	-15 to 94 mA
Power Dissipation, Pdiss	24 W
RF Input Power, CW, T = 25 °C	26 dBm
Channel Temperature, Tch	200 °C
Mounting Temperature (30 sec)	260 °C
Storage Temperature	-40 to 150 °C

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
Vd		6		V
Idq		1.6		A
Id_drive (Under RF Drive)		3.0		A
Id_drive (Under RF Drive) 1/	2.0			A
Vg		-0.7		V
Ig			1	mA
Ig_drive (Under RF drive)	-5		14	mA

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

1/ For operation above 30 GHz, stability is degraded for large signal drain current less than 2.0 A.

Electrical Specifications

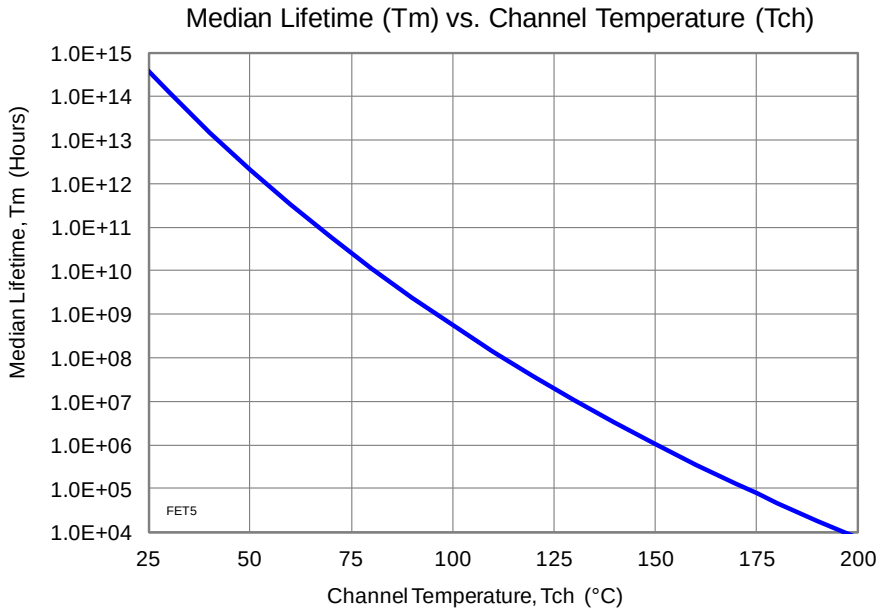
Test conditions unless otherwise noted: Vd =+6V, Idq = 1.6A, Vg= -0.7V Typical, Temp= +25°C
Z_0: 50 Ω

Parameter	Conditions	Min	Typ	Max	Units
Operational Frequency Range		28		31	GHz
Gain			22		dB
Input Return Loss			12		dB
Output Return Loss			6		dB
Output Power @ Saturation			36		dBm
28 to < 29 GHz		34			dBm
29 to < 30 GHz		35			dBm
30 to < 31 GHz		33			dBm
Output Power @ 1dB Gain Compression			34.5		dBm
Output TOI @ 20 dBm/Tone Pout/tone			38		dBm
Gain Temperature Coefficient			-0.05		dB/°C
Saturated Output Power Temperature Coefficient			-0.01		dB/°C

Specifications

Thermal and Reliability Information

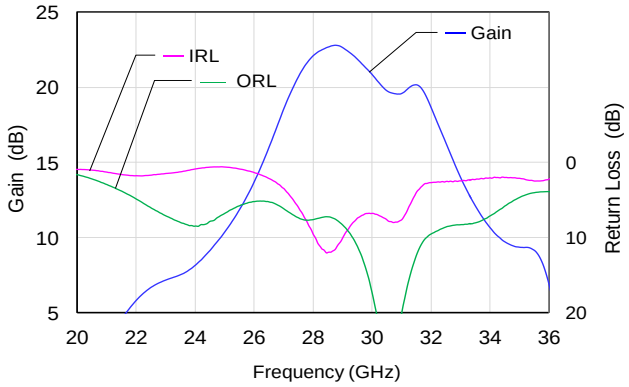
Parameter	Conditions	Rating
Thermal Resistance, θ_{JC}, measured to back of package	Tbase = 85 °C	θ_{JC} = 3.5 °C/W
Channel Temperature (Tch), and Median Lifetime (Tm)	Tbase = 85 °C Vd = 6 V Id = 1.6 A Pdiss = 9.6 W	Tch = 119 °C Tm = 4.1E+7 Hours
Channel Temperature (Tch), and Median Lifetime (Tm) Under RF Drive	Tbase = 85 °C Vd = 6 V Id = 3.0 A Pout = 36 dBm (4W) Pdiss = 14 W	Tch = 134 °C Tm = 6.4E+6 Hours



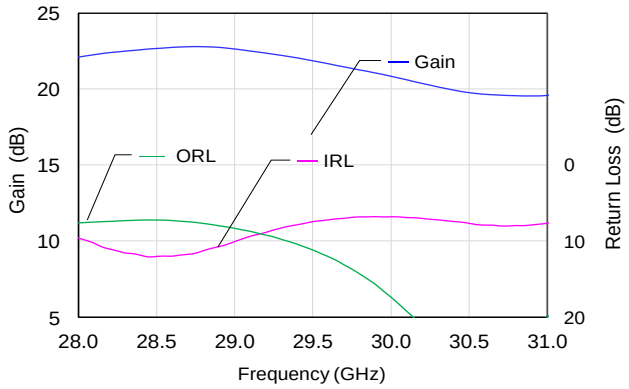
Typical Performance

Test conditions unless otherwise noted: Vd =+6V, Idq = 1.6 A, Vg = -0.7 V (Typical) Temp= +25 °C

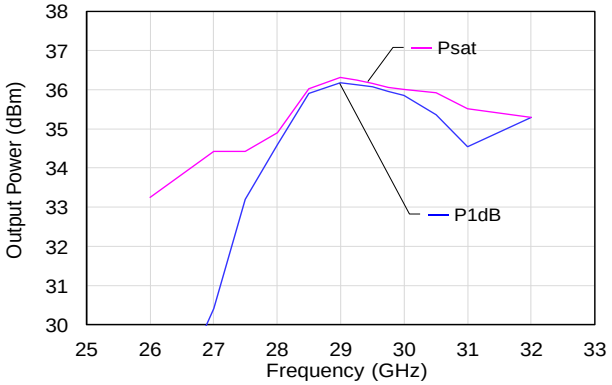
S-Parameters vs. Frequency



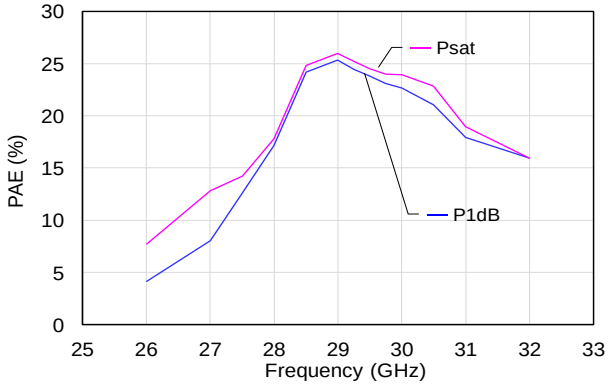
S-Parameters vs. Frequency



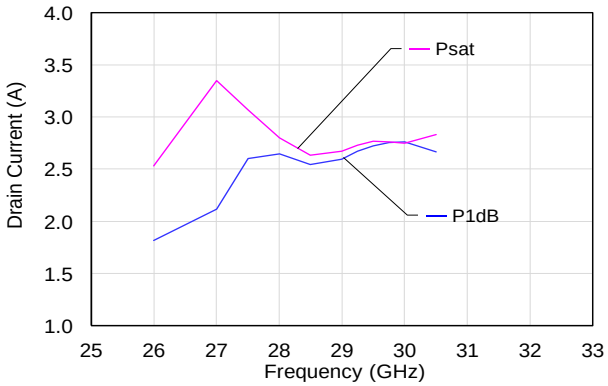
Output Power vs. Frequency



Power Added Efficiency vs. Frequency



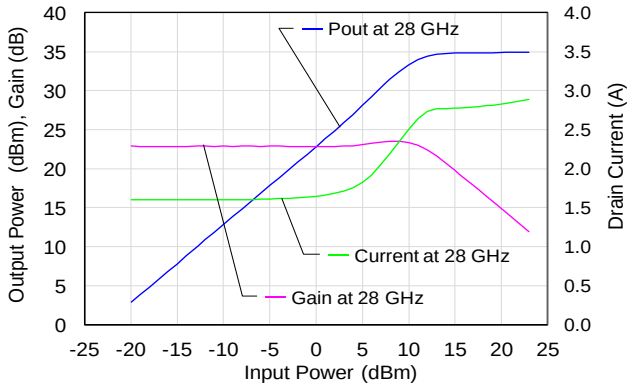
Drain Current vs. Frequency



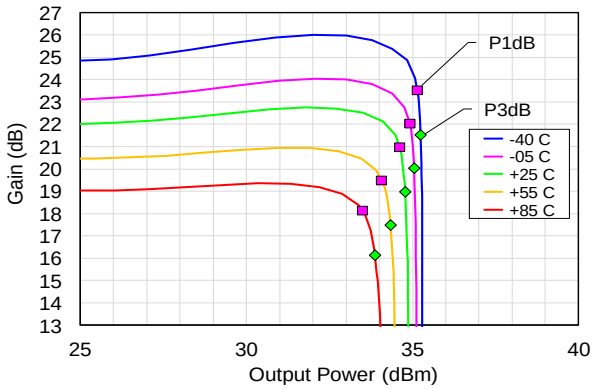
Typical Performance

Test conditions unless otherwise noted: Vd =+6V, Idq = 1.6 A, Vg = -0.7 V (Typical) Temp= +25 °C

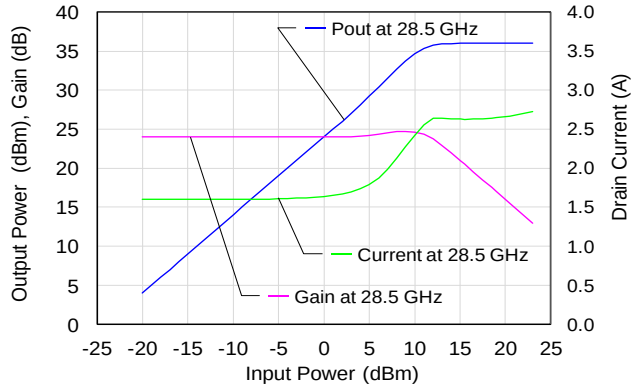
28 GHz Power, Gain, and Current vs. Input Power



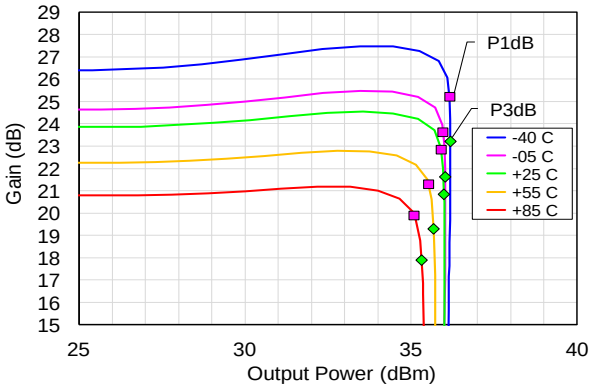
28 GHz Gain vs. Output Power vs. Temperature



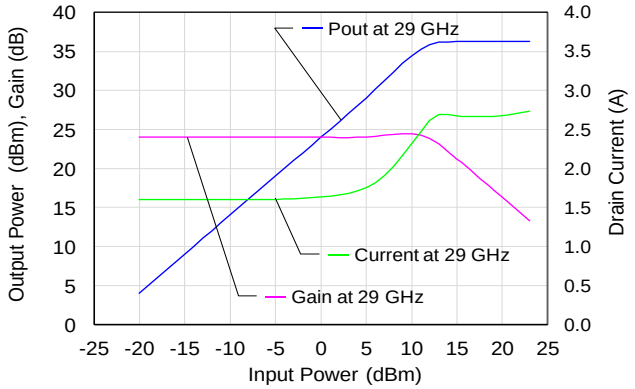
28.5 GHz Power, Gain, and Current vs. Input Power



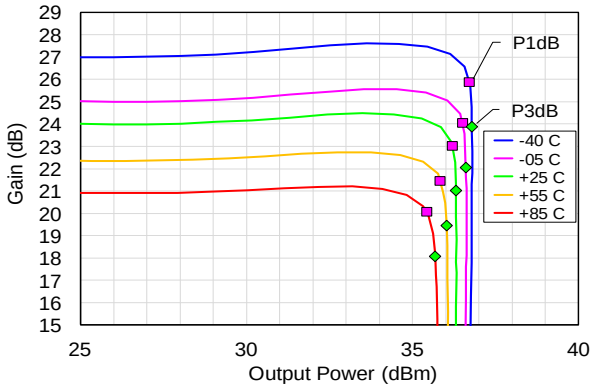
28.5 GHz Gain vs. Output Power vs. Temperature



29 GHz Power, Gain, and Current vs. Input Power



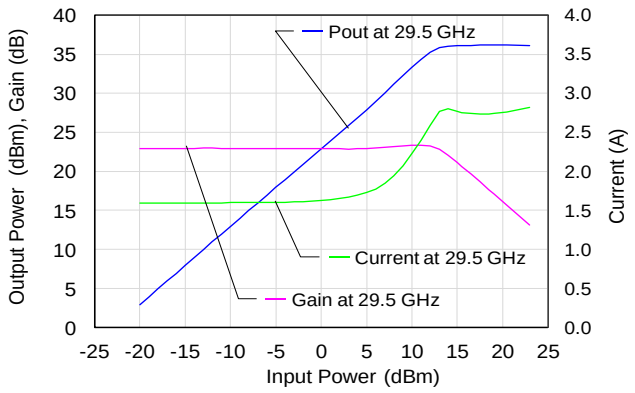
29 GHz Gain vs. Output Power vs. Temperature



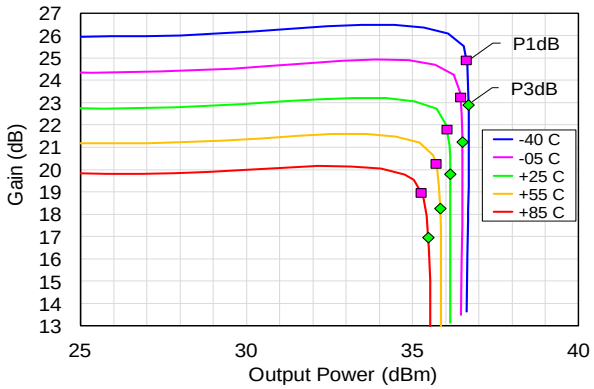
Typical Performance

Test conditions unless otherwise noted: Vd =+6V, Idq = 1.6 A, Vg = -0.7 V (Typical) Temp= +25 °C

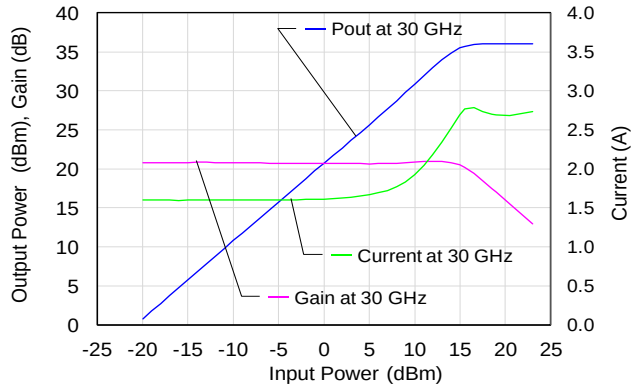
29.5 GHz Power, Gain, and Current vs. Input Power



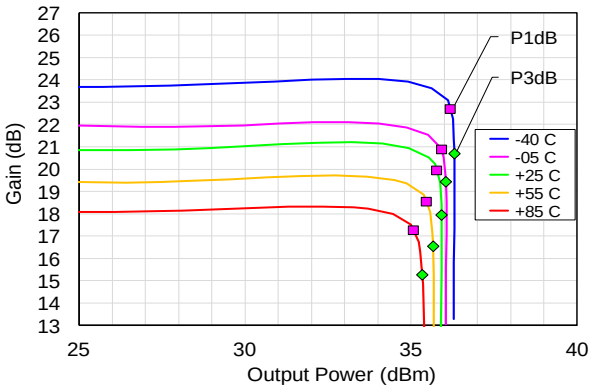
29.5 GHz Gain vs. Output Power vs. Temperature



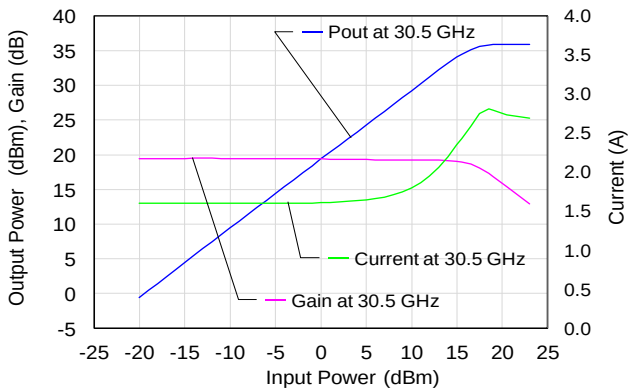
30 GHz Power, Gain, and Current vs. Input Power



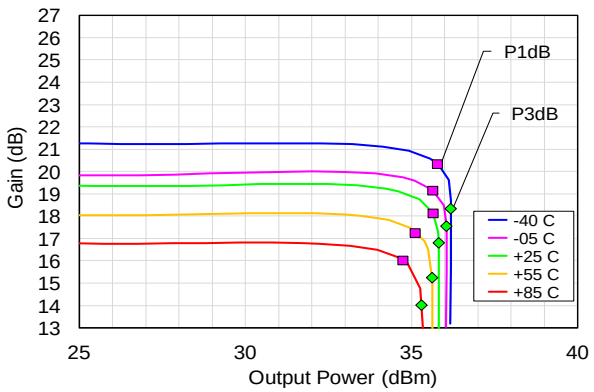
30 GHz Gain vs. Output Power vs. Temperature



30.5 GHz Power, Gain, and Current vs. Input Power



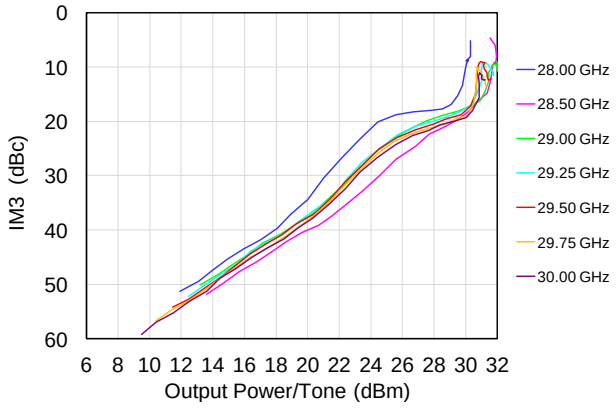
30.5 GHz Gain vs. Output Power vs. Temperature



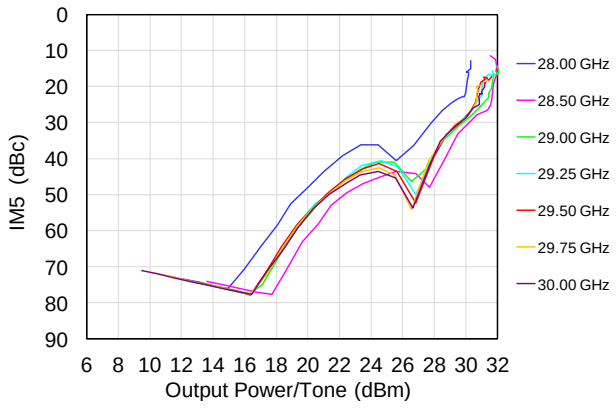
Typical Performance

Test conditions unless otherwise noted: Vd =+6V, Idq = 1.6 A, Vg = -0.7 V (Typical) Temp= +25 °C

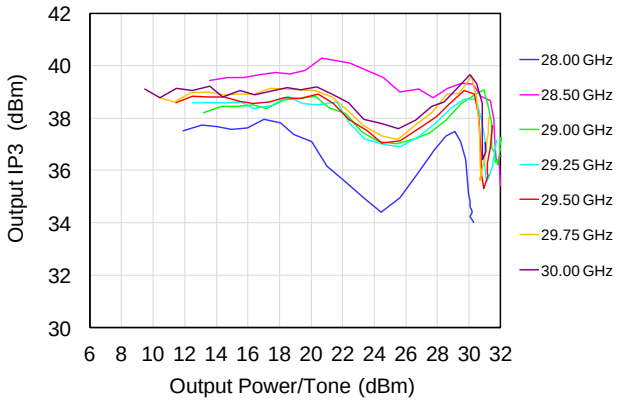
IM3 vs. Pout/Tone vs. Frequency



IM5 vs. Pout/Tone vs. Frequency



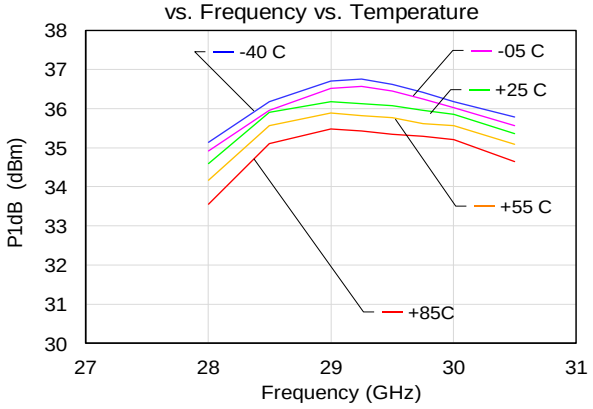
Output IP3 vs. Pout/Tone vs. Frequency



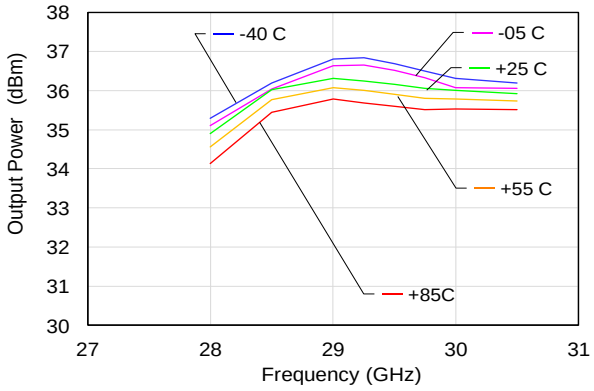
Typical Performance

Test conditions unless otherwise noted: Vd =+6V, Idq = 1.6 A, Vg = -0.7 V (Typical) Temp as noted

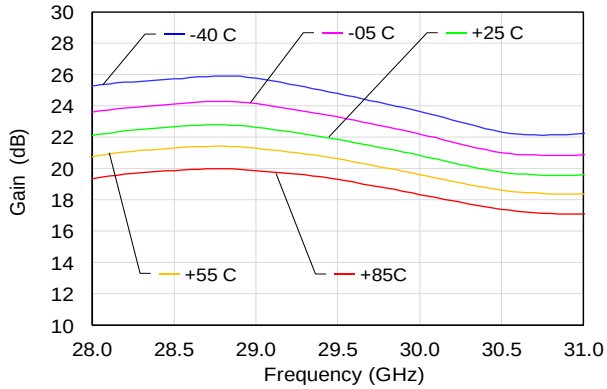
Output Power at 1dB Gain Compression vs. Frequency vs. Temperature



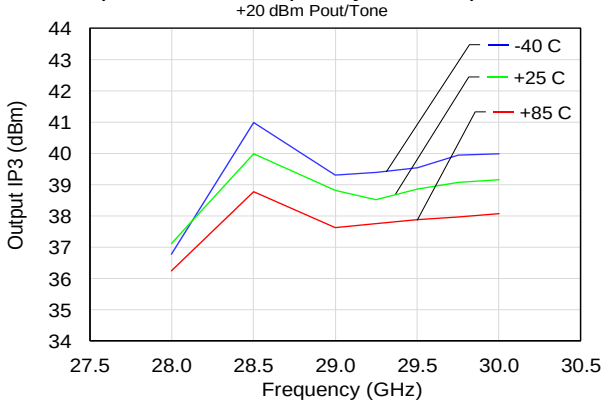
Saturated Output Power vs. Frequency vs. Temperature



Gain vs. Frequency vs. Temperature



Output IP3 vs. Frequency vs. Temperature
+20 dBm Pout/Tone



Device Characterization Data

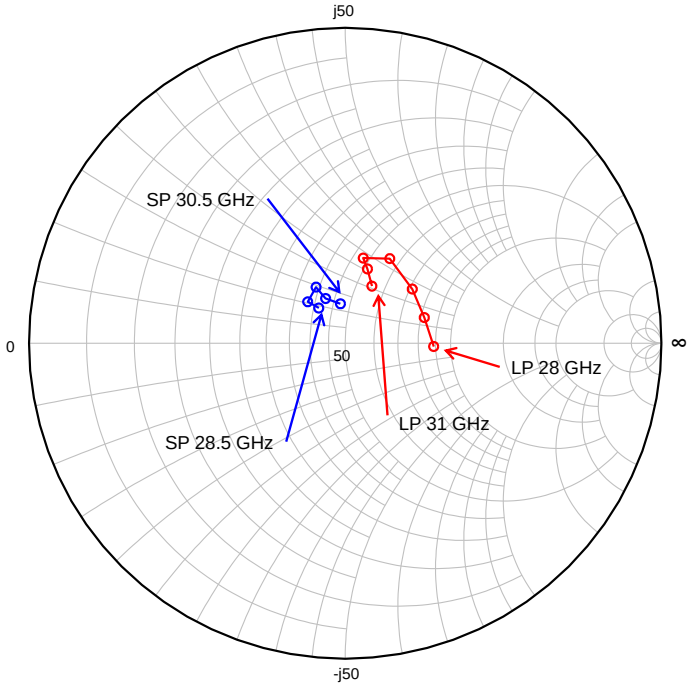
Source Pull and Load Pull Data

RF performance of the TGA4906-SM is optimum when placed in the impedance environment specified below. These impedances are NOT the impedances of the device; they are the impedances presented to the device via an RF circuit or load pull system. Z_{SOURCE} is the source impedance presented at pin 4. Z_{LOAD} is the load impedance presented at pin 21. This data was used to design the input and output structures shown in 'PC Board Tuning Layout'. The configuration described in 'Mounting Configuration' Note 3 applies to this data.

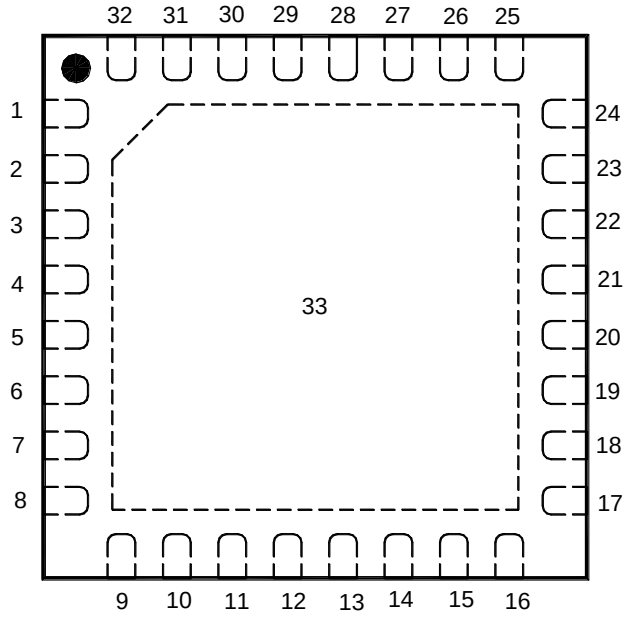
Contact **info-networks@tqs.com** for further information.

Input power for load pull:	+18 dBm	Z_{SOURCE} for load pull:	50+j0
Input power for source pull:	+10 dBm	Z_{LOAD} for source pull:	Z_{OPT} for maximum power

Freq (GHz)	Γ_{SOURCE} (Mag, Ang)	Z_{SOURCE} (Ω)	Gain (dB)		Γ_{LOAD} (Mag, Ang)	Z_{LOAD} (Ω)
28.0					0.280, –2.1°	88.8 - j2.0
28.5	0.140, +126.8°	41.3 + j9.4	25.6		0.263, +18.1°	81.8 + j14.4
29.0	0.177, +132.0°	38.2 + j10.4	25.6		0.273, +39.0°	71.2 + j26.4
29.5	0.200, +117.4°	39.2 + j14.6	23.8		0.303, +62.3°	56.1 + j33.1
30.0	0.155, +113.6°	42.5 + j12.4	21.1		0.276, +78.1°	48.0 + j28.1
30.5	0.126, +96.87°	47.1 + j12.0	19.7		0.246, +73.4°	51.1 + j25.7
31.0					0.200, +65.0°	55.1 + j20.8



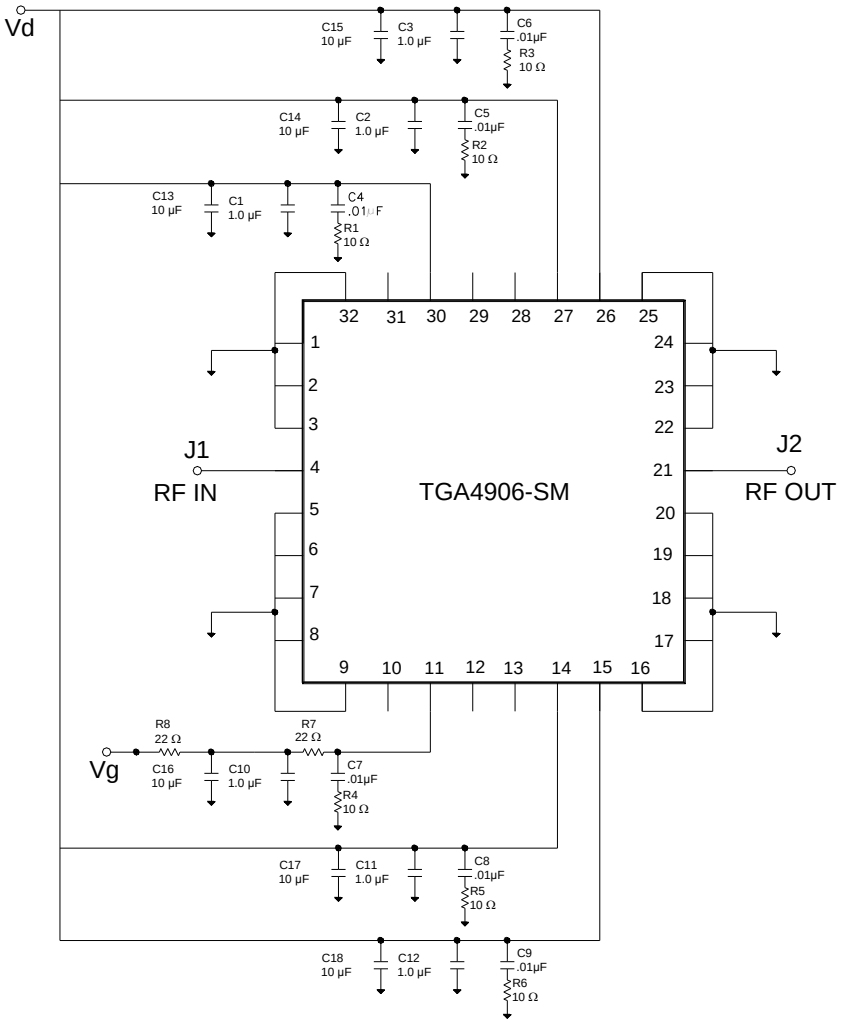
Pin Configuration and Description



Pin No.	Label	Description
2, 3, 5 thru 7, 18 thru 20, 22, 23	N/C	No internal connection; See 'PCB Mounting Pattern' section.
4	RF IN	Input, matched to 50 ohms.
11	Vg	Gate voltage. Bias network is required; see 'Application Circuit' section.
21	RF OUT	Output, matched to 50 ohms.
30	Vd1	Drain voltage for 1st stage. Bias network is required; see 'Application Circuit' section.
14	Vd2_Bot	Drain voltage for 2nd Stage. 1/
15	Vd3_Bot	Drain voltage for 3rd Stage. 1/
26	Vd3_Top	Drain voltage for 3rd Stage. 1/
27	Vd2_Top	Drain voltage for 2nd Stage. 1/
10, 12, 13, 28, 29, 31	N/C	No internal connection; may be grounded or left open on the PCB.
1,8,9,16,17,24,25,32,33	GND	Backside Paddle. See 'PCB Mounting Pattern' section.

1/ Must be biased from both sides; Bias network is required; see 'Application Circuit' section.

Application Circuit



Vd2 and Vd3 must be biased from both sides (pin 14, 15, 26, 27).
See Bill of Materials for note on C13 thru C18

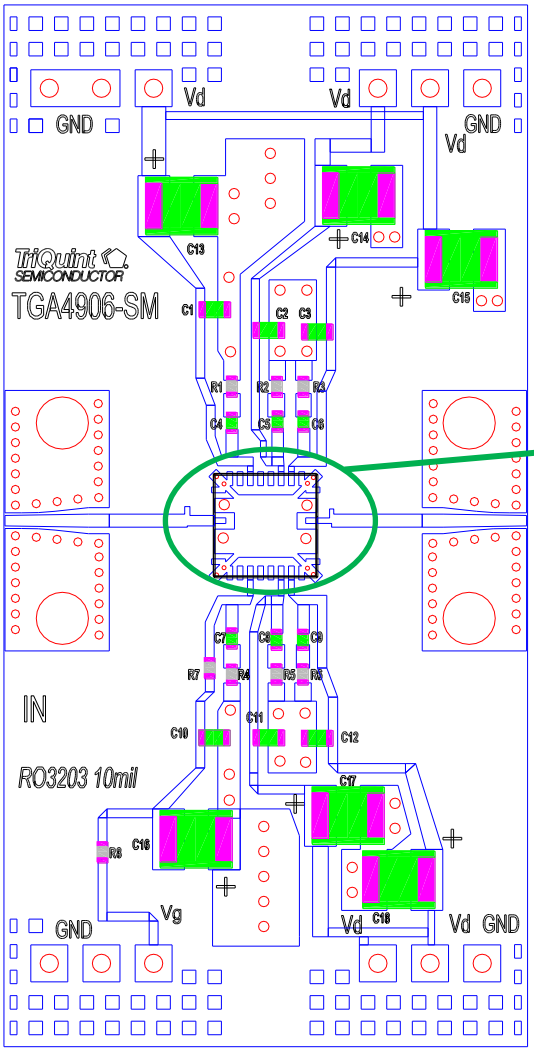
Bias-up Procedure	Bias-down Procedure
Vg set to -1.5 V	Turn off RF supply
Vd set to +6 V	Reduce Vg to -1.5 V. Ensure Id ~ 0 mA
Adjust Vg more positive until quiescent Id is 1600 mA. This will be ~ Vg = -0.7 V typical	Turn Vd to 0 V
Apply RF signal to RF Input	Turn Vg to 0 V

Application Circuit

PC Board Layout

Top RF layer is 0.010" thick Rogers RO3203, ϵ_r = 3.02. Metal layers are 0.5-oz copper. Microstrip 50 Ω transmission line detail: width = 0.025". See 'PC Board Tuning Layout' on for tuning details.

For further technical information, refer to the TGA4906-SM Product Information page.



Detail is on the next page

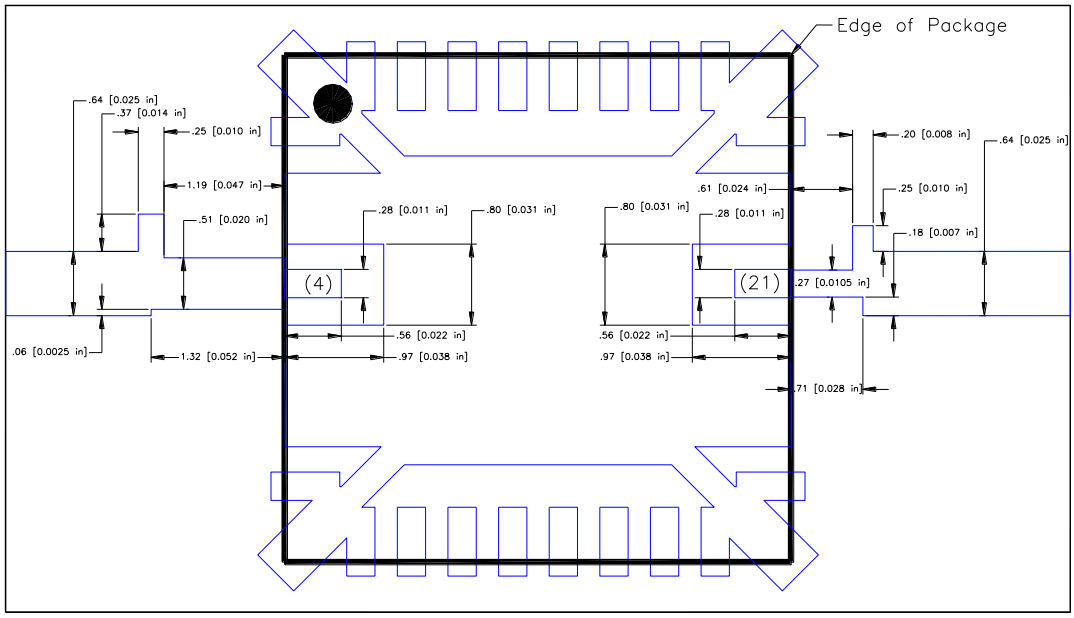
Application Circuit

Bill of Material

Ref Des	Value	Description	Manufacturer	Part Number
C1, C2, C3, C10, C11, C12	1 µF	Cap, 0603, 25 V, 10%, X5R	various	
C4,C5, C6, C7, C8, C9	.01 µF	Cap, 0402, 25 V, 10%, X7R	various	
R1, R2, R3 R4, R5, R6	10 Ohms	Res, 0402, 0.1 W, 5%, SMD	various	
R7	22 Ohms	Res, 0402, 0.1 W, 5%, SMD	various	
R8	22 Ohms	Res, 0402, 0.1 W, 5%, SMD	various	1/
C13, C14, C15 C16, C17, C18	10 µF	Cap, 3528-21, 16V, 20%, SMD Tantalum	Kemet	T491B106M016AT 1/

1/ Optional. The presence and value of these components varies by application. Variables include power supply impedance, power supply stability with reactive loads, and inductance from the power supply to this circuit. One to 47 µF tantalum capacitors are commonly used for C13-C18. R8 may be replaced by a jumper.

PC Board Tuning Layout

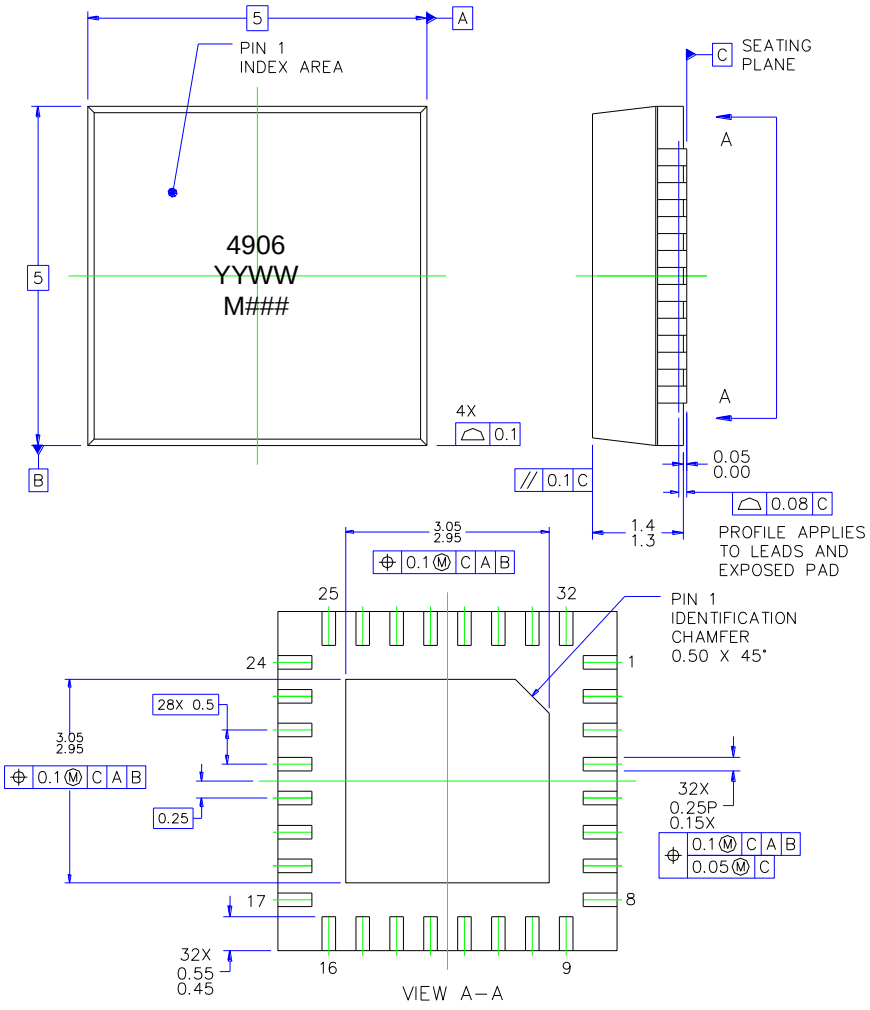


All performance data in this data sheet was measured using the transmission line tuning elements shown at pins 4 (RF In) and pin 21 (RF Out). These transmission line dimension apply to transmission lines on 0.010" thick Rogers RO3203, ϵ_r = 3.02.

Mechanical Information

Package Marking and Dimensions

All dimensions are in millimeters.



This package is lead-free/RoHS-compliant. The package base is copper alloy and the plating material on the leads is NiPdAu. It is compatible with a lead-free (maximum 260 °C reflow temperature) soldering process.

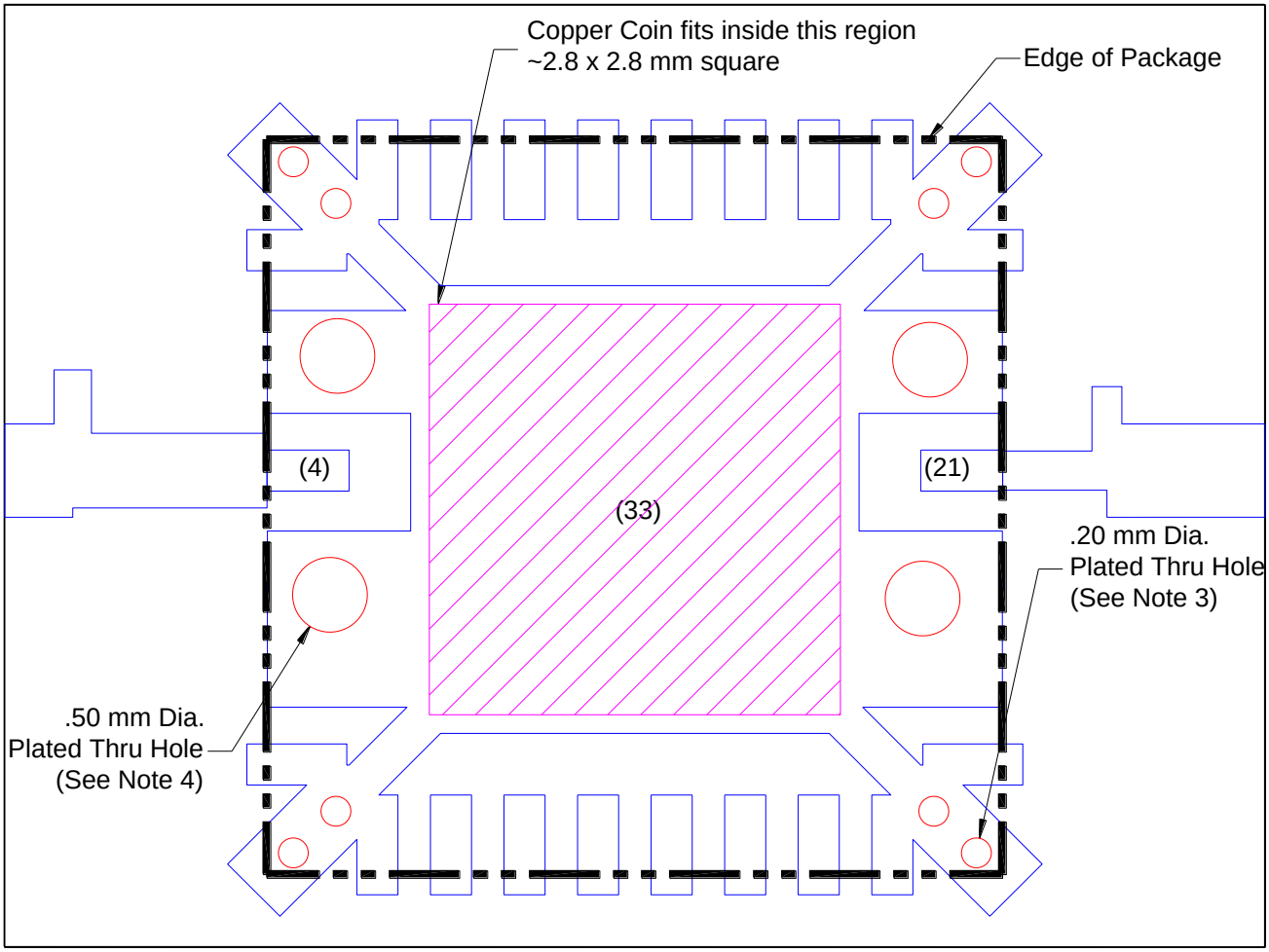
The TGA4906-SM will be marked with the “4906” designator and a lot code marked below the part designator. The “YY” represents the last two digits of the year the part was manufactured, the “WW” is the work week, and the “M###” is an auto-generated sequence.

Mechanical Information

PCB Mounting Pattern

Notes:

1. A heatsink underneath the area of the PCB for the mounted device is recommended for proper thermal operation.
2. Use of an embedded heat spreader in the PCB underneath the ground pad (pin 33) of the TGA4906-SM package as shown is recommended for proper thermal and electrical operation. Data in this document was taken using this configuration. It is recommended to contact **info-networks@tqs.com** for further information regarding heat spreader design and your application.
3. Additional vias as shown in red at the four package corners and on either side of pins 4 and 21 are required for proper operation. Diameter of these additional vias is not critical.
4. The 4 0.50 mm diameter vias on either side of pins 4 and 21 may be reduced in size in order to place the via between package pin pairs 2-3, 5-6, 19-20, and 22-23. These vias may also be replaced with internal edge plating on the PCB around the perimeter of the PCB cutout prior to the insertion of the heat spreader. In both cases, the purpose of the plating and the vias is to provide a good RF ground transition from the PCB to the backside of the TGA4906-SM package.
5. Contact **info-networks@tqs.com** for further information.

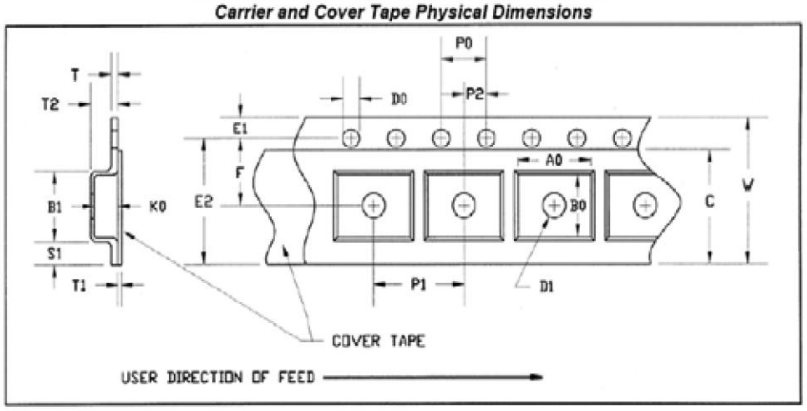


Tape and Reel Information

Standard T/R size = 500 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	QFN0500X0500F-L500	5.3	5.3	1.65	8.0	2.00	5.50	12.0	9.20

Carrier and Cover Tape Physical Dimensions



Product Compliance Information

ESD Sensitivity Ratings

Caution! ESD-Sensitive Device

ESD Rating: Class 1A
Value: ≥ 300 V and < 350 V
Test: Human Body Model (HBM)
Standard: JEDEC Standard JESD22-A114

ESD Rating: Class M1
Value: ≥ 80 V and < 90 V
Test: Machine Model (MM)
Standard: JEDEC Standard JESD22-A114

MSL Rating

Level MSL1 at +260 °C convection reflow
The part is rated Moisture Sensitivity Level MSL1 at 260°C per JEDEC standard IPC/JEDEC J-STD-020.

Solderability

Compatible with lead-free (260°C maximum reflow temperature) soldering processes.

Package lead plating: NiPdAu.

The use of no-clean solder to avoid washing after soldering is recommended.

This package is not compatible with solder containing lead.

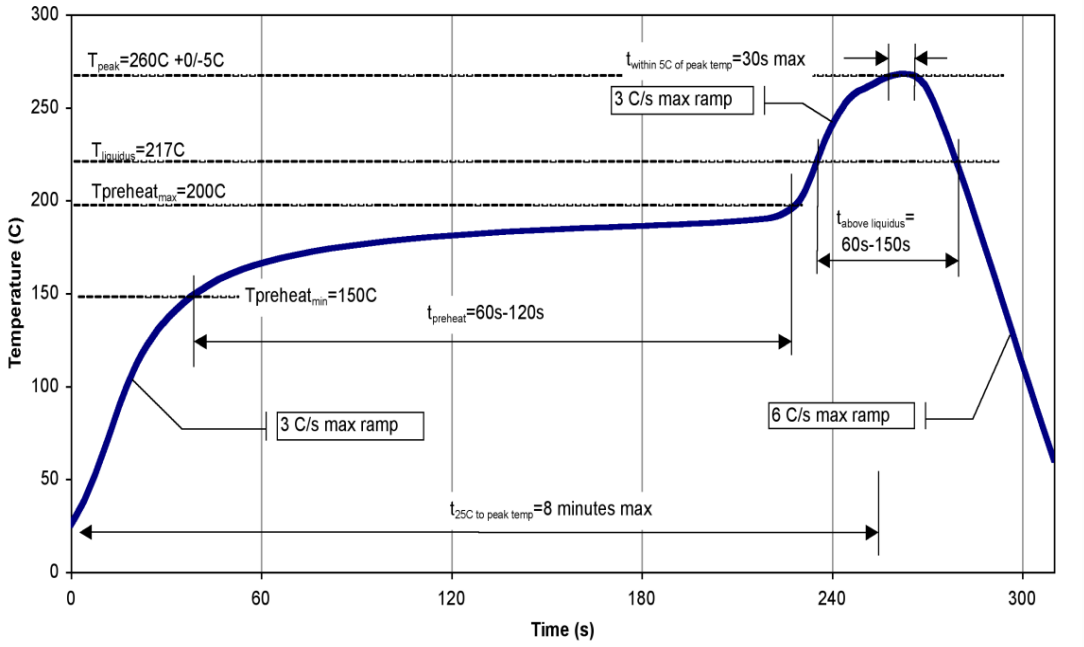
RoHs Compliance

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 ($C_{15}H_{12}Br_4O_2$) Free
- PFOS Free
- SVHC Free

Recommended Solder Temperature Profile



Contact Information

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

Web: www.triquint.com **Tel:** +1.972.994.8465
Email: info-sales@tqs.com **Fax:** +1.972.994.8504

For technical questions and application information: **Email:** info-networks@tqs.com

Important Notice

The information contained herein is believed to be reliable. TriQuint makes no warranties regarding the information contained herein. TriQuint assumes no responsibility or liability whatsoever for any of the information contained herein. TriQuint assumes no responsibility or liability whatsoever for the use of the information contained herein. The information contained herein is provided "AS IS, WHERE IS" and with all faults, and the entire risk associated with such information is entirely with the user. All information contained herein is subject to change without notice. Customers should obtain and verify the latest relevant information before placing orders for TriQuint products. The information contained herein or any use of such information does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other intellectual property rights, whether with regard to such information itself or anything described by such information.

TriQuint products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.