

### Applications

- General Purpose Wideband Gain Block
- Electronic Warfare
- Military & Commercial Radar
- Military Communications
- Commercial Communications
- Instrumentation

### Product Features

- Frequency Range: 2 – 30 GHz
- Small Signal Gain: 11.5 dB mid-band
- Return Loss: >9 dB
- NF: 3.4 dB typical
- P1dB: 8 dBm,  $P_{SAT} = 12$  dBm at  $P_{IN} = 5$  dBm
- OTOI: 17 dBm at  $P_{out}/tone = 5$  dBm
- Bias:  $V^+ = 5$  V ( $V_D = 3$  V),  $I_{DQ} = 50$  mA,  $V_G = -1.5$  V Typical,  $V_{CTRL} = 0$  V
- Package Dimensions: 5 x 5 x 1.5 mm

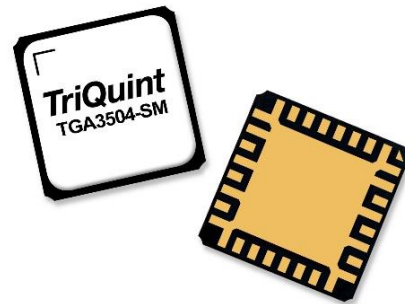
### General Description

TriQuint's TGA3504-SM is a packaged wideband gain block with adjustable gain control giving the user extra flexibility to fine tune system performance. Operating from 2 to 30 GHz, the TGA3504-SM provides 8 dBm P1dB and 11 dB of small signal gain with return losses of greater than 9 dB.

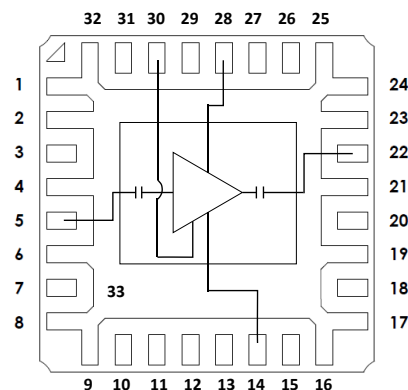
The TGA3504-SM is fabricated on TriQuint's TQPHT15 0.15  $\mu$ m GaAs pHEMT process and is offered in a robust 5x5 mm air-cavity QFN. With integrated DC blocking caps and fully matched to 50ohms, the TGA3503-SM is easily integrated in both commercial and military system architectures.

Lead-free and RoHS compliant

Evaluation Boards are available upon request.



### Functional Block Diagram



### Pad Configuration

Pad No.	Symbol
1-4, 6-13, 15-21, 23-27, 29, 31-32	Gnd
5	RF <sub>IN</sub>
14	V <sub>G1</sub>
22	RF <sub>OUT</sub>
28	V <sup>+</sup>
30	V <sub>CTRL</sub>
33	Gnd

### Ordering Information

Part	ECCN	Description
TGA3504-SM	EAR99	2 – 30 GHz GaAs Wideband Gain Block

### Absolute Maximum Ratings

Parameter	Value (1)
Bias Voltage ( $V^+$ )	10 V
Drain Voltage ( $V_D$ )	6 V
Gate Voltage Range ( $V_{G1}$ )	-5 to 0 V
Control Voltage Range ( $V_{CTRL}$ )	-1 to 3.9 V (2)
Drain Current ( $I_D$ )	72 mA
Gate Current ( $I_G$ )	-10 to 19 mA
Control Current ( $I_{CTRL}$ )	-0.5 to 16 mA
Power Dissipation, 85 °C ( $P_{DISS}$ )	1.3 W
Input Power, CW, 50 $\Omega$ , ( $P_{IN}$ )	13 dBm
Channel temperature ( $T_{CH}$ )	200 °C
Mounting Temperature (30 Seconds)	260 °C
Storage Temperature	-55 to 150 °C

Notes:

1. Operation of this device outside the parameter ranges given above may cause permanent damage. These are stress ratings only, and functional operation of the device at these conditions is not implied.
2. Assure  $V_D - V_{CTRL} \leq 8$  V. Compute  $V_D = V^+ - I_{DQ} \cdot 40$

### Recommended Operating Conditions

Parameter	Value (1)
Supply Voltage ( $V^+$ )	5 V
Drain Voltage ( $V_D$ )	3 V
Drain Current ( $I_{DQ}$ )	50 mA
Gate Voltage ( $V_{G1}$ )	-1.5 V Typical
Control Voltage ( $V_{CTRL}$ )	0 V
Temperature ( $T_{BASE}$ )	-40 to 85 °C

Notes:

1. Electrical specifications are measured at specified test conditions. Specifications are not guaranteed overall operating conditions

### Electrical Specifications

Test conditions unless otherwise noted: 25 °C,  $V^+ = 5$  V,  $I_{DQ} = 50$  mA,  $V_{G1} = -1.5$  V Typical,  $V_{CTRL} = 0$  V, CW

Parameter	Min	Typical	Max	Units
Operational Frequency Range	2		30	GHz
Small Signal Gain		>10		dB
Input Return Loss		>9		dB
Output Return Loss		>9		dB
Noise Figure		3.4		dB
Output Power at 1 dB Gain Compression		10		dBm
Output TOI at Pout/1tone = 5 dBm		17		dBm

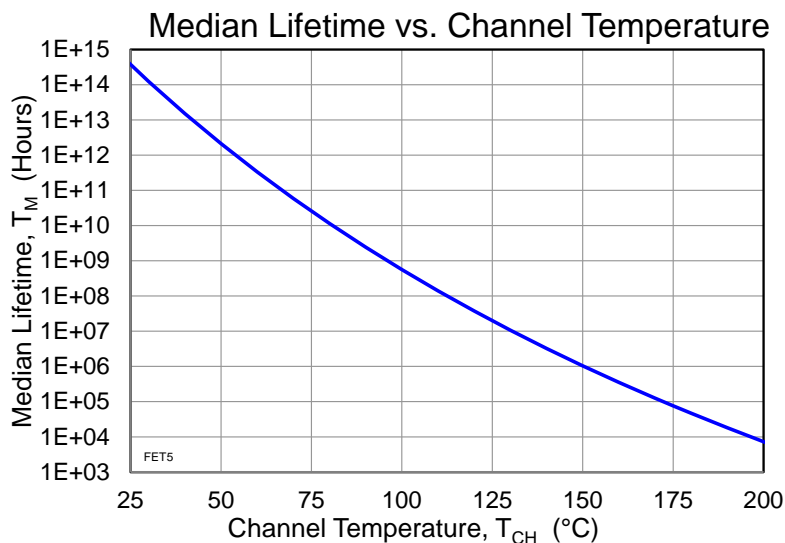
### Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance ( $\theta_{JC}$ ) <sup>(1)</sup>	$T_{base} = 85\text{ }^{\circ}\text{C}$ , $V_{+} = 5\text{ V}$ $V_D = 3\text{ V}$ , $V_{CTRL} = 0\text{ V}$ , $I_{DQ} = 50\text{ mA}$ , $P_{DISS} = 0.21\text{ W}$	48	$^{\circ}\text{C/W}$
Channel Temperature ( $T_{CH}$ ) (No RF drive)		95	$^{\circ}\text{C}$
Median Lifetime ( $T_M$ )		$1.2 \times 10^9$	Hrs
Thermal Resistance ( $\theta_{JC}$ ) <sup>(1)</sup>	$T_{base} = 85\text{ }^{\circ}\text{C}$ , $V_{+} = 5\text{ V (CW)}$ $V_D = 3\text{ V}$ , $V_{CTRL} = 0\text{ V}$ , $I_{DQ} = 50\text{ mA}$ , $I_{D\_Drive} = 58\text{ mA}$ $P_{IN} = 5\text{ dBm}$ , $P_{OUT} = 11\text{ dBm}$ , $\text{Freq} = 16\text{ GHz}$ , $P_{DISS} = 0.16\text{ W}$	42	$^{\circ}\text{C/W}$
Channel Temperature ( $T_{CH}$ ) (Under RF drive)		92	$^{\circ}\text{C}$
Median Lifetime ( $T_M$ )		$1.8 \times 10^9$	Hrs

Notes:

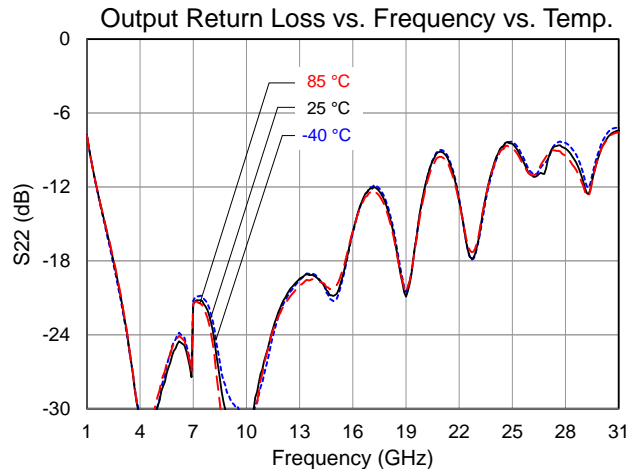
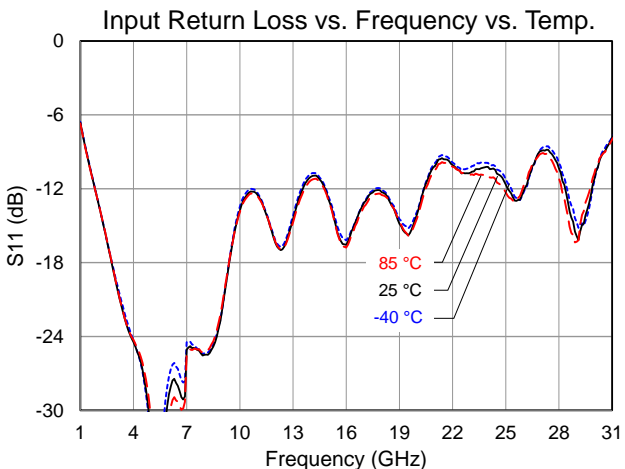
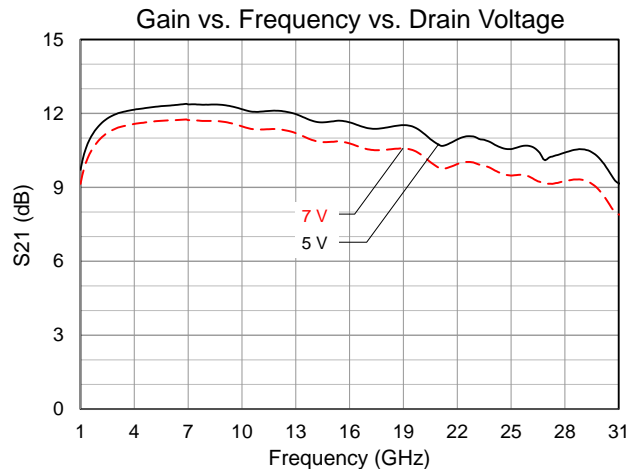
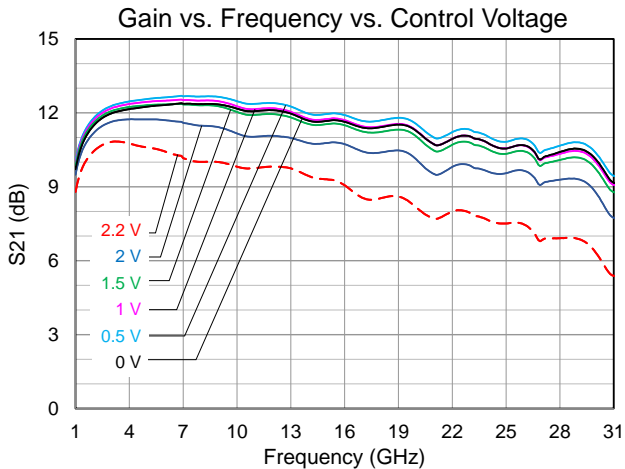
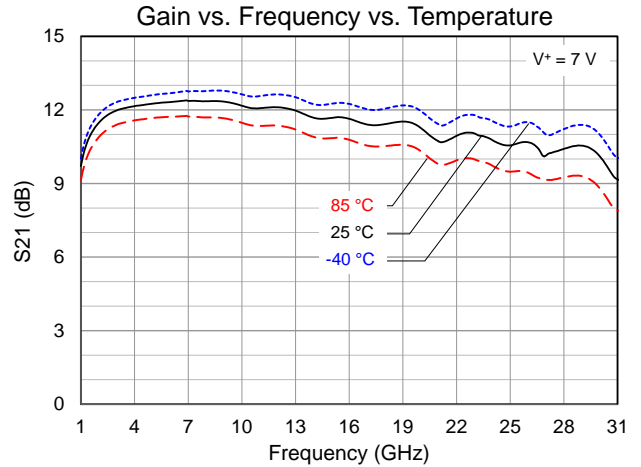
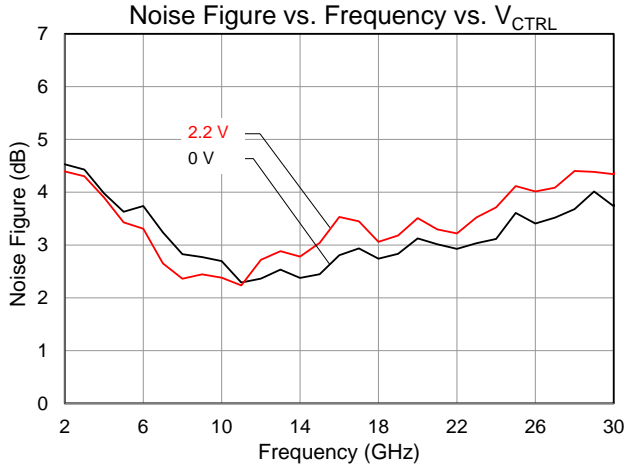
1. Thermal resistance measured at back of the package.

Test Conditions:  $V_D = 6\text{ V}$ ; Failure Criteria is 10% reduction in  $I_{D\_MAX}$



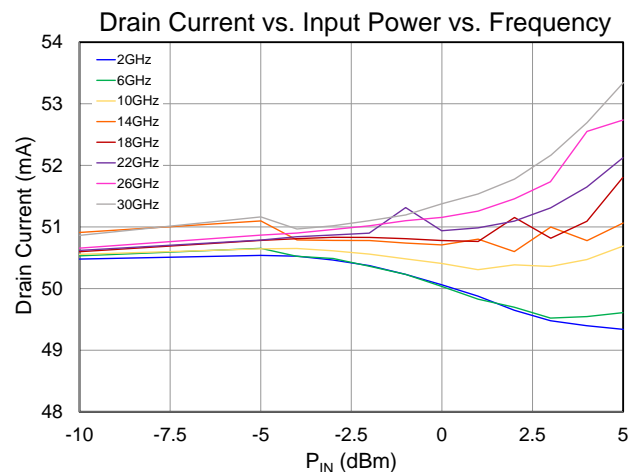
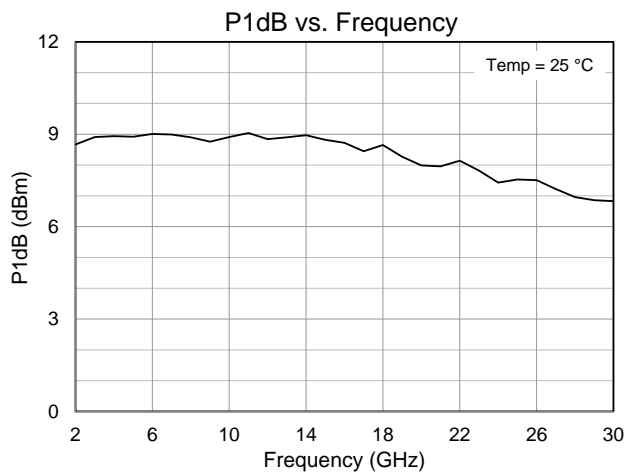
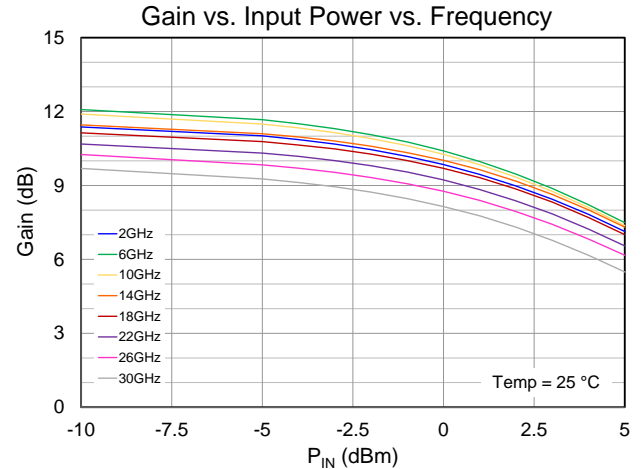
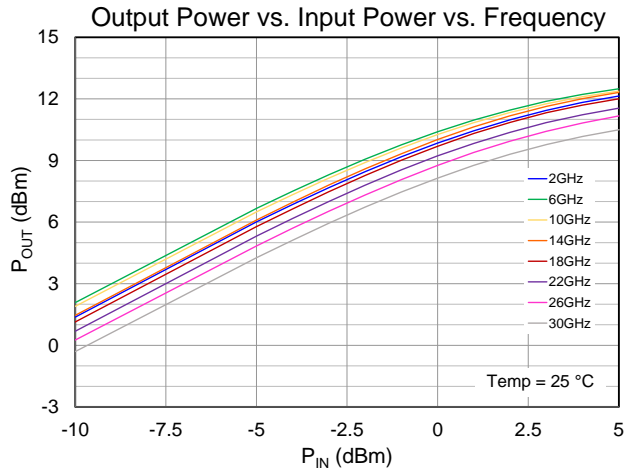
### Typical Performance: Small Signal

Conditions unless otherwise specified:  $V^+ = 5\text{ V}$ ,  $I_{DQ} = 50\text{ mA}$ ,  $V_{G1} = -1.5\text{ V}$  Typical,  $V_{CTRL} = 0\text{ V}$ , CW



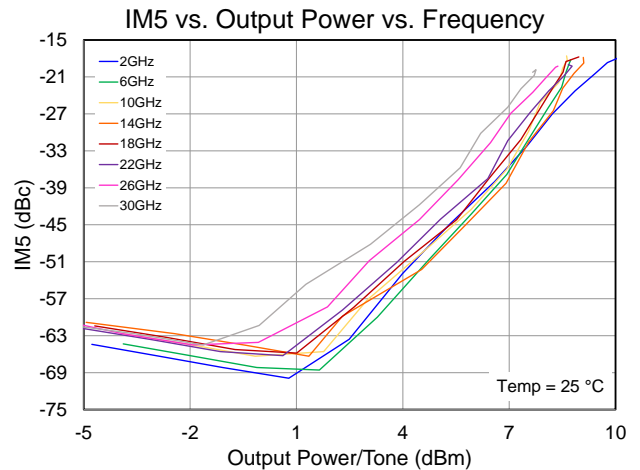
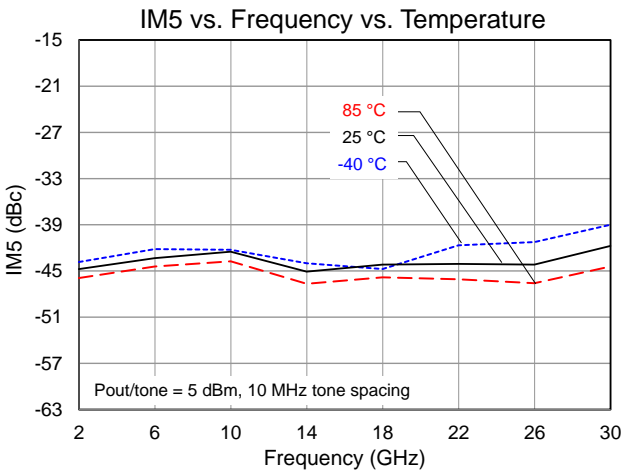
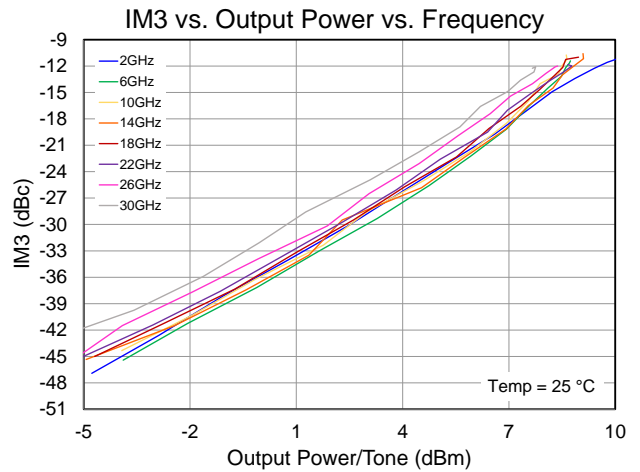
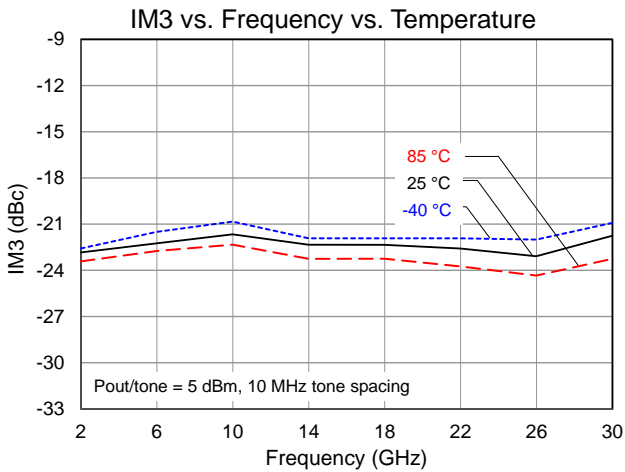
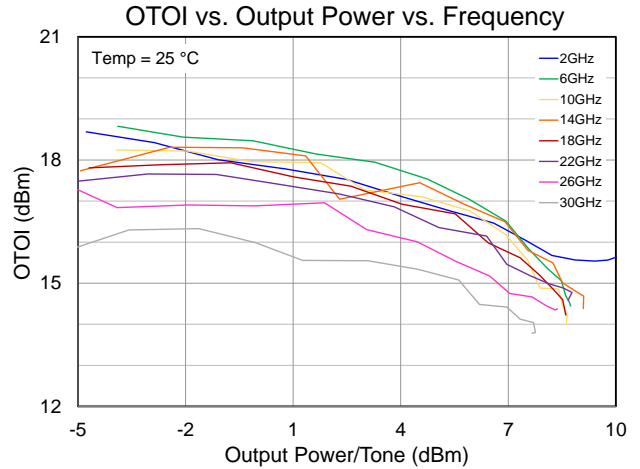
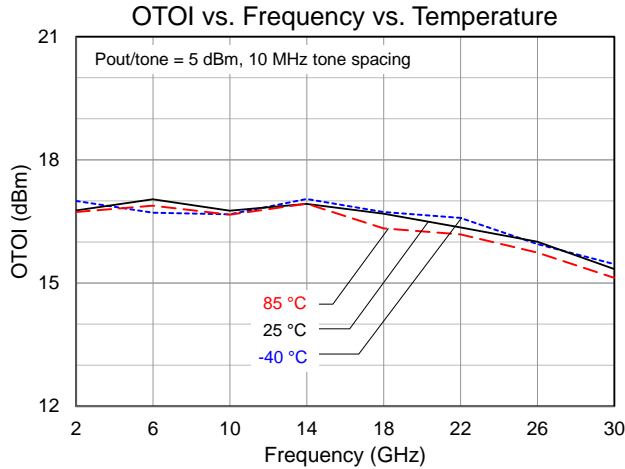
### Typical Performance: Large Signal

Conditions unless otherwise specified:  $V^+ = 5\text{ V}$ ,  $I_{DQ} = 50\text{ mA}$ ,  $V_{G1} = -1.5\text{ V}$  Typical,  $V_{CTRL} = 0\text{ V}$ , CW

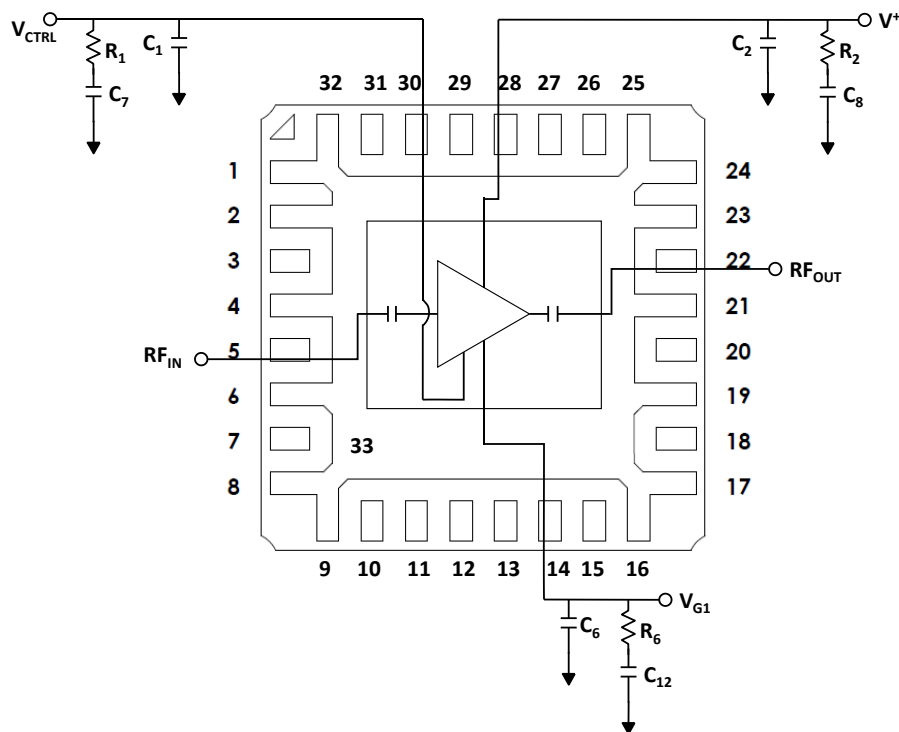


### Typical Performance: Linearity

Conditions unless otherwise specified:  $V^+ = 5\text{ V}$ ,  $I_{DQ} = 50\text{ mA}$ ,  $V_{G1} = -1.5\text{ V}$  Typical,  $V_{CTRL} = 0\text{ V}$ , CW



### Application Information



### Bias-up Procedure

1. Set  $I_D$  limit to 72 mA,  $I_G$  limit to 10 mA
2. Apply -2 V to  $V_{G1}$  for pinch off
3. Apply desired value to  $V_{CTRL}$
4. Apply +5 V to  $V_+$ , resulting in  $V_D = 3$  V
5. Adjust  $V_{G1}$  more positive until  $I_{DQ} = 50$  mA ( $V_G \sim -1.5$  V Typical)
6. Apply Gain Control signal ( $V_{CTRL}$ )
7. Apply RF signal

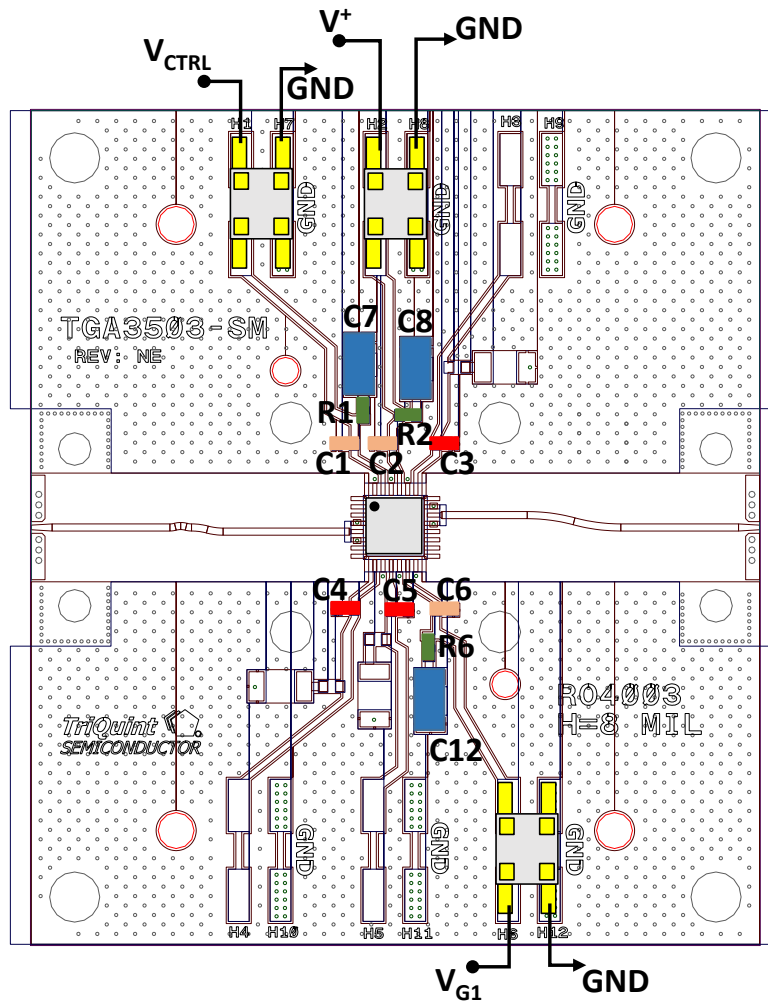
### Bias-down Procedure

1. Turn off RF signal
2. Reduce  $V_{G1}$  to -2 V. Ensure  $I_{DQ} \sim 0$  mA
3. Set  $V_+$  to 0 V
4. Turn off  $V_{CTRL}$  supply
5. Turn off  $V_D$  supply
6. Turn off  $V_{G1}$  supply

### Pin Description

Pin No.	Symbol	Description
1-4, 6-13, 15-21, 23-27, 29, 31-32	Gnd	Recommend grounding on PCB
5	RF <sub>IN</sub>	Input; matched to 50 Ω; DC blocked
14	$V_{G1}$	Gate voltage; bias network is required; see recommended Application Information above.
22	RF <sub>OUT</sub>	Output; matched to 50 Ω; DC blocked
28	$V_+$	Drain voltage; bias network is required; see recommended Application Information above.
30	$V_{CTRL}$	Gain control voltage; bias network is required; see recommended Application Information above.

## Evaluation Board

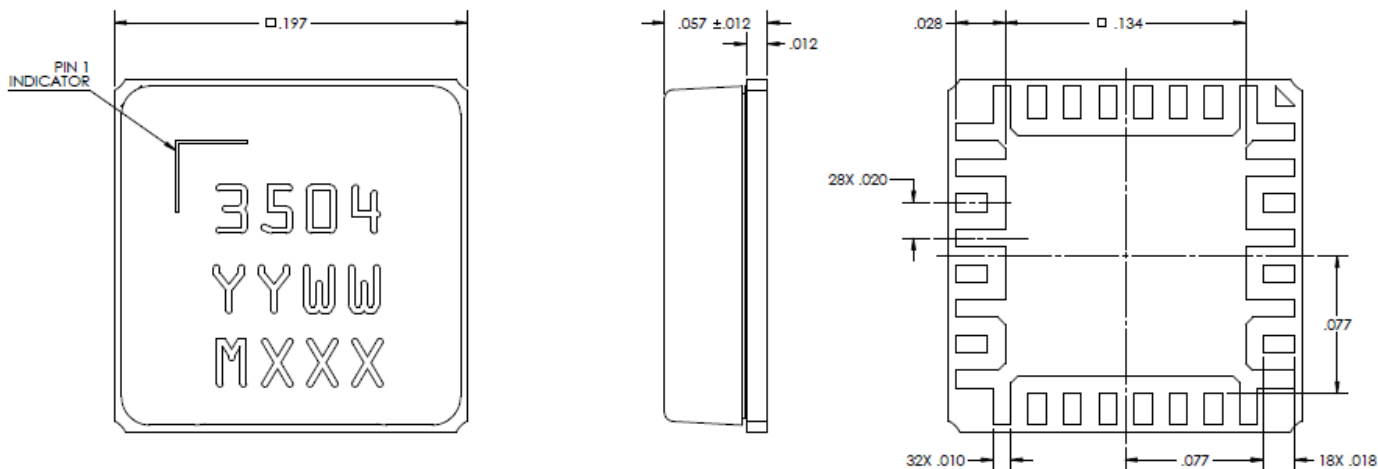


## Bill of Material

Reference Des.	Value	Description	Manuf.	Part Number
C1, C2, C6	1 $\mu$ F	Cap, 0402, 50 V, 10%, X7R	Various	
C3, C4, C5	0 Ohms	Res, 0402, 5% (Required for above EVB design)	Various	
C7, C8, C12	2.2 $\mu$ F	Res, 1206, 50 V, 10%, X7R	Various	
R1, R2, R6	15 Ohms	Res, 0402, 50 V, 5%	Various	



**Mechanical Information**



Units: inches

Tolerances: unless specified

x.xx = ± 0.01

x.xxx = ± 0.005

Materials:

Base: Aluminum Nitride

All metalized features are Au plated

Part is mold encapsulated

Marking:

3504: Part number

YY: Part Assembly year

WW: Part Assembly week

MXXX: Batch ID

**Recommended Soldering Temperature Profile**

