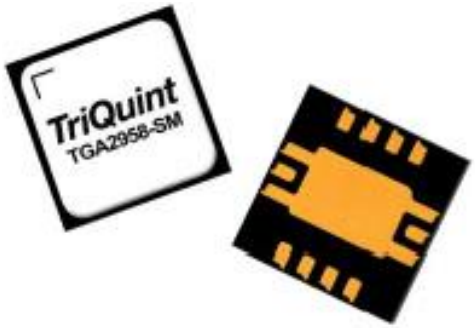
TGA2958-SM

13 – 18 GHz 2 W GaN Driver Amplifier

Product Description

The TGA2598-SM is a packaged Ku-band amplifier fabricated on Qorvo's 0.15 um GaN on SiC production process (QGaN15). Operating over a 13 – 18 GHz bandwidth, the TGA2598-SM delivers 2W of saturated output power with 20 dB large signal gain and > 25 % power-added efficiency. This, along with >25 dB small signal gain allows it to support a variety of low power Ku-band systems or as a linear, high-voltage driver for Qorvo's line of high power Ku-band amplifiers.

Packaged in a 4 x 4 air-cavity package for high performance and easy handling, the TGA2958-SM is fully matched to 50 ohms with integrated DC blocking capacitors on both I/O ports for simple system integration. This makes for an ideal general purpose RF amplifier which can provide needed functionality across both commercial and defense related markets.



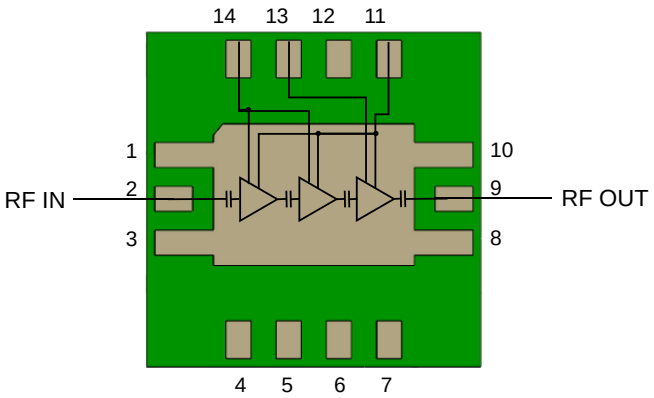
14 Lead 4 x 4 Air Cavity Laminate Package

Product Features

- Frequency Range: 13 – 18 GHz
- P_{SAT}: 33 dBm at P_{IN} = 13 dBm
- PAE: 25 % at P_{IN} = 13 dBm
- Small Signal Gain: 25 dB
- Input Return Loss: > 7 dB
- Output Return Loss: > 13 dB
- Bias: V_D = +20 V, I_{DQ} = 70 mA, V_G = −2.7 V Typical
- Package Dimensions: 4.0 x 4.0 x 1.74 mm
- Performance under CW operation

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

Functional Block Diagram



Applications

- Satellite Communications
- Data Links
- Radar
- General Purpose

Ordering Information

Part No.	Description
TGA2958-SM	13 – 18 GHz 2 W GaN Driver Amplifier
TGA2958-SM EVB	Evaluation Board

Electrical Specifications

Parameter	Freq. (GHz)	Min	Typ	Max	Units
Operational Frequency Range		13	–	18	GHz
Small Signal Gain			25		dB
Input Return Loss			> 7		dB
Output Return Loss			> 13		dB
Output Power at P_{IN} = 13 dBm	13	31	32.5		dBm
	14, 15, 16, 17	32.5	34		
	18	31.5	33		
Power Added Efficiency at P_{IN} = 13 dBm	13	16	22		%
	14, 15, 16, 17	19	28		
	18	17	23		
Large Signal Gain at P_{IN} = 13 dBm			> 20		dB
IM3 (Pout/tone = 24 dBm, 1 MHz spacing)			−31		dBc
IM5 (Pout/tone = 24 dBm, 1 MHz spacing)			−46		dBc
Gate Leakage (V_D = 10 V, V_G = -3.7 V), Ig	n/a	-1.4		1.4	mA
Small Signal Gain Temperature Coefficient			−0.07		dB/°C
Output Power Temperature Coefficient - at P_{IN} = 0 dBm - at P_{IN} = 12 dBm			 −0.04 −0.01		dB/°C

Test conditions unless otherwise noted: 25 °C, V_D = +20 V, I_{DQ} = 70 mA, V_G = −2.7 V Typ, CW

Recommended Operating Conditions

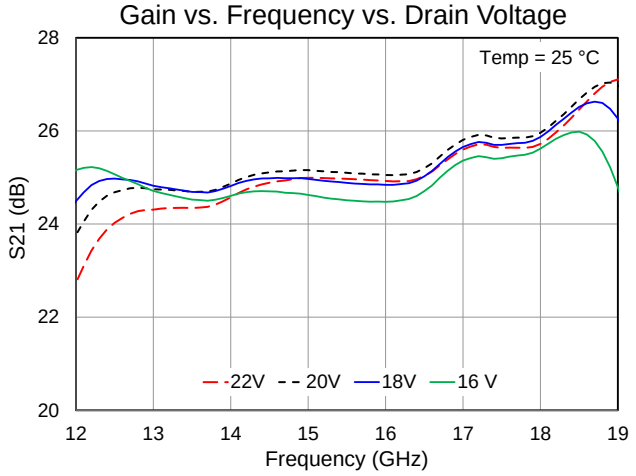
Parameter	Value / Range
Drain Voltage (V_D) CW	20 - 22 V
Drain Current (I_{DQ})	70 mA
Drain Current Under RF Drive (I_{D_DRIVE})	See plots p. 6
Gate Voltage Range, Typical (V_G)	−2.0 to −3.2 V
Gate Current Under RF Drive (I_{G_DRIVE})	See plots p. 6
Temperature (T_{BASE})	−40 to 85 °C

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

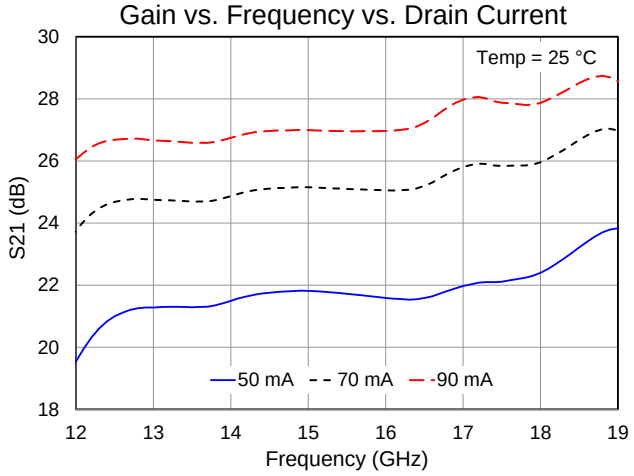
Typical Performance – Small Signal

Conditions unless otherwise specified: V_D = +20 V, I_{DQ} = 70 mA, V_G = −2.7 V Typ, CW

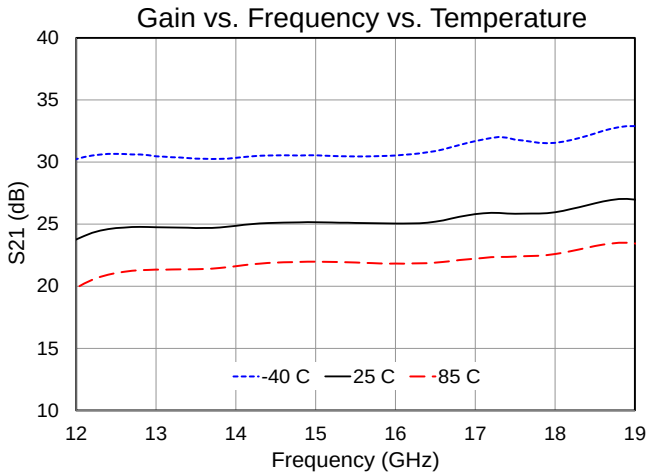
Gain vs. Frequency vs. Drain Voltage



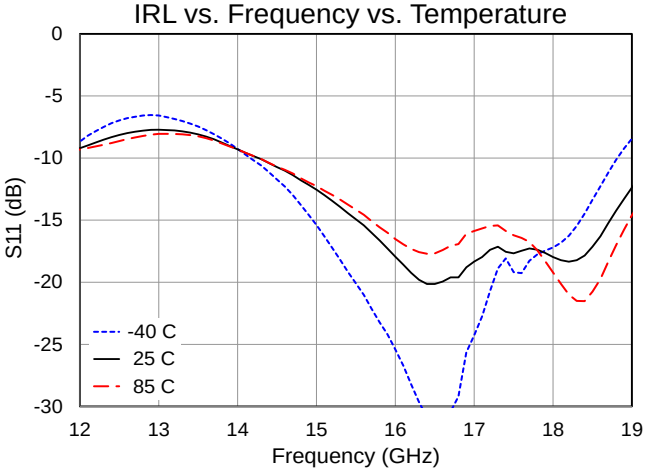
Gain vs. Frequency vs. Drain Current



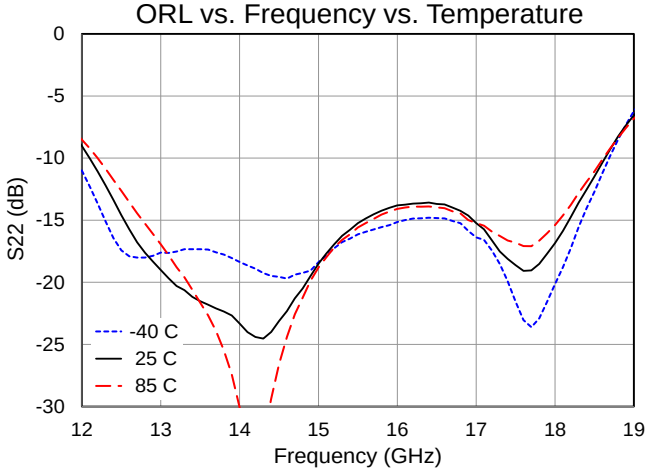
Gain vs. Frequency vs. Temperature



IRL vs. Frequency vs. Temperature

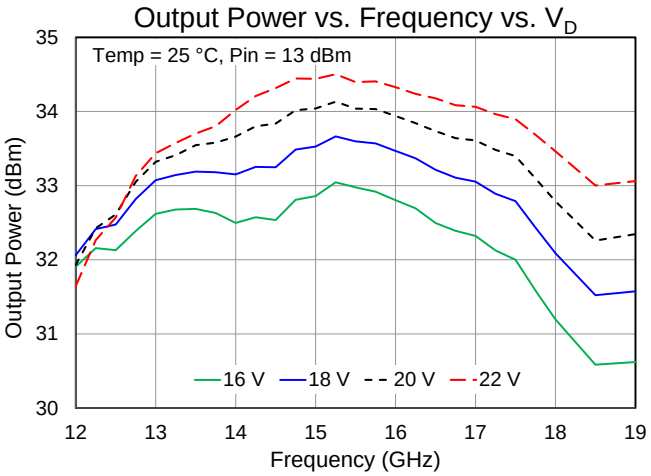


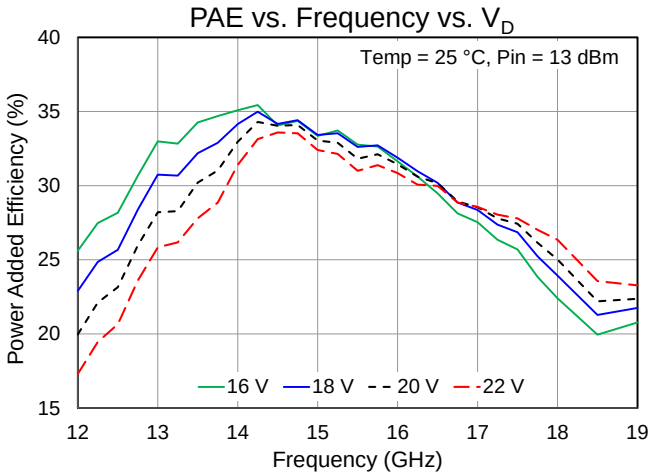
ORL vs. Frequency vs. Temperature

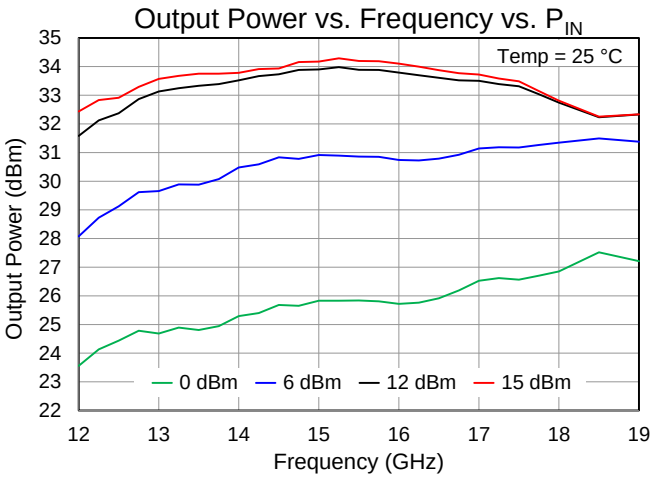


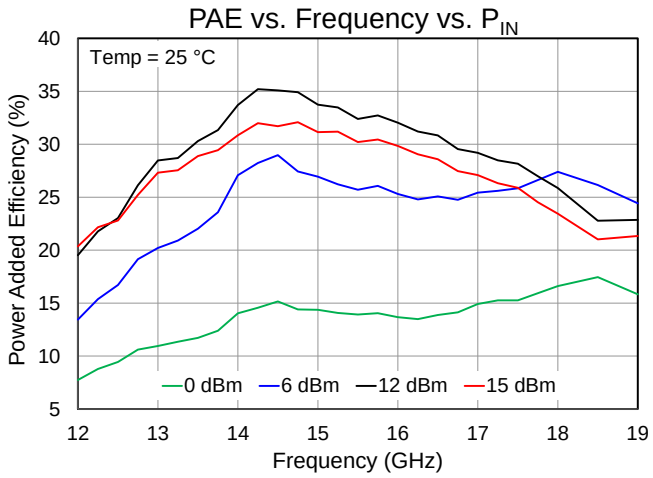
Performance Plots – Large Signal

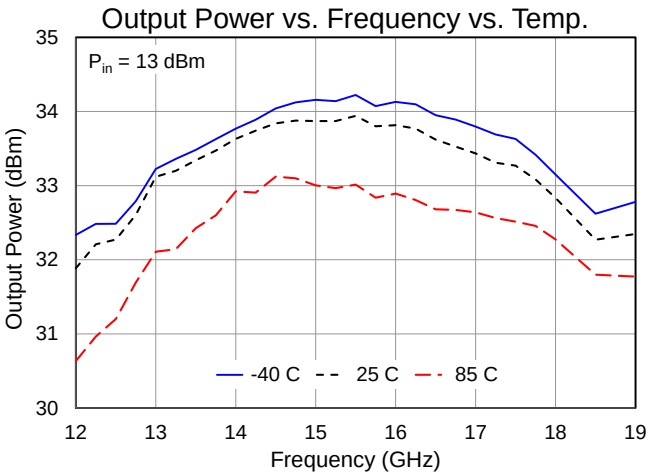
Conditions unless otherwise specified: V_D = +20 V, I_{DQ} = 70 mA, V_G = −2.7 V Typ, CW

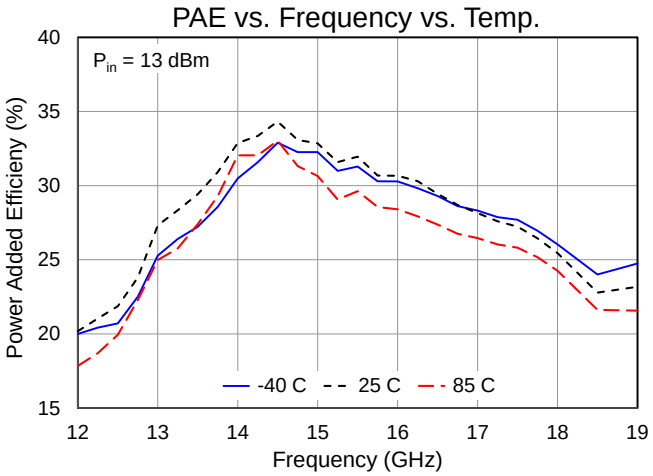








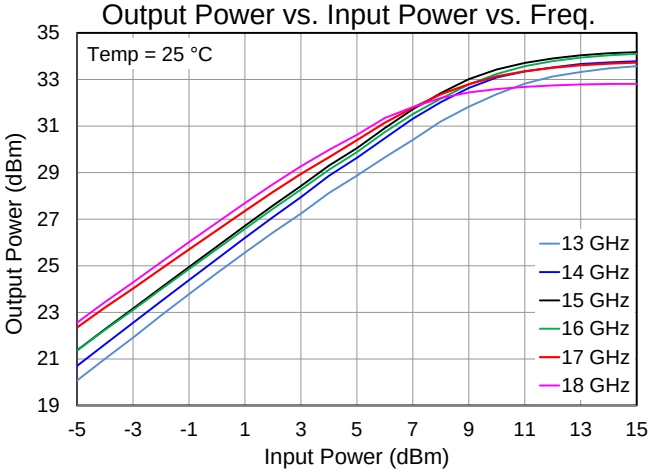




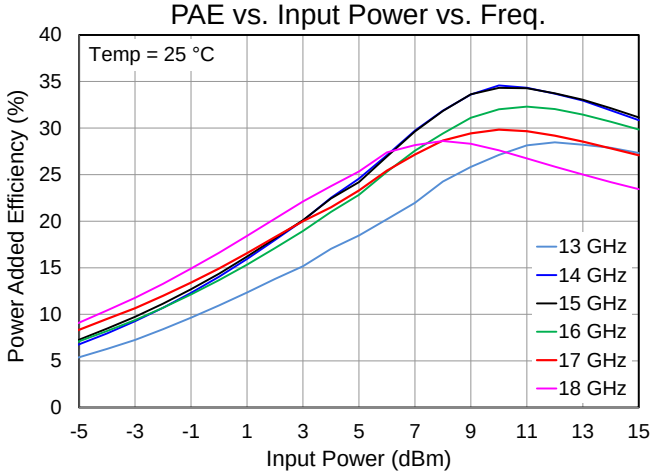
Typical Performance – Large Signal

Conditions unless otherwise specified: V_D = +20 V, I_{DQ} = 70 mA, V_G = −2.7 V Typ, CW

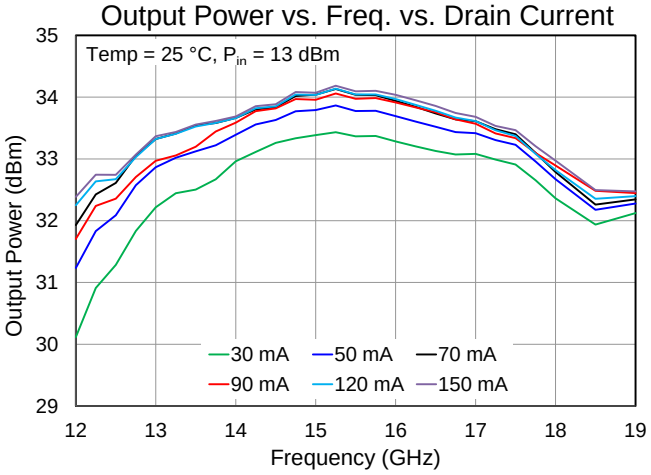
Output Power vs. Input Power vs. Freq.



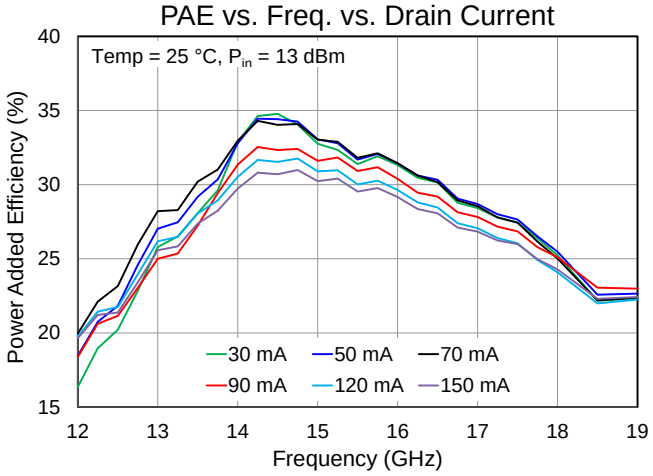
PAE vs. Input Power vs. Freq.



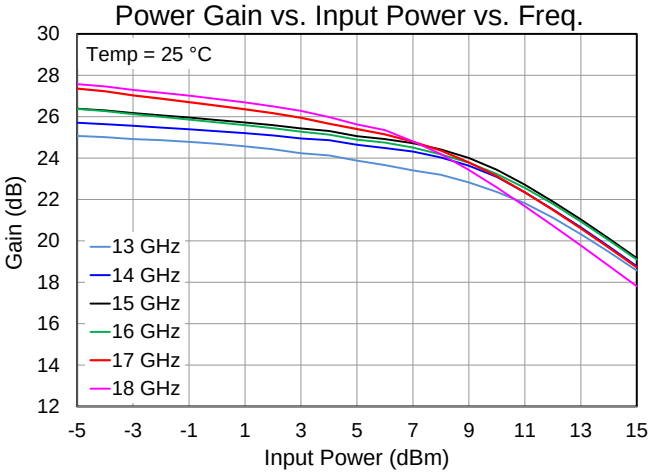
Output Power vs. Freq. vs. Drain Current



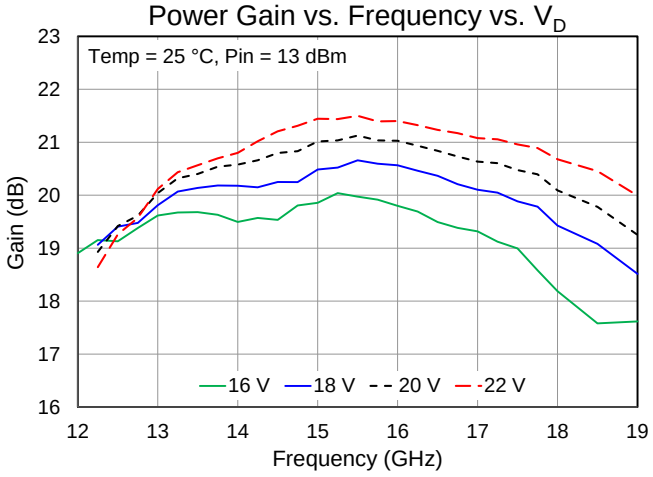
PAE vs. Freq. vs. Drain Current



Power Gain vs. Input Power vs. Freq.

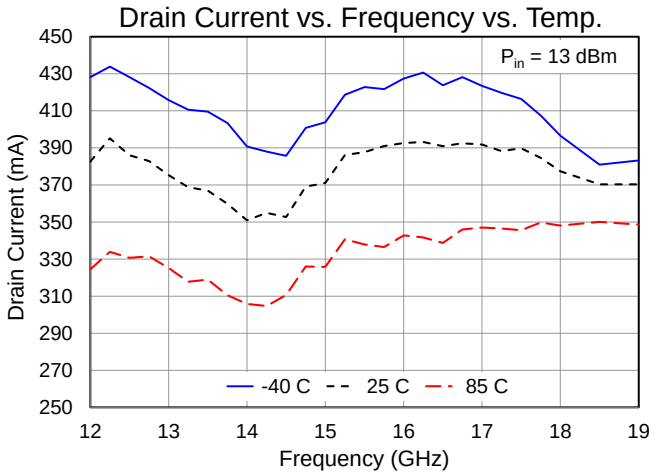


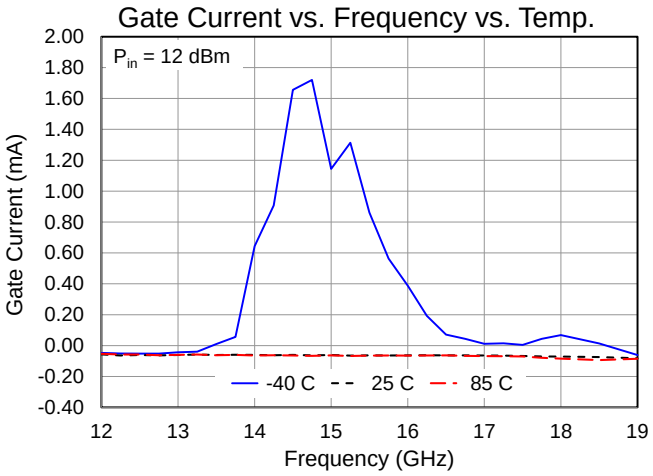
Power Gain vs. Frequency vs. V_D

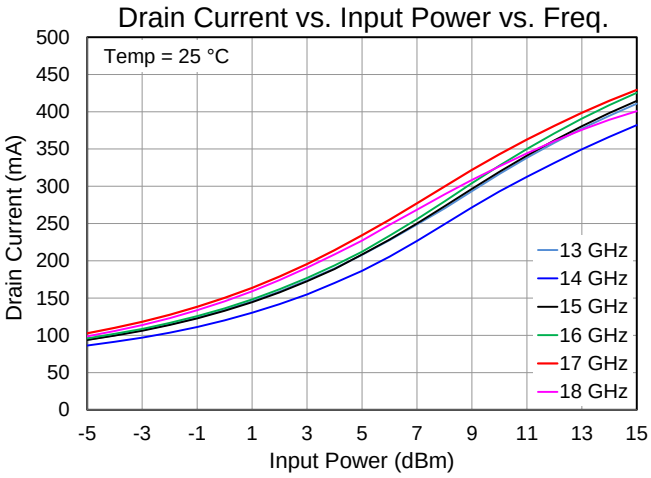


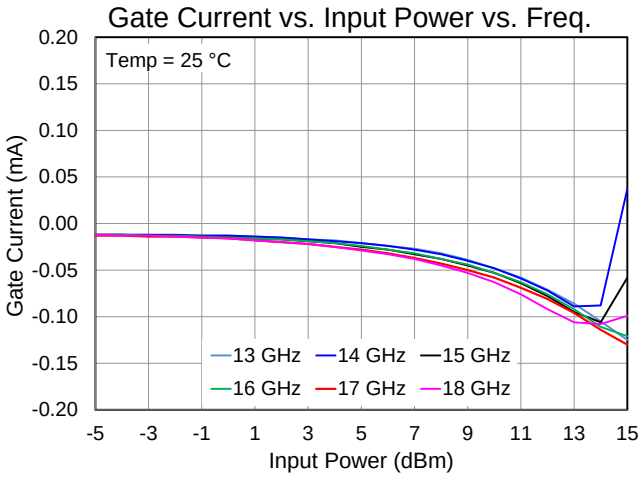
Typical Performance – Large Signal

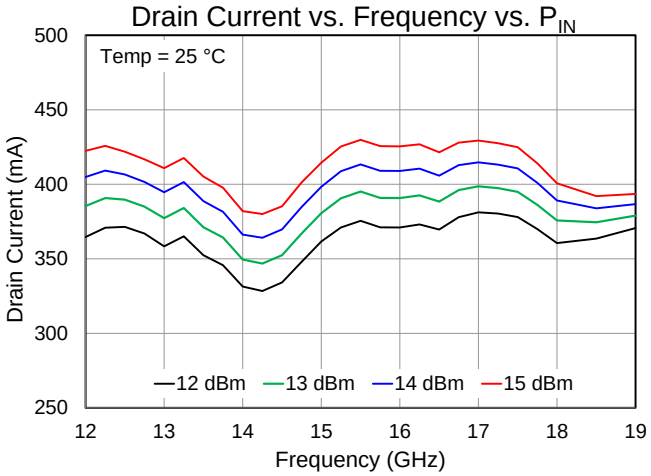
Conditions unless otherwise specified: V_D = +20 V, I_{DQ} = 70 mA, V_G = −2.7 V Typ, CW

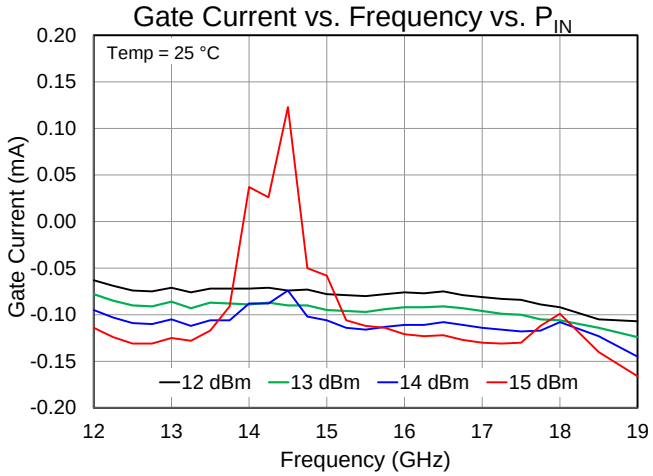






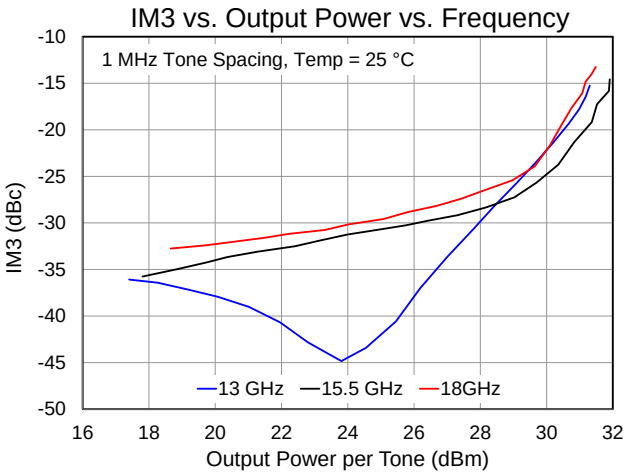


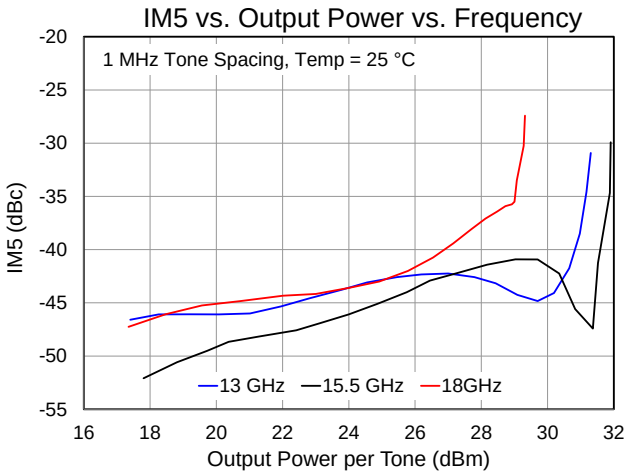


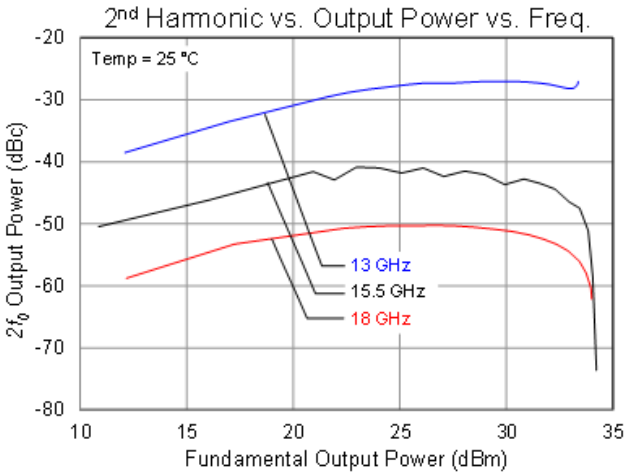


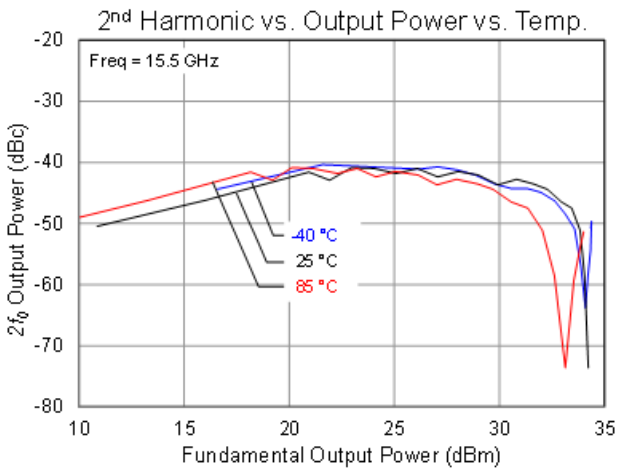
Typical Performance – Linearity

Conditions unless otherwise specified: V_D = +20 V, I_{DQ} = 70 mA, V_G = −2.7 V Typ, CW; harmonic data from die version







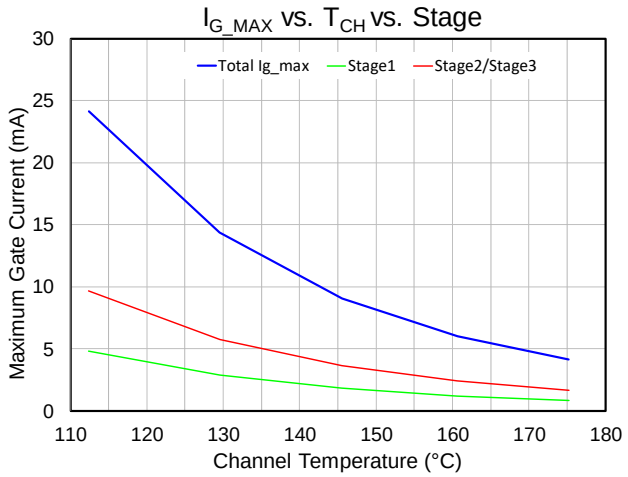


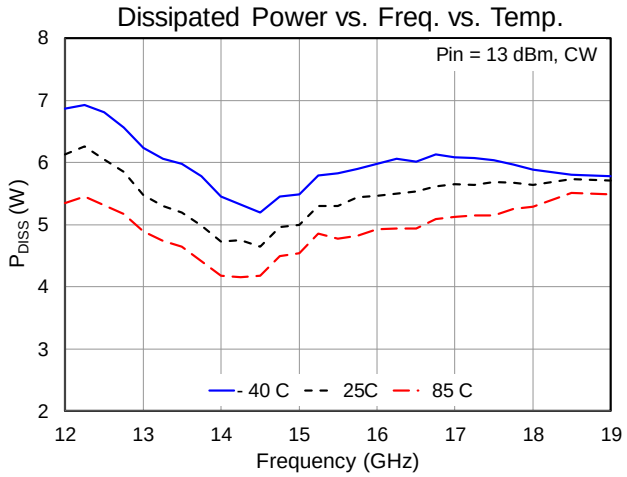
Thermal and Reliability Information

Parameter	Test Conditions	Value	Units
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85 °C, V_D = +20 V (CW) At I_{DQ} = 70 mA, P_{DISS} = 1.4 W	7.14	°C/W
Channel Temperature (T_{CH}) (No RF) (2)		95	°C
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85 °C, V_D = +20 V (CW) At Freq = 17 GHz, I_{DQ} = 70 mA, P_{OUT} = 27 dBm, P_{DISS} = 2.6 W	9.62	°C/W
Channel Temperature (T_{CH}) (Under RF drive) (2)		110	°C
Thermal Resistance (θ_{JC}) (1)	T_{BASE} = 85 °C, V_D = +20 V (CW) At Freq = 17 GHz, I_{DQ} = 70 mA, P_{OUT} = 33.5 dBm, P_{DISS} = 5.3 W	10.0	°C/W
Channel Temperature (T_{CH}) (Under RF drive) (2)		138	°C

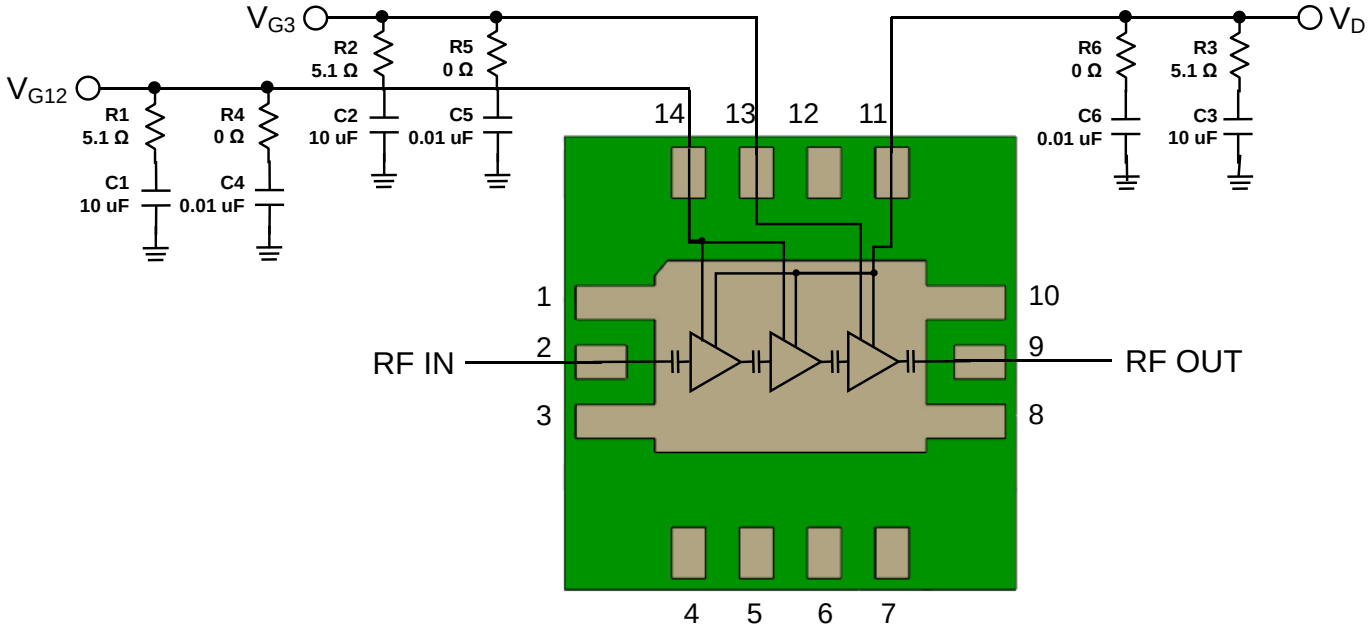
Notes:
1. Thermal resistance is referenced to the package backside T_{BASE}
2. IR scan equivalent. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Power Dissipation and Maximum Gate Current





Application Circuit



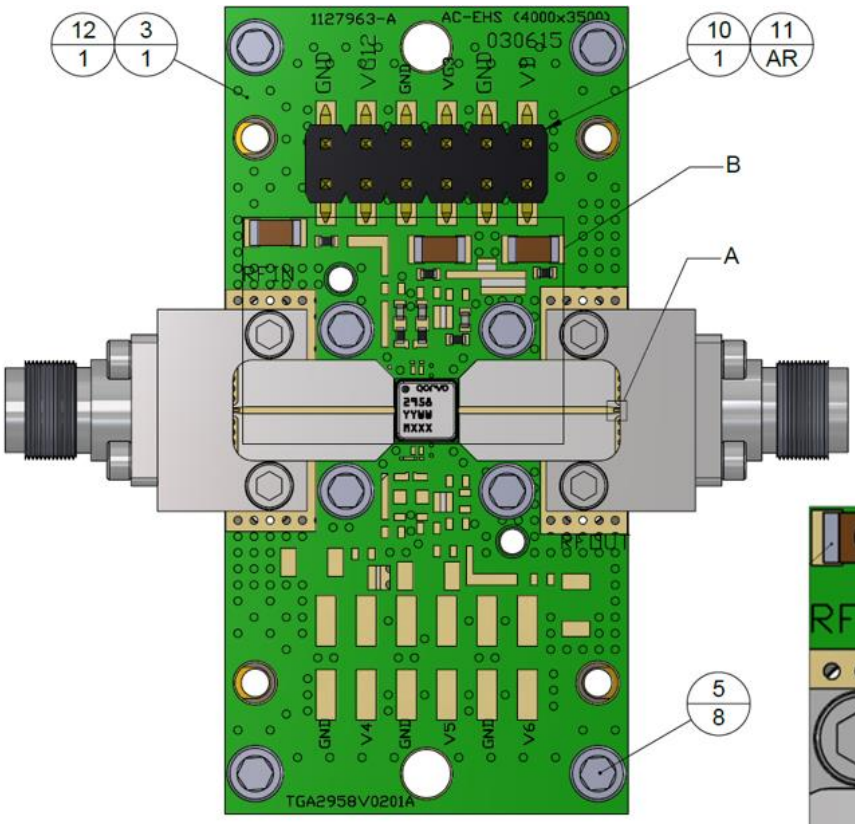
Bias Up Procedure

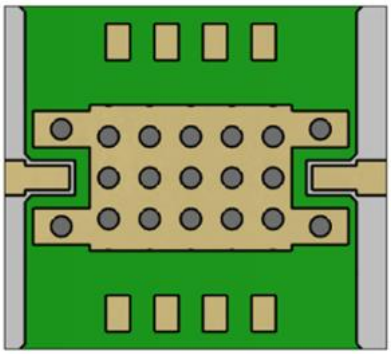
1. Set I_D limit to 500 A, I_G limit to 13 mA
2. Apply −5 V to V_G
3. Apply +20 V to V_D; ensure I_{DQ} is approx. 0 mA
4. Adjust V_G until I_{DQ} = 70 mA (V_G ~ −2.7 V Typ.).
5. Turn on RF signal generator

Bias Down Procedure

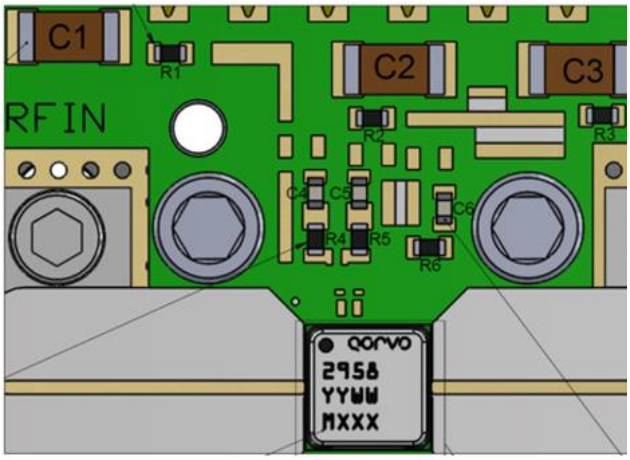
1. Turn off RF signal generator
2. Reduce V_G to −5 V; ensure I_{DQ} is approx. 0 mA
3. Set V_D to 0 V
4. Turn off V_D supply
5. Turn off V_G supply

Evaluation Board





Mounting Pad Details

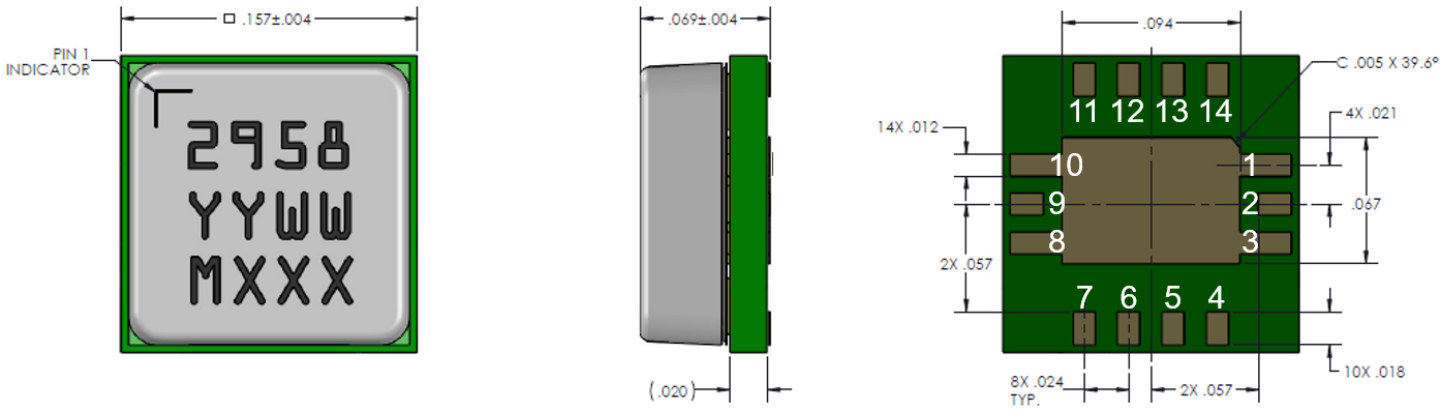


Component Placement

Bill of Materials

Reference Des.	Value	Description	Manuf.	Part Number
C1, C2, C3	10 µF	Cap., 1206, +50 V, 20 %, X5R	Various	–
C4, C5, C6	0.01 µF	Cap., 0402, +50 V, 10 %, X7R	Various	–
R1, R2, R3	5.1 Ohms	Res., 0402, 5 %, SMD	Various	–
R4, R5, R6	0.0 Ohms	Res., 0402, 5 %, SMD	Various	–

Mechanical Information



Units: inches
Tolerances: unless specified
x.xx = ± 0.01
x.xxx = ± 0.005
Marking:
2958: Part number
YY: Part Assembly year
WW: Part Assembly week
MXXX: Batch ID

Pad Description

Pad No.	Symbol	Description
1, 3, 8, 10	GND	RF Ground
2	RF_{IN}	RF Input; matched to 50 Ω; DC blocked
4, 5, 6, 7, 12	NC	No connection inside package; pads can be grounded if desired
9	RF_{OUT}	RF Output; matched to 50 Ω; DC blocked
11	V_D	Drain voltage; Bias network is required; see recommended Application Information
13	V_{G3} (1)	Gate Voltage; Bias network is required; see recommended Application Information
14	V_{G12} (1)	Gate Voltage; Bias network is required; see recommended Application Information

Notes:
1. Pads 13 & 14 may be tied together for biasing

Absolute Maximum Ratings

Parameter	Value / Range
Drain Voltage (V_D)	29.5 V
Gate Voltage Range (V_G)	−8 to 0 V
Drain Current – common drain - 1st Stage (I_{D1}) - 2nd Stage (I_{D2}) - 3rd Stage (I_{D3})	576 mA 72 mA 192 mA 384 mA
Forward Gate Current (I_G)	See I_{G_MAX} plot (page 8)
Power Dissipation (P_{DISS}), 85 °C	13 W
Input Power (P_{IN}), CW, 50 Ω, V_D = +22 V, I_{DQ} = 70 mA, 85 °C	27 dBm
Input Power (P_{IN}), CW, VSWR 3:1, V_D = +22 V, I_{DQ} = 70 mA, 85 °C	20 dBm
Storage Temperature	−55 to 150 °C

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.

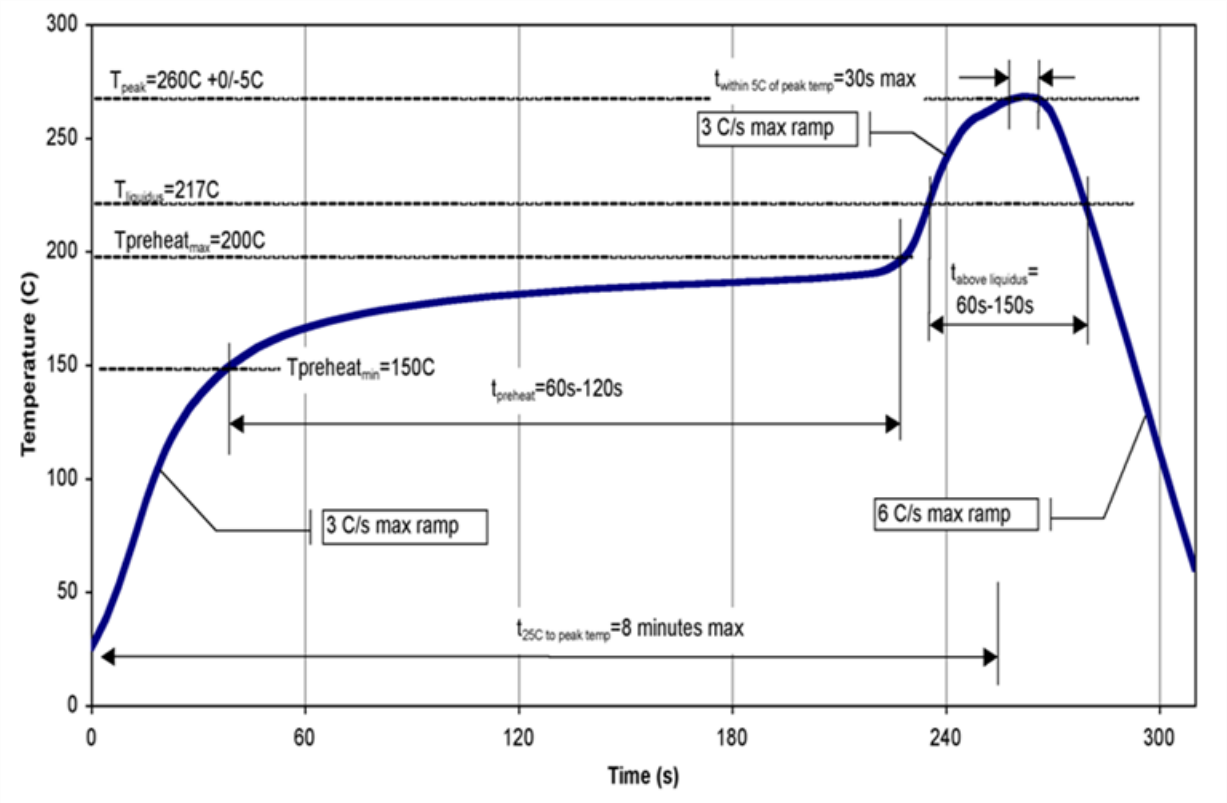
Assembly Notes

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-Au

Solder rework not recommended



Recommended Soldering Temperature Profile