TQP0104

30 W, 32 V, DC to 4 GHz, GaN RF Transistor

Product Overview

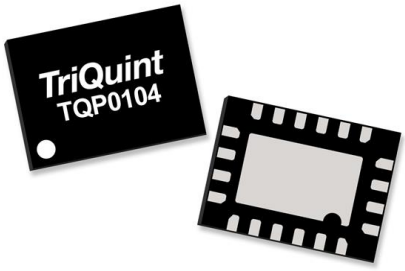
The TQP0104 is a wide band over-molded QFN discrete GaN power amplifier. The device is a single stage unmatched power amplifier transistor.

The TQP0104 can be used in Doherty architecture for the final stage of a base station power amplifier for small cell, microcell, and active antenna systems. The TQP0104 can also be used as a driver in a macrocell base station power amplifier.

The wide bandwidth of the TQP0104 makes it suitable for many different applications from DC to 4 GHz. TQP0104 can deliver P_{SAT} of 30 W at 28 to 32 V operation.

The device is housed in an industry-standard 3 x 4 mm surface mount QFN package.

Lead-free and ROHS compliant

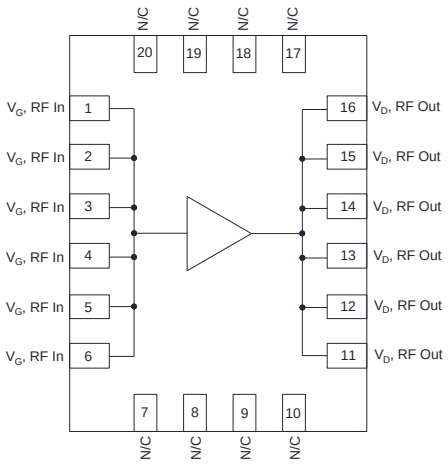


Key Features

- Frequency: DC to 4.0 GHz
- Output Power (P_{3dB})[1]: 30.0 W
- Linear Gain[1]: 17.0 dB
- Typical PAE_{3dB}[1]: 64.0%
- Operating Voltage: 32 V
- Low thermal resistance package
- CW and Pulse capable
- 3 x 4 x 0.85 mm package

Note 1: @ 2.6 GHz

Functional Block Diagram



Applications

- Macrocell Base Station Driver
- Microcell Base Station
- Small Cell Final Stage
- Active Antenna
- General Purpose Applications
- Military and Civilian radar
- Land mobile and military radio communications
- Test instrumentation
- Wideband and narrowband amplifiers
- Jammers

Pad Configuration

Pad No.	Symbol
1-6	RF IN, V_G
7-10, 17-20	N/C
11-16	RF OUT, V_D
Backside Paddle	RF/DC GND

Ordering Information

Part Number	Description
TQP0104	30W, DC-4GHz, 250 Piece 13” Reel
TQP0104-2.6-EVB	2.5-2.7 GHz Eval Board
TQP0104-2.1-DOH	2.1 GHz Doherty Eval Board

Absolute Maximum Ratings

Parameter	Rating
Drain to Gate Voltage (V_{DG})	100 V
Gate Voltage Range (V_G)	−7 to +2 V
RF Input Power Over Drive above P_{IN} at 36 dBm P_{OUT}, 50 Ω, T = 25°C	8 dB
VSWR Mismatch, P1dB Pulse (20% duty cycle, 100 µs width), T = 25°C	10:1
Storage Temperature	−65 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	Value	Units
Drain Voltage Range (V_D)	32 (Typ.)	V
Drain Quiescent Current (I_{DQ})	70	mA
Peak Drain Current (I_D)	1800 (Typ.)	mA
Gate Voltage (V_G)[1]	−2.8 (Typ.)	V

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

Note:
1. To be adjusted to desired I_{DQ}

RF Characterization – Simulated Performance CW (1)

Parameter	Conditions (1)	Typical Value				Units
Frequency		2	2.5	3.0	3.5	GHz
V_D		32	32	32	32	V
I_{DQ}		65	65	65	65	mA
G_{LIN}	Power Tuned	19.1	17.4	16.3	15.3	dB
Output P_{1dB}	Power Tuned	43.8	43.7	43.6	43.4	dBm
PAE_{1dB}	Power Tuned	70.6	63	62.3	62.5	%
G_{1dB}	Power Tuned	18.1	16.4	15.3	14.3	dB

Notes:
1. Test conditions unless otherwise noted: T_A =+25 °C

RF Characterization – Test Performance at 2.6 GHz

Symbol	Parameter	Min	Typical	Max	Units
P_{3dB}	Output Power at 1 dB Gain Compression		21.4		W
DrE_{3dB}	Drain Efficiency at 3 dB Gain Compression		65		%
G_{3dB}	Gain at 3 dB Compression		14.3		dB

Notes:
1. Test conditions unless otherwise noted: T_A = 25 °C, V_D = 32 V, I_{DQ} = 60 mA, Signal: 100uS Pulse Width, 20% Duty Cycle

Electrical Characterization

Symbol	Parameter	Min	Typical	Max	Units
Gate Leakage	V_D = +10 V, V_G = −3.7 V	−7.56			mA

Thermal and Reliability Information - CW (1)

Parameter	Test Conditions	Value	Units
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	P_{DISS} = 11.3 W, Tbaseplate = 85°C	3.2	ºC/W
Channel Temperature, T_{CH}		121	°C
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	P_{DISS} = 15.1 W, Tbaseplate = 85°C	3.3	°C/W
Channel Temperature, T_{CH}		126	°C
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	P_{DISS} = 18.9 W, Tbaseplate = 85°C	3.3	ºC/W
Channel Temperature, T_{CH}		148	°C
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	P_{DISS} = 22.7 W, Tbaseplate = 85°C	3.4	ºC/W
Channel Temperature, T_{CH}		162	°C
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	P_{DISS} = 30.2 W, Tbaseplate = 85°C	3.6	ºC/W
Channel Temperature, T_{CH}		194	°C

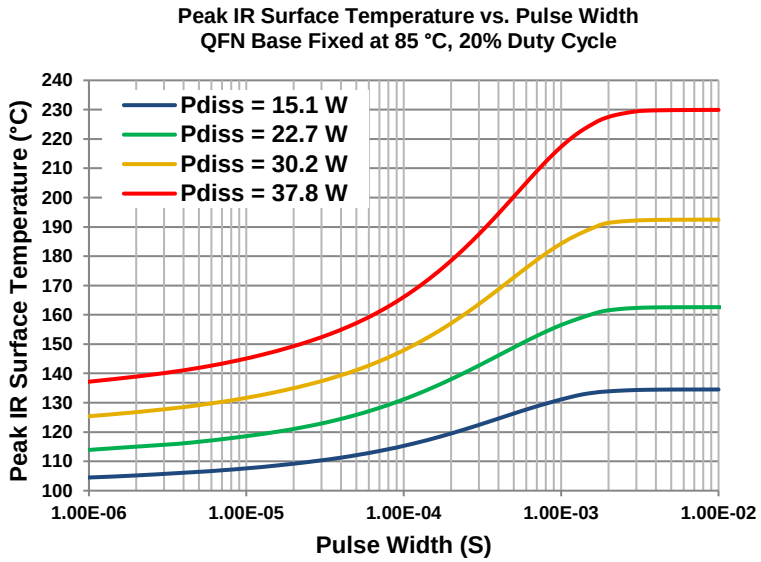
Notes:
1. Thermal resistance measured to bottom of package.
2. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

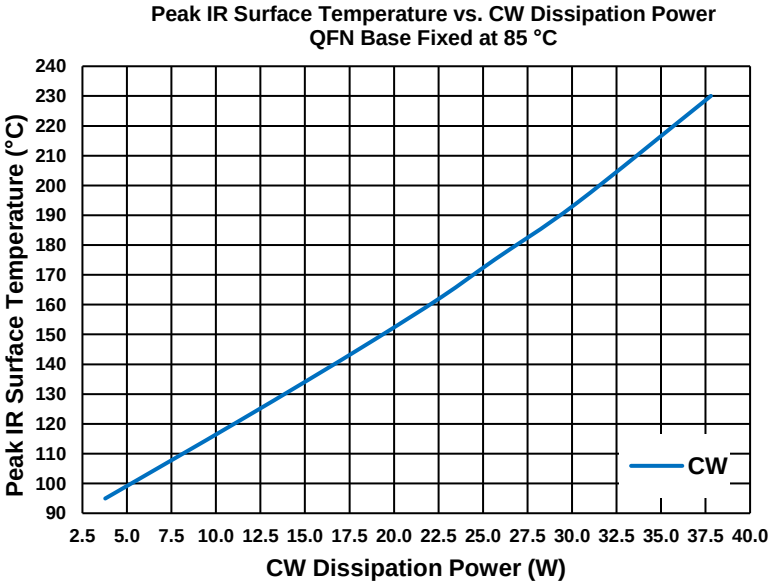
Thermal and Reliability Information - Pulsed (1)

Parameter	Test Conditions	Value	Units
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	P_{DISS} = 15.1 W, Tbaseplate = 85°C Pulse Width = 100 uS Duty Cycle = 5%	2.0	ºC/W
Channel Temperature, T_{CH}		115	°C
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	P_{DISS} = 22.7 W, Tbaseplate = 85°C Pulse Width = 100 uS Duty Cycle = 10%	2.0	°C/W
Channel Temperature, T_{CH}		131	°C
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	P_{DISS} = 30.2 W, Tbaseplate = 85°C Pulse Width = 100 uS Duty Cycle = 20%	2.1	ºC/W
Channel Temperature, T_{CH}		148	°C
Thermal Resistance, Peak IR Surface Temperature at Average Power (θ_{JC})	P_{DISS} = 37.8 W, Tbaseplate = 85°C Pulse Width = 100 uS Duty Cycle = 20%	2.1	ºC/W
Channel Temperature, T_{CH}		166	°C

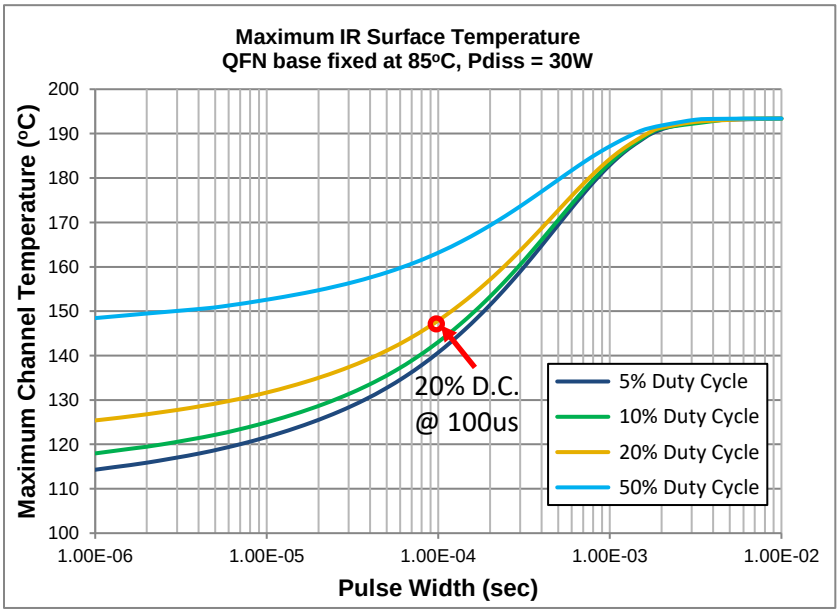
Notes:
1. Thermal resistance measured to bottom of package.
2. Refer to the following document: GaN Device Channel Temperature, Thermal Resistance, and Reliability Estimates

Maximum Channel Temperature





Maximum Channel Temperature

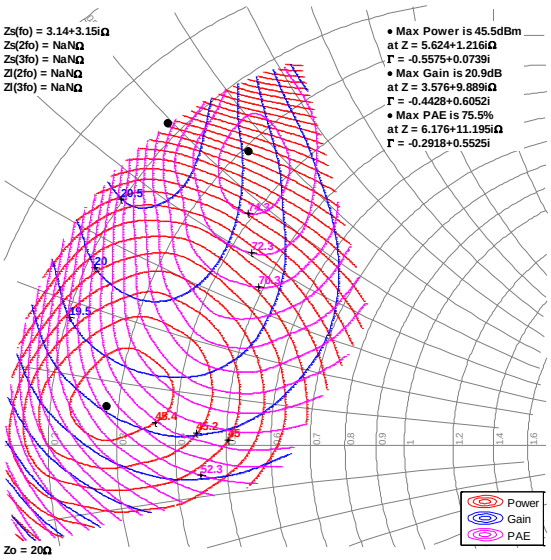


Model Load Pull Contours – Pulsed (1,2,3)

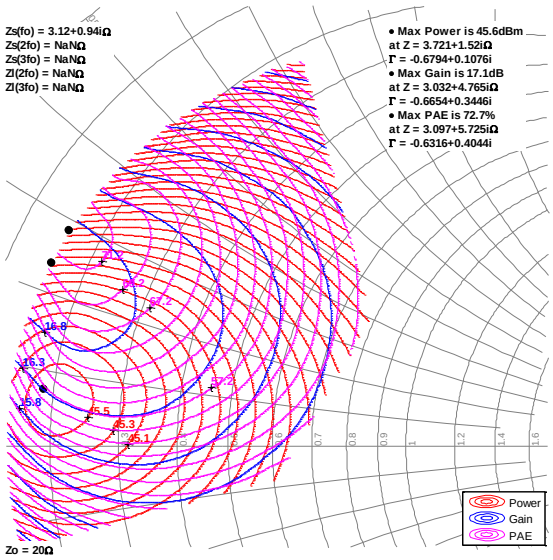
RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency.

Notes:
1. 32 V, 65 mA, Pulsed signal with 100 uS pulse width and 20% duty cycle. 3 dB compression referenced to peak gain.
2. See page 30 for load pull and source pull reference planes.
3. NaN means the impedances are undefined in load-pull system.

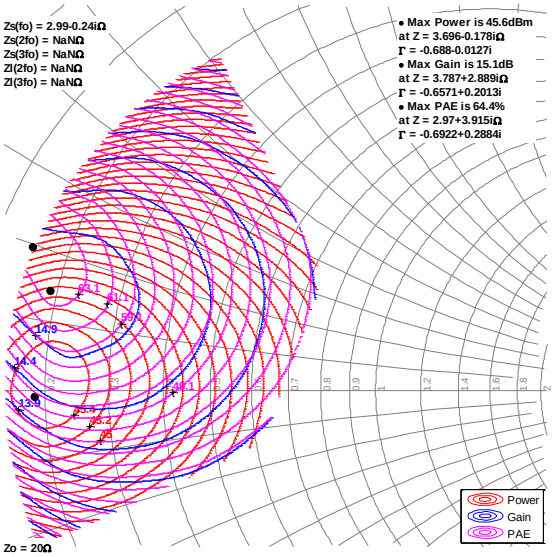
1.5GHz, Load-pull



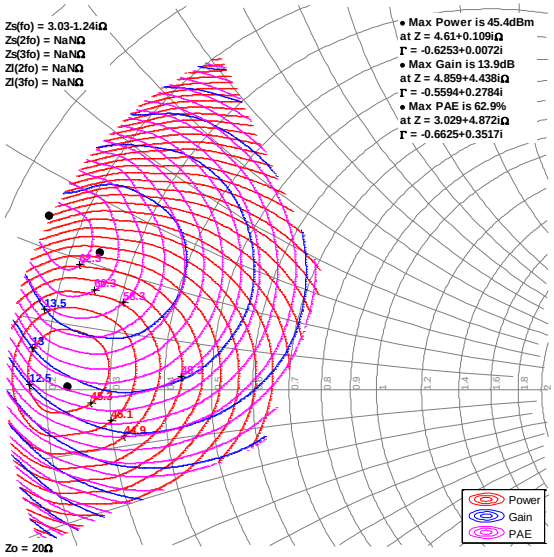
2GHz, Load-pull



2.5GHz, Load-pull



3GHz, Load-pull

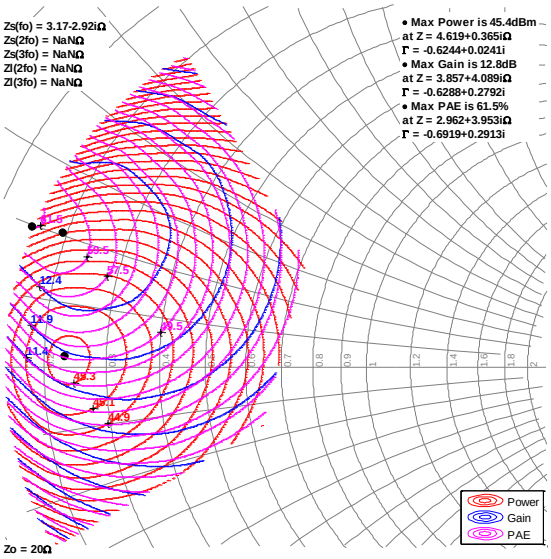


Model Load Pull Contours – Pulsed (1,2,3)

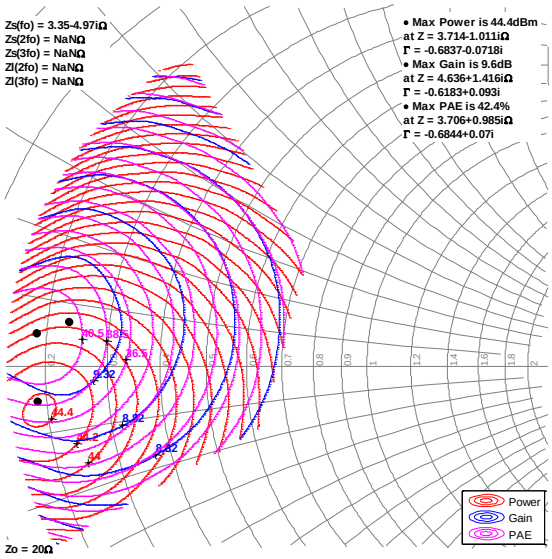
RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency.

Notes:
1. 32 V, 65 mA, Pulsed signal with 100 uS pulse width and 20% duty cycle. 3 dB compression referenced to peak gain.
2. See page 28 for load pull and source pull reference planes.
3. NaN means the impedances are undefined in load-pull system.

3.5GHz, Load-pull



4GHz, Load-pull

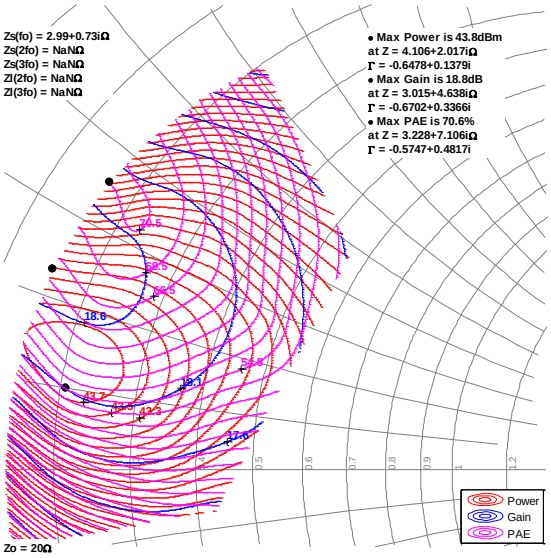


Model Load Pull Contours – CW (1,2,3)

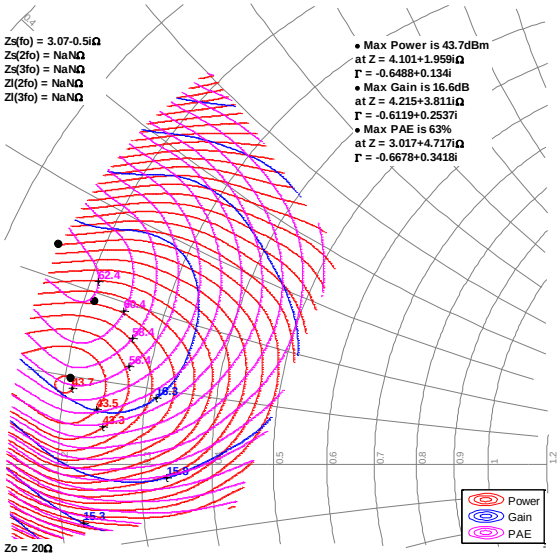
RF performance that the device typically exhibits when placed in the specified impedance environment. The impedances are not the impedances of the device, they are the impedances presented to the device via an RF circuit or load-pull system. The impedances listed follow an optimized trajectory to maintain high power and high efficiency.

Notes:
1. 32 V, 65 mA. 1 dB compression referenced to peak gain.
2. See page 28 for load pull and source pull reference planes.
3. NaN means the impedances are undefined in load-pull system.

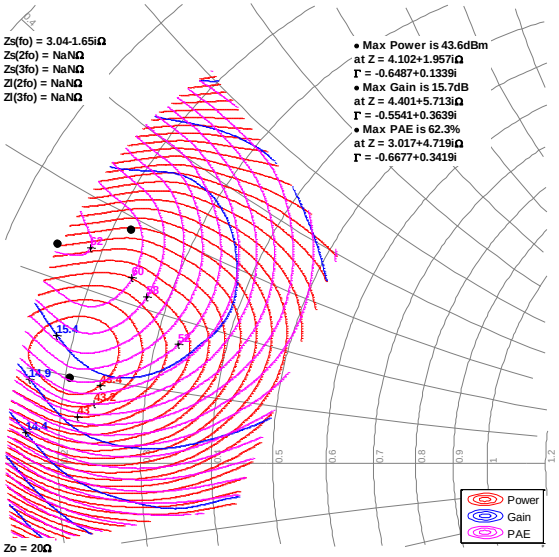
2GHz, Load-pull



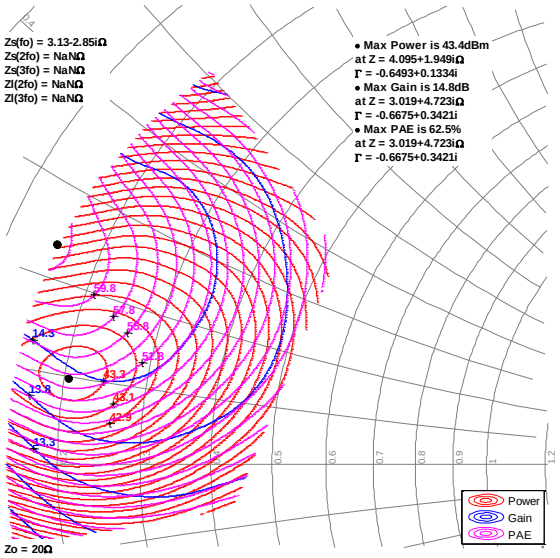
2.5GHz, Load-pull



3GHz, Load-pull

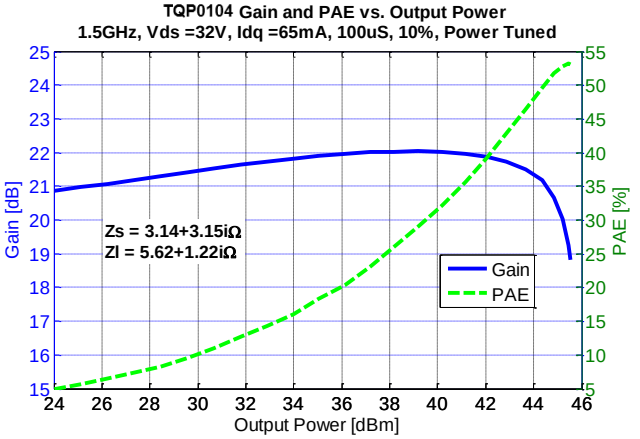


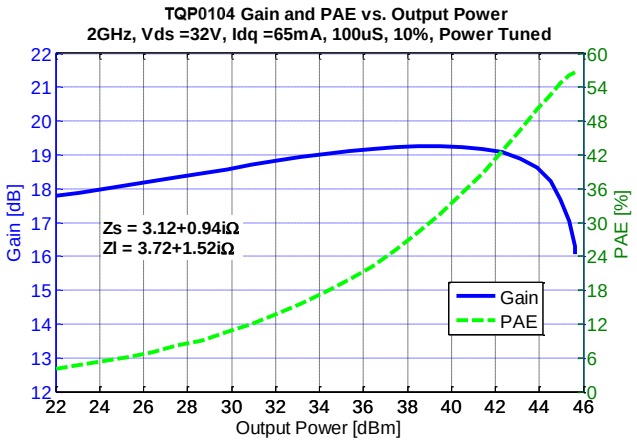
3.5GHz, Load-pull

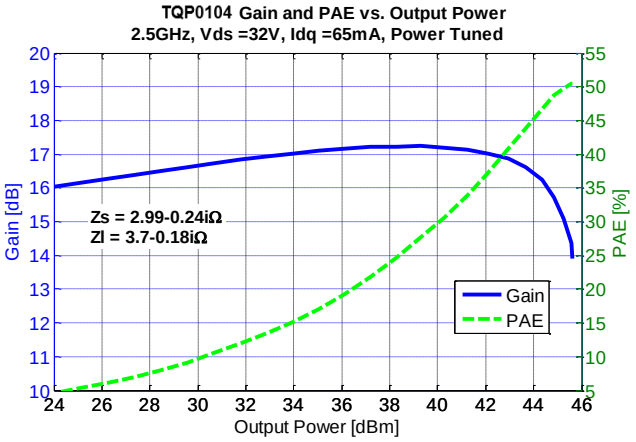


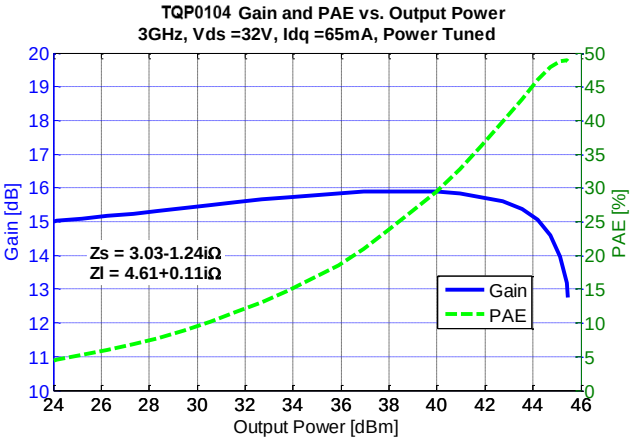
Typical Pulsed Performance – Power Tuned (1)

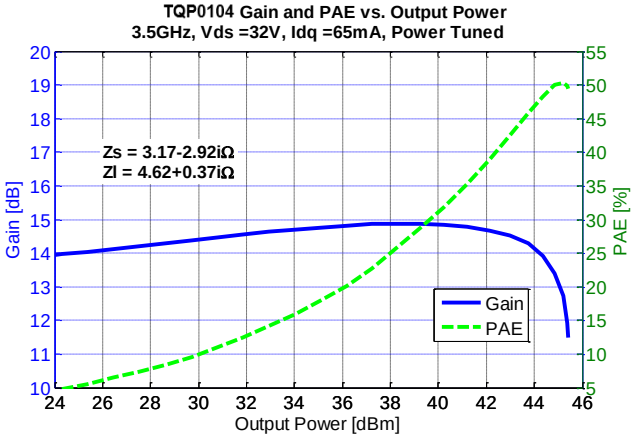
Notes:
1. Pulsed signal with 100 uS pulse width and 10% duty cycle

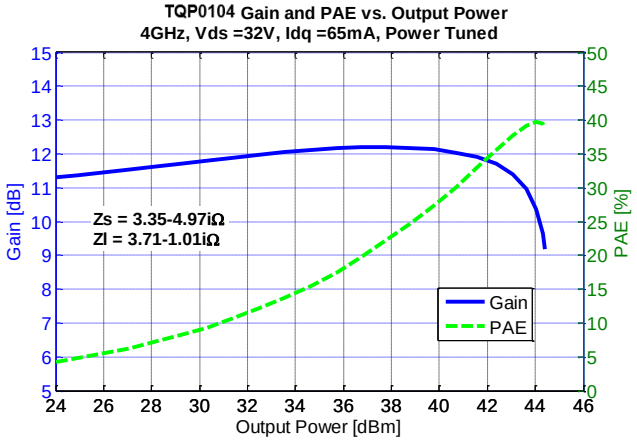








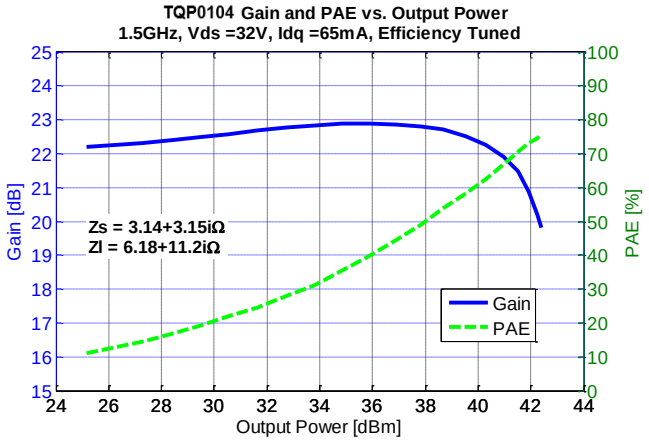


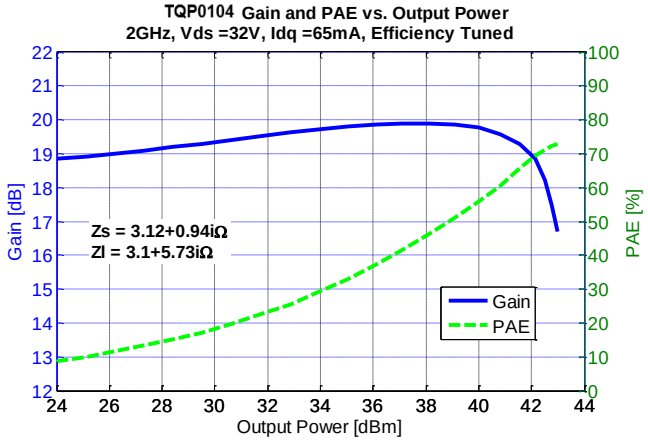


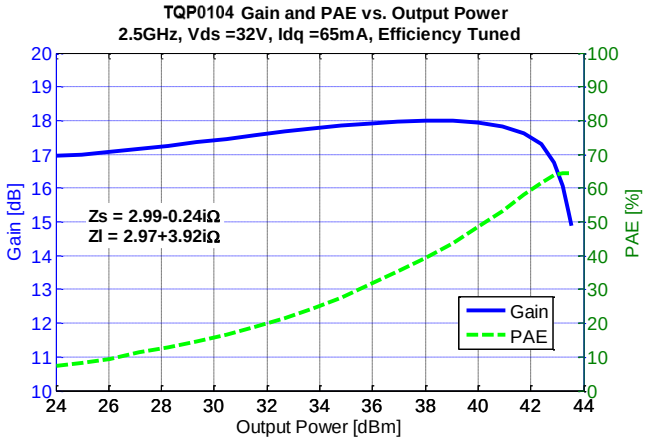
Typical Pulsed Performance – Efficiency Tuned (1)

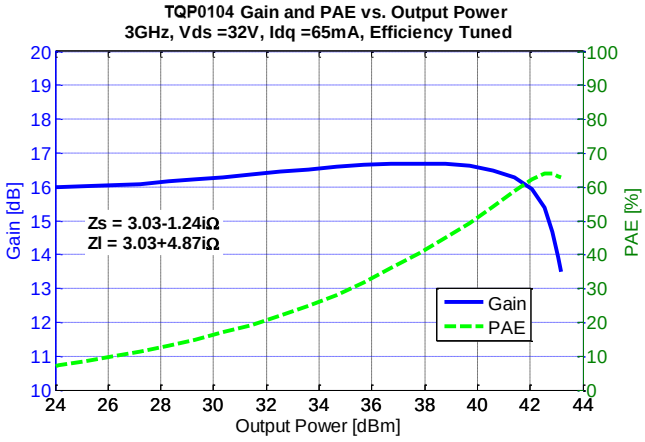
Notes:

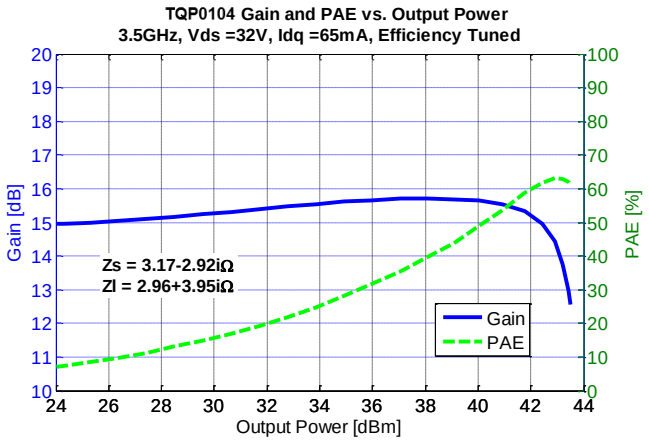
Pulsed signal with 100 uS pulse width and 10% duty cycle

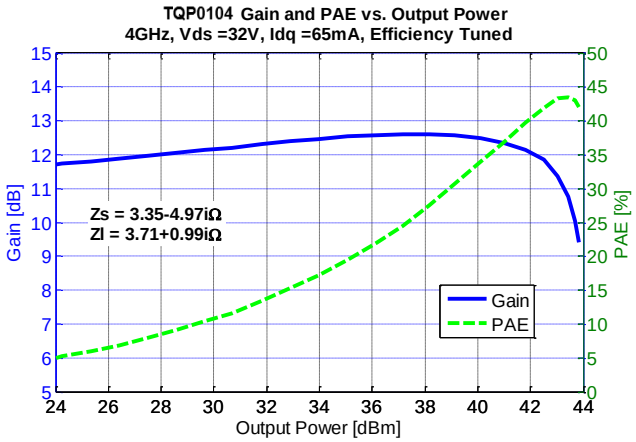




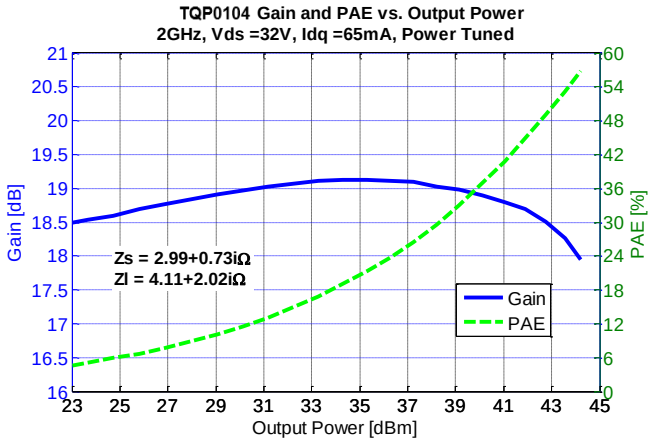


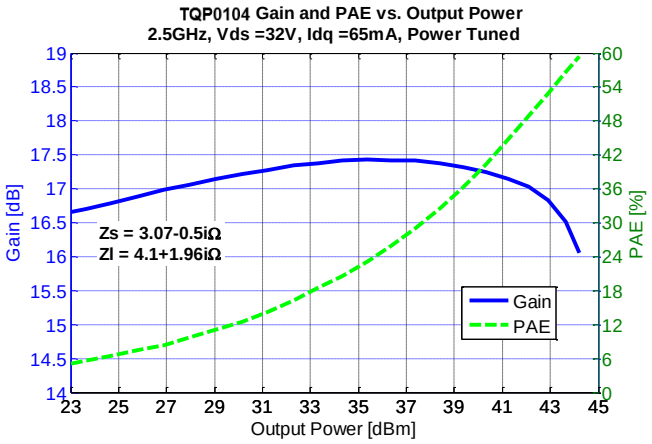


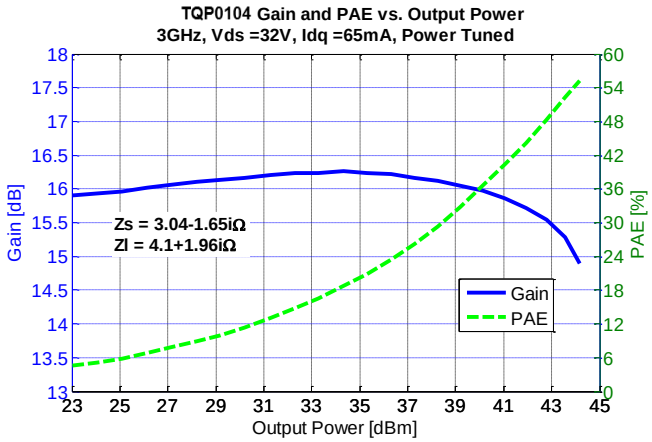


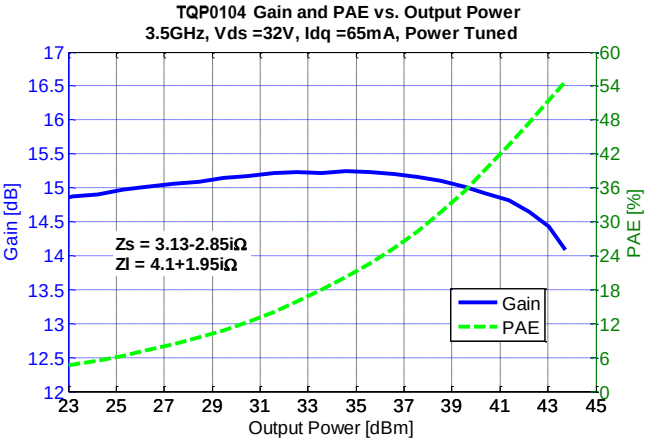


Typical CW Performance – Power Tuned (1)

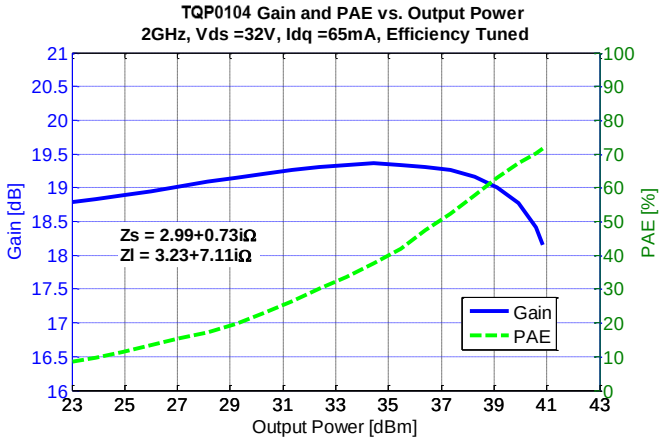


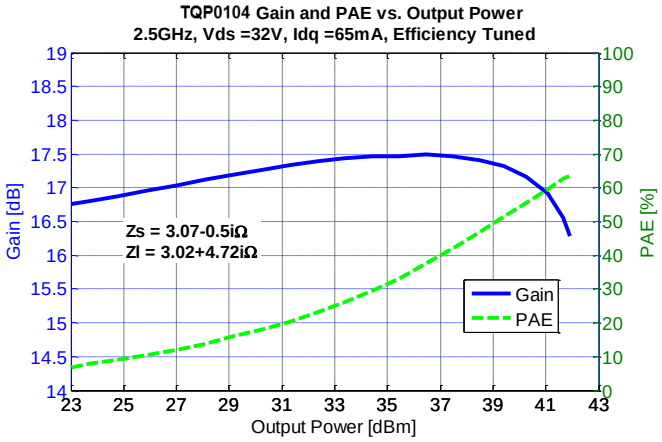


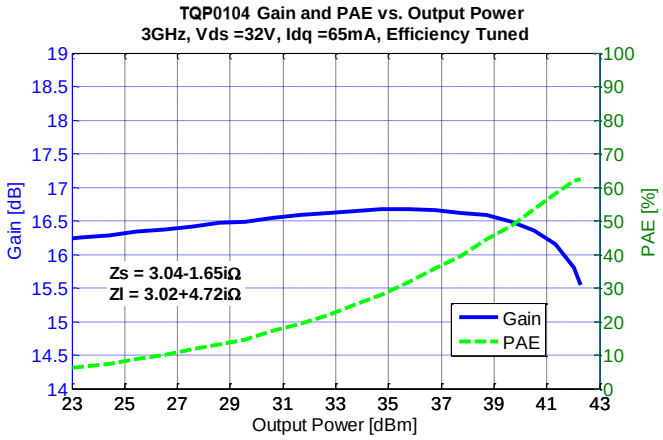


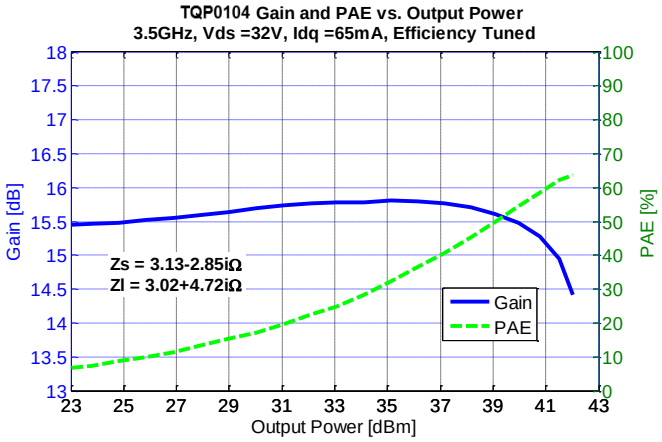


Typical CW Performance – Efficiency Tuned (1)

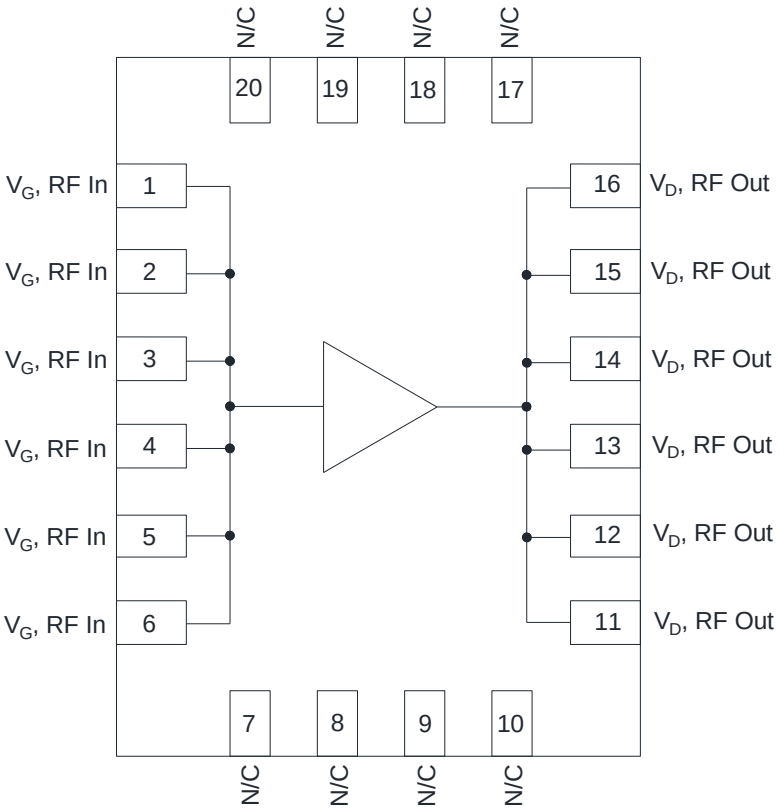








Pin Layout

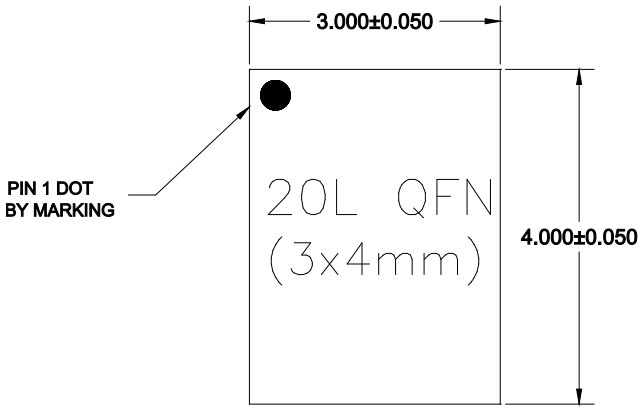


Pin Description

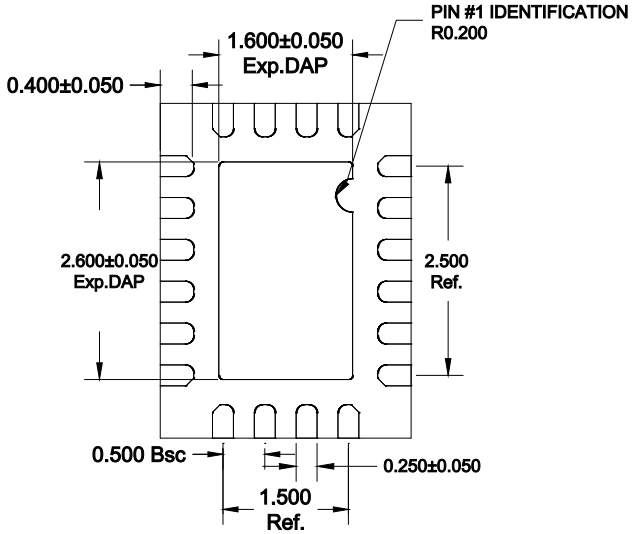
Pin	Symbol	Description
11 - 16	V_D / RF OUT	Drain voltage / RF Output
1 - 6	V_G / RF IN	Gate voltage / RF
7 – 10, 17 - 20	NC	Not connected
Back side	Source	Source connected to ground

Mechanical Information

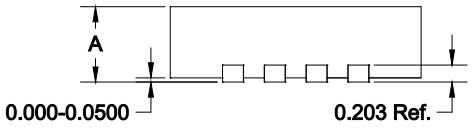
All dimensions are in millimeters.



TOP VIEW



BOTTOM VIEW



SIDE VIEW

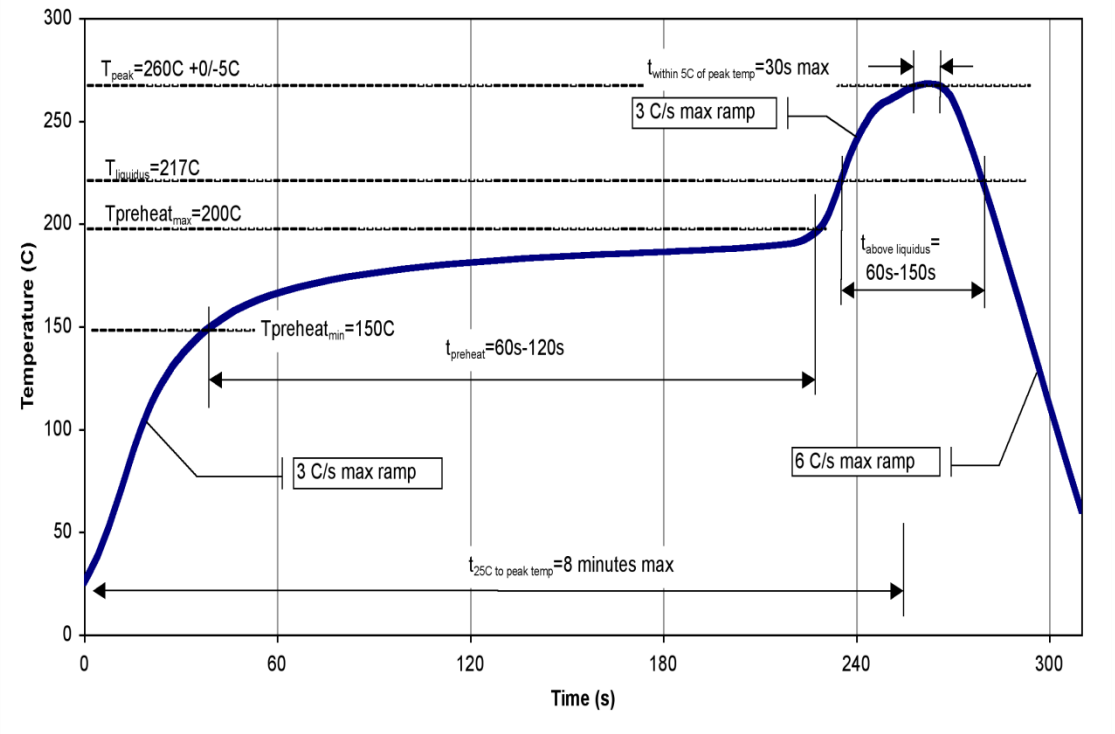
		QFN
A	MAX.	0.900
	NOM.	0.850
	MIN.	0.800

Note:

Unless otherwise noted, all dimension tolerances are +/-0.127 mm.

This package is lead-free/RoHS-compliant. The plating material on the leads is NiPdAu. It is compatible with both lead-free (maximum 260 °C reflow temperature) and tin-lead (maximum 245°C reflow temperature) soldering processes.

Recommended Soldering Temperature Profile



Handling Precautions

Parameter	Rating	Standard
ESD – Human Body Model (HBM)	Class 1B	ANSI/ESD/JEDEC JS-001
ESD – Charged Device Model (CDM)	Class C3	ANSI /ESD/JEDEC JS-002
MSL – Moisture Sensitivity Level	Level 3	IPC/JEDEC J-STD-020

Caution!
ESD-Sensitive Device

Solderability

Compatible with the latest version of J-STD-020, Lead free solder, 260 °C

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
- Halogen Free (Chlorine, Bromine)
- Antimony Free
- TBBP-A ($C_{15}H_{12}Br_4O_2$) 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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