

WS1A2639

GaN on SiC Power Amplifier Module for 5G

Description

The WS1A2639 is an Asymmetric Doherty Power Amplifier Module (PAM) integrating the GaN on SiC technology with RF matching and biasing networks on a multilayer laminate substrate with advanced heat sinking technology. The WS1A2639 has been designed to operate from 2496 MHz to 2690 MHz supply voltages of up to 50 V at average output power levels of 6 to 8 W with crest-factor reduced and digitally pre-distorted LTE and 5G NR signals with instantaneous bandwidths of up to 200 MHz. The device is housed in a 6 mm X 6 mm land grid array (LGA) package.

Features

- GaN on SiC technology
- Frequency: 2496-2690 MHz
- Average Output Power : 6 to 8 W maximum
- $P_{SAT} = 48$ dBm
- RF inputs matched to 50 Ω and DC matched
- Gate bias supply for main and peak sides available from either side of device
- Integrated harmonic terminations
- Pb-free and RoHS compliant



WS1A2639
Package PG-LGA-6x6-3-1

Typical Broadband Performance

Single-carrier LTE Performance (tested in the applications circuit for 2500 – 2700 MHz)

$V_{DD} = 48$ V, $I_{DQ(main)} = 25$ mA, $V_{GS(peak)} = -5$ V, channel bandwidth = 5 MHz, input PAR = 10 dB @ 0.01% CCDF

	P_{OUT} (dBm)	Gain (dB)	Efficiency (%)	ACPR – (dBc)	ACPR + (dBc)	PAR (dB)
2500 MHz	38.5	17.8	53.5	–26.5	–26.2	8.05
2600 MHz	38.5	17.8	54.3	–26	–25.7	7.95
2700 MHz	38.5	16.9	53.2	–28	–28.5	8.2

All published data at $T_{CASE} = 25^{\circ}\text{C}$ unless otherwise indicated



Maximum Ratings at $T_{CASE} = 25^{\circ}C$

Parameter		Symbol	Value	Unit
Drain-source Voltage		V_{DSS}	125	V
Gate-source Voltage		V_{GS}	-10 to +2	V
Operating Voltage		V_{DD}	55	V
RF Input Power (main) (peak)	Pulse CW, 10% duty cycle, 20 μs pulse width	P_{IN}	32.7	dBm
		P_{IN}	32.8	dBm
Case Temperature		T_C	135	$^{\circ}C$
Storage Temperature Range		T_{STG}	-65 to +150	$^{\circ}C$

Operation above the maximum values listed here may cause permanent damage. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the component. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. For reliable continuous operation, the device should be operated within the operating voltage range (V_{DD}) specified above.

DC Characteristics

Characteristics	Conditions	Symbol	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage (main) (peak)	$V_{GS} = -8V, I_D = 2.58mA$	$V_{(BR)DSS}$	150	—	—	V
	$V_{GS} = -8V, I_D = 4.3mA$	$V_{(BR)DSS}$	150	—	—	V
Gate Leakage Current	$V_{GS} = -8V, V_{DS} = 50V$	I_{GSS}	—	—	-1.5	mA
Gate Threshold Voltage (main) (peak)	$V_{DS} = 10V, I_D = 2.58mA$	$V_{GS(th)}$	-3.8	-3.0	-2.3	V
	$V_{DS} = 10V, I_D = 4.3mA$	$V_{GS(th)}$	-3.8	-2.7	-2.3	V

Recommended Operating Conditions

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Operating Voltage		V_{DD}	0	—	50	V
Gate Quiescent Voltage (main) (peak)	$V_{DS} = 48V, I_D = 30mA$	$V_{GS(Q)}$	-3.6	-3.1	-2.6	V
	$V_{DS} = 48V, I_D = 50mA$	$V_{GS(Q)}$	-3.6	-3.0	-2.6	V

Moisture Sensitivity Level

Level	Test Standard	Package Temperature	Unit
3	IPC/JEDEC J-STD-020	260	$^{\circ}C$

ESD Characteristics

Parameter	Class	Standard
Human Body Model (HBM)	Class 1B	ANSI/ESDA/JEDEC JS-001
Charge Device Model (CDM)	Class C2b	ANSI/ESDA/JEDEC JS-002

RF Characteristics (tested in the production test fixture)

 $V_{DD} = 48\text{ V}$, Pulse CW 10% duty cycle, 20 μs pulse width

Parameter	Symbol	Conditions	Main		Peak		Unit
			Min	Max	Min	Max	
2496 MHz							
Gain	G	P _{OUT} = 37 dBm (main) P _{OUT} = 39 dBm (peak)	15	19	17.5	21	dB
Saturated Power	P _{SAT}	I _{DQ} = 30 mA (main) I _{DQ} = 50 mA (peak)	41.5	–	44	–	dBm
Efficiency	Eff	I _{DQ} = 30 mA (main), P _{SAT} I _{DQ} = 50 mA (peak), P _{SAT}	42	–	45	–	%
2690 MHz							
Gain	G	P _{OUT} = 37 dBm (main) P _{OUT} = 39 dBm (peak)	15.5	19.5	17	21	dB
Saturated Power	P _{SAT}	I _{DQ} = 30 mA (main) I _{DQ} = 50 mA (peak)	41.5	–	43.5	–	dBm
Efficiency	Eff	I _{DQ} = 30 mA (main), P _{SAT} I _{DQ} = 50 mA (peak), P _{SAT}	47	–	52	–	%

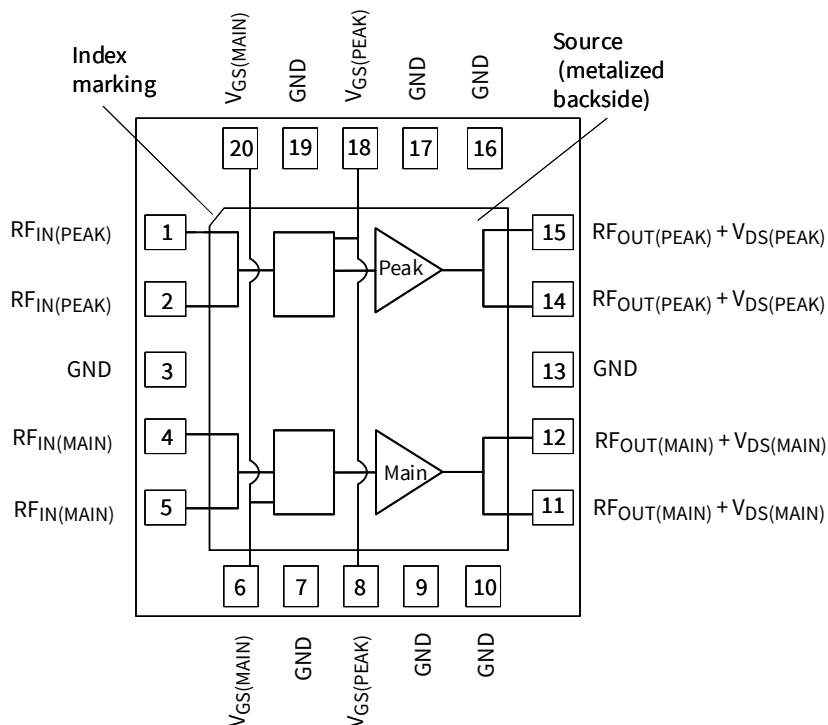
Ordering Information

Order Code	Description
WS1A2639-V2-R00A	Sample Quantities
WS1A2639-V2-R1	330 mm (13") Reel 100 pcs
WS1A2639-V2-R3K	330 mm (13") Reel 3,000 pcs
FXA/WS1A2639V2-05	2.495-2.690 GHz Evaluation Board
FXA/WSGPA01V1-19	2.495-2.690 GHz Driver Evaluation Board
FXL/WS1A2639V2-06	Integrated Driver+Final Stage 2.496-2.690 GHz Evaluation Board

Evaluation Boards - Typical RF Performance

Part Number	Frequency	P_{OUT} (dBm)	Eff (%)	Gain (dB)	PAR (dB)	ACPR+ (dBc)	ACPR- (dBc)
Output Stage : WS1A2639							
Single-carrier WCDMA Performance, $V_{DD} = 48\text{ V}$, $I_{DQ}(\text{main}) = 30\text{ mA}$, channel bandwidth = 3.84 MHz, input PAR = 10 dB @ 0.01% CCDF							
FXA/WS1A2639V2-05	2.495-2.690 GHz	38.5	52	17	8	-26	-26
WSGPA01 Driver							
Single-carrier WCDMA Performance, $V_{DD} = 48\text{ V}$, $I_{DQ} = 25\text{ mA}$, channel bandwidth = 3.84 MHz, input PAR = 10 dB @ 0.01% CCDF							
FXA/WSGPA01V1-19	2.496-2.690 GHz	25	17.1	19.4	8.5	-36.7	-36.9

Pinout Diagram (top view)



Bias Sequencing

Bias ON

1. Ensure RF is turned off
2. Apply pinch-off voltage of -5 V to the gate
3. Apply nominal drain voltage
4. Bias gate to desired quiescent drain current
5. Apply RF

Bias OFF

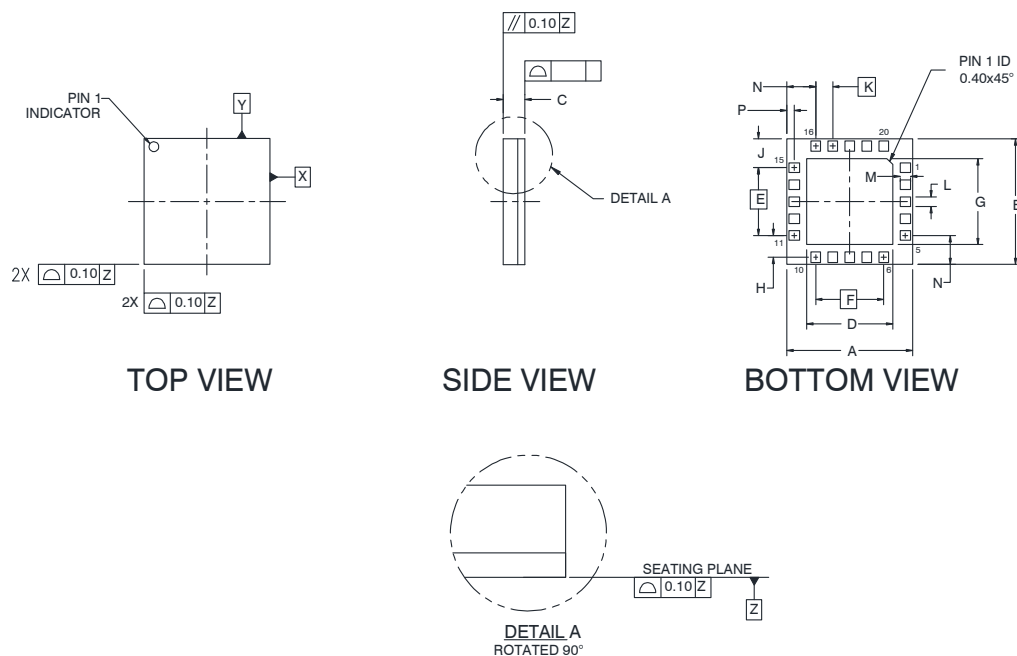
1. Turn RF off
2. Apply pinch-off voltage to the gate
3. Turn-off drain voltage
4. Turn-off gate voltage

[illegible]

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- Technical drawing of a KOSTAT® wheel rim, showing three views: front view, side view, and a detail view of the rim profile.
- Front View:** The rim is circular with a central hub. The hub features a central bolt and four surrounding bolts. The rim has five spokes. The brand name "KOSTAT®" is visible on the upper left spoke. The overall diameter is labeled "A".
- Side View:** The rim is shown in profile. The width of the rim at the top is labeled "W3". The width of the rim at the bottom is labeled "W1". The width of the central hub is labeled "W2". The height of the rim from the ground line to the top of the spokes is labeled "N". The width of the central hub is labeled "C".
- Detail View:** A cross-section of the rim profile. The angle between the spokes is labeled "120°". The radius of the rim is labeled "10.50". The width of the rim at the bottom is labeled "2.00".

Size	A	B	C	D	N	W1	W2	W3
16mm	330 ^{+2.0} _{-2.0}	1.5min	13.0 ^{+0.5} _{-0.2}	20.2 min	100 ^{+3.0} _{-0.0}	16.4 ^{+2.0} _{-0.0}	20.4 ^{+2.0} _{-2.0}	17.65 ^{+1.75} _{-1.75}

Package Outline Specifications - Package PG-LGA-6x6-3-1



DIM	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	.234	.236	.238	5.95	6.00	6.05
B	.234	.236	.238	5.95	6.00	6.05
C	.037	.041	.045	0.93	1.03	1.13
D	.157	.161	.165	4.00	4.10	4.20
E	—	.128	—	—	3.24	—
F	—	.128	—	—	3.24	—
G	—	.161	—	—	4.10	—
H	—	.041	—	—	1.03	—
J	.054	.054	.055	1.37	1.38	1.39
K	—	.032	—	—	0.81	—
L	—	.018	—	—	0.46	—
M	—	.020	—	—	0.50	—
N	.054	.054	.055	1.37	1.38	1.39
P	.013	.014	.014	0.34	0.35	0.36

Diagram Notes—unless otherwise specified:

1. Interpret dimensions and tolerances per ASME Y14.5M-1994.

Notes & Disclaimer

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