GTH2r-1014150S 50V, 1.0-1.4GHZ, 150W GaN HEMT

FEATURES

- Operating Frequency Range: 1.0 - 1.4 GHz
- Operating Drain Voltage: 50V
- Maximum Output Power (P_{SAT}): 150W
- Surface Mount Plastic Package
- Suitable for Pulsed, Linear applications
- 100% DC & RF Production Tested

6 Pin 6.5x7 mm DFN Package

DESCRIPTION

The GTH2r-1014150S is a 150W (P3dB) pre-matched discrete GaN-on-SiC HEMT which operates from 1.0 to 1.4 GHz on a 50V supply rail. The wide bandwidth of the GTH2r-1014150S makes it suitable for radar, avionics, satellite communications and pulse operations.

RoHS compliant

The device is housed in an industry-standard 6.5x7 mm surface mount DFN package. Lead-free and RoHS compliant.

Typical Performances 1 Tone pulsed CW (10% duty cycle, 100µs width), Measured on 1.2-1.4 GHz Evaluation Board

Freq. (GHz)	Pout (dBm)	Pout (W)	D.E. (%)	Gt(dB)
1.20	51.73	149	77.1	15.2
1.30	51.5	141	72.7	15.7
1.40	51.73	149	78.2	15.3

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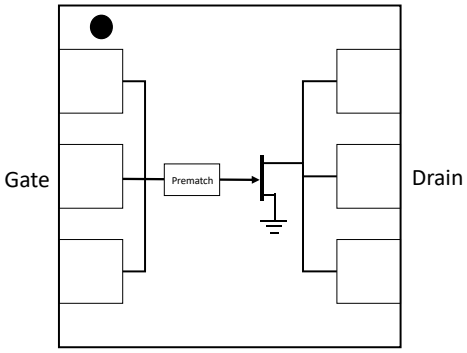
ABSOLUTE MAXIMUM RATINGS(1, 2)

Parameter	Rating	Symbols and Units
Drain Source Voltage	150	V_{DS} (V)
Gate Source Voltage	-8 to +2	V_{GS} (V)
Operating Voltage	55	V_{dsq} (V)
Junction Temperature	+225	T_{JUNC}(°C)
Storage Temperature	-65 to +150	$T_{STORAGE}$(°C)
Case Operating Temperature	-40 to +105	T_{CASE}(°C)

1. Exceeding any of these limits may cause permanent damage to this device or seriously limit the life time (MTTF)
2. GalliumSemi does not recommend sustained operation above maximum operating conditions.

BLOCK DIAGRAM



ELECTRICAL SPECIFICATIONS: T_A = 25°C

Parameter	Min.	Typ.	Max.	Symbols and Units	Test conditions
Frequency Range	1000		1400	MHz	
DC Characteristics					
Drain Source Breakdown Voltage	150			V_{BDSS} (V)	
Drain Source Leakage Current		9		I_{DLK} (mA)	Vgs = -8V, Vds = 50V
Gate Threshold Voltage	-3.4		-1.5	V_{GS} (V)	Vds = 50V
Operating Conditions					
Drain Voltage		50		V_{DSQ} (V)	
Quiescent Drain Current		200		I_{DQ} (mA)	

RF ELECTRICAL SPECIFICATIONS: T_A = 25°C, VDS = 50 V, IDQ = 150mA, Freq= 1300MHz
Note: Performance(1) in GalliumSemi Production Test Fixture, 50 Ω system

Parameter	Symbol	Min.	Typ.	Max.	Units	Notes
Small Signal Gain	G_{ss}		17.5		dB	
Power Gain	G_{SAT}		15.7		dB	
Saturated Drain Efficiency	$DEff_{SAT}$		72.7		%	
Saturated Output Power	P_{SAT}		51.5		dBm	
Ruggedness Output mismatch	Ψ	VSWR = tbd, all angles				No damage or shift in performances

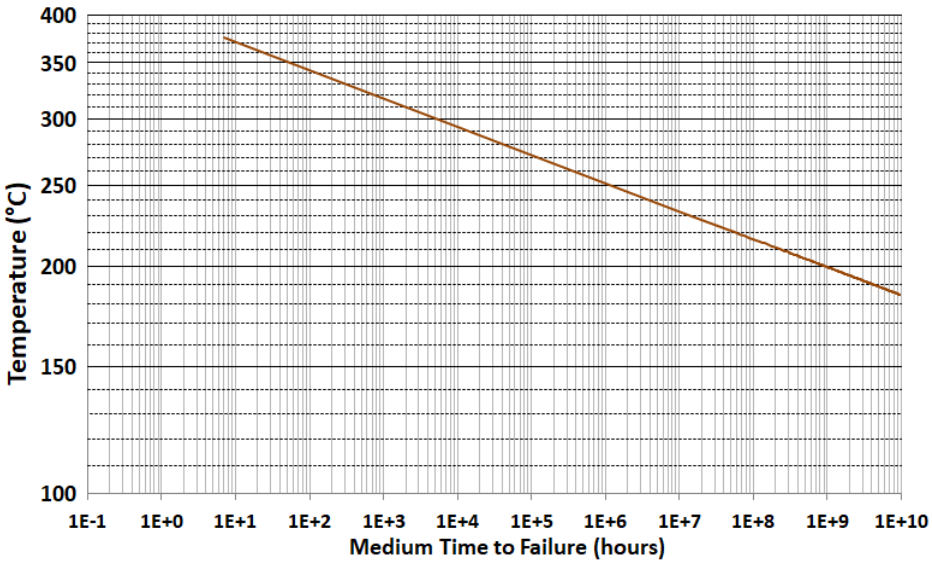
1. 1 Tone Pulse CW, pulse width 100us, duty cycle 10%

THERMAL AND RELABILITY INFORMATION (1, 2, 3)

Rth(ºC/W)= 0.0038 x Pdiss(W) + 1.676

Parameter	Test condition	Value	Units
Channel Temperature, Tch(2)	T_C = 80.4°C Pdiss = 120 W 100 us PW, 10% Duty Cycle	172.5	°C
Rth		0.76	ºC/W
Rsur		0.4	ºC/W
MTTF		>1.0E10	Hrs
Channel Temperature, Tch(2)	T_C = 80.4°C Pdiss = 120 W 1 ms PW, 10% Duty Cycle	190	°C
Rth		0.91	ºC/W
Rsur		0.55	ºC/W
MTTF		4.0E+09	Hrs

1.Using 5um thermal grease - 4W/m-K.
2.Thermal Resistance using Finite Element Analysis (FEA) simulation, calibrated with Infrared measurement on surface temperature.
3.Rsur: Thermal resistance based on Surface Temperature, only provided as a reference.



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LOADPULL MEASUREMENT, Vds= 50V Idq = 200 mA

1 Tone Pulse CW, pulse width 100us, duty cycle 10%

For Optimum Peak Power @ 2.5dB Compression

Freq-MHz	Zin_F0	Zl_F0	Gain-dB	Pout-dBm	Pout-W	Eff-%	AMPM-deg
1200	2 + 6.4j	4.9-0.5j	19.3	52.93	196.3	62.3	0
1400	11+13j	3.7-0.3j	18.45	53.1	204	60.3	-7.9
1500	26.6 -3.3j	3.7 --0.3j	18.54	52.72	187	60	-6
1700	2.7 -6.6j	3.0 +0.1j	17.7	52.6	185.6	62.2	5.3

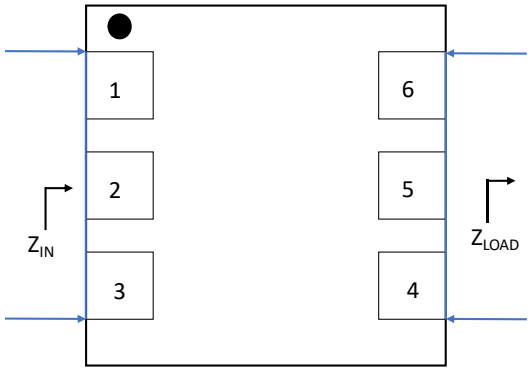
For Optimum Peak Efficiency @ 2.5dB Compression

Freq-MHz	Zin_F0	Zl_F0	Gain-dB	Pout-dBm	Pout-W	Eff-%	AMPM-deg
1200	2.0 + 7.4j	7.0 + 2.8j	21.3	51.8	151	70.1	-2.8
1400	15.5+19j	4.7+2.7j	20.77	51.3	134	71.9	-8.3
1500	21 -16.7j	4.7+ 2.7j	21	51.43	139	74	-9.8
1700	1.8 -5.8j	4+2.4j	19.2	51.3	135	74	0

LOADPULL MEASUREMENT NOTES

Load impedance @ 2nd Harmonic are set to 10 Ohms
With proper 2nd Harmonic termination, expect +5% Efficiency with Drain 2nd Harmonic.
Z_{LOAD}: Measured Impedance presented to the output of the device in the reference plane
Z_{IN}: Measured input Impedance at the input of the device in the reference plane

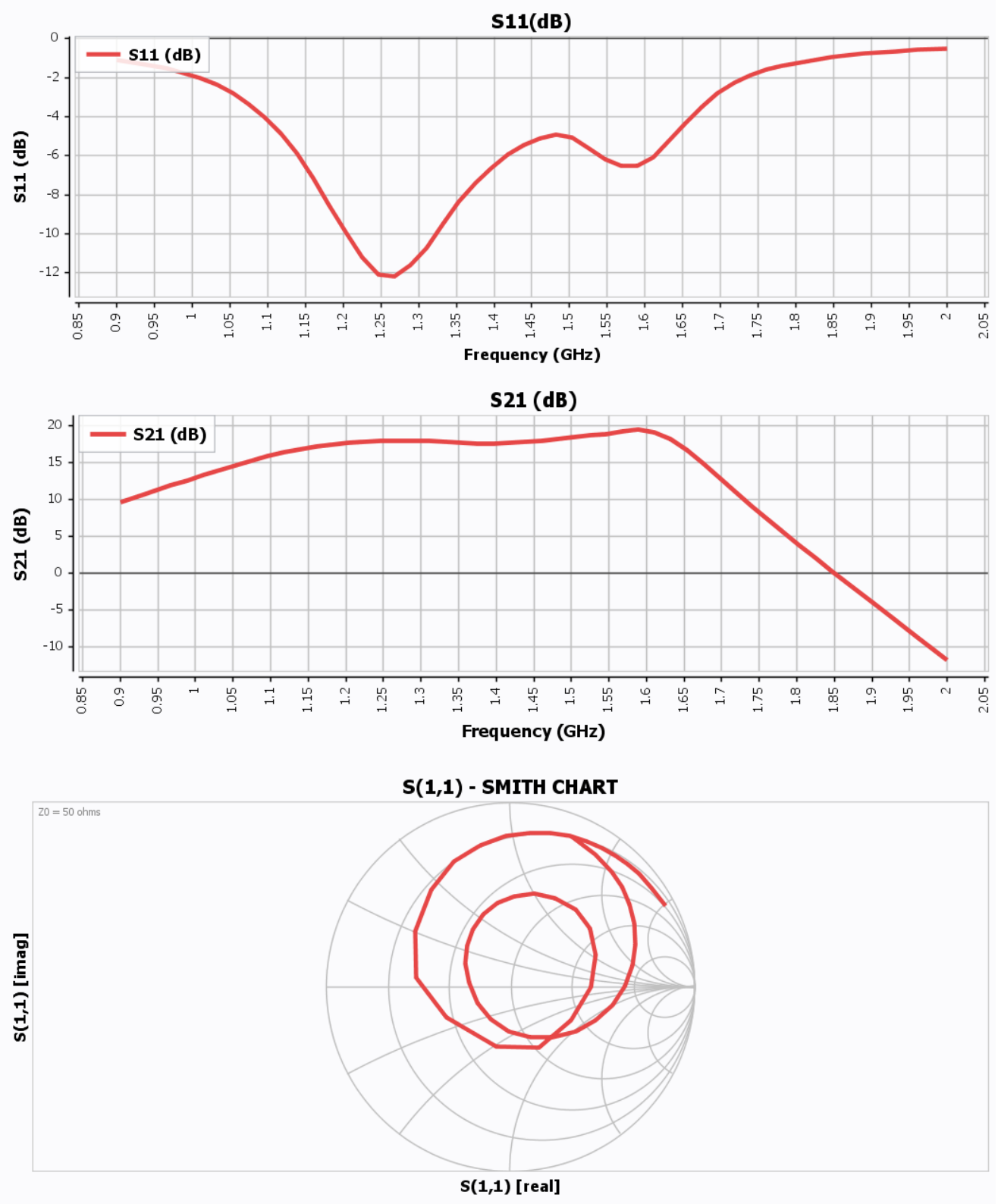
Impedance Reference Plane



Raw data and full Loadpull measurement report available at request: sales@galliumsemi.com

SMALL SIGNAL PERFORMANCE AT 1.2-1.4 GHZ EVB, Vds= 50V Idq = 150 mA

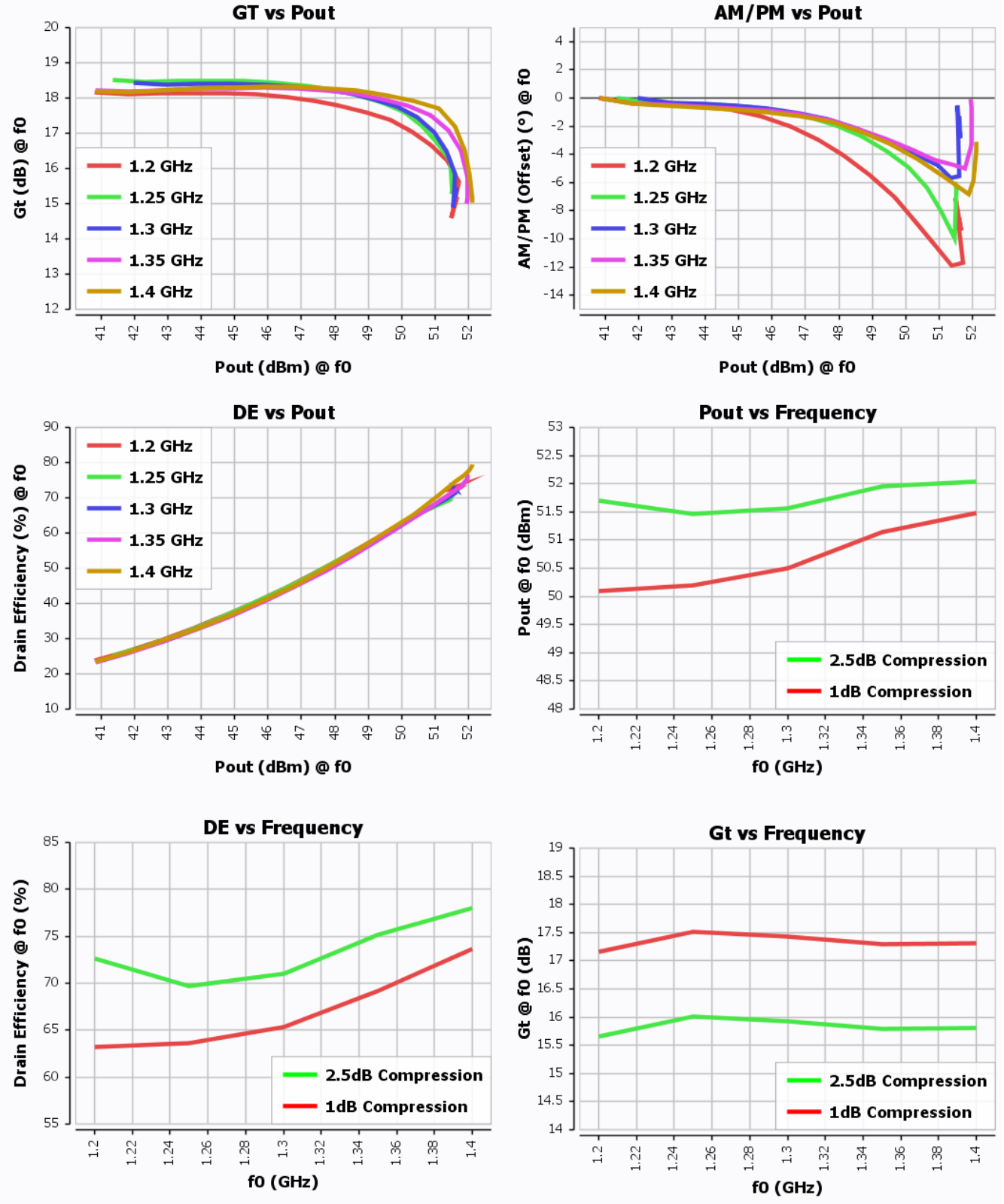
Pulse width 100us, duty cycle 10%



GTH2r-1014150S 50V, 1.0-1.4GHZ, 150W GaN HEMT

LARGE SIGNAL PERFORMANCE AT 1.2-1.4 GHZ EVB, Vds= 50V Idq = 150 mA

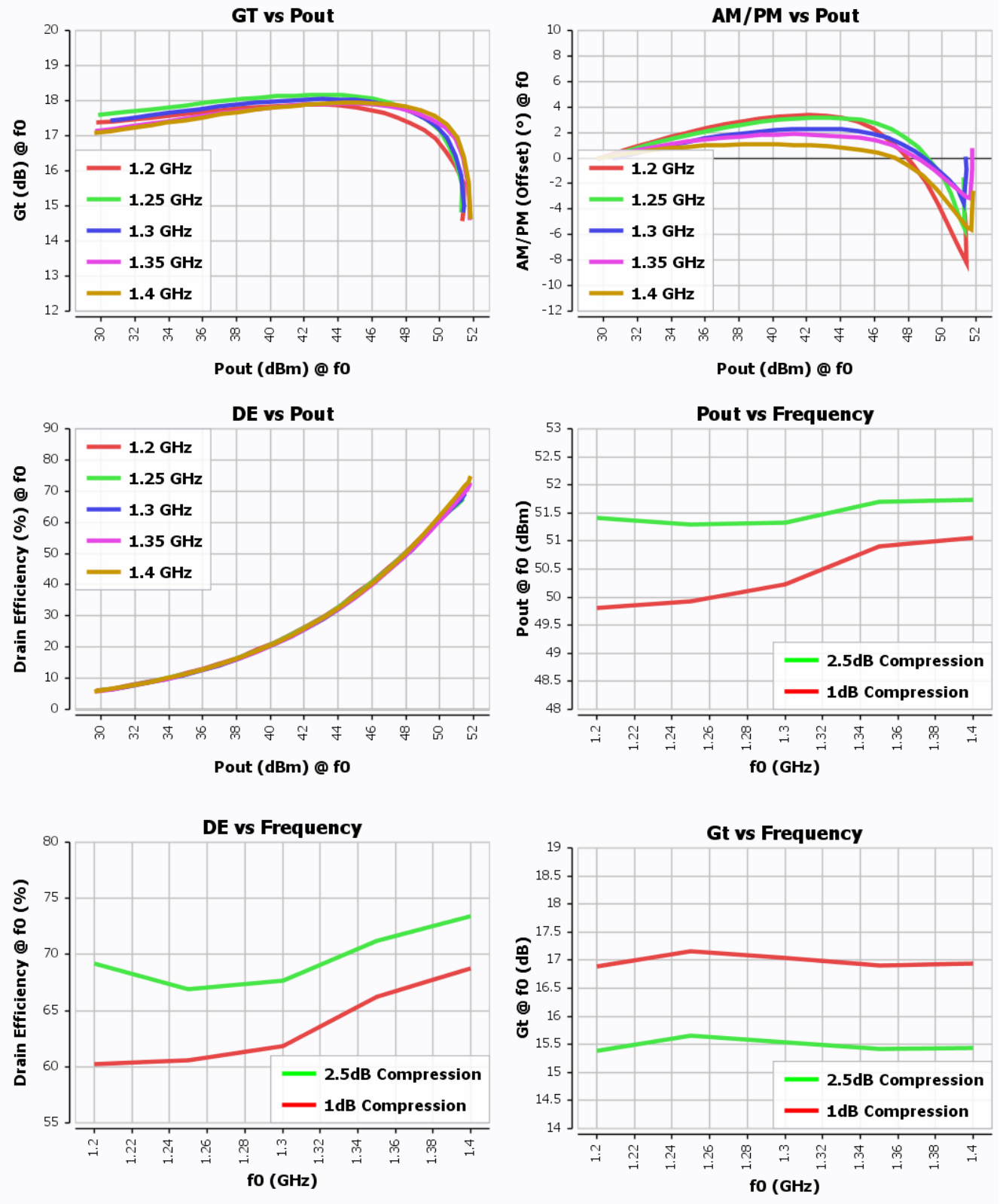
1 Tone Pulse CW, pulse width 100us, duty cycle 10%



GTH2r-1014150S 50V, 1.0-1.4GHZ, 150W GaN HEMT

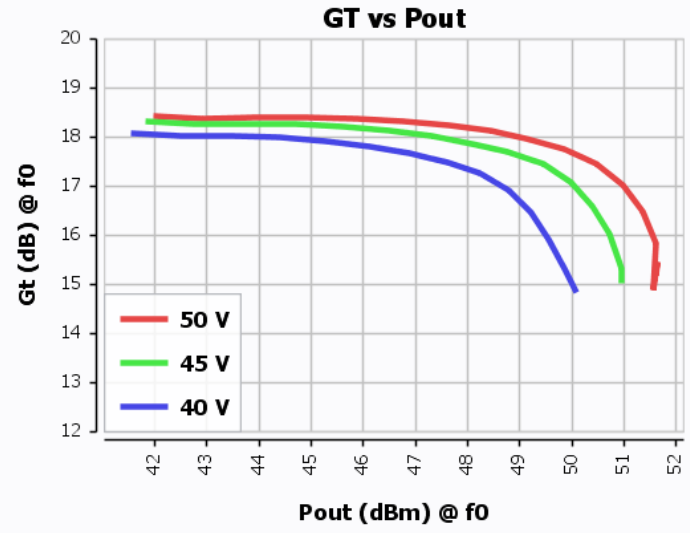
LARGE SIGNAL PERFORMANCE AT 1.2-1.4 GHZ EVB, Vds= 50V Idq = 150 mA

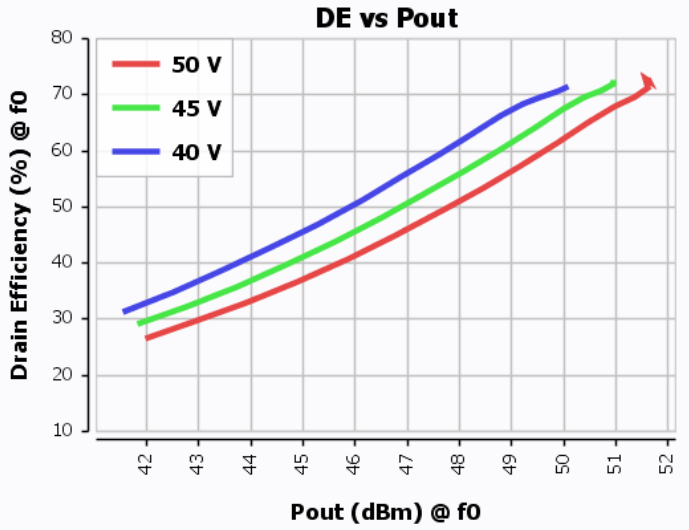
1 Tone Pulse CW, pulse width 1ms, duty cycle 10%

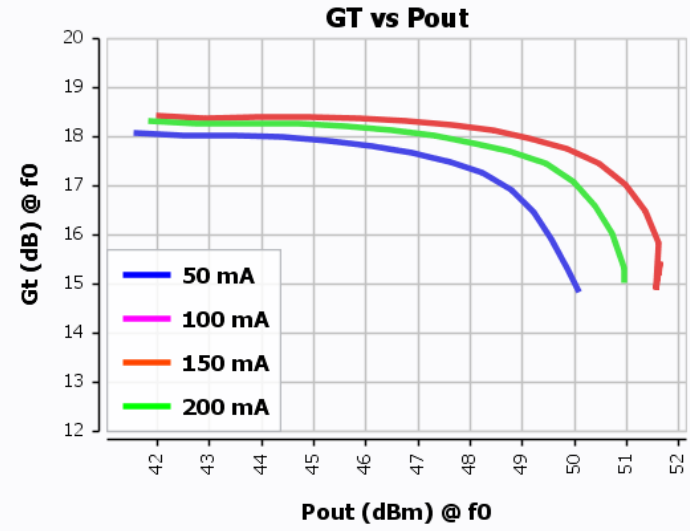


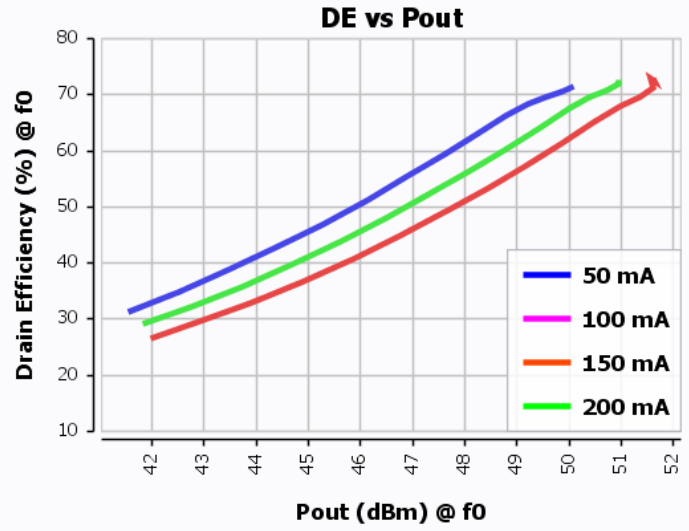
LARGE SIGNAL PERFORMANCE AT 1.2-1.4 GHZ EVB

1 Tone Pulse CW, pulse width 100us, duty cycle 10%, f=1.3 GHz

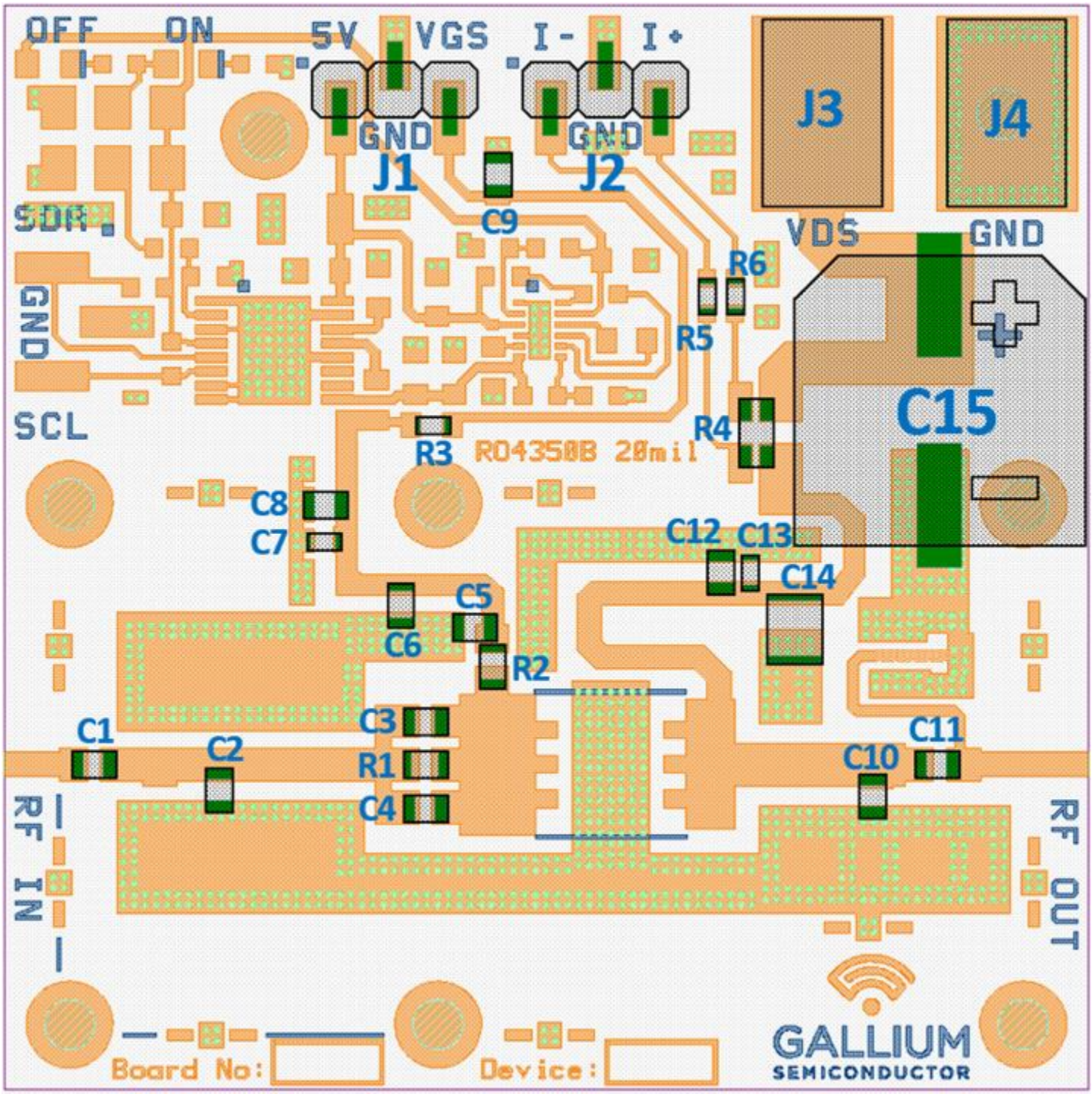








1.2-1.4 GHZ EVALUATION BOARD LAYOUT AND BILL OF MATERIALS



BILL OF MATERIALS

Designator	Description	Quant	Manufacture	Part Number
U1	RF Power Transistor	1	Gallium Semiconductor	GTH2r-1014150S
C1,C5,C12	CAP, SMD 100 pF +/- 5% 0805	3	ATC	600F101JT250WVDC
C2	CAP, SMD 3.9 pF +/- 0.25 pF 0805	1	ATC	600F3R9CT250WVDC
C3, C4	CAP, SMD 10 pF +/- 5% 0805	2	ATC	600F100JT250WVDC
C6	CAP, CER 1000 pF +/- 5% 0805	1	Murata	GRM2165C2A102JA01D
C7,C13	CAP, SMD 10 nF 100V 5% 0603	2	TDK	CGA3EAC0G2A103J080AC
C8	CAP, SMD 0.1 UF 100V 10% 0805	1	Murata	GCM21BR72A104KA37L
C9	CAP, SMD 10 UF 16V 10% 0805	1	Murata	GRM21BC71C106KE11L
C10	CAP, SMD 6.8 pF +/- 0.25 pF 0805	1	ATC	600F6R8CT250WVDC
C11	CAP, SMD 4.7 pF +/- 0.25 pF 0805	1	ATC	600F4R7CT250WVDC
C14	CAP, SMD 10UF 100V 10% 1210	1	Murata	GRM32EC72A106KE05L
C15	SMD 63VDC 220uF 20%	1	Panasonic	EEE-FK1J221AV
R1	RES, SMD 75c ohm +/- 1% 0805	1	YAGEO	RC0805FR-7W75RL
R2	RES, SMD 20 ohm +/- 1% 0805	1	YAGEO	RC0805FR-7W20RL
R3	RES, SMD 0 ohm +/- 5% 0603	1	YAGEO	RC0603JR-SK0RL
R4	SMD .01 OHM.25% 1/2W	1	Ohmite	LVK12R010CER
R5,R6	RES, SMD 1 K +/- 5% 0603	2	YAGEO	RC0603JR-SK1KRL
J1,J2	Pin header 5.1mm	2	Samtec	TSM-103-01- L-SV
J3,J4	Drain Pin	2	-	-

GaN HEMT BIASING SEQUENCE

To turn the transistor ON

1. Set V_{GS} to -5V
2. Turn on V_{DS} to normal operation voltage (50V)
3. Slowly increase V_{GS} to set I_{DQ} current (150mA)
4. Apply RF power

To turn the transistor OFF

1. Turn the RF power off
2. Decrease V_{GS} to -5V
3. Turn off $V_{D.}$ Wait a few seconds for drain capacitor to discharge
4. Turn off V_{GS}

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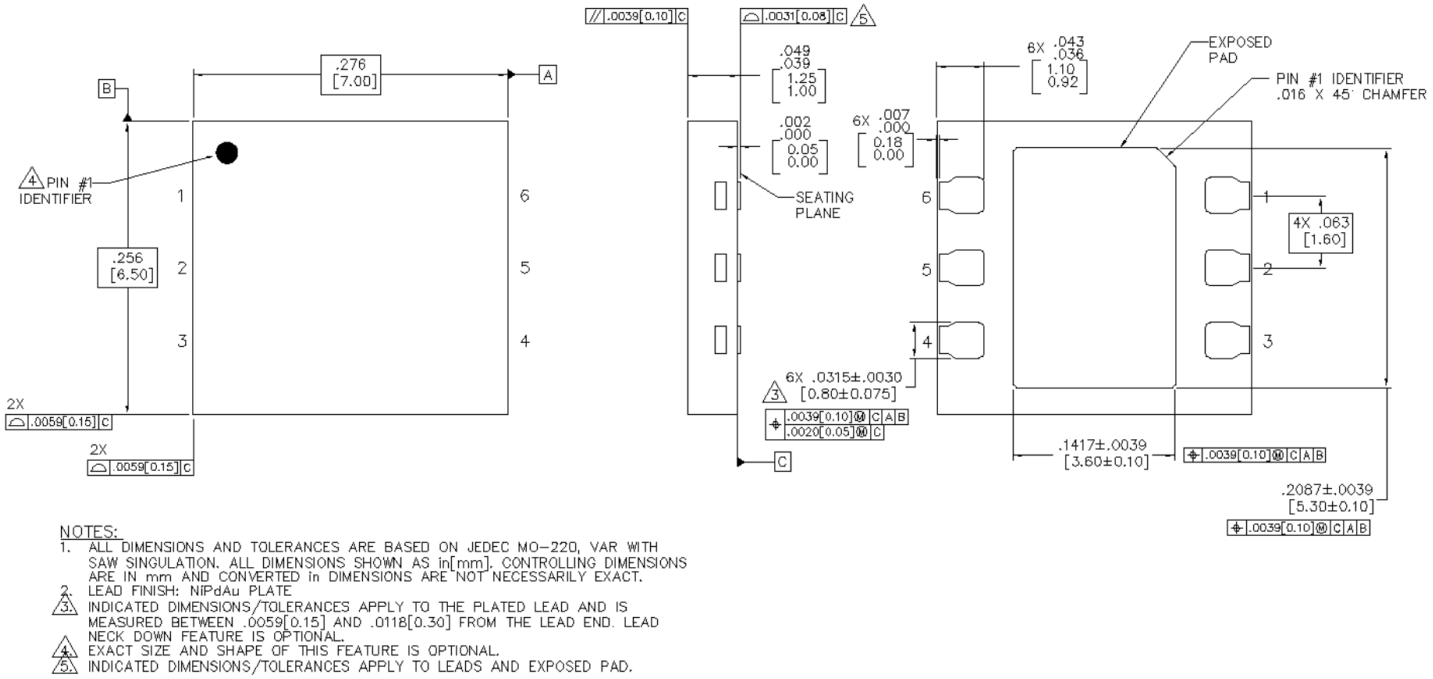
PACKAGE DIMENSIONS



NOTES:
1. ALL DIMENSIONS AND TOLERANCES ARE BASED ON JEDEC MO-220, VAR WITH SAW SINGULATION. ALL DIMENSIONS SHOWN AS in[mm]. CONTROLLING DIMENSIONS ARE IN mm AND CONVERTED in DIMENSIONS ARE NOT NECESSARILY EXACT.
2. LEAD FINISH: NiPdAu PLATE
3. INDICATED DIMENSIONS/TOLERANCES APPLY TO THE PLATED LEAD AND IS MEASURED BETWEEN .0059[0.15] AND .0118[0.30] FROM THE LEAD END. LEAD NECK DOWN FEATURE IS OPTIONAL.
4. EXACT SIZE AND SHAPE OF THIS FEATURE IS OPTIONAL.
5. INDICATED DIMENSIONS/TOLERANCES APPLY TO LEADS AND EXPOSED PAD.

Note: Dimension in inch [mm]

PIN CONFIGURATION

Pin	Input/Output
1, 2, 3	RF Input / Gate Voltage
4, 5, 6	RF Output / Drain Voltage
7(Paddle)	Ground

DEVICE LABEL

Line 1:	COMPANY NAME: GALLIUM	
Line 2:	PART NUMBER - WAFER #	
Line 3:	AA:	Assembly Code
	YYWW:	Assembly Date Code
	R:	Reserved code

HANDLING PRECAUTIONS

Parameter	Symbol	Class	Test Methodology
ESD – Human Body Model	HBM	Class 1A (250 V)	ANSI/ESDA/JEDEC Standard JS-001
ESD – Charged Device Model	CDM	Class C3 (1500 V)	ANSI/ESDA/JEDEC Standard JS-002
MSL – Moisture Sensitivity Level	MSL	MSL 3	IPC/JEDEC Standard J-STD-020

RoHS COMPLIANCE

Gallium Semiconductor's Policy on EU RoHS available online:
https://www.galliumsemi.com/_files/ugd/3748d3_1107b9788f9845f78f45d424097c4c97.pdf

REVISION HISTORY

Revision	Date	Datasheet Status	Modifications
A	01/19/2023	Advanced	Init
B	04/04/2023	Advanced	Updated Application and Thermal data

CONTACT INFORMATION

To request latest information and samples, please contact us at:

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Email: sales@galliumsemi.com

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