NPT1015

NITRONEX

Gallium Nitride 28V, 45W, DC-3.5 GHz HEMT

Built using the SIGANTIC® process - A proprietary GaN-on-Silicon technology

Features

- Suitable for linear and saturated applications
- Tunable from DC-3.5 GHz
- 28V Operation
- Industry Standard Package
- High Drain Efficiency (>55%)
- Rugged Design Passes 15:1 VSWR test
- Reliable with MTTF > 10^6 at T_J = 200°C

Applications

- Defense Communications
- Land Mobile Radio
- Avionics
- Wireless Infrastructure
- ISM Applications
- VHF/UHF/L-Band Radar

DC-3.5 GHz
45W
GaN HEMT

RoHS

Product Description

The NPT1015 GaN HEMT is a wideband transistor optimized for DC-3.5 GHz operation. This device has been designed for CW, pulsed, and linear operation with output power levels to 45W (46.5 dBm) in an industry standard metal-ceramic package with a bolt down flange. This product has been designed to be reliable, with a low thermal resistance, and rugged, able to withstand extreme mismatch on the input and output with no device damage.

RF Specifications (CW, 2.5 GHz): V_{DS} = 28V, I_{DQ} = 400mA, T_C= 25°C

Symbol	Parameter	Min	Typ	Max	Units
G_{SS}	Small-signal Gain	-	13.5	-	dB
P_{SAT}	Saturated Output Power	-	47.3	-	dBm
η_{SAT}	Efficiency at Saturated Output Power	-	57	-	%
G_P	Gain at P_{OUT} = 45W	10.5	12	-	dB
η	Drain Efficiency at P_{OUT} = 45W	47	54	-	%
V_{DS}	Drain Voltage	-	28	-	V
Ψ	Ruggedness: Output Mismatch, All Phase Angles	VSWR = 15:1, No Device Damage			

DC Specifications: T_C = 25°C

Symbol	Parameter	Min	Typ	Max	Units
Off Characteristics					
I_{DLK}	Drain-Source Leakage Current (V_{GS}=-8V, V_{DS}=100V)	-	-	16	mA
I_{GLK}	Gate-Source Leakage Current (V_{GS}=-8V, V_{DS}=0V)	-	-	8	mA
On Characteristics					
V_T	Gate Threshold Voltage (V_{DS}=28V, I_D=16mA)	-2.3	-1.5	-0.7	V
V_{GSQ}	Gate Quiescent Voltage (V_{DS}=28V, I_D=400mA)	-2.1	-1.2	-0.5	V
R_{ON}	On Resistance (V_{DS}=2V, I_D=120mA)	-	0.22	-	Ω
$I_{D, MAX}$	Maximum Drain Current (V_{DS}=7V pulsed, 300μS pulse width, 0.2% Duty Cycle)	-	9.2	-	A

Thermal Resistance Specification:

Symbol	Parameter	Typ	Units
$R_{\theta JC}$	Thermal Resistance (Junction-to-Case), T_J = 180 °C	2.1	°C/W

Junction Temperature (T_J) measured using IR Microscopy, Case Temperature (T_C) measured using a thermocouple embedded in heatsink.

Absolute Maximum Ratings: Not simultaneous, T_C = 25°C unless otherwise noted

Symbol	Parameter	Max	Units
V_{DS}	Drain-Source Voltage	100	V
V_{GS}	Gate-Source Voltage	-10 to 3	V
I_G	Gate Current	32	mA
P_T	Total Device Power Dissipation (Derated above 25°C)	83	W
T_{STG}	Storage Temperature Range	-65 to 150	°C
T_J	Operating Junction Temperature	200	°C
HBM	Human Body Model ESD Rating (per JESD22-A114)	Class 1B	

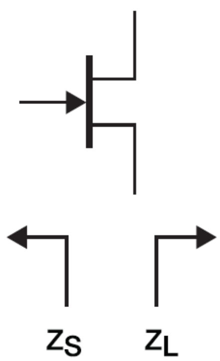
Load-Pull Data, Reference Plane at Device Leads

V_{DS}=28V, I_{DQ}=400mA, T_C=25°C unless otherwise noted

Optimum Source and Load Impedances:

(CW Drain Efficiency and Output Power Tradeoff Impedance)

Frequency (MHz)	Z_S (Ω)	Z_L (Ω)	P_{SAT} (W)	G_{SS} (dB)	Drain Efficiency @ P_{SAT} (%)
900	1.1 + j0.7	6.3 + j1.8	53.7	22.5	65.1
2200	1.6 - j6.0	5.4 - j0.6	53.2	15.8	64.8
2500	1.5 - j6.7	5.2 - j2.2	50.9	15.0	60.8
3500	2.6 - j15	3.9 - j6.3	42.0	13.9	55.4



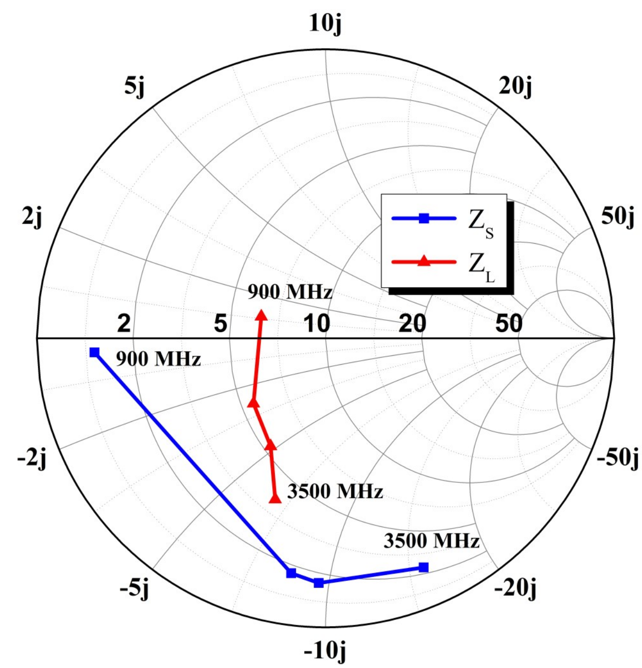


Figure 1: CW Power/Drain Efficiency Tradeoff Impedances, Z_O=10Ω

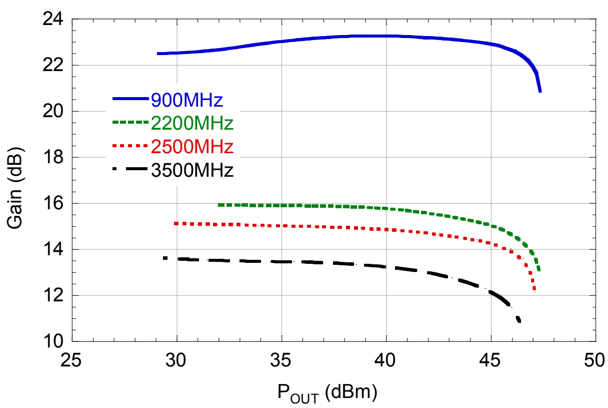


Figure 2: Gain vs. P_{OUT}

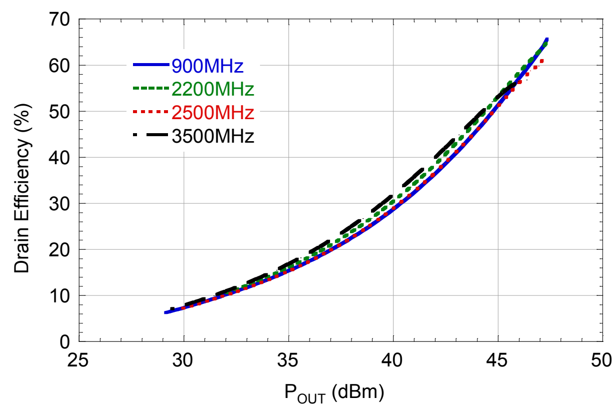


Figure 3: Drain Efficiency vs. P_{OUT}

2.5 GHz Narrowband Circuit

(CW, V_{DS}=28V, I_{DQ}=400mA, T_C=25°C, unless otherwise noted)

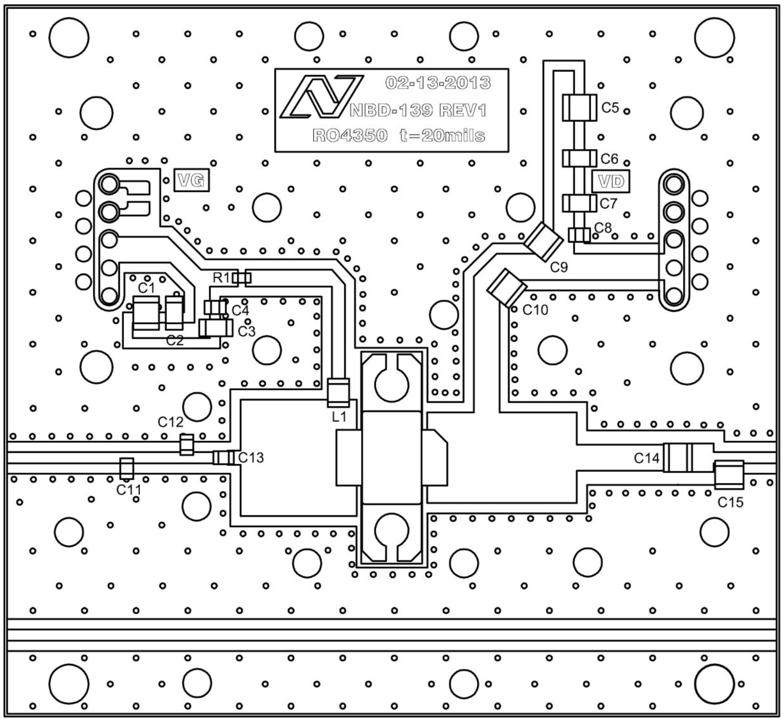


Figure 4: Component Placement of 2.5 GHz Narrowband Circuit for NPT1015

Reference	Value	Manufacturer	Part Number
C1, C5	1uF	AVX	1210C105KAT2A
C2, C6	0.1uF	Kemet	C1206C104K1RACTU
C3, C7	0.01uF	AVX	1206C103KAT2A
C4, C8	1000pF	Kemet	C0805C102K1RACTU
C9, C14	10pF	ATC	ATC800B100B
C10	20pF	ATC	ATC800B200B
C11	2.4pF	ATC	ATC600F2R4B
C12	2.2pF	ATC	ATC600F2R2B
C13	10pF	ATC	ATC600F100B
C15	0.6pF	ATC	ATC600F0R6B
L1	19.4nH	CoilCraft	0806SQ-19NJL
R1	15Ω	Panasonic	ERJ-2RKF15R0X
PCB	RO4350, ε_r=3.5, 0.020"	Rogers	Nitronex NBD-139r1

Typical Performance in 2.5 GHz Narrowband Circuit

(CW, V_{DS}=28V, I_{DQ}=400mA, f=2.5GHz, T_C=25°C, unless otherwise noted)

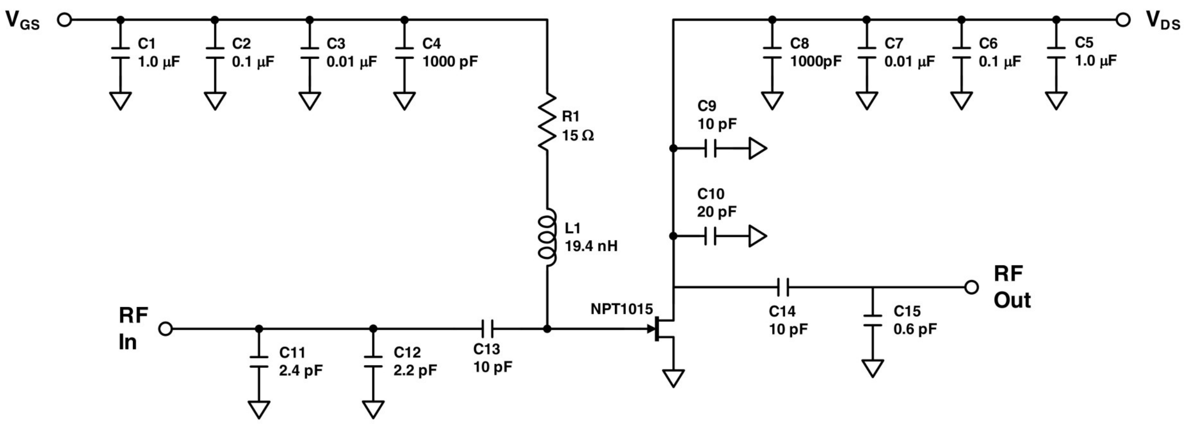


Figure 5. Electrical Schematic of 2.5 GHz Narrowband Circuit for NPT1015
(For RF Tuning details see Component Placement Diagram Figure 4)

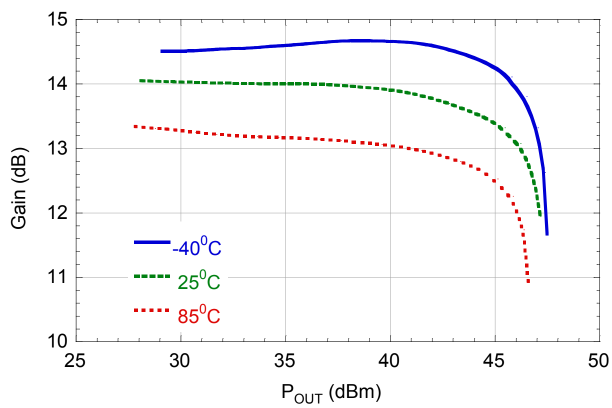


Figure 6: Gain vs. P_{OUT}

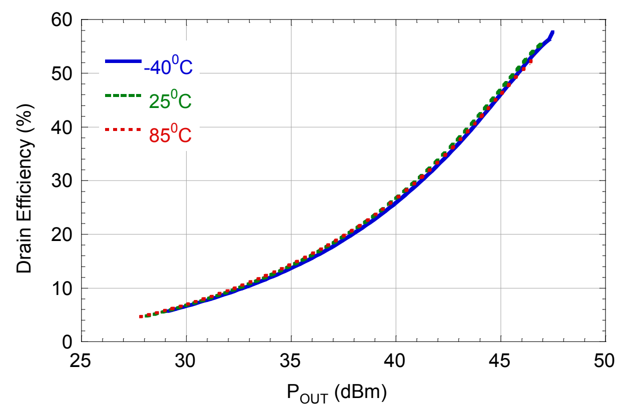


Figure 7: Drain Efficiency vs. P_{OUT}

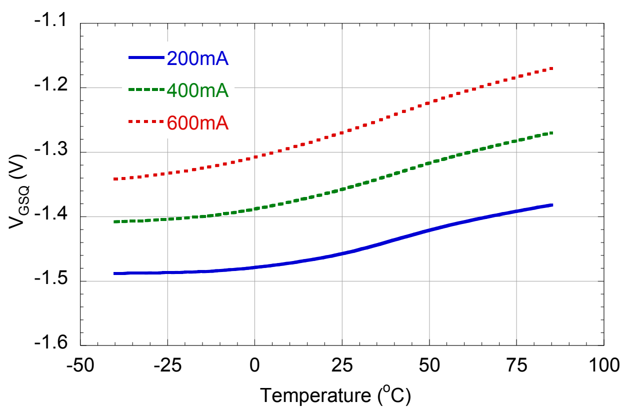


Figure 8: Quiescent V_{GS} vs. Temperature

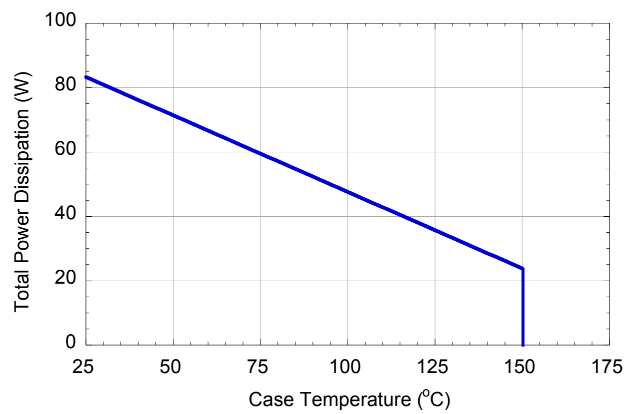


Figure 9: Power De-rating Curve
(T_J = 200°C, T_C > 25°C)

Typical Performance in 2.5 GHz Narrowband Circuit

(CW, V_{DS}=28V, I_{DQ}=400mA, f=2.5GHz, T_C=25°C, unless otherwise noted)

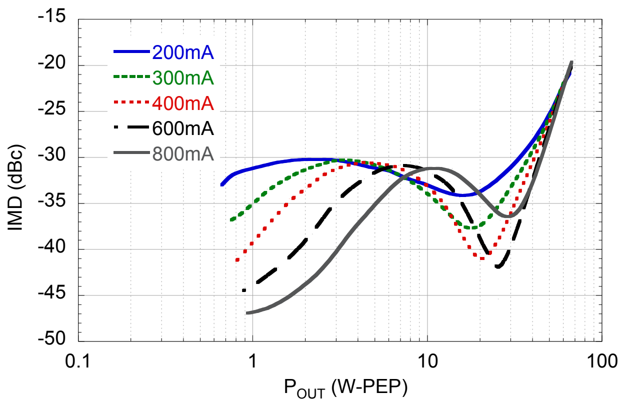


Figure 10: 2-Tone IMD3 vs. P_{OUT} vs. I_{DQ}
(1MHz Tone Spacing)

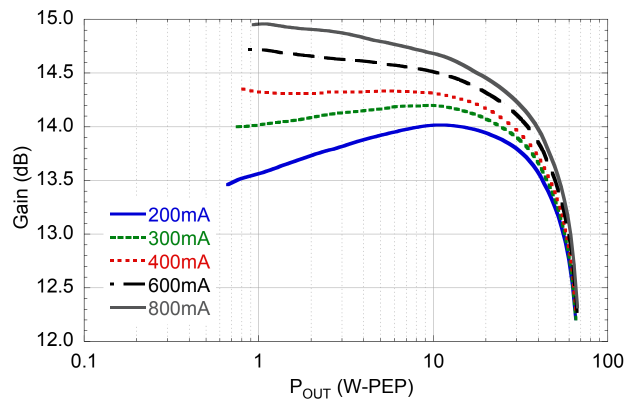


Figure 11: 2-Tone Gain vs. P_{OUT} vs. I_{DQ}
(1MHz Tone Spacing)

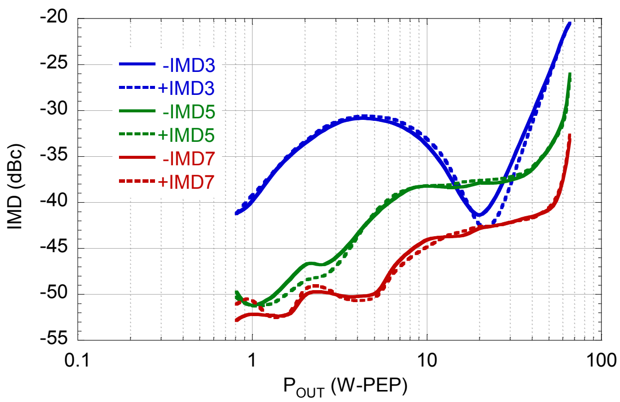


Figure 12: 2-Tone IMD vs. P_{OUT}
(1MHz Tone Spacing)

600-1000 MHz Broadband Circuit

(CW, V_{DS}=28V, I_{DQ}=400mA, T_C=25°C, unless otherwise noted)

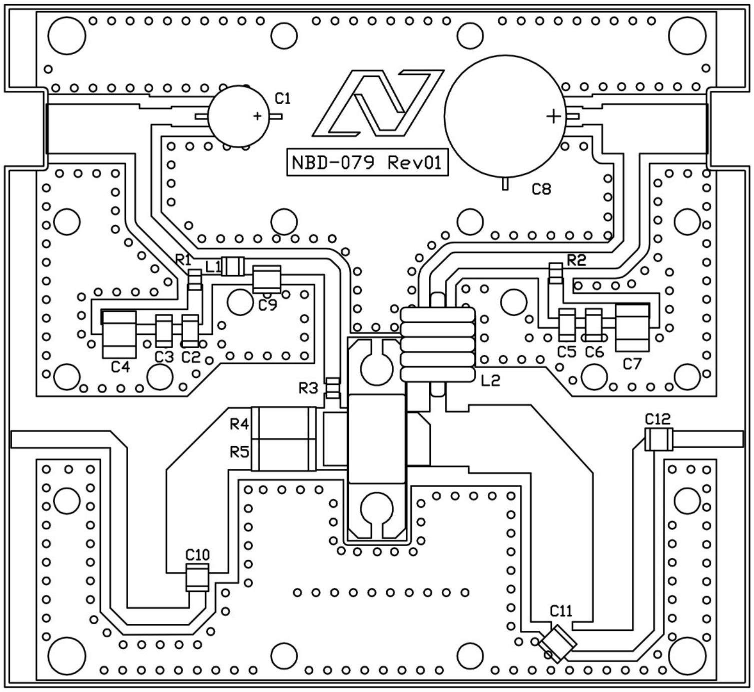


Figure 13: Component Placement of 600-1000 MHz Broadband Circuit for NPT1015

Reference	Value	Manufacturer	Part Number
C1	150uF	Nichicon	UPW1C151MED
C2, C5	0.01uF	AVX	1206C103KAT2A
C3, C6	0.1uF	Kemet	C1206C104K1RACTU
C4, C7	1uF	AVX	1210C105KAT2A
C8	270uF	United Chemi-Con	ELXY 630ELL271MK25S
C9	56pF	ATC	ATC100B560J
C10, C12	100pF	ATC	ATC100B101J
C11	6.8pF	ATC	ATC100B6R8J
R1, R2	0.33Ω	Panasonic	ERJ-6RQFR33V
R3	10Ω	Panasonic	ERJ-6ENF10R0V
R4, R5	7.5Ω	Stackpole	RHC2512FT7R50
L1	120nH	Coilcraft	0805CS-121XJB
L2	~50nH	16 AWG Cu Wire	5 turn, 0.2"ID
PCB	RO4350, ε_r=3.5, 0.020”	Rogers	Nitronex NBD-079r1

Typical Performance in 600-1000 MHz Broadband Circuit

(CW, V_{DS}=28V, I_{DQ}=400mA, T_C=25°C, unless otherwise noted)

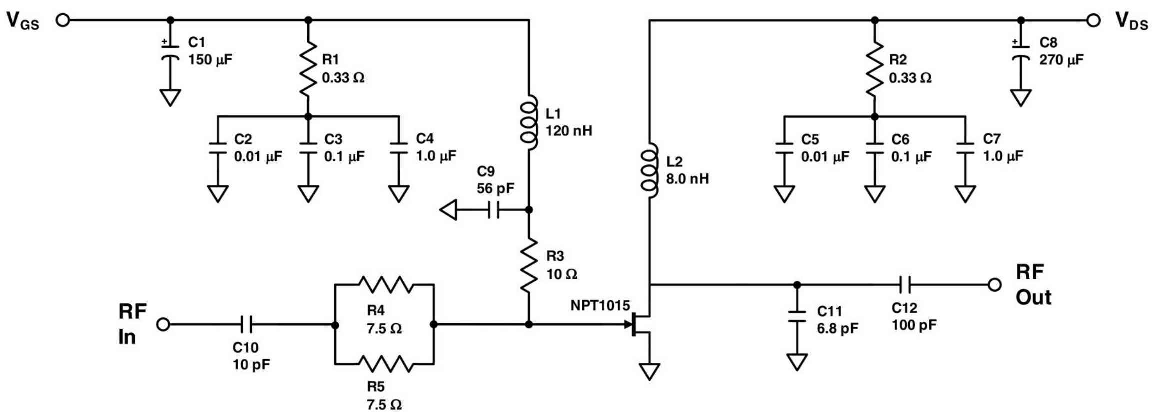


Figure 14. Electrical Schematic of 600-1000 MHz Broadband Circuit for NPT1015
(For RF Tuning details see Component Placement Diagram Figure 13)

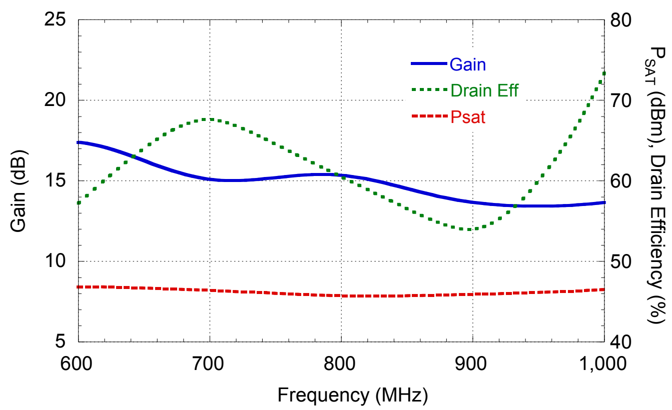


Figure 15: Performance vs. Frequency
(P_{OUT} = P_{SAT})

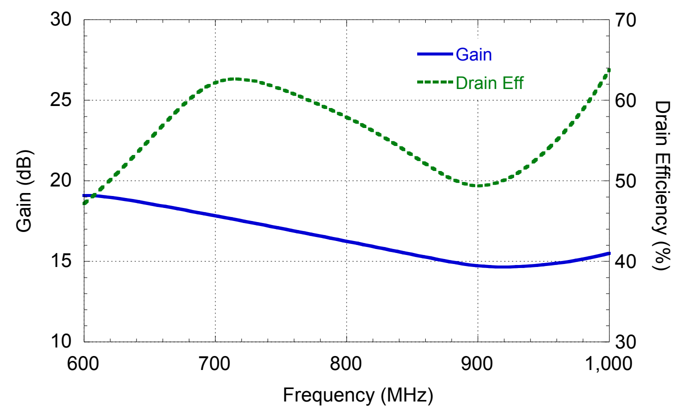


Figure 16: Performance vs. Frequency
(P_{OUT} = 45dBm)

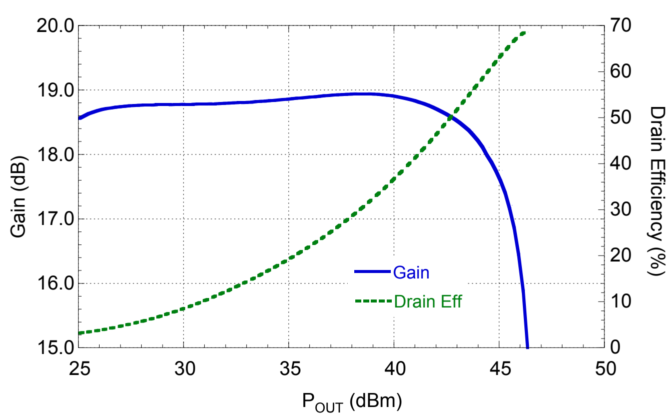


Figure 17: Gain/Drain Efficiency vs. P_{OUT}
(f = 700MHz)

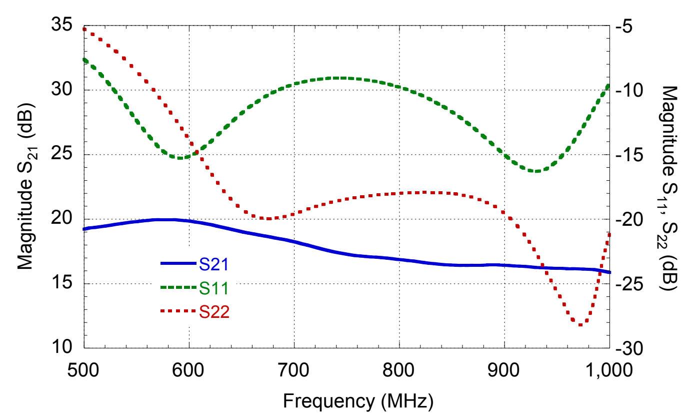


Figure 18: Small Signal s-parameters vs. Frequency

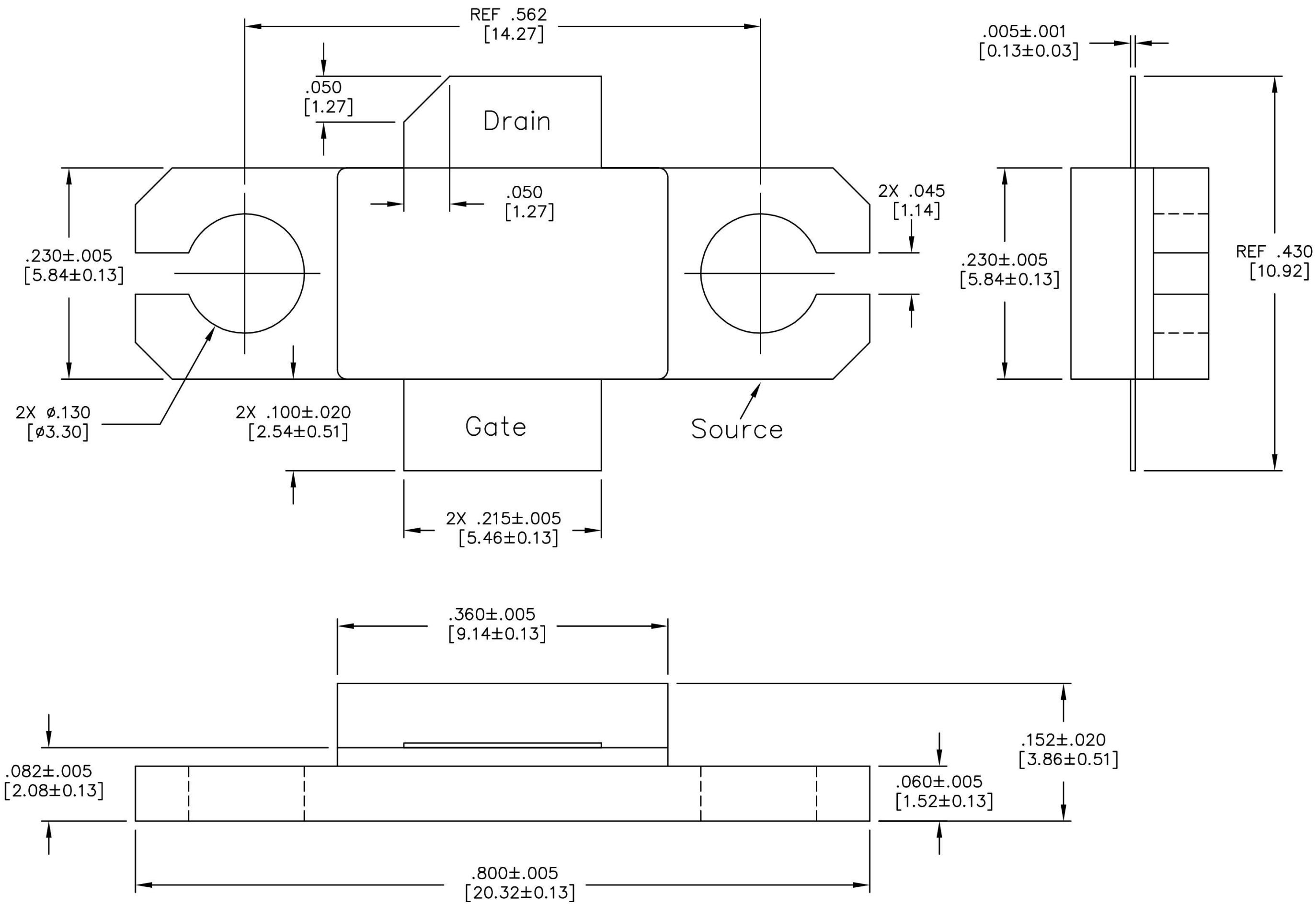


Figure 19 - AC360B-2 Metal-Ceramic Package Dimensions (all dimensions in inches [millimeters])

Function
Gate — RF Input
Drain — RF Output (Cut lead)
Source — Ground (Flange)

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Additional Information

This part is lead-free and is compliant with the RoHS directive (Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment).

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