

GaN Amplifier 50 V, 400 W 2.9 - 3.5 GHz



CGHV35400F1

Rev. V3

Features

- 400 W Minimum Output Power
- Large Signal Gain: 13 dB
- Drain Efficiency: 65%
- Internally Matched: 50 Ω
- High Temperature Operation
- RoHS* Compliant

Applications

- Civil & Military Pulsed Radar Amplifiers

Description

The CGHV35400F1 is a gallium nitride (GaN) amplifier designed specifically with high efficiency and high gain for the 2.9 - 3.5 GHz S-Band radar band.

The device has been developed with long pulse capability to meet the developing trends in radar architectures.

The amplifier is matched to 50-ohms on the input and 50-ohms on the output. The CGHV35400F1 is based on the high power density 50 V, 0.4 μm GaN on silicon carbide (SiC) manufacturing process.

The amplifier is supplied in a ceramic/ metal flange package of type 440226.

Typical RF Performance:

Measured in Evaluation Test Fixture¹ at $P_{IN} = 46$ dBm, 2 msec pulse width and 20% Duty Cycle.

- $V_{DS} = 50$ V, $I_{DQ} = 500$ mA, $T_C = 25^\circ\text{C}$

Frequency (GHz)	Output ¹ Power (dBm)	Power ¹ Gain (dB)	η_D ¹ (%)
2.9	57.1	11.1	69
3.2	56.9	10.9	64
3.5	56.4	10.4	60

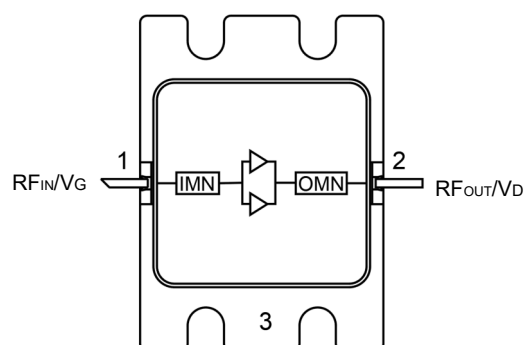
1. Performance values and curves in this data sheet were measured in this fixture.

* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.



440226

Functional Schematic



Pin Configuration

Pin #	Pin Name	Function
1	RF_{IN} / V_G	RF Input / Gate
2	RF_{OUT} / V_D	RF Output / Drain
3	Flange ²	Ground / Source

2. The flange on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

Part Number	MOQ Increment
CGHV35400F1	Bulk
CGHV35400F1-AMP	Sample Board

DC Electrical Characteristics @ $T_C = +25^\circ\text{C}$

Characteristics	Symbol	Conditions	Units	Min.	Typ.	Max.
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS} = 10\text{ V}$, $I_D = 83.6\text{ mA}$	V	-3.8	-3.0	-2.3
Gate Quiescent Voltage	$V_{GS(Q)}$	$V_{DS} = 50\text{ V}$, $I_D = 500\text{ mA}$	V	—	-2.7	—
Saturated Drain Current ⁴	I_{DS}	$V_{DS} = 6\text{ V}$, $V_{GS} = 2\text{ V}$	A	62.7	75.5	—
Drain-Source Breakdown Voltage	V_{BR}	$V_{GS} = -8\text{ V}$, $I_D = 83.6\text{ mA}$	V	125	—	—

4. Scaled from PCM data.

RF Electrical Characteristics⁵ @ $T_C = +25^\circ\text{C}$, Freq. = 2.9 - 3.5 GHz, $V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$

Characteristics	Symbol	Conditions	Units	Min.	Typ.	Max.
Small Signal Gain	S21	$P_{IN} = -20\text{ dBm}$	dB	—	13.7	—
Input Return Loss	S11	$P_{IN} = -20\text{ dBm}$	dB	—	7.1	—
Output Return Loss	S22	$P_{IN} = -20\text{ dBm}$	dB	—	5.8	—
Power Gain	G_P	$P_{IN} = 46\text{ dBm}$ 2.9 GHz 3.2 GHz 3.5 GHz	dB	10.0	11.2 11.0 10.7	—
Output Power	P_{OUT}	$P_{IN} = 46\text{ dBm}$ 2.9 GHz 3.2 GHz 3.5 GHz	dBm	56.0	57.2 57.1 56.7	—
Drain Efficiency	D_E	$P_{IN} = 46\text{ dBm}$ 2.9 GHz 3.2 GHz 3.5 GHz	%	54	68 63 62	—
Output Mismatch Stress	VSWR	No damage at all phase angles	Ψ	—	—	3:1

5. Pulse Width = 500 μs , Duty Cycle = 10%.

Thermal Characteristics

Parameter	Symbol	Test Conditions	Units	Rating
Operating Junction Temperature	T_J	Pulse Width = 2 ms, Duty Cycle = 20%, $P_{DISS} = 418\text{ W}$, $T_C = 57.2^\circ\text{C}$	$^\circ\text{C}$	224
Thermal Resistance, Junction to Case	$R_{\theta JC}$		$^\circ\text{C/W}$	0.4

Absolute Maximum Ratings (Not Simultaneous)

Parameter	Symbol	Conditions	Units	Rating
Drain-Source Voltage	V_{DS}	25°C	V	150
Gate-Source Voltage	V_{GS}	25°C	V	-10 to +2
Maximum Forward Gate Current	I_{GMAX}	25°C	mA	80
DC Drain Current	I_{DMAX}	25°C	A	12
Soldering Temperature	T_S	—	°C	245
Pulse Width	PW	—	mS	2000
Duty Cycle	DC	—	%	20
Operating Junction Temperature	T_J	MTTF > 1e6 Hours	°C	225
Storage Temperature	T_{STG}	—	°C	-65 to +150

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 3A and CDM C3 Class devices.

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2.9 - 3.5 GHz



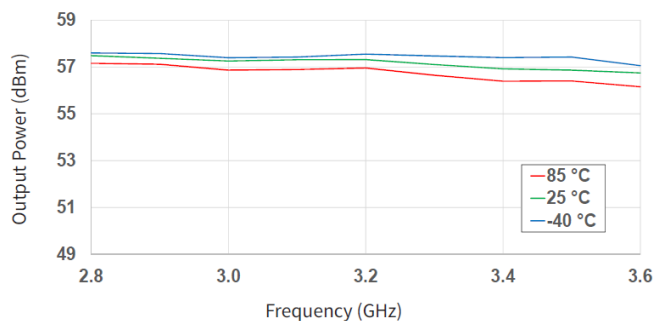
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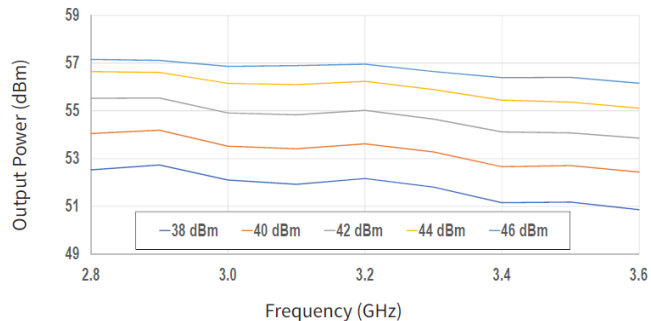
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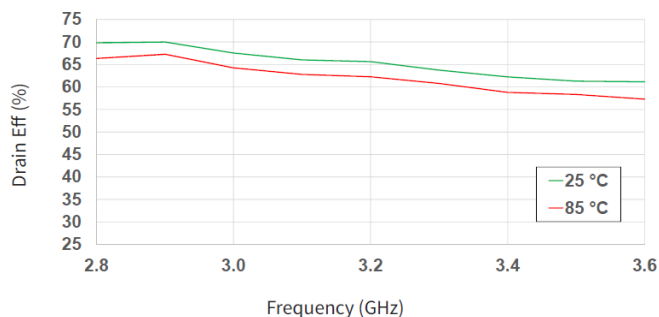
Output Power vs. Frequency over Temperature



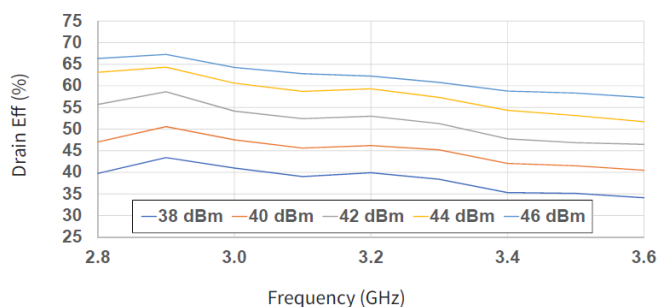
Output Power vs. Frequency over Input Power



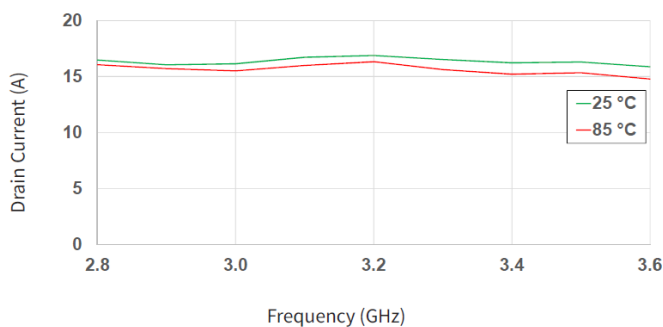
Drain Efficiency vs. Frequency over Temperature



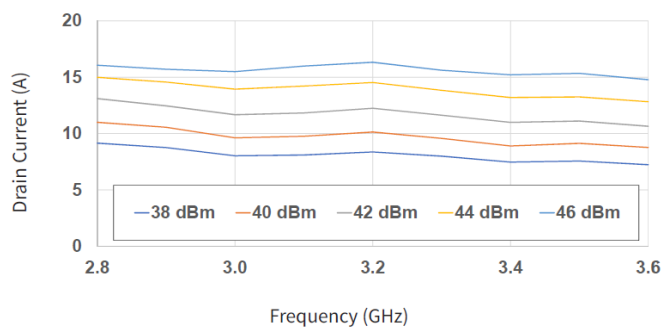
Drain Efficiency vs. Frequency over Input Power



Drain Current vs. Frequency over Temperature



Drain Current vs. Frequency over Input Power



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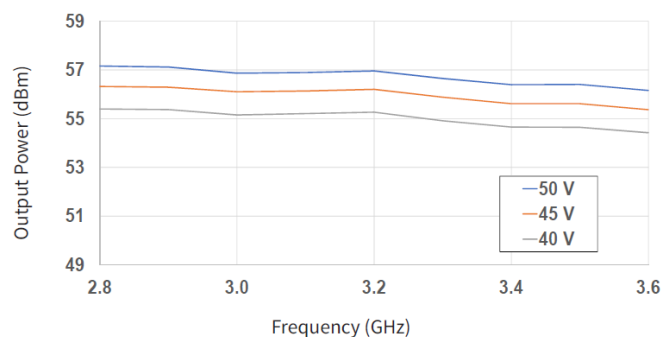
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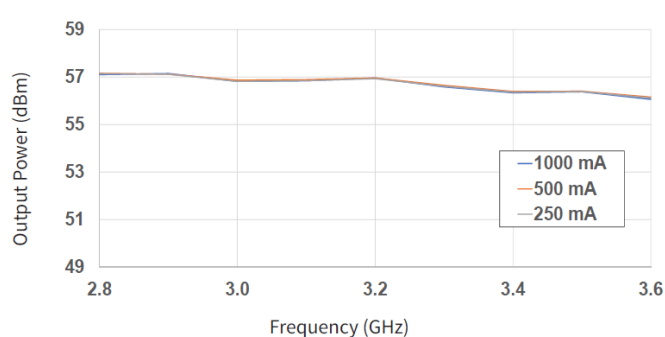
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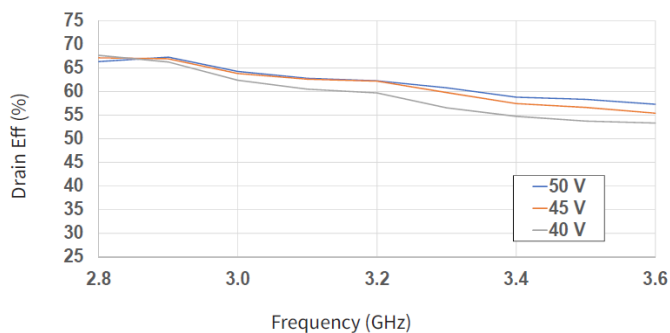
Output Power vs. Frequency over Voltage



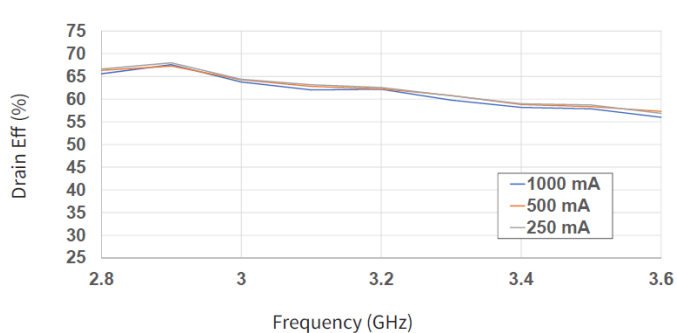
Output Power vs. Frequency over I_{DQ}



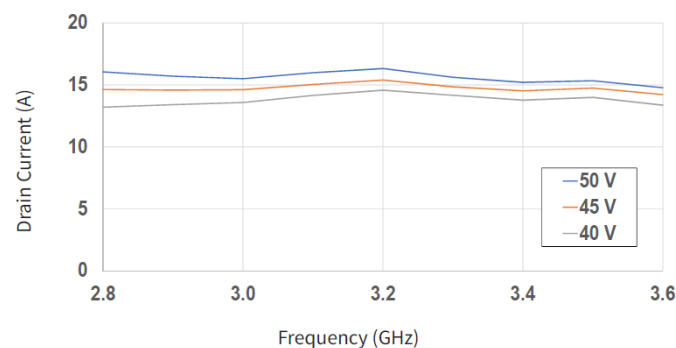
Drain Efficiency vs. Frequency over Voltage



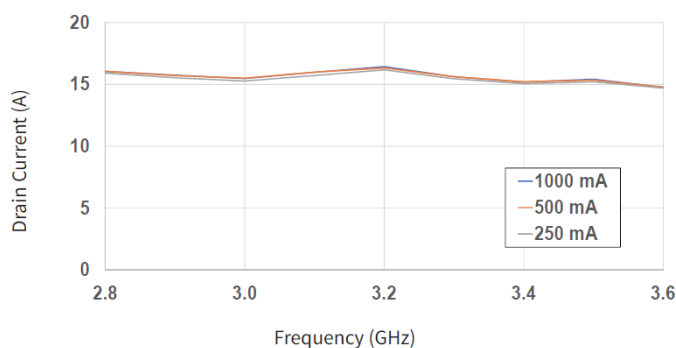
Drain Efficiency vs. Frequency over I_{DQ}



Drain Current vs. Frequency over Voltage



Drain Current vs. Frequency over I_{DQ}



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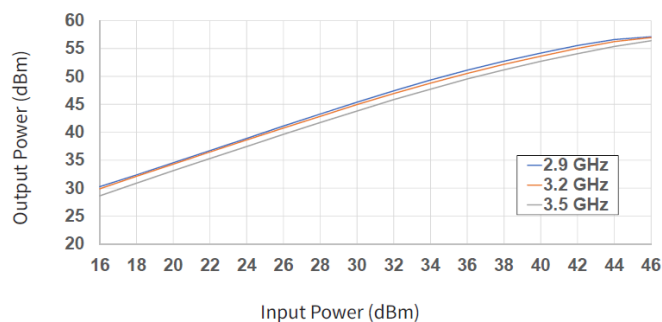
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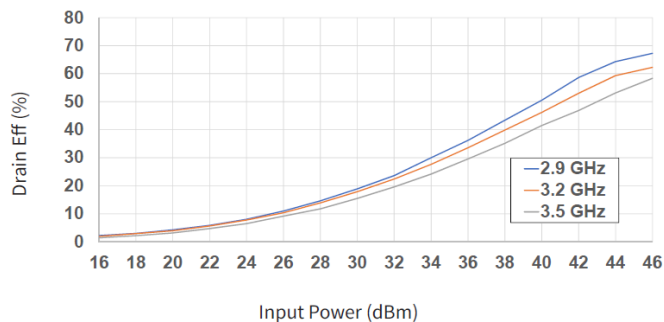
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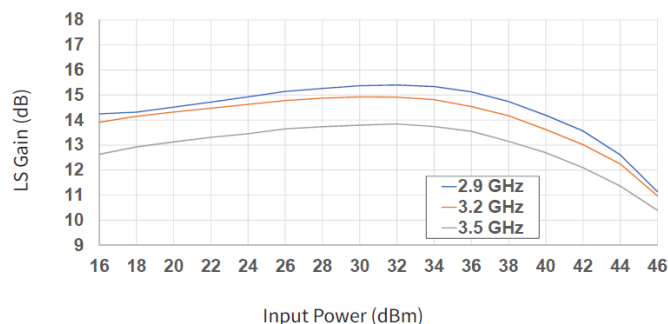
Output Power vs. Input Power Over Frequency



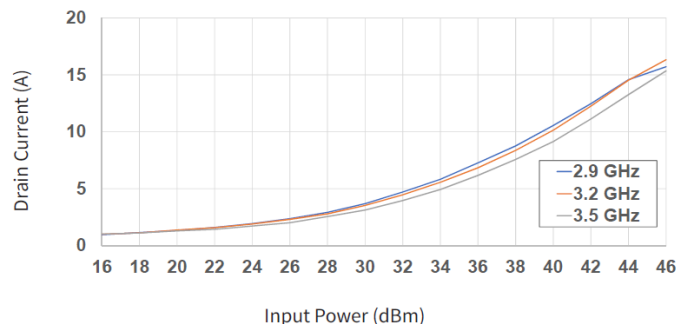
Drain Efficiency vs. Input Power Over Frequency



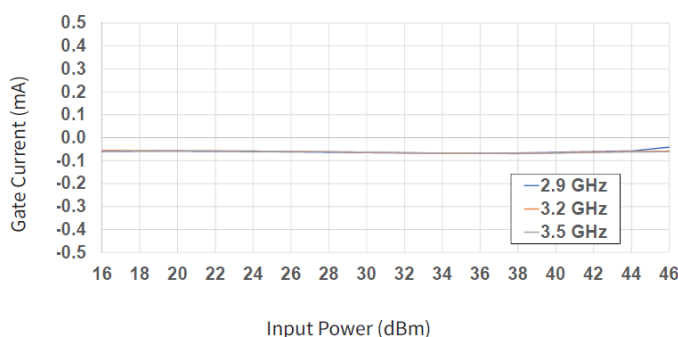
LS Gain vs. Input Power Over Frequency



Drain Current vs. Input Power Over Frequency



Gate Current vs. Input Power Over Frequency



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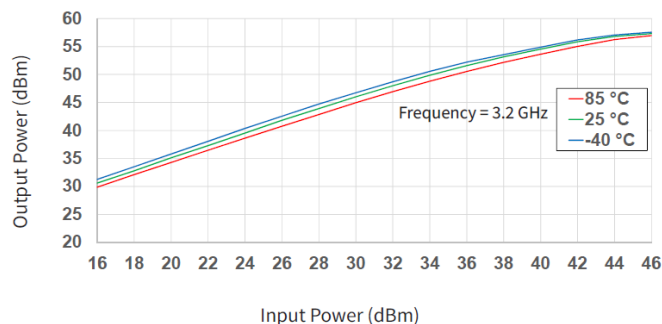
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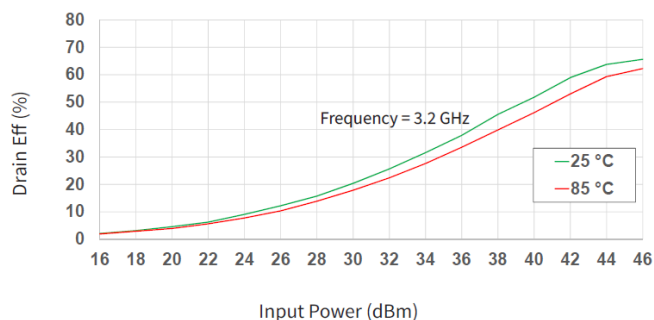
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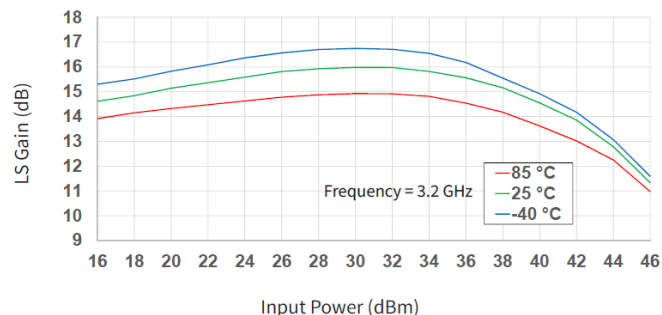
Output Power vs. Input Power Over Temperature



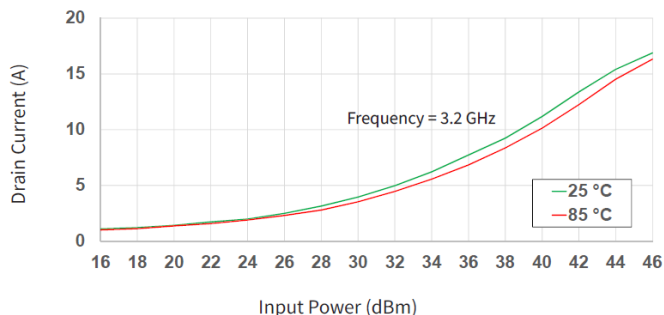
Drain Efficiency vs. Input Power Over Temperature



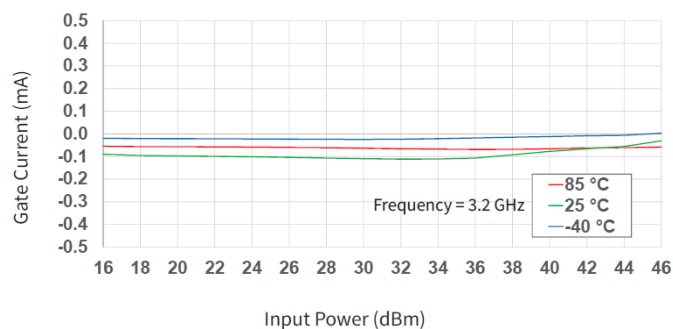
LS Gain vs. Input Power Over Temperature



Drain Current vs. Input Power Over Temperature



Gate Current vs. Input Power Over Temperature



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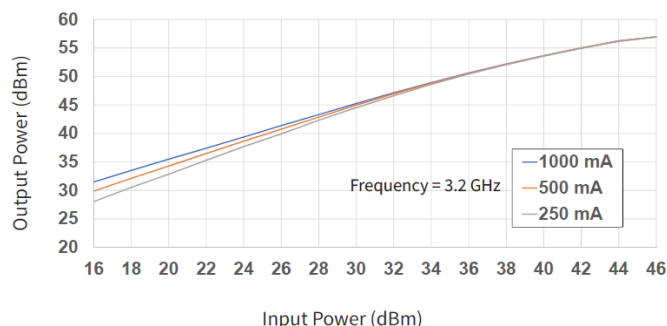
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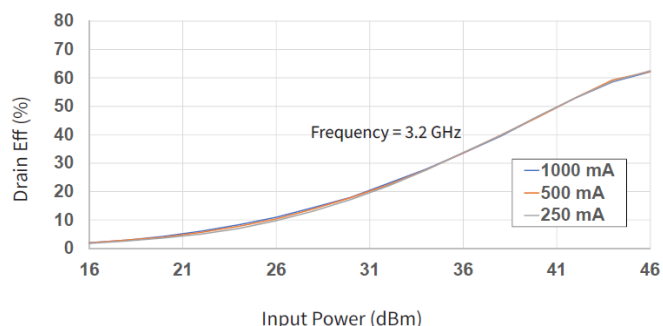
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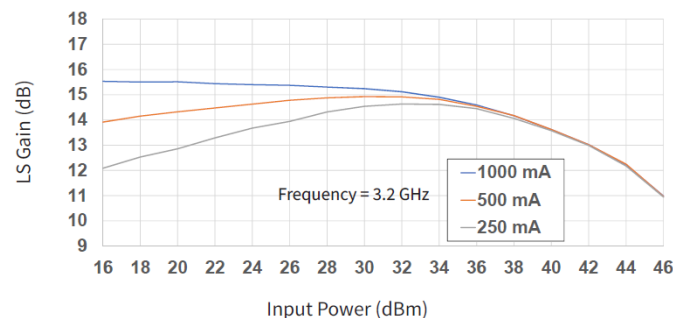
Output Power vs. Input Power Over I_{DQ}



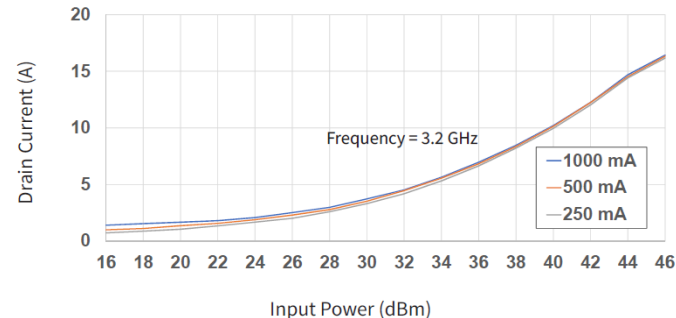
Drain Efficiency vs. Input Power Over I_{DQ}



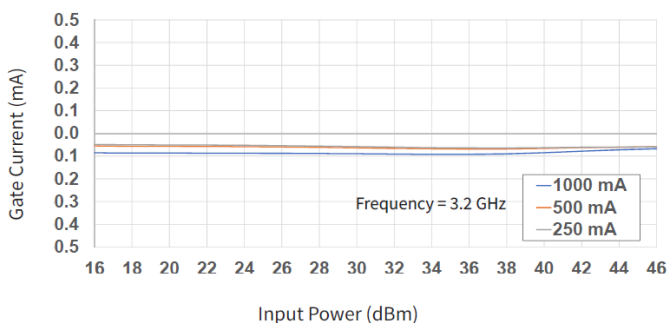
LS Gain vs. Input Power Over I_{DQ}



Drain Current vs. Input Power Over I_{DQ}



Gate Current vs. Input Power Over I_{DQ}



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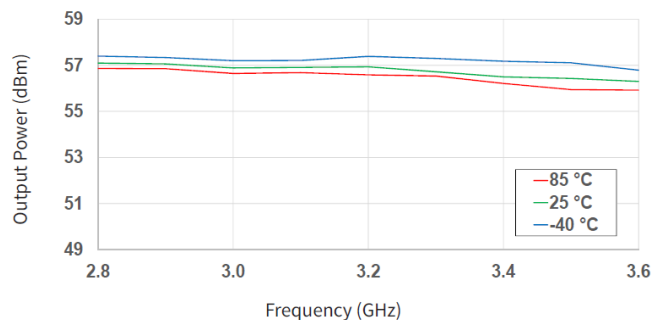
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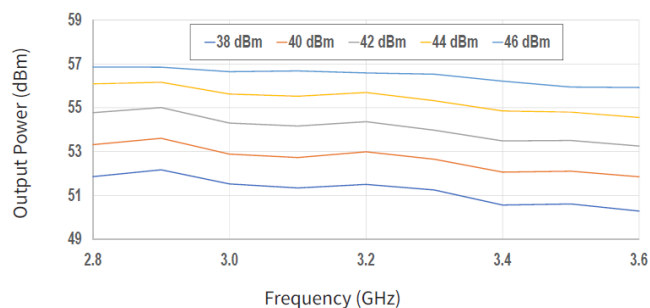
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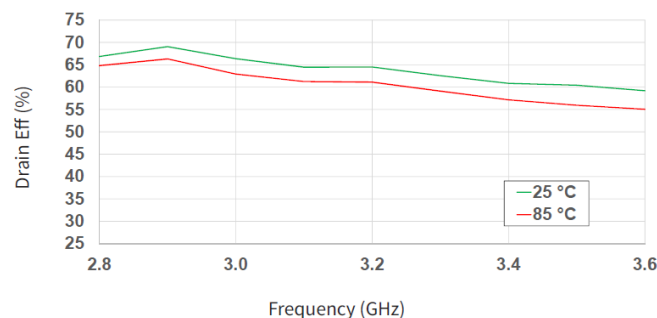
Output Power vs. Frequency over Temperature



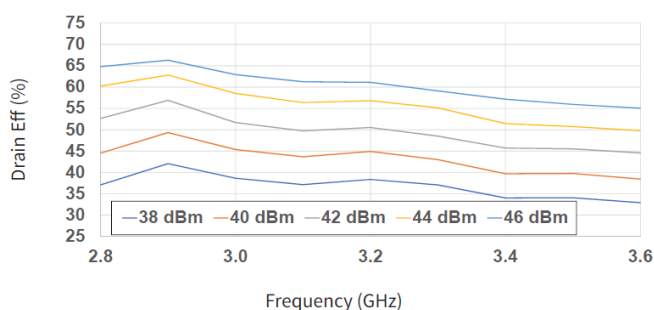
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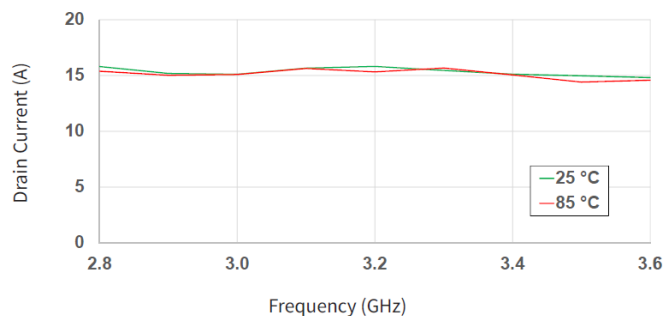
Drain Efficiency vs. Frequency over Temperature



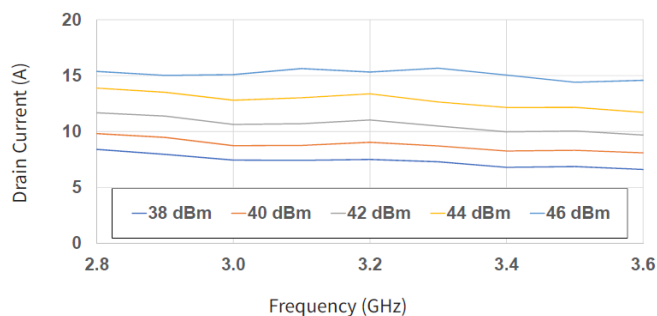
Drain Efficiency vs. Frequency over Input Power



Drain Current vs. Frequency over Temperature



Drain Current vs. Frequency over Input Power



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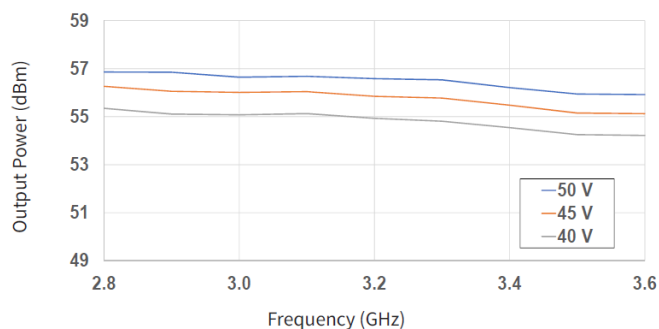
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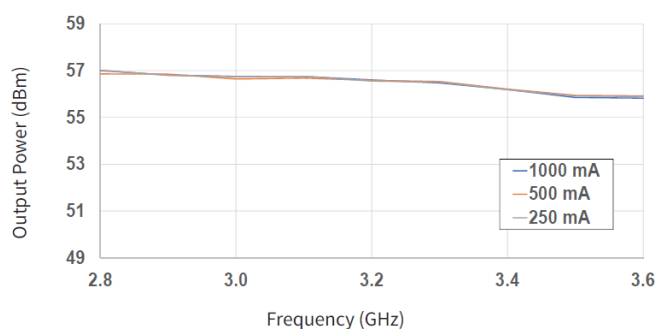
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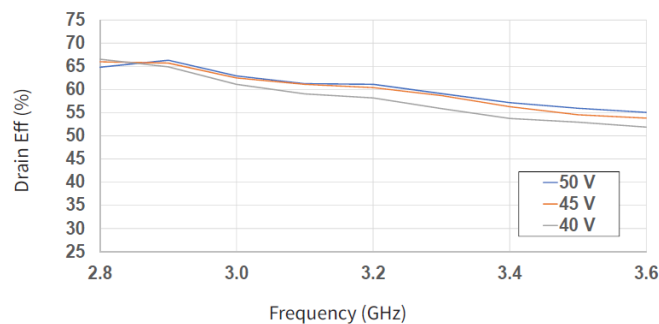
Output Power vs. Frequency over Voltage



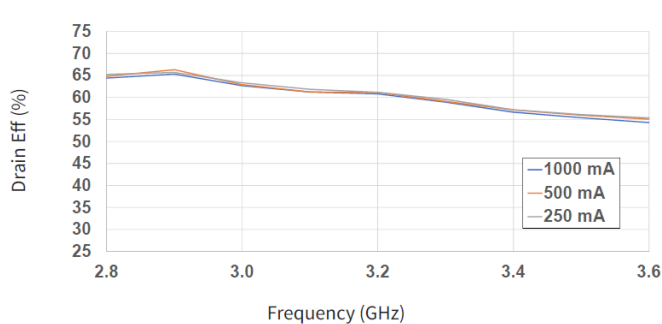
Output Power vs. Frequency over I_{DQ}



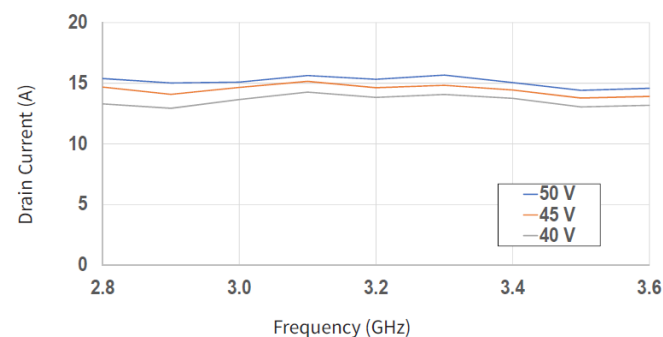
Drain Efficiency vs. Frequency over Voltage



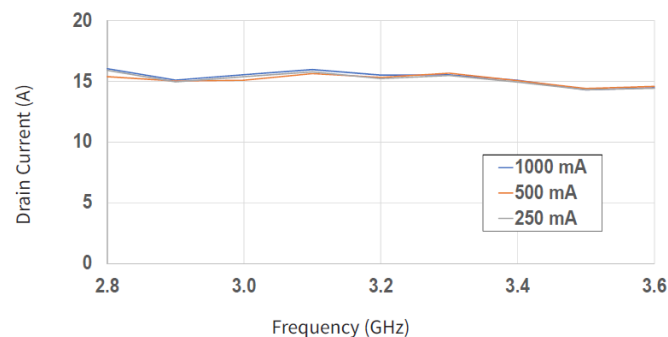
Drain Efficiency vs. Frequency over I_{DQ}



Drain Current vs. Frequency over Voltage



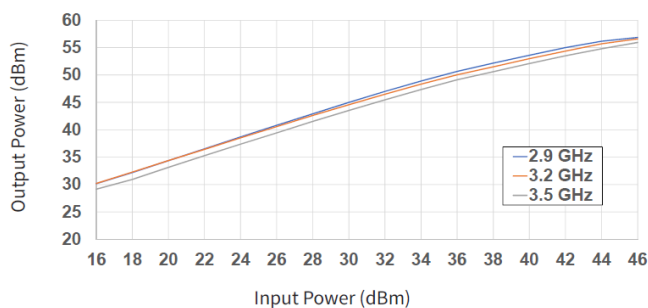
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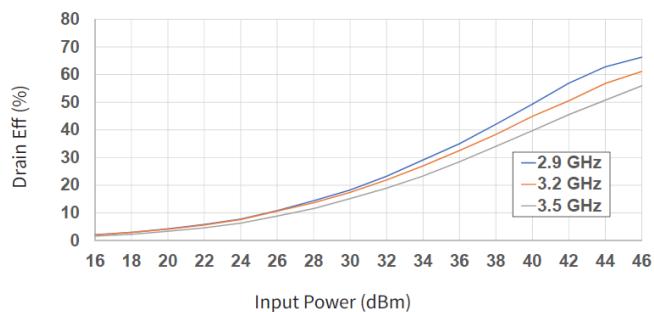
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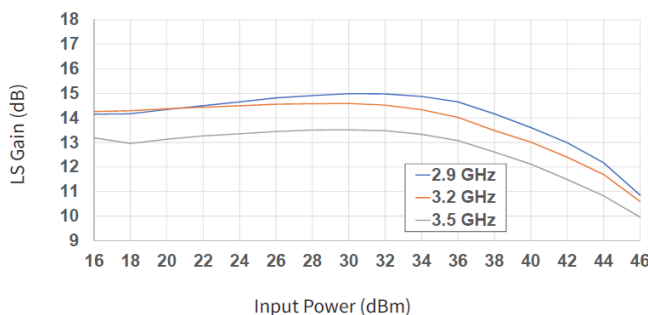
Output Power vs. Input Power over Frequency



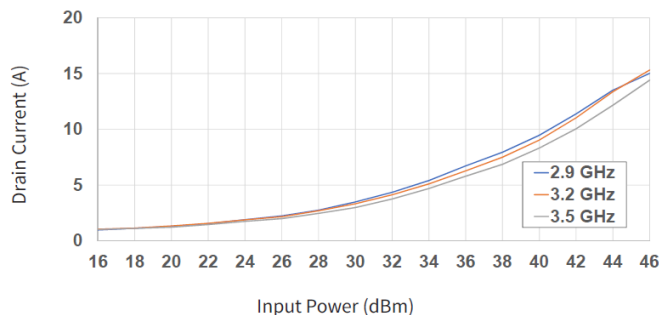
Drain Efficiency vs. Input Power over Frequency



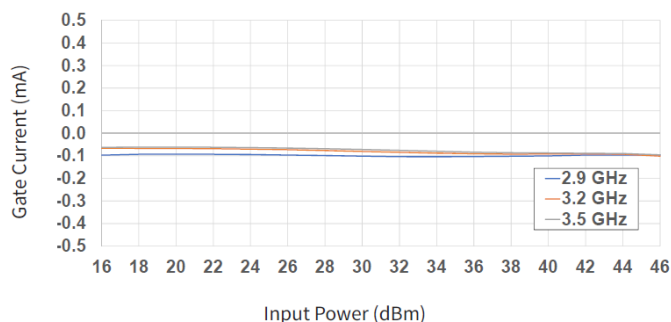
LS Gain vs. Input Power over Frequency



Drain Current vs. Input Power over Frequency



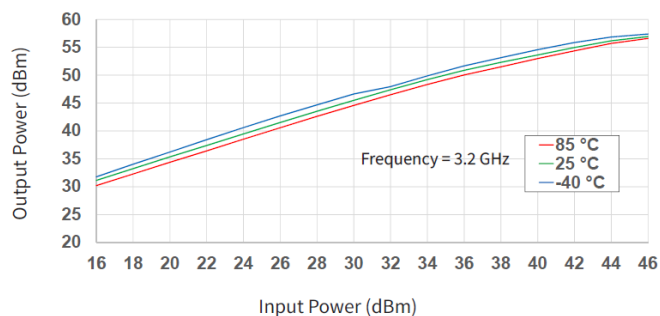
Gate Current vs. Input Power over Frequency



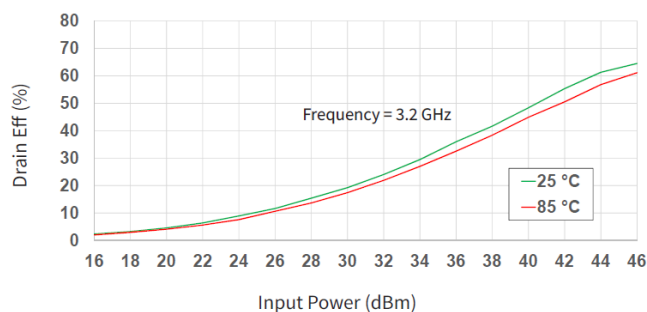
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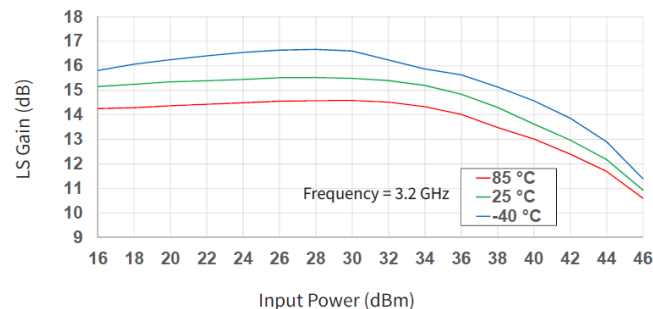
Output Power vs. Input Power over Temperature



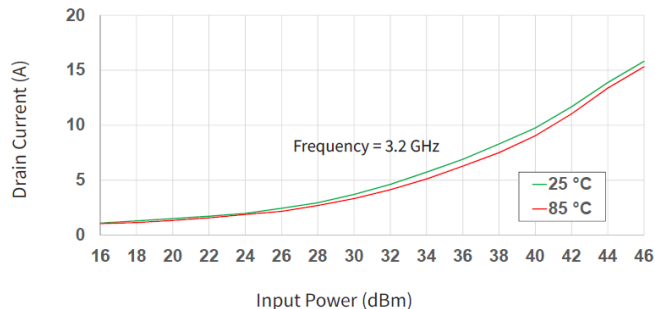
Drain Efficiency vs. Input Power over Temperature



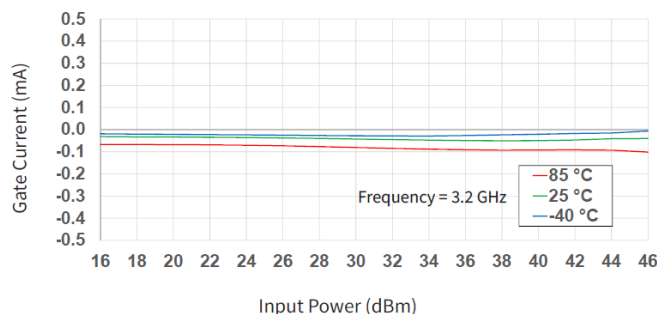
LS Gain vs. Input Power over Temperature



Drain Current vs. Input Power over Temperature



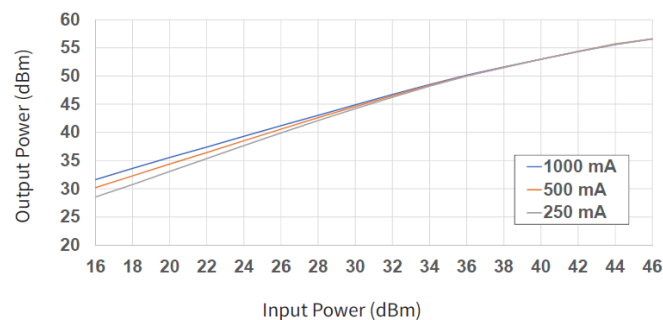
Gate Current vs. Input Power over Temperature



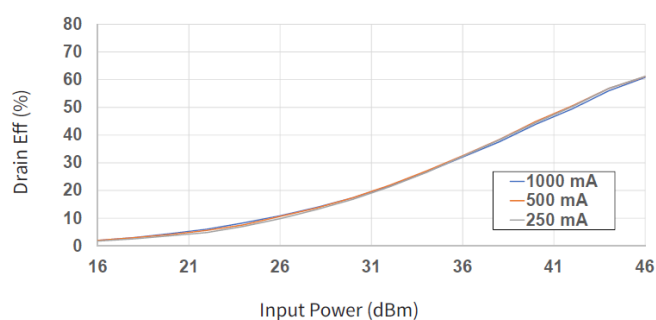
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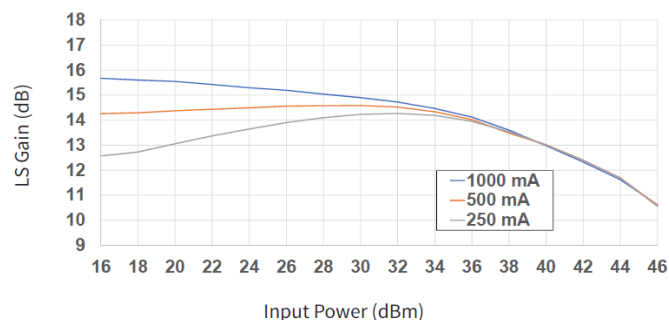
Output Power vs. Input Power over I_{DQ}



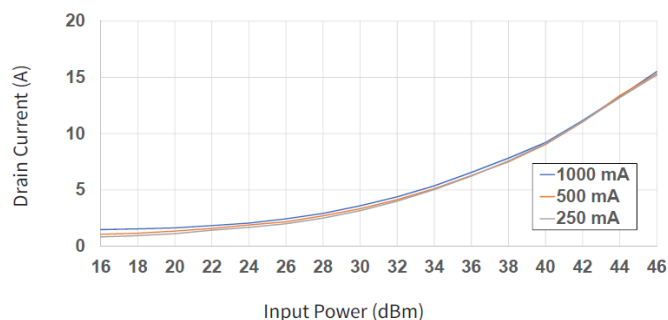
Drain Efficiency vs. Input Power over I_{DQ}



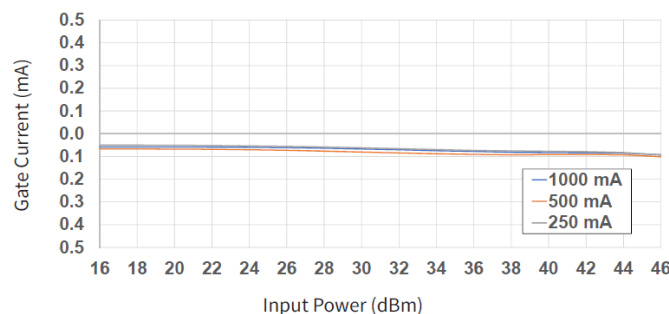
LS Gain vs. Input Power over I_{DQ}



Drain Current vs. Input Power over I_{DQ}



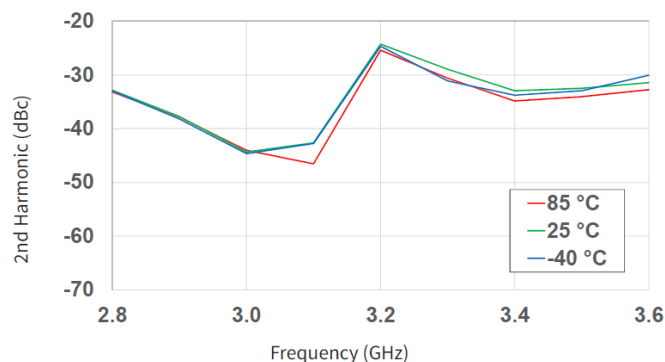
Gate Current vs. Input Power over I_{DQ}



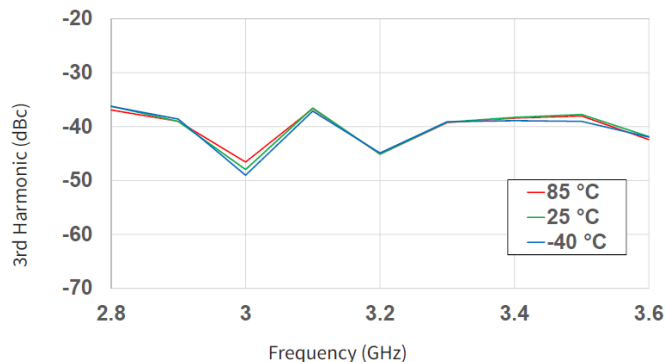
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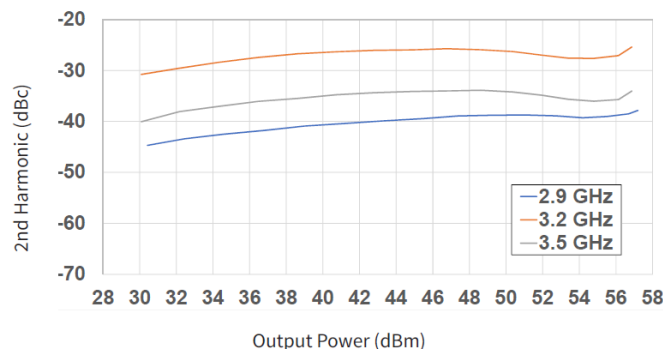
2nd Harmonic vs. Frequency over Temperature



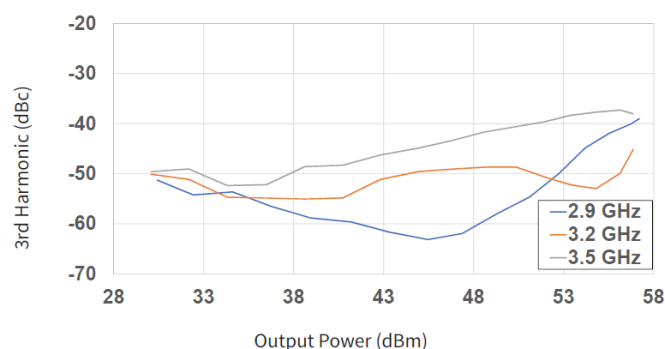
3rd Harmonic vs. Frequency over Temperature



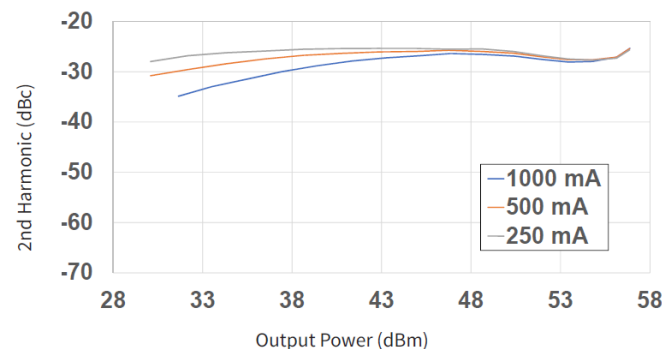
2nd Harmonic vs. Output Power over Frequency



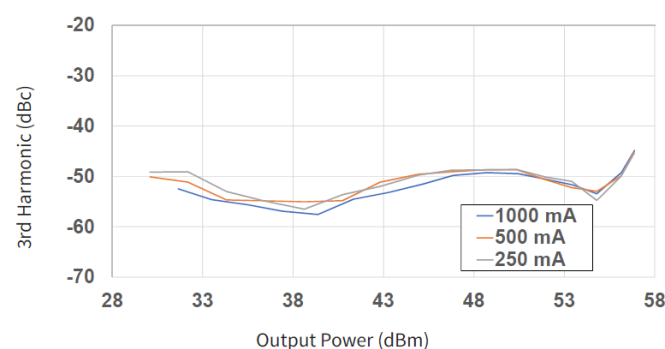
3rd Harmonic vs. Output Power over Frequency



2nd Harmonic vs. Output Power over I_{DQ}



3rd Harmonic vs. Output Power over I_{DQ}



GaN Amplifier 50 V, 400 W 2.9 - 3.5 GHz



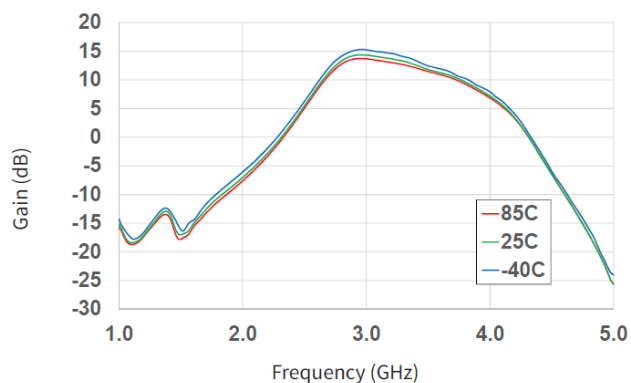
CGHV35400F1

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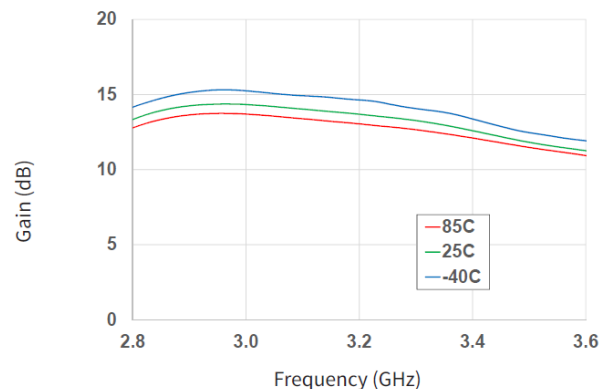
Typical Performance Curves:

$V_D = 50$ V, $I_{DQ} = 500$ mA, $P_{IN} = -20$ dBm, $T_B = +25^\circ\text{C}$

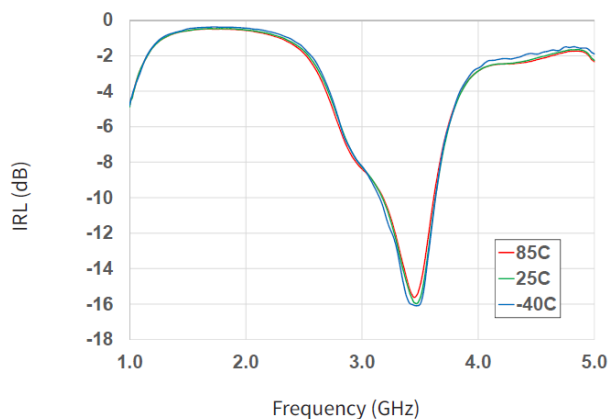
Gain vs. Frequency over Temperature



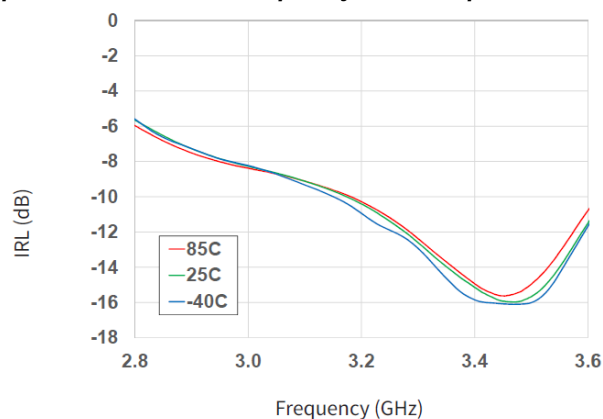
Gain vs. Frequency over Temperature



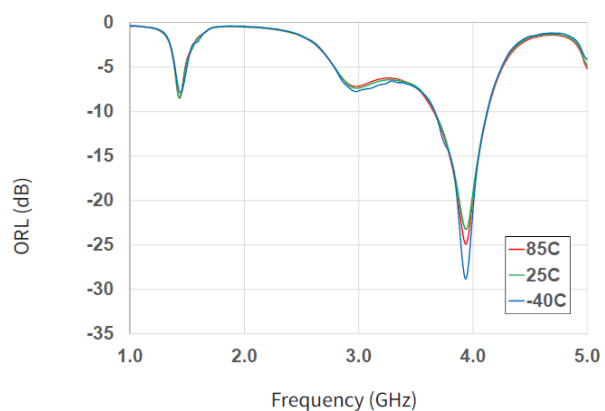
Input Return Loss vs. Frequency over Temperature



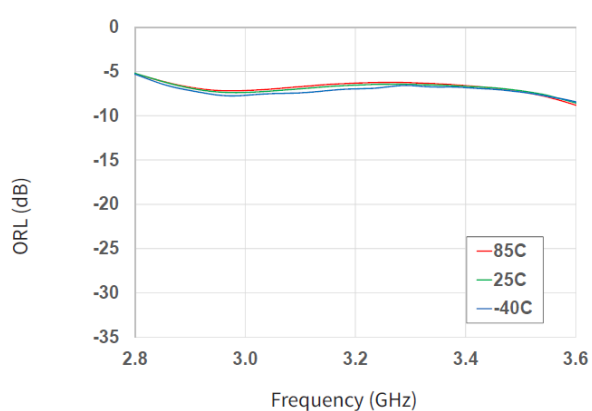
Input Return Loss vs. Frequency over Temperature



Output Return Loss vs. Frequency over Temperature



Output Return Loss vs. Frequency over Temperature



GaN Amplifier 50 V, 400 W

2.9 - 3.5 GHz



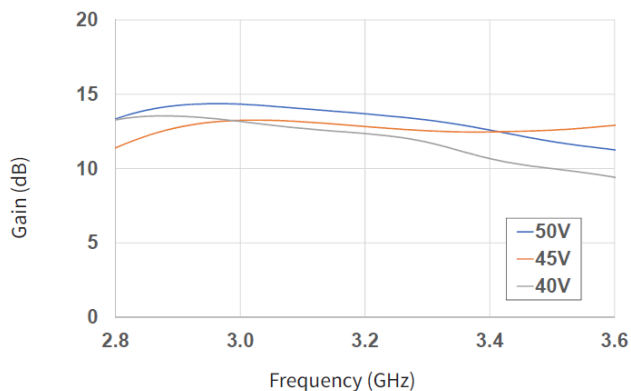
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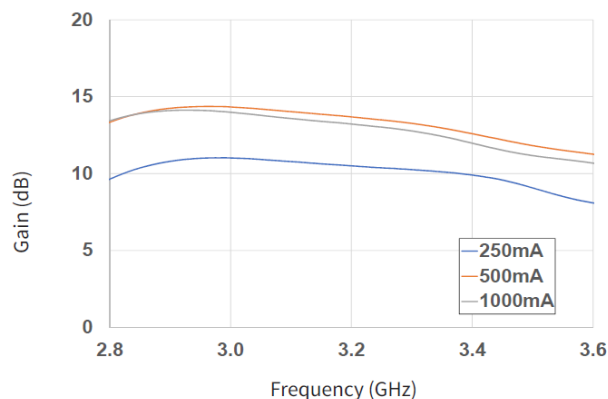
Typical Performance Curves:

$V_D = 50 \text{ V}$, $I_{DQ} = 500 \text{ mA}$, $P_{IN} = -20 \text{ dBm}$, $T_B = +25^\circ\text{C}$

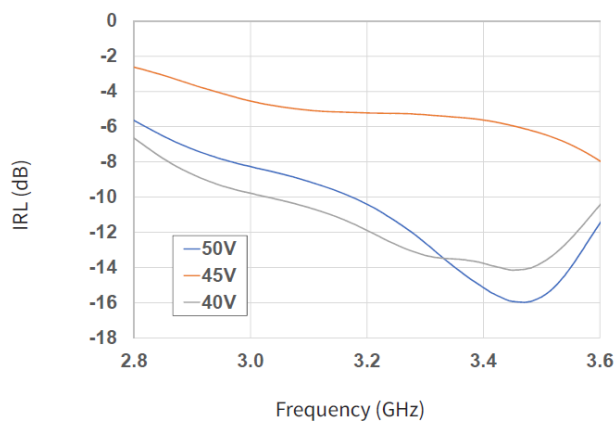
Gain vs. Frequency over Voltage



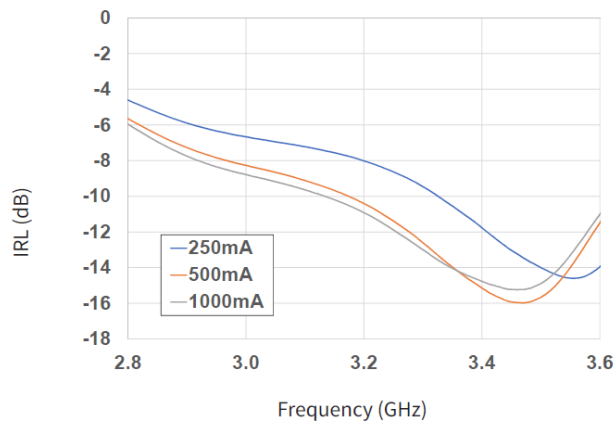
Gain vs. Frequency over I_{DQ}



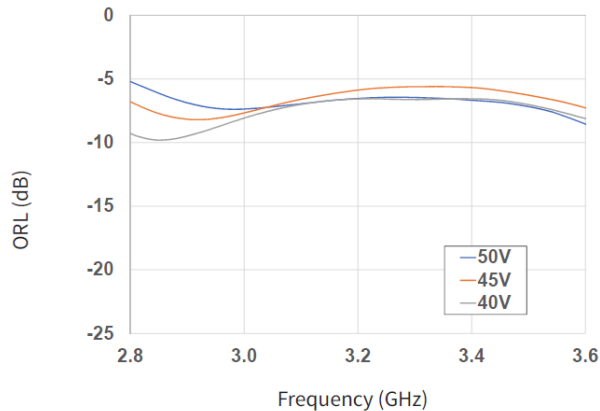
Input Return Loss vs. Frequency over Voltage



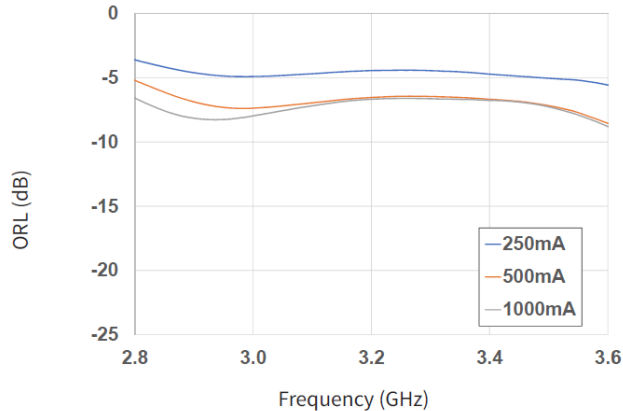
Input Return Loss vs. Frequency over I_{DQ}



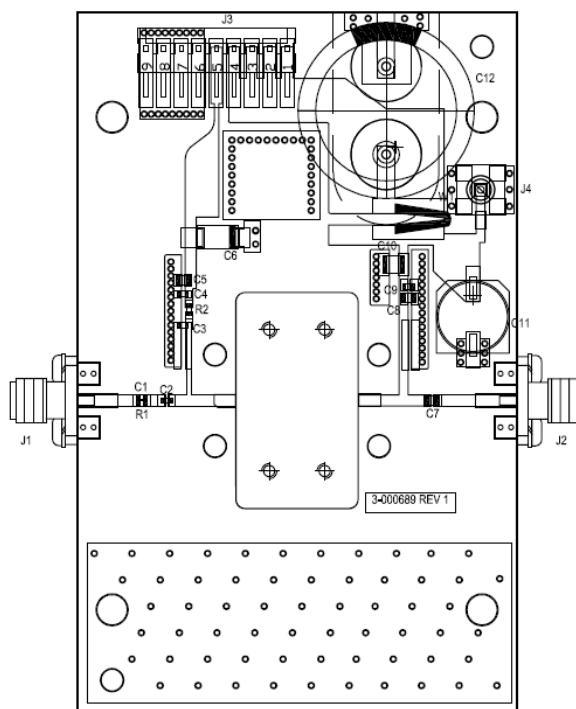
Output Return Loss vs. Frequency over Voltage



Output Return Loss vs. Frequency over I_{DQ}



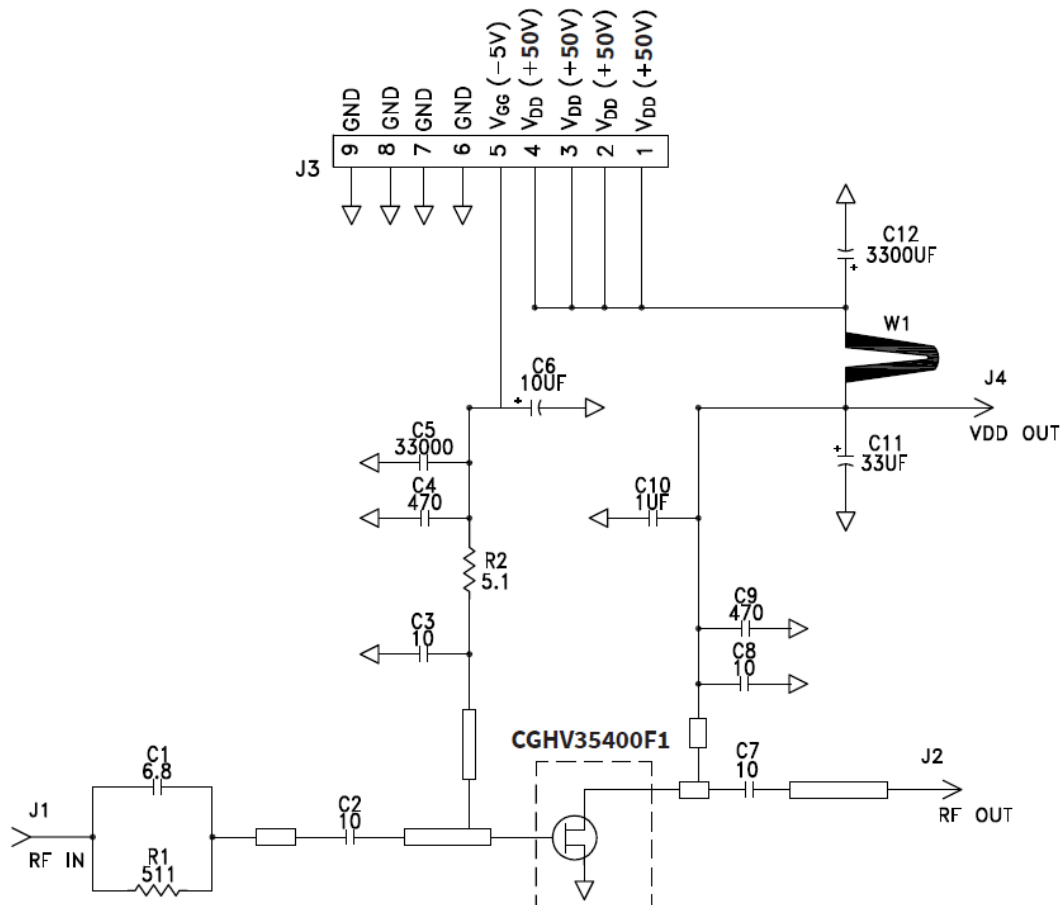
Assembly Drawing



Parts List

Designator	Description	QTY.
C1	CAP, 6.8 pF, +/-0.25%, 250V, 0603	1
C2, C7, C8	CAP, 10 pF, +/-1%, 250V, 0805	3
C3	CAP, 10 pF, +/-5%, 250V, 0603	1
C4, C9	CAP, 470 pF, 5%, 100V, 0603, X	2
C5	CAP, 33000 pF, 0805, 100V, X7R	1
C6	CAP, 10 µF, 16V, TANTALUM	1
C10	CAP, 1 µF, 100V, 10%, X7R, 1210	1
C11	CAP, 33 µF, 20%, G CASE	1
C12	CAP, 3300 µF, +/-20%, 100V, ELECTROLYTIC	1
J1, J2	CONN, SMA, PANEL MOUNT JACK, FL	2
J3	HEADER, RT>PLZ, 0.1CEN LK 9POS	1
J4	CONNECTOR; SMB, Straight, JACK, SMD	1
R1	RES, 511 Ω, +/- 1%, 1/16W, 0603	1
R2	RES, 5.1 Ω, +/- 1%, 1/16W, 0603	1
W1	CABLE, 18 AWG, 4.2	1
—	PCB, RO4350, 2.5 X 4.0 X 0.030	1
Q1	CGHV35400F1	1

Application Circuit Schematic



GaN Amplifier 50 V, 400 W 2.9 - 3.5 GHz



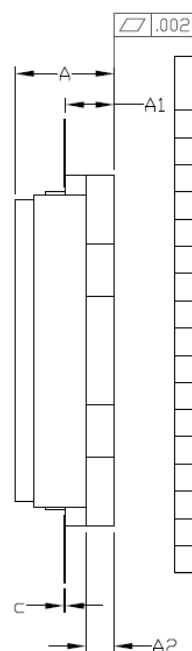
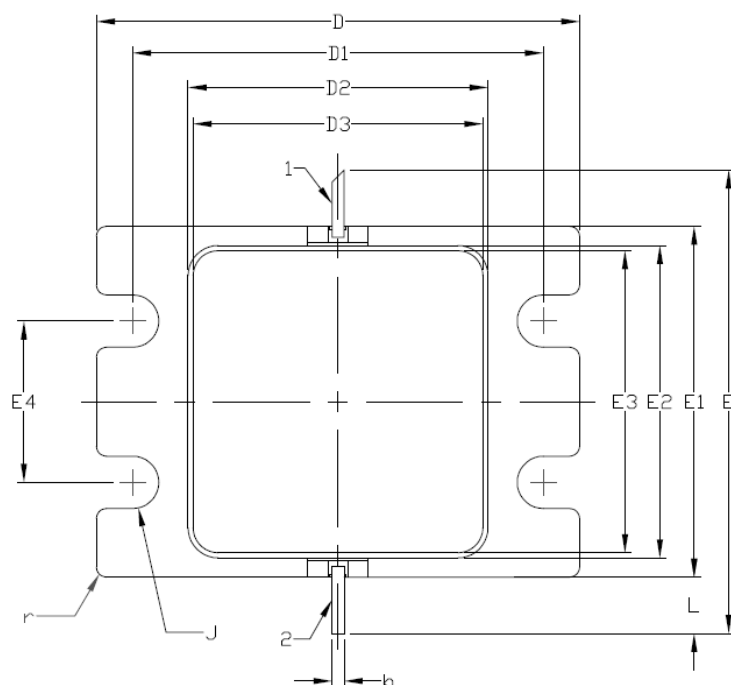
CGHV35400F1

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Product Dimensions (Package Type 440226)

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. INTERPRET DRAWING IN ACCORDANCE WITH ANSI Y14.5M-2009
2. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF .020 BEYOND EDGE OF LID
3. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF .008 IN ANY DIRECTION
4. ALL PLATED SURFACES ARE GOLD OVER NICKEL



1. GATE
2. DRAIN

DIM	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.185	0.201	4.70	5.11	
A1	0.088	0.100	2.24	2.54	2x
A2	0.049	0.061	1.24	1.55	
b	0.022	0.026	0.56	0.66	2x
c	0.003	0.006	0.08	0.15	
D	0.935	0.955	23.75	24.26	
D1	0.797	0.809	20.24	20.55	2x
D2	0.581	0.593	14.76	15.06	
D3	0.565	0.571	14.35	14.50	
E	0.906		23.01		REF
E1	0.679	0.691	17.25	17.55	
E2	0.604	0.616	15.34	15.65	
E3	0.588	0.594	14.93	15.09	
E4	0.309	0.321	7.85	8.15	2x
J	Ø0.097	Ø0.107	Ø2.46	Ø2.72	4x
L	0.090	0.130	2.29	3.30	2x
r	0.02 TYP		0.51 TYP		12x

Pin #	Description
1	Gate / RFIN
2	Drain / RFOUT
3	Source / Flange

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