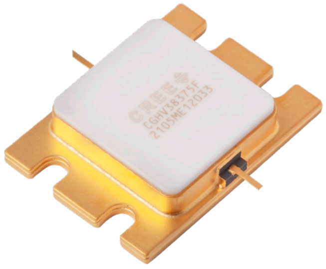
CGHV38375F

400 W, 2.75 - 3.75 GHz, Internally-Matched, GaN on SiC Transistor (IM-FET)

Description

Wolfspeed's CGHV38375F is a packaged, 400 W HPA matched to 50 ohms at both input and output ports. The CGHV38375F operates from 2.75 - 3.75 GHz providing coverage over the entire S-Band radar band. This high-power amplifier provides >10 dB of large signal gain and 40% power-added efficiency and is ideally suited as a high-power building block supporting both pulsed and CW radar applications.



PN: CGHV38375F
Package Type: 440226

Typical Performance Over 2.75 - 3.75 GHz (T_C = 25˚C)

Parameter	2.75 GHz	2.9 GHz	3.3 GHz	3.5 GHz	3.75 GHz	Units
Small Signal Gain[1,2]	10.0	12.5	12.6	12.6	13.5	dB
Output Power[1,3]	55.9	57.4	57.5	57.7	56.8	dBm
Power Gain[1,3]	9.9	11.4	11.5	11.7	10.8	dB
Drain Efficiency[1,3]	50	67	62	60	60	%

Notes:
[1] V_{DD} = 50 V, I_{DQ} = 500 mA
[2] Measured at Pin = -10 dBm
[3] Measured at Pin = 46 dBm and 100 µs; Duty Cycle = 10%

Features

- Full S-Band Radar Coverge
- 400 W Typical P_{SAT}
- 55% Typical Drain Efficiency
- >10 dB Large Signal Gain
- Pulsed and CW Operation

Note: Features are typical performance across frequency under 25°C, pulsed operation. Please reference performance charts for additional details.

Applications

- Civil and Military, Pulsed and CW S-Band Radar

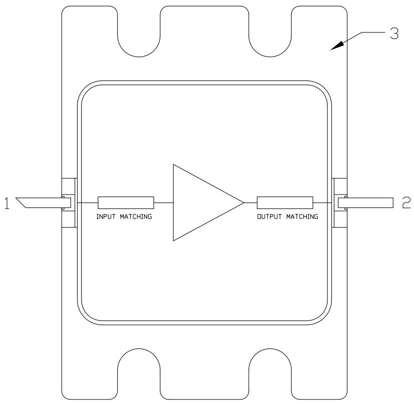


Figure 1.

RoHS COMPLIANT

Absolute Maximum Ratings (not simultaneous) at 25˚C

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DSS}	150	VDC	25°C
Gate-source Voltage	V_{GS}	-10, +2	VDC	25°C
Storage Temperature	T_{STG}	-55, +150	˚C	
Maximum Forward Gate Current	I_G	80	mA	25°C
Maximum Drain Current	I_{DMAX}	24	A	
Soldering Temperature	T_S	260	˚C	
Junction Temperature	T_J	225	˚C	MTTF > 1e6 Hours

Electrical Characteristics (Frequency = 2.75 GHz to 3.75 GHz unless otherwise stated; T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{GS(TH)}$	-3.8	-3.0	-2.3	V	V_{DS} = 10 V, I_D = 83.6 mA
Gate Quiescent Voltage	$V_{GS(Q)}$	–	-2.7	–	V_{DC}	V_{DD} = 50 V, I_{DQ} = 500 mA
Saturated Drain Current[1]	I_{DS}	54.4	77.7	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BD}	125	–	–	V	V_{GS} = -8 V, I_D = 83.6 mA
RF Characteristics[2]						
Small Signal Gain	$S21_1$	–	12.5	–	dB	Pin = -10 dBm, Freq = 2.75 - 3.75 GHz
Output Power	P_{OUT1}	–	55.9	–	dBm	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 2.75 GHz
Output Power	P_{OUT2}	–	57.4	–	dBm	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 2.9 GHz
Output Power	P_{OUT3}	–	57.5	–	dBm	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 3.3 GHz
Output Power	P_{OUT4}	–	57.7	–	dBm	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 3.5 GHz
Output Power	P_{OUT5}	–	56.8	–	dBm	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm,Freq = 3.75 GHz
Drain Efficiency	DE_1	–	50	–	%	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 2.75 GHz
Drain Efficiency	DE_2	–	67	–	%	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 2.9 GHz
Drain Efficiency	DE_3	–	62	–	%	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 3.3 GHz
Drain Efficiency	DE_4	–	60	–	%	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 3.5 GHz
Drain Efficiency	DE_5	–	60	–	%	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 3.75 GHz
Power Gain	G_{P2}	–	9.9	–	dB	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 2.75 GHz
Power Gain	G_{P3}	–	11.4	–	dB	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 2.9 GHz
Power Gain	G_{P4}	–	11.5	–	dB	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 3.3 GHz
Power Gain	G_{P5}	–	11.7	–	dB	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 3.5 GHz
Power Gain	G_{P6}	–	10.8	–	dB	V_{DD} = 50 V, I_{DQ} = 500 mA, P_{IN} = 46 dBm, Freq = 3.75 GHz

Electrical Characteristics (Frequency = 2.75 GHz to 3.75 GHz unless otherwise stated; T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
RF Characteristics[2]						
Input Return Loss	S11	–	-6	–	dB	Pin = -10 dBm, 2.75 - 3.75 GHz
Output Return Loss	S22	–	-6	–	dB	Pin = -10 dBm, 2.75 - 3.75 GHz
Output Mismatch Stress	VSWR	–	–	5 : 1	Ψ	No damage at all phase angles

Notes:
[1] Scaled from PCM data
[2] Unless otherwise noted: Pulse Width = 100 µs, Duty Cycle = 10%

Thermal Characteristics

Parameter	Symbol	Rating	Units	Conditions
Operating Junction Temperature	T_J	177	˚C	Pulse Width = 100 µs, Duty Cycle =10%, P_{DISS} = 418 W, T_{CASE} = 85 ˚C
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.22	˚C/W	
Operating Junction Temperature	T_J	185	˚C	CW, P_{DISS} = 200 W, T_{CASE} = 85 ˚C
Thermal Resistance, Junction to Case	$R_{\theta JC}$	0.5	˚C/W	

Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 100 µs, Duty Cycle = 10%, Pin = 46 dBm, T_{BASE} = +25 °C

Figure 1. Output Power vs Frequency as a Function of Temperature

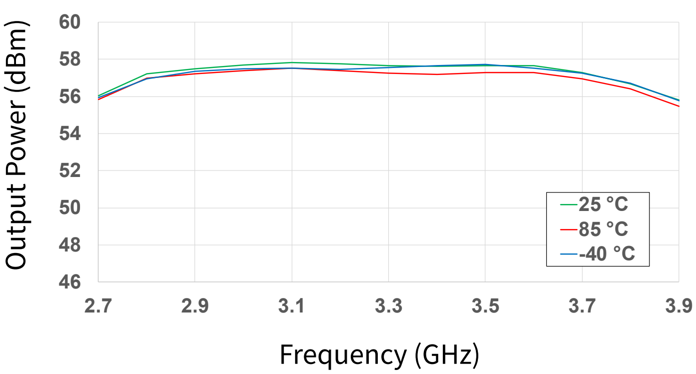


Figure 2. Output Power vs Frequency as a Function of Input Power

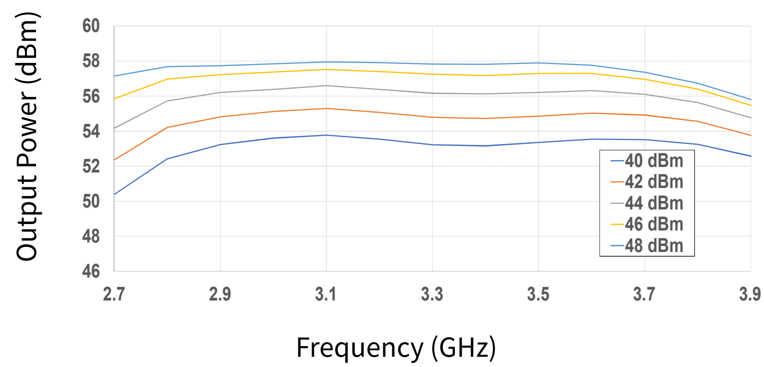


Figure 3. Drain Eff. vs Frequency as a Function of Temperature

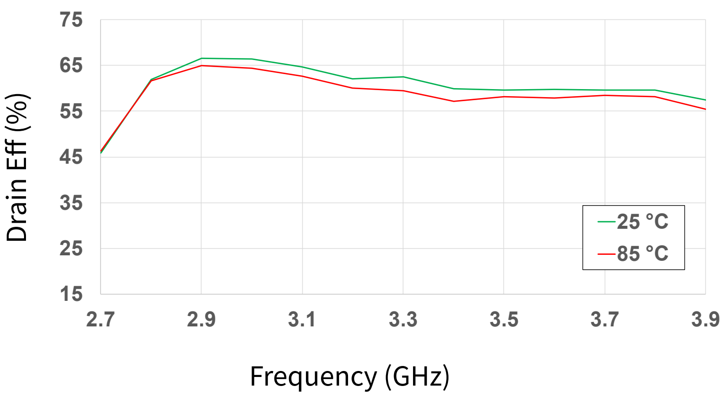


Figure 4. Drain Eff. vs Frequency as a Function of Input Power

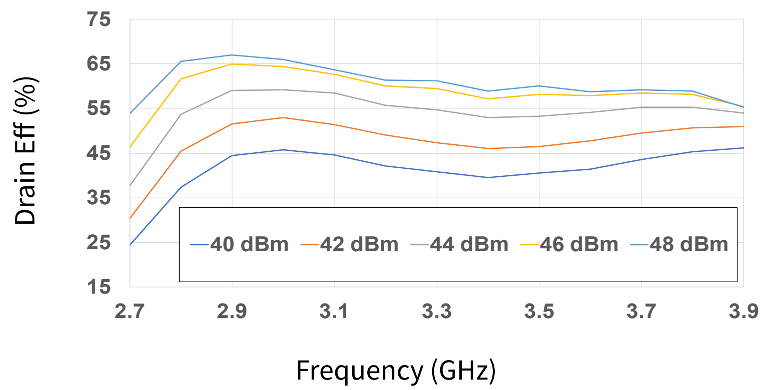


Figure 5. Drain Current vs Frequency as a Function of Temperature

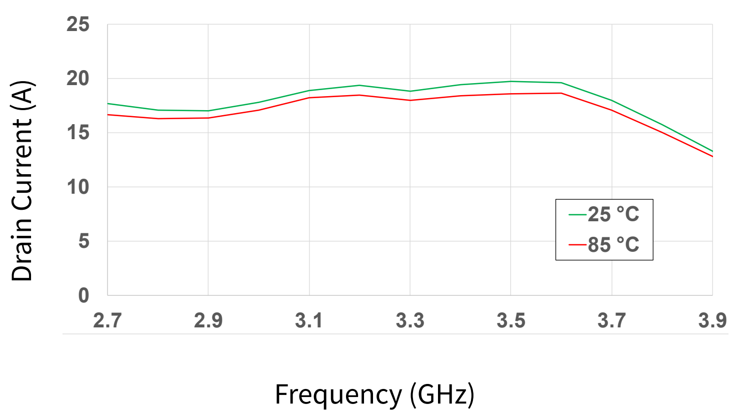
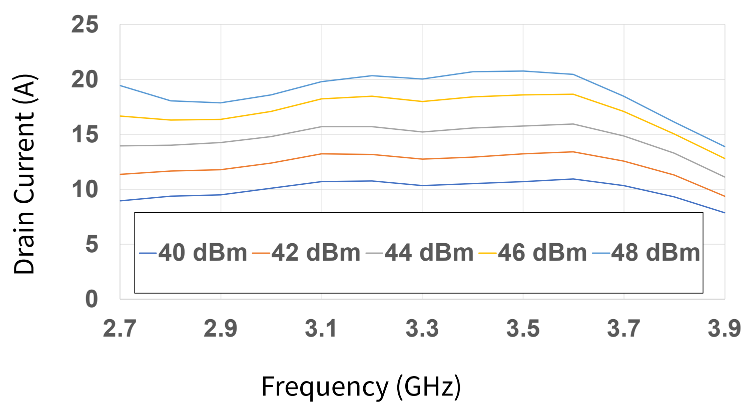


Figure 6. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 100 µs, Duty Cycle = 10%, Pin = 46 dBm, T_{BASE} = +25 °C

Figure 7. Output Power vs Frequency as a Function of VD

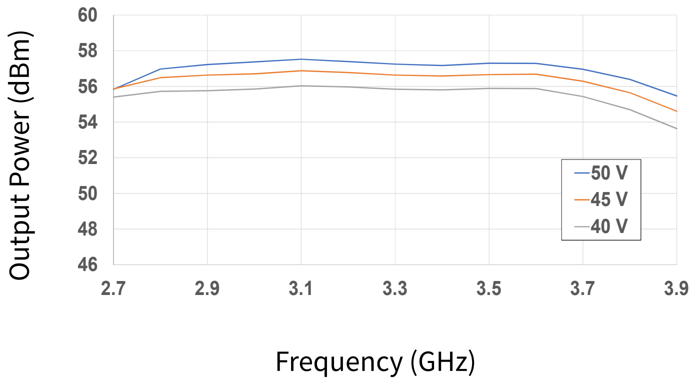


Figure 8. Output Power vs Frequency as a Function of IDQ

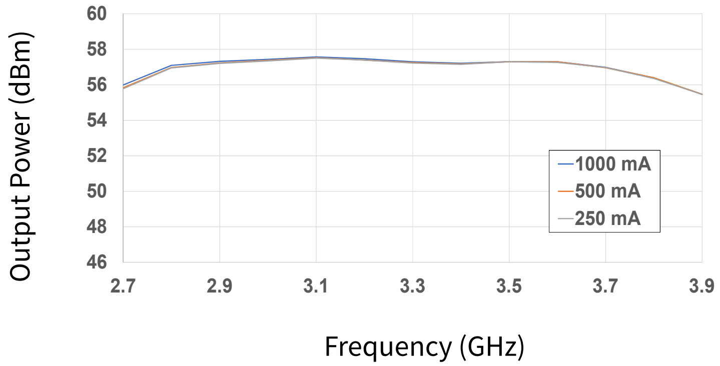


Figure 9. Drain Eff. vs Frequency as a Function of VD

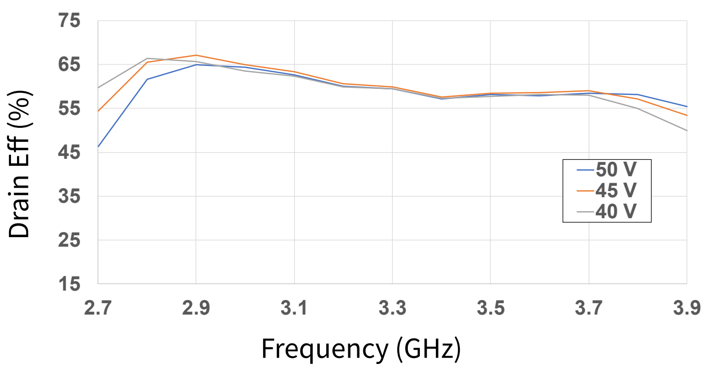


Figure 10. Drain Eff. vs Frequency as a Function of IDQ

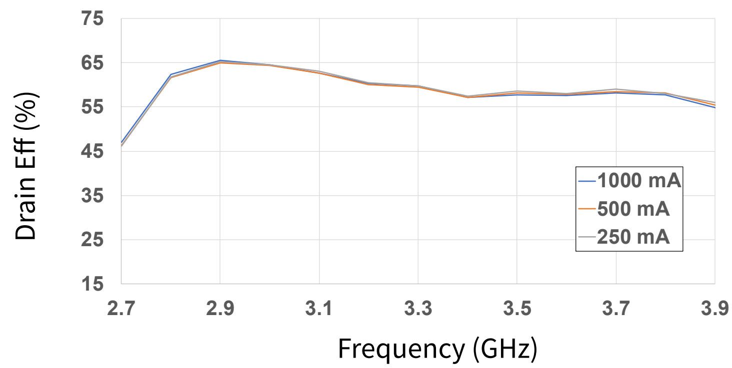


Figure 11. Drain Current vs Frequency as a Function of VD

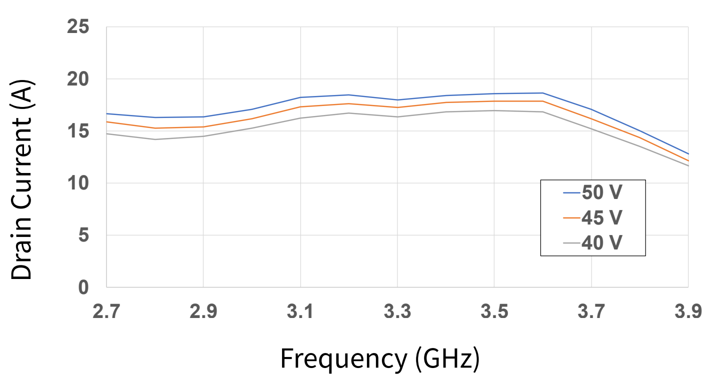
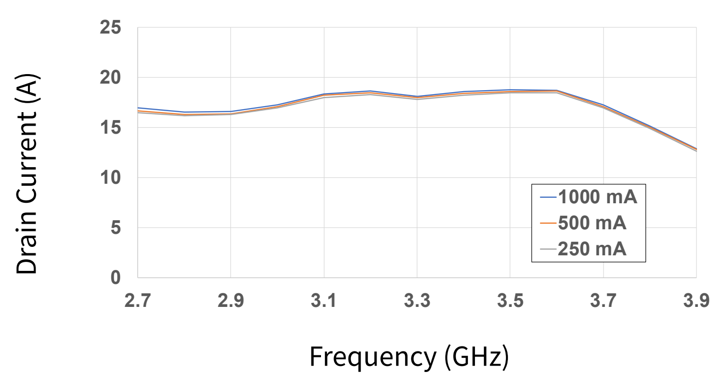


Figure 12. Drain Current vs Frequency as a Function of IDQ



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 100 µs, Duty Cycle = 10%, Pin = 46 dBm, T_{BASE} = +25 °C

Figure 13. Output Power vs Input Power as a Function of Frequency

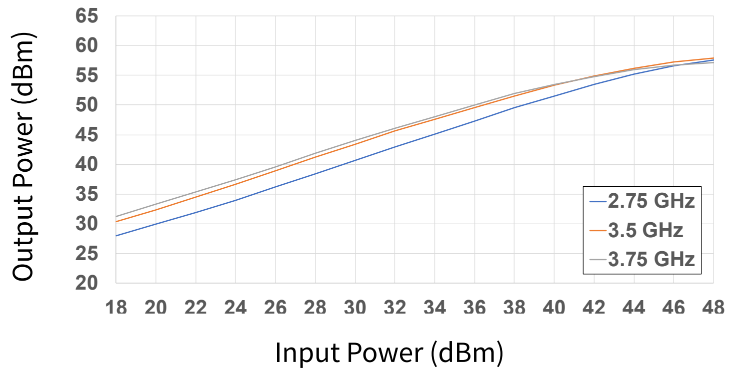


Figure 14. Drain Eff. vs Input Power as a Function of Frequency

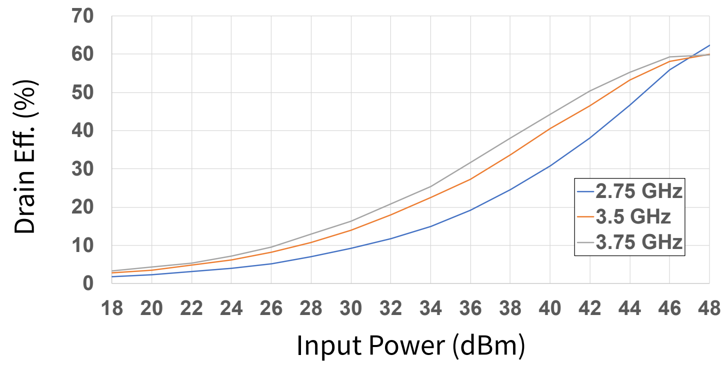


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

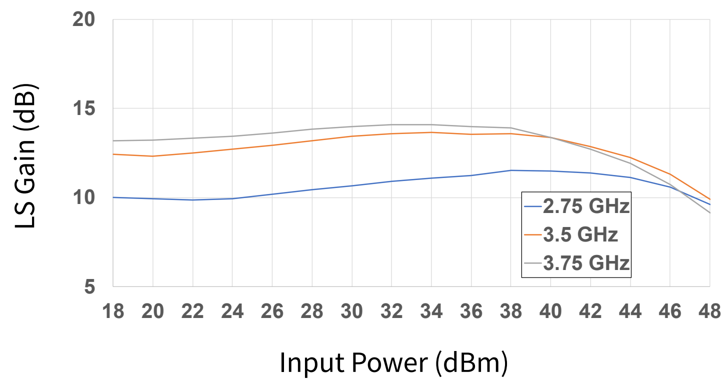


Figure 16. Drain Current vs Input Power as a Function of Frequency

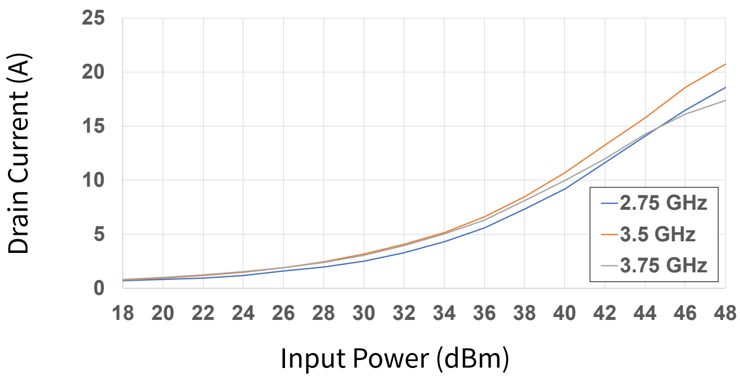
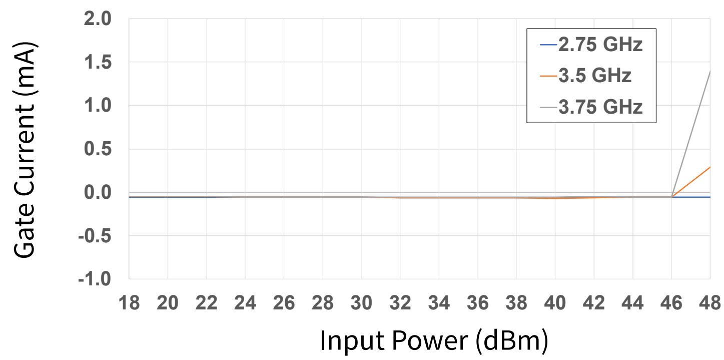


Figure 17. Gate Current vs Input Power as a Function of Frequency



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 100 µs, Duty Cycle = 10%, Pin = 46 dBm, T_{BASE} = +25 °C

Figure 18. Output Power vs Input Power as a Function of Temperature

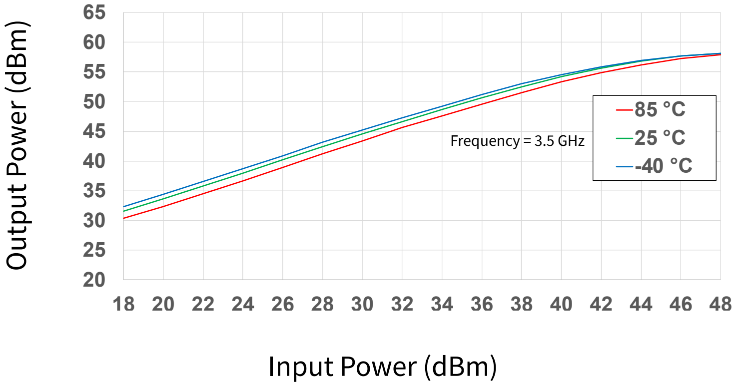


Figure 19. Drain Eff. vs Input Power as a Function of Temperature

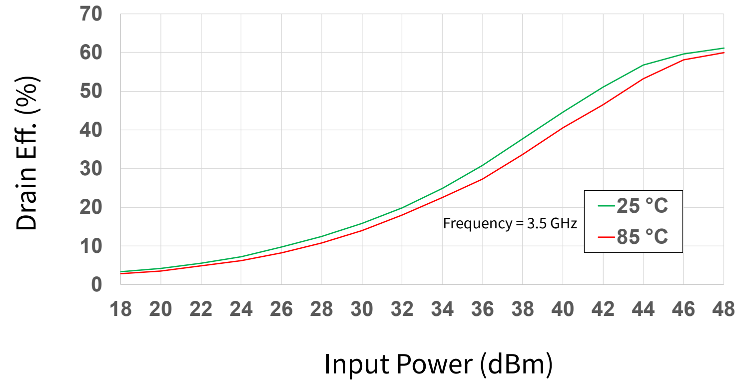


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

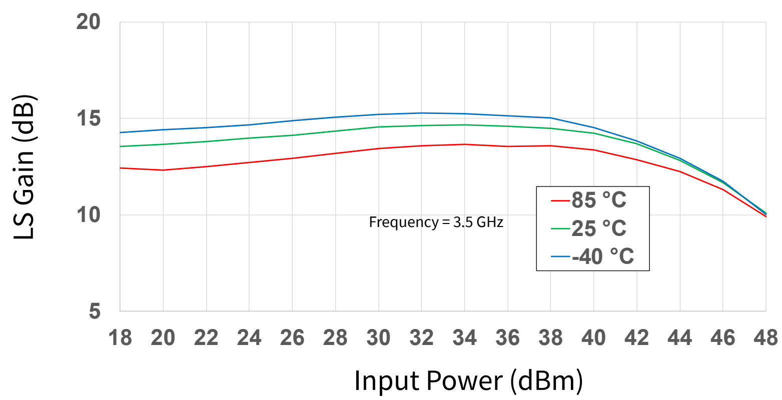


Figure 21. Drain Current vs Input Power as a Function of Temperature

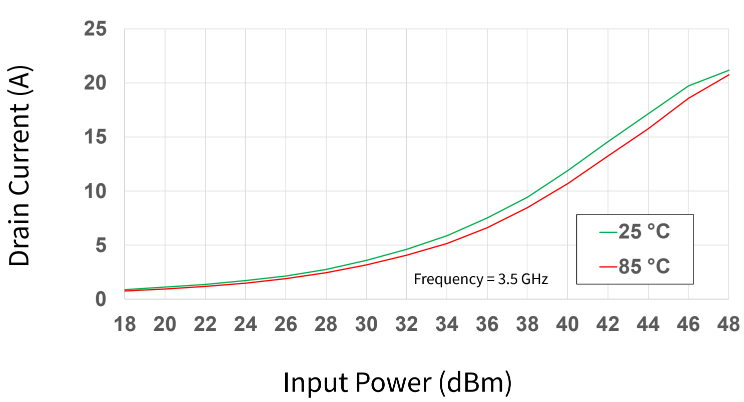
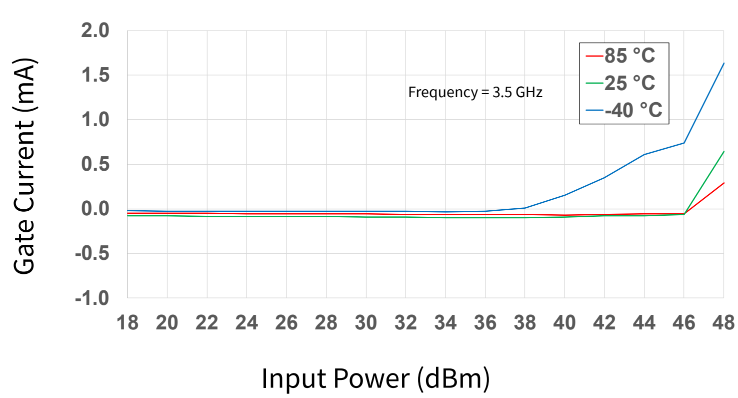


Figure 22. Gate Current vs Input Power as a Function of Temperature



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 100 µs, Duty Cycle = 10%, Pin = 46 dBm, T_{BASE} = +25 °C

Figure 23. Output Power vs Input Power as a Function of IDQ

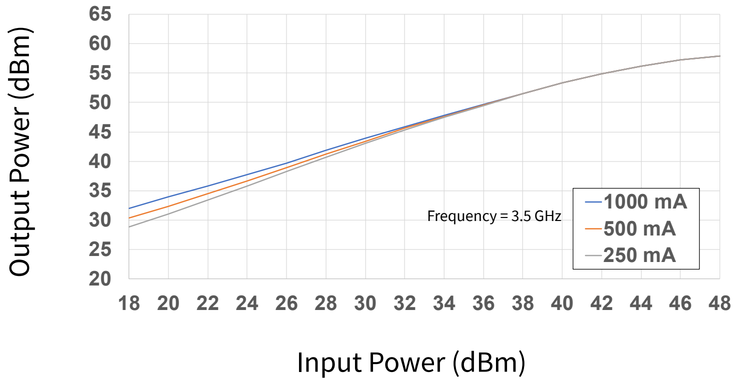


Figure 24. Drain Eff. vs Input Power as a Function of IDQ

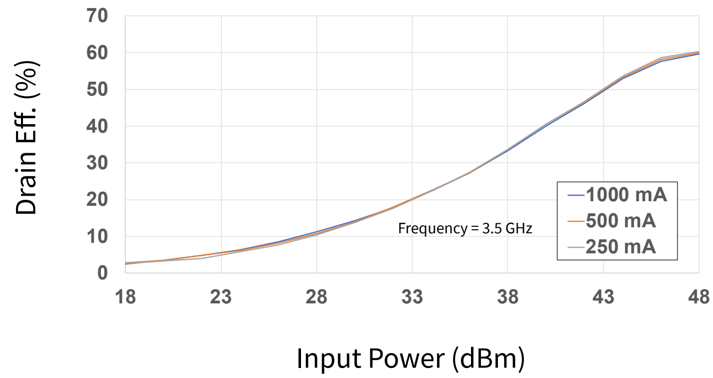


Figure 25. Large Signal Gain vs Input Power as a Function of IDQ

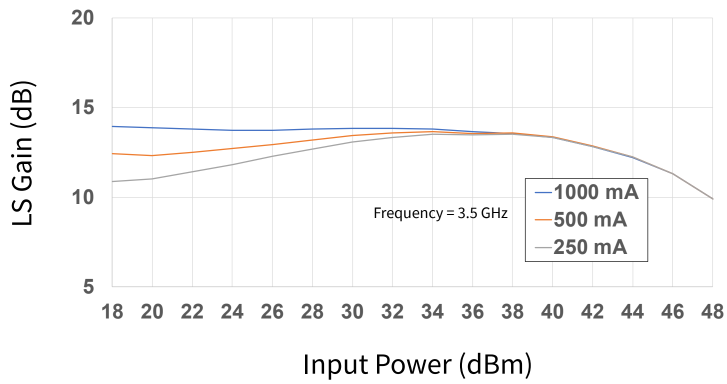


Figure 26. Drain Current vs Input Power as a Function of IDQ

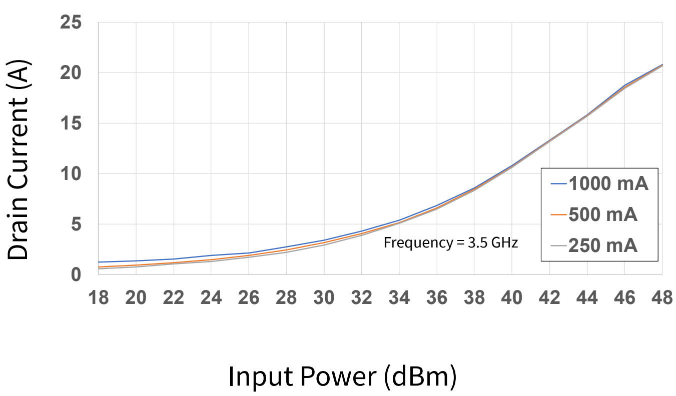
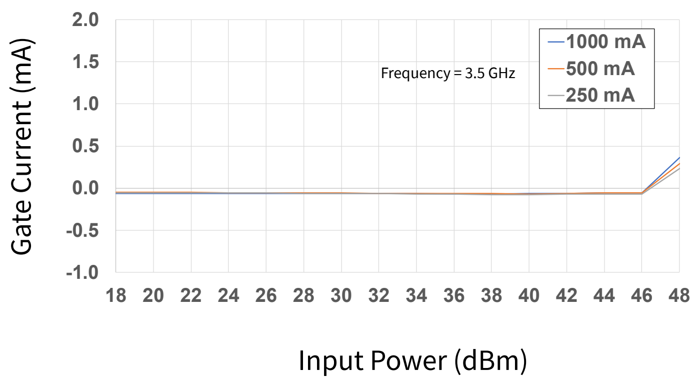


Figure 27. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, CW, Pin = 43 dBm, T_{BASE} = +25 °C

Figure 28. Output Power vs Frequency as a Function of Temperature

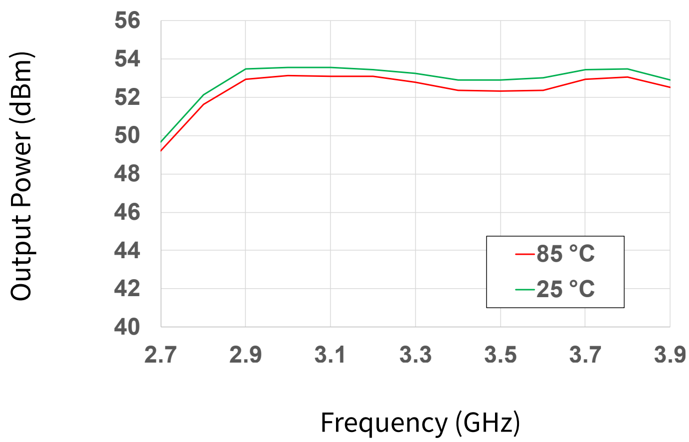


Figure 29. Output Power vs Frequency as a Function of Input Power

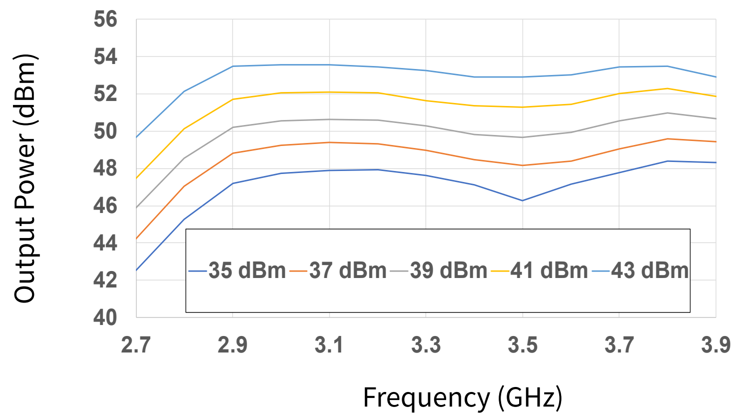


Figure 30. Drain Eff. vs Frequency as a Function of Temperature

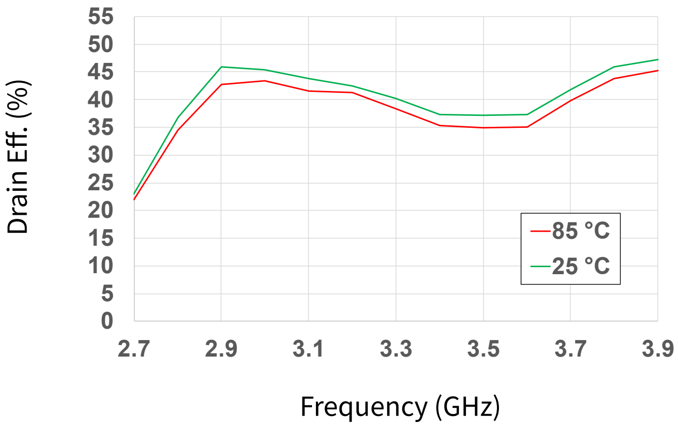


Figure 31. Drain Eff. vs Frequency as a Function of Input Power

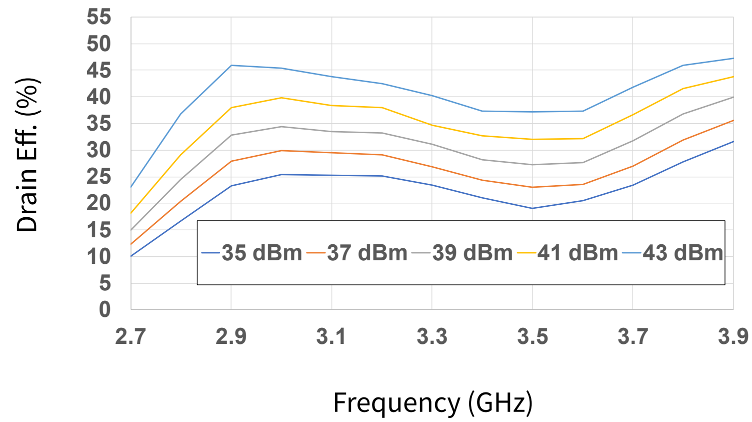


Figure 32. Drain Current vs Frequency as a Function of Temperature

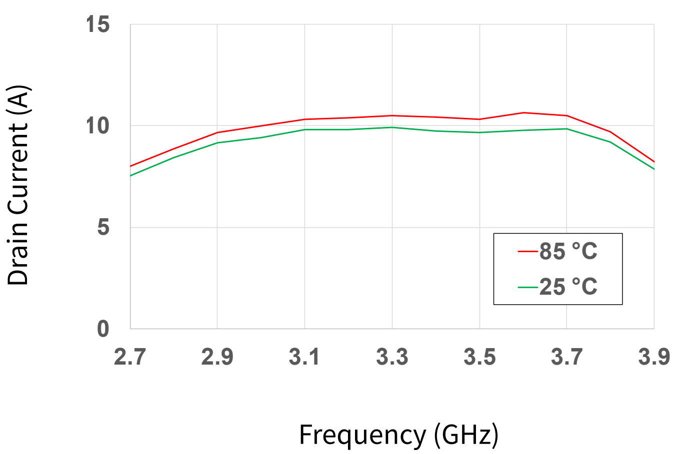
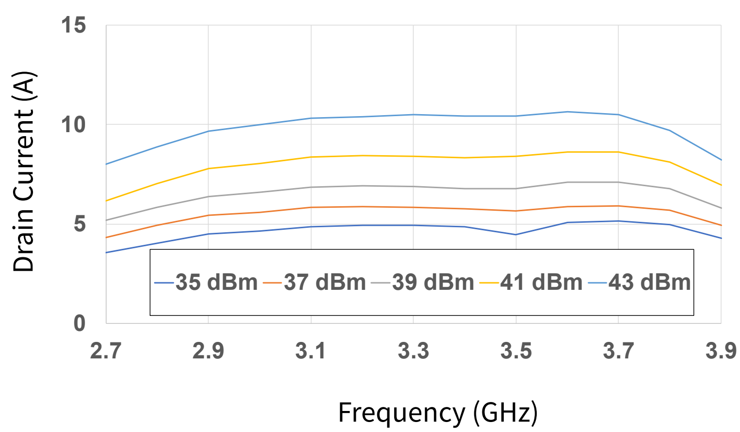


Figure 33. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, CW, Pin = 43 dBm, T_{BASE} = +25 °C

Figure 34. Output Power vs Frequency as a Function of Voltage

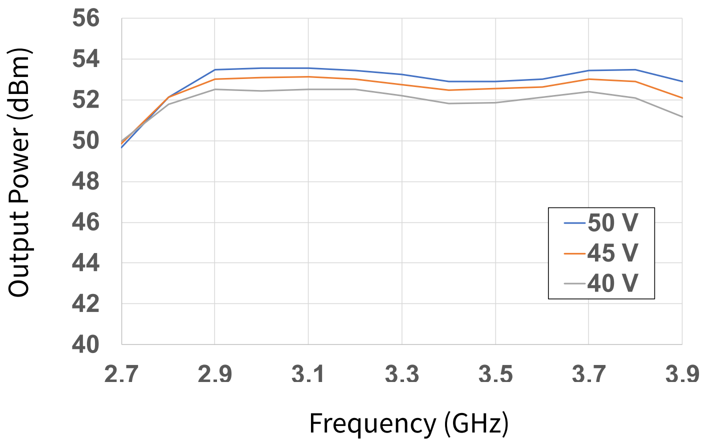


Figure 35. Output Power vs Frequency as a Function of IDQ

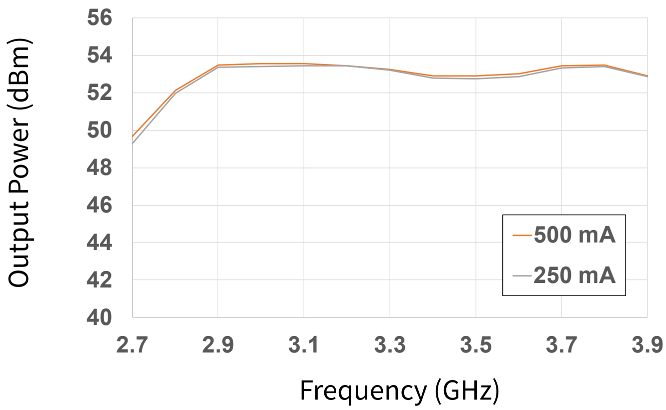


Figure 36. Drain Eff. vs Frequency as a Function of Voltage

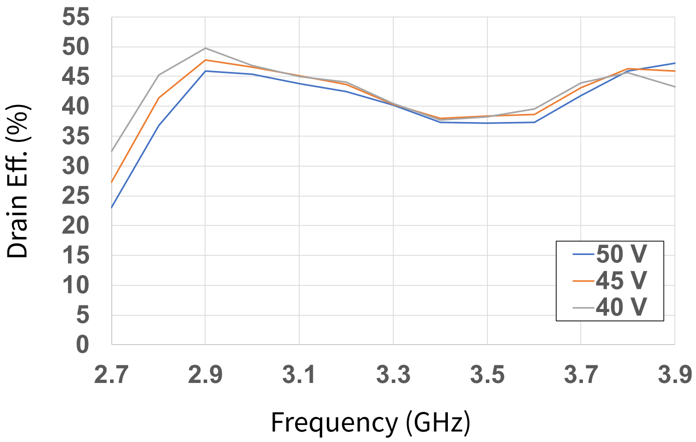


Figure 37. Drain Eff. vs Frequency as a Function of IDQ

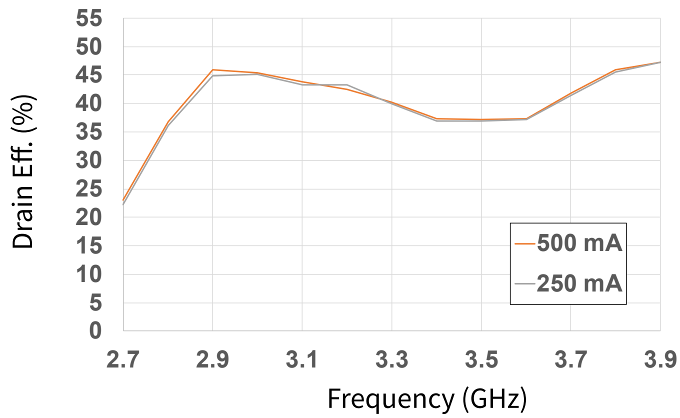


Figure 38. Drain Current vs Frequency as a Function of Voltage

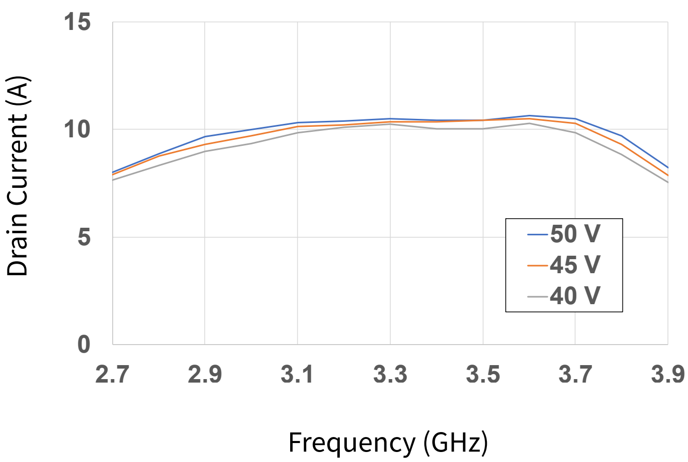
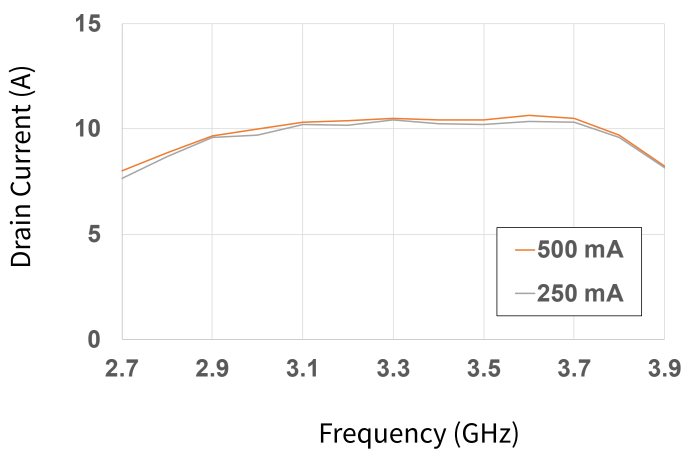


Figure 39. Drain Current vs Frequency as a Function of IDQ



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, CW, Pin = 43 dBm, T_{BASE} = +25 °C

Figure 40. Output Power vs Input Power as a Function of Frequency

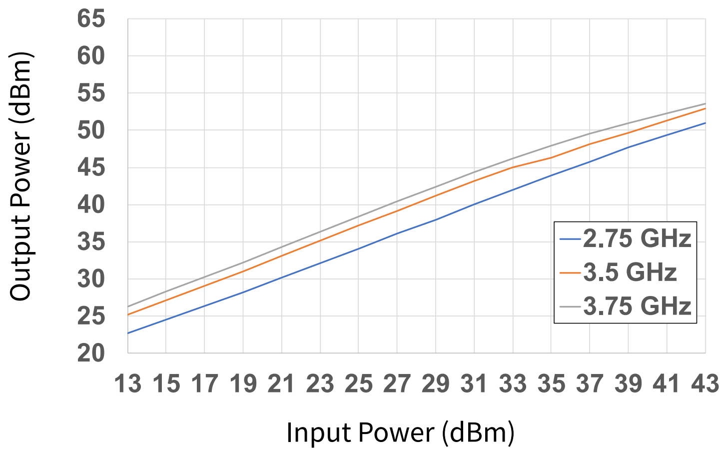


Figure 41. Drain Eff. vs Input Power as a Function of Frequency

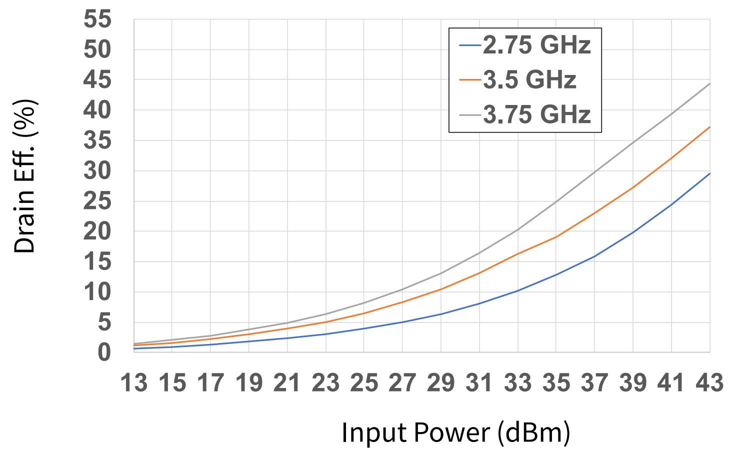


Figure 42. Large Signal Gain vs Input Power as a Function of Frequency

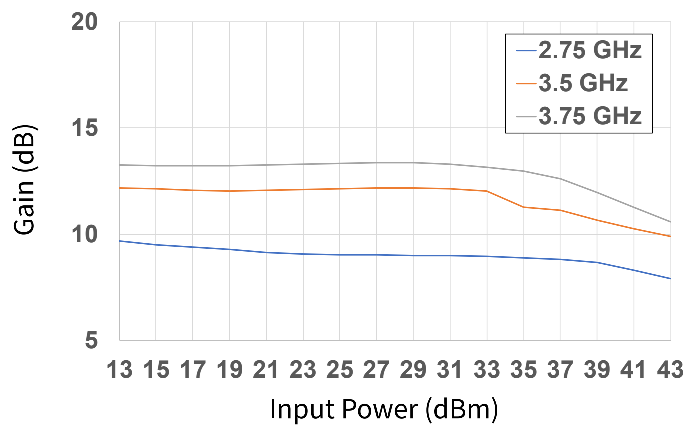


Figure 43. Drain Current vs Input Power as a Function of Frequency

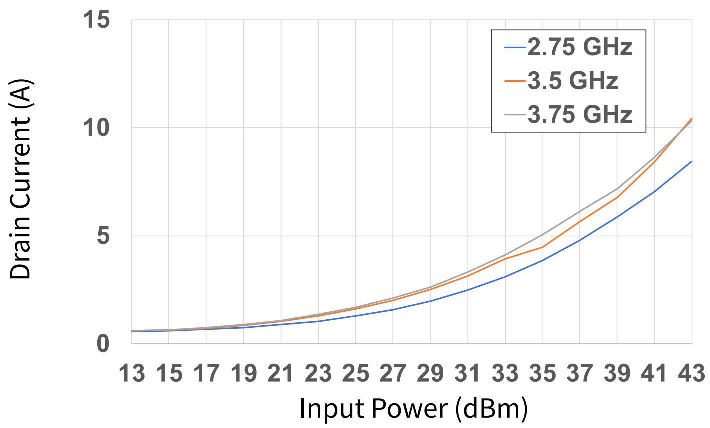
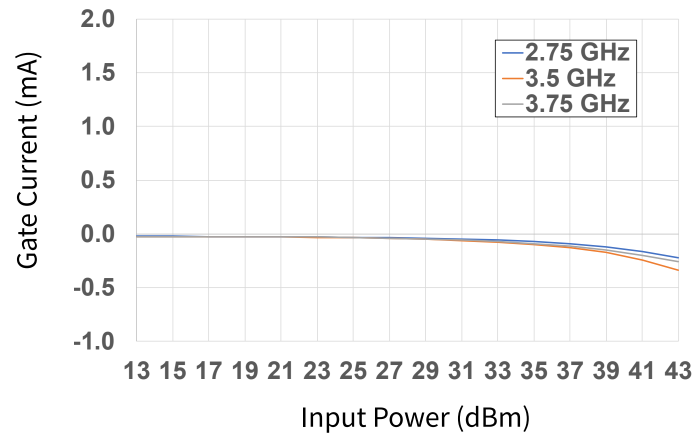


Figure 44. Gate Current vs Input Power as a Function of Frequency



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, CW, Pin = 43 dBm, T_{BASE} = +25 °C

Figure 45. Output Power vs Input Power as a Function of Temperature

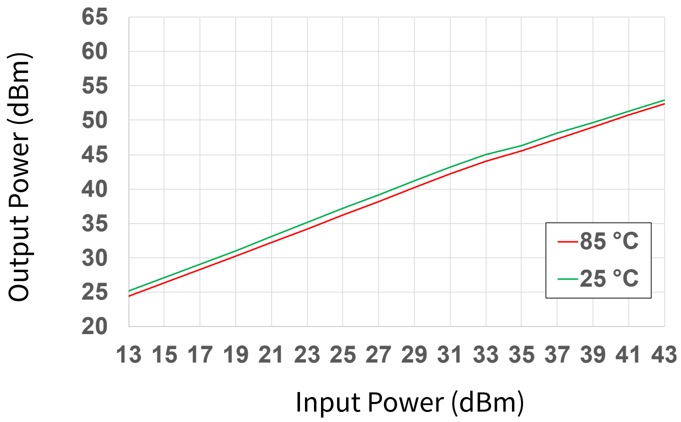


Figure 46. Drain Eff. vs Input Power as a Function of Temperature

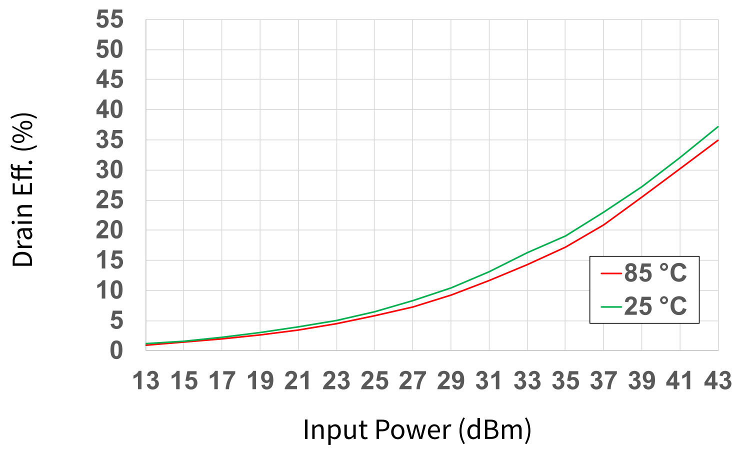


Figure 47. Large Signal Gain vs Input Power as a Function of Temperature

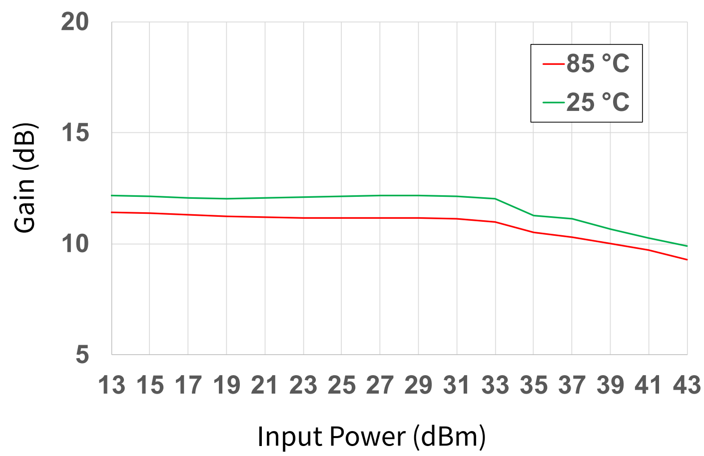


Figure 48. Drain Current vs Input Power as a Function of Temperature

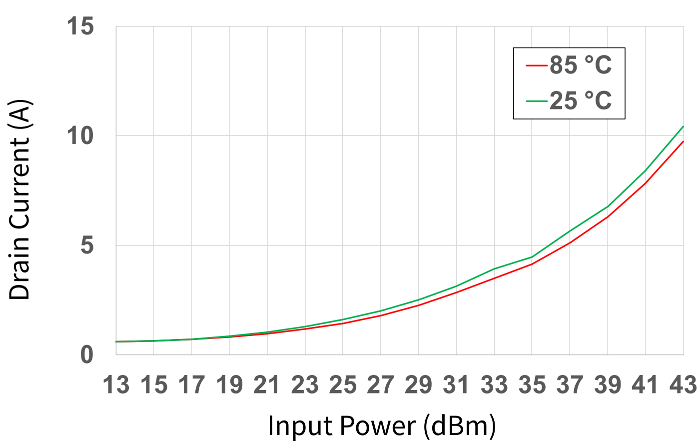
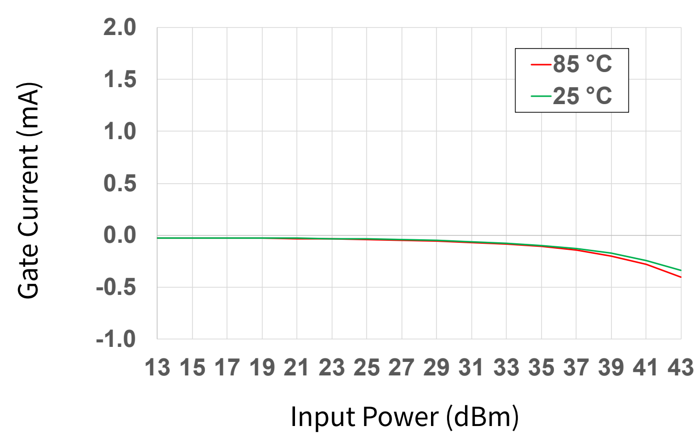


Figure 49. Gate Current vs Input Power as a Function of Temperature



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, CW, Pin = 43 dBm, T_{BASE} = +25 °C

Figure 50. Output Power vs Input Power as a Function of IDQ

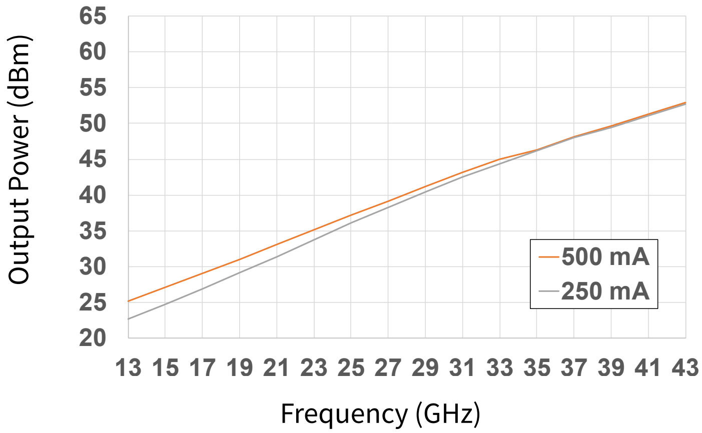


Figure 51. Drain Eff. vs Input Power as a Function of IDQ

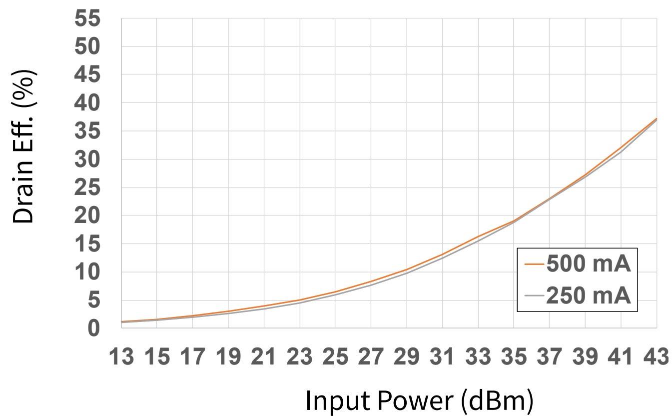


Figure 52. Large Signal Gain vs Input Power as a Function of IDQ

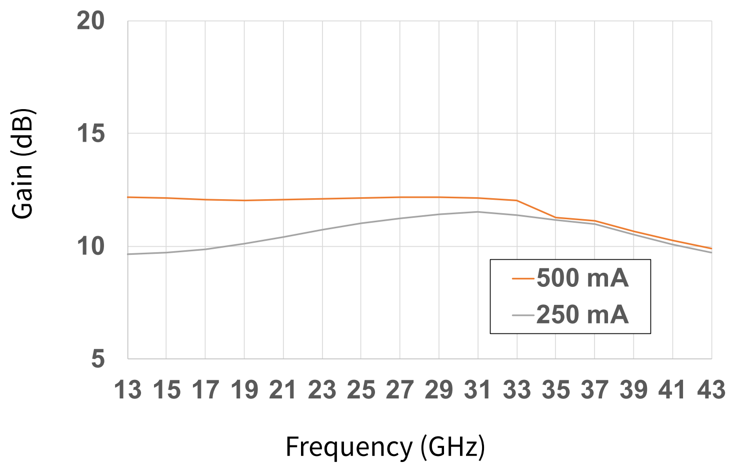


Figure 53. Drain Current vs Input Power as a Function of IDQ

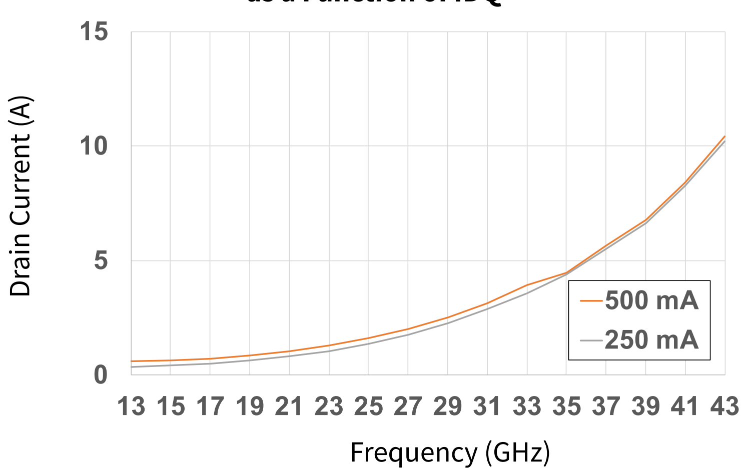
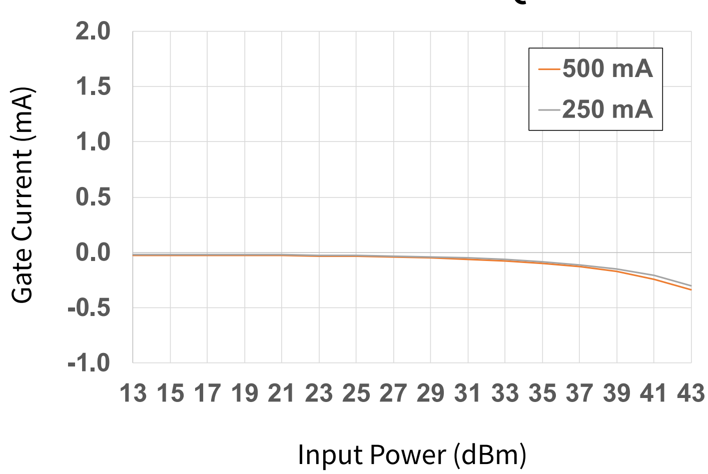


Figure 54. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pulse Width = 100 µs, Duty Cycle = 10%, Pin = 46 dBm, T_{BASE} = +25 °C

Figure 55. 2nd Harmonic vs Frequency as a Function of Temperature

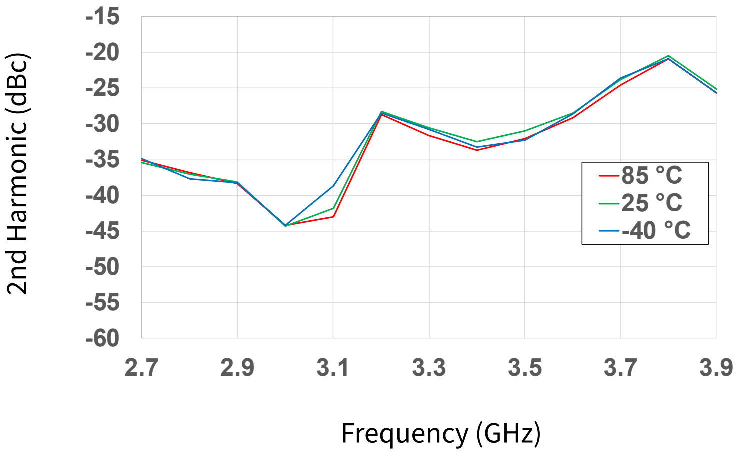


Figure 56. 3rd Harmonic vs Frequency as a Function of Temperature

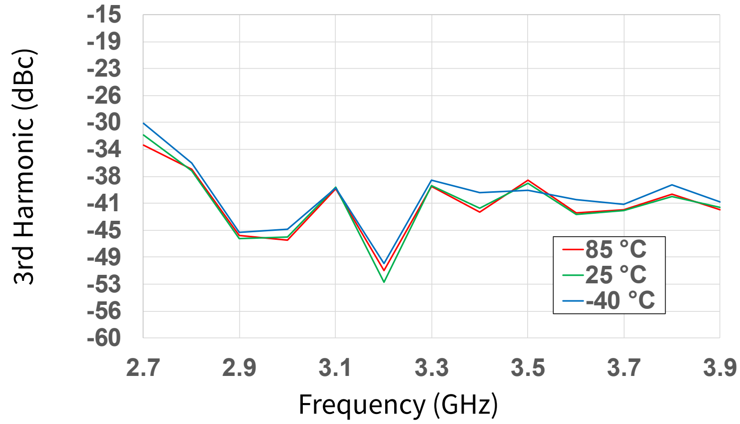


Figure 57. 2nd Harmonic vs Output Power as a Function of Frequency

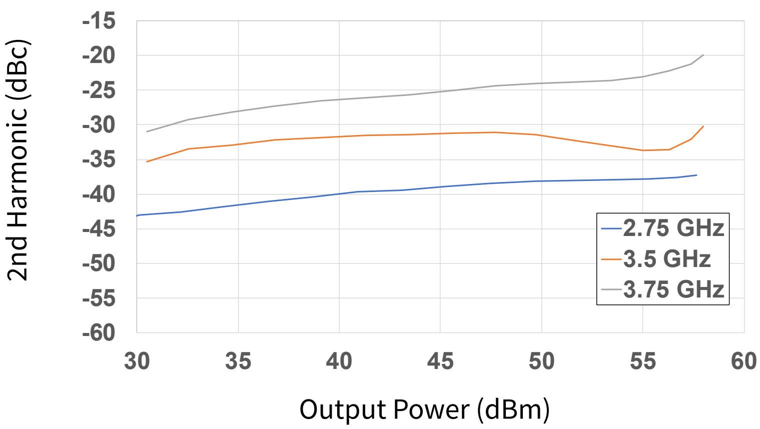


Figure 58. 3rd Harmonic vs Output Power as a Function of Frequency

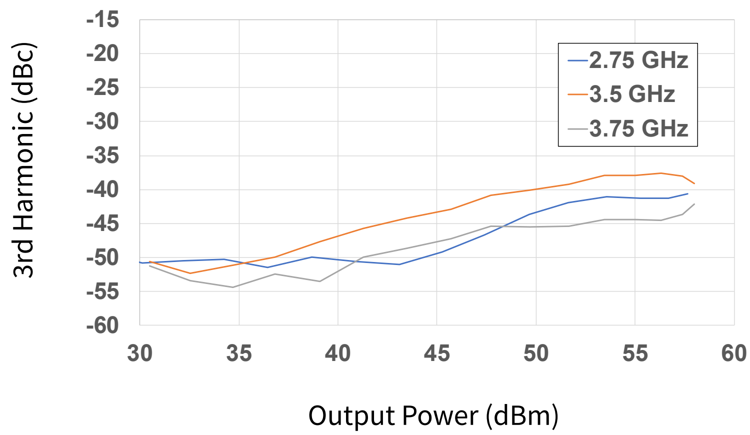


Figure 59. 2nd Harmonic vs Output Power as a Function of IDQ

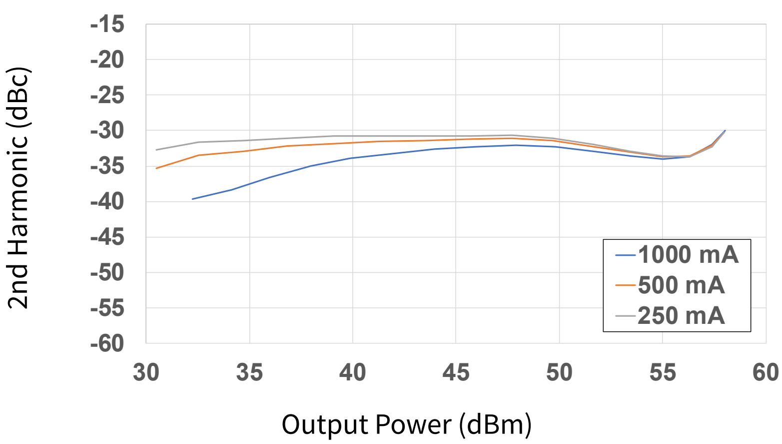
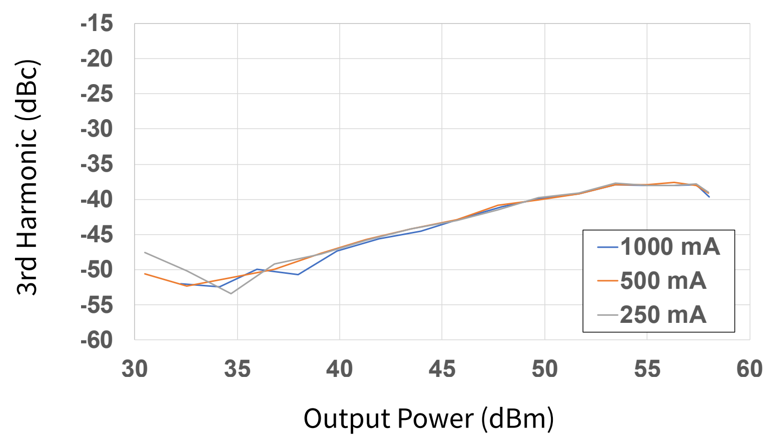


Figure 60. 3rd Harmonic vs Output Power as a Function of IDQ



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pin = -10 dBm, T_{BASE} = +25 °C

Figure 61. Gain vs Frequency as a Function of Temperature

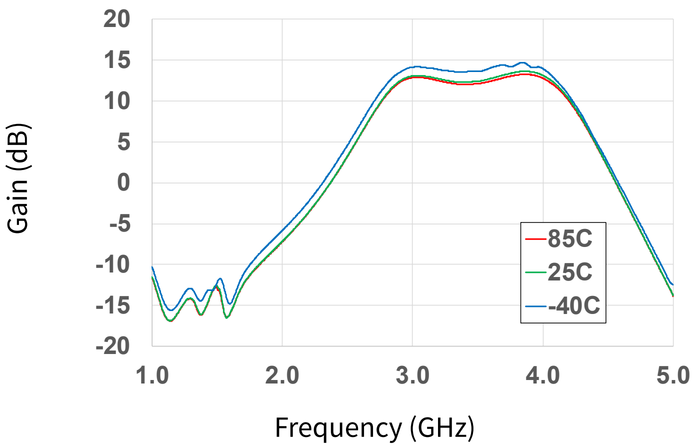


Figure 62. Gain vs Frequency as a Function of Temperature

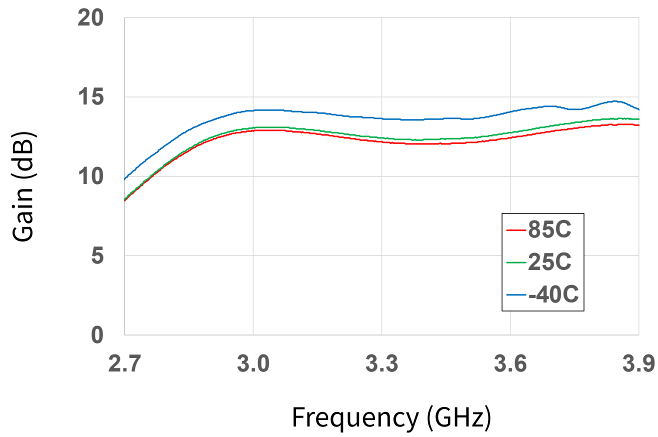


Figure 63. Input RL vs Frequency as a Function of Temperature

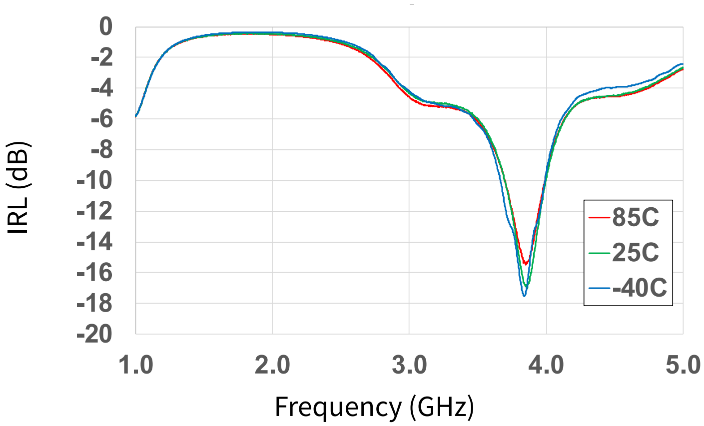


Figure 64. Input RL vs Frequency as a Function of Temperature

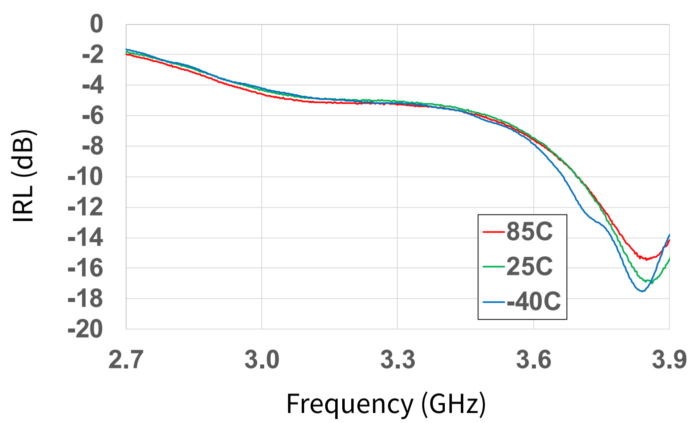


Figure 65. Output RL vs Frequency as a Function of Temperature

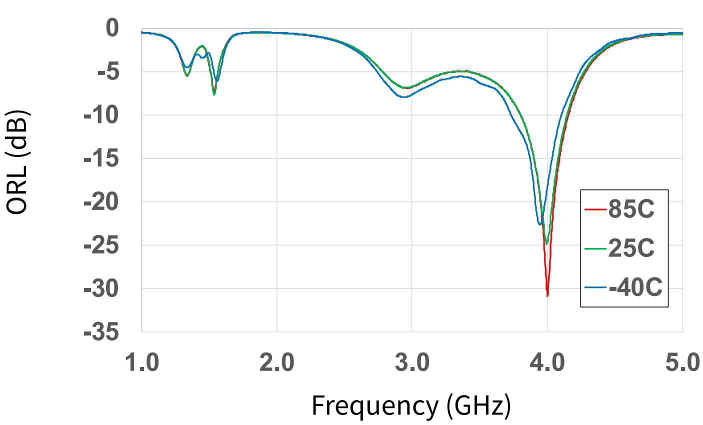
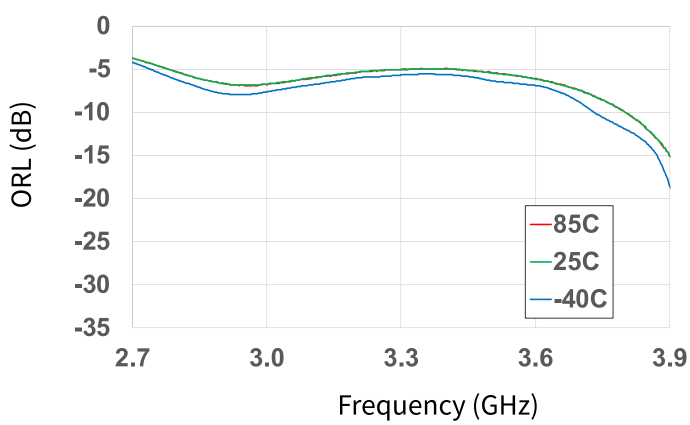


Figure 66. Output RL vs Frequency as a Function of Temperature



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: V_D = 50 V, I_{DQ} = 500 mA, Pin = -10 dBm, T_{BASE} = +25 °C

Figure 67. Gain vs Frequency as a Function of Voltage

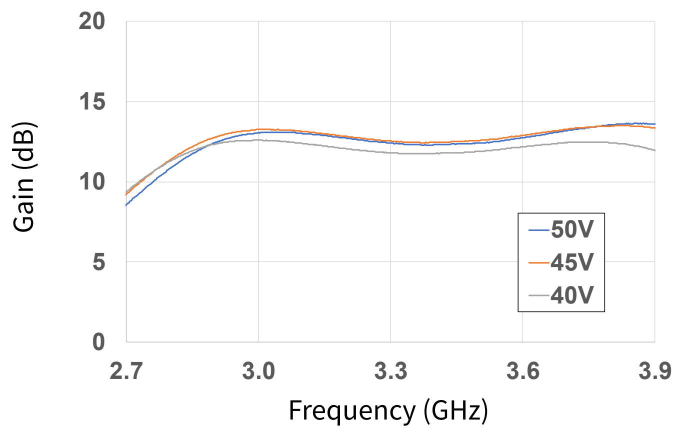


Figure 68. Gain vs Frequency as a Function of IDQ

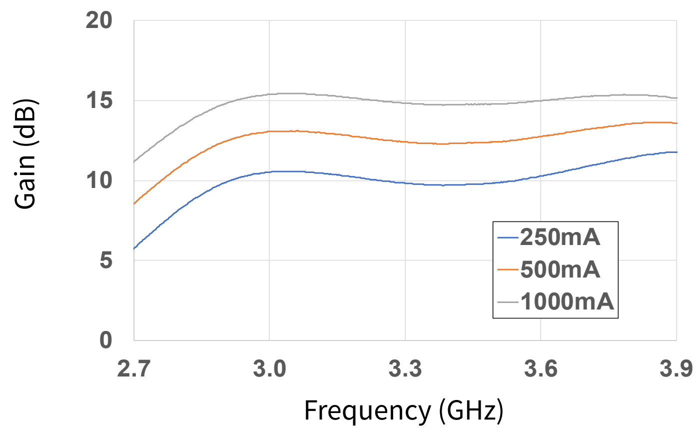


Figure 69. Input RL vs Frequency as a Function of Voltage

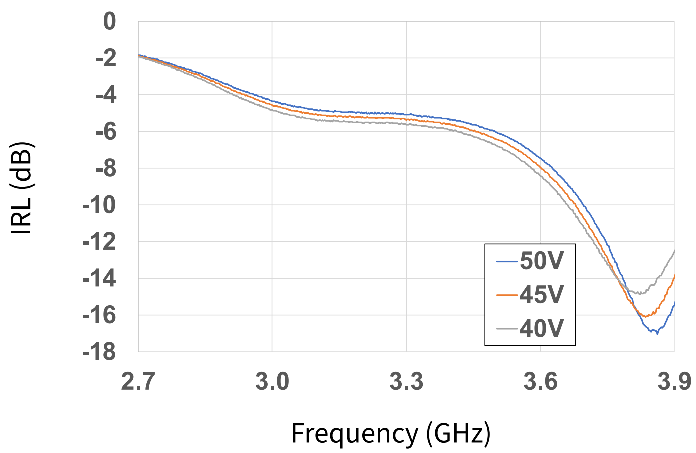


Figure 70. Input RL vs Frequency as a Function of IDQ

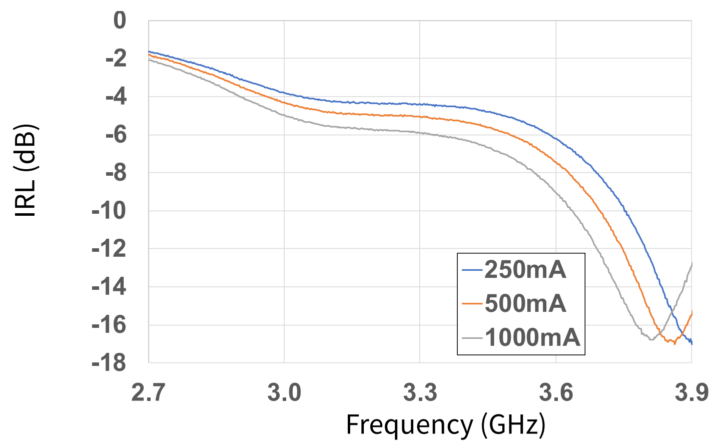


Figure 71. Output RL vs Frequency as a Function of Voltage

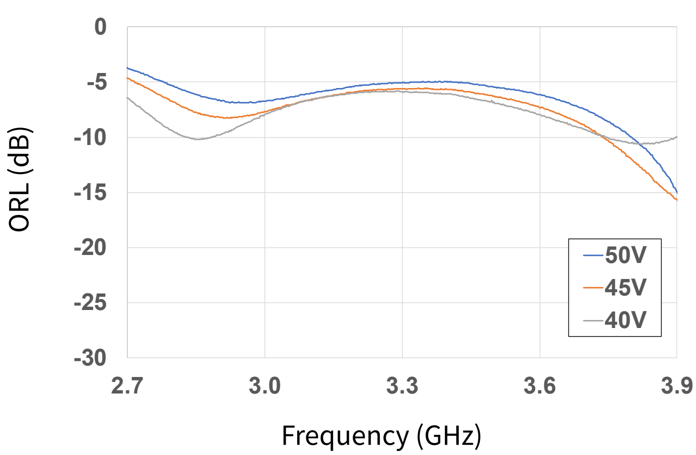
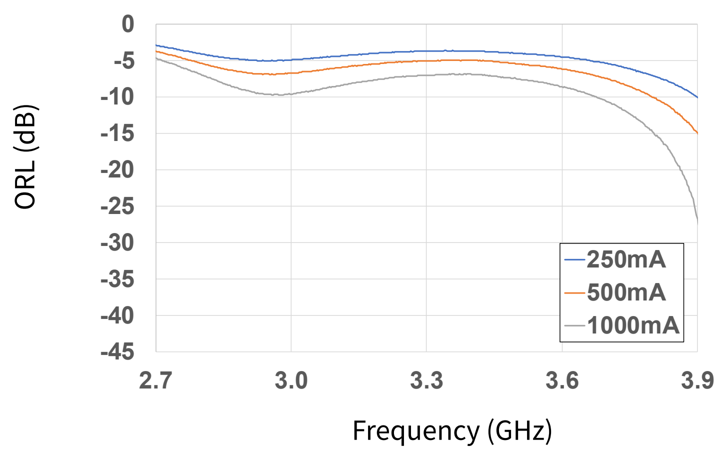
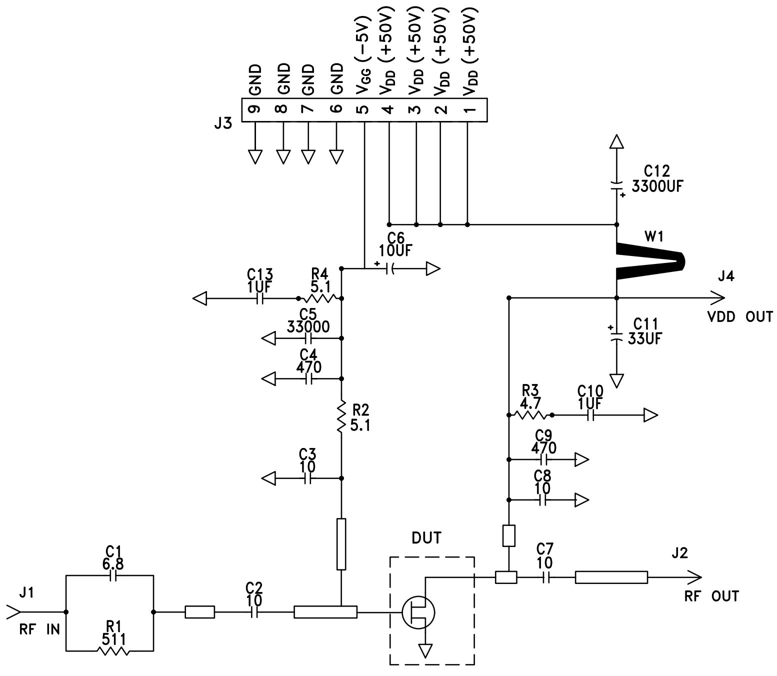


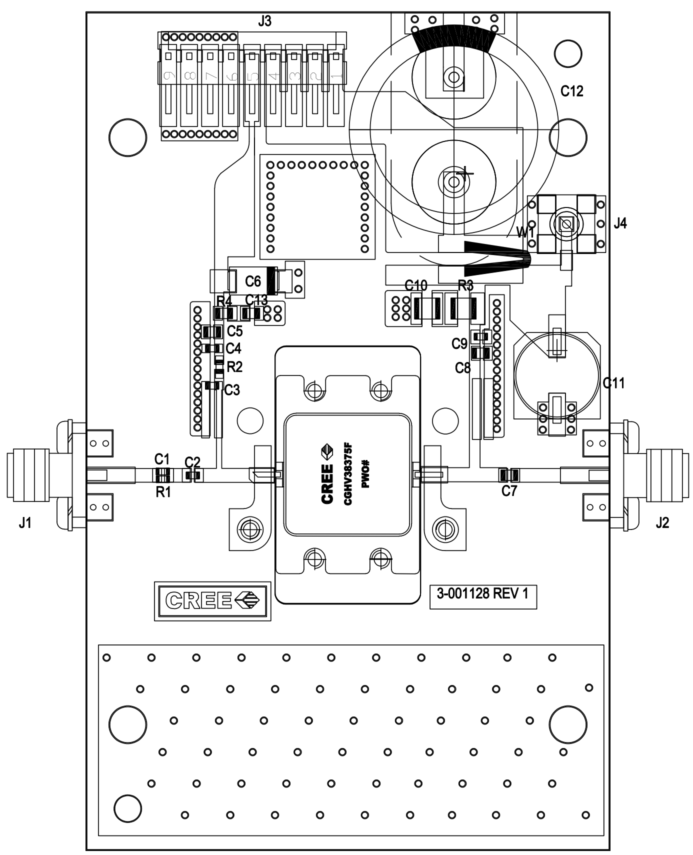
Figure 72. Output RL vs Frequency as a Function of IDQ



CGHV38375F-AMP Evaluation Board Schematic



CGHV38375F-AMP Evaluation Board Outline



CGHV38375F-AMP Evaluation Board Bill of Materials

Designator	Description	Qty
R1	RES, 511 OHM, +/- 1%, 1/16W,0603	1
R2, R4	RES, 5.1,OHM, +/- 1%, 1/16W,0603	2
R3	RES, 4.7 OHM, 1%, 1/4W, 1206	1
C1	CAP, 6.8pF, +/- 0.25 pF,250V, 0603	1
C2,C7,C8	CAP, 10pF, +/- 1%, 250V, 0805	3
C3	CAP, 10.0pF, +/-5%,250V, 0603,	1
C4,C9	CAP, 470PF, 5%, 100V, 0603, X	2
C5	CAP,33000PF, 0805,100V, X7R	1
C6	CAP 10UF 16V TANTALUM	1
C10	CAP, 1.0UF, 100V, 10%, X7R, 1210	1
C11	CAP, 33 UF, 20%, G CASE	1
C12	CAP, 3300 UF, +/-20%, 100V, ELECTROLYTIC	1
C13	CAP, 1UF, 0805, 100V, X7S	1
J1,J2	CONN, SMA, PANEL MOUNT JACK, FL	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
J4	CONNECTOR ; SMB, Straight, JACK,SMD	1
W1	CABLE ,18 AWG, 4.2	1
	PCB, RF35-TC, 2.5 X 4.0 X 0.030	1
	BASEPLATE, AL, 4.0 X 2.5X 0.5	1
	2-56 SOC HD SCREW 1/4 SS	4
	#2 SPLIT LOCKWASHER SS	4
Q1	Transistor CGHV38375F	1

Electrostatic Discharge (ESD) Classifications

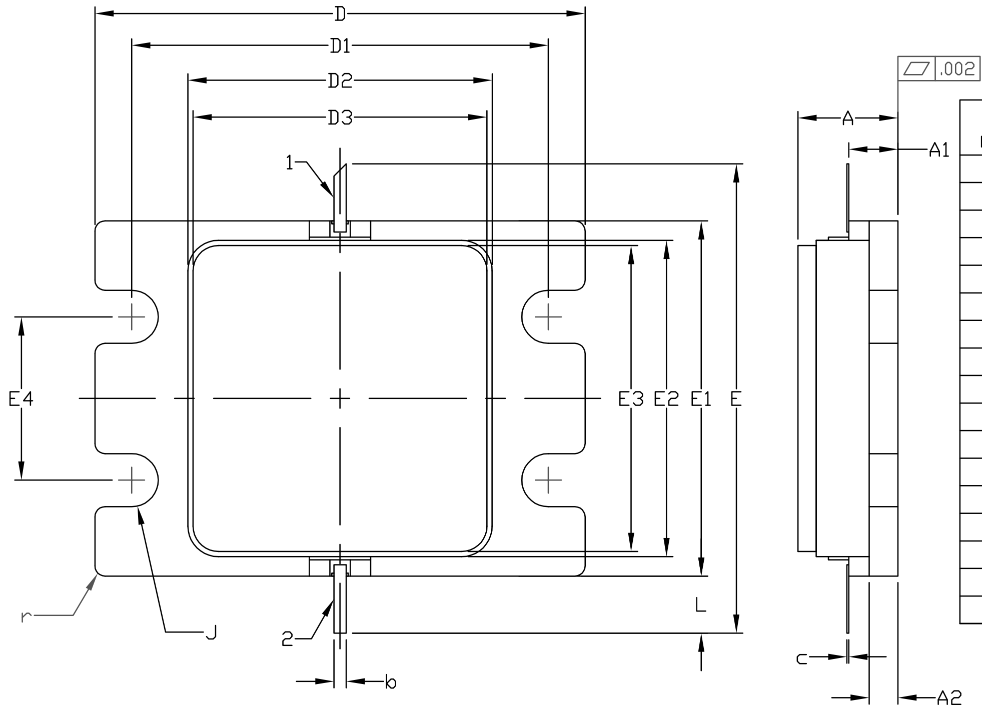
Parameter	Symbol	Class	Test Methodology
Human Body Model	HBM	1B (≥ 500 V)	JEDEC JESD22 A114-D
Charge Device Model	CDM	II (≥ 200 V)	JEDEC JESD22 C101-C

Moisture Sensitivity Level (MSL) Classification

Parameter	Symbol	Level	Test Methodology
Moisture Sensitivity Level	MSL	3 (168 hours)	IPC/JEDEC J-STD-20

Product Dimensions CGHV38375F (Package 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	DESC.
1	RFIN
2	RFOUT
3	SOURCE/FLANGE

Part Number System

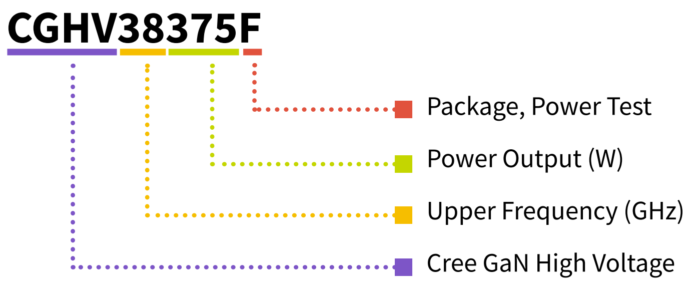


Table 1.

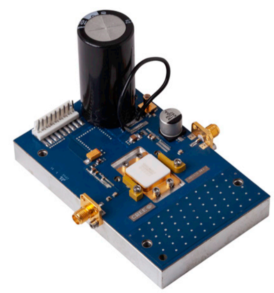
Parameter	Value	Units
Lower Frequency	2.75	GHz
Upper Frequency	3.75	GHz
Power Output	375	W
Package	Flange	-

Note[1]: Alpha characters used in frequency code indicate a value greater than 9.9 GHz. See Table 2 for value.

Table 2.

Character Code	Code Value
A	0
B	1
C	2
D	3
E	4
F	5
G	6
H	7
J	8
K	9
Examples:	1A = 10.0 GHz 2H = 27.0 GHz

Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGHV38375F	GaN HEMT	Each	
CGHV38375F-AMP	Test board with GaN HEMT installed	Each	

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Notes

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