

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 ($T_c = 25^\circ\text{C}$)

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 $V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$

² Measured at Pin = -10 dBm

³ Measured at Pin = 46 dBm and 100 μs ; Duty Cycle = 10%

Features

- Full S-Band Radar Coverage
- 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

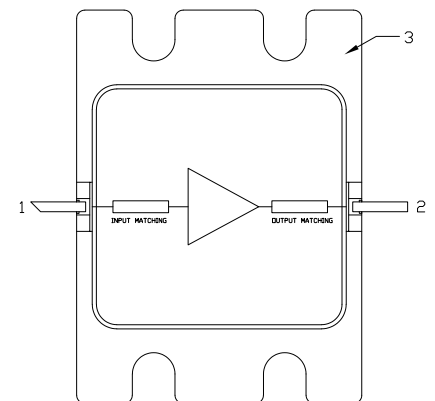


Figure 1.

RoHS
COMPLIANT

Absolute Maximum Ratings (not simultaneous) at 25 °C

Parameter	Symbol	Rating	Units	Conditions
Drain-source Voltage	V_{DS}	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; $T_c = 25^\circ\text{C}$)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics						
Gate Threshold Voltage	$V_{GS(TH)}$	-3.8	-3.0	-2.3	V	$V_{DS} = 10\text{ V}$, $I_D = 83.6\text{ mA}$
Gate Quiescent Voltage	$V_{GS(Q)}$	-	-2.7	-	V _{DC}	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$
Saturated Drain Current ¹	I_{DS}	54.4	77.7	-	A	$V_{DS} = 6.0\text{ V}$, $V_{GS} = 2.0\text{ V}$
Drain-Source Breakdown Voltage	V_{BD}	125	-	-	V	$V_{GS} = -8\text{ V}$, $I_D = 83.6\text{ mA}$
RF Characteristics²						
Small Signal Gain	S_{21_1}	-	12.5	-	dB	Pin = -10 dBm, Freq = 2.75 - 3.75 GHz
Output Power	P_{OUT1}	-	55.9	-	dBm	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 2.75 GHz
Output Power	P_{OUT2}	-	57.4	-	dBm	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 2.9 GHz
Output Power	P_{OUT3}	-	57.5	-	dBm	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 3.3 GHz
Output Power	P_{OUT4}	-	57.7	-	dBm	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 3.5 GHz
Output Power	P_{OUT5}	-	56.8	-	dBm	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 3.75 GHz
Drain Efficiency	DE_1	-	50	-	%	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 2.75 GHz
Drain Efficiency	DE_2	-	67	-	%	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 2.9 GHz
Drain Efficiency	DE_3	-	62	-	%	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 3.3 GHz
Drain Efficiency	DE_4	-	60	-	%	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 3.5 GHz
Drain Efficiency	DE_5	-	60	-	%	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 3.75 GHz
Power Gain	G_{P2}	-	9.9	-	dB	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 2.75 GHz
Power Gain	G_{P3}	-	11.4	-	dB	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 2.9 GHz
Power Gain	G_{P4}	-	11.5	-	dB	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 3.3 GHz
Power Gain	G_{P5}	-	11.7	-	dB	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 3.5 GHz
Power Gain	G_{P6}	-	10.8	-	dB	$V_{DD} = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{IN} = 46\text{ dBm}$, Freq = 3.75 GHz

Electrical Characteristics (Frequency = 2.75 GHz to 3.75 GHz unless otherwise stated; $T_c = 25^\circ\text{C}$)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
RF Characteristics²						
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 data² Unless otherwise noted: Pulse Width = 100 μs, Duty Cycle = 10%
Thermal Characteristics

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

Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, Pulse Width = $100\text{ }\mu\text{s}$, Duty Cycle = 10%, $P_{in} = 46\text{ dBm}$, $T_{BASE} = +25\text{ }^\circ\text{C}$

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

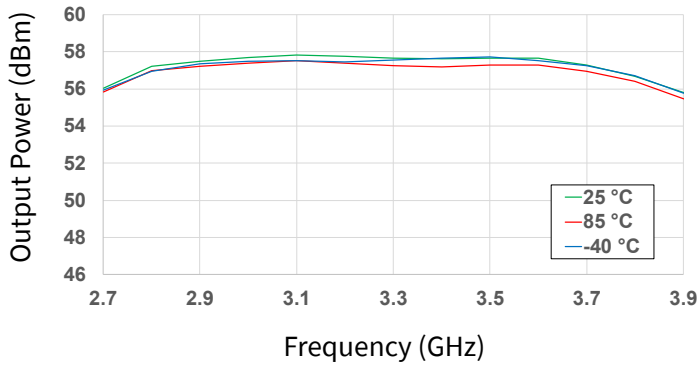


Figure 2. Output Power vs Frequency as a Function of Input Power

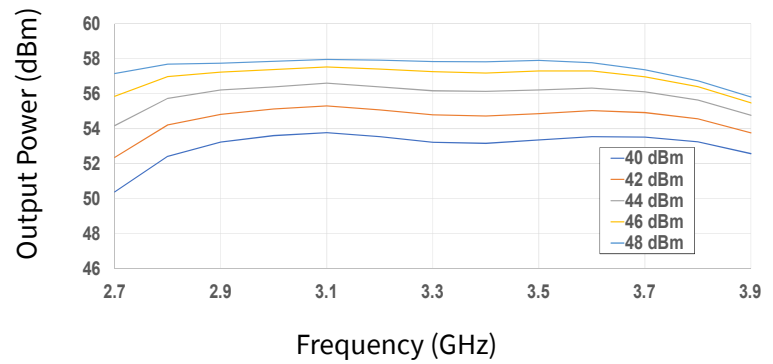


Figure 3. Drain Eff. vs Frequency as a Function of Temperature

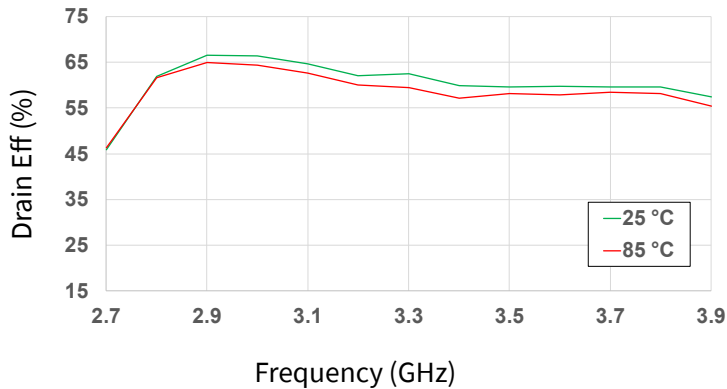


Figure 4. Drain Eff. vs Frequency as a Function of Input Power

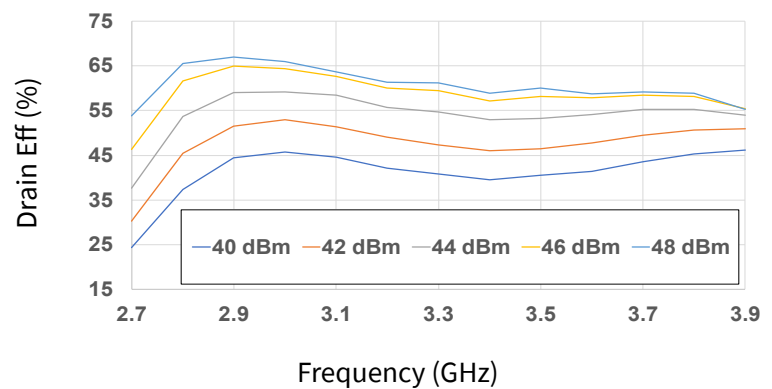


Figure 5. Drain Current vs Frequency as a Function of Temperature

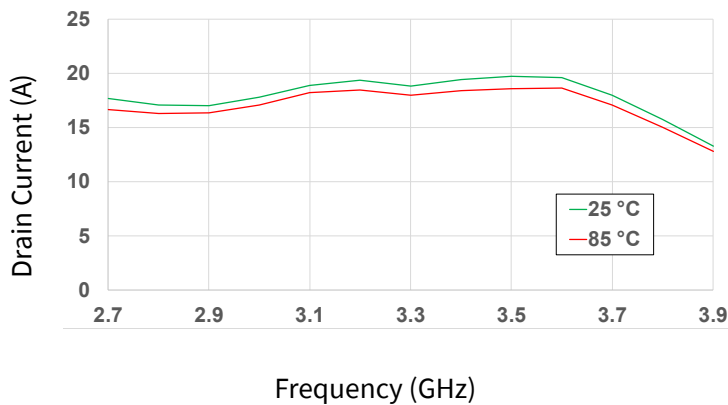
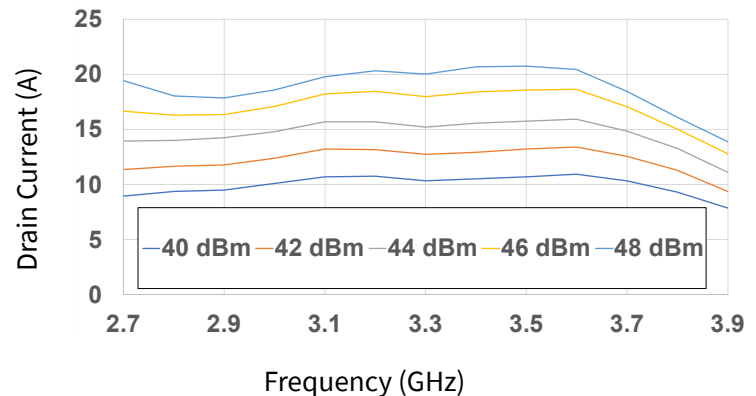


Figure 6. Drain Current vs Frequency as a Function of Input Power



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, Pulse Width = $100\text{ }\mu\text{s}$, Duty Cycle = 10%, $P_{in} = 46\text{ dBm}$, $T_{BASE} = +25\text{ }^\circ\text{C}$

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

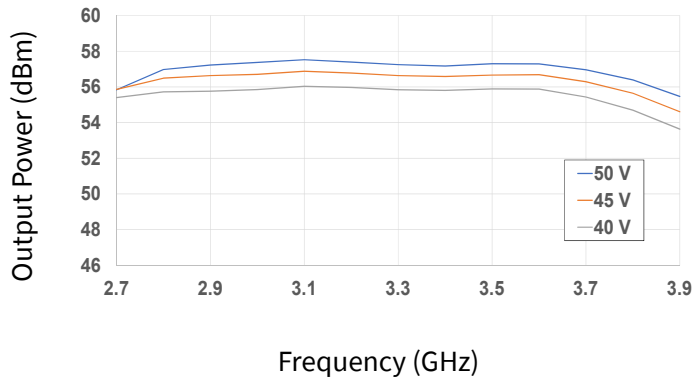


Figure 8. Output Power vs Frequency as a Function of I_{DQ}

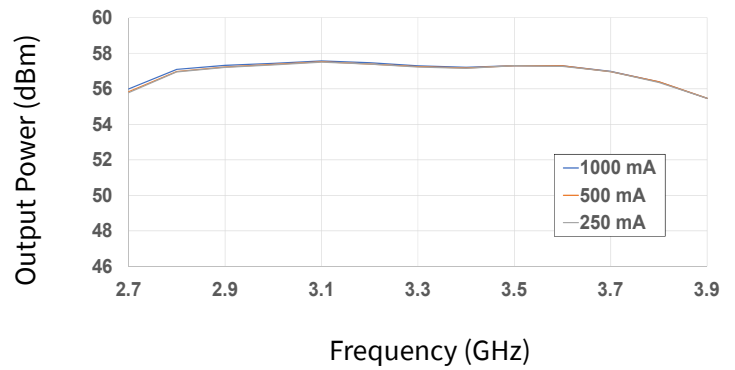


Figure 9. Drain Eff. vs Frequency as a Function of V_D

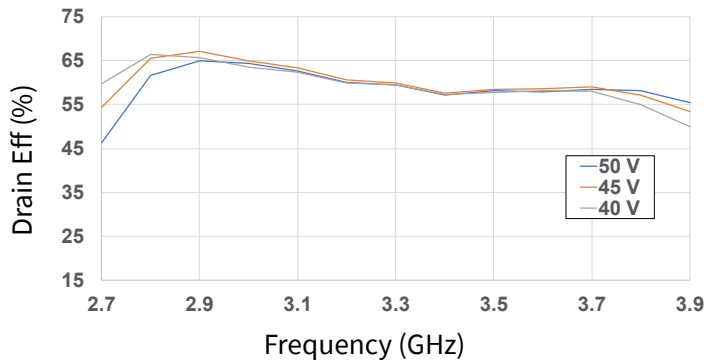


Figure 10. Drain Eff. vs Frequency as a Function of I_{DQ}

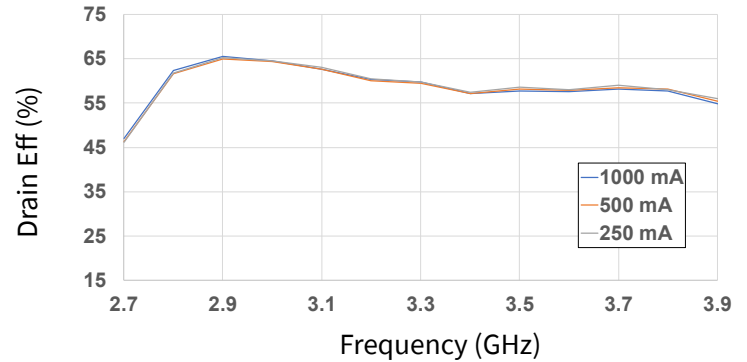


Figure 11. Drain Current vs Frequency as a Function of V_D

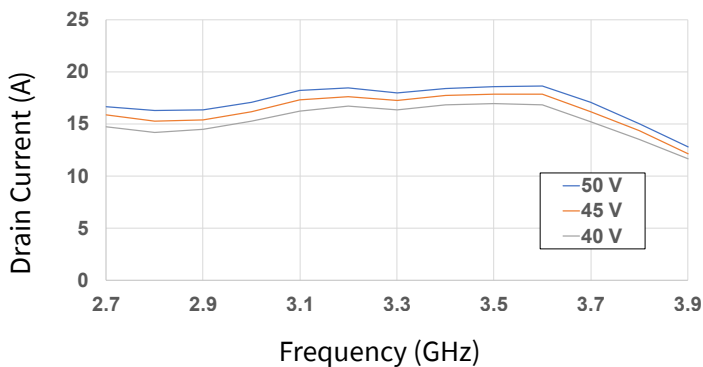
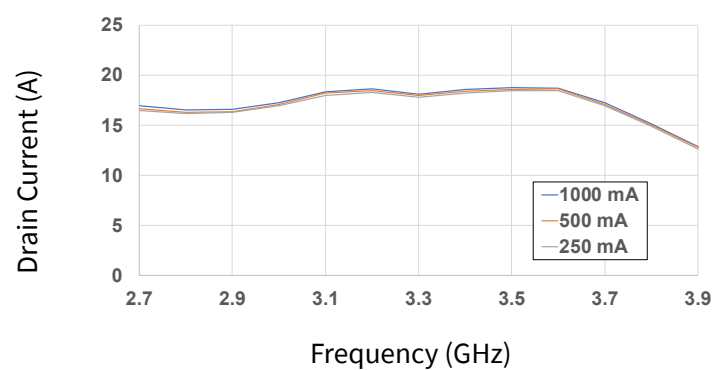


Figure 12. Drain Current vs Frequency as a Function of I_{DQ}



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, Pulse Width = $100\text{ }\mu\text{s}$, Duty Cycle = 10%, $P_{in} = 46\text{ dBm}$, $T_{BASE} = +25\text{ }^\circ\text{C}$

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

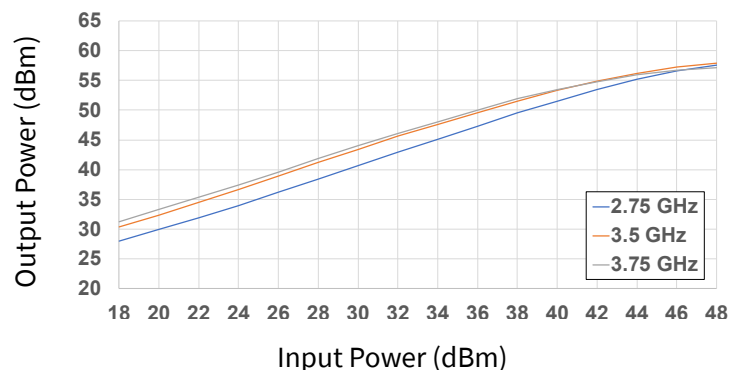


Figure 14. Drain Eff. vs Input Power as a Function of Frequency

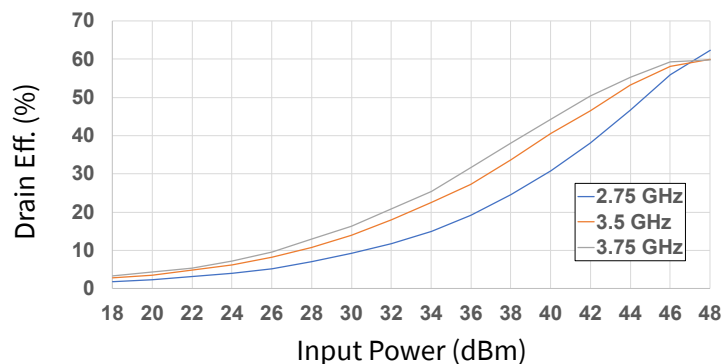


Figure 15. Large Signal Gain vs Input Power as a Function of Frequency

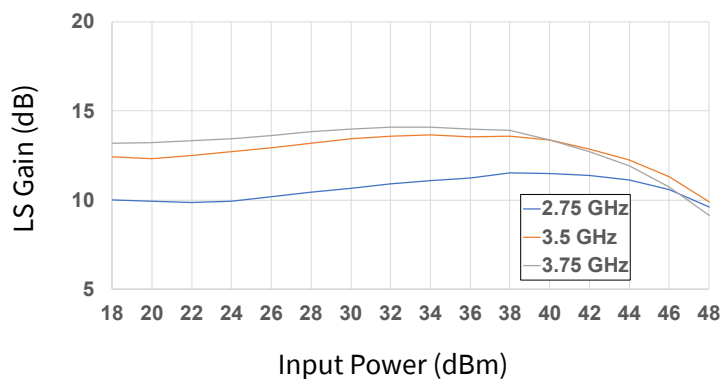


Figure 16. Drain Current vs Input Power as a Function of Frequency

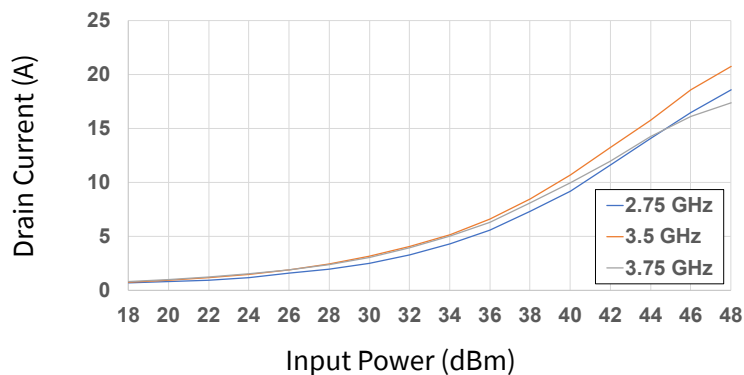
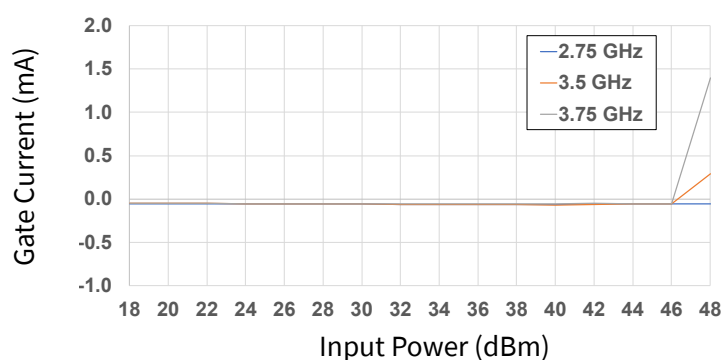


Figure 17. Gate Current vs Input Power as a Function of Frequency



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, Pulse Width = $100\text{ }\mu\text{s}$, Duty Cycle = 10%, $P_{in} = 46\text{ dBm}$, $T_{BASE} = +25\text{ }^\circ\text{C}$

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

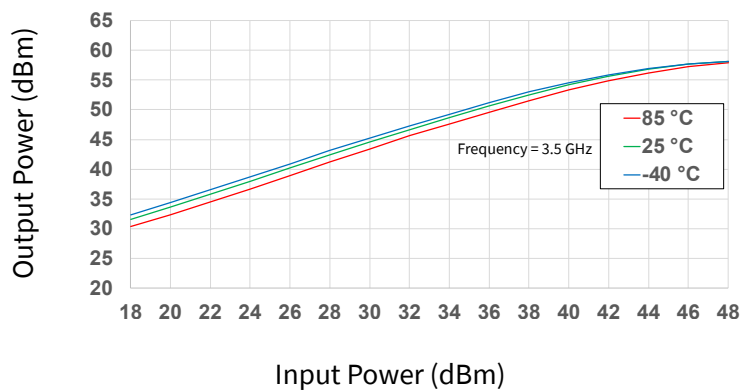


Figure 19. Drain Eff. vs Input Power as a Function of Temperature

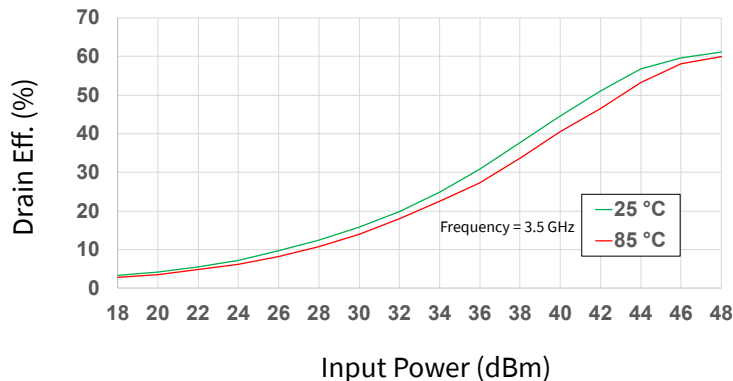


Figure 20. Large Signal Gain vs Input Power as a Function of Temperature

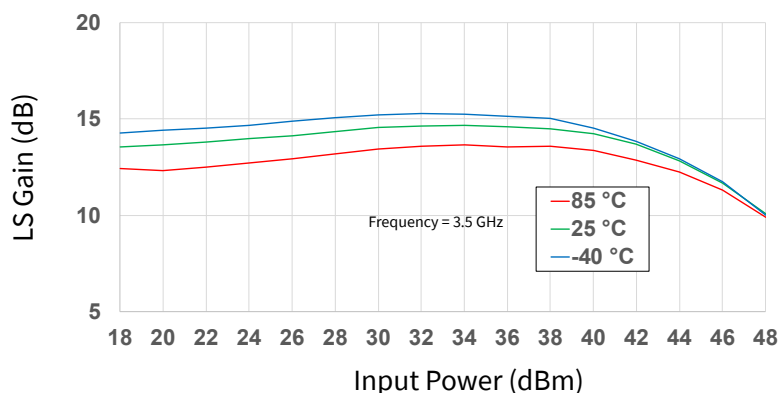


Figure 21. Drain Current vs Input Power as a Function of Temperature

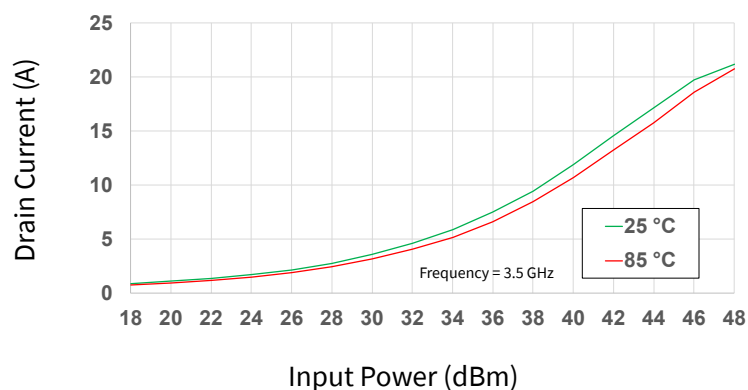
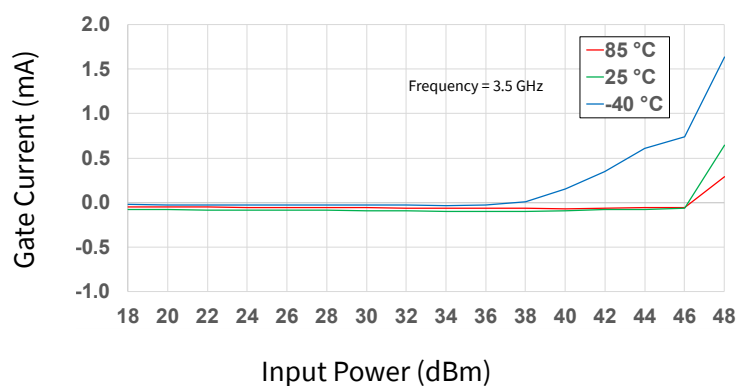


Figure 22. Gate Current vs Input Power as a Function of Temperature



Typical Performance of the CGHV38375F

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

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

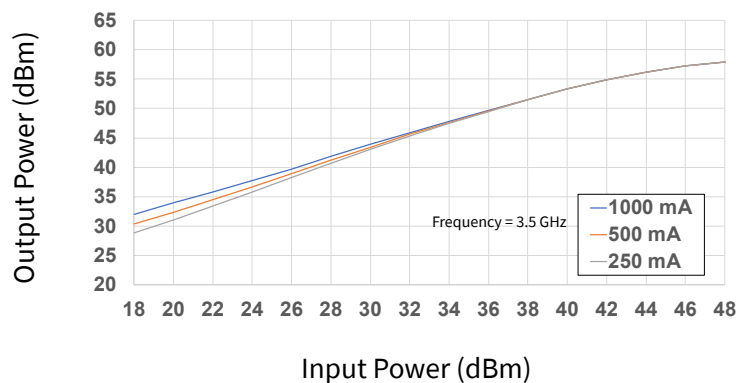


Figure 24. Drain Eff. vs Input Power as a Function of IDQ

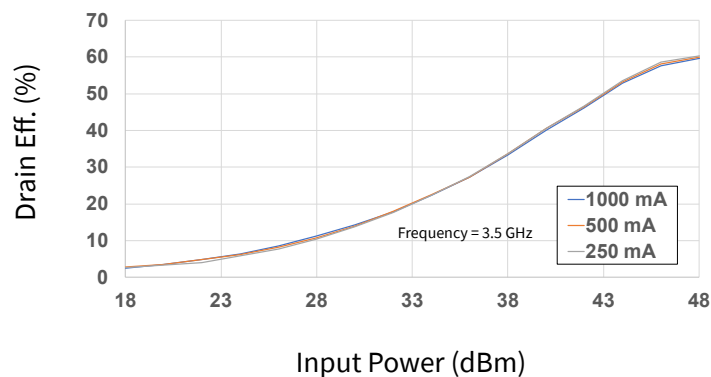


Figure 25. Large Signal Gain vs Input Power as a Function of IDQ

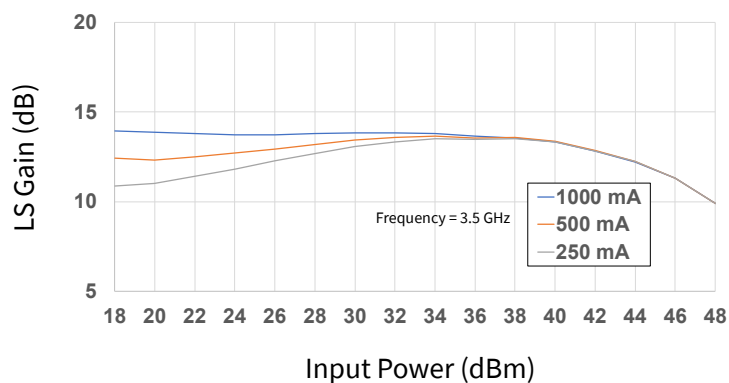


Figure 26. Drain Current vs Input Power as a Function of IDQ

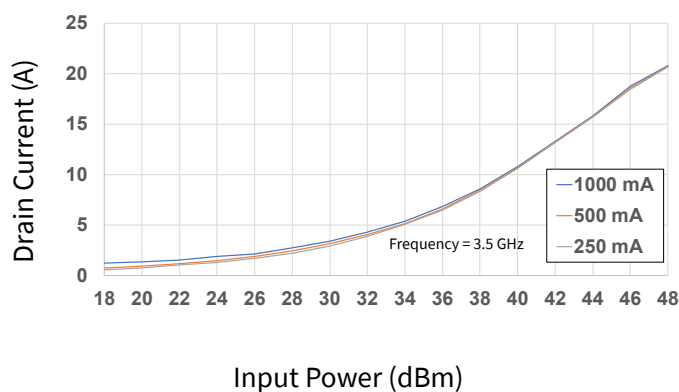
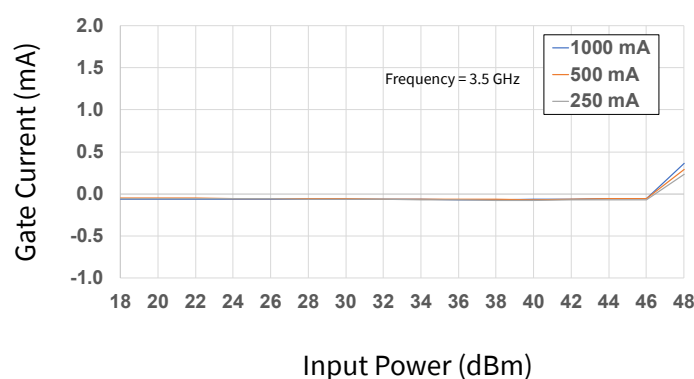


Figure 27. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, CW, $P_{in} = 43\text{ dBm}$, $T_{BASE} = +25\text{ }^{\circ}\text{C}$

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

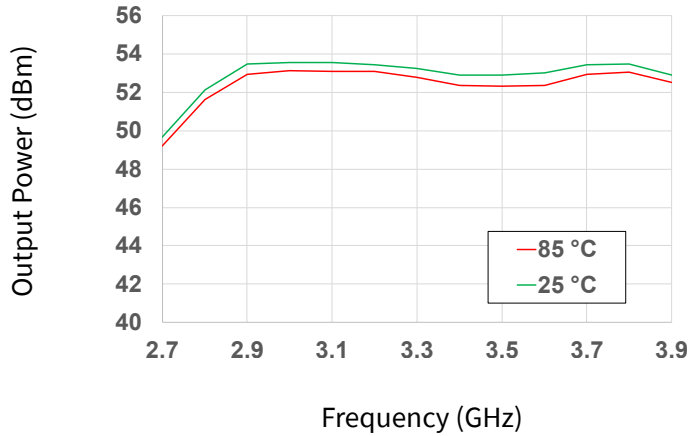


Figure 29. Output Power vs Frequency as a Function of Input Power

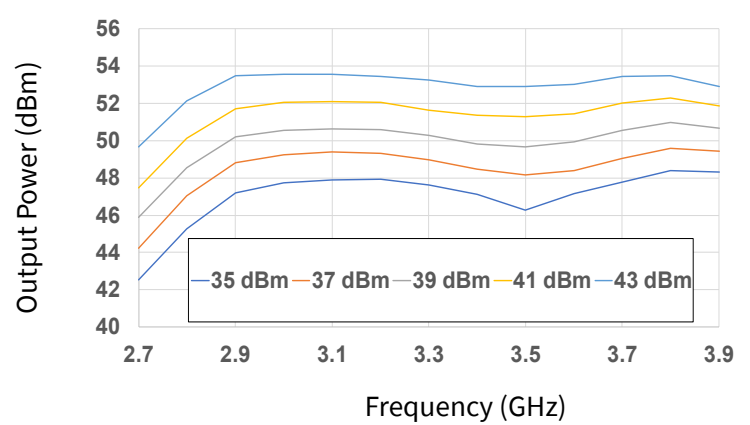


Figure 30. Drain Eff. vs Frequency as a Function of Temperature

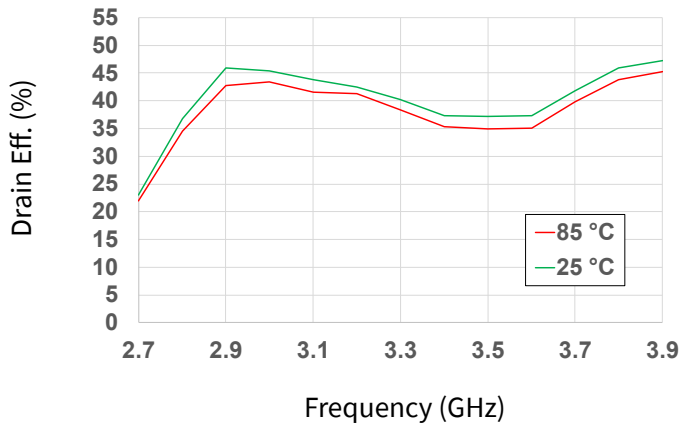


Figure 31. Drain Eff. vs Frequency as a Function of Input Power

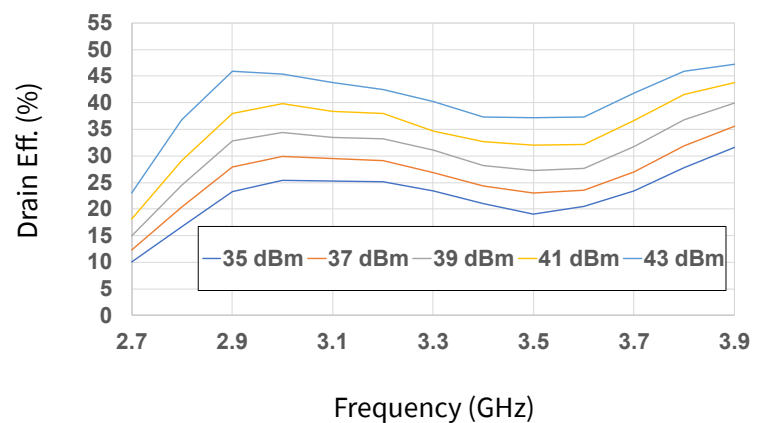


Figure 32. Drain Current vs Frequency as a Function of Temperature

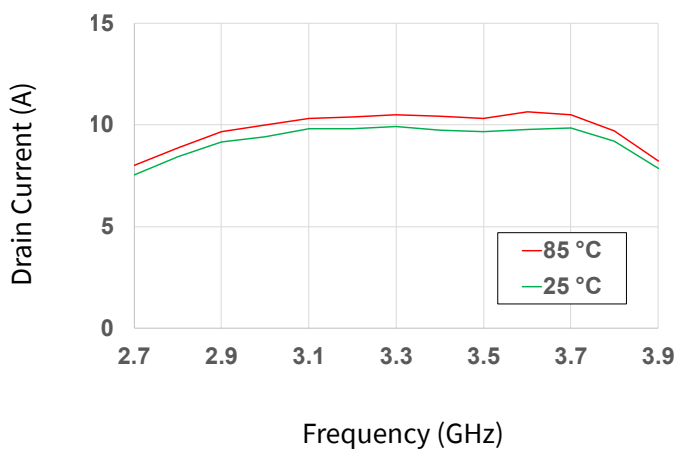
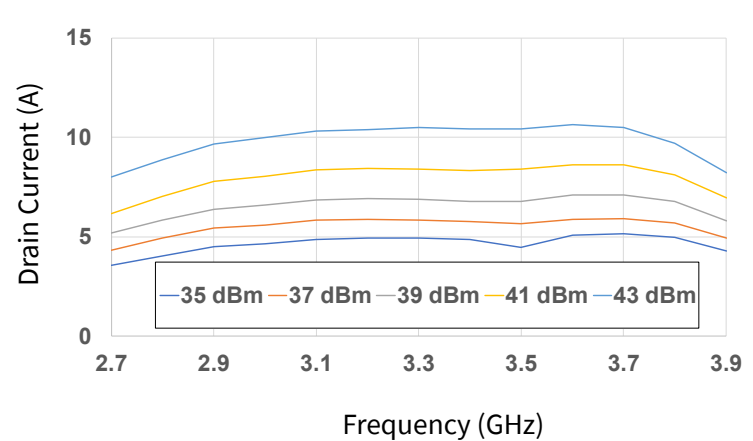
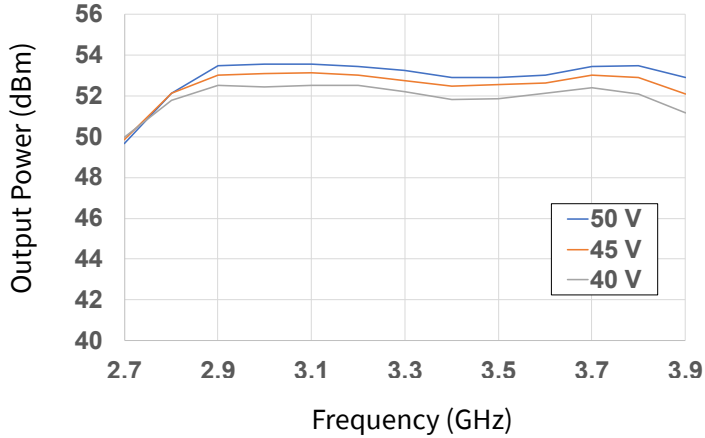
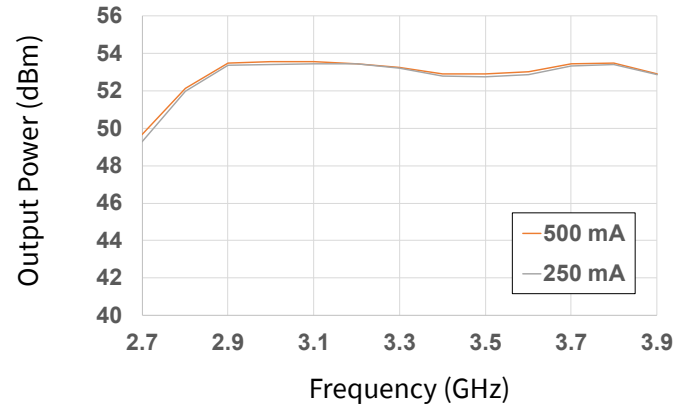
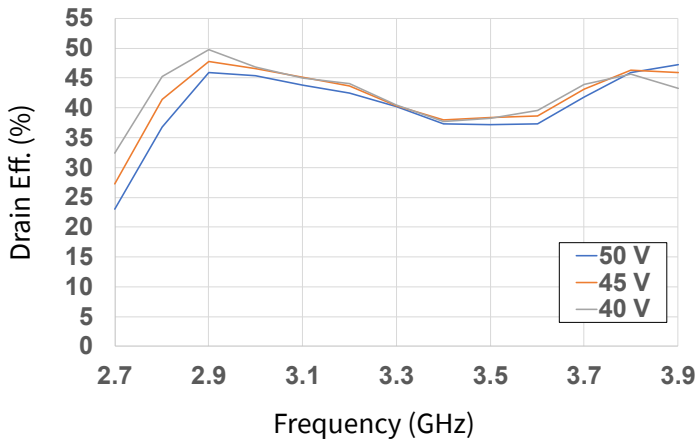
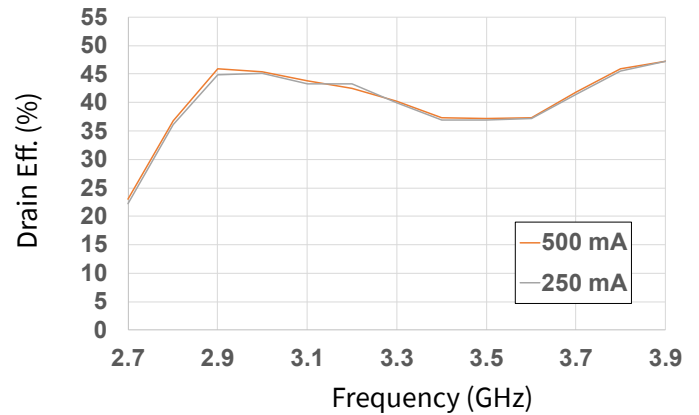
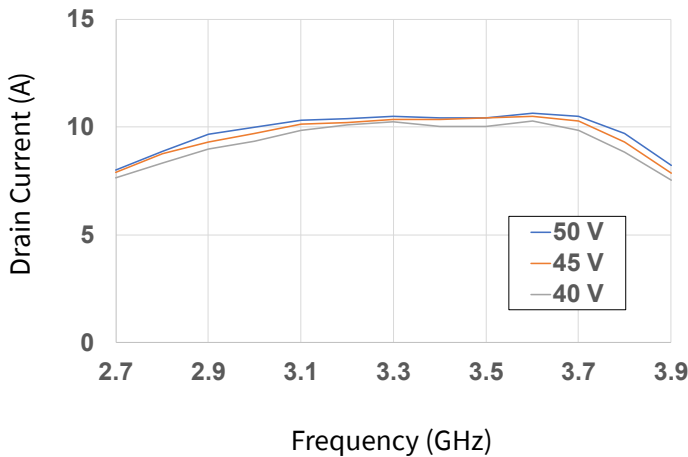
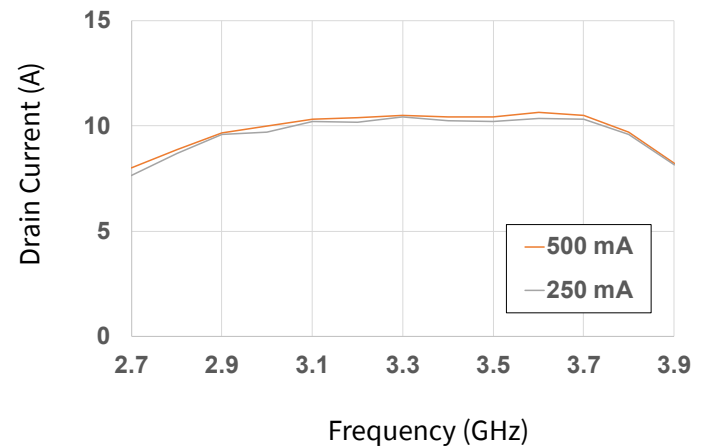


Figure 33. Drain Current vs Frequency as a Function of Input Power



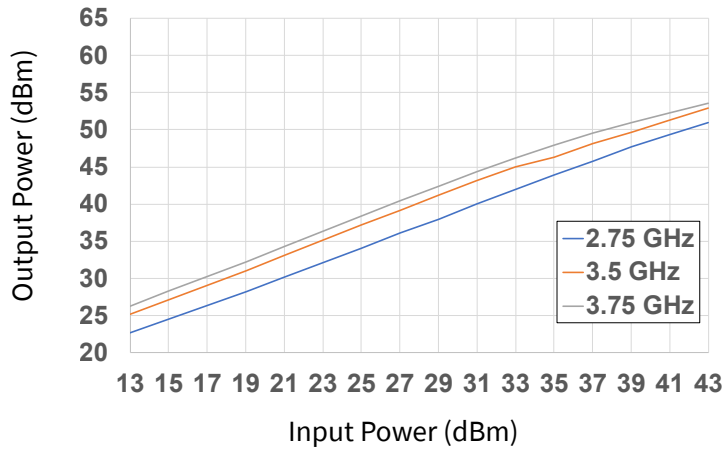
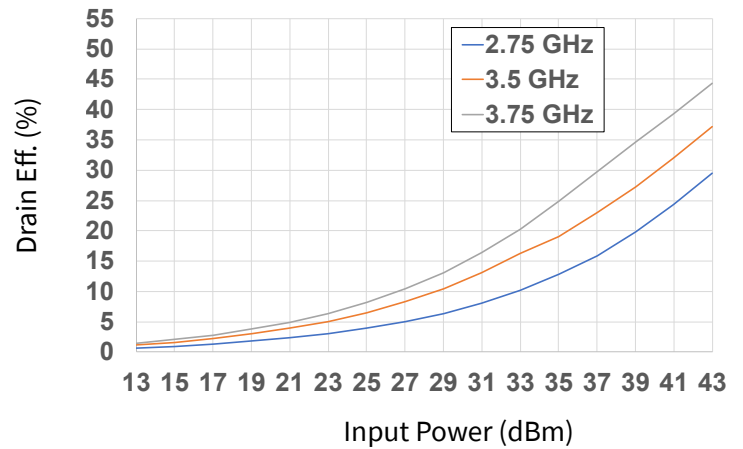
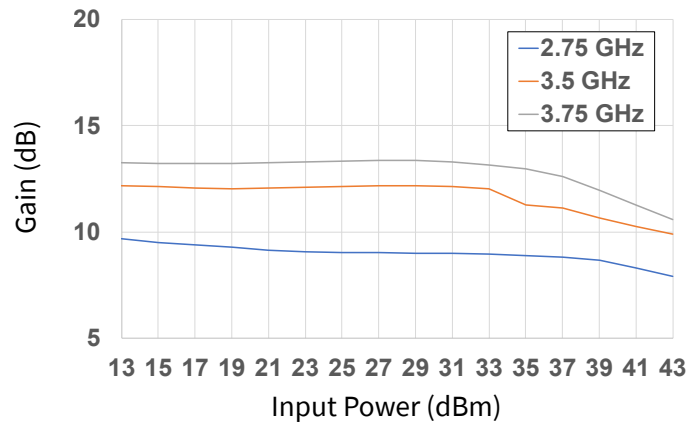
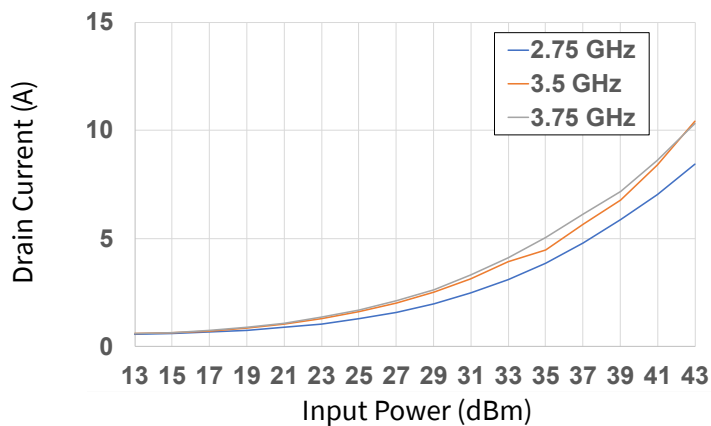
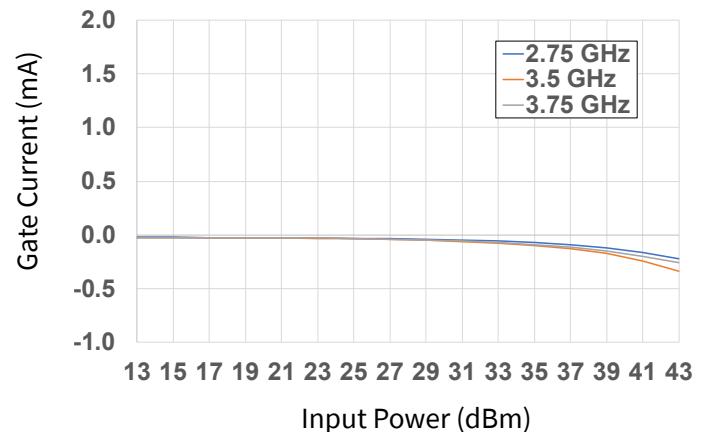
Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, CW, $P_{in} = 43\text{ dBm}$, $T_{BASE} = +25\text{ }^\circ\text{C}$

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**

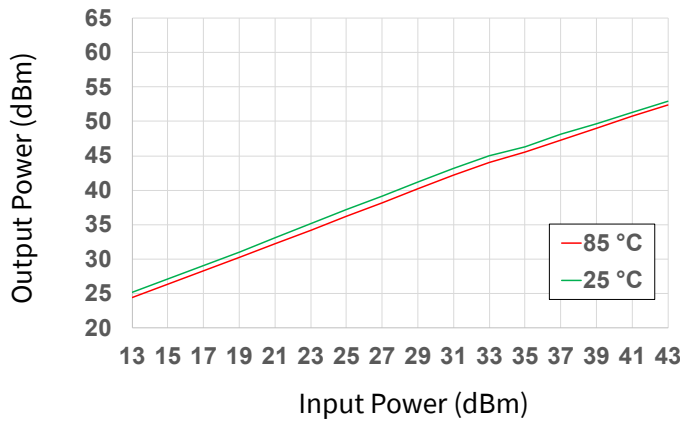
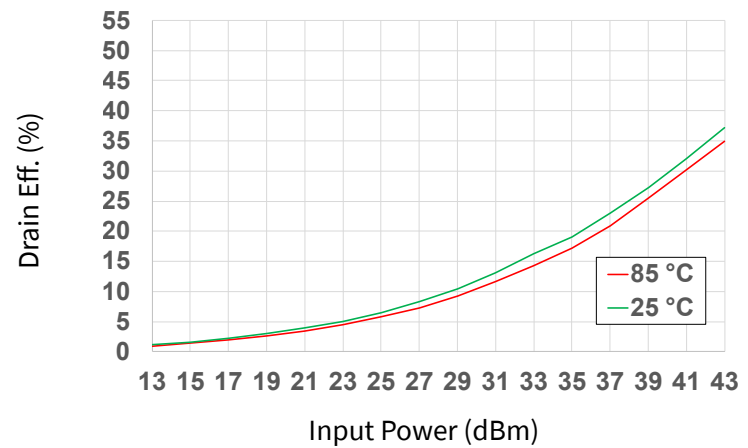
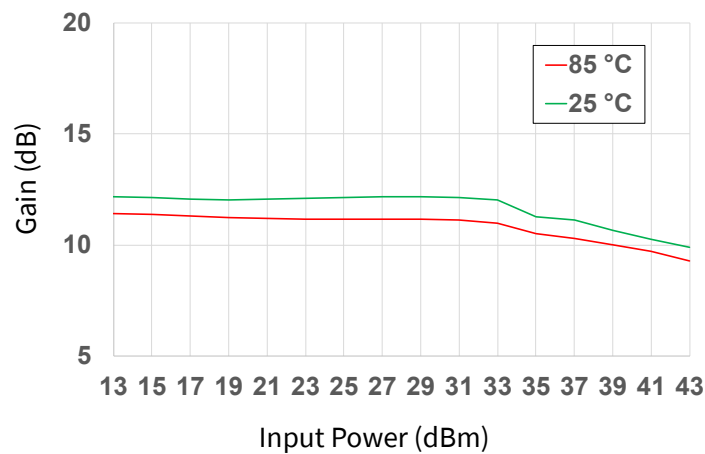
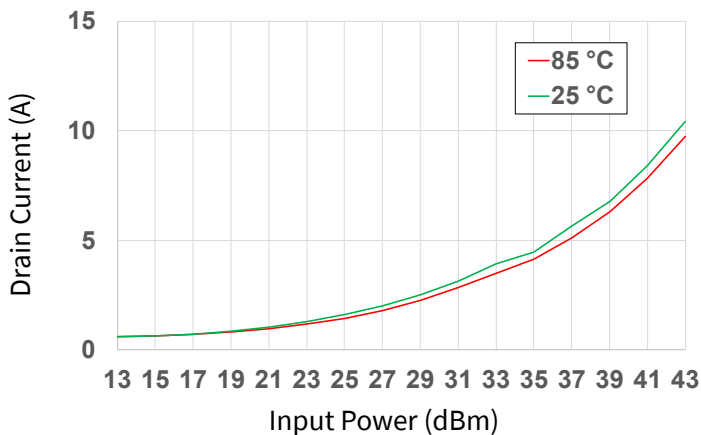
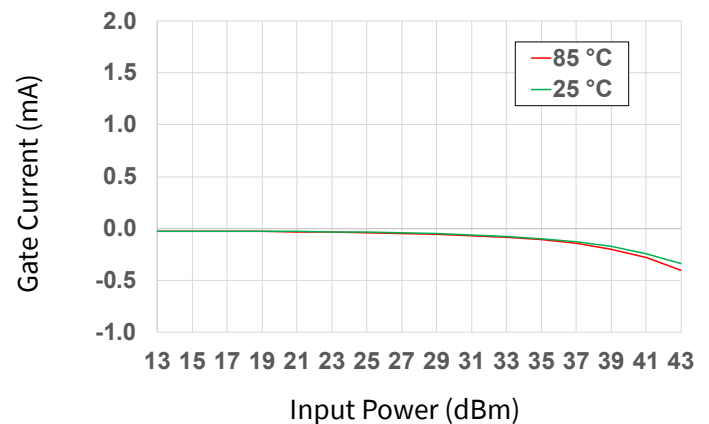
Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: $V_0 = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, CW, $P_{in} = 43\text{ dBm}$, $T_{BASE} = +25\text{ }^\circ\text{C}$

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: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, CW, $P_{in} = 43\text{ dBm}$, $T_{BASE} = +25\text{ }^\circ\text{C}$

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: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, CW, $P_{in} = 43\text{ dBm}$, $T_{BASE} = +25\text{ }^\circ\text{C}$

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

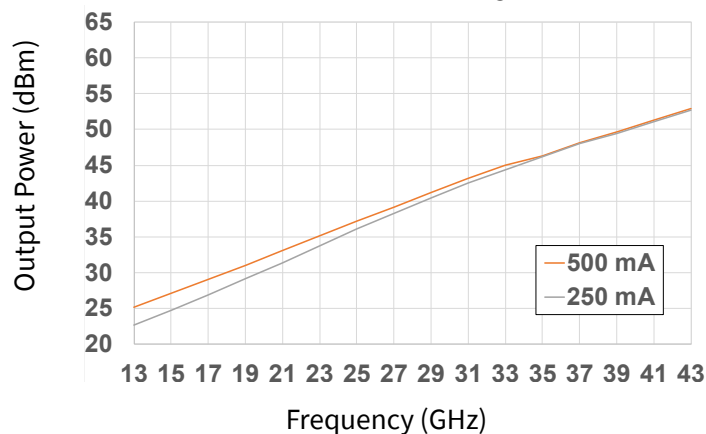


Figure 51. Drain Eff. vs Input Power as a Function of IDQ

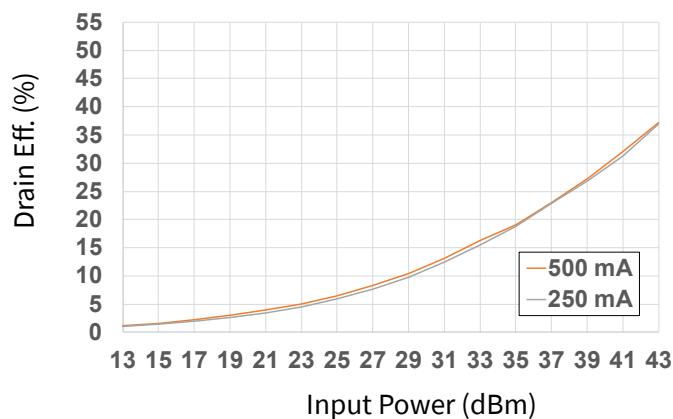


Figure 52. Large Signal Gain vs Input Power as a Function of IDQ

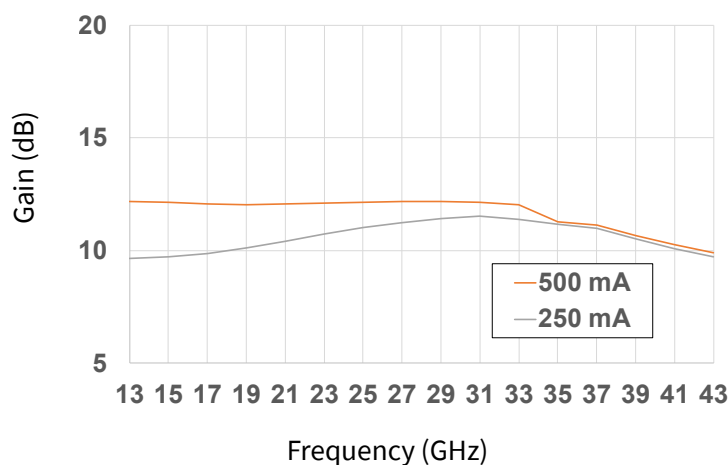


Figure 53. Drain Current vs Input Power as a Function of IDQ

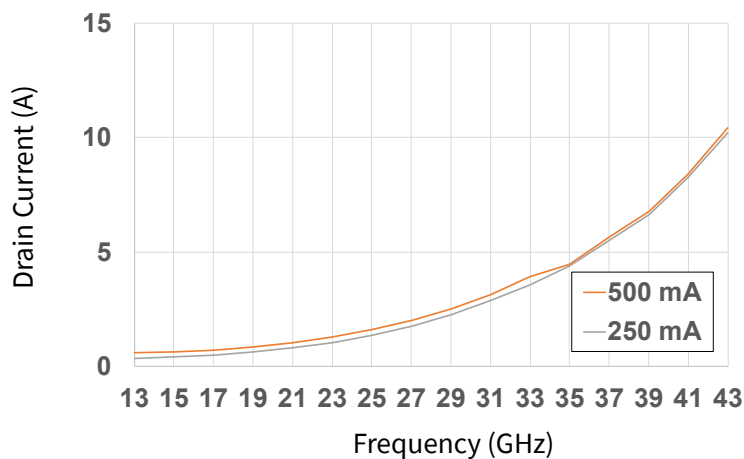
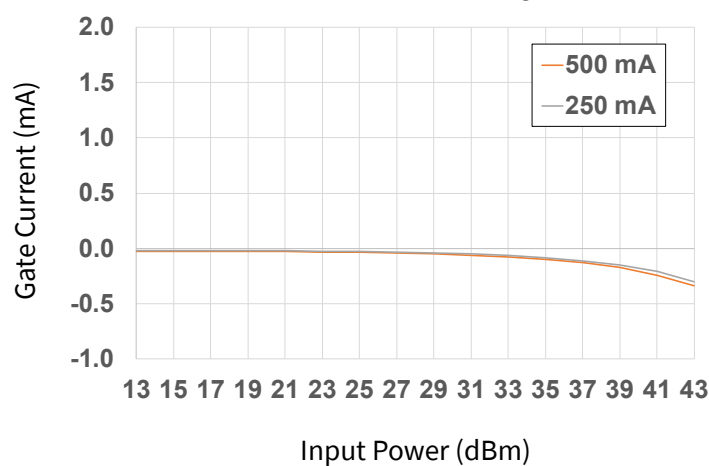


Figure 54. Gate Current vs Input Power as a Function of IDQ



Typical Performance of the CGHV38375F

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

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

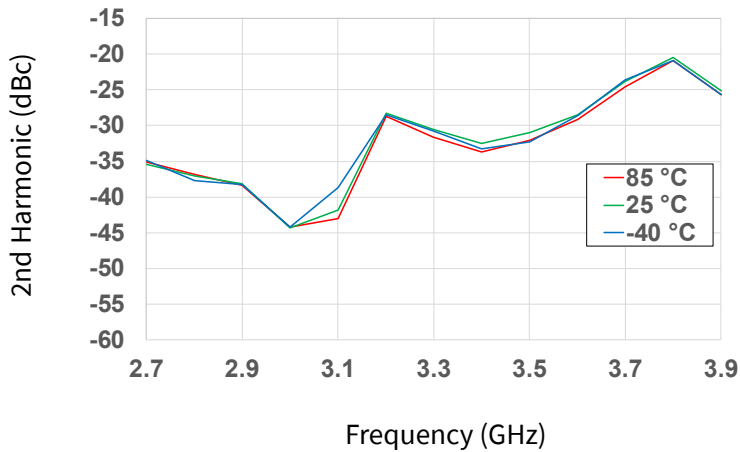


Figure 56. 3rd Harmonic vs Frequency as a Function of Temperature

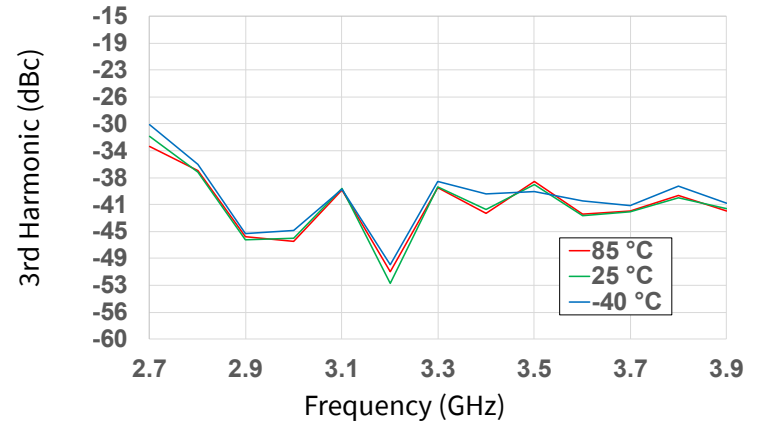


Figure 57. 2nd Harmonic vs Output Power as a Function of Frequency

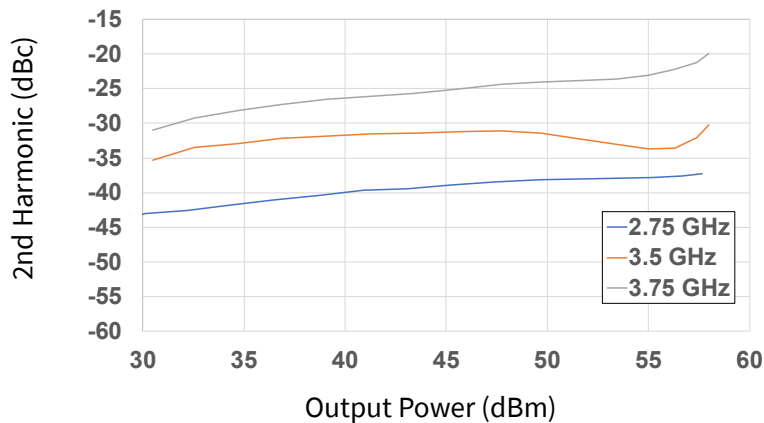


Figure 58. 3rd Harmonic vs Output Power as a Function of Frequency

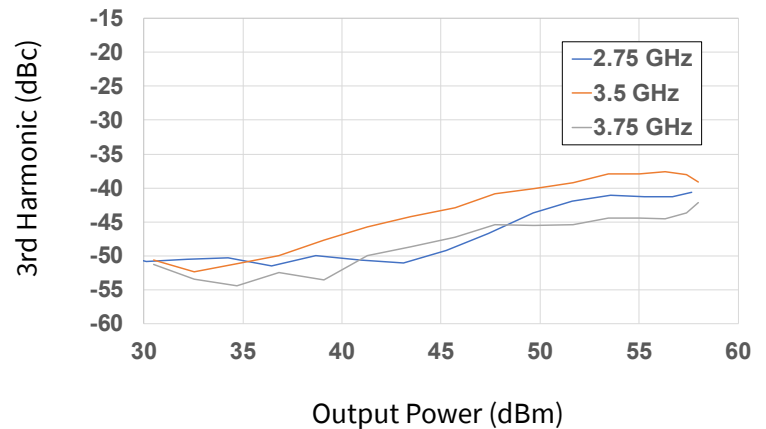


Figure 59. 2nd Harmonic vs Output Power as a Function of IDQ

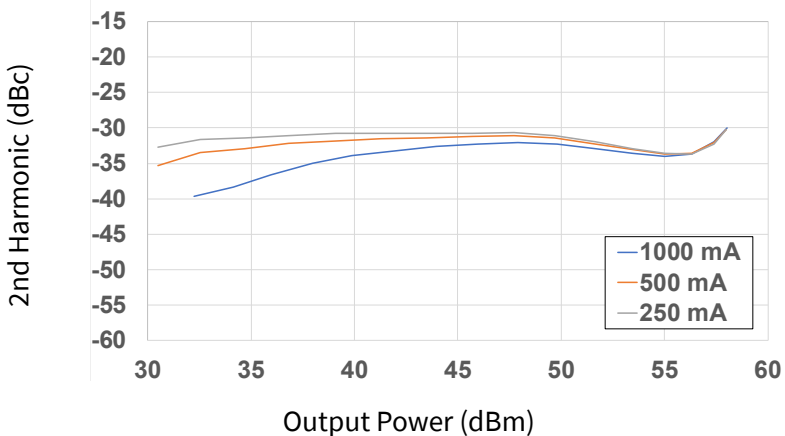
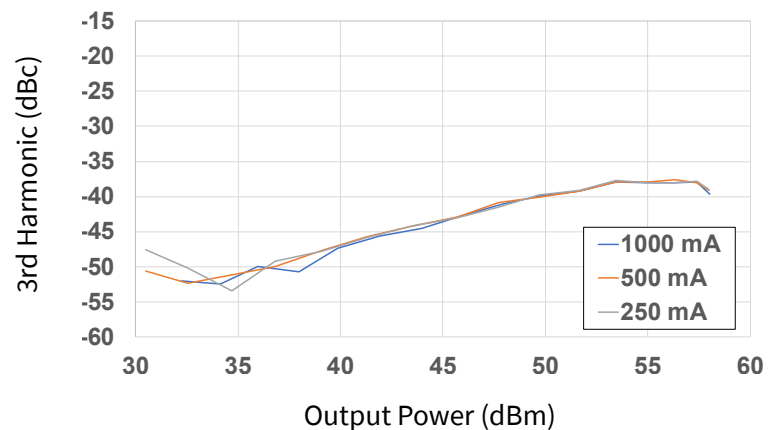
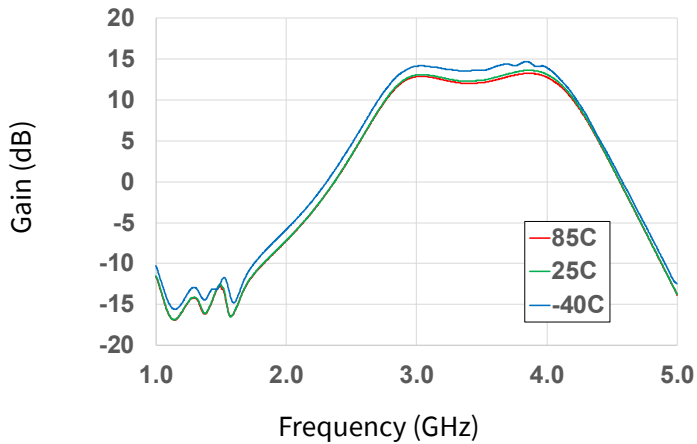
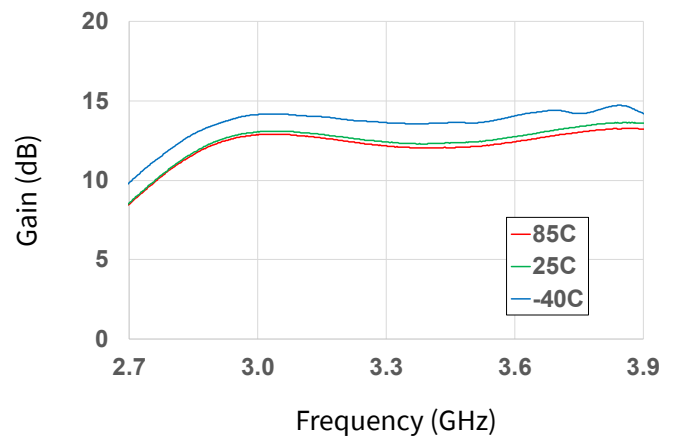
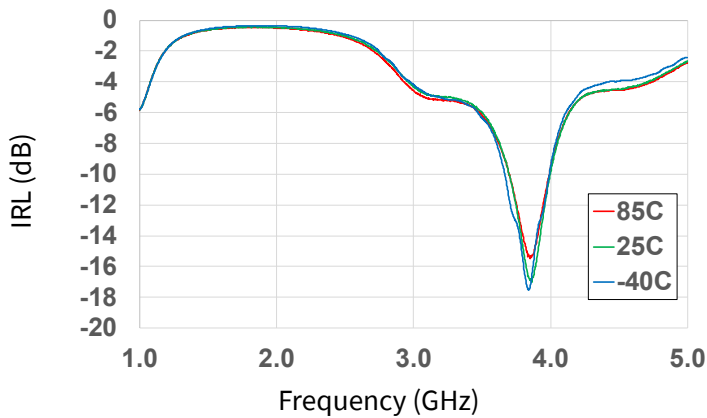
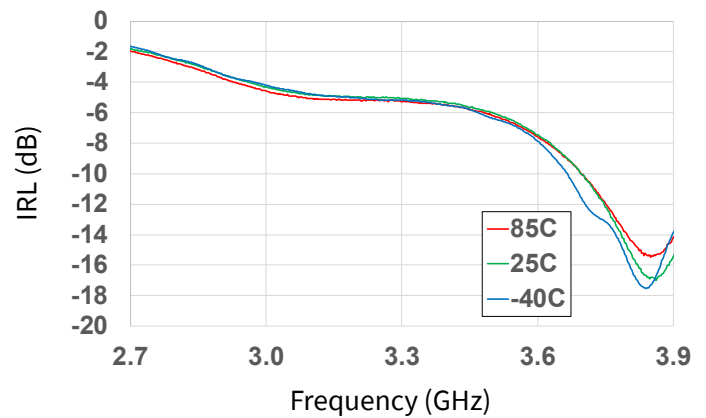
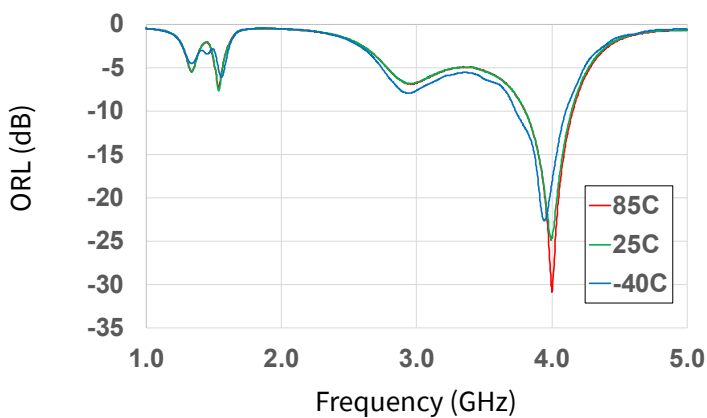
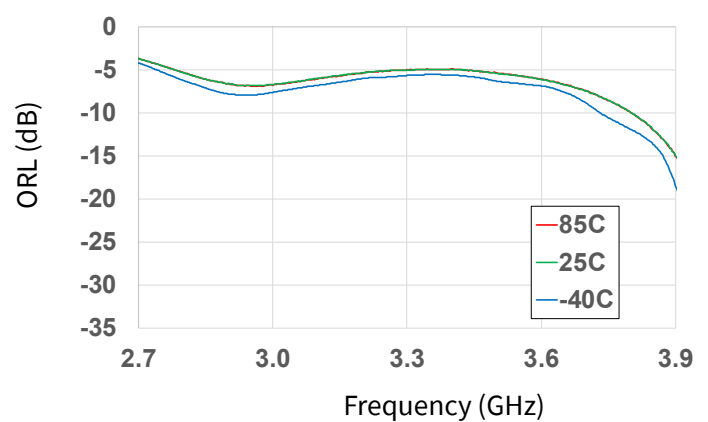


Figure 60. 3rd Harmonic vs Output Power as a Function of IDQ



Typical Performance of the CGHV38375F

Test conditions unless otherwise noted: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $P_{in} = -10\text{ dBm}$, $T_{BASE} = +25\text{ }^{\circ}\text{C}$

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: $V_D = 50\text{ V}$, $I_{DQ} = 500\text{ mA}$, $\text{Pin} = -10\text{ dBm}$, $T_{\text{BASE}} = +25^\circ\text{C}$

Figure 67. Gain vs Frequency as a Function of Voltage

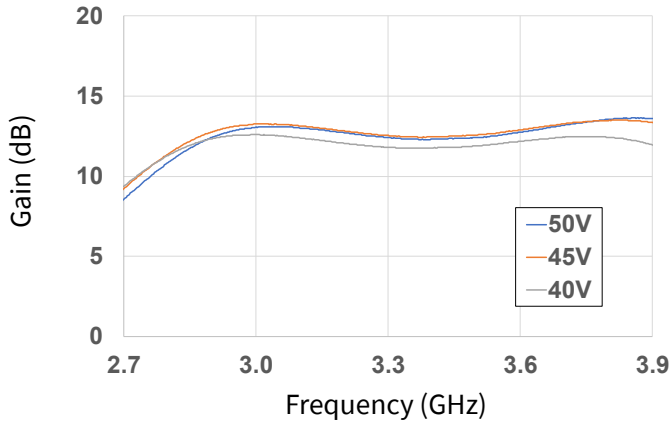


Figure 68. Gain vs Frequency as a Function of IDQ

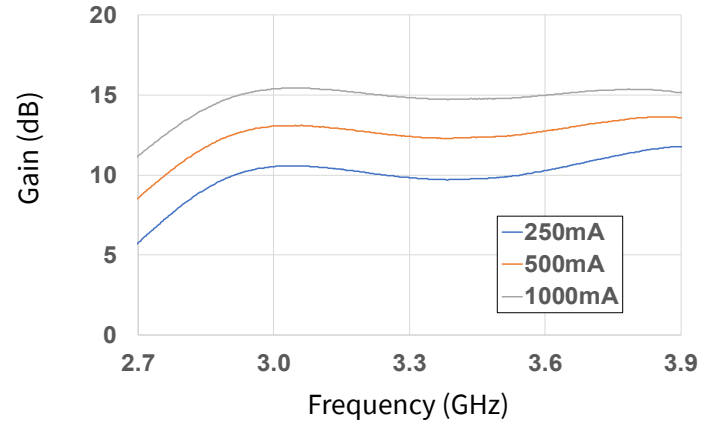


Figure 69. Input RL vs Frequency as a Function of Voltage

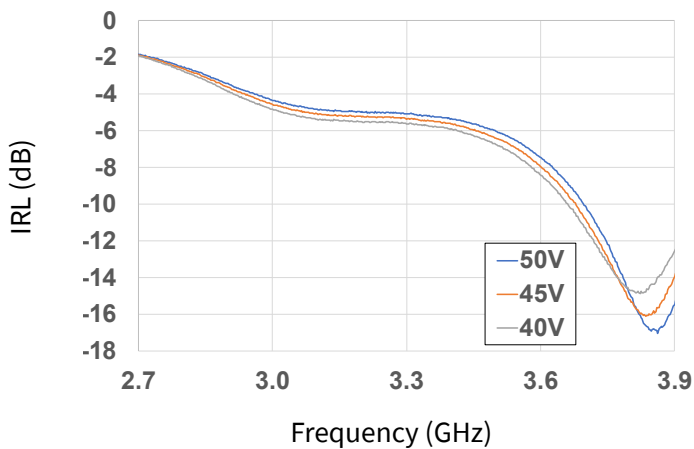


Figure 70. Input RL vs Frequency as a Function of IDQ

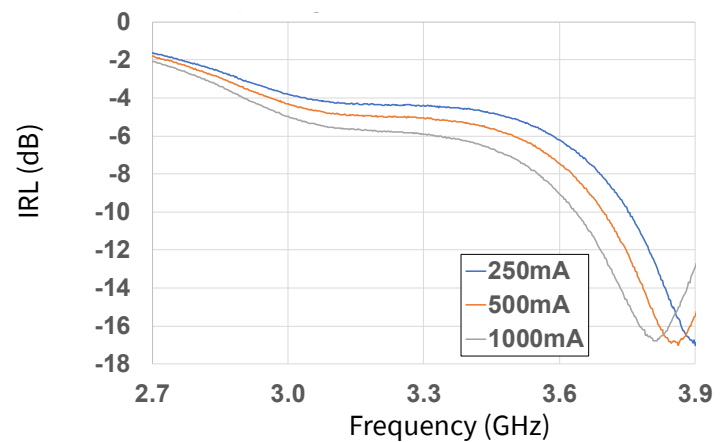


Figure 71. Output RL vs Frequency as a Function of Voltage

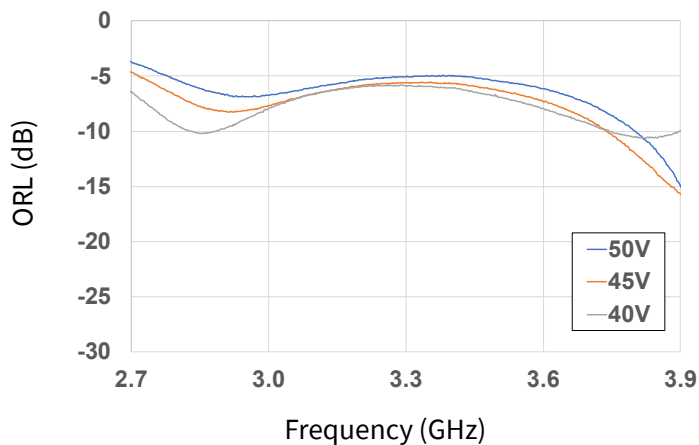
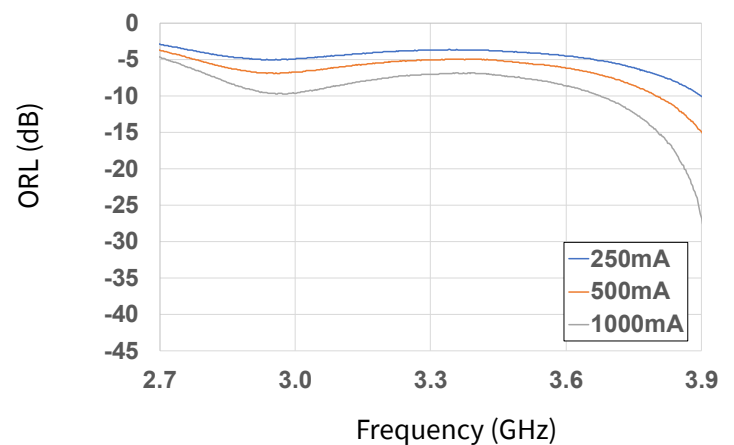
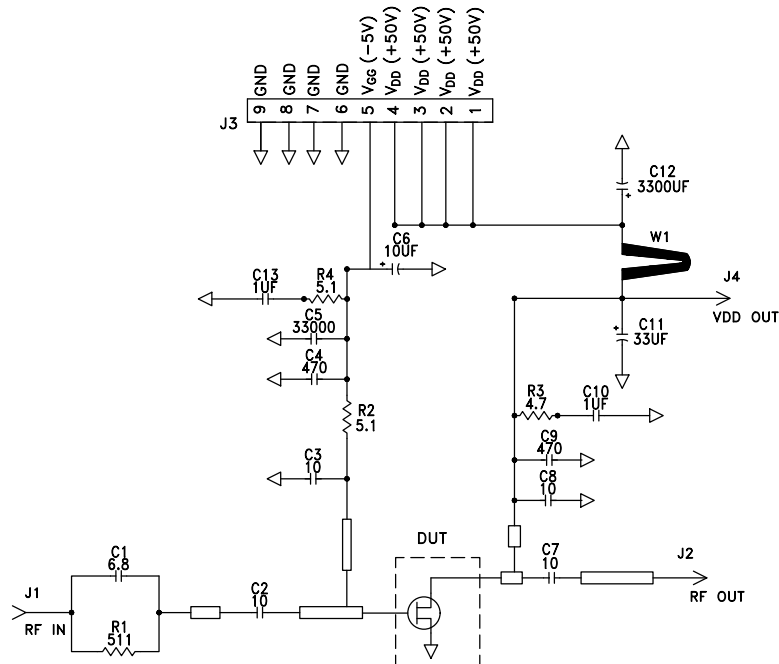


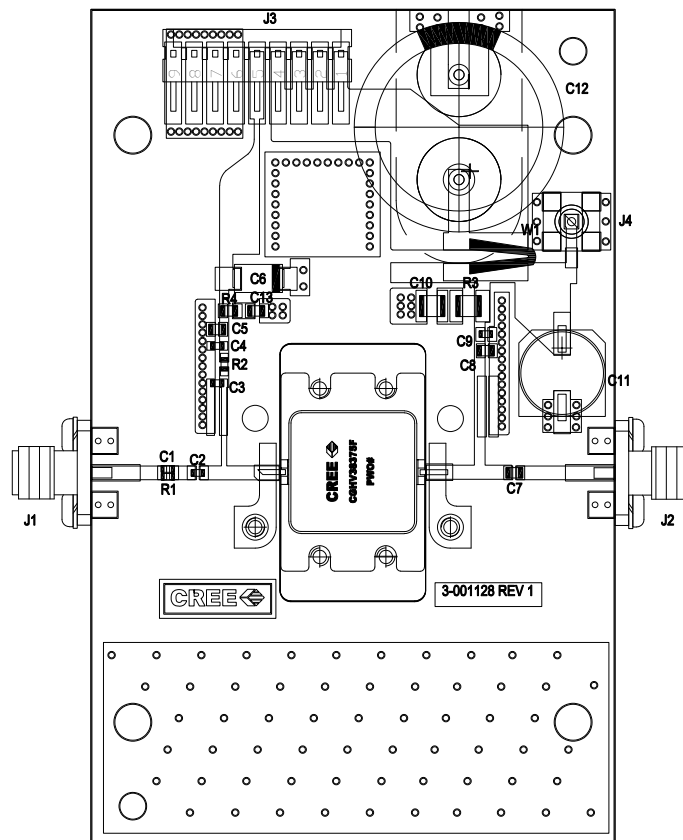
Figure 72. Output RL vs Frequency as a Function of IDQ



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

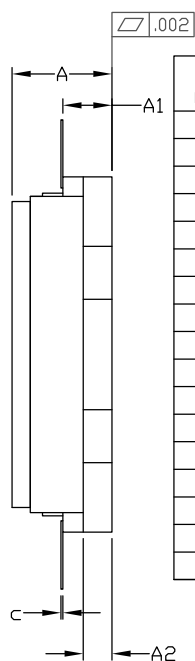
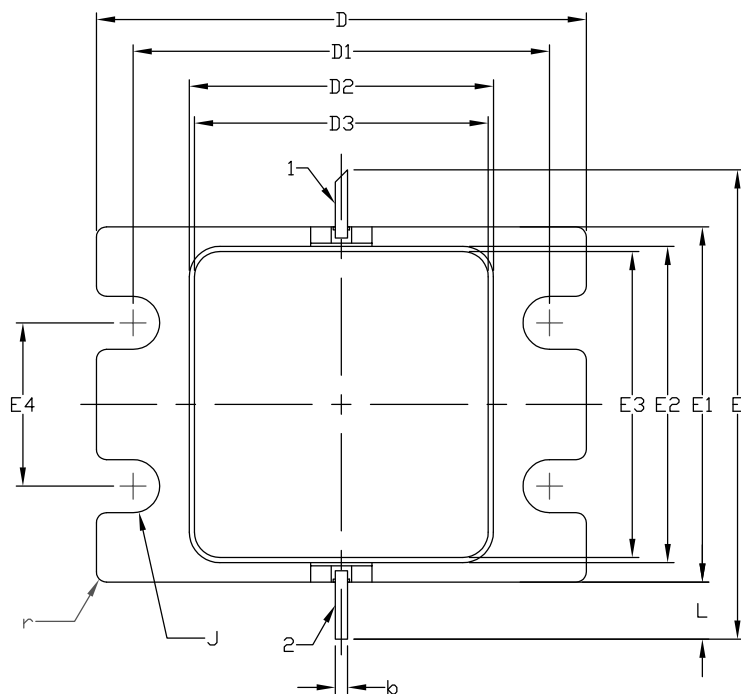
Moisture Sensitivity Level (MSL) Classification

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

CGHV38375F



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	

For more information, please contact:

4600 Silicon Drive
Durham, North Carolina, USA 27703
www.wolfspeed.com/RF

Sales Contact
RFSales@wolfspeed.com

RF Product Marketing Contact
RFMarketing@wolfspeed.com

Notes

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