

CGHV40100

100 W, DC - 3.0 GHz, 50 V, GaN HEMT

Description

The CGHV40100 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGHV40100, operating from a 50 volt rail, offers a general purpose, broadband solution to a variety of RF and microwave applications. GaN HEMTs offer high efficiency, high gain and wide bandwidth capabilities making the CGHV40100 ideal for linear and compressed amplifier circuits. The transistor is available in a 2-lead flange and pill package.



Package Types: 440193 & 440206
PN: CGHV40100F & CGHV40100P

Features

- Up to 3 GHz Operation
- 100 W Typical Output Power
- 17.5 dB Small Signal Gain at 2.0 GHz
- Application Circuit for 0.5 - 2.5 GHz
- 55% Efficiency at P_{SAT}
- 50 V Operation

Typical Performance Over 500 MHz - 2.5 GHz ($T_c = 25^\circ\text{C}$), 50 V

Parameter	500 MHz	1.0 GHz	1.5 GHz	2.0 GHz	2.5 GHz	Units
Small Signal Gain	17.6	16.9	17.7	17.5	14.8	dB
Saturated Output Power	147	100	141	116	112	W
Drain Efficiency @ P_{SAT}	68	56	58	54	54	%
Input Return Loss	6	5.1	10.5	5.5	8.8	dB

Notes:

¹ Measured CW in the CGHV40100F-AMP application circuit.

Large Signal Models Available for ADS and MWO



Absolute Maximum Ratings (not simultaneous) at 25°C Case Temperature

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DS}	150	V	25°C
Gate-to-Source Voltage	V_{GS}	-10, +2		
Storage Temperature	T_{STG}	-65, +150	°C	
Operating Junction Temperature	T_J	225		
Maximum Forward Gate Current	I_{GMAX}	20.8	mA	25°C
Maximum Drain Current ¹	I_{DMAX}	8.7	A	
Soldering Temperature ²	T_S	245	°C	
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case ³	$R_{\theta JC}$	1.62	°C/W	85°C
Thermal Resistance, Junction to Case ⁴	$R_{\theta JC}$	1.72		
Case Operating Temperature ⁵	T_C	-40, +150	°C	

Notes:

¹ Current limit for long term, reliable operation

² Refer to the Application Note on soldering

³ Measured for the CGHV40100P at $P_{DISS} = 83$ W

⁴ Measured for the CGHV40100F at $P_{DISS} = 83$ W

⁵ See also, Power Derating Curve on Page 13

Electrical Characteristics ($T_C = 25^\circ\text{C}$)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics¹						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-3.0	-2.3	V_{DC}	$V_{DS} = 10$ V, $I_D = 20.8$ mA
Gate Quiescent Voltage	$V_{GS(Q)}$	—	-2.7	—		$V_{DS} = 50$ V, $I_D = 0.6$ A
Saturated Drain Current ²	I_{DS}	13.5	19.3	—	A	$V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V
Drain-Source Breakdown Voltage	V_{BR}	100	—	—	V_{DC}	$V_{GS} = -8$ V, $I_D = 20.8$ mA
RF Characteristics² ($T_C = 25^\circ\text{C}$, $F_0 = 2.0$ GHz unless otherwise noted)						
Small Signal Gain	G_{SS}	16	17.5	—	dB	$V_{DD} = 50$ V, $I_{DQ} = 0.6$ A
Power Gain	G_P	—	11.0	—		$V_{DD} = 50$ V, $I_{DQ} = 0.6$ A, $P_{OUT} = P_{SAT}$
Output Power at Saturation ⁴	P_{SAT}	100	116	—	W	$V_{DD} = 50$ V, $I_{DQ} = 0.6$ A
Drain Efficiency ⁴	η	47	54	—	%	$V_{DD} = 50$ V, $I_{DQ} = 0.6$ A, $P_{OUT} = P_{SAT}$
Output Mismatch Stress	VSWR	—	—	10 : 1	Ψ	No damage at all phase angles, $V_{DD} = 50$ V, $I_{DQ} = 0.6$ A, $P_{OUT} = 100$ W CW
Dynamic Characteristics						
Input Capacitance	C_{GS}	—	29.3	—	pF	$V_{DS} = 50$ V, $V_{GS} = -8$ V, $f = 1$ MHz
Output Capacitance	C_{DS}	—	7.3	—		
Feedback Capacitance	C_{GD}	—	0.61	—		

Notes:

¹ Measured on wafer prior to packaging

² Scaled from PCM data

³ Measured in CGHV40100-AMP

⁴ P_{SAT} is defined as $I_G = 0.208$ mA

⁵ Includes package

CGHV40100 Typical Performance

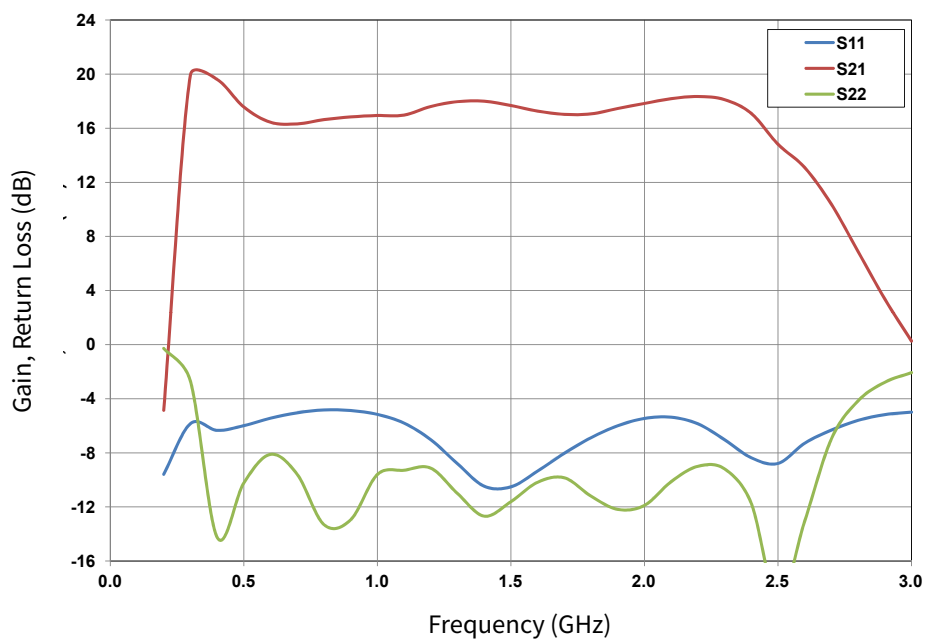


Figure 1. Small Signal Gain and Return Losses vs Frequency
measured in application circuit CGHV40100-AMP
 $V_{DD} = 50\text{ V}$, $I_{DQ} = 600\text{ mA}$, $T_{CASE} = 25^\circ\text{C}$

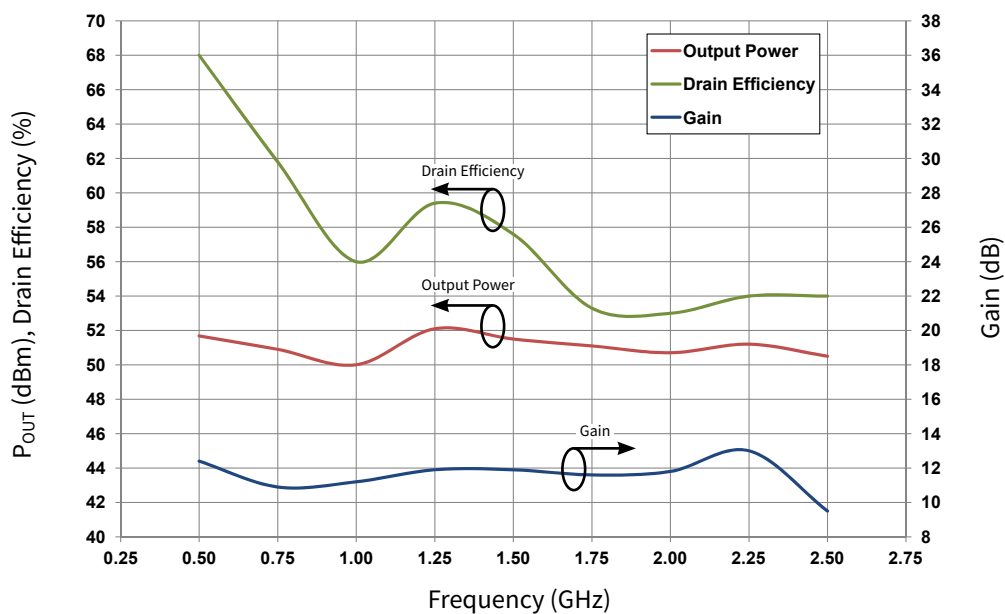


Figure 2. Output Power and Drain Efficiency vs Frequency
 $V_{DD} = 50\text{ V}$, $I_{DQ} = 600\text{ mA}$

CGHV40100 Typical Performance

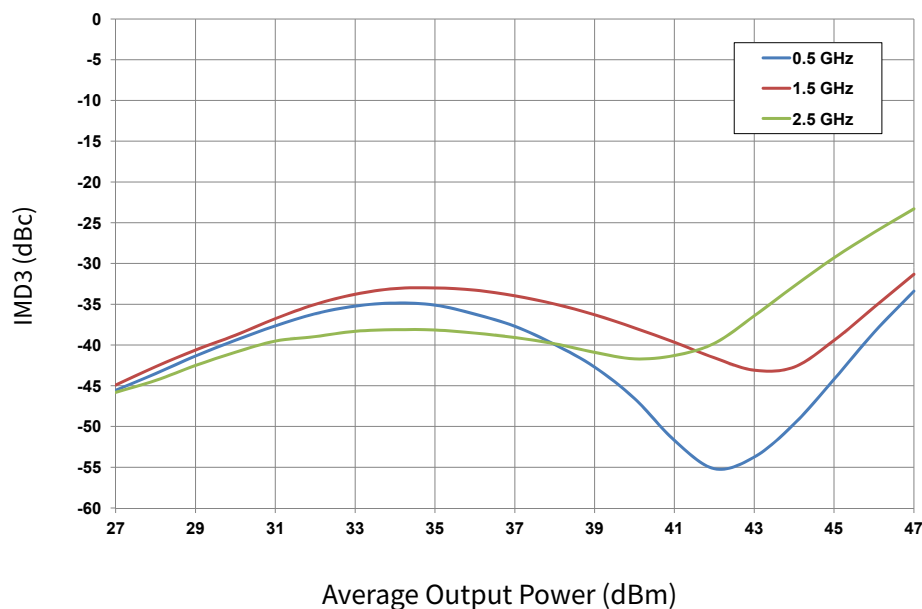


Figure 3. Third Order Intermodulation Distortion vs Average Output Power measured in Broadband Amplifier Circuit CGHV40100-AMP
Spacing = 1 MHz, $V_{DD} = 50$ V, $I_{DQ} = 600$ mA, $T_{CASE} = 25^{\circ}\text{C}$

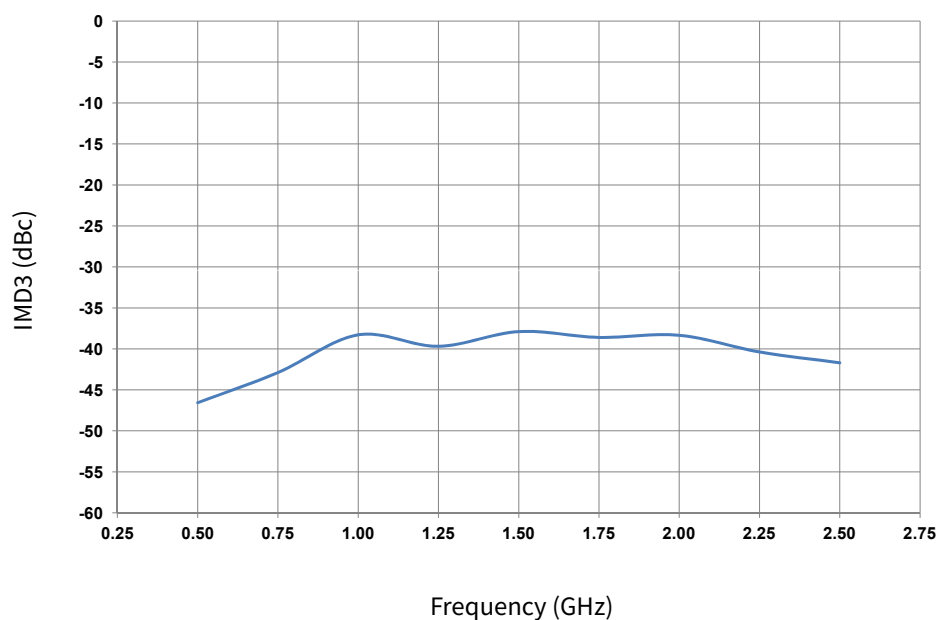


Figure 4. Third Order Intermodulation Distortion vs Frequency measured in Broadband Amplifier Circuit CGHV40100-AMP
Spacing = 1 MHz, $V_{DD} = 50$ V, $I_{DQ} = 600$ mA, $T_{CASE} = 25^{\circ}\text{C}$

CGHV40100 Typical Performance

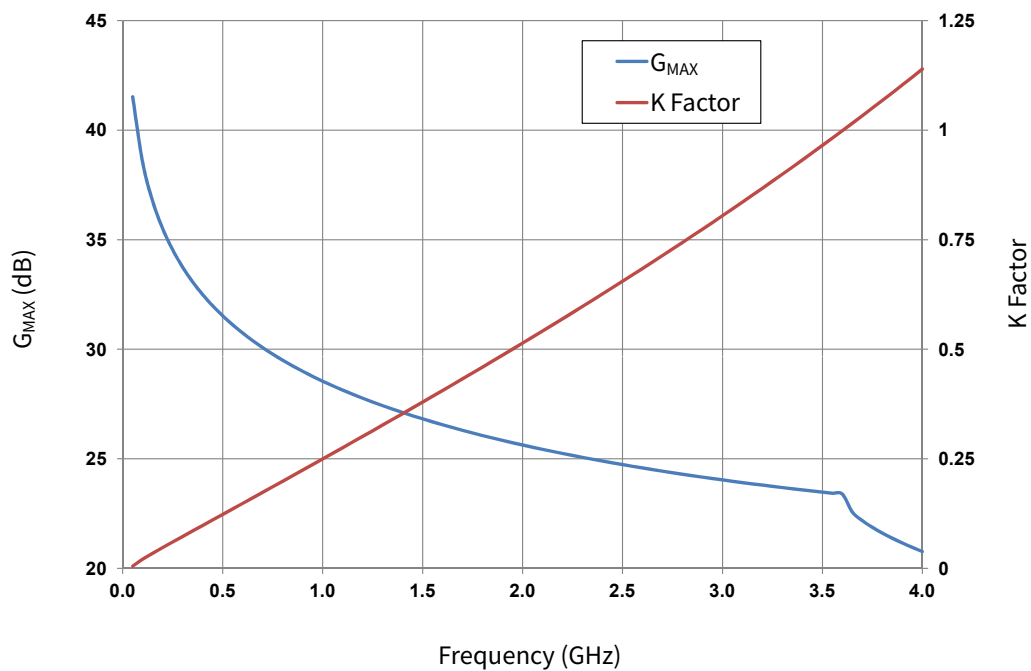
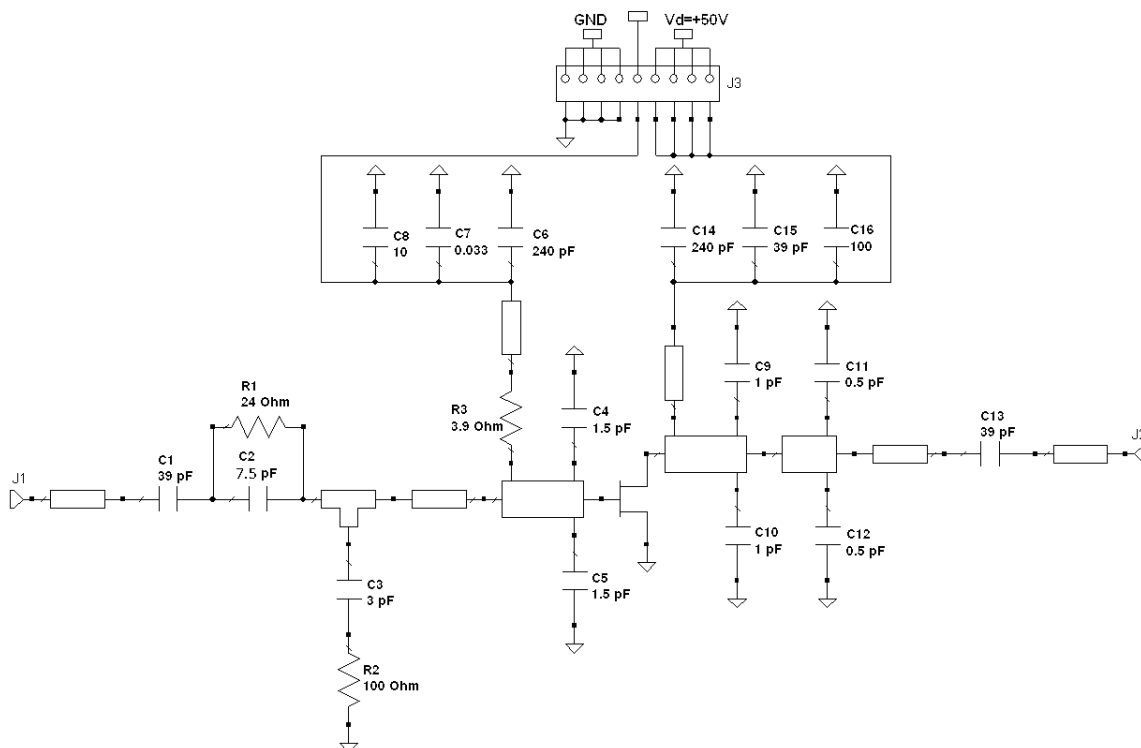


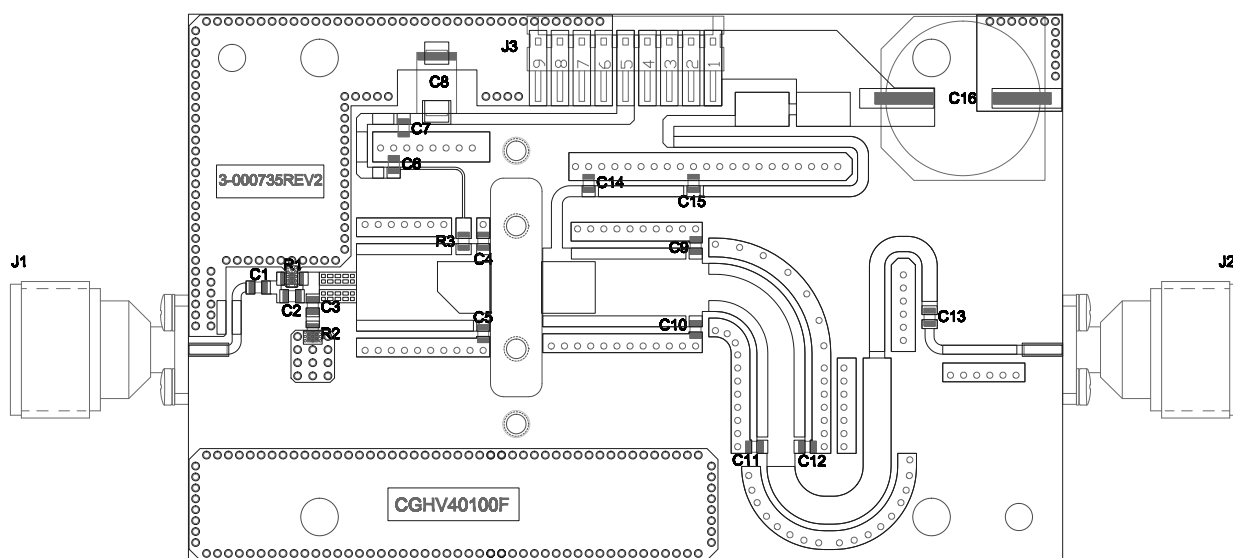
Figure 5. G_{MAX} and K Factor vs Frequency

$V_{DD} = 50\text{ V}$, $I_{DQ} = 600\text{ mA}$, $T_{CASE} = 25^\circ\text{C}$

CGHV40100-AMP Application Circuit Schematic



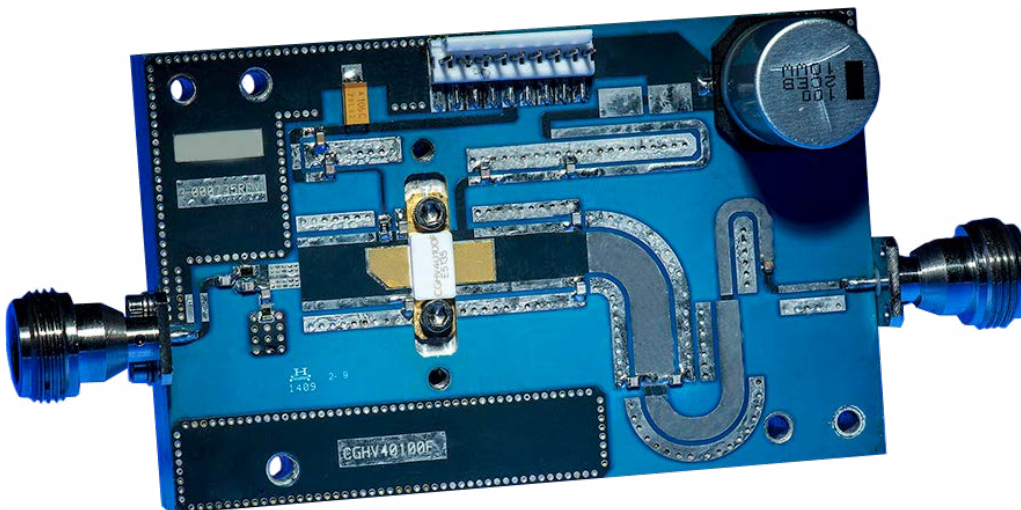
CGHV40100-AMP Application Circuit



CGHV40100-AMP Application Circuit Bill of Materials

Designator	Description	Qty
C1, C13, C15	CAP, 39pF, ± 0.1 pF, 250V, 0805, ATC600F	3
C2	CAP, 7.5pF, ± 0.1 pF, 250 V, 0806, ATC600F	1
C3	CAP, 3pF ± 0.1 pF, 250 V, 0805, ATC600F	1
C4, C5	CAP, 1.5pF, ± 0.1 pF, 250 V, 0805, ATC600F	2
C7	CAP, 33000pF, 0805 100V, X7R	1
C6, C14	CAP, 240pF, ± 0.5 pF, 250 V, 0805, ATC600F	2
C8	CAP, 10 μ F, 16V TANTALUM, 2312	1
C9, C10	CAP, 1pF, ± 0.1 pF, 250 V, 0805, ATC600F	2
C11, C12	CAP, 0.5pF, ± 0.1 pF, 250 V, 0805, ATC600F	2
C16	CAP, 100 μ F, 20%, 160 V, ELEC	1
R1	RES, 24 OHMS, IMS ND3-1005CS24R0G	1
R2	RED, 100 OHMS, IMS ND3-0805EW1000G	1
R3	RES, 3.9 OHMS, 0805	1
J1, J2	CONN, SMA, PANEL MOUNT JACK	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
-	BASEPLATE, CGH35120	1
-	PCB, RO4350B, 2.5" X 4" X 0.020", CGHV40100F	1

CGHV40100-AMP Demonstration Amplifier Circuit



Electrical Characteristics When Tested in CGHV40100F-AMP2

Characteristics	Symbol	Typ.	Max.	Units	Conditions
DC Characteristics ¹ (T _C = 25°C, F0 = 1.2 - 1.4 GHz unless otherwise noted)					
Output Power	P _{OUT}	51		dBm	V _{DD} = 50 V, I _{DQ} = 10 mA, P _{IN} = 38 dBm
Drain Efficiency	η	72		%	
Output Mismatch Stress	VSWR		10 : 1	Y	No damage at all phase angles, V _{DD} = 50 V, I _{DQ} = 10 mA, P _{IN} = 38 dBm

Typical Performance in Application Circuit CGHV40100F-AMP2

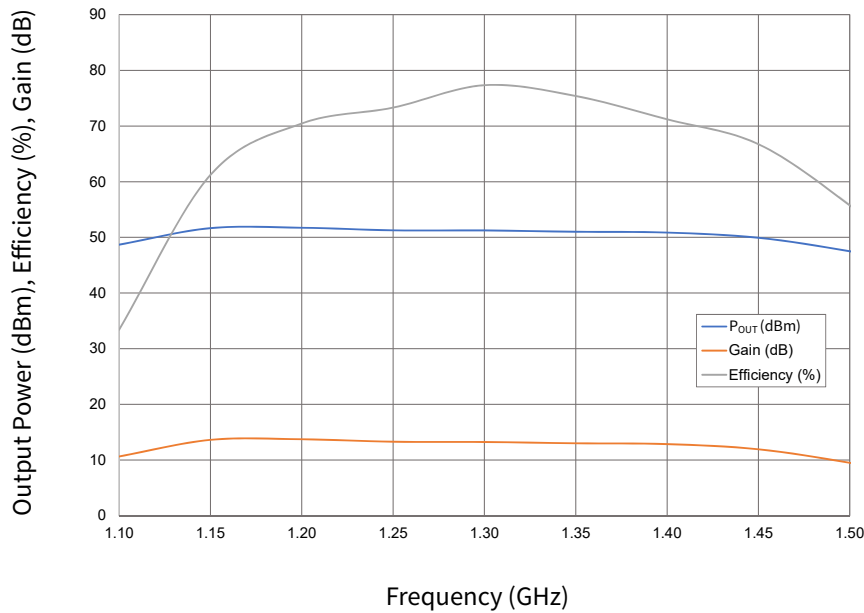
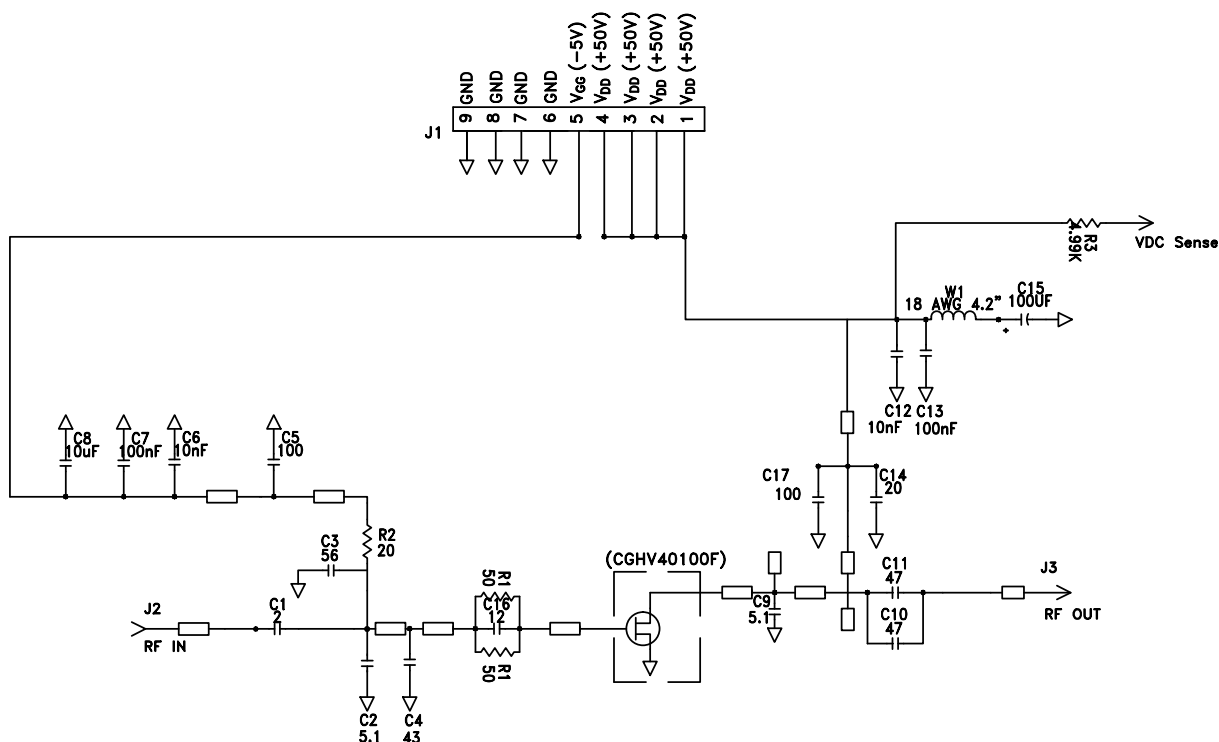
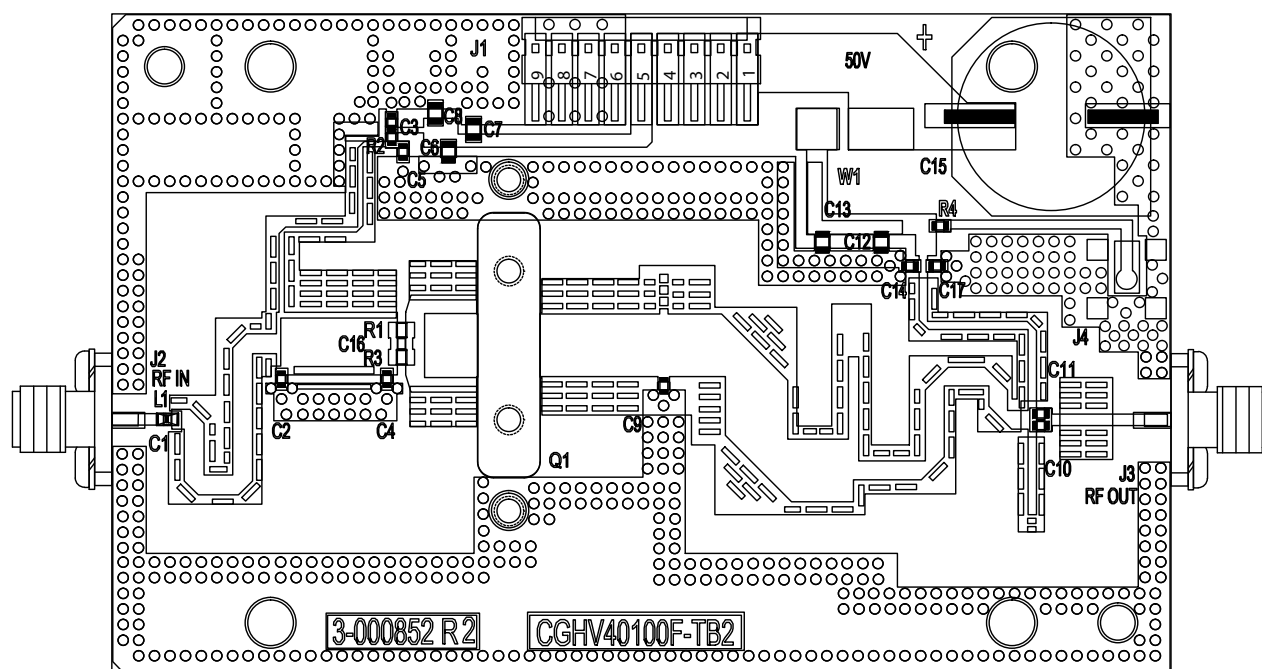


Figure 6. Output Power, Efficiency, and Gain vs. Frequency of the CGHV40100F
Measured in Demonstration Amplifier Circuit CGHV40100F-AMP2
V_{DD} = 50 V, I_{DQ} = 10 mA, Pulse Width = 100μs, Duty Cycle = 10%

CGHV40100-AMP2 Application Circuit Schematic



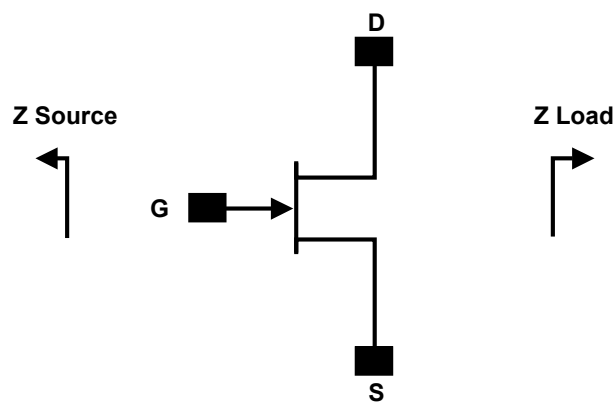
CGHV40100-AMP2 Application Circuit



CGHV40100F-AMP2 Bill of Materials

Designator	Description	Qty
C1	CAP, 2.0pF, +/-0.1pF, 0603, ATC	1
R2	RES, 1/16W, 0603, 1%, 20 OHMS	1
R4	RES, 1/16W, 0603, 1%, 4.99K OHMS	1
R1, R3	RES, AIN, 50.0 OHM, +/- 5%, 0505, PtAg TERMINATION	1
C8	CAP, 10μF, 10%, 1206, 16V	1
C1, C5, C17	CAP, 100.0pF, +/-5%, 0603, ATC	3
C16	CAP, 12.0pF, +/-5%, 0603, ATC600	1
C14	CAP, 20.0pF, +/-5%, 0603, ATC600S	1
C4	CAP, 43pF, +/-5%pF, 0603, ATC	1
C10, C11	CAP, 47pF, +/-5%pF, 0603, ATC	2
C3	CAP, 56pF +/- 5%, 0603, ATC600S	1
C2, C9	CAP, 5.1pF, +/-0.05pF, 0603, 600S	2
C6, C12	CAP, 0805, 100V, TEMP STBL, 1000pF	2
C7, C13	CAP, 10000PF, +/-10%, 0805, X7R, 100V, TEMP STBL	2
-	PCB, RO4350, 0.020 THK, CGHV40100F-TB2 1.2-1.4GHz RADAR	1
-	BASEPLATE, AL, 4.00 X 2.50 X 0.49 FOR THRU HOLE CAPACITORS	1
-	2-56 SOC HD SCREW 1/4 SS	4
-	#2 SPLIT LOCKWASHER SS	4
J2, J3	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE, BLUNT POST	2
J4	CONN, SMB, STRAIGHT JACK RECEPTACLE, SMT, 50 OHM, Au PLATED	1
J1	HEADER RT>PLZ .1CEN LK 9POS	1
W1	WIRE, BLACK, 18 AWG, EXTRUDED TFE TEFLON	1
L1	INDUCTOR, CHIP, 2.2nH, 0603, SMT	1
C2	CAP, 6.8pF, +/- 0.25pF, 0603, ATC	1
C15	CAP, 100μF, +/-20%, 100V, ALUM ELEC	1
Q1	Transistor CGHV40100F	1

Source and Load Impedances



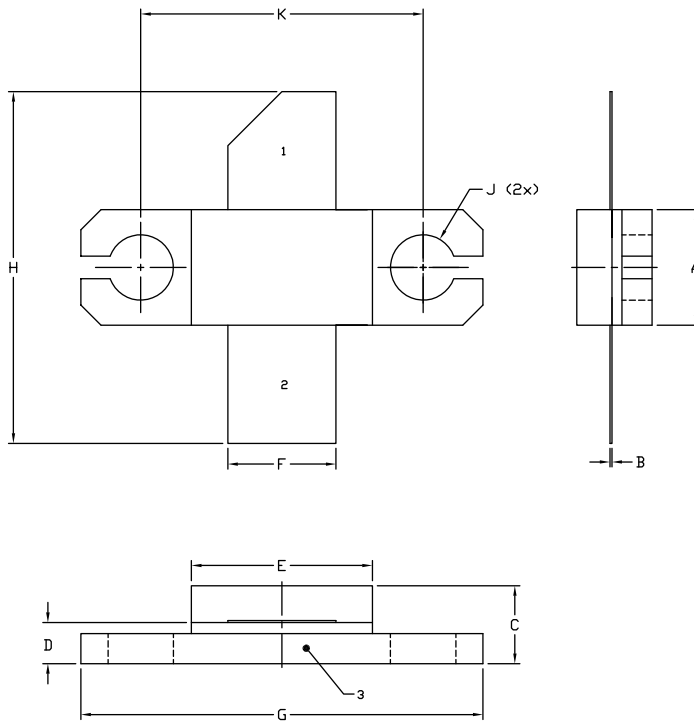
Frequency (MHz)	Z Source	Z Load
500	0.43 + j5.25	8.83 + j0.85
750	0.40 + j2.62	10.78 + j2.50
1000	0.30 + j1.31	9.06 + 4.23
1250	0.30 + j0.44	7.40 + j3.85
1500	0.30 - j0.44	6.39 + j3.44
1750	0.25 - j0.87	4.41 + j3.03
2000	0.25 - j1.31	3.68 + j2.17
2250	0.25 - j2.18	3.42 + j2.17
2500	0.26 - j2.62	2.65 + j1.74

Notes:
¹ V_{DD} = 50 V, I_{DQ} = 600 mA in the 440193 package
² Optimized for power gain, P_{SAT} and PAE

Electrostatic Discharge (ESD) Classifications

Parameter	Symbol	Class	Classification Level	Test Methodology
Human Body Model	HBM	1B	ANSI/ESDA/JEDEC JS-001 Table 3	JEDEC JESD22 A114-D
Charge Device Model	CDM	2	ANSI/ESDA/JEDEC JS-002 Table 3	JEDEC JESD22 C101-C

Product Dimensions CGHV40100F (Package Type — 440193)



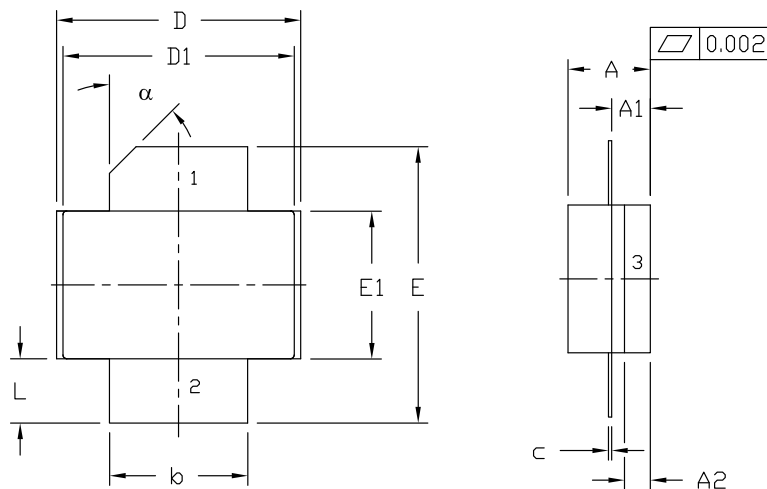
NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE Ni/AU.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.225	0.235	5.72	5.97
B	0.004	0.006	0.10	0.15
C	0.145	0.165	3.68	4.19
D	0.077	0.087	1.96	2.21
E	0.355	0.365	9.02	9.27
F	0.210	0.220	5.33	5.59
G	0.795	0.805	20.19	20.45
H	0.670	0.730	17.02	18.54
J	Ø .130		3.30	
k	0.562		14.28	

PIN 1. GATE
PIN 2. DRAIN
PIN 3. SOURCE

Product Dimensions CGHV40100P (Package Type — 440206)



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M - 1994.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

DIM	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.125	0.145	3.18	3.68	
A1	0.057	0.067	1.45	1.70	
A2	0.035	0.045	0.89	1.14	
b	0.210	0.220	5.33	5.59	2x
c	0.004	0.006	0.10	0.15	2x
D	0.375	0.385	9.53	9.78	
D1	0.355	0.365	9.02	9.27	
E	0.400	0.460	10.16	11.68	
E1	0.225	0.235	5.72	5.97	
L	0.085	0.115	2.16	2.92	2x
α	45° REF		45° REF		

PIN 1. GATE
PIN 2. DRAIN
PIN 3. SOURCE

CGHV40100 Power Dissipation De-rating Curve

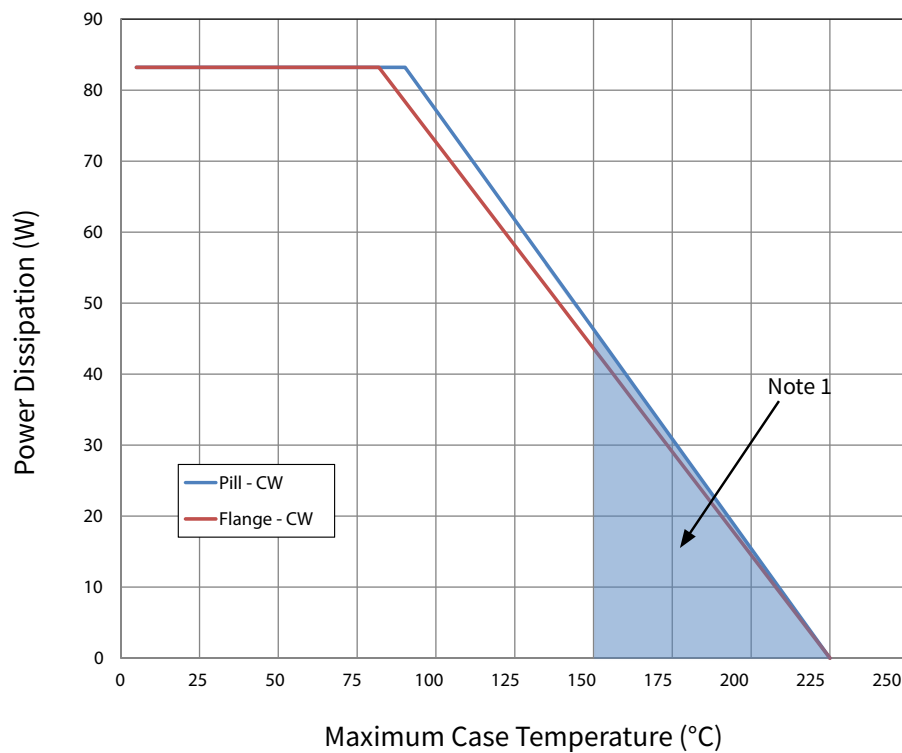


Figure 7. Transient Power Dissipation De-Rating Curve

Note

¹ Area exceeds Maximum Case Temperature (See Page 2).

Part Number System

CGHV40100F

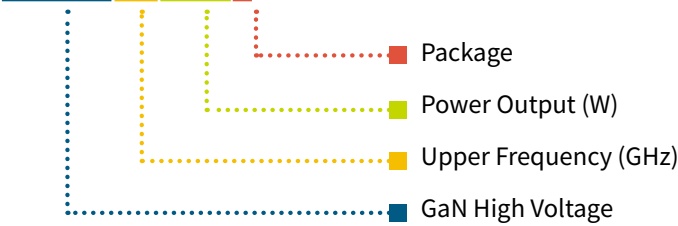


Table 1.

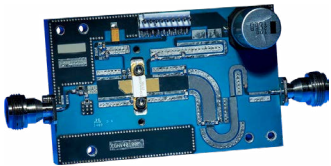
Parameter	Value	Units
Upper Frequency ¹	4.0	GHz
Power Output	100	W
Package	Flange	—

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
CGHV40100F	GaN HEMT	Each	
CGHV40100P	GaN HEMT	Each	
CGHV40100F-AMP	Test board with GaN HEMT (CGHV40100F) installed, operating from 0.5 - 2.5 GHz for communications or ISM applications.	Each	
CGHV40100F-AMP2	Test board with GaN HEMT (CGHV40100F) installed, operating from 1.2 - 1.4 GHz for L-Band Radar.	Each	

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