PRELIMINARY

CGHV59070

70 W, 4.4-5.9 GHz, 50 V, RF Power GaN HEMT

Cree's CGHV59070 is an internally matched gallium nitride (GaN) high electron mobility transistor (HEMT). The CGHV59070, 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 CGHV59070 ideal for linear and compressed amplifier circuits. The transistor is available in a flange and pill package.

Package Type: 440224, 440170
PN's: CGHV59070F, CGHV59070P

Typical Performance Over 4.8 - 5.9 GHz (T_c = 25°C)

Parameter	4.8 GHz	5.0 GHz	5.2 GHz	5.4 GHz	5.6 GHz	5.8 GHz	5.9 GHz	Units
Power Gain at 50 V	13.7	14.2	14.5	14.6	14.3	13.7	13.3	dB
Output Power at 50 V	84	93	101	102	95	84	76	W
Drain Efficiency at 50 V	55	56	57	56	54	50	48	%

Note: Measured in CGHV59070F-AMP (838269) under 100 µS pulse width,10% duty, Pin = 35.5 dBm (3.5 W)

Features

- 4.4 - 5.9 GHz Operation
- 90 W P_{OUT} typical at 50 V
- 14 dB Power Gain
- 55 % Drain Efficiency
- Internally Matched

Applications

- Marine Radar
- Weather Monitoring
- Air Traffic Control
- Maritime Vessel Traffic Control
- Port Security
- Troposcatter Communications
- Beyond Line of Sight - BLOS
- Satellite Communications

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_{DSS}	150	Volts	25˚C
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts	25˚C
Storage Temperature	T_{STG}	-65, +150	˚C	
Operating Junction Temperature	T_J	225	˚C	
Maximum Forward Gate Current	I_{GMAX}	10.4	mA	25˚C
Maximum Drain Current[1]	I_{DMAX}	6.3	A	25˚C
Soldering Temperature[2]	T_S	245	˚C	
Screw Torque	τ	40	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	2.99	˚C/W	85˚C, CW @ P_{DISS} = 57 W
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	0.85	˚C/W	85˚C, 100 µsec, 10% Duty Cycle @ P_{DISS} = 70 W
Case Operating Temperature[2]	T_C	-40, +150	˚C	

Note:
[1] Current limit for long term, reliable operation
[2] Refer to the Application Note on soldering at www.cree.com/RF/Document-Library
[3] Simulated for the CGHV59070F at P_{DISS} = 57.6 CW or P_{DISS} = 70 W Pulsed
[4] See also, the Power Dissipation De-rating Curve on Page 8.

Electrical Characteristics (T_C = 25˚C)

Characteristics	Symbol	Min.	Typ.	Max.	Units	Conditions
DC Characteristics[1]						
Gate Threshold Voltage	$V_{GS(th)}$	-3.8	-2.8	-2.3	V_{DC}	V_{DS} = 10 V, I_D = 10.4 mA
Saturated Drain Current[2]	I_{DS}	7.8	10.4	–	A	V_{DS} = 6.0 V, V_{GS} = 2.0 V
Drain-Source Breakdown Voltage	V_{BR}	150	–	–	V_{DC}	V_{GS} = -8 V, I_D = 10.4 mA
RF Characteristics[3] (T_C = 25˚C, F_0 = 2.5 GHz unless otherwise noted)						
Output Power	P_{OUT1}	–	100	–	W	V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{IN} = 35.5 dBm, Freq = 5.2 GHz
Output Power	P_{OUT1}	–	95	–	W	V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{IN} = 35.5 dBm, Freq = 5.55 GHz
Output Power	P_{OUT1}	–	76	–	W	V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{IN} = 35.5 dBm, Freq = 5.9 GHz
Drain Efficiency	EFF_1	–	57	–	%	V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{IN} = 35.5 dBm, Freq = 5.2 GHz
Drain Efficiency	EFF_2	–	54	–	%	V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{IN} = 35.5 dBm, Freq = 5.55 GHz
Drain Efficiency	EFF_3	–	48	–	%	V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{IN} = 35.5 dBm, Freq = 5.9 GHz
Power Gain	PG_1	–	14.5	–	dB	V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{IN} = 35.5 dBm, Freq = 5.2 GHz
Power Gain	PG_2	–	14.3	–	dB	V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{IN} = 35.5 dBm, Freq = 5.55 GHz
Power Gain	PG_3	–	13.3	–	dB	V_{DD} = 50 V, I_{DQ} = 0.15 A, P_{IN} = 35.5 dBm, Freq = 5.9 GHz
Output Mismatch Stress	VSWR	–	–	5 : 1	Ψ	No damage at all phase angles, V_{DD} = 50 V, I_{DQ} = 0.15A, P_{IN} = 35.5 dBm Pulsed
Dynamic Characteristics						
Input Capacitance	C_{GS}	–	36	–	pF	V_{DS} = 50 V, V_{gs} = -8 V, f = 1 MHz
Output Capacitance	C_{DS}	–	109	–	pF	V_{DS} = 50 V, V_{gs} = -8 V, f = 1 MHz
Feedback Capacitance	C_{GD}	–	0.26	–	pF	V_{DS} = 50 V, V_{gs} = -8 V, f = 1 MHz

Notes:
[1] Measured on wafer prior to packaging.
[2] Scaled from PCM data.
[3] Measured in CGHV59070F-AMP
[4] Drain Efficiency = P_{OUT} / P_{DC}

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Typical Performance

Figure 1 - Small Signal Gain and Return Losses of the CGHV59070-AMP vs Frequency
V_{DD} = 50 V, I_{DQ} = 150 mA

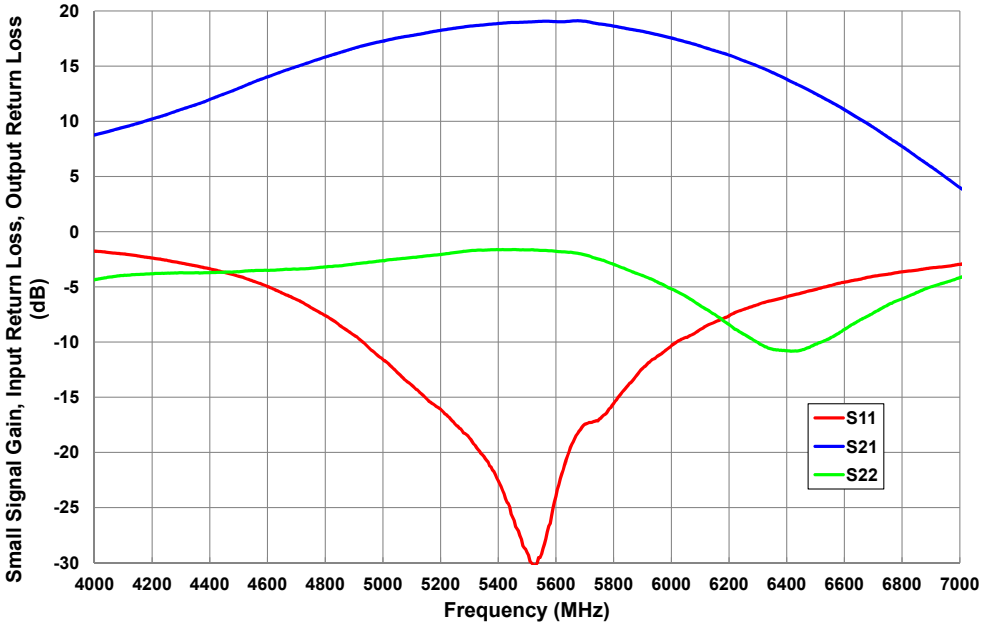
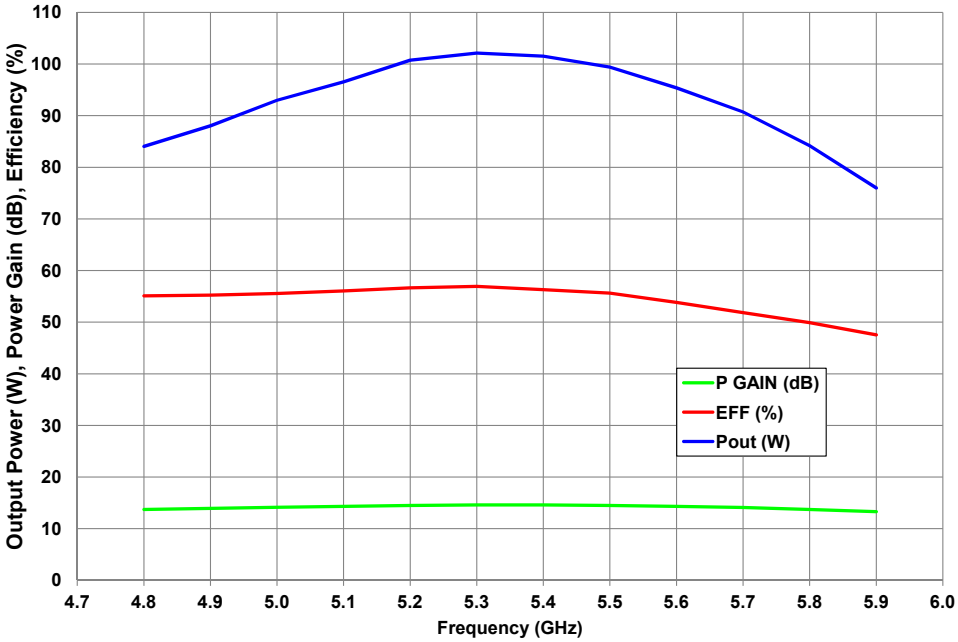


Figure 2 - Power Gain, Drain Efficiency, and Output Power vs Frequency measured in Amplifier Circuit CGHV59070P-AMP
V_{DD} = 50 V, I_{DQ} = 150 mA, P_{IN} = 35.5 dBm, Pulse Width = 100 µsec, Duty Cycle = 10%



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Typical Performance

Figure 3 - Maximum Available Gain and K Factor of the CGHV59070
V_{DD} = 50 V, I_{DQ} = 150 mA

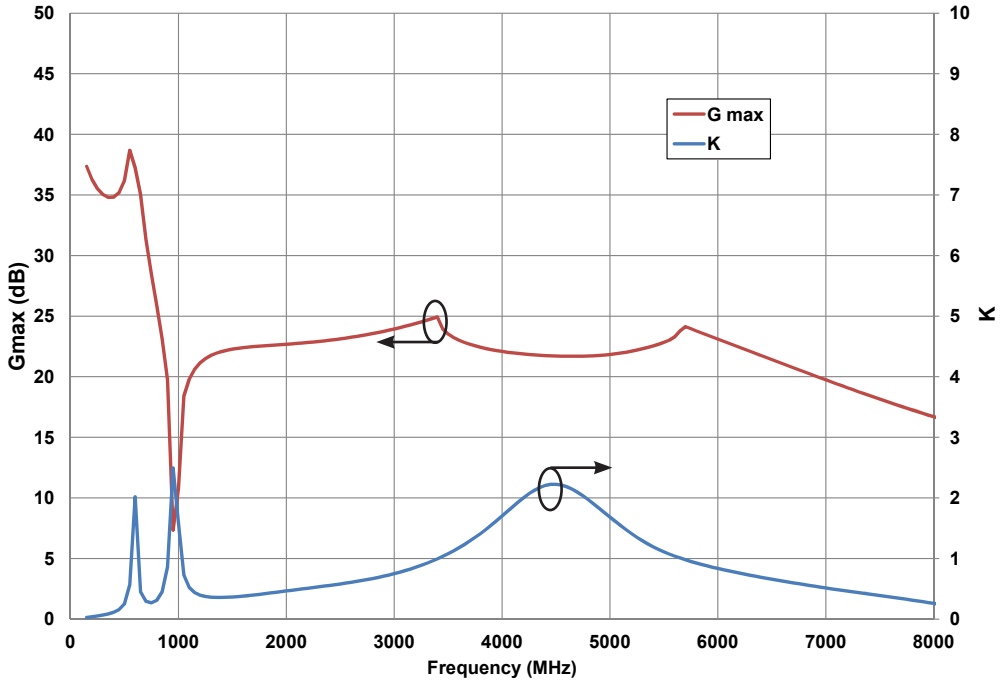
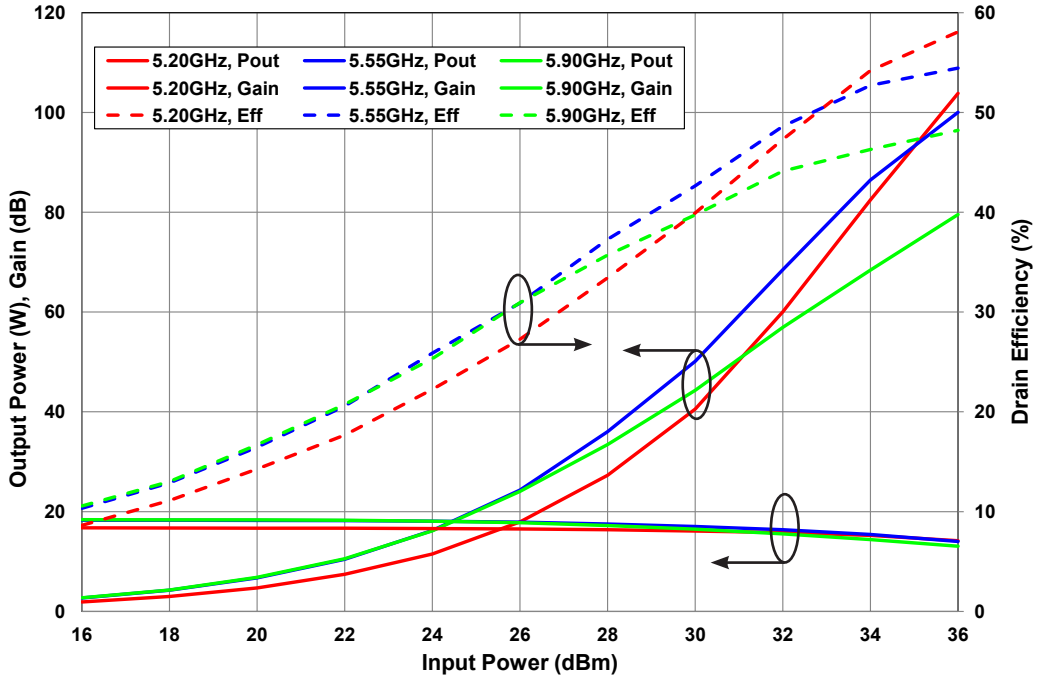


Figure 4 - Power Gain, Drain Efficiency and Output Power vs Input Power of the CGHV59070
V_{DD} = 50 V, I_{DQ} = 150 mA, Pulse Width = 100 µsec, Duty Cycle = 10%



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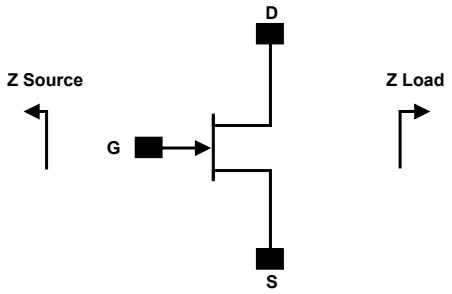
Simulated Source and Load Impedances



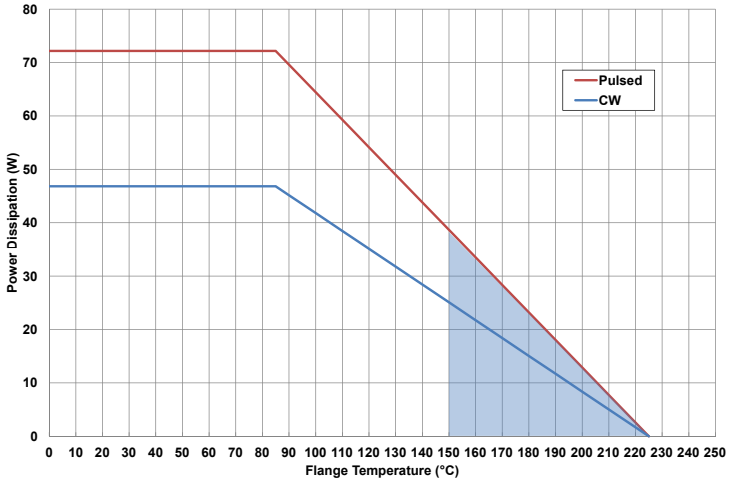
Frequency (MHz)	Z Source	Z Load
4400	2.6 - j12.9	14.0 - j6.9
4600	3.8 - j14.2	15.0 - j6.7
4800	5.8 - j15.3	16.0 - j7.0
5000	8.8 - j15.4	16.7 - j8.0
5200	8.8 - j14.7	17.1 - j9.1
5300	8.5 - j14.5	16.9 - j10.0
5400	8.1 - j14.2	16.5 - j10.7
5500	7.8 - j13.9	15.4 - j11.4
5600	7.5 - j13.6	15.4 - j12.0
5700	7.2 - j13.3	14.6 - j12.5
5800	6.9 - j13.3	13.8 - j12.8
5900	6.6 - j12.7	12.9 - j13.1

Note 1. V_{DD} = 50 V, I_{DQ} = 150 mA in the 440224 package.

Note 2. Optimized for power gain, P_{SAT} and PAE.

Note 3. When using this device at low frequency, series resistors should be used to maintain amplifier stability.

CGHV59070 Power Dissipation De-rating Curve, CW and Pulse (100 µsec, 10%)



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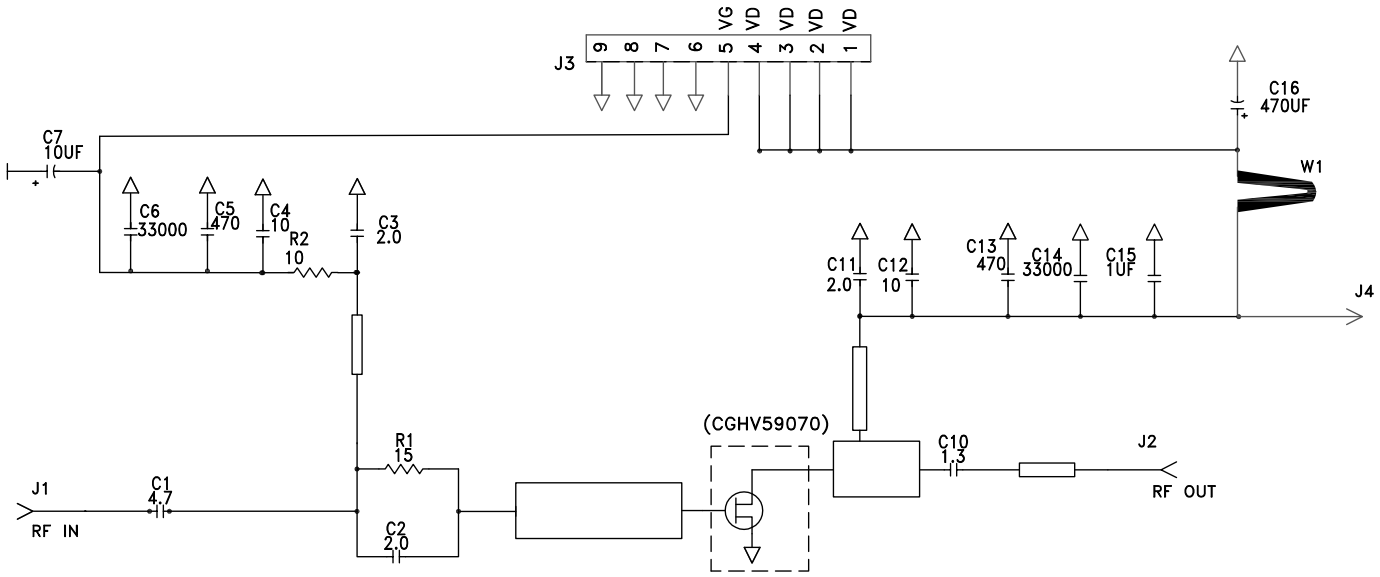
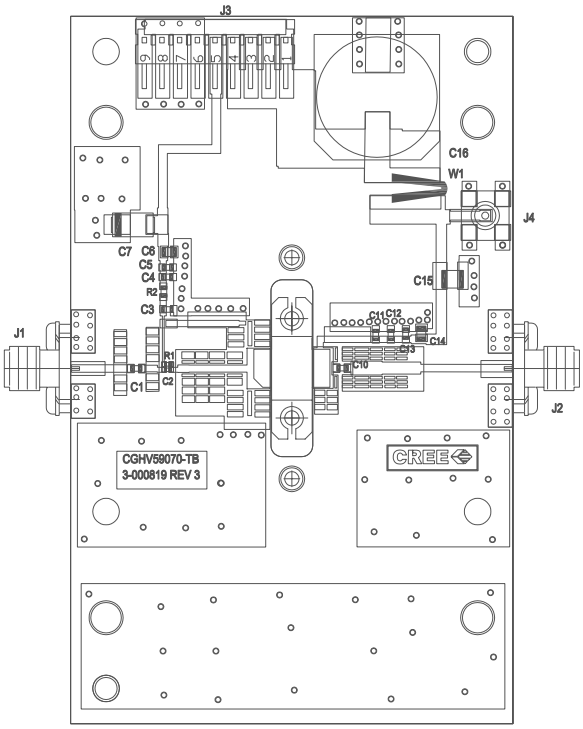
CGHV59070-AMP Demonstration Amplifier Circuit Schematic



CGHV59070-AMP Demonstration Amplifier Circuit Outline



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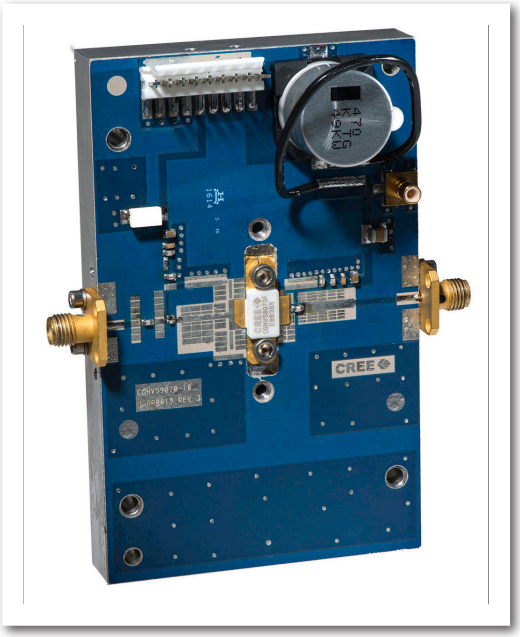
CGHV59070-AMP Demonstration Amplifier Circuit Bill of Materials

Designator	Description	Qty
R1	RES, 15,OHM, +/- 1%, 1/16W, 0402	1
R2	RES,1/16W,0603,1%,10.0 OHMS	1
C1	CAP, 4.7 pF,+/-0.1pF, 0603, ATC600S	1
C10	CAP, 1.3 pF,+/-0.1pF, 0603, ATC600S	1
C3,C11	CAP, 2.0 pF,+/-0.1pF, 0603, ATC600S	1
C2	CAP, 2.0 pF, +/- 0.05 pF, 0402, ATC	1
C4,C12	CAP, 10pF,+/-5%, 0603, ATC	2
C5,C13	CAP, 470PF, 5%, 100V, 0603, X	2
C6,C14	CAP, 33000PF, 0805,100V, X7R	2
C15	CAP, 1.0UF, 100V, 10%, X7R, 1210	1
C7	CAP 10UF 16V TANTALUM	1
W1	CABLE ,18 AWG, 4.2 inch	1
C16	CAP, 470uF, 20%, 80V, ELECT, SMD Size K	1
J1,J2	CONN, SMA, PANEL MOUNT JACK, FLANGE, 4-HOLE	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
J4	CONNECTOR ; SMB, Straight, JACK,SMD	1
Q1	CGHV59070	1

CGHV59070-AMP Demonstration Amplifier Circuit



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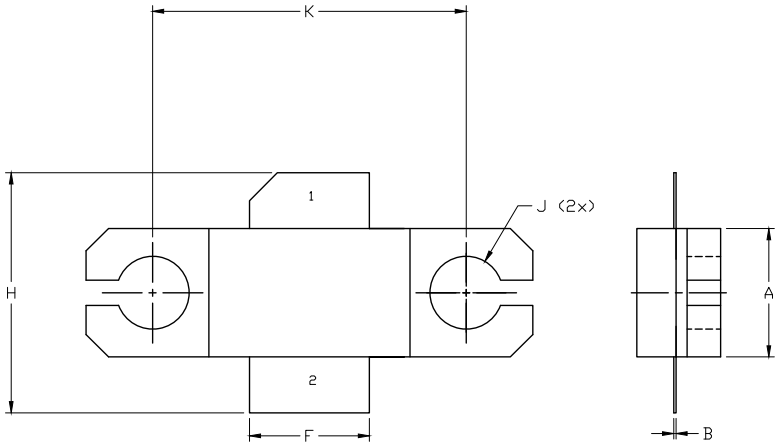
Product Dimensions CGHV59070F (Package Type — 440224)

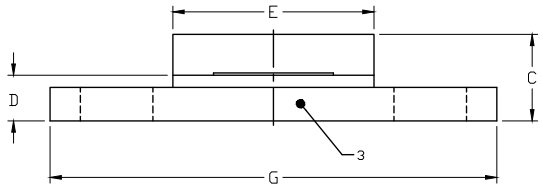


NOTES:

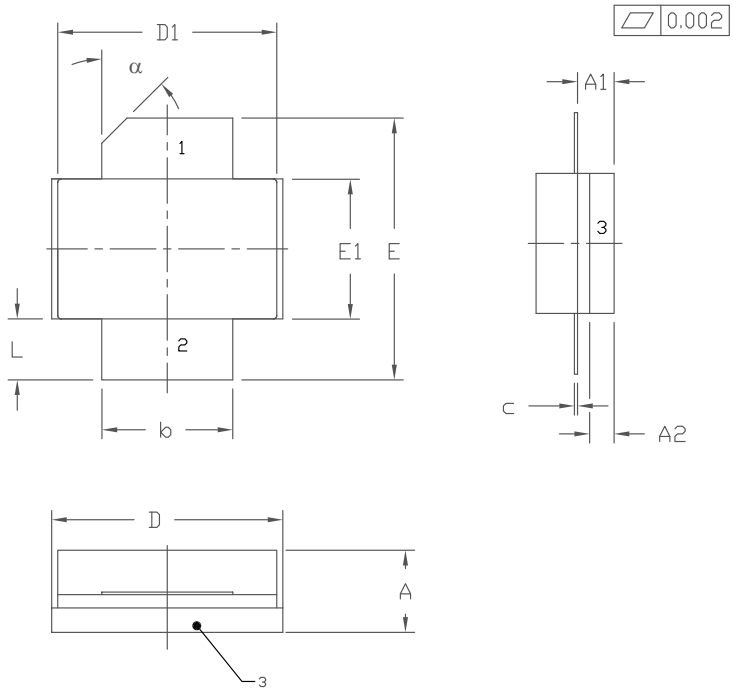
1. DIMENSIONING AND TOLERANICING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

	INCHES		MILLIMETERS	
DIM	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	0.400	0.460	10.16	11.68
J	ø .130		3.30	
k	0.562		14.27	

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



Product Dimensions CGHV59070P (Package Type — 440170)



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.

	INCHES		MILLIMETERS		NOTES
DIM	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
2. DRAIN
3. SOURCE

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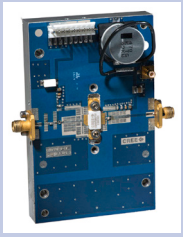
Product Ordering Information

Order Number	Description	Unit of Measure	Image
CGHV59070F	GaN HEMT	Each	
CGHV59070P	GaN HEMT	Each	
CGHV59070F-TB	Test board without GaN HEMT	Each	
CGHV59070F-AMP	Test board with GaN HEMT installed	Each	

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