RF Power GaN HEMT
120 W, 28 V

CG2H40120
Rev. V3

Features

- Up to 2.5 GHz Operation
- 28 V Operation
- Small Signal Gain:
  20 dB @ 1 GHz
  15 dB @ 2 GHz
- P_{SAT}: 130 W
- Efficiency: 70% @ P_{SAT}
- RoHS* Compliant

Package Types: 440206 and 440223
PNs: CG2H40120P and CG2H40120F

Applications

- 2-Way Private Radio
- Broadband Amplifiers
- Test Instumentation

Description

The CG2H40120 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CG2H40120, operating from a 28 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 CG2H40120 ideal for linear and compressed amplifier circuits. The transistor is available in a flange and pill package.

Large signal models available for ADS & MWO.

Ordering Information

Part Number	Package
CG2H40120F	Bulk
CG2H40120P	bulk
CG2H40120F-AMP	Test Board GaN HEMT (flange) installed

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

DC Characteristics: Measured on wafer prior to packaging
T_C = +25°C

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Gate Threshold Voltage	V_{DS} = 10 V, I_D = 28.8 mA	VDC	-3.8	-3.0	-2.3
Gate Quiescent Voltage	V_{DS} = 28 V, I_D = 1 A	VDC	—	-2.7	—
Saturated Drain Current (scaled from PCM data)	V_{DS} = 6 V, V_{GS} = 2 V	A	20.7	28.2	—
Drain-Source Breakdown Voltage	V_{GS} = -8 V, I_D = 28.8 mA	VDC	84	—	—

RF Characteristics: Measured in CG2H40120F/P-AMP
T_C = +25°C, Freq. = 1.3 GHz (unless otherwise noted)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Small Signal Gain	V_{DD} = 28 V, I_{DQ} = 1 A	dB	18.5	20	—
Power Output (P_{SAT} is defined as I_G = 2.8 mA	V_{DD} = 28 V, I_{DQ} = 1 A	W	100	130	—
Drain Efficiency (Drain Efficiency = P_{OUT} / P_{DC})	V_{DD} = 28 V, I_{DQ} = 1 A, P_{OUT} = P_{SAT}	%	62	72	—
Output Mismatch Stress	No damage at all phase angles, V_{DD} = 28 V, I_{DQ} = 1 A, P_{OUT} = 100 W CW	Y	—	—	10:1

Dynamic Characteristics

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Input Capacitance	V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz	pF	—	35.7	—
Output Capacitance	V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz	pF	—	15.1	—
Feedback Capacitance	V_{DS} = 28 V, V_{GS} = -8 V, f = 1 MHz	pF	—	1.5	—

Absolute Maximum Ratings[1,2]

Parameter	Absolute Maximum
Drain Source Voltage	120 V
Gate Source Voltage	-10 V to +2 V
Gate Current	30 mA
Drain Current	12 A
Junction Temperature	+225°C
Operating Temperature	-40°C to +65°C
Storage Temperature	-65°C to +150°C
Soldering Temperature	245°C
Screw Torque	40 in-oz

1. Exceeding any one or combination of these limits may cause permanent damage to this device.
2. MACOM does not recommend sustained operation near these survivability limits.

Thermal Characteristics

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Thermal Resistance ($R_{\theta JC}$) CG2H40120F CG2H40120P	T_C = +85°C, P_{DISS} @ 115 W	°C/W	—	1.39 1.32	—

Handling Procedures

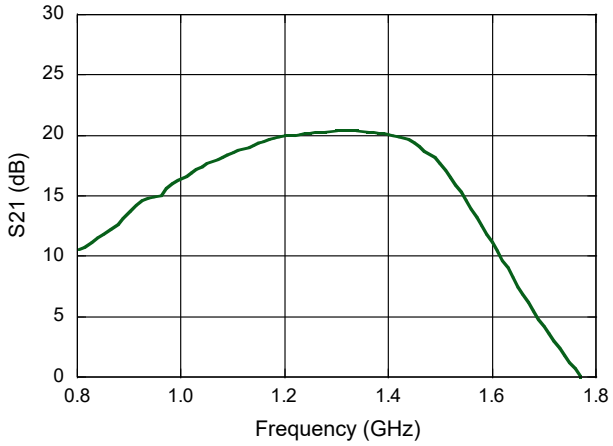
Please observe the following precautions to avoid damage:

Static Sensitivity

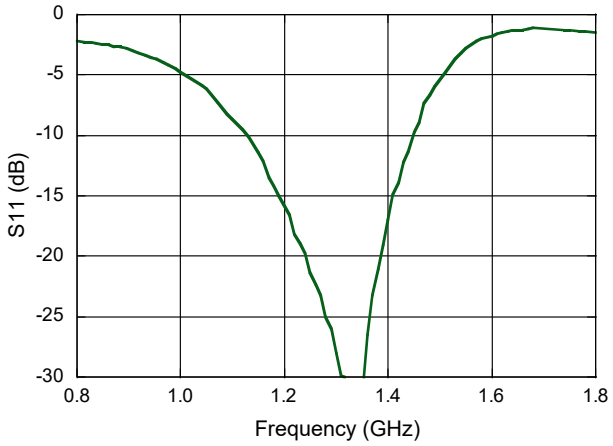
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A and CDM Class C3 devices.

Typical Performance Curves: V_{DD} = 28 V, I_{DQ} = 1 A
Measured in Broadband Amplifier Circuit CG2H40120F/P-AMP

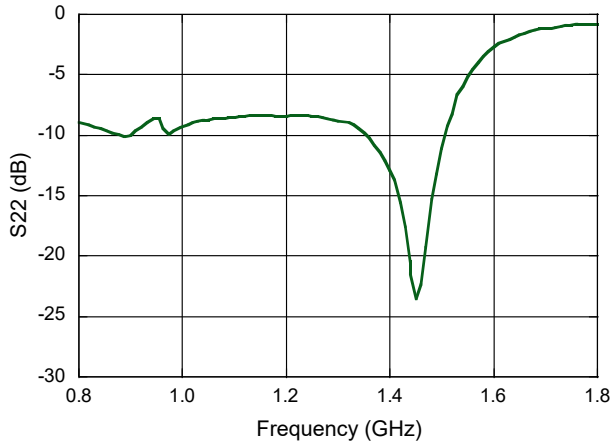
Gain vs Frequency



Input Return Loss vs Frequency

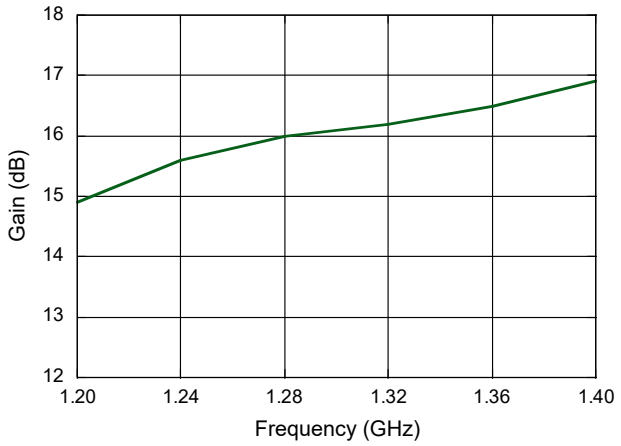


Output Return Loss vs Frequency

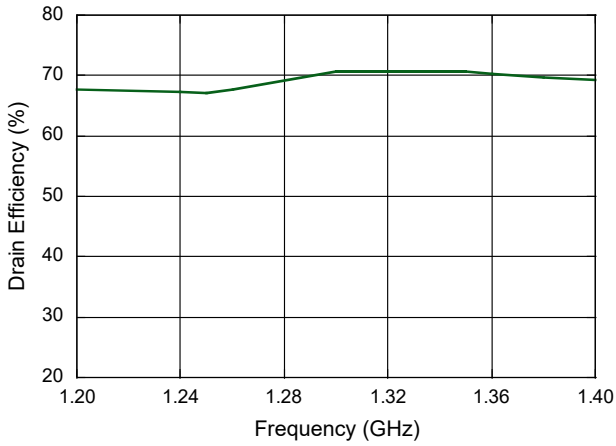


Typical Performance Curves: V_{DD} = 28 V, I_{DQ} = 1 A
Measured in Broadband Amplifier Circuit CG2H40120F/P-AMP

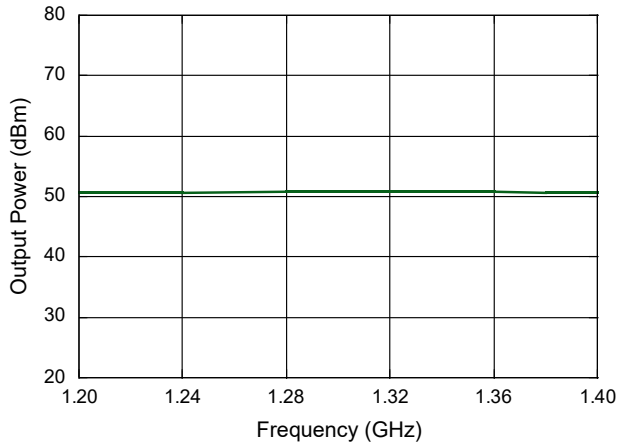
Gain vs Frequency



Drain Efficiency vs Frequency

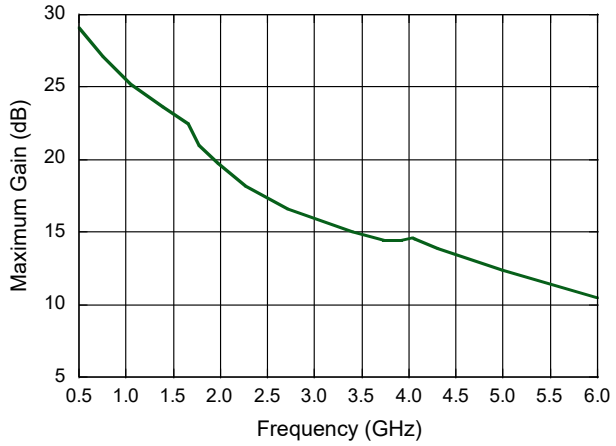


Saturated Output Power vs Frequency

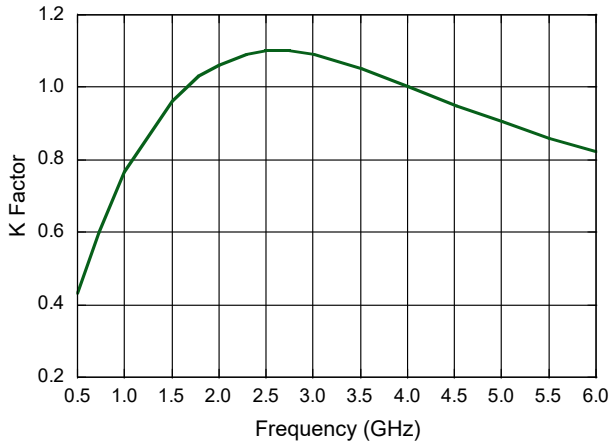


Typical Performance Curves: V_{DD} = 28 V, I_{DQ} = 1 A
Measured in Broadband Amplifier Circuit CG2H40120F/P-AMP

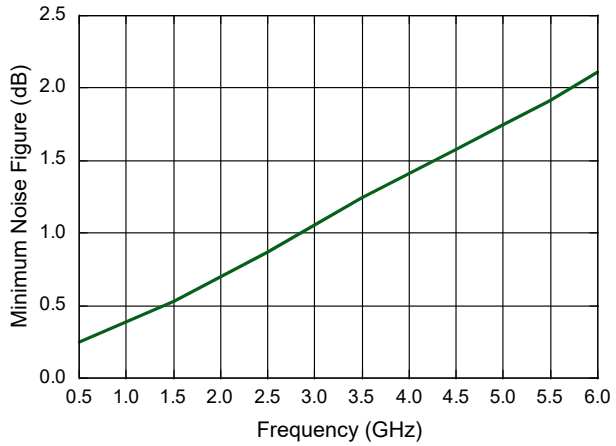
Simulated Maximum Available Gain vs Frequency



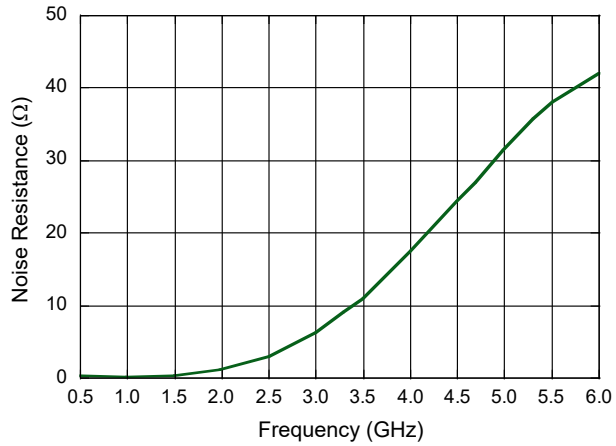
K Factor vs Frequency



Minimum Noise Figure vs Frequency

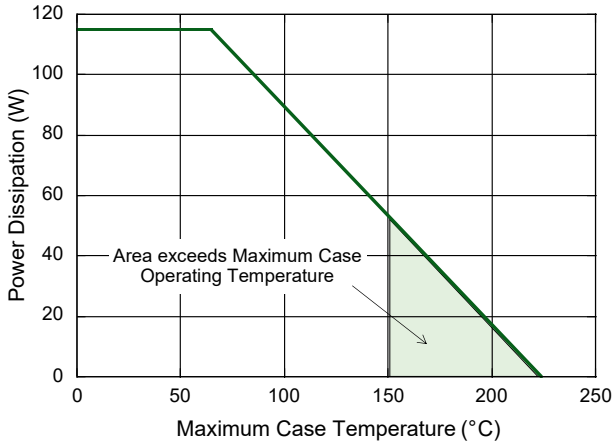


Noise Resistance vs Frequency

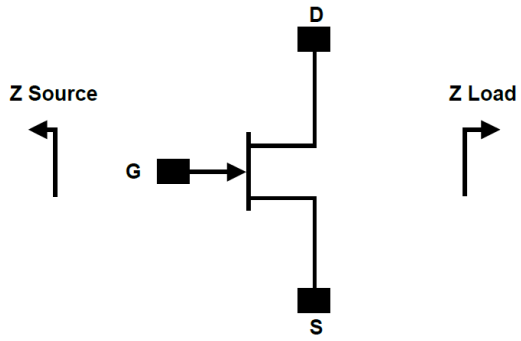


Typical Performance Curves:

CW Power Dissipation De-Rating Curve



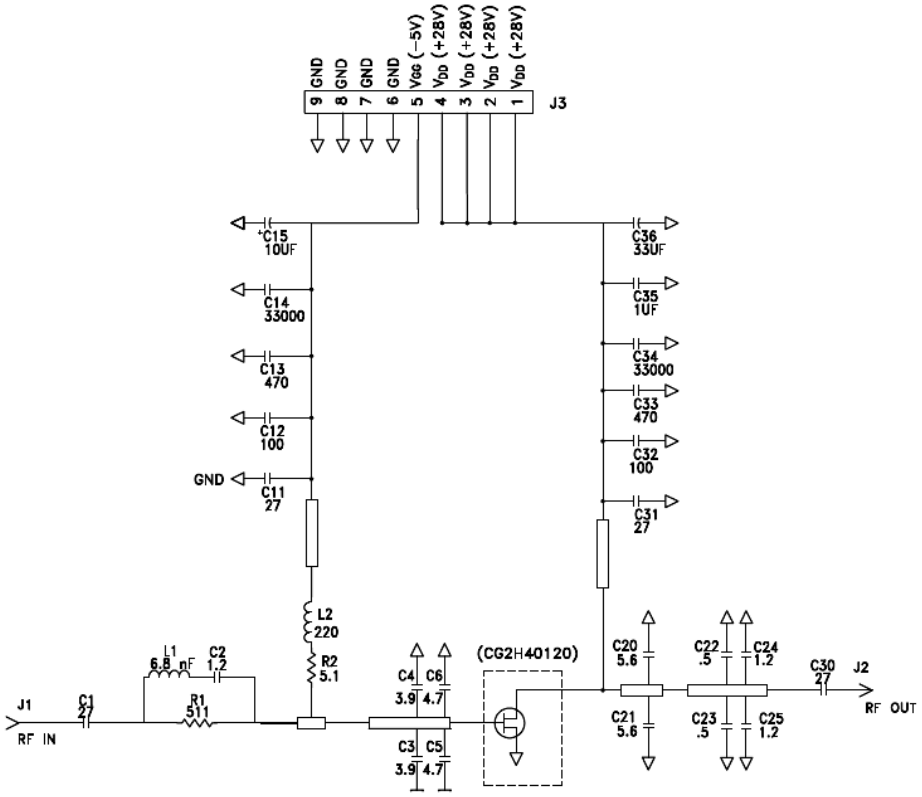
Source and Load Impedances[3,4,5]



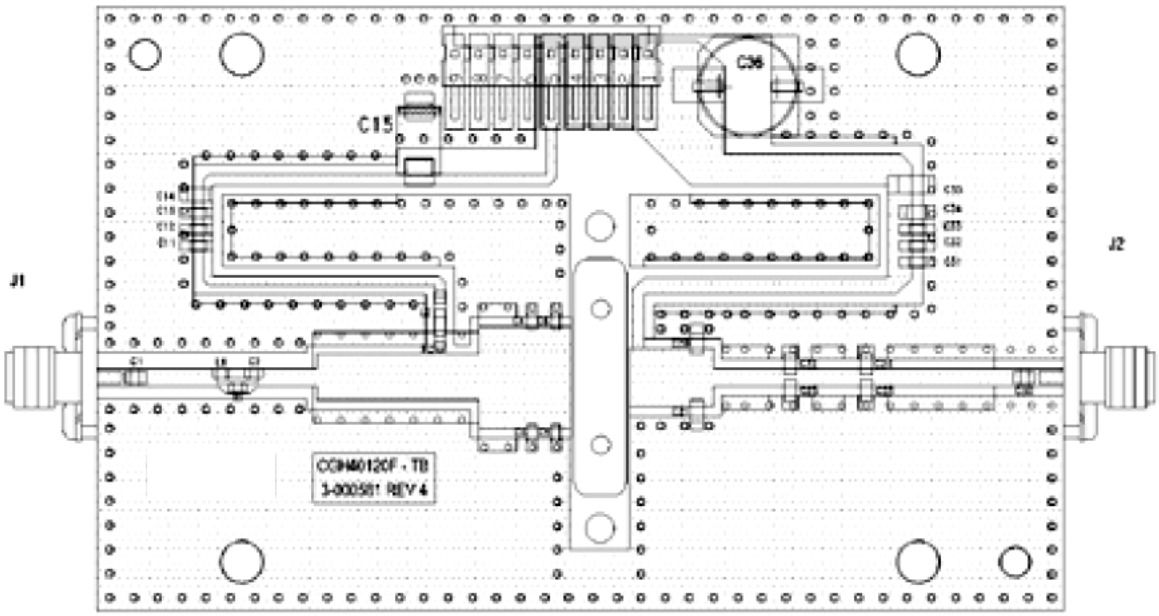
Frequency (MHz)	Z Source	Z Load
500	1.73 + j0.34	4.25 – j1.43
1000	1.65 – j3.12	4.50 – j1.87
1500	1.63 – j3.50	2.58 – j3.26
2000	1.67 – j5.58	2.62 – j4.81
2500	2.00 – j4.92	4.25 – j6.43
3000	2.24 – j8.63	3.10 – j8.82

3. V_{DD} = 28 V, I_{DQ} = 1 A in the 440223/440206 package.
4. Optimized for Power Gain, PSAT and PAE.
5. When using this device at low frequency, series resistors should be used to maintain amplifier stability.

CGH40120F-AMP Demonstration Amplifier Circuit Schematic



CGH40120F-AMP Demonstration Amplifier Circuit Outline



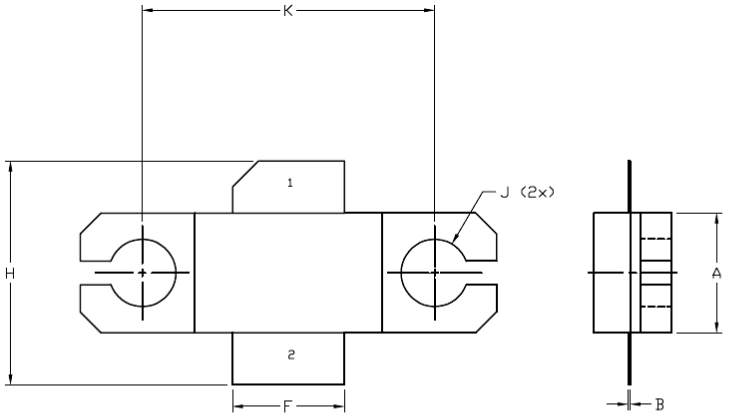
CG2H40120-AMP Demonstration Amplifier Circuit Bill of Materials

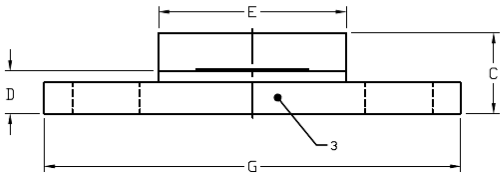
Designator	Description	Qty
R2	RES, 1/16W, 0603, 1%, 5.1 ohms	1
R1	RES, 1/16W, 0603, 1%, 511 ohms	1
C13, C33	CAP, 470pF, 5%, 100V, 0603	2
C36	CAP, 33µF, 20%, G CASE	1
C35	CAP, 1.0µF, 100V, 10%, X7R	1
C15	CAP, 10µF, 16V, TANTALUM	1
C12, C32	CAP, 100.0pF, 5%, 0603, ATC	2
C2	CAP, 1.2pF, 0.1pF, 0603, ATC	1
C11, C31	CAP, 27pF, 5%, 0603, ATC	2
C3, C4	CAP, 3.9pF, 0.1pF, 0603, AT	2
C5, C6	CAP, 4.7pF, 0.1pF, 0603, AT	2
C14, C34	CAP,33000pF, 0805,100V, X7R	2
C22, C23	CAP, 0.5pF, 0.05pF, 0805,	2
C24, C25	CAP, 1.2pF, 0.1pF, 0805	2
C1, C30	CAP, 27pF, 5%, 250V, 0805	2
C20, C21	CAP, 5.6pF, 0.1pF, 0805, A	2
1	PCB, RO4003, 0.032 THK, CGH40120F	1
	BASEPLATE, CGH35120	1
J1, J2	CONN, SMA, PANEL MOUNT JACK	2
J3	HEADER RT>PLZ .1CEN LK 9POS	1
L2	IND, FERRITE, 220 ohm, 0805	1
L1	INDUCTOR,CHIP,6.8nH, 0603 SMT	1
	2-56 SOC HD SCREW ¼ SS	4
	#2 SPLIT LOCKWASHER SS	4
W1	WIRE, BLACK, 22 AWG ~ 2.0”	1
Q1	CG2H40120F	1

Typical Package S-Parameters: Small Signal, V_{DS} = 28 V, I_{DQ} = 1 A, angle in degrees

Frequency	Mag S11	Ang S11	Mag S21	Ang S21	Mag S12	Ang S12	Mag S22	Ang S22
500 MHz	0.953	-179.24	5.30	79.16	0.007	11.58	0.848	178.11
600 MHz	0.953	179.13	4.42	76.14	0.007	12.91	0.848	177.31
700 MHz	0.952	177.74	3.80	73.25	0.007	14.29	0.849	176.55
800 MHz	0.952	176.49	3.33	70.44	0.007	15.67	0.849	175.84
900 MHz	0.952	175.33	2.97	67.69	0.007	17.01	0.849	175.14
1.0 GHz	0.951	174.25	2.68	64.99	0.007	18.29	0.849	174.46
1.1 GHz	0.951	173.20	2.44	62.32	0.008	19.51	0.850	173.78
1.2 GHz	0.950	172.19	2.25	59.68	0.008	20.65	0.850	173.10
1.3 GHz	0.950	171.21	2.09	57.08	0.008	21.71	0.851	172.43
1.4 GHz	0.949	170.24	1.95	54.51	0.008	22.68	0.851	171.76
1.5 GHz	0.948	169.28	1.83	51.95	0.009	23.55	0.851	171.08
1.6 GHz	0.947	168.33	1.73	49.41	0.009	24.33	0.850	170.41
1.7 GHz	0.946	167.38	1.64	46.88	0.010	25.00	0.850	169.72
1.8 GHz	0.945	166.42	1.57	44.36	0.010	25.57	0.849	169.03
1.9 GHz	0.943	165.45	1.51	41.84	0.011	26.03	0.848	168.32
2.0 GHz	0.941	164.47	1.45	39.33	0.011	26.38	0.847	167.61
2.1 GHz	0.940	163.48	1.40	36.80	0.012	26.61	0.846	166.88
2.2 GHz	0.937	162.46	1.36	34.27	0.012	26.74	0.844	166.14
2.3 GHz	0.935	161.41	1.33	31.72	0.013	26.75	0.842	165.38
2.4 GHz	0.932	160.34	1.30	29.16	0.014	26.65	0.840	164.60
2.5 GHz	0.929	159.23	1.27	26.58	0.015	26.43	0.837	163.80
2.6 GHz	0.926	158.09	1.25	23.97	0.016	26.10	0.835	162.98
2.7 GHz	0.923	156.91	1.24	21.33	0.017	25.64	0.831	162.13
2.8 GHz	0.919	155.68	1.22	18.65	0.018	25.07	0.828	161.26
2.9 GHz	0.914	154.40	1.22	15.94	0.019	24.37	0.824	160.37
3.0 GHz	0.910	153.06	1.21	13.17	0.020	23.55	0.819	159.45
3.2 GHz	0.904	151.67	1.21	10.35	0.022	22.60	0.814	158.50
3.4 GHz	0.898	150.20	1.22	7.47	0.023	21.51	0.809	157.52
3.6 GHz	0.892	148.67	1.22	4.51	0.025	20.29	0.802	156.51
3.8 GHz	0.884	147.05	1.23	1.48	0.027	18.92	0.796	155.47
4.0 GHz	0.876	145.36	1.25	-1.63	0.029	17.39	0.788	154.40
4.2 GHz	0.867	143.56	1.26	-4.85	0.032	15.71	0.780	153.30
4.4 GHz	0.857	141.67	1.29	-8.17	0.034	13.86	0.772	152.17
4.6 GHz	0.846	139.67	1.31	-11.62	0.037	11.84	0.762	151.02
4.8 GHz	0.834	137.55	1.34	-15.19	0.040	9.63	0.752	149.84
5.0 GHz	0.820	135.30	1.37	-18.90	0.044	7.23	0.740	148.65
5.2 GHz	0.883	137.25	0.71	-16.29	0.064	34.45	0.805	152.81
5.4 GHz	0.866	132.84	0.74	-21.37	0.074	30.53	0.791	150.19
5.6 GHz	0.845	127.78	0.78	-26.94	0.086	25.97	0.774	147.33
5.8 GHz	0.820	121.95	0.83	-33.09	0.101	20.69	0.755	144.21
6.0 GHz	0.789	115.17	0.88	-39.95	0.118	14.58	0.731	140.79

Product Dimensions CG2H40120F (Package Type: 440223)





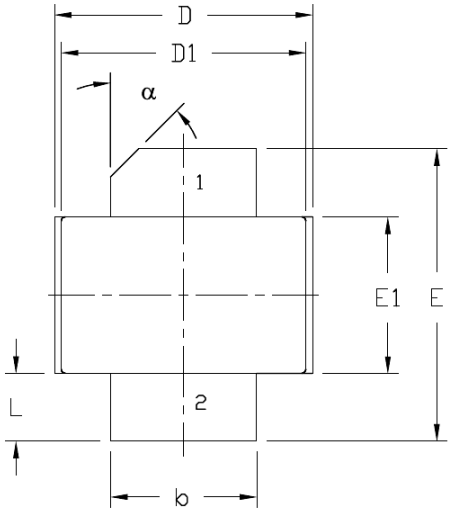
NOTES:

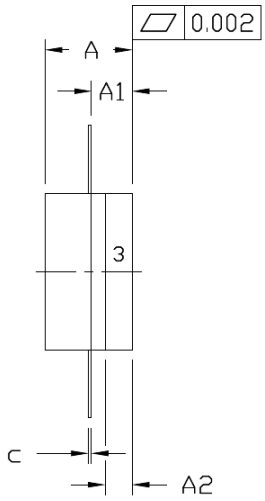
1. DIMENSIONING AND TOLERANICING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
5. ALL PLATED SURFACES ARE NI/AU

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	0.400	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 CG2H40120P (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
2. DRAIN
3. SOURCE