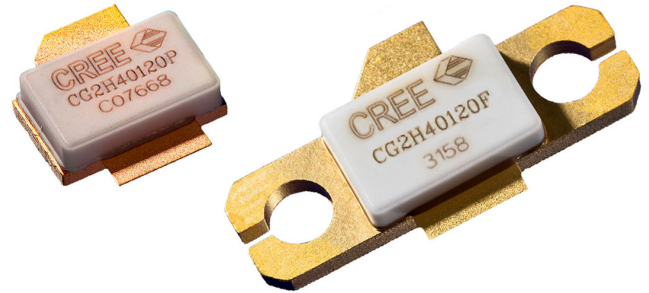


CG2H40120

120 W, 28 V, RF Power GaN HEMT

Description

Cree's 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.



Package Types: 440206 and 440223
PNs: CG2H40120P and CG2H40120F

Features

- Up to 2.5 GHz Operation
- 20 dB Small Signal Gain at 1.0 GHz
- 15 dB Small Signal Gain at 2.0 GHz
- 130 W Typical P_{SAT}
- 70% Efficiency at P_{SAT}
- 28 V Operation

Applications

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

 Large Signal Models Available for ADS and MWO

RoHS
COMPLIANT

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

| Parameter | Symbol | Rating | Units | Conditions |
|---|-----------------|-----------|-------|------------|
| Drain-Source Voltage | V_{DSS} | 120 | 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} | 30 | mA | 25 °C |
| Maximum Drain Current ¹ | I_{DMAX} | 12 | A | 25 °C |
| Soldering Temperature ² | T_S | 245 | °C | |
| Screw Torque | τ | 40 | in-oz | |
| Thermal Resistance, Junction to Case ³ | $R_{\theta JC}$ | 1.39 | °C/W | 85 °C |
| Thermal Resistance, Junction to Case ⁴ | $R_{\theta JC}$ | 1.32 | °C/W | 85 °C |
| Case Operating Temperature ⁵ | T_S | -40, +65 | °C | |

Notes:

¹ Current limit for long term, reliable operation² Refer to the Application Note on soldering at www.wolfspeed.com/rf/document-library³ Measured for the CG2H40120F at $P_{DISS} = 115$ W⁴ Measured for the CG2H40120P at $P_{DISS} = 115$ W⁵ See also, the Power Dissipation De-rating Curve on Page 5**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, $I_D = 28.8$ mA |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | - | -2.7 | - | V_{DC} | $V_{DS} = 28$ V, $I_D = 1.0$ A |
| Saturated Drain Current ² | I_{DS} | 20.7 | 28.2 | - | A | $V_{DS} = 6.0$ V, $V_{GS} = 2.0$ V |
| Drain-Source Breakdown Voltage | V_{BR} | 84 | - | - | V_{DC} | $V_{GS} = -8$ V, $I_D = 28.8$ mA |
| RF Characteristics³ ($T_c = 25^\circ\text{C}$, $F_0 = 1.3$ GHz unless otherwise noted) | | | | | | |
| Small Signal Gain | G_{SS} | 18.5 | 20 | - | dB | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A |
| Output Power ⁴ | P_{SAT} | 100 | 130 | - | W | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A |
| Drain Efficiency ⁵ | η | 62 | 72 | - | % | $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = P_{SAT}$ |
| Output Mismatch Stress | VSWR | - | - | 10 : 1 | Y | No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 1.0$ A, $P_{OUT} = 100$ W CW |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{GS} | - | 35.7 | - | pF | $V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz |
| Output Capacitance | C_{DS} | - | 15.1 | - | pF | $V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz |
| Feedback Capacitance | C_{GD} | - | 1.5 | - | pF | $V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz |

Notes:

¹ Measured on wafer prior to packaging² Scaled from PCM data³ Measured in CG2H40120F/P-AMP⁴ P_{SAT} is defined as $I_G = 2.8$ mA⁵ Drain Efficiency = P_{OUT} / P_{DC}



Typical Performance

Figure 1. Gain and Input Return Loss vs Frequency measured in Broadband Amplifier Circuit CG2H40120F/P-AMP
 $V_{DD} = 28\text{ V}, I_{DQ} = 1.0\text{ A}$

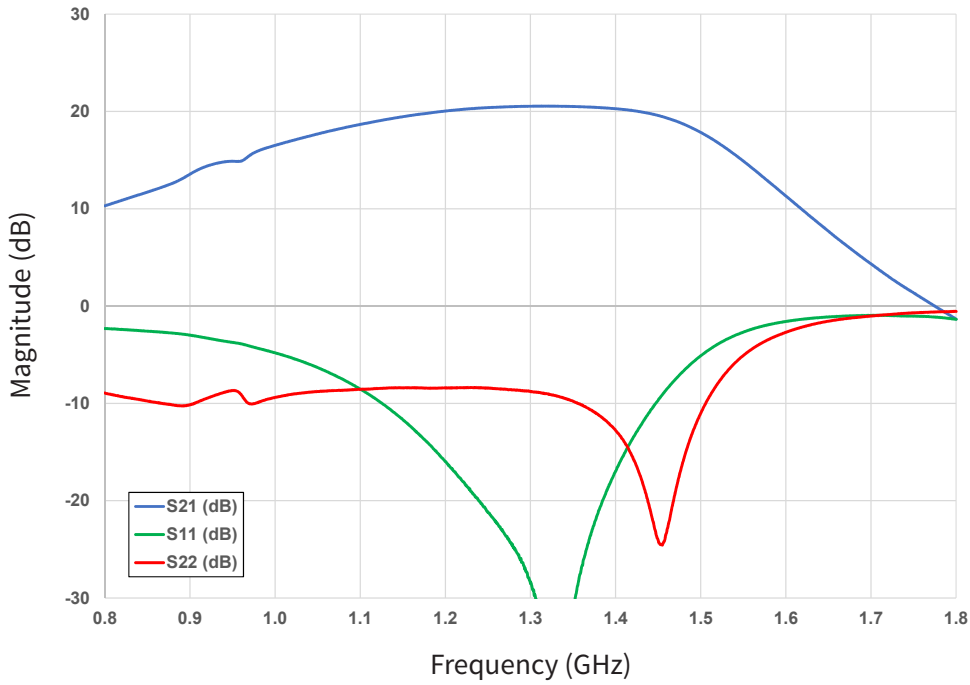
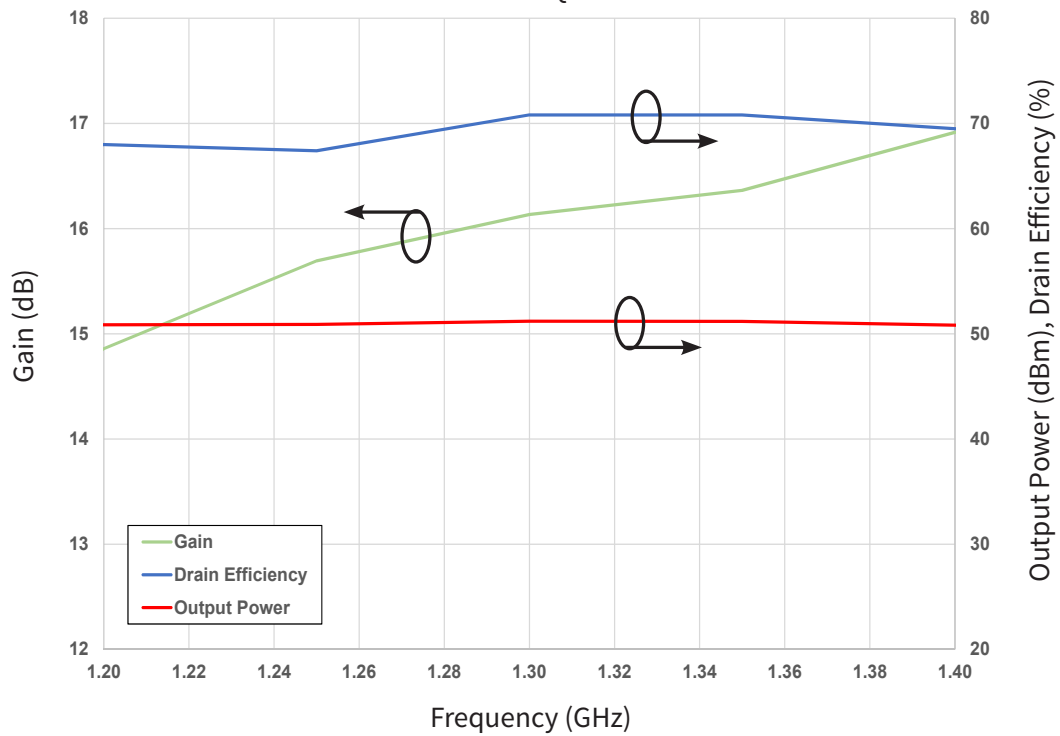


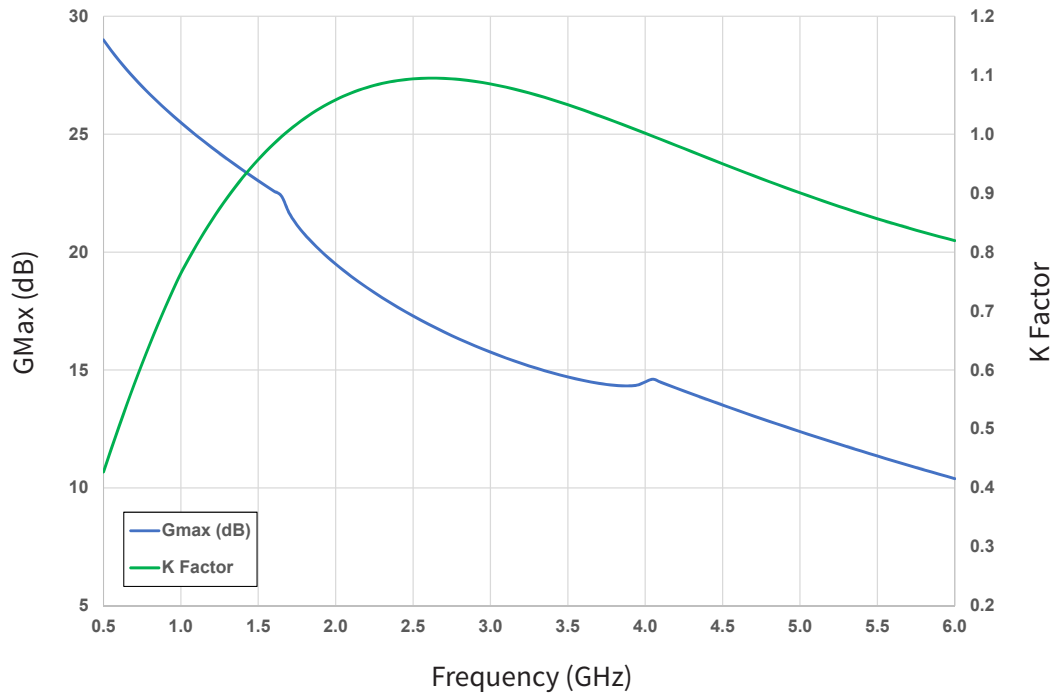
Figure 2. Saturated Output Power, Gain and Drain Efficiency vs Frequency measured in Broadband Amplifier Circuit CG2H40120F/P-AMP
 $V_{DD} = 28\text{ V}, I_{DQ} = 1.0\text{ A}$



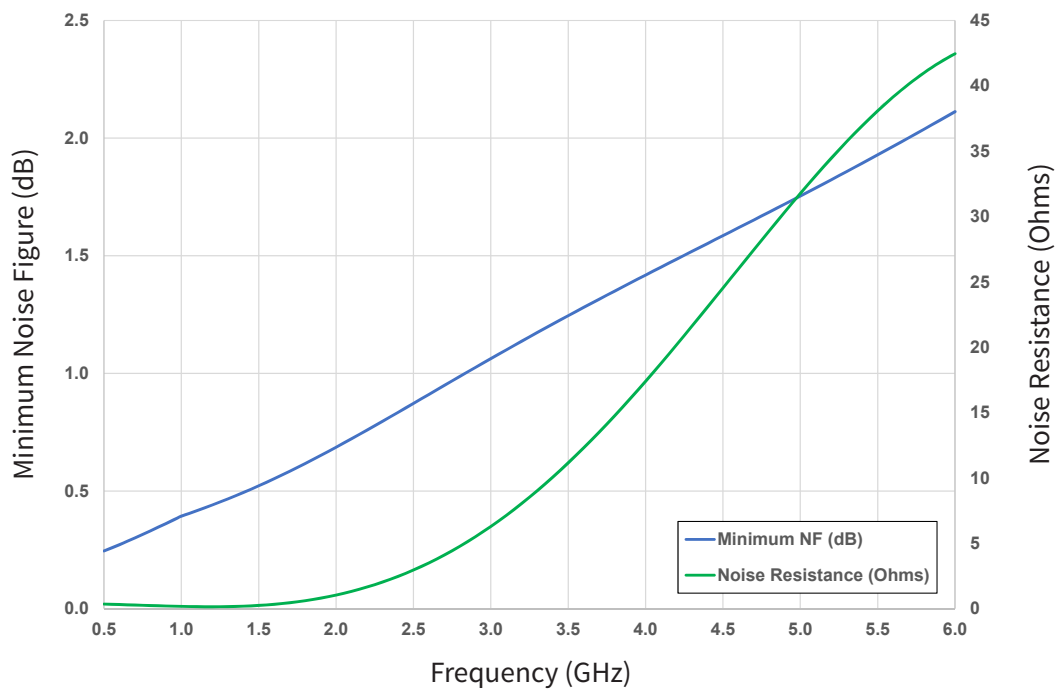


Typical Performance

**Figure 3. Simulated Maximum Available Gain and K Factor vs Frequency
Broadband Amplifier Circuit CG2H40120F/P-AMP**



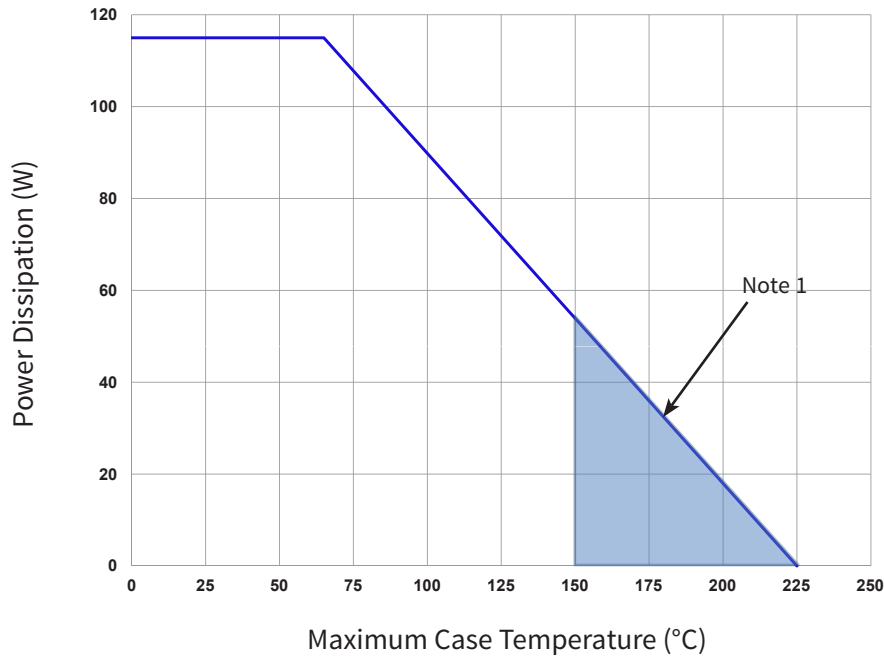
**Figure 4. Simulated Minimum Noise and Noise Resistance vs Frequency
Broadband Amplifier Circuit CG2H40120F/P-AMP**





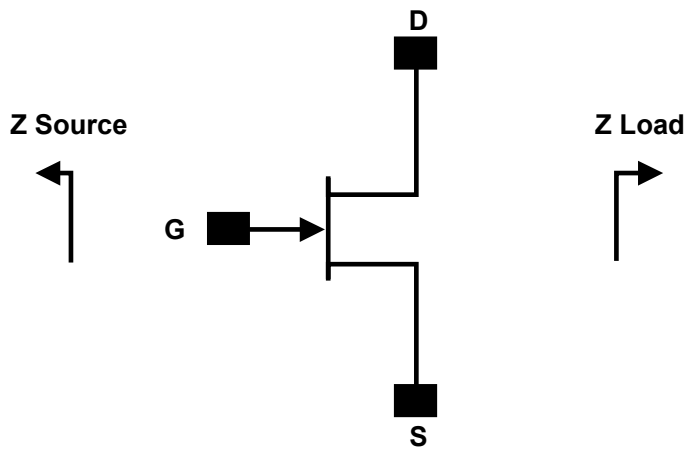
Typical Performance

Figure 5. CG2H40120 CW Power Dissipation De-Rating Curve



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

Source and Load Impedances



| Frequency | 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 |

Note 1. $V_{DD} = 28\text{ V}$, $I_{DQ} = 1.0\text{ A}$ in the 440223/440206 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

CG2H40120-AMP Demonstration Amplifier Circuit Bill of Materials

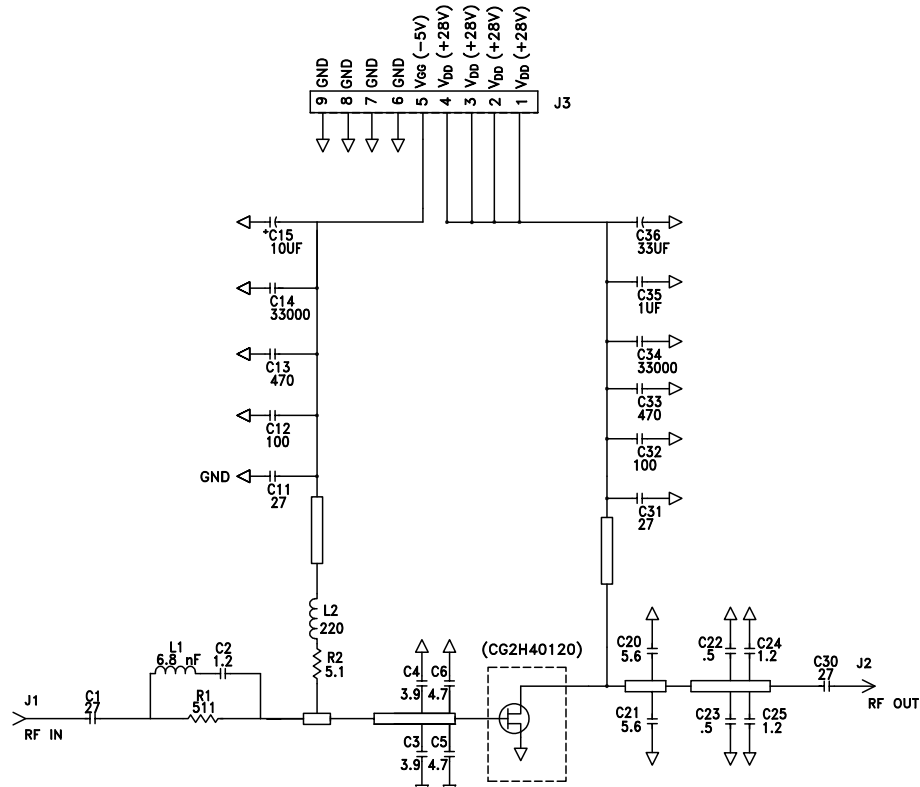
| Designator | Description | Qty |
|------------|-----------------------------------|-----|
| R2 | RES, 1/16W, 0603, 1%, 5.1 Ohms | 1 |
| R1 | RES,1/16W,0603,1%,511 OHMS | 1 |
| C13, C33 | CAP, 470PF, 5%, 100V, 0603 | 2 |
| C36 | CAP, 33 UF, 20%, G CASE | 1 |
| C35 | CAP, 1.0UF, 100V, 10%, X7R | 1 |
| C15 | CAP 10UF 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, 3.9 pF,0.1pF, 0603, AT | 2 |
| C5, C6 | CAP, 4.7 pF,0.1pF, 0603, AT | 2 |
| C14, C34 | CAP,33000PF, 0805,100V, X7R | 2 |
| C22, C23 | CAP, 0.5 PF 0.05 pF, 0805, | 2 |
| C24, C25 | CAP, 1.2 PF 0.1 pF, 0805 | 2 |
| C1, C30 | CAP, 27 PF 5%,, 250V, 0805 | 2 |
| C20, C21 | CAP, 5.6 PF 0.1 pF, 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 |

Electrostatic Discharge (ESD) Classifications

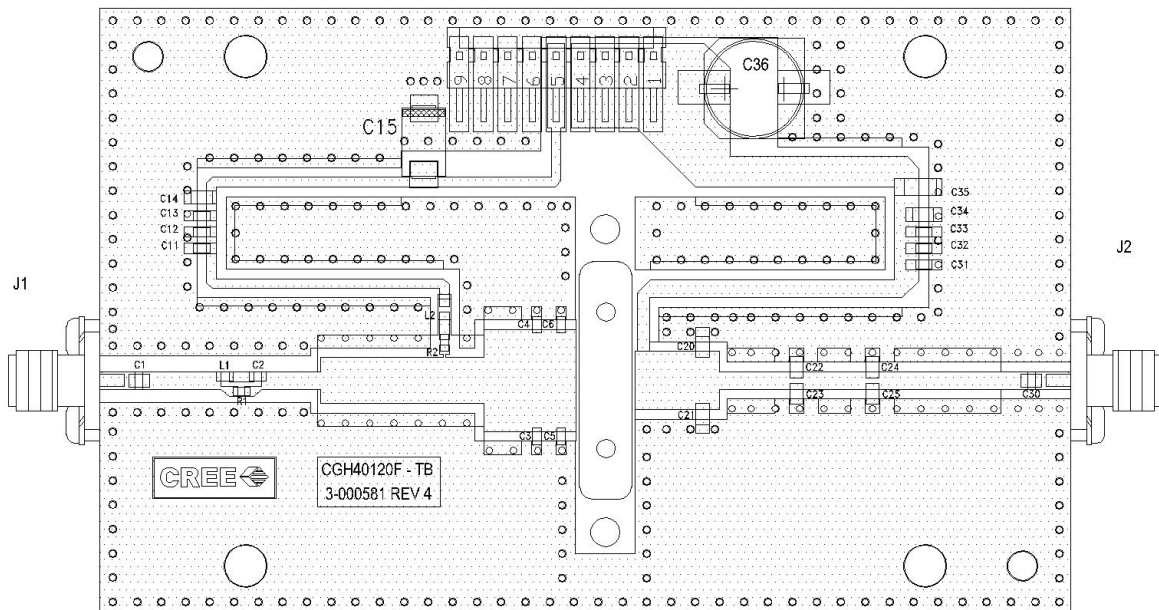
| Parameter | Symbol | Class | Test Methodology |
|---------------------|--------|------------|---------------------|
| Human Body Model | HBM | 1A > 250 V | JEDEC JESD22 A114-D |
| Charge Device Model | CDM | 1 < 200 V | JEDEC JESD22 C101-C |



CGH40120F-AMP Demonstration Amplifier Circuit Schematic



CGH40120F-AMP Demonstration Amplifier Circuit Outline





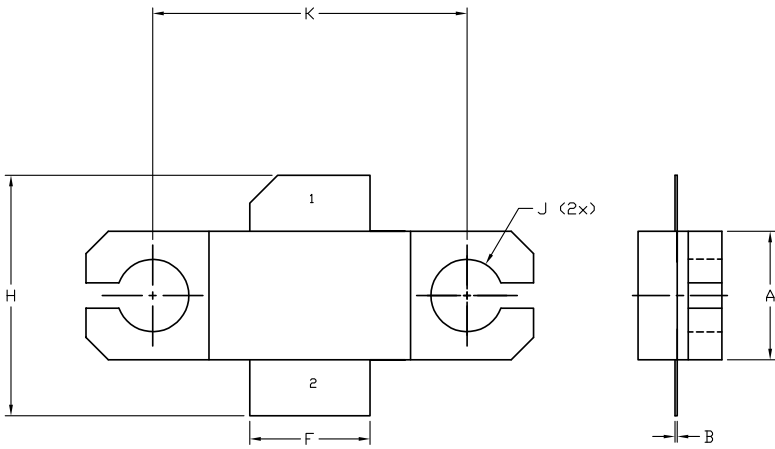
Typical Package S-Parameters for CG2H40120
(Small Signal, $V_{DS} = 28\text{ V}$, $I_{DQ} = 1.0\text{ A}$, angle in degrees)

| 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 |

To download the s-parameters in s2p format, go to the [CG2H40120F](#) Product page and click on the documentation tab.



Product Dimensions CG2H40120F (Package Type — 440223)

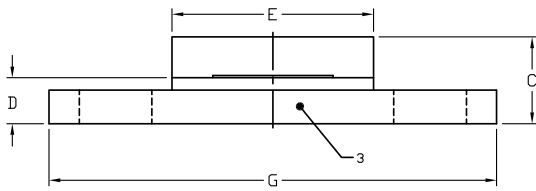


NOTES:

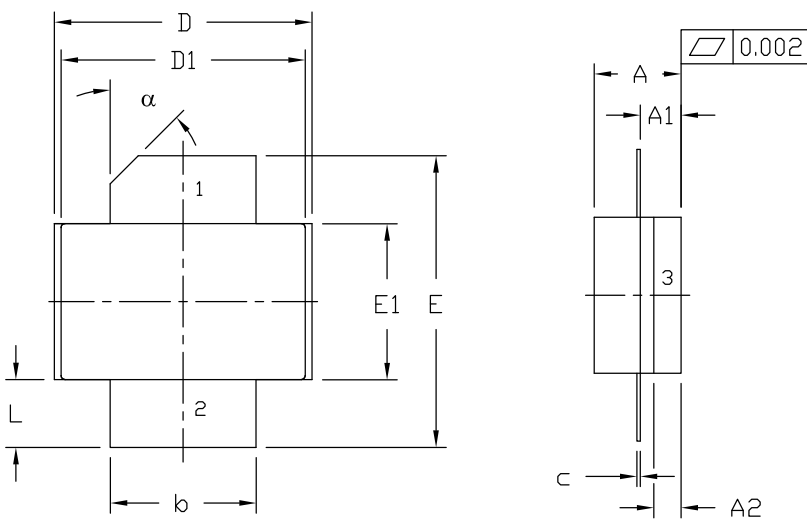
- 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- 2. CONTROLLING DIMENSION: INCH.
- 3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
- 4. LID MAY BE MISALIGNED TO THE BODY OF THE PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.
- 5. ALL PLATED SURFACES ARE Ni/AU

| 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 | 0.400 | 0.460 | 10.16 | 11.68 |
| J | ∅ .130 | | 3.30 | |
| k | | 0.562 | | 14.27 |

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



Product Dimensions CG2H40120P (Package Type — 440206)



NOTES:

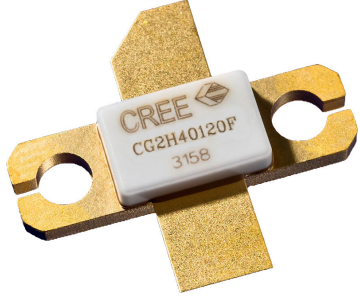
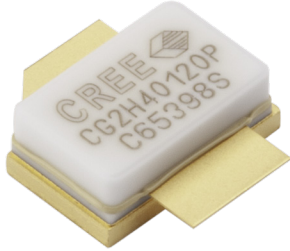
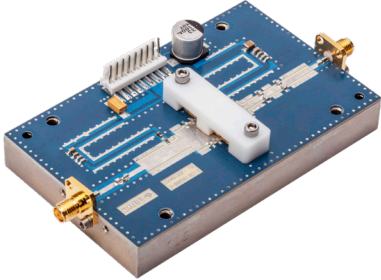
- 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M - 1994.
- 2. CONTROLLING DIMENSION: INCH.
- 3. ADHESIVE FROM LID MAY EXTEND A MAXIMUM OF 0.020" BEYOND EDGE OF LID.
- 4. LID MAY BE MISALIGNED TO THE BODY OF PACKAGE BY A MAXIMUM OF 0.008" IN ANY DIRECTION.

| 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 |
| alpha | 45° | REF | 45° | REF | |

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



Product Ordering Information

| Order Number | Description | Unit of Measure | Image |
|---------------|---|-----------------|--|
| CG2H40120F | GaN HEMT | Each |  |
| CG2H40120P | GaN HEMT | Each |  |
| CGH40120F-AMP | Test board with GaN HEMT (flange) installed | Each |  |



For more information, please contact:

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

Sales Contact
RFSales@cree.com

Notes

Disclaimer

Specifications are subject to change without notice. Cree, Inc. believes the information contained within this data sheet to be accurate and reliable. However, no responsibility is assumed by Cree for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Cree. Cree makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose. “Typical” parameters are the average values expected by Cree in large quantities and are provided for information purposes only. These values can and do vary in different applications and actual performance can vary over time. All operating parameters should be validated by customer’s technical experts for each application. Cree products are not designed, intended or authorized for use as components in applications intended for surgical implant into the body or to support or sustain life, in applications in which the failure of the Cree product could result in personal injury or death or in applications for planning, construction, maintenance or direct operation of a nuclear facility.