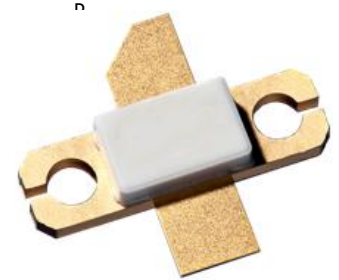


CWAT-0040P70

60 W Peak, 28 V, GaN HEMT for Linear Communications from VHF to 3 GHz

Description

CW's CWAT-0040P70 is a gallium nitride (GaN) high electron mobility transistor (HEMT) designed specifically for high efficiency, high gain and wide bandwidth capabilities, which makes the CWAT-0040P70 ideal for VHF, Comms, 3G, 4G, LTE, 2.3-2.9GHz WiMAX and BWA amplifier applications. The unmatched transistor is supplied in a ceramic/metal flange package.



Package Types: 440193
PN: CWAT-0040P70

Typical Performance Over 2.3-2.7 GHz ($T_c = 25^\circ\text{C}$) of Demonstration Amplifier

| Parameter | 2.3 GHz | 2.4 GHz | 2.5 GHz | 2.6 GHz | 2.7 GHz | Units |
|---------------------------|---------|---------|---------|---------|---------|-------|
| Small Signal Gain | 15.1 | 14.7 | 14.3 | 14.3 | 14.5 | dB |
| EVM @ 39 dBm | 2.35 | 2.16 | 2.01 | 2.13 | 2.82 | % |
| Drain Efficiency @ 39 dBm | 28.3 | 27.6 | 27.3 | 26.7 | 26.3 | % |
| Input Return Loss | 10.0 | 7.3 | 6.0 | 7.0 | 10.3 | dB |

Note:

Measured in the CWAT-0040P70-AMP amplifier circuit, under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, 5ms Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01% Probability on CCDF

Features

- VHF - 3.0 GHz Operation
- 14 dB Small Signal Gain
- 8.0 W P_{AVE} at < 2.0% EVM
- 27% Drain Efficiency at 8 W Average Power
- WiMAX Fixed Access 802.16-2004 OFDM
- WiMAX Mobile Access 802.16e OFDMA

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

| Parameter | Symbol | Rating | Units | Conditions |
|---|-----------------|-----------|-------|------------|
| Drain-Source Voltage | V_{DSS} | 120 | 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} | 15 | mA | 25°C |
| Maximum Drain Current ¹ | I_{DMAX} | 6 | A | |
| Soldering Temperature ² | T_S | 245 | °C | |
| Screw Torque | τ | 40 | in-oz | |
| Thermal Resistance, Junction to Case ³ | $R_{\theta JC}$ | 2.8 | °C/W | 85°C |
| Case Operating Temperature ³ | T_C | -40, +150 | °C | |

Notes:

¹ Current limit for long term, reliable operation² Refer to the Application Note on soldering at CW.com/rf/document-library³ Measured for the CWAT-0040P70 at $P_{DISS} = 56$ W.**Electrical Characteristics ($T_C = 25^\circ\text{C}$)**

| Characteristics | Symbol | Min. | Typ. | Max. | Units | Conditions |
|--|--------------|------|------|------|----------|---|
| DC Characteristics¹ | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | -3.5 | -3.0 | -2.0 | V_{DC} | $V_{DS} = 10$ V, $I_D = 14.4$ mA |
| Gate Quiescent Voltage | $V_{GS(Q)}$ | – | -2.7 | – | | $V_{DS} = 28$ V, $I_{DQ} = 300$ mA |
| Saturated Drain Current | I_{DS} | 11.6 | 14.0 | – | A | $V_{DS} = 6.0$ V, $V_{GS} = 2$ V |
| Drain-Source Breakdown Voltage | V_{BR} | 84 | – | – | V_{DC} | $V_{GS} = -8$ V, $I_D = 14.4$ mA |
| RF Characteristics^{2,3} ($T_C = 25^\circ\text{C}$, $F_0 = 2.5$ GHz unless otherwise noted) | | | | | | |
| Small Signal Gain | G_{SS} | 11.0 | 13.0 | – | dB | $V_{DD} = 28$ V, $I_{DQ} = 300$ mA |
| Drain Efficiency ⁴ | η | 21 | 24 | – | % | $V_{DD} = 28$ V, $I_{DQ} = 300$ mA, $P_{AVE} = 8$ W |
| Error Vector Magnitude | EVM | – | 2.0 | – | | |
| Output Mismatch Stress | VSWR | – | – | 10:1 | Ψ | No damage at all phase angles, $V_{DD} = 28$ V, $I_{DQ} = 300$ mA, $P_{AVE} = 8$ W |
| Dynamic Characteristics | | | | | | |
| Input Capacitance | C_{GS} | – | 19.0 | – | pF | $V_{DS} = 28$ V, $V_{GS} = -8$ V, $f = 1$ MHz |
| Output Capacitance | C_{DS} | – | 5.9 | – | | |
| Feedback Capacitance | C_{GD} | – | 0.8 | – | | |

Notes:

¹ Measured on wafer prior to packaging.² Measured in the CWAT-0040P70-AMP test fixture³ Under 802.16 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, 5ms Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3, PAR = 9.8 dB @ 0.01% Probability on CCDF⁴ Drain Efficiency = P_{OUT} / P_{DC}

Typical WiMAX Performance

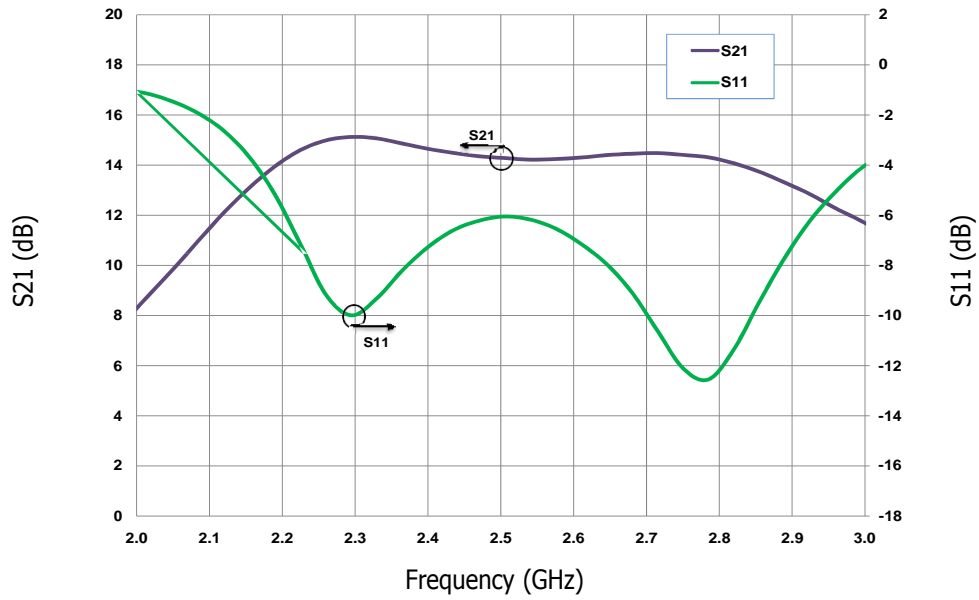


Figure 1. Gain and Return Loss vs Frequency measured in Broadband Amplifier Circuit CWAT-0040P70-AMP $V_{DD} = 28\text{ V}$, $I_{DQ} = 300\text{ mA}$

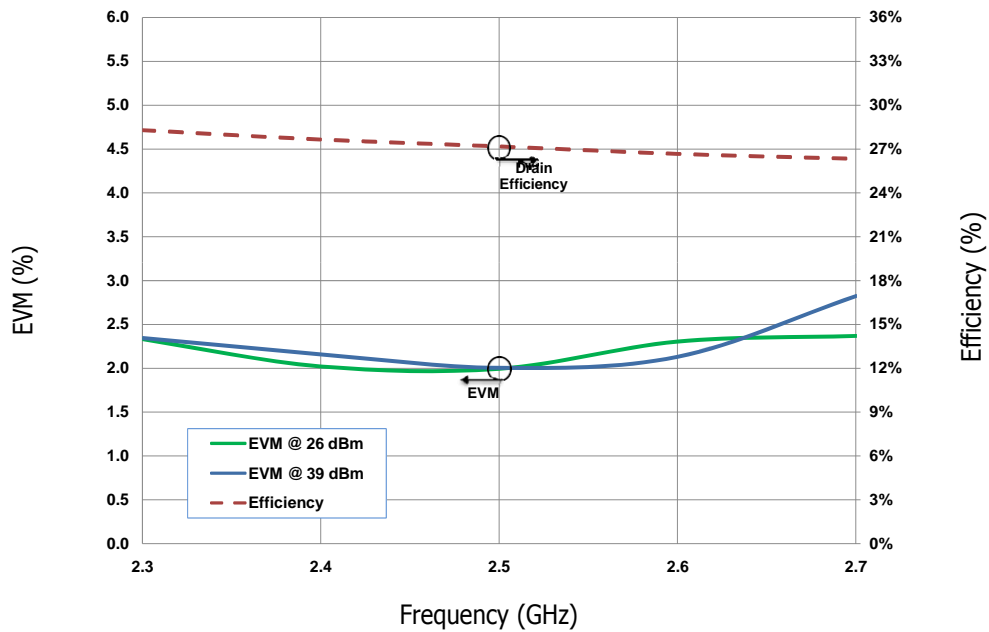


Figure 2. Typical EVM at 24 dBm and 39 dBm vs Frequency measured in Broadband Amplifier Circuit CWAT-0040P70-AMP

Note:
¹ Under 802.16-2004 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3.

Typical WiMAX Performance

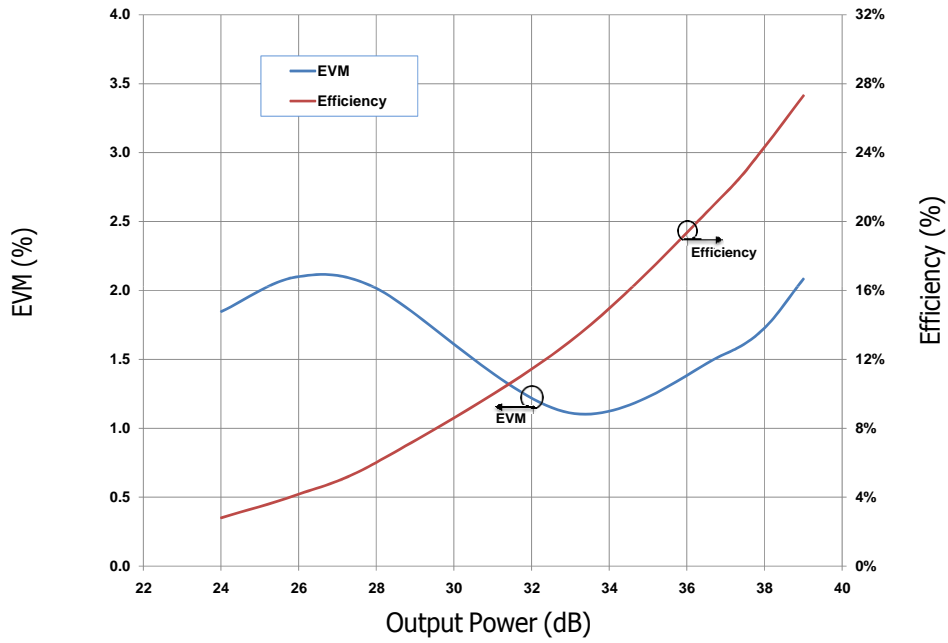


Figure 3. Drain Efficiency and EVM vs Output Power measured in CWAT-0040P70-
 $AMPV_{DD} = 28\text{ V}$, $I_{DQ} = 300\text{ mA}$, 802.16-2004 OFDM, PAR = 9.8 dB

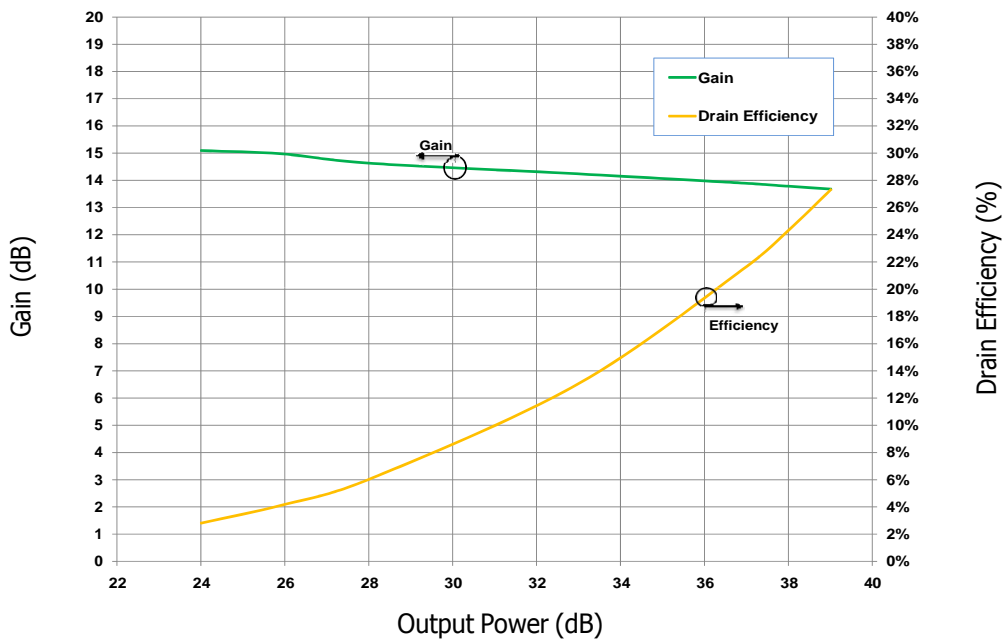


Figure 4. Typical Gain and Efficiency vs Output Power measured in CWAT-0040P70-
 $AMPV_{DD} = 28\text{ V}$, $I_{DQ} = 300\text{ mA}$, 802.16-2004 OFDM, PAR = 9.8 dB

Note:
¹ Under 802.16-2004 OFDM, 3.5 MHz Channel BW, 1/4 Cyclic Prefix, 64 QAM Modulated Burst, Symbol Length of 59, Coding Type RS-CC, Coding Rate Type 2/3.

Typical Performance

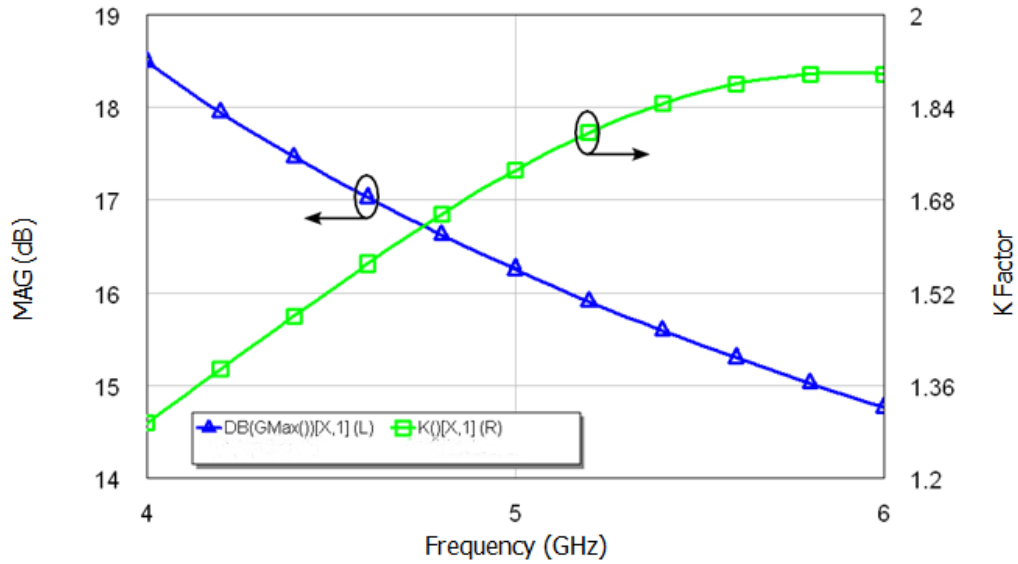


Figure 5. Simulated Maximum Available Gain and K Factor of the CWAT-0040P70 $V_{DD} = 28\text{ V}$, $I_{DQ} = 300\text{ mA}$

Typical Noise Performance

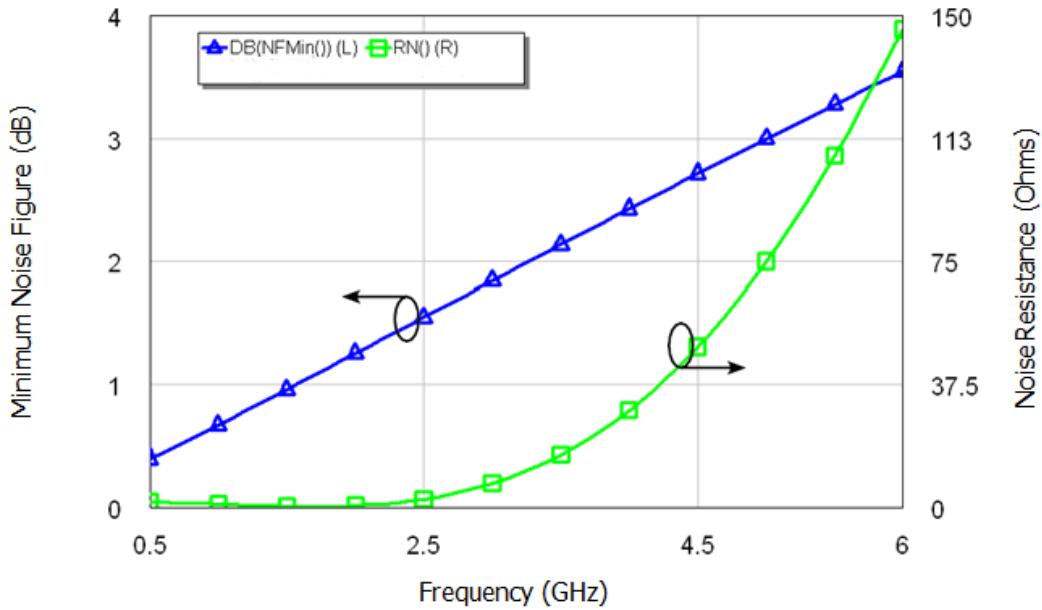
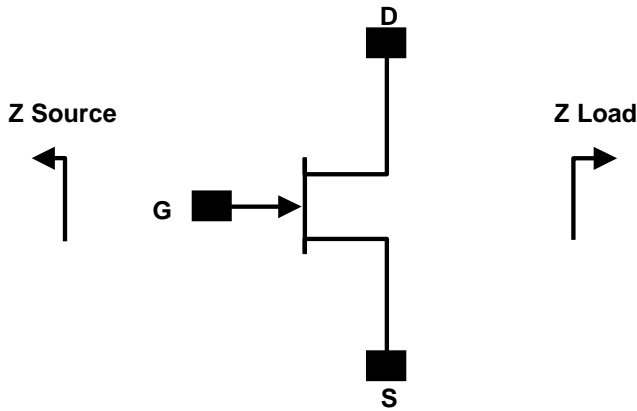


Figure 6. Simulated Minimum Noise Figure and Noise Resistance vs Frequency of the CGH27060 $V_{DD} = 28\text{ V}$, $I_{DQ} = 100\text{ mA}$

Electrostatic Discharge (ESD) Classifications

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

Source and Load Impedances



| Frequency | Z Source | Z Lead |
|-----------|----------------|----------------|
| 500 | $3.34 + j4.56$ | $10.8 - j8.24$ |
| 1000 | $2.07 - j0.05$ | $6.18 - j4.17$ |
| 2000 | $1.3 - j3.37$ | $4.65 - j0.05$ |
| 3000 | $1.64 - j8.15$ | $4.75 - j3.4$ |
| 4000 | $1.9 - j10.8$ | $4.56 - j7.9$ |

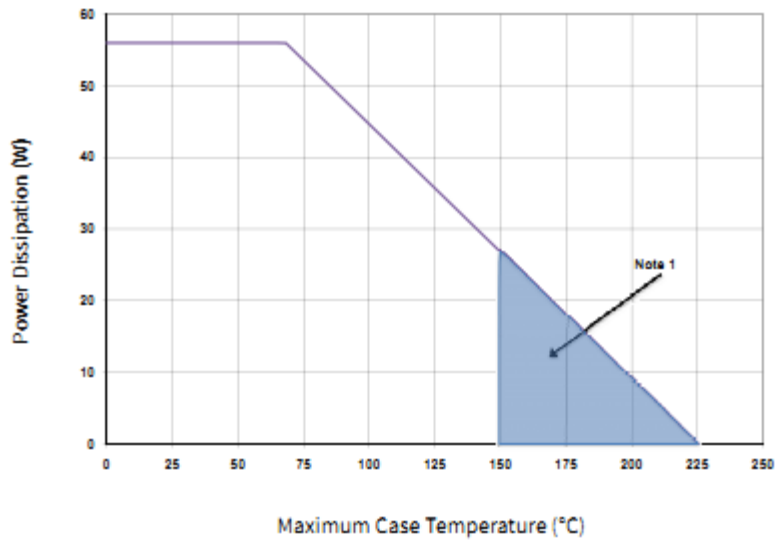
Notes:

¹ $V_{DD} = 28V, I_{DQ} = 300mA$ in the 440193 package

² Optimized for P_{SAT} and PAE

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

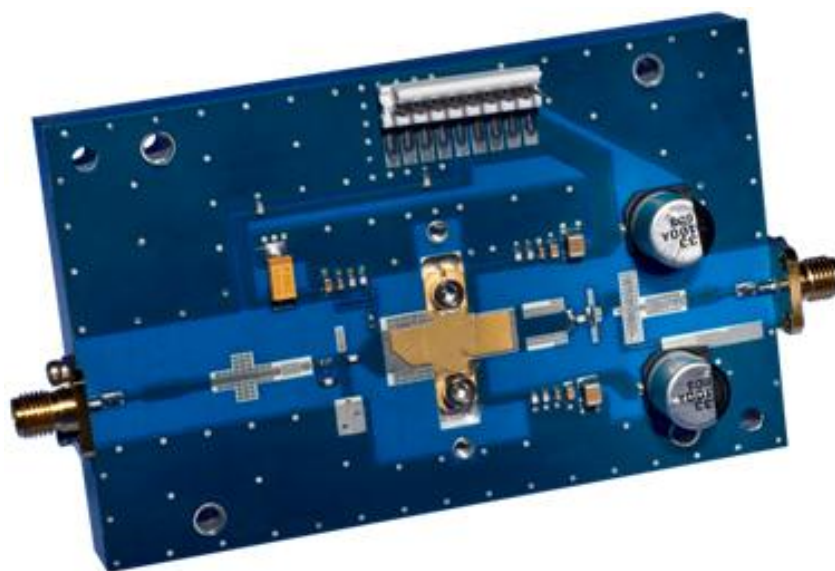
CWAT-0040P70 Power Dissipation De-rating Curve



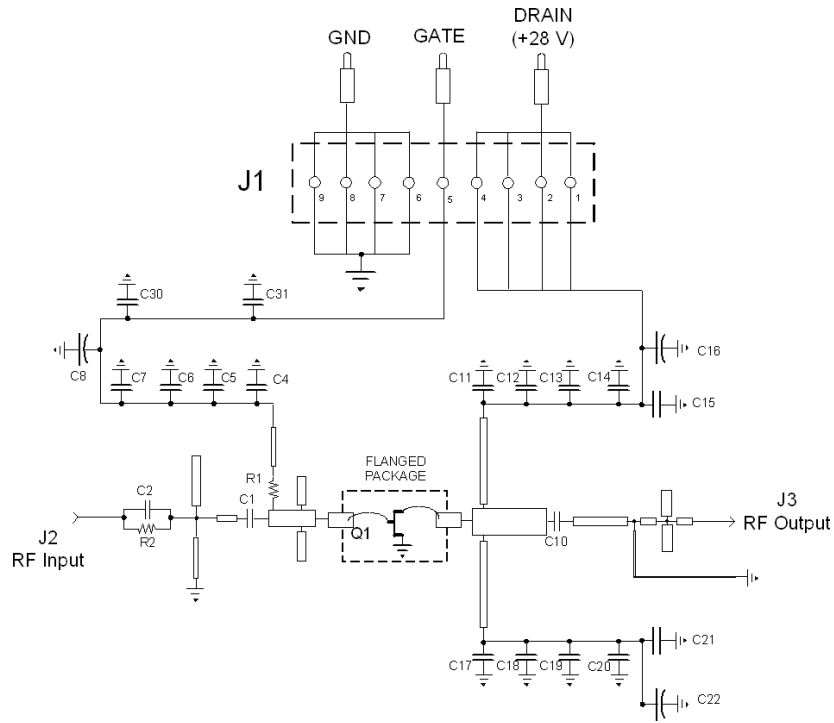
Note: Area exceeds Maximum Case Operating Temperature (See Page 2)

CWAT-0040P70-AMP Demonstration Amplifier Circuit Bill of Materials

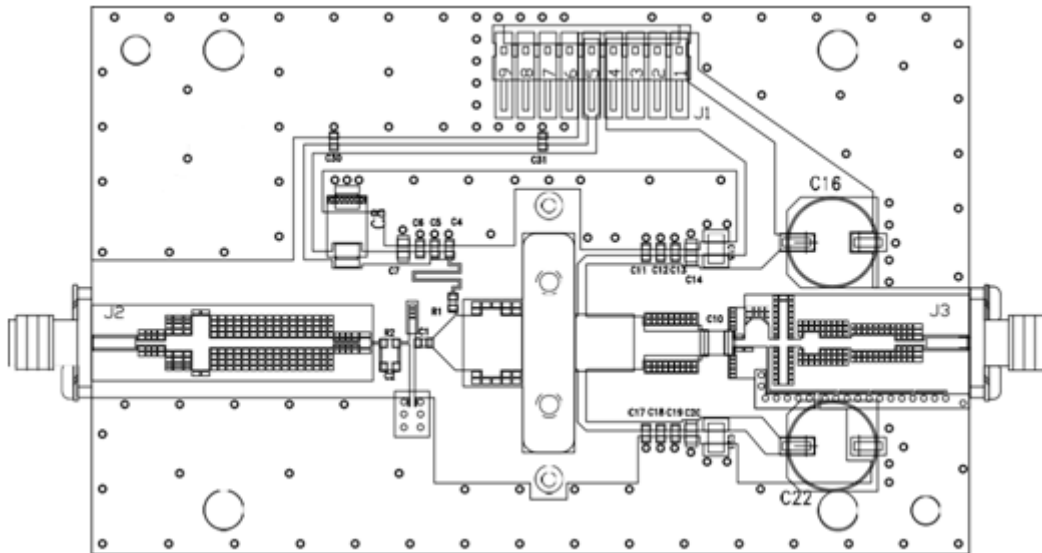
| Designator | Description | Qty |
|------------------------|--|------------|
| R1 | RES, 1/16W, 0603, 1%, 5.1 OHMS | 1 |
| R2 | RES, 1/16W, 0603, 1%, 100 OHMS | 1 |
| C6, C13, C19 | CAP, 470pF, 10%, 100V, 0603 | 3 |
| C16, C22 | CAP, 33 μ F, 20%, G CASE | 1 |
| C15, C21 | CAP, 1.0 μ F, 100V, 10%, X7R, 1210 | 1 |
| C8 | CAP 10 μ F 16V TANTALUM | 1 |
| C10 | CAP, 8.2pF, +/-5%, 100B | 1 |
| C1 | CAP, 0.9pF, +/-0.05pF, 0603 | 1 |
| C2 | CAP, 2.2pF, +/-0.1pF, 0603 | 1 |
| C10, C11, C17 | CAP, 10.0pF, +/-5%, 0603 | 3 |
| C5, C12, C18, C30, C31 | CAP, 82pF, +/-5%, 0603 | 5 |
| C7, C14, C20 | CAP, 33000pF, 0805, 100V, X7R | 3 |
| J2, J3 | CONN SMA STR PANEL JACK RECP | 1 |
| J1 | HEADER RT>PLZ .1CEN LK 9POS | 1 |
| - | PCB, RO4350B, Er = 3.48, h = 20 mil | 1 |
| - | CWAT-0040P70 | 1 |

CWAT-0040P70-AMP Demonstration Amplifier Circuit

CWAT-0040P70-AMP Demonstration Amplifier Circuit Schematic



CWAT-0040P70-AMP Demonstration Amplifier Circuit Outline

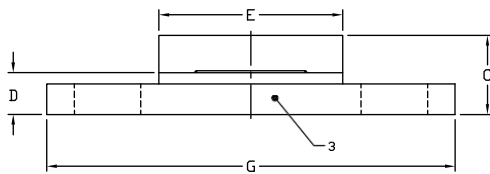
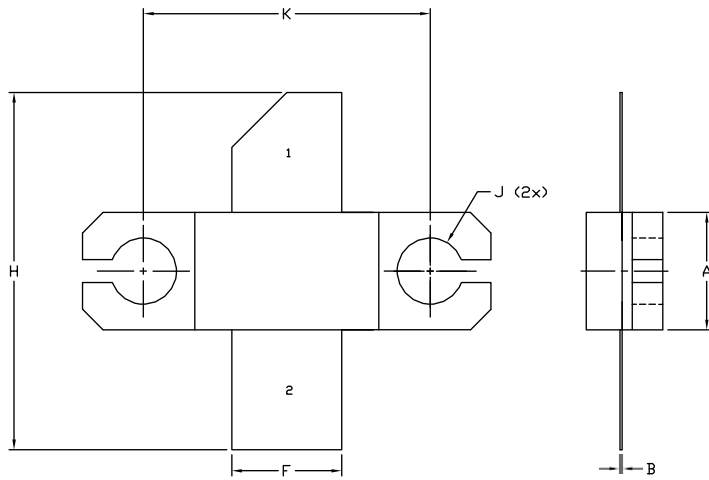


Typical Package S-Parameters for CWAT-0040P70
 (Small Signal, $V_{DS} = 28\text{ V}$, $I_{DQ} = 300\text{ mA}$, angle in degrees)

| Frequency | Mag S11 | Ang S11 | Mag S21 | Ang S21 | Mag S12 | Ang S12 | Mag S22 | Ang S22 |
|-----------|---------|---------|---------|---------|---------|---------|---------|---------|
| 500 MHz | 0.935 | -171.10 | 7.31 | 80.30 | 0.013 | -4.81 | 0.629 | -171.50 |
| 600 MHz | 0.935 | -173.48 | 6.08 | 76.43 | 0.013 | -7.68 | 0.635 | -171.81 |
| 700 MHz | 0.936 | -175.34 | 5.20 | 72.85 | 0.013 | -10.25 | 0.642 | -171.96 |
| 800 MHz | 0.937 | -176.87 | 4.54 | 69.47 | 0.013 | -12.62 | 0.649 | -172.04 |
| 900 MHz | 0.937 | -178.19 | 4.03 | 66.24 | 0.013 | -14.82 | 0.656 | -172.11 |
| 1.0 GHz | 0.938 | -179.38 | 3.62 | 63.13 | 0.013 | -16.89 | 0.664 | -172.18 |
| 1.1 GHz | 0.939 | -179.54 | 3.28 | 60.12 | 0.013 | -18.84 | 0.672 | -172.28 |
| 1.2 GHz | 0.939 | -178.52 | 3.00 | 57.20 | 0.012 | -20.69 | 0.680 | -172.42 |
| 1.3 GHz | 0.940 | -177.55 | 2.77 | 54.36 | 0.012 | -22.44 | 0.688 | -172.60 |
| 1.4 GHz | 0.941 | -176.60 | 2.57 | 51.59 | 0.012 | -24.10 | 0.695 | -172.83 |
| 1.5 GHz | 0.942 | -175.68 | 2.39 | 48.89 | 0.012 | -25.67 | 0.703 | -173.11 |
| 1.6 GHz | 0.942 | -174.77 | 2.24 | 46.24 | 0.012 | -27.15 | 0.710 | -173.42 |
| 1.7 GHz | 0.943 | -173.87 | 2.11 | 43.66 | 0.012 | -28.56 | 0.718 | -173.78 |
| 1.8 GHz | 0.943 | -172.96 | 2.00 | 41.12 | 0.011 | -29.88 | 0.724 | -174.18 |
| 1.9 GHz | 0.944 | -172.04 | 1.90 | 38.63 | 0.011 | -31.12 | 0.731 | -174.61 |
| 2.0 GHz | 0.944 | -171.11 | 1.81 | 36.19 | 0.011 | -32.29 | 0.737 | -175.07 |
| 2.1 GHz | 0.944 | -170.16 | 1.73 | 33.78 | 0.011 | -33.39 | 0.743 | -175.57 |
| 2.2 GHz | 0.944 | -169.19 | 1.67 | 31.41 | 0.011 | -34.42 | 0.748 | -176.10 |
| 2.3 GHz | 0.945 | -168.19 | 1.61 | 29.06 | 0.011 | -35.38 | 0.753 | -176.65 |
| 2.4 GHz | 0.944 | -167.16 | 1.55 | 26.74 | 0.010 | -36.28 | 0.758 | -177.23 |
| 2.5 GHz | 0.944 | -166.10 | 1.51 | 24.43 | 0.010 | -37.11 | 0.762 | -177.83 |
| 2.6 GHz | 0.944 | -165.00 | 1.47 | 22.14 | 0.010 | -37.88 | 0.765 | -178.45 |
| 2.7 GHz | 0.944 | -163.85 | 1.43 | 19.85 | 0.010 | -38.60 | 0.769 | -179.10 |
| 2.8 GHz | 0.943 | -162.64 | 1.41 | 17.56 | 0.010 | -39.27 | 0.771 | -179.77 |
| 2.9 GHz | 0.942 | -161.38 | 1.38 | 15.27 | 0.010 | -39.90 | 0.774 | -179.54 |
| 3.0 GHz | 0.941 | -160.06 | 1.36 | 12.96 | 0.010 | -40.48 | 0.776 | -178.82 |
| 3.2 GHz | 0.939 | -157.18 | 1.34 | 8.27 | 0.010 | -41.54 | 0.778 | -177.32 |
| 3.4 GHz | 0.935 | -153.93 | 1.33 | 3.43 | 0.010 | -42.52 | 0.779 | -175.73 |
| 3.6 GHz | 0.931 | -150.21 | 1.34 | -1.65 | 0.010 | -43.50 | 0.778 | -174.01 |
| 3.8 GHz | 0.925 | -145.88 | 1.37 | -7.06 | 0.010 | -44.60 | 0.774 | -172.17 |
| 4.0 GHz | 0.916 | -140.74 | 1.43 | -12.95 | 0.011 | -45.95 | 0.769 | -170.17 |
| 4.2 GHz | 0.906 | -134.55 | 1.50 | -19.47 | 0.011 | -47.77 | 0.760 | -167.98 |
| 4.4 GHz | 0.891 | -126.90 | 1.61 | -26.85 | 0.012 | -50.32 | 0.749 | -165.56 |
| 4.6 GHz | 0.872 | -117.26 | 1.75 | -35.39 | 0.013 | -53.96 | 0.733 | -162.84 |
| 4.8 GHz | 0.848 | -104.85 | 1.92 | -45.48 | 0.014 | -59.15 | 0.713 | -159.74 |
| 5.0 GHz | 0.817 | -88.57 | 2.14 | -57.60 | 0.016 | -66.44 | 0.688 | -156.11 |
| 5.2 GHz | 0.784 | -67.16 | 2.37 | -72.25 | 0.018 | -76.37 | 0.654 | -151.74 |
| 5.4 GHz | 0.759 | -39.85 | 2.58 | -89.71 | 0.020 | -89.30 | 0.609 | -146.35 |
| 5.6 GHz | 0.757 | -8.00 | 2.70 | -109.65 | 0.021 | -104.92 | 0.546 | -139.55 |
| 5.8 GHz | 0.788 | -24.14 | 2.67 | -130.98 | 0.022 | -122.14 | 0.460 | -130.98 |
| 6.0 GHz | 0.836 | -52.18 | 2.49 | -152.33 | 0.021 | -139.60 | 0.347 | -119.94 |

To download the s-parameters in s2p format, go to the [CWAT-0040P70 Product Page](#) and click on the documentation tab.

Product Dimensions CWAT-0040P70 (Package Type — 440193)



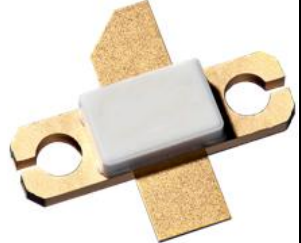
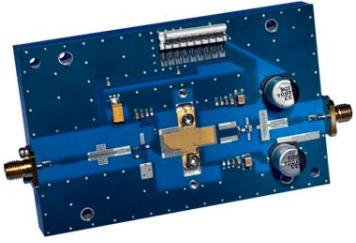
NOTES:

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 | ∅ .130 | | 3.30 | |
| k | 0.562 | | 14.28 | |

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

Product Ordering Information

| Order Number | Description | Unit of Measure | Image |
|------------------|------------------------------------|-----------------|---|
| CWAT-0040P70 | GaN HEMT | Each |  |
| CWAT-0040P70-AMP | Test board with GaN HEMT installed | Each |  |