COAXIAL

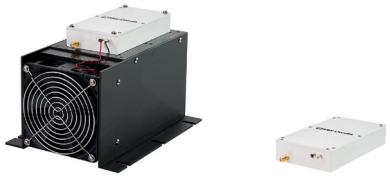
# High Power Amplifier

# ZHL-50W-GAN+ ZHL-50W-GANX+

50Ω 20 to 500 MHz Broadband 50W SMA-Female

## THE BIG DEAL

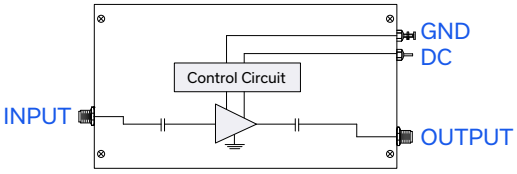
- High Output Power, 50W
- High Output IP2, +80dBm typ.
- High Output IP3, +55dBm typ.
- Reverse Polarity Protected
- Unconditionally stable
- Protected by US patent 7,348,854



*With heatsink* *Without heatsink*

*Generic photo used for illustration purposes only*

## FUNCTIONAL DIAGRAM




## APPLICATIONS

- Broad based test laboratory amplifier
- Test setup driver amplifier
- VHF test amplifier
- Amplifier for burn-in test setups

## PRODUCT OVERVIEW

The ZHL-50W-GAN+ and ZHL-50W-GANX+ are Class A, high power amplifiers that utilize a Gallium Nitride (GaN) push-pull output stage, which results in a higher efficiency (50% typ.) as compared to GaAs, LDMOS and VDMOS counterparts. These amplifiers provide 50 W (typical) of output power at 1dB Compression Point from 20 MHz to 500 MHz and are well suited for a variety of high-power test setups as well as communication applications. They are ruggedly designed and provide unconditional stability and built-in self-protection against over and reverse voltage and over temperature conditions. The GaN Transistors boast a maximum junction temperature up to +250 °C translating into the higher MTBF and improved reliability.

## KEY FEATURES

| Features | Advantages |
|---|---|
| High Efficiency | Higher PAE results in significant cost savings over the operating life of the amplifier. |
| Rugged Design | Extreme load mismatch such as open/short at the RF output are tolerated without damaging the amplifier. At constant open/short and +28V nominal supply voltage. |
| Range of Protections | Over temperature, over voltage and reverse polarity protection add to the ruggedness of the amplifier. |

## ELECTRICAL SPECIFICATIONS AT $T_{BASEPLATE}$ = +25°C, $V_{DC}$= +28V

| Parameter | Condition | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Frequency Range | | 20 | | 500 | MHz |
| Small Signal Gain | $P_{IN}$ = -40 dBm | 40 | 43.5 | 47 | dB |
| Small Signal Gain Flatness | $P_{IN}$ = -40 dBm | | ± 1.2 | ± 2.7 | dB |
| Output Power at 1dB compression, reference level $P_{IN}$ = -10 dBm | 20-100 MHz | +46.2 | +47 | | dBm |
| | 100-500 MHz | +46.8 | +48 | | dBm |
| Output Power at 3dB compression, reference level $P_{IN}$ = -10 dBm | 20-100 MHz | | +48 | | dBm |
| | 100-500 MHz | | +49 | | dBm |
| Noise Figure | | | 7 | 12 | dB |
| Output Third Order Intercept Point | | | +55 | | dBm |
| Output Second Order Intercept Point | | | +80 | | dBm |
| Input VSWR | | | 1.7 | | :1 |
| Output VSWR | | | 2.6 | | :1 |
| DC Supply Voltage | | | +28 | +31 | V |
| DC Supply Current for ZHL-50W-GAN+ (with heatsink/fan)[1] | | | 7.2 | 7.4 | A |

1. DC Power Supply should be able to deliver 13A DC at startup.

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# ZHL-50W-GAN+
# ZHL-50W-GANX+

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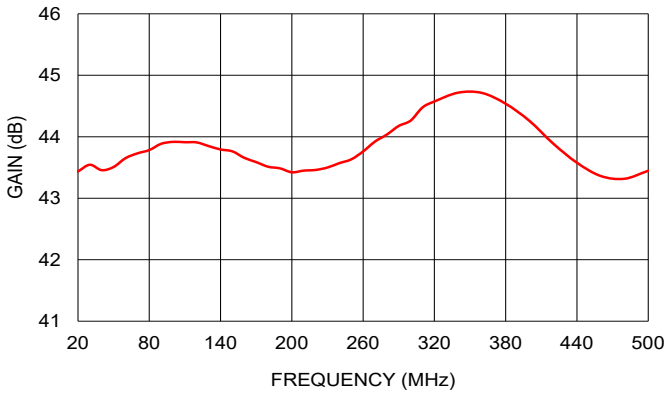
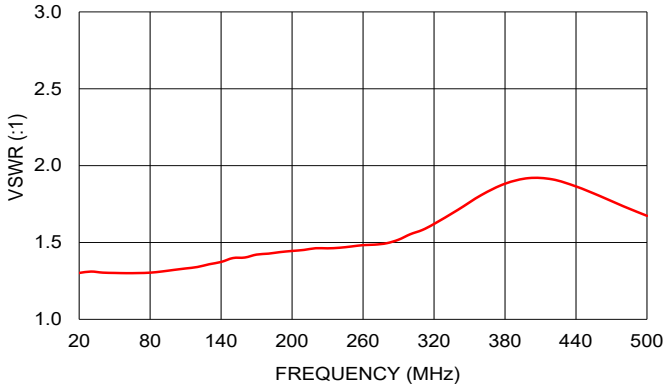
## TYPICAL PERFORMANCE GRAPHS @+25C

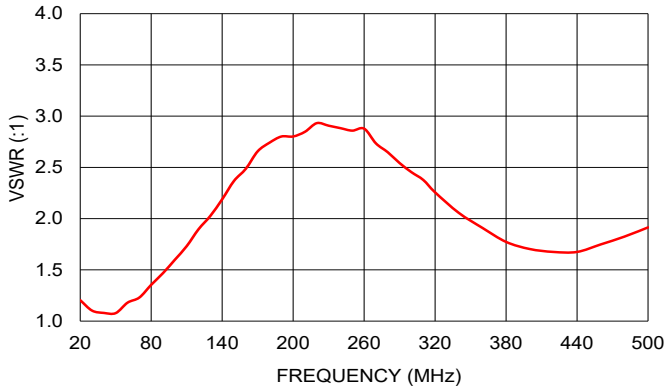
### SMALL SIGNAL GAIN AT +28V



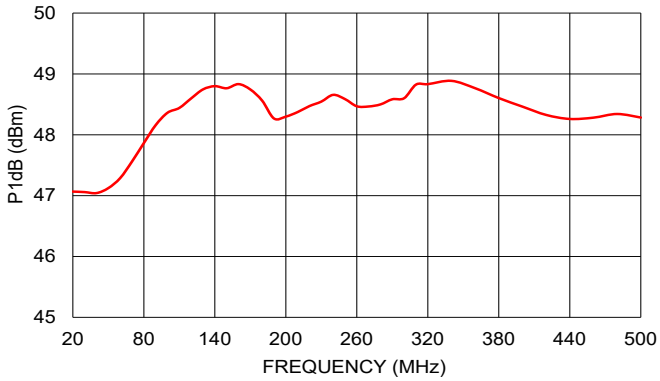

### INPUT VSWR AT +28V



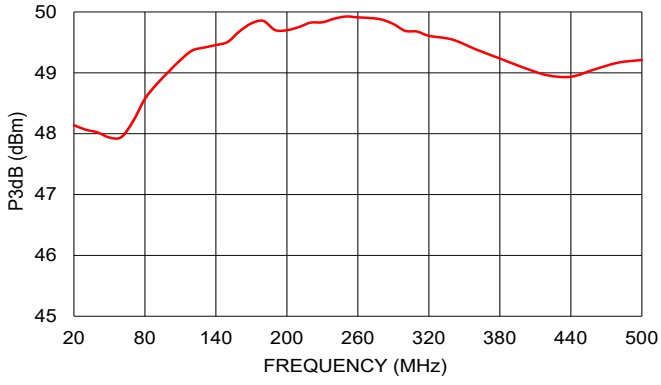

### OUTPUT VSWR AT +28V



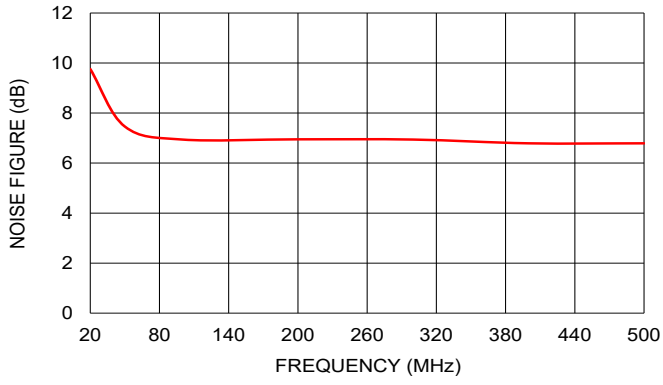

### P1dB AT +28V




### P3dB AT+ 28V




### NOISE FIGURE AT +28V



## ABSOLUTE MAXIMUM RATINGS[2]

| Parameter | Ratings | |
|---|---|---|
| Operating Temperature | ZHL-50W-GAN+ | $T_{AIR\ AMBIENT}$: -25 °C to +65 °C |
| | ZHL-50W-GANX+ | $T_{BASEPLATE}$: -25 °C to +85 °C |
| Storage Temperature | -55 °C to +100 °C | |
| RF Input Power (no damage) | +13 dBm | |
| DC Operating Voltage | +31 V | |

2. Permanent damage may occur if any of these limits are exceeded.

## DETERMINING MAXIMUM THERMAL RESISTANCE OF USERS' EXTERNAL HEAT SINK

$$\textit{MAXIMUM THERMAL RESISTANCE} = \frac{\textit{MAXIMUM OPERATING CASE TEMP} - \textit{MAXIMUM USER AMBIENT TEMP}}{\textit{POWER DISSIPATION}}$$

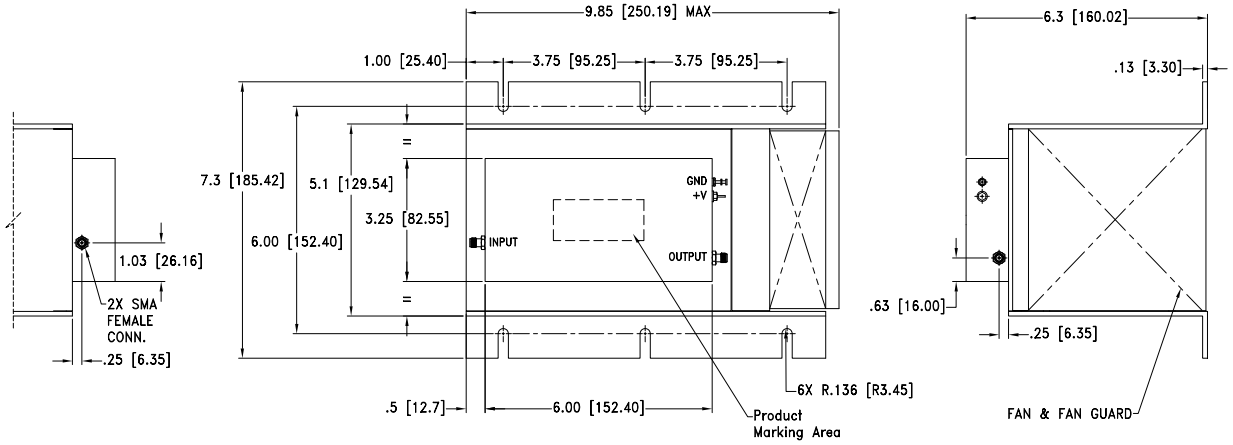
| | |
|---|---|
| **Example:** | MAXIMUM MOUNTING BASE TEMP = +85 °C (CHECK MAXIMUM RATINGS TABLE FOR THIS VALUE)<br>MAXIMUM USER AMBIENT TEMP = +65 °C (USER DEFINED)<br>POWER DISSIPATION = 7.1A*28V=199 WATTS<br>THEN MAXIMUM ALLOWABLE THERMAL RESISTANCE = (85 °C - 65 °C)/199W = 0.1 °C/W |

# High Power Amplifier

# ZHL-50W-GAN+
# ZHL-50W-GANX+

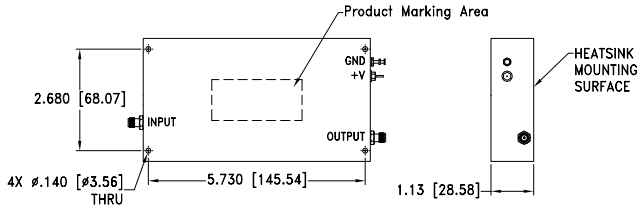
50Ω 20 to 500 MHz Broadband 50W SMA-Female

## CASE STYLE DRAWING WITH HEATSINK AND FAN (ZHL-50W-GAN+)




**PRODUCT MARKING*:** ZHL-50W-GAN+

## CASE STYLE DRAWING WITHOUT HEATSINK AND FAN (ZHL-50W-GANX+)




Weight With Heatsink: 4185 grams; Without Heatsink: 500 grams
Dimensions are in inches [mm]. Tolerances: 1 Pl.±0.1; 2 Pl.±0.03; 3Pl.±0.015 Inch

**PRODUCT MARKING*:** ZHL-50W-GANX+

*Marking may contain other features or characters for internal lot control.

# High Power Amplifier

## ZHL-50W-GAN+
## ZHL-50W-GANX+

50Ω 20 to 500 MHz Broadband 50W SMA-Female

## ADDITIONAL INFORMATION IS AVAILABLE ON OUR DASHBOARD.

| | |
|---|---|
| **Performance Data** | Electrical Specifications<br>Graphs<br>S-Parameters (S2P Files) |
| **RoHs Status** | Compliant |
| **Environmental Ratings** | ENV23T3 |

## ORDERING INFORMATION

| **Model No. Links** | ZHL-50W-GAN+ | ZHL-50W-GANX+ |
|---|---|---|
| **Option** | With heatsink & fan | Without heatsink & fan |
| **Case Style** | BT1165 | |
| **Connector** | IN (SMA-Female) / OUT (SMA-Female) | |

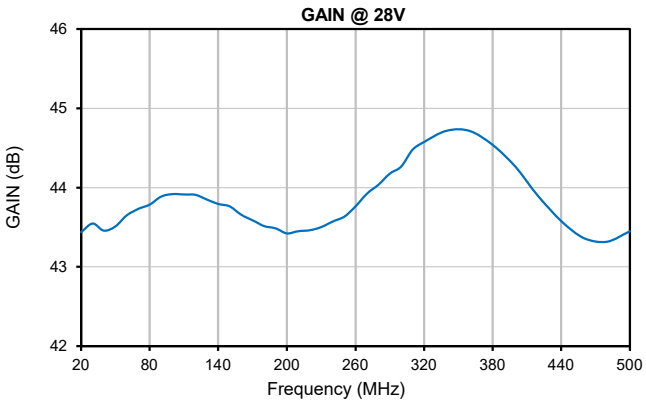
NOTES

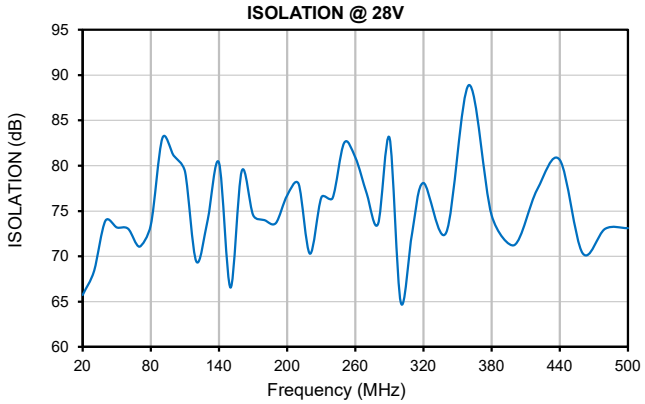
A. Performance and quality attributes and conditions not expressly stated in this specification document are intended to be excluded and do not form a part of this specification document.
B. Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
C. The parts covered by this specification document are subject to Mini-Circuits standard limited warranty and terms and conditions (collectively, "Standard Terms"); Purchasers of this part are entitled to the rights and benefits contained therein. For a full statement of the standard terms and the exclusive rights and remedies thereunder, please visit Mini-Circuits' website at www.minicircuits.com/terms/viewterm.html

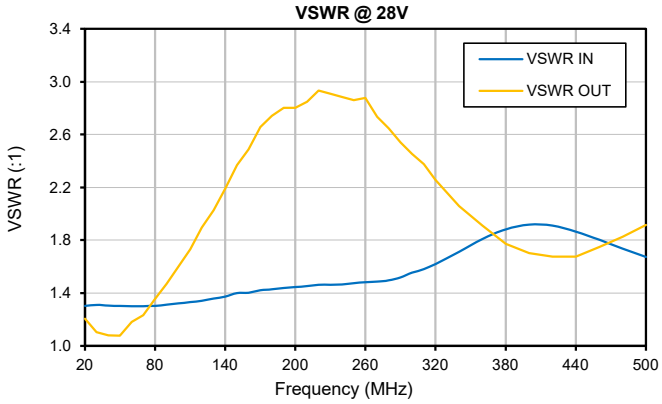
## Typical Performance Data

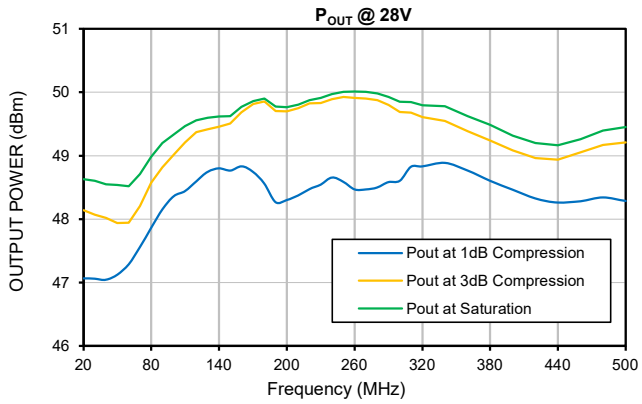
| FREQUENCY (MHz) | GAIN (dB) 28V | ISOLATION (dB) 28V | VSWR (:1) IN 28V | VSWR (:1) OUT 28V | $P_{OUT}$ @ 1 dB COMPRESSION (dBm) 28V | $P_{OUT}$ @ 3 dB COMPRESSION (dBm) 28V | $P_{OUT}$ at SATURATION (dBm) 28V |
|---|---|---|---|---|---|---|---|
| 20 | 43.44 | 65.74 | 1.30 | 1.20 | 47.07 | 48.14 | 48.63 |
| 30 | 43.54 | 68.42 | 1.31 | 1.10 | 47.06 | 48.07 | 48.61 |
| 40 | 43.46 | 73.92 | 1.30 | 1.08 | 47.04 | 48.02 | 48.55 |
| 50 | 43.51 | 73.17 | 1.30 | 1.08 | 47.12 | 47.94 | 48.54 |
| 60 | 43.65 | 73.04 | 1.30 | 1.18 | 47.29 | 47.94 | 48.52 |
| 70 | 43.73 | 71.07 | 1.30 | 1.23 | 47.56 | 48.20 | 48.71 |
| 80 | 43.78 | 73.45 | 1.30 | 1.35 | 47.86 | 48.57 | 48.98 |
| 90 | 43.89 | 83.02 | 1.31 | 1.47 | 48.16 | 48.81 | 49.20 |
| 100 | 43.92 | 81.12 | 1.32 | 1.60 | 48.36 | 49.02 | 49.34 |
| 110 | 43.91 | 79.31 | 1.33 | 1.73 | 48.44 | 49.21 | 49.47 |
| 120 | 43.91 | 69.42 | 1.34 | 1.90 | 48.60 | 49.37 | 49.55 |
| 130 | 43.85 | 74.07 | 1.36 | 2.03 | 48.75 | 49.41 | 49.60 |
| 140 | 43.79 | 80.32 | 1.37 | 2.19 | 48.80 | 49.46 | 49.62 |
| 150 | 43.76 | 66.54 | 1.40 | 2.37 | 48.76 | 49.51 | 49.62 |
| 160 | 43.66 | 79.39 | 1.40 | 2.49 | 48.83 | 49.68 | 49.76 |
| 170 | 43.59 | 74.52 | 1.42 | 2.66 | 48.74 | 49.81 | 49.86 |
| 180 | 43.51 | 74.01 | 1.43 | 2.74 | 48.56 | 49.85 | 49.90 |
| 190 | 43.49 | 73.68 | 1.44 | 2.80 | 48.27 | 49.70 | 49.78 |
| 200 | 43.42 | 76.71 | 1.44 | 2.80 | 48.30 | 49.70 | 49.76 |
| 210 | 43.45 | 77.98 | 1.45 | 2.85 | 48.37 | 49.75 | 49.80 |
| 220 | 43.46 | 70.28 | 1.46 | 2.93 | 48.47 | 49.82 | 49.87 |
| 230 | 43.50 | 76.51 | 1.46 | 2.91 | 48.54 | 49.83 | 49.91 |
| 240 | 43.57 | 76.42 | 1.47 | 2.88 | 48.66 | 49.89 | 49.97 |
| 250 | 43.63 | 82.51 | 1.47 | 2.86 | 48.59 | 49.93 | 50.00 |
| 260 | 43.76 | 80.91 | 1.48 | 2.88 | 48.47 | 49.91 | 50.01 |
| 270 | 43.92 | 76.89 | 1.49 | 2.73 | 48.46 | 49.90 | 50.00 |
| 280 | 44.04 | 73.56 | 1.50 | 2.65 | 48.50 | 49.88 | 49.98 |
| 290 | 44.18 | 83.08 | 1.52 | 2.54 | 48.58 | 49.80 | 49.93 |
| 300 | 44.26 | 64.92 | 1.55 | 2.45 | 48.60 | 49.69 | 49.85 |
| 310 | 44.48 | 72.66 | 1.58 | 2.38 | 48.82 | 49.68 | 49.85 |
| 320 | 44.57 | 78.08 | 1.62 | 2.26 | 48.83 | 49.61 | 49.79 |
| 340 | 44.72 | 72.62 | 1.71 | 2.06 | 48.89 | 49.55 | 49.78 |
| 360 | 44.71 | 88.90 | 1.81 | 1.91 | 48.77 | 49.38 | 49.62 |
| 380 | 44.54 | 74.52 | 1.88 | 1.77 | 48.60 | 49.24 | 49.48 |
| 400 | 44.26 | 71.23 | 1.92 | 1.70 | 48.46 | 49.09 | 49.32 |
| 420 | 43.89 | 77.35 | 1.91 | 1.68 | 48.33 | 48.96 | 49.20 |
| 440 | 43.58 | 80.62 | 1.86 | 1.68 | 48.26 | 48.94 | 49.16 |
| 460 | 43.36 | 70.37 | 1.80 | 1.75 | 48.28 | 49.06 | 49.26 |
| 480 | 43.32 | 73.04 | 1.74 | 1.82 | 48.34 | 49.17 | 49.39 |
| 500 | 43.45 | 73.12 | 1.67 | 1.91 | 48.28 | 49.21 | 49.45 |

*Typical Performance Curves*



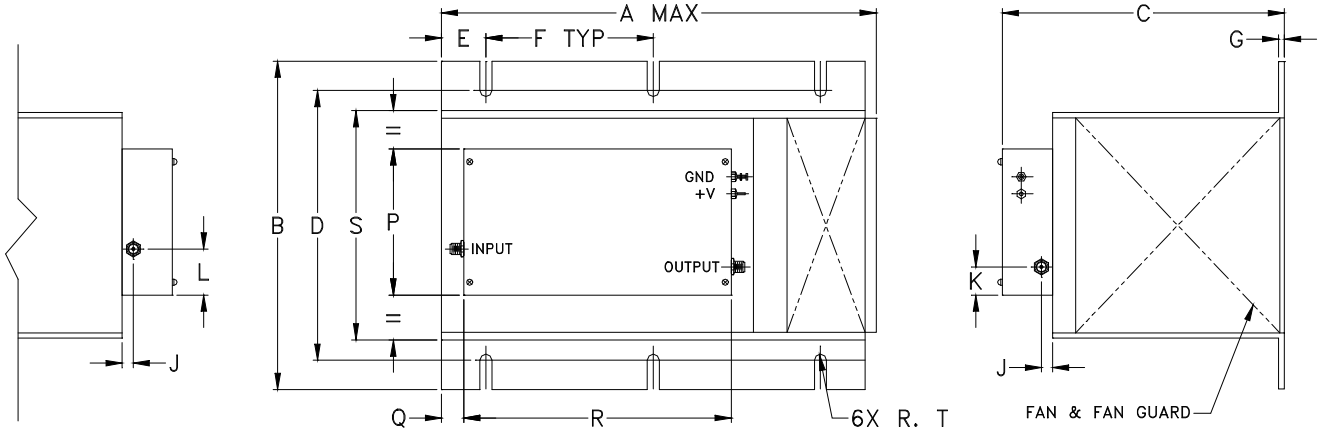



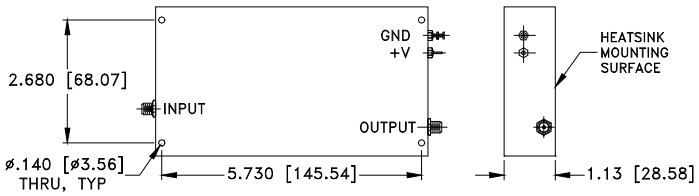
# Case Style BT

**BT1165**

## Outline Dimensions




**MOUNTING INFORMATION FOR MODELS WITHOUT HEATSINK.**




| CASE# | A | B | C | D | E | F | G | H | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BT1165 | 9.85 (250.19) | 7.3 (185.42) | 6.3 (160.02) | 6.00 (152.40) | 1.00 (25.40) | 3.75 (95.25) | .13 (3.30) | - - | .25 (6.35) | .63 (16.00) | 1.03 (26.16) | - - | - - |

| CASE# | P | Q | R | S | T | WT, GRAM | WT WITHOUT HEATSINK, GRAM |
|---|---|---|---|---|---|---|---|
| BT1165 | 3.25 (82.55) | .5 (12.70) | 6.00 (152.40) | 5.1 (129.54) | .135 (3.43) | 4185 | 500 |

**Dimensions are in inches (mm). Tolerances: 1 Pl. ± .1; 2 Pl. ± .03; 3 Pl. ± .015**

### Notes:

1. Case material: Aluminum alloy.
2. Finish:
   For RoHS Case Styles: Clear Chemical conversion coating, non-chrome or trivalent chrome based.
   For non RoHS Case Styles: Yellow Chromate with low electrical Resistance.
3. Heatsink finish: Black anodize.
4. Refer to the individual model data sheet for the type of connectors available.
5. Recommended screws for mounting model without heat sink on 3/32" thick sheet: #6-32, 1.50" Length.

Mini-Circuits

# Environmental Specifications ENV23T3

All Mini-Circuits products are manufactured under exacting quality assurance and control standards, and are capable of meeting published specifications after being subjected to any or all of the following physical and environmental test.

| Specification | Test/Inspection Condition | Reference/Spec |
|---|---|---|
| Operating Temperature | -20° to 65° C<br>Ambient Environment | Individual Model Data Sheet |
| Storage Temperature | -55° to 100° C<br>Ambient Environment | Individual Model Data Sheet |
| Stabilization Bake | (non-operating)<br>125°C, 24 hours | - - - |
| Burn-in at Elevated Temp. | (DC on)<br>160 hours at 85° C | MIL-STD-202, Method 108 |
| Thermal Shock | -55° to 100°C, 5 cycles | MIL-STD-202, Method 107, Condition A, except 100°C |