



Mini-Circuits

COAXIAL

# High Power Amplifier

**ZHL-5W-202-S+**  
**ZHL-5W-202X-S+**

50Ω 5W 10 to 2000 MHz

## THE BIG DEAL

- High Power, 5 Watt at saturation
- Class AB Amplifier
- Low Current consumption
- High IP3, +47 dBm typ.
- Usable from 5.0 MHz to 2200 MHz
- Good Gain Flatness,  $\pm 2.0$  dB typ.
- No damage with an open or short output load while delivering up to 5W
- Shuts off when base plate temperature exceeds +85°C

## APPLICATIONS

- Cellular
- PCN
- GSM
- ISM
- Lab Test

## PRODUCT OVERVIEW

The ZHL-5W-202-S+ is a Class AB, high-power amplifier providing 5W saturated power over the 10 to 2000 MHz band, ideal for a variety of high-power test setups as well as applications including communications, radar and more. The ruggedly-designed amplifier provides unconditional stability and built-in self-protection against reverse polarity, excessive drive and overheating. The amplifier's output stage is further protected in the event of a fault condition, allowing high power operation into an OPEN or SHORT load (refer to the maximum input power specifications). Housed in a rugged aluminum alloy case measuring 4.3 x 6.7 x 1.2", the unit features SMA connectors and an optional heat sink and fan attachment for cooling.

## KEY FEATURES

| Feature                                     | Advantages                                                                                                                                                                                                                  |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Ultra Wideband, usable from 5.0 to 2200 MHz | Suitable for a broad range of high-power, wideband applications, including test setups, communications and defense applications.                                                                                            |
| High Gain, 50 dB                            | Enables signal amplification to 5W output without the need for multiple gain stages.                                                                                                                                        |
| Built-in self-protection                    | In instances of potentially-damaging excessive drive current, heat buildup within the housing, unshorting of DC supply, and short or open loads at the output, an automatic sensing feature signals the unit to power down. |
| Unconditional stability                     | Provides reliable performance independent of input and load conditions.                                                                                                                                                     |



Generic photo used for illustration purposes only

|            |               |                 |
|------------|---------------|-----------------|
| Model No.  | ZHL-5W-202-S+ | ZHL-5W-202X-S+▲ |
| Case Style | BT1689-1      |                 |
| Connectors | SMA           |                 |

### +RoHS Compliant

The +Suffix identifies RoHS Compliance.  
See our website for methodologies and qualifications





## ELECTRICAL SPECIFICATIONS AT 25°C

| Parameter                          | Min. | Typ. | Max. | Units |
|------------------------------------|------|------|------|-------|
| Frequency Range                    | 10   |      | 2000 | MHz   |
| Gain <sup>1</sup>                  | 44   | 50   | 56   | dB    |
| Gain Flatness                      | —    | ±2.0 | ±2.7 | dB    |
| Output Power at 3dB compression    | —    | +38  | —    | dBm   |
| Output Power at Saturation         | +36  | +40  | —    | dBm   |
| Noise Figure                       | —    | 10   | —    | dB    |
| Output third order intercept point | +39  | +47  | —    | dBm   |
| Input VSWR                         | —    | 1.2  | —    | :1    |
| Output VSWR                        | —    | 2.0  | —    | :1    |
| DC Supply Voltage                  | —    | 28   | 30   | V     |
| Supply Current <sup>2</sup>        | —    | 1.5  | 3.0  | A     |

1. Small signal input power -50 dBm typ.

2. Power Supply should be capable of delivering 4A at start up.

▲ Heat sink and fan not included. Alternative heat sinking and heat removal must be provided by the user to limit maximum base-plate temperature to 85°C, in order to ensure proper performance. For reference, this requires thermal resistance of user's external heat sink to be 1.0°C/W max.

ABSOLUTE MAXIMUM RATINGS<sup>3</sup>

| Parameter                  | Ratings                                     |
|----------------------------|---------------------------------------------|
| Operating Temperature      | -20 °C to +60 °C                            |
| Storage Temperature        | -55 °C to +100 °C                           |
| Base Plate Temperature     | +85 °C                                      |
| Input RF Power (no damage) | +5 dBm <sup>4</sup><br>-19 dBm <sup>5</sup> |

3. Specifications apply to CW signals only permanent damage may occur if any of these limits are exceeded.

4. Into 50 ohm load.

5. Into open or short load



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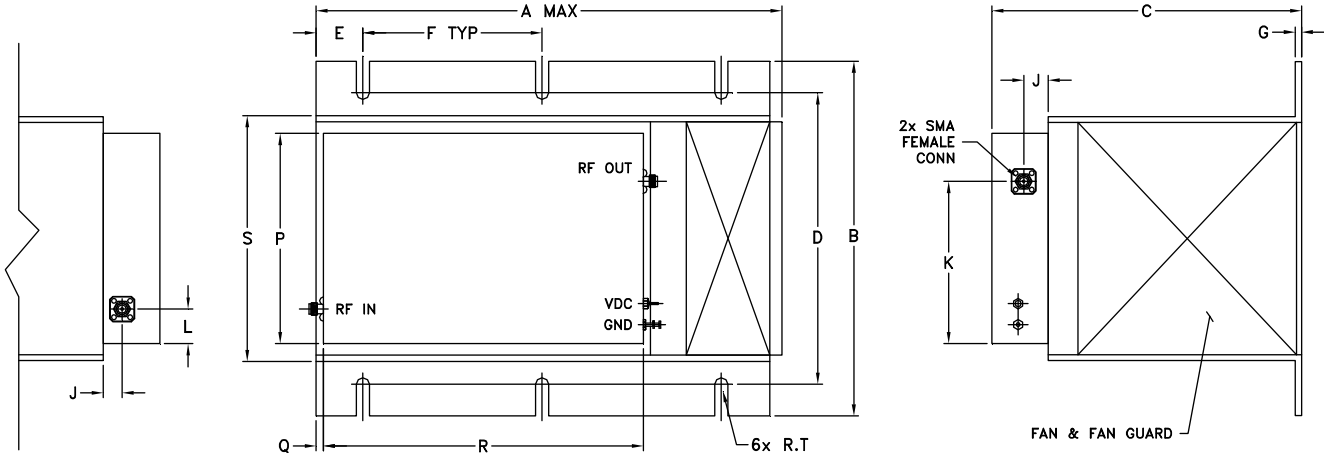
# High Power Amplifier

**ZHL-5W-202-S+**  
**ZHL-5W-202X-S+**

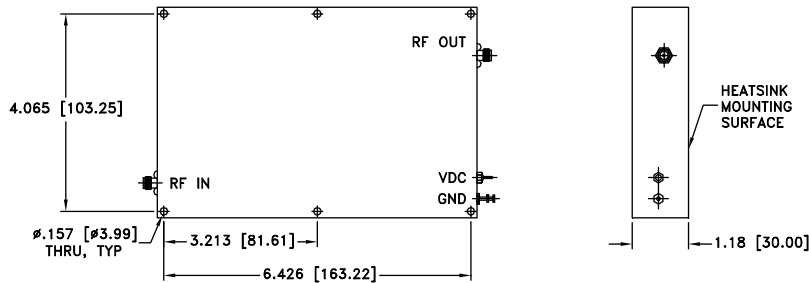
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50Ω 5W 10 to 2000 MHz

## OUTLINE DRAWING FOR MODELS WITH HEATSINK



## OUTLINE DRAWING FOR MODELS WITHOUT HEATSINK



## OUTLINE DIMENSIONS (Inch mm)

| A      | B      | C      | D     | E     | F     | G    | J     | K     | L     | M  | P      | Q    | R      | S      | T    | wt     |
|--------|--------|--------|-------|-------|-------|------|-------|-------|-------|----|--------|------|--------|--------|------|--------|
| 9.85   | 7.30   | 6.50   | 6.00  | 0.98  | 3.75  | 0.13 | 0.47  | 3.34  | 0.71  | -- | 4.33   | 0.20 | 6.69   | 5.10   | 0.14 | grams* |
| 250.19 | 185.42 | 167.64 | 152.4 | 24.89 | 95.25 | 3.30 | 12.00 | 84.80 | 18.00 | -- | 110.00 | 5.08 | 170.00 | 129.54 | 3.45 | 4565   |

\*880 grams without heatsink





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## High Power Amplifier

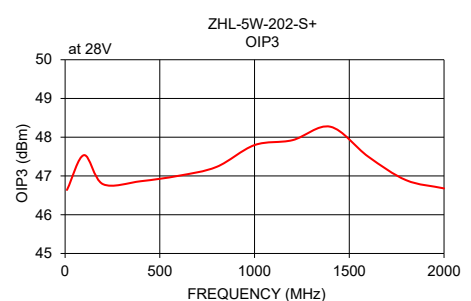
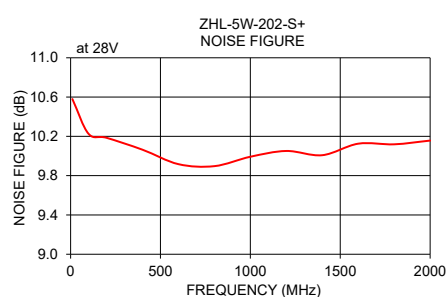
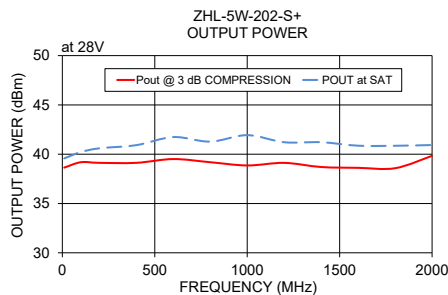
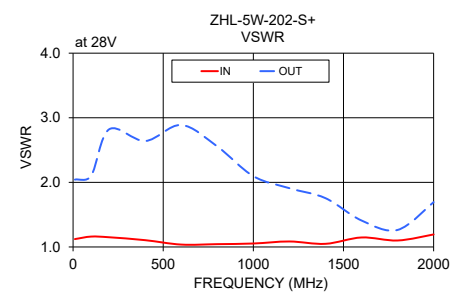
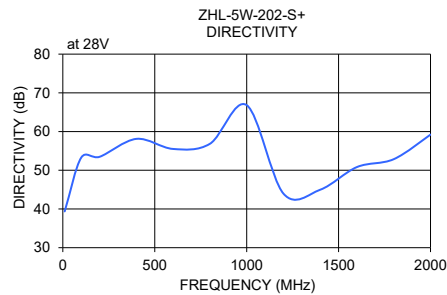
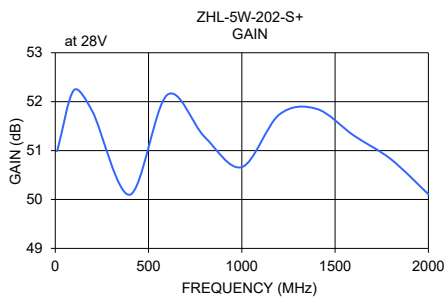
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**ZHL-5W-202X-S+**

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50Ω 5W 10 to 2000 MHz

## TYPICAL PERFORMANCE DATA / GRAPHS

| FREQUENCY<br>(MHz) | GAIN<br>(dB) | DIRECTIVITY<br>(dB) | VSWR<br>(:1) |      | NOISE<br>FIGURE<br>(dB) | POUT<br>at 3 dB<br>COMPR.<br>(dBm) | POUT<br>at SAT<br>(dBm) | OUTPUT<br>IP3<br>(dBm) |
|--------------------|--------------|---------------------|--------------|------|-------------------------|------------------------------------|-------------------------|------------------------|
|                    | 28V          | 28V                 | IN           | OUT  | 28V                     | 28V                                | 28V                     | 28V                    |
| 10                 | 50.99        | 39.37               | 1.12         | 2.04 | 10.58                   | 38.64                              | 39.58                   | 46.64                  |
| 100                | 52.24        | 53.26               | 1.16         | 2.10 | 10.23                   | 39.19                              | 40.22                   | 47.54                  |
| 200                | 51.79        | 53.48               | 1.15         | 2.82 | 10.19                   | 39.13                              | 40.60                   | 46.79                  |
| 400                | 50.10        | 58.11               | 1.11         | 2.64 | 10.06                   | 39.13                              | 40.92                   | 46.86                  |
| 600                | 52.14        | 55.50               | 1.04         | 2.89 | 9.92                    | 39.51                              | 41.74                   | 47.01                  |
| 800                | 51.28        | 56.84               | 1.04         | 2.56 | 9.90                    | 39.19                              | 41.28                   | 47.23                  |
| 1000               | 50.66        | 66.82               | 1.05         | 2.10 | 9.99                    | 38.86                              | 41.93                   | 47.80                  |
| 1200               | 51.73        | 43.97               | 1.08         | 1.91 | 10.05                   | 39.12                              | 41.22                   | 47.92                  |
| 1400               | 51.85        | 44.97               | 1.05         | 1.76 | 10.01                   | 38.70                              | 41.22                   | 48.27                  |
| 1600               | 51.31        | 50.83               | 1.15         | 1.41 | 10.13                   | 38.62                              | 40.86                   | 47.50                  |
| 1800               | 50.82        | 52.86               | 1.10         | 1.26 | 10.12                   | 38.58                              | 40.86                   | 46.89                  |
| 2000               | 50.11        | 59.21               | 1.19         | 1.69 | 10.16                   | 39.84                              | 40.93                   | 46.68                  |



## 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](http://www.minicircuits.com/terms/viewterm.html)



# High Power Amplifier

ZHL-5W-202-S+

## Typical Performance Data

| FREQUENCY<br>(MHz) | GAIN<br>(dB)<br>28V | DIRECTIVITY<br>(dB)<br>28V | VSWR (:1) |            | NOISE FIGURE<br>(dB)<br>28V | Pout @ 3 dB<br>COMPRESSION | Pout @<br>SATURATION | OUTPUT IP3   |
|--------------------|---------------------|----------------------------|-----------|------------|-----------------------------|----------------------------|----------------------|--------------|
|                    |                     |                            | IN<br>28V | OUT<br>28V |                             | (dBm)<br>28V               | (dBm)<br>28V         | (dBm)<br>28V |
| 5                  | 49.2                | 38.5                       | 1.12      | 2.22       | --                          | 38.91                      | 40.02                | 45.98        |
| 6                  | 49.8                | 34.0                       | 1.13      | 2.18       | --                          | 38.82                      | 39.85                | 46.31        |
| 7                  | 50.2                | 31.0                       | 1.13      | 2.10       | --                          | 38.73                      | 39.74                | 46.55        |
| 8                  | 50.5                | 30.8                       | 1.13      | 2.09       | --                          | 38.68                      | 39.66                | 46.65        |
| 9                  | 50.8                | 35.3                       | 1.12      | 2.08       | --                          | 38.65                      | 39.61                | 46.67        |
| 10                 | 51.0                | 39.4                       | 1.12      | 2.04       | 10.58                       | 38.64                      | 39.58                | 46.64        |
| 15                 | 51.6                | 59.4                       | 1.12      | 1.95       | 10.58                       | 38.68                      | 39.56                | 47.34        |
| 20                 | 51.9                | 33.1                       | 1.13      | 1.91       | 10.36                       | 38.77                      | 39.60                | 47.62        |
| 25                 | 52.1                | 46.4                       | 1.13      | 1.86       | 10.36                       | 38.78                      | 39.62                | 47.75        |
| 30                 | 52.2                | 35.6                       | 1.14      | 1.81       | 10.32                       | 38.79                      | 39.64                | 47.87        |
| 35                 | 52.2                | 30.0                       | 1.14      | 1.79       | 10.32                       | 38.82                      | 39.72                | 48.06        |
| 40                 | 52.3                | 34.6                       | 1.14      | 1.77       | 10.27                       | 38.88                      | 39.82                | 48.12        |
| 45                 | 52.3                | 39.8                       | 1.14      | 1.74       | 10.27                       | 38.98                      | 39.91                | 48.29        |
| 50                 | 52.3                | 42.2                       | 1.15      | 1.75       | 10.26                       | 39.06                      | 40.00                | 48.46        |
| 55                 | 52.2                | 46.9                       | 1.15      | 1.73       | 10.26                       | 39.13                      | 40.07                | 48.38        |
| 60                 | 52.2                | 52.2                       | 1.15      | 1.75       | 10.25                       | 39.17                      | 40.12                | 48.46        |
| 65                 | 52.2                | 47.6                       | 1.16      | 1.78       | 10.25                       | 39.18                      | 40.14                | 48.46        |
| 70                 | 52.2                | 43.5                       | 1.16      | 1.80       | 10.25                       | 39.18                      | 40.14                | 48.47        |
| 75                 | 52.2                | 51.5                       | 1.16      | 1.84       | 10.25                       | 39.16                      | 40.14                | 48.33        |
| 80                 | 52.2                | 55.9                       | 1.16      | 1.89       | 10.24                       | 39.17                      | 40.13                | 48.51        |
| 85                 | 52.3                | 42.0                       | 1.16      | 1.96       | 10.24                       | 39.15                      | 40.13                | 47.77        |
| 90                 | 52.3                | 45.4                       | 1.16      | 2.00       | 10.23                       | 39.18                      | 40.15                | 47.72        |
| 95                 | 52.3                | 51.4                       | 1.16      | 2.05       | 10.23                       | 39.19                      | 40.20                | 47.68        |
| 100                | 52.2                | 53.3                       | 1.16      | 2.10       | 10.23                       | 39.19                      | 40.22                | 47.54        |
| 150                | 52.1                | 43.4                       | 1.15      | 2.44       | 10.22                       | 39.09                      | 40.22                | 46.84        |
| 200                | 51.8                | 53.5                       | 1.15      | 2.82       | 10.19                       | 39.13                      | 40.60                | 46.79        |
| 250                | 51.2                | 54.3                       | 1.14      | 2.85       | 10.15                       | 39.02                      | 40.26                | 46.37        |
| 300                | 50.5                | 50.1                       | 1.13      | 2.86       | 10.13                       | 39.28                      | 40.77                | 46.75        |
| 350                | 50.2                | 45.4                       | 1.12      | 2.71       | 10.08                       | 38.67                      | 40.20                | 46.12        |
| 400                | 50.1                | 58.1                       | 1.11      | 2.64       | 10.06                       | 39.13                      | 40.92                | 46.86        |
| 450                | 50.3                | 47.0                       | 1.09      | 2.71       | 10.02                       | 38.73                      | 40.87                | 46.45        |
| 500                | 50.9                | 56.4                       | 1.07      | 2.79       | 9.98                        | 39.46                      | 41.35                | 47.00        |
| 550                | 51.6                | 43.3                       | 1.05      | 2.86       | 9.94                        | 38.71                      | 40.97                | 46.17        |
| 600                | 52.1                | 55.5                       | 1.04      | 2.89       | 9.92                        | 39.51                      | 41.74                | 47.01        |
| 650                | 52.4                | 58.8                       | 1.04      | 2.83       | 9.91                        | 39.13                      | 41.24                | 46.84        |
| 700                | 52.2                | 49.4                       | 1.04      | 2.71       | 9.90                        | 39.41                      | 41.09                | 46.60        |
| 750                | 51.8                | 39.6                       | 1.04      | 2.66       | 9.88                        | 38.37                      | 40.89                | 46.21        |
| 800                | 51.3                | 56.8                       | 1.04      | 2.56       | 9.90                        | 39.19                      | 41.28                | 47.23        |
| 850                | 50.8                | 52.3                       | 1.05      | 2.50       | 9.93                        | 39.01                      | 41.48                | 47.30        |
| 900                | 50.5                | 57.5                       | 1.05      | 2.33       | 9.96                        | 39.47                      | 41.55                | 47.29        |
| 950                | 50.4                | 66.5                       | 1.05      | 2.26       | 10.00                       | 38.54                      | 41.64                | 47.24        |
| 1000               | 50.7                | 66.8                       | 1.05      | 2.10       | 9.99                        | 38.86                      | 41.93                | 47.80        |
| 1050               | 51.2                | 44.3                       | 1.05      | 2.07       | 9.98                        | 38.29                      | 41.10                | 47.88        |
| 1100               | 51.7                | 42.9                       | 1.07      | 2.01       | 9.95                        | 38.39                      | 41.22                | 47.59        |
| 1150               | 51.9                | 43.7                       | 1.08      | 2.01       | 9.99                        | 38.68                      | 41.57                | 48.23        |
| 1200               | 51.7                | 44.0                       | 1.08      | 1.91       | 10.05                       | 39.12                      | 41.22                | 47.92        |
| 1250               | 51.5                | 42.6                       | 1.08      | 1.92       | 10.09                       | 39.50                      | 41.46                | 48.33        |
| 1300               | 51.4                | 52.0                       | 1.07      | 1.85       | 10.06                       | 39.59                      | 41.38                | 48.23        |
| 1350               | 51.6                | 44.4                       | 1.05      | 1.84       | 10.03                       | 39.47                      | 41.41                | 48.23        |
| 1400               | 51.9                | 45.0                       | 1.05      | 1.76       | 10.01                       | 38.70                      | 41.22                | 48.27        |
| 1450               | 52.1                | 43.9                       | 1.07      | 1.70       | 10.02                       | 38.98                      | 41.35                | 48.29        |
| 1500               | 52.1                | 45.3                       | 1.10      | 1.60       | 10.07                       | 38.81                      | 41.11                | 47.90        |
| 1550               | 51.8                | 51.6                       | 1.13      | 1.48       | 10.11                       | 38.97                      | 41.04                | 47.34        |
| 1600               | 51.3                | 50.8                       | 1.15      | 1.41       | 10.13                       | 38.62                      | 40.86                | 47.50        |
| 1650               | 50.7                | 50.5                       | 1.15      | 1.31       | 10.12                       | 38.56                      | 40.99                | 46.69        |
| 1700               | 50.4                | 47.6                       | 1.14      | 1.27       | 10.12                       | 38.35                      | 40.76                | 46.65        |
| 1750               | 50.3                | 45.8                       | 1.13      | 1.23       | 10.11                       | 38.43                      | 40.70                | 46.58        |
| 1800               | 50.8                | 52.9                       | 1.10      | 1.26       | 10.12                       | 38.58                      | 40.86                | 46.89        |
| 1850               | 51.5                | 67.4                       | 1.09      | 1.27       | 10.14                       | 38.77                      | 40.92                | 46.89        |
| 1900               | 52.0                | 47.3                       | 1.14      | 1.41       | 10.17                       | 39.53                      | 41.18                | 47.27        |
| 1950               | 51.4                | 48.5                       | 1.18      | 1.49       | 10.17                       | 39.79                      | 40.99                | 46.89        |
| 2000               | 50.1                | 59.2                       | 1.19      | 1.69       | 10.16                       | 39.84                      | 40.93                | 46.68        |
| 2050               | 48.7                | 47.5                       | 1.16      | 1.64       | 10.20                       | 39.97                      | 41.16                | 47.07        |
| 2100               | 47.6                | 53.4                       | 1.13      | 1.96       | 10.25                       | 39.90                      | 40.98                | 46.20        |
| 2150               | 46.9                | 48.3                       | 1.10      | 1.91       | 10.30                       | 39.21                      | 40.34                | 45.66        |
| 2200               | 46.2                | 57.4                       | 1.08      | 2.38       | 10.35                       | 38.14                      | 39.27                | 45.07        |



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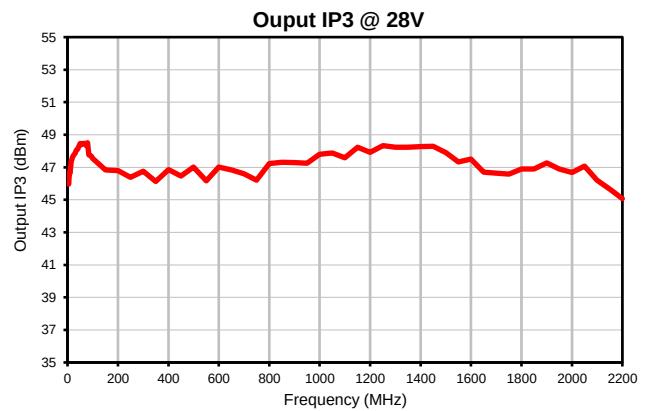
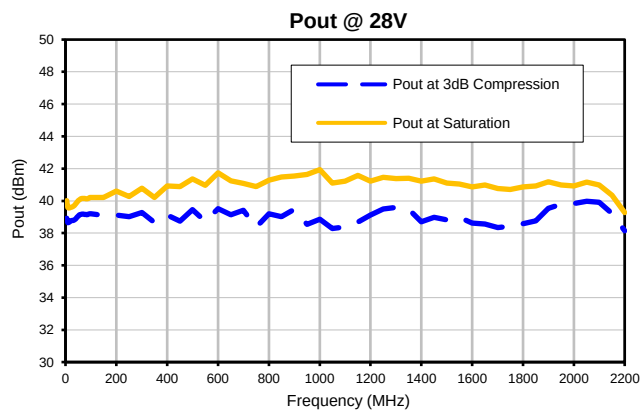
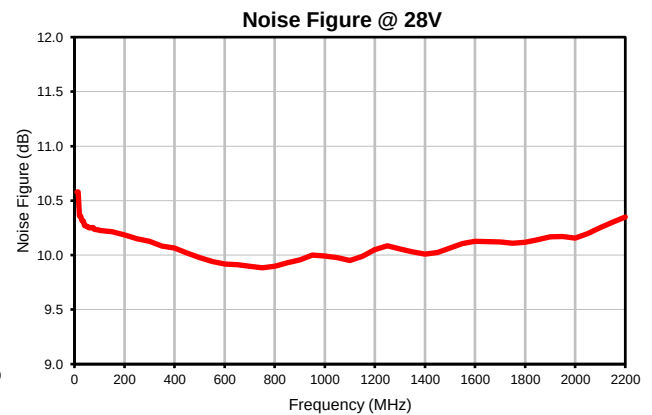
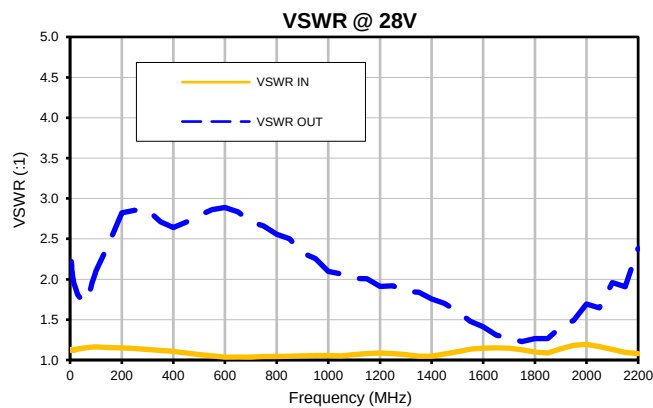
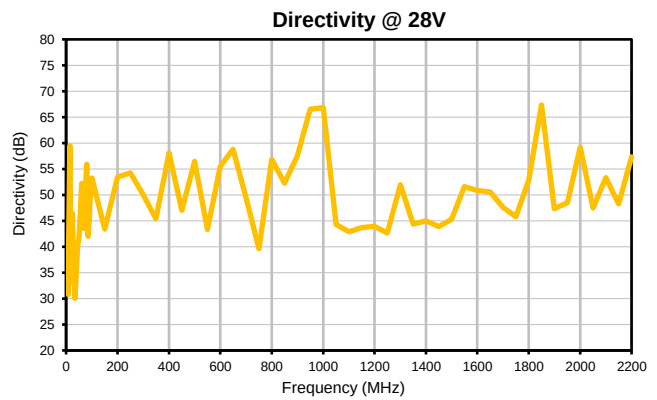
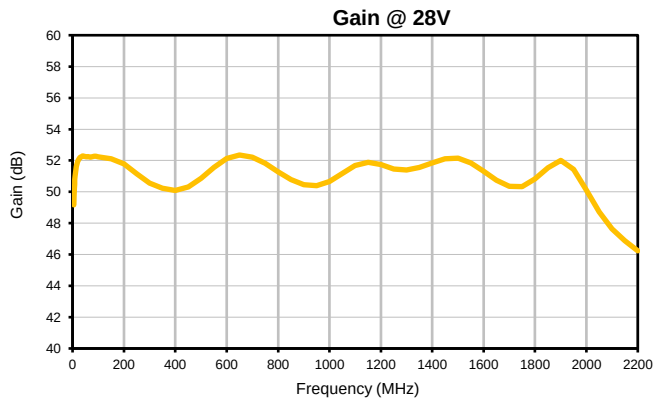
IF/RF MICROWAVE COMPONENTS

REV. OR  
ZHL-5W-202-S+  
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# High Power Amplifier

## Typical Performance Curves

**ZHL-5W-202-S+**



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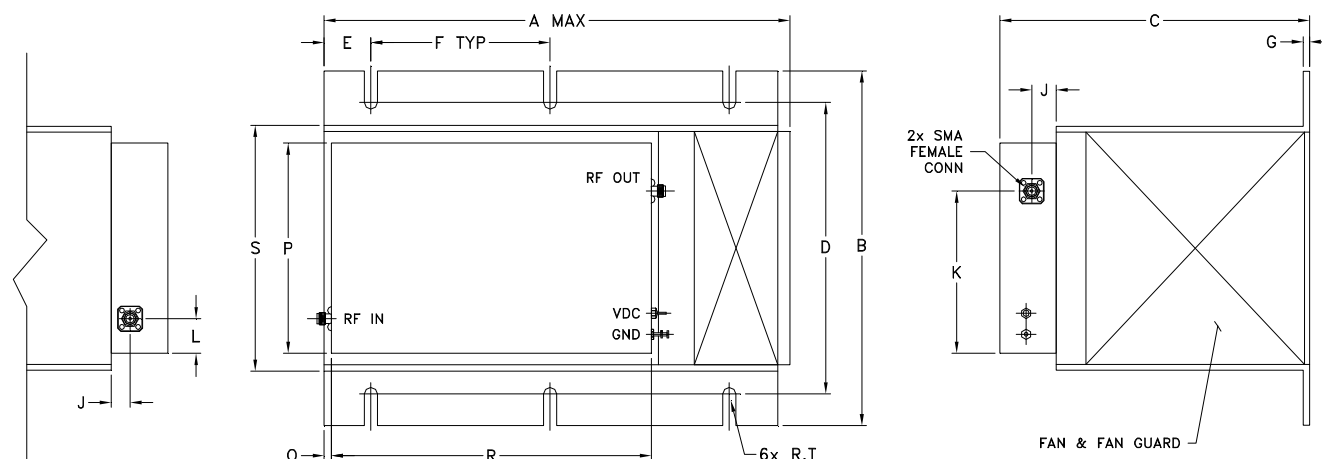


IF/RF MICROWAVE COMPONENTS

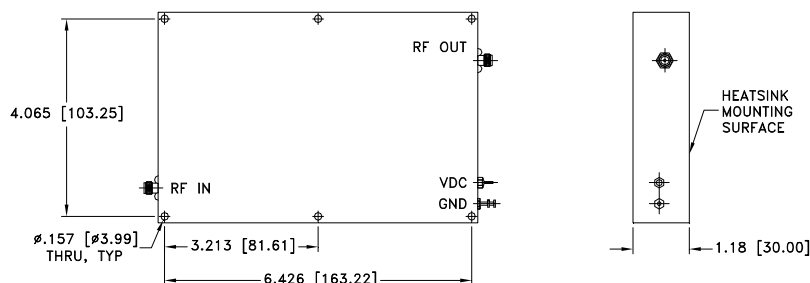


REV. OR  
ZHL-5W-202-S+  
4/19/2019  
Page 1 of 1

### Outline Dimensions



### MOUNTING INFORMATION FOR MODELS WITHOUT HEATSINK



| CASE#    | A                | B               | C               | D                | E              | F               | G             | H | J             | K              | L             | M | N |
|----------|------------------|-----------------|-----------------|------------------|----------------|-----------------|---------------|---|---------------|----------------|---------------|---|---|
| BT1689-1 | 9.85<br>(250.19) | 7.3<br>(185.42) | 6.5<br>(165.10) | 6.00<br>(152.40) | .98<br>(24.89) | 3.75<br>(95.25) | .13<br>(3.30) | - | .47<br>(12.0) | 3.34<br>(84.8) | .71<br>(18.0) | - | - |

| CASE#    | P                | Q            | R                | S               | T              | WT, GRAM | WT WITHOUT HEATSINK, GRAM |
|----------|------------------|--------------|------------------|-----------------|----------------|----------|---------------------------|
| BT1689-1 | 4.33<br>(110.00) | .2<br>(5.08) | 6.69<br>(170.00) | 5.1<br>(129.54) | .136<br>(3.45) | 4565     | 880                       |

Dimensions in inches (mm). Tolerances: 1 Pl.  $\pm .1$ ; 2Pl.  $\pm .03$ ; 3 Pl.  $\pm .015$

### Notes:

- Case material: Aluminum alloy.
- Finish:  
For RoHS Case Styles: Clear Chemical conversion coating, non-chrome or trivalent chrome based.
- Heatsink finish: Black anodize.
- Refer to the individual model data sheet for the type of connectors available.
- Recommended screws for mounting model without heat sink on 3/32" thick sheet: #6-32, 1.50" Length.
- Shape of connector flange may vary.



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RF/IF MICROWAVE COMPONENTS



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 45°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 60° C base plate Temperature | MIL-STD-202, Method 108                            |
| Thermal Shock             | -55° to 100°C, 5 cycles                              | MIL-STD-202, Method 107, Condition A, except 100°C |