COAXIAL

# Low Noise Amplifier ZX60-10203LN+

50Ω 12.5 to 20 GHz SMA Female

## KEY FEATURES

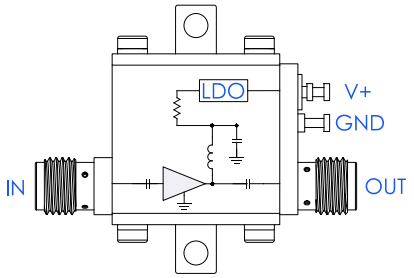
- Low Noise Figure, Typ. 1.9 dB from 12.5 GHz to 20 GHz
- High Output IP3, +24 dBm Typ.
- High Output P1dB, +17 dBm Typ.
- Voltage Regulated Internally and Reverse Voltage Protected
- Ideal Evaluation Module for PMA3-10203+

*Generic photo used for illustration purposes only*

## APPLICATIONS

- Test & Measurement Equipment
- Back Haul Radio Systems
- Radar, EW, and ECM Defense Systems
- Satellite Systems

## FUNCTIONAL DIAGRAM




## PRODUCT OVERVIEW

Mini-Circuits' ZX60-10203LN+ is a low noise amplifier utilizing MCL's own pHEMT-based amplifier, PMA3-10203+. Operating from 12.5 to 20 GHz, this amplifier features high dynamic range with typical 1.9 dB noise figure, 20 dB gain, +17 dBm P1dB, and +24 dBm OIP3. This combination of characteristics makes it ideal for sensitive, high dynamic range receiver applications. The ZX60-10203LN+ operates on a single +6 V supply at 58 mA and comes in a rugged, compact unibody case (0.74 × 0.75 × 0.46") with integrated SMA female connectors, making it an excellent candidate for demanding operating conditions and crowded system layouts.

## ELECTRICAL SPECIFICATIONS AT +25 °C BASEPLATE AND $V_S$ = +6 V, UNLESS NOTED OTHERWISE

| Parameter | Frequency (GHz) | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Frequency Range | | 12.5 | | 20 | GHz |
| Gain | 12.5 | 16.8 | 20.3 | – | dB |
| | 14 | 16.5 | 20.0 | – | |
| | 16 | 18.3 | 21.4 | – | |
| | 18 | 17.0 | 20.1 | – | |
| | 20 | 14.7 | 18.1 | – | |
| Input Return Loss | 12.5 | – | 15.5 | – | dB |
| | 14 | – | 7.1 | – | |
| | 16 | – | 5.5 | – | |
| | 18 | – | 10.1 | – | |
| | 20 | – | 7.2 | – | |
| Output Return Loss | 12.5 | – | 23.2 | – | dB |
| | 14 | – | 10.0 | – | |
| | 16 | – | 15.7 | – | |
| | 18 | – | 13.3 | – | |
| | 20 | – | 11.9 | – | |
| Directivity | 12.5–20 | – | 28 | – | dB |

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## ELECTRICAL SPECIFICATIONS AT +25 °C BASEPLATE AND $V_S$ = +6 V, UNLESS NOTED OTHERWISE

| Parameter | Frequency (GHz) | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Output Power at 1 dB Compression (P1dB) | 12.5 | – | +16.9 | – | dBm |
| | 14 | – | +17.1 | – | |
| | 16 | – | +17.0 | – | |
| | 18 | – | +17.4 | – | |
| | 20 | – | +16.3 | – | |
| Output Third Order Intercept Point (Output Power = +5 dBm/Tone) | 12.5 | – | +24.1 | – | dBm |
| | 14 | – | +25.0 | – | |
| | 16 | – | +24.1 | – | |
| | 18 | – | +22.8 | – | |
| | 20 | – | +20.6 | – | |
| Noise Figure | 12.5 | – | 2.1 | – | dB |
| | 14 | – | 1.7 | – | |
| | 16 | – | 1.8 | – | |
| | 18 | – | 2.1 | – | |
| | 20 | – | 2.8 | – | |
| DC Supply Voltage ($V_S$) | – | +5.6 | +6 | +10 | V |
| DC Current[1] | – | – | 58 | 95 | mA |

1. Typical current measured under small signal conditions. Max DC current measured at $P_{SAT}$. DC current increases as amplifier is driven into compression.

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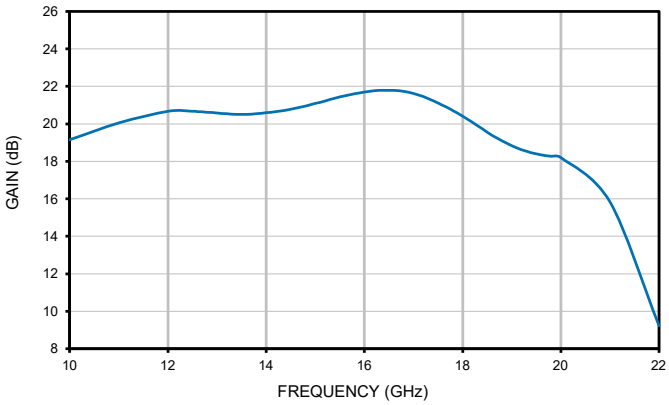
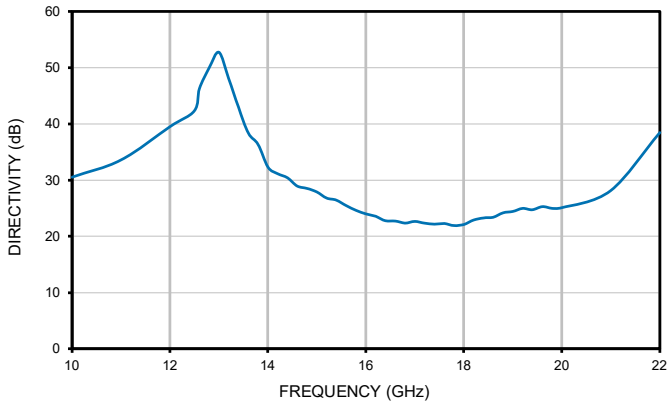
## TYPICAL PERFORMANCE GRAPHS

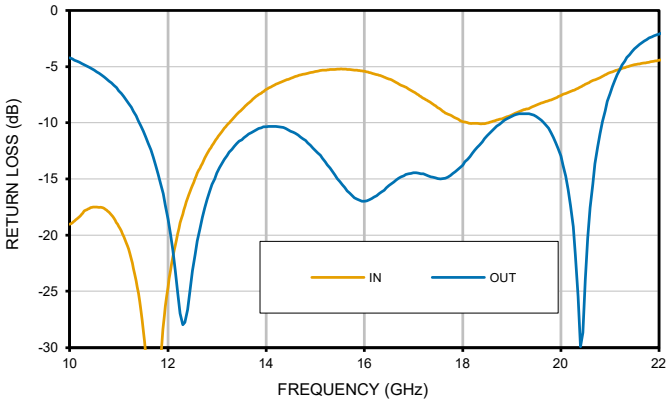
### GAIN



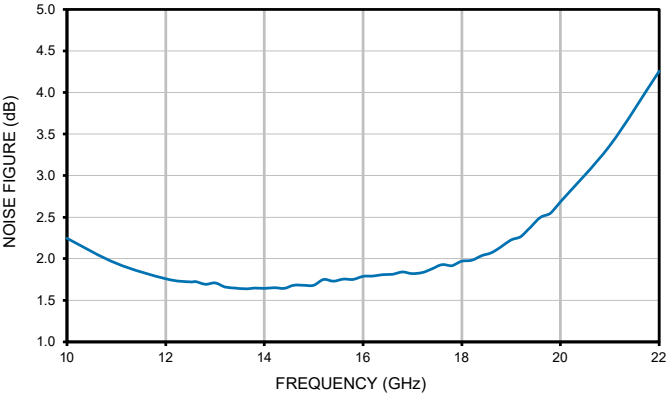

### DIRECTIVITY



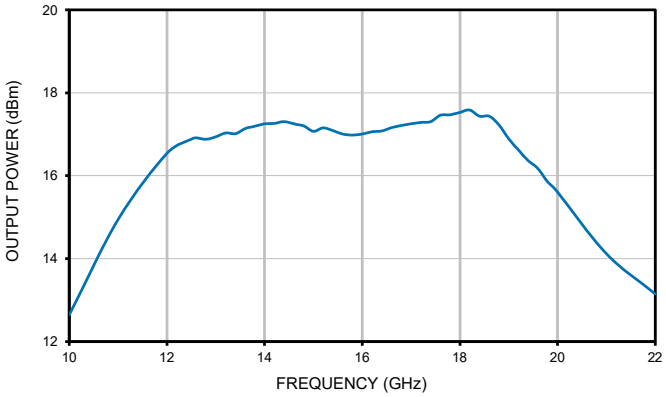

### RETURN LOSS



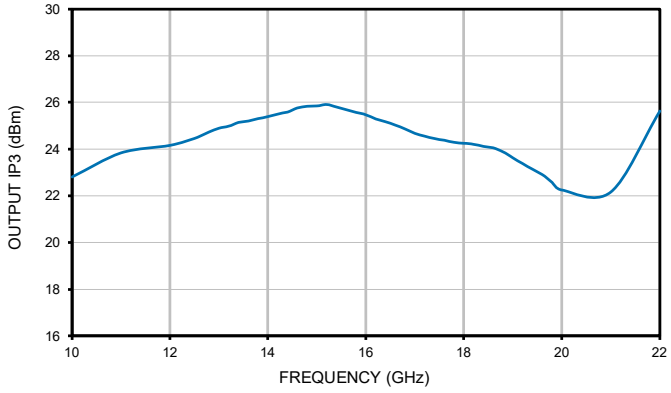

### NOISE FIGURE




### OUTPUT POWER AT 1dB COMPRESSION




### OUTPUT IP3



## ABSOLUTE MAXIMUM RATINGS[2,3]

| Parameter | Ratings |
|---|---|
| Operating Temperature (Case) | -40 °C to +85 °C |
| Storage Temperature | -55 °C to +100 °C |
| Total Power Dissipation[4] | 1 W |
| RF Input Power (CW) | +13 dBm |
| DC Operating Voltage ($V_S$) | +10.5 V |

2. Specified under matched load to 50Ω.
3. Continuous operation is not recommended at these extremes. Permanent damage may occur if any of these limits are exceeded.
4. Total power dissipation determined at $V_S$ = +10.5 V with the amplifier operating in max DC Current conditions.

## DETERMINING MAXIMUM THERMAL RESISTANCE OF USERS' EXTERNAL HEATSINK

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

| | |
|---|---|
| **Example:** | MAXIMUM OPERATING CASE TEMP = +50 °C (CHECK MAXIMUM RATINGS TABLE FOR THIS VALUE)<br>MAXIMUM USER AMBIENT TEMP = +30 °C (USER DEFINED)<br>POWER DISSIPATION = 10 WATTS (CHECK MAXIMUM RATINGS TABLE FOR THIS VALUE)<br>THEN MAXIMUM ALLOWABLE THERMAL RESISTANCE = 2 °C/W |

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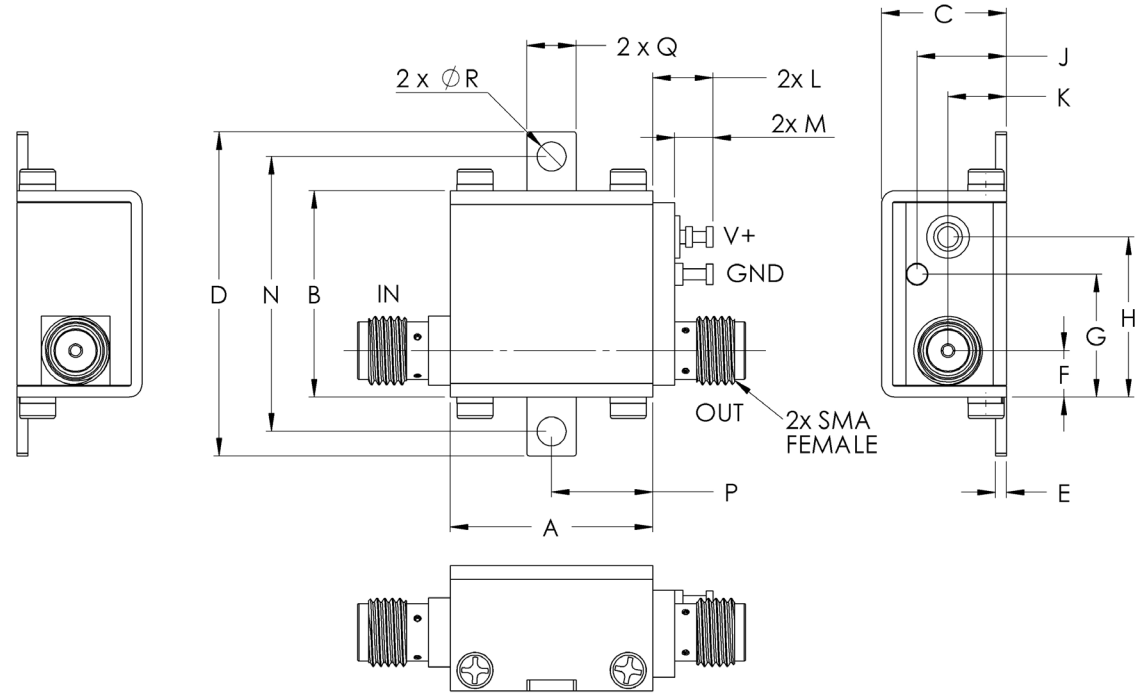
## CASE STYLE DRAWING




⚠ NOTE: When soldering the DC connections, caution must be used to avoid overheating the DC terminal. See Application Note AN-40-010.

## OUTLINE DIMENSIONS ( Inch / mm )

| A | B | C | D | E | F | G | H | J | K | L | M | N | P | Q | R | wt |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| .74 | .75 | .46 | 1.18 | .04 | .17 | .45 | .59 | .33 | .21 | .22 | .14 | 1.00 | .37 | .18 | .106 | grams |
| 18.80 | 19.15 | 11.61 | 30.07 | 1.02 | 4.32 | 11.40 | 14.86 | 8.31 | 5.44 | 5.59 | 3.56 | 25.4 | 9.40 | 4.57 | 2.69 | 23.0 |

# Low Noise Amplifier ZX60-10203LN+

50Ω 12.5 to 20 GHz SMA Female

## ADDITIONAL INFORMATION IS AVAILABLE ON OUR DASHBOARD.

| | |
|---|---|
| **Performance Data & Graphs** | Data<br>Graphs<br>S-Parameter (S2P Files) Data Set (.zip file) |
| **RoHS Status** | Compliant |
| **Environmental Ratings** | ENV23T10 |
| **Export Information** | ECCN# EAR99 |

## ORDERING INFORMATION

| | |
|---|---|
| **Model No. Link** | ZX60-10203LN+ |
| **Case Style** | GC957 |
| **Connector** | IN: SMA Female<br>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-Circuits' 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

# Coaxial Amplifier ZX60-10203LN+

## *Typical Performance Data*

**Definitions:**
Input Return Loss = -S11 (dB)
Gain(Power Gain) = S21 (dB)
Reverse Isolation = -S12 (dB)
Output Return Loss = -S22 (dB)

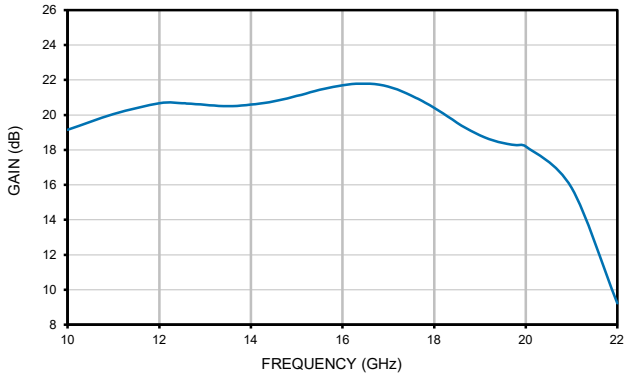
TEST CONDITIONS: Vd = 6V, Id = 58mA @ Temperature = +25°C

| FREQUENCY | GAIN | DIRECTIVITY | RETURN LOSS (dB) | | STABILITY | | Pout @ 1 dB COMPRESSION | NOISE FIGURE | OIP3 |
|---|---|---|---|---|---|---|---|---|---|
| (GHz) | (dB) | (dB) | IN | OUT | K | Measure | (dBm) | (dB) | (dBm) |
| 10.0 | 19.2 | 30.5 | 19.0 | 4.2 | 10.3 | 0.63 | 12.6 | 2.2 | 22.8 |
| 11.0 | 20.1 | 33.6 | 19.2 | 7.2 | 19.1 | 0.82 | 15.0 | 1.9 | 23.8 |
| 12.0 | 20.7 | 39.5 | 24.6 | 18.6 | 46.5 | 0.99 | 16.5 | 1.8 | 24.2 |
| 12.5 | 20.7 | 42.3 | 15.6 | 23.2 | 63.3 | 1.02 | 16.9 | 1.7 | 24.5 |
| 12.6 | 20.7 | 46.3 | 14.5 | 20.5 | 98.7 | 1.03 | 16.9 | 1.7 | 24.5 |
| 12.8 | 20.6 | 49.9 | 12.7 | 16.8 | 145.3 | 1.03 | 16.9 | 1.7 | 24.7 |
| 13.0 | 20.6 | 52.7 | 11.4 | 14.5 | 193.2 | 1.04 | 16.9 | 1.7 | 24.9 |
| 13.2 | 20.5 | 48.1 | 10.2 | 12.9 | 108.9 | 1.04 | 17.0 | 1.7 | 25.0 |
| 13.4 | 20.5 | 43.0 | 9.3 | 11.9 | 57.8 | 1.05 | 17.0 | 1.6 | 25.1 |
| 13.6 | 20.5 | 38.3 | 8.4 | 11.2 | 32.5 | 1.06 | 17.1 | 1.6 | 25.2 |
| 13.8 | 20.5 | 36.3 | 7.6 | 10.6 | 24.7 | 1.07 | 17.2 | 1.6 | 25.3 |
| 14.0 | 20.6 | 32.3 | 7.0 | 10.3 | 15.0 | 1.09 | 17.3 | 1.6 | 25.4 |
| 14.2 | 20.6 | 31.1 | 6.6 | 10.3 | 12.7 | 1.11 | 17.3 | 1.7 | 25.5 |
| 14.4 | 20.7 | 30.4 | 6.2 | 10.5 | 11.5 | 1.13 | 17.3 | 1.6 | 25.6 |
| 14.6 | 20.8 | 28.9 | 5.9 | 11.0 | 9.5 | 1.16 | 17.3 | 1.7 | 25.8 |
| 14.8 | 21.0 | 28.5 | 5.6 | 11.6 | 9.1 | 1.18 | 17.2 | 1.7 | 25.8 |
| 15.0 | 21.1 | 27.9 | 5.5 | 12.5 | 8.4 | 1.21 | 17.1 | 1.7 | 25.8 |
| 15.2 | 21.2 | 26.8 | 5.3 | 13.5 | 7.5 | 1.23 | 17.2 | 1.8 | 25.9 |
| 15.4 | 21.4 | 26.5 | 5.3 | 14.6 | 7.2 | 1.25 | 17.1 | 1.7 | 25.8 |
| 15.6 | 21.5 | 25.4 | 5.2 | 15.8 | 6.4 | 1.26 | 17.0 | 1.8 | 25.7 |
| 15.8 | 21.6 | 24.6 | 5.3 | 16.7 | 5.9 | 1.26 | 17.0 | 1.8 | 25.6 |
| 16.0 | 21.7 | 24.0 | 5.4 | 17.0 | 5.6 | 1.26 | 17.0 | 1.8 | 25.5 |
| 16.2 | 21.8 | 23.5 | 5.7 | 16.6 | 5.4 | 1.24 | 17.1 | 1.8 | 25.3 |
| 16.4 | 21.8 | 22.8 | 5.9 | 16.0 | 5.0 | 1.22 | 17.1 | 1.8 | 25.2 |
| 16.6 | 21.8 | 22.7 | 6.3 | 15.3 | 5.1 | 1.19 | 17.2 | 1.8 | 25.0 |
| 16.8 | 21.7 | 22.4 | 6.8 | 14.7 | 5.1 | 1.16 | 17.2 | 1.8 | 24.9 |
| 17.0 | 21.6 | 22.6 | 7.2 | 14.5 | 5.4 | 1.14 | 17.3 | 1.8 | 24.7 |
| 17.2 | 21.5 | 22.4 | 7.8 | 14.5 | 5.4 | 1.11 | 17.3 | 1.8 | 24.6 |
| 17.4 | 21.2 | 22.2 | 8.4 | 14.9 | 5.4 | 1.10 | 17.3 | 1.9 | 24.5 |
| 17.6 | 21.0 | 22.3 | 9.0 | 15.0 | 5.6 | 1.08 | 17.5 | 1.9 | 24.4 |
| 17.8 | 20.7 | 21.9 | 9.4 | 14.5 | 5.4 | 1.06 | 17.5 | 1.9 | 24.3 |
| 18.0 | 20.4 | 22.1 | 9.9 | 13.8 | 5.6 | 1.04 | 17.5 | 2.0 | 24.3 |
| 18.2 | 20.1 | 22.9 | 10.1 | 12.7 | 6.1 | 1.02 | 17.6 | 2.0 | 24.2 |
| 18.4 | 19.7 | 23.3 | 10.1 | 11.7 | 6.2 | 1.01 | 17.4 | 2.0 | 24.1 |
| 18.6 | 19.4 | 23.4 | 9.9 | 10.7 | 6.2 | 0.99 | 17.4 | 2.1 | 24.1 |
| 18.8 | 19.1 | 24.2 | 9.6 | 10.0 | 6.6 | 0.98 | 17.2 | 2.1 | 23.9 |
| 19.0 | 18.8 | 24.4 | 9.3 | 9.4 | 6.6 | 0.98 | 16.9 | 2.2 | 23.6 |
| 19.2 | 18.6 | 24.9 | 8.9 | 9.2 | 6.9 | 0.98 | 16.6 | 2.3 | 23.4 |
| 19.4 | 18.5 | 24.7 | 8.6 | 9.3 | 6.7 | 0.99 | 16.4 | 2.4 | 23.1 |
| 19.6 | 18.3 | 25.3 | 8.3 | 9.8 | 7.1 | 1.02 | 16.2 | 2.5 | 22.9 |
| 19.8 | 18.3 | 25.0 | 8.0 | 10.9 | 6.9 | 1.06 | 15.8 | 2.5 | 22.6 |
| 20.0 | 18.2 | 25.1 | 7.6 | 12.9 | 7.1 | 1.11 | 15.6 | 2.7 | 22.3 |
| 21.0 | 15.8 | 28.1 | 5.5 | 7.4 | 7.8 | 1.03 | 14.1 | 3.4 | 22.2 |
| 22.0 | 9.2 | 38.5 | 4.5 | 2.1 | 10.8 | 0.51 | 13.2 | 4.3 | 25.6 |

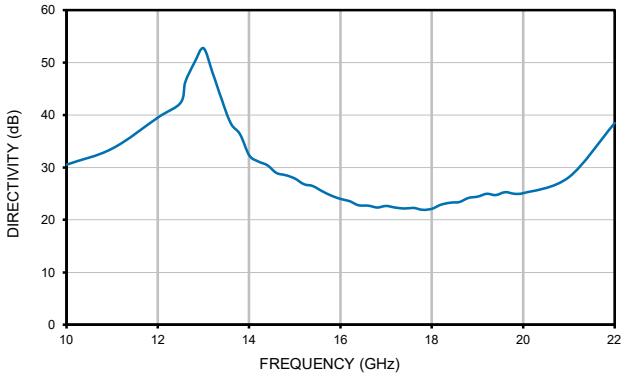
# Coaxial Amplifier ZX60-10203LN+

## *Typical Performance Curves*

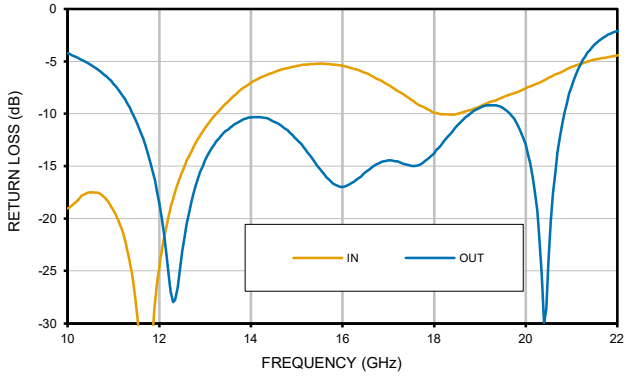
### GAIN



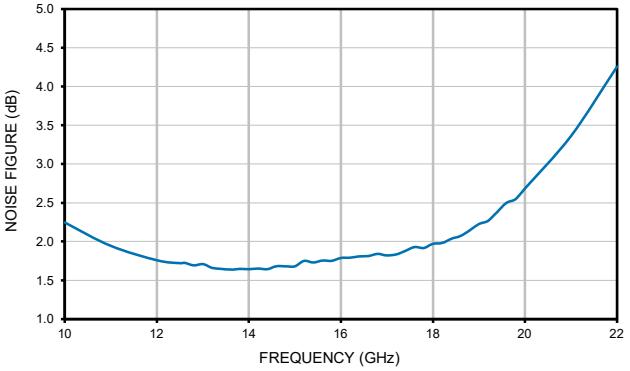

### DIRECTIVITY



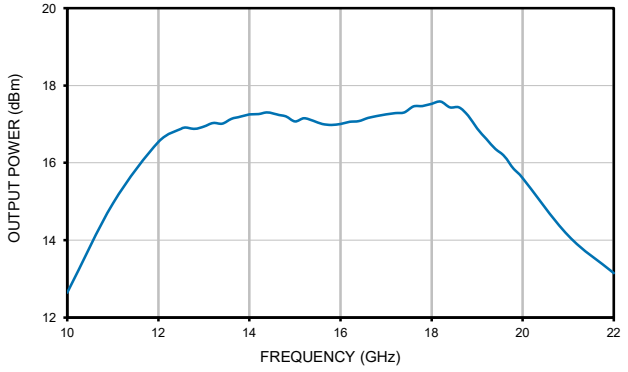

### RETURN LOSS



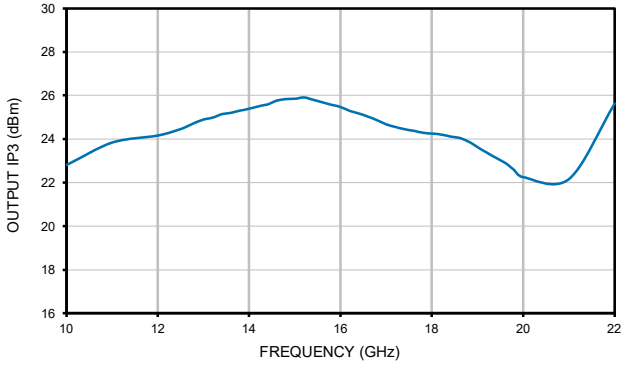

### NOISE FIGURE




### OUTPUT POWER AT 1dB COMPRESSION



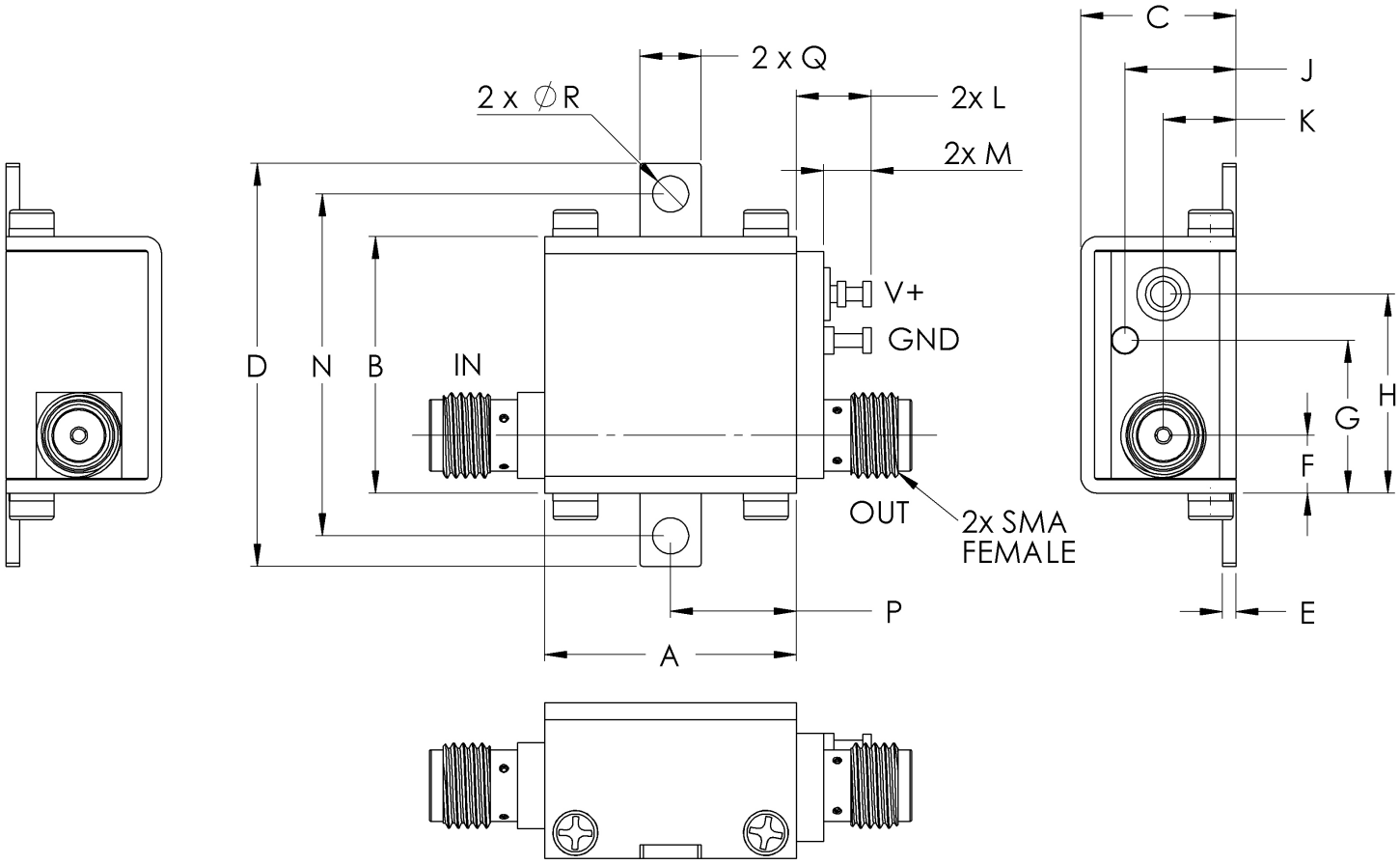

### OUTPUT IP3



# Case Style GC

## Outline Dimensions

GC957




| CASE #. | A | B | C | D | E | F | G | H | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GC957 | .74 (18.80) | .75 (19.15) | .46 (11.61) | 1.18 (30.07) | .04 (1.02) | .17 (4.32) | .45 (11.40) | .59 (14.86) | .33 (8.31) | .21 (5.44) | .22 (5.59) | .14 (3.56) | 1.00 (25.4) |

| CASE #. | P | Q | R | WT GRAMS |
|---|---|---|---|---|
| GC957 | .37 (9.40) | .18 (4.57) | .106 (2.69) | 23.0 |

**Dimensions are in inches (mm). Tolerances: 2Pl. ± .03; 3Pl. ± .015**
**Tolerance on hole size and interaxes dimensions to be ± .005.**

**Note:**

1. Case material: Brass
2. Case finish: Nickel plate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Mini-Circuits

# Environmental Specifications ENV23T10

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 | -40° to 85° C<br>Case Temperature | 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 |