# AMPLIFIER, BROADBAND GAIN BLOCK, 0.1 – 4.0 GHz

**Part Numbers:** KA121

## Preliminary Data Sheet

KA121 is a InGaP HBT gain block amplifier in a 4-lead Micro-X Hermetic Surface-Mount Technology (SMT) package for Harsh Environments including Defense and Satellite application. This device can be ordered with the 100% screening requirements of MIL-PRF-38535 Class C, B and S.

## Features

- Broadband Frequency Range:
  100 MHz to 4.0 GHz
- Consistent Gain Across Entire Band

## Applications

- Microwave Radios
- Military Radios
- VSAT
- Telecom Infrastructure
- Test Equipment

## Revision History

| Revision | Description | Release Date |
|---|---|---|
| 1.0 | | 4/23/2021 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

## Table of Contents

## List of Figures



## List of Tables

## 1.0 Electrical Characteristics

*(VCC = +5V, TOP = +25 °C, PIN = = -20 dBm, Z0 = 50 Ω)*

| Table 1. Electrical Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Condition** | **Min** | **Typical** | **Max** | **Units** |
| Gain | \|S21\| | 0.1-1.0GHz | 14.5 | 15.7 | | dB |
| | | 1.0-2.0GHz | 14 | 15.3 | | dB |
| | | 2.0-3.0GHz | 13 | 14.2 | | dB |
| | | 3.0-4.0GHz | 13 | 13.7 | | dB |
| Input Return Loss | \|S11\| | 0.1-1.0GHz | 16 | 20.5 | | dB |
| | | 1.0-2.0GHz | 8 | 13.5 | | dB |
| | | 2.0-3.0GHz | 7 | 8.5 | | dB |
| | | 3.0-4.0GHz | 8 | 11.0 | | dB |
| Output Return Loss | \|S22\| | 0.1-1.0GHz | 16 | 19.5 | | dB |
| | | 1.0-2.0GHz | 10 | 16.5 | | dB |
| | | 2.0-3.0GHz | 8 | 13.5 | | dB |
| | | 3.0-4.0GHz | 10 | 15.5 | | dB |
| Supply Current | $I_{CC}$ | 0.1-4.0GHz | | 55 | | mA |

1/ Performance is guaranteed only under the conditions listed in Table 1

2/ See plots for more details

## 2.0 Dynamic Operating Characteristics

*(VCC = 5 V, TOP = -40 TO 85 °C, PIN = -20 dBm, Z0 = 50 Ω)*

| Table 2. Dynamic Operating Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Symbol** | **Test Condition** | **Min** | **Typical** | **Max** | **Units** |
| 1 dB Output Compression Point | OP1dB | 100 MHz<br>1.0 GHz<br>2.0 GHz<br>4.0 GHz | 10<br>13<br>12<br>6 | 13.2<br>14.5<br>12.7<br>7.7 | | dBm<br>dBm<br>dBm<br>dBm |
| Output 3rd Order Interception Point | OIP3 | 100 MHz<br>1.0 GHz<br>2.0 GHz<br>4.0 GHz | 27<br>28<br>24<br>14 | 31.6<br>30.0<br>25.9<br>16.4 | | dBm<br>dBm<br>dBm<br>dBm |
| Noise Figure | NF | 0.1 – 2.0 GHz<br>2.0 – 4.0 GHz | | 5.5<br>6.2 | 7.6<br>8.5 | dB |

## 3.0 Absolute Maximum Ratings

| Table 3. Absolute Maximum Ratings | | | | |
|---|---|---|---|---|
| **Parameter** | **Symbol** | **Min** | **Max** | **Units** |
| Collector Bias Voltage | $V_{CC}$ | 0 | +5.7 | V |
| RF Input Power ($V_{CTL}$ > 0.9GHz) 1/ | $P_{IN}$ | | +10.0 | dBm |
| Operating Temperature | $T_{OP}$ | 50 | +85 | °C |
| Thermal Resistance | $Z_T$ | | 165 | °C/W |
| Storage Temperature | $T_{ST}$ | -65 | 15- | °C |
| Dissipated Power (Continuous) | | | 0.35 | W |

1/ Maximum power for junction temperature to remain below maximum in worst-case conditions

Note: Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to the device with only one parameter set at the limit and all other parameters set at or below their nominal value.

Caution: Class 1A (HBM 250V) Electrostatic Sensitive Device. Proper ESD precaution should be used when handling device.

## 4.0 Plots

*(VCC = 5V, PIN = -20 dBm, Z0 = 50 Ω)*

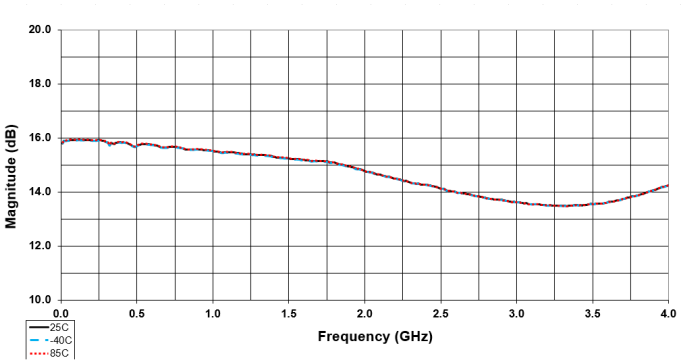



**Figure 1. Gain Over Temperature**

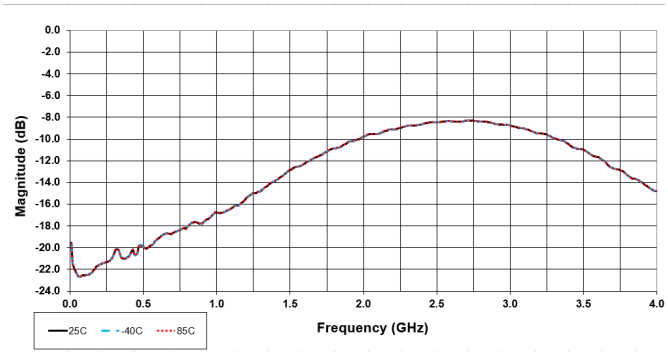



**Figure 2. Input Return Loss Over Temperature**

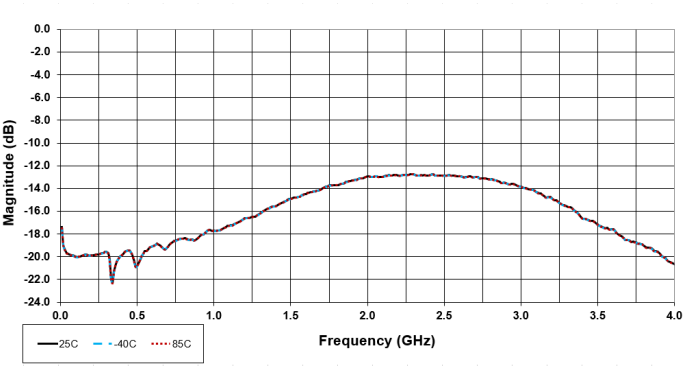



**Figure 3. Output Return Loss Over Temperature**

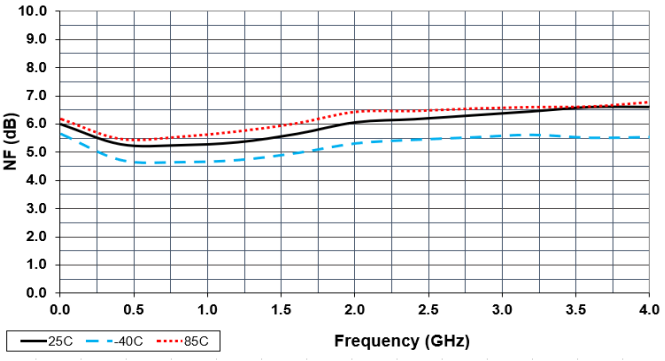



**Figure 4. Noise Figure Over Temperature**

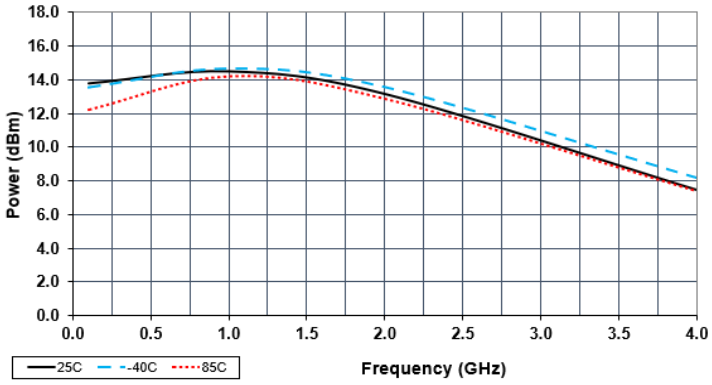



**Figure 5. OP1DB Over Temperature**

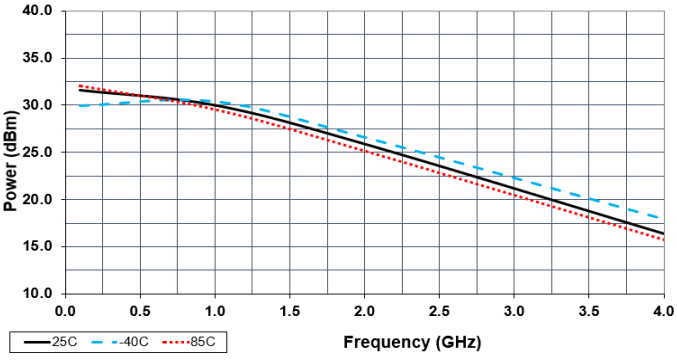



**Figure 6. OIP3 Over Temperature**

## 5.0 Test Fixture

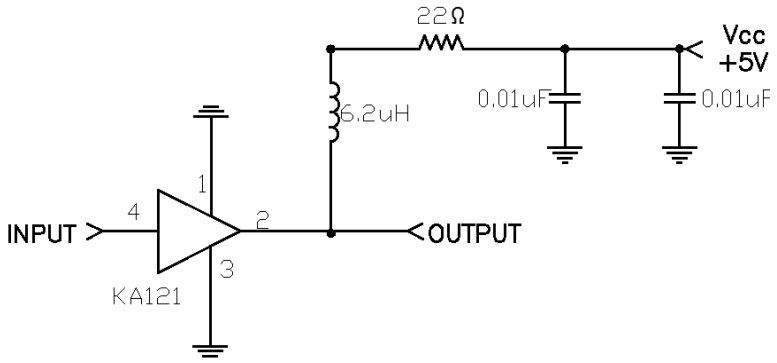



**Figure 7. Test Fixture Schematic**

1. $R_{BIAS}$ set to 22Ω to achieve typical supply current of 55mA.
2. Modify $R_{BIAS}$ to achieve supply current sufficient for higher power.
3. Broadband conical inductor (PN CC82T44K240G5-C or equivalent) used for optimal performance.
4. DC blocks must be used (PN BLK-89-S+ or equivalent) on RF Input and Output

## 6.0 Solder Layout

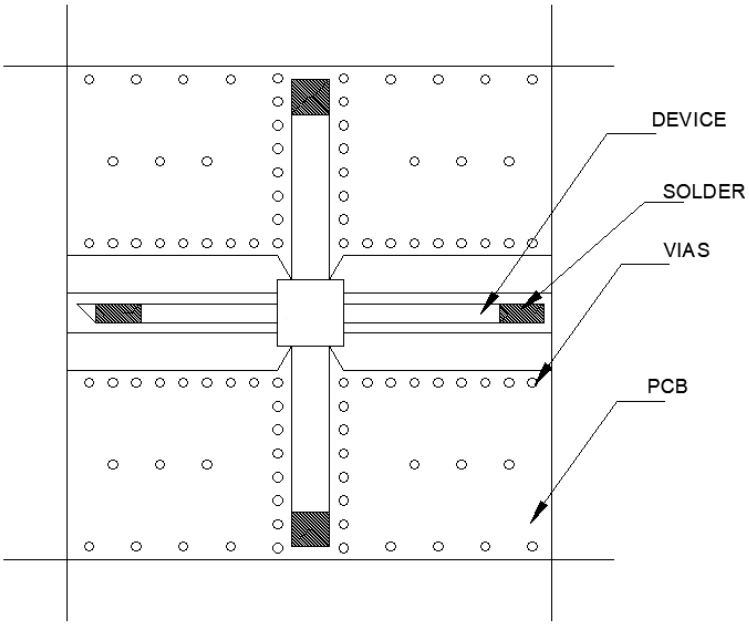
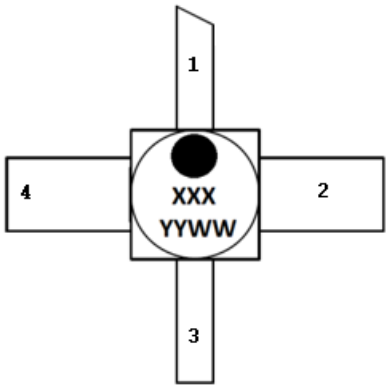



**Figure 8. Solder Layout**

1. Ports 2 and 4 soldered to ground plane
2. Contact Micross Hi-Rel RF Solutions for further guidance on device placement and attachment

## 7.0 Device Marking/Pin Out




*XXX = Serial # Will be Added for Class B and S Part #s*

**Figure 9. Device Marking/Pin Out**

Package:

- Lid: ASTM F 15 Alloy
- Base/Walls: Alumina
- Lid/Bottom Finish: Gold over Nickel
-

Additional

- Maximum reflow temperature: 265°C for 90 seconds maximum

| Table 4. Pin Layout | |
|---|---|
| **Pin** | **Designation** |
| 1 | RF Input |
| 2 | GND |
| 3 | RF Output |
| 4 | GND |

## 8.0 Tape and Reel

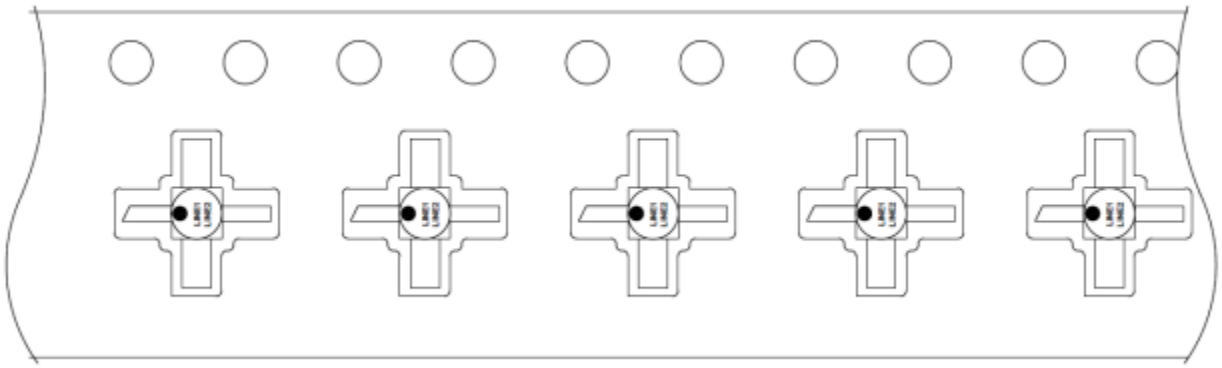


**Figure 10. Tape and Reel**

W: 12mm
P0: 4mm
P1: 8mm
P2: 2mm

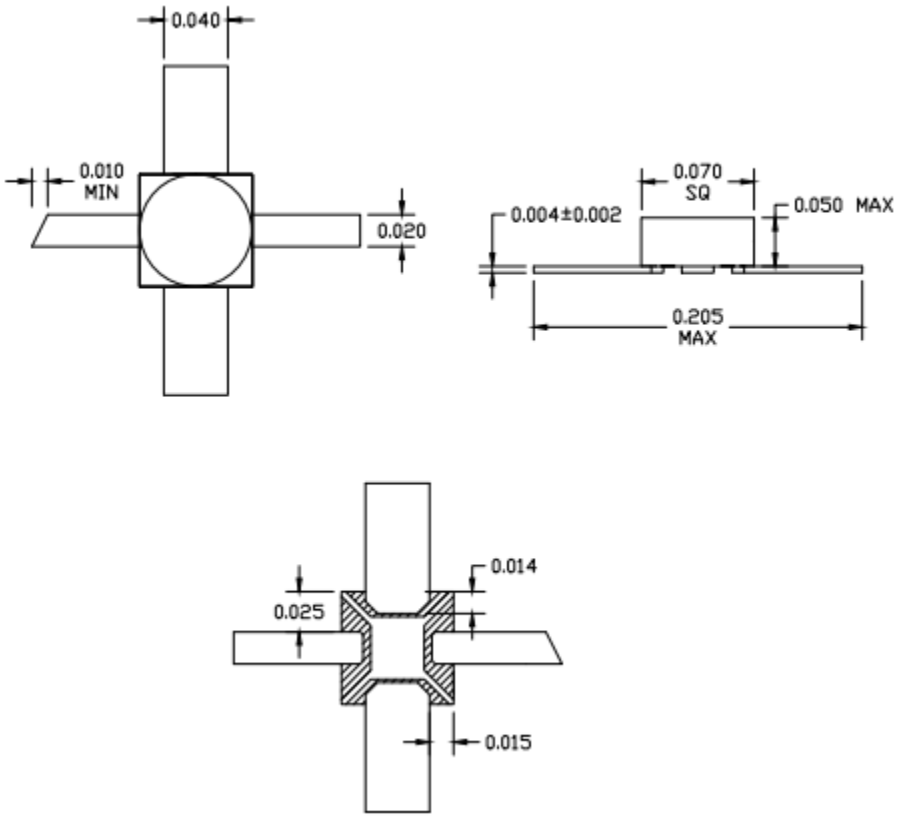



**Figure 11. Outline**

Dimensions are in inches

## 9.0 Screening Flow

| Table 5. Screening Flow | | | | |
|---|---|---|---|---|
| **Test Inspection** | **MIL-STD-883** | | **Requirement** | |
| | Method | Condition | Class B | Class S |
| Wafer Lot Acceptance /1 | 5007 | | N/A | Per Wafer Lot |
| Non-Destructive Bond Pull | 2023 | | SPC | SPC |
| Internal Visual | 2010 | A = Class S, B = Class B | 100% | 100% |
| Temperature Cycle | 1010 | C | 100% | 100% |
| Acceleration | 2001 | E (Y1 Only) | 100% | 100% |
| PIND | 2020 | A (5 Cycles) | N/A | 100% |
| Serialization | Per Product Specification | | 100% | 100% |
| Radiographic | 2012 | 2 Views | N/A | 100% |
| Electrical Test | Small Signal Testing | +25°C | 100% | 100% |
| Burn In | 1015 | A | 100%/160 Hours/85°C | 100%/240 Hours/85°C |
| Final Electrical | Small Signal Testing | +25°C | 100% | 100% |
| PDA Calculation | 5004 | 25% Δ Gain / 10% Δ $I_{CC}$ | 5% | 5%/3% Functional |
| Group A Electrical /5 | Per Product Specification | -40°C + 85°C | 45/0 | 45/0 |
| Leak Test | 1014 A and C | 1 x 10 -8 Max | 100% | 100% |
| External Visual | 2009 | | 100% | 100% |

1/ Product under configuration control per Micross QAP 015.

2/ Customer will be notified of all class 1 changes for Class B and S part numbers.

3/ Wafer Lot Acceptance will include 100% die visual, SEM analysis and Lot Traceability.

4/ Electrical Test Data will be recorded for each serial number and included in Final Test Report for all Class S part numbers.

5/ Group A Electrical testing will include the Small Signal at the Min/Max operating condition. The Dynamic test (P1dB, IP3, NF) will be tested at +25c only.

## 10.0 Order Information

| Table 6. Ordering Information | | | |
|---|---|---|---|
| **Part Number** | **Upscreened** | **Class B** | **Class S** |
| # | KA121C | KA121B | KA121S |