

Ultra High Dynamic Range

# Monolithic Amplifier

PHA-202+

50Ω 0.03 to 2.7 GHz

## The Big Deal

- Ultra High IP3, +46.1 dBm
- Broadband High Dynamic Range without external Matching Components
- Medium power, 1W
- Excellent return loss over 15 dB



CASE STYLE: DL1636

## Product Overview

The PHA-202+ (RoHS compliant) is a medium power amplifier fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the PHA-202+ has good input and output return loss over a broad frequency range without the need for external matching components and has demonstrated excellent reliability. It has repeatable performance from lot to lot and is enclosed in a 5mm x 6mm, 8 lead package for very good thermal performance.

## Key Features

| Feature  | Advantages  |
|--|---|
| Broad Band: 0.03 to 2.7 GHz  | Broadband covering primary wireless communications bands:<br>Cellular, PCS, LTE   |
| Extremely High IP3<br>Versus DC power Consumption<br>46 dBm typical at 1.0 GHz | The PHA-202+ matches industry leading IP3 performance relative to device size and power consumption. The combination of the design and E-PHEMT Structure provides enhanced linearity over a broad frequency range as evidence in the IP3 being typically 14-23 dB above the P1dB point. This feature makes this amplifier ideal for use in: <ul style="list-style-type: none"><li>• Driver amplifiers for complex waveform up converter paths</li><li>• Drivers in linearized transmit systems</li><li>• Secondary amplifiers in ultra High Dynamic range receivers</li></ul> |
| No External Matching Components Required                                       | Unlike competing products, Mini-Circuits PHA-202+ provides Input and Output Return Loss of over 15 dB up to 2 GHz without the need for any external matching components   |



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# Monolithic Amplifier

0.03-2.7 GHz

## Product Features

- High IP3, 46.1 dBm typ. at 1 GHz
- Gain, 17.0 dB typ. at 1 GHz
- High Pout, P1dB 30.4 dBm typ. at 1 GHz
- No external matching components required



Generic photo used for illustration purposes only

CASE STYLE: DL1636

## PHA-202+

**+RoHS Compliant**

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

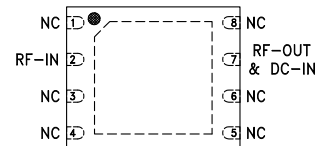
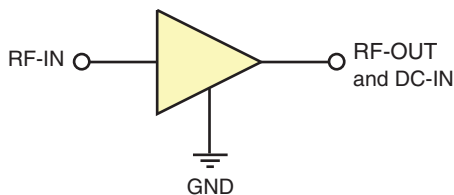
## Typical Applications

- Base station infrastructure
- CATV
- LTE

## General Description

The PHA-202+ (RoHS compliant) is a medium power amplifier fabricated using E-PHEMT technology and offers extremely high dynamic range over a broad frequency range and with low noise figure. In addition, the PHA-202+ has good input and output return loss over a broad frequency range without the need for external matching components and has demonstrated excellent reliability. It has repeatable performance from lot to lot and is enclosed in a 5mm x 6mm, 8 lead package for very good thermal performance.

### simplified schematic and pin description



| Function         | Pin Number | Description            |
|------------------|------------|------------------------|
| RF-IN            | 2          | RF input               |
| RF-OUT and DC-IN | 7          | RF output and DC input |
| GND              | Paddle     | Ground                 |
| NC               | 1,3-6,8    | No connection          |

## Electrical Specifications at 25°C, 50 ohms, unless noted

| Parameter   | Condition (MHz) | Vd=11V <sup>1</sup> |        |      | Vd=11V <sup>2</sup> | Units |
|---|-----------------|---------------------|--------|------|---------------------|-------|
|   |                 | Min.                | Typ.   | Max. | Typ.                |       |
| Frequency range   |                 | 0.03                |        | 2.7  | 0.03-2.7            | GHz   |
| Gain  | 30              | —                   | 18.3   | —    | 18.3                | dB    |
|   | 500             | —                   | 17.9   | —    | 17.7                |       |
|   | 1000            | —                   | 17.0   | —    | 16.8                |       |
|   | 2000            | 13.2                | 14.7   | 16.1 | 14.3                |       |
|   | 2700            | —                   | 12.7   | —    | 12.1                |       |
| Input return loss   | 30              |                     | 21.2   |      | 20.5                | dB    |
|   | 500             |                     | 21.7   |      | 25.5                |       |
|   | 1000            |                     | 19.5   |      | 28.6                |       |
|   | 2000            |                     | 20.3   |      | 17.7                |       |
|   | 2700            |                     | 14.9   |      | 12.0                |       |
| Output return loss  | 30              |                     | 15.1   |      | 15.5                | dB    |
|   | 500             |                     | 16.4   |      | 15.2                |       |
|   | 1000            |                     | 19.4   |      | 15.7                |       |
|   | 2000            |                     | 22.5   |      | 19.1                |       |
|   | 2700            |                     | 9.8    |      | 9.4                 |       |
| Reverse isolation   | 2000            |                     | 23     |      | 23.3                | dB    |
| Output power @ 1dB compression                                  | 30              |                     | 28.4   |      | 29.2                | dBm   |
|   | 500             |                     | 30.2   |      | 29.8                |       |
|   | 1000            |                     | 30.4   |      | 29.8                |       |
|   | 2000            |                     | 28.1   |      | 27.0                |       |
|   | 2700            |                     | 25.7   |      | 25.2                |       |
| Output IP3 <sup>3</sup>   | 30              |                     | 51.0   |      | 50.3                | dBm   |
|   | 500             |                     | 48.5   |      | 48.8                |       |
|   | 1000            |                     | 46.1   |      | 46.2                |       |
|   | 2000            |                     | 43.2   |      | 41.7                |       |
|   | 2700            |                     | 39.4   |      | 38.8                |       |
| Noise figure  | 30              |                     | 3.2    |      | 3.0                 | dB    |
|   | 500             |                     | 3.3    |      | 3.0                 |       |
|   | 1000            |                     | 3.5    |      | 3.3                 |       |
|   | 2000            |                     | 4.4    |      | 4.3                 |       |
|   | 2700            |                     | 5.4    |      | 5.2                 |       |
| Device operating voltage  |                 |                     | 11     |      | 11                  | V     |
| Device operating current  |                 | —                   | 350    | 416  | 335                 | mA    |
| Device current variation vs. temperature <sup>4</sup>           |                 |                     | 188.6  |      | 188.6               | μA/°C |
| Device current variation vs voltage <sup>5</sup>                |                 |                     | 0.0485 |      | 0.0485              | mA/mV |
| Thermal Resistance, junction-to-ground lead at 85°C stage temp. |                 |                     | 16.1   |      | 16.1                | °C/W  |

1. Measured on Mini-Circuits Characterization test board MB018. See Characterization Test Circuit (Fig. 1)

2. Measured on Mini-Circuits Application test board TB-962+. See Characterization Test Circuit (Fig. 2)

3. Tested at Pout=16dBm / tone.

4. (Current at 85°C — Current at -45°C)/130

5. (Current at 11.5V-current - Current at 10.5V)/1000

Absolute Maximum Ratings<sup>6</sup>

| Parameter                           | Ratings  |
|-------------------------------------|--|
| Operating Temperature (ground lead) | -40°C to 85°C                                    |
| Storage Temperature                 | -65°C to 150°C                                   |
| Junction Temperature                | 179°C  |
| Power Dissipation                   | 5.8W   |
| Input Power (CW)                    | +24 dBm (5 minutes max.)<br>+19 dBm (continuous) |
| DC Voltage on Pin 7                 | 14V  |

6. Permanent damage may occur if any of these limits are exceeded.  
Electrical maximum ratings are not intended for continuous normal operation.

Characterization Test Circuit

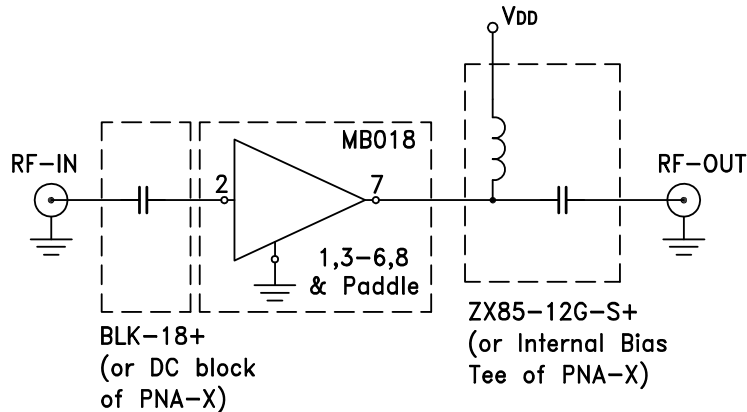


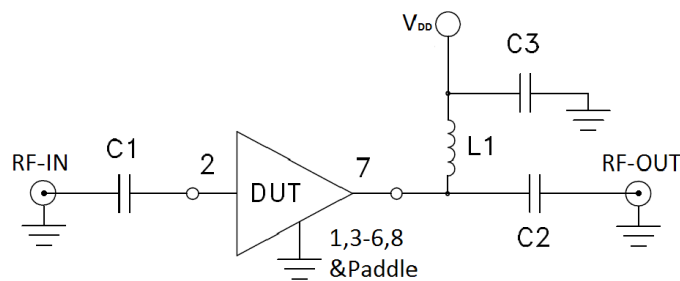
Fig 1. Characterization Circuit

Note: This block diagram is used for characterization. (DUT soldered on Mini-Circuits Characterization test board MB018) Gain, Return loss, Output power at 1dB compression (P1 dB), output IP3 (OIP3) and noise figure measured using Agilent’s N5242A PNA-X microwave network analyzer.

Conditions:

1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 16 dBm/tone at output.

Recommended Application Circuit



| Component  | P/N                | SUPPLIER  | Value  | Size |
|------------|--------------------|-----------|--------|------|
| C1, C2, C3 | GRM155R71E103KA01D | MURATA    | 0.01uF | 0402 |
| L1         | WA8514-AE          | COILCRAFT | 5.6uH  | 1708 |

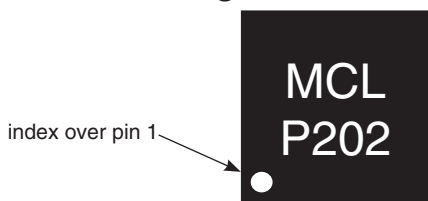
Fig 2. Application Circuit

Note: (DUT soldered on Mini-Circuits Application test board TB-962+) Gain, Return loss, Output power at 1dB compression (P1 dB), output IP3 (OIP3) and noise figure measured using Agilent’s N5242A PNA-X microwave network analyzer.

Conditions:

1. Gain and Return loss: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 16 dBm/tone at output.

Product Marking



Marking may contain other features or characters for internal lot control

| <b>Additional Detailed Technical Information</b>  |   |
|---|---|
| <i>additional information is available on our dash board. To access this information <a href="#">click here</a></i> |   |
| <b>Performance Data</b>   | Data Table  |
|   | Swept Graphs  |
|   | S-Parameter (S2P Files) Data Set (.zip file)  |
| <b>Case Style</b>   | DL1636 <i>Plastic package, exposed paddle lead finish: Matte Tin</i>                                  |
| <b>Tape &amp; Reel</b><br>Standard quantities available on reel   | F68<br><i>7" reels with 20, 50, 100, 200, 500 or 1K devices<br/>13" reels with 2K, 3K, 4K devices</i> |
| <b>Suggested Layout for PCB Design</b>  | PL-522  |
| <b>Evaluation Board</b>   | TB-962+   |
| <b>Environmental Ratings</b>  | ENV08T1   |

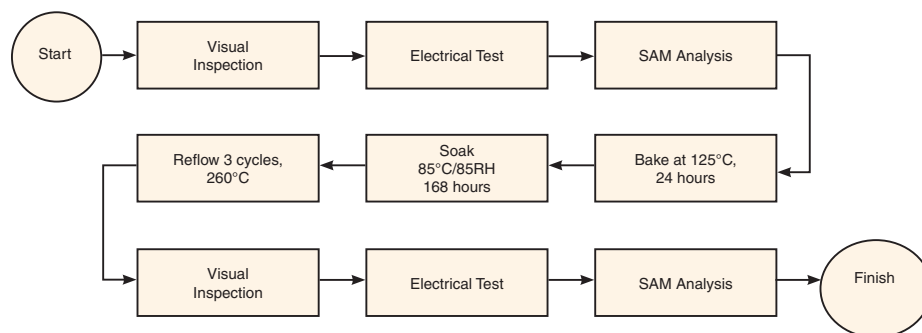
### ESD Rating

Human Body Model (HBM): Class 1B (Pass 500V) in accordance with ANSI/ESD STM 5.1 - 2001

### MSL Rating

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020D

### MSL Test Flow Chart



### Additional 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/MCLStore/terms.jsp](http://www.minicircuits.com/MCLStore/terms.jsp)