

# Ultra High Dynamic Range Monolithic Amplifier

## PHA-13LN+

50Ω      1MHz to 1 GHz

### The Big Deal

- Ultra-High IP3, +39 dBm typ.
- Low supply voltage, 3 to 5V
- Excellent Noise Figure, 0.9 dB typ.



SOT-89 PACKAGE

### Product Overview

PHA-13LN+ (RoHS compliant) is an advanced wideband 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-13LN+ has good input and output return loss over a broad frequency range. Relatively low supply voltage gives the model advantage in low power consumption. PHA-13LN+ is enclosed in a SOT-89 package and has very good thermal performance.

### Key Features

| Feature  | Advantages  |
|--|---|
| Broad Band: 1MHz to 1GHz   | Broadband covering primary wireless communications bands: VHF, UHF, Cellular  |
| Extremely High IP3<br>40 dBm typical at 20 MHz<br>39 dBm typical at 0.5GHz | The PHA-13LN+ 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 approximately 15 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> |
| Low Noise Figure<br>0.9 dB at 0.5 GHz                                      | Enables lower system noise figure performance and along with High OIP3 provides high dynamic range.   |
| Low Supply Voltage, 3 to 5V  | PHA-13LN+ supports low supply voltage operation which indicate low power consumption, 3V operation is ideal for battery operated system.  |

#### Notes

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# Ultra High Dynamic Range Monolithic Amplifier

1MHz to 1 GHz

## Product Features

- High IP3, 39 dBm typ. at 0.5GHz
- Gain, 22.4 dB typ. at 0.5 GHz
- Low noise figure, 0.9 dB at 0.5 GHz
- Low Voltage, 5V and 3V.



Generic photo used for illustration purposes only

CASE STYLE: DF782

## Typical Applications

- Base station infrastructure
- CATV
- Cellular
- VHF/UHF

## PGA-13LN+

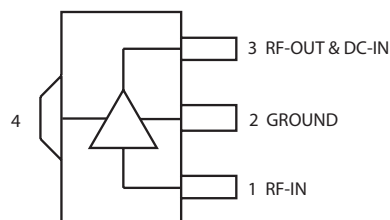
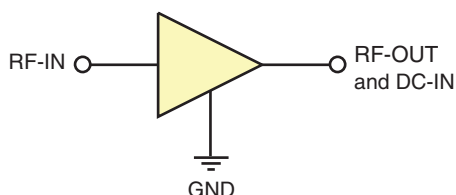
**+RoHS Compliant**

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

## General Description

PHA-13LN+ (RoHS compliant) is an advanced wideband 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-13LN+ has good input and output return loss over a broad frequency range. Relatively low supply voltage gives the model advantage in low power consumption. PHA-13LN+ is enclosed in a SOT-89 package and has very good thermal performance.

### simplified schematic and pin description



| Function         | Pin Number | Description            |
|------------------|------------|------------------------|
| RF IN            | 1          | RF Input               |
| RF-OUT and DC-IN | 3          | RF Output and DC Bias  |
| GND              | 2,4        | Connections to ground. |

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REV. OR  
M159854  
PHA-13LN+  
MCL NY  
171129  
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**Electrical Specifications<sup>1</sup> at 25°C, 50Ω, unless noted**

| Parameter   | Condition<br>(MHz) | Vd=5V <sup>1</sup> |        |      | Vd=3V <sup>1</sup> | Units |
|---|--------------------|--------------------|--------|------|--------------------|-------|
|   |                    | Min.               | Typ.   | Max. | Typ.               |       |
| Frequency Range                                       |                    | 1                  |        | 1000 | 1-1000             | MHz   |
| Gain  | 1                  | 22.1               | 24.6   | 27.1 | 23.7               | dB    |
|   | 20                 | —                  | 24.0   | —    | 23.3               |       |
|   | 250                | —                  | 22.8   | —    | 22.1               |       |
|   | 500                | 20.2               | 22.4   | 24.6 | 21.5               |       |
|   | 1000               | —                  | 20.1   | —    | 18.7               |       |
| Input Return Loss                                     | 1                  |                    | 10.3   |      | 9.4                | dB    |
|   | 20                 |                    | 15.4   |      | 14.6               |       |
|   | 250                |                    | 17.5   |      | 17.9               |       |
|   | 500                |                    | 17.4   |      | 14.7               |       |
|   | 1000               |                    | 10.2   |      | 7.9                |       |
| Output Return Loss                                    | 1                  |                    | 11.3   |      | 11.0               | dB    |
|   | 20                 |                    | 19.1   |      | 21.5               |       |
|   | 250                |                    | 17.7   |      | 20.2               |       |
|   | 500                |                    | 23.9   |      | 20.0               |       |
|   | 1000               |                    | 8.9    |      | 7.8                |       |
| Reverse isolation                                     | 500                |                    | 26.1   |      | 25.7               | dB    |
| Output Power @ 1 dB compression                       | 1                  |                    | 21.3   |      | 15.1               | dBm   |
|   | 20                 |                    | 23.0   |      | 16.9               |       |
|   | 250                |                    | 24.4   |      | 19.5               |       |
|   | 500                |                    | 24.5   |      | 19.5               |       |
|   | 1000               |                    | 24.2   |      | 18.7               |       |
| Output IP3 <sup>2</sup>                               | 1                  | —                  | 37.0   | —    | 30.6               | dBm   |
|   | 20                 | —                  | 40.2   | —    | 33.3               |       |
|   | 250                | —                  | 40.2   | —    | 33.4               |       |
|   | 500                | 36                 | 39.0   | —    | 32.3               |       |
|   | 1000               | —                  | 36.4   | —    | 28.6               |       |
| Noise Figure  | 1                  |                    | 3.1    |      | 3.0                | dB    |
|   | 20                 |                    | 1.2    |      | 1.1                |       |
|   | 250                |                    | 0.9    |      | 0.9                |       |
|   | 500                |                    | 1.0    |      | 1.0                |       |
|   | 1000               |                    | 1.2    |      | 1.3                |       |
| Device Operating Voltage                              |                    |                    | 5.0    |      | 3.0                | V     |
| Device Operating Current                              |                    | —                  | 138.9  | 162  | 71.2               | mA    |
| Device Current Variation vs. Temperature <sup>3</sup> |                    |                    | 21.7   |      | 30.3               | μA/°C |
| Device Current Variation vs Voltage                   |                    |                    | 0.0338 |      | 0.0338             | mA/mV |
| Thermal Resistance, junction-to-ground lead           |                    |                    | 23.3   |      | 23.3               | °C/W  |
| Junction-to-ground lead at 85°C stage temperature     |                    |                    |        |      |                    |       |

1. Measured on Mini-Circuits Characterization test board TB-969-13LN+. See Characterization Test Circuit (Fig. 1)

2. Tested at Pout= 0 dBm / tone.

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

**Absolute Maximum Ratings<sup>4</sup>**

| Parameter                           | Ratings   |
|-------------------------------------|---|
| Operating Temperature (ground lead) | -40°C to 105°C  |
| Storage Temperature                 | -65°C to 150°C  |
| Power Dissipation                   | 3.3 W <sup>5</sup>  |
| Input Power (CW)                    | +21 dBm (5 minutes max) <sup>6</sup><br>+6 dBm (continuous) for 1-10 MHz<br>+8 dBm (continuous) for 10-1000 MHz |
| DC Voltage on Pin 3                 | 10V   |

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

Electrical maximum ratings are not intended for continuous normal operation.

5. up to 85°C, derate linearly to 2.5 W at 105°C

6. up to 85°C, derate linearly to +18dBm at 105°C

**Notes**

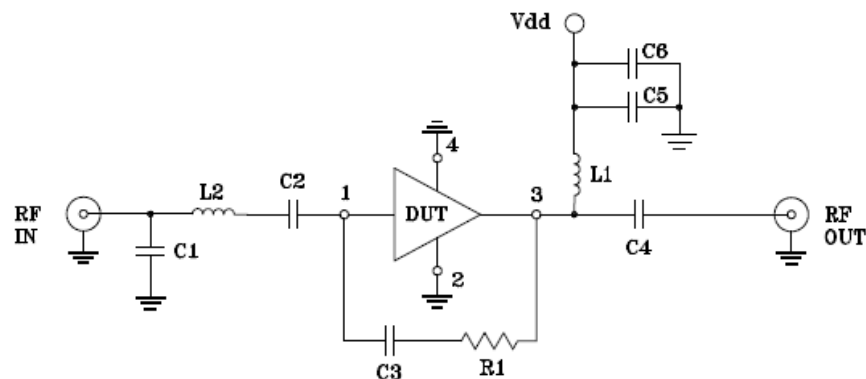
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## Characterization Test / Recommended Application Circuit



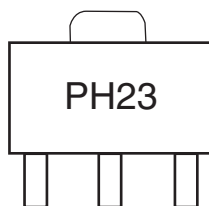
| Components | Size | Value         | Manufacturer | P/N               |
|------------|------|---------------|--------------|-------------------|
| C1         | 0402 | 1.5 pF        | Murata       | GRM1555C1H1R5CZ01 |
| C2         | 0603 | 2.2 uF        |              | GRM188R61C225KE15 |
| C3         | 0402 | 0.1uF         |              | GRM155R71C104KA88 |
| C4         | 0603 | 2.2 uF        |              | GRM188R61C225KE15 |
| C5         | 0402 | 1000 pF       |              | GRM1555C1H102JA01 |
| C6         | 0805 | 10 uF         |              | GRM21BR61C106KE15 |
| L1         | 1210 | 15 uH         |              | LQH32DN150K53L    |
| L2         | 0603 | 5.1 nH        | Coilcraft    | 0603CS-5N1XJL     |
| R1         | 0402 | 1500 $\Omega$ | Koa          | RK73H1ET1501F     |

**Fig 1. Block Diagram of Test Circuit used for characterization.** (DUT soldered on Mini-Circuits Characterization test board TB-969-13LN+) Gain, Return loss, Output power at 1dB compression (P1dB), 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 0.5 MHz apart, 0 dBm/ tone at output.

## Product Marking



Marking may contain other features or characters for internal lot control

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**Additional Detailed Technical Information**

additional information is available on our dash board. To access this information [click here](#)

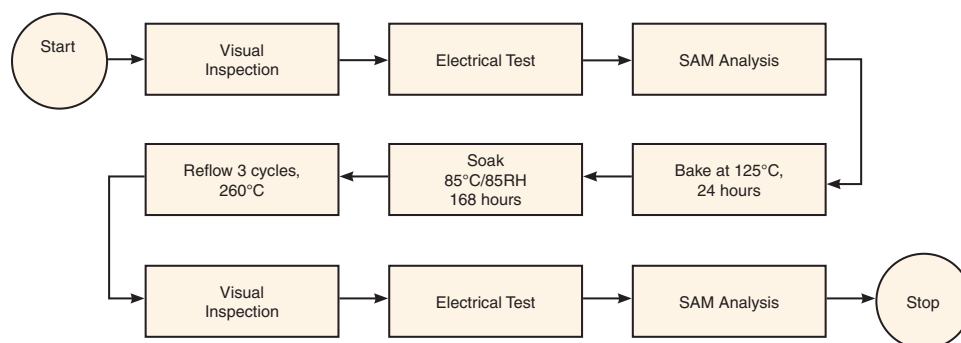
|   |  |
|---|--|
| <b>Performance Data</b>   | Data Table   |
|   | Swept Graphs   |
|   | S-Parameter (S2P Files) Data Set (.zip file)                                   |
| <b>Case Style</b>   | DF782 (SOT 89)<br><i>Plastic package, exposed paddle lead finish: Matt-Tin</i> |
| <b>Tape &amp; Reel</b><br>Standard quantities available on reel | F55<br><i>7" reels with 20, 50, 100, 200, 500 or 1K devices</i>                |
| <b>Suggested Layout for PCB Design</b>                          | PL-523   |
| <b>Evaluation Board</b>   | TB-969-13LN+   |
| <b>Environmental Ratings</b>                                    | ENV08T9  |

**ESD Rating**

Human Body Model (HBM): Class 1B (Pass 500 V) 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****Notes**

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