# ULTRA HIGH DYNAMIC RANGE

# Monolithic Amplifier     PHA-1H+

50Ω     0.05 to 6GHz

## THE BIG DEAL
- Ultra High IP3
- High Pout, P1dB 22 dBm typ. at 2 GHz, 5V
- Low noise figure, 2.2 dB @2 GHz, 5V
- Usable to 4.0V
- Broadband High Dynamic Range without External Matching Components
- May be used as a replacement to WJ AH1[a,b]
- Suitable for low phase noise applications

*Generic photo used for illustration purposes only*

CASE STYLE: DF782

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

## APPLICATIONS
- Base station infrastructure
- Portable Wireless
- CATV & DBS
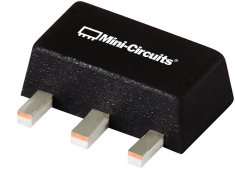- MMDS & Wireless LAN
- LTE

## PRODUCT OVERVIEW

PHA-1H+ (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-1H+, unlike competitive models, 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 SOT-89 package for very good thermal performance.

## KEY FEATURES

| Feature | Advantages |
|---|---|
| Broad Band: 0.05 to 6.0 GHz | Broadband covering primary wireless communications bands:<br>Cellular, PCS, LTE, WiMAX |
| Extremely High IP3<br>Versus DC power Consumption<br>40.4 dBm typical at 2.4 GHz | The PHA-1H+ 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 20 dB above the P 1dB point.  This feature makes this amplifier ideal for use in:<br>• Driver amplifiers for complex waveform up converter paths<br>• Drivers in linearized transmit systems<br>• Secondary amplifiers in ultra High Dynamic range receivers |
| No External Matching Components Required | Unlike competing products, Mini-Circuits PHA-1H+ provides Input and Output Return Loss of 10-23 dB up to 4 GHz without the need for any external matching components |
| Low Noise Figure: 2.6dB typ. up to 4 GHz<br>3.4dB typ. up to 6 GHz | A unique feature of the PHA-1H+ which separates this design from all competitors is the low noise figure performance in combination with the high dynamic range. |
| Low Juction Temperature<br>Tj=115°C at 85°C lead temperature and 135°C at 105°C lead temperature | Results in excellent reliability. |
| Low additive phase noise, typically -164 dBc/Hz @10 KHz offset | Ideal for low phase noise synthesizer applications |

a. Suitability for model replacement within a particular system must be determined by and is solely the responsibility of the customer based on, among other things, electrical performance criteria, stimulus conditions, application, compatibility with other components and environmental conditions and stresses.
b. The WJ AH1 part number is used for identification and comparison purposes only.

# Monolithic Amplifier     PHA-1H+

## ELECTRICAL SPECIFICATIONS AT 25°C, UNLESS NOTED

| Parameter | Condition (GHz) | Vd=5.0V[1] | | | Units |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Frequency range | | 0.05 | | 6.0 | GHz |
| Gain | 0.05 | 15.9 | 17.7 | 19.5 | dB |
| | 0.8 | 14.3 | 15.9 | 17.5 | |
| | 2.0 | — | 13.8 | — | |
| | 3.0 | — | 12.1 | — | |
| | 4.0 | 9.8 | 10.9 | 12.0 | |
| | 6.0 | — | 9.6 | — | |
| Input return loss | 0.05 | — | 11.9 | — | dB |
| | 0.8 | 13.0 | 18.2 | — | |
| | 2.0 | — | 12.5 | — | |
| | 3.0 | — | 10.8 | — | |
| | 4.0 | — | 10.3 | — | |
| | 6.0 | — | 8.1 | — | |
| Output return loss | 0.05 | — | 14.2 | — | dB |
| | 0.8 | 13.0 | 22.9 | — | |
| | 2.0 | — | 19.7 | — | |
| | 3.0 | — | 17.1 | — | |
| | 4.0 | — | 15.5 | — | |
| | 6.0 | — | 13.7 | — | |
| Reverse isolation | 2.0 | | 19.6 | | dB |
| Output power @1 dB compression | 0.05 | 20.0 | 22.1 | — | dBm |
| | 0.8 | 20.0 | 21.8 | — | |
| | 2.0 | 20.0 | 22.6 | — | |
| | 3.0 | — | 22.2 | — | |
| | 4.0 | — | 22.5 | — | |
| | 6.0 | — | 22.0 | — | |
| Output IP3 | 0.05 | — | 39.6 | — | dBm |
| | 0.8 | 38.0 | 40.6 | — | |
| | 2.0 | — | 40.4 | — | |
| | 3.0 | — | 40.8 | — | |
| | 4.0 | — | 41.4 | — | |
| | 6.0 | — | 41.0 | — | |
| Noise figure | 0.5 | | 1.7 | | dB |
| | 1.0 | | 1.8 | | |
| | 2.0 | | 2.2 | | |
| | 3.0 | | 2.4 | | |
| | 4.0 | | 2.6 | | |
| | 6.0 | | 3.4 | | |
| Additive Phase Noise          2 GHz, 10 KHz offset | | | -164.1 | | dBc/Hz |
| Device operating voltage | | 4.8 | 5.0 | 5.2 | V |
| Device operating current | | — | 132 | 165 | mA |
| Device current variation vs. temperature[2] | | | 101 | | µA/°C |
| Device current variation vs voltage | | | 0.057 | | mA/mV |
| Thermal resistance, junction-to-ground lead at 88°C | | | 36.1 | | °C/W |

1. Measured on Mini-Circuits characterization test board TB-313. See characterization test circuit (Fig. 1)
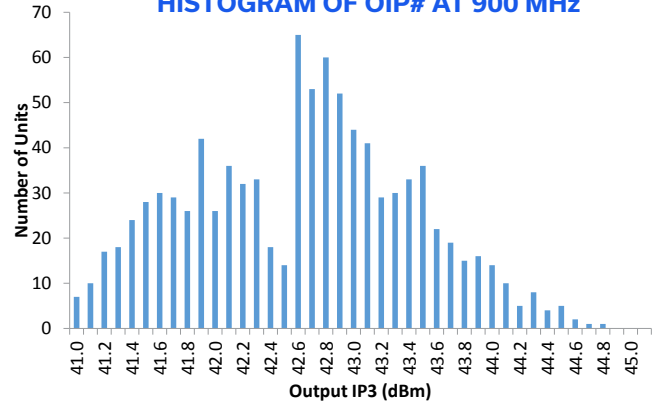2. (Current at 85°C — Current at -45°C)/130

## MAXIMUM RATINGS[3]

| Parameter | Ratings |
|---|---|
| Operating temperature (ground lead) | -40°C to 105°C |
| Storage temperature | -65°C to 150°C |
| Operating current at 5V | 210 mA |
| Power dissipation | 1 W |
| Input power (CW) | 24 dBm |
| DC voltage on Pin 3 | 6 V |

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

### HISTOGRAM OF OIP# AT 900 MHz



## SIMPLIFIED SCHEMATIC AND PIN DESCRIPTION



| Function | Pin Number | Description |
|---|---|---|
| RF IN | 1 | RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation. |
| RF-OUT and DC-IN | 3 | RF output and bias pin.  DC voltage is present on this pin; therefore a DC blocking capacitor is necessary for proper operation.  An RF choke is needed to feed DC bias without loss of RF signal due to the bias connection, as shown in "Recommended Application Circuit", Fig. 2 |
| GND | 2,4 | Connections to ground.  Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance. |

a. Suitability for model replacement within a particular system must be determined by and is solely the responsibility of the customer based on, among other things, electrical performance criteria, stimulus conditions, application, compatibility with other components and environmental conditions and stresses.
b. The WJ AH1 part number is used for identification and comparison purposes only.

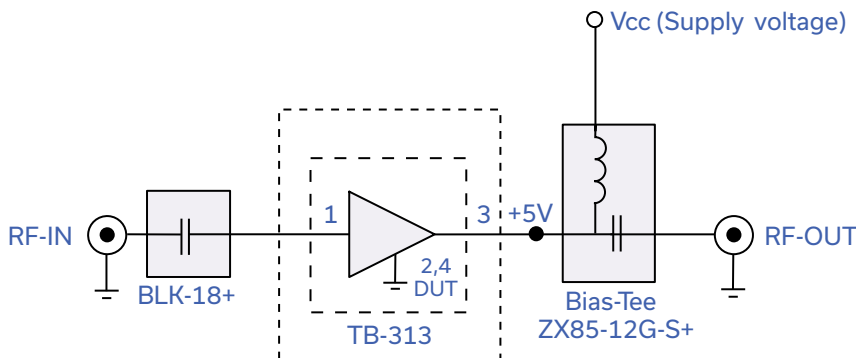## CHARACTERIZATION TEST CIRCUIT



Fig 1. Block Diagram of Test Circuit used for characterization. (DUT soldered on Mini-Circuits Characterization test board TB-313)

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, 5 dBm/tone at output.
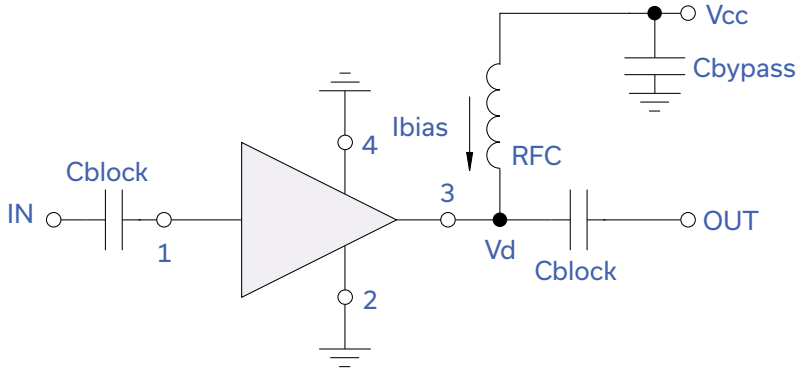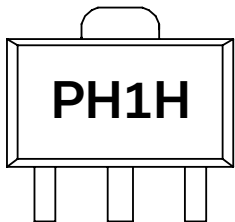
## RECOMMENDED APPLICATION CIRCUIT



Fig 2. Test Board includes case, connectors, and components soldered to PCB

## PRODUCT MARKING



PH1H

Marking may contain other features or characters for internal lot control