



Mini-Circuits

LOW NOISE, HIGH IP3

# Monolithic Amplifier

PSA-5451+

50Ω 0.05 to 4 GHz

## THE BIG DEAL

- Single Positive Supply Voltage, +3V, Id=30mA
- Ultra Low Noise Figure, 0.7 dB typ. at 0.5GHz
- High IP3, 29 dBm typ. 1GHz
- Gain, 18.8 dB typ. at 1GHz
- Output Power, up to +16.7 dBm typ.
- Micro-miniature size SOT-363 package
- Aqueous washable



Generic photo used for illustration purposes only

CASE STYLE: CA1389

### +RoHS Compliant

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

## APPLICATIONS

- Cellular
- ISM
- GSM
- WCDMA
- LTE
- WiMAX
- WLAN
- UNII and HIPERLAN

## PRODUCT OVERVIEW

Mini-Circuits PSA-5451+ is a E-PHEMT\* based Ultra-Low Noise MMIC Amplifier operating from 50 MHz to 4 GHz with a unique combination of low noise and high IP3 making this amplifier ideal for sensitive receiver applications. This design operates on a single 3V supply at only 30mA and is internally matched to 50 ohms.

## KEY FEATURES

| Feature                 | Advantages   |
|-------------------------|--|
| Ultra Low Noise, 0.7 dB | Outstanding Noise Figure, measured in a 50 Ohm environment without any external matching   |
| High IP3, 29 dBm        | Combining Low Noise and High IP3 makes this MMIC amplifier ideal for Low Noise Receiver Front End (RFE) because it gives the user advantages at both ends of the dynamic range: sensitivity & two-tone spur-free dynamic range |
| Low Current, 30mA       | At only 30mA, the PSA-5451+ is ideal for remote applications with limited available power or densely packed applications where thermal management is critical.   |
| Broad Band              | Operating over a broadband the PSA-5451+ covers the primary wireless communications bands: Cellular, PCS, LTE, WiMAX   |
| Internally Matched      | No external matching elements required to achieve the advertised noise and output power over the full band   |
| SOT-363 Package         | Small size, industry standard package  |
| Max Input Power, +15dBm | Ruggedized design operates up to input powers of +15dBm without the need of an external limiter  |
| High Reliability        | Low, small signal operating current of 30 mA nominal maintains junction temperatures typically below 100°C at 85°C ground lead temperature   |

\* Enhancement mode pseudomorphic High Electron Mobility Transistor.





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## ELECTRICAL SPECIFICATIONS<sup>(1)</sup> AT 25°C, Z<sub>0</sub>=50Ω, (REFER TO CHARACTERIZATION CIRCUIT, FIG. 1)

| Parameter  | Condition (GHz) | Min. | Typ.  | Max. | Units |
|--|-----------------|------|-------|------|-------|
| Frequency Range  |                 | 0.05 |       | 4.0  | GHz   |
| DC Voltage (V <sub>d</sub> )                                       |                 |      | 3.0   |      | V     |
| DC Current (I <sub>d</sub> ) <sup>(6)</sup>                        |                 | 20   | 30    | 40   | mA    |
| DC Current (I <sub>Rbias</sub> )                                   |                 |      | 1.6   |      | mA    |
| Noise Figure   | 0.05            |      | 2.1   | —    | dB    |
|  | 0.5             |      | 0.7   | —    |       |
|  | 1.0             |      | 0.8   | —    |       |
|  | 2.0             |      | 1.0   | 1.3  |       |
|  | 3.0             |      | 1.3   | —    |       |
|  | 4.0             |      | 1.5   | —    |       |
| Gain   | 0.05            | —    | 22.6  | —    | dB    |
|  | 0.5             | —    | 22.3  | —    |       |
|  | 1.0             | —    | 18.8  | —    |       |
|  | 2.0             | 12.6 | 14.0  | 15.4 |       |
|  | 3.0             | —    | 11.3  | —    |       |
|  | 4.0             | —    | 9.6   | —    |       |
| Input Return Loss  | 0.05-0.5        |      | 8.8   |      | dB    |
|  | 0.5-4.0         |      | 6.5   |      |       |
| Output Return Loss   | 0.05-0.5        |      | 8.3   |      | dB    |
|  | 0.5-1.0         |      | 17.0  |      |       |
|  | 1.0-4.0         |      | 20.0  |      |       |
| Output IP3   | 0.05            |      | 26.3  |      | dBm   |
|  | 0.5             |      | 28.3  |      |       |
|  | 1.0             |      | 29.1  |      |       |
|  | 2.0             |      | 30.2  |      |       |
|  | 3.0             |      | 30.1  |      |       |
|  | 4.0             |      | 29.8  |      |       |
| Output Power @ 1 dB compression (P <sub>1dB</sub> ) <sup>(2)</sup> | 0.05            |      | 10.5  |      | dBm   |
|  | 0.5             |      | 16.7  |      |       |
|  | 1.0             |      | 16.8  |      |       |
|  | 2.0             |      | 16.2  |      |       |
|  | 3.0             |      | 16.2  |      |       |
|  | 4.0             |      | 16.7  |      |       |
| DC Current Variation vs. Temperature <sup>(3)</sup>                |                 |      | -0.05 |      | mA/°C |
| Thermal Resistance   |                 |      | 165   |      | °C/W  |

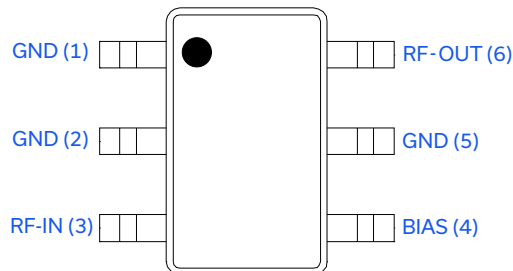
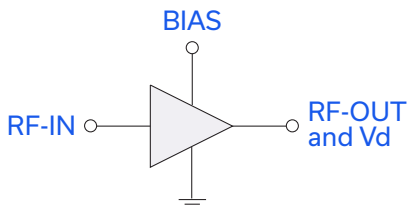


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**PSA-5451+****MAXIMUM RATINGS<sup>(4)</sup>**

| Parameter                            | Ratings        |
|--------------------------------------|----------------|
| Operating Temperature <sup>(5)</sup> | -40°C to 85°C  |
| Storage Temperature                  | -65°C to 150°C |
| Channel Temperature                  | 150°C          |
| DC Voltage (Pin 6)                   | 5V             |
| Power Dissipation                    | 390 mW         |
| DC Current (Pin 6)                   | 80mA           |
| Bias Current (Pin 4)                 | 10mA           |
| Input Power (CW) <sup>(7)</sup>      | 15dBm          |

- (1) Measured on Mini-Circuits Characterization test board TB-533+. See Characterization Test Circuit (Fig. 1)  
(2) P1dB specified with external current limiting of 40 mA; Capable of higher P1dB at higher current (see Fig.2)  
(3) (Current at 85°C - Current at -45°C)/130  
(4) Permanent damage may occur if any of these limits are exceeded. These maximum ratings are not intended for continuous normal operation.  
(5) Defined with reference to ground pad temperature.  
(6) Specified DC current consumption is under small signal conditns. Current will increase with input RF Power. To maintain maximum current consumption, external DC current limiting circuits are required on Vd line.  
(7) Maximum input power is specified based upon external Vd current limiting of 60 mA. Maximum input power will degrade without external current limiting.

**SIMPLIFIED SCHEMATIC AND PIN DESCRIPTION**

| Function    | Pin Number | Description (See Application Circuit, Fig. 3)   |
|-------------|------------|---|
| RF-IN       | 3          | RF input pin (connect to RF-IN via blocking cap C1 and Pin 4 via L2)                          |
| RF-OUT & Vd | 6          | RF output pin (connected to RF-out via blocking cap C2 and supply voltage Vd via RF Choke L1) |
| BIAS        | 4          | Connected to Vs via Rbias. (Connect to ground via C4 & R1)                                    |
| GND         | 1,2,5      | Connections to ground   |



## CHARACTERIZATION TEST CIRCUIT

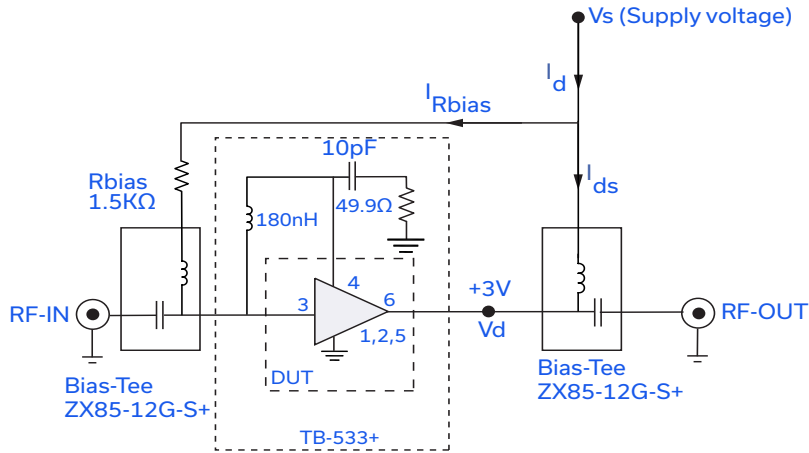


Fig 1. Block Diagram of Test Circuit used for characterization. (DUT soldered on Mini-Circuits Characterization Test Board TB-533+) Gain, Output power at 1dB compression (P1 dB), output IP3 (OIP3) and Noise Figure measured using Agilent's N5242A PNA-X microwave network analyzer.

## Conditions:

1. Gain: Pin= -25dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 0 dBm/tone at output.
3. Vs adjusted for 3V at device (Vd), compensating loss of bias tee.

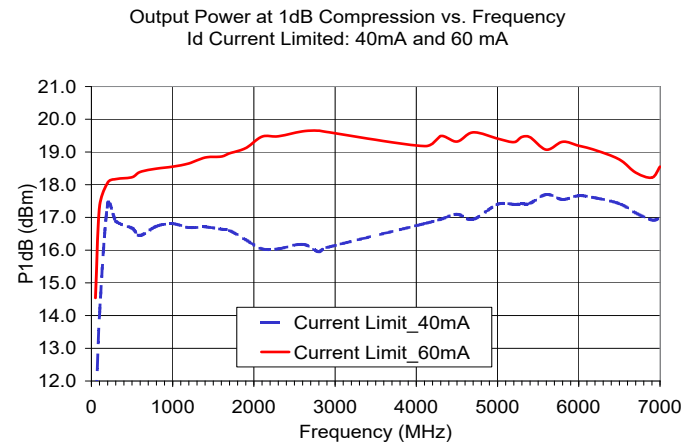
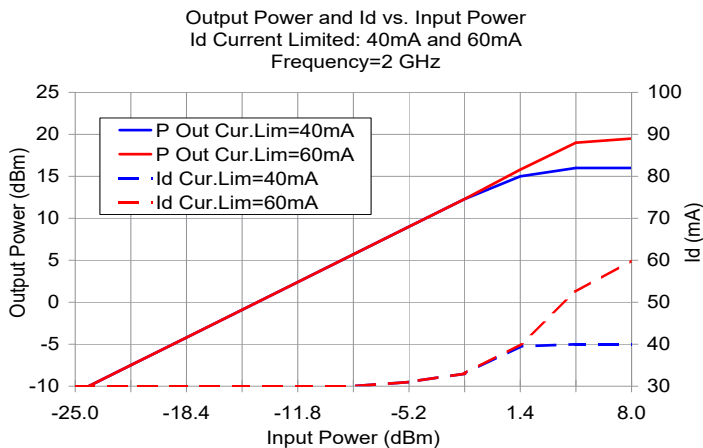


Fig 2. Output Power and Id vs. Input Power and Frequency.

Performance measured on Mini-Circuits Characterization test board TB-533+. See Characterization Test Circuit (Fig. 1)  
Measurements performed with current (Id) limited as noted.



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## RECOMMENDED APPLICATION CIRCUIT

(refer to evaluation board for PCB Layout and component values)

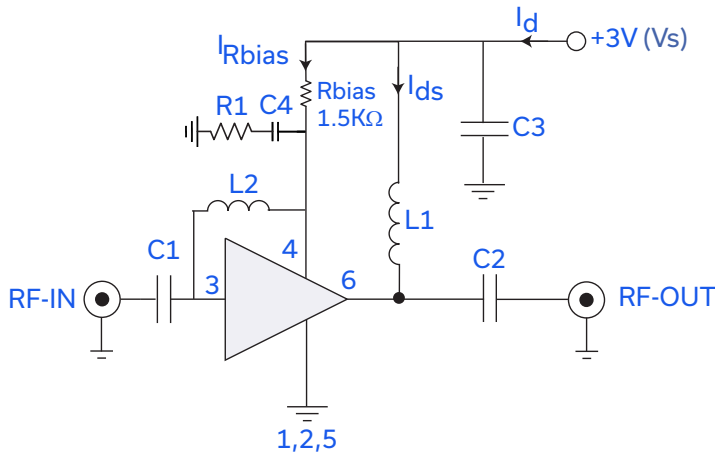


Fig 3. Recommended Application Circuit  
Note: Resistance of L1, 0.1-0.2Ω typically

## TYPICAL CURRENT ( $I_D$ ) AS A FUNCTION OF $R_{BIAS}$ ( $V_S = 3V$ )

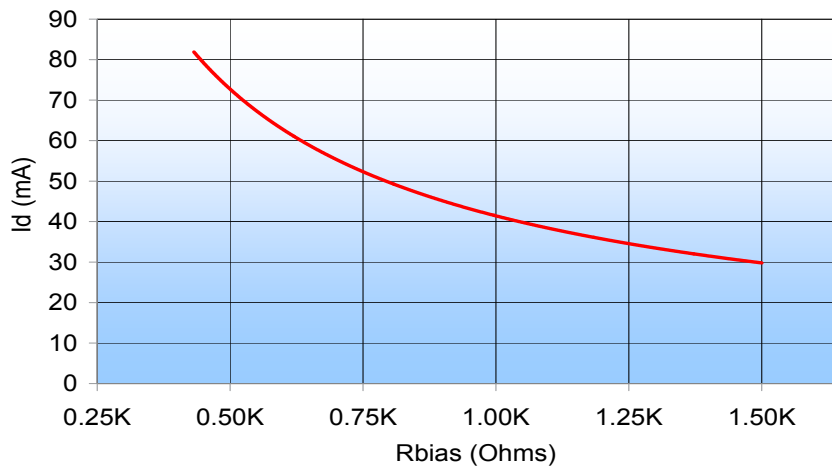
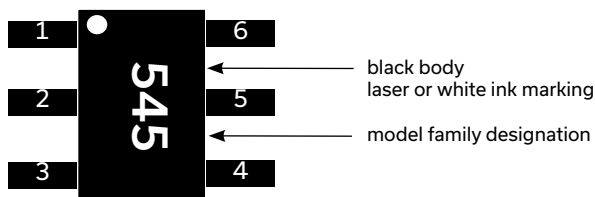


Fig 4.  $I_D$  varies as a function of  $R_{bias}$ . The  $I_D$  current range is defined based upon the specific  $R_{bias}$  value noted in the Application Circuit (Fig 3).  $R_{bias}$  may be adjusted to optimize  $I_D$  for a customers' application. RF performance will vary accordingly.

## PRODUCT MARKING



Marking may contain other features or characters for internal lot control





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ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD. TO ACCESS [CLICK HERE](#)

|  |  |
|--|--|
| Performance Data                                     | Data Table<br>Swept Graphs<br>S-Parameter (S2P Files) Data Set (.zip file) |
| Case Style   | CA1389 Plastic molded SOT-363 package, lead finish: Matte-Tin              |
| Tape & Reel<br>Standard quantities available on reel | F101<br>7" reels with 20, 50, 100, 200, 500, 1K, or 2K devices             |
| Suggested Layout for PCB Design                      | PL-311   |
| Evaluation Board                                     | TB-534-1+  |
| Environmental Ratings                                | ENV08T2  |

## ESD RATING

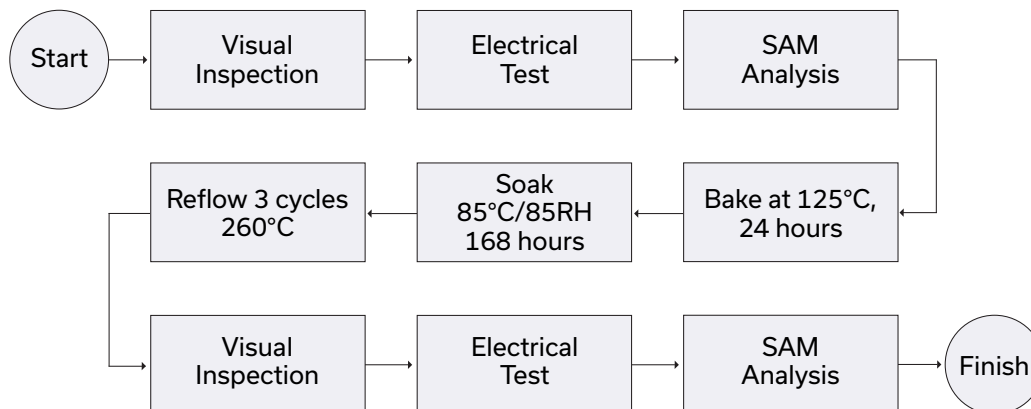
Human Body Model (HBM): Class 1A (250 to <500V) in accordance with ANSI/ESD STM 5.1 - 2001

Machine Model (MM): Class M1 (<100V) in accordance with ANSI/ESD STM5.2-1999; passes 40V

## MSL RATING

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

## MSL TEST FLOW CHART



- NOTES
- 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.
  - Electrical specifications and performance data contained in this specification document are based on Mini-Circuit's applicable established test performance criteria and measurement instructions.
  - 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)



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