LOW NOISE, HIGH IP3

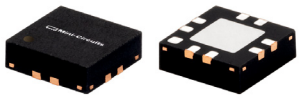
# Monolithic Amplifier

# PMA-5456+

50Ω 0.05 to 6 GHz

## THE BIG DEAL

- Ultra Low Noise Figure, 0.8 dB
- High IP3, 34 dBm typ. 1GHz
- Wideband, up to 6 GHz
- Low Additive Phase Noise
- Suitable for low phase noise applications



*Generic photo used for illustration purposes only*

CASE STYLE: DQ849

***+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

PMA-5456+ is a high dynamic range, low noise, high IP3, high output power, monolithic amplifier. Manufactured using E-PHEMT* technology enables it to work with a single positive supply voltage. Unconditionally stable over the operating frequency.

## KEY FEATURES

| Feature | Advantages |
|---|---|
| Ultra Low Noise, 0.8 dB | Outstanding Noise Figure, measured in a 50 Ohm environment without any external matching |
| High IP3, 34 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, 60 mA | At only 60mA, the PMA-5456+ 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 PMA-5456+ 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 |
| MCLP Package | Low Inductance, repeatable transitions, excellent thermal pad |
| Max Input Power, +20 dBm | Ruggedized design operates up to input powers of +20 dBm without the need of an external limiter |
| High Reliability | Low, small signal operating current of 60mA nominal maintains junction temperatures typically below 125°C at 85°C ground lead temperature |
| Low additive phase noise, typically -161 dBc/Hz @10 KHz offset | Ideal for low phase noise synthesizer applications |

*Enhancement mode Pseudomorphic High Electron Mobility Transistor

REV. G
ECO-011027
PMA-5456+
TH/RS/CP/AM
211203

## ELECTRICAL SPECIFICATIONS[1] AT 25°C, ZO=50Ω (REFER TO CHARACTERIZATION CIRCUIT, SEE FIG. 1)

| Parameter | Condition (GHz) | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Frequency Range | | 0.05 | | 6.0 | GHz |
| DC Voltage ($V_d$) | | | 5.0 | | V |
| DC Current ($I_d$)[6] | | 47 | 60 | 80 | mA |
| DC Current ($I_{Rbias}$) | | | 2.4 | | mA |
| Noise Figure | 0.05<br>0.5<br>1.0<br>2.0<br>3.0<br>4.0<br>5.0<br>6.0 | | 1.8<br>0.8<br>0.8<br>1.0<br>1.3<br>1.6<br>1.9<br>2.4 | —<br>—<br>—<br>1.3<br>—<br>—<br>—<br>— | dB |
| Additive Phase Noise, 2.0 GHz, 10KHz offset | | | -160.5 | | dBc/Hz |
| Gain | 0.05<br>0.5<br>1.0<br>2.0<br>3.0<br>4.0<br>5.0<br>6.0 | —<br>—<br>—<br>12.7<br>—<br>—<br>—<br>— | 26.0<br>23.2<br>19.4<br>14.4<br>11.1<br>9.2<br>7.3<br>5.8 | —<br>—<br>—<br>15.8<br>—<br>—<br>—<br>— | dB |
| Input Return Loss | 0.05-0.5<br>0.5-6 | | 10.0<br>7.0 | | dB |
| Output Return Loss | 0.05-0.1<br>0.1-6 | | 15.0<br>20.0 | | dB |
| Output IP3 | 0.05<br>0.5<br>1.0<br>2.0<br>3.0<br>4.0<br>5.0<br>6.0 | | 31.8<br>33.0<br>34.0<br>36.0<br>36.4<br>36.4<br>37.2<br>37.2 | | dBm |
| Output Power @ 1 dB compression [2] | 0.05<br>0.5<br>1.0<br>2.0<br>3.0<br>4.0<br>5.0<br>6.0 | | 22.0<br>21.7<br>21.7<br>21.6<br>21.5<br>21.7<br>22.0<br>22.1 | | dBm |
| DC Current Variation vs. Temperature [3] | | | -0.072 | | mA/°C |
| Thermal Resistance | | | 128 | | °C/W |

## MAXIMUM RATINGS[4]

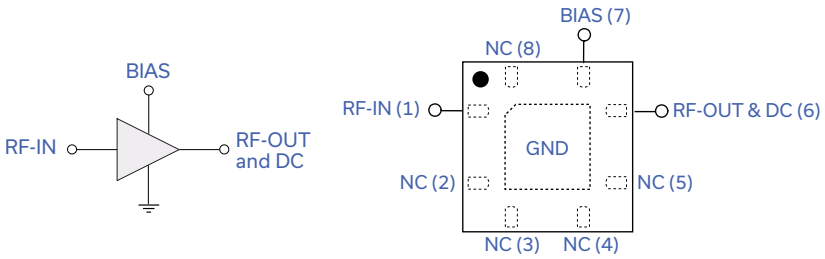
| Parameter | Ratings |
|---|---|
| Operating Temperature [5] | -40°C to 85°C |
| Storage Temperature | -55°C to 100°C |
| Channel Temperature | 150°C |
| DC Voltage (Pad 6) | 6V |
| Power Dissipation | 500mW |
| DC Current (Pad 6) | 100mA |
| Bias Current (Pad 7) | 10mA |
| Input Power[7] | 20dBm |

(4) Permanent damage may occur if any of these limits are exceeded. Electrical maximum ratings are not intended for continuous normal operation.
(5)Measured on Mini-Circuits test board, TB-736+

(1) Measured on Mini-Circuits Characterization test board TB-502+. See Characterization Test Circuit (Fig. 1)
(2) P1dB specified with external current limiting of 70mA;
(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 conditions. 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 80 mA. Maximum input power will degrade without external current limiting.

# Monolithic Amplifier PMA-5456+

## SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION




| Function | Pad Number | Description (See Application Circuit, Fig. 3) |
|---|---|---|
| RF-IN | 1 | RF input pad |
| RF-OUT & DC | 6 | RF output pad (connected to RF-OUT via blocking external cap C2, and Supply voltage Vs via RF Choke L1) |
| BIAS | 7 | Bias pad (connected to Vs via Rbias) |
| GND | paddle in center of bottom | Connected to ground |
| NOT USED | 2,3,4,5,8 | No internal connection; recommended use: per PCB Layout PL-299 |

## CHARACTERIZATION TEST CIRCUIT

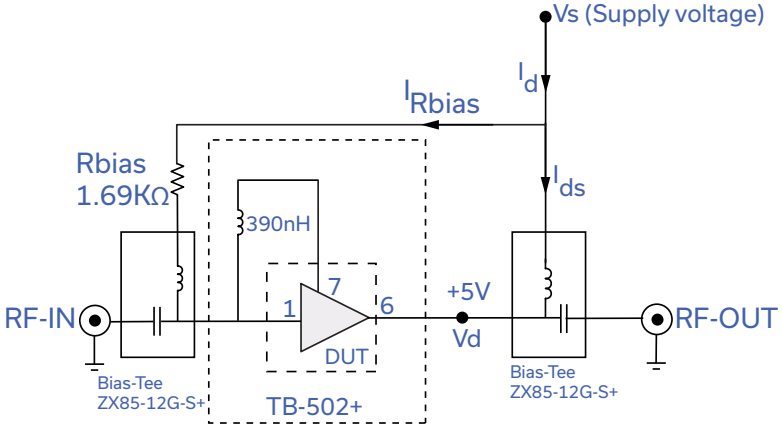
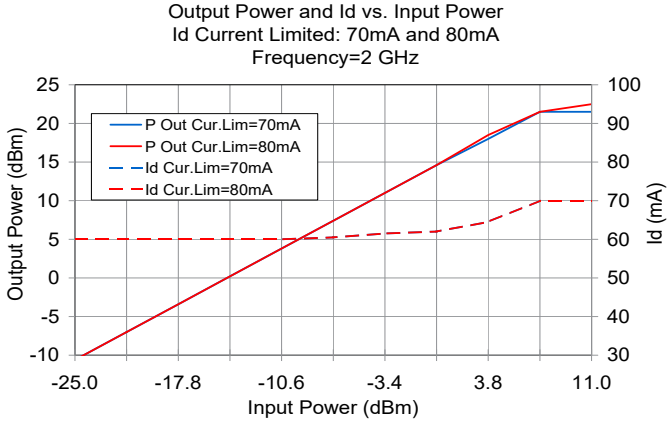



Fig 1. Block Diagram of Test Circuit used for characterization. (DUT soldered on Mini-Circuits Characterization Test Board TB-502+) Gain, Output power at 1dB compression (P1dB), Output IP3 (OIP3) and Noise Figure measured using Agilent's N5242A PNA-X Microwave network analyzer.

Conditions:
1. Gain: Pin=-25 dBm
2. Output IP3 (OIP3): Two tones, spaced 1 MHz apart, 5 dBm/tone at output.
3. Vs adjusted for 5V at device (Vd), compensating loss of bias tee.



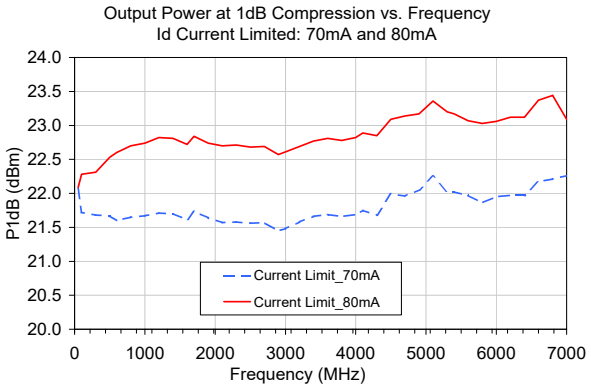




Fig 2. Output Power and Id vs. Input Power and Frequency.
Performance measured on Mini-Circuits Characterization test board TB-502+. See Characterization Test Circuit (Fig. 1)
Measurements performed with current (Id) limited as noted.

## RECOMMENDED APPLICATION CIRCUIT

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

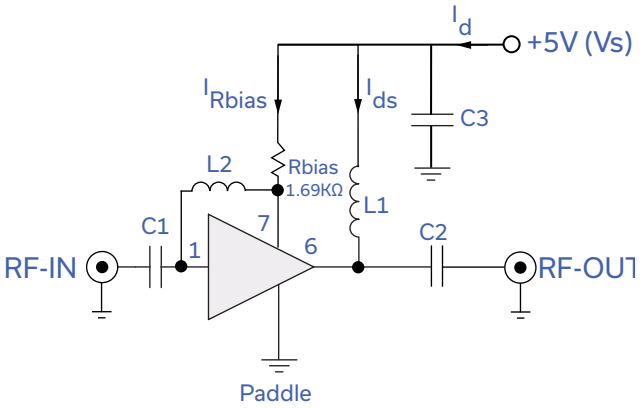
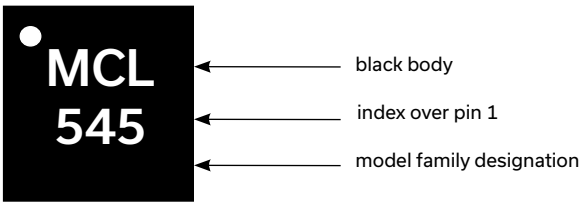



Fig 3. Recommended Application Circuit
Note: Resistance of L1, 0.1-0.2Ω typically

## PRODUCT MARKING




Marking may contain other features or characters for internal lot control

**ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASH BOARD. TO ACCESS CLICK HERE**

| | |
|---|---|
| Performance Data | Data Table<br>graphs, s-parameter data set (.zip file) |
| Case Style | DQ849<br>Plastic package, exposed paddle, lead finish: tin-silver over nickel |
| Tape & Reel<br>Standard quantities available on reel | F104<br>7" reels with 20, 50, 100, 200, 500, 1K, or 2K devices. |
| Suggested Layout for PCB Design | PL-299 |
| Evaluation Board | TB-501-6+ (50-5000 MHz) |
| Environmental Ratings | ENV08T1 |

## ESD RATING

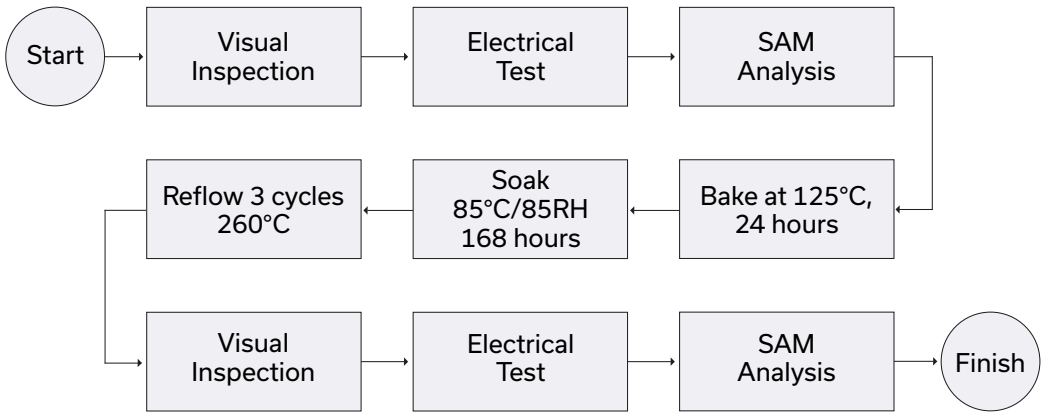
Human Body Model (HBM): Class 1A (250V to <500V) in accordance with ANSI/ESD STM 5.1 - 2001

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

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