



MMIC SURFACE MOUNT

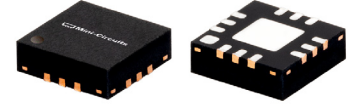
# Wideband Amplifier

## PMA3-15453+

50Ω 15 to 45 GHz High Dynamic Range

### THE BIG DEAL

- Low Noise Figure, Typ. 3.2 dB
- High OIP3, Typ. +25 dBm
- P1dB, Typ. +17 dBm
- Single +5 V positive supply voltage
- 3x3 mm, 12-Lead QFN-Style Package

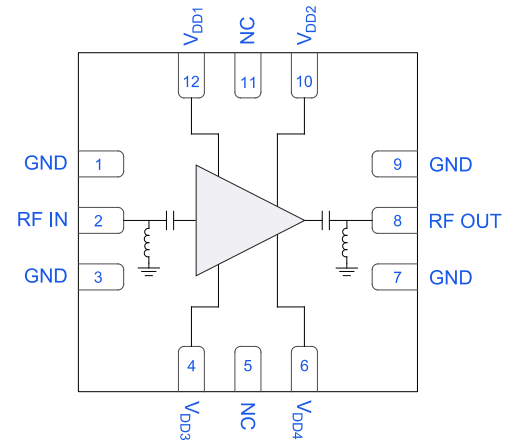


Generic photo used for illustration purposes only

### APPLICATIONS

- Test & Measurement Equipment
- 5G mmWave and Back Haul Radio Systems
- Satellite Communications
- Radar, EW, and ECM Defense Systems

### FUNCTIONAL DIAGRAM



### PRODUCT OVERVIEW

The PMA3-15453+ is a pHEMT based wideband, low noise MMIC amplifier with a unique combination of high dynamic range and low noise figure over a very broad bandwidth making it ideal for use in a wide variety of transmitter and receiver applications. This design operates on a single 5 V positive supply, is matched to 50 Ohm and comes in a tiny plastic package (3 x 3 x 0.89mm), accommodating dense circuit board layouts.

### KEY FEATURES

| Feature   | Advantages   |
|---|--|
| Low Noise Figure, Typ. 3.2 dB   | Enables lower system noise figure performance.   |
| High Dynamic Range <ul style="list-style-type: none"> <li>• OIP3, Typ. +25 dBm</li> <li>• P1dB, Typ. +17 dBm</li> </ul> | Offer low noise figure with correspondingly high P1dB and OIP3 enables flexibility to achieve systems performance with multiple device cascade signal chains |
| 3x3mm 12-lead QFN-Style Package   | Small footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB.               |





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Mini-Circuits

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ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C, V<sub>S</sub> = +5 V, UNLESS NOTED OTHERWISE

| Parameter   | Condition (GHz) | Min.  | Typ.   | Max.  | Units |
|---|-----------------|-------|--------|-------|-------|
| Frequency Range   |                 | 15    |        | 45    | GHz   |
| Gain  | 15              | 17.9  | 18.9   |       | dB    |
|   | 20              | 15.9  | 17.2   |       |       |
|   | 30              | 15.0  | 16.7   |       |       |
|   | 40              | 13.1  | 14.9   |       |       |
|   | 45              | 7.2   | 11.0   |       |       |
| Output Power at 1 dB Compression (P1dB)                       | 15              |       | +13.2  |       | dBm   |
|   | 20              |       | +13.0  |       |       |
|   | 30              |       | +17.1  |       |       |
|   | 40              |       | +15.0  |       |       |
|   | 45              |       | +12.1  |       |       |
| Output Third-Order Intercept (P <sub>OUT</sub> = -5 dBm/Tone) | 15              |       | +21    |       | dBm   |
|   | 20              |       | +23    |       |       |
|   | 30              |       | +25    |       |       |
|   | 40              |       | +25    |       |       |
|   | 45              |       | +24    |       |       |
| Input Return Loss   | 15              |       | 20     |       | dB    |
|   | 20              |       | 11     |       |       |
|   | 30              |       | 13     |       |       |
|   | 40              |       | 20     |       |       |
|   | 45              |       | 10     |       |       |
| Output Return Loss  | 15              |       | 12     |       | dB    |
|   | 20              |       | 10     |       |       |
|   | 30              |       | 12     |       |       |
|   | 40              |       | 21     |       |       |
|   | 45              |       | 14     |       |       |
| Isolation   | 15 - 45         |       | 40     |       | dB    |
| Noise Figure  | 15              |       | 2.6    |       | dB    |
|   | 20              |       | 2.8    |       |       |
|   | 30              |       | 3.2    |       |       |
|   | 40              |       | 3.7    |       |       |
|   | 45              |       | 5.2    |       |       |
| Device Operating Voltage (V <sub>S</sub> )                    |                 | +4.75 | +5.0   | +5.25 | V     |
| Device Operating Current (I <sub>S</sub> ) <sup>2</sup>       |                 |       | 128    |       | mA    |
| DC Current Variation vs. Temperature <sup>3</sup>             |                 |       | -19.23 |       | μA/°C |
| DC Current Variation vs. Voltage <sup>4</sup>                 |                 |       | 0.03   |       | mA/mV |

1. Tested in Mini-Circuits Characterization Test/Evaluation Board TB-PMA3-15453+. See Figure 2. Board loss de-embedded to the device.

2. Current at P<sub>IN</sub> = -25 dBm. Increases to 139 mA at P1dB.

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

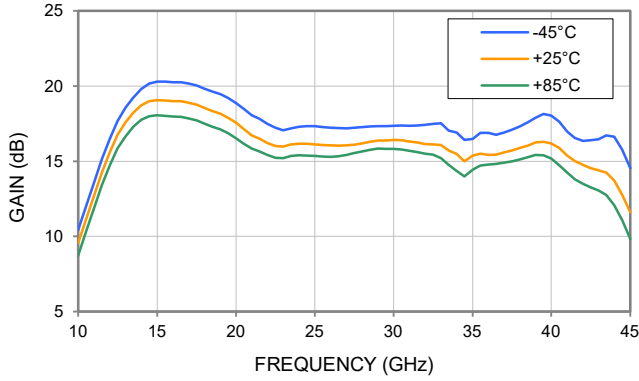
4. ((Current at +5.25 V mA) - (Current at +4.75V in mA)) / ((+5.25V - +4.75V) \* 1000 mA/mV)



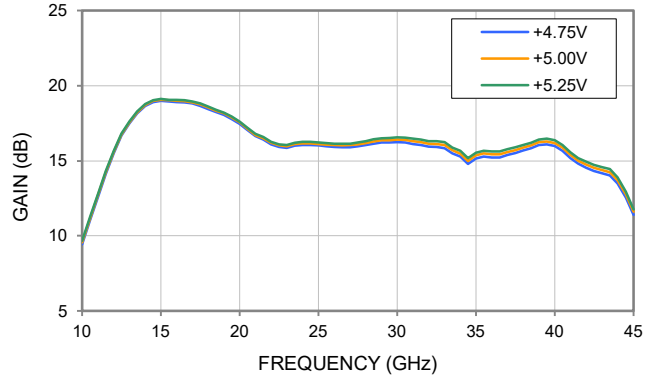


### TYPICAL PERFORMANCE GRAPHS

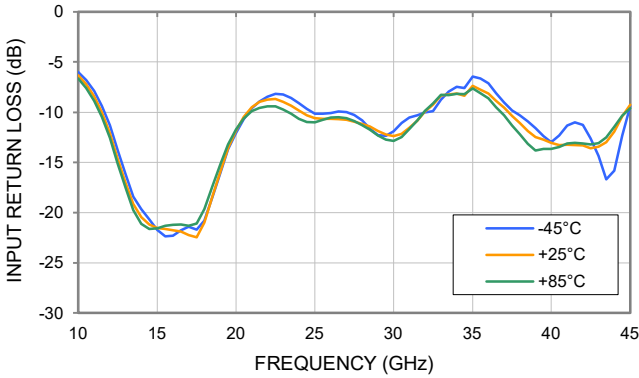
**GAIN vs. TEMPERATURE,**  
 $P_{IN} = -25 \text{ dBm}$ ,  $V_S = +5 \text{ V}$



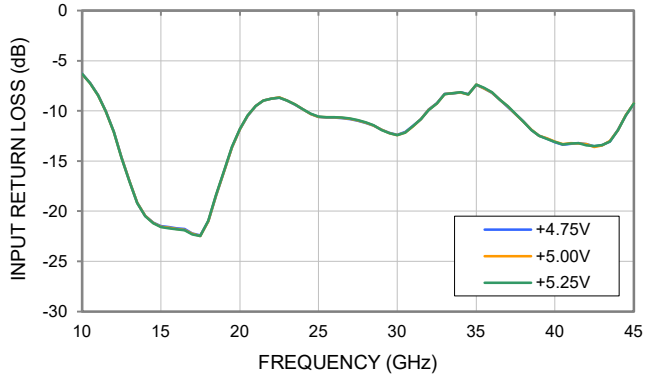
**GAIN vs. DEVICE VOLTAGE,**  
 $P_{IN} = -25 \text{ dBm}$ , TEMPERATURE = +25°C



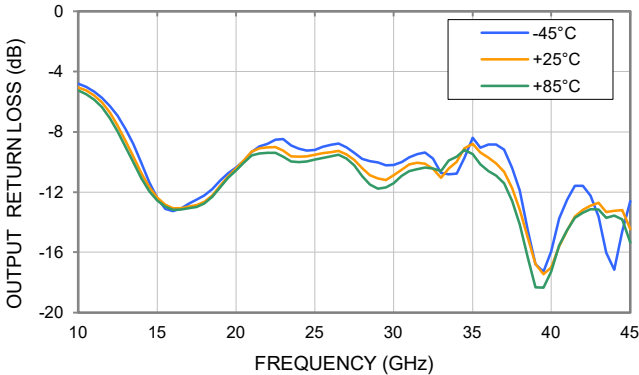
**INPUT RETURN LOSS vs. TEMPERATURE,**  
 $P_{IN} = -25 \text{ dBm}$ ,  $V_S = +5 \text{ V}$



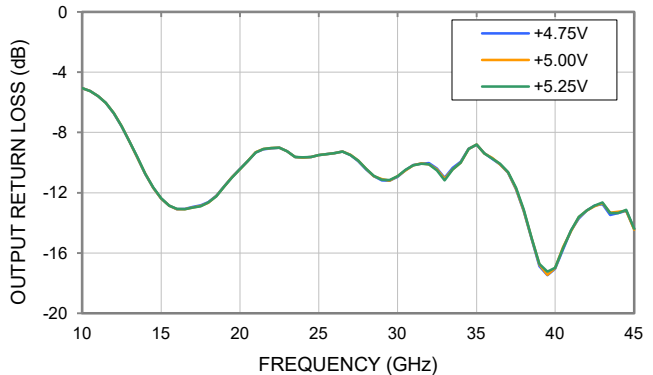
**INPUT RETURN LOSS vs. DEVICE VOLTAGE,**  
 $P_{IN} = -25 \text{ dBm}$ , TEMPERATURE = +25°C



**OUTPUT RETURN LOSS vs. TEMPERATURE,**  
 $P_{IN} = -25 \text{ dBm}$ ,  $V_S = +5 \text{ V}$

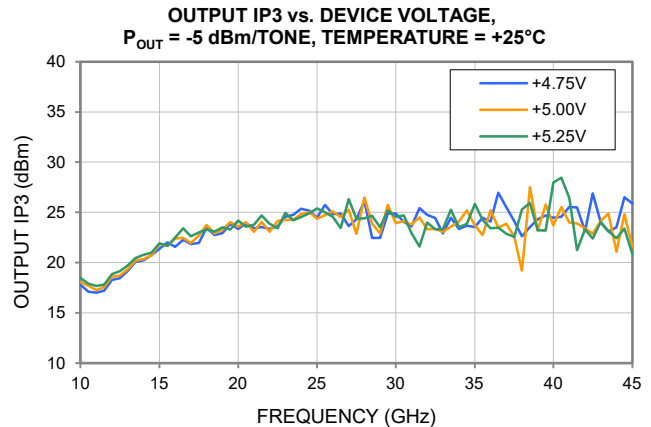
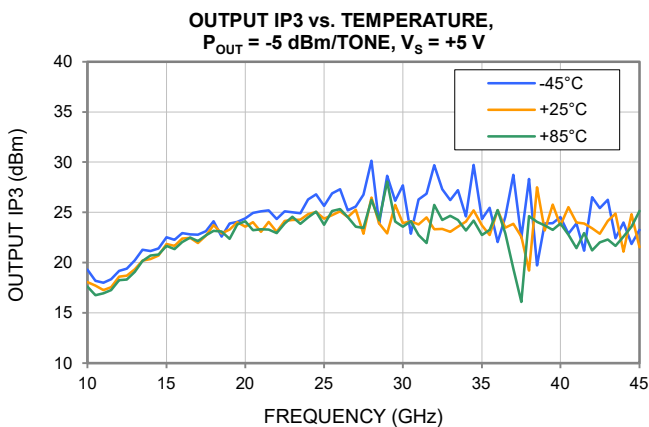
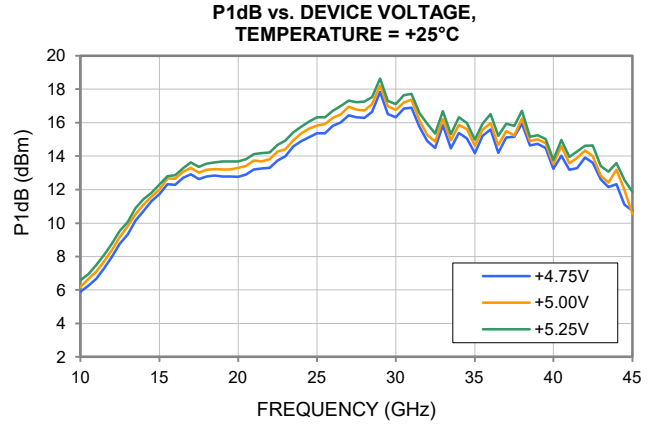
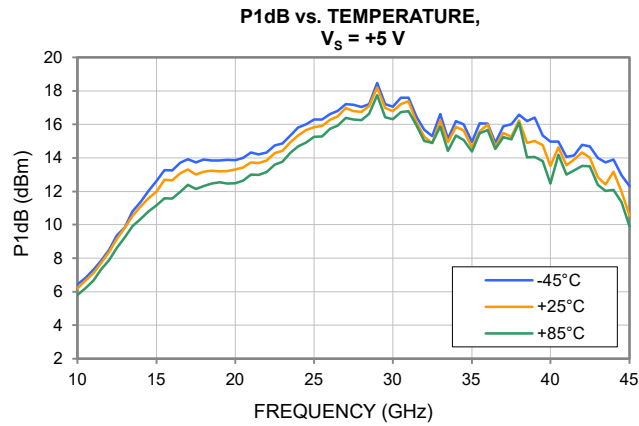
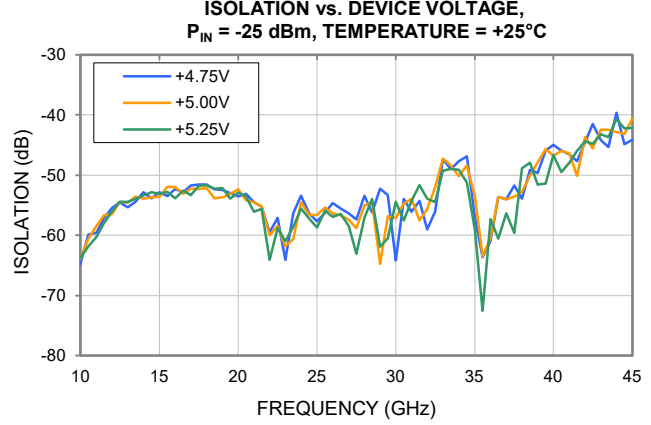
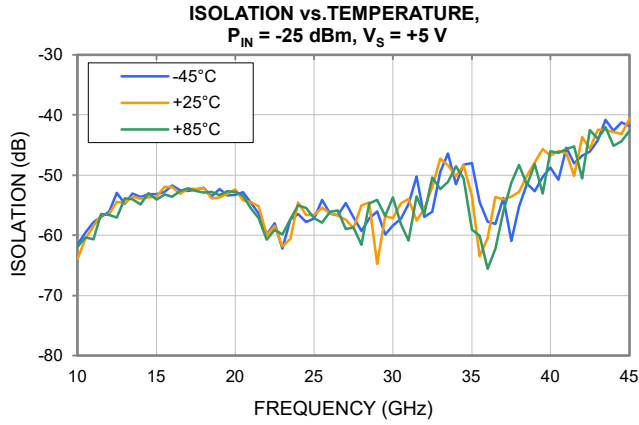


**OUTPUT RETURN LOSS vs. DEVICE VOLTAGE,**  
 $P_{IN} = -25 \text{ dBm}$ , TEMPERATURE = +25°C





### TYPICAL PERFORMANCE GRAPHS





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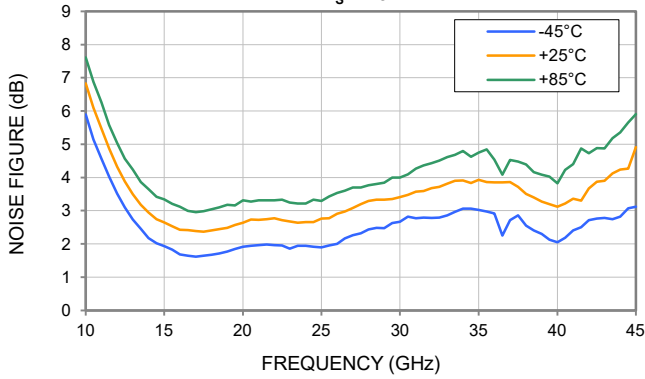
## PMA3-15453+

Mini-Circuits

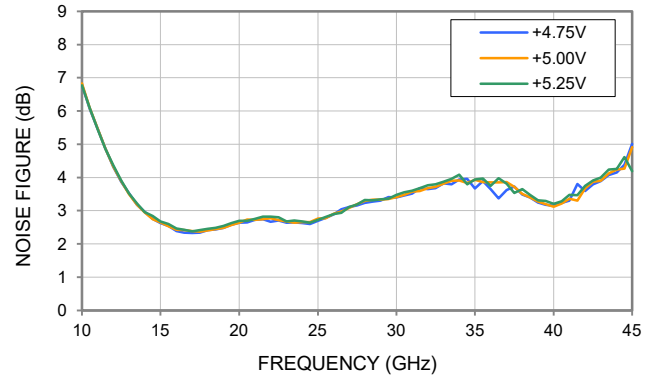
50Ω 15 to 45 GHz High Dynamic Range

### TYPICAL PERFORMANCE GRAPHS

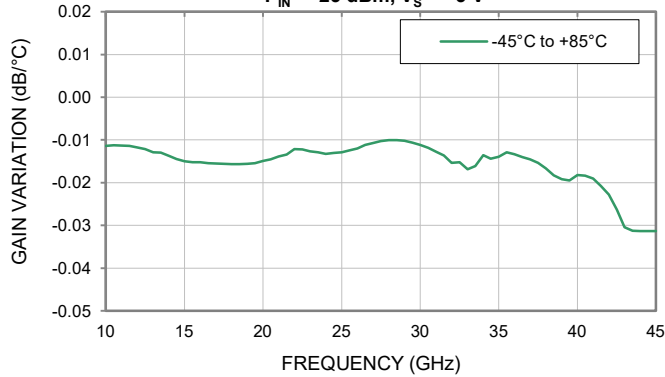
NOISE FIGURE vs. TEMPERATURE,  
 $V_S = +5\text{ V}$



NOISE FIGURE vs. DEVICE VOLTAGE,  
TEMPERATURE = +25°C



GAIN VARIATION vs. TEMPERATURE,  
 $P_{IN} = -25\text{ dBm}$ ,  $V_S = +5\text{ V}$





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## PMA3-15453+

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### ABSOLUTE MAXIMUM RATINGS<sup>5</sup>

| Parameter   | Ratings           |
|---|-------------------|
| Operating Temperature                                       | -45 °C to +85 °C  |
| Storage Temperature   | -65 °C to +150 °C |
| Junction Temperature <sup>6</sup>                           | +150 °C           |
| Total Power Dissipation                                     | 1.62 W            |
| Input Power (CW), $V_S = +5$ V                              | +23 dBm           |
| DC Voltage at $V_{DD1}$ , $V_{DD2}$ , $V_{DD3}$ , $V_{DD4}$ | +10 V             |

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

6. Peak temperature on top of Die.

### THERMAL RESISTANCE

| Parameter   | Ratings   |
|---|-----------|
| Thermal Resistance ( $\Theta_{JC}$ ) <sup>7</sup> | 32.2 °C/W |

7.  $\Theta_{JC}$  = (Hot Spot Temperature on Die - Temperature at Ground Lead)/Dissipated Power

### ESD RATING

|                        | Class | Voltage Range | Reference Standard          |
|------------------------|-------|---------------|-----------------------------|
| Human Body Model (HBM) | 1A    | 250V to <500V | ANSI/ESDA/JEDEC JS-001-2017 |



ESD HANDLING PRECAUTION: This device is designed to be Class 1A for HBM. Static charges may easily produce potentials higher than this with improper handling and can discharge into DUT and damage it. As a preventive measure Industry standard ESD handling precautions should be used at all times to protect the device from ESD damage.

### MSL RATING

Moisture Sensitivity: MSL1 in accordance with IPC/JEDEC J-STD-020E /JEDEC J-STD-033C





### FUNCTIONAL DIAGRAM

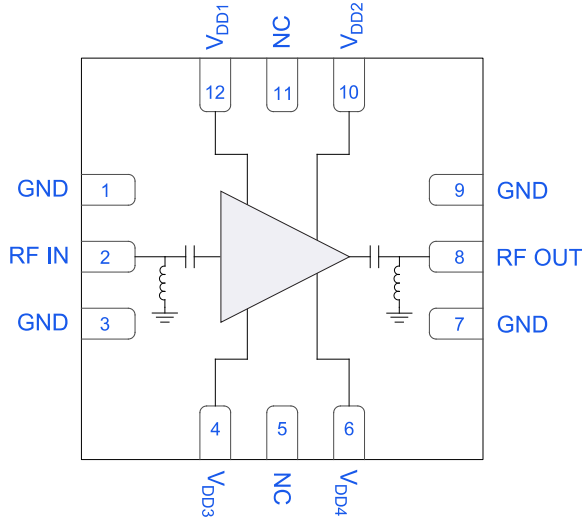


Figure 1. PMA3-15453+ Functional Diagram

### PAD DESCRIPTION

| Function         | Pad Number | Description (Refer to Figure 2)                              |
|------------------|------------|--|
| RF-IN            | 2          | RF-IN Pad connects to RF Input port.                         |
| RF-OUT           | 8          | RF-OUT Pad connects to RF Output port.                       |
| V <sub>DD1</sub> | 12         | DC Input Pad connects to voltage input port V <sub>DD1</sub> |
| V <sub>DD2</sub> | 10         | DC Input Pad connects to voltage input port V <sub>DD2</sub> |
| V <sub>DD3</sub> | 4          | DC Input Pad connects to voltage input port V <sub>DD3</sub> |
| V <sub>DD4</sub> | 6          | DC Input Pad connects to voltage input port V <sub>DD4</sub> |
| GND              | 1, 3, 7, 9 | Connects to ground   |
| NC               | 5, 11      | Not used internally. Connected to ground on test board.      |

### CHARACTERIZATION TEST BOARD

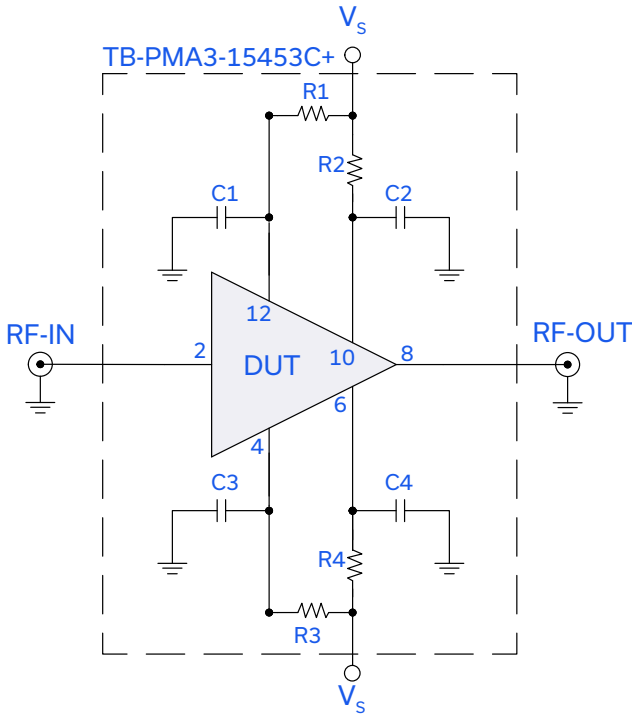


Figure 2. DUT soldered on Mini-Circuits Characterization Test Board: TB-PMA3-15453C+

Gain, Return Loss, Output Power at 1dB Compression (P<sub>1dB</sub>), Output IP<sub>3</sub> (OIP<sub>3</sub>) and Noise Figure measured using N5242A PNA-X microwave network analyzer.

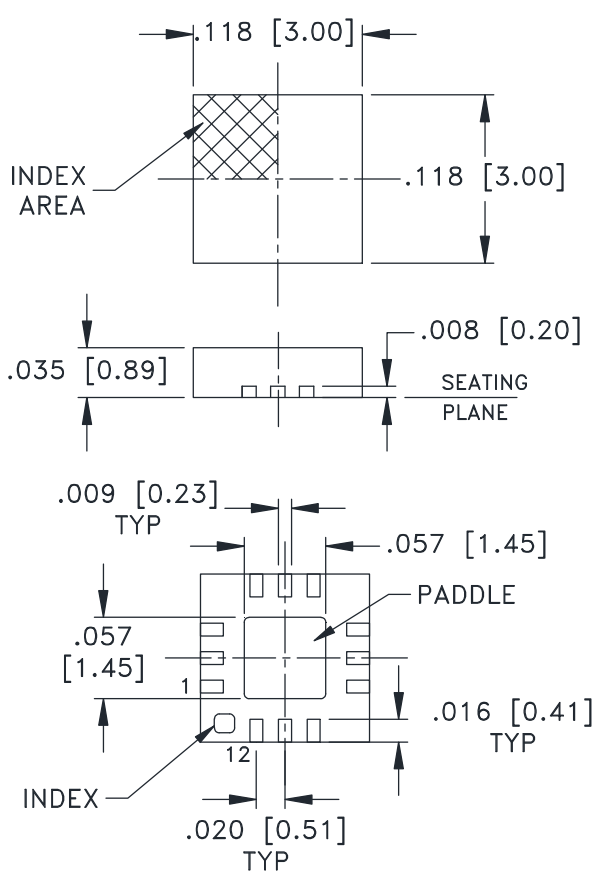
Conditions:

- Gain and Return Loss: P<sub>IN</sub> = -25 dBm
- Output IP<sub>3</sub> (OIP<sub>3</sub>): Two tones, spaced 1 MHz apart, -5 dBm/ tone at output.
- V<sub>s</sub> = +5 V

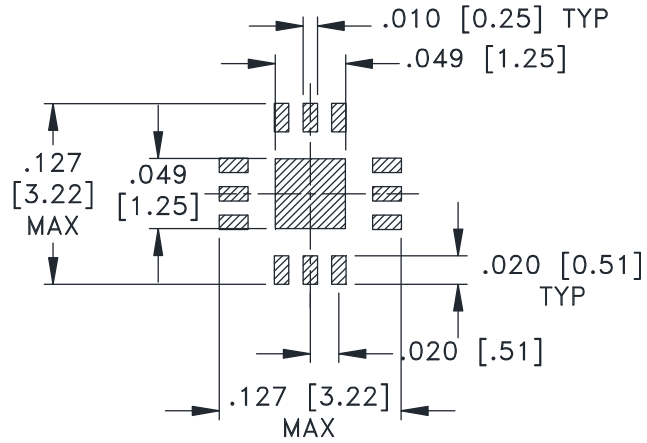
| Component      | Vendor | Vendor P/N         | Value  | Size |
|----------------|--------|--------------------|--------|------|
| C1, C2, C3, C4 | Murata | GRM1555C1H101JA01D | 100 pF | 0402 |
| R1, R3         | KOA    | SG73P1JTDD39R0F    | 39 Ω   | 0603 |
| R2, R4         | KOA    | SG73S1JTDD24R0F    | 24 Ω   | 0603 |



### CASE STYLE DRAWING



### PCB Land Pattern



SUGGESTED LAYOUT,  
TOLERANCE TO BE WITHIN ±.002

Weight: .02 Grams

Dimensions are in inches [mm]. Tolerances in inches: 2 Pl. ±.01; 3 Pl.±.004 inches

Figure 3. DQ1225 Case Style Drawing

### PRODUCT MARKING



Marking may contain other features or characters for internal lot control

Figure 4. PMA3-15453+ Product Marking



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## PMA3-15453+

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ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASHBOARD [CLICK HERE](#)

|  |  |
|--|--|
| <b>Performance Data</b>                      | Data<br>Graphs<br>S-Parameter (S2P Files) Data Set (.zip file) |
| <b>Case Style</b>                            | DQ1225 Plastic package, exposed paddle, lead finish: Matte-Tin |
| <b>RoHs Status</b>                           | Compliant  |
| <b>Tape &amp; Reel</b>                       | F66  |
| <b>Standard quantities available on reel</b> | 7" reels with 20, 50, 100, 200, 500,1K or 2K devices           |
| <b>Suggested Layout for PCB Design</b>       | PL-731   |
| <b>Evaluation Board</b>                      | TB-PMA3-15453C+<br>Gerber File                                 |
| <b>Environmental Ratings</b>                 | ENV08T1  |

### 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/terms/viewterm.html](http://www.minicircuits.com/terms/viewterm.html)



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