



MMIC SURFACE MOUNT

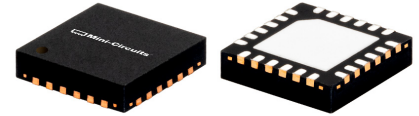
# Wideband Amplifier

LVA-273PN+

50Ω 0.01 to 26.5 GHz Ultra-Low Additive Phase

## THE BIG DEAL

- Wide Bandwidth 0.01 to 26.5 GHz
- Ultra-low Phase Noise Typ. -172 dBc/Hz @ 10 kHz Offset
- Output P1dB Typ. +18 dBm
- Output IP3 Typ. +28 dBm
- Supply Voltage: +5 V and 85 mA
- 4x4mm 24-Lead QFN-style Package

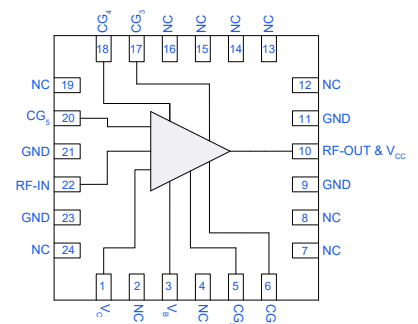


Generic photo used for illustration purposes only

## APPLICATIONS

- Test and Measurement Equipment
- Radar, EW, and ECM Defense Systems
- 5G MIMO and Back Haul Radio Systems
- Signal Distribution Networks

## FUNCTIONAL DIAGRAM



## PRODUCT OVERVIEW

Mini-Circuits LVA-273PN+ is an ultra-low phase noise distributed MMIC amplifier fabricated on a GaAs HBT process technology. Operating from 0.01 to 26.5 GHz, this amplifier features high dynamic range and ultra-low phase noise along with 18dB gain, +18dBm P1dB, +28 dBm OIP3, and 3.7 dB noise figure. The LVA-273PN+ is ideal for use with low noise signal sources and highly sensitive transceiver signal chains for commercial, industrial, and defense applications.

## KEY FEATURES

| Features                                                                                                                              | Advantages                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wide Bandwidth: 0.01 to 26.5 GHz                                                                                                      | Supports a broad variety of applications including Test and Measurement Equipment, 5G Microwave Radio, Radar, and Electronic Warfare Systems.                                                   |
| Ultra-low Phase Noise:<br>-172 dBc/Hz @ 10 kHz offset                                                                                 | Enables the detection of signal levels in the presence of noise.                                                                                                                                |
| High Dynamic Range: <ul style="list-style-type: none"><li>• +18 dBm P1dB</li><li>• 18 dB Gain</li><li>• 3.7 dB Noise Figure</li></ul> | The MMIC amplifier's unique combination of ultra-low phase noise, high operating P1dB, high gain, and low noise features enable optimum performance for high dynamic range transceiver systems. |
| 4x4mm 24-Lead QFN-style package                                                                                                       | Small footprint saves space in dense layouts while providing low inductance, repeatable transitions, and excellent thermal contact to the PCB.                                                  |



MMIC SURFACE MOUNT

## Wideband Amplifier

LVA-273PN+

Mini-Circuits

50Ω 0.01 to 26.5 GHz Ultra-Low Additive Phase

ELECTRICAL SPECIFICATIONS<sup>1</sup> AT +25°C,  $V_{CC} = +5V$ ,  $V_C = +5V$ ,  $V_B = +5V$ , &  $Z_0 = 50\Omega$  UNLESS NOTED OTHERWISE

| Parameter                                                             | Condition (GHz) | Min.  | Typ.  | Max.  | Units  |
|-----------------------------------------------------------------------|-----------------|-------|-------|-------|--------|
| Frequency Range                                                       |                 | 0.01  |       | 26.5  | GHz    |
| Gain                                                                  | 0.01            |       | 19.5  |       | dB     |
|                                                                       | 5               |       | 17.7  |       |        |
|                                                                       | 10              |       | 17.7  |       |        |
|                                                                       | 20              |       | 17.2  |       |        |
|                                                                       | 26.5            |       | 17.9  |       |        |
| Input Return Loss                                                     | 0.01            |       | 16.4  |       | dB     |
|                                                                       | 5               |       | 16.5  |       |        |
|                                                                       | 10              |       | 20.0  |       |        |
|                                                                       | 20              |       | 12.8  |       |        |
|                                                                       | 26.5            |       | 15.2  |       |        |
| Output Return Loss                                                    | 0.01            |       | 18.2  |       | dB     |
|                                                                       | 5               |       | 14.3  |       |        |
|                                                                       | 10              |       | 14.4  |       |        |
|                                                                       | 20              |       | 13.7  |       |        |
|                                                                       | 26.5            |       | 9.1   |       |        |
| Isolation                                                             | 0.01-26.5       |       | 41.2  |       | dB     |
| Output Power at 1dB Compression<br>(P <sub>1dB</sub> ) <sup>2</sup>   | 0.01            |       | +19.9 |       | dBm    |
|                                                                       | 5               |       | +17.6 |       |        |
|                                                                       | 10              |       | +18.3 |       |        |
|                                                                       | 20              |       | +16.1 |       |        |
|                                                                       | 26.5            |       | +11.0 |       |        |
| Output Power at 3dB Compression<br>(P <sub>3dB</sub> ) <sup>3</sup>   | 0.01            |       | +21.6 |       | dBm    |
|                                                                       | 5               |       | +21.2 |       |        |
|                                                                       | 10              |       | +20.6 |       |        |
|                                                                       | 20              |       | +17.6 |       |        |
|                                                                       | 26.5            |       | +13.1 |       |        |
| Output Third-Order Intercept Point<br>(P <sub>OUT</sub> = -2dBm/Tone) | 0.01            |       | +27.4 |       | dBm    |
|                                                                       | 5               |       | +27.1 |       |        |
|                                                                       | 10              |       | +27.8 |       |        |
|                                                                       | 20              |       | +26.4 |       |        |
|                                                                       | 26.5            |       | +19.3 |       |        |
| Input Third-Order Intercept Point<br>(P <sub>OUT</sub> = -2dBm/Tone)  | 0.01            |       | +7.9  |       | dBm    |
|                                                                       | 5               |       | +9.4  |       |        |
|                                                                       | 10              |       | +10.1 |       |        |
|                                                                       | 20              |       | +9.2  |       |        |
|                                                                       | 26.5            |       | +1.4  |       |        |
| Noise Figure                                                          | 2               |       | 7.7   |       | dB     |
|                                                                       | 5               |       | 4.3   |       |        |
|                                                                       | 10              |       | 3.7   |       |        |
|                                                                       | 20              |       | 5.6   |       |        |
|                                                                       | 26.5            |       | 9.2   |       |        |
| Additive Phase Noise (@10kHz Offset)                                  |                 |       | -172  |       | dBc/Hz |
| Device Operating Voltage ( $V_{CC}$ )                                 |                 | +4.75 | +5    | +5.25 | V      |
| Device Operating Current ( $I_{CC}$ ) <sup>4</sup>                    |                 |       | 85    |       | mA     |
| Control Voltage ( $V_C$ )                                             |                 |       | +5    |       | V      |
| Control Current ( $I_C$ )                                             |                 |       | 1.2   |       | mA     |
| Base Voltage ( $V_B$ )                                                |                 |       | +5    |       | V      |
| Base Current ( $I_B$ )                                                |                 |       | 4.5   |       | mA     |
| Device Current Variation Vs. Temperature <sup>5</sup>                 |                 |       | 7     |       | uA/°C  |
| Device Current Variation Vs. Voltage <sup>6</sup>                     |                 |       | 0.013 |       | mA/mV  |

1. Tested on Mini-Circuits Characterization Test Board TB-LVA-273PNC+. See Figure 2. De-embedded to the device reference plane. Device does not feature internal blocking capacitors so that low frequency performance could be achieved.

2. Defined as Output Power at which Gain is compressed by 1dB.

3. Defined as Output Power at which Gain is compressed by 3dB.

4. Current at P<sub>IN</sub> = -25dBm. Increases to 105mA at P<sub>3dB</sub>.

5. ((Current in mA at +105°C) - (Current in mA at -45°C))/(+150 °C)

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

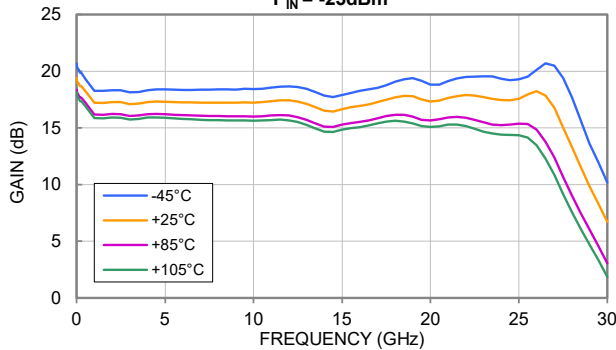




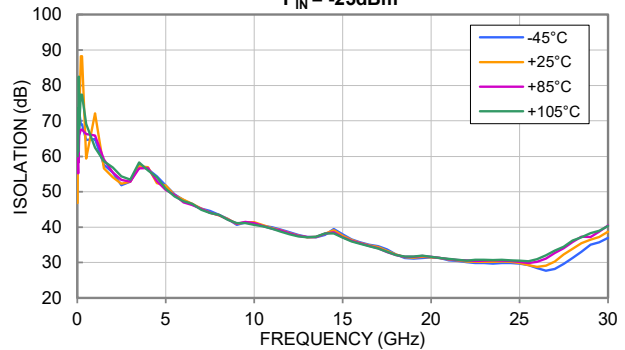
## TYPICAL PERFORMANCE GRAPHS

Note: All data taken at nominal conditions  $V_{CC} = +5V$ ,  $V_C = +5V$ , and  $V_B = +5V$  unless noted otherwise.

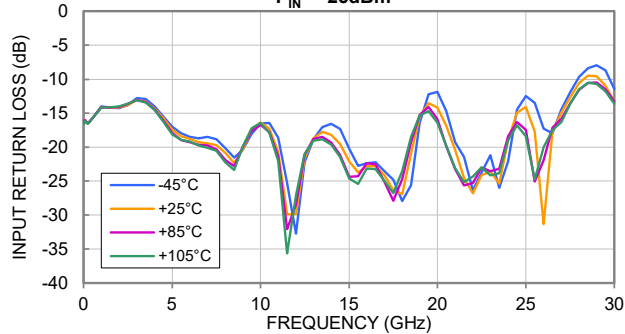
**GAIN vs. TEMPERATURE**  
 $P_{IN} = -25dBm$



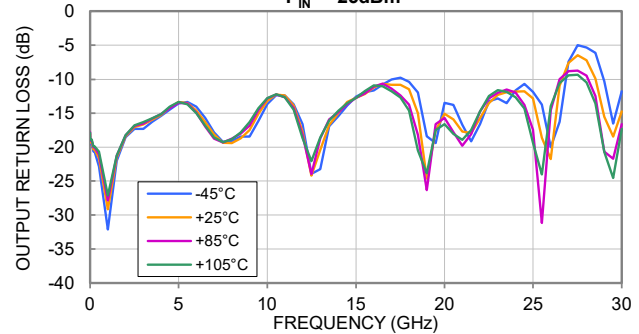
**ISOLATION vs. TEMPERATURE**  
 $P_{IN} = -25dBm$



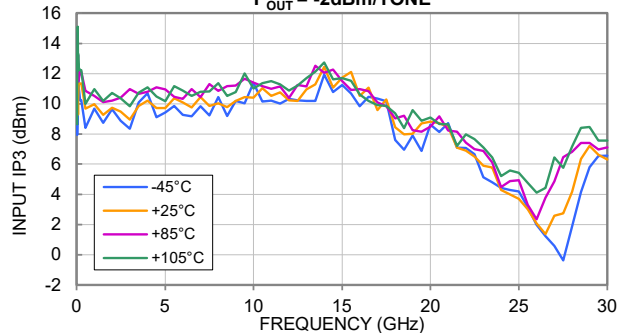
**INPUT RETURN LOSS vs. TEMPERATURE**  
 $P_{IN} = -25dBm$



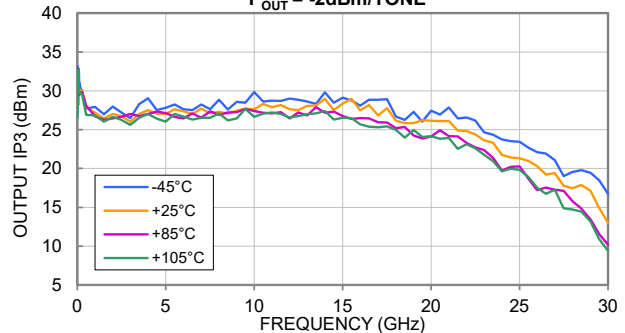
**OUTPUT RETURN LOSS vs. TEMPERATURE**  
 $P_{IN} = -25dBm$



**INPUT IP3 vs. TEMPERATURE**  
 $P_{OUT} = -2dBm/TONE$



**OUTPUT IP3 vs. TEMPERATURE**  
 $P_{OUT} = -2dBm/TONE$





MMIC SURFACE MOUNT

# Wideband Amplifier

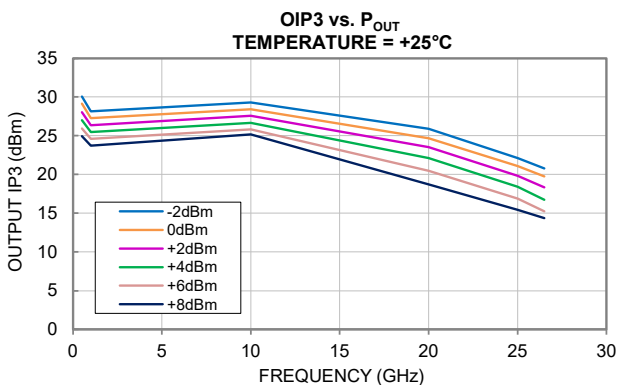
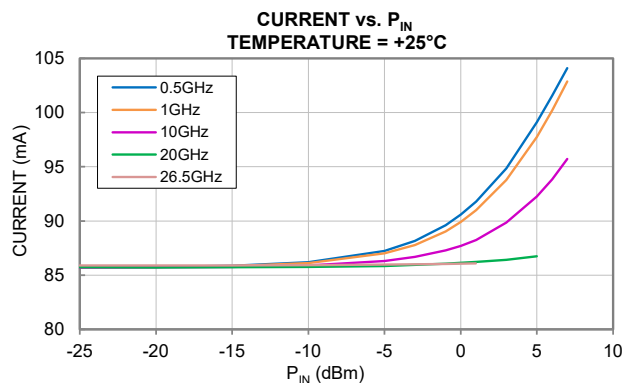
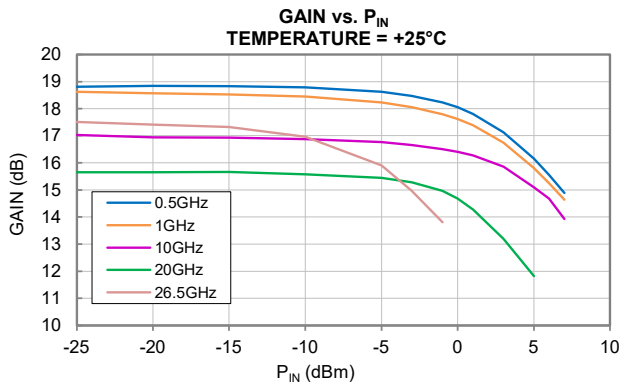
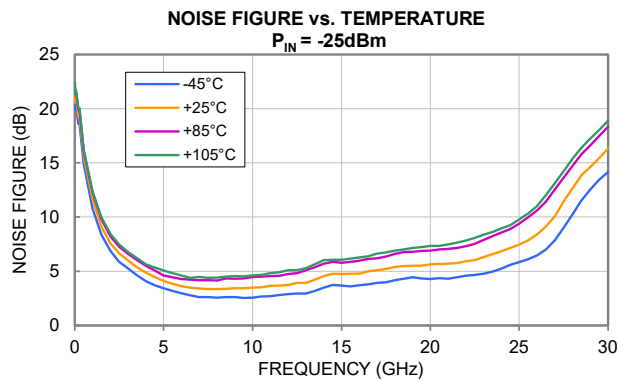
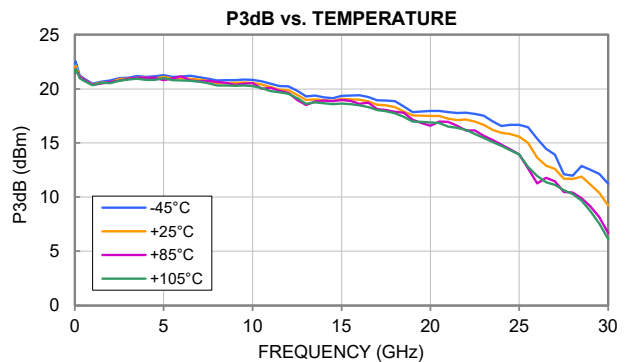
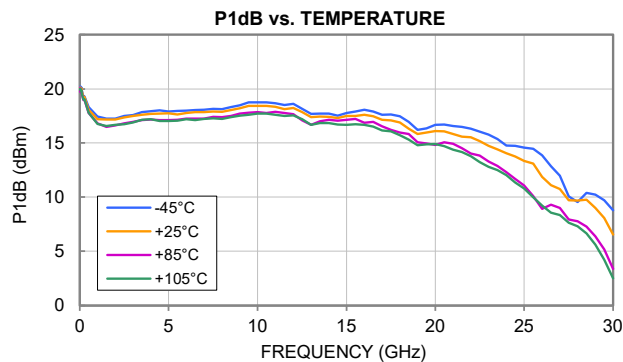
LVA-273PN+

Mini-Circuits

50Ω 0.01 to 26.5 GHz Ultra-Low Additive Phase

## TYPICAL PERFORMANCE GRAPHS

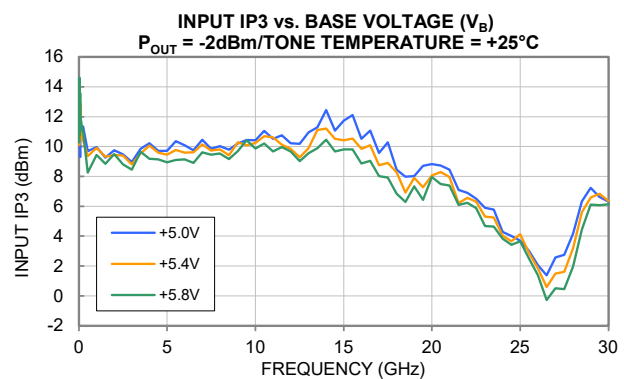
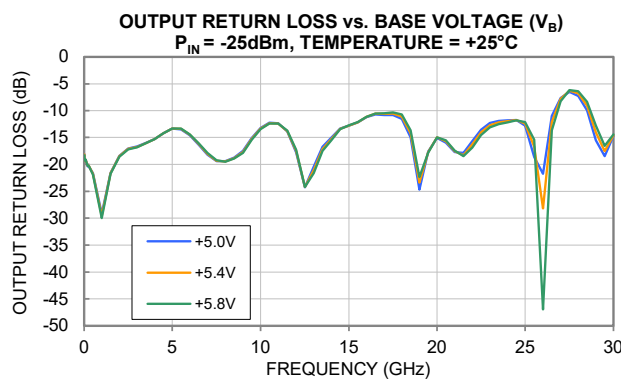
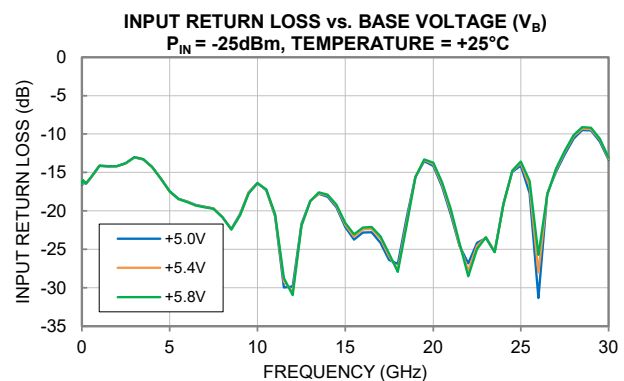
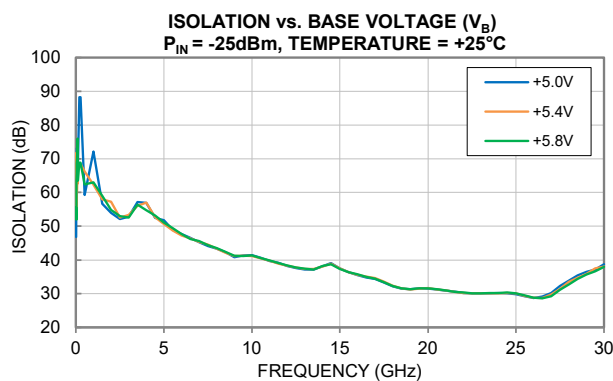
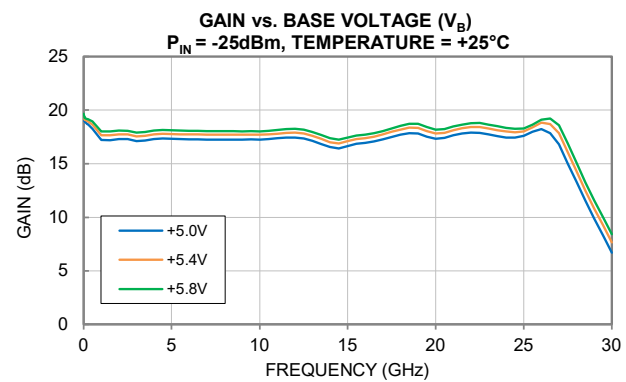
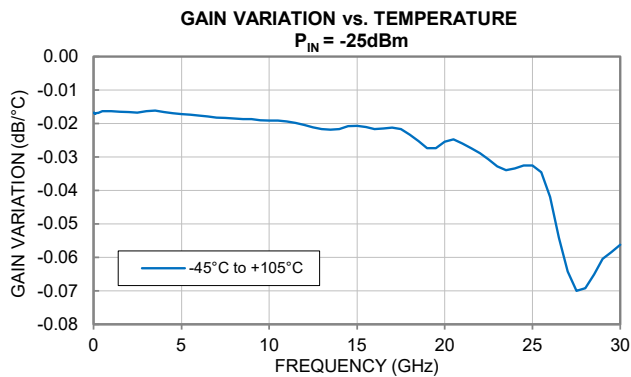
Note: All data taken at nominal conditions  $V_{CC} = +5V$ ,  $V_C = +5V$ , and  $V_B = +5V$  unless noted otherwise.





## TYPICAL PERFORMANCE GRAPHS

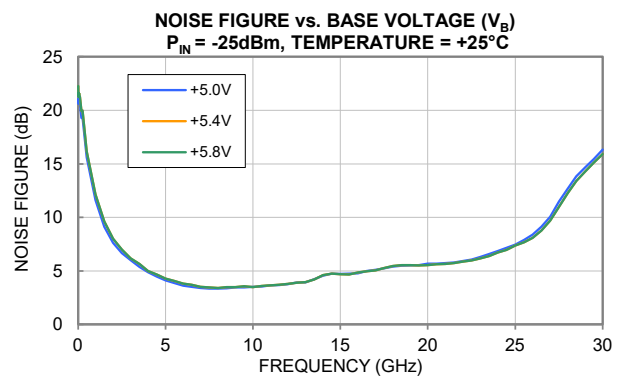
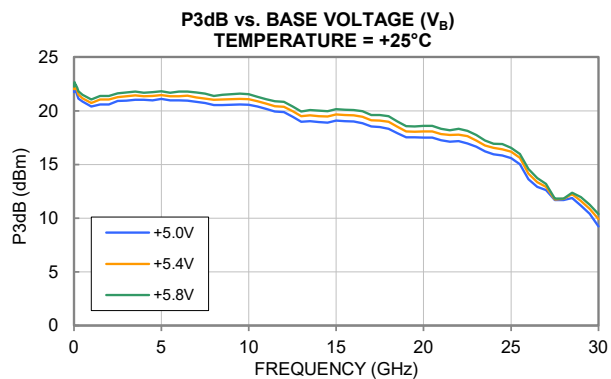
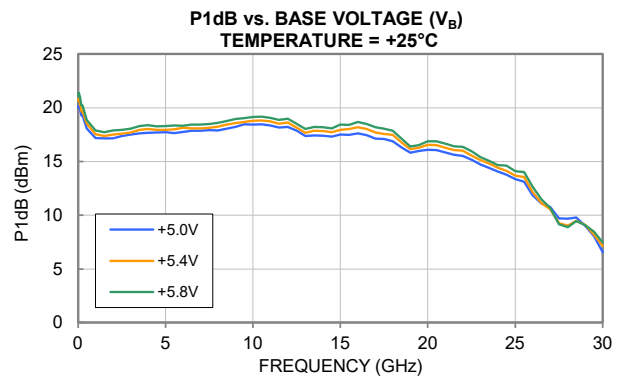
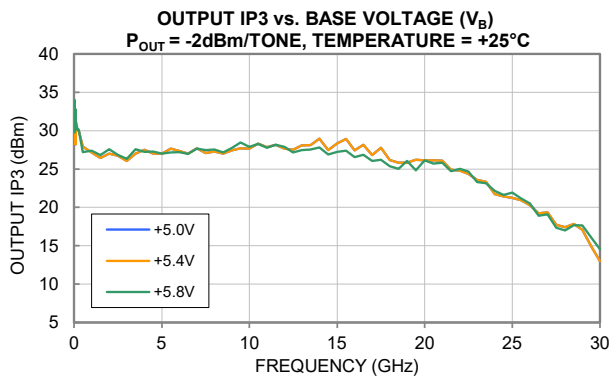
Note: All data taken at nominal conditions  $V_{CC} = +5V$ ,  $V_C = +5V$ , and  $V_B = +5V$  unless noted otherwise.





## TYPICAL PERFORMANCE GRAPHS

Note: All data taken at nominal conditions  $V_{CC} = +5V$  and  $V_C = +5V$  unless noted otherwise.





MMIC SURFACE MOUNT

# Wideband Amplifier

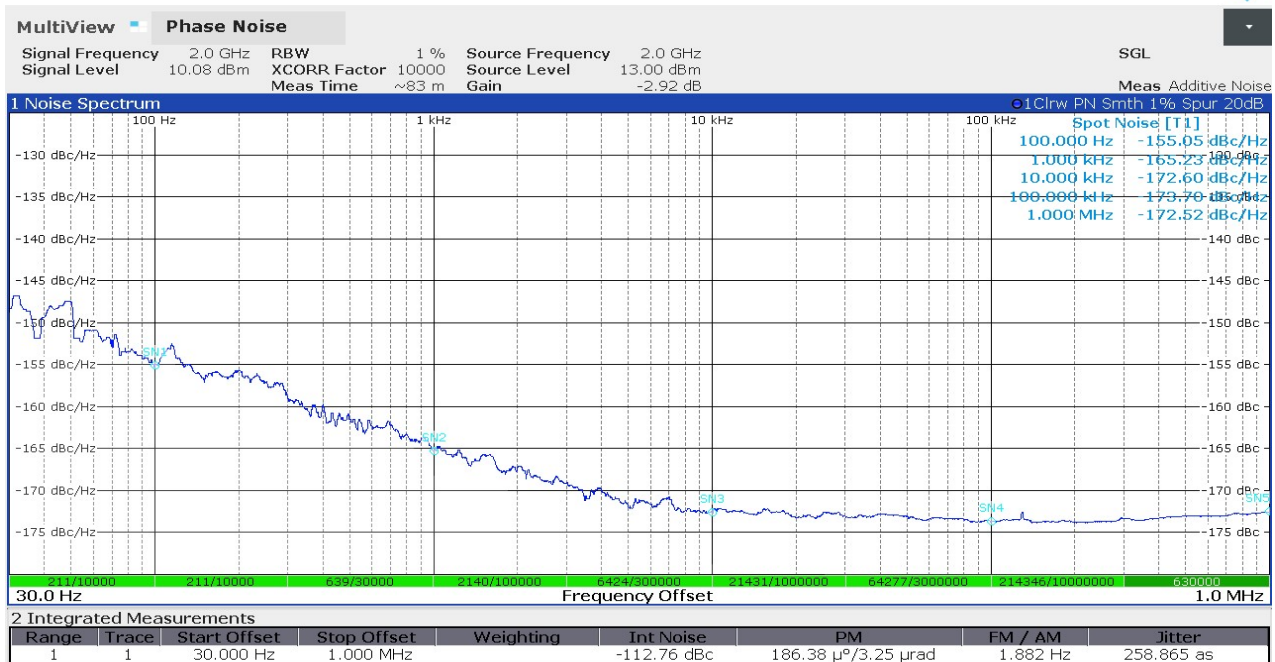
LVA-273PN+

Mini-Circuits

50Ω 0.01 to 26.5 GHz Ultra-Low Additive Phase

## TYPICAL PERFORMANCE GRAPHS

Note: All data taken at nominal conditions  $V_{CC} = +5V$ ,  $V_C = +5V$ , and  $V_B = +5V$  unless noted otherwise.





MMIC SURFACE MOUNT

# Wideband Amplifier

**LVA-273PN+**

50Ω 0.01 to 26.5 GHz Ultra-Low Additive Phase

## ABSOLUTE MAXIMUM RATINGS<sup>7</sup>

| Parameter                                                    | Ratings         |
|--------------------------------------------------------------|-----------------|
| Operating Temperature (ground lead)                          | -45°C to +105°C |
| Storage Temperature                                          | -65°C to +150°C |
| Total Power Dissipation                                      | 1.54W           |
| Junction Temperature <sup>8</sup>                            | +150°C          |
| Input Power (CW), $V_{CC} = +5V$ , $V_C = +5V$ , $V_B = +5V$ | +25dBm          |
| DC Voltage on RF-OUT & $V_{CC}$                              | +10V            |
| DC Voltage on RF-IN                                          | +10V            |
| Current $I_{CC}$                                             | 150mA           |
| DC Voltage on $V_C$                                          | +10V            |
| Current $I_C$                                                | 5mA             |
| DC Voltage on $V_B$                                          | +10V            |
| Current $I_B$                                                | 14mA            |

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

8. Peak temperature on top of Die.

## THERMAL RESISTANCE

| Parameter                                         | Ratings  |
|---------------------------------------------------|----------|
| Thermal Resistance ( $\Theta_{JC}$ ) <sup>9</sup> | 29.2°C/W |

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

## ESD RATING

|     | Class | Voltage Range   | Reference Standard          |
|-----|-------|-----------------|-----------------------------|
| HBM | 1B    | 500V to < 1000V | ANSI/ESDA/JEDEC JS-001-2017 |
| CDM | C2    | 500V to < 1000V | JESD22-C101F                |



ESD HANDLING PRECAUTION: This device is designed to be Class 1B 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





MMIC SURFACE MOUNT

# Wideband Amplifier

LVA-273PN+

Mini-Circuits

50Ω 0.01 to 26.5 GHz Ultra-Low Additive Phase

## FUNCTIONAL DIAGRAM

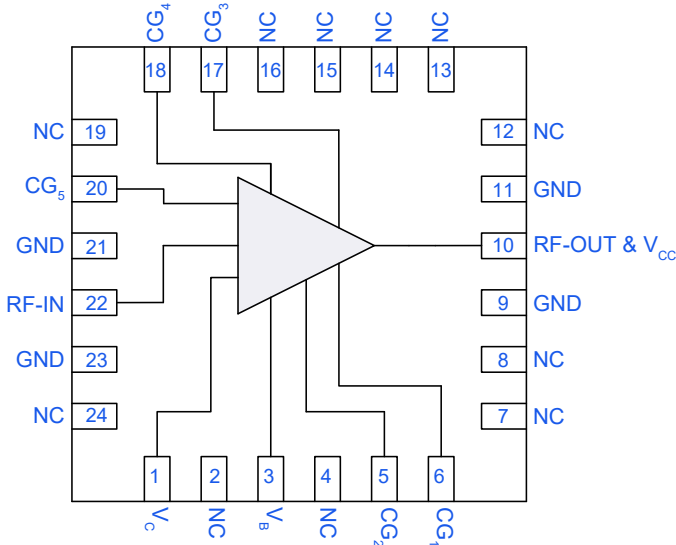
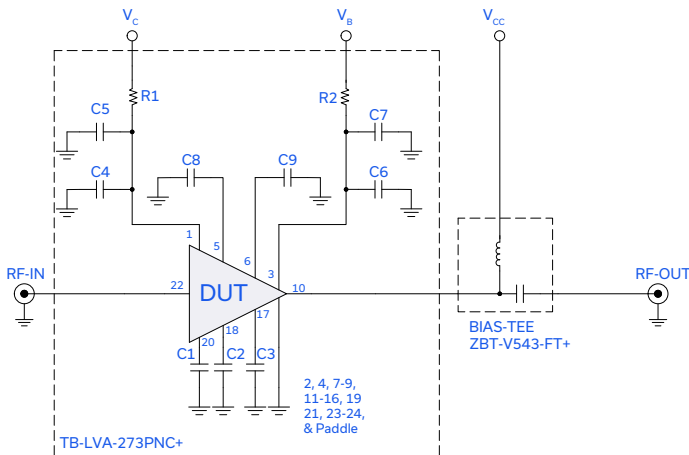


Figure 1. LVA-273PN+ Functional Diagram

## PAD DESCRIPTION

| Function                 | Pad Number                | Application Description (Refer to Figure 2)                   |
|--------------------------|---------------------------|---------------------------------------------------------------|
| RF-IN                    | 22                        | RF-IN Pad connects to RF input port.                          |
| RF-OUT & V <sub>CC</sub> | 10                        | RF-OUT Pad connects to RF output and V <sub>CC</sub> port.    |
| V <sub>C</sub>           | 1                         | DC Input Pad connects to voltage input port, V <sub>C</sub> . |
| V <sub>B</sub>           | 3                         | DC Input Pad connects to voltage input port, V <sub>B</sub> . |
| CG <sub>1</sub>          | 6                         | Connects to AC ground through external capacitor C9.          |
| CG <sub>2</sub>          | 5                         | Connects to AC ground through external capacitor C8.          |
| CG <sub>3</sub>          | 17                        | Connects to AC ground through external capacitor C3.          |
| CG <sub>4</sub>          | 18                        | Connects to AC ground through external capacitor C2.          |
| CG <sub>5</sub>          | 20                        | Connects to AC ground through external capacitor C1.          |
| GND                      | 9, 11, 21, 23, & Paddle   | Connects to ground.                                           |
| NC                       | 2, 4, 7, 8, 12-16, 19, 24 | Not used internally. Connects to ground on evaluation board.  |

## EVALUATION BOARD



### Electrical Parameters and Conditions

Gain, Return Loss, Output Power at 1dB Compression (P1dB), Output Power at 3dB Compression (P3dB), Output IP3 (OIP3), and Noise Figure measured using N5247B PNA-X Microwave Network Analyzer.

#### Conditions:

1. Gain, Noise Figure, and Return Loss: P<sub>IN</sub> = -25dBm.
2. Output IP3 (OIP3): Two tones, spaced 1MHz apart, -2dBm/tone at output.

#### Power ON/Power OFF Sequence

Caution: Permanent damage to the device will occur if the Power ON and Power OFF Sequences are not followed.

#### Power ON:

- 1) Set V<sub>CC</sub> = +5V.
- 2) Set V<sub>C</sub> = +5V.
- 3) Set V<sub>B</sub> = +5V.
- 4) Turn on V<sub>CC</sub>, V<sub>C</sub>, and V<sub>B</sub>.
- 5) Apply RF Signal.

#### Power OFF:

- 1) Turn off RF Signal.
- 2) Turn off V<sub>CC</sub>, V<sub>C</sub>, and V<sub>B</sub>.

Note: Bias Tee ZBT-V543-FT+ is external to the Evaluation Board TB-LVA-273PNC+. To achieve proper low frequency performance, no blocking capacitors were used on the input of the DUT.

Figure 2. DUT soldered on Mini-Circuits Evaluation Board: TB-LVA-273PNC+

| Component  | Value  | Size | Part Number        | Manufacturer |
|------------|--------|------|--------------------|--------------|
| C1         | 5100pF | 0603 | GCM1885C1H512JA16D | Murata       |
| C2         | 1μF    | 0603 | GCM188R71E105KA64J | Murata       |
| C3, C9     | 1000pF | 0402 | GRM1555C1H102JA01D | Murata       |
| C4, C6     | 100pF  | 0402 | GRM1555C1H101JA01D | Murata       |
| C5, C7, C8 | 0.1μF  | 0402 | GRM155R71H104KE14J | Murata       |
| R1, R2     | 0Ω     | 0402 | RK73Z1ETTP         | KOA Spear    |

Mini-Circuits



MMIC SURFACE MOUNT

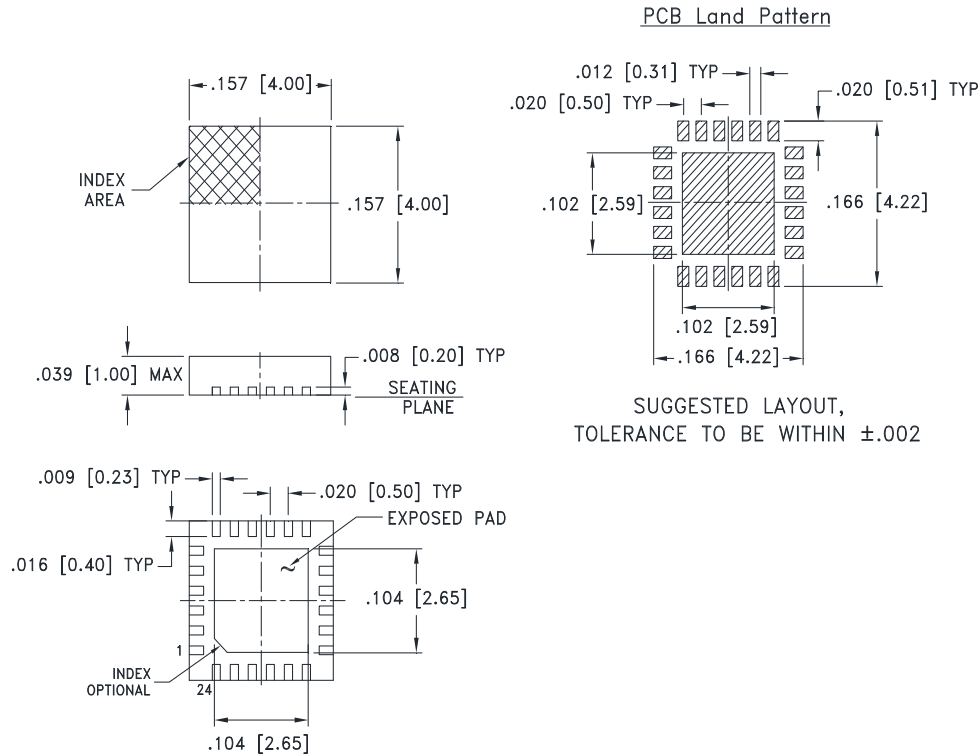
# Wideband Amplifier

**LVA-273PN+**

Mini-Circuits

50Ω 0.01 to 26.5 GHz Ultra-Low Additive Phase

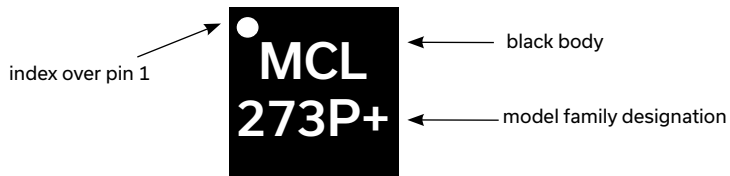
## CASE STYLE DRAWING



Weight: .04 Grams

Dimensions are in inches [mm]. Tolerances in inches: 2 Pl.  $\pm .01$ ; 3 Pl.  $\pm .005$  inches

## PRODUCT MARKING



Marking may contain other features or characters for internal lot control



Mini-Circuits

MMIC SURFACE MOUNT

# Wideband Amplifier

LVA-273PN+

50Ω 0.01 to 26.5 GHz Ultra-Low Additive Phase

ADDITIONAL DETAILED INFORMATION IS AVAILABLE ON OUR DASH BOARD

[CLICK HERE](#)

|                                                      |                                                                |
|------------------------------------------------------|----------------------------------------------------------------|
| Performance Data & Graphs                            | Data                                                           |
|                                                      | Graphs                                                         |
|                                                      | S-Parameter (S2P Files) Data Set (.zip file)                   |
| Case Style                                           | DG1847 Plastic package, exposed paddle, Lead Finish: Matte-Tin |
| RoHs Status                                          | Compliant                                                      |
| Tape & Reel<br>Standard quantities available on reel | F68<br>7" reels with 20, 50, 100, 200, 500, or 1K devices      |
| Suggested Layout for PCB Design                      | PL-756                                                         |
| Evaluation Board                                     | TB-LVA-273PNC+                                                 |
|                                                      | Gerber File                                                    |
| Environmental Ratings                                | 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)

