

Surface Mount

# Monolithic Amplifier

LEE2-6+

50Ω DC to 7 GHz



2mm x 2mm

## The Big Deal

- Low Noise figure, 2.3 dB at 2 GHz
- Low Current, 16 mA
- Broadband matched

## Product Overview

LEE2-6+ (RoHS compliant) is wideband current driven amplifier fabricated using HBT technology. In addition, the LEE2-6+, has good input and output return loss over a broad frequency range without the need for external matching components. Lead finish is Tin Silver over Nickel. It has repeatable performance from lot to lot and is enclosed in a 2mm x 2mm x 0.89mm 6-lead MCLP package for very good electrical performance.

## Key Features

| Feature   | Advantages  |
|---|---|
| Broadband, DC* to 7 GHz<br>(* Low frequency cut off determined by external coupling capacitors) | A single amplifier covering DC* to C band. <ul style="list-style-type: none"><li>• Reduced component inventory</li><li>• Ideal for wideband applications such as instrumentation and military</li></ul> |
| Low Noise Figure:<br>2.3 dB at 2 GHz  | Low noise figure and low current (16mA) is ideal for use as an LNA in receivers   |
| High Gain, 18.9 dB at 2 GHz   | Minimizes the effect of NF of succeeding stages.  |
| MCLP Package  | Low inductance, repeatable transitions, excellent thermal pad.  |



# Surface Mount Monolithic Amplifier

## LEE2-6+

50Ω DC to 7 GHz

### Product Features

- Wideband, DC-7 GHz
- Internally Matched to 50 Ohms
- Noise figure, 2.3 dB at 2 GHz
- Low current, 16 mA



Generic photo used for illustration purposes only

CASE STYLE: MC1630-1

### Typical Applications

- Cellular
- PCN instrumentation
- VHF/UHF receivers/transmitters

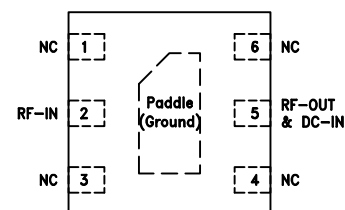
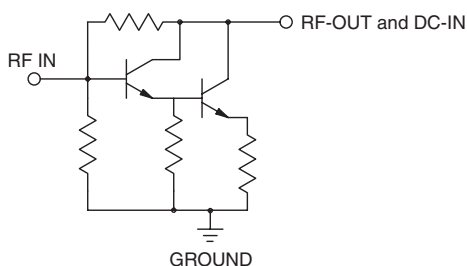
#### +RoHS Compliant

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

### General Description

LEE2-6+ (RoHS compliant) is wideband current driven amplifier fabricated using HBT technology. In addition, the LEE2-6+, has good input and output return loss over a broad frequency range without the need for external matching components. Lead finish is Tin Silver over Nickel. It has repeatable performance from lot to lot and is enclosed in a 2mm x 2mm x 0.89mm 6-lead MCLP package for very good electrical performance.

### simplified schematic and pin description



| Function         | Pin Number | Description  |
|------------------|------------|--|
| RF IN            | 2          | 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 | 5          | 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". |
| GND              | Paddle     | Connections to ground.   |
| NC               | 1,3,4,6    | No connection. Use via holes as shown in "Suggested Layout for PCB Design" to reduce ground path inductance for best performance.  |

**Electrical Specifications<sup>1</sup> at 25°C and 16mA, unless noted**

| Parameter   | Condition (GHz) | Min.            | Typ. | Max. | Units |
|---|-----------------|-----------------|------|------|-------|
| Frequency Range                                   |                 | DC <sup>2</sup> |      | 7.0  | GHz   |
| Gain  | 0.01            | —               | 21.5 | —    | dB    |
|   | 1.0             | —               | 20.6 | —    |       |
|   | 2.0             | 17.1            | 18.9 | 21.1 |       |
|   | 4.0             | —               | 15.3 | —    |       |
|   | 6.0             | —               | 12.2 | —    |       |
|   | 7.0             | —               | 10.8 | —    |       |
| Isolation   | 2.0             |                 | 22.5 |      | dB    |
| Input return loss                                 | 0.01            |                 | 29.9 |      | dB    |
|   | 1.0             |                 | 21.3 |      |       |
|   | 2.0             |                 | 16.0 |      |       |
|   | 4.0             |                 | 11.7 |      |       |
|   | 6.0             |                 | 9.3  |      |       |
|   | 7.0             |                 | 8.4  |      |       |
| Output return loss                                | 0.01            |                 | 36.6 |      | dB    |
|   | 1.0             |                 | 17.0 |      |       |
|   | 2.0             |                 | 13.4 |      |       |
|   | 4.0             |                 | 11.6 |      |       |
|   | 6.0             |                 | 11.0 |      |       |
|   | 7.0             |                 | 10.4 |      |       |
| Output IP3  | 0.01            |                 | 18.9 |      | dBm   |
|   | 1.0             |                 | 16.5 |      |       |
|   | 2.0             |                 | 17.6 |      |       |
|   | 4.0             |                 | 17.8 |      |       |
|   | 6.0             |                 | 15.3 |      |       |
|   | 7.0             |                 | 14.5 |      |       |
| Output power @ 1dB compression                    | 0.01            |                 | 4.3  |      | dBm   |
|   | 1.0             |                 | 2.9  |      |       |
|   | 2.0             |                 | 2.8  |      |       |
|   | 4.0             |                 | 3.1  |      |       |
|   | 6.0             |                 | 2.2  |      |       |
|   | 7.0             |                 | 1.2  |      |       |
| Noise figure                                      | 0.01            |                 | 2.4  |      | dB    |
|   | 1.0             |                 | 2.2  |      |       |
|   | 2.0             |                 | 2.3  |      |       |
|   | 4.0             |                 | 2.5  |      |       |
|   | 6.0             |                 | 2.9  |      |       |
|   | 7.0             |                 | 3.1  |      |       |
| Device Operating Current (I <sub>bias</sub> )     |                 |                 | 16   |      | mA    |
| Device Voltage (V <sub>b</sub> )                  |                 |                 | 3.6  |      | V     |
| Device Voltage Variation vs Temperature at 16mA   |                 |                 | -3   |      | mV/°C |
| Device Voltage Variation vs Current at 25°C       |                 |                 | 10.6 |      | mV/mA |
| Thermal Resistance, Junction-to-case <sup>3</sup> |                 |                 | 95   |      | °C/W  |

1. Measured on Mini-Circuits Characterization test board TB-621+. See characterization test circuit. (Fig. 1)

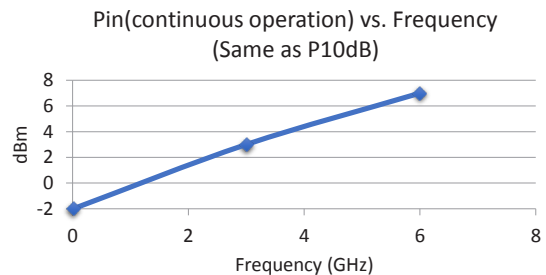
2. Low frequency cut-off determined by external coupling capacitor.

**Absolute Maximum Ratings<sup>4</sup>**

| Parameter                          | Ratings        |
|------------------------------------|----------------|
| Operating temperature              | -40°C to 85°C  |
| Storage temperature                | -65°C to 150°C |
| Operating current                  | 50 mA          |
| Power dissipation                  | 200 mW         |
| Input power (5 minutes max.)       | 29 dBm         |
| Input power (continuous operation) | See Fig. 3     |

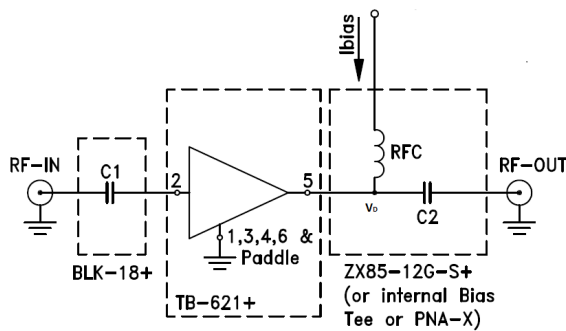
3. Case is defined as ground lead.

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



**Fig 3. Power Input vs. Frequency**

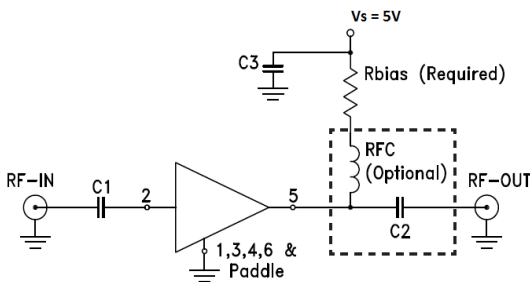
Characterization Test Circuit



**Fig 1.** Block Diagram of Test Circuit used for characterization. (DUT soldered on Mini-Circuits Test Board TB-621+. Gain, Return Loss, Output Power at 1 dB Compression (P1 dB), Output IP3 (OIP3) and Noise Figure measured using key signal N5242A, PNA-X microwave network analyzer. Conditions:

1. I<sub>bias</sub>=16mA
2. Gain and Return loss: -25dBm
3. Output IP3: Two tones, spaced 1 MHz apart, -8 dBm/tone at output.

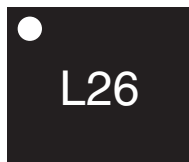
Recommended Application Circuit



| Component | Value   | Size        | Part Number | Manufacturer  |
|-----------|---------|-------------|-------------|---------------|
| C1, C2    | 2400 pF | 0805        | —           | Various       |
| RF C      | —       | 0.15"X0.15" | TCCH-80+    | Mini-Circuits |
| Rbias     | 93.1Ω   | 0402        | —           | Various       |
| C3        | 0.1μF   | 0805        | —           | Various       |

**Fig 2.** Evaluation Board TB-899+ includes case, connectors and components soldered to PCB.

Product Marking



Marking may contain other features or characters for internal lot control

| <b>Additional Detailed Technical Information</b>  |   |
|---|---|
| <i>additional information is available on our dash board. To access this information <a href="#">click here</a></i> |   |
| <b>Performance Data</b>   | Data Table  |
|   | Swept Graphs  |
|   | S-Parameter (S2P Files) Data Set (.zip file)                          |
| <b>Case Style</b>   | MC1630-1, <i>Plastic package, lead finish: tin-silver over nickel</i> |
| <b>Tape &amp; Reel</b>  | F66<br><i>7" Reels with 20, 50, 100, 200, 500, 1K, or 2K devices</i>  |
| <b>Suggested Layout for PCB Design</b>  | PL-349  |
| <b>Evaluation Board</b>   | TB-899+   |
| <b>Environmental Ratings</b>  | ENV08T1   |

**ESD Rating**

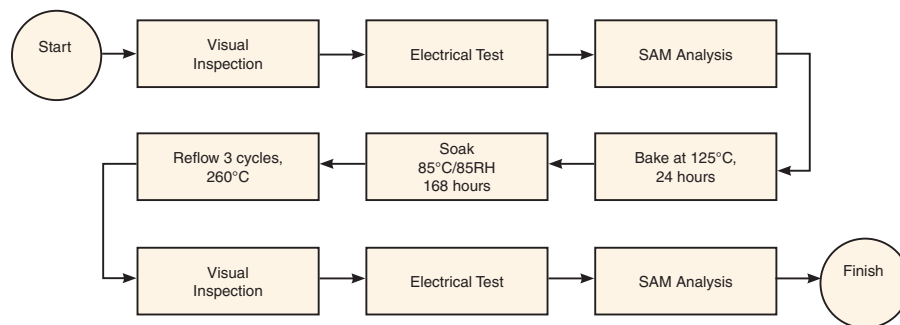
Human Body Model (HBM): Class 1C (1000 to <2000V) in accordance with ANSI/ESD STM 5.1 - 2001

Machine Model (MM): Class M2 (100V) in accordance with ANSI/ESD STM5.2-1999

**MSL Rating**

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

**MSL Test Flow Chart**



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