MMIC DIE

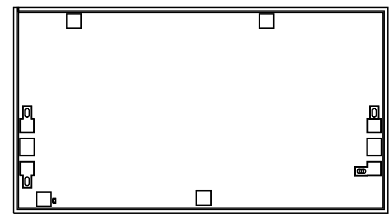
# Wideband Amplifier

# AVA-2183-D+

50Ω 2 to 18 GHz

## THE BIG DEAL

- Wideband, 2 to 18 GHz
- Flat Gain 16.6 ± 0.65 dB
- P1dB, +19.6 dBm Typ. at 10 GHz
- OIP3, +27.4 dBm Typ. at 10 GHz



**+RoHS Compliant**
The +Suffix identifies RoHS Compliance.
See our website for methodologies and qualifications

SEE ORDERING INFORMATION ON THE LAST PAGE

## APPLICATIONS

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

## PRODUCT OVERVIEW

The AVA-2183-D+ is an amplifier die that operates from 2 to 18 GHz that is fabricated on a GaAs pHEMT MMIC process. The Amplifier provides 16.6 dB of Gain, +27.3 dBm OIP3 and +18.7 dBm Output Power at 1 dB Compression point with 15.5 dB typical Return Loss while requiring +4 V and 210 mA DC power. Gain flatness is ±0.65 dB across the operating bandwidth. The Amplifier is ideal for use in very wideband ECM, Test & Measurement and Microwave communications systems.

## KEY FEATURES

| Feature | Advantages |
|---|---|
| Wideband: 2 to 18 GHz<br>• 15.9 dB Gain Typ. at 2 GHz<br>• 16.9 dB Gain Typ. at 18 GHz | Suitable for wide bandwidth defense and test and measurement application as well as narrow band performance driven applications. |
| Good P1dB & OIP3<br>• +19.6 dBm P1dB Typ. at 10 GHz<br>• +27.4 dBm OIP3 Typ. at 10 GHz | Suitable as a driver amplifier in receiver/transmitter chains. |
| High Reverse Isolation | Isolates adjacent circuitry without need for an external expensive isolator. |
| Input and Output Return Loss | Eliminates need for external matching circuit providing published Return Loss. |
| Unpackaged Die | Suitable for chip and wire hybrid assemblies. |



Mini-Circuits
www.minicircuits.com P.O. Box 350166, Brooklyn, NY 11235-0003 (718) 934-4500 sales@minicircuits.com

## ELECTRICAL SPECIFICATIONS[1] AT +25°C, $V_{DD}$ = +4 V, $I_{DD}$ = 210 mA & Zo = 50Ω UNLESS NOTED OTHERWISE

| Parameter | Condition (GHz) | $V_{DD}$ = +4 V Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Frequency Range | | 2 | | 18 | GHz |
| Gain | 2 | | 15.9 | | dB |
| | 5 | | 16.1 | | |
| | 10 | | 17.2 | | |
| | 15 | | 16.7 | | |
| | 18 | | 16.9 | | |
| Input Return Loss | 2 | | 12 | | dB |
| | 5 | | 16 | | |
| | 10 | | 14 | | |
| | 15 | | 11 | | |
| | 18 | | 14 | | |
| Output Return Loss | 2 | | 18 | | dB |
| | 5 | | 20 | | |
| | 10 | | 19 | | |
| | 15 | | 16 | | |
| | 18 | | 15 | | |
| Reverse Isolation | 2 - 18 | | 47.4 | | dB |
| Output Power at 1 dB Compression | 2 | | +18.9 | | dBm |
| | 5 | | +19.3 | | |
| | 10 | | +19.6 | | |
| | 15 | | +18.2 | | |
| | 18 | | +17.6 | | |
| Output Third-Order Intercept ($P_{OUT}$ = 0 dBm/Tone) | 2 | | +31.2 | | dBm |
| | 5 | | +29.1 | | |
| | 10 | | +27.4 | | |
| | 15 | | +25.2 | | |
| | 18 | | +23.7 | | |
| Noise Figure | 2 | | 6.8 | | dB |
| | 5 | | 6.4 | | |
| | 10 | | 5.5 | | |
| | 15 | | 4.7 | | |
| | 18 | | 5.1 | | |
| Device Operating Voltage ($V_{DD}$) | | | +4 | | V |
| Device Operating Current ($I_{DD}$) | | | 210 | | mA |
| Device Gate Voltage ($V_{GG}$) | | | -0.46 | | V |
| Device Gate Current ($I_{GG}$) | | | -0.2 | | µA |
| Thermal Resistance, Junction-to-Ground Lead (ΘJC) | | | 38.8 | | °C/W |

1. Die is soldered and measured on Mini-Circuits die characterization board. See characterization circuit (Fig. 1).

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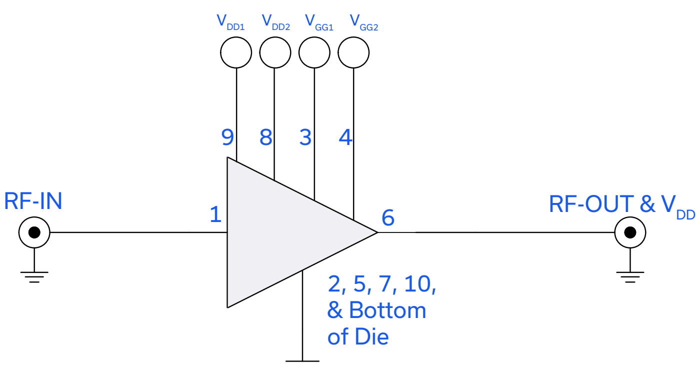
## ABSOLUTE MAXIMUM RATINGS[2]

| Parameter | Ratings |
|---|---|
| Operating Temperature (Ground Lead)[3] | -40°C to +85°C |
| Storage Temperature[4] | -65°C to +150°C |
| Junction Temperature[5] | +150°C |
| Power Dissipation | 1.7 W |
| Input Power (CW) | +23 dBm (5 minutes max.)<br>+14 dBm (continuous) |
| DC Voltage on RF-OUT | +7 V |
| Current $I_{GG}$ | -5 mA to 0 mA |
| Current $I_{DD}$ | 320 mA |
| DC Voltage on $V_{DD}$ ($V_{DD1}$ & $V_{DD2}$) | +7 V |
| DC Voltage on $V_{GG}$ ($V_{GG1}$ & $V_{GG2}$) | -1.5 V to -0.2 V |

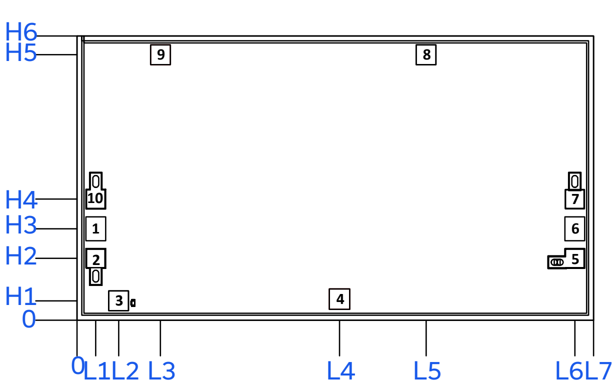
2. Permanent damage may occur in any of these limits are exceeded. Electrical maximum ratings are not intended for continuous normal operation.
3. Bottom of die.
4. For die shipped in Gel-Pak, see ENV-80 (limited by packaging).
5. Hot spot temperature on top of die.

## SIMPLIFIED SCHEMATIC AND PAD DESCRIPTION




| Function | Pad Number | Description |
|---|---|---|
| RF-IN | 1 | RF Input Pad |
| GROUND | 2, 5, 7, 10, & Bottom of Die | The bond pads are connected to backside through vias and do not require wire-bond connections to ground. |
| $V_{GG1}$ | 3 | Gate Bias Pad #1 |
| $V_{GG2}$ | 4 | Gate Bias Pad #2 |
| RF-OUT | 6 | RF Output Pad |
| $V_{DD2}$ | 8 | Drain Bias Pad #2 |
| $V_{DD1}$ | 9 | Drain Bias Pad #1 |

## BONDING PAD POSITION



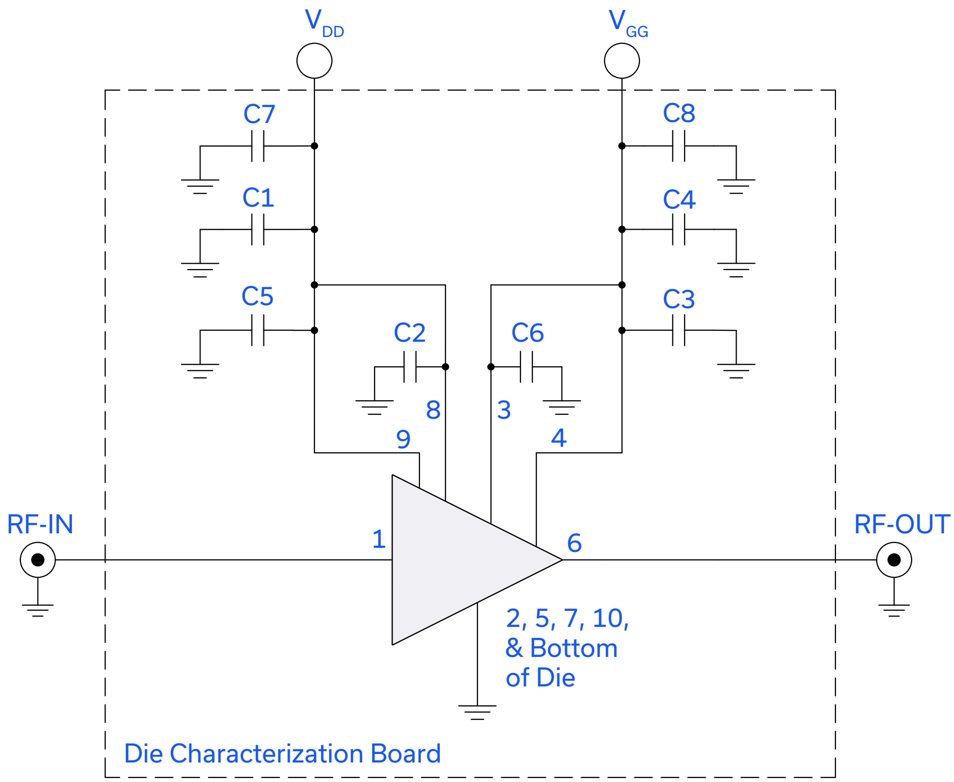

## DIMENSION IN µM, TYP.

| L1 | L2 | L3 | L4 | L5 | L6 | L7 |
|---|---|---|---|---|---|---|
| 95 | 211 | 422 | 1328 | 1767 | 2519 | 2614 |

| H1 | H2 | H3 | H4 | H5 | H6 |
|---|---|---|---|---|---|
| 98 | 312 | 462 | 612 | 1343 | 1438 |

| Thickness | Die size | Pad size 1 & 6 | Pad size 2,3,5,7,8,9 & 10 | Pad size 4 |
|---|---|---|---|---|
| 100 | 2614x1438 | 93x113 | 93x93 | 96x96 |

## CHARACTERIZATION & APPLICATION CIRCUIT




| Component | Value | Size | Part Number | Manufacturer |
|---|---|---|---|---|
| C2, C3, C5 & C6 | 100 pF | 22x22 mil | MA4M3100 | MACOM |
| C1 & C4 | 0.47 uF | 0402 | GRM155R71A474KE01D | Murata |
| C7 & C8 | 10 uF | 1206 | CL31B106KBHNNNE | Samsung |

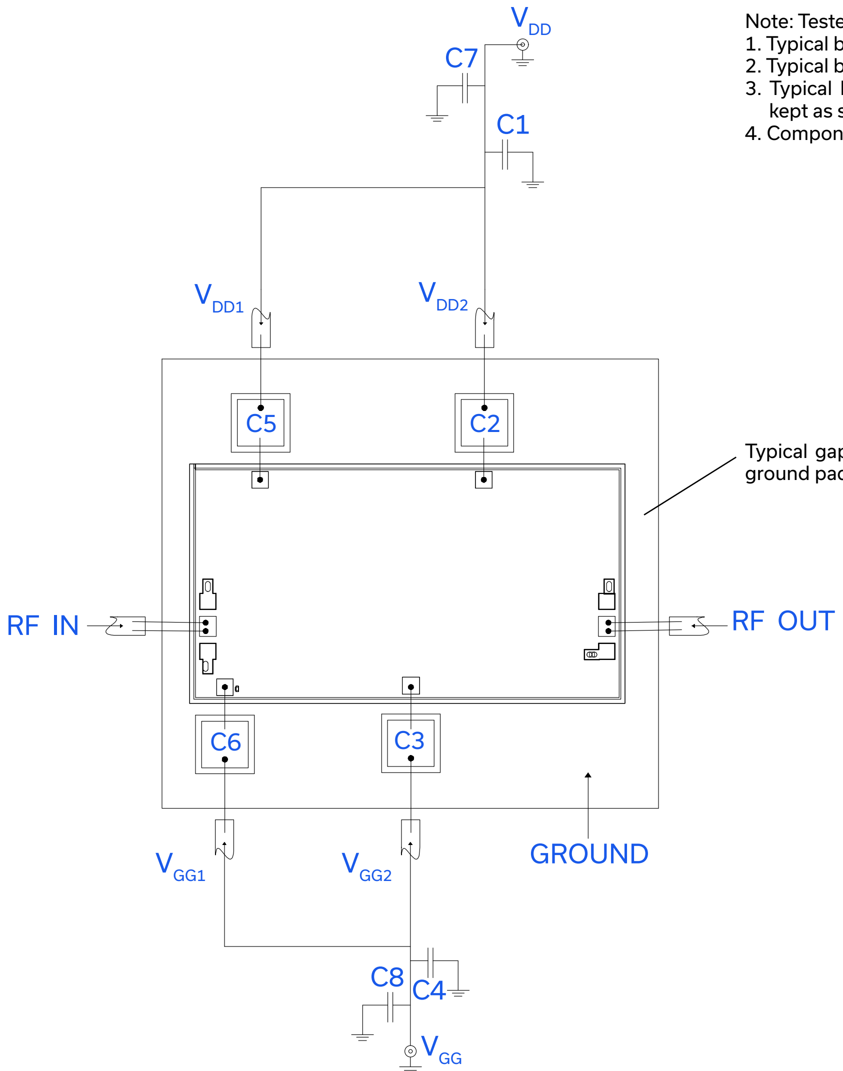
Fig.1: Characterization & Application Circuit
Note: This block diagram is used for characterization (Die is attached and wire-bonded on a die characterization test board). Gain, Return Loss, Output Power at 1 dB Compression (P1dB), Output IP3 (OIP3) and Noise Figure are measured using Agilent's N5242A PNA-X Microwave Network Analyzer.

Conditions:
1. $V_{DD}$ = +4 V
2. $V_{GG}$ is set to obtain desired $I_{DD}$ as shown in specification table.
3. Gain and Return Loss: $P_{IN}$ = -25 dBm
4. Output IP3 (OIP3): Two Tones, spaced 1 MHz apart, 0 dBm/Tone at Output.

Power ON Sequence:
1. Set $V_{GG}$ = -1.3 V. Apply $V_{GG}$.
2. Set $V_{DD}$ = +4 V. Apply $V_{DD}$.
3. Increase $V_{GG}$ to obtain desired $I_{DD}$ as shown in specification table.
4. Apply RF Signal

Power OFF Sequence:
1. Turn off RF Signal.
2. Adjust $V_{GG}$ down to -1.3 V.
3. Turn off $V_{DD}$.
4. Turn off $V_{GG}$.

## ASSEMBLY DIAGRAM




Note: Tested on die characterization board with following bond lengths:
1. Typical bond length for RF-IN: 280 µm (11 mils)
2. Typical bond length for RF-OUT: 280 µm (11 mils)
3. Typical bond lengths from die, capacitor, $V_{DD1}$, $V_{DD2}$, $V_{GG1}$, and $V_{GG2}$ were kept as short as possible
4. Component list given in Figure 1.

Typical gap of 76 µm (3 mils) between the edge of the die and edge of the ground pad.

## ASSEMBLY AND HANDLING PROCEDURE

1. Storage
   Die should be stored in a dry nitrogen purged desiccators or equivalent.
2.  ESD
   MMIC PHEMT amplifer die are susceptible to electrostatic and mechanical damage. Die are supplied in antistatic protected material, which should be open in clean room conditions at an appropriately grounded anti-static workstation.
3. Die Handling and Attachment
   Devices need careful handling using correctly designed collets, it is recommended to handle the chip along the edges with a custom design collet. The die mounting surface must be clean and flat. Using conductive silver filled epoxy, recommended epoxies are Ablestik 84-1 LMISR4 or equivalents. Apply sufficient epoxy to meet required epoxy bond line thickness, epoxy fillet height and epoxy coverage around total periphery. Parts shall be cured in a nitrogen filled atmosphere per manufacturer's cure condition. The surface of the chip has exposed air bridges and should not be touched with vacuum collet, tweezers or fingers.
4. Wire Bonding
   Bond pad openings in the surface passivation above the bond pads are provided to allow wire bonding to the Die gold bond pads. Thermo-sonic bonding is used with minimized ultrasonic content. Bond force, time, ultrasonic power and temperature are all critical parameters. Suggested wire is pure gold, 1mil diameter. Bonds must be made from the bond pads on the die to the packaged or substrate. All bond wire length and bond wire height should be kept as short as possible unless specified by the Assembly Drawing to minimize performance degradation due to undesirable series inductance.

## ADDITIONAL DETAILED TECHNICAL INFORMATION IS AVAILABLE ON OUR DASHBOARD. CLICK HERE

| | | |
|---|---|---|
| **Performance Data** | Data Table<br>Swept Graphs<br>S-Parameter (S2P Files) Data Set with and without port extension (.zip file) | |
| **Case Style** | Die | |
| **Die Ordering and Packaging Information** | Quantity, Package<br><br>Gel - Pak: 5,10,50,100 KGD*<br>Medium†, Partial wafer: KGD*<570<br>Full wafer<br><br>† Available upon request contact sales representative<br>Refer to AN-60-067 | Model No.<br><br>AVA-2183-DG+<br>AVA-2183-DP+<br>AVA-2183-DF+ |
| **Die Marking** | EL-AMP-11-2 | |
| **Environmental Ratings** | ENV80 | |

* Known Good Die ("KGD") means that the die in question have been subjected to Mini-Circuits DC test performance criteria and measurement instructions and that the parametric data of such die fall within a predefined range. While DC testing is not definitive, it does provide a higher degree of confidence that die are capable of meeting typical RF electrical parameters specified by Mini-Circuits.