



# CMD163C4

## 17-27 GHz Low Noise Amplifier

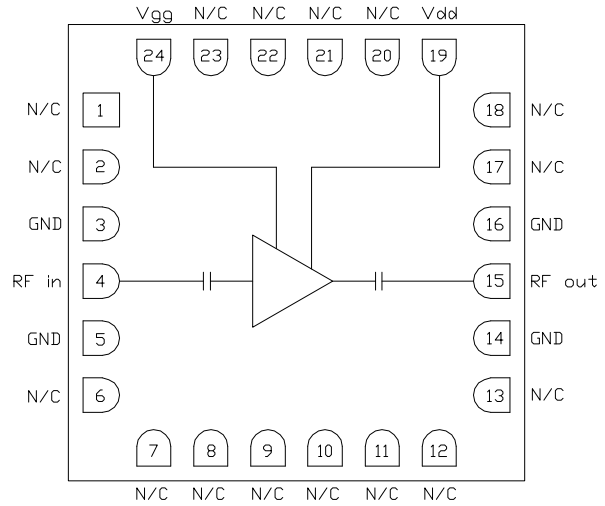
### Features

- ▶ Ultra low noise performance
- ▶ High linearity
- ▶ All positive supply voltages
- ▶ Pb-free RoHs compliant 4x4 QFN package

### Description

The CMD163C4 is a high dynamic range GaAs MMIC low noise amplifier housed in a leadless 4x4 mm surface mount package. The CMD163C4 is ideally suited for military, space and communications systems where small size and high linearity are needed. The device is optimized for 21 GHz and delivers greater than 23 dB of gain with a corresponding output 1 dB compression point of +18 dBm and noise figure of 1.7 dB. The CMD163C4 is a 50 ohm matched design which eliminates the need for external DC blocks and RF port matching.

### Functional Block Diagram



### Electrical Performance - $V_{dd} = 4.0\text{ V}$ , $V_{gg} = 3.0\text{ V}$ , $T_A = 25\text{ }^\circ\text{C}$ , $F=21\text{ GHz}$

| Parameter          | Min     | Typ  | Max | Units |
|--------------------|---------|------|-----|-------|
| Frequency Range    | 17 - 27 |      |     | GHz   |
| Gain               |         | 23   |     | dB    |
| Noise Figure       |         | 1.7  |     | dB    |
| Input Return Loss  |         | 10   |     | dB    |
| Output Return Loss |         | 11   |     | dB    |
| Output P1dB        |         | 17.5 |     | dBm   |
| Supply Current     |         | 120  |     | mA    |

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### Specifications

#### Absolute Maximum Ratings

| Parameter                            | Rating        |
|--------------------------------------|---------------|
| Drain Voltage, V <sub>dd</sub>       | 5.0 V         |
| Gate Voltage, V <sub>gg</sub>        | 4.0 V         |
| RF Input Power                       | +20 dBm       |
| Channel Temperature, T <sub>ch</sub> | 150 °C        |
| Power Dissipation, P <sub>diss</sub> | 600 mW        |
| Thermal Resistance                   | 108 °C/W      |
| Operating Temperature                | -40 to 85 °C  |
| Storage Temperature                  | -55 to 150 °C |

Operation of this device outside the maximum ratings may cause permanent damage.

#### Recommended Operating Conditions

| Parameter       | Min | Typ | Max | Units |
|-----------------|-----|-----|-----|-------|
| V <sub>dd</sub> | 2.0 | 4.0 | 5.0 | V     |
| I <sub>dd</sub> |     | 120 |     | mA    |
| V <sub>gg</sub> | 0   | 3.0 | 4.0 | V     |

Electrical performance is measured at specific test conditions. Electrical specifications are not guaranteed over all recommended operating conditions.

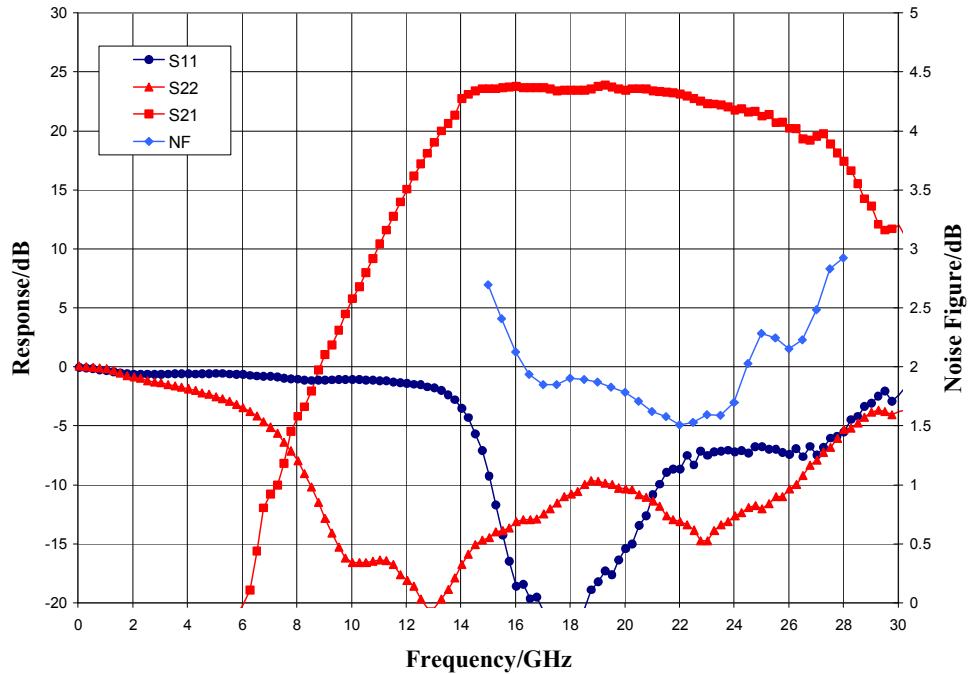
#### Electrical Specifications, V<sub>dd</sub> = 4.0 V, V<sub>gg</sub> = 3.0 V, T<sub>A</sub> = 25 °C

| Parameter                            | Min     | Typ   | Max | Min         | Typ   | Max | Units |
|--------------------------------------|---------|-------|-----|-------------|-------|-----|-------|
| Frequency Range                      | 17 - 27 |       |     | 17.7 - 23.6 |       |     | GHz   |
| Gain                                 | 17      | 23    | 27  | 19          | 23    | 27  | dB    |
| Noise Figure                         |         | 1.8   | 2.8 |             | 1.8   | 2.3 | dB    |
| Input Return Loss                    |         | 8     |     |             | 10    |     | dB    |
| Output Return Loss                   |         | 12    |     |             | 12    |     | dB    |
| Output P1dB                          |         | 18    |     |             | 18    |     | dBm   |
| Output IP3                           |         | 25    |     |             | 25    |     | dBm   |
| Supply Current                       | 70      | 120   | 150 | 70          | 120   | 150 | mA    |
| Gain Temperature Coefficient         |         | 0.015 |     |             | 0.015 |     | dB/°C |
| Noise Figure Temperature Coefficient |         | 0.01  |     |             | 0.01  |     | dB/°C |

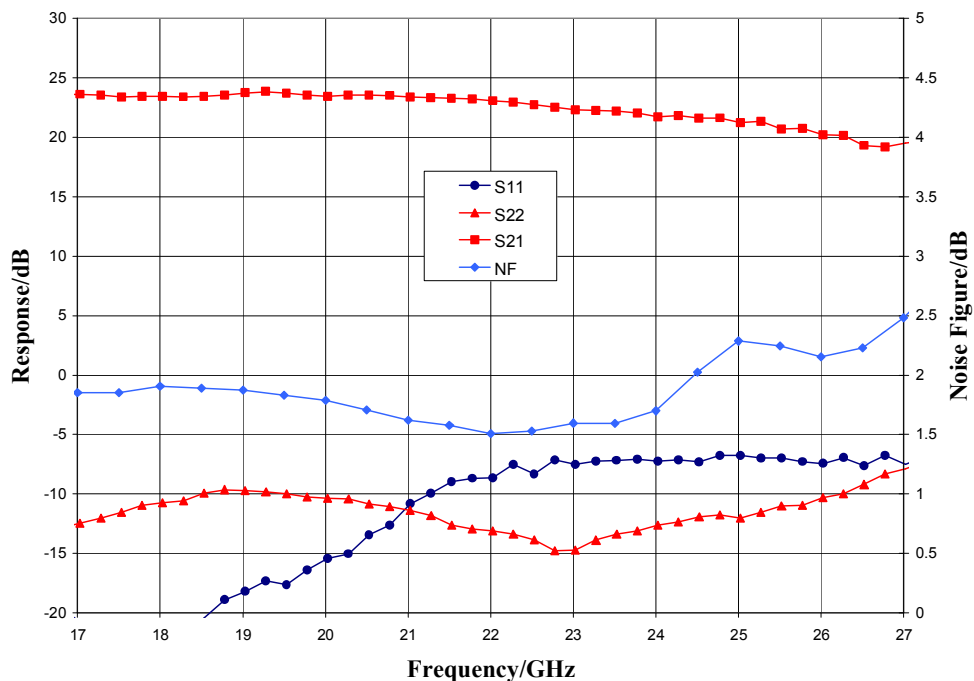
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### Typical Performance

**Broadband Performance,  $V_{dd} = 4.0$  V,  $V_{gg} = 3.0$  V,  $I_{dd} = 120$  mA,  $T_A = 25$  °C**



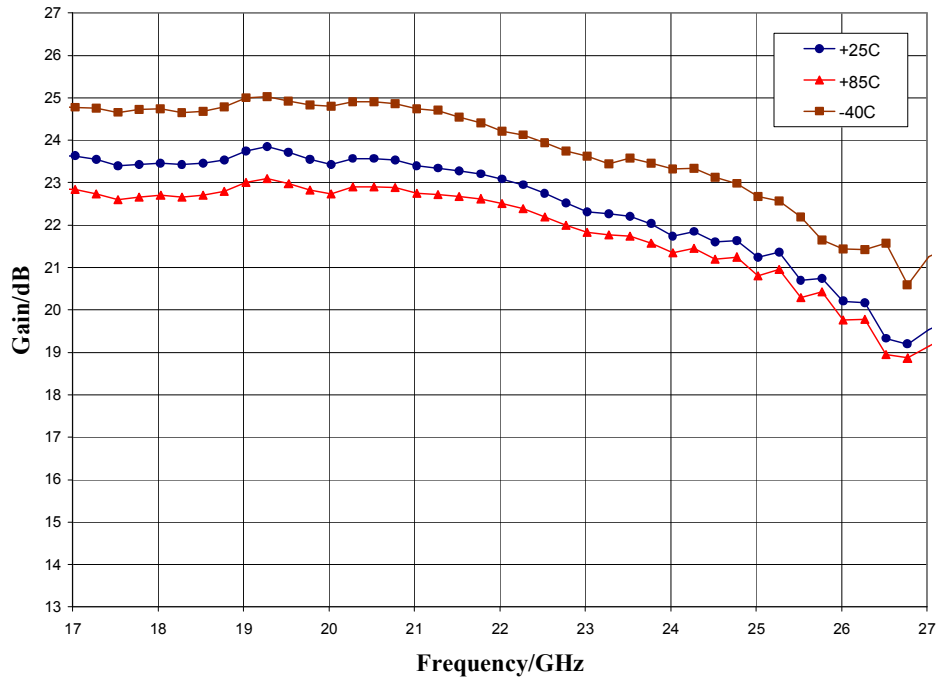
**Narrow-band Performance,  $V_{dd} = 4.0$  V,  $V_{gg} = 3.0$  V,  $I_{dd} = 120$  mA,  $T_A = 25$  °C**



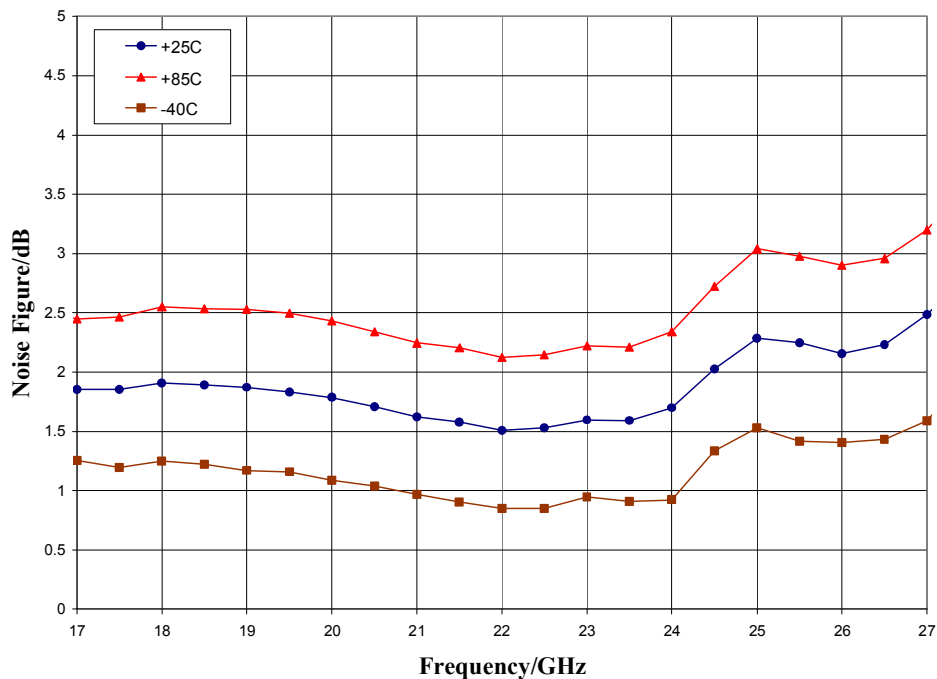
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### Typical Performance

Gain vs. Temperature,  $V_{dd} = 4.0\text{ V}$ ,  $V_{gg} = 3.0\text{ V}$



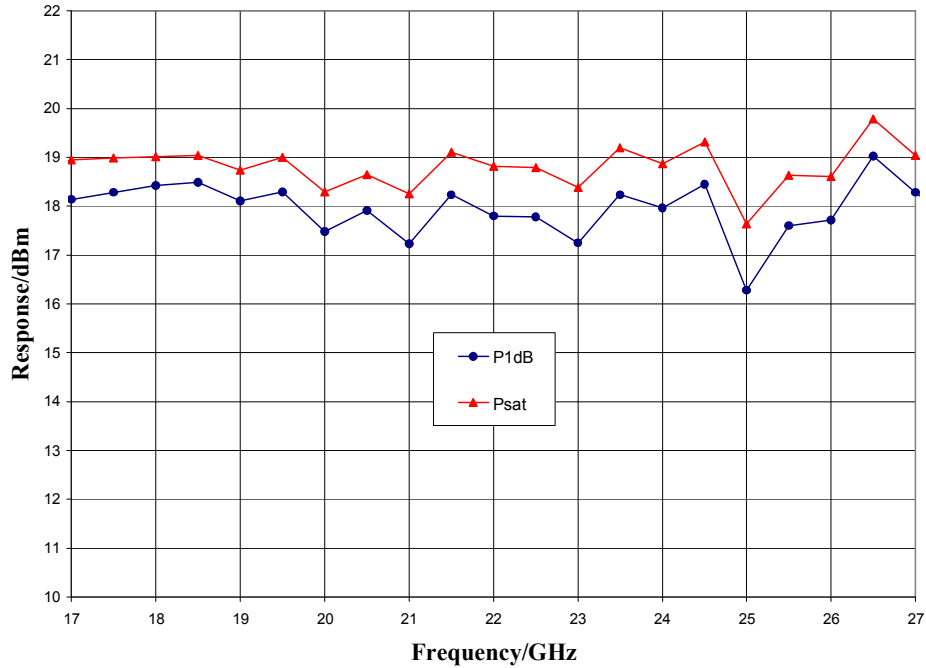
Noise Figure vs. Temperature,  $V_{dd} = 4.0\text{ V}$ ,  $V_{gg} = 3.0\text{ V}$



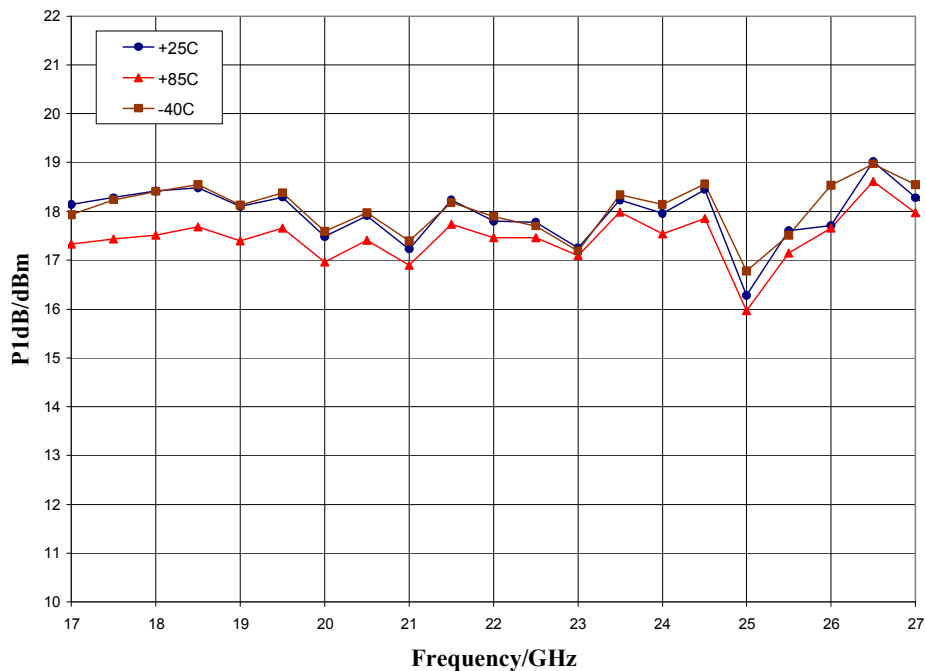
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### Typical Performance

Output Power,  $V_{dd} = 4.0\text{ V}$ ,  $V_{gg} = 3.0\text{ V}$ ,  $T_A = 25\text{ }^\circ\text{C}$



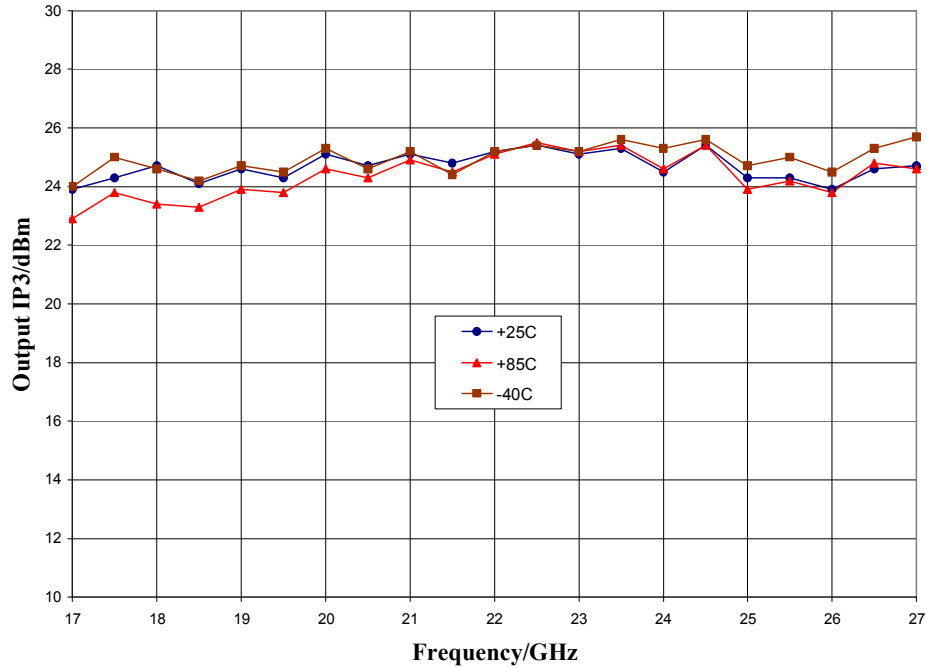
P1dB vs. Temperature,  $V_{dd} = 4.0\text{ V}$ ,  $V_{gg} = 3.0\text{ V}$



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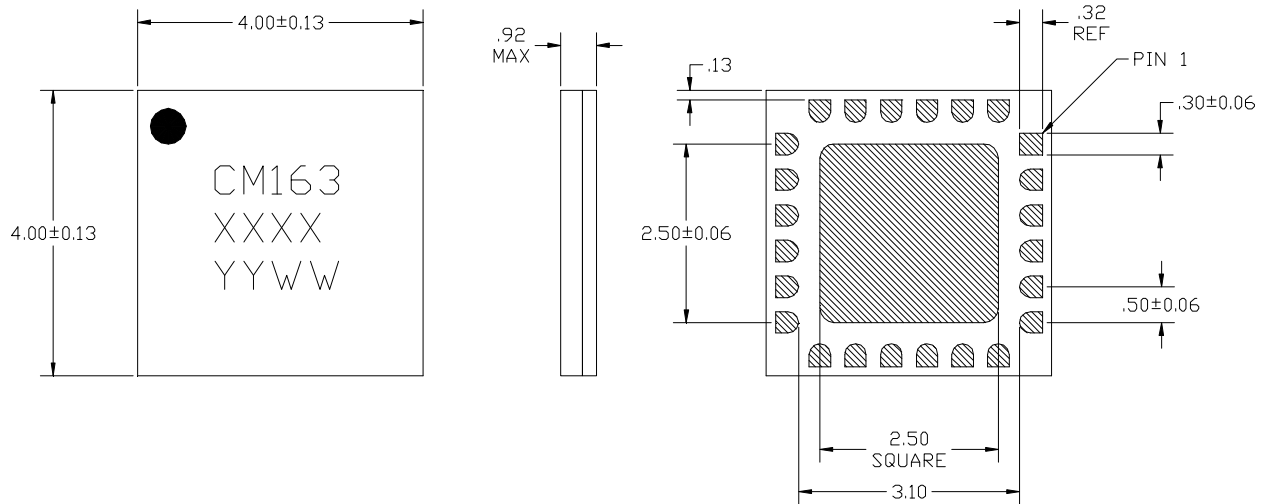
### Typical Performance

Output IP3 vs. Temperature,  $V_{dd} = 4.0\text{ V}$ ,  $V_{gg} = 3.0\text{ V}$



### Mechanical Information

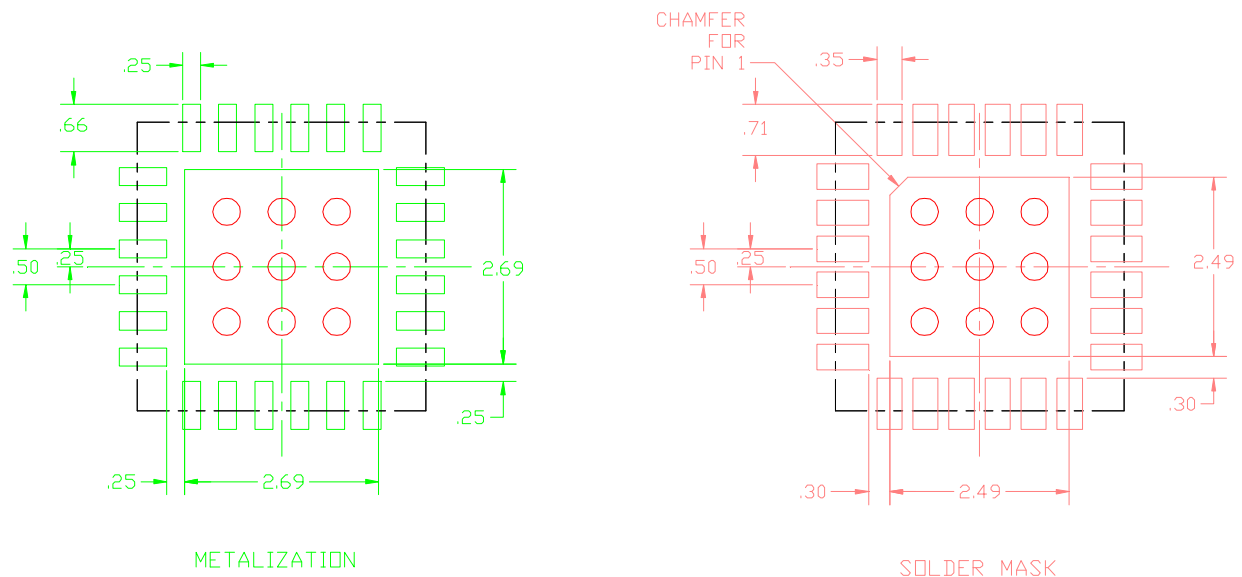
#### Package Information and Dimensions



NOTES:

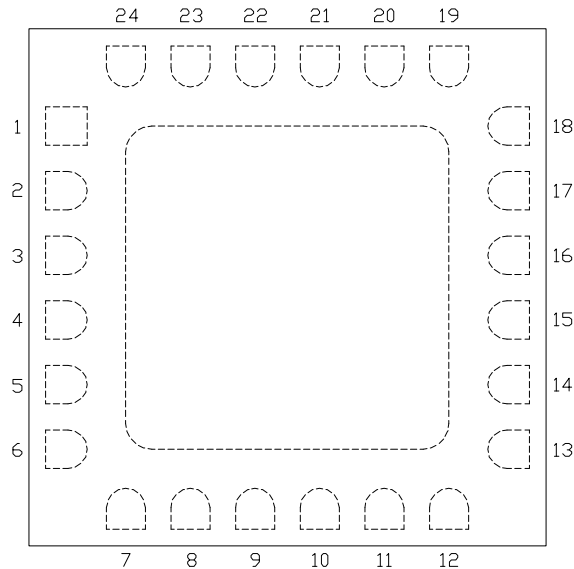
1. DIMENSIONS ARE IN MILLIMETERS
2. MATERIAL: BLACK ALUMINA
3. LEAD FINISH: 30-80 MICROINCHES GOLD OVER 50 MICROINCHES NICKEL.
4. ALTERNATE PIN #1 IDENTIFIER IS SINGLE SQUARE PAD.

#### Recommended PCB Land Pattern



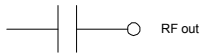
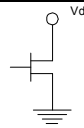
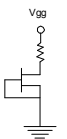


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### Pin Description



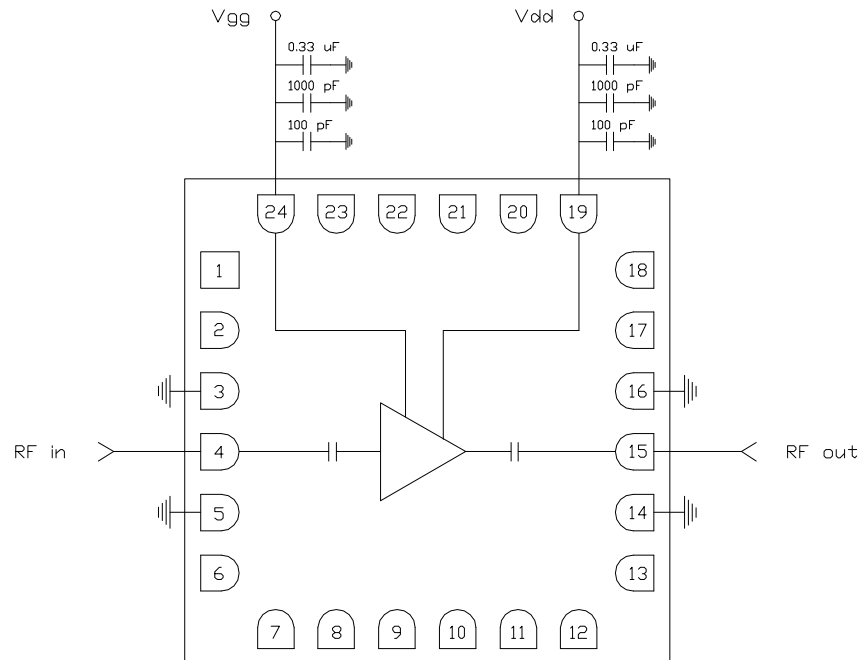
### Functional Description

| Pin                         | Function | Description   | Schematic   |
|-----------------------------|----------|---|---|
| 1, 2, 6-13, 17, 18, 20-23   | N/C      | No connection required. These pins may be connected to RF/DC ground |   |
| 3, 5, 14, 16 and die paddle | Ground   | Connect to RF/DC ground   |  |
| 4                           | RF in    | DC blocked and 50 ohm matched                                       |  |
| 15                          | RF out   | DC blocked and 50 ohm matched                                       |  |
| 19                          | Vdd      | Power supply voltage<br>Decoupling and bypass caps required         |  |
| 24                          | Vgg      | Power supply voltage<br>Decoupling and bypass caps required         |  |



### Applications Information

#### Application Circuit



#### Biasing and Operation

The CMD163C4 is biased with a positive drain supply and positive gate supply. Performance is optimized when the drain voltage is set to +4.0 V, though it may be set to a minimum of +2.0 V and a maximum of +4.0 V. The recommended gate voltage is +3.0 V.

Turn ON procedure:

1. Apply drain voltage  $V_{dd}$  and set to +4 V
2. Apply gate voltage  $V_{gg}$  and set to +3 V

Turn OFF procedure:

1. Turn off gate voltage  $V_{gg}$
2. Turn off drain voltage  $V_{dd}$

RF power can be applied at any time.

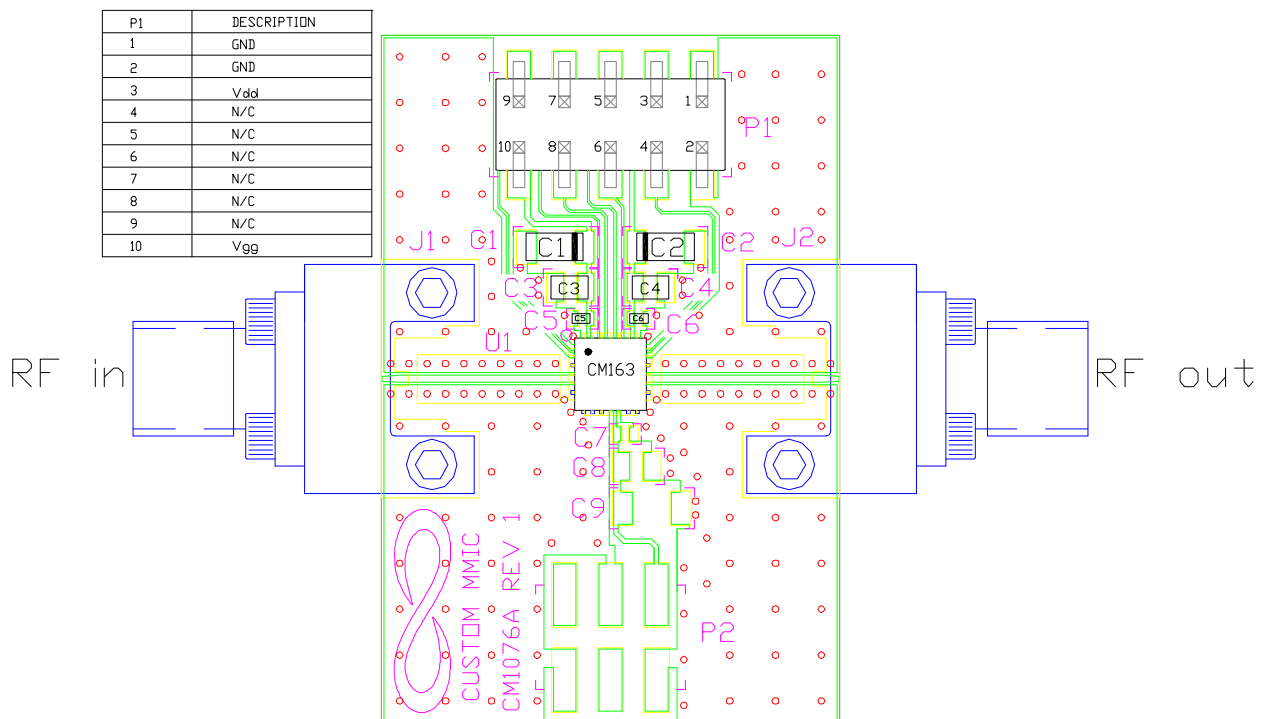
**GaAs MMIC devices are susceptible to damage from Electrostatic Discharge. Proper precautions should be observed during handling, assembly and test.**

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### Applications Information

#### Evaluation Board

The circuit board shown has been developed for optimized assembly at Custom MMIC. A sufficient number of via holes should be used to connect the top and bottom ground planes. As surface mount processes vary, careful process development is recommended.



| Designator | Value        | Description                  |
|------------|--------------|------------------------------|
| J1, J2     |              | SMA End Launch Connector     |
| P1         |              | 10 Pin Header                |
| C1, C2     | 0.33 $\mu$ F | Capacitor, Tantalum          |
| C3,C4      | 1000 pF      | Capacitor, 0603              |
| C5, C6     | 100 pF       | Capacitor, 0402              |
| U1         |              | CMD163C4 Low Noise Amplifier |
| PCB        |              | CM1076A Evaluation PCB       |

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