



# CMD196

## DC-28 GHz SPDT Non-reflective Switch

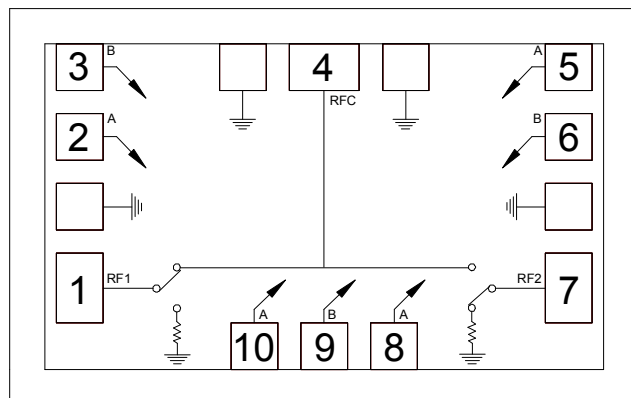
### Features

- ▶ Low loss broadband performance
- ▶ High isolation
- ▶ Fast switching speed
- ▶ Non-reflective design
- ▶ Small die size

### Description

The CMD196 is a general purpose broadband high isolation non-reflective MMIC SPDT switch in die form. Covering DC to 28 GHz, the CMD196 features a low insertion loss of 1.75 dB and high isolation of 46 dB at 14 GHz. The CMD196 operates using complementary control voltage logic lines of 0/-5 V and requires no bias supply.

### Functional Block Diagram



### Electrical Performance - $V_{ctl} = 0/-5\text{ V}$ , $T_A = 25\text{ }^{\circ}\text{C}$ , $F = 14\text{ GHz}$

| Parameter                        | Min     | Typ  | Max | Units |
|----------------------------------|---------|------|-----|-------|
| Frequency Range                  | DC - 28 |      |     | GHz   |
| Insertion Loss                   |         | 1.75 |     | dB    |
| Isolation                        |         | 46   |     | dB    |
| Return Loss - On State           |         | 15   |     | dB    |
| Return Loss RF1, RF2 - Off State |         | 25   |     | dB    |
| Input P1dB                       |         | 23   |     | dBm   |
| Switching Characteristics        |         |      |     |       |
| tRISE, tFALL (10/90% RF)         |         | 1.8  |     | ns    |
| tON, tOFF (50% CTL to 10/90% RF) |         | 11/4 |     | ns    |

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### Specifications

#### Absolute Maximum Ratings

| Parameter                                                  | Rating         |
|------------------------------------------------------------|----------------|
| RF Input Power                                             | +27 dBm        |
| Control Voltage Range (A,B)                                | +0.5V to -7.5V |
| Channel Temperature, T <sub>ch</sub>                       | 150 °C         |
| Operating Temperature                                      | -55 to 85 °C   |
| Storage Temperature                                        | -55 to 150 °C  |
| Thermal Resistance, $\Theta_{JC}$<br>(insertion loss path) | 103 °C/W       |
| Thermal Resistance, $\Theta_{JC}$<br>(terminated path)     | 258 °C/W       |
| Terminated Power Level<br>(V <sub>ctl</sub> = -5 V, CW)    | +24 dBm        |

#### Control Voltages

| State | Bias Condition                   |
|-------|----------------------------------|
| Low   | 0 to -0.5V @ 1 uA Typ            |
| High  | -3V @ 1 uA Typ to -7V @ 6 uA Typ |

#### Truth Table

| Control Input |      | Signal Path State |            |
|---------------|------|-------------------|------------|
| A             | B    | RFC to RF1        | RFC to RF2 |
| High          | Low  | On                | Off        |
| Low           | High | Off               | On         |

Exceeding any one or combination of the maximum ratings may cause permanent damage to the device.

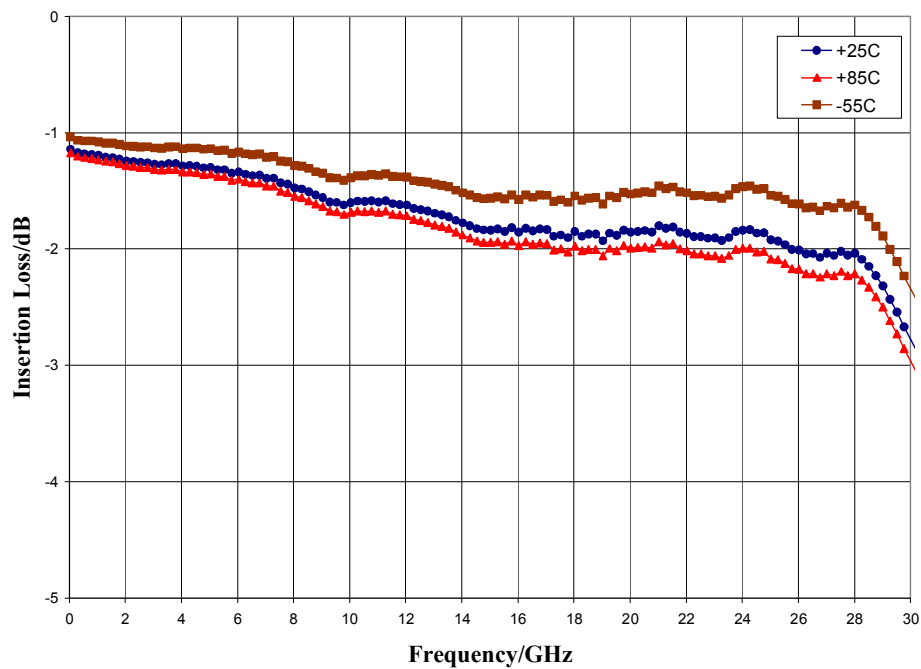
#### Electrical Specifications - V<sub>ctl</sub> = 0/-5 V, T<sub>A</sub> = 25 °C

| Parameter                                                                                                                                   | Min    | Typ         | Max | Min     | Typ         | Max | Min     | Typ         | Max | Units    |
|---------------------------------------------------------------------------------------------------------------------------------------------|--------|-------------|-----|---------|-------------|-----|---------|-------------|-----|----------|
| Frequency Range                                                                                                                             | DC - 8 |             |     | DC - 20 |             |     | DC - 28 |             |     | GHz      |
| Insertion Loss                                                                                                                              |        | 1.5         | 1.9 |         | 1.8         | 2.2 |         | 2.0         | 2.5 | dB       |
| Isolation                                                                                                                                   | 45     | 50          |     | 37      | 42          |     | 30      | 35          |     | dB       |
| Return Loss - On State                                                                                                                      |        | 18          |     |         | 15          |     |         | 12          |     | dB       |
| Return Loss - RF1, 2 - Off State                                                                                                            |        | 17          |     |         | 25          |     |         | 15          |     | dB       |
| Input P1dB                                                                                                                                  |        | 23          |     |         | 23          |     |         | 23          |     | dBm      |
| Input IP3                                                                                                                                   |        | 37          |     |         | 38          |     |         | 38          |     | dBm      |
| Switching Characteristics<br>t <sub>RISE</sub> , t <sub>FALL</sub> (10/90% RF)<br>t <sub>ON</sub> , t <sub>OFF</sub> (50% CTL to 10/90% RF) |        | 1.8<br>11/4 |     |         | 1.8<br>11/4 |     |         | 1.8<br>11/4 |     | ns<br>ns |

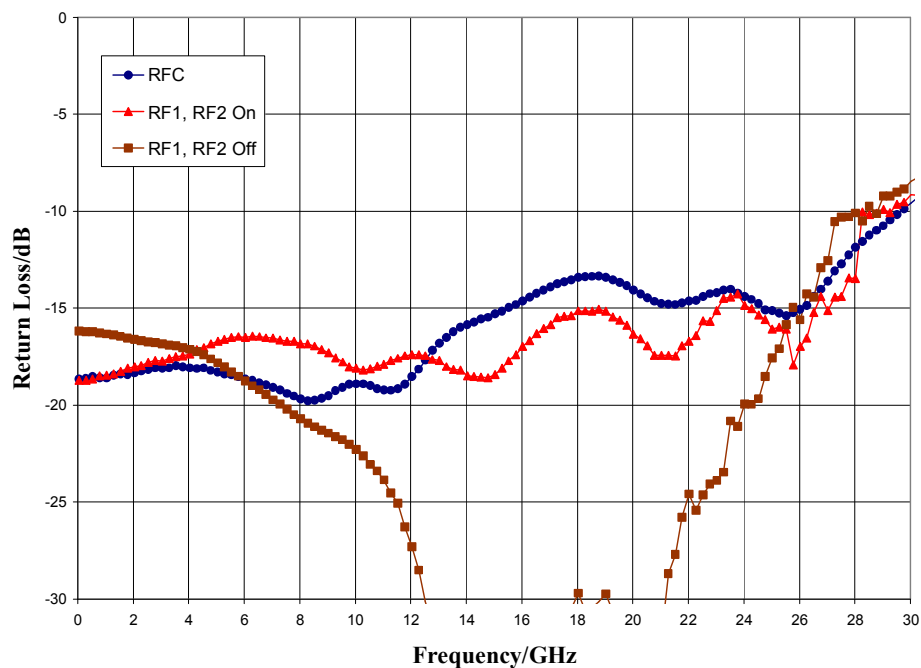
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### Typical Performance

#### Insertion Loss vs. Temperature



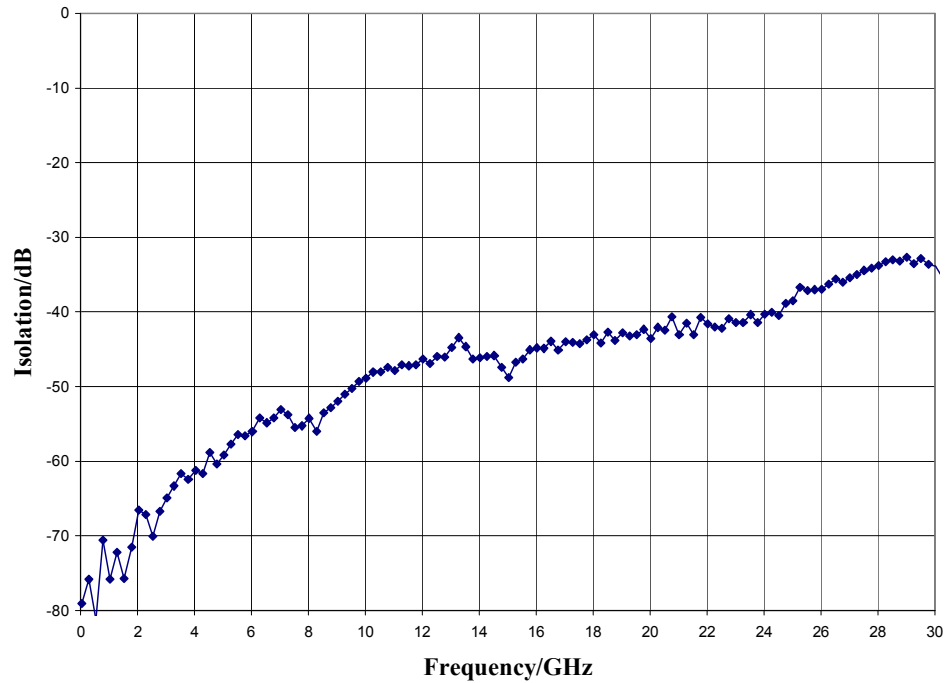
#### Return Loss



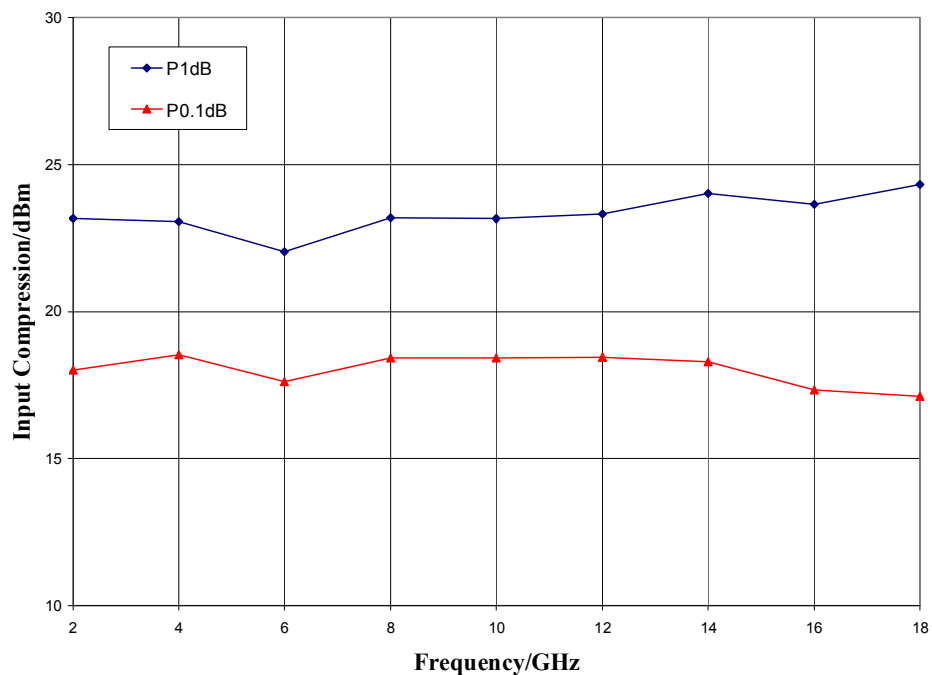
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### Typical Performance

#### Isolation Between Ports RFC and RF1/RF2



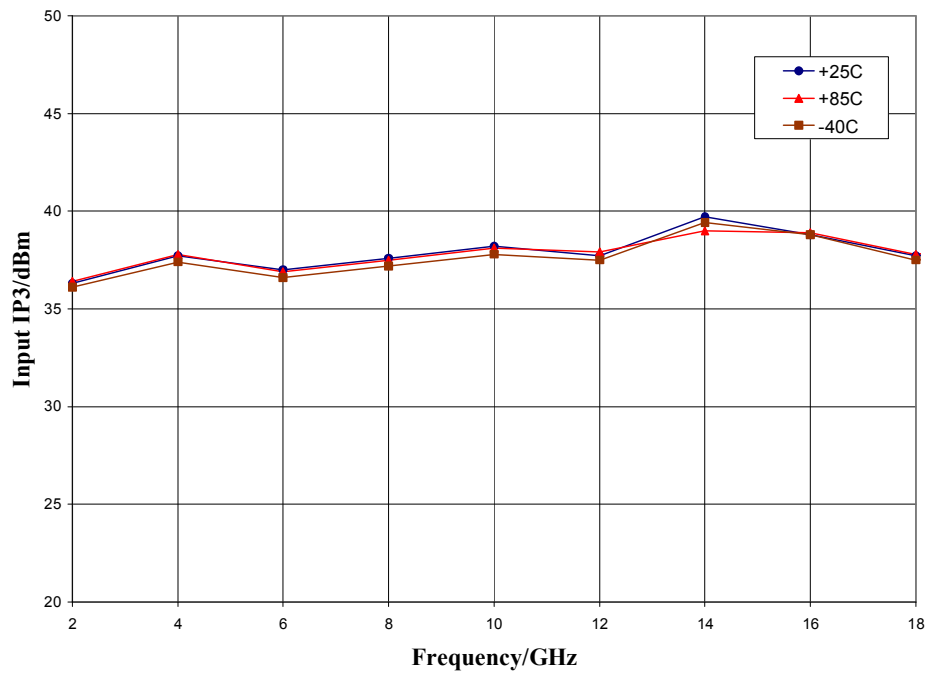
#### Input P1dB and P0.1dB Compression Point



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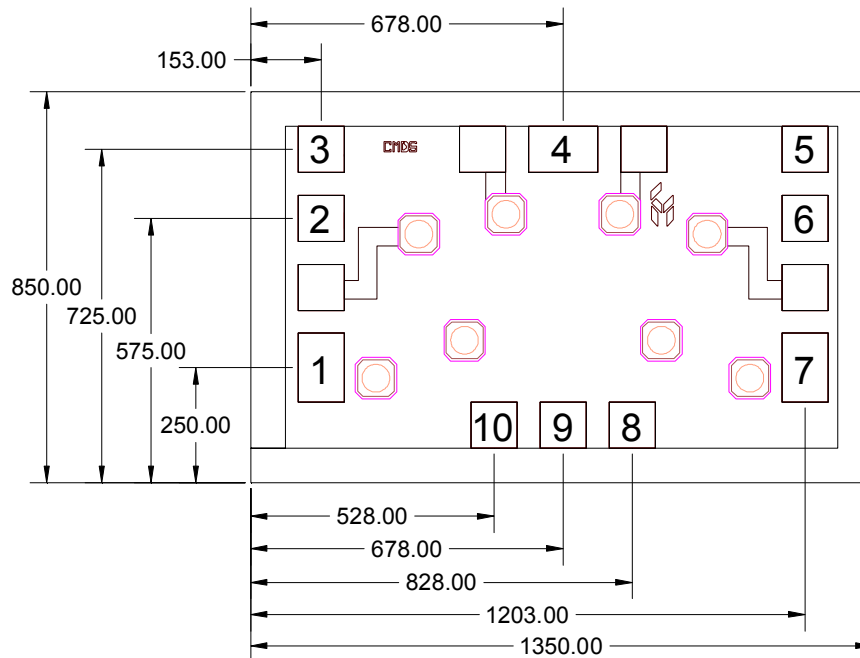
### Typical Performance

#### Input Third Order Intercept Point



### Mechanical Information

#### Die Outline (all dimensions in microns)

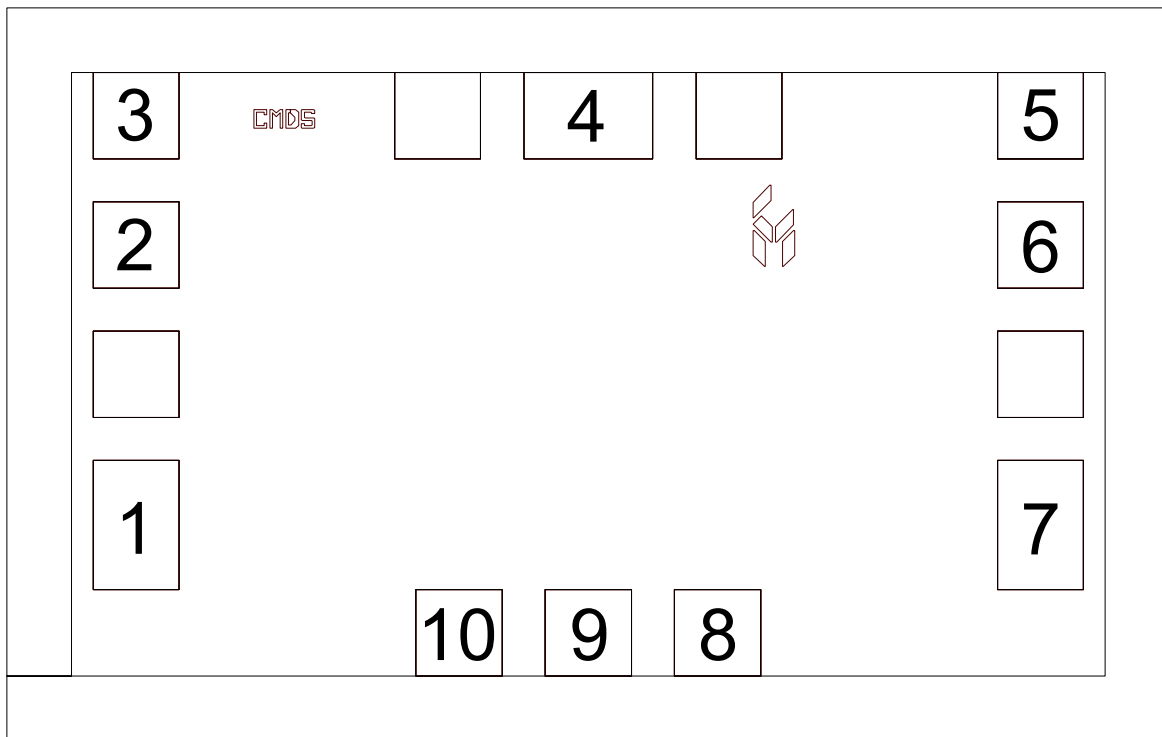


#### Notes:

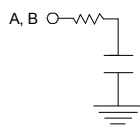
1. No connection required for unlabeled pads
2. Backside is RF and DC ground
3. Backside and bond pad metal: Gold
4. Die is 85 microns thick
5. DC bond pads (2, 3, 5, 6, 8, 9, 10) are 100 x 100 microns
6. RF bond pads (1, 4, 7) are 100 x 150 microns

### Pad Description

### Pad Diagram



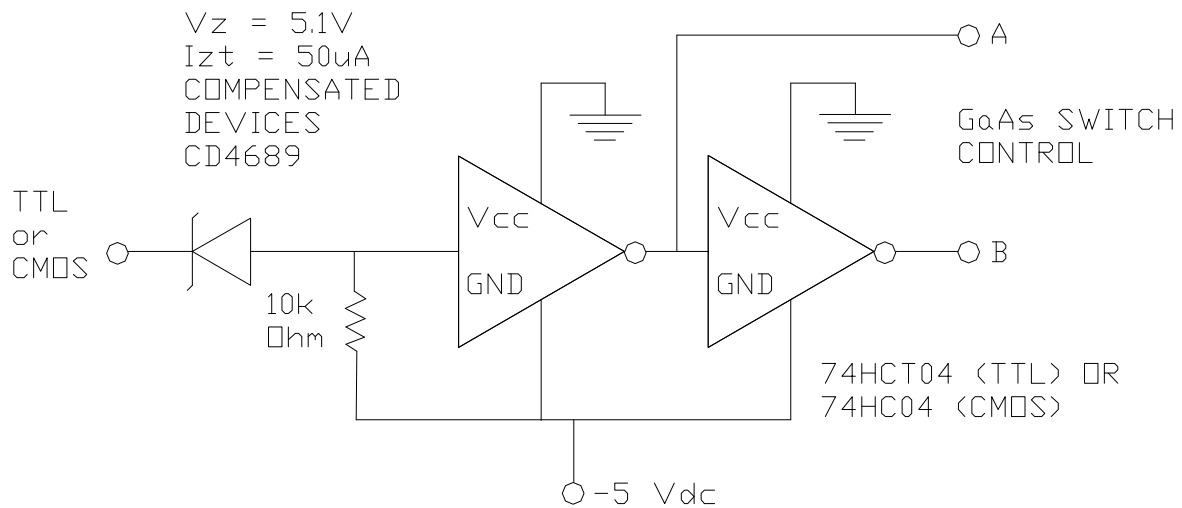
### Functional Description

| Pin         | Function      | Description                                                                                                               | Schematic                                                                             |
|-------------|---------------|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1, 4, 7     | RF1, RFC, RF2 | These pins are DC coupled and matched to 50 Ohm. Blocking capacitors are required if RF line potential is not equal to 0V |                                                                                       |
| 2, 5, 8, 10 | CTRLA         | See truth table and control voltage table                                                                                 |  |
| 3, 6, 9     | CTRLB         | See truth table and control voltage table                                                                                 |                                                                                       |
| Backside    | Ground        | Connect to RF / DC ground                                                                                                 |  |

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### Applications Information

#### Suggested Driver Circuit



**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

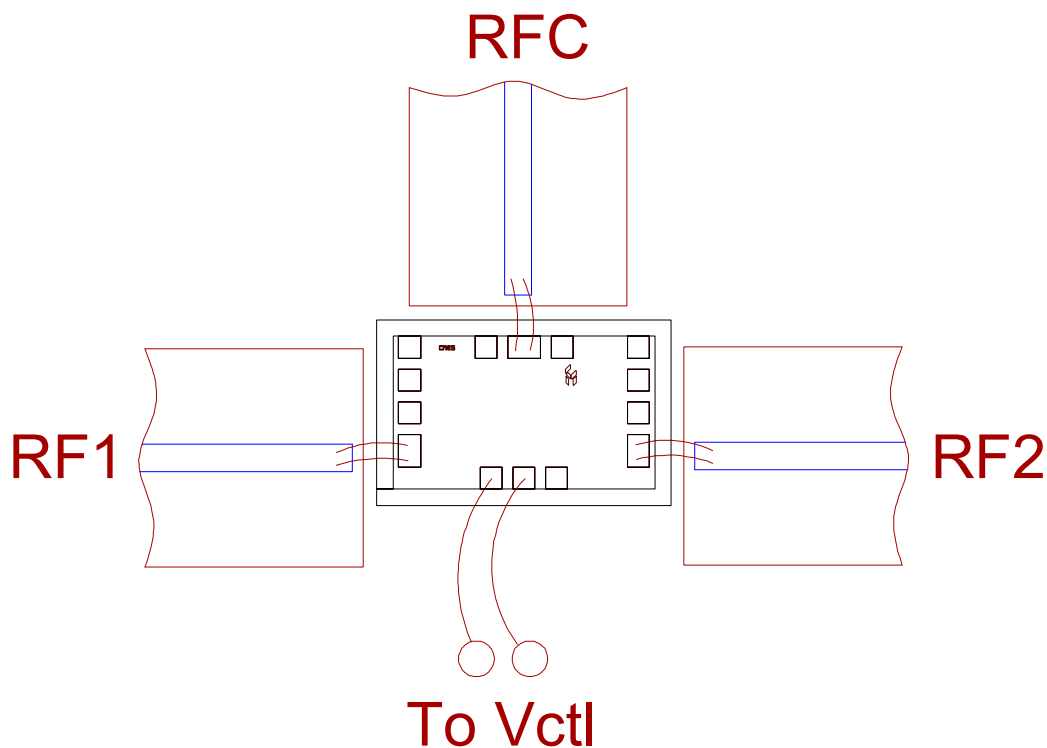
#### Assembly Guidelines

The backside of the CMD196 is RF ground. Die attach should be accomplished with electrically and thermally conductive epoxy only. Eutectic attach is not recommended. Standard assembly procedures should be followed for high frequency devices. The top surface of the semiconductor should be made planar to the adjacent RF transmission lines, and the RF decoupling capacitors placed in close proximity to the DC connections on chip.

RF connections should be made as short as possible to reduce the inductive effect of the bond wire. Use of a 0.8 mil thermosonic wedge bonding is highly recommended as the loop height will be minimized. The RF inputs and outputs require a double bond wire as shown.

The semiconductor is 85  $\mu\text{m}$  thick and should be handled by the sides of the die or with a custom collet. Do not make contact directly with the die surface as this will damage the monolithic circuitry. Handle with care.

#### Assembly Diagram



Please note, all information contained in this data sheet is subject to change without notice.

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