



Package: SOT-89

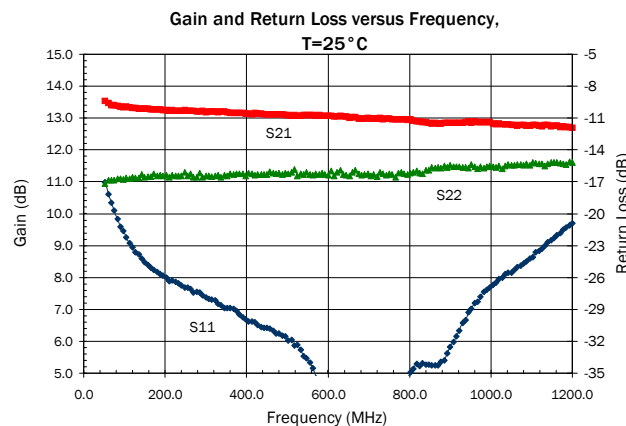


### Product Description

RFMD's CXE-1089Z is a high performance 75Ω pHEMT MMIC low-noise amplifier utilizing a Darlington configuration with active bias. The active bias network provides stable current over temperature and process threshold voltage variations. The CXE-1089Z amplifier operates linearly from +3.3V<sub>DC</sub>, +4.75V<sub>DC</sub>, or +5V<sub>DC</sub> power supplies.

#### Optimum Technology Matching® Applied

- ☐ GaAs HBT
- ☐ GaAs MESFET
- ☐ InGaP HBT
- ☐ SiGe BiCMOS
- ☐ Si BiCMOS
- ☐ SiGe HBT
- ☒ GaAs pHEMT
- ☐ Si CMOS
- ☐ Si BJT
- ☐ GaN HEMT
- ☐ InP HBT
- ☐ RF MEMS
- ☐ LDMOS



### Features

- Flat Gain: 13dB+/-0.4 dB, 50MHz to 1000MHz
- Excellent Return Loss: > 15.5dB
- Low Distortion: CTB=-82dBc, CSO=-66dBc
- Operates from Single, Fixed +3.3V<sub>DC</sub>, +4.75V<sub>DC</sub>, or +5V<sub>DC</sub> Supply
- On-Chip Active Bias Network

### Applications

- CATV Set Top Box / Tuners
- CATV Drop Amplifiers
- Optical Rx/Tx
- FTTH Video Solutions

| Parameter                          | Specification |        |      | Unit | Condition                                              |
|------------------------------------|---------------|--------|------|------|--------------------------------------------------------|
|                                    | Min.          | Typ.   | Max. |      |                                                        |
| Small Signal Gain                  |               | 13.0   |      | dB   | 500MHz                                                 |
| Gain Flatness                      |               | +/-0.4 |      | dB   | 50MHz to 1000MHz                                       |
| Output Power at 1dB Compression    |               | 18.5   |      | dBm  | 500MHz                                                 |
| Output Third Order Intercept Point |               | 38.5   |      | dBm  | 500MHz                                                 |
| CSO                                |               | -66.0  |      | dBc  | 55.25 MHz to 745.25MHz, 110Ch, Flat Tilt, 15dBmV Input |
| CTB                                |               | -82.0  |      | dBc  | 55.25 MHz to 745.25MHz, 110Ch, Flat Tilt, 15dBmV Input |
| XMOD                               |               | -78.0  |      | dBc  | 55.25 MHz to 745.25MHz, 110Ch, Flat Tilt, 15dBmV Input |
| Input Return Loss, Worst Case      |               | 16.5   |      | dB   | 50MHz to 1000MHz                                       |
| Output Return Loss, Worst Case     |               | 15.5   |      | dB   | 50MHz to 1000MHz                                       |
| Noise Figure                       |               | 3.0    |      | dB   | 500MHz                                                 |
| Device Operating Voltage           |               | 5.00   | 5.25 | V    |                                                        |
| Device Operating Current           |               | 110.0  |      | mA   | Quiescent                                              |
| Thermal Resistance                 |               | 57.5   |      | °C/W | Junction-to-case                                       |

Test Conditions: V<sub>D</sub>=5V, I<sub>D</sub>=110mA Typ, OIP<sub>3</sub> Tone Spacing=1MHz, P<sub>OUT</sub> per tone=8dBm, T<sub>L</sub>=25°C, Z<sub>S</sub>=Z<sub>L</sub>=75Ω, Tested with App Circuit

| Parameter                          | Specification |        |      | Unit            | Condition                                                        |
|------------------------------------|---------------|--------|------|-----------------|------------------------------------------------------------------|
|                                    | Min.          | Typ.   | Max. |                 |                                                                  |
| Small Signal Gain                  |               | 12.9   |      | dB              | 500MHz                                                           |
| Gain Flatness                      |               | +/-0.4 |      | dB              | 50MHz to 1000MHz                                                 |
| Output Power at 1dB Compression    |               | 17.2   |      | dBm             | 500MHz                                                           |
| Output Third Order Intercept Point |               | 37.8   |      | dBm             | 500MHz                                                           |
| CSO                                |               | -61    |      | dBc             | 55.25 MHz to 547.25 MHz, 79Ch, NTSC, Flat Tilt, +15.5 dBmV Input |
| CTB                                |               | -79    |      | dBc             | 55.25 MHz to 547.25 MHz, 79Ch, NTSC, Flat Tilt, +15.5 dBmV Input |
| Input Return Loss, Worst Case      |               | 16.4   |      | dB              | 50 MHz to 1000 MHz, -40 °C to +85 °C                             |
| Output Return Loss, Worst Case     |               | 17.5   |      | dB              | 50 MHz to 1000 MHz, -40 °C to +85 °C                             |
| Noise Figure                       |               | 2.9    |      | dB              | 500MHz                                                           |
| Device Operating Voltage           |               | 4.75   | 4.9  | V <sub>DC</sub> |                                                                  |
| Device Operating Current           |               | 106    |      | mA              | Quiescent                                                        |

Test Conditions: V<sub>D</sub>=+4.75V<sub>DC</sub>, I<sub>D</sub>=106mA, Typ. OIP3 Tone Spacing=1MHz, P<sub>OUT</sub> per tone=+8dBm  
T=+25 °C, Z<sub>S</sub>=Z<sub>L</sub>=75Ω, Tested with +5V<sub>DC</sub> Applications Circuit

| Parameter                          | Specification |        |      | Unit            | Condition                                                        |
|------------------------------------|---------------|--------|------|-----------------|------------------------------------------------------------------|
|                                    | Min.          | Typ.   | Max. |                 |                                                                  |
| Small Signal Gain                  |               | 12.7   |      | dB              | 500MHz                                                           |
| Gain Flatness                      |               | +/-0.4 |      | dB              | 50MHz to 1000MHz                                                 |
| Output Power at 1dB Compression    |               | 14.2   |      | dBm             | 500MHz                                                           |
| Output Third Order Intercept Point |               | 35.4   |      | dBm             | 500MHz                                                           |
| CSO                                |               | -56    |      | dBc             | 55.25 MHz to 547.25 MHz, 79Ch, NTSC, Flat Tilt, +15.5 dBmV Input |
| CTB                                |               | -78    |      | dBc             | 55.25 MHz to 547.25 MHz, 79Ch, NTSC, Flat Tilt, +15.5 dBmV Input |
| Input Return Loss, Worst Case      |               | 16.4   |      | dB              | 50 MHz to 1000 MHz, -40 °C to +85 °C                             |
| Output Return Loss, Worst Case     |               | 17.5   |      | dB              | 50 MHz to 1000 MHz, -40 °C to +85 °C                             |
| Noise Figure                       |               | 2.8    |      | dB              | 500MHz                                                           |
| Device Operating Voltage           |               | 3.3    | 3.5  | V <sub>DC</sub> |                                                                  |
| Device Operating Current           |               | 75     |      | mA              | Quiescent                                                        |

Test Conditions: V<sub>D</sub>=+3.3V<sub>DC</sub>, I<sub>D</sub>=75mA, Typ. OIP3 Tone Spacing=1MHz, P<sub>OUT</sub> per tone=+8dBm  
T=+25 °C, Z<sub>S</sub>=Z<sub>L</sub>=75Ω, Tested with +5V<sub>DC</sub> Applications Circuit

## Absolute Maximum Ratings

| Parameter                                     | Rating      | Unit |
|-----------------------------------------------|-------------|------|
| Device Current (I <sub>D</sub> )              | 125         | mA   |
| Device Voltage (V <sub>D</sub> )              | 5.5         | V    |
| Power Dissipation                             | 690         | mW   |
| RF Input Power* (See Note)                    | 23          | dBm  |
| Junction Temperature (T <sub>J</sub> )        | +150        | °C   |
| Operating Temperature Range (T <sub>L</sub> ) | -40 to +85  | °C   |
| Storage Temperature Range                     | -65 to +150 | °C   |
| ESD Rating - Human Body Model (HBM)           | Class 1A    |      |
| Moisture Sensitivity Level                    | MSL 2       |      |

\*Note: Load condition, 10:1 VSWR

Operation of this device beyond any one of these limits may cause permanent damage. For reliable continuous operation, the device voltage and current must not exceed the maximum operating values specified in the table on page one.

Bias conditions should also satisfy the following expression:

$$I_D V_D < (T_J - T_L) / R_{TH}, J-I$$

$$T_L = T_{LEAD}$$



**Caution!** ESD sensitive device.

Exceeding any one or a combination of the Absolute Maximum Rating conditions may cause permanent damage to the device. Extended application of Absolute Maximum Rating conditions to the device may reduce device reliability. Specified typical performance or functional operation of the device under Absolute Maximum Rating conditions is not implied.

RoHS status based on EU Directive 2002/95/EC (at time of this document revision).

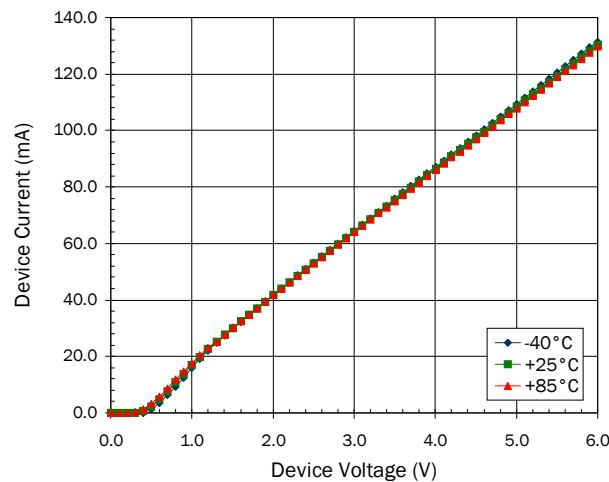
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| Parameters                          | Units | Frequency (MHz) |       |       |       |       |       |
|-------------------------------------|-------|-----------------|-------|-------|-------|-------|-------|
|                                     |       | 50              | 250   | 550   | 750   | 850   | 1050  |
| Small Signal Gain                   | dB    | 13.5            | 13.2  | 13.1  | 13.0  | 12.8  | 12.8  |
| Output Power at 1dB Compression     | dBm   | 16.6            | 17.2  | 18.6  | 18.9  | 19.1  | 19.5  |
| Output Third Order Intercept Point  | dBm   | 37.5            | 38.5  | 38.5  | 37.5  | 37.5  | 37.5  |
| Output Second Order Intercept Point | dBm   | 63.5            | 64.5  | 62.5  | 60.5  | 55.5  | 54.5  |
| Input Return Loss                   | dB    | -17.5           | -27.5 | -33.5 | -38.5 | -34.5 | -25.5 |
| Reverse Isolation                   | dB    | -17.5           | -17.5 | -17.5 | -17.5 | -17.5 | -17.5 |
| Output Return Loss                  | dB    | -17.5           | -16.5 | -16.5 | -16.5 | -15.5 | -15.5 |
| Noise Figure                        | dB    | 3.5             | 2.5   | 2.5   | 2.5   | 2.5   | 2.5   |

Test Conditions:  $V_D = 5V$   $I_D = 110mA$  Typ.  
 $T_L = 25^\circ C$   $Z_S = Z_L = 75\Omega$

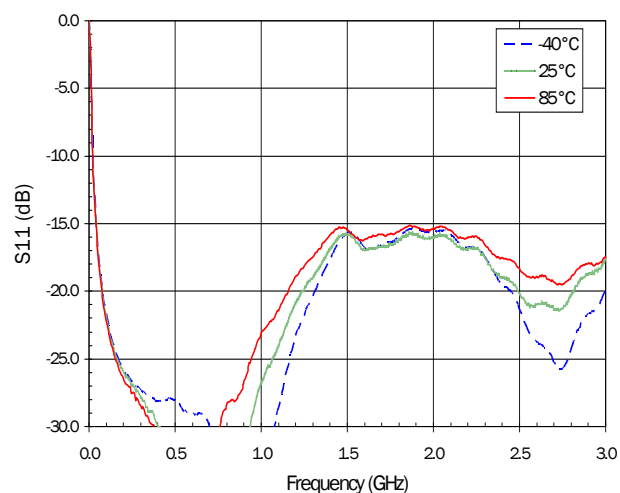
OIP<sub>3</sub>, OIP<sub>2</sub> Tone Spacing=1MHz, P<sub>OUT</sub> per tone=8dBm  
 Tested with App Circuit

Current versus Voltage ( $R_{BIAS} = \text{Open}$ )

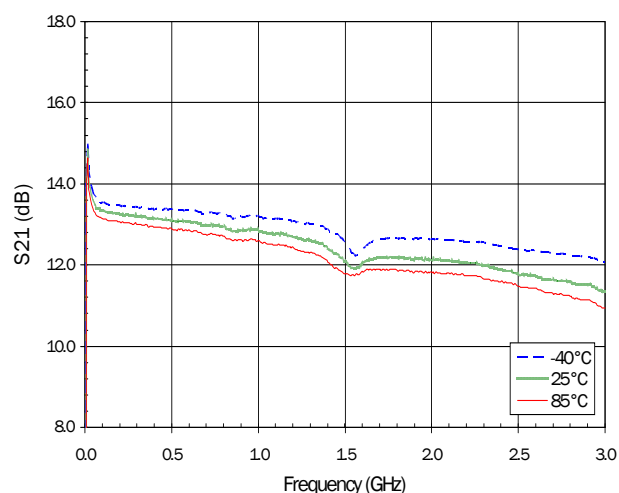


Application Circuit Performance ( $V_D = 5V$ ,  $I_D = 110mA$ ,  $R_{BIAS} = \text{open}$ )

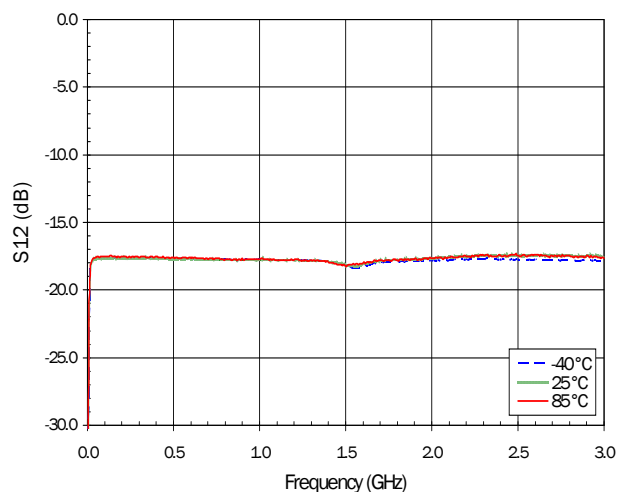
**S11 versus Frequency**



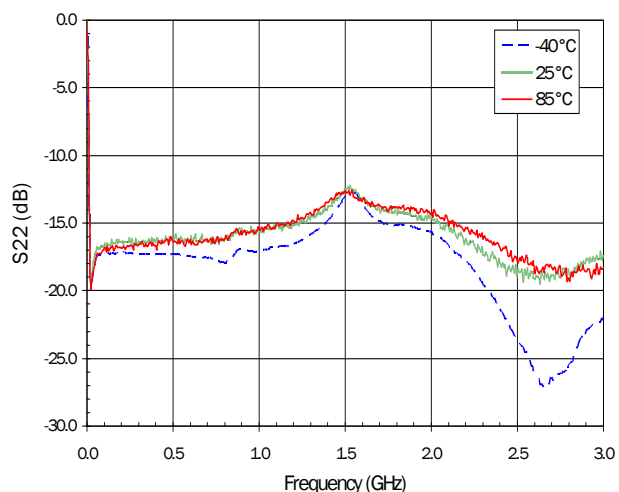
**S21 versus Frequency**



**S12 versus Frequency**

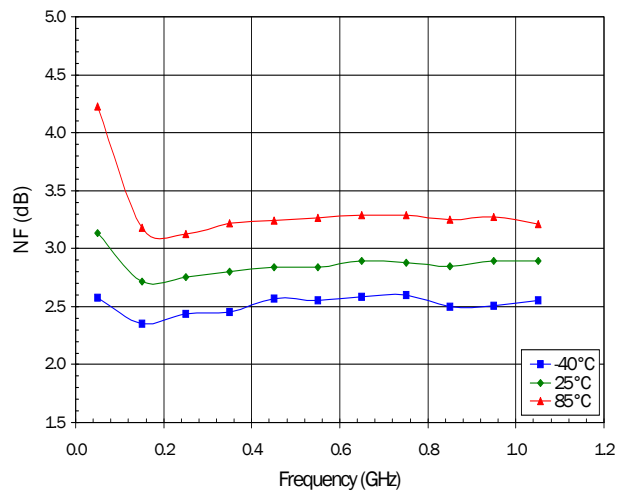


**S22 versus Frequency**

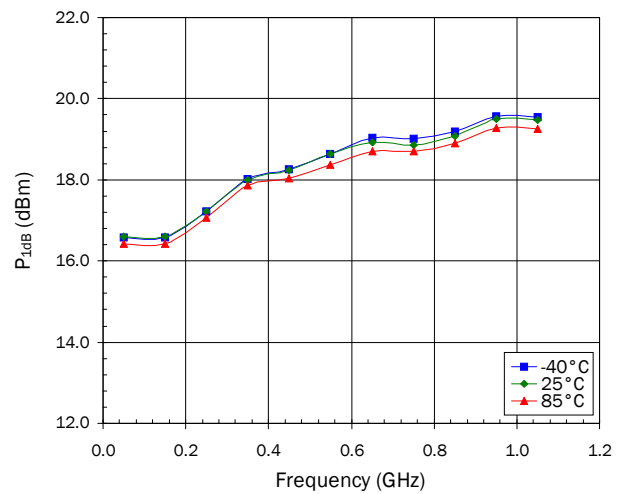


Application Circuit Performance ( $V_D=5V$ ,  $I_D=110mA$ ,  $R_{BIAS}=open$ )

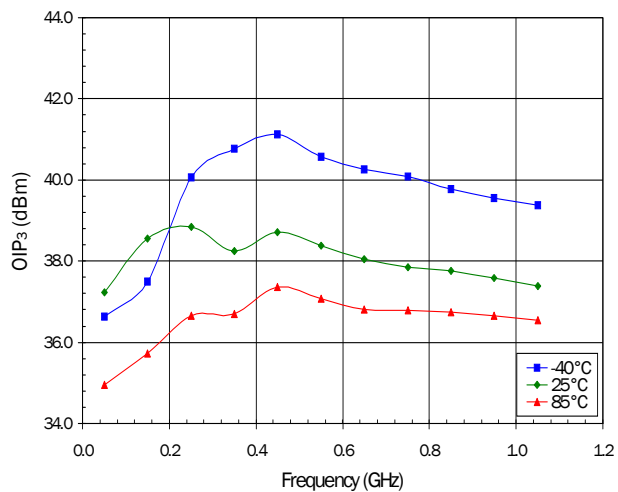
**NF versus Frequency**



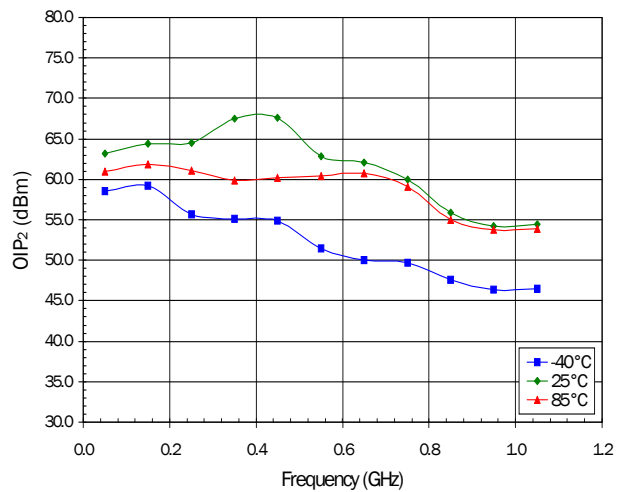
**$P_{1dB}$  versus Frequency**



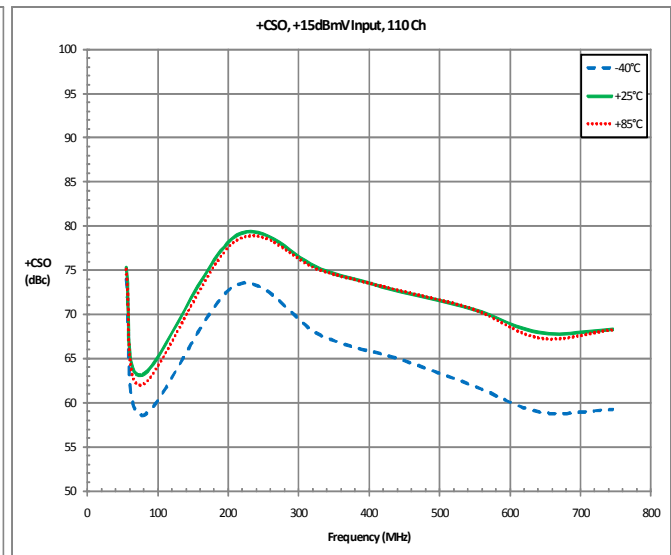
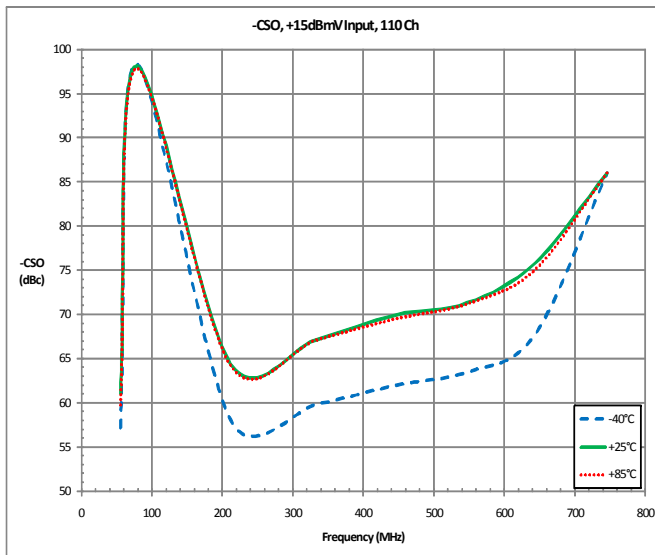
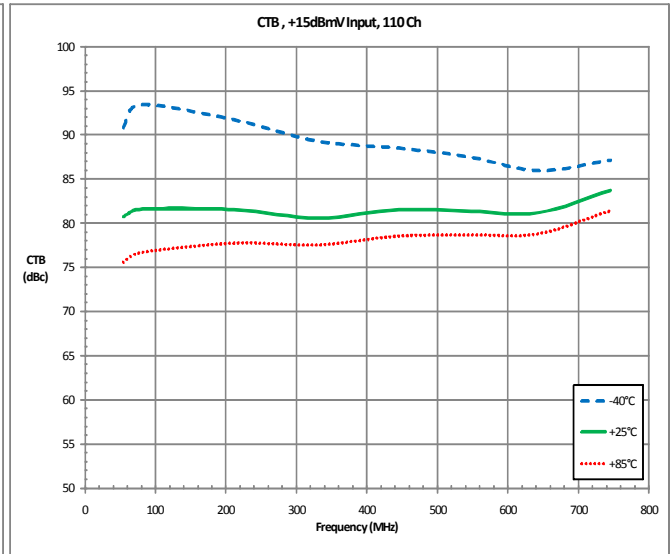
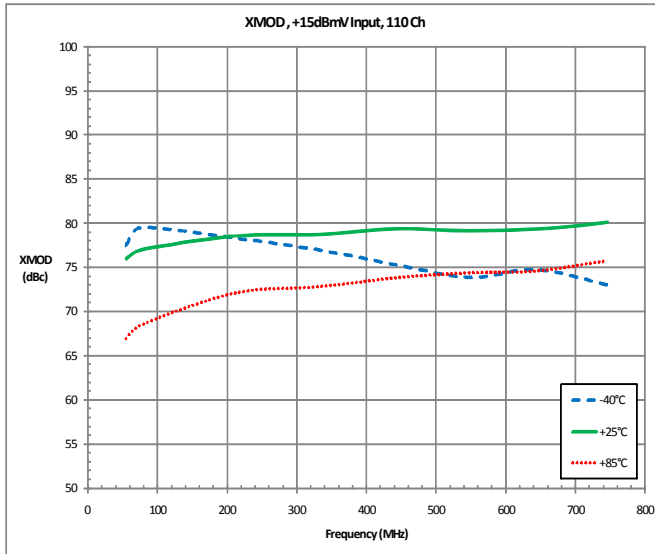
**OIP<sub>3</sub> (8dBm/tone, 1MHz spacing)**



**OIP<sub>2</sub> (8dBm/tone, 1MHz spacing)**

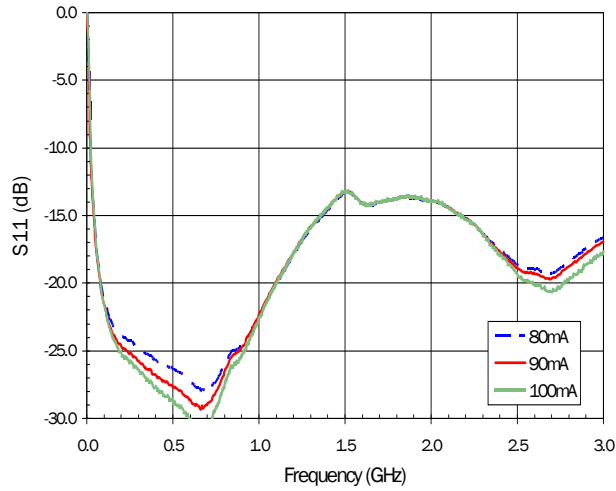


Composite Performance - Application Circuit: ( $V_D = 5V$ ,  $I_D = 110mA$ , 110Ch. Flat Tilt,  $R_{BIAS} = \text{Open}$ )

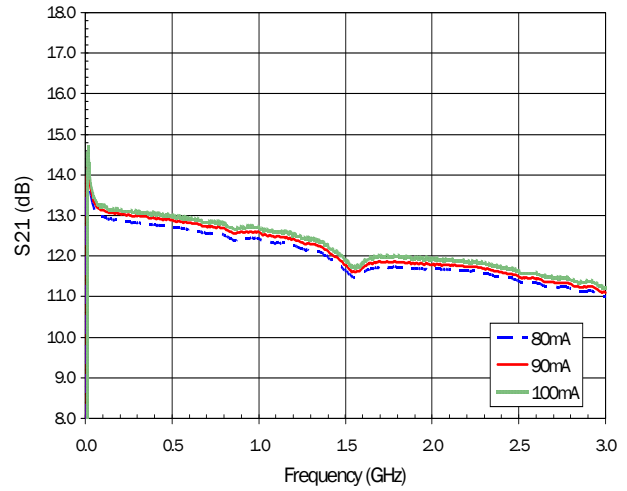


Application Circuit Performance versus Device Current (varying  $R_{BIAS}$ )  $V_D = 5.0V$ ,  $T = +25^\circ C$

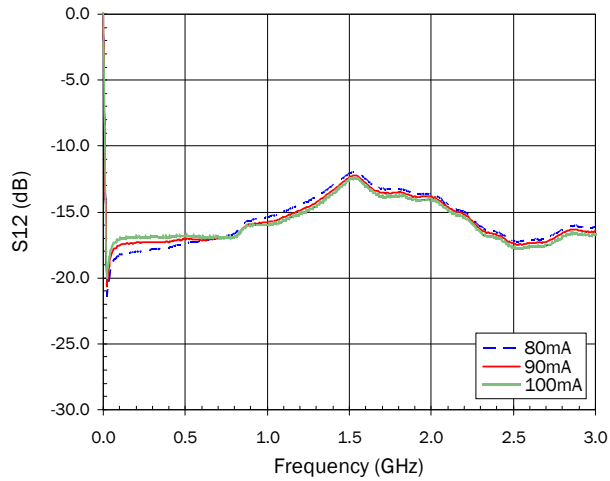
**S11 versus Frequency**



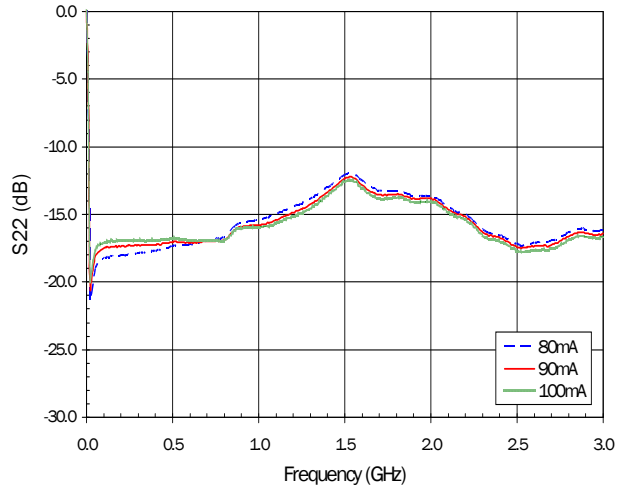
**S21 versus Frequency**



**S12 versus Frequency**

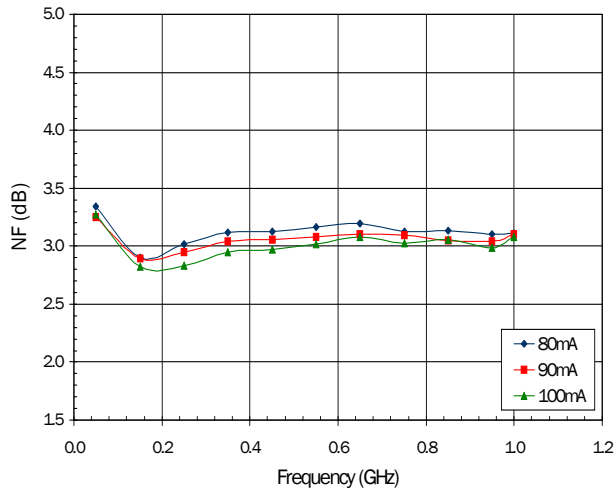


**S22 versus Frequency**

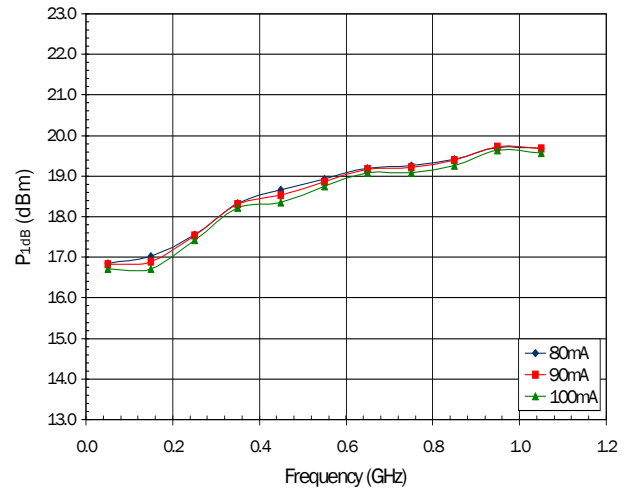


Application Circuit Performance versus Device Current ( $R_{BIAS}$ )  $V_D=5.0V$ ,  $T=+25^\circ C$

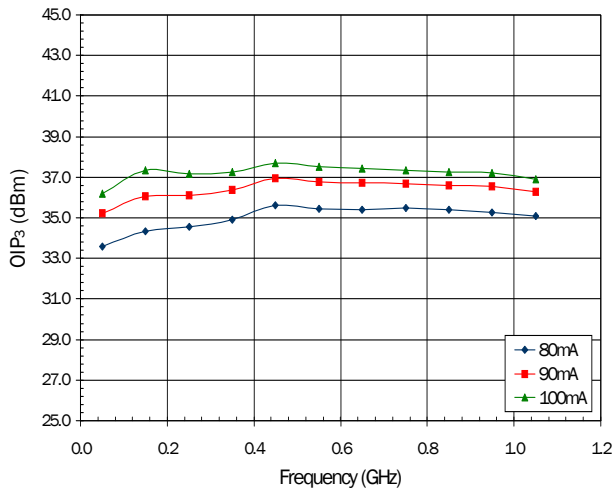
NF versus Frequency



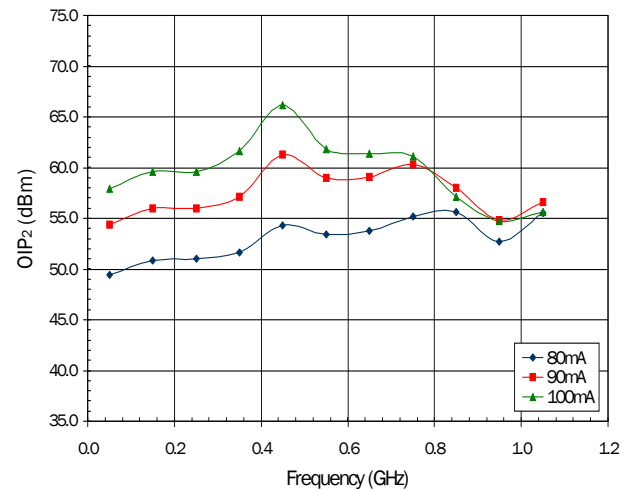
$P_{1dB}$  versus Frequency



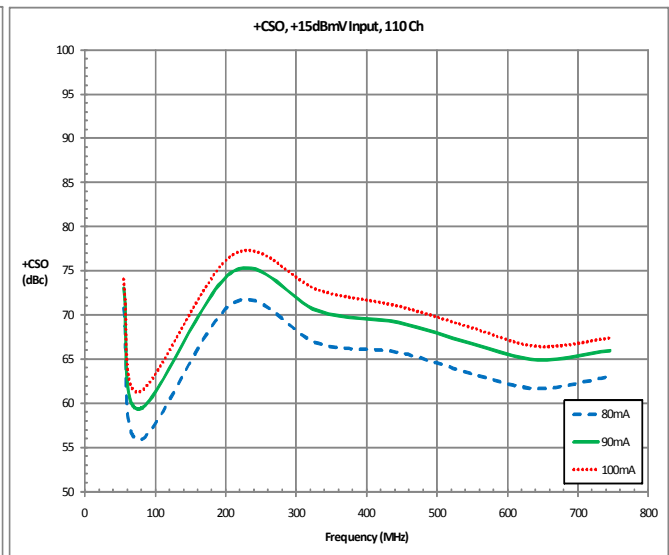
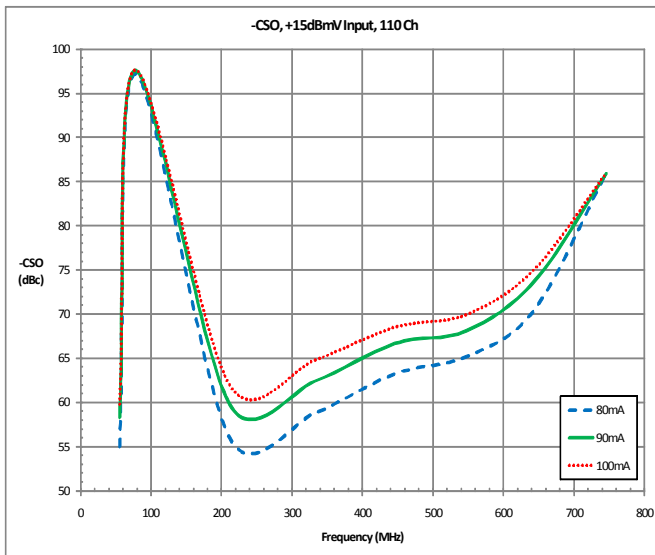
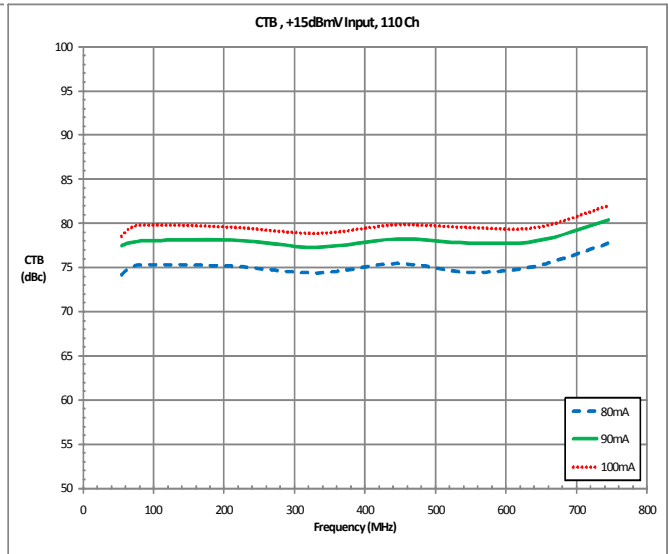
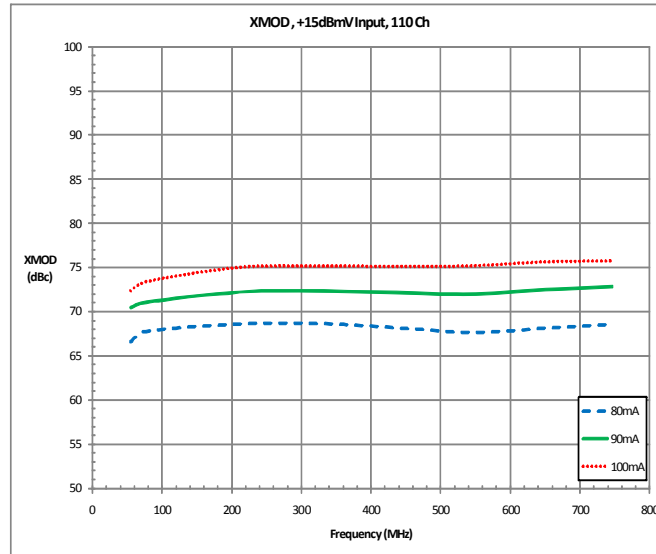
OIP<sub>3</sub> versus Frequency (8dBm/tone, 1MHz spacing)



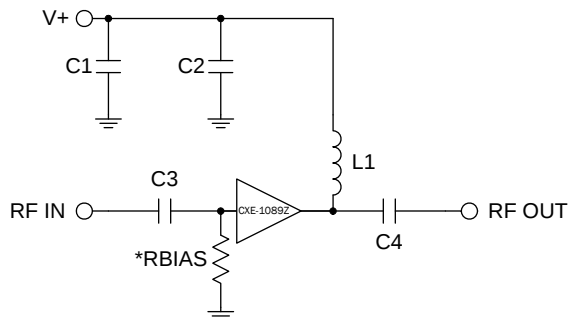
OIP<sub>2</sub> versus Frequency (8dBm/tone, 1MHz spacing)



## Application Circuit Performance versus Device Current ( $R_{BIAS}$ ) $V_D=5.0V$ , $T=+25^\circ C$



## Application Schematic



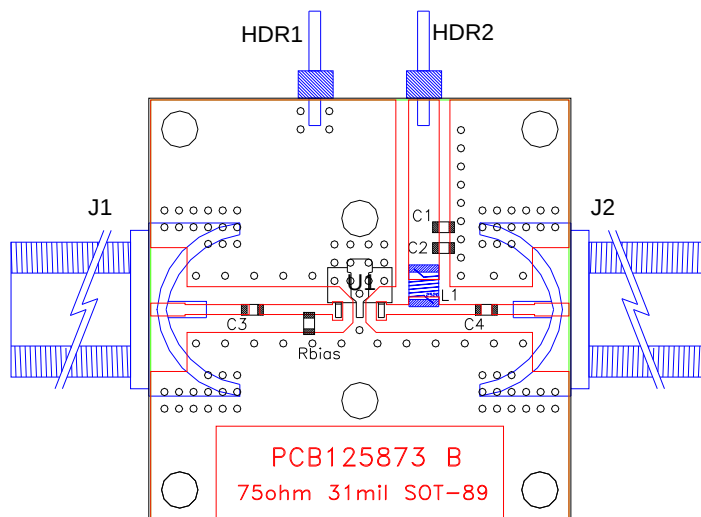
### Application Circuit Element Values

| Reference Designator | Frequency (MHz) 50 to 1200 |
|----------------------|----------------------------|
| F-connectors         |                            |
| C1, C3, C4           | 1000pF 0603 size           |
| C2                   | 100pF 0603 size            |
| L1                   | 1.2 uH 1008LS size         |
| *R <sub>BIAS</sub>   | See table below            |

\*Optional shunt resistor can be used to lower device current.  
Performance degradation may occur.

| R <sub>BIAS</sub> | Device Current (V <sub>D</sub> =5.0V) |
|-------------------|---------------------------------------|
| 1.3kΩ             | 80mA                                  |
| 2.4kΩ             | 90mA                                  |
| 4.7kΩ             | 100mA                                 |
| open              | 110mA                                 |

## Evaluation Board Layout and Bill of Materials

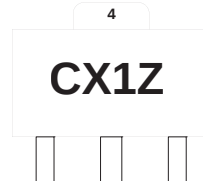


### Mounting Instructions

1. Solder the copper pad on the backside of the device package to the ground plane.
2. Use a large ground pad area with many plated through-holes as shown.
3. We recommend 1 or 2 ounce copper. Measurements for this data sheet were made on a 31mil thick GTEK board with 1 ounce copper on both sides.

| Pin         | Function          | Description                                                                                                                     |
|-------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b>    | <b>RFIN</b>       | RF input pin. This pin requires the use of an external DC blocking capacitor chosen for the frequency of operation.             |
| <b>2, 4</b> | <b>GND</b>        | Connection to ground. Use via holes as close as possible to the ground leads to minimize inductance.                            |
| <b>3</b>    | <b>RFOUT/BIAS</b> | RF output and bias pin. DC voltage is present on this pin, therefore a DC blocking capacitor is necessary for proper operation. |

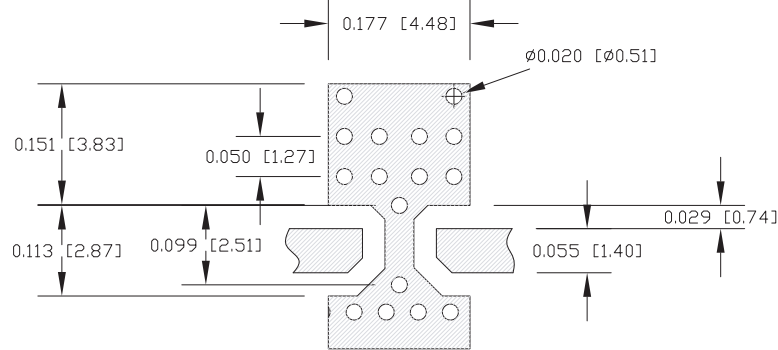
### Package Marking



Alternate marking “CXE1089Z” on line one with Trace Code on line two.

### Recommended Land Pattern Drawings

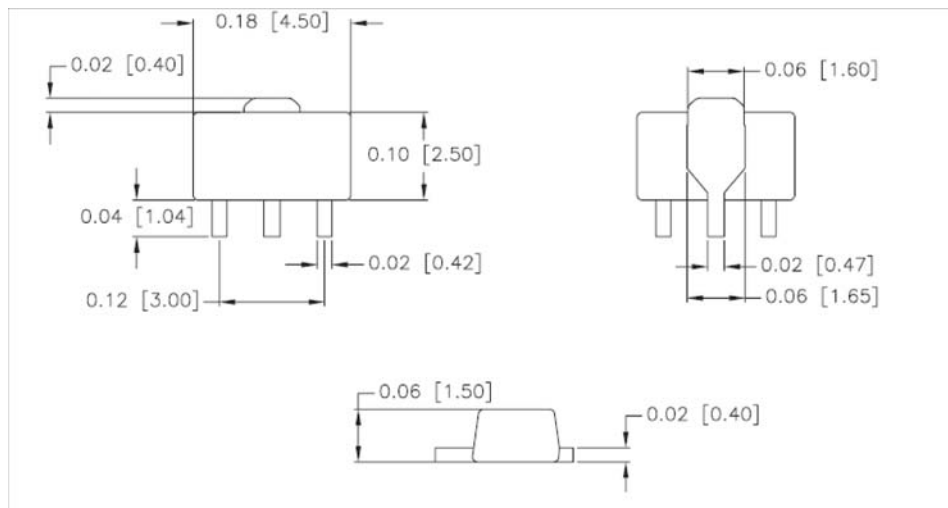
Dimensions shown in inches [mm]



### Package Drawing

Dimensions in inches (millimeters)

Refer to drawing posted at [www.rfmd.com](http://www.rfmd.com) for tolerances.



## Ordering Information

| Part Number     | Description                           | Reel Size | Devices/Reel |
|-----------------|---------------------------------------|-----------|--------------|
| CXE-1089ZSB     | 5 pcs Sample Bag                      | N/A       | N/A          |
| CXE-1089ZSQ     | 25 pcs Sample Bag                     | N/A       | N/A          |
| CXE-1089ZSR     | 50 MHz to 1200 MHz 75Ω pHEMT MMIC LNA | 7"        | 100 pcs      |
| CXE-1089Z       | 50 MHz to 1200 MHz 75Ω pHEMT MMIC LNA | 7"        | 1000 pcs     |
| CXE1089PCK-EVB1 | 75Ω Evaluation Board & 5 Loose Pieces | N/A       | N/A          |

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