# 0.3-3.0 GHz
# High Dynamic Range Amplifier

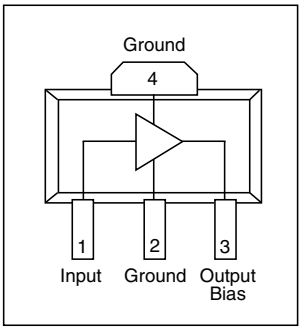
August 2007 - Rev 09-Aug-07

**CMM6004-SC**
**RoHS**

## Features

- 0.25 to 3.0 GHz Frequency Range
- 41 dBm Output IP3
- 2.1 dB Noise Figure
- 14.5 dB Gain
- 23.5 dBm P1dB
- SOT-89 SMT Package
- Single Power Supply
- +3V to +5V Voltage Rail

## Functional Block Diagram




## Circuit Description

The CMM6004-SC is a high dynamic range amplifier designed for applications operating within the 035 to 3.0 GHz frequency range. It is an ideal solution for transmit and receive functions where high linearity is required. The amplifier has the flexibility of being optimized for a number of wireless applications. The combination of low NF and high IP3 at the same bias point make it an ideal transmit or receive solution when used in applications including cellular and PCS (personal communications service) operating from 0.8 to 2.2 GHz; MMDS (multichannel multipoint distribution systems) operating from 2.2 to 2.7 GHz; and WLAN (wireless LAN) operating at 2.4 GHz. The CMM6004-SC is packaged in a low-cost, space efficient, surface mount SOT-89 package which provides excellent electrical stability and low thermal resistance. All devices are 100% RF and DC tested.

## Absolute Maximum Ratings

| | |
|---|---|
| Supply Voltage | +6.0 V |
| RF Input Power* | +20 dBm |
| Storage Temperature (Tstg) | -55 °C to +125 °C |
| Junction Temperature | 150 °C |
| Operating Temperature | -40 °C to +85°C |
| Thermal Resistance | 52 °C/W |

Operation of this device above any of these parameters may cause damage.
*Operation with more than 10 dBm of input power may cause 2 dB degradation in OIP3 performance.

## Typical Parameters

| Parameter | Typical | | | Units |
|---|---|---|---|---|
| Frequency Range | 900 | 1900 | 2400 | MHz |
| Gain | 16.5 | 14.5 | 13.6 | dB |
| Input Return Loss | -18 | -15 | -15 | dB |
| Output Return Loss | -14 | -10 | -12 | dB |
| Output IP3 | +41.5 | +41.0 | +41.0 | dBm |
| Output P1dB | 23.8 | 23.5 | 23.0 | dBm |
| Noise Figure | 1.8 | 2.2 | 2.3 | dB |

1. Typical values reflect performance in recommended application circuit.

## Electrical Characteristics (T=25°C)

Unless otherwise specified, the following specifications are guaranteed at room temperature in a Mimix fixture.

| Parameter | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| Frequency Range | | 0.3 | | 3.0 | GHz |
| Gain | Externally matched | 13.5 | 14.5 | | dB |
| Input Return Loss | Externally matched | | -10 | | dB |
| Output IP3 | | +38 | +41 | | dBm |
| Noise Figure | | | 2.1 | | dB |
| Output P1dB | | | 23 | | dBm |
| Operating Current Range | | 120 | 150 | 180 | mA |
| Supply Voltage | | | 5.0 | | V |

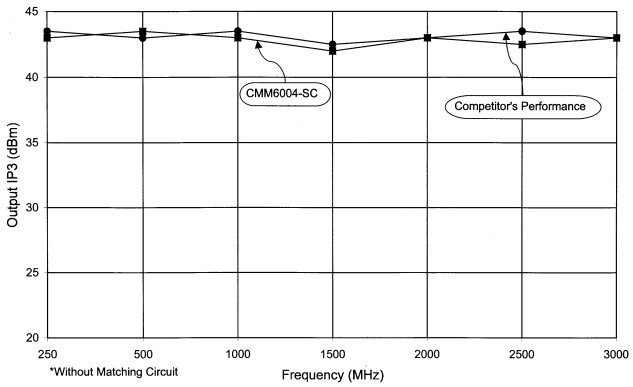
Notes:
1. T = 25°C, Vdd = 5.0, Frequency = 800 MHz, 50 Ohm system
2. OIP3 measured with two tones at output power of 5 dBm/tone separated by 10 MHz.



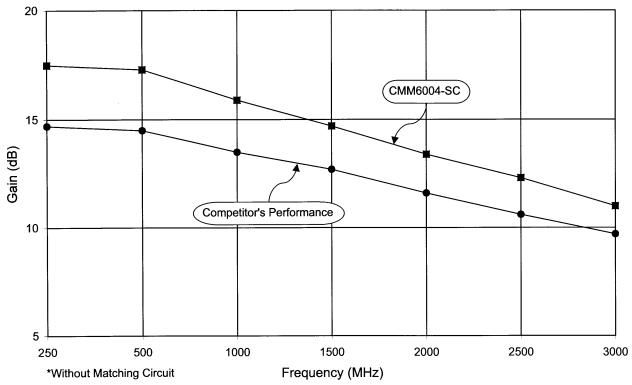
Mimix Broadband, Inc., 10795 Rockley Rd., Houston, Texas 77099
Tel: 281.988.4600 Fax: 281.988.4615 mimixbroadband.com

## Typical Performance

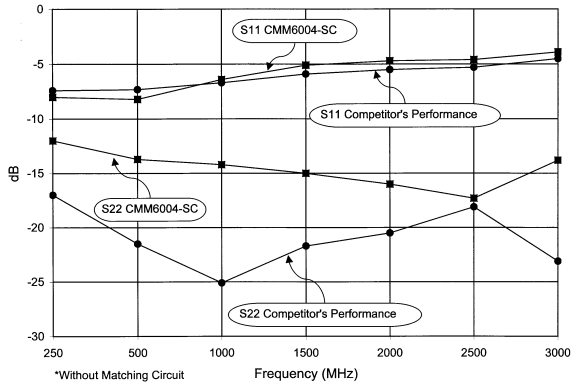
**Output IP3 vs Frequency ***



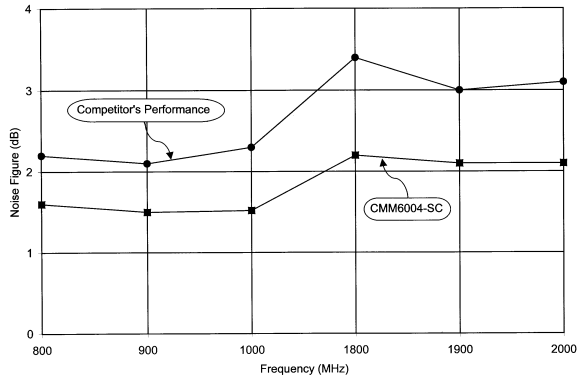

**Gain vs Frequency ***



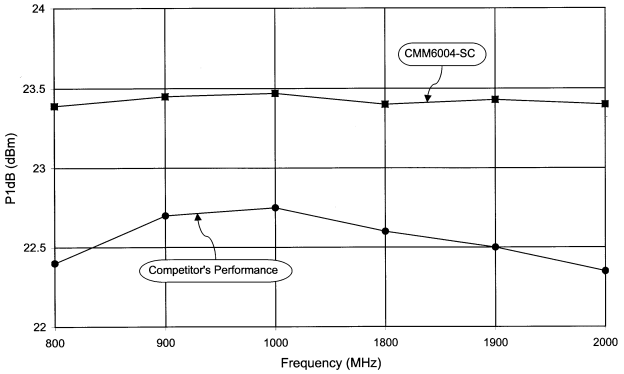

**Input/Output Return Loss ***



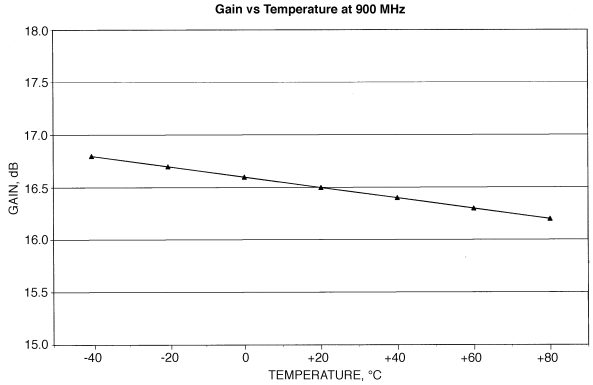

**Noise Figure vs Frequency**




**P1dB vs Frequency**



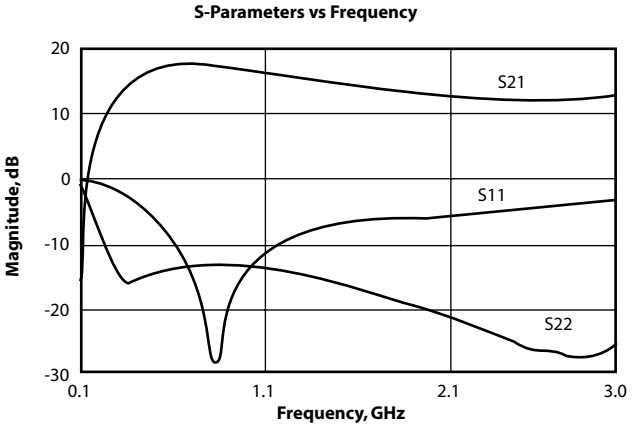

**Gain vs Temperature at 900 MHz**

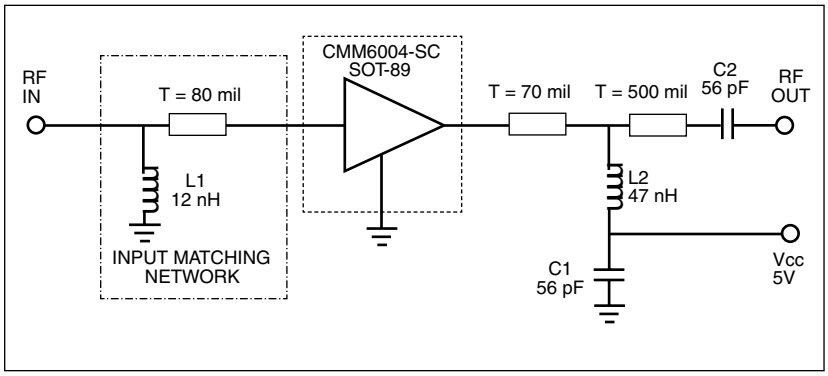


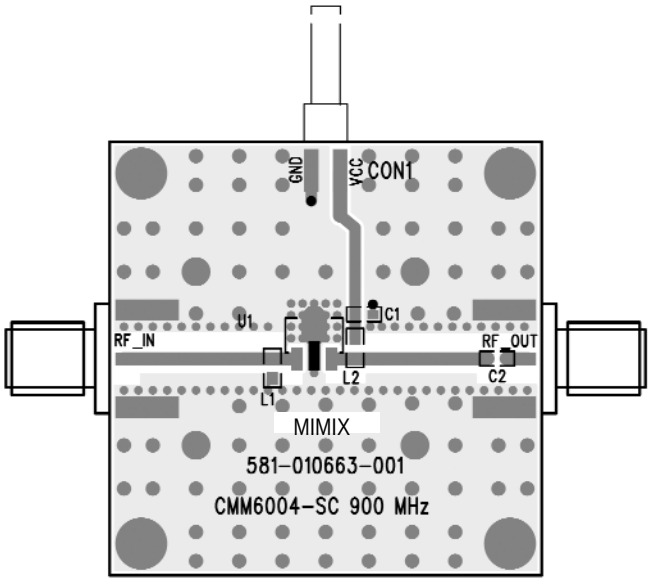
## Application Circuit - 900 MHz

Typical Performance (50 Ohm System)

| | 5V | 3.3V |
|---|---|---|
| Frequency | 900 MHz | 900 MHz |
| Gain | 16.5 dB | 16.2 dB |
| Input Return Loss | -18.0 dB | -19.0 dB |
| Output Return Loss | -14.0 dB | -16.0 dB |
| OIP3 | 41.0 dBm | 38.0 dBm |
| Noise Figure | 1.8 dB | 1.8 dB |
| Drain Current | Id = 173 mA | Id = 173 mA |
| P1dB | 23.8 dBm | 18.5 dBm |



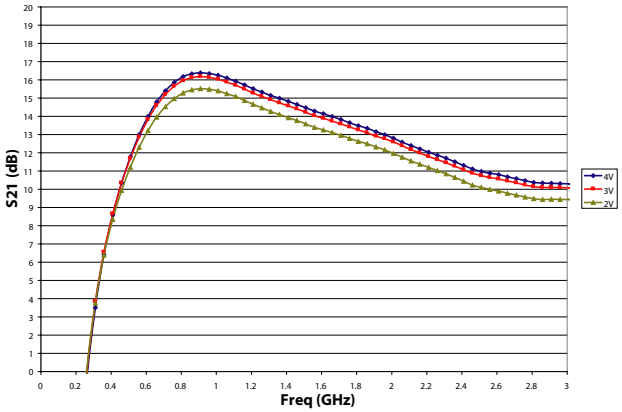



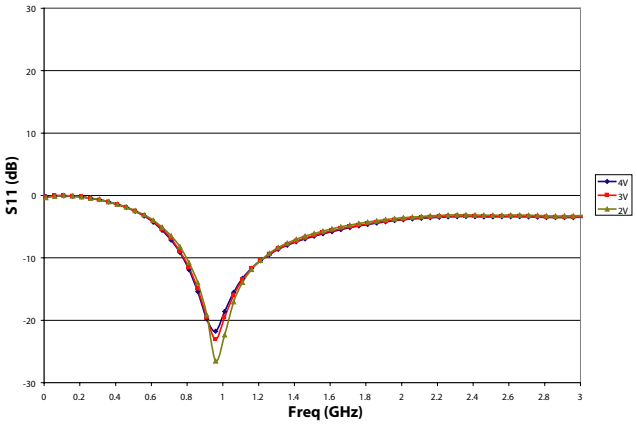

| Ref Designator | Value | Description | Size |
|---|---|---|---|
| C1, C2 | 56 pF | MCH185A560JK | 0603 |
| L1 | 12 nH | TOKO LL1608-F12NK | 0603 |
| L2 | 47 nH | TOKO LL1608-F47NK | 0603 |

## Typical Performance Over Voltage

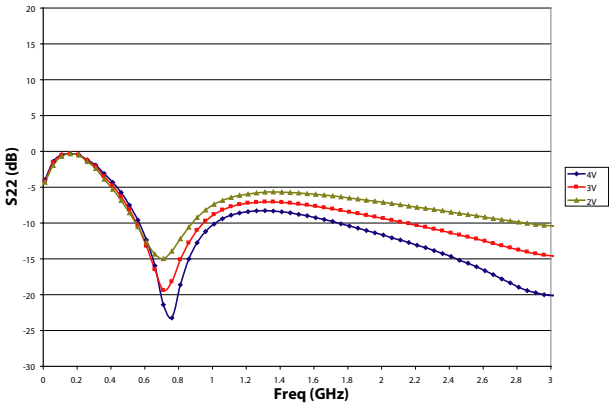
CMM6004-SC Evaluation board @ 900MHz
S21 Over Voltage



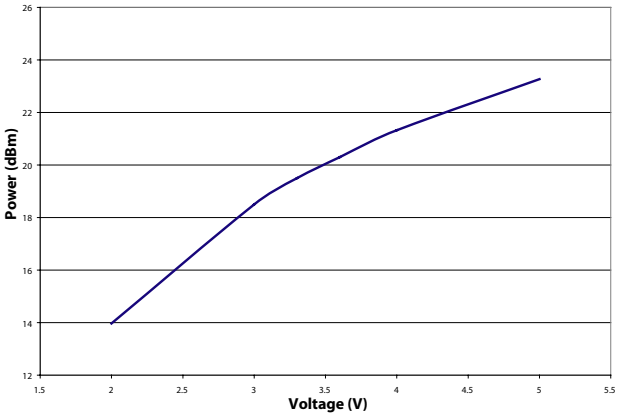

CMM6004-SC Evaluation board @ 900MHz
S11 Over Voltage



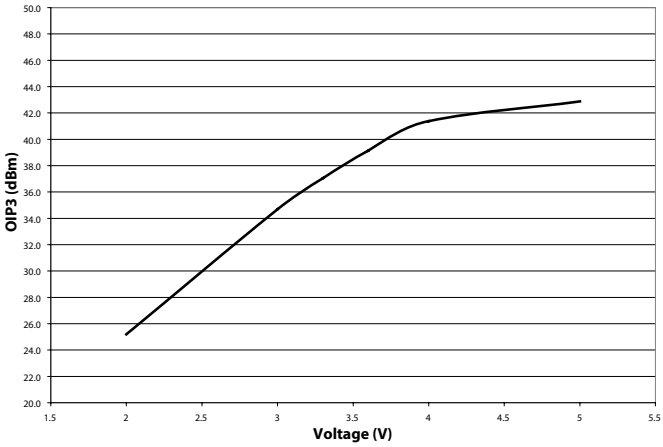

CMM6004-SC Evaluation board @ 900MHz
S22 Over Voltage




CCMM6004-SC Evaluation board @ 900MHz
P1dB Over Voltage

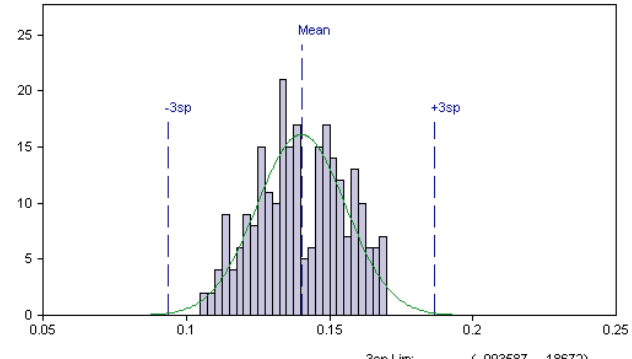



CCMM6004-SC Evaluation board @ 900MHz
OIP3 Over Voltage



## Distribution Charts @ 3.3V

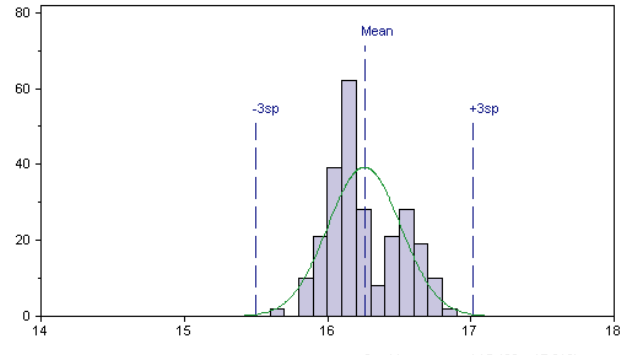
**Idss @ 3.3V**




3sp Lim: ( .093587, .18672)

Mean: .140152
Std Dev: .015522
Skewness: -.068129

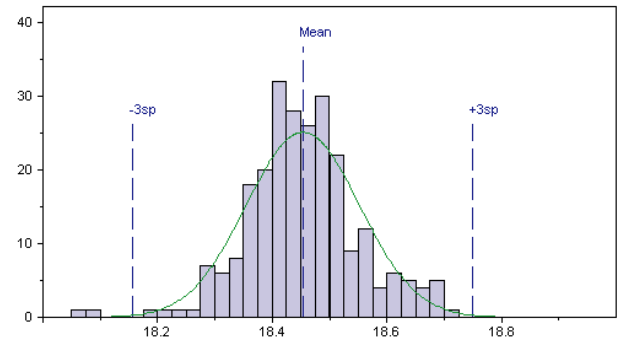
**Gain @ 3.3V**




3sp Lim: ( 15.496, 17.019)

Mean: 16.2574
Std Dev: .2538
Skewness: .41984

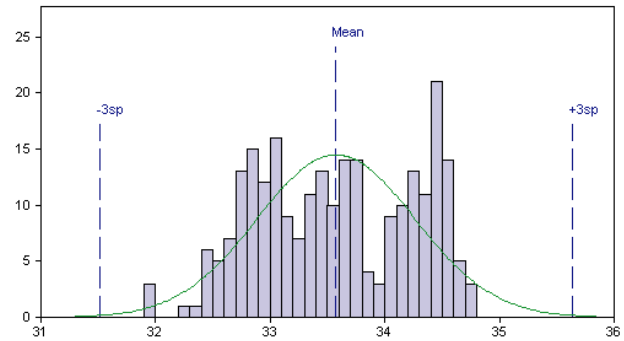
**P1dB @ 3.3V**




3sp Lim: ( 18.157, 18.75)

Mean: 18.4536
Std Dev: .098756
Skewness: -.090151

**OIP3 @ 3.3V**




3sp Lim: ( 31.51, 35.638)

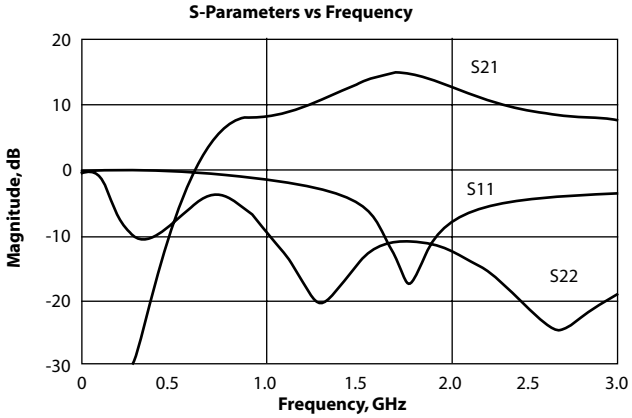
Mean: 33.5739
Std Dev: .68807
Skewness: -.076963

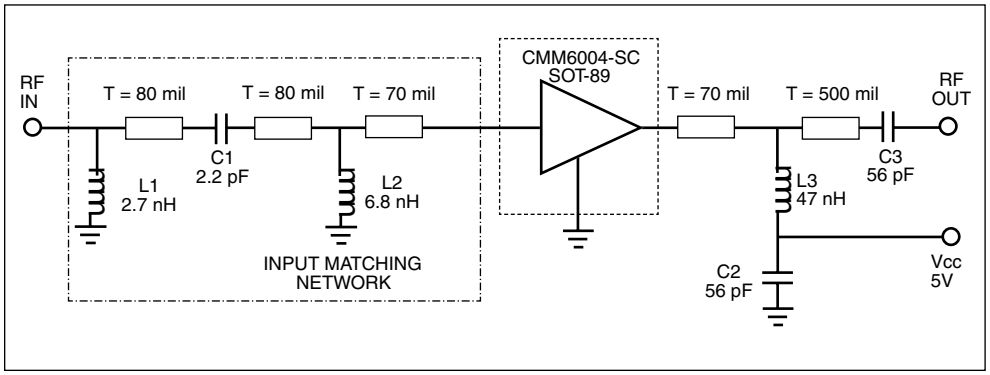
**Note: Sample size is 250 samples taken from 3 different wafer lots.**

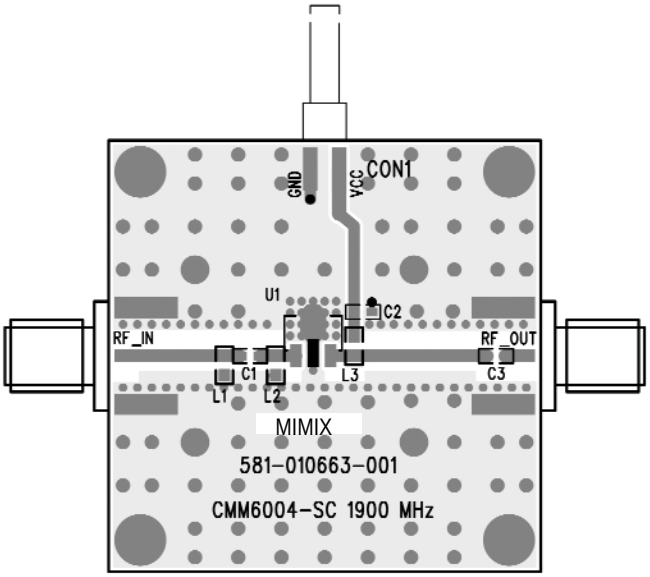
## Application Circuit - 1900 MHz

Typical Performance (50 Ohm System)

| | |
|---|---|
| Frequency | 1900 MHz |
| Gain | 14.5 dB |
| Input Return Loss | -15 dB |
| Output Return Loss | -10 dB |
| OIP3 | 41.0 dBm |
| Noise Figure | 2.2 dB |
| Bias | Vds = 5V, Id = 174 mA |
| P1dB | 23.5 dBm |



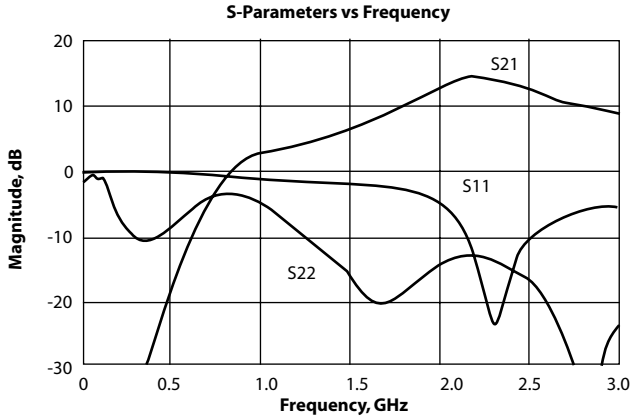



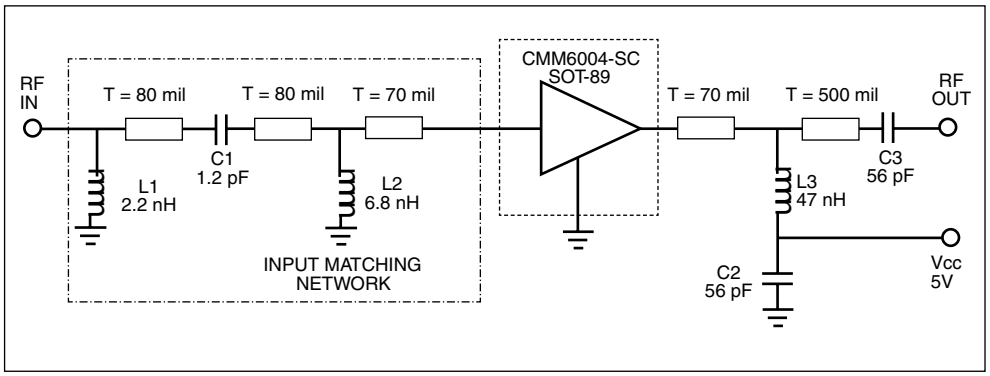

| Ref Designator | Value | Description | Size |
|---|---|---|---|
| C1 | 2.2 pF | KOA 2.2pF 50V CER CAP 0603 NPO ±.25pF | 0603 |
| C2, C3 | 56 pF | MCH185A560JK | 0603 |
| L1 | 2.7 nH | TOKO LL1608-F2N7S | 0603 |
| L2 | 6.8 nH | TOKO LL1608-F6N8K | 0603 |
| L3 | 47 nH | TOKO LL1608-F47NK | 0603 |

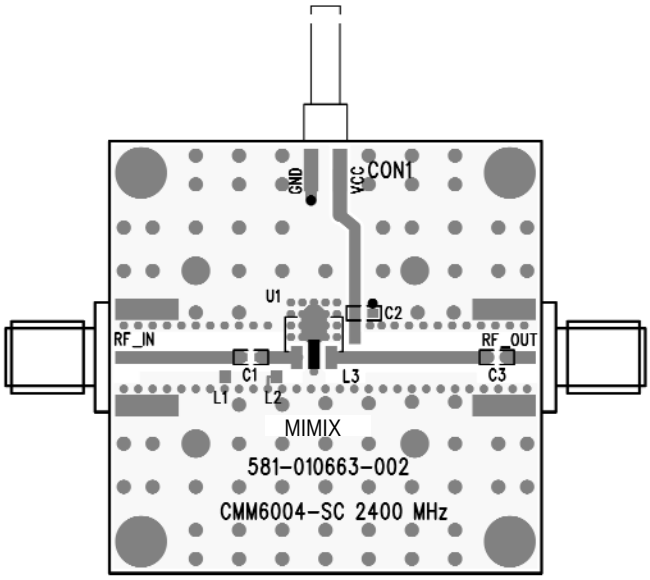
## Application Circuit - 2400 MHz

Typical Performance (50 Ohm System)

| | |
|---|---|
| Frequency | 2400 MHz |
| Gain | 13.6 dB |
| Input Return Loss | -15 dB |
| Output Return Loss | -12 dB |
| OIP3 | 41.0 dBm |
| Noise Figure | 2.3 dB |
| Bias | Vds = 5V, Id = 175 mA |
| P1dB | 23.0 dBm |




| Ref Designator | Value | Description | Size |
|---|---|---|---|
| C1 | 1.2 pF | PHYC 1.2pF 50V CER CAP 0603 NPO ±.25pF | 0603 |
| C2, C3 | 56 pF | MCH185A560JK | 0603 |
| L1 | 2.2 nH | TOKO LL1608-F2N2S | 0603 |
| L2 | 6.8 nH | TOKO LL1608-F6N8K | 0603 |
| L3 | 47 nH | TOKO LL1608-F47NK | 0603 |

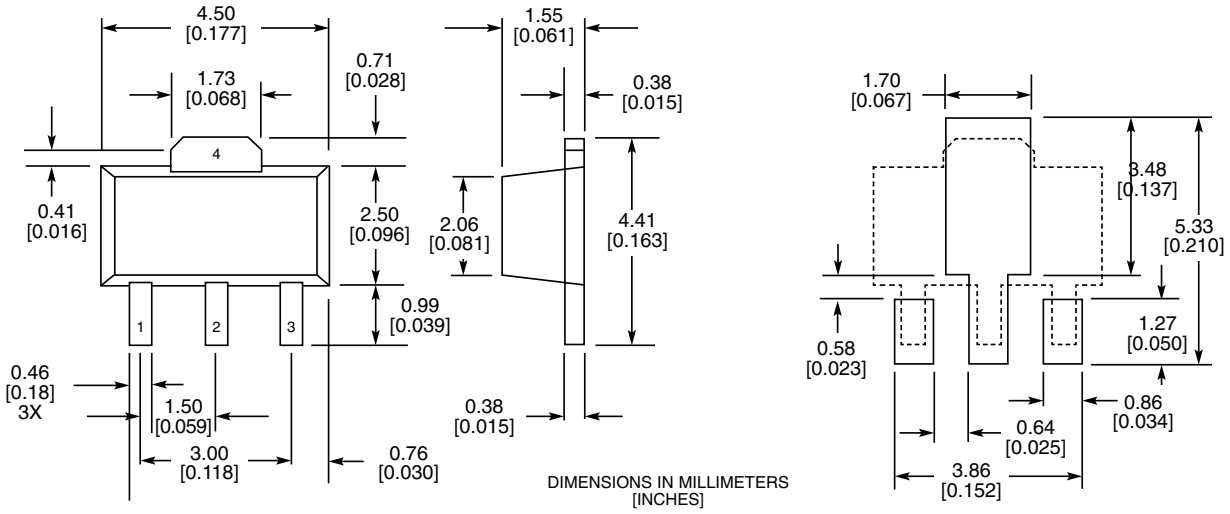
## Typical Scattering Parameters

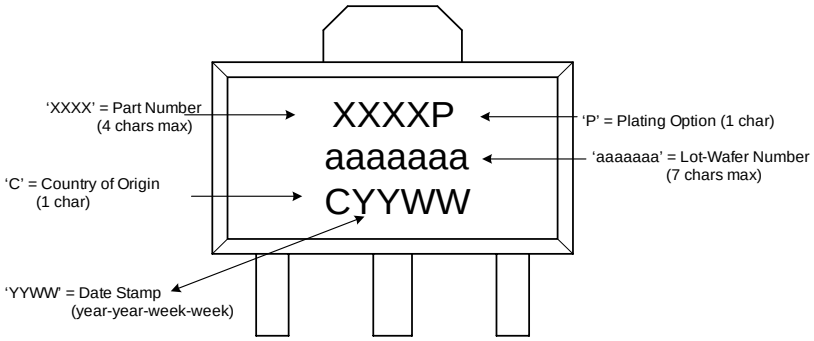
(Vds = +5V, Ids = 150 mA, T = 22°C, unmatched device in a 50 ohm system)

| Frequency (MHz) | $S_{11}$ (Mag) | $S_{11}$ (Ang) | $S_{21}$ (Mag) | $S_{21}$ (Ang) | $S_{12}$ (Mag) | $S_{12}$ (Ang) | $S_{22}$ (Mag) | $S_{22}$ (Ang) |
|---|---|---|---|---|---|---|---|---|
| 300 | 0.337 | -47.270 | 7.379 | 157.500 | 0.066 | -3.397 | 0.067 | -164.10 |
| 400 | 0.349 | -58.240 | 7.259 | 151.400 | 0.066 | -6.123 | 0.064 | -173.50 |
| 500 | 0.363 | -68.990 | 7.127 | 145.300 | 0.066 | -8.429 | 0.062 | -179.70 |
| 600 | 0.379 | -79.290 | 6.986 | 139.300 | 0.066 | -10.740 | 0.060 | -173.90 |
| 700 | 0.396 | -89.000 | 6.829 | 133.300 | 0.065 | -12.900 | 0.059 | -169.10 |
| 800 | 0.413 | -98.120 | 6.666 | 127.400 | 0.065 | -14.990 | 0.057 | -165.00 |
| 900 | 0.430 | -106.700 | 6.502 | 121.600 | 0.065 | -16.990 | 0.055 | -161.60 |
| 1000 | 0.447 | -114.700 | 6.330 | 115.900 | 0.065 | -18.970 | 0.053 | -158.60 |
| 1100 | 0.467 | -122.400 | 6.162 | 110.300 | 0.065 | -20.840 | 0.052 | -155.50 |
| 1200 | 0.475 | -129.600 | 5.991 | 104.900 | 0.065 | -22.900 | 0.049 | -152.50 |
| 1300 | 0.490 | -136.500 | 5.820 | 99.610 | 0.065 | -24.660 | 0.047 | -150.10 |
| 1400 | 0.502 | -143.100 | 5.655 | 94.400 | 0.065 | -26.510 | 0.046 | -147.00 |
| 1500 | 0.513 | -149.400 | 5.494 | 89.350 | 0.064 | -28.490 | 0.044 | -144.30 |
| 1600 | 0.524 | -155.500 | 5.339 | 84.370 | 0.064 | -30.130 | 0.042 | -141.50 |
| 1700 | 0.534 | -161.400 | 5.189 | 79.490 | 0.064 | -32.120 | 0.041 | -138.80 |
| 1800 | 0.543 | -167.100 | 5.045 | 74.690 | 0.064 | -34.010 | 0.040 | -136.00 |
| 1900 | 0.551 | -172.60 | 4.906 | 69.960 | 0.064 | -35.800 | 0.039 | -133.00 |
| 2000 | 0.559 | -178.000 | 4.775 | 65.320 | 0.064 | -37.620 | 0.038 | -130.00 |
| 2100 | 0.565 | 176.800 | 4.647 | 60.730 | 0.064 | -39.550 | 0.037 | -127.20 |
| 2200 | 0.571 | 171.500 | 4.523 | 56.180 | 0.064 | -41.370 | 0.037 | -124.10 |
| 2300 | 0.577 | 166.400 | 4.402 | 51.720 | 0.064 | -43.200 | 0.036 | -119.80 |
| 2400 | 0.582 | 161.400 | 4.289 | 47.320 | 0.064 | -45.090 | 0.035 | -116.00 |
| 2500 | 0.588 | 156.500 | 4.183 | 42.960 | 0.064 | -46.900 | 0.036 | -111.50 |
| 2600 | 0.539 | 151.600 | 4.081 | 38.610 | 0.065 | -48.790 | 0.035 | -106.20 |
| 2700 | 0.597 | 146.800 | 3.983 | 34.330 | 0.065 | -50.760 | 0.035 | -101.30 |
| 2800 | 0.600 | 142.000 | 3.886 | 30.050 | 0.065 | -52.670 | 0.036 | -95.96 |
| 2900 | 0.605 | 137.200 | 3.795 | 25.810 | 0.065 | -54.540 | 0.037 | -90.92 |
| 3000 | 0.608 | 132.500 | 3.706 | 21.620 | 0.065 | -56.660 | 0.038 | -85.54 |

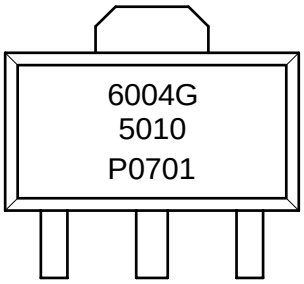
S-Parameter Data Files are available online at www.mimixbroadband.com.

## Physical Dimensions




Example:




| | |
|---|---|
| Base Part #: | 6004 |
| Lot-Wafer #: | 5010 |
| Plating Option: | G (matte tin) |
| Date Code: | 2007, week 1 |
| Country of Origin: | Philippines |

## Handling and Assembly Information

**CAUTION!** - Mimix Broadband MMIC Products contain gallium arsenide (GaAs) which can be hazardous to the human body and the environment. For safety, observe the following procedures:

- Do not ingest.
- Do not alter the form of this product into a gas, powder, or liquid through burning, crushing, or chemical processing as these by-products are dangerous to the human body if inhaled, ingested, or swallowed.
- Observe government laws and company regulations when discarding this product. This product must be discarded in accordance with methods specified by applicable hazardous waste procedures.

**Life Support Policy** - Mimix Broadband's products are not authorized for use as critical components in life support devices or systems without the express written approval of the President and General Counsel of Mimix Broadband. As used herein: (1) Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user. (2) A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

**Package Attachment** - This packaged product from Mimix Broadband is provided as a rugged surface mount package compatible with high volume solder installation. Care should be taken not to apply heavy pressure to the top or base material to avoid package damage. Vacuum tools or other suitable pick and place equipment may be used to pick and place this part. Care should be taken to ensure that there are no voids or gaps in the solder connection so that good RF, DC and ground connections are maintained. Voids or gaps can eventually lead not only to RF performance degradation, but reduced reliability and life of the product due to thermal stress.

**Mimix Lead-Free RoHS Compliant Program -** Mimix has an active program in place to meet customer and governmental requirements for eliminating lead (Pb) and other environmentally hazardous materials from our products. All Mimix RoHS compliant components are form, fit and functional replacements for their non-RoHS equivalents. Lead plating of our RoHS compliant parts is 100% matte tin (Sn) over copper alloy and is backwards compatible with current standard SnPb low-temperature reflow processes as well as higher temperature (260°C reflow) "Pb Free" processes.

## Ordering Information

The CMM6004-SC is available in a surface-mount SOT-89 package and devices are available in tape and reel.

| Part Number for Ordering | Description |
|---|---|
| CMM6004-SC-0G00 | Matte Tin finished RoHS compliant SOT-89 surface-mount power package in bulk quantity |
| CMM6004-SC-0G0T | Matte Tin finished RoHS compliant SOT-89 surface-mount power package in tape and reel |
| PB-CMM6004-SC-00A0 | Evaluation Board with SMA connectors for CMM6004-SC matched at 900 MHz |
| PB-CMM6004-SC-00B0 | Evaluation Board with SMA connectors for CMM6004-SC matched at 1900 MHz |
| PB-CMM6004-SC-00C0 | Evaluation Board with SMA connectors for CMM6004-SC matched at 2400 MHz |

We also offer the plastic package with SnPb (Tin-Lead) or NiPdAu plating. Please contact your regional sales manager for more information regarding different plating types.