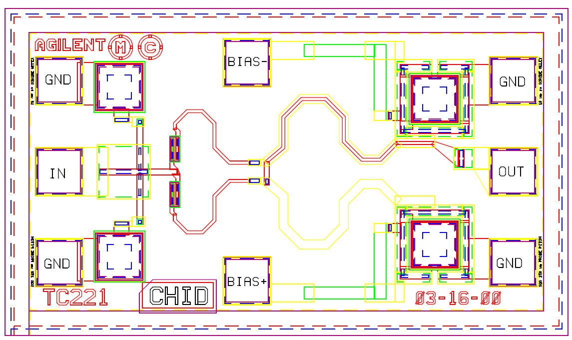
Agilent 1GC1-8038
50 GHz Frequency Doubler

TC221 Data Sheet



Chip Size: 890 × 500 µm (35.0 x 19.7 mils)
Chip Size Tolerance: ±10 µm (±0.4 mils)
Chip Thickness: 127 ± 15 µm (5.0 ± 0.6 mils)

Features

- **Conversion Efficiency: –12 dB Typical**
- **1/2 and 3/2 spurs: 15 dBc Typical**
- **Broad Bandwidth, 20–50 GHz Output Frequency**

Description

The TC221 is a passive diode frequency doubler. It is specified to operate with a 20–50 GHz output frequency. Conversion efficiency is usually around –12 dB. The device has low 1/2 and 3/2 spurious output, typically 15 dBc or better. The doubler can be biased through on–chip resistors to allow operation at low input levels. Up to 22 dBm at the input can be accommodated. On–chip DC blocking capacitors are included at the input and output.

Absolute Maximum Ratings[1]

Symbol	Parameters/Conditions	Min.	Max.	Units
$P_{in,max}$	Max Input Power		22	dBm
V_{dcin}	DC voltage at Input	–9	9	V
V_{dcout}	DC voltage at Output	–9	9	V
T_{case}	Operating Case Temperature	0	+85	°C
T_{st}	Storage Temperature	–55	+150	°C
T_{max}	Max. Assembly Temperature (60 seconds max)		+300	°C
Vbias,max	Voltage Limits at +/– Bias Pads	–4	+4	V

Notes:

1. Operation in excess of any one of these may result in permanent damage to this device. T_{case} = 85°C except for T_{op}, T_{st}, and T_{max}, unless noted.

RF Specifications

(T_A = 25°C, P_{in} = 15 dBm, Z_0 = 50Ω, BIAS+=1.0, adj. for 5mA [≈ 1V], BIAS–=0V)

Symbol	Parameters/Conditions	Min.	Typ.	Max.	Units
CE10	Conversion Efficiency at 10.0 GHz Input	–15	–12		dB
CE17	Conversion Efficiency at 17 GHz Input	–14	–12		dB
CE25	Conversion Efficiency at 25 GHz Input	–14	–12		dB
RL_{in}	Input Return Loss, 10–25 GHz		10		dB
Fund25	Fund. Feedthru of 25.0 GHz (relative to 50 GHz output)	17	20		dBc

Typical Performance
("Bias" means bias + SMA, Bias– 0V. "No bias" means bias + open, bias– open)

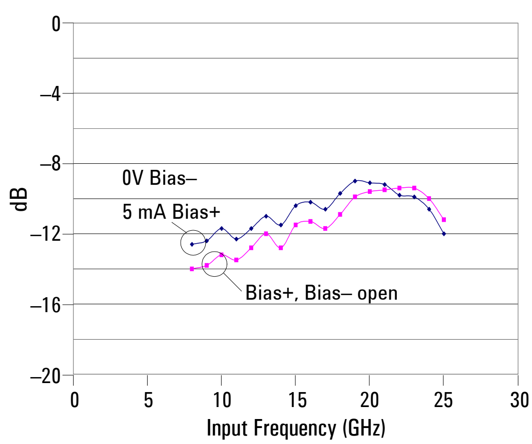


Figure 1.
Typical TC221 Conversion Efficiency vs. Freq. at P_{in} = 15 dBm

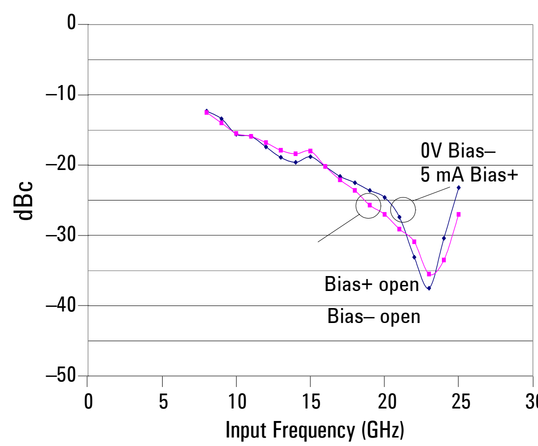


Figure 2.
Typical TC221 Fundamental Feedthru vs. Freq. at P_{in} = 15 dBm

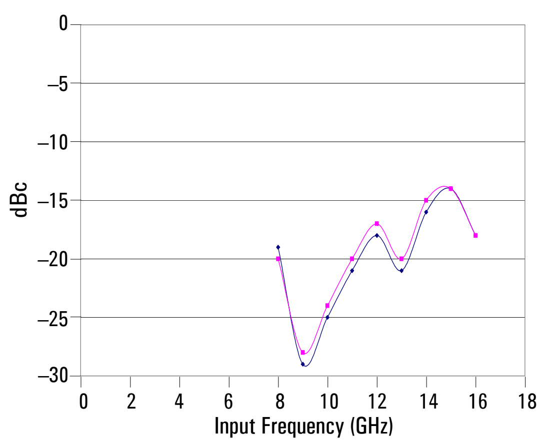


Figure 3.
Typical TC221 3rd Harmonic vs. Freq. at P_{in} = 15 dBm

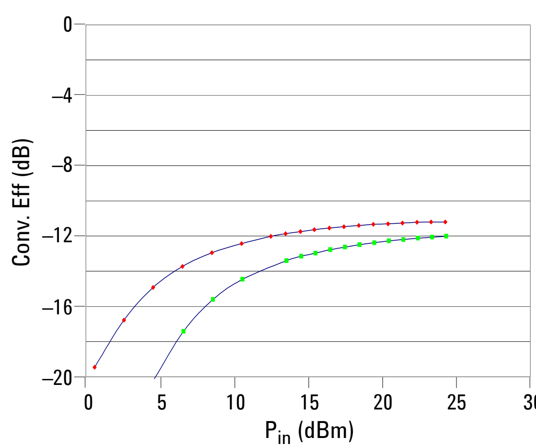


Figure 4.
Typical TC221 Conversion Efficiency vs. Freq. at P_{in} at f = 10 GHz

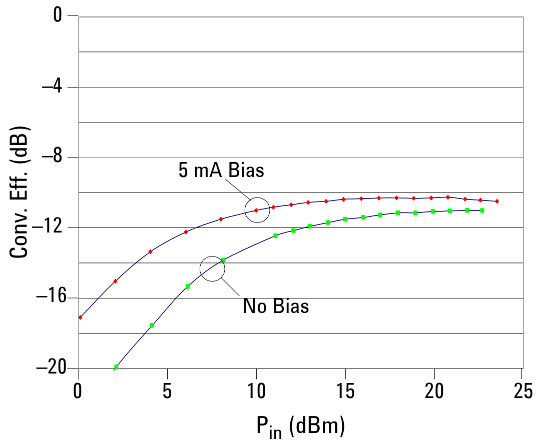


Figure 5.
Typical TC221 Conversion Efficiency vs. P_{in} at Freq. = 15 GHz

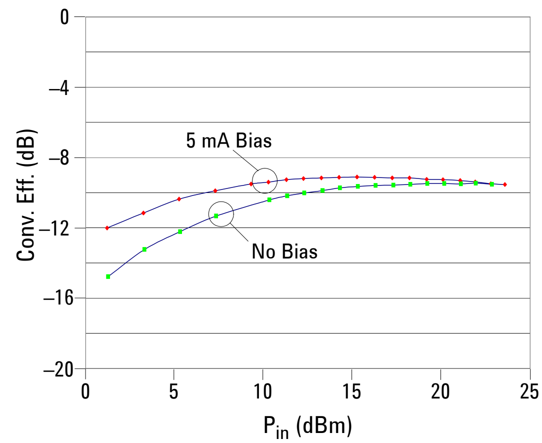


Figure 6.
Typical TC221 Conversion Efficiency vs. P_{in} at f req. = 20 GHz

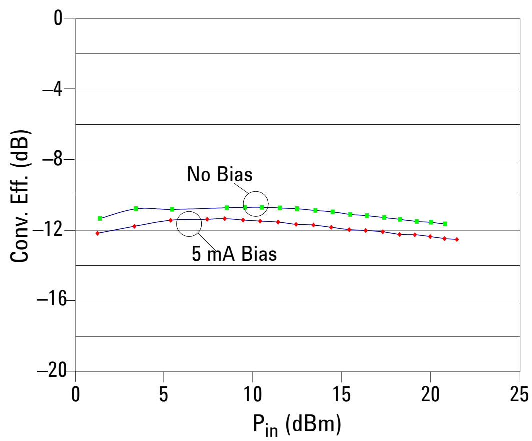


Figure 7.
Typical TC221 Conversion Efficiency vs. P_{in} at Freq. = 25 GHz

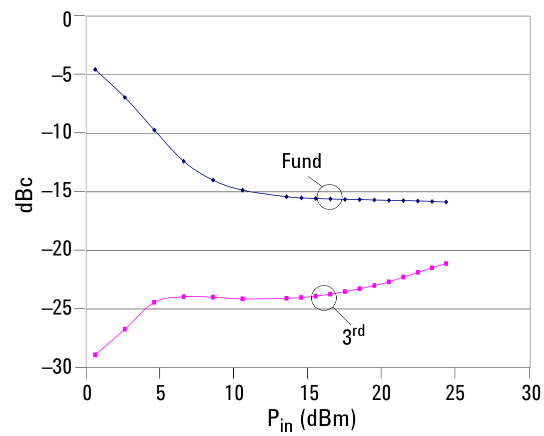


Figure 8.
Typical TC221 Spurious vs. P_{in} at Freq. = 10 GHz, No Bias

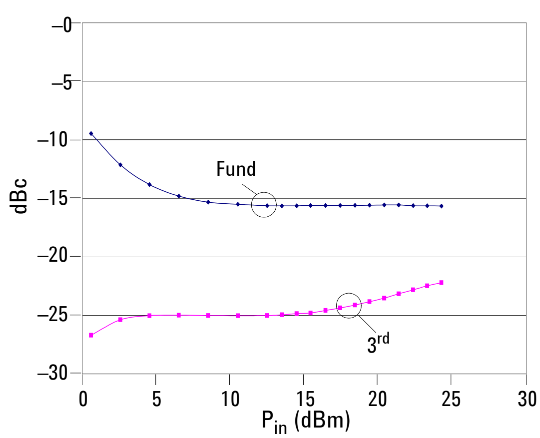


Figure 9.
Typical TC221 Spurious vs. P_{in} at Freq. = 10 GHz, with Bias

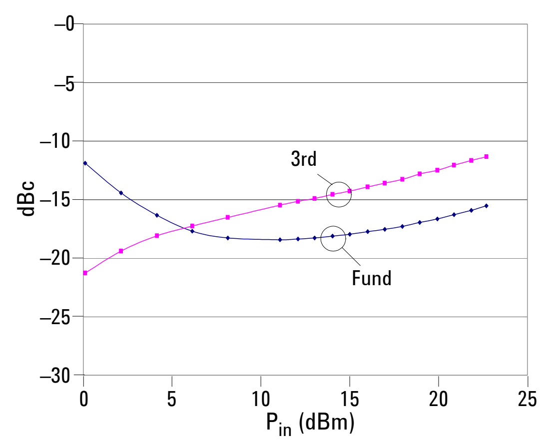


Figure 10.
Typical TC221 Spurious vs. P_{in} at Freq.= 15 GHz, No Bias

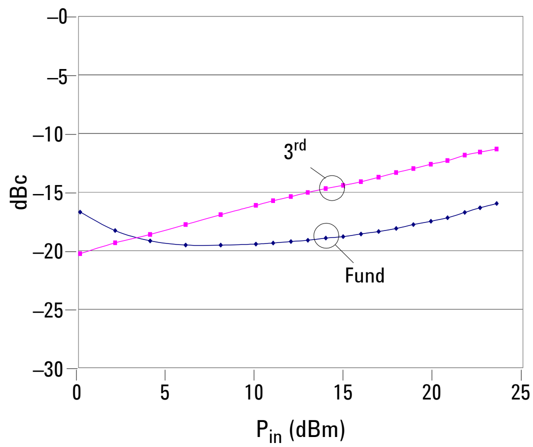


Figure 11.
Typical TC221 Spurious
vs. P_{in} at Freq. = 15 GHz, with Bias

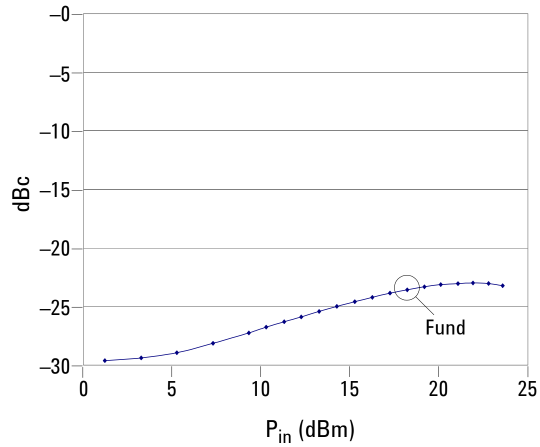


Figure 12.
Typical TC221 Spurious
vs. P_{in} at Freq. = 20 GHz, with Bias

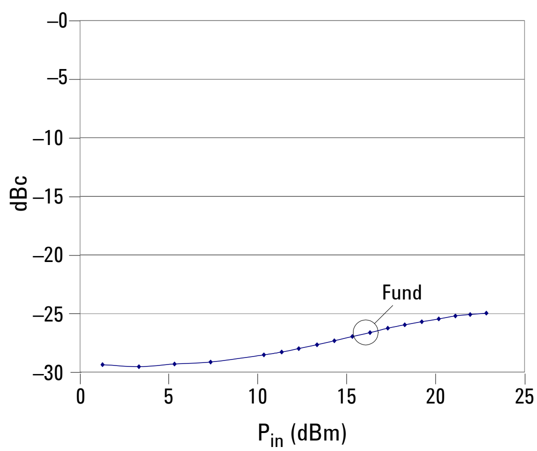


Figure 13.
Typical TC221 Spurious
vs. P_{in} at Freq. = 20 GHz, no Bias

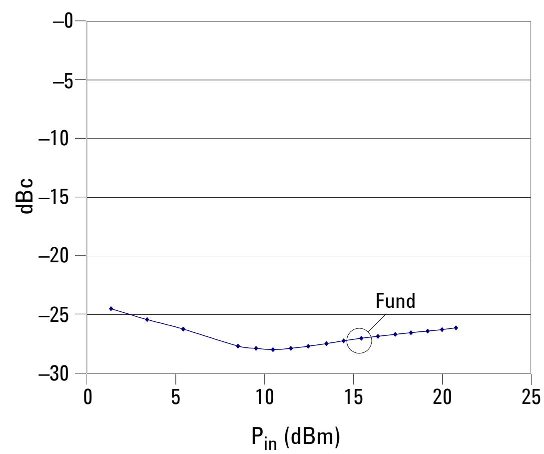


Figure 14.
Typical TC221 Spurious
vs. P_{in} at Freq. = 25 GHz, no Bias

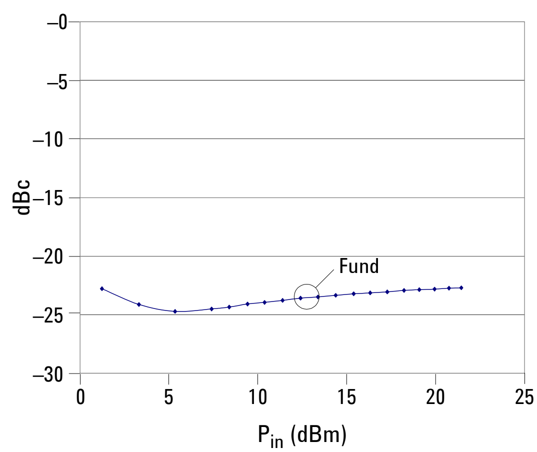


Figure 15.
Typical TC221 Spurious
vs. P_{in} at Freq. = 25 GHz, with Bias

Applications

The TC221 frequency doubler is designed for use in microwave instrumentation source applications.

Operation

The TC221 is a passive diode doubler, with "+" and "–" DC bias pads included to optimize performance at low input power levels. Bias can be applied through either the "+" or "–" bias pad or both, with the other pad either grounded or open. The optimum bias will depend on frequency and input power level, and must be empirically optimized for each application.

DC blocking capacitors have been included at the input and output of the device for ease of interface to other devices.

The device should be mounted using epoxy or solder to a metal case with thermal conductivity equal to, or better than, aluminum, and the case temperature should not exceed 85°C. This will keep the diode junctions at or below 130°C for an input power of 22 dBm, and will keep the rectified diode currents well within acceptable limits for reliable operation.

Assembly Techniques

Epoxy die–attach using conductive epoxy or solder die–attach using a fluxless AuSu solder preform can be used for assembly. Gold thermosonic wedge bonding with 0.7 mil diameter Au wire is recommended for all bonds. Tool force should be 22 ± 1 gram, stage temperature should be 150 ± 2°C, and ultrasonic power and duration should be 64 ± 1 dB and 76 ± 8 msec, respectively. The bonding pad and chip backside metallization is gold.

GaAs MMICs are ESD sensitive. ESD preventive measures must be employed in all aspects of storage, handling, and assembly.

MMIC ESD precautions, handling considerations, die attach and bonding methods are critical factors in successful GaAs MMIC performance and reliability.

Agilent application note #54, "GaAs MMIC ESD, Die Attach and Bonding Guidelines" provides basic information on these subjects.

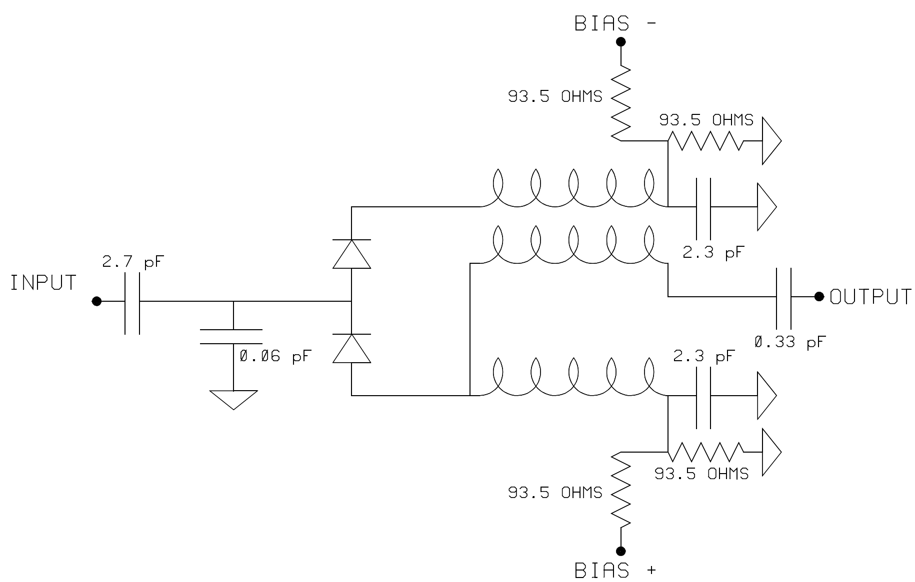


Figure 16.
TC221 Simplified Schematic

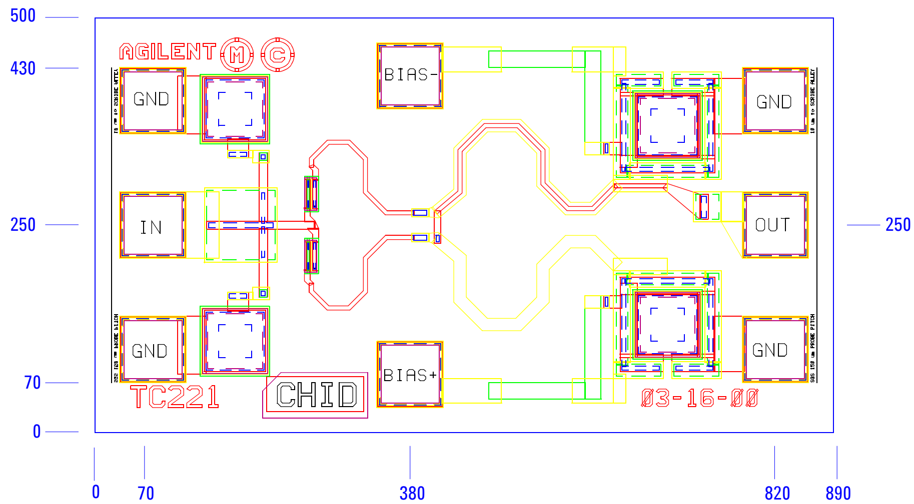


Figure 17.
TC221 Bond Pad Locations and Chip Dimensions
(all dimensions in um)

This data sheet contains a variety of *typical* and guaranteed performance data. The information supplied should not be interpreted as a complete list of circuit specifications. In this data sheet the term *typical* refers to the 50th percentile performance. For additional information contact WPTC Marketing at 1-577-4482.