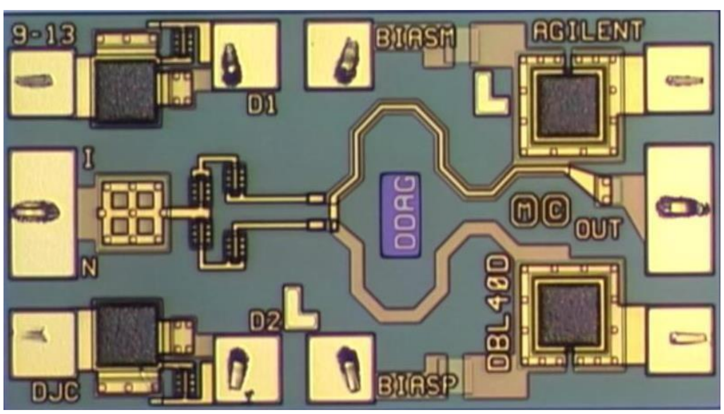
Keysight TC814
40 GHz
Doubler

HMMC-5645

Data Sheet



Features

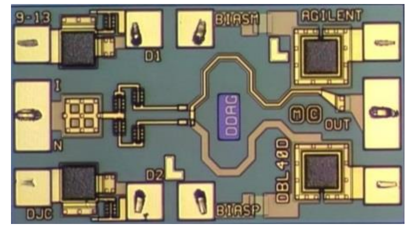
Input Frequency 10-20 GHz

Output Frequency 20-40 GHz (useable to 50 GHz)

Conversion Efficiency -12 dB typical

Flat Conversion Efficiency over input power level using bias

Description



The TC814 is a frequency doubler covering 20-40 GHz output frequency (useable to 50 GHz), with access to diode bias such that the conversion loss can be made relatively flat over about a 20 dB input power range.

Absolute Maximum Ratings [1]

Symbol	Parameter / Condition	Min	Max	Units
VD1, VD2	D1, D2 reverse voltage	-3		V
ID1, ID2	D1, D2 forward current		55	mA
Vmax	BIASP to BIASM reverse voltage	-12		V
Imax	BIASP/BIASM forward current		55	mA
Pin max	CW input power		24	dBm
Tthermo[2,3]	Thermocouple temperature		80	°C
Tstg	Storage temperature	-65	150	°C
Tmax[4]	Assembly temperature		260	°C

[1] Operation in excess of any one of these rating may result in permanent damage to this device.

[2] Cumulative failures < 5% in 10 years and < 50% in 30 years. Operation in excess of Tthermo will reduce part lifetime. Instructions for measuring Tthermo can be found here: http://sharedoc.collaboration.is.keysight.com/sites/HFTC/SD/No%20Prog/Components%20and%20Technologies/QFN%20Application%20and%20Support/Device_Thermocouple_Measurements.pdf

[3] IC reliability is determined based on all HFTC IC's included in a Keysight instrument. Review and signoff on instrument board design is done during the PLC process. Keysight's quality standards are guaranteed for instruments that have been properly reviewed during the PLC process. Operation above the stated max temperature will significantly degrade IC reliability unless it is determined otherwise during the HFTC PLC review.

[4] Refer to JEDEC J-STD-020D for detailed reflow profile, three reflows maximum.

Vital Stats

Chip size:
- 900× 510 µm (35.4 × 20.1 mils)

Chip size tolerance:
- ±10 µm (±0.4 mils)

Chip thickness:
- 127 ± 15 µm (5.0 ± 0.6 mils)

Pad dimensions:
- 70 × 70 µm (2.8 × 2.8 mils) openings in polyimide for DC pads;
- 140 x 70 um (5.6 x 2.8 mils) for RF pads

DC Specifications [1]

Symbol	Parameter / Condition	Min	Typ	Max	Units
VBIASP_1mA	1 mA forward current into BIASP, BIASM grounded, RF power "off"	2.5	2.75	3.1	V
VD_1mA	D1, D2 voltage at 1 mA forward bias	0.6	0.68	0.8	V

[1] Tbs = 25°C

Frequency-Domain AC Specifications [1]

Symbol	Parameter / Condition	Min	Typ	Max	Units
CE20	Conversion Efficiency, 10 GHz input	-13.0	-11	-9.5	dB
CE34	Conversion Efficiency, 17 GHz input	-13.6	-12.5	-11	dB
CE50	Conversion Efficiency, 25 GHz input	-13.6	-12.5	-8	dB
Feedthru10	X1 Feedthru, 10 GHz	10	13.5	15	dBc
Feedthru17	X1 Feedthru, 17 GHz	18	24	29	dBc
Feedthru25	X1 Feedthru, 25 GHz	21	25	32	dBc

[1] Tbs = 25°C, 50 ohm wafer probe system, 1.6V BIASP, BIASM grounded, 18 dBm RF input power

ESD Sensitivity [1]

Symbol	Parameter / Condition	Min	Max	Units
D1, D2	HBM [2]	-400	+1700	V
RF Input	HBM [2]	-700	+700	V
RF Output	HBM [2]	-400	+400	V
BIASP, BIASM	HBM [2]	-500	+500	V

[1] Tbs = 25°C
[2] Human body model: 100 pF, 1.5 kΩ.

Applications

The TC814 can be used as a general-purpose frequency doubler. If flat conversion loss vs. input level is needed, access to the diodes is provided for biasing in an optimal fashion.

Operation

The circuit is a full wave rectifier, using diodes and a balun. Double diode junctions are used to increase power handling.

Recommended Biasing

Nominal Bias

In non-critical applications, BIASP and BIASM will simply be connected to ground with bond wires. Where flat conversion loss vs. input level is desired, BIASP and BIASM will be connected to voltage sources which have been empirically designed to minimize conversion loss variations over the input range. “Dummy” diodes D1 and D2 are provided to help create the desired bias voltages via off-chip analog circuitry, and will be useful to help minimize performance changes due to temperature variations. BIASP and/or BIASM can also be used to peak up conversion efficiency at any specific use condition.

Bias Sequencing

There is no critical order involved with biasing, simply apply bias in any convenient manner. It is acceptable to ground one side and apply bias only to the other side if desired; or a symmetrical +/- bias can be used.

Assembly Techniques

Die attach should be done with conductive epoxy. Gold thermosonic bonding is recommended for all bonds. The top and bottom metallization is gold.

ESD Warning

III-V MMICs are ESD sensitive. Damage from ESD events can significantly affect III-IV MMIC performance and reliability. Preventative ESD measures must be employed in all aspects of storage, handling, and assembly, in compliance with the Keysight ESD Control Program. Information on the Keysight ESD Control Program can be found at:

http://emg.communications.keysight.com/quality/esd/

For information on ESD precautions during die attach and bonding, please refer to Keysight application note #54, "III-V MMIC ESD, Die Attach and Bonding Guidelines" pub # 5991-3484.

Reliability Warning

The chip must be die-attached to a substantial thermal mass, such as an aluminum microcircuit or PC board trace with plenty of copper and vias to ground planes. The backside of the chip must be kept at or below 75C. The maximum allowed input power is 24 dBm, with 3V bias from BIASP to BIASM (or less). Failure to comply with these requirements will result in reduced chip lifetime, or immediate catastrophic failure.

RoHS Compliance

This part is RoHS compliant, meeting the requirements of the EU Restriction of Hazardous Substances Directive 2002/95/EC, commonly known as RoHS. Six substances are regulated: lead, mercury, cadmium, chromium VI (hexavalent chromium), polybrominated biphenyls (PBB), and polybrominated biphenyl ethers (PBDE). RoHS compliance requires that any residual concentration of these substances is below the Directive's maximum concentration values (MCV): cadmium 100ppm by weight and all others 1000ppm by weight.

Figure 1. TC814 Schematic.

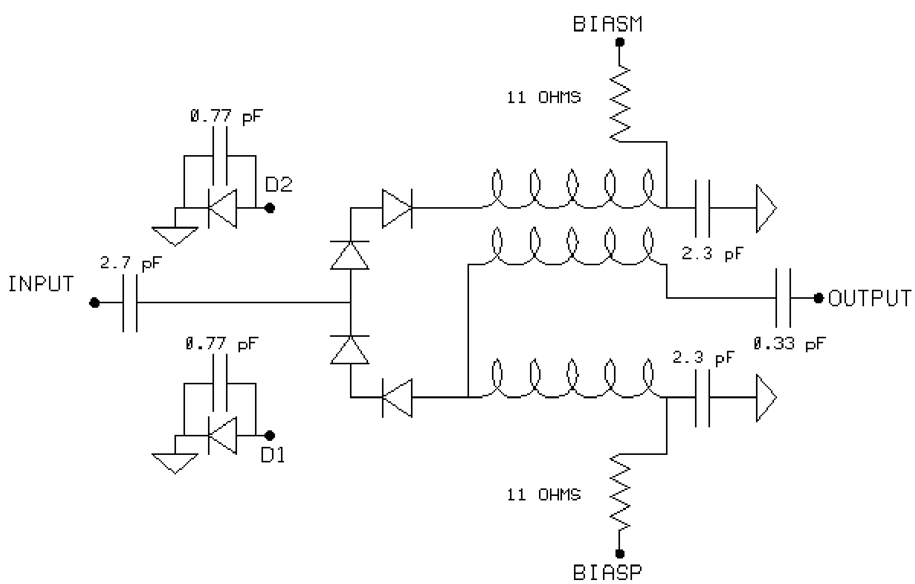


Figure 2. TC814 Pad Locations. Dimensions in um.

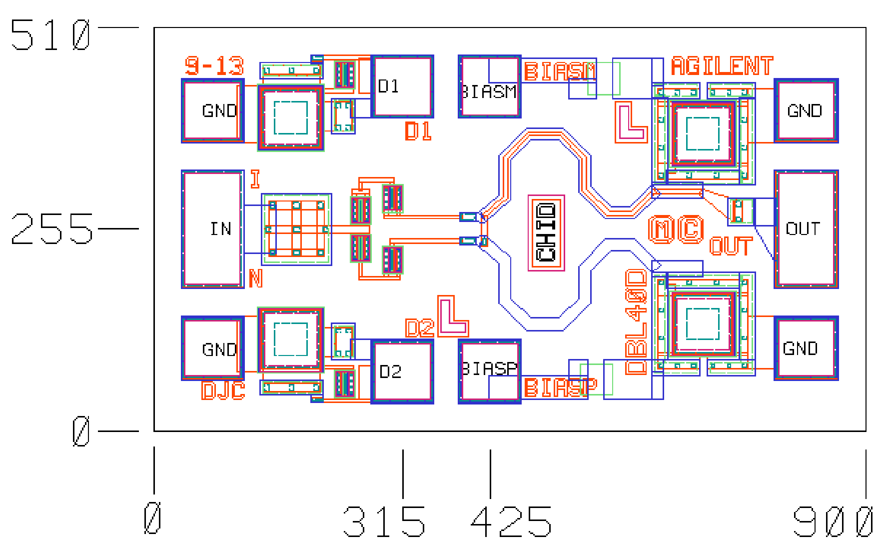


Figure 3. TC814 Conversion Efficiency and x1 feedthrough.

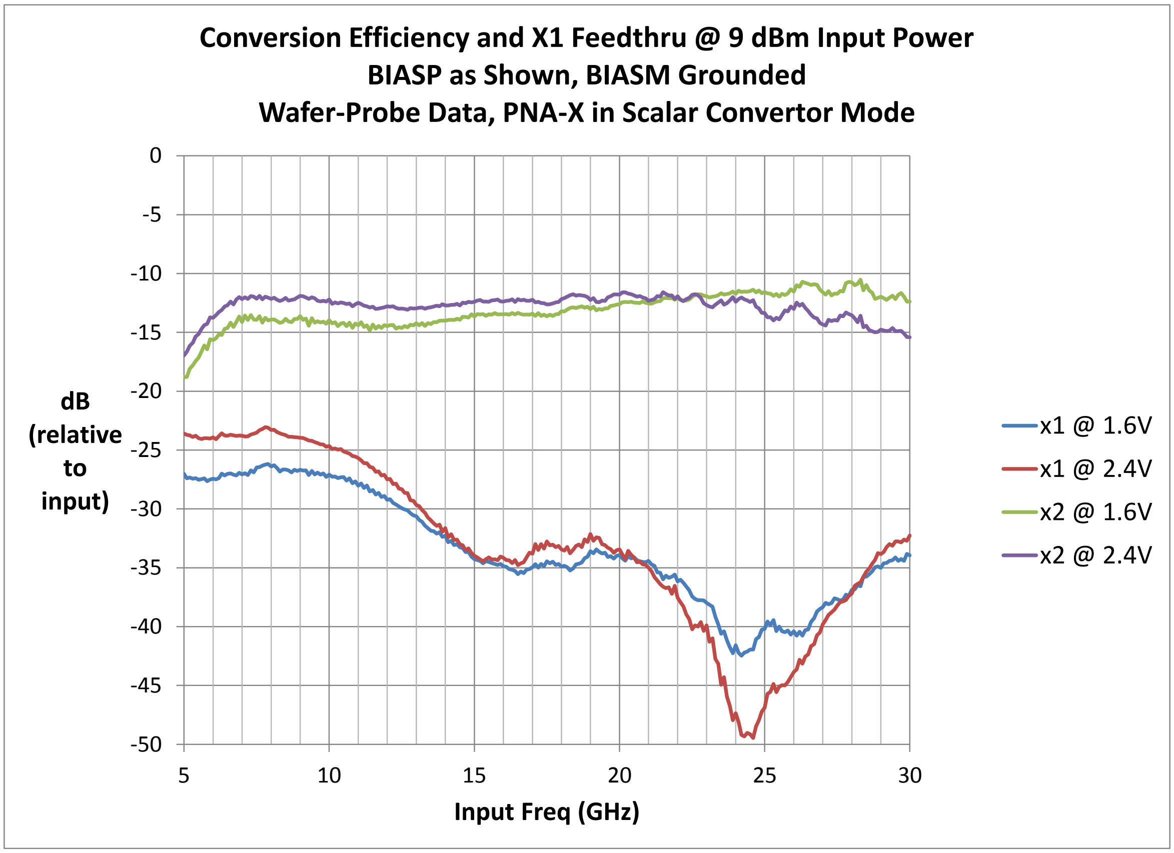
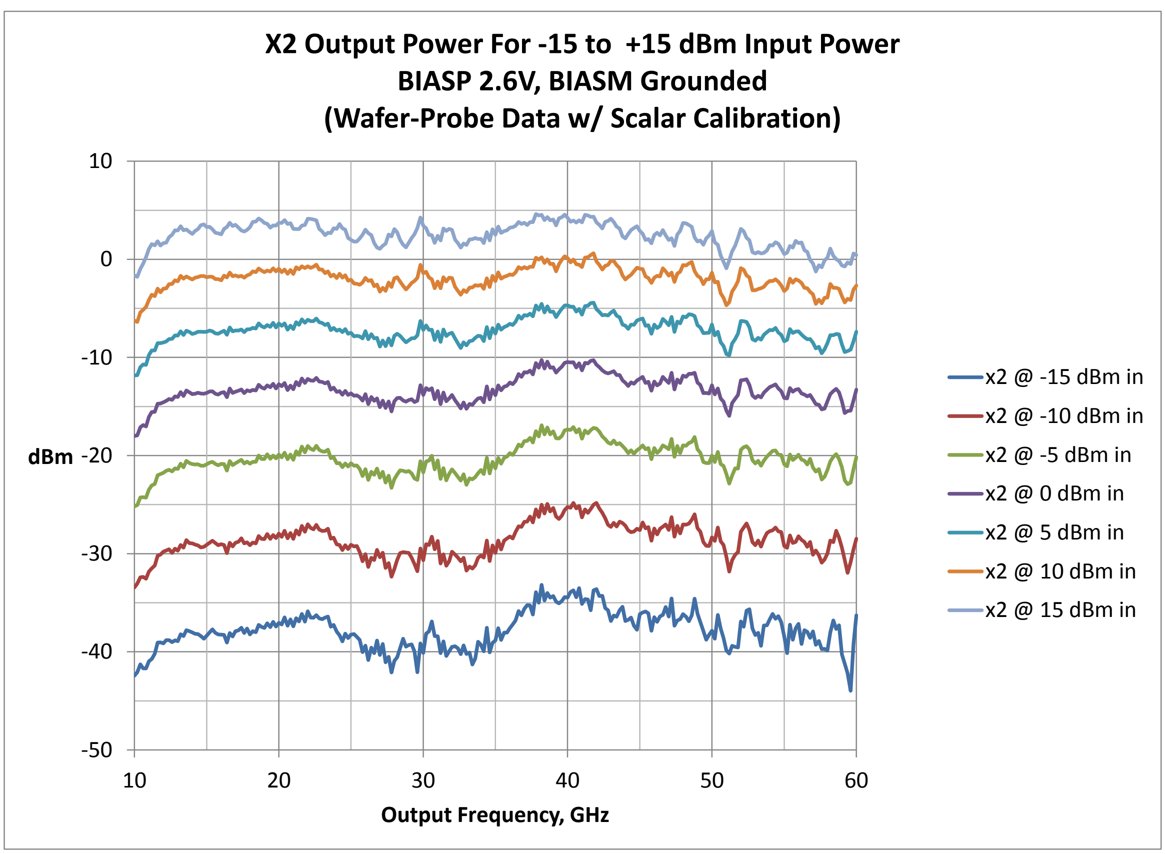


Figure 4. TC814 Conversion Efficiency for various input power levels.



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