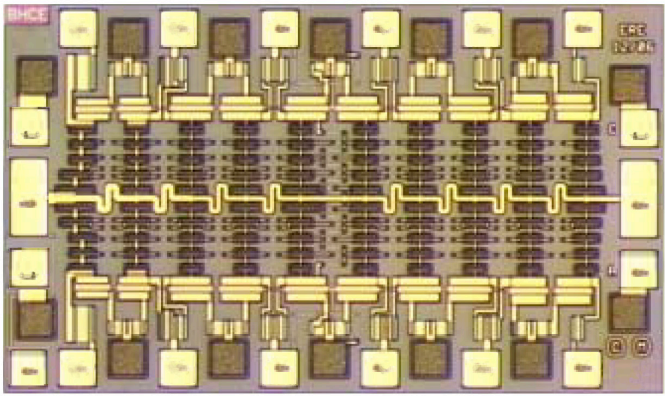
Keysight 1GC1-4094
DC - 26.5 GHz Biasable Integrated Diode Limiter

Data Sheet



Features

- DC to 26.5 GHz limiter
- Can be biased for adjustable limit level
- Low distortion

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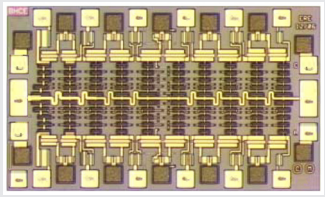
Description

The 1GC1-4094 is a 26.5 GHz integrated diode limiter that can be used to protect sensitive RF circuits from excess RF power, DC transients, and ESD.

The 1GC1-4094 can be used as an unbiased 23 dBm passive limiter; it also provides adjustable limiting and peak power detection capabilities.

The 1GC1-4094 is fabricated using Keysight Technologies, Inc. GaAs HBT process.



- Chip size: 1,440 × 870 µm (56.7 × 34.2 mils)
- Chip size tolerance: ±10 µm (± 0.4 mils)
- Chip thickness: 127 ± 15 µm (5.0 ± 0.6 mils)
- Pad dimensions:
  80 × 80 µm (3.2 × 3.2 mils) DC
  80 × 160 µm (3.2 × 6.3 mils) RF

Absolute maximum ratings[1] [2]

Symbol	Parameters/conditions		Min	Max	Units
P_{in}	Continuous incident power at RF_{IN} RL at RF_{IN} = 10 dB	RL at RF_{OUT} > 10 dB		30	dBm
		RL at RF_{OUT} > 15 dB		33	dBm
	Continuous incident power at RF_{OUT} RF at RF_{IN} = 0 dB	RL at RF_{OUT} > 10 dB		25	dBm
		RL at RF_{OUT} > 15 dB		28	dBm
V_{anode}	Bias on anode ads		–15	0	dBm
$V_{cathode}$	Bias on cathode pads		0	15	V
I_{in}	DC current into RF_{IN} or RF_{OUT} pads			288	V
T_{bs}	Maximum backside temperature			85	mA
T_j	Diode junction temperature			170	°C
T_{max}	Maximum assembly temperature[3]			300	°C
T_{stg}	Storage temperature		–65	165	°C

1. Operation in excess of any one of these conditions may result in permanent damage to this device. If you need to operate higher, please contact your local Keysight sales office.
2. Calculated using backside (ambient) temperature of 85 °C, unless otherwise noted.
3. Sixty–second maximum.

DC specifications/physical properties[1]

Symbol	Parameters/conditions	Min	Typ	Max	Units
Vfwd_A, Vfwd_B	Diode forward voltage at 1.0 mA, anode or cathode pads to RF_{IN}	2.5	2.8	3.5	V
Rfwd_A, Rfwd_B	Diode forward voltage at 1.0 mA, anode or cathode pads to RF_{IN}		8	15	Ω
Irev_A Irev_B	Reverse current in bias network, anode or cathode pads to RF_{IN}	2.5	3	3.5	mA
Rseries	Through series resistance (RF_{IN} to RF_{OUT})		2.4	7	Ω
Rsense	Sense Resistor	8	10	12.5	kΩ
V_RF_{IN}	Vanode = -15 V, Vcathode = +15 V	-0.1	0	o.1	V

1. Measured on wafer with T_{chuck} = 25 °C.

RF specifications[1]

Symbol	Parameters/conditions		Min.	Typ.	Max.	Units
S_{11}, S_{22}	Reflection	10 GHz		–28	–18	dB
		20 GHz		–16	–10	
		26.5 GHz		–16	–9	
S_{21}, S_{12}	Through gain	10 GHz	–1	–0.7		dB
		20 GHz	–2	–1.3		
		26.5 GHz	–2.7	–1.8		
Δτd	Group delay flatness	40 GHz		±1.0		pS
$P_{-1\ dB}$	1 dB gain compression	Vanode = 0, Vcathode = 0		23		dBm
		Vanode = -10 V, Vcathode = 10		32		
		Vanode = -10 V, Vcathode = 10		Voltage variable		
SHI	Second harmonic intercept f_o = 10 GHz	Vanode = Vcathode = 0		84		dBm
		Vanode = -10 V, Vcathode = 10		101		
THI	Third harmonic intercept f_o = 10 GHz	Vanode = Vcathode = 0		36		dBm
		Vanode = -10 V, Vcathode = 10		52		
TOI	Third order intercept f_o = 10 GHz, Δf = 100 kHz	Vanode = 0 V, Vcathode = 0V 36		36		dBm
		Vanode = -6.5 V, Vcathode = 6.5V		47		
		Vanode = -10 V, Vcathode = 10V		50		
		Vanode = -15 V, Vcathode = 15V		55		

1. Measured on wafer with T_{chuck} = 25 °C.

ED specifications[1]

Symbol	Parameters/conditions		Min.	Typ.	Max.	Units
ESD	ESD No Damage Level	RF_{IN} and RF_{OUT} pads, anode & cathode grounded		15,000		V
		Any pad with all other pads open		500		
		Any pad with another pad shorted to Gnd		200		

1. Using human body model as ESD generator. circuit equivalent is 100 pF, 1500 Ω.

Applications

The 1GC1-4094 can be used as a protection circuit for ESD and DC transients, as a Reverse Power Protection (RPP) device, or as an adjustable RF limiter.

Typical applications include receiver and source protection from overpower and ESD. RF_{OUT} is connected to the device that needs protection.

Biasing

Vanode can be biased from 0V to -15 V and Vcathode can be biased from 0 V to + 15 V. Typically the magnitude of these two biases are made equal so that the DC voltage on the RF_{IN} and RF_{OUT} pads is 0 V. A typical assembly drawing is shown in Fig. 10 with caps mounted close to the chip for the bias lines. It is important that the bias lines provide a low impedance to ground close to the chip for maximum ESD protection.

Operation

The 1GC1-4094 functions as a limiter with the limiting level set by the bias at Vanode and Vcathode. It will also protect against electrical transisents and ESD.

RoHS Compliance

This device is RoHS Compliant. This means the component meets the requirements of the European Parliament and the Council of the European Union Restriction of Hazardous Substances Directive 2011/65/EU, commonly known as RoHS. The six regulated substances are lead, mercury, cadmium, chromium VI (hexavalent), polybrominated biphenyls (PBB) and polybrominated biphenyl ethers (PBDE). RoHS compliance implies that any residual concentration of these substances is below the RoHS Directive's maximum concentration values (MVC); being less than 1000 ppm by weight for all substances except for cadmium which is less than 100 ppm by weight.

Assembly Techniques

See Figure 11 for bond pad locations. Epoxy die–attach using a conductive epoxy or solder die–attach using a fluxless gold–tin nsolder preform. Gold wire bonds or mesh bonds (500–line/inch or equivalent) should be used at the RF_{IN} and RF_{OUT} pads. The RF_{IN} and RF_{OUT} pads can accommodate double wire bonds. The 1GC1-4094 is designed to have better return loss with a small inductance at the RF_{IN} and RF_{OUT} pads; a single bond wire about 10 mils long is best. For long bond wires, double bond wires are recommended.

Properly assembled, the 1GC1-4094 is very ESD rugged when zapped at the RF_{IN} and RF_{OUT} Pads, However, during assembly and handling, the device requires all ESD precautions since an ESD zap of more than 200 V can damage the device.

The Keysight Technologies, Inc. *GaAs MMIC ESD, Die Attach and Bonding Guidelines - Application Note* (5991-3484EN) provides basic information on these subjects.

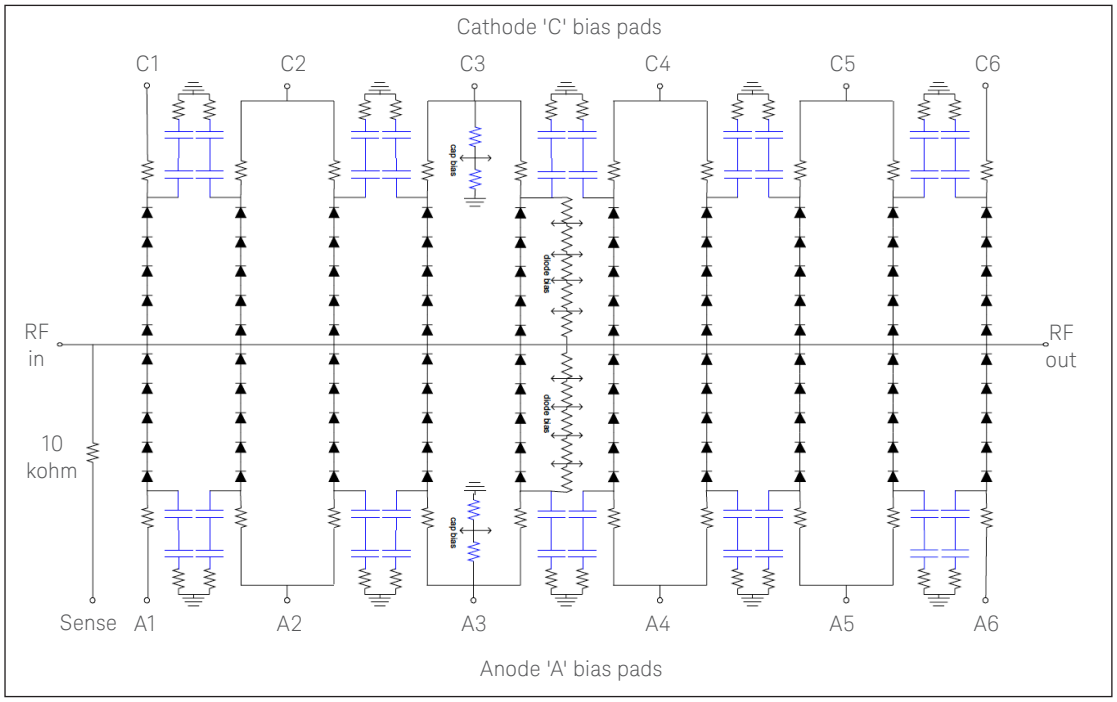


Figure 1. 1GC1-4094 functional topologies

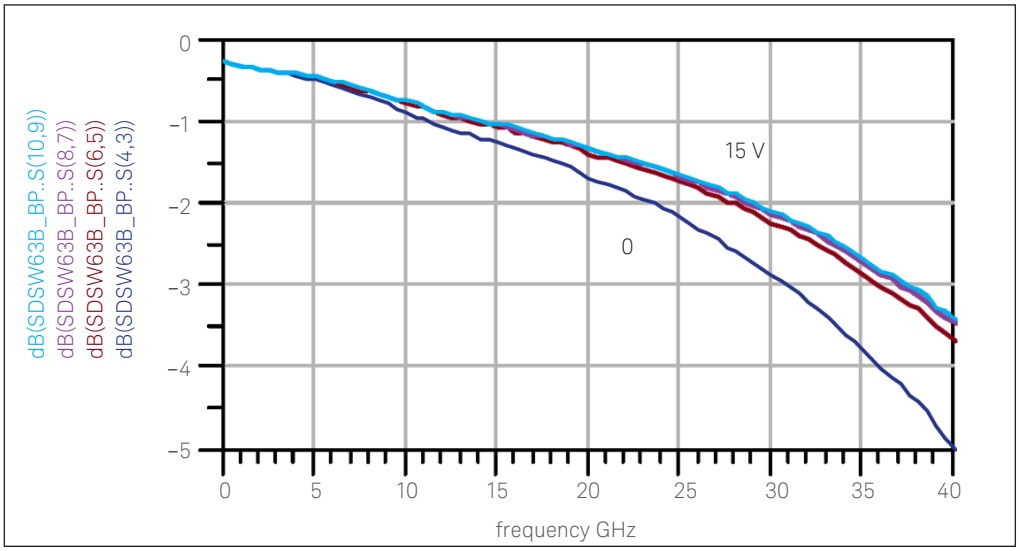


Figure 2. 1GC1-4094 insertion loss bias = 0 V, ±5 V, ±10 V, ±15 V

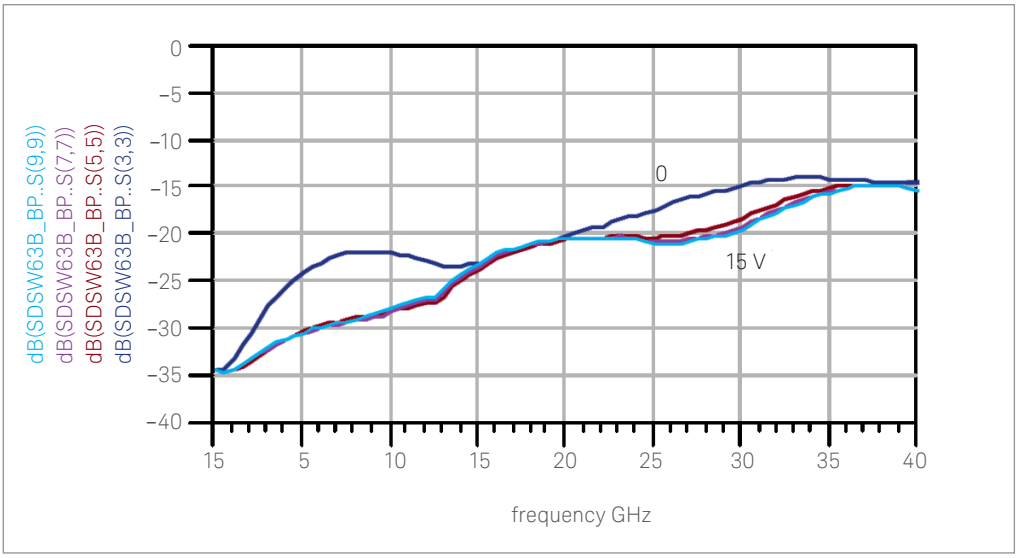


Figure 3. 1GC1-4094 input return loss bias = 0 V, ±5 V, ±10 V, ±15 V

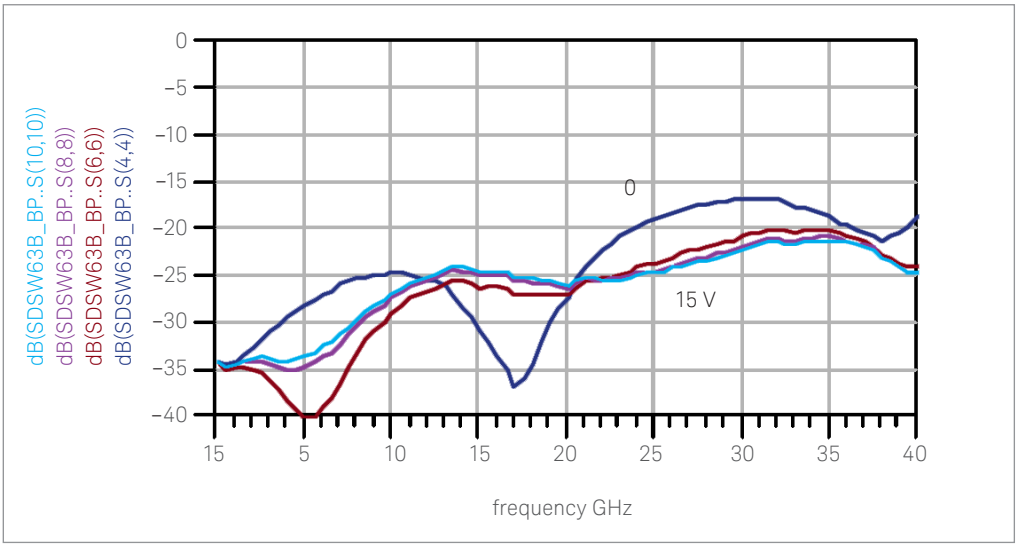


Figure 4. 1GC1-4094 output return loss bias = 0 V, ±5 V, ±10 V, ±15 V

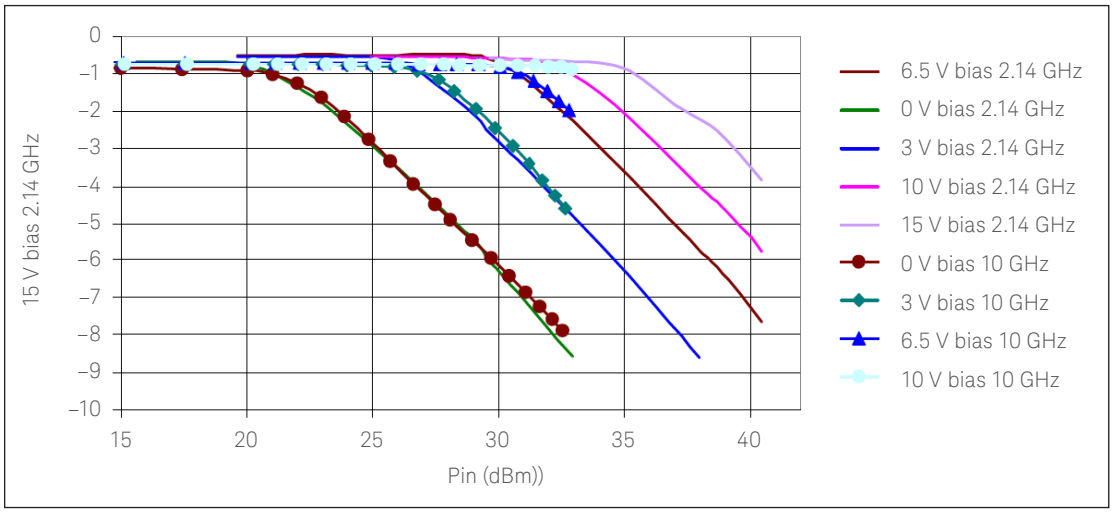


Figure 5. 1GC1-4094 gain vs pin vs bias (2.14 GHz and 10 GHz)

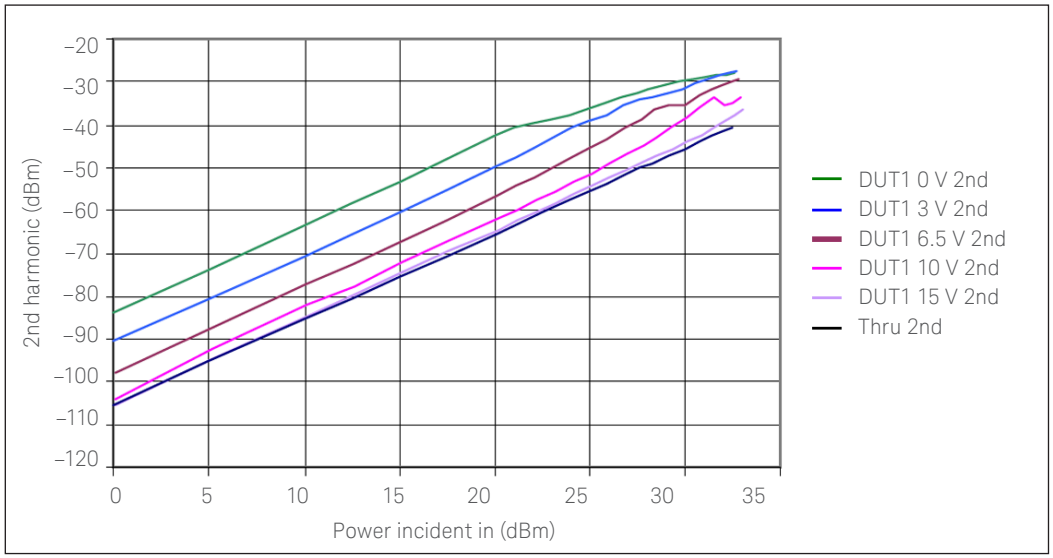


Figure 6. 1GC1-4094 2nd harmonic vs pin vs bias @ f_0 = 10 GHz

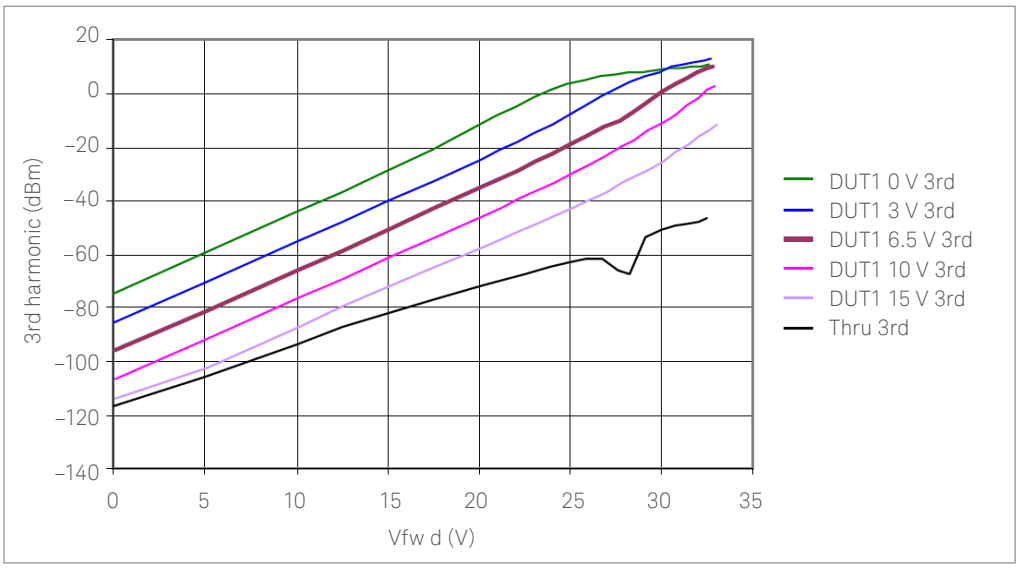


Figure 7. 1GC1-4094 3rd harmonic vs pin vs bias @ f_0 = 10 GHz

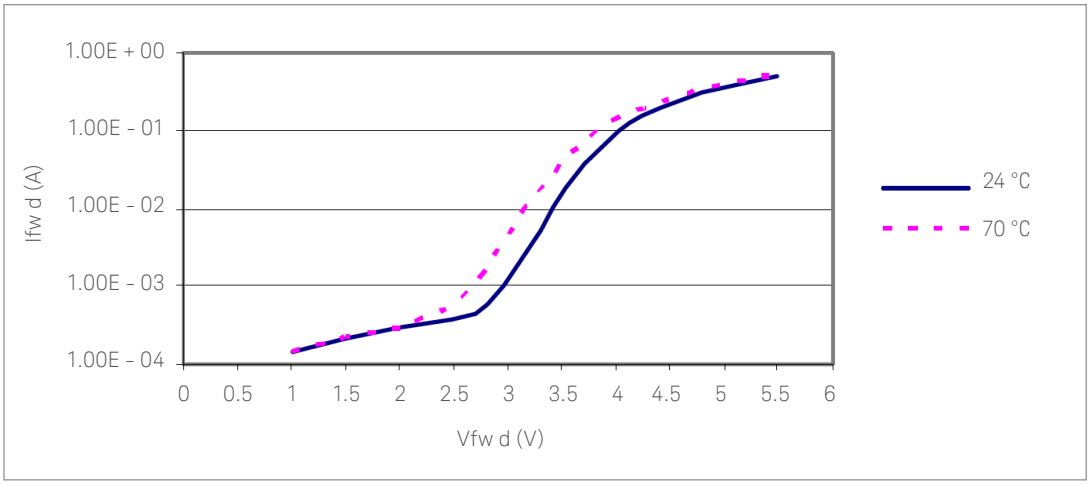


Figure 8. I-V center conductor (RF_{in}) to anode or cathode bias

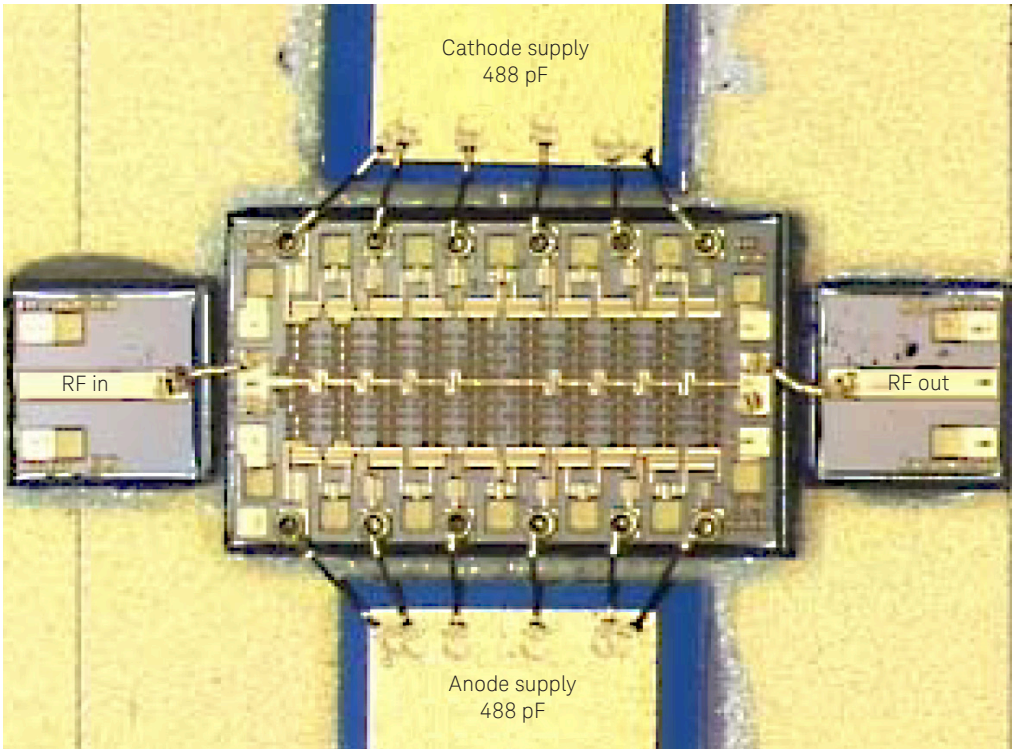


Figure 10. 1GC1-4094 sample bonding & assembly

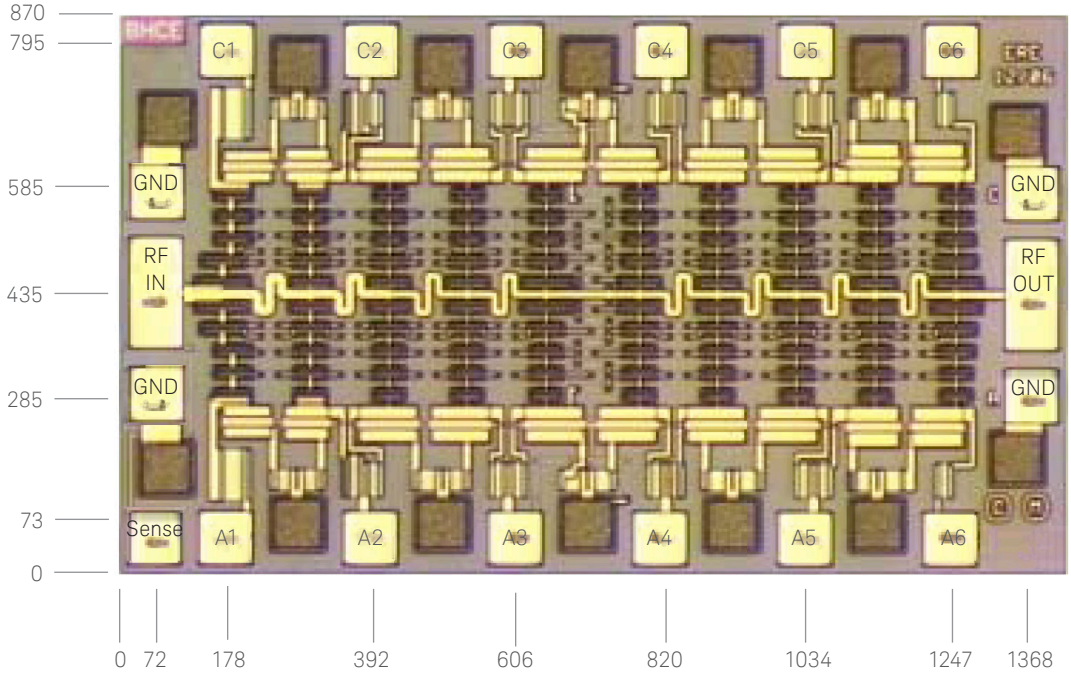


Figure 11. 1GC1-4094 bonding pad locations

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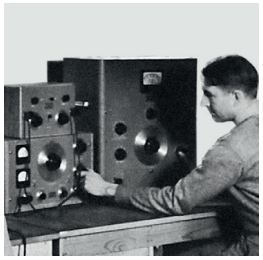

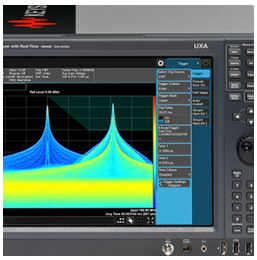

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The product described in this data sheet is RoHS Compliant. See RoHS Compliance section for more details.

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