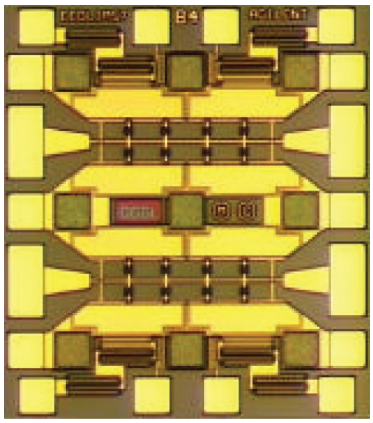
Keysight 1GC1-4053
DC - 65 GHz Integrated Diode Limiter

Data Sheet



Features

- Two independent limiters for single-ended or differential signals
- Can be biased for adjustable limit level and signal detection
- Minimum group delay

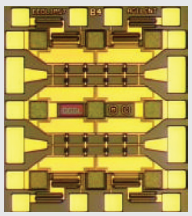
KEYSIGHT TECHNOLOGIES

Unlocking Measurement Insights

Description

The 1GC1-4053 is a 65 GHz integrated diode limiter that can be used to protect sensitive RF circuits from excess RF power, DC transients, and ESD. Two limiters are provided on-chip to enable single–ended or differential use.

The 1GC1-4053 can be used as an unbiased 10 or 18 dBm passive limiter; it also provides adjustable limiting and peak power detection capabilities. The 1GC1-4053 has been designed for minimal insertion loss. Group delay characteristics have been optimized to allow use in millimeter–wave analog and gigabit digital designs.



- Chip size: 840 × 940 µm (33.1 × 37.0 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 RF power	A & C grounded		+17	dBm
		DGND grounded		+19	dBm
I_{bias}	Continuous forward current into A_1, A_2, C_1, C_2, $DGND_{1-4}$			36	mA
V_{bias}	Voltage at A_1, A_2, C_1, C_2, $DGND_{1-4}$		–5	+5	V
V_{rev}	Reverse bias voltage on each diode			8	V
I_{fwd}	Forward bias current on each diode			36	mA
V_{in}	Voltage at IN_1, IN_2, OUT_1, OUT_2		–5	+5	V
I_{in}	Current into IN_1, IN_2, OUT_1, OUT_2		–80	80	mA
T_{bs}	Maximum backside temperature			85	°C
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 HFTC Marketing.
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
V_{fwd_A} V_{fwd_C}	Limiting diode forward voltage @ 0.1 mA	0.6	0.64	0.7	V
V_{fwd_D}	2-diode bias stack forward voltage @ 0.1 mA	1	1.15	1.3	V
R_{S_A} R_{S_C}	Limiting diode series resistance @ 15 mA (Including 2 ohm resistor)	7	12	17	Ω
I_A, I_C	Limiting diode reverse leakage current @ -1 V		0.1	1	uA
R_{S_Series}	Through series resistance		1.2		Ω

1. Measured on wafer with T_{chuck} = 25 °C, unless otherwise noted.

RF specifications[1]

Symbol	Parameters/conditions		Min	Typ	Max	Units
S_{11},S_{22}	Reflection	10 GHz		–24	–20	dB
		30 GHz		–20	–15	
		50 GHz		–12	–8	
		65 GHz		–10		
S_{21},S_{12}	Through loss	10 GHz	–0.4	–0.2		dB
		30 GHz	–0.75	–0.3		
		50 GHz	–1.7	–1.3		
		65 GHz		–2		
$\Delta\tau_d$	Group delay flatness	26.5 GHz		±0.5		pS
		50 GHz		±0.75		
		65 GHz		±1.0		
P_{-1dB}	1 dB gain compression	A&C grounded		10		dBm
		DGND grounded		18		
		A & C biased		Voltage variable		
SHI	Second harmonic intercept	f_0 = 5 GHz, A & C or DGND grounded		70		dBm
THI	Third harmonic intercept	f_0 = 5 GHz, A & C or DGND grounded		32		dBm
TOI	Third order intercept	f_1 = 5 GHz, f_2 = 5.25 GHz, A & C or DGND grounded		32		dBm

1. Measured on wafer with T_{chuck} = 25 °C. Numbers shown are over 0–50 GHz band unless otherwise specified.

ESD specifications[1]

(T_A = 25 °C unless otherwise listed)

Symbol	Parameters/conditions		Min	Typ	Max	Units
ESD	ESD no damage	A & C grounded		2400		V
		DGND grounded		2800		V

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

Applications

The 1GC1-4053 can be used as a protection circuit for ESD and DC transients, as a Reverse Power Protection (RPP) device, or as an RF limiter with optional power detection.

The different modes of use require different attachments. These are described under *Operation*.

Biasing

None required for traditional operation. For adjustable limiting, the bias voltage will set the limiting value as described under *Operation*.

Operation

The 1GC1-4053 has three primary modes of operation. 10 dBm and 18 dBm limiting can be done with no active bias required. See Figures 1(a) & 1(b). Both of these uses will provide ESD protection at the limiting value. For adjustable limiting and detection, the bias should be applied as shown in Figure 1(c). Adjustable limiting is achieved by setting the A pin to a DC voltage ~0.7 volts higher than the desired minimum voltage, and the C pin to a DC voltage ~0.7 volt lower than the desired maximum voltage.

If the voltage is not forced, the capacitor will function as a peak detector.

As an ESD protection device, the 1GC1-4053 can protect ESD sensitive components. The degree of protection depends on the protected components characteristics. ESD damage level for the 1GC1-4053 by itself is around 2400V using the human body model.

Assembly Techniques

See Figure 11 for bond pad locations.

Epoxy die-attach using a conductive epoxy and solder die-attach using a fluxless gold–tin solder preform are both suitable assembly methods. Gold wire mesh bonds (500–line/inch or equivalent) should be used at the RF input and output ports. These bonds must be kept as short as possible to minimize parasitic inductance. DC bias may be supplied through conventional 0.7-mil gold wire bonds. In both cases, thermosonic wedge bonding is recommended.

Diodes are ESD sensitive. ESD preventive measures must be employed in all aspects of storage, handling and assembly. ESD precautions, handling considerations, and die attach and bonding methods are critical factors in successful diode performance and reliability. Please refer to the Keysight Technologies, Inc. document, *GaAs MMIC ESD, Die Attach and Bonding Guidelines*, Application Note (5991-3484EN) provides basic information on these subjects.

RoHS Compliance

This part is RoHS compliant, meeting the requirements of the EU *Restriction of Hazardous Substances* Directive 2011/65/EU, 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 100 ppm by weight and all others 1000 ppm by weight.

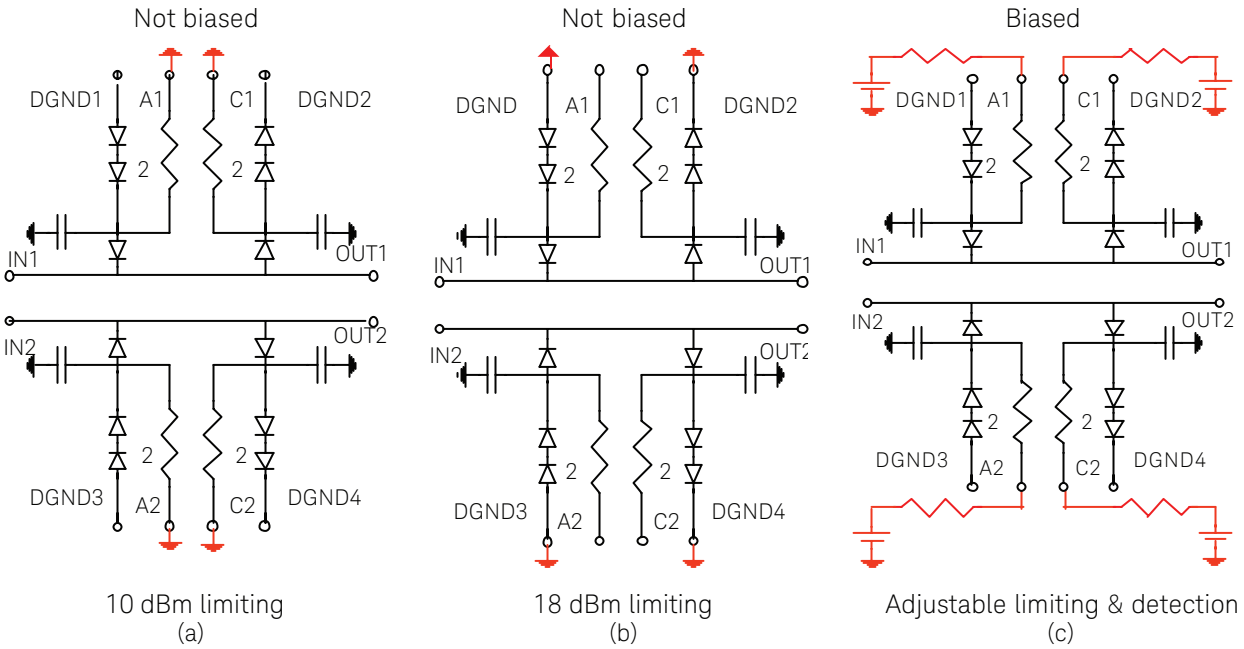


Figure 1. 1GC1-4053 functional topologies

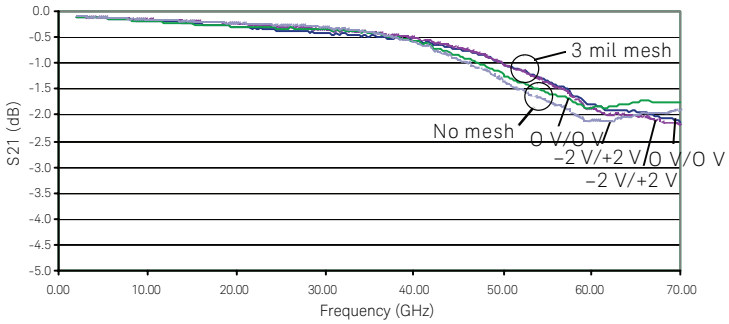


Figure 2. 1GC1-4053 S_{21}

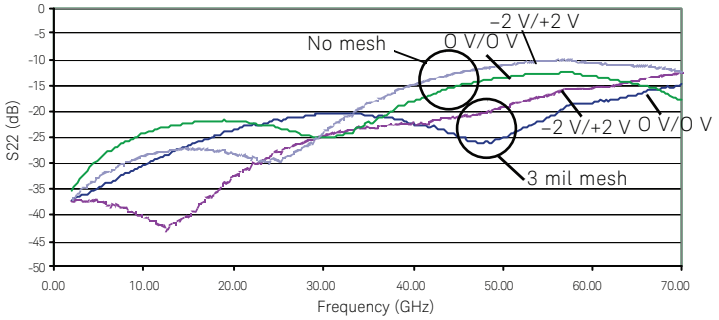


Figure 4. 1GC1-4053 S_{22}

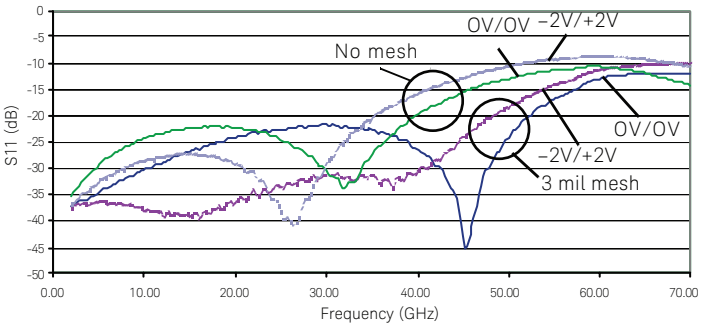


Figure 3. 1GC1-4053 S_{11}

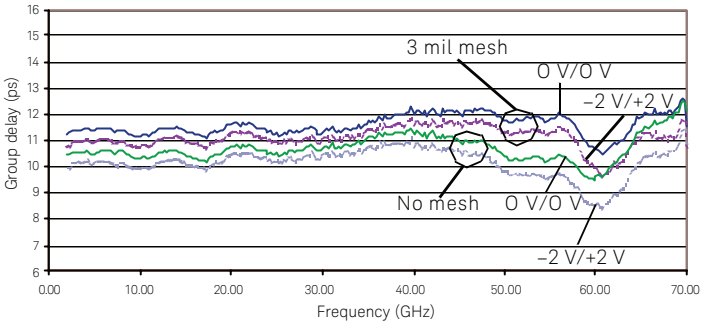


Figure 5. 1GC1-4053 group delay

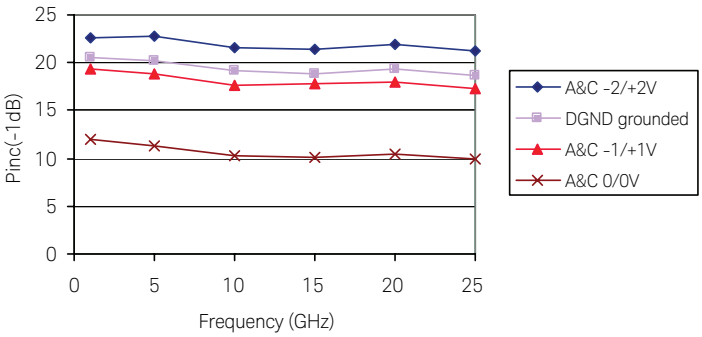


Figure 6. 1GC1-4053 Pinc(–1 dB) vs. frequency

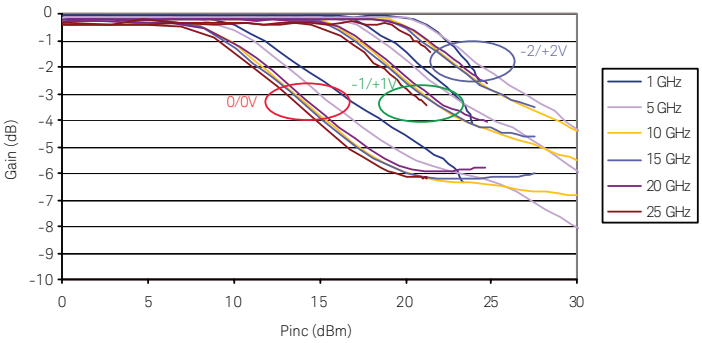


Figure 7. 1GC1-4053 gain vs. Pinc, A & C biased

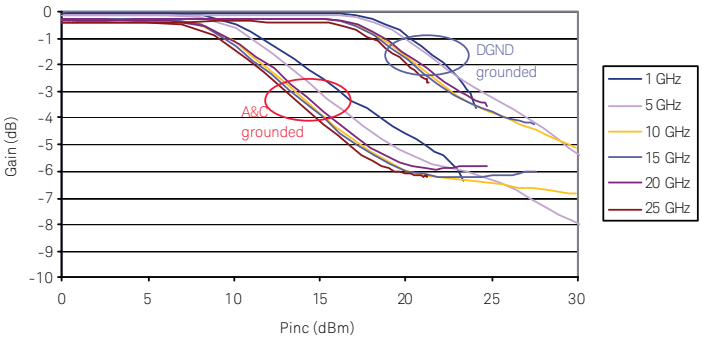


Figure 8. 1GC1-4053 gain vs. Pinc, not biased

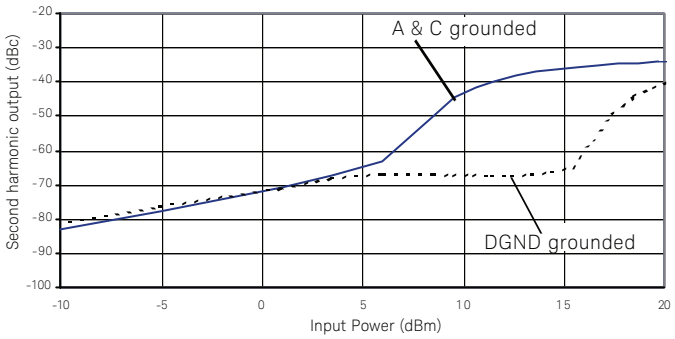


Figure 9. 1GC1-4053 typical second harmonic performance @ f_0 = 5 GHz

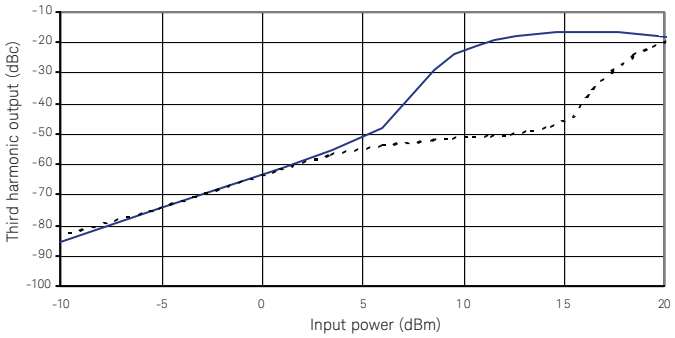


Figure 10. 1GC1-4053 typical third harmonic performance @ f_0 = 5 GHz

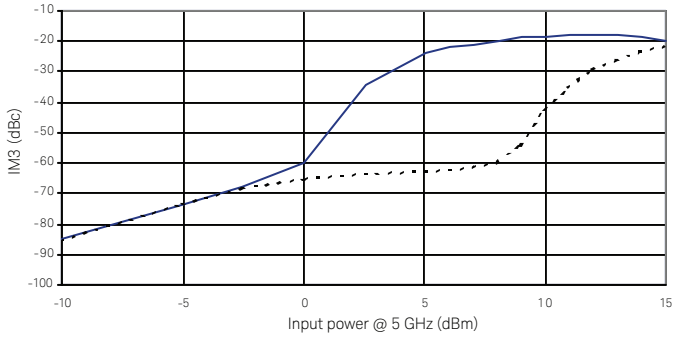


Figure 11. 1GC1-4053 typical third order intermodulation @ f_1 = 5 GHz, f_2 = 5.25 GHz

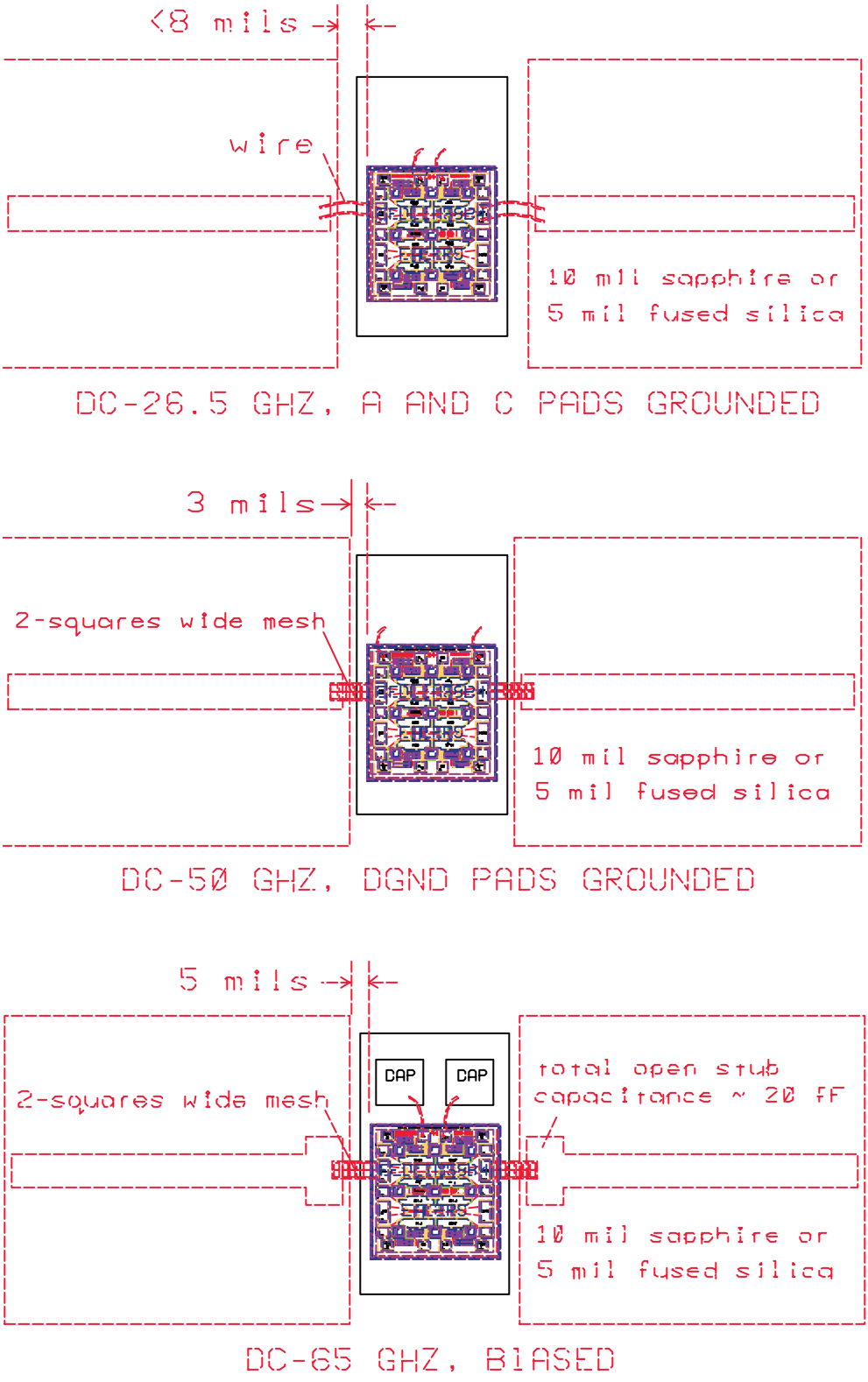


Figure 12. 1GC1-4053 sample bonding and assembly options

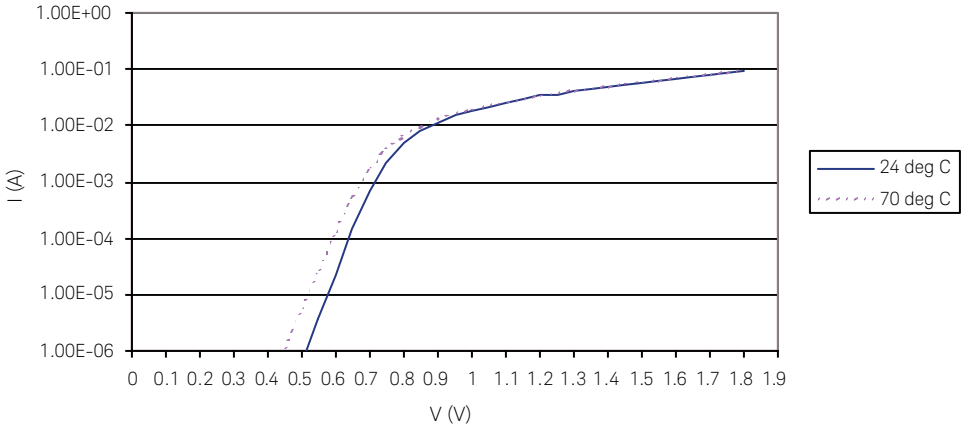


Figure 13. 1GC1-4053 limiter I–V, A & C pads grounded
Tbackside 24° & 70°

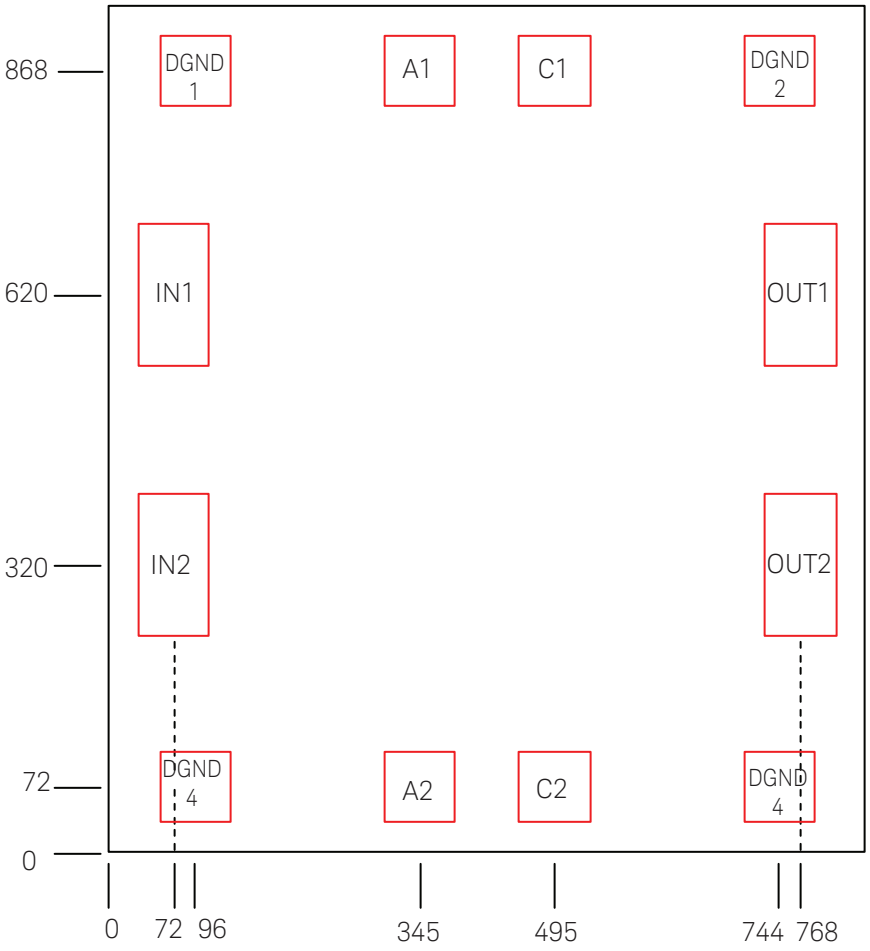
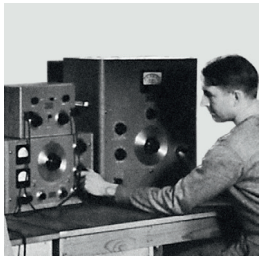
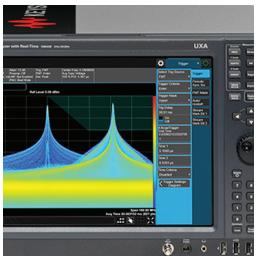


Figure 14. 1GC1-4053 bond pay layout

Evolving

Our unique combination of hardware, software, support, and people can help you reach your next breakthrough. We are unlocking the future of technology.





From Hewlett-Packard to Agilent to Keysight

myKeysight

myKeysight
www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

KEYSIGHT SERVICES
Accelerate Technology Adoption.
Lower costs.

Keysight Services
www.keysight.com/find/service
Keysight Services can help from acquisition to renewal across your instrument's lifecycle. Our comprehensive service offerings—one-stop calibration, repair, asset management, technology refresh, consulting, training and more—helps you improve product quality and lower costs.

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight's measurement expertise and product breadth, combined with channel partner convenience.

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. Customers considering the use of this, or other Keysight Technologies GaAs ICs, for their design should obtain the current production specifications from Keysight. In this data sheet the term typical refers to the 50th percentile performance. For additional information contact Keysight at MMIC_Helpline@keysight.com.

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

www.keysight.com/find/mmic

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

Americas

Canada	(877) 894 4414
Brazil	55 11 3351 7010
Mexico	001 800 254 2440
United States	(800) 829 4444

Asia Pacific

Australia	1 800 629 485
China	800 810 0189
Hong Kong	800 938 693
India	1 800 11 2626
Japan	0120 (421) 345
Korea	080 769 0800
Malaysia	1 800 888 848
Singapore	1 800 375 8100
Taiwan	0800 047 866
Other AP Countries	(65) 6375 8100

Europe & Middle East

Austria	0800 001122
Belgium	0800 58580
Finland	0800 523252
France	0805 980333
Germany	0800 6270999
Ireland	1800 832700
Israel	1 809 343051
Italy	800 599100
Luxembourg	+32 800 58580
Netherlands	0800 0233200
Russia	8800 5009286
Spain	800 000154
Sweden	0200 882255
Switzerland	0800 805353 Opt. 1 (DE) Opt. 2 (FR) Opt. 3 (IT)
United Kingdom	0800 0260637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-06-08-16)

DEKRA Certified
ISO9001 Quality Management System

www.keysight.com/go/quality
Keysight Technologies, Inc.
DEKRA Certified ISO 9001:2015
Quality Management System

KEYSIGHT TECHNOLOGIES
Unlocking Measurement Insights

Published in USA, September 22, 2016
5992-1770EN
www.keysight.com