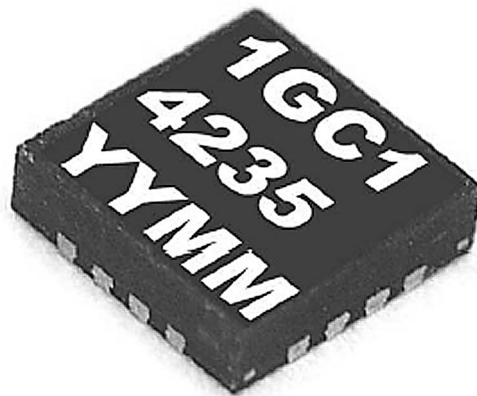


# Keysight TC231P

## 0-20 GHz Integrated Diode Limiter

1GC1-8235

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

# Introduction

## Description

The TC231 is a 20 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 TC231 can be used as an unbiased 10 or 18 dBm passive limiter; it also provides adjustable limiting and peak power detection capabilities.

The TC231 has been designed for minimal insertion loss. Group delay characteristics have been optimized to allow use in millimeter-wave analog and gigabit digital designs..

Package Type:  
3 x 3 mm MLF-16/QFN-16  
Package Dimensions:  
3 x 3 mm (118 x 118 mils)  
Package Thickness:  
0.90 mm (35 mils)  
Pad (lead) Pitch:  
0.5 mm (20 mils)  
Pad (lead) Width:  
0.20 mm (8 mils)

## Absolute Maximum Ratings<sup>[1]</sup>

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
$T_A$	Ambient Temperature		+85	°C
$T_{max}$	Maximum Assembly Temperature <sup>[2]</sup>		240	°C
$T_{stg}$	Storage Temperature	-65	165	°C

1. Operation in excess of any one of these ratings may result in permanent damage to this device. For normal operation, all combined bias and thermal conditions should be chosen such that the maximum junction temperature ( $T_J$ ) is not exceeded.  $T_A = 25^\circ\text{C}$  except for  $T_{op}$ ,  $T_{st}$ , and  $T_{max}$ .
2. Sixty-second maximum.

## DC Specifications/Physical Properties<sup>[1]</sup>

Symbol	Parameters/Conditions	Min.	Typ.	Max.	Units
$V_{fwd\_A}, V_{fwd\_C}$	Limiting Diode Forward Voltage @ 0.1 mA	0.5	0.64	0.8	V
$V_{fwd\_D}$	2-Diode Bias Stack Forward Voltage @ 0.1 mA	0.8	1.15	1.5	V
$R_{S\_A}, R_{S\_C}$	Limiting Diode Series Resistance @ 15 mA Including 2-ohm Resistor	5	12	20	$\Omega$
$I_A, I_C$	Limiting Diode Reverse Leakage Current @ -1V		0.1	1.2	$\mu\text{A}$
$R_{S\_Series}$	Through Series Resistance		1.2	5.5	$\Omega$

1. Measured in wafer form with  $T_{chuck} = 25^\circ\text{C}$ . unless otherwise noted.

## RF Specifications<sup>[1]</sup>

Symbol	Parameters/Conditions	Min.	Typ.	Max.	Units
$S_{11}, S_{22}$	Reflection	10 GHz	-24	-20	dB
$S_{11}, S_{22}$	Through Loss	10 GHz	-0.4	-0.2	dB
$\Delta T_d$	Group Delay Flatness	26.5 GHz	$\pm 0.5$		pS
$P_{-1dB}$	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	-14	dBm
THI	Third Harmonic Intercept	$f_0 = 5$ GHz, A&C or DGND Grounded	32	-14	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  $T_{chuck} = 25^\circ\text{C}$ . Numbers shown are over 0–50 GHz band unless otherwise specified.

## ESD Specifications<sup>[1]</sup>

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, 1500Ω.

## Applications

The TC231 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 TC231 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 TC231 can protect ESD sensitive components. The degree of protection depends on the protected components characteristics. ESD damage level for the TC231 by itself is around 2400V using the human body model.

## Assembly Techniques

The 1GC1-4235 is designed for surface mount on a printed surface board using standard SMT techniques and wave solder.

Well-designed PCB transitions and via structures are essential for obtaining good performance from this and other high-frequency parts. Diodes are ESD sensitive. ESD preventive measures must be employed in all aspects of handling and assembly. Diode ESD precautions, handling considerations, and soldering methods are critical factors in successful diode performance and reliability.

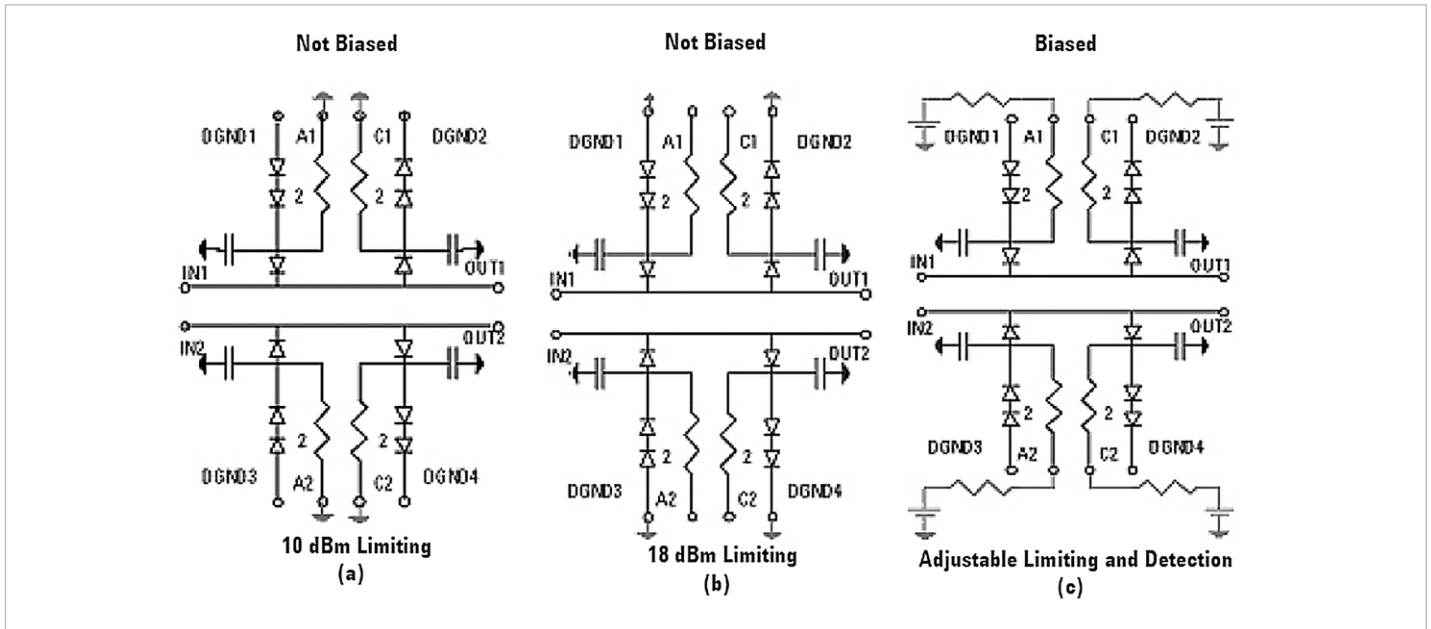


Figure 1. TC231 Functional Topologies

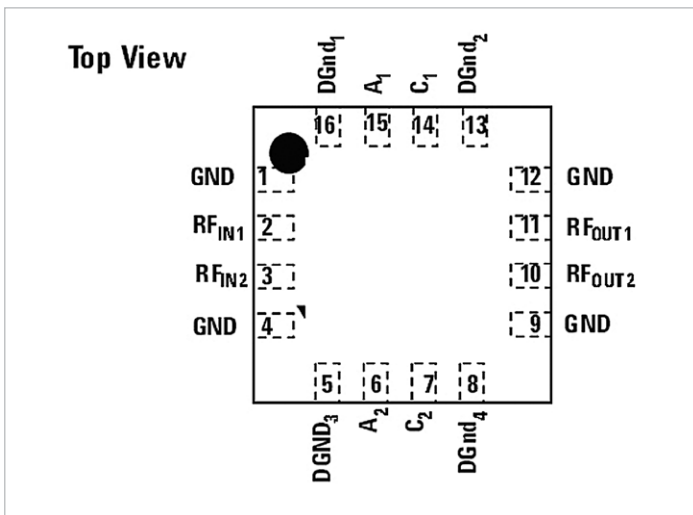


Figure 2. TC231P Pin Outs.

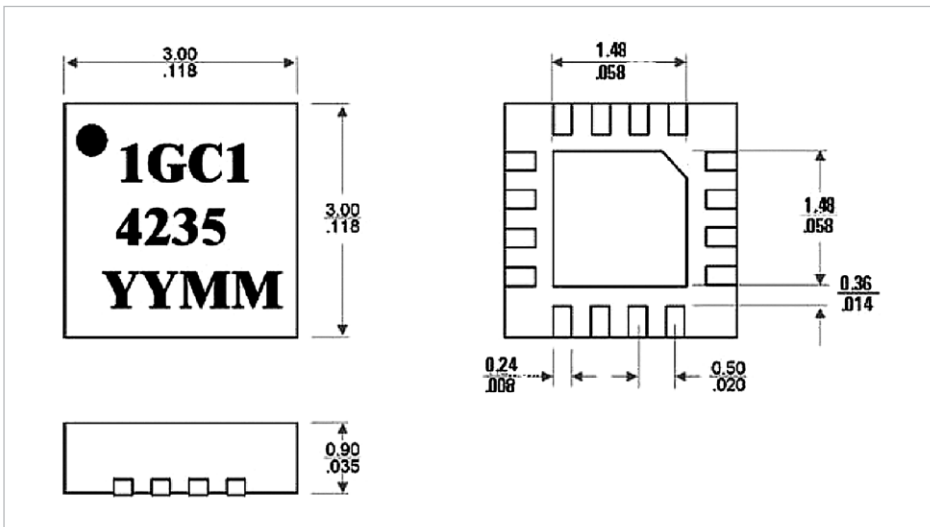


Figure 3. TC231P Dimensions

This datasheet 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 design should obtain the current production specifications from Keysight Technologies. In this datasheet, the term typical refers to the 50th percentile performance



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