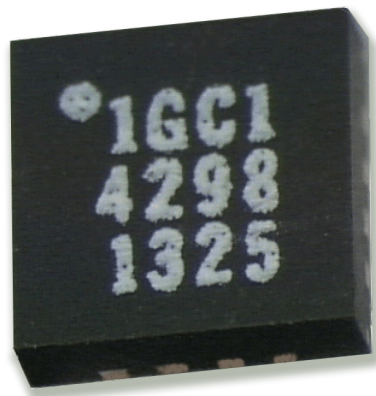


Keysight 1GC1-4298

DC - 26.5 GHz Packaged Gilbert-Cell Mixer



Data Sheet

Features

- DC to 26.5 GHz on RF and LO
- DC to 1 GHz IF
- Low conversion loss:
4 dB typical
- High input $P_{-1\text{dB}}$:
+9 dBm @ 10 GHz
+2 dBm @ 20 GHz
- Single-supply operation:
 $V_{\text{supply}} = -7\text{ V}$
- RoHS compliant
- QFN SMT package

Description

The 1GC1-4298 offers substantially improved frequency range and improved broadband performance in a Gilbert-cell mixer.

The 1GC1-4298 can be utilized as a fundamental, 3rd, 5th, or 7th order harmonic mixer. The mixer is fabricated using Keysight Technologies, Inc. GaAs HBT process, which provides excellent process uniformity, reliability, and 1/f noise performance.

The 1GC1-4298 is available in a 3 mm x 3 mm quad flat - no leads (QFN) SMT package to preserve BW performance and save space on densely populated PC board designs.

Absolute maximum ratings¹

Symbol	Parameters/conditions	Min	Max	Units
V_{EE}	Emitter voltage	-7.5	-6.5	V
V_{in-RF}	CW input power - RF port		+10	dBm
P_{in-LO}	CW input power - LO port		+10	dBm
T_{bs}	Maximum backside temperature		75	°C
T_{stg}	Storage temperature	-55	+150	°C
T_{assy}^2	Maximum solder reflow temperature (max. 3 cycles @ 30 sec./cycle)		+260	°C

- Operation in excess of any one of these conditions may result in permanent damage to this component.
 $T_A = 25\text{ °C}$ except for T_{bs} , T_{stg} , and T_{assy} .
- Refer to JEDEC J-STD-020D for detailed reflow profile, 3 reflows max.

DC specifications/physical properties¹

($T_A = 25\text{ °C}$, unless otherwise listed)

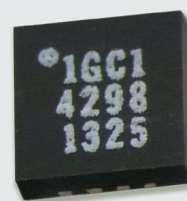
Symbol	Parameters/conditions	Min	Typ	Max	Units
V_{EE}	Emitter voltage		-7		V
I_{EE}	Emitter current	-90	-81	-75	mA

RF performance¹

($T_A = 25\text{ °C}$, V_{EE} and PLO = -5 dBm, unless otherwise listed)

Symbol	Parameters/conditions	DC 0 - 20 GHz			DC 20-26.5 GHz			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	
BW -LO	LO bandwidth	0		20	20	-24	26	GHz
BW - RF	RF bandwidth	0		20	20		26	GHz
BW - IF	IF bandwidth	0		1	0		1	GHz
P_{comp}	Power compression at 0 dBm input		0.25			0.4		dB
CE	Conversion efficiency	-7		-1	-10		-5	dB
NF	Noise figure		25					dB
L - R	LO to RF isolation		40					dB
R - L	RF to LO isolation		45					dB
L - I	LO to IF isolation		40 ²					dB
R - I	RF to IF isolation	21	15					dB
RL RF	RF port return loss	11	15					dB
RL LO	LO port return loss		15					dB
RL IF	IF port return loss		20					dB

- Numbers given are worst-case across the band unless otherwise noted.
- Measured at 1 GHz



- Package type: Quad flat - no leads (SMT QFN)
- Package dimensions: 3.0 x 3.0 mm (0.118 x 0.118 in)
- Package thickness: 0.90 ± 0.10 mm (0.035 ± 0.0039 in)
- Lead pitch: 0.5 mm (0.197 in)
- Lead width: 0.2 mm (0.078 in)

Applications

The 1GC1-4298 is ideal for downconverting 0 to 20 GHz signals to an IF of 0 to 1 GHz. The 1GC1-4298 is particularly well suited for applications that require load-insensitive conversion loss, good spurious signal suppression, reasonable dynamic range, and low LO power over a wide bandwidth.

Biasing and Operation

The 1GC1-4298 requires a single -7 V power supply to V_{EE} . Current will be approximately 81 mA.

Operation

The 1GC1-4298 does not require capacitors on any ports other than V_{EE} . It is capable of operation (including pass-through operation) without connecting RFbar and LO bar. LO power can vary between -10 and 0 dBm.

Pass-thru mode is available with LO bar held at a non-zero voltage – see the Pass-Thru mode S-parameter plot. For increased gain (S_{21b}), hold LO bar positive; for decreased gain (S_{21a}), hold LO bar negative.

Recommended pass-thru LO bar voltage is ± 0.5 V, although voltages between ± 0.4 V and ± 1 V are acceptable. These are dissipated through 55 ohms on-chip.

Temperature diode operation

High accuracy (bench process)

With part mounted on a good heat sink, measure V_{fwd} with 1 mA of current from TD pad to ground (either polarity is ok) with backside at 25 °C, 45 °C, and 65 °C (or other temperature points as desired). One of these should be same as bias on case.

Plot V_{fwd} vs. backside temperature and determine $\Delta V/\Delta T$. For these diodes, this value is ~ 1 mV / °C, and the plot should be very linear.

Bias on part with desired backside temperature.

Allow part to stabilize and measure V_{fwd} with 1 mA of current as before. Determine ΔT from calibration curve developed above.

Collect data to determine $\Delta V/\Delta T$ for date code under analysis. The variation part to part should be fairly small.

In situ estimation (micro-circuit process)

With part unbiased and micro-circuit temperature stabilized, measure V_{fwd} with 1 mA of current from TD pad to ground.

Bias on part and measure V_{fwd} as before.

Parts with good heat sink and good thermal path should have $\Delta T \sim < 15$ °C.

Parts with poor heat sink or thermal path may have ΔT values of 60 °C or higher.

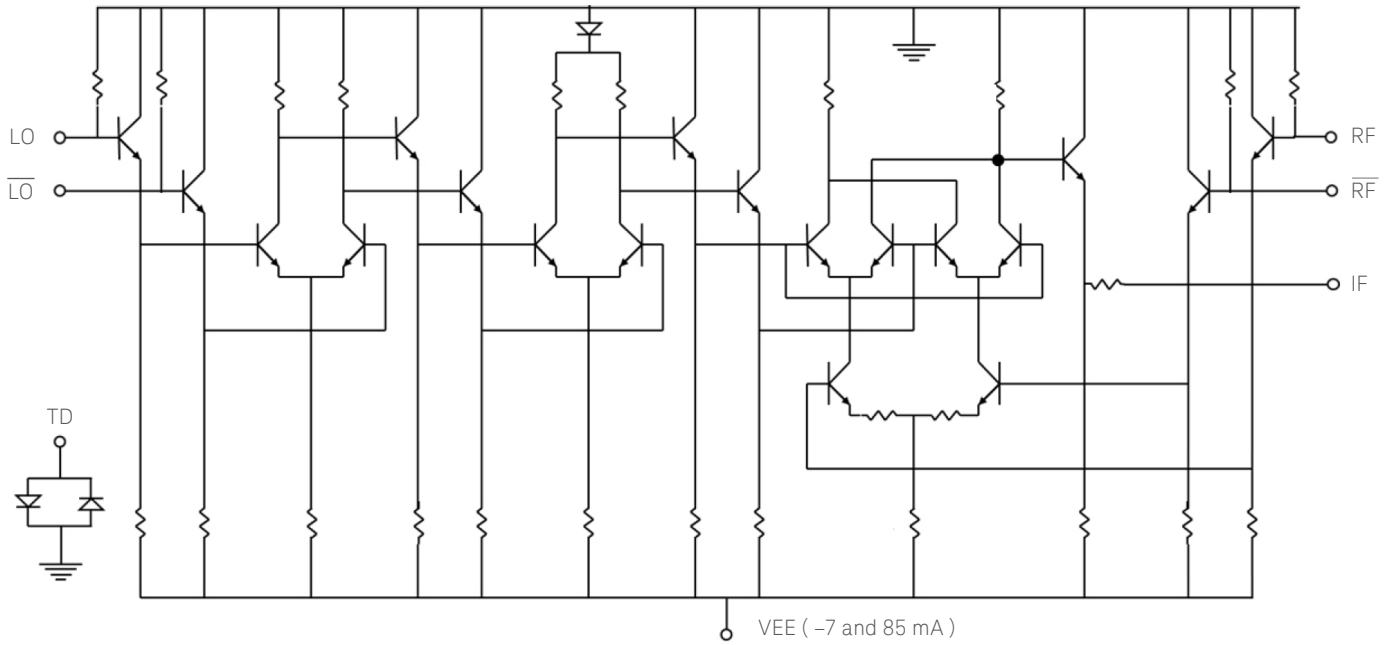


Figure 1. 1GC1-4298 schematic

Moisture Compatibility

Injection mold components like the 1GC1-4298 in QFN are moisture-sensitive. The product is tested to the Moisture and Reflow Sensitivity Level 3 as per IPC/Jedec J-STD-020 and must be mounted within 168 hours of opening the shipping container. Store and handle parts for reflow and for rework per IPC/Jedec J-STD-033B. An example of the moisture sensitivity label is shown in Figure 2.

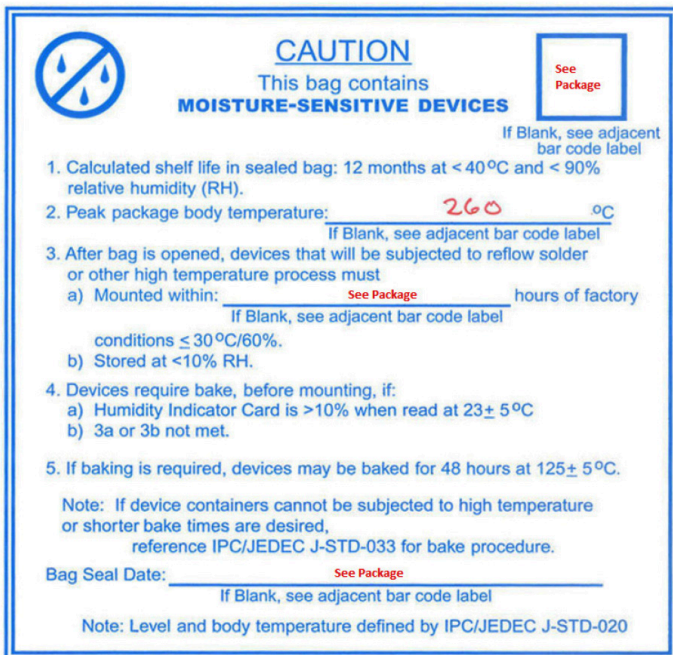


Figure 2. 1GC1-4298 moisture sensitivity label

Tape and Reel

The 1GC1-4298 is available in tape and reel format to facilitate automatic pick and place manufacturing. See Figure 9.

RoHS Compliance

The 1GC1-4298 Mixer 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.

ESD and Handling Precautions

GaAs MMICs in either chip or SMT packages 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.

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

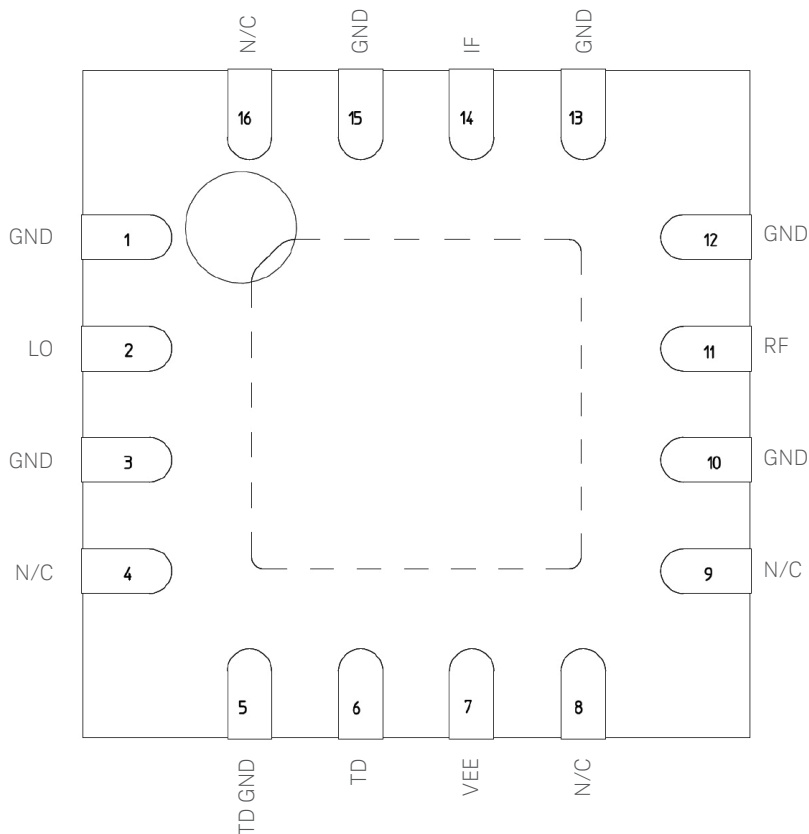


Figure 3. 1GC1-4298 pin-out diagram

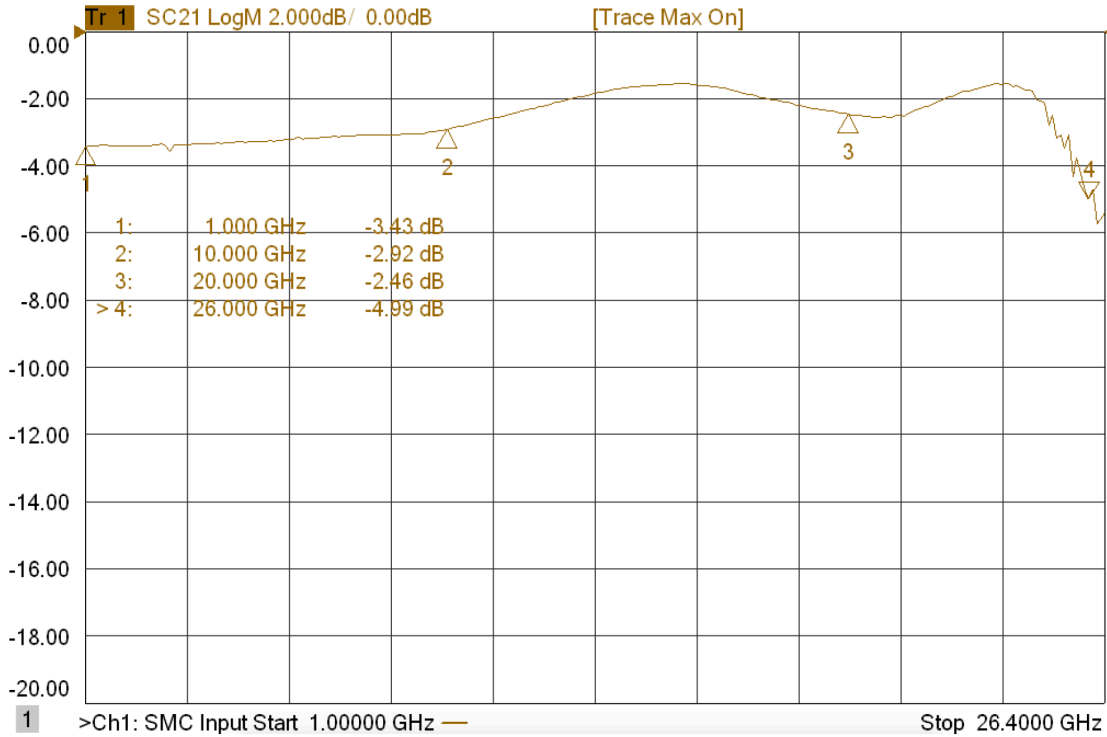


Figure 3. 1GC1-4298 conversion gain (QFN pkg on an evaluation board)

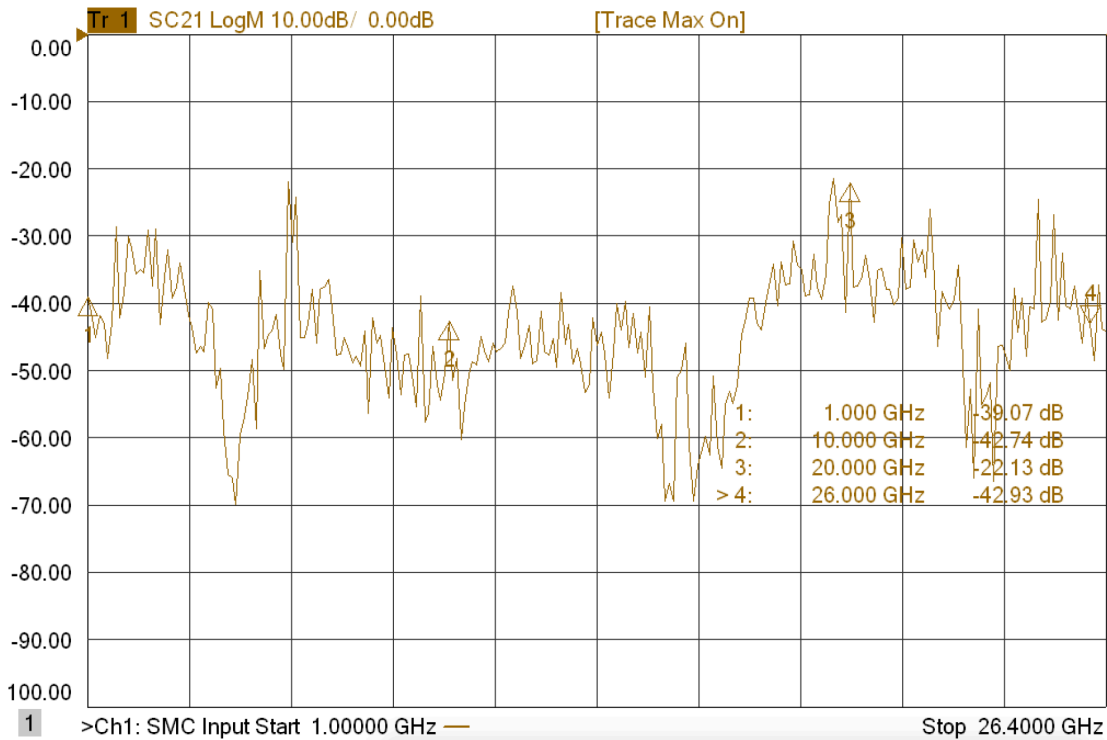


Figure 5. 1GC1-4298 self conversion gain (QFN pkg on an evaluation board)

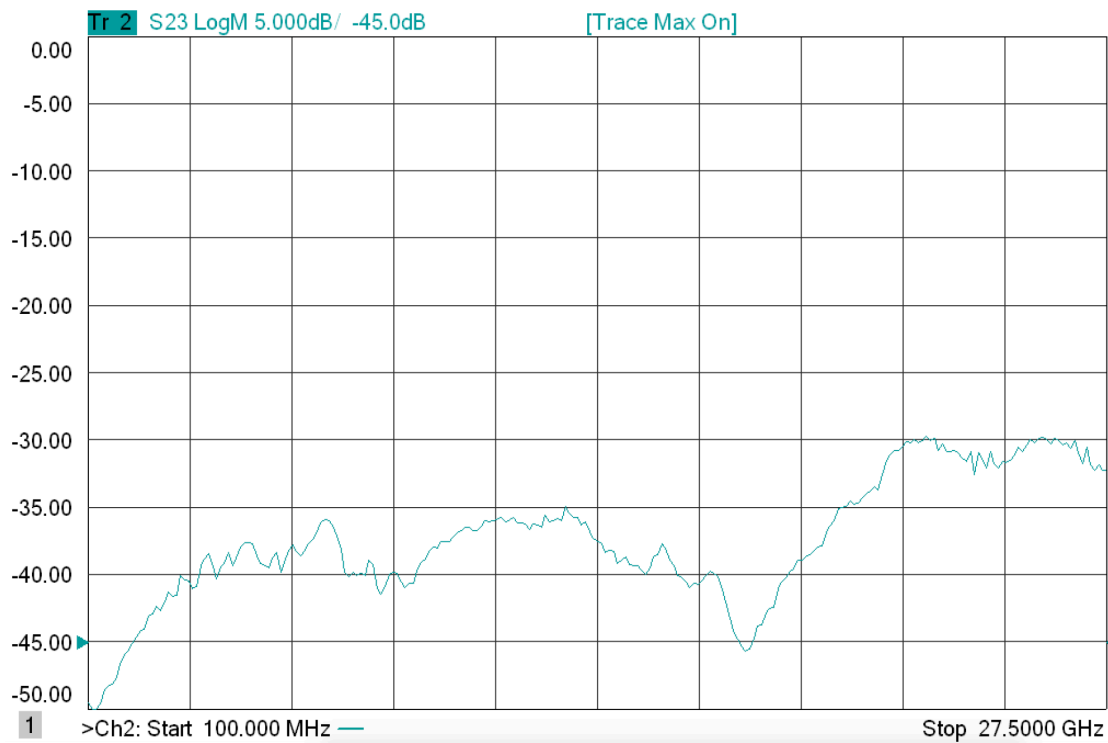


Figure 6. 1GC1-4298 L-to-I isolation (QFN pkg on an evaluation board)

Vias must be filled and plated over
VIPPO recommend 7.9 mil FHS (no
solder mask)

Use grounded 'area filled' copper
on opposite side of the board for
proper heatsinking

Use 'area fill' copper (grounded
if possible) on inner layers for
additional heatsinking

Sample RF transition to 50 ohm
on Rogers, and sample topside
copper area fill on Doc layer.

For footprints compatible
with other layout tools, email
MMIC_Helpline@keysight.com

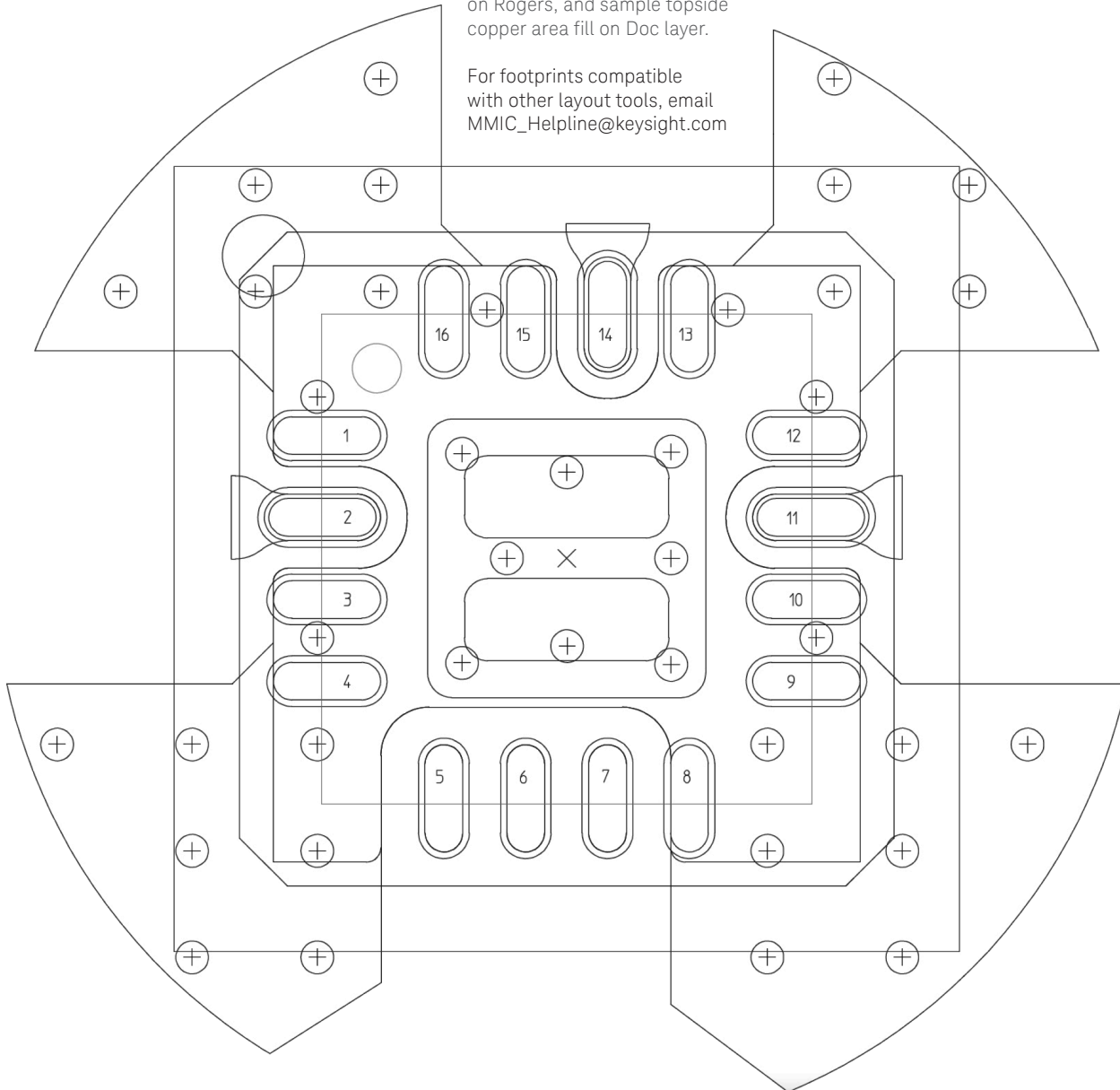


Figure 7. 1GC1-4298 footprint diagram

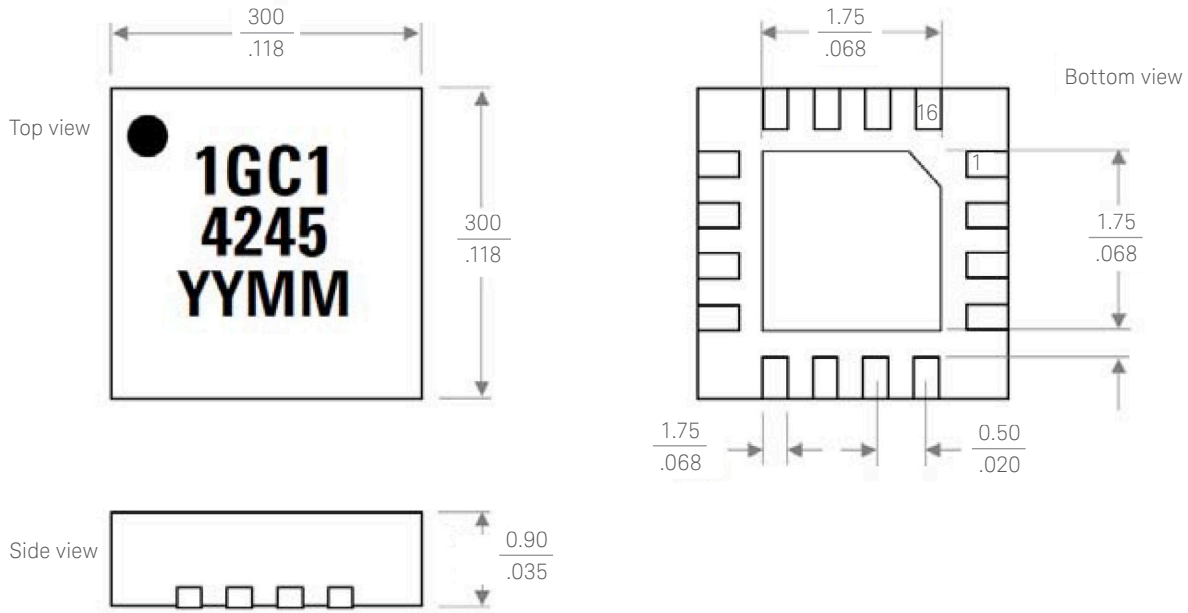


Figure 5. 1GC1-4298 package dimensions

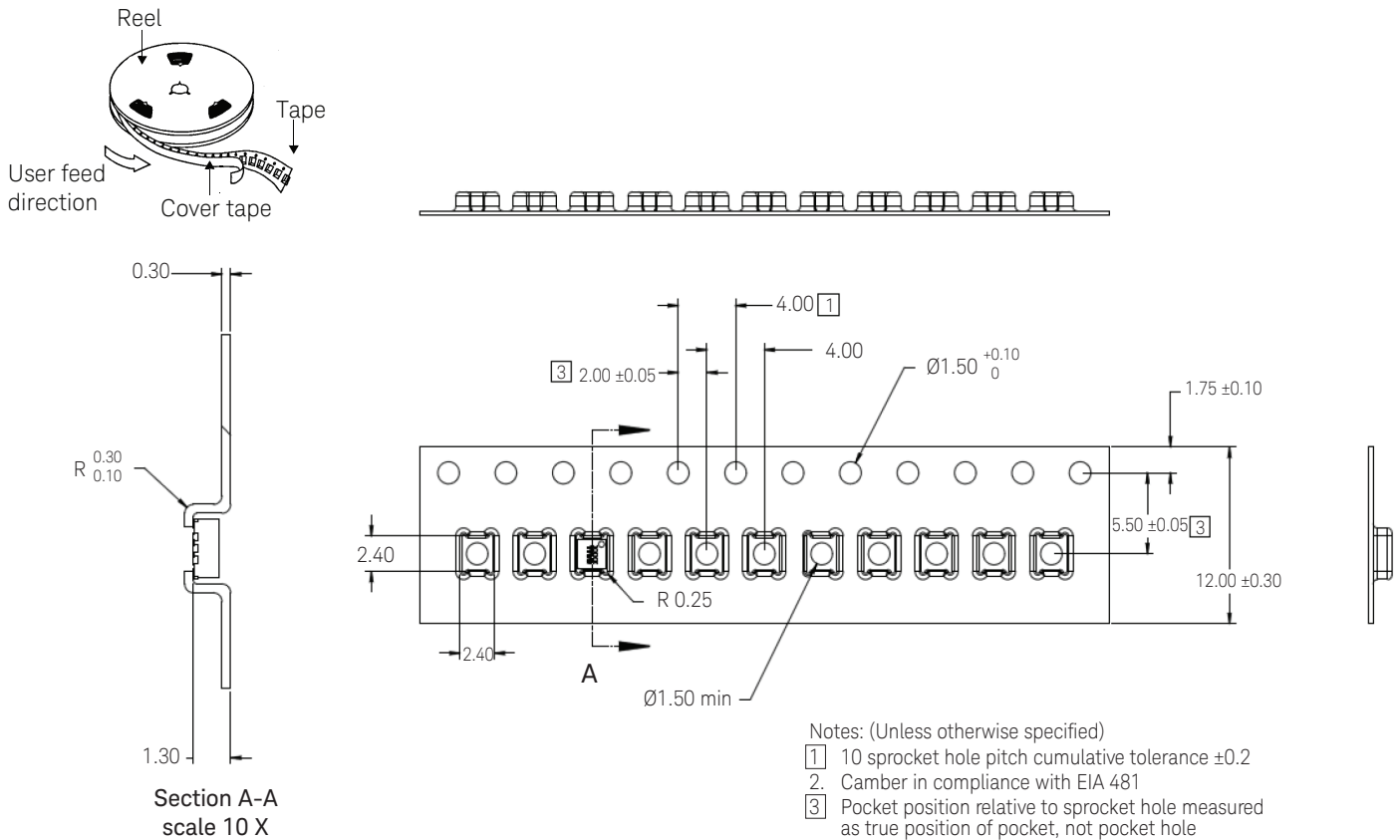


Figure 6. 1GC1-4298 tape in reel

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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** and **RoHS Process Compatible** with a maximum temperature of 260 °C and a maximum of 3 temperature cycles

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