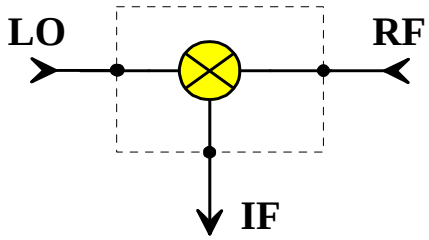
W-band Mixer

Preliminary

GaAs Monolithic Microwave IC

Description

The CHM2179b is a single channel mixer. The structure is a balanced mixer based on a six-quarter wave ring. The non-linear devices are high quality Schottky diodes providing low conversion loss and very low 1/f noise.
This circuit is manufactured with the BES-MMIC process: 1 µm Schottky diode device, air bridges, via holes through the substrate, stepper lithography.
It is available in chip form.



Main Features

- W-band LO and RF frequency range
- Low conversion loss
- IF from DC to 100MHz
- High LO/RF isolation
- High LO/AM noise rejection
- Very low IF noise
- Low LO input power
- Automatic assembly oriented
- BCB layer protection
- Small chip size: 1.53 x 1.17 x 0.10 mm

Main Characteristics

Tamb. = +25°C

Symbol	Parameter	Min	Typ	Max	Unit
F_lo, F_rf	LO, RF frequency	76	76.5	77	GHz
F_if	IF frequency range	[DC;100]			MHz
Lc	Conversion loss		8		dB
I_lo/rf	LO/RF isolation		22		dB
N_if	IF noise @ 100kHz		-162		dBm/Hz

ESD Protection : Electrostatic discharge sensitive device. Observe handling precautions !

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Electrical Characteristics

Full operating temperature range, used according to section "Typical assembly and bias configuration"

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Symbol	Parameter	Min	Typ	Max	Unit
F_lo, F_rf	LO, RF frequency	76		77	GHz
F_if	IF frequency range	[DC;100]			MHz
Lc	Conversion loss	5	8	10	dB
P_lo	LO input power	3	5.5	8	dBm
P_RF_1dB	RF input power at 1 dB	-3	0		dBm
VSWR_lo	LO port VSWR (50Ω)		2:1	2.5:1	
VSWR_rf	RF port VSWR (50Ω)		2:1	2.5:1	
IMP_if	IF load impedance (1)		200		Ω
I_lo/rf	LO/RF isolation	16	22		dB
R_lo_am	LO AM noise rejection (SSB)	20	27		dB
NF	Noise figure for IF=1kHz (2)		35	40	dB
	Noise figure for IF=10kHz (2)		29	34	dB
	Noise figure for IF=100kHz (2)		21.5	26.5	dB
	Noise figure for IF=200kHz (2)		18	23	dB
+V	Positive supply voltage (3)		4.5		V
+I	Positive supply current (3)		1.5	2.5	mA
Top	Operating temperature range	-40		+100	℃

(1) The IF optimum load for conversion loss is 200Ω. For minimum noise figure this load can be lower, the best results have been obtained on 50Ω.
(2) Measured on 200Ω IF impedance.
(3) An external resistor controls the bias current (see section "Typical Assembly and Bias Configuration")

Absolute Maximum Ratings (1)

Symbol	Parameter	Values	Unit
+V	Supply voltage	6	V
+I	Supply current	2.5	mA
P_lo	Maximum peak input power overdrive at LO port (2)	10	dBm
P_rf_cw	Maximum input power at RF port (3)	3	dBm
Tstg	Storage temperature range	-55 to +125	℃

(1) Operation of this device above anyone of these parameters may cause permanent damage.
(2) Duration < 1s
(3) Continuous wave mode.

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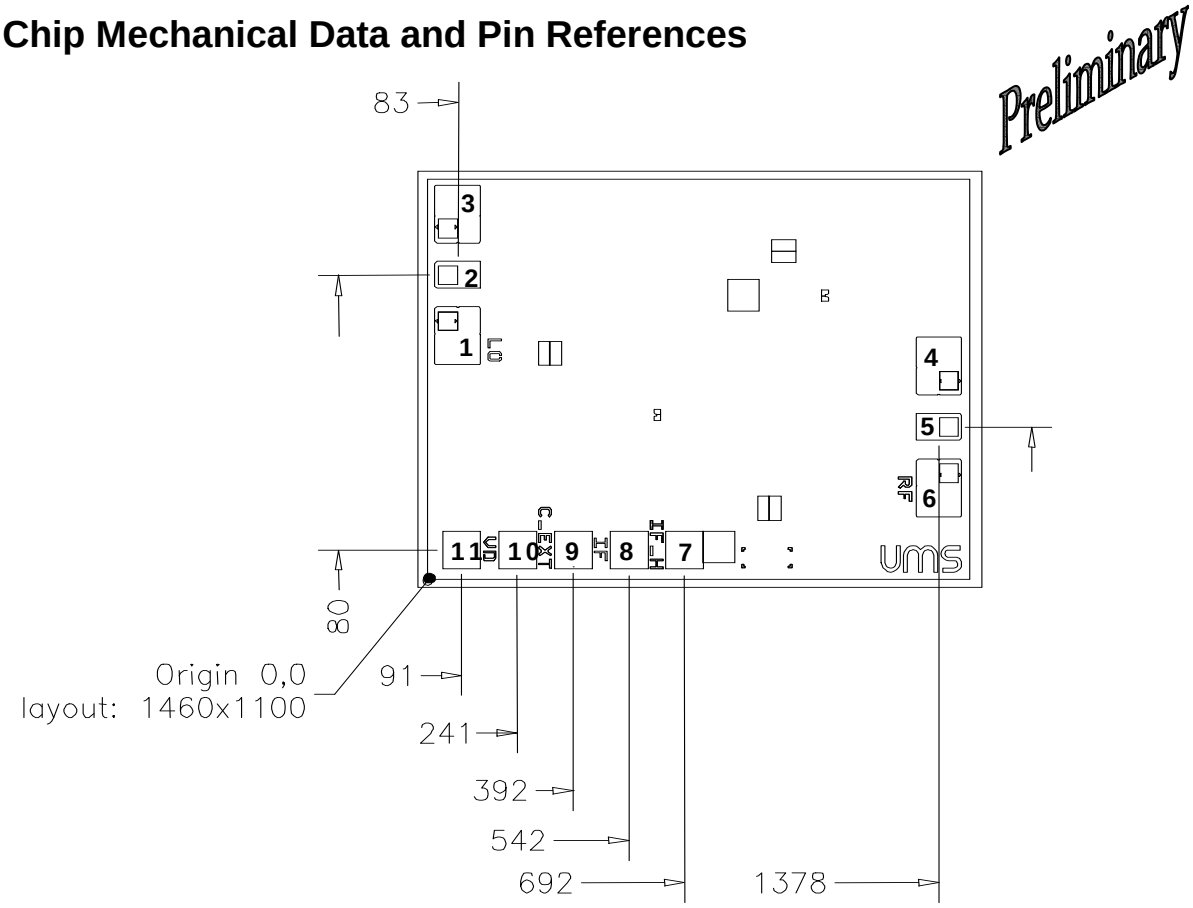
Chip Mechanical Data and Pin References



Unit = µm
External chip size = 1530 x 1170
Chip thickness = 100 +/- 10
HF Pads (2,5) = 105 X 86 (BCB opening)
DC/IF Pads = 86 x 83 (BCB opening)

Pin number	Pin name	Description
1,3,4,6		Ground: should not be bonded. If required, please ask for more information.
2	**LO**	LO input
5	**RF**	RF input
7	**GND**	Ground (optional)
8		Not Connected
9	**IF**	IF output
10	**C_ext**	Bias decoupling
11	**+V**	Positive supply voltage

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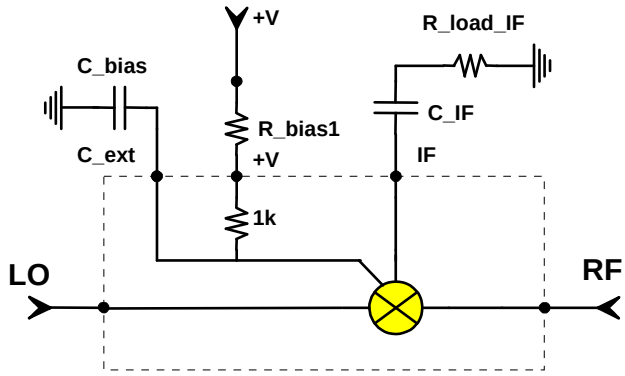
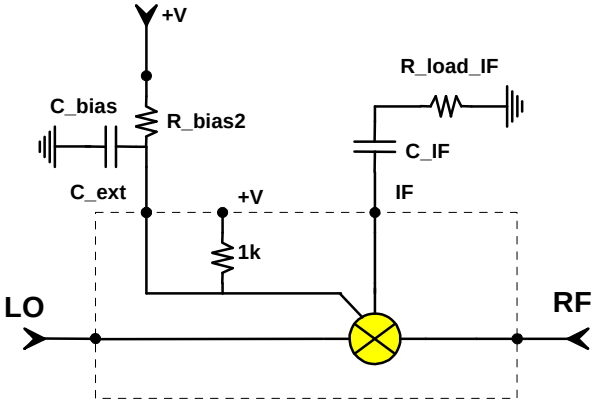
Typical Bias and IF Configuration

Preliminary

Several external configurations are possible for bias and IF. The objective is to give flexibility for the integration.
As this component is mainly dedicated to low IF use, there are several possibilities for interfacing with low noise IF amplifier. The optimum IF load for conversion loss is 200Ω, however depending on the IF amplifier noise characteristic this load can be modified in order to optimise the noise figure.
A series capacitor, between IF output and the load is recommended.
Due to high sensitivity to electrical discharges an integrated resistance is used and two ports are available for biasing. One is for the connection of a decoupling capacitor (C_ext) and the other one is for the supply voltage connection through an external series resistance (+V port). However, in order to keep the compatibility with the CHM2179, only the "C_ext" port can be used.



Recommended external bias and IFconfiguration



Other possible configuration
(Compatible with the previous version)

The recommended values for external components are:

C_bias	R_bias*C >> 1/F_IF
R_bias1	2.9kΩ for 1mA current consumption (V = 4.5V, typical LO power)
R_bias2	R_bias2 = R_bias1 + 1kΩ
R_load_IF	From 50 to 200Ω

Notes::
1. R_bias = R_bias1 + 1kΩ when "+V" port is used, otherwize R_bias = R_bias2
2. R_bias can be adjusted if necessary; This allows to optimise the performances when some parameters are different from recommended ones (Supply voltage, LO power …). However maximum ratings for the current have to be taken into account.
3. A series capacitor at IF outputs is recommended for DC decoupling.

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Typical Assembly and RF Configuration

In order to use acceptable wire bonding length, compatible with automatic pick and place and wire bonding equipment, an external matching network is proposed on low dielectric constant substrate.

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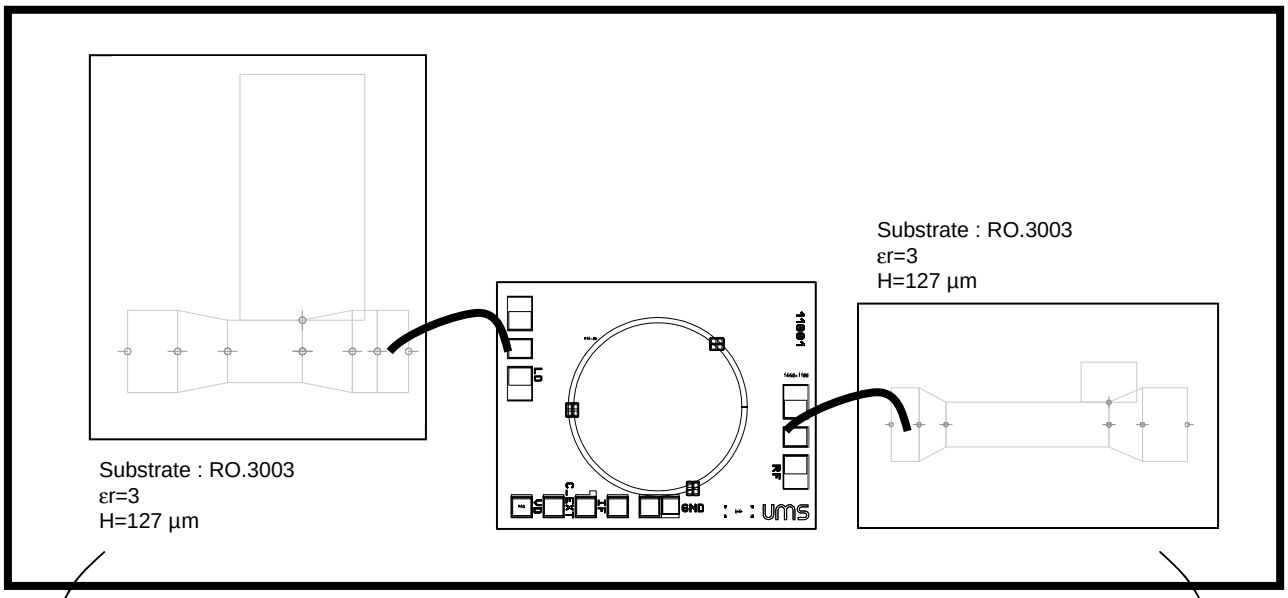
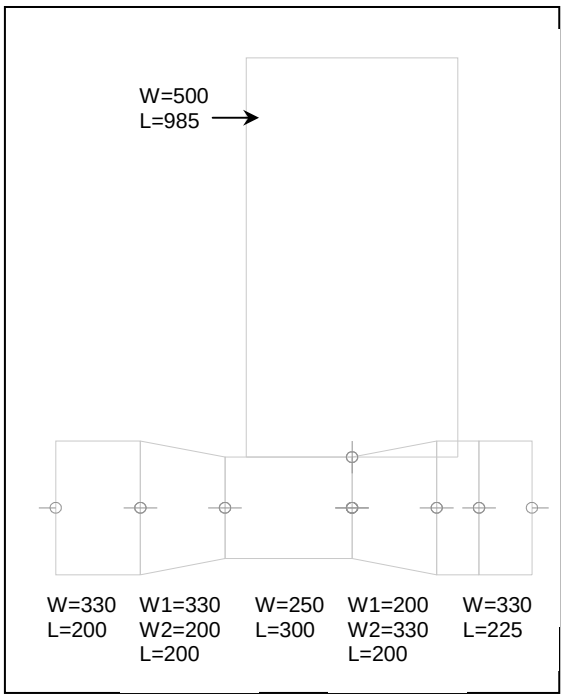
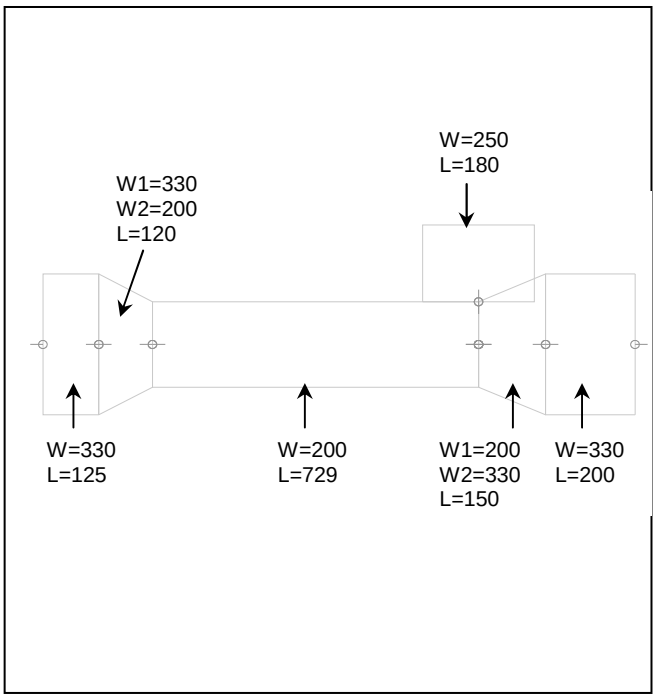


Example of integration using low dielectric constant substrate : Er=3, heigh=0.127mm (dimensions are in µm)





Unit =µm

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Ordering Information

Chip form : CHM2179b98F/00

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