

## W-band Mixer

### GaAs Monolithic Microwave IC

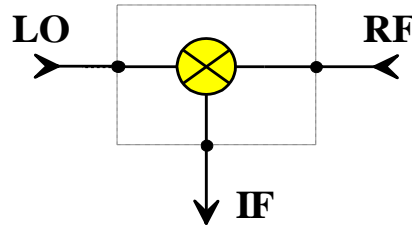
#### Description

The CHM2179b98F is a monolithic single channel mixer, which integrates high quality Schottky diodes that produces low conversion loss and very low 1/f noise.

The circuit is designed for sensors system at W-band, such as automotive long range radar and industrial sensors.

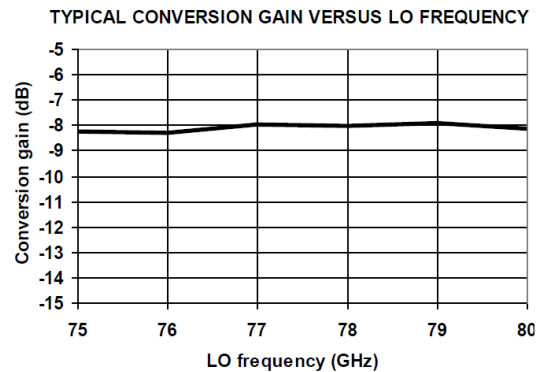
The circuit is manufactured with a Schottky diode MMIC process, 1 $\mu$ m gate length, via holes through the substrate, air bridges and stepper lithography.

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 assembled oriented
- BCB layer protection
- Small chip size 1.53 x 1.17 x 0.10mm



#### Main Electrical Characteristics

Tamb.= +25°C

| Symbol        | Parameter          | Min      | Typ  | Max | Unit   |
|---------------|--------------------|----------|------|-----|--------|
| F_lo,<br>F_rf | LO, RF frequency   | 76       |      | 79  | 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 |

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|------------|---|----------|------|-------|------|
| F_lo, F_rf | LO, RF frequency                          | 76       |      | 79    | GHz  |
| F_if       | IF frequency range                        | [DC;100] |      |       | MHz  |
| Lc         | Conversion loss                           |          | 8    |       | dB   |
| P_lo       | LO input power                            | 3        | 5    | 8     | dBm  |
| P_RF_1dB   | RF input power at 1 dB                    | -3       | 0    |       | dBm  |
| VSWR_lo    | LO port VSWR (50Ω) <sup>(1)</sup>         |          | 2:1  | 2.5:1 |      |
| VSWR_rf    | RF port VSWR (50Ω) <sup>(1)</sup>         |          | 2:1  | 2.5:1 |      |
| IMP_if     | IF load impedance <sup>(2)</sup>          |          | 200  |       | Ω    |
| L_lo/rf    | LO/RF isolation                           |          | 23   |       | dB   |
| R_lo_am    | LO AM noise rejection (SSB)               |          | 27   |       | dB   |
| NF         | Noise figure for IF=1KHz <sup>(3)</sup>   |          | 35   |       | dB   |
|            | Noise figure for IF=10KHz <sup>(3)</sup>  |          | 29   |       | dB   |
|            | Noise figure for IF=100KHz <sup>(3)</sup> |          | 21.5 |       | dB   |
|            | Noise figure for IF=200KHz <sup>(3)</sup> |          | 18   |       | dB   |
| +V         | Positive supply voltage <sup>(4)</sup>    |          | 4.5  |       | V    |
| +I         | Positive supply current <sup>(4)</sup>    |          | 1    | 2.5   | mA   |
| Top        | Operating temperature range               | -40      |      | +100  | °C   |

<sup>(1)</sup> An external matching network is required (see section "Recommended assembly plan")

<sup>(2)</sup> 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.

<sup>(3)</sup> Measured on 200Ω IF impedance.

<sup>(4)</sup> An external resistor controls the bias current (see section "Typical bias and IF Configuration")

## Absolute Maximum Ratings <sup>(1)</sup>

Tamb.= +25°C

| Symbol  | Parameter  | Values      | Unit |
|---------|--|-------------|------|
| +I      | Supply current <sup>(2)</sup>                                | 2.5         | mA   |
| P_lo    | Maximum peak input power overdrive at LO port <sup>(3)</sup> | 9           | dBm  |
| P_rf_cw | Maximum input power at RF port <sup>(4)</sup>                | 3           | dBm  |
| Tj      | Junction temperature   | 175         | °C   |
| Top     | Operating temperature range                                  | -40 to +100 | °C   |
| Tstg    | Storage temperature range                                    | -55 to +150 | °C   |

<sup>(1)</sup> Operation of this device above anyone of these parameters may cause permanent damage.

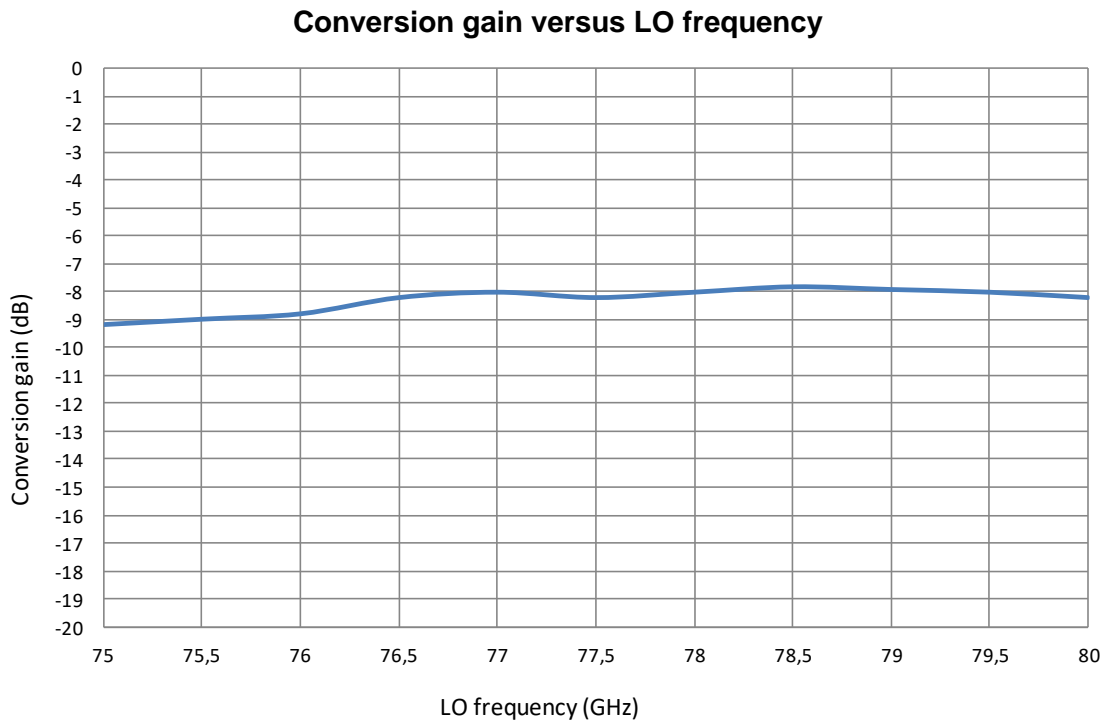
<sup>(2)</sup> An external resistor controls the bias current (see section "Typical bias and IF Configuration").

<sup>(3)</sup> Duration < 1s.

<sup>(4)</sup> Continuous wave mode.

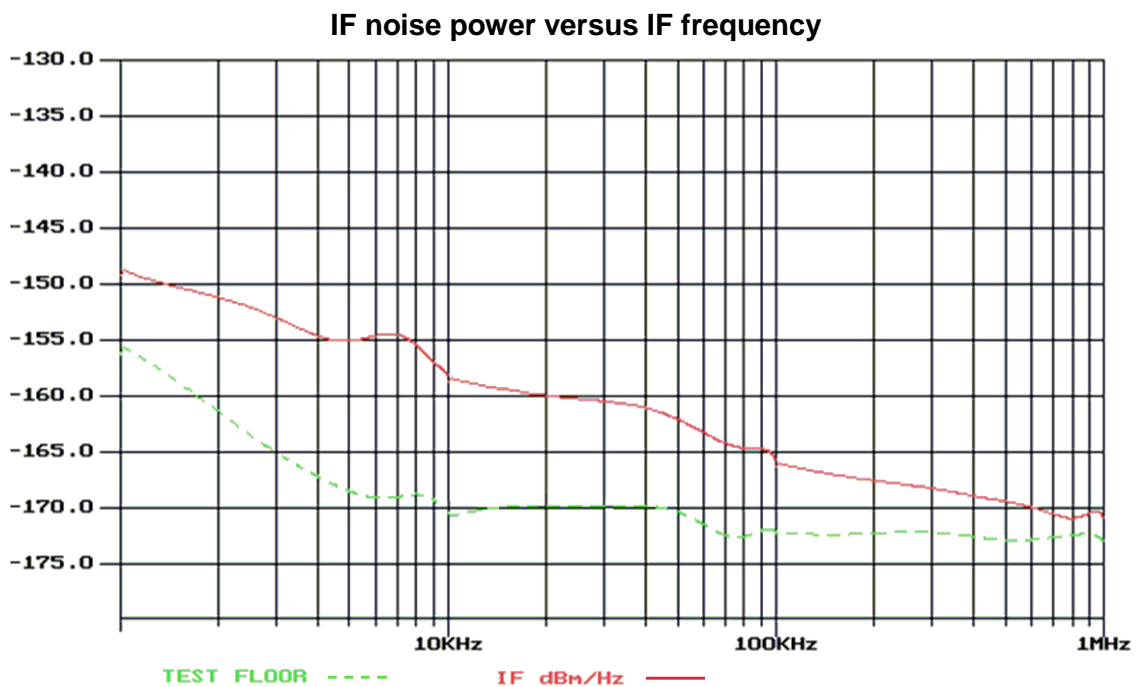
### Typical conversion gain

Measured on 200Ω IF load

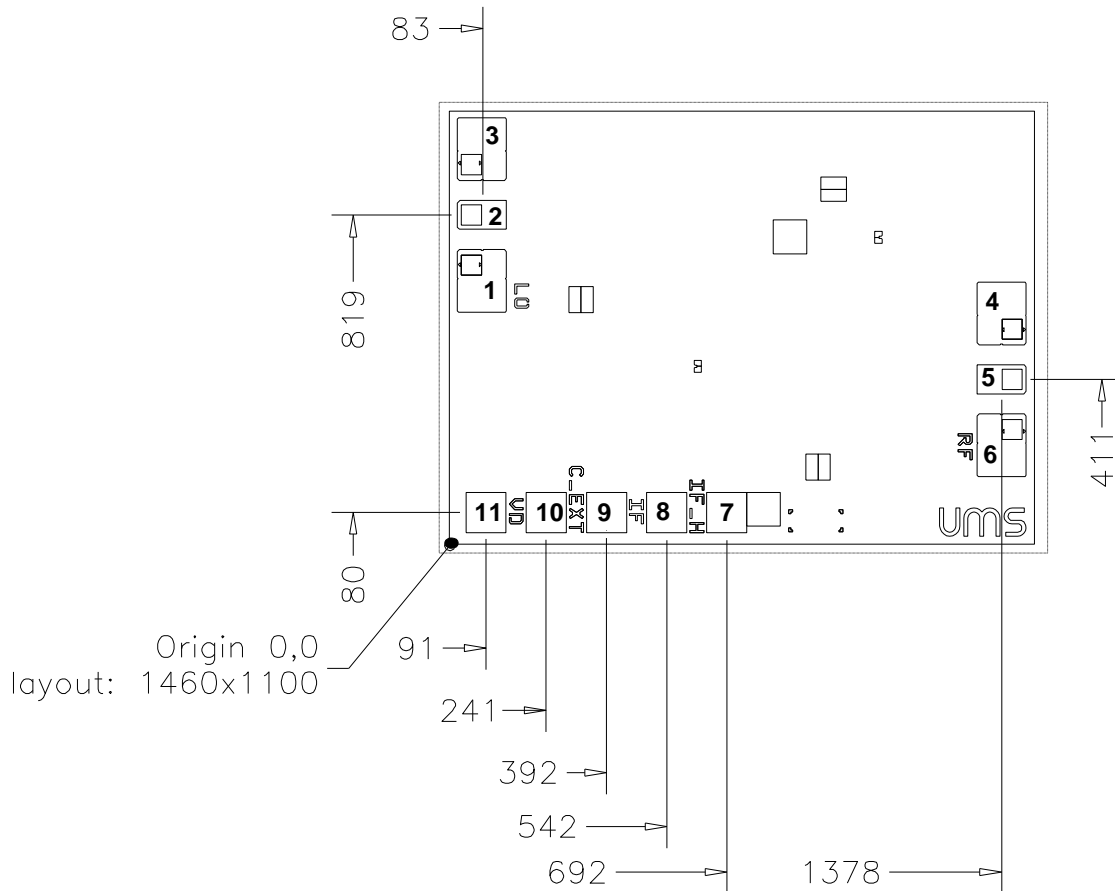


### Typical IF noise power

Measured on 50Ω IF load



## Mechanical data



Chip thickness: 100µm.  
 Chip size: 1530x1170 ±35µm  
 HF Pads (2,5) = 105 X 86 (BCB opening)  
 DC/IF Pads = 86 x 83 (BCB opening)  
 All dimensions are in micrometers

| Pin number | Pin name | Description                                  |
|------------|----------|--|
| 1,3,4,6    |          | On chip Ground: Not connected <sup>(1)</sup> |
| 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                      |

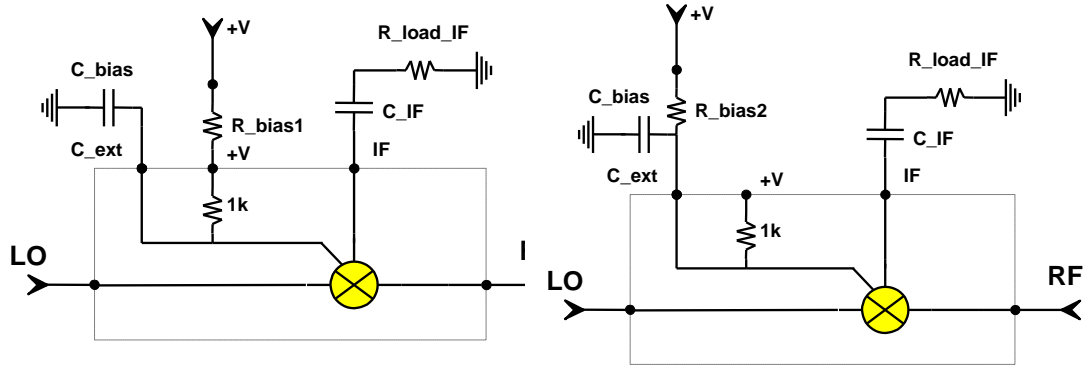
<sup>(1)</sup> If required, please ask for more information.

## Typical Bias and IF Configuration

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  $200\Omega$ , 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 CHM2179b98F, only the “ $C_{ext}$ ” port can be used.



**Recommended external bias and IF configuration**

**Other possible configuration**  
(compatible with the previous version)

The recommended values for external components are:

|                |   |
|----------------|---|
| $C_{bias}$     | $R_{bias} \times C \gg 1/F_{IF}$  |
| $R_{bias1}$    | $2.9k\Omega$ for 1mA current consumption ( $V = 4.5V$ , typical LO power) |
| $R_{bias2}$    | $R_{bias2} = R_{bias1} + 1k\Omega$  |
| $R_{load\_IF}$ | From 50 to $200\Omega$  |

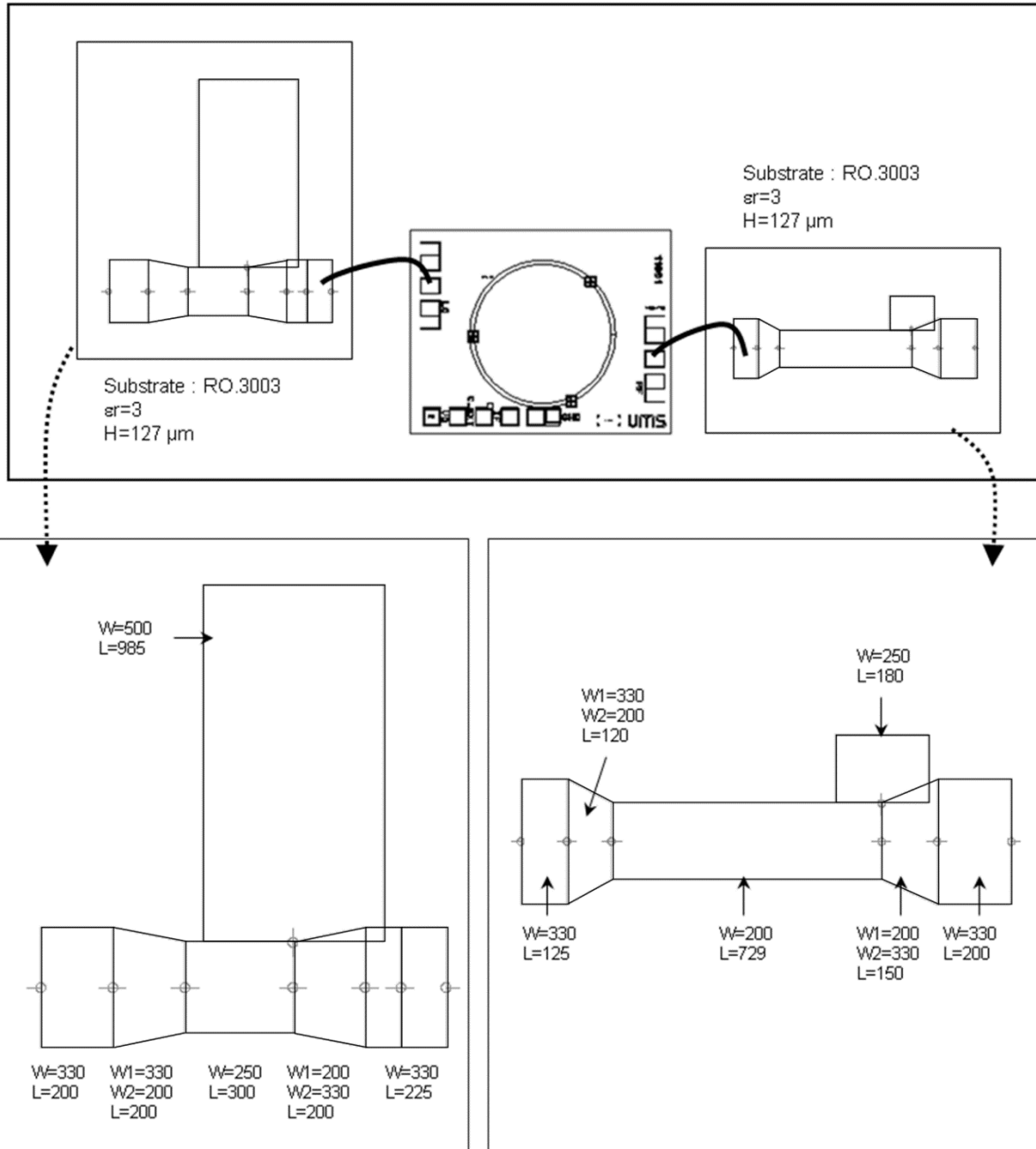
Notes:

(1)  $R_{bias} = R_{bias1} + 1k\Omega$  when “+V” port is used, otherwise  $R_{bias} = R_{bias2}$ .  $R_{bias}$  can be adjusted if necessary; this allows optimizing 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.

(2) A series capacitor at IF outputs is recommended for DC decoupling.

## Recommended assembly plan

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 for 76-77GHz band.

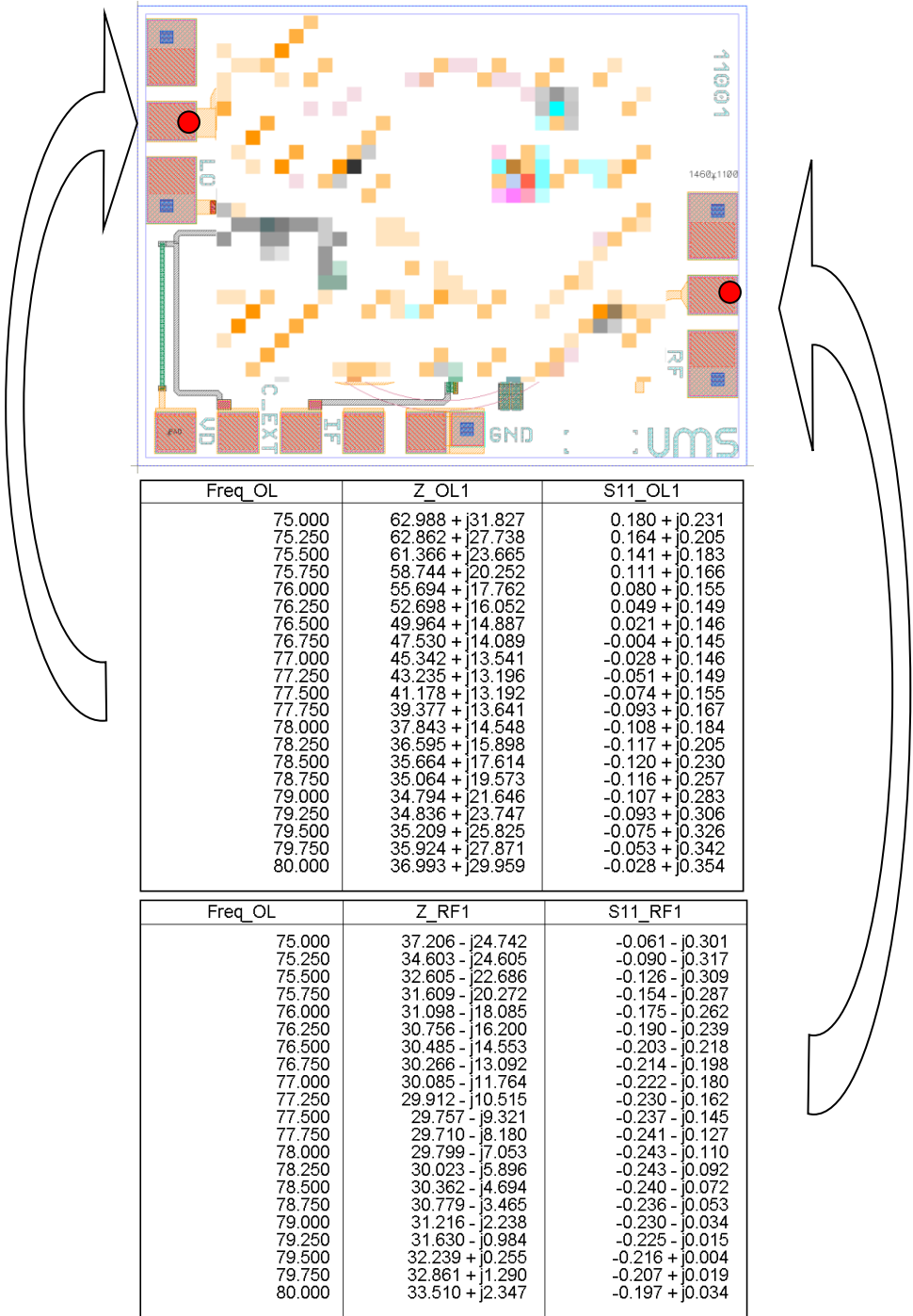


Example of integration using low dielectric constant substrate ( $\epsilon_r=3$ , Thickness= $127 \mu\text{m}$ )

All dimensions are in micrometers

**RF and LO ports impedance**

For use at frequency band outside 76 to 77GHz range, and for custom assembly configuration, the typical RF and LO ports impedance versus frequency are given below in the bond pad centre plan. This can be used to design external matching network for compensation of wire bonding.



## Recommended ESD management

Refer to the application note AN0020 available at <https://www.ums-rf.com> for ESD sensitivity and handling recommendations for the UMS products.

## Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACH N°1907/2006. More environmental data are available in the application note AN0019 also available at <https://www.ums-rf.com>.

## Ordering Information

Chip form: CHM2179b98F/00

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