A SURFACE MOUNTABLE MEMBRANE SUPPORTED FILTER

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OUTLINE OF THE TALK

1) MICRO-MACHINED FILTER

WET ETCHING PROCESS

Q_0 MEASUREMENT

NARROW BAND FILTER

2) SURFACE MOUNTABLE FILTER

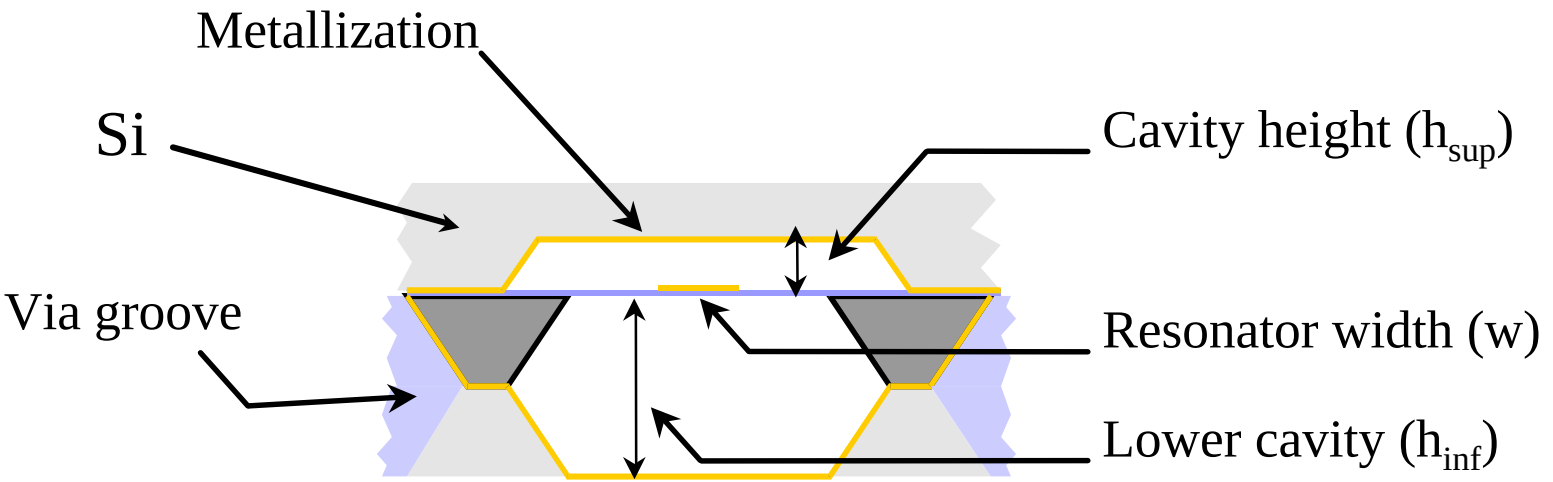
DESCRIPTION OF THE STRUCTURE

3) A 2 POLE 30 GHz MICRO-STRIP FILTER

DESIGN AND FABRICATION

MICRO-MACHINING OVERVIEW

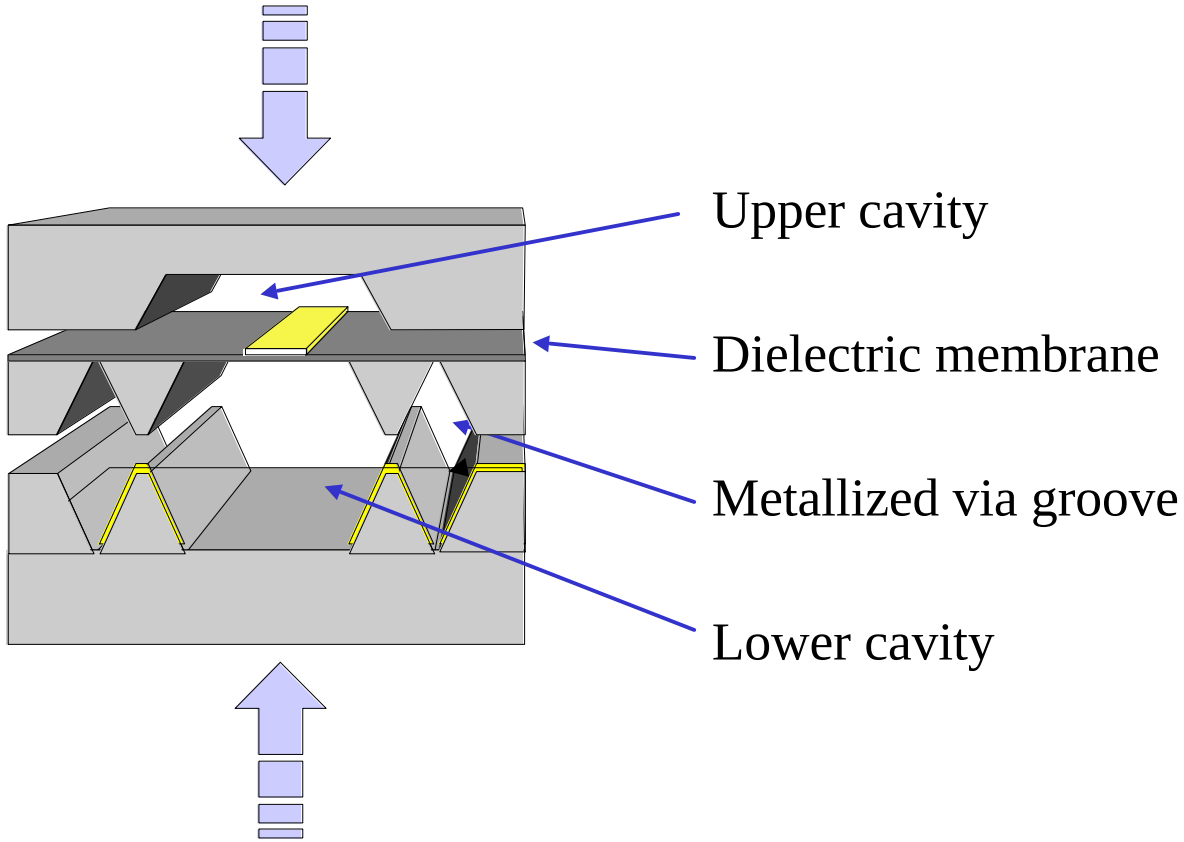
TRANSVERSE SECTION



ASSOCIATION OF 2 CAVITIES

ASSEMBLY

FABRICATION OF 2 CAVITIES WITH 3 MICROMACHINED SUBSTRATES



MICRO-MACHINING OVERVIEW

☺ ADVANTAGES

PLANAR SOLUTION

SMALL SIZE

LOW COST

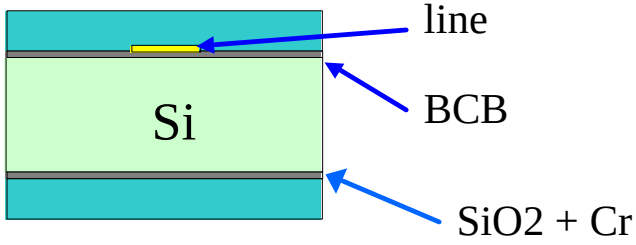
NO DISPERSION OR RADIATION

HIGH QUALITY FACTOR (600)

😐 NEED OF TRANSITION TO CONNECT IT

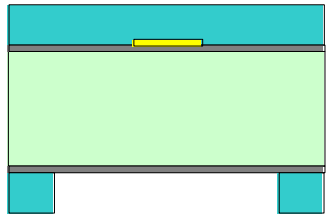
FABRICATION PROCESS

1)



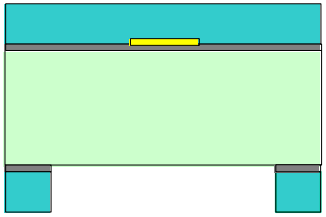
deposit of a resin layer in the upper and lower part

2)



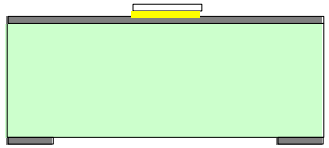
Exposure of the resin in the lower part

3)



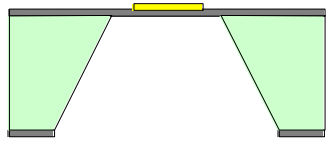
etching of the mask level in the lower part

4)



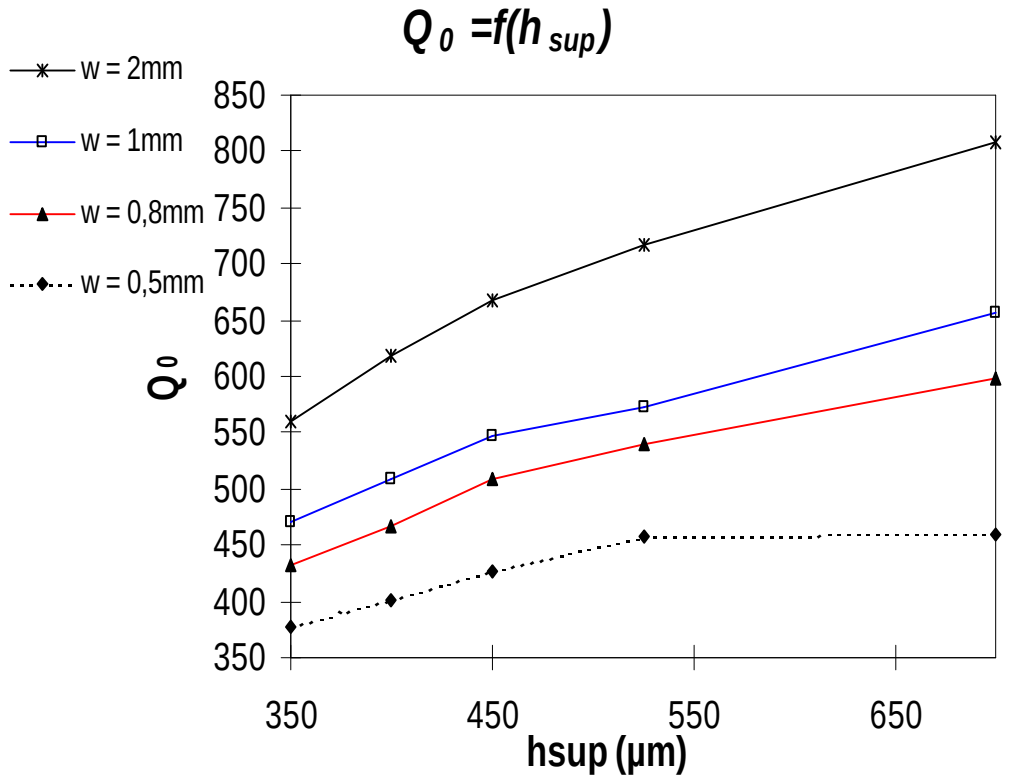
Elimination of the resin

5)

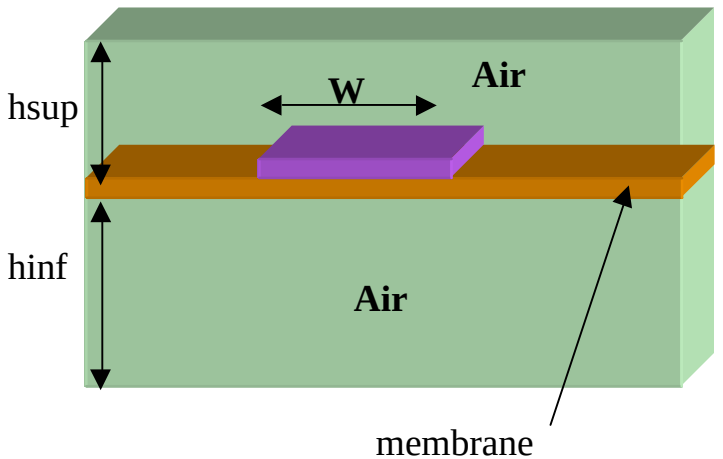


Selective etching of Si unt the membrane is released

DIMENSION AND RESONATOR OPTIMIZATION



COMPUTED WITH ADS MOMENTUM

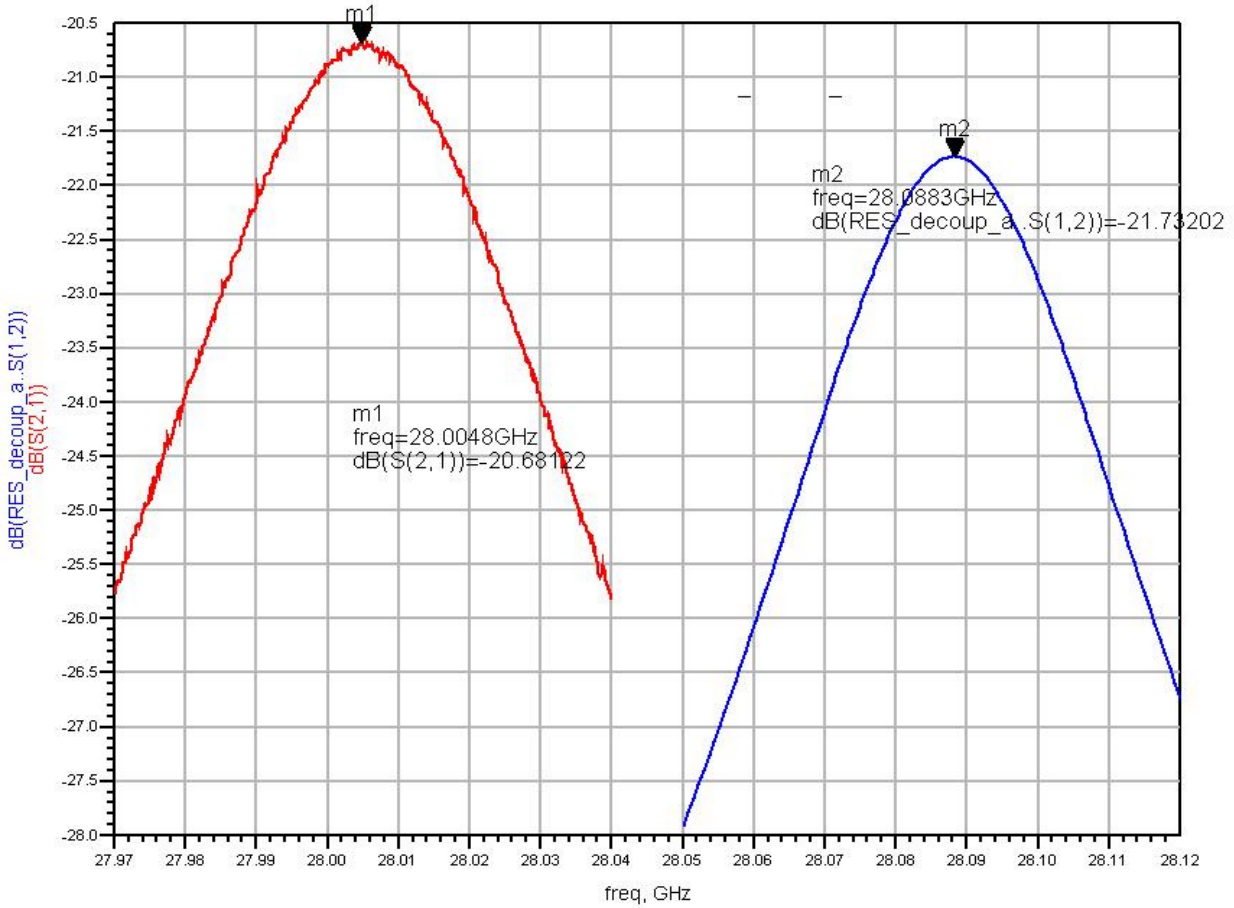


W = 2 mm

h_{sup} = 0.425 mm

h_{inf} = 0.76 mm

Q_0 MEASUREMENTS - 28 GHz



$Q_{0\ mes} = 602$ $Q_{0\ sim} = 657$

$a = 0.0042$ dB/mm $Df = 0.2\%$

NARROW BAND MICRO-MACHINED FILTER - 28 GHz

3 POLES

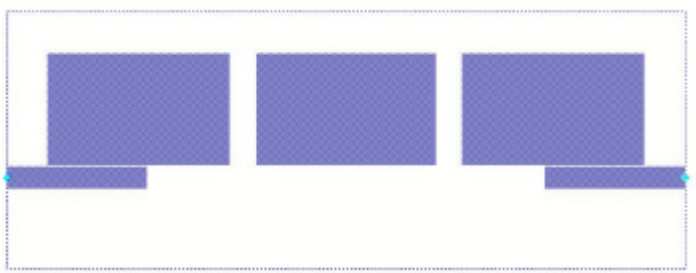
HALF WAVELENGTH RESONATORS

f_{min} = 27.5 GHz

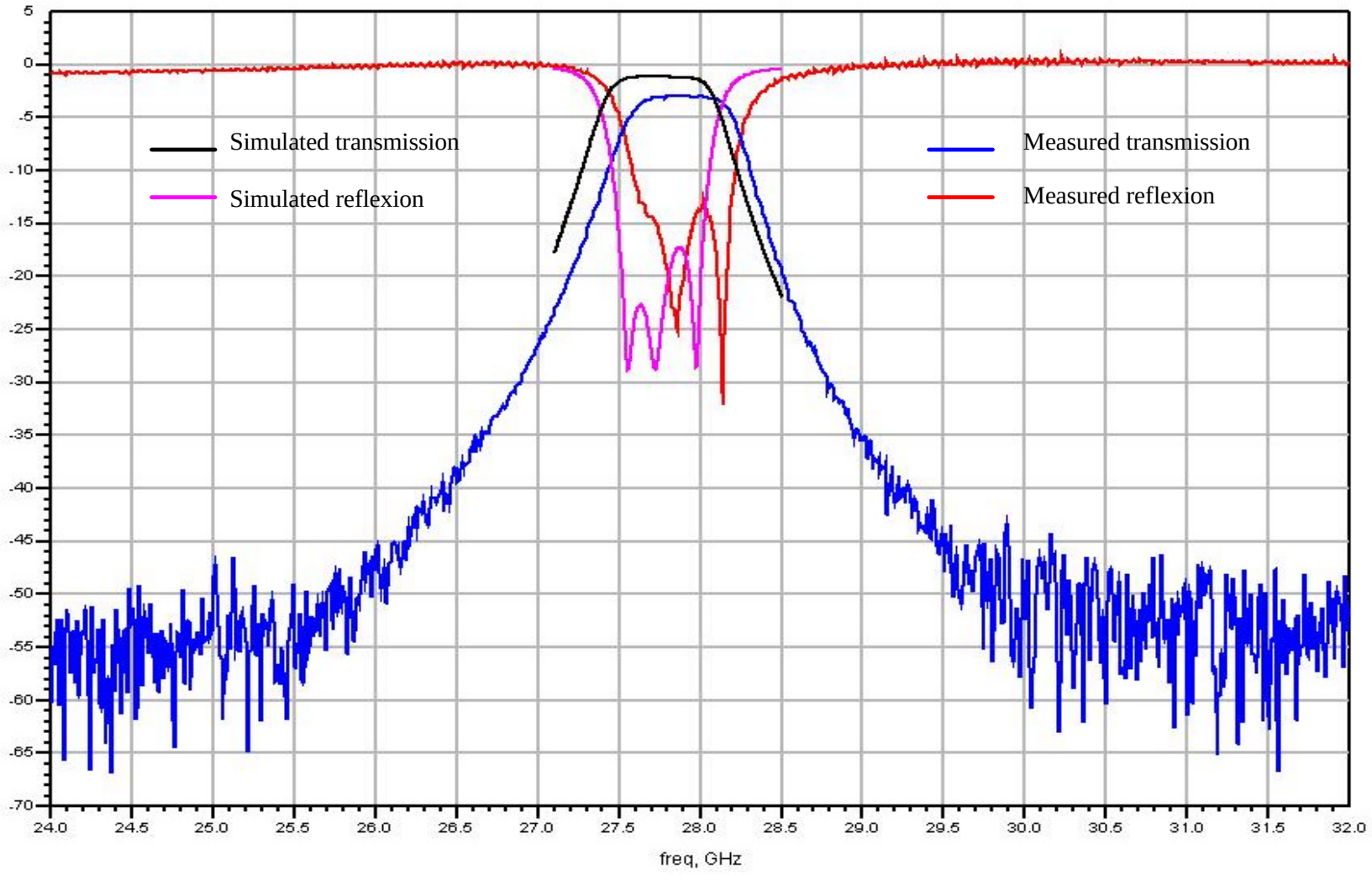
Df_{min} = 500 MHz (1.8%)

HIGH REJECTION NEEDED (50 dB)

Filter scheme



FILTER MEASUREMENTS



MEASUREMENT RESULTS

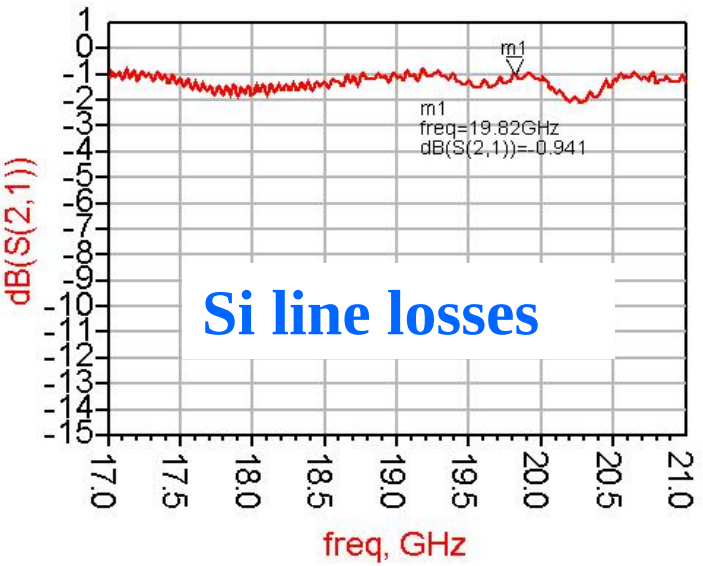
VERY GOOD MATCHING (13.5 dB)

FREQUENCY SHIFT (meas/sim)= 0.4%

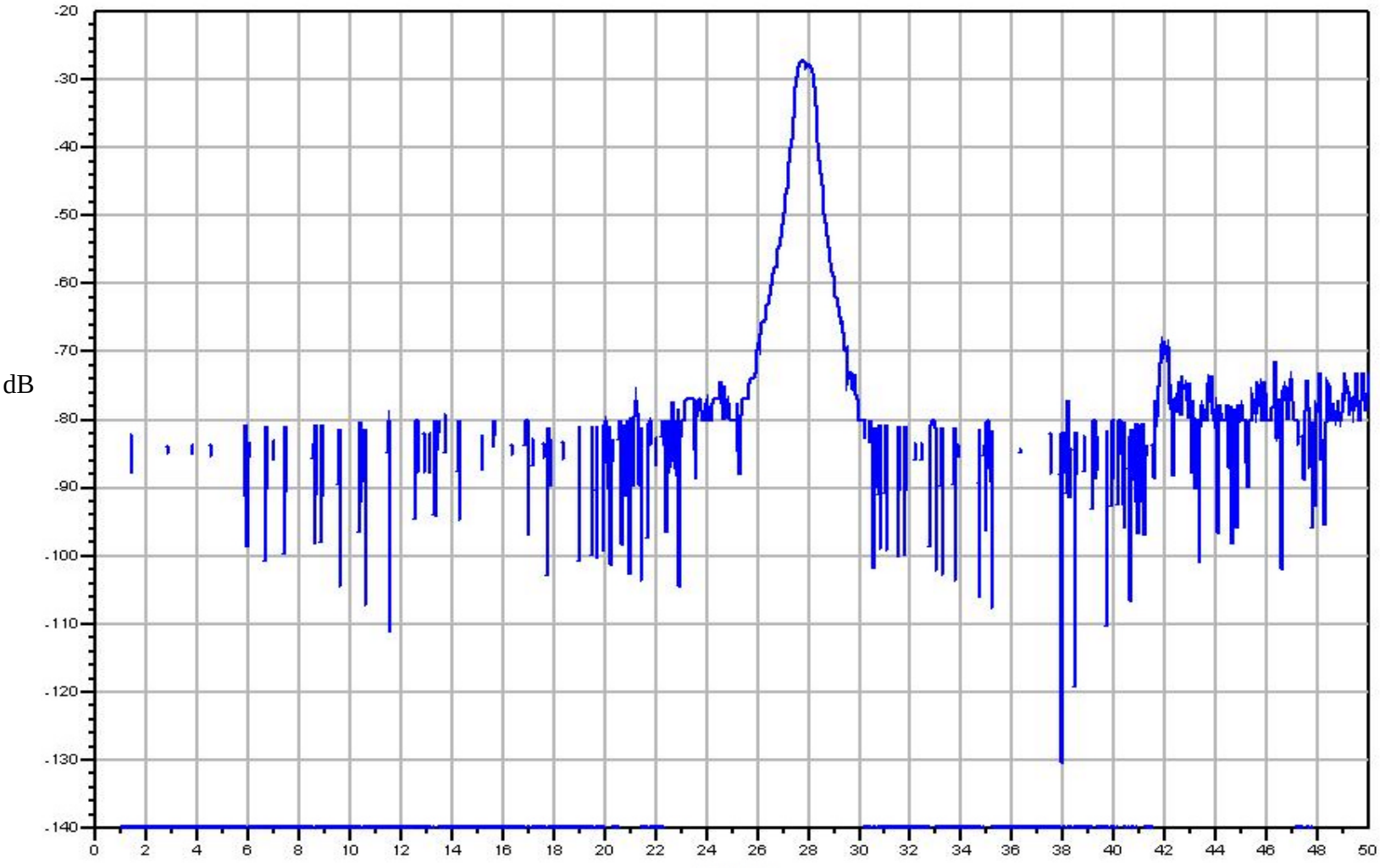
INSERTION LOSSES = 2.9 dB (1.2 dB_{theo} +1 dB line)

HIGH REJECTION (50 dB)

VERIFIED BAND-WIDTH



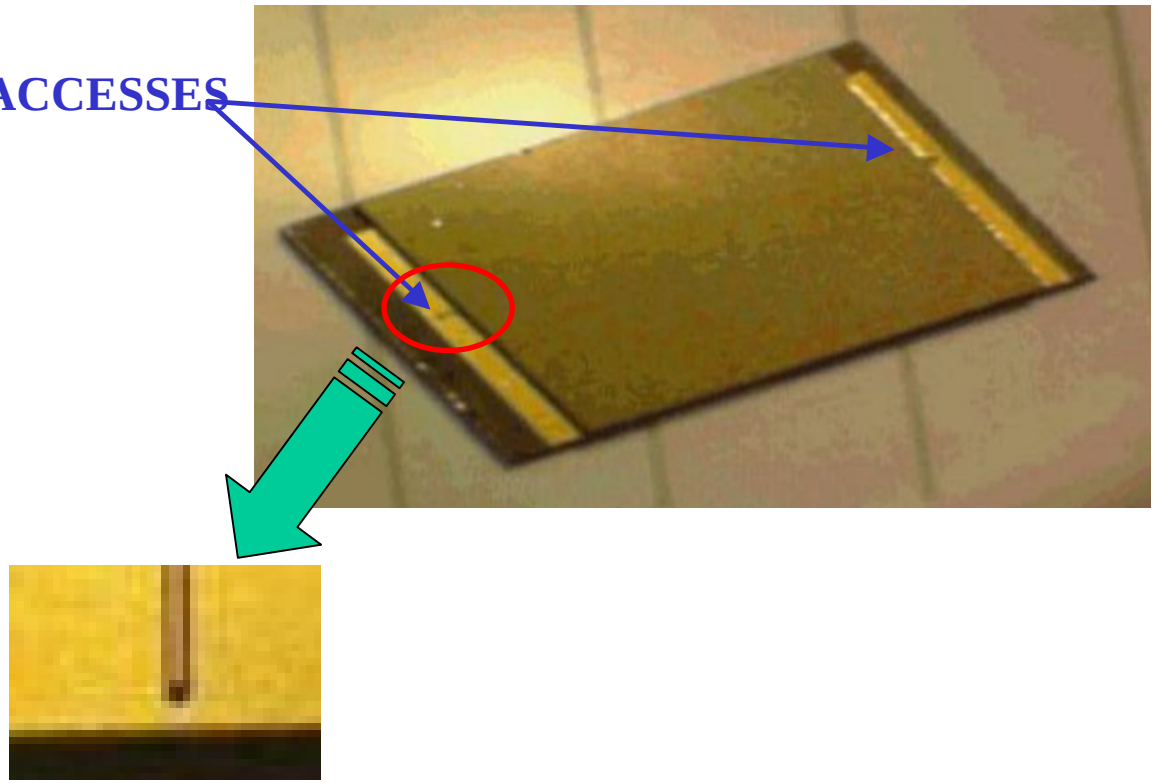
MEASUREMENT WITHOUT CALIBRATION



HIGH FREQUENCY ISOLATION

FILTER REPORT

FILTER ACCESSES



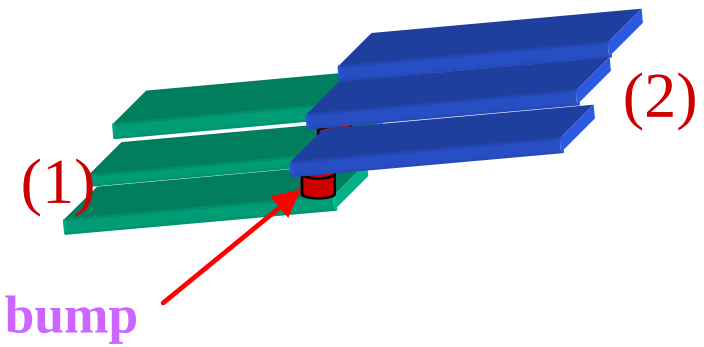
TARGET : ACCESSES ON THE TOP WAFER TO AVOID TRANSITION

GOOD IMPROVEMENT

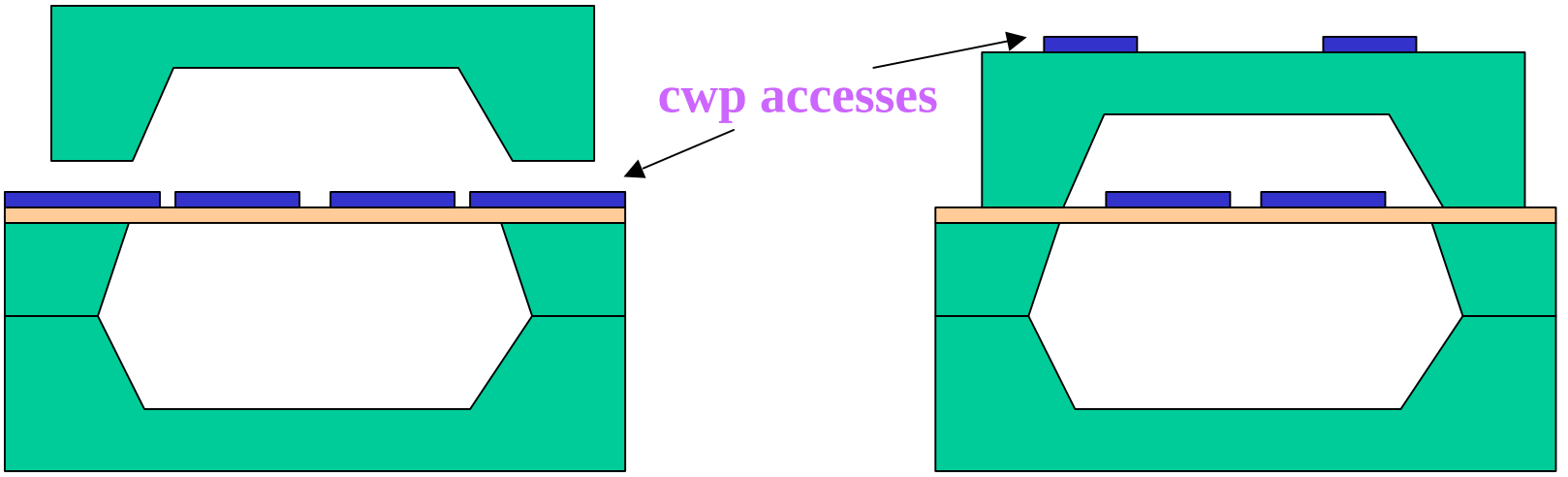
SURFACE MOUNTABLE FILTER

CPW ACCESSES ON THE TOP OF THE STRUCTURE

FLIP - CHIP REPORT



COMPARISON CLASSICAL/PROPOSED TOPOLOGY

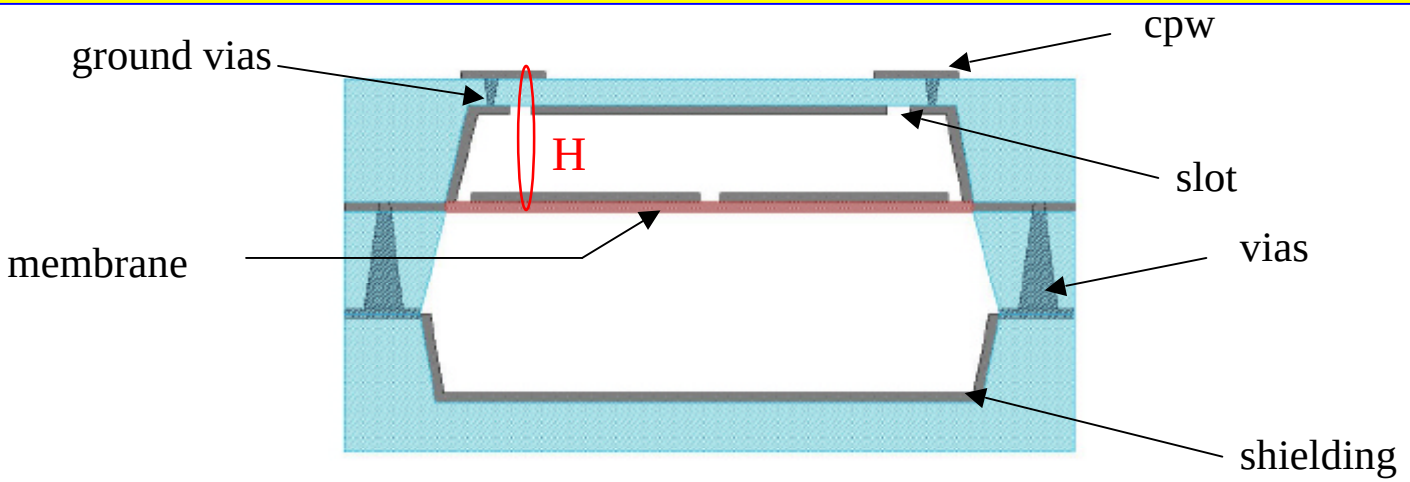


Wire bonding or transition to compensate the height of the upper cavity

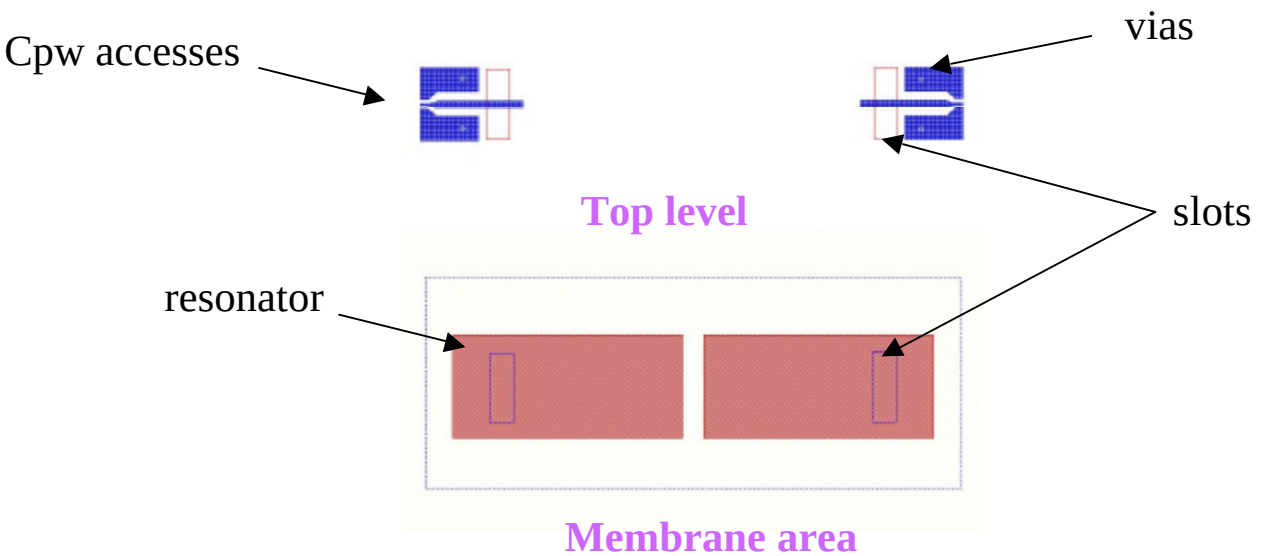
LOSSES

EASY REPORT

DETAILS OF THE PROPOSED STRUCTURE



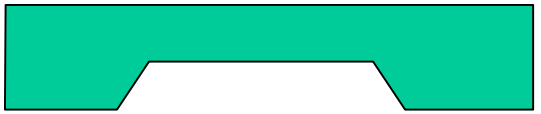
Cross section



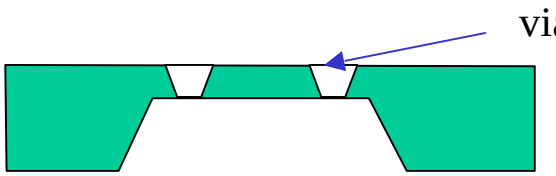
Top level

Membrane area

TOP WAFER PROCESS

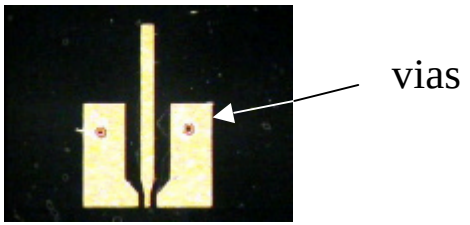


BOTTOM ETCHING 200 µm

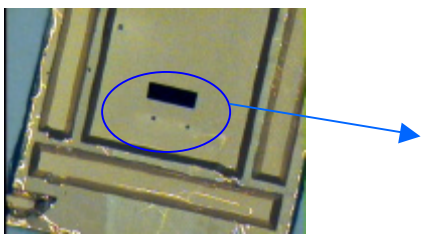


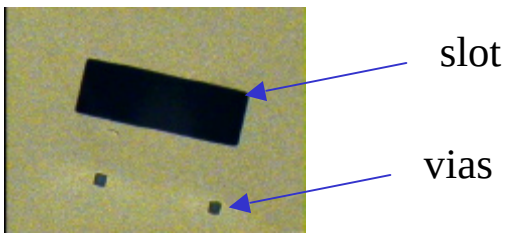
VIAS + BOTTOM ETCHING

FABRICATION OF THE UPPER CPW ACCESSES

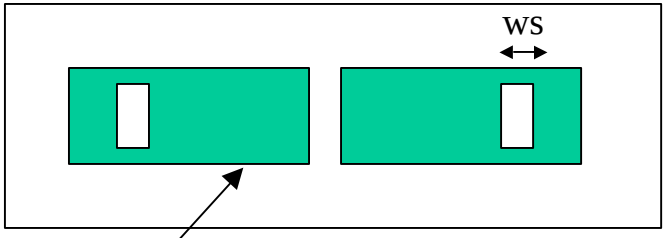


FABRICATION OF THE SLOTS TO FEED THE FILTER

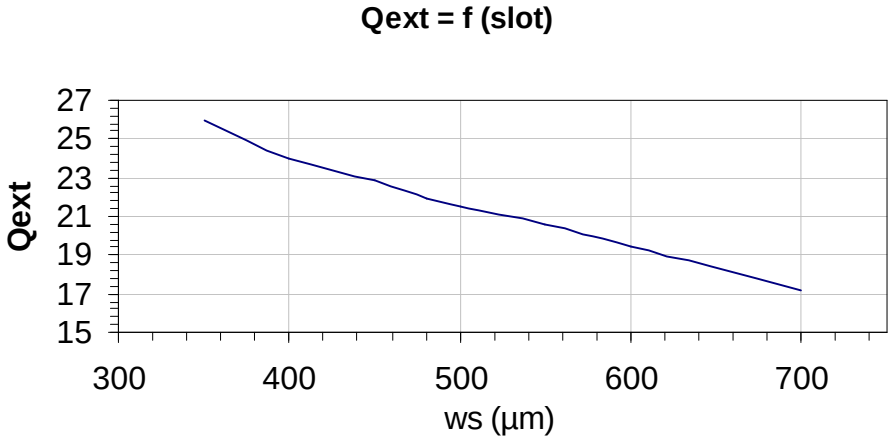




INPUT / OUTPUT COUPLING



THE FEEDING OF RESONATORS DEPENDS ON THE SLOTS DIMENSIONS

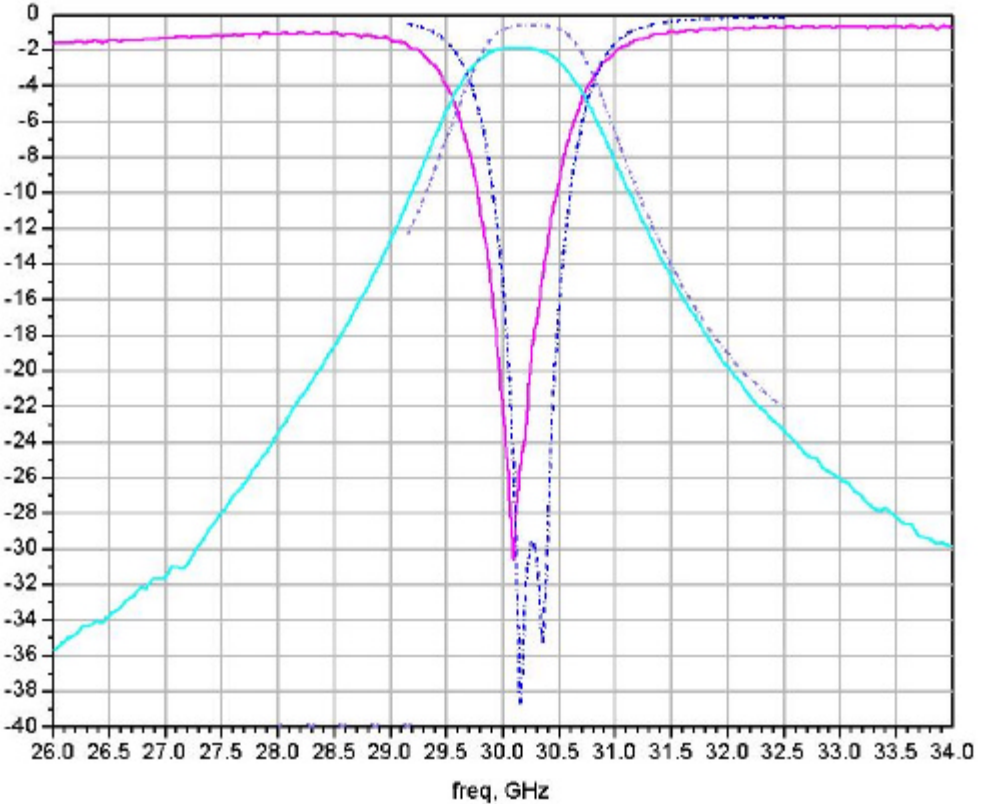


TO INCREASE THE INPUT/OUTPUT COUPLING

→ INCREASE THE SIZE OF THE SLOTS

→ H LOOP COUPLES MORE THE RESONATORS

SIMULATIONS/MEASUREMENTS COMPARISON



simulations h_{ins} = 0.8dB f_0 = 30.3 GHz Df = 500 MHz

measurements h_{ins} = 1.8dB f_0 = 30.1 GHz Df = 450 MHz

GOOD AGREMENT

CONCLUSIONS / PERSPECTIVES

PRESENTATION OF A NARROW MICRO-MACHINED BAND-PASS FILTER

3 POLES WITH HIGH REJECTION

DESIGN AND FABRICATION OF A SURFACE MOUNTABLE MICRO-MACHINED FILTER

EASILITY OF REPORT

GOOD AGREEMENT SIMULATIONS/MEASUREMENTS

2 POLE FILTER AT 30 GHz

POSSIBILITY TO ACHIEVE COARSER FILTER