

### Quasioptical multipliers using patch-slot antenna structures

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#### Abstract

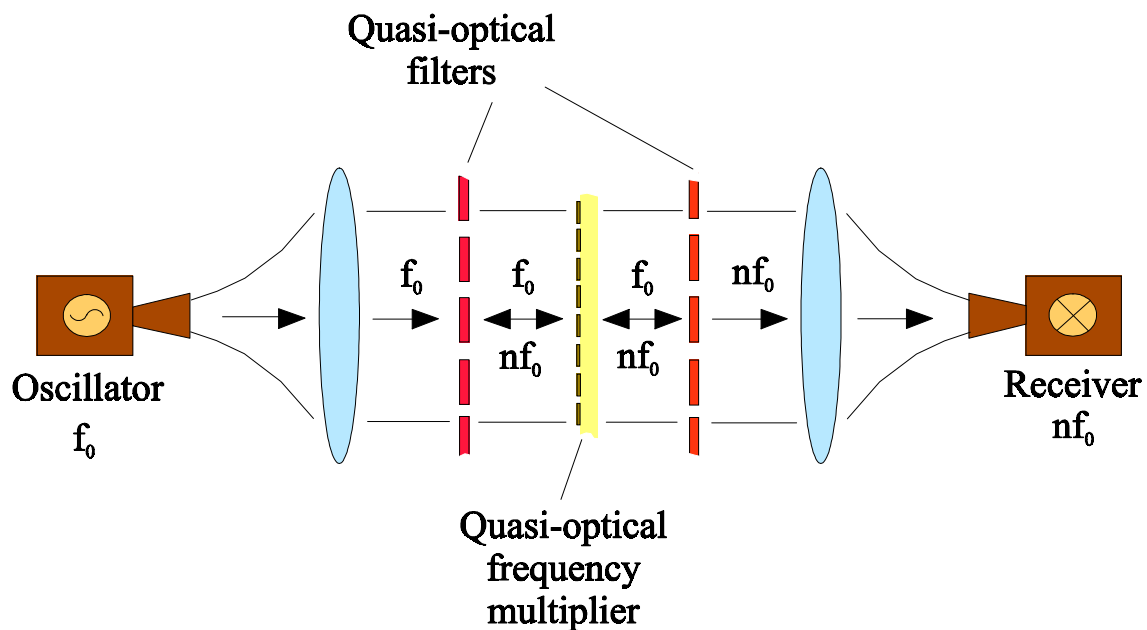
An antenna structure based on the combination of two slots and a patch is investigated as the basic (antenna) structure for a millimeter-wave quasi-optical multiplier [1], [2]. This arrangement, on the one hand, is receiving and re-radiating the RF, and on the other hand, is acting as a simple frequency and direction filter. Radiation diagrams at both fundamental and harmonic frequencies are investigated in a scaled frequency range, showing the potential of this structure for quasi-optical doubler and tripler applications. First results will be presented for a frequency doubler arrangement consisting of an array of 12 patches and two printed reflectors [3], [4] to focus the waves.

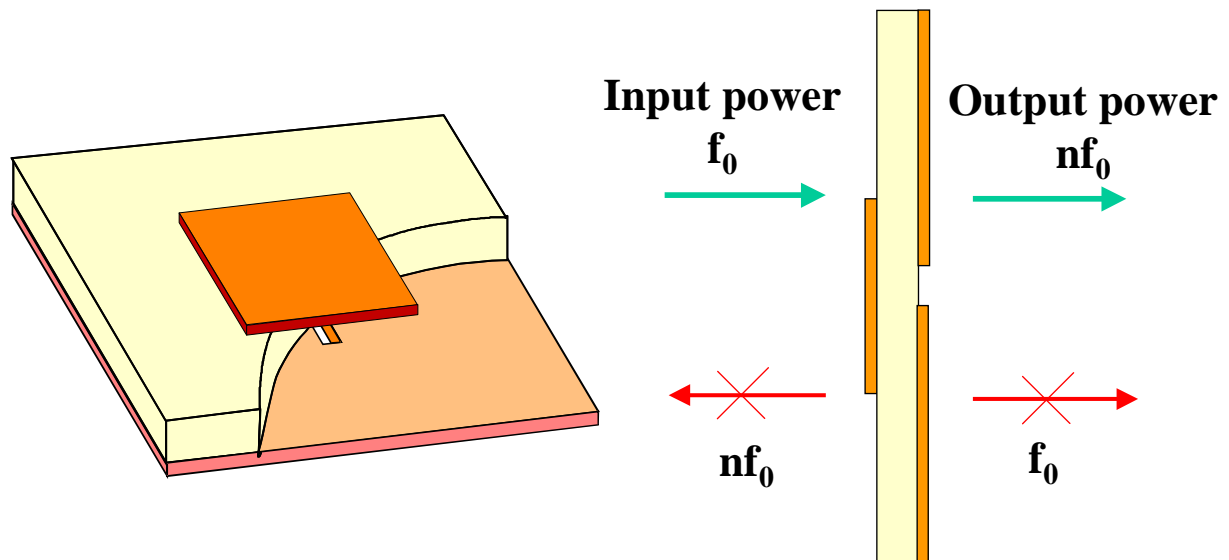
#### References

- [1] Shaalan, M., Bozzi, M., Beilenhoff, K., Weinzierl, J., Steup, D., Rehm, G., Conciauro, G., Menzel, W., Brand, H., Hartnagel, H. L.: An antenna array for quasi-optical frequency multiplier applications. Proc. 20th ESTEC Antenna Workshop, ESTEC, Noordwijk, The Netherlands, June 18 - 20, 1997.
- [2] F. Tiezzi, W. Menzel, F. Alimenti, P. Mezzanotte, L. Roselli, R. Sorrentino, M. Shaalan: A patch – slot antenna structure for quasioptical multipliers. 28th Europ. Microw. Conf., 1998, Amsterdam, Vol. 1, pp. 212 – 216.
- [3] Menzel, W.: A planar reflector antenna. MIOP '95, Sindelfingen, 608 - 612.
- [4] Pilz, D., Menzel, W.: Periodic and quasi-periodic structures for antenna applications. European Microwave Conf. 1999, Munich, Germany, Session MF-ThD3.

#### Acknowledgment

This work was funded by the European Union under Contract Number FMRX-CT96 0050..DG 12-ORGS.





- Good gain in one direction (patch) at the fundamental frequency
- Good gain in the opposite direction (slot) at the harmonic frequency

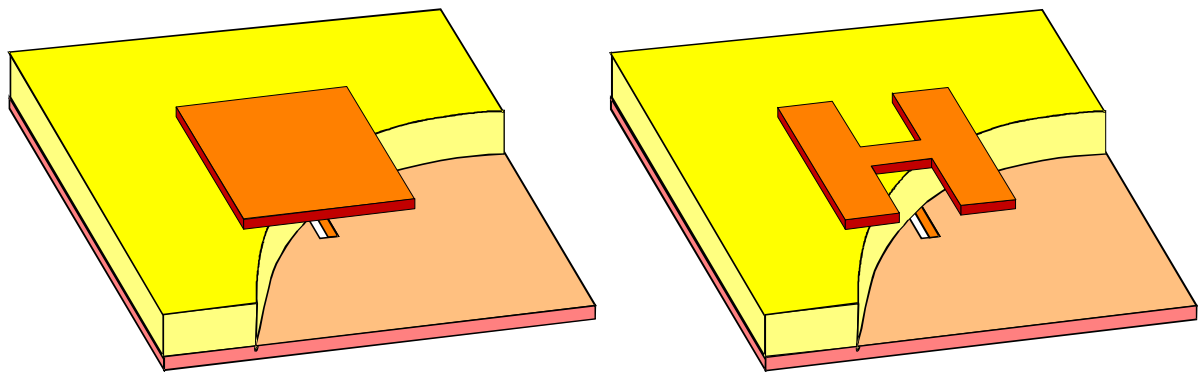
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Basic idea for novel multiplier antenna element

### **Theoretical approach**

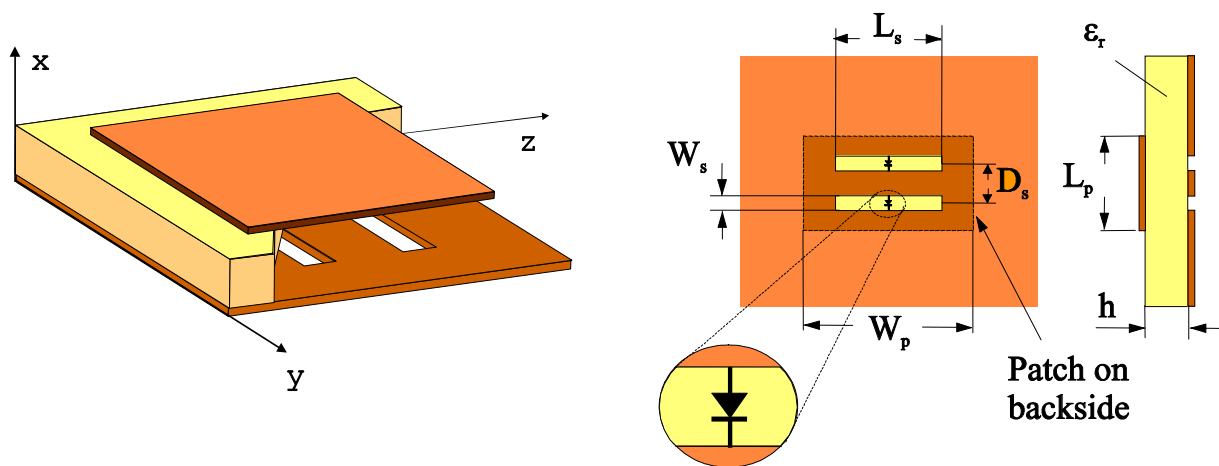
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- Finite differences in the time domain (FDTD)
  - *Software developed at the University of Perugia*
- Near-to-far field transformation in the FDTD scheme for antenna calculations
- Method of moments (HP Momentum)
- Standard CAD packages (HP MDS)




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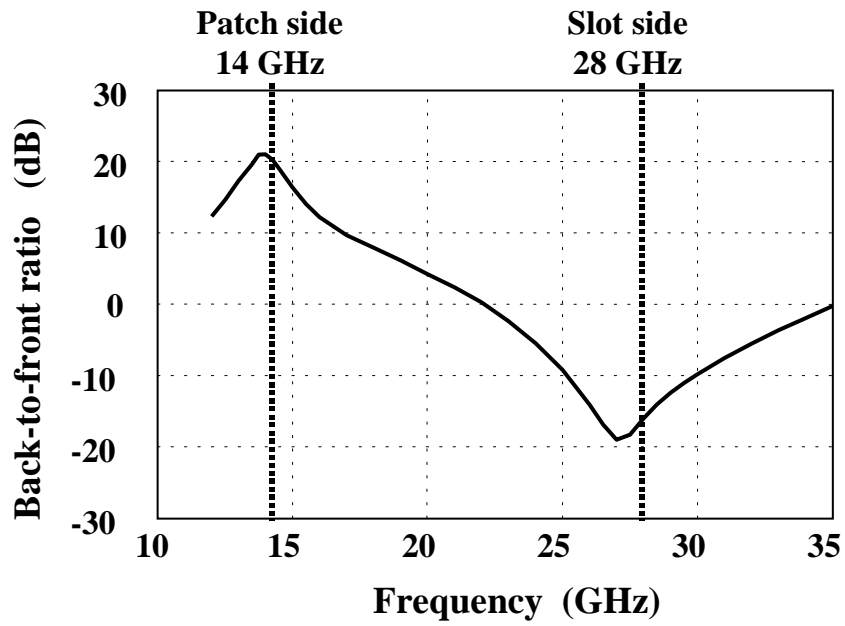
### Some first basic antenna structures



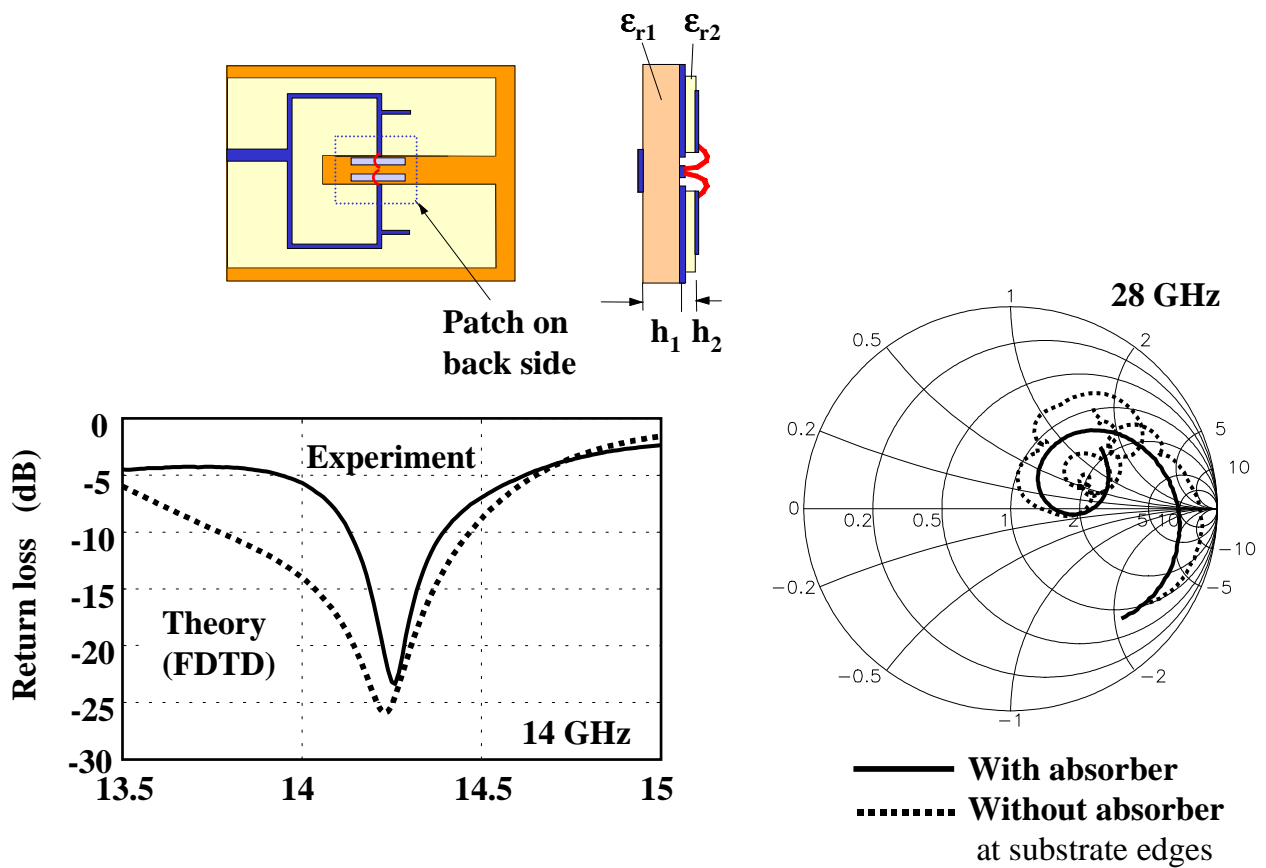
- Improvement of the back-to-front ratio at the harmonic frequency
- Reduction of the surface wave excitation

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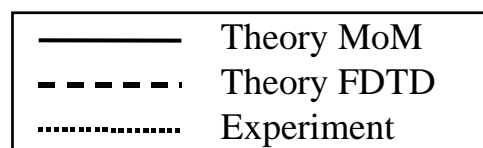
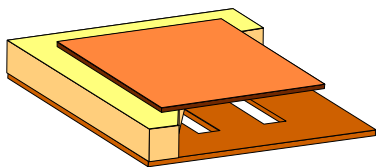
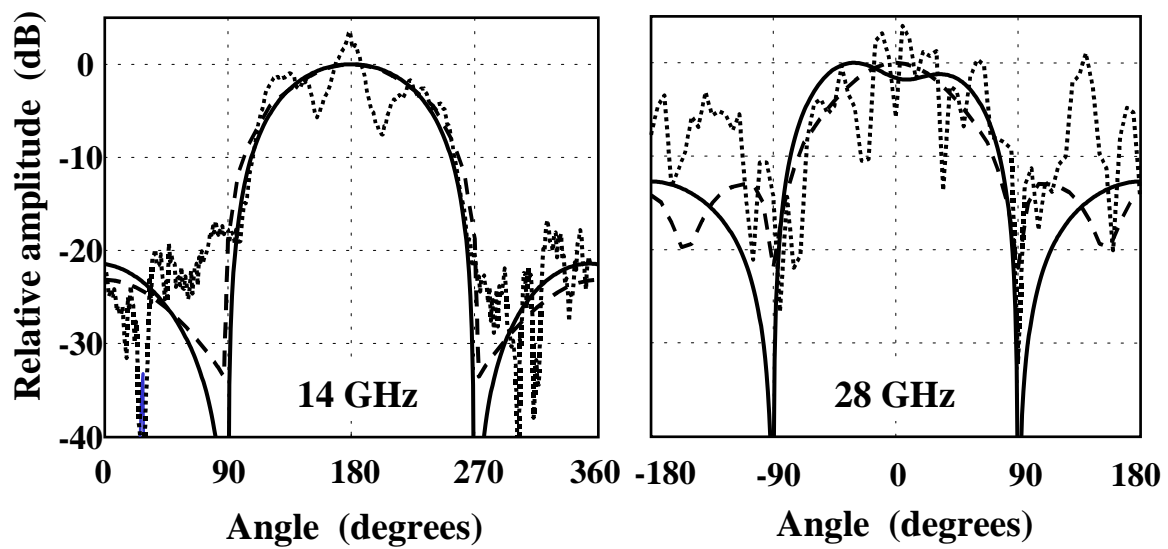
### Elementary cell of multiplier based on two slots and a patch antenna



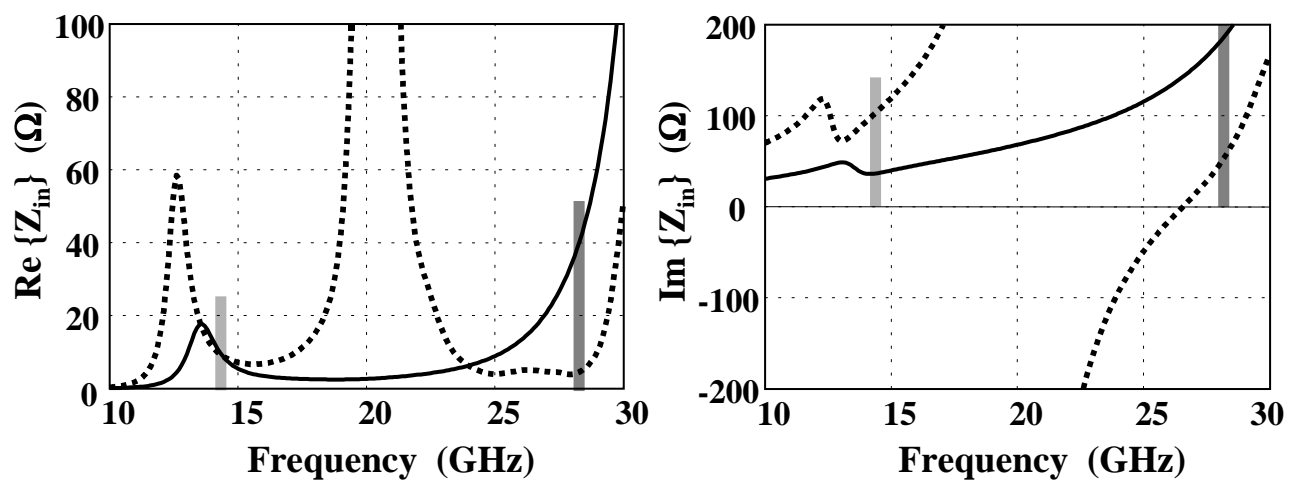
Theoretical back-to-front ratio of the two slot/patch antenna structure



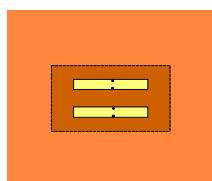
Input reflection coefficients of patch and slots



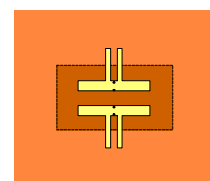
E-plane radiation diagrams of two-slot antenna configuration



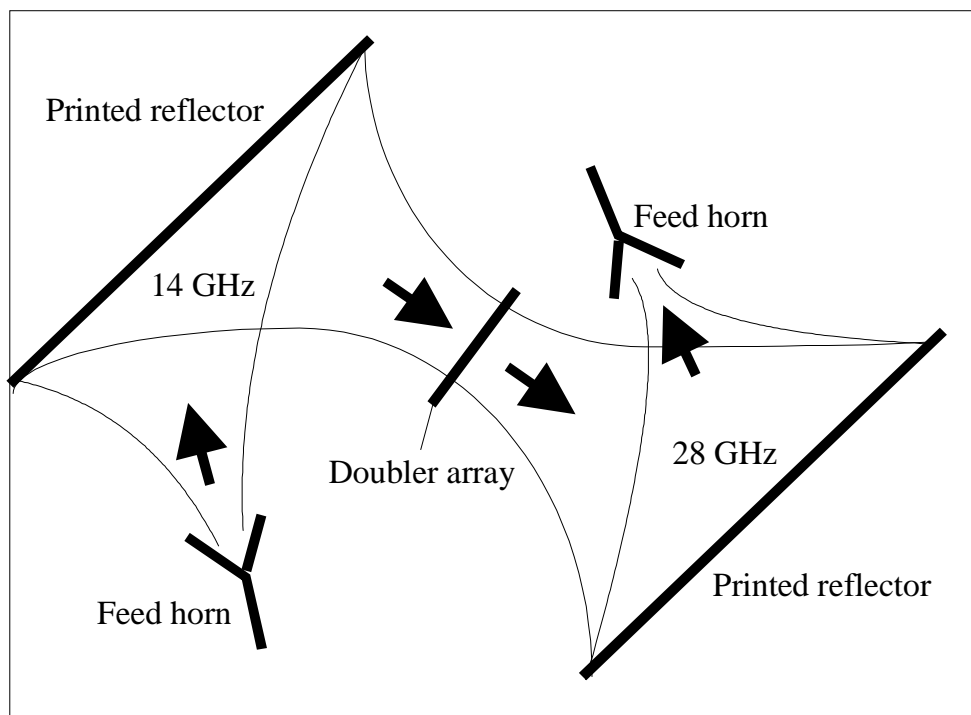
Solid lines



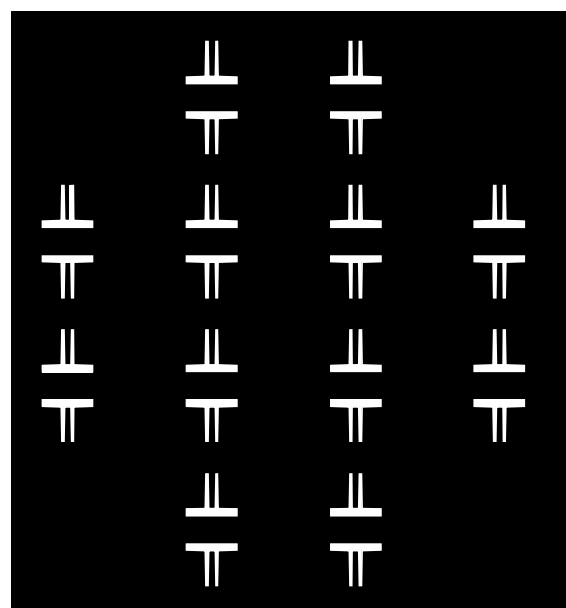
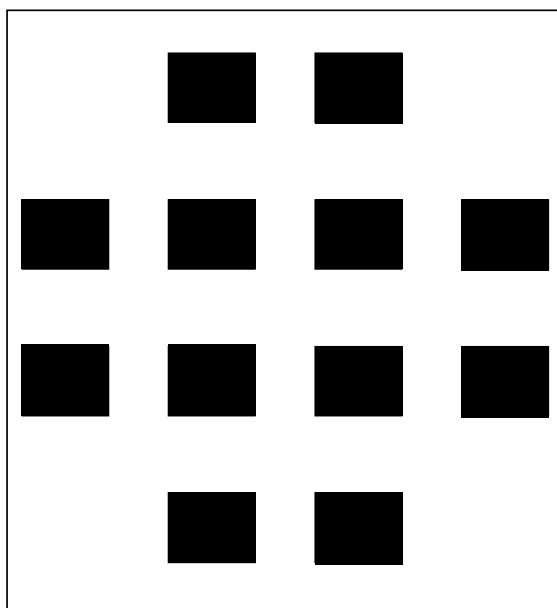
Dashed lines



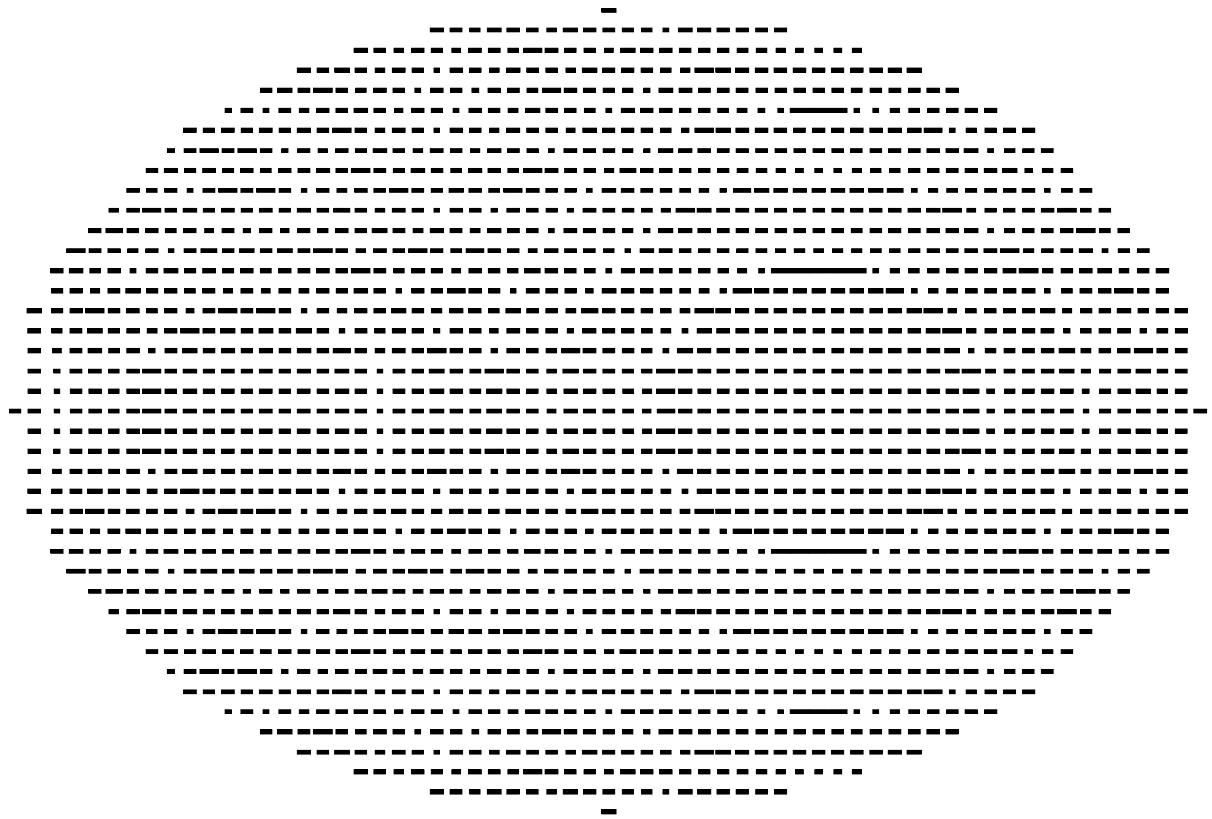
Input impedances at the diode position for matched and unmatched structure



**Principle arrangement of quasi-optical frequency doubler**



**Front and back side layout of doubler array**



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**Layout of Ka-band reflector array**