New Electronic Switching Arrangement for mm-wave Radiometer Calibration

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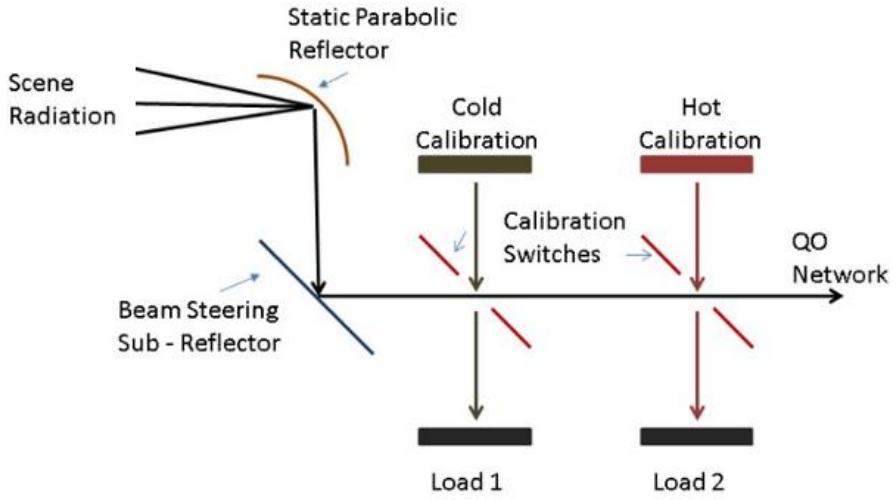
Motivation – Space Borne Radiometers

To devise a new high frequency switch that reduces the demands imposed on mechanical systems currently used for hot and cold radiometric calibration.

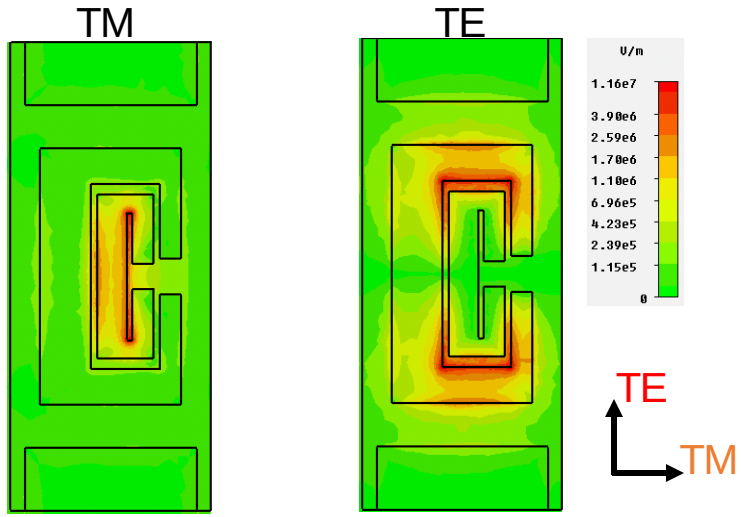
In operation two FSS switches provide isolated signal paths between the OBCT's and the scene radiation. In combination with a beam steering sub-reflector the mechanical motor could be removed completely.

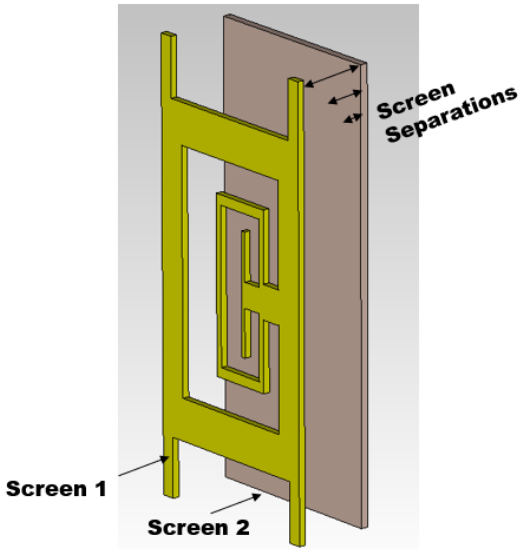


300 GHz Quasi-Optical Switch

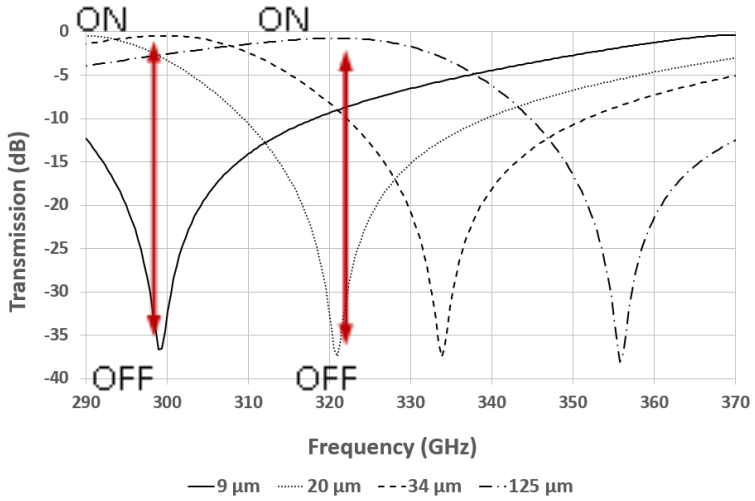
- ‘ON’ states shown at two centre operation frequencies of 300 and 320 GHz
- Corresponding insertion losses of 0.4 dB and 0.7 dB
  - separations of 34 µm and 125 µm respectively

- ‘OFF’ states predicted transmission drops below -30 dB
- Changing the physical separation between the FSS and dielectric
  - 9 µm and 20 µm

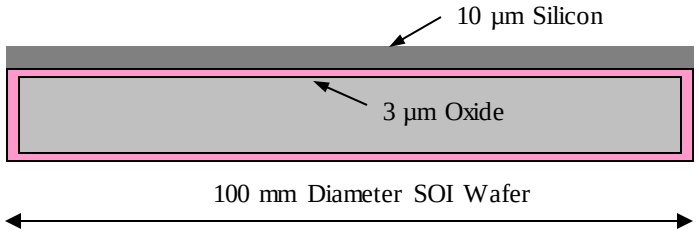


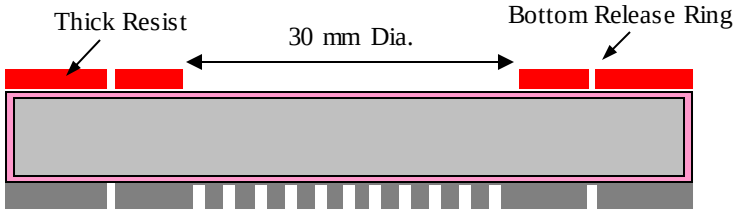


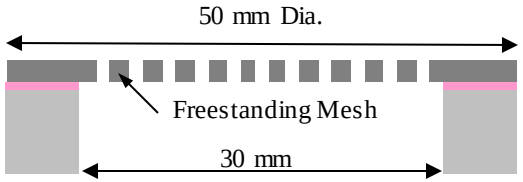
Predicted ‘ON/OFF’ transmission states for TM polarization 45° incidence through the FSS switch

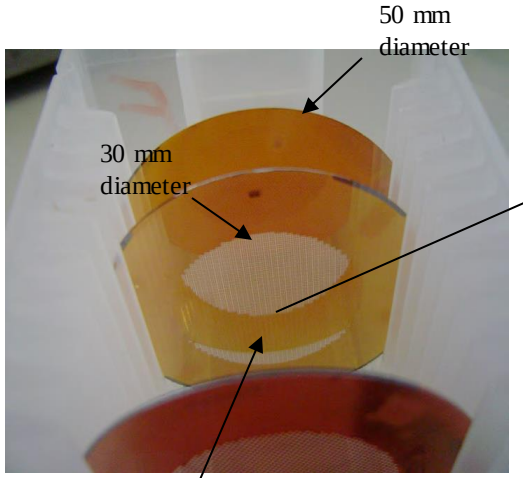


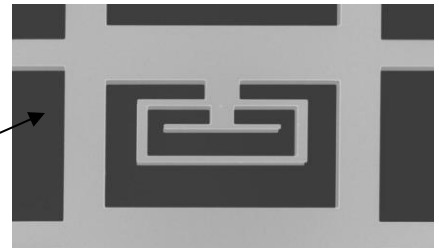
Device Fabrication & Separation Method

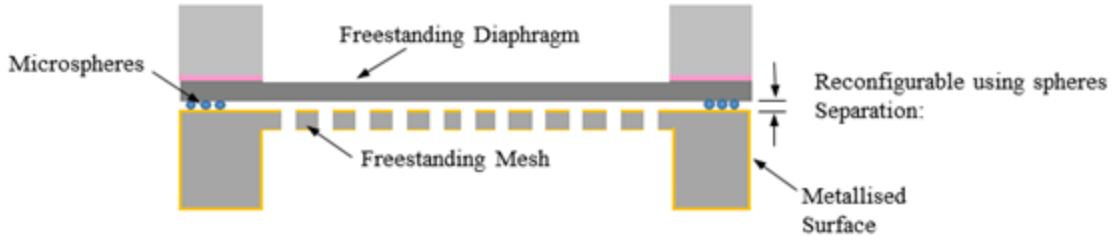






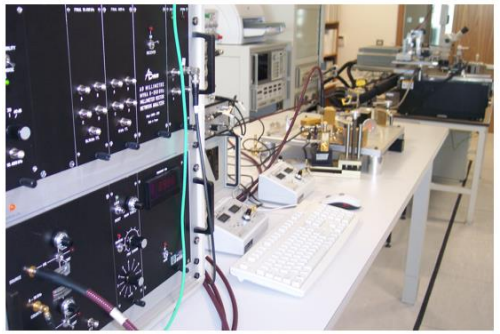


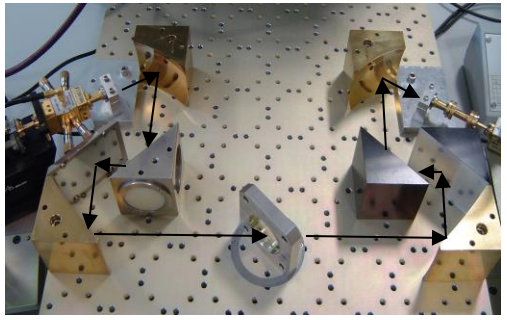




Transmission Measurements 316 – 334 GHz

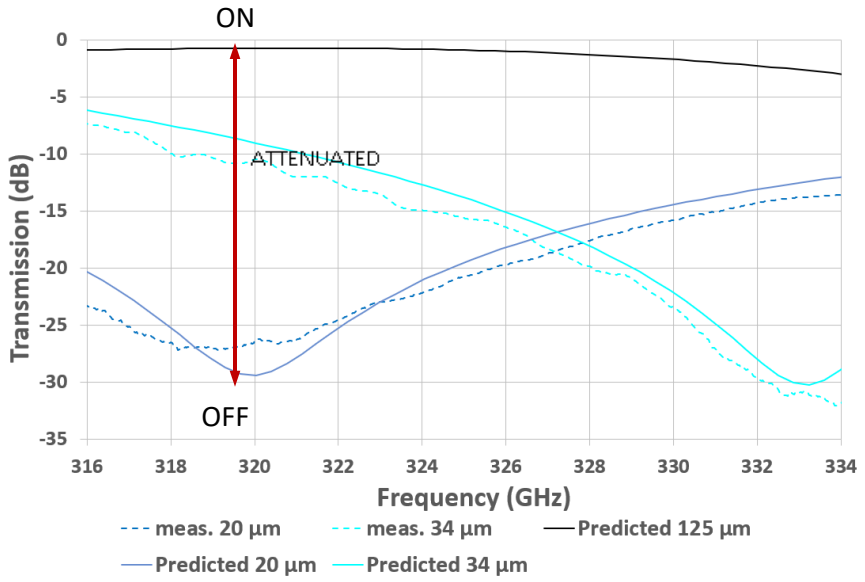
- ABmm VNA system used with quasi-optical test bench
- FSS mounted on bench at 45°
- Dynamic range at 300 GHz > 65 dB





- OFF' state transmission null at 320 GHz similar to predictions
- The attenuated state was achieved by increasing the screen separation to 34 µm
- To achieve the 'ON' state at 320 GHz requires a 125 µm separation

  – simulated result



Conclusions

•We have demonstrated for the first-time the ability to produce sub-mm wave quasi-optical switching in the frequency range 316 – 334 GHz by changing the separation distance between a mesh FSS and a high resistivity silicon layer.

• Numerical simulations and measured results show that by adjusting the separation distance between the two layers, it is possible to obtain a dynamic switching range of more than 30 dB.

•These results show that the required reconfigurability is well within the limits of mechanically amplified piezoelectric actuators, which are space qualified and exhibit fast operation times of milliseconds.

•The FSS switch has clear benefits for deployment in remote sensing instruments which require low-loss and fast switching times, and most importantly a hot and cold load calibration arrangement that do not require motor driven systems.

Acknowledgements

esa
European Space Agency
Agence spatiale européenne

Centre for
EO Instrumentation

UK SPACE
AGENCY

AIRBUS

Thank you for your Attention!