In this Letter, we present an on-wafer measurement technique for determining the impedance of a 100GHz planar double slot antenna structure with a dielectric lens at the point where a bolometric detector is inserted into the receiver. This methodology was developed to enable an independent scale model determination of the driving point impedance of a 50GHz planar antenna/dielectric lens receiver for which the optimisation had been performed theoretically [1]

**Experiments:** A 48-12V 15W converter was built and tested to confirm the theory and the practicality of the HRC. \( \phi_0 \) was chosen to be 2\( \times \)500\( \times \)1000 krad/s, i.e., a harmonic of \( \phi_1 \) and \( L_2 \) were \( 4\mu \)H. \( C_f \) and \( C_s \) were \( 15.8\) nF which included the output capacitances of the IRF602 MOSFET and the filter diodes, respectively. The transformer consisted of an air core with a coupling of 0.6. Fig. 2 shows the measured waveforms for an output of 12V and 15W which demonstrates that \( V_{DS} \) can be less than two times \( V_{DS} \) and still provide ZVS. The \( V_{DS} \) peak was 90V (1.9 \( V_{DS} \)), the switching frequency was 488kHz and the efficiency was 66%. The lowest output power where the output voltage could be maintained at 12V and still provide ZVS was 2W. For this case \( V_{DS} \) peak was 75V (1.6 \( V_{DS} \)), the switching frequency was 905kHz and the efficiency was 36%. With no load connected, the input power was 4.5W.

**Conclusion:** In this Letter a harmonic resonant converter has been presented. This converter is more general than the multi-resonant converter and it can use transformers with low coupling level. The switch voltage can be less than two times the input voltage. The harmonic resonant converter has two frequencies present during any resonant state. A 15W converter with an air core transformer and a coupling of 0.6 was built and tested to confirm the theory and the practicality of the converter.

**Acknowledgment:** This work is supported by the Australian Research Council.

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Electronics Letters Online No: 19990903
DOI: 10.1049/el:19990903
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**References**

**On-wafer determination of impedance of planar 100GHz double slot antenna**


An on-wafer measurement strategy for determining the driving point impedance of a planar 100GHz double slot antenna is presented. The technique is verified by comparison with a theoretical determination of the antenna impedance.

**Introduction:** Earth observation instruments and astronomical missions such as MASTER, SORPANO, FIRST and PLANCK will use high-sensitivity (ctb)-millimetre wave imaging systems incorporating planar antenna receivers on dielectric substrates with a dielectric lens placed beneath the substrate to minimise power loss to the substrate modes. In this configuration, high receiver efficiency can only be achieved if the antenna is well matched to the detector in the imaging sub-system, thus a knowledge of the driving point impedance of the antenna is required.
of 20mm. The extension length of the lens was 3.35mm. The combined sample and silicon lens assembly was held in a perspex housing 50mm above the metal chuck of the on-wafer probe system which was covered with a sheet of Eccosorb to minimise unwanted reflections back onto the antenna.

Fig. 2 Photograph of test structure for determining antenna impedance

Fig. 3 Comparison of measured and modelled antenna impedance

(i) Re(Zmeas)
(ii) Re(Zmod)
(iii) Im(Zmeas)
(iv) Im(Zmod)

To enable a comparison of the experimental and modelled data, the lens antenna geometry on which extensive EM simulations have been performed [1] was modified by adding two CPWs at both slots using standard transmission line techniques. In this way, the modelled impedance of the 100GHz scaled version of the antenna structure was obtained.

Fig. 3 shows a comparison of the real and imaginary parts of the experimentally and theoretically determined driving point impedance of the 100GHz antenna structures evaluated using the methods outlined above. It can be seen that the agreement is good across the complete measurement frequency range. There are small deviations in the absolute impedance and resonant frequency values, which may be due to the degree of de-embedding required in the analysis and the resulting uncertainties arising from reference plane definitions in the on-wafer measurements. Additionally, between the antenna slots, the test structure groundplane configuration is not identical to the simulated structure which may account for a change in the resonant frequency.

Conclusion: In summary, the agreement between the experimental and simulated impedance values is good, suggesting that this measurement strategy can be used in the future for validating planar antenna simulation studies.

Wideband single layer microstrip antenna for array applications

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A wideband single layer microstrip antenna, fed by two different networks, is presented. A bandwidth of ~15%, for SWR < 2 is obtained. As its dimensions are the same as those of a conventional 2 x 2 sub-array, this radiating element can be used in array configuration.

Introduction: Microstrip antennas have been used for two decades in many applications in millimetre and microwave systems because of their thin profile, light weight, low cost and capability of being integrated in active devices. However, they suffer from a narrow bandwidth behaviour, due to their resonant nature. Different techniques have been developed to increase their bandwidth, all based on the addition of another resonator. Examples include coupled coplanar patches [1], stacked patches [2], resonant slot inserted in the main patch [3], or a combination of these techniques [4]. As most applications require high gain, we propose a wideband microstrip antenna element, which can be used in array configuration. To avoid increasing the complexity of fabrication, the proximity coupling technique is used to achieve a wide bandwidth. Two feeding networks are studied. One uses quarter wavelength transformers, while the second is designed to avoid width discontinuities, to reduce their undesirable radiation. Results from simulation and measurement, for the impedance bandwidth, are presented.

Antenna geometry: The geometries of the sub-arrays are shown in Fig. 1. They are realised in the C-band on a dielectric substrate of permittivity 2.5 and thickness 3.2mm. The lengths of the excited resonators and the parasitic elements are slightly different to obtain the wide bandwidth behaviour. The air gap between them is optimised for maximum impedance bandwidth. The distance between the horizontal resonators corresponds to a 0.8λ, inter-element spacing. Two feeding network have been considered. In the first configuration (Fig. 1a), a quarter wavelength transformer (QWT) is added to match the single patch to 100Ω. It is bent at 45° in order to reduce the width of the corporate feeding network, which must be confined between the patches. In the second configuration (Fig. 1b), the feeding network is realised with a 100Ω line. The position of the feedline on the non-radiating edge of the patch is chosen such that the impedance of the antenna element at the input of the 'T' junction is 200Ω. In both cases, the