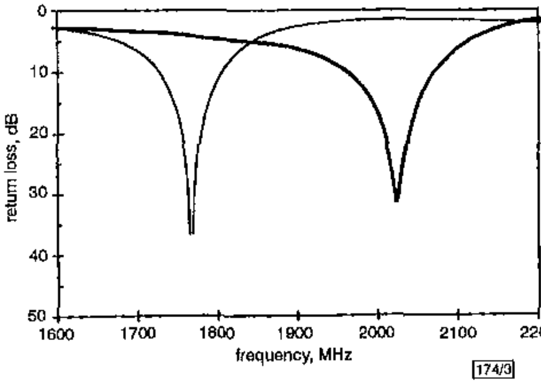

Fig. 3 *Measured return loss of annular slot antenna with and without loaded capacitor*

r = 20mm, other parameters are same as shown in Fig. 2
- - - - with loaded capacitor
——— without loaded capacitor

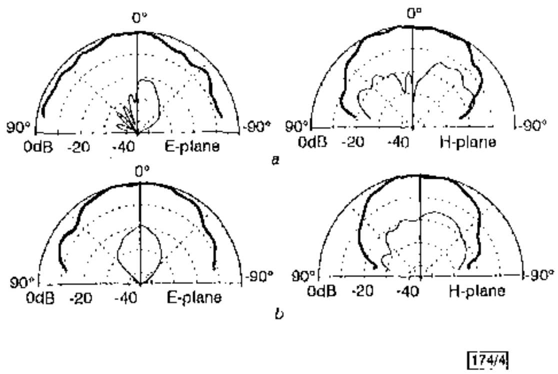

Fig. 4 *Measured radiation patterns in E- and H-planes of proposed antennas shown in Fig. 3*

a Antenna without loaded capacitor at resonant frequency 2024MHz
b Antenna with loaded capacitor at resonant frequency 1766MHz
······ cross-polarisation
——— co-polarisation

Conclusions: A small-size annular slot antenna has been developed. By using a loading capacitor, the area of the slot antenna can be reduced by ~23.4%. It has good radiation patterns and bandwidth. The antenna design can be used to realise a compact antenna system where limited size is a major requirement.

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Test results of 310GHz hologram compact antenna test range

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The quiet-zone field test results of a submillimetre-wave compact antenna test range (CATR) based on a 60cm diameter hologram are presented. The instrumentation setup based on a dedicated millimetre-wave vector network analyser is also briefly described. The presented test results at 310GHz show the potential of the hologram CATR for submillimetre-wave antenna testing.

Introduction: Proven and accurate antenna testing facilities at high submillimetre-wave frequencies up to 1THz are required for future scientific satellite missions. These facilities are most likely to be built using the compact antenna test range principle, i.e. simulating the far-field conditions in a short range, enabling accurate environment control. A compact antenna test range can be based on a lens, a reflector, a hologram, or a combination of these. The hologram CATR has less stringent surface accuracy requirements compared to reflector CATRs [1].

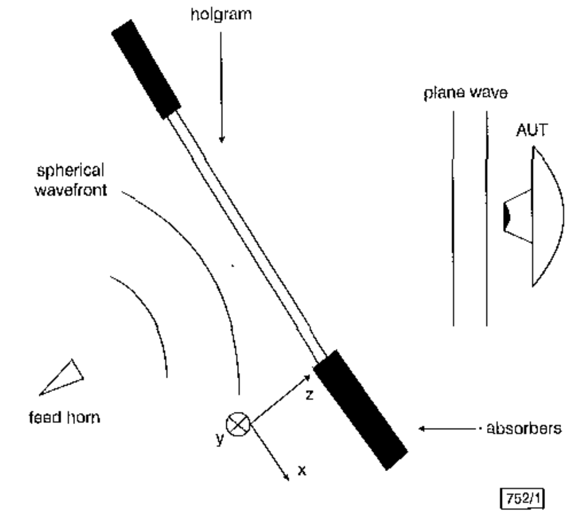

Fig. 1 *Layout of hologram CATR*

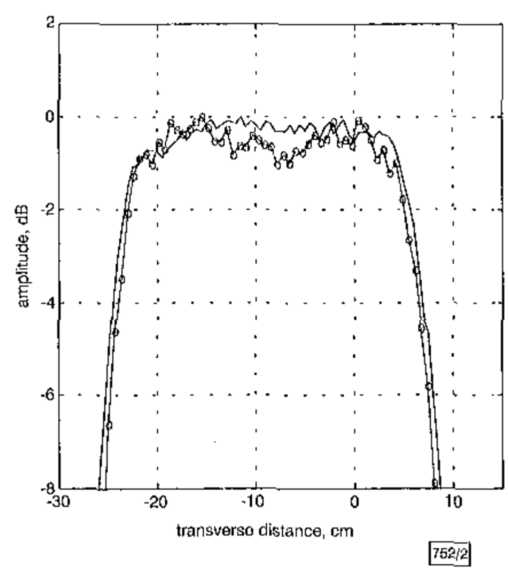

Fig. 2 *Measured and theoretical amplitudes of horizontal scan*

- ○ measured
— theoretical

Measurement setup: For the submillimetre-wave hologram CATR demonstrator, a 60cm diameter planar binary amplitude hologram was designed and manufactured [2]. This size was the largest that could be accurately manufactured using the available facilities in Finland. The designed distances of the source and receiver (antenna-under-test) antennas from the hologram are 1.5m. The computer-generated hologram pattern is etched on a copper-plated mylar film using a conventional printed-circuit board (PCB) process. The thicknesses of the mylar and copper are 75 and 17μm, respectively. The layout of the hologram CATR facility is shown in Fig. 1.

The test instrumentation was built around a millimetre-wave vector network analyser MVNA-8-350 by AB Millimètre. The analyser can be used with various source and receiver configurations and is easily adaptable to different frequency bands. A phase-locked Gunn oscillator with a frequency multiplier was used as the source and a sensitive Schottky mixer pumped with a phase-locked Gunn oscillator as the receiver for the quiet-zone testing. The source was mounted to a small *xyz*-scanner and the receiver to a large planar *xy*-scanner. A 310GHz corrugated horn was used as the transmitting antenna and an open-ended WR-3 waveguide as the receiving probe antenna. The dynamic range of the quiet-zone test setup was measured to be 65dB.

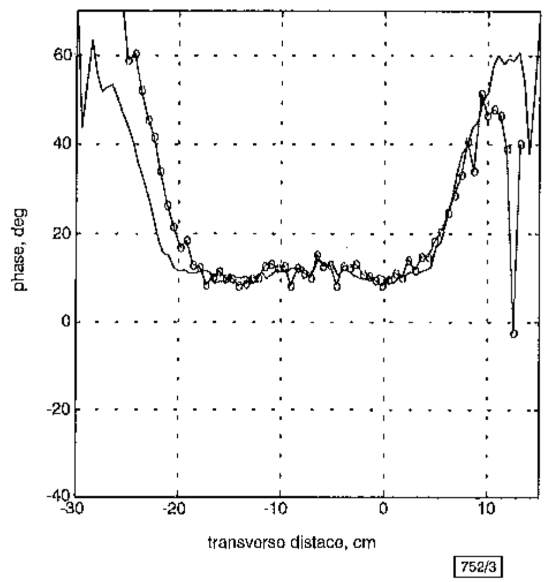

Fig. 3 *Measured and theoretical phases of horizontal scan*

- -O- · measured
——— theoretical

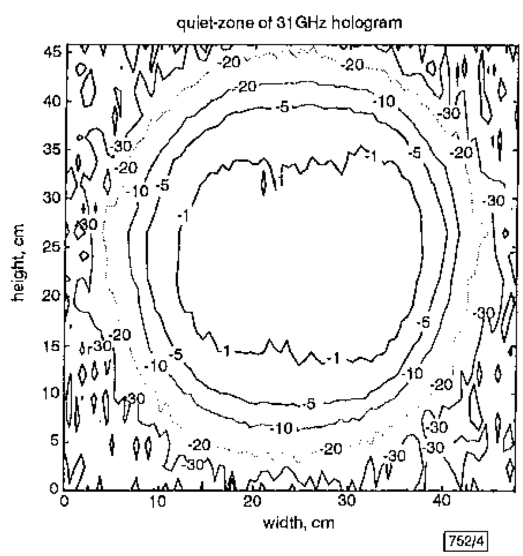

Fig. 4 *Quiet-zone contour map*

Measurement results: The quiet-zone field of the CATR was scanned at a distance of 1.5m from the hologram. The measured and theoretical (calculated with FDTD and physical optics (PO) [3]) amplitude and phase of the quiet-zone field on a single horizontal scan along the hologram centreline are presented in Figs. 2 and 3, respectively. The peak-to-peak amplitude ripples in the horizontal direction are ~0.8 and 1.0dB for the theoretical and measured curves. The peak-to-peak phase ripples are ~5 and 10°. The quiet-zone width is ~25cm. A two-dimensional contour map of the quiet-zone field amplitude 1.5m away from the hologram plane is shown in Fig. 4. The size of the quiet-zone is ~25 × 20cm².

Conclusions: A demonstration version of a submillimetre-wave CATR based on a 60cm hologram has been designed, fabricated and tested. The measured quiet-zone fields at 310GHz agree well with the simulation results from the theoretical model. The design and manufacturing of the hologram were successful. A standard good quality printed-circuit board process was used for the hologram pattern etching.

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Triple band planar inverted F antennas for handheld devices

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Two novel triple band planar inverted F antennas (PIFAs) are presented. The first antenna is realised by housing a dual frequency L-shaped spur line loaded PIFA element within the lower resonance PIFA element. The second antenna is realised by embedding two single element PIFAs within a quarter-wave patch. For both antennas, an isolation of better than −15 dB between the feed ports and a good agreement between simulation and measurement results was obtained.

Introduction: The recent explosion in the communications market has resulted in the emergence of a number of systems operating at different frequencies [1]. Currently, the market is aimed at providing multiple services within a single communications terminal unit. The planar inverted F antenna (PIFA), which can be implemented in a small space, is an attractive design approach for mobile units [2, 3]. The ability to incorporate dualband or multi-band performance further enhances the merit of these antennas for future application [3, 4].

In this Letter we describe a novel method for designing a compact, triple band, dual feed PIFA. This triple band antenna is