Coaxial-line Connection between a Patch Array on the Thick Resin of a Silicon Chip and a Quadrature Oscillator in the 60 GHz-band

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The authors proposed a circularly-polarized patch antenna placed on a thick resin layer with 200μm, which is fed from the opposite side of a silicon chip through a hole with coaxial-line structure in the 60GHz band (J.Hirokawa et al., EuCAP, A29-1, Apr.2011). The high antenna efficiency of 77% was measured by a reverberation chamber with ±3% error (J.Asano et al., APMC, 4A4-2, Oct.2012). This paper presents a 2x2 array of the patches in 5mm square area, which is fed by a quadrature oscillator chip sized by 1mm square from the opposite side through holes with the coaxial-line structure, as shown in the figure. The 2x2 array of the patches has sequential arrangement to get good axial ratio at the boresite. The oscillator chip has ten DC ports and four sets of the ground and signal RF ports with 90-degree difference. Each ground port is realized by a quarter-wavelength open stub. Each signal port is connected to each patch by using a stub for matching. We design two types of wirings. One is to have the sum pattern at boresite while the other is to have the difference pattern. The phase difference is controlled at this moment by the length of the signal line among the patches. In the simulations, the desired sum and difference patterns are obtained. Also, the total loss is estimated to be 2.2dB (antenna: 0.9dB, coaxial-line structure: 0.2dB and RF microstrip lines for the pattern: 1.1dB) at 60GHz by using $\varepsilon_r = 2.8 - j0.043$ for the resin and $\sigma = 2.0 \times 10^7$S/m for the metal. The antennas are now under fabrication and the measured results will be shown in the conference.