Millimeter Wave Antenna-in-package (AIP) for 5G Commercial Products

Dohyuk Ha, JunSig Kum, Kwanghyun Baek, Ki Joon Kim, Jinsu Heo, Jungyub Lee, and YoungJu Lee

Network Business Division
Samsung Electronics Co., Ltd
Suwon-si, Gyeonggi-do 16677, Republic of Korea
dohyuk1.ha@samsung.com

Attention to 5G cellular technology as a next generation communication trend has widely been given because of its advantages of higher data rates, and lower latency. One of possible use case of 5G service is fixed wireless access (FWA). Recently, the FWA system is being tested in real customers' environment for commercialization. Passive repeater techniques required for such commercial 5G services has been studied. The antenna module package that can support dual polarization has been presented. The work has shown module-level concurrent Tx and Rx operation with dual polarization. However, set-level performance including radome effect has not been presented yet.

In this paper, a mm-wave antenna-in-package module for 5G commercial products and its performance are presented. First of all, overall package module structure and its manufacturing are described. An air-stacked dual patch antenna is exploited for wide operating frequency bandwidth and high efficiency. A metal spacer is inserted to reduce coupling between antenna elements. The air-stacked antenna array structure is mounted on a printed circuit board (PCB) and RFIC is attached on the bottom of the PCB by flip-chip bonding. Additionally, in order to cool down the RFIC, a heat sink metal is attached under the unit PCB module and thermal interface material (TIM) is attached between the RFIC and the heat sink.

Then, parameters such as antenna gain and return loss are characterized. The measured bandwidth is 4GHz and 16-element antenna gain measured in anechoic chamber is 17.3dBi at 28GHz and the capability of beam steering is also shown. Finally, after the antenna module is integrated in a customer premise equipment (CPE) product for 5G FWA service, measurement results of set-level EIRP and beam steering are given. The measured performance is EIRP of 36.6 dBm at boresight direction and beam scan range more than 40 degree for 32-array antenna on two 16-element package modules. This work shows final set-level performance using customer premise equipment (CPE) for 5G fixed wireless access (FWA) service. To be authors' best knowledge, this is the first set-level performance test of a 5G commercial product, which demonstrates a feasibility of commercially available 5G mm-wave beam-forming system. The AIP module is able to be extended and applied to other 5G products such as base station and mobile cell.

More detailed analysis and application to other 5G products portfolio will be presented in the conference.