A Study on the Effects between a Commercial Space Solar Cell and Optically Transparent Patch Antenna that is Integrated on Top of It

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Integrating antennas directly on top of solar cell has been an active topic in the last decade. Such integration finds applications in space exploration tools such as Cube Satellites and Rovers. While many have attempted initial research, there have not been consistent results on the effect between the solar cells and Antennas. In the past, we have presented design methods in achieving optically transparent antenna with the optimal transparencies and gain. We have also performed integration on dummy solar cells. Next we move on to quantifying the effect of real-world active space solar cell on a solid patch antenna integrated on it. A commercial space solar cell always has a cover glass on top of the photovoltaic layer as protection. The existence of the cover glass is the design basis of the integrated patch antenna, where the cover glass acts as the dielectric substrate of the antenna. With assistance from engineers at the Space Dynamics Laboratory (www.sdl.usu.edu), who regularly launches space vehicles, several test fixtures were fabricated to characterize the effect of a triple junction solar cell on transparent and solid patch antennas integrated on it with different orientations at 2 GHz, 5 GHz, and 10 GHz. From theory, it is seen that the solar cell affects the gain decrease of a solid patch the same fashion as a transparent meshed patch antenna. Our tests also confirmed the same argument. For the gain decrease, although it is related to the material properties of the solar cell, cover glass, and their geometries, for the most popularly used solar cell that we have tested, it can be concluded that the gain decrease is between 2 to 3 dB. In addition, we have found that when it is possible to engineer the conductivity of the solar cell, then one may be able to reduce the gain loss. The effect of the antenna on the solar is relatively easy to quantify by using natural or artificial lights and a standard set-up for measuring solar cells' efficiency. We report our latest assessments on the effect in between the solar cells and antennas with varied transparencies.