# Performance of a 3D-printed horn antenna working at Ka-band for satellite communications

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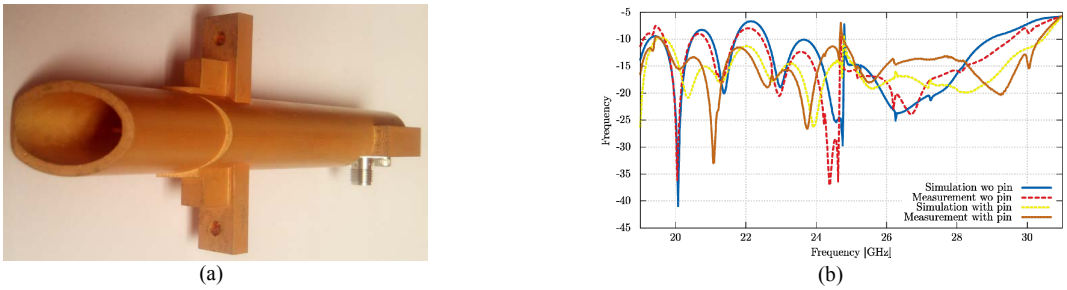
Satellite connectivity is a well-established system to provide wireless connectivity to peers that are either in a remote location or which have a high mobility and cannot use a fixed data-link.

The authors have designed a wide-band circular horn antenna that covers the frequency band from 19.7 to 30 GHz, including simultaneously the down-link and up-link bands of satellite communication in Ka-band. Wide-band behavior for both linear modes of the circular waveguide is achieved using 4 ridges symmetrically placed; and a small back-cavity near the input coaxial port is used to improve and fine-tune the return losses of the antenna. An additional degree of freedom is achieved by introducing a tuning pin in the cylindrical waveguide. The position of this tuning pin allows fine-tuning the prototype once manufactured.

Due to the complexity of the antenna, its fabrication using standard milling techniques is challenging, as previously presented by the authors, and requires a split-block approach that divides the antenna in several blocks that are assembled afterwards, with potential inaccuracies negatively influencing the performance. In this paper the authors are presenting a version of the antenna prototype that has been fully manufactured, in collaboration with the company Swissto12, as a single block using 3D stereo-lithography. Finally a metal-coating post-processing over the plastic piece ensures the conductivity of all the surfaces. Because the manufacturing process is based on polymers rather than bulk metal, not only can the prototype be built with a single piece, thus avoiding contact problems and as such improving the performance of the antenna, but there is also an inherent weight reduction of the prototype.

It must be noted that since the technology is based on metal-coated polymers, iron-soldering of the connector cannot be easily done. This implies that a modification of the design must be done to accommodate the connector, which must be glued with conductive epoxy to the cylindrical quad-ridged waveguide.




(a) (b)

**Figure 1. Prototype fabricated using stereo-lithography techniques and metal-plating.**

Figure 1a presents the fabricated prototype and Figure 1b shows a comparison of the simulation and the measurement results for the standalone. It must be noted the extremely good agreement between simulation and measurement over the whole band for the first measurement without any tuning pin, including the peak in the response around 24.7 GHz. This peak originates from the modification of the cavity of the waveguide to accommodate the connector used in the measurements. Finally, since the design considered a tuning pin to do the final adjustments of the antenna in, two additional curves within Figure 1b show the tuned performance of the antenna (simulation and measurement), which ensure the performance of the antenna over the bands of interest.