A GaAs Ka-band (26-36 GHz) LNA for radio astronomy

Work Description
An LNA has been designed to operate across the Ka-band from 26 to 36 GHz. It has been designed using a commercial GaAs process, and according to the simulations, it is believed that its performance would be superior to any other GaAs based LNA so far reported in the same band at room temperature.

Design
The proposed LNA design is based on the WIN Semiconductors 100 nm GaAs process. It contains 4 stages, and the transistors have 2 fingers of 50 μm width each. The size of the MMIC is 1.3 x 2.8 mm.

LNA Performance
Scattering and noise parameters have been simulated at room temperature, and the associated results are presented here. Special attention has been paid to ensure the stability of the design. When it is fabricated, its performance is expected to be similar to the one shown here - this is a benefit of using a well-established process.

Applications
I. Low-cost LNA for large arrays
The two major concerns in the near future of radio astronomy are related to increasing the collecting area and extending the field of view. The methods for increasing the collecting area consists of increasing the diameter of the large single-dish telescopes, which may be unaffordable, or of distributing multiple antennas in the appropriate region, which is more feasible. Aperture arrays and Phased Array Feeds (PAFs) are the two methods for extending the field of view.

II. Yebes Observatory
The RAEGE network is a Spanish-Portuguese project that will consist of four 13.2 meter radio telescopes equipped with S/X/Ka tri-band receivers. The first of these telescopes has been recently constructed in the Yebes Observatory.

The non-cryogenic stage of the Ka-band chain has an amplifier with a maximum noise figure of 2.9 dB. If we replace this amplifier with the one proposed in this work, we will experience a:

\[ \Delta T = \frac{T_{\text{MIN}}}{\sqrt{B \cdot f}} \]

10 % time saving when observing a source with a fixed sensitivity

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>26 – 36 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise figure</td>
<td>1.5 dB min. / 1.8 dB max.</td>
</tr>
<tr>
<td>Gain</td>
<td>33 dB</td>
</tr>
<tr>
<td>Gain ripple</td>
<td>0.7 dB</td>
</tr>
<tr>
<td>Input return loss</td>
<td>12 dB min.</td>
</tr>
<tr>
<td>Output return loss</td>
<td>12 dB min.</td>
</tr>
</tbody>
</table>

Table 1. Specifications of the LNA

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