

**SOLID-STATE LOCAL OSCILLATOR SYSTEMS
FOR
MILLIMETRE-WAVE RADIO ASTRONOMY RECEIVERS**

A Thesis

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By

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A **man** should not abandon his work, O Son of Kunti (Arjuna),
even if he cannot achieve **it** in full perfection;
because in all work there may be imperfection,
even as in all fire there is smoke.

Bhagavadgita-18:48.

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ABSTRACT

Presented in this thesis is the work on the **development** of solid-state sources for local oscillator application in **milli-**metre-wave radio **astronomy** receivers for the two widely used **atmospheric transmission** windows, 33-50 GHz and 75-110 GHz. Such sources are **required** to provide a **reliable** alternative to the highly expensive and short-lived **klystrons** which have been **traditionally** employed as local oscillators.

Post-coupled **Gunn** oscillators have been developed for the 33-50 GHz **frequency band** in various circuit configurations using a standard **rectangular** waveguide, a reduced-height waveguide and a circular waveguide. Effects of the post **diameter** and the **backshort** position on the **oscillation frequency** and power output of these oscillators have been investigated.

Resonant-cap **Gunn** oscillators have been developed for the 75-110 GHz **frequency band**. These oscillators **have been realized** in a new circuit **configuration** using circular **waveguide** as well as in the **standard rectangular** waveguide circuit. The effect of the resonant-cap **dimensions** on the oscillation **frequency** has been studied. An **empirical** relation between the oscillation frequency and the resonant-cap **dimensions** has been obtained for the circular waveguide configuration. **The performance of the** circular waveguide oscillator which is **simpler** in construction is found to be **comparable** to that of the rectangular waveguide design.

AM sideband noise, which is a critical **parameter** for local oscillator **application**, has been measured for a **number** of **millimetre-wave Gunn** oscillators and **klystrons** in the 75-110 GHz **frequency band**. The **noise performance** of the **Gunn** oscillators is found to be better than that of the klystrons,

A phase-lock loop **circuit** has been **developed** for the **frequency stabilization** of **millimetre-wave** oscillators. The circuit has been **used** to phase-lock several **millimetre-wave Gunn** oscillators to a highly stable **signal** derived from a VHF frequency synthesizer.

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