

# **Microwave Data Link for high bandwidth data communication**

Project Leader: Dr JB de Swardt

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## **1. Introduction**

Microwave communication forms an integral part of many telecommunication systems in South Africa. The increasing need for higher bandwidth makes microwave frequencies indispensable because the higher the carrier frequency, the easier it is to obtain higher bandwidth. Various factors determine the quality of a microwave communications link, but the specifications of the microwave components itself is one of the most critical factors.

The demand from South African companies for the high technology know-how and good microwave engineers to compete internationally asks for a centre that can act as a source for knowledge, manpower and manufacturing capability.

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## **2. Objectives and Rationale**

The purpose of the proposed program is to establish a centre of knowledge and capability at the University of Stellenbosch in the field of microwave data links. This will include design and analysis procedures, manufacturing and measurement of microwave components. Components will include oscillators, mixers, amplifiers, manufacturing of Gunn diodes and the use of superconductors for modulation and demodulation.

The program will expand the existing collaboration between the university and its industrial partners. The knowledge and capability produced by this program will find application in many microwave communication systems in South Africa as well as part of the satellite systems currently under development by the Department of Communication and the University of Stellenbosch.

The program is designed to train a number of high level engineers through the use of Masters degree programs. Three lecturers at the University of Stellenbosch (Dr Johann de Swardt and Prof. WJ Perold, Dr Cornell van Niekerk), five students (masters degree at the University of Stellenbosch), Dr Reinhardt Botha (lecturer) and masters students at the Department of Physics at the University of Port Elizabeth, Robert van Zyl from Telkom, Mr C Whaits from the Cape Technikon, Avitronics, Etse Electronics and Kentron will be involved in the program.

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## 2. Proposed Workplan

Figure 1 shows a typical block diagram of a microwave data link. The tasks described in the section below refer mostly to components in the diagram.

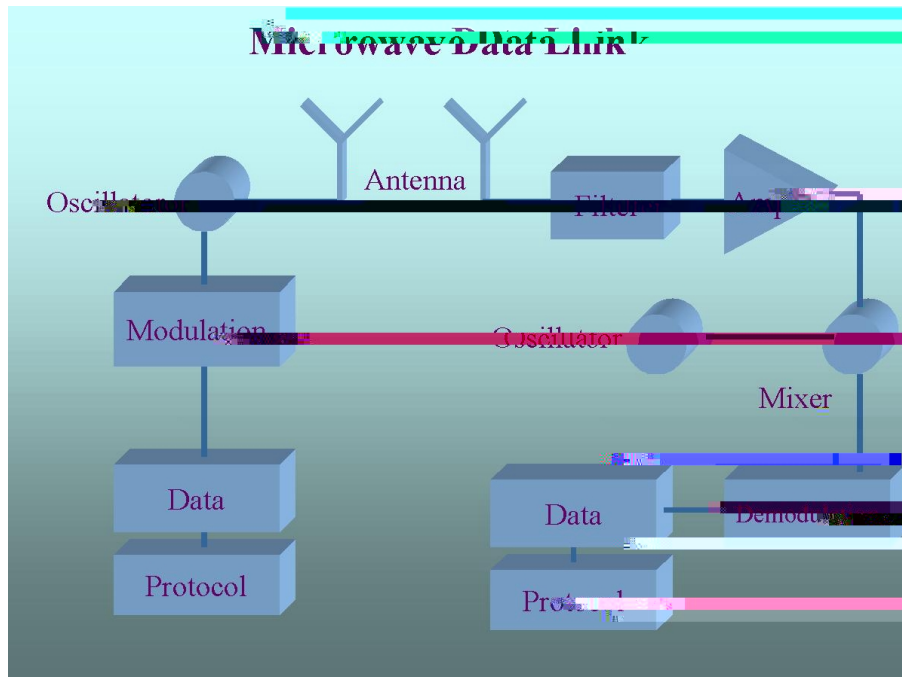


Figure 1. Block diagram of the microwave data link

### a) Tasks

The following tasks will be carried out during the project:

#### i) **Microwave oscillators**

This topic includes the design, analysis, manufacturing and measurement of microwave oscillators at 2.45GHz and 10.525GHz. Different design techniques for oscillators using dielectric resonators and microstrip filters will be investigated. The aim would be to obtain a highly stable oscillator as well as variable oscillators to be used in phase locked loops.

Mr A Snyman and N Geldenhuys (masters students) will start the work on this task under the supervision of Dr JB de Swardt.

#### ii) **Microwave filters**



This topic includes the design, analysis, manufacturing and measurement of microwave mixers at 2.45GHz and 10.525GHz. Special attention will be given to harmonic mixers for which very little literature exists. The aim would be to obtain a harmonic mixer with low insertion loss.

Mr M van der Merwe (masters student) will work on this task under the supervision of Dr JB de Swardt.

iv)



This program will also have strong interaction with the other COE projects at the University of Stellenbosch.

### **c) Corrective action**

During 1999 the Department of Electrical and Electronic Engineering presented a one-year course to previously disadvantaged students. About 15 of the 38 black students will enrol for master studies in 2000. At least one of these students will form part of the microwave link team.

The Gunn diode task at the University of Port Elizabeth will be a team effort involving several of their post-graduate students, some of whom will be corrective action candidates.

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### **Human resource development**

The students from the University of Stellenbosch to be involved in the program are shown below:

1 Microwave synthesizer

- ⇒ Masters
- ⇒ Mr A Snyman
- ⇒ No support

2 Microwave oscillator

- ⇒ Masters
- ⇒ Mr N Geldenhuys
- ⇒ Avitronics

3 Microwave harmonic mixer

- ⇒ Masters
- ⇒ Mr M van der Merwe
- ⇒ No support

4 Superconductor demodulation

- ⇒ Masters
- ⇒ Mr C Fourie
- ⇒ Prestige bursary (Telkom student)

5 Link performance

- ⇒ Masters
- ⇒ Mr W Koen
- ⇒ No support

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## **5. Outputs for 2000**



## Outputs for 2000

### 1 Microwave oscillators

- ⇒ Literature study
- ⇒ Oscillator
- ⇒ Masters student

### 2 Microwave synthesizers

- ⇒ Literature study
- ⇒ Synthesizer
- ⇒ Masters student

### 3 Microwave mixers

- ⇒ Literature study
- ⇒ Mixer
- ⇒ Masters student

### 4 Microwave amplifiers

- ⇒ Literature study
- ⇒ High power amplifier
- ⇒ Gunn diodes
- ⇒ Literature study
- ⇒ Gunn diode

### 6 Microwave superconductor modulation/demodulation

- ⇒ Literature study
- ⇒ Superconductor logic for demodulation
- ⇒ Masters student

### 7 Evaluation of microwave link performance

- ⇒ Literature study

## 6. Conclusions

The proposed program will produce five masters students at the University of Stellenbosch, masters students at the University of Port Elizabeth and B Tech students at the Cape

