

Gunn Diode Oscillator Minutes

David Headland

2003-11-13 14:00

Attendance

- Fourth year students
 - DP Headland
 - AJ Nelms
 - RE Irwin [Arrived 14:45, but with sandwiches]
 - R Wan
 - JM Higginbotham
 - MP Gaskill

- UMIST staff
 - WS Truscott
 - R Sloan

Approvals

- The minutes from the previous meeting were approved.

Interim report proposal

- The draft proposal was discussed.
- Individual sections can be written in any format.
- DP Headland will collate sections to create L^AT_EX source with L_YX.
- Deadlines:
 - All section submitted for collation: 15 December 2003 AM.
 - Submission of collated document for proof reading: 16 December 2003 AM.
 - Submission of changes to create final documents: 17 December 2003 AM.
 - Print document: 18 December 2003 AM.
 - Document submission deadline: 19 December 2003.
- Supervisors suggest flexibility in who is writing report sections.
- The main delay points were identified as:
 - Waveguide machining time.
 - * Suggested getting a large section of waveguide machined.
 - * It can be chopped up and used as needed.
 - The test equipment may not always be available.

Tasks split

- Design a single diode oscillator before Christmas.
 - JM Higginbotham.
 - R Wan.
 - MP Gaskill.
- Learn to use test equipment, thoroughly test and document the existing oscillator.
 - Tests to perform.

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- * Spectrum analysis.
 - * Power measurements.
 - * Voltage vs. frequency relationship (should be positive).
 - * Phase noise (target is 75-80 dB/Hz at 100kHz offset).
 - Members performing tests.
 - * AJ Nelms.
 - * DP Headland.
 - Design and simulation of the bias choke effects on the oscillator.
 - RE Irwin.
 - Electromagnetic analysis of the waveguide.
 - Unassigned.
 - The supervisors commented on this split.
 - Tasks should be available for when delays are in place.
 - This can be documentation or information assimilation.

Photocopier account

- A photocopier PIN number was made available.
- Details were given to all members at the time.

Phase noise

- Very important in any communications system.
- Research into QPSK was suggested.
- Phase errors will introduce errors in determining the transmitted signal.
- If the local oscillator is noisy, errors can also be introduced.
- Phase noise is a measure of the steepness of the power vs. frequency slope.

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- Look for a paper by Leeson from the 1960s that describes this. The relationship is along the lines of

$$L(f) \propto \frac{1}{PQ}$$

Radial discs

- A radial disc acts like a capacitor at low frequencies, and an inductor at high frequencies.
- The frequency when the components are matched is the resonant frequency.

Second harmonic waveguide

- Using a second harmonic, the first harmonic will be attenuated quickly.
- Positioning devices close together there may still be enough first harmonic power to allow injection locking.
- This can be an advantage, as if the coupling is too strong there may be two solutions to the injection locking equation.
- Building on WS Truscott's explanation of wave propagation in a waveguide:
 - λ_G increases as f drops.
 - As $f \rightarrow f_{\text{cutoff}}$, $\lambda_G \rightarrow \infty$.

Miscellaneous points

- R Sloan tried to get us all to learn HFSS to some degree.
- Web of Science allows you to provide details of one paper and get forward and reverse citation lists for that paper.

Related paper

- “A wideband BackShort-Tunable Second Harmonic W-Band Gunn Oscillator” by H Barth was discussed
- WS Truscott thought that this paper was very useful to our project.
- It’s very encouraging, it shows that similar work has been undertaken.
- It was suggested that everyone get hold of this paper and read it.
- The fact that the paper is 22 years old was discussed.
 - Much work was done in this area for defence in the 1980s.
 - Funding was withdrawn as the cold war ended.
 - This doesn’t mean to say that the work is incorrect or has been disproved.
- We should find out:
 - Has anyone improved on it?
 - Has anyone disproved on it?
- We should talk to e2V, ask them where does the varactor diode go with respect to the radial disc. This will help give insight into the coupling of the devices.

Test equipment tutorial

- Spectrum analyser will work with mixers to 110 GHz.
- Need to order a rotary vein attenuator from Flann in Bodmin.
- Session organised for AJ Nelms and DP Headland.
- Meet Keith Williams in the Agilent lab at 10:00 on Thursday 20 November.

Proposed actions

All	Read up on quadrature phase shift keying (QPSK).
All	Read the paper by H Barth.
All	Look up and read the paper on phase noise by Leeson.
All	Decide upon a time for R Sloan to organise HFSS simulations and mail him with it.
AJ Nelms	Start learning to use the test equipment.
DP Headland	Start learning to use the test equipment.
MP Gaskill	Start designing the single Gunn diode oscillator.
R Wan	Start designing the single Gunn diode oscillator.
JM Higginbotham	Start designing the single Gunn diode oscillator.
RE Irwin	Look into the dimensions of resonant discs.
Supervisors	Check for any existing suitable waveguides.

Next meeting

Time Tuesday 18 November 2003, 10:00.

Place D floor coffee room

Meeting adjourned, 17:00.