

IEEE RF Engineering Penang Malaysia 2006 Technical Report

Introduction

During our inaugural year we have focused on technical presentations from several distinguished people from academia and industry. In addition, we have had several presentations from individuals doing leading edge microwave and RF design here in Penang. We succeeded in establishing a balance between having presentations from world class researchers and engineers in the microwave industry and some of the finest microwave designers right here in Malaysia.

Some of the highlights include technical presentations from Steve Cripps, Rolf Jansen, and Ron Patston.

Our chapter also would like to acknowledge the help and support from the following:

1. Dato' Boonler Somchit and Hilary Wong of the Penang Skills and Development Center (PSDC)
2. Teo Pek Bing of Motorola, Penang Malaysia

Summary of Meetings

1. March 23, 2006 Professor Dr. Ing. Rolf Jansen, Development of models for large RF power transistors including temperature, memory and packaging.

The rapid technological development in wireless communications together with increasing bandwidths and linearity requirements needs advanced and more accurate large signal device models for circuit and system design. In this context, GaN/AlGaN power transistors represent a promising new device technology but require particular consideration of thermal, memory and packaging effects.

This contribution focuses on the extension and subsequent application of the standard EEHEMT1 ADS model (which originally was developed for GaAs/AlGaAs HEMT devices) to the accurate modeling of GaN/AlGaN HEMT power-devices. A two-stage large signal model development approach is described for a 50 W power device. Starting with an isothermal basic model, in a first step parameter extraction is performed using small signal pulsed RFOV measurements of 3 W devices over a broad frequency range. The basic model of the 3 W device is then scaled up and completed by extensions and parameters describing especially the trap induced memory and temperature effects. Furthermore, S-parameters for a typical power transistor package geometry are derived with an electromagnetic Finite Element simulator and added to extended HEMT model. The presentation will include first verification and application steps to demonstrate the capabilities of the developed comprehensive model and the quality of the presented modeling approach.



2. April 17th. 2006, Mr. Thomas Chong, "Low-Noise, High-Linearity Balanced Amplifier in Enhancement-mode GaAs pHEMT Technology for Wireless Base-Stations"

1) "A Low-Noise, High-Linearity Balanced Amplifier in Enhancement-mode GaAs pHEMT Technology for Wireless Base-Stations" (This is the high power version)

This paper describes the design and realization of a balanced low-noise amplifier (LNA) module in the 2GHz band suitable for wireless infrastructure (base-station) receiver front-end applications. The design effort entails both aspects of MMIC and module/packaging design to realize a fully-matched solution in a miniature 5mmx6mm footprint. The MMIC design leverages Agilent Technologies' Agilent's proprietary 0.25 micron GaAs enhancement-mode Pseudomorphic High-Electron-Mobility Transistor Pseudomorphic High-Electron-Mobility Transistor (e-pHEMT) technology for best-in-class noise performance and linearity. is employed in the fabrication of the die. In a balanced amplifier application with external 3-dB hybrids, this design demonstrated exhibits a very low noise figure (NF) of 0.9dB, coupled with a high OIP3 (Output Third Order Intercept Point) of 46dBm at 31dB gain. It is also capable of delivering a P-1dB of 31dBm at 2.0GHz with a 5.0V supply.

2) "Design and Performance of a 1.6-2.2GHz Low-Noise, High Gain Dual Amplifier in GaAs E-pHEMT" (This is the low power version)

The design and realization of a dual low-noise amplifier (LNA) module in the 2GHz band suitable for balanced receiver front-end application is presented. The module was designed to operate from a 5V supply with a control voltage for

convenient adjustment of bias condition for optimum noise figure. The MMIC portion of the designed was fabricated in Agilent Technologies' proprietary 0.5um GaAs enhancement-mode Pseudomorphic High-Electron-Mobility Transistor (e-pHEMT) process. This module is suitable for balanced amplifier applications when combined with external 3-dB hybrids, giving an extremely low noise figure (NF) of 0.55-0.8dB, coupled with a moderately high OIP3 (Output Third Order Intercept Point) of 38-42dBm at 28-32dB gain. It is also capable of delivering a P-1dB of more than 20dBm at 180mA current drain.



3. May 23rd 2006, Mr. Richard Keating, "RF and Mixed Signal Devices on Silicon"

Devices for use in the GHz range are now being incorporated onto Silicon. In addition, the quality and quantity of mixed signal components has improved. These new devices offer the RF and Mixed Signal designers more opportunities to execute RF designs onto the much cheaper silicon process. This talk will give an overview of the RF and Mixed Signal devices now available on Silicon and their key characteristics. Background information on Modeling will also be covered. Focus of discussion will be Inductors, MIM Capacitors and Resistors. As an integration engineer at Silterra, I will talk from the perspective of a wafer manufacturer which must balance device performance by the added cost and complexity of the processes.



4. June 26th 2006, Mr. Tan Teik Siew, “Distributed Power Amplifier Design with Discrete MOSFET Devices”

This paper will describe the analysis of a distributed power amplifier using discrete MOSFET devices. The design will begin with small signal analysis followed by large signal design, where non-uniform of drain line's characteristic impedance was introduced to enhance the output power and efficiency performance. Simulation results and some limitations of such a structure are discussed in the final section.

5. July 25th 2006, Dr. Steve C. Cripps, “The Class E Power Amplifier Mode – a Microwave Rationale”

The Class E mode has been vigorously touted by its inventors for several decades, and continues to cause debate and controversy in the microwave PA community. Papers continue to appear frequently in the literature claiming Class E performance, based on nothing more than the application of a design procedure based on an inappropriate ideal switch model for the active device. This talk will present analysis, simulation and measured results which demonstrate how a “quasi-E” mode can be realized at microwave frequencies by implementing a simple, but highly counter-intuitive, output harmonic matching environment. Not only is this mode, re-named “Class J”, able to give high efficiency operation in the 80% plus region, but it can also demonstrate linear performance at backed-off power levels, something which true switch mode amplifiers cannot do.



Steve Cripps

6. August 21, 2006, Arokia Nathan, "Electronics on Non-Conventional Substrates".

The evolution in materials and process fabrication technologies is posing new challenges and application areas in large area electronics. A driving force in this evolution is thin film Si technology. Interest in Si thin film technology stems from a variety of desired technological features including low temperature manufacturing with few constraints on the substrate size, material, or topology. More recently, the extension of this technology to flexible plastic substrates has received considerable attention. Interests on plastic is being driven by the need for lightweight, unbreakable, and foldable display screens for computers and cell phones as well as for a plethora of new applications such as electronic books, newspapers, maps, and RF ID tags.

While the need for this technology is overwhelming, the material is intrinsically limited in speed and stability, as compared to poly-Si or crystalline-Si. Hence, the quest for improved material structure at low deposition temperatures and improved system stability through use of circuit compensation techniques. This talk will review precisely these challenges. Specifically, it examines growth conditions for realization of nano-crystalline Si along with design considerations pertinent to thin film circuits whose integration requires non-conventional design solutions to deal with the high instability. The family of devices and circuits presented here are applicable for a new generation of displays based on the organic light emitting diode.

7. August 30, 2006, R.E. Sheriff, " European Advances in Telecommunications Engineering: Signposting the way towards the Global Information Society " (INTI College, Bukit Jambul, Penang)

The last quarter of the 20th century witnessed significant and rapid advances in telecommunications engineering, which together with developments in computer processing capabilities and Internet access technologies, have laid the foundation for the establishment of the Global Information Society. Today, there are more than 2 billion mobile subscribers world-wide, 75% of which have signed up to Europe's Global System for Mobile Communications (GSM). The take-up of third-generation (3G) systems, such as the European-developed Universal Mobile Telecommunications System (UMTS) and America's cdma2000, is now starting to gain momentum, especially in parts of Asia, where 3G was first launched in Japan in 2001. Recently, the introduction of wireless Internet access under the IEEE 802.11 family of standards has created new opportunities for mobile computing, resulting in Wi-Fi access becoming increasingly available, with now more than 100,000 hot-spots world-wide, in places such as hotels, airports and coffee bars. Satellites are also playing their part in providing mobile communication services, high-precision navigation applications and digital video broadcasts. There are now a number of competing and, in some cases, complementary technologies, each vying for a share of a lucrative global market. How these technologies can be brought together to form a seamless service offering is a challenge now facing the telecommunications research community.

This paper initially provides an insight into the research challenges that are likely to dominate the European research agenda over the coming years, as Europe sets its stall out to become the world's leading knowledge economy by 2010.

The paper then proceeds to highlight the latest European advances in telecommunications engineering that are bringing ever closer the realisation of the Global Information Society. The current state and future developments in wireless Internet, mobile and satellite communications are discussed. The paper concludes with a presentation of how the various access technologies can be brought together to form a cohesive, heterogeneous network capable of meeting the diverse telecommunications needs of the world's population.

8. October 30th 2006, Mr. Chow Yut Hoong "Circuit Design with Enhancement-mode pHEMT Technology"

The pHEMT device possesses many desirable properties that make it very attractive to realize high performance RF/Microwave circuits. Among these are its low broadband noise, high linearity and efficiency. Until recently, mass produced pHEMT devices have relied on depletion mode (d-mode) technology, a trait often cited as the chief Achilles heel of the technology. However, the advent of enhancement-mode (e-mode) pHEMT technology is beginning to change this as e-mode devices require no negative voltage supplies and its associated disadvantages. This talk will broadly survey technologies available for RF/Microwave circuit design, in particular, applications for RF Front-ends of today's wireless standards. The main focus, though, will be on circuit design using e-mode pHEMT technology. Low-noise amplifiers, power amplifiers, switches and mixer circuits will be featured as examples of what this technology affords us. Device models requirements will also be highlighted and discussed.



Drop In →
Short term
→ 'Drop in' ch
→

x Long term
→ L' Budget Risk
→ Core Competency Bk
→
→ Sil

9. November 20th 2006, Mr. Ronald W. Patston, “Multi-Chip Module Design”

Today the design of multichip modules is a design problem cover many different design mediums; GaAs HBT, GaAs PHEMT, Si RFIC and Laminate/PCB. Traditionally this has been accomplished using a serial design process of a collection of design tools all being specific for the design medium. Mr. Patston will discuss concurrent module design where all aspects of the module can be designed in parallel in a common tool. This process has shown in companies such as Skyworks to reduce MCM module design times by 65%. The concurrent flow shall be introduced and discussed and the implementation into a common design tool will be demonstrated.



10. December 12, 2006, Grant Ellis, “2006 Year End Meeting and Annual General Meeting”

- i. Thank you & appreciation to:
 - Dato' Boonler Somchit and Hilary Wong of PSDC
 - Teo Pek Bing of Motorola, Penang Malaysia
 - 2006 Chapter Officers
- ii. 2006 accomplishments review
- iii. Election of 2007 chapter officers (IEEE Members Only)



Appendix A: Financial Report

IEEE Penang Chapter Bank Account

Bank Southern Bank Berhad
 Branch Bayan Baru
 A/C NO. 2067564741
 Names Yong Chin Kong (Treasurer)
 Ellis Grant Andrew (Chapter Chair)
 Currency RM

Date	Withdrawal	Deposit	Balance	Note
03-Feb-06		20.00	20.00	Open account. Sponsored by Yong.
03-Feb-06	0.50	1000.00	1019.50	Deposit Maybank cheque numbered 115331 from IEEE section. Outstation cheque charges RM0.50.
22-Mar-06	122.50		897.00	Catering charges for MTT Meeting on 23 March 2006 (35 people). Paid on Mar 22.
07-Apr-06	105.00		792.00	Catering charges for MTT Meeting on 17 April 2006 (30 people). Paid on Apr 18.
25-May-06	105.00		687.00	Catering charges for MTT Meeting on 23 May 2006 (30 people). Paid on May 23.
22-Jun-06	105.00		582.00	Catering charges for MTT Meeting on 26 June 2006 (30 people). Paid on June 27.
30-Jun-06		0.45	582.45	Interest
01-Aug-06	122.50		459.95	Catering charges for MTT Meeting on 25 July 2006 (35 people). Paid on July 25.
08-Sep-06	105.00		354.95	Catering charges for MTT Meeting on 21 Aug 2006 (30 people). Paid on Aug 22.
01-Nov-06	105.00		249.95	Catering charges for MTT Meeting on 30 Oct 2006 (30 people). Paid on Nov 1.
01-Dec-06	105.00		144.95	Catering charges for MTT Meeting on 20 Nov 2006 (30 people). Paid on Nov 21.

Appendix B: L-31 Meeting Reports

Record # : 1

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: Yes
Meeting Date: 08/10/2005	Attendance: IEEE Members: 9	Attendance: Guests: 9	Category: Technical
Title of Paper 1: Modern Circulators and Isolators for Wireless and Automotive Applications	Speaker: Lionel E. Davis	Title of Paper 2:	Speaker:

Record # : 2

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: Yes
Meeting Date: 11/07/2005	Attendance: IEEE Members: 8	Attendance: Guests: 19	Category: Technical
Title of Paper 1: The Life of James Clerk Maxwell	Speaker: James Rautio	Title of Paper 2:	Speaker:

Record # : 3

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: Yes
Meeting Date: 11/18/2005	Attendance: IEEE Members: 7	Attendance: Guests: 18	Category: Technical

Title of Paper 1: On chip transmission line interconnect technology & Si RF CMOS reconfigurable circuit technology	Speaker: Professor Masu Kazuya	Title of Paper 2:	Speaker:
-------------------------------------------------------------------------------------------------------------------------------	---------------------------------------	-------------------	----------

Record # : 4

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: No
Meeting Date: 12/06/2005	Attendance: IEEE Members: 7	Attendance: Guests: 3	Category: Administrative
Title of Paper 1:	Speaker:	Title of Paper 2:	Speaker:

Record # : 5

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: No
Meeting Date: 12/06/2005	Attendance: IEEE Members: 7	Attendance: Guests: 3	Category: Administrative
Title of Paper 1: General Annual Meeting 2005	Speaker:	Title of Paper 2:	Speaker:

Record # : 6

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: Yes
Meeting Date: 01/04/2006	Attendance: IEEE Members: 10	Attendance: Guests: 105	Category: Technical
Title of Paper 1: Design And	Speaker: Professor Sandeep	Title of Paper 2:	Speaker:

Test Of Digital Systems In The Era Of High Process Variations And Defect Rates	Gupta		
---------------------------------------------------------------------------------------	--------------	--	--

Record # : 7

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: No
Meeting Date: 03/23/2006	Attendance: IEEE Members: 9	Attendance: Guests: 5	Category: Educational
Title of Paper 1: Development of models for large RF power transistors including temperature, memory and packaging.	Speaker: Professor Dr. Ing. Rolf Jansen	Title of Paper 2:	Speaker:

Record # : 8

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: No
Meeting Date: 04/17/2006	Attendance: IEEE Members: 11	Attendance: Guests: 33	Category: Technical
Title of Paper 1: Low-Noise, High-Linearity Balanced Amplifier in Enhancement Mode GaAs pHEMT Technology for Wireless	Speaker: Thomas Chong	Title of Paper 2:	Speaker:

Record # : 9

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17	SubCode: 10341	Was this meeting joint with	Was this meeting part of the

(PENANG)		student branch(es)?: No	Distinguished Lecturers Program?: No
Meeting Date: 05/23/2006	Attendance: IEEE Members: 9	Attendance: Guests: 28	Category: Technical
Title of Paper 1: RF and Mixed Signal Devices on Silicon	Speaker: Richard Keating	Title of Paper 2:	Speaker:

Record # : 10

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: No
Meeting Date: 06/26/2006	Attendance: IEEE Members: 5	Attendance: Guests: 22	Category: Technical
Title of Paper 1: Distributed Power Amplifier Design with Discrete MOSFET Devices	Speaker: Mr. Tan Teik Siew	Title of Paper 2:	Speaker:

Record # : 11

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: No
Meeting Date: 07/25/2006	Attendance: IEEE Members: 9	Attendance: Guests: 45	Category: Technical
Title of Paper 1: The Class E Power Amplifier Mode – a Microwave Rationale	Speaker: Steve C. Cripps	Title of Paper 2:	Speaker:

Record # : 12

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers

			Program?: No
Meeting Date: 08/21/2006	Attendance: IEEE Members: 5	Attendance: Guests: 22	Category: Technical
Title of Paper 1: Electronics on Non-Conventional Substrates	Speaker: Arokia Nathan	Title of Paper 2:	Speaker:

Record # : 13

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: No
Meeting Date: 08/30/2006	Attendance: IEEE Members: 8	Attendance: Guests: 51	Category: Educational
Title of Paper 1: Latest European advances in telecommunications engineering	Speaker: Prof. Ray Sheriff	Title of Paper 2:	Speaker:

Record # : 14

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: No
Meeting Date: 10/30/2006	Attendance: IEEE Members: 9	Attendance: Guests: 9	Category: Technical
Title of Paper 1: Circuit Design with Enhancement-mode pHEMT Technology	Speaker: Chow Yut Hoong	Title of Paper 2:	Speaker:

Record # : 15

Section: MALAYSIA	Type: CHAPTER	Geocode: R00035	RecID: 2379
SubName: AP03/ED15/MTT17 (PENANG)	SubCode: 10341	Was this meeting joint with student branch(es)?: No	Was this meeting part of the Distinguished Lecturers Program?: No
Meeting Date: 11/20/2006	Attendance: IEEE Members: 5	Attendance: Guests: 14	Category: Technical
Title of Paper 1: Ronald W. Patston	Speaker: Multi Chip Module Design	Title of Paper 2:	Speaker:

499 Total Attendees