Vol II Issue XI

ISSN No : 2230-7850

Monthly Multidisciplinary Research Journal

# Indían Streams Research Journal

**Executive Editor** 

Ashok Yakkaldevi

Editor-in-chief

H.N.Jagtap



## Welcome to ISRJ

#### **RNI MAHMUL/2011/38595**

#### ISSN No.2230-7850

Indian Streams Research Journal is a multidisciplinary research journal, published monthly in English, Hindi & Marathi Language. All research papers submitted to the journal will be double - blind peer reviewed referred by members of the editorial Board readers will include investigator in universities, research institutes government and industry with research interest in the general subjects.

## International Advisory Board

Flávio de São Pedro Filho	Mohammad Hailat	Hasan Baktir									
Federal University of Rondonia, Brazil	Dept. of Mathmatical Sciences.	English Language and Literature									
•	University of South Carolina Aiken, Aiken SC	Department, Kayseri									
Kamani Perera	29801	The state of the s									
Regional Centre For Strategic Studies, Sr	i	Ghavoor Abbas Chotana									
Lanka	Abdullah Sabbagh	Department of Chemistry, Lahore									
20000	Engineering Studies Sydney	University of Management Sciences [ PK									
Janaki Sinnasamy	Engineering Studies, Sydney										
Librarian University of Malaya	Catalina Neculai	Anna Maria Constantinovici									
Malaysia ]	University of Coventry UK	AL I Cuza University Romania									
Malaysia ]	University of Coventry, OK	AL. I. Cuza Oniversity, Romania									
Romona Mihaila	Featering Patroscu	Horia Patrascu									
Spiru Haret University Romania	Spiru Harat University Bucharast	Spiru Haret University Bucharest									
Spiru Haret Oniversity, Romania	Spiru Haret Oliversity, Bucharest	Pomonio									
Delia Serbescu	Laradana Dagaa	Komama									
Spiru Harat University Bucharast	Loreualia Dosca	Ilia Dintan									
Pomenia	Spiru Haret University, Romania	Spire Harat University Domania									
Komama	Estuisia Managa da Almaida	Spiru Haret Oniversity, Komama									
A nuroa Miaro	Fabricio Moraes de Almeida	Viachua Vana									
DPS College Kennur	rederal University of Kondonia, Brazil										
DBS College, Kalipul	C C I' CEDITAN	Nowah Ali Khan									
Titus Don	George - Calin SERITAN	Callage of Dusiness Administration									
Thus Pop	Postdoctoral Researcher	College of Business Administration									
	Editorial Board										
Pratan Vyamktrao Naikwade	Iresh Swami	Raiendra Shendge									
Diru Haret University, Bucharest, omaniaSpiru Haret University, RomaniaIne Pintea, Spiru Haret University, RomaniaDirurag Misra BS College, KanpurFabricio Moraes de Almeida Federal University of Rondonia, BrazilXiaohua Yang PhD, USA Nawab Ali Khan College of Businestus PopGeorge - Calin SERITAN Postdoctoral ResearcherNawab Ali Khan College of Businesatap Vyamktrao NaikwadeIresh Swami Editorial BoardRajendra Shendge Director, B.C.U.D. SolapurR. Patil ad Geology Department Solapur sivarrity SolapurN.S. Dhaygude Ex. Prin. Dayanand College, Solapur Ex. Prin. Dayanand College, SolapurR. R. Yalikar Director Managme		Director BCUD Solanur University									
Abi Conege Deviaki,Ramagiri,Wis mai	i Ex VC. Solupui Oniversity, Solupui	Solapur									
R R Patil	N S Dhavoude	Solupui									
Head Geology Department Solanur	Fy Prin Davanand College Solanur	R R Valikar									
University Solapur	Ex. 1 III. Dayanana Conege, Solapui	Director Managment Institute Solanur									
Oniversity, Solapui	Narandra Kadu	Director Managment Institute, Solapur									
Dama Phosala	It Director Higher Education Pune	Umesh Raiderkar									
Prin and It Director Higher Education	st. Director Higher Education, I une	Head Humanities & Social Science									
Print, and Jt. Director Higher Education,	V M Dhandarkar	VCMOU Nachik									
Palivel	R. W. Dilanualkan	I UNIOU, NASNIK									
Calma D. N.	Platui Patel College of Education, Gondia	C. D. Dondyo									
Salve K. N.	Canal Single	S. K. Panuya									
Department of Sociology, Snivaji	Sonai Singn	Head Education Dept. Mumbal University,									
University, Kolnapur	vikrain University, Ujjain	wumoai									
Covind D Shinda	G. D. Dotonkor	Alka Darshan Shriyastaya									
Ouvilla F. Sillillat Rharati Vidyanaath Sahaal of Distance	U. F. Fatalikal S. D. M. Dagrad College Honoyar Vermetalis	Alka Dalslidli Sillivästävä Shaskiva Spatkottar Mahavidvalava Dhar									
Education Contan Navi Mumbri	5. D. W. Degree Conege, nonavar, Kamataka	i Shaskiya Shalkotlar ivianavitiyalaya, Dhar									
Education Center, Navi Mumbai											

Chakane Sanjay Dnyaneshwar Arts, Science & Commerce College, Indapur, Pune Maj. S. Bakhtiar Choudhary Director,Hyderabad AP India.

S.Parvathi Devi

Rahul Shriram Sudke Devi Ahilya Vishwavidyalaya, Indore

S.KANNAN

Ph.D.-University of Allahabad

Ph.D , Annamalai University, TN

Awadhesh Kumar Shirotriya Secretary, Play India Play (Trust),Meerut Sonal Singh

Satish Kumar Kalhotra

Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.net

Indian Streams Research Journal Volume 2, Issue.11,Dec. 2012 ISSN:-2230-7850

Available online at www.isrj.net



### ORIGINAL ARTICLE



## EFFECT OF TEMPERATURE ON THE PERFORMANCE OF MODFET LOW NOISE AMPLIFIER

#### V.J.K.KISHOR SONTI AND V.KANNAN

Research Scholar, Sathyabama University, Chennai Principal, Jeppiaar Institute of Science and Technology, Kunnam, Sriperumbudur

#### Abstract:

In this paper the temperature influence on the performance of the modulated doped field effect transistor is analyzed. MODFET LNA design at 5.8GHz centre frequency is analyzed, whose dielectric constant of the substrate is 2.2 and the maximum gain value obtained is 16.203 dB with minimum noise figure value obtained as 0.24. Noise resistance variation w.r.t temperature was also obtained. Different values of performance parameters were obtained for different device temperatures, which clearly justifies the effect of thermal noise on the performance of the design. Lines used in the design along with the components are properly placed in the layout obtained. This work has been carried out using ADS software and the results obtained are in greater coherence with theoretical facts.

#### **KEYWORDS:**

MODFET, Temperature, Noise, Gain, Microstrip.

#### **INTRODUCTION**

In this current trend of integration technology, various advancements pertaining to speed, area and power consumption are path breaking. Semiconductor technology has reached the stages, where sometimes the tradeoffs among these factors become so serious. This situation forced researchers in the recent past to shift in different directions and one such way leads to high speed devices and their applications those contribute to the growth of this technology. Semiconductor compounds have become the topic of interest for many researchers and devices using AlGaAs and GaN have become major contenders in these developments. MESFETs (Metal Semiconductor Field Effect Transistor) and MODFETs (Modulated Doped Field Effect Transistor) are most commonly used devices in the manufacturing of monolithic circuits. Silicon is the most explored technology but it cannot show good performance in all operating conditions. The new wide band gap semiconductors like Gallium Nitride (GaN) based devices are useful for ultra-high power and ultra high frequency microwave applications. [1].This paper is organized as follows: Section I deals with the introduction and Section II is about the MODFET , its operation and MODFET Low Noise Amplifier operation and Section III discuss about the Results and Section IV is conclusion.

#### **II MODFET and MODFET LNA**

MODFET is popularly known as Modulated Doped Field Effect Transistor. A typical structure of Modulated Doped Field Effect Transistor is as shown in Fig.1.

Title:EFFECT OF TEMPERATURE ON THE PERFORMANCE OF MODFET LOW NOISE AMPLIFIER Source:Indian Streams Research Journal [2230-7850] V.J.K.KISHOR SONT, , V.KANNAN yr:2012 vol:2 iss:11



Fig.1. Typical Modulated Doped Field Effect Transistor Structure[3]

The electron traveling in the vertical direction will be collected by Two Dimensional Electron Gas layer (2DEG). [2]. The n-type AlGaAs layer acts as donor and an undoped AlGaAs acts as spacer along with an Undoped GaAs channel. [3]. Substrate is semi insulating and the concentration of two dimensional electron gas can be controlled by gate voltage.

MODFET LNA design using ADS can be carried out using different techniques. The method adopted in this design is microstrip based methodology.[7]. EEHEMT model of MODFET is chosen for this design and the design parameters are taken into consideration. Impedance matching is obtained in the design as shown in the Figure.2.



Fig.2. MODFET Low Noise Amplifier Design at 25 degree Celsius temperature

Micro strip line based methodology is followed and a line of 2.2 dielectric constant value is with H=0.75mm, and the centre frequency is 5.8GHz [4]. In the circuit, Impedance matching networks are designed using L and C components with terminations of 50 ohms at input and output. Operating voltage is 3v dc. [5].

Noise is an unwanted energy and this random motion constitutes an electric current. [6] The device structure consists of parameters, which are sources of noise. Ambient conditions also play a vital role on the performance of the device and most importantly device temperature is significant. Noise is inherent in the device along with the external factors like variable biasing and ambient conditions.

#### **III RESULTS AND DISCUSSION**

Fig.3, Fig.4 and Fig.5 represents the variation of Noise Figure, Noise resistance and Gain values w.r.t frequency and at 25 degree Celsius temperature. Noise influence on the device performance in

Indian Streams Research Journal • Volume 2 Issue 11 • Dec 2012

2





Fig.4. Noise Resistance variation 25 degree Celsius



Fig.5. Gain variation at 25 degree Celsius

Different temperature values are considered starting from lower temperature of 5 degree Celsius to 45 degree Celsius and the results were tabulated. Table I represents the variation of noise figure, noise resistance and gain values w.r.t to temperature variations. Fig.6 represents the layout of the MODFET LNA design. It also shows the perfect placement of components and microstrip lines on the layout.

3

Indian Streams Research Journal • Volume 2 Issue 11 • Dec 2012

#### EFFECT OF TEMPERATURE ON THE PERFORMANCE OF MODFET LOW.....



4

S.NO.	TEMPERATURE	NFMIN	RN	GAIN
1	5	0.246	0.057	16.203
2	15	0.263	0.060	16.202
3	25	0.358	0.068	16.199
4	27	0.378	0.074	16.197
5	35	0.655	0.166	10.579
6	45	1.943	1.579	4.603

Table I: Variation of NF min, Noise resistance and Gain w.r.t temperature

-+-	+																											
-+-	-	-+-																										
+	+	+																										
-+-	-+-	-+-																										
+-	-+-	+																										
+	* 57	5. HT 2	<u>Б И</u>	17.	+	+-	+	+-	+	+-	+-	+	<u>+</u>	-	+	-												
-+-	-**E		13 T	14.1									+			+												
+	*		-																									
+	•		1 *																									
+	-1-																											
+	-8-																											
+	-4		•																									
+	-1-																											
+	*		-																									
+-	-																											
+	-																											
+	-4-	-																										
+	- 1 -																											
+	-1-																											
+-	-																											
+	÷.,																											
+	*		1 *																									
+	-1-																											
+	15								+	+	-	-			+	-			+	+	-	+	+	-	+	+	+	
+	-8-		-	+	+	+	+	-									-	+	- T									
+	÷	-1-	- C					+	-1-			÷	-	-1-		-1-	 		1									110
-		-																	-	-								
			1000																									

Fig.6. Layout of the MODFET low noise amplifier design

#### **IV CONCLUSION**

From the above results it is crystal clear that the thermal noise is added to the device as the temperature increases, this is clear from increased noise figure values and increased noise resistance. Gain also drops from 16.203 dB to 4.603 dB i.e. approximately 12 dB for raise in temperature of 40 degree Celsius. Theoretical facts also reveal the effect of temperature on the design performance. Therefore, inference can be drawn out as the effect of thermal noise on the modulated doped field effect transistor based low noise amplifier is quite evident and significant to deal with.

#### REFERENCES

[1] Hasina F. Huq, Syed K. Islam.(2005), "Self-Aligned AlGaN/GaN MODFET with Liquid Phase Deposited Oxide Gate for Microwave Power Applications", IEEE, Department of Electrical and Computer Engineering, The University of Tennessee.
[2]B.VanZeghbroeck, Principles of semiconductor devices, 2011, ecee.colorado.edu/~bart/book/book/chapter3/pdf/ch3\_6.pdf.
[3] Mark C. Lau, Virginia Polytechnic Institute and State University, Small Signal Equivalent Circuit Extraction From A Gallium Arsenide Mesfet Device, 1997.
[4] ZHANG Hualiang, The Design of Low Noise Amplifier Using ADS, December 22, 2004
[5] V.J.K.Kishor Sonti, V.Kannan," Comparative analysis of HEMT LNA performance based on microstrip based design methodology "International Conference on Trends in Electrical, Electronics and Power Engineering (ICTEEP'2012), July 15 -16, 2012.
[6] www.wikipedia.org
[7] L.Aucoin, HEMTs and PHEMTs, parts.jpl.nasa.gov/mmic/3-IV.pdf

Indian Streams Research Journal • Volume 2 Issue 11 • Dec 2012

# Publish Research Article International Level Multidisciplinary Research Journal For All Subjects

Dear Sir/Mam,

We invite unpublished research paper.Summary of Research Project,Theses,Books and Books Review of publication,you will be pleased to know that our journals are

# Associated and Indexed, India

- ★ International Scientific Journal Consortium Scientific
- \* OPEN J-GATE

# Associated and Indexed, USA

- \*Google Scholar
- \*EBSCO
- \*DOAJ
- \*Index Copernicus
- \*Publication Index
- \*Academic Journal Database
- \*Contemporary Research Index
- \*Academic Paper Databse
- ★Digital Journals Database
- \*Current Index to Scholarly Journals
- \*Elite Scientific Journal Archive
- \*Directory Of Academic Resources
- \*Scholar Journal Index
- ★Recent Science Index
- \*Scientific Resources Database

Indian Streams Research Journal 258/34 Raviwar Peth Solapur-413005,Maharashtra Contact-9595359435 E-Mail-ayisrj@yahoo.in/ayisrj2011@gmail.com Website : www.isrj.net