ANALYSIS OF DIFFERENT RF BIPOLAR JUNCTION TRANSISTOR FOR APPLICATION OF VARIOUS MICROWAVE APPLICATION

[1] MAULIK B. PATEL, [2] DR.G.R.KULKARNI

1 Research scholar, Department of Electronics and communication, Kadi Sarva Vishwavidyalaya, Road Number 5, Sector 15, Gandhinagar, Gujarat 382016
[2] Research Guide , Department of Electronics and communication, Kadi Sarva Vishwavidyalaya, Road Number 5, Sector 15, Gandhinagar, Gujarat 382016

mbpatel_job@rediffmail.com, grkulkarni29264@rediffmail.com

ABSTRACT: RF FRONT END of every communication system the most precious block is LNA and its design to catch the optimum noise figure with faithful gain. So for getting the desired terms generally we are using FET FAMILY. But in today's technology formation of LNA using RF BJT with different Transistor Families with their essential characteristics can be possible. So for that purpose here we are trying to conclude some precious characterizing of RF BJT with practical hardware components available with their fundamental properties in the admirable pattern for the design point of view in the LNA formation for the RF Front End.

I.INTRODUCTION :

As nowadays the wireless communication Technology gets upgraded drastically in the form of design of Low Noise Amplifier. For the advancement of the noise figure we are using LNA devices by using various High Frequency components, As one of the major suppliers in the area of High Frequency (HF) components, the NXP Semiconductors N.V. is a Dutch global semiconductor manufacturer headquartered in Eindhoven, Netherlands stands for a continuous commitment to innovative Technologies and Products combined with volume strategy.[1] The NXP Semiconductors N.V. and Product Roadmap is directed to complete RF system solutions and device kits as well as standard and custom specific components in enhanced Si, GaAs and Hetero Materials(SiGe HBT, GaAs HEMT, GaAs HBT). A core competence is the fabrication of RF components in Surface Mounted Technology (SMT). High volume discrete in Si & GaAs, MMICs (Monolithic Microwave IC's) in Si & GaAs, and finally Fast Logic Circuits in enhanced Si technologies.[2]

II.TECHNOLOGIES

In wireless communication RF component using various microwave transistor family should be characterized in detail. The various RF TRANSISTOR can be the working horse technology. It is mostly based on ion implantation into semi insulating substrates. This is the least expensive process concerning raw material cost,

The latest addition to our broad RF transistor portfolio: QUBiC4 Si and SiGe:C transistors.
These next generation devices offer the best RF noise figure versus gain performance, drawing the lowest current. This performance allows for better signal reception at low power and enables RF receivers to operate more robustly in noisy environments.
Our broad portfolio of RF transistors can be used to perform nearly any RF function. We have categorizes them in different cluster of functionalities and frequencies (VHF to Ku band) to ease the selection.
As a global leader in RF technology and component design, NXP Semiconductors offers a complete portfolio of RF products.The use of various technology for the implementation of the high frequency devises are utilized for the same advancement criteria. from low- to high-power signal conditioning, that delivers advanced performance and helps simplify your design and the development process. Our solutions range from discretes and amplifiers (LNA, VGA, MPA) to mixers/oscillators.[3]

III.CHARACTERIZATION COMPARISON ON PERFORMANCE BASIS.:

There are various aspects are to be considered for the analysis of Hfe,fT,NF,GAIN,Ptoal,Application RF BJT of this high-frequency(HF) SiGe device is much higher than the fT of this high frequency(HF) Si device However, the fT of this high voltage(HV) SiGe device is comparable to the fT of this high-voltage (HV) Si device. This GaAs device has a higher breakdown than these Si and SiGe devices →Good for PA survivability to mismatch. PNPs and FETs are main attraction of Si and SiGe technologies →Increased PA functionality.

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The Si and SiGe technologies have a higher thermal conductivity than the GaAs technology →Can help ruggedness (PA survivability to mismatch), but die must be sufficiently thinned These Si and SiGe devices experience quasi-saturation at higher current densities→Bad for linearity which is to be considered.

NPN silicon microwave transistor for high speed, low noise applications in a plastic, 4-pin dual emitter SOT343F package.Some device is sensitive to Electr oStatic Discharge (ESD). Observe precautions for handling electrostatic sensitive devices.Such precautionsdescribed in the ANSI/ESD S20.20, IEC/ ST 61340-5, JESD625-A or equivalent standards.
SiGe will result in only minor improvements concerning the known cellular and cordless phone systems, i.e. will not substitute any Si Bipolar circuit due to higher cost. A key question is whether the material benefits justify the realization of 1-chip UMTS transceivers. Moreover, the main potential is for receivers at higher frequencies (2-20GHz). -- GaAs HEMT technology is the best MMW material upto 100GHz. It combines the advantages of unipolar transistors with outstanding performance down to 1.5V supply, but with a factor 2 higher wafer cost compared to GaAs MESFET.[4]

The GaAs HBT process is a candidate of a single supply voltage. Disadvantage to GaAs MESFET and HEMT are reduced shrink potential due to thermal problems ,reduced linearity of bipolar transistors and cost levels.
compared to HEMT. It could be argued that these Si and SiGe devices should achieve higher PAE than this GaAs device since they do not have a VCE offset.
These GaAs devices should provide more gain per stage than these Si or SiGe devices. BJT requires 0.07 V more than the emitter-base voltage. This reduction in turn-on voltage is caused by a decrease in the barrier height for injection of electrons. It is possible to reduce the power dissipation in the circuit environment. On the other hand, due to the smaller band gap in the base, the high temperature range is going to be more restricted than in Si. The mobility is computed using Bufler *et al.*, data. They have reported that minority carrier mobility in unstrained and strained *S*i0.88Ge0.12 are different as in the case of Si BJT.[5]
From the above table we can analyze the device level performance so that we can concentrate on improved gain as well as the noise figure analysis in the desired criteria so while designing the LNA using BJT which is really cost effective the recent market demand on the required level characteristics so that on the fulfillment of the product establishment features.

As we can say that we should also emphasize on the compromise base terminology for the every product features on the optimum level.
So for the thinking in the positive direction we can get the uplifting of the on the way device level judgmental view for the design based on low noise amplifier by using the bipolar junction transistor families which can emphasize on more solid state analysis.
The performance analysis chart shows the characteristics advantage and disadvantage depending upon the frequencies standard so we can judge that the solid state device characteristics gives us the different snapp off time which is analyzed in step recovery diode which is used in the microwave transistor families.
so we can use the overall minority charge life time study how they can give us the perfect criteria of the general show fall of the high frequency compatibility of the devices so we can judge the desired level characteristics according to the perfect microwave compatibility.

C.Pacakges Availability in different forms:

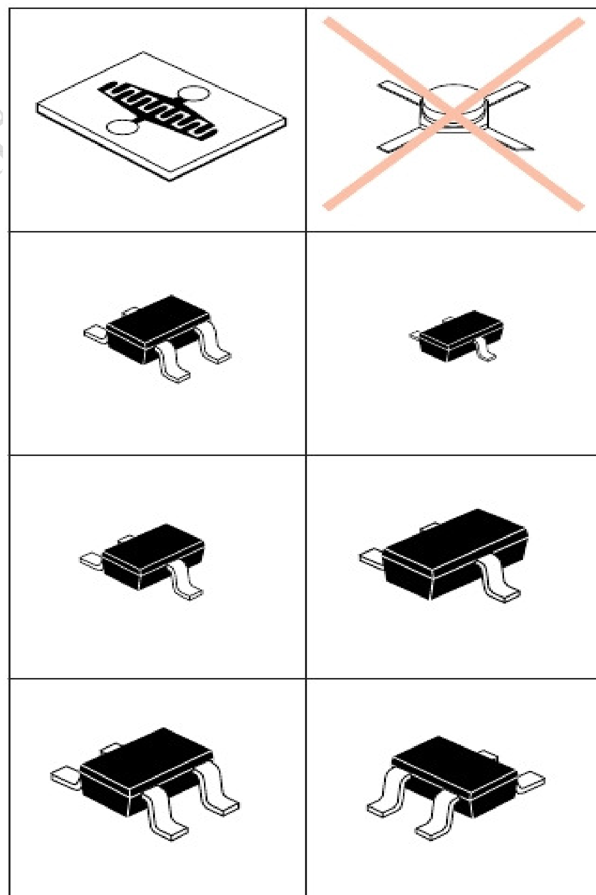

Figure:1 NEC PACKAGES

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Sr. No	RF BJT	hFE	fT	Ptot	NF	Gp(max)	APPLICATION
01	**NE68139R**	200	9.0	200	2	13.5	Low noise, high gain, low cost amplifier application.[6]
02	**AT41411**	150	7.0	225	1.4	18.0	Low noise, wideband amplifier, mixer and oscillator applications in the VHF, UHF, and microwave frequencies.[7]
03	**BFU690F**	135	18	490	0.65	20.5	Ka band oscillators DRO's,Cband high output buffer amplifi er,ZigBee,LTE, cellular, UMTS.[8]
04	**BFU710F**	375	43	136	1.45	14	2nd LNA stage and mixer stage in DBS LNB's, Low noise amplifiers for microwave communications syste m Ka band oscillators DRO's Low current battery equipped applications Microwave driver / buffer applications[9]
05	**BFU725F/N1**	280	55	136	0.7	18	2nd LNA stage and mixer stage in DBS LNB's Satellite radio Low noise amplifiers for microwave communications syste ms[10]
06	**BFU730F**	380	55	197	1.30	12.5	2nd LNA stage and mixer stage in DBS LNB's Low noise amplifiers for microwave communications syste ms Ka band oscillators DRO's Low current battery equipped applications[11]
07	**BFU760F**	330	45	220	0.50	22	Ka band oscillators DRO's High linearity applications Medium output power applications Wi-Fi / WLAN / WiMAX[12]
08	**BFU910F**	1900	90	300	0.65	13.0	K_u band DBS Low-Noise blocks[13]
09	**ON5088**	280	55	136	1.1	13	2nd and 3rd LNA stage in DBS LNBs Satellite radio Low noise amplifiers for microwave communications syste ms[14]

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WHERE:
1.Hfe:DC CURRENT GAIN:
2.ft: transition frequency ;Ghz
3.Ptotal: total power dissipation:mw
4.NF: noise figure : db
5. Gp(max): maximum power gain : dB

V.CONCLUSION:

From the above analysis we re trying to characterize the overall performance analysis of RF Bipolar Junction Transistor Families on the bases of Microwave Frequency compatibility and trying to find out the optimum resolution for the design of Low Noise Amplifier design point of view .The Various NXP SEMICONDUCTOR RF BJT has the fundamental suitable characteristic for design of Low Noise Amplifier at different frequency band.

REFERENCES:

[1] David M.POZAR"Microwave Engineering 3rd edition."
[2] MOS BJT Comparison lecture notes.
[3]RF maual 17 th addition NXP SEMICONDUCTOR.
[4] Otto Berger By" GaAs MESFET, HEMT and HBT Competition with Advanced Si RF Technologies" Siemens Semiconductor Group.
[5] Viswanathan Subramanian#1, Marko Krcmar #, M. Jamal Deen*, Georg Boeck, "A 6 GHz Fully Integrated SiGe LNA with Simplified Matching Circuitries ,", Proceedings of the 1st European Wireless Technology Conference
[6]Datasheet of NE68139R.
[7] Datasheet of AT41411
[8] Datasheet of BFU690F
[9] Datasheet of BFU710F
[10] Datasheet of BFU725F/N1
[11] Datasheet of BFU730F
[12] Datasheet of BFU760F
[13] Datasheet of BFU910F
[14] Datasheet of ON5088