

**HICUM/L2 & HICUM/L0 :  
implementation status  
in circuit simulators.  
A real case...**




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# SYNOPSIS

## INTRODUCTION.

-  Purpose : compare simulation results for a dedicated circuit, with different compact models and different commercial simulators.

## ABOUT THE CIRCUIT.

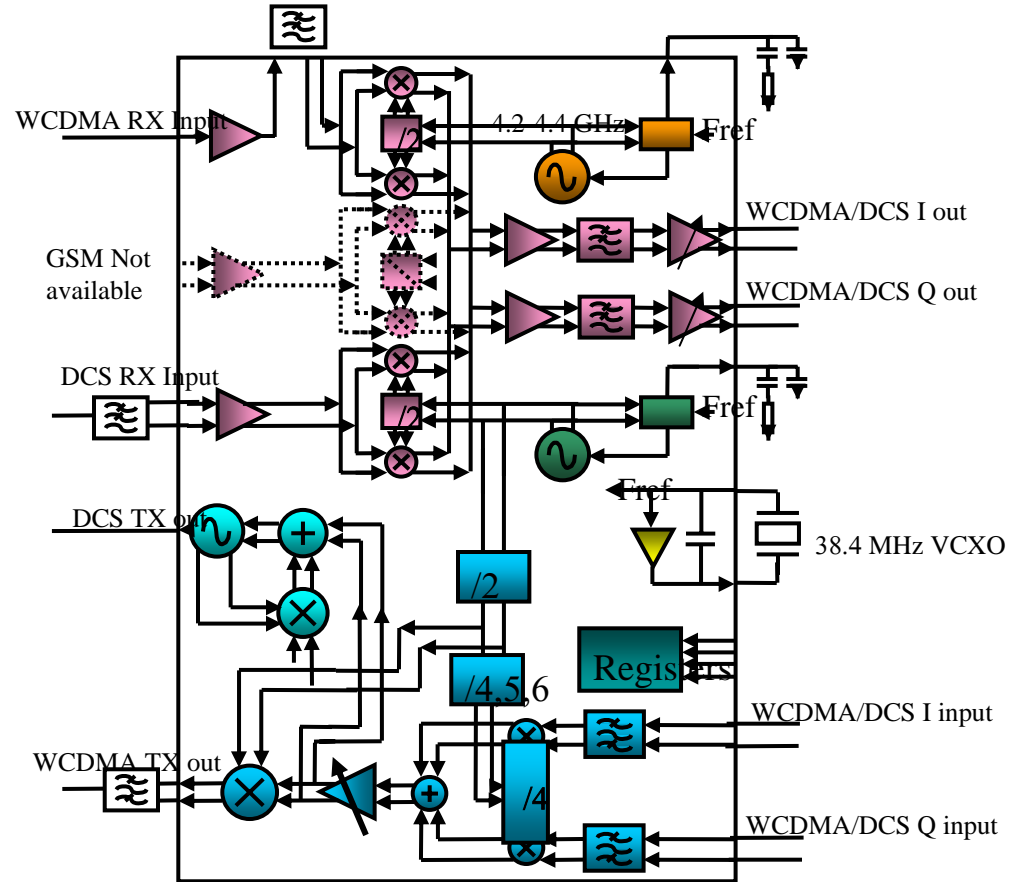
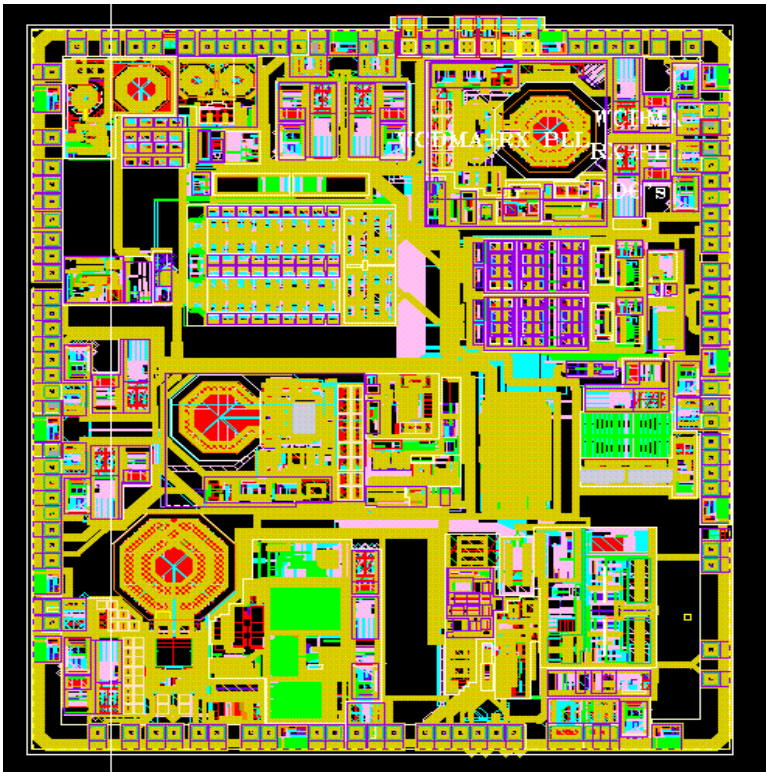
## THE SIMULATION TEST DETAILS.

## THE RESULTS.

## CONCLUSION.

# THE CIRCUIT

- Complete Multimode RF monochip Transceiver, including around 100 bipolar devices.



# THE SIMULATION TESTS DETAILS


## Models used :

- Hicum L0 v1.11
- ST-BJT
- Hicum L2 v2.10
- Hicum L2 v2.21

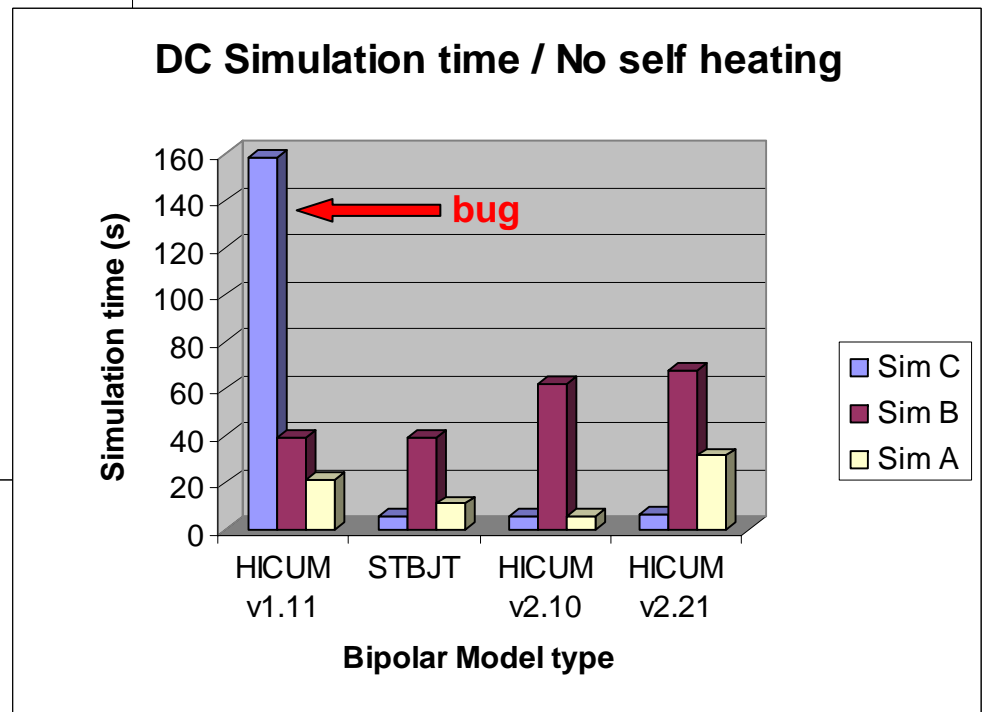
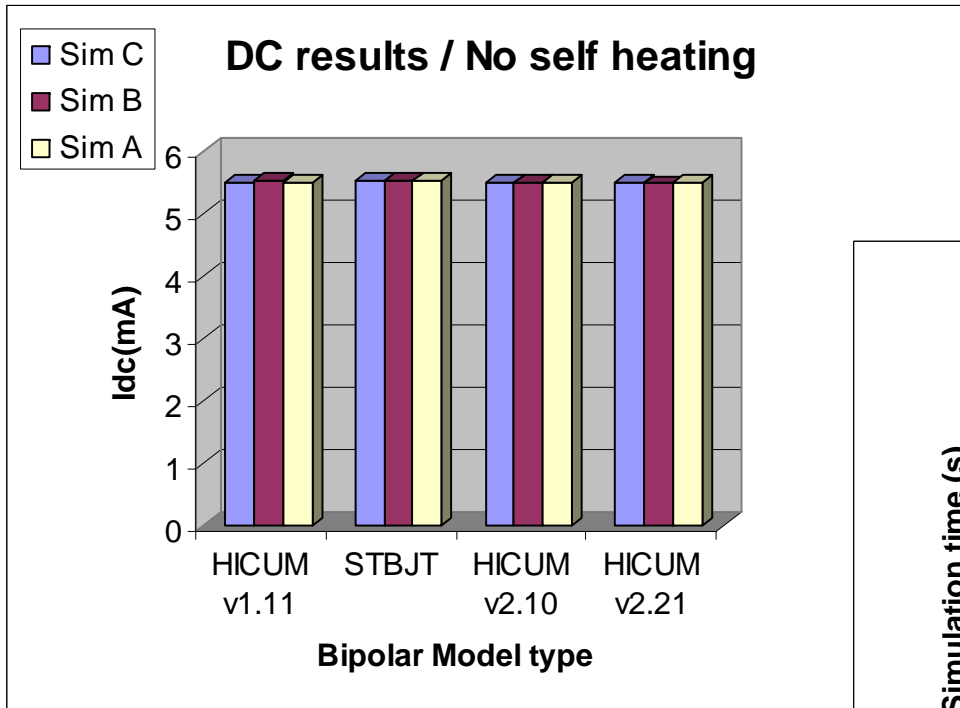
## 4 simulations performed :

- DC Analysis (circuit consumption)
- Noise Analysis (total noise, AC analysis, SNF=Spot Noise Figure)
- A swept harmonic balance for the IP1 computation
- A 2 tone harmonic balance for the IP3 computation

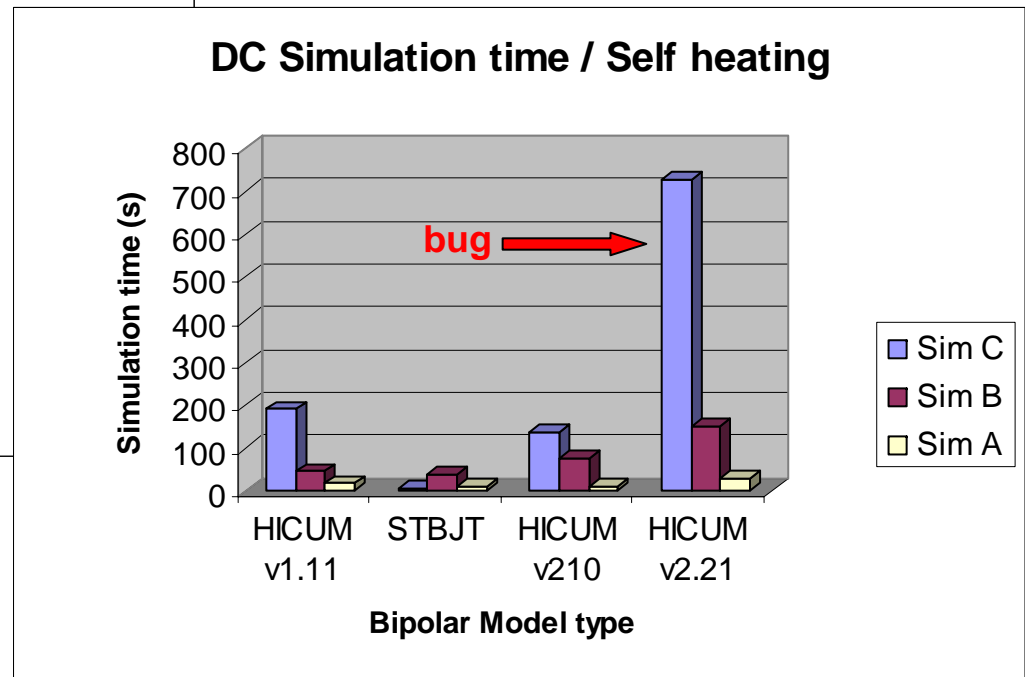
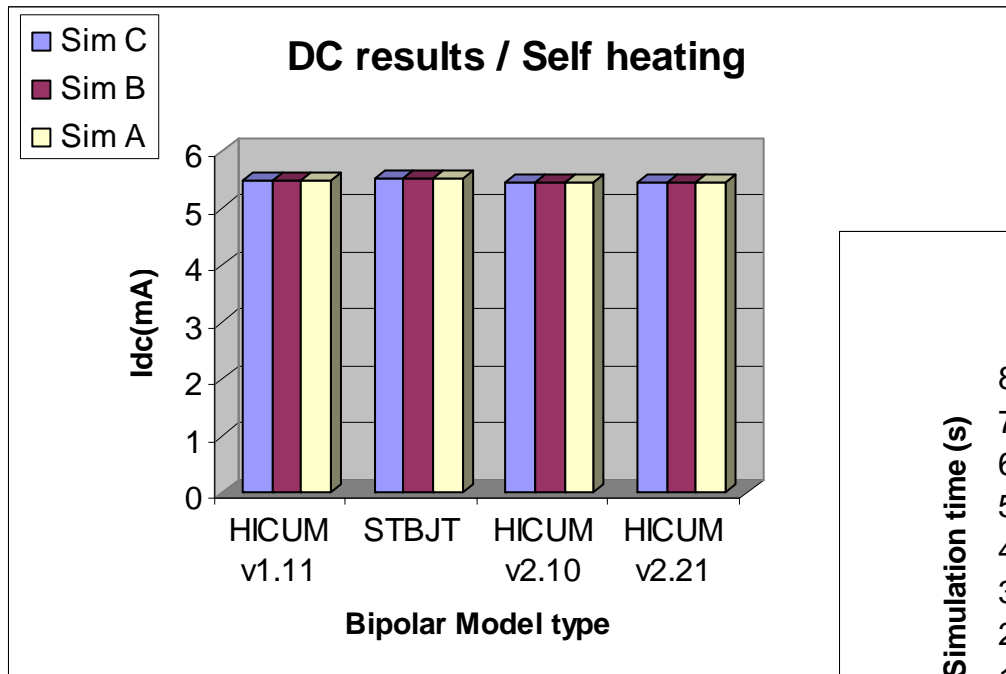
 Using the last version of 3 different simulators (A, B, C 😊) : each release available in June 2007.

 Used a Linux Redhat 32bits machine 2cpus 4GbRAM. The CPU time is the global CPU time reported by each simulator in its log files.

# DC NOSH @ T=27°C : results & CPU time



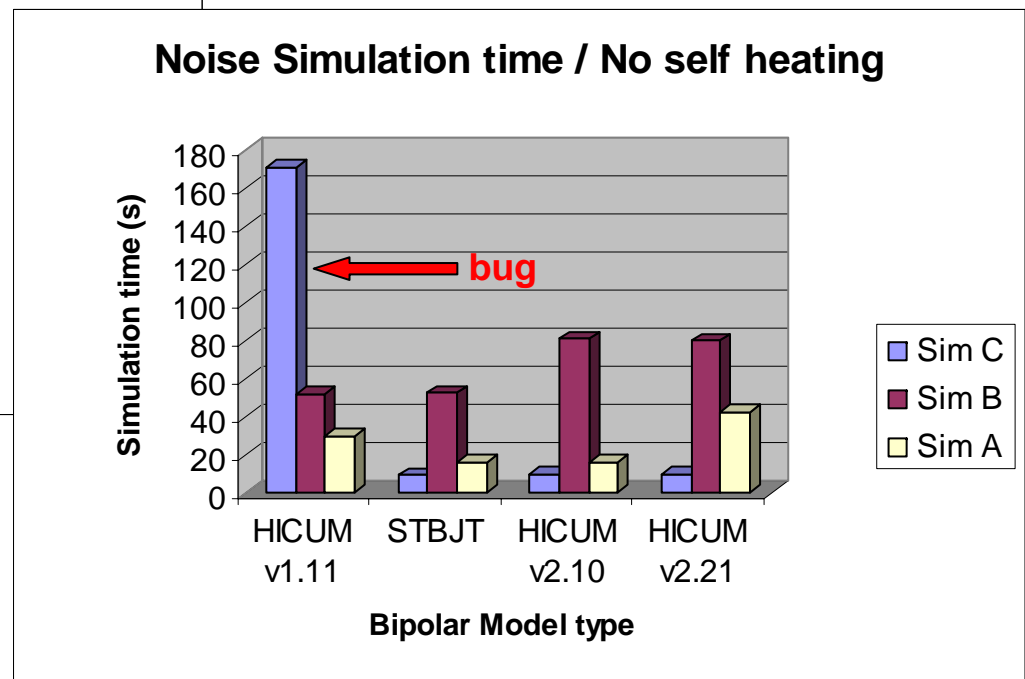
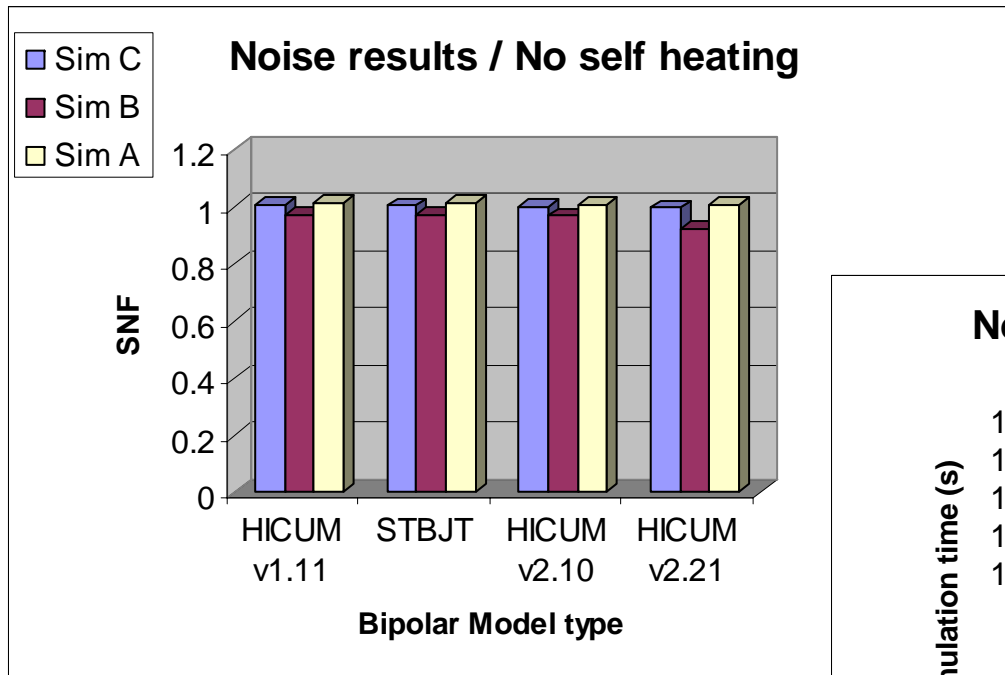
# DC SH @ T=27°C : results & CPU time



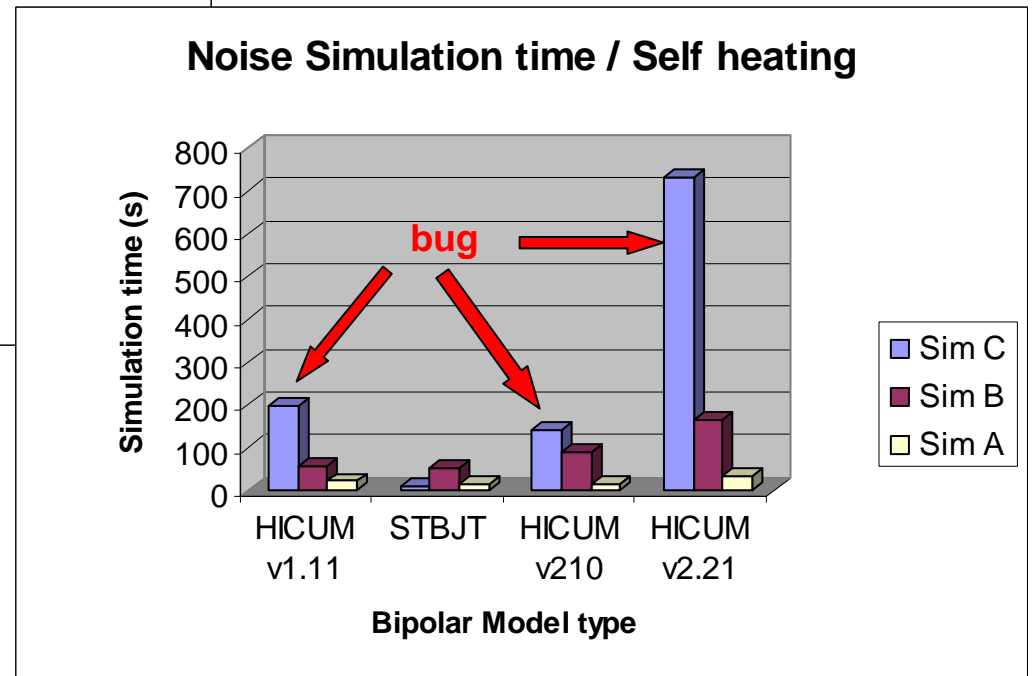
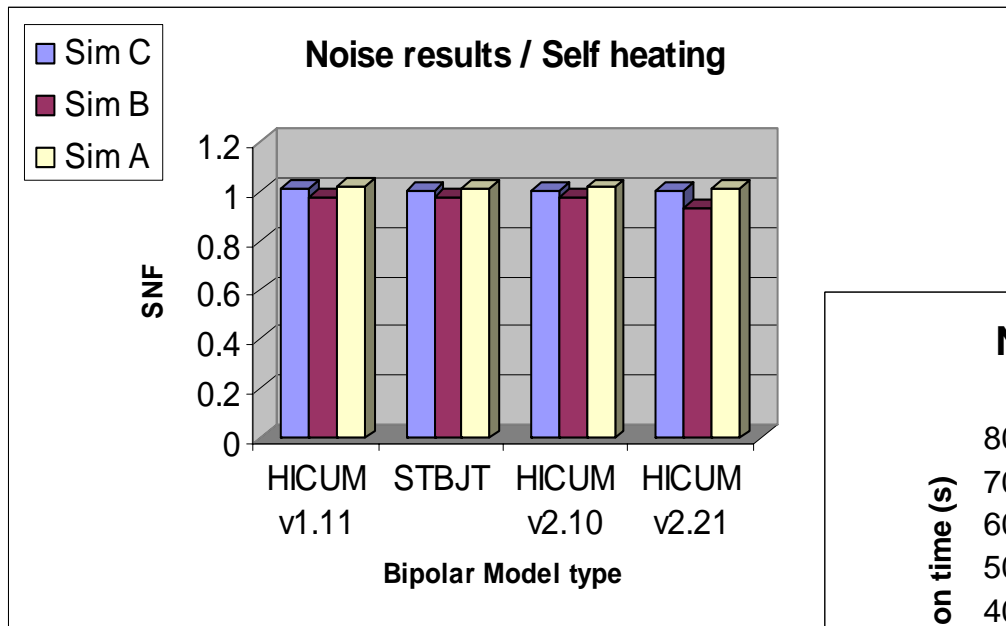
## DC results summary @ T=27°C

		HICUM level0 v1.11		STBJT		HICUM L2 v2.10		HICUM L2 v2.21 (if SH, FLSH=1)	
		Results (mA)	CPU Time	Results (mA)	CPU Time	Results (mA)	CPU Time	Results (mA)	CPU Time
<b>C</b>	NOSH	5.5		5.52	1x = 5.67s	5.49	1.05x	5.49	1.11x
	SH	5.507		5.52	1x =	<b>With SH, TIME(HL2 2.21) = 2 x TIME(HL2 2.10) ...</b>			
<b>B</b>	NOSH	5.52	1x	5.52	1x = 39s	5.49	1.59x	5.48	1.75x
	SH	5.496	1.17x	5.52	1x = 39s	5.474	1.97x	5.48	3.90x
<b>A</b>	NOSH	<b>In some simulator (where the model may be well implemented), TIME(HL0) = TIME(STBJT) (as expected)</b>				5.49	1.02x	5.49	2.83x
	SH					5.49	1.09x	5.49	2.52x

# Noise NOSH @ T=27°C : results & CPU time



# Noise SH @ T=27°C : results & CPU time

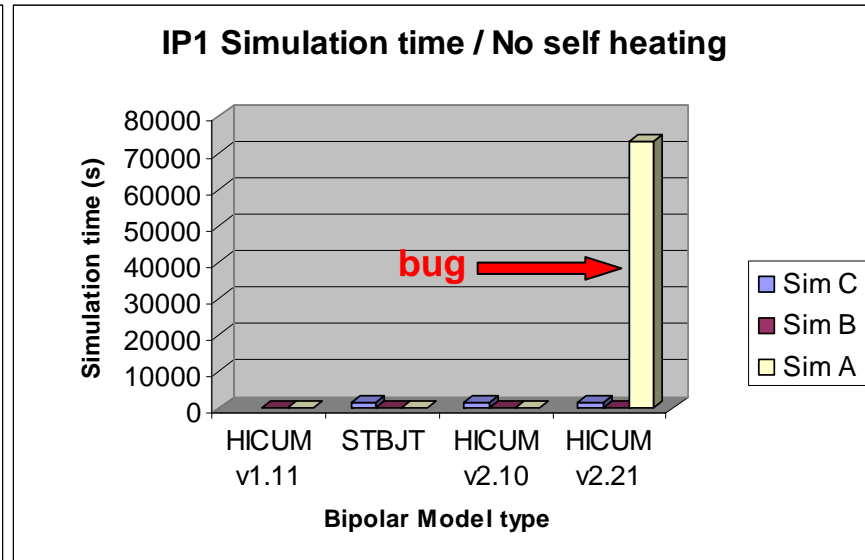
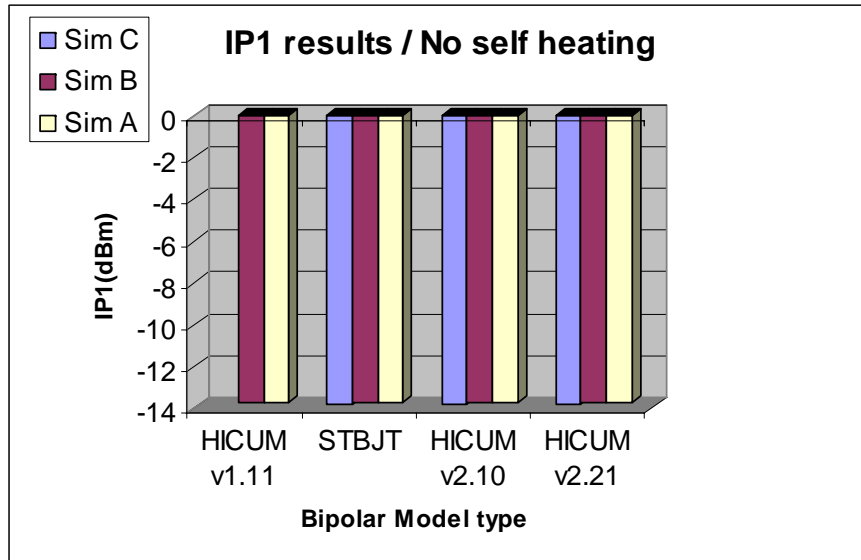


# Noise results summary (SNF) @ T=27°C

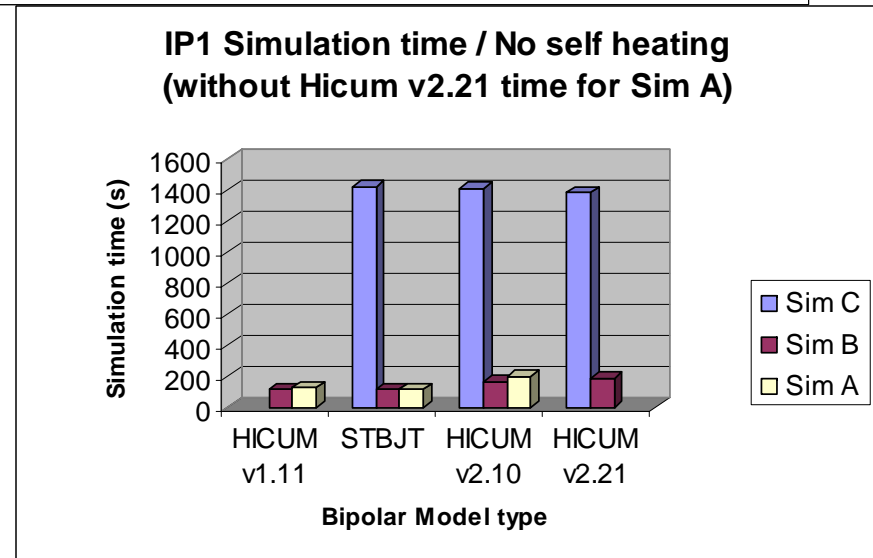
		HICUM level0 v1.11		STBJT		HICUM L2 v2.10		HICUM L2 v2.21 (if SH, FLSH=1)	
		Results (dB)	CPU Time	Results (dB)	CPU Time	Results (dB)	CPU Time	Results (dB)	CPU Time
C	NOSH	1.006		1.004	1x = 9.26s	0.999	1.05x	0.998	1.08x
	SH	1.011		1.004	1x =	With SH, TIME(HL2 2.21) = 2 x TIME(HL2 2.10) ...			
B	NOSH	0.97	1x	0.97	1x = 52.5s	0.97	1.54x	0.93	1.53x
	SH	0.974	1.1x	0.974	1x = 52.7s	0.975	1.74x	3.13x	
A	NOSH						1.02x	1.008	2.7x
	SH						1.08x	2.01x	

In some simulator (where the model may be well implemented),  
TIME(HL0) = TIME(STBJT) (as expected)

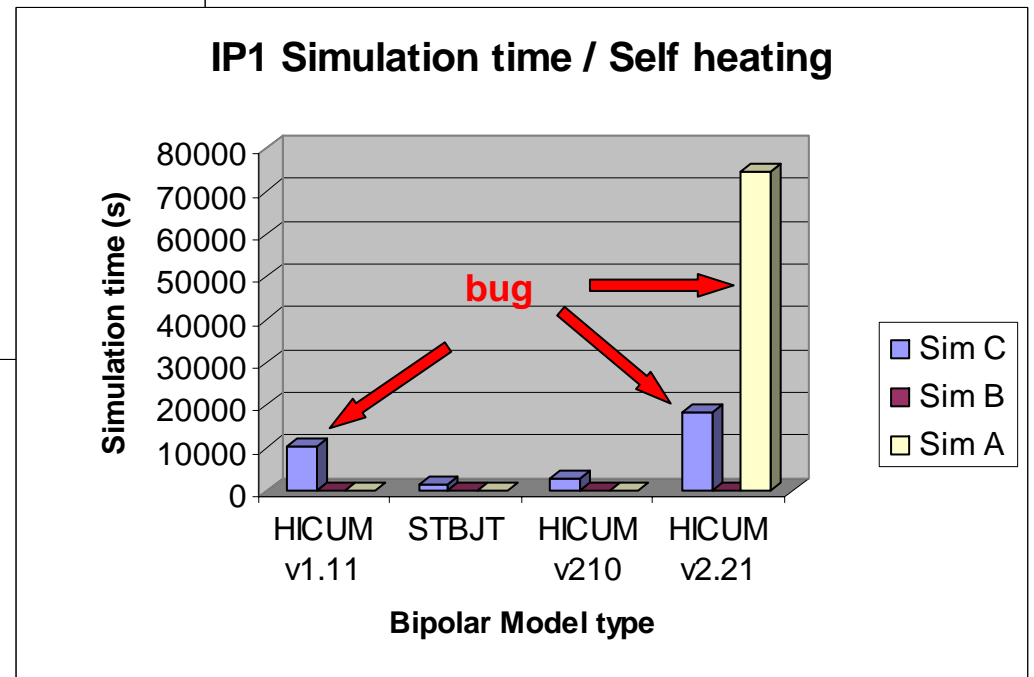
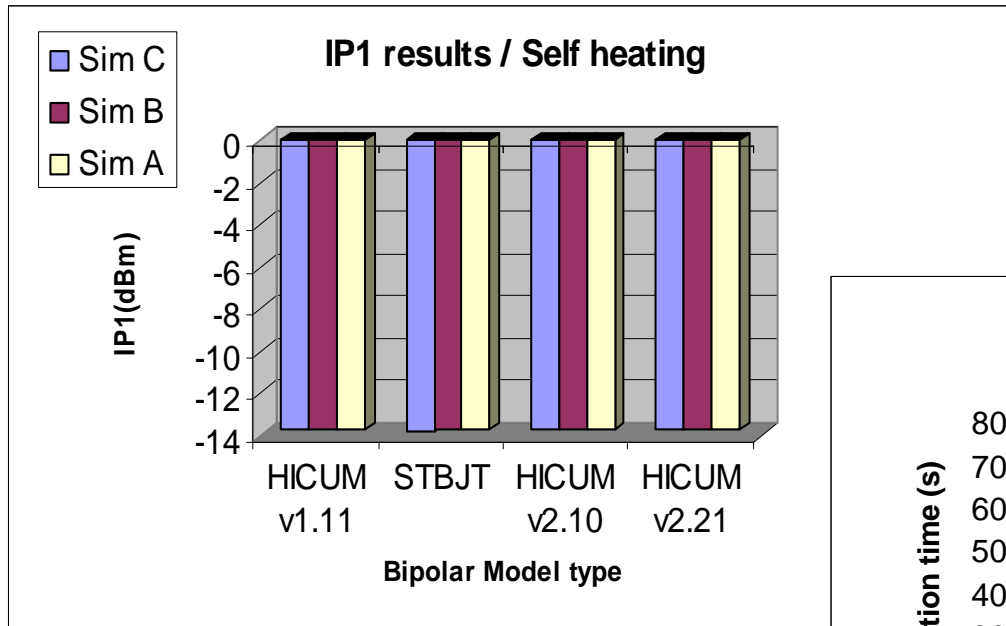
# IP1 NOSH @ T=27°C : results & CPU time



**Sim C** : If Hicum v1.11 ,no convergence.



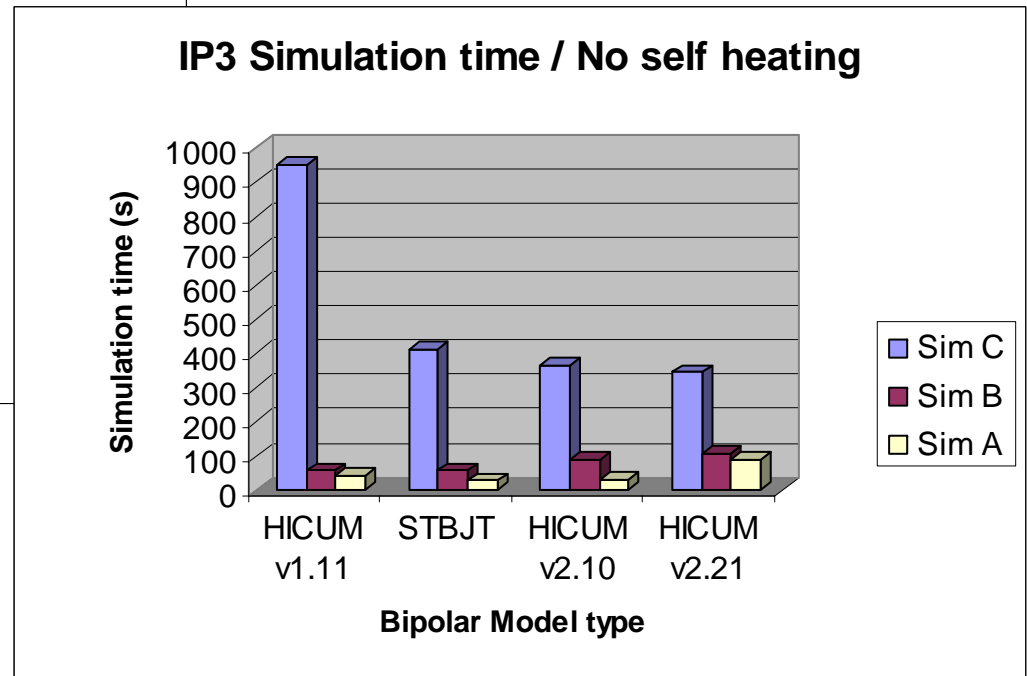
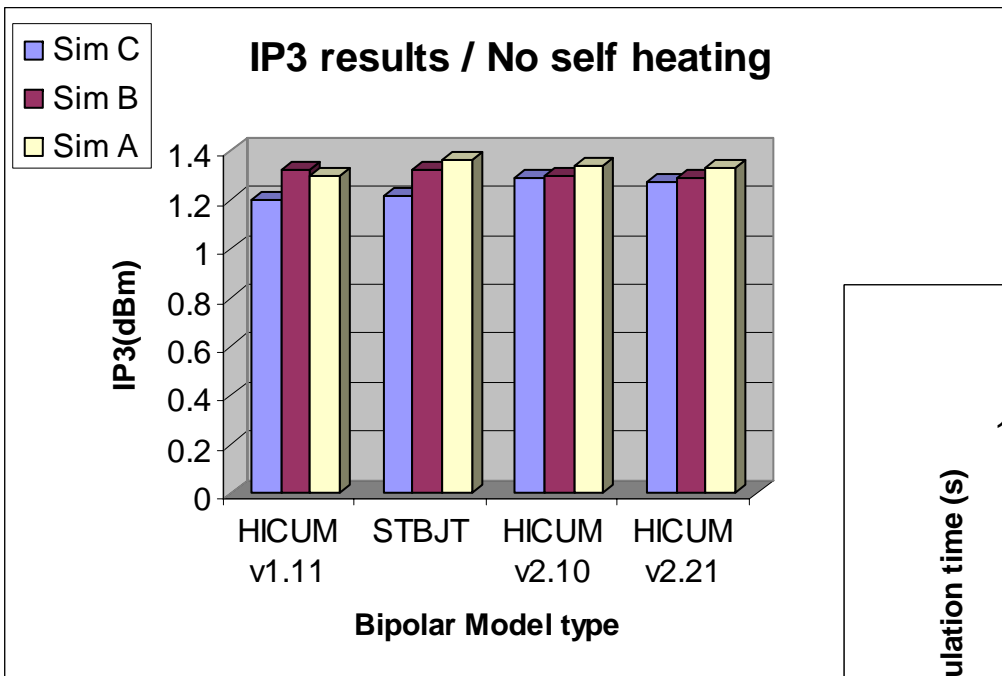
# IP1 SH @ T=27°C : results & CPU time



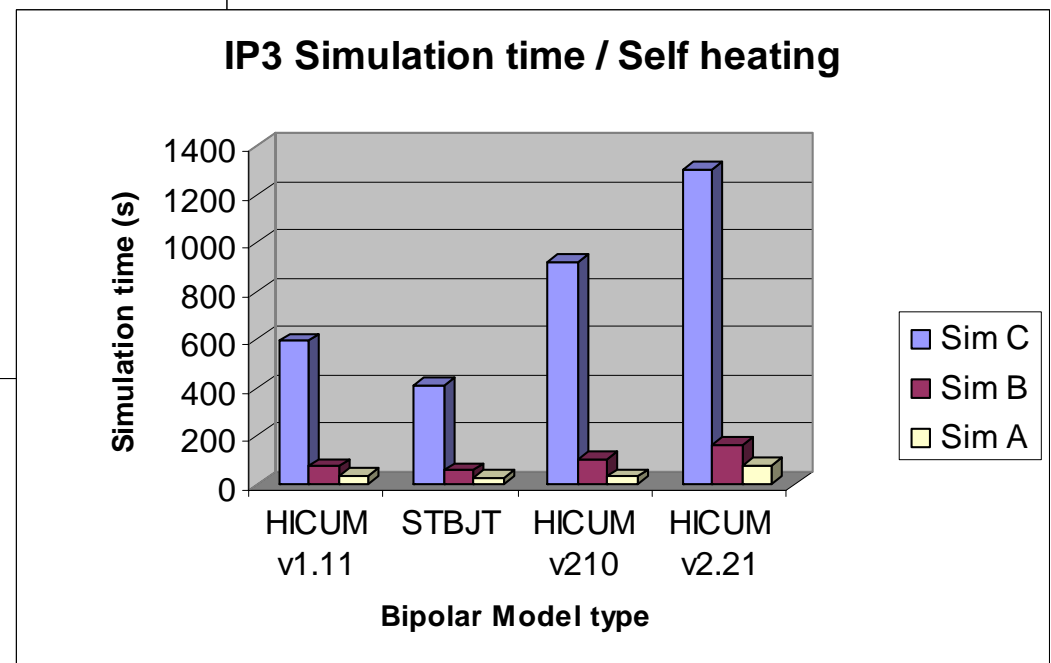
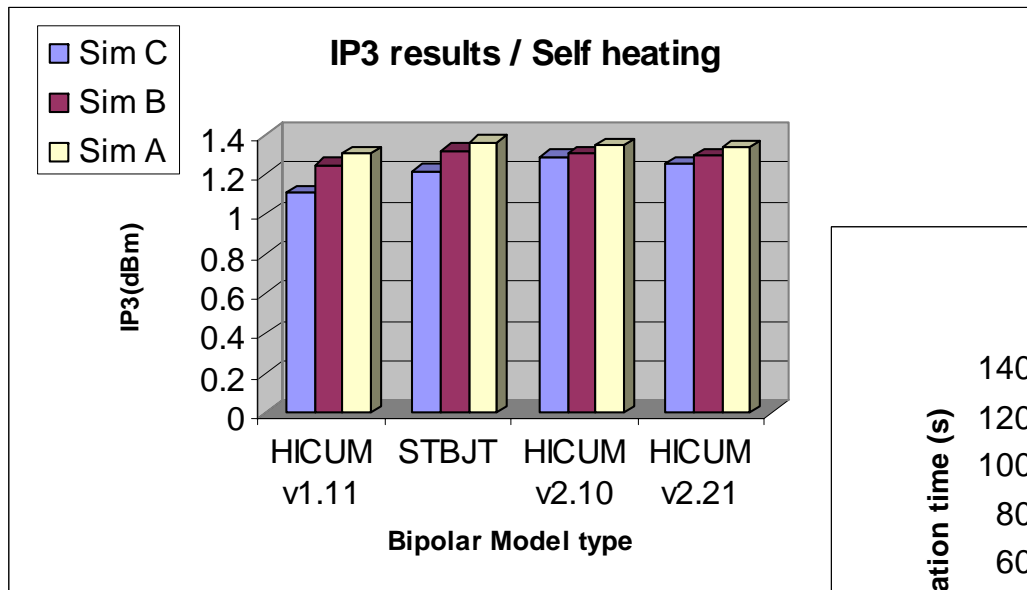
# IP1 results summary @ T=27°C

		HICUM level0 v1.11		STBJT		HICUM L2 v2.10		HICUM L2 v2.21 (if SH, FLSH=1)		
		Results (dBm)	CPU Time	Results (dBm)	CPU Time	Results (dBm)	CPU Time	Results (dBm)	CPU Time	
C	NOSH			-13.8	1x = 1425s	-13.8	0.99x	-13.8	0.97x	
	SH			-13.8	1x =	With SH, TIME(HL2 2.21) = 2 x TIME(HL2 2.10) ...				
B	NOSH	-13.7	1.01x	-13.7	1x = 117s	-13.7	1.43x	-13.7	1.61x	
	SH	-13.71	1.25x	-13.7	1x = 121s	-13.68	1.53x	-13.68	2.32x	
A	NOSH	In some simulator (where the model may be well implemented),					1.75x	-13.7		
	SH	TIME(HL0) = TIME(STBJT) (as expected)					1.90x	-13.68		

# IP3 NOSH @ T=27°C : results & CPU time



# IP3 SH @ T=27°C : results & CPU time



# IP3 results summary @ T=27°C

		HICUM level0 v1.11		STBJT		HICUM L2 v2.10		HICUM L2 v2.21 (if SH, FLSH=1)	
		Results (dBm)	CPU Time	Results (dBm)	CPU Time	Results (dBm)	CPU Time	Results (dBm)	CPU Time
<b>C</b>	NOSH	1.2	2.3x	1.22	1x = 413s	1.29	0.89x	1.27	0.83x
	SH	1.1					2.24x		3.2x
<b>B</b>	NOSH	1.32	1.0x	1.32	1x = 57.2s	1.30	1.56x	1.29	1.85x
	SH	1.25	1.31x	1.32	1x = 57.8s	1.31	1.85x		2.78x
<b>A</b>	NOSH						1.16x	1.33	3.2x
	SH						1.25x		2.94x

**With SH, TIME(HL2 2.21) = 2 x TIME(HL2 2.10) ...**

**In some simulator (where the model may be well implemented), TIME(HL0) = TIME(STBJT) (as expected)**

## CONCLUSION

- ❏ On a circuit realistic case, whatever the compact model and the simulator, the results quality is good and similar.
- ❏ However, an important difference exists for the CPU convergence runtime versus each simulator.  
*But for some simulator, HLO=STBJT for the convergence runtime, without sacrificing the quality (even in high injection area – not shown here).*

HLO would replace STBJT in the near future ...

- ❏ In SH mode, HL2 2.21 simu is longer than with HL2 2.10 ?!  
However, FLSH=1 is used for HL2 2.21 (power dissipation easier to compute...).

THANK YOU.  
Questions ... ?



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