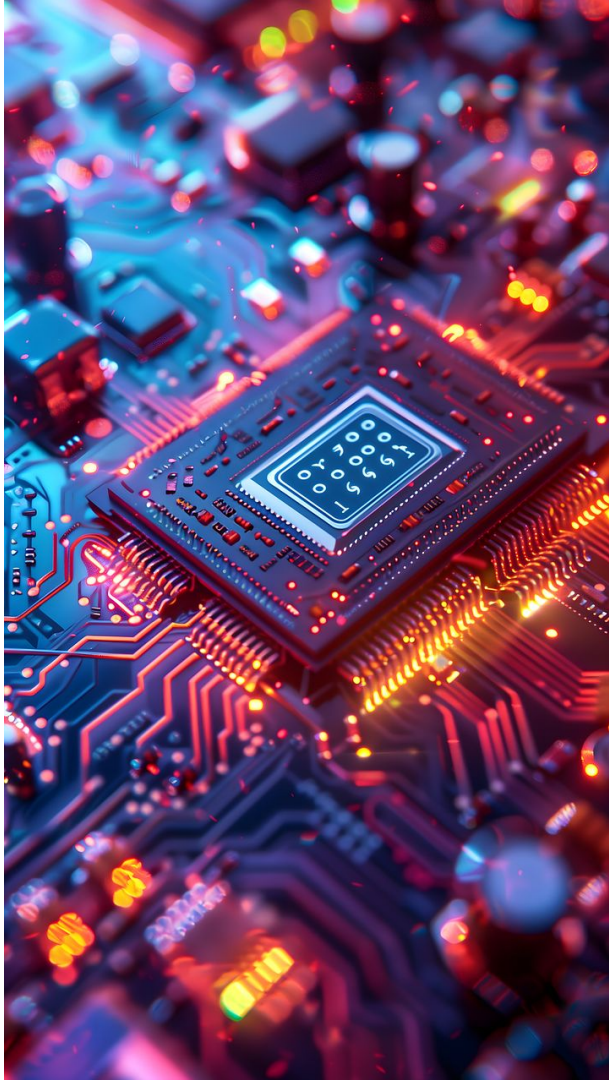
Building an Ecosystem Through IC Education in Colombia: A Model for Emerging Semiconductor Regions

Juan Sebastián Moya Baquero - SymbioticEDA



About me

- 03/2025: AMS Designer at SymbioticEDA
- 2024: Researcher at MICL - University of Michigan
- 2023: Ph.D.
- 2016: Master in Electrical Engineering - IC Area
- 2011: Electronics and Electrical Engineer

About me

- 2025-2
  Professor
    Introduction to IC design - Analog Flow (8 weeks) - gf180mcuD
    Digital IC design (8 weeks) - ihp 130

- 2023-1:
  Professor
    IC design - sky130A

- 2017 - 2022:
  Professor
    Electronics Devices (Semiconductors, PN junction, BJT, AC and DC MOSFET model).

    Electronics System Design (Negative feedback, stability, frequency compensation and noise)

IC design Flow - Proprietary CAD tools

cadence®

Tools license → $10,000 - $100,000
Virtuoso → $15,000 per license
In some countries in Latam, no possibility to access directly the tools. Via third party.

SYNOPSYS®
Silicon to Software™

Tools license → $20,000 - $100,000
Chile (Victor Grimblatt) → Prices are affordable in Latam

SIEMENS Mentor® A Siemens Business

Tools license → $1,000s - $10,000s

Taken from : https://www.cadence.com/content/dam/cadence-www/global/en_US/documents/training/training-na-catalog-price-list.pdf
https://c2s2.engineering.cornell.edu/blogposts/SP23/MagicVLSIvsCadenceVirtuoso#:~:text=If%20you%20want%20to%20be,the%20tool%20outside%20of%20industry.
https://www.quora.com/How-much-is-a-single-license-of-mentor-graphics-synopsys-or-cadence-electronic-design-automation-software

IC design Flow - PDK access

MUSE SEMICONDUCTOR

It's not just an MPW.

TSMC MPW FULL BLOCK TAPEOUTS

We support all TSMC technologies. Some of the most popular are below.

	180 MS RF G	180 HV BCD G2	130 MS RF G	65 MS RF GP/LP	40 MS RF G/LP
Price ($/mm2)	1,000	1,160	1,800	4,625	7,000
	28 HPC+ RF	**22 ULL**	**16 FFC**	**12 FFC**	**7 FF**
Price ($/mm2)	10,600	10,600	28,000	28,000	87,500

CMC MICROSYSTEMS

AMF Silicon Photonics General-Purpose Fabrication Process

amf ADVANCED MICRO FOUNDRY

$22,000
(per 3 mm x 8 mm design)

AMS 0.35 µm CMOS Process Technology (Basic)

ams

$998/mm^2
(Minimum charge is for a 10 mm^2 design)

GlobalFoundries® 12 LP

GlobalFoundries

$37,050/mm^2
(Minimum charge is for a 1 mm^2 design)

Note: This price is available only to academic researchers.

$29,952/mm^2
(Minimum charge is for a 9 mm^2 design)

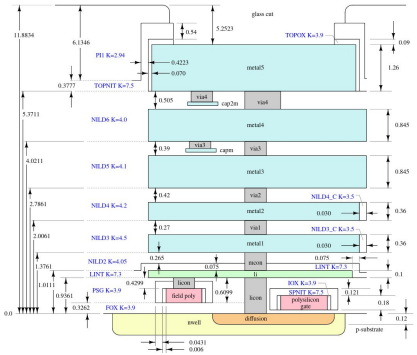
Tomado de :
https://www.musesemi.com/dedicated-mask-tapeouts
https://www.cmc.ca/technologies/

Open Source PDKs

2020

Google + skywater TECHNOLOGY

FOSS 130nm Production PDK
github.com/google/skywater-pdk



1.8V/ 5V/ 10V

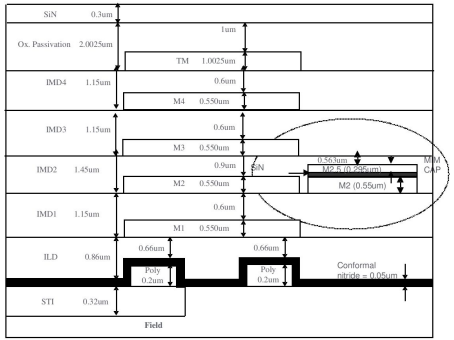
poly, high-res poly, N-well, P-well

MIM capacitor, varactores, poly capacitors.

2022

Google + GLOBAL FOUNDRIES

FOSS 180nm Production PDK
github.com/google/gf180mcu-pdk



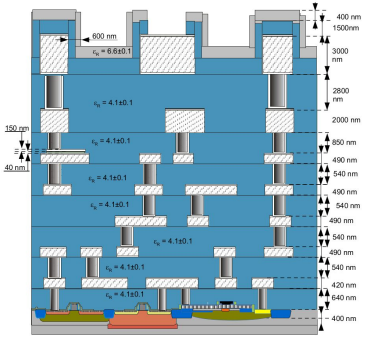
3.3V/ 5V/ 6V

P+Poly, N+Poly and HRES resistors

MIM caps

2023

ihp

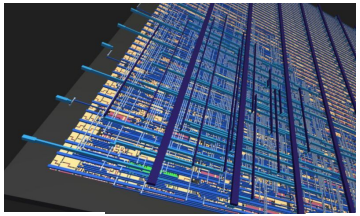


SiGe BiCMOS

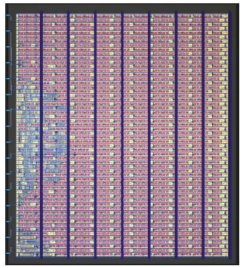
1.2V digital / 3.3 thick oxide

Polysilicon resistors / MIM caps

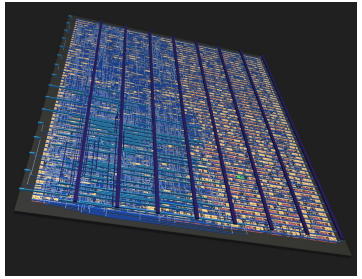
Tiny Tapeout 3 (2023)



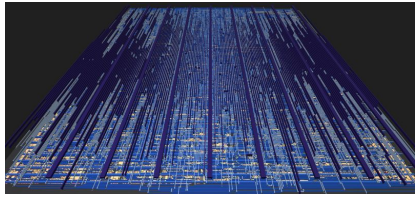
Pseudo Random
Number Generator



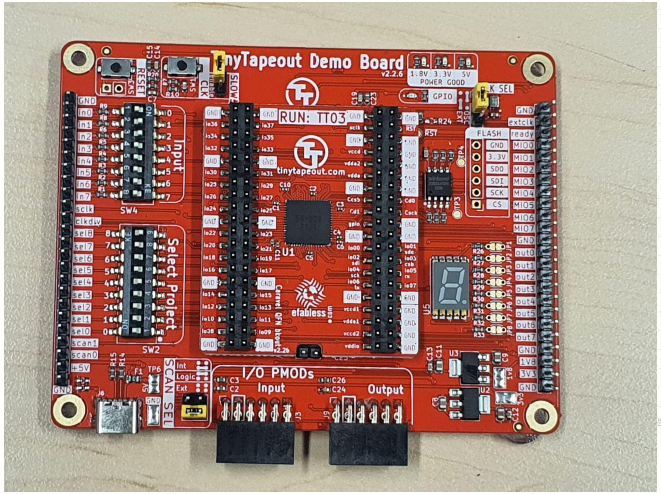
Microrobot /Finite State Machine

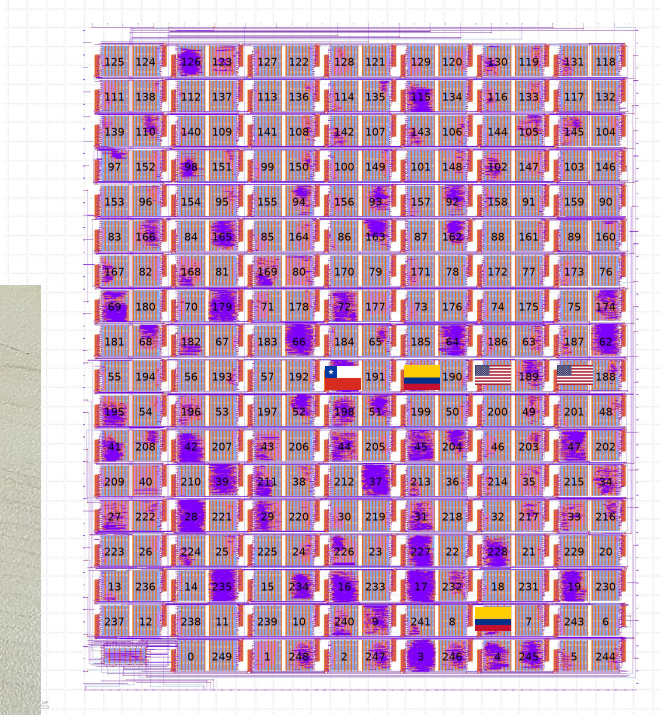


Programmable Finite
State Machine

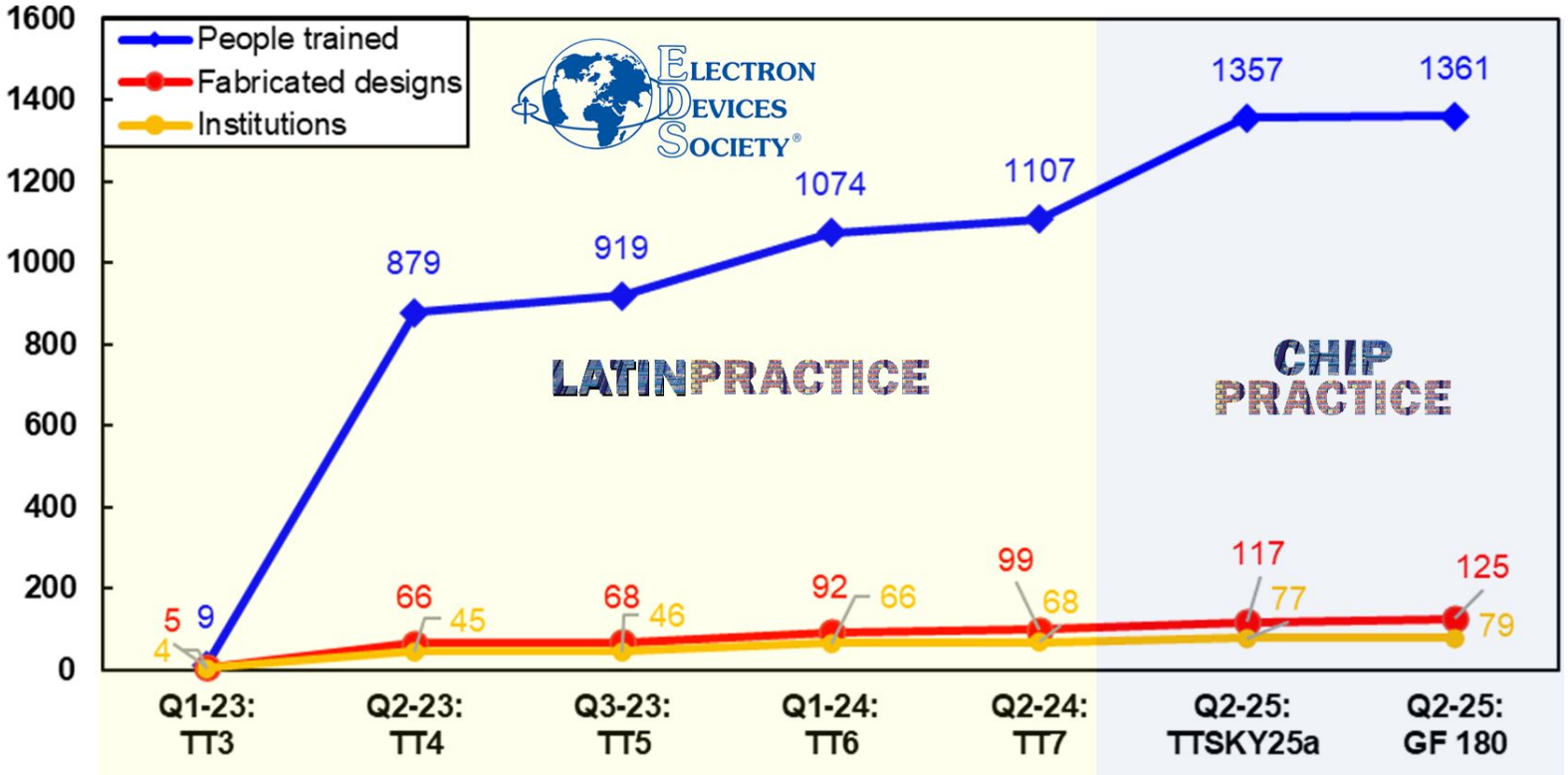


Digital Temperature sensor



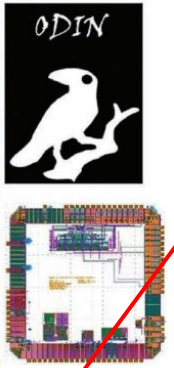


Some numbers



SSCS Contests

Chipathon 2023



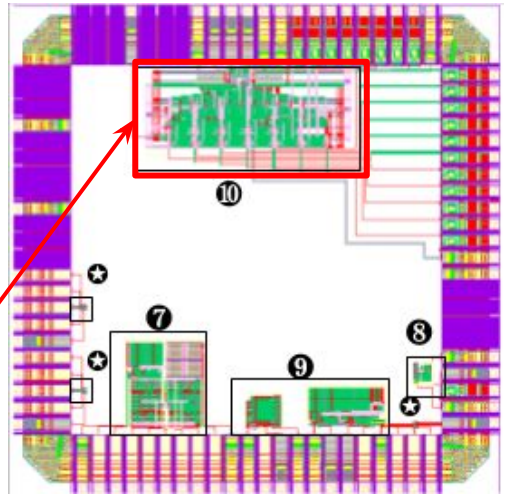
BRACOLIN - 2023 SSCS PICO OPEN-SOURCE CHIPATHON

UFSC - LCI:
GABRIEL MARANHAO SOARES
DENI GERMANO ALVES NETO
CESAR AUGUSTO MARCELO ALBUQUERQUE
AUGUSTO DE PAULO FRANCO
FELIPE HUGO COSTA DE OLIVEIRA
THIAGO HENRIQUE SANTOS
NATANAEL RISSI BERTAMONI

UNIANDES - CMUA:
JUAN SEBASTIAN MOYA BAQUERO
FREDY SEGURA QUIJANO

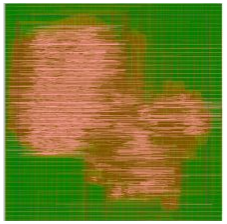
FIGURE 4: "Team Odin": team snapshots.

https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10858185

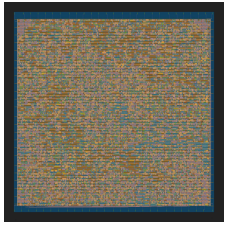


❼ Current controlled band-pass filter
❽ Clock reference generator (1MHz)
❾1.3V Voltage Reference (left) & Vout= 1.65V LDO (right)
❿SAR ADC
✪Short Channel transistors (characterization)

Code-a-Chip



GreenRio 2: A Linux-compatible RISC-V processor developed with a fully open-source EDA flow. (link)



Coordinate rotation digital computer (CORDIC) with OpenLane. (link)

2025 TC-OSE @ CAC y Chipathon

2025 Technical Committee on the Open-Source Ecosystem

Boris Murmann
Univ. Hawaii
USA

Mehdi Saligane
Brown University
USA

Mitch Bailey
Indep. Contractor
Japan

Kwantae Kim
Aalto University
Finland

Ali Sabir
FAST-NUCES
Pakistan

Jorge Marín
U Tec. Federico
Chile

NEW

Juan S. Moya
Symbiotic EDA
Colombia

NEW

Tim Ansell
ARC PBC
USA

NEW

Saptarshi Ghos
ETH Zurich
Switzerland

Matt Venn
Chipflow
Spain

Harald Pretl
Kepler Univ., Linz
Austria

Sadayuki Yoshitomi
Rapidus
Japan

Tim Edwards
Efabless
USA

NEW

Jun-Ichi Okamura
AIST Solutions
Japan

NEW

Akira Tsuchiya
University of Shiga
Japan

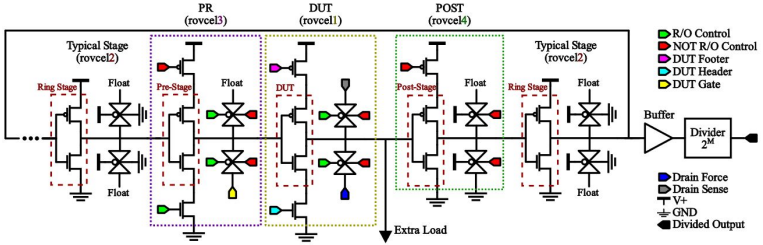
NEW

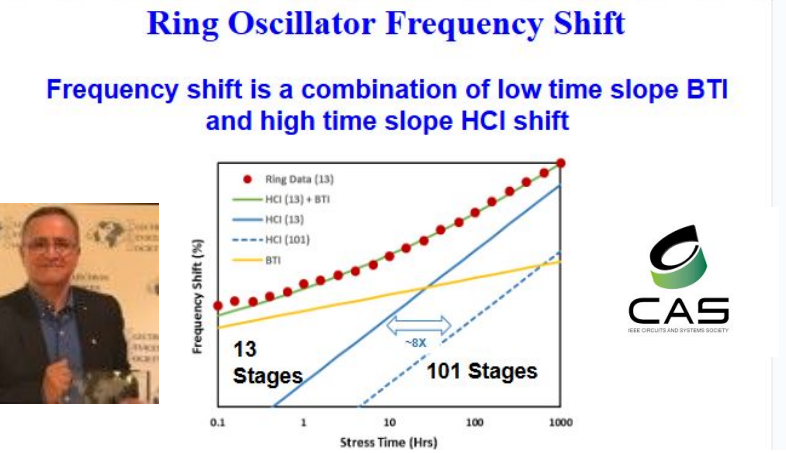
Gregory Kielian
Google
USA

IEEE
Advancing Technology for Humanity

UNIC-CASS contest 2024 (sky130)

UNIC-CASS Material



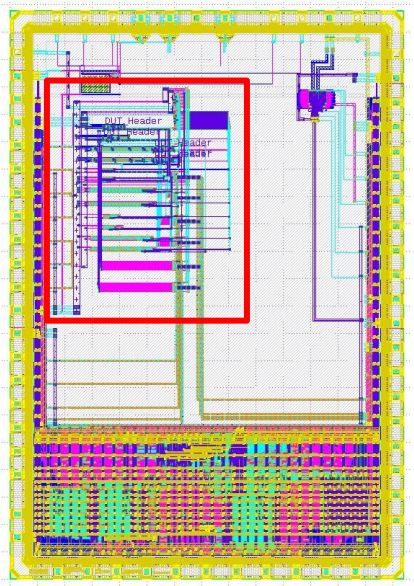


From: HC_BTI_RingOsc_Overview. Fernando Guarín

Jeison Acevedo
(Est. MSc. UIS)

Jorge Angarita
(Est. MSc. UIS)

Eduardo Caballero
(Est. MSc. UIS)



Juan S. Moya
(Investigador UMich)

Nestor Matajira
(Ingeniero UIS)

Ramón Stiven Sarmiento Castro (Estudiante UIS)

Nicolas Orcasitas Garcia
(Ingeniero UIS)

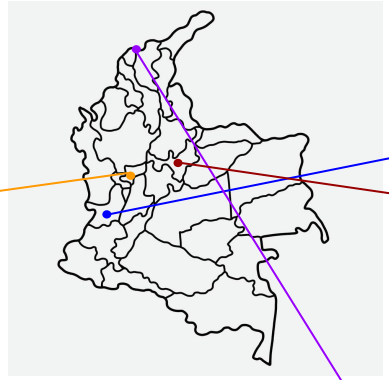
Daniel Barrios
(Ingeniero UIS)

Workshops in 2024 and 2025 (COL)

2024

Onsilicon

42 participants



2025

Symbiotic EDA

45 participants

Sept. 1st and 2nd

16 participants

Oct. 27th and 28th

31 participants

Nov. 11th and 12th

FVTVRVM ÆDIFICAMVS

Uptc®

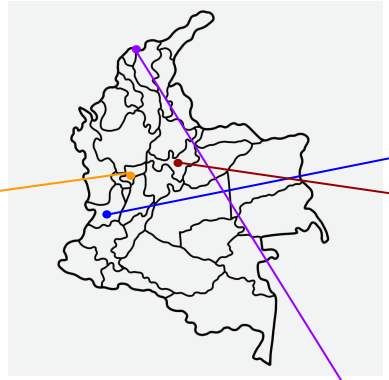
Universidad Pedagógica y Tecnológica de Colombia

Workshops in 2024 and 2025 (COL)

2024

Onsilicon

42 participants



2025

Symbiotic EDA

45 participants

Sept. 1st and 2nd

16 participants

Oct. 27th and 28th

31 participants

Nov. 11th and 12th

FVTVRVM ÆDIFICAMVS

Uptc®

Universidad Pedagógica y Tecnológica de Colombia

134 participants trained in both digital and analog IC flows (fundamentals courses).

2025 Cherry on Top


JSMB


Jorge Iván Marín


Lorena García

Dec. 1st - 11th

43 participants
5.5 days Workshop

Universidad del Quindío

Analog Training

Digital Training

November 3, 2025

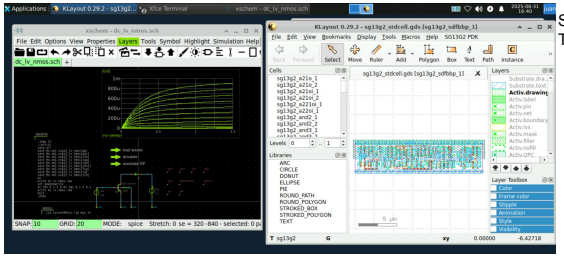
Dear Dr. Moya-Baquero,

Thank you for applying to the IEEE SSCS / EDS Semiconductor Education, Empowerment, and Industry Development (SEED) Program. We are following up on your recent interview with the SEED selection committee members. Congratulations on your selection to the 2025 roster!

The interviewers enjoyed speaking with you regarding your plans for student outreach in Columbia and your plans for a workshop and engagements at the university level. They are looking forward to learning more about the outcome of this visit, your report that will highlight the results of the engagement and your recommendations for future longer term engagements. The selection committee encourages you to include a high-school visit to your itinerary and outreach plans.

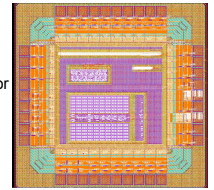
Symbiotic EDA

Bluegarden: Environment for IC design and verification using open source tools



SymbioticEDA tapeout with ihp130 TO09/25:

- SPI core
- ADC
- 13- RO and 101-RO for reliability characterization



Digital Flow
Analog Flow
AMS Flow

2025 Cherry on Top

November 3, 2025

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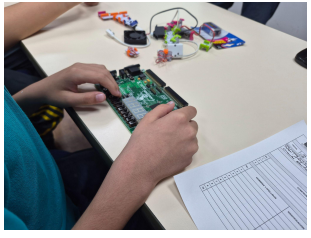
JSMB


Jorge Iván Marín


Lorena García

Dec. 1st - 11th



2025 Cherry on Top


JSMB

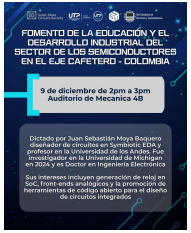

Jorge Iván Marín


Lorena García

Dec. 1st - 11th

Universidad Tecnológica

UNIVERSIDAD NACIONAL DE COLOMBIA
SEDE MANIZALES



COFFEE ELECTRONICS
Measurement Environments For Everyone, Everywhere

ZanySignals

iNGE LEAN
Ingeniería especializada a la medida

November 3, 2025

Dear Dr. Moya-Baquero,

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Visit to local electronics industry with the possibility to develop ASIC solutions with OS tools

Undergrad Thesis 2023 (sky130)

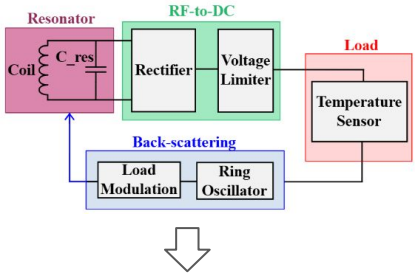
Senior applications Engineer (Synopsys)

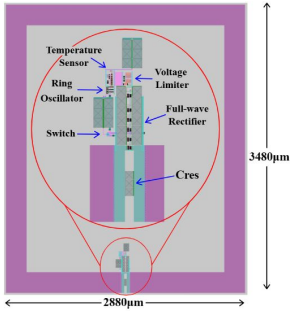
Master's student at Dresden University of Technology + Testing Engineer (Intern) at Infineon

Universidad Industrial de Santander

Block Design for an RFID Integrated Tag in an Open-Access Technology Node.

Antony Sanabria Calderón, Karla Camacho Mercado, Juan Sebastián Moya Baquero* and Ernesto Aguilera Bermúdez†
*Integrated Systems Research Group - OnChip, Universidad Industrial de Santander, Bucaramanga - Colombia
† Research Group - RadioGis, Universidad Industrial de Santander, Bucaramanga - Colombia
antony2180367@correo.uis.edu.co, karla2180397@correo.uis.edu.co,
juan2178217@correo.uis.edu.co, eaguiler@uis.edu.co





Open-source standard cell and I/O cell design

Jhon Steven Pinto, Nelson Rodríguez, Juan Sebastián Moya, Jaime Barrero
Integrated Systems Research Group - OnChip, Universidad Industrial de Santander, Bucaramanga - Colombia
jhon2180408@correo.uis.edu.co, nelson.rodriguez4@correo.uis.edu.co,
juan2178217@correo.uis.edu.co, jbarrrero@e3t.uis.edu.co

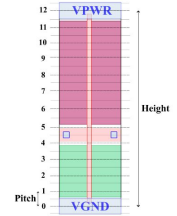
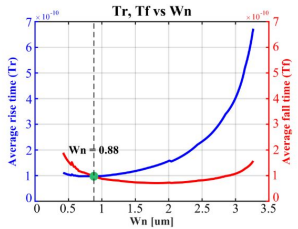
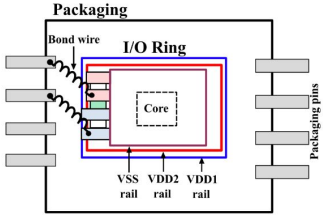
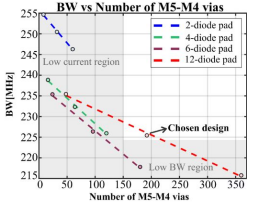


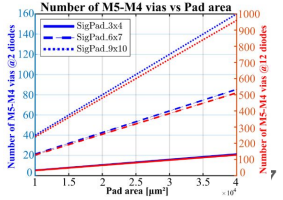
Fig. 1: An standard cell of 12-track height.



Cell	Area	Function
INV	8.83	!A
BUFF	11.04	A1
NAND2	11.04	!(A1 & B1)
NOR2	11.04	!(A1 | B1)
AOI21	15.46	!((A1 & A2) | B1))
OAI21	15.46	!((A1 | A2) & B1))
AOI22	19.87	!((A1 & A2) | (B1& B2))
OAI22	19.87	!(A1 | A2) & (B1 | B2))
AOI211	19.87	!((A1 & A2) | B1 | C1)
OAI211	19.87	!((A1 | A2) & B1 & C1))







Politics in Colombia

Asunto: Radicación Proyecto de Ley por la cual se fomenta la industria electrónica y de semiconductores en Colombia.

Respetados señores,

Por medio de la presente nos permitimos radicar el Proyecto de Ley "Por la cual se fomenta la industria electrónica y de semiconductores en Colombia".

De manera atenta solicitamos respetuosamente iniciar el trámite correspondiente, en cumplimiento de las disposiciones previstas en la Constitución y la Ley, conforme el siguiente articulado y la respectiva exposición de motivos.

Cordialmente,

ARTÍCULO 1. Objeto. La presente ley tiene por objeto crear condiciones que favorezcan el fortalecimiento del ecosistema de la industria electrónica y de semiconductores, a través de reconocer esta industria como un eslabón estratégico para la soberanía tecnológica y el crecimiento económico del país; fomentar la creación y consolidación de empresas especializadas en electrónica y semiconductores; propender por el entrenamiento y la formación de capital humano nacional; apoyar el desarrollo de procesos de investigación, transformación, comercialización e innovación y crear mecanismos para atraer la inversión nacional y extranjera en el sector, con el fin de apoyar la inserción de Colombia en la cadena de valor global de la industria electrónica.

Approved in second debate in the Senate on August 19, 2025.

Continues its passage through the House of Representatives

Lorena García

Conclusions and Remarks

- OS tools are important for developing the IC design workforce in Latin America.
- OS tools democratise IC design and lower the barriers to accessing manufacturing.
- Great efforts from IEEE are contributing to this OS ecosystem.
- This could be an interesting approach for developing commercial ASICs for the local industry.
- OS tools and flows need to be improved to develop more reliable solutions and attract more attention from industry.

Thanks a lot!

Questions?

Contact Information: jsmoya07@gmail.com