A 500-MS/s 8-bit SAR ADC Generated from an Automated Layout Generation Framework in 14-nm FinFET Technology

ASP-DAC 2025

University Design Contest

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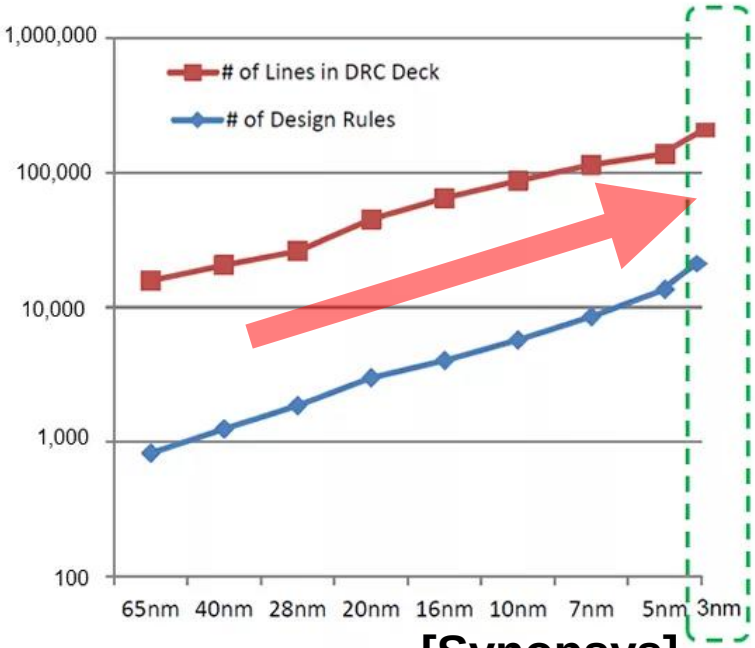
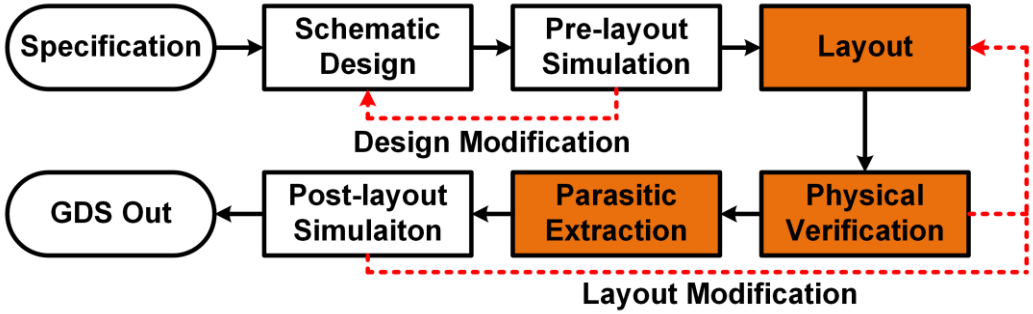
Motivation

- **Advanced technology nodes**
  - **Increased design rule & sign-off flow complexity**
  - **High human & time resources requirement**
  - **High cost in custom layout design process**

⇒ Need automated layout generation !

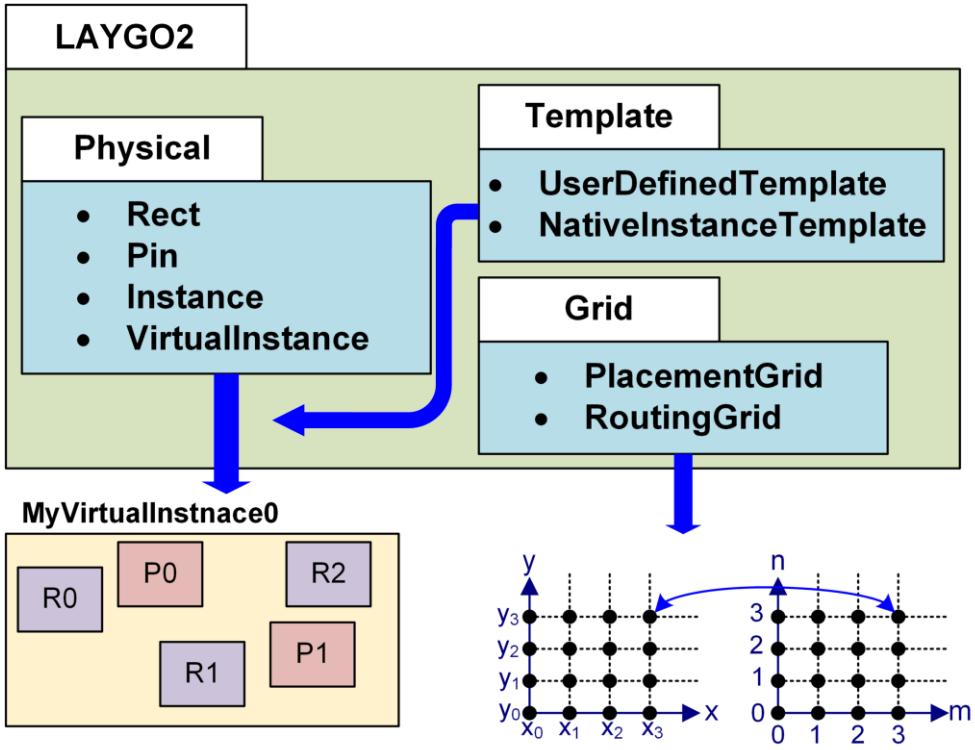


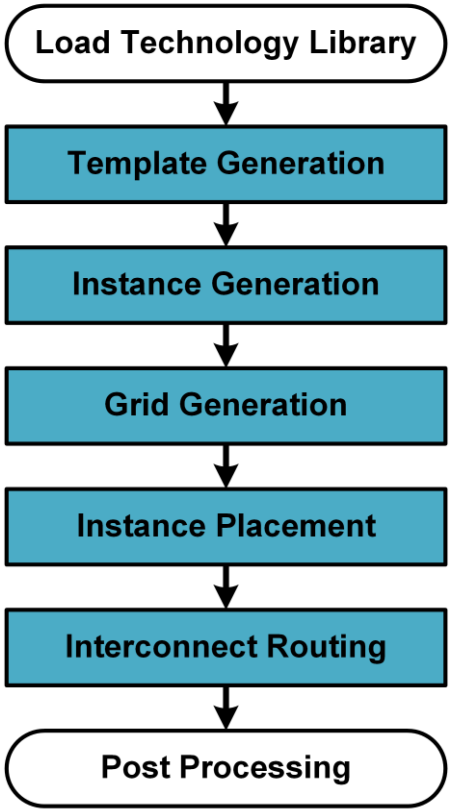
[Synopsys]



Automated Layout Generation Framework

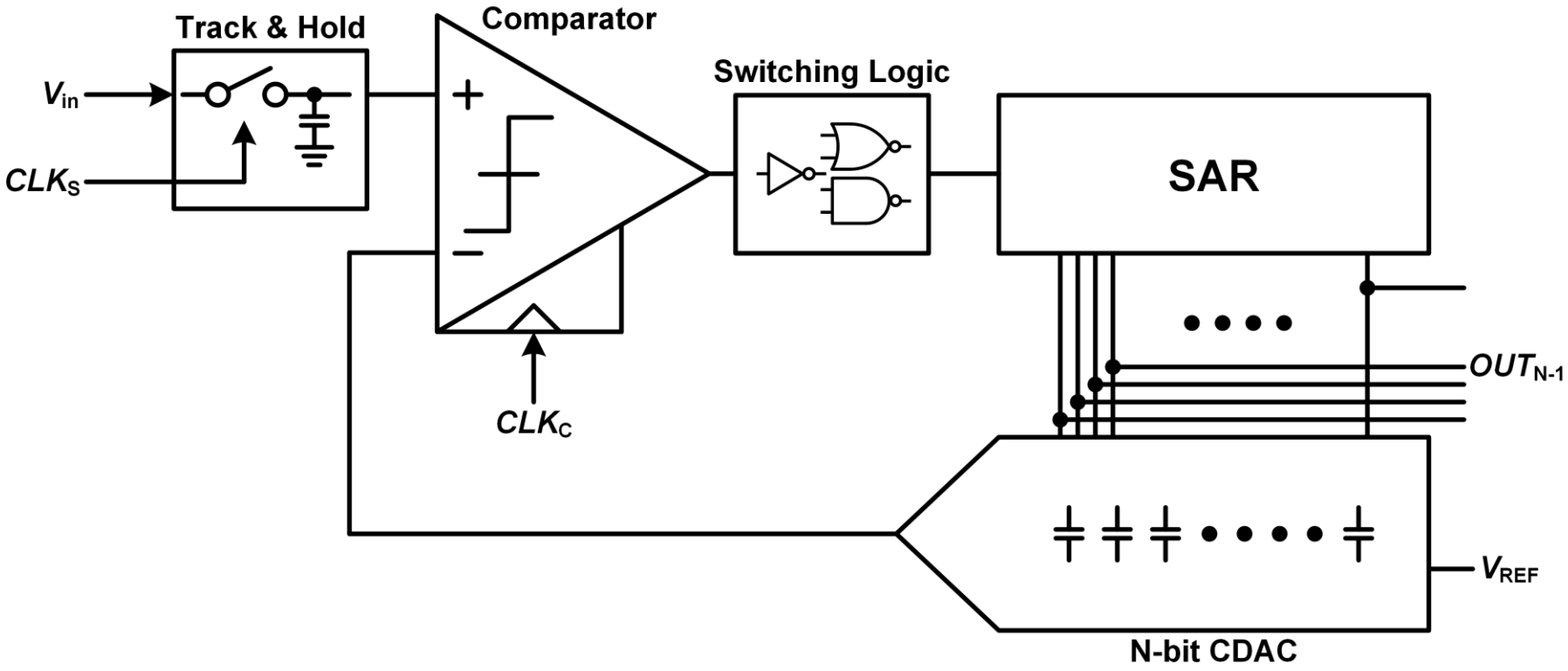
- **LAYGO2**
  - **Gridded object-based layout generation framework**





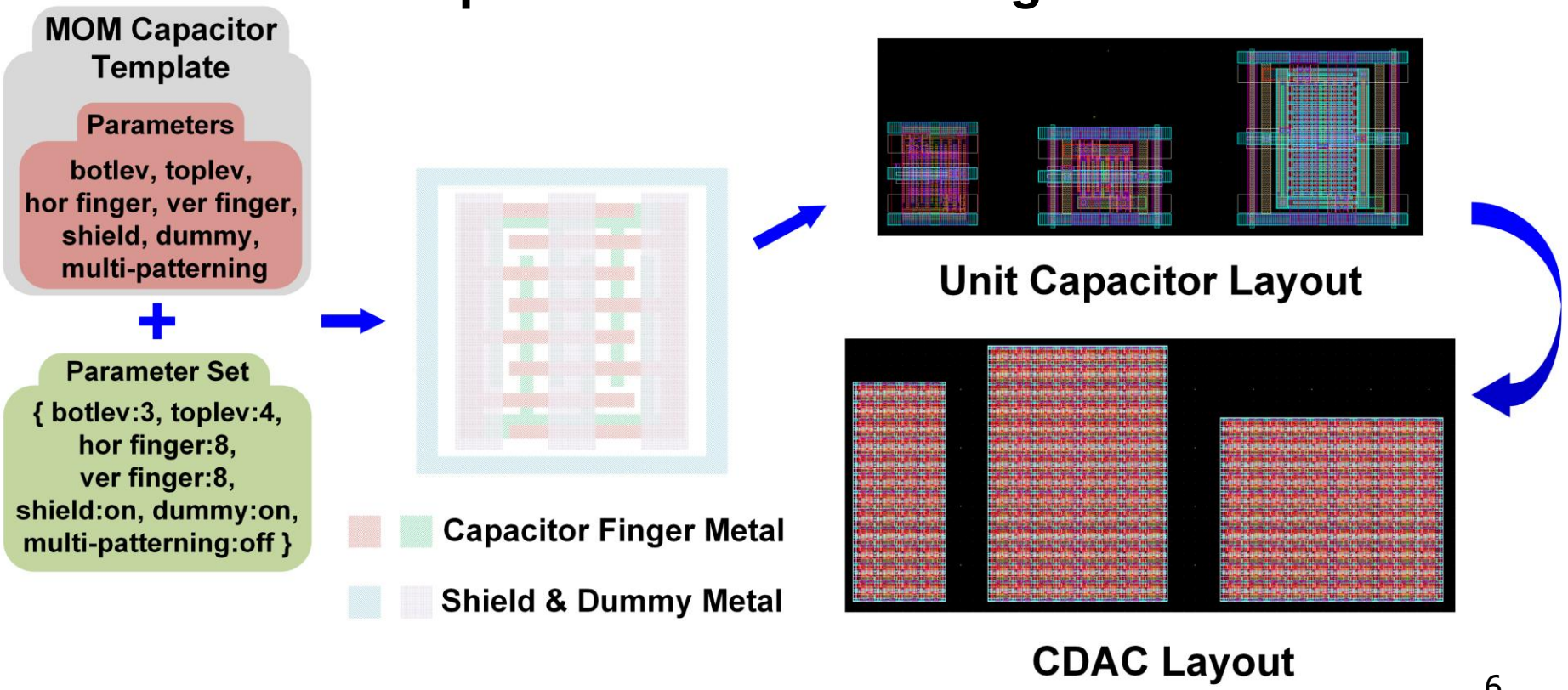
SAR ADC Building Blocks

- **SAR ADC architecture**
  - **CDAC, comparator, track & hold, and switching logic**



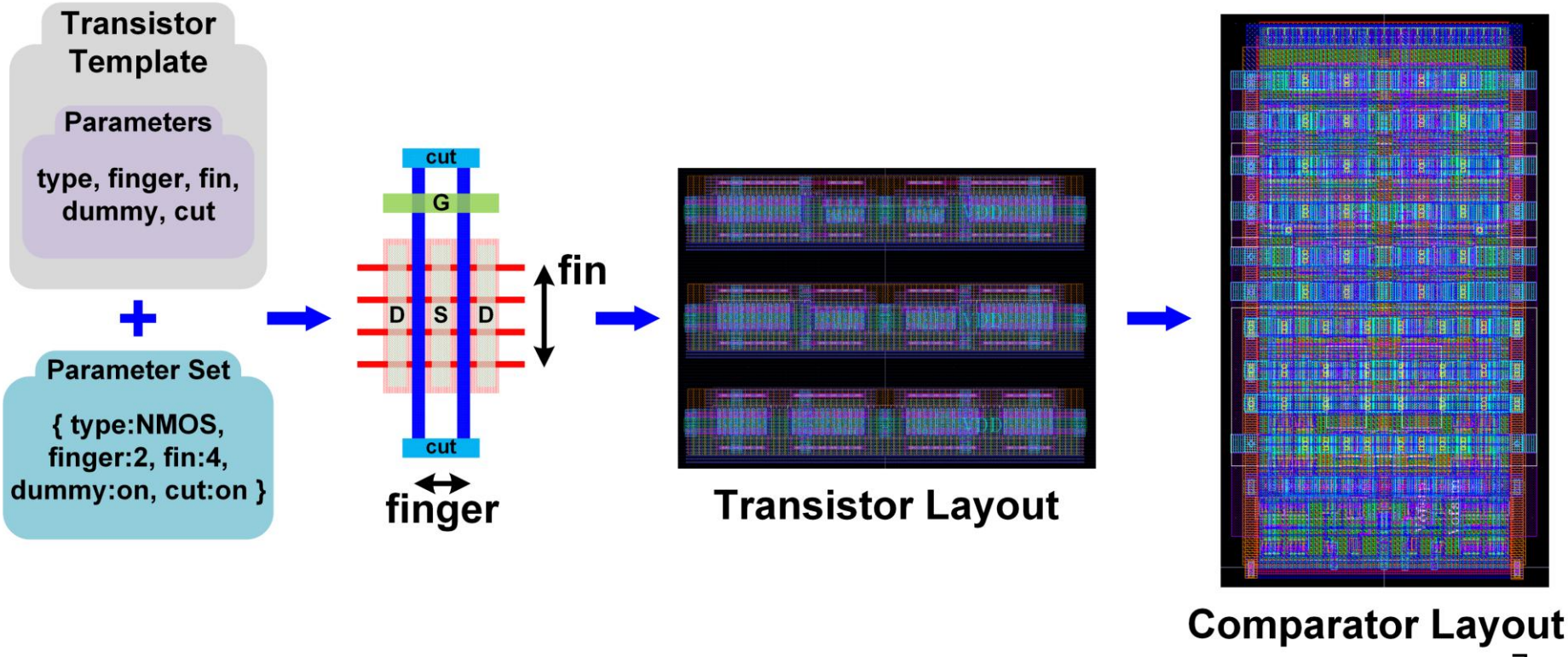
Layout Generation (1/3)

- **CDAC layout**
  - **Software-Defined Template** ***(UserDefinedTemplate)*** **for MOM capacitor**
  - **Grid-based placement and routing**



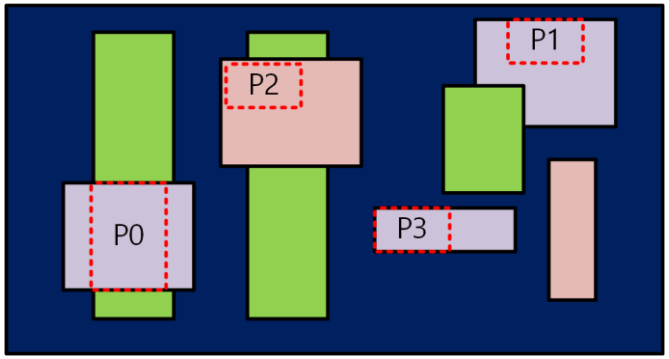
Layout Generation (2/3)

- **Comparator layout**
  - **Software-Defined Template** ***(UserDefinedTemplate)*** **for transistors**
  - **Grid-based placement and routing**

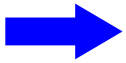


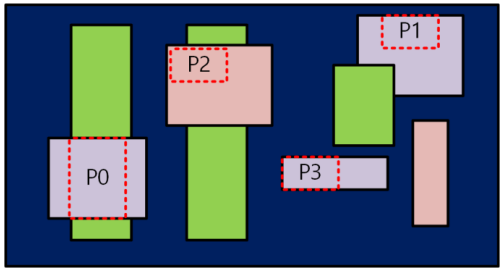
Layout Generation (3/3)

- **Track & hold, switching logic layout**
  - **Wrapper Template (*NativeInstanceTemplate*) for manual structures**
  - **Efficient area with hand-crafted layout**



Hand-crafted Layout





Physical Information

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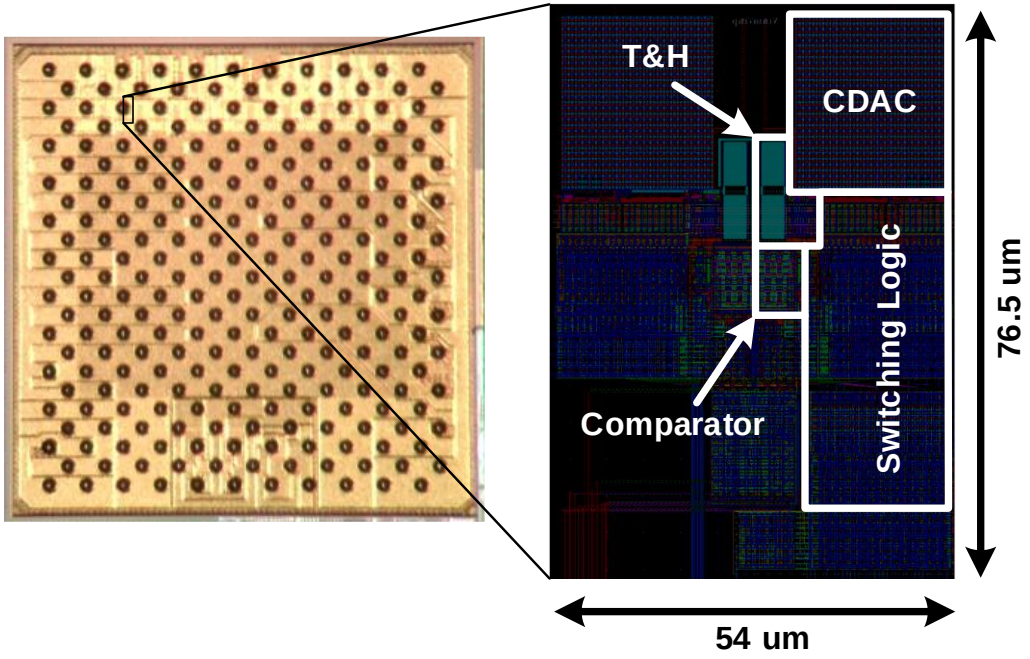
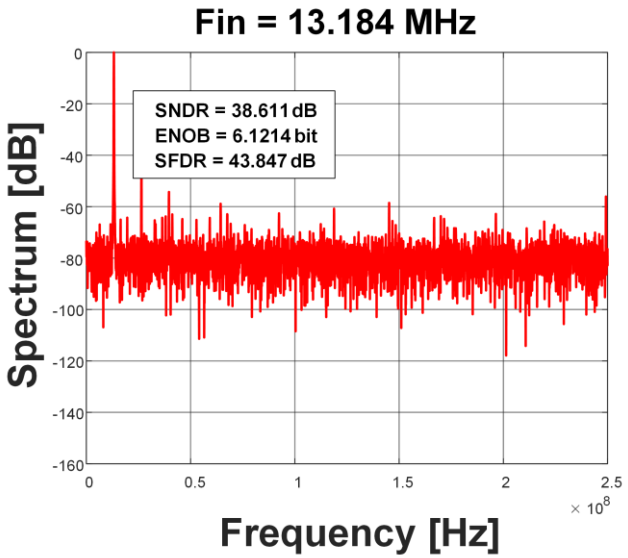
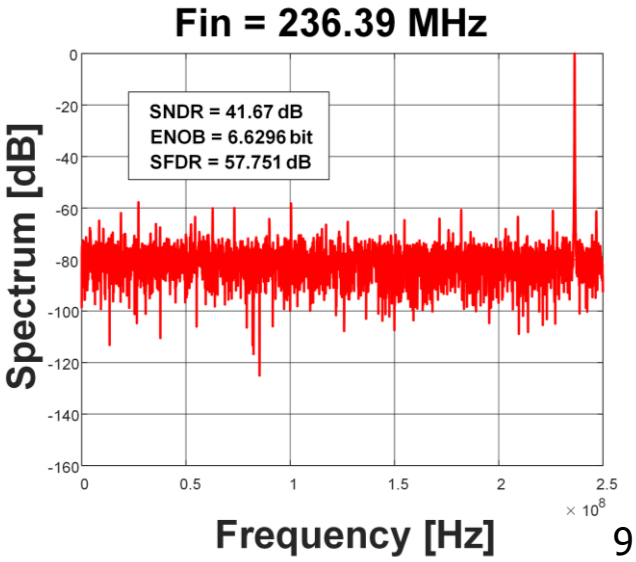
libname='mylib'
cellname='mycell'
bbox=[[0,0],[200,100]]
pins={p0,p1,p2,p3}
```

Measurement Results

- **Generated SAR ADC**
  - **Fabricated in 14-nm FinFET**
  - **Occupies 4,131 um^2**
  - **500 MS/s with 8-bit resolution**







Conclusion

- **Automated layout generation** in **advanced technology nodes**
  - Essential for addressing increasing complexity in custom designs
- **SAR ADC layout generation** with **LAYGO2**
  - Grid-based placement and routing
  - Customizable template for each building block

⇒ **Foundation for enhanced design efficiency**

Layout mismatch mitigation
& Layout productivity improvement