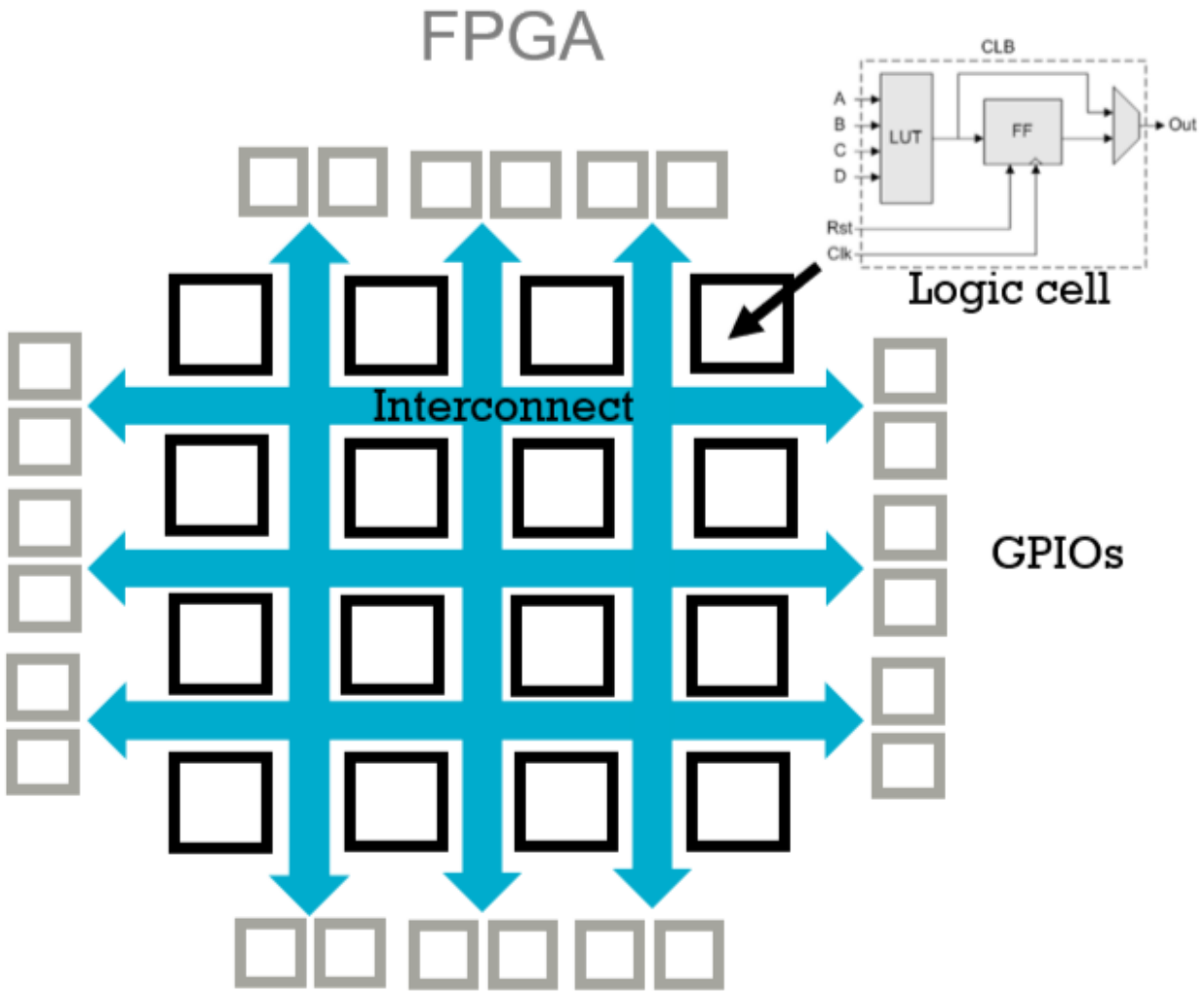
GreenPAK™ Programmable Mixed-Signal Matrix Technology

RENESAS

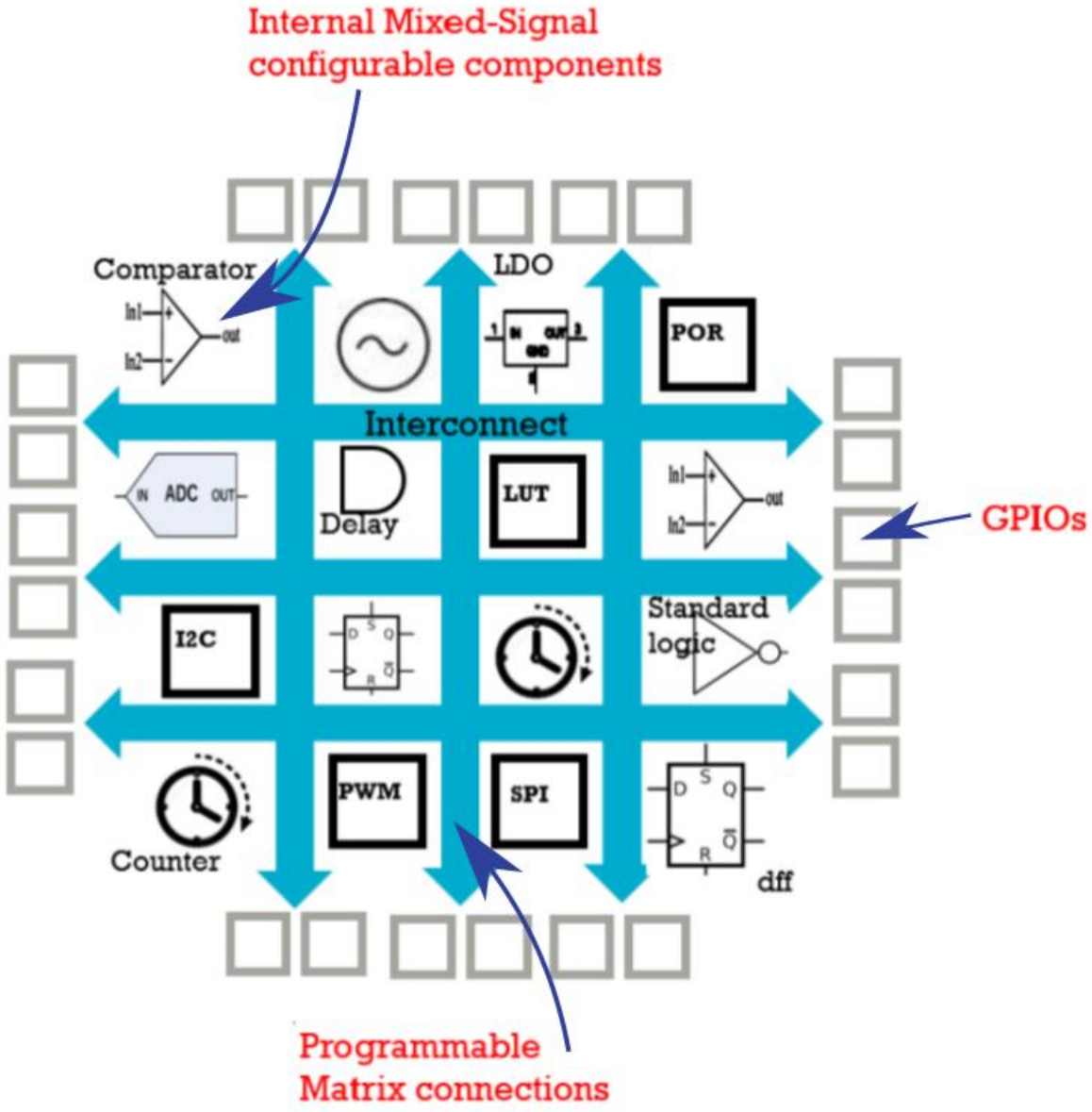
What is GreenPAK: FPGA architecture



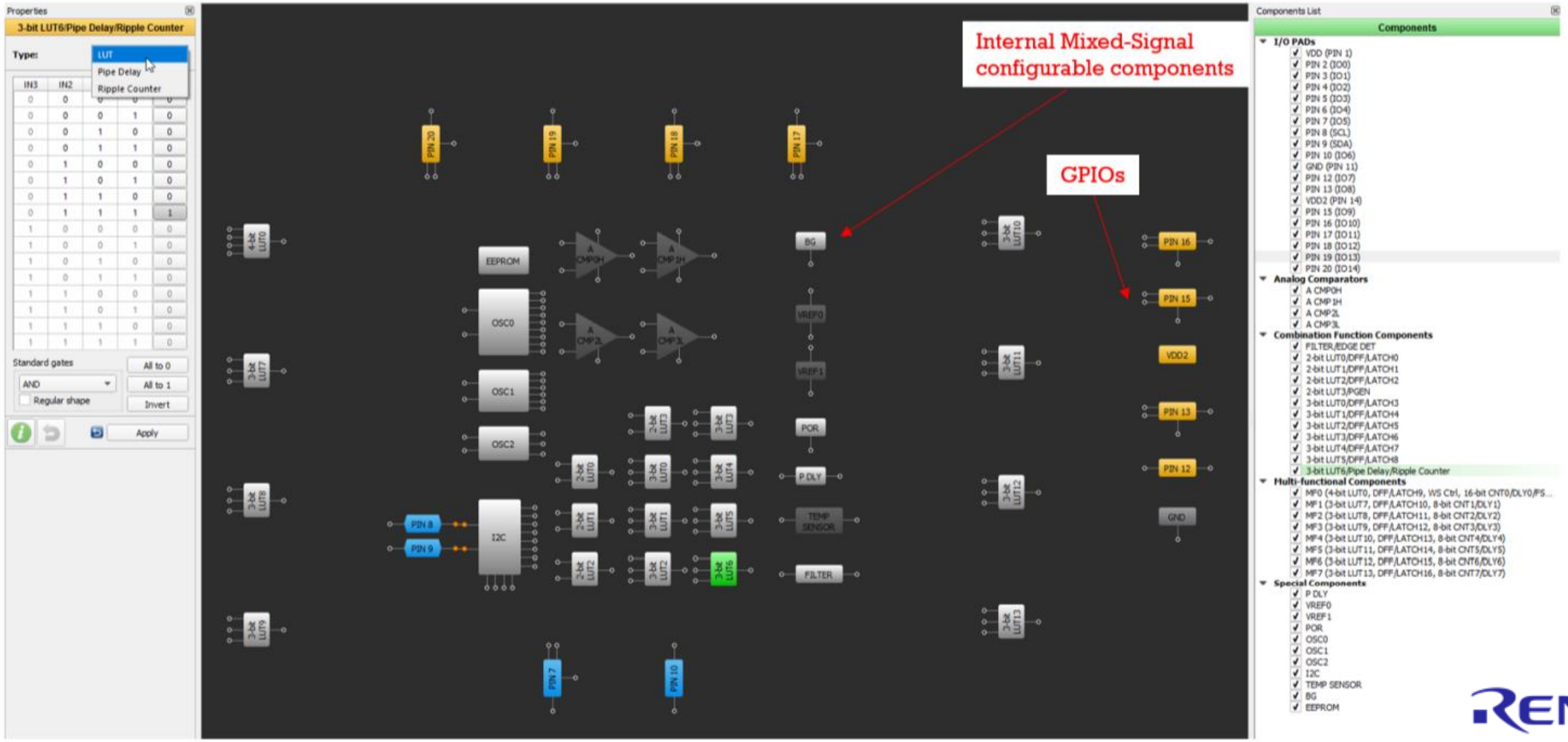
RENESAS

D&E EVENT
Het ontwerpen van innovatieve elektronica
Woensdag 20 maart 2024
1931 Congrescentrum 's-Hertogenbosch

What is GreenPAK: GreenPAK architecture

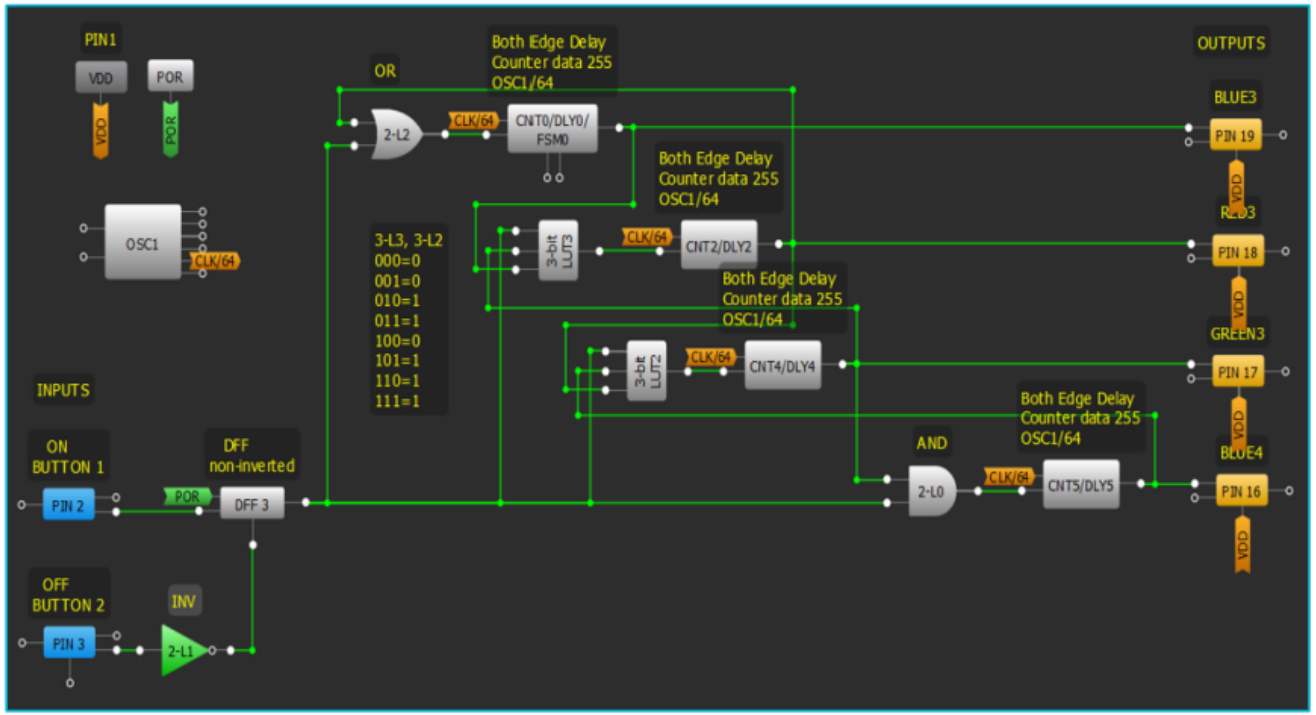


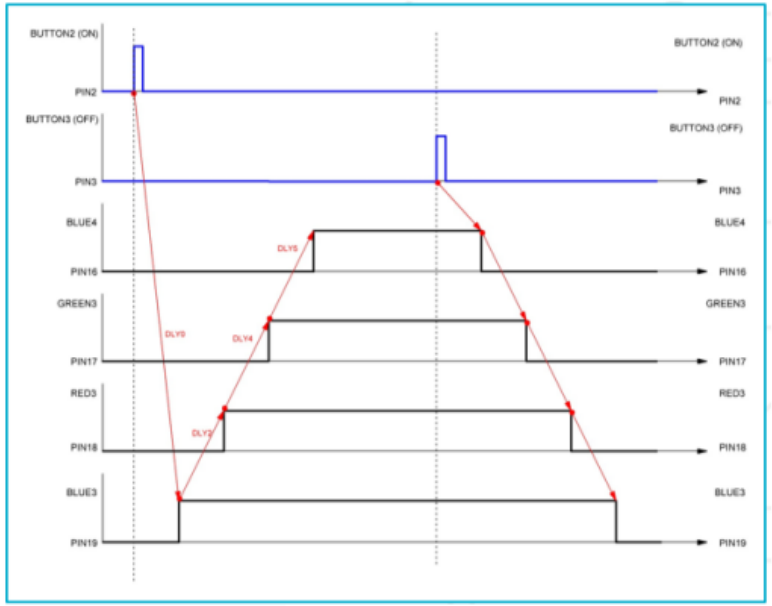
GreenPAK Macrocells



Design with GPAK

GPAK example: Power Sequencer





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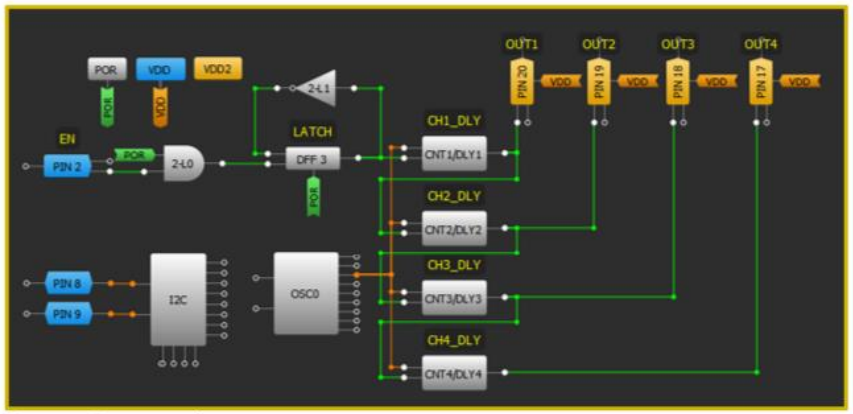
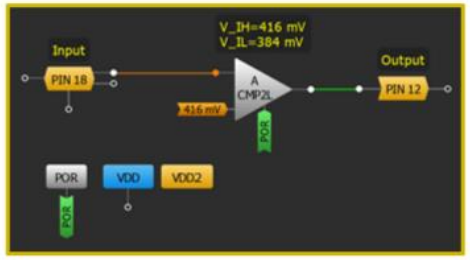
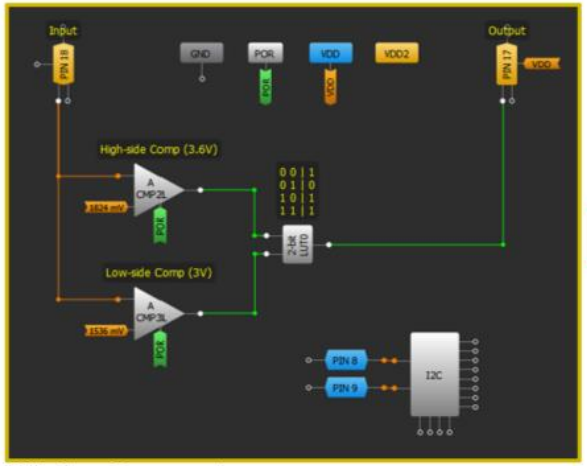
Create unique solution



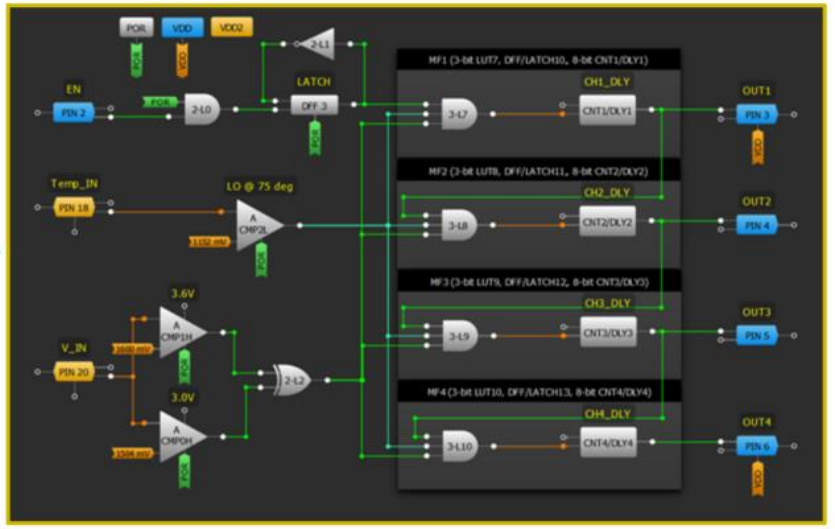
Power Sequencing



Overtemperature Detection



Window Comparator



Unique Solution

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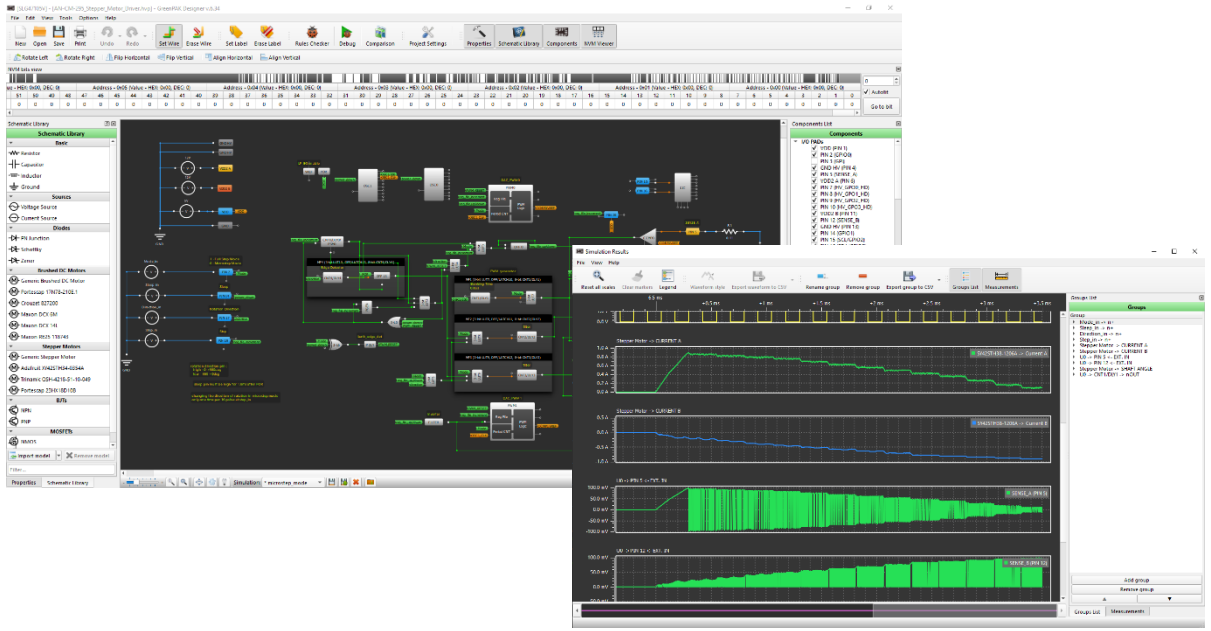
Minimize Components, Reduce PCB Space, and Lower Power

GreenPAK is ideal for

- Functional replacement of popular mixed-signal standard products and stand-alone discrete circuits
- Providing reliable hardware supervisory functions for devices such as SoCs and Microcontrollers

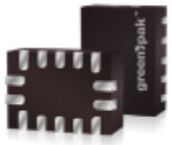
Easy & fast development tools

- GUI-based GreenPAK Designer software
- Development Kits for circuit emulation and IC programming

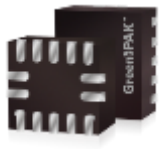


1.0 mm x 1.2 mm
0.4 mm pitch
STQFN
8-pin package

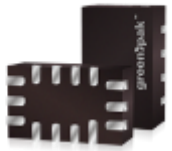
1.6 mm x 1.6 mm
0.4 mm pitch
STQFN
12-pin package



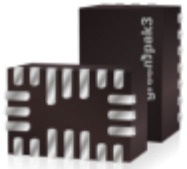
1.6 mm x 2.0 mm
0.4 mm pitch
STQFN
14-pin package



2.0 mm x 2.2 mm
0.4 mm pitch
STQFN
14-pin package

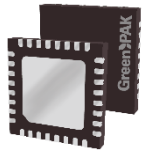


1.6 mm x 2.5 mm
0.4 mm pitch
STQFN
14-pin package



2.0 mm x 3.0 mm
0.4 mm pitch
STQFN
20-pin package

2.0 mm x 2.2 mm
0.4 mm pitch
MSTQFN
22-pin package



4.0 mm x 4.0 mm
0.4 mm pitch
STQFN
32-pin package

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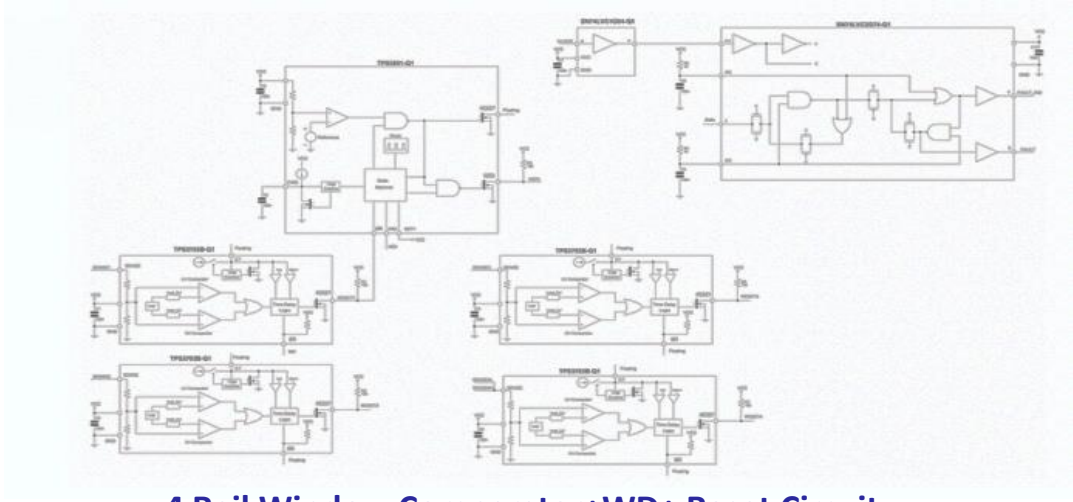
GreenPAK Approach – from Concept to application

Implementation with Discrete Components

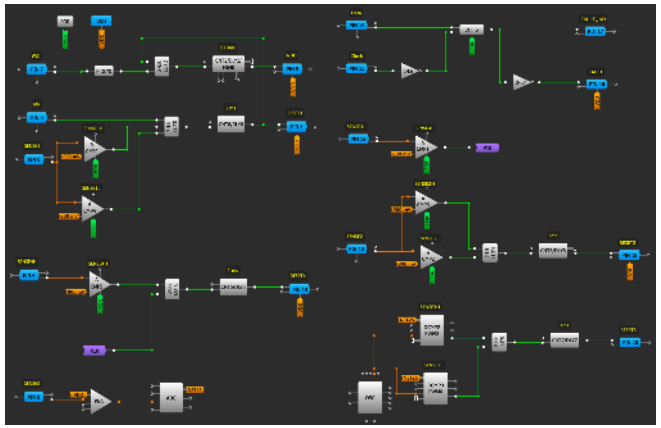


4 Rail Window Comparator+WD+ Reset Circuit

Components	Volume Price	Component Size (mm2)	Component + Clearance
4 Rail Supervisors IC	$ 1.04	9	11.25
1 Watchdog	$ 0.27	9	11.25
1 D FF w/Clear & Preset	$ 0.11	6.72	8.4
15 Passives	~ 0	~2.4*15 = 36	36
Inverter	$ 0.04	9	11.25
Total	**$ 1.46**	69.72 mm^2	***78.15 mm^2**

*Assumed clearance = 25% of component size and 0 clearance for passives

GreenPAK Implementation



- ✓ Replace all discrete components
  - Save pick & place costs
  - Reduce reliability & sourcing issues
- ✓ 3x lower price
- ✓ 6 times smaller solution
- ✓ Secure design
- ✓ Enable easy, low cost changes throughout development

Size – 13 mm^2 TQFN
Volume price: < $ 0.40

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What can I do with GreenPAK™?

GreenPAK Functions

- Level Translation
- ADC
- Glue Logic (IN5, IN4, IN3, IN2, IN1, 5-bit LUT)
- Pulse Width Modulator
- Voltage Monitor
- H-/Half-Bridge*
- Finite State Machine (S1, S2)
- Op Amp
- Counters / Delays
- Rheostat / Potentiometer

Example Applications

- Supervisory Circuits
- System Reset
- LED Control
- Motor & Fan Control
- Power Sequencing
- Voltage Detection
- Frequency Detection
- Sensor Interface
- Port Detection
- Temperature Control
- Battery Monitor
- See COOKBOOK for more!

★ **Multiple functions & applications can be combined into one IC** ★

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GreenPAK is Cost effective

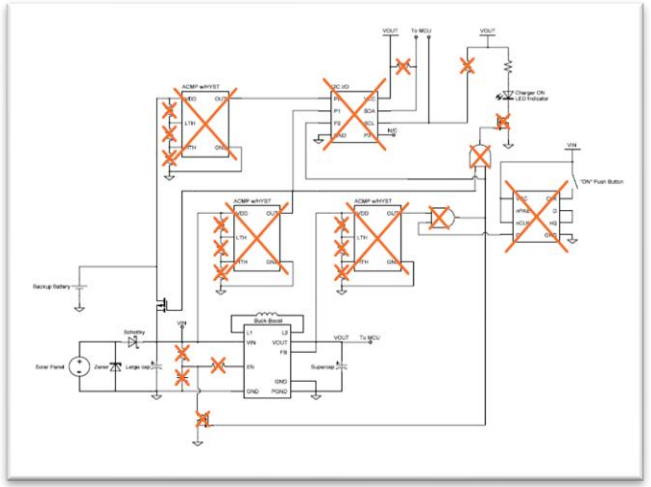
Integrating multiple discrete ICs & passives into GreenPAK lowers design cost

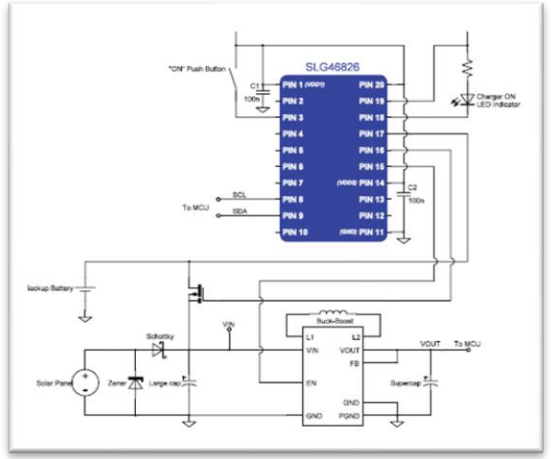
GreenPAK IC Costs

- Entire portfolio designed to be cost effective
- Fit as much as you can into GreenPAK*
- Average pricing between **~$0.10 - $0.50****
- Auto GreenPAK between **~$0.35 - $0.70****

Other Costs Benefits

- *No coding required* – streamlined design time
- Reduced prototyping time
- Reduces need for additional components
- Design changes are quick and inexpensive





Simple or Small Design ⟷ **More Complex Designs / Higher Integration**

* Cost independent of circuit design
** Volume dependent

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What Are the GreenPAK Benefits?

Integrate and Differentiate

Implement new features and functionality in one device as small as 1.0 mm x 1.2 mm

Shrink PCB Footprint

Fewer components and less routing complexity

Reduce Power Consumption

Extend battery life by powering fewer discrete devices and dynamically managing power within the GreenPAK

Adapt Design as Needed

Adapt to changing requirements quickly and spin new prototypes in minutes

Faster Time to Market

Development tools exploit the power of silicon without NRE charges and long lead times

Secure

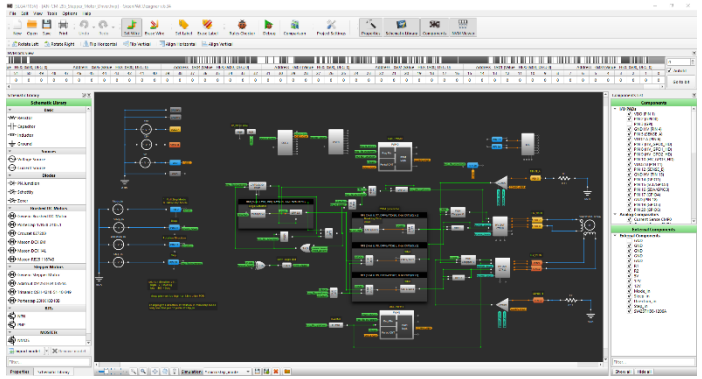
Circuit implementation is not visible to competition

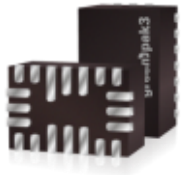
GreenPAK Design Development process

- Development with GreenPAK is **FAST**
- Create a custom design and debug with Evaluation Kit, or program individual ICs at your fingertips

Design Revisions?

Ready for Production Samples?





Production Samples Process Covered on Next Slide

GreenPAK Design Created

Design in as little as a few minutes with the FREE Go Configure Software Hub.

Circuit design is done via SW

No EVK needed for creation of design!

Can Use EVK to Test & Debug*

Custom design can be tested with EVK or **FREE** samples requested from Renesas

Program at Your Desk

Can program prototype ICs at your fingertips or ask Renesas for **FREE** programmed samples

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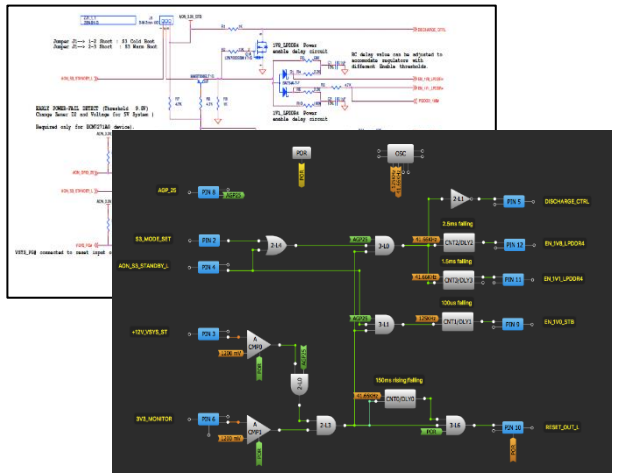
GreenPAK Sample & Production Flow

- Design changes can be made throughout the development cycle
- Datasheet revision and part top markings reflect different versions of the device through development

Design Revisions?

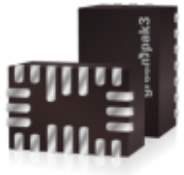
Design Finalized?

Production



72 Hours

7-14 Days



8 weeks

GreenPAK Design Created
Submit design to Renesas

Datasheet Generated Customer specific part number & datasheet generated

Need Samples?
FREE Programmed samples arrive within 7-14 days

Purchase Production Parts
8 Week Lead Time

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Selecting Right GreenPAK For Design

Best GreenPAK for application dependent on design requirements

Picking Right Base Die

- Number of GPIO? (6 to 28)
- What is VDD? (1.0V to 5.5V)
- Need for VDD2? (Yes or No)
- SPI or I2C? (Yes, or not required)
- MTP (Multiple-Time Programmable) or OTP?
- Number of voltage rails being monitored?

What Functions / Features?

- With many use cases for GreenPAK it is important to determine which functions and features would be utilized. Examples Include:

Analog		Digital	
Analog switch	OpAmp	Control	Level shifting
Battery charge indicator	Over-temp detection	Deserialization/serialization	Motor driving
Comparators	Potentiometer	Frequency detection	Pattern generator
Current sense/limiter	Rheostat	Frequency divider	PWM generation
LDOs	Voltage level detection	GPIOs (6-28)	Sequencer
Low voltage indicator	Wake/sleep function	H-/Half-Bridge	SPI or I²C Communication
Logic (Mux, gates, etc.)	and More	I²C expansion	System reset
		Interrupt	Watchdog timer
		LED driving/pattern	and More

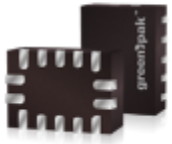
Selecting GreenPAK

- Filter by parametric search on web
- Reach out to Renesas FAE for support
- Email GreenPAK team for help to ID GreenPAK part for design
- Email both for design support
- GreenPAKsupport@Renesas.com

Simple or Small Design ← → **More Complex Designs / Higher Integration**

1.0 mm x 1.2 mm
0.4 mm pitch
STQFN
8-pin package

1.6 mm x 1.6 mm
0.4 mm pitch
STQFN
12-pin package



1.6 mm x 2.0 mm
0.4 mm pitch
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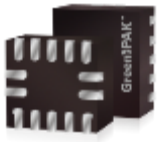
14-pin package



2.0 mm x 2.2 mm
0.4 mm pitch
STQFN
14-pin package

1.6 mm x 2.5 mm
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2.0 mm x 3.0 mm
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STQFN
20-pin package

2.0 mm x 2.2 mm
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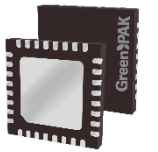

4.0 mm x 4.0 mm
0.4 mm pitch
STQFN
32-pin package

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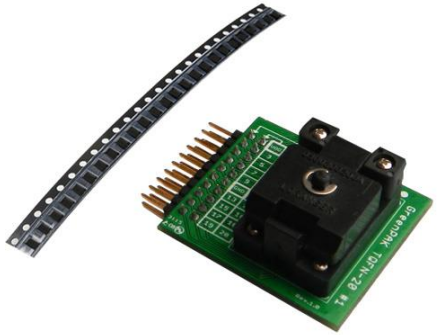
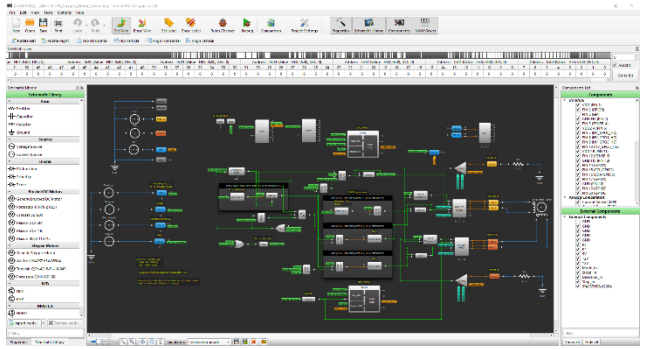
GreenPAK Development Tools Overview

- **SLG4DVKADV** – GreenPAK Advanced Development Board
  - EVK to program individual ICs & test GreenPAK designs
  - Do not need EVK to do GreenPAK design
  - SLG4DVKADV - GreenPAK Advanced Development Board | Renesas



- **Socket Adapters**
  - Each GreenPAK IC has a corresponding socket adapter for use with dev board
  - SLG46018V-SKT shown here on slide for reference
  - SLG46108V-SKT - GreenPAK SLG46108 Development Kit with Socket Adapter | Renesas

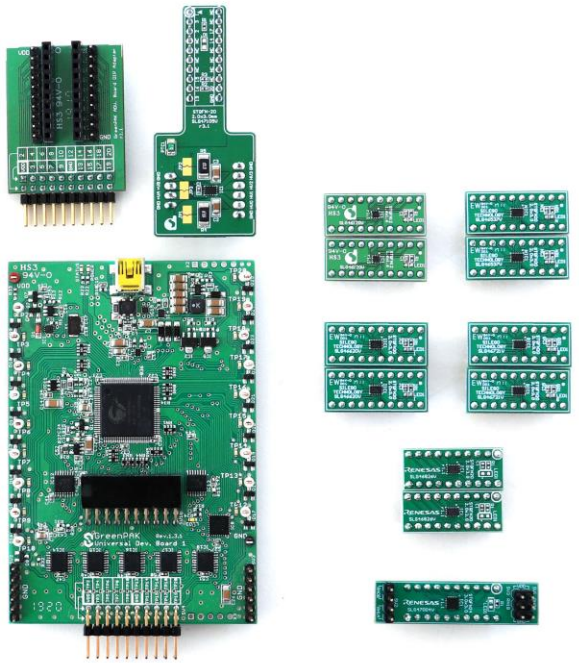


- **Go Configure Software Hub** – Design Software for GreenPAK
  - Used for GreenPAK circuit design (**FREE DOWNLOAD**)
  - Supports GreenPAK & ForgeFPGA design through GUI design environment
  - No code required, Faster configuration, programming, and testing of custom
  - Go Configure Software Hub - GreenPAK Designer | Renesas

GreenPAK Development Tools – starting with hardware

Where to start with hardware:

- If hardware is required Renesas FAE or GreenPAK product line can provide feedback on which tools / devices to begin design with
- Another option is the **SLG4DVKINTRO – GreenPAK Introduction Kit** which includes:
    - 1x Universal Development Board (this might later change to the Lite board, but for now it is Advanced Dev Board)
    - 1x USB cable
    - 1x SLG4SADIP
    - 2x SLG46120V-DIP
    - 2x SLG46721V-DIP
    - 2x SLG46620V-DIP
    - 2x SLG46537V-DIP
    - 2x SLG46826V-DIP
    - 1x SLG47105V-DIP
    - 1x SLG47004V-DIP



GreenPAK Design Steps Are Fast

Design in minutes
Prototype in hours

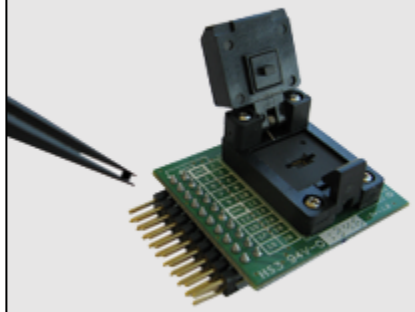
No NRE

No Production
Commitment

8 Week
Production
Lead-time

Custom
Datasheet

Step 1



Place unprogrammed
GreenPAK into socket

Step 2

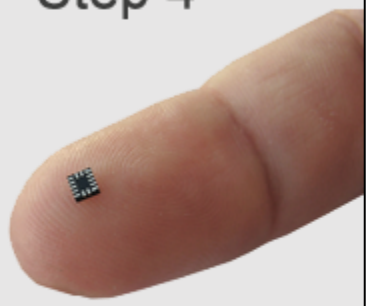
Design your IC with
GreenPAK GUI

Step 3

Program

Click **Program** to freeze
GreenPAK's NVM

Step 4



Your custom IC
is ready for use

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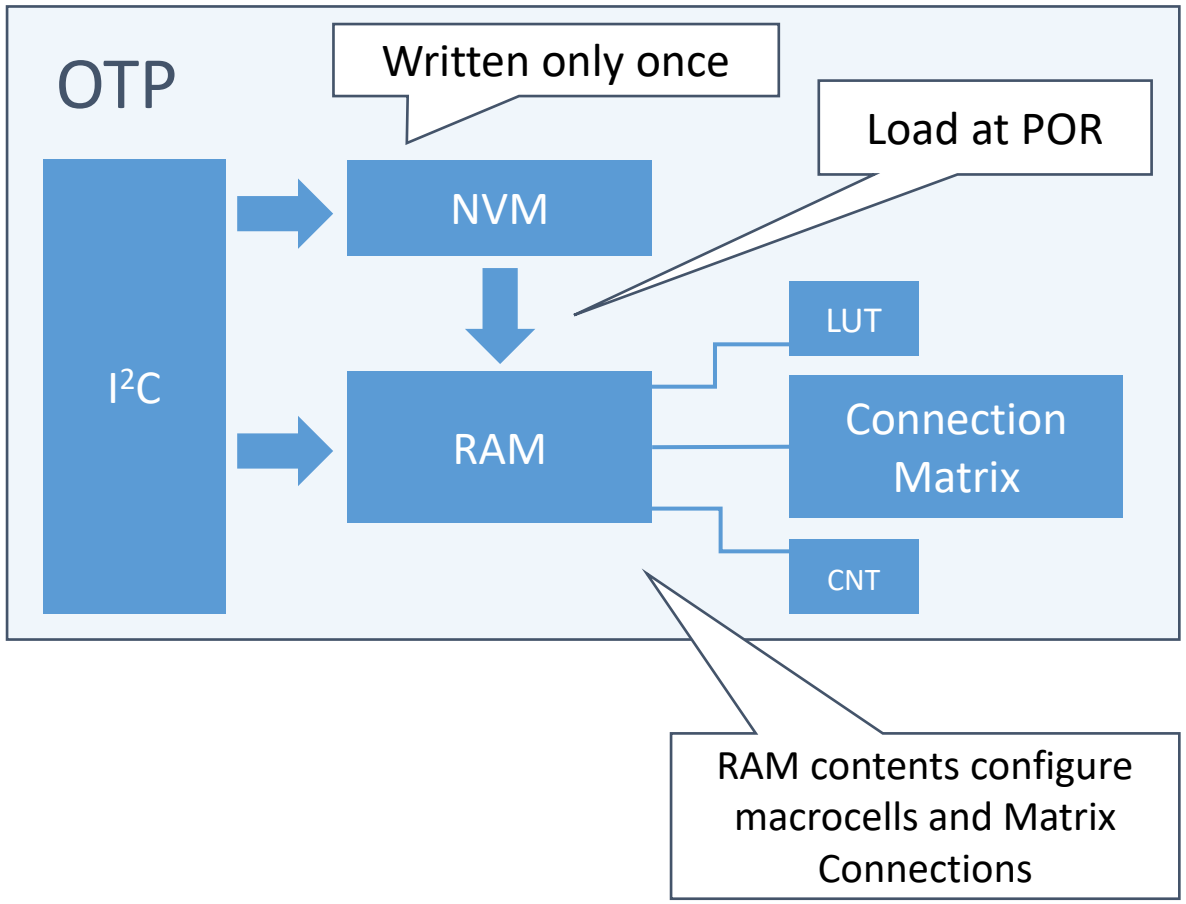
Structure of the GreenPAK IC Memory - OTP

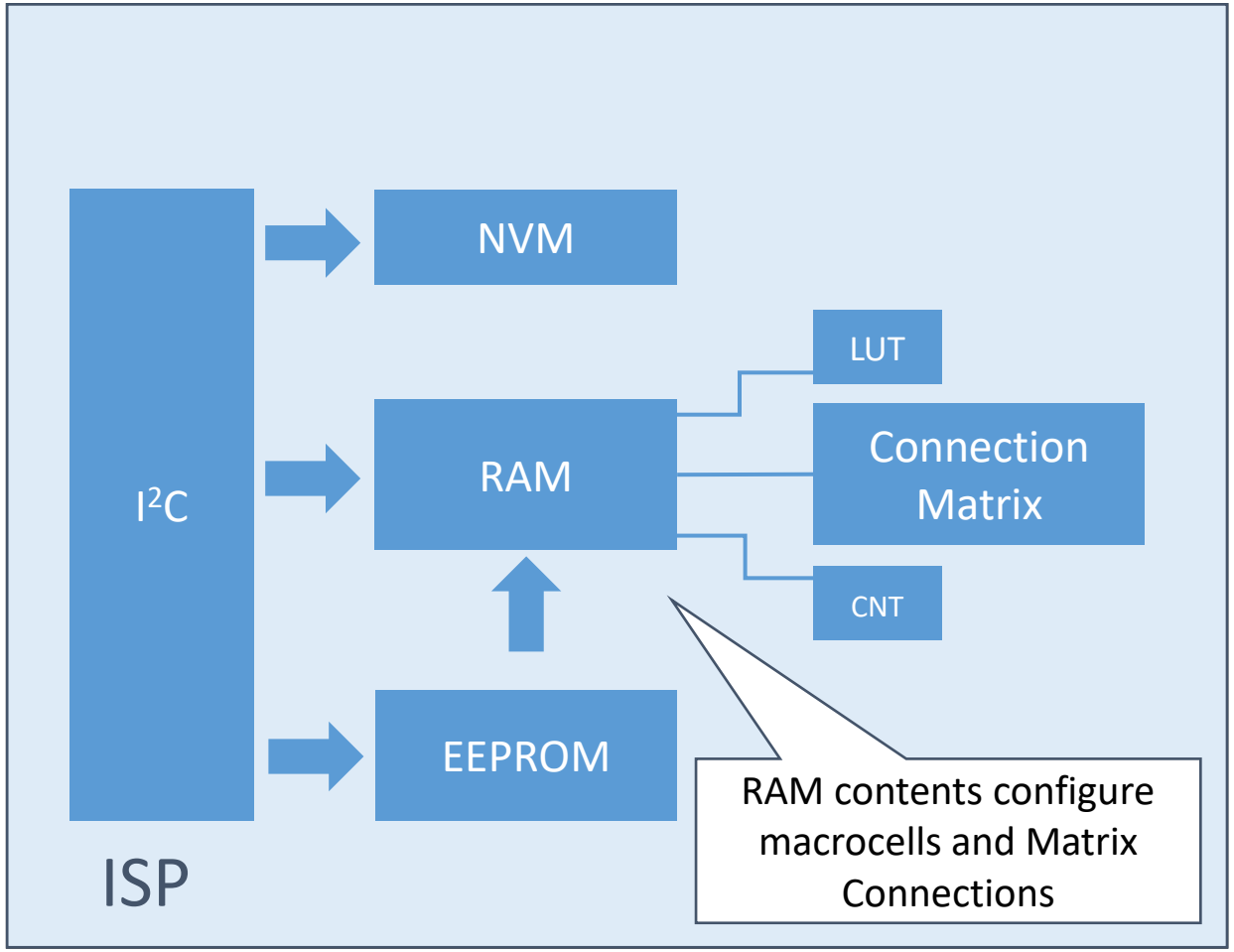
How IC Memory Works in OTP and MTP/ISP Circuits



- During start NVM memory is emulated to RAM.
- Inside the NVM, there is a specifically dedicated protection page, MTP enables to change security settings.

Structure of the GreenPAK IC Memory - ISP

How IC Memory Works in OTP and MTP/ISP Circuits



- During start NVM memory is emulated to RAM.
- Inside the NVM, there is a specifically dedicated protection page, MTP enables to change security settings.
- ISP device can write to EEPROM via I^2C and from EEPROM to RAM.

A Wide Family of Products for Many Applications

Overview of Existing Subfamilies

GreenPAK

- Dual Supply GreenPAK
- GreenPAK with Load Switches
- GreenPAK with Asynchronous State Machine
- GreenPAK with Low Drop Out Regulators
- GreenPAK with In-System Programmability
- PN*: SLG46*xxx* and SLG47*xxx*

More Info

HVPAK

- Programmable Mixed-Signal ASIC with High Voltage Features
- Integrated High Voltage up to 26.4 V and Hight Current up 3 A Output Drivers*
- PN: SLG471*xx*

More Info

Automotive GreenPAK

- Cost-effective NVM programmable devices allowing to integrate many system functions into a single AEC-Q100 qualified IC
- PN: SLG46*xxx*-A

More Info

AnalogPAK

- Programmable Mixed-Signal ASIC with Analog Features
- Rich set of analog blocks (OpAmp's, digital rheostats, etc.)
- MTP NVM with in-system programmability
- PN: SLG470*xx*

More Info

Power GreenPAK

- High PSRR, low noise multi-output LDO IC for advanced camera and sensor systems
- PN: SLG5100*x*

More Info

* PN stands for part number

Go Configure™ Software

Schematic capture-like tool allowing design, configuration, and programming

GreenPAK Cookbook

Outlines different techniques and provides completed applications for reference

Application Notes

Collection of application specific collateral documenting design process for various solutions using GreenPAK

GreenPAK Forum

Online community for questions and support on everything GreenPAK

GreenPAK Partners

Certified experienced GreenPAK third-party design partners

FAQs

Knowledge base addressing common questions

GreenPAK™ Programmable Mixed-Signal Products | Renesas