GREENPAK™

PROGRAMMABLE MIXED-SIGNAL MATRIX TECHNOLOGY

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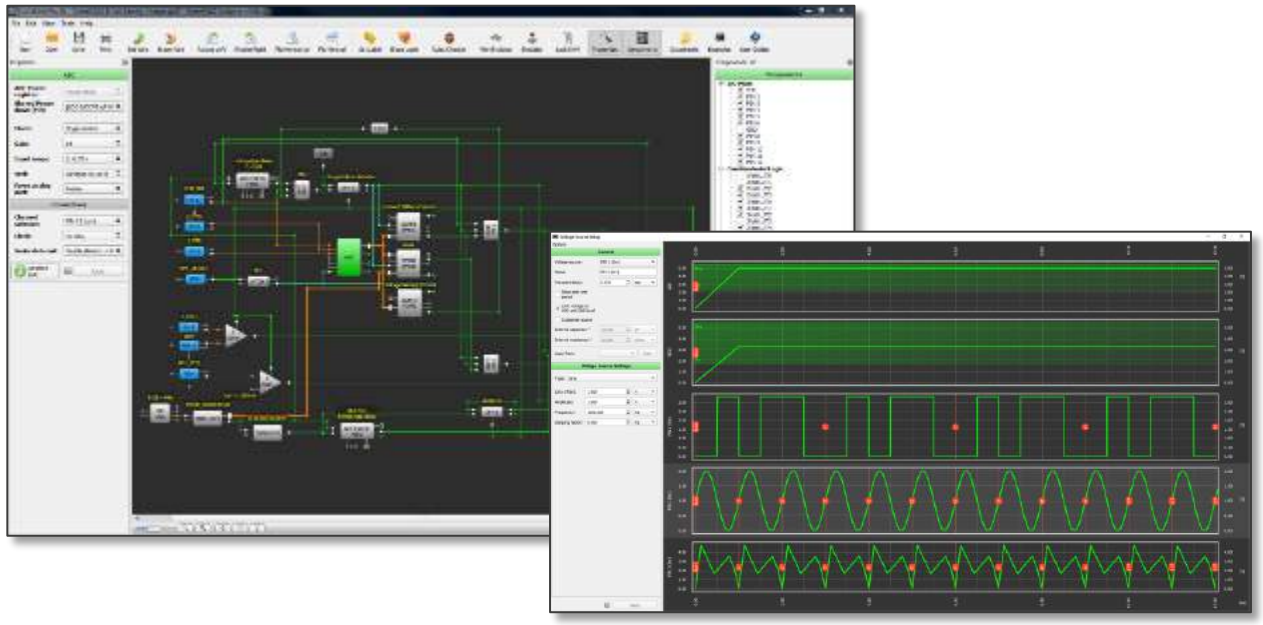
NATHAN JOHN AT NATHAN.JOHN.ZJ@RENESAS.COM
SR. DIRECTOR - MARKETING,
CMBG | AAD | EPSG
RENESAS ELECTRONICS CORPORATION

GREENPAK

Integrate Many System Functions to 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

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

AGENDA

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

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

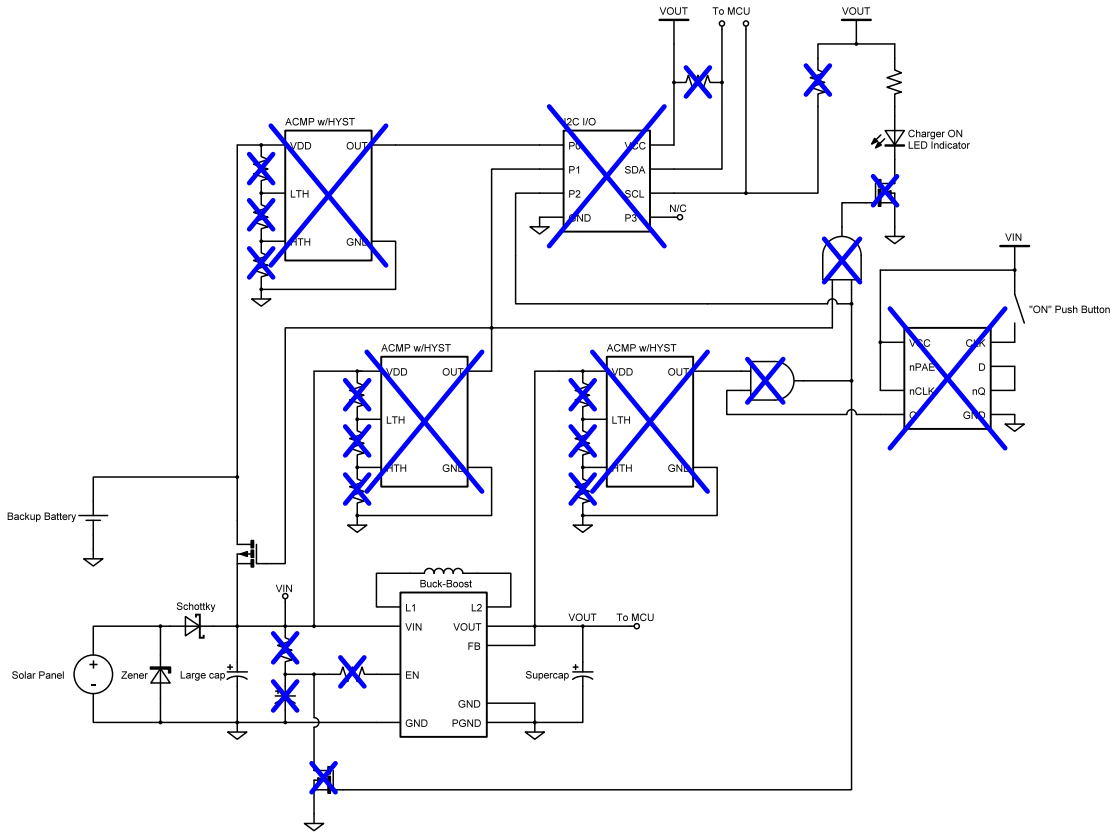
Step 4

Your custom IC is ready for use

THE GREENPAK APPROACH

Example: IOT Power Charger

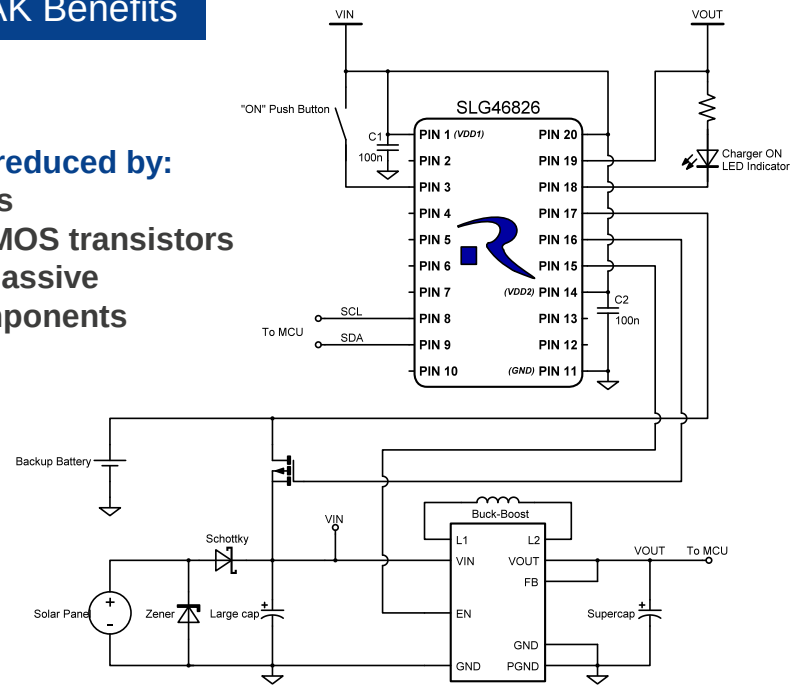
Original Design



GreenPAK Benefits

Design reduced by:

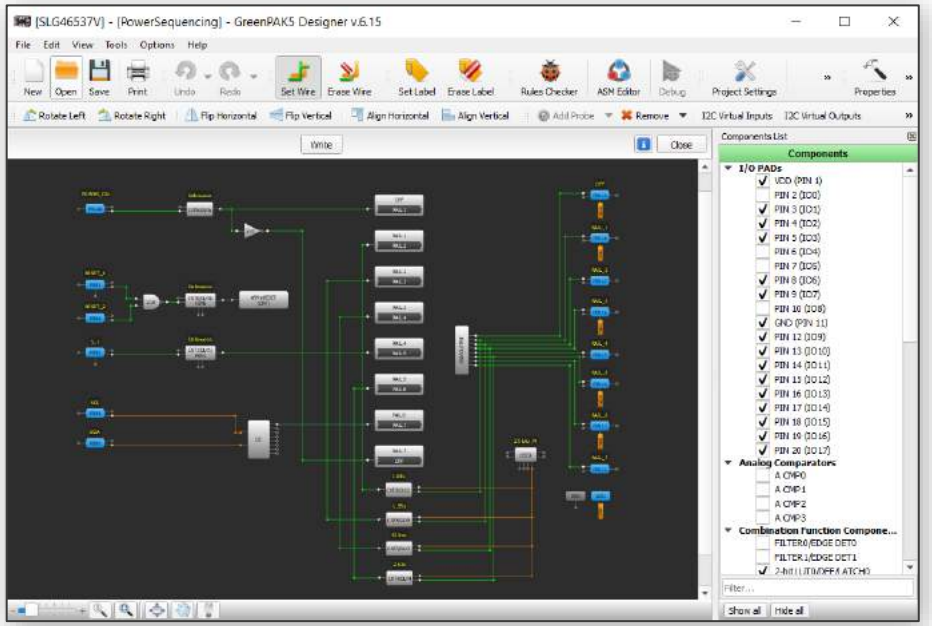
- 5 ICs
- 2 NMOS transistors
- 14 passive components



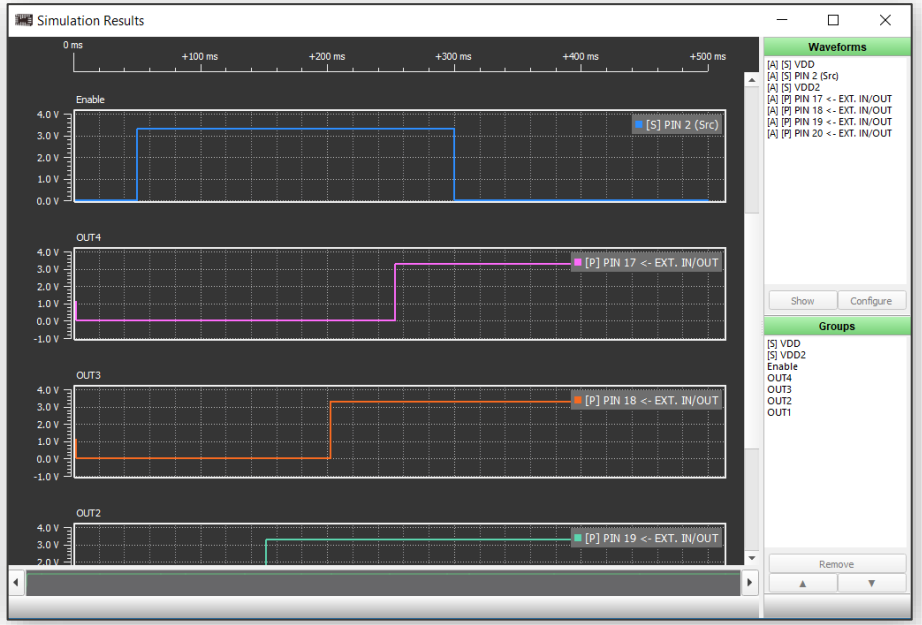
Value	Approx. savings with GreenPAK
Layout Size	17.8 mm^2
Cost Savings	$ 1.33

AGENDA

CREATE DESIGNS QUICKLY & EFFICIENTLY



- ✓ Supports design creation, emulation & IC programming
- ✓ GUI-based schematic capture approach to design entry
- ✓ Allows real-time design iterations



- ✓ SPICE simulation available for select families
- ✓ Software configurable function generators for design validation

Download for free at [Go Configure™ Software Hub | Renesas]

RECOMMENDED HARDWARE FOR NEW USERS

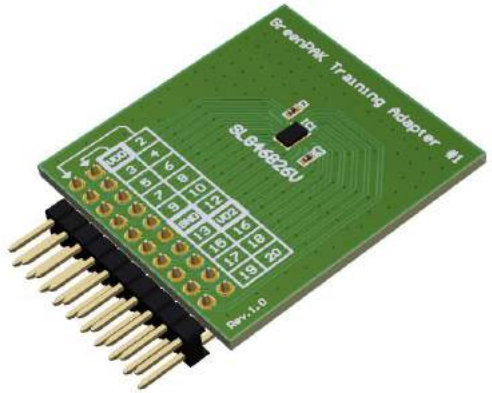
Perfect for Developers New to GreenPAK

Advanced Development Board*

- Ordering: ***SLG4DVKADV***

*USB Cable included

More info



Training Adapter for SLG46826**

- Ordering: ***SLG4TA20SP-SLG46826***

** Recommended for developers using SLG46826, use available socket kits for other devices

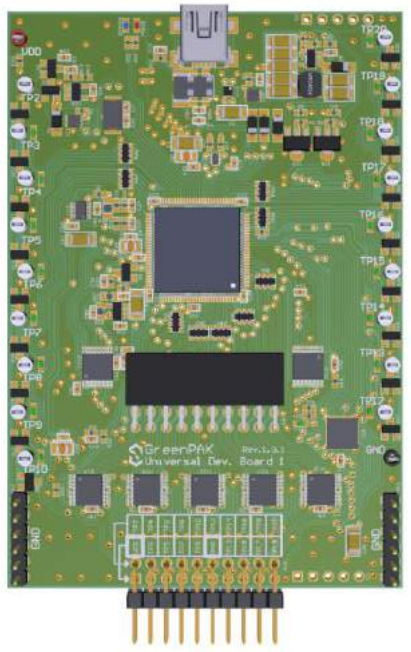
More info

GREENPAK DEVELOPMENT HARDWARE OPTIONS

- USB interface
- MacOS, Windows and Linux compatible
- Expansion header for connection to external test equipment*
- Integrated signal and logic generators*
- LEDs for visual indication*
- DIP form or Sockets for easy programming**

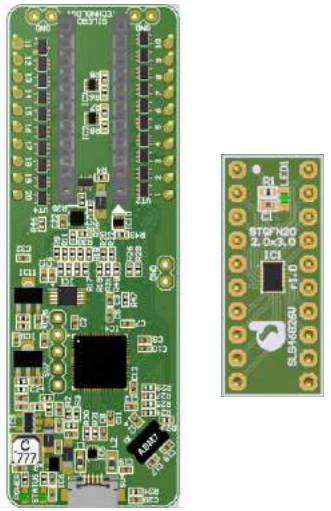
* Features only in Advanced Development Board
** Features only in DIP Development Board

Advanced Development Board



or

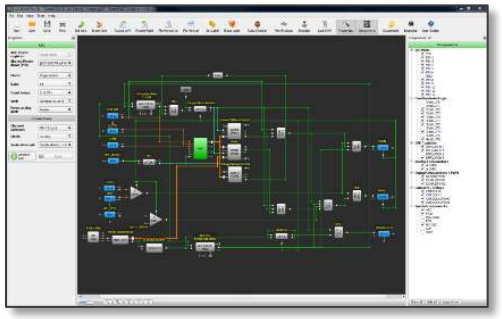
DIP Development Board and DIP Adapter



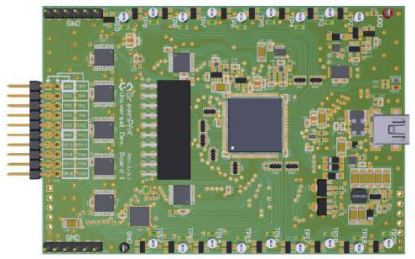
Available online from local/global distribution partners!

GREENPAK SOLUTION PLATFORM

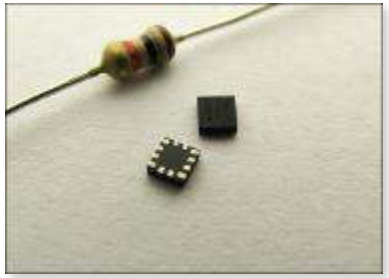
Design in MINUTES



Prototype in HOURS



Production in DAYS



The Choice is Yours

Customers create solutions & program samples

- Renesas provides un-programmed GreenPAK ICs
- Customer retains design control

Renesas creates designs and provides samples

- Customers communicate design requirements
- Design feedback and datasheet within 72 hours (typical)
- Custom part numbers assigned
- Delivery of programmed samples and tested production units

AGENDA

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 High Current up 3 A Output Drivers
- PN: SLG471*xx*

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

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

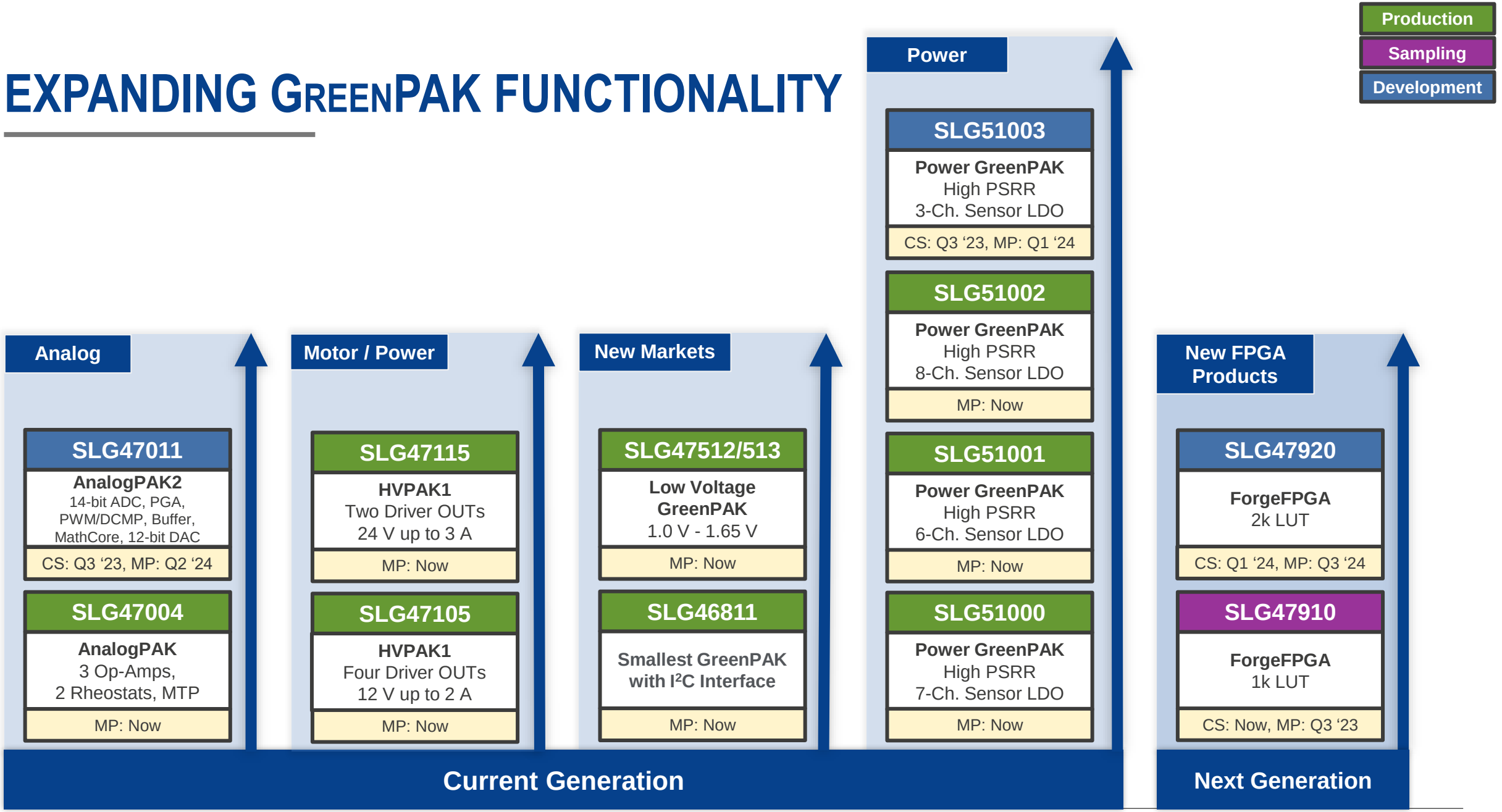
PowerPAK

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

More Info

* PN stands for part number

EXPANDING GREENPAK FUNCTIONALITY



PRODUCTION GREENPAK FEATURE SETS

	SLG46108	SLG46127	SLG46116/7	SLG46110	SLG46120	SLG46140	SLG46169	SLG46170
# of GPIOs	6	6	7	8	10	12	12	12
Operating Voltage (V)	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0
Dual Supply (VDD2 1.8 V to VDD)	-	-	-	-	SLG46121[1]	-	-	-
8-bit SAR ADC	-	-	-	-	-	1	-	-
Analog/Digital Comparators	-	2/0	2/0	2/0	2/0	2/3	2/0	-
Look Up Tables (LUTs)	4	4 Total	4 Total	4 Total	5 Total	8 Total	9 Total	15 Total
2-bit LUT	2	2	2	2	1	4	2	5
3-bit LUT	2	2	2	2	4	4	7	9
4-bit LUT	-	-	-	-	-	-	-	1
Combination Function Macro-cells	6 Total	6 Total	6 Total	6 Total	11 Total	8 Total	9 Total	2 Total
Selectable LUT/DFF/Latch	4	4	4	4	8	4	6	1
Selectable LUT/Pipe Delay	1	1	1	1	1	1	1	1
Selectable LUT/CNT/DLY	1	1	1	1	2	2	2	-
Selectable LUT/Pattern Gen	-	-	-	-	-	1	-	-
PWMs	-	-	-	-	-	3	-	-
Counters/Delays	3	3	3	3	2	2	5	8
DFF / Latch	-	-	-	-	-	2	-	6
Pipe Delay	-	8-stage	8-stage	8-stage	8-stage	16-stage	16-stage	16-stage
Programmable Delay	1	1	1	1	1	1	1	1
Internal Oscillator (Hz)	25k/2M	25k/2M	25k/2M	25k/2M	25k/2M	1.7k/25k/ 2M/27M	25k/2M	25k/2M
Load Switch	-	2 x 2 A P-FET	1.25 A P-FET	-	-	-	-	-
Asynchronous State Machine	-	-	-	-	-	-	-	-
Communication Interface	-	-	-	-	-	SPI	-	-
TQFN Part Number	SLG46108V	-	SLG46116V SLG46117V	SLG46110V	SLG46120V SLG46121V	SLG46140V	SLG46169V	SLG46170V
TQFN Package Size (mm)	1.0 x 1.2	-	1.6 x 2.5	1.6 x 1.6	1.6 x 1.6	1.6 x 2.0	2.0 x 2.2	2.0 x 2.2
MSTQFN Part Number	-	SLG46125M SLG46127M	-	-	-	-	-	-
MSTQFN Package Size (mm)	-	1.6 x 2.0	-	-	-	-	-	-

PRODUCTION GREENPAK FEATURE SETS

	SLG46534	SLG46536	SLG46517	SLG46533	SLG46537	SLG46620	SLG46721	SLG46722
# of GPIOs	12	12	16	18	18	18	18	18
Operating Voltage (V)	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0	1.8 to 5.0
Dual Supply (VDD2 1.8 V to VDD)	SLG46535ǂ	-	-	-	SLG46538ǂ	SLG46621ǂ	-	-
8-bit SAR ADC	-	-	-	-	-	1	-	-
Analog/Digital Comparators	3/0	3/0	4/0	4/0	4/0	6/3	4/0	-
Look Up Tables (LUTs)	-	-	-	-	-	25 Total	9 Total	15 Total
2-bit LUT	-	-	-	-	-	8	2	5
3-bit LUT	-	-	-	-	-	16	7	9
4-bit LUT	-	1	-	1	-	1	-	1
Combination Function Macro-cells	17 Total	24 Total	17 Total	24 Total	17 Total	1 Total	9 Total	2 Total
Selectable LUT/DFF/Latch	8	15	8	15	8	-	6	1
Selectable LUT/Pipe Delay	1	1	1	1	1	-	1	1
Selectable LUT/CNT/DLY	7	7	7	7	7	-	2	-
Selectable LUT/Pattern Gen	1	1	1	1	1	1	-	-
PWMs	-	-	-	-	-	3	-	-
Counters/Delays	-	-	-	-	-	10	5	8
DFF / Latch	-	-	-	-	-	12	-	6
Pipe Delay	16-stage	16-stage	16-stage	16-stage	16-stage	2 x 16-stage	16-stage	16-stage
Programmable Delay	1	1	1	1	1	2	1	1
Internal Oscillator (Hz)	25k/2M/25M	25k/2M/25M	25k/2M/25M	25k/2M/25M	25k/2M/25M	1.7k/25k/ 2M/27M	25k/2M	25k/2M
Load Switch	-	-	2 x 2 A P-FET	-	-	-	-	-
Asynchronous State Machine	8-state	-	8-state	-	8-state	-	-	-
Communication Interface	I²C	I²C	I²C	I²C	I²C	SPI	-	-
TQFN Part Number	SLG46534V SLG46535V	SLG46536V	-	SLG46533V	SLG46537V SLG46538V	SLG46620V SLG46621V	SLG46721V	SLG46722V
TQFN Package Size (mm)	2.0 x 2.2	2.0 x 2.2	-	2.0 x 3.0	2.0 x 3.0	2.0 x 3.0	2.0 x 3.0	2.0 x 3.0
MSTQFN Part Number	-	-	SLG46515M SLG46517M	SLG46533M	SLG46537M SLG46538M	-	-	-
MSTQFN Package Size (mm)	-	-	2.0 x 3.0	2.0 x 2.2	2.0 x 2.2	-	-	-

NEW & AVAILABLE FOR SAMPLING

	SLG46880V	SLG46855V	SLG46811	SLG46580V	SLG46582V	SLG46583V	SLG46585V	SLG46867M
# of Pins / # of GPIOs	32/28	14/12	12/10	20/9	20/9	20/9	29/6	20/10
Operating Voltage, VDD (V)	2.3 to 5.5	2.3 to 5.5	2.3 to 5.5	2.3 to 5.5	2.3 to 5.5	2.3 to 5.5	2.3 to 5.5	2.3 to 5.5
Dual Supply, VDD2 (V)	2.3 to VDD	-	-	-	-	-	-	-
Dual Supply Version	SLG46881	-	-	-	-	-	-	-
Analog/Digital Comparators	4/0	4/0	1(4)/0	4/0	4/0	4/0	4/0	4/0
Voltage Reference	Trimmed	Trimmed	Integrated	Trimmed	Trimmed	Trimmed	Trimmed	Trimmed
Combo Function Macro-cells	12 Total	15 Total	12 Total	17 Total	17 Total	17 Total	15 Total	15 Total
Multi-Function Macro-cells	-	8 Total	6 Total	-	-	-	-	8 Total
PWMs	-	-	-	-	-	-	-	-
Special Features	-	-	92x8 bit Pattern Generator	-	-	-	-	-
Counters/Delays	-	-	-	-	-	-	-	-
DFF / Latch	-	-	-	-	-	-	-	-
3-Output Pipe Delay / Shift Register	16-stage/0	16-stage/0	-/4	16-stage/0	16-stage/0	16-stage/0	16-stage/0	16-stage/0
Programmable Delay	Yes	Yes	Yes	-	-	-	-	-
Internal Oscillator (Hz)	2k/2M/25M	2k/2M/25M	2k/10k/25M	25k/2M/25M	25k/2M/25M	25k/2M/25M	25k/2M/25M	2k/2M/25M
Power Switch	-	-	-	-	-	-	-	2 x PFET
LDO	-	-	-	4 x 150 mA	2 x 300 mA	1 x 600 mA	4 x 150 mA	-
DC/DC	-	-	-	-	-	-	1 A Buck	-
Asynchronous State Machine	12-state	-	-	8-state	8-state	8-state	8-state	-
Temp Sensor	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Crystal Oscillator Cell	Yes	-	-	-	-	-	-	-
Communication Interface	I^2C	I^2C	I^2C	I^2C	I^2C	I^2C	I^2C	I^2C
Package Size (mm)	4.0 x 4.0	1.6 x 2.0	1.6 x 1.6	2.0 x 3.0	2.0 x 3.0	2.0 x 3.0	3.0 x 3.0	1.6 x 3.0
Package Type	STQFN	STQFN	STQFN	STQFN	STQFN	STQFN	MSTQFN	MIS

NEW & AVAILABLE FOR SAMPLING

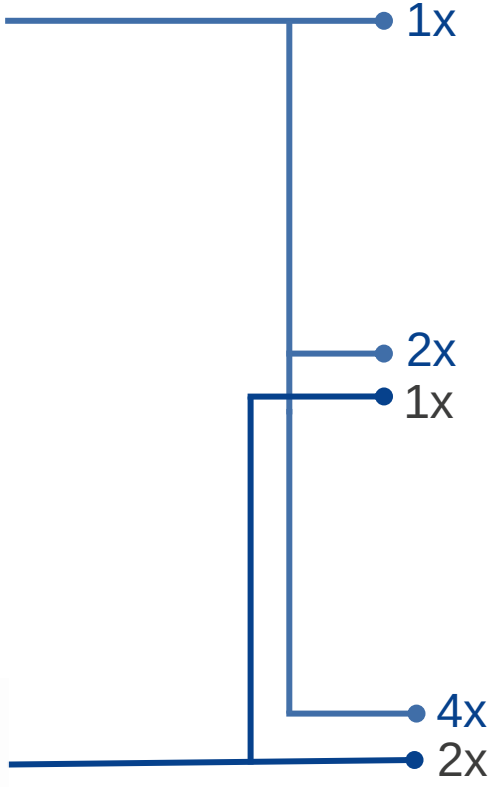
In-System Programmable

	SLG47105	SLG47115	SLG46824/SLG46826	SLG47004V	SLG47512/SLG47513
# of Pins / # of GPIOs	20/8 + 4 x HD	20/8 + 2 x HD	20/17	24/8	SLG47512 – 12/10 SLG47513 – 16/14
Operating Voltage, VDD (V)	2.3 to 5.5	2.3 to 5.5	2.3 to 5.5	2.3 to 5.5	1.0 to 1.65
Dual Supply, VDD2 (V)	3.0 to 13.2	4.5 to 26.4	1.71 to VDD	-	-
Dual Supply Version	-	-	-	-	-
Analog/Digital Comparators	4/0	3/0	4(2)/0	3(2)/0	2/0
Voltage Reference	Trimmed	Trimmed	Trimmed	Trimmed	Trimmed
Combo Function Macro-cells	12 Total	12 Total	11 Total	13 Total	15 Total
Multi-Function Macro-cells	5 Total	5 Total	8 Total	7 Total	8 Total
PWMs	2	2	-	-	-
Special Features	-	-	SLG46826: 2-kbit I^2C compatible serial EEPROM emulation	2 Op Amps, 2 Rheostats, 2 analog switches, EEPROM	-
Counters/Delays	5	5	-	-	-
DFF / Latch	15	15	-	-	-
3-Output Pipe Delay	16-stage	16-stage	16-stage	16-stage/0	-/14
Programmable Delay	Yes	Yes	Yes	Yes	Yes
Internal Oscillator (Hz)	2k/25M	2k/25M	2k/2M/25M	2k/2M/25M	2k/25M
Power Switch	-	-	-	-	-
LDO	-	-	-	-	-
DC/DC	-	-	-	-	-
Asynchronous State Machine	-	-	-	-	-
Temp Sensor	Yes	Yes	Yes (SLG46826)	Yes	Yes
Crystal Oscillator Cell	-	-	-	-	-
Communication Interface	I^2C	I^2C	I^2C	I^2C	I^2C
Package Size (mm)	2.0 x 3.0	2.0 x 3.0	2.0 x 3.0	3.0 x 3.0	1.6 x 1.6
Package Type	STQFN	STQFN	STQFN & TSSOP	STQFN	STQFN

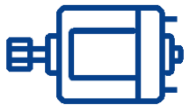
GET YOUR MOTOR RUN WITH HVPAK

- **4** High Voltage High Current Outputs
- Power Supply Voltage up to **13.2 V**
- Up to **2 A** Current per Output

- **2** High Voltage High Current Outputs
- Power Supply Voltage up to **26.4 V**
- Up to **3 A** Current per Output



Stepper Motor:
- Full-, Half-, Microstep Mode
- Configurable Current Limit
- Configurable Fault Monitor
- Sleep Mode

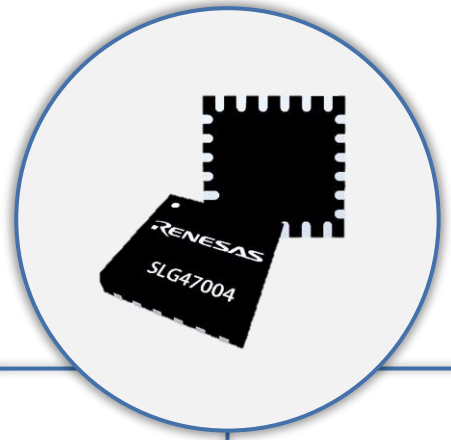


DC Motors:
- Constant Voltage Mode
- Constant Current Mode
- Custom Current Sensing
- Custom Fault Monitor
- PWM Soft start

Solenoids:
- Don’t need external diode for relay coil
- Multi-drivers
- Zero-Crossing Detection

WHAT IS ANALOGPAK?

AnalogPAK Product Introduction



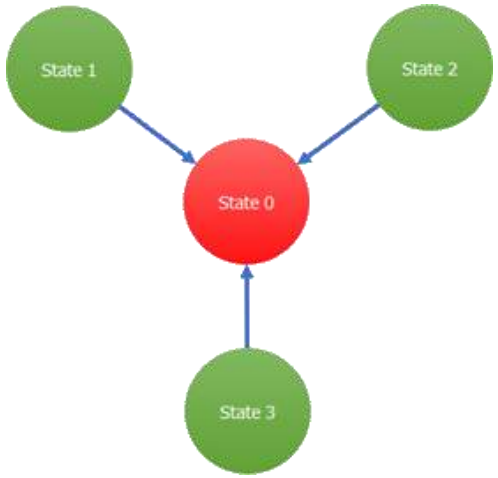
- Integration of New Analog Resources:
  - Two Op Amps (3-opamp InAmp)
  - Two 10-bit Rheostats
  - Two Analog Switches

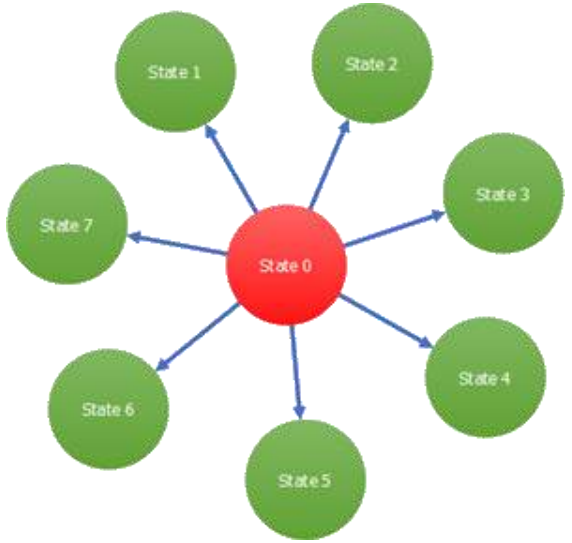
- Traditional Features:
  - Configurable Digital Logic Cells, Oscillators, ACMPs
  - I^2C Communication
  - Multi-Time Programmable Memory (NVM + EEPROM)

- Unique Auto-Trim Solution:
  - Tunable Amplifiers & Filters
  - Tolerance, Drift, & Error Compensation

GREENPAK ICS NEW FEATURES

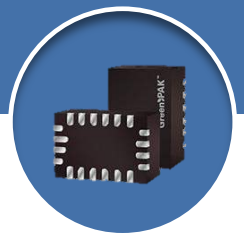
- Low current consumption (200 nA – 300 µA)
- In-system programmable
  through I^2C port (ISP) in SLG46824 and SLG46826
- Temperature range up to 105 °C (for automotive ICs)
- LDO up to 4 x 150 mA / Load Switches 2 x 2 A / DC/DC
- State machine up to 12 states –
  zero current consumption, no clock needed





STAND OUT FEATURES OF SLG46824/SLG46826 AND SLG47004

SLG46824/SLG46826 Features

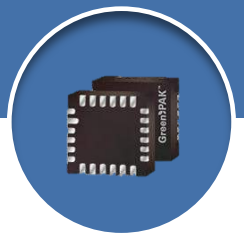


- Two low power ACMPs and two high speed ACMPs
- In-System Programmable through I2C port (ISP)
- Multi-Time Programmable (MTP / 1K Erase/Write cycles)
- 2k bits of memory for independent customer use (EEPROM emulation)
- Analog temperature sensor
- Multi-Function Macrocells
- 2.0 mm x 3.0 mm, 20-pin TQFN

Very Low Current Consumption

- VDD applied, no blocks active: 80 nA
- Lower power consumption for ACMPs:
  - Each of these devices includes two ACMPs optimized for low power
- AnalogPAK OpAmps power consumption depends on selectable bandwidth:
  - 33/90/237/611 µA
- Low power 2.048 kHz oscillator:
  - 370 nA typical when VDD = 3.3 V

AnalogPAK™ SLG47004 Features



- Rich set of analog blocks (op amps, in amp mode, digital rheostats etc.)
- Unique Auto-Trim Feature
- EEPROM, multi-time programmable NVM, and in-system programmability
- Three fully configurable Op Amps
- Two 10-bit 100 kOhm digital rheostats
- Power saving features for all blocks
- 3.0 mm x 3.0 mm, 24-pin STQFN

NEW ROADMAP DEVICES SLG46880/1 AND SLG46855 HIGHLIGHTS

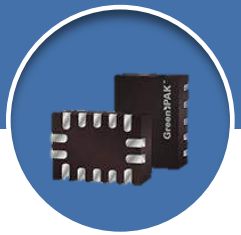
SLG46880 and SLG46881 Features

- 12 state ASM with 84 possible state transitions
- Two low power ACMPs and two high speed ACMPs
- (f1) computation macrocell
- Analog temperature sensor
- 4.0 mm x 4.0 mm, 32-pin TQFN

Very Low Current Consumption

- VDD applied, no blocks active: 80 nA
- Lower power consumption for ACMPs:
  - Each of these devices includes two ACMPs optimized for low power
  - 1.9 µA typical for one ACMP with internal VREF
  - 1.0 µA typical for one ACMP with external VREF
- Low power 2.048 kHz oscillator:
  - 370 nA typical when VDD = 3.3 V

SLG46855 Features



- Two low power ACMPs and two high speed ACMPs
- Multi-Function Macrocells
- Analog temperature sensor
- 1.6 mm x 2.0 mm, 14-pin STQFN

NEW ROADMAP DEVICES SLG4658X AND SLG46585 HIGHLIGHTS

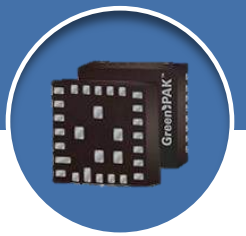
SLG46580, SLG46582 and SLG46583 Features

- Integrated, programmable LDOs
  - Four 150 mA channels (SLG46580)
  - Two 300 mA channels (SLG46582)
  - One 600 mA channel (SLG46583)
  - Each channel can be programmed as a load switch
  - Low power modes available
- 8-state ASM
- Analog temperature sensor
- 2.0 mm x 3.0 mm, 20-pin STQFN

Very Low Current Consumption

- VDD applied, no blocks active: 80 nA
- Low power 2.048 kHz oscillator:
  - 370 nA typical when VDD = 3.3 V

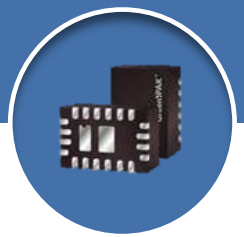
SLG46585 Features



- 1 A DC/DC Buck Converter with programmable output voltage
- Integrated, programmable LDOs
  - Four 150 mA channels
  - Each channel can be programmed as a load switch
  - Low power modes available
- 8-state ASM
- Analog temperature sensor
- 3.0 mm x 3.0 mm, 29-pin MSTQFN

HVPAK™ HIGHLIGHTS

SLG47105 Features

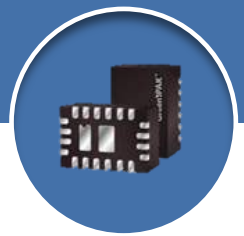


- **4** High Voltage Hight Current Outputs
- Power Supply Voltage up to **13.2 V**
- Up to 2 A Current per Output
- 8 Configurable General Purpose In/Out
- 20-pin STQFN package

Very Low Current Consumption

- VDD applied, no blocks active: 80 nA
- Low power 2.048 kHz oscillator:
  - 370 nA typical when VDD = 3.3 V

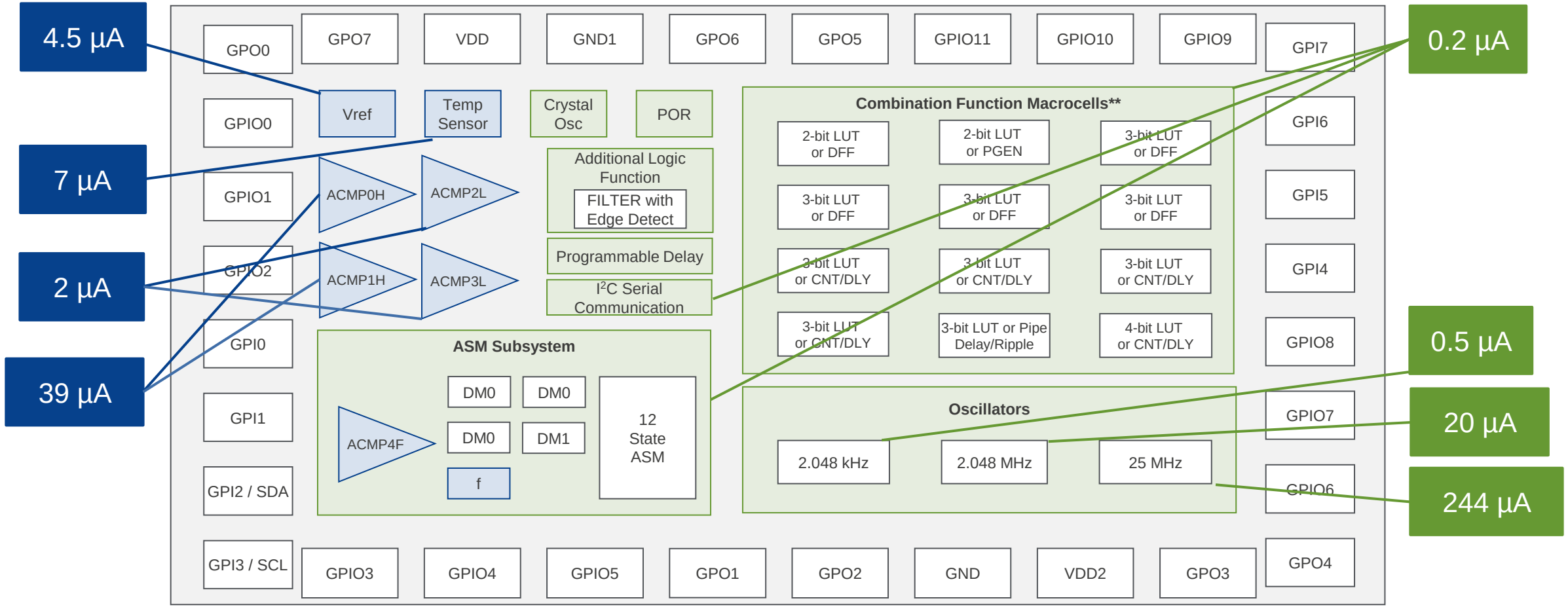
SLG47115 Features



- **2** High Voltage Hight Current Outputs
- Power Supply Voltage up to **26.4 V**
- Up to 3 A Current per Output
- 8 Configurable General Purpose In/Out
- 20-pin STQFN package

CURRENT CONSUMPTION

Digital (Green) Versus Analog (Blue) Blocks Current Consumption*



*current consumption of SLG46880 and SGL46881 under V_{DD} = 5 V

** Combination Function Macrocells current consumption equals to 0 µA

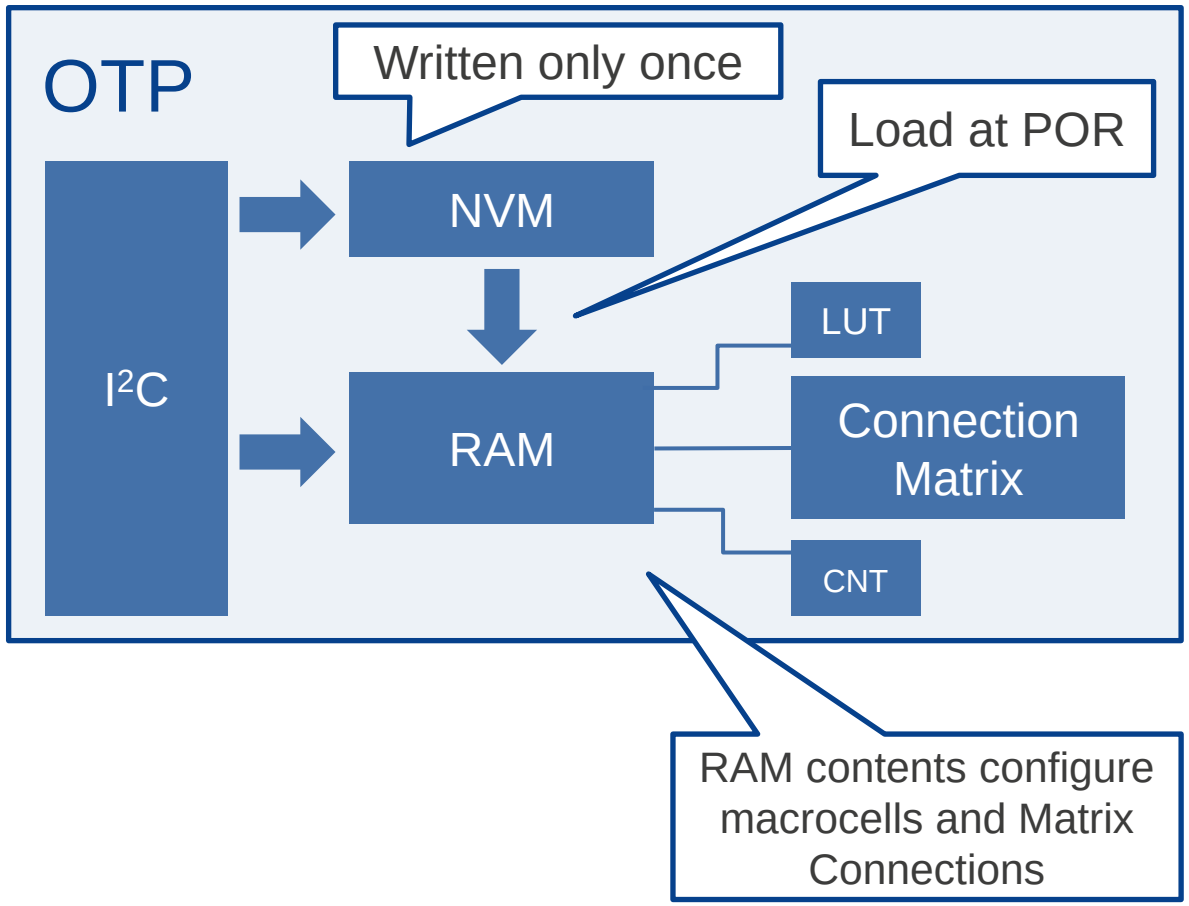
WHAT IS THE DIFFERENCE BETWEEN OTP AND ISP DEVICES?

Discover What Fits Your Expectations

Comparison Area	One Time Programmable	Multiple Time / In-System Programmable
Optimized for:	Lower per unit cost	Greatest flexibility
Most popular programming scenario	Programmed in Renesas factory (sold in custom-tested and custom-marked form)	Programmed by customer during final test using I^2C connection (sold in unprogrammed form)
Other programming options	No other options available	Programmed in Renesas factory Programming upgrade in the filed (requires other components in system to provide programming information)
Additional benefits		Programming can be changed in previously programmed devices (avoids inventory obsolescence)

STRUCTURE OF THE GREENPAK IC MEMORY

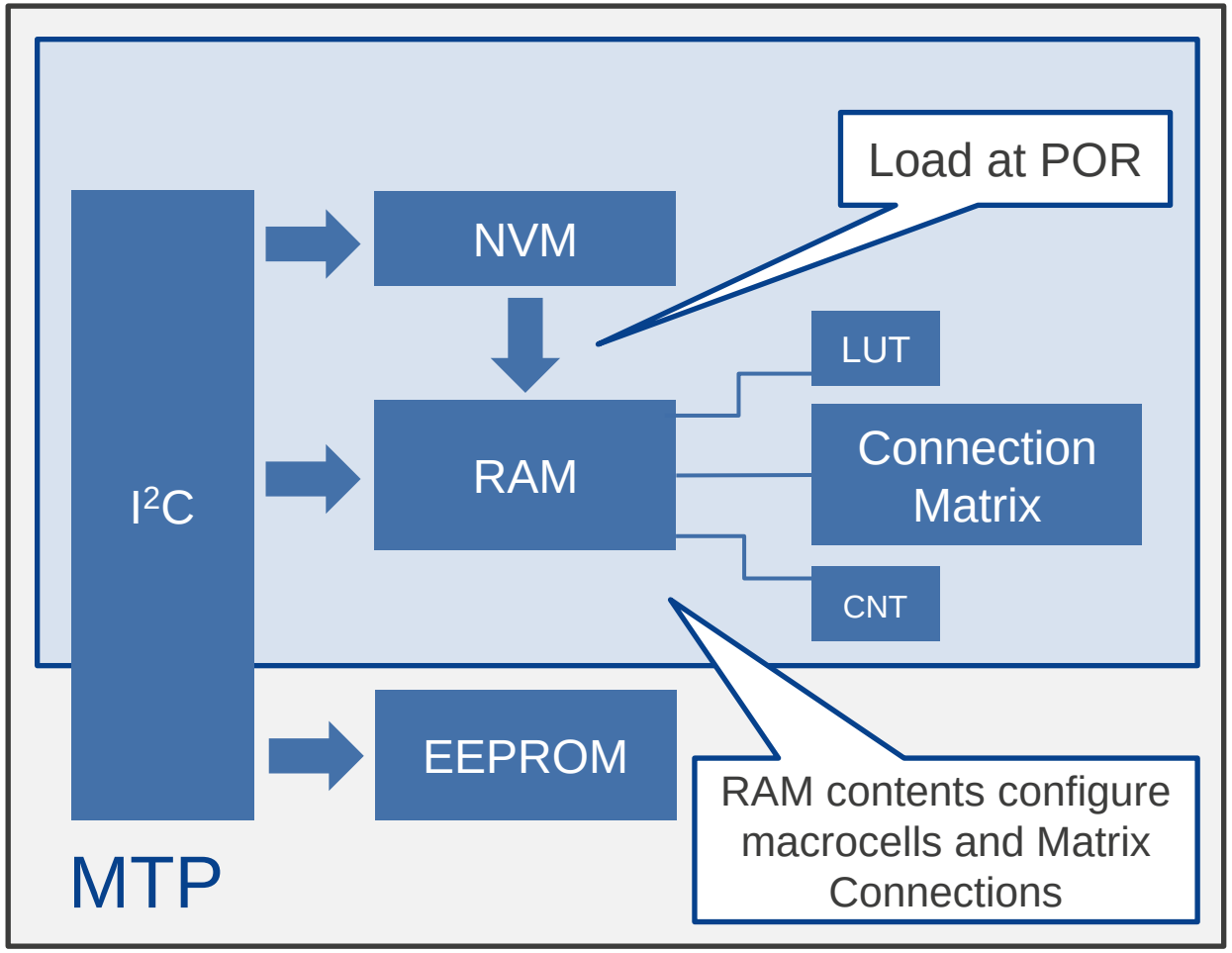
How IC Memory Works in OTP and MTP/ISP Circuits



- 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

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.

RENESAS MANUFACTURING ADVANTAGES

Device Level Features

- **Operating Temperature Range:** -40 °C to 85 °C
- **Moisture Sensitivity Level:** 1 (Unlimited)
- **ESD Protection:** 2 kV HBM, 500+ V CDM
- **Quality Management:** ISO9001:2010 certified
- **Failure Rate:** < 10 DPPM
- **FIT:** < 25
- **Long Product Lifecycles:**
  - Driven by customer requirements
- **Environmental:** Sony Green Partner
  - All subcons ISO14001, RoHS Compliant , Halogen-Free

Design Benefits

- Higher Reliability
- Design Security
- Tested Solution

DEPENDABLE HIGH-VOLUME PRODUCTION

Over 5 Billion
GreenPAK and GreenFET™ ICs Delivered!

Availability and Continuity of Supply

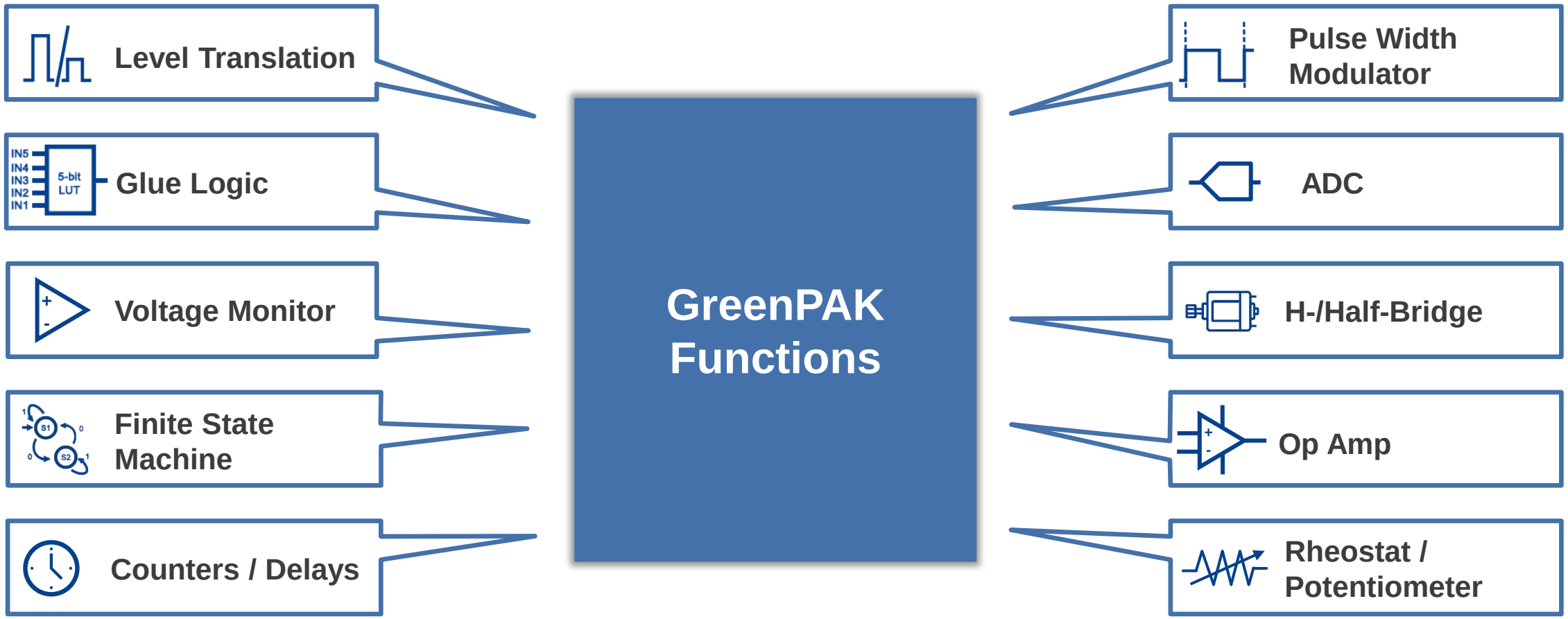
- Standard CMOS and packaging with a flexible inventory system
- Rapidly expanding product offering to achieve a wide range of price points
- Engineering support centers and distributor hubs located globally

Custom Silicon at Commodity Prices

- BOM, board space, cost and vendor reduction
- Cost effective analog solution by trimming for operating condition

AGENDA

WHAT CAN I DO WITH GREENPAK?

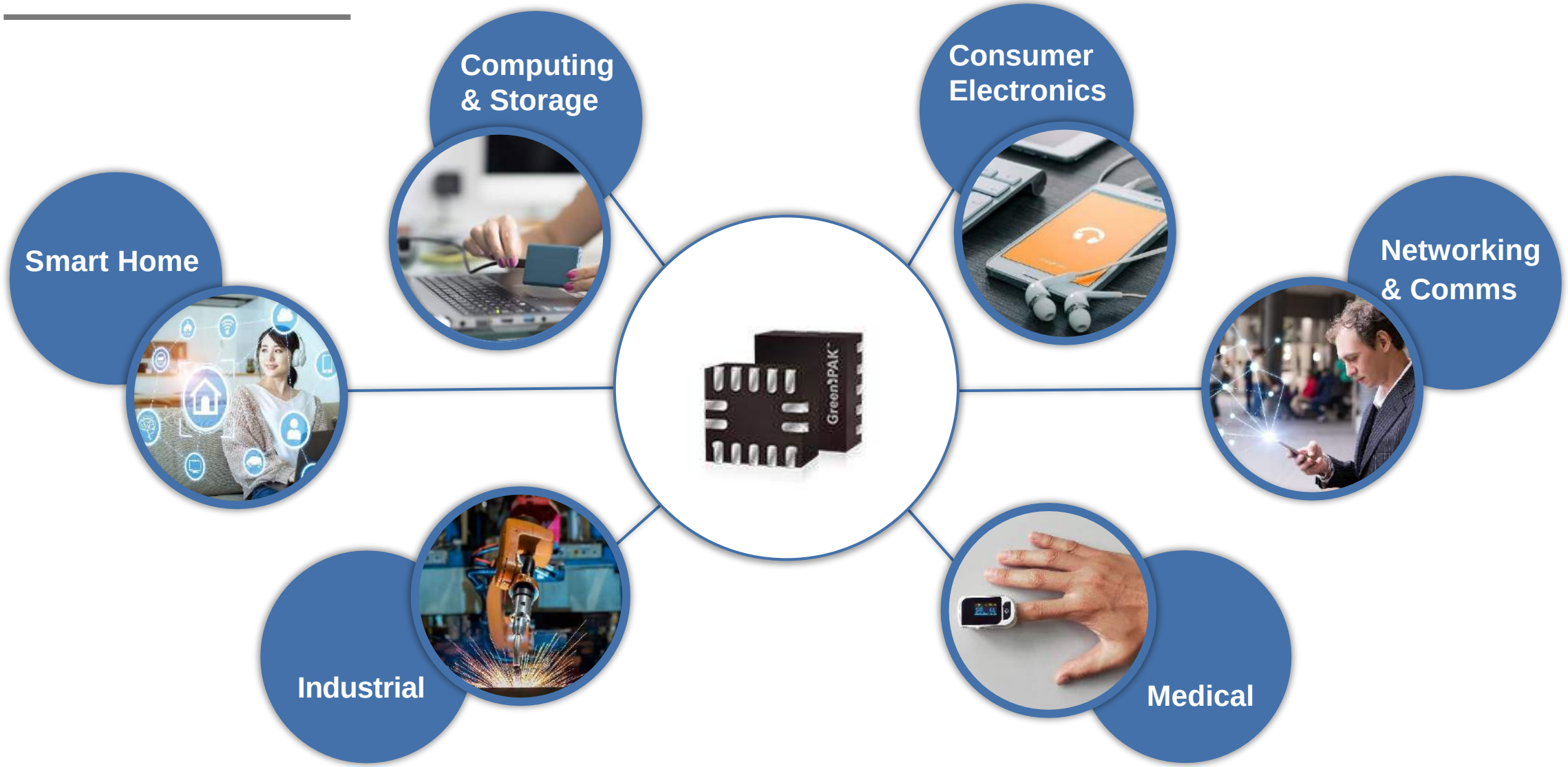


WHAT CAN I DO WITH GREENPAK? - APPLICATIONS

- Power Sequencing
- Supervisory Circuits
- System Reset
- Voltage Detection
- LED Control
- Motor & Fan Control

- Frequency Detection
- Sensor Interface
- Port Detection
- Temperature Control
- Coulomb Counter

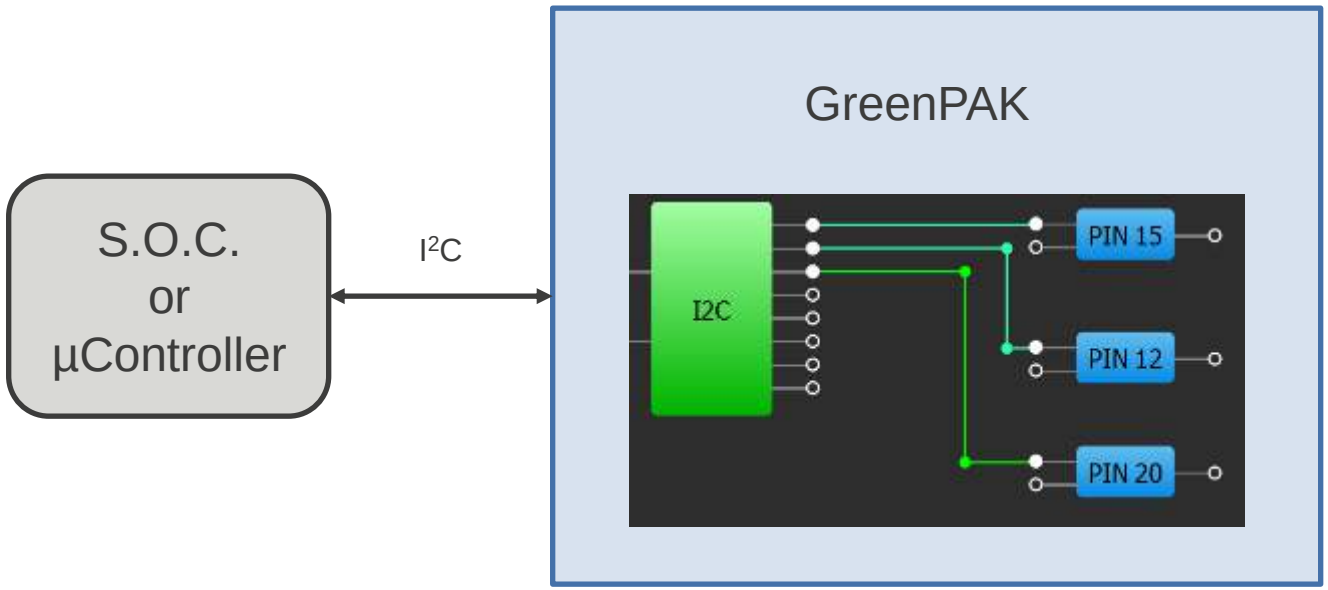
GREENPAK TARGET MARKETS



GREENPAK APPLICATION EXAMPLES

GPIO Expander

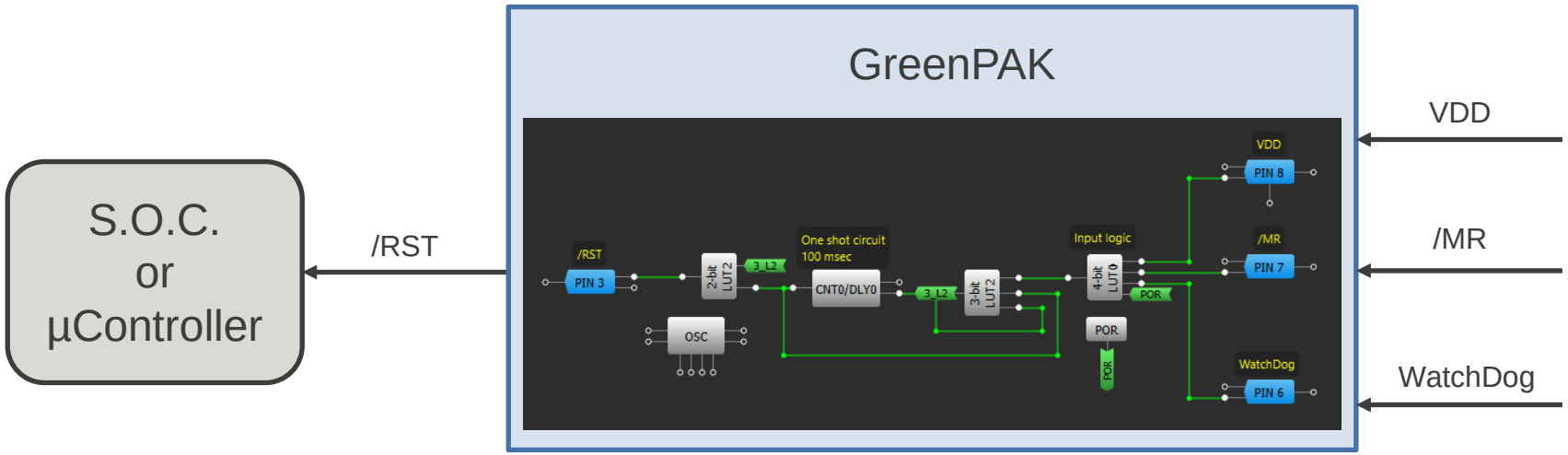
- Uses the I²C port in SLG4653xV
- Access GreenPAK pin state by a read command
  (up to 16 pins with SLG46533/SLG46537/SLG46538V)
- Optional /INT pin can be implemented for continuous pin monitoring



GREENPAK APPLICATION EXAMPLES

System Reset

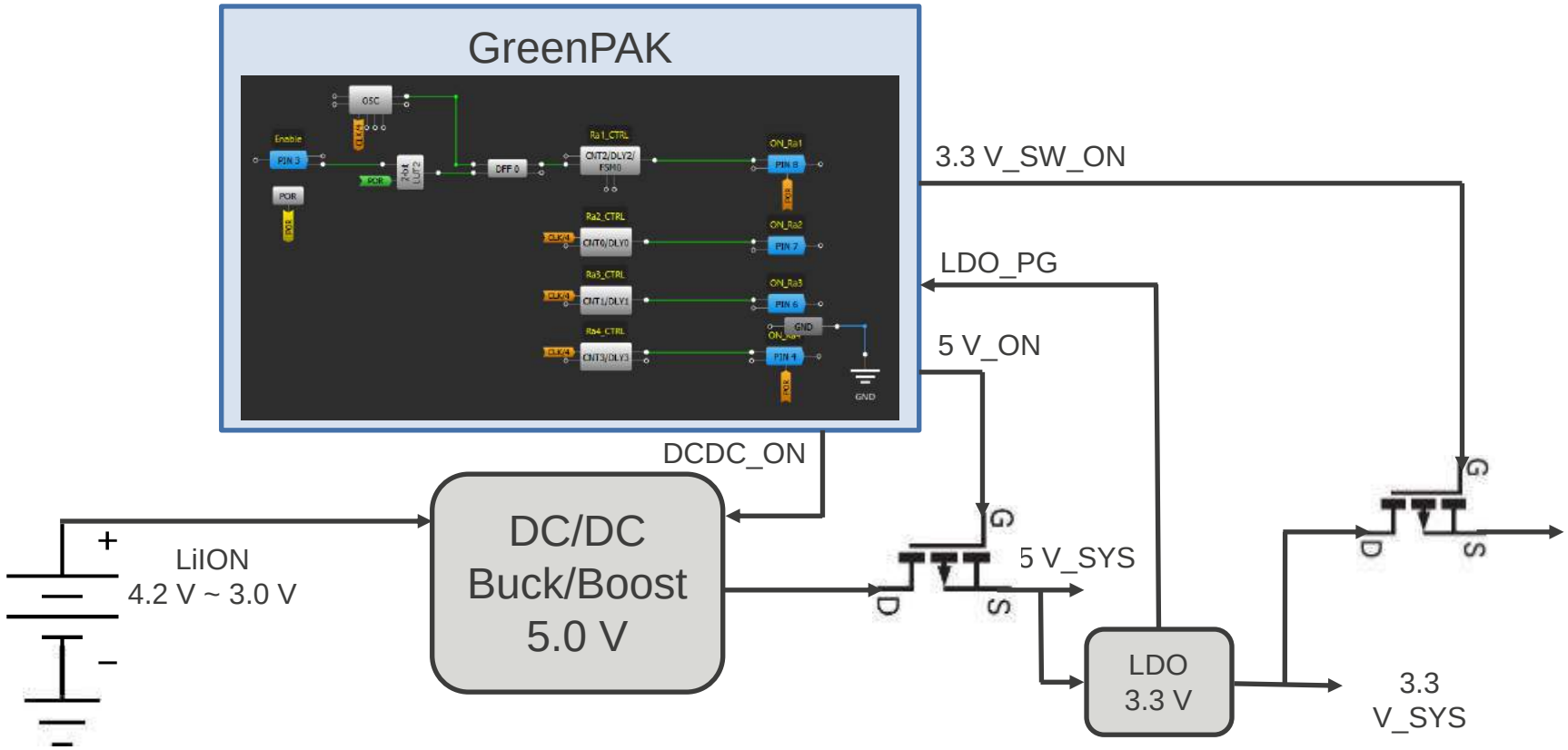
- Can be implemented in any GreenPAK silicon
- Inputs: /MR, VDD, WatchDog, voltage rail, logic signal
- Output: one shot pulse of almost any time length, level shifted logic



GREENPAK APPLICATION EXAMPLES

Power Rail Sequencing

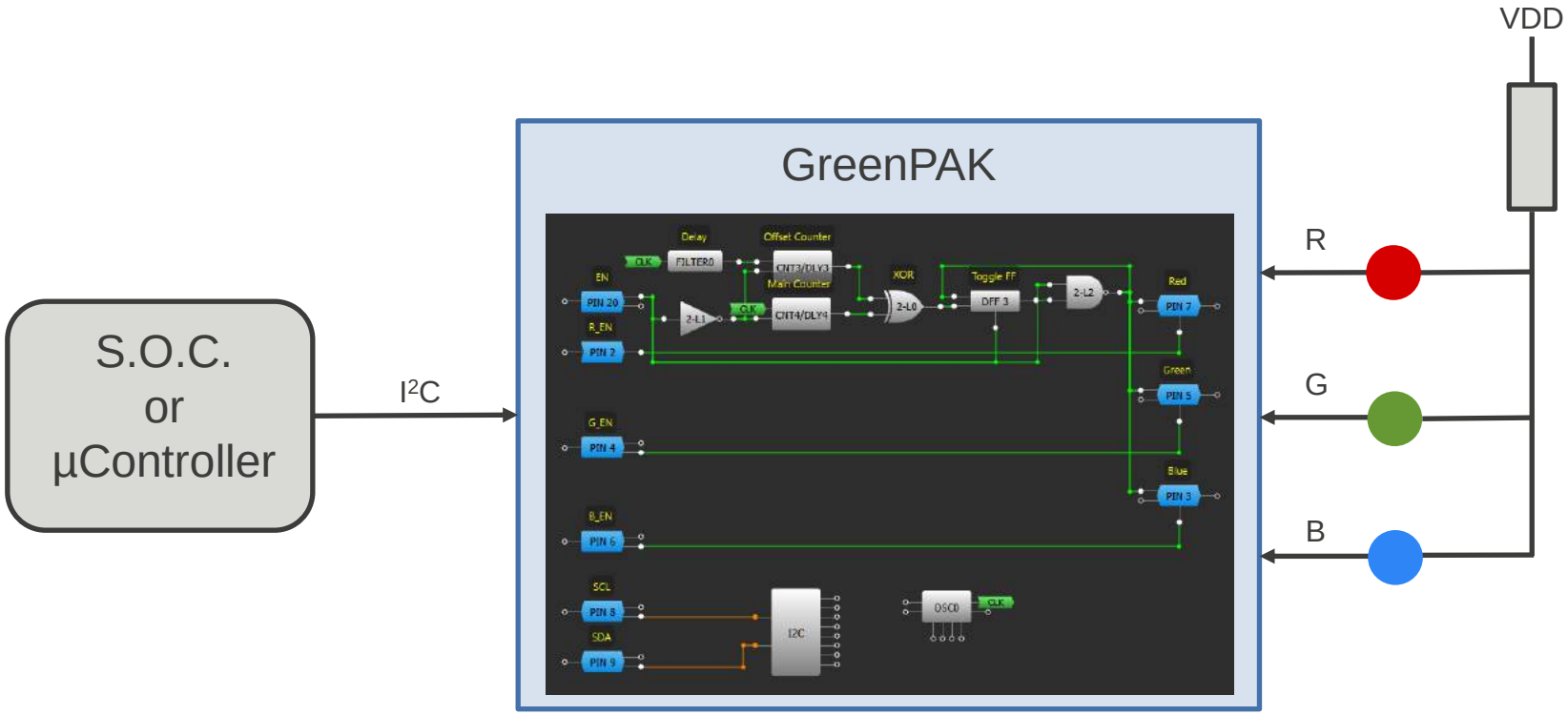
- Can be implemented in any GreenPAK silicon
- Inputs: logic signals, PGs, voltage levels
- Outputs: load switch OEs, LDO OEs, DC/DC OEs, MOSFET gates



GREENPAK APPLICATION EXAMPLES

RGB LED Driver

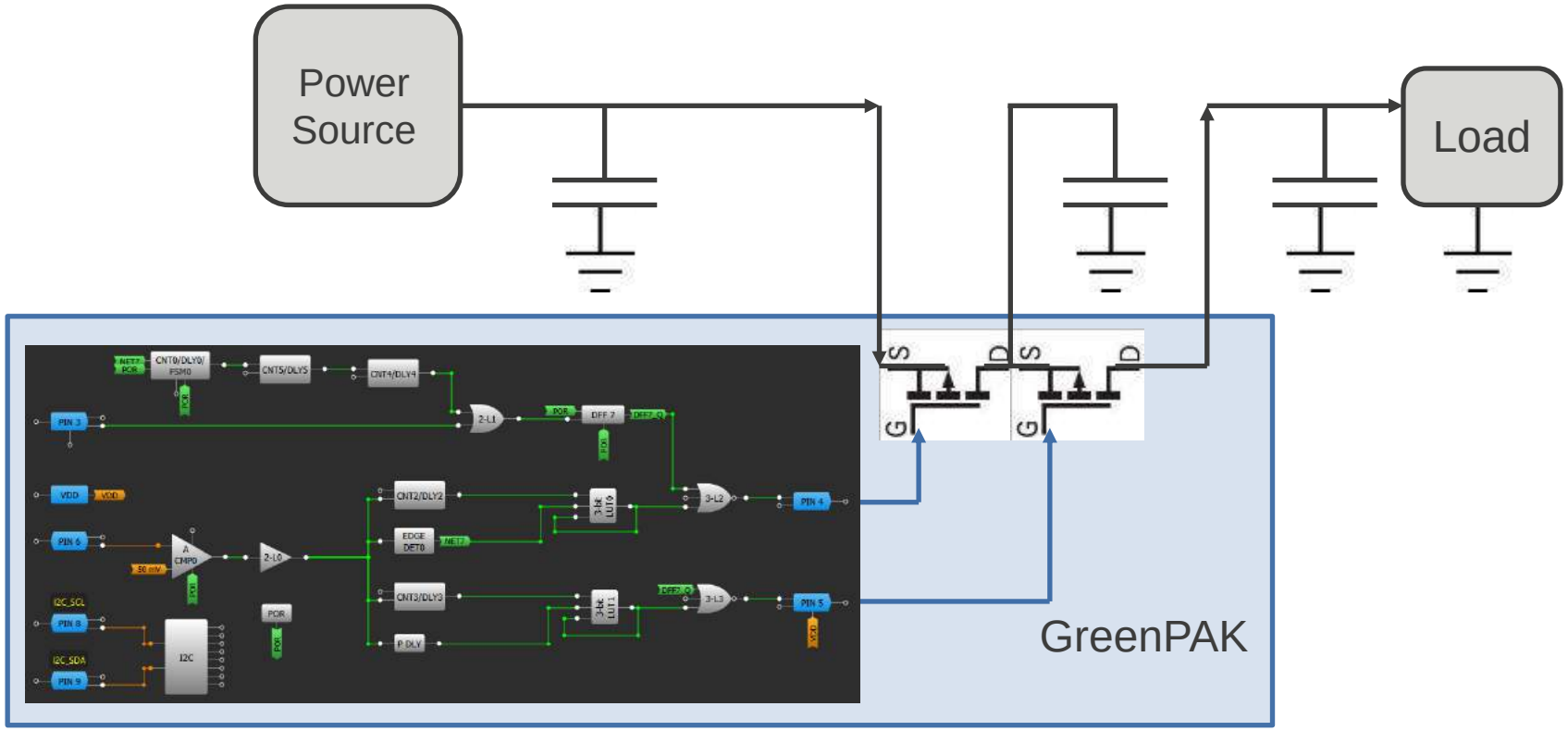
- Uses the I2C port in SLG4653xV, can be implemented with SPI in other GreenPAKs
- Inputs: write command for color, flashing time, pulsing time, breath time
- Output: PWM signal with timing to drive RGB diode(s)



GREENPAK APPLICATION EXAMPLES

Coulomb Counter

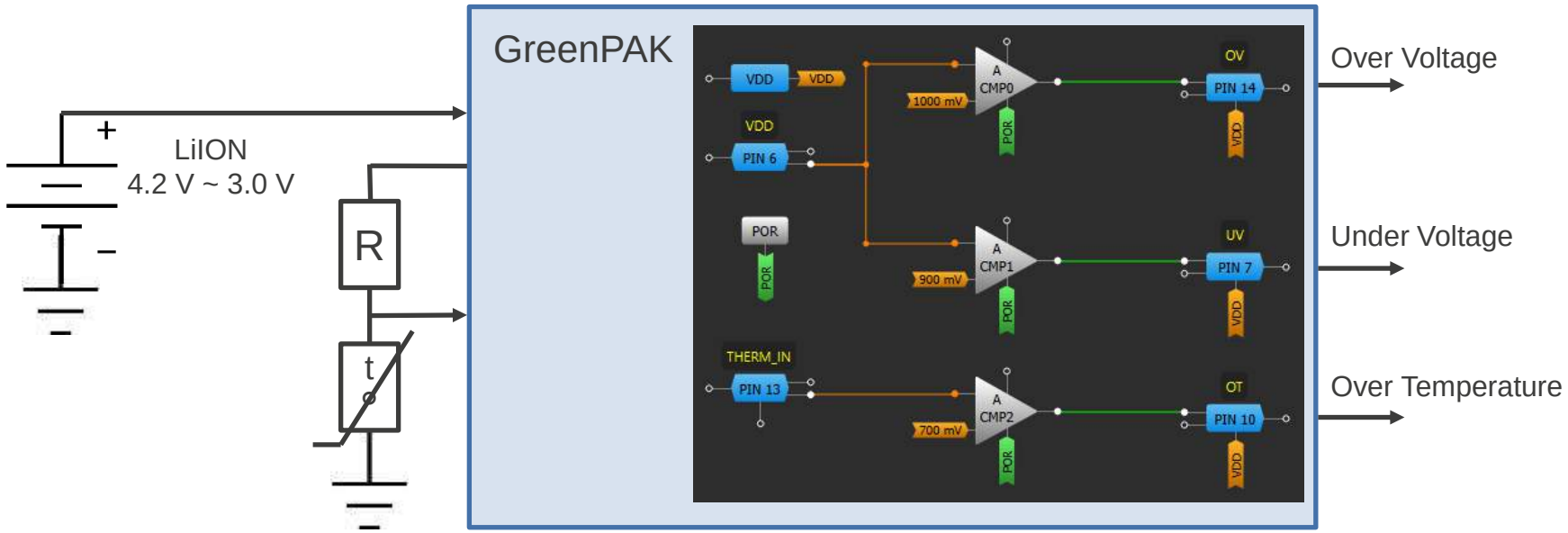
- 2 uA power consumption; linear for power switch currents from uA to mA
- Inputs: Current through power switches
- Output: Frequency proportional to current through switches or I2C counter read



GREENPAK APPLICATION EXAMPLES

Safety Features

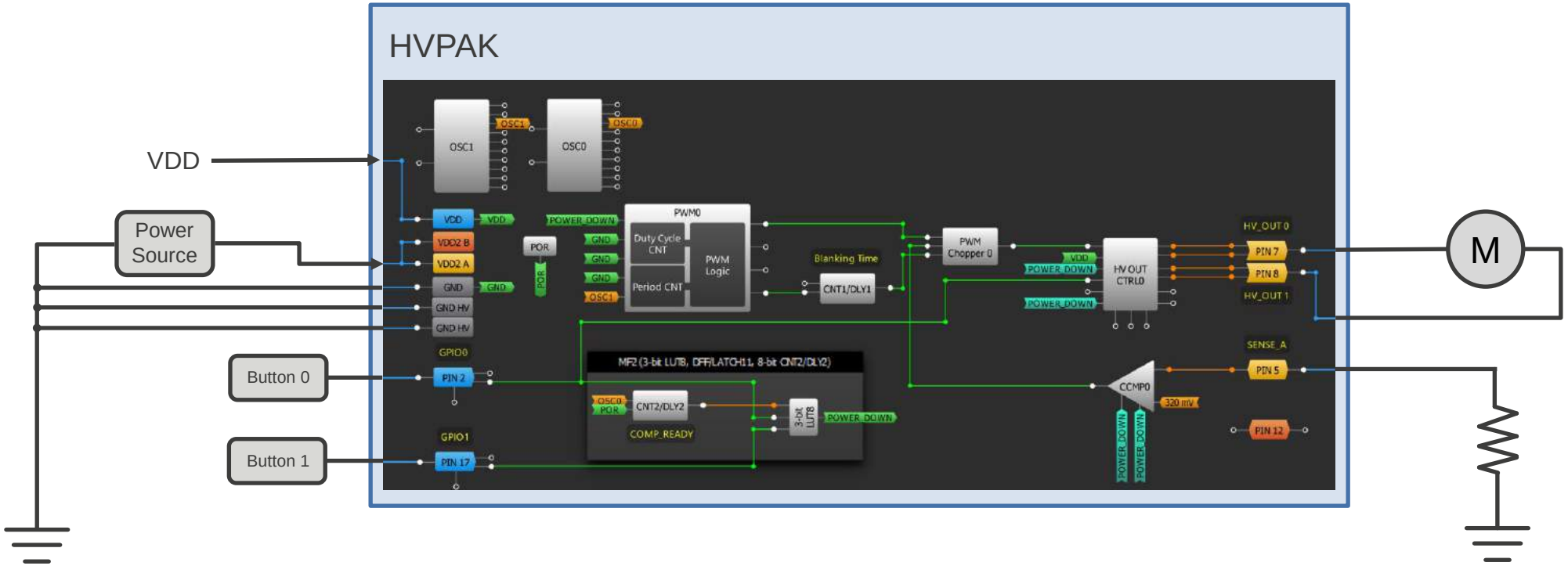
- Can be implemented in any GreenPAK silicon with ACMPs
- Inputs: VDD, voltage rails, thermistors, other sensing elements
- Outputs: over/under voltage indication, over temperature



GREENPAK APPLICATION EXAMPLES

HVPAK Motor Driver with Current Limiting Application

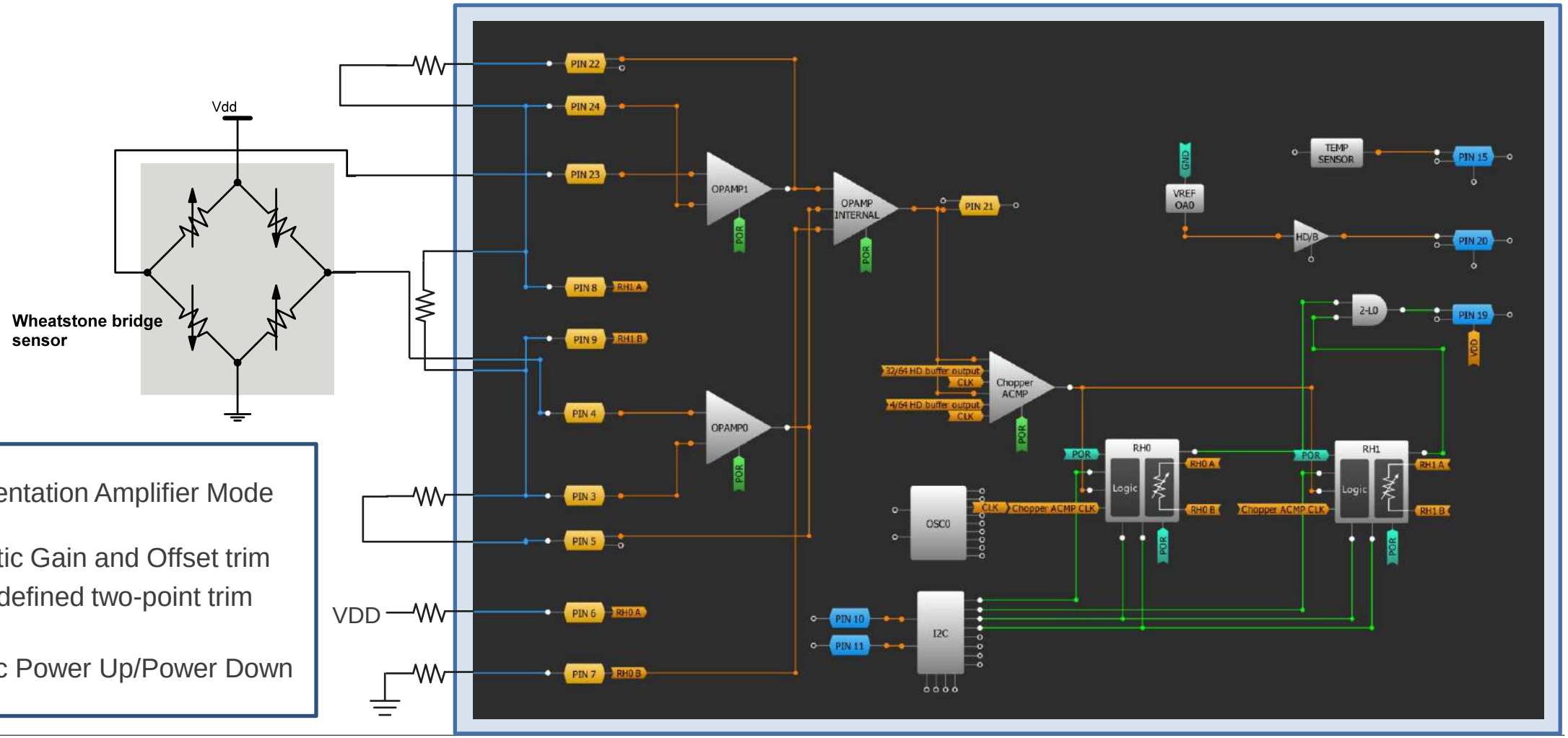
- Can be implemented using HVPAK family ICs
- Inputs: VDD, power source, two buttons
- Outputs: custom motor control with over current protection



GREENPAK APPLICATION EXAMPLES

Wheatstone Bridge Sensors Interface Using AnalogPAK SLG47004

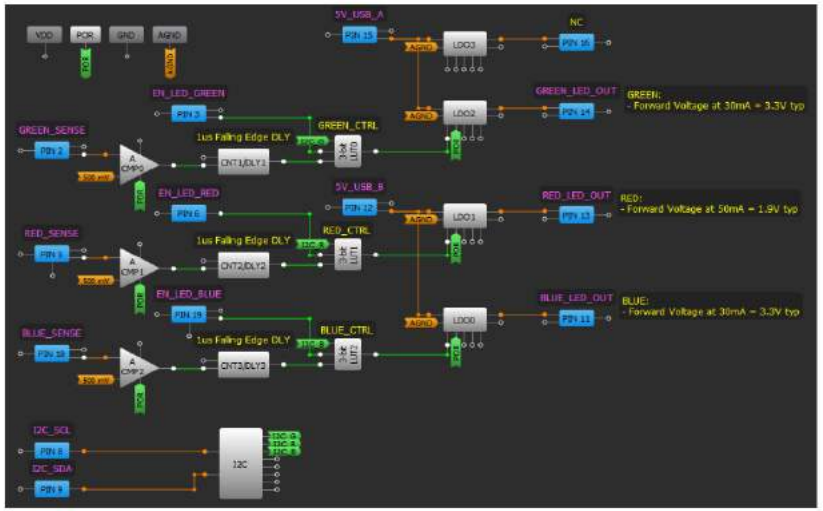
AnalogPAK



- Instrumentation Amplifier Mode
- Automatic Gain and Offset trim or user-defined two-point trim
- Dynamic Power Up/Power Down

CHECK OUT THE DESIGN EXAMPLES

- Great library of training videos **Link**
- Comprehensive library of **around 300** fully documented apps notes & reference designs **Link**



AN-CM-300

Using a Dialog GreenPAK™ for Automatic Amplifier Bias Control

3 Introduction

Dialog's configurable mixed signal GreenPAK ICs are an ideal product to use when configurable and flexible control circuits are desired. This application note will detail using a GreenPAK to automatically set an amplifier bias circuit.

4 Background Concept

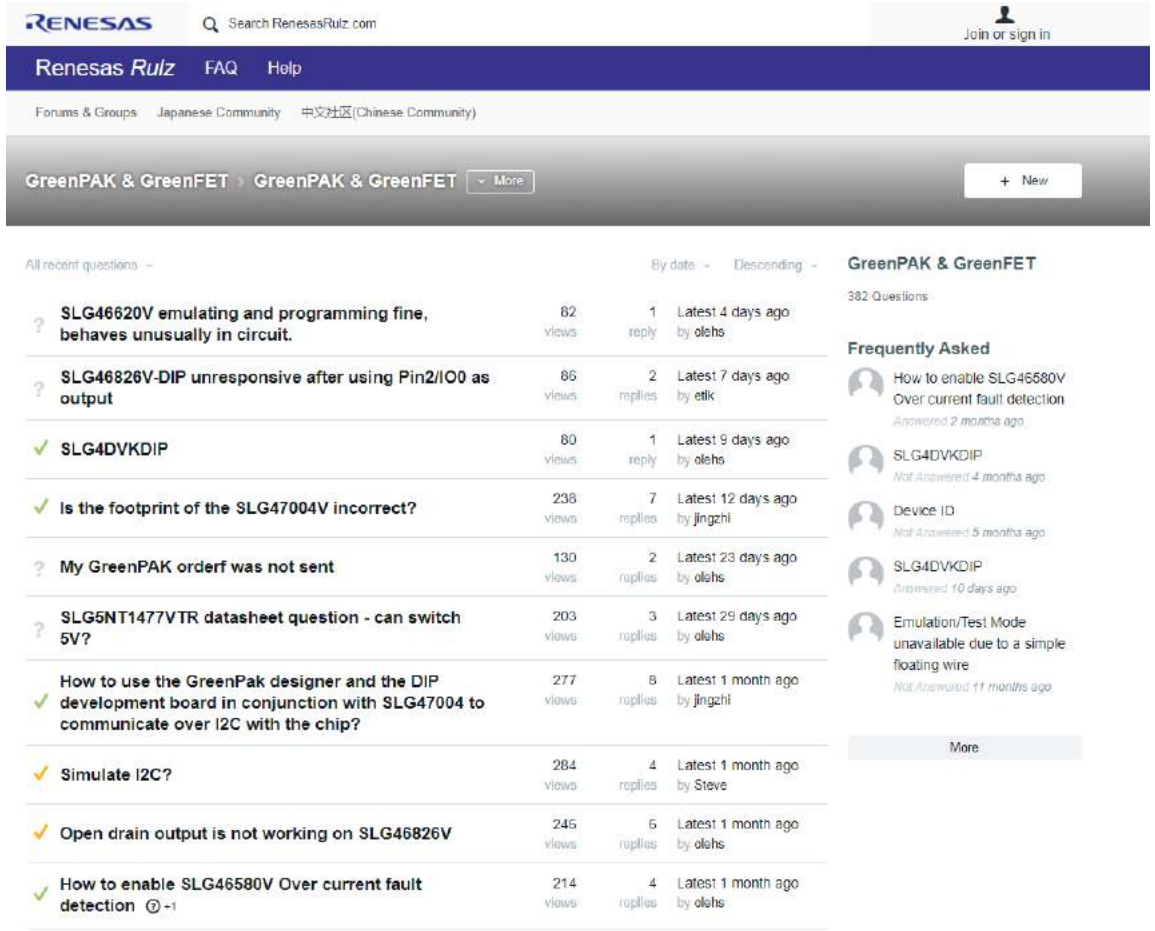
It usually is desired to operate the amplifier at as low a power level as necessary. This saves power consumption, reduces heat, increases reliability, etc. At times a higher power level may be desired due to the radio link being insufficient. Developing a circuit to handle his can be complex and have multiple external components. Using a Dialog GreenPAK IC, the designer can easily use a single component to provide the needed voltages and control circuits to the amplifier as well as provide useful alarm and monitoring functions.

This app note assumes operation at 900 MHz and will use the following devices as examples:

- GreenPAK: Dialog SLG46582V [5]
- Amplifier: Mini-Circuits PHA-23LNB+
- LNA: Mini-Circuits TSY-13LNB+
- Digital Step Attenuator: Skyworks SKY12325-35-LF
- Detector Diode: Skyworks SMS3923-079LF

ONLINE SUPPORT WHENEVER YOU NEED IT

- Online support from Renesas experts **Link**
- Simple one-time registration **Link**



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