LESENSE - Low Energy Sensor interface

Analog events
Capacitive, inductive or resistive sensors
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Generic MCU
Wake-up periodically to detect the events
LESENSE - Low Energy Sensor interface

Analog events
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Generic MCU
Wake-up periodically to detect the events

EFM32 MCU
Wake-up only on the events
LESENSE - Low Energy Sensor interface

Analog events
Capacitive, inductive or resistive sensors

Generic MCU
Wake-up periodically to detect the events

Gecko MCU
Wake-up only on the events

Gecko MCU
Conditional wake-up (e.g. on every 2nd event)
LESENSE – Low Energy Sensor Interface

- Autonomous sensing in Deep Sleep
  - LESENSE with central control logic
  - ACMP for sensor input
  - DAC for reference generation
- Measure up to 16 sensors
  - Inductive (LC)
  - Capacitive (e.g. capacitive buttons)
  - General analog sensors (e.g. resistive)
- Programmable state machine
  - 16 states, 4 input channels
  - Can do quadrature decoding
- Interrupt/PRS on sensor events
LESENSE – Requirements & Interactions

CPU and Memory
- ARM Cortex-M3 processor
- Memory Protection Unit
- Embedded Trace Macrocell
- Flash Program Memory
- RAM Memory
- Debug Interface

Clock Management
- High Freq Crystal Osc
- High Freq RC Osc
- Low Freq Crystal Osc
- Low Freq RC Osc
- Ultra Low Freq RC Osc
- Auxiliary RC Osc

Energy Management
- Voltage Regulator
- Brown-out Detector
- Power-on Reset
- Back-up Power Domain

Serial Interfaces
- USART
- UART
- I2C
- USB

I/O Ports
- External Bus Interface
- TFT Driver
- General Purpose I/O
- Pin Reset
- GPIO Wake-up

Timers and Triggers
- Timer/Counter
- Low Energy Timer
- Real Time Counter
- Real Time Counter
- Pulse Counter
- Watchdog Timer
- Backup RTC

Analog Modules
- ADC
- LCD Controller
- Operational Amplifier
- Analog Comparator

Security
- AES Accelerator

Energy Management Domains:
- EM0 (Run Mode)
- EM1 (Sleep)
- EM2 (Deep Sleep)
- EM3 (Stop Mode)
- EM4 (Shutoff Mode)

Available down to:
- EM1 (Sleep)

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www.energymicro.com
Capacitive Measurement

<2 μA
Live DEMO

Capsense
Resistive/General Measurement

EFM32

LESENSE

Excitation

Input

ACMP

PRS

.101..

CPU

Z

Z

Z

Sample

Sample

Sample

Power supply

Sensor

Output

<1.5 μA

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Live DEMO

Lightsense
LESENSE Inductive Measurement

<2 μA

Fixed at Vdd/2

EFM32

DAC0_OUT0

ACMP0_CH0

No metal

Metal

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... the world’s most energy friendly microcontrollers and radios
LESENSE Inductive Measurement – Timing

- LESENSE scans all the enabled channels at a configurable frequency.

Analog Comparator and DAC Enabled

Excitation (pull CH0 pin low)

Sampling Window

Acmp and DAC on

Hi-Z

High-Z input

Acmp gated to counter

LESENSE

EFM32

DAC0_OUT0

ACMP0_CH0

www.energymicro.com
Live DEMO

LC sense
Feel the flow!!

EFM32

LESENSE

CH0

CH1

Flow
State Machine - Slide to Wake up!

- Autonomous Gesture Detection
- Up to 16 Different States
- Output to PRS or Interrupt
Slide to Wake up!

- What happens on incomplete gesture??
LESENSE – Statemachine / Decoder

- Up to 16 states.
- 4 Inputs from scan-result or PRS.
- 2 configurable next states per transition.
- 3 output action signals on state transition.
- Interrupt on state transition.
- One transition per scan-sequence.