EFM32
...the world’s most energy friendly microcontrollers
The EFM32 lineup

www.energymicro.com
...the world’s most energy friendly microcontrollers and radios
Comparing the EFM32 performance

<table>
<thead>
<tr>
<th></th>
<th>1 Active 25 MHz @ 3V</th>
<th>2 Reduced processing time</th>
<th>3 Very fast wake-up time</th>
<th>4 Ultra low stand-by current</th>
<th>5 Autonomous peripherals</th>
<th>6 Peripheral Reflex System</th>
<th>7 Well architected Energy Modes</th>
<th>8 Ultra Energy Efficient Peripherals</th>
<th>9 Low Energy Sensor Interface</th>
<th>10 Advanced Energy Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>32-bit EFM32TG840F32</td>
<td>150 µA/MHz</td>
<td>2 µs</td>
<td>0.9 µA</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>32-bit STM32L151xx</td>
<td>294 µA/MHz</td>
<td>8 µs</td>
<td>4.5 µA (1.9 µA*)</td>
<td>No</td>
<td>No</td>
<td>Partial</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>32-bit SAM4Lx</td>
<td>218 µA/MHz</td>
<td>5 µs (1.5 µs**)</td>
<td>50.3 µA (6.9 µA*)</td>
<td>Partial</td>
<td>Yes</td>
<td>Partial</td>
<td>Partial</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>32-bit LPC11xxL</td>
<td>150 µA/MHz</td>
<td>TBD</td>
<td>57 µA (6 µA*)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>16-bit MSP430F543x</td>
<td>226 µA/MHz</td>
<td>5 µs</td>
<td>2.6 µA</td>
<td>Partial</td>
<td>No</td>
<td>Partial</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>16-bit PIC24F16KA102</td>
<td>344 µA/MHz</td>
<td>1 µs (1 ms for PLL)</td>
<td>0.93 µA (0.85 µA*)</td>
<td>No</td>
<td>No</td>
<td>Partial</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

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* Brown-out detection disabled  ** Added consumption in active mode
EFM32 – packed with features

The top 10 EFM32 features

ARM Cortex-M processor

Serial Interfaces
- USART
- UART
- Low Energy UART
- I2C
- USB

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

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

Security
- AES Accelerator

CPU and Memory
- Memory Protection Unit
- Embedded Trace Macrocell

Peripheral Reflex System
- Security
- Serial Interfaces
- High Freq Crystal Osc
- High Freq RC Osc
- Low Freq Crystal Osc
- Low Freq RC Osc
- Ultra Low Freq RC Osc

Security
- Memory Protection Unit
- Security

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

Security
- AES Accelerator

Security
- Memory Protection Unit
- Security
Peripheral Reflex System
Example – Autonomous Sound Loopback

CPU

TIMER
Overflow @ 44 kHZ

Peripheral Reflex System

Reflex Signals

DMA

ADC

Trigger ADC

DAC

Trigger DAC

Sample DATA

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Example: Pulse length measurement

Analog input

Reference

+ Analog Comparator

Peripheral Reflex System

Reference

Analog input

Reflex signal

TIMER Count value

Reset & Start

Capture

Reset & Start

Capture
Highly Flexible

Reflex Producers
- ACMP
- ADC
- DAC
- GPIO
- RTC
- BURTC
- TIMER
- LETIMER
- LESENSE
- UART
- USART
- USB
- VCMP

Reflex Consumers
- ADC
- DAC
- TIMER
- LESENSE
- UART
- USART
- PCNT

Reflex signals
Reflex System – Key Benefits

- Save energy by letting peripherals communicate directly while CPU is sleeping
- Predicable timing
- Highly configurable

But why?
Analog to Digital Converter
Analog to Digital Converter

ADC Highlights

• **12-bit @ 1 Msps:** 350 µA
• **12-bit @ 10 ksps:** 63 µA
• Scalable resolution: 16, 12, 8, or 6 bits
• Up to 8 input channels
  • Integrated temperature sensor
• Internal/external references
• Scan/single conversions
• Hardware controlled warmup
• Tailgating
• Differential or Single Ended Input
From AN0021 ADC Appnote

Total Consumption vs. Sampling Frequency

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ADC – Key Benefits

- Lower total energy when sampling
- Flexible inputs and references
- Less CPU use with HW control

But why?
Flexible Display Drivers
Energy Efficient LCD Controller

LCD Controller highlights:

- Directly driving segment LCD displays
  - G (Up to 4x40 segments)
  - TG (Up to 8x20 segments)
  - LG, GG, WG (Up to 8x36 segments)
- Energy Efficient
  - 550 nA for 4x40
  - 250 nA for 1x40
- Configurable:
  - Contrast
  - Segment blink/Animation
- Integrated voltage booster
**TFT Driver**

TFT Driver Highlights

- TFT/(AM)OLED displays
  - Up to 16-bit color
- Full video from external memory
  - 0% CPU load
  - 320x240 pixels (QVGA) @ 60 fps
  - 480x320 pixels (HVGA) @ 30 fps
- Supports displays without internal frame buffer
- Accelerated graphics update
  - Scrolling
  - Rectangle copy
  - Alpha blending
  - Bit masking

---

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Display Drivers – Key Benefits

- Save energy when driving LCDs
- Full QVGA TFT animations with 0% CPU load
- Save cost with TFT displays without buffer

But why?
Wide Cortex-M Portfolio WITH Energy Friendliness
ARM Cortex-M Processors

Cortex-M highlights
• Industry standard CPU
• Software/tool compatible across M0/M3/M4F
• High performance, low power platform
  • Up to 2.19 CoreMark/MHz
  • As little as 150 µA/MHz in EFM32
• Excellent code density
• DSP options in M4F
# 240+ Scalable Low Energy EFM32s

- **Software compatible**
- **Pin compatibility within each package**

<table>
<thead>
<tr>
<th>Optional Features</th>
<th>EFM32WG940</th>
<th>EFM32WG942</th>
<th>EFM32WG980</th>
<th>EFM32WG982</th>
<th>EFM32LG990</th>
<th>EFM32LG995</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSP with FPU</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Software compatible**

<table>
<thead>
<tr>
<th>M4F</th>
<th>Wonder</th>
<th>EFM32WG840</th>
<th>EFM32WG880</th>
<th>EFM32WG900</th>
<th>EFM32WG950</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LCD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total 16 MCUs**
- Flash: 4 - 32
- RAM: 2 - 4

**Total 35 MCUs**
- Flash: 4 - 32
- RAM: 2 - 4

**Total 31 MCUs**
- Flash: 16 – 128
- RAM: 8 - 16

**Total 60 MCUs**
- Flash: 64 – 256
- RAM: 32

**Total 60 MCUs**
- Flash: 64 – 256
- RAM: 32

**Total 40 MCUs**
- Flash: 512 – 1024
- RAM: 128
Cortex-M Portfolio—Key Benefits

- Industry standard CPU
- Wide Cortex-M scalability
- Pin/SW compatibility across families
- Energy friendly MCU with up to 1 MB/128 KB memory

But why?
Well Architectured Energy Modes
Well Architectured Energy Modes

**EM0 “Run Mode”:** 150µA/MHz

**EM1 “Sleep Mode”:** 45µA/MHz

**EM2 “Deep Sleep Mode”:** 900nA

*RTC, Brown-Out Detection, RAM and CPU retained*

2 µs wake-up

**EM3 “Stop Mode”:** 600nA

*Brown-Out Detection, RAM & CPU retained*

2 µs wake-up

**EM4 “Shutoff Mode”:** 20nA

*Pin/GPIO Reset*

*RTC + 512-byte backup memory:* 400 nA
EFM32 Peripherals can be used in Ultra Low Power EM2 and EM3: For example DMA can be used in EM2 Mode with the MCU in a 900nA mode!!

<table>
<thead>
<tr>
<th>Feature</th>
<th>EM0¹</th>
<th>EM1²</th>
<th>EM2²</th>
<th>EM3³</th>
<th>EM4⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wakeup time to EM0</td>
<td>-</td>
<td>-</td>
<td>2 µs</td>
<td>2 µs</td>
<td>160 µs</td>
</tr>
<tr>
<td>MCU clock tree</td>
<td>On</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>High frequency peripheral clock trees</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Core voltage regulator</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>High frequency oscillator</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>( ^2 \text{C} ) full functionality</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Low frequency peripheral clock trees</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Low frequency oscillator</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Real Time Counter</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LCD</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LEUART</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LETIMER</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PCNT</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ACMP</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
</tr>
<tr>
<td>( ^2 \text{C} ) receive address recognition</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
</tr>
<tr>
<td>Watchdog</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On³</td>
<td>-</td>
</tr>
<tr>
<td>Pin interrupts</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
</tr>
<tr>
<td>RAM voltage regulator/RAM retention</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
</tr>
<tr>
<td>Brown Out Reset</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>-</td>
</tr>
<tr>
<td>Power On Reset</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>Pin Reset</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>GPIO state retention</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>On³</td>
<td>-</td>
</tr>
<tr>
<td>EM4 Reset Wakeup Request</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>On⁴</td>
</tr>
<tr>
<td>EM4 Reset Wakeup Request</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>On⁴</td>
</tr>
</tbody>
</table>

*Table 10.1. EMU Energy Mode Overview*

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Energy Modes—Key Benefits

- Low power consumption
- A lot of peripherals available in lower sleep modes
- 2us wake-up

But why?
Low Energy UART
Low Energy UART

LEUART Highlights
• Up to 2 LEUARTs
• Full UART with 32 kHz clock
• Can operate entirely in EM2(900nA) with DMA
• 150 nA at 9600 baud/s
• DMA support
• Valid wake-up packet
Low Energy UART—Key Benefits

- Stay in Deep Sleep while sending or receiving data
- Save energy by only waking up on specific data

But why?
Hardware AES Acceleration
AES Encryption Accelerator

AES Highlights
• Encryption/decryption
• 128/256-bit keys @ 54/75 cycles
• 20 – 80 times faster than software
• On-the-fly key generation
  • No memory required
• Key buffering in 128-bit mode
  • No reload of key
• DMA support for autonomous cipher modes
• 2.5uA/MHz

How are you? → AES → &G#%5(F

I am fine ← AES ← !T4/#2@2
AES Accelerator – Key Benefits

- Faster encryption
- Save energy when encrypting
- Fully integrated HW saves memory

But why?
3

Back-up Power Domain
Backup Power Domain

Backup Domain Highlights

• Automatic main/backup power switch

• 32-bit Backup RTC
  • Use any LF oscillator

• 512-byte backup register

• **400nA** with RTC and registers

• AN0041 Backup RTC/Power Domain Appnote w/Source Code
Backup Domain – Key Benefits

- Energy Friendly backup mode
- No external switches needed
- Retention of critical data at minimum energy and cost

But why?
Integrated Operational Amplifiers
Operational Amplifiers

OpAmp Highlights

• 3 rail-to-rail OPAMPs integrated
• Inputs from pin, DAC or OPAMPs
• Outputs to pin, ADC or OPAMPs
• Various configuration modes
  • Programmable gain
  • Inverting / non-inverting
  • Cascading
  • +++
• 6.1 MHz gain bandwidth product
• 13 – 400 µA active current
• 65 degree phase margin
• 1 mV offset voltage

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OPAMPs – Key Benefits

- Save space
- Save cost

But why?
Low Energy Sensor Interface
Low Energy Sensor Interface (LESENSE)

LESENSE Highlights
• Autonomous sensing in EM2/EM3 (w/ ULFRCO)
• LESENSE with central control logic
  • ACMP for sensor input
  • DAC for reference generation
• Measure up to 16 sensors
• Programmable state machine
  • 16 states, 4 input channels
  • Can do quadrature decoding
• Interrupt/PRS on sensor events

~1µA!!

Wake-on-Touch
LESENSE - Low Energy Sensor interface

Analog events
Capacitive, inductive or resistive sensors

Generic MCU
Wake-up periodically to detect 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
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)
Capacitive Measurement

LESENSE

300 Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!

Compare

Counter

ACMP

Interrupt!
**LESENSE – Capacitive Example**

- Analog Comparators measure one input at a time
- Counts oscillations for a given time period
- Touched sensor gives lower frequency
- Performs action if threshold is breached
  - Wake-up
  - State-machine input
  - Buffer results
- **1.2 µA @ 20 Hz**
LESENSE – Resistive Example

- Capacitor charged to VDD during excitation
- Sample ACMP output after a programmable time
  - Wake-up
  - Buffer results
  - State Machine input
- Adjustable time period before sampling

ACMP trigger level

VDD

VSS

Sample
LESENSE – Inductive Example

- DAC drives common level
- Excitation pulses individual lines low
- Oscillations damped faster when close to metal
- LESENSE counts the number of times the oscillation breaches the ACMP threshold (red)
- Action if lower than compare value
  - Wake-up
  - State machine input
  - Buffer results
- Autonomous in Deep Sleep
  - 1.4 µA @ 20 Hz
Autonomous «slide-to-unlock»

- Use LESENSE state machine to detect order of capasitive button press
- Stay in Deep Sleep until right order is detected
- Reduce energy impact of frequent unintentional touches
LESENSE—Key Benefits

- Save energy by staying in Deep Sleep while monitoring sensors
- Save cost of expensive dedicated sensor ICs with wake-up functionality

But why?
EFM32 – packed with features

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

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
- Voltage Comparator
- Brown-out Detector
- Power-on Reset
- Back-up Power Domain

Serial Interfaces
- USART
- UART
- Low Energy UART
- I2C
- USB

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

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

Analog Modules
- ADC
- DAC
- LCD Controller
- Analog Comparator

Security
- AES Accelerator

32-bit bus
Peripheral Reflex System

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Simplicity Studio

- Easily access all free software tools
- Always the latest updates and news
The energyAware Profiler is an energy debugging tool that use Advanced Energy Monitoring (AEM) data available from the development tools to perform real-time profiling and debugging of the associated object code.
Some interesting Appnotes

- AN047 Interfacing Graphical Displays
  - FREE Segger emWin Graphics library
- AN048 Energy Optimized Display Application
  - uA Sharp Memory display application using emWin
- AN0052 USB MSD Host Bootloader
- AN0053 IR Sensor Monitoring Using LESENSE
  - Low Energy operation of Photointerrupter and Prox Sensor
- AN0054 Smart Phone Audio Jack Interface
  - EH application with audio jack communication
- AN0055 Speex Codec
  - On board Differential A/D and DAC
Some interesting Technologies

- **Wireless**
  - 802.11 partnerships with Atheros, Digi, RTX
  - BTLE
    - Have our own BTLE Stack that can be used on our EFM32 with an external radio.
  - BT v2.1, BT Dual Mode
    - Searan dotstack

- **E-Paper**
  - PDI Eval Kits: 4.41” and Shelf Label Retronix Kit
  - Create boost converter with PRS System

- **RTOS**
  - Keil RTX RTOS allows RTC to be used in EM2
  - Pumpkin Salvo RTOS allows use of EM modes also
  - uCOS2/3, FreeRTOS, CMX, etc
So you say you want a FREE Development Environment?

- Check out AN0023 ‘Configuring Eclipse & GNU/GCC Compiler, ask for detailed Installation Guide!!
  - Eclipse is a FREE Open Source Project Manager/IDE. Eclipse front-end is commonly used even in ‘Pay for’ IDE’s.
    http://www.eclipse.org/downloads/packages/eclipse-ide-cc-developers-includes-incubating-components/indigosr2
  - Codesourcery is the GNU toolchain containing a FREE gcc compiler/linker and gdb debugger.
  - Debugger: Your STK or DK is your FREE J-LINK Debugger!! This can be used with your own Target Board. Refer to the link below.

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Software libraries

- Provided free of charge with our chips
- Open source
- Production quality (but no warranty given)
- Supported by our technical support team
- CMSIS register definitions / HAL
- emlib driver library
- Protocol stacks (USB, RF, etc)
- GUI library
**USB stack**

- Free stack with source available on web
- Includes:
  - Device – base, MSD, HID, CDC, VUD
  - Host – base, MSD, HID, HUB
- The Giant Gecko with USB stack has passed the USB-IF compliance certification
- Partner with commercial vendors (SEGGER emUSB and Jungo USBware)
GUI library

- Free stack available – SEGGER emWin
- Includes:
  - emWin Color basic package
  - emWin GUIDRV Lin
  - Window manager
  - Memory device module
  - Anti-aliasing module
- Windows PC tools:
  - Bitmap converter
  - Font converter (supports also Asian languages)
  - Simulation environment
  - GUI-Builder
## Full featured hardware tools

<table>
<thead>
<tr>
<th></th>
<th>$69</th>
<th>$69</th>
<th>$299</th>
<th>$349</th>
<th>$349</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device</strong></td>
<td>EFM32G890F128</td>
<td>EFM32TG840F32</td>
<td>EFM32G890F128, EFM32G290F128</td>
<td>EFM32LG990F256</td>
<td>EFM32GG990F1024</td>
</tr>
<tr>
<td><strong>Advanced Energy Monitoring</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>USB J-Link Debugger</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Plug-in MCU and prototyping board</strong></td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Onboard J-Trace</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Screen</strong></td>
<td>4x40 segment LCD</td>
<td>8x20 segment LCD (EFM32G890-DK only)</td>
<td>4x40 segment LCD</td>
<td>320x240 RGB TFT</td>
<td>320x240 RGB TFT</td>
</tr>
</tbody>
</table>

Glossary:
- **Device**
- **Advanced Energy Monitoring**
- **USB J-Link Debugger**
- **Plug-in MCU and prototyping board**
- **Onboard J-Trace**
- **Screen**

Prices:
- **$69**
- **$299**
- **$349**

Visit [www.energymicro.com](http://www.energymicro.com) for more details.
www.energymicro.com
EFR Update
**EFR4D-STK6500**

- Available at launch, Q4 2013
- Familiar features: AEM and on-board J-Link debugger
- Modular approach – the same main board will support all frequency bands, with different RF modules
- 128x128 pixel SHARP Memory LCD
- Connects to any Gecko MCU STK, allowing two-chip configurations
Later kits

- USB stick
- Wireless sensor nodes
- TBD
Protocol availability

At Sample time:
802.15.4-2006
BTLE – Licensed WiCentric BTLE Stack!!
SimpliPHY

Later:
More to come...
Protocols details - SimpliPHY

SimpliPHY is a very simple proprietary protocol with a very small footprint. Ideal for companies that want:

- Simple solution
- Make their own protocol
- Low complexity and footprint
- Full source code

Send, receive, set channel, energy detect, Clear channel Assessment.
Protocols details – Bluetooth Low Energy

Stack will be provided by a partner – no license cost for customers.
Stack is already certified and stable.

Profiles and services that will be supported at launch time (minimum list):

- Alert Notification Profile
- Blood Pressure Profile
- Find Me Profile
- Heart Rate Profile
- Phone Alert Status Profile
- Proximity Profile
- Time Profile
- Battery Service
- Blood Pressure Service
- Device Information Service
- Heart Rate Service
- Immediate Alert Service
- Link Loss Service
- TX Power Service
- Weight Scale
- Blood Glucose
- Proprietary Profiles
Protocols details – 802.15.4

- Non Beacon Mode
- Beacon Mode
- Security (802.15.4-2006)
- 868/915 MHZ
- 2.4 GHZ

All features required for running ZigBee PRO, ZigBee RF4CE, ZigBee IP/6Lowpan protocols.
Using EFM32 for wireless applications

EFM32 is an ideal host processor paired together with a wireless module or transceiver.

Example: Several companies now supply low Power WIFI modules that contain an EFM32 MCU. Example a module from RTX:
Additional EFM32 Slides
Core and Peripherals
Clocks and Oscillators

HFPER
- 1,7,11,14,21,28 MHz HFRCO
- 4-32/48 MHz HFXO

HFCORE
- HFCLK
- DIV 1-512
- CPU
- Bus System

LFA
- 32 kHz LFRCO
- LFACLK
- DIV 1-512
- LETIMER
- LCD
- RTC
- PCNT
- LESENSE
- LEUART0

LFB
- 32.768 kHz LFXO
- LFBCLK
- DIV 1-512
- LEUART1

14 MHz AUXHFRCO
- LESENSE
- Flash Write
- Trace Out
- 1 kHz ULFRC
- WDOG

50 nA
Universal Serial Bus (USB)

USB Highlights
- USB 2.0 compliant
- Support for USB Device, Host and On-The-Go (OTG)
- Full speed (12 Mbit/s)
- 14 endpoints (2 KB buffers)
- Integrated 3.3V regulator (up to 100 mA)
- Dedicated DMA for USB
- Pre-programmed USB device bootloader
- Free stack in Simplicity Studio
  - Mass Storage Host/Device
  - Human Interface Host/Device
  - Vendor Unique Device
  - Communication Class Device (USB-to-RS232)
Direct Memory Access Controller

DMA Highlights

- Transfer between Flash/RAM and peripherals
- 8 channel DMA
  - 12 channels in LG/GG/WG
- Multiple operational modes
  - Scatter-Gather, Ping-pong
- Reduce workload of CPU
- Reduce latency

- **8.12uA/MHz**
External Bus Interface

EBI Highlights

• Standard EBI (Gecko)
  • External SRAM
  • Displays (8080 interface)
  • Memory mapped
• Giant/Leopard/Wonder Gecko EBI
  • Gecko EBI compatible
  • Independent timing for 4 CS
  • 32-bit data access
    • Code execution
  • 28 address lines and 16 data lines
• NAND Flash support
Low Energy Timer

Low Energy Timer Highlights
• 16-bit counter, 8-bit repeat
• Clocked from LFXO/LFRCO/ULFRCO
• Waveform generation
• Duty cycle control of external components/sensors
• Available down to Stop Mode (EM3)
• 150nA
Real Time Counter

RTC Highlights (100nA)

- Real Time Counter
  - 24-bit counter
  - 2 compare values
  - Clocked from LFXO/LFRCO/ULFRCO
  - Available in EM0 – EM3
- Backup Real Time Counter (LG/GG/WG)
  - 32-bit counter
  - Clocked from LFXO/LFRCO/ULFRCO
  - Wake-up on LFXO failure
  - Available in EM0 - EM4
  - Can run from backup power
Analog Comparators

ACMP Highlights
• Up to 2 analog comparators
• 8 input pins per comparator
• Programmable speed/current
  • 4.5 µs / 0.1 µA
  • 0.2 µs / 2 µA
• Capacitive Sense mode
• Internal references
Digital to Analog Converter

DAC Highlights
- 12-bit resolution
- 200 µA @ 500 ksp
- 38 µA @ 1 ksp
- 2 independent channels
- Continuous/sample&hold
- Internal references
- Sine generation mode
- PRS/DMA Trigger
Power Supply Supervision

Power Supervision Highlights
- 1.85 V to 3.8 V
- Power-on Reset
  - Always enabled
- Brown-out Detector
  - Enabled in EM0 – EM3
  - Available in EM4 on LG/GG/WG
- Voltage/Battery Supply Comparator
  - Programmable trigger level
  - Interrupt trigger
- 100nA
High Frequency Timer/Counters

Timer/Counter Highlights

- Up to 3 16-bit Timers
  - Up, Down, Up/Down Modes
  - Quadrature Decoder
  - 3 Compare/Capture/PWM
  - Dead-Time Insertion on TIMER0
- Systick Timer
  - Integrated in Cortex-M
- OS Timer
Pulse Counter

Pulse Counter Highlights
• Up to 3 8/16-bit Pulse Counters included
• Counts incoming rising or falling edges
• Asynchronous quadrature decoder
  • Interrupt on direction change
• Available down to Stop Mode (EM3)
SPI and UART

SPI and UART Highlights

• Up to 3 USARTs
  • UART/SPI (master/slave)
  • IrDA
  • SmartCards (ISO7816)
  • 8 Mbit/s UART, 16 Mbit/s SPI master
  • I²S support (ZG, TG, LG, GG and WG)
• Up to 2 UARTs
  • Subset of USART with support for asynchronous communication
I²C Highlights
• Up to 2 I²C peripherals included
• I²C and SMBus support
• Data rates up to 1 MBit/s
• Hardware address recognition in EM3
General Purpose Input/Output

GPIO Highlights
• Up to 93 GPIO pins
• Configurable
  • Pull up / down
  • Input/Output enable
  • Drive strength (0.5 / 2 / 6 / 20 mA)
  • Input filter
• 16 pin interrupts
• Alternate functions
• Reset trigger from GPIO in EM4
  • ZG, TG, LG, GG and WG
Debug/Programming

Debug/Programming Highlights
- 2-wire Serial Wire debug interface
  - Debugging/Programming
- 1-wire Serial Wire Viewer output
  - printf-style debug information
  - PC sampling
- 5-wire Embedded Trace Macrocell (LG/GG/WG)
  - Instruction and Data Trace
- Debug lock for firmware protection
- Pre-programmed Bootloader
  - UART in all EFM32s
  - UART+USB in parts with USB
ARM Cortex-M4F

Cortex-M4F highlights

• High performance, low power platform
  • 1.25 DMIPS/MHz
  • 2.19 CoreMark/MHz
• Digital Signal Processing instructions
  • Single cycle 32-bit MAC
  • 8, 16-bit SIMD arithmetic
  • Single precision FPU
• Scalability for future products
• Software/tool compatible with Cortex-M
• Memory Protection Unit
• Embedded Trace Macrocell