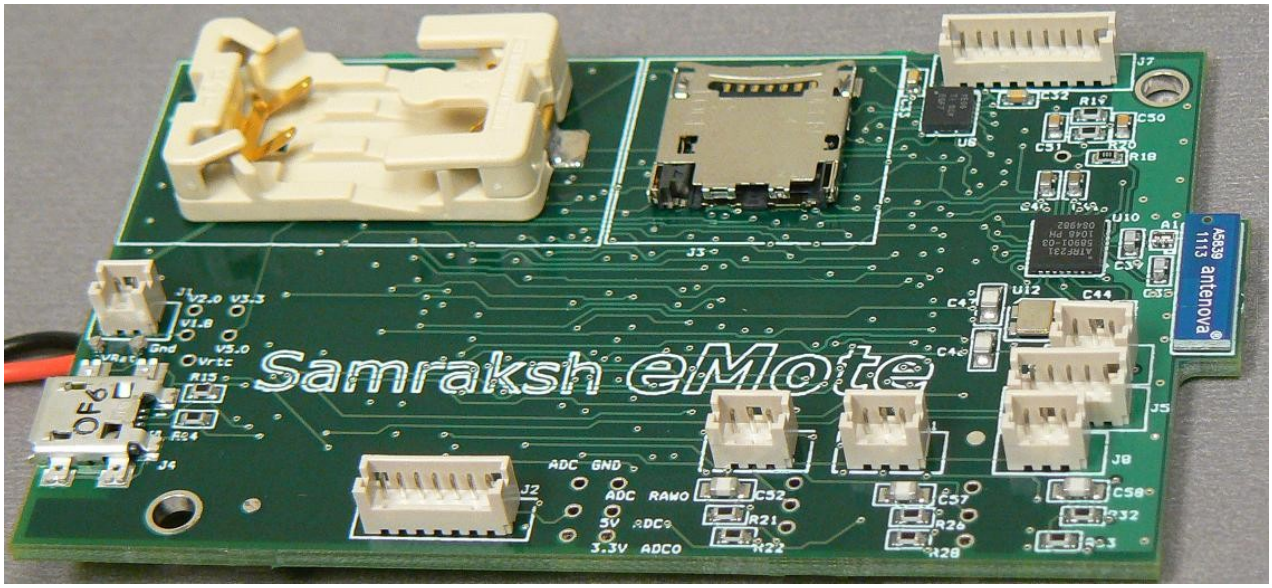
eMote Specification Sheet



The Samraksh Company

eMote Summary Specs

Dimensions	8.5cm by 5cm (not including battery)
Processor	32-bit Cortex M3
	1Mbyte Flash Program Memory
	96 Kbyte SRAM
	8 MHz – 60 MHz
RF	AT86RF231 chip
	2.4 GHz ISM Band
	Zigbee, 802.15.4, 6LoWPAN
	Receive Sensitivity -101 dBm
	Chip antenna or SMA for external antenna
Memory	256 Mbit NOR Flash (XIP capable)
Interface/Features	USB, SPI, I2C, UART
	1x 12-bit 2V DAC
	3x 12-bit 200 kHz ADC, 5V or 3.3V input
	Up to 8 interrupt capable GPIOs @ 10 MHz
	MicroSD, Hardware CRC
	Unique 96-bit read-only hardware ID
	16-bit Timers, 32 kHz crystal and RTC with backup registers
	JTAG available
	12-channel DMA
	Independent and Window watchdog timers
Supported Software	.NET MicroFramework 4.0
	TinyOS 2
Power	3 Low Power Sleep modes

eMote MCU

- STM32F103 (144-pin package)
- Cortex M-3 (Thumb2 instruction set)
- 8 MHz to 60 MHz run clock configurations (48 MHz only when using USB)
- 1 MByte onboard Flash for program and data storage
- 96 kB SRAM

Further Reading

STM's Product Page:

http://www.st.com/internet/mcu/product/247490.jsp

Reference Manual (User Guide):

http://www.st.com/internet/com/TECHNICAL_RESOURCES/TECHNICAL_LITERATURE/REFERENCE_MANUAL/CD00171190.pdf

Datasheet:

http://www.st.com/internet/com/TECHNICAL_RESOURCES/TECHNICAL_LITERATURE/DATASHEET/CD00253742.pdf

Programming Manual:

http://www.st.com/internet/com/TECHNICAL_RESOURCES/TECHNICAL_LITERATURE/PROGRAMMING_MANUAL/CD00228163.pdf

Flash Programming Manual:

http://www.st.com/internet/com/TECHNICAL_RESOURCES/TECHNICAL_LITERATURE/PROGRAMMING_MANUAL/CD00264852.pdf

Sleep Modes

The STM32 supports three sleep modes with varying levels of energy savings and wakeup requirements, listed below from the datasheet.

- Sleep - 1.8µs wakeup
- Stop - 5.4µs wakeup
- Standby - 50µs wakeup (wakeup source limited to RTC and external WKUP pin).

For more information see the STM32F103 Datasheet section 5.3.7, and Reference Manual section 5.3.

Run Modes

At startup the default operating frequency for the system clock and all busses is 8 MHz sourced from an internal RC oscillator (HSI). Using the internal PLL as a clock source, operation up to 60 MHz is allowed. When using USB, the PLL output must be 48 MHz.

See Reference Manual section 7.2 and 7.3 for more information.

Real Time Clock, Backup, Watchdogs

Additionally, a 32.768 kHz crystal is provided on the mote. In conjunction with the included CR2032 lithium coin battery, the eMote can continue to keep accurate and long-term time (32 bit) time and allows for backup registers in the event of main battery loss.

Two watchdog timers are included in the MCU, the IWDG (independent watchdog) and WWDG (windowed watchdog). The independent watchdog is a totally independent process outside the main application but has lower timing constraints than the WWDG.

See Reference Manual sections, 6 (backup registers), 18 (RTC), and 19-20 (Watchdog Timers).

eMote Power

The eMote is optimized for low-voltage battery chemistries (alkaline, NiCd, NiMH) using only a single cell.

Input Requirements

- 0.68 volt minimum for startup
- 1.8 volt maximum for best efficiency
- 6 volt absolute maximum (not recommended)
- 100mA peak current (typically <15mA)

Voltage Domains

- 2.0 volt (main, “always on”)
- User controlled and user exposed:
    - 3.3 volt (I/O for MicroSD, NOR Flash)
    - 5.0 volt (USB[1])
- 3.0 volt backup domain (backup registers and RTC only)

Except for the backup domain, all domains are sourced using high efficiency boost converters.

[1] 5.0v domain not available in revision 0.

Power Profiles

- 16.3mW @ 8 MHz (busy loop)
- Others TBD

eMote Flash Memory

In addition to the 1 MByte of flash memory onboard the MCU, external flash is provided:

- 256Mbit external NOR Flash
- 70 ns
- Interfaced to MCU FSMC (Flexible Static Memory Controller)

See the M29W256G datasheet for more information:

http://media.digikey.com/pdf/Data%20Sheets/Micron%20Technology%20Inc%20PDFs/M29W256GH,GL.pdf

For more information on the FSMC, see the MCU Reference Manual Section 21.

eMote RF

RF functionality uses the Atmel AT86RF231 RF chip interfaced with a dedicated SPI bus.

Max output power	3 dBm
Receiver Sensitivity	-101 dBm
Link Budget	104 dB
Sleep Current	0.02 µA
RX Current	12.3 mA
TX Current	14 mA
Data Rates	250 kb/s to 2 Mb/s
Hardware AES Module	
2.4 GHz	
802.15.4, Zigbee, 6LoWPAN	
Antenna	SMA connector or built-in Chip Antenna
Chip Antenna Test Range	TBD
SMA (“rubber duck”) Antenna Test Range	TBD

For more information see the AT86RF231 datasheet:

http://www.atmel.com/dyn/resources/prod_documents/doc8111.pdf

eMote Peripheral Interfaces

- **SPI**: Dedicated SPI channel up to 18 Mbit/s exposed via Hirose DF13 connector. GPIOs used for CS. 8-bit or 16-bit format, MSB or LSB first, automatic CRC.
- **GPIO**: 8 GPIOs + ground exposed on 9-pin DF13 connector. 10 MHz, 5mA, 5v tolerant.
- **USB**[2]: Integrated USB serial engine, host or device mode, Full Speed USB 2.0 (12mbit).
- **MicroSD**: MMC spec version 4.2. Databus modes 1-bit, 4-bit, 8-bit, up to 48 MHz.
- **UART**: Up to 4.5 Mbit/s, 8 or 9 bit
- **I2C**: Multimaster, 100 kHz or 400 kHz, interrupts, SMBus 2.0
- **DAC**: 8-bit or 12-bit mode. Noise-wave, triangle-wave modes. Shared with GPIO.
- **ADC**: 3x 12-bit ADCs with DF13 or solder-able test points. 3.3 volt or 5 volt inputs. Two additional 2 volt input ADCs are shared with GPIO. 200 kHz, sample times as low as 1µs.
- **MCO**: One Main Clock Output is shared with GPIO.
- **Timers**: 7x 16-bit timer channels are shared with GPIO.

As many functions are shared with GPIO and overlap with each other, the table below shows conflicts. Please see datasheets for detailed information.

Pin	**Alt Functions** (Timer #:channel)
GPIO 0: PA9	UART1 TX / Timer 1:2
GPIO 1: PA10	UART1 RX / Timer 1:3
GPIO 2: PB6	I2C1_SCL / Timer 4:1
GPIO 3: PA0	WKUP / ADC / Timer 5:1
GPIO 4: PA8	MCO / Timer 1:1
GPIO 5: PB7	I2C_SDA / Timer 4:2
GPIO 6: PA4	DAC / ADC
GPIO 7: PC6	Timer 8:1

For more information see the STM32F103 reference manual

GPIO section 9, SPI section 25, USB section 23, MicroSD section 22 (SDIO), UART section 27 (USART), I2C section 26, DAC section 12, ADC section 11, Timers sections 15-17.

[2] eMote revision 0 only supports Full-Speed (12 mbit) device mode and has a MicroB connector