

Stellaris® 32-bit ARM® Cortex™-M3 MCUs

Open architecture software, cost-effective real time performance, and rich communications options



One Day, Multiple Solutions

Stellaris family technology



As I mentioned, the New Technologies is the most captivating subject matter within MSP430 training, because it takes innovative technologies and makes them easy to implement. This year, will have launched FRAM, a revolutionary non-volatile memory, an integrated RF radio, full speed USB, and energy harvesting systems.

Four generations of ARM Cortex-M3

- 1st Generation of Stellaris = Sandstorm Class
 - LM3S100 Series, LM3S300 Series, LM3S600 Series, LM3S800 Series
 - First ARM Cortex-M3 microcontrollers available anywhere
 - Up to 50MHz operation, Single-cycle memory up to 64K flash / 8K SRAM
 - Meticulous motion-control IP integration
- 2nd Generation of Stellaris = Fury Class
 - LM3S1000 Series, LM3S2000 Series, LM3S6000 Series, and LM3S8000 Series
 - Extending Sandstorm Class with integrated Ethernet MAC+PHY and CAN
 - Increasing single-cycle memory up to 256K flash / 64K SRAM
 - Further optimized for battery-backed applications
 - Added peripherals, such as additional UART, I2C, SSI, and QEI
- 3rd Generation of Stellaris = Dust Devil Class
 - LM3S1000 Series, LM3S3000 Series, and LM3S5000 Series
 - Improving Stellaris offering with integration of USB OTG, Host, and Device options
 - Added DMA, improved GPIO drive strength, and additional PWM outputs
 - Additional fault protection inputs for advanced motion control
 - Bootloader and StellarisWare™ peripheral driver library in preloaded in ROM
 - Providing new small package options (64 pin LQFP)
- 4th Generation of Stellaris = Tempest Class
 - LM3S2000 Series, LM3S5000 Series, and LM3S9000 Series
 - Higher performance with lower operating power (80 MHz and 100 MHz, 1.2v internal supplies)
 - Powerful external interface for high-speed chip-to-chip interconnect
 - Enhanced subsystems including dual ADCs, extended in-ROM software, precision oscillator, and I2S interface
 - Expanded networking and connectivity with Ethernet, CAN and USB options and combinations



Stellaris family technology

ARM® Cortex™-M3 v7-M Processor Core

- Up to 100 MHz
- Up to 125 MIPS (at 100 MHz)

On-chip Memory

- 256 KB Flash; 96 KB SRAM
- ROM loaded with Stellaris DriverLib, BootLoader, AES tables, and CRC

External Peripheral Interface (EPI)

- 32-bit dedicated parallel bus for external peripherals
- Supports SDRAM, SRAM/Flash, M2M

Advanced Serial Integration

- 10/100 Ethernet MAC and PHY
- 3 CAN 2.0 A/B Controllers
- USB (full speed) OTG / Host / Device
- 3 UARTs with IrDA and ISO 7816 support*
- 2 I²Cs
- 2 Synchronous Serial Interfaces (SSI)
- Integrated Interchip Sound (I²S)

System Integration

- 32-channel DMA Controller
- Internal Precision 16MHz Oscillator
- Two watchdog timers with separate clock domains
- ARM Cortex SysTick Timer
- 4 32-bit timers (up to 8 16-bit) with RTC capability
- Lower-power battery-backed hibernation module
- Flexible pin-muxing capability

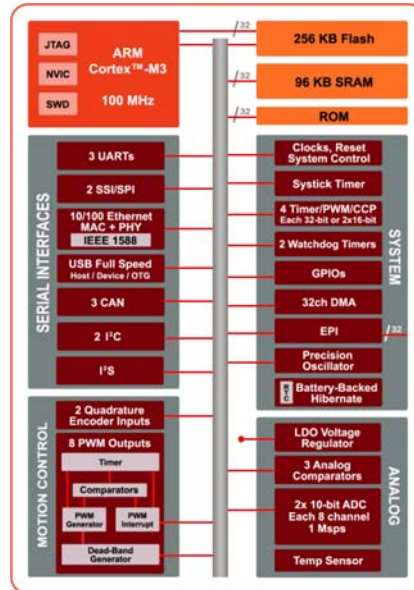
Advanced Motion Control

- 8 advanced PWM outputs for motion and energy applications
- 2 Quadrature Encoder Inputs (QEI)

Analog

- 2x 8-ch 10-bit ADC (for a total of 16 channels)
- 3 analog comparators
- On-chip voltage regulator (1.2V internal operation)

* One UART features full modem controls



Every GPIO is 5V tolerant, interrupt capable, drive strength and slew rate control.

External Peripheral Interface (EPI)

- Multiple device types supported
 - SDRAM: Supports x16 (Single Data Rate) at up to 50MHz
 - Supports low-cost SDRAMs up to 64 MB
 - Includes automatic refresh and access to all banks/rows.
 - Includes a sleep/standby mode to keep contents alive with minimal power draw.
 - Host-Bus Interface: Traditional x8 MCU bus interface capabilities
 - Similar device compatibility options as PIC, ATmega, 8051, and others
 - Access to SRAM, NOR Flash, and other devices, with up to 24MB of addressing
 - Support of both muxed and de-muxed address and data
 - Access to a range of devices supporting the non-address FIFO x8 interface variant, with support for TXempty and RXfull
 - Speed controlled, with read and write data wait-state counters
 - Manual chip-enable (or use extra address pins)
 - Machine-to-Machine: Wide parallel interfaces for fast communications
 - For instance, CPLDs and FPGAs
 - Data widths up to 32-bits, data rates up to 150 Mbytes/second
 - Optional "address" sizes from 4-bits to 16-bits
 - Optional clock output, read/write strobes, framing (with counter-based size), and clock-enable input
- Other features
 - General parallel GPIO, FIFOed with speed control – for custom peripherals or digital controls
 - Blocking and non-blocking reads
 - FIFOed writes separate the processor from timing details
 - Direct memory access (DMA)



Low pin count real-time MCUs

	MCUs in Series	Memory and Speed		Core		General Purpose Timer Modules				Motion Control		Serial Interfaces						Analog			Digital		Package Options										
		Flash (KB)	SRAM (KB)	Max Speed (MHz)	Internal Precision Oscillator	32-bit Timer	16-bit Timer	Watchdog	CCP	RTC	Outputs	PWM	Fail Inputs	QEI	10/100 Ethernet MAC+PHY	IEEE 1588	CAN MAC	USB Full Speed	UART	I ² C	SS/SPi	I ² S		ADC Channels	ADC Speed (Ksps)	Internal Temp Sensor	LDO Voltage Regulator	Analog Comparators	Digital Comparators	GPIOs (5V)	Hibernate		
LM3S100s	8	8	2	20	-	2	4	1	2	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	18	-	28-SOIC	
LM3S300s	8	16	4	25	-	3	6	1	6	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	36	-	48-LQFP
LM3S600s	14	32	8	50	-	3	6	1	6	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	36	-	48-LQFP
LM3S800s	9	64	8	50	-	3	6	1	6	✓	✓	✓	✓	✓	-	-	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	36	-	48-LQFP

- Low pin count, low cost, and feature rich real time control
- LM3S100's and LM3S300's : For basic embedded control applications
- LM3S600's and LM3S800's : Optimized for embedded control requiring more sophisticated algorithms

Stellaris LM3S811 Evaluation Kit



- LM3S811 evaluation platform
 - 50 MHz LM3S811 MCU with 64K flash, 8K SRAM, 8 ADCs, and up to 32 GPIOs
 - OLED graphics display
 - 2 pushbuttons and 2 LEDs
 - Potentiometer
 - LM3S811 I/O available on labeled break-out pads
- Integrated serial JTAG debugger
- Can be used as a serial debugger for target applications platform



For more information:

Keil tools version (EKK-LM3S811):

<http://www.luminarymicro.com/products/ekk-lm3s811.html>

IAR tools version (EKI-LM3S811):

<http://www.luminarymicro.com/products/eki-lm3s811.html>

Code Red tools version (EKT-LM3S811):

<http://www.luminarymicro.com/products/ekt-lm3s811.html>

Code Sourcery tools version (EKC-LM3S811):

<http://www.luminarymicro.com/products/ekc-lm3s811.html>

High pin count real-time MCUs

	MCUs in Series	Memory and Speed		Core	General Purpose Timer Modules				Motion Control		Serial Interfaces						Analog				Digital		Package Options								
		Flash (KB)	SRAM (KB)		Max Speed (MHz)	Internal Precision Oscillator	32-bit Timer	16-bit Timer	Watchdog Timers	CCP	RTC	Outputs	PWM	QEI	10/100 Ethernet MAC+PHY	IEEE 1588	CAN MAC	USB Full Speed	UART	I ² C	SSI/SPi	I ² S		ADC (10-bit)		Internal Temp Sensor	LDO Voltage Regulator	Analog Comparators	Digital Comparators	GPIOs (5-V)	
				Fault Inputs									ADC Channels											ADC Speed (Ksps)							
LM3S1000s	29	256	64	✓	50	-	4	8	1	8	✓	8	3	2	-	-	-	-	3	2	2	-	8	1000	✓	✓	3	-	60	✓	64-LQFP 100-LQFP 108-BGA

- Expanded general purpose I/O, larger on-chip memories, and low power optimization for battery-backed applications
- Wide package selection: 64-pin LQFP, 100-pin LQFP, 108-ball BGA

Stellaris LM3S1968 Evaluation Kit



- LM3S1968 Evaluation Board
 - Stellaris LM3S1968 MCU with 256K flash, 64K SRAM, 8 ADCs, and up to 52 GPIOs
 - OLED graphics display with 128 x 64 pixel resolution
 - User LED, navigation switches, and select pushbuttons
 - Magnetic speaker
 - LM3S1968 I/O available on labeled break-out pads
 - Standard ARM® 20-pin JTAG debug connector with input and output modes
- USB and JTAG cables



For more information:

Keil tools version (EKK-LM3S1968):

<http://www.luminarymicro.com/products/ekk-lm3s1968.html>

IAR tools version (EKI-LM3S1968):

<http://www.luminarymicro.com/products/eki-lm3s1968.html>

Code Red tools version (EKT-LM3S1968):

<http://www.luminarymicro.com/products/ekt-lm3s1968.html>

Code Sourcery tools version (EKC-LM3S1968):

<http://www.luminarymicro.com/products/ekc-lm3s1968.html>

Ethernet connected MCUs

	MCUs in Series	Memory and Speed		Core	General Purpose Timer Modules				Motion Control		Serial Interfaces						Analog				Digital		Package Options								
		Flash (KB)	SRAM (KB)		ROM SW	Max Speed (MHz)	Internal Precision Oscillator	32-bit Timer	16-bit Timer	Watchdog	Trnas	COP	RTC	Outputs	Fault Inputs	QEI	10/100 Ethernet MAC+PHY	IEEE 1588	CAN MAC	USB Full Speed	UART	I ² C		SSI/SPI	I ² S	ADC Channels	ADC Speed (Ksps)	Internal Temp Sensor	LDO Voltage Regulator	Analog Comparators	Digital Comparators
LM3S6000s	19	256	64	-	50	-	4	8	1	6	✓	6	1	2	✓	✓	-	-	3	2	2	-	8	1000	✓	✓	3	-	46	✓	100-LQFP 108-BGA
LM3S8000s	12	256	64	-	50	-	4	8	1	6	✓	6	1	2	✓	✓	3	-	3	2	2	-	8	1000	✓	✓	3	-	46	✓	100-LQFP 108-BGA
LM3S9000s	6	256	96	✓	100	✓	4	8	2	8	✓	8	4	2	✓	✓	2	O/H/D	3	2	2	✓	16	1000	✓	✓	3	7	65	✓	100-LQFP

- Wide selection of industrial real-time connectivity options with fully integrated 10/100 Ethernet MAC+PHY on chip
- IEEE 1588 Precision Time Protocol hardware assist

Stellaris LM3S6965 Evaluation Kit



- LM3S6965 Evaluation Board
 - OLED graphics display with 128 x 64 pixel resolution
 - User LED, navigation switches, and select pushbuttons
 - Magnetic speaker
 - LM3S6965 I/O available on labeled break-out pads
 - Standard ARM® 20-pin JTAG debug connector with input and output modes
 - MicroSD card slot
 - Included µIP Web Server (from FreeRTOS.org™)
- Ethernet, USB, and JTAG Cables



For more information:

Keil tools version (EKK-LM3S6965):

<http://www.luminarymicro.com/products/ekk-lm3s6965.html>

IAR tools version (EKI-LM3S6965):

<http://www.luminarymicro.com/products/eki-lm3s6965.html>

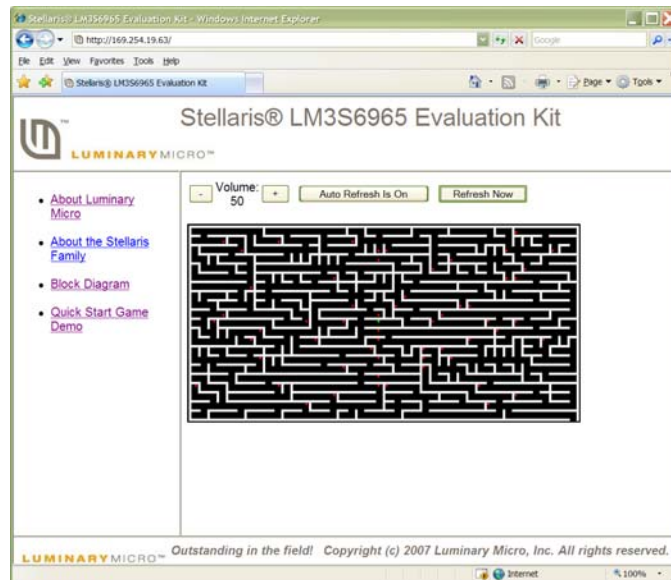
Code Red tools version (EKT-LM3S6965):

<http://www.luminarymicro.com/products/ekt-lm3s6965.html>

Code Sourcery tools version (EKC-LM3S6965):

<http://www.luminarymicro.com/products/ekc-lm3s6965.html>

LM3S6965 web server – game mode



Shown on this slide is the web page served up by the quickstart application provided within StellarisWare using the lwIP stack.

The web page shows the maze that must be navigated using the push buttons on the LM3S6965 evaluation board. Within the maze you can see your character along with the stars which must be defended off by the character.

This example demonstrates the ability for the LM3S6965 to serve a dynamic web page while processing the application and handling user input.

USB connected MCUs

	MCUs in Series	Memory and Speed		Core	General Purpose Timer Modules				Motion Control		Serial Interfaces							Analog				Digital		Package Options							
		Flash (KB)	SRAM (KB)		Max Speed (MHz)	Internal Precision Oscillator	32-bit Timer	16-bit Timer	Watchdog	I2C	CCP	RTC	Outputs	Fault Inputs	Serial Interfaces				Analog				Digital Comparators		GPIOs (5-V)						
															QEI	10/100 Ethernet MAC+PHY	IEEE 1588	CAN MAC	USB Full Speed	UART	I2C	SSI/SPI				FS	ADC Channels	ADC Speed (Ksps)	Internal Temp Sensor	LDO Voltage Regulator	
LM3S3000s	4	128	64	✓	50	-	4	8	1	8	✓	8	4	1	-	-	0/H/D	3	2	2	-	8	1000	✓	✓	3	-	61	✓	64-LQFP 100-LQFP	
LM3S5000s	12	256	96	✓	80	✓	4	8	2	8	✓	8	4	2	-	-	2	0/H/D	3	2	2	✓	16	1000	✓	✓	3	7	71	✓	64-LQFP 100-LQFP
LM3S9000s	6	256	96	✓	100	✓	4	8	2	8	✓	8	4	2	✓	✓	2	0/H/D	3	2	2	✓	16	1000	✓	✓	3	7	65	✓	100-LQFP

- Featuring USB 2.0 full speed (12 Mbps) support (MAC+PHY) : Host/Device/OTG – with DMA
- Compact 64-pin LQFP or feature-rich 100-pin LQFP options

Stellaris LM3S3748 Evaluation Kit



- LM3S3748 Evaluation Board
 - CSTN graphics display (128x128 resolution, 16-bit color)
 - User LED, navigation switch and pushbutton
 - Magnetic speaker
 - LM3S3748 I/O available on labeled break-out pads
 - Standard ARM® 20-pin JTAG debug connector with input and output modes
 - MicroSD card slot
- USB and JTAG cables, Jumper wires
- USB Flash Drive (128MB)



3000 – USB

5000 – USB + CAN

9000 – USB + CAN + Ethernet

For more information:

General kit page:

http://www.luminarymicro.com/products/lm3s3748_usb_h_d_evaluation_kits.html

Keil tools version (EKK-LM3S8962):

<http://www.luminarymicro.com/products/ekk-lm3s3748.html>

IAR tools version (EKI-LM3S8962):

<http://www.luminarymicro.com/products/eki-lm3s3748.html>

Code Red tools version (EKT-LM3S8962):

<http://www.luminarymicro.com/products/ekt-lm3s3748.html>

Code Sourcery tools version (EKC-LM3S8962):

<http://www.luminarymicro.com/products/ekc-lm3s3748.html>

USB host/device oscilloscope demonstration



Oscilloscope Wiring



Oscilloscope Demo



Oscilloscope Options



USB Host Mode
Data dump to the memory stick



USB Device Mode
Control the demo via a PC



CAN connected MCUs

		ADC in Series		Memory and Speed		Core	General Purpose Timer Modules			Motion Control		Serial Interfaces										Analog		Digital		Package Options							
		Flash (KB)	SRAM (KB)	Max. External Memory	32-bit Precision		16-bit Timing	CP	RTC	Full Input	PWM	QEI	10/100 Ethernet	IEEE 1389	CAN/AC	USB Full Speed	UART	FC	SPI/PS	I ² S	ADC Channels	ADC Speed (kSPS)	10-Bit	Trim Amp	Temp Sensor		1.8V Voltage Regulator	Analog Comparator	Digital Comparator	GPIO (4x8)	Heatsink		
LM352000s	25	256	96	✓	✓	80	✓	✓	4	8	2	8	✓	✓	4	2	✓	2	3	3	2	2	✓	16	1000	✓	✓	✓	3	7	60	✓	64-LQFP 100-LQFP 108-BG
	12	256	96	✓	✓	80	✓	✓	4	8	2	8	✓	✓	4	2	✓	2	3	3	2	2	✓	16	1000	✓	✓	✓	3	7	71	✓	64-LQFP 100-LQFP 108-BG
LM358000s	12	256	64	-	-	50	-	✓	4	8	1	6	✓	6	1	2	✓	3	3	3	2	2	-	8	1000	✓	✓	✓	3	-	48	✓	100-LQFP 108-BG
LM359000s	6	256	96	✓	✓	100	✓	✓	4	8	2	8	✓	8	4	2	✓	3	3	3	2	2	✓	16	1000	✓	✓	✓	3	7	65	✓	100-LQFP

- Featuring up to 3 Bosch CAN 2.0 A/B CAN MACs
- Independent CAN buffer allows simultaneous CAN usage with all other peripherals

Stellaris LM3S2965 Evaluation Kit



- **LM3S2965 Evaluation Board**
 - OLED graphics display with 128 x 64 pixel resolution
 - User LED, navigation switches, and select pushbuttons
 - Magnetic speaker
 - LM3S2965 I/O available on labeled break-out pads
 - Standard ARM® 20-pin JTAG debug connector with input and output modes
- Standalone CAN device board using Stellaris LM3S2110 microcontroller
- CAN ribbon cable, USB and JTAG cables



2000 - CAN

5000 – CAN + USB

8000 – CAN + Ethernet

9000 – CAN + Ethernet + USB

Stress 2 boards – allows a CAN network to be set up right out of the box

For more information:

Keil tools version (EKK-LM3S2965):

<http://www.luminarymicro.com/products/ekk-lm3s2965.html>

IAR tools version (EKI-LM3S2965):

<http://www.luminarymicro.com/products/eki-lm3s2965.html>

Code Red tools version (EKT-LM3S2965):

<http://www.luminarymicro.com/products/ekt-lm3s2965.html>

Code Sourcing tools version (EKC-LM3S2965):

<http://www.luminarymicro.com/products/ekc-lm3s2965.html>

Ethernet+CAN connected MCUs

	MCUs in Series	Memory and Speed		Core		General Purpose Timer Modules				Motion Control		Serial Interfaces						Analog				Digital		Package Options								
		Flash (KB)	SRAM (KB)	ROM/Boot Libs	Max Speed (MHz)	Internal Precision Interrupt	32-bit Timer	16-bit Timer	Watchdog	TMRs	CCP	RTC	PWM		10/100 Ethernet MAC+PHY	IEEE 1588	CAN MAC	USB Full Speed	UART	I ² C	SSI/SPDI	I ² S	ADC (10-bit)		Internal Temp Sensor	LDO Voltage Regulator	Analog Comparators	Digital Comparators	GPIOs (5-V)	Hibernate		
													Outputs	Fault Inputs									QEI								ADC Channels	ADC Speed (Ksps)
LM3S8000s	12	256	64	-	50	-	4	8	1	6	✓	6	1	2	✓	✓	3	✓	3	3	2	2	-	8	1000	✓	✓	3	-	46	✓	100-LQFP 108-BGA
LM3S9000s	6	256	96	✓	100	✓	4	8	2	8	✓	8	4	2	✓	✓	2	O/H/D	3	2	2	✓	16	1000	✓	✓	3	7	65	✓	100-LQFP	

- First MCUs featuring fully integrated 10/100 Ethernet MAC+PHY and up to 3 Bosch CAN 2.0 A/B MACs
- IEEE 1588 Precision Time Protocol hardware assist

Stellaris LM3S8962 Evaluation Kit



- LM3S8962 Evaluation Board
 - Stellaris LM3S8962 MCU with fully-integrated CAN module
 - OLED graphics display with 128 x 64 pixel resolution
 - User LED, navigation switches, and select pushbuttons
 - Magnetic speaker
 - LM3S8962 I/O available on labeled break-out pads
 - Standard ARM® 20-pin JTAG debug connector with input and output modes
- Standalone CAN device board using Stellaris LM3S2110 microcontroller
- Ethernet cable, CAN ribbon cable, USB and JTAG cables



For more information:

General kit page:

http://www.luminarymicro.com/products/lm3s8962_can_ethernet_evaluation_kit.html

Keil tools version (EKK-LM3S8962):

<http://www.luminarymicro.com/products/ekk-lm3s8962.html>

IAR tools version (EKI-LM3S8962):

<http://www.luminarymicro.com/products/eki-lm3s8962.html>

Code Red tools version (EKT-LM3S8962):

<http://www.luminarymicro.com/products/ekt-lm3s8962.html>

Code Sourcery tools version (EKC-LM3S8962):

<http://www.luminarymicro.com/products/ekc-lm3s8962.html>

Ethernet+USB OTG connected MCUs

	MCUs in Series	Memory and Speed				Core	General Purpose Timer Modules				Motion Control		Serial Interfaces						Analog				Digital		Package Options							
		Flash (KB)	SRAM (KB)	ROM SW Library	Ext. Peripheral Interface		Max Speed (MHz)	Internal Precision Oscillator	32-bit Timer	16-bit Timer	Watchdog Timers	CCP	RTC	Outputs	PWM	QEI	10/100 Ethernet MAC+PHY	IEEE 1588	CAN MAC	USB Full Speed	UART	I ² C	SS/USPI	I ² S		ADC Channels	ADC Speed (Ksps)	Internal Temp Sensor	LD0 Voltage Regulator	Analog Comparators	Digital Comparators	GPIOs (5-V)
LM3S3000s	4	128	64	✓	-	50	✓	4	8	1	8	✓	8	4	1	-	-	✓	O/H/D	3	2	2	-	8	1000	✓	✓	3	-	61	✓	64-LQFP, 100-LQFP
LM3S5000s	12	256	96	✓	✓	80	✓	4	8	2	8	✓	8	4	2	-	-	2	O/H/D	3	2	2	✓	16	1000	✓	✓	3	7	71	✓	64-LQFP, 100-LQFP
LM3S9000s	6	256	96	✓	✓	100	✓	4	8	2	8	✓	8	4	2	✓	-	2	O/H/D	3	2	2	✓	16	1000	✓	✓	3	7	65	✓	100-LQFP

- First MCUs featuring fully integrated 10/100 Ethernet MAC+PHY, USB OTG MAC+PHY, and up to 2 Bosch CAN 2.0 A/B MACs
- LM3S9B96 features SAFERTOS in ROM



- Evaluation board with LM3S9B90 (hibernate) or LM3S9B92 (max GPIOs)
- In-Circuit Debug Interface (BD-ICDI) board
 - Connects to USB port on PC and to 10-pin ARM JTAG connector on the evaluation board
 - 8-pin Power/UART connector provides power and virtual comm-port to the evaluation board
- Cables
 - USB miniB to USB-A cable, USB-μA to USB-A receptacle cable, USB-μB to USB-A plug cable
 - 10-pin ribbon cable for JTAG/SWD connection, 8-pin ribbon cable for Power/UART connection
- CD with evaluation software tools, documentation, source code, schematics



For more information:

Keil tools version (EKK-LM3S9B90):

<http://www.luminarymicro.com/products/ekk-lm3s9B90.html>

IAR tools version (EKI-LM3S9B90):

<http://www.luminarymicro.com/products/eki-lm3s9B90.html>

Code Red tools version (EKT-LM3S9B90):

<http://www.luminarymicro.com/products/ekt-lm3s9B90.html>

Code Sourcery tools version (EKC-LM3S9B90):

<http://www.luminarymicro.com/products/ekc-lm3s9B90.html>

Keil tools version (EKK-LM3S9B92):

<http://www.luminarymicro.com/products/ekk-lm3s9B92.html>

IAR tools version (EKI-LM3S9B92):

<http://www.luminarymicro.com/products/eki-lm3s9B92.html>

Code Red tools version (EKT-LM3S9B92):

<http://www.luminarymicro.com/products/ekt-lm3s9B92.html>

Code Sourcery tools version (EKC-LM3S9B92):

<http://www.luminarymicro.com/products/ekc-lm3s9B92.html>

LM3S9B96 MCU development kit (DK-LM3S9B96)

	MCUs in Series	Memory and Speed		Core	General Purpose Timer Modules				Motion Control		Serial Interfaces							Analog					Digital		Package Options						
		Flash (KB)	SRAM (KB)		ROM SW Library	Max Speed (MHz)	Internal Precision Oscillator	32-bit Timer	16-bit Timer	Watchdog Timers	CCP	RTC	Outputs	Fault Inputs	QEI	10/100 Ethernet MAC+PHY	IEEE 1588	CAN MAC	USB Full Speed	UART	I ² C	SSI/SPH	I ² S	ADC Channels		Internal Temp Sensor	LDO Voltage Regulator	Analog Comparators	Digital Comparators	GPIOs (5-V)	
				ADC (10-bit)																											
				ADC Speed (Ksps)																				FS							
LM3S2000s	26	256	96	✓	80	✓	4	8	2	8	✓	8	4	2	-	-	2	-	3	2	2	✓	16	1000	✓	✓	3	7	60	✓	64-LQFP 100-LQFP 108-BGA
LM3S5000s	12	256	96	✓	80	✓	4	8	2	8	✓	8	4	2	-	-	2	O/H/D	3	2	2	✓	16	1000	✓	✓	3	7	71	✓	64-LQFP 100-LQFP
LM3S9000s	6	256	96	✓	100	✓	4	8	2	8	✓	8	4	2	✓	✓	2	O/H/D	3	2	2	✓	16	1000	✓	✓	3	7	65	✓	100-LQFP



\$425

- LM3S9B96 Full-Featured Development Board
 - 80 MHz Stellaris LM3S9B96 MCU with fully-integrated Ethernet, CAN, and USB OTG/Host/Device
 - Bright 3.5" QVGA LCD touch-screen display
 - Navigation POT and select pushbuttons
 - Integrated Interchip Sound (I2S) Audio Interface
 - EPI cards: I/O break-out board and 8 MB SDR SDRAM module
 - MicroSD card interface
 - LM3S9B96 I/O available on labeled break-out pads
 - ARM® 20-pin JTAG debug connector with input and output modes
- 1 GB MicroSD Card, 128 MB USB Flash Drive
- Ethernet cable, CAN ribbon cable, USB and JTAG cables
- CDs containing evaluation software tools, documentation, quickstart guide, StellarisWare Graphics, USB, and Peripheral Driver Libraries, and source code

Evaluation version software tools included in the kit:



Includes SAFERTOS in ROM.

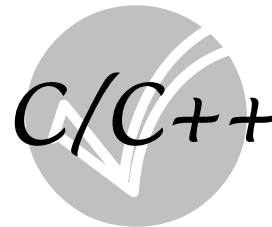
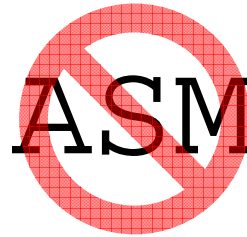
It's all about the software



As I mentioned, the New Technologies is the most captivating subject matter within MSP430 training, because it takes innovative technologies and makes them easy to implement. This year, will have launched FRAM, a revolutionary non-volatile memory, an integrated RF radio, full speed USB, and energy harvesting systems.

No assembly required!

- Cortex-M3 has complete hardware support for interrupts
 - Interrupt Service Routines (ISRs) are purely written in C/C++
 - Interrupt setup is easily done in C/C++
 - C/C++ array which contains the vectors (pointers to the C/C++ functions)
 - Pointer to the stack (a C/C++ array)
- No boot code ASM, no system configuration ASM
 - ARM7 compilers normally comes with a ASM boot routine (in object form) that does setup.
 - For Cortex-M3, no boot routine is needed
 - Cortex-M3 hardware loads the stack pointer from memory and the initial PC from memory and enters as a normal C function.
 - User C/C++ code is all that is required.
- Entire software code base can be written in C/C++
 - ISRs
 - RTOS
 - Application code

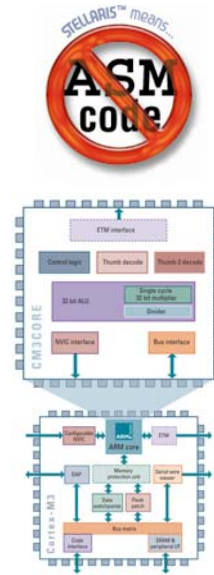


Cortex™-M3 benefits

- Capabilities beyond ARM7 for the MCU market:
 - No Assembly Required!
 - Cortex-M3 requires approximately ½ the flash of ARM7 implementations
 - 2-4 times faster on MCU control applications
 - Raw interrupt performance: we're 85% faster
 - PID (process control) main loop: we're 217% faster
 - Multiply-intensive code: we're 294% faster
 - Divide-intensive code: we're 726% faster

Features	ARM7TDMI	ARM Cortex-M3
Architecture	ARMv4T (von Neumann)	ARMv7-M (Harvard)
ISA Support	Thumb / ARM	Thumb / Thumb-2
Pipeline	3-stage	3-stage + branch speculation
Interrupts	FIQ / IRQ	NMI + 1 to 240 physical interrupts
Interrupt Latency	24 - 42 cycles	12 cycles
Inter-Interrupt Latency	24 cycles	6 cycles
Sleep Modes	None	Integrated
Memory Protection	None	8 region MPU
Dhrystone	0.95 DMIPS/MHz (ARM) 0.74 DMIPS/MHz (Thumb)	1.25 DMIPS/MHz

Source: http://www.arm.com/products/CPUs/ARM_Cortex-M3.html

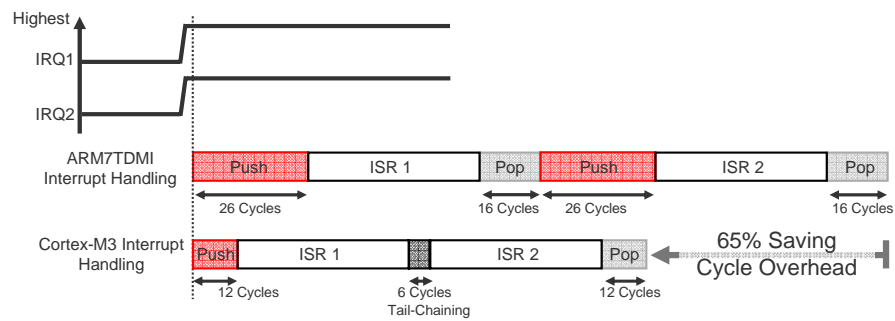


Benchmarks – same C code on Stellaris and NXP ARM7, same CPU clock speed.

Stellaris microcontrollers are based on the microcontroller version, Cortex-M3. Cortex-M3 has been optimized for single cycle flash usage, and in fact, all Stellaris microcontrollers are always single cycle flash for awesome performance. Cortex-M3 is also the only ARM processor core with deterministic interrupt processing, a required feature in deeply embedded microcontroller applications. There are three different sleep modes and clock gating throughout the microcontroller for low power, a single-cycle multiply instruction and hardware divide instruction, superior new debug features including data breakpoints and flash patching, support for atomic operations for memory-mapped I/O, and an amazing 1.25 Dhrystone MIPS per Megahertz. ARM7TDMI is 0.9 DMIPS/MHz, and ARM9 is 1.1 DMIPS/MHz -- and on a clock-for-clock basis, Cortex-M3 outperforms them both!

Cortex-M3 extends beyond ARM7 with other features especially for the microcontroller market: first, Cortex-M3 requires no assembly code – none at all – not in boot code, not in interrupt services routines – everything can be done in C! In benchmarks run against Philips' LPC2103 evaluation board, Stellaris microcontrollers required half the flash than the LPC2103 did, for the same code, and the performance was 2-4 times faster on typical control applications, as you can see here.

Interrupt response – tail chaining



ARM7TDMI

- 26 cycles from IRQ1 to ISR1 (up to 42 cycles if in LSM)
- 42 cycles from ISR1 exit to ISR2 entry
- 16 cycles to return from ISR2

Cortex-M3

- 12 cycles from IRQ1 to ISR1 (Interruptible/Continual LSM)
- 6 cycles from ISR1 exit to ISR2 entry
- 12 cycles to return from ISR2

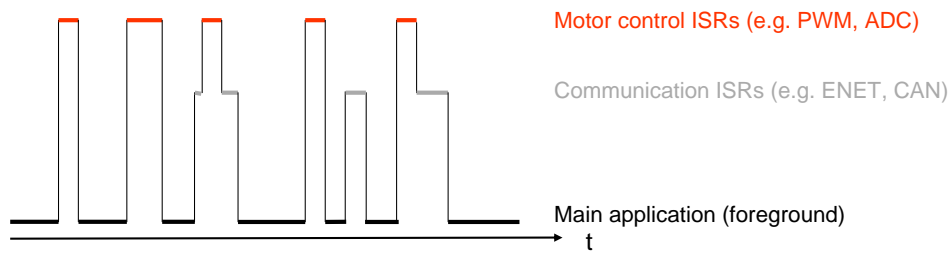


Furthermore, it is not only the priority of the Interrupt, but how the interrupts are handled.

This shows how it takes fewer cycles for the Cortex-M3 to handle different interrupts.

The reduced cycles was a targeted enhancement of from the ARM7 architecture.

How it works on Cortex-M3



- Main application runs as foreground (base level)
 - Easy to write since no “factoring” – just normal application or RTOS based
 - Can use PLC style state-machine poll loop safely: ISRs keep data available
- ISRs for Motor control are highest priority(ies)
 - PWM, ADCs, Timer(s), Fault (may be highest), Temp sensor, etc
- ISRs for communications below that
 - Ethernet, CAN, and/or serial
- May use other priorities as needed
 - Very fast interrupt response time, true nested interrupts, priority masking, easy ISR setup all contribute to making an easy solution
 - Application uses priority masking vs. interrupt-disable if needs critical region



As you can see, the Cortex-M3 model of fast and prioritizeable interrupts allows for a mix of both easily. So, the motor control runs entirely as interrupts, thereby leaving the main thread for a PID loop or RTOS application. Communications also run as lower priority interrupts, and so do not disturb the motor control.

In a DSP, the main function or thread of the DSP focuses on motor control. Any other operations have to be fit in between times, if time is available. Often, a separate MCU is used for communications and other control functions. The problem is that the DSP is excellent for tight loops and terrible for interrupt processing and context switching. A common complaint with DSP is that if you mix an app using 40% with one using 20%, you end up exceeding 100% of the processor.

For MCUs, the problem is usually just lack of horsepower. So, one MCU is focused on motor control, with another handling control functions and communications.

StellarisWare® Peripheral driver library

- High-level API interface to complete peripheral set
- Free license and royalty-free use
- Simplifies and speeds development of applications
- Can be used for application development or as programming example
- Available as object library and as source code
- Compiles on ARM/Keil, IAR, Code Red, and GNU tools
- Includes Stellaris Graphics Library and Stellaris USB Library
- Peripheral driver library functions are preprogrammed in ROM on select Stellaris MCUs




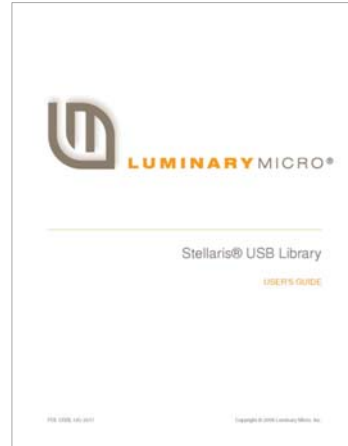
Also supports multiple ways of writing an application:

- Polled vs. interrupt driven
- Hardware engineer (register access), software engineer (C function calls), embedded engineer (graphical design – NI LabView)

StellarisWare®

USB library stacks and examples

- USB-IF Compliance 
 - Stellaris has passed USB Device and Embedded Host compliance testing
- Examples available:
 - Device Examples:
 - HID Keyboard
 - HID Mouse
 - CDC Serial
 - Generic Bulk
 - Audio
 - Device Firmware Upgrade
 - Oscilloscope
 - Host Examples:
 - Mass Storage
 - HID Keyboard
 - HID Mouse
 - Windows INF for supported classes
 - Points to base Windows drivers
 - Sets config string
 - Sets PID/VID
 - Precompiled DLL saves development time
 - Device framework integrated into USBLib



StellarisWare®

Graphics library examples



StellarisWare®

Safe at home with IEC 60730



The International
Electrotechnical
Commission (IEC)

- IEC: World's authority in international standards for household appliances
- StellarisWare extension provides support for IEC 60730 Class B safety requirements
- Class B covers most home appliances, such as washers/dryers, refrigerators, freezers, and cookers/stoves
- Free license and royalty-free use for use on Stellaris MCUs
- Library supports both startup and periodic testing requirements of IEC 60730

<http://www.iec.ch/index.html>

	Module	Description
StellarisWare™ Software	Reset Handler	Performs basic register and memory test out of reset.
	CPU Test	Performs stuck bit testing on the CPU PC and registers.
	SRAM Test	Performs stuck bit testing on the SRAM.
	Flash Test	Performs a CRC test on the Flash.
	ADC Test	Performs a conversion test on an ADC channel connected to a known voltage reference.
	GPIO Test	Performs ADC temperature sensor test.
	GPIO Test	Performs GPIO input/output plausibility test.
	Clock/Interrupt Test	Performs tests to check the clock frequency, interrupt handling, and execution.
Stellaris® Hardware	Nested Vector Interrupt Controller	Deterministic, fast interrupt processing for execution certainty.
	Automotive-grade Flash Memory	High reliability non-volatile memory for robust environments.
	Cyclical Redundancy Check in ROM	Especially useful in verifying the contents of memory in a Stellaris microcontroller.
	2 Watchdog Timers	Clocked with precision oscillator, a second WDT takes advantage of the non-maskable interrupt (NMI) handler safety feature of the ARM Cortex-M3 processor.
	Precision Oscillator	Supplies an accurate, independent time base when periodic safety tests are executed.
	Advanced Motion Control with Multiple Fault Conditioning Inputs	Provides quick motor shutdown in low latency situations.
	Quadrature Encoder Inputs	Provides precise, closed loop control of motors.
	Integrated Analog Comparators	Used to trigger Stellaris' accurate ADC and to trigger an interrupt when needed, which is useful for infrequent out-of-range events such as a current or voltage spike.
	Internal Temperature Sensor	Eliminates the performance-wasting requirement of constant CPU polling.
	Used to monitor and shut down an appliance if the appliance overheats.	
	10/100 Ethernet MAC/PHY with IEEE 1588 PTP	Offers highly synchronized connectivity features for precision internetworking.
	Controller Area Network (CAN) 2.0 MACs	



StellarisWare®

In-system programming options

Stellaris Serial Flash Loader

- Small piece of code that allows programming of the flash without the need for a debugger interface.
- All Stellaris MCUs ship with this pre-loaded in flash
- Interface options include UART or SSI
- We supply a Windows™ application (GUI or command line) that makes full use of all commands supported by the serial flash loader (LMflash.exe)
- See application note [AN01242](#)

Stellaris Boot Loader

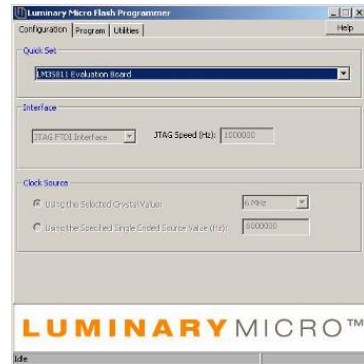
- Small piece of code that can be programmed at the beginning of flash to act as an application loader
- Also used as an update mechanism for an application running on a Stellaris microcontroller.
- Interface options include UART (default), I2C, SSI, Ethernet, USB
- Included in the Stellaris Peripheral Driver Library with full applications examples
- See application note [AN01248](#)
- Preloaded in ROM on select Stellaris Microcontrollers



StellarisWare®

Serial flash programming GUI

- LM Flash Programming GUI
 - Simple graphical user interface
 - Support for all Evaluation Kits
 - Key features include:
 - Program
 - Verify
 - Erase
 - Read memory
 - Available now
 - http://www.luminarymicro.com/products/software_updates.html



On-chip software enhancements (ROM)

StellarisWare® DriverLib

- High-level API interface to complete peripheral set.
- Simplifies and speeds development of applications.
- Saves user flash by storing peripheral setup and configuration code
- Allows programmer focus to be on the application—not setup

StellarisWare® Bootloader

- Download code to flash memory for firmware updates
- Interface options include UART (default), I2C, SSI, Ethernet

Other flash memory-saving options

- Advanced Encryption Standard (AES) tables – for cryptography
 - Supported by the current AES example application
 - Covers all three sizes: 128, 192, 256
- Cyclic Redundancy Check (CRC) functionality – for error detection

StellarisWare®

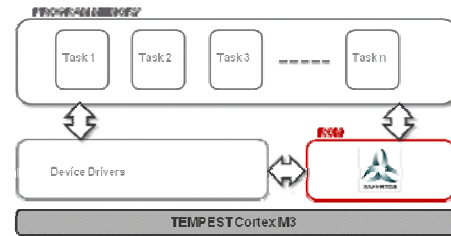


Stored in exclusive ROM on select Stellaris MCUs







SAFERTOS included in the LM3S9B96

- High-integrity RTOS in ROM
- Can be used as a standard operating system *OR* as part of a high integrity application which requires certification to **IEC61508** or **FDA510(k)**
- RTOS **value \$65k free** with Tempest LM3S9B96
- Integrated hardware/software solution shortens the time to market and significantly reduces cost for **Industrial** and **Medical** Applications
- Innovative *Design Assurance Pack* available separately from WITTENSTEIN provides **complete turnkey evidence** and process documentation



Certification requires more than using SAFERTOS but Design Assurance Pack helps this process.

Development Tools for Stellaris MCUs

				
Eval Kit License	30-day full function. Upgradeable.	32KB address-limited. Upgradeable.	32KB address-limited. Upgradeable.	Full functional; locked to board. Upgradeable.
Compiler	GNU C/C++	IAR C/C++	RealView C/C++	GNU C/C++
Debugger / IDE	gdb / Eclipse	C-SPY / Embedded Workbench	µVision	code_probe / Eclipse-based tool suite
Full Upgrade	199 USD personal edition / 3000 USD full support	2700 USD	MDK-Basic (256 KB) = €2000 (2895 USD)	999 USD (upgrade to run on customer platform)
JTAG Debugger		J-Link, ~299 USD	U-Link, ~199 USD	Red Probe, 150 USD

Remember: In addition to its original use as an evaluation kit, each Stellaris evaluation kit has the built-in capability for use as a simple USB-to-20-pin JTAG debugger.



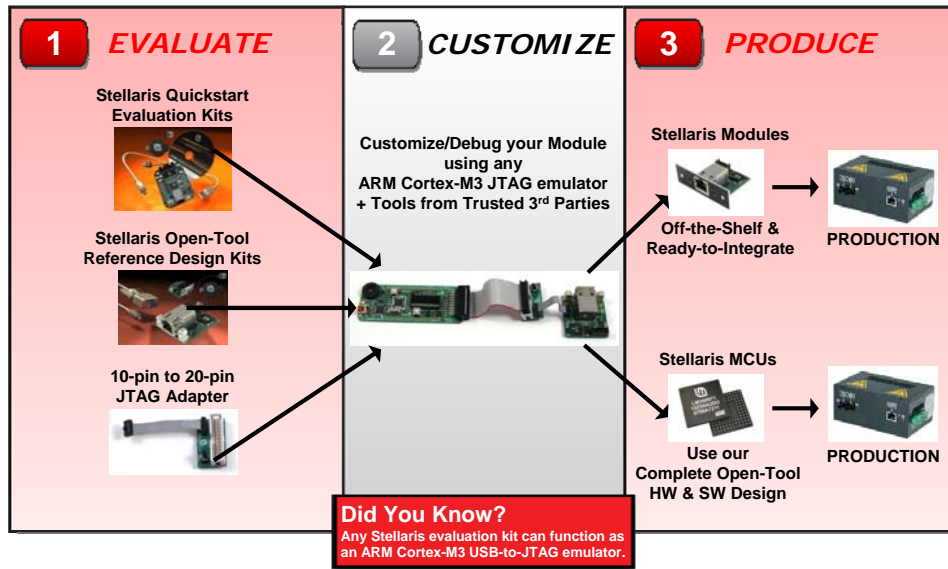
Lists limitations and capabilities of the various eval toolchains.
Can download other versions from the web to try out.

Our time-to-market focus

Getting you to market quickly



Flexibility in production options



Open-Tool Modules Speed Time-to-Market



Brush DC Motor Control
MDL-BDC
Single unit: 109 USD



Intelligent Display Module

MDL-IDM-L35
Single unit: 185 USD

...with Ethernet

MDL-IDM28
Single unit: 185 USD

...with PoE

MDL-IDM
Single unit: 199 USD



Ethernet+CAN BLDC Motor Controller
MDL-BLDC
Single unit: 149 USD



STEPPER Motor Control
MDL-STEPPER
Single unit: 169 USD



Serial-to-Ethernet
MDL-S2E
Single unit: 49 USD



AC Induction Motor Control
MDL-ACIM
Single unit: 239 USD



These modules are the “just-a-board” components of the reference design kits discussed earlier. The modules come with nothing else – no CD, no power bricks, no cables, no motors, no software tools ... nothing. They also sell in bulk quantities for direct use in customer’s production. The most popular modules in customer production usage today are MDL-S2E, all of the MDL-IDM variants, and MDL-BDC.

Stellaris means:



Stellaris Means Building Control:

- Control capability for precision gas/liquid manipulation
- Rich lighting management with 32-bit performance
- CAN/Ethernet connectivity for Building Management (elevators, doors, windows, restrooms)

Specific Stellaris Wins:

- Lighting Controls
 - LED Drivers
 - Panel Motor Controller
- HVAC
 - Pump Inverter
 - Compressor Motor
- Building Automation
 - Audio



Stellaris Means Automation:

- Design for accurate factory motion control
- Performance and integration yields factory multi-tasking (drive a motor while measuring attributes)
- CAN and Ethernet connect factory machines for remote accessibility
- USB Host for field updates and data dumping

Specific Stellaris Wins:

- Machines
 - Controllers
 - Sorters
 - Analyzers
 - Component Motors
- Monitors
 - Ethernet Bridges
 - Sensors



Stellaris Means Security Monitoring and Control:

- Robust industrial control capability for invulnerable security systems
- ARM Cortex-M3 ISRs for event multi-tasking
- Ethernet connected systems for remote monitoring and concurrent control (Motor control in connected CCTV cameras)
- USB Host for video storage, Device for CPU playback

Specific Stellaris Wins:

- Surveillance
 - Alarm Systems
 - CCTV
- Access Control
 - Building Access
 - Safe Disposal
- Emergency Alarm Control



Specific customers have gone to market with applications in these areas.

Stellaris means:



Stellaris Means Transaction Control:

- 32-bit performance for massive data retrieval, recognition, and manipulation
- Performance and integration for print-head control
- Ethernet / USB connectivity for Storefront (card swipes, ATMs, vending machines)
- Enhanced single-cycle memory footprint for more complex EPOS systems

Specific Stellaris Wins:

- Point-of-Sale
 - Printers
 - Data Acquisition
- AutoID
 - Tag Scanner
 - Vehicle ID
 - Inventory RFID



Stellaris Means Medical:

- Motion Control capability for precision robotics and drilling
- Intelligent analog-to-digital for precision input
- CAN/Ethernet connectivity for remote monitoring

Specific Stellaris Wins:

- Motor Control
 - Dental Drilling Machine
 - Robotic DNA Extraction
- Pumps and Analyzers
 - Blood Analyzer
 - Spinal Column Correction Analyzer



Stellaris Means Toys:

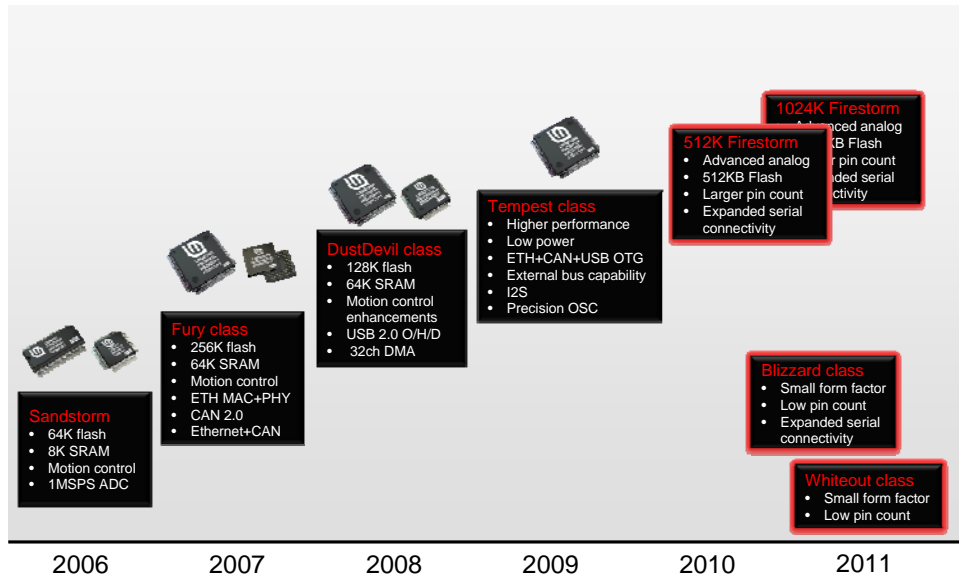
- Control capability for precision robotics
- Processing speed for multifunction
- Low-power for long battery life
- Small package for small enclosures
- Ethernet connectivity for Remote Access (Remote vacuum initiation, digital home automation)
- USB for CPU connection, power, consumer connect

Specific Stellaris Wins:

- Toys
 - Remote Control
 - Motors
- Handhelds
 - Gaming accessories
- Digital Home
 - Remote Vacuums
 - Audio / Video



Stellaris roadmap



TI Information – Selective Disclosure



Stellaris is the industrial connectivity solution!

Performance

20-100 MHz ARM-M3 CPU

- Optimized for single-cycle flash usage
- Thumb-2 ISA with high code density
- Flexible clock system sources up to 8 timers
- Single-cycle multiply and hardware divide
- Three power modes and battery-backed hibernation with non-volatile memory
- Integrated 32-ch DMA for ease of use & high data rate without CPU overhead

Broad Portfolio

Largest ARM MCU portfolio in the world with over 140 devices

- 8KB-256KB Flash and 96KB RAM
- 10-bit, 8ch ADCs from 250ksps-1MSPS
- Up to 8 advanced PWM modules
- RTC, BOR, and integrated LDO
- Analog comparators and temp sensor
- 28 to 108 pin from SOIC to BGA



Connectivity

Only family in the industry with:

- Ethernet MAC & PHY with 1588 PTP support
- USB Host, Device, or On-The-Go
- CAN 2.0 A/B with 32 mailboxes
- Integrated UART, I2C, SSI modules
- Integrated I2S master or slave
- External Peripheral Interface supporting SRAM, SDRAM, M2M, FPGA, CPLD

Ease of Use

- C friendly IDE and compilers from industry leaders
- Low cost development tools
- Application specific and advanced development kits
- Production-ready application modules
- StellarisWare on ROM includes driver and peripheral libraries to ease development



Hope you have some feel for the capabilities of the Stellaris range of microcontrollers.