



# Stellaris<sup>®</sup> One Day Workshop 2010

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*Student Guide*



*Revision 1.4  
July 2010*



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## Revision History

Version 1.0	November 2009	TTO release of workshop
Version 1.1	January 2010	Errata
Version 1.2	January 2010	Errata
Version 1.3	February 2010	Lab step errata
Version 1.31	February 2010	Lab step errata
Version 1.4	July 2010	New roadmap and portfolio slides

### Mailing Address

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# Stellaris<sup>®</sup> One-Day Workshop

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## Introduction

Welcome to the Texas Instruments Stellaris one-day workshop. This workshop has been segmented in order for it to be presented in a variety of formats: lunch and learn style, half day and full day.

If you are attending the lunch and learn format, this introductory presentation will be presented.

If you are attending a half-day format, you will also have the chance to get hands-on with Code Composer Studio, and the LM3S3748 and LM3S8962 evaluation kits.

If you are attending the full-day presentation, your afternoon will be a series of in-depth presentations and labs covering the USB, CAN and Ethernet peripherals.

Whichever format that you're here for, welcome to the class ... let's get started!

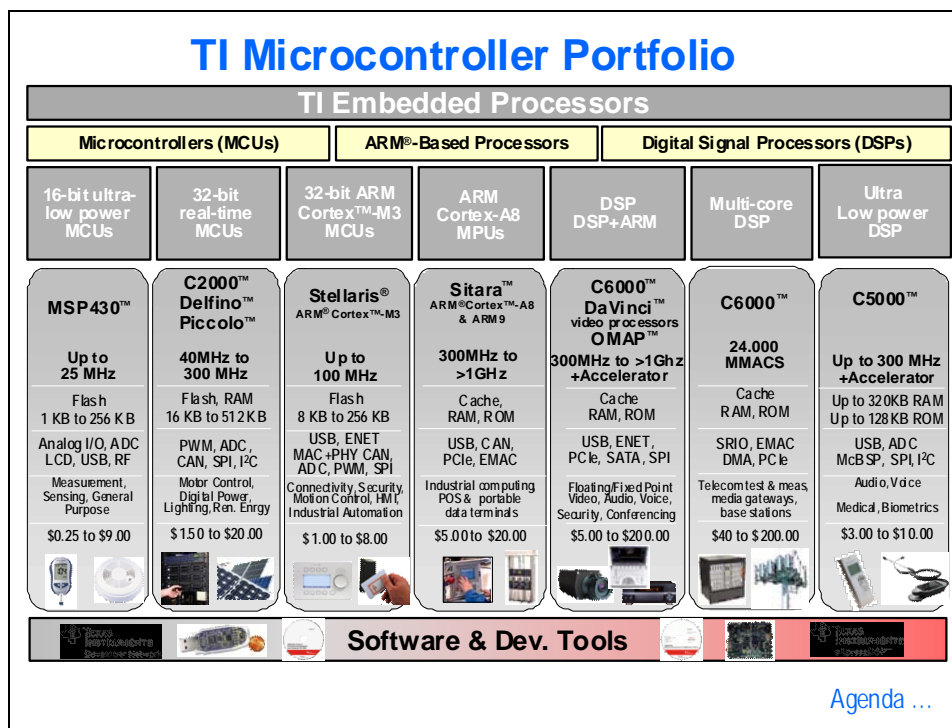
## Objectives

- **Stellaris Microcontrollers Overview**
- **Stellaris Key Advantages**
- **Evaluation and Reference Design Kits**
- **Development Tools and Software Support**
- **Product Demonstrations**
- **Summary**

# Module Topics

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# TI Microcontroller Portfolio



# Stellaris ARM® Cortex™- M3 Overview

## What Is The ARM® Cortex™-M3?

The ARM Cortex family is comprised of three series

- **ARM Cortex-A Series**
  - Applications processors for complex OS and user applications.
  - Supports the ARM, Thumb and Thumb-2 instruction sets.
- **ARM Cortex-R Series**
  - Embedded processors for real-time systems.
  - Supports the ARM, Thumb, and Thumb-2 instruction sets
- **ARM Cortex-M Series**
  - Deeply embedded processors
  - Optimized for cost sensitive applications.
  - Supports the Thumb-2 instruction set only

**Note:**

- ARM Code 32-bit
- Thumb Code 16-bit
- Thumb-2 Code mostly 16-bit & some 32-bit (25% Faster, 26% Smaller)



**Cortex™**  
Intelligent Processors by ARM®

For more information on the ARM Cortex-M3, see:

**The Definitive Guide to the ARM Cortex-M3** by Joseph Yiu

ISBN: 978-0-7506-8534-4

Benefits ...

## ARM® Cortex™-M3 Benefits

### Cortex™-M3 Benefits

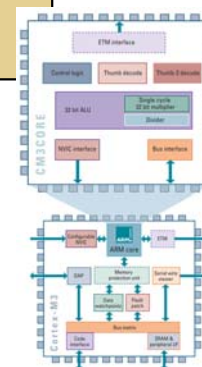
◆ **Capabilities beyond ARM7 for the MCU market:**

- **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\\_CortexM3.html](http://www.arm.com/products/CPUs/ARM_CortexM3.html)


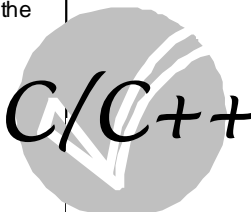


No ASM Required ...

## No Assembly Required

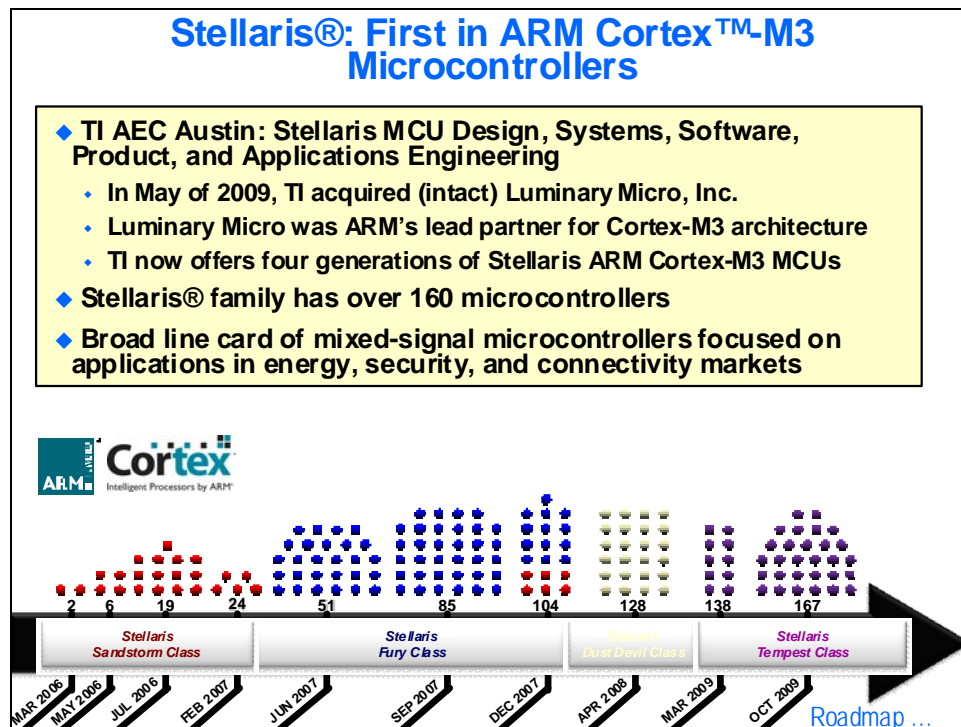
### No Assembly Required

- ◆ **Cortex-M3 has complete hardware support for interrupts**
  - Interrupt Service Routines (ISRs) are 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 come with an ASM boot routine (in object form) that does the 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

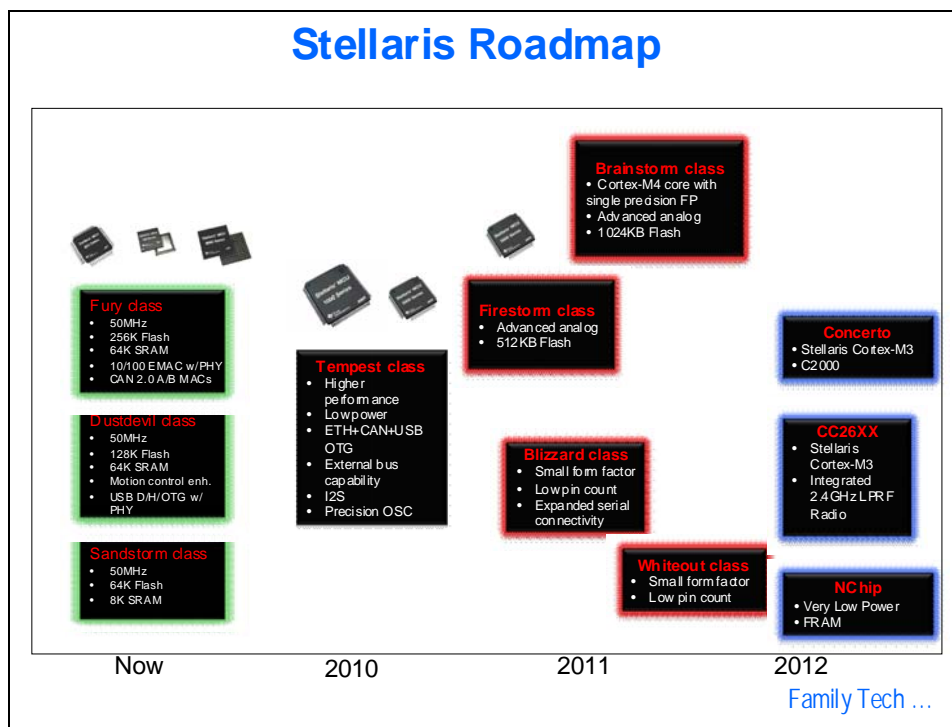



First in ARM ...

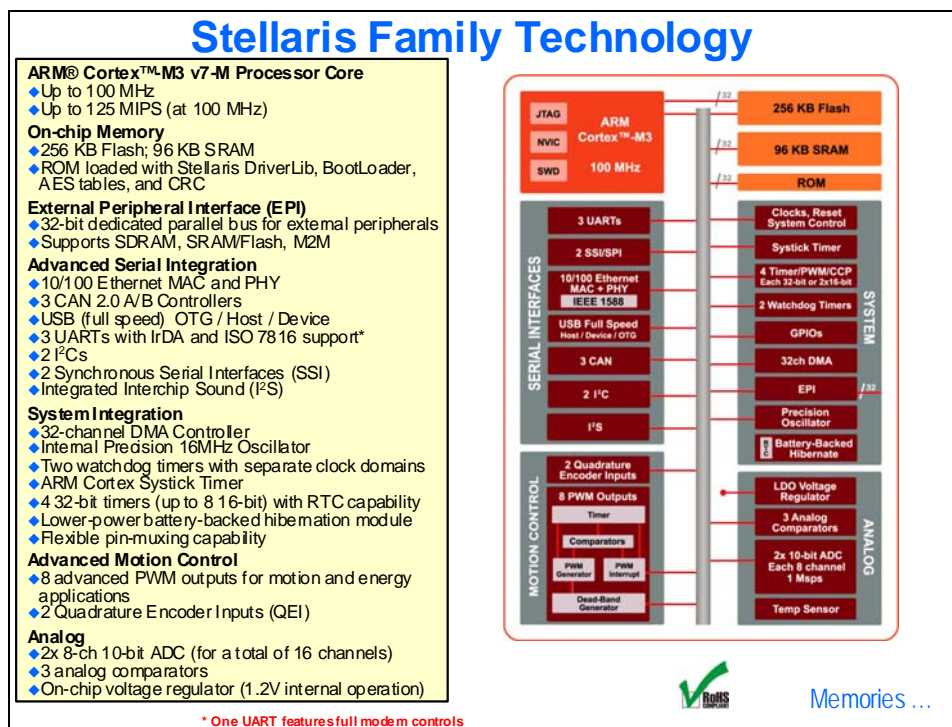
## First in ARM® Cortex™-M3 Microcontrollers



## Roadmap

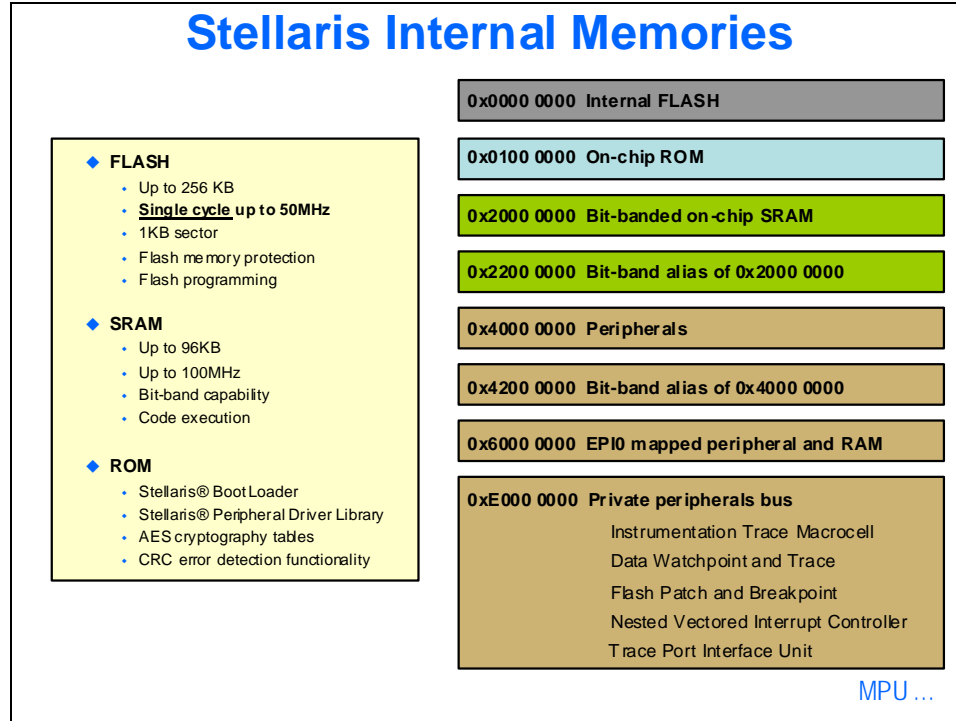


## Family Technology

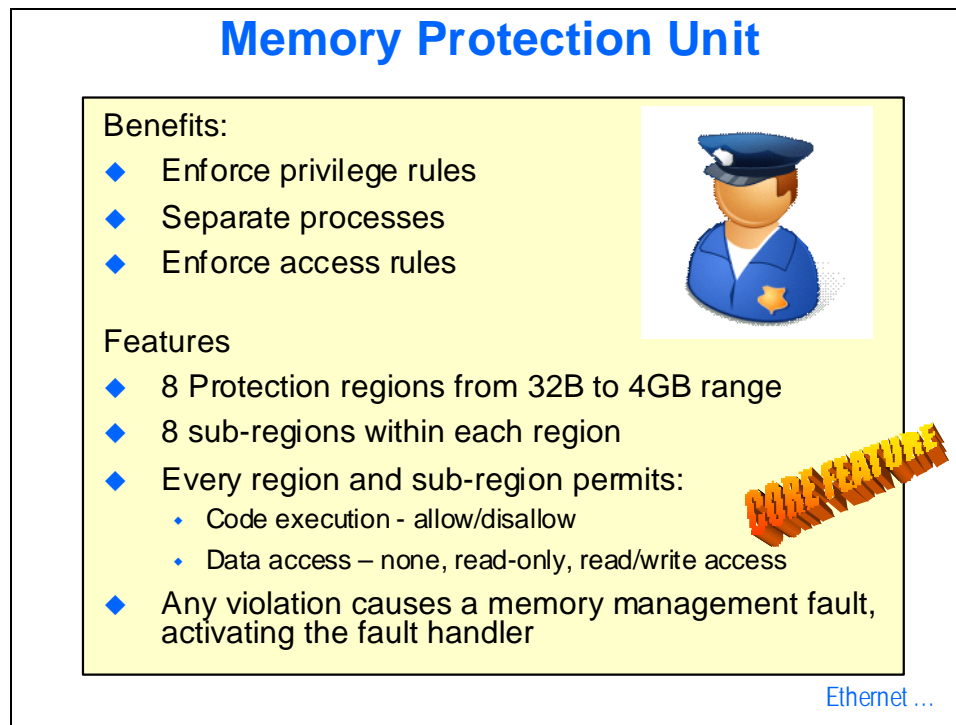




## Internal Memories



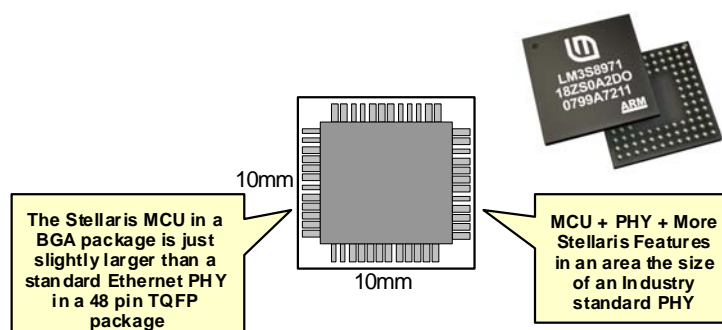
## Memory Protection Unit



## Integrated MAC+PHY

### The Only ARM MCU w/ Integrated 10/100 Ethernet MAC+PHY

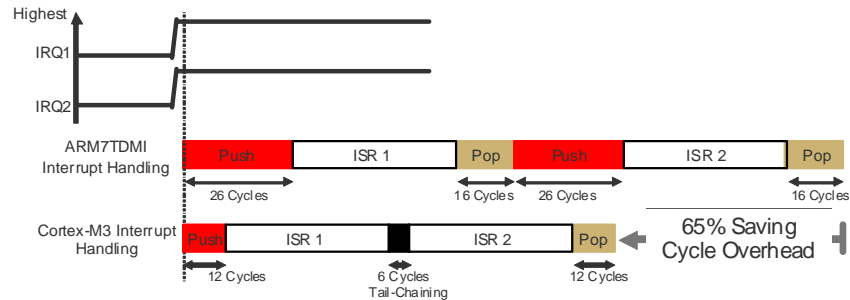
- ◆ Enables network connectivity and embedded web servers
- ◆ Lower external power budget requirements than solutions using an external PHY
- ◆ Savings in board space and system cost
- ◆ Hardware support for Precision Time Protocol (IEEE 1588 PTP)



NVIC ...

# NVIC

## Nested Vectored Interrupt Controller – 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

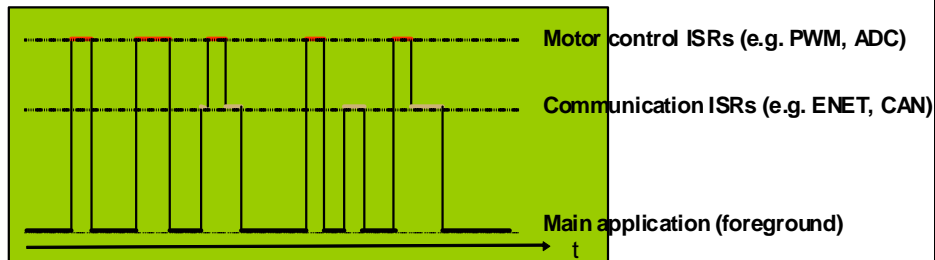
### Cortex-M3

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

LSM = Load/Store Multiple instruction

**CORE FEATURE**  
NVIC ...

## NVIC Interrupt Priorities Example



- ◆ Main application runs as foreground (base level)
  - Easy to write since no “factoring” – 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 motor controls
  - 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

**CORE FEATURE**

EPI ...

## External Peripheral Interface

### 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)

Hibernation ...

## Battery-Backed Hibernation

### Battery-Backed Hibernation

#### ◆ Battery-backed Hibernation Module (Standby current as low as 10µA\*)

- ◆ **32-bit real-time counter (RTC)**
  - Programmable 32.768-kHz external oscillator or a 4.194304-MHz crystal
  - RTC software trim for making fine adjustments to the clock rate
- ◆ **256 bytes (sixty-four 32-bit words) of non-volatile battery-backed memory**
- ◆ **Power-switching logic to discrete external regulator (switch to battery)**
- ◆ **Low-battery detection, signaling, and interrupt generation**
- ◆ **Wake on RTC match and / or external pin**



#### ◆ On-chip Low Drop-Out (LDO) voltage regulator

#### ◆ Low-power options on controller: Sleep and Deep-sleep modes

#### ◆ Low-power options for peripherals: software controls shutdown of individual peripherals

#### ◆ 3.3-V supply brownout detection and reporting via interrupt or reset

Operating Mode	Sandstorm Class	Fury Class	Dust Devil Class	Tempest Class*
Run	< 120 mA	160 mA (w/ETH)	120 mA	60 mA (w/o ETH) 80 mA (w/ETH)
Sleep	20 mA	20 mA (w/ETH)	20 mA	8 mA
Deep Sleep	700 µA	5 mA (w/ETH)	350 µA	600 µA
Hibernate	—	10 to 18 µA	10 to 18 µA	10 to 18 µA

\* Preliminary

Motor Control ...

## Motor Control

### Motor Control

- ◆ Stellaris supports up to 8 general-purpose PWMs **and** up to 8 channels of motion control PWMs.

- ◆ **General-purpose PWMs**

- Stellaris 16-bit timer simple PWM mode with programmable output negation.

- ◆ **Motion-control PWM Module**

- Can generate simple PWM signals for a simple charge pump.
- Can generate paired PWM signals with dead-band delays for a half-H bridge driver.
- Can generate the full six channels of gate controls for a 3-Phase inverter bridge.
- Dead-band generator providing shoot-through protection.
- Synchronization of timers enables precise alignment of all edges.

- ◆ Up to 4 fault-condition handling inputs in hardware quickly provide low-latency shutdown.

- ◆ Up to 2 Quadrature Encoder Inputs provide accurate positioning for closed-feedback control.



## Evaluation and Reference Design Kits

### Evaluation Kits: “Zero-to-32bits” In 10 Minutes

- Everything a developer needs to get up and running in 10 minutes or less
  - Evaluation board(s)
  - All required cables
  - A choice of evaluation tools suites for popular development tools
  - Documentation
  - StellarisWare software
  - Applications notes
- Each kit functions both as an evaluation platform and as a serial in-circuit debug interface for any Stellaris microcontroller-based target board

							
E-K-LM3S811 Low pin count \$49	E-K-LM3S1968 High pin count \$59	E-K-LM3S2965 CAN Functionality \$79	E-K-LM3S3748 USB Host/Device \$109	E-K-LM3S6965 Ethernet MAC+PHY \$69	E-K-LM3S8962 Ethernet+CAN \$89	E-K-LM3S9B90 Ethernet+USB OTG \$99	E-K-LM3S9B92 Ethernet+OTG+MC \$99

Each kit comes in four versions:



And now ...


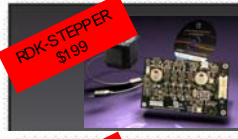




Order the kit you like, the other IDEs can be downloaded from  
[www.ti.com/Stellaris](http://www.ti.com/Stellaris)

Ref Des Kits ...

## Motor Control Reference Design Kits

### Open-Tool Motor Control Reference Design Kits

	<b>AC Induction Motor Controller Design</b> <b>Example applications:</b> <ul style="list-style-type: none"> <li>• White goods</li> <li>• Residential and light commercial HVAC</li> <li>• 3-ph Industrial Motor Drives</li> </ul>
	<b>Stepper Motor Controller Design</b> <b>Example applications:</b> <ul style="list-style-type: none"> <li>• 2 and 3 axis CNC equipment</li> <li>• Sorting and grading equipment</li> <li>• Specialized printers and scanners</li> </ul>
	<b>Brushless DC Motor Controller with CAN/Ethernet</b> <b>Example applications:</b> <ul style="list-style-type: none"> <li>• Small appliances</li> <li>• Electric wheelchairs and mobility devices</li> <li>• Pumping and ventilation systems</li> </ul>
	<b>Brush DC Motor Controller with CAN</b> <b>Example applications:</b> <ul style="list-style-type: none"> <li>• Small appliances</li> <li>• Electric wheelchairs and mobility devices</li> <li>• Pumping and ventilation systems</li> </ul>







Official FRST KoP Speed Controller – FRC 2009

Ref Des Kits ...

## Reference Design Kits







### Open-Tool Reference Design Kits

 <p><b>RDK-DM</b> \$219</p>	<p><b>Touch-screen Intelligent Display Module with PoE</b></p> <p><b>Example applications:</b></p> <ul style="list-style-type: none"> <li>• Security Systems &amp; Building Access Controllers</li> <li>• White Goods and other Home Appliances</li> <li>• Factory Automation (System Status and Configuration)</li> </ul>
 <p><b>RDK-DM-L35</b> \$219</p>	<p><b>Landscape-oriented Touch-screen Intelligent Display Module</b></p> <p><b>Example applications:</b></p> <ul style="list-style-type: none"> <li>• Security Systems &amp; Building Access Controllers</li> <li>• White Goods and other Home Appliances</li> <li>• Factory Automation (System Status and Configuration)</li> </ul>
 <p><b>RDK-DM-SBC</b> \$299</p>	<p><b>Stellaris 3.5" Landscape IDM Single Board Computer</b></p> <p><b>Example applications:</b></p> <ul style="list-style-type: none"> <li>• Security Systems &amp; Building Access Controllers</li> <li>• White Goods and other Home Appliances</li> <li>• Factory Automation (System Status and Configuration)</li> </ul>
 <p><b>RDK-S2E</b> \$139</p>	<p><b>Tiny Footprint Serial-to-Ethernet Module</b></p> <p><b>Example applications:</b></p> <ul style="list-style-type: none"> <li>• SCADA Remote Terminal Units (RTUs)</li> <li>• Electronic Flow Meters (EFMs)</li> <li>• CCTV RS-232 Recorders</li> </ul>

Modules ...

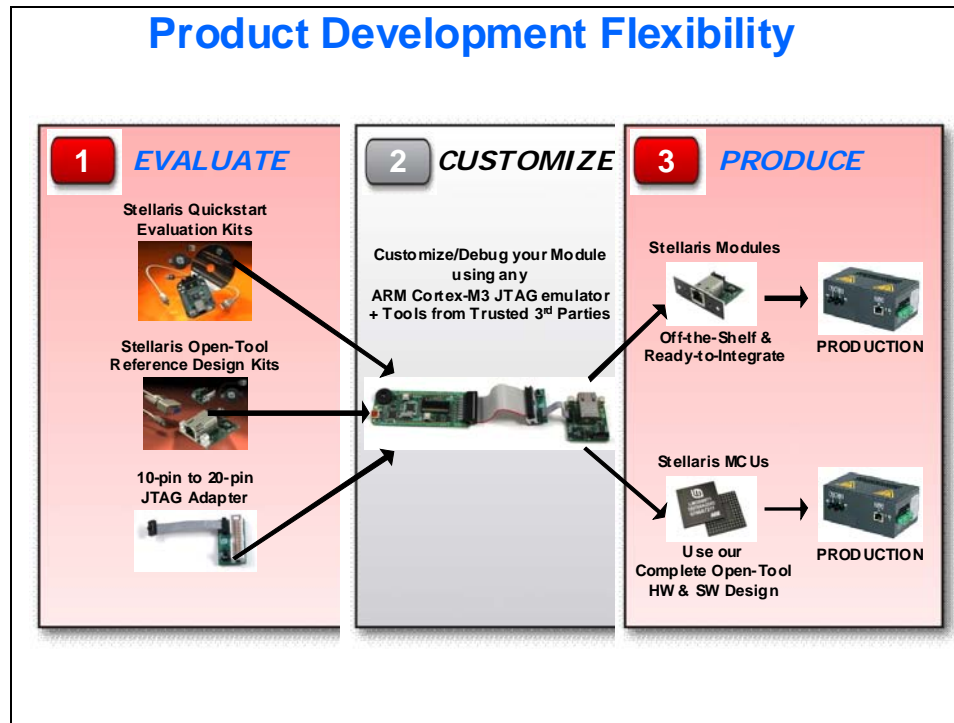
## Modules

### Open-Tool Modules Speed Time-to-Market

 <p><b>Brush DC Motor Control</b> <i>MDL-BDC</i> Single unit: 109 USD</p>	 <p><b>Intelligent Display Module</b> <i>MDL-IDM-L35</i> Single unit: 185 USD ...with Ethernet <i>MDL-IDM28</i> Single unit: 185 USD ...with PoE <i>MDL-IDM</i> Single unit: 199 USD</p>	 <p><b>Ethernet+CAN BLDC Motor Controller</b> <i>MDL-BLDC</i> Single unit: 149 USD</p>
 <p><b>STEPPER Motor Control</b> <i>MDL-STEPPER</i> Single unit: 169 USD</p>	 <p><b>Serial-to-Ethernet</b> <i>MDL-S2E</i> Single unit: 49 USD</p>	 <p><b>AC Induction Motor Control</b> <i>MDL-ACIM</i> Single unit: 239 USD</p>

Flexibility ...






## Product Development Flexibility





# Development Tools and Support Software

## Development Tools for Stellaris MCUs

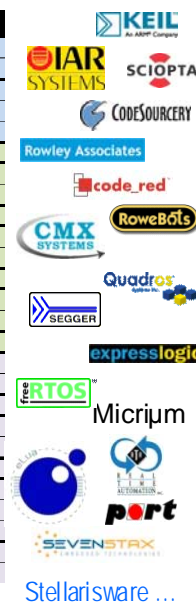
					
Eval Kit License	30-day full function. Upgradeable	32KB address-limited. Upgradeable	32KB address-limited. Upgradeable	90-day full function. Upgradeable	Full function. Onboard emulation limited
Compiler	GNU C/C++	IAR C/C++	RealView C/C++	GNU C/C++	TI C/C++
Debugger / IDE	gdb / Eclipse	C-SPY / Embedded Workbench	µVision	code_probe / Eclipse-based tool suite	CCS/Eclipse-based suite
Full Upgrade	199 USD personal edition / 3000 USD full support	2700 USD	MDK-Basic (256 KB) = €000 (2895 USD)	999 USD (upgrade to run on customer platform)	495 USD
JTAG Debugger		J-Link, ~299 USD	U-Link, ~199 USD	Red Probe, 150 USD	XDS510 / XDS560

Partners ...

## Stellaris Partners

## Stellaris Partners in Excellence

Product	Third Party	Description
Compiler / Debugger	Code Red	Red Suite (GNU C/C++ Compiler, code_probe / Eclipse Debugger / IDE)
	CodeSourcery	CodeSourcery G++ (C/C++ Compiler), GDB / Eclipse Debugger / IDE
	IAR	IAR C/C++ Compiler, C-SPY / Embedded Workbench Debugger / IDE
	Keil	RealView C/C++ Compiler, µVision Debugger / IDE
	Rowley	CrossWorks for ARM (C/C++ Compiler, CrossStudio Debugger / IDE)
RTOS	CMX	CMX-RTX™ RTOS offering small footprint, fast context switch times
	ExpressLogic	ThreadX advanced RTOS designed specifically for deeply embedded applications
	FreeRTOS.org	FreeRTOS.org™ Open-Source mini real-time kernel
	IAR	PowerPac™ fully featured RTOS combined with a high performance file system
	Keil	RTX flexible royalty-free RTOS with source code
	Micrium	Portable, scalable, preemptive real-time, multitasking kernel (RTOS)
	Quadrus	RTXC for embedded applications
	RoweBots	Unison Ultra Tiny Embedded Linux and POSIX Compatible RTOS
	SCIOPTA	SCIOPTA real-time operating system for safety-critical applications
	SEGGER	embOS RTOS for embedded applications designed
Stacks / Specialty	CMX	CMX-USB Device, CMX-CANopen™, CMX MicroNet, and TCP/IP protocol stacks
	eLua	Embedded Lua Programming Language for Stellaris
	ExpressLogic	NetX™ TCP/IP and USBX™ supporting USB Host and Device
	Interneche	NicheLite and ARM Network Evaluation Kits
	Micrium	µC/USB Device, µC/USB Host, µC/TCP-IP, µC/Modbus, µC/CAN protocol stacks
	MicroDigital	smxUSB Device, smxUSB Host, and smxUSB On-The-Go (OTG) Stacks
	port GmbH	CANopen Library for Stellaris Microcontrollers
	Quadrus	RTXCusb Host and Device stacks, CANopenRT CAN stack, and QuadNet TCP/IP
	RTA Automation	RTA Automation DeviceNet™ protocol stacks
	SEGGER	embOS/IP TCP/IP and emUSB Device Stack
	SEVENSTAX	SEVENSTAX TCP/IP-Stack and Embedded Web Server



Stellarisware ...

## StellarisWare

# StellarisWare®

**License-free and Royalty-free source code for TI Cortex-M3 devices:**

- Peripheral Driver Library
- Graphics Library
- USB Library
- Boot Loader
- IEC 60730 Library
- Flash Programming
- On-Chip ROM Enhancements

On-line ...

## Available On-Line

# StellarisWare®

## Available On-Line

The screenshot shows the StellarisWare website interface. The main navigation bar includes links for Products, Applications, Design Support, and Sample & Buy. The 'StellarisWare & Code Examples' link is circled in red. Below the navigation bar, the 'Microcontrollers (MCU)' section is visible, with a 'Stellaris ARM Cortex-M3-based MCUs' link also circled in red. The 'Complete Listing of StellarisWare Software' section is shown, with a 'StellarisWare Software' link circled in red. The 'StellarisWare Complete (all boards, all components)' status is shown as 'ACTIVE'.

Driver Lib ...

## Peripheral Driver Library

### 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, CCS and GNU tools
- ◆ Peripheral driver library functions are preprogrammed in ROM on select Stellaris MCUs



GrLib ...

## Graphics Library

### StellarisWare® Graphics Library

- ◆ Set of graphics primitives and widgets for use on Stellaris MCUs.
- ◆ Three subsequent layers of functionality:
  - Display Driver Layer
  - Graphics Primitives Layer
  - Widget Layer
- ◆ Each API in each layer is directly callable
- ◆ Written entirely in C (except where not possible), self-contained, easy-to-understand, efficient.
- ◆ Compiles on ARM/Keil, IAR, Code Red, CCS and GNU tools.
- ◆ Computations that can be performed at compile time whenever possible.
- ◆ Graphics Primitives:
  - Point, Line, Rectangle, Circle, Font, Image, Context, Buffer
  - 134 Computer Modern predefined fonts available
  - Up to 24-bit color (~150 common colors conveniently referenced in GraphicsLib)
- ◆ Widgets:
  - Canvas, Checkbox, Container, Push Button, Radio Button, Slider, ListBox
- ◆ Special Utilities
  - *frasterize*: render your own font to be recognized by GraphicsLib
  - *lmi-button*: predefined button shape with shadow and 3-D
  - *pnmto*: Convert a NetPBM image file into a format recognized by GraphicsLib



USLib ...

## USB Library

### StellarisWare® USB Library Stacks and Examples

◆ **USB-IF Compliance**

- Stellaris has passed USB Device and Embedded Host compliance testing

◆ **Device Examples:**

- HID Keyboard
- HID Mouse
- CDC Serial
- Generic Bulk
- Audio class
- 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**

VID Request for embedded USB products

**FREE**  
Vendor ID/  
Product  
ID  
sharing  
program

IEC60730 ...

## IEC 60730

### StellarisWare® Safe At Home With IEC 60730

**IEC** 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
<b>StellarisWare™ Software</b>	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.
<b>Stellaris® Hardware</b>	Clock/Interrupt Test	Performs GPIO input/output plausibility test.
	Nested Vector Interrupt Controller	Performs tests to check the clock frequency, interrupt handling, and execution.
	Automotive-grade Flash Memory	Deterministic, fast interrupt processing for execution certainty.
	Cyclical Redundancy Check in ROM	High reliability non-volatile memory for robust environments.
	2 Watchdog Timers	Especially useful in verifying the contents of memory in a Stellaris microcontroller.
	Precision Oscillator	Clocked with precision oscillator, a second WDT takes advantage of the non-maskable interrupt (NMI) handler safety feature of the ARM Cortex-M3 processor.
	Advanced Motion Control with Multiple Fault Conditioning Inputs	Supplies an accurate, independent time base when periodic safety tests are executed.
	Quadrature Encoder Inputs	Provides quick motor shutdown in low latency situations.
	Integrated Analog Comparators	Provides precise, closed loop control of motors.
	Internal Temperature Sensor	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.
	10/100 Ethernet MAC/PHY with IEEE 1588 PTP	Eliminates the performance-wasting requirement of constant CPU polling.
	Controller Area Network (CAN) 2.0 MACs	Used to monitor and shut down an appliance if the appliance overheats.

**Note:** Watchdog timers are completely independent hardware timers In System Programming ...

1 - 18

Stellaris One Day Workshop

## In System Programming

### 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
- ◆ TI supplies 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), I<sup>2</sup>C, SSI, Ethernet, USB
- ◆ Included in the Stellaris Peripheral Driver Library with full applications examples
- ◆ Preloaded in ROM on select Stellaris Microcontrollers

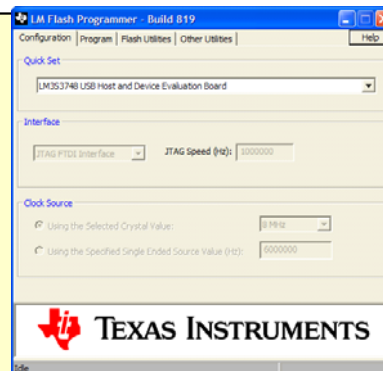
Flash GUI ...

## Flash Programming GUI

### StellarisWare® 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 online
  - <http://focus.ti.com/mcu/docs/mcuorphan.tsp?contentId=87903>



ROM ...

## ROM Enhancements


### StellarisWare® 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

**Other flash memory-saving options**

- ◆ Advanced Encryption Standard (AES) cryptographic tables
  - Supported by the current AES example application
  - 128, 192 and 256-bits
- ◆ Cyclic Redundancy Check (CRC) functionality – for error detection



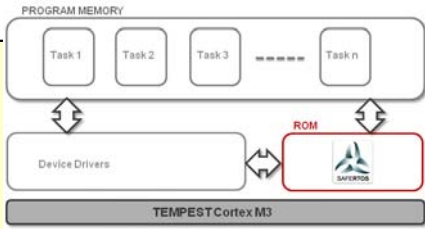
Stored in ROM on select Stellaris MCUs

SAFERTOS ...

## SAFERTOS

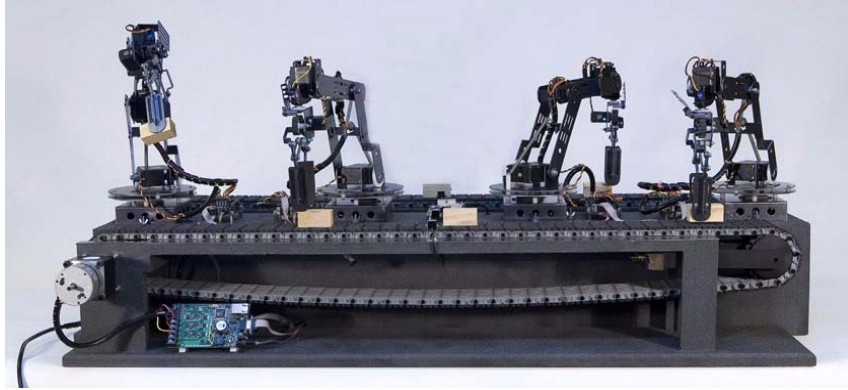
### SAFERTOS Included On The LM3S9B96

- ◆ 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



# Product Demonstrations

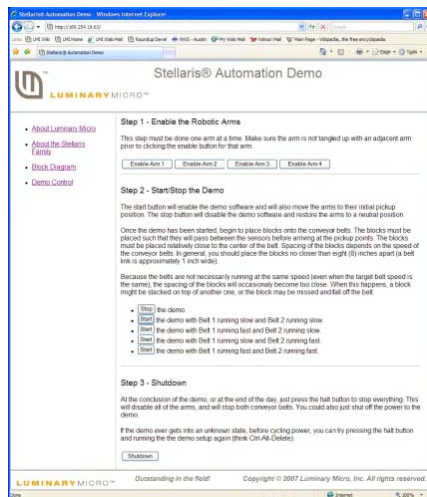
## Stellaris CAN/Ethernet Automation Demo



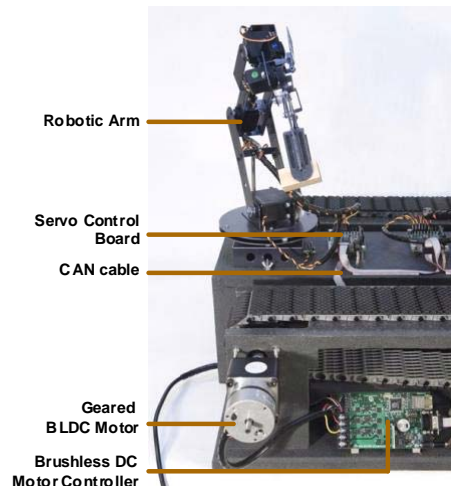
<http://www.youtube.com/watch?v=RyeUMx5cwSM>

## CAN/Ethernet Demo

## Stellaris CAN/Ethernet Automation Demo



Web Browser Console for Automation System Demo



<http://www.youtube.com/watch?v=RyeUMx5cwSM> CNC Demo ...



## CNC Machine Demo

### Stellaris 3-axis CNC Machine (AN01246)



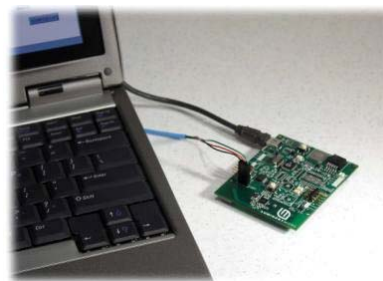
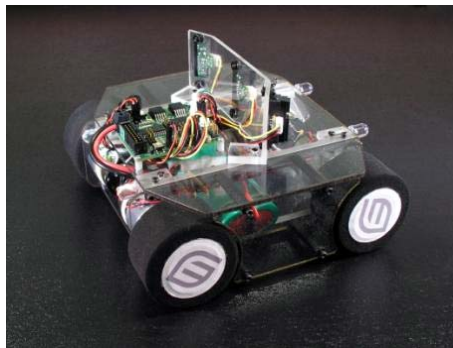
- ◆ **LM3S615 controls all three axes of stepper motion**
  - 6 advanced motion-control PWMs
  - Current sensing
  - Six limit switches
  - Active Indicator
  - Driver for tool control signals
  - Connectivity
  - CNC = Computer Numerical Control
- ◆ **LM3S316 controls QVGA LCD Touch Panel**

<http://www.youtube.com/watch?v=W8FpEJ5ZIY>

Car Demo ...

## Autonomous Car

### Stellaris Autonomous Car (AN01245)



- ◆ **Robot Uses one LM3S316 Stellaris MCU**
  - Four advanced motion-control PWMs drive four brushed motors
  - Four ADC channels for three infrared sensors and a bridge current monitor
  - Analog Comparator for photocell "nighttime" sensor
  - GPIOs for LED headlights
  - SPI for connection to 802.15.4 radio connection


<http://www.youtube.com/watch?v=M-7C7TIYJ8I>


FIRST ...



## FIRST Robotics

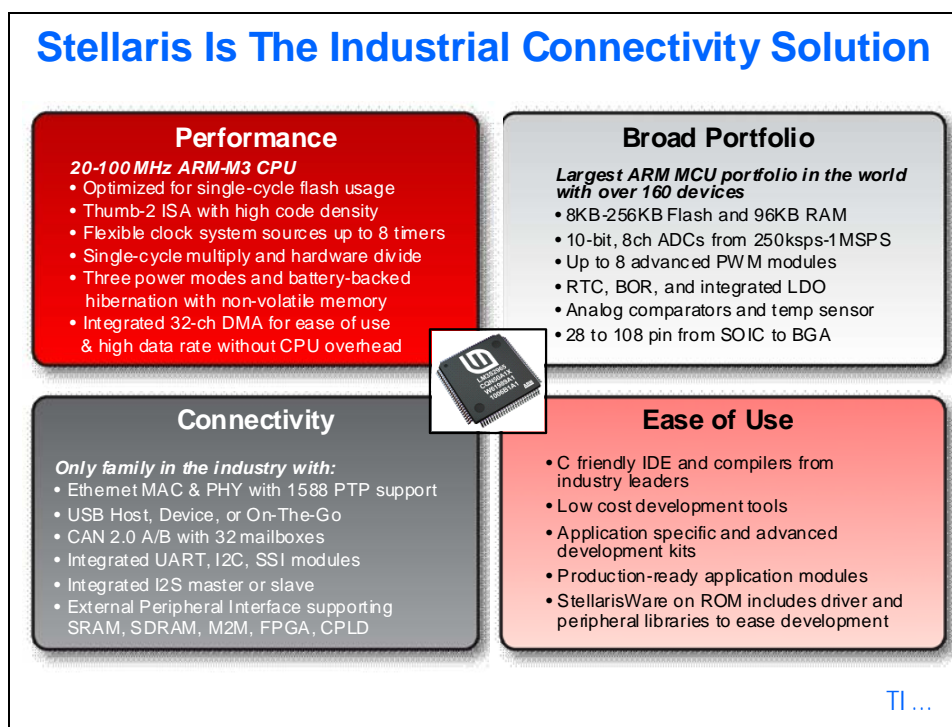
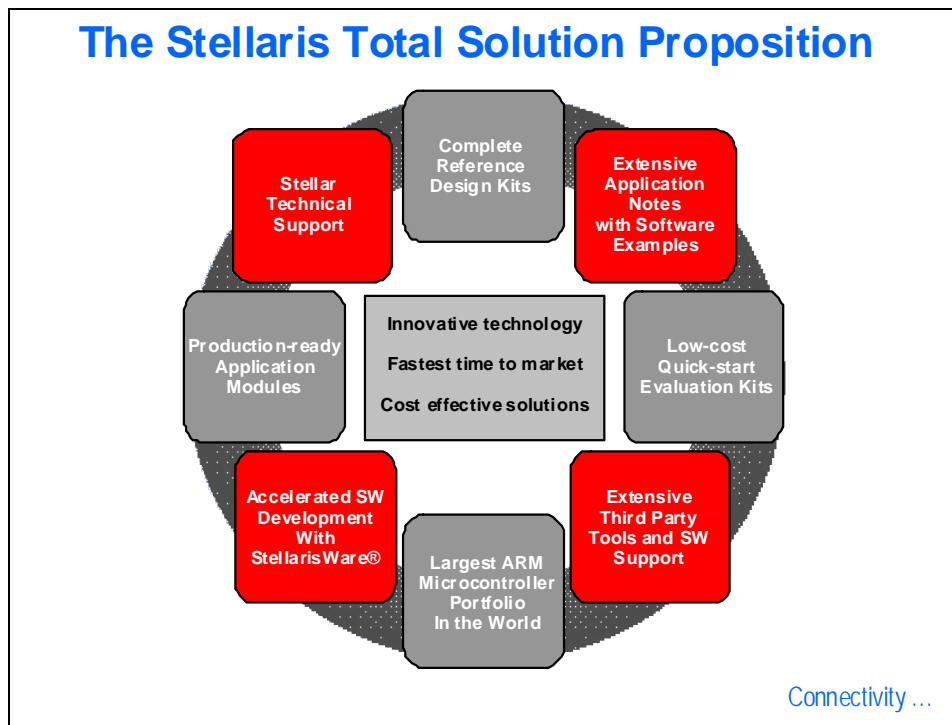
### FIRST Robotics Competition





- ◆ **FRC** is a worldwide robotics competition for high school students.
- ◆ FRC 2009 featured 1700 international teams.
- ◆ Stellaris MDL-BDC “Jaguar” selected as the Official Supplier of the speed controller in the FRC 2009 Kit-of-Parts delivered to each FRC 2009 team.

## Summary



## Introduction

Thanks for attending the workshop. Make sure to take all your belongings and handouts with you. Good luck with your project!

### Don't Forget!

- ◆ Take your workbook and purchased board(s) home with you
- ◆ Please leave the installation flash drives on the table
- ◆ Fill out the evaluation form on line if possible:  
[www.tiworkshop.com](http://www.tiworkshop.com) and click Online feedback form  
(use paper forms otherwise)
- ◆ Visit the TI Wiki for this workshop:  
[http://wiki.davincidsp.com/index.php/Stellaris\\_One\\_Day\\_Workshop](http://wiki.davincidsp.com/index.php/Stellaris_One_Day_Workshop)

*Thank you for attending*

*Have a safe trip home*

2

