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## Get to Work in 10 Minutes



### Introduction

*Complete Kits, Popular Software, and Meaningful Examples Speed the Evaluation and Development of Stellaris 32-bit Microcontrollers for Real Applications*

When developing a new systems design, evaluating and choosing the proper microcontroller (MCU) is a critical step. An evaluation kit needs to demonstrate how capable the MCU is at performing the tasks of the end application. Many evaluation kits available today can present frustrations to systems designers because of their time-consuming set-up and their lack of tools to assess the MCU being evaluated. With the Stellaris® MCU evaluation kits, however, ten minutes is all that is needed to begin running relevant programs, exercising peripherals, and customizing code for unique operations. Most boards are operational before they are even plugged into a PC.

Texas Instruments offers three levels of evaluation kits for its ARM® Cortex™-M3-based, 32-bit Stellaris microcontrollers, demonstrating increasingly advanced capabilities. All are designed to set up easily and utilize well-known development tools, while providing complete hardware and an operational set of programs appropriate for typical applications.

Evaluation kits for other microcontrollers might only bring up the MCU to a functional state but leave the user to figure out how to do anything meaningful with it: interface to a memory card, drive a display, manage the serial ports, service the network, connect to the analog inputs, or set up the pulse-width modulators (PWM). Without providing pertinent programs that exercise key

peripherals on the chip for critical pieces of the application, the user would be stuck grinding through data sheets and instruction manuals for hours trying to piece together bits of code to make the most basic operation work. With a Stellaris Evaluation Kit (EK), Development Kit (DK), or Reference Design Kit (RDK) in hand, the user can be exercising the MCU by using well-documented code provided in the kit, modifying it to fit a user's particular application, and really getting a feel for the capabilities of the chip and the actual development tools that can be used to build the ultimate application.

#### **Evaluation Kits (EKs)**

Evaluate all the features of a microcontroller with one tool set

#### **Development Kits (DKs)**

Check out the variety of tools available for developing software for a series of microcontrollers

#### **Reference Design Kits (RDKs)**

Guides and functional examples of major subsystems

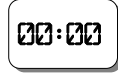
**A Complete Kit —  
No Further  
Accessories  
Needed**

Within 10 minutes of opening a Stellaris evaluation kit, the user can get to work studying, running, and modifying hardware and programs, and be on the way to understanding how the product will fit the desired end-application.

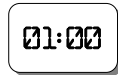
**Sample Kit Contents**

- Evaluation Board (EVB)
- In-Circuit Debug Interface Board (ICDI)
- Cables
- Evaluation Kit CD containing:
  - Evaluation version of the software tools
  - Complete documentation
  - Quickstart guide and source code
  - StellarisWare® software including peripheral driver library and example source code

**Full  
Functionality  
Ready-to-Go—  
Examples on  
Board**

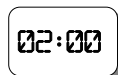


The first action to take when opening a Stellaris evaluation kit may be to power on the personal computer (PC) or laptop. Depending on the corporate software image and virus scan settings, it may take longer to boot up the PC and let it settle down for the day than to get the evaluation board ready to run.



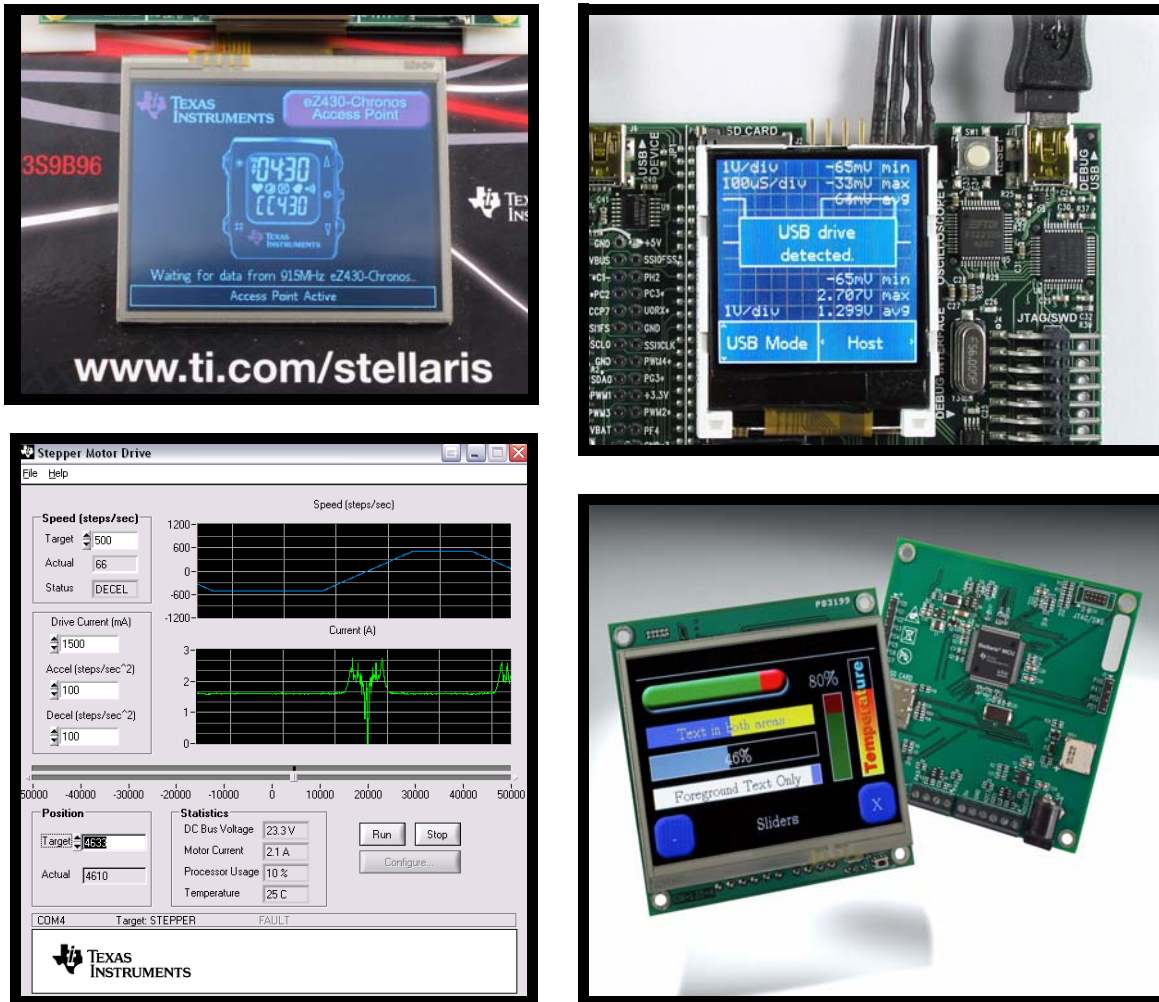
Open the evaluation kit box, take the board out of the antistatic sleeve, and place it on the desk. A USB cable in the box connects the board to a PC and in many cases provides all the power needed for the small board. Some kits include an AC/DC power supply to provide more current to the board or auxiliary equipment such as motors. The boards that utilize Ethernet to communicate with the computer, serial channels to communicate with a host, or CAN (controller area network) to link between boards come with Ethernet, DB-9, and CAN ribbon cables with proper connectors included in the kit. The kits that demonstrate USB host, device, and on-the-go (OTG) applications even include a USB Flash drive, and kits that with an SD card interface that includes a MicroSD Flash card.

Some kits include additional cables to connect between headers for debug operations. The more advanced Reference Design Kits might include a typical motor in the box, such as a stepper or an AC induction motor, so these kits include wires to carry both the power and the control signals to the motors, all marked for proper connection. The kit designed to demonstrate CAN operability has a second CAN-connected device board included so that a slave device is available for testing. A Quickstart guide clearly illustrates the necessary connections.

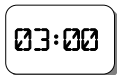


Once powered up, most Stellaris® kits are self-sufficient and can start demonstrating their abilities immediately. On-board OLED displays, LEDs, navigation controls, and pushbuttons let the user begin exercising the microcontroller in a meaningful manner right away. Simpler evaluation kits present a game to play or can operate as an oscilloscope, while more sophisticated reference designs demonstrate the ramping, running, stability, and braking of stepper motors or the electronic unlocking of a device using a secure-entry touchpad. The Quickstart guide leads the user through some simple instructions for playing games, setting up the oscilloscope, running the display, changing security codes, configuring the network, and controlling motors. The activities possible on the board at this stage are impressive, especially considering a PC is not even behind them—yet.

Connecting a PC to the kits and installing the included software really opens unlimited possibilities to explore the capabilities of the MCUs and modify programs to meet the needs of any target application.

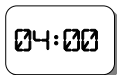


**Figure 1.** You can be here in ten minutes or less. Clockwise from top left: LCD display on LM3S9B96 Development Board with Stellaris Expansion Board wireless interface, LM3S3748 USB Host/Device Evaluation Kit display, LM3S1958 IDM L35 Display, and LM3S818 Stepper Motor Drive GUI.



Each kit comes with a CD containing a variety of useful software and documentation. Many boards have drivers for the PC over the USB connection and can support sophisticated software control interfaces permitting more thorough setup and operation of the boards and their given applications. Additional application software packages are included with the kits or readily available. The networking kits include TCP/IP, CAN and USB stacks and interfaces. Web servers are utilized and available.

## **StellarisWare® — Invaluable Programs that Work**



Extremely useful programs on the CD are found in the StellarisWare® software package which includes libraries for peripheral drivers, graphics, and USB, plus example application code designed specifically for Texas Instruments' ARM® Cortex™-M3-based microcontrollers. Source code with detailed comments is provided for all of the programs. These examples give programmers a solid starting point from which to refine the operation of their application.

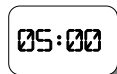
The drivers aren't a bulky configuration system but rather the annotated code in C or C++ that a programmer can modify to fit his or her system particulars, recompile, and include in the final application program. 90%+ of the work may come from proven StellarisWare code, greatly reducing the debug needed to get the user's system fully operational. Application Programming Interfaces (APIs) are provided for functions ranging from pulse-width modulation and Ethernet support to diagnostics and drawing a line on a display screen. These code stubs and routines are available at no additional cost and are royalty-free when used on Stellaris MCUs.

A sampling of APIs, drivers, functions, and programs available - within ten minutes:

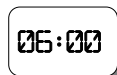
- |                     |                       |                                       |
|---------------------|-----------------------|---------------------------------------|
| • A-to-D Conversion | • IEEE-1588 Precision | • Pulse Width Modulation              |
| • ADCPM Decode      | • Time Protocol (PTP) | • MicroSD Card Manager                |
| • Audio Playback    | • GPIO/JTAG switch    | • Maze Game                           |
| • Bitbanding        | • Graphics Drawing    | • Screensaver                         |
| • Boot Loader       | • Hibernation         | • Serial, I <sup>2</sup> C, SSI, UART |
| • CAN Device        | • Image Draw          | • Timers                              |
| • Date/Time         | • Interrupt Handler   | • TCP/IP                              |
| • Diagnostics/Test  | • JTAG Interfaces     | • USB Host, Device, OTG               |
| • Ethernet          | • LCD/LED Drivers     | • Watchdog Timer                      |
| • FLASH Management  | • Memory Protection   | • Web Server                          |
| • FLASH Loader      | • Printf              |                                       |

## Modify Programs with Real IDE Tools

*Working with development tools is where the true advantage of a ubiquitous 32-bit architecture emerges.*



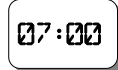
The motion control Reference Design Kits include a National Instruments LabWindows-based graphical control interface in a run time engine that operates on the PC. The kit implements sophisticated electric motor control algorithms which the user can manipulate through the graphical control interface, monitoring and changing sensor and motor control operations. Different algorithms and techniques can be evaluated with just a few keystrokes, although it is prudent to have a good understanding of the limits of the motor to prevent inadvertent damage.



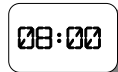
Once the evaluation board is up and running and the power of the Stellaris MCU within is obvious, the next step is just as simple. Each Evaluation Kit comes with an evaluation copy of a selected development tool set, while the more robust Development Kits offer more freedom with evaluation copies of all the tool sets for just a few dollars more. The most popular Integrated Development Environment (IDE) tools are available, like ARM's Keil™ RealView® Microcontroller Development Toolkit, CodeSourcery's GNU compiler, IAR Systems' Embedded Workbench®, CodeRed Technology's tool suite, and Texas Instruments' Code Composer Studio™, providing editors, compilers, debuggers, simulators, tracers and profilers.

It is working with the development tools where the true advantage of a ubiquitous 32-bit architecture over an 8-bit, 16-bit, or even proprietary 32-bit architecture emerges. Working with professional tools on an able RISC processor makes it so easy to write and edit code that the shackles of assembly language and cramped architectures are quickly forgotten, and the programmer's focus can return to the end application.

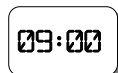
## **Borrow and Expand**



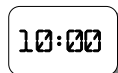
Small kernels and real-time operating systems (RTOS) are included in some kits, reside on the board, or are available for download. Many are provided with source code and are royalty-free. The rest can be quickly evaluated and ultimately used as a solid foundation for the target application.



It's not just about software, of course. The evaluation and development boards are well-equipped with appropriate hardware and designed for further hardware enhancement as well. Along with the hardware drivers and displays for the LCD and LED screens that exist on most evaluation boards, the more sophisticated reference designs include opto-isolators, drive circuits, power transistors, dynamic braking, and power switching circuits to accommodate the harsh world of electric motors. These are detailed in schematics, bills-of-materials (BOM), and Gerber files while application notes aid the designer in his or her own system design.



Most boards contain numerous forms of hardware interfaces, from pushbuttons, joysticks, potentiometers, microphone inputs, magnetic speakers, piezoelectric buzzers, LEDs, and screens, to generic analog and digital inputs and outputs. All of the I/O signals of the Stellaris MCUs are brought to clearly-labeled break-out pads on the boards. Headers and PHYs are supplied for serial and network (CAN, Ethernet, and USB) ports and JTAG or single-wire debug connectors. The Development Kits support daughter boards for additional Stellaris MCU family members, as well as demonstrating additional device capabilities. Many of the boards are so complete they are available as modules for purchase in bulk to be used in end-equipment.



The CD in the kits also includes appropriate documentation such as data sheets, users manuals, selection guides, and ARM® Cortex™ reference manuals. These are provided for the MCU and other significant components on the board. Numerous application notes are provided on general topics, such as pin multiplexing, analog-to-digital converter use, Flash programming, code optimization, and upgrading from other architectures, as well as more targeted issues such as networking, serial communications, motor control, and USB certification.

## **How Easy Was That?**

The Stellaris microcontroller evaluation, development, and reference design kits are designed to demonstrate the rich capabilities of the 32-bit ARM® Cortex-M3-based processors with all their powerful peripheral complement. Yet a person can open the box and be fully exercising the MCU in a real application in less time than it takes to read this short paper.

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