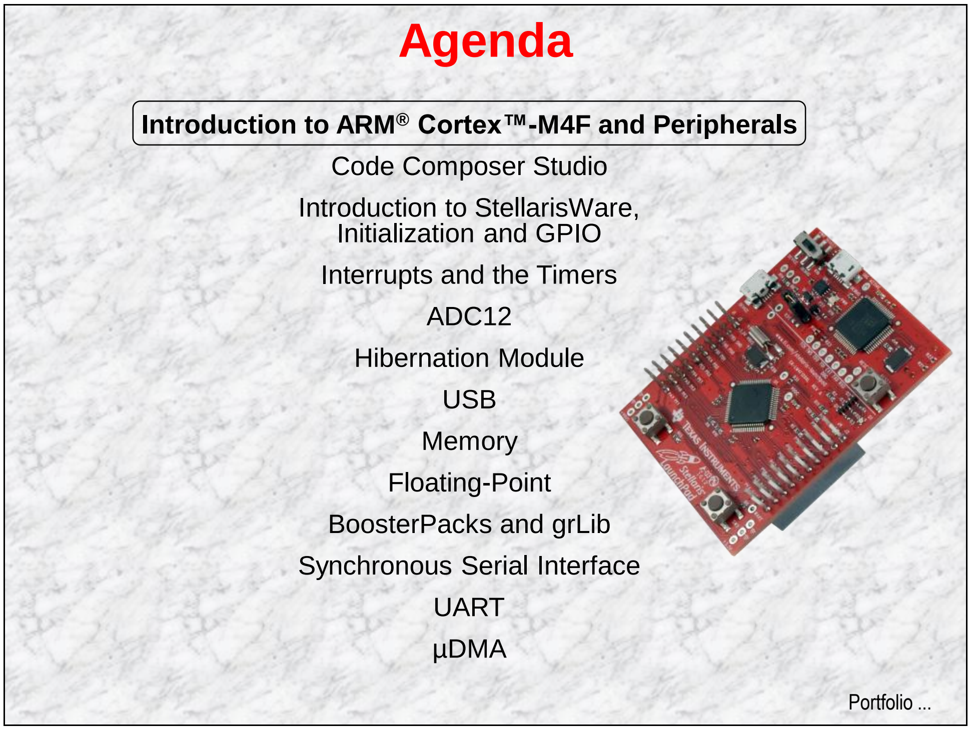
Introduction

This chapter will introduce you to the basics of the Cortex-M4F and the Stellaris peripherals. The lab will step you through setting up the hardware and software required for the rest of the workshop.



Agenda

Introduction to ARM® Cortex™-M4F and Peripherals

Code Composer Studio

Introduction to StellarisWare,
Initialization and GPIO

Interrupts and the Timers

ADC12

Hibernation Module

USB

Memory

Floating-Point

BoosterPacks and grLib

Synchronous Serial Interface

UART

µDMA

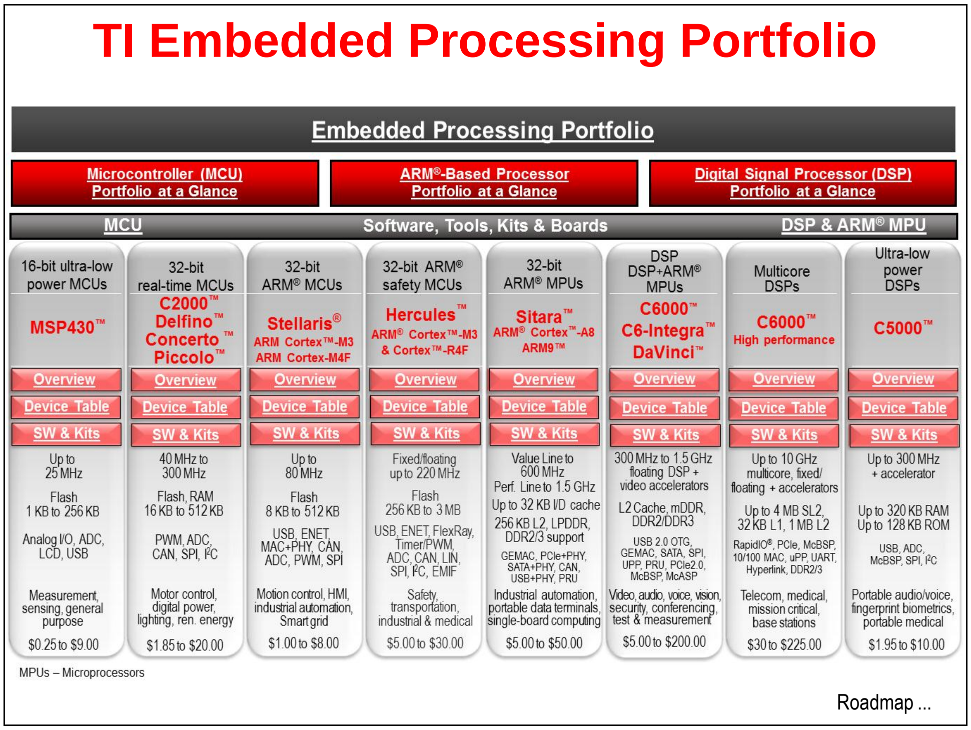
Portfolio ...

The Wiki page for this workshop is located here:

www.ti.com/StellarisLaunchPadWorkshop

Chapter Topics

TI Processor Portfolio and Stellaris Roadmap



TI Embedded Processing Portfolio

Embedded Processing Portfolio

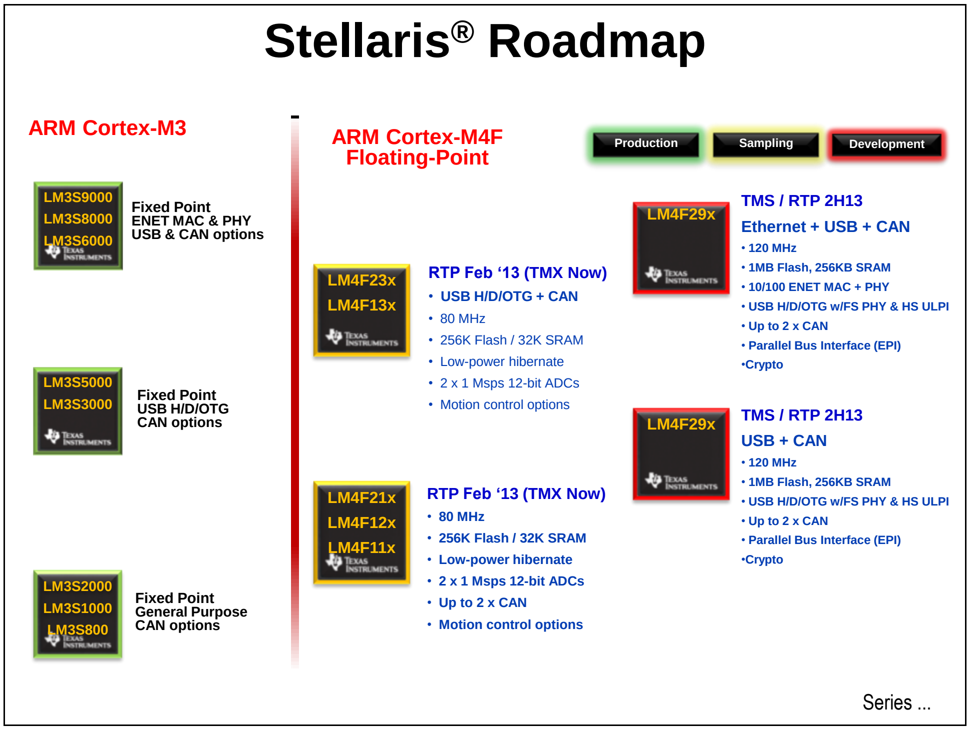
Microcontroller (MCU) Portfolio at a Glance | ARM®-Based Processor Portfolio at a Glance | Digital Signal Processor (DSP) Portfolio at a Glance

MCU | Software, Tools, Kits & Boards | DSP & ARM® MPU

16-bit ultra-low power MCUs	32-bit real-time MCUs	32-bit ARM® MCUs	32-bit ARM® safety MCUs	32-bit ARM® MPUs	DSP DSP+ARM® MPUs	Multicore DSPs	Ultra-low power DSPs
MSP430™	C2000™ Delfino™ Concerto ™ Piccolo™	Stellaris® ARM Cortex™-M3 ARM Cortex-M4F	Hercules™ ARM® Cortex™-M3 & Cortex™-R4F	Sitara™ ARM® Cortex™-A8 ARM9™	C6000™ C6-Integra™ DaVinci™	C6000™ High performance	C5000™
Overview	Overview	Overview	Overview	Overview	Overview	Overview	Overview
Device Table	Device Table	Device Table	Device Table	Device Table	Device Table	Device Table	Device Table
SW & Kits	SW & Kits	SW & Kits	SW & Kits	SW & Kits	SW & Kits	SW & Kits	SW & Kits
Up to 25 MHz	40 MHz to 300 MHz	Up to 80 MHz	Fixed/floating up to 220 MHz	Value Line to 600 MHz Perf. Line to 1.5 GHz	300 MHz to 1.5 GHz floating DSP + video accelerators	Up to 10 GHz multicore, fixed/ floating + accelerators	Up to 300 MHz + accelerator
Flash 1 KB to 256 KB	Flash, RAM 16 KB to 512 KB	Flash 8 KB to 512 KB	Flash 256 KB to 3 MB	Up to 32 KB I/D cache 256 KB L2, LPDDR, DDR2/3 support	L2 Cache, mDDR, DDR2/DDR3	Up to 4 MB SL2, 32 KB L1, 1 MB L2	Up to 320 KB RAM Up to 128 KB ROM
Analog I/O, ADC, LCD, USB	PWM, ADC, CAN, SPI, I²C	USB, ENET, MAC+PHY, CAN, ADC, PWM, SPI	USB, ENET, FlexRay, Timer/PWM, ADC, CAN, LIN, SPI, I²C, EMIF	GEMAC, PCIe+PHY, SATA+PHY, CAN, USB+PHY, PRU	USB 2.0 OTG, GEMAC, SATA, SPI, UPP, PRU, PCIe2.0, McBSP, McASP	RapidIO®, PCIe, McBSP, 10/100 MAC, uPP, UART, Hyperlink, DDR2/3	USB, ADC, McBSP, SPI, I²C
Measurement, sensing, general purpose	Motor control, digital power, lighting, ren. energy	Motion control, HMI, industrial automation, Smart grid	Safety, transportation, industrial & medical	Industrial automation, portable data terminals, single-board computing	Video, audio, voice, vision, security, conferencing, test & measurement	Telecom, medical, mission critical, base stations	Portable audio/voice, fingerprint biometrics, portable medical
$0.25 to $9.00	$1.85 to $20.00	$1.00 to $8.00	$5.00 to $30.00	$5.00 to $50.00	$5.00 to $200.00	$30 to $225.00	$1.95 to $10.00

MPUs – Microprocessors

Roadmap ...



Stellaris® Roadmap

ARM Cortex-M3

LM3S9000
LM3S8000
LM3S6000

Fixed Point
ENET MAC & PHY
USB & CAN options

LM3S5000
LM3S3000

Fixed Point
USB H/D/OTG
CAN options

LM3S2000
LM3S1000
LM3S800

Fixed Point
General Purpose
CAN options

ARM Cortex-M4F Floating-Point

LM4F23x
LM4F13x

RTP Feb '13 (TMX Now)
- USB H/D/OTG + CAN
- 80 MHz
- 256K Flash / 32K SRAM
- Low-power hibernate
- 2 x 1 Msps 12-bit ADCs
- Motion control options

LM4F21x
LM4F12x
LM4F11x

RTP Feb '13 (TMX Now)
- 80 MHz
- 256K Flash / 32K SRAM
- Low-power hibernate
- 2 x 1 Msps 12-bit ADCs
- Up to 2 x CAN
- Motion control options

LM4F29x

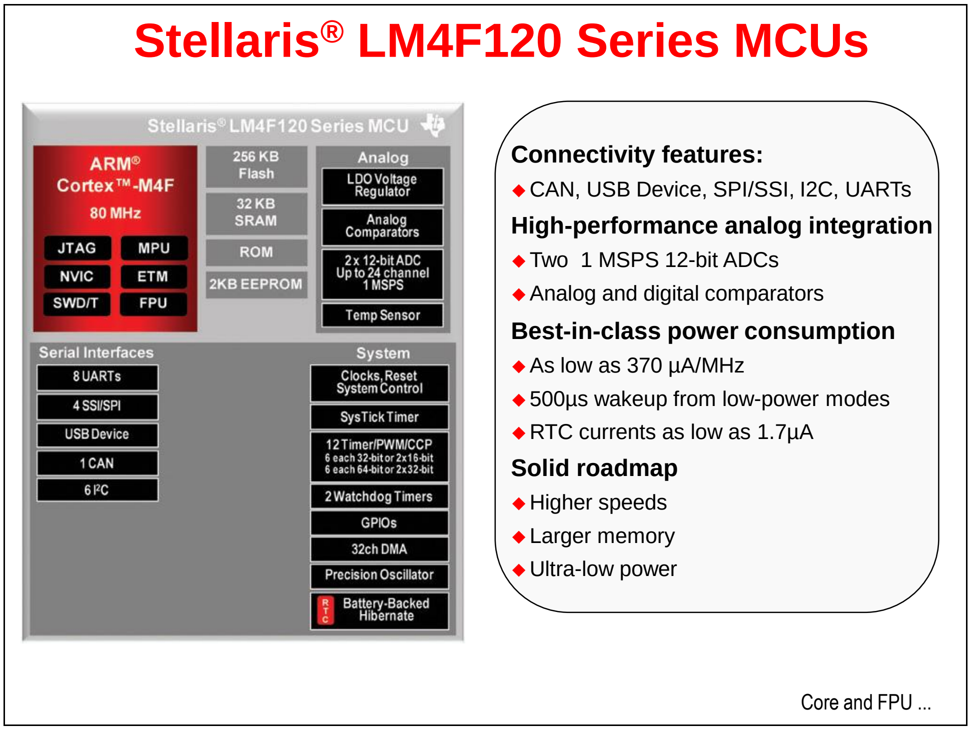
TMS / RTP 2H13
Ethernet + USB + CAN
- 120 MHz
- 1MB Flash, 256KB SRAM
- 10/100 ENET MAC + PHY
- USB H/D/OTG w/FS PHY & HS ULPI
- Up to 2 x CAN
- Parallel Bus Interface (EPI)
- Crypto

LM4F29x

TMS / RTP 2H13
USB + CAN
- 120 MHz
- 1MB Flash, 256KB SRAM
- USB H/D/OTG w/FS PHY & HS ULPI
- Up to 2 x CAN
- Parallel Bus Interface (EPI)
- Crypto

Series ...

Stellaris LM4F120 Series Overview



Stellaris® LM4F120 Series MCUs

Stellaris® LM4F120 Series MCU

ARM®
Cortex™-M4F
80 MHz

JTAG
MPU
NVIC
ETM
SWD/T
FPU

256 KB Flash

32 KB SRAM

ROM

2KB EEPROM

Analog

LDO Voltage Regulator

Analog Comparators

2x 12-bit ADC
Up to 24 channel
1 MSPS

Temp Sensor

Serial Interfaces

8 UARTs

4 SSI/SPI

USB Device

1 CAN

6 I²C

System

Clocks, Reset
System Control

SysTick Timer

12 Timer/PWM/CCP
6 each 32-bit or 2x16-bit
6 each 64-bit or 2x32-bit

2 Watchdog Timers

GPIOs

32ch DMA

Precision Oscillator

RTC Battery-Backed Hibernate

Connectivity features:

- CAN, USB Device, SPI/SSI, I2C, UARTs

High-performance analog integration

- Two 1 MSPS 12-bit ADCs
- Analog and digital comparators

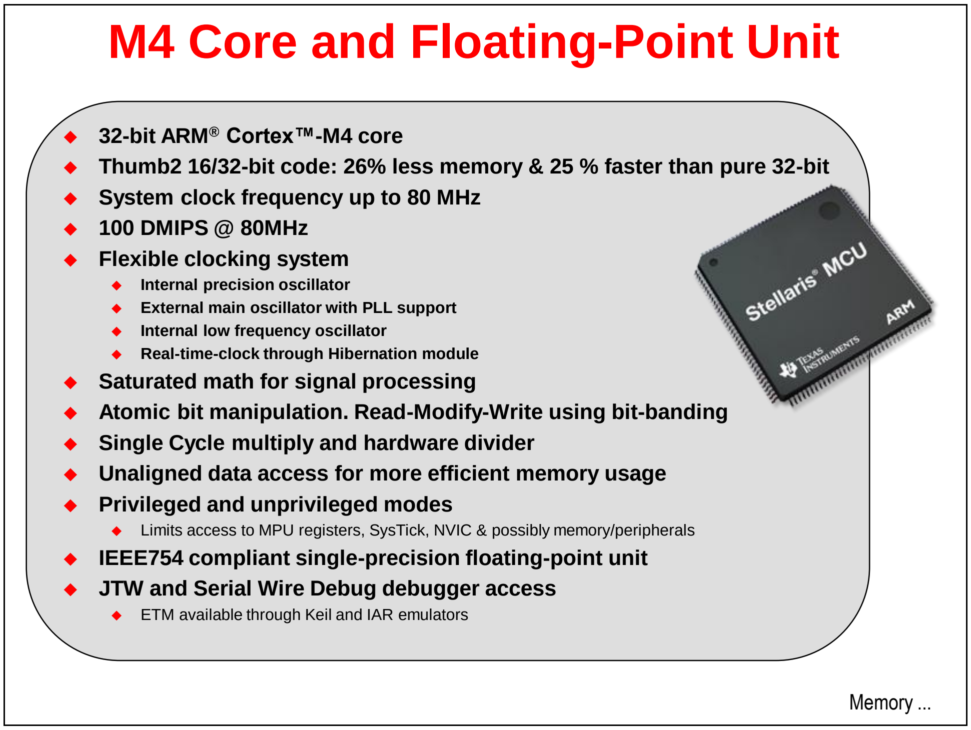
Best-in-class power consumption

- As low as 370 µA/MHz
- 500µs wakeup from low-power modes
- RTC currents as low as 1.7µA

Solid roadmap

- Higher speeds
- Larger memory
- Ultra-low power

Core and FPU ...

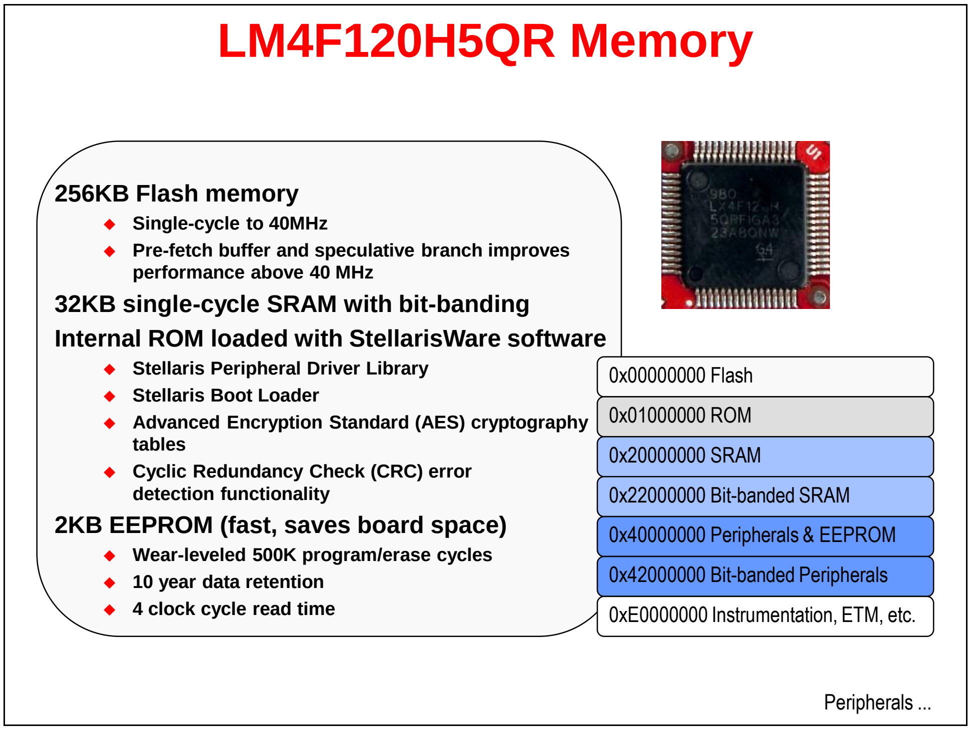


M4 Core and Floating-Point Unit

- **32-bit ARM® Cortex™-M4 core**
- **Thumb2 16/32-bit code: 26% less memory & 25 % faster than pure 32-bit**
- **System clock frequency up to 80 MHz**
- **100 DMIPS @ 80MHz**
- **Flexible clocking system**
  - **Internal precision oscillator**
  - **External main oscillator with PLL support**
  - **Internal low frequency oscillator**
  - **Real-time-clock through Hibernation module**
- **Saturated math for signal processing**
- **Atomic bit manipulation. Read-Modify-Write using bit-banding**
- **Single Cycle multiply and hardware divider**
- **Unaligned data access for more efficient memory usage**
- **Privileged and unprivileged modes**
  - Limits access to MPU registers, SysTick, NVIC & possibly memory/peripherals
- **IEEE754 compliant single-precision floating-point unit**
- **JTW and Serial Wire Debug debugger access**
  - ETM available through Keil and IAR emulators

Memory ...

LM4F120H5QR Specifics



LM4F120H5QR Memory

256KB Flash memory

- Single-cycle to 40MHz
- Pre-fetch buffer and speculative branch improves performance above 40 MHz

32KB single-cycle SRAM with bit-banding

Internal ROM loaded with StellarisWare software

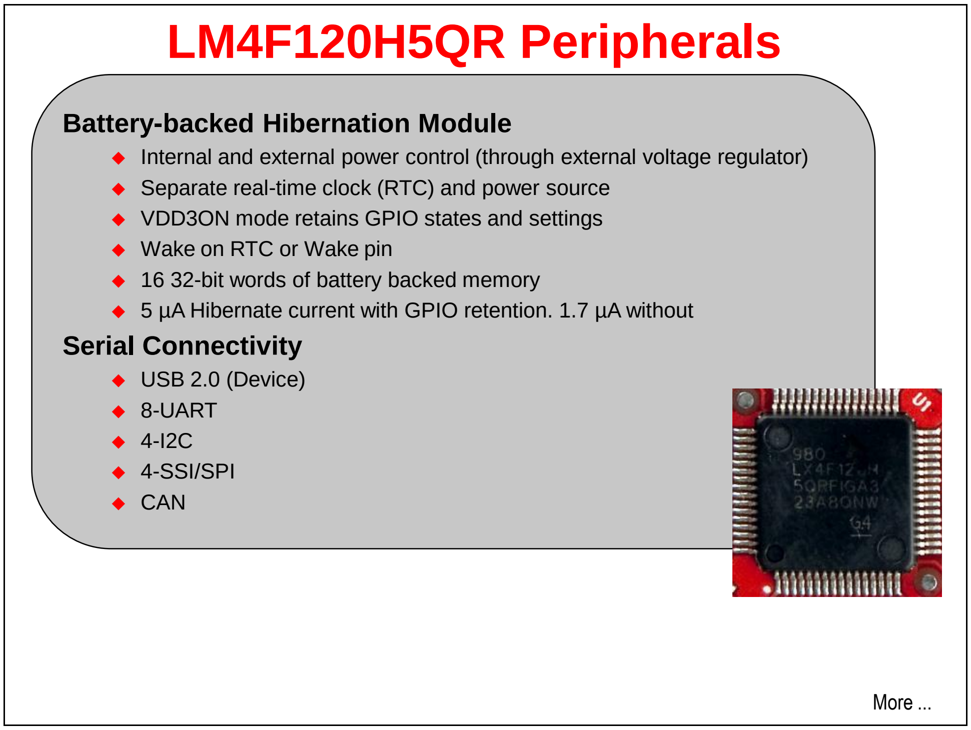
- Stellaris Peripheral Driver Library
- Stellaris Boot Loader
- Advanced Encryption Standard (AES) cryptography tables
- Cyclic Redundancy Check (CRC) error detection functionality

2KB EEPROM (fast, saves board space)

- Wear-leveled 500K program/erase cycles
- 10 year data retention
- 4 clock cycle read time

0x00000000 Flash
0x01000000 ROM
0x20000000 SRAM
0x22000000 Bit-banded SRAM
0x40000000 Peripherals & EEPROM
0x42000000 Bit-banded Peripherals
0xE0000000 Instrumentation, ETM, etc.

Peripherals ...



LM4F120H5QR Peripherals

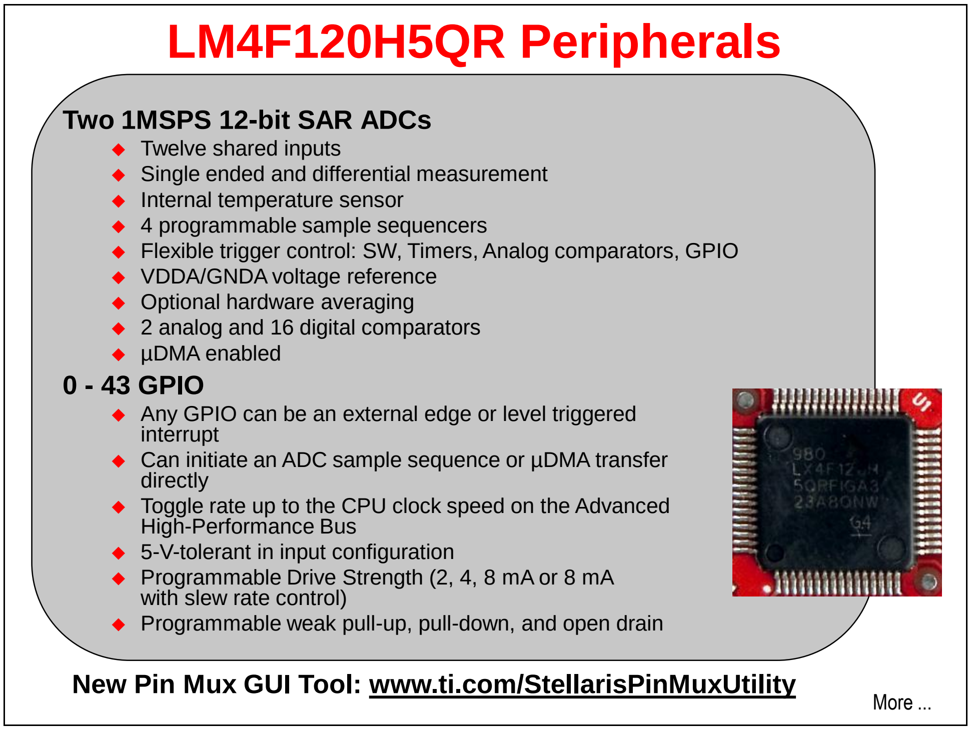
Battery-backed Hibernation Module

- Internal and external power control (through external voltage regulator)
- Separate real-time clock (RTC) and power source
- VDD3ON mode retains GPIO states and settings
- Wake on RTC or Wake pin
- 16 32-bit words of battery backed memory
- 5 µA Hibernate current with GPIO retention. 1.7 µA without

Serial Connectivity

- USB 2.0 (Device)
- 8-UART
- 4-I2C
- 4-SSI/SPI
- CAN

More ...



LM4F120H5QR Peripherals

Two 1MSPS 12-bit SAR ADCs

- Twelve shared inputs
- Single ended and differential measurement
- Internal temperature sensor
- 4 programmable sample sequencers
- Flexible trigger control: SW, Timers, Analog comparators, GPIO
- VDDA/GNDA voltage reference
- Optional hardware averaging
- 2 analog and 16 digital comparators
- µDMA enabled

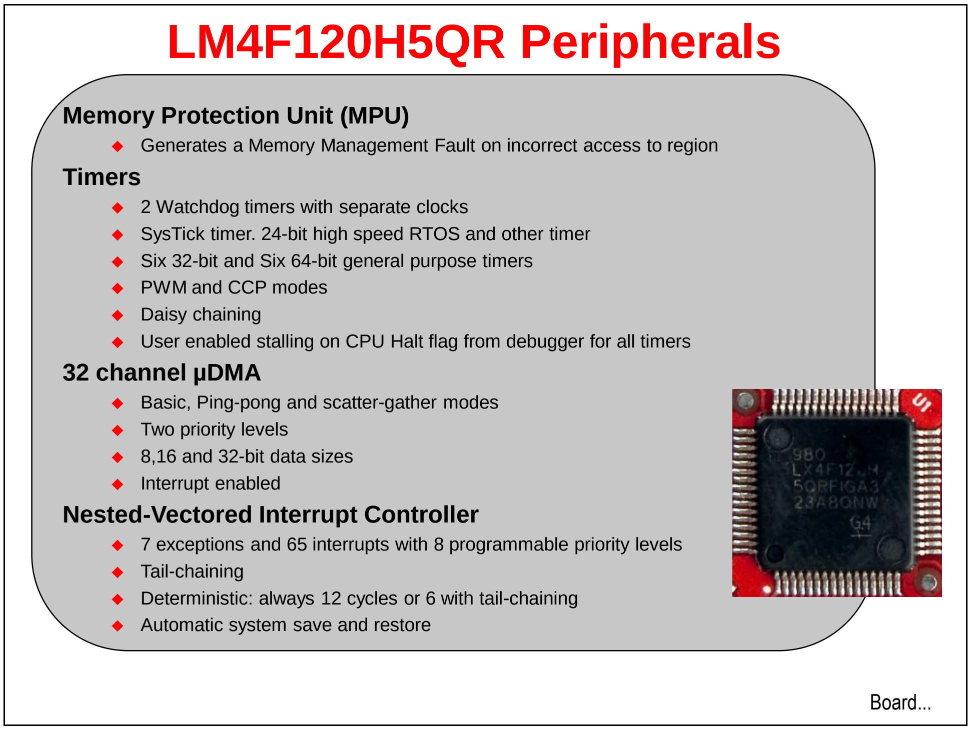
0 - 43 GPIO

- Any GPIO can be an external edge or level triggered interrupt
- Can initiate an ADC sample sequence or µDMA transfer directly
- Toggle rate up to the CPU clock speed on the Advanced High-Performance Bus
- 5-V-tolerant in input configuration
- Programmable Drive Strength (2, 4, 8 mA or 8 mA with slew rate control)
- Programmable weak pull-up, pull-down, and open drain

New Pin Mux GUI Tool: www.ti.com/StellarisPinMuxUtility

More ...

www.ti.com/StellarisPinMuxUtility



LM4F120H5QR Peripherals

Memory Protection Unit (MPU)

- Generates a Memory Management Fault on incorrect access to region

Timers

- 2 Watchdog timers with separate clocks
- SysTick timer. 24-bit high speed RTOS and other timer
- Six 32-bit and Six 64-bit general purpose timers
- PWM and CCP modes
- Daisy chaining
- User enabled stalling on CPU Halt flag from debugger for all timers

32 channel µDMA

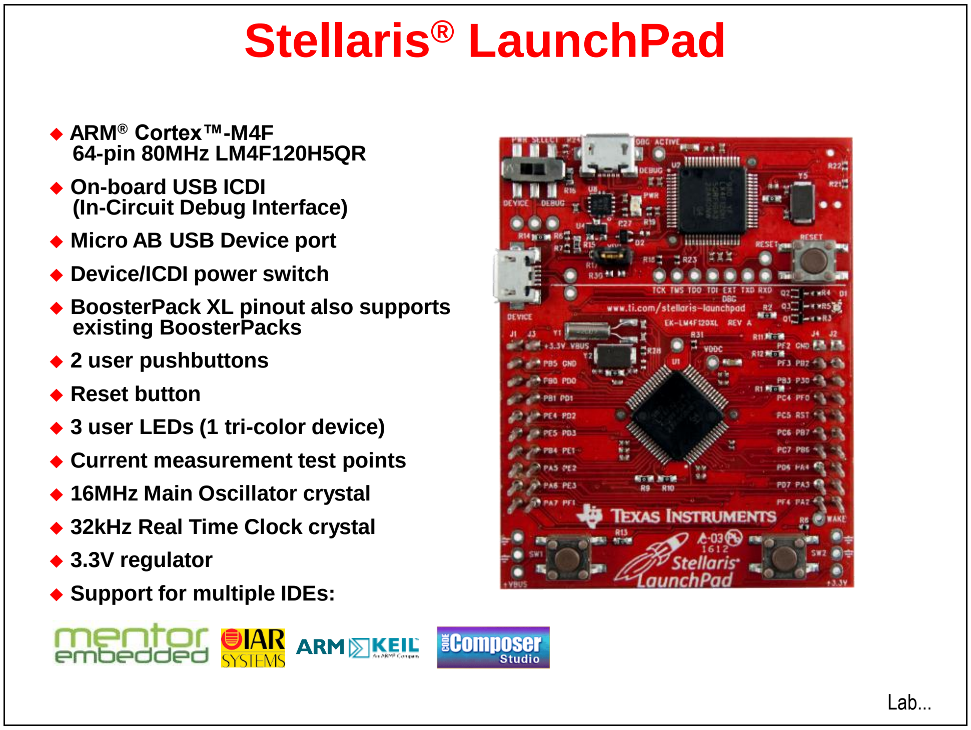
- Basic, Ping-pong and scatter-gather modes
- Two priority levels
- 8,16 and 32-bit data sizes
- Interrupt enabled

Nested-Vectored Interrupt Controller

- 7 exceptions and 65 interrupts with 8 programmable priority levels
- Tail-chaining
- Deterministic: always 12 cycles or 6 with tail-chaining
- Automatic system save and restore

Board...

LaunchPad Board



Stellaris® LaunchPad

- ARM® Cortex™-M4F
  64-pin 80MHz LM4F120H5QR
- On-board USB ICDI
  (In-Circuit Debug Interface)
- Micro AB USB Device port
- Device/ICDI power switch
- BoosterPack XL pinout also supports existing BoosterPacks
- 2 user pushbuttons
- Reset button
- 3 user LEDs (1 tri-color device)
- Current measurement test points
- 16MHz Main Oscillator crystal
- 32kHz Real Time Clock crystal
- 3.3V regulator
- Support for multiple IDEs:

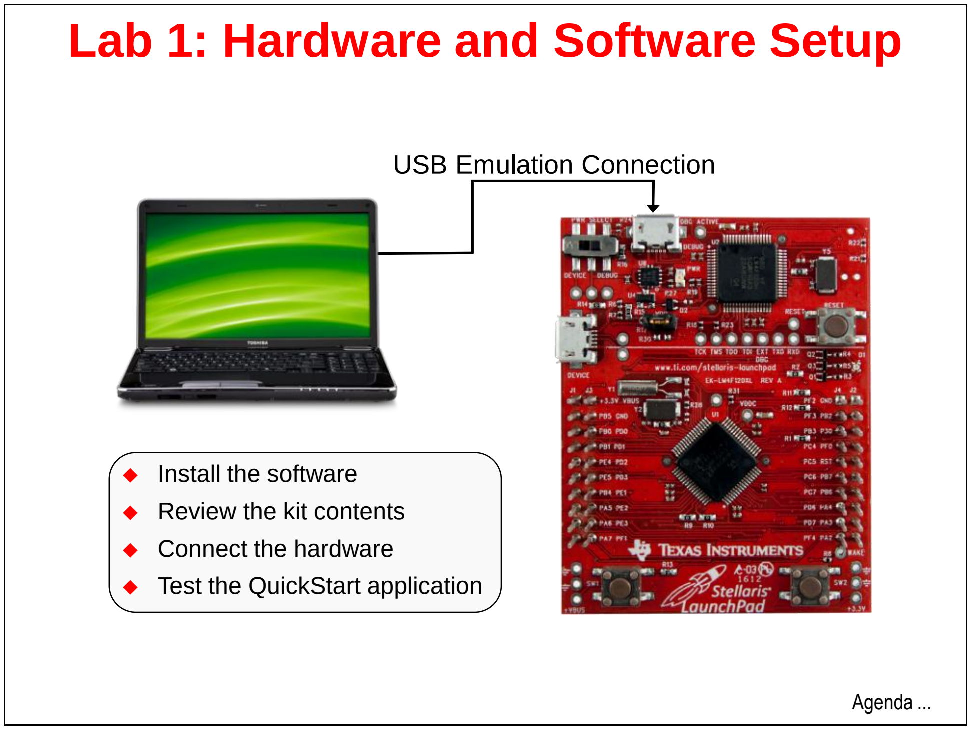
mentor embedded · IAR SYSTEMS · ARM KEIL · Code Composer Studio

Lab...

Lab1: Hardware and Software Set Up

Objective

The objective of this lab exercise is to download and install Code Composer Studio, as well as download the various other support documents and software to be used with this workshop. Then we'll review the contents of the evaluation kit and verify its operation with the pre-loaded quickstart demo program. These development tools will be used throughout the remaining lab exercises in this workshop.



Lab 1: Hardware and Software Setup

USB Emulation Connection

- Install the software
- Review the kit contents
- Connect the hardware
- Test the QuickStart application

Agenda ...

Procedure

Hardware

1. You will need the following hardware:

   - A 32 or 64-bit Windows XP or Windows7 laptop with 2G or more of free hard drive space. 1G of RAM should be considered a minimum … more is better.
   - A laptop with Wi-Fi is highly desirable
   - If you are working the labs from home, a second monitor will make the process much easier. If you are attending a live workshop, you are welcome to bring one.
   - If you are attending a live workshop, please bring a set of earphones or ear-buds.
   - If you are attending a live workshop, you will receive an evaluation board; otherwise you need to purchase one. (http://www.ti.com/tool/EK-LM4F120XL)
   - If you are attending a live workshop, a digital multi-meter will be provided; otherwise you need to purchase one like the inexpensive version here: (http://www.harborfreight.com/catalogsearch/result?q=multimeter)
   - If you are attending a live workshop, you will receive a second **A-male to micro-B-male** USB cable. Otherwise, you will need to provide your own to complete Lab 7.
   - If you are attending a live workshop, you will receive a Kentec 3.5” TFT LCD Touch Screen BoosterPack (**Part# EB-LM4F120-L35).** Otherwise, you will need to provide your own to complete Lab 10.

   As you complete each of the following steps, check the box in the title, like the below, to assure that you have done everything in order.

Download and Install Code Composer Studio □

2. Download and start the latest version of Code Composer Studio (CCS) 5.x web installer from http://processors.wiki.ti.com/index.php/Download_CCS (do not download any beta versions). Bear in mind that the web installer will require Internet access until it completes. If the web installer version is unavailable or you can’t get it to work, download, unzip and run the offline version. The offline download will be much larger than the installed size of CCS since it includes all the possible supported hardware.

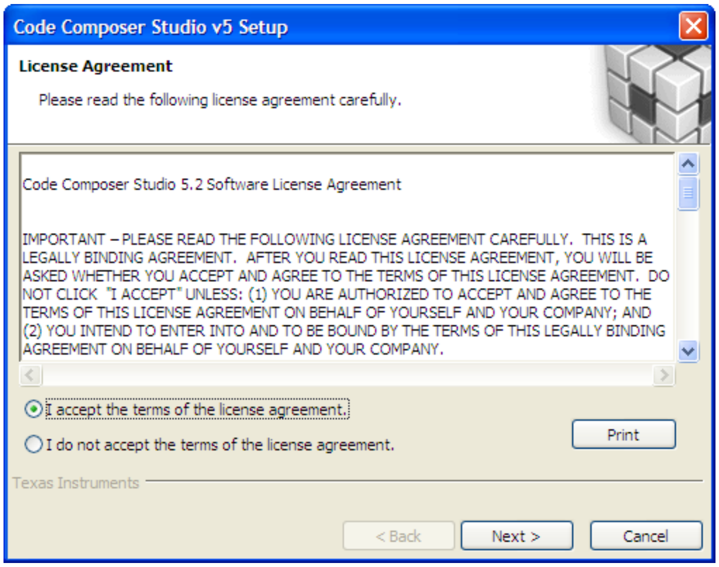
   This version of the workshop was constructed using build number 5.3.0.00090. Your version will likely be later. For this and the next few steps, you will need a my.TI account (you will be prompted to create one or log into your existing account).

   You should note that the 16K limitation on the free, code size limited version of CCS is too small to work with most of the projects in this workshop.

   Note that the evaluation license of CCS will operate with full functionality for free while connected to a Stellaris evaluation board. Most Stellaris boards can also operate as an emulator interface for your target system, although this function requires a licensed version of CCS.

3. If you have downloaded the offline file, start the `ccs_setup_5.xxxxx.exe` file in the folder created when you unzipped the download.

4. Accept the Software License Agreement and click Next.



Code Composer Studio v5 Setup

License Agreement

Please read the following license agreement carefully.

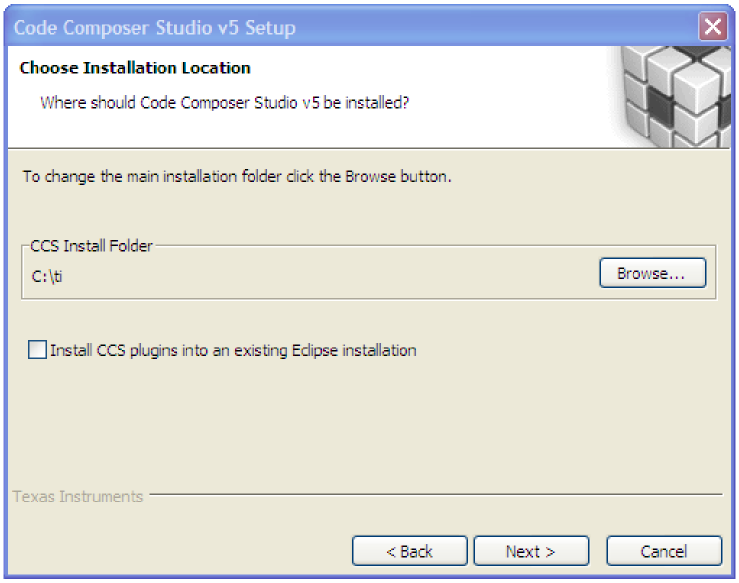
Code Composer Studio 5.2 Software License Agreement

IMPORTANT – PLEASE READ THE FOLLOWING LICENSE AGREEMENT CAREFULLY. THIS IS A LEGALLY BINDING AGREEMENT. AFTER YOU READ THIS LICENSE AGREEMENT, YOU WILL BE ASKED WHETHER YOU ACCEPT AND AGREE TO THE TERMS OF THIS LICENSE AGREEMENT. DO NOT CLICK "I ACCEPT" UNLESS: (1) YOU ARE AUTHORIZED TO ACCEPT AND AGREE TO THE TERMS OF THIS LICENSE AGREEMENT ON BEHALF OF YOURSELF AND YOUR COMPANY; AND (2) YOU INTEND TO ENTER INTO AND TO BE BOUND BY THE TERMS OF THIS LEGALLY BINDING AGREEMENT ON BEHALF OF YOURSELF AND YOUR COMPANY.

● I accept the terms of the license agreement.

○ I do not accept the terms of the license agreement.

5. Unless you have a specific reason to install CCS in another location, accept the default installation folder and click Next. If you have an another version of CCS and you want to keep it, we recommend that you install this version into a different folder.



Code Composer Studio v5 Setup

Choose Installation Location

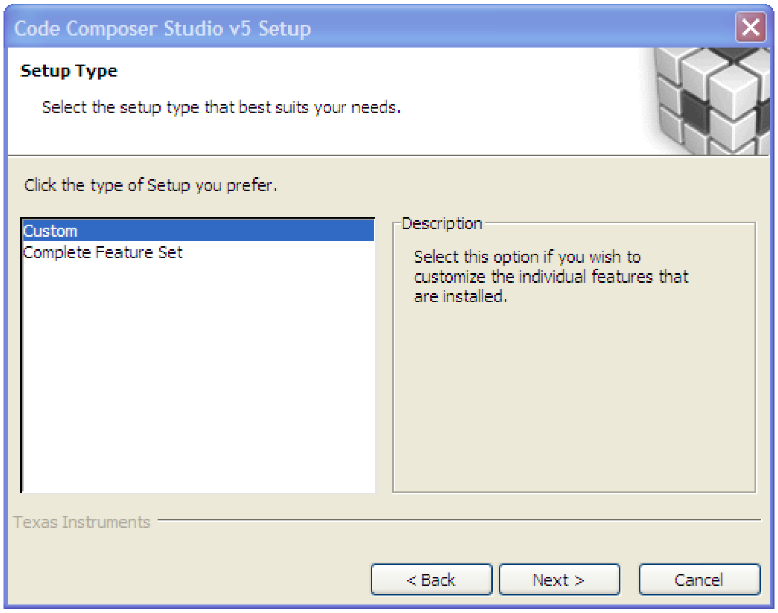
Where should Code Composer Studio v5 be installed?

To change the main installation folder click the Browse button.

CCS Install Folder: C:\ti

□ Install CCS plugins into an existing Eclipse installation

6. Select "Custom" for the Setup type and click Next.



Code Composer Studio v5 Setup

Setup Type

Select the setup type that best suits your needs.

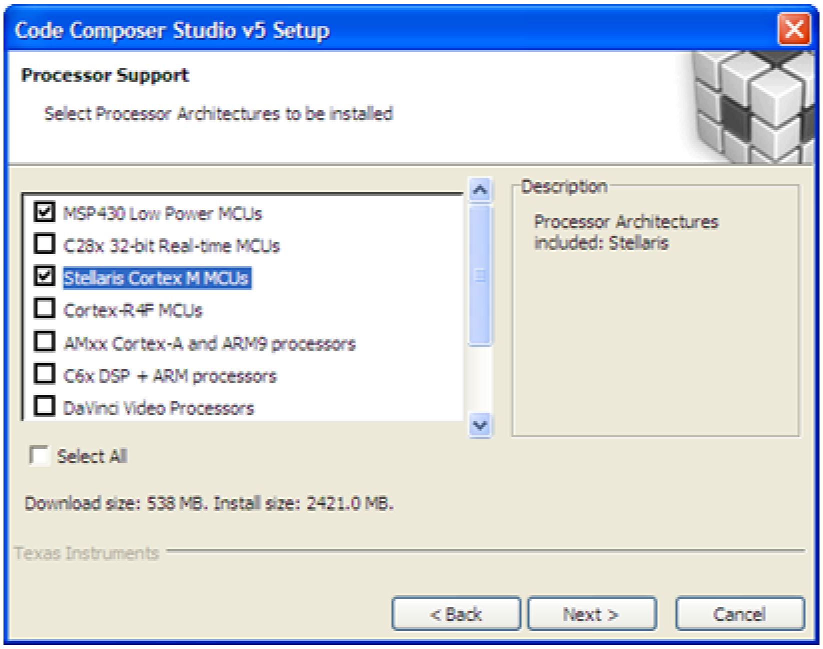
Click the type of Setup you prefer.

- Custom
- Complete Feature Set

Description

Select this option if you wish to customize the individual features that are installed.

7. The next dialog, select the processors that your CCS installation will support. You should select "Stellaris Cortex M MCUs" in order to run the labs in this workshop. If you are also attending the MSP430 workshop you should also select "MSP430 Low Power MCUs". You can select other architectures, but the installation time and size will increase. Click Next.



Code Composer Studio v5 Setup

Processor Support

Select Processor Architectures to be installed

☑ MSP430 Low Power MCUs
☐ C28x 32-bit Real-time MCUs
☑ Stellaris Cortex M MCUs
☐ Cortex-R4F MCUs
☐ AMxx Cortex-A and ARM9 processors
☐ C6x DSP + ARM processors
☐ DaVinci Video Processors

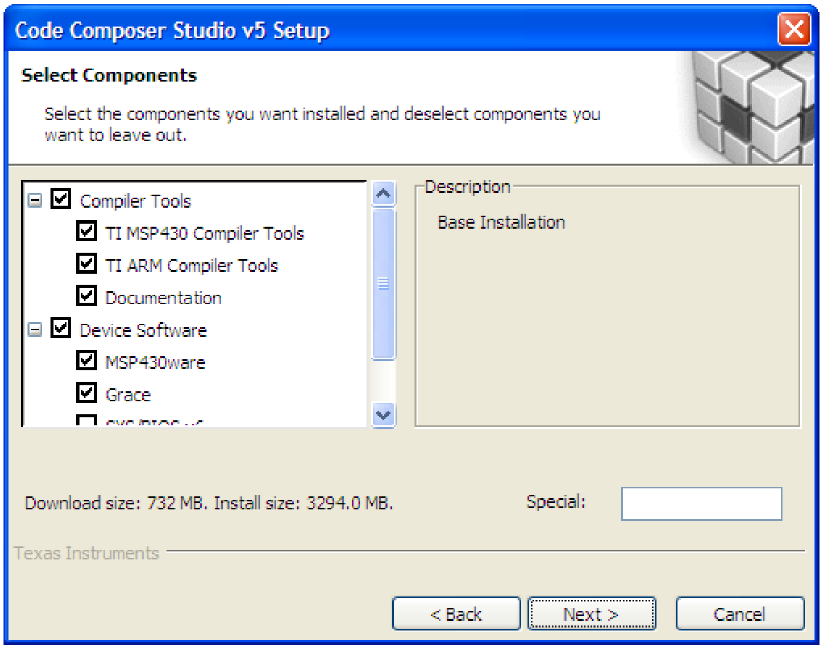
Description

Processor Architectures included: Stellaris

☐ Select All

Download size: 538 MB. Install size: 2421.0 MB.

8. In the Component dialog, keep the default selections and click Next.



Code Composer Studio v5 Setup

Select Components

Select the components you want installed and deselect components you want to leave out.

- ☑ Compiler Tools
  - ☑ TI MSP430 Compiler Tools
  - ☑ TI ARM Compiler Tools
  - ☑ Documentation
- ☑ Device Software
  - ☑ MSP430ware
  - ☑ Grace
  - ☐ SYS/BIOS v6

Description

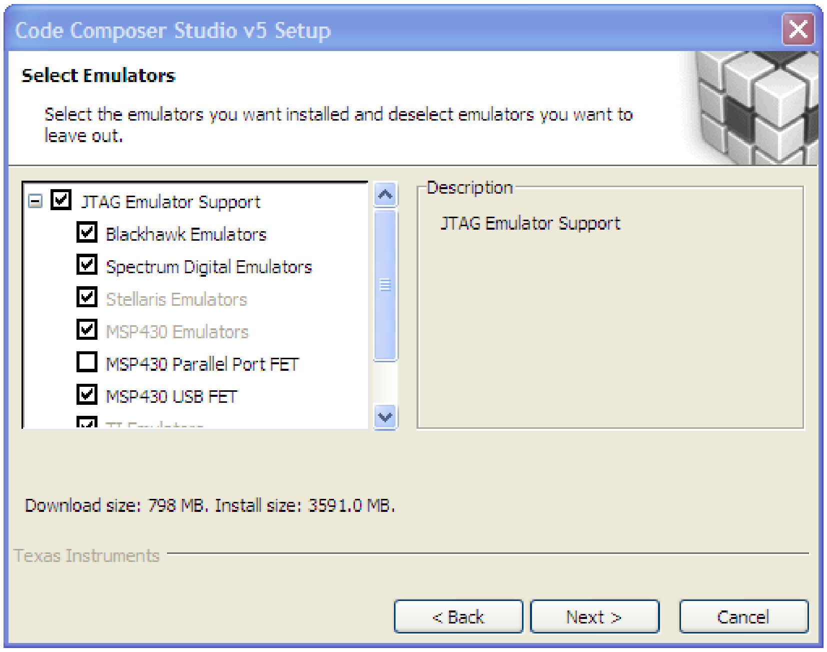
Base Installation

Download size: 732 MB. Install size: 3294.0 MB.

Special:

Texas Instruments

9. In the Emulators dialog, uncheck the Blackhawk and Spectrum Digital emulators, unless you plan on using either of these.



Code Composer Studio v5 Setup

Select Emulators

Select the emulators you want installed and deselect emulators you want to leave out.

- ☑ JTAG Emulator Support
  - ☑ Blackhawk Emulators
  - ☑ Spectrum Digital Emulators
  - ☑ Stellaris Emulators
  - ☑ MSP430 Emulators
  - ☐ MSP430 Parallel Port FET
  - ☑ MSP430 USB FET
  - ☑ TI Emulators

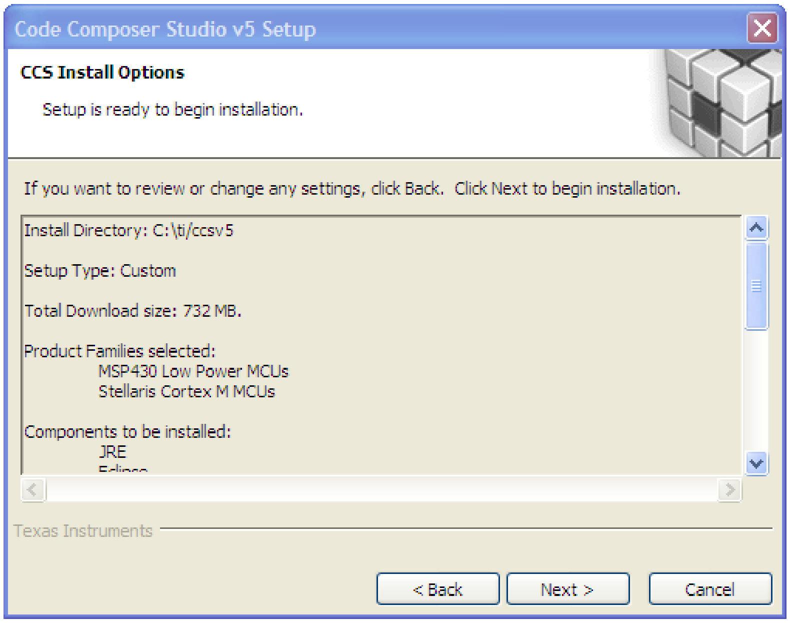
Description

JTAG Emulator Support

Download size: 798 MB. Install size: 3591.0 MB.

Texas Instruments

10. When you reach the final installation dialog, click Next. The web installer process should take 15 - 30 minutes, depending on the speed of your connection. The offline installation should take 10 to 15 minutes. When the installation is complete, don't start CCS.



CCS Install Options

Setup is ready to begin installation.

If you want to review or change any settings, click Back. Click Next to begin installation.

```
Install Directory: C:\ti/ccsv5

Setup Type: Custom

Total Download size: 732 MB.

Product Families selected:
          MSP430 Low Power MCUs
          Stellaris Cortex M MCUs

Components to be installed:
          JRE
          Eclipse
```

Install StellarisWare □

11. Download and install the latest full version of StellarisWare from: http://www.ti.com/tool/sw-lm3s . This workshop was built using release number 9107. Your version will likely be a later one. If at all possible, please install StellarisWare into the default `C:\StellarisWare` folder.

Install LM Flash Programmer □

12. Download, unzip and install the latest LM Flash Programmer (LMFLASHPROGRAMMER) from http://www.ti.com/tool/lmflashprogrammer . This workshop was built using version number 1381. Your version will likely be a later one.

Download ICDI Drivers □

13. Download the latest version of the in-circuit debug interface drivers from http://www.ti.com/tool/stellaris_icdi_drivers . Unzip the file and place the `stellaris_icdi_drivers` folder in `C:\StellarisWare`.

Download and Install Workshop Lab Files □

14. Download the lab installation file from the workshop materials section of the Wiki site below. The file will install your lab files in: `C:\StellarisWare\boards\MyLaunchPadBoard`. So please be sure that you have installed StellarisWare before installing the labs.

    www.ti.com/StellarisLaunchPadWorkshop

Download Workshop Workbook □

15. Download a copy of the workbook pdf file from the workshop materials section of the Wiki site below to your desktop. It will be handy for copying and pasting code.

    www.ti.com/StellarisLaunchPadWorkshop

Terminal Program □

16. If you are running WindowsXP, you can use HyperTerminal as your terminal program. Windows7 does not have a terminal program built-in, but there are many third-party alternatives. The instructions in the labs utilize HyperTerminal and PuTTY. You can download PuTTY from the address below.

    http://the.earth.li/~sgtatham/putty/latest/x86/putty.exe

Windows-side USB Examples □

17. Download and install the StellarisWare Windows-side USB examples from this site:

    www.ti.com/sw-usb-win

Download and Install GIMP □

18. We will need a graphics manipulation tool capable of handing PNM formatted images. GIMP can do that. Download and install GIMP from here:

    www.gimp.org

LaunchPad Board Schematic

19. For your reference, the schematic is included at the end of this workbook.

Helpful Documents and Sites □

20. There are many helpful documents that you should have, but at a minimum you should have the following documents at your fingertips.

    Look in `C:\StellarisWare\docs` and find:

    Peripheral Driver User's Guide (SW-DRL-UGxxxx.pdf)

    USB Library User's Guide (SW-USBL-UGxxxx.pdf)

    Graphics Library User's Guide (SW-GRL-UGxxxx.pdf)

    LaunchPad Board User's Guide (SW-EK-LM4F120XL-UG-xxxx.pdf)

21. Go here: http://www.ti.com/product/lm4f120h5qr and download the LM4F120H5QR Data Sheet. Stellaris data sheets are actually the complete user's guide for the device. So expect a large document.

22. Download the ARM Optimizing C/C++ Compilers User Guide from http://www.ti.com/lit/pdf/spnu151 (SPNU151). Of particular interest are the sizes for all the different data types in table 6-2. You may see the use of "TMS470" here … that is the TI product number for its ARM devices.

23. You will find a "Hints" section at the end of chapter 2. You will find this information handy when you run into problems during the labs.

24. Search the TI website for these additional documents of interest:

SPMU287:	Stellaris Driver Installation Guide (for ICDI and FTDI drivers)
SPMU288:	BoosterPack Development Guide
SPMU289:	LaunchPad Evaluation Board User's Manual (includes schematic)

You can find additional information at these websites:

Main page: www.ti.com/launchpad

Stellaris LP: www.ti.com/stellaris-launchpad

EK-LM4F120XL product page: http://www.ti.com/tool/EK-LM4F120XL

BoosterPack webpage: www.ti.com/boosterpack

LaunchPad WiKi: www.ti.com/launchpadwiki

LM4F120H5QR folder: http://www.ti.com/product/lm4f120h5qr

Kit Contents □

25. Open up your kit

You should find the following in your box:

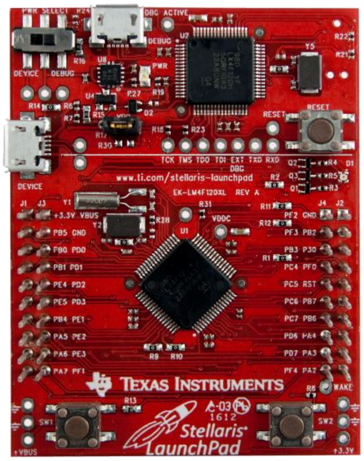
- **The LM4F120H5QR LaunchPad Board**
- **USB cable (A-male to micro-B-male)**
- **README First card**
- **If you are in a live workshop, you should find a 2nd USB cable**

Initial Board Set-Up □

26. Connecting the board and installing the drivers

The LM4F120 LaunchPad Board ICDI USB port (marked DEBUG and shown in the picture below) is a composite USB port and consists of three connections:

Stellaris ICDI JTAG/SWD Interface	- debugger connection
Stellaris ICDI DFU Device	- firmware update connection
Stellaris Virtual Serial Port	- a serial data connection

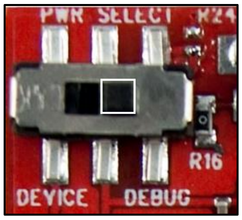


Using the included USB cable, connect the USB emulation connector on your evaluation board (marked DEBUG) to a free USB port on your PC. A PC's USB port is capable of sourcing up to 500 mA for each attached device, which is sufficient for the evaluation board. If connecting the board through a USB hub, it must be a powered hub.

The drivers should install automatically. Manual driver installation steps are included in the appendix of this workbook.

QuickStart Application

Your LaunchPad Board came preprogrammed with a quickstart application. Once you have powered the board, this application runs automatically. You probably already noticed it running as you installed the drivers.



27. Make sure that the power switch in the upper left hand corner of your board is in the right-hand DEBUG position as shown:

28. The software on the LM4F120H5QR uses the timers as pulse-width modulators (PWMs) to vary the intensity of all three colors on the RGB LED (red, green, and blue) individually. By doing so, your eye will perceive many different colors created by combining those primary colors.

    The two pushbuttons at the bottom of your board are marked **SW1** (the left one) and **SW2** (the right one). Press or press and hold **SW1**to move towards the red-end of the color spectrum. Press or press and hold **SW2** to move towards the violet-end of the color spectrum.

    If no button is pressed for 5 seconds, the software returns to automatically changing the color display.

29. Press and hold both **SW1** and **SW2** for 3 seconds to enter hibernate mode. In this mode the last color will blink on the LEDs for ½ second every 3 seconds. Between the blinks, the device is in the VDD3ON hibernate mode with the real-time-clock (RTC) running. Pressing **SW2** at any time will wake the device and return to automatically changing the color display.

30. We can communicate with the board through the UART. The UART is connected as a virtual serial port through the emulator USB connection.

    The following steps will show how to open a connection to the board using HyperTerminal (in WinXP) and PuTTY (in Windows 7 or 8).

31. We need to find the COM port number of the Stellaris Virtual Serial Port in the Device Manager. **Skip to step 32 if you are using Windows 7 or 8.**

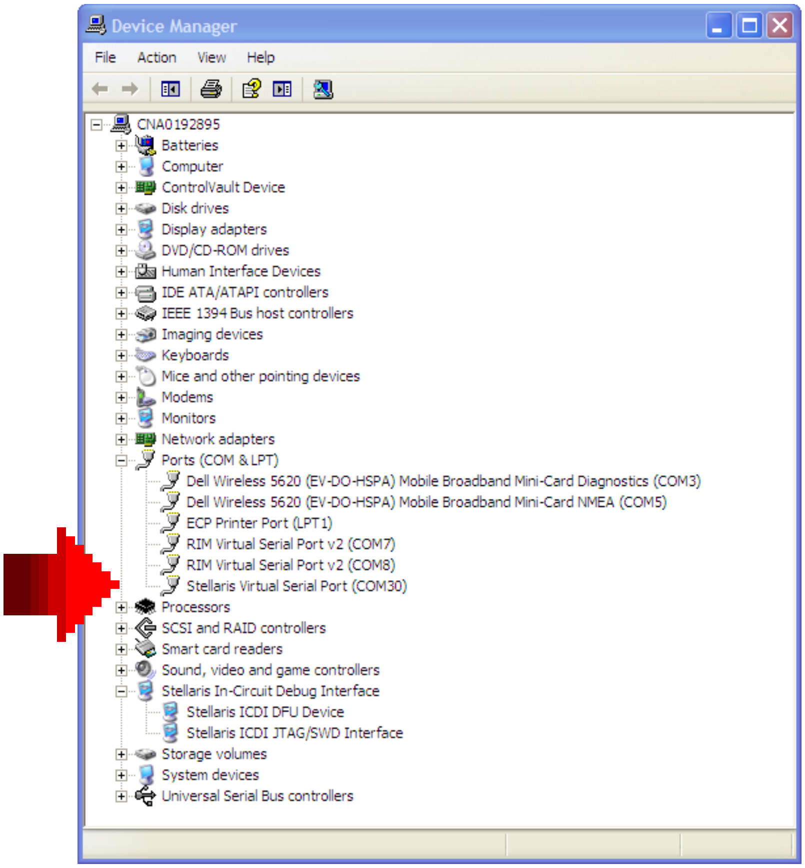
Windows XP:

A. Click on the Windows Start button. Right-click on My Computer and select Properties from the drop-down menu.

B. In the System Properties window, click the Hardware tab.

C. Click the Device Manager button.

The Device Manager window displays a list of hardware devices installed on your computer and allows you to set the properties for each device.



- CNA0192895
  - Batteries
  - Computer
  - ControlVault Device
  - Disk drives
  - Display adapters
  - DVD/CD-ROM drives
  - Human Interface Devices
  - IDE ATA/ATAPI controllers
  - IEEE 1394 Bus host controllers
  - Imaging devices
  - Keyboards
  - Mice and other pointing devices
  - Modems
  - Monitors
  - Network adapters
  - Ports (COM & LPT)
    - Dell Wireless 5620 (EV-DO-HSPA) Mobile Broadband Mini-Card Diagnostics (COM3)
    - Dell Wireless 5620 (EV-DO-HSPA) Mobile Broadband Mini-Card NMEA (COM5)
    - ECP Printer Port (LPT1)
    - RIM Virtual Serial Port v2 (COM7)
    - RIM Virtual Serial Port v2 (COM8)
    - Stellaris Virtual Serial Port (COM30)
  - Processors
  - SCSI and RAID controllers
  - Smart card readers
  - Sound, video and game controllers
  - Stellaris In-Circuit Debug Interface
    - Stellaris ICDI DFU Device
    - Stellaris ICDI JTAG/SWD Interface
  - Storage volumes
  - System devices
  - Universal Serial Bus controllers

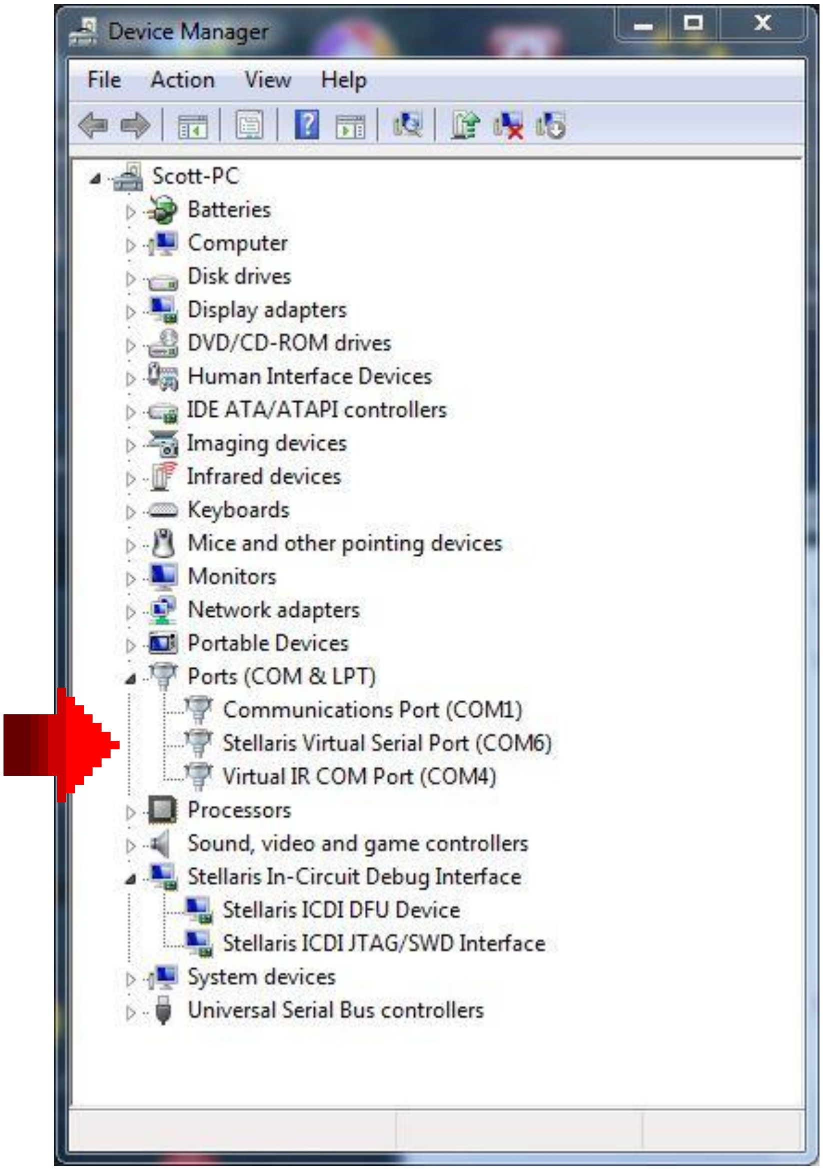
Expand the Ports heading and write number for the Stellaris Virtual Serial Port here: **COM_____**

32. Windows 7 or 8:

A. Click on the Windows Start button. Right-click on Computer and select Properties from the drop-down menu.

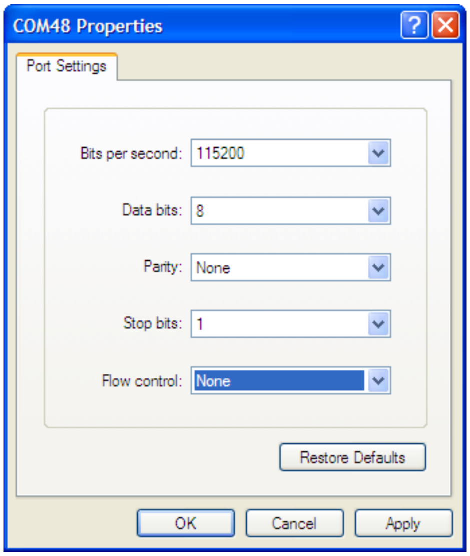
B. Click on Device Manager on the left of the dialog.

The Device Manager window displays a list of hardware devices installed on your computer and allows you to set the properties for each device.


Device Manager
File
Action
View
Help
Scott-PC
Batteries
Computer
Disk drives
Display adapters
DVD/CD-ROM drives
Human Interface Devices
IDE ATA/ATAPI controllers
Imaging devices
Infrared devices
Keyboards
Mice and other pointing devices
Monitors
Network adapters
Portable Devices
Ports (COM & LPT)
Communications Port (COM1)
Stellaris Virtual Serial Port (COM6)
Virtual IR COM Port (COM4)
Processors
Sound, video and game controllers
Stellaris In-Circuit Debug Interface
Stellaris ICDI DFU Device
Stellaris ICDI JTAG/SWD Interface
System devices
Universal Serial Bus controllers

Expand the Ports heading and write number for the Stellaris Virtual Serial Port here: **COM_____**

33. **In WinXP**, open HyperTerminal by clicking Start → Run…, then type `hypertrm` in the Open: box and click OK. Pick any name you like for your connection and click OK. In the next dialog box, change the Connect using: selection to COM##, where ## is the COM port number you noted earlier. Click OK. Make the selections shown below and click OK.



COM48 Properties

Port Settings

Bits per second: 115200

Data bits: 8

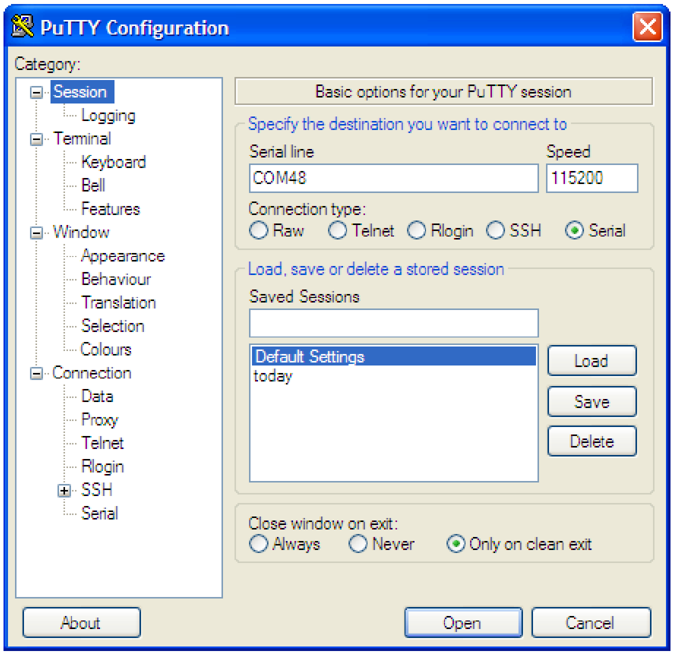
Parity: None

Stop bits: 1

Flow control: None

When the terminal window opens, press Enter once and the LaunchPad board will respond with a > indicating that communication is open. Skip to step 31.

34. In **Win7 or 8**, double-click on `putty.exe`. Make the settings shown below and then click Open. Your COM port number will be the one you noted earlier



PuTTY Configuration

Basic options for your PuTTY session

Specify the destination you want to connect to

Serial line: COM48

Speed: 115200

Connection type: ○ Raw ○ Telnet ○ Rlogin ○ SSH ● Serial

Load, save or delete a stored session

Saved Sessions

Default Settings
today

Close window on exit: ○ Always ○ Never ● Only on clean exit

When the terminal window opens, press Enter once and the LaunchPad board will respond with a > indicating that communication is open.

35. You can communicate by typing the following commands and pressing enter:

    help: will generate a list of commands and information

    hib: will place the device into hibernation mode. Pressing SW2 will wake the device.

    rand: will start a pseudo-random sequence of colors

    intensity: adjust the LED brightness between 0 to 100 percent. For instance intensity 100 will change the LED to maximum brightness.

    rgb: follow with a 6 hex character value to set the intensity of all three LEDs. For instance: rgb FF0000 lights the red LED, rgb 00FF00 lights the blue LED and rgb 0000FF lights the green LED.

36. Close your terminal program.

You’re done.