FRDM-KEA Lab Examples

Supports FRDM-KEAZ128 and FRDM-KEAZ64

Ultra-Reliable Microcontrollers (MCU) for Industrial and Automotive

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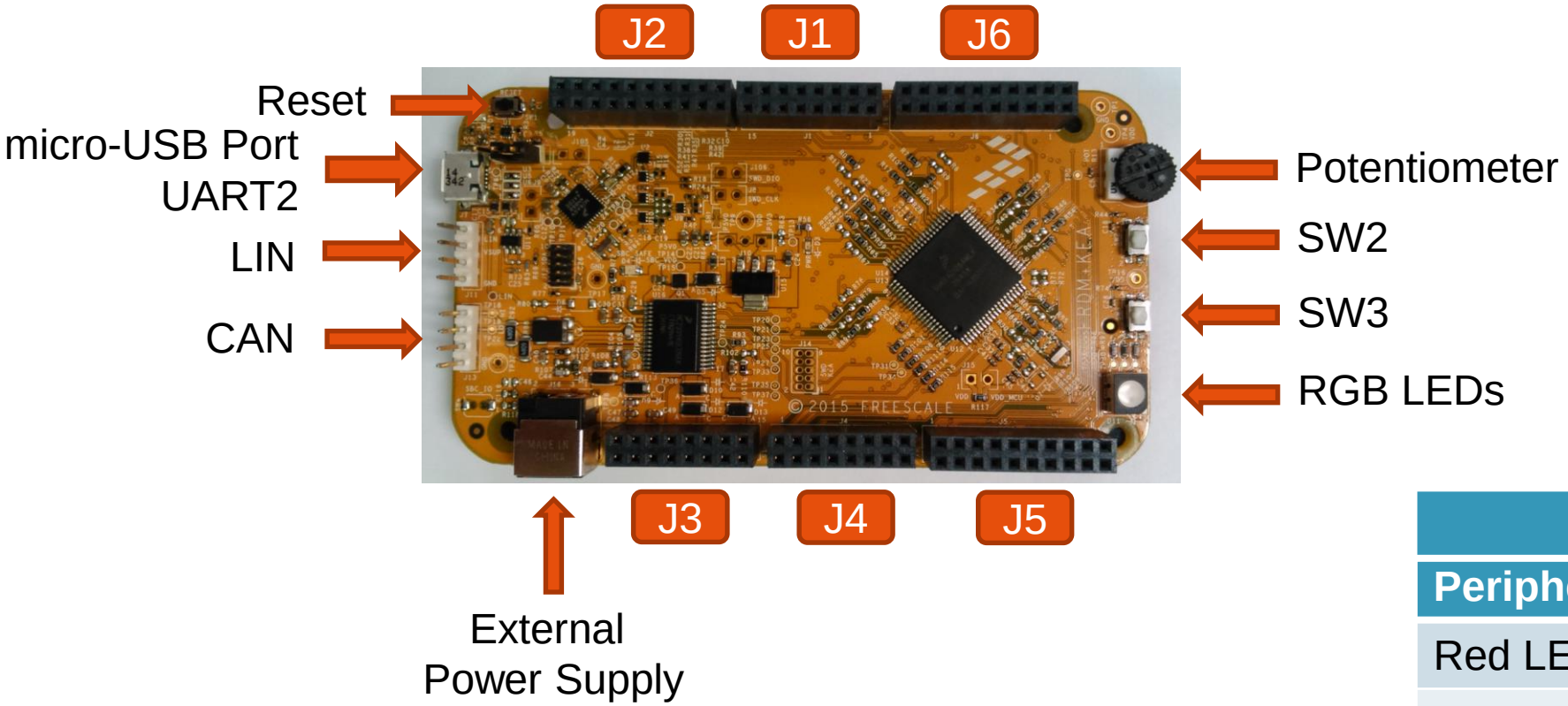
Index

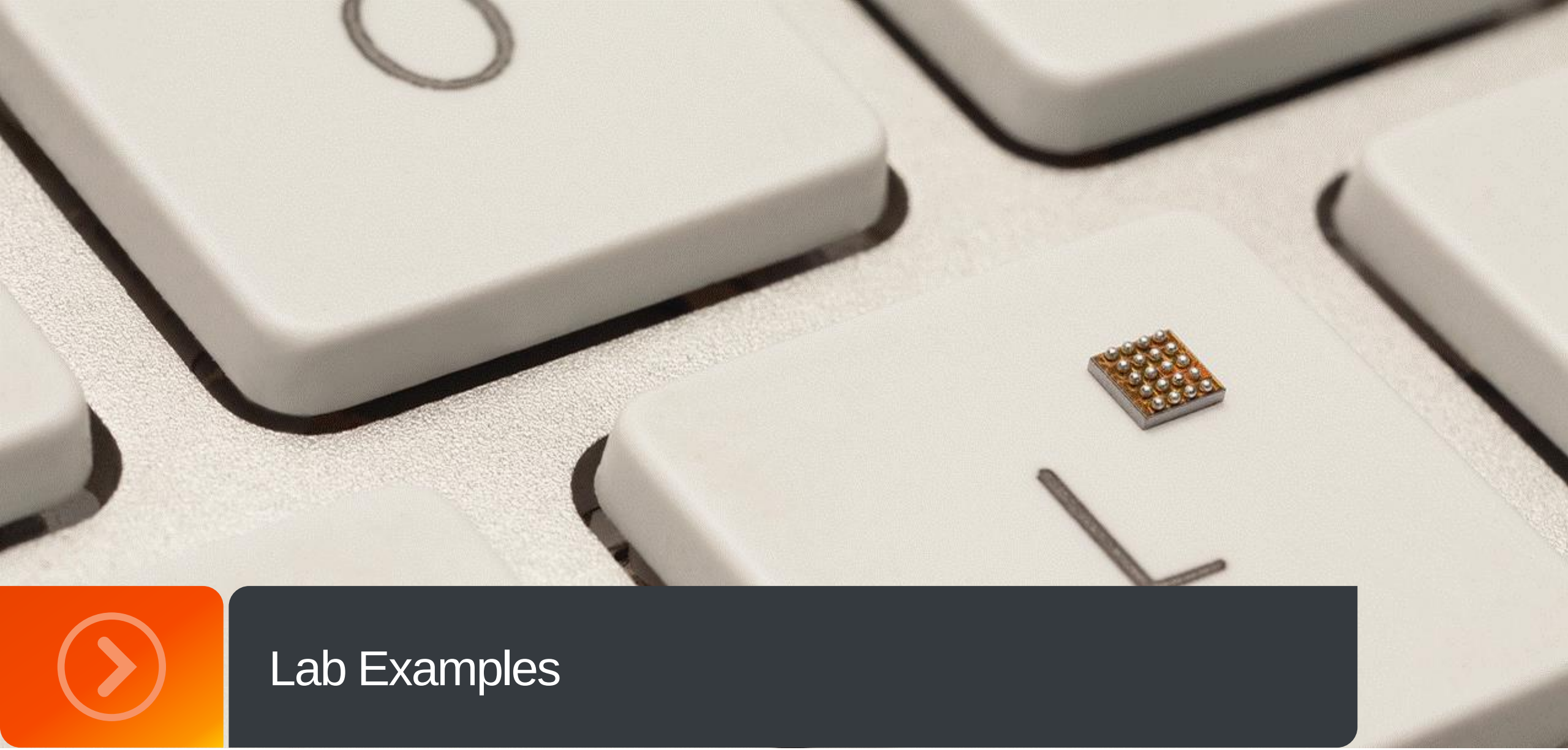
- **Board Overview**
- **Lab Examples**

Board Overview



Note : for more information please see Schematics

Pin Mapping Table	
Peripheral Name	**Pin Number**
Red LED	PTH0
Green LED	PTH1
Blue LED	PTE7
SW2	PTE4
SW3	PTE5
Potentiometer	PTC2



Lab Examples

Lab1. Blink LEDs using Loops : Blinky Loop

Things to Learn:

- Configure GPIO
- Initialize Clock in FEI mode

RGB LEDs

Overview:

This Lab demonstrates that how to define the GPIO port pins and how to manipulate them to change their direction and there value(high/low).

More over, it explains basic configuration to set clock into FEI – FLL Engaged Internal mode to generate the core frequency of 40 MHz and Bus Frequency of 20MHz.

Hardware Connections:

No Hardware connections required

Observation:

Running this example, changes the color of RGB LEDs periodically. It uses simple loop to generate the delay and to repeat the pattern.

Lab2. Blink LEDs using FlexTimer Module : Blinky FTM

Things to Learn:

- Make GPIO configuration generic
- Initialize FTM in Output Compare mode
- Use Interrupts

RGB LEDs

Overview:

This Lab demonstrates that how to make GPIO functions generic by making header file. For example, make functions to configure any GPIO pin input, output, set, reset etc.

Further, it teaches how to use FTM module in Output Compare mode and how to utilize periodic interrupt to generate patterns on LEDs.

Hardware Connections:

No Hardware connections required

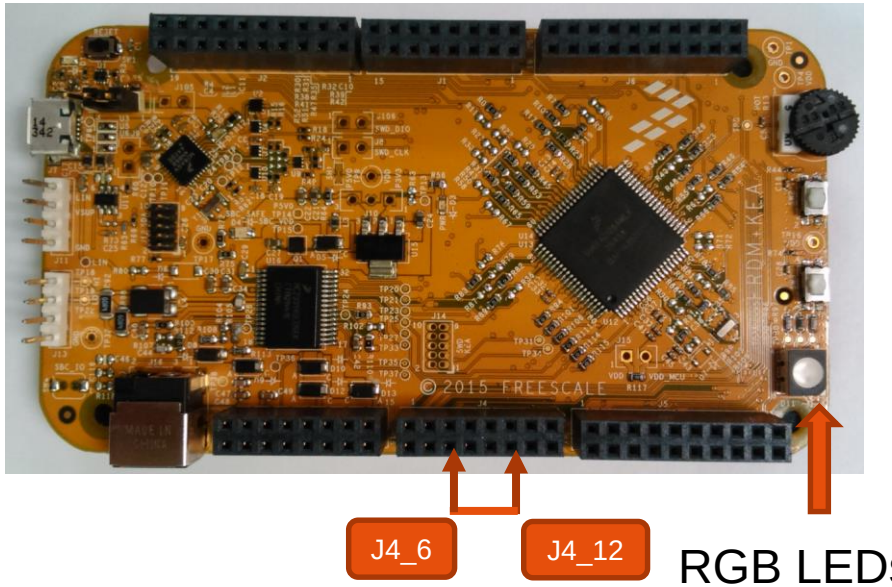
Observation:

Running this example, changes the color of RGB LEDs . It uses interrupt to jump to the subroutine and perform the change in LED color when counter value match occurs. So, blinking of different LEDs can be observed.

Lab3. Blink LEDs using Real Time Clock : Blinky RTC

Things to Learn:

- Initialize RTC



Overview:

The RTC can be used for time-of-day, calendar or any task scheduling functions. It can also serve as a cyclic wake-up from low-power modes.

This example has configured to generate precise waveform on external pin to show that it can be used as a clock source for some other devices.

Hardware Connections:

Connect PTC5(J4_6) to PTE7(J4_12)

Observation:

Running this example will toggle the Blue LED periodically.

Lab4. Getting Familiar with Pulse Width Modulation : Dimmer PWM

Things to Learn:

- Initialize FTM in Pulse Width Modulation mode

RGB LEDs

Overview:

PWM feature can be used in BLDC motor control applications, DC motor control, lighting control etc applications.

Example teaches how to use FTM module in Edge-aligned PWM mode and how to utilize interrupt to realize different functionality through call to subroutine.

Hardware Connections:

No Hardware connections required

Observation:

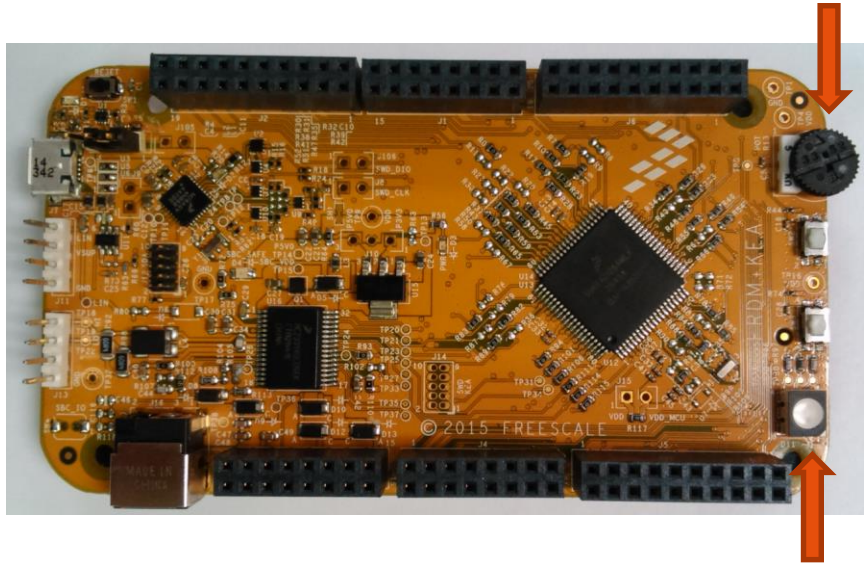
Running this example, changes brightness of Red LED periodically.

Lab5. Getting Familiar with Analog to Digital Converter : ADC

Things to Learn:

- Initialize & Read ADC Module

Potentiometer



RGB LEDs

Overview:

ADC is used to measure some real world values like Temperature, Pressure, Resistance etc.

Example teaches how to use ADC to read the port value and generate a feedback to indicate the measured reading.

Hardware Connections:

No Hardware connections required

Observation:

Potentiometer is connected to the ADC CH10.

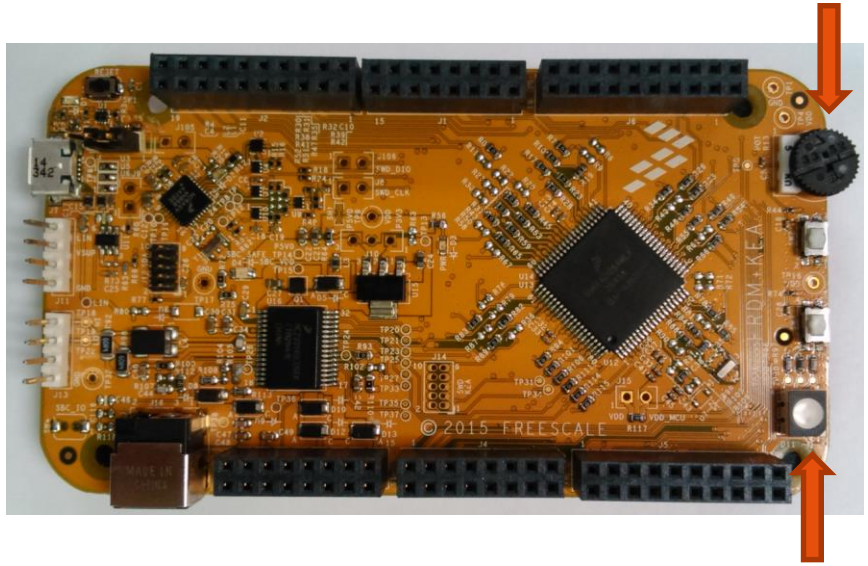
Whenever potentiometer crosses the threshold the LED color changes.

Lab6. Combine FTM and ADC : Blinky FTM-ADC

Things to Learn:

- Co-operating between two modules

Potentiometer



RGB LEDs

Overview:

This Example demonstrates that how to realize intended functionality using by running two modules and achieving co-operation between both.

In this simple example, the FTM will function accordingly the value of the ADC port.

Hardware Connections:

No Hardware connections required

Observation:

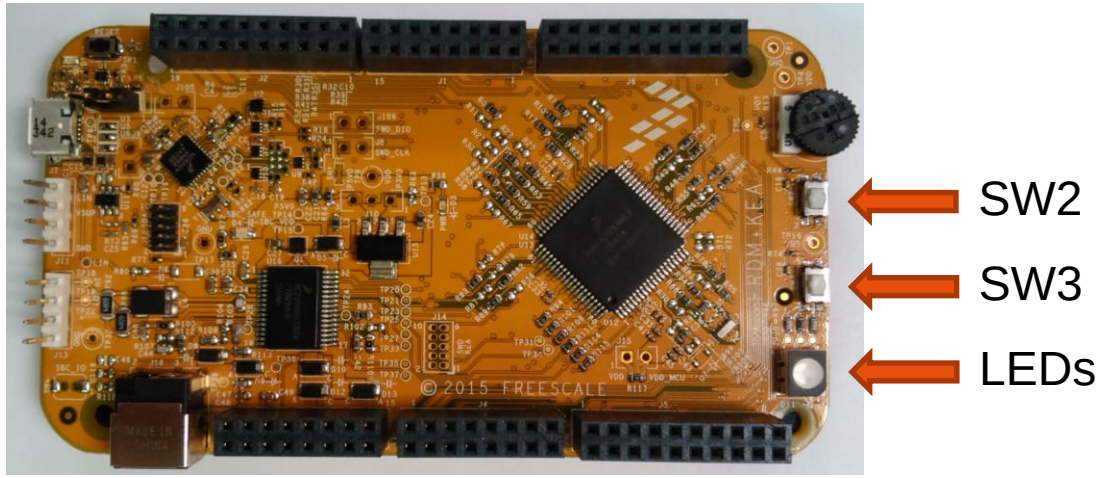
The application reads the potentiometer, ADC channel 10.

According to this value the FTM will adjust its Value register and generated the different blinking frequency and/or different color of LEDs at different ADC value.

Lab7. Getting Started with Key board Interrupt : KBI

Things to Learn:

- Initialize KBI



Overview:

KBI can be used for HMI – Human Machine Interface.

This example demonstrates that how to configure the port pins in KBI mode so that any change in pin polarity, will generate a KBI interrupt.

Hardware Connections:

No Hardware connections required

Observation:

Pressing SW2 & SW3 toggles the Green and Red LEDs respectively.

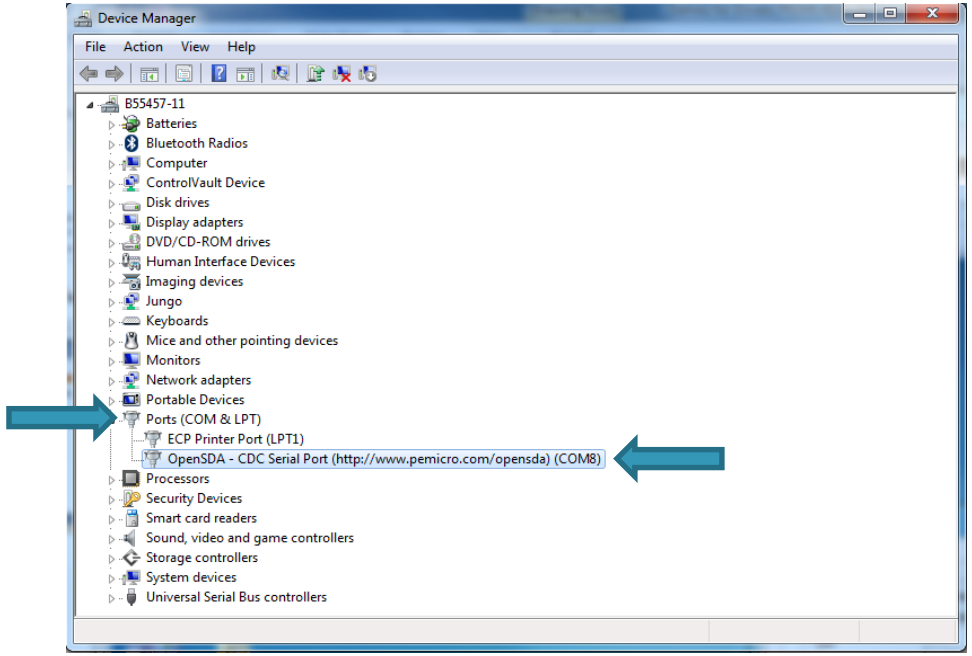
Required Before Lab8 – Set Terminal Window for Serial Communication

1. Terminal client:

(Download Link)

2. Finding COM port number:

Open Device manager and follow the snapshot



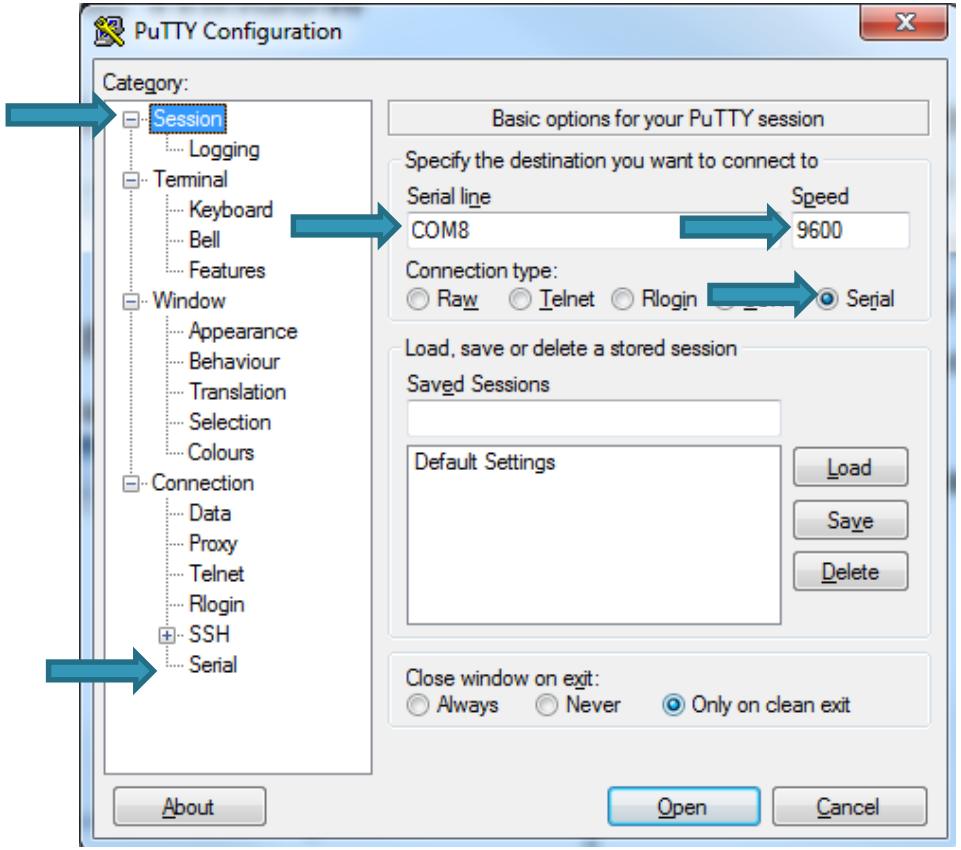
3. Open the Terminal Window using Putty:

Open Putty, Go to Session, Change Connection Type to Serial

Serial Line as of COM port number

Speed as of Baud Rate

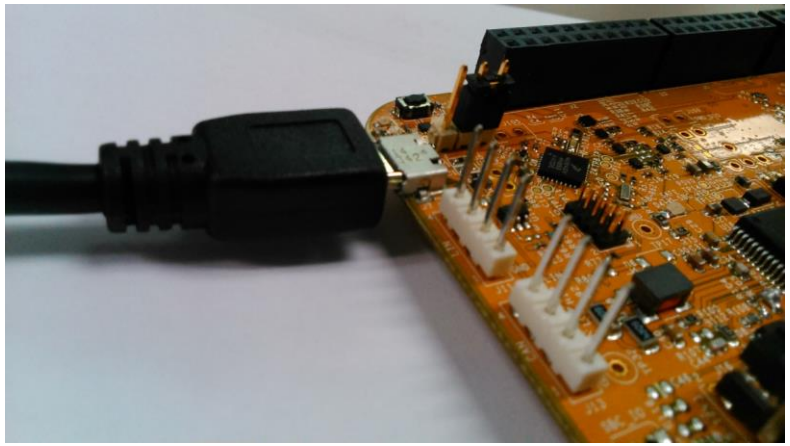
Additional Settings go to Connection > Serial



Lab8. Communicate using Universal Asynchronous Receiver Transmitter (UART)

Things to Learn:

- Initialize & communicate through UART



Overview:

UART can be used to send and receive data between the different peripherals as well as computer.

Hardware Connections:

Connect Board with computer using micro-USB port.

Set Putty as shown in the previous slide but with baud-rate of 9600

Observation:

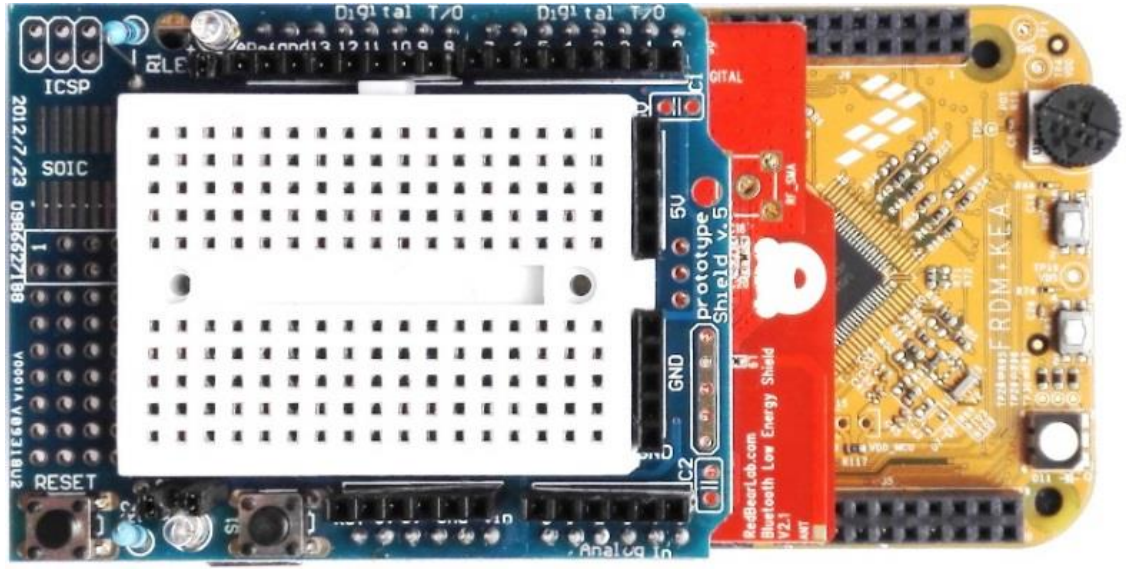
Running the example, displays the message on terminal window.

Try to write any character on terminal window, board will echo back the same character

Lab9. Communicate to Your Phone Using Bluetooth

Things to Learn:

- Expand your board's capability by adding an Arduino shield



Overview:

Bluetooth is a popular wireless communication protocol that is available on most smartphones

Hardware Connections:

RedBearLab BLE Shield connected to FRDM KEA following Arduino standard

Prototype v5 Arduino breadboard stacked atop BLE shield

Additional Software:

Free RedBearLab BLE Controller (available in App Store and Play Store)

Set app to BLE Controller mode and connect to FRDM board

Observation:

Change Pin 11, 12, and 13 to PWM mode then use the virtual slides to control LED

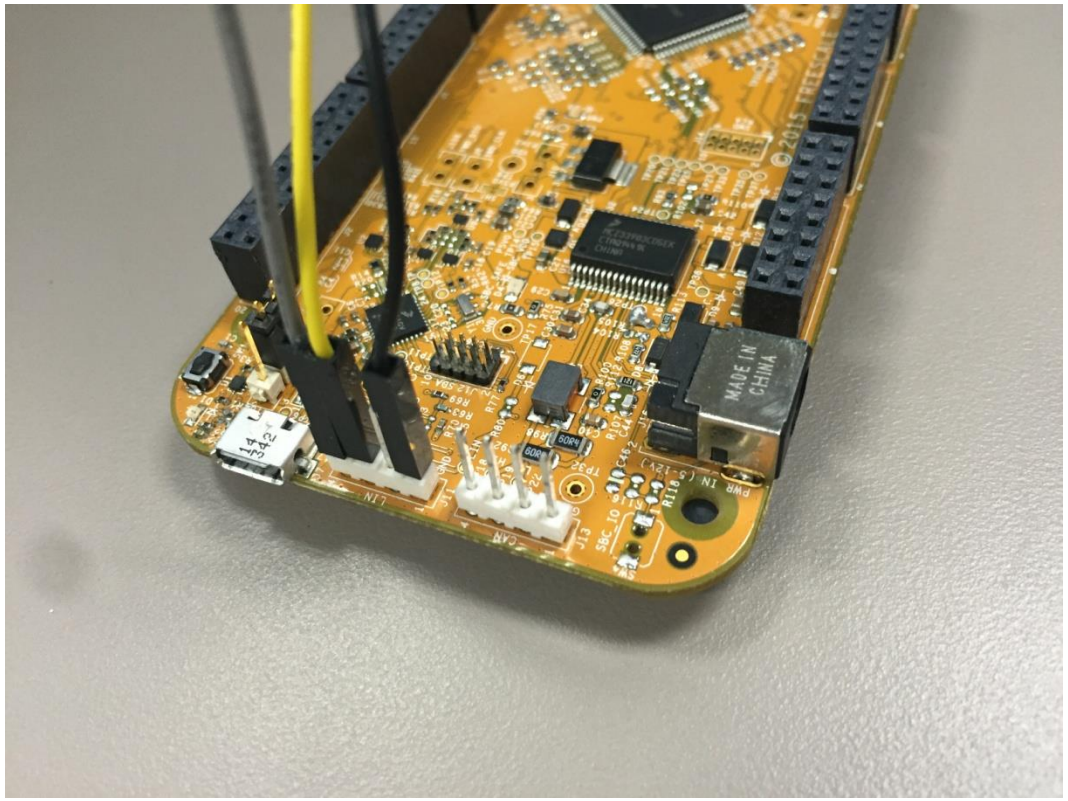
Press SW3 and watch state of Pin 14 change

Change Pin 22 to Analog mode and turn potentiometer to see reading on app change

Lab10. Communicate using Local Interconnect Network (LIN)

Things to Learn:

- Communicate between two FRDM boards through LIN



Overview:

LIN is a low-cost communication protocol used in automotive applications

Hardware Connections:

Two FRDM KEA Boards

One 12V Power Supply to J16 of either board

Connect LIN PHY of both boards using wires: LIN-LIN, Vsup-Vsup, GND-GND

Enable external power: Connect Pins 1 and 2 of J107 with jumper

Observation:

Potentiometer of Master controls LED of Slave

Push buttons of Slave controls LED of Master

Lab11. Control LCD Arduino Shield with KEA

Things to Learn:

- Communicate between PC, KEA, and LCD Display

Overview:

LCD is a simple way to display images, which may communicate a variety of information from plain messages to interactive outputs such as ADC values.

Polling Mode: Uses UART polling to communicate with hyperterminal

Interrupt Mode: Uses UART interrupts

Hardware Connections:

DFRobot DFR0009 Arduino LCD Shield: ~US$20

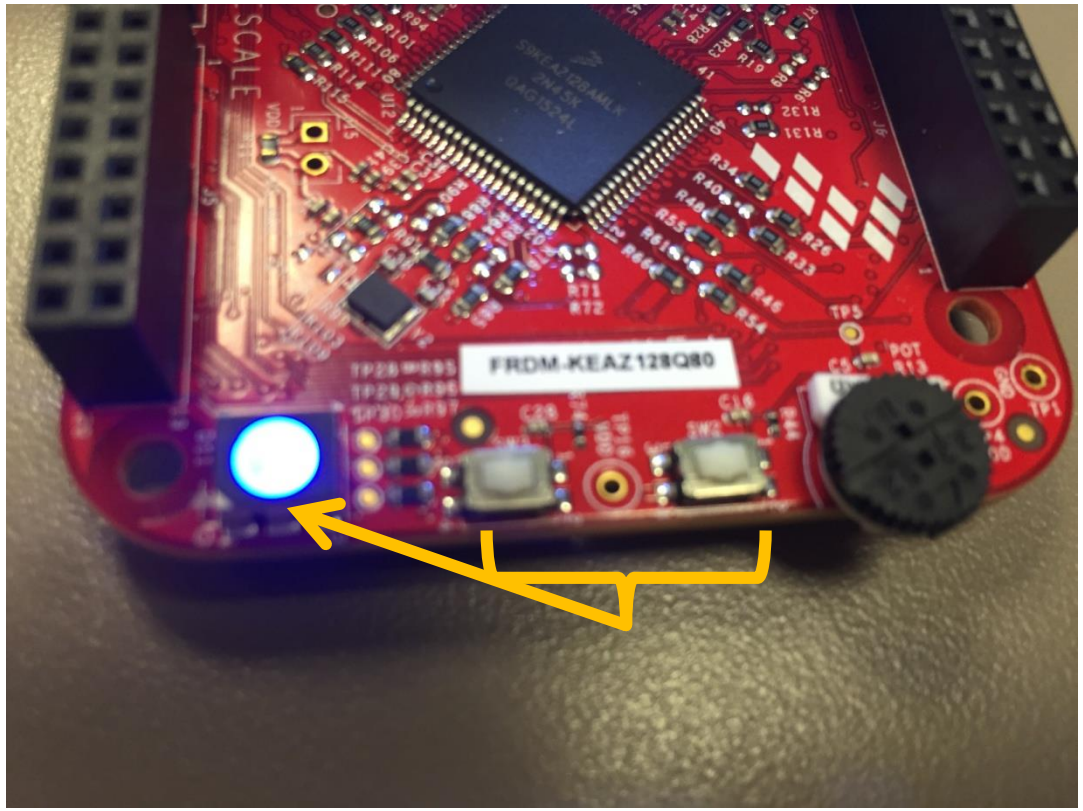
Hardware connection to computer using microUSB to USB adapter

Additional Software:

Hyperterminal software such as Putty (installation instructions shown before Lab8)

Set baud rate to 115200

Lab11. Control LCD Arduino Shield with KEA



Observation 1:

RGB LED will shine blue. It uses the FTM in Edge-Aligned PWM mode.

This code example also uses keyboard interrupts to regulate the duty cycle. Pushing SW2 brightens the LED by increasing the duty cycle while SW3 dims the LED by decreasing it.

Lab11. Control LCD Arduino Shield with KEA

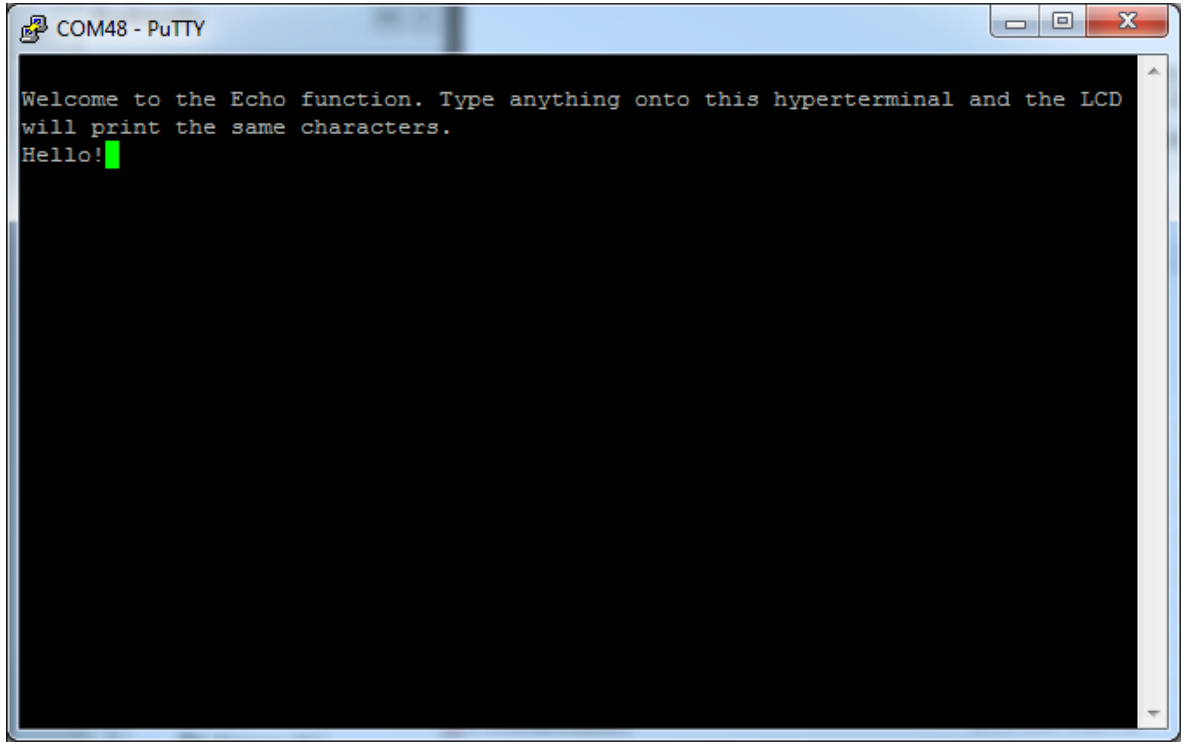
Observation 2:

On startup, the LCD prints “Welcome!”

You can then cycle between four LCD functions by pressing the ‘Select’ button the LCD shield. Demo uses RTC interrupt to time push button checks

The first function prints a message and continually scrolls the display back-and-forth to display it in its entirety.

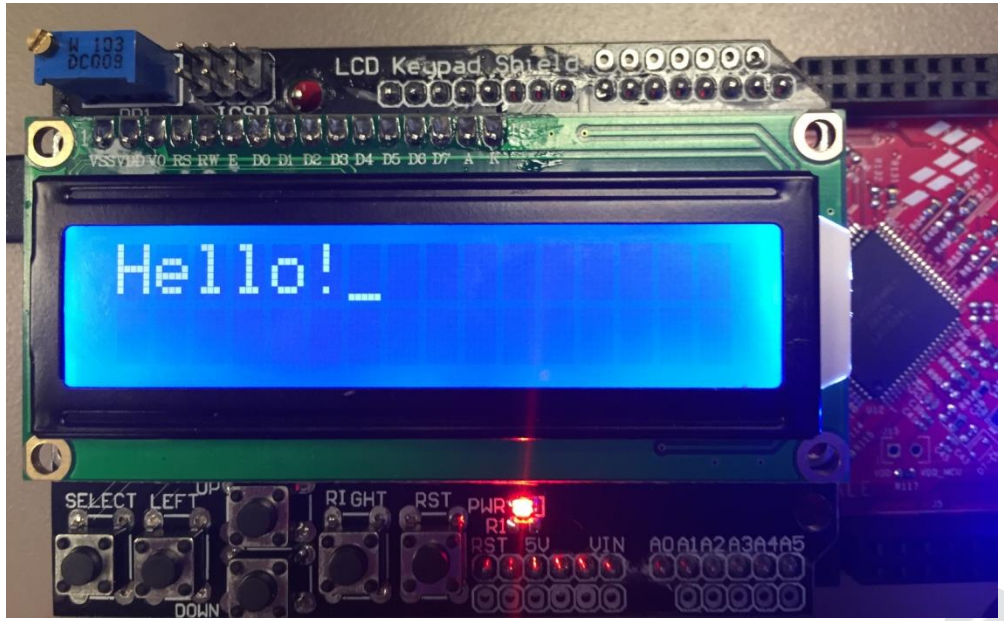
Lab11. Control LCD Arduino Shield with KEA



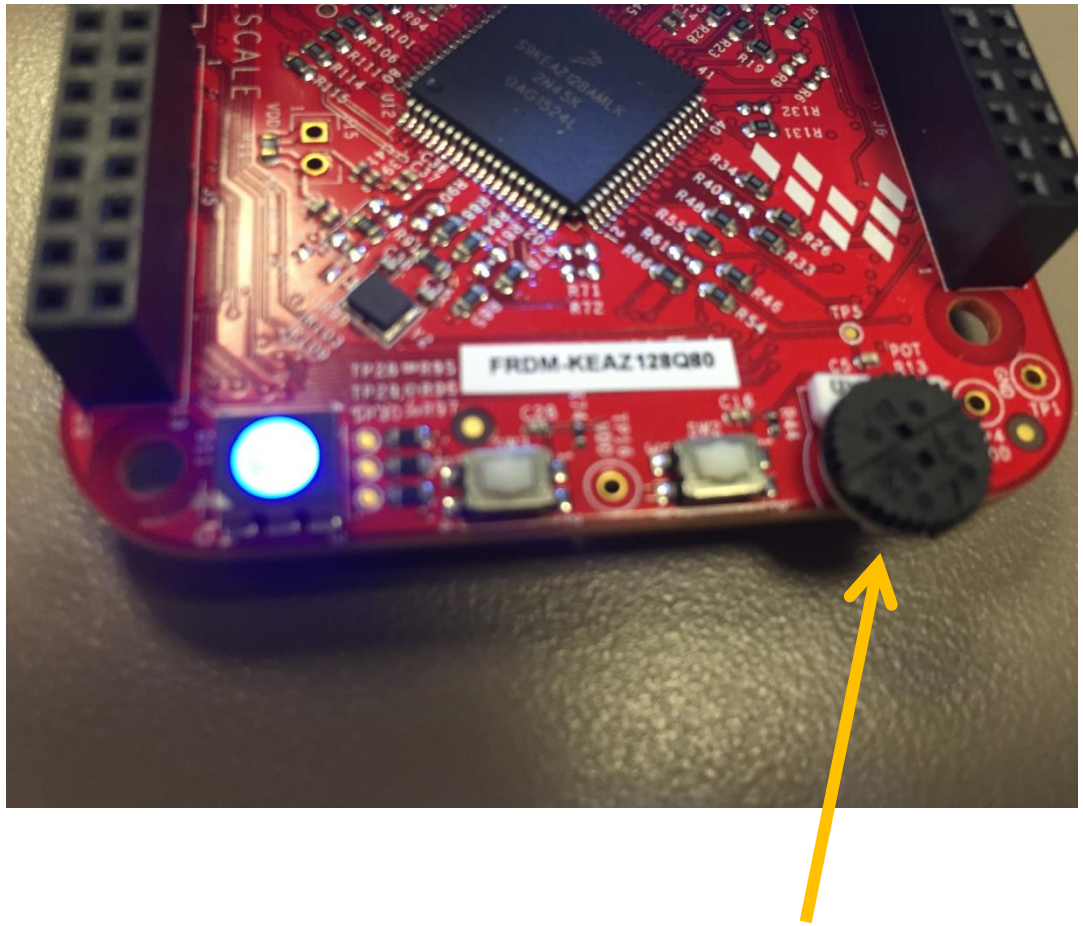
Observation 3:

The second LCD function prints on the LCD whatever you type into your hyperterminal.

Communicates with KEA over UART, which forwards the information to the LCD using GPIO

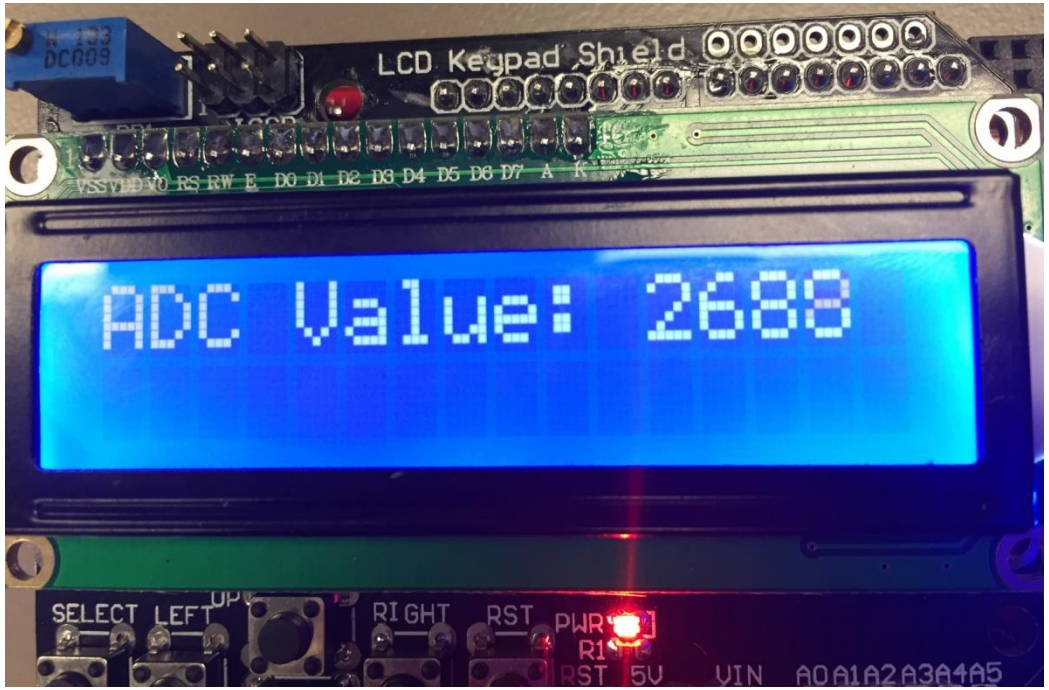


Lab11. Control LCD Arduino Shield with KEA



Observation 4:

The third LCD function prints the ADC value of the KEA potentiometer



Lab11. Control LCD Arduino Shield with KEA

Observation 5:

The fourth LCD function prints the answer to a simple arithmetic problem of your choosing

Type into the hyperterminal an arithmetic operation of two operands. Each operand can be any positive integer up to 9999. The LCD will print the answer up to two decimal point precision

Examples: 4+4, 333*9875, 195/255, 9000-9005

```
5
Please enter simple arithmetic problem
 a max of 4 digits per operand (no high

Type your problem and press Enter
100-1005
```

Lab11. Control LCD Arduino Shield with KEA

Observation 6:

The fifth LCD function is a mimic of a magic 8-balls.

Type a question into the UART terminal (make sure you end the sentence with a '?') and hit *Enter*

LCD will print you an answer to your question!

The function uses a random number generator to choose a response.

```
Welcome to the Fortune function. Type any question to the hyperterminal and pres
s Enter. The LCD will display your fortune!
Is this the ooolest demo ever?!?
```

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