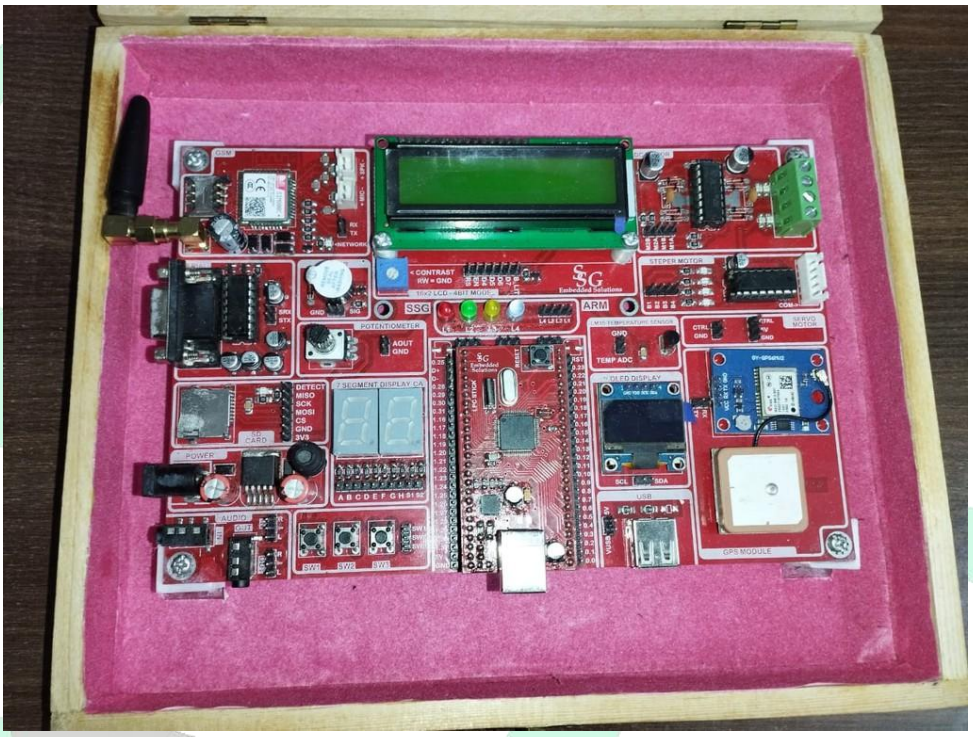
LPC2148 DEVELOPMENT BOARD



“Level up your hardware game. 32-bit ARM7 power, ready to build from Day 1."

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INTRODUCTION

Every electronics engineer loves to break electronics things and explore what is present inside it. Recently I opened an LED TV and found ARM Chip inside it. ARM based microcontrollers are heavily used in various types of embedded products and systems.

They comprise many advanced features that make them powerful and superior to other microcontrollers such as 8051, AVR and PIC. LPC2148 is one of the most commonly used ARM based Microcontroller. ARM (Advanced RISC Machines) originally known as Acorn RISC Machine is a family of reduced instruction set computing (RISC) architecture for computer processors, configured for various environments.

Arm holdings is a British company who developed this architecture and licensed it to other companies, who design their own product by using this architecture.

ARM processor is widely found in electronics products such as LED TV, mobile phones, tablets, multimedia devices, gaming devices etc. Even popular electronics company like Apple's mobiles and iPods, Raspberry pi 3 uses ARM architecture and Arm processor in it. Arm Architecture Examples: ARM7, ARM9, ARM11, CORTEX.

LPC2148 Microcontroller

The LPC2148 microcontroller is designed by Philips (NXP Semiconductor) with several in-built features & peripherals. Due to these reasons, it will make more reliable as well as the efficient option for an application developer. LPC2148 is a 16-bit or 32-bit microcontroller based on ARM7 family.

Features of LPC2148

The main features of LPC2148 include the following.

- The LPC2148 is a 16 bit or 32 bit ARM7 family based microcontroller and available in a small LQFP64 package.
- ISP (in system programming) or IAP (in application programming) using on-chip boot loader software.

- On-chip static RAM is 8 kB-40 kB, on-chip flash memory is 32 kB-512 kB, the wide interface is 128 bit, or accelerator allows 60 MHz high-speed operation.
- It takes 400 milliseconds time for erasing the data in full chip and 1 millisecond time for 256 bytes of programming.
- Embedded Trace interfaces and Embedded ICE RT offers real-time debugging with high-speed tracing of instruction execution and on-chip Real Monitor software.
- It has 2 kB of endpoint RAM and USB 2.0 full speed device controller. Furthermore, this microcontroller offers 8kB on-chip RAM nearby to USB with DMA.
- One or two 10-bit ADCs offer 6 or 14 analogs i/ps with low conversion time as 2.44 μs/ channel.
- Only 10 bit DAC offers changeable analog o/p.
- External event counter/32 bit timers-2, PWM unit, & watchdog.
- Low power RTC (real time clock) & 32 kHz clock input.
- Several serial interfaces like two 16C550 UARTs, two I2C-buses with 400 kbit/s speed.
- 5 volts tolerant quick general purpose Input/output pins in a small LQFP64 package.
- Outside interrupt pins-21.
- 60 MHz of utmost CPU CLK-clock obtainable from the programmable-on-chip phase locked loop by resolving time is 100 μs.
- The incorporated oscillator on the chip will work by an exterior crystal that ranges from 1 MHz-25 MHz
- The modes for power-conserving mainly comprise idle & power down.
- For extra power optimization, there are individual enable or disable of peripheral functions and peripheral CLK scaling.

Memory

The LPC2148 microcontroller has 512-kB on-chip FLASH memory as well as 32-kB on-chip SRAM. Also, this microcontroller includes inherent support up to 2kB finish point USB RAM. This memory is well matched for all the microcontroller applications.

On-chip FLASH Memory System

This microcontroller includes a 512-kB Flash memory system and this memory may be useful for both the data storage as well as code. The programming of this memory can be done by the following.

- By incorporating JTAG interface in serial
- Using UART or ISP (in system programming)
- Capabilities of IAP (In Application Programming)

The IAP function Based application program may also remove while the program is running. Whenever the microcontroller LPC2148 on-chip boot-loader is utilized, then 500 kB of Flash memory is obtainable for consumer code. The Flash memory of this microcontroller offers the smallest amount of 100,000 writes/erase cycles as well as 20-years of data preservation.

On-chip SRAM

This microcontroller offers static RAM with 32-kB and very useful for data storage or code. It is accessible for 8-bits, 16-bits, & 32-bits.

Input/Output Ports

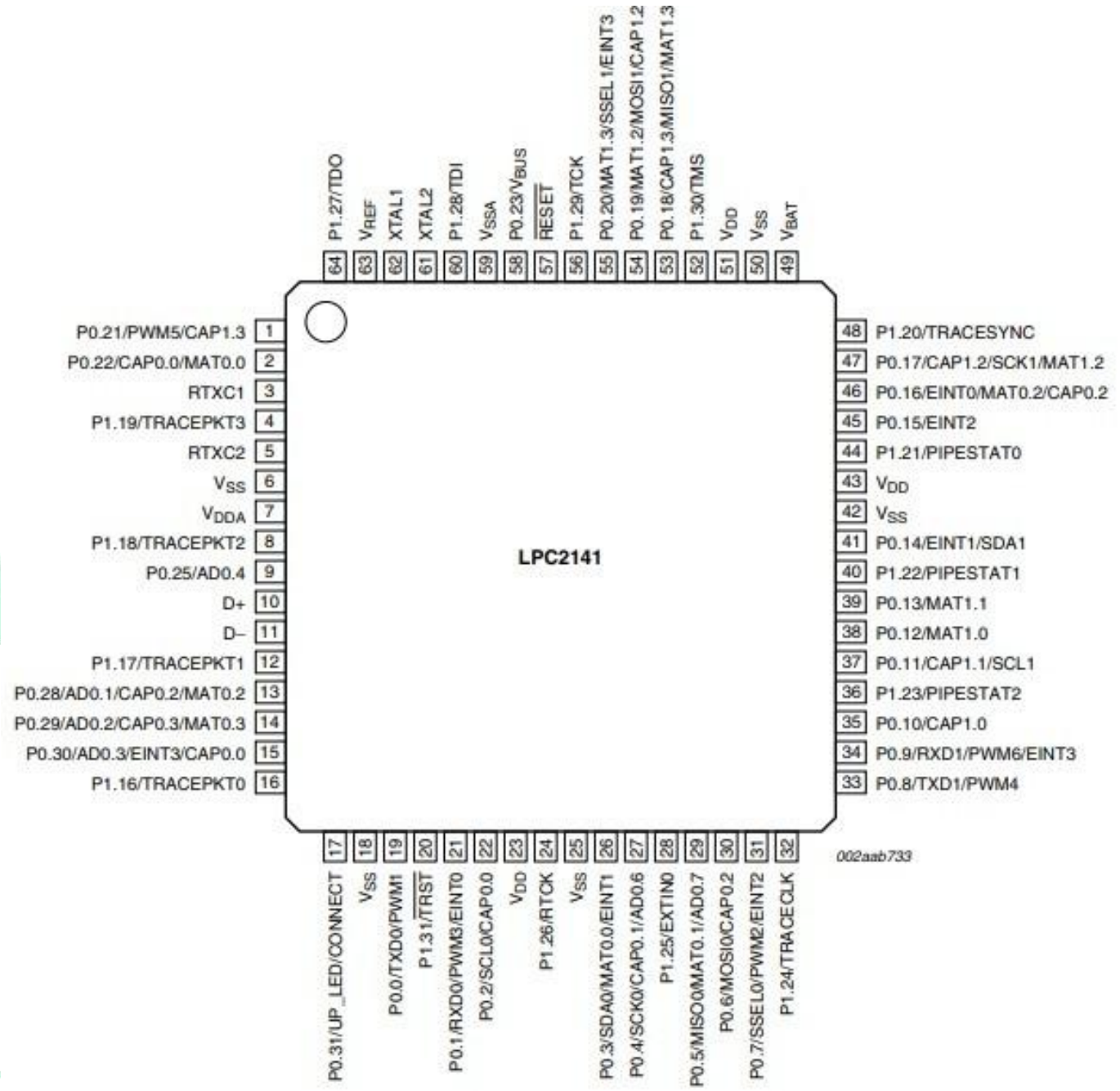
The LPC2148 microcontroller has two input/output ports and these are termed as P0 &P1. Every port pins are branded with PX.Y. Here, 'X' denotes port number like 0 or 1, whereas 'Y' denotes pin number 0-31. All the pins can execute alternate tasks also. For instance, P0.8 provides as GPIO and Tx pin of the UART1, AD1.1, PWM4. On RST (RESET), every pin is arranged as GPIO.

How to Start with Programming?

The initial step toward lpc2148 programming is an arrangement of GPIO Pins. So here are the related concepts as well as registers. The general purpose I/O port pins in LPC2148 includes P0.0 to P0.31 and P1.16 to P1.31, and actually, these pins are available based on the alternate function utilization.

Port-0 and Port-1 are 32-bit Input/output ports, and every bit of these ports can be controlled by an individual direction. The operations of port-0 & port-1 depend upon the function of a pin that is selected using the pin connected block. In Port-0, pins like P0.24, P0.26 & P0.27 are not obtainable whereas, in Port-1, the Pins 0 to 15 are not obtainable. Here, both the pins like Port-0 & Port-1 are controlled by two groups of registers discussed below.

LPC2148 Pin Conflguration



Pin1-(P0.21/ PWM5CAP1.3/ AD1.6)

- P0.21 is a GPIO pin (general purpose I/O pin)

- AD1.6 is obtainable in LPC2144/46/48 microcontrollers only where an AD1.6 denotes ADC-1, i/p-6.
- PWM5 is a pulse width modulator output-5.
- CAP1.3 is a Capture i/p for Timer-1, channel-3

Pin2-(P0.22/ CAP0.0/AD1.7/ MAT0.0 2

- P0.22 is a GPIO digital pin
- AD1.7 pin is available in LPC2144/46/48 only where an AD1.7 denotes ADC-1, input-7
- CAP0.0 is a capture input pin for Timer-0, channel-0.
- MAT0.0 is a match o/p for Timer-0, channel-0

Pin3-RTXC1 3

It is an I/p to the RTC-oscillator circuit

Pin4- TRACEPKT3/ P1.19

- TRACEPKT3 is a trace packet, bit-3, standard input/output port by the inner pull-up.
- P1.19 is a GPIO digital pin

Pin5-RTXC2

This is an output pin from the RTC oscillator circuit

Pin6, Pin18, Pin25, Pin42, and Pin50

These pins are a ground reference

Pin7-VDDA

This pin is an analog voltage power supply (3.3V), and this voltage is very useful for the on-chip analog to digital converters and digital to analog converters.

Pin8- P1.18/TRACEPKT2

- P1.18 is a GPIO digital pin

- TRACEPKT2 is a trace packet, bit-2, standard input/output port by the inner pull-up.

Pin9- P0.25/AOUT/AD0.4

- P0.25 is a GPIO digital pin I
- AD0.4 denotes ADC-0, input-4

- Aout- the output of DAC and that is accessible only in LPC2142/ LPC2144/ LPC2146/ LPC2148

Pin10- D+

This pin is a USB bidirectional D+ line

Pin11- D-

This pin is a USB bidirectional D- line

Pin12-P1.17/TRACEPKT1

- P1.17 is a GPIO digital pin
- TRACEPKT1 is a trace packet, bit-1, standard input/output port by the inner pull-up.

Pin13-P0.28/ CAP0.2/ AD0.1/MAT0.2

- P0.28 is a GPIO digital pin
- AD0.1 denotes ADC-0, input-1
- CAP0.2 is a capture i/p for Timer-0, channel-2.
- MAT0.2 is a match o/p for Timer-0, channel-2

Pin14-P0.29/ CAP0.3/ AD0.2/MAT0.3

- P0.29 is a GPIO digital pin
- AD0.2 denotes ADC-0, input-2
- CAP0.3 is a capture i/p for Timer-0, channel-3.
- MAT0.3 is a match o/p for Timer-0, channel-3

Pin15-P0.30/ EINT3/ AD0.3/CAP0.0

- P0.30 is a GPIO digital pin
- AD0.3 denotes ADC-0, input-3
- EINT3 is an external interrupt 3-input.
- CAP0.3 is a capture i/p for Timer-0, channel-0.

Pin16- P1.16/TRACEPKT0

- P1.16 is a GPIO digital pin
- TRACEPKT1 is a trace packet, bit-0, standard input/output port by inner pull-up

Pin17-P0.31/UP_LED/CONNECT

- P0.31 is a GPIO digital pin
- UP_LED is a USB good link LED indicator. When the device is arranged then it is low and when the device is not arranged, then it is high.
- CONNECT- This signal is used to control an exterior resistor (1.5 kΩ) under the control of a software control, and it is used by the feature of Soft Connect

Pin19- P0.0/PWM/TXD0

- P0.0 is a GPIO digital pin
- TXD0 is a transmitter o/p for UART0.
- PWM1 is a pulse width modulator o/p-1.

Pin20- P1.31/TRST

- P1.31 is a GPIO digital pin
- TRST is a test reset for JTAG interface.

Pin21-P0.1/ PWM3/ RXD0/EINT0

- P0.1 is a GPIO digital pin
- RXD0 is a receiver i/p for UART0.
- PWM3 is a pulse width modulator o/p-3.
- EINT0 is an external interrupt 0-input

Pin22- P0.2/ CAP0.0/ SCL0

- P0.2 is a GPIO digital pin
- SCL0 is an I2C0 clock I/O, and open-drain o/p
- CAP0.0 is a capture i/p for Timer-0, channel-0.

Pin 23, 43, and 51- VDD

These pins are power supply voltage for the I/O ports as well as the core.

Pin24- P1.26/RTCK

- P1.26 is a GPIO digital pin
- RTCK is a returned test CLK o/p, an additional signal added to the JTAG-port. When the frequency of processor changes then it helps debugger synchronization.

Pin26- P0.3/ SDA0/ MAT0.0/EINT1

- P0.3 is a GPIO digital pin
- SDA0 is an I2C0 data I/O and open drain o/p for I2C bus observance.
- MAT0.0 is matched o/p for timer-0, channel-0.
- EINT1 is an external interrupt 1-i/p.

Pin27-P0.4/ CAP0.1/ SCK0/AD0.6

- P0.4 is a GPIO digital pin I/O
- SCK0 is a serial CLK for SPI0 and SPI CLK o/p from master/ i/p to slave.
- CAP0.1 is a capture i/p for timer-0, channel-0.
- IAD0.6 denotes ADC-0, input-6

Pin28-P1.25/EXTIN0

- P1.25 is a GPIO digital pin I/O
- EXTIN0 is an external trigger i/p, and standard input/output with inner pull-up

Pin29- P0.5/MAT0.1/MISO0/AD0.7

- P0.5 is a GPIO digital pin I/O

- MISO0 is a master in slave out for SPI0, data i/p to SPI-master/data o/p from SPI slave.
- MAT0.1 is a match o/p for timer-0, channel-1.
- AD0.7 denotes ADC-0, input-7.

Pin30-P0.6/MOSI0/CAP0.2/AD1.0

- P0.6 is a GPIO digital pin I/O
- MOSI0 is a master out slave in for SPI0, and data o/p from SPI master/ data i/p to SPI slave.
- CAP0.2 is a capture i/p for Timer-0, channel-2.

Pin31-P0.7/ PWM2/ SSEL0/EINT2

- P0.7 is a GPIO digital pin I/O
- SSEL0 is a slave select for SPI0 and chooses the SPI-interface as a slave.
- PWM2 is a pulse width modulator output-2.
- EINT2 is an external interrupt 2-input.

Pin32-P1.24/TRACECLK

- P1.24 is a GPIO digital pin I/O.
- TRACECLK is a trace CLK and standard input/output port with inner pull-up

Pin33-P0.8/TXD1/PWM4/AD1.1

- P0.8 is a GPIO digital pin I/O
- TXD1 is a transmitter o/p for UART1.
- PWM4 is a pulse width modulator o/p-4.
- AD1.1 denotes ADC-1, input-1, and it is obtainable only in LPC2144/46/48.

Pin34- P0.9/PWM6/RXD1/EINT3

- P0.9 is a GPIO digital pin I/O
- RXD1 is a receiver i/p for UART1.
- PWM6 is a pulse width modulator o/p-6.
- EINT3 is an external interrupt 3-input

Pin35-P0.10/RTS1/CAP1.0/AD1.2

- P0.10 is a GPIO digital pin I/O
- RTS1 is requesting to send o/p for UART1 and LPC2144/46/48.
- CAP1.0 is a capture i/p for timer-1, channel-0.
- AD1.2 denotes ADC-1, input-2, and it is obtainable only in LPC2144/46/48

Pin36-P1.23/PIPESTAT2

- P1.23 is a GPIO digital pin I/O
- PIPESTAT2 is a pipeline status, bit-2., and standard Input/Output port with inner pull-up

Pin37-P0.11/ CAP1.1/CTS1/ SCL1

- P0.11 is a GPIO digital pin I/O
- CTS1 is clear to send i/p for UART1, and these are accessible only in LPC2144/46/48
- CAP1.1 is a capture i/p for timer-1, channel-1.
- SCL1 — I2C1 CLK I/O, and open drain o/p for the I2C-bus observance

Pin38-P0.12/ MAT1.0/AD1.3/ DSR1

- P0.12 is a GPIO digital pin I/O
- DSR1 is a data set ready i/p for UART1, and these are accessible only in LPC2144/46/48.
- MAT1.0 is a match o/p for timer-1, channel-0.
- AD1.3 denotes ADC input-3, and it is accessible only in LPC2144/46/48.

Pin39-P0.13/DTR1/MAT1.1/AD1.4

- P0.13 is a GPIO digital pin I/O
- DTR1 is a data terminal ready o/p for UART1 and LPC2144/46/48 only.
- MAT1.1 is a match o/p for timer-1, channel-1.
- AD1.4 denotes ADC input-4, and these are accessible only in LPC2144/46/48.

Pin40-P1.22/PIPESTAT1

- P1.22 is a GPIO digital pin I/O
- PIPESTAT1 is a pipeline status, bit-1, and standard Input/Output port with

inner pull-up

Pin41-P0.14/DCD1/EINT1/SDA1

- P0.14 is a GPIO digital pin I/O
- DCD1 is a data carrier detect i/p for UART1, and also only for LPC2144/46/48 only.

- EINT1 is an exterior interrupt 1-input.
- SDA1 is an I2C1 data I/O and an open drain o/p for I2C bus observance

Pin44:P1.21/ PIPESTAT0 44

- I/O P1.21 is a GPIO digital pin I/O
- PIPESTAT0 is a Pipeline Status, bit 0, and standard Input/Output port by the inner pull-up.

Pin45: P0.15/ EINT2/ RI1/ AD1.5 45

- I/O P0.15 is a GPIO digital pin I/O
- RI1 is a ring pointer i/p for UART1 and it is accessible only in LPC2144/46/48.
- EINT2 is an external interrupt 2-input.
- AD1.5 indicates ADC 1, input-5, and also available only in LPC2144/46/48

Pin46: P0.16/ MAT0.2/ EINT0/ CAP0.2

- P0.16 is a GPIO digital pin I/O
- EINT0 is an external interrupt0- input.
- MAT0.2 is a match o/p for Timer-0, channel -2
- CAP0.2 is a capture i/p for Timer-0, channel-2.

Pin47: P0.17/ SCK1/ CAP1.2/ MAT1.2 47

- P0.17 is a GPIO digital pin I/O
- CAP1.2 is a capture i/p for Timer-1, channel-2.
- SCK1 is a serial CLK for SSP and CLK o/p from master to slave.
- MAT1.2 is a match o/p for Timer-1, channel-2.

Pin48: P1.20/ TRACESYNC

- P1.20 is a GPIO digital pin I/O
- TRACESYNC is trace synchronization.

Pin49: VBAT

RTC power supply: This pin gives the supply to the RTC.

Pin52: P1.30/TMS

P1.30 is a GPIO digital pin I/O

TMS is a test mode select for interfacing of JTAG.

Pin53: P0.18/CAP1.3/ MISO1/MAT1.3

- P0.18 is a GPIO digital pin I/O
- CAP1.3 is a capture i/p for Timer 1, channel 3.
- MISO1 is a master In Slave-out for SSP, and data i/p to SPI- master

Pin54: P0.19/ MOSI1/MAT1.2/ CAP1.2

- P0.19 is a GPIO digital pin I/O.
- MAT1.2 denotes match o/p for Timer 1, channel 2.
- MOSI1 is a master out slave for SSP master.
- CAP1.2 is a capture i/p for Timer 1, channel 2.

Pin 55: P0.20/ SSEL1/ MAT1.3/ EINT3

- P0.20 is a GPIO digital pin I/O.
- MAT1.3 is a match o/p for Timer 1, channel 3. I
- SSEL1 is a Slave Select designed for SSP. Here, chooses the interface of SSP as a slave.
- EINT3 is an external interrupt 3-input.

Pin56: P1.29/TCK

- P1.29 is a GPIO digital pin I/O
- TCK is a test CLK for an interface of JTAG.

Pin57: External Reset Input

The device can be rearranged by a LOW on this pin, effecting Input/Output ports as well as peripherals for obtaining on their default conditions, & processor execution begins at address 0.

Pin58: P0.23/VBUS

- P0.23 is a GPIO digital pin I/O
- VBUS specifies the existence of USB-bus power

Pin59: VSSA

VSSA is an analog ground, and this must be the similar voltage like VSS, although it should be separated to reduce error and noise

Pin60: P1.28/TDI 60

- P1.28 is a GPIO digital pin I/O
- TDI pin is a test data is used for interfacing JTAG

Pin61: XTAL2

XTAL2 is an o/p from the oscillator amplifier

Pin62: XTAL1

XTAL1 is an i/p to the internal CLK generator as well as oscillator circuits

Pin63: VREF-ADC Reference

This pin should be nominally equal or less than to the voltage VDD although it should be separated for reducing error as well as noise.

Pin64: P1.27/TDO 64

- P1.27 is a GPIO digital pin I/O
- TDO is a test data out used for interfacing JTAG.

Thus, this is about ARM 7 based LPC2148 microcontroller pin configuration

Applications

Embedded System: Consumer electronics, medical medical devices, and automotive control system, due to its compact size and low power consumption.

IoT: LPC2148 can collect data from sensor and send it to the cloud or other devices using wireless communication protocol like WIFI, Bluetooth, or MQTT.

Robotics: LPC2148 can serve as brain of robots. It can control motor, sensors, and provide the necessary processing power for robot navigation, manipulation, and communication.

Installing Software

KEIL uVision 5 Installation

Step 1 - get the installation file

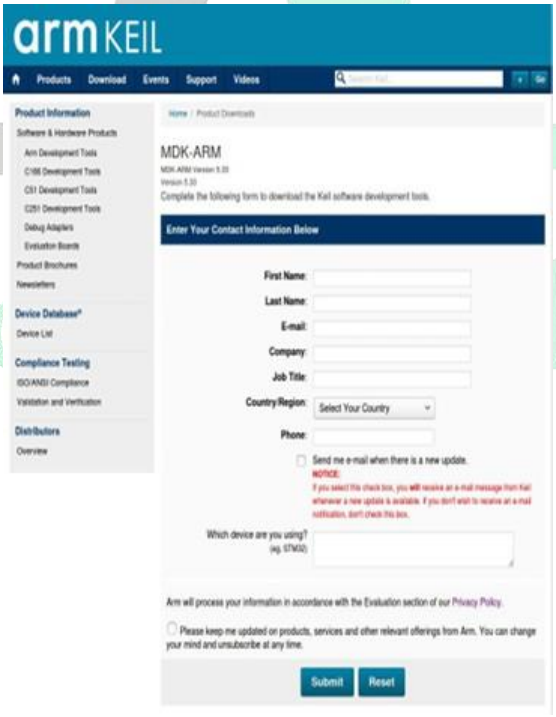
The first step to installing the development software we will be using this quarter is to get the program which comes in a self-installing .exe file. Get the file but don't run the installation until further instructions are give.

1) Go to https://www.keil.com/download/product/ page and select MDK-Arm. Download the installer program (a file likely named mdk533.exe). This is a big file, about 924 megabytes, so download when you have a good internet

connection.

2) You likely will be asked to register. There is no cost to getting the Keil development software but it will run in its "lite" mode. Actually, it is the full version but is limited to 32k bytes of user program. This likely will not be a limitation for this class.

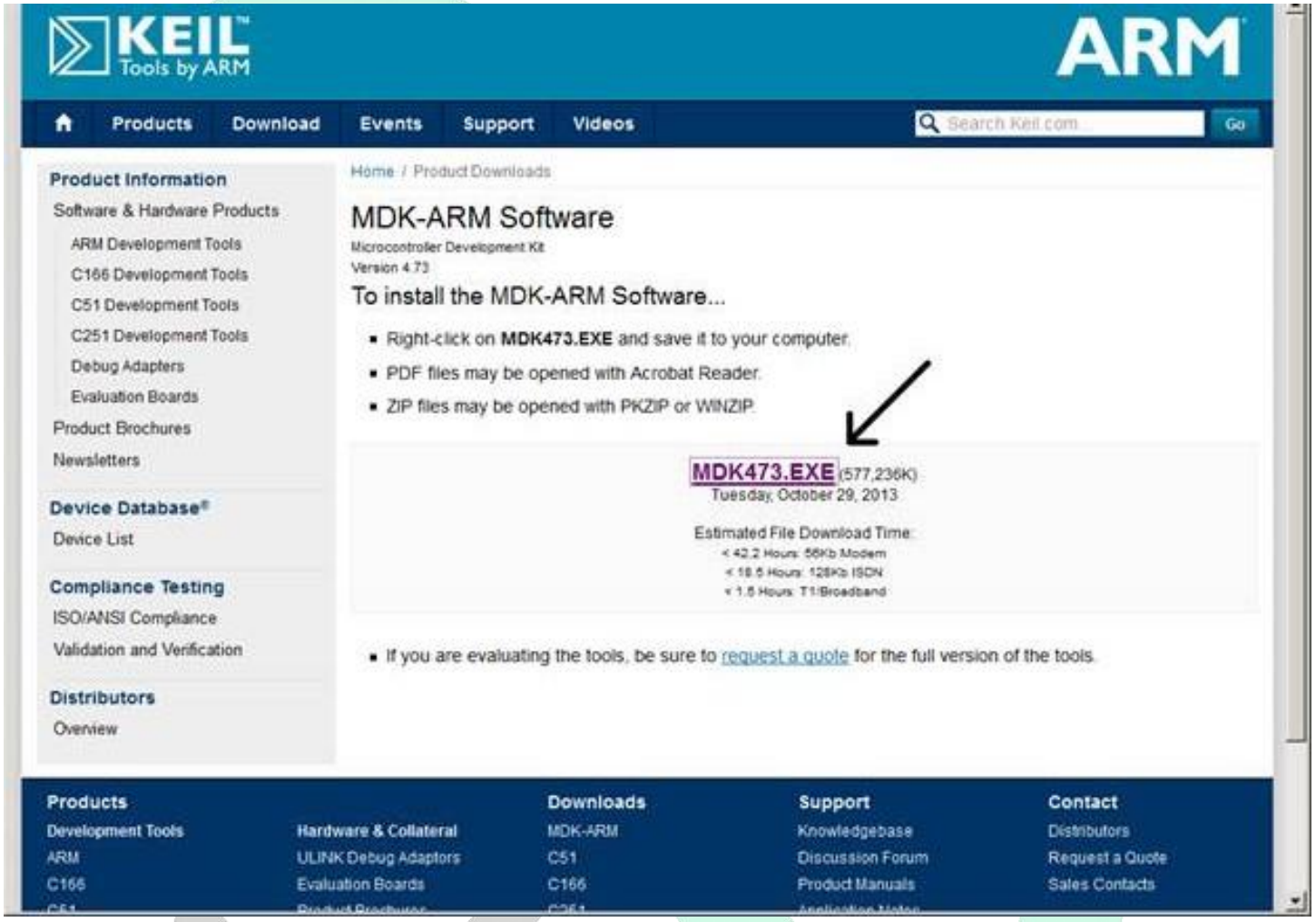
The registration page.



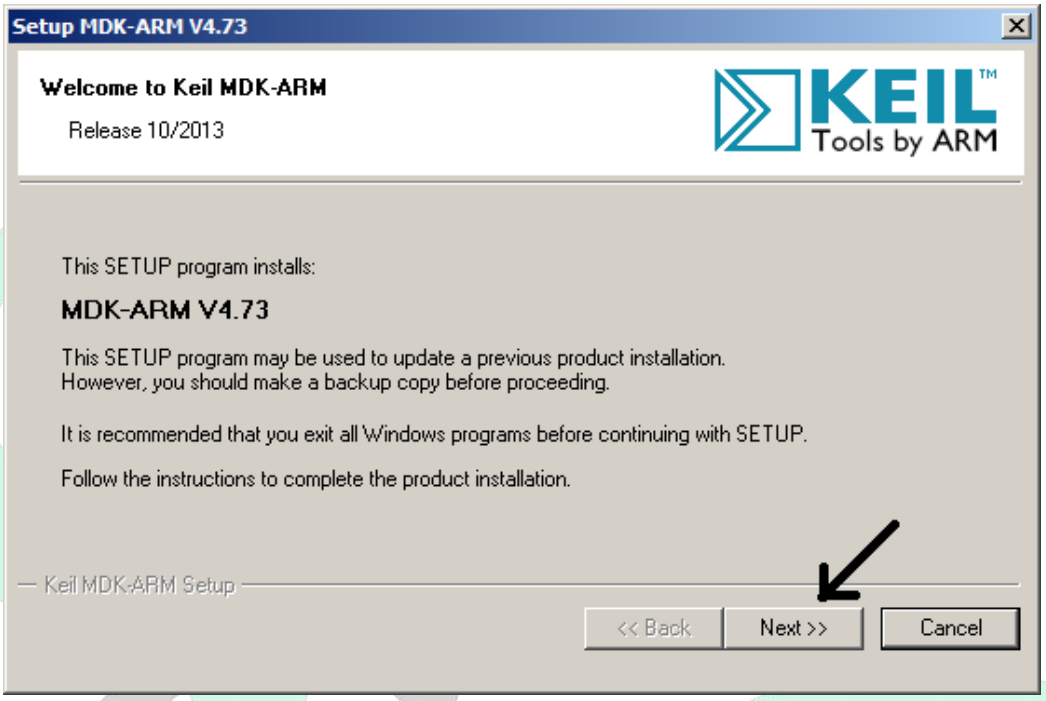
After answering the registration questions the download page should appear.

Click on MDK533.EXE and a download destination may appear or it may just

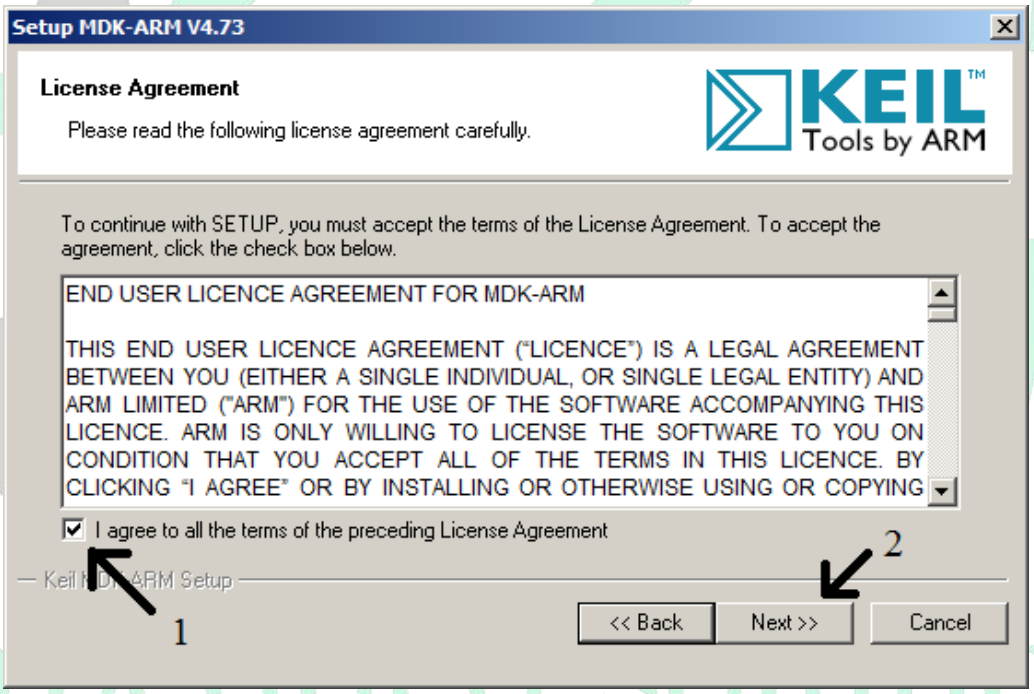
begin downloading to your downloads folder. As noted, it is a large file (924 MegaBytes) and may take a while to download.



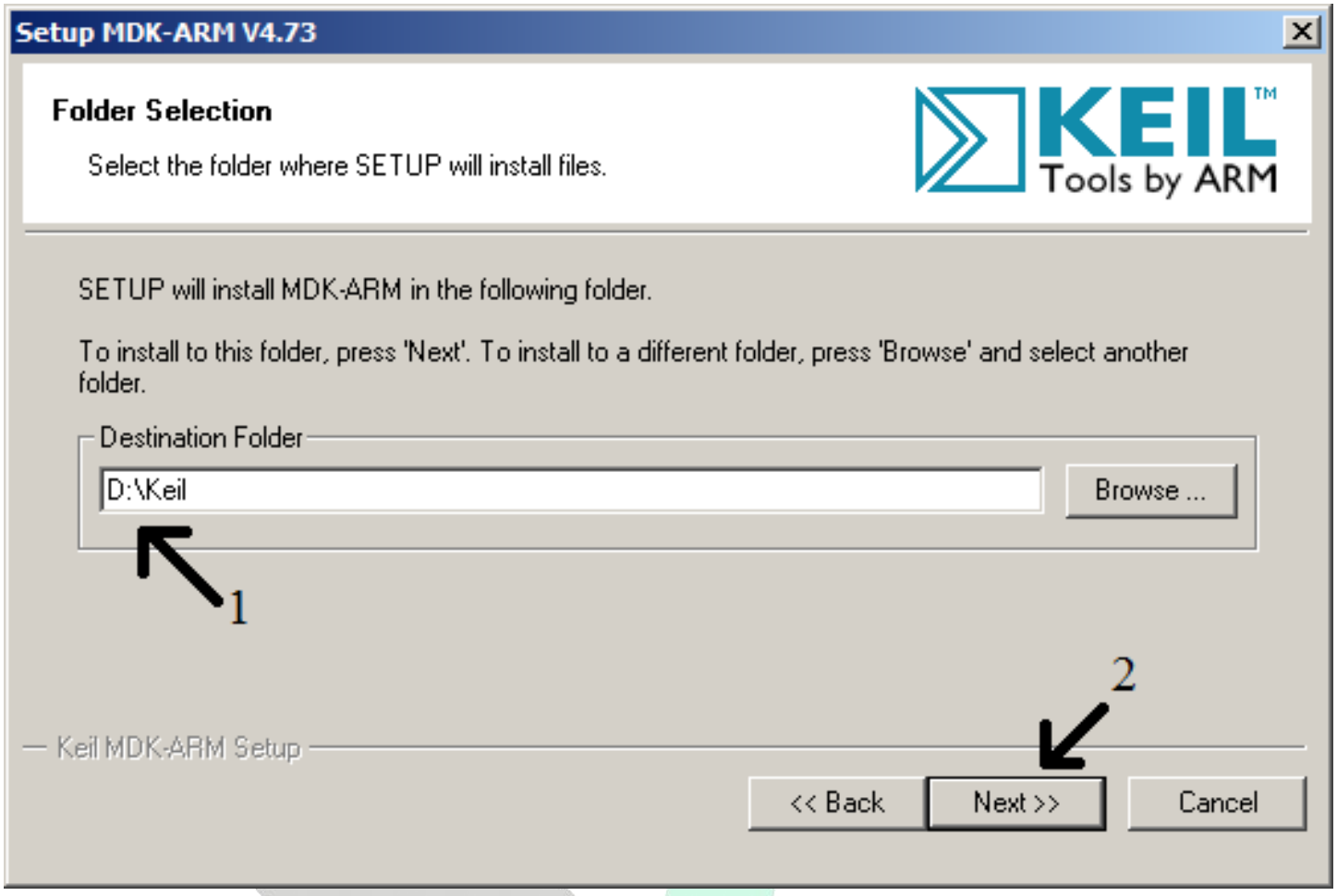
3) Execute the **mdk473.exe** file, installing the application some place easy to find, like C:\Keil or D:\Keil. This is the first screen:



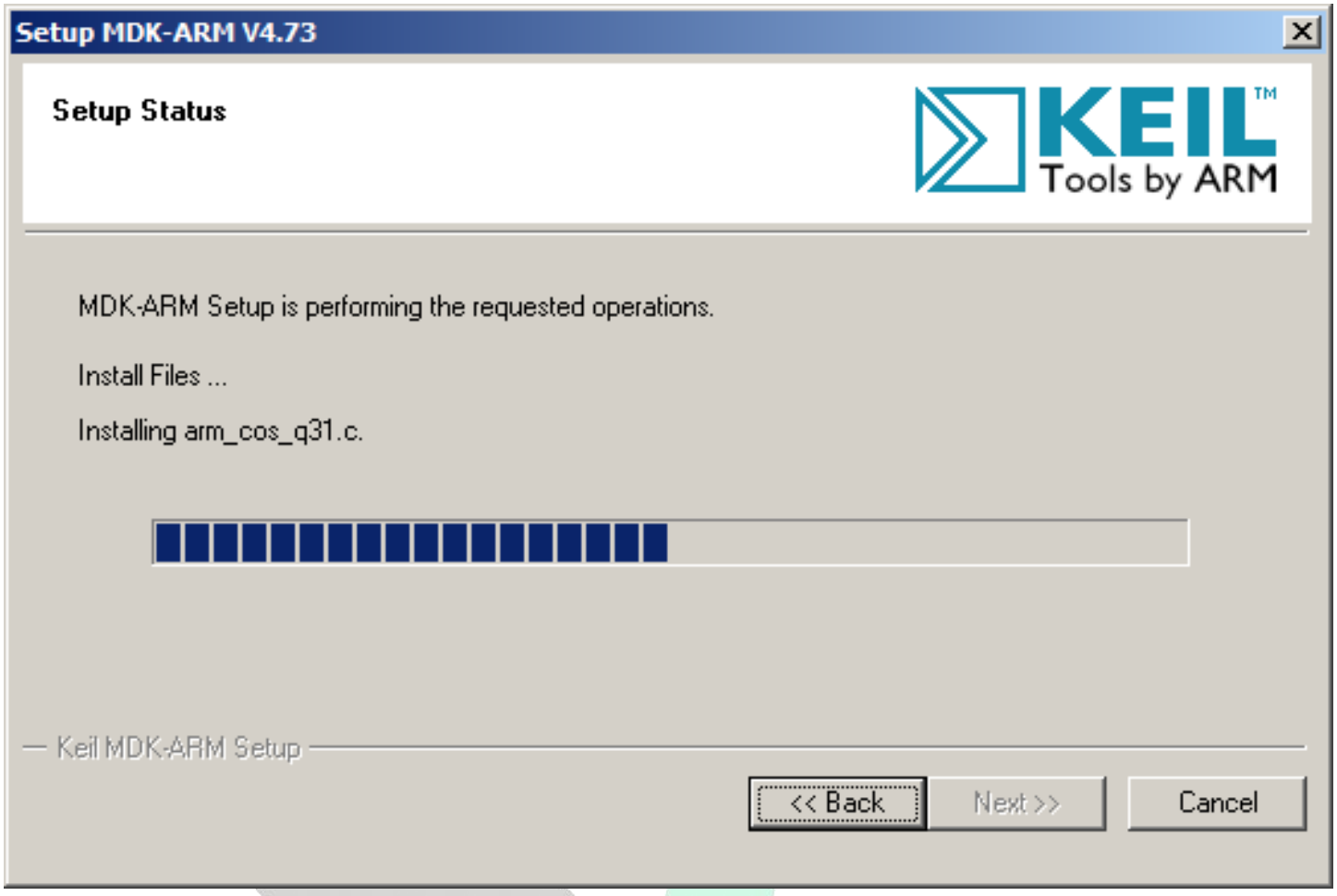
4) Read license agreement, agree to terms, and click **Next**.



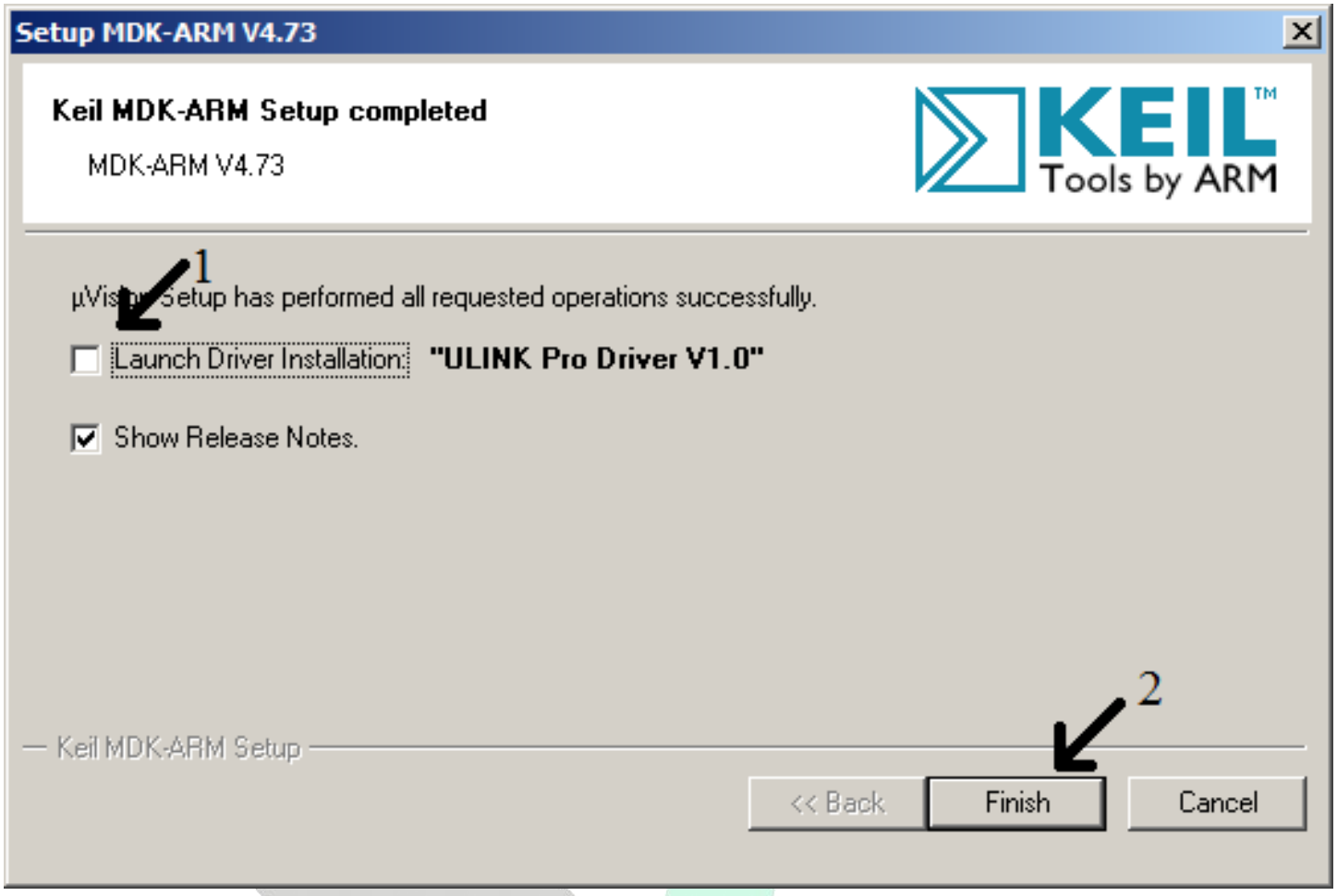
5) Select a place to install Keil (I chose D: because there was more room on the computer on drive D), and click **Next**.



6) Wait while it installs



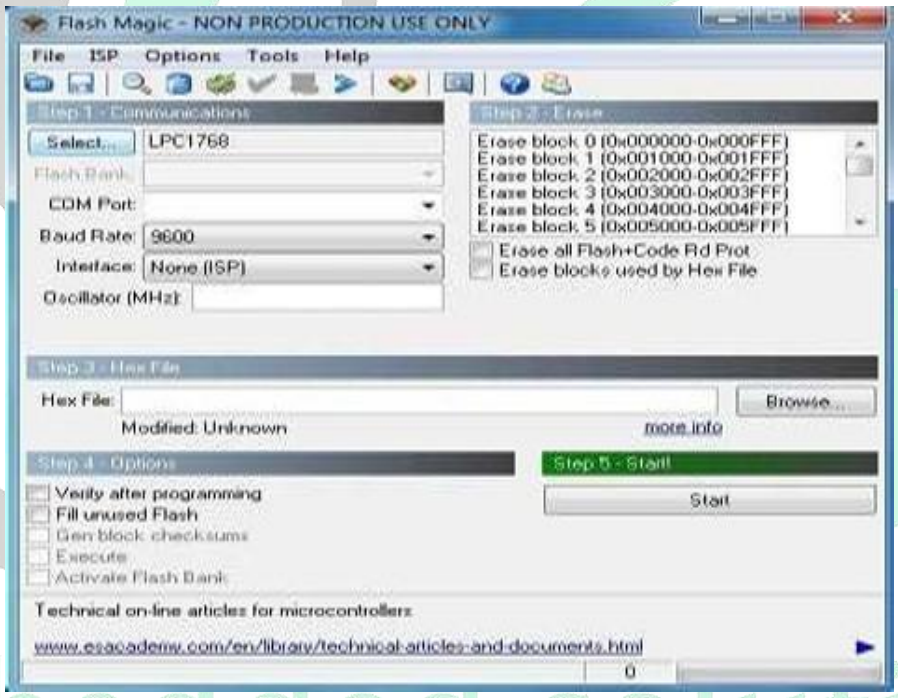
8) Deselect ULINK Pro Driver V1.0 (the drivers you need will be installed later), and click **Finish**.



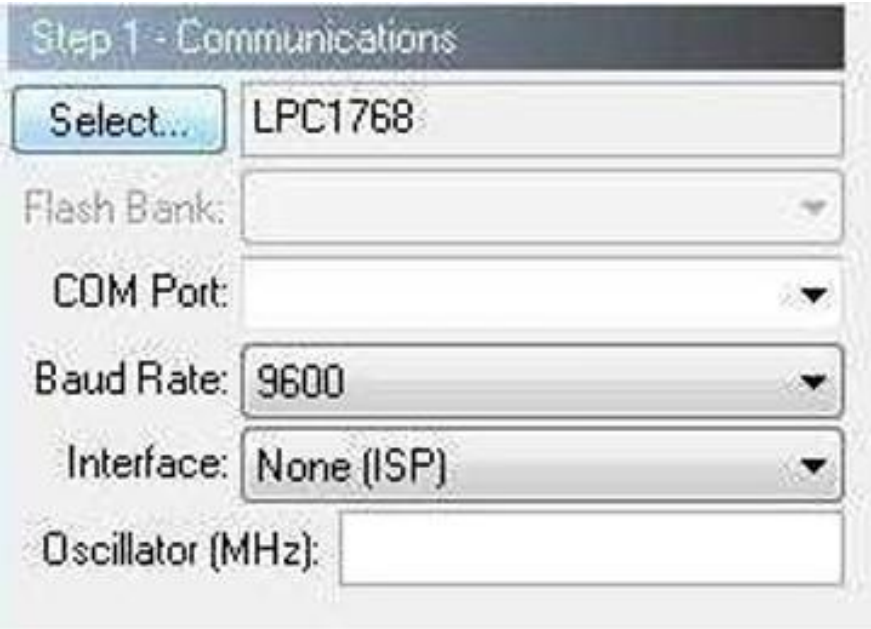
The **Release Notes** contain links to information about the Keil development tool.

Now we're done, install Keil to Program 8051 Microcontroller under windows.

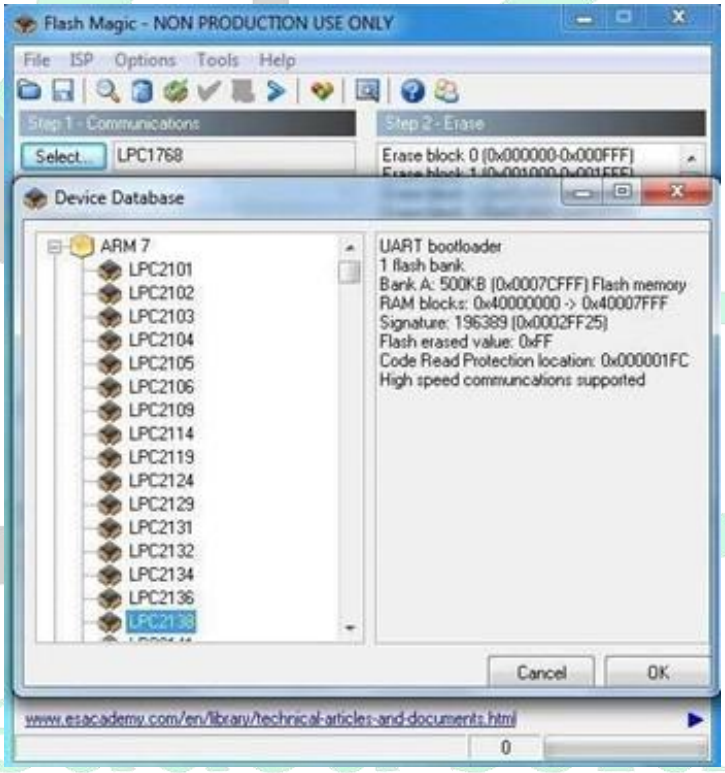
Flash Magic is a PC tool for programming flash based microcontrollers from NXP using a serial or Ethernet protocol while in the target hardware.



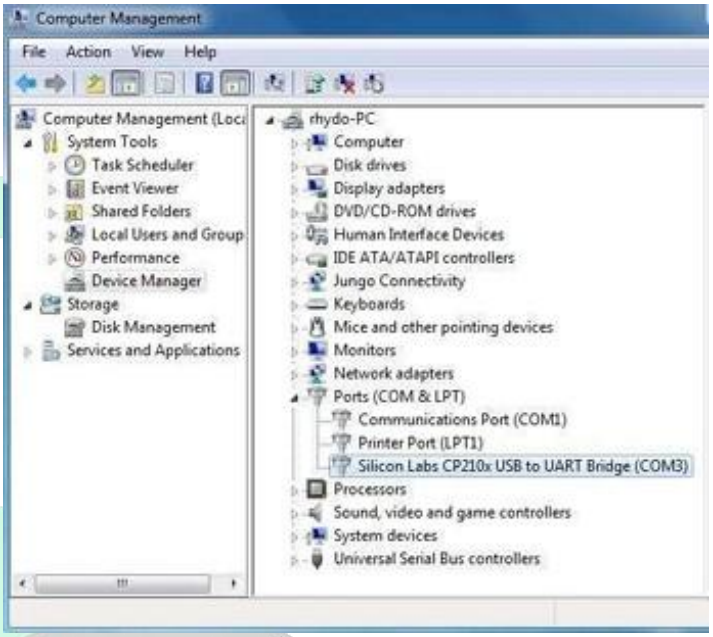
Step 1 : Communication



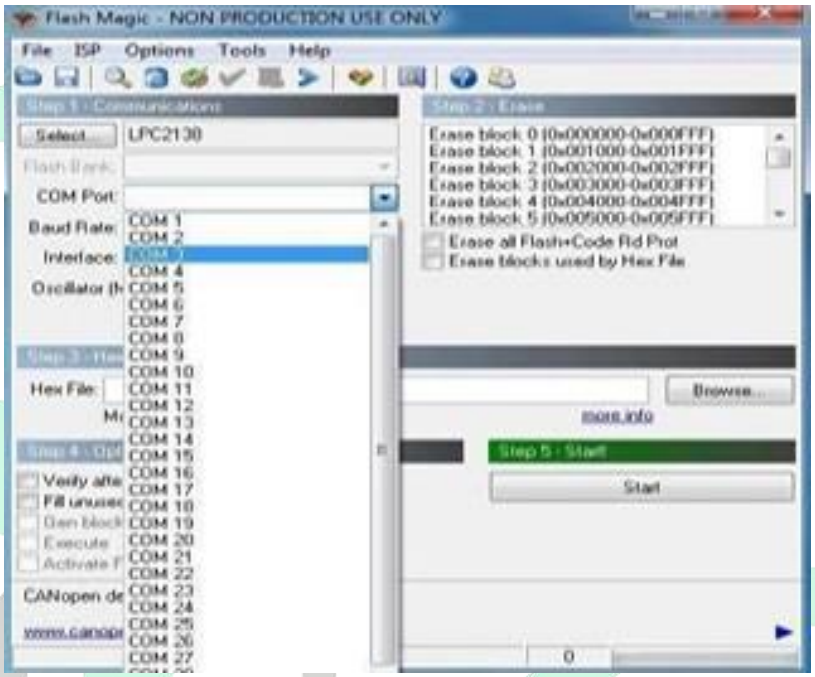
- Select your target device



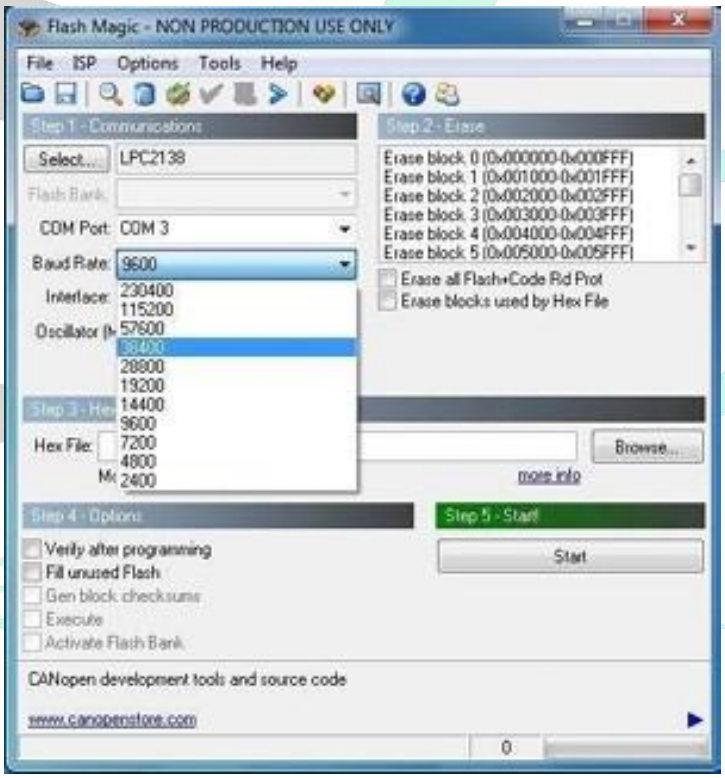
- Check for the COM port in device manager if you are using USB.



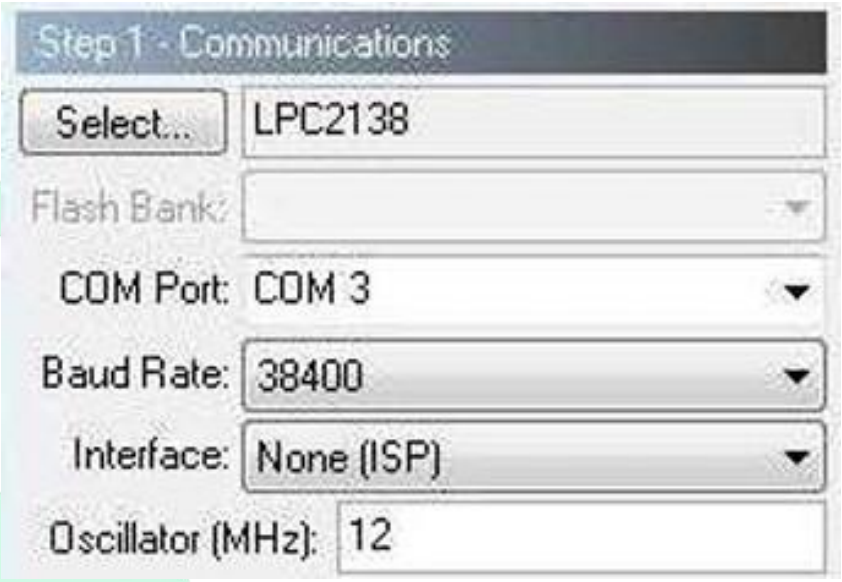
- Select your com port.



- Select baud rate for program to the target.

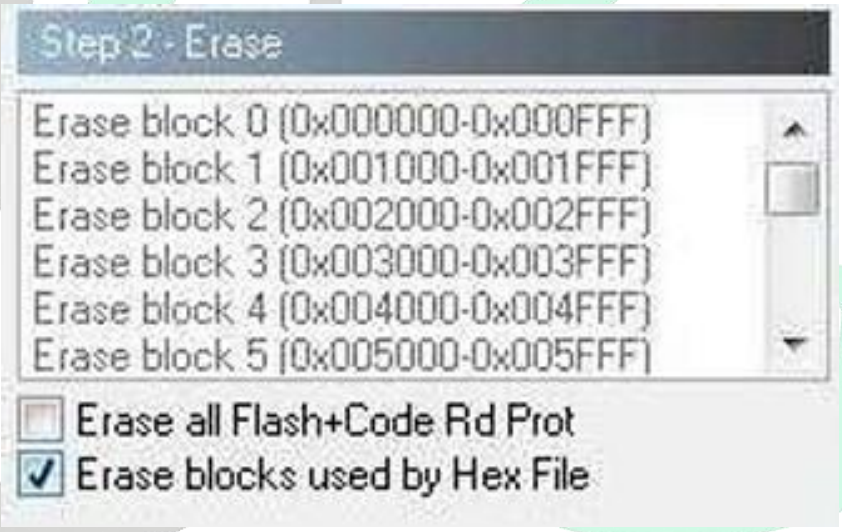


- Select your interface if you are using DB-9 then it will be None (ISP).
- Give your oscillator frequency in MHz.



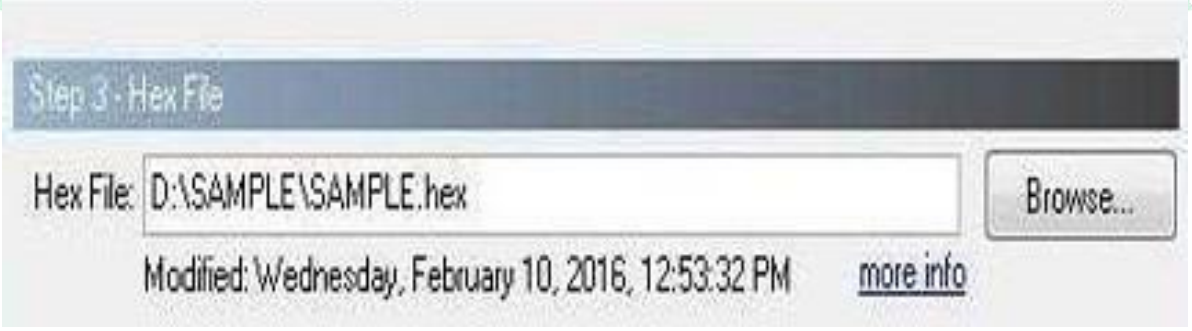
Step: Erase

- Tick erase block used hex file.



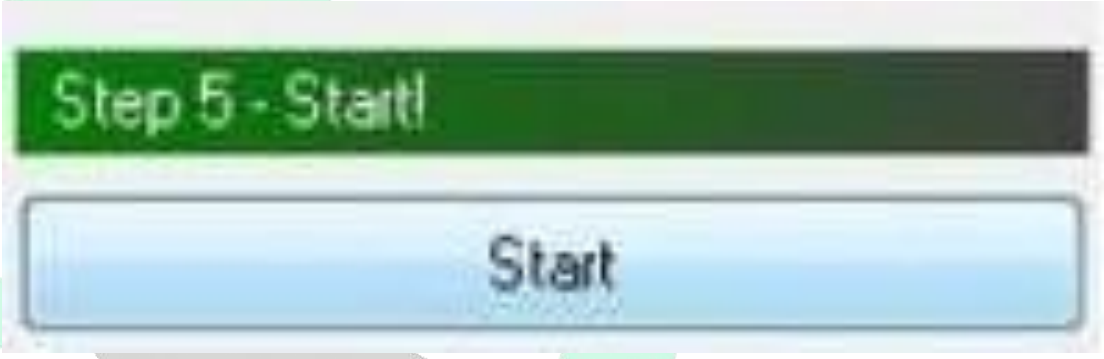
Step 3 : Hex file

- Browse the path of your Hex file which is to be loaded on chip.

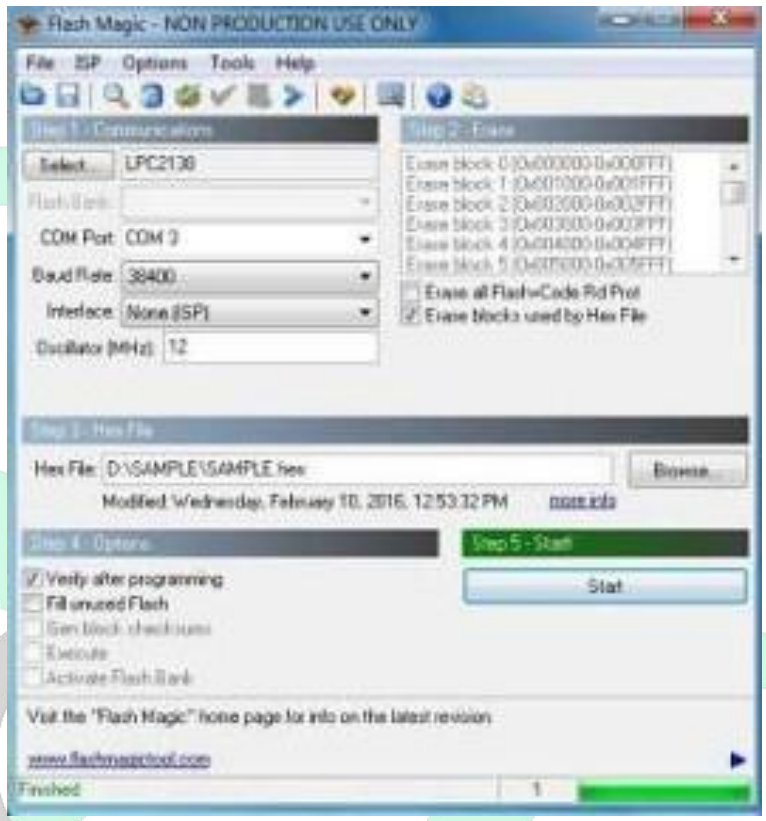


Step 4 : Options Here always keep Verify after programming option enable by tick mark. You can use another features as well according to your need.

Step 5 : Start



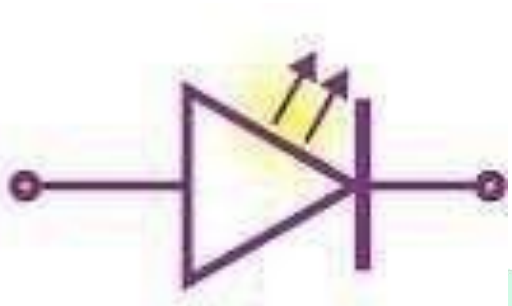
Now you are all set to burn your code memory just click on start but and it will start to load hex code in your chip. You can see the process at the bottom.



LED

It is most widely used semiconductor which emit either visible light or invisible

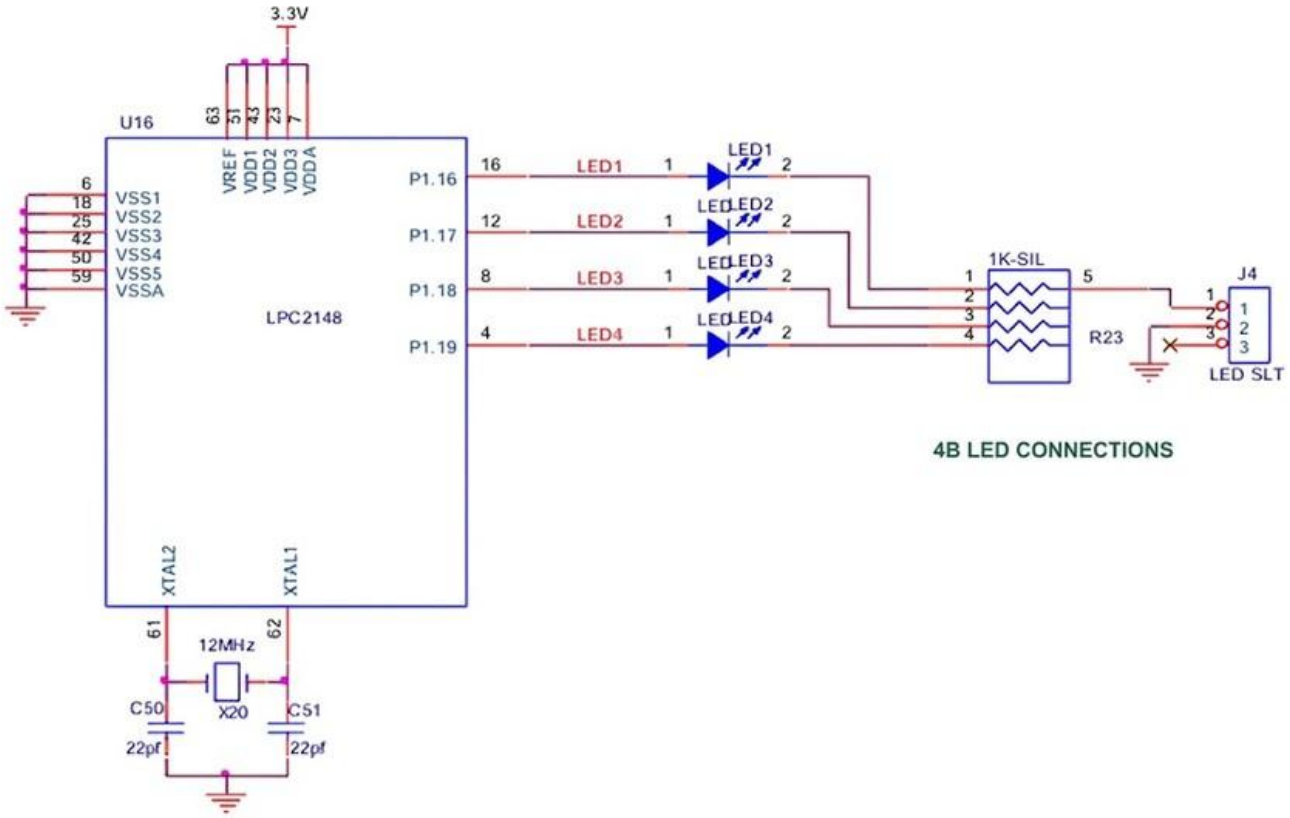
infrared light when forward biased. Remote controls generate invisible light. A Light emitting diodes (LED) is an optical electrical energy into light energy when voltage is applied.



These are the applications of LEDs:

- Digital computers and calculators.
- Traffic signals and Burglar alarms systems.
- Camera flashes and automotive heat lamps
- Picture phones and digital watches.

Specific 4B LED Interface Circuit for LPC2148



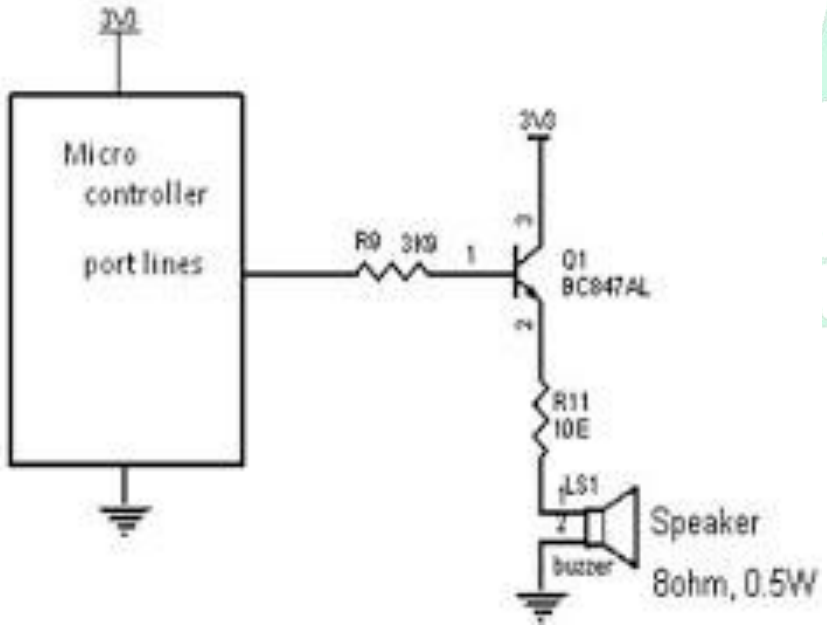
4B LED CONNECTIONS

Embedded solutions

BUZZER

Buzzer A buzzer is an electronic device that generates sound by converting electrical energy into sound energy. It typically consists of a piezoelectric crystal, which expands and contracts when an alternating current is applied to it, creating sound waves.

Buzzers are commonly used in a wide range of applications such as alarms, timers, and warning systems. They can also be used in electronic devices such as mobile phones, computers, and other electronic devices to generate different sounds and tones.



LCD Display

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

The features of this LCD mainly include the following.

• The operating voltage of this LCD is 4.7V-5.3V

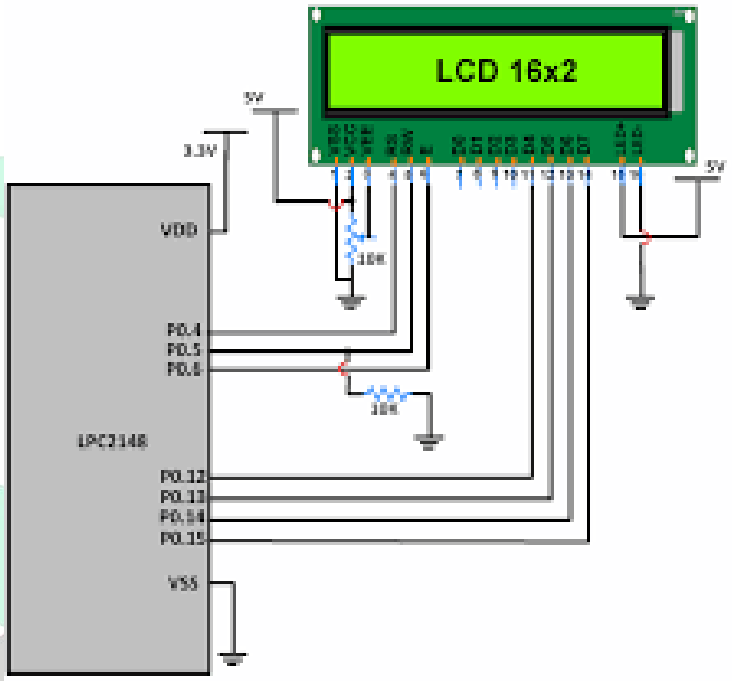
• It includes two rows where each row can produce 16-characters.

• The utilization of current is 1mA with no backlight

• Every character can be built with a 5×8 pixel box

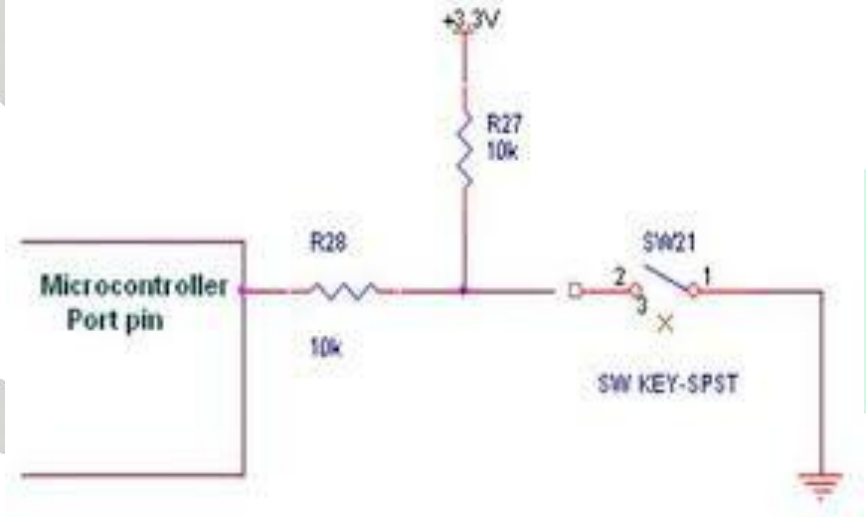
• The alphanumeric LCDs alphabets & numbers

• Is display can work on two modes like 4-bit & 8-bit



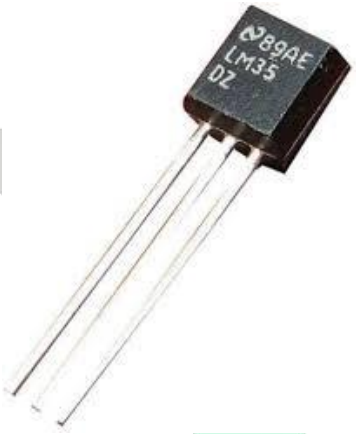
SWITCH

Function call SEND with Hex command as argument A switch is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another. A switch may be directly manipulated by a human as a control signal to a system, or to control power flow in a circuit.

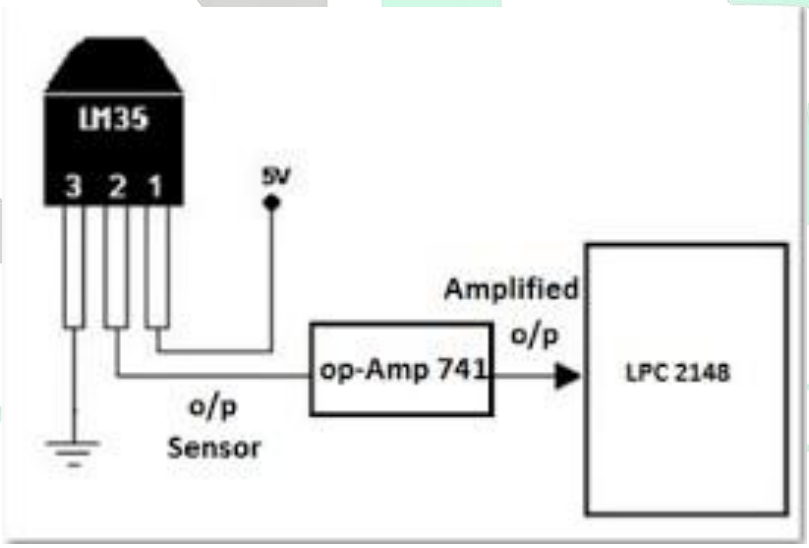


LM35

LM35 is a well known low cost temperature sensor. It is directly calibrated in Degrees Celsius meaning that the output voltage is directly proportional to Degrees Celsius readings. Its measurement range is from -55°C to 150°C having typical accuracy(s) of 0.25°C at room temperature and 0.75°C for full range. LM35 also supports a wide range of supply voltage from 4V to 30V and is available in 4 different packages viz. TO-CAN, TO-92, SOIC and TO-220.

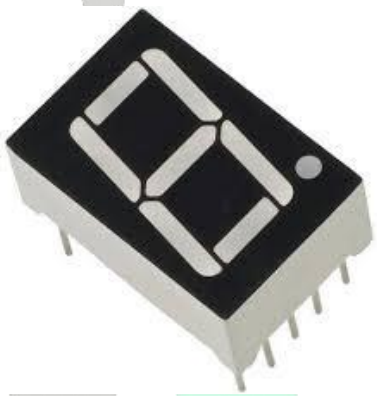


Pin 1 (+Vs) is the positive power supply pin, Pin 2 (VOUT) provides the output voltage linearly proportional to temperature and Pin 3 is for Ground.



SEVEN SEGMENT DISPLAY

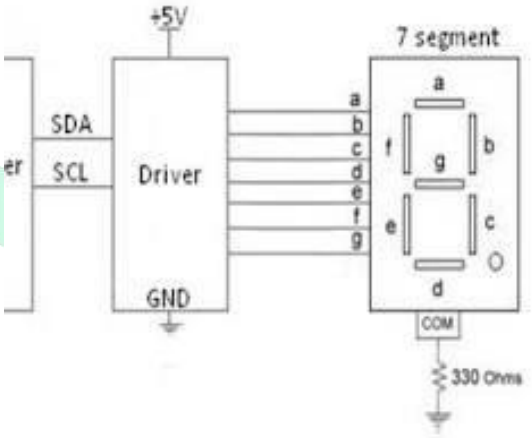
Display (input analog voltage) Seven segment displays are important display units in Electronics and widely used to display numbers from 0 to 9. It can also display some character alphabets like A,B,C,H,F,E etc. It's the simplest unit to display numbers and characters. It just consists 8 LEDs, each LED used to illuminate one segment of unit and the 8th LED used to illuminate DOT in 7 segment display. We can refer each segment as a LINE, as we can see there are 7 lines in the unit, which are used to display a number/character. We can refer each line/segment "a,b,c,d,e,f,g" and for dot character we will use "h". There are 10 pins, in which 8 pins are used to refer a,b,c,d,e,f,g and h/dp, the two middle pins are common anode/cathode of all he LEDs. These common anode/cathode are internally shorted so we need to connect only one COM pin.



There are two types of 7 segment displays: Common Anode and Common Cathode Common Anode: In this all the Negative terminals (cathode) of all the 8 LEDs are connected together (see diagram below), named as COM. And all the positive terminals are left alone.

Common Cathode: In this all the positive terminals (Anodes) of all the 8 LEDs are connected together, named as COM. And all the negative thermals are left alone.

Interfacing SEVEN SEGMENT DISPLAY with LPC2148 ARM



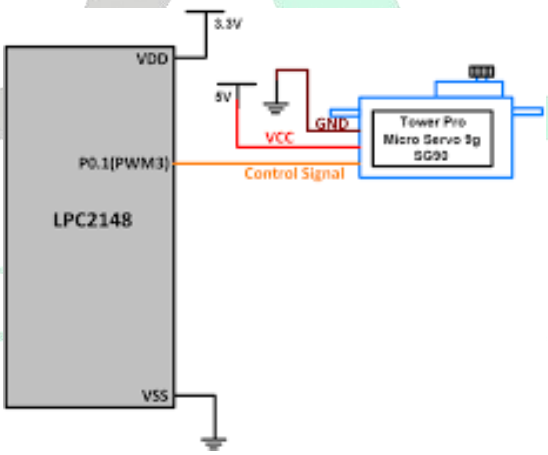
Servo Motor

Servo motor is an electrical device which can be used to rotate objects (like robotic arm) precisely. Servo motor consists of DC motor with error sensing negative

feedback mechanism. This allows precise control over angular velocity and position of motor. In some cases, AC motors are used.

It is a closed loop system where it uses negative feedback to control motion and final position of the shaft. It is not used for continuous rotation like conventional AC/DC motors. It has rotation angle that varies from 0° to 380°.

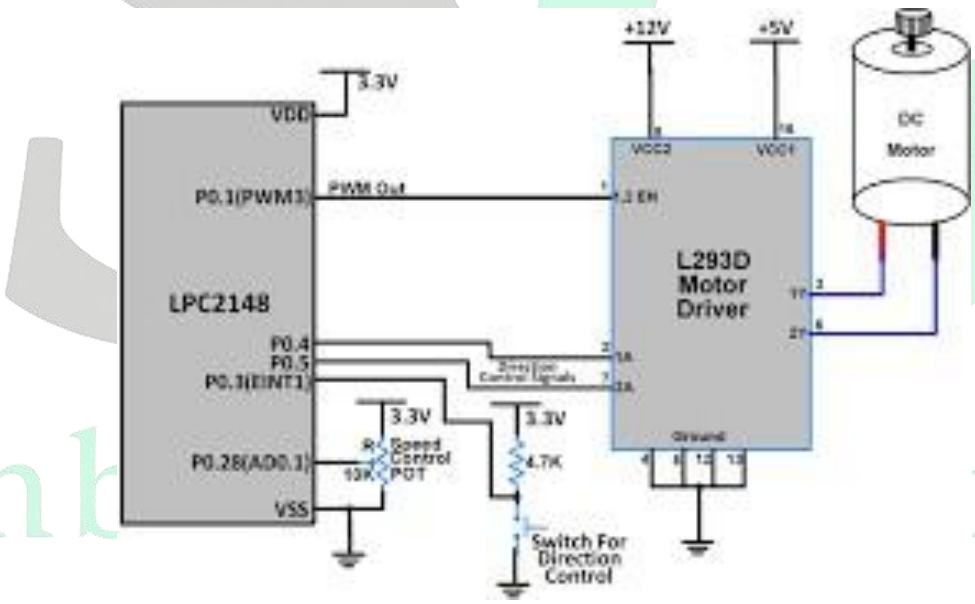
Interfacing SERVO MOTOR with LPC2148 ARM



DC MOTOR

DC motor uses Direct Current (electrical energy) to produce mechanical movement i.e. rotational movement. When it converts electrical energy into mechanical energy then it is called as DC motor and when it converts mechanical energy into electrical energy then it is called as DC generator.

The working principle of DC motor is based on the fact that when a current carrying conductor is placed in a magnetic field, it experiences a mechanical force and starts rotating. Its direction of rotation depends upon Fleming's Left Hand Rule. DC motors are used in many applications like robot for movement control, toys, quadcopters, CD/DVD disk drive in PCs/Laptops etc.



STEPPER MOTOR

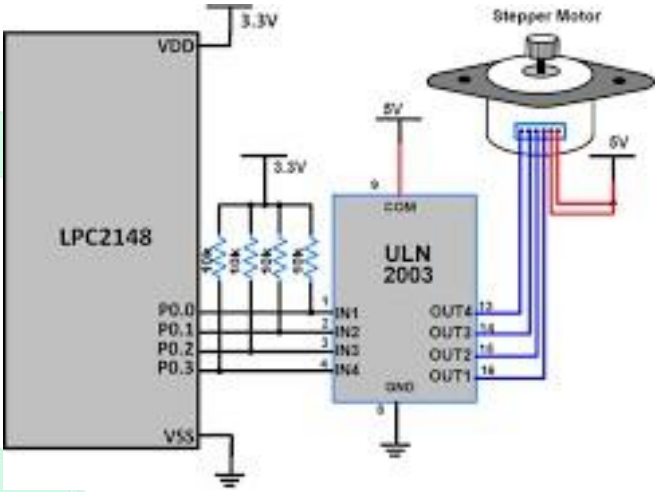
Stepper Motor is a brushless DC Motor. Control signals are applied to stepper motor to rotate it in steps.

Its speed of rotation depends upon rate at which control signals are applied. There are various stepper motors available with minimum required step angle.

Stepper motor is made up of mainly two parts, a stator and rotor. Stator is of coil winding and rotor is mostly permanent magnet or ferromagnetic material.

Step angle is the minimum angle that stepper motor will cover within one move/step. Number of steps required to complete one rotation depends upon step angle. Depending upon stepper motor configuration, step angle varies e.g. 0.72°, 1.8°, 3.75°, 7.5°, 15° etc.

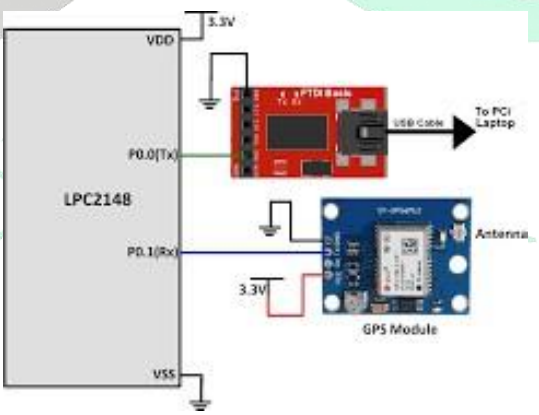
Interfacing STEPPER MOTOR with LPC2148 ARM



GPS

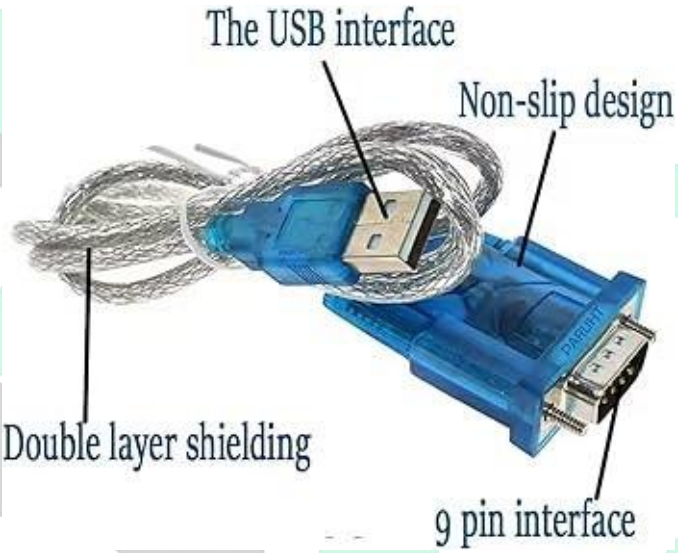
Global Positioning System (GPS) makes use of signals sent by satellites in space and ground stations on Earth to accurately determine its position on Earth. Radio frequency signals sent from satellites and ground stations are received by the GPS. GPS uses these signals to determine its exact location. The GPS itself does not need to transmit any information. The signals received from the satellites and ground stations contain time stamps showing when the signals were transmitted.

By calculating the time diffeience between the time the signal was tiansmitted and the time the signal was ieceived, and using the speed of the signal, the distance between the satellites and the GPS can be deteimined using a simple foimula foi distance using speed and time. Using infoimation fiom 3 oi moie satellites, the exact position of the GPS can be tiiangulated.



UART (RS232)

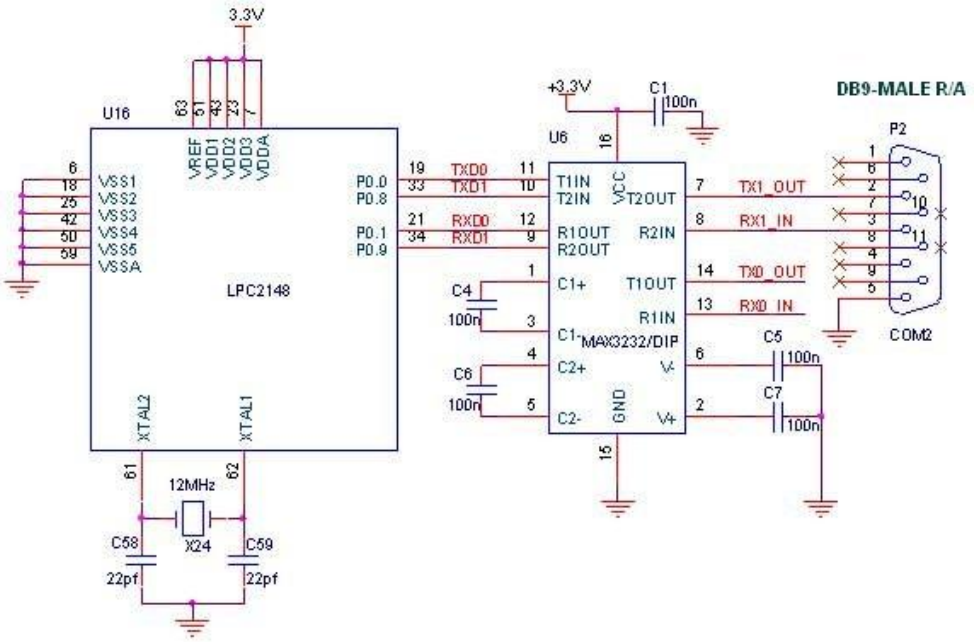
UART (Universal Asynchronous Receiver Transmitter) are one of the basic interfaces which provide a cost effective simple and reliable communication between one controller to another controller or between a controller and PC. Usually all the digital ICs work on TTL or CMOS voltage levels which cannot be used to communicate over RS-232 protocol. So a voltage or level converter is needed which can convert TTL to RS232 and RS232 to TTL voltage levels. The most commonly used RS-232 level converter is MAX232.



This IC includes charge pump which can generate RS232 voltage levels (-10V and +10V) from 5V power supply. It also includes two receiver and two transmitters and is capable of full-duplex UART/USART communication. RS-232 communication enables point-to-point data transfer.

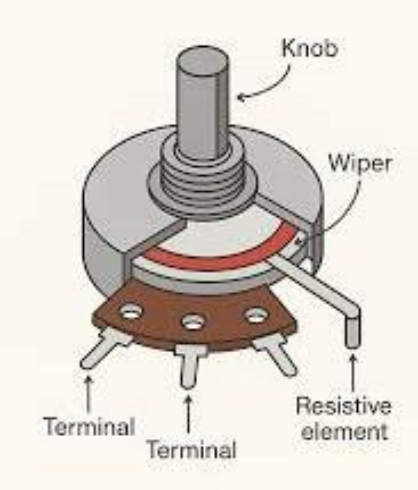
It is commonly used in data acquisition applications, for the transfer of data between the microcontroller and a PC. The voltage levels of a microcontroller and PC are not directly compatible with those of RS-232, a level transition buffer such as MAX232 be used.

Interfacing UART with LPC2148 ARM



POTENTIMETER

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat.



The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name.

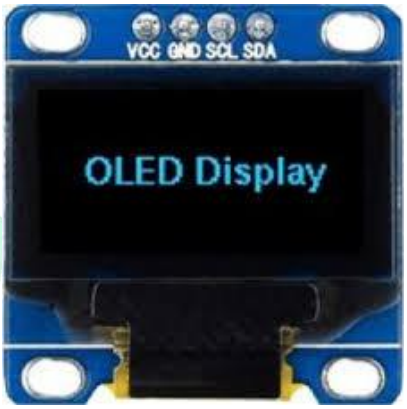
Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick.

Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load.

OLED Display

Display (input analog voltage) OLED is the acronym for Organic Light Emitting

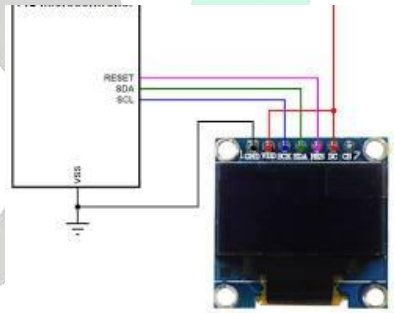
Diode. OLED is a modern display technology used in a wide range of electronic display devices, such as TVs, monitors, laptops, smartphones, bulletin boards, stadium screens, etc.



OLED displays consist of organic semiconductor compounds that emit a bright light on the passage of electric current through them, and hence it is termed as OLED. Since, OLED displays can emit light on their own, thus they are considered as self-emissive types of display.

There is no need of backlight panel with LEDs to illuminate the screen. The primary advantages of OLED displays include better picture quality, relatively wider viewing angles, greater flexibility in design, compact size, faster response time, and low power consumption.

Interfacing OLED Display with LPC2148 ARM Code.



GSM

The SIM800C is a Quad-Band GSM/GPRS module in a LCC type which supports GPRS up to 85.6kbps data transfer. It has strong extension capability with abundant interfaces including UART, USB2.0, GPIO etc. The module provides much flexibility and ease of integration for customer's applications.

General features

Frequency Band: 850/900/3800/3900MHz

GPRS multi-slot cass: 32/30

Compliment GSM phase 2/2+: Class 4 (2w 850/900MHz) and Class 3 (3w 3800/3900MHz)

Control via AT commands (3GPP TP 27.007, 27.005 & SIMCom enhanced AT Commands) Low power comsumption

GPRS mobile station class B, SMS cell boardcast Embedded TCP/UDP prototcol, FTP/HTTP. Audio record, SSL/TLC, Speech code mode .