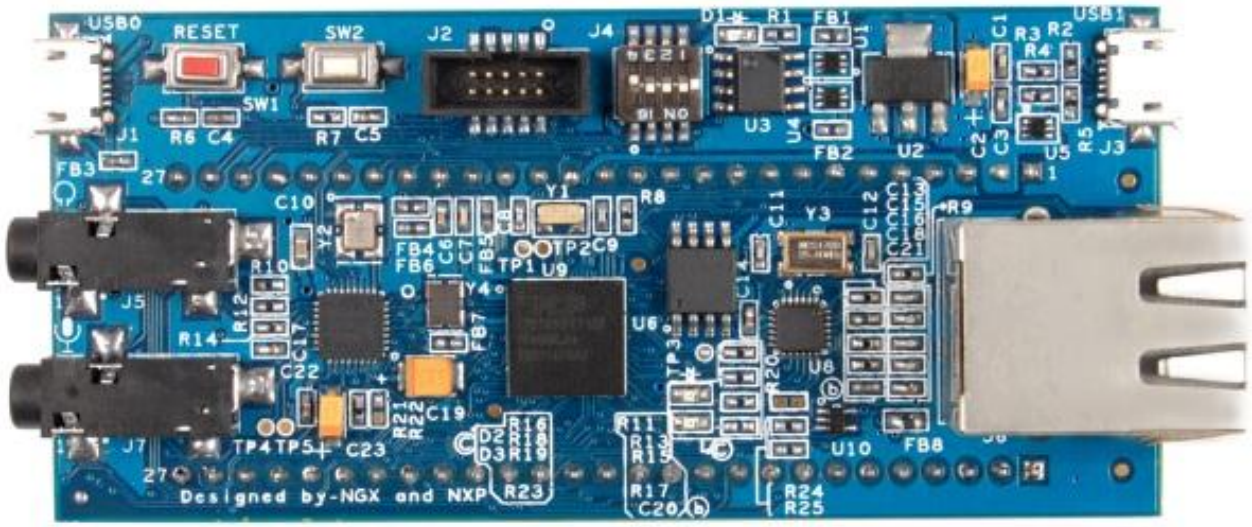
LPC4330-Xplorer



About NGX Technologies

NGX Technologies is a premier supplier of development tools for the ARM7, ARM Cortex M0, M3 and M4 series of microcontrollers. NGX provides innovative and cost effective design solutions for embedded systems. We specialize in ARM MCU portfolio, which includes ARM7, Cortex-M0, M3 & M4 microcontrollers. Our experience with developing evaluation platforms for NXP controller enables us to provide solutions with shortened development time thereby ensuring reduced time to market and lower development costs for our customers. Our cost effective and feature rich development tool offering, serves as a testimony for our expertise, cost effectiveness and quality.

Contact Information:

NGX Technologies Pvt. Ltd.
No.216, 5th main Road, R.P.C. Layout,
Vijayanagar 2nd Stage,
Bangalore – 560 104
Phone : +91-80-40925507
email:sales@ngxtechnologies.com

Table of Contents

1.0 INTRODUCTION

This document is the System Reference Manual for LPC4330-Xplorer; a cost effective evaluation platform for NXP's LPC43xx (dual core Cortex M4 and M0) MCUs. This document reflects its contents which include system setup, debugging, and software components. This document provides detailed information on the overall design and usage of the board from a systems perspective.

2.0 LPC4330-Xplorer Overview

2.1 Introduction

The NGX LPC4330-Xplorer is a compact and versatile evaluation platform for the NXP's Cortex-M4 based MCUS. NGX's evaluation platforms are generally not tied up to any particular debugger or compiler/IDE. However it is not practical to test and ensure that the solution would work out of box with all the available debuggers and compilers/IDE. As long as the compiler supports the particular MCU and the debugger supports the standard debug interfaces like the SWD/JTAG you can use this platform with any tool. For our development we use ULINK and KEIL as the debugger and compiler/IDE respectively. The board is supported by extensive sample examples allowing you to focus on the application development.

2.2 Board Features

Following are the salient features of the board

- Dimensions: 86mm X 40mm
- Controller: LPC4330, 100 pin BGA
- PCB: 4-layer (RoHS complaint)
- Two LEDs
- One user switch and one reset switch
- Boot select switch
- 32Mb Quad flash
- On board crystals for controller, RTC and audio codec
- On board Ethernet PHY, 50 MHz Oscillator and RJ45 connector with magnetics
- On board audio codec and audio jacks
- On board USB host power switch
- Two USB ports, one HS (High speed) port and one FS (Full Speed) port
- 10-pin cortex debug header
- The board is shipped with two USB cables, one USB device cable and one USB host adapter cable
- Unused I/Os brought to a header (pin compatible with Xpresso pinning*)

**The I/0s brought out to the header are not 100% pin compatible with Xpresso Pinning, unlike the Xpresso boards, this evaluation platform has lot of connectors on board and also the controller has some other special features like the SGPIO, which have been brought out to the header. We have put in our best efforts to have maximum number of pins to be Xpresso pin compatible.*

2.3 BLOCK DIAGRAM

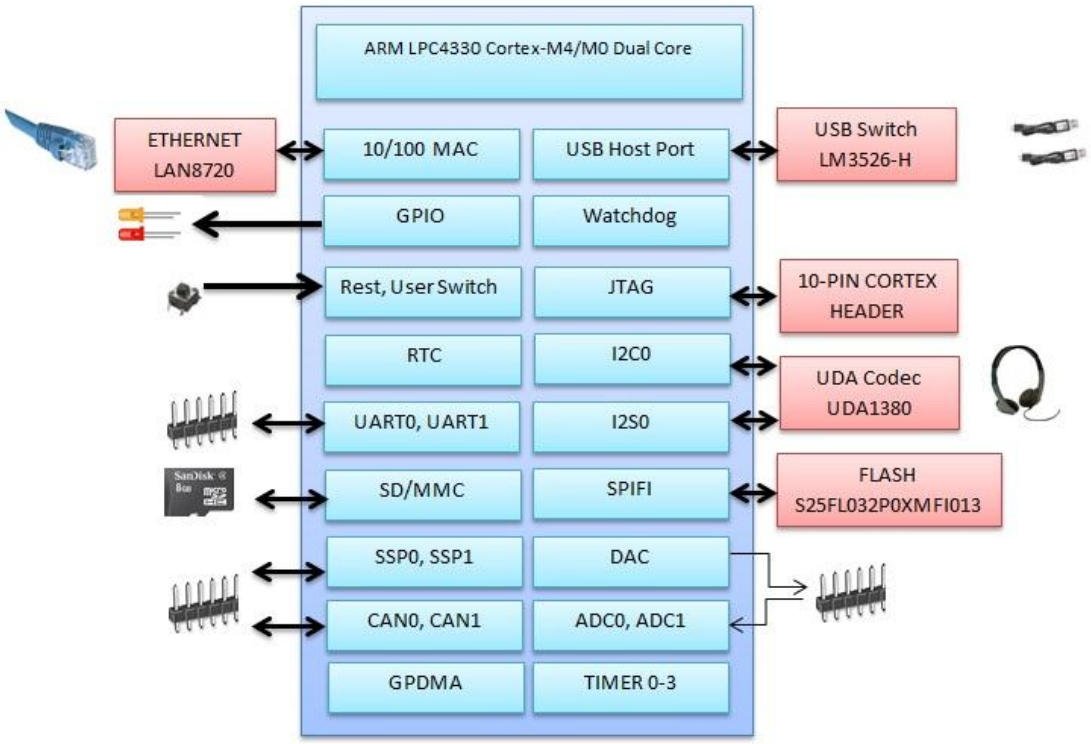


Fig. 1

2.4 LPC4330-Xplorer pin out

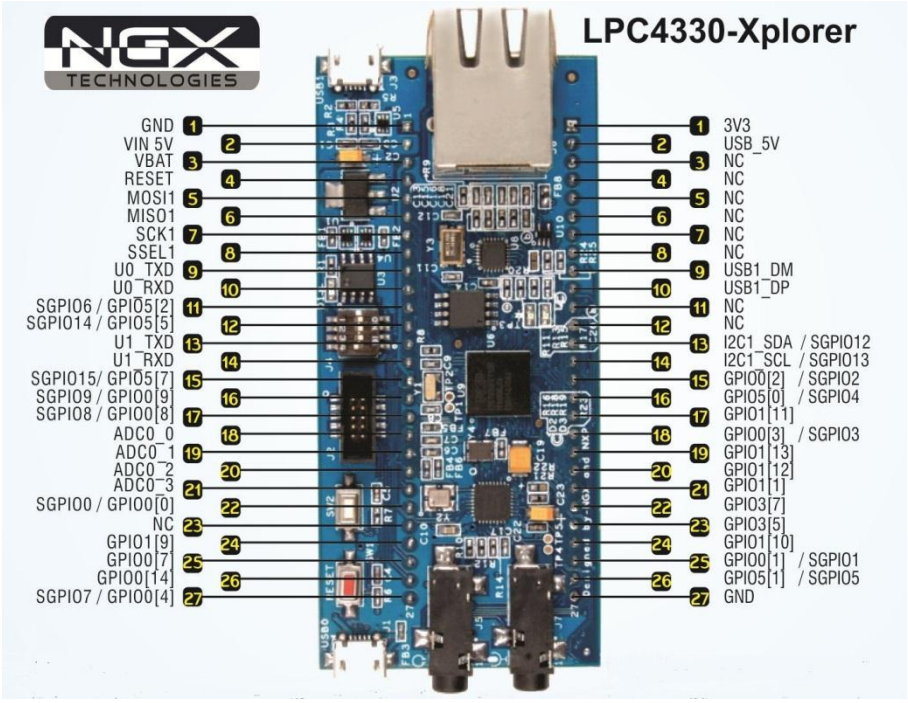


Fig.2

2.5 LPC4330 description

The LPC4330 is an ARM Cortex-M4 based digital signal controller with an ARM Cortex-M0 coprocessor designed for embedded applications requiring signal processing. The ARM Cortex-M4 core offers single-cycle Multiply-Accumulate and SIMD instructions and a hardware floating-point unit to support signal processing while the M0 coprocessor handles I/O and digital control processing. The LPC4330 includes 264 KB of data memory, two High Speed USB 2.0 Host/OTG/Devices, advanced configurable peripherals such as the State Configurable Timer (SCT), Serial General Purpose I/O (SGPIO), and SPI Flash Interface (SPIFI) as well as Ethernet, an external memory controller and multiple digital and analog peripherals.

Features

- ARM Cortex-M4 processor, running at frequencies of up to 204 MHz
- ARM Cortex-M4 built-in Memory Protection Unit (MPU) supporting eight regions
- ARM Cortex-M4 built-in Nested Vectored Interrupt Controller (NVIC)
- Hardware floating-point unit
- Non-maskable Interrupt (NMI) input
- JTAG and Serial Wire Debug (SWD)
- System tick timer
- ARM Cortex-M0 co-processor running at frequencies of up to 204 MHz
- 264 kB SRAM for code and data use
- Two 32 kB SRAM blocks with separate bus access
- 32 kB ROM containing boot code and on-chip software drivers
- 32 bit One-Time Programmable (OTP) memory for customer use
- Serial GPIO (SGPIO) interface
- State Configurable Timer (SCT) subsystem on AHB
- Quad SPI Flash Interface (SPIFI) with four lanes and up to 40 MB per second
- 10/100T Ethernet MAC with RMII and MII interfaces and DMA support
- One High-speed USB 2.0 Host/Device/OTG interface with DMA support
- One High-speed USB 2.0 Host/Device interface with DMA support
- One 550 UART with DMA support and full modem interface
- Three 550 USARTs with DMA and synchronous mode support
- One C_CAN 2.0B controller with one channel
- Two SSP controllers with FIFO and multi-protocol support
- One SPI controller
- One Fast-mode Plus I2C-bus interface with rates of up to 1 Mbit/s
- One Fast-mode I2C-bus interface
- Two I2S interfaces
- External Memory Controller (EMC) supporting external SRAM, ROM, flash, SDRAM
- Secure Digital Input Output (SDIO) card interface
- Eight-channel General-Purpose DMA (GPDMA) controller
- Up to 49 General-Purpose Input/Output (GPIO) pins
- Four general-purpose timer/counters with capture and match capabilities
- One motor control Pulse Width Modulator (PWM) for three-phase motor control
- One Quadrature Encoder Interface (QEI)
- Repetitive Interrupt timer (RI timer)
- Windowed watchdog timer (WWDT)
- Ultra-low power Real-Time Clock (RTC) on separate power domain
- Alarm timer; can be battery powered

- One 10-bit DAC with DMA support and a data conversion rate of 400 kSamples/s
- Two 10-bit ADCs with DMA support and a data conversion rate of 400 kSamples/s
- Two 128-bit secure OTP memories for AES key storage and customer use
- Crystal oscillator with an operating range of 1 MHz to 25 MHz
- 12 MHz Internal RC (IRC) oscillator trimmed to 1 % accuracy
- Ultra-low power Real-Time Clock (RTC) crystal oscillator
- Three PLLs allow CPU operation up to the maximum CPU rate
- Clock output
- Single 3.3 V (2.2 V to 3.6 V) power supply with on-chip DC-to-DC converter
- RTC power domain can be powered separately by a 3 V battery supply
- Four reduced power modes
- Processor wake-up from Sleep mode via wake-up interrupts
- Brownout detect with four separate thresholds for interrupt and forced reset
- Power-On Reset (POR)

For the most updated information on the MCU please refer to NXP's website.

3.0 LPC4330-Xplorer verification

NGX's evaluation platforms ship with a factory-programmed test firmware that verifies all the on-board peripherals. It is highly recommended that you verify the board, before you start programming. Also this exercise helps you get acclimatized with the board quickly.

To run the tests you will need the following:

- LPC4330-Xplorer
- Power: USB cable (you can power it through either port, we recommend to use USB1 for the verification) or external power supply (Alternatively the Xplorer has a 5V in pin available for powering through external power source)
- PC: With Windows7 or XP (32-bit)
- One USB AM to Micro B cable in addition to the one provided with the KIT
- Micro SD card
- 2-GB USB pen drive
- Audio-in (Auxiliary) cable (3.5mm diameter connector)

3.1 Board Image with pointers to the peripherals

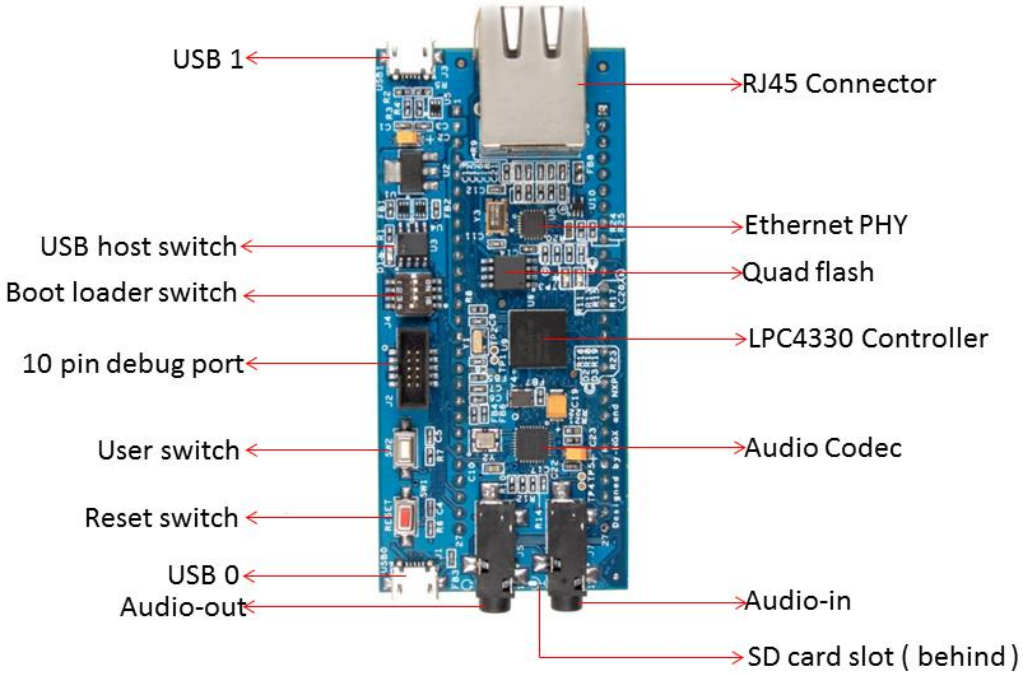


Fig.3

3.2 Powering the Board

The LPC4330-Xplorer can be powered through USB; we can either power it from USB0 port or USB1 port. It is highly recommended that the user tests all the peripherals as soon as the board is received. A regulated supply can be supplied to the 5V pin on the Xplorer-LPC4330 header.

Note: The USB power can source only up to 500 mA of current. For applications having higher current requirements we recommend to use an external power supply. Please note that the external power supply is not a part of standard delivery.

3.3 Verifying all the peripherals on LPC4330-Xplorer

The following section focuses on the verification of all the peripherals supported on the LPC4330-Xplorer. The order of the tests is mentioned in the same manner as the flow of the test firmware. We highly recommend that you follow the order of the test. The test firmware is designed in a manner that the user needs to spend as minimum time as possible to verify all the on-board peripherals. The test firmware executable resides on the Quad Flash. The BOOT select switch is configured to execute from the Quad Flash interface.

Note: The test firmware "Debug Messages" or flow might be changed in due course. Generally these are only cosmetic changes so that the usage is easier. If you observe a different message than the one mentioned in the Manual, do not worry and please proceed with the test

Important Note: ***The user needs to press the RESET switch twice to be able to reset the controller. This is due to the issue with the silicon. Please note that if you power-up the board then it would have been reset once (power-on reset) and in this case you need to press the RESET switch only once for the controller to reset. In situations where the Xplorer is powered up and running a firmware and you wish to reset the controller, one needs to press the RESET switch twice.***

Power up the board over USB1 port and we are all set to verify the LPC4330-Xplorer peripherals. Before we get to the verification we need to install the Virtual COM port drivers needed for the LPC4330-Xplorer (USB1 port) to appear as a Virtual COM port (Used for viewing the debug messages on serial emulation tool). Fortunately, this is a one-time setup and fairly simple. On a Windows machine the user needs to point to the location of the INF file.

Steps to install the VCOM drivers on Windows 7 machine:

Step 1: Connect USB1 to the computer, Open Device Manager, You can find "NXP LPC18xx VCOM" new device listed under 'Other devices'.

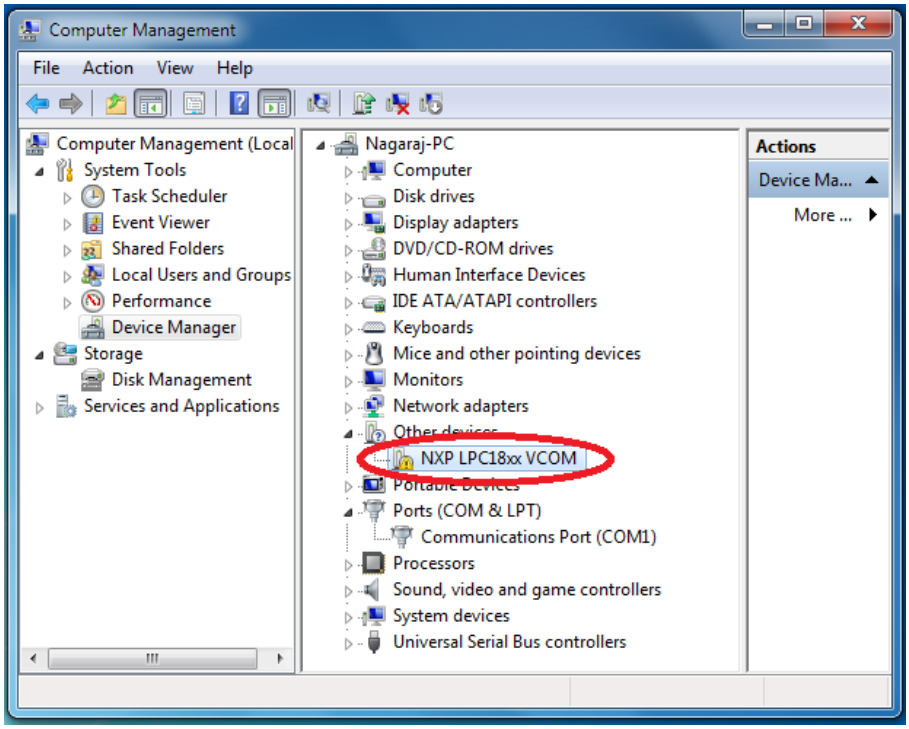


Fig.4

Step 2: Next, Right click on the NXP LPC18xx VCOM and then left click on Update Driver Software.

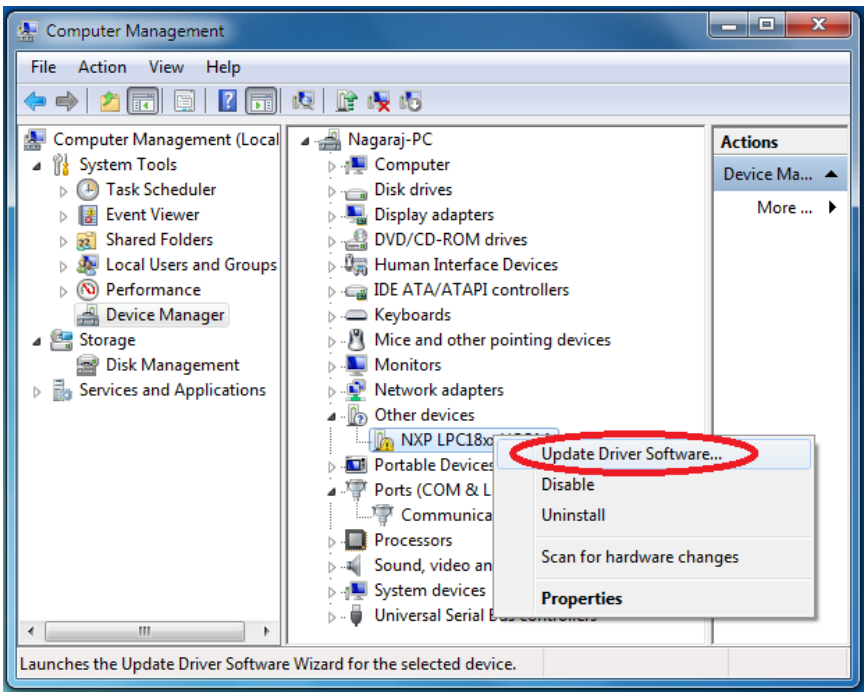


Fig.5

Step 3: Click on Browse my computer for driver software.

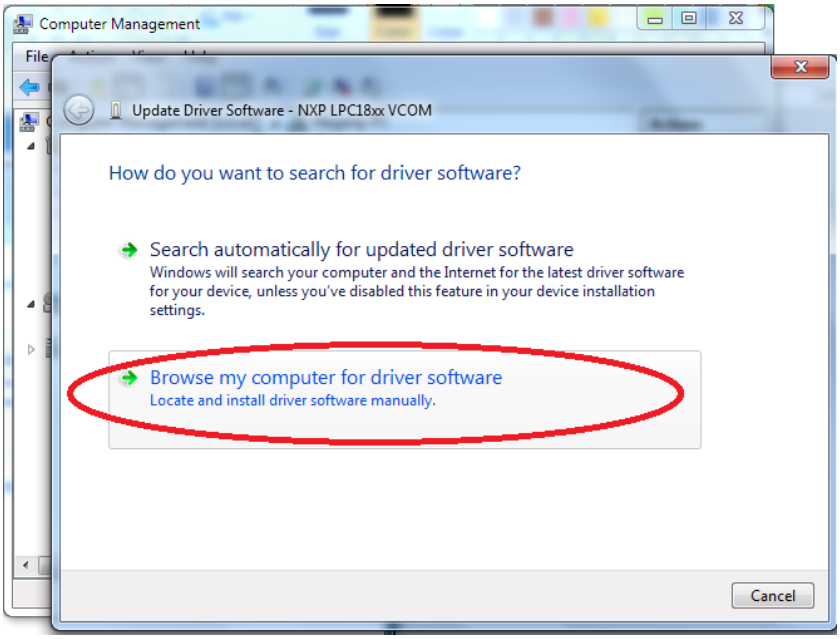


Fig.6

Step 4: Left click on Browse, Select lpc18xx-vcom.inf driver folder and then click on OK.

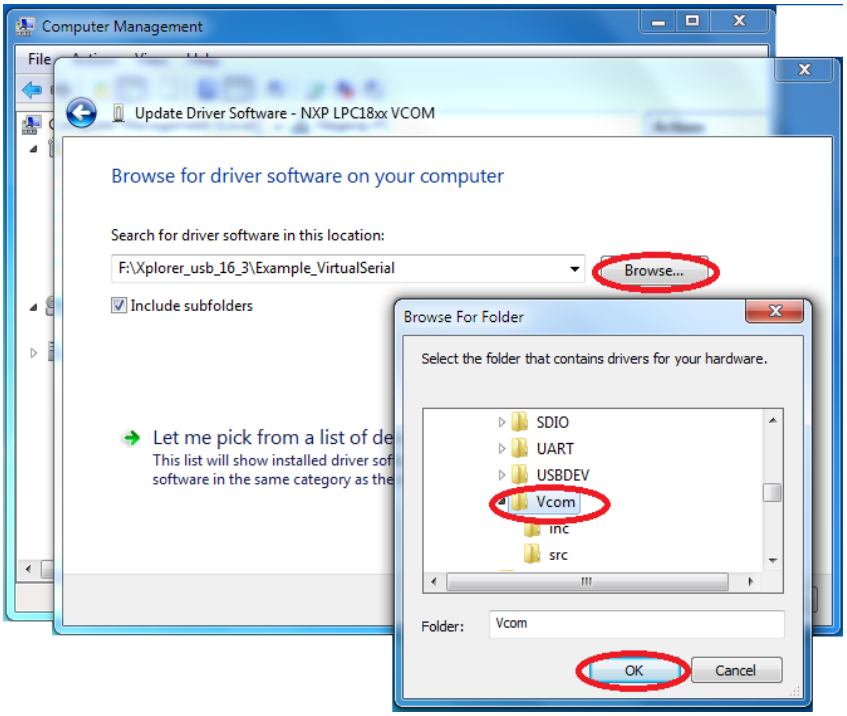


Fig.7

Step 5: Click on Next to continue driver installation.

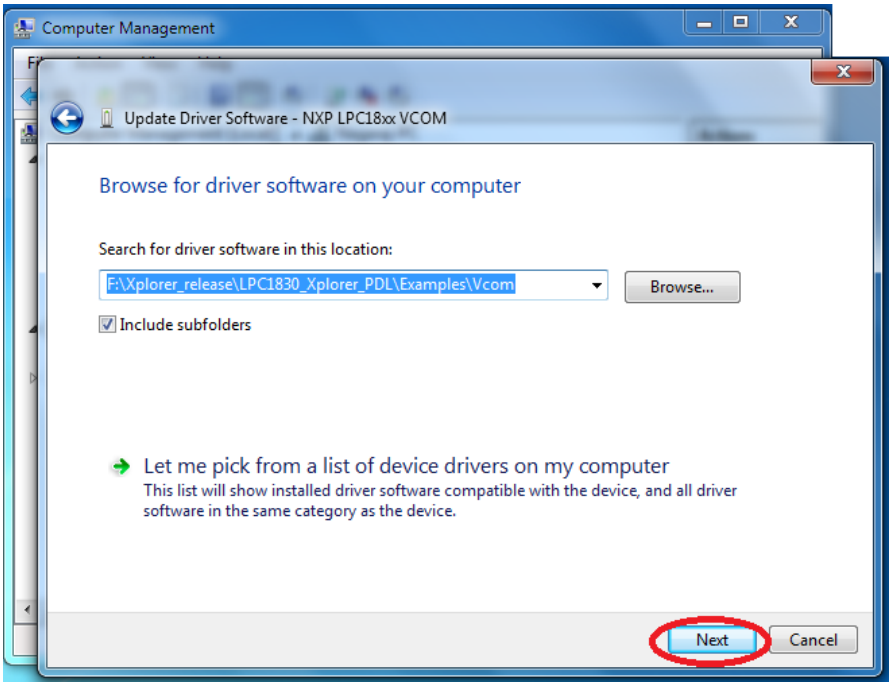


Fig.8

Step 6: Click on Install this driver software anyway.

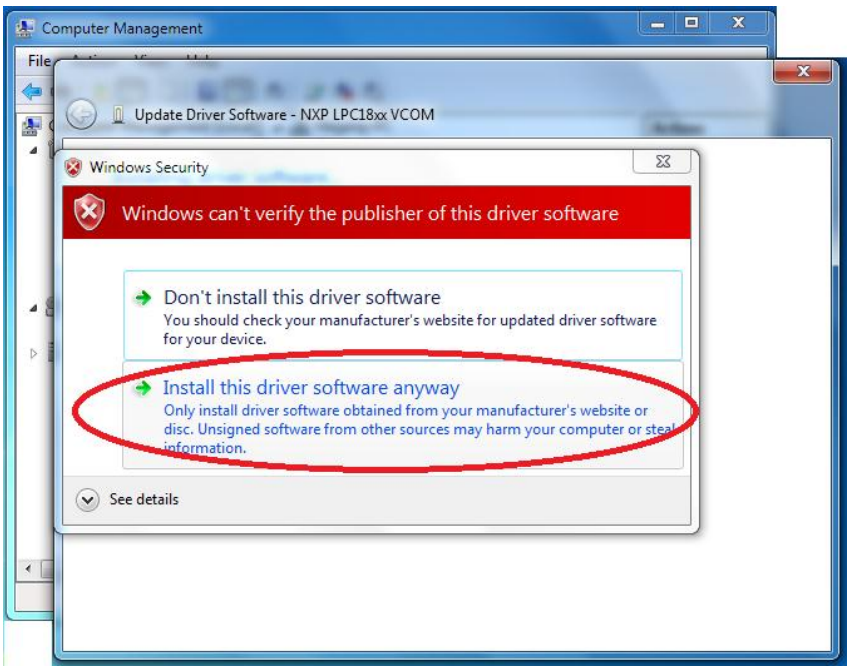


Fig.9

Step 7: The LPC18xx USB VCom driver is successfully installed. Click on close.

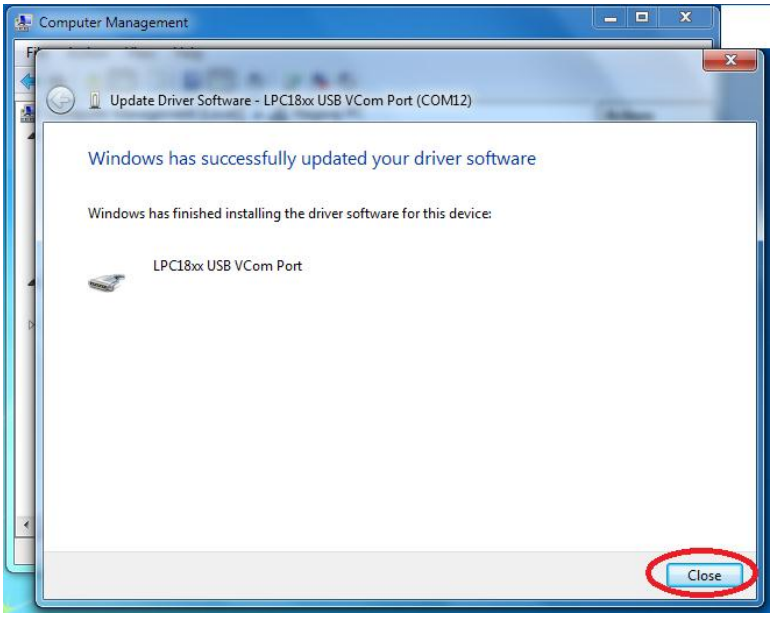


Fig.10

Step 8: Now LPC18xx USB VCom Port (COM12) is ready to use.

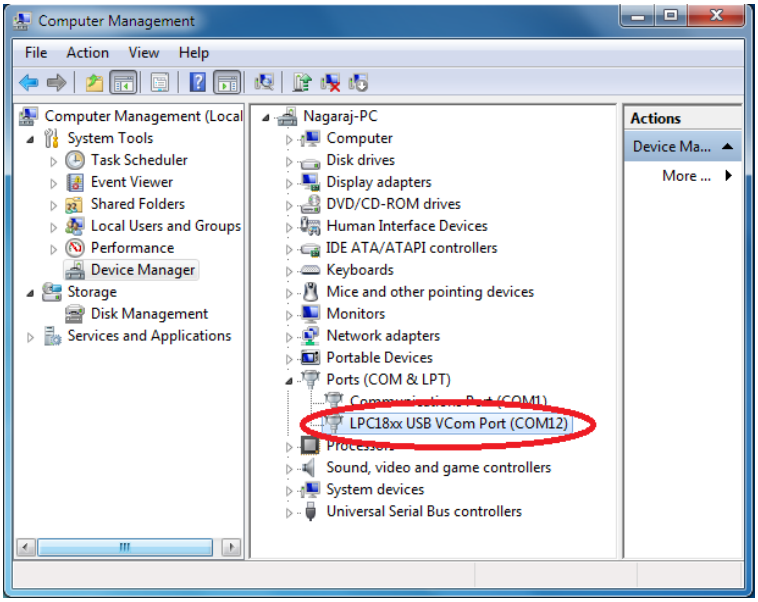
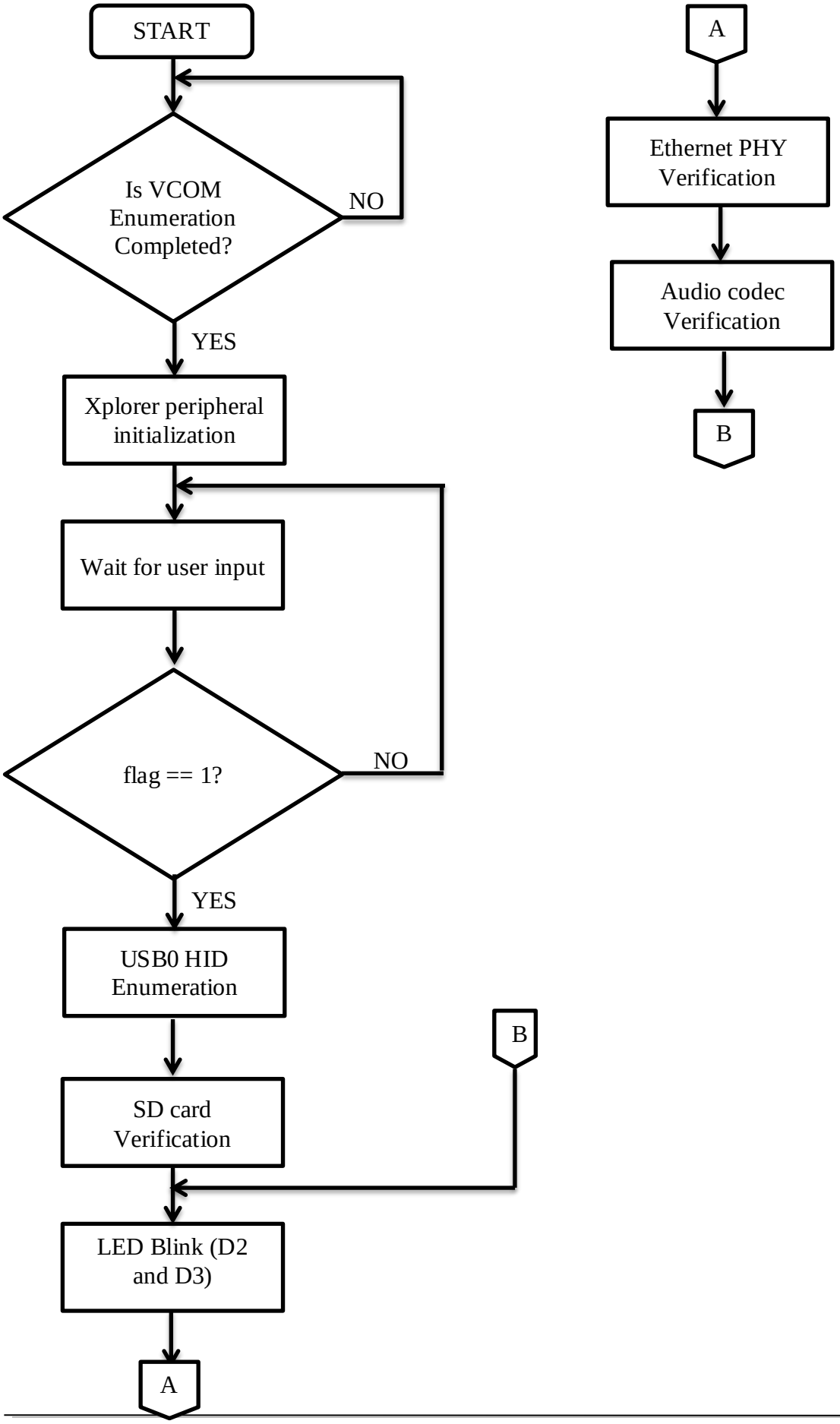


Fig.11

Note: The Virtual COM is listed under the device manager. Please note that the COM port list under the Device Manager is automatically updated with the COM port number for the Virtual COM. On our test machine we see two COM ports listed COM1 and COM12. COM1 is the actual COM port and COM12 is the virtual COM port. The COM12 will appear only if the Xplorer board is connected (USB1) to the PC. ***Every time the Xplorer is reset the user needs to close the Hyper Terminal application and restart it again.***

The order in which the on-board peripherals are verified by the firmware are as follows:
Test Firmware Flowchart:



3.3.1 LEDs

Test setup and verification:
As soon as the Xplorer is turned ON or reset; the test LEDs go ON & OFF for a couple of times, this simple test validates the LEDs. The Xplorer has one Green LED and one Blue LED. These LEDs are also connected to the outputs of the SCT lines. Please refer to the schematics for more details.

3.3.2 USB1 (Virtual COM port)

Test setup and verification:
For the very first time the Windows machine will ask for the appropriate Virtual COM drivers to be installed.

Steps to select USB1 VCOM port on HyperTerminal in Windows 7 machine:

Step 1: Open a HyperTerminal, Enter the name and then click on OK.

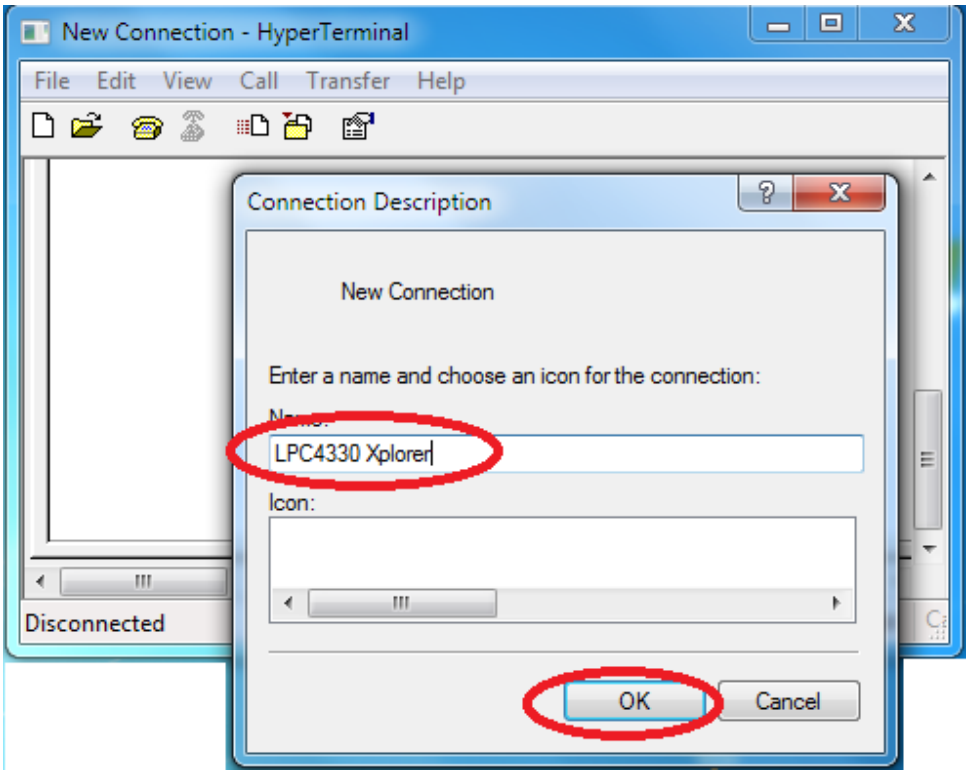


Fig.12

Step 2: Select USB1 Vcom Port (COM12) and then click on OK.

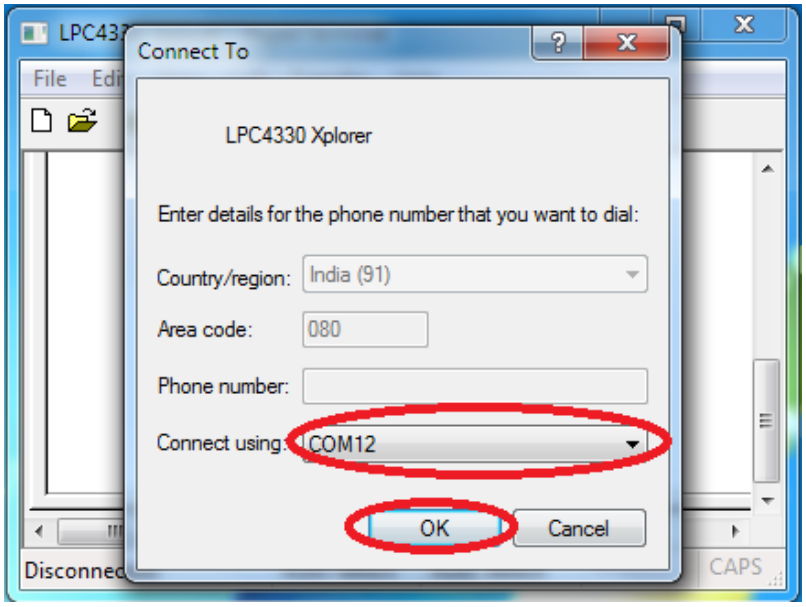


Fig.13

Step 3: Click on Restore Defaults and then click on OK.

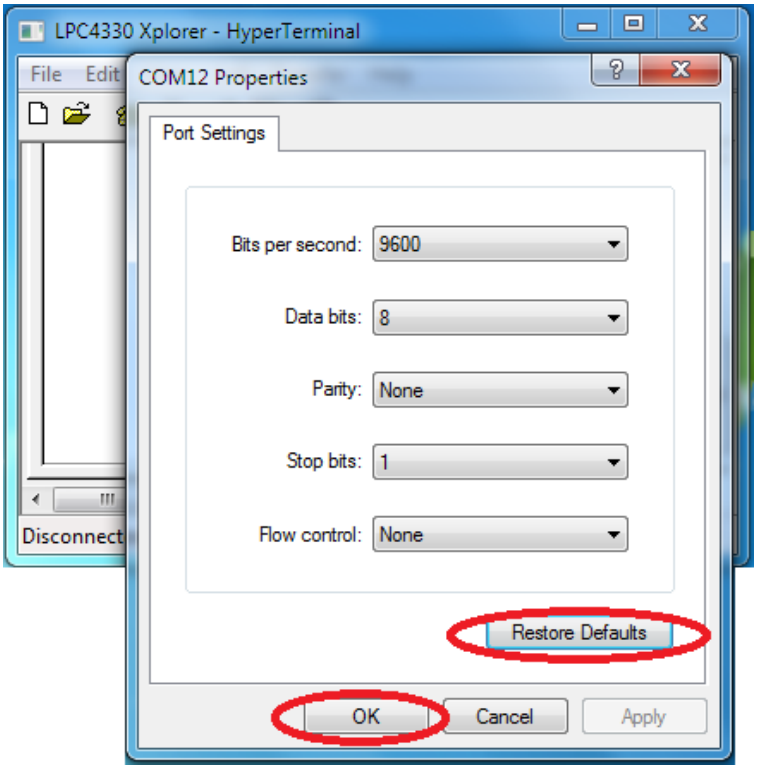


Fig.14

Step 4: Now the USB1 VCom is ready to use.

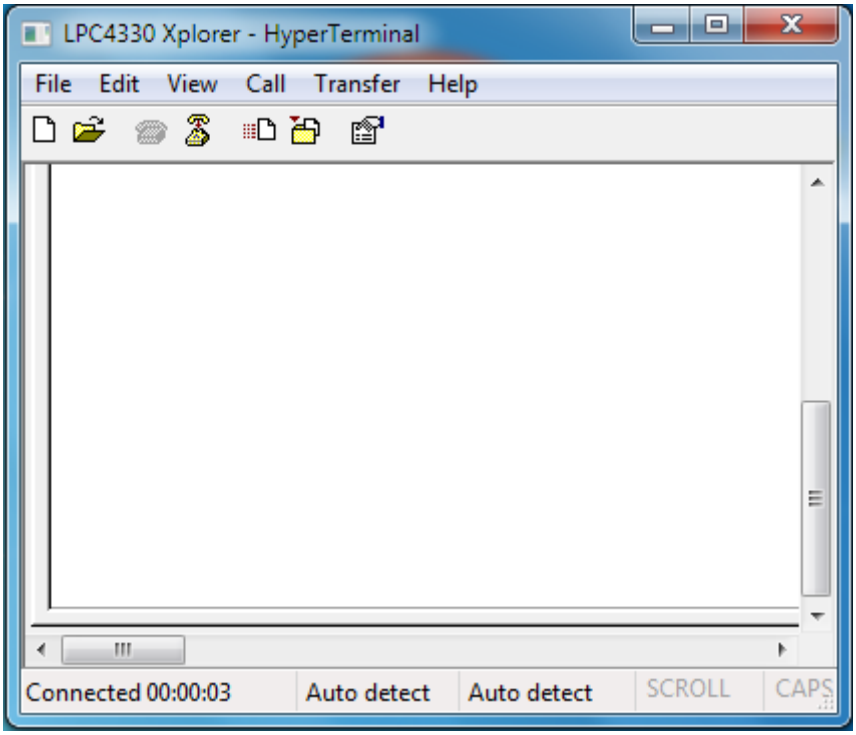


Fig.15

Note: You would not be able to proceed with the verification unless the Virtual COM drivers are installed. The firmware waits for the USB1 to enumerate as VCOM port.

3.3.3 User Input Switch

Test setup and verification:

Once the VCOM drivers are installed the Xplorer waits for the User Input Switch to be pressed. Only after detecting a user button (SW2) press the test firmware proceeds with validating other peripherals. This synchronization is necessary to ensure that the debug messages on the VCOM port can be viewed from the start of the test. Without this synchronization the test firmware would proceed with the debug messages being displayed, while the user is still configuring the Hyper-Terminal or other serial emulation tool.

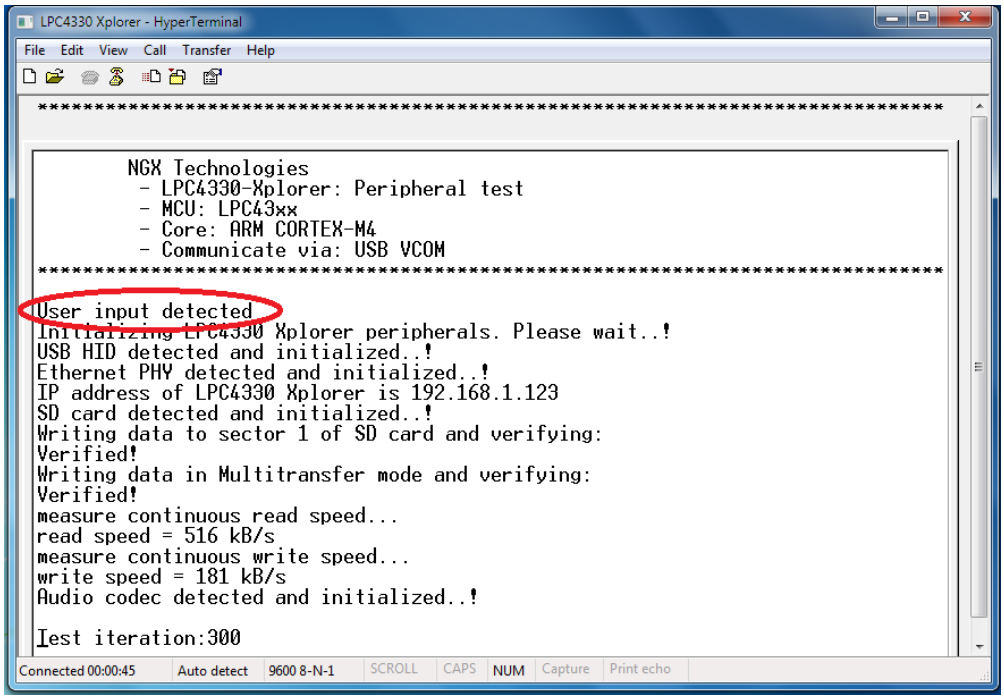


Fig.16

3.3.4 USB0 (HID device)

Test setup and verification:
Connect the USB cable to USB0 connector. The USB enumeration can be checked in device manager. The Xplorer enumerates as a Human Interface Device (HID). On a Windows machine this can be confirmed by looking in to the ‘Device Manager’ under ‘Human Interface Devices’.

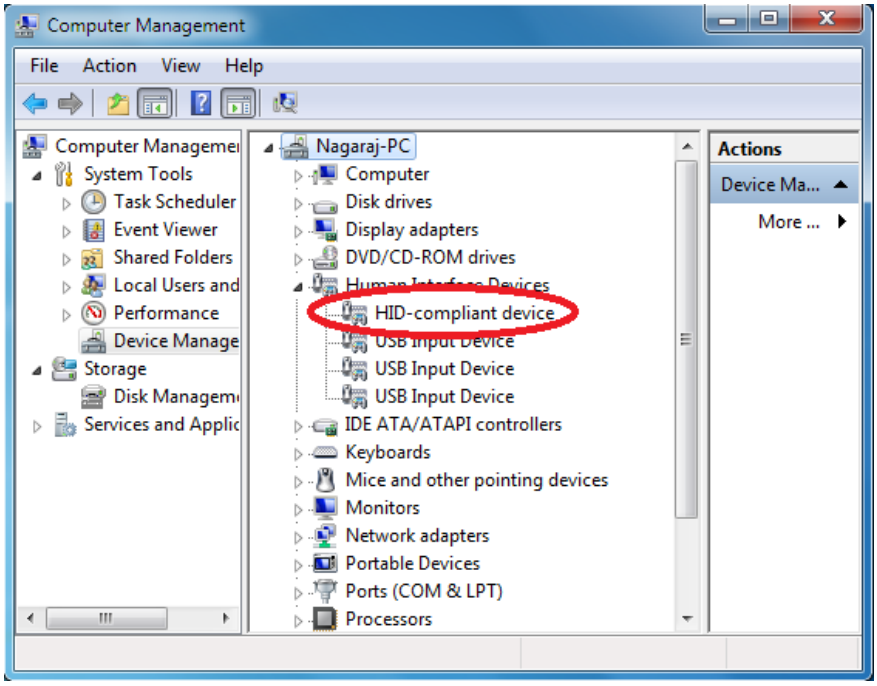


Fig.17

Note: The Xplorer is shipped with only one 'USB AM to micro B'; to test the USB1 interface you would require another similar cable. In the subsequent firmware releases the firmware would configure the USB0 port as USB host.

3.3.5 Ethernet

Test setup and verification:
The test firmware configures the Xplorer board as a Webserver.

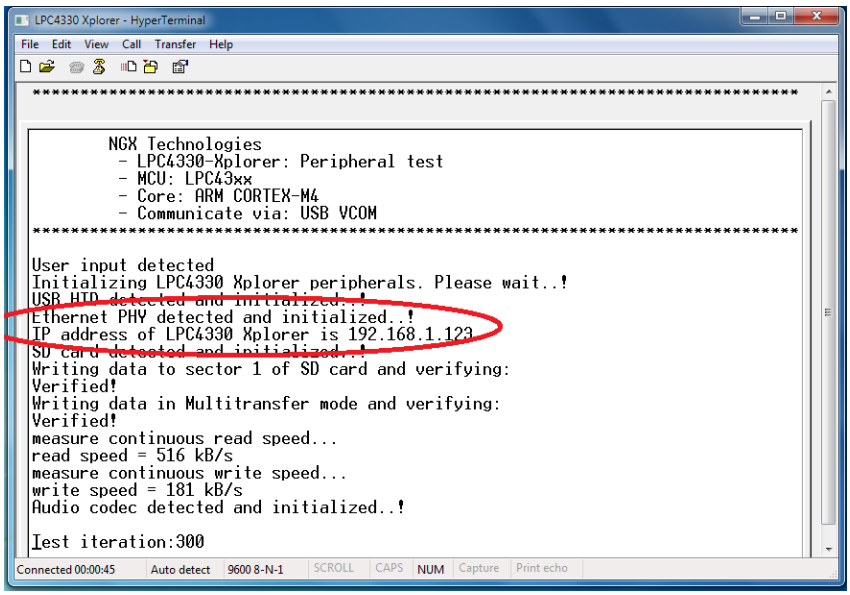


Fig.18

The Ethernet interface can be verified by either using a PING command in the windows command prompt.

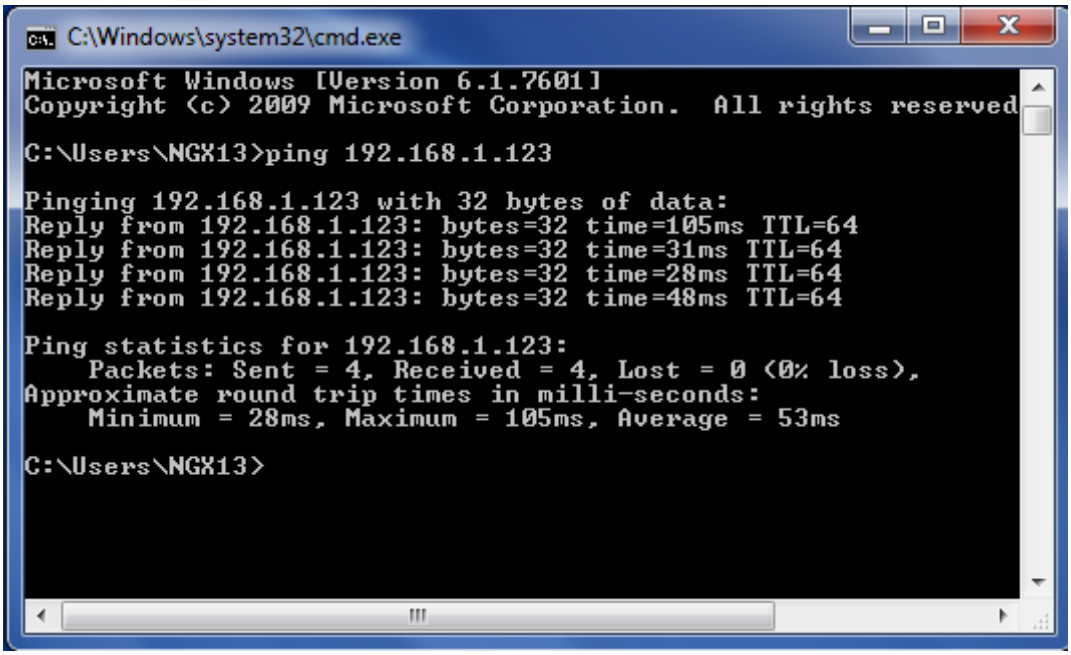


Fig.19

The IP address of the Xplorer board is configured as 192.168.1.123. Type the same IP address in the browser.

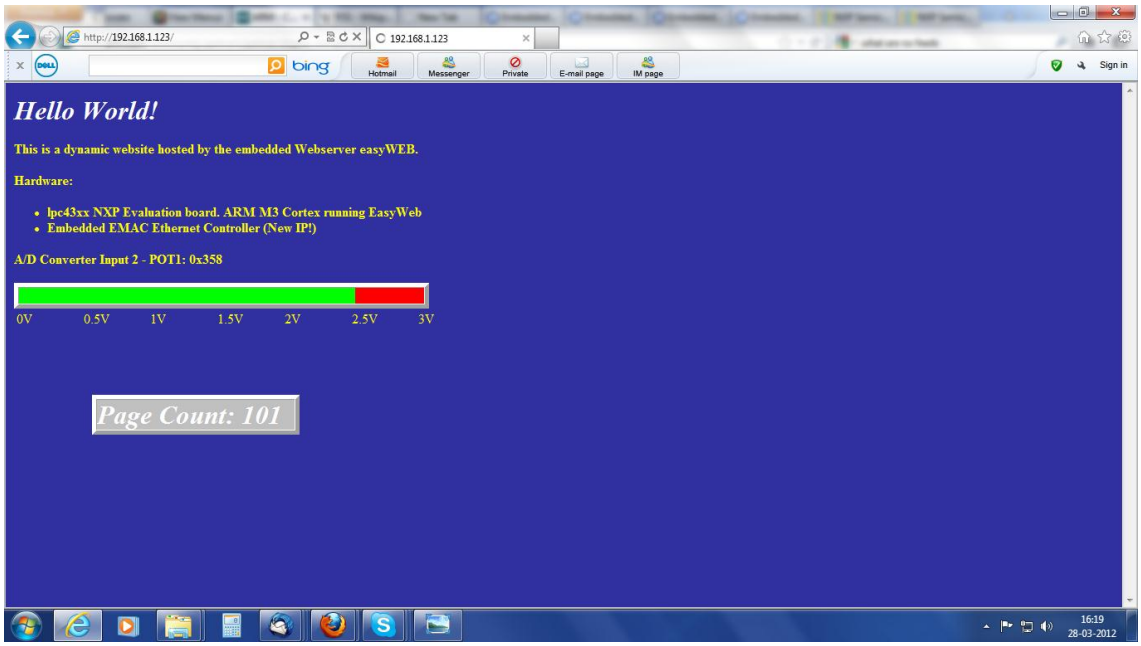


Fig.20

3.3.6 Micro SD connector

Test setup and verification:
The firmware validates the micro SD card interface by writing and reading a sector of the SD card connected. Please note that we need to use a micro SD card with FAT file system. The result of this test is displayed over the VCOM port.

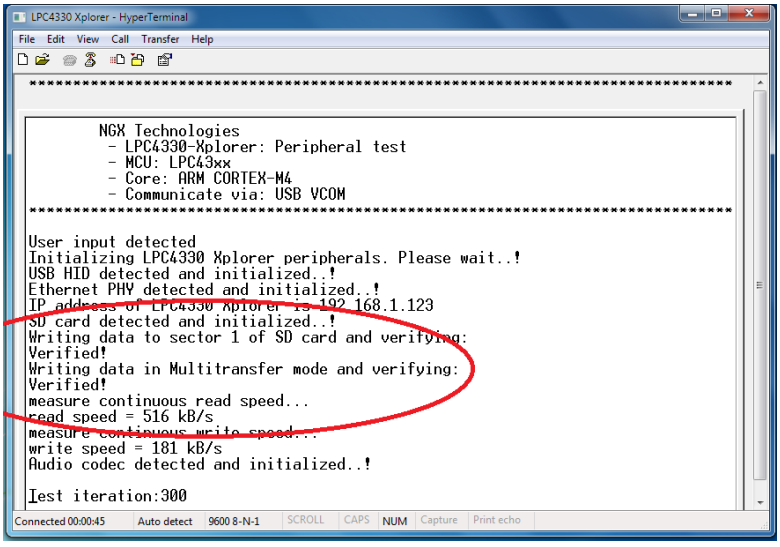


Fig.21

3.3.7 Audio Interface

Test setup and verification:
For the audio interface the LPC4330 Xplorer incorporates external audio codec from NXP. The codec is interfaced to the MCU over I2S0 for data and over I2C0 for command interface. The test firmware verifies both the audio-in and audio-out path. To verify the audio interface the user needs to feed some audio data through the audio-in (LINE-IN) interface and then connect a headphone at the audio-out jack. If one is able to hear the same audio data that is being fed over audio-in interface, we have verified the audio interface.

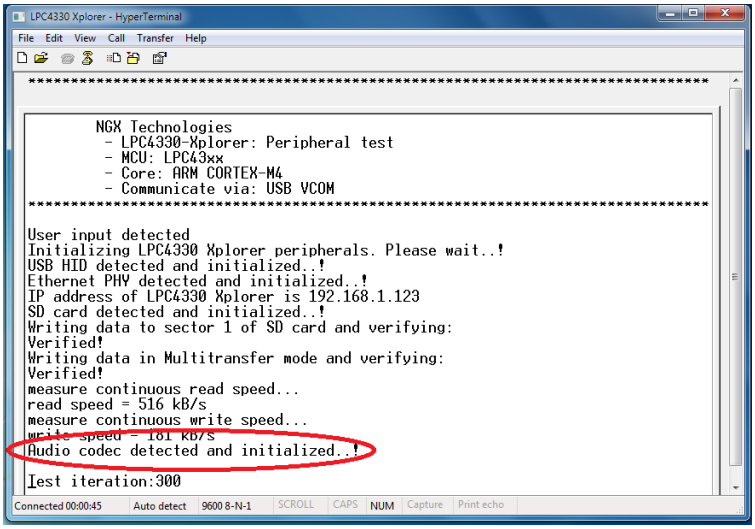


Fig.22

4.0 LPC4330-Xplorer Development Tool Setup

4.1 IDE and debugger

As mentioned in the earlier section, NGX's MCU evaluation platforms are not coupled tightly with any one particular combination of IDE and debugger. The following sections will explain the setup for KEIL and ULINK as the IDE and debugger respectively.

Other tool options that could be considered are:

- LPC-link and LPCXpresso
- Red_Probe and Code Red IDE
- J-link and IAR

4.2 Installation & Configuration of KEIL software

The Installation of KEIL software is explained below:

Step 1: Open the keil setup

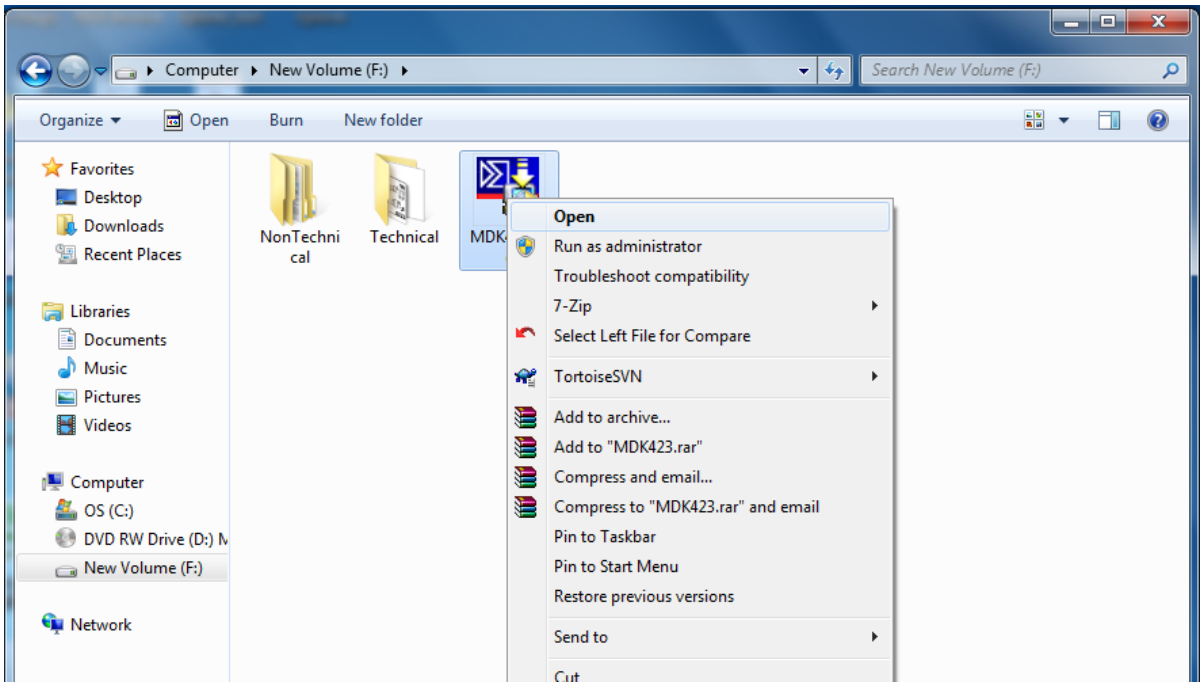


Fig.23

Step 2: Click on Next.

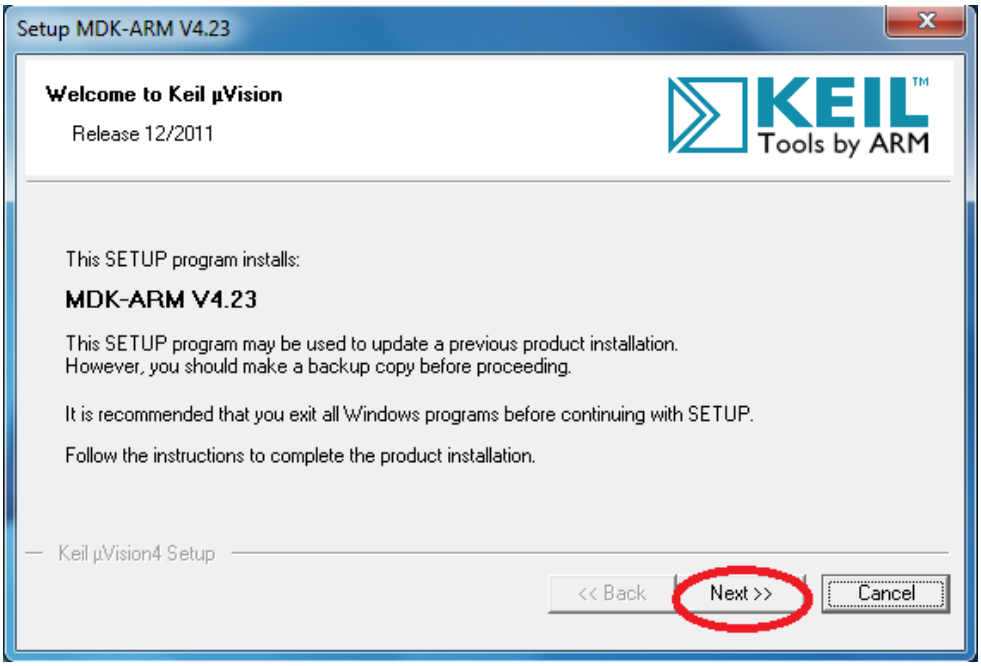


Fig.24

Step 3: Select Terms & conditions check box and click on Next

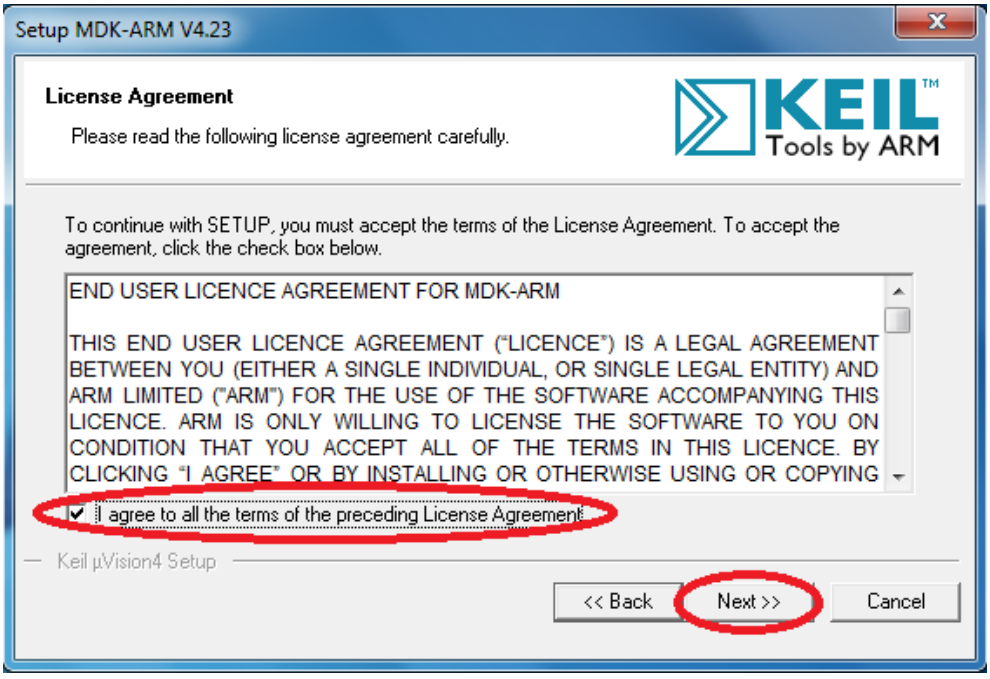


Fig.25

Step 4: Provide the destination path and Click on Next

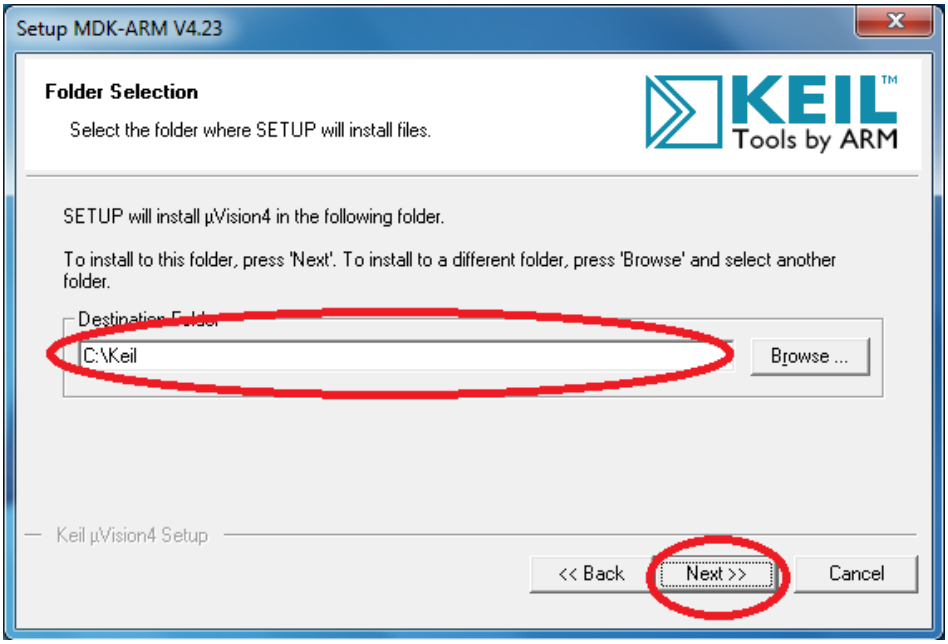


Fig.26

Step 5: Fill your Personal information and Click on Next

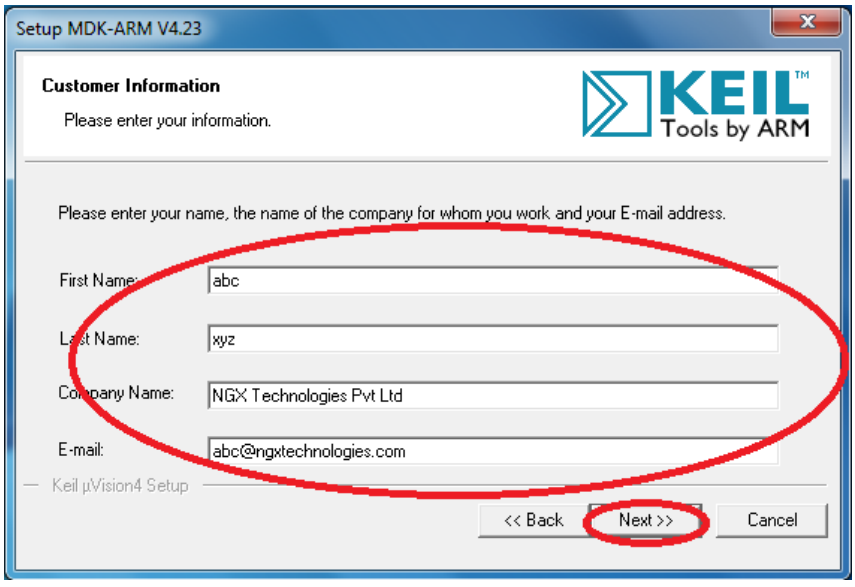


Fig.27

Step 6: Click on Next

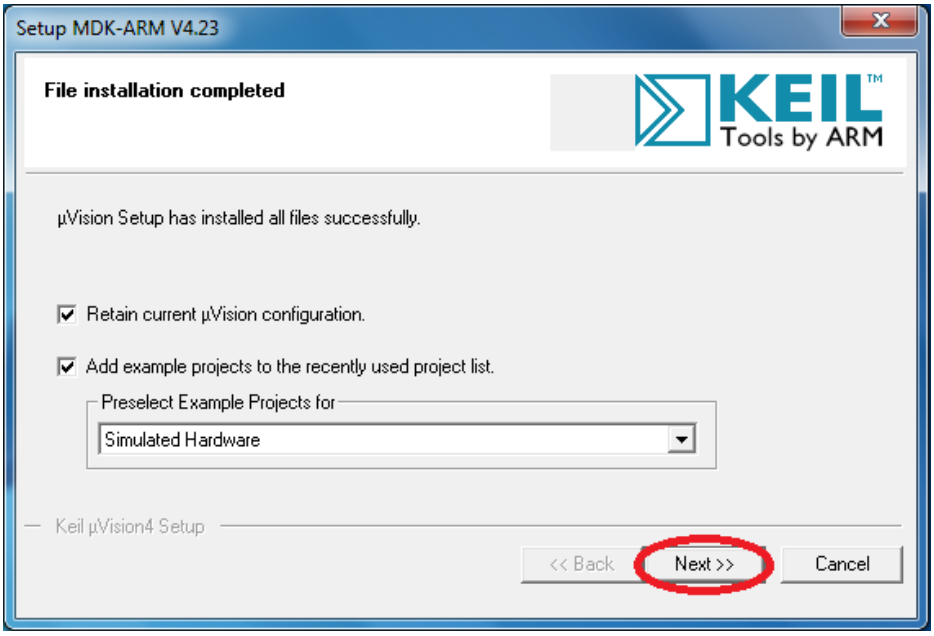


Fig.28

Step 6: Keil µVision4.23 setup is completed. Click on Finish.

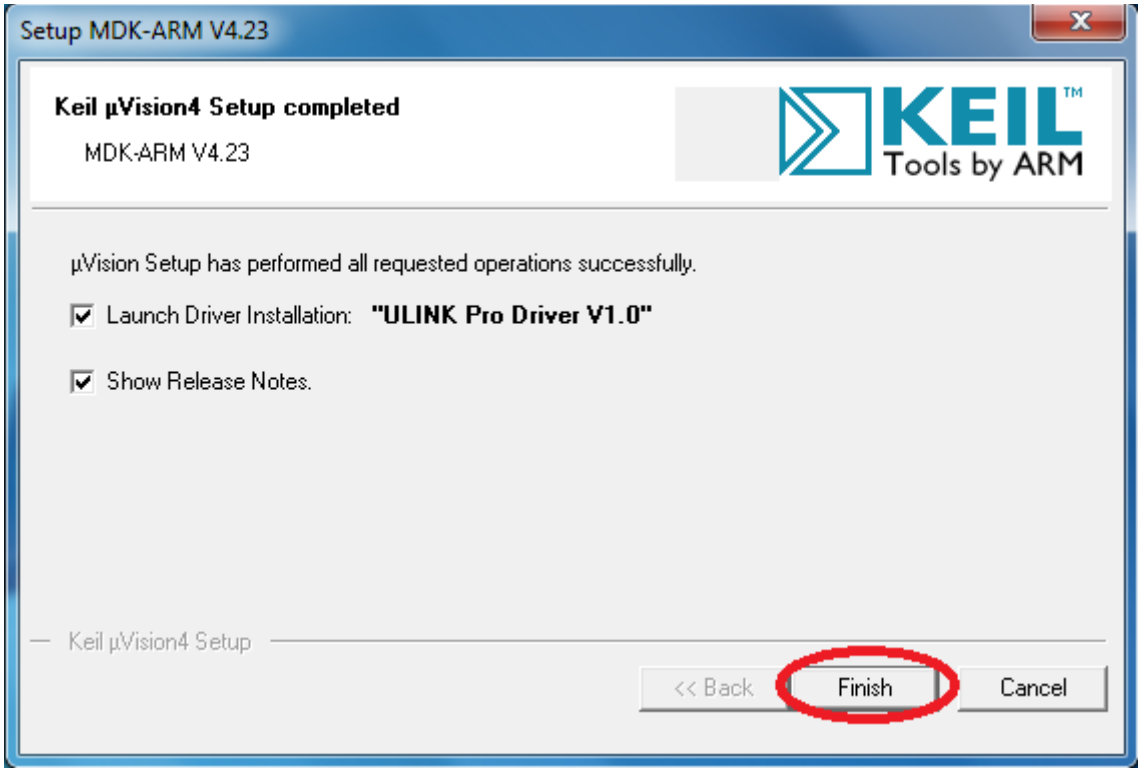


Fig.29

4.3 Configuration of ULINK Debugger

The configuration flow of ULINK Debugger is explained below:

Step 1: Open the Keil Workspace, then by clicking on the **target** option, the window opens as shown below. Next click on Debug and then select the ULINK2/ME Cortex Debugger as shown in the image.

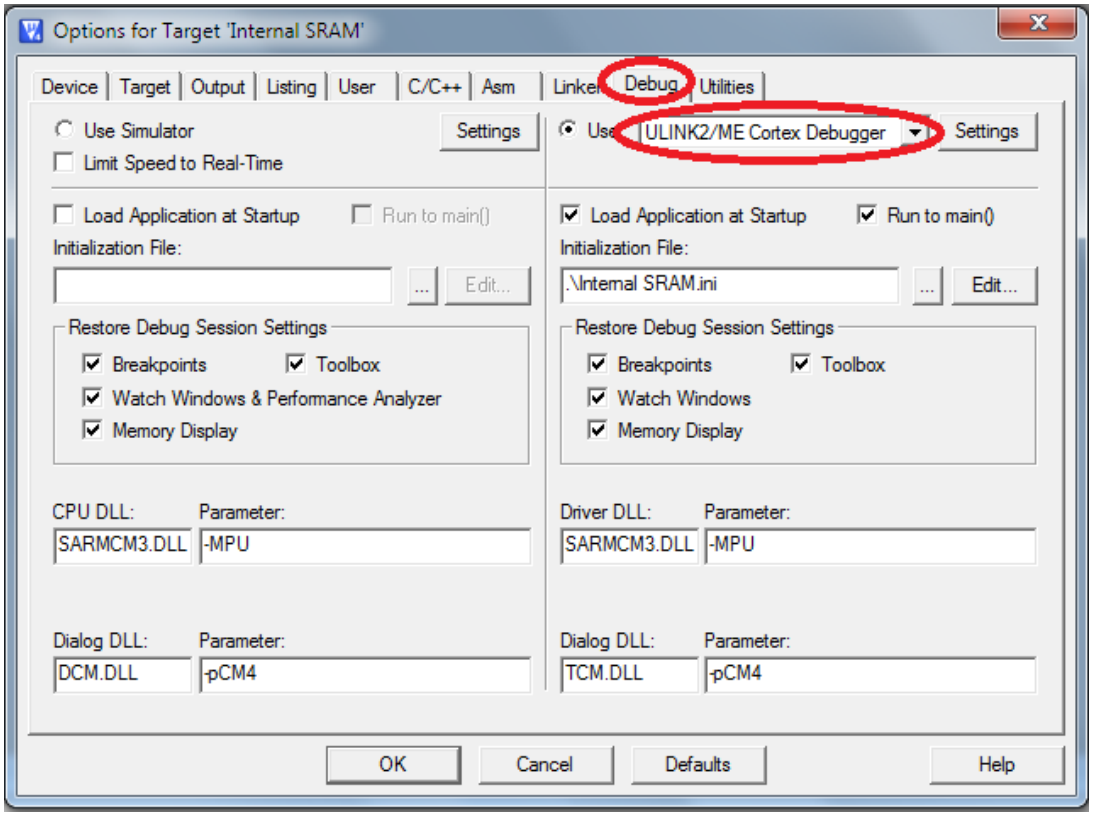


Fig.30

Step 2: Next Click on the settings option, the Cortex-M Target Driver Setup window opens then select SW port. After selection of the SW port the ULINK2 detected is as shown in the image below

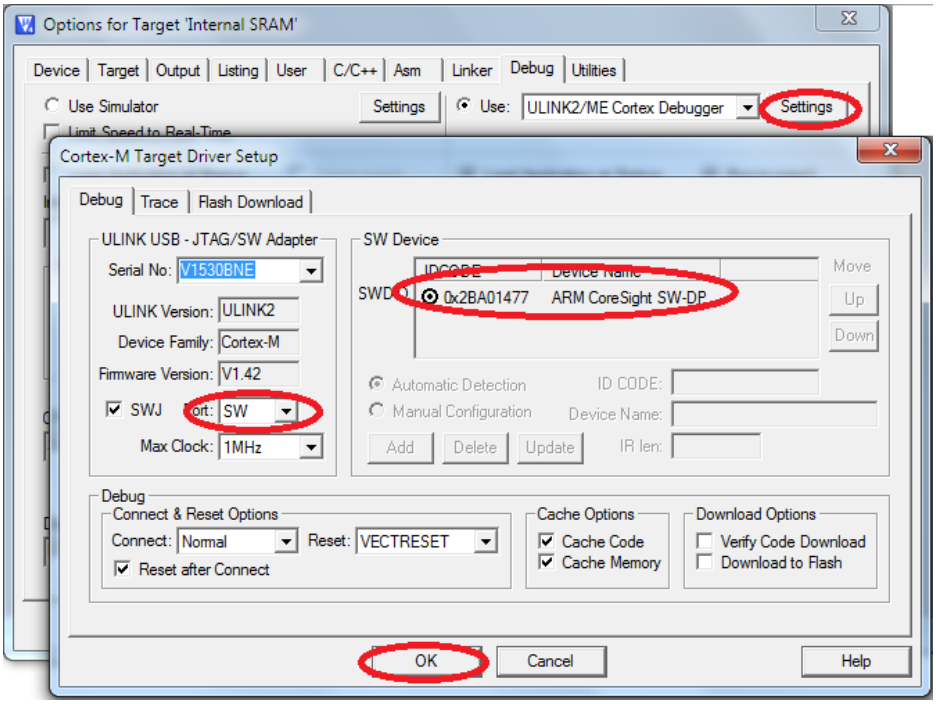


Fig.31

Note : The Cortex M4 can be programed using SW or JTAG, while the Cortex M0 is visible through JTAG port.

4.3.1 Configuring External Quad Flash

Step 1: Open the Keil Workspace, then by clicking on the **target** option the widow opens as shown below, Click on Utilities and select ULINK2/ME Cortex Debugger

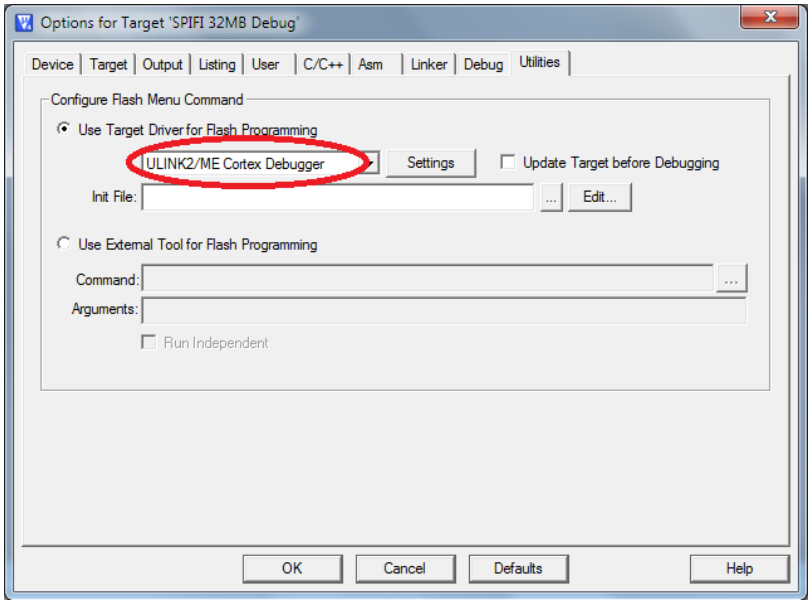


Fig.32

Step 2: Now Click on Settings, then in Cortex-M Target Driver setup click add and select SPIFI on LPC18xx/43xx @ 14000000 Flash programing algorithm and click add.

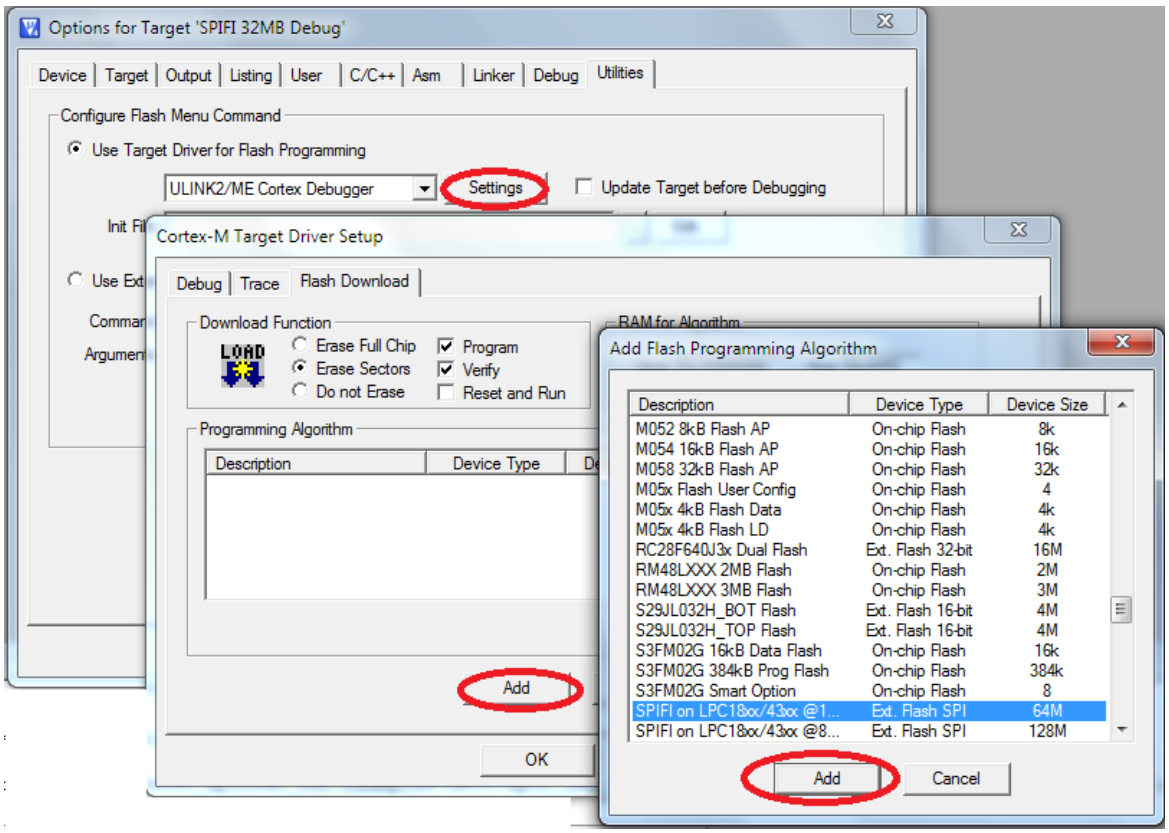


Fig.33

Click OK to complete the ULINK2 Debugger configuration.

5.0 LPC4330 Xplorer firmware Development

5.1 Executing the sample projects

Please note that the sample programs are available once the product is registered.

Steps to execute the sample project in Internal SRAM:

1. Open the project folder.
2. Then open the file project_name.uvproj (Example: Gpio_LedBlinky.uvproj.)

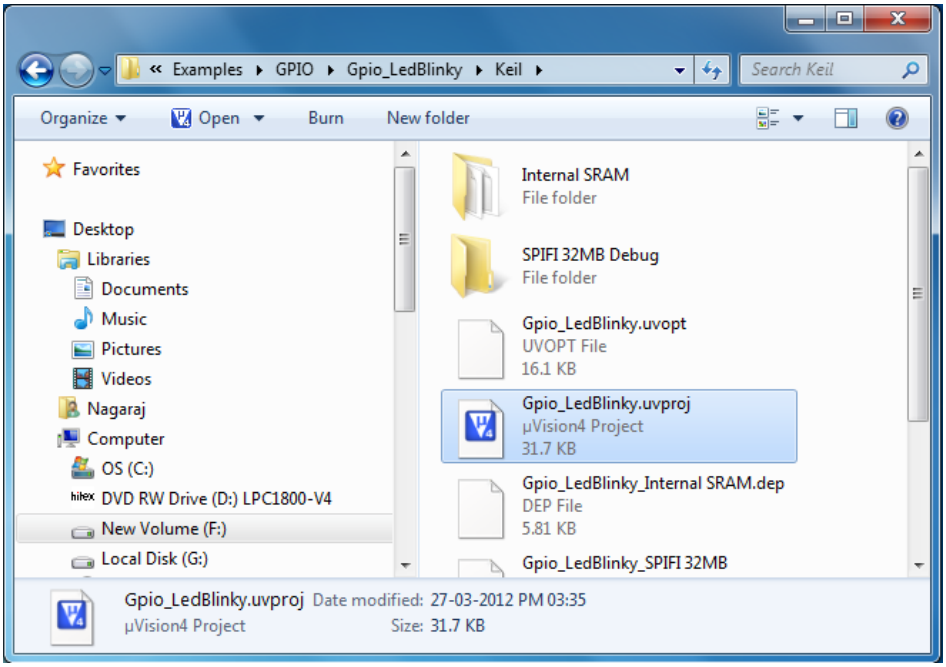


Fig.34

3. This launches the IDE

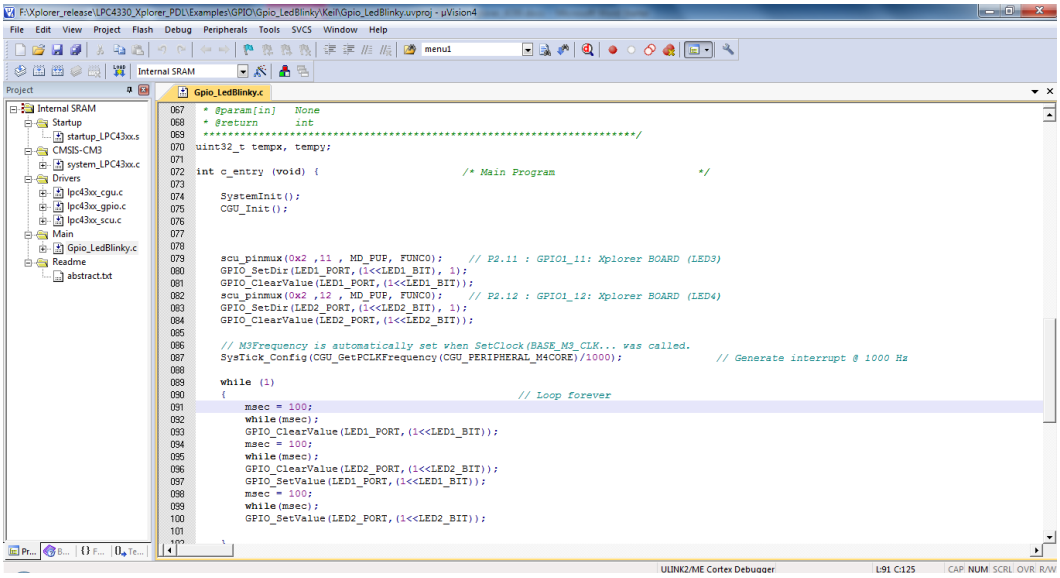


Fig.35

4. If you are using ulink debugger, click Debug on menu bar then click on start/stop debug session, click Run (F5) to execute from the Internal SRAM, two LED's (D2 and D3) on Xplorer should blink.

Steps to execute the sample project in External Quad Flash (SPIFI 32MB Debug):

Step 1: Select SPIFI 32MB Debug option as shown in the below image.

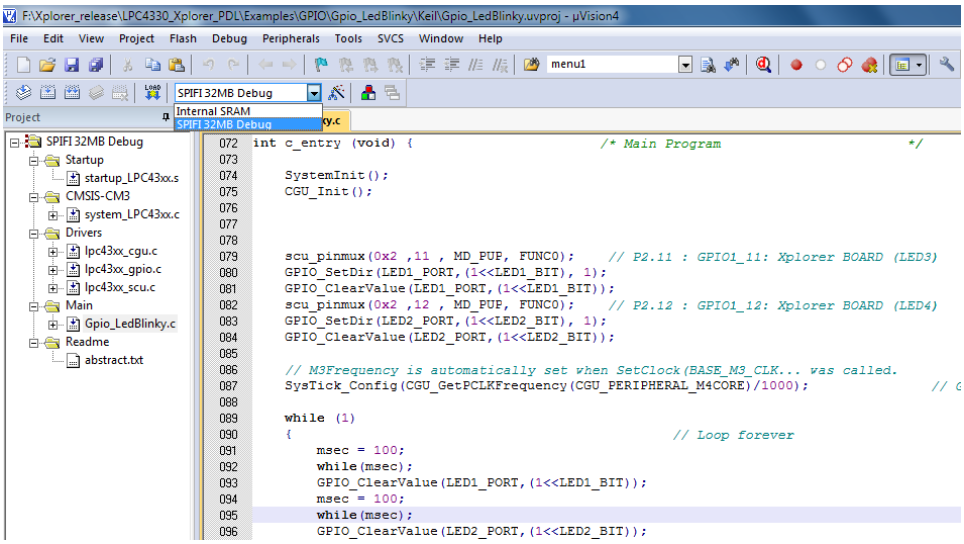


Fig.36

Step 2: Click on LOAD, the executable is loaded into SPIFI 32MB flash. The program can be run by pressing RESET switch twice or the program can be debugged from the flash by clicking start/stop debug session. Click Run (F5) to execute from the Flash, two LED's (D2 and D3) on Xplorer should blink.

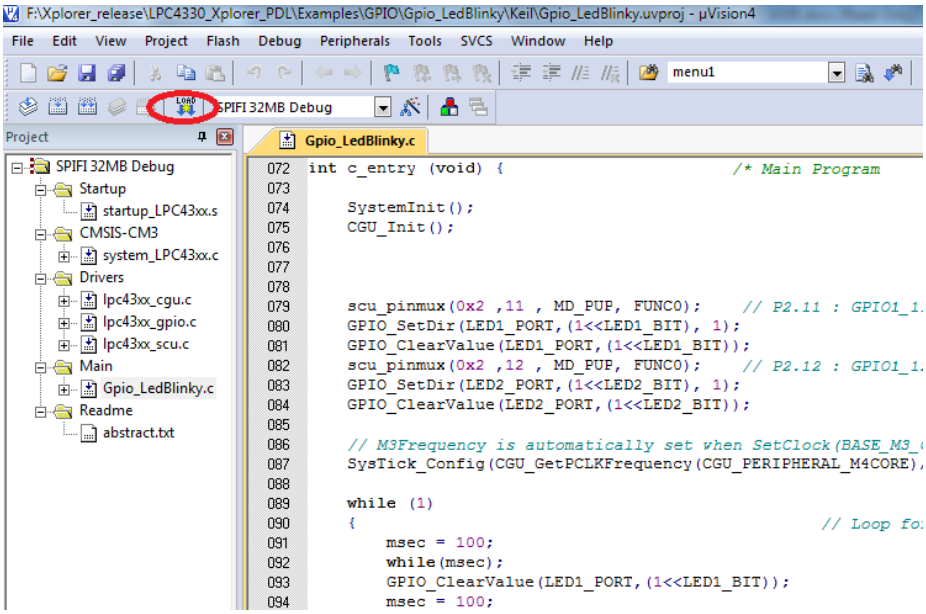


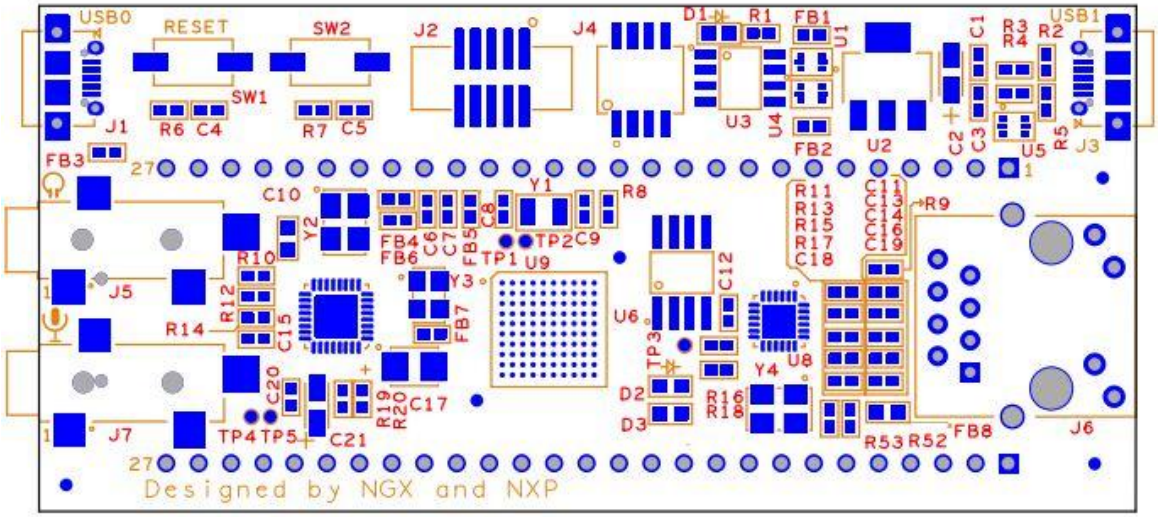
Fig.37

6.0 Schematic & Board Layout

6.1 Schematic

This manual will be periodically updated, but for the latest documentations please check our website for the latest documents. The Board schematic and sample code are available after the product has been registered on our website.

6.2 Board layout



SILKSCREEN TOP SIDE

Fig.38

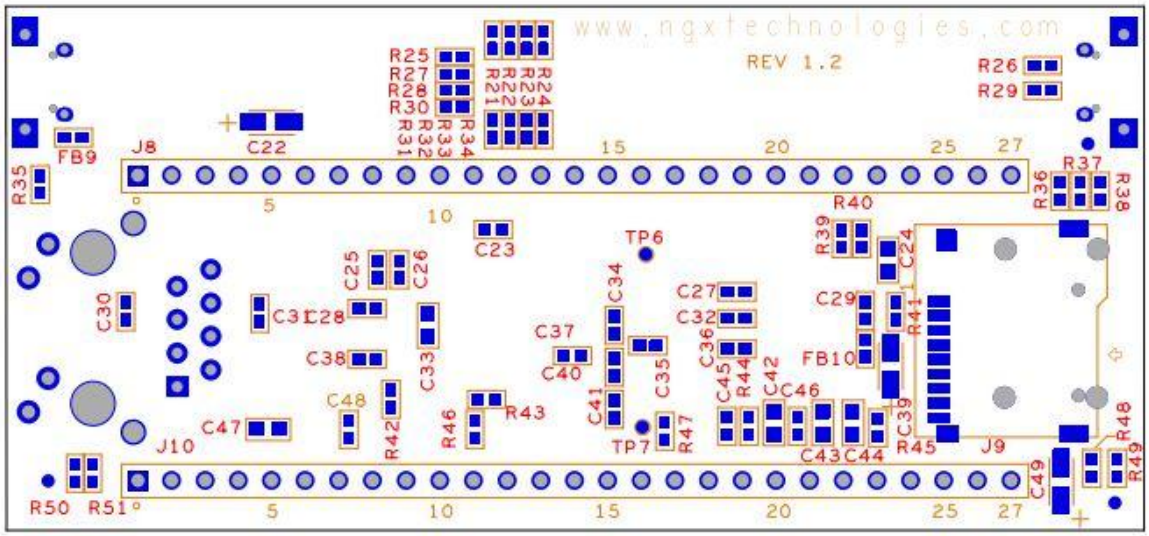


Fig. 39

7.0 CHANGE HISTORY

7.1 Change History

Rev	Changes	Date (dd/mm/yy)	By
1.0	Initial release of the manual	29/03/2012	Ashwin Athani

About this document:

Revision History

Version: V1.0 author: Ashwin Athani

Company Terms & Conditions

Legal

NGX Technologies Pvt. Ltd. provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION, and EDUCATION OR EVALUATION PURPOSES ONLY and is not considered by NGX Technologies Pvt. Ltd to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL and therefore may not meet the technical requirements of these directives or other related directives.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies NGX Technologies from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

NGX Technologies currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. NGX Technologies assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages.

No license is granted under any patent right or other intellectual property right of NGX Technologies covering or relating to any machine, process, or combination in which such NGX Technologies products or services might be or are used.

Disclaimers

Information in this document is believed to be reliable and accurate. However, NGX Technologies does not give any representations or warranties, expressed or implied, as to the completeness or accuracy of such information and shall have no liability for the consequences of use of such information.

NGX Technologies reserves the right to make changes to information published in this document, at any time and without notice, including without limitation specifications and product descriptions. This document replaces and supersedes all information supplied prior to the publication hereof.

Trademarks

All referenced trademarks, product names, brands and service names are the property of their respective owners.