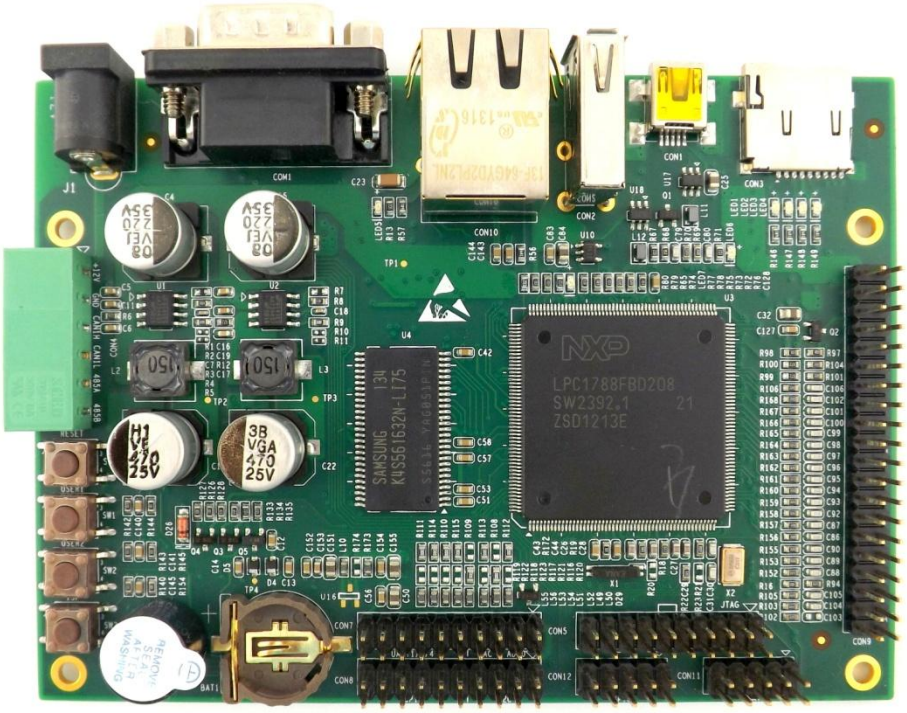
SBC1788

Industrial Single Board Computer



User Manual

Version 1.4

15th Jan 2014

mbest
A Premier Farnell Company

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- SBC1788 and its related intellectual property are owned by Shenzhen Embest Technology Co., Ltd.

Revision History:

Version	Date	Description
1.0	06/08/2012	Original Version
1.1	29/11/2012	First Revision
1.2	14/06/2013	Second Revision
1.3	11/10/2013	Third Revision
1.4	15/01/2014	Localisation

Table of Contents

1 Product Overview

1.1 Introduction

The SBC1788 is an industrial single board computer designed by Embest Technology based on the LPC1788FBD208 - a 32-bit ARM Cortex-M3 processor from NXP. It is built to industrial standards with features including: support for real-time operating systems, good EMC performance, and abundant interfaces such as UART, I2C, SPI, PWM, AD, and DA. In addition, the CD-ROM provided along with the SBC1788 contains drivers and example programs for all the on-board devices, helping users start their evaluation and development quickly and easily.

The SBC1788 is suited for a wide scope of applications and can meet the requirements in many different fields including:

- Instrumentation,
- Home automation,
- Medical diagnosis,
- Motor control.

1.2 Kit Contents

- SBC1788
- Cross-Over Serial Cable (DB9, 150CM)
- Cross-Over Network Cable (150CM)
- USB A Male to MINI USB B Male Cable
- 12V/1.25A Power Adaptor
- Four Hex Head Cap Screws with four Brass Tube Plugs
- CD-ROM
- **Optional** LCD Touch-Screen (4.3” with 480x272 resolution or 7” with 800x480 resolution)

1.3 Board Interfaces

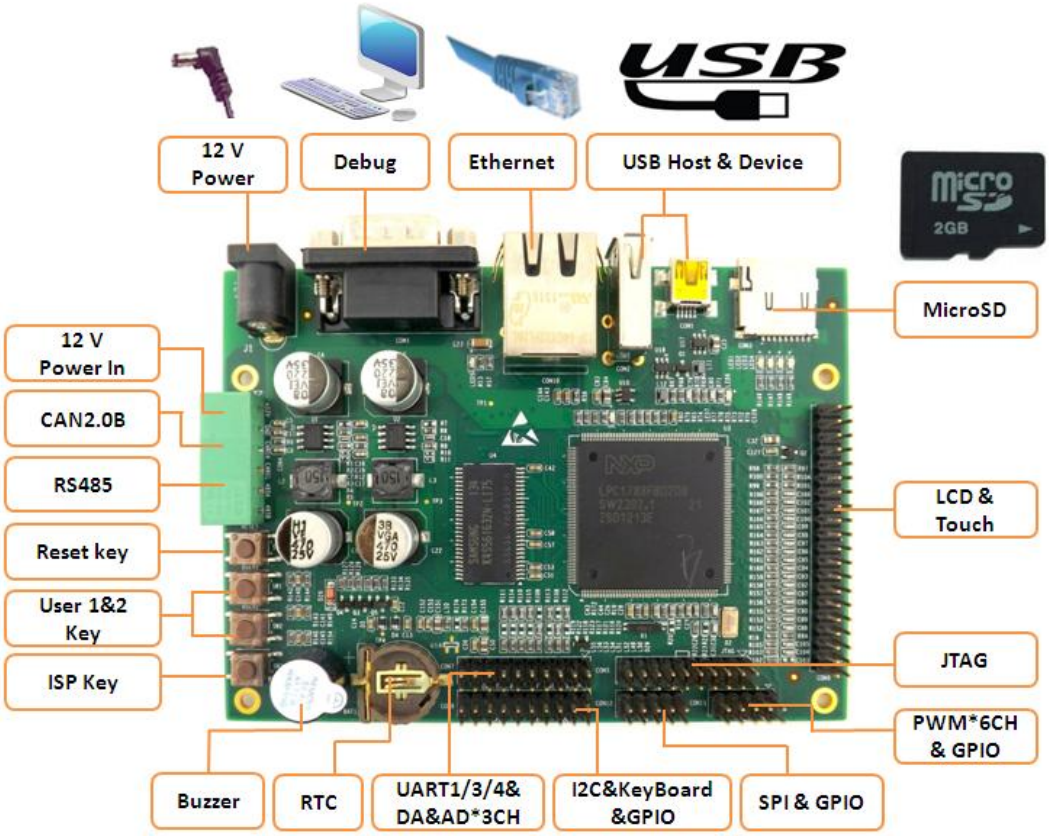


Figure 1: SBC1788 Board Interfaces

1.4 System Diagram

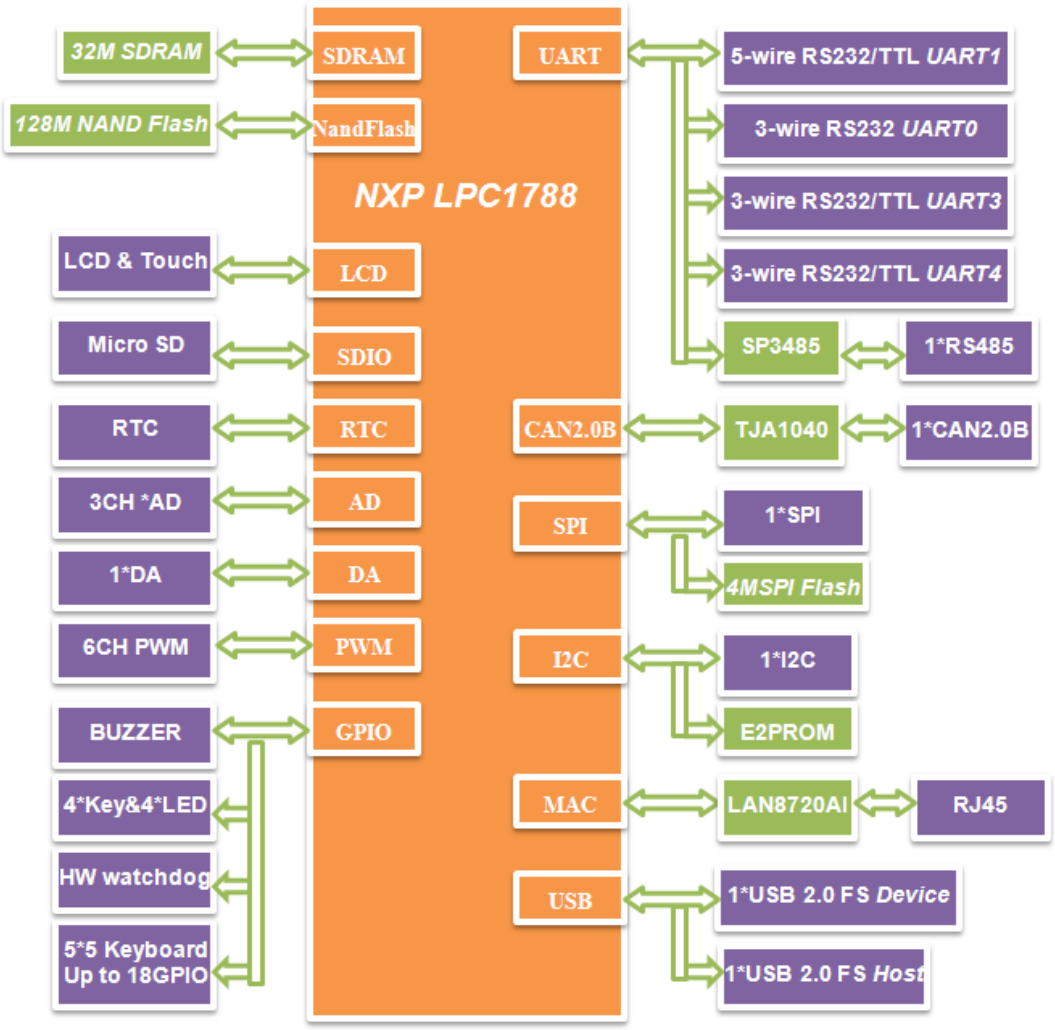


Figure 2: SBC1788 System Block Diagram

Block	Description
	Interface modules of CPU
	Chips or spare solder pads on the board
	Interfaces on the board

1.5 Physical Dimensions

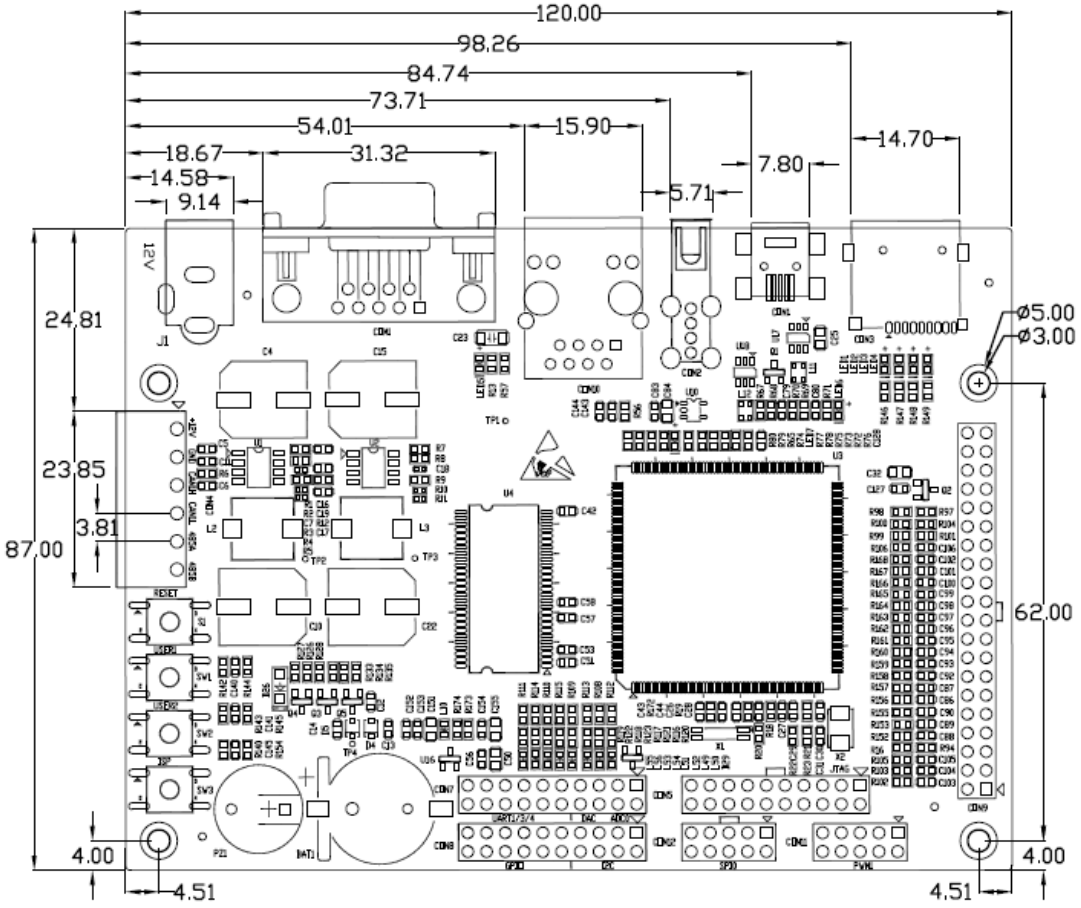


Figure 3: SBC1788 Hardware Dimensions

Top Layer Component Height$_{MAX}$ = 13 mm

Bottom Layer Component Height$_{MAX}$ = 3 mm

Board Thickness =1.6mm, 6 layer PCB

2 Hardware Features

2.1 Processor

- NXP 32-bit ARM Cortex-M3 LPC1788FBD208
- On-Board Memory:
    - 128MB NAND Flash
    - 32MB SDRAM
    - 4MB SPI Flash (spare solder pads)
    - 2Kb EEPROM (spare solder pads)

2.2 Interfaces

- LCD Touch-Screen Interface:
    - Supports 4.3” (480×272) and 7” (800×480) TFT LCDs
    - Supports 4-wire resistive touch-screen
    - 16bit RGB565 mode
- 4 serial interfaces:
        - UART0: 3-wire serial interface from DB9 male connector with RS232 level
        - UART1: 5-wire serial interface from DIP connector with default TTL level which can be customized as RS232 level
        - UART3: 3-wire serial interface from DIP interface with default RS232 level which can be customized as TTL level
        - UART4: 3-wire serial interface from DIP interface with default TTL level which can be customized as RS232 level
- 1-channel RS485 Serial port (brought out by Phoenix Connector)
- USB 2.0 host interface at 2Mbps
- USB 2.0 host/device interface at 12Mbps
- 10/100 Mbps Ethernet interface

- TF card interface
- CAN2.0B interface
- 2 user custom buttons, 1 reset button, 1 ISP button
- 20-pin standard JTAG debugging interface
- buzzer
- 6-channel PWM interface
- 3-channel ADC interface
- DAC interface
- SPI interface
- I2C interface
- 18 separated GPIO interfaces
- 5×5 matrix keypad interface
- External 12V power jack
- high-precision RTC interface
- 2 WDT in chip and an on-board spare interface for external hardware WDT
- Power indicator
- USB Device FS indictor
- USB Host FS indicator
- 4 user customisable indicators

2.3 Operational Parameters

- Dimensions: 120x87mm (6-layer PCB)
- Operating Temperature: -40 ~ +85℃
- Storage Temperature: -40 ~ +85℃
- Operating Humidity: 0% ~ 90% (Non-Condensing)
- Power Supply: 12V/1.25A

Electric Standards: CE, FCC and CCC

3 Hardware Details

This chapter will give you an overview of the product hardware system by introducing the CPU and interfaces used on the SBC1788.

3.1 CPU Introduction

The SBC1788 uses an LPC1788FBD208 from NXP – a low-power ARM Cortex-M3 MCU with high performance-price ratio. This MCU works at a frequency of up to 120MHz and integrates an LCD image controller, 512 KB of flash memory, 96KB of SRAM, 4KB of EEPROM and abundant peripherals including Ethernet, USB device/host/OTG, 5 UARTs, 3 SPI/SSPs, 3 I2Cs and 165 GPIOs.

3.2 Interface Introduction

The SBC1788 provides many different on-board interfaces such as RS232, Ethernet, USB host/OTC, TF card and LCD interfaces. This section will give you brief introductions for each of these interfaces.

3.2.1 Power Jack

J1		
Pins	**Definitions**	**Descriptions**
1	+12V	Power supply +12V/1.25A
2	GND	Grounded
3	GND	Grounded

3.2.2 RS232 Interface

COM1		
Pins	**Definitions**	**Descriptions**
1	NC	NC
2	RXD	Receive data
3	TXD	Transit data

COM1		
Pins	**Definitions**	**Descriptions**
4	NC	NC
5	GND	GND
6	NC	NC
7	NC	NC
8	NC	NC
9	NC	NC

3.2.3 Ethernet Interface

CON10		
Pins	**Definitions**	**Descriptions**
1	TX+	TX+ output
2	TX-	TX- output
3	RX+	RX+ input
4	CT	CT
5	CT	CT
6	RX-	RX- input
7	NC	NC
8	SHIELD	Shield
9	LED1	LINK LED
10	VDD3V3	3.3V Power for LED
11	LED2	SPEED LED
12	VDD3V3	3.3V Power for LED
13	4&5	Connect to shield
14	7&8	Connect to shield

CON10		
Pins	**Definitions**	**Descriptions**
15	NC	NC
16	NC	NC

3.2.4 USB Host Interface

CON2		
Pins	**Definitions**	**Descriptions**
1	VBUS	+5V
2	D-	USB Data-
3	D+	USB Data+
4	GND	GND

3.2.5 USB Device Interface

CON1		
Pins	**Definitions**	**Descriptions**
1	VBUS	+5V
2	D-	USB Data-
3	D+	USB Data+
4	ID	USB ID
5	GND	GND

3.2.6 TF Card Slot

CON3		
Pins	**Definitions**	**Descriptions**
1	DAT2	Card data 2
2	DAT3	Card data 3

CON3		
Pins	**Definitions**	**Descriptions**
3	CMD	Command Signal
4	VDD	VDD
5	CLK	Clock
6	VSS	VSS
7	DAT0	Card data 0
8	DAT1	Card data 1
9	CD	Card detect

3.2.7 LCD Interface

CON9		
Pins	**Definitions**	**Descriptions**
1	GND	GND
2	DCLK	DCLK
3	HSYNC	HSYNC
4	VSYNC	VSYNC
5	GND	GND
6	RST	RST(Reserved)
7	R3	Red data input
8	R4	Red data input
9	R5	Red data input
10	R6	Red data input
11	R7	Red data input
12	GND	GND
13	G2	Green data input

CON9		
Pins	**Definitions**	**Descriptions**
14	G3	Green data input
15	G4	Green data input
16	G5	Green data input
17	G6	Green data input
18	G7	Green data input
19	GND	GND
20	GPIO_0	GPIO(Reserved)
21	B3	Blue data input
22	B4	Blue data input
23	B5	Blue data input
24	B6	Blue data input
25	B7	Blue data input
26	GND	GND
27	DEN	Display enable
28	VDD3V3	+3.3V power supply
29	VDD3V3	+3.3V power supply
30	GPIO_1	I2C_SCL(Reserved)
31	GPIO_2	I2C_SDA(Reserved)
32	Y+	Terminal of touch panel
33	X-	Terminal of touch panel
34	Y-	Terminal of touch panel
35	X+	Terminal of touch panel
36	PWREN	LCD power enable

CON9		
Pins	**Definitions**	**Descriptions**
37	VDD5V	+5V power supply
38	PWM	LED Dimming Control by PWM Signal
39	VDD5V	+5V power supply
40	VDD12V	+12V power supply

3.2.8 JTAG Interface

CON5		
Pins	**Definitions**	**Descriptions**
1	VTREF	+3.3V power supply
2	VSUPPLY	+3.3V power supply
3	NTRST	Test system reset
4	GND	GND
5	TDI	Test data input
6	GND	GND
7	TMS	Test mode select
8	GND	GND
9	TCK	Test clock
10	GND	GND
11	RTCK	GND
12	GND	GND
13	TDO	Test data output
14	GND	GND
15	NSRST	Test system reset

CON5		
Pins	**Definitions**	**Descriptions**
16	GND	GND
17	DBGRQ	Connect to GND
18	GND	GND
19	DBGACK	Connect to GND
20	GND	GND

3.2.9 PWM Interfaces

CON11		
Pins	**Definitions**	**Descriptions**
1	P3_22	P3[22]
2	VDD3V3	+3.3V power supply
3	PWM1_1	PWM1[1]
4	PWM1_2	PWM1[2]
5	PWM1_3	PWM1[3]
6	PWM1_4	PWM1[4]
7	PWM1_5	PWM1[5]
8	PWM1_6	PWM1[6]
9	P3_23	P3[23]
10	GND	GND

3.2.10 SPI Interfaces

CON12		
Pins	**Pins**	**Pins**
1	SPI0_MOSI	SPI0_MOSI
2	VDD3V3	+3.3V power supply
3	P3_20	P3[20]
4	P3_19	P3[19]
5	SPI0_SSEL	SPI0_SSEL
6	P3_14	P3[14]
7	SPI0_SCK	SPI0_SCK
8	P2_25	P2[25]
9	SPI0_MISO	SPI0_MISO
10	GND	GND

3.2.11 UART & ADC/DAC Interfaces

CON7		
Pins	**Definitions**	**Descriptions**
1	VDD5V	+5V power supply
2	VDD3V3	+3.3V power supply
3	ADC0_IN0	ADC0_IN0
4	ADC0_IN2	ADC0_IN2
5	ADC0_IN1	ADC0_IN0
6	DAC_OUT	DAC_OUT
7	P1_05	P1[5]
8	GND	GND
9	TXD3	UART3_ TXD

CON7		
Pins	**Definitions**	**Descriptions**
10	TXD1	UART1_ TXD
11	RXD3	UART3_ RXD
12	RXD1	UART1_ RXD
13	P1_13	P1[13]
14	P5_02	P5[02]
15	TXD4	UART4_ TXD
16	CTS1	UART1_CTS1
17	RXD4	UART4_ RXD
18	RTS1	UART1_RTS1
19	GND	GND
20	GND	GND

3.2.12 GPIO & I2C Interfaces

CON8		
Pins	**Definitions**	**Descriptions**
1	VDD5V	5V power supply
2	VDD3V3	+3.3V power supply
3	I2C0_SCL	I2C0_SCL
4	I2C2_SCL	I2C2_SCL
5	I2C0_SDA	I2C0_SDA
6	I2C2_SDA	I2C2_SDA
7	P4_21	P4[21]
8	GND	GND
9	P4_22	P4[22]

CON8		
Pins	**Definitions**	**Descriptions**
10	P0_04	P0[04]
11	P4_23	P4[23]
12	P0_05	P0[05]
13	P4_26	P4[26]
14	P0_18	P0[18]
15	P4_27	P4[27]
16	P3_21	P3[21]
17	P4_28	P4[28]
18	GND	GND
19	GND	GND
20	GND	GND

3.2.13 CAN & RS485 Interfaces

CON4		
Pins	**Definitions**	**Descriptions**
1	+12V	Power
2	GND_IN	GND
3	CAN1H	CAN1_H
4	CAN1L	CAN1_L
5	485A	RS485
6	485B	RS485

3.2.14 Buttons

S1 SW1~SW3		
Pins	**Definitions**	**Descriptions**
S1	RESET	System
SW1	USER1	User-defined
SW2	USER2	User-defined
SW3	ISP	ISP

3.2.15 LED Indicators

LED1~4		
LEDs	**Definitions**	**Descriptions**
LED1	P4[15]	User
LED2	P4[16]	User
LED3	P4[17]	User
LED4	P4[18]	User

4 Preparations

Before you get started with software development, you need to make a series of preparations including configuring HyperTerminal, setting up a network, and installing a Keil MDK or IAR EWARM integrated development environment. The following contents will show you how to complete the installation and configuration processes on a PC running Windows XP.

4.1 Configuring HyperTerminal

1. Select:

- Start
- All Programs
- Accessories
- Communications
- HyperTerminal

On your PC's desktop to open a HyperTerminal window as shown below;

Figure 4: New HyperTerminal Window

Enter a name for the new HyperTerminal in the **Name** textbox, and then click **OK**;

2. Select the serial interface used to connect to the SBC1788 from the **Connect using** drop-down menu as shown in the window to the right, and then click **OK**;

Figure 5: Select Serial Interface

3. Configure the serial interface according to the configurations in the window shown to the right, and then click **OK**;

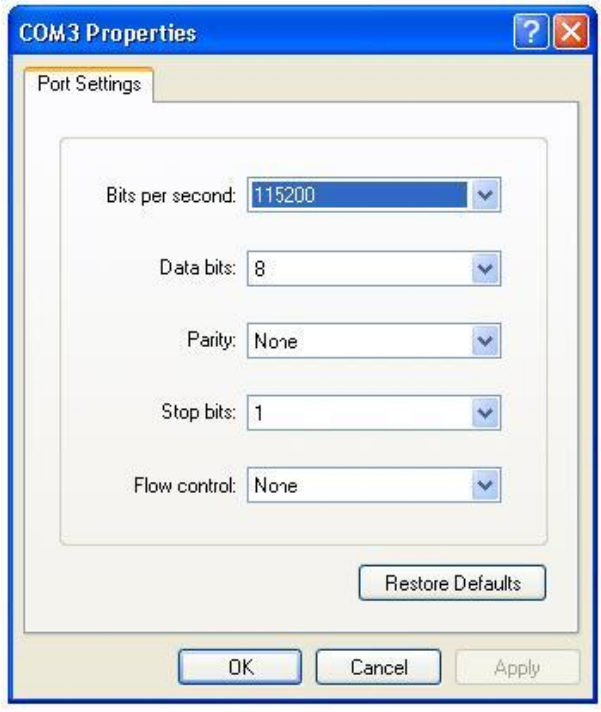


Figure 6: Configure Serial Interface

4. The window below indicates that the HyperTerminal configuration has been set up successfully;

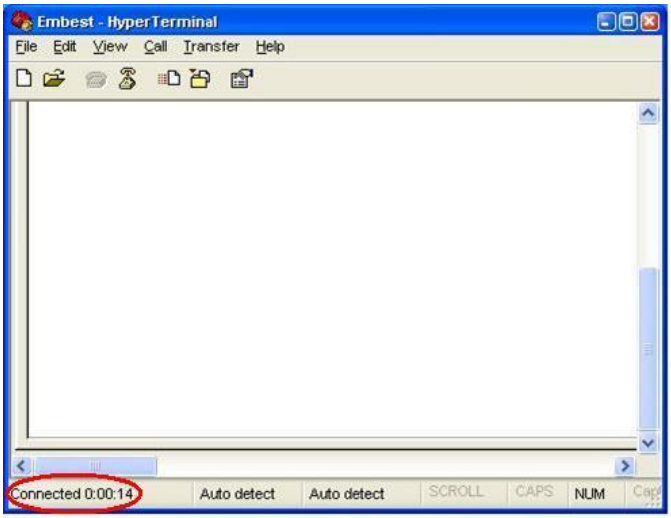


Figure 7HyperTerminal Is Connected

4.2 Configuring the Network

1. Click

- Start
- Control Panel
- Network and Internet
- Network Connections

On your PC's desktop, and then double-click **Local Area Connection** to open the window as shown right;

Then click **Properties** to open the Local Area Connection Properties window;

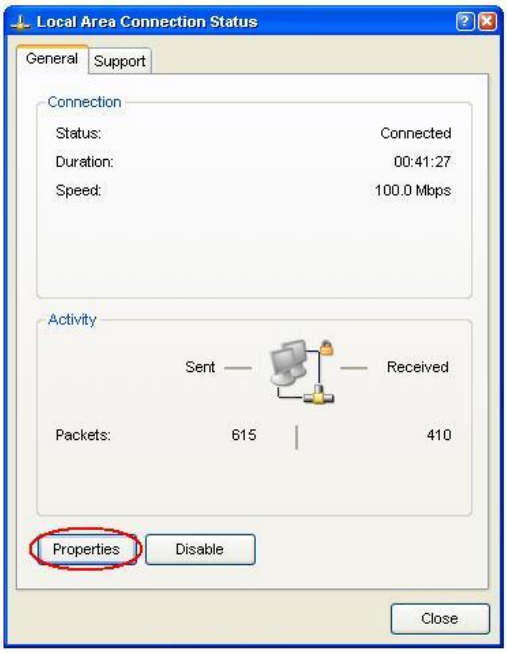


Figure 8: Local Area Connection Status

2. Double-click **Internet Protocol (TCP/IP)** as in the window shown to the right;

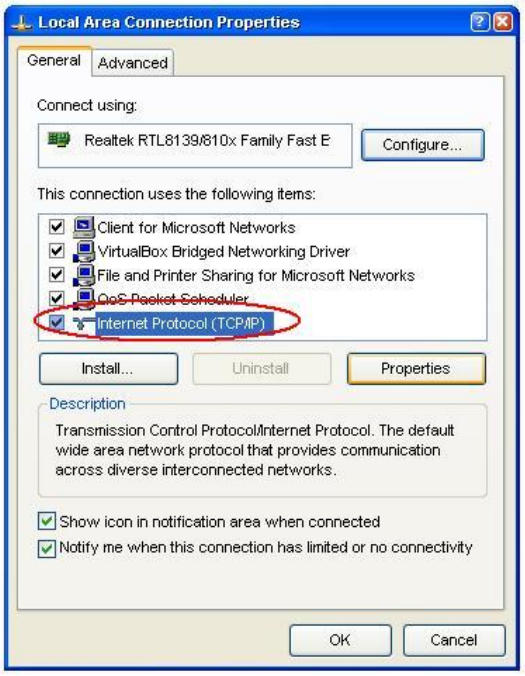


Figure 9: Internet Protocol TCP/IP

3. Click **Advanced** in the window shown to the right;

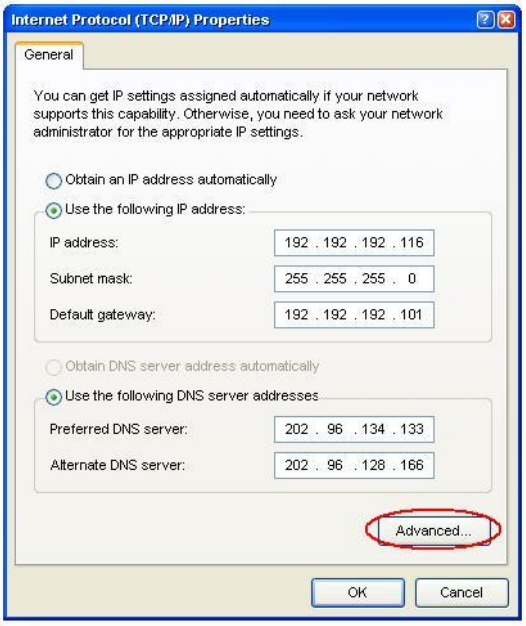


Figure 10: Select Advanced

Note:

🕮 Please ensure the option **Use the following IP address** is checked, and then click **Advanced** to specify additional IP addresses for PC.

4. Click **Add** in the **IP address** block in the window shown below;

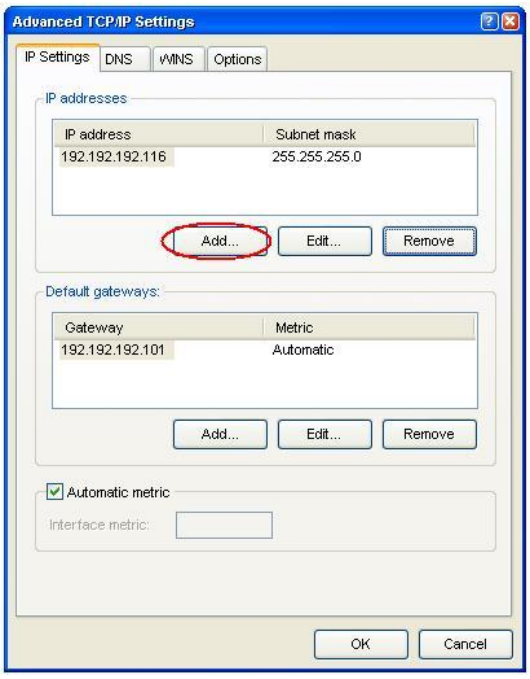


Figure 11: Click Add

5. Enter an IP address that is in the same network segment as the SBC1788 (the SBC1788s default IP address is 192.168.0.232), e.g. 192.168.0.40 in the pop-up window, and then enter a subnet mask and click **Add**;

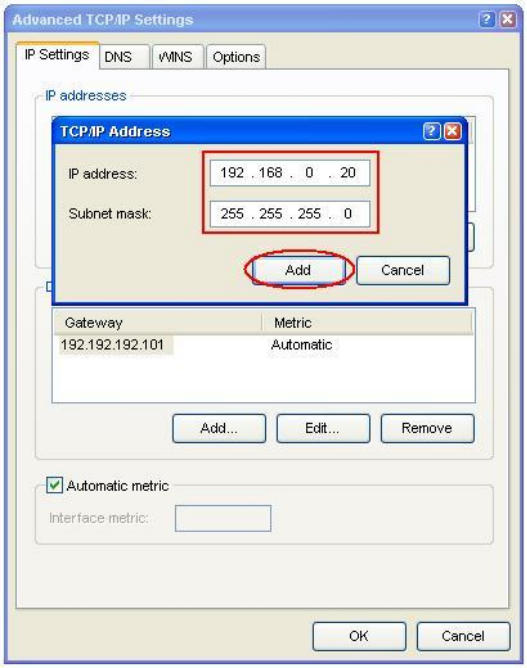


Figure 12: Enter an IP Address

Note:

🕮 You can use any IP address from 192.168.0.1 to 192.168.0.254 except 192.168.0.100, because this address will cause IP conflict when the **Ethernet** example program is running.

6. The window shown below indicates that a new IP address has been added to the PC; Now click **OK** to finish the configuration;

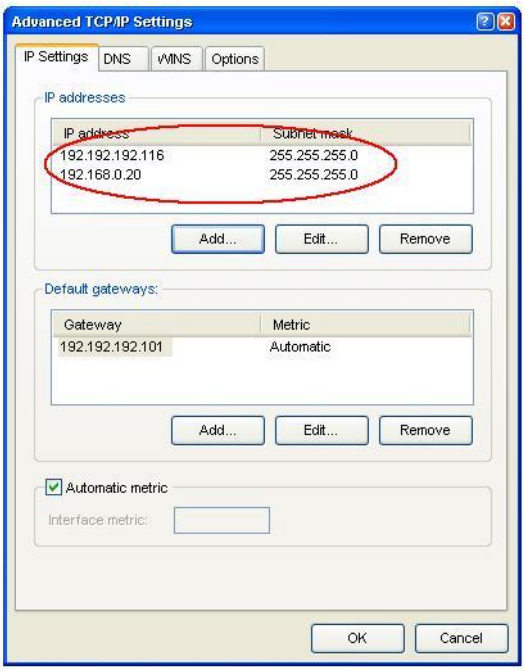


Figure 13: Click OK

4.3 Installing Keil MDK

Development on the LPC1788 requires version 4.20 or higher of the Keil MDK. All the MDK projects contained in the CD-ROM provided along with the board are created in MDK 4.22a. You can download the latest version from Keil's official website:

www.keil.com.

The following content will show you how to install the Keil MDK integrated development environment using MDK 4.22a as an example.

1. Launch the installation package to open the window shown below;

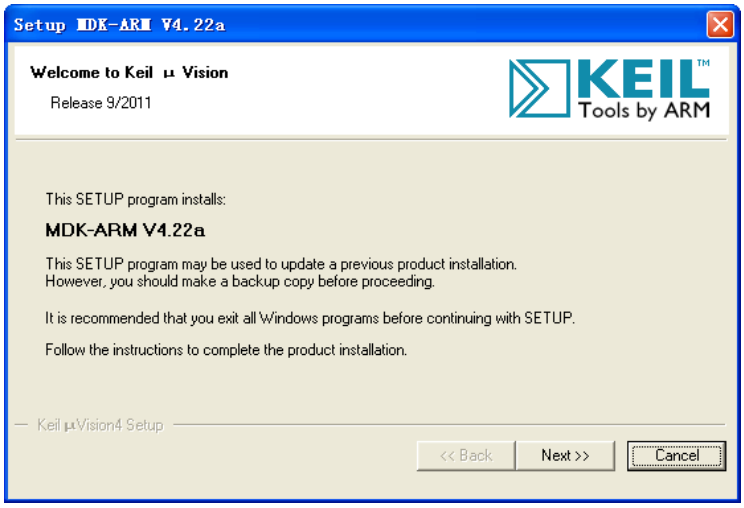


Figure 14: Installation Program

2. Click **Next** to continue;

3. Check I agree to all the terms of the preceding License Agreement and click Next in the window shown below;

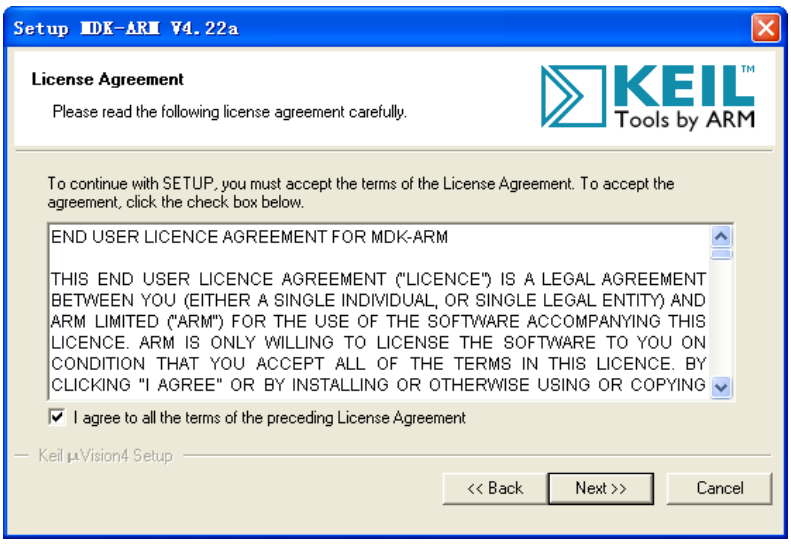


Figure 15: License Agreement

4. Click **Browse** in the window shown below to specify an installation path, and then click **Next**;

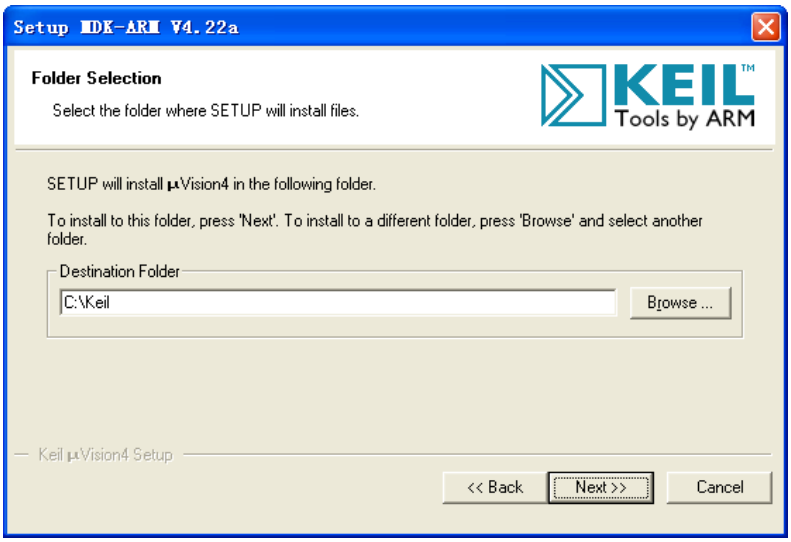


Figure 16: Specify the installation path

5. Enter user information such as name, company name and email, and then click **Next** to start file installation process;

Figure 17: Enter User Information

6. After file installation is completed, keep the default settings unchanged in the window shown below and click **Next**;

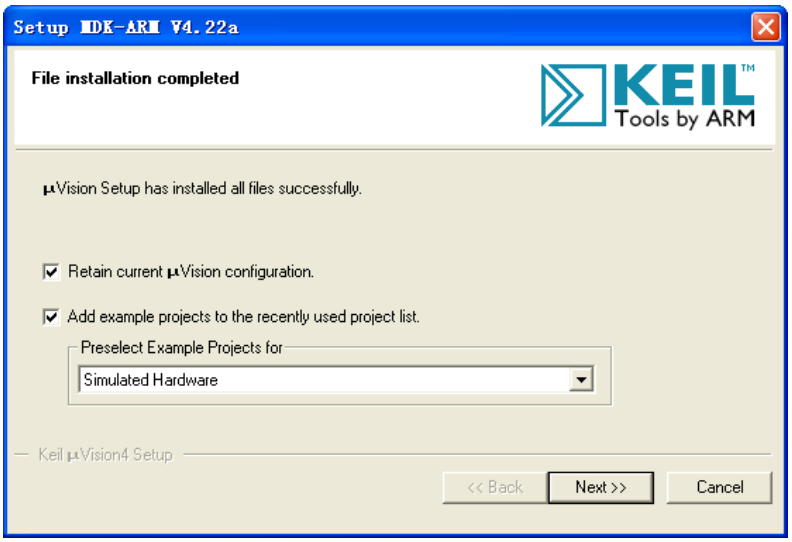


Figure 18: Installing Example Projects

7. Keep the default settings unchanged in the window shown below and click **Finish**;

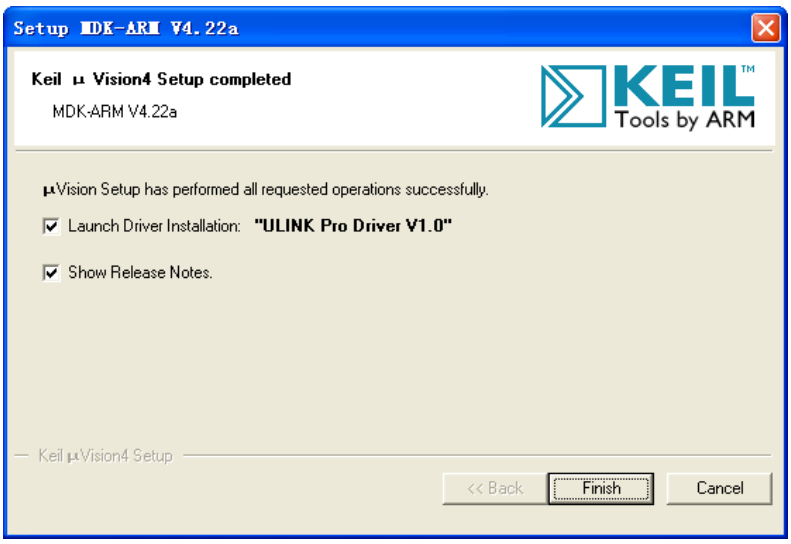


Figure 19: Installing ULINK Pro Driver

8. Click **Continue Anyway** in the pop-up window as shown below;

Figure 20: Click Continue Anyway

9. The installation window as shown below will be closed automatically after ULINK Pro driver is installed;

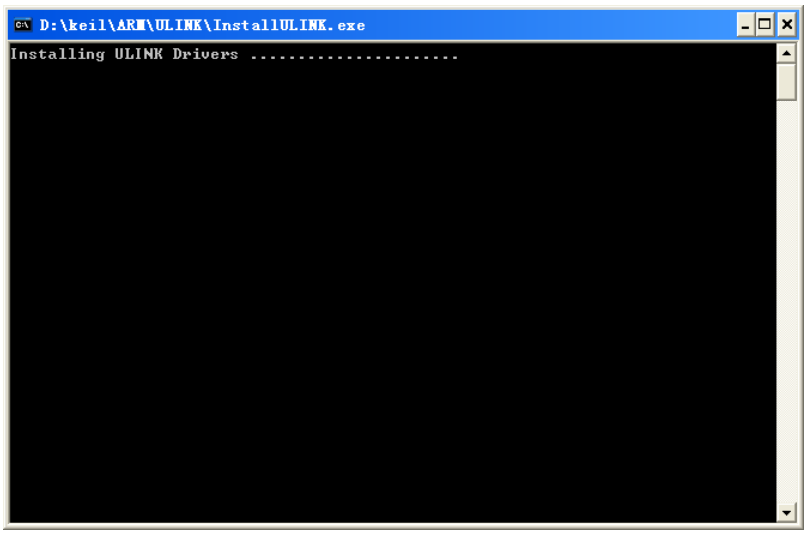


Figure 21: Installing ULINK Pro Driver

10. Now the installation of the Keil MDK integrated development environment has been completed successfully.

4.4 Installing IAR EWARM

Development on the LPC1788 requires version 6.20 or higher of IAR EWARM. All the EWARM projects contained in the CD-ROM provided with the board are created by using IAR EWARM 6.40.2. You can download the latest version from IAR's official website:

www.iar.com.

The following content will show you how to install an IAR EWARM integrated development environment, using IAR EWARM 6.40.2 as an example.

1. Double-click the installation file of IAR EWARM to open the installation interface as shown below;

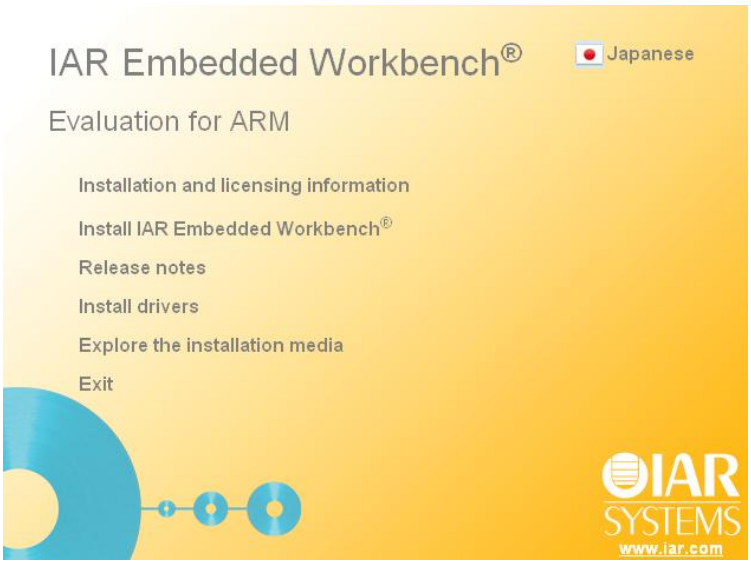


Figure 22: IAR EWARM Installation Interface

2. Click **Install IAR Embedded Workbench**;

3. Click **Next** in the following window to continue installation;

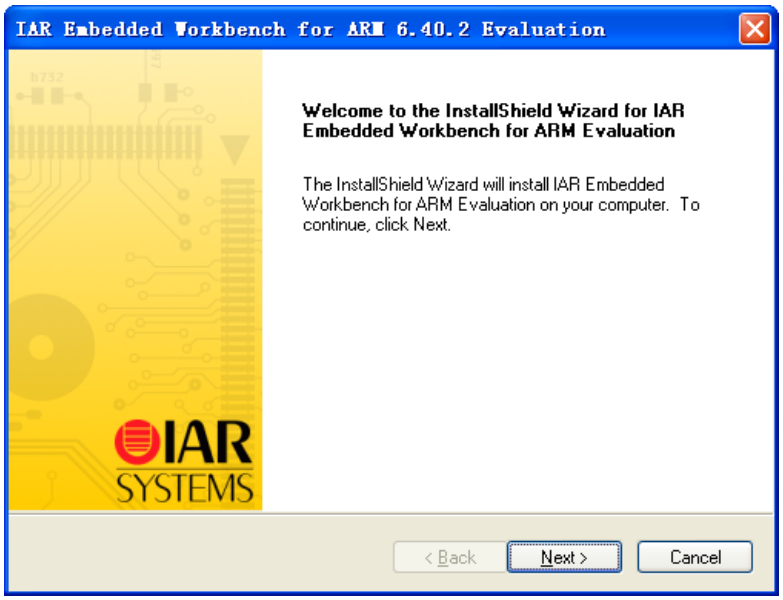


Figure 23: Click Next

4. Select the radio button **I accept the terms of the license agreement**, and the click **Next** in the following window;

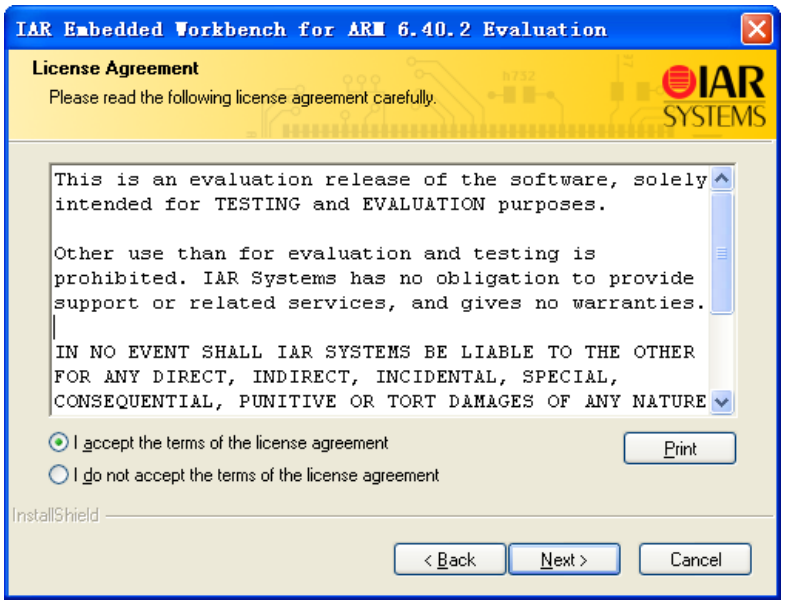


Figure 24: License Agreement

5. Enter your name and your company's name, as well as the license number in the following window, and then click **Next**;

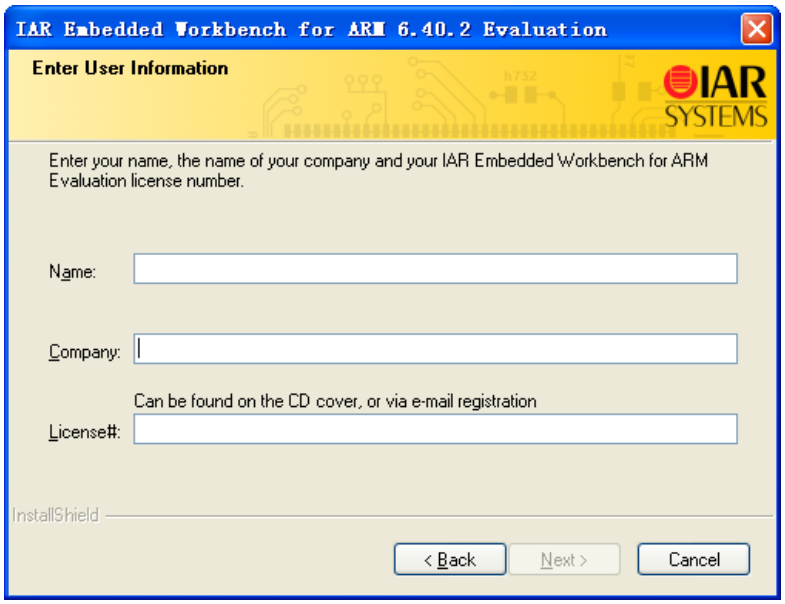


Figure 25: Enter User Information

6. Copy your license key into the **License Key** textbox, or click **Browse** to specify the path where the license key is saved, and then click **Next**;

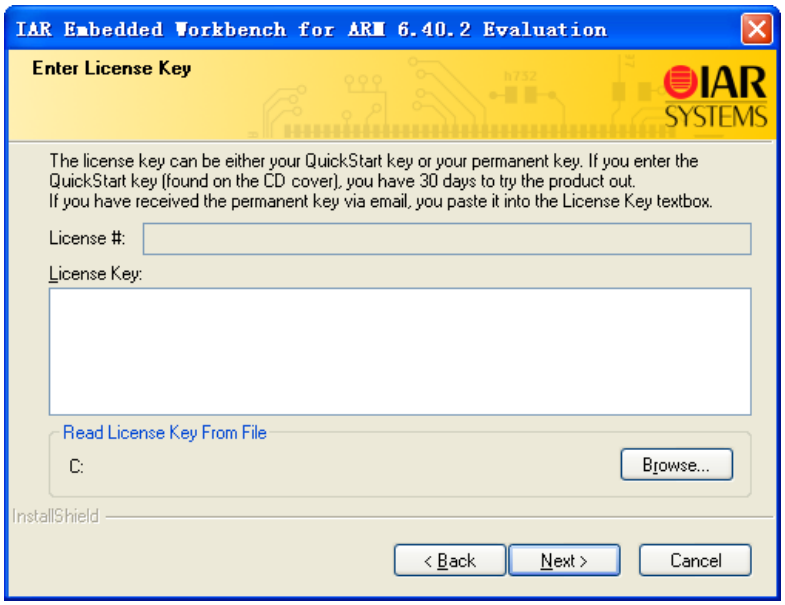


Figure 26: Enter License Key

7. Click **Change** in the following window to specify installation path, and then click **Next**;

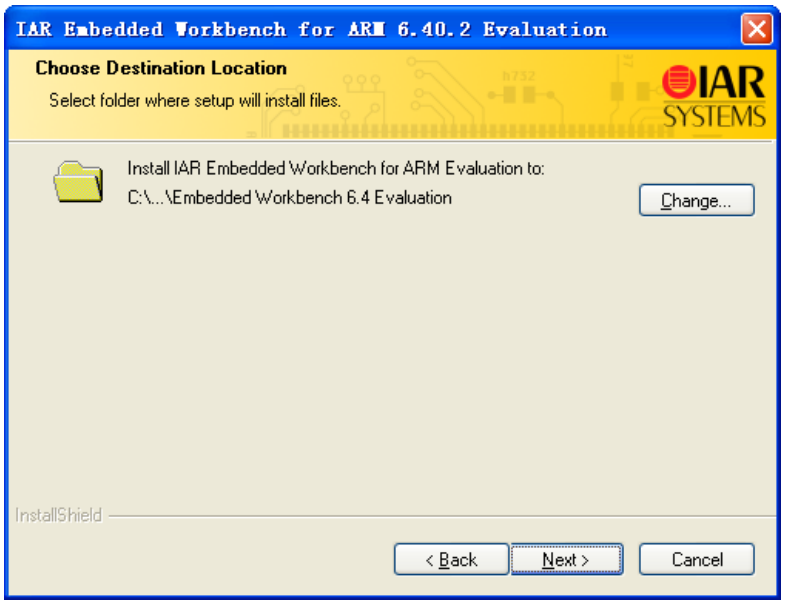


Figure 27: Select Installation Path

8. The following window allows you select a folder in which the software icon is contained; You may keep the default settings unchanged and click **Next**;

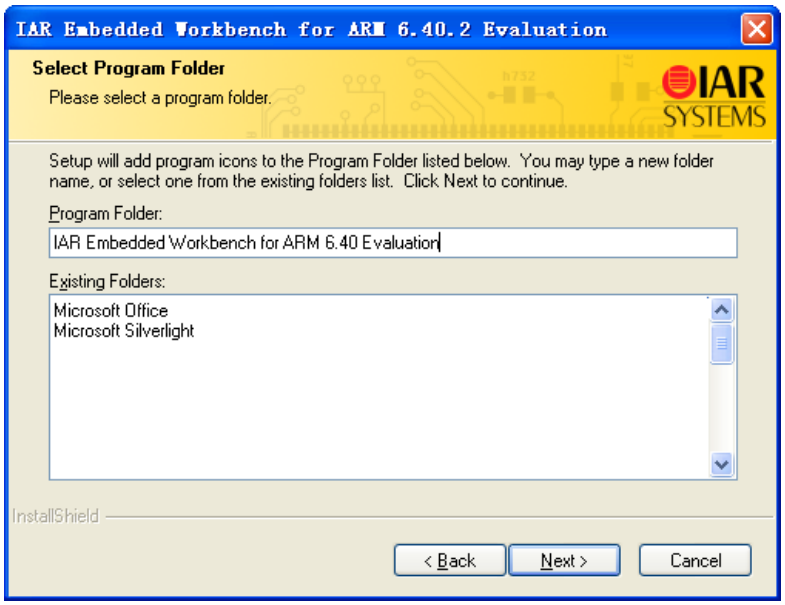


Figure 28: Select Software Icon Location

9. Click **Install i**n the following window to start the installation process;

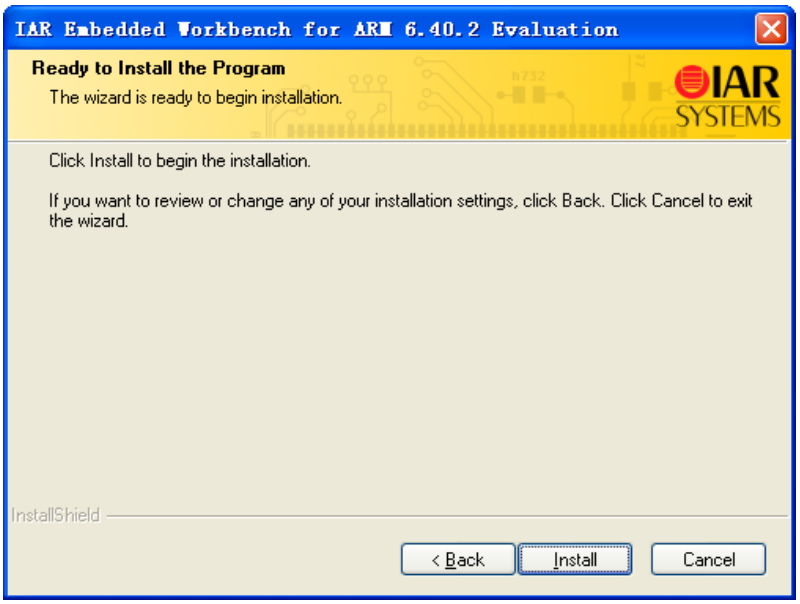


Figure 29: Select Install

10. Click Finish in the following window to finish the installation process;

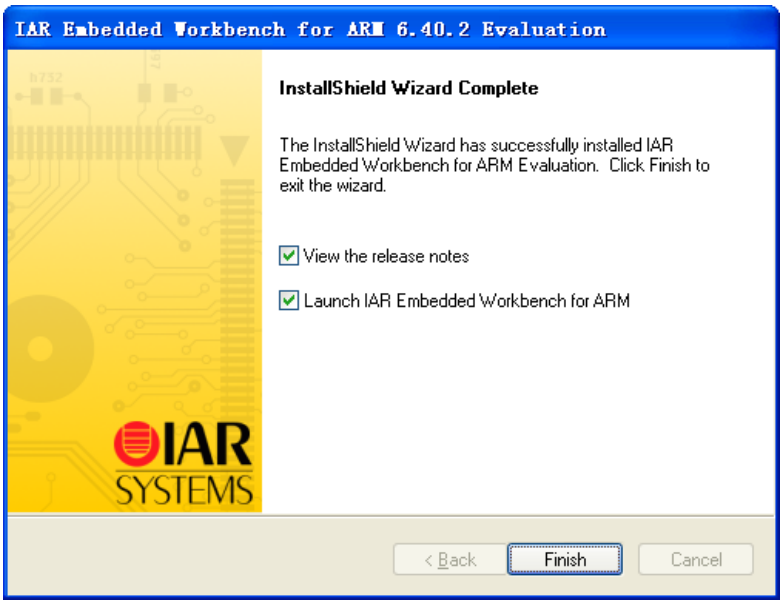


Figure 30: Installation is Complete

4.5 Installing Flash Magic (Optional)

Flash Magic is a free downloadable tool designed to run on a Windows based PC. It is used for downloading programs to NXP's Flash MCU by

using serial or Ethernet protocols. The supported chips include the ARM, C51 and LPC families.

Please visit:

http://www.flashmagictool.com/supporteddevices.html

To view all the supported target devices.

Note:

If you don't want to use this tool to download programs, please ignore this section.

1. Download Flash Magic from:

http://www.flashmagictool.com

2. Double-click the installation file to open the window as shown below;

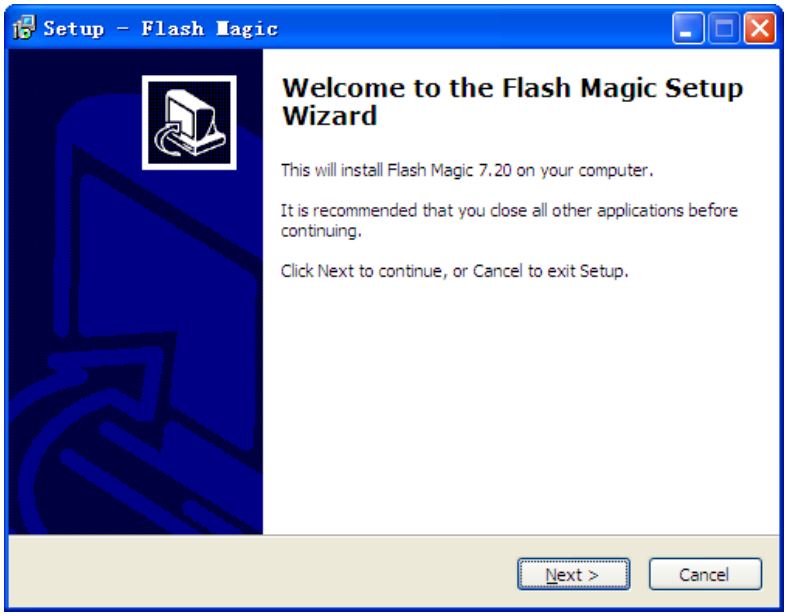


Figure 31: Flash Magic Installation Window

3. Click **Next** to continue;

4. Select **I accept the agreement** in the window shown below and click **Next**;

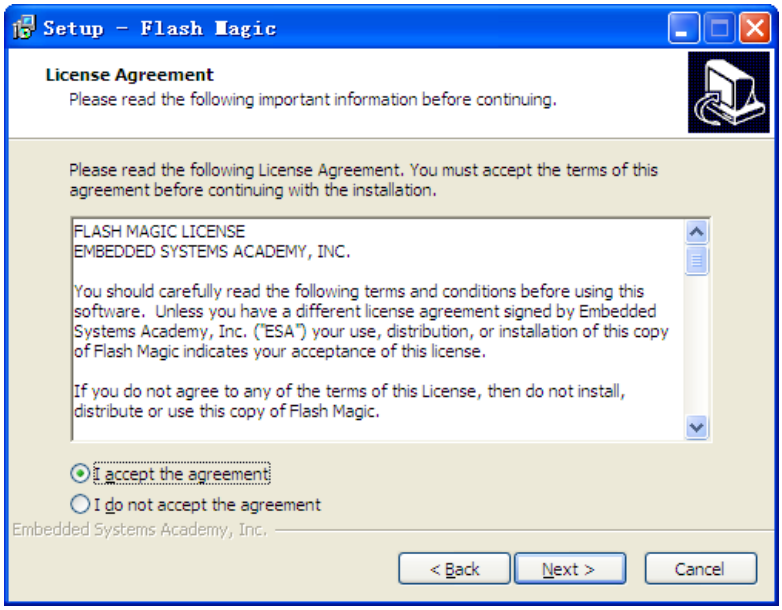


Figure 32: License Agreement

5. Click **Browse** in the window shown below to specify an installation path, and then click **Next**;

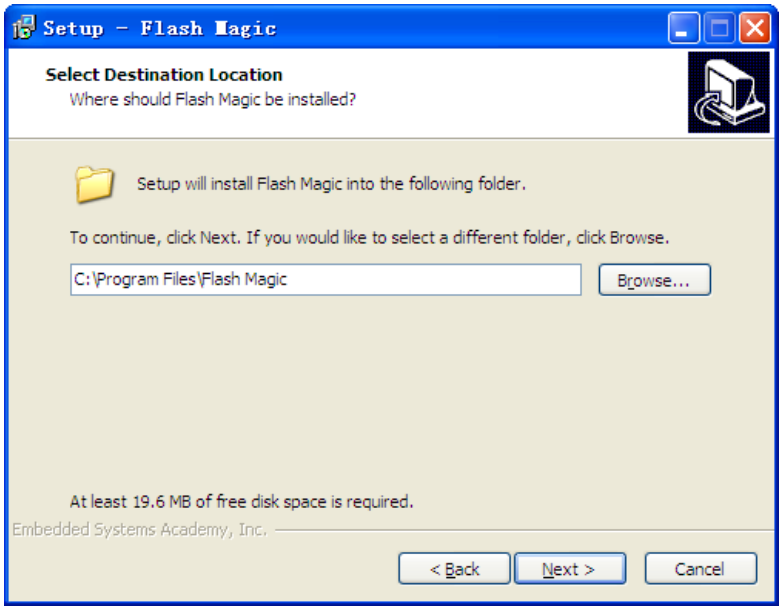


Figure 33: Installation Path

6. Click **Browse** in the window shown below to specify the position of the Flash Magic shortcut icon in the **Start** Menu, and then click **Next**;

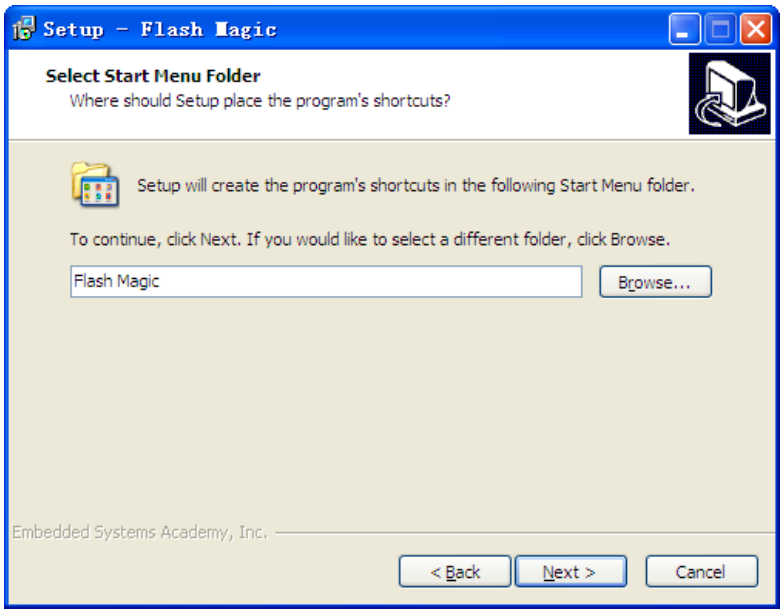


Figure 34: Position of Short Cut Icon

7. Select the options **Create a desktop icon** and **Create a Quick Launch icon** according your requirements, and then click **Next**:

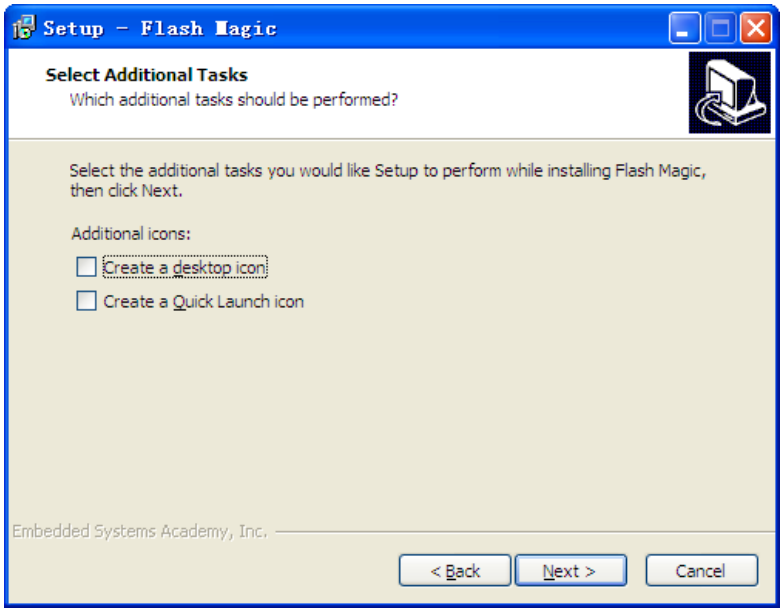


Figure 35: Create Icons

8. Click **Install** in the window shown below to start installation;

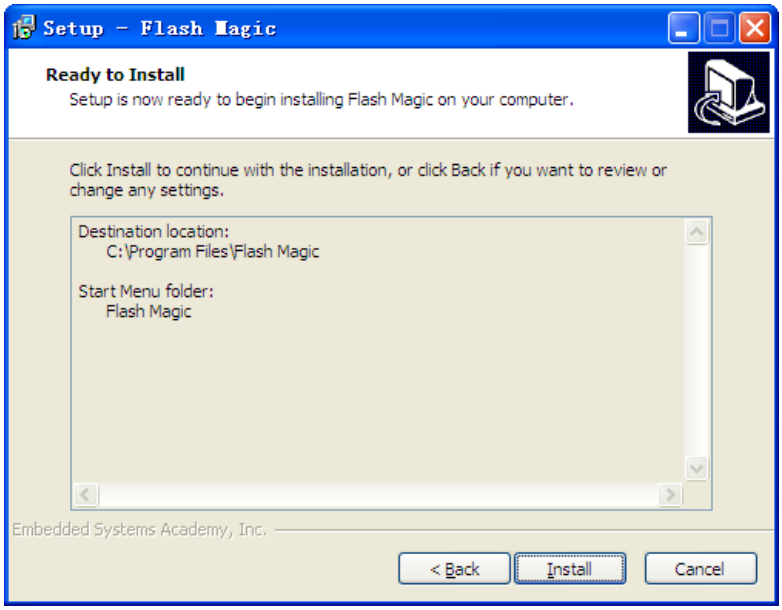


Figure 36: Start Installation

9. The window shown below indicates that installation has been completed; If **Launch Flash Magic** is checked, Flash Magic will be launched immediately after you click **Finish**; If **View the Release Notes** is checked, the software release notes will be opened immediately after clicking **Finish**;

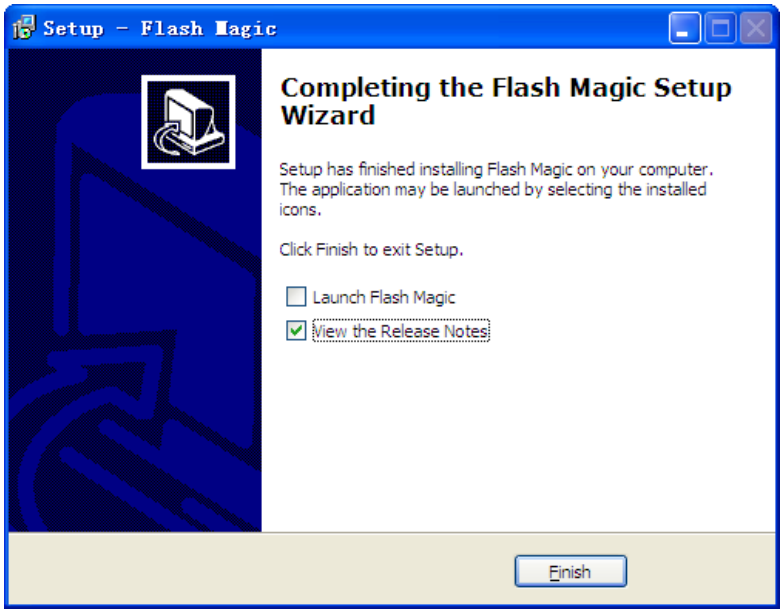


Figure 37: Installation Finished

5 Software Development Process

After all the preparations are completed, the development process can be started. This chapter will introduce how to conduct software development under two different environments, Keil MDK and IAR EWARM by using the development of NXP's LPC1788 processor as an example.

Note:

Development on LPC1788 requires version 4.20 or higher of Keil MDK or, version 6.20 or higher of IAR EWARM; this document uses Keil MDK 4.60 and IAR EWARM 6.40.2.

5.1 Development Based on the Keil MDK

The following content is composed of two parts which introduce how to create and compile MDK projects, as well as program and debug the compiled files.

5.1.1 Creating and Compiling a New Project

1. Click

   - Start
   - All Programs
   - Keil uVision4

on the PC's desktop to open a uVision4 window as shown right;

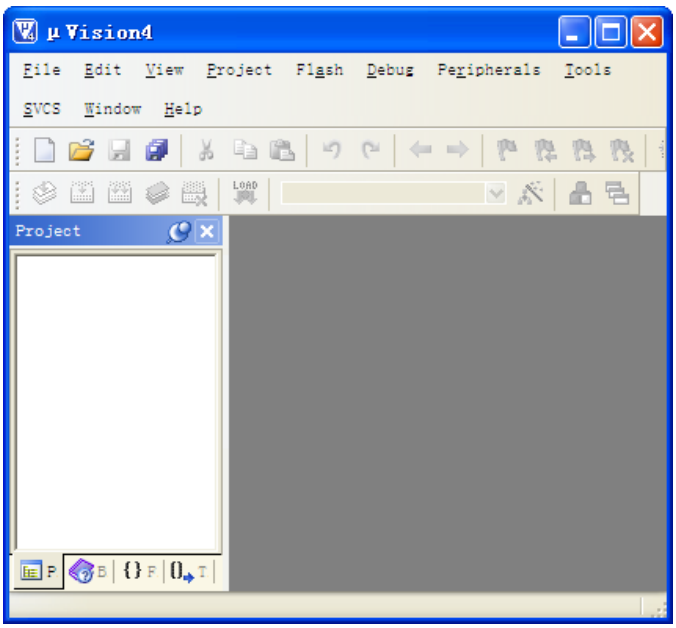


Figure 38: uVision 4 Window

2. Click **Project** > **New uVision Project** on the menu bar of the uVision4 window to open the following window;

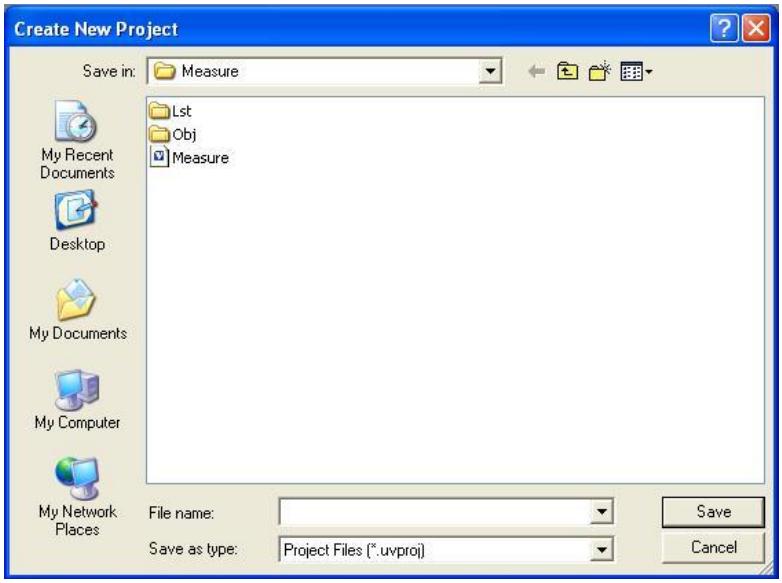


Figure 39: Create a New Project

3. Specify the storage path and name for the new project (e.g. Target1), and then click **Save**;

4. Select **NXP (founded by Philips)** > **LPC4357** in the tree view of the window shown below, and then click **OK**;

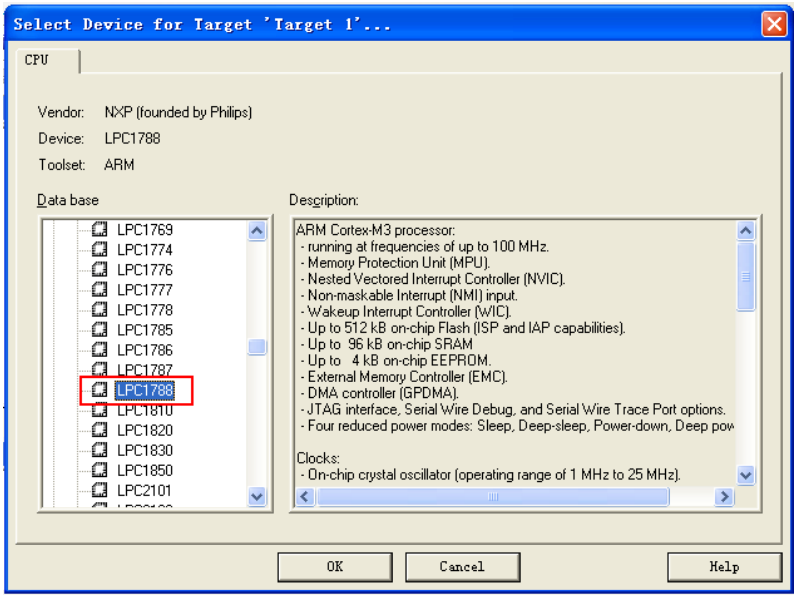


Figure 40: CPU Selection

5. The following pop-up window prompts you to determine if NXP LPC177x_8x Start Code should be copied to the project folder; "**Yes**" is recommended;

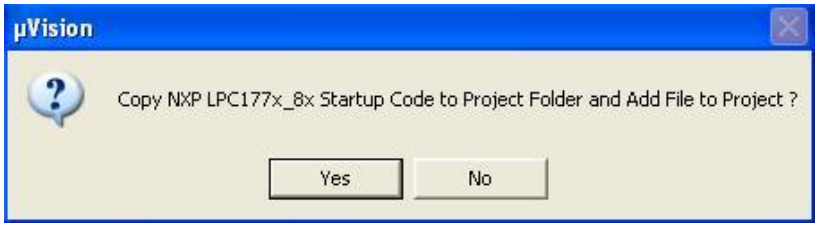


Figure 41: Adding Start Code

6. Right-click the project **Target1** in the tree view on the left part of the following window and select **Add Group** to create different groups to which the corresponding code will be added, for example a group named "Drivers" to which the EDM1070xx's driver source files will be added later;

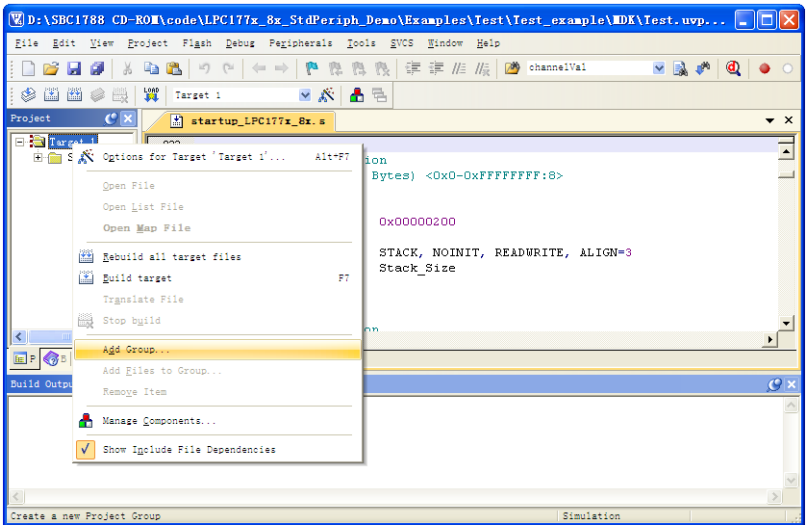


Figure 42: Add New Groups

7. After all the groups are created, right-click each group and select **Add Files to Group...** to add relevant source code;

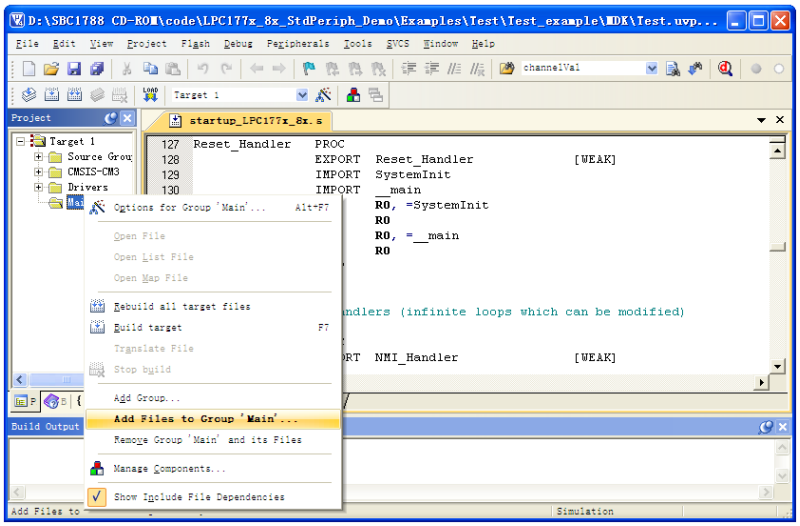


Figure 43: Adding Source Code to Groups

8. Right-click **Target1** in the tree view of the uVision4 window and select **Options for Target 'Target1'**, and then select **C/C++** tab in the pop-up window as shown below;

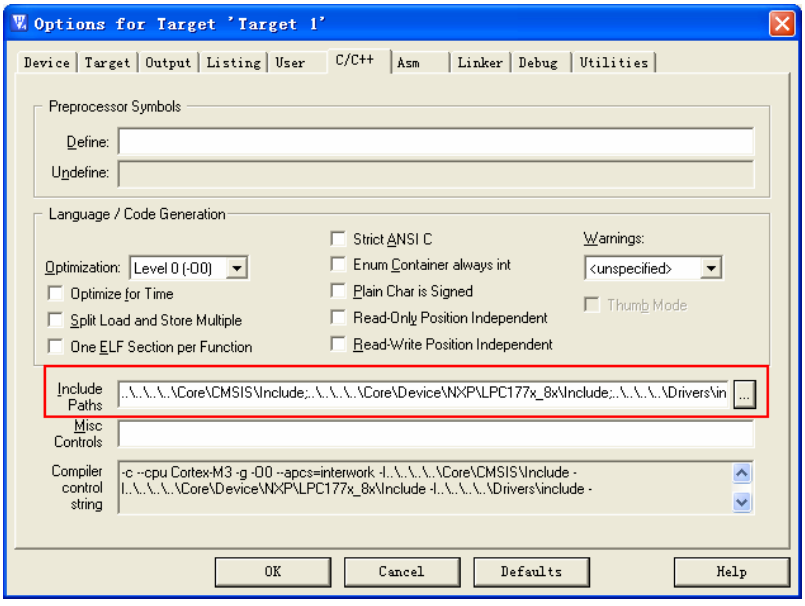


Figure 44: C/C++ Tab

Specify the paths where the head files are saved in the **Include Paths** textbox, and then click **OK**;

9. Click the **Rebuild button:**  on the tool bar as shown in the following window to start compiling all the files;

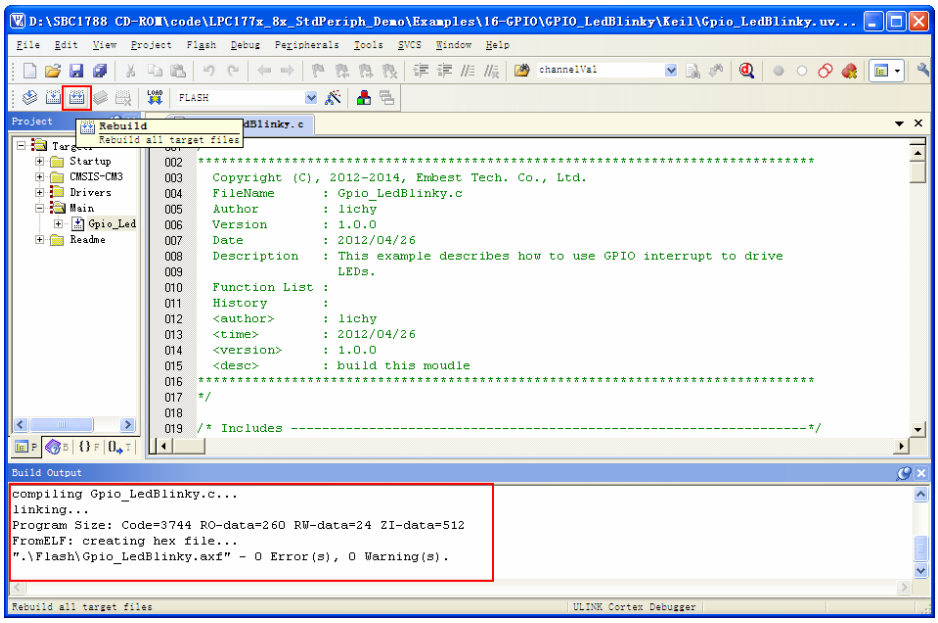


Figure 45: Click Rebuild

The information box at the bottom of the window shows that compilation has completed successfully. Now the process of creating and compiling a project is finished.

5.1.2 Programming and Debugging

You can now proceed with flash programming and debugging by following the steps listed below;

1. Right-click **Target1** in the tree view of uVision4 window and select **Options for Target 'Target1'**, and then select the **Utilities** tab in the pop-up window as shown below;

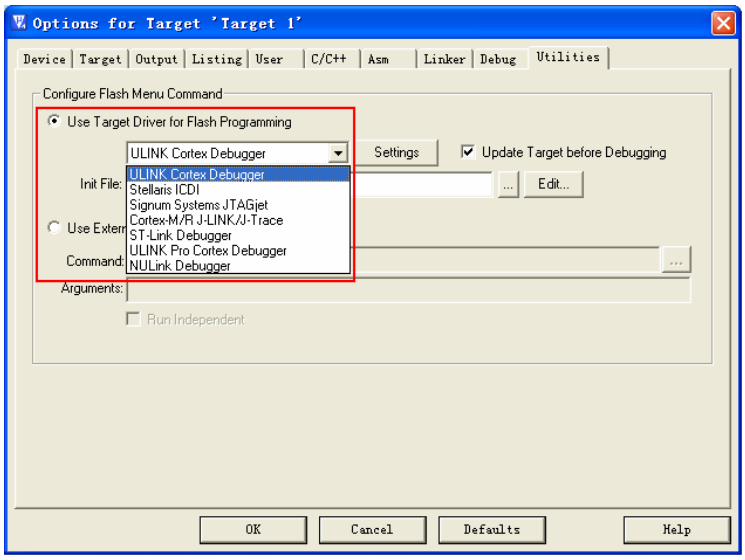


Figure 46: Utilities Tab

2. Check the radio button **Use Target Device for Flash Programming** and the checkbox **Update Target before Debugging**, select **ULINK Cortex Debugger** in the corresponding drop-down menu, and then click **Settings**;

3. Select the **Flash Download** tab in the pop-up window as shown right;

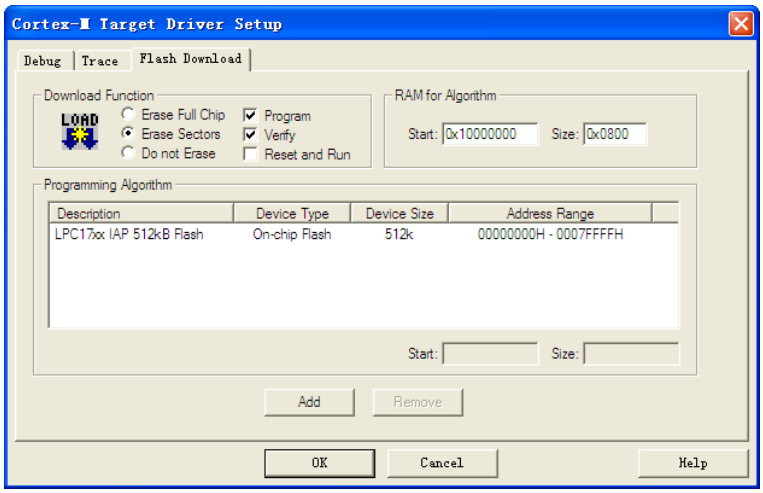


Figure 47: Flash Download Settings

Click **Add** at the bottom of the window;

Note:

🕮 The purpose of this step is to add necessary flash programming algorithms. If LPC17xx IAP 512kB Flash is already in the list of Programming Algorithms, there is no need to add it again and you can jump to step 4.

4. Select **LPC17xx IAP 512Kb Flash** in the pop-up window as shown below and click **Add**;

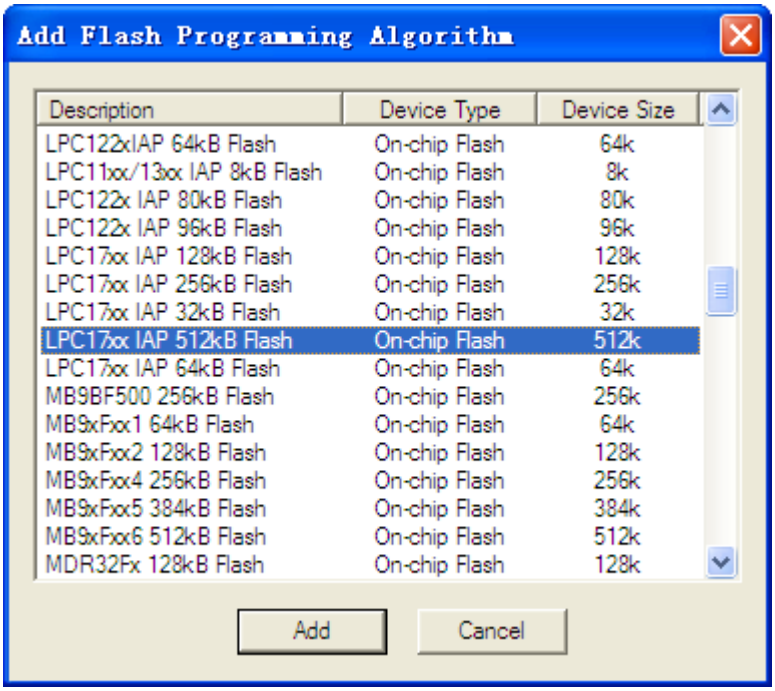


Figure 48: Add a Flash Programming Algorithm

5. Click **OK** twice to go back to the uVision4 window;

6. Click the **Download button:**  on the tool bar of the uVision4 window to start flash programming;

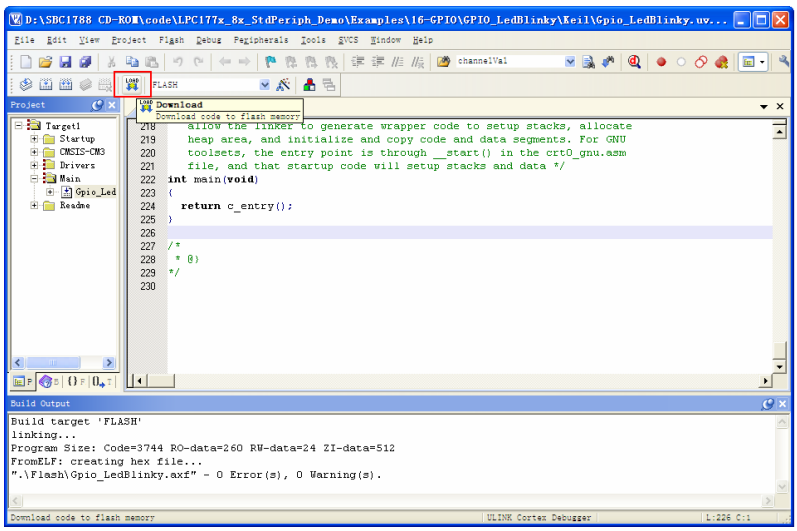


Figure 49: Start Flash Programming

7. After programming is done, right-click **Target1** in the tree view of the uVision4 window and select **Options for Target 'Target1'**, and then select the **Debug** tab in the pop-up window as shown below;

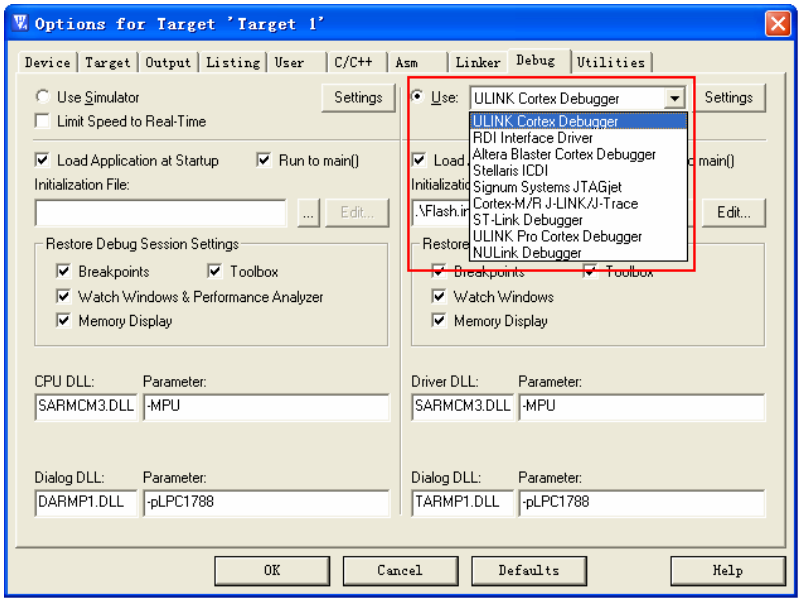


Figure 50: Debug Settings

8. Check the radio button **Use** at the top right of the **Debug** tab and select **ULINK Cortex Debugger** in the corresponding drop-down menu, and then click **OK**;

9. Click the **Debug button:**  on the tool bar of the uVision4 window as shown below to start online debugging;

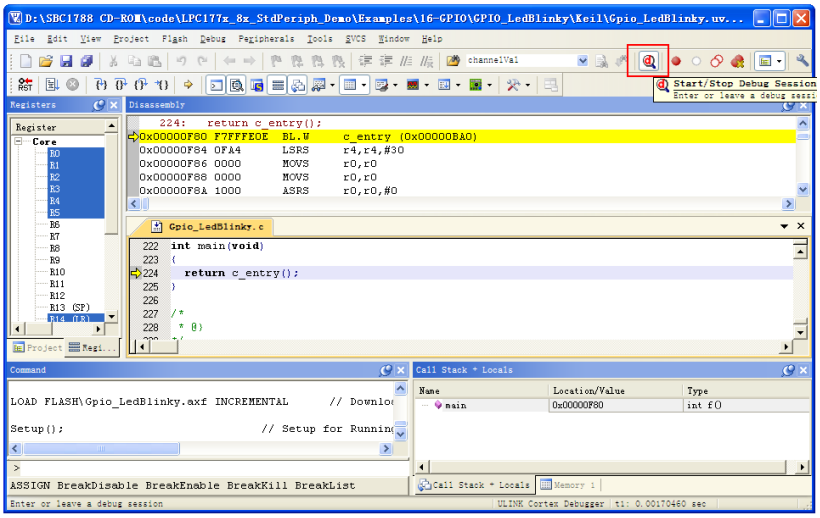


Figure 51: Start Debugging

5.2 Development Based on IAR EWARM

The following content is composed of two parts which introduce how to create and compile IAR projects, as well as program and debug the compiled files.

5.2.1 Creating New Project Compiling

1. Launch the software to open the IAR Embedded Workbench IDE window as shown below;

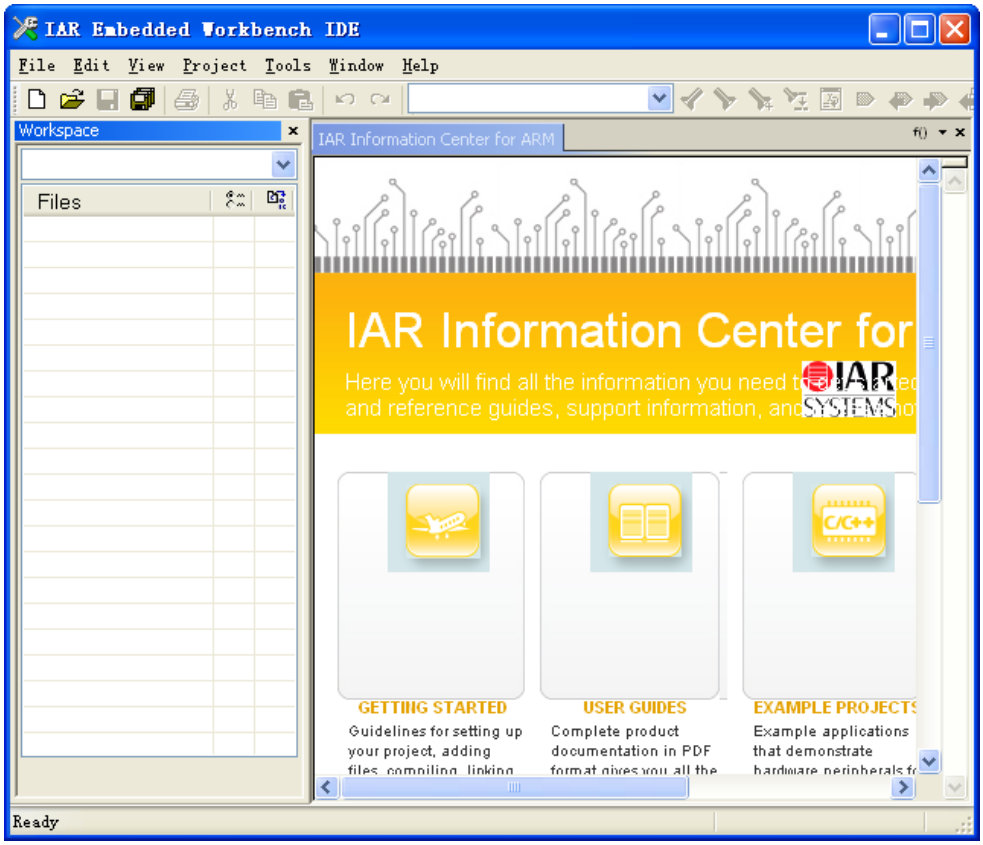


Figure 52: IAR Embedded Workbench Window

2. Select **Project > Create new project** on the menu bar of the above window to create a new project;

3. Select **Empty project** in the following pop-up window, and then click **OK**;

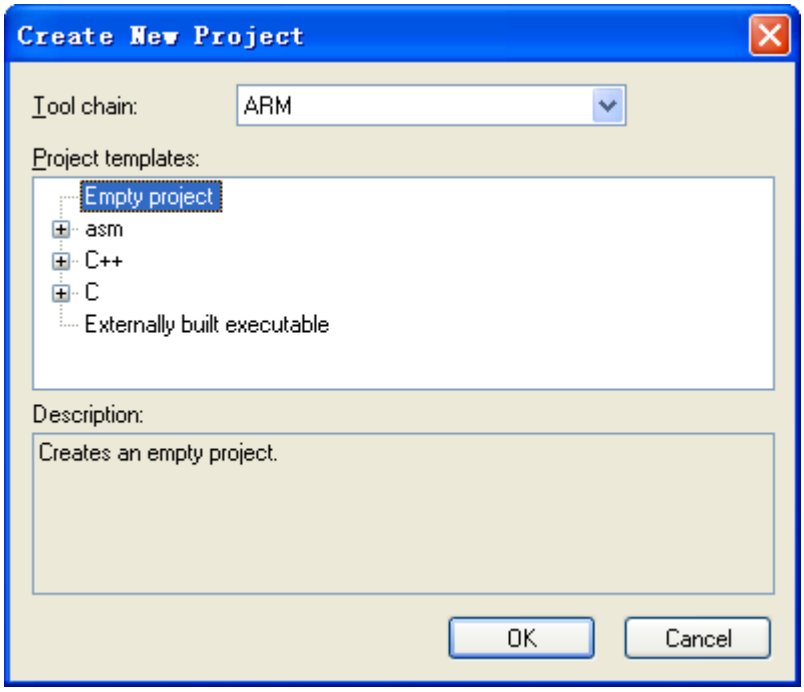


Figure 53: Select an Empty Project

4. Select a path to save the new project in the following pop-up window, and then click **Save**;

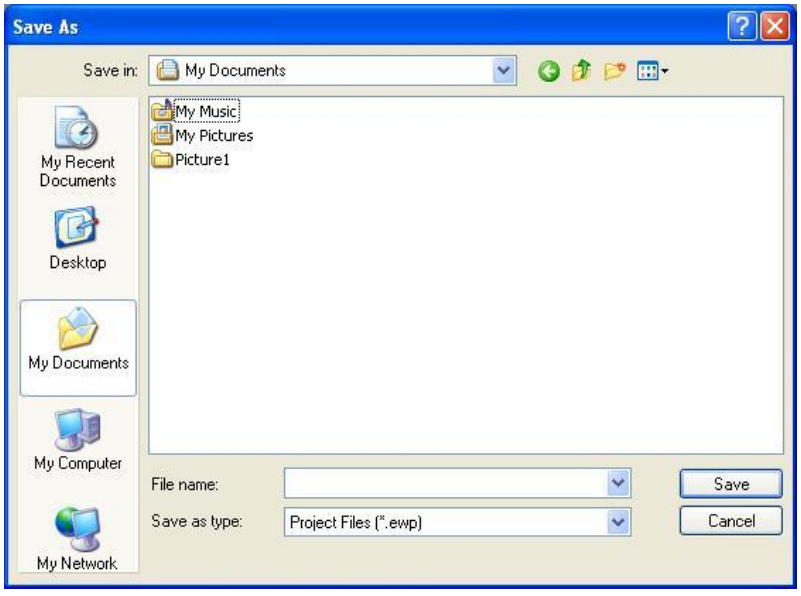


Figure 54: Set New Project Save Path

5. Right-click the project name on the left side of the IAR Embedded Workbench IDE window and select **Add > Add Group** to create different groups to which the corresponding code will be added, for example a group named "Drivers" to which driver source files will be added later;

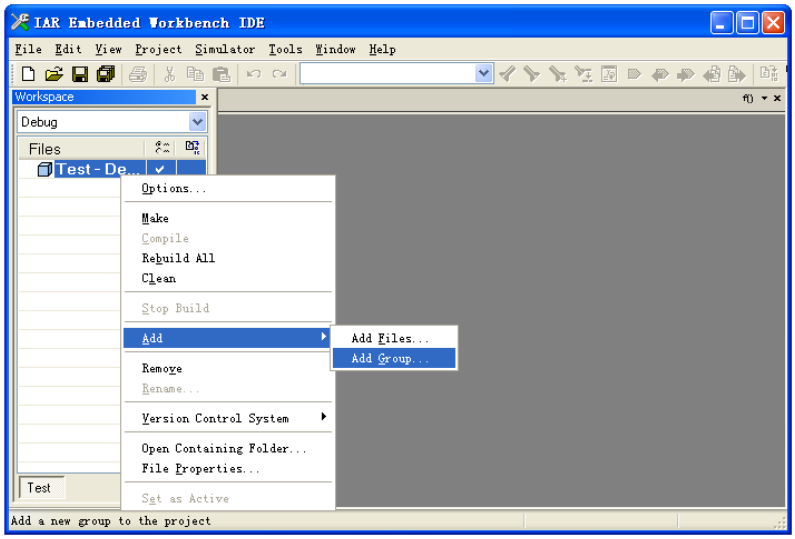


Figure 55: Create New Groups

6. After all the necessary groups are added, right-click each group and select **Add > Add Files** to add relevant source code;

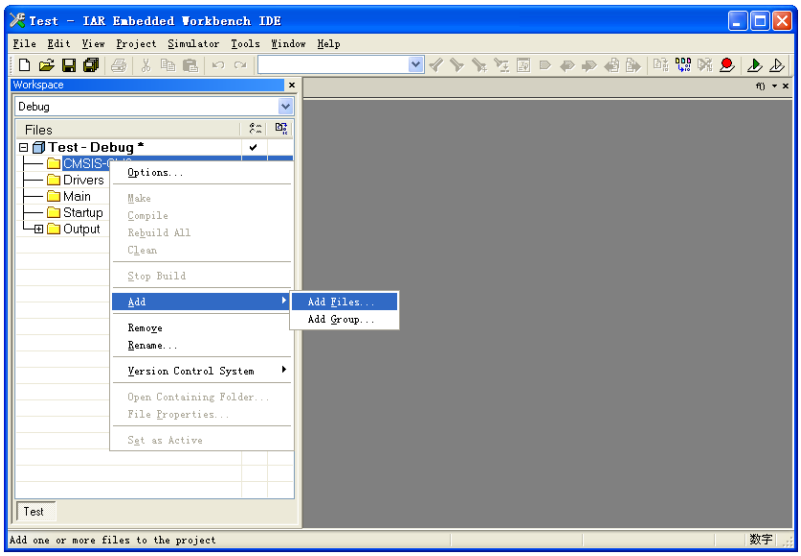


Figure 56: Add Source Code to Groups

7. After all the files are added, right-click the project name and select **Options** to open the window below;

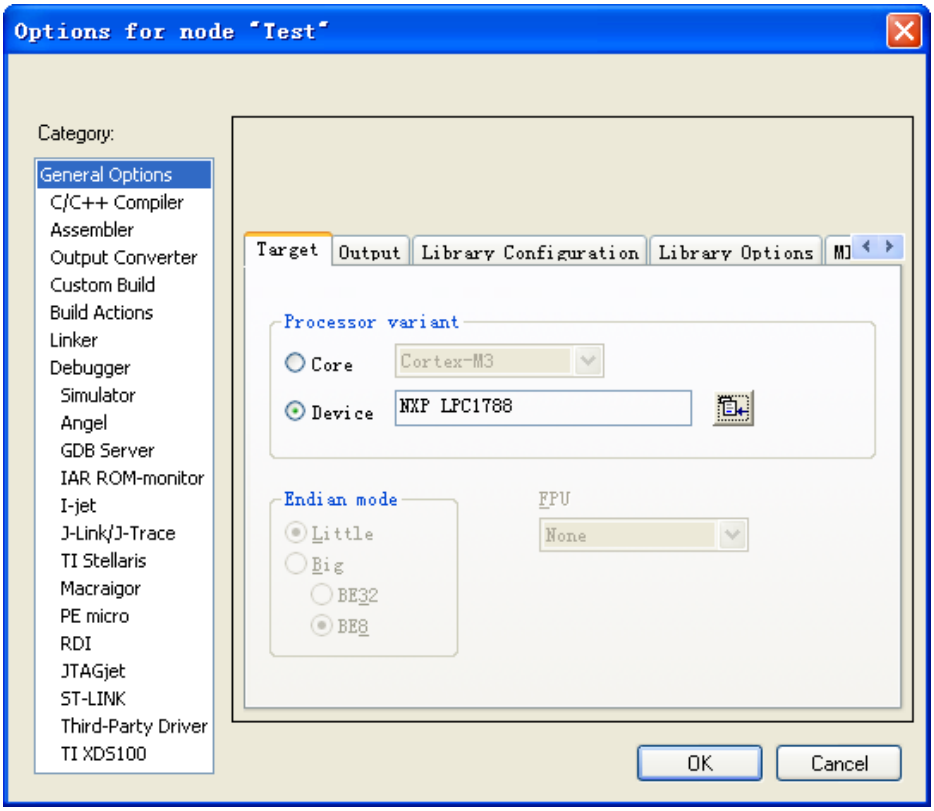


Figure 57: Project Options Window

8. Under the **Target** tab, check the radio button Device and click the  button on the right, and then select **NXP > LPC1700 > NXP LPC1788** in the pop-up menu;

9. Click **C/C++ Compiler** on the left side of the window and select the **Preprocessor** tab in the right part of the window, and then add the paths of the head files to the **Additional include directories** textbox;

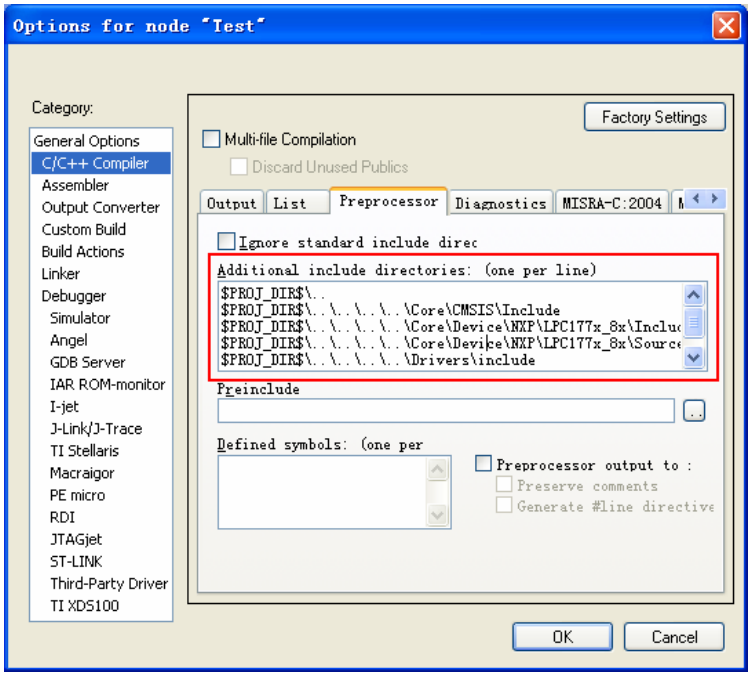


Figure 58: Head File Paths

10. Click **Linker** on the left side of the window and select the **Config** tab in the right part of the window, and then check the **Override default** checkbox and click the ... button as shown below to specify the paths of the linker configuration files;

11. Click **OK** to save settings;

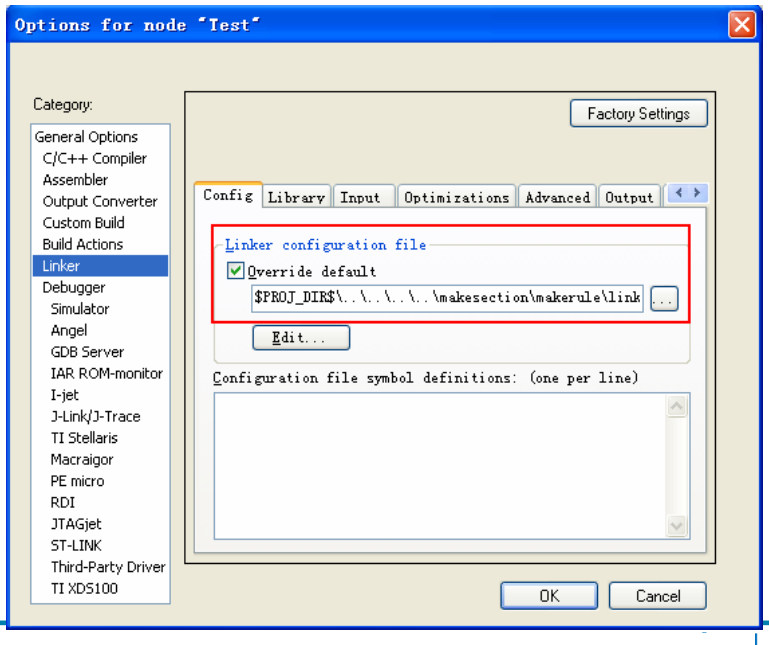


Figure 59:Linker Configuration File Locations

12. Right-click the project name on the left side of the IAR Embedded Workbench IDE window and select **Rebuild All** to recompile the project;

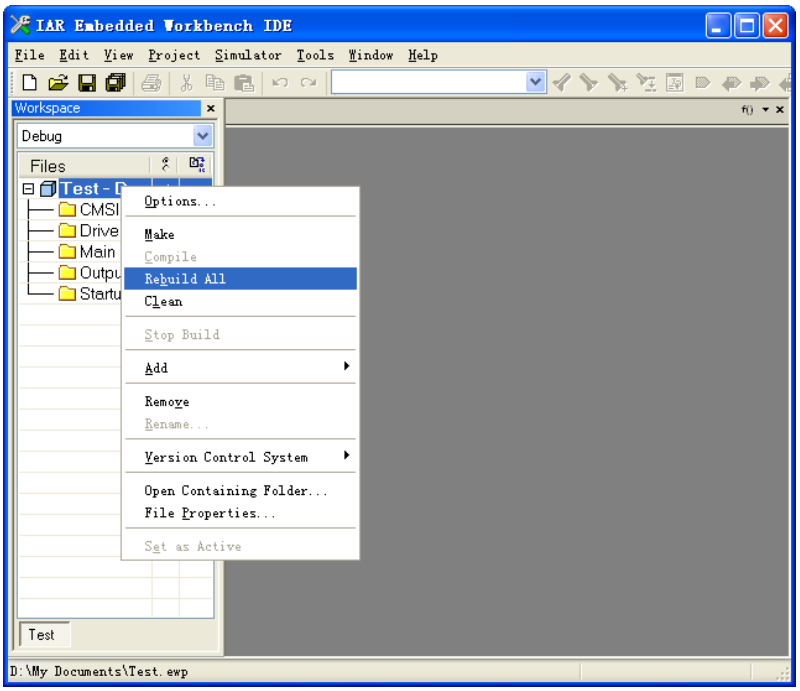


Figure 60: Recompile the Project

13. Now the creation and compilation of a new project has been completed successfully.

5.2.2 Programming and Debugging

1. You can now proceed with flash programming and debugging by following the steps listed below;

2. Right-click the project name on the left side of the IAR Embedded Workbench IDE window and select **Options** to open the following window;

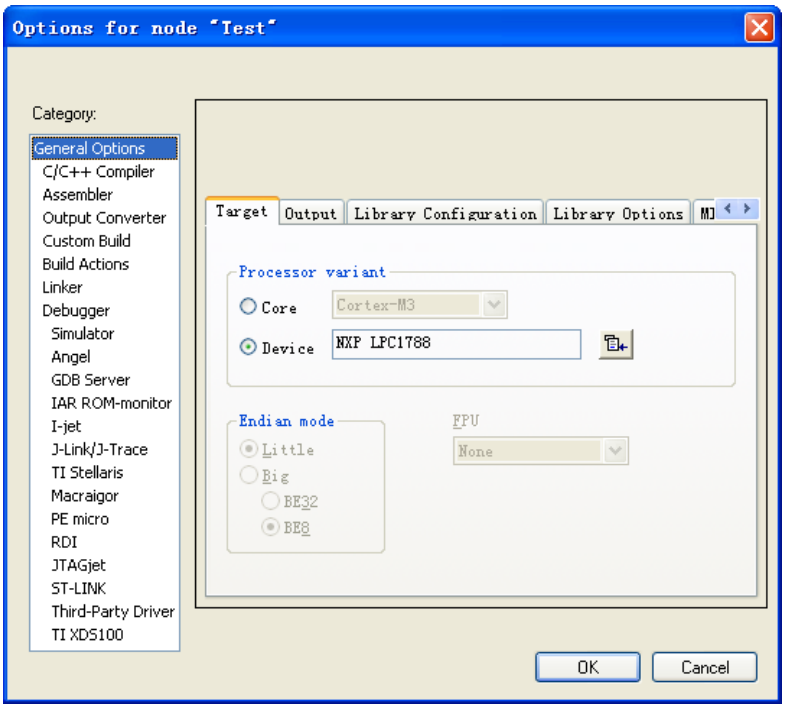


Figure 61: Project Options Window

3. Click **Debugger** on the left side of the window and select the **Setup** tab in the right part, and then select **J-Link/J-Trace** in the **Driver** drop-down menu;

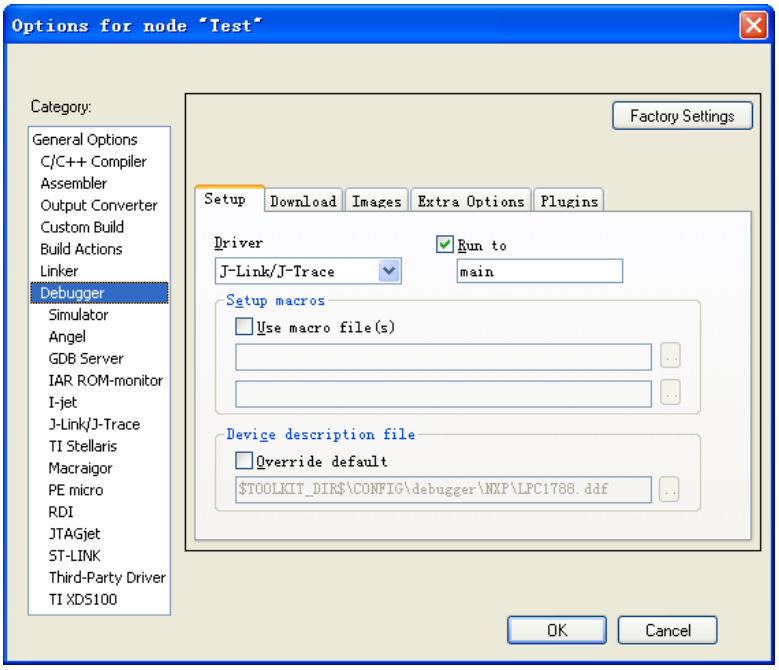


Figure 62: Downloading & Debugging Tool

4. Click the Download tab and check the **Verify download** checkbox, and then click **OK**;

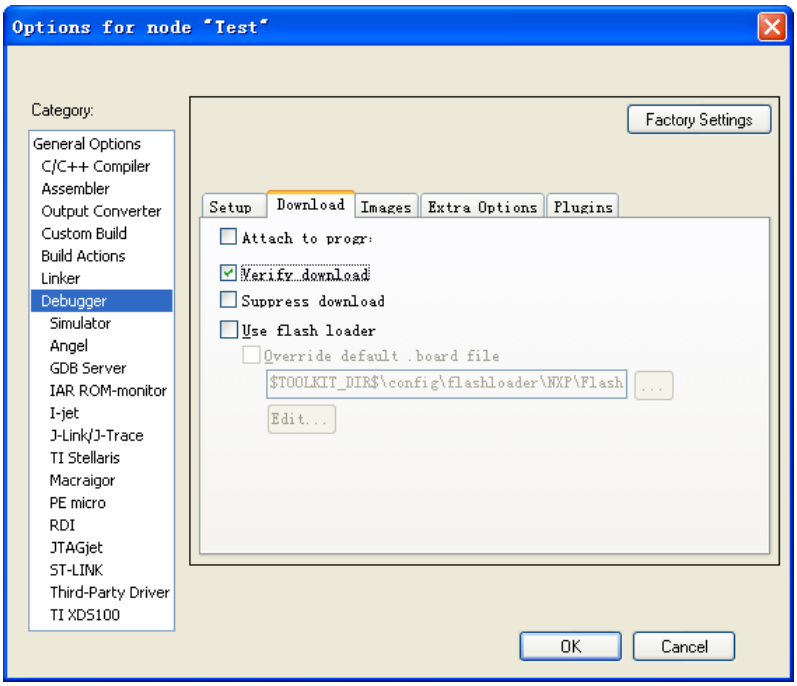


Figure 63: Check the Verify Download Checkbox

5. Select **Project > Download and Debug** on the menu bar of the IAR Embedded Workbench IDE window to start downloading and debugging;

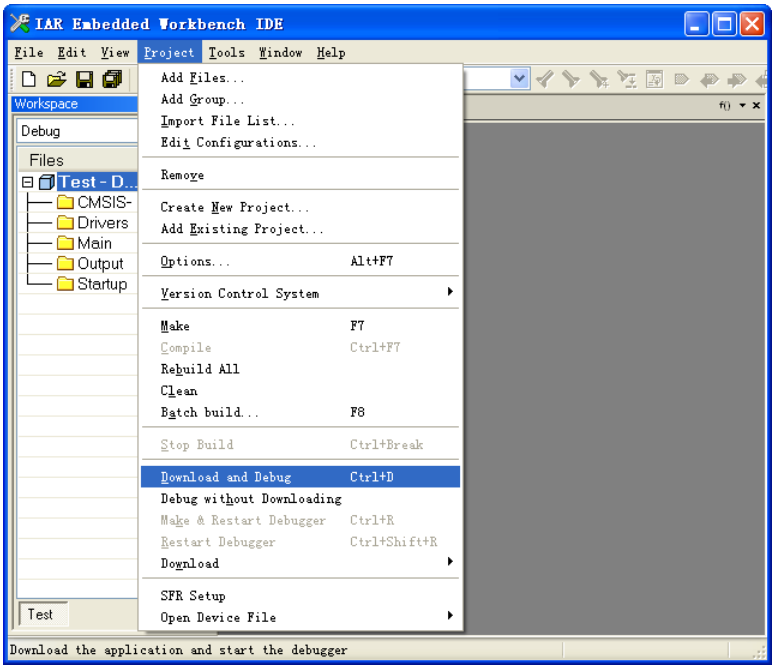


Figure 64: Select Download and Debug

5.3 In System Programming

The LPC1788 contains a bootloader in ROM that can be enabled by pulling pin P2.10 low during reset. The application can then be downloaded over UART#0 (serial channel).

In order to run ISP, please follow the steps below:

1. Connect a null-modem female/female RS232 cable between the DB9 connector COM1 (USART0) and the PC serial port.
2. Plug in the 12V power adapter.

5.3.2 Create a HEX file with MDK-ARM.

1. Open an MDK project, configure **Target Option** and select Create HEX file.
2. Rebuild the Project, generate the HEX file.
3. The HEX file is located in the **\Keil\Flash** subfolder of the project directory.

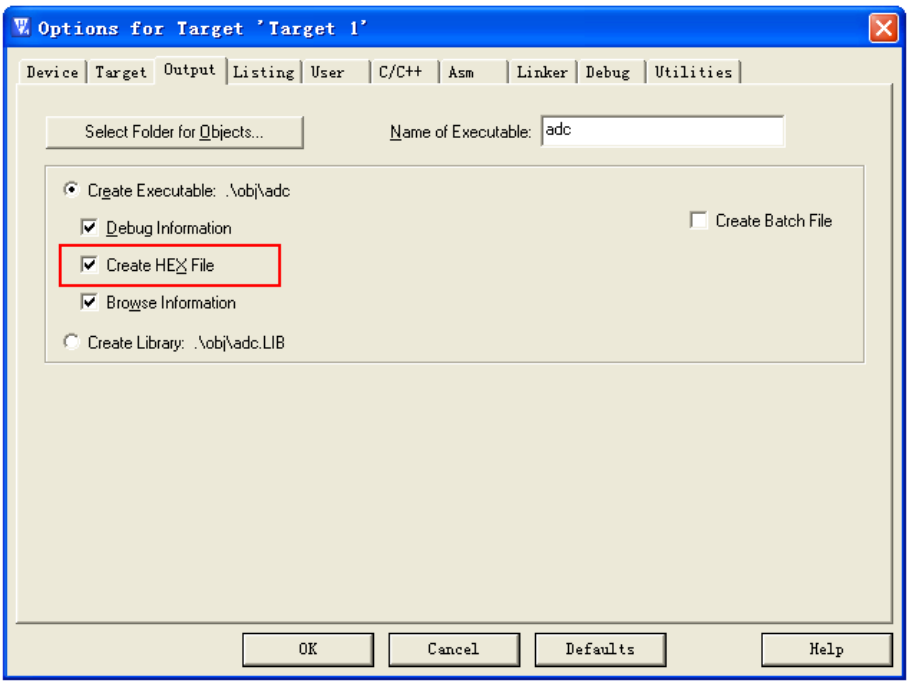


Figure 65: Configure MDK output option

5.3.3 Create HEX file with IAR EWARM.

1. Open an EWARM project, configure the options and select the output format.

2. Select **Intel extended** for output. Rebuild the Project, generate the HEX file.

3. The HEX file is located in the **\EWARM\Flash\Exe** subfolder of the project directory.

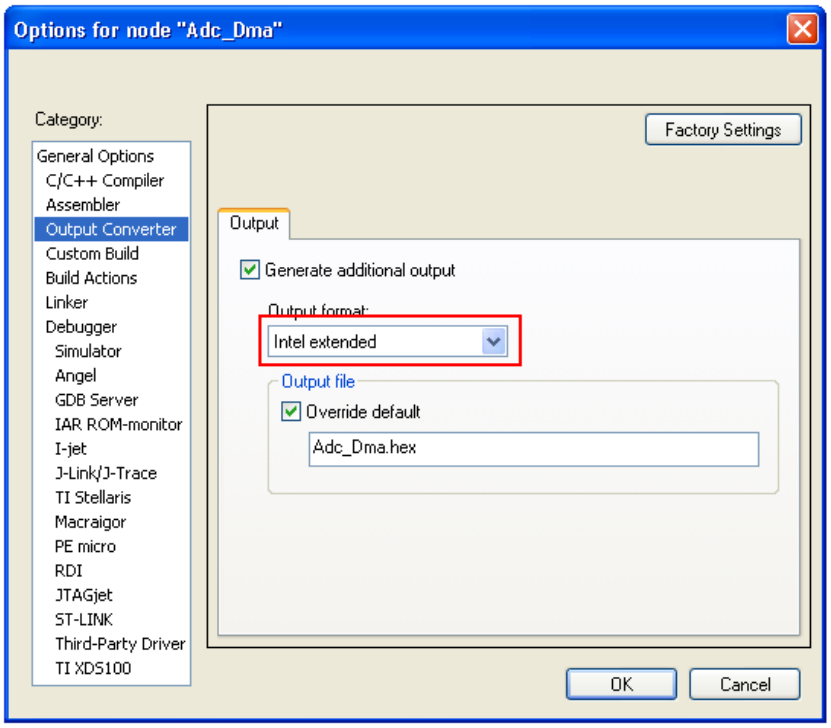


Figure 66: Configure EWARM output option

5.3.4 Flash Magic

1. Open the Flash magic software, select **Options->Advanced Options**.

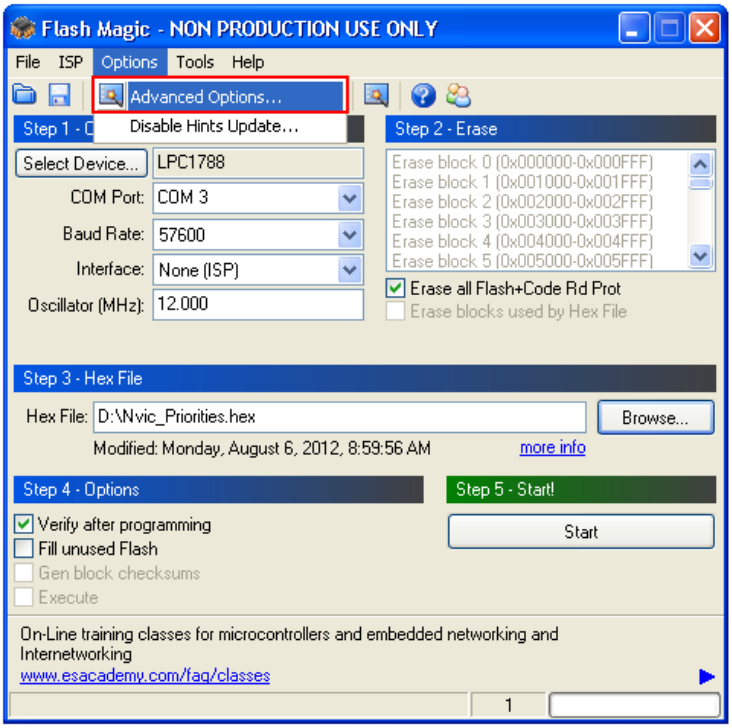


Figure 67: Flash Magic Advanced Options

2. Then select the **Hardware Config** tab and set the T1/T2 numbers according to figure below.

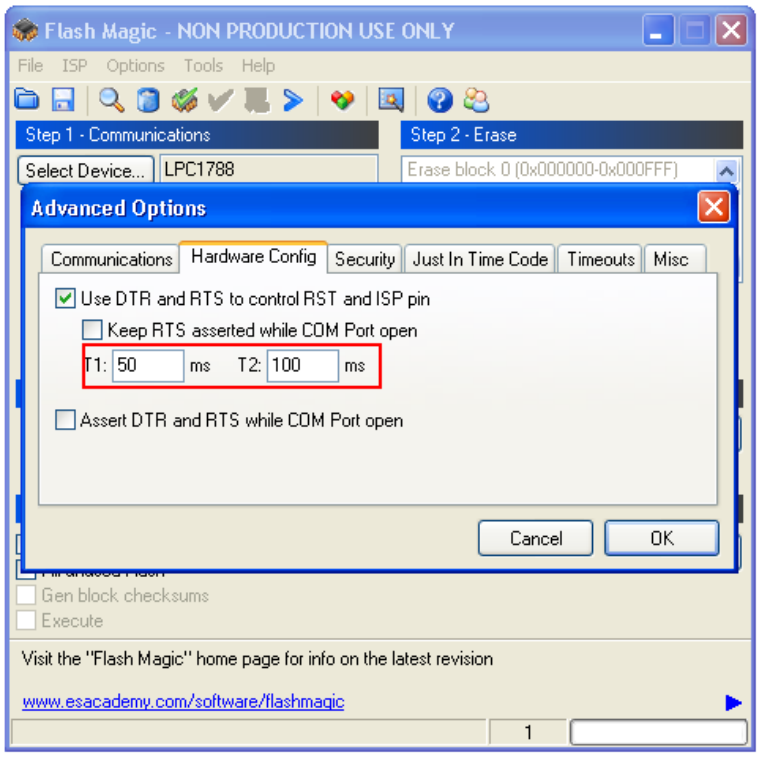


Figure 68: Flash Magic T1 & T2 Settings

3. Ensure the Flash magic settings are set as below.

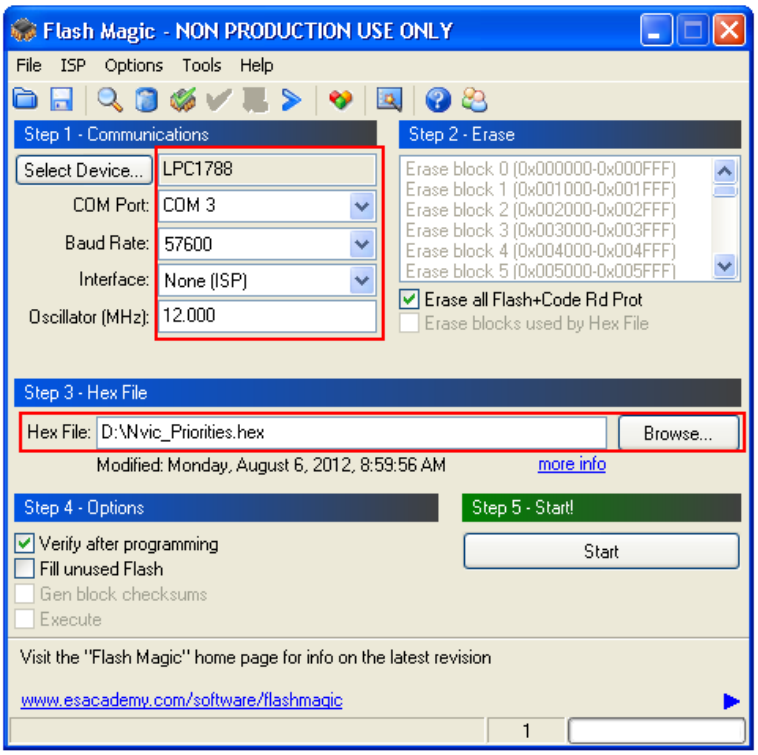


Figure 69: Flash Magic Configuration Settings

- **Select Device:** LPC1788
- **COM Port:** Set this according to your PC serial port
- **Baud Rate:** Set to 57600 or lower
- **Interface:** None (ISP)
- **Oscillator:** (MHz): 12.000
- **Hex File:** Select the hex/binary file to be downloaded

4. Download the hex file

Note:

🕮 The **ISP (SW3)** button should be constantly pressed. Press the **RESET** button and then release the **ISP (SW3)** button, LPC1788 will then enter ISP mode. Click the **Start** icon to start downloading the hex file.

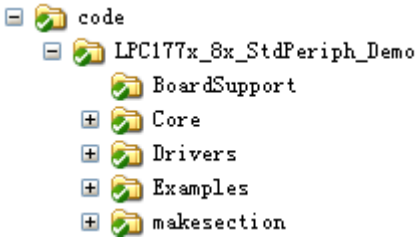
After the download finishes, press the RESET button, and the MCU will start to run.

6 Software Examples

The CD-ROM provided along with the SBC1788 contains abundant example programs. All the programs are created based on the standard peripheral libraries from NXP. This chapter will introduce how to learn about the features of the LPC1788 through a variety of example programs which consist of basic and additional examples.

6.1 Basic Example Programs for Peripherals

The basic example programs are saved under **X:\code\LPC177x_8x_StdPeriph_Demo\Examples** of the CD-ROM (where X:\ is the label of CD-ROM drive) as shown below;



The folders that are saved under the same directory as **Examples** include **BoardSupport**, **Core**, **Drive** and **makesection**; The following numbered entries give a brief introduction of the files contained in these folders;

1. **BoardSupport:** The drivers for the on-board peripherals of the SBC1788 including SDRAM, NAND Flash, PhyLAN and LCD interfaces.
2. **Core:** CMSIS files and the startup code from NXP for MDK and IAR environments.
3. **Drivers:** Driver codes for peripherals of the LPC177x_8x including two folders –**include** and **source**.
4. **Examples:** Basic example programs for peripherals of the LPC1788 under Keil and EWARM environments.
5. **Makesection:** Configuration files for development environments.

The table shown below lists all the basic example programs for peripherals and their relevant descriptions. This section will use a selection of the example programs to introduce the detailed operations.

Name of Example Programs		Descriptions
LCD	LCD_Display	Using the LCD controller of the LPC1788 to drive an LCD module
	LCD_Touch	Configuring an LCD and calibrating a touch-screen
USB	USB_MassStorage	A simple application of USB mass storage devices
	USB_VirtualCom	Configuring the USB device on the SBC1788 to work as a virtual serial interface
	UsbHost_MassStorage	Configuring the LPC1788 to work as a USB host
Ethernet	Emac_EasyWeb	A simple web application
	Emac_Raw	Testing the EMAC driver without involving a protocol layer
	Emac_uIP	A simple web application that involves IP, ICMP, UDP and TCP protocols
UART	UART_Autobaud	UART communication under auto baud mode
	UART_Dma	Using UART under DMA mode
	UART_Interrupt	Using UART under interrupt mode
	UART_Polling	Using UART under polling mode
	Uart_Rs485Master	Host application for RS485 communication
	Uart_Rs485Slave	Slave application for RS485 communication
EMC	Emc_NandFlashDemo	Writing and calibrating on-board NAND Flash

Name of Example Programs		Descriptions
	Emc_SdramDemo	Writing and calibrating on-board SDRAM
RTC	Rtc_Alarm	Generating interrupts in the second counter increment interrupts, and an alert interrupt every 10 seconds as well
	Rtc_Calendar	Configuring RTC calendar
	Rtc_Calibration	Calibrating RTC clock
CAN	Can_Aflut	Using the function of CAN driver to configure and alter the receiving filter loot-up table
	Can_Selftest	Self test mode of CAN
DMA_Flash2Ram		Testing GPDMA (General Purpose Direct Memory Access) by data transfer from flash to RAM
WDT	Wdt_Interrupt	Using WDT to generate interrupts after a certain period of time
	Wdt_Reset	Using WDT to generate reset signal after a certain period of time to reset MCU
	Wdt_WindowMode	Generating interrupt or reset signal under WDT window mode
Timer	Timer_Capture	Using the input capture function of the timer
	Timer_FreqMeasure	Using the timer to measure the frequency of an input signal
	Timer_MatchInterrupt	Using timer matching to generate a certain time interval (e.g. 1 second) under interrupt mode.
SYSTICK	Systick_10msBase	System timer generates an interrupt every 10ms
	Systick_Stclk	System timer uses an external clock signal
NVIC	Nvic_Priorities	Testing Tail-chaining or Late-arriving interrupt mode through NVIC priority

Name of Example Programs		Descriptions
		grouping
	Nvic_VectorTableRelocation	Relocating vector table
PWR	PWR_DeepPowerDown	System enters deep power down mode and is woken up by an RTC interrupt
	PWR_DeepSleep	System enters deep sleep mode and is woken up by an external interrupt
	PWR_PowerDown	System enters power down mode and is woken up by an NMI interrupt
	PWR_Sleep	System enters sleep mode and is woken up by a WWD interrupt
GPIO	GPIO_Interrupt	Using the interrupt function of the GPIO
	GPIO_LedBlinky	Using GPIO to receive button interrupts, drive the LED and the buzzer
PWM	Pwm_DualEdge	Generating a PWM signal under single/dual edge mode
	Pwm_MatchInterrupt	Using the PWM matching function under interrupt mode
	Pwm_SingleEdge	Generating a PWM signal under single edge mode
MCI	Mci_CidCard	Using the MCI (Multimedia Card Interface) of the LCP1788
	Mci_Fatfs_v008a	Using a MicroSD in the file system
	Mci_ReadWrite	Writing and reading the MCI of the LPC1788
SSP	SSP_Dma	Testing SSP under DMA mode
	SSP_LCD_Touch	Configuring the touch function chip of an LCD through the SPI bus
ADC	ADC_Burst	Using AD conversion under burst mode

Name of Example Programs		Descriptions
	ADC_Dma	Using the AD conversion function and transferring AD conversion results under DMA mode
	ADC_Interrupt	Using AD conversion under interrupt mode
	ADC_Polling	Using AD conversion under polling mode
DAC	Dac_Dma	Using the DAC to generate an analog output under DMA mode
	Dac_SineWave	Generating a sine wave output by using the DAC
BOD		Using BOC (Brown-Out Detector) function
CRC	Crc_Demo	Implementing a CRC-CCITT, CRC-16 and CRC-32 calibration based on given data by using the LPC1788's CRC function
	Crc_Dma	Implementing CRC-32 calibration based on given data under DMA mode by using the LPC1788's CRC function
IAP		Using IAP to update the space after the user code in flash, and read chip information including ID, boot code version and serial number

6.1.2 LCD_Display Program

1. Connect an LCD screen to the CON9 interface (marked as "**LCD & Touch**" in Figure 1 on page 2) of the SBC1788 with an LCD flat cable;

2. Expand the **Main** branch in the tree view on the left side of the uVision4 window and double-click **lcd_driver.h**, and then select a definition of initialization macro on the right side according to the LCD screen size as shown below;

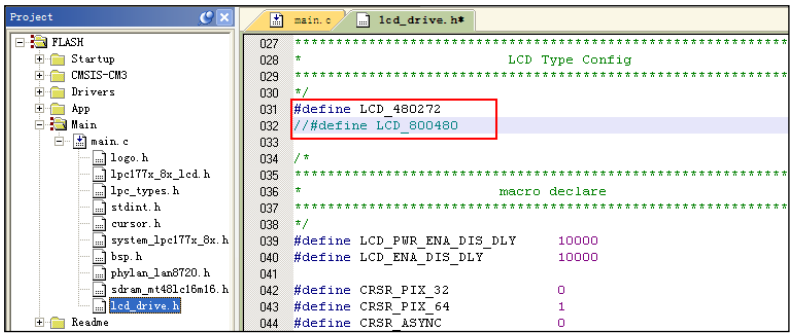


Figure 70: Macro Definition for 4.3"

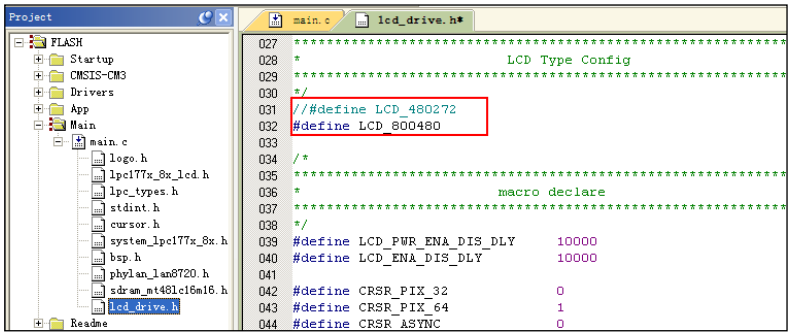


Figure 71: Macro Definition for 7"

Note:

- The SBC1788 supports two LCD modules, LCD6000-43T and LCD6000-70T which have a 480×272, 4.3” and an 800×480 7” screen respectively.
- The red line of the LCD flat cable should be on the same side as the 1st pin (marked with a triangle) of the CON9 interface.
- The capacitors C3, C5, C6 and C7 should be removed from the board if a 4.3” touch-screen LCD is used.

3. Power on the SBC1788 and recompile the project, and then download it to flash;
4. Reboot the SBC1788; The LCD will display 4 colour stripes – red, green, blue and yellow, as well as a light-blue round spot moving along the red stripe;

6.1.3 LCD_Touch Program

1. Connect the LCD screen to the CON9 interface (marked as "**LCD & Touch**" in Figure 1 on page 2) of the SBC1788 with an LCD flat cable;

2. Expand the **Main** branch in the tree view on the left side of the uVision4 window and double-click **lcd_driver.h**, and then select a definition of initialization macro on the right side according to LCD screen size as shown below;

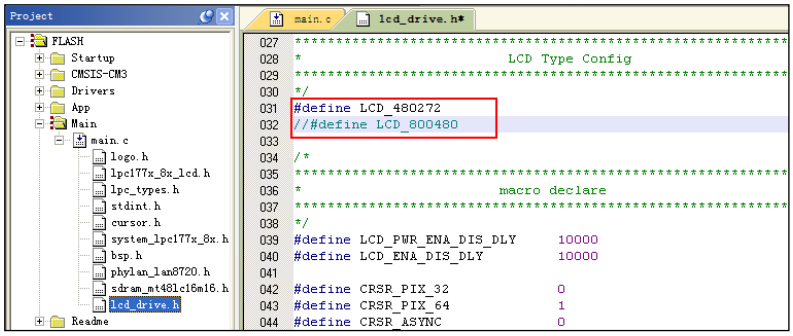


Figure 72: Macro Definition for 4.3"

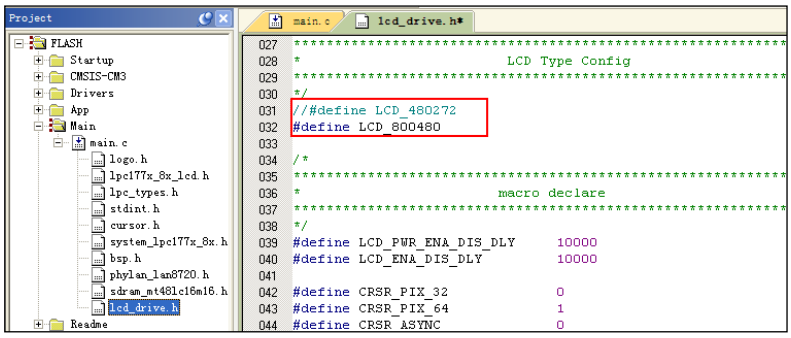


Figure 73: Macro Definition for 7"

Note:

- The SBC1788 supports two LCD modules, LCD6000-43T and LCD6000-70T which have a 480×272, 4.3" and an 800×480, 7" screen respectively.
- The red line of the LCD flat cable should be on the same side as the 1st pin (marked with a triangle) of the CON9 interface.
- The capacitors C3, C5, C6 and C7 should be removed from the board if a 4.3" touch-screen LCD is used.

3. Power on the SBC1788 and recompile the project, and then download it to flash;

4. Reboot the SBC1788 and use a stylus to touch the points which are marked with "+" symbols on the screen to implement calibration. When **please touch the screen** appears on the screen, please use a stylus to touch a random point on the screen. The voltage value generated by the touching will be converted by the ADC and displayed on the screen, along with the corresponding coordinates.

6.1.4 USB_MassStorage Program

1. Connect the SBC1788 to your PC with a USB-A (M) to USB-B (M) cable and a cross-over serial cable.

2. Open a HyperTerminal window on your PC; (please refer to 4.1 Configuring HyperTerminal on page 18)

3. Power on the SBC1788 and recompile the project, and then download it to flash;

4. Reboot the SBC1788; The board will be recognized as a USB mass storage device by the PC and the LED6 indicator will light up; You can find a file named **README.TXT** by opening the drive **LPC178x** in the My Computer window on your PC as shown below;

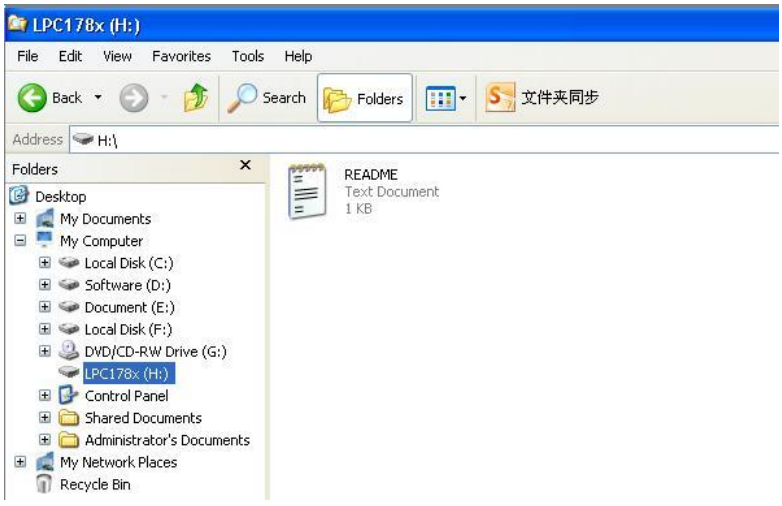


Figure 74: LPC178x Working as a USB Mass Storage Device

6.1.5 USB_VirtualCom Program

1. Connect the SBC1788 to your PC with a USB-A (M) to USB-B (M) cable and a cross-over serial cable;

2. Open a HyperTerminal window on your PC; (refer to 4.1 Configuring HyperTerminal on page 18)

3. Power on the SBC1788 and recompile the project, and then download it to flash;

4. Reboot the SBC1788; The board will be recognized as a virtual serial device and the LED6 indicator will light up; You can find a serial device named **LPC178x USB VCOM Port (COMx)** under the **Ports (COM & LPT)** branch in the **Device Manager** window of your PC as shown below;

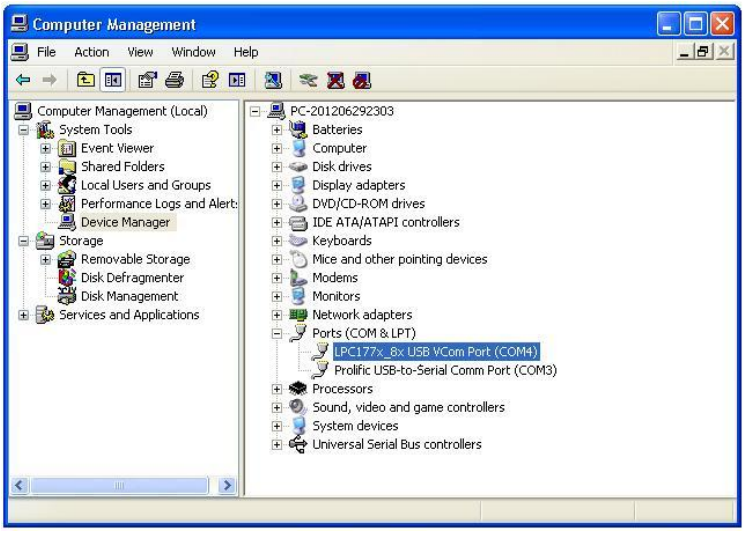


Figure 75: LPC177x Working as a Serial Device

Note:

🕮 If the PC prompts you to install a driver, you can find the driver under X:\ code\LPC177x_8x_StdPeriph_Demo\Examples\02-USB-Device\USB_VirtualCom. (where X:\ is the label of CD-ROM drive)

5. Open a HyperTerminal window for the virtual serial device; Any characters entered in a window will be received and displayed in the other as shown below;

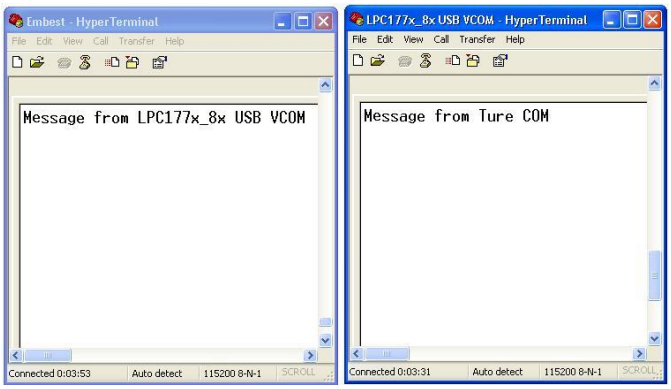


Figure 76: Communication Between Serial Devices

6.1.6 USB-HostLite Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

2. Copy the folder **Folder** and the file **FILENAME_R.txt** from

3. **X:\code\LPC177x_8x_StdPeriph_Demo\Examples\03-USBHostLite\UsbHost_MassStorage** to a USB flash drive (where X:\ is the label of CD-ROM drive), and then insert the drive into the USB interface of the SBC1788;

Note:

📖 Due to the uncertainty of compatibility, some USB flash drives may not work properly with this program. Please try another drive if you encounter this issue.

4. Power on the SBC1788 and recompile the project, then download it to flash;

5. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
************************************************************
********************
 Hello NXP Semiconductors
 UART Host Lite example
         - MCU: LPC177x_8x
         - Core: ARM CORTEX-M3
         - UART Communication: 115200 bps
```

```
 This example used to test USB Host function.
************************************************************
********************
Host Initialized
Connect a Mass Storage device
Mass Storage device connected
Copying file...
Copy completed
```

6. Connect the USB flash drive to your PC and check the contents of the drive to see if **FILENAME_R.txt** has been copied to the folder **Folder**;

6.1.7 Emac_EasyWeb Program

1. Connect the input lead of a 10K potentiometer to a 3.3V input, and the output lead to the ADC0_IN2 pin on the SBC1788 (the 4th pin of the connector marked as **UART1/3/4&DA&AD*3CH** in Figure 1 on page 2), and the last one to ground;

2. Connect the SBC1788 to your PC with a cross-over network cable and a cross-over serial cable, and then open a HyperTerminal window;

3. Power on the SBC1788 and recompile the project, and then download it to flash;

4. Reboot the SBC1788; The HyperTerminal window displays the IP address 192.168.0.100 of the SBC1788;

5. Click **Start > Run** on your PC's desktop, type **cmd** in the pop-up window, and then press **Enter** on your keyboard to open a command line window; Type **ping 192.168.0.100 –t** in the window and press **Enter** again to receive the information as shown below;

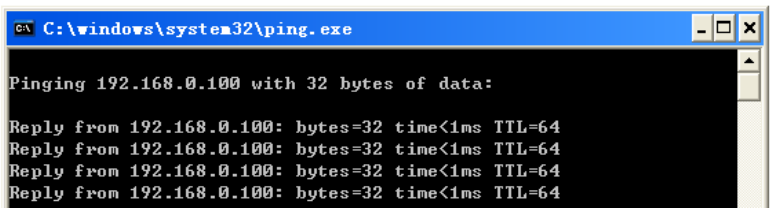


Figure 77: Network Testing

6. Type http://192.168.0.100 in the address bar of your Internet browser and press **Enter** on your keyboard to open the page as shown below;

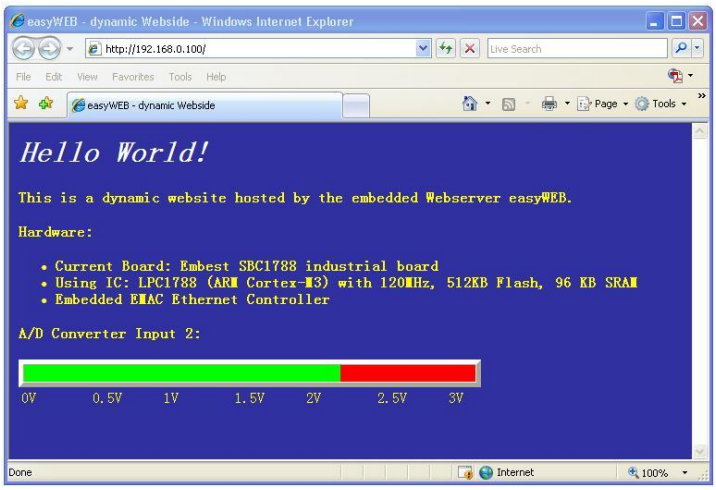


Figure 78: Potentiometer Level Display

When the potentiometer is being turned, the voltage value converted by the ADC will change accordingly;

6.1.8 UART_Autobaud Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

2. Power on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788 and type **a** in HyperTerminal window as shown below to enter auto baud mode;

```
AutoBaudrate Status: Synchronous!
************************************************************
********************
 Hello NXP Semiconductors
 UART Auto-Baudrate example
        - MCU: LPC177x_8x
        - Core: ARM CORTEX-M3
        - UART Communication: 115200 bps
 This example used to test UART component with autobaudrate
function.
 It will adjust its rate to synchronize with the sending
data
```

```
  + Please press any key to be echoed
  + Press 'r' to re-show the welcome string
  + Press ESC to terminate
************************************************************
********************
a
```

Type any character and the HyperTerminal window will respond with the same character;

Note:

- Type **r** to show the welcome string again;
- Press **ESC** on your keyboard to terminate the program.

6.1.9 Uart_Rs485Master & Uart_Rs485Slave Programs

1. Connect the fifth and sixth pins of the RS485 interface (marked as "**RS485**" in Figure 1 on page 2) on an SBC1788 to the same pins on another SBC1788 as shown below;

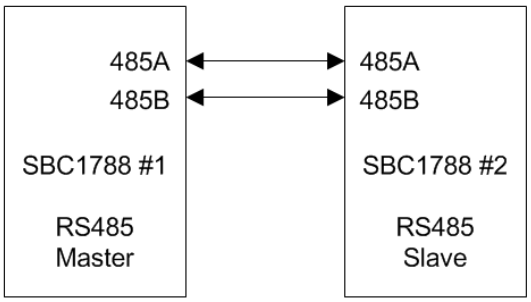


Figure 79: Connection Between Two SBC1788

2. Connect one of the boards to a PC with a cross-over serial cable and open a HyperTerminal window;
3. Power on both boards and recompile the Uart_Rs485Master and Uart_Rs485Slave projects, and then download them to the flash memories of host (the board with cross-over serial cable) and slave respectively;
4. Reboot both SBC1788s; The HyperTerminal will display information as shown below;

```
Hello NXP Semiconductors
```

```
RS485 demo in Master mode
Sending to A...
Receive: ACK

Sending to B...
Receive: No Dev Reply
……
Sending to A...
Receive: ACK

Sending to B...
Receive: No Dev Reply
```

6.1.10 Emc_NandFlashDemo Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;
2. Power on the SBC1788 and recompile the project, and then download it to flash;
3. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
************************************************************
********************
 Hello NXP Semiconductors
 # NANDFLASH K9F1G08U0B testing
         - MCU: LPC177x_8x
         - Core: Cortex-M3
         - UART Communication: 115200 bps
 Write and verify data with on-board NAND FLASH
************************************************************
********************
Init NAND Flash...
Read NAND Flash ID:  ECF19500
Checking valid block...
Erase entire NAND Flash...
Write a block of 2K data to NAND Flash...
Read back a block of 2K data from NAND Flash...
Verify data...
Verifying complete! Testing terminated!
```

6.1.11 Emc_SdramDemo Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

2. Power on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
************************************************************
*********************
 Hello NXP Semiconductors
 Test SDRAM mt48lc16m16A2P with LPC1788 EMC
        - MCU: LPC177x_8x
        - Core: Cortex-M3
        - UART Communication: 115200 bps
 Write and verify data with on-board SDRAM
************************************************************
*********************
Init  SDRM...
Clear content of SDRAM…
Writing in 8 bits format...
Verifying data...
Continue writing in 16 bits format...
Clear content of SRAM...
Writing in 16 bits format...
Verifying complete! Testing terminated!
```

6.1.12 RTC_Calendar Program

1. Install a CR1220 battery in the RTC battery holder (marked as **RTC** in Figure 1 on page 2) on the SBC1788;
2. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;
3. Power on the SBC1788 and recompile the project, and then download it to flash;
4. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
************************************************************
**********************
 Hello NXP Semiconductors
 RTC Set Example:
        - MCU: LPC177x_8x
        - Core: ARM CORTEX-M3
        - UART Communication: 115200 bps
 A simple RTC Calendar example.
 To generate interrupt in Second Counter Increment
Interrupt (1s)
************************************************************
**********************
Current time set to:
02012/003/013 016:015:030
02012/003/013 016:015:031
02012/003/013 016:015:032
02012/003/013 016:015:033
02012/003/013 016:015:034
02012/003/013 016:015:035
02012/003/013 016:015:036
02012/003/013 016:015:037
02012/003/013 016:015:038
02012/003/013 016:015:039
02012/003/013 016:015:040
```

6.1.13 Can_Aflut Program

1. Connect the third and fourth pins of the CAN interface (marked as **CAN2.0B** in Figure 1 on page 2) on a SBC1788 to the same pins on another SBC1788 as shown below;

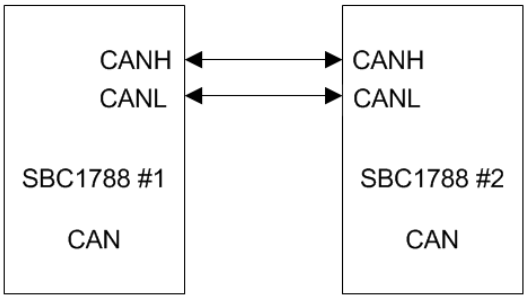


Figure 80: CAN Connection Diagram

2. Connect one SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

3. Power on both boards and recompile the project, and then download it to their flash memories;

4. Reboot both SBC1788s; The HyperTerminal displays information as shown below;

```
************************************************************
*********************
Hello NXP Semiconductors
CAN AFLUT example:
         - MCU: LPC17xx
         - Core: ARM CORTEX-M3
         - UART Communication: 115200 bps
Use 2 CAN peripherals: CAN1&CAN2 to transfer data
This example tests full Acceptance Filter operation
and load/remove AFLUT entry dynamically functions
************************************************************
*********************
Test Acceptance Filter function...
Init message finished!!!
Setup AF: SUCCESSFUL!!!


Message ID:     0x00000001
Message length: 0x00000008 BYTES
```

```
Message type:   DATA FRAME
Message format: STANDARD ID FRAME FORMAT
Message dataA:  0x78787878
Message dataB:  0x21212121

Message ID:     0x00000008
Message length: 0x00000008 BYTES
Message type:   DATA FRAME
Message format: STANDARD ID FRAME FORMAT
Message dataA:  0x15151515
Message dataB:  0x36363636
……
Sending finished !!!
display received messages...

Message ID:     0x00000001
Message length: 0x00000008 BYTES
Message type:   DATA FRAME
Message format: STANDARD ID FRAME FORMAT
Message dataA:  0x78787878
Message dataB:  0x21212121
……
messages Check OK...
```

6.1.14 DMA_Flash2Ram Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

2. Power on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
************************************************************
*********************
 Hello NXP Semiconductors
 GPDMA FLASH to RAM example
         - MCU: LPC177x_8x
         - Core: ARM CORTEX-M3
         - UART Communication: 115200 bps
 This example used to test GPDMA function by transfer data
from Flash
 to RAM memory
************************************************************
*********************
Start transfer on channel 000
Buffer Check success!
Demo terminated!
```

6.1.15 Wdt_Reset Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;
2. Power on the SBC1788 and recompile the project, and then download it to flash;
3. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
****************************************************************
*****************
This Welcome Screen below will executive after reset event
Hello NXP Semiconductors
Watch dog timer reset when timeout demo
         - MCU: LPC177x_8x
         - Core: ARM CORTEX-M3
         - UART Communication: 115200 bps
Use WDT with Internal RC OSC, reset mode, timeout = 5 seconds
To reset MCU when time out. After reset, program will determine
what cause of last reset time (external reset or WDT time-out)
The program is currently working in FLASH mode
****************************************************************
*****************
Last MCU reset caused by External!

****************************************************************
*****************
This Welcome Screen below will executive after reset event
Hello NXP Semiconductors
Watch dog timer reset when timeout demo
         - MCU: LPC177x_8x
         - Core: ARM CORTEX-M3
         - UART Communication: 115200 bps
Use WDT with Internal RC OSC, reset mode, timeout = 5 seconds
To reset MCU when time out. After reset, program will determine
what cause of last reset time (external reset or WDT time-out)
The program is currently working in FLASH mode
****************************************************************
*****************
Last MCU reset caused by WDT TimeOut!
```

6.1.16 Timer_MatchInterrupt Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;
2. Power on the SBC1788 and recompile the project, and then download it to flash;
3. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
************************************************************
********************
 Hello NXP Semiconductors
 Timer Match Interrupt demo
        - MCU: LPC177x_8x
        - Core: ARM CORTEX-M3
        - UART Communication: 115200 bps
 Use timer x toggle MATx.0 at frequency 1Hz
************************************************************
********************
Match interrupt occur...
Match interrupt occur...
Match interrupt occur...
Match interrupt occur...
Match interrupt occur...
```

A 0.5Hz spare wave can be viewed using an oscilloscope detecting the output signal from CON11.4 (the 4th pin of the interface marked as **PWM*6CH &GPIO** in Figure 1 on page 2) on the SBC1788.

6.1.17 Systick_10msBase Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

2. Power on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788; A 100Hz spare wave can be viewed using an oscilloscope as shown below, detecting the output signal from CON12.4(the 4th pin of the interface marked as **SPI & GPIO** in in Figure 1 on page 2) on the SBC1788;

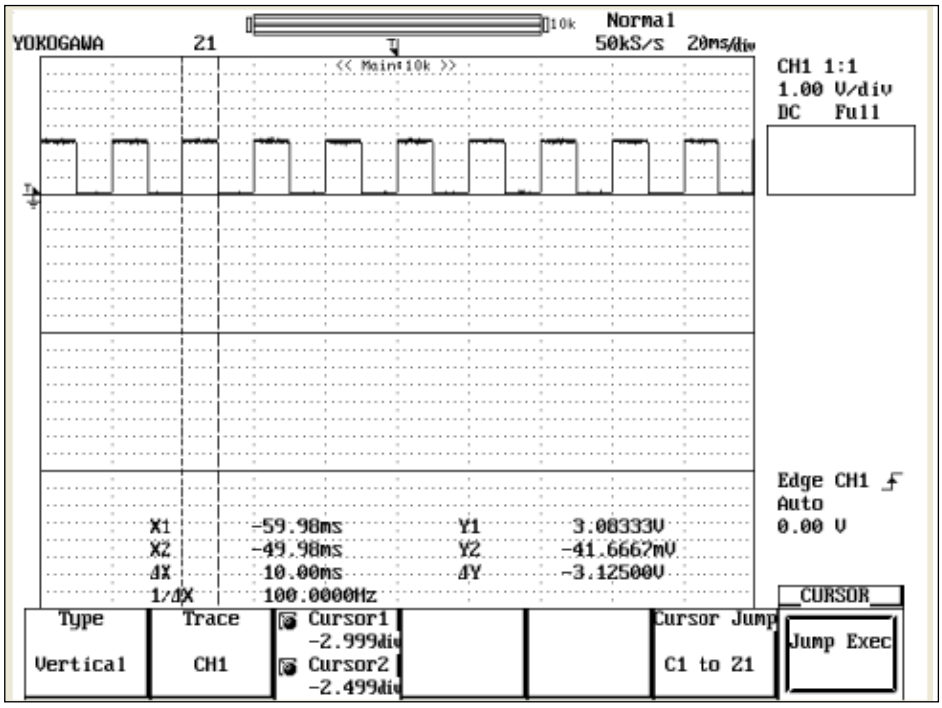


Figure 81: Oscilloscope Showing Square Waves

6.1.18 NVIC Program

1. Modify the macro definition of INT_MODE as shown in the following uVision4 window to test Tail-Chaining or Late-arriving interrupt mode;

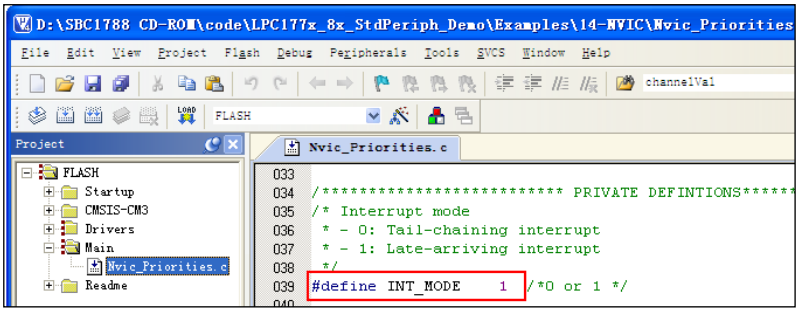


Figure 82: Modify INT_MODE Macro Definition

2. Recompile the project after modification, and then download it to flash;

3. Reboot the SBC1788 to run the program; The testing processes under two modes are listed below;

- **Tail-Chaining interrupt mode:** When the LED2 indicator is blinking (triggered by ADC interrupt), press the SW3 button to generate an INT0 interrupt, and LED1 will blink 10 times after the ADC interrupt expires;
- **Late-arriving interrupt mode:** When the LED2 indicator is blinking (triggered by ADC interrupt), press the SW3 button to generate an INT0 interrupt, which will take over control from the ADC interrupt and trigger LED1 to blink 10 times; After the INT0 interrupt expires, the ADC interrupt will take back control and LED2 will resume blinking;

6.1.19 PWR_DeepSleep Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

2. Power on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788; Type **1** in the HyperTerminal window to instruct the system enter deep sleep mode, and then press the **ISP** button (marked as **ISP Key** in in Figure 1 on page 2) to wake up the system as shown below;

```
************************************************************
********************
 Hello NXP Semiconductors
 Power - Deep Sleep example
         - MCU: LPC177x_8x
         - Core: ARM CORTEX-M3
         - UART Communication115200 bps
 This example used to enter system in deep sleep mode and
wake up it by using
 external interrupt
************************************************************
********************
Press '1' to enter system in deep sleep mode.
If you want to wake-up the system, press ISP button.
-------- I'm wake up! --------
```

6.1.20 GPIO_LedBlinky Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

2. Power on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788; The buzzer will beep 3 times and all the LEDs will blink in sequence repeatedly; Press and hold the SW1 button, the LEDs will blink at a higher frequency; Press and hold the SW2 button, the LEDs will blink at a lower frequency;

Note:

📖 For the location of the SW1 and SW2 buttons, please refer to the components marked as **User1&2 Key** in Figure 1 on page 2.

6.1.21 Pwm_SingleEdge Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;
2. Power on the SBC1788 and recompile the project, and then download it to flash;
3. Reboot the SBC1788; the PWM1 pin will provide a 234.4KHz output signal; Please view the output signal from the channels in the following table by using a oscilloscope;

PWM	Pins
Channel 1	**CON11.3** (the 4th pin of the interface marked as **PWM*6CH& GPIO** in Figure 1 on page 2)
Channel 2	**CON11.4** (the 6th pin of the interface marked as **PWM*6CH& GPIO** in Figure 1 on page 2)
Channel 3	**CON11.5** (the 8th pin of the interface marked as **PWM*6CH& GPIO** in Figure 1 on page 2**)**
Channel 4	**CON11.6** (the 10th of the interface marked as **PWM*6CH& GPIO** in Figure 1 on page 2**)**
Channel 5	**CON11.7** (the 12th pin of the interface marked as **PWM*6CH &GPIO** in Figure 1 on page 2**)**
Channel 6	**CON11.8** (the 14th pin of the interface marked as **PWM*6CH &GPIO** in Figure 1 on page 2)

6.1.22 Mci_Fatfs_v008a Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;
2. Insert a TF card in the TF card slot (marked as **Micro SD** in Figure 1 on page 2) on SBC1788;

3. Power on the SBC1788 and recompile the project, and then download it to flash;

4. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
>*********************************************************
**********************
 Hello NXP Semiconductors
 MCI File System Example
        - MCU: LPC177x_8x
        - Core: ARM CORTEX-M3
        - UART Communication: 115200 bps
 This example is used to demonstrate how to implement a
filesystem using MCI.
 FatFs,a generic FAT file system module for small embedded
systems, is used in
 ver = R0.08a
*********************************************************
********************
Type the message.txt content
Hello NXP Semiconductors
MCI File System Example
Close the file
Create a new file (hello.txt)
Write a text data. (hello.txt)
14 bytes written
Close the file
read the file (hello.txt)
Type the file content(hello.txt)
Hello world!
Close the file (hello.txt)
Open root directory
Directory listing...
      65  message.txt
      14  hello.txt
Test completed
>
```

6.1.23 SSP_LCD_Touch Program

1. Connect an LCD to the CON9 interface (marked as **LCD & Touch** in Figure 1 on page 2) on the SBC1788 using an LCD flat cable;

2. Expand the **Main** branch in the tree view on the left side of the uVision4 window and double-click **lcd_driver.h**, and then select a definition of initialization macro on the right side according to LCD screen size as shown below;

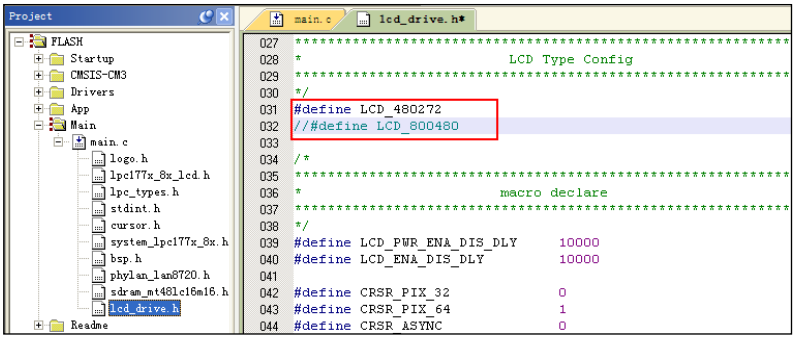


Figure 83: 4.3" Macro Definition

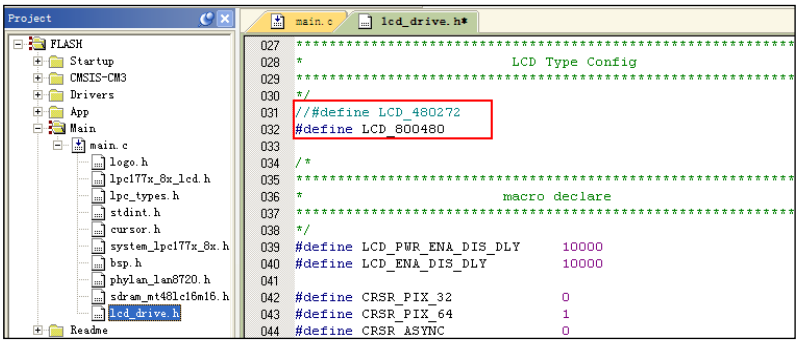


Figure 84: 7" Macro Definition

Note :

- The SBC1788 supports two LCD modules, LCD6000-43T and LCD6000-70T which have a 480×272, 4.3” and a 800×480, 7” screen respectively.
- The red line of the LCD flat cable should be on the same side as the 1st pin (marked with a triangle) of the CON9 interface
- The capacitors C3, C5, C6 and C7 should be removed from the board if a 4.3” touch-screen LCD is used.

3. Power on the SBC1788 and recompile the project, and then download it to flash;

4. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
************************************************************
********************
 Hello NXP Semiconductors
 SSP DMA example
         - MCU: LPC177x_8x
         - Core: ARM CORTEX-M3
         - UART Communication: 115200 bps
 This example uses SSP function in MASTER mode
 Read the LCD Touch Sensor Value
************************************************************
********************
Detect the LCD Touch Event
Channel X data is:00000
Channel Y data is:00000
Channel X data is:00000
Channel Y data is:00000
……
```

5. The values of X and Y change in the HyperTerminal window when using a stylus to slide across the surface of the touch-screen;

6.1.24 ADC_Polling Program

1. Connect the input lead of a 10K potentiometer to a 3.3V input, and the output lead to the ADC0_IN2 pin on the SBC1788 (the 4th pin of the connector marked as **UART1/3/4&DA&AD*3CH** in Figure 1 on page 2), and the last one to ground;

2. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

3. Power on the SBC1788 and recompile the project, and then download it to flash;

4. Reboot the SBC1788; When the potentiometer is being turned, the voltage value converted by the ADC changes accordingly and is displayed in the HyperTerminal window as shown below;

```
************************************************************
************
 Hello NXP Semiconductors
 ADC POLLING example:
        - MCU: LPC177x_8x
        - Core: ARM CORTEX-M3
        - Communicate via: UART0 - 115200 bps
 Use ADC with 12-bit resolution rate of 400KHz, read in
POLLING mode
 To get ADC value and display via UART interface
 Turn the potentiometer to see ADC value changes
 Press q to stop the demo
************************************************************
************
ADC value on channel 002 is: 0000003889
ADC value on channel 002 is: 0000003853
ADC value on channel 002 is: 0000003640
ADC value on channel 002 is: 0000003459
ADC value on channel 002 is: 0000003270
ADC value on channel 002 is: 0000003146
ADC value on channel 002 is: 0000003002
ADC value on channel 002 is: 0000002847
ADC value on channel 002 is: 0000002730
ADC value on channel 002 is: 0000002604
ADC value on channel 002 is: 0000002594
ADC value on channel 002 is: 0000002596
ADC value on channel 002 is: 0000002611
```

6.1.25 Dac_SineWave Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;

2. Power on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788, and then use an oscilloscope to detect the signal on the DAC_OUT pin (the 6th pin of the interface

marked as **UART1/3/4&DA&AD*3CH** in Figure 1 on page 2); A sine wave with Vpp=3.3V and frequency at 300Hz can be detected by oscilloscope as shown below;

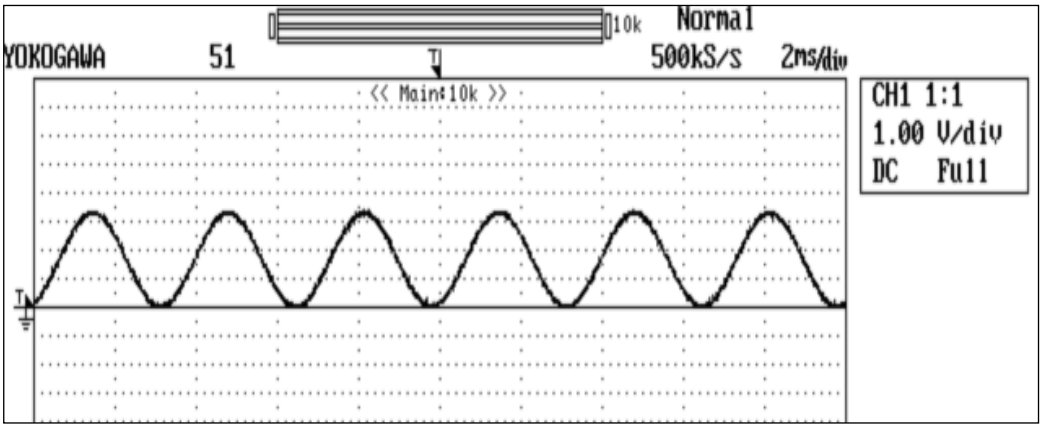


Figure 85: Oscilloscope Showing Sine Wave

6.1.26 BOD Program

1. Use a regulated DC power supply to provide +12V voltage for the SBC1788;
2. Recompile the project and download it to flash;
3. Reboot the SBC1788 and use a multimeter or oscilloscope to monitor VDD3V3, and then adjust the input voltage of the regulated DC power supply;

When 1.85V < VDD3V3 <2.2V, the BOD program generates a NVIC interrupt which triggers LED1 to blink for 5 times;

When VDD3V3 < 1.85V, the BOD generates a reset signal which will trigger LED1 to blink constantly;

6.1.27 Crc_Demo Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;
2. Power on the SBC1788 and recompile the project, and then download it to flash;
3. Reboot the SBC1788; the HyperTerminal window will display information as shown below;

```
************************************************************
*********************
 Hello NXP Semiconductors
 CRC Demo example:
        - MCU: LPC177x_8x
        - Core: ARM CORTEX-M3
        - UART Communication: 115200 bps
 Use CRC engine on LPC177x_8x to calculate CRC for a 8-bit
block data
 You can choose one of three polynomial type:
        - CRC-CCITT
        - CRC-16
        - CRC-32
************************************************************
*********************
Block data:
0x00000000     0x00000001     0x00000002     0x00000003
0x00000004     0x00000005     0x00000006     0x00000007
0x00000008     0x00000009     0x0000000A     0x0000000B
0x0000000C     0x0000000D    0x0000000E     0x0000000F
0x00000010     0x00000011     0x00000012     0x00000013
0x00000014     0x00000015     0x00000016     0x00000017
0x00000018     0x00000019     0x0000001A     0x0000001B
0x0000001C     0x0000001D    0x0000001E     0x0000001F
0x00000020     0x00000021     0x00000022     0x00000023
0x00000024     0x00000025     0x00000026     0x00000027
0x00000028     0x00000029     0x0000002A     0x0000002B
0x0000002C     0x0000002D    0x0000002E     0x0000002F
0x00000030     0x00000031     0x00000032     0x00000033
0x00000034     0x00000035     0x00000036     0x00000037
0x00000038     0x00000039     0x0000003A     0x0000003B
0x0000003C     0x0000003D    0x0000003E     0x0000003F
Choose what polynomial that you want to use, type:
        - '1': CRC-CCITT
        - '2': CRC-16
        - '3': CRC-32
        - 'Q': Quit
CRC-CCITT Result: 0x0000FD2F
Choose what polynomial that you want to use, type:
        - '1': CRC-CCITT
        - '2': CRC-16
        - '3': CRC-32
        - 'Q': Quit
```

```
CRC-16 Result: 0x00002799
Choose what polynomial that you want to use, type:
        - '1': CRC-CCITT
        - '2': CRC-16
        - '3': CRC-32
        - 'Q': Quit
CRC-32 Result: 0x100ECE8C
```

6.1.28 IAP Program

1. Connect the SBC1788 to your PC with a cross-over serial cable and open a HyperTerminal window;
2. Power on the SBC1788 and recompile the project, and then download it to flash;
3. Reboot the SBC1788; the HyperTerminal window displays information as shown below, which includes chip related information such as: PartID, Boot code version and UID, as well as the feedback of whether the flash programming was successful;

```
************************************************************
*********************
 Hello NXP Semiconductors
 IAP Demonstration
        - MCU: LPC177x_8x
        - Core: ARM CORTEX-M3
        - UART Communication: 115200 bps
************************************************************
*********************
PartID: 0x281D3F47
Boot Code Version: 008.001
UID: 0185272594-1397563950-1319636093-4110417927
Erase chip: Success
Program chip: Success
Demo termination
```

6.2 Application Programs

Application programs are the developed based on the basic ones in order to provide system-level demonstration programs with extended features. These programs include uC/OS-II, GUI and LWIP examples. The table shown below lists all the application programs and their corresponding descriptions. This section will introduce the detailed operations to run the application programs.

Name		Description
SBC1788-emWin512		Demonstrating the GUI of emWin
SBC1788-Lwip-v1.4.0	httpraw_sa	Implementing a HTTP server on SBC1788
	tcpecho_sa	Implementing a TCP echo server on SBC1788
SBC1788-uCOSII-uCGUI		Demonstration programs of uC/OS-II & uC/GUI
SBC1788-uCOS-II-v2.86		Demonstration programs ouC/OS-II v2.86

1.1.1 SBC1788-emWin512 Program

1. Connect an LCD to the CON9 interface (marked as **LCD & Touch** in Figure 1 on page 2) on the SBC1788 with a LCD flat cable;

2. Expand the **Main** branch in the tree view on the left side of the uVision4 window and double-click **lcd_driver.h**, and then select a definition of initialization macro on the right side according to LCD screen size as shown below;

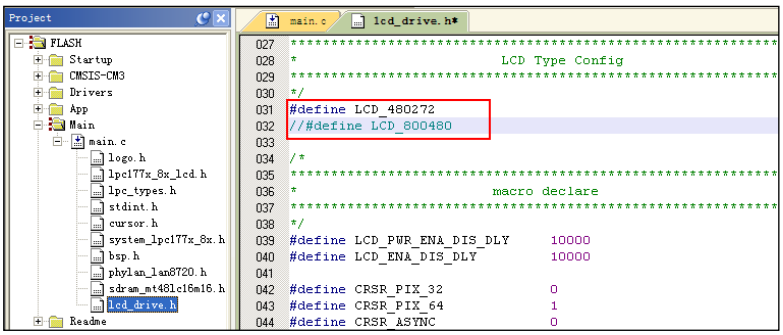


Figure 86: 4.3" Macro Definition

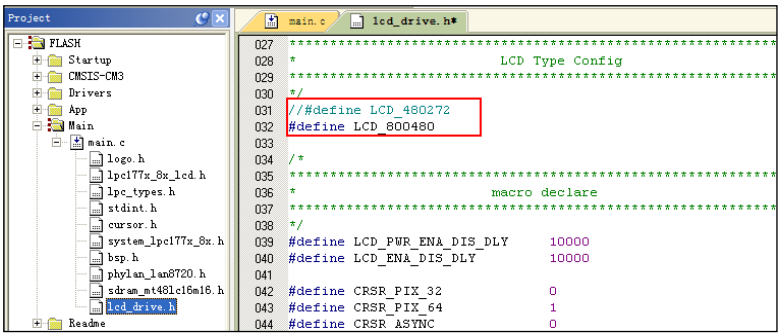


Figure 87: 7" Macro Definition

Note :

- The SBC1788 supports two LCD modules, LCD6000-43T and LCD6000-70T which have a 480×272, 4.3" and a 800×480, 7" screen respectively.
- The red line of the LCD flat cable should be on the same side as the 1st pin (marked with a triangle) of the CON9 interface
- The capacitors C3, C5, C6 and C7 should be removed from the board if a 4.3" touch-screen LCD is used.

The Keil project of **SBC1788-emWin512** is saved under **X:\code\SBC1788-emWin512\MDK-ARM\Start** (where X:\ is the label of the CD-ROM drive); Power on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788; the LCD will display the demonstration images of emWin; Two groups of LEDs – LED1 & LED3 and LED2 & LED4 will light up alternately;

6.2.2 httpraw_sa Program

1. Connect the SBC1788 to PC with a cross-over network cable and power on the board; the LED1 indicator will light up, which indicates the network is connected properly;
2. The Keil project: **httpraw_sa** is saved under **X:\code\SBC1788-Lwip-v1.4.0\lwip_lpc\nxpcommon\examples\SBC1788\http**

raw_sa (where X:\ is the label of the CD-ROM drive); Turn on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788; Select **Start > Run** on your PC's desktop and type **cmd** in the pop-up window, and then press **Enter** on your keyboard; Type **ping 192.168.0.232 –t** in following command line window and press **Enter** again to receive replies from the board;

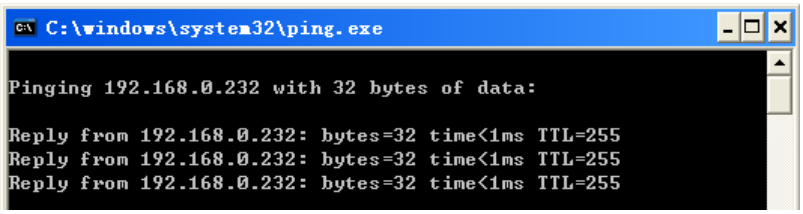


Figure 88: Network Test

4. Open an Internet browser and type http://192.168.0.232 in the address bar to open the following page;

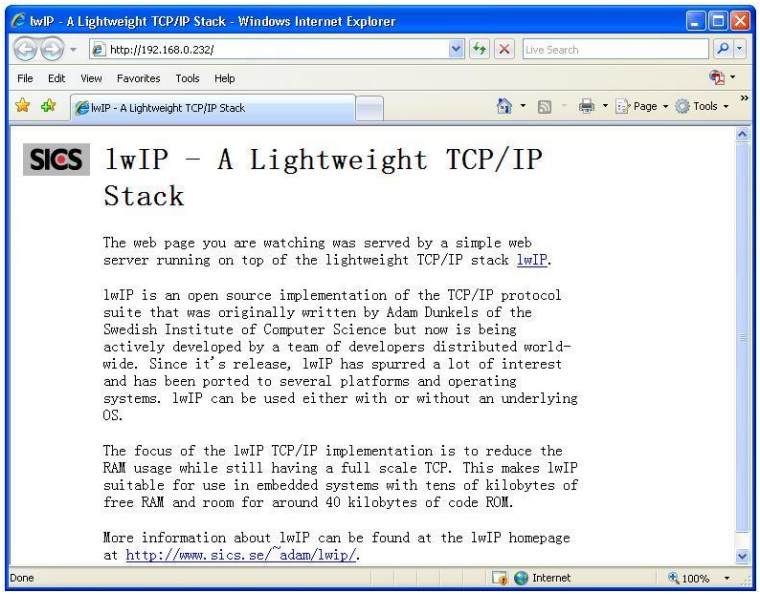


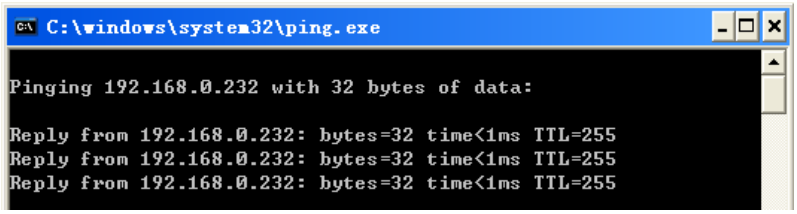
Figure 89: 1wIP Landing Page

6.2.3 tcpecho_sa Program

1. Connect the SBC1788 to a PC with a cross-over network cable and power on the board; the LED1 indicator will light up, which indicates the network is connected properly;

2. The Keil project: **tcpecho_sa** is saved under : **X:\code\SBC1788-Lwip-v1.4.0\lwip_lpc\nxpcommon\examples\SBC1788\tcpecho_sa** (where X:\ is the label of the CD-ROM drive); Power on the SBC1788 and recompile the project, and then download it to flash;

3. Reboot the SBC1788; Select **Start > Run** on your PC's desktop and type **cmd** in the pop-up window, and then press **Enter** on your keyboard; Type **ping 192.168.0.232 –t** in following command line window and press **Enter** again to receive replies from the board;



4. Figure 90: Network Test

5. Copy the file **echotool.exe** from **X:\code\SBC1788-Lwip-v1.4.0\Utilities\PC_Software** (where X:\ is the label of the CD-ROM drive) to the drive C root directory; Select **Start > Run** on your PC's desktop and type the command line as shown blow in the pop-up window and press **Enter** on your keyboard;

```
C:\>echotool.exe IP_address /p tcp /r 7 /n 10 /t 2 /d Testing LwIP TCP echo server
```

6. Running information of the program is shown in the following window;

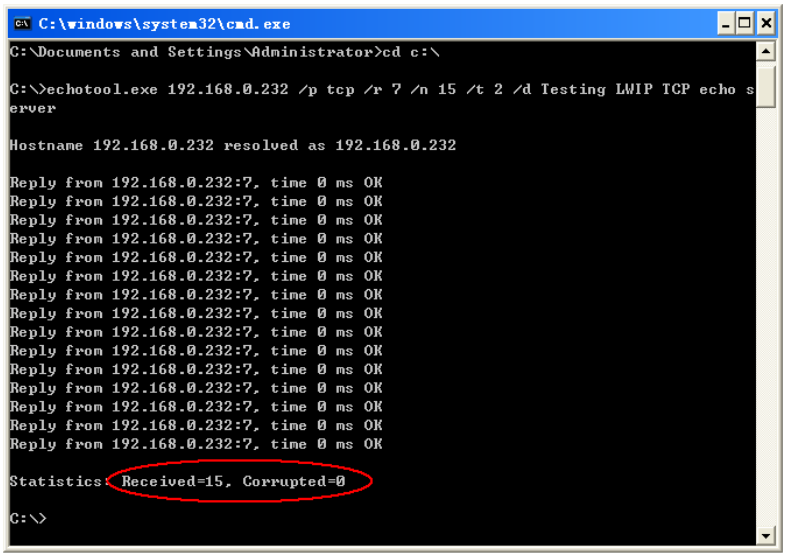


Figure 91: Echotool Running Information

6.2.4 SBC1788-uCOSII-uCGUI Program

1. Connect an LCD to the CON9 interface (marked as **LCD & Touch** in Figure 1 on page 2) on the SBC1788 with an LCD flat cable;

2. Expand the **Main** branch in the tree view on the left side of the uVision4 window and double-click the **lcd_driver.h**, and then select a definition of initialization macro on the right side according to the LCD screen size as shown below;

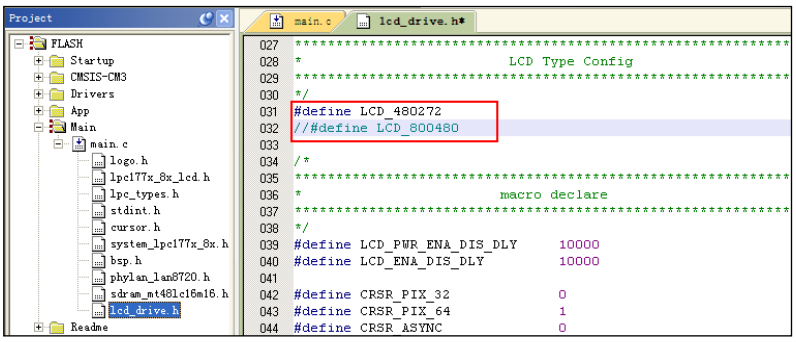


Figure 92: 4.3" Macro Definition

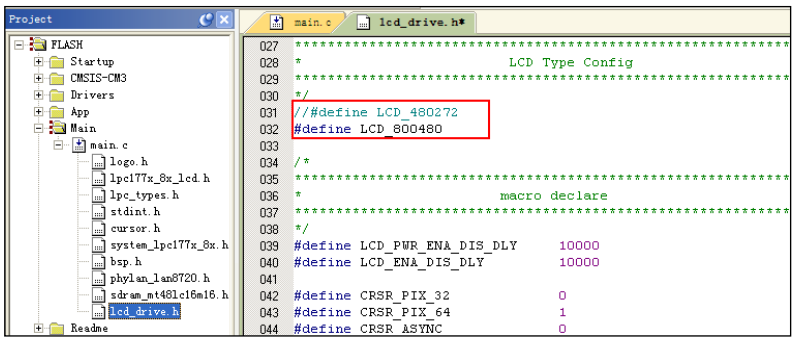


Figure 93: 7" Macro Definition

Note :

- The SBC1788 supports two LCD modules, LCD6000-43T and LCD6000-70T which have a 480×272, 4.3" and a 800×480, 7" screen respectively.
- The red line of the LCD flat cable should be on the same side as the 1st pin (marked with a triangle) of the CON9 interface
- The capacitors C3, C5, C6 and C7 should be removed from the board if a 4.3" touch-screen LCD is used.

3. The keil project: **uC/OSII–uC/GUI** is saved under **X:\code\SBC1788-uCOSII-uCGUI\MDK-ARM** (where X:\ is the label of the CD-ROM drive); Power on the SBC1788 and recompile the project, and then download it to flash;
4. Reboot the SBC1788; The LCD will display demonstration images of uC/OSII-uC/GU, Two groups of LEDs – LED1 & LED3 and LED2 & LED4 will light up alternately;

6.2.5 SBC1788-uCOS-II-v2.86 Program

1. Power on the SBC1788 and recompile the project, and then download it to flash;
2. Reboot the SBC1788; Two groups of LEDs – LED1 & LED3 and LED2 & LED4 will light up alternately; Press and hold the SW1

button, LEDs will blink at a higher frequency; Press and hold the SW2 button, LEDs will blink at a lower frequency;

7 Function Test

The testing entries listed in the following table can help users verify the function of the peripherals on the SBC1788;

Entries	Descriptions
LCD & Touch Screen	Please refer to 6.1.2 LCD_Display Program and 6.1.3 LCD_Touch Program
USB Device	Please refer to 6.1.4 USB_MassStorage Program and 6.1.5 USB_VirtualCom Program
USB Host	Please refer to 6.1.6 USB-HostLite Program
Ethernet	Please refer to 6.1.7 Emac_EasyWeb Program
UART	Please refer to 6.1.8 UART_Autobaud Program
RS485	Please refer to 6.1.9 Uart_Rs485Master & Uart_Rs485Slave Programs
NAND Flash	Please refer to 6.1.10 Emc_NandFlashDemo Program
SDRAM	Please refer to 6.1.11 Emc_SdramDemo Program
RTC	Please refer to 6.1.12 RTC_Calendar Program
CAN	Please refer to 6.1.13 Can_Aflut Program
LED & Buzzer	Please refer to 6.1.20 GPIO_LedBlinky Program
MicroSD	Please refer to 6.1.22 Mci_Fatfs_v008a Program
ADC	Please refer to 6.1.24 ADC_Polling Program
DAC	Please refer to 6.1.25 Dac_SineWave Program

Appendix 1: ESD Precautions & Handling Procedures

Please note that the board comes without any case/box and all components are exposed. Therefore, extra attention must be paid to ESD (electrostatic discharge) precautions. To effectively prevent electrostatic damage, please follow the steps below:

- Avoid carpets in cool, dry areas. Leave development kits in their anti-static packaging until ready to be installed.
- Dissipate static electricity before handling any system components (development kits) by touching a grounded metal object, such as the system unit unpainted metal chassis.
- If possible, use antistatic devices, such as wrist straps and floor mats.
- Always hold an evaluation board by its edges. Avoid touching the contacts and components on the board.
- Take care when connecting or disconnecting cables. A damaged cable can cause a short in the electrical circuit.
- Prevent damage to the connectors by aligning connector pins before you connect the cable. Misaligned connector pins can cause damage to system components at power-on.
- When disconnecting a cable, always pull on the cable connector or strain-relief loop, not on the cable itself.

Warning:

📖 This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Appendix 2: Technical support & Warranty

Embest Technology Co., Ltd. established in March of 2000, is a global provider of embedded hardware and software. Embest aims to help customers reduce time to market with improved quality by providing the most effective total solutions for the embedded industry. In the rapidly growing market of high end embedded systems, Embest provides comprehensive services to specify, develop and produce products and help customers to implement innovative technology and product features. Progressing from prototyping to the final product within a short time frame and thus shortening the time to market, and to achieve the lowest production costs possible. Embest insists on a simple business model: to offer customers high-performance, low-cost products with the best quality and service.

2.1 Technical support service

Embest provides one year of free technical support for all products. The technical support service covers:

- Embest embedded platform products software/hardware materials
- Assistance to customers with regards to compiling and running the source code we offer.
- Troubleshooting problems occurring on embedded software/hardware platforms if users have followed the instructions provided.
- Judge whether a product failure exists.

The situations listed below are not covered by our free technical support service, and Embest will handle the situation at our discretion:

- Customers encounter issues related to software or hardware during their development process

- Issues occur when users compile/run the embedded OS which has been modified by themselves.
- Customers encounter issues related to their own applications.
- Customers experience problems caused by unauthorised alteration of our software source code

2.2 Maintenance service clause

1. Product warranty will commence on the day of sale and last 12 months provided the product is used under normal conditions
2. The following situations are not covered by the warranty, Embest will charge service fees as appropriate:

- Customers fail to provide valid proof of purchase or the product identification tag is damaged, unreadable, altered or inconsistent with the product.
- Products are subject to damage caused by operations inconsistent with their specification;
- Products are subject to damage in either appearance or function due to natural disasters (flood, fire, earthquake, lightning strike or typhoon) or natural aging of components or other force majeure;
- Products are subject to damage in appearance or function due to power failure, external forces, water, animals or foreign materials;
- Products malfunction due to disassembly or alteration of components by customers, or repair by persons or organizations unauthorized by Embest Technology, or alteration from factory specifications, or configured or expanded with components that are not provided or recognized by Embest Technology;
- Product failures due to the software or systems installed by customers, inappropriate software settings or computer viruses;

- Products purchased from unauthorized merchants;
- Embest Technology takes no responsibility for fulfilling any warranty (verbal or written) that is not made by Embest Technology and not included in the scope of our warranty.

3. Within the period of warranty, the cost for sending products to Embest should be paid by the customer. The cost for returning the product to the customer will be paid by Embest. Any returns in either direction occurring after the warranty period has expired should be paid for by the customer.

4. Please contact technical support with any repair requests.

Note:

📖 Embest Technology will not take any responsibility for products returned without the prior permission of the company.

2.3 Basic guidelines for protection and maintenance of LCDs

1. Do not use finger nails or other hard sharp objects to touch the surface of the LCD

2. Embest recommends purchasing specialist wipes to clean the LCD after long time use, avoid cleaning the surface with fingers or hands as this may leave fingerprints or smudges.

3. Do not clean the surface of the screen with unsuitable chemicals

Note:

Embest do not supply a maintenance service for LCDs. We suggest the customer immediately checks the LCD once in receipt of the goods. In the event that the LCD does not run or shows no display, the customer should inform Embest within 7 business days of delivery.

2.4 Value Added Services

We will provide following value added services:

- Driver development based on Embest embedded platforms for devices such as: serial ports, USB interface devices, and LCD screens.
- Control system transplantation, BSP driver development, API software development.
- Other value added services including supply of power adapters and LCD parts.
- Other OEM/ODM services.
- Technical training.

Please contact Embest with any technical support queries:

http://www.embest-tech.com/contact-us.html