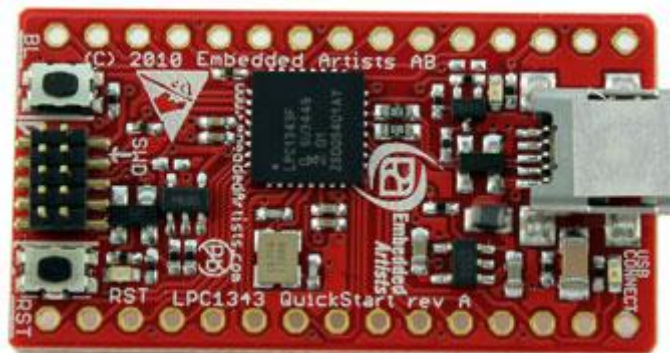


LPC1343 QuickStart Board User's Guide



*Get Up-and-Running Quickly and
Start Developing Your Applications On Day 1!*

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Table of Contents

1	Document Revision History	4
2	Introduction	5
2.1	Features	5
2.2	ESD and Handling Precaution	5
2.3	General Handling Care	6
2.4	Code Read Protection	6
2.5	CE Assessment	6
2.6	Other Products from Embedded Artists	6
2.6.1	Design and Production Services	6
2.6.2	OEM / Education / QuickStart Boards and Kits	7
3	Schematic	8
3.1	Powering	8
3.2	LPC1343 MCU	8
3.3	Reset Generation	8
3.4	LED on PIO0_7	8
3.5	USB Interface	8
3.6	Bootload Enable Push-button	9
3.7	I2C-E2PROM	9
3.8	SWD interface	9
3.9	Expansion Connectors	10
3.10	Usage of MCU Pins	11
4	Physical Design	13
4.1	Main Components	13
4.2	Mechanical Dimensions	14
5	Getting Started	15
5.1	SWD Interface	15
5.2	Activate LPC1343 ISP Mode	16
5.2.1	USB-ISP Mode	16
6	Further Information	20

1 Document Revision History

<i>Revision</i>	<i>Date</i>	<i>Description</i>
PA1	2010-10-25	First draft.
PA2	2010-10-27	Updated section 3.6.
A	2012-01-13	Added note about CE marking. Removed schematic from document.
B	2013-04-22	Updated 5.1 with note about requirement to power the board

2 Introduction

Thank you for buying Embedded Artists' *LPC1343 QuickStart Board* based on NXP's LPC1343 ARM Cortex-M3 microcontroller.

This document is a User's Guide that describes the *LPC1343 QuickStart Board* hardware design.

2.1 Features

Embedded Artists' *LPC1343 QuickStart Board* with NXP's LPC1343 microcontroller lets you get up-and-running quickly. The small sized board offers many features that ease your learning curve and speed up your program development. The features of the *LPC1343 QuickStart Board* are:

- NXP's LPC1343 ARM Cortex-M3 microcontroller in 33-pin HVQFN package, with 8 KByte internal SRAM and 32 Kbyte internal FLASH.
- 12.0000 MHz crystal for maximum execution speed and standard serial bit rates, including USB requirements. The LPC1343 runs at frequencies up to 72 MHz.
- 32 Kbit I2C E2PROM for storing non-volatile parameters
- On-board USB Device interface
 - Mini-B USB connector on-board
 - USB connect circuit with LED signaling
 - Proper ESD protection
- All LPC1343 pins available on expansion connector (dual 15 pos, 100 mil/2.54 mm pitch rows, 700 mil/17.78 mm apart).
 - Expansion connectors has DIP30 structure, suitable for breadboard prototyping
- Flexible powering, with on-board 150mA 3.3V voltage regulator
 - Can be powered from USB connector or an external +5V supply
- Onboard reset generation
 - Reset push button
- Push button for enabling Bootloader mode of the LPC1343
- LED on pin PIO0_7
- SWD/JTAG connector
 - 2x5 pos, 50 mil/1.27 mm pitch, standard SWD/JTAG connector
- Compact size: 22 x 40 mm (22 x 41 mm incl. USB connector)
 - Four layer PCB design for best noise immunity

2.2 ESD and Handling Precaution

Please note that the *LPC1343 QuickStart Board* come without any case/box and all components are exposed for finger touches – and therefore extra attention must be paid to ESD (Electro-Static Discharge) precaution.

Make it a habit to always first touch the metal surface of the USB connectors for a few seconds with both hands before touching any other parts of the boards. That way, you will have the same electrical potential as the board and therefore minimize the risk for ESD damages.



In general, touch as little as possible directly on the *LPC1343 QuickStart Board*. The push buttons on the *LPC1343 QuickStart Board* have grounded shield to minimize the effect of ESD.

Note that Embedded Artists does not replace boards that have been damaged by ESD.

2.3 General Handling Care

Handle the *LPC1343 QuickStart Board* with care. The board is not mounted in a protective case/box and is not designed for rough physical handling. The USB connector can wear out after excessive use. The board is mainly designed for evaluation and prototyping use.

2.4 Code Read Protection

The LPC1343 has a Code Read Protection function (specifically CRP3, see LPC1343 datasheet/user's manual for details) that, if enabled, will make the LPC1343 impossible to reprogram (unless the user program has implemented such functionality).

Note that Embedded Artists does not replace boards where the LPC1343 has CRP3 enabled. It's the user's responsibility to not invoke this mode by accident.

2.5 CE Assessment

The *LPC1343 QuickStart Board* is CE marked. See separate *CE Declaration of Conformity* document.

The *LPC1343 QuickStart Board* is a class B product.

EMC emission test has been performed on the *LPC1343 QuickStart Board*. The USB interface has been in use and also powered the device during the test. General expansion connectors where internal signals are made available have been left unconnected. Connecting other devices to the product via the general expansion connectors may alter EMC emission. It is the user's responsibility to make sure EMC emission limits are not exceeded when connecting other devices to the general expansion connectors of the *LPC1343 QuickStart Board*.

Due to the nature of the *LPC1343 QuickStart Board* – an evaluation board not for integration into an end-product – fast transient immunity tests and conducted radio-frequency immunity tests have not been executed. Externally connected cables are assumed to be less than 3 meters. The general expansion connectors where internal signals are made available do not have any other ESD protection than from the chip themselves. Observe ESD precaution.

Note that the *LPC1343 QuickStart Board* can also be considered to be a component if integrated into another product. The CE mark on the *LPC1343 QuickStart Board* cannot be extended to include the new (user created) product. It is the user's responsibility to make sure EMC emission limits are not exceeded and CE mark the final product.

2.6 Other Products from Embedded Artists

Embedded Artists have a broad range of LPC1000/2000/3000/4000 based boards that are very low cost and developed for prototyping / development as well as for OEM applications. Modifications for OEM applications can be done easily, even for modest production volumes. Contact Embedded Artists for further information about design and production services.

2.6.1 Design and Production Services

Embedded Artists provide design services for custom designs, either completely new or modification to existing boards. Specific peripherals and I/O can be added easily to different designs, for example, communication interfaces, specific analog or digital I/O, and power supplies. Embedded Artists has a broad, and long, experience in designing industrial electronics in general and with NXP's LPC1000/2000/3000/4000 microcontroller families in specific. Our competence also includes wireless and wired communication for embedded systems. For example IEEE802.11b/g (WLAN), Bluetooth™, ZigBee™, ISM RF, Ethernet, CAN, RS485, and Fieldbuses.

2.6.2 OEM / Education / QuickStart Boards and Kits

Visit Embedded Artists' home page, www.EmbeddedArtists.com, for information about other *OEM / Education / QuickStart* boards / kits or contact your local distributor.

3 Schematic

This chapter contains detailed information about the electrical and mechanical design of the *LPC1343 QuickStart Board*. The schematic can be downloaded in pdf format from the support page, and is recommended to have printed out while reading this chapter.

3.1 Powering

The board is powered either via the USB interface or from an external +5V supply. U2 is an on-board voltage regulator capable of creating a +3.3V voltage for the LPC1343. It can deliver up to 150 mA. The LPC1343 itself does not consume that much so there is at least 100mA available for external circuit use.

If an external +5V supply is used, it shall be stable with less than 50mV noise. Input supply voltage should not exceed +5.5V since this is the maximum allowed voltage on the LPC1343 VBUS pin. Technically it is possible to have higher voltage on the external supply since the VBUS pin is connected via a 2Kohm resistor. The input protection diodes on the VBUS pin will clamp the voltage to +5.5V. Under no circumstances should the input voltage exceed 16V, which is the maximum input voltage for the voltage regulator, U2. See the datasheet for details.

3.2 LPC1343 MCU

The microcontroller unit (MCU), U1, is the LPC1343 from NXP. It contains a Cortex-M3 core that can operate at frequencies up to 72 MHz. Internal PLL:s can create the core clock of 72 MHz from the external 12.0000 MHz crystal. A USB clock reference of 48 MHz can also be created this way.

The LPC1343 contains a lot of different peripheral units. See the *LPC1343 User's Manual* [2] for details about the peripherals, clock and power control.

3.3 Reset Generation

The reset generation is handled by a voltage supervisor chip, MIC6315-29D3U from Micrel. The reset signal will be held active (i.e., low) until the supply voltages, +3.3V, is within margins (above 2.93V). The reset duration is typically 200 mS (consult the MIC6315-29D3U datasheet for exact details). The output reset signal is open-drain so a pull-up resistor is needed (R15). There is a reset-LED that lights when reset is active.

An external reset source can pull the reset signal low (with an open-collector/open-drain output).

There is also a reset push-button (SW1) for manual triggering of a reset pulse.

3.4 LED on PIO0_7

Further, there is a LED connected to pin PIO0_7. A 2Kohm resistor limits the diode current to about 0.9mA. The LED will light when PIO0_7 is high. The PIO0_7 pin is a high-drive output capable of supplying up to 20 mA. See the datasheet for details.

3.5 USB Interface

The LPC1343 has an on-chip USB Device interface. This interface is supported on-board via a mini-B USB connector, J3. There is also a USB connect functionality to connect a 1.5Kohm resistor to the USB-DP signal. This functionality also has LED indication. The board is typically powered via the USB interface.

The USB interface is protected by ESD protection diode, D1.

Note that if USB-ISP mode is activated, it is possible to download firmware into the LPC1343 via the USB interface.

3.6 Bootload Enable Push-button

The LPC1343 samples the state of the PIO0_1 pin immediately after a reset. If the pin is low, the ISP mode is activated and further the pin PIO0_3 is sampled. If high, USB-ISP mode is activated and if low, UART-ISP mode is activated. Read the *LPC1343 User's Manual* [2] for details.

The bootloader push-button, SW2, will pull pin PIO0_1 low via a 2Kohm resistor. The resistor minimizes the risk of damaging the PIO0_1 pin if it is operating as an output. Also, possible external drivers of the pin are protected via the 2Kohm resistor. Note that if an external source drives the signal strong, the 2Kohm resistor will not be enough to pull Pin PIO0_1 low.

To summarize the following pin states after reset are affecting the ISP mode:

PIO0_1	PIO0_3	Mode after reset
1	N/A	Execute code from flash memory
0	0	Enter UART-ISP mode
0	1	Enter USB-ISP mode

3.7 I²C-E²PROM

There is a 32 kbit E²PROM accessible via the I²C interface. This interface should always be enabled on the LPC1343 since the on-board I²C-E²PROM is connected to the LPC1343. More peripheral units are easily connected to the two-wire I²C bus, just as long as the addresses do not collide. The address of the 32kbit E²PROM is 1.0.1.0.0.0.rw (in binary representation), which is also indicated in the schematic. The lowest rw bit determines if an access is a read or write access to the chip.

There are two on-board 2Kohm pull-up resistors (pull-ups are always needed on I²C busses).

3.8 SWD interface

There is a 10 pos (2x5 pos, 50 mil pitch) connector SWD interface for debugging and program download. This is a standard connector for the ARM Cortex-M3 processor.

3.9 Expansion Connectors

There are two expansion connectors, J1 and J2. They both have 15 positions and are placed at the board edges. See *Figure 2* on page 13 for details about J1 and J2 placement on the board. All programmable pins of the LPC1343 are available on the expansion connectors; see the table below for details.

On-board function	LPC1343 pin	Exp. conn.	DIL30 pin no
	GND	J1-1	1
	VBUS-5V	J1-2	2
LED	PIO0_7	J1-3	3
	PIO0_8	J1-4	4
	PIO0_9	J1-5	5
SWCLK	PIO0_10	J1-6	6
	PIO1_10	J1-7	7
	PIO0_11	J1-8	8
	PIO1_0	J1-9	9
	PIO1_1	J1-10	10
	PIO1_2	J1-11	11
SWDIO	PIO1_3	J1-12	12
	PIO1_4	J1-13	13
	PIO1_11	J1-14	14
	PIO3_2	J1-15	15

DIL30 pin no	Exp. conn.	LPC1343 pin	On-board function
30	J2-1	GND	
29	J2-2	+3.3V	
28	J2-3	PIO0_6	USB conn.
27	J2-4	PIO1_9	
26	J2-5	PIO0_5	I2C-SDA
25	J2-6	PIO0_4	I2C-SCL
24	J2-7	PIO0_3	USB VBUS
23	J2-8	PIO0_2	
22	J2-9	PIO1_8	
21	J2-10	PIO0_0	RESET inp.
20	J2-11	PIO2_0	
19	J2-12	PIO0_1	
18	J2-13	PIO1_7	
17	J2-14	PIO1_6	
16	J2-15	PIO1_5	

The picture below shows how the *LPC1343 QuickStart Board* looks on the bottom side. The pinning of the expansion connectors is printed on the bottom side in order to simplify usage of the board.

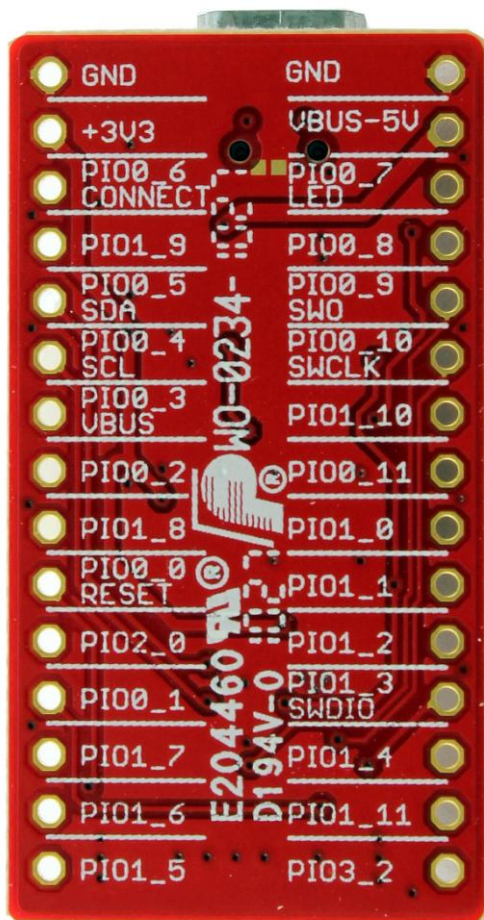


Figure 1 – LPC1343 QuickStart Board Bottom Side

3.10 Usage of MCU Pins

All pins of the LPC1343 are directly available on the expansion connectors. Some of these pins have connections to circuits on-board. The table below lists all pins and what to consider when using them.

<i>Pin</i>	<i>Expansion connector</i>	<i>On-board usage</i>
PIO0_0	J2-10	This is the reset input, which is active low. On-board reset generator drives this signal (open-drain).
PIO0_1	J2-12	The BL (Bootloader) pushbutton is connected to this pin via a 2Kohm resistor. The pin can be used for other purpose.
PIO0_2	J2-8	No on-board connection. Routed directly to expansion connector.
PIO0_3	J2-7	Connected to VBUS of the mini-B USB connector. If USB is not used this pin can be used for other purpose.
PIO0_4	J2-6	This is the I2C-SCL signal. This is connected to the on-board I2C-E2PROM. This pin must have I2C-SCL functionality.
PIO0_5	J2-5	This is the I2C-SDA signal. This is connected to the on-board I2C-

		E2PROM. This pin must have I2C-SDA functionality.
PIO0_6	J2-3	Connected to control USB Device connect functionality (attaching a 1.5Kohm resistor to DUB-DP signal). Is USB is not used this pin can be used for other purpose. The pin is also connected to a LED (active low).
PIO0_7	J1-3	Is connected to a LED (active high) via a 2Kohm resistor. Pin can be used for any purpose as long as the LED circuit does not affect.
PIO0_8	J1-4	No on-board connection. Routed directly to expansion connector.
PIO0_9	J1-5	Connected to on-board SWD connector. Normally not used so pin can be used for other purpose.
PIO0_10	J1-6	Connected to on-board SWD connector. This is the SWCLK signal which is normally used during debugging over SWD.
PIO0_11	J1-8	No on-board connection. Routed directly to expansion connector.
PIO1_0	J1-9	No on-board connection. Routed directly to expansion connector.
PIO1_1	J1-10	No on-board connection. Routed directly to expansion connector.
PIO1_2	J1-11	No on-board connection. Routed directly to expansion connector.
PIO1_3	J1-12	Connected to on-board SWD connector. This is the SWDIO signal which is normally used during debugging over SWD.
PIO1_4	J1-13	No on-board connection. Routed directly to expansion connector.
PIO1_5	J2-15	No on-board connection. Routed directly to expansion connector.
PIO1_6	J2-14	No on-board connection. Routed directly to expansion connector.
PIO1_7	J2-13	No on-board connection. Routed directly to expansion connector.
PIO1_8	J2-9	No on-board connection. Routed directly to expansion connector.
PIO1_9	J2-4	No on-board connection. Routed directly to expansion connector.
PIO1_10	J1-7	No on-board connection. Routed directly to expansion connector.
PIO1_11	J1-14	No on-board connection. Routed directly to expansion connector.
PIO2_0	J2-11	No on-board connection. Routed directly to expansion connector.
PIO3_2	J1-15	No on-board connection. Routed directly to expansion connector.
USB pins USB-DP/ USB-DM	Mini-B USB connector	Connected directly to on-board mini-B USB connector. Signals only available on on-board mini-B USB connector because of strict requirements on routing impedance.

4 Physical Design

This chapter contains information about the physical design of the *LPC1343 QuickStart Board*.

4.1 Main Components

Figure 2 below illustrates where the main components in the design can be found on the board.

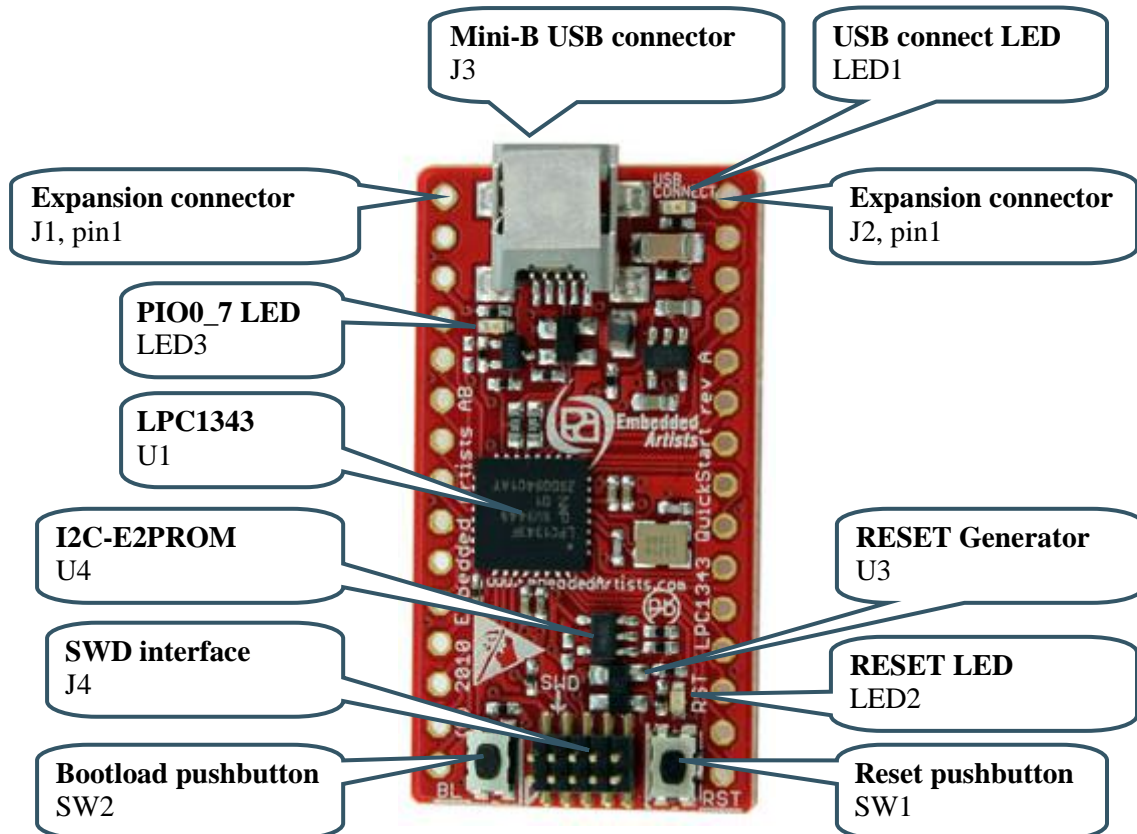


Figure 2 – Main Components on LPC1343 QuickStart Board

4.2 Mechanical Dimensions

Figure 3 below contains a picture of the board that includes mechanical measures. The distance between the two expansion connectors is 700 mil, which simplifies prototyping work with the board.

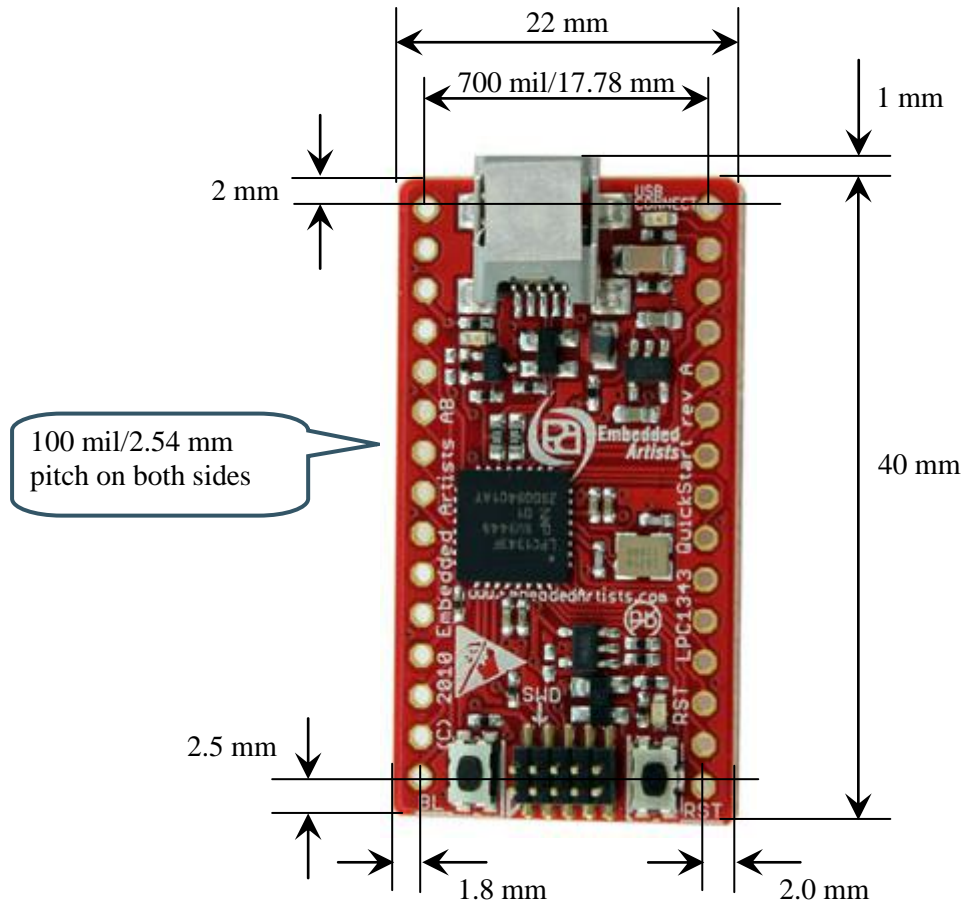


Figure 3 – LPC1343 QuickStart Board Mechanical Dimensions

5 Getting Started

The chapter gives some pointer about how to get started with the *LPC1343 QuickStart Board* hardware. It does not describe how program development is done. For information about how to get started with program development in general, see the LPCXpresso IDE documentation: www.nxp.com/lpcxpresso. LPCXpresso is a concept from NXP, containing both a program development environment (LPCXpresso IDE) and target boards (jointly developed by Embedded Artists). The target boards also contain a SWD/JTAG interface, called the LPC-LINK. The LPCXpresso IDE is free and well-supported on the LPCXpresso forum. It is recommended to use for program development on the *LPC1343 QuickStart Board*.

Sample applications for the *LPC1343 QuickStart Board* can be downloaded from the Embedded Artists support site. These samples have been developed in the LPCXpresso IDE.

5.1 SWD Interface

The SWD interface is the recommended interface to use for program development, including debugging. Any SWD/JTAG debug interface that supports ARM Cortex-M3 processors will work. Figure 4 below shows how the LPC-LINK (part of a LPCXpresso target board) is connected to the SWD interface of the *LPC1343 QuickStart Board*. Note the orientation of the SWD cable in the LPC1343 end. Pin 1 of the SWD connector (J4) is at the board edge, see picture below. This is because the orientation of the SWD/JTAG connector on the LPC-LINK board.

Note: You also need to power the LPC1343 QuickStart Board by connecting a USB cable to the USB connector. The SWD interface does not power the board.

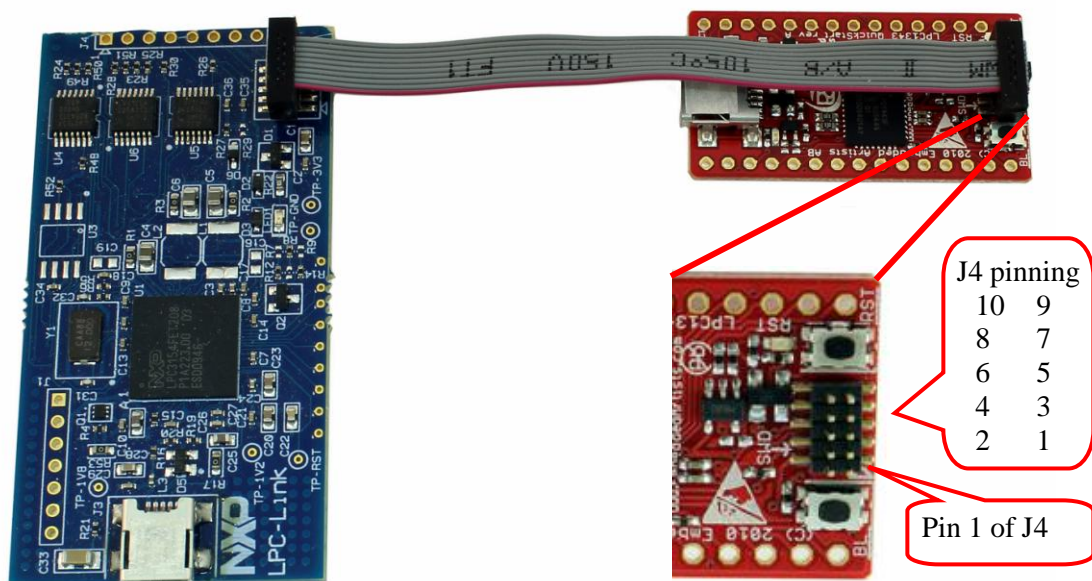


Figure 4 – LPC1343 QuickStart Board connected to LPC-LINK, via SWD

It is also possible to use the (physically) bigger 2x10 pos, 100 mil pitch ARM SWD/JTAG interface. Embedded Artists has an adapter for the purpose, see Figure 5 below. Note that the SWD/JTAG debug interface must support the SWD protocol in order to work.

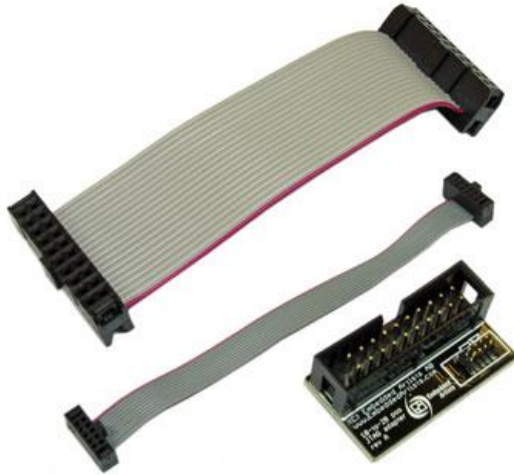


Figure 5 – SWD/JTAG Adapter

5.2 Activate LPC1343 ISP Mode

The LPC1343 supports In-System Programming (ISP) mode, which is easily activated. In this mode it is possible to download (and program into flash memory) new program images. The LPC1343 samples the state of the PIO0_1 pin immediately after a reset. If the pin is low, the ISP mode is activated. By pressing the bootstrap push-button, SW2, pin PIO0_1 is pulled low. ISP mode is activated this way:

1. Press both the bootstrap push-button (SW2) and the reset push-button (SW1). See *Figure 2* on page 13 for details about where to find the two push-buttons.
2. Release the reset push-button while keeping the bootstrap push-button pressed.
3. Then finally release the bootstrap push-button. The LPC1343 is now in ISP mode.

The sequence of steps can be done quickly. The minimum time between step 2 and 3 is in the region of 200mS (which is the reset pulse minimum time from U3 plus the time until the LPC1343 samples the PIO0_1 pin).

There are two different ISP modes. Which one gets activated depends on the PIO0_3 pin:

- USB-ISP mode is active if pin PIO0_3 is sampled high immediately after reset. Pin PIO0_3 is the USB-VBUS pin so this pin is high if the USB interface is connected to a USB Host (for example a PC).
- UART-ISP mode is active if pin PIO0_3 is sampled low immediately after reset. Note that this pin must be externally pulled to ground in order to activate this mode. The on-board resistor R6 (2Kohm) will always pull this pin high unless pulled low externally.

For more information about the ISP mode, read the *LPC1343 User's Manual* [2] from NXP.

5.2.1 USB-ISP Mode

USB-ISP mode is supported through enumeration as a Mass Storage Class Device, i.e., it is possible to drag and drop a binary file to the drive associated with the LPC1343.

This section describes how you generate the binary file, adds the necessary checksum to the binary file and downloads the file to the *LPC1343 QuickStart Board*.

The steps necessary to download an image (i.e., the application program) are described below:

1. Build the application in the LPCXpresso IDE.

2. Right-click on the generated axf file, go to the Binary Utilities menu and select Create binary. See *Figure 6*.
3. Open a command prompt in the directory containing the axf file. This can be done from the Utilities menu, see *Figure 7*.
4. Update the binary file with a correct checksum. In the example below it is assumed that you are using LPCXpresso IDE 3.2 installed in C:\nxp\lpcxpresso_3.2. It is also assumed that you are using a LPC1343 and the binary file is named demo.bin.

```
C:\nxp\lpcxpresso_3.2\bin\checksum.exe -p lpc1343 -v demo.bin
```

5. A USB cable (mini-B to A) must be connected between a computer (i.e., PC) and the USB interface (J3 on the *LPC1343 QuickStart Board*).
6. Press down the bootload push-button (SW2) and then press and release the reset push-button (SW1) on the *LPC1343 QuickStart Board*. A storage device named CRP DISABLD will now appear on your computer, see *Figure 8*.
7. Open the Mass storage device and there will be a file named firmware.bin. Delete this file and then copy the file created in step 4 above to the CRP DISABLD drive.
8. Reset the board (SW1 push-button) and the (just downloaded) application will start executing.

For details, see *LPC1343 User's Manual* [2] from NXP as well as *AN10986* [4] (application note from NXP).

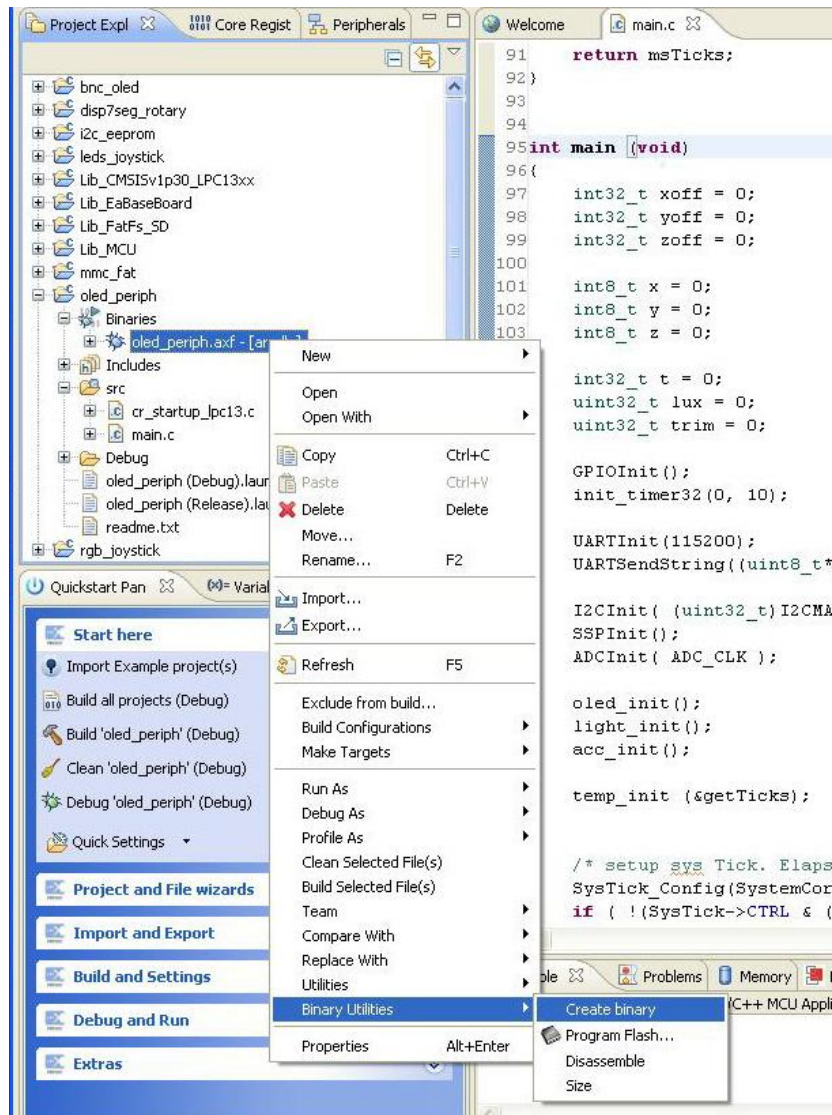


Figure 6 – LPCXpresso IDE Create a Binary File

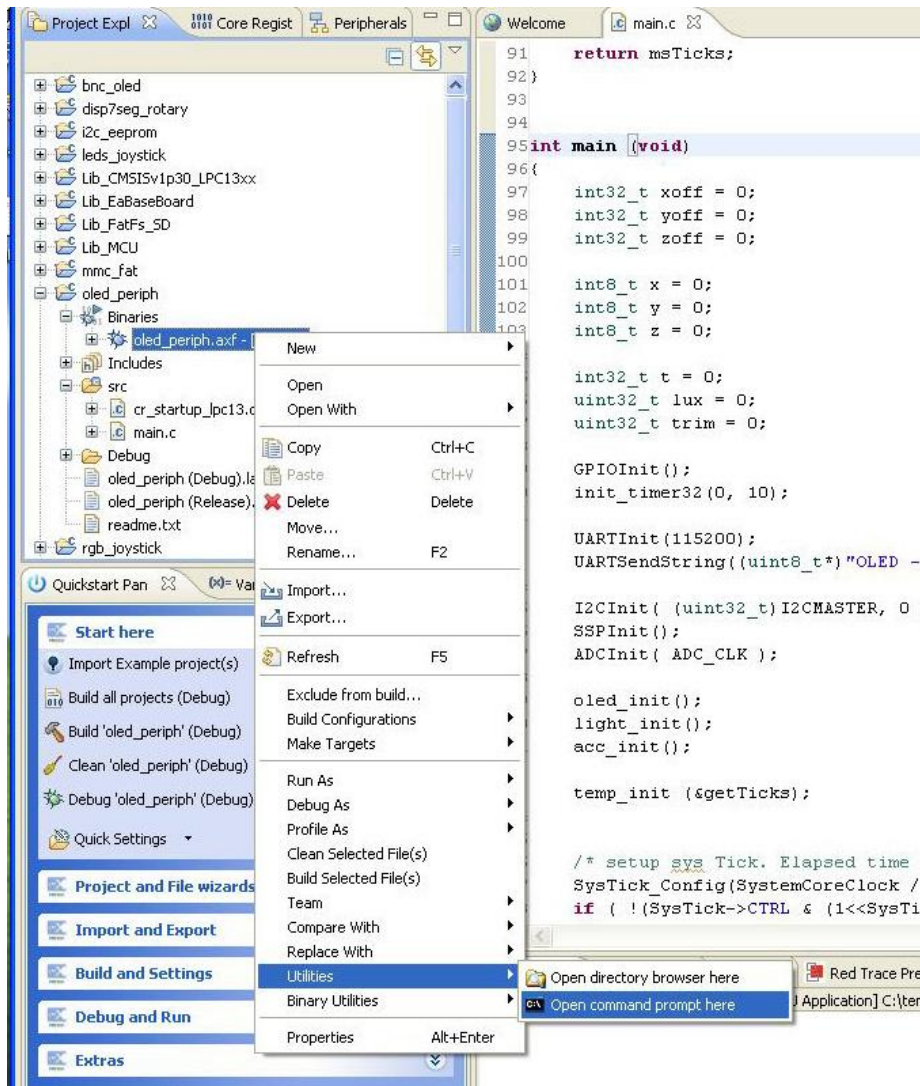


Figure 7 – LPCXpresso IDE Open Command Prompt

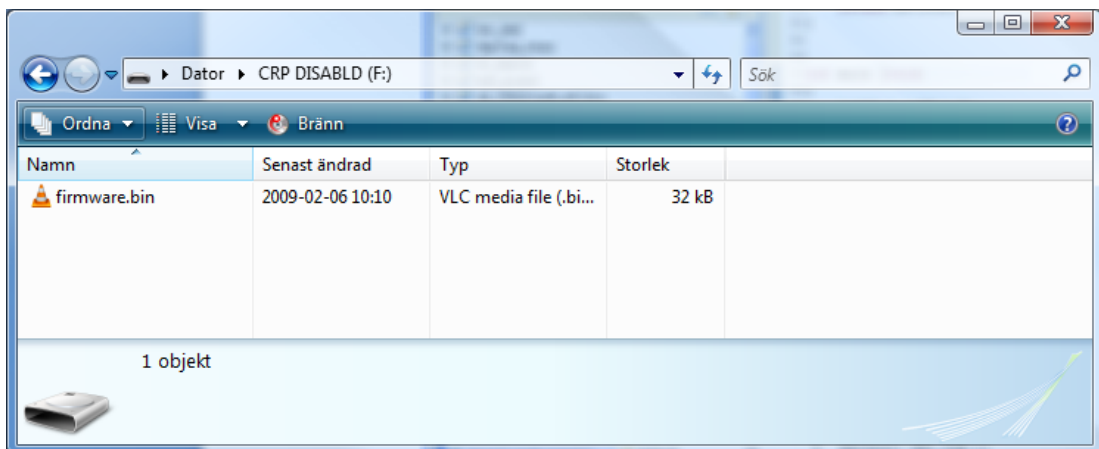


Figure 8 – Mass Storage Device

6 Further Information

The LPC1343 microcontroller is a complex circuit and there are a number of other documents with more information. The following documents are recommended as a complement to this document.

- [1] NXP LPC1343 Datasheet
<http://ics.nxp.com/products/lpc1000/datasheet/lpc1311.lpc1313.lpc1342.lpc1343.pdf>
- [2] NXP LPC1343 User's Manual
<http://ics.nxp.com/support/documents/microcontrollers/pdf/user.manual.lpc13xx.pdf>
- [3] NXP LPC1343 Errata
<http://ics.nxp.com/support/documents/microcontrollers/pdf/errata.lpc1343.pdf>
- [4] AN10986 USB In-System Programming with the LPC1300, with software
<http://ics.nxp.com/support/documents/microcontrollers/zip/an10986.zip>
- [5] ARM Processor Documentation
Documentation from ARM can be found at: <http://infocenter.arm.com/>.
- [6] Information on different ARM Architectures
<http://www.arm.com/products/processors/technologies/instruction-set-architectures.php>
- [7] ARMv7-M Architecture Reference Manual. Document identity: DDI 0403D
<http://infocenter.arm.com/help/index.jsp?topic=/com.arm.doc.ddi0403c/index.html>
- [8] Cortex-M3 Technical Reference Manual. Revision: r2p1
<http://infocenter.arm.com/help/index.jsp?topic=/com.arm.doc.ddi0337i/index.html>
- [9] LPCXpresso IDE: NXP's low-cost development platform for LPC families, which is an Eclipse-based IDE.
<http://ics.nxp.com/lpcxpresso/>
- [10] LPC1000 Yahoo Group. A discussion forum dedicated entirely to the NXP LPC1xxx series of microcontrollers.
<http://tech.groups.yahoo.com/group/lpc1000/>
- [11] LPC2000 Yahoo Group. A discussion forum dedicated entirely to the NXP LPC2xxx series of microcontrollers. This group might be more active than the LPC1000 group.
<http://tech.groups.yahoo.com/group/lpc2000/>

Note that there can be newer versions of the documents than the ones linked to here. Always check for the latest information/version.