

## LPCXpresso

# An Introduction to NXP's Tool Suite for the LPC Microcontroller Family

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**L**PCXpresso is the name of a low cost development platform for the ARM-based LPC family of microcontrollers from NXP. The platform supports the ARM-based LPC microcontrollers and includes a simplified Eclipse-based IDE and a low-cost target board combined with a JTAG debug Probe. LPCXpresso provides all of the software and hardware required to evaluate NXP microcontrollers and develop complete applications using the user's own production hardware.

The LPCXpresso IDE is a customized version of Eclipse CDT (C development tools) based on the Galileo release. On the surface saying that LPCXpresso is Eclipse may seem like an irrelevant point, but has many positive attributes that will improve developers' efficiency and brings an extensible common platform to the embedded world.

Eclipse came out of IBM as part of a project to reduce the large number of different development tools their internal teams and customers were using. This was an important objective because it would reduce the amount of time other teams needed to relearn different aspects of an IDE as well as bring all the great ideas each had into one common platform. In addition, Eclipse was designed as an integration platform which meant that plug-ins can be used to extend the capabilities of the IDE. As an example, if one group had a great lint tool or reuse checker it could be deployed easily to customers and internal groups that were using this open platform. This would also make it easier for third party tool companies to integrate their software into the IDE.

In 2001 Eclipse was announced as an open source project and is now freely available at Eclipse.org. It is now widely used by Java and Web developers and has a rich third party plug-in ecosystem as well.

Eclipse is an ideal candidate for an embedded environment for all the reasons that started the development in the first place. With an Eclipse IDE all tool vendors IDE's would be consistent, developers from different fields would find the embedded environment familiar. Third party plug-ins could be developed and used across tool vendor IDE's. Three to four years ago embedded developers

interested in low cost tools started to use Eclipse along with GNU tools to cobble together a fairly competent tool chain. The only problem was that this required time and expertise to put the pieces together. Now there are several companies that have done the integration work and are providing additional functions that make the Eclipse platform a complete IDE for embedded development.

### LPCXpresso IDE

One of these companies is CodeRed Technologies. NXP engaged with CodeRed to provide the LPCXpresso IDE. The intent behind LPCXpresso was to provide a simple and easy to use interface for NXP's Cortex-M0 based microcontrollers, but this was extended to include most of the LPC ARM family. The IDE can build an executable of any size and has a download limit of 128K bytes that will cover all parts based on Cortex-M0.

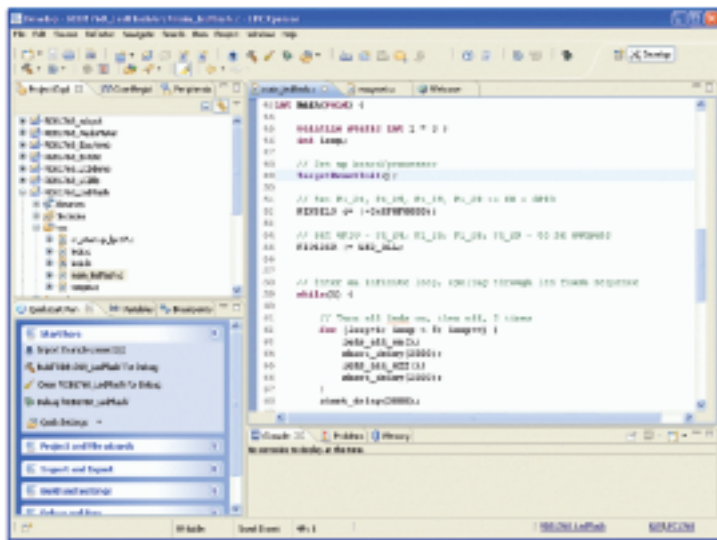


Figure 1: LPCXpresso IDE

Because the LPCXpresso IDE is Eclipse it includes all of the advanced programming environment features of Eclipse such as syntax highlighting, code folding, and click-through links to definitions and

declarations. Eclipse uses the word perspective to describe a collection of windows called views. LPCXpresso uses only one perspective, where the collection of views changes when going from editing to debugging. The single perspective greatly simplifies the Eclipse environment and enhances the entire LPCXpresso experience. In addition, LPCXpresso includes a view that has a quickstart panel that contains wizards that create projects, import example projects, and invoke commonly used commands. In debug mode LPCXpresso shows fully annotated and interactive views of the core registers and of all the peripheral registers.

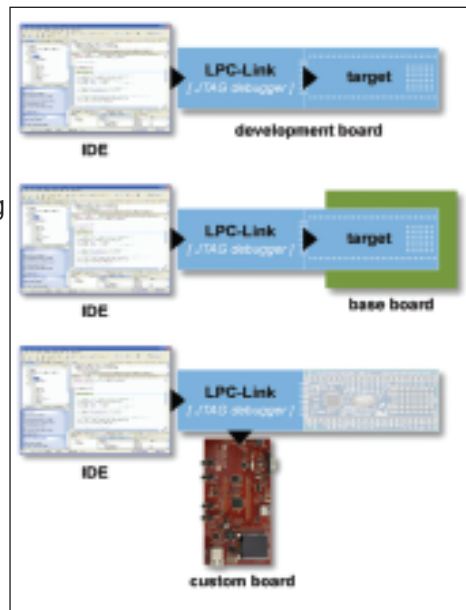
LPCXpresso is a fully integrated IDE and features the latest version of the industry standard GNU tool chain with a proprietary optimized C library for the Cortex-M0™ and Cortex-M3™, including revision control and the software components required to communicate with the debug hardware via High Speed USB. These components are all included in the installation of LPCXpresso. The following is a summary of the key features of the LPCXpresso IDE.

- Simplified Eclipse-based Integrated Development Environment
- Device-specific support for a range of NXP LPC family microcontrollers including:
  - NXP LPC1100 (Cortex-M0)
  - NXP LPC1300 (Cortex-M3)
  - NXP LPC1700 (Cortex-M3)
- Selected members of the NXP LPC2000 (ARM7TDMI) and NXP LPC3100 (ARM926-EJ) families
- Wizards to quickly create microcontroller programming frameworks
- Peripherals views of all supported microcontrollers
- Support for LPC-Link and Red Probe debug emulators
- No-fuss, single install for complete product
- Available for Windows XP, Windows Vista, and Windows 7
- Discounted upgrades to full Red Suite

### LPCXpresso Hardware

The LPCXpresso board was jointly

developed by Embedded Artists, Code Red, and NXP. The board consists of two sides, the debug hardware side called LPC-Link and the target side. The LPCXpresso hardware was designed to be inexpensive. This meant minimizing component and board cost. The only connectors on the boards are the mini USB for debug and the JTAG header, and the board was routed using only 2 layers. Functionality can be expanded through baseboards and breadboards. There are currently two versions of the LPCXpresso board—one with the LPC1300 on the target side and the other with an LPC1100 on the target side.



More versions are planned to support new LPC1100 and LPC1300 derivatives as well as the LPC1700 family.

**LPC-Link** The LPC-Link is powered by the LPC3154. The LPC3154 is a very inexpensive high speed USB ARM9 device that has 192KB of internal ram and 16KB of I and D cache. In addition, the part has an integrated PMU (Power Management Unit) that takes the USB voltage and supplies all the internal voltages as well as providing 3 volts to the target. Using the LPC3154 minimized the number of components required for the JTAG interface. The PMU in the LPC3154 has both linear LDO's and buck switching regulators. The linear regulators were meant for operation from the USB supply and the switching regulators from an optional battery supply.

Because of the amount of internal RAM in the LPC3154 and the fact that it supports DFU class from ROM means no flash or other external components are required for program storage. The required LPC-Link software is downloaded from the IDE to the LPC-Link when the LPC-Link is first plugged into the USB port.

The LPC-Link is flexible, with two ways to use it. The part is shipped with the JTAG interface connected to the target side of the board via traces between 0.1 inch spaced holes. If the target side is no longer needed, the traces can be cut and the LPC-Link can be used to debug the user's development or production board as a standalone JTAG debugger. The LPC-Link has the standard ARM 10-pin header and is pinned out according to the ARM pin definition and supports JTAG and serial wire interfaces. The LPCXpresso platform can be connected to an external target and used to develop for a wide variety of NXP's Cortex-M0, Cortex-M3, and ARM7/9 based applications. If the target side needed to be reconnected, the user can install 0.1 inch pin headers and reconnect with header jumpers.

### LPC-Link features

- High speed USB to JTAG environment
- No obsolete debug software. Always loaded during a debug session.
- Easy connection
- LPC-Link can be fully utilized for final product development



### LPCXpresso Target

The target side of LPCXpresso is simple. It contains the target processor a LED connected to one of the target processor port pin, a crystal, two rows of 0.1 inch holes 0.9 inches apart and a small grid of 0.1 inch holes. However, there are many expansion options. For USB targets the only thing missing is the connector and the D+ resistor. The D+ and D- signals are brought out to the 0.1 inch holes. To add USB, take a USB cable, cut off the device end, and solder the green and white wires to the correct holes and a 1.5k

ohms resistor to VDD. The 0.1 inch holes on the side are pin out compatible with mbed. Any mbed baseboards can be used with LPCXpresso. Embedded Artist produces an mbed/LPCXpresso baseboard that enables most features of the target processor. In addition, any 0.1 inch spaced breadboards can also be used to expand the capabilities of LPCXpresso.

### Embedded Artist Baseboard features

#### Common features

- Socket for LPCXpresso and mbed module
- 50-pin expansion dual row pin list connector (male, 100 mil pitch) for simple connection external designs and to a logic analyzer
- 50-pin expansion dual row header connector (female, 100 mil pitch) for simple connection to breadboard
- Battery powering (small coin battery)
- USB interface
- Reset pushbutton

#### Digital IO

- RGB-LED (can be PWM controlled)
- 5-key joystick switch
- 2 pushbuttons, one for activating bootloader
- Rotary switch with quadrature encoding (timer capture)
- Temperature sensor with PWM output (timer capture)

#### Analog IO

- Trimming potentiometer input (analog input)
- PWM to analog LP-filtering (PWM output and analog input)
- Speaker output (PWM output)
- Oscilloscope probe in/out stage

#### Serial bus - SPI

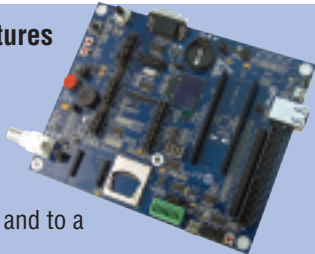
- Shift register driving 7-segment LED
- SD/MMC memory card interface
- Dataflash SPI-NOR flash

#### Serial bus - I<sup>2</sup>C

- PCA9532 port expander connected to 16 LEDs
- 8K-bit E2PROM
- MMA7455L accelerometer with I<sup>2</sup>C interface
- Light sensor

#### Serial bus - I<sup>2</sup>C/SPI shared

- SC16IS752 - I<sup>2</sup>C/SPI to 2xUART bridge; connected to RS232 full-modem interface and one expansion UART
- 96x64 pixel white OLED (alternative I<sup>2</sup>C/SPI interface)



#### Serial bus - UART

- USB-to-serial bridge, with automatic ISP activation
- RS422/485 interface
- Interface socket for XBee RF-module

#### Specific mbed module support

- CAN bus interface (can be simulated with LPCXpresso)
- Ethernet RJ45 connector with integrated magnetic

**Dimensions** 150 x 180 mm

**Power** Powered via USB (+5V)

### Summary

The LPCXpresso platform is a low-cost tool based on Eclipse. It gives entry level through to advanced power users an Eclipse development platform option where all of the required components are installed in one package. The latest version of the IDE is always available for download from the LPCXpresso website.

NXP created an exclusive LPCXpresso community forum, application resource page with up-to-date example projects, online training modules, tool wiki and support knowledgebase that enhance the online experience for the LPCXpresso platform. The Eclipse IDE has been enhanced with a simplified perspective and includes a built-in datasheet browser feature within the IDE. The platform is not just about software. LPCXpresso provides a low cost hardware JTAG interface through LPC-Link and includes both JTAG and a serial wire interface and is connected to the IDE through a high speed USB interface.

LPC-Link also works with customer designed targets, for prototypes and for production. In addition, LPCXpresso offers many expansion options. LPCXpresso fully supports the current LPC1100 and LPC1300 families and all planned LPC1700 derivatives up to 128 KB. Code Red supports low-cost upgrade options for 256 KB and 512 KB. The fully featured Red Suite package by Code Red will support run-time execution trace and OS wizards for fast FreeRTOS configuration; in addition, Red Probe provides even higher debug performance.

LPCXpresso is a great option for any developer looking for a low-cost Eclipse based platform to start using the LPC microcontrollers in their designs. The suggested retail price for LPCXpresso is \$29.95

**END**