

UM10974

LPC54114 Audio and Voice Recognition Kit

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User manual

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Contact information

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1. Introduction

The LPC54114 audio and voice recognition kit (“The Kit”) combines the LPC54114 MCU with an OLED display, digital microphone and audio CODEC in a two board set, complemented by a software framework optimized for always-on sensing applications. The hardware consists of an LPCXpresso54114 board and Shield Board (Mic/Audio/OLED or MAO Shield), developed by NXP for flexibility and ease of use. The Kit can be used with a wide range of development tools, including the LPCXpresso IDE, Keil uVision, and IAR EWARM of NXP.



Fig 1. LPC54114 Audio and Voice Recognition Kit

This document describes the LPC54114 Kit hardware. The following aspects of using the Kit are covered by this guide:

- Main board features.
- Setup for use with development tools.
- Downloading examples using the mass storage boot feature.
- Board jumper settings.

Detailed description of the LPCXpresso54114 board is not provided in this document, but can be found in the User Manual for that board (UM10973).

2. Feature summary

The Kit comprises an LPCXpresso54114 board and MAO shield. The LPCXpresso54114 board includes the following features:

- On-board, high-speed USB based, Link2 debug probe with ARM's CMSIS-DAP and SEGGER J-Link protocol options.
- Link2 probe can be used with on-board LPC54114 or external target.
- Support for external debug probes.
- Tri-color LED.
- Target Reset, ISP and WAKE buttons.
- Expansion options based on Arduino UNO and PMod™, plus additional expansion port pins.
- On-board 1.8/3.3 V or external power supply options.
- Built-in power consumption measurement, compatible with LPCXpresso V3 boards and LPCXpresso IDE.
- UART, I²C and SPI port bridging from LPC54114 target to USB via the on-board debug probe.
- 8Mb Macronix MX25R SPI flash.
- FTDI UART connector.

The MAO shield includes the following features:

- 128x128 pixel OLED display.
- Knowles SPH0641LM4H digital microphone.
- Cirrus Logic (Wolfson) WM8904.
- Built-in power measurement circuitry, compatible with LPCXpresso V3 boards and LPCXpresso IDE.

3. Getting Started

This section describes how to get started developing with The Kit. The out-of-box behavior of The Kit is described, along with the basic steps to start a debug session. The board comes pre-assembled (MAO shield board mounted on the LPCXpresso54114.)

3.1 Powering up and running the built-in demo

The internal flash memory of the LPC54114 in the Kit is pre-loaded with a demonstration voice-band sound detection application. Connect the supplied micro USB cable from connector J5 on the LPCXpresso54114 board to a USB power adaptor or host computer to run this application. After a short delay, the OLED display will show an NXP logo and the Kit name, and the board will respond to sound changes in the voice band by lighting the green channel of the tricolor LED (D2) in response to those changes.

3.2 Starting a debug session

By default, the LPCXpresso54114 in the Kit is configured to use the on-board debug probe (Link2) to debug the on-board target (LPC54114), using the CMSIS-DAP debug protocol pre-programmed into the Link2 Flash memory. The LPCXpresso IDE (available for free download at <http://www.nxp.com/lpcxpressoide>) or development tools that support the CMSIS-DAP protocol can be used in the default configuration. Check with your toolchain vendor for availability of specific device support packs for the LPC54110 family of devices.

Note that when using the LPCXpresso IDE, the on-board Link2 can also be booted in DFU mode by installing a jumper on JP5; if this is done then the IDE will download CMSIS-DAP to the probe as needed. Fitting JP5 is recommended when using the LPCXpresso IDE as this will ensure that the most up-to-date / compatible firmware image is used.

Installation steps for use with LPCXpresso IDE on a Windows 7/8/10 platform (booting Link2 in DFU mode):

1. Download and install the LPCXpresso IDE (version 8.1 or later).
2. Install JP5 to force the Link2 debug probe to boot in DFU mode (see notes above).
3. Connect the LPCXpresso54114 board to the USB port of your host computer, connecting a micro USB cable to connector J7 ("Link"). The board will boot the example described in Section 3.1.
4. Allow about 10 seconds for the LPCXpresso54114 devices to enumerate for the first time; the device will appear as "LPC Device".
5. Download the LPCOpen examples & drivers from <https://www.nxp.com/lpcopen> or <https://www.nxp.com/OM13090>, selecting the version for the toolchain you are using; project files for LPCXpresso IDE, Keil and IAR tools are available.
6. Start the LPCXpresso IDE and import the LPCOpen zip file by clicking Import project(s) in the "Start here panel."
7. The simplest example is periph_blinky, which will blink the tricolor LED (fast blinking of the red LED) on the LPCXpresso54114. Click on the periph_blinky in the "Project

Explorer” panel, then click Debug ‘periph_blinky’ in the “Start here” panel. This will build the project and then launch the debug session.

8. After detecting and booting the Link2, the IDE will prompt for selection of the processor core to debug – M4 or M0. Select the M4 target. Note that after this selection has been made once for a given project, the IDE will assume this as the default for that project.
9. The IDE will show a source code window and break at the function main(). Press F8 (or use the Resume icon) to run the program.

Installation steps for use with third party tools on a Windows 7/8/10 platform (Link2 configured for CMSIS-DAP):

1. Download and install LPCScrypt or the Windows drivers for LPCXpresso boards (<http://www.nxp.com/lpcutilities>). This will install required drivers for the board.
2. Ensure JP5 is open to force the Link2 debug probe to boot from internal flash.
3. Connect the LPCXpresso54114 board to the USB port of your host computer, connecting a micro USB cable to connector J7 (“Link”). The board will a simple LED blinky example using the tricolor LED, alternating between red and green.
4. Allow about 30 seconds for the LPCXpresso54114 devices to enumerate for the first time. It is not necessary to check the Hardware Manager, however if this is done there will be five devices; four under Human Interface Devices (CMSIS-DAP, LPC-SIO, two HID Compliant Devices, and a USB Input Device) and one under Ports (LPC-LinkII Ucom.)
5. Your board is now ready to use with your 3rd party tool. Follow the instructions for those tools for using a CMSIS-DAP probe.

3.3 Running other demo (binary) images

Demo firmware binary (.bin) images for The Kit from NXP and partners are available through the [nxp.com](http://www.nxp.com) website. These can be programmed into the board using either a flash programming utility, such as Flash Magic or LPCXpresso IDE’s Program Flash, or by using the LPCXpresso54114 mass storage boot capability. This section describes the mass storage boot method.

1. Connect micro USB connector J5 (Target USB) on The Kit to a host computer using the cable provided.
2. On the LPCXpresso54114 board hold down the ISP0 button, press and release the Reset button, then release the ISP0 button.
3. Open a File Explorer on the Host computer. A mass storage device called CRP_DISABLED should be visible; this is the LPC54114 MCU. If it does not appear, hold down ISP0 while disconnecting and reconnecting the board to the Computer, then release ISP0.
4. Navigate to the CRP_DISABLED device and delete the file “firmware.bin” that should be there.

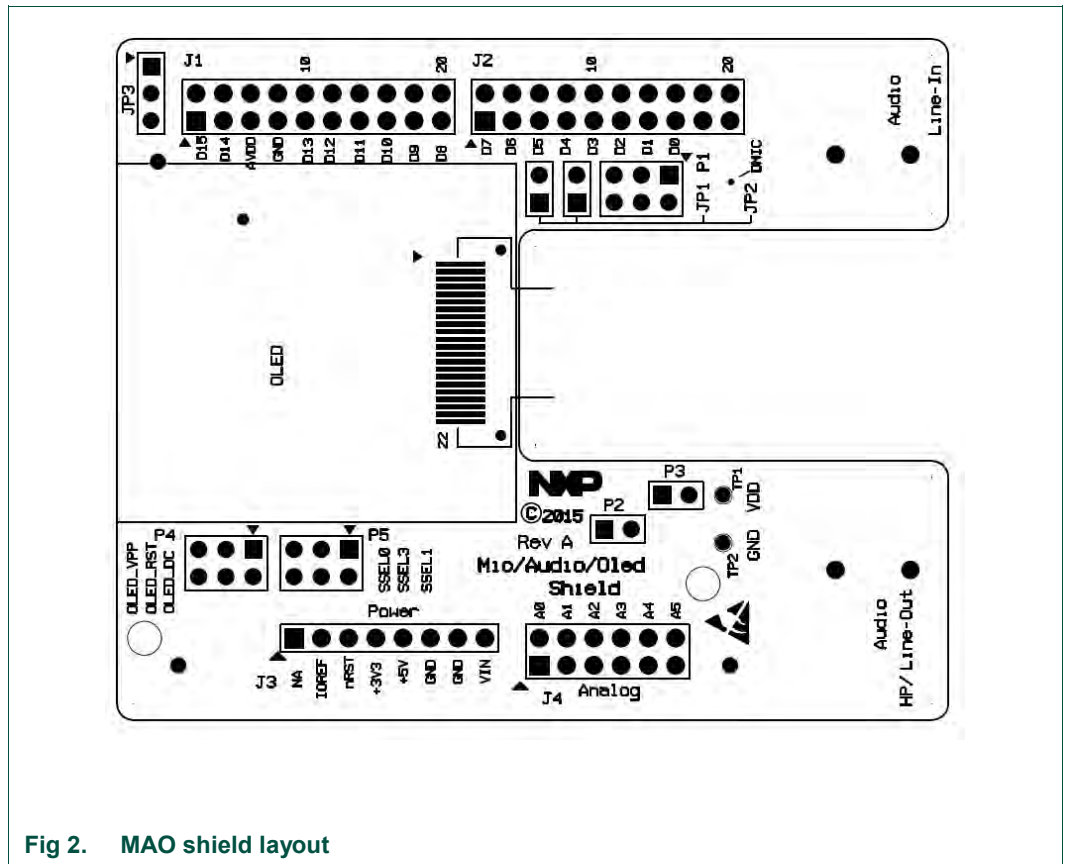
5. Drag and drop the demo binary file on to the CRP_DISABLED device. The binary file must be named firmware.bin.
6. Reset the board; the demo should now be running.

4. Board Configuration

The details of the LPCXpresso54114 board described in this manual are limited specific to those specific to this Kit; for a full description of the board’s features, see the LPCXpresso54102 User Manual (UM10973), available at <http://www.nxp.com/OM13090>. Also refer to the schematics for both boards, also available at this site.

4.1 MAO Shield layout, configuration and settings

Fig 2 shows the MAO Shield layout. Note that the majority of components are mounted on the underside of the board, with only jumpers and OLED display on the top side. Also note that the Knowles digital microphone is designed to be mounted on the underside of a board, with audio passing through a hole in the board.



4.2 Jumper settings

[Table 1](#) shows the jumpers on the MAO shield, describing their purpose and default settings.

Table 1. TMAO shield jumpers

| Reference | Description | Default | See section |
|----------------|--|---------|---|
| J1, J2, J3, J4 | Expansion connectors | n/a | Error! Reference source not found. |
| P1 | Digital microphone enable/disabled. These three jumpers should be fitted to use the on-board digital microphone, or remove if there is a conflict with other signals used on the expansion connectors. | Fitted | n/a |
| P2 | Current sense resistor bypass. Installing P2 shunts the 10Ω sense resistor in the current measurement circuit. | Open | 4.5 |
| P3 | Ammeter connection. An ammeter may be connected between the terminals of P3 to directly measure current drawn by the Shield. For P3 to be used in this manner, the 0Ω resistor on solder jumper JS1 must first be removed. | Open | 4.5 |
| P4 | OLED power connections. By removing the jumpers on P4 the 13V supply, reset and data/command lines can be disconnected to minimize power and leakage to the OLED display. This feature is provided for optimizing power consumption when the OLED is not required. | Fitted | 4.5 |
| P5 | OLED SPI chip select configuration. These jumpers are used to select the desired SPI select for the OLED display. See boards schematics for more information. | SSEL_0 | n/a |
| JP1, JP2 | Digital microphone connection for LPCXpresso54102. The MAO Shield may be used with LPCXpresso54102 boards. That type of LPCXpresso board connects to digital microphones at a different location on the expansion connectors; fit JP1 and JP2 to connect the digital microphone to those locations. Note that the LPC54102 does not have I2S interfaces so the audio codec cannot be used with that MCU. | Open | n/a |

4.3 Power supply configuration

The LPCXpresso54114 includes on-board regulators to supply 3.3 V or 1.8 V to the LPC54114, configured using JP9. The supply is configured to 3.3 V by default (position 2-3.)

The OLED display and audio codec have dedicated regulators, which supply them with the required operating voltages from the 5 V supply on the J3 expansion connector. Note that the OLED display will not operate with the board configured for 1.8 V operation since the VPP enable signal which enables the OLED regulator requires an enable signal of >2.5 V. This enable signal is located on pin 5 of expansion connector J2.

4.4 Expansion connector usage

The Kit utilizes the LPCXpresso54114 expansion connector to interface to the MAO Shield. Since the Arduino Uno Revision 3 standard does not provide enough signals to support all the functionality required for the Shield, the LPCXpresso54114 board has an extended version of that connection standard. The new expansion connector footprint has been designed for future expansion and provides more connections than are needed to support the LPC54114, so only a subset of the connectors are installed.

The MAO shield requires digital microphone clock and data, one SPI port and two I2S channels in order for all its features to be supported.

Other Arduino shields may be stacked below the MAO Shield, but care should be taken to ensure no conflicts exist with the signals used by the MAO Shield.

4.5 Supply current/power measurement

The LPCXpresso54114 has built-in power measurement circuitry, controlled by its on-board Link2 debug probe. This circuitry can measure power consumed by the LPC54114 by sampling the voltage dropped across a sense resistor on the board using a differential amplifier, sampled at up to 200 kHz by a 12-bit ADC. The power consumed by the MAO Shield can be measured as well, since the Shield has a similar differential amplifier/sense resistor circuit. An analog multiplexer is used to select between these measurement sources. To use the LPCXpresso IDE power measurement tools please refer to the documentation for that product.

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