

# LPC845 Capacitive Touch Kit User Manual

User Manual for LPC845 Development Kit

Rev. 1.0 — 27 November 2017

User Manual

## Document information

Info	Content
<b>Keywords</b>	LPC845, OM40004, LPC845, LPC844, UM11080
<b>Abstract</b>	LPC845 Capacitive Touch Kit User Manual



**Revision history**

Rev	Date	Description
1.0	20171115	First draft

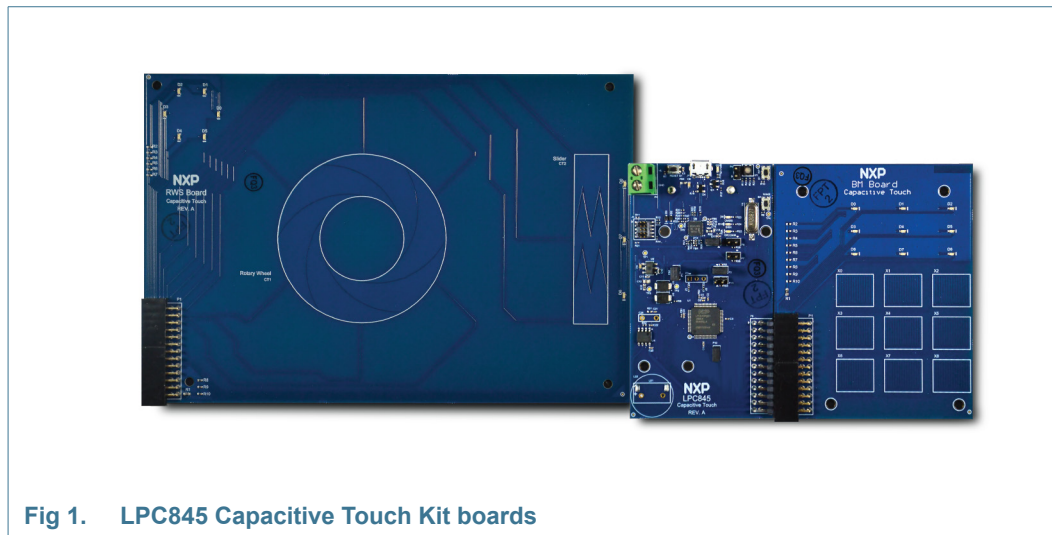
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## 1. Introduction

The LPC845 Capacitive Touch Kit enables easy evaluation of the capacitive touch features of the LPC84x family of devices. The Kit can be used with a range of development tools, including the MCUXpresso IDE, IAR EWARM and Keil MDK.



The LPC845 Capacitive Touch Kit board includes the following features:

- Compatible with MCUXpresso IDE and other popular toolchains (incl. IAR and Keil)
- On-board CMSIS-DAP (debug probe) with VCOM port, based on LPC11U35 MCU
- LPC845 Main Processor (MP) Board, compatible with LPCXpresso845MAX board (for common features), for easy code porting/sharing
- Rotary wheel and slider (RWS) sensor board
- 9 button matrix (BM) sensor board
- Debug connector to allow debug of target MCU using an external probe
- LEDs on sensor boards for each capacitive touch pad
- Target ISP and User/Wake buttons
- Target Reset button
- DAC output via speaker driver and speaker

## 2. Board Layout

[Figure 2](#) below shows the layout of the MP board, indicating location of jumpers, buttons, connectors/expansion options and MCU devices.

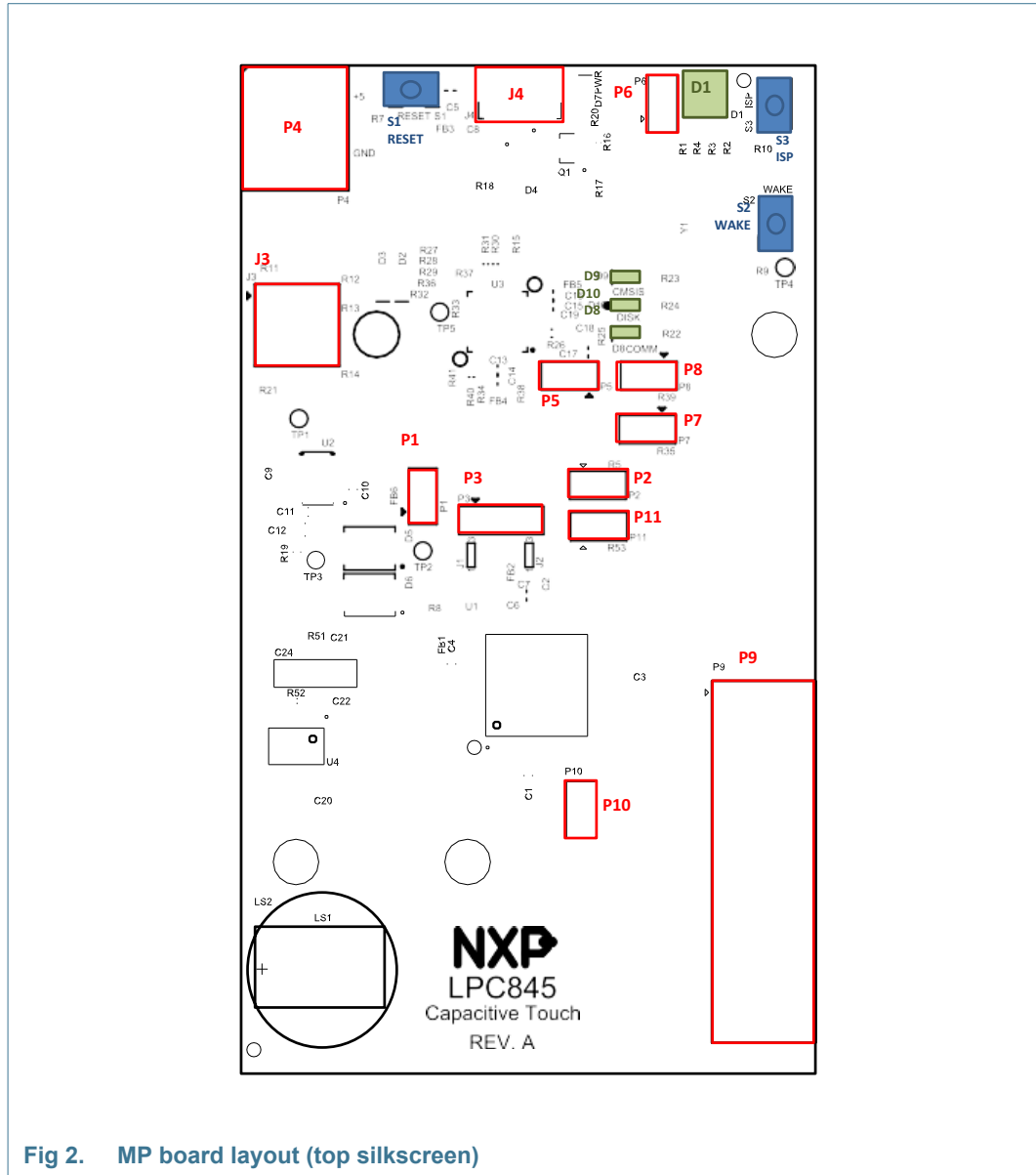


Fig 2. MP board layout (top silkscreen)

Table 1 below shows the layout of the MP board, indicating location of jumpers, buttons, connectors/expansion options and MCU devices.

Table 1. Jumpers and connectors

Circuit reference	Description	Reference section
J3	External SWD debug connector for LPC845	<a href="#">[4.1]</a>
J4	USB connector for debug probe / board power	<a href="#">[4]</a>
J5	External SWD debug connector for LPC11U35 (not installed, would be mounted on underside of PCB.)	<a href="#">[4]</a>
P1	P1 is not normally installed during production. After removing R6 (which is a zero ohm resistor in parallel with P1), the VDD supply to the LPC845 can be isolated from that to other devices on the board.	n/a

Table 1. Jumpers and connectors

Circuit reference	Description	Reference section
P2	Power measurement point. Connect a voltmeter across P2 to measure voltage drop across a 2.43 ohm resistor connected in-line with the supply to the LPC845 device.	<a href="#">[6]</a>
P4	External supply voltage connection. An external power supply may be used by connecting it to P4; pin 1 should be connected to pin 1 and ground to pin 2. A 5V nominal supply should be used.	n/a
P5	LPC11U35 Device Firmware Update (DFU) mode enable. Install P5 before powering up the board via USB in order to place the LPC11U35 in DFU mode (thus enabling software update via drag and drop programming on a host computer.)	<a href="#">[3.1]</a>
P6	Inserting a jumper on JP1 holds the LPC11U35 debug probe in reset. Install JP1 when using an external debug probe.	<a href="#">[4.1]</a>
P7	Once R35 has been removed, P7 can be used to connect/disconnect the LPC845 UART TX from the LPC11U35 debug probe (VCOMM connection).	n/a
P8	Once R39 has been removed, P6 can be used to connect/disconnect the LPC845 UART RX from the LPC11U35 debug probe (VCOMM connection).	n/a
P9	Sensor board connector. The RWS, BM or other custom sensor board connect to the MP via this connector.	<a href="#">[5]</a>
P10	Connects CAPT_YH signal (PIO1_9) to the comparator input 5 (PIO0_30). Should be installed for normal use.	n/a
P11	Ammeter connection. After removal of R53, an ammeter can be installed between the pins of JP2 to measure current flow to the LPC845. Once R53 has been removed, P11 must either be installed or an ammeter in place in order for the LPC845 to be powered.	<a href="#">[6]</a>

### 3. Getting Started

The firmware for the on-board debug probe and Windows 7/8 driver for the virtual com (VCOM) port are available from <http://nxp.com/demoboard/om40004> under the Software and Tools tab (look under “Software” download types). If using Window 7 or 8, you will need to install the VCOM driver by running the installer program (see installation notes included in the package.)

The MP board is pre-programmed with a simple program to demonstrate use of the BM and MP boards together. Connect a micro USB cable from connector J4 to a host computer or power supply to power up the board and run this program. When the program is running, firmly press a button on the BM board to light the associated LED (i.e. X0 to light D0, X1 for D1, etc.)

The rest of this section describes how to set up your board for use with MCUXpresso IDE and/or third party tools.

#### 3.1 Driver installation and (optional) debugger firmware update

The MP board comes pre-programmed with a CMSIS-DAP firmware image; it is not necessary to update the debugger firmware image, but this can be done by following the steps below.

1. With the board unpowered, install jumper P5.
2. Power the board. Using File Explorer (or equivalent on Mac/Linux platforms), look at the available drives on your system. A device called CRP\_DISABLED will appear.
3. Delete the firmware.bin file on the CRP\_DISABLED drive.
4. Drag and drop the firmware.bin file you downloaded from nxp.com on to the CRP\_DISABLED drive.
5. Remove P5, unplug then repower the board.
6. The board should now enumerate on your system - allow 20-30 seconds for this to complete.

#### 3.2 Using the board with MCUXpresso IDE

To use the board during a debug session in MCUXpresso IDE, connect to the host computer then follow the steps below.

Note that MCUXpresso IDE has built-in knowledge of the LPC84x part family, so does not require any SDK installation steps. Follow the steps below to build and run a simple example from the LPC84x Code Bundles provided by NXP.

1. Download the latest LPC84x Code Bundle from nxp.com:  
<http://www.nxp.com/products/software-and-tools/software-development-tools/software-tools/lpc800-code-bundles:LPC800-Code-Bundles>.
2. Open a new workspace in the IDE.
3. In the Quickstart panel of the IDE, click in “Import a new project from the file system”

4. In the “Import project(s) from file system...” dialog box that opens, click “Browse...” in the Project Archive (from zip) section, and select the LPC84x Code Bundle zip file downloaded in step (1). Click “Next >” on the “Import project(s) from file system...” dialog to continue.
5. You will see several projects listed in the Code Bundle; click “Finish” to import them all.
6. The dialog box will close, and you will see the imported projects in the Project tab at the upper left window of the IDE. Click on CapTouch\_9Sensor\_Button to select it, then select Build from the Quickstart panel. You will see the build processing in the Console window to the right of the Quickstart panel. The projects are set up to include dependency checking, so the build process will automatically build the utility and peripheral libraries as well as the example program.
7. Ensuring the MP is connected to the host computer, click Debug in the Quickstart panel. The IDE will search for available debug probes. Select the debug probe that appears for your board, then click OK. Note that the IDE will remember your selection for the next time you debug this project, so will not prompt for this again, unless it cannot find the board.
8. The code will execute to main. Press F8 to resume and run the program. You will now see the same demonstration program for the BM board running. Note that the Code Bundle includes similar examples for the Slider (“CapTouch\_3Sensor\_Slider”) and Rotary Wheel (“CapTouch\_6Sensor\_Wheel”) sensors of the RWS board.

### 3.3 Using MP with 3rd Party IDEs

Once the board debugger firmware has been installed (as described in [Section 3.2](#)), to use the board during a debug session in MCUXpresso IDE, it can be used with 3rd party development tools. Set up will vary between Development Tools, but the board debug probe should be supported as a CMSIS-DAP probe in all cases).

Code Bundles, including sample projects for Keil MDK and IAR EWARM, are available from NXP’s website at <http://www.nxp.com/products/software-and-tools/software-development-tools/software-tools/lpc800-code-bundles:LPC800-Code-Bundles>. Refer to the readme files provided with each code bundle in order to build/debug.

When using Keil MDK, install the Device Pack for the LPC84x (version 1.5 or later) before attempting to use the board.

When using IAR EWARM, ensure that you have version 8.12.2 or later in order to have LPC84x device family support.

## 4. Debug Probe

The on-board LPC11U35 provides CMSIS-DAP debug probe functionality, plus a virtual comm port (VCOM) capability via PIO1\_16 and PIO1\_17 of the LPC845 target. This functionality bridges the LPC845 serial port via USB, so that PC applications such as the FreeMASTER utility (used to tune capacitive touch board designs) can communicate directly with the target. (See the notes included with the Code Bundle examples for how to use FreeMaster with this Kit.)

The CMSIS, DISK and COMM LEDs are connected to the LPC11U35 device. The behavior of the LEDs will vary depending on firmware used, typically the CMSIS LED will blink when debug communication is occurring, and the COMM LED will blink when data is being transferred over the VCOMM port.

The board design includes pads for an external debug probe to be connected to the LPC11U35 (connector J5). This connector is not installed, and is not intended for customer use.

#### 4.1 Using an external debug probe

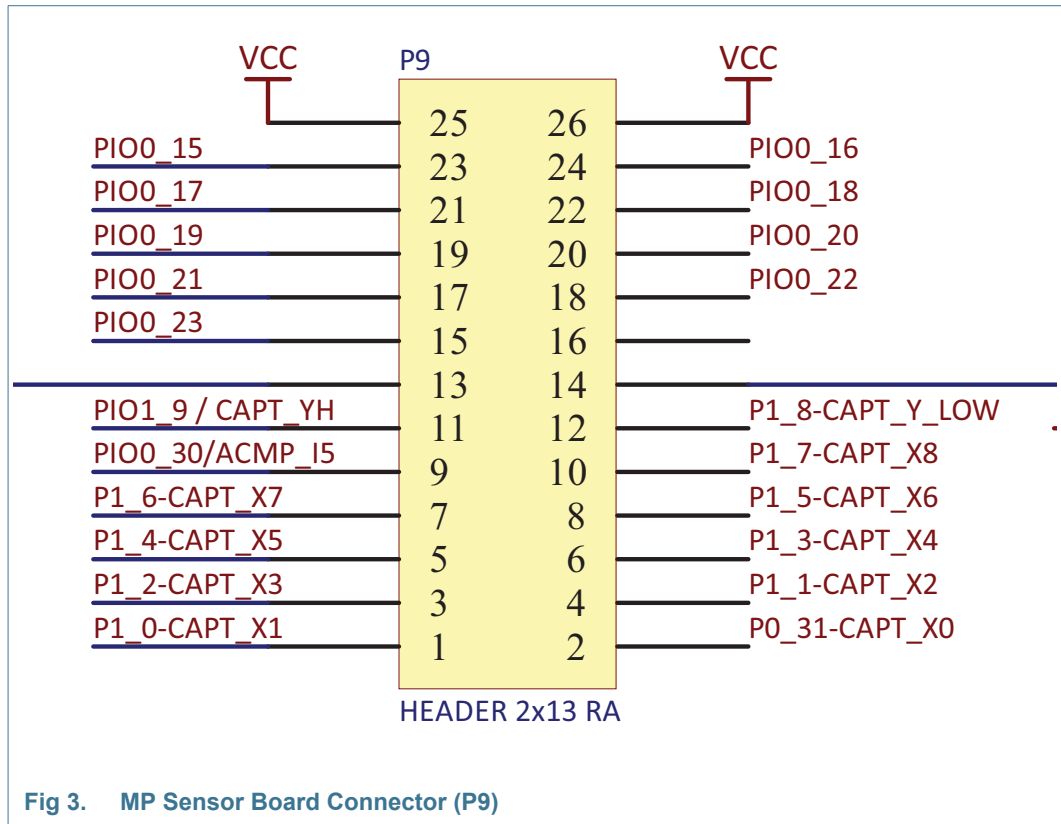
An external debug probe that supports ARM's SWD interface, such as a SEGGER J-Link or PE Micro probe, can be used with the MP board. The external probe must be connected to header J3. When an external debug probe is used, the on-board probe must be held in reset by placing a jumper on P6. It is recommended that P6 is fitted before powering the board.

## 5. Sensor Board Connection

The BM and RWS board connect to the MP board via a 2 x 13 right-angled connector (circuit reference P9 on the MP board.) This connector provides all the capacitive touch signals plus power, ground and GPIO signals to drive the LEDs. It is recommended that power be removed before connecting / disconnecting the boards.

Custom designed sensor boards may be used with the MP board. Refer to the LPC84x User Manual and the application note AN12083. for further information on sensor design and associated software development. The pin connections for P9 are shown in [Figure 3](#) below.





## 6. Power measurement

P2 is provided to enable supply current to the LPC845 to be measured by placing an ammeter in line with P2 pins. By default this jumper is bypassed by a resistor (R5) which needs to be removed in order to use an ammeter. Header P1 may be installed to measure supply power to the LPC845 by measuring voltage drop across a 2.43 ohm resistor on the board.

## 7. Other board features

This section describes other board features not detailed elsewhere in this document.

### 7.1 ISP booting and the ISP button

The LPC845 can be forced into ISP boot mode by holding down the ISP button (S3) and then holding and releasing reset. The ISP button is connected via a 100 ohm resistor to LPC845 pin PIO0\_12, which is also routed to the LPCXpresso expansion connector (pin 45) and to the cathode of the red user LED. LPC845 pin PIO0\_12 can be reconfigured by software so that the button can be used by an application as a general purpose button (refer to the LPC84x User Manual).

## 7.2 Wake button

The Wake button (S2) is for general purpose use by LPC845 applications. It is connected via a 100 ohm resistor to a 100K ohm pull-up to 3.3V, and to the LPC845 PIO0\_4 pin. This pin can wake the LPC845 from deep power-down.

## 7.3 User LEDs

Three users LEDs are provided on the board, one blue, one green and one red. The anodes of the LEDs are connected together, then through solder jumper SJ1 to the 3.3V regulator output. SJ1 can be opened to prevent leakage from the LPC845 pins through the diodes if accurate power measurement measurements are being performed. The LEDs are connected to the LPC845 as shown in the table below.

**Table 2. LED connections**

LED	LPC845 pin	Notes
Blue (D2)	PIO1_15	Shared with LPCXpresso connector pin 44
Red (D3)	PIO0_12	Shared with ISP pin and LPCXpresso connector pin 45
Green (D1)	PIO0_0	

## 7.4 Speaker driver

The LPC845 DACOUT output PIO0\_29 is route to an IS31AP4991 speaker driver (see Integrated Silicon Solutions web site for datasheet). This device can drive 8 to 32 ohm speakers; a 32 ohm speaker is supplied with the board and resistors have been selected to provide a reasonable volume level for musical tones. If desired, a capacitor can be added in parallel with the speaker driver feedback resistor, in order to reduce the speaker circuit bandwidth and reject DAC output sampling artifacts. This capacitor can be added using the through holes with circuit reference designator C24.

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