

# UM10940

LPC General Purpose Shield (OM13082)

Rev. 1.0 — 17 November 2015

User manual

## Document information

Info	Content
<b>Keywords</b>	LPCXpresso, LPC General Purpose Shield, OM13082
<b>Abstract</b>	LPC General Purpose Shield User Manual



**Revision history**

<b>Rev</b>	<b>Date</b>	<b>Description</b>
1.0	20151117	OM13082 User Manual release

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## 1. Introduction

The LPC General Purpose Shield Board has been designed to complement NXP's range of LPCXpresso MCU development boards by providing easy access to several commonly used peripherals. The LPC General Purpose Shield plugs into the top-side expansion connectors of LPCXpresso V2, V3, and MAX boards. The LPC General Purpose Shield connectors have the standard Arduino UNO R3 pins plus the additional expansion connections available on LPCXpresso V3 boards. LPCXpresso V2 and MAX boards may still be used with the LPC General Purpose Shield but not all features of the Shield will be available.

LPCXpresso™ is a low-cost development platform available from NXP, supporting NXP's ARM-based microcontrollers. The platform is comprised of an Eclipse-based IDE and low-cost target boards which include an on-board debugger. LPCXpresso is an end-to-end solution enabling embedded engineers to develop their applications from initial evaluation to final production.

This document describes the LPC General Purpose Shield ("LPC GP Shield") hardware.

## 2. Feature summary

The LPC GP Shield includes the following features:

- 128 x 64 LCD dot matrix display connected via SPI
- 4 user LEDs and 5 position joystick, controlled via an NXP PCA9535BS I<sup>2</sup>C port expander
- NXP LM75ADP temperature sensor connected via I<sup>2</sup>C
- Bosch BMI160 inertial measurement unit (3-axis accelerometer and 3-axis gyroscope, I<sup>2</sup>C)
- Potentiometer
- Features requiring LPCXpresso V3 board:
  - SD/MMC card slot
  - Ethernet RJ45 connector
  - CAN terminal block
  - Micro AB USB device connector

### 2.1 Board layout and settings

This section provides a quick reference guide to the main board components, configurable items, visual indicators and expansion connectors. The LPC GP Shield board layout is shown in Fig 1. NOTE: The BMI160 IMU sensor, High speed CAN transceiver chip and NXP PCA9535BS I<sup>2</sup>C port expander are below the LCD display. To view them, gently push in the LCD stands from the back of the shield board; however it is not recommended to do this unless absolutely needed in order to avoid damage to the board.

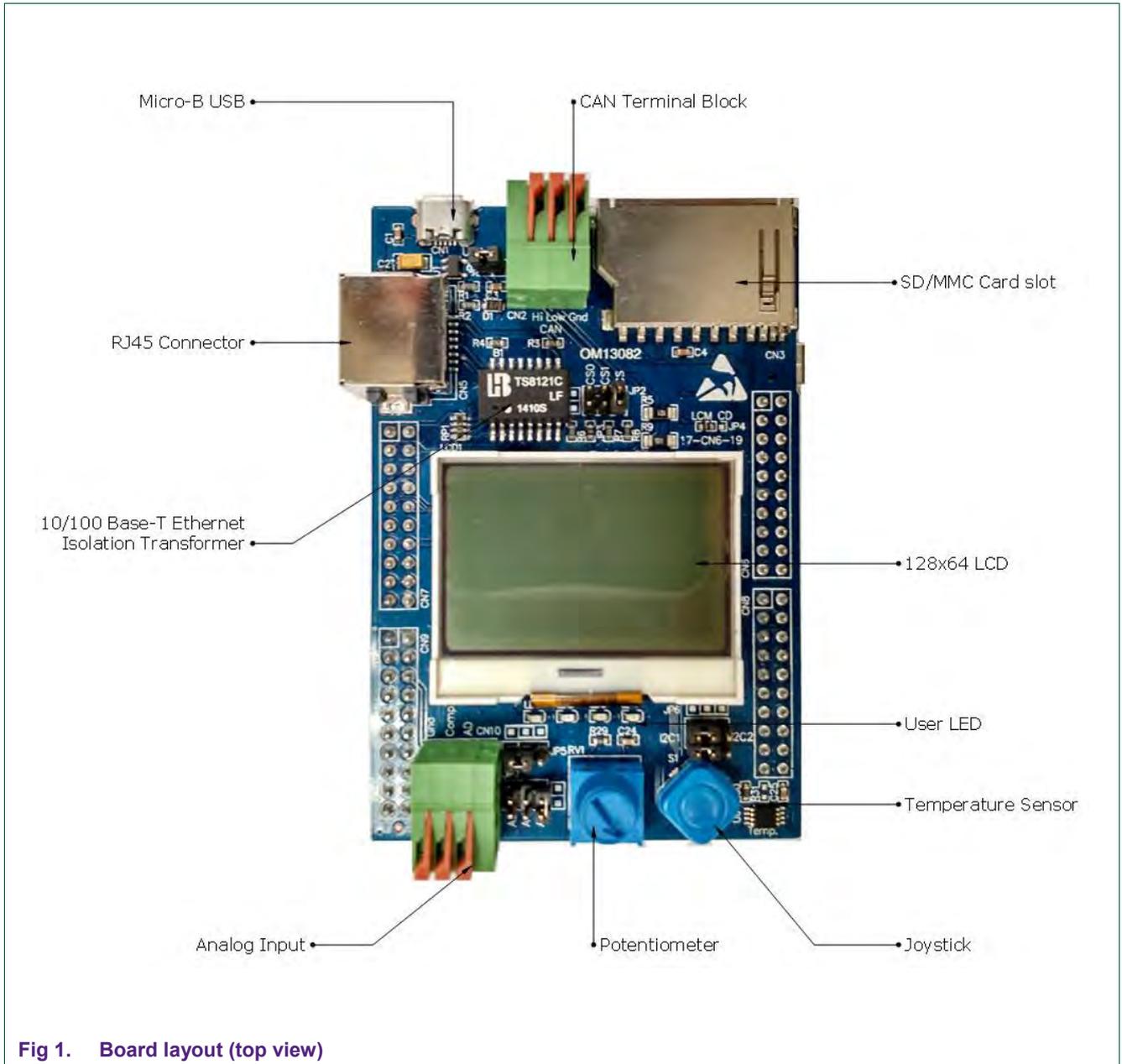


Fig 1. Board layout (top view)

## 3. Getting Started

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### 3.1 Compatibility with LPCXpresso boards

The LPC GP Shield can be mounted on any LPCXpresso V2, V3 or MAX board. However, since LPCXpresso V2 and MAX boards do not have the extended expansion connectors available on the LPCXpresso V3 board, some features are not physically connected and cannot be used. Features used by the LPC GP Shield that are not available on V2 and MAX boards are:

- CAN
- USB
- Ethernet
- SD card

The LPCXpresso board used may also not include the on-chip peripherals required to support some of the features of the LPC GP Shield; please refer to the manual for your LPCXpresso board and/or the target MCU for further information.

Although the LPC GP Shield does not use all the signals available on the expansion connector, it is built with connectors to mate with all connections. This is to allow access to the signals from the LPCXpresso from the top of the shield for debug purposes.

### 3.2 Supporting Software

As mentioned earlier in this Section, the LPC GP Shield can be used with most boards that have Arduino UNO R3-style connectors, and at least one of I2C, SPI, and/or analog inputs. NXP provides drivers and example code for the LPC GP Shield in its LPCOpen packages for the LPCXpresso boards shown below. To download these examples please visit <http://www.lpcware.com/lpcopen>. For the most up to date list of boards with LPCOpen example support for the LPC GP Shield please visit:

<http://www.lpcware.com/lpcxpressoboards>.

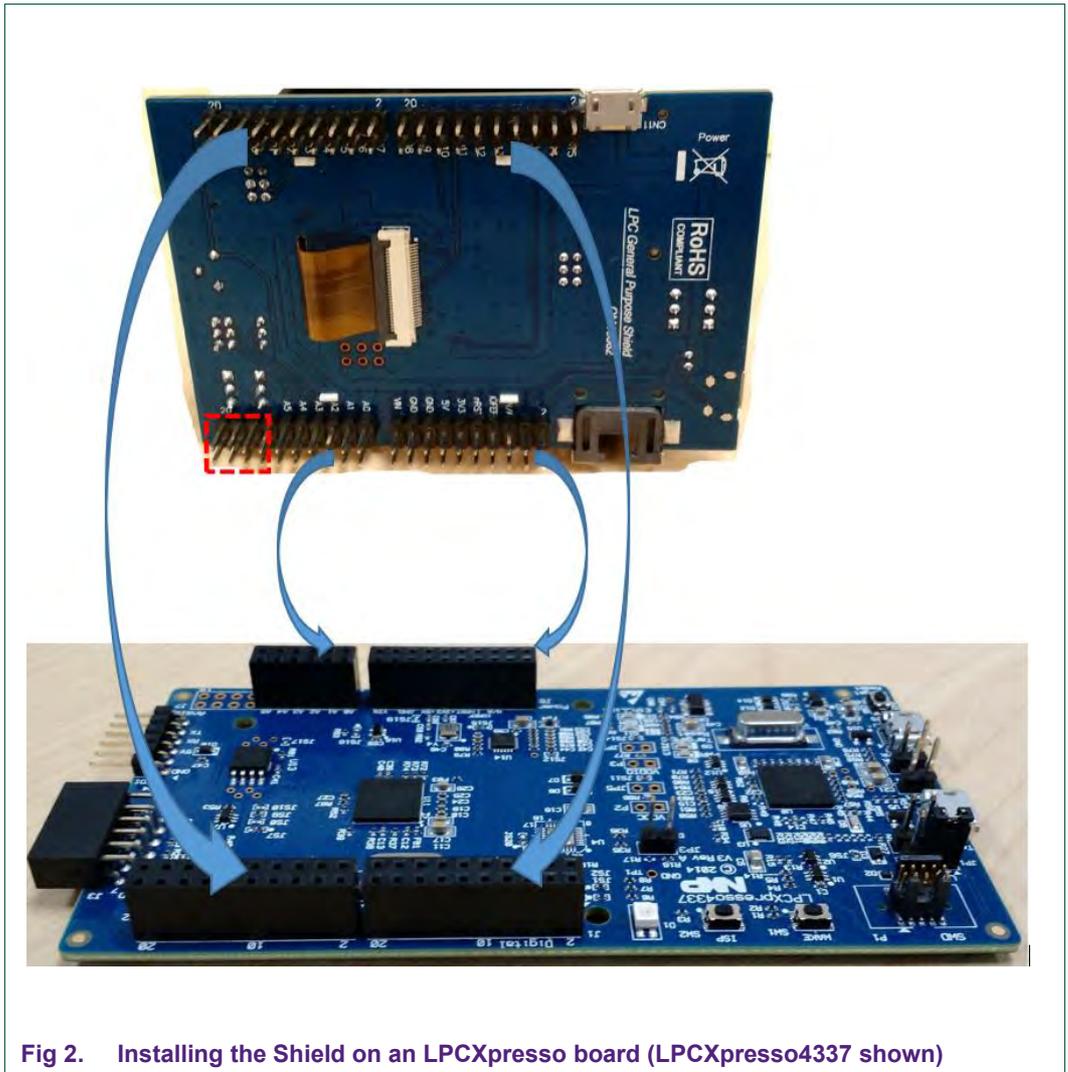
- LPCXpresso1837 & LPCXpresso18S37
- LPCXpresso 4337 & LPCXpresso43S37

### 3.3 Board installation and removal

There is only one orientation in which the Shield board can be correctly mounted on an LPCXpresso board; this is shown in Fig 2. The Shield and LPCXpresso boards are static sensitive boards, so take appropriate precautions to avoid ESD damage while assembling and using them. Carefully align the pins of the LPC GP Shield with the receptacles on the LPCXpresso board then apply even pressure with one thumb pressing between CN7 and CN9 and the other thumb pressing between CN6 and CN8.

### 3.4 Board revisions

Boards from revision B onward include a FET placed in-line with the VDD connection to the SD/MMC card slot (see Section 4.7). Revision B and later boards have revision printed on the silkscreen on the underside of the board near the board name; revision A boards do not have the revision shown.



**Fig 2. Installing the Shield on an LPCXpresso board (LPCXpresso4337 shown)**

Note: The last 4 pins, marked by the red square in the figure, are not required for operation of the shield and may be missing on your LPCXpresso board.

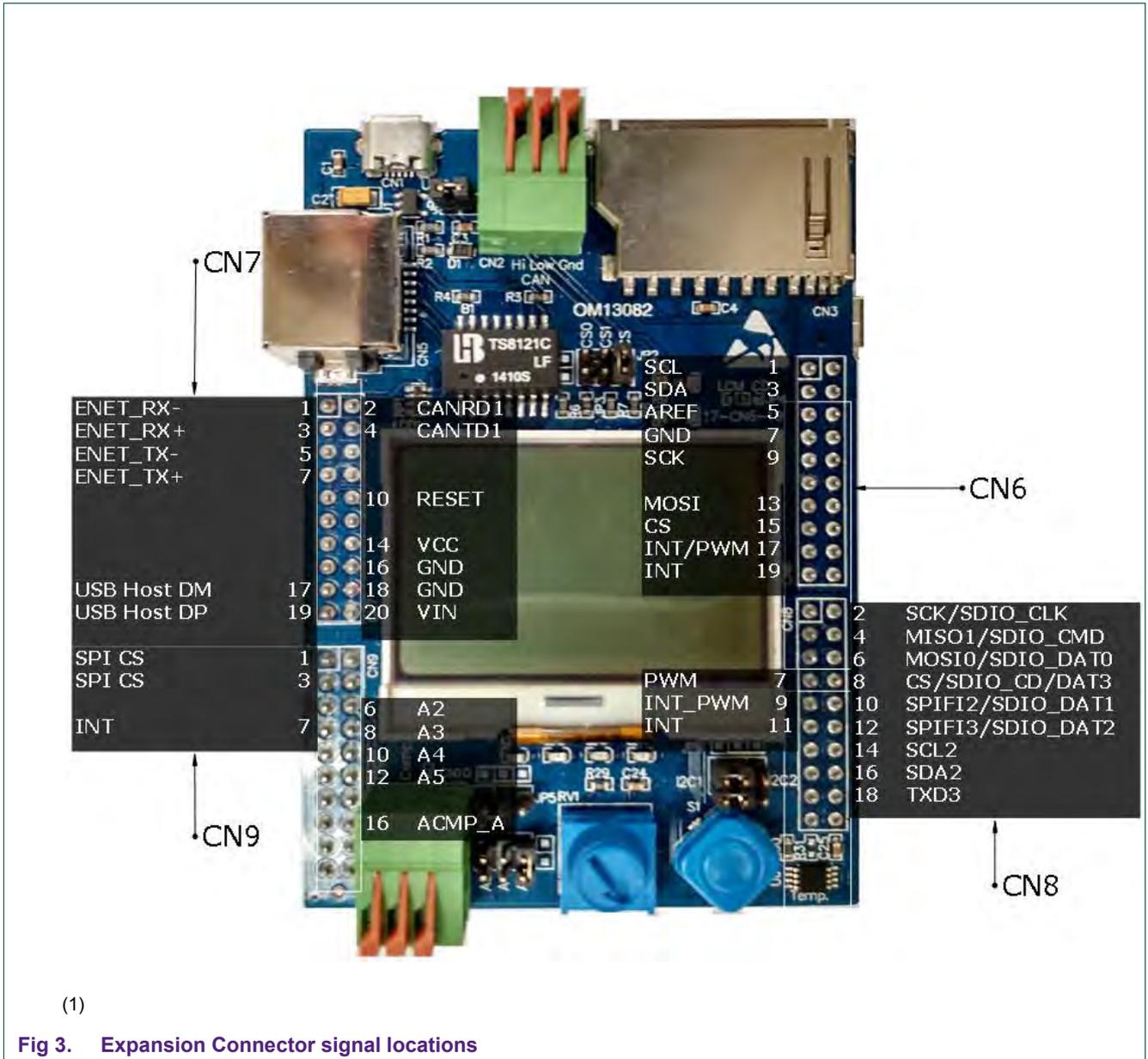
To remove the shield gently pry up each corner in turn, a few millimeters at a time, repeating until the shield lifts away completely.

### 3.5 Powering the board

When mounted onto any other LPCXpresso V2, V3, or MAX boards, there should be no need to power the board separately as power is supplied to the Shield through the extension connectors. However, when an SD card module such as a Wifi card is being used, or if the USB connector (CN1) is being used as a USB host, then it may be necessary to supply additional power by connecting a USB power supply to connector CN11 (on the underside of the Shield). When applying power to CN11 be sure to remove JP1 to disconnect the supply from the LPCXpresso board. Refer to Section 4.10 for more information on using CN1 as a USB host connection.

### 4. Hardware Functionality and Peripherals

The various available peripherals on the LPC GP Shield are described in this Section. The LPCXpresso V3 standard expansion connectors allow for two standard I<sup>2</sup>C busses and multiple SPI chip selects so that the LPC GP Shield can be used with other shields mounted underneath it. Fig 3 shows the location of the signals used by the LPC GP Shield.



### 4.1 I<sup>2</sup>C Devices bus selection

I<sup>2</sup>C connectivity is available from CN6 (standard Arduino location, labelled I2C1) or CN8 (LPCXpresso V3 boards only, labelled I2C2). Jumper JP6 can be used to select between these I<sup>2</sup>C ports, with I2C1 being the default. All devices on the LPC GP Shield that use I<sup>2</sup>C share the same bus.

### 4.2 LCD display

The 128x64 pixel LCD display module incorporates a Sitronix ST7565S controller. The LCD is controlled via the standard Arduino SPI connections (on connector CN6). One of 3 SPI chip selects can be used with the display, using jumper JP2. CS is the standard Arduino chip select (default), while CS0 and CS1 are LPCXpresso V3 signals available at CN9.

Note that the LPCOpen drivers/examples (if available for your LPCXpresso board) include the basic SWIM graphics library, so direct programming of the Sitronix controller is not normally required.

### 4.3 LEDs and Joystick

4 user LEDs and a 5 position joystick (left, right, up, down and push) are provided on the LPC GP Shield. These devices are controlled over the selected I<sup>2</sup>C bus (see Section 4.1) by the NXP PCA9535BS, which provides 16 bits of general purpose parallel input/output (GPIO). The connection of this circuit is shown in Fig 4. For more information on the Port Expander please visit

[http://www.nxp.com/products/interface\\_and\\_connectivity/i2c/i2c\\_general\\_purpose\\_i\\_o/P\\_CA9535BS.html](http://www.nxp.com/products/interface_and_connectivity/i2c/i2c_general_purpose_i_o/P_CA9535BS.html).

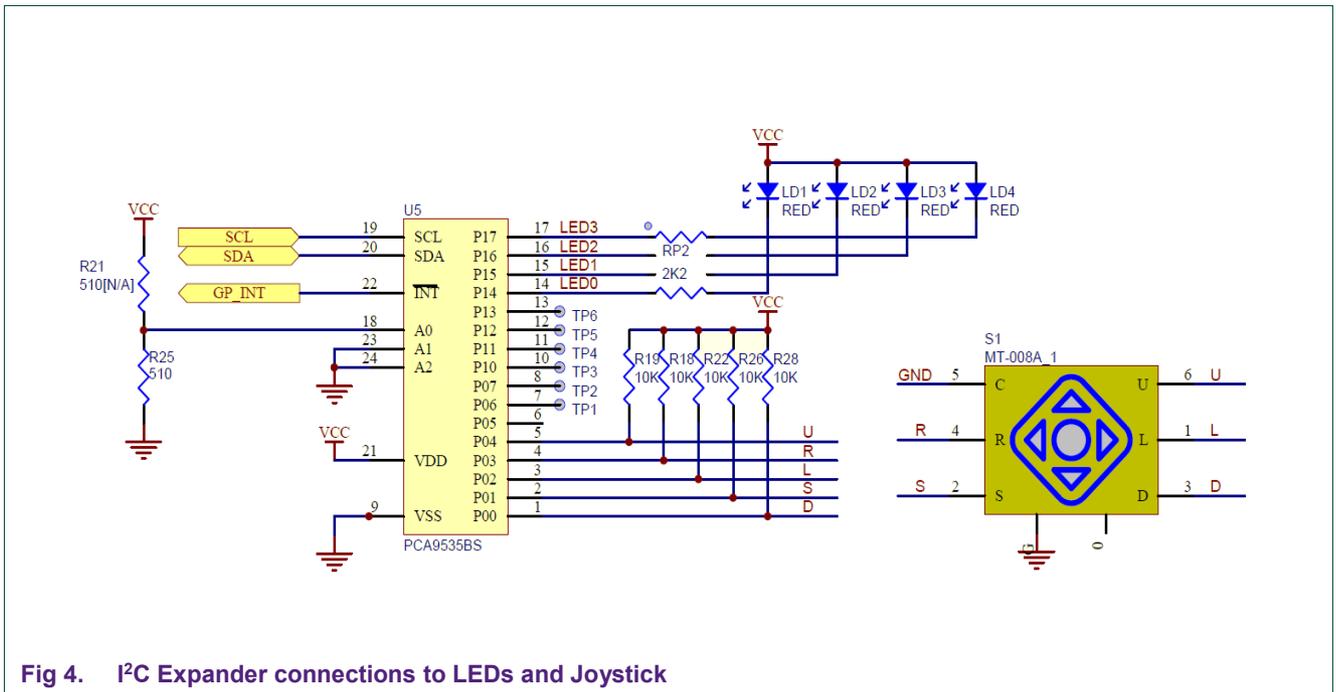


Fig 4. I<sup>2</sup>C Expander connections to LEDs and Joystick

#### 4.4 Temperature Sensor

The temperature sensor is interfaced via I<sup>2</sup>C bus. To get more information about this sensor please visit:

[http://www.nxp.com/products/interface\\_and\\_connectivity/i2c/i2c\\_temperature\\_voltage\\_monitors/LM75ADP.html](http://www.nxp.com/products/interface_and_connectivity/i2c/i2c_temperature_voltage_monitors/LM75ADP.html)

#### 4.5 Bosch BMI160 Inertial Measurement Unit

The Bosch BMI160 IMU is a highly integrated, low power inertial measurement unit (IMU). It provides precise acceleration and angular rate (gyroscopic) measurement. This sensor is interfaced to the LPCXpresso host MCU via I<sup>2</sup>C. For further information please visit Bosch Sensortec's website (<http://www.bosch-sensortec.com>).

#### 4.6 Potentiometer

A 10K trimming potentiometer, connected between ground and VCC is provided on the shield board to provide stimulus to the analog inputs of the host MCU on the LPCXpresso board onto which the Shield is mounted. The potentiometer wiper, can be routed to any or all of the A3, A4 and A5 connections on CN9 using JP7. Be sure to remove the connection to A5 if that pin is being used to control the USB host power enable.

#### 4.7 SD/MMC card slot

CN3 is a socket for an SD or a Multimedia Card, suitable for use with memory cards or select WiFi adapters such as the Gainspan GS2100M SDIO Wi-Fi Adapter Board. When using a wireless card such as the GS2100M mentioned above it may be necessary to supply extra power use the extra micro-B USB connector, CN11 (see Section 3.5).

On revision B and later boards there is a FET placed in-line with the VDD connection to the SD/MMC card slot. This enables the power to this peripheral to be controlled using a GPIO connection from pin 1 of CN8 LPC GP Shield.

#### 4.8 Ethernet RJ45 connector

The onboard isolation transformer (TS8121CRJ45) and RJ45 connector (CN5) provide Ethernet connectivity via a category 5 cable. To use this connection the LPCXpresso board must include an Ethernet PHY.

#### 4.9 CAN terminal block

The CAN terminal block (CN2) gives a convenient option to connect with other systems via CAN bus. There is an on-board CAN transceiver chip (TJA1040) that provides an interface between the Controller Area Network (CAN) protocol controller and the physical bus.

#### 4.10 USB connector

CN1 is a micro-AB type USB connector, and thus can be configured to act for use with the LPCXpresso and LPC GP Shield system as a USB host or device. When configured as a host, the Shield needs to supply power to the connected USB device. The current-

limited power-distribution switch (TPS2041B) allows the shield to drive power from the base board to the device, with this switch having an active low enable control input. There are two possible sources for this enable control, configured using JP5. In the default jumper position, the control signal is sourced from A5 on CN9, with the alternative being pin 7 from CN9. If no jumpers are fitted on JP5 then the power switch is disabled (because there is a pull up resistor its enable), thus setting up the shield to acts as a USB device. If the jumper position is changed, it gets connected to the INT pin. This gives user the option to control the switch via software.

### 4.11 Jumper settings

The table below shows the available jumper configurations and their default settings.

Circuit ref	Description	Default setting
JP1	Connects power from LPCXpresso board to LPC GP shield. Remove when using power supplied from CN1 or CN11. See Section 4.10.	Fitted
JP2	Selects SPI chip select for the LCD display. See Section 4.2.	CS (pins 5 & 6)
JP3	Connects SD card detect signal to pin 18 of CN6. JP3 is a solder jumper, located immediately above the LCD.	Fitted
JP5	Selects between A5 and INT (pin 7 and pin 12 on connector) CN9 as active low source for CN1 USB power switch enable. Can be removed if CN1 is not used as a USB host connection. See Section 4.10.	A5 (pins 1 & 2)
JP6	Selects the I <sup>2</sup> C interface for I <sup>2</sup> C devices on the Shield. See Section 4.1.	I2C1 interface (pins 1 & 3 or CN6)
JP7	Selects which analog input channels are connected to the potentiometer wiper (can be any combination of A3, A4 and A5 on CN9). See Section 4.6.	A3

Fig 5 below shows the jumper locations with default positions highlighted.

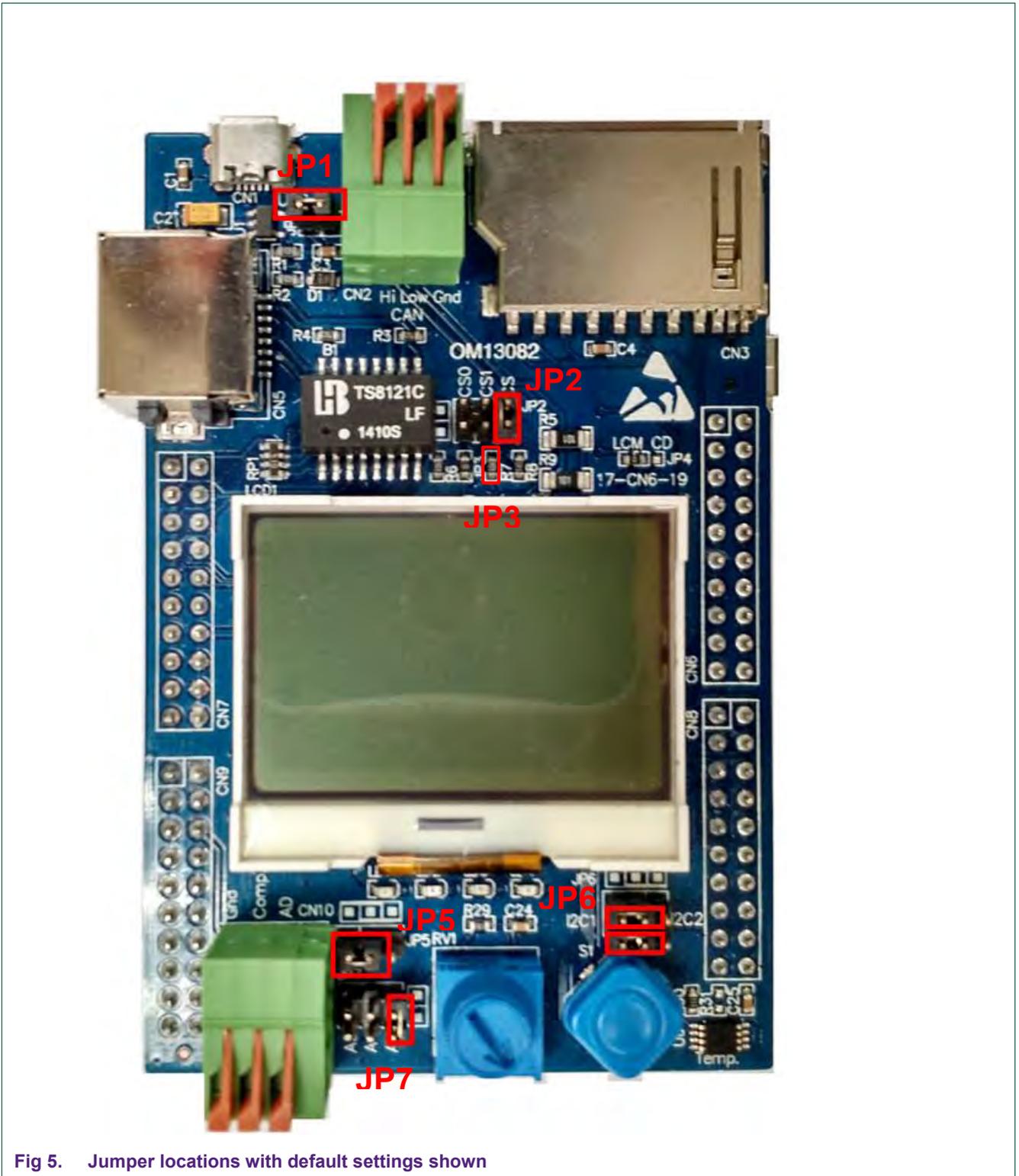


Fig 5. Jumper locations with default settings shown

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Date of release: 17 November 2015

Document identifier: UM10940