UM10718

OM13501, PCA8538 demo board user manual

Rev. 1 — 23 July 2013 User manual

Document information

Info	Content
Keywords	LCD driver, segment driver, COG, chip-on-glass, PCA8538, LPCXpresso, Vertical Alignment , VA
Abstract	The OM13501 is an LCD demo board which can be used to demonstrate and evaluate the PCA8538 segment driver. This is a Chip-On-Glass LCD driver which can drive up to 918 segments in mux 1:9. The board is controlled by an LPCXpresso micro controller board, which contains the LPC1115, a Cortex M0 controller. A free IDE can be downloaded in order to modify the software. Supply of the board can be via two AA batteries, an AC adapter or USB.

Revision history

Rev	Date	Description
1	20130723	Initial version

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1. Introduction

This user manual describes the OM13501 demo board. The board consists of a base board, with a plugged in LPCXpresso board which contains the microcontroller to control the display driver. The PCA8538 is a peripheral device which interfaces to almost any Liquid Crystal Display (LCD) with low multiplex rates. It generates the drive signals for any static or multiplexed LCD containing up to nine backplanes, 102 segments and up to 918 display elements. PCA8538 communicates either via a two-line bidirectional I^2C-bus or a four-line bidirectional SPI-bus.

This board was developed in order to provide a low cost tool to engineers, wishing to demonstrate and evaluate this LCD driver, and to get hands-on experience with writing code for it. Code written using this board can serve as an example for the final application. This enables rapid prototyping.

Features:

- Demonstrates PCA8538 LCD driver
- Features a vertical alignment (VA) COG display module with integrated backlight
- Plugged in OM13035 LPCXpresso board with LPC1115 microcontroller
- 3 push buttons
- User modifiable firmware, In-System/In-Application Programming (ISP/IAP) via USB.
- Power supply can be either using two AA batteries, via USB or via an AC adapter/external power supply. This can also be used for external Vlcd.
- Box contents:
    - OM13501 base board (marked on the board)
    - OM13035 LPCXpresso board

The 12nc of the OM13501 board is 9353 014 43598.

2. Board description and layout

In Fig 1 the top view of the board is given.

Fig 1. Top view of OM13501 demo board

For best optical performance, remove the protective foil from the display.

2.1 Power Supply

Please refer to the schematic diagram of the board, which is given in Fig 2.

Besides applying power via the plugged in LPCXpresso board, there are three ways to provide power to the base board:

1. Via mini-USB connector P1. Now the 5 V comes directly from the USB port.
2. Using two AA batteries. An on-board switching regulator, built around IC3, generates 5 V (5V_Bat). Whenever the batteries are inserted this regulator is running. The current consumption at no load is very low, in the order of 20 µA. Nevertheless, it is advisable to remove the jumper labeled “JP7” when the board will not be used for a long time while the batteries are inserted. This will interrupt the connection between batteries and switching regulator.
3. Via an external AC/DC adapter or DC power supply. The voltage may be in the range from 7 V to 18 V. For the adapter a plug P2 has been provided, the internal pin is +. It is also possible to connect the voltage to two pins (P3) using a DC power supply. A diode protects against damage in case of wrong polarity. Two linear regulators (IC1 and IC2) provide 5 V (5V_ext) and VLCD_EXT. The latter voltage can be adjusted using the potentiometer labeled as Vlcd.

PCA8538 includes a temperature compensated internal Vlcd generator. If the internal voltage generator for Vlcd is not used, and one wants to quickly see the optical result of varying Vlcd, this can be achieved using the third supply option. Rotating potmeter Vlcd will change the voltage, rotating it clockwise decreases the voltage Vlcd. Make sure that the voltage Vlcd does not exceed the maximum limit of 12 V of PCA8538. If external Vlcd is used, also jumper JP9 must be placed. Ensure that the internal voltage generation (control register settings) is disabled.

Switch SW1 is used to select which of the three power supply options is being selected (5V_BAT, 5V_USB or 5V_EXT). The 5 V output of the switch is used to supply the backlight of the display. Furthermore the voltage labeled “3V3_LPCXPR” is generated with an additional regulator, IC5. This 3.3 V is used to supply the microcontroller board LPCXpresso and to supply the logic voltages Vdd of the LCD driver.

The LPCXpresso board contains a JTAG/SWD debugger called the “LPC-Link” and a target MCU. LPC-Link is equipped with a 10-pin JTAG header and it seamlessly connects to the target via USB (the USB interface and other debug features are provided by NXP’s ARM9 based LPC3154 MCU). When the firmware needs to be updated, the LPCXpresso board will be connected using USB to the computer on which the IDE is installed. In this case, a 3.3 V supply is generated on the LPCXpresso board via a linear regulator which is integrated in LPC3154. However, this regulator has limited current delivery capability. If the LPCXpresso board is connected via USB to a computer, without any other supply to the base board, the 3.3 V from the LPCXpresso board is used to supply also the LCD base board. In this case however the backlight will have limited intensity. Supply is via diode D2 and resistor R16.

It is allowed to provide power to the base board while LPCXpresso is connected to a computer, for example using two USB cables.

2.2 LPCXpresso

LPCXpresso is a low-cost development platform available from NXP. The software consists of an enhanced, Eclipse-based IDE, a GNU C compiler, linker, libraries, and an enhanced GDB debugger. The hardware consists of the LPCXpresso development board which has an LPC-Link debug interface and an NXP LPC ARM-based microcontroller target. LPCXpresso is an end-to-end solution enabling embedded engineers to develop their applications from initial evaluation to final production.

The LPCXpresso IDE, is based on the popular Eclipse development platform and includes several LPC-specific enhancements. It is an industry-standard GNU tool chain with an optimized C library that gives engineers all the tools necessary to develop high-quality software solutions quickly and cost-effectively. The C programming environment includes professional-level features. There is syntax coloring, source formatting, function folding, on- and offline help, and extensive project management automation.

The LPCXpresso target board, jointly developed by NXP, Code Red Technologies, and Embedded Artists, includes an integrated JTAG debugger (LPC-Link), so there is no need for a separate JTAG debug probe. The target portion of the board can connect to expansion boards to provide a greater variety of interfaces, and I/O devices. The on-board LPC-Link debugger provides a high-speed USB to JTAG/SWD interface to the IDE and it can be connected to other debug targets such as a customer prototype. Users can also use the LPCXpresso IDE with the Red Probe JTAG adapter from Code Red Technologies.

Refer to the “Getting started with NXP LPCXpresso”, listed in the references, for more information.

The board included with the base board is OM13035 which contains the LPC1115 MCU.

2.3 Switches

Three push buttons are present on the board, SW2, SW3 and SW4. At the time of writing this user manual, functionality was not defined yet.

2.4 Jumpers

The board contains a number of jumpers. Below they are listed, along with their functionality.

- JP1 through JP6: These are all used to select either the I^2C-bus interface, or the SPI interface. They need to be all in the same position. Refer also to the datasheet.
- JP7: This jumper connects the two AA batteries to the subsequent boost converter. Remove if the board will be stocked with the batteries inserted.
- JP8: This jumper connects the Vlcdout and Vlcdsense connections to the Vlcdin pin of PCA8538. It must be placed if the internal voltage generation is used.
- JP9: This jumper connects the Vlcdin pin of the LCD driver to the voltage VLCD_EXT which is generated on the base board if a supply option 3 is used. However, if also the internal voltage generator is enabled, this can cause damage to the LCD driver. If the internal voltage generator is used, jumper JP9 should be removed.

- JP10: This jumper may not have been soldered into the board during manufacturing. Instead, a 0 Ω resistor (R19) is mounted, in parallel with this jumper. Removing the 0 Ω resistor and mounting the jumper makes it easy to insert a current meter and measure the current consumption to the Vdd pins of PCA8538. After measurements, a jumper header can be inserted.

In addition a few SMD 0 Ω resistors are mounted for I^2C address selection. The expectation is that these will seldom be removed, but if the wish comes up to select a different I^2C slave address for PCA8538 (resistors R7 – R10, pins SA0 and SA1), this is possible without cutting tracks on the PCB.

2.5 Use of internal/external oscillator

PCA8538 offers the option of using the internal oscillator or to use an external oscillator. Resistor R12 connects the OSC pin to Vss, selecting the internal oscillator. If an external oscillator signal is desired, R12 must be removed and R11 must be mounted. If the internal oscillator is used, the oscillator signal is available at connector “CLK”. If an external oscillator signal is used, this can be supplied to the LCD driver using this connector “CLK”.

2.6 Connectors

Besides the previously mentioned connectors, connector P4 contains the I^2C and SPI signals, along with Vss and a reset signal. This connector can be used to connect the baseboard to another application / microcontroller. In that case, the LPCXpresso board must be removed.

3. Board schematic and layout

On the next pages the circuit diagram and PCB layout of the board are given. Refer to Fig 2 and Fig 3.

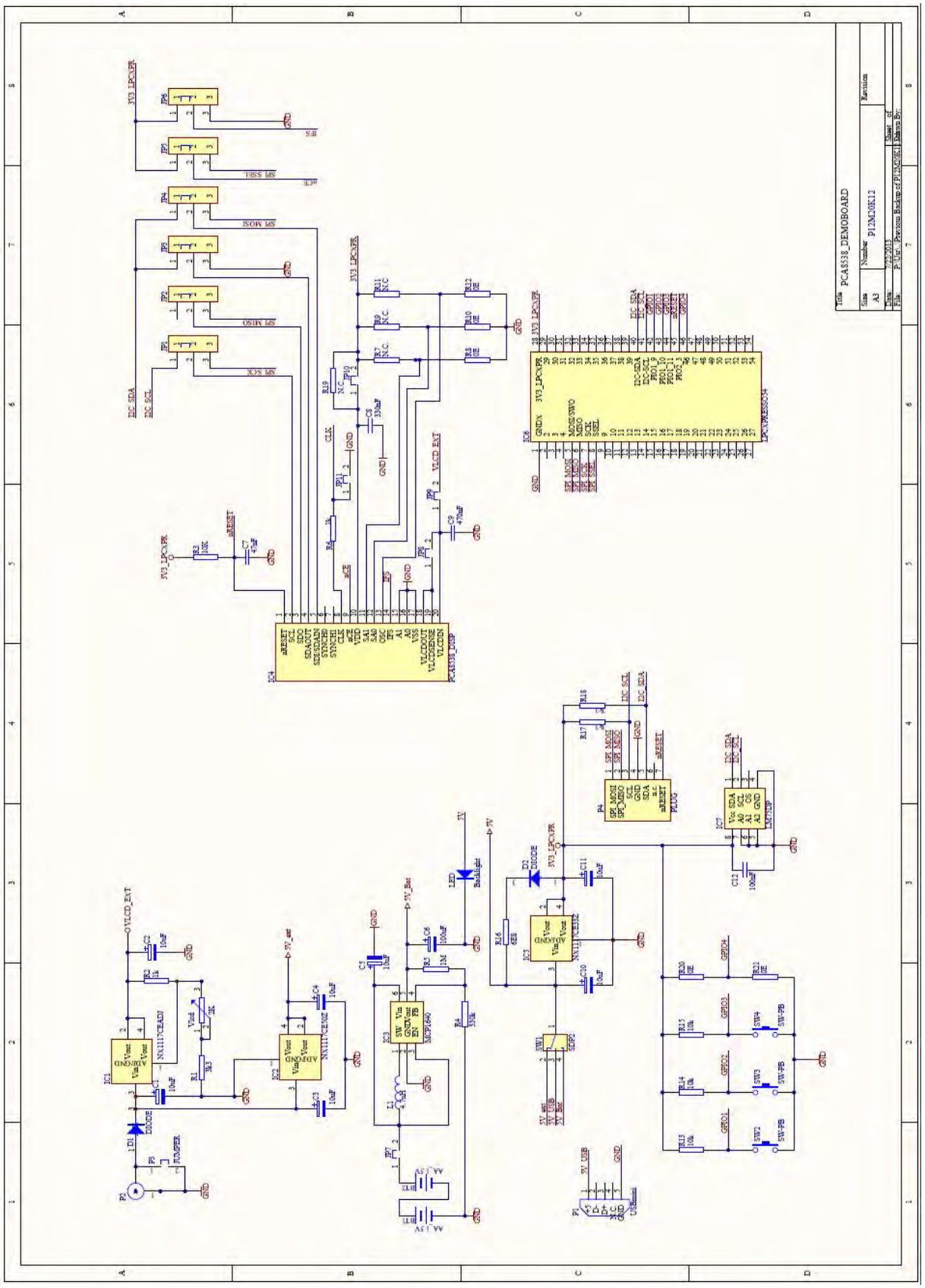

Fig 2. Schematic OM13501

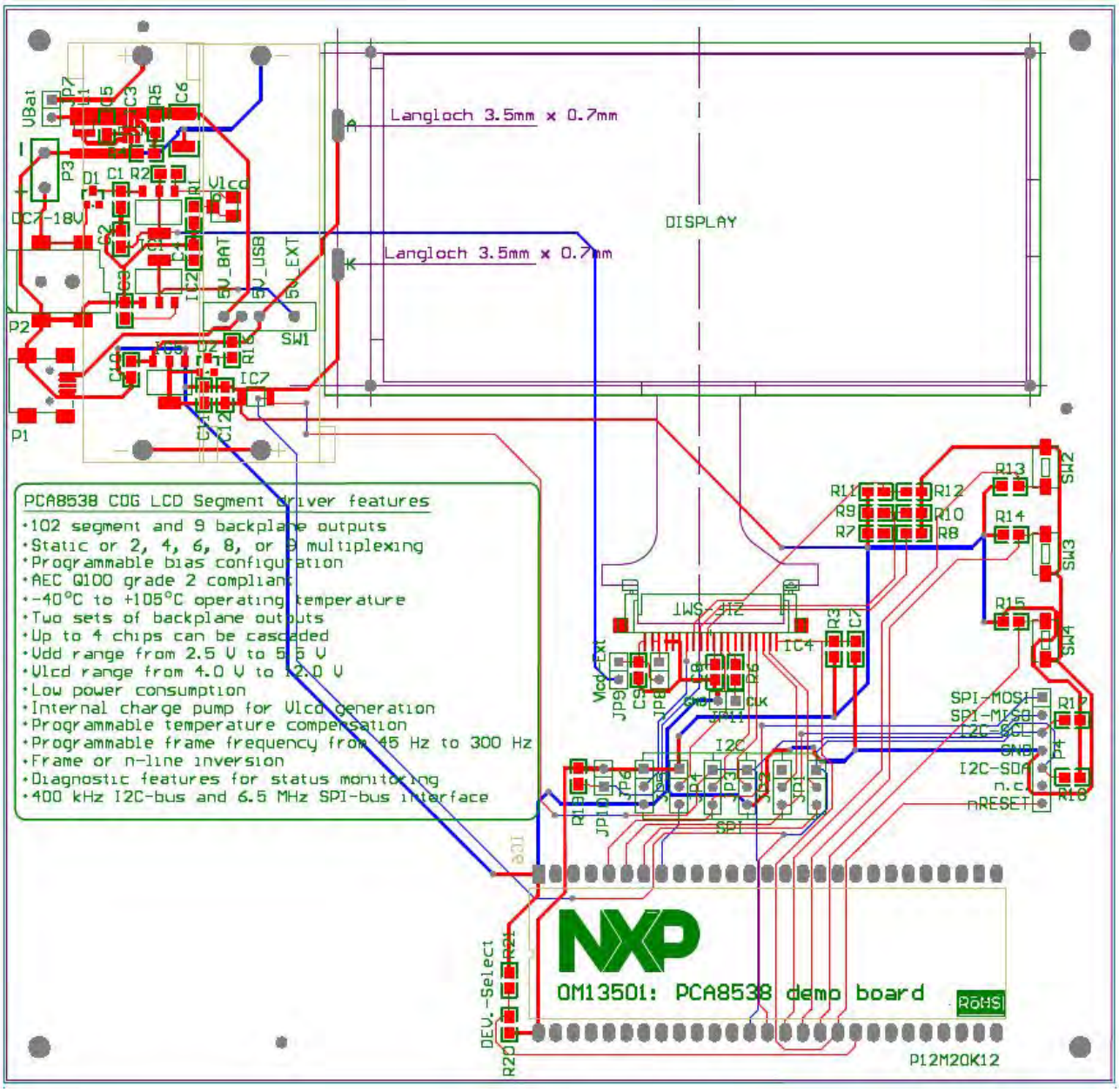

Fig 3. PCB layout

The LPCXpresso board and battery holder are on the reverse side of the base board.

4. Software code example

Section 8 of the PCA8538 data sheet contains all the commands and their description. In order to write software for this driver, it will be necessary to read the datasheet.

Below, an example for the configuration of the module is listed. Exact details of how to write the functions are left to the programmer. This example shows the data to be sent to the PCA8538 to configure it for use with the module on this board.

```
I2CWrite = PCA8538_ADDR;
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0x3A;        // Initialize
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0xD8;        // OTP refresh
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0x18;        // Device Select 0
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0xD4;        // CLKOUT disabled
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0xC9;        // Charge pump enabled, Vlcd = 3*Vdd2
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0x45;        // set VLCD, MSB
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0x73;        // set VLCD, LSB. VLCD = 6.4 V
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0x00;        // Temp. comp. and measurement disabled
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0xD0;        // Set 1/4 bias
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0xB3;        // Driving scheme C, 3-line inversion
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0x39;        // Display enable
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0x80;        // Set Data pointer x-MSB = 0
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0x90;        // Set Data pointer x-LSB = 0
I2CWrite = 0b10000000;  // control byte
I2CWrite = 0xA0;        // Set Data pointer y = 0
I2CWrite = 0b00100000;  // Write to DDRAM
```

5. References

The documents listed below provide further useful information. They are available at NXP's website www.nxp.com.

[1] **LPCXPresso: Getting started with NXP LPCXpresso**

[2] **PCA8538**: Product data sheet

[3] **UM10204**: I^2C-bus specification and user manual

[4] **AN11267**: EMC & system level ESD design guidelines for LCD drivers

[5] NXP LPCXpresso http://www.nxp.com/lpcxpresso

[6] NXP LPCZone http://www.nxp.com/techzones/microcontrollers-techzone/news.html

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