UM10818

OM13502, PCA2117 demo board

Rev. 1 — 3 September 2014 **User manual**

Document information

Info	Content
Keywords	LCD driver, character driver, COG, Chip-On-Glass, PCA2117, LPCXpresso, Vertical Alignment, VA
Abstract	The OM13502 is an LCD demo board which can be used to demonstrate and evaluate the PCA2117 character driver. This is a Chip-On-Glass LCD character driver specifically designed to drive LCD dot-matrix displays of 2-lines by 20 characters or 1-line by 40 characters with 5 × 8 dot format. In addition 200 icons can be displayed. 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 done via an AC adapter or USB connector.

Revision history

Rev	Date	Description
1	20140903	Initial version

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1. Introduction

This user manual describes the OM13502 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 PCA2117 is a low-power Liquid Crystal Display (LCD) controller and driver. It is specifically designed to drive LCD dot-matrix displays of 2-lines by 20 characters or 1-line by 40 characters with 5 × 8 dot format. In addition 200 icons can be displayed. The chip contains a character generator and displays alphanumeric characters. The PCA2117 features an internal charge pump with internal capacitors for on-chip generation of the LCD driving voltage. To ensure an optimal and stable contrast over the full temperature range, the PCA2117 offers a programmable temperature compensation of the LCD supply voltage. The PCA2117 can be easily connected to a microcontroller by either the two-line I²C-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 PCA2117 LCD driver
- Features a vertical alignment (VA) COG display module with integrated backlight. It was designed with Car Entertainment and Home Entertainment in mind
- 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 done either via USB or an external power supply. This can also be used for external V_{LCD}
- Box contents:
  - OM13502 base board (marked on the board)
  - OM13035 LPCXpresso board

The 12NC of the OM13503 board is 9353 031 19598.

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2. Board description and layout

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



Fig 1. Top view of OM13502 demo board

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For best optical performance, remove the protective foil from the display. In contrast to many displays there is no pull tape to remove the protective foil. The optimal viewing angle for this display is 12 o'clock.

2.1 Power Supply

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

1. Via mini-USB connector P1. Now the 5 V come directly from the USB port. This supply is used for a 3.3 V linear regulator and a switch mode boost converter to generate 19 V for the back light.
2. Via an external DC power supply, for which connector P2 has been provided. Connect a voltage in the range of 7 V to 15 V to pin 1. Again, that voltage is to supply the 3.3 V regulator and the boost converter. In addition it supplies the linear regular IC1 which can be used to provide an external LCD operating voltage. The potentiometer PT1 is used to adjust this voltage. Diode D1 protects against damage in case of wrong polarity.

It is not possible to apply power via the plugged in LPCXpresso board. The USB connector on the LPCXpresso board is only meant for programming the flash memory. There are two ways to provide power to the base board:

The PCA2117 includes a temperature compensated internal V_{LCD} generator. If the internal voltage generator for V_{LCD} is not used, and one wants to quickly see the optical result of varying V_{LCD}, this can be achieved using the second supply option. Varying the output voltage of IC1 using potentiometer PT1 will directly influence the display contrast and the optimal voltage can be selected. Make sure that the voltage V_{LCD} does not exceed the maximum limit of 16 V of the PCA2117. If external V_{LCD} is used, jumper JP7 must be removed and jumper JP8 must be placed. Ensure that the internal voltage generation (control register settings) is disabled.

Switch SW1 is used to select which of the two power supply options is being selected. The output of the switch is used to supply linear regulator IC2 which is used to generate the voltage labeled "3V3". This 3.3 V supply is used to supply the LCD driver and the LPCXpresso board. The output of SW1 is also connected to a boost generator to generate 19 V for the LCD back light.

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 the USB to the computer on which the IDE is installed.

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 Switches

Three push buttons are present on the board, SW2, SW3 and SW4. Currently is no function assigned to them.

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2.3 Jumpers

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

- **JP1 through JP6**: They are all used to select either the I²C-bus interface, or the SPI interface. They need to be all in the same position. The silk screen indicates which position to use for a given interface. Refer also to the datasheet.
- **JP7**: This jumper connects the V_{LCDOUT} and $V_{LCDSENSE}$ to the V_{LCDIN} pin of the PCA2117. It must be placed if the internal voltage generation is used.
- **JP8**: This jumper connects the V_{LCDIN} pin of the LCD driver to the external voltage VLCD_EXT from regulator IC1. However, if also the internal voltage generator is enabled, this can cause damage to the LCD driver.
- **JP9**: This jumper may not have been soldered into the board during manufacturing. Instead, a 0 Ω resistor (R0) 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 V_{DD} pins of the PCA2117. After measurements, a jumper header can be inserted.

2.4 Use of internal/external oscillator

The PCA2117 offers the option of using the internal oscillator or to use an external oscillator. Resistor jumper R13 (0 Ω) connects the OSC pin to V_{SS} for selecting the internal oscillator. If an external oscillator signal is desired, R13 must be removed and R12 must be mounted. If the internal oscillator is used, the oscillator signal is available at connector pin “CLK”. If an external oscillator signal is used, this can be supplied to the LCD driver using this connector “CLK”.

2.5 Connectors

Besides the previously mentioned connectors, connector P3 contains the I²C and SPI signals, along with V_{SS} 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.

2.6 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

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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.

3. Display module

The display module is a GDV negative display with almost black background and a white backlight. It has a very high contrast (> 1:800), a very low loss of transmittance of the backlight (< 0.05 %) and a very large viewing angle.

4. Board schematic and layout of OM13502

On the next pages the circuit diagram and PCB layout of the OM13502 board are given. Refer to Fig 2 and Fig 3.

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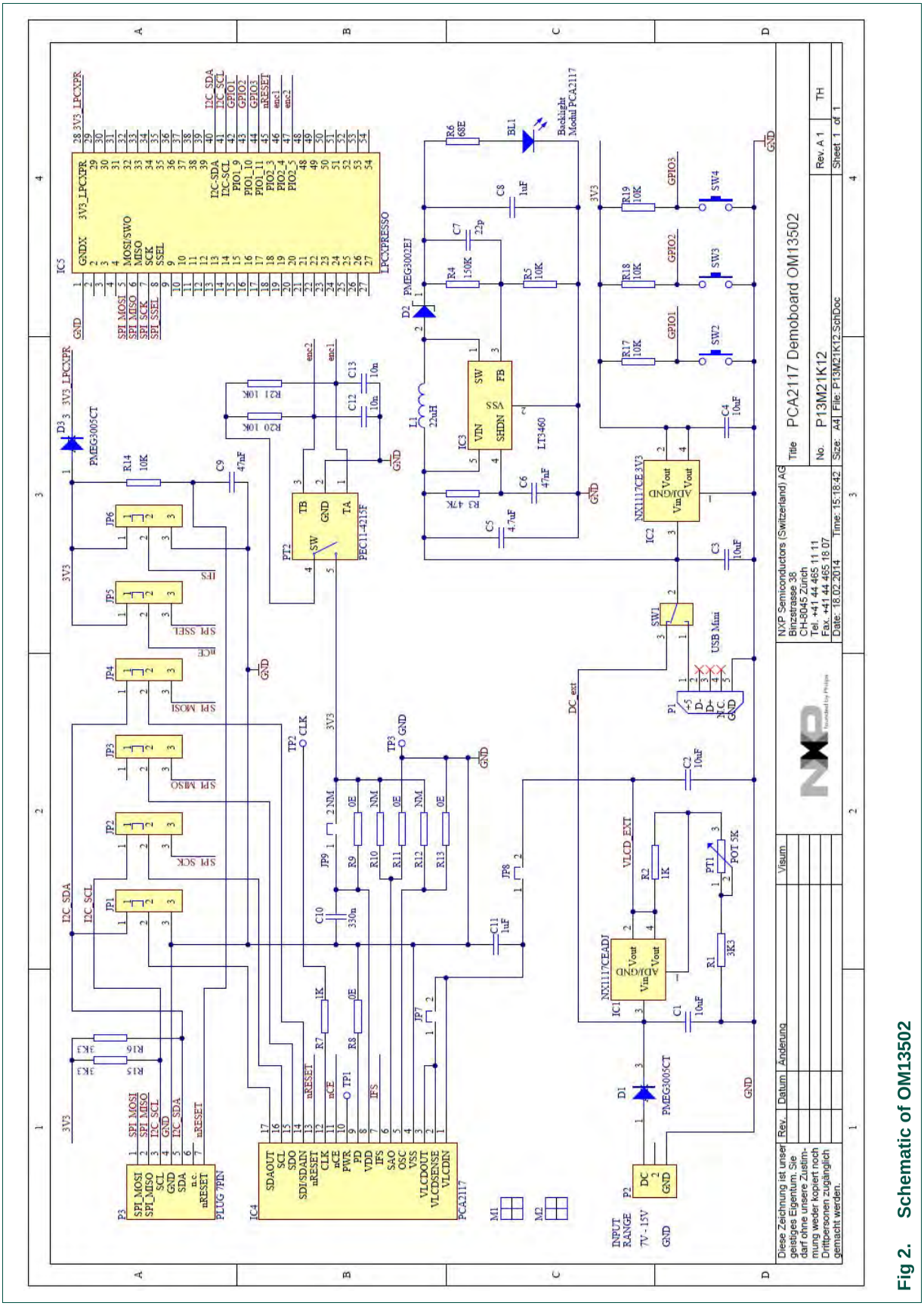


Fig 2. Schematic of OM13502

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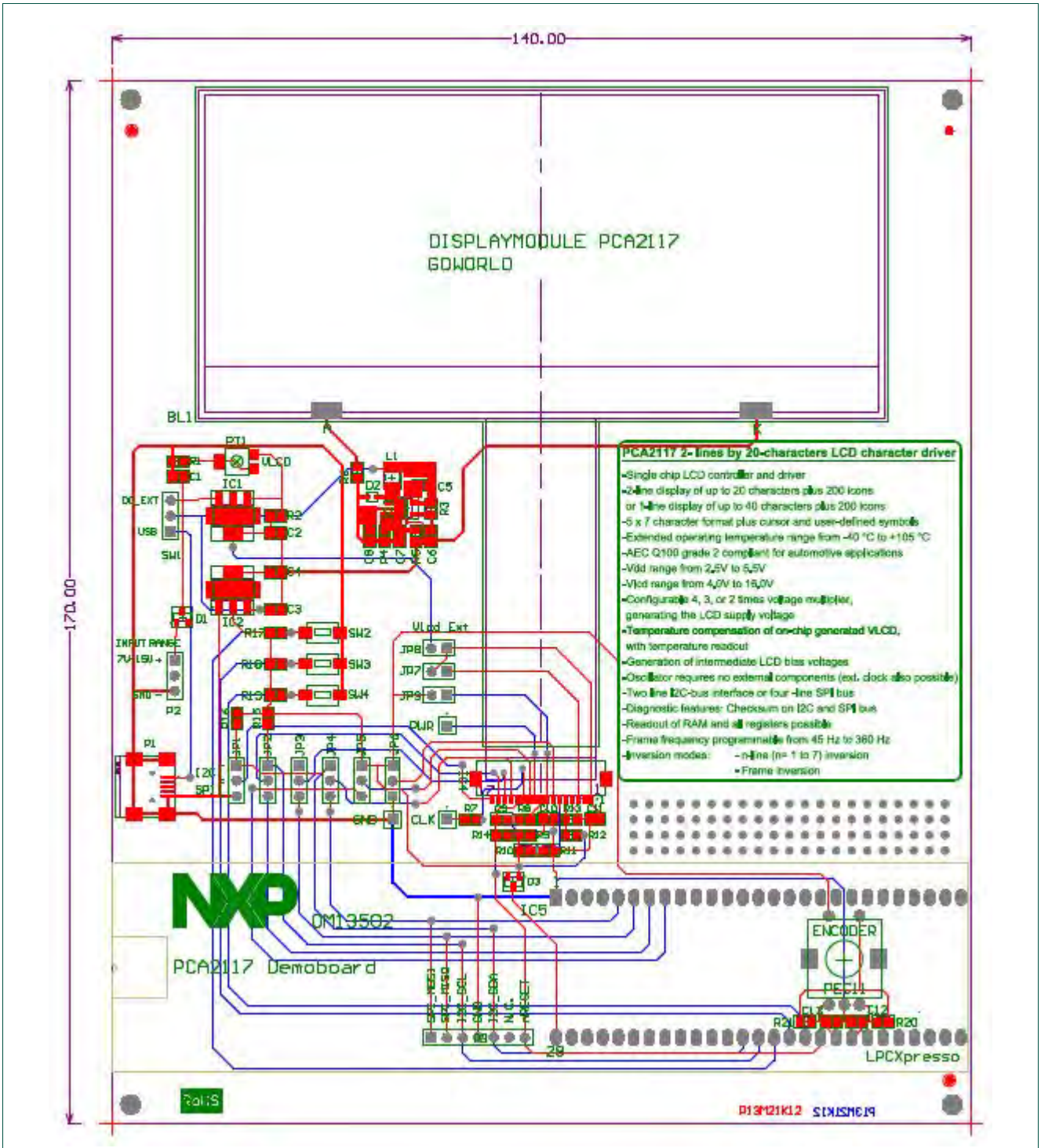


Fig 3. PCB layout of OM13502, with the LPCXpresso board on the reverse side of the base board

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5. Software code example

The PCA2117 data sheet contains all the commands and their description. In order to write software for this driver, it is 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 PCA2117 to configure it for use with the module on this board.

```
//Initialize and configure PCA2117
I2CWrite = PCA2117_ADDR;
I2CWrite = 0b10000000;      // control byte
I2CWrite = 0x01;            // Initialize (chip wide reset)
I2CWrite = 0b10000000;      // control byte
I2CWrite = 0x1F;            // Clear reset flag
I2CWrite = 0b10000000;      // control byte
I2CWrite = 0x02;            // OTP refresh

delay_ms(40);

I2CWrite = PCA2117_ADDR;
I2CWrite = 0b10000000;      // control byte
I2CWrite = 0x21;            // Enable CLKOUT signal
I2CWrite = 0b10000000;      // control byte
I2CWrite = 0x50;            // RAM_ROM_Config: Column 1, 2 CGROM
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x20;            // Disp ctrl; display disable, no blink
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x2A;            // Entry Mode. DDRAM incr. by 1, no sh
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x32;            // Function set, 2-line,20char, MUX1:18
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x40;            // Set to frame inversion
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x92;            // Set frame frequency to 210 Hz
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x00;            // Command clear display
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x10;            // Cursor display shift. Move cursor.
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x02;            // Screen config, split screen standard
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x07;            // Display config. R to L, bot. to top
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x08;            // Icon config. Full display, no blink
I2CWrite = 0b11100000;      // control byte
I2CWrite = 0x86;            // Charge pump control. Charge pump 4x
I2CWrite = 0b11100000;      // control byte
I2CWrite = 0xAC;            // VLCD_A MSB (factor = 203, 10.1 V)
I2CWrite = 0b11100000;      // control byte
I2CWrite = 0x9F;            // VLCD_A LSB   (factor = 203,10.1 V)
I2CWrite = 0b01100000;      // last control byte
```


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```
delay_ms(30);

I2CWrite = PCA2117_ADDR;
I2CWrite = 0b11000000;      // control byte
I2CWrite = 0x24;            // Enable display
I2CWrite = 0b10000000;      // control byte
I2CWrite = 0x00;            // Register_update
```

6. 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] **PCA2117**: Product data sheet

[3] **UM10204**: I²C-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-echzone/news.html

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