Interfacing LCDs to OMAP-L138 eXperimenter and EVM Baseboards

Application Note 418

Logic // Products
Published: December 2009

Abstract

This application note explains at a high-level how to interface LCD panels to the baseboard included in Zoom OMAP-L138 EVM and eXperimenter Kits.

This document contains valuable proprietary and confidential information and the attached file contains source code, ideas, and techniques that are owned by Logic Product Development Company (collectively “Logic’s Proprietary Information”). Logic’s Proprietary Information may not be used by or disclosed to any third party except under written license from Logic Product Development Company.

Logic Product Development Company makes no representation or warranties of any nature or kind regarding Logic’s Proprietary Information or any products offered by Logic Product Development Company. Logic’s Proprietary Information is disclosed herein pursuant and subject to the terms and conditions of a duly executed license or agreement to purchase or lease equipment. The only warranties made by Logic Product Development Company, if any, with respect to any products described in this document are set forth in such license or agreement. Logic Product Development Company shall have no liability of any kind, express or implied, arising out of the use of the Information in this document, including direct, indirect, special or consequential damages.

Logic Product Development Company may have patents, patent applications, trademarks, copyrights, trade secrets, or other intellectual property rights pertaining to Logic’s Proprietary Information and products described in this document (collectively “Logic’s Intellectual Property”). Except as expressly provided in any written license or agreement from Logic Product Development Company, this document and the information contained therein does not create any license to Logic’s Intellectual Property.

The Information contained herein is subject to change without notice. Revisions may be issued regarding changes and/or additions.

© Copyright 2009, Logic Product Development Company. All Rights Reserved.

Revision History

REV	EDITOR	DESCRIPTION	APPROVAL	DATE
A	JCA, SV	Initial release	SV	12/09/09

Logic Product Development Company, All Rights Reserved

Table of Contents

1 Introduction 1
2 Interfacing LCDs to OMAP-L138 Baseboards 1
2.1 Options 1
2.2 The OMAP-L138 Baseboard and LCD Interface 2
2.2.1 The OMAP-L138 Baseboard 2
2.2.2 Display Signals 3
2.2.3 Power Signals and Power Enable Signals 4
2.3 User Display Interfacing: A Process Guide 5

 Logic Product Development Company, All Rights Reserved

1 Introduction

This application note guides you through the steps to interface an LCD (Liquid Crystal Display) to the Zoom OMAP-L138 EVM and eXperimenter Kit baseboards. Included are steps for users who have chosen Logic's displays and services, as well as steps for those who have chosen other display products. Since each LCD and software configuration is unique, it is beyond the scope of this document to provide details for every scenario. Therefore, the intention of this document is to point you in the right direction so that you may confidently approach your particular situation.

The most frequently asked question about displays and Development Kits is: "Will this SOM work with this display?" The answer is typically "yes"—for STN (mono and color), CSTN, TFT, ADTFT, and HRTFT displays—qualified by fact that users must verify this conclusion with the appropriate documentation: SOM specification, LCD controller specification, processor specification (in most cases), and an LCD specification.

Logic urges customers who are not familiar with displays and LCD controllers to (1) use the available support channels, and (2) study available specification manuals before trying to interface an LCD to the baseboard.

2 Interfacing LCDs to OMAP-L138 Baseboards

2.1 Options

You have three options for interfacing a display with an OMAP-L138 baseboard.

1. Buy a Logic Display Kit: www.logicpd.com/products/display-kits
    a. What value does this provide?
        i. Application development begins immediately.
        ii. Schematics are provided for the interface, saving engineering time.
        iii. No time is lost on acquiring a display, touch screen, inverter, cable, etc.
    b. **Note:** Logic does not sell components from the kit separately.
2. Allow Logic to do all of the interfacing for you:
    a. Set up a contract. www.logicpd.com/product-support/support-packages
    b. Contact Logic. Logic can do as much or as little as you want, including:
        i. Hardware integration
            1. Acquire display
            2. Acquire touch
            3. Acquire backlight inverter power supply
            4. Create a custom professional cable and custom circuit board, if necessary
        ii. Software integration
            1. Determine the correct LCD controller registers for the display
            2. Integrate the LCD settings into the software display driver
        iii. Design reviews
            1. Logic can review your schematics for your product design

 Logic Product Development Company, All Rights Reserved

c. What value does this provide?

i. Logic has a great deal of experience interfacing displays, so you know you will receive a quality end-product on time.

ii. Logic will add the display mode to the software source code, meaning you will not have to do any software work besides picking the correct mode from the registry.

iii. You don't spend time and money acquiring the components, designing the interface circuit, determining the correct register values in the LCD controller, and modifying the software to reflect the new display mode.

iv. Logic can provide indispensable feedback on your design schematics, which can eliminate costly board spins.

3. Interface the display yourself

a. Use this document as a reference. It provides the hardware information and the processes that you need to get a display working with your OMAP-L138 EVM or eXperimenter Kit.

2.2 The OMAP-L138 Baseboard and LCD Interface

2.2.1 The OMAP-L138 Baseboard

The OMAP-L138 baseboards have a 60-pin 0.100" header at reference designator J15 that connects all of the LCD signals directly from the SOM's LCD controller. Depending on your specific display, only a few of the LCD signals may be needed. The arrow in Figure 2.1 shows the baseboard location of the LCD connector and the baseboard silkscreen will indicate where pins 1 and 60 are located on the connector. Figure 2.2 provides signal connection information.

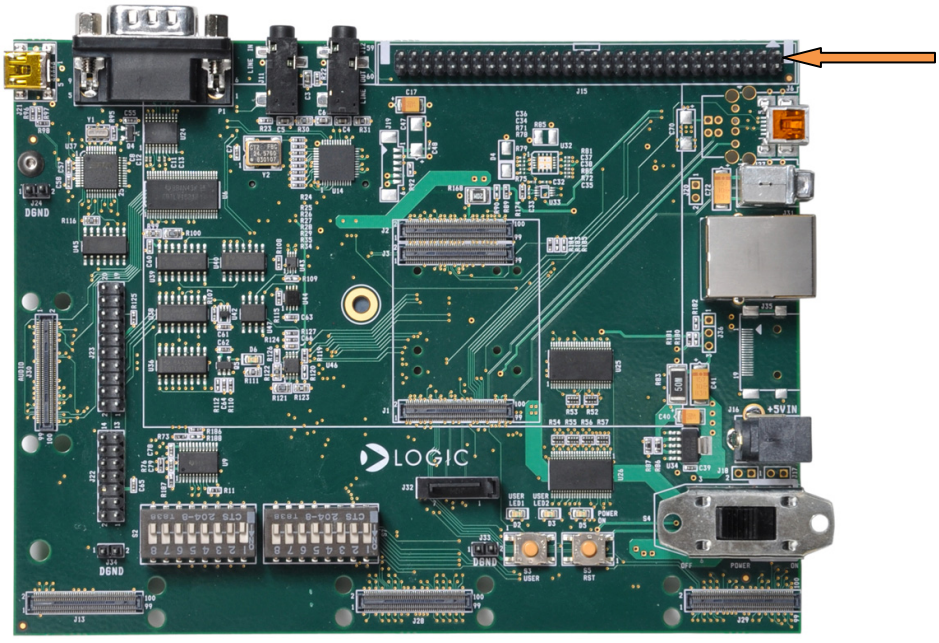

Figure 2.1: 60-pin LCD Connector on the OMAP-L138 Baseboard

 Logic Product Development Company, All Rights Reserved

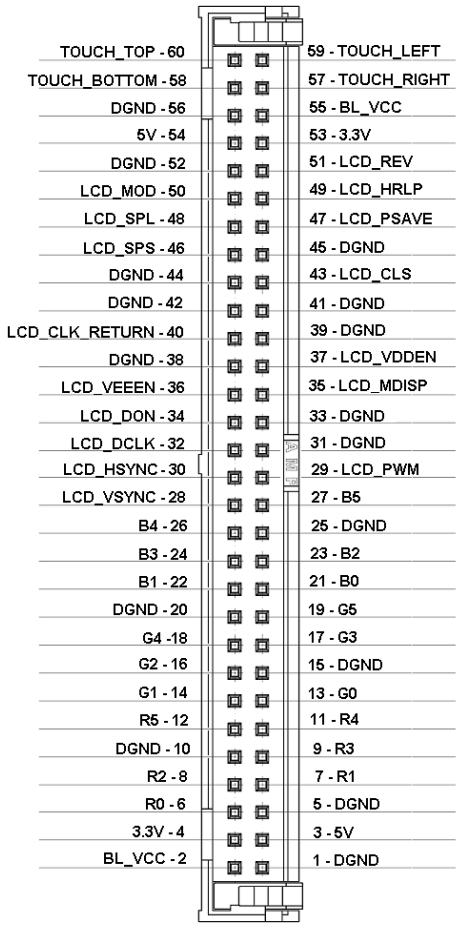

Figure 2.2: Signal Connection Information

2.2.2 Display Signals

The display signals should be adequate for any ADTFT, TFT, or STN display. Table 2.1 provides examples of connections to each display type.

 Logic Product Development Company, All Rights Reserved

Table 2.1: Connection Examples for Each Display Type

Display Interfacing Table	
Example TFT Display	
Typical Signals	**Baseboard Signals**
B0 - B5	B0 - B5
G0 - G5	G0 - G5
R0 - R5	R0 - R5
Hsync	LCD_HSYNC
Vsync	LCD_VSYNC
Dclk	LCD_DCLK
ENAB / DISP	LCD_MDISP
Example ADTFT/HRTFT Display	
Typical Signals	**Baseboard Signals**
B0 - B5	B0 - B5
G0 - G5	G0 - G5
R0 - R5	R0 - R5
MOD	LCD_MOD
SPL	LCD_SPL
SPS	LCD_SPS
REV	LCD_REV
HRLP	LCD_HRLP
PSAVE	LCD_PSAVE
CLS	LCD_CLS
Example STN Display	
Typical Signals	**Baseboard Signals**
D0-D15	* B0-B5, G0-G5,R0-R5
FLM (Frame)	LCD_VSYNC
CL1 (Load)	LCD_HSYNC
CL2 (CP)	LCD_DCLK
M	LCD_MDISP
* Each SOM maps the D0-D15 pins differently to the Color Bits. For example, B2 might be the LCD controller's D4 pin. The table showing the mapping of Colors bits to LCD Data signals is located on the specific SOM schematics. * STN (mono/color) displays will typically use 4 or 8 data signals, meaning all of the data signals would not be used.	

Note: The signals displayed above are the most common signals you will see in the industry. Also, LCD manufacturers may have chosen different names for signals displayed in this table.

2.2.3 Power Signals and Power Enable Signals

There are several power signals and power enable signals. Display signals have been noted in Table 2.1. Table 2.2 is a description of the power and power enable signals.

 Logic Product Development Company, All Rights Reserved

Table 2.2: Power and Enable Signals Description

Baseboard Signals	Description
5V	5V Power Supply
3.3V	3.3V Power Supply
LCD_DON	[1]DON signal
LCD_VDDEN	VDD enable
LCD_VEEEN	[1]VEE enable
DGND	Ground
LCD_PWM	*No circuitry on OMAP-L138 baseboard*
BL_VCC	[2]Alternative Backlight Power

[1]Available on some SOMs, please see SOM specification for availability of this signal.

[2]If an alternative Power Supply is needed besides 3.3V or 5V, a power supply may be hooked up to baseboard power-input connector. This power supply will then be available on BL_VCC.

2.3 User Display Interfacing: A Process Guide

1. Acquire components:
    a. Display
    b. Touch screen (if needed)
    c. Backlight inverter (if needed)
2. Create a custom cable and circuit board using:
    a. LCD specification, including:
        i. Signals needed
        ii. Necessary power supplies
        iii. Backlight info
        iv. Touch info (if it is a built-in touch screen)
        v. Notes:
            1. The LCD controller is typically built into the processor; therefore, the processor specification should be used in such a situation.
            2. This is created by the silicon manufacturer, not Logic.
    b. This application note, including:
        i. Pinout
        ii. Example signal interfacing
        iii. Short signal descriptions
    c. LCD controller specification; highlights:
        i. This document provides the best description of each signal.
        ii. Notes:

 Logic Product Development Company, All Rights Reserved

1. The LCD controller is typically built into the processor; therefore, the processor specification should be used in such a situation.
2. This is created by the silicon manufacturer, not Logic.

d. OMAP-L138 Baseboard Schematic, providing:
   i. Available signals
   ii. Pinout

e. OMAP-L138 SOM-M1 Schematic, providing:
   i. Available signals
   ii. A depiction of how signals are mapped to the LCD controller

f. OMAP-L138 SOM-M1 Hardware Specification, providing:
   i. Available signals
   ii. Short descriptions of functions

3. Fabricate the circuit board and/or cable
   a. For custom cables, Logic typically uses the company Quadrangle Products Inc. to create the cabling. You can find information by searching for Quadrangle Products on the web. *Please note that Logic has no affiliation with Quadrangle Products and only provides this information based on past experience; there are other companies that provide similar services.*
4. Determine LCD controller register settings using:
   a. LCD controller specification
      i. This is the most important in terms of figuring out the register settings for the display. This information is not provided in the SOM Hardware Specification.
      ii. Notes:
         1. The LCD controller is typically built into the processor; therefore, the processor specification should be referenced.
         2. This is created by the silicon manufacturer, not Logic.
   b. LCD specification
      i. Typically gives timing characteristics.
   c. Software user manual / documentation (specific to the software being used, e.g., U-Boot, Linux)
      i. Applicable document describes the process of entering new modes into the display driver.
      ii. The following BSL files show the low level LCD controller configuration and some plotting functions:
         1. C:\CCStudio_v3.3\boards\evmomapl138_v1\bsl\inc\evmomapl138_lcd_raster.h
         2. C:\CCStudio_v3.3\boards\evmomapl138_v1\bsl\src\evmomapl138_lcd_raster.c
      iii. The following example code file shows some examples of how to use the above functions:

 Logic Product Development Company, All Rights Reserved

1. C:\CCStudio_v3.3\boards\evmomapl138_v1\tests\evm\lcd_graphics\src\test_lcd_graphics.c

5. Once the LCD controller registers have been calculated, it is time to test them out on the hardware.
    a. Software user manual / documentation / BSL (specific to software being used, e.g., U-Boot, Linux)
        i. Applicable document describes the process of entering new modes into the display driver.
        ii. The following BSL files show the low level LCD controller configuration and some plotting functions:
            1. C:\CCStudio_v3.3\boards\evmomapl138_v1\bsl\inc\evmomapl138_lcd_raster.h
            2. C:\CCStudio_v3.3\boards\evmomapl138_v1\bsl\src\evmomapl138_lcd_raster.c
        iii. The following example code file shows some examples of how to use the above functions:
            1. C:\CCStudio_v3.3\boards\evmomapl138_v1\tests\evm\lcd_graphics\src\test_lcd_graphics.c

 Logic Product Development Company, All Rights Reserved