Interfacing LCD's to Logic's SDK Board
Application Note 161

Michael Aanenson

Logic Product Development

Published: November 2003

Abstract

This application note explains how to interface LCD panels to Logic's Zoom Starter Development Kits.

REVISION HISTORY

REV	EDITOR	DESCRIPTION	APPROVAL	DATE
A	Michael Aanenson	Release	HAR	12/04/03

1 Introduction

This document guides you through the necessary steps to interface a LCD to Logic's SDK board; this document includes steps for users who have chosen Logic's displays and services, as well as steps for users who have chosen alternative display products. Since each LCD, Card Engine/LCD Controller, and Software configuration is unique, it is beyond the scope of this document to provide details for every conceivable scenario. Therefore, the intention of this document is to point users in the right direction so that they may confidently approach their particular situation.

The most frequently asked question about displays and Card Engines/SDK's is: "*Will this card engine 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 information in a Card Engine Specification, LCD Controller Specification (the Processor Spec in most cases), and a LCD Specification. Keep in mind that most card engines will display up to at least SVGA (800x600) resolution.

Free support is provided on the LPD Technical Discussion Group for help with answering frequently asked questions; for direct phone/email support, please set up a contract with LPD. 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 a LCD to a SDK board.

2 Interfacing LCD's to SDK Boards

2.1 Options

You have three options for interfacing a display with a SDK board.

1) Buy a Logic Product Development Display Kit (several Kits available):
   a. http://www.logicpd.com/eps/peripherals.php
   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: LPD does not sell components from the kit separately.

2) Allow Logic Product Development to do all of the interfacing for you:
   a. Set up a contract. http://www.logicpd.com/support/supportpackages.php
   b. Contact Logic. LPD 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 a 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. LogicPD can review your schematics for your product design.
   What value does this provide?
        iv. Logic has a great deal of experience interfacing displays, so you know you will receive a quality end product on time.

    v. 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.

    vi. 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.

    vii. Logic PD 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 SDK.

2.2 The SDK Board and LCD Interface

2.2.1 The SDK Board

The SDK board has a 2x30 pin 0.100" header (Amp 1-104128-0) that connects all of the LCD signals directly from the card engine's LCD controller. Depending on your specific display, only a few of the LCD signals may be needed. Figure 1 (below) provides an image of this connector, while Figure 2 (following page) provides signal connection information.
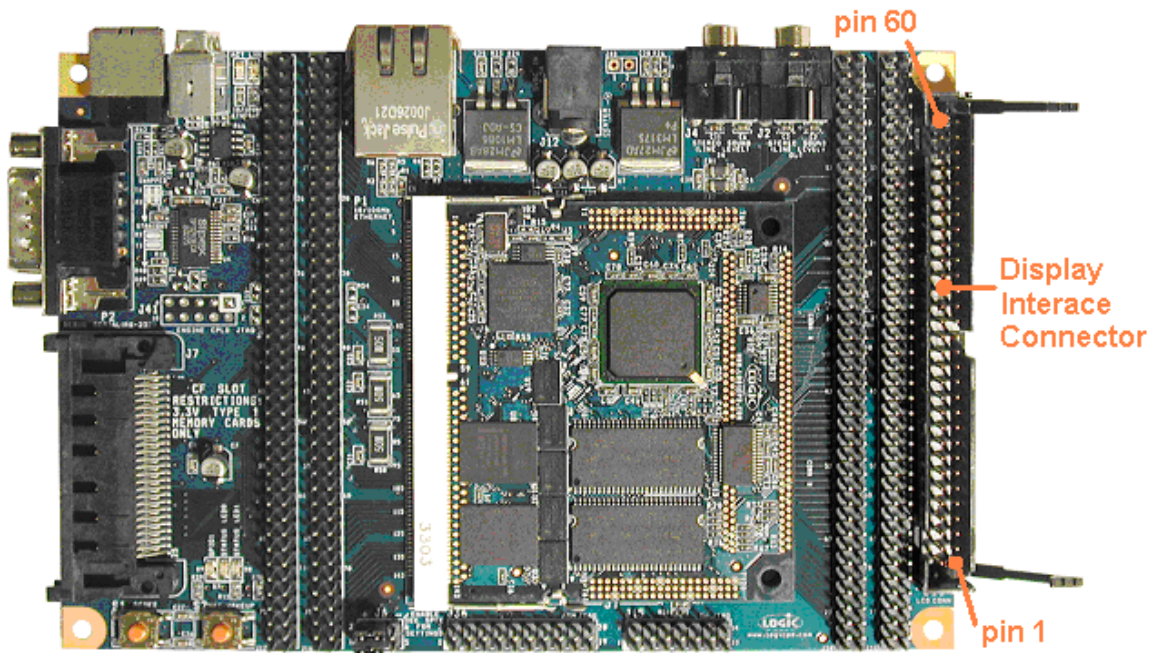

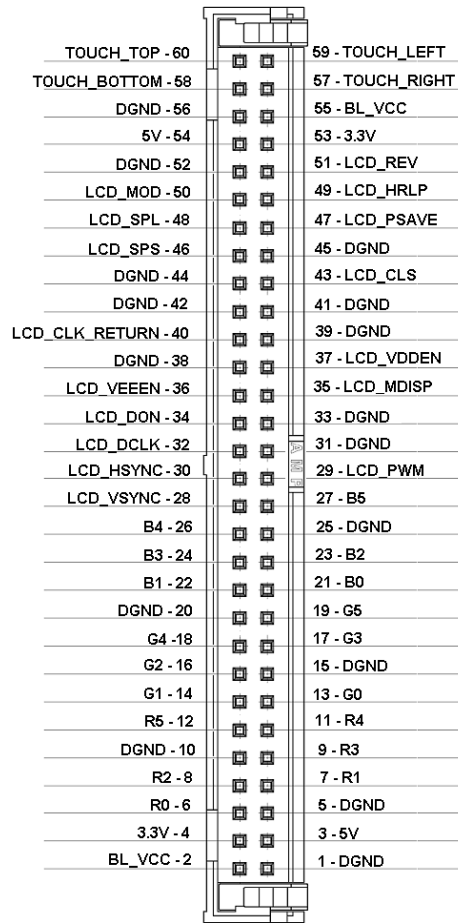*Figure 1: The 60 Pin Integrated LCD, Touch, and Backlight Connector*

Left	Right
TOUCH_TOP - 60	59 - TOUCH_LEFT
TOUCH_BOTTOM - 58	57 - TOUCH_RIGHT
DGND - 56	55 - BL_VCC
5V - 54	53 - 3.3V
DGND - 52	51 - LCD_REV
LCD_MOD - 50	49 - LCD_HRLP
LCD_SPL - 48	47 - LCD_PSAVE
LCD_SPS - 46	45 - DGND
DGND - 44	43 - LCD_CLS
DGND - 42	41 - DGND
LCD_CLK_RETURN - 40	39 - DGND
DGND - 38	37 - LCD_VDDEN
LCD_VEEEN - 36	35 - LCD_MDISP
LCD_DON - 34	33 - DGND
LCD_DCLK - 32	31 - DGND
LCD_HSYNC - 30	29 - LCD_PWM
LCD_VSYNC - 28	27 - B5
B4 - 26	25 - DGND
B3 - 24	23 - B2
B1 - 22	21 - B0
DGND - 20	19 - G5
G4 -18	17 - G3
G2 - 16	15 - DGND
G1 - 14	13 - G0
R5 - 12	11 - R4
DGND - 10	9 - R3
R2 - 8	7 - R1
R0 - 6	5 - DGND
3.3V - 4	3 - 5V
BL_VCC - 2	1 - DGND

Figure 2: Signal Connection Information: Amp Part Number 1-104128-0

2.2.2 Display Signals

The display signals should be adequate for any ADTFT, TFT, or STN display. Table 1 (below) provides examples of connections to each display type.

Display Interfacing Table	
Exmaple TFT Display Typical Signals	**SDK 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
Exmaple ADTFT / HRTFT Display Typical Signals	**SDK 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	**SDK Signals**
Typical 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 Card Engine 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 Card Engine schematics. * STN (mono/color) displays will typically use 4 or 8 data signals, meaning all of the data signals would not be used.	

Table 1: Connection Examples for each Display Type

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 1 (previous page). Table 2 (below) is a timing diagram of the power and power enable signals.

SDK 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 SDK board*
BL_VCC	[2]Alternative Backlight Power

[1]Available on some card engines, please see card engine spec 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 J40 on the SDK. This power supply will then be available on BL_VCC.

Table 2: Enable Signals Timing Diagram

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 Spec, 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 spec should be used in such a situation.
         (2) This is created by the silicon manufacturer, not LPD.
   b) This Document, including:
      i) Pinout
      ii) Example signal interfacing
      iii) Short signal descriptions
   c) LCD Controller Spec; highlights:
      i) This document provides the best description of each signal.
      ii) Notes:
         (1) The LCD controller is typically built into the processor, therefore the processor spec should be used in such a situation.
         (2) This is created by the silicon manufacturer, not LPD.
   d) SDK Schematic, providing:
      i) Available signals

        ii)   Pinout
   e) Card Engine schematic, providing:
        i)   Available signals
        ii)   A depiction of how signals are mapped to the LCD controller
   f) Card Engine Spec, providing:
        i)   Available signals
        ii)   Short descriptions of functions

3) Fabricate the Board and/or Cable.
   a) For custom cables, Logic typically uses the company Quadrangle to create custom cabling. You can find information by searching for Quadrangle Products on the web. *Please note that Logic has no affiliation with Quadrangle and only provides this useful information based on past experience. Certainly there are other companies that provide similar services.*

4) Determine LCD Controller register settings using:
   a) LCD Controller Spec:
        i)   This is the most important in terms of figuring out the register settings for the display. This information is not provided in the Card Engine Spec.
        ii)   Notes:
            (1) The LCD controller is typically built into the processor, therefore the processor spec should be used in such a situation.
            (2) This is created by the silicon manufacturer, not LPD.
   b) LCD Spec:
        i)   Typically gives timing characteristics.
   c) LPD software user manual/ documentation (Specific to software being used, e.g. LogicLoader, LoCE, Linux, etc.)
        i)   Applicable document describes the process of entering new modes into the Display Driver.

5) Once the LCD controller registers have been calculated, it is time to test them out on the hardware.
   a) LPD software user manual/ documentation (Specific to software being used, e.g. LogicLoader, LoCE, Linux, etc.)
        i)   Applicable document describes the process of entering new modes into the Display Driver.