LCD8000-43T-EX1/ LCD8000-70T-EX1

A Portable LCD Solution for Atmel SAMA5D3 Xplained

By

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DISCLAIMER

This product is intended to be used for **ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY** and is not considered by element14 to be a finished end product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards.

The goods being provided are not intended to be complete in terms of required design and/or manufacturing related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards.

Revision History:

Version	Date	Description
1.0	30/7/2014	Original Version

Table of Contents

1 Product Overview

1.1 Brief Introduction

LCD-EX is a 16/24-bit RGB parallel conversion module designed for TFT-LCD displays. The module integrates a TSC2046 chip to provide touch functionality and a 3.3V regulation chip with the capability to implement I^2C control and PWM backlight control. It supports 16-bit and 24-bit driving modes for LCD displays, as well as the connection of SPI 4-wire resistive touch-screens.

1.2 Block Diagrams

Figure 1 shown below, is a block diagram demonstrating how the LCD-EX works when using a 16-bit logic interface.

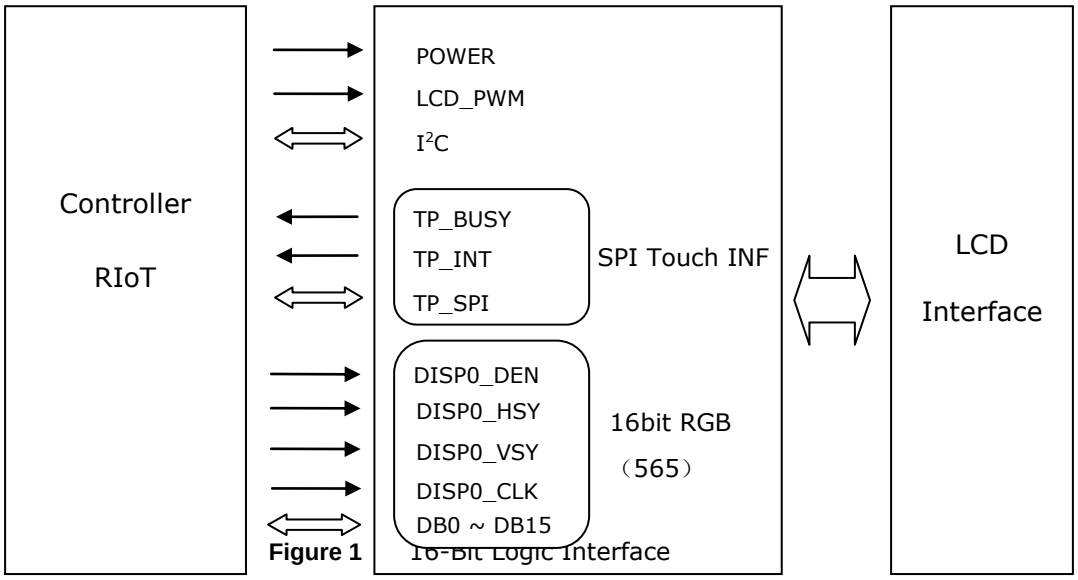

Figure 1

Figure 2 shown below, is a block diagram demonstrating how LCD-EX works when using 24-bit logic interface.

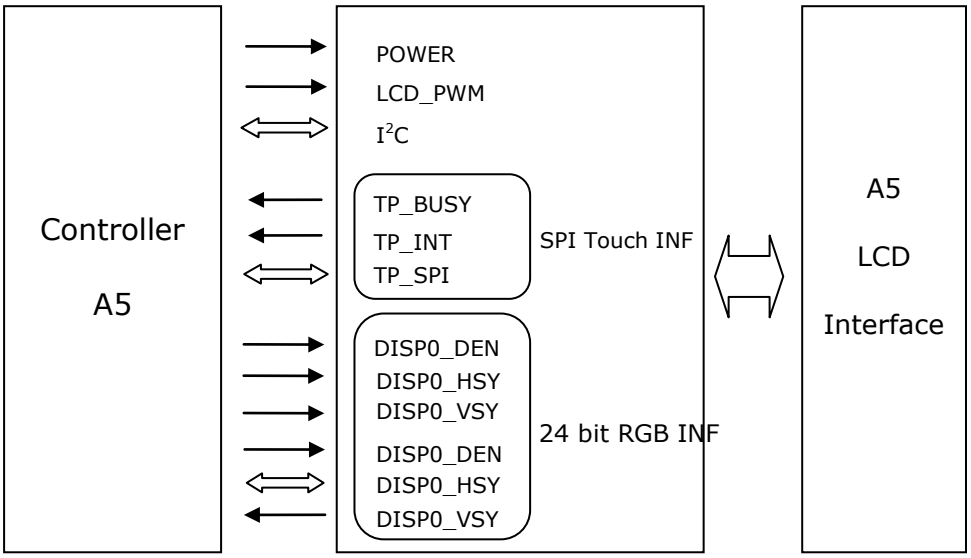

Figure 2 24-Bit Logic Interface

2 Interfaces on LCD-EX

2.1 Locations and Types of Interfaces

The following images show the locations of the interfaces on LCD-EX.

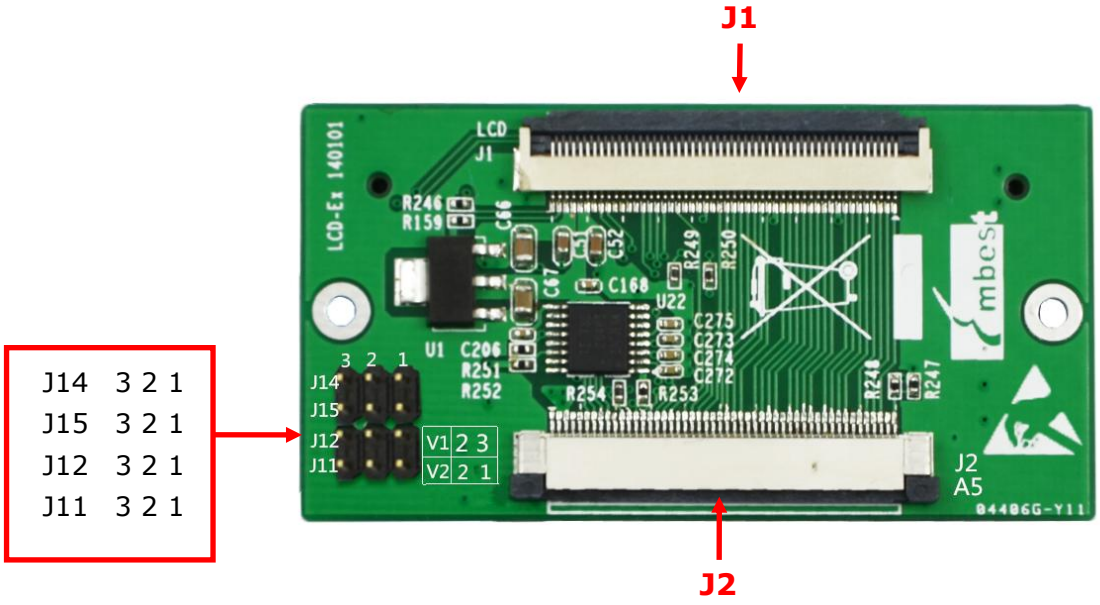

Figure 3 J1/J2 Interfaces

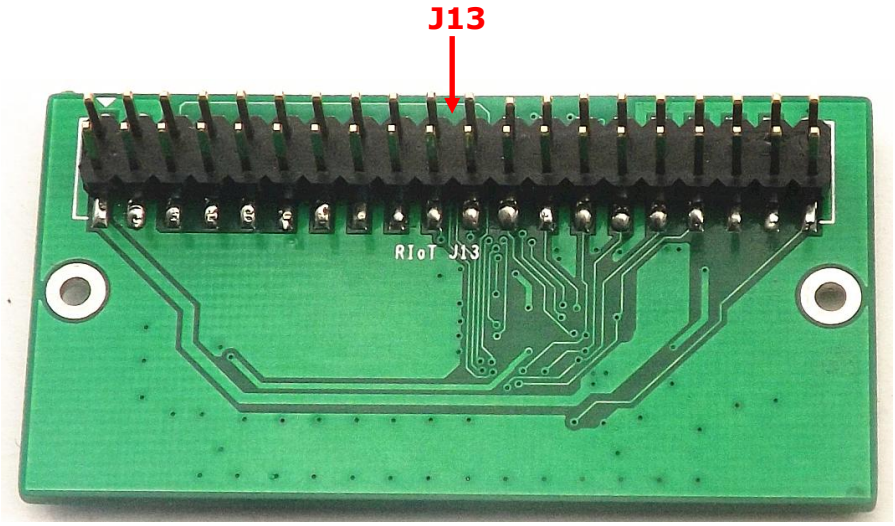

Figure 4 J13 Interface

The following table lists the descriptions of the interfaces on LCD-EX.

Name	Description
J1	50-Pin interface for coloured display
J2	24-bit RGB A5 interface
J13	16-bit 565 RIoT interface
J11	SPI line module Select
J12	
J14	
J15	

2.2 Pin Definitions of Interfaces

The following tables contain detailed information about the interfaces on LCD-EX.

2.2.1 Pin Definitions of J1

Pin	Definition	Description
1	B0	Blue Data0
2	B1	Blue Data1
3	B2	Blue Data2
4	B3	Blue Data3
5	B4	Blue Data4
6	B5	Blue Data5
7	B6	Blue Data6
8	B7	Blue Data7
9	GND	GND

Pin	Definition	Description
10	G0	Green Data0
11	G1	Green Data1
12	G2	Green Data2
13	G3	Green Data3
14	G4	Green Data4
15	G5	Green Data5
16	G6	Green Data6
17	G7	Green Data7
18	GND	GND
19	R0	Red Data0
20	R1	Red Data1
21	R2	Red Data2
22	R3	Red Data3
23	R4	Red Data4
24	R5	Red Data5
25	R6	Red Data6
26	R7	Red Data7
27	GND	GND
28	DEN	Pixel data enable (TFT)
29	HSYNC	LCD Horizontal Synchronization
30	VSYNC	LCD Vertical Synchronization
31	GND	GND
32	CLK	LCD Pixel Clock

Pin	Definition	Description
33	GND	GND
34	X+	X+ Position Input
35	x-	X- Position Input
36	Y+	Y+ Position Input
37	Y-	Y - Position Input
38	SPI_CLK	SPI serial clock
39	SPI_MOSI	SPI Master Output, Slave Input
40	SPI_MISO	SPI Master Input, Slave Output
41	SPI_CS	SPI Chip Select
42	IIC_CLK	IIC master serial clock
43	IIC_DAT	IIC serial bidirectional data
44	GND	GND
45	VDD1	3.3V
46	VDD2	3.3V
47	VDD3	5V
48	VDD3	5V
49	RESET	Reset
50	PWREN	Backlight enable

2.2.2 Pin Definitions of J2

Pin	Definition	Description
1	GND	GND
2	5V	VCC Input
3	5V	VCC Input
4	NC	NC
5	LCD_PWM	Backlight enable
6	TP_BUSY	Touch Pad Busy Signal
7	TP_INT	Touch Pad Interrupt
8	I2C_CLK	IIC master serial clock
9	I2C_DAT	GND
10	NC	VCC Input
11	CSPI_CLK	VCC Input
12	CSPI_MOSI	NC
13	CSPI_MISO	Backlight enable
14	TP_SPI_SCSn	Touch Pad Busy Signal
15	DISP0_DEN	Touch Pad Interrupt
16	DISP0_HSYNC	IIC master serial clock
17	DISP0_VSYNC	IIC serial bidirectional data
18	DISP0_CLK	NC
19	GND	SPI serial clock
20	DISP0_DAT23	SPI Master Output, Slave Input
21	DISP0_DAT22	SPI Master Input, Slave Output
22	DISP0_DAT21	SPI Chip Select

23	DISP0_DAT20	Data enable (TFT)
24	GND	LCD Horizontal Synchronization
25	DISP0_DAT19	LCD Vertical Synchronization
26	DISP0_DAT18	DISP0_DAT18
27	DISP0_DAT17	DISP0_DAT17
28	DISP0_DAT16	DISP0_DAT16
29	GND	GND
30	DISP0_DAT15	DISP0_DAT15
31	DISP0_DAT14	DISP0_DAT14
32	DISP0_DAT13	DISP0_DAT13
33	DISP0_DAT12	DISP0_DAT12
34	GND	GND
35	DISP0_DAT11	DISP0_DAT11
36	DISP0_DAT10	DISP0_DAT10
37	DISP0_DAT9	DISP0_DAT9
38	DISP0_DAT8	DISP0_DAT8
39	GND	GND
40	DISP0_DAT7	DISP0_DAT7
41	DISP0_DAT6	DISP0_DAT6
42	DISP0_DAT5	DISP0_DAT5
43	DISP0_DAT4	DISP0_DAT4
44	GND	GND
45	DISP0_DAT3	DISP0_DAT3
46	DISP0_DAT2	DISP0_DAT2

47	DISP0_DAT1	DISP0_DAT1
48	DISP0_DAT0	DISP0_DAT0
49	GND	GND
50	ID_SYS	ID_SYS

2.2.3 Pin Definitions of J13

Pin	Definition	Description
1	NC	NC
2	5VIN	VCC Input
3	GND	GND
4	GND	GND
5	DISP0_CLK	LCD Pixel Clock
6	DISP0_DAT3	DISP0_DAT3
7	DISP0_DEN	Data enable (TFT)
8	DISP0_DAT4	DISP0_DAT4
9	DISP0_HSYNC	Horizontal Synchronization
10	DISP0_DAT5	DISP0_DAT5
11	DISP0_VSYNC	Vertical Synchronization
12	DISP0_DAT6	DISP0_DAT6
13	DISP0_DAT7	DISP0_DAT7
14	DISP0_DAT23	DISP0_DAT23
15	DISP0_DAT15	DISP0_DAT15
16	NC	NC
17	DISP0_DAT19	DISP0_DAT19

18	NC	NC
19	DISP0_DAT20	DISP0_DAT20
20	TBD	TBD
21	DISP0_DAT21	DISP0_DAT21
22	TBD	TBD
23	DISP0_DAT22	DISP0_DAT22
24	TP_BUSY	Touch Pad Busy Signal
25	DISP0_DAT10	DISP0_DAT10
26	TP_INT	Touch Pad Interrupt
27	DISP0_DAT11	DISP0_DAT11
28	CSPI_MOSI	SPI Master Output, Slave Input
29	DISP0_DAT12	DISP0_DAT12
30	CSPI_CLK	SPI Master Input, Slave Output
31	NC	NC
32	TP_SPI_SCSn	DISP0_DAT6
33	NC	NC
34	CSPI_MISO	DISP0_DAT5
35	I2C4_SCL	IIC master serial clock
36	DISP0_DAT13	DISP0_DAT13
37	I2C4_SDA	IIC serial bidirectional data
38	DISP0_DAT14	DISP0_DAT14
39	GND	GND
40	LCD_PWM	Backlight Enable

2.2.4 SPI Line Module Select

module	Application	Jumper cap select	The SPI module of SAMA5D3 Xplained (J22)
V 1	SAMA5D3 Xplained Version A	J11 PIN3------PIN2 J12 PIN3------PIN2 J14 PIN3------PIN2 J15 PIN3------PIN2	PIN 37 = SPI0_NPCS3 PIN 38 = SPI0_MISO PIN 39 = SPI0_MOSI PIN 40 = SPI0_SPCK
V 2	SAMA5D3 Xplained Version B	J11 PIN1------PIN2 J12 PIN1------PIN2 J14 PIN1------PIN2 J15 PIN1------PIN2	PIN 37 = SPI0_SPCK PIN 38 = SPI0_MOSI PIN 39 = SPI0_MISO PIN 40 = SPI0_NPCS3

3 Use of LCD-EX

Hereafter the SAMA5D3 Xplained development board and a 4.3” LCD module will be used as the example devices working with LCD-EX.

Note:

🕮 If using a 7” LCD module, it is recommended to use a mains power supply, **do not** use a PC based USB power supply.

3.1 Configuring the Kernel

1. The Linux kernel includes many DTS files suited for different kinds of chips and platforms. Assuming a 4.3” LCD display is used, the configuration file should be selected accordingly. (Different sizes of LCDs need different DTS files, but with similar configuration.)

Note:

🕮 The code marked in blue in the following examples can be modified to cater for different configurations.

3.1.1 Configuration File for 4.3” LCD

```
cd linux-3.10.0

vim arch/arm/boot/dts/ at91-sama5d3_xplained_pda4.dts

ahb {

   apb {

      mmc0: mmc@f0000000 {

         pinctrl-names = "default";

         pinctrl-0 = <&pinctrl_mmc0_clk_cmd_dat0 &pinctrl_mmc0_dat1_3
&pinctrl_mmc0_dat4_7 &pinctrl_mmc0_cd>;

         status = "okay";

         slot@0 {

            reg = <0>;
```

```
            bus-width = <8>;
            cd-gpios = <&pioE 0 GPIO_ACTIVE_LOW>;
        };
    };
    spi0: spi@f0004000 {
        cs-gpios = <&pioD 13 0>, <&pioD 16 0>, <0>, <0>;
        status = "okay";
        ads7846: touchscreen@0 {
            compatible = "ti,tsc2046";
            reg = <1>;
            spi-max-frequency = <1000000>;
            pinctrl-names = "default";
            pendown-gpio = <&pioE 7 0>;
            irq = <&pioE 7 0>;
            ti,settle-delay-usec = /bits/ 16 <150>;
            ti,debounce-max = /bits/ 16 <10>;
            ti,debounce-tol = /bits/ 16 <5>;
            ti,debounce-rep = /bits/ 16 <1>;
            ti,keep-vref-on = /bits/ 16 <1>;
            ti,x-min = /bits/ 16 <0>;
            ti,x-max = /bits/ 16 <8000>;
            ti,y-min = /bits/ 16 <0>;
            ti,y-max = /bits/ 16 <4800>;
            ti,x-plate-ohms = /bits/ 16 <40>;
            ti,pressure-max = /bits/ 16 <255>;
            linux,wakeup;
            status = "okay";
        };
    };
    can0: can@f000c000 {
        status = "okay";
    };
```

The IRQ register information of mxt needs to be removed when connecting a resistive touch-screen, because the atmel_mxt_ts IRQ pin of the display would be used by module driver too.

3.1.2 Remove IRQ Register Information

```
vim arch/arm/boot/dts/at91-sama5d3_xplained_dm_pda4.dtsi

ahb {

   apb {

      i2c1: i2c@f0018000 {

         qt1070: keyboard@1b {

            compatible = "qt1070";

            reg = <0x1b>;

            interrupt-parent = <&pioE>;

            interrupts = <8 0x0>;

            pinctrl-names = "default";

            pinctrl-0 = <&pinctrl_qt1070_irq>;

            wakeup-source;

         };


         atmel_mxt_ts@4a {

            compatible = "atmel,atmel_mxt_ts";

            reg = <0x4a>;

            /*

            interrupt-parent = <&pioE>;

            interrupts = <7 0x0>;

            pinctrl-names = "default";

            pinctrl-0 = <&pinctrl_mxt_ts>;

            */

            status = "okay";

         };

      };
```

3.1.3 Configuring the kernel to include drivers for TSC2045.

```
make ARCH=arm menuconfig

Device Drivers  --->

  Input device support  --->

    [*]   Touchscreens  --->

      <*>   ADS7846/TSC2046/AD7873 and AD(S)7843 based touchscreens
```

2. Execute the following instructions to recompile the kernel

   - **make ARCH=arm CROSS_COMPILE=arm-none-linux-gnueabi- dtbs**
   - **make ARCH=arm CROSS_COMPILE=arm-none-linux-gnueabi- uImage**

3. The image files generated can be found under the following directories:

   DTB image: arch/arm/boot/dts/at91-sama5d3_xplained_pda4.dtb

   uImage: arch/arm/boot/uImage

3.2 Connections and Tests

1. Use two flat ribbon cables with pins on same side to connect the conversion module, SAMA5D3 Xplained and LCD module together as shown below.

Figure 5 Hardware Connections

2. Connect the debugging serial interface of the SAMA5D3 Xplained to a PC and then power on the development board.

3. Update the system with the new uImage and at91-sama5d3_xplained_pda4.dtb, and then reboot to enter the Linux system.

4. Execute the following instruction to view the device node of the touch-screen.

   - root@sama5d3_xplained:~# **dmesg |grep -ir ads7846**

The terminal window shows the following information:

```
ads7846 spi0.1: touchscreen, irq 52

input: ADS7846 Touchscreen as
/devices/ahb.0/apb.1/f0004000.spi/spi_master/spi0/spi0.1/input/input0
```

Note:

- The characters above marked in blue represent the device node.
- input0 is associated to /dev/input/event0, input1 is associated to /dev/input/event1, and so on.

5. Execute the following instruction to set environment variable for tslib:

```
root@sama5d3_xplained:~# export TSLIB_TSDEVICE=/dev/input/event0
```

6. Execute the following instruction to run a calibration on touch-screen:

```
root@sama5d3_xplained:~# ts_calibrate
```

7. Execute the following instruction to test touch-screen:

```
root@sama5d3_xplained:~# ts_test
```

4 Troubleshooting

Please note the following common issues which can be encountered when connecting hardware to LCD-EX:

1. If the touch-screen is not as precise as it should be after screen calibration, please check the connection between the module and the flat ribbon cable to ensure that the 4 touch interface pins on the module are correctly connected to the pins of the touch-screen.

2. There are two 50-pin PFC interfaces on the module named J1 and J2 respectively. J1 is a flip-lock connector used to connect LCDs, J2 is a slide-lock connector used to connect controllers. LCD displays will not function correctly if connected to the wrong interface.