
AVR1909: Display Xplained Hardware User's Guide

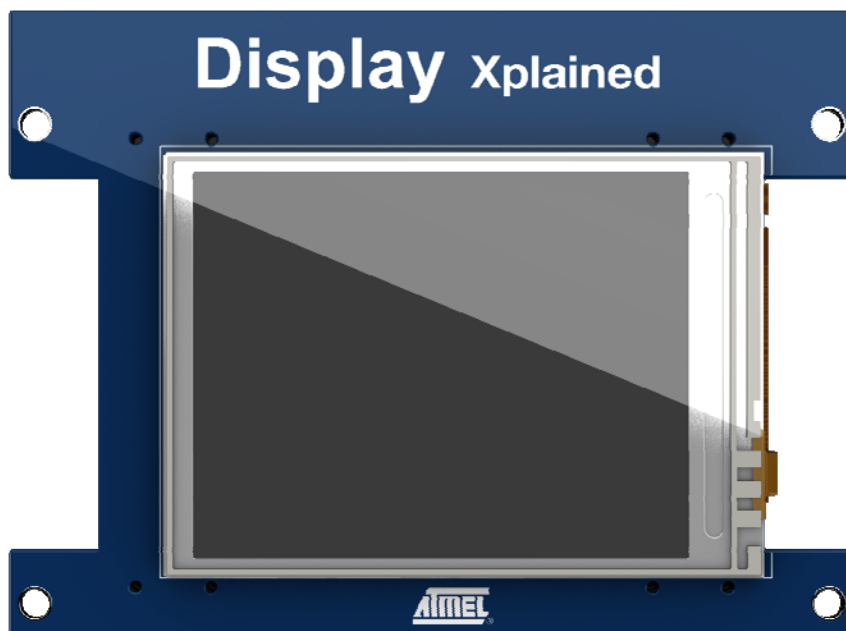
Features

- 240 x 320 (QVGA) graphical TFT display
 - With resistive touch
 - LED Backlight
 - Internal controller
- Simple SPI interface for control
- Digital (PWM) control interface for backlight
- One 40pin, 0.5mm FPC connector
- Display and backlight powered by single 3.3V

1 Introduction

The Display Xplained module gives the possibility to evaluate a 240 x 320 pixel (QVGA) graphical RGB TFT display with a 4-wire touch interface and LED backlight. The display is interfaced with a simple SPI interface to send and receive commands and data. The Xplain kit provides tested low-level drivers and high-level functions in order to get the developer quickly up to speed with his application development.

Figure 1-1. Display Xplained evaluation module.



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Application Note

Rev. 8297A-AVR-04/10



2 Related Items

Datasheet for the LCD module (ET024006DHU) from EDT can be found here:
<http://www.farnell.com/datasheets/86386.pdf>

Datasheet for the graphical controller (HX8347-A) from Himax can be obtained by contacting EDT. It may also found on the web.

Firmware for Xplain kit can be found here:
<http://www.atmel.com/Xplain>

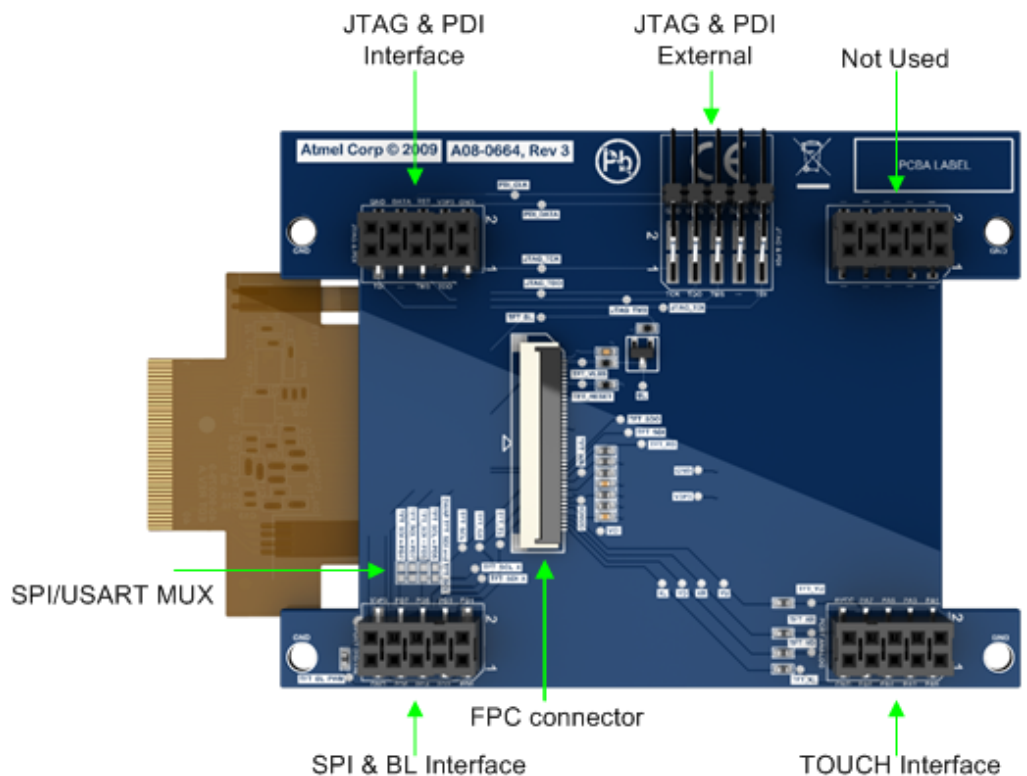
Also checkout these application note:

- AVR1913: Display Xplained Firmware – Getting Started training
- AVR1921: Reprogramming the Xplain AT90USB1287 and ATxmega128A1
- AVR1922: Xplain Board Controller Firmware

3 General information

The LCD module (ET024006DHU from EDT) has a 240 x 320 pixel resolution, with up to 6 bit pr color, giving 256k colors. The Display Xplained board uses a regular 4-wire SPI interface to access the display. The touch interface is a 4-wire resistive touch that should be interfaced to ADC/IO pins to work. The backlight system has three white LEDs in parallel that can draw up to 60mA at 3.3V. For further details see the datasheet from EDT.

Figure 3-1. Overview of the Xplain kit backside.



The Display Xplained module is quite simple. It basically connects the TFT display SPI interface, resistive touch interface, and backlight interface from a 40pin FPC connector to two female pin-headers that fit the Xplain kit.

In addition it has a program/debug interface that will connect an external programmer/debugger to the Xplain kit through a male and a female pin-header.

3.1 The LCD Module

The LCD module is produced by EDT (Emerging Display Technologies Corp), and is called ET024006DHU. It will be replaced with a new version called ET024008DHU in mid 2010 that have the same outline dimension and same electronics and optical specification.

The LCD module embeds a graphical controller/driver from Himax called HX8347-A. This controller provides several communication interfaces like 8/16bit parallel MCU interface, 16/18bit RGB, and 4-wire serial SPI interface. On the Display Xplained module this has been hardwired to use serial SPI interface.

The display is attached to the PCB with a strong dual-sided foam tape adhesive that make it easy to mount. This will electrically insulate the display from the PCB avoiding any short-circuit problems that may be caused by vibration wearing on the solder mask and tracks/vias. It will also provide some vibration damping for the display to protect the glass surface from cracking. It is also quite easy to remove the display if needed.

3.2 The Touch module

The LCD module has a 4-wire resistive touch interface. This consists of four lines (2 in each X and Y direction) that should be connected to ADC/IO pins on the MCU interfacing it. The general procedure is to apply a voltage (VCC) for instance on the X-lines and then measure the voltage on the Y-lines. Then the operation is repeated, but switching the X and Y lines. This will give a (X,Y) coordinate for the touch.

In order to avoid over driving (saturate) the ADC inputs, serial resistors have been added so the maximum voltage is within the ADC capability. This is a very simple and low-cost solution to adjust the touch sensor output to fit the ADC inputs. It will also lower the current consumption a little to increase the overall power performance.

For more details on how to use 4-wire resistive touch sensors, see the application note AVR341: Four and five-wire Touch screen Controller using tinyAVR® and megaAVR® devices

3.3 The Backlight module

The backlight module of the display consists of three white LEDs connected in parallel. These can draw up to 60mA and have a maximum voltage drop up to 3.6V.

On the Display Xplained module the backlight is connected to the V3P3 (3.3V) power-supply. This will somewhat limit the maximum light output in change of a simpler design.

A MOSFET turns the backlight LEDs on/off and a 4.7ohm resistor limits the maximum current through the LEDs. This makes it quite easy to control the backlight with a PWM signal to adjust intensity.





3.4 The SPI interface

The Display Xplained module uses a simple SPI interface to communicate with the LCD module. This consists of a Chip-Select (CS) line, a clock line (SCL), and two data lines (SDI/SDO). The SPI is operated in mode 3, i.e. inactive clock is 'high', and data is latched on rising clock edge.

3.5 The SPI/USART MUX resistors

The ATxmega128A1 has swapped the MOSI and SCK signals between using the regular SPI and using the USART in master SPI mode, which is available on the same pins. In order to offer the possibility to use both interfaces, a simple 0-ohm resistor mux is added to the Display Xplained module. It is currently set up to use the USART in master SPI mode. To switch to the regular SPI mode, move the two resistors mounted in position R111/R114 to position R112/R113.

See schematic diagram and PCB assembly drawing for details on where to find these resistors. Note that they are placed under the LCD flexprint cable, so this needs to be disconnected from the FPC connector to get access to the resistors. Please refer to Figure 2-1 page 2.

3.6 The LCD Tear-Enable signal (TE)

The LCD Module has an output signal that indicates when the display can be updated without getting any tearing effects. This signal basically indicates the scan retrace period of the display, meaning the time-period after the last pixel update and before the first pixel is written again. This period can be used to update the graphical RAM, and the update will be shown in the next scan period. For further details, see the Himax HX8347-A datasheet and application notes.

3.7 The LCD Reset signal

This signal is an input to the LCD module and is used to reset it. It has a pull-up resistor connected to avoid unintended resets. For further details, see the Himax HX8347-A datasheet and application notes.

4 Connectors

The Display Xplained module has five 10-pin 100mil headers. Two are used for programming/debugging interface to the Xplain kit. One is used for SPI interface and the backlight control of the LCD module. One is used for the touch interface to the LCD module. The last one is only used as a mechanical stabilizer to the Xplain kit.

Note that the female SMD mounted pin-headers might get damaged if not handled carefully. The plastic insulation might come off and exposes the conductors.

The last connector on the Display Xplained module is the FPC connector for the LCD module.

4.1 Programming headers (J103/J104)

The AVR XMEGA™ can be programmed and debugged by connecting an external programming/debugging tool to the "JTAG & PDI XMEGA" pin header (J100). The pin header is having a standard JTAG programmer pinout (refer to online help in AVR Studio®), and tools like the JTAGICE mkII or the AVR ONE! can thus be connected

directly to the header. If it is desired to use PDI programming/debugging an adapter or squid cable (included in the JTAGICE mkII kit) must be used. Please see Table 4-1 below for pin-out description.

Table 4-1. Programming headers (J103/J104) – JTAG and PDI.

J103/J104 pin	JTAG ⁽¹⁾	PDI ⁽²⁾
J103/J104-1	TCK	-
J103/J104-2	GND	GND ⁽³⁾
J103/J104-3	TDO	-
J103/J104-4	V3P3	V3P3 ⁽³⁾
J103/J104-5	TMS	-
J103/J104-6	nSRST	PDI_CLK
J103/J104-7	V3P3	V3P3 ⁽³⁾
J103/J104-8	-	PDI_DATA
J103/J104-9	TDI	-
J103/J104-10	GND	GND ⁽³⁾

- Notes:
1. Standard pin-out for JTAGICE mkII and other Atmel programming tools.
 2. Requires adapter or squid cable to connect a JTAGICE mkII (refer to AVR Studio help).
 3. It is only required to connect one V3P3/GND pin.

The AT90USB1287 can be programmed by connecting a programming tool, such as a JTAGICE mkII, to the “JTAG USB” pin header (J200) on the Xplain board. Please refer to AVR1907: Xplain Hardware User’s Guide for details.

4.2 The resistive touch pin-header (J101)

This connector connects the resistive touch interface to AVR XMEGA’s analog PORTA that is available on the “XMEGA PORT A” pin header on the Xplain board (J101). This allows the user to connect external signals to the ADC, DAC and Analog Comparators on PORTA. Please see Table 4-2 below for pin-out description

Table 4-2. The resistive touch pin-header (J101) connections.

J101 pin	LCD resistive touch signals
J101-1	-
J101-2	-
J101-3	-
J101-4	-
J101-5	TFT_XL (X-direction, Left side)
J101-6	TFT_XR (X-direction, Right side)
J101-7	TFT_YD (Y-direction, Bottom [lower] side)
J101-8	TFT_YU (Y-direction, Upper side)
J101-9	GND
J101-10	-





4.3 The SPI/TE/Reset/backlight pin-header (J102)

This connector connects to the display's SPI interface and backlight to the AVR XMEGA's digital PORTD that is available on the "AVR XMEGA PORT D" pin header on the Xplain board(J102). Please see Table 4-3 page below for pin-out description.

Table 4-3. The SPI/TE/Reset/backlight pin-header (J102)

J102 pin	LCD SPI interface signals + backlight
J102-1	TFT_BL_PWM
J102-2	TFT_RESET
J102-3	TFT_TE (Tear-Enable signal to synchronize write)
J102-4	-
J102-5	TFT_CS
J102-6	TFT_SCL_X (Can be swapped with J102-8)
J102-7	TFT_SDO
J102-8	TFT_SDI_X (Can be swapped with J102-6)
J102-9	GND
J102-10	V3P3

4.4 The unused pin-header (J105)

This connector is not used for electrical connection on the Display Xplained module. It is only used as mechanical stabilizing to the Xplain kit.

4.5 The LCD connector (J100)

The LCD connector is a 40-pin FPC connector with 0.5mm pitch. For details on signal/power connections, see the schematic diagram for the Display Xplained module.

5 Available code examples and drivers

A Getting-Started training for the Display Xplained kit can be downloaded from the Atmel web site. The application note is called: **AVR1913: Display Xplained Firmware – Getting Started training.**

Further information and drivers for Display Xplained can be downloaded as application notes, also distributed from Atmel's web site.

6 Mounting Display Xplained module to Xplain kit

The Display Xplained module will fit onto the expansion connectors on the Xplain kit. Be careful to rotate the Display Xplained module correctly to the Xplain kit. The text direction should be the same on both when rotated correctly. Also be careful to align the connectors to avoid wrong signal/power connections that might cause damage to the boards.

Also be careful when the Display Xplained module is removed to avoid bending pins. Don't use any hard tools that might cause damage to the boards. Pay attention to EMC guidelines and proper handling precautions to avoid ESD damage to the boards.



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