APPLICATION NOTE

Atmel AVR32936: mXT143E Xplained Hardware Users Guide

Atmel maXTouch Touchscreen Controller

Features

- 2.8 inch mXT143E LCD display module from Precision Design Associates (PDA)
  - Atmel® ATMXT143E touchscreen controller
  - Capacitive touch ITO
  - 320 x 240 pixel LCD display with SPI interface
  - LED backlight
- Memory
  - Standard 2GB SD card (SPI interface)
- Xplained header compatible

Description

The Atmel mXT143E Xplained evaluation kit is a hardware platform to evaluate the Atmel ATMXT143E touchscreen controller. The kit enables the user to easily get started using the maXTouch® touchscreen controller and learn how to interface the ATMXT143E device into their own design. This kit requires one of the Xplained MCU boards to run applications.

Figure 1. Atmel mXT143E Xplained kit.



Table of Contents

1. Getting started 3
   - 1.1 Quick start 3
     - 1.1.1 What is required to get started? 3
     - 1.1.2 Connecting mXT143E Xplained 3
     - 1.1.3 Configuring SPI mode 3
     - 1.1.4 Running demo applications 3
   - 1.2 Tools and documentation for mXT143E Xplained 3
2. Hardware users guide 5
   - 2.1 Overview 5
   - 2.2 Power supply 5
   - 2.3 SPI mode switch 5
   - 2.4 Headers 6
   - 2.5 SD card 7
   - 2.6 Precision Design Associates (PDA) 2.8 inch mXT143E LCD display module 7
     - 2.6.1 Displaytech Ltd. 2.8 inch LCD 7
     - 2.6.2 LED backlight 8
     - 2.6.3 mXT143E touchscreen controller 9
   - 2.7 Alternative backlight control 9
   - 2.8 ID device 10
3. Code examples 10
4. Revision history 11
   - 4.1 Revision 1 11
   - 4.2 Revision 2 11
5. Document Revision History 12

1. Getting started

1.1 Quick start

1.1.1 What is required to get started?

Basically the following items are required in addition to the Atmel mXT143E Xplained to run demo applications:

- Xplained MCU base board
- Programming tool for the Xplained MCU board
- Atmel Studio

For more detailed information on each item take a look at Section 1.2.

1.1.2 Connecting mXT143E Xplained

Place the mXT143E Xplained onto an Xplained MCU board by connecting the four headers J1, J2, J3 and J4 to the according headers on the base board. An orientation marking is present in the top left corner (a white silkscreen border around the mounting hole) and the same marking is present on the Xplained MCU board.

1.1.3 Configuring SPI mode

For XMEGA® based MCU board set the SPI mode switch on the mXT143E Xplained to “XMEGA USART in SPI mode”. For all other Xplained MCU boards set the switch in “Native SPI” position.

1.1.4 Running demo applications

If not already done, download and install Atmel Studio. Start Atmel Studio, select a demo application for the Xplained MCU base board and the mXT143E Xplained, and download it via the programming tool.

1.2 Tools and documentation for mXT143E Xplained

The following list contains links to the most relevant documents, software and tools for the mXT143E Xplained.

Xplained products
Atmel Xplained is a series of small-sized and easy-to-use evaluation kits for 8- and 32-bit Atmel microcontrollers. It consists of a series of low cost MCU boards for evaluation and demonstration of feature and capabilities of different MCU families.

mXT143E Xplained design documentation
mXT143E Xplained design documentation is a package containing schematics, BOM, assembly drawings, 3D plots, layer plots ...

Atmel AVR32936: mXT143E Xplained Users Guide
This document.

Precision Design Associates (PDA)
PDA is an Atmel partner that designed the PDA TM2800 display module.

Displaytech
Displaytech is an LCD module manufacturer that provided the SDT028ATFT display which is used in the PDA TM2800 display module. The display and display driver IC datasheets are available on their website.

Atmel Studio
Atmel Studio is a free Atmel IDE for development of C/C++ and assembler code for Atmel microcontrollers.

IAR Embedded Workbench for Atmel AVR

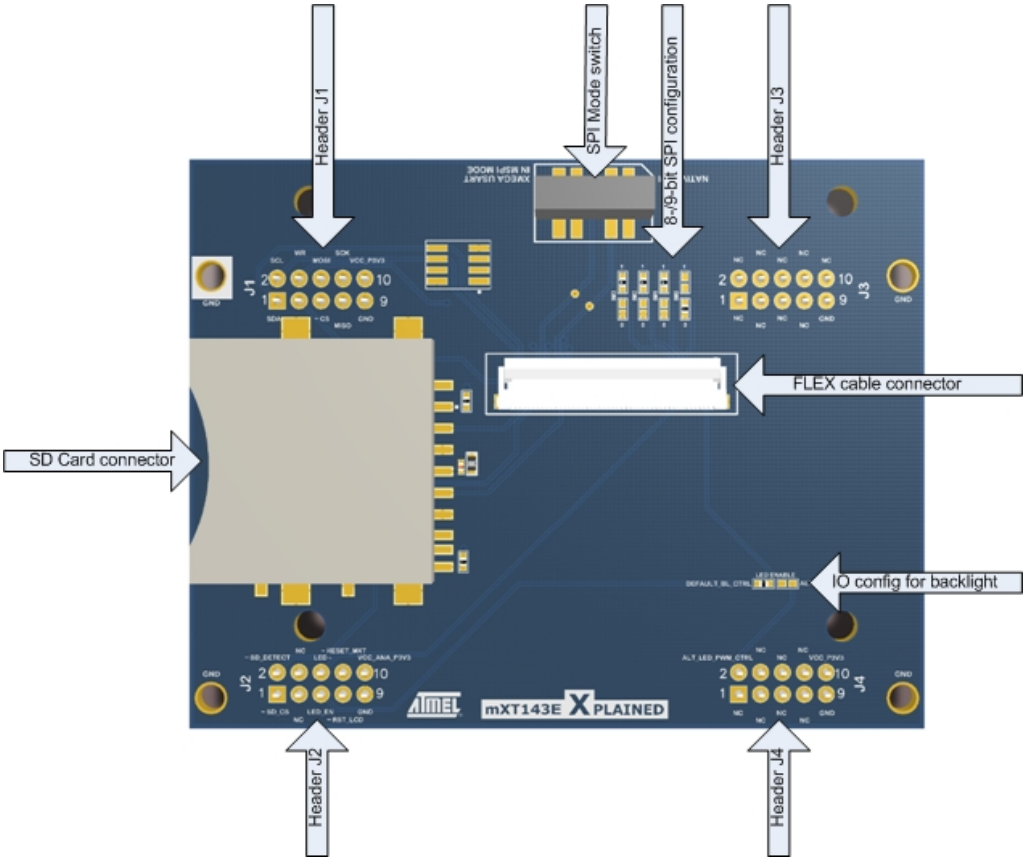
IAR Embedded Workbench® for Atmel AVR® is a commercial C/C++ compiler that is available for 8-bit AVR. There is a 30 day evaluation version as well as a 4k (code size limited) kick-start version available from their website.

2. Hardware users guide

2.1 Overview

The display module is mounted on a routing board that is shown in Figure 2-1 and connected with a FFC cable. All components in the figure are therefore located under the display module.

Figure 2-1. Routing board overview.



2.2 Power supply

The kit is powered via the four headers on the board and is compliant to the Xplained-series base boards. The input voltage is 3.3V.

2.3 SPI mode switch

The Atmel mXT143E Xplained has a SPI Mode switch which can be used for the XMEGA based Xplained MCU boards, where the XMEGA has the option to use the USART in Master SPI mode. This enables the user to use the USART in SPI mode in combination with DMA, as the normal SPI module does not support DMA transfers.

For all non XMEGA based Xplained base boards the switch should be set to normal SPI mode.

2.4 Headers

The Atmel mXT143E Xplained kit has four 10-pins, 100mil female headers. The headers fit onto the Xplained series MCU boards.

Table 2-1. Signal connections on the mXT143E Xplained.

Header	Pin	Xplained std. function	mXT143E	Display	SD-card
J1	1	SDA	SDA	-	-
	2	SCL	SCL	-	-
	3	RXD	~CHG	-	-
	4	TXD	-	WR	-
	5	SS	-	~CS	-
	6	MOSI	-	SDI	MOSI
	7	MISO	-	SDO	MISO
	8	SCK	-	RS/SCL	CLK
	9	GND	GND	GND	VSS
	10	VCC	VCC	+Vin	VDD
J2	1	ADC1/AREF	-	-	~SD_CS
	2	ADC2	-	-	~SD_DETECT
	3	ADC3	-	-	-
	4	ADC4	-	-	-
	5	ADC5	-	LED_EN	-
	6	ADC6	-	LED-	-
	7	ADC7	-	~RESET_LCD	-
	8	ADC8	~RESET_MXT	-	-
	9	GND	GND	GND	GND
	10	VCC	VCC	+Vin	VDD
J3	1	GPIO	-	-	-
	2	GPIO	-	-	-
	3	GPIO	-	-	-
	4	GPIO	-	-	-
	5	GPIO	-	-	-
	6	GPIO	-	-	-
	7	GPIO	-	-	-
	8	GPIO	-	-	-
	9	GND	GND	GND	GND
	10	VCC 5V0	-	-	-

Header	Pin	Xplained std. function	mXT143E	Display	SD-card
J4	1	SDA	-	-	-
	2	SCL	-	(optional LED_EN)	-
	3	RXD	-	-	-
	4	TXD	-	-	-
	5	SS	-	-	-
	6	MOSI	-	-	-
	7	MISO	-	-	-
	8	SCK	-	-	-
	9	VCC	VCC	+Vin	VDD
	10	GND	GND	GND	GND

2.5 SD card

The Atmel mXT143E Xplained kit features a standard size SD memory card connector. The interface to the SD card is based on SPI. The MOSI, MISO and SCK lines of the SPI interface is routed from the header J1, while the chip select (~CS) and card detect (CD) lines are routed to header J2.

Drivers for the SD memory card can be found in ASF. For further information about how to interface a SD card, please refer to the the SD-card Association.

The SD card interface share the same SPI lines with the LCD except for the Chip Select, so it is not possible to communicate with both at the same time.

2.6 Precision Design Associates (PDA) 2.8 inch mXT143E LCD display module

The display module PDA TM2800 was designed by the Atmel partner Precision Design Associates (PDA) and it contains:

- A 2.8 inch LCD display from Displaytech Ltd (model SDT028ATFT)
- ITO sensor
- Routing PCB that contains
  - Atmel mXT143E touchscreen controller
  - Regulator
  - Backlight control circuit for the display
  - Connector for ITO
  - Connector for the display
  - Connector that makes all signals available for the application
- Plastic casing that holds all parts together

The display module is available via DigiKey.

2.6.1 Displaytech Ltd. 2.8 inch LCD

The LCD of the display module is from Displaytech Ltd. and the used model is SDT028ATFT. The specifications for the display are listed in Table 2-2.

The display driver (ILI9341) offers a parallel and a serial interfaces, but for compatibilty between the different Xplained boards and standardization on the headers, only the SPI interface is routed. The default communication with the display is 8-bit SPI and the change between command and data (CMD/DATA) is done with a separate IO pin. The board can be reconfigured to use SPI in 9-bit mode. In this mode the 9th bit will be used to control if a command or data is transferred and hence the extra IO line will not be needed. To reconfigure this, you it is necessary to alter the display configuration by moving some resistors. Please look at the schematics for more information.

For a complete set of commands and settings for controlling the display, please refer to the datasheet of the display controller. Atmel provides a driver, code examples and graphics libraries in ASF (Atmel Software Framework).

Table 2-2. Display specifications.

Item	Specification
LCD module	Transmissive
Resolution	320 x 240 pixels
Diagonal size	2.8 inch
Overall size	50mm x 69.2mm
Active area	43.2mm x 57.6mm
Driver IC	ILI9341
Interface type	Serial, parallel and RGB
Colors	Up to 262k

The SD card interface share the same SPI lines with the LCD except for the chip select, so it is not possible to communicate with both at the same time.

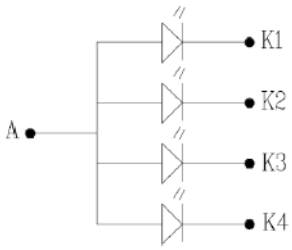
2.6.2 LED backlight

The display module has a LED backlight which is build up by four parallel diodes. The ratings for the LED backlight can be found in Table 2-3.

Table 2-3. LED backlight specification.

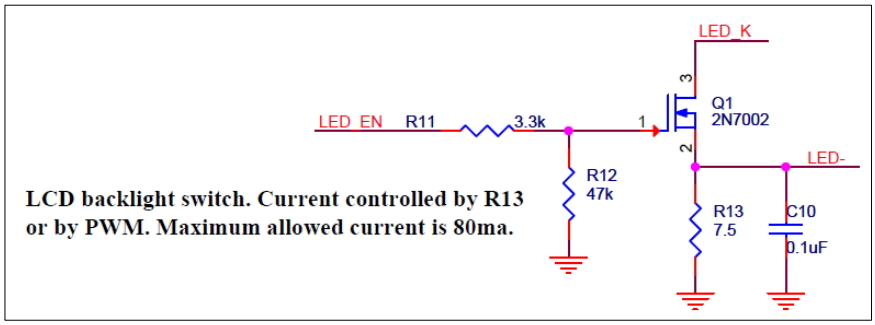
	Condition	Minimum	Typical	Maximum
Forward current	-	-	-	20mA
Forward voltage	20mA	2.9V	3.2V	3.5V

Figure 2-2. Backlight LEDs circuit of the display mode.



The backlight diodes are driven by the circuit seen in Figure 2-3 inside the display module:

Figure 2-3. Backlight LED driving circuit.



LED_K is connected to K1, K2, K3 and K4 in figure TBD. The anode (A) in figure TBD is connected to the supply voltage of the module (3.3V).

In a worst case scenario where the diodes have a forward voltage of 2.9V@20mA the voltage over R13 must be at least 3.3V – 2.9V = 0.4V. That means R13 needs to be at least 0.4V / 4 * 20mA = 5Ω. The chosen resistor value of 7.5Ω will reduce the current to 0.4V / 7.5Ω = 53mA in a worst case scenario. That means through each diode a current of 53mA / 4 = 13.25mA will flow. Because of the reduced current it is also possible to drive the backlight without PWM but with additional losses in the resistor. The LED-signal can be used to measure the current that flows through the backlight diodes. LED_EN can be used to enable the backlight, which is by default off, either by using PWM or by driving this signal to VCC.

2.6.3 mXT143E touchscreen controller

The interface to the mXTE143E touchscreen sensor is I²C. The device also has an alert pin (~CHG), which will toggle when a touch event occurs. The I²C address of the device is 0x4A and the maximum bus clock speed is 400kHz.

The protocol that is used to communicate with the touchscreen controller as well as the datasheet of the device is only available under NDA but these documents are not necessary to use the controller on the mXT143E Xplained because all the required code and the configuration is available in the Atmel Software Framework (ASF).

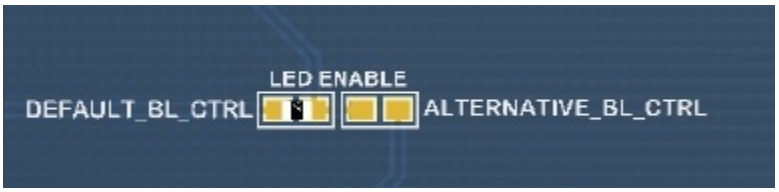
If the user intends to fully evaluate the mXT143E in order to make his own maXTouch design please contact the nearest Atmel sales representative to get an NDA agreement.

Application notes for maXTouch can be obtained from the Atmel website by registration.

2.7 Alternative backlight control

The mXT143E Xplained has an optional routing possibility for the LED backlight control. The alternative signal is pin 2 of the header J4. To change to the alternative location, it is necessary to disassemble the display module and de-solder the existing 0Ω resistor shown in Figure 2-4, and solder it back onto the alternative footprint. It is also possible to just add a solder joint between the two pads to get a new connection.

Figure 2-4. Alternative backlight control.



2.8 ID device

This device is not mounted because the Xplained platform does not offer expansion module detection.

3. Code examples

The example applications are based on the Atmel Software Framework (ASF) that is included in Atmel Studio. The Atmel Software Framework can also be found as a separate package.

4. Revision history

To identify the revision of the Atmel mXT143E Xplained kit, locate the bar-code sticker on the back side of the board. The first line on the sticker shows the product ID and the revision. For example “A09-1573/2” can be resolved to ID=A09-1573 and revision=2.

4.1 Revision 1

Not released.

4.2 Revision 2

Revision 2 of the mXT143E Xplained kit is the initially released version. This revision of the kit has the following product ID: A09-1573/2.

5. Document Revision History

Doc. Rev.	Date	Comments
42032B	05/2013	Section 2.6.3 has been updated
42032A	01/2013	Initial document release

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