Application Note

AN_333

FT800 and FT801 Touch Capabilities

Version 1.0

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The FTDI EVE video controllers offer low cost solutions for embedded graphics requirements. In addition to the graphics, touch inputs and an audio output provide a complete human machine interface to the outside world.

This application note describes the differences between the resistive touch interface on the FT8x0 and capacitive touch interface on the FT8x1.

Use of FTDI devices in life support and/or safety applications is entirely at the user's risk, and the user agrees to defend, indemnify and hold FTDI harmless from any and all damages, claims, suits or expense resulting from such use.

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1 Introduction

EVE, or the Embedded Video Engine, is a family of ICs designed to control TFT displays. In addition to controlling the display, the EVE family also includes embedded support for touch control and audio output.

The device is controlled over a low bandwidth SPI or I^{2}C interface allowing interface to nearly any microcontroller with a SPI or I^{2}C master port. Simple and low-pin-count microcontrollers can now have a high-end graphical user interface by using the EVE technology.

Unique to EVE, images are rendered on a line by line basis. This eliminates the need for an external, and costly, frame buffer. EVE connects directly between the MCU and LCD panel.

The User Interface is managed by the MCU and displayed by the EVE graphics controller. The integrated PWM audio processor provides single-channel sound and file playback. Touch feedback is handled by the integrated resistive touch controller on the FT800 devices or an I^{2}C master to a capacitive touch controller with the FT801. Interaction to all three controllers on the FT800 and FT801 – video, touch and audio – is accomplished through a single microcontroller interface.

1.1 Touch Hardware

The FT800 devices support resistive touch screens and provide a direct connection for the X and Y inputs. The FT801 devices support an interface to an external capacitive touch controller which is typically integrated into the LCD panel assembly. While the video and audio operation is identical between the two series, this document provides a comparison of the different touch features.

As noted in Table 1.1, below, the only differences between the FT800 and FT801 series is the touch interface. The FT800 follows the original FT800 with a direct X, Y analog input. The FT801, however replaces the analog input with an I^{2}C master that is specifically directed to two external capacitive touch controllers: Azoteq and focaltech. Fortunately, one of these external touch controllers is usually available integrated with the LCD assembly. The controller IC typically does not need to be separately added to the design.
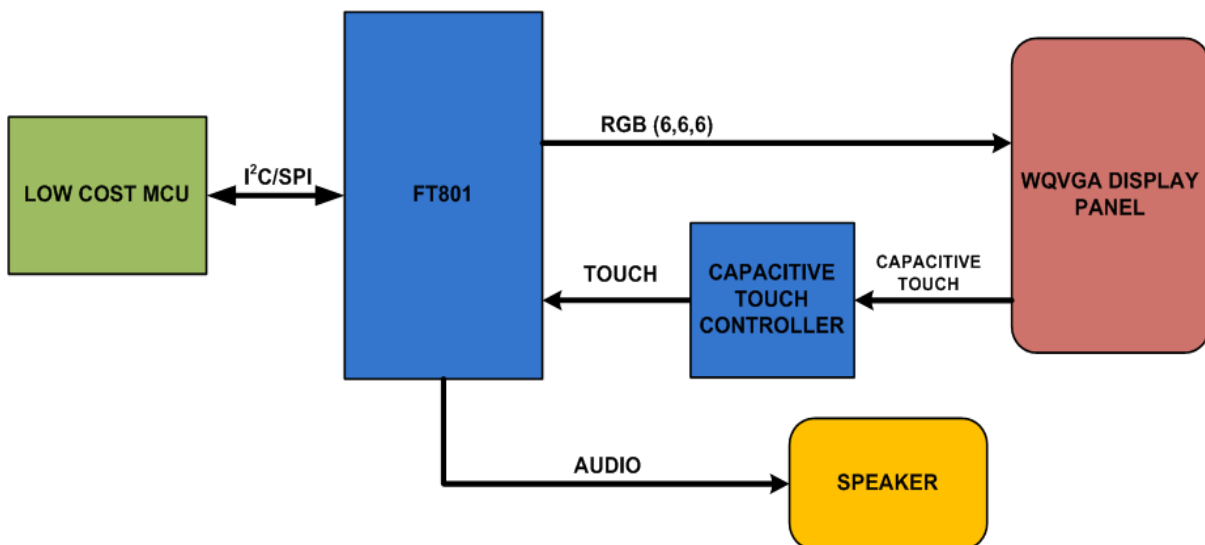
Hardware Feature	FT800 (resistive)	FT801 (capacitive)
Video	Identical	Identical
Audio	Identical	Identical
Touch Interface	Direct X± and Y±	I^{2}C to external controller
Touch Controller	Integrated to FT800	External, usually integrated on the LCD panel assembly
Supported Touch Controllers	Integrated	Azoteq and focaltech

Table 1.1 - EVE Touch Hardware Comparison

The MCU, LCD and audio connections are identical between the two series. Only the touch interface is different through the addition of an external controller.
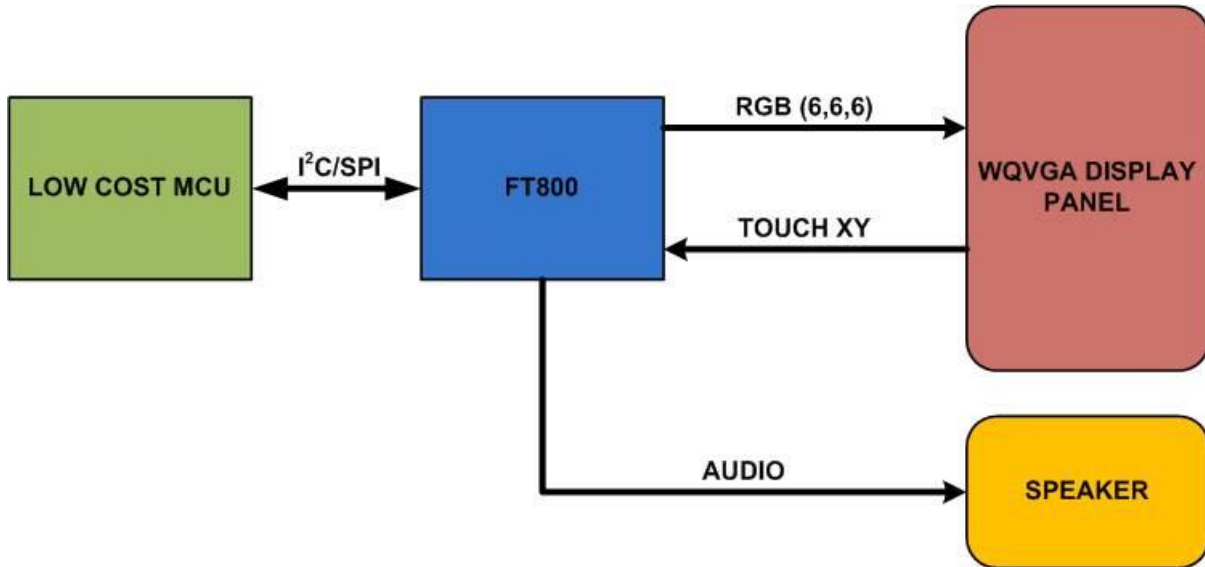
Figure 1.1 - FT800 - Resistive Touch Connection

Figure 1.2 – FT801 – Capacitive Touch Connection

1.2 Touch Features

The FT801 EVE controllers have two modes for touch. Compatibility mode mimics the FT800 resistive touch operation and supports a single touch point. Extended mode allows up to 5 simultaneous multi-touch points which is useful when panning and zooming an image. Each feature is noted in Table 1.2, below.

Touch Feature	FT800 resistive	FT801 capacitive compatibility mode	FT801 capacitive extended mode
Simultaneous Points	1	1	5
Calibration	Yes	Yes	No
Sampling Frequency	Approx. 1,000 Hz	80-100 Hz	80-100 Hz
Operating Modes	Off One-Shot Frame-Sync Continuous	Off One-Shot Continuous	Off One-Shot Continuous
Interrupt on touch	Yes	No	No
Sketch	cmd_sketch	cmd_csketch	cmd_csketch
Tags	Single tag at one time	Single tag at one time	First touch is tagged – remainder of simultaneous touches use coordinates
Power Mode	Inactive in POWERDOWN	External controller is active in POWERDOWN	External controller is active in POWERDOWN

Table 1.2 - EVE Touch Features

1.3 Capacitive Touch Types

There are a variety of different construction techniques in capacitive touch displays and different controller ICs are suitable for different display types. The FT801 supports the Focaltech FT5x06 series or Azotech IQS5xx series of touch controllers.

1.3.1 Mutual Capacitance

With mutual capacitance, a capacitor is located at each intersection of the row and column grid. One direction is driven. Bringing a finger close to the surface changes the local electrostatic field and each of the capacitors are measured, allowing for accurate detection and location of more than one touch. This is supported by the Azoteq devices.

1.3.2 Self-Capacitance

With a similar construction as mutual capacitance, here the rows and columns operate independently. While it may provide a stronger signal, only one touch point can be accurately sensed. This is supported by the Focaltech devices.

2 Touch Feature Description

2.1 Compatibility Mode vs Original FT800

When in compatibility mode, the capacitive touch controller is configured to allow a single touch point. This method allows direct compatibility with the original FT800. All tag features are identical. The only difference is the touch controller does not generate an interrupt so the touch information must be polled.

2.1.1 Limitations

- **Sketch**: There are separate resistive (cmd_sketch) and capacitive (cmd_csketch) calls to account for the different data polling rates required for each display type.
- **Touch Frequency**: Lower than resistive at ~100Hz
- **Operation mode**: FRAME-SYNC – collecting touch data while the screen is not actively drawing an image – is not available
- **Interrupt**: not available for capacitive touch

2.2 Extended Mode vs Original FT800

When in extended mode, the capacitive touch controller allows up to 5 simultaneous touch points.

2.2.1 Touch Point Index

The first point is assigned touch zero. Successive points are assigned the next index up to 4. The index is maintained until the touch is released (finger-up). Once the touch is released, the index is freed up for the next touch. For example if the following sequence happened:

a) Finger 1 down = index 0 and assigned tag
b) Finger 2 down = index 1, no tag
c) Finger 3 down = index 2, no tag
d) Finger 2 up = index 1 freed
e) Finger 4 down = index 1 – this is re-assigned at this point, no tag
f) Finger 1 up = index 0 freed
g) Finger 5 down = index 0 and assigned tag

While a finger is down, the finger location is updated if it moves around the screen.

2.2.2 Limitations

- **Sketch**: There are separate resistive (cmd_sketch) and capacitive (cmd_csketch) calls to account for the different data polling rates required for each type.
- **Calibration**: Calibration is not available for extended mode.
- **Operation mode**: FRAME-SYNC – collecting touch data while the screen is not actively drawing an image – is not available
- **Tags**: Only the first touch point (index 0) is assigned a tag. Host MCU must identify all other points based on X,Y data.
- **Interrupt**: not available for capacitive touch

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Appendix A – References

Document References

http://en.wikipedia.org/wiki/Touchscreen#Capacitive

FT800 Datasheet

FT801 Datasheet

Acronyms and Abbreviations

Terms	Description
EVE	Embedded Video Engine
I^2C	Inter Integrated Circuit
SPI	Serial Peripheral Interface
PCAP	Projected Capacitive Touch (also PCT)

Appendix B – List of Tables & Figures

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Appendix C – Revision History

Document Title: AN_333 FT800 and FT801 Touch Capabilities

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Document Feedback: Send Feedback

Revision	Changes	Date
1.0	Initial Release	2014-07-08