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## GENERAL QUESTIONS

### Why enter the display market?

From the current solutions available in the market, FTDI Chip saw a technology solution which represented a perfect fit with our corporate strategy, namely, make design easy and provide a hi- value solution with key differentiating features and benefits. This is exactly similar to what we have done in USB...USB Made Easy. In addition, it was noted that many of our primary USB markets (POS, industrial, medical, meters, etc.) have display needs as well as connectivity, and that our worldwide support structure could be readily upgraded for this new capability.

### What is EVE?

EVE stands for Embedded Video Engine, which is powered by FTDI Chip in-house technology developed for embedded graphics and video application. It will greatly reduce the development effort as well as MCU bandwidth required for graphic displays. EVE has 3 in 1 functionality including display, audio, and touch, and in combination with its object oriented methodology makes the creation and rendering of graphics very easy/intuitive while at the same time greatly reducing the system implementation costs.

### Why is EVE different from other GPUs?

EVE has many differentiators when compared to GPUs, including:

- No external frame buffer
- Integrated touch screen
- Simple serial MCU interfaces for controlling and implementing the display, namely SPI and I<sup>2</sup>C
- Audio playback with built-in sound synthesizer
- Backlight LED PWM output
- Overall an advanced architecture that provides complete GUI functionality that enables the creation of advanced graphics, while being easy to develop with.

### What are EVE's key Features and Benefits?

Key features include:

- Built-in graphics operations allow user with little expertise to create high-quality display
- Widget support can offload the system MCU and provide a variety of advanced graphic capabilities and efficiencies
- Integrated with 4-wire touch-screen controller for providing complete GUI experience
- Serial interfaces to host MCU with SPI or I2C for lower pin count and system cost
- Programmable interrupt controller provides maximum flexibility with host MCU



- Internal 12MHz oscillator within +/- 5.6% accuracy; integrated clock multiplier and system clock out function (48 or 36MHz)
- Clock switch command to switch internal or external oscillator with 12MHz crystal, or external 12MHz clock input for better clock requirement
- LCD display support for WQVGA (480x272) and QVGA (320x240) supporting data enable mode and VSYNC/HSYNC modes
- Audio channel output via PWM output
- Sound synthesizer
- Low power consumption
- Flexible power mode control including power down, sleep and standby states
- Supports host interface I/O voltage from 1.62V to 3.63V
- Supports extended temperature range, -40 to 85 °C, to address a wide range of market applications
- Low internal voltage regulator supplies 1.2V to the digital core, enabling low power operation

## **What is the pricing for the first in the EVE series, the FT800?**

Pricing is 2.75 at 100KU and under \$5 for smaller quantities (500-1000 pcs).

## **Will there be more products released which employ EVE technology?**

The FT800 functionality provides the highest value and addresses the widest market. The architecture can be scaled and readily partitioned so that other family members can be quickly introduced, and this has already been experienced with the technology of the capacitive touch enabled FT801, due to be released in mid-2014. In addition, we continuously evaluate market feedback and strategic opportunities prior to publically announcing the EVE roadmap, and appreciate user inputs.

## **Is there any third party development support for EVE/FT800?**

Yes, our partner, MikroElektronika, offers a product, Visual TFT, which supports many of EVE's capabilities, objects, and widgets. Visual TFT retails for \$90-99 and will help customers develop graphic solutions quickly and easily. It will shorten the learning curve dramatically, as the software employs many high level graphic elements that can be readily used and manipulated to create professional looking displays (visit [www.mikroe.com](http://www.mikroe.com) for more details).

## **What is a display list?**

The display list is the commands which EVE will interpret and processes accordingly to render the display. One display command is usually 4 bytes length. A display list can be a maximum of 8KB of RAM.



## **What is a widget?**

Widgets are predefined graphic objects intended for a specific display/functionality, like items as clocks, toggle switch, progress bar, etc. They are used to assist developers in creating the screen shot much easier. Widgets styles can also be changed by specifying various parameters appropriate to the widget.

## **What is the graphic memory size?**

256K Bytes

## **Can EVE display a bitmap, JPEG?**

EVE can display a bitmap and has the capability to decompress JPEG data (only baseline profile).

## **Can EVE play back MP3 music?**

No, EVE has no MP3 decoder functionality.

## **Can EVE do video animation?**

No, but EVE has the ability to render displays that give the sense of animation. Details for these capabilities and example code are provided in the FT800 Programming Guide.

## **What are the system requirements for EVE?**

As long as MCU has SPI or I2C interface and has the capability to construct display list commands, it can work with EVE. This means that a low end 8 bit microcontroller can be readily used with EVE or that because the bandwidth requirements are minimal that the current MCU can be used and the display capability readily added into the architecture/system.

## **How much memory does the MCU require to display a simple graph?**

Realistically, as long as the MCU has the memory to construct one 4 byte display command and transfer it to EVE via chip interface, EVE is able to display the graph.

## **Can I use alternative widgets from other tools?**

No. The EVE series uses internal widgets supplied with the device. To make additional composite objects would require a function in the controller firmware to construct a display list to send to the FT800. This is not the same as using a 4 byte widget.



## **Why are there two display list buffers?**

There are two display list buffers as one buffer is required for editing to create a new display and the other is the one that contains the display list currently being actioned. A swap command is required in the controller code to swap between the editable buffer and the actioned buffer.

## **You offer conversion tools for images, audio files and fonts to run on windows. Will there be Linux and MAC equivalents?**

Not at this time. The utilities are free examples of converting standard file formats to alternative standard file formats compatible with EVE. As such alternative tools could be sourced by the user for Linux and MAC.

## **Can I store both audio and image files in the object RAM at the same time?**

Yes. They will be treated as separate objects. The only limitation is the files must be small enough to fit in the memory (256kBytes)

## **Can the MikroE Visual TFT output be used with non-MikroE compilers?**

No. The output is dependent upon MikroE libraries allowing for an integrated, single source solution to application development.



## INTERFACE

### What interfaces does EVE support?

Standard serial interfaces to the host MCU include: SPI up to 30MHz or I<sup>2</sup>C clocked up to 3.4MHz.

### How do you design EVE with minimum external components?

EVE can be designed into a system without the need to add an external crystal component. EVE has an internal oscillator that is enabled by default upon power on. The frequency of the internal oscillator is 12MHz  $\pm$ 5.6% across operating temperature (-40° to 85°C).

### What is crystal frequency supported?

When external crystal component is used, the crystal component should be 12MHz.

### What connectors do I require to connect with the red connectors on the VM800P?

These connectors are 2x8 way Micro-MaTch connectors and allow for expanding the IO of the VM800P to add interfaces such as Ethernet, RS485, relays etc. via the SPI port of the ATMEGA328P.

<http://www.te.com/catalog/minf/en/439>

### Can the FT800 access an SD card directly?

No. For designs requiring additional memory for storing objects such as images and audio files the additional memory must connect to the MCU. This allows for extra flexibility as the MCU can access the memory for other non-EVE associated files without going via the FT800 and as such the extra system memory becomes general purpose. This architecture also allows for the additional memory to be either USB, SD Card or other formats.

### Can EVE work with Intel 8080 Interfaces?

No. Current device in the series are designed for RGB only

### Can I adjust the FT800 pinout in software?

Yes. The FT800 contains a function called swizzle which allows the assignment of the Red, Green and Blue data lines to be changed. The user can either swap an entire bank of colour pins or reverse the bit order. To make the swaps the application code must access the REG\_SWIZZLE register.



## **What is the package for the FT800?**

The FT800 is packaged in a 48 pin VQFN, 7 x 7 mm.

## **Does the microcontroller need to handle raw, touch-screen input?**

No, the raw touch screen information is acquired and processed and updated in the respective register for the MCU to read. EVE does the noise filtering for the resistive touch-screen. The x, y data is loaded into registers to be read by the MCU. In addition, a resistive location can be defined and mapped to a specific character (i.e. a specific alpha-numeric) so that this specific character is transferred from the FT800 to the MCU, such that the MCU need not execute any parsing functions.

## **Can the FT800 run from an FPGA?**

Essentially yes. The FT800 at its most basic level can be considered as an SPI peripheral to a host controller. Whether that hosts is in the MCU or FPGA is up to the designer.

## **When I write to the FT800 do all instructions take the same time to execute?**

Although each instruction sent over SPI is 4 bytes long, this cannot be guaranteed as not every instruction does the same thing. E.g. some instructions must fetch objects from object RAM while others draw primitives on the fly. Widget instructions are like zip files which must be extracted to create a full list of commands for the display list.



## POWER

### How does EVE power up?

On power up, EVE is in STANDBY state. A dummy read at location 0 from the host interface will send EVE from STANDBY state to ACTIVE state.

### What kind of power modes does EVE support?

There are 4 power modes that EVE supports.

- 1) Active state – EVE is in full function mode performing graphic rendering, touch processing and audio processing.
- 2) Standby state – in this state, the crystal oscillator and PLL are functioning, the system clock to EVE’s core is disabled. All register content is retained.
- 3) Sleep state – in this state, the crystal oscillator and PLL is disabled, the system clock applied to EVE’s core is disabled. All register content is retained.
- 4) Power down state – in this state, the internal 1.2V regulator supplying the core digital logic is disabled. The crystal oscillator and PLL is disabled, and the system clock applied to EVE’s core is disabled. All register contents are lost and reset to default upon power on reset.

### Typical power consumption of the FT800 (VCC = VCCIO = 3.3V)

Parameter	Description	Icc+Iccio	Unit	Condition
Icc1	Power Down current	3.3	µA	Power down mode
Icc2	Sleep current	0.25	mA	Sleep Mode
Icc3	Standby current	1.5	mA	Standby Mode (internal oscillator)
Icc4	Operating current	23	mA	Active mode (Normal Operation with demo graphics, FT800 chip)



## DISPLAY

### What is the refresh rate?

- For WQVGA (480x272), the refresh rate is 60Hz (typical configuration) For QVGA (320x240); the refresh rate is 60Hz (typical configuration)
- Depending on the display panel requirement, other values of refresh rates can be configured by adjusting PCLK\_DIV, HCYCLE and VCYCLE registers.

### What screen sizes does EVE support?

EVE supports LCD displays such as WQVGA (480x272) and QVGA (320x240) available in the market. Data enable and VSYNC/HSYNC modes are also supported to provide flexibility for the various displays on the market.

### What LCD interfaces does EVE support?

EVE support video RGB, parallel output (default RGB data width of 6-6-6) with 2 bit dithering; configurable to support resolution up to 512x512 and LCD R/G/B data width of 1 to 6.

### How do you connect EVE to the LCD?

Signals required are R [7:2], G [7:2], B [7:2], PCLK, DE, VSYNC and HSYNC. R, G, B signals locations are user configurable. In addition, endian of R, G, B signals are also configurable. These will make PCB routing much easier.

### Does the FT800 support backlight control?

Yes, EVE has a PWM output that is used to drive backlight LED drivers. It supports fully on, off and dimming the backlight.

### What backlight driver does EVE support?

There is no specific requirement on what type of backlight drivers are to be used. It normally depends on the LCD/LED specifications. The back light driver in FT800 design is the MIC2289-34.

## How do you make the home icon in your examples fade in and fade out?

The fading is really controlled by the MCU controlling EVE. The fade affect is related to the alpha value of the icon (bitmap).

```
static void showhome()
{
  if (!screen.snapshot && homefade) {
    VC.command(COLOR_A(min(255, homefade * 3)));
    static PROGMEM prog_uint32_t std1[] = {
      TAG(TAG_HOME),
      LINE_WIDTH(48),
      BEGIN(RECTS),
      COLOR_RGB(0,0,0),
      VERTEX2II(4, 4, 0, 0),
      VERTEX2II(6+32, 6+32, 0, 0),
      COLOR_RGB(255,255,255),
      VERTEX2II(5, 5, 0, 0),
      VERTEX2II(5+32, 5+32, 0, 0),
      BEGIN(BITMAPS),
      COLOR_RGB(0,0,0),
      VERTEX2II(5, 5, 14, 0),
    };
    MEMCMD(std1);
  }
  endframe();
}
```

The value of “homefade” is affected by touch events on the screen.

## Is it possible to use different fonts for letters and numbers?

Yes. Treat each character to be displayed separately. This will allow a unique font to be applied to the character whether it is a number or a letter.

## Do I have to calibrate the display every time I power on?

No. Calibration should be done at least once (manufacture/first use) and after that the calibration values may be stored to internal non-volatile memory for use in subsequent power-ons as per the example below.

```
// If the EEPROM starts with byte 0x7c, then it already holds
// the 24 byte touchscreen calibration values.
if (istouch() || (EEPROM.read(0) != 0x7c)) {
  blank();
  while (istouch())
  ;
  VC.wr(REG_PWM_DUTY, 128);
  MEMCMD(start_clear);
  VC.cmd_text(screen.w/2, screen.h/2, 28, OPT_CENTERX|OPT_CENTERY, "please tap on the dot");
}
```



```
BLK_START
  CMD_CALIBRATE,
  0
  BLK_END
  VC.waitidle();
  for (int i = 0; i < 24; i++)
    EEPROM.write(1 + i, VC.rd(REG_TOUCH_TRANSFORM_A + i));
  EEPROM.write(0, 0x7c); // is written!
}
else {
  for (int i = 0; i < 24; i++)
    VC.wr(REG_TOUCH_TRANSFORM_A + i, EEPROM.read(1 + i));
}
```

## How do I adjust the curvature of the corner on a rectangle?

Rectangles are drawn with the primitive command RECTS. To adjust the appearance of the corners call the command LINE\_WIDTH before drawing to the rectangle to adjust the corner radius.

## How do I load my own company logo?

A logo is simply a picture (bitmap). As such it should be treated no differently to any other bitmap. Create your image and size it using PC tools such as PAINT or GIMP. Use the image conversion utility to convert to a format that is suitable (higher resolution = more memory) and load the image. See the examples page for code examples e.g. Example 6 – Image Viewer.



## **TOUCH**

### **What kind of touch screen does the FT800 support?**

EVE supports 4-wires resistive touch-screen controller that incorporate median filtering and touch force sensing.

### **How does the FT800 touch screen work?**

Please refer to this link for detailed description on how a 4 wire resistive touch screen works.

<http://www.sparkfun.com/datasheets/LCD/HOW%20DOES%20IT%20WORK.pdf>

### **Does the FT800 support touch pressure measurement?**

Yes. Touch pressure measurement can be detected.

### **Does the FT800 support multi touch?**

As this is a resistive touch solution, there is no multi touch support. However the FT801 which is due for release in mid-2014 is capacitive touch enabled.

### **Does the FT800 support touch slide?**

Yes, users can drag a screen slider with a stylus or finger.



## AUDIO

### What audio format does EVE support?

EVE supports audio wave playback for mono 8-bit Linear PCM, 4-bit ADPCM, and  $\mu$ -Law coding format at sampling frequencies from 8kHz to 48kHz.

### What is EVE's audio output?

The audio output is a PWM signal that goes through 3 stage of filtering to generate the final analogue audio signal. The signal to noise ratio is 46db.

### Is audio output mono or stereo?

The output audio from EVE is mono.

### What is the audio output sampling rate?

48KHz, up sampled if source is not 48Khz.

### Does EVE support digital audio volume control?

Yes, EVE has 8 bit resolution volume control.