Application Note

AN_354

FT51A Standalone Demo Application

Version 1.1

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This document provides a guide for using the FT51A development environment to read sensors and send results to the LCD screen on the FT51 EVM.

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1 Introduction

This application note documents an example firmware project for the FT51A. The source code is available in the "examples\AN_354_Standalone_Demo_Application" folder of the FT51A Software Development Kit.

1.1 Overview

The standalone demo application firmware demonstrates data conversion using GPIO, ADC and SPI, and ultimately displaying the data via I^2C to the LCD screen on the FT51A EVM.

The example code also includes the DFU functionality from AN_344 FT51A DFU Sample.

Please refer to the following Application Notes which use different methods to display this data:

- AN_347 FT51A Test and Measurement Sample
  - displays data via USB TMC Class
- AN_348 FT51A FT800 Sensors Sample
  - displays data on a TFT via FTDI EVE Controller

1.2 Features

The standalone demo application example has the following features:

- Open source firmware layered on the FT51A USB Library.
- Reads data from a temperature sensor using the SPI Master interface.
- Converts the analogue voltage from a force sensor to a digital reading.
- Detects transitions on an analogue voltage input to make a simple heart rate monitor.
- Reads switches connected to GPIO inputs to alternate between temperate, heart rate and force screens.
- Uses GPIO output pins to display backlight colours (Red, Green and Blue) on the LCD unit
- Displays data via I2C on the LCD screen

1.3 Limitations

The firmware is designed for the FT51A EVM module.

1.4 Scope

The guide is intended for developers who are creating applications, extending FTDI provided applications or implementing example applications for the FT51A.

In the reference of the FT51A, an "application" refers to firmware that runs on the FT51A; "libraries" are source code provided by FTDI to help user, access specific hardware features of the chip.

The FT51A Tools are currently only available for Microsoft Windows platform and are tested on Windows 7 and Windows 8.1.

2 Standalone Demo Application Operation

When the standalone demo application has been programmed into the flash of the FT51A MCU, the application should look similar to Figure 2-1 below.

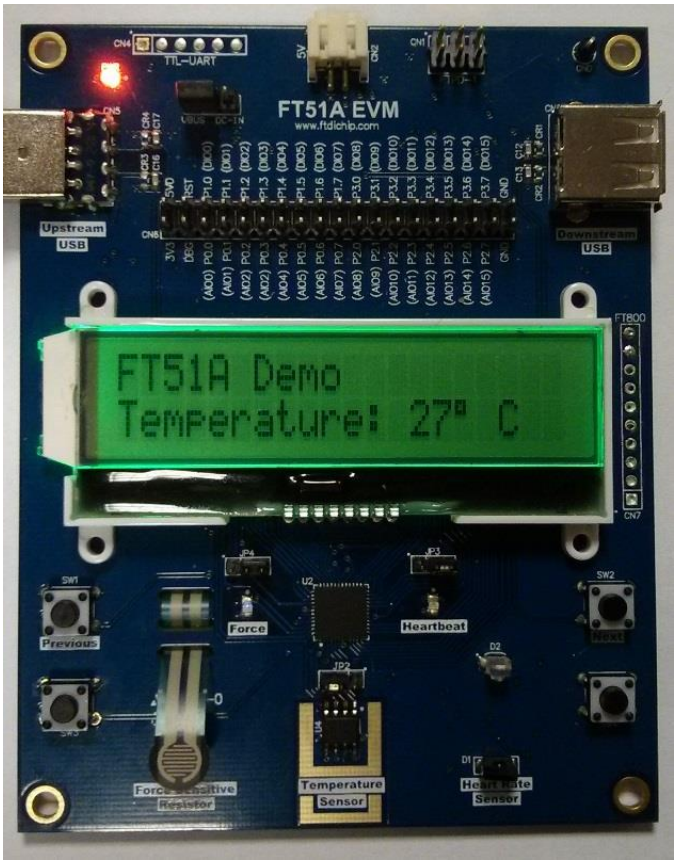

Figure 2-1 Stand-alone Demo running on Hardware

The LCD displays the data from the 3 sensors on the board:

- Force Sensitive Resistor
- Temperature Sensor
- Heart Rate Sensor

SW1 (Previous) and SW2 (Next) allows the user to switch between each screen to display the various data.

The user can touch the force sensitive resistor and see the varying force measured in Newtons. The Force LED should also reflect the force applied.

If the user places a finger on the temperature sensor, the temperature should rise and is displayed in °C (degrees Celsius).

To measure your heart rate, place a finger in between D1 and D2. The heartbeat LED should pulse matching your pulse rate. Initially the display will show 'Calculating' before the rate in beats per minute (bpm) is displayed.

The LCD screen's background colour will also change depending on the levels of the data recorded.

3 Stand-alone Demo Application Firmware

The standalone demo application firmware included in the example code demonstrates a standalone test and measurement device.

The firmware uses the FT51A USB library, DFU library, SPI Master library, I2C library, general config library and the IOMUX library. The IOMUX library is not used in the example code but is included to allow further functionality to be added. A code module for the ADT7310 temperature sensor (via the SPI Master library) is included.

DFU functionality is implemented as described in AN_344 DFU Sample.

The firmware is designed for the FT51A EVM module. It will use the force sensor, temperature sensor and heart rate sensor. The force and heart rate sensors use an analogue voltage input which is converted using the ADC features. The temperature sensor uses an ADT7310 which is connected to the FT51A *via* an SPI bus.

The DFU functionality is enabled but can be disabled by removing the associated code and DFU library. Removing the DFU code will reduce the size of the compiled code by approximately 1600 bytes.

3.1 Timer

A timer is used to provide delays and time measurements for implementing polling intervals.

The `ms_timer` timer is used to create general purpose delays, for instance when resetting the temperature sensor, and checking the screen menu buttons.

The DFU also needs a millisecond timer to accurately return to the appIDLE state from the appDETACH state. The `dfu_timer()` function in the DFU library, if enabled, should be called every millisecond to enable this.

3.2 Sensor Reading Acquisition

Each sensor is read from the firmware's `main` loop.

3.2.1 Force Sensor

A new ADC is triggered and the conversion will take place in the background and an interrupt generated when it is complete.

```
    IO_REG_INTERRUPTS_WRITE(IO_CELL_SAMPLE_0_7_1, MASK_IO_CELL_0_SAMPLE);
```

The ADC interrupt handler will update the `force` variable when the reading is complete:

```
    // Determine the interrupt source.
    IO_REG_GENERAL_READ(IO_CELL_INT_0_1, interrupt);
    // FSR Output
    if (interrupt & MASK_SD_CELL_0_INT)
    {
        IO_REG_GENERAL_READ(IO_CELL_0_ADC_DATA_L_1, sample_l);
        IO_REG_GENERAL_READ(IO_CELL_0_ADC_DATA_U_1, sample_h);

        force = ((sample_h << 8) | sample_l);

        // Clear ADC interrupt register bit
        IO_REG_GENERAL_WRITE(IO_CELL_INT_0_1, MASK_SD_CELL_0_INT);
    }
```

3.2.2 Heart Rate Sensor

A new ADC is triggered and the conversion will take place in the background and an interrupt generated when it is complete.

```
    IO_REG_GENERAL_WRITE(IO_CELL_SAMPLE_8_15_1, MASK_IO_CELL_10_SAMPLE);
```

The ADC interrupt handler will update the `pulseSample` variable when the reading is complete:

```
    IO_REG_GENERAL_READ(IO_CELL_INT_1_1, interrupt);
    // Pulse Rate
    if (interrupt & MASK_SD_CELL_10_INT)
    {
       IO_REG_GENERAL_READ(IO_CELL_10_ADC_DATA_L_1, sample_l);
       IO_REG_GENERAL_READ(IO_CELL_10_ADC_DATA_U_1, sample_h);
        pulseSample = ((sample_h << 8) | sample_l);

        // Clear ADC interrupt register bit
        IO_REG_GENERAL_WRITE(IO_CELL_INT_1_1, MASK_SD_CELL_10_INT);
    }
```

3.2.3 Temperature Sensor

An SPI bus is used to measure the temperature from an ADT7310 sensor connected to the SPI Master interface. When the `tempTimer` reaches zero the timer is reset and an SPI Master read is performed to the ADT3710. The library file "adt7310.c" implements the interface between the temperature sensor and the application using the SPI Master bus.

```
            // Read the temperature from the SPI Master
            temperature = temperature_read();
```

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Please visit the Sales Network page of the FTDI Web site for the contact details of our distributor(s) and sales representative(s) in your country.

Appendix A – References

Document References

FTDI MCU web page: http://www.ftdichip.com/MCU.html

AN_344 FT51A DFU Sample

AN_347 FT51A Test and Measurement Sample

AN_348 FT51A FT800 Sensors Sample

Acronyms and Abbreviations

Terms	Description
MTP	Multiple Time Program – non-volatile memory used to store program code on the FT51A.
USB	Universal Serial Bus

Appendix B – List of Tables & Figures

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Appendix C – Revision History

Document Title: AN_354 FT51A Standalone Demo Application
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Document Feedback: Send Feedback

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1.0	Initial Release	2014-12-12
1.1	Update FT51 references to FT51A	2015-11-26