# AN_246

# FT800 Sample Application Introduction For VM800B or VM800C Development Kits and Arduino Pro

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This document introduces how to setup the FT800 Sample Application running on an Arduino Pro system. The objective of the Sample Application is to enable users to become familiar with the usage of the FT800, the design flow, and display list language used to design the desired user interface or visual effect.

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# 1 Introduction

The FT800 combines display, audio and touch functionality into one single chip, powered by FTDI Chip's advanced EVE technology (Embedded Video Engine). The FT800 device interfaces with a system MCU via either an SPI or $I^2C$ interface. To enable customers to more easily utilize the functionality of the FT800 in a project, a Sample Application is provided here for tutorial purposes.

The sample application has been written for the Arduino Pro platform.

Users can read the source code of the Sample Application first, and then run the code to observe the effects. Editing the code is also encouraged to help learn the features of the FT800.

Note that although the basic project is created for Arduino Pro, the code relating to the creation of the screen shots could be reused in different MCU design environments. In addition, the set-up steps for the Arduino Pro would be necessary for other MCU's.

This document introduces how to set up and use the Sample Application with an FTDI VM800B or VM800C development system in relation to conjunction with an Arduino Pro platform. Further information regarding the FT800 programming language or pseudo-code can be found in the FT800 Programmer Guide.

For VM800B and VM800C development board details, please refer to the datasheets: DS_VM800C or DS_VM800B. To learn more about Arduino Pro and its IDE, please check http://www.arduino.cc

**NOTE: Any source code is provided on an "as is" basis, and is neither guaranteed nor supported.**

**We recommend to use the Arduino Pro based on ATmeg328.**

## 1.1 Audience

This document assumes the audience has read the datasheet and Programmer Guide of the FT800. In addition, familiarity of the C/C++programming language is necessary to understand the Sample Application source code. To understand the SPI of the Arduino Pro Platform, knowledge of Arduino Pro hardware and IDE (Independent Design Environment) is required.

## 1.2 Scope

The Sample Application mentioned in this document is created in Arduino Pro IDE and runs on Arduino Pro connecting with a VM800B or VM800C. It is comprised of the source code as well as project files.



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## 1.3 Overview

### 1.3.1 Hardware

The diagram below gives the basic hardware setup.

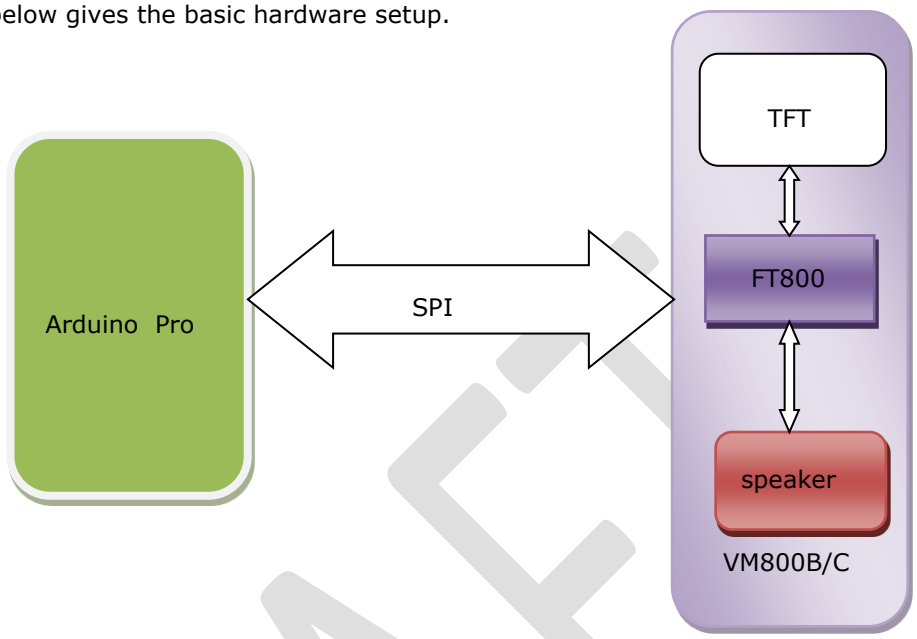


**Figure 1.1: Block Diagram of Setup**

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### 1.3.2 Application flow

The diagram below gives the basic flow and structure to configuring the FT800 in an application.

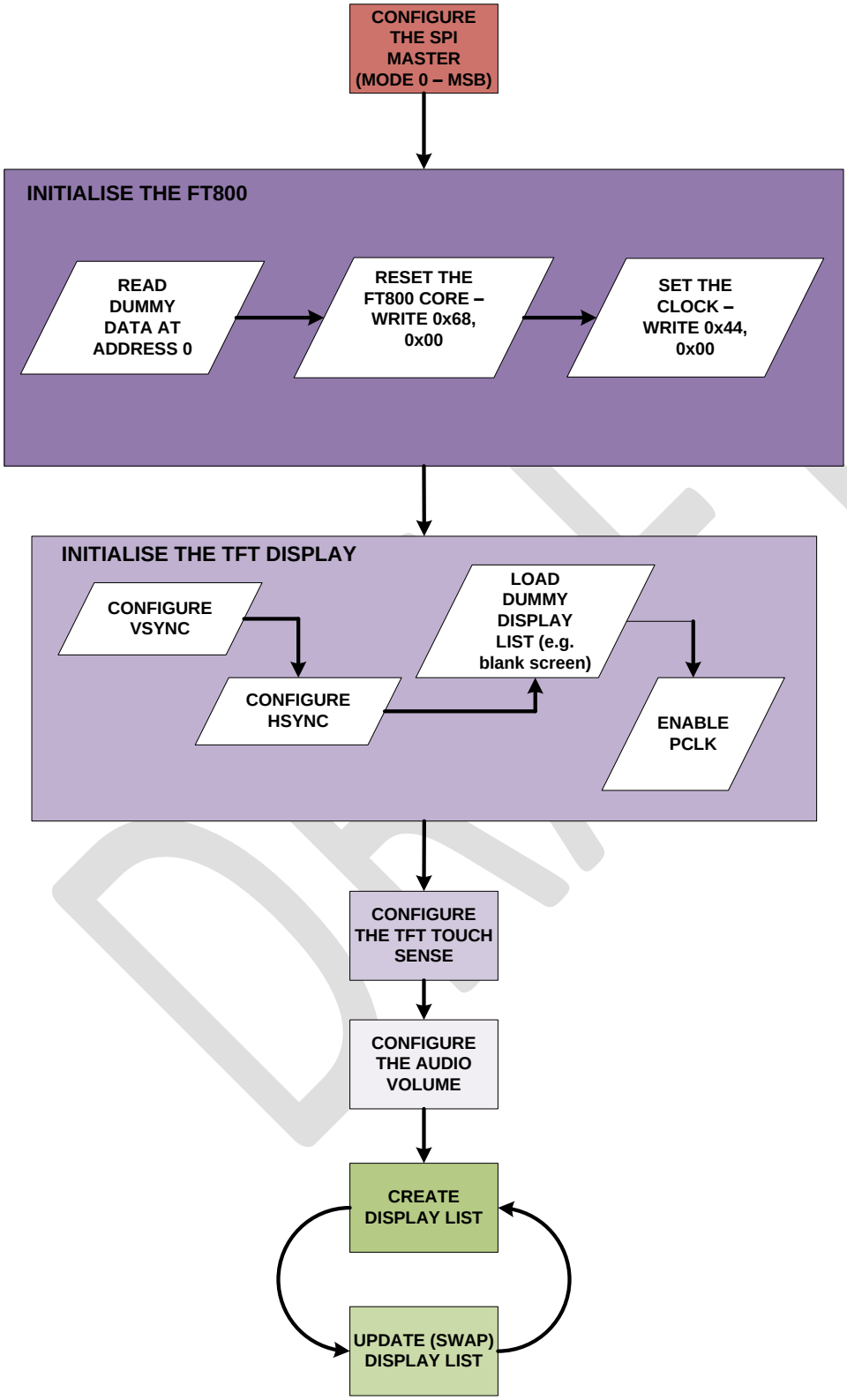


**Figure 1.2: Application Flow**



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### 1.3.3 Architecture

The Sample Application is designed to easily port to various platforms with SPI host functionality. Therefore, this sample application introduces one generic HAL (hardware abstraction layer) which can be used as a guideline for other platforms.

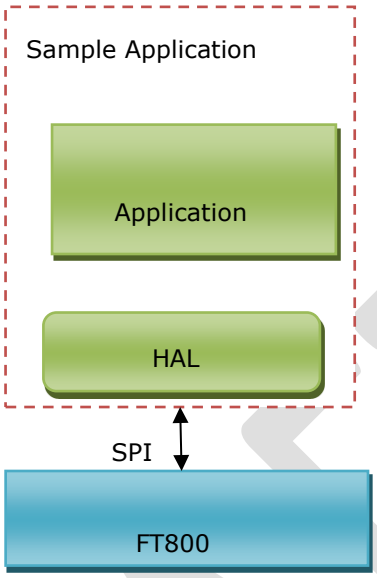


**Figure 1.3: Architecture diagram**

## 1.4 Hardware requirement

- VM800B or VM800C development kit.

  Note that the development system has an option for 3 different size displays, 3.5”, 4.3”, or 5.0”(VM800B35A-D, VM800C35A-D, VM800B35AVM800B43A-D, VM800C43A-D, VM800B50A-D, or VM800C50A-D, respectively).
- One USB cable with a MicroB connector to provide power to the VM800 board. It is optional if battery is provided for power supply.

## 1.5 Software requirement

- Arduino IDE 1.0.5
- FT800 Sample Application release package.

### 1.5.1 Software package introduction

#### 1.5.1.1 Folder introduction

- Folder "Project\Arduino" contains all the source code and project file "SampleApp.ino".
- Folder "Docs\Arduino" contains this document.
- The other folders are not relevant to the Arduino Pro platform.



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#### 1.5.1.2 Dependency

The Sample Application uses the SPI library provided by Arduino with Arduino IDE. Please check the Arduino website for details.

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# 2 Set up steps

## 2.1 Hardware Connection

The table below describes the connection between the Arduino Pro and the VM800 board. Please check the datasheet of the VM800 system for more details.

**For details of the power supply requirements of Arduino Pro and VM800, check the Arduino Pro datasheet and VM800 system datasheet accordingly.**

| Arduino Pro | VM800C Board | Description |
|---|---|---|
| Digital Pin 13 | SCK in J5 | Signal SCK of SPI |
| Digital Pin 11 | MOSI in J5 | Signal MOSI of SPI |
| Digital Pin 12 | MISO in J5 | Signal MISO of SPI |
| Digital Pin 10 | CS# in J5 | Signal CS of SPI |
| GND | GND in J5 | Ground |
| Digital Pin 4 | PD# in J5 | Power Down Pin(PD_N#) of FT800 |
| Digital Pin 3 | INT# in J5 | Interrupt Pin(INT_N#) of FT800 |

**Table 1: Hardware signal connection**

## 2.2 Source code build and download

Please note that all the related source code resides at folder “Project\Arduino\SampleApp”.

To build the project, open the file "Project\Arduino\SampleApp\SampleApp.ino " with the Arduino IDE and the following screen will be shown:



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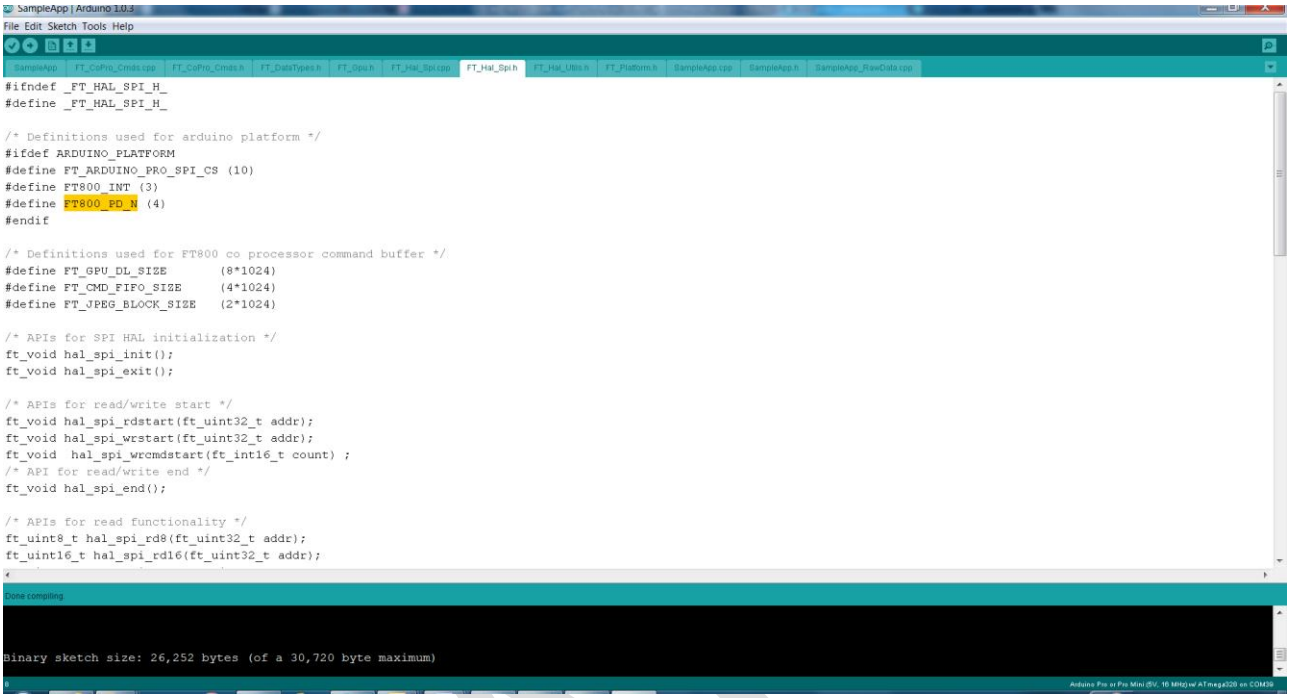


**Figure 1.4 :Arduino IDE with the opened project**

Press "Ctrl+R" to rebuild and "Ctrl+U" to download the binary generated into Arduino Pro.

For further details of downloading or programming Arduino Pro, check the website of Arduino Pro.

### 2.2.1 Determine the screen size

For 3.5 inch displays, ensure the compilation macro switch ″#define SAMAPP_DISPLAY_QVGA″ in file "Project\Arduino\FT_Platform.h"is defined.

For the other development boards (4.3” and 5.0” displays), make sure the macro above is undefined within the sample application project. This will ensure the correct display resolution is selected to match the correct display size.

After correctly setting the definition, re-build the project.

### 2.2.2 Determine the group of functions to build and run

Due to the limitation of the Arduino Pro flash size(32KBytes), it is impossible to put all the functions together and program them into the Arduino Pro. All the functions are grouped into 5 categories, which are compiled and built under following compiler switches in the file "Project\Arduino\FT_Platform.h "

```
#define SAMAPP_ENABLE_APIS_SET0
#define SAMAPP_ENABLE_APIS_SET1
#define SAMAPP_ENABLE_APIS_SET2
#define SAMAPP_ENABLE_APIS_SET3
#define SAMAPP_ENABLE_APIS_SET4
```

Users must enable one API set exclusively, by defining one of the above macro’s at a time, otherwise the binary build will not fit into the Arduino Pro flash.



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Note the categories mentioned here are not same as the groups mentioned in section 2.2.5. The groups here are defined for the purpose of running on the Arduino Pro.

### 2.2.3 Source file brief

*"SampleApp.cpp"* is the main source file for the Sample Application. The main entry function is inside. It defines all the sample functions.

The functions in "SampleApp.cpp" are mostly in the form of "SAMAPP_GPU_xxx" and "SAMAPP_CoPro_xxx".

*"FT_Gpu_Hal.cpp"* defines the transportation layer functions, which provides one SPI abstraction layer to access the FT800. Editing this file allows for porting the application to alternative MCU's and compilers with minimal effort. It is more specific to the SPI master interface.

*"FT_CoPro_Cmds.cpp"* defines the APIs of the FT800 coprocessor engine commands. This file is structured to be generic and could be ported to other projects for other target MCU's.

*"FT_GPU.h"* defines the FT800 specific instruction parameters, register names and memory maps. The contents of this file relate directly to the FT800 Programmers Guide and is structured to be generic such that it could be ported to other projects for other target MCU's.

*"SampleApp_RawData.cpp"* defines the bitmap data used in sample application.

### 2.2.4 Project file brief

"SampleApp.ino" is the project file used by the Arduino IDE and it includes all the necessary files in this project.

The major functions in the sample application can be classified into the following groups according to functionality and design purpose.

### 2.2.5 Major function groups in sample application

The major functions in sample application can be classified into following group according to its functionality and design purpose.

#### 2.2.5.1 Primitives group

The functions in this group are designed to demonstrate the usage of FT800 primitives.

An FT800 primitive is the basic drawing command e.g. Points are used to draw circles, while Lines is used for straight lines. More information on the primitives may be found in the FT800 Programmers Guide.

All the function are in the form of "SAMAPP_GPU_xxx". Here is the list:

```
/*draw circles*/
SAMAPP_GPU_Points();
/*draw a triangle*/
SAMAPP_Gpu_Polygon();
/*draw lines*/
SAMAPP_GPU_Lines();
/*draw rectangles*/
SAMAPP_GPU_Rectangles();
/*draw bitmaps*/
SAMAPP_GPU_Bitmap();
/*draws chars with different fonts*/
SAMAPP_GPU_Fonts();
```



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- SAMAPP_GPU_Text8x8();
- SAMAPP_GPU_TextVGA();

```
/*draws a bargraph*/
```

- SAMAPP_GPU_Bargraph();
- SAMAPP_GPU_LineStrips();
- SAMAPP_GPU_EdgeStrips();

```
/*example of cutting away an active area on the display*/
```

- SAMAPP_GPU_Scissor();

```
/*Font and Points Primitives combination*/
```

- SAMAPP_GPU_FtdiString();

```
/*Call and Return Primitives combination*/
```

- SAMAPP_GPU_StreetMap();

```
/*Additive blending of fonts*/
```

- SAMAPP_GPU_AdditiveBlendText();

```
/*Usage of Macro*/
```

- SAMAPP_GPU_MacroUsage();

```
/*Additive blending of points*/
```

- SAMAPP_GPU_AdditiveBlendPoints();

#### 2.2.5.2 Widgets group

The functions in this group are designed to demonstrate the FT800 graphic engine widgets, which are visual components to reduce the effort of GUI programmers.

A widget will create a complex object with one command as opposed to many e.g. the clock widget provides a large circle for the face, twelve circles for each number and 3 lines for each clock hand. If this was created without the widget the programmers would need to draw 13 circles and 3 hands in separate primitive commands.

There are 14 in-built widgets and the sample functions are in the form of "SAMAPP_CoPro_Widget_xxx".

- SAMAPP_CoPro_Widget_Logo();
- SAMAPP_CoPro_Widget_Text();
- SAMAPP_CoPro_Widget_Number();
- SAMAPP_CoPro_Widget_Button();
- SAMAPP_CoPro_Widget_Clock();
- SAMAPP_CoPro_Widget_Guage();
- SAMAPP_CoPro_Widget_Gradient();
- SAMAPP_CoPro_Widget_Keys();
- SAMAPP_CoPro_Widget_Progressbar();
- SAMAPP_CoPro_Widget_Scroll();
- SAMAPP_CoPro_Widget_Slider();
- SAMAPP_CoPro_Widget_Dial();
- SAMAPP_CoPro_Widget_Toggle();
- SAMAPP_CoPro_Widget_Spinner();

The following functions are designed to demonstrate additional FT800 commands, which are frequently used by programmers to simplify a project. They are in the form of "SAMAPP_CoPro_xxx".

```
/*Screen calibrate example*/
```

- SAMAPP_CoPro_Calibrate();
- SAMAPP_CoPro_Screensaver();

```
/*Matrix example for Bitmap manipulation*/
```



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- SAMAPP_CoPro_Matrix();
  /*Appending block of memory to the current display list*/
- SAMAPP_CoPro_AppendCmds();
  /*Decompress functionality example*/
- SAMAPP_CoPro_Inflate();
  /*JPEG decoding functionality example*/
- SAMAPP_CoPro_Loadimage();
  /*Customer Font example*/
- SAMAPP_CoPro_Setfont();
  /*Track usage example for touch*/
- SAMAPP_CoPro_Track();
  /*Screenshot example*/
- SAMAPP_CoPro_Snapshot();
  /*Sketch example*/
- SAMAPP_CoPro_Sketch();

#### 2.2.5.3 Audio & Touch group

/* Audio playback API */
- SAMAPP_Aud_Music_Player();

/* Audio Playback sample function in streaming way*/
- SAMAPP_Aud_Music_Player_Streaming();

/*FT800 Built-In Sound sample function*/
- SAMAPP_Sound()

/*FT800 Touch and Tag usage sample function*/
- SAMAPP_Touch()

/* FT800 Track coprocessor engine command usage sample */
- SAMAPP_CoPro_Track();

/* FT800 keys widget and touch tag example*/
- SAMAPP_CoPro_Widget_Keys_Interactive();

#### 2.2.5.4 Host Command Group

/*Toggle the PD_N pin of FT800 for power cycle*/
- Ft_Gpu_Hal_Powercycle ()

/*
FT800 Host Command Function: users can send the respective host commands to achieve clock source selection, power mode switch, frequency selection as well as core reset.
*/
- Ft_Gpu_HostCommand()

/*
This API defines 6 scenarios of power mode switch, implemented by calling functions above.
*/
- SAMAPP_PowerMode()



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# 3 Helpful Hints

- Audio playback functions "SAMAPP_Aud_Music_Player" and "SAMAPP_Aud_Music_Player_Streaming()", are not available on the Arduino Pro Platform due to the audio playback file being too large to fit into the Arduino Pro flash.

- Note that a calibration procedure (e.g. `SAMAPP_CoPro_Calibrate();`) is required if experimenting with the touch screen feature.

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# 5 Appendix A– References

## Document References

1. datasheet for VM800C: DS_VM800C EVE
2. datasheet for VM800B: DS_VM800B EVE
3. FTDI MPSSE for SPI application note
4. FT800 Programmer Guide
5. FT800 Embedded Video Engine Datasheet

## Acronyms and Abbreviations

| Terms | Description |
|---|---|
| Arduino Pro | The open source platform variety based on ATMEL's ATMEGA chipset |
| EVE | Embedded Video Engine |
| SPI | Serial Peripheral Interface |
| UI | User Interface |
| USB | Universal Serial Bus |

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# 6 Appendix B – List of Tables & Figures

## List of Figures and Tables



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# 7 Appendix C– Revision History

| | |
|---|---|
| Document Title: | AN_246 VM800C/B Sample App Arduino Introduction |
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| 1.0 | Initial Release | 2013-xx-xx |

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# Revision History

Revision history (internal use only, please clearly state any changes here before saving the file)

| Revision | Date YYYY-MM-DD | Changes | Editor |
|---|---|---|---|
| 0.1 | 2013-05-20 | Initial draft | Jiao Shouwu Paul |
| 0.1 | 2013-05-22 | Reviewed and commented | G Lunn |
| 0.1 | 2013-08-12 | Updated contact page, headers, other minor edits | G Lunn |
| 0.5 | 2013-08-14 | Add more APIs to sync with source code | Jiao Shouwu Paul |
| | | | |

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