



# Application Note

## AN\_208

### FT311D and FT312D Demo\_APK\_User\_GuideFT311D and FT312D Demo\_APK\_User\_Guide

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FTDI's FT311D device is targeted specifically at providing a data bridge from an Android USB device port to alternative interfaces such as GPIO, UART, PWM, I<sup>2</sup>C or SPI, while the FT312D device is specific to UART interfaces. To use the device requires JAVA applications developed to run on Android platforms that support Open Accessory Mode (3.1 onwards). This user guide describes how to use the sample applications FTDI has provided.

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

FTDI's FT311D device is targeted at providing a data bridge from an Android USB device port through a USB2.0 Full-Speed Host to alternative interfaces such as GPIO, UART, PWM, I<sup>2</sup>C or SPI, while the FT312D device is specific to UART interfaces. To enable complete functionality, the development of JAVA applications to run on Android platforms is required. This user guide provides sample applications that have been developed by FTDI Chip as design examples.

### 1.1 Overview

Android is a commonly used operating system, mostly applied in portable devices such as mobile phones and tablet computing devices. Sometimes it is desirable to connect these devices to external peripherals ("accessories" in Android terminology). One possible solution is to use USB technology to provide the necessary connectivity. To enable this digital link, the FT311D and FT312D integrated circuits from FTDI Chip will enumerate the USB device port of an Android device per the Android Open Accessory Mode Specification (Android version 3.1 onwards). This application note outlines how to run demonstration applications that FTDI Chip has provided. Although source code is provided, it is not discussed in this application note and is provided as is; functionality is neither guaranteed nor supported.

All files may be downloaded from the FTDI website:

<http://www.ftchip.com/Support/SoftwareExamples/Android/Android.zip>

## 2 Loading Examples onto the Android

An "executable" file for Android has the extension, .apk. To load the file onto the Android operating system it is recommended to follow the steps below.

Step 1 is to allow non-market applications to install. This is done from the settings window. Select security -> unknown sources, to allow the application to install.

Step 2 is to copy the .apk file to the Android device. This can be done by connecting the device directly to your desktop/laptop and simply copying the file to the desired destination with Windows Explorer (assumes a windows PC). An Android app such as "File Expert" may then be used to browse to the file on the Android device.

Step 3 is to open the apk file which should launch the application installer to allow the application to be installed. By default the application will appear in the applications window of your device. Note, dragging it to the desktop is optional but not essential.

For advanced users, if the PC side USB driver for the Android device is properly installed, with the help of the Android SDK, the application may be installed using the **adb** (Android Debug Bridge) to install applications from the PC. The steps are:

Step 1 is to connect the Android device with the PC via the USB cable. Please make sure only one Android device is connected to the PC at a time. Next, open a command prompt window and issue the "**adb devices**" command to check if the requirement is met:

```
➤ adb devices↵  
List of devices attached  
4df1f70914328f09 device
```

When a device is successfully found by the Android SDK, it will display its ID and device state below the "**List of devices attached**" line. Note: ensure there is only one device attached to PC.

Step 2 is to use a command prompt window, changing the directory to where the .apk files are stored, and using "**adb install <your\_android\_app>.apk**" command to install. Note, please replace "<your\_android\_app>.apk" with the real file name.

### 3 Examples

Examples exist to verify each interface:

- UARTLoopback.apk for FT311D or FT312D
- UARTTest.apk for FT311D or FT312D
- GPIODemo.apk for FT311D
- PWMDemo.apk for FT311D
- I2CDemo.apk for FT311D
- SPIMasterDemo.apk for FT311D
- SPISlaveDemo.apk for FT311D

#### 3.1 Avoid Android read() Pitfall

In certain cases, the accessory has to support plug-in for a relatively long time and the user might manually re-run the application multiple times while the accessory is attached. When creating applications for this scenario, one could easily encounter an Android framework limitation caused by the **FileInputStream.read()** block-reading behaviour.

The issue occurs when an application comes to an end due to the user putting it to the background or running another application. The read thread holding the **FileInputStream** does not clean up and exit, because the **FileInputStream.read()** is still in block-reading, and not able to return as expected. One way to overcome this limitation is to send an **END** request defined by users and have the connected UART device respond with an **OK** signal to let the **read()** return.

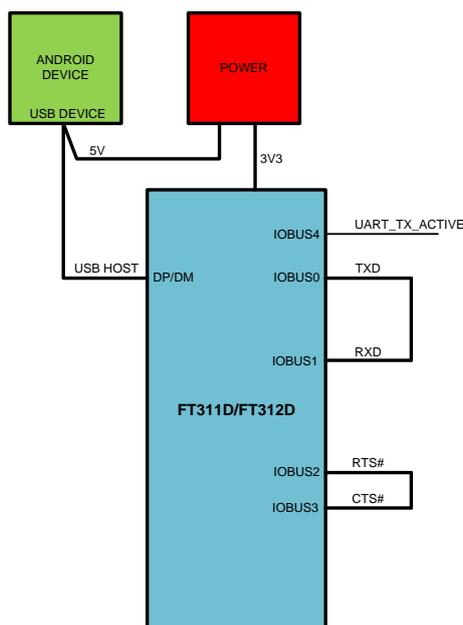
Please refer to *UART Loopback* demo application source for a sample design.

#### 3.2 UART Loopback

This UART example application is named UARTLookback.apk.

##### 3.2.1 UART Loopback Hardware

The diagram below shows how the FT311D or FT312D can be connected to be used with this demo.



### Figure 3.1 UART Block Diagram

The block diagram represents either the FT311D or FT312D UART signals shorted together (RXD to TXD, RTS to CTS) this). This will allow data to loop in and out of the FT311D or FT3112D without external hardware. The setup could be expanded to connect to an external UART for two way traffic. Note that the FT311D and FT312D interface operates at 3.3V levels. To connect to RS232/RS422/RS485 interfaces, an external transceiver to match the interface is required.

### 3.2.2 UART Loopback Application

The GUI is shown in **Error! Reference source not found.** It consists of data boxes to accept inputs to send to the device and display boxes to report back the status of the pins.

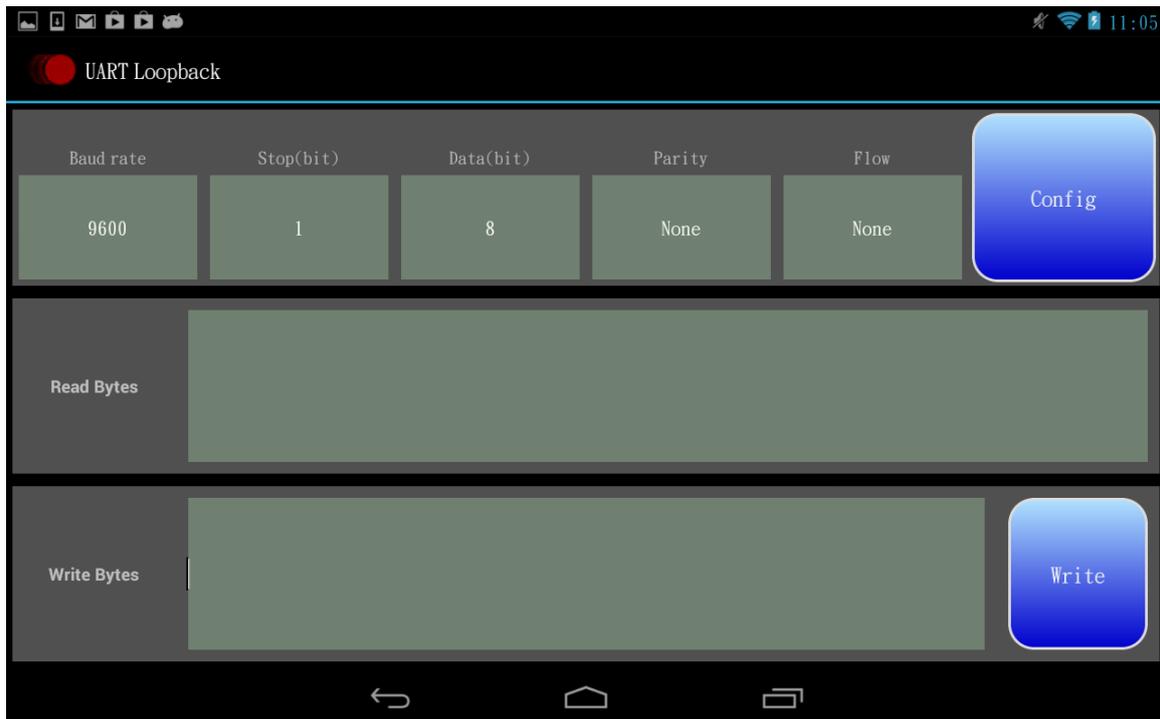


Figure 3.2 UART Loopback Application Screen



**Figure 3.3 Configured UART Loopback Application Screen**

The first row of the application allows the FT311D or FT312D UART interface to be configured.

The configuration settings allow the baud rate to be set at standard values between 300 and 921600 baud.

Stop bits may be set for 1 or 2.

Data bits may be set for 7 or 8

Parity may be set for ODD, EVEN, Mark, Space, None.

Flow allows for no flow control or RTS/CTS flow control.

Note: you can only do this once. Once configured, the **Config** button turns grey and disabled, as shown in Figure 3.3. To change settings a second time, the accessory has to be unplugged from the Android system and then re-inserted.

The READ BYTES box displays the data received on the FT311D or FT312D RXD pin. It is currently displayed as an ASCII value.

The WRITE BYTES box allows a user to type in ASCII values for sending from the Android device over USB and out the FT311D or FT312D TXD pin. The data is sent when the **WRITE** button is pressed.

This application supports UTF-8 character set and some special characters(like pi, square root...) won't be shown correctly in the READ BYTES box.

Note the WRITE BYTES box only accepts 64 characters to write.

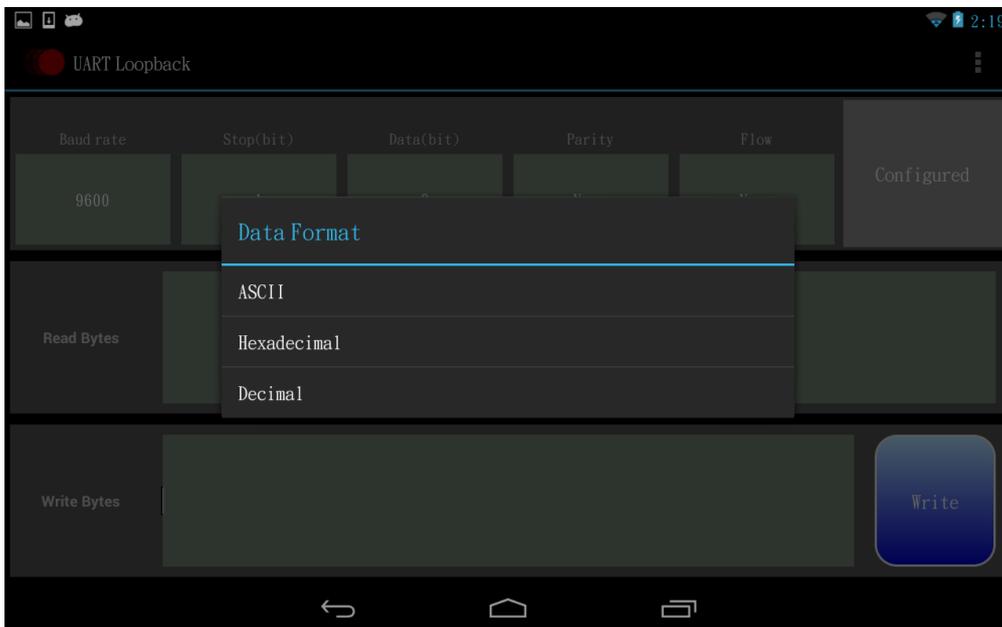
### 3.2.3 Menu Functions

There are two functions in menu: 1. Change input format and 2. Clean Read Bytes Field.



**Figure 3.4 Menu Functions**

It supports ASCII, Hexadecimal and Decimal input formats. Default format is ASCII.



**Figure 3.5 Data Format**

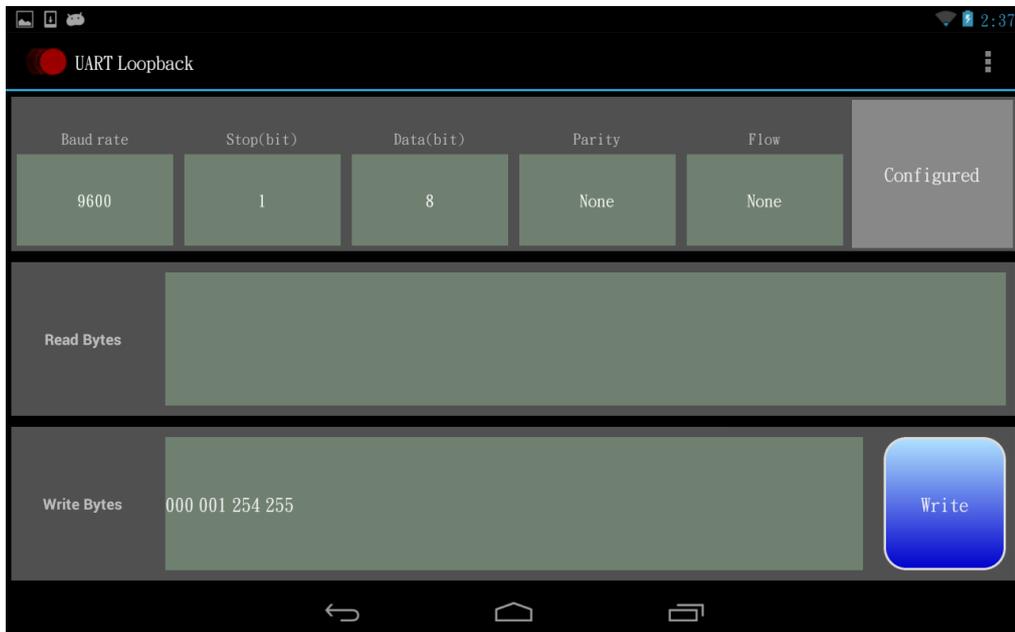
- i. ASCII  
The write data is the same as what we type.
- ii. Hexadecimal  
Every 2 characters are treated as a hexadecimal word. It accepts 00 ~ ff for a hexadecimal word.



**Figure 3.6 Hexadecimal Input**

iii. Decimal

Every 3 characters are treated as a decimal word. It accepts 000 ~ 255 for a decimal word.



**Figure 3.7 Decimal Input**

The function of "Clean Ready Bytes Field" is cleaning the data in "Read Bytes" field.

### 3.2.4 Multi-Applications

When a user installs more than one application registered for the FT311D or FT312D in UART mode on Android, and the user configures the FT311D or FT312D development module as a UART bridge (with default descriptors), the plugging-in of the FT311D or FT312D causes the Android to prompt the user to choose an application to handle it, as shown in below:



**Figure 3.8 Choose UART Application dialogue**

When such a dialogue shows up, please select **UART Loopback**, then tap **Just once** button.

### 3.2.5 Auto-run or Manually-run

This application is configured to support auto-run when the accessory is plugged-in, and manually if the user exits the application and attempts to restart it, by pressing or tapping the HOME or BACK button on the Android and then tapping the application icon. To disable auto-run behaviour, one can just remove an intent filter and an accessory filter from AndroidManifest.xml, which resides in the root of project source directory, as listed below:

```
<intent-filter>
<actionandroid:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED" />
</intent-filter>
<meta-
dataandroid:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED"android:res
ource="@xml/accessory_filter" />
```

If the above text is removed and the project recompiled, the UART Loopback won't show up as an auto-run application when the FT311D or FT312D is plugged-in. Please remove all UART related demo applications on Android before testing this scenario.

### 3.2.6 Running UART Loopback Multiple Times

In this demo application, the **END** request behaviour described in section 3.1 is implemented by sending one dummy character when the application ends. This character would loopback to read() as an **OK** packet and the read thread could terminate cleanly. Please refer to the **FT311UARTInterface.java** file and check the code around **READ\_ENABLE** flag. Because the corresponding **FileInputStream** object can be cleaned up successfully, when one wants to run



this application again, everything can be initialized, so the demo application could run for multiple times while accessory is attached.

### 3.3 UART Test

The UART Test example application is named UARTTest.apk. This application can receive data from and send received data back to a PC, and is suitable for designing a UART stress test.

#### 3.3.1 Hardware Setup for UART Test Application

The picture below shows how the FT311D development module (UMFT311EV) is connected to a PC via a USB to TTL Serial cable (TTL-232R-3V3). This setup allows the PC to use a terminal emulator program to send/receive test data to/from Android. Note that the FT311D can be used to emulate the FT312D UART operation.

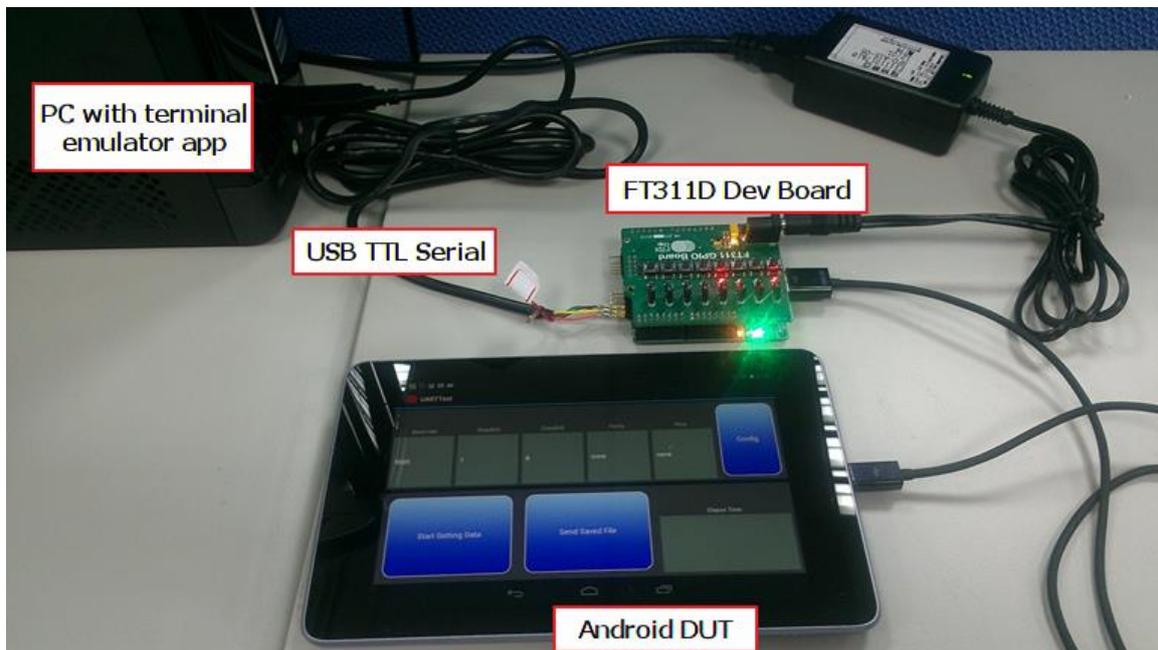
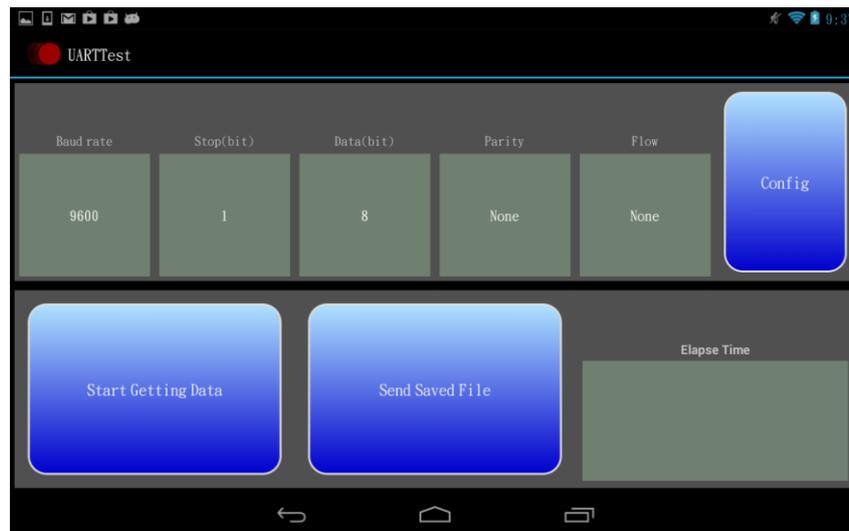


Figure 3.9 UART Test Setup

#### 3.3.2 UART Test Application

As shown in Figure 3.6, the first row is used to configure the UART interface parameters, the second row is to control receiving data or sending received data back to a connected device, such as an MCU or PC. The UART configuration is the same as UART Demo application introduced in the previous section.



**Figure 3.10 UART Test Application Screen**

If the user installs both the UART Loopback & UART Test application on the Android platform, a dialog box similar to Figure 3.4 will pop-up when the FT311D or FT312D is configured for UART bridge mode and plugged in. If such a dialogue shows up, please select **UARTTest**, then tap the **Just once** button.

To use this application, please follow the steps below:

- Step 1: Configure desired UART parameters first
- Step 2: Attach the Android device under test to the PC via a USB to TTL Serial cable
- Step 3: Tap the **Start Getting Data** button on the Android, then use a PC terminal emulator to send a text file to the Android in raw mode, i.e., send all text data as it is, without extra encoding by X/Y/Z-modem protocol.
- Step 4: After the file is sent, tap **Start Getting Data** button again to stop receiving the file.
- Step 5: Now on the PC terminal, prepare to receive a text file from Android
- Step 6: Tap the **Send Saved File** button on the Android. The data stored during Steps 3~4 will now be received on PC.
- Step 7: Now compare whether the sent and received files are the same.

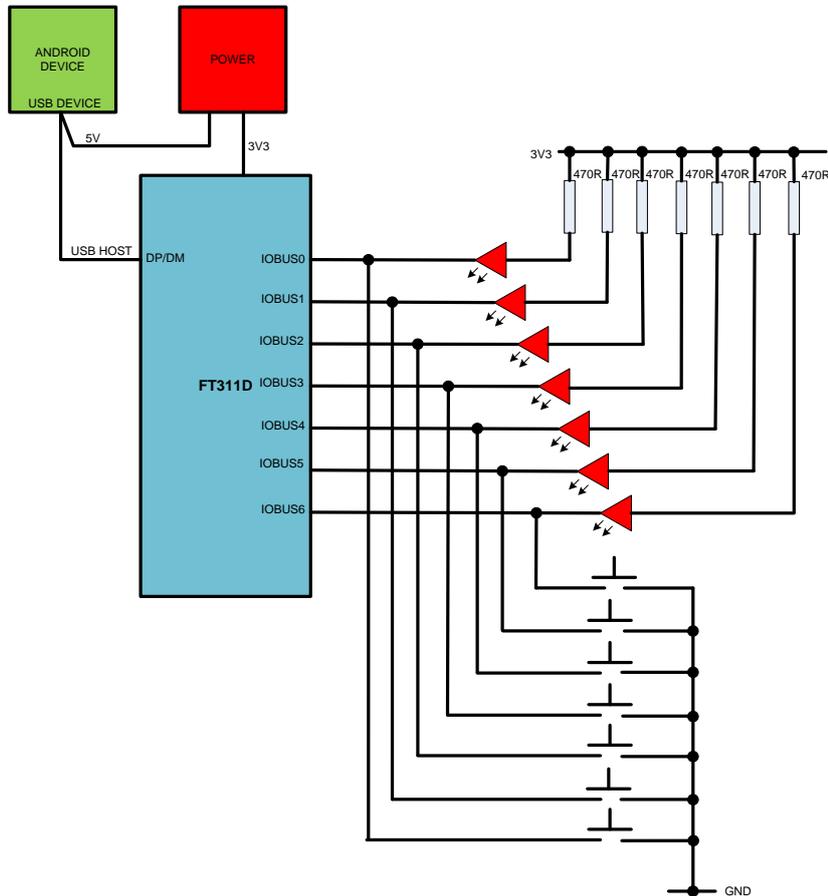
The Elapse Time box displays the transferred data bytes and transmission time during getting data and sending data.

### 3.4 GPIO Demo

The GPIO example application is named GPIODemo.apk.

#### 3.4.1 GPIO Test Hardware

The diagram below shows how the FT311D may be connected up to be used with this demo.



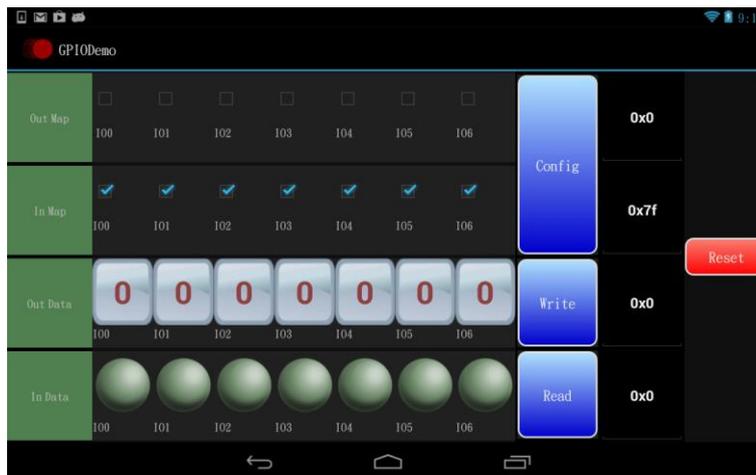
**Figure 3.11 GPIO Demo Block Diagram**

If the GPIO line (IOBUS0-6) is an output then the LED will be lit or unlit depending on whether the value written out is logic 1 or 0.

If the GPIO line is an input then by default it is logic 1. Pushing the switch will create a logic 0 input.

#### 3.4.2 GPIO Application

The GUI is shown in Figure 3.8. It consists of touch key buttons to accept inputs to send to the device and display boxes to report back the status of the pins.



**Figure 3.12 GPIO Demo Application Screen**

To use the application the pins must first be defined as inputs or outputs.

To do this, tick the relevant box for the OUT MAP or the IN MAP. Note it is not valid to select the same pin as an input and an output at the same time.

Use the **CONFIG** button to send the setup to the chip.

If the pin is an output and OUT Data pin is set to 0 then the **WRITE** button will set the corresponding pin to logic 0. Conversely if the OUT Data pin is set to 1, the pin state is changed to logic 1 when the **WRITE** button is pressed. The values remain set on the output pins until the **WRITE** button sends new data. Pins defined as inputs are not changed by the **WRITE** button.

If the pin is an input then the IN Data will report back the value. If the pin is logic 0 then the green ball (LED) will change to bright green when the **READ** button is pressed. If the pin is logic 1 then the green ball will change to dull green. Pins designated as outputs should be ignored. The display remains fixed until the **READ** button updates the screen.

Note the hexadecimal value equivalent of the GPIO lines is displayed next to the command buttons.

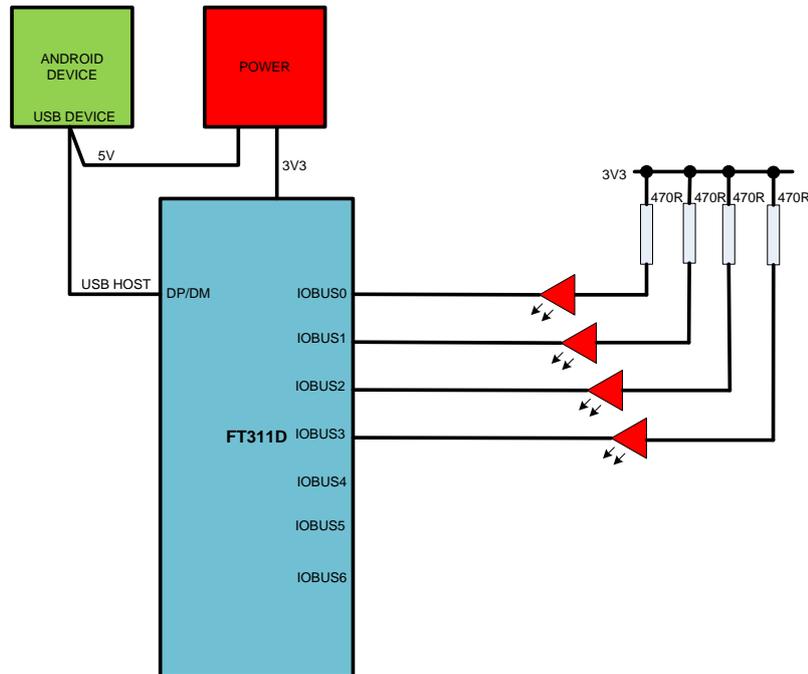
**RESET** will return all pins to inputs.

### 3.5 PWM Demo

The PWM example application is named PWMDemo.apk.

#### 3.5.1 PWM Test Hardware

The diagram below shows how the FT311D may be connected up to be used with this demo.

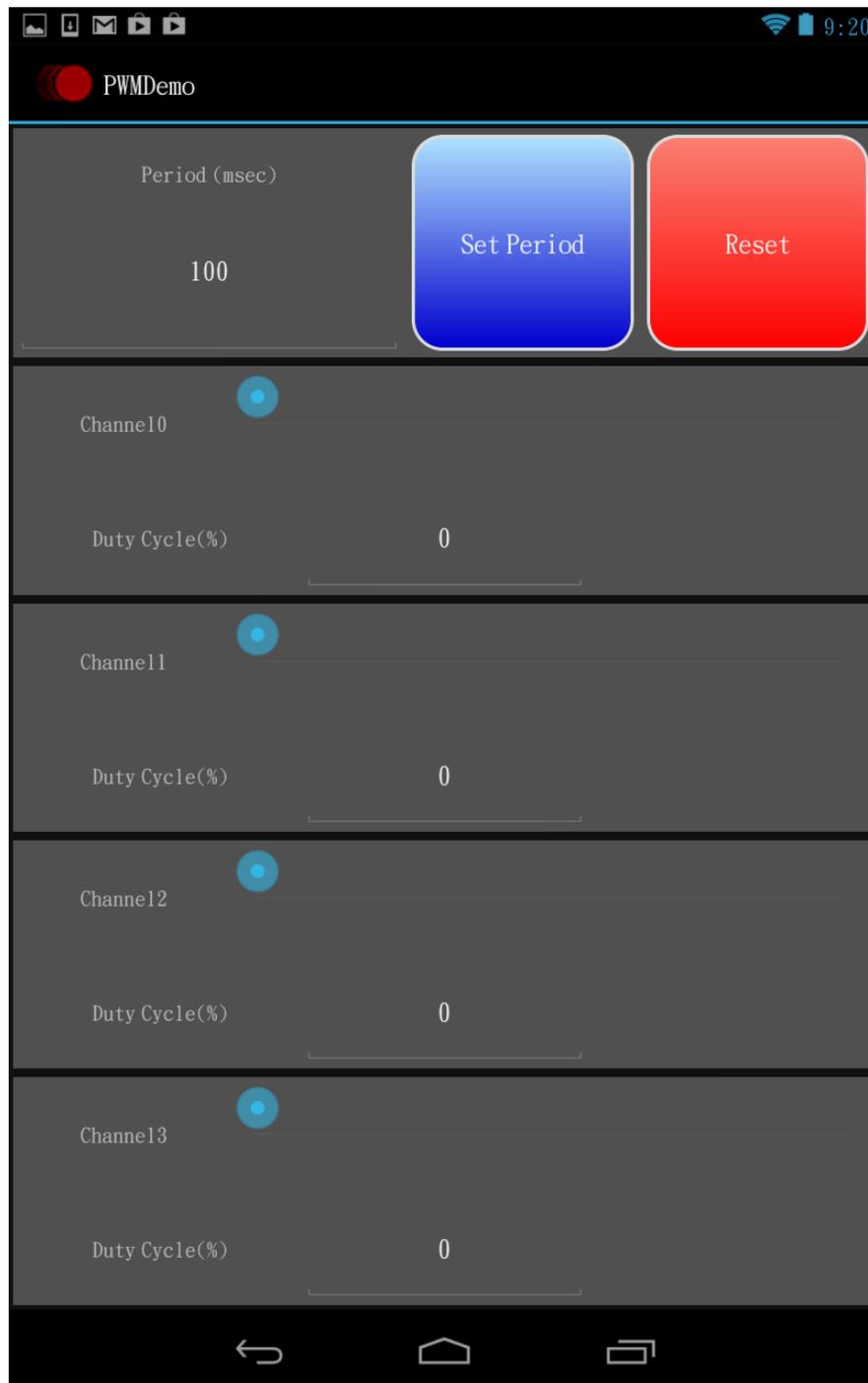


**Figure 3.13 PWM Demo Block Diagram**

The PWM application will output different PWM pulse trains on the 4 channels (IOBUS0-3). The result can then be observed as an LED flashing at different rates.

#### 3.5.2 PWM Application

The GUI is shown in Figure 3.10. It consists of data boxes to accept configuration data.



**Figure 3.14 PWM Demo Application Screen**

The first row of the application allows the user to enter the period for the PWM waveform. This is effectively a setting to define how often the pulse repeats. "Set Period" button should be pressed whenever we change the period.

The next 4 rows are the setting for the 4 channels. The duty cycle is defining the percentage of the period time when the signal is logic 1 or logic 0. The duty cycle may be set between 0 and 95%

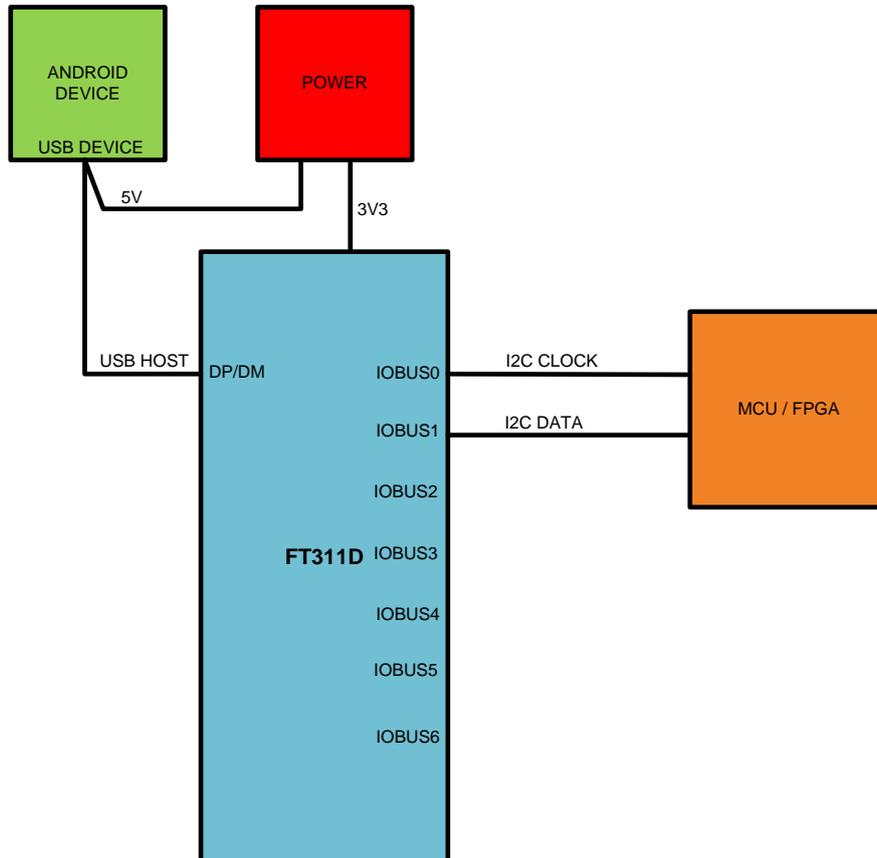
**RESET** will reset the application to its default state.

## 3.6 I<sup>2</sup>C Demo

The I<sup>2</sup>C example application is named I2CDemo.apk.

### 3.6.1 I<sup>2</sup>C Test Hardware

The diagram below shows how the FT311D may be connected up to be used with this demo.

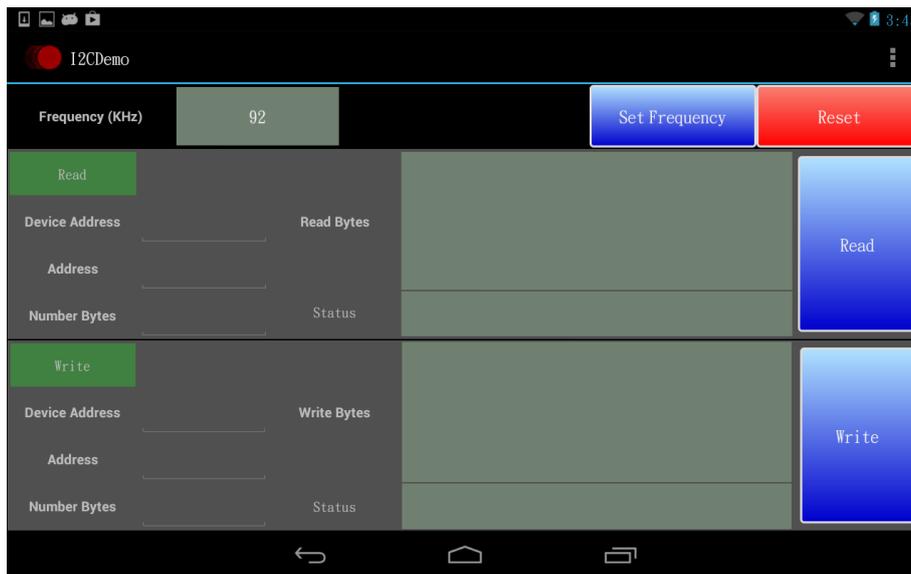


**Figure 3.15 I<sup>2</sup>C Demo Block Diagram**

The I<sup>2</sup>C clock is an output to the I<sup>2</sup>C slave which may be an FPGA or an MCU with an I<sup>2</sup>C port. The I<sup>2</sup>C data line is bidirectional with the FT311D being the master of the data line.

### 3.6.2 I<sup>2</sup>C Application

The GUI is shown in Figure 3.12. It consists of touch key buttons and data boxes to accept inputs to send to the device and display boxes to report back the status of the pins.



**Figure 3.16 I<sup>2</sup>C Demo Application Screen**

The first row sets the frequency of the clock output. The accepted range is 23, 44, 60 or 92kHz

The second row is for reading data from the I<sup>2</sup>C slave.

The user must input the Device Address that the FT311D is attempting to access.

The Address field is for any specific register in the target device which may be set to 0 if there are no specific registers e.g. a FT200XD USB to I<sup>2</sup>C bridge device.

The number of bytes to read defines the amount of data to be read.

The values should be entered as decimal values.

Pressing the **READ** button will update the green box with data from the I<sup>2</sup>C slave. The data will be displayed in ASCII.

The third row is for writing data to the I<sup>2</sup>C slave.

The user must input the Device Address that the FT311D is attempting to access.

The Address field is for any specific register in the target device which may be set to 0 if there are no specific registers e.g. a FT200XD USB to I<sup>2</sup>C bridge device.

The "number of bytes" field reports back the number of bytes written.

Pressing the **WRITE** button will send the data from the "Write bytes" box to the I<sup>2</sup>C slave. The data should be input as ASCII.

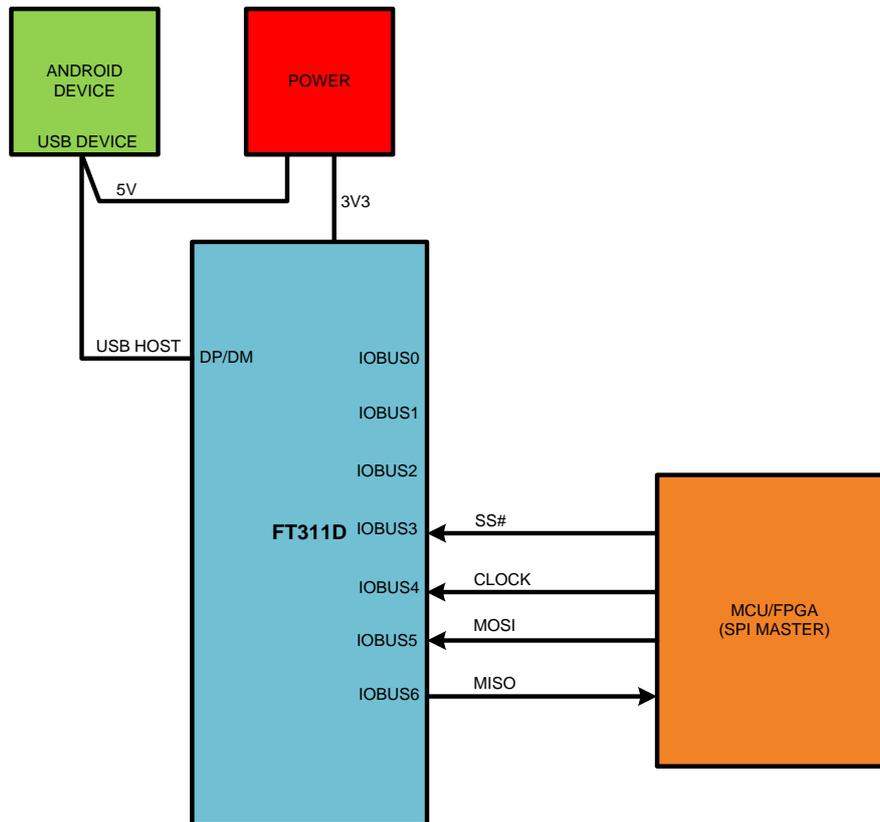
There are menu functions in this application and please refer to 3.2.3 Menu Functions for the usages.

### 3.7 SPI Slave Demo

The SPI Slave example application is named SPISlaveDemo.apk.

#### 3.7.1 SPI Slave Test Hardware

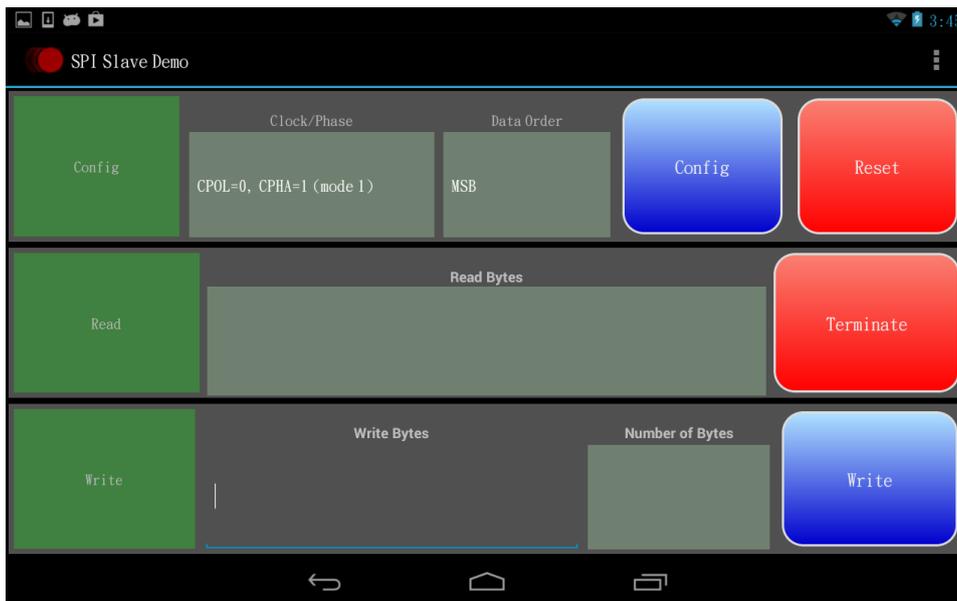
The diagram below shows how the FT311D may be connected up to be used with this demo.



**Figure 3.17 SPI Slave Demo Block Diagram**

#### 3.7.2 SPI Slave Application

The GUI is shown in Figure 3.14. It consists of touch key buttons and data boxes to accept inputs to send to the device and display boxes to report back the read data.



**Figure 3.18 SPI Slave Demo Application Screen**

The first row sets the SPI mode. The options are Mode 0, Mode 1, Mode 2 and Mode 3 with the data order being either MSB or LSB. The **CONFIG** button is used to send the selected option to the chip.

The second row is for displaying data sent from the external SPI master and read by the FT311. The data is displayed in ASCII.

The third row is for writing data to the SPI master. The user must input the data on ASCII. Pressing **WRITE** will send the data. The panel will also report back the number of bytes written in decimal.

To support the re-run, multiple times scenario (section 3.1) the user has to tap the **TERMINATE** button, before exiting this app, and then using the SPI master to send extra data out to this slave as an **OK** response. After receiving the **OK** packet, this application will close automatically. This is a workaround solution.

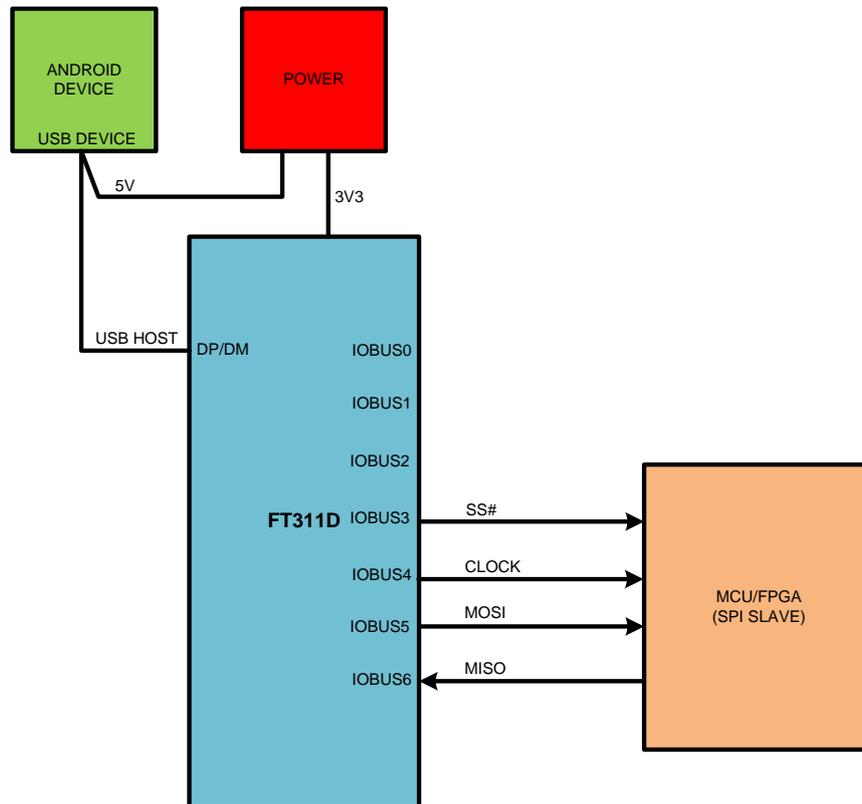
There are menu functions in this application and please refer to 3.2.3 Menu Functions for the usages.

### 3.8 SPI Master Demo

The SPI Master example application is named SPIMasterDemo.apk.

#### 3.8.1 SPI Master Test Hardware

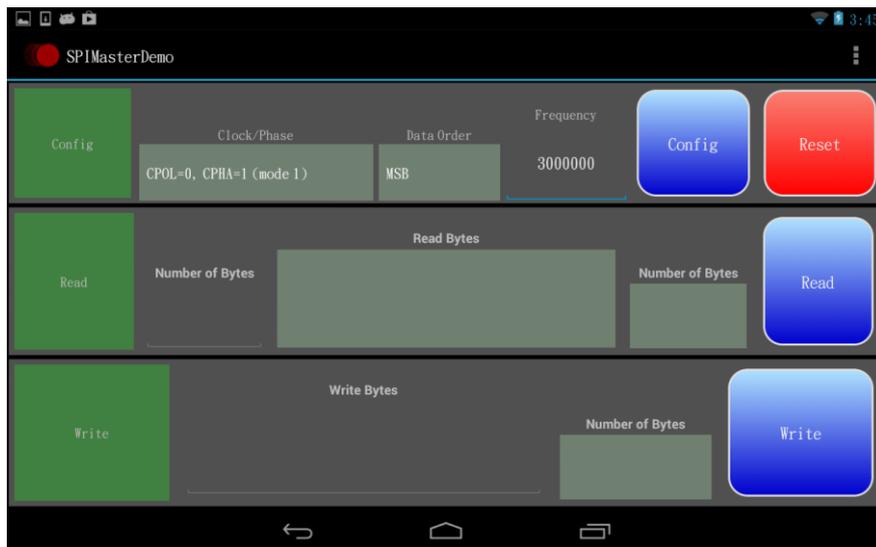
The diagram below shows how the FT311D may be connected up to be used with this demo.



**Figure 3.19 SPI Master Demo Block Diagram**

#### 3.8.2 SPI Master Application

The GUI is shown in Figure 3.16. It consists of touch key buttons and data boxes to accept inputs to send to the device and display boxes to report back the read data.



**Figure 3.20 SPI Master Demo Application Screen**

The first row sets the SPI mode. The options are Mode 0, Mode 1, Mode 2 and Mode 3 with the data order being either MSB or LSB.

The clock output frequency must also be set in this window. The valid range is 1 ... 24000000

The **CONFIG** button is used to send the selected option to the chip.

The second row is for displaying data sent from the external SPI slave and read by the FT311D. The user must input the number of bytes to be read in decimal before pressing **READ** to get the bytes of data. Data is displayed in ASCII.

The third row is for writing data to the SPI slave. The user must input the data as ASCII. Pressing **WRITE** will send the data. The panel will also report back the number of bytes written in decimal.

There are menu functions in this application and please refer to 3.2.3 Menu Functions for the usages.

## 4 Contact Information

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## Appendix A – References

### Document References

[FT311D Data Sheet](#)

[FT312D Data Sheet](#)

### Acronyms and Abbreviations

Terms	Description
GPIO	General Purpose Input output
I <sup>2</sup> C	Inter Integrated Circuit
PWM	Pulse Width Modulation
SPI	Serial peripheral interface
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
USB-IF	USB Implementers Forum

## Appendix B – List of Figures

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Revision	Changes	Date
1.0	Initial Release	2012-07-20
1.1	Update Android App screenshots & describe limitations	2013-01-09
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1.3	Update for ASCII/HEX/DEC input	2013-09-09