Application Note

AN_331

VI800A Relay

Sample Application

Version 1.0

Issue Date: 2014-10-23

This document introduces a sample application to demonstrate the VI800A-RELAY module. This accessory module connects to the VM800P series of boards and provides four relay outputs along with four logic inputs.

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1 Introduction

This application note demonstrates a simple application for the VI800A-RELAY plug-in module for the VM800P Plus board. The application gives a basic understanding of the relay module's features. The sample application has been written for the VM800P platform using the Arduino IDE.

Users can refer to the source code of the sample application, and then run the code to observe the demonstration. Editing the code is also encouraged to help learn the features of the RELAY plug-in module.

This document shows how to set up and use the sample application with the FTDI VM800P development kits in relation to an Arduino IDE.

For the VI800A-RELAY development board details, please refer to the following datasheet DS_VI800A-RELAY

To learn more about the Arduino IDE, please visit http://www.arduino.cc

Note: This application note includes sample application code and library API definitions/usage based on the Arduino IDE 1.0.5.

1.1 Audience

This document assumes that the reader is familiar with the features and operation of the VI800A-RELAY and the VM800P as described in the module datasheets. In addition, familiarity of the Arduino IDE and C/C++programming language is required to understand the sample application source code. Familiarity with SPI protocol is also assumed in order to understand the communication between the VM800P and the relay module.

1.2 Scope

The Sample Application mentioned in this document was created in the Arduino IDE (1.0.5) and runs on a VM800P platform with the relay board attached. The source code and supporting files are provided as a download (see Appendix A– References).

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2 Overview

2.1 Hardware

The diagram below shows the basic hardware setup. The VI800A-RELAY is connected to the red J5 expansion connector on the FT800 plus (VM800P) board. The VM800P is then connected to the PC using a micro USB cable as shown in the figure below.

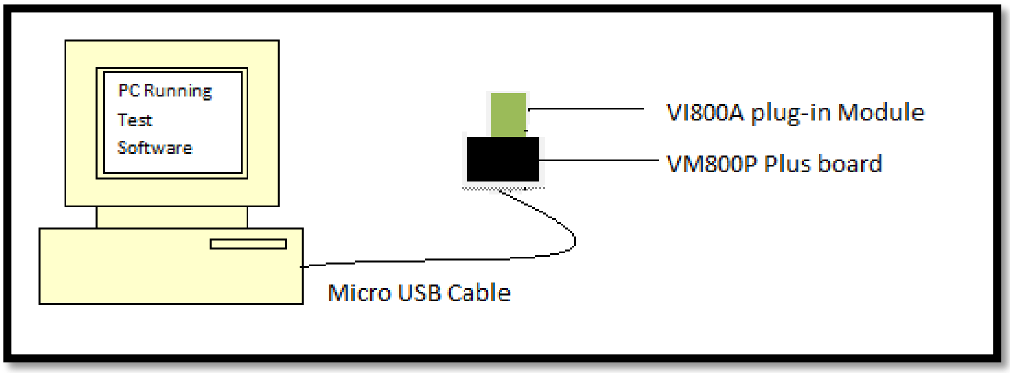

Figure 2.1 Block Diagram of Setup

2.2 Architecture

The Sample application is designed to easily port to the VM800P Arduino platform via its SPI host functionality.

An Arduino Library based sample application introduces the Arduino library for the RELAY module

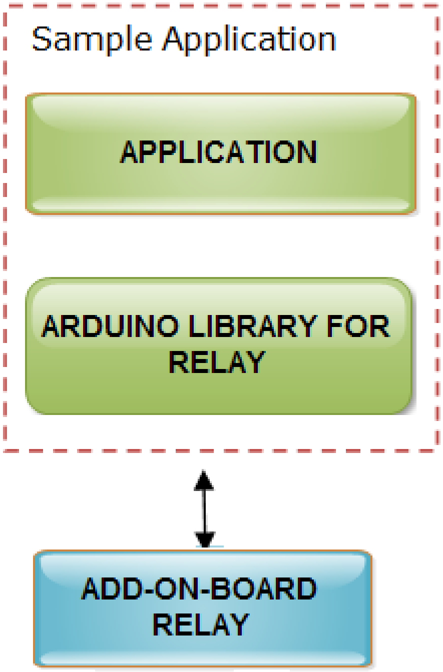

Figure 2.2 Arduino Library SampleApp Architecture diagram

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2.3 Hardware requirement

The following items are required in order to use the demonstration code

- VI800A-RELAY Module x 1
- FTDI FT800 Plus Board (VM800P) x 1
- Micro USB cable to connect VM800P to PC x 1
- PC (Windows operating system)
- FTDI UART cable which will give 5V and GND connections x 2 (see note)

  Note: As described in a later section, the demonstration code uses two FTDI USB-UART (TTL) cables to supply 5V to the relay contacts as these cables are also used in the demonstration code for other VM800P plug-in modules which feature serial-style interfaces. Other 5V power sources could be used instead.

2.4 Software requirement

- Arduino IDE 1.0.5 and later
- VI800A_RELAY Arduino Library Sample Application release package (see Appendix A– References).

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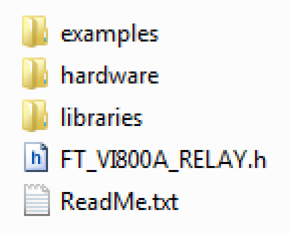
3 Software Package Introduction

This section describes the software package provided for the sample application, which consists of the Arduino library and the demo application.

3.1 Library Folder Structure

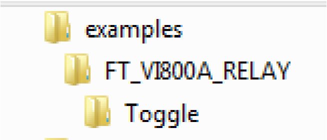
The contents of the provided zip file are shown below:



examples
hardware
libraries
FT_VI800A_RELAY.h
ReadMe.txt

Figure 3.1 FTDI Library folder contents

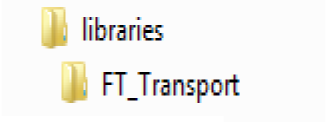
Examples Folder: This folder contains the example sketch. The 'Toggle' example mentioned later in this application note can be found at the path shown below:



examples
FT_VI800A_RELAY
Toggle

Figure 3.2 FTDI Library - examples folder

Libraries folder: This folder contains APIs to access the hardware of the VI800A-RELAY module over SPI. The FT_ VI800A_RELAY.h file, which can be found at the path shown below, is a class which implements the functionality of the VI800A-RELAY module:



libraries
FT_Transport

Figure 3.3 FTDI Library - libraries folder

Platform headers: The platform header in the top-level of the zip file contains macros specific to the VI800A-RELAY module. This should be included in the Arduino sketch.

FT_VI800A_RELAY.h

Figure 3.4 FTDI Library - platform headers

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3.2 FT_VI800A_RELAY class

As mentioned above, the FT_ VI800A_RELAY.h file in the \libraries\FT_Transport folder implements a class which provides functions specific to the VI800A-RELAY module. The API functions are described in the following table:

Prototype	Description
void WriteByte(char data)	API to write byte
char ReadByte(char data)	API to read byte
void SetCSpin(uint8_t cspin)	API to set the cs pin number
void SetDaughter1SSpin(uint8_t daughter1_ss)	API to set Daughter1_SS pin
void Init()	Initialization API
void Exit()	End SPI connection

Table 3.1 API description

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4 Setup steps

4.1 Preparing Hardware

1. Before making any connections, refer to the following screenshot of the FT800 Plus board. There are two Daughter Card connectors (coloured red in the image below). The VI800A_RELAY module should be connected to the left-hand connector labelled J5.

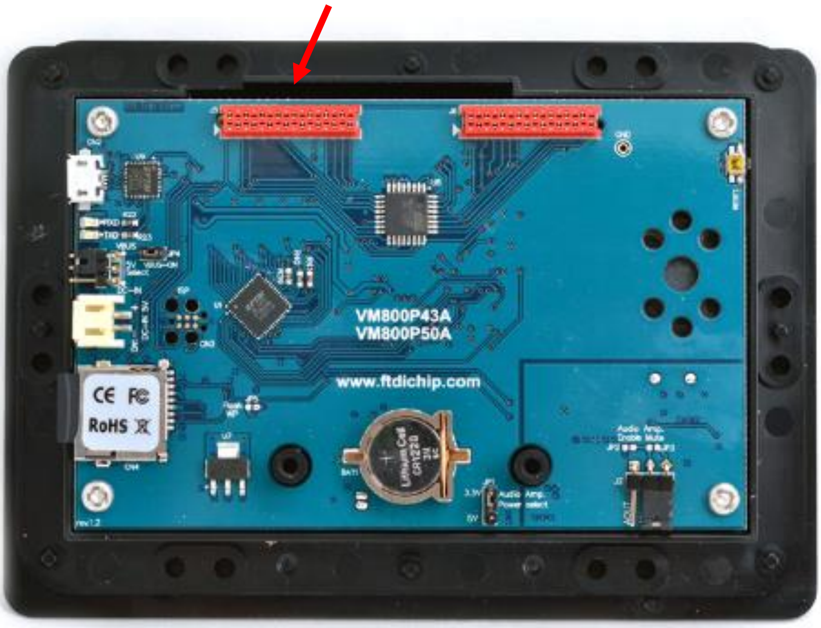

Figure 4.1 VM800P Board

Note: The VM800P should be powered off before connecting or disconnecting any modules

2. For the VI800A-RELAY module, the image below shows the OUT LEDs and IN LEDs.

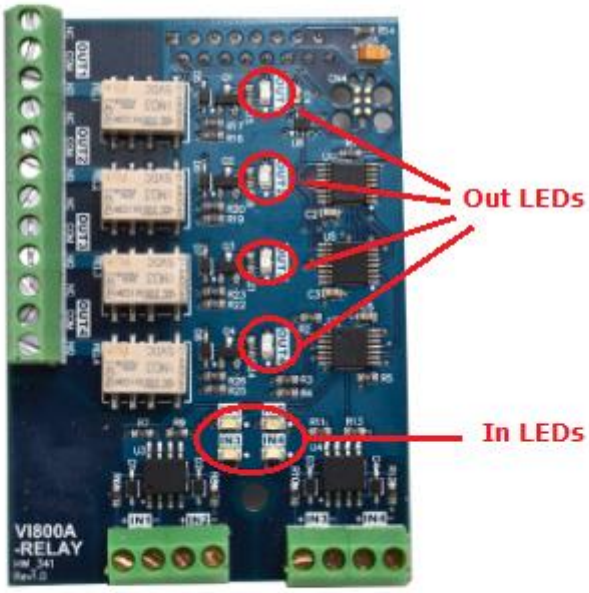

Figure 4.2 VI800A-RELAY module

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3. Connect the VI800A-RELAY module to the VM800P board’s left-hand connector (J5) as shown below. Connect the VM800P board to a PC using a micro USB cable.

   Note: The VM800P should be powered off before connecting or disconnecting any modules

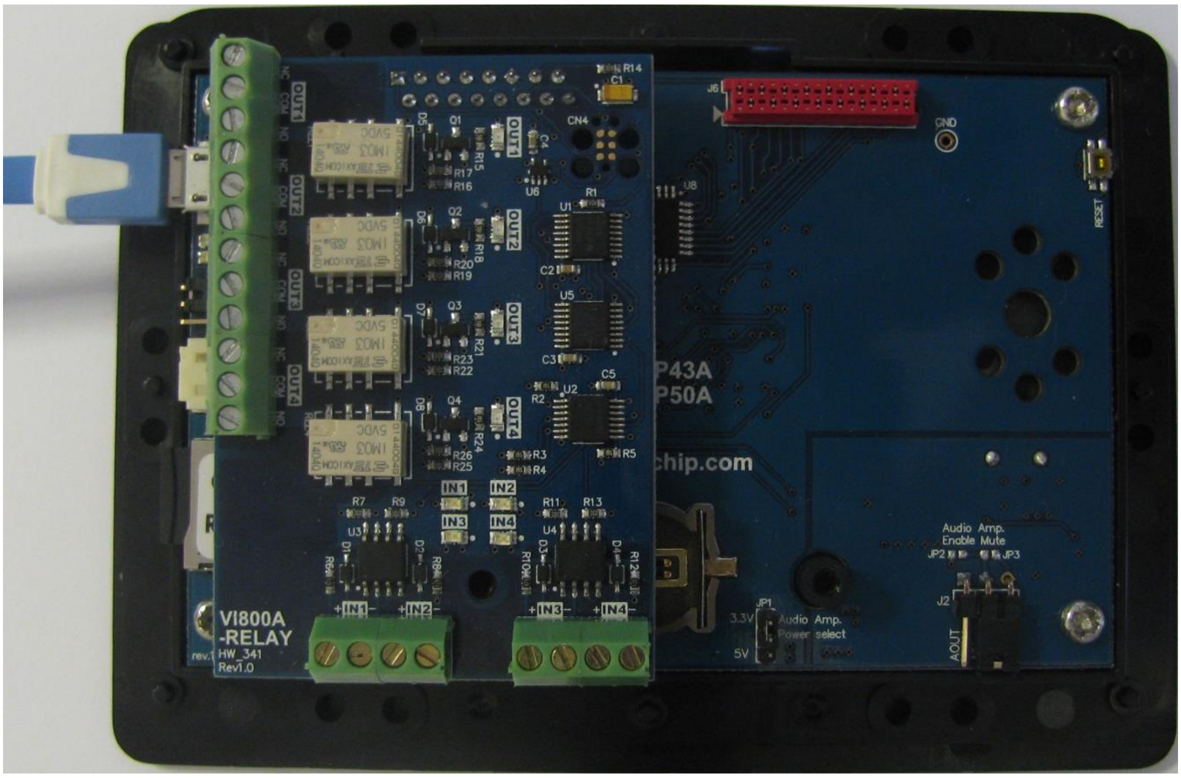


Figure 4.3 VI800A-RELAY module connected to VM800P

4.2 Arduino Library based SampleApp - Source code upload

To use the sample application, the first step is to install the Arduino Library. Refer to the section below to install the Arduino library for the VI800A-RELAY.

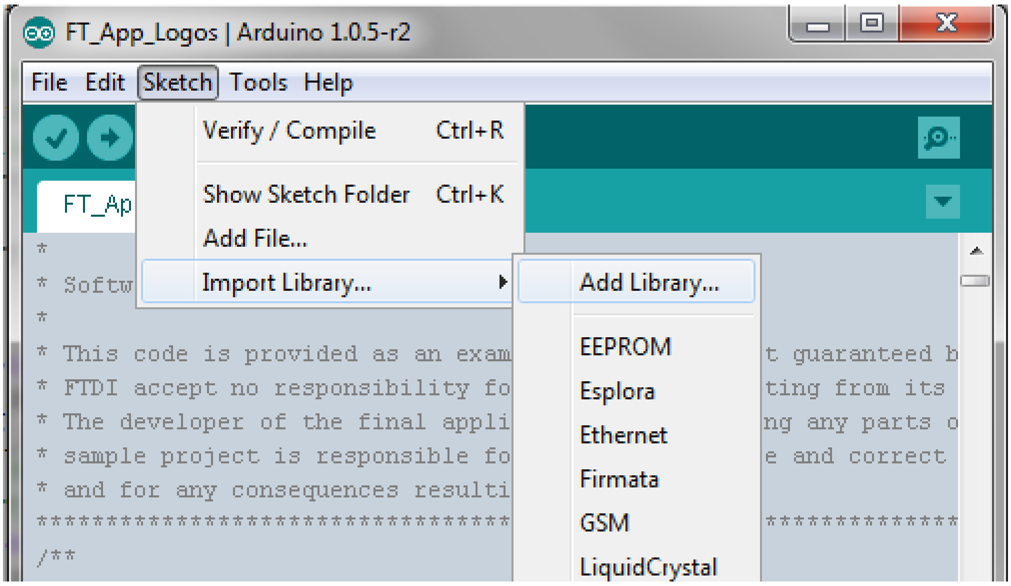
4.2.1 Install Library

4.2.1.1 Another FTDI Library Is Present

If there is an existing FTDI library in the library folder, simply extract the library files and put the new files/folders into their respective location in the existing library directory.

4.2.1.2 Automatic Installation

This method will install the library by the IDE and the library itself can be a ZIP file or unzipped folder. This method will install the library to the location specified in the IDE's Sketchbook location. The default directory, on OSX, would be at "~/Documents/Arduino/". On Windows, it would be at "My Documents\Arduino\". For further information on the library installation, please refer to http://arduino.cc/en/Guide/Libraries.



```
*
* Softw
*
* This code is provided as an exam            t guaranteed b
* FTDI accept no responsibility fo            ting from its
* The developer of the final appli            ng any parts o
* sample project is responsible fo            e and correct
* and for any consequences resulti
*********************************             **************
/**
```

Figure 4.4 Arduino IDE – add library option

In the Arduino IDE, click "Sketch", hover over the "Import Library" option in the drop down menu, and then click the "Add Library…" item.

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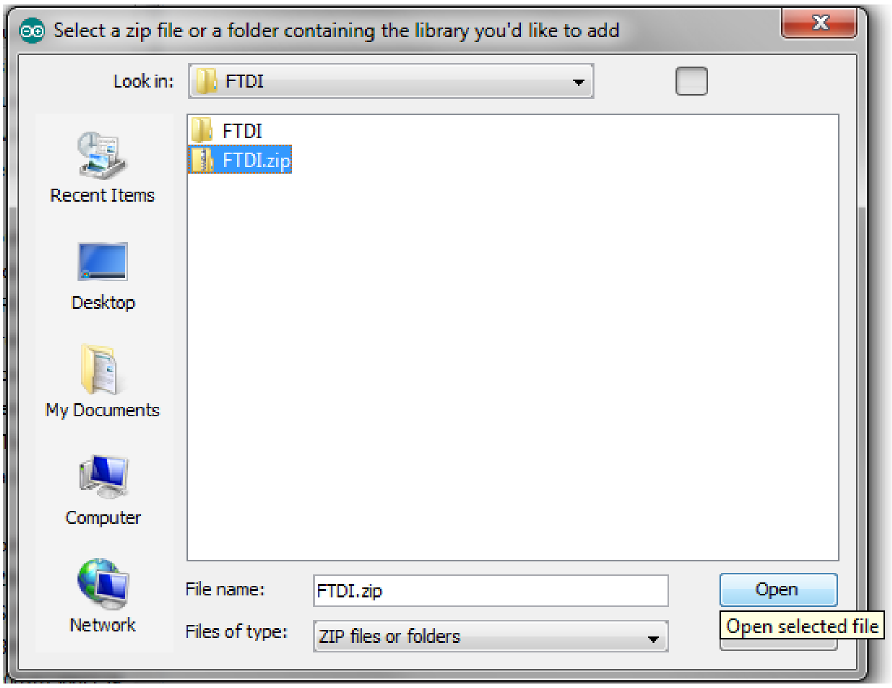

Figure 4.5 Arduino IDE - library selection browser

Navigate to the downloaded FTDI library file or unzipped folder and open it. The IDE will automatically install the files to the library folder of the Sketchbook location.

4.2.1.3 Manual Installation

To manually install the library, simply unzip the library and put the FTDI folder into the library folder of the IDE's Sketchbook location. The Sketchbook location is in the preferences window accessed by choosing *File->Preferences*. Users will need to make a folder called "*libraries*" in the Sketchbook location if it doesn't contain one.

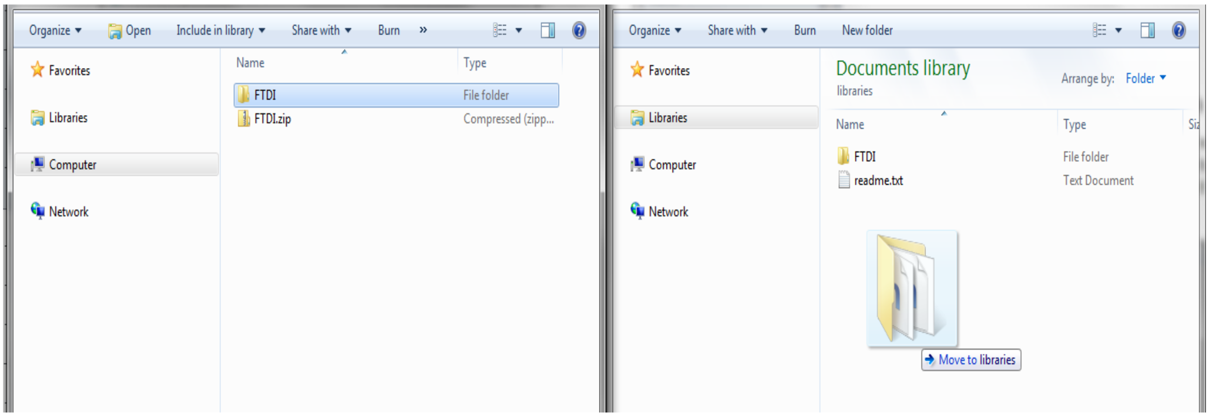

Figure 4.6 Library Installation - Manual Installation

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4.2.2 Source Code Upload

This section demonstrates the uploading of the code to the VM800P board.

A successfully installed library will contain "FTDI" as one of the items in the Examples list menu and hovering over it will reveal the 'Toggle' sketch as shown below.

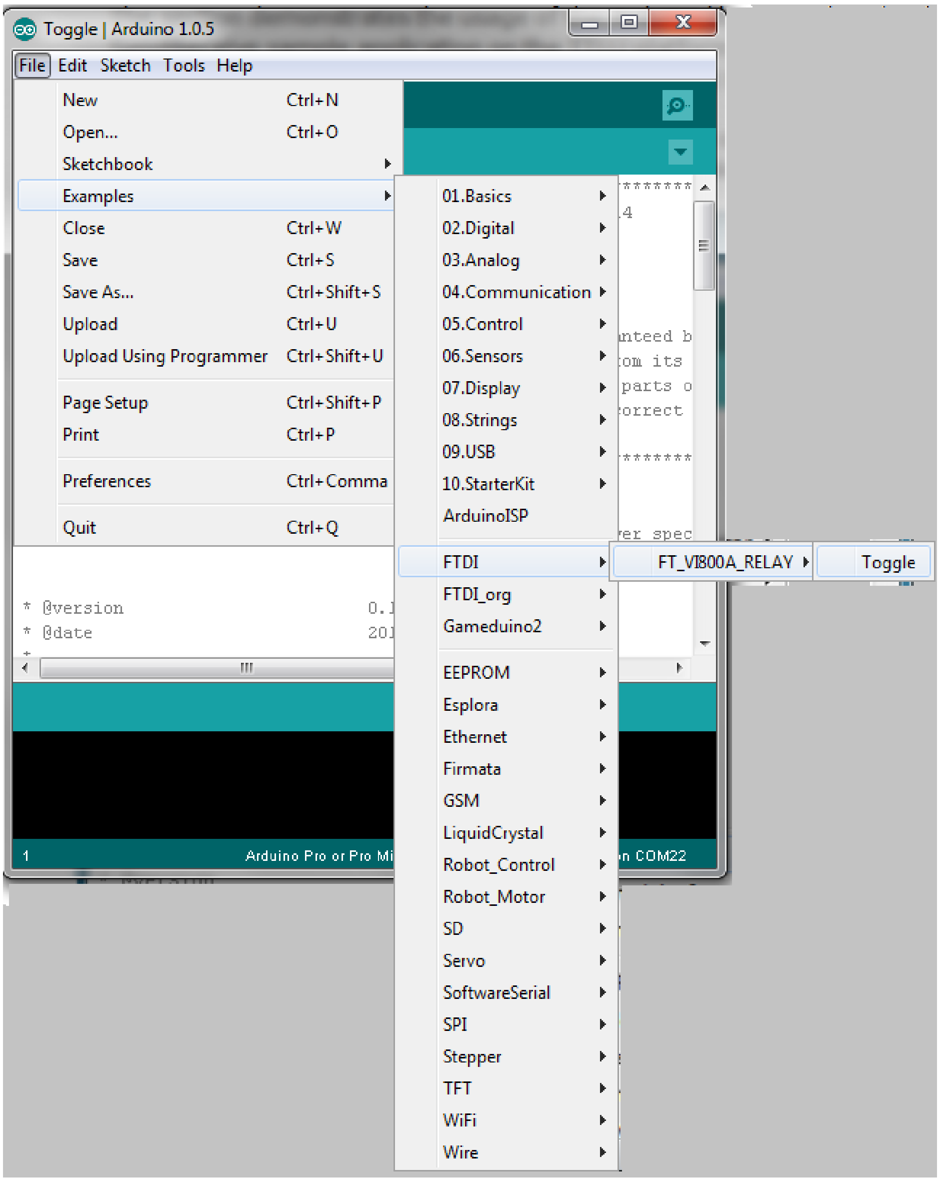

Figure 4.7 Arduino IDE – example sketch

Clicking on the Toggle example sketch will open it up in a new sketch window. The code itself can be viewed and used as a reference for future applications of the VI800A-RELAY.

After making connections for the respective module as described in section 7, upload the program. The code can be uploaded to the VM800P board by selecting the correct board and Serial Port then choosing Upload. The following screenshots demonstrate the settings and the upload button.

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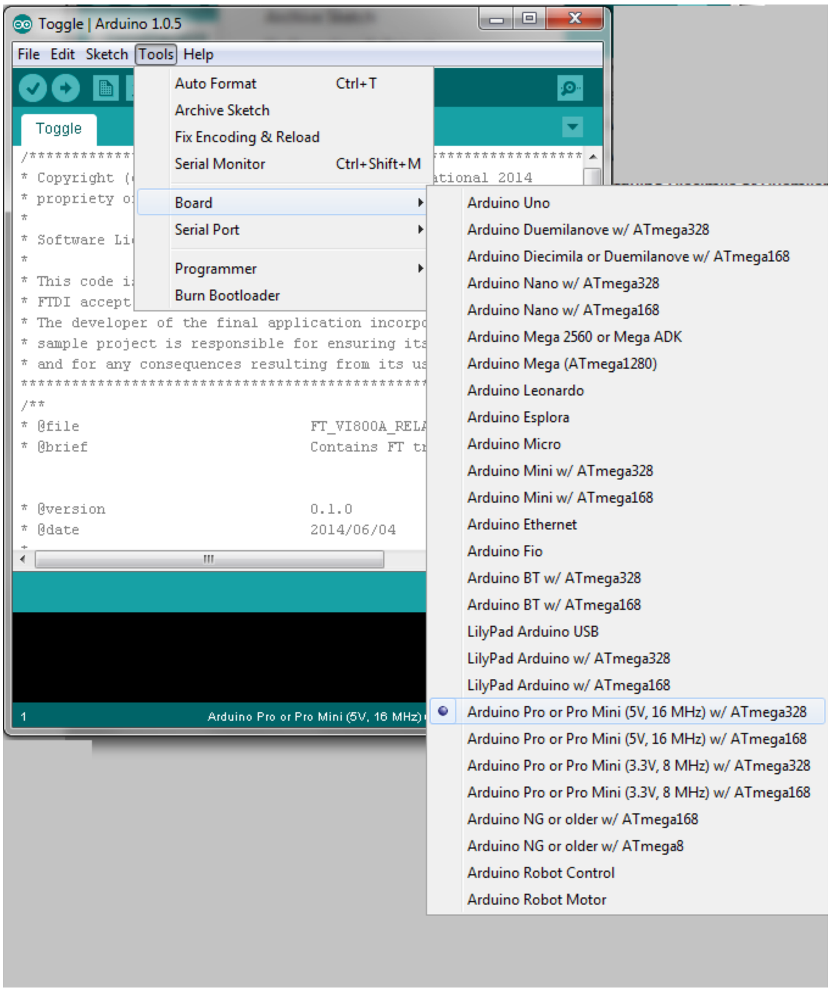
This example is intended for use with the VM800P and so the board selection should be set for "Arduino Pro or Pro Mini (5V, 16MHz) w/ Atmega328".


Toggle | Arduino 1.0.5
File
Edit
Sketch
Tools
Help
Toggle
Auto Format Ctrl+T
Archive Sketch
Fix Encoding & Reload
Serial Monitor Ctrl+Shift+M
Board
Serial Port
Programmer
Burn Bootloader
Arduino Uno
Arduino Duemilanove w/ ATmega328
Arduino Diecimila or Duemilanove w/ ATmega168
Arduino Nano w/ ATmega328
Arduino Nano w/ ATmega168
Arduino Mega 2560 or Mega ADK
Arduino Mega (ATmega1280)
Arduino Leonardo
Arduino Esplora
Arduino Micro
Arduino Mini w/ ATmega328
Arduino Mini w/ ATmega168
Arduino Ethernet
Arduino Fio
Arduino BT w/ ATmega328
Arduino BT w/ ATmega168
LilyPad Arduino USB
LilyPad Arduino w/ ATmega328
LilyPad Arduino w/ ATmega168
● Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328
Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega168
Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328
Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega168
Arduino NG or older w/ ATmega168
Arduino NG or older w/ ATmega8
Arduino Robot Control
Arduino Robot Motor
1
Arduino Pro or Pro Mini (5V, 16 MHz)

```
/************                            *****************
* Copyright (                            ational 2014
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*
* Software Li
*
* This code i
* FTDI accept
* The developer of the final application incorpo
* sample project is responsible for ensuring its
* and for any consequences resulting from its us
*************************************************
/**
* @file                            FT_VI800A_RELA
* @brief                           Contains FT tr


* @version                         0.1.0
* @date                            2014/06/04
```

Figure 4.8 Arduino IDE – Board selection

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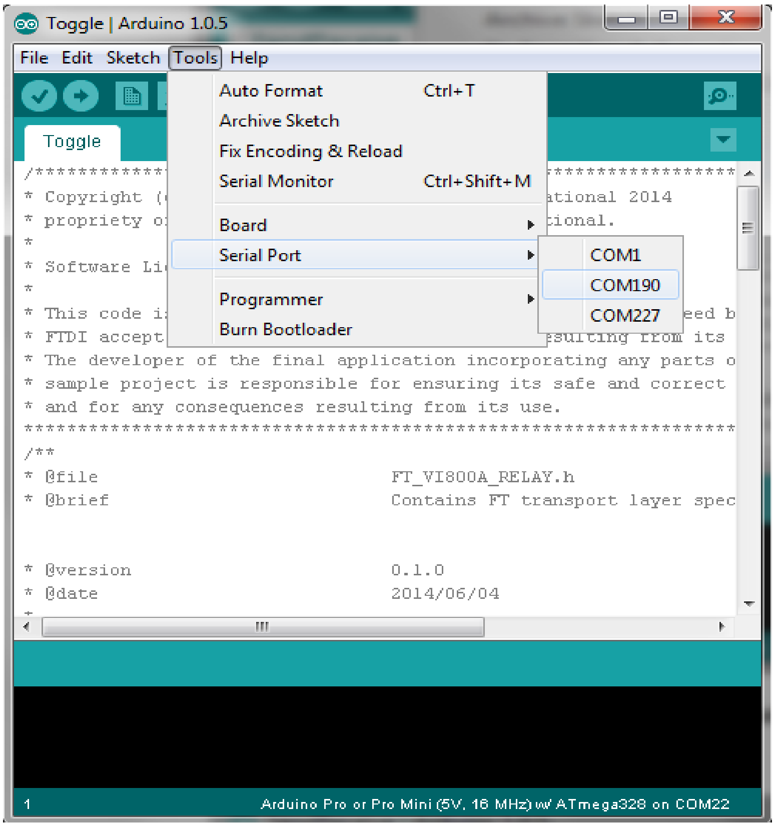
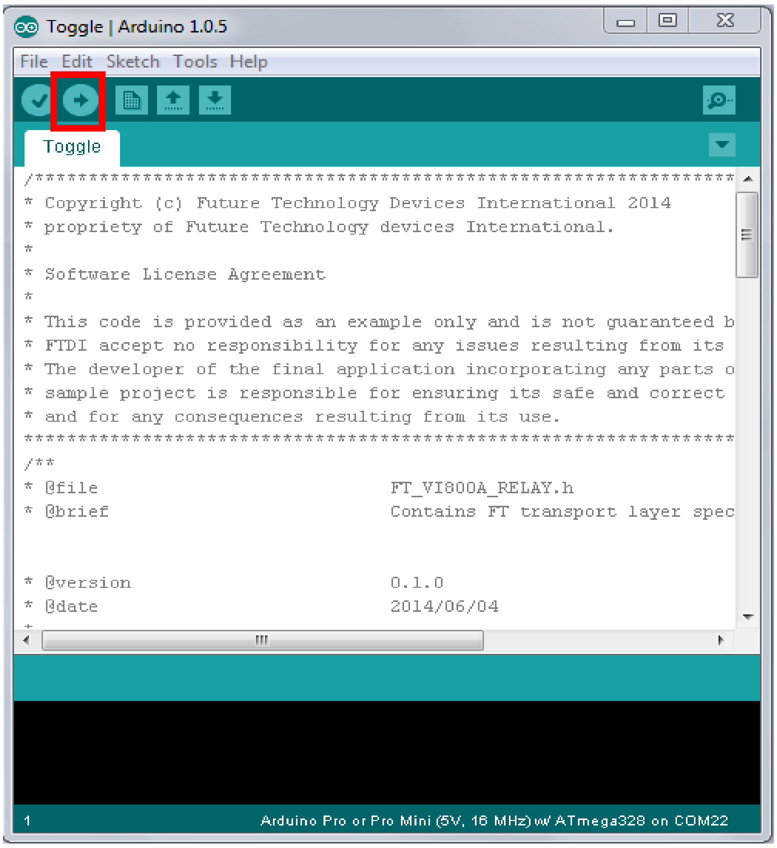


```
/************                        *****************
* Copyright (                         ational 2014
* propriety o                         tional.
*
* Software Li
*
* This code i                                        eed b
* FTDI accept                          sulting from its
* The developer of the final application incorporating any parts o
* sample project is responsible for ensuring its safe and correct
* and for any consequences resulting from its use.
******************************************************************
/**
* @file                                 FT_VI800A_RELAY.h
* @brief                                Contains FT transport layer spec


* @version                              0.1.0
* @date                                 2014/06/04
```

Figure 4.9 Serial port selection


Toggle | Arduino 1.0.5
File Edit Sketch Tools Help
Toggle
1
Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328 on COM22

```
/******************************************************************
* Copyright (c) Future Technology Devices International 2014
* propriety of Future Technology devices International.
*
* Software License Agreement
*
* This code is provided as an example only and is not guaranteed b
* FTDI accept no responsibility for any issues resulting from its
* The developer of the final application incorporating any parts o
* sample project is responsible for ensuring its safe and correct
* and for any consequences resulting from its use.
******************************************************************
/**
* @file                                 FT_VI800A_RELAY.h
* @brief                                Contains FT transport layer spec


* @version                              0.1.0
* @date                                 2014/06/04
```

Figure 4.10 Arduino IDE – upload button

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5 Sample Application Flowchart

The Sample application demonstrates usage of the RELAY module and its functionality. In this case, each of the relays is switched on in turn. The contacts have been wired up to switch 5V into the Input pins depending on which relay is energised. This allows a simple demonstration of using both inputs and outputs.

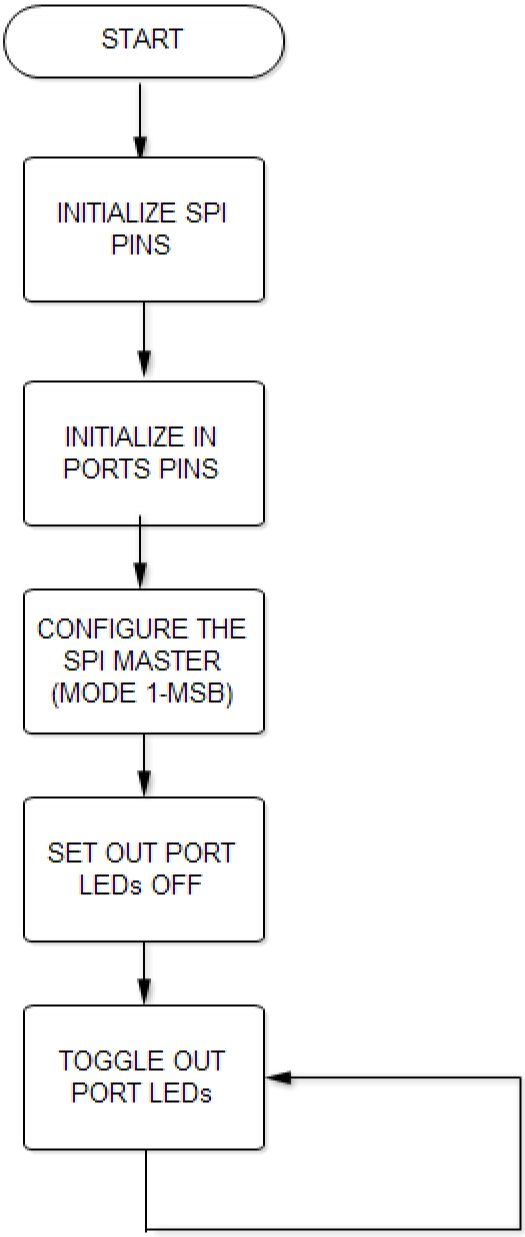

Figure 5.1 Flowchart

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6 Sample Application

This section explains the sample application based on the Arduino Library.

6.1 Platform Setup

Library Includes :

```
/* Arduino standard includes */
#include "SPI.h"
#include "Wire.h"

/* Platform specific includes */
#include "FT_VI800A_RELAY.h"
```

Global Object declaration :

```
FT_VI800A_RELAY RELAY;
```

Pin configuration :

```
// Arduino SPI pins
const char Daughter1_SS   = 7;
const char FT800_CS = 9;
const char SD_CS = 8;
const char _3state_IO = 5;

//In port pins
int ploadPin       = 1;  // Connects to SH/!LD Parallel load pin the 165
int clockEnablePin  = 9;  // Connects to Clock Enable pin the 165
int clockPin        = 2; // Connects to the Clock pin the 165
```

6.2 Functionality

The RELAY module's setup function initializes the SPI pins and IN port pins, initializes the SPI interface, and sets the outputs.

```
void setup()
{
        RELAY.SetCSpin(SS); //set CS pin
        RELAY.SetDaughter1SSpin(Daughter1_SS); //set Daughter1_SS pin

        /* Initialize SPI pins*/
        pinMode(SD_CS,OUTPUT);
        pinMode(FT800_CS,OUTPUT);
        digitalWrite(SD_CS,HIGH);
        digitalWrite(FT800_CS,HIGH);

        //IN ports pins
        pinMode(ploadPin, OUTPUT); //pin 1
        pinMode(clockEnablePin, INPUT); //pin 9
        pinMode(clockPin, OUTPUT); //pin 2
        pinMode(_3state_IO,OUTPUT);  // bus buffer 3-state
        pinMode(A0,OUTPUT);

        digitalWrite(A0,HIGH);
        digitalWrite(ploadPin, LOW);
        digitalWrite(ploadPin, HIGH);
        digitalWrite(_3state_IO,LOW);

        /* Initialize serial print related functionality */
        Serial.begin(9600);
  Serial.println("\n\r\n\r-----------Sample Application for TTLU--------------");

        RELAY.Init();  //Initialize SPI
        RELAY.WriteByte(0x00); //set OUT port LEDs off
}
```

Loop function :

The code then sits in the loop function, where the outputs are asserted in turn.

```
void loop()
{
 RELAY.WriteByte(OutPortValues[OutPortCount]);
 val = RELAY.ReadByte(OutPortValues[OutPortCount]);
 Serial.print("OUT-IN value :");
 Serial.println(val,HEX);
 delay(400);
 OutPortCount++;
 if(OutPortCount >= 4)
 {
  OutPortCount=0;
 }
}
```

7 Application execution

The use of the sample application is described below.

1. Ensure that the VI800A-RELAY is connected to the VM800P's J5 expansion connector. The VM800P must be powered down when connecting or disconnecting any expansion cards to avoid damage.

2. The loopback connections between the relay contacts and the Input pins can then be made. In this example, FTDI USB-UART cables (red wire = 5V, black wire = 0V) were used for the 5V and 0V external supplies used to provide power to the contacts of the relays. Other 5V supplies could be used instead.

3. Connections to the VI800A-RELAY module are shown in the table below. The principle is that 5V is supplied to the common contact of relays 1 and 2, and these relays have their normally-open and normally-closed contacts connected to the input lines of the relay board. The states of relays 1 and 2 will therefore determine which of the four Inputs are asserted.

Connect	**Connect TO**
OUT1 - NC	IN1+
OUT1 - COM	5V from UART cable
OUT1 - NO	IN2+
OUT2 - NC	IN3+
OUT2 - COM	5V from UART cable
OUT2 - NO	IN4+
IN1-	GND from UART cable
IN2-	GND from UART cable
IN3-	GND from UART cable
IN4-	GND from UART cable

Table 7.1 RELAY Connections

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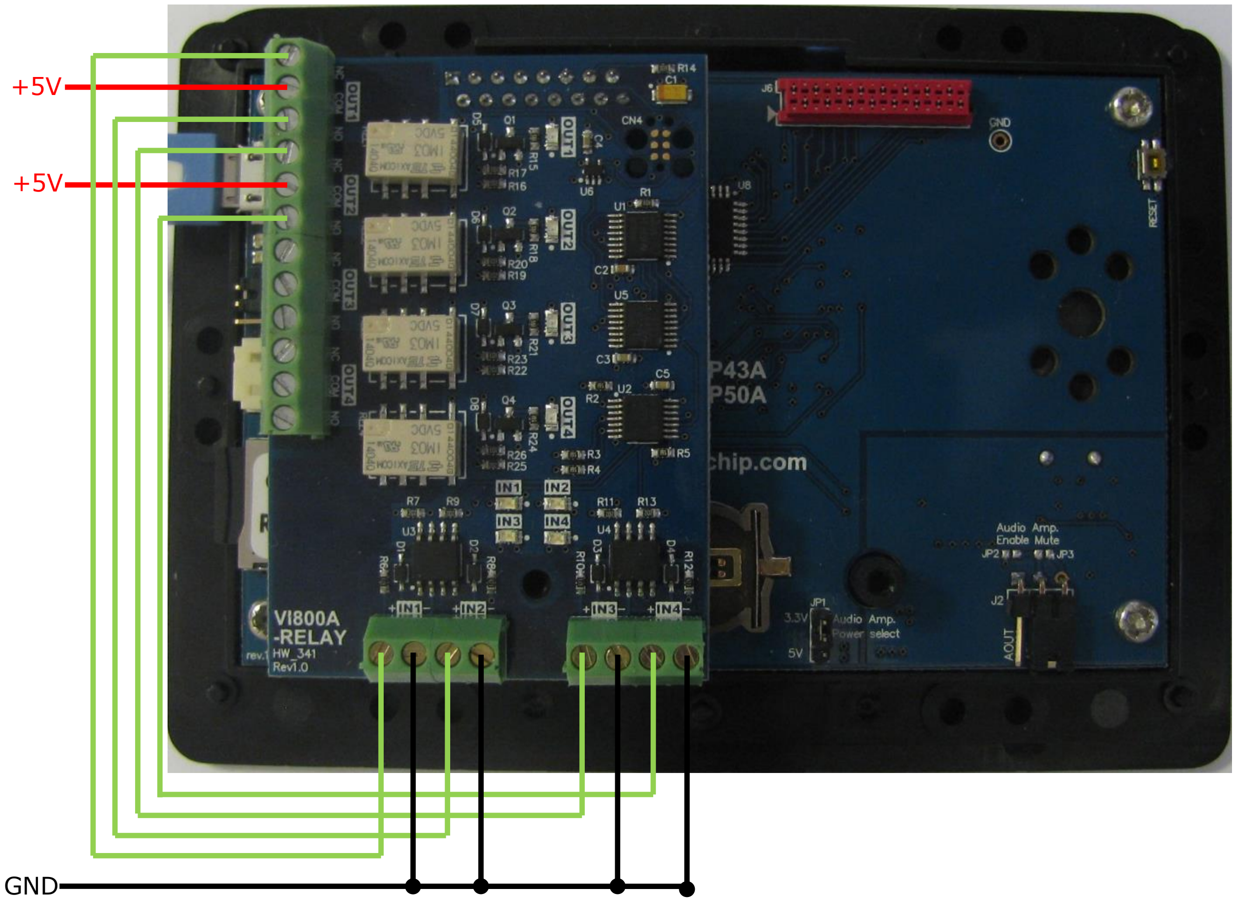

Figure 7.1 Connections to the relays

4. After making the connections shown above, connect the board to the PC via the VM800P's micro-B USB connector.

5. Open the sample application in the Arduino IDE and upload the sample application as shown in section 4.2.2

6. After uploading the program, the input and output LEDs will start toggling in a loop. Each OUT LED will turn on in sequence whilst the others are off. The Input LED states for each of the four output states is summarised in the following points:

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7. When the OUT1 LED is on,
   Relay 1 is on, switching 5V to its Normally Open contact which connects to IN2+
   Relay 2 is off, switching 5V to its Normally Closed contact which connects to IN3+
   Relay 3 is off (no connections to its contacts in this demonstration)
   Relay 4 is off (no connections to its contacts in this demonstration)

   Therefore, the IN2 and IN3 LEDs will be on.

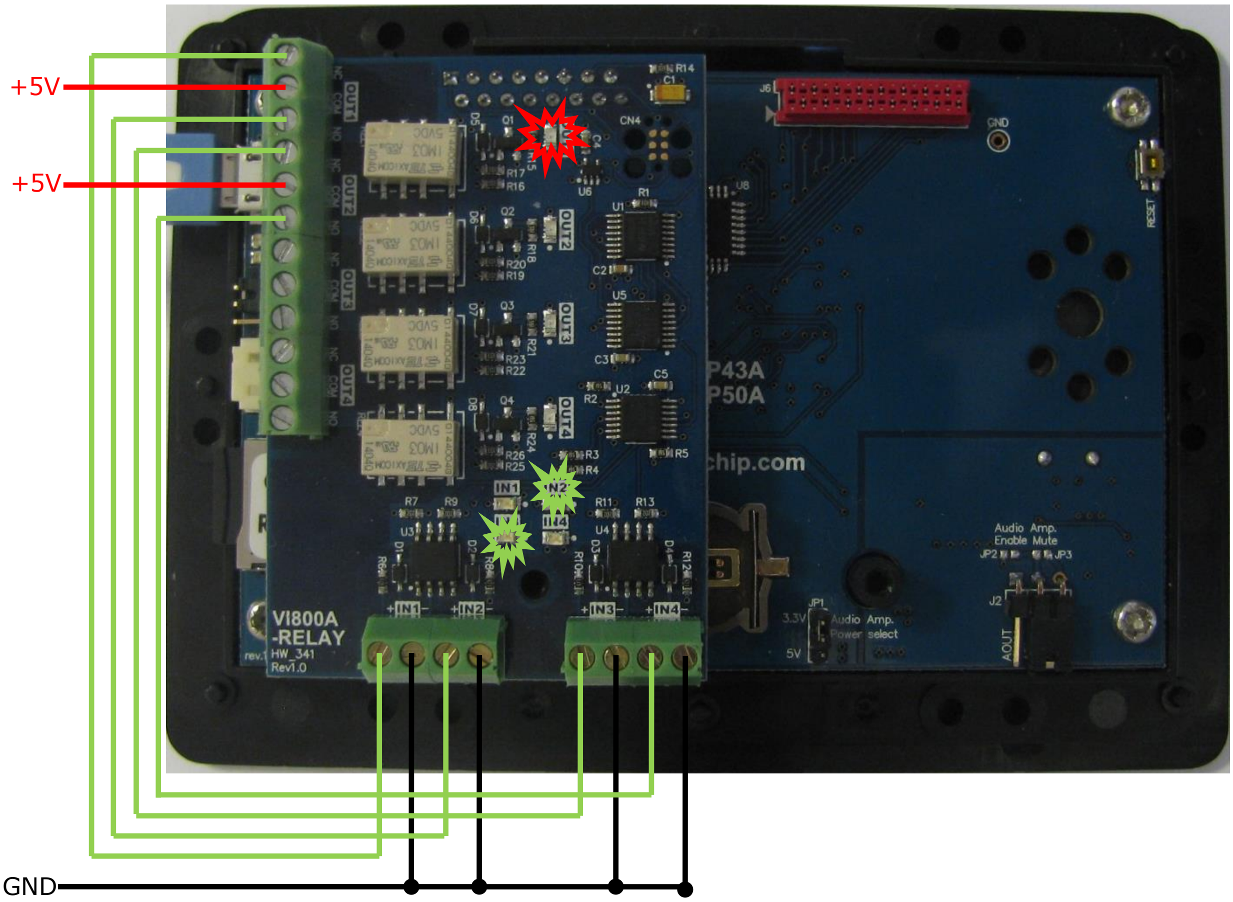

Figure 7.2 RELAY: OUT1 – ON, IN2 & IN3 – ON

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8. When the OUT2 LED is on,
   Relay 1 is off, switching 5V to its Normally Closed contact which connects to IN1+
   Relay 2 is on, switching 5V to its Normally Open contact which connects to IN4+
   Relay 3 is off (no connections to its contacts in this demonstration)
   Relay 4 is off (no connections to its contacts in this demonstration)

   Therefore, the IN1 and IN4 LEDs will be on.

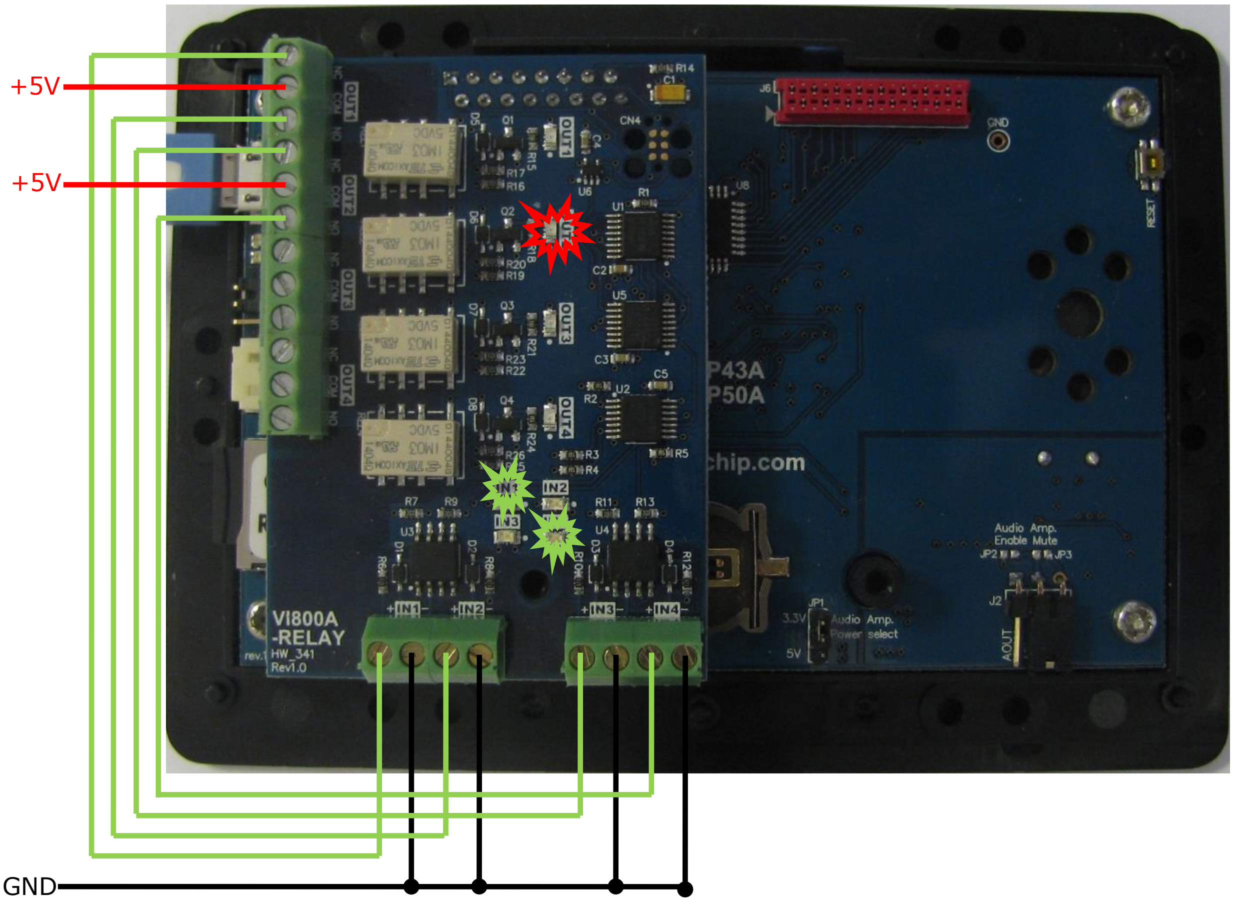

Figure 7.3 RELAY: OUT2 – ON, IN1 & IN4 – ON

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9. When the OUT3 LED is on,

   Relay 1 is off, switching 5V to its Normally Closed contact which connects to IN1+
   Relay 2 is off, switching 5V to its Normally Closed contact which connects to IN3+
   Relay 3 is on (no connections to its contacts in this demonstration)
   Relay 4 is off (no connections to its contacts in this demonstration)

   Therefore, the IN1 and IN3 LEDs will be on.

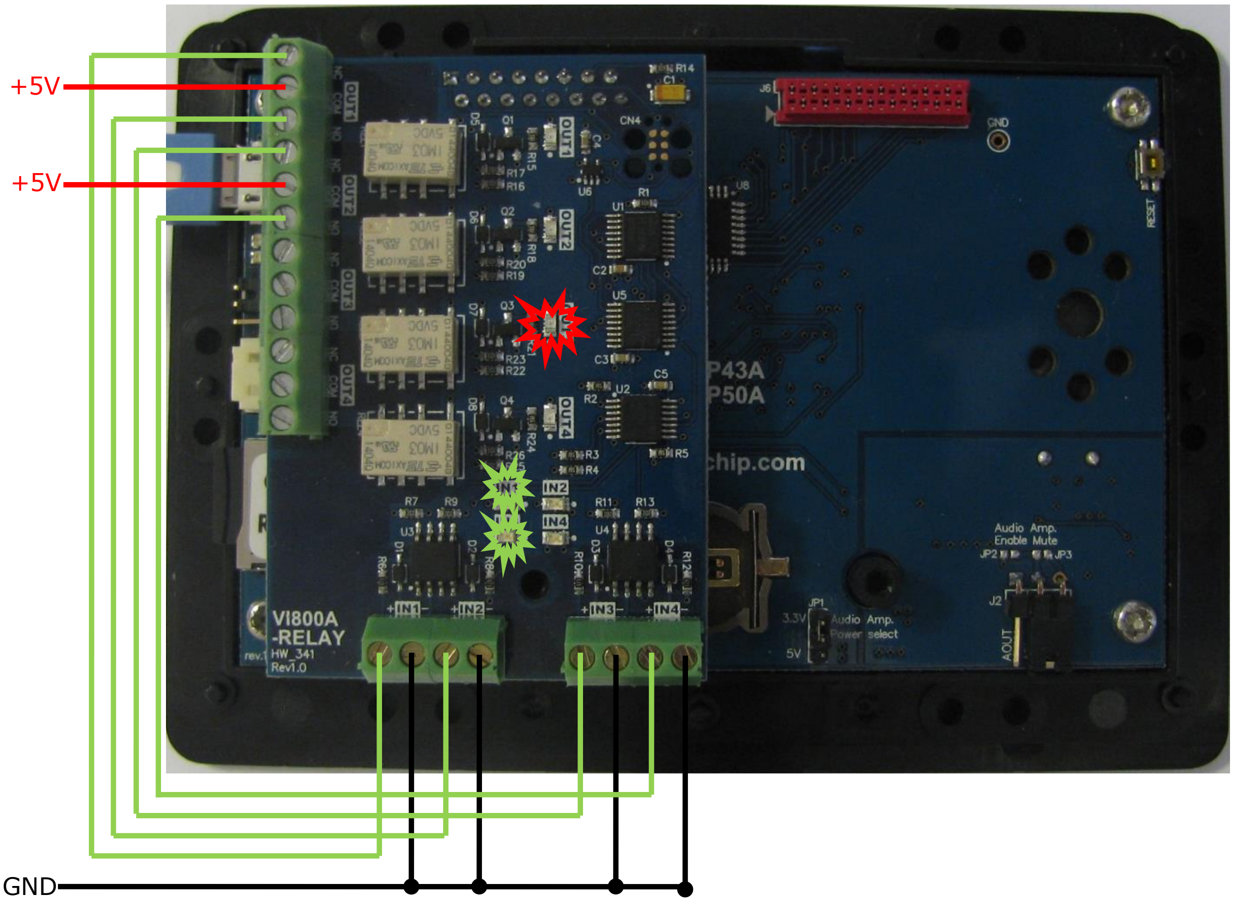

Figure 7.4 RELAY: OUT3 – ON, IN1 & IN3 – ON

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10. When the OUT4 LED is on,
    Relay 1 is off, switching 5V to its Normally Closed contact which connects to IN1+
    Relay 2 is off, switching 5V to its Normally Closed contact which connects to IN3+
    Relay 3 is off (no connections to its contacts in this demonstration)
    Relay 4 is on (no connections to its contacts in this demonstration)

  Therefore, the IN1 and IN3 LEDs will be on.

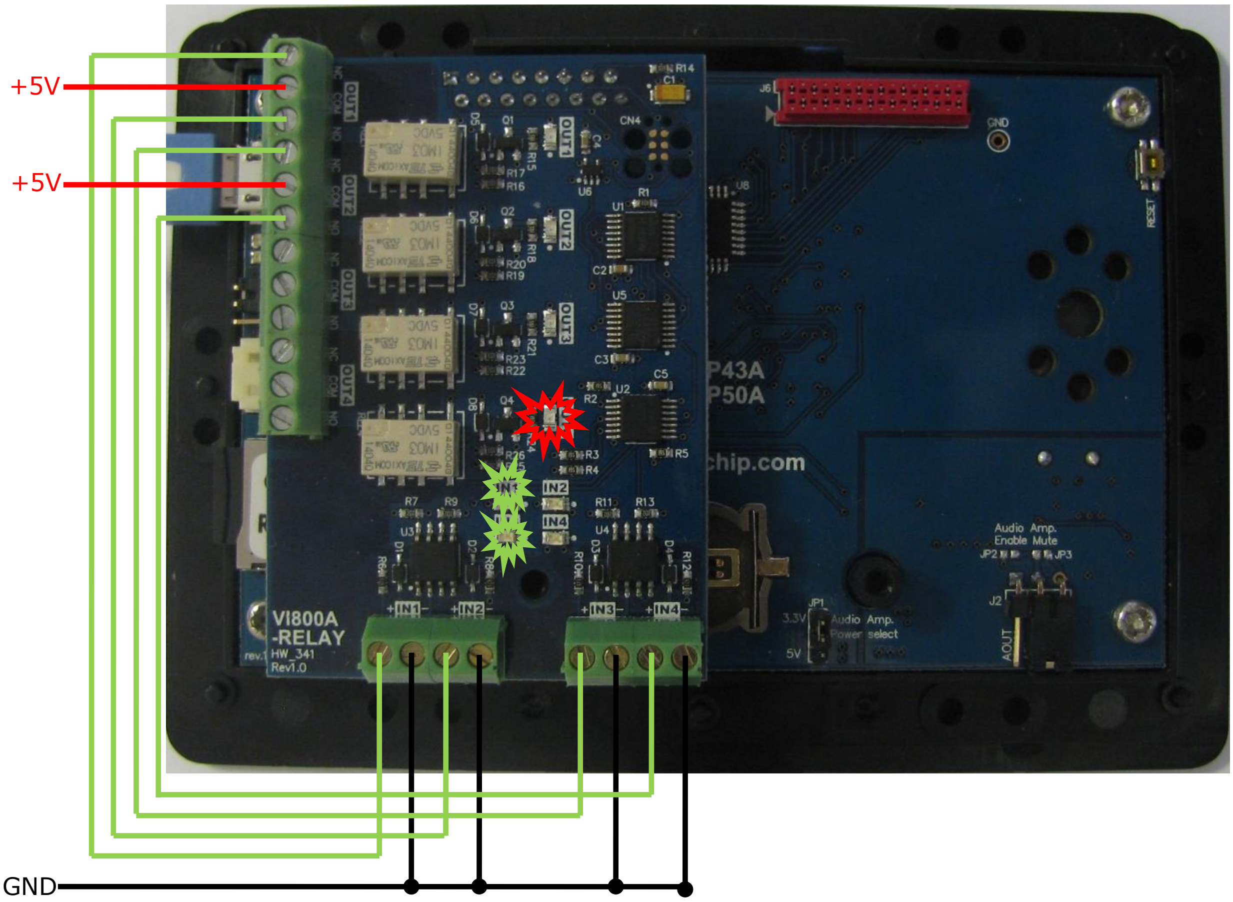

Figure 7.5 RELAY: OUT4 – ON, IN1 & IN3 – ON

This simple demonstration shows how both inputs and outputs can be used. The code itself can be used as a reference and a basis for development of other applications using the relays and the inputs.

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Appendix A– References

Document References

1. FT800 Datasheet
2. VI800A-RELAY Datasheet
3. EVE Product Page
4. Arduino IDE
5. Example code for VI800A-RELAY

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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Appendix B – List of Tables & Figures

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9 Appendix C– Revision History

Document Title:	AN_331 VI800A Relay Sample Application
Document Reference No.:	FT_001069
Clearance No.:	FTDI#418
Product Page:	http://www.ftdichip.com/EVE.htm
Document Feedback:	Send Feedback

Revision	Changes	Date
1.0	Initial release	2014-10-23

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