VINCULUM

BINDING USB TECHNOLOGIES

# Future Technology Devices International Ltd.

# Vinco Ethernet MP3 RTC Shield

# Datasheet

**Document Reference No.: FT_000550**

**1.0**

**Issue Date: 2011-12-23**

The FTDI Vinco Ethernet, MP3, RTC shield is designed to interface to the FTDI Vinco USB development module and provides a development platform to create interfaces to Ethernet ports, Real Time Clock (RTC) and an Audio Codec using the Vinculum-II.

**Future Technology Devices International Ltd (FTDI)**

**Unit 1, 2 Seaward Place, Centurion Business Park, Glasgow, G41 1HH, United Kingdom**

**Tel.: +44 (0) 141 429 2777 Fax: + 44 (0) 141 429 2758**

**E-Mail (Support): support1@ftdichip.com**

**Web: www.ftdichip.com**

# 1 Introduction

The FTDI Vinco Ethernet RTC MP3 shield is designed to connect directly to the FTDI Vinco development PCB. The shield will allow the Vinculum-II (VNC2) device on the Vinco PCB to access an Ethernet port which uses the Wiznet W5100 chipset, audio files using the VLSI VS1053b CODEC and access a Real Time Clock using the NXP PCF32123 device. These 3 functions are accessed via the VNC2 SPI Master mode.

Vinco is a development module based on the FTDI Vinculum-II (VNC2) dual channel USB host/slave controller IC. Vinco is designed as a prototyping platform for VNC2 based designs and applications.

The mechanical form of the module, and the concept of providing free software development library and tools, is inspired by the Arduino concept. Vinco is a superset of the Duemilanove / Uno with 2 extra rows of headers providing an extra 10 pins.

**Software libraries which support the development of the Ethernet, MP3 and RTC applications are available with the free** Vinculum-II development Toolchain available at **VNC2 IDE**.

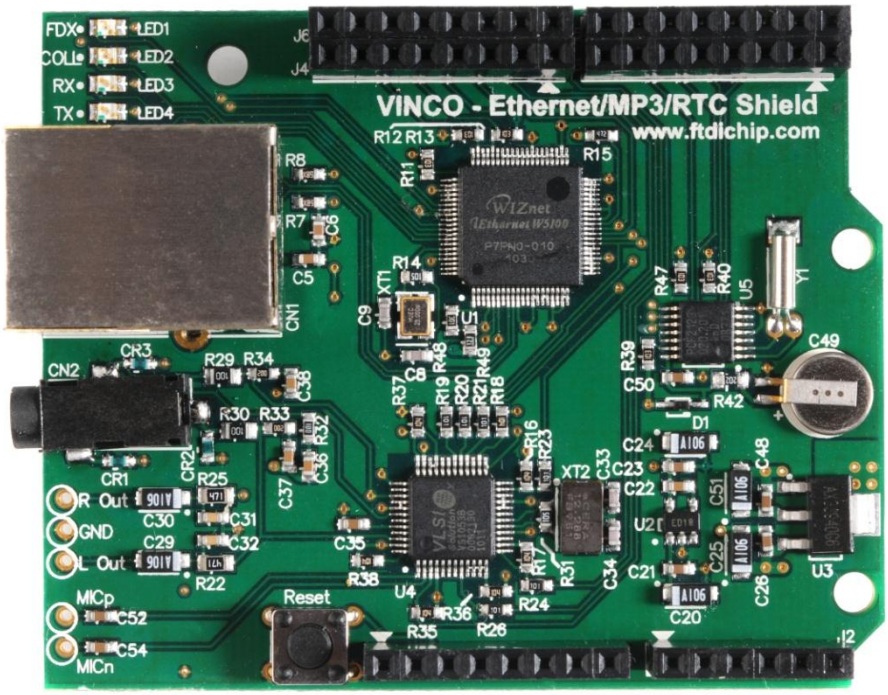


**Figure 1.1 – Vinco Ethernet RTC MP3 Shield**

## 1.1 Key Features

The Vinco Ethernet RTC MP3 shield incorporates the following features:

- Uses the VLSI VS1053b audio CODEC: Decodes various audio files (Ogg Vorbis, MP3,AAC,WMA,FLAC, WAV and MIDI)
- Uses the Wiznet W5100 Ethernet chipset: Hardwired TCP/IP stack (10Mbps or 100Mbps) supports TCP, UDP, ICMP, IPv4 ARP, IGMP and PPPoE
- Uses the NXP PC2123 RTC chipset: Provides time and date information
- SPI Interface: Data transfer over the SPI bus to the Vinco via pin headers
- 3.5mm audio socket: Provides the audio signal for headphones or amplifier.
- MP3 audio files player: Provides access to MP3 files from USB drive
- RJ45 ethernet connector: Inbuilt Speed indicator LED's and Ethernet magnetics.
- 4 Ethernet traffic LEDs: RX/TX/Collision/Full Duplex indication
- 5V operation: Power supplied from Vinco baseboard
- Onboard 3V3 regulator: Driven from 5V supply to power ICs
- Onboard 1V8 regulator: Used by the VS1053b
- MIC input to the audio codec
- Stereo Audio Line Out
- Mates with the Vinco Development Platform: Data transfer to and from the local network, playback audio files and provide timing functions (time and date, timestamp files access and alarms)
- Available GPIO pins via pin headers and free Ethernet/RTC/ MP3 source codes for customisation purposes and adding new features.
- FTDI Integrated Development Environment (IDE) including code editor, compiler and debugger, which is available as a free download from the FTDI website.
- Free software libraries and drivers (SPI Master, GPIO, RTC, Ethernet and MP3 drivers) for accessing these functions accessible via the Vinculum-II toolchain VNC2 IDE

## 1.2 Part Numbers

| Part Number | Description |
|---|---|
| VSHLD-EMR | Vinco Ethernet MP3 RTC shield |

**Table 1.1 – Vinco Ethernet/MP3/RTC Shield Part Numbers**

# Table of Contents

# 2 Functionality

## 2.1 Power

The shield requires a 3V3 supply to power the PCB. This is generated with an onboard 3V3 regulator supplied with 5V supplied by the Vinco baseboard.

An additional 1V8 supply for the VS1053b audio codec is generated from an onboard regulator.

## 2.2 Input/Output

Connection to the Vinco baseboard is via pin headers. The Ethernet port, the audio CODEC and the Real Time Clock are accessed by the VNC2 via SPI interface between the boards.

An RJ45 connector with inbuilt Speed and Link LEDs is provided for connecting to external Ethernet ports.

A 3.5mm audio socket is provided for connecting headphones to the audio CODEC output.

MIC input to the audio CODEC is available on header pins.

## 2.3 LEDs

There are 4 LEDs available on the shield.

1. LED1: Ethernet Full Duplex indicator is driven from the W5001 IC to indicate the Ethernet port is in full duplex mode.
2. LED2: Ethernet Collision indicator is driven from the W5001 IC to indicate the Ethernet port is experiencing data collisions.
3. LED3: Ethernet Received Data indicator is driven from the W5001 IC to indicate the Ethernet port is receiving data.
4. LED4: Ethernet Transmitted Data indicator is driven from the W5001 IC to indicate the Ethernet port is transmitting data.

## 2.4 Switches

SW1: A momentary switch to send a reset signal to the VNC2 controller on the Vinco baseboard.

## 2.5 Ethernet Operation

Ethernet is accessed via the Wiznet W5100 IC. This device converts Ethernet data to SPI data and vice versa. The SPI port is a slave to the VNC2 SPI Master. Ethernet, SPI Master and GPIO drivers are supplied with the Vinculum-II Toolchain at VNC2 IDE to allow programming and reading data over the SPI interface to the W5100 IC

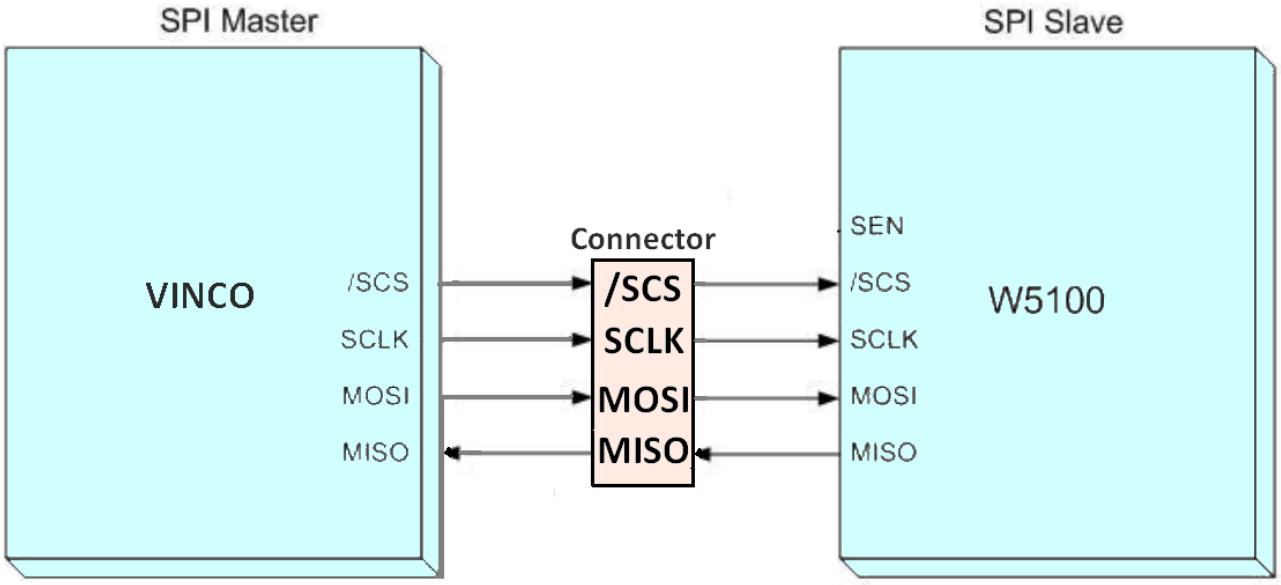


**Figure 2.1 – SPI Master communicates with W5100 via the SPI bus**

This Ethernet device will support TCP/IP and UDP protocol and allow for 10Mbps or 100Mbps transfers on the Ethernet link.

All the Ethernet magnetics to support the Ethernet link are integrated into the RJ45 connector on the PCB and as such the user only needs to supply a standard CAT5 cable to complete the link.

## 2.6 Real Time Clock Operation

The Real Time Clock (RTC) on the Ethernet/RTC/MP3 Shield is an NXP PCF2123 device. This is an SPI peripheral accessed via the SPI Master on the Vinco baseboard. RTC, SPI Master and GPIO drivers are available with the Vinculum-II Toolchain at VNC2 IDE to allow user applications access to the RTC Shield.

The device provides time and date information, allowing a possible mechanism to timestamp files accessed with the Vinco base board on a USB memory device.

Time resolution is days, hours, minutes, seconds.

The calendar supports weekdays, months, years.

The RTC supports alarm and countdown timer functions.

Note: the board must be powered at all time to prevent the RTC losing its data.

## 2.7 Audio Codec Operation

The audio codec is the VLSI VS1053b. This will allow encoded audio files in MP3 format to be decoded to analogue for playback over headphones or a speaker.

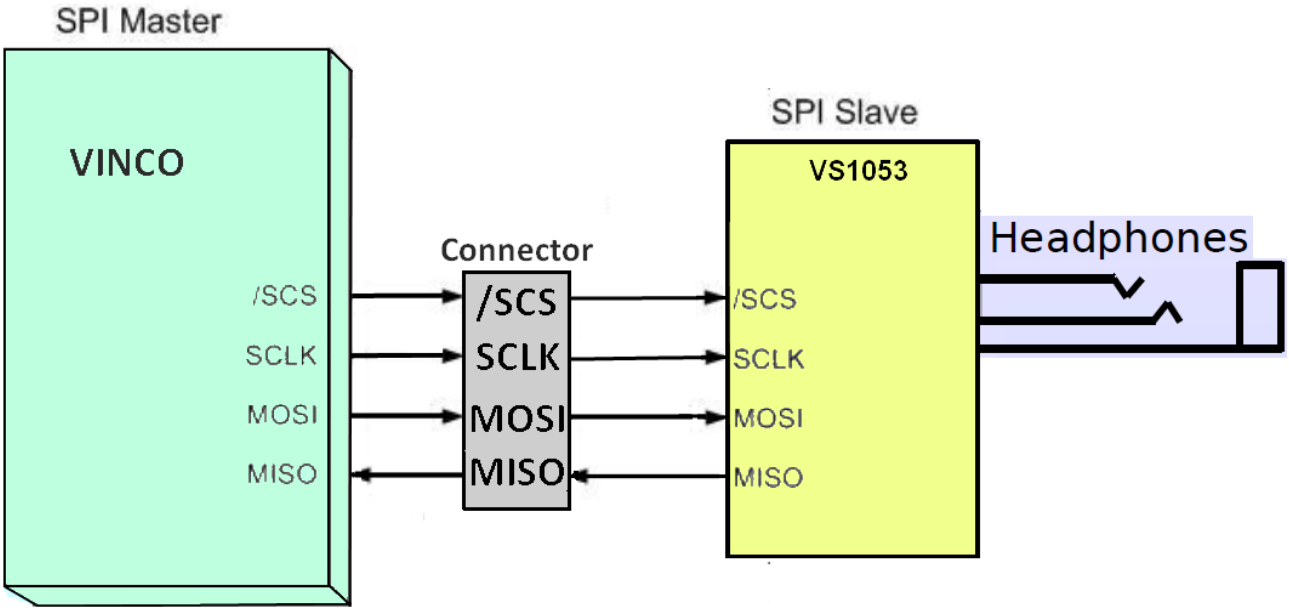


**Figure 2.2 – SPI Master communicates with VS1053b via the SPI bus**

RTC, SPI Master and GPIO drivers are available with the Vinculum-II Toolchain at VNC2 IDE to allow data transfer over the SPI interface to the VNC2 on the Vinco baseboard.

Additionally the VS1053b can accept analogue audio from a MIC to be encoded for transfer over SPI to the VNC2 on the Vinco baseboard. In theory the Vinco could then be used to save the encoded audio file on a USB memory device for playback later, or possibly transfer over Ethernet to a second device for playback using the Ethernet chip on this shield.

**NOTE:** At the time of writing this document, the current driver does not support audio recording.

# 3 Pin Out and Signal Description

## 3.1 Module Connector Descriptions

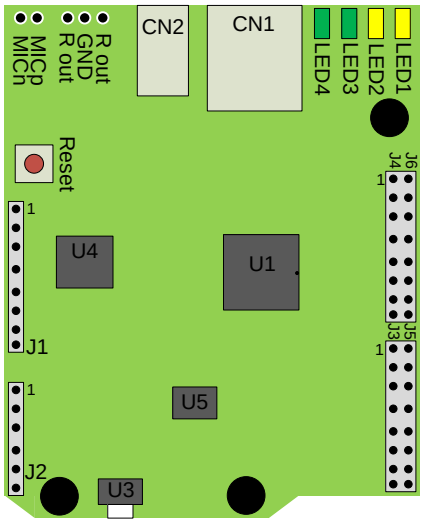


**Figure 3.1 – Vinco Ethernet MP3 RTC Block Diagram**

A detailed description of each pin out is given in the next section.

| CONNECTOR | FUNCTION |
|---|---|
| CN1 | RJ45 Ethernet Connector with integrated LEDs and Ethernent magnetics |
| CN2 | Analogue Audio output for headphones |
| J1 | Interface to Vinco board |
| J2 | Interface to Vinco board |
| J3 | Interface to Vinco board |
| J4 | Interface to Vinco board |
| J5 | Interface to Vinco board |
| J6 | Interface to Vinco board |
| R OUT, GND, L OUT | Stereo Audio Line out |
| MICp MICn | Audio input |

**Table 3.1 – Vinco Ethernet MP3 RTC Connector Descriptions**

## 3.2 Vinco Ethernet MP3 RTC Shield Connectors : Pins and Signal Description

| Pin No. | Name | Type | Description | Routed to VNC2 Pin on VINCO BaseBoard |
|---|---|---|---|---|
| CN1-1 | TXOP | Analogue Output | Positive differential Ethernet transmit line. | N/A |
| CN1-2 | TXON | Analogue Output | Negative differential Ethernet transmit line. | N/A |
| CN1-3 | TCT | Digital Ouptut | Transmit coil centre tap connected to 3V3 | N/A |
| CN1-6 | RCT | Digital Ouptut | Receive coil centre tap connected to 3V3 | N/A |
| CN1-7 | RXIP | Analogue Input | Positive differential Ethernet receive line. | N/A |
| CN1-8 | RXIN | Analogue Input | Negative differential Ethernet receive line. | N/A |
| CN1-9 | LINK LED | Digital Output | Logic Low to illuminate the Green LED. Indicates a link has been established over Ethernet | N/A |
| CN1-10 | GLED+ | PWR Output | 3V3 supply to the Green LED Anode in the connector | N/A |
| CN1-11 | SPE_LED | Digital Output | Logic Low to illuminate the Yellow LED. Indicates 10Mbps connection when not lit. Indicates 100Mbps connection when lit. | N/A |
| CN1-12 | YLED+ | PWR Output | 3V3 supply to the Yellow LED Anode in the connector | N/A |
| | | | | |
| CN2-3 | Right | Analogue Output | Audio Right output for headphones | N/A |
| CN2-4 | Left | Analogue Output | Audio Left output for headphones | N/A |
| CN2-5 | GND | GND | Audio GND to headphones | N/A |
| | | | | |
| J1-1 | AIN6 | Analogue Input | NOT IN USE | |
| J1-2 | AIN7 | Analogue Input | NOT IN USE | |
| J1-3 | RESET# | Outut | Reset for the VNC2-64Q | 9 |
| J1-4 | VCC3V3 | PWR input | NOT IN USE | |
| J1-5 | VCC5V | Power output | 5V input to power shield | N/A |
| J1-6 | GND | GND | GND for PCB | 1, 6, 8, 30, 35, 53, 64 |
| J1-7 | GND | GND | GND for PCB | 1, 6, 8, 30, 35, 53, 64 |
| J1-8 | VCCIN | PWR Input | NOT IN USE | |
| | | | | |
| J2-1 | AIN0 | Analogue Input | NOT IN USE | |
| J2-2 | AIN1 | Analogue Input | NOT IN USE | |
| J2-3 | AIN2 | Analogue Input | NOT IN USE | |
| J2-4 | AIN3 | Analogue Input | NOT IN USE | |
| J2-5 | AIN4 | Analogue Input | NOT IN USE | |
| J2-6 | AIN5 | Analogue Input | NOT IN USE | |
| | | | | |
| J3-1 | IOBUS33 | I/O | NOT IN USE | |

| Pin No. | Name | Type | Description | Routed to VNC2 Pin on VINCO BaseBoard |
|---|---|---|---|---|
| J3-2 | IOBUS32 | I/O | NOT IN USE | |
| J3-3 | IOBUS34 | I/O | NOT IN USE | |
| J3-4 | IOBUS35 | I/O | NOT IN USE | |
| J3-5 | IOBUS36 | I/O | NOT IN USE | |
| J3-6 | IOBUS37 | I/O | NOT IN USE | |
| J3-7 | IOBUS38 | I/O | NOT IN USE | |
| J3-8 | IOBUS39 | I/O | NOT IN USE | |
| | | | | |
| J4-1 | IOBUS6 | I/O | NOT IN USE | |
| J4-2 | IOBUS7 | I/O | NOT IN USE | |
| J4-3 | SS# | I/O | NOT IN USE | |
| J4-4 | MOSI | Input | 3V3 level SPI MOSI data line to send data to the IC's on the shield. | 20 |
| J4-5 | MISO | Output | 3V3 level SPI MISO data line to send data from the IC's on the shield. | 22 |
| J4-6 | SCLK | Input | 3V3 level SPI SCLK line to clock the SPI peripherals on the shield | 19 |
| J4-7 | GND | GND | GND for PCB | 1, 6, 8, 30, 35, 53, 64 |
| J4-8 | AREF | I/O | NOT IN USE | |
| | | | | |
| J5-1 | IOBUS41 | I/O | NOT IN USE | |
| J5-2 | IOBUS42 | I/O | NOT IN USE | |
| J5-3 | IOBUS43 | I/O | NOT IN USE | |
| J5-4 | RTC_CE | Input | 3V3 Input to enable the RTC chip | 12 |
| J5-5 | RTC_INT# | Output | 3V3 Output | 13 |
| J5-6 | RTC_CLKO | Output | 3V3 Output | 14 |
| J5-7 | RTC_CLKO | Input | 3V3 Input | 15 |
| J5-8 | IOBUS5 | I/O | NOT IN USE | |
| | | | | |
| J6-1 | MP3_RST# | Input | Active Low 3V3 Input to reset the audio codec. | 24 |
| J6-2 | MP3_DREQ | Output | 3V3 Output | 25 |
| J6-3 | MP3_DCS | Input | 3V3 Input | 26 |
| J6-4 | MP3_CS# | Input | Active low 3V3 input to enable the audio codec | 27 |
| J6-5 | ETH_CS# | Input | Active low 3V3 input to enable the Ethernet chip | 28 |
| J6-6 | ETH_INT# | Output | 3V3 Output | 29 |
| J6-7 | ETH_RST# | Input | Active Low 3V3 Input to reset the Ethernet chip. | 31 |
| J6-8 | IOBUS19 | I/O | NOT IN USE | |
| | | | | |
| J7 | Left | Analogue Output | Audio Right output for headphones | N/A |
| J8 | Right | Analogue Output | Audio Left output for headphones | N/A |
| J9 | GND | GND | Audio GND to headphones | N/A |
| | | | | |
| J10 | MICp | Analogue In | Audio input from MIC positive | N/A |
| J11 | MICn | Analogue In | Audio input from MIC negative | N/A |

**Table 3.2 – Pin Signal Descriptions**

# 4 Firmware

Firmware libraries and sample applications code to demonstrate using this Shield with the Vinco baseboard are available for download with the VNC2 IDE from Toolchain revision 1.4.2 onwards (VNC2 tools). Please refer to section 3 of AN_142 Vinculum-II Tool Chain Getting Started Guide or section 4 of AN_138 Vinculum-II Debug Interface on how to load, build, program and debug the sample applications on the VNC2 device.

## 4.1 Ethernet Sample Application

There are 2 ethernet sample applications called TCP.vproj and UDP.vproj. Both applications demonstrarate the use of the Ethernet library and the Vinco Shield.

### 4.1.1 TCP Sample Application

The "TCP" application turns the Vinco board into a TCP server that accepts incoming connections. When a connected client sends a message "On!" to the Vinco board, the on-board LED1 is turned on and a message "LED On!" is sent back to the client. When the client sends a message "Off!" to the Vinco board, the on-board LED1 is turned off and a message "LED Off!" is sent back to the client.

Setup:This application uses the Ethernet/MP3/RTC shield mated with the Vinco module and a Host PC installed with the VNC2 IDE. The Vinco module consists of a J7 connector which connects with the VNC2 debugger/programmer module, (also available from FTDI), this allows the IDE running on the PC to communicate with the VNC2 debugger port. The debugger module can also be used to load/program the ROM file created by the IDE into the VNC2 Flash memory.
Depending on the local network configuration, an Ethernet switch or router may be needed to connect the Ethernet/MP3/RTC Shield to the network via CN1, RJ45 Ethernet connector. The PC should also be installed with a TCP client software (such as Tera Term) and connected to the network to send messages to the board. If Tera Term is used, the settings should be set as follow:

- Host: < The IP address of the Ethernet shield in the network >
- Service: Other
- TCP port: 80
- Protocol: IPv4

Please note that no external circuit is needed to run this application

### 4.1.2 UDP Sample Application

The "UDP" sample application configures the Vinco board to accept incoming UDP connection. When a peer sends a message "On" to the Vinco board, the on-board LED1 is turned on and the message "LED On!" is sent back to the sender. When the peer sends the message "Off" to the Vinco board, the on-board LED1 is turned off and the message "LED Off!" is send back to the sender.

Setup:This application uses the Ethernet/MP3/RTC shield mated with the Vinco module and a Host PC installed with the VNC2 IDE. The Vinco module consists of a J7 connector which connects with the VNC2 debugger/programmer module, (also available from FTDI), this allows the IDE running on the PC to communicate with the VNC2 debugger port. The debugger module can also be used to load the rom file created by the IDE into the VNC2 chip.
Depending on the local network configuration, an Ethernet switch or router may be needed to connect the Ethernet/MP3/RTC Shield to the network via CN1, RJ45 Ethernet connector. The PC should also be installed with a UDP client software (such as UDP Win Chat) and connected to the network to send messages to the board. Please note that no external circuit is needed to run this application.

## 4.2 MP3 Sample Application

An "MP3" sample application called "MP3FlashDisk.vproj" demonstrates how to play songs (MP3 and WMA) from a FAT-formatted USB flash drive. The application automatically find MP3 and WMA files in the root directory of the flash drive and plays them one after another. Currently the application only plays back the first 25 songs found. This limit can be changed by adjusting the macro MAX SONG count in MP3FlashDisk.c. Due to a limit in the SPI transfer speed, only songs at 96kbps or lower can be played smoothly. Three push buttons can be attached to emulate an MP3 player – see example in 4.1.

Setup:This application uses the Ethernet/MP3/RTC Shield mated with the Vinco module, a flash drive connected to the CN2 (USB port 2) connector on the Vinco module and a Host PC with the installed VNC2 IDE. The Ethernet/MP3/RTC Shield also has a CN2 connector to allow the user to connect headsphones onto it. The Vinco module consists of a J7 connector which connects with the VNC2 debugger/programmer module, (also available from FTDI), this allows the IDE running on the PC to communicate with the VNC2 debugger port. The debugger module can also be used to load the rom file created by the IDE into the VNC2 chip.

Three push buttons can be attached as follows to emulate the MP3 player:

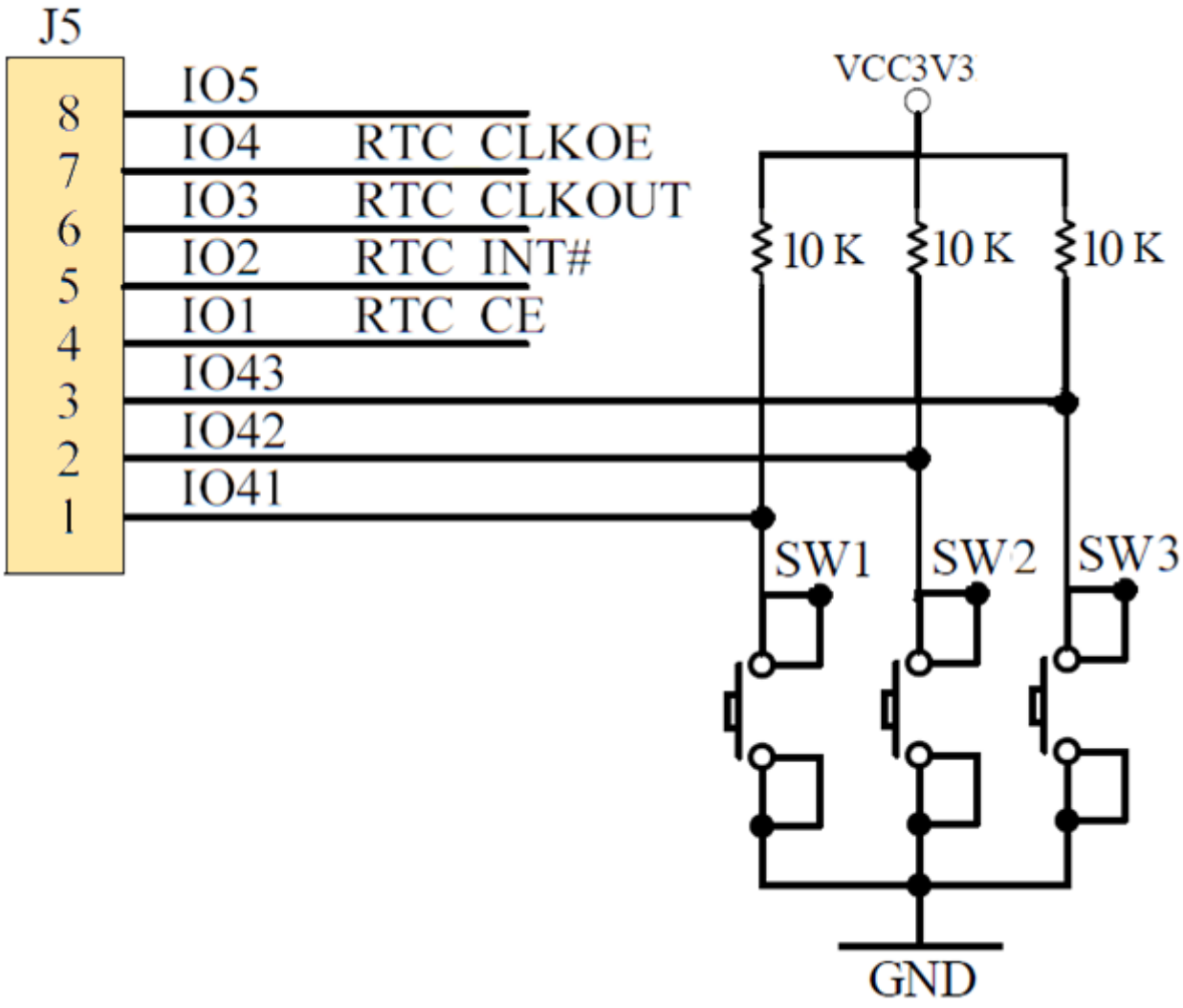


**Figure 4.1 – MP3 Player Push Buttons Schematic**

SW1 is used to play/pause and skip songs:

- Short press (> 0.1s and < 0.8s): play/pause
- Long press (>0.8s): skip to the next song

SW2 is used to control volume:

- Short press (> 0.1s and < 0.8s): decrease volume
- Long press (>0.8s): increase volume

SW3 is used to control volume:

- Short press (> 0.1s and < 0.8s): fast forward
- Long press (>0.8s): rewind

Since a long button press takes about 0.8s to be recognized, the program will delay for about 0.8s since a button is pressed to verify if it is a short press or a long press. Hence there will be a delay of about 0.8s since the button is press before the operation is performed. As a result, even for short presses, two consecutive presses should still be about 1s apart from each other (i.e. do not press too fast). The use of an external power supply (provided with the purchase of Vinco) is recommended.

## 4.3 RTC Sample Application

The "RTC" sample application called "RTCExample.vproj" demonstrarates the use of the NXP PCF2123 Real Time Clock to set/read the time and start a countdown timer.

Setup:This application uses the Ethernet/MP3/RTC Shield mated with the Vinco module and a Host PC with the installed VNC2 IDE. The Vinco module consists of a J7 connector which connects with the VNC2 debugger/programmer module, (also available from FTDI), this allows the IDE running on the PC to communicate with the VNC2 debugger port. It also used to load the rom file created by the IDE into the VNC2 chip.

# 5 Mechanical Details

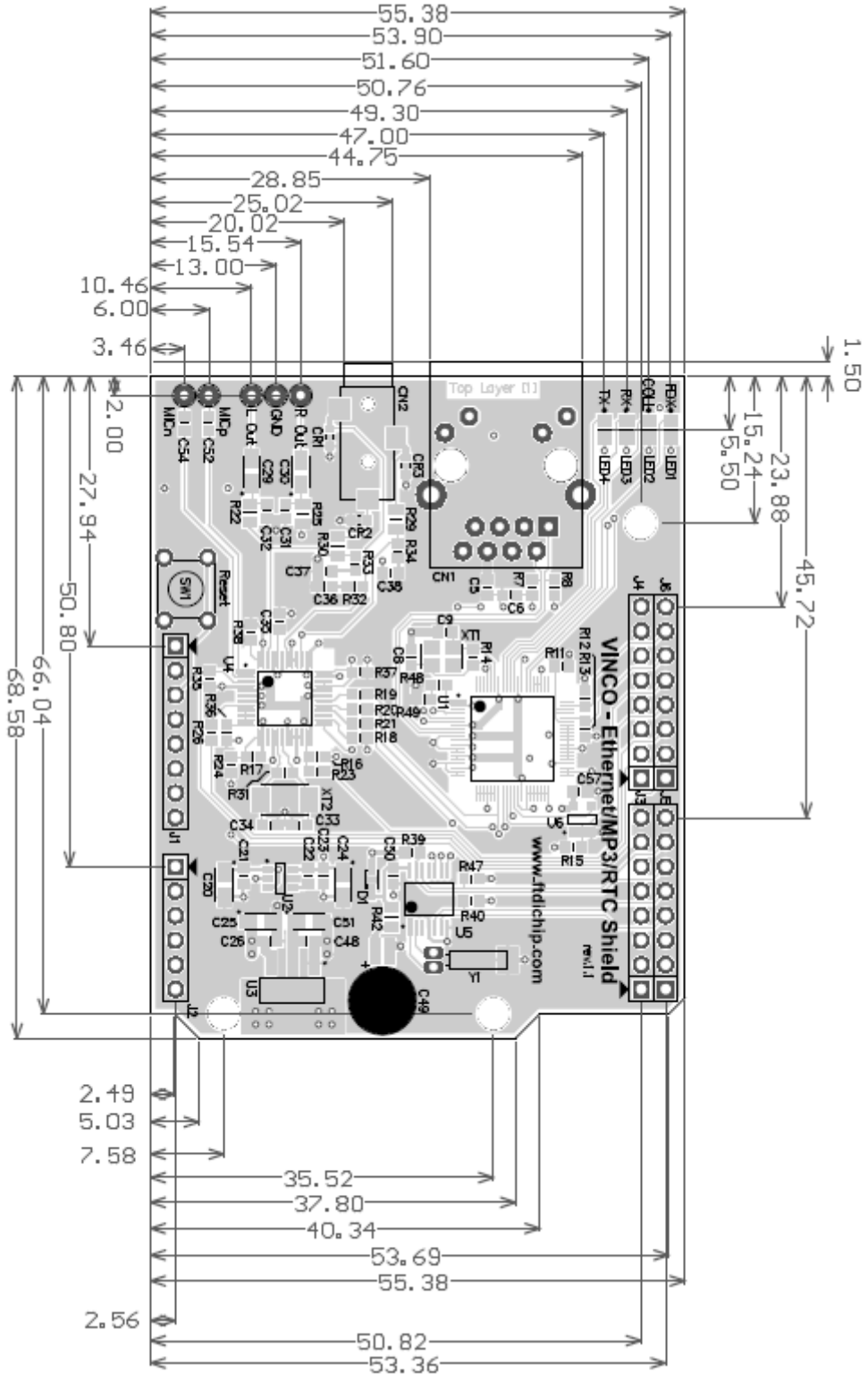


**Figure 5.1 –Vinc Ethernet RTC MP3 Dimensions**

±0.20mm Tolerance (except pitch)

Maximum height is 15mm

All dimensions are in mm

# 6 Schematic Diagram

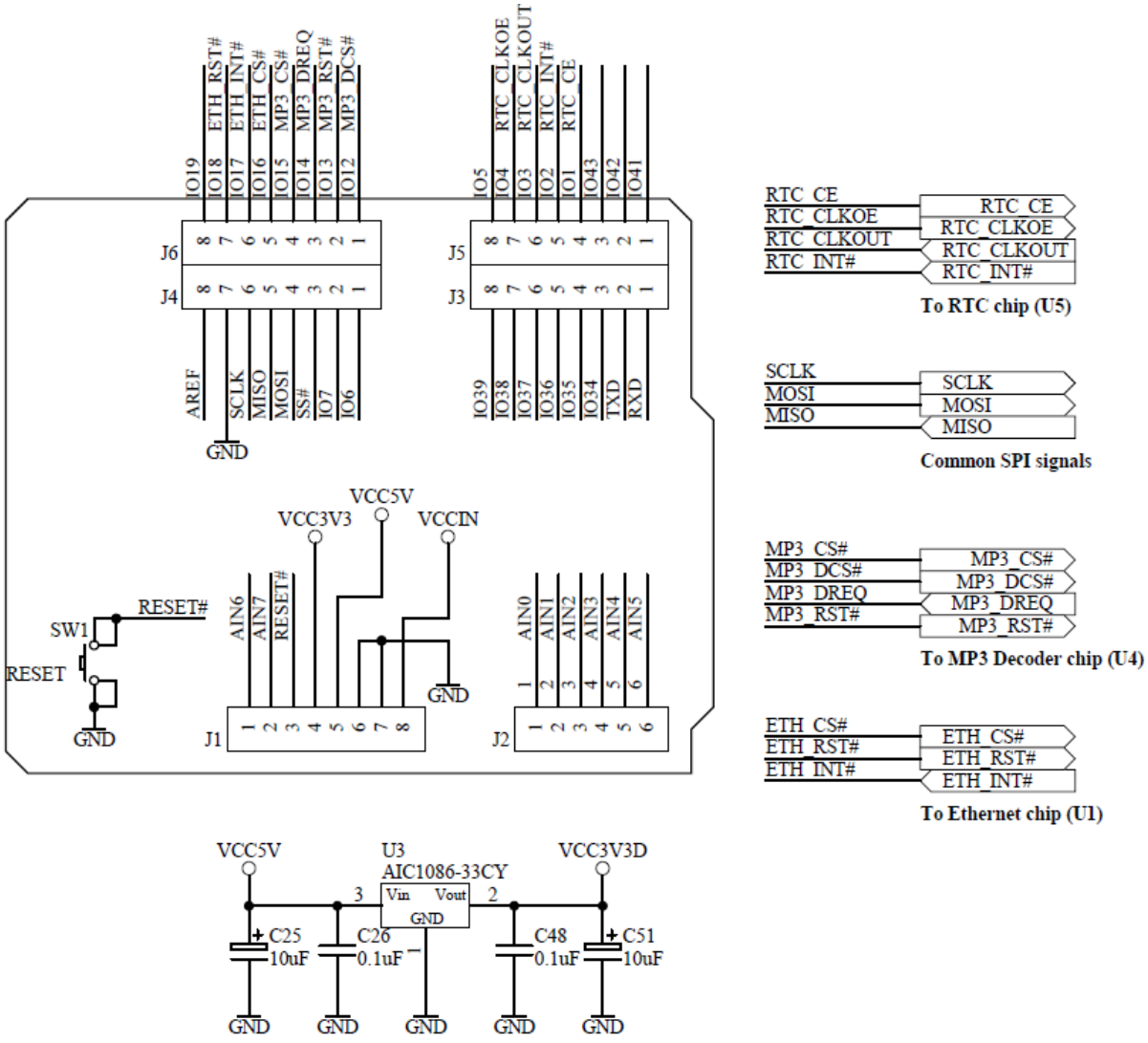


**Figure 6.1 – Vinco Ethernet RTC MP3 Shield Schematic – Connectors**

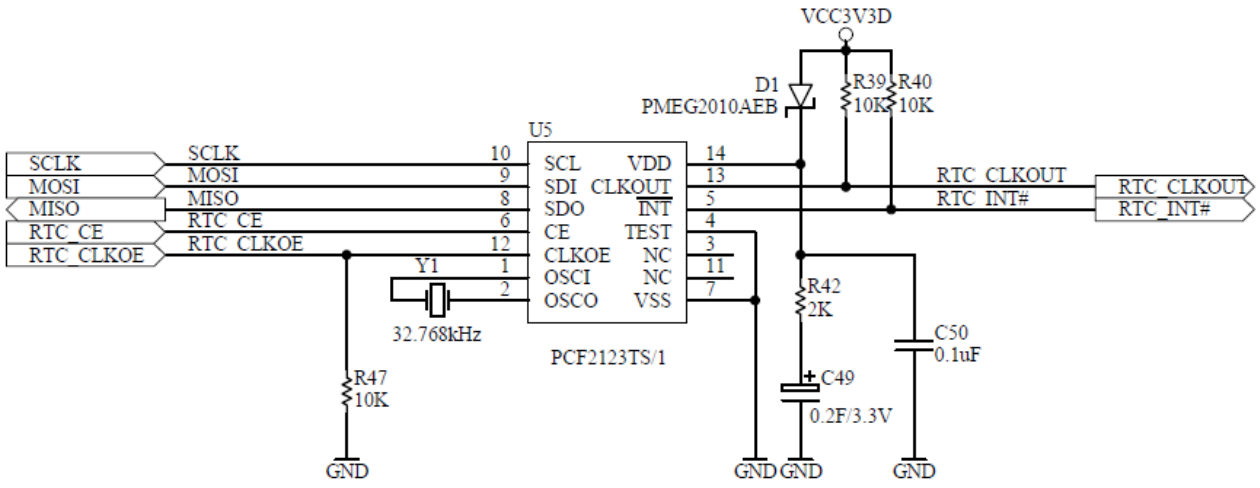


**Figure 6.2 – Vinco Ethernet RTC MP3 Shield Schematic – RTC**

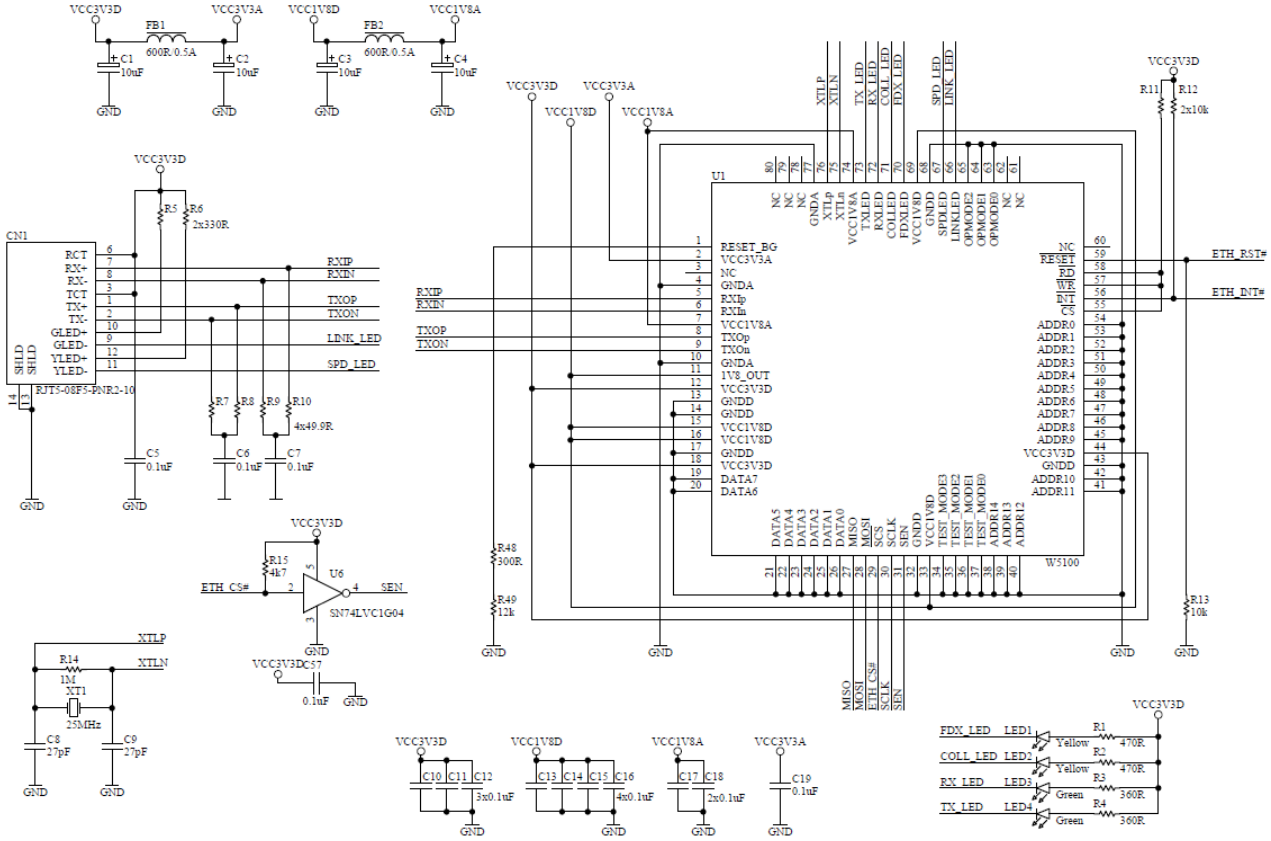


**Figure 6.3 – Vinco Ethernet RTC MP3 Shield Schematic - Ethernet**

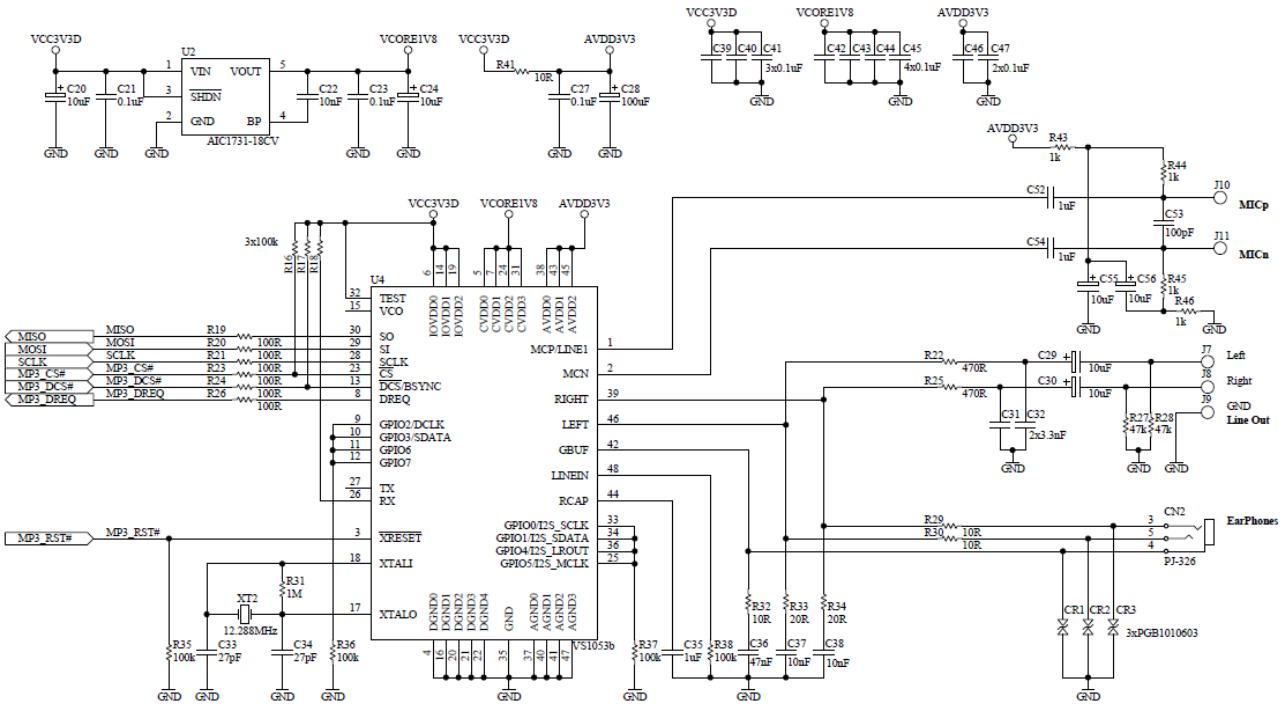


**Figure 6.4 – Vinco Ethernet RTC MP3 Shield Schematic – MP3**

# 7 Contact Information

**Head Office – Glasgow, UK**

Future Technology Devices International Limited
Unit 1, 2 Seaward Place, Centurion Business Park
Glasgow G41 1HH
United Kingdom
Tel: +44 (0) 141 429 2777
Fax: +44 (0) 141 429 2758

E-mail (Sales) sales1@ftdichip.com
E-mail (Support) support1@ftdichip.com
E-mail (General Enquiries) admin1@ftdichip.com

**Branch Office – Taipei, Taiwan**

Future Technology Devices International Limited
(Taiwan)
2F, No. 516, Sec. 1, NeiHu Road
Taipei 114
Taiwan , R.O.C.
Tel: +886 (0) 2 8791 3570
Fax: +886 (0) 2 8791 3576

E-mail (Sales) tw.sales1@ftdichip.com
E-mail (Support) tw.support1@ftdichip.com
E-mail (General Enquiries) tw.admin1@ftdichip.com

**Branch Office – Hillsboro, Oregon, USA**

Future Technology Devices International Limited (USA)
7235 NW Evergreen Parkway, Suite 600
Hillsboro, OR 97123-5803
USA
Tel: +1 (503) 547 0988
Fax: +1 (503) 547 0987

E-Mail (Sales) us.sales@ftdichip.com
E-Mail (Support) us.support@ftdichip.com
E-Mail (General Enquiries) us.admin@ftdichip.com

**Branch Office – Shanghai, China**

Future Technology Devices International Limited
(China)
Room 408, 317 Xianxia Road,
Shanghai, 200051
China
Tel: +86 21 62351596
Fax: +86 21 62351595

E-mail (Sales) cn.sales@ftdichip.com
E-mail (Support) cn.support@ftdichip.com
E-mail (General Enquiries) cn.admin@ftdichip.com

**Web Site**

http://ftdichip.com

## Appendix A – References

VNC2 Datasheet

VINCO Datasheet

Application and Technical Notes

Vinculum-II Errata Technical NoteVinculum-II IO Cell Description

Vinculum-II Debug Interface Description

Vinculum-II IO Mux Explained

Vinculum-II PWM Example

Migrating Vinculum Designs From VNC1L to VNC2-48L1A

Vinculum-II Toolchain Installation Guide

Vinculum-II Toolchain Getting Started Guide

Vinculum-II User Guide

Wiznet W5100 datasheetNXP PCF2123 datasheet

VLSI VS1053b datasheet

Wiznet W5100 SPI Application note

# Appendix B – List of Figures and Tables

## List of Figures



## List of Tables

## Appendix C – Revision History

Document Title: Vinco Ethernet MP3 RTC Shield Datasheet
Document Reference No.: FT_000550
Clearance No.: FTDI#
Document Folder: Vinculum-II
Document Feedback: Send Feedback

| Revision | Changes | Date |
|---|---|---|
| 1.0 | First release | 2011-12-23 |
| | | |
| | | |
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