Application Note

AN_195

Vinculum-II UART to SPI Master Bridge

Version 1.0

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This application note forms part of a series of application notes detailing the new simplified ROM images for VNC2. It will detail the implementation and use of a VNC2 ROM file for bridging a UART interface to an SPI Slave device connected to a VNC2 SPI Master interface.

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1 Introduction

FTDI have introduced a new suite of simplified "bridging" ROM files to allow for fast interconnect between differing interfaces. These ROM images (and sample source code) are targeted at those users who would like to implement VNC2 into a design without creating their own firmware.

As well as providing the source code for users wishing to modify setup parameters the default project is supplied as a precompiled ROM file ready for installation into the VNC2.

This application note forms part of a series of application notes detailing the new simplified ROM images for VNC2. It will detail the implementation and use of a VNC2 ROM file for bridging a UART interface to an SPI Slave device connected to a VNC2 SPI Master interface. This particular project may be used in 32, 48 or 64 pin packages.

For users not intending to edit the code in any way the precompiled code may be loaded over the UART interface with FT_PROG as an alternative to using the IDE. Links for the project file UART_SPIM.vproj and the precompiled ROM file UART_SPIM.rom file may be found at the end of the document in Appendix A.

1.1 VNC2 Devices

VNC2 is the second of FTDI's Vinculum family of embedded dual USB host controller devices. The VNC2 device provides USB Host interfacing capability for a variety of different USB device classes including support for BOMS (bulk only mass storage), Printer and HID (human interface devices). For mass storage devices such as USB Flash drives, VNC2 transparently handles the FAT file structure.

Communication with non USB devices, such as a low cost microcontroller, is accomplished via either UART, SPI or parallel FIFO interfaces. VNC2 provides a new, cost effective solution for providing USB Host capability into products that previously did not have the hardware resources available to do this.

VNC2 allows designers to develop their own firmware using the Vinculum-II software development tool suite. These development tools provide compiler, assembler, linker and debugger tools complete within an integrated development environment (IDE).

The Vinculum-II VNC2 family of devices are available in Pb-free (RoHS compliant) 32-lead LQFP, 32-lead QFN, 48-lead LQFP, 48-lead QFN, 64-Lead LQFP and 64-lead QFN packages For more information on the ICs refer to http://www.ftdichip.com/Products/ICs/VNC2.htm.

2 Using the Sample Code

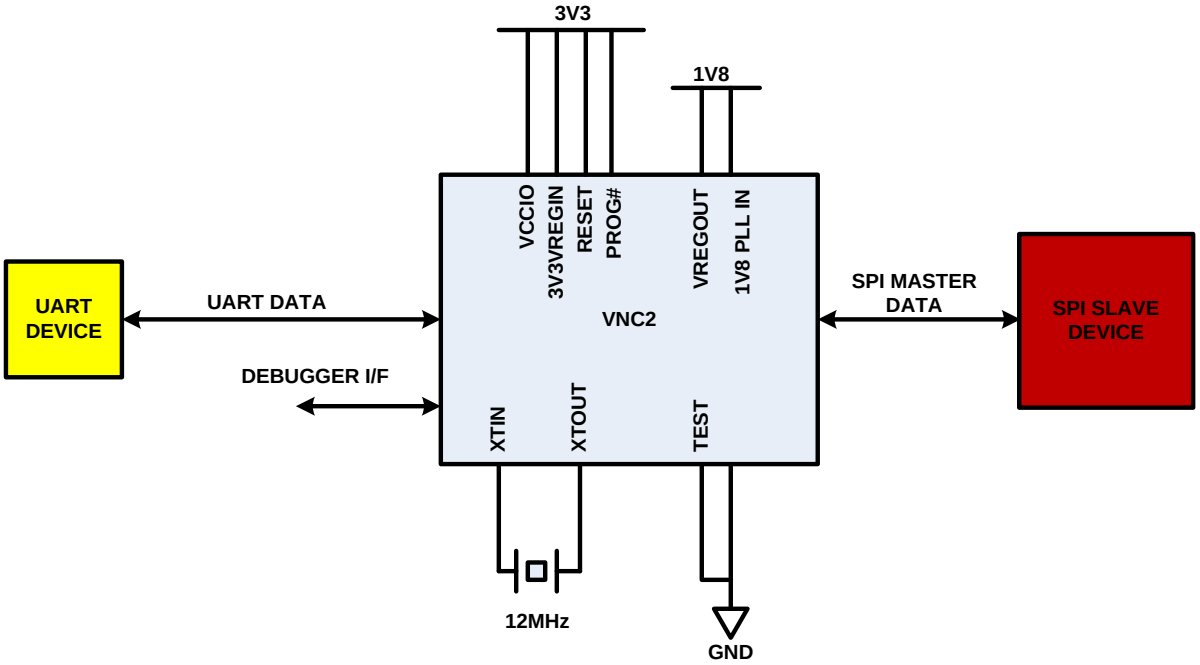

Figure 2.1 Connecting the Demo

When the VNC2 is programmed, the user simply passes data from the UART device to the VNC2. The VNC2 will process this data to pass it out to the SPI Slave device via the SPI Master interface.

Similarly any data passed from the SPI Slave device via SPI Master interface to the VNC2 will be processed by the VNC2 and passed out the UART port to the UART device.

There are no additional commands required it is a simple data bridge.

The project default sets the UART to 9600-8-N-1 (RTS/CTS flow control).

The project uses VNC2 SPI Master interface. The default interface sends data most significant bit first, with a clock speed of 50kHHz. The mode is SPI mode 0.

3 Default Pin-out

The VNC2 can assign the same signal to a variety of pins. The default pins used for this ROM image are shown in Table 3.1:

Signal	32-pin pkg	48-pin pkg	64-pin pkg	Description
GND	1, 16, 19, 27	1, 24, 27, 39	1, 30, 35, 53	Device ground supply pins
3V3 VREGIN	2	2	2	+3.3VDC supply to the regulator
1V8 VCC PLL IN	3	3	3	+1.8VDC supply to internal clock multiplier Requires 100nF decoupling capacitor close to pin
GND PLL	6	6	6	Device analog ground supply for internal clock multiplier
VREG OUT	7	7*	7	+1.8VDC output from regulator to device core *Not used on 48-pin LQFP package
VCCIO	13, 22, 28	17, 30, 40	21, 38, 54	+3.3VDC supply to I/O interface pins (IOBUS) VCCIO must be connected for proper operation
XTIN	4	4	4	Input to 12MHz Oscillator Connect 12MHz crystal across pins 4 and 5 with proper loading capacitance
XTOUT	5	5	5	Output from 12MHz Oscillator Connect 12MHz crystal across pins 4 and 5 with proper loading capacitance
TEST	8	8	8	Test – Must be connected to GND for normal operation
RESET#	10	9	9	Can be used by an external device to reset VNC2
PROG#	9	10	10	Asserting PROG# enables program mode
DEBUGGER I/F	11	11	11	I/O for programming and in-circuit debugging
spi_m_clk	29	20	61	SPI master clock input
spi_m_mosi	12	21	62	Master Out Slave In Synchronous Data from master to slave

Signal	32-pin pkg	48-pin pkg	64-pin pkg	Description
spi_m_miso	14	22	63	Master In Slave Out Synchronous Data from slave to master
spi_m_ss_0#	15	23	64	Active low slave select 0 from master to slave 0
UART RXD	24	32	40	UART data input to VNC2
UART TXD	23	31	39	UART data output from VNC2
UART RTS#	25	33	41	UART RTS# output from VNC2 Logic 0 implies the VNC2 can accept more data
UART CTS#	26	34	42	UART CTS# input to VNC2 Logic 0 allows the VNC2 to send more data on UART TXD

Table 3.1 VNC2 Pin-Out

Designers wishing to customize the design should refer to the iomux.c file for changing pin-out options.

4 Building and Loading the Firmware into the VNC2

Everything can be controlled by the IDE. To access the application simply use the Project -> Open tab to browse to the UART_SPIM.vproj file for your project.

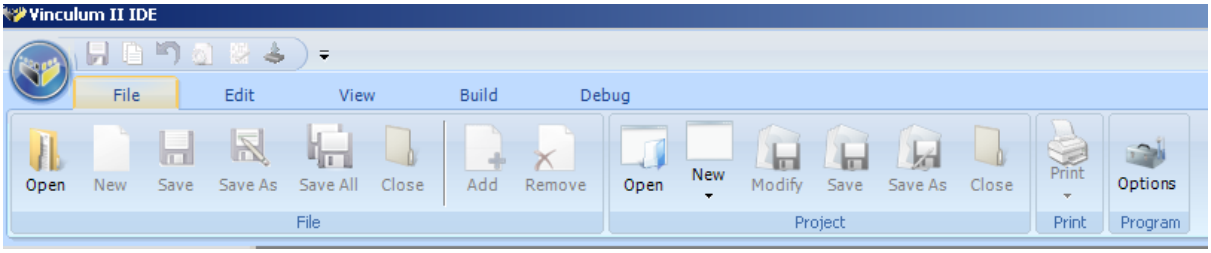

Figure 4.1 Vinculum-II Project Open Button

4.1 Build

This step is only necessary if you are not using the precompiled version of the ROM. Otherwise proceed to loading the ROM file.

To build the application you simply press the Build button on the IDE ribbon bar under the build tab.

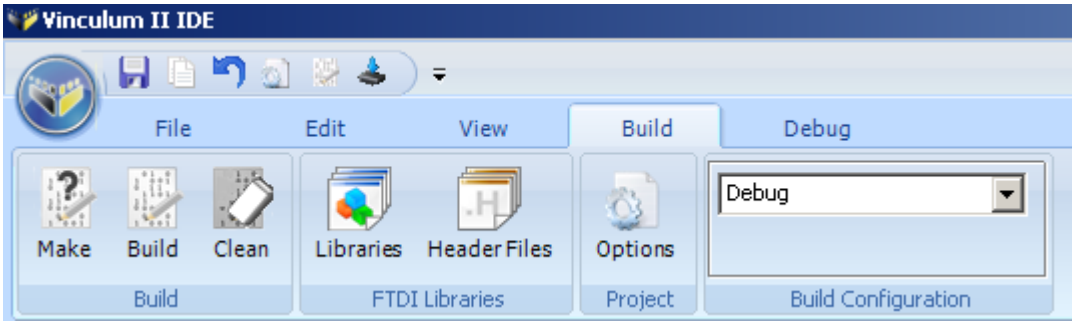

Figure 4.2 Vinculum-II IDE Build Button

4.2 Load

Loading the code is equally simple. Just click on the "Flash" button on the ribbon bar under the debug tab. The Flash button will automatically pick up the Rom file in your project but for reference the filename is UART_SPIM.rom.

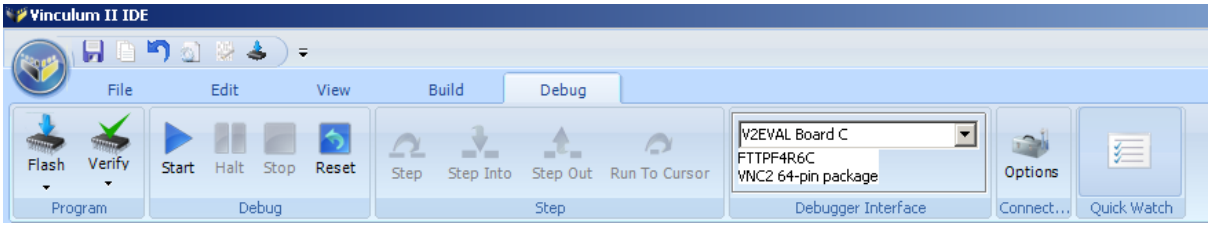

Figure 4.3 Vinculum-II IDE Flash Button

Note the Debugger Interface is listed as V2EVAL Board C. It is important that this box shows a device is connected before attempting to flash a device.

4.3 Loading with FT_Prog

If the precompiled ROM file meets all the requirements of the end design then the IDE and source code are not required. The precompiled UART_SPIM.rom file may be loaded into the VNC2 with FT_PROG over the UART interface.

FT_Prog is used to program the VNC2 with a ROM file. FT_Prog is available from the FTDI website utilities page (version 1.12 or later supports VNC2).

- Select the flash ROM tab at the top of the window.
- Select VNC2 from the pull down tab.
- Select D2xx or VCP interface (either will work).
- Select the location where the ROM file resides.
- Press the program button.
- Perform a hard reset (power cycle) prior to running the firmware.

Figure 4.4 is an example of programming the VNC2 Evaluation board revision 2 with the V2DAP firmware.

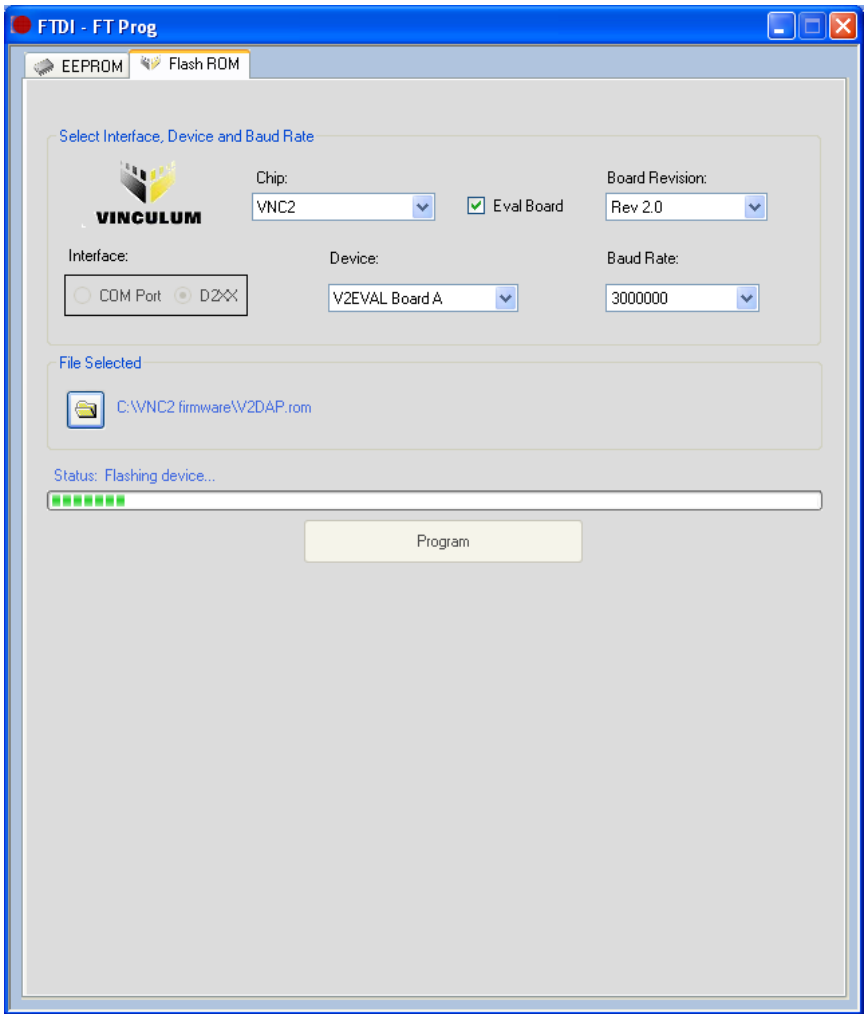

Figure 4.4 FT_Prog Programming Utility

For more information on loading ROM files onto a VNC2 device refer to:

AN_159_Vinculum_II_Firmware_Flash_Programming.pdf

5 Source Code for the VNC2 Application

This section is aimed at those wanting to learn about coding VNC2 devices or modifying the existing project.

All VNC2 application firmware follows a similar format and most of the code can be "written" using the IDE application wizard.

The basic steps are:

1. Initialise device drivers
2. Define pin-outs
3. Open ports to be used
4. Configure ports to be used
5. Read/write data
6. Close ports

The VNC2 source code for this project can be viewed in appendix A and can also be downloaded free from the FTDI website.

5.1 UART_SPIM.C

UART_SPIM.c is the main firmware file. This file is split into multiple functions.

```
void main();
void iomux_setup(void);
void open_drivers(void);
void close_drivers(void);
void UARTSPIM();
void SPIMUART();
```

5.1.1 main()

Main is the entry point for all VNC2 applications. It is used to definethe VNC2 core clock speed, loads the drivers to be used and creates the threads to be used in the application. At the very end of main is the call:

```
vos_start_scheduler();
```

After this call there can be no further configuration of the device.

5.1.2 iomux_setup()

iomux_setup calls a function in the file UART_SPIM_iomux.c within the project; this file is used to define the VNC2 pin-out. Most signals can be programmed to appear on different pins;notable exceptions are power, GND and the USB ports.

5.1.3 Open drivers/close drivers

The open drivers function call will provide a handle to each hardware block used in the project and this handle can be used by subsequent commands to control the hardware. The close_drivers function is used to close handles to all open devices.

5.1.4 UARTSPIM

5.1.5 This function will configure the UART port 9600-8-N-1 (RTS/CTS flow control). The function will also read data from the UART port and write it out to the SPI Slave device via the SPI Master interface. In this function a semaphore is used to control access to the SPIMUART thread. In this way the application will never transfer data before interface configuration is complete.SPIMUART

This function will read from the SPI Slave device connected to an SPI Master interface and write out to the UART. Data is read from the slave at the same time that data is written to the slave. Therefore data can only be received from the slave when data is written to it.

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Appendix A – References

Document References

Application and Technical Notes available at
http://www.ftdichip.com/Support/Documents/AppNotes.htm

VNC2 Datasheet

V2-EVAL datasheet

Vinculum II Toolchain

AN_139 IO_Mux explained

AN_151 Vinculum II User Guide

AN_159_Vinculum_II_Firmware_Flash_Programming.pdf

Project source code download

http://www.ftdichip.com/Firmware/Precompiled/UART_SPIM.zip

Project precompiled ROM file download

http://www.ftdichip.com/Firmware/Precompiled/UART_SPIM.ROM

Acronyms and Abbreviations

Terms	Description
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
USB-IF	USB Implementers Forum

Appendix B – List of Tables & Figures

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Appendix C – Revision History

Document Title: AN_195 Vinculum-II UART to SPI_Master Bridge
Document Reference No.: FT_000542
Clearance No.: FTDI#235
Product Page: http://www.ftdichip.com/Products/ICs/VNC2.htm
Document Feedback: Send Feedback

Revision	Changes	Date
1.0	Initial Release	15/11/11