Preliminary - Subject to Change

Future Technology
Devices International Ltd.

VINCULUM

BINDING USB TECHNOLOGIES

Vinculum VNC1L
Firmware - VDIF

USB Slave Device and USB Flash Disk Interface with USB Monitor Port

Version 1.06

The Vinculum VNC1L-1A is the first of F.T.D.I.'s Vinculum family of Embedded USB host controller integrated circuit devices. Not only is it able to handle the USB Host Interface, and data transfer functions but owing to the inbuilt MCU and embedded Flash memory, Vinculum can encapsulate the USB device classes as well. When interfacing to mass storage devices such as USB Flash drives, Vinculum also transparently handles the FAT File structure communicating via UART, SPI or parallel FIFO interfaces via a simple to implement command set. Vinculum provides a new cost effective solution for providing USB Host capability into products that previously did not have the hardware resources available.

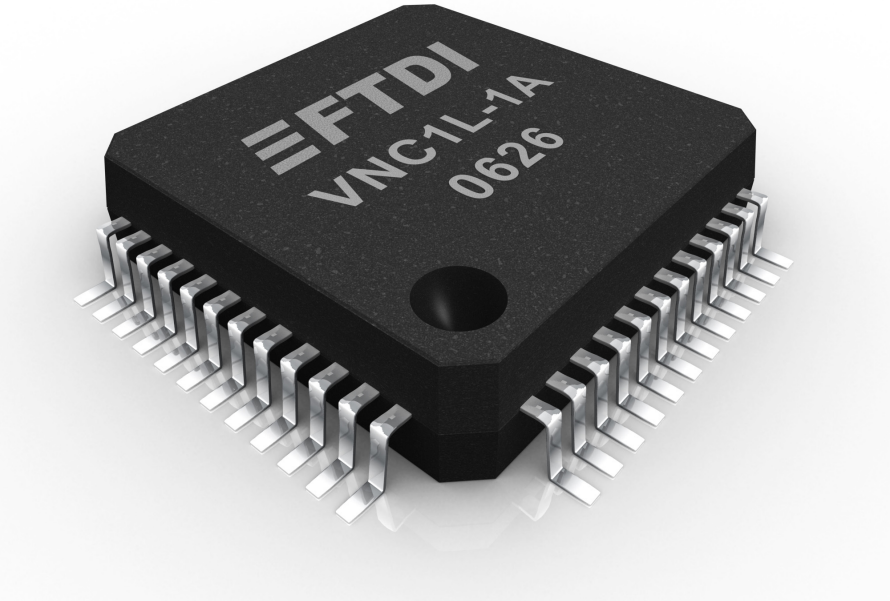
The VNC1L-1A is available in Pb-free (RoHS compliant) compact 48-Lead LQFP package.

http://www.vinculum.com

1. Overview

1.1 Introduction

This document describes the VDIF version of Vinculum VNC1L USB flash disk interface and monitor firmware.VDIF uses the UART, parallel FIFO, SPI interface or a USB host port as the command monitor port. The I/O interface is configured using a set of jumpers which pull up or pull down two of the VNC1L's interface pins.



The Vinculum VNC1L I.C. hardware specification is described separately in its own datasheet which is available from the Vinculum website.

2. Firmware Description

2.1 VDIF - Vinculum Disk Interface

The VDIF firmware is designed to allow an FTDI Vinculum VNC1L device to act as an interface between a USB flash disk (or other USB mass storage class device) on USB Port 2, and the VNC1L's I/O interface, or a suitable USB peripheral device on USB Port 1. This firmware allows the VNC1L's interface to be externally configured as a UART, parallel FIFO or SPI, using external jumpers. The device connected to the serial UART / parallel FIFO / SPI interface or the suitable USB peripheral device can issue commands which allow operations to be performed on the USB flash disk using the command set defined herein. The VNC1L port which is configured to receive these commands is know as the **command monitor port**.

A suitable USB peripheral device for connection to the command monitor port on USB port 1 could be a mobile phone USB slave interface, a PDA USB slave interface, or any USB slave peripheral device capable of running software which can issue commands to the VNC1L.

2.1.1 VDIF System Operation and Command Monitor Port Selection

The VDIF firmware assumes that a USB flash disk (or other USB mass storage class device) will be connected to USB Host port 2. USB host port 1 or the jumper configurable UART / Parallel FIFO / SPI interface port act as the command monitor port.

The firmware will default to using the device interface mode as selected on the ACBUS5 (pin 46) and ACBUS6 (pin 47) jumper pins as the command monitor port, i.e. serial UART, Parallel FIFO, or SPI. The jumper circuit configuration shown in Figure 2, below. This circuit will default to the UART interface if no jumper links are fitted. See Table 1 for the port selection jumper pin configuration.

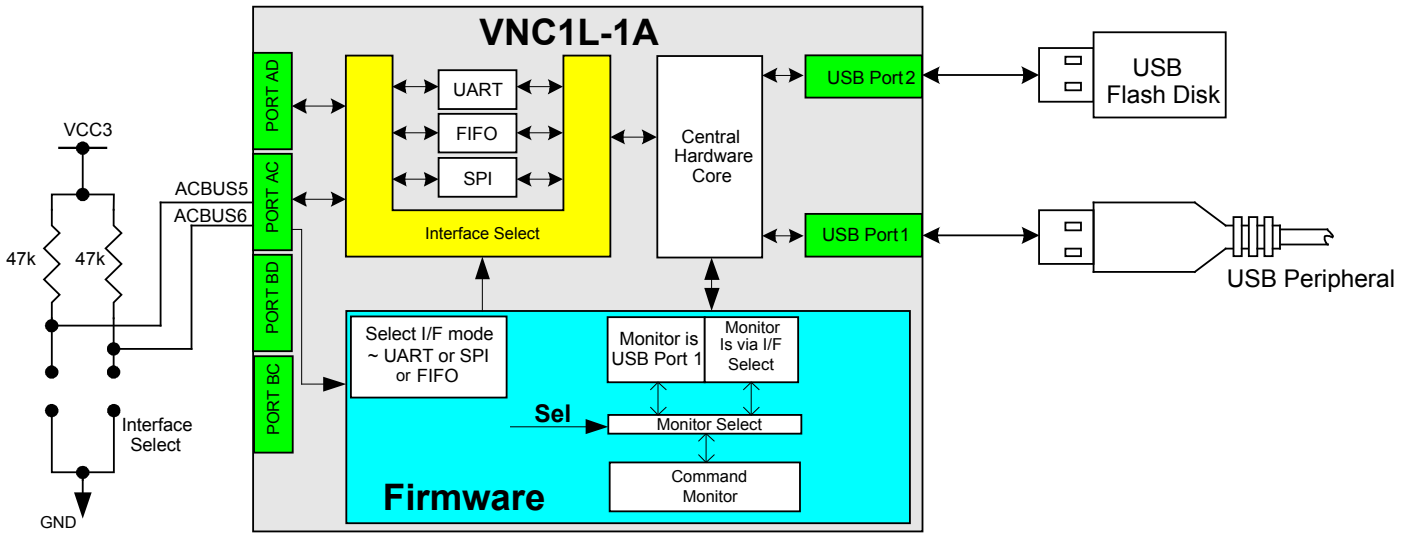


Figure 1 - VDIF Firmware model

Table 1 - Port Selection Jumper Pins

ACBUS6 (pin 47)	ACBUS5 (pin 46)	Mode
Pull-Up	Pull-Up	Serial UART
Pull-Up	Pull-Down	SPI
Pull-Down	Pull-Up	Parallel FIFO
Pull-Down	Pull-Down	Serial UART

This firmware will default to using the UART / parallel FIFO / SPI interface as the command monitor port if no device is connected to USB Port 1. However if a suitable USB device is connected to USB Port 1 and is detected by the VNC1L this port will take precedence, and thus USB Port 1 will become the command monitor port. If the USB device is disconnected from USB Port 1 the firmware will switch back, and try to use the UART / parallel FIFO / SPI port as the command monitor. USB Port 2 is always a USB flash disk (USB mass storage class) device interface only.
There are three I/O interface options which use ADBUS and ACBUS which are configured using the jumpers - serial UART, parallel FIFO and SPI. The VNC1L device pins are shown on table 2.

Table 2 - I/O Interface Options

Pin No.	Name	Type	Description	Interface Mode		
				UART Interface	Parallel FIFO Interface	SPI Slave Interface
31	ADBUS0	I/O	5V safe bidirectional data / control bus, AD bit 0	TXD	D0	SCLK
32	ADBUS1	I/O	5V safe bidirectional data / control bus, AD bit 1	RXD	D1	SDI
33	ADBUS2	I/O	5V safe bidirectional data / control bus, AD bit 2	RTS#	D2	SDO
34	ADBUS3	I/O	5V safe bidirectional data / control bus, AD bit 3	CTS#	D3	CS
35	ADBUS4	I/O	5V safe bidirectional data / control bus, AD bit 4	DTR#	D4	
36	ADBUS5	I/O	5V safe bidirectional data / control bus, AD bit 5	DSR#	D5	
37	ADBUS6	I/O	5V safe bidirectional data / control bus, AD bit 6	DCD#	D6	
38	ADBUS7	I/O	5V safe bidirectional data / control bus, AD bit 7	RI#	D7	
41	ACBUS0	I/O	5V safe bidirectional data / control bus, AC bit 0	TXDEN#	RXF#	
42	ACBUS1	I/O	5V safe bidirectional data / control bus, AC bit 1		TXE#	
43	ACBUS2	I/O	5V safe bidirectional data / control bus, AC bit 2		WR#	
44	ACBUS3	I/O	5V safe bidirectional data / control bus, AC bit 3		RD#	

2.2 UART Interface Configuration

When using the UART interface as the command monitor port the VNC1L expects its CTS# pin to be driven active low. The default baud rate used by the UART port is 9600 baud, although this can be changed using one of the monitor port commands. The standard data format is 8 data bits, 1 start bit, 1 stop bit, and no parity with RTS/CTS hardware handshaking enabled.

2.3 Start Sequence and USB Firmware

The firmware will, at system start up, send out a message with a firmware version number to the command monitor port. This message takes the form :

Ver *x.xx* On-Line:

Where *x.xx* is the version number. It may be longer than 4 characters.

If a USB Flash Disk is connected to USB Port 2 of the VNC1L chip, it will scan it and perform a free sector count. This can take quite a few seconds depending on the exact size of the disk. Under normal circumstances you will see an LED on the USB Flash Disk showing activity while this is happening. A scan of the root directory is also performed by the VNC1L firmware checking for a firmware upgrade file. If no upgrade is found it will display :

No Upgrade
D:\>

If a suitable firmware upgrade file if found on the USB flash disk the VNC1L firmware will automatically be updated.

3. Firmware Command Set

3.1 Monitor Port Commands

This VNC1L firmware command monitor system uses the following command set. There is an extended ASCII command set which is designed for use with a terminal, and there is a shortened hexadecimal command set designed for use with a microprocessor.

Table 3 - Monitor Port Commands

Extended ASCII Command for Terminal mode	*Shortened Hexadecimal Command for microprocessor mode*	*Command function*	*Response*
Switching between Shortened and Extended Command sets			
'SCS'<cr>	$10,$0D	Switches to the shortened command set	This will return the prompt '>',$0D to indicate that the device is in shortened command set mode.
'ECS'<cr>	$11,$0D	Switches to the extended command set	This will return the prompt 'D:\>',$0D to indicate that the device is in extended command set mode.
'E'<cr>	'E'<cr>	Echo	This will return 'E',$0D for synchronisation purposes
'e'<cr>	'e'<cr>	Echo	This will return 'e',$0D for synchronisation purposes
Responses to indicate if disk is online			
<cr>	$0D	Check if online	This will return the appropriate prompt or 'no disk' message for the current command set.
Response to Check if online for Extended Command Mode		If no valid disk is found	'No Disk',$0D
		If a valid disk is found	'D:\>',$0D
Response to Check if online for Short Command Mode		If no valid disk is found	'ND',$0D
		If a valid disk is found	'>',$0D
Directory operations			
'DIR'<cr>	$01,$0D	Lists the current directory	A list of file names and directory names are returned. Each entry is terminated by $0D. A directory entry has <sp>'DIR' after the name and before the $0D.
'DIR'<sp> <name><cr>	$01,$20, <name>,$0D	Lists the file name followed by the size. Use this before doing a file read to know how many bytes to expect.	$0D,<name><sp><size in hex(4 bytes) LSB first> $0D
'DLD'<sp> <name><cr>	$05,$20,<name>, $0D	Delete directory	Deletes the directory <name> from the current directory. <prompt>$0D
'MKD'<sp> <name><cr>	$07,$20, <name>,$0D	Make directory	Creates a new directory <name> in the current directory. <prompt>$0D
'CD'<sp> <name><cr>	$02,$20,<name> $0D	The current directory is changed to the new directory <name>	<prompt>$0D
'CD'<sp>'..'<cr>	$02,$20,$2E,$2E,$0D	Move up one directory level.	<prompt>$0D

Table 3 - Monitor Port Commands (continued)

File operations			
'RD'<sp> <name><cr>	$04,$20,<name> $0D	Read file <name>	This will send back the entire file in binary to the monitor. The size should first be found by using the 'DIR' <sp> <name> <cr> command so that the expected number of bytes is known. <prompt>$0D
'RDF'<sp> <size in hex(4 bytes) ><cr>	$0B,$20,size in hex(4 bytes) , $0D	Reads the data of <size in hex(4 bytes) > from the current open file.	This will send back the requested amount of data to the monitor. <prompt>$0D
'DLF'<sp> <name><cr>	$07,$20,<name> $0D	Delete file <name>	This will delete the file from the current directory and free up the FAT sectors. <prompt>$0D
'WRF'<sp> <size in hex(4 bytes) ><cr> <data bytes of size><cr>	$08,$20,size in hex(4 bytes) , $0D $data,$0D	Writes the data of <size in hex(4 bytes) > to the end of the current open file.	<prompt>$0D
'OPW'<sp> <name><cr>	$09,$20, <name>,$0D	Opens a file for writing to with 'WRF'	<prompt>$0D
'OPR'<sp> <name><cr>	$0E,$20, <name>,$0D	Opens a file for reading to with 'RDF'	<prompt>$0D
'CLF'<sp> <name><cr>	$0A,$20, <name>,$0D	Closes a file for writing.	<prompt>$0D
'REN'<sp> <orig name> <sp> <new name><cr>	$0C,$20, <orig name>,$20, <new name> <cr>	Rename a file or directory	<prompt>$0D
'FS'<cr>	$12,$0D	Returns free space in bytes on disk	<free space in hex(4 bytes) LSB first> $0D
Commands for UART monitor mode only			
'SBD'<sp><divisor (3 bytes) LSB first ><cr>	$14, $20,divisor (3 bytes) LSB first >,$0D	Set Baud Rate (See Baud Rate Table)	<prompt>$0D
Power Management Commands			
'SUD'<cr>	$15,$0D	Suspend the disk when not in use to conserve power. The disk will be woken up automatically the next time a disk command is sent to it.	<prompt>$0D
'WKD'<cr>	$16,$0D	Wake Disk and do not put it into suspend when not in use.	<prompt>$0D
'SUM'<cr>	$17,$0D	Suspend Monitor and stop clocks	<prompt>$0D
Debug commands			
'SD'<sp> <sector number in ASCII hex><cr>	$03,$20,…$0D	Sector Dump. This is used for debug purposes and may be removed. e.g. 'SD 0000>cr>' will dump sector 0000. 'SD 0010'<cr> will dump sector 16 decimal.	Sends back 512 bytes from the sector specified in HEX converted to ASCII. Every 16 bytes is followed by a $0D. <prompt>$0D
'IDD'<cr>	$0F,$0D	Identify Disk Drive. This will display information about the attached disk.	Sends IDD data block and then <prompt>$0D
'FWV'<cr>	$13,$0D	Get Firmware Versions	Displays the version numbers of the main firmware and the reprogramming firmware in the VNC1L 'MAIN x.xx'$0D 'RPRG x.xx'$0D then <prompt>$0D

Table 4 - Error Reporting

Error	Command Mode	Result
If command is unrecognised	Extended Command set	'Bad Command',$0D
	Shortened Command Set	'BC',$0D
If command fails	Extended Command set	'Command Failed',$0D
	Shortened Command Set	'CF',$0D

Table 5 - IDD Command Results Format

IDD - Identify Disk Drive Results
'USB VID = $', 2 bytes in ASCII, $0D
'USB PID = $', 2 bytes in ASCII, $0D
'Vendor Id = ', 8 bytes in ASCII, $0D
'Product Id = ', 16 bytes in ASCII, $0D
'Revision Level = ', 4 bytes in ASCII, $0D
'I/F = ','SCSI' or 'ATAPI' in ASCII, $0D
'FAT12' or 'FAT16' or 'FAT32' in ASCII, $0D
'Bytes/Sector = $', 2 bytes in ASCII, $0D
'Bytes/Cluster = $', 3 bytes in ASCII, $0D
'Capacity = $', 4 bytes in ASCII, $0D
'Free Space = $', 4 bytes in ASCII, $0D

Table 6 - Baud Rate Table for UART Interface

Baud Rate	1st Byte	2nd Byte	3rd Byte
300	$10	$27	$00
600	$88	$13	$00
1200	$C4	$09	$00
2400	$E2	$04	$00
4800	$71	$02	$00
9600*	$38	$41	$00
19200	$9C	$80	$00
38400	$4E	$C0	$00
57600	$34	$C0	$00
115200	$1A	$00	$00
230400	$0D	$00	$00
460800	$06	$40	$00
921600	$03	$80	$00
1000000	$03	$00	$00
1500000	$02	$00	$00
2000000	$01	$00	$00
3000000	$00	$00	$00

* default baud rate after reset is 9600 baud.

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Version 1.06 - Initial firmware datasheet created August 2006

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