USB Bus Interface Chip CH375

English manual
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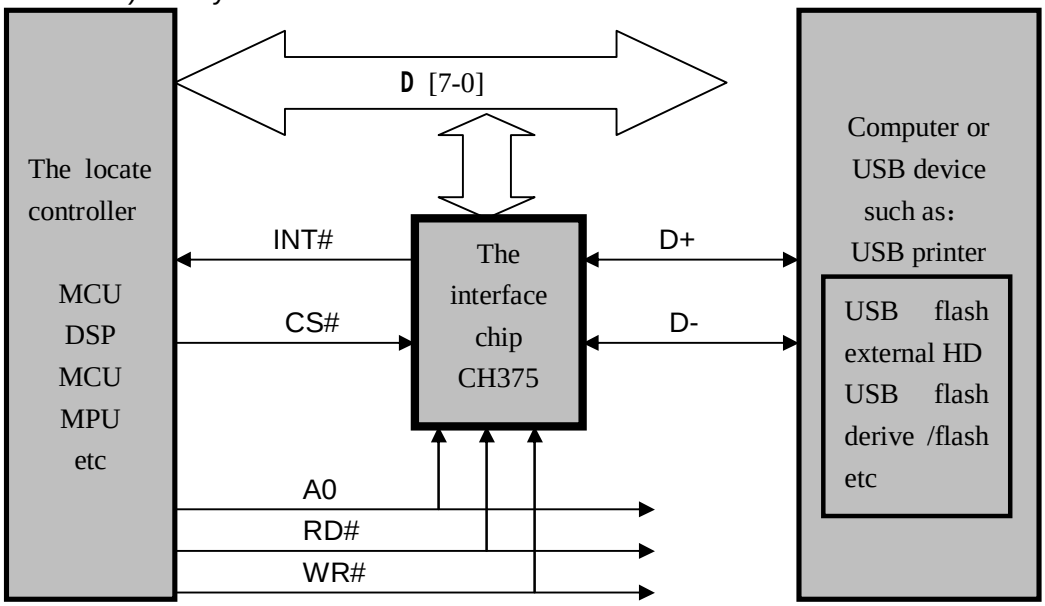
http://wch.cn

1. Introduction

CH375 is a USB bus universal interface chip, supports USB-HOST Mode and USB-DEVICE/SLAVE Mode. There are 8-bit data bus and read、write、chip select control wire and interrupt output in CH375.It is convenient to link CH375 to controller system bus of MCU/DSP/MPU.CH375 also provides serial communication in USB-HOST mode. It connects with DSP/MCU/MPU through serial input 、output and interrupt output.

The USB device mode of CH375 is compatible with CH372 and CH375 incorporates all functions of CH372. For USB-DEVICE/SLAVE mode operation and specification, please refer to the CH372 specification. This data sheet only covers USB-HOST mode operation.

The USB-HOST mode of CH375 supports common USB full-speed devices. Peripheral MCU can communicate with USB device through CH375 according relevant USB protocol. The CH375 configures firmware of special communication protocol inside which can deal with Mass-Storage. Peripheral MCU can read and write general USB store devices (including USB HD、USB flash and USB flash drive)directly while sector as unit.

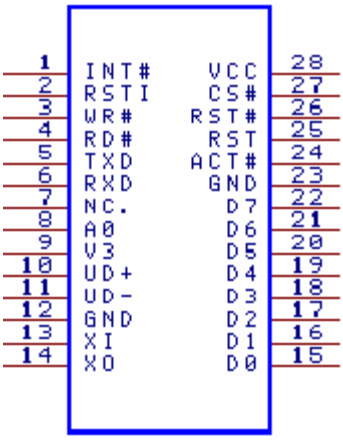


2. Features

- Full-speed USB-HOST interface, conforms to USB Specification Version 2.0, only needs crystal and capacitance external.
- Full-speed USB device interface, compatible with CH372, supports exchanging USB-HOST mode and USB-DEVICE/SLAVE mode dynamically.
- Input and output buffers of host endpoint occupy 64-byte respectively, supports common full-speed USB device with 12Mbps.
- Supports USB device control transfer、bulk transfer and interrupt transfer.

- Detects USB device plug and unplug automatically and sends message to USB host.
- Configures protocol processor control transfer inside to simplify usual control transfer.
- Set up firmware of special communication protocol to do with Mass-storage. Supports Bulk-Only transfer protocol and USB storage device of SCSI、UFI、RBC and other equivalent storage device which accommodates the minimum set of command including USB HD、USB flash and USB flash drive.
- Reaches MCU reads and writes the file of USB storage device through file layer subprogram in USB flash drive.
- Parallel interface contains 8-bit data bus and 4 control wires i.e. read、write、chip select input and interrupt output
- Serial interface embodies serial input、output and interrupt ,adjusts communication baud rate dynamically.
- Source power is 5V or 3.3V, and low-power mode is supported.
- Adoption SOP-28 lead-free package, compatible with RoHS, supplies diversion board from SOP28 to DIP28.

3. Package



CH375A requires a 5V voltage source while CH375V requires a 3.3V voltage source.

Package shape	Width of plastic		pin dimensions		Instruction of package	Purchase type
SOP-28	7.62mm	300mil	1.27mm	50mil	Standard 28-PIN surface mount	CH375A
SOP-28	7.62mm	300mil	1.27mm	50mil	Standard 28-PIN surface mount	CH375V

4. Pins

PIN No.	PIN Name	Pin Type	Pin Description
28	VCC	POWER	Positive power input port, requires an external 0.1uF power decoupling capacitance
12、23	GND	POWER	Public ground, ground connection for USB
9	V3	POWER	Attachment of VCC input external power while 3.3V;connects of 0.01uF decoupling capacitance outside while 5V
13	X1	IN	Input of crystal oscillator, attachment of crystal and crystal oscillator capacitance outside
14	XO	OUT	Opposite output of crystal oscillator, attachment of crystal and crystal oscillator capacitance outside
10	UD+	Bi-directional of tri-state	USB Data Signal plus, set up controlled pull-up resistor internal
11	UD-	Bi-directional of tri-state	USB Data Signal minus
22～15	D7～D0	Bi-directional of tri-state	8-bit bi-directional data bus, set up pull-up resistor internal
4	RD#	IN	Read Strobe Input, an active LOW input, set up pull-up resistor internal
3	WR#	IN	Write Strobe Input, an active LOW input, set up pull-up resistor internal
27	CS#	IN	Active LOW CH375 chip select, set up pull-up resistor internal
1	INT#	OUT	Interrupter request output after reset, active with low-level
8	AO	IN	Address wire input to identify command and data port, set up pull-up resistance inside, A0=1,write order; A0=0,read/write data
24	ACT#	OUT	After USB device configure output state on firmware Inside USB-DEVICE mode, active with low-level under USB-DEVICE; USB device connection state output under USB-HOST, active with low-level

5	TXD	IN OUT	Used to USB-HOST only, supports parallel interface in USB-DEVICE, input pin, set up pull-up resistor internal, enable parallel interface otherwise serial interface during reset input low-level, after reset is serial data output
6	RXD	IN	Serial data input, set up pull-up resistor internal
2	RSTI	IN	Reset input external, active with high level, set up pull-down resistor internal
25	RST	OUT	Reset with power-up and external reset output, active with high-level
26	RST#	OUT	Reset with power-up and external reset output, active with low-level
7	NC	NC	Must be left unconnected

5. Command

The data in this manual has three types. Binary numbers are followed by a “B”. Hexadecimal numbers are followed by an “H”. Numbers without annotations are decimals.

The MCU referred in this manual are basically applied to DSP or MCU/MPU.

The manual mainly supplies commands of USB storage device, specially uses to USB Mass-storage. Commands of executing and controlling transfer can refer to the second manual.

Code	Command name	Input data	Output data	Functions
05H	RERET_ALL		(Wait for 40mS)	Execute hardware reset
06H	CHECK_EXIST	Any data	OPP. accord bit	Test working status
15H	SET_USB_MODE	Mode code	(Wait for 20uS) Operation status	Configure the work mode of USB
22H	GET_STATUS		Interruption status	Get interruption status and cancel requirement
02H	SET_BAUDRATE	Detach freq coef Detach freq const	(Wait for 1mS) Operation status	Set serial communication baud rate
28H	RD_USB_DATA		Data length Data flow	Read data from current interrupt port buffer of USB
2BH	WR_USB_DATA7	Data length Data flow		Write data to endpoint output buffer of USB host
17H	ABORT_NAK			Give up retrying of NAK
51H	DISK_INIT		Produce interruption	Initialize USB storage device
53H	DISK_SIZE		Produce	Get the capability of USB

			interruption	storage device
54H	DISK_READ	LBA address Sector number	Produce interruption	Read data from USB storage device
55H	DISK_RD_GO		Produce interruption	Go on reading operation of USB storage device
56H	DISK_WRITE	LBA address Sector number	Produce interruption	Write data to USB storage device
57H	DISK_WR_GO		Produce interruption	Go on writing operation of USB storage device
01H	GET_IC_VER		Version number	Obtain chip and firmware version number
03H	ENTER_SLEEP			Go to low-power and suspending
0BH	SET_DISK_LUN	Data 34H Logical unit number		Set current logical unit number of USB storage device
58H	DISK_INQUIRY		Produce interruption	Inquiry features of USB storage device
59H	DISK_READY		Produce interruption	Detect USB storage device ready or not
5AH	DISK_R_SENSE		Produce interruption	Examine errors of USB storage device
5DH	DISK_MAX_LUN		Produce interruption	Get the max unit number of USB storage device

If the output data of command is operation status, please consult the following table.

Status code	Status name	State explanation
51H	CMD_RET_SUCCESS	Operation successful
5FH	CMD_RET_ABORT	Operation failure

5.1. Command RESET_ALL

The Command of RESET_ALL makes the CH375 reset through hardware. Usually, the hardware reset finishes within 40mS.

5.2. Command CHECK_EXIST

The Command CHECK_EXIST is used to check the status to examine the CH375.when using the order, one data at random needs to input .The output data is contrary to the input data if the CH375 is working normally. For example, the output data is A8H while the input data is 57H.

5.3. Command SET_USB_MODE

The command of SET_USB_MODE can determine the work mode of USB. The mode code may input.

The code of 00H means switch to invalid USB-DEVICE mode (the default mode after power-up

or reset)

The code of 01H means switch to valid USB-DEVICE, peripheral firmware mode.

The code of 02H means switch to valid USB-DEVICE, inner firmware mode.

The code of 04H means switch to invalid USB-HOST mode.

The code of 05H means switch to valid USB-HOST, non-generate SOF package.

The code of 06H means switch to valid USB-HOST, produce SOF package automatically.

The code of 07H means switch to valid USB-HOST, and reset USB bus.

The handbook of CH372 explains the USB-DEVICE/SLAVE manner.

Un-automatically detect the USB device connection is defined as invalid, under USB-HOST mode, exterior MCU is needed to detect. Validation refers to examine USB device connection automatically. There is a piece of information to peripheral MCU when the USB device attachment or unlatch. The CH375 timing sends SOF to attachment USB device automatically while switch to mode code of 06H.In general, the mode code of 07H supplies USB bus reset state for attached USB device. USB bus reset won't finish until it changes to other mode.

Ordinarily, the time of set USB work mode is within 20uS and outputs operation station after setting.

5.4. Command GET_STATUS

The GET_STATUS order can obtain interrupt state of CH375 and notice CH375 to cancel the interrupt requests. MCU receives interrupt status, analyzes interrupt and deal with interrupt after the CH375 sends interrupt to MCU.

The byte of interruption state	Sort of interruption
00H～0FH	The interruption state of USB-device refer to the CH372 handbook
10H～1FH	Interruption state in common of USB-HOST
20H～3FH	The failure operation of USB-HOST used to analyze reasons

The following is common interruption state of USB-HOST mode.

State byte	State name	Description of analyzing interruption state
14H	USB_INT_SUCCESS	Success of USB transaction or transfer operation
15H	USB_INT_CONNECT	Detection of USB device attachment
16H	USB_INT_DISCONNECT	Detection of USB device detachment
17H	USB_INT_BUF_OVER	Buffer overflow
1DH	USB_INT_DISK_READ	Read operation of USB storage device
1EH	USB_INT_DISK_WRITE	Write operation of USB storage device
1FH	USB_INT_DISK_ERR	Failure of USB storage device

The following is operation failure status of USB-HOST mode used to analyze the reasons induce failure.

The byte of interrupt status	Name	Description of analyzing interruption status
Bit 7～bit 6	Reserved	00
Bit 5	Flag	1,failture flag
Bit 4	Synchronous sign of IN	The data may be invalid

	transaction	when the bit is 0
Bit 3～bit 0	Return of USB device when failure	1010,device return to NAK
		1110,device return STALL
		XX00, device return over time, no return
		Other data is PID of device return

5.5. Command SET_BAUDRATE

The command of SET_BAUDRATE is used to set up the serial port communication baud-rate of CH375.After the reset, the default communication baud-rate of CH375 is 9600bps when it works serial communication mode. Through the order adjusts serial communication baud-rate dynamically if the MCU supports upper communication speed. The command needs to input baud-rate detach frequency coefficient and detach frequency const.

Usually, the active of set baud-rate costs within 1mS,then the CH375 output operation state according the new-setting communication baud-rate. Consequently, the MCU regulates itself communication baud-rate after giving the order out.

Many detach frequency coefficient and detach frequency constant corresponding serial communication baud-rate is given below.

Detach freq coef	Detach freq const	Serial interface communication baud- rate (bps)	Error
02H	B2H	9600	0.16%
02H	D9H	19200	0.16%
03H	98H	57600	0.16%
03H	CCH	115200	0.16%
03H	F3H	460800	0.16%
07H	F3H	921600	0.16%
03H	C4H	100000	0%
03H	FAH	1000000	0%
03H	FDH	2000000	0%
02H	Const	Formula: 750000/(256-const)	
03H	Const	Formula: 6000000/(256-const)	

5.6. Command RD_USB_DATA

The command reads data block from current interrupt endpoint buffer of USB. Interrupt endpoint buffer of USB is input buffer of host endpoint under USB-HOST. The length of data block is read at first, i.e. the byte number of following data flow. The virtual value of data block length is from 0 to 64.If the length is not Zero, MCU reads following data one by one from CH375.

5.7. Command WR_USB_DATA7

The command means writing data block to output buffer of USB host endpoint or upstream buffer of USB endpoint 2. Also, the data is first written is length of data block, i.e. the byte number of following data flow. The virtual value of data block length is from 0 to 64.When the length isn't zero, MCU writes the following data one by one to CH375.

5.8. Command ABORT_NAK

Giving up the retry of current NAK when executes the order of ABORT_NAK.When CH375 works on the USB-HOST, in default, CH375 receives NAK will retry until return successfully or failure. The command can force the CH375 abort retry to execute new operation. In addition, uses command SET_RETRY can constrain retry of NAK.

5.9. Command DISK_INIT

The command initializes USB storage device. For attached USB device, the order resets USB bus firstly, analyzes the description of USB device, if supporting USB storage device, configure device automatically. In the end, establishes connection of USB storage device. CH375 requests interrupt to MCU after carrying out the order. MCU reads interrupt state as operation state of the order. The operation state possibly is USB_INT_DISCONNECT if the USB device is disconnect. Usually the operation state is USB_INT_DISK_ERR or USB_BUF_OVER when USB device is unidentified or the USB storage device is unsupported. The operation state is USB_INT_SUCCESS if the USB device is successfully initialized.

5.10. Command DISK_SIZE

The command is used to obtain physical capability of USB storage device. The order can get the total capability of USB storage device after successfully initializes USB storage device. CH375 requests interrupt to MCU after executing the order. MCU reads interrupter state as operation state. If the operation is USB_INT_SUCCESS, gets data via command RD_USB_DATA. The data is composed of 8-byte. the former 4-byte represents total sector number of USB storage device when the high byte is headed in the double data. The latter four bytes is byte number of each sector while the high byte is headed in the double byte data, usually is 512 bytes in every sector. The result of the two data multiplied is total capability of USB when byte as unit.

5.11. Command DISK_READ

The command is employed to read state from USB device. The starting address and the length of data parameter is needed when sector as unit to read data. The address of starting is LBA address while 4-byte represents wire sector number. The length is one byte represents sector number. This command needs five input data are the lowest byte of LBA address, the lower byte of LBA address, the upper byte of LBA address, the highest byte of LBA address and the sector number. The command can read data from sector 1 to 255 at random in the USB storage device of capability up to 2000GB.This order must be used with the following command DISK_RD_GO.

5.12. Command DISK_RD_GO

This command makes CH375 continue performing reading of USB storage device. Once the CH375 reads 64 bytes from USB storage device may request to interrupt after MCU sends DISK_RESD command, MCU gets interrupter state USB_INT_READ. So the MCU must send RD_USB_DATA to take away 64 bytes, then sends DISK_RD_GO to make CH375 continue to read. The CH375 reactive until reads all data and requests interrupter for the last time, also, the MCU get interrupter state as the whole reading operation state. If the operation is successful, the state is USB_INT_SUCCESS, otherwise may be USB_INT_DISK_ERR.

Normally, MCU will receive nine (8+1) interrupters even MCU sends DISK__READ to read one sector because of the length of sector number is 512 bytes. The former eight interrupters are asking

MCU to take data away while the later interrupter returns to the final operation state. When reading four sectors, MCU will get thirty three (4*8+1) interrupters as the former thirty-two are asking MCU to get data away. If the reading operation is failure in midway, MCU may receive USB_DISK_ERR to end the reading operation in advanced.

5.13. Command DISK_WRITE

The command is writing data block to USB storage device. Like the command of DISK_RESD, the starting address and the length of data parameter is needed when sector as unit to write data. The address of starting is LBA address while 4-byte represents wire sector number. The length is one byte represents sector number. This command needs five input data are the lowest byte of LBA address, the lower byte of LBA address, the upper byte of LBA address, the highest byte of LBA address and the sector number. The command can write data from sector 1 to 255 at random in the USB storage device of capability up to 2000GB.This order must be used with the following command DISK_WR_GO.

5.14. Command DISK_WR_GO

Similarly to command DISK_RD_GO, makes CH375 continue performing writing USB storage device. The CH375 may request interrupt after MCU sends DISK_WRITE command, and MCU gets interrupter state USB_INT_DISK_WRITE. So the MCU must send RD_USB_DATA7 to supply 64 bytes, then sends DISK_WR_GO to make CH375 continue to write. The CH375 reactive until write all data and requests interrupter for the last time, also, the MCU gets interrupter state as the whole writing operation state. If the operation is successful, the state is USB_INT_SUCCESS, otherwise may be USB_INT_DISK_ERR.

Normally, MCU will receive nine (8+1) interrupters even MCU sends DISK__READ to write one sector because of the length of sector number is 512 bytes. The former eight interrupters are asking MCU to supply data while the later interrupter returns to the final operation state. When writing four sector, MCU will get thirty-three (4*8+1) interrupters as the former thirty-two are asking MCU to supply data. If the writing operation is failure in midway, MCU may receive USB_DISK_ERR to end the writing operation in advanced.

5.15. Command GET_IC_VER

This command can get chip and firmware version number and the return byte data is version number. The bit 7 is 1,bit 6 is 0 and bit 5 to bit 0 is version number. IF the return byte data is 0A4H, take the bit 7 out, the actual minimum version number is 24H.

5.16. Command ENTER_SLEEP

The order suspends the CH375 and let it enter into low power. The clock of CH375 stops oscillating to economize power when keeping low power. Once detection the signal of USB bus or MCU writes new command without input data to CH375 the CH375 can exit the low-power state.

In general, the time to wake up CH375 from low-power state to work normally is several milliseconds. The CH375 will send USB_INT_WAKE_UP interrupter while totally recovering to work state.

5.17. Command SET_DISK_LUN

Uses the command to set the current logical unit number of USB storage device. The data 34H

and new current logical unit number are needed to input. Some USB storage device supports multiplied logical units, CH375 visits the 0# unit in default after initializing USB storage device. Selects current logical unit number through command of SET_DISK_LUN to visit other logical unit.

5.18. Command DISK_INQUIRY

The command is used to detect characteristics of USB storage device. MCU can read interrupter as operation state of this command after CH375 finishing order and requesting interrupter to MCU. The data is usually 36-byte including characteristics of USB storage device 、vendor and product identification which can obtain from RD_USB_DATA if the operation state is USB_INT_SUCCESS. The command of DISK_INQUIRY doesn't use except analyzing new logical unit.

5.19. Command DISK_READY

The command can examine USB storage device ready or not. MCU can read interrupter as operation state of this command after CH375 finishing order and requesting interrupter to MCU. The USB storage devise is ready if the operation state is USB_INT_SUCCESS.

5.20. Command DISK_R_SENSE

The command can check error of USB storage device. MCU can read interrupter as operation state of this command after CH375 finishing order and requesting interrupter to MCU. In normal operation state is USB_INT_SUCCESS, the data gets from RD_USB_DATA and then analyze the error.

5.21. Command DISK_MAX_LUN

The command can get the max logical unit number of USB storage device. MCU can read interrupter state as operation state of this command after CH375 finishing order and requesting interrupter to MCU. The data is one byte usually taking from RD_USB_DATA if the operation state is USB_INT_SUCCESS.

6. Functions Description

6.1 General Description

CH375 can work in the mode of both USB-HOST and USB-DEVICE/SLAVE.

The USB-DEVICE/SLAVE mode of CH375 is compatible with CH372, and relative information can refer to the manual of CH372.

The USB-HOST mode of CH375 supports parallel and serial interface. The CH375 also supports various common full-speed devices of USB while peripheral MCU communicates with USB device added firmware program according relative USB protocol in the USB–HOST mode. External MCU communicates with USB device directly for CH375 set interrelated protocol inside of USB storage devices.

6.2. Location hardware

The CH375 gives common passive parallel and point-to-point serial interface in location.

6.2.1. Parallel interface

The parallel interface signal wires contain 8-bit bi-directional data bus D7 to D0、read selection input pin RD#、write selection input pin WR#、chip selection input pin CS#、interrupt output pin INT# and address input pin A0.The CH375 is easily attached to system bus of multifarious MCU with 8-bit、DSP and MCU through passive parallel interface. Also coexist with many peripheral parts.

The RD# and WR# of CH375 can connect to the read selection output pin and write selection output pin of MCU respectively. The CS# is driven by address decoding circuit used to select device while MCU embody many peripheral equipments. The output of interrupter request with INT# is valid when it is low-level and connects to interrupter input pin or common I/O pin of MCU. The MCU may get the interruption through interrupter manner or detection manner.

The data of CH375 can output through D7 to D0 while WR# is high-level besides CS#、WR# and A0 are low-level. The data of D7 to D0 are written to CH375 while RD# is high-level、CS#、WR# and A0 are low-level. The data of D7 to D0 are written to the chip CH375 as command code when RD# is high-level、CS# and WR# are low-level besides A0 is high-level.

6.2.2. Serial interface

Serial interface is only used to USB-HOST mode while USB-DEVICE/SLAVE is unsupported.

The serial interface signal wires contain serial data input pin RXD、serial data output pin TXD and interrupt output pin INT#. The CH375 connects of MCU、DSP and MCU point-to-point for a distance using the least connections through the serial interface.

The RXD and TXD of CH375 can connect to the serial data output pin and serial data input pin of MCU respectively. The output interrupter request of INT# is low-level valid to inform to MCU.

Format of CH375's serial data is composed of one starting bit、nine data bits and one stopping bit while the former eight data bits are one byte, the later is command flag bit. The former eight data are written to CH375 while the 9 bit is zero. The former eight data are written to CH375 as command code when the ninth is logical 1.The serial communication baud rate is 9600bps in default as MCU can select appropriate communication baud rate at any time through command SET_BAUDRATE.

6.2.3. Other

The pin of TXD selects communication interface during reset the CH375.The CH375 starts serial interface when detecting low-level of TXD pin during reset period. Otherwise starts parallel interface. If starts serial interface, the TXD will output serial data after reseting and the CH375 works in USB-HOST mode only.

The ACT# shows state in CH375.The pin output high-level while device is not configured or cancel configuring of USB in the mode of USB-DEVICE setting firmware internal. The pin outputs low level after configure USB device. In the USB-HOST mode, ACT# outputs high-level when USB device detach in USB-HOST mode. The pin will output low-level after USB device connection. The ACT# pin of CH375 can attach to current-limited resistance LED to indicate relative state.

UD+ and UD- are signal bus of USB directly connect to USB bus when works in the USB-DEVICE mode. They can attach to USB device directly on USB-HOST. The direct or alternating current equal serial resistance is within 5Ω which is protect chip to serial link of insure resistance、inductance or ESD.

The chip CH375 set power-up reset circuit inside, and external supplies reset is not need in generally. RSTI inputs asynchronous reset signal from outside. The ch375 is reset when RSTI is high-level. When RSTI recovered to low-level, CH375 will go on time-lapse reset about 20mS and

step into work normally. In order to reduce external disturb and make sure of reset during power-up, capacitance about 0.47uF can attach between RSTI and VCC. RST and RST# are output reset state pin, act with high-level and low-level respectively. They output high-level and low-level respectively if CH375 is power-up reset or forced to reset by outside circuit or reset time-lapse. After reset RST and RST# recovered to low-level and high-level. RST and RST# offer power-up reset signal to external MCU.

The CH375 needs outside clock of 12MHz to work normally. In common, clock signal is generated by inverter in CH375 through oscillating of crystal keeping frequency. A crystal of 12MHz between XI and XO, XI and XO connect a high frequency oscillator capacitance to ground respectively can compose the peripheral circuit. The 12MHz clock signal directly input to XI while suspending XO.

CH375A supports 5V power and CH375V supports 3.3V.The VCC pin inputs external 5V power and V3 pin connects to power decoupling capacitance with the capacity from 1000pF to 0.01uF when with 5V power. The V3 must attach to VCC and input external 3.3V power while work power is 3.3V.In addition, the power of other circuit connection of CH375 is not surpass 3.3V.

6.3. Internal configuration

In the inner of CH375 integrate PLL multiplier、the host and slave USB interface SIE、data buffer、passive parallel interface、asynchronous serial interface、command explanation device、protocol transaction device to control transmission、firmware program in common etc.

PLL multiplier takes the 12MHz input from clock and generates a 48MHz reference clock for SIE.

Host-slave USB interface SIE mixes the USB-HOST mode with USB-DEVICE mode. It takes charge of physical USB data receive and transfer、deals with bit track and synchronization automatically 、coding and decoding of NRZI、bit stuffing、parallel/serial data conversion、CRC data check、transaction handshake、retry when error、detection USB bus state etc.

Data buffer delays data receive and transfer of USB interface SIE.

Passive parallel interface exchanges data with peripheral MCU/DSP/MUC.

Asynchronous serial interface exchanges data with peripheral MCU/DSP/MUC substance of passive parallel interface.

Command explanation device analyzes and executes various commands from peripheral MCU/DSP/MCU.

Protocol transaction device deals controlling transfer at many layers automatically to simplify peripheral firmware program.

Common firmware program contains two groups. One group used to USB-DEVICE to treat with numbers of normal affairs in default port 0 of USB automatically. The other used to USB-HOST, handles with special communication protocol in Mass-Storage automatically.

There are seven endpoints in CH375 inner.

The port0 is a default endpoint, supports upstreaming and downstreaming. The buffer of upstream and downstream is 8-byte respectively.

The port1 includes upstream and downstream endpoint and buffer of each is 8-byte. The upstream endpoint number is 81H while the downstream endpoint number is 01H.

The port2 includes upstream and downstream endpoint and buffer of each is 64-byte. The upstream endpoint number is 82H while the downstream endpoint number is 02H.

The host endpoints include output and input endpoint, and each buffer is 64 bytes. The host

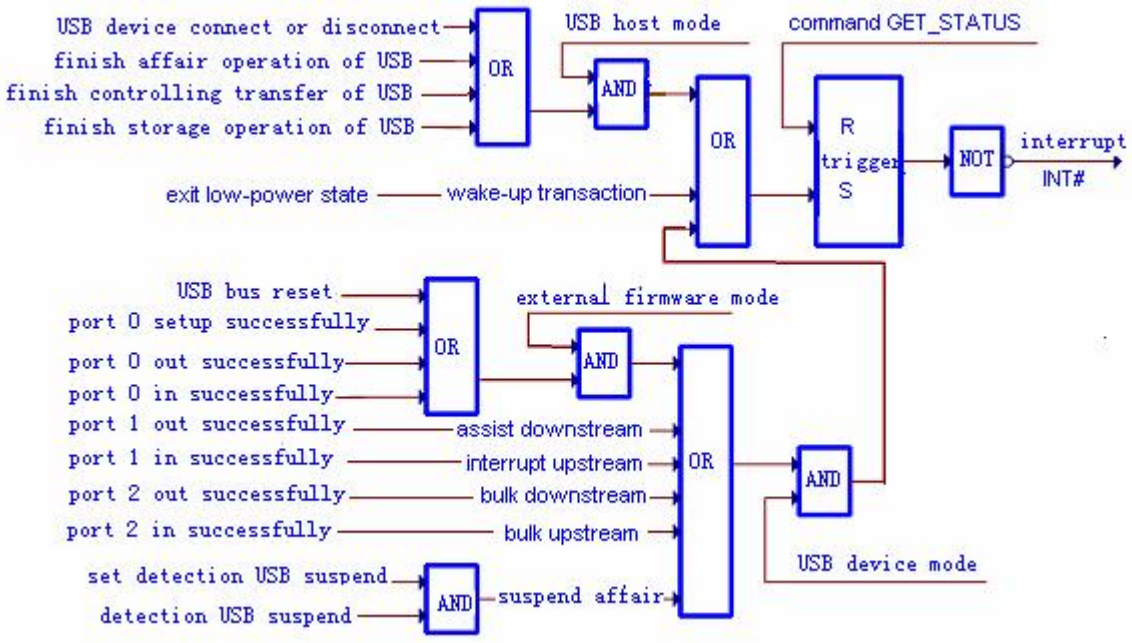
endpoint is operable to port2 with one buffer. The output buffer of host is the upstream buffer of port2 as the input buffer of host is downstream buffer of port2.

The port0、port1 and port2 of CH375 are used to USB-DEVICE mode while the host endpoint is used to USB-HOST.

The CH375 supports various common USB full-speed devices in the USB-HOST mode. The endpoint number of USB device varies from 0 to 15 and the two directions can support 31 ports at best. The package length of USB device varies from 0 to 64 bytes.

The peripheral firmware deals with communication protocol of Mass-Storage device and commands USB storage device to satisfy the following requests: supports Bulk-Only transfer protocol 、supports SCSI、UFI、RBC and other equivalent storage device which accommodates the minimum set of command、the longest package length of data endpoint is 64-byte but the longest package length of default endpoint is 8、16、32 or 64 bytes. If the USB storage device isn't according to requests, the peripheral MCU must deal with referred communication protocol automatically through control transfer and ISSUE_TOKEN command or ISSUE_TKN_X.

The following is interrupt logical drawing inner of CH375.



6.4. Locate MCU software

The CH375 takes up two address bits. When A0 is high-level, selects command port to write command. Otherwise selects data port to read or write data.

MCU read from or write to CH375 through 8-bit parallel interfaces. Each operation is composed of one command、several input data and several output data. Some commands don't need input data while some command don't have output data. The following is command operation process:

①、Write command code to command port while A0=1.

②、If the command has input data, then write input data one byte each time when A0=0.

③、If the command has output data, then read output data one byte each time when A0=0.

④、After the command is finished , pause or return to ① to execute next command.

The CH375 is specially handling USB communication. It will inform the MCU to deal with through interrupt manner when detection the change of USB bus or command is finished.

7. Parameter

7.1. Absolute maximum rating (Stresses above those listed can cause permanent damage to the device. Exposure to maximum rated conditions can affect device operation and reliability.)

Name	Parameter note		Min.	Max.	Units
TA	Ambient operating temperature	CH375A VCC=5V	-40	85	℃
		CH375V VCC=3.3V	-40	65	
TS	Storage temperature		-55	125	℃
VCC	Voltage source (VCC connects to power, GND to ground)		-0.5	6.5	V
VIO	The voltage of input or output pin		-0.5	VCC+0.5	V

7.2. Electrical parameter (test conditions: TA=25℃,VCC=5V,exclude pin connection of USB bus)

(The every current parameter must multiply the coefficient of 40% when the power is 3.3V)

Name	Note of parameter		Min.	Typical	Max.	Units
VCC	Power	CH375A, V3 doesn't connect to VCC	4.5	5	5.3	V
		CH375V, V3 connects to VCC	3.3	3.3	3.8	
ICC	Total source current when working	VCC=5V		12	30	mA
		VCC=3.3V		6	15	
ISLP	Source current with low-power, I/O pin in suspend /internal pull up	VCC=5V		0.25		mA
		VCC=3.3V		0.1		
VIL	Input Voltage LOW		-0.5		0.7	V
VIH	Input Voltage HIGH		2.0		VCC+0.5	V
VOL	Output Voltage LOW (draw 4mA current)				0.5	V
VOH	Output Voltage HIGH (output 4mA current)		VCC-0.5			V
IUP	Input current in input port with internal pull-up resistor		40	80	160	uA
IDN	Input current in input port with internal pull-down resistor		-80	-140	-240	uA
VR	Edge power when power-up reset		2.4	2.7	3.0	V

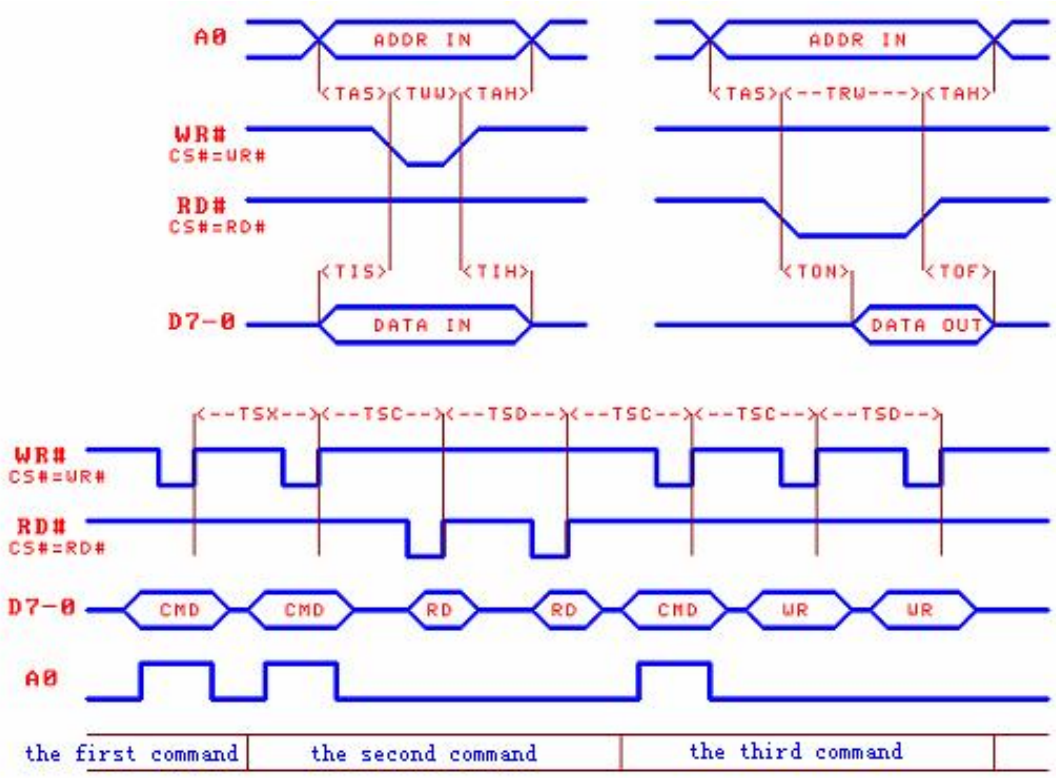
Note: When ACT# is low-level, it can draw 4mA current from USB bus. When ACT# is high-level, it output 200uA current.

INT# and TXD supply 80uA high-level output current during CH375 reset.

7.3. Time sequence parameter (test conditions: TA=25℃,VCC=5V,refer the following picture)

(RD implies RD# and CS# are active, execute read operation when RD#=CS#=0)
(WR implies WR# and CS# are active, execute write operation when WR#=CS#=0)

Name	Explanation of parameter	Min.	Typical	Max.	Units
FCLK	The clock freq of X1 in mode of USB-HOST	11.995	12.00	12.005	MHz
TPR	Reset time of internal power-up	18	20	40	mS
TRI	Effective signal width of external reset	100			nS
TRD	Delay time of external reset	18	20	40	mS
TE1	The execute time of RESET_ALL		20	40	mS
TE2	The execute time of SET_USB_MODE		10	20	uS
TE3	The execute time of SET_ENDP?		3	4	uS
TE4	The execute time of SET_BAUDRATE	100		1000	uS
TE0	The execute time of other commands			2	uS
TSX	The interval time between commands	2			uS
TSC	The interval time between command and data	2		100	uS
TSD	The interval time between data	1		100	uS
TCC	The cycle of write command	2			uS
TCD	The cycle of read or write data operation	1		100	uS
TWW	Write pulse width	90		10000	nS
TRW	Read pulse width	90		10000	nS
TAS	Address to Read HIGH or Write HIGH SET-UP TIME	5			nS
TAH	Address hold time after Read HIGH or Write HIGH	5			nS
TIS	Data to Write HIGH set-up time	0			nS
TIH	Data hold time after Write HIGH	5			nS
TON	Data valid after Read LOW	0		30	nS
TOF	Data hold after Read HIGH	0		20	nS
TINT	The time from receiving GET_STATUS to INT# recall interruption		2	3	uS
TWAK	The woke-up time from low-power state	2	3	5	mS



8. Application

8.1. Parallel interface mode (the following diagram)

The following diagram is CH375 connection of common MCS-51 circuit. The TXD of CH375 connects to ground through about 1KΩ pull-down resister or directly connects to ground. So the CH375 works on the parallel manner.

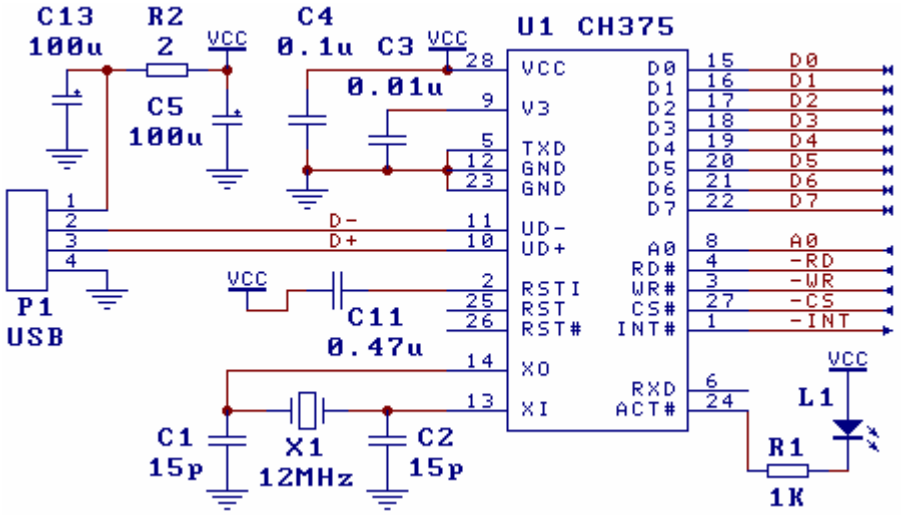
The USB bus contains a double power bus and a double data signal bus. Usually, +5V power wire is red, ground wire is black, D+ signal wire is green and D- is white. The USB receptacle P1 connects to USB device directly. In need, serial connects flash switch with limiting current in +5V power bus that supplies to USB device. The USB power must be 5V.

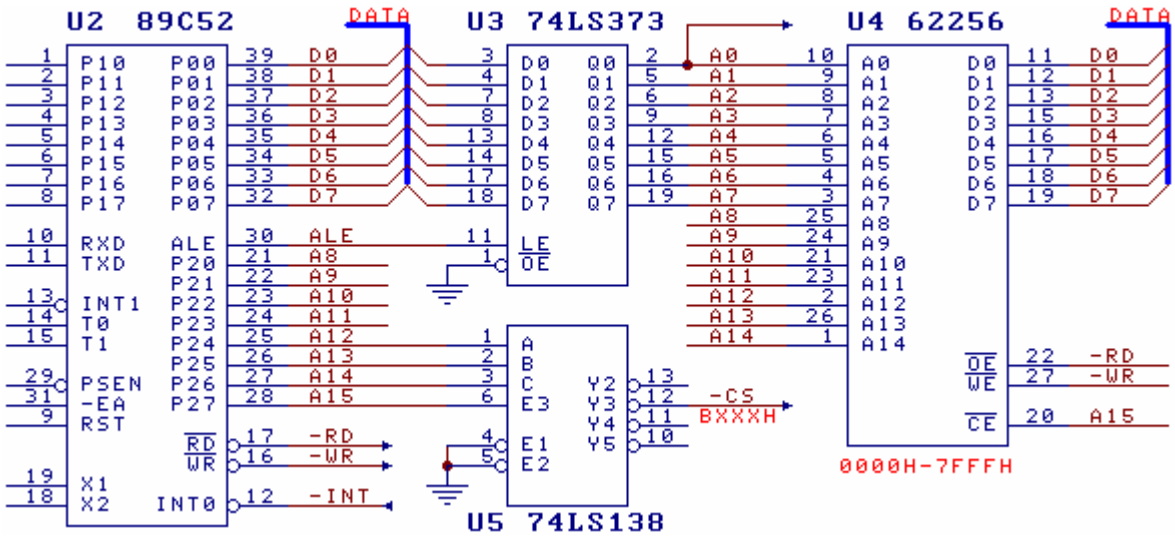
The capacitance C3 eliminates the coupling of inner power of CH375.The capacity of C3 is 1000pF to 0.01uF.It is made of monolithic or high frequency ceramic. If there is no request to EMI, the C3 is not necessary. The C4 and C5 are used to decoupling of external power. The C4 is 0.1uF and made of monolithic or high frequency ceramic. The crystal X1、capacitance C1 and C2 are composed of clock oscillating circuit of CH375.The USB-HOST mode needs exact frequency. The frequency of X1 is 12MHz±0.4‰,C1 and C2 are monolithic or high frequency ceramic capacitors of 15pF.

In order to reset CH375 credibly, the time is below 100mS when the power raises from 0V to 5V.If the process of power-up is slow and discharge is not in time when cut the power, and the CH375 reset is not credible. One solution is to connect a capacitance of 0.47uF between RSTI and VCC to delay the reset time.

When designing the PCB, pay much attention to some notes: decoupling capacitance C3 and C4 must keep near to connection pin of CH375; makes sure D+ and D- are parallel and supply ground net or pour copper beside them to decrease the disturbance from outside signal; the

relevant signal between X1 and X2 must be kept as short as possible. In order to lessen the high frequency clock disturbance, play ground net or pour copper to the relative equipment.





The CH375 has the common passive parallel interface, connects to various MCU、DSP and MCU directly. In common MCS-51 typical application circuit, CH375 can connects to system bus of MCU through 8-bit passive parallel interfaces D7～D0、-RD、-WR、-CS and A0.

If the MCS-51 has not lock A7 ～A0 through U3,uses the P20 of U2 to drive the address bus A0 of CH375 and modify the port address of MCU program.U4 takes charge of simple address encoding, produces chip selection signal in need. The chip selection address varies from B000H to BFFFH of CH375 in the image while occupies two address in actually. The BXX1H used to write commend as the BXX0H used to read or write data.

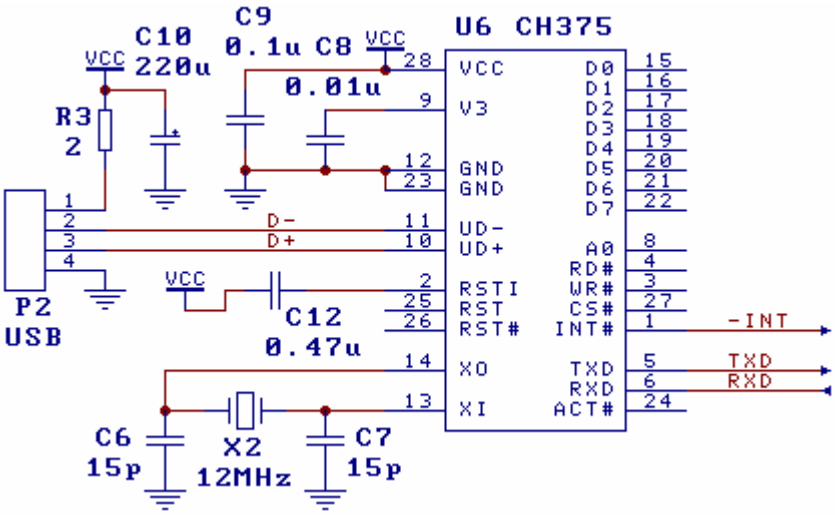
8.2. Serial interface mode (the following diagram)

The CH375 works in serial interface mode while the TXD is suspended or connection of ground without pull-down resistance. In the mode, CH375 only to connect to MCU/DSP/MCU through three signal pin such as TXD、RXD and INT#, others may suspend. The peripheral circuit is the same to

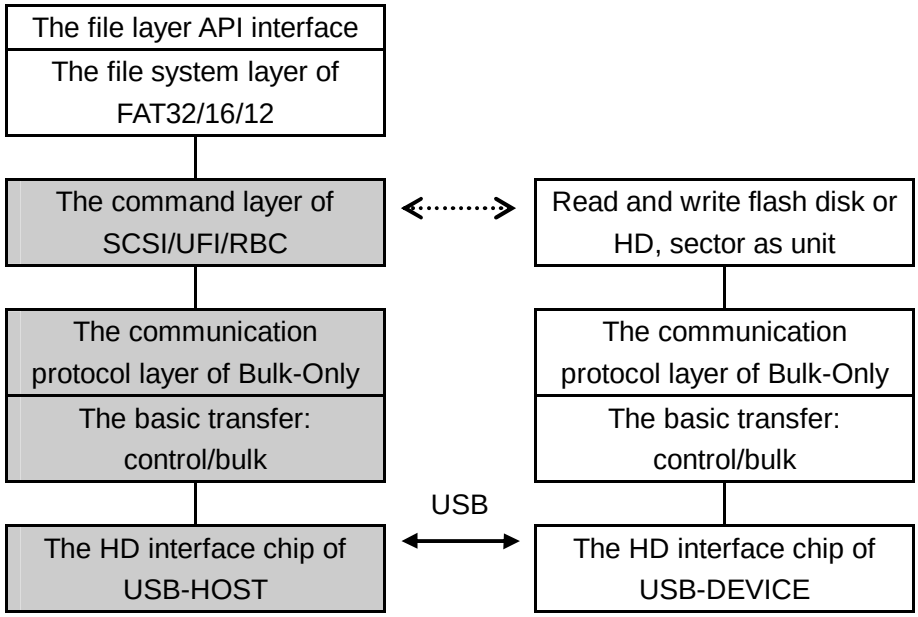
the parallel mode except fewer connection pin.

In addition, mends communication baud-rate dynamically, one suggest is that controlling RSTI of CH375 through MCU I/O point in order to reset CH375 to default baud-rate. Driving the RSTI through the standard bi-direction I/O point of MCS51 may add several KΩ pull-up resistance because of RSTI setting inside of pull-down resistance.

Because of the INT# and TXD only supply faint high-level output current during reseting, on the further distance connection, in order to avoid disturb INT# or TXD during reset of CH375,one 2KΩ to 5KΩ pull-up resistance can add to INT# or TXD to keep the high-level steady. After reset, the INT# and TXD may enable to supply 5mA high–level output current or 5mA low-level draft current.



8.3. MCU read and write file to USB flash drive (the file layer interface of USB storage device)



In general, MCU or embed system deal with file system of USB storage device need to achieve four layers in the left of upper picture. The right of upper picture is inner configure layer of USB storage device. Because CH375 is not only a common USB-HOST hardware interface chip, but also set relative firmware program inside, contains three layers of the left upper picture (the grayer block). The real MCU only to deal with file system layer of FAT and even this layer can handle by file

layer subprogram congregation in USB flash drive of CH375.

The CH375 offers data bulk read and write interface directly if no need to deal with file system i.e. the top layer of the left upper picture. Taking 512-byte physical sector as unit to read and write simplifies the USB storage device as peripheral data storage. The MCU reads and write data in USB storage device and defines data structure at random.

Because computer organizes the USB storage device as file system, in order to give convenience to exchange data between MCU and computer through USB move storage device, MCU can also organize the USB storage device as file system, i.e., handling the top of the left picture.

CH375 supplies USB storage device file layer interface through the subprogram congregation of C language. These API contain common file layer operation and can transplant and embed to various program in MCU.

The USB flash drive file layer subprogram congregation of CH375 has the following features: supports general file system of FAT12、FAT16 and FAT32;the capacity of disk up to 100GB;supports several layers subdirectory; supports the capital letter with 8.3 format and file name of Chinese; supports lowercase and long name of file ;supports open、create、delete、read、write 、search of file and so on.

The file layer subprogram congregation of CH375 needs about 600 bytes RAM as buffer. Takes the general MCS-51 as example, all the code of subprogram in file system vary from 4KB to 8KB,needs about 80 bytes internal RAM and 512 bytes external RAM as buffer. The detail information about file layer subprogram congregation of USB flash drive can refer to the explanation of CH375 experimentation board.

After transferring each API in file layer subprogram congregation may return operation state but no answer data. The note about API parameter refers to CH375HF?.H. The main subprograms are as follow:

Initialize CH375: CH375Init
Query the USB flash drive: CH375DiskReady
Demand the capacity of USB flash drive: CH375DiskSize
Query the information of USB flash drive (the total and the remain capacity): CH375DiskQuery
Open file: CH375FileOpen
Enumerate or search for file: CH375FileEnumer
Close file: CH375FileClose
Create file: CH375FileCreate
Delete file: CH375FileErase
Read data from file take the sector as unit: CH375FileReadX
Write data to file take the sector as unit: CH375FileWriteX
Move file point take the sector as unit: CH375FileLocate
Query file property (property/date/time/size): CH375FileQuery
Set property of file (property/date/time/size): CH375FileModify
Read data from file take byte as unit: CH375ByteRead
Write data to file take byte as unit: CH375ByteWrite
Move file point take byte as unit: CH375ByteLocate