

# 使用 HT82K95E 实现与 PC 的数据传输

文件编码: HA0267S

## 简介

HT82K95E 是盛群推出的 USB Keyboard OTP MCU,符合 USB HID 1.1 规格相容产品, 具备 4K×15 ROM Size、160 Bytes RAM、3 个端点(FIFO Size 为 8 Bytes)可定义为 Boot Device Keyboard、Mouse 产品, 具有 USB、PS/2 硬件自动判断辅助接口, 适用于 USB, USB+PS/2 产品开发。

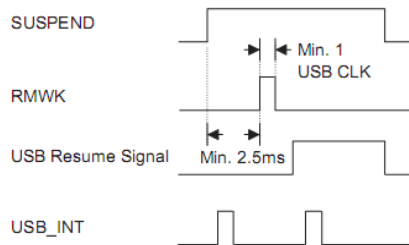
本范例将介绍 HT82K95E 与 PC 的数据传输, 将端点 1 配置为 IN, 端点 2 配置为 OUT, 通过 PC 端的测试软件利用中断传输实现 8 Bytes 数据的输入与输出。

## 工作原理

跟 USB 相关的寄存器有 13 个, 包括 USC(1AH)、USR(1BH)、SCC(1CH)、PIPE\_CTRL(41H)、AWR(42H)、STALL(43H)、PIPE(44H)、SIES(45H)、MISC(46H)、Endpt\_EN(47H)、FIFO0(48H)、FIFO1(49H)、FIFO2(4AH)。

### USC 寄存器的定义

如果在 USB 总线上超过 3ms 没有信号, 设备将进入 Suspend Mode, 此时 USC 寄存器中的 SUSP 位将被设定, 并产生 USB 中断, 如下图所示。为了减小 Suspend 电流需要清除 SCC 寄存器中的 USBCKEN 位, 为了进一步降低功耗可以通过设定位 SUSPEND2 来实现。当设备接收到主机发送的 Resume 信号时, MCU 会产生中断, 此时我们需要打开 USB 的时钟, 即 USBCKEN=1,并清除 SUSP2。



HT82K95E 支持远程唤醒功能, 如果设备配置为具有该功能时, 设备通过控制 RMWK 发送一个唤醒脉冲来唤醒 USB 主机, 如上图所示。

Bit No.	Label	R/W	Function
0	SUSP	R	Read only, USB suspend indication. When this bit is set to "1" (set by SIE), it indicates the USB bus enters suspend mode. The USB interrupt is also triggered on any changes of this bit.
1	RMWK	W	USB remote wake up command. It is set by MCU to force the USB host leaving the suspend mode. When this bit is set to "1", 2 $\mu$ s delay for clearing this bit to "0" is needed to insure the RMWK command is accepted by SIE.
2	URST	R/W	USB reset indication. This bit is set/cleared by USB SIE. This bit is used to detect which bus (PS2 or USB) is attached. When the URST is set to "1", this indicates that a USB reset has occurred (the attached bus is USB) and a USB interrupt will be initialized.
3	RESUME	R	USB resume indication. When the USB leaves the suspend mode, this bit is set to "1" (set by SIE). This bit will appear 20ms waiting for the MCU to detect. When the RESUME is set by the SIE, an interrupt will be generated to wake-up the MCU. In order to detect the suspend state, the MCU should set the USBCKEN and clear SUSP2 (in SCC register) to enable the SIE detecting function. The RESUME will be cleared while the SUSP is going "0". When the MCU is detecting the SUSP, the RESUME (wakes-up the MCU ) should be remembered and taken into consideration.
4	PS2DAI	R	Read only, USB-/DATA input
5	PS2CKI	R	Read only, USB+/CLK input
6	PS2DAO	W	Data for driving the USB-/DATA pin when working under 3D PS2 mouse function. (Default="1")
7	PS2CKO	W	Data for driving the USB+/CLK pin when working under 3D PS2 mouse function. (Default="1")

USC (1AH) Register

### USR 寄存器的定义

USR 寄存器中 EP0IF、EP1IF、EP2IF 用来指示 USB 中断是由存取端点 0、端点 1 还是端点 2 引起的，SPS2 和 SUSB 是用来选择 MCU 工作在 PS2 模式还是 USB 模式，USB\_flag 指示 MCU 工作在 USB 模式。

Bit No.	Label	R/W	Function
0	EP0IF	R/W	When this bit is set to "1" (set by the SIE), it indicates the endpoint 0 is accessed and a USB interrupt will occur. When the interrupt has been served, this bit should be cleared by firmware.
1	EP1IF	R/W	When this bit is set to "1" (set by the SIE), it indicates the endpoint 1 is accessed and a USB interrupt will occur. When the interrupt has been served, this bit should be cleared by firmware.
2	EP2IF	R/W	When this bit is set to "1" (set by the SIE), it indicates the endpoint 2 is accessed and a USB interrupt will occur. When the interrupt has been served, this bit should be cleared by firmware.
3, 6	—	—	Reserved
4	SPS2	R/W	The PS2 function is selected when this bit is set to "1". (Default="0")
5	SUSB	R/W	The USB function is selected when this bit is set to "1". (Default="0")
7	USB_flag	R/W	This flag is used to show the MCU is in USB mode. (Bit=1) This bit is R/W by FW and will be cleared to "0" after power-on reset. (Default="0")

USR (1BH) Register

### SCC 寄存器的定义

SCC 寄存器中 USBCKEN 用于控制 USB Clock, SYSCLK 用于选择系统时钟采用 6MHz 还是 12MHz, PS2\_flag 用来指示 MCU 工作在 PS2 模式。

Bit No.	Label	R/W	Function
2~0, 7	—	—	Undefined, should be cleared to "0"
3	USBCKEN	R/W	USB clock control bit. When this bit is set to "1", it indicates that the USB clock is enabled. Otherwise, the USB clock is turned-off. (Default="0")
4	SUSP2	R/W	This bit is used to reduce power consumption in the suspend mode. In the normal mode this bit must be cleared to zero (Default=0). In the HALT mode this bit should be set high to reduce power consumption. If in USB mode set this bit LVR OPT must disable
5	PS2_flag	R/W	This flag is used to show the MCU is under PS2 mode. (Bit=1) This bit is R/W by FW and will be cleared to "0" after power-on reset. (Default="0")
6	SYSCLK	R/W	This bit is used to specify the system oscillator frequency used by the MCU. If a 6MHz crystal oscillator or resonator is used, this bit should be set to "1". If a 12MHz crystal oscillator or resonator is used, this bit should be cleared to "0" (default).

SCC (1CH) Register

### AWR 寄存器的定义

AWR 寄存器用于控制远程唤醒功能和设置 USB 设备的地址。

Bit No.	Label	R/W	Function
0	WKEN	W	Remote wake-up enable/disable
7~1	AD6~AD0	W	USB device address

AWR (42H) Register

### PIPE\_CTRL 寄存器的定义

PIPE\_CTRL 寄存器用于控制 USB 端点的方向 (IN 或 OUT)。

### STALL 寄存器的定义

STALL 寄存器用于控制 USB 端点进入 STALL 状态。

### PIPE 寄存器的定义

PIPE 寄存器用于指示主机是否存取相应的端点。

### Endpt\_EN 寄存器的定义

Endpt\_EN 用于使能或除能相应的端点, 为 1 是使能, 为 0 是除能。

Register Name	R/W	Register Address	Bit7~Bit3 Reserved	Bit 2	Bit 1	Bit 0	Default Value
PIPE_CTRL	R/W	01000001B	—	Pipe 2	Pipe 1	Pipe 0	00000110
STALL	R/W	01000011B	—	Pipe 2	Pipe 1	Pipe 0	00000110
PIPE	R	01000100B	—	Pipe 2	Pipe 1	Pipe 0	00000000
Endpt_EN	R/W	01000001B	—	Pipe 2	Pipe 1	Pipe 0	00000111

PIPE\_CTRL (41H), STALL (43H), PIPE (44H) and Endpt\_EN (47H) Registers

### SIES 寄存器的定义

Bit No.	Function	Read/Write	Register Address
7	MNI	R/W	01000001B
6~2	—	—	
1	F0_ERR	R/W	
0	Adr_set	R/W	

SIES (45H) Register Table

### MISC 寄存器的定义

Bit No.	Label	R/W	Function
0	REQ	R/W	After setting the other status of the desired one in the MISC, endpoint FIFO can be requested by setting this bit to "1". After the job has been done, this bit has to be cleared to "0".
1	TX	R/W	This bit defines the direction of data transferring between MCU and endpoint FIFO. When the TX is set to "1", this means that the MCU wants to write data to the endpoint FIFO. After the job has been done, this bit has to be cleared to "0" before terminating request to represent the end of transferring. For reading action, this bit has to be cleared to "0" to represent that MCU wants to read data from the endpoint FIFO and has to be set to "1" after the job is done.
2	CLEAR	R/W	Clear the requested endpoint FIFO, even if the endpoint FIFO is not ready.
4 3	SELP1 SELP0	R/W	Defines which endpoint FIFO is selected, SELP1,SELP0: 00: endpoint FIFO0 01: endpoint FIFO1 10: endpoint FIFO2 11: reserved
5	SCMD	R/W	Used to show that the data in endpoint FIFO is a SETUP command. This bit has to be cleared by firmware. That is to say, even the MCU is busy, the device will not miss any SETUP commands from the host.
6	READY	R	Read only status bit, this bit is used to indicate that the desired endpoint FIFO is ready to work.
7	LEN0	R/W	Used to indicate that a 0-sized packet is sent from a host to the MCU. This bit should be cleared by firmware.

MISC (46H) Register

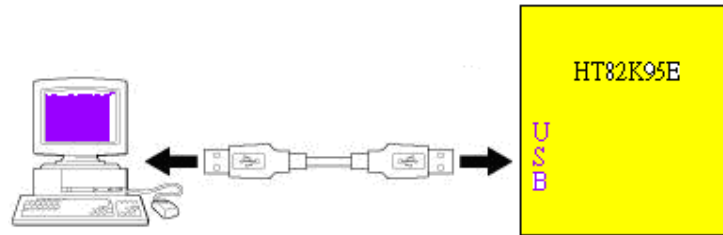
在 MISC 寄存器中有几个跟 USB FIFO 读取相关的设置，可分为写入 FIFO 与读取 FIFO 的时序。以下图来说明 FIFO 写入和读取的时序。



Actions	MISC Setting Flow and Status
Read FIFO0 sequence	00H→01H→delay 2μs, check 41H→read* from FIFO0 register and check not ready (01H)→03H→02H
Write FIFO1 sequence	0AH→0BH→delay 2μs, check 4BH→write* to FIFO1 register and check not ready (0BH)→09H→08H
Check whether FIFO0 can be read or not	00H→01H→delay 2μs, check 41H (ready) or 01H (not ready)→00H
Check whether FIFO1 can be written or not	0AH→0BH→delay 2μs, check 4BH (ready) or 0BH (not ready)→0AH
Read 0-sized packet sequence form FIFO0	00H→01H→delay 2μs, check 81H→read once (01H)→03H→02H
Write 0-sized packet sequence to FIFO1	0AH→0BH→delay 2μs, check 0BH→0FH→0DH→08H

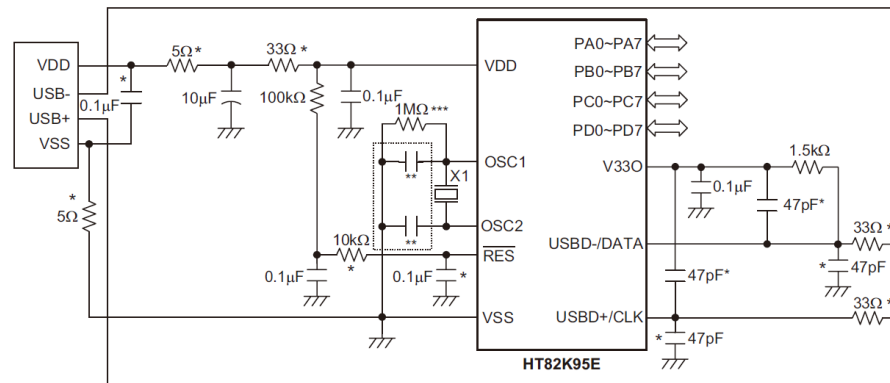
Note: \*: There are 2μs existing between 2 reading action or between 2 writing action

### H/W 功能方框图



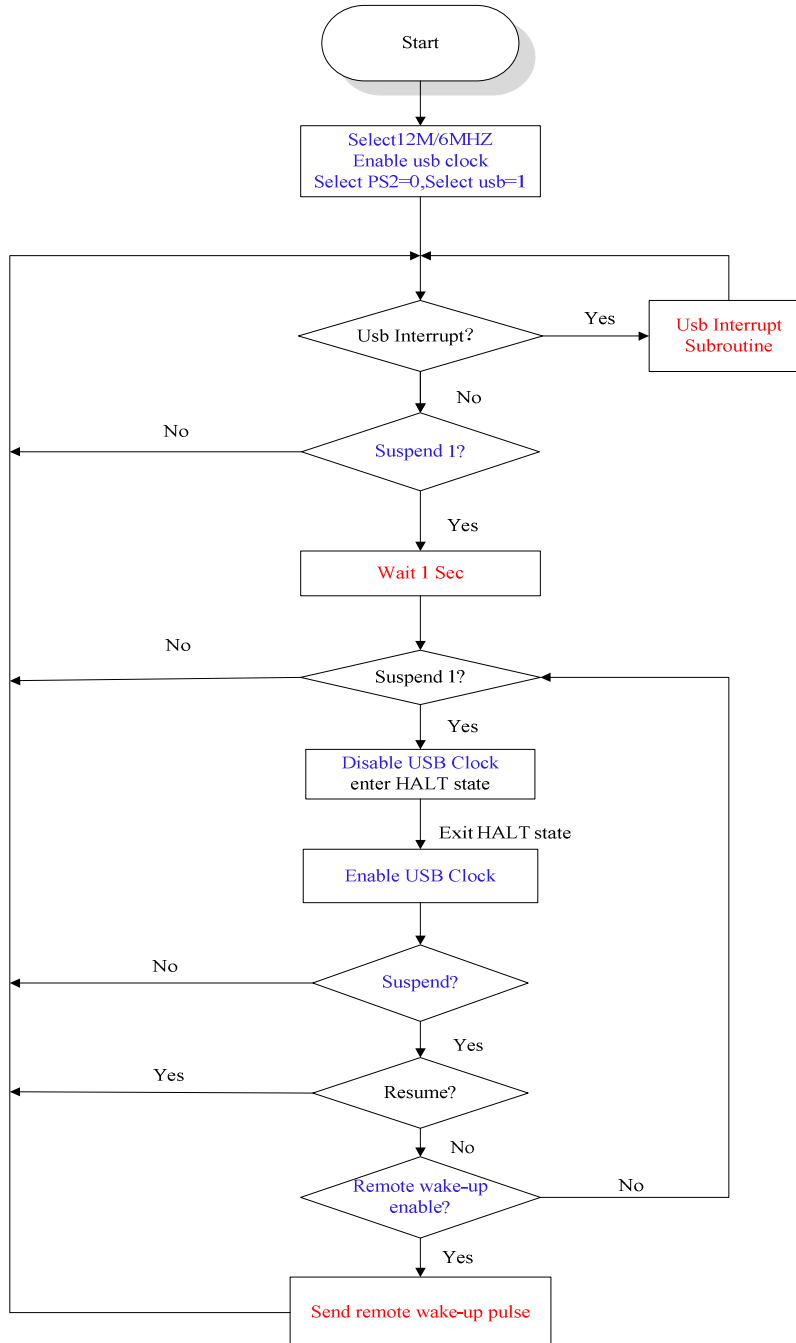
PC 通过 USB 向 HT82K95E 传输 8 Bytes 的数据，HT82K95E 收到数据后，将这数据回传给 PC。

### 应用电路



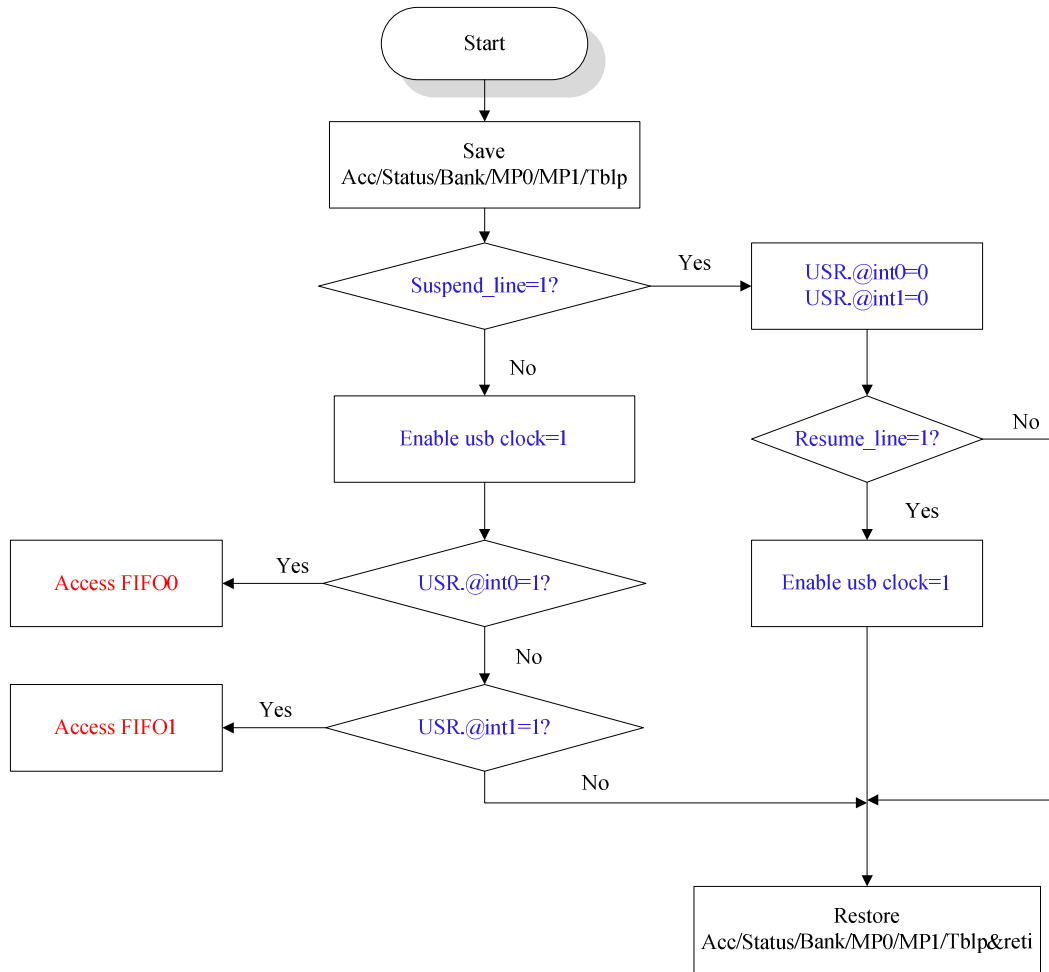
## S/W 流程图

主流程图



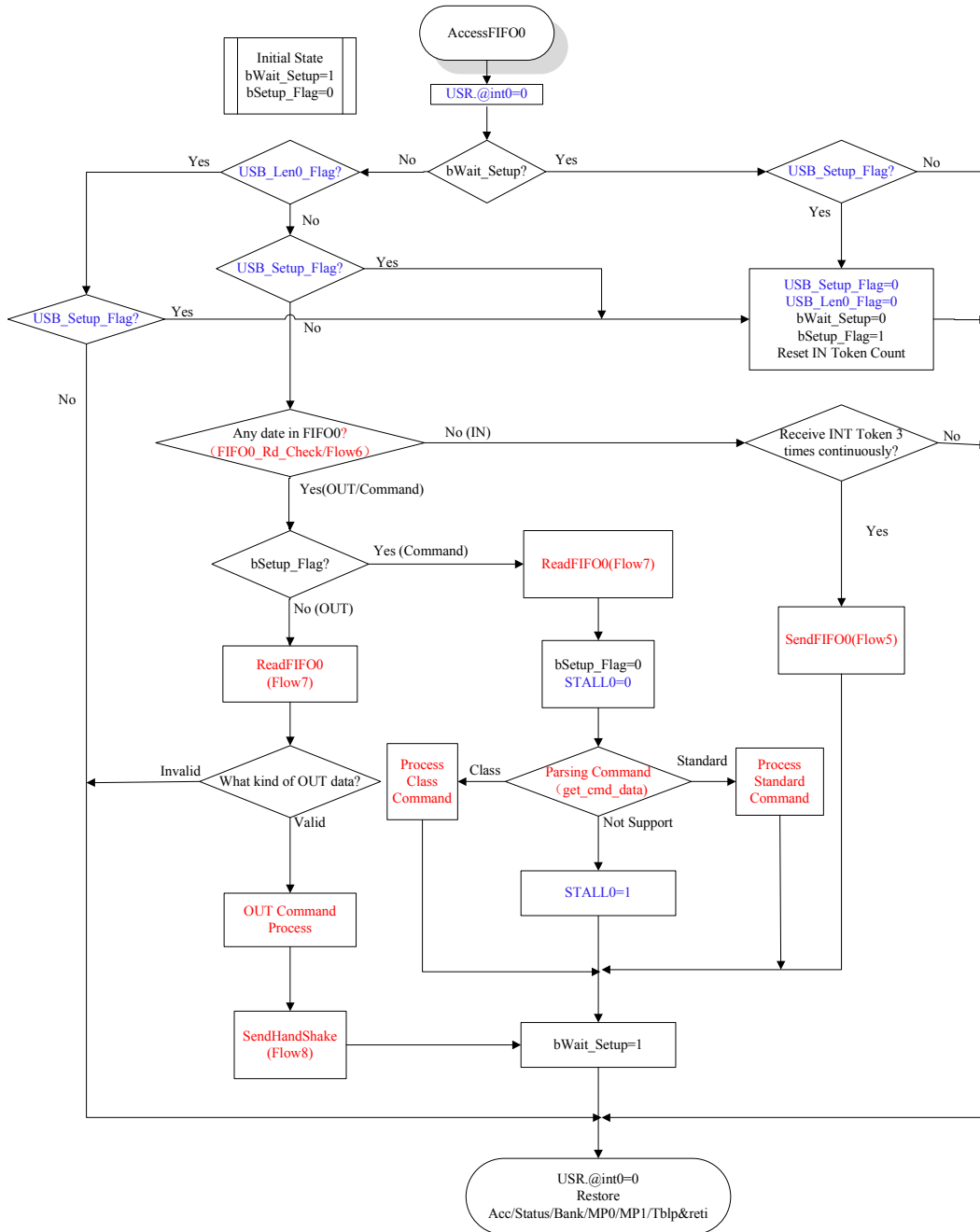
主程序主要是系统的初始化, Suspend 的检测, 当有 USB 中断产生时进入 USB 中断子程序; 当 USB 进入 Suspend 模式时, MCU 进入 HALT 模式, 当有外部中断唤醒 MCU, 打开 USB Clock, 判断是否允许远程唤醒, 如果允许则发送远程唤醒脉冲。

USB 中断子程序流程图



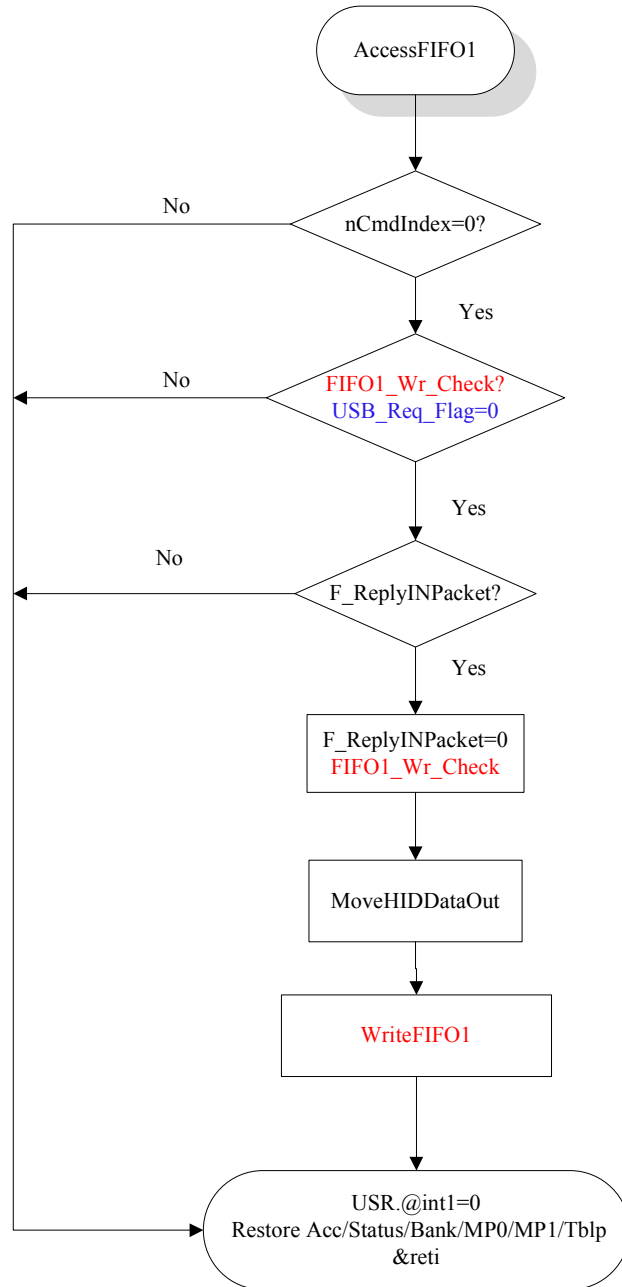
中断子程序主要是判断是 Suspend、Resume 引起的中断还是存取端点产生的中断如果是存取中断端点产生的中断，则进入相应的子程序。

存取端点 0 子程序流程图



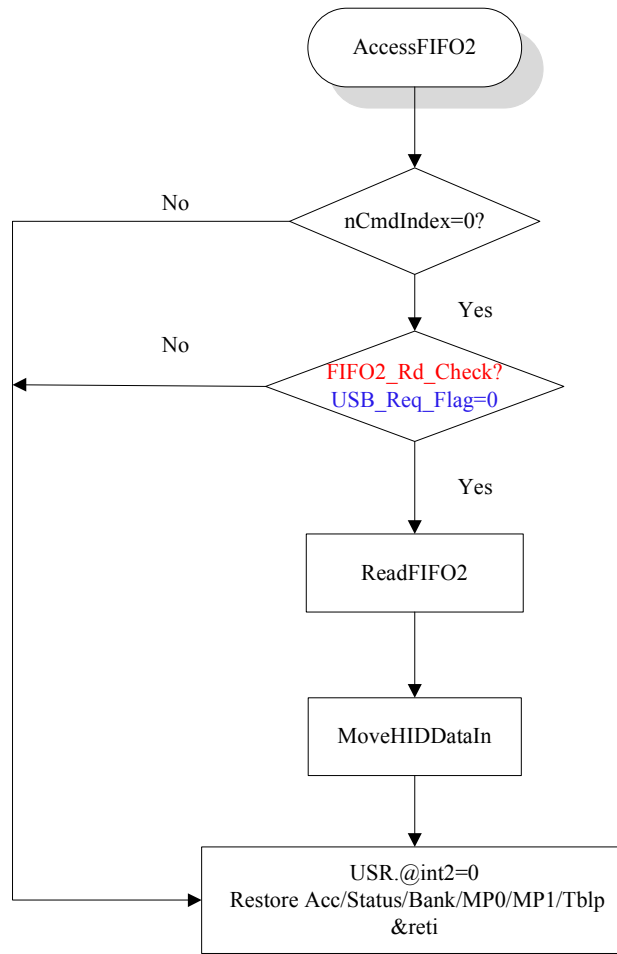
存取端点 0 子程序，主要是用于 USB 枚举过程的，首先判断有没有 Setup Token,如果有，将相应标志位设为 1，退出中断；如果没有，判断是不是 Len0 包，如果是，则退出中断；如果不是 Setup Token 也不是 Len0 包，则先判断 FIFO0 是否可读（IN 或 OUT），如果可读（OUT），则读取 FIFO 的数据，若 bSetup\_flag=1，代表要处理 Setup Command,再根据命令返回 HOST 所需的数据，若 bSetup\_flag 不为 1，代表是一般的 OUT Data；如果 FIFO 可写（IN），则发送数据。

存取端点 1 子程序流程图



存取端点 1 子程序，主要是用来发送 8 Bytes 的数据给 PC。

存取端点 2 子程序流程图

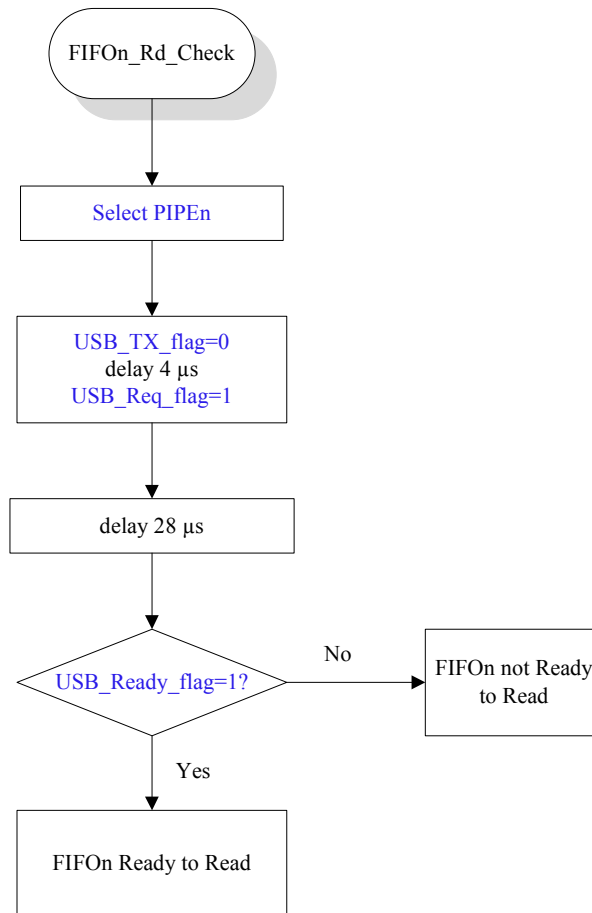


存取端点 2 子程序，主要是用来接收 PC 发过来的 8 Bytes 数据。

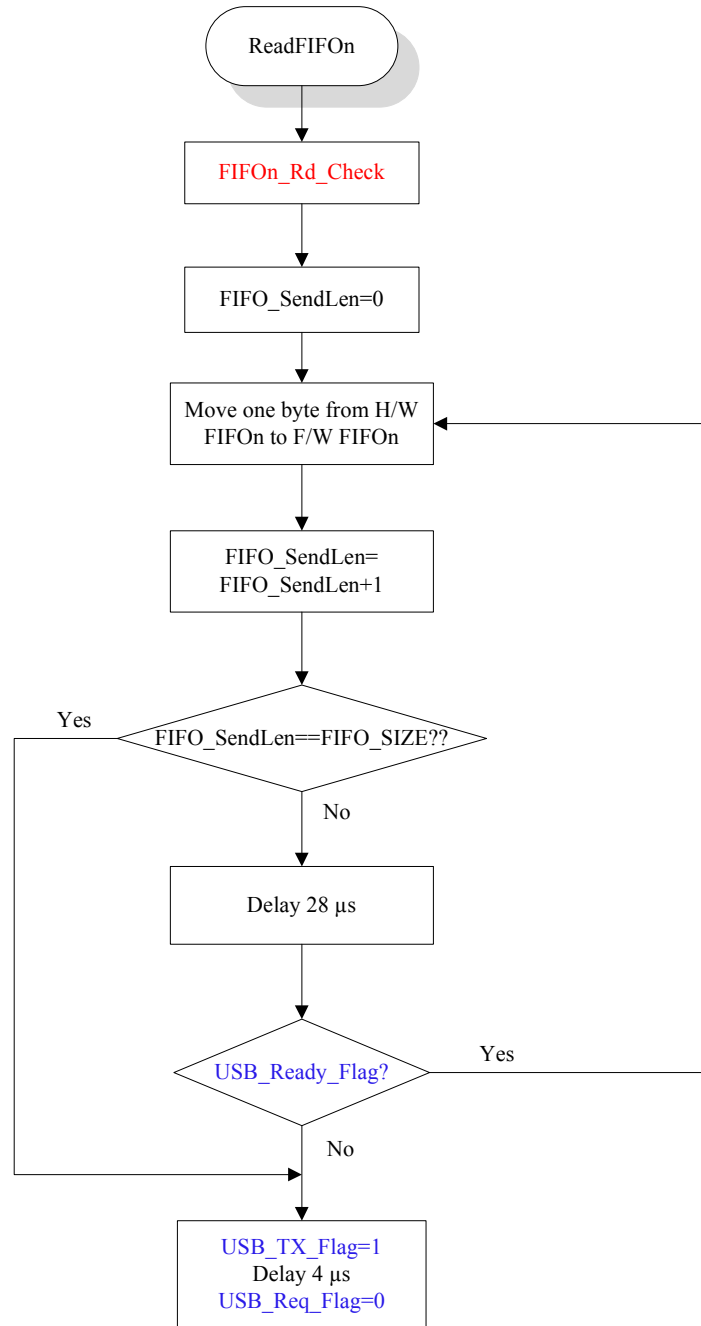
SendFIFO 程序流程图



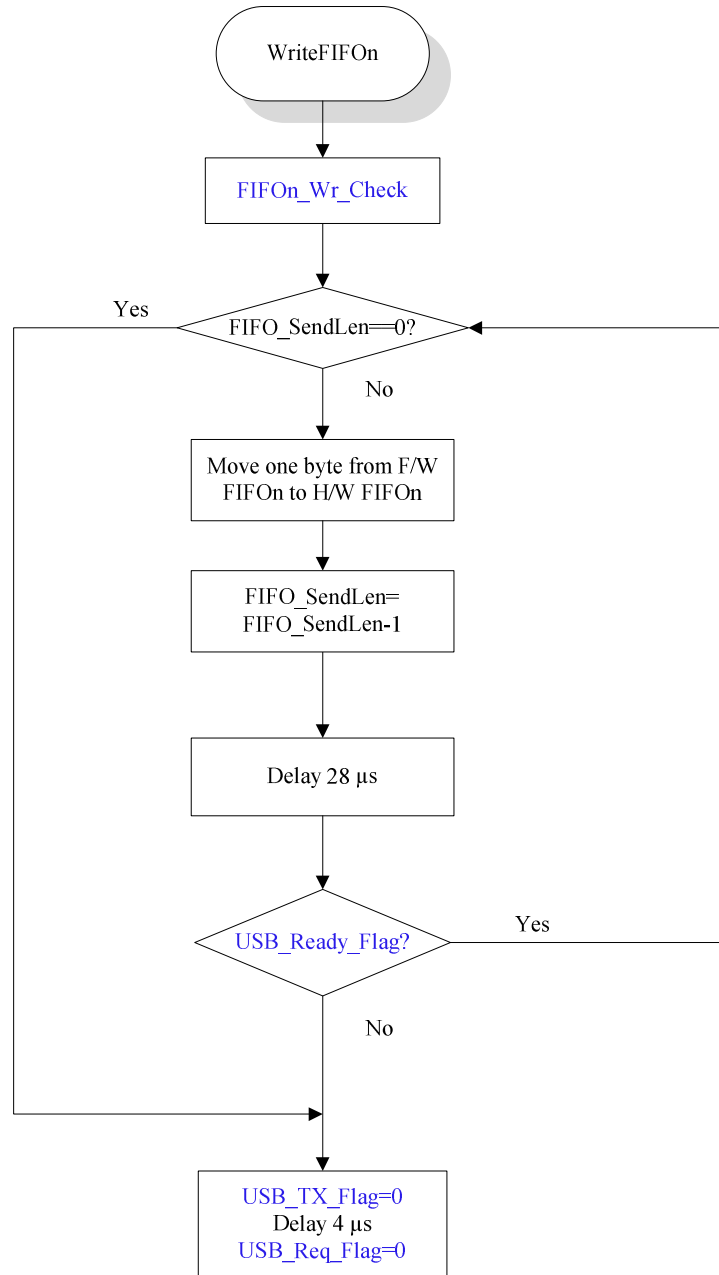
FIFO\_Rd\_Check 子程序流程图



读取 FIFO 的数据子程序流程图



写入 FIFO 的数据子程序流程图



## 文件说明

- MAIN.ASM  
该 ASM 文件中的内容为主程序，包括寄存器和 I/O 口的初始化操作等。
- USB\_INT.ASM  
该 ASM 文件中的内容为 USB 的中断服务程序，当发生 USB 中断时，程序会跳到此处。
- USB\_LIB.ASM  
该 ASM 文件中的内容为对 FIFO 进行读、写的子程序。
- STD.ASM  
该 ASM 文件中的内容为 USB 定义的 11 种标准 USB 请求的子程序。
- CLS.ASM  
该 ASM 文件中的内容为 HID 设备类请求子程序。
- DES.ASM  
该 ASM 文件中的内容为所有描述符的定义。
- Variable.ASM  
该 ASM 文件中的内容定义了 USB 功能所用到的所有变量。

## 结论

本文通过介绍如何使用 HT82K95E 的 USB 功能来实现与 PC 端 USB 主机的 8 Bytes 数据的接收与发送。