

关于 USB 高速 (HighSpeed) 和中速(FullSpeed)的区分

USB 中区分当前设备是低速还是中速(初始时,高速也被当做中速)的方法是检查 D+ 或者 D- 上的电阻。如果发现时中速设备,还要有额外的动作来区分是中速还是高速设备。具体的做法是:

“主机识别一个中速设备是否支持高速。要知道一个设备是否支持高速,需使用两个特殊的信号状态。在 Chirp J 状态时只有 D+线会被驱动,在 Chirp K 状态时只有 D-线会被驱动。

在重置期间,支持高速的设备会送出一个 Chirp K。高速的集线器检测到该 Chirp 后,会反映遗传的交替 Chirp K 与 J。当设备检测到 KJKJKJ 的样式后,它会移除它的中速上升,然后在高速执行所有的通信。如果集线器没有对设备的 Chirp K 做出相应,设备知道它必须继续使用中速通信。高速的设备必须能够在中速时,相应检测设备的请求”【注释 1】

使用 Ellisys USB 分析仪查看,其中的一个例子: Mass-storage USB 2.0 HS.ufo 可以看到这样一个握手。

The screenshot shows the Ellisys Visual USB software interface. The main window title is "Mass-storage USB 2.0 HS.ufo - Ellisys Visual USB". The menu bar includes File, View, Search, Record, Help. The toolbar contains various icons for file operations and analysis. The main pane displays a "High speed Detection Handshake" capture. A status message at the top says "High speed Detection Handshake state detected". Below it, a "Status" section states "The handshake completed successfully." A note below explains the detection logic: "All high speed devices start at full speed to ensure USB 1.1 backward compatibility. If the upstream port (device) supports high speed signaling, it will generate a Chirp K state on the bus after Reset. If the downstream port (host) also supports high speed signaling, it will generate Chirps to change the link speed into high speed. If the downstream port (host) does not support high speed signaling, it will never see the upstream port (device) Chirp and the link speed will stay at full speed." A large table below lists the transaction details, including Item, Device, Endian, Interface, Status, Speed, Payload, and Time.

Item	Device	Endian	Interface	Status	Speed	Payload	Time
在此处输入文字	在此...	在此...	在此...	在此输入...	在此...	在此输入...	在此输入文字
[+] [+] Reset (0.8 ms)						0.000 000 000	
[+] [+] Power ON						0.002 798 067	
[+] [+] Suspended (1.1 ms)						0.003 756 817	
[+] [+] Reset (663.9 us)						0.004 863 600	
[+] [+] High speed Detection Handshake	0 (1)	0		OK	HS	10 bytes (1...	0.005 387 583
[+] [+] GetDescriptor (Device)	0 (1)	0		OK	HS	No data	0.146 061 817
[+] [+] Reset (728.4 us)						0.148 217 600	
[+] [+] High speed Detection Handshake				OK			0.148 772 033
[+] [+] SetAddress (1)	0 (1)	0		OK	HS	18 bytes (1...	0.320 712 450
[+] [+] GetDescriptor (Device)	1	0		OK	HS	9 bytes (09...	0.321 047 383
[+] [+] GetDescriptor (Configuration)	1	0		OK	HS	4 bytes (04...	0.321 370 500
[+] [+] GetDescriptor (String lang IDs)	1	0		OK	HS	34 bytes (2...	0.321 550 133
[+] [+] GetDescriptor (String iSerialNumber)	1	0		OK	HS	39 bytes (0...	0.321 930 100
[+] [+] GetDescriptor (Configuration)	1	0		OK	HS	4 bytes (04...	0.322 337 600
[+] [+] GetDescriptor (String lang IDs)	1	0		OK	HS	34 bytes (2...	0.322 554 133
[+] [+] GetDescriptor (String iProduct)	1	0		OK	HS	4 bytes (04...	0.322 921 167
[+] [+] GetDescriptor (String lang IDs)	1	0		OK	HS	34 bytes (2...	0.323 174 550
[+] [+] GetDescriptor (String iProduct)	1	0		OK	HS		

上面的解释是

- “ High speed Detection Handshake
- High speed Detection Handshake state detected

Status

The handshake completed successfully.

When does this state occur?

All high speed devices start at full speed to ensure USB 1.1 backward compatibility. If the upstream port

(device) supports high speed signaling, it will generate a Chirp K state on the bus after Reset. If the downstream port (host) also supports high speed signaling, it will generate Chirps to change the link speed into high speed. If the downstream port (host) does not support high speed signaling, it will never see the upstream port (device) Chirp and the link speed will stay at full speed.”

可惜的是无法看清楚具体的电气特性。

这里还有一个 Failed 的情况：

High speed Detection Handshake

High speed Detection Handshake state detected

Status
The upstream port (device) did not generate Chirp K state. This usually happens when the upstream port does not support high speed signaling (full speed or low speed device)

When does this state occur?
All high speed devices start at full speed to ensure USB 1.1 backward compatibility. If the upstream port (device) supports high speed signaling, it will generate a Chirp K state on the bus after Reset. If the downstream port (host) also supports high speed signaling, it will generate Chirps to change the link speed into high speed. If the downstream port (host) does not support high speed signaling, it will never see the upstream port (device) Chirp and the link speed will stay at full speed.

Item	Device	En...	Interface	Status	Speed	Payload	Time
在此处输入文字	在此处输入文字	在此处输入文字	在此处输入文字	在此处输入文字	在此处输入文字	在此处输入文字	在此处输入文字
SRST Reset (4.6 s)							0.000 000 000
SRST Reset (171.1 ms)							4.554 590 883
HSR High speed Detection Handshake				TIMOUT			4.564 601 550
SUSP Suspended (0.3 ms)							4.725 735 717
SRST Reset (280.5 ms)							4.732 031 500
HSR High speed Detection Handshake				TIMOUT			4.742 042 350
SUSP Suspended (20.4 ms)							5.012 504 850
SRST Reset (50.4 ms)							5.032 937 083
HSR High speed Detection Handshake				TIMOUT			5.042 947 933
SUSP Suspended (446.7 ms)							5.083 398 200
SRST Reset (30.0 ms)							5.630 878 317
HSR High speed Detection Handshake				TIMOUT			5.840 889 183
GetDescriptor (Device)	0	0		INVALID	FS	No data	5.766 776 833
GetDescriptor (Device)	0	0		INVALID	FS	No data	5.766 814 433
GetDescriptor (Device)	0	0		INVALID	FS	No data	5.766 838 833
GetDescriptor (Device)	0	0		INVALID	FS	No data	5.772 192 433
GetDescriptor (Device)	0	0		INVALID	FS	No data	5.772 214 900

主机多次尝试握手设备，不但没有相应，反而后面看起来将设备“握手死了”，以至于无法相应后面的 GetDescriptor 命令……设备是 Datalogic Quickscan L 2330 条码枪。

上方文字解释是

“High speed Detection Handshake

High speed Detection Handshake state detected

Status

The upstream port (device) did not generate Chirp K state. This usually happens when the upstream port does not support high speed signaling (full speed or low speed device)

When does this state occur?

All high speed devices start at full speed to ensure USB 1.1 backward compatibility. If the upstream port (device) supports high speed signaling, it will generate a Chirp K state on the bus after Reset. If the downstream port (host) also supports high speed signaling, it will generate Chirps to change the link speed into high speed. If the downstream port (host) does not support high speed signaling, it will never see the upstream port (device) Chirp and the link speed will stay at full speed.

”

The screenshot shows a software interface for analyzing USB traffic. At the top, there's a menu bar with File, View, Search, Record, Help. Below the menu is a toolbar with various icons. The main window has a title bar "另外的zai rs780上工作正常的条码枪.ufo - Ellisys Visual USB". Under the title bar, there's a "Details" tab and a search bar "Instant Search". The main area displays a table of transaction details:

Item	Device	En...	Interface	Status	Speed	Payload	Time
在此处输入文字	在此...	在...	在此...	在此处输入...	在此...	在此处输入文字	在此处输入文字
Reset (4.6 s)							-4.318 350 600
Power ON							0.000 000 000
Reset (485.5 ms)							0.288 231 900
High speed Detection Handshake				TIMEOUT			0.298 242 767
Suspended (0.4 s)							0.773 733 933
Reset (50.4 ms)							9.124 269 500
High speed Detection Handshake				TIMEOUT			9.134 280 450
Suspended (1.5 s)							9.174 062 100
Reset (29.6 ms)							10.741 315 250
High speed Detection Handshake				TIMEOUT			10.751 327 117
GetDescriptor (Device)	0 (2)	0		OK	FS	8 bytes (12...)	10.876 020 000
GetDescriptor (Device)	0 (2)	0		OK	FS	18 bytes (1...	10.892 913 500
GetDescriptor (Configuration)	0 (2)	0		OK	FS	34 bytes (0...)	10.898 873 417
SetAddress (2)	0 (2)	0		OK	FS	No data	10.904 936 333
SetConfiguration (1)	2	0		OK	FS	No data	10.920 955 287
Class request OUT (0x0A)	2	0	0	OK	FS	No data	10.926 085 033
Class request OUT (0x0B)	2	0	0	OK	FS	No data	10.932 874 983
SetFeature (Device, RemoteWakeUp)	2	0		OK	FS	No data	10.938 894 500
Class request OUT (0x09)	2	0	0	OK	FS	1 byte (00)	10.944 005 617

Ready 23 elements displayed CAP RUN SCR 3.1.3400.0

上面是一个工作正常的条码枪（同样的主机平台），可以看到，主机握手三次，然后放弃了，后面还能正常工作。

注释 1：来自 USB2.0 硬件设计（第二版） P57 第 3 章 检测设备 萧世文 宋延清 编著 清华大学出版

参考： Ellisys Visual USB Analysis Software Version 3.1.3400.0 32-bit edition