# UVC描述符

* Each video function has a single VideoControl (VC) interface and can have several VideoStreaming (VS) interfaces

每个视频有且仅有1个VideoControl (VC)接口和可有多个 VideoStreaming (VS) 接口

* The **VideoControl** (VC) interface is used to access the device controls of the function whereas

the **VideoStreaming** (VS) interfaces are used to transport data streams into and out of the function.

VC接口用于设备功能控制,VS接口用于传输数据流进出

* Video Interface Class Code(A.1 P171)

视频接口类代码就是宏定义的USB\_CLASS\_VIDEO

总共有3种子类subclass

1.VideoControl Interface 视频控制接口子类

2.VideoStreaming Interface 视频数据流接口子类

3.Video Interface Collection 视频接口集合子类

* Units provide the basic building blocks to fully describe most video functions ,A Unit has one or more Input Pins and a single Output Pin,

Unit提供了基础模块来全面描述大部分的视频功能,一个Unit可以由一个或多个输入引脚和仅一个输出引脚(这里的每一个pin代表一个逻辑上的数据流)

Unit可以通过pin引脚连接在一起,一个输出pin可以连接多个输入pin,但一个输入pin只能连接一个输出pin

* An **Input Terminal** (IT) is an entity that represents a starting point for data streams inside the video function.

一个输入Terminal (IT)终端是一个实体代表数据流的开始端点

* An **Output Terminal** (OT) represents an ending point for data streams.

一个输出Terminal (OT)终端是一个实体代表数据流的结束端点

* Terminals have one Input or Output Pin that is always numbered one.

Terminal只有1个输入或一个输出引脚pin

* The **Camera Terminal** (CT) controls mechanical (or equivalent digital) features of the device component that transmits the video stream.

摄像头Terminal (CT)控制传输视频流的设备组件特性(Scanning Mode扫描模式 Auto-Exposure Mode自动曝光模式 Auto-Exposure Priority自动曝光优先级Exposure Time 曝光时间 Focus聚焦 Auto-Focus自动聚焦 Simple Focus简单聚焦 Iris红外 Zoom放大 Pan摇动 Roll滚动 Tilt倾斜 Digital Windowing数字窗口Region of Interest 感应区)

* The **Selector Unit** (SU) selects from n input data streams and routes them unaltered to the single output stream.

选择Unit (SU)选择多个输入数据流并路由它们到单一的输出流

* The **Processing Unit** (PU) controls image attributes of the video being streamed through it.

处理Unit (PU)控制流经它的视频流图像属性(【Brightness背光 Hue色度 Saturation饱和度 Sharpness锐度 Gamma伽马值 Digital Multiplier (Zoom)数字放大】

【White Balance Temperature白平衡色温 White Balance Component白平衡组件 Backlight Compensation背光补偿 Contrast对比度】

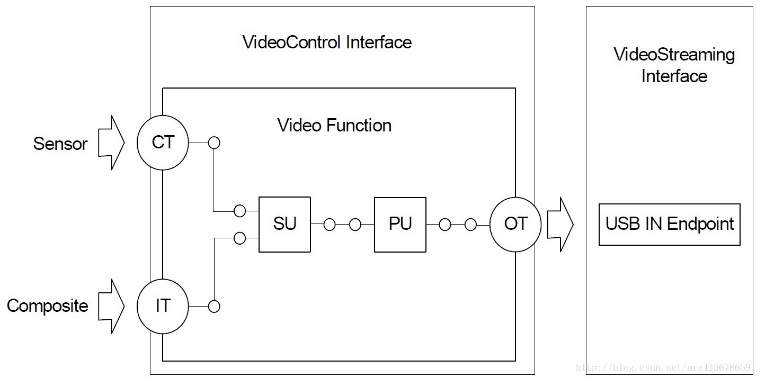
【Gain增益 Power Line Frequency电源线频率 Analog Video Standard模拟视频标准 Analog Video Lock Status模拟视频锁存状态】)

* The **Encoding Unit** controls attributes of the encoder that encodes the video being streamed through it.

编码Unit (EU)控制流过的视频流编码的编码器的属性(...)

* The **Extension Unit** (XU) is the method provided by this specification to add vendor-specific building blocks to the specification

扩展Unit (XU)提供厂商特殊控制模块方法



# USB描述符

**描述符说明:**

**设备描述符:**

**一个设备只有一个设备描述符**

* **bDeviceProtocol=0x01 ： 有多个接口描述符，具体看IAD描述符**
* **bNumConfigurations : 表示配置描述符的个数**

**配置描述符:**

**一个设备有多个配置描述符， 每个配置描述符可以有多个接口描述符**

* **bNumInterfaces： 表示接口描述符的个数**

**接口描述符：**

**一个配置有多个接口描述符，一个接口描述符有多个设置**

* **bInterfaceClass ： 接口描述符的类型，14(video), 1(Audio)**
* **bInterfaceSubClass ： 接口描述符的子类型，1(Control), 2(Streaming)**
* **bInterfaceNumber ： 接口描述符编号**
* **bAlternateSetting ；接口描述符设置编号**
* **bNumEndpoint : 端点描述符的个数**

**端点描述符:**

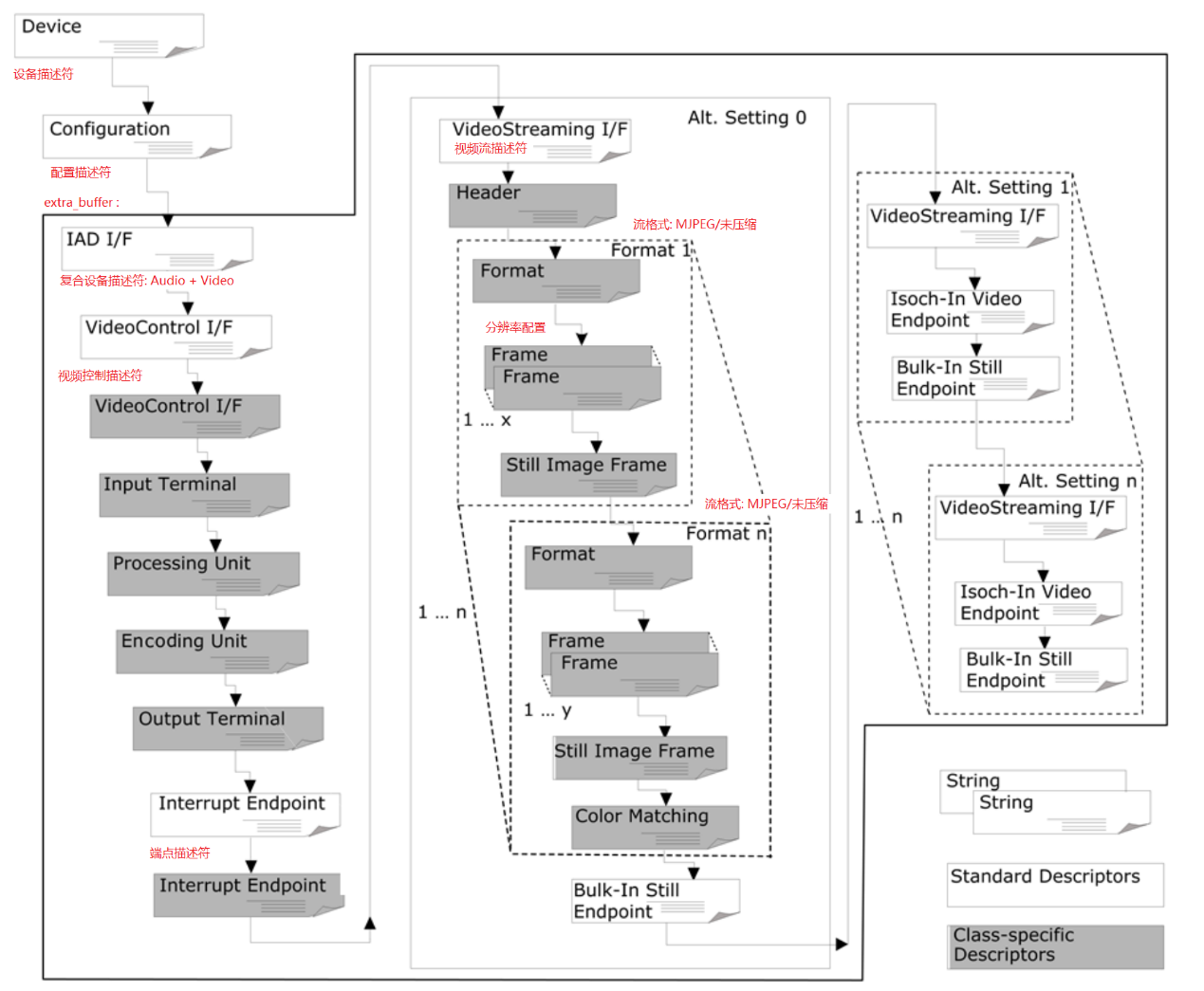
* **bEndpointAddress ： 端点地址及传输防线**
* **wMaxPacketSize ： 端点数据大小**
* **bmAttributes ： 端点传输类型: isoc/ bulk**

**IAD描述符**

**一个设备有多个Interface时需要存在IAD描述符。**

**IAD描述符主要提供Function的信息**

* **bFunctionClass ： IAD描述符的Function信息，14(video), 1(Audio)**



## USB设备的插入检测机制

USB主机如何检测到设备插入的那？首先在USB集线器的每个下游端口的D+和D-上，分别接上一个15K的下拉电阻，而在USB设备端，在D+或者D-上接上1.5K的上拉电阻，高速设备接在D+上，低俗设备上拉接在D-上。这样当有设备插入到集线器时，就将差分数据线上的一条拉高了，集线器检测到这个状态后，它就报告给USB主控制器，这样就检测到设备插入了。

## USB设备的枚举过程

usb主机检测到USB设备插入后，就要对设备进行枚举了。枚举的作用就是从设备是那个读取一些信息，知道设备是什么样的设备，如果通信，这样主机就可以根据这些信息假造合适的驱动程序。调试USB设备，很重要的一点就是USB枚举过程，只要枚举成功了，那就成功一大半了。

USB的一种传输模式---控制传输

这种传输在USB中是非常重要的，它保证数据的正确性，在设备的枚举过程中都是控制传输。

控制传输分为三个过程：1.建立过程；2可选的数据过程；3状态过程。

建立过程都是由USB主机发起，它开始于一个Setup令牌包，后面紧跟着一个DATA0包，如果是控制输入传输，那么数据过程就是输入数据；如果控制输出传输，那么数据过程就是输出数据。数据过程之后是状态过程。状态过程刚好与数据过程的数据传输放喜爱那个相反。

首先：主机检测到USB设备插入后，就会先对设备进行复位，复位后，USB主机就会对地址为0的设备发送获取设备描述符的标准请求。所有的USB设备在总线复位后其地址都为0，这样主机就可以跟那些刚刚插入的设备通过地址0通信，获取玩设备描述符后，主机就会获取配置描述符9个字节， 主机获取到配置描述符后，根据里面的配置集合总长度，在获取配置结合。配置集合包括配置描述符，接口描述符，端点描述符等。

## USB描述符

### 设备描述符：

一个设备只有一个设备描述符

typedef struct \_USB\_DEVICE\_DESCRIPTOR\_

{

BYTE bLength, //描述符大小．固定为0x12．

BYTE bDescriptorType, //设备描述符类型．固定为0x01

WORD bcdUSB,

BYTE bDeviceClass,

BTYE bDeviceSubClass,

BYTE bDeviceProtol,

BYTE bMaxPacketSize0,

WORD idVenderI,

WORD idProduct,

WORD bcdDevice,

BYTE iManufacturer,

BYTE iProduct,

BYTE iSerialNumber,

BYTE iNumConfiguations

}USB\_DEVICE\_DESCRIPTOR;

bcdUSB : USB 规范发布号．表示了本设备能适用于那种协议，如2.0=0200，1.1=0110等．

bDeviceClass : 类型代码（由USB指定）。当它的值是0时，表示所有接口在配置描述符里，并且所有接口是独立的。当它的值是1到FEH时，表示不同的接口关联的。当它的值是FFH时，它是厂商自己定义的．

bDeviceSubClass : 子类型代码（由USB分配）．如果bDeviceClass值是0，一定要设置为0．其它情况就跟据USB-IF组织定义的编码．

bDeviceProtocol : 协议代码（由USB分配）．如果使用USB-IF组织定义的协议，就需要设置这里的值，否则直接设置为0。如果厂商自己定义的可以设置为FFH．

bMaxPacketSize0 : 端点０最大分组大小（只有8,16,32,64有效）．

idVendor : 供应商ID（由USB分配）．

idProduct : 产品ID（由厂商分配）．由供应商ID和产品ID，就可以让操作系统加载不同的驱动程序．

bcdDevice : 设备出产编码．由厂家自行设置．

iManufacturer : 厂商描述符字符串索引．索引到对应的字符串描述符． 为０则表示没有．

iProduct : :产品描述符字符串索引．同上．

iSerialNumber : 设备序列号字符串索引．同上．

bNumConfigurations : 可能的配置数．指配置字符串的个数

### 配置描述符：

配置描述符定义了设备的配置信息，一个设备可以有多个配置描述符

typedef struct \_USB\_CONFIGURATION\_DESCRIPTOR\_

{

BYTE bLength, //描述符大小．固定为0x09．

BYTE bDescriptorType, //配置描述符类型．固定为0x02

WORD wTotalLength,

BYTE bNumInterfaces,

BYTE bConfigurationValue,

BYTE iConfiguration,

BYTE bmAttributes,

BYTE MaxPower

}USB\_CONFIGURATION\_DESCRIPTOR;

wTotalLength : 返回整个数据的长度．指此配置返回的配置描述符，接口描述符以及端点描述符的全部大小．

bNumInterfaces : 配置所支持的接口数．指该配置配备的接口数量，也表示该配置下接口描述符数量．

bConfigurationValue : 作为Set Configuration的一个参数选择配置值．

iConfiguration : 用于描述该配置字符串描述符的索引．

bmAttributes : 供电模式选择．Bit4-0保留，D7:总线供电，D6:自供电，D5:远程唤醒．

MaxPower : 总线供电的USB设备的最大消耗电流．以2mA为单位．

### 接口描述符：

接口描述符说明了接口所提供的配置，一个配置所拥有的接口数量通过配置描述符的bNumInterfaces决定

typedef struct \_USB\_INTERFACE\_DESCRIPTOR\_

{

BYTE bLength, //描述符大小．固定为0x09

BYTE bDescriptorType, //接口描述符类型．固定为0x04

BYTE bInterfaceNumber,

BYTE bAlternateSetting,

BYTE bNumEndpoint,

BYTE bInterfaceClass,

BYTE bInterfaceSubClass,

BYTE bInterfaceProtocol,

BYTE iInterface

}USB\_INTERFACE\_DESCRIPTOR;

bInterfaceNumber: 该接口的编号．

bAlternateSetting : 用于为上一个字段选择可供替换的位置．即备用的接口描述符标号．

bNumEndpoint : 使用的端点数目．端点０除外．

bInterfaceClass : 类型代码（由USB分配）．

bInterfaceSubClass : 子类型代码（由USB分配）．

bInterfaceProtocol : 协议代码（由USB分配）．

iInterface : 字符串描述符的索引

### 端点描述符：

USB设备中的每个端点都有自己的端点描述符，由接口描述符中的bNumEndpoint决定其数量

typedef struct \_USB\_ENDPOINT\_DESCRIPTOR\_

{

BYTE bLength, //描述符大小．固定为0x07

BYTE bDescriptorType, //接口描述符类型．固定为0x05

BYTE bEndpointAddress,

BYTE bmAttributes,

WORD wMaxPacketSize,

BYTE bInterval

}USB\_ENDPOINT\_DESCRIPTOR;

bEndpointType : USB设备的端点地址．Bit7，方向，对于控制端点可以忽略，1/0:IN/OUT．Bit6-4，保留．BIt3-0：端点号．

bmAttributes : 端点属性．Bit7-2，保留．BIt1-0：00控制，01同步，02批量，03中断．

wMaxPacketSize : 本端点接收或发送的最大信息包大小．

bInterval : 轮训数据传送端点的时间间隔．对于批量传送和控制传送的端点忽略．对于同步传送的端点，必须为１，对于中断传送的端点，范围为１－２５５．

### 字符串描述符：

其中字符串描述符是可选的．如果不支持字符串描述符，其设备，配置，接口描述符内的所有字符串描述符索引都必须为０

typedef struct \_USB\_STRING\_DESCRIPTION\_

{

BYTE bLength,

BYTE bDescriptionType, //接口描述符类型．固定为0x03．

BYTE bString[1];

}USB\_STRING\_DESCRIPTION;

bLength : 描述符大小．由整个字符串的长度加上bLength和bDescriptorType的长度决定．

bString[1] : Unicode编码字符串．

## USB组合设备

USB复合设备(USB Compound Device) Compound Device内嵌Hub和多个Function，每个Function都相当于一个独立的USB外设，有自己的PID/VID。

USB组合设备(USB Composite Device)Composite Device内只有一个Function，只有一套PID/VID，通过将不同的interface定义为不同的类来实现多个功能的组合。

|  |
| --- |
| typedef struct \_USBInterfaceAssociationDescriptor {  BYTE bLength: 0x08 //描述符大小  **BYTE bDescriptorType: 0x0B //IAD描述符类型**  BYTE bFirstInterface: 0x00 //起始接口  BYTE bInterfaceCount: 0x02 //接口数  BYTE bFunctionClass: 0x0E //类型代码  BYTE bFunctionSubClass: 0x03 //子类型代码  BYTE bFunctionProtocol: 0x00 //协议代码  BYTE iFunction: 0x04 //描述字符串索引  } |
| Interface Association: ==============================USB复合设备  bLength 8  **bDescriptorType 11**  //IDA接口描述符  bFirstInterface 0 //起始接口  bInterfaceCount 2 //接口数  **bFunctionClass 14 Video**  //代码类型  bFunctionSubClass 3 Video Interface Collection //子代码类型  bFunctionProtocol 0 //协议代码  iFunction 5 Kingcome FHD Camera //描述字符串索引 |
| Interface Association:  bLength 8  **bDescriptorType 11**  bFirstInterface 2  bInterfaceCount 2  **bFunctionClass 1 Audio**  bFunctionSubClass 2 Streaming  bFunctionProtocol 0  iFunction 6 Realtek USB2.0 MIC |

## lsusb -d 2b7e:220f –v

可以通过Video Control描述符布局,分析出摄像头框架: IT(1)->PU(2)->XU(4)->OT(3)

可以通过Audio Control描述符布局,分析出MIC设备框架: **IT(1)->FU(3)->OT(2)**

### Device Descriptor: 设备描述符

**bDeviceProtocol** =1，表示USB为组合设备，组合设备的详细描述参见**Interface Association**

**bNumConfigurations=1，** 有1个Configuration Descriptor

|  |
| --- |
| Bus 001 Device 004: ID 2b7e:220f  Device Descriptor: =================Device  bLength 18  **bDescriptorType 1**  //设备描述符  bcdUSB 2.00  bDeviceClass 239 Miscellaneous Device  bDeviceSubClass 2 ?  **bDeviceProtocol 1 Interface Association** //表示存在IAD描述符: USB组合设备: Video & Audio  bMaxPacketSize0 64  **idVendor 0x2b7e**  **idProduct 0x220f**  bcdDevice 10.3a  iManufacturer 3 Kingcome  iProduct 1 KNC\_220F  iSerial 2 20170227  **bNumConfigurations 1**  //配置描述符总数 |

### Configuration Descriptor：配置描述符

**bNumInterfaces=4,** USB设备一共有4个Interface Descriptor

|  |
| --- |
| Configuration Descriptor: =================Configuration:1  {  bLength 9  **bDescriptorType 2**  //配置描述符  wTotalLength 1331  **bNumInterfaces 4**  //接口描述符总数  bConfigurationValue 1 //配置描述符编号  iConfiguration 4 USB Camera  bmAttributes 0x80  (Bus Powered)  MaxPower 500mA  } |

### Interface Association(IDA)： IAD描述符

Video占用2个Interface, 第一个interface序号为0

Audio占用2个Interface, 第一个interface序号为2

|  |
| --- |
| Interface Association: ==============================USB复合设备: Video  {  bLength 8  **bDescriptorType 11**  //IDA接口描述符  **bFirstInterface 0 //接口描述符起始编号**  **bInterfaceCount 2 //接口描述符总数**  **bFunctionClass 14 Video**  //接口描述符类型: Video  bFunctionSubClass 3 Video Interface Collection  bFunctionProtocol 0  iFunction 5 Kingcome FHD Camera  }  Interface Association: ==============================USB复合设备: Audio  {  bLength 8  **bDescriptorType 11**  **bFirstInterface 2**  **bInterfaceCount 2**  **bFunctionClass 1 Audio**  //接口描述符类型: Audio  bFunctionSubClass 2 Streaming  bFunctionProtocol 0  iFunction 6 Realtek USB2.0 MIC  } |

### Interface Descriptor：接口描述符

Interface 0: video control

Interface 1: video streaming

Interface 2: audio control

Interface 3: audio stream

|  |
| --- |
| Interface Descriptor:{  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 0 //接口描述符编号: 0**  bAlternateSetting 0 //接口描述符配置编号: 0  bNumEndpoints 1  **bInterfaceClass 14 Video**  **bInterfaceSubClass 1 Video Control**  bInterfaceProtocol 0  iInterface 5 Kingcome FHD Camera  }  Interface Descriptor: {  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 1**  bAlternateSetting 0  bNumEndpoints 0  **bInterfaceClass 14 Video**  **bInterfaceSubClass 2 Video Streaming**  bInterfaceProtocol 0  iInterface 0  }  Interface Descriptor:{  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 2**  bAlternateSetting 0  bNumEndpoints 0  **bInterfaceClass 1 Audio**  **bInterfaceSubClass 1 Control Device**  bInterfaceProtocol 0  iInterface 6 Realtek USB2.0 MIC  }  Interface Descriptor:{  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  bAlternateSetting 0  bNumEndpoints 0  **bInterfaceClass 1 Audio**  **bInterfaceSubClass 2 Streaming**  bInterfaceProtocol 0  iInterface 0  } |

#### Interface Descriptor 0: (bAlternateSetting 0) Video Control

可以通过Video Control描述符布局,分析出摄像头框架: IT(1)->PU(2)->XU(4)->OT(3)

|  |
| --- |
| Interface Descriptor:{  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 0**  bAlternateSetting 0  **bNumEndpoints 1**  **bInterfaceClass 14 Video**  **bInterfaceSubClass 1 Video Control**  bInterfaceProtocol 0  iInterface 5 Kingcome FHD Camera  } |

##### VideoControl: HEADER(freg.=15Hz)

|  |
| --- |
| VideoControl Interface Descriptor:{  bLength 13  **bDescriptorType 36**  **bDescriptorSubtype 1 (HEADER)**  bcdUVC 1.00  wTotalLength 78  **dwClockFrequency 15.000000MHz**  bInCollection 1  baInterfaceNr( 0) 1  } |

##### VideoControl: INPUT\_TERMINAL(bTerminalID=1)

|  |
| --- |
| VideoControl Interface Descriptor:{  bLength 18  **bDescriptorType 36**  **bDescriptorSubtype 2 (INPUT\_TERMINAL)**  **bTerminalID 1**  **wTerminalType 0x0201 Camera Sensor**  bAssocTerminal 0  iTerminal 0  wObjectiveFocalLengthMin 0  wObjectiveFocalLengthMax 0  wOcularFocalLength 0  bControlSize 3  **bmControls 0x0000000e**  Auto-Exposure Mode  Auto-Exposure Priority  Exposure Time (Absolute)  } |

##### VideoControl: PROCESSING\_UNIT(bSourceID=1，bUnitID=2)

|  |
| --- |
| VideoControl Interface Descriptor:{  bLength 11  **bDescriptorType 36**  **bDescriptorSubtype 5 (PROCESSING\_UNIT)**  Warning: Descriptor too short  **bUnitID 2**  **bSourceID 1**  wMaxMultiplier 0  bControlSize 2  **bmControls 0x0000157f**  Brightness  Contrast  Hue  Saturation  Sharpness  Gamma  White Balance Temperature  Backlight Compensation  Power Line Frequency  White Balance Temperature, Auto  iProcessing 0  bmVideoStandards 0x 9  None  SECAM - 625/50  } |

##### VideoControl: OUTPUT\_TERMINAL(bSourceID=4, bTerminalID=3)

|  |
| --- |
| VideoControl Interface Descriptor:{  bLength 9  **bDescriptorType 36**  **bDescriptorSubtype 3 (OUTPUT\_TERMINAL)**  **bTerminalID 3**  **wTerminalType 0x0101 USB Streaming**  bAssocTerminal 0  **bSourceID 4**  iTerminal 0  } |

##### VideoControl: EXTENSION\_UNIT(baSourceID( 0) =2, bUnitID=4)

|  |
| --- |
| VideoControl Interface Descriptor:{  bLength 27  **bDescriptorType 36**  **bDescriptorSubtype 6 (EXTENSION\_UNIT)**  **bUnitID 4**  guidExtensionCode {8ca72912-b447-9440-b0ce-db07386fb938}  bNumControl 2  bNrPins 1  **baSourceID( 0) 2**  bControlSize 2  bmControls( 0) 0x00  bmControls( 1) 0x06  iExtension 0  } |

##### Endpoint(Ep: addr=0x83, Interrupt, 1x16B)

|  |
| --- |
| Endpoint Descriptor:{  bLength 7  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x83** EP 3 IN  bmAttributes 3  **Transfer Type Interrupt**  Synch Type None  Usage Type Data  **wMaxPacketSize 0x0010 1x 16 bytes**  bInterval 6  } |

#### Interface Descriptor 1: (bAlternateSetting 0)

|  |
| --- |
| Interface Descriptor: {  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 1**  **bAlternateSetting 0**  **bNumEndpoints 0**  bInterfaceClass 14 Video  bInterfaceSubClass 2 Video Streaming  bInterfaceProtocol 0  iInterface 0  } |

##### VideoStreaming: INPUT\_HEADER

bNumFormats =2： 表示有2种format 【FORMAT\_MJPEG, FORMAT\_UNCOMPRESSED】

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 15  **bDescriptorType 36**  **bDescriptorSubtype 1 (INPUT\_HEADER)**  **bNumFormats 2**  wTotalLength 685  **bEndPointAddress 129**  bmInfo 0  bTerminalLink 3  bStillCaptureMethod 2  bTriggerSupport 1  bTriggerUsage 0  bControlSize 1  bmaControls( 0) 11  bmaControls( 1) 11  } |

##### VideoStreaming: FORMAT\_MJPEG

**bNumFrameDescriptors** =10： 当前format有10种分辨率 【FRAME\_MJPEG】

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 11  **bDescriptorType 36**  **bDescriptorSubtype 6 (FORMAT\_MJPEG)**  **bFormatIndex 1**  **bNumFrameDescriptors 10**  bFlags 1  Fixed-size samples: Yes  **bDefaultFrameIndex 1**  bAspectRatioX 0  bAspectRatioY 0  bmInterlaceFlags 0x00  Interlaced stream or variable: No  Fields per frame: 1 fields  Field 1 first: No  Field pattern: Field 1 only  bCopyProtect 0  } |

###### VideoStreaming: FRAME\_MJPEG(1920x1080)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 1**  bmCapabilities 0x00  Still image unsupported  **wWidth 1920**  **wHeight 1080**  dwMinBitRate 995328000  dwMaxBitRate 995328000  dwMaxVideoFrameBufferSize 4147200  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_MJPEG(352x288)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 2**  bmCapabilities 0x00  Still image unsupported  **wWidth 352**  **wHeight 288**  dwMinBitRate 48660480  dwMaxBitRate 48660480  dwMaxVideoFrameBufferSize 202752  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_MJPEG(320x240)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 3**  bmCapabilities 0x00  Still image unsupported  **wWidth 320**  **wHeight 240**  dwMinBitRate 36864000  dwMaxBitRate 36864000  dwMaxVideoFrameBufferSize 153600  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_MJPEG(176x144)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 4**  bmCapabilities 0x00  Still image unsupported  **wWidth 176**  **wHeight 144**  dwMinBitRate 12165120  dwMaxBitRate 12165120  dwMaxVideoFrameBufferSize 50688  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_MJPEG(160x120)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 5**  bmCapabilities 0x00  Still image unsupported  **wWidth 160**  **wHeight 120**  dwMinBitRate 9216000  dwMaxBitRate 9216000  dwMaxVideoFrameBufferSize 38400  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_MJPEG(640x480)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 6**  bmCapabilities 0x00  Still image unsupported  **wWidth 640**  **wHeight 480**  dwMinBitRate 147456000  dwMaxBitRate 147456000  dwMaxVideoFrameBufferSize 614400  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_MJPEG(800x600)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 7**  bmCapabilities 0x00  Still image unsupported  **wWidth 800**  **wHeight 600**  dwMinBitRate 230400000  dwMaxBitRate 230400000  dwMaxVideoFrameBufferSize 960000  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_MJPEG(1280x720)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 8**  bmCapabilities 0x00  Still image unsupported  **wWidth 1280**  **wHeight 720**  dwMinBitRate 442368000  dwMaxBitRate 442368000  dwMaxVideoFrameBufferSize 1843200  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_MJPEG(1280x1024)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 9**  bmCapabilities 0x00  Still image unsupported  **wWidth 1280**  **wHeight 1024**  dwMinBitRate 629145600  dwMaxBitRate 629145600  dwMaxVideoFrameBufferSize 2621440  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_MJPEG(1920x1080)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 7 (FRAME\_MJPEG)**  **bFrameIndex 10**  bmCapabilities 0x00  Still image unsupported  **wWidth 1920**  **wHeight 1080**  dwMinBitRate 995328000  dwMaxBitRate 995328000  dwMaxVideoFrameBufferSize 4147200  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: STILL\_IMAGE\_FRAME (静态图像帧)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 10  **bDescriptorType 36**  **bDescriptorSubtype 3 (STILL\_IMAGE\_FRAME)**  bEndpointAddress 0  bNumImageSizePatterns 1  **wWidth( 0) 1920**  **wHeight( 0) 1080**  bNumCompressionPatterns 1  } |

###### VideoStreaming: COLORFORMAT(颜色格式帧)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 6  **bDescriptorType 36**  **bDescriptorSubtype 13 (COLORFORMAT)**  bColorPrimaries 1 (BT.709,sRGB)  bTransferCharacteristics 1 (BT.709)  bMatrixCoefficients 4 (SMPTE 170M (BT.601))  } |

##### VideoStreaming: FORMAT\_UNCOMPRESSED

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 27  **bDescriptorType 36**  **bDescriptorSubtype 4 (FORMAT\_UNCOMPRESSED)**  **bFormatIndex 2**  **bNumFrameDescriptors 10**  guidFormat {59555932-0000-1000-8000-00aa00389b71}  bBitsPerPixel 16  bDefaultFrameIndex 1  bAspectRatioX 0  bAspectRatioY 0  bmInterlaceFlags 0x00  Interlaced stream or variable: No  Fields per frame: 2 fields  Field 1 first: No  Field pattern: Field 1 only  bCopyProtect 0  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(1920x1080)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 1**  bmCapabilities 0x00  Still image unsupported  **wWidth 1920**  **wHeight 1080**  dwMinBitRate 132710400  dwMaxBitRate 132710400  dwMaxVideoFrameBufferSize 4147200  dwDefaultFrameInterval 2500000  bFrameIntervalType 1  dwFrameInterval( 0) 2500000  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(352x288)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 2**  bmCapabilities 0x00  Still image unsupported  **wWidth 352**  **wHeight 288**  dwMinBitRate 48660480  dwMaxBitRate 48660480  dwMaxVideoFrameBufferSize 202752  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(320x244)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 3**  bmCapabilities 0x00  Still image unsupported  **wWidth 320**  **wHeight 240**  dwMinBitRate 36864000  dwMaxBitRate 36864000  dwMaxVideoFrameBufferSize 153600  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(176x144)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 4**  bmCapabilities 0x00  Still image unsupported  **wWidth 176**  **wHeight 144**  dwMinBitRate 12165120  dwMaxBitRate 12165120  dwMaxVideoFrameBufferSize 50688  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(160x120)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 5**  bmCapabilities 0x00  Still image unsupported  **wWidth 160**  **wHeight 120**  dwMinBitRate 9216000  dwMaxBitRate 9216000  dwMaxVideoFrameBufferSize 38400  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(640x480)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 6**  bmCapabilities 0x00  Still image unsupported  **wWidth 640**  **wHeight 480**  dwMinBitRate 147456000  dwMaxBitRate 147456000  dwMaxVideoFrameBufferSize 614400  dwDefaultFrameInterval 333333  bFrameIntervalType 1  dwFrameInterval( 0) 333333  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(800x600)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 7**  bmCapabilities 0x00  Still image unsupported  **wWidth 800**  **wHeight 600**  dwMinBitRate 153600000  dwMaxBitRate 153600000  dwMaxVideoFrameBufferSize 960000  dwDefaultFrameInterval 500000  bFrameIntervalType 1  dwFrameInterval( 0) 500000  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(1280x720)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 8**  bmCapabilities 0x00  Still image unsupported  **wWidth 1280**  **wHeight 720**  dwMinBitRate 147456000  dwMaxBitRate 147456000  dwMaxVideoFrameBufferSize 1843200  dwDefaultFrameInterval 1000000  bFrameIntervalType 1  dwFrameInterval( 0) 1000000  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(1280x1024)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 9**  bmCapabilities 0x00  Still image unsupported  **wWidth 1280**  **wHeight 1024**  dwMinBitRate 104857600  dwMaxBitRate 104857600  dwMaxVideoFrameBufferSize 2621440  dwDefaultFrameInterval 2000000  bFrameIntervalType 1  dwFrameInterval( 0) 2000000  } |

###### VideoStreaming: FRAME\_UNCOMPRESSED(1920x1080)

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 30  **bDescriptorType 36**  **bDescriptorSubtype 5 (FRAME\_UNCOMPRESSED)**  **bFrameIndex 10**  bmCapabilities 0x00  Still image unsupported  **wWidth 1920**  **wHeight 1080**  dwMinBitRate 132710400  dwMaxBitRate 132710400  dwMaxVideoFrameBufferSize 4147200  dwDefaultFrameInterval 2500000  bFrameIntervalType 1  dwFrameInterval( 0) 2500000  } |

###### VideoStreaming: STILL\_IMAGE\_FRAME

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 10  **bDescriptorType 36**  **bDescriptorSubtype 3 (STILL\_IMAGE\_FRAME)**  bEndpointAddress 0  bNumImageSizePatterns 1  **wWidth( 0) 1920**  **wHeight( 0) 1080**  bNumCompressionPatterns 1  } |

###### VideoStreaming: COLORFORMAT

|  |
| --- |
| VideoStreaming Interface Descriptor:{  bLength 6  **bDescriptorType 36**  **bDescriptorSubtype 13 (COLORFORMAT)**  bColorPrimaries 1 (BT.709,sRGB)  bTransferCharacteristics 1 (BT.709)  bMatrixCoefficients 4 (SMPTE 170M (BT.601))  } |

#### Interface Descriptor 1: (bAlternateSetting 1) (Ep: addr=0x81, Isoc, 1x128B)

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 1**  **bAlternateSetting 1**  **bNumEndpoints 1**  bInterfaceClass 14 Video  bInterfaceSubClass 2 Video Streaming  bInterfaceProtocol 0  iInterface 0  Endpoint Descriptor:{  bLength 7  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x81** EP 1 IN  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x0080 1x 128 bytes**  bInterval 1 |

#### Interface Descriptor 1: (bAlternateSetting 2) (Ep: addr=0x81, Isoc, 1x512B)

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 1**  **bAlternateSetting 2**  **bNumEndpoints 1**  bInterfaceClass 14 Video  bInterfaceSubClass 2 Video Streaming  bInterfaceProtocol 0  iInterface 0  Endpoint Descriptor:{  bLength 7  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x81 EP 1 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x0200 1x 512 bytes**  bInterval 1 |

#### Interface Descriptor 1: (bAlternateSetting 3) (Ep: addr=0x81, Isoc, 1x1024B)

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 1**  **bAlternateSetting 3**  **bNumEndpoints 1**  bInterfaceClass 14 Video  bInterfaceSubClass 2 Video Streaming  bInterfaceProtocol 0  iInterface 0  Endpoint Descriptor:{  bLength 7  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x81 EP 1 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x0400 1x 1024 bytes**  bInterval 1 |

#### Interface Descriptor 1: (bAlternateSetting 4) (Ep: addr=0x81, Isoc, 2x768B)

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 1**  **bAlternateSetting 4**  **bNumEndpoints 1**  bInterfaceClass 14 Video  bInterfaceSubClass 2 Video Streaming  bInterfaceProtocol 0  iInterface 0  Endpoint Descriptor:{  bLength 7  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x81 EP 1 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x0b00 2x 768 bytes**  bInterval 1 |

#### Interface Descriptor 1: (bAlternateSetting 5) (Ep: addr=0x81, Isoc, 2x1024B)

对于音频跟视频这种同步传输方式，在2.0协议中，端点大小最大可以是1024，但D11~D12表示这个端点在一个Interval间隔中可以传输n次，所以在视频类中可以看到端点包大小有2x1024这样的格式。

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 1**  **bAlternateSetting 5**  **bNumEndpoints 1**  bInterfaceClass 14 Video  bInterfaceSubClass 2 Video Streaming  bInterfaceProtocol 0  iInterface 0  Endpoint Descriptor:{  bLength 7  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x81 EP 1 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x0c00 2x 1024 bytes**  bInterval 1 |

#### Interface Descriptor 1: (bAlternateSetting 6) (Ep: addr=0x81, Isoc, 3x896B)

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 1**  **bAlternateSetting 6**  **bNumEndpoints 1**  bInterfaceClass 14 Video  bInterfaceSubClass 2 Video Streaming  bInterfaceProtocol 0  iInterface 0  Endpoint Descriptor:{  bLength 7  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x81 EP 1 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x1380 3x 896 bytes**  bInterval 1 |

#### Interface Descriptor 1: (bAlternateSetting 7) (Ep: addr=0x81, Isoc, 3x1024B)

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 1**  **bAlternateSetting 7**  **bNumEndpoints 1**  bInterfaceClass 14 Video  bInterfaceSubClass 2 Video Streaming  bInterfaceProtocol 0  iInterface 0  Endpoint Descriptor:{  bLength 7  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x81 EP 1 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x1400 3x 1024 bytes**  bInterval 1 |

#### Interface Descriptor 2: (bAlternateSetting 0) Audio Control

可以通过Audio Control描述符布局,分析出MIC设备框架: **IT(1)->FU(3)->OT(2)**

|  |
| --- |
| Interface Descriptor:{  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 2**  **bAlternateSetting 0**  **bNumEndpoints 0**  **bInterfaceClass 1 Audio**  **bInterfaceSubClass 1 Control Device**  bInterfaceProtocol 0  iInterface 6 Realtek USB2.0 MIC  } |

##### AudioControl: HEADER

|  |
| --- |
| AudioControl Interface Descriptor:{  bLength 9  **bDescriptorType 36**  **bDescriptorSubtype 1 (HEADER)**  bcdADC 1.00  wTotalLength 39  bInCollection 1  baInterfaceNr( 0) 3  } |

##### AudioControl: INPUT\_TERMINAL(bTerminalID=1)

|  |
| --- |
| AudioControl Interface Descriptor:{  bLength 12  **bDescriptorType 36**  **bDescriptorSubtype 2 (INPUT\_TERMINAL)**  **bTerminalID 1**  **wTerminalType 0x0201 Microphone**  bAssocTerminal 0  **bNrChannels 1**  wChannelConfig 0x0003  Left Front (L)  Right Front (R)  iChannelNames 0  iTerminal 0  } |

##### AudioControl: OUTPUT\_TERMINAL(bSourceID=3, bTerminalID=2)

|  |
| --- |
| AudioControl Interface Descriptor:{  bLength 9  **bDescriptorType 36**  **bDescriptorSubtype 3 (OUTPUT\_TERMINAL)**  **bTerminalID 2**  **wTerminalType 0x0101 USB Streaming**  bAssocTerminal 1  **bSourceID 3**  iTerminal 0  } |

##### AudioControl: FEATURE\_UNIT(bSourceID=1, bUnitID=3)

|  |
| --- |
| AudioControl Interface Descriptor:{  bLength 9  **bDescriptorType 36**  **bDescriptorSubtype 6 (FEATURE\_UNIT)**  **bUnitID 3**  **bSourceID 1**  bControlSize 2  bmaControls( 0) 0x03  **bmaControls( 0) 0x02**  Mute Control  Volume Control  Loudness Control  iFeature 0  } |

#### Interface Descriptor 3: (bAlternateSetting 0)

|  |
| --- |
| Interface Descriptor:{  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  **bAlternateSetting 0**  **bNumEndpoints 0**  bInterfaceClass 1 Audio  bInterfaceSubClass 2 Streaming  bInterfaceProtocol 0  iInterface 0  } |

#### Interface Descriptor 3: (bAlternateSetting 1) (Ep: addr=0x82, Isoc, 1x120B, 22050)

Sample rate: 2chn \* 16bit 🡪 22050, PCM

|  |
| --- |
| Interface Descriptor:  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  **bAlternateSetting 1**  **bNumEndpoints 1**  bInterfaceClass 1 Audio  bInterfaceSubClass 2 Streaming  bInterfaceProtocol 0  iInterface 0  AudioStreaming Interface Descriptor:  bLength 7  **bDescriptorType 36**  bDescriptorSubtype 1 (AS\_GENERAL)  bTerminalLink 2  bDelay 1 frames  **wFormatTag 1 PCM**  AudioStreaming Interface Descriptor:  bLength 11  **bDescriptorType 36**  bDescriptorSubtype 2 (FORMAT\_TYPE)  bFormatType 1 (FORMAT\_TYPE\_I)  **bNrChannels 2**  bSubframeSize 2  **bBitResolution 16**  bSamFreqType 1 Discrete  **tSamFreq[ 0] 22050**  Endpoint Descriptor:  bLength 9  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x82 EP 2 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x0078 1x 120 bytes**  bInterval 4  bRefresh 0  bSynchAddress 0  AudioControl Endpoint Descriptor: … |

#### Interface Descriptor 3: (bAlternateSetting 2) (Ep: addr=0x82, Isoc, 1x160B, 32000)

Sample rate: 2chn \* 16bit 🡪 32000, PCM

|  |
| --- |
| Interface Descriptor:  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  **bAlternateSetting 2**  **bNumEndpoints 1**  AudioStreaming Interface Descriptor:  **bDescriptorType 36**  bDescriptorSubtype 1 (AS\_GENERAL)  bTerminalLink 2  bDelay 1 frames  **wFormatTag 1 PCM**  AudioStreaming Interface Descriptor:  **bDescriptorType 36**  bDescriptorSubtype 2 (FORMAT\_TYPE)  bFormatType 1 (FORMAT\_TYPE\_I)  **bNrChannels 2**  bSubframeSize 2  **bBitResolution 16**  bSamFreqType 1 Discrete  **tSamFreq[ 0] 32000**  Endpoint Descriptor:  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x82 EP 2 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x00a0 1x 160 bytes**  bInterval 4 |

#### Interface Descriptor 3: (bAlternateSetting 3) (Ep: addr=0x82, Isoc, 1x216B, 48000)

Sample rate: 1chn \* 16bit 🡪 48000, PCM

|  |
| --- |
| Interface Descriptor:  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  **bAlternateSetting 3**  **bNumEndpoints 1**  bInterfaceClass 1 Audio  bInterfaceSubClass 2 Streaming  AudioStreaming Interface Descriptor:  **bDescriptorType 36**  bDescriptorSubtype 1 (AS\_GENERAL)  bTerminalLink 2  bDelay 1 frames  **wFormatTag 1 PCM**  AudioStreaming Interface Descriptor:  **bDescriptorType 36**  bDescriptorSubtype 2 (FORMAT\_TYPE)  bFormatType 1 (FORMAT\_TYPE\_I)  **bNrChannels 1**  bSubframeSize 2  **bBitResolution 16**  bSamFreqType 1 Discrete  **tSamFreq[ 0] 48000**  Endpoint Descriptor:  bLength 9  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x82 EP 2 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x00d8 1x 216 bytes**  bInterval 4 |

#### Interface Descriptor 3: (bAlternateSetting 4) (Ep: addr=0x82, Isoc, 1x216B, 48000)

Sample rate: 2chn \* 16bit 🡪 48000, PCM

|  |
| --- |
| Interface Descriptor:  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  **bAlternateSetting 4**  **bNumEndpoints 1**  bInterfaceClass 1 Audio  bInterfaceSubClass 2 Streaming  AudioStreaming Interface Descriptor:  **bDescriptorType 36**  bDescriptorSubtype 1 (AS\_GENERAL)  bTerminalLink 2  bDelay 1 frames  **wFormatTag 1 PCM**  AudioStreaming Interface Descriptor:  **bDescriptorType 36**  bDescriptorSubtype 2 (FORMAT\_TYPE)  bFormatType 1 (FORMAT\_TYPE\_I)  **bNrChannels 2**  bSubframeSize 2  **bBitResolution 16**  bSamFreqType 1 Discrete  **tSamFreq[ 0] 48000**  Endpoint Descriptor:  bLength 9  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x82 EP 2 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x00d8 1x 216 bytes**  bInterval 4 |

#### Interface Descriptor 3: (bAlternateSetting 5) (Ep: addr=0x82, Isoc, 1x432B, 96000)

Sample rate: 2chn \* 16bit 🡪 96000, PCM

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  **bAlternateSetting 5**  bNumEndpoints 1  bInterfaceClass 1 Audio  bInterfaceSubClass 2 Streaming  AudioStreaming Interface Descriptor:  bLength 7  **bDescriptorType 36**  bDescriptorSubtype 1 (AS\_GENERAL)  bTerminalLink 2  bDelay 1 frames  **wFormatTag 1 PCM**  AudioStreaming Interface Descriptor:  bLength 11  **bDescriptorType 36**  bDescriptorSubtype 2 (FORMAT\_TYPE)  bFormatType 1 (FORMAT\_TYPE\_I)  **bNrChannels 2**  bSubframeSize 2  **bBitResolution 16**  bSamFreqType 1 Discrete  **tSamFreq[ 0] 96000**  Endpoint Descriptor:  bLength 9  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x82 EP 2 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x01b0 1x 432 bytes**  bInterval 4 |

#### Interface Descriptor 3: (bAlternateSetting 6) (Ep: addr=0x82, Isoc, 1x304B, 44100)

Sample rate: 2chn \* 24bit 🡪 44100, PCM

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  **bAlternateSetting 6**  bNumEndpoints 1  bInterfaceClass 1 Audio  bInterfaceSubClass 2 Streaming  bInterfaceProtocol 0  iInterface 0  AudioStreaming Interface Descriptor:  bLength 7  **bDescriptorType 36**  bDescriptorSubtype 1 (AS\_GENERAL)  bTerminalLink 2  bDelay 1 frames  **wFormatTag 1 PCM**  AudioStreaming Interface Descriptor:  bLength 11  **bDescriptorType 36**  bDescriptorSubtype 2 (FORMAT\_TYPE)  bFormatType 1 (FORMAT\_TYPE\_I)  **bNrChannels 2**  bSubframeSize 3  **bBitResolution 24**  bSamFreqType 1 Discrete  **tSamFreq[ 0] 44100**  Endpoint Descriptor:  bLength 9  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x82 EP 2 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x0130 1x 304 bytes**  bInterval 4 |

#### Interface Descriptor 3: (bAlternateSetting 7) (Ep: addr=0x82, Isoc, 1x336B, 48000)

Sample rate: 2chn \* 24bit 🡪 48000, PCM

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  **bAlternateSetting 7**  bNumEndpoints 1  bInterfaceClass 1 Audio  bInterfaceSubClass 2 Streaming  AudioStreaming Interface Descriptor:  bLength 7  **bDescriptorType 36**  bDescriptorSubtype 1 (AS\_GENERAL)  bTerminalLink 2  bDelay 1 frames  **wFormatTag 1 PCM**  AudioStreaming Interface Descriptor:  bLength 11  **bDescriptorType 36**  bDescriptorSubtype 2 (FORMAT\_TYPE)  bFormatType 1 (FORMAT\_TYPE\_I)  **bNrChannels 2**  bSubframeSize 3  **bBitResolution 24**  bSamFreqType 1 Discrete  **tSamFreq[ 0] 48000**  Endpoint Descriptor:  bLength 9  **bDescriptorType 5**  //端点描述符  bEndpointAddress 0x82 EP 2 IN  bmAttributes 5  Transfer Type Isochronous  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x0150 1x 336 bytes** |

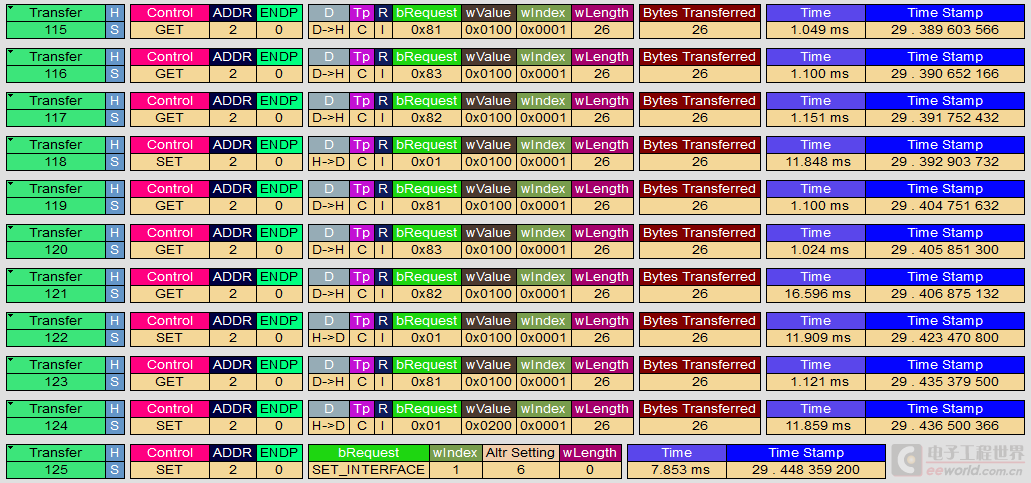
#### Interface Descriptor 3: (bAlternateSetting 8) (Ep: addr=0x82, Isoc, 1x656B, 96000 )

Sample rate: 2chn \* 24bit 🡪 96000, PCM

|  |
| --- |
| Interface Descriptor:  bLength 9  **bDescriptorType 4**  //接口描述符  **bInterfaceNumber 3**  **bAlternateSetting 8**  bNumEndpoints 1  bInterfaceClass 1 Audio  bInterfaceSubClass 2 Streaming  AudioStreaming Interface Descriptor:  bLength 7  **bDescriptorType 36**  bDescriptorSubtype 1 (AS\_GENERAL)  bTerminalLink 2  bDelay 1 frames  **wFormatTag 1 PCM**  AudioStreaming Interface Descriptor:  bLength 11  **bDescriptorType 36**  bDescriptorSubtype 2 (FORMAT\_TYPE)  bFormatType 1 (FORMAT\_TYPE\_I)  **bNrChannels 2**  bSubframeSize 3  **bBitResolution 24**  bSamFreqType 1 Discrete  **tSamFreq[ 0] 96000**  Endpoint Descriptor:  bLength 9  **bDescriptorType 5**  //端点描述符  **bEndpointAddress 0x82 EP 2 IN**  bmAttributes 5  **Transfer Type Isochronous**  Synch Type Asynchronous  Usage Type Data  **wMaxPacketSize 0x0290 1x 656 bytes**  bInterval 4 |

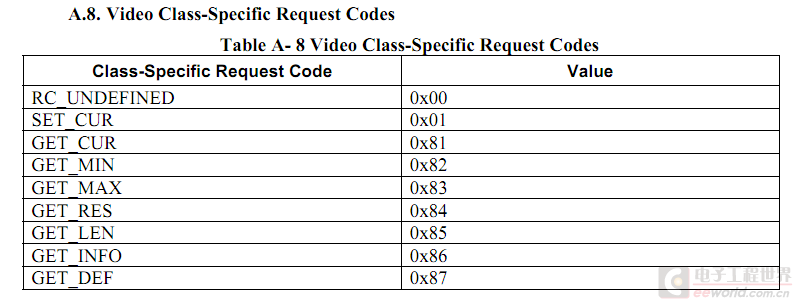
# USB枚举过程

系统对视频流接口的参数进行了probe和commit两种操作，先通过probe进行参数协商，最后commit激活。



## bRequest意义参考此表

整个流程中使用了GET\_CUR,GET\_MIN,GET\_MAX以及SET\_CUR四种请求



## wIndex

wIndex都是0x0001，即指定了entity0及interface1。由配置描述符可知interface1为VideoStreaming

## wValue

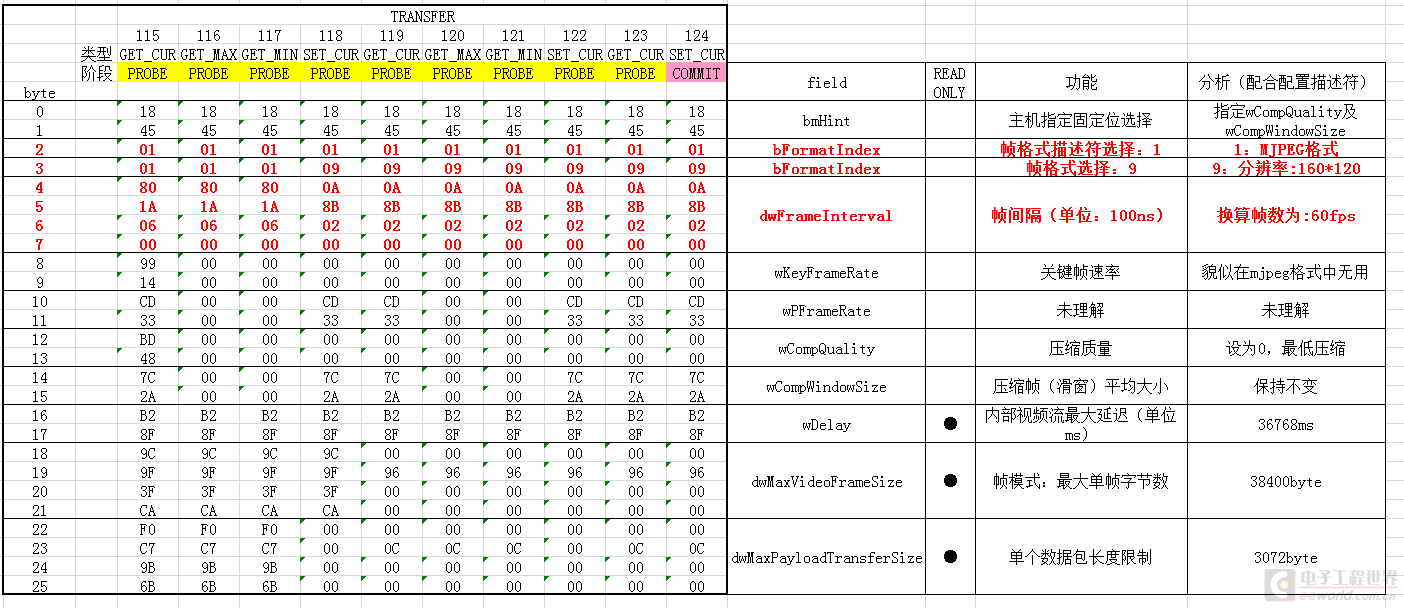
wValue是选择控制器，除一个0x0200外，都是0x0100

## wLength

wLength指定附件参数长度，都是26

## data

关于data中26字节数据的分析，请看下表



# USB协议分类

## USB Device Requests：8bytes

**bmRequestType** : 1Byte, Characteristics of request:

**bRequest** : 1Byte, Specific request (refer to Table 9-3)

**wValue** : 2Byte, Word-sized field that varies according to request

**wIndex**: 2Byte,Word-sized field that varies according to request; typically used to pass an index or offset

**wLength**: 2Byte, Number of bytes to transfer if there is a Data stage

**bmRequestType：**

80 06 00 01 00 00 12 00 ==》 80 : Device-to-host | Standard | Device //Get Descriptor

00 09 01 00 00 00 00 00 ==》 00 : Host-to-device | Standard | Device //Set Config

01 0B 00 00 01 00 00 00 ==》 01 : Host-to-device | Standard | Interface //Set Interface

A1 86 00 04 00 01 01 00 ==》 A1 : Host-to-device | Class | Interface //Get Class Interface

### bmRequestType

D7: Data transfer direction

0 = Host-to-device //Set

1 = Device-to-host //Get

D6...5: Type

0 = Standard

1 = Class

2 = Vendor

3 = Reserved

D4...0: Recipient

0 = Device

1 = Interface

2 = Endpoint

3 = Other

4...31 = Reserved

### bRequest：Standrad

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| bmRequestType(1) | bRequest(1) | wValue(2) | wIndex(2) | wLength(2) | Data(2) |
| 0x00  0x01  0x02 | CLEAR\_FEATURE(0x01) | Feature Selector | Zero Interface Endpoint | 0x0000 | None |
| 0x80  0x81  0x02 | GET\_STATUS(0x00) | 0x0000 | Zero Interface Endpoint | 0x0002 | Device, Interface, or Endpoint Status |
| 0x00  0x01  0x02 | SET\_FEATURE(0x03) | **Feature Selector** | Zero Interface Endpoint | 0x0000 | None |
| 0x82 | SYNCH\_FRAME(0x0C) | 0x0000 | Endpoint | 0x0002 | Frame Number |
| 0x00 | SET\_ADDRESS(0x05) | Device Address | 0x0000 | 0x0000 | None |
| 0x80 | GET\_CONFIGURATION(0x08) | 0x0000 | 0x0000 | 0x0001 | Configuration Value |
| 0x00 | SET\_CONFIGURATION(0x09) | Configuration Value | 0x0000 | 0x0000 | None |
| 0x81 | GET\_INTERFACE(0x0A) | 0x0000 | Interface | 0x0001 | Alternate Interface |
| 0x01 | SET\_INTERFACE(0x0B) | Alternate Setting | Interface | 0x0000 | None |
| 0x80 | GET\_DESCRIPTOR(0x06) | **Descriptor Type** and Descriptor Index | 0x0000 or Language ID | Descriptor Length | Descriptor |
| 0x00 | SET\_DESCRIPTOR(0x07) | Descriptor Type and Descriptor Index | 0x0000 or Language ID | Descriptor Length | Descriptor |

### bRequest：Class-Specific

wValue: specifies the Control Selector (CS) in the high byte, and the low byte must be

set to zero.

wIndex: specifies the interface or endpoint to be addressed in the low byte, and the

entity ID or zero in the high byte.

ctrl->wIndex & 0xff :

= UVC\_INTF\_CONTROL = 0

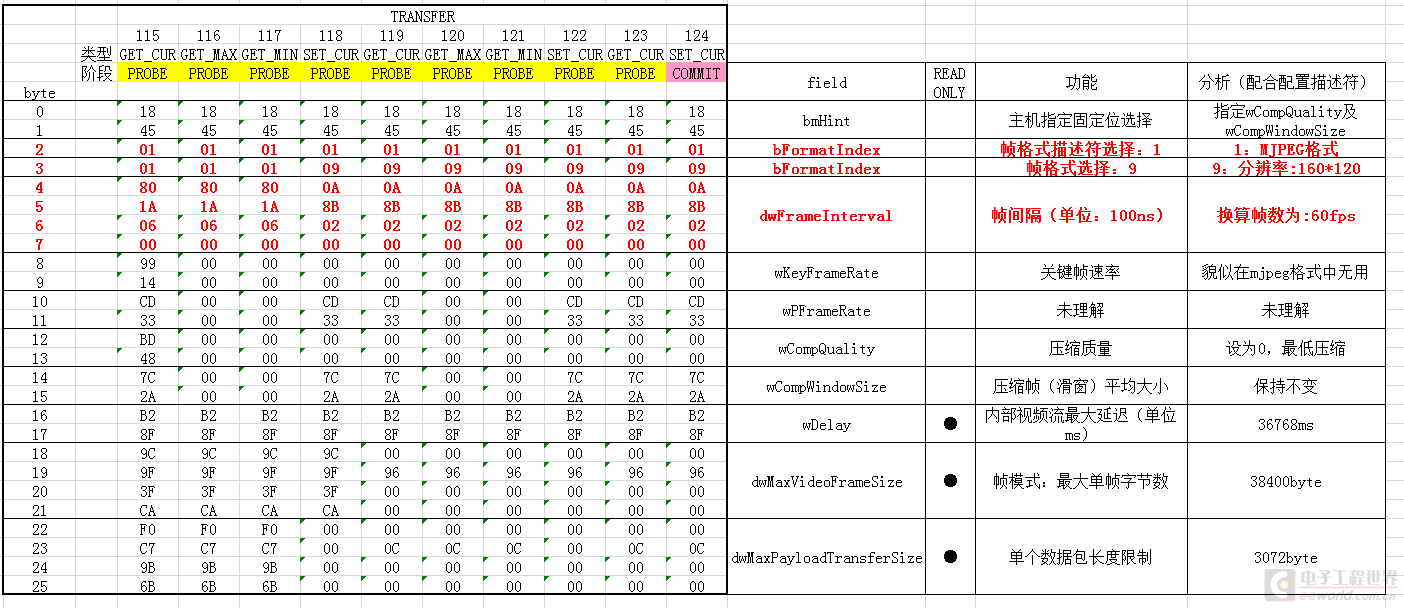
= UVC\_INTF\_STREAMING = 1

#### VideoControl Requests

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| bmRequestType(1) | bRequest(1) | wValue(2) | wIndex(2) | wLength(2) | Data(2) |
| 0x21 | SET\_CUR (0x01) | CS | Entity ID and Interface  wIndex & 0xff = 0 | Length of parameter block | Parameter block. |
| 0xA1 | GET\_CUR(0x81)  GET\_MIN(0x82)  GET\_MAX(0x83)  GET\_RES(0x84)  GET\_LEN(0x85)  GET\_INFO(0x86)  GET\_DEF(0x87) | CS | Entity ID and Interface  wIndex & 0xff = 0 | Length of parameter block | Parameter block. |

#### VideoStreaming Requests

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| bmRequestType(1) | bRequest(1) | wValue(2) | wIndex(2) | wLength(2) | Data(2) |
| 0x21 | SET\_CUR (0x01) | CS | Zero and Interface  wIndex & 0xff = 1 | Length of parameter block | Parameter block. |
| 0xA1 | GET\_CUR(0x81)  GET\_MIN(0x82)  GET\_MAX(0x83)  GET\_RES(0x84)  GET\_LEN(0x85)  GET\_INFO(0x86)  GET\_DEF(0x87) | CS | Zero and Interface  wIndex & 0xff = 1 | Length of parameter block | Parameter block. |



#### CS

**VideoControl Interface Control Selectors**

VC \_CONTROL\_ UNDEFINED 0x00

VC\_VIDEO\_POWER\_MODE\_CONTROL 0x01

VC\_REQUEST\_ERROR\_CODE\_CONTROL 0x02

Reserved 0x03

Terminal Control Selectors

TE\_CONTROL\_UNDEFINED 0x00

Selector Unit Control Selectors

SU\_CONTROL\_UNDEFINED 0x00

SU\_INPUT\_SELECT\_CONTROL 0x01

Camera Terminal Control Selectors

CT\_CONTROL\_UNDEFINED 0x00

CT\_SCANNING\_MODE\_CONTROL 0x01

CT\_AE\_MODE\_CONTROL 0x02

CT\_AE\_PRIORITY\_CONTROL 0x03

CT\_EXPOSURE\_TIME\_ABSOLUTE\_CONTROL 0x04

CT\_EXPOSURE\_TIME\_RELATIVE\_CONTROL 0x05

CT\_FOCUS\_ABSOLUTE\_CONTROL 0x06

CT\_FOCUS\_RELATIVE\_CONTROL 0x07

CT\_FOCUS\_AUTO\_CONTROL 0x08

CT\_IRIS\_ABSOLUTE\_CONTROL 0x09

CT\_IRIS\_RELATIVE\_CONTROL 0x0A

CT\_ZOOM\_ABSOLUTE\_CONTROL 0x0B

CT\_ZOOM\_RELATIVE\_CONTROL 0x0C

CT\_PANTILT\_ABSOLUTE\_CONTROL 0x0D

CT\_PANTILT\_RELATIVE\_CONTROL 0x0E

CT\_ROLL\_ABSOLUTE\_CONTROL 0x0F

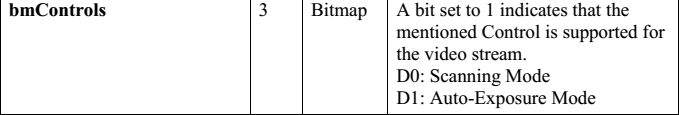
CT\_ROLL\_RELATIVE\_CONTROL 0x10

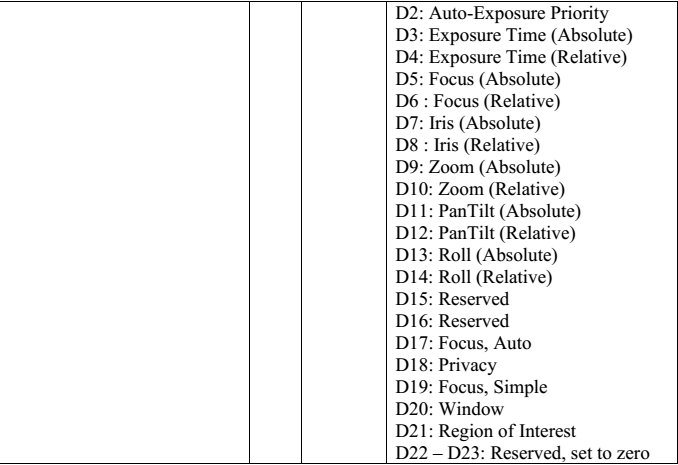
CT\_PRIVACY\_CONTROL 0x11

CT\_FOCUS\_SIMPLE\_CONTROL 0x12

CT\_WINDOW\_CONTROL 0x13

CT\_REGION\_OF\_INTEREST\_CONTROL 0x14





Processing Unit Control Selectors

PU\_CONTROL\_UNDEFINED 0x00

PU\_BACKLIGHT\_COMPENSATION\_CONTROL 0x01

PU\_BRIGHTNESS\_CONTROL 0x02

PU\_CONTRAST\_CONTROL 0x03

PU\_GAIN\_CONTROL 0x04

PU\_POWER\_LINE\_FREQUENCY\_CONTROL 0x05

PU\_HUE\_CONTROL 0x06

PU\_SATURATION\_CONTROL 0x07

PU\_SHARPNESS\_CONTROL 0x08

PU\_GAMMA\_CONTROL 0x09

PU\_WHITE\_BALANCE\_TEMPERATURE\_CONTROL 0x0A

PU\_WHITE\_BALANCE\_TEMPERATURE\_AUTO\_CONTROL 0x0B

PU\_WHITE\_BALANCE\_COMPONENT\_CONTROL 0x0C

PU\_WHITE\_BALANCE\_COMPONENT\_AUTO\_CONTROL 0x0D

PU\_DIGITAL\_MULTIPLIER\_CONTROL 0x0E

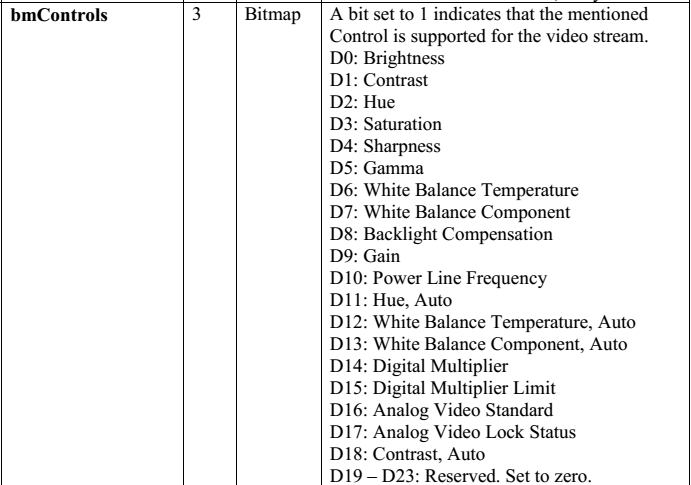
PU\_DIGITAL\_MULTIPLIER\_LIMIT\_CONTROL 0x0F

PU\_HUE\_AUTO\_CONTROL 0x10

PU\_ANALOG\_VIDEO\_STANDARD\_CONTROL 0x11

PU\_ANALOG\_LOCK\_STATUS\_CONTROL 0x12

PU\_CONTRAST\_AUTO\_CONTROL 0x13



Encoding Unit Control Selectors

EU\_CONTROL\_UNDEFINED 0x00

EU\_SELECT\_LAYER\_CONTROL 0x01

EU\_PROFILE\_TOOLSET\_CONTROL 0x02

EU\_VIDEO\_RESOLUTION\_CONTROL 0x03

EU\_ MIN\_FRAME\_INTERVAL\_CONTROL 0x04

EU\_ SLICE\_MODE\_CONTROL 0x05

EU\_RATE\_CONTROL\_MODE\_CONTROL 0x06

EU\_AVERAGE\_BITRATE\_CONTROL 0x07

EU\_CPB\_SIZE\_CONTROL 0x08

EU\_PEAK\_BIT\_RATE\_CONTROL 0x09

EU\_QUANTIZATION\_PARAMS\_CONTROL 0x0A

EU\_SYNC\_REF\_FRAME\_CONTROL 0x0B

EU\_LTR\_BUFFER\_ CONTROL 0x0C

EU\_LTR\_PICTURE\_CONTROL 0x0D

EU\_LTR\_VALIDATION\_CONTROL 0x0E

EU\_LEVEL\_IDC\_LIMIT\_CONTROL 0x0F

EU\_SEI\_PAYLOADTYPE\_CONTROL 0x10

EU\_QP\_RANGE\_CONTROL 0x11

EU\_PRIORITY\_CONTROL 0x12

EU\_START\_OR\_STOP\_LAYER\_CONTROL 0x 13

EU\_ERROR\_RESILIENCY\_CONTROL 0x14

Extension Unit Control Selectors

XU\_CONTROL\_UNDEFINED 0x00

VideoStreaming Interface Control Selectors

VS\_CONTROL\_UNDEFINED 0x00

VS\_PROBE\_CONTROL 0x01

VS\_COMMIT\_CONTROL 0x02

VS\_STILL\_PROBE\_CONTROL 0x03

VS\_STILL\_COMMIT\_CONTROL 0x04

VS\_STILL\_IMAGE\_TRIGGER\_CONTROL 0x05

VS\_STREAM\_ERROR\_CODE\_CONTROL 0x06

VS\_GENERATE\_KEY\_FRAME\_CONTROL 0x07

VS\_UPDATE\_FRAME\_SEGMENT\_CONTROL 0x08

VS\_SYNCH\_DELAY\_CONTROL 0x09

#### GET\_INFO

**the wLength field shall always be set to a value of 1 byte.**

**wData:**

Bit field Description Bit State

D0 : 1=Supports GET value requests //Capability

D1 : 1=Supports SET value requests //Capability

D2 : 1=Disabled due to automatic mode (underdevice control) //State

D3 : 1= Autoupdate Control //Capability

D4 : 1= Asynchronous Control //Capability

D5 : 1= Disabled due to incompatibility with Commit state. //State

D7..D6 Reserved (Set to 0) --

### wValue ：Descriptor Types

DEVICE 1

CONFIGURATION 2

STRING 3

INTERFACE 4

ENDPOINT 5

DEVICE\_QUALIFIER 6

OTHER\_SPEED\_CONFIGURATION 7

INTERFACE\_POWER1 8

### Standard Feature Selectors

Feature Selector Recipient Value

DEVICE\_REMOTE\_WAKEUP Device 1

ENDPOINT\_HALT Endpoint 0

TEST\_MODE Device 2

## UVC Control

### uvc\_camera\_terminal

static const struct uvc\_camera\_terminal\_descriptor uvc\_camera\_terminal = {

.bLength = UVC\_DT\_CAMERA\_TERMINAL\_SIZE(3),

.bDescriptorType = USB\_DT\_CS\_INTERFACE,

.bDescriptorSubType = UVC\_VC\_INPUT\_TERMINAL,

**.bTerminalID = 1, //wIndex**

.wTerminalType = cpu\_to\_le16(0x0201),

.bAssocTerminal = 0,

.iTerminal = 0,

.wObjectiveFocalLengthMin = cpu\_to\_le16(0),

.wObjectiveFocalLengthMax = cpu\_to\_le16(0),

.wOcularFocalLength = cpu\_to\_le16(0),

.bControlSize = 3,

.bmControls[0] = 2,

.bmControls[1] = 0,

.bmControls[2] = 0,

};

#### bmControls：

D0: Scanning Mode

D1: Auto-Exposure Mode

D2: Auto-Exposure Priority

D3: Exposure Time (Absolute)

D4: Exposure Time (Relative)

D5: Focus (Absolute)

D6 : Focus (Relative)

D7: Iris (Absolute)

D8 : Iris (Relative)

D9: Zoom (Absolute)

D10: Zoom (Relative)

D11: PanTilt (Absolute)

D12: PanTilt (Relative)

D13: Roll (Absolute)

D14: Roll (Relative)

D15: Reserved

D16: Reserved

D17: Focus, Auto

D18: Privacy

D19: Focus, Simple

D20: Window

D21: Region of Interest

D22 – D23: Reserved, set to zero

#### wIndex

**.bTerminalID = 1, //wIndex**

#### wValue

/\* A.9.4. Camera Terminal Control Selectors \*/

#define UVC\_CT\_CONTROL\_UNDEFINED 0x00

#define UVC\_CT\_SCANNING\_MODE\_CONTROL 0x01

#define UVC\_CT\_AE\_MODE\_CONTROL 0x02

#define UVC\_CT\_AE\_PRIORITY\_CONTROL 0x03

#define UVC\_CT\_EXPOSURE\_TIME\_ABSOLUTE\_CONTROL 0x04

#define UVC\_CT\_EXPOSURE\_TIME\_RELATIVE\_CONTROL 0x05

#define UVC\_CT\_FOCUS\_ABSOLUTE\_CONTROL 0x06

#define UVC\_CT\_FOCUS\_RELATIVE\_CONTROL 0x07

#define UVC\_CT\_FOCUS\_AUTO\_CONTROL 0x08

#define UVC\_CT\_IRIS\_ABSOLUTE\_CONTROL 0x09

#define UVC\_CT\_IRIS\_RELATIVE\_CONTROL 0x0a

#define UVC\_CT\_ZOOM\_ABSOLUTE\_CONTROL 0x0b

#define UVC\_CT\_ZOOM\_RELATIVE\_CONTROL 0x0c

#define UVC\_CT\_PANTILT\_ABSOLUTE\_CONTROL 0x0d

#define UVC\_CT\_PANTILT\_RELATIVE\_CONTROL 0x0e

#define UVC\_CT\_ROLL\_ABSOLUTE\_CONTROL 0x0f

#define UVC\_CT\_ROLL\_RELATIVE\_CONTROL 0x10

#define UVC\_CT\_PRIVACY\_CONTROL 0x11

### uvc\_processing

static const struct uvc\_processing\_unit\_descriptor uvc\_processing = {

.bLength = UVC\_DT\_PROCESSING\_UNIT\_SIZE(2),

.bDescriptorType = USB\_DT\_CS\_INTERFACE,

.bDescriptorSubType = UVC\_VC\_PROCESSING\_UNIT,

**.bUnitID = 2, //wIndex**

.bSourceID = 1,

.wMaxMultiplier = cpu\_to\_le16(16\*1024),

.bControlSize = 2,

.bmControls[0] = 1,

.bmControls[1] = 0,

.iProcessing = 0,

};

#### bmControls：

D0: Brightness

D1: Contrast

D2: Hue

D3: Saturation

D4: Sharpness

D5: Gamma

D6: White Balance Temperature

D7: White Balance Component

D8: Backlight Compensation

D9: Gain

D10: Power Line Frequency

D11: Hue, Auto

D12: White Balance Temperature, Auto

D13: White Balance Component, Auto

D14: Digital Multiplier

D15: Digital Multiplier Limit

D16: Analog Video Standard

D17: Analog Video Lock Status

D18: Contrast, Auto

D19 – D23: Reserved. Set to zero

#### wIndex

**.bUnitID = 2, //wIndex**

#### wValue

/\* A.9.5. Processing Unit Control Selectors \*/

#define UVC\_PU\_CONTROL\_UNDEFINED 0x00

#define UVC\_PU\_BACKLIGHT\_COMPENSATION\_CONTROL 0x01

#define UVC\_PU\_BRIGHTNESS\_CONTROL 0x02

#define UVC\_PU\_CONTRAST\_CONTROL 0x03

#define UVC\_PU\_GAIN\_CONTROL 0x04

#define UVC\_PU\_POWER\_LINE\_FREQUENCY\_CONTROL 0x05

#define UVC\_PU\_HUE\_CONTROL 0x06

#define UVC\_PU\_SATURATION\_CONTROL 0x07

#define UVC\_PU\_SHARPNESS\_CONTROL 0x08

#define UVC\_PU\_GAMMA\_CONTROL 0x09

#define UVC\_PU\_WHITE\_BALANCE\_TEMPERATURE\_CONTROL 0x0a

#define UVC\_PU\_WHITE\_BALANCE\_TEMPERATURE\_AUTO\_CONTROL 0x0b

#define UVC\_PU\_WHITE\_BALANCE\_COMPONENT\_CONTROL 0x0c

#define UVC\_PU\_WHITE\_BALANCE\_COMPONENT\_AUTO\_CONTROL 0x0d

#define UVC\_PU\_DIGITAL\_MULTIPLIER\_CONTROL 0x0e

#define UVC\_PU\_DIGITAL\_MULTIPLIER\_LIMIT\_CONTROL 0x0f

#define UVC\_PU\_HUE\_AUTO\_CONTROL 0x10

#define UVC\_PU\_ANALOG\_VIDEO\_STANDARD\_CONTROL 0x11

#define UVC\_PU\_ANALOG\_LOCK\_STATUS\_CONTROL 0x12

### uvc\_output\_terminal

static const struct uvc\_output\_terminal\_descriptor uvc\_output\_terminal = {

.bLength = UVC\_DT\_OUTPUT\_TERMINAL\_SIZE,

.bDescriptorType = USB\_DT\_CS\_INTERFACE,

.bDescriptorSubType = UVC\_VC\_OUTPUT\_TERMINAL,

**.bTerminalID = 3, //wIndex**

.wTerminalType = cpu\_to\_le16(0x0101),

.bAssocTerminal = 0,

.bSourceID = 2,

.iTerminal = 0,

};

# USB协议解析

## USB Camera Insert //参见bRequest:Standrad

### 80 06 00 01 00 00 12 00 // 00 01 = DEVICE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 0x80 | GET\_DESCRIPTOR(0x06) | **Descriptor Type** and Descriptor Index | 0x0000 or Language ID | Descriptor Length | Descriptor |

#### 80 =（Device-to-host | Standard | Device）//GET

#### 06 = (GET\_DESCRIPTOR)

12 01 00 02 EF 02 01 40 DA 0B 41 1A 06 00 03 01 02 01

### 80 06 00 02 00 00 FF 00 // 00 02 = CONFIGURATION[0]

09 02 92 05 02 01 04 80 FA 08 0B 00 02 0E 03 00 05 09 04 00 00 01 0E 01 00 05 0D 24

01 00 01 4E 00 C0 E1 E4 00 01 01 12 24 02 01 01 02 00 00 00 00 00 00 00 00 03 0E 20

00 0B 24 05 02 01 00 00 02 7F 17 00 09 24 03 03 01 01 00 04 00 1B 24 06 04 8C A7 29

12 B4 47 94 40 B0 CE DB 07 38 6F B9 38 02 01 02 02 00 06 00 07 05 83 03 10 00 06 05

25 03 10 00 09 04 01 00 00 0E 02 00 00 0F 24 01 02 A5 04 81 00 03 02 01 00 01 00 00

1B 24 04 01 0D 59 55 59 32 00 00 10 00 80 00 00 AA 00 38 9B 71 10 01 00 00 00 00 2A

24 05 01 00 80 02 E0 01 00 00 65 04 00 00 CA 08 00 60 09 00 15 16 05 00 04 15 16 05

00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00 2A 24 05 02 00 A0 00 78 00 00 50 46 00 00 A0

8C 00 00 96 00 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00 2A

24 05 03

### 80 06 00 02 00 00 92 05 // 00 02 = CONFIGURATION[0]

#### bLength: Byte0

#### bDescriptorType: Byte1

#define USB\_DT\_DEVICE 0x01

#define USB\_DT\_CONFIG 0x02

#define USB\_DT\_STRING 0x03

#define USB\_DT\_INTERFACE 0x04

#define USB\_DT\_ENDPOINT 0x05

#define USB\_TYPE\_STANDARD (0x00 << 5)

#define USB\_TYPE\_CLASS (0x01 << 5)

#define USB\_DT\_CS\_DEVICE (USB\_TYPE\_CLASS | USB\_DT\_DEVICE) 0x21

#define USB\_DT\_CS\_CONFIG (USB\_TYPE\_CLASS | USB\_DT\_CONFIG) 0x22

#define USB\_DT\_CS\_STRING (USB\_TYPE\_CLASS | USB\_DT\_STRING) 0x23

#define USB\_DT\_CS\_INTERFACE (USB\_TYPE\_CLASS | USB\_DT\_INTERFACE) 0x24

#define USB\_DT\_CS\_ENDPOINT (USB\_TYPE\_CLASS | USB\_DT\_ENDPOINT) 0x25

#### bDescriptorSubtype：Byte2

##### Video Class-Specific VC Interface Descriptor Subtypes

**bDescriptorType = USB\_DT\_CS\_INTERFACE**

VC\_DESCRIPTOR\_UNDEFINED 0x00

VC\_HEADER 0x01

VC\_INPUT\_TERMINAL 0x02

VC\_OUTPUT\_TERMINAL 0x03

VC\_SELECTOR\_UNIT 0x04

VC\_PROCESSING\_UNIT 0x05

VC\_EXTENSION\_UNIT 0x06

VC\_ENCODING\_UNIT 0x07

##### Video Class-Specific VS Interface Descriptor Subtypes

**bDescriptorType = USB\_DT\_CS\_INTERFACE**

VS\_ UNDEFINED 0x00

VS\_INPUT\_HEADER 0x01

VS\_OUTPUT\_HEADER 0x02

VS\_STILL\_IMAGE\_FRAME 0x03

VS\_FORMAT\_UNCOMPRESSED 0x04

VS\_FRAME\_UNCOMPRESSED 0x05

VS\_FORMAT\_MJPEG 0x06

VS\_FRAME\_MJPEG 0x07

Reserved 0x08

Reserved 0x09

VS\_FORMAT\_MPEG2TS 0x0A

Reserved 0x0B

VS\_FORMAT\_DV 0x0C

VS\_COLORFORMAT 0x0D

Reserved 0x0E

Reserved 0x0F

VS\_FORMAT\_FRAME\_BASED 0x10

VS\_FRAME\_FRAME\_BASED 0x11

VS\_FORMAT\_STREAM\_BASED 0x12

VS\_FORMAT\_H264 0x13

VS\_FRAME\_H264 0x14

VS\_FORMAT\_H264\_SIMULCAST 0x15

#### Data

09 **02** 92 05 02 01 04 80 FA // CONFIG

08 **0B** 00 02 0E 03 00 05 // INTERFACE\_ASSOCIATION

09 **04** 00 00 01 0E 01 00 05 // INTERFACE

0D **24** 01 00 01 4E 00 C0 E1 E4 00 01 01 // CS\_INTERFACE

//0D =UVC\_DT\_HEADER\_SIZE (1) = 12+1

//24 = CS\_INTERFACE = 0x24

//01 =UVC\_VC\_HEADER = 0x01

12 **24** 02 01 01 02 00 00 00 00 00 00 00 00 03 0E 20 00

//12 = UVC\_DT\_CAMERA\_TERMINAL\_SIZE(3) = 15+3

//24 = CS\_INTERFACE = 0x24

//02 = UVC\_VC\_INPUT\_TERMINAL = 0x02

//01 = bTerminalID: uniquely identified

//0E 20 00 : 0000 0000 0010 0000 0000 1110

//D1: Auto-Exposure Mode

// D2: Auto-Exposure Priority

// D3: Exposure Time (Absolute)

// D13: Roll (Absolute)

0B **24** 05 02 01 00 00 02 7F 17 00

//0B =UVC\_DT\_PROCESSING\_UNIT\_SIZE (2) = 9+2

//24 = CS\_INTERFACE = 0x24

//05 =UVC\_VC\_PROCESSING\_UNIT = 0x05

//02 = bUnitID: uniquely identified

09 **24** 03 03 01 01 00 04 00

//09 =UVC\_DT\_OUTPUT\_TERMINAL\_SIZE = 9

//24 = CS\_INTERFACE = 0x24

//03 =UVC\_VC\_OUTPUT\_TERMINAL = 0x03

//03 = bTerminalID: uniquely identified

1B **24** 06 04 8C A7 29 12 B4 47 94 40 B0 CE DB 07 38 6F B9 38 02 01 02 02 00 06 00

//1B =UVC\_DT\_EXTENSION\_UNIT\_SIZE(p, n) = 27

//24 = CS\_INTERFACE = 0x24

//06 =UVC\_VC\_EXTENSION\_UNIT = 0x06

//04 = bUnitID: uniquely identified

07 **05** 83 03 10 00 06 // ENDPOINT

05 **25** 03 10 00

09 **04** 01 00 00 0E 02 00 00

0F **24** 01 02 A5 04 81 00 03 02 01 00 01 00 00

1B **24** 04 01 0D 59 55 59 32 00 00 10 00 80 00 00 AA 00 38 9B 71 10 01 00 00 00 00

2A **24** 05 01 00 80 02 E0 01 00 00 65 04 00 00 CA 08 00 60 09 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 05 02 00 A0 00 78 00 00 50 46 00 00 A0 8C 00 00 96 00 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 05 03 00 B0 00 90 00 00 D0 5C 00 00 A0 B9 00 00 C6 00 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 05 04 00 40 01 F0 00 00 40 19 01 00 80 32 02 00 58 02 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 05 05 00 60 01 20 01 00 40 73 01 00 80 E6 02 00 18 03 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 05 06 00 80 02 E0 01 00 00 65 04 00 00 CA 08 00 60 09 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2E **24** 05 07 00 20 03 58 02 00 F0 49 02 00 B0 71 0B 00 A6 0E 00 80 1A 06 00 05 80 1A 06 00 20 A1 07 00 2A 2C 0A 00 40 42 0F 00 80 84 1E 00

22 **24** 05 08 00 00 04 00 03 00 00 C0 03 00 00 80 07 00 00 18 00 40 42 0F 00 02 40 42 0F 00 80 84 1E 00

22 **24** 05 09 00 00 05 D0 02 00 00 65 04 00 00 CA 08 00 20 1C 00 40 42 0F 00 02 40 42 0F 00 80 84 1E 00

1E **24** 05 0A 00 00 05 00 04 00 00 40 06 00 00 40 06 00 00 28 00 80 84 1E 00 01 80 84 1E 00

1E **24** 05 0B 00 80 07 38 04 00 40 E3 09 00 40 E3 09 00 48 3F 00 80 84 1E 00 01 80 84 1E 00

1E **24** 05 0C 00 40 06 B0 04 00 C0 27 09 00 C0 27 09 00 98 3A 00 80 84 1E 00 01 80 84 1E 00

1E **24** 05 0D 00 00 08 00 06 00 00 00 09 00 00 00 09 00 00 60 00 D5 DC 32 00 01 D5 DC 32 00

36 **24** 03 00 0C 00 08 00 06 40 06 B0 04 80 07 38 04 00 05 00 04 00 05 D0 02 00 04 00 03 20 03 58 02 80 02 E0 01 60 01 20 01 40 01 F0 00 B0 00 90 00 A0 00 78 00 00

06 **24** 0D 01 01 04

0B **24** 06 02 0D 01 01 00 00 00 00

2A **24** 07 01 00 80 02 E0 01 00 00 65 04 00 00 CA 08 00 60 09 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 02 00 A0 00 78 00 00 50 46 00 00 A0 8C 00 00 96 00 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 03 00 B0 00 90 00 00 D0 5C 00 00 A0 B9 00 00 C6 00 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 04 00 40 01 F0 00 00 40 19 01 00 80 32 02 00 58 02 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 05 00 60 01 20 01 00 40 73 01 00 80 E6 02 00 18 03 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 06 00 80 02 E0 01 00 00 65 04 00 00 CA 08 00 60 09 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 07 00 20 03 58 02 00 D0 DD 06 00 A0 BB 0D 00 A6 0E 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 08 00 00 04 00 03 00 00 40 0B 00 00 80 16 00 00 18 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 09 00 00 05 D0 02 00 00 2F 0D 00 00 5E 1A 00 20 1C 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 0A 00 00 05 00 04 00 00 C0 12 00 00 80 25 00 00 28 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

2A **24** 07 0B 00 80 07 38 04 00 C0 A9 1D 00 80 53 3B 00 48 3F 00 15 16 05 00 04 15 16 05 00 80 1A 06 00 20 A1 07 00 2A 2C 0A 00

22 **24** 07 0C 00 40 06 B0 04 00 40 77 1B 00 80 EE 36 00 98 3A 00 15 16 05 00 02 15 16 05 00 2A 2C 0A 00

22 **24** 07 0D 00 00 08 00 06 00 00 00 2D 00 00 00 5A 00 00 60 00 15 16 05 00 02 15 16 05 00 2A 2C 0A 00

36 **24** 03 00 0C 00 08 00 06 40 06 B0 04 80 07 38 04 00 05 00 04 00 05 D0 02 00 04 00 03 20 03 58 02 80 02 E0 01 60 01 20 01 40 01 F0 00 B0 00 90 00 A0 00 78 00 00

06 **24** 0D 01 01 04

09 **04** 01 01 01 0E 02 00 00

07 **05** 81 05 80 00 01

09 **04** 01 02 01 0E 02 00 00

07 **05** 81 05 00 02 01

09 **04** 01 03 01 0E 02 00 00

07 **05** 81 05 00 04 01

09 **04** 01 04 01 0E 02 00 00

07 **05** 81 05 00 0B 01

09 **04** 01 05 01 0E 02 00 00

07 **05** 81 05 00 0C 01

09 **04** 01 06 01 0E 02 00 00

07 **05** 81 05 80 13 01

09 **04** 01 07 01 0E 02 00 00

07 **05** 81 05 00 14 01

### 80 06 02 03 09 04 FF 00 // 02 03 = STRING[2]

1A 03 32 00 30 00 30 00 39 00 30 00 31 00 30 00 31 00 30 00 30 00 30 00 31 00 //200901010001

### 80 06 00 03 00 00 FF 00 // 02 03 = STRING[0]

04 03 09 04

### 80 06 01 03 09 04 FF 00 // 02 03 = STRING[1]

16 03 55 00 53 00 42 00 20 00 43 00 61 00 6D 00 65 00 72 00 61 00 //USB Camera

### 80 06 00 01 00 00 12 00 // 00 01 = DEVICE

### 80 06 00 02 00 00 09 00 // 00 02 = CONFIGURATION[0]

09 02 92 05 02 01 04 80 FA

### 80 06 00 02 00 00 92 05 // 00 02 = CONFIGURATION[0]

### 00 09 01 00 00 00 00 00 // 01 00 = Configuration[1]

#### 00 =（Host-to-device | Standard | Device）//SET Config

#### 09 = (SET\_CONFIGURATION)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 0x00 | SET\_CONFIGURATION(0x09) | Configuration Value | 0x0000 | 0x0000 | None |

### 01 0B 00 00 01 00 00 00 // 00 00 = Alt=0=OFF, 01 00 = iface=1

#### 01 =（Host-to-device | Standard | Interface）//SET Interface

#### 0B = (SET\_INTERFACE)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 0x01 | SET\_INTERFACE(0x0B) | Alternate Setting | Interface | 0x0000 | None |

### 80 06 05 03 09 04 04 00 // 05 03 = STRING[5]

STALL

### 80 06 05 03 09 04 22 00 // 05 03 = STRING[5]

22 03 55 00 53 00 42 00 32 00 2E 00 30 00 20 00 33 00 4D 00 20 00 63 00 61 00 6D 00 65 00 72 00 61 00 //USB2.0 3M camera

### 01 0B 00 00 01 00 00 00 // 00 00 = Alt[0], 01 00 = Interface[1]

### A1 86 00 04 00 01 01 00 //00 04 = EXPOSURE\_TIME\_ABSOLUTE

#### A1 =（Device-to-host | Class | Interface）//GET

0F

### A1 82 00 04 00 01 04 00

32 00 00 00

### A1 83 00 04 00 01 04 00

10 27 00 00

### A1 84 00 04 00 01 04 00

01 00 00 00

### A1 87 00 04 00 01 04 00

10 27 00 00

### A1 82 00 04 00 01 04 00

32 00 00 00

### A1 83 00 04 00 01 04 00

10 27 00 00

### A1 84 00 04 00 01 04 00

01 00 00 00

### A1 86 00 03 00 01 01 00 //00 03 = VC:AE\_PRIORITY

### //86 = GET\_INFO

### //00 01 = IT

03

### A1 82 00 03 00 01 01 00

### //82 = GET\_MIN

00

### A1 83 00 03 00 01 01 00

### //83 = GET\_MAX

01

### A1 84 00 03 00 01 01 00

### //84 = GET\_RES

01

### A1 87 00 03 00 01 01 00

### //87 = GET\_DEF

01

### A1 86 00 09 00 01 01 00 //00 09 = VC:IRIS\_ABSOLUTE

STALL

### A1 81 00 02 00 00 01 00 //00 02 = VC:AE\_MODE

### //81 = GET\_CUR

06

### A1 86 00 0F 00 01 01 00 //00 0F = VC: ROLL\_ABSOLUTE

03

### A1 82 00 0F 00 01 02 00

00 00

### A1 83 00 0F 00 01 02 00

03 00

### A1 84 00 0F 00 01 02 00

01 00

### A1 87 00 0F 00 01 02 00

00 00

### A1 86 00 02 00 02 01 00 //00 02 = VC:BRIGHTNESS

### //86 = GET\_INFO

### //00 02 = PU

03

### A1 82 00 02 00 02 02 00

00 00

### A1 83 00 02 00 02 02 00

FF 00

### A1 84 00 02 00 02 02 00

01 00

### A1 87 00 02 00 02 02 00

80 00

### A1 86 00 03 00 02 01 00 //00 03 = VC:CONTRAST

03

### A1 82 00 03 00 02 02 00

00 00

### A1 83 00 03 00 02 02 00

FF 00

### A1 84 00 03 00 02 02 00

01 00

### A1 87 00 03 00 02 02 00

80 00

### A1 86 00 06 00 02 01 00 //00 06 = VC:HUE

03

### A1 82 00 06 00 02 02 00

00 00

### A1 83 00 06 00 02 02 00

FF 00

### A1 84 00 06 00 02 02 00

01 00

### A1 87 00 06 00 02 02 00

80 00

### A1 86 00 07 00 02 01 00 //00 07 = VC:SATURATION

03

### A1 82 00 07 00 02 02 00

00 00

### A1 83 00 07 00 02 02 00

FF 00

### A1 84 00 07 00 02 02 00

01 00

### A1 87 00 07 00 02 02 00

80 00

### A1 86 00 08 00 02 01 00 //00 08 = VC:SHARPNESS

03

### A1 82 00 08 00 02 02 00

00 00

### A1 83 00 08 00 02 02 00

FF 00

### A1 84 00 08 00 02 02 00

01 00

### A1 87 00 08 00 02 02 00

80 00

### A1 86 00 09 00 02 01 00 //00 09 = VC:GAMMA

03

### A1 82 00 09 00 02 02 00

00 00

### A1 83 00 09 00 02 02 00

FF 00

### A1 84 00 09 00 02 02 00

01 00

### A1 87 00 09 00 02 02 00

80 00

### A1 86 00 0A 00 02 01 00 //00 0A = VC:WB\_TEMPERATURE

0F

### A1 82 00 0A 00 02 02 00

F0 0A

### A1 83 00 0A 00 02 02 00

64 19

### A1 84 00 0A 00 02 02 00

0A 00

### A1 87 00 0A 00 02 02 00

F8 11

### A1 86 00 01 00 02 01 00 //00 01 = VC:BACKLIGHT

03

### A1 82 00 01 00 02 02 00

00 00

### A1 83 00 01 00 02 02 00

02 00

### A1 84 00 01 00 02 02 00

01 00

### A1 87 00 01 00 02 02 00

00 00

### A1 86 00 04 00 02 01 00 //00 04 = VC:GAIN

03

### A1 82 00 04 00 02 02 00

00 00

### A1 83 00 04 00 02 02 00

FF 00

### A1 84 00 04 00 02 02 00

01 00

### A1 87 00 04 00 02 02 00

80 00

### A1 86 00 05 00 02 01 00 //00 05 = VC:POWER\_LINE\_FREQUENCY

03

### A1 82 00 05 00 02 01 00

00

### A1 83 00 05 00 02 01 00

02

### A1 84 00 05 00 02 01 00

01

### A1 87 00 05 00 02 01 00

01

### A1 85 00 0A 00 04 02 00 //00 0A = VC:EU cmd

### //85 = GET\_LEN

### //00 04 = EU

08 00

### A1 86 00 0A 00 04 01 00

### //86 = GET\_INFO

03

### A1 82 00 0A 00 04 08 00

00 00 00 00 00 00 00 00

### A1 83 00 0A 00 04 08 00

FF FF FF FF FF FF FF FF

### A1 84 00 0A 00 04 08 00

01 00 00 00 00 00 00 00

### A1 87 00 0A 00 04 08 00

00 00 00 00 00 00 00 00

### A1 85 00 0B 00 04 02 00 //00 0A = EU cmd

08 00

### A1 86 00 0B 00 04 01 00

03

### A1 82 00 0B 00 04 08 00

00 00 00 00 00 00 00 00

### A1 83 00 0B 00 04 08 00

FF FF FF FF FF FF FF FF

### A1 84 00 0B 00 04 08 00

01 00 00 00 00 00 00 00

### A1 87 00 0B 00 04 08 00

00 00 00 00 00 00 00 00

## USB Camera Open

VideoStreaming Interface Control Selectors

VS\_CONTROL\_UNDEFINED 0x00

VS\_PROBE\_CONTROL 0x01

VS\_COMMIT\_CONTROL 0x02

VS\_STILL\_PROBE\_CONTROL 0x03

VS\_STILL\_COMMIT\_CONTROL 0x04

VS\_STILL\_IMAGE\_TRIGGER\_CONTROL 0x05

VS\_STREAM\_ERROR\_CODE\_CONTROL 0x06

VS\_GENERATE\_KEY\_FRAME\_CONTROL 0x07

VS\_UPDATE\_FRAME\_SEGMENT\_CONTROL 0x08

VS\_SYNCH\_DELAY\_CONTROL 0x09

### A1 81 00 01 01 00 1A 00 // 00 01 = VS:PROBE

### //01 00 = VS

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

### A1 83 00 01 01 00 1A 00

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

### A1 82 00 01 01 00 1A 00

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

### 21 01 00 01 01 00 1A 00

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 00 00 00

00 00

01 //bFormatIndex

09 //bFrameIndex

80 84 1E 00 //dwFrameInterval = 0x001e8480 = 2000000\*100ns = 200ms

00 00

00 00

00 00

00 00

20 00

00 20 1C 00 //dwMaxVideoFrameSize

00 00 00 00

### A1 81 00 01 01 00 1A 00

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

### A1 83 00 01 01 00 1A 00

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

### A1 82 00 01 01 00 1A 00

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

### A1 81 00 03 01 00 0B 00 //00 03 = VS:STILL\_PROBE

01 01 00 00 00 60 00 00 0C 00 00

### A1 82 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### A1 83 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### 21 01 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 00 00 00

### A1 81 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### A1 82 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### A1 83 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### A1 81 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### A1 82 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### A1 83 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### 21 01 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 00 00 00

### A1 81 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### A1 82 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### A1 83 00 03 01 00 0B 00

01 01 00 00 00 60 00 00 0C 00 00

### 21 01 00 01 01 00 1A 00

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 00 00 00

### A1 81 00 01 01 00 1A 00

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

### 21 01 00 02 01 00 1A 00 //00 02 = VS:COMMIT

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

### 01 0B 07 00 01 00 00 00 // 07 00 = Alt=7=ON, 01 00 = iface=1

#### 01 =（Host-to-device | Standard | Interface）//SET Interface

#### 0B = (SET\_INTERFACE)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 0x01 | SET\_INTERFACE(0x0B) | Alternate Setting | Interface | 0x0000 | None |

### 01 0B 00 00 01 00 00 00 //data

### 21 01 00 01 01 00 1A 00 //00 02 = VS:PROBE

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 00 00 00

### A1 81 00 01 01 00 1A 00

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

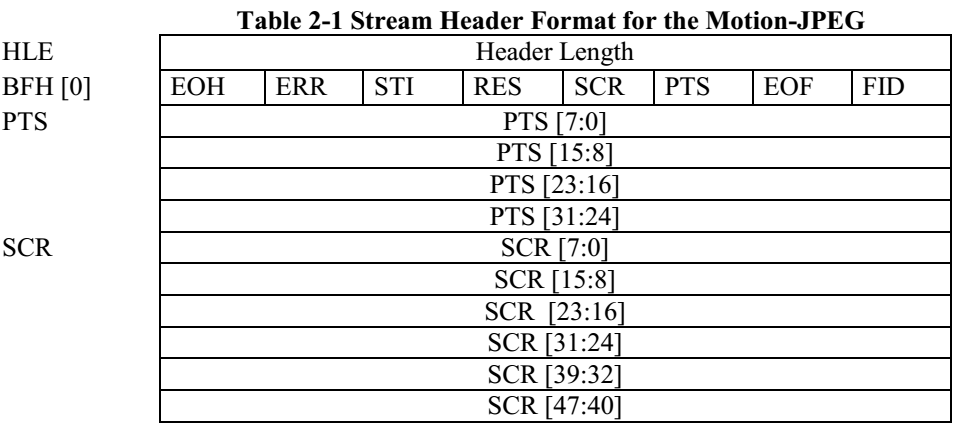
### 21 01 00 02 01 00 1A 00 //00 02 = VS:COMMIT

00 00 01 09 80 84 1E 00 00 00 00 00 00 00 00 00 20 00 00 20 1C 00 00 0C 00 00

### 01 0B 07 00 01 00 00 00 // 07 00 = Alt=7=ON, 01 00 = iface=1

# URB 数据分析

## MLPEG:



FID: Frame Identifier

This bit toggles at each frame start boundary and stays constant for the rest of the frame.

EOF: End of Frame

This bit indicates the end of a video frame and is set in the last video sample that belongs to a

frame.

PTS: Presentation Time Stamp

This bit, when set, indicates the presence of a PTS field.

SCR: Source Clock Reference

This bit, when set, indicates the presence of a SCR field

RES: Reserved.

Set to 0.

STI: Still Image

This bit, when set, identifies a video sample that belongs to a still image.

ERR: Error Bit

This bit, when set, indicates an error in the device streaming.

EOH: End of Header

This bit, when set, indicates the end of the BFH fields.

**Fid相同的packet数据属于同一个frame的数据。**

[14098.690958] [0] [L=1024] 0c cc 01 a6 a8 00 af 2c a9 00 d5 06 [fid:0][eof:0][sti:0][err:0]

[14098.695500] [0] [L=2048] 0c cc 01 a6 a8 00 5b 34 aa 00 d9 06 [fid:0][eof:0][sti:0][err:0]

[14098.699974] [0] [L=1024] 0c cc 01 a6 a8 00 06 3c ab 00 de 06 [fid:0][eof:0][sti:0][err:0]

[14098.704499] [0] [L=2048] 0c ce 01 a6 a8 00 b1 43 ac 00 e2 06 [fid:0][eof:2][sti:0][err:0]

[14098.708932] [0] [L= 76] 0c ce 01 a6 a8 00 5c 4b ad 00 e7 06 [fid:0][eof:2][sti:0][err:0]

[14098.713287] [0] [L= 12] 0c cc 01 a6 a8 00 06 53 ae 00 eb 06 [fid:0][eof:0][sti:0][err:0]

[14098.717745] [0] [L= 24] 0c cc 01 a6 a8 00 5d 53 af 00 ef 06 [fid:0][eof:0][sti:0][err:0]

[14098.722122] [0] [L= 12] 0c cc 01 a6 a8 00 b4 53 b0 00 f4 06 [fid:0][eof:0][sti:0][err:0]

[14098.726503] [0] [L=1024] 0c cd 62 46 b0 00 0d 54 b1 00 f8 06 [fid:1][eof:0][sti:0][err:0]

[14098.730967] [0] [L=1024] 0c cd 62 46 b0 00 66 54 b2 00 fd 06 [fid:1][eof:0][sti:0][err:0]

[14098.735367] [0] [L=1024] 0c cd 62 46 b0 00 10 5c b3 00 01 07 [fid:1][eof:0][sti:0][err:0]

[14098.739838] [0] [L=1024] 0c cd 62 46 b0 00 67 5c b4 00 05 07 [fid:1][eof:0][sti:0][err:0]

[14098.744239] [0] [L=1024] 0c cf 62 46 b0 00 12 64 b5 00 0a 07 [fid:1][eof:2][sti:0][err:0]

[14098.748707] [0] [L=1024] 0c cf 62 46 b0 00 69 64 b6 00 0e 07 [fid:1][eof:2][sti:0][err:0]

[14098.753066] [0] [L= 76] 0c cf 62 46 b0 00 13 6c b7 00 13 07 [fid:1][eof:2][sti:0][err:0]

[14098.757464] [0] [L=1024] 0c cc c3 e6 b7 00 6a 6c b8 00 17 07 [fid:0][eof:0][sti:0][err:0]

[14098.761912] [0] [L=1024] 0c cc c3 e6 b7 00 c2 6c b9 00 1c 07 [fid:0][eof:0][sti:0][err:0]

[14098.766313] [0] [L=1024] 0c cc c3 e6 b7 00 6c 74 ba 00 20 07 [fid:0][eof:0][sti:0][err:0]

[14098.770759] [0] [L=1024] 0c cc c3 e6 b7 00 c3 74 bb 00 24 07 [fid:0][eof:0][sti:0][err:0]

[14098.775143] [0] [L=1024] 0c ce c3 e6 b7 00 1b 75 bc 00 29 07 [fid:0][eof:2][sti:0][err:0]

[14098.779605] [0] [L=1024] 0c ce c3 e6 b7 00 73 75 bd 00 2d 07 [fid:0][eof:2][sti:0][err:0]

[14098.784063] [0] [L= 88] 0c ce c3 e6 b7 00 1c 7d be 00 32 07 [fid:0][eof:2][sti:0][err:0]

[14098.788491] [0] [L= 12] 0c cc c3 e6 b7 00 c6 84 bf 00 36 07 [fid:0][eof:0][sti:0][err:0]

[14098.792891] [0] [L=1024] 0c cd 23 87 bf 00 1f 85 c0 00 3b 07 [fid:1][eof:0][sti:0][err:0]

[14098.797291] [0] [L=1024] 0c cd 23 87 bf 00 78 85 c1 00 3f 07 [fid:1][eof:0][sti:0][err:0]

[14098.801740] [0] [L=1024] 0c cd 23 87 bf 00 22 8d c2 00 43 07 [fid:1][eof:0][sti:0][err:0]

[14098.806243] [0] [L=2048] 0c cd 23 87 bf 00 79 8d c3 00 48 07 [fid:1][eof:0][sti:0][err:0]

[14098.810692] [0] [L=1024] 0c cf 23 87 bf 00 24 95 c4 00 4c 07 [fid:1][eof:2][sti:0][err:0]

[14098.815053] [0] [L= 76] 0c cf 23 87 bf 00 ce 9c c5 00 51 07 [fid:1][eof:2][sti:0][err:0]

[14098.819454] [0] [L= 12] 0c cd 23 87 bf 00 26 9d c6 00 55 07 [fid:1][eof:0][sti:0][err:0]

## Isoc

Urb：**urb->transfer\_buffer + urb->iso\_frame\_desc[i].offset;**

**Fid相同的packet数据属于同一个frame的数据。**

[14098.690958] [0] [L=1024] 0c cc 01 a6 a8 00 af 2c a9 00 d5 06 [fid:0][eof:0][sti:0][err:0]

[14098.695500] [0] [L=2048] 0c cc 01 a6 a8 00 5b 34 aa 00 d9 06 [fid:0][eof:0][sti:0][err:0]

[14098.699974] [0] [L=1024] 0c cc 01 a6 a8 00 06 3c ab 00 de 06 [fid:0][eof:0][sti:0][err:0]

[14098.704499] [0] [L=2048] 0c ce 01 a6 a8 00 b1 43 ac 00 e2 06 [fid:0][eof:2][sti:0][err:0]

[14098.708932] [0] [L= 76] 0c ce 01 a6 a8 00 5c 4b ad 00 e7 06 [fid:0][eof:2][sti:0][err:0]

[14098.713287] [0] [L= 12] 0c cc 01 a6 a8 00 06 53 ae 00 eb 06 [fid:0][eof:0][sti:0][err:0]

[14098.717745] [0] [L= 24] 0c cc 01 a6 a8 00 5d 53 af 00 ef 06 [fid:0][eof:0][sti:0][err:0]

[14098.722122] [0] [L= 12] 0c cc 01 a6 a8 00 b4 53 b0 00 f4 06 [fid:0][eof:0][sti:0][err:0]

[14098.726503] [0] [L=1024] 0c cd 62 46 b0 00 0d 54 b1 00 f8 06 [fid:1][eof:0][sti:0][err:0]

[14098.730967] [0] [L=1024] 0c cd 62 46 b0 00 66 54 b2 00 fd 06 [fid:1][eof:0][sti:0][err:0]

[14098.735367] [0] [L=1024] 0c cd 62 46 b0 00 10 5c b3 00 01 07 [fid:1][eof:0][sti:0][err:0]

[14098.739838] [0] [L=1024] 0c cd 62 46 b0 00 67 5c b4 00 05 07 [fid:1][eof:0][sti:0][err:0]

[14098.744239] [0] [L=1024] 0c cf 62 46 b0 00 12 64 b5 00 0a 07 [fid:1][eof:2][sti:0][err:0]

[14098.748707] [0] [L=1024] 0c cf 62 46 b0 00 69 64 b6 00 0e 07 [fid:1][eof:2][sti:0][err:0]

[14098.753066] [0] [L= 76] 0c cf 62 46 b0 00 13 6c b7 00 13 07 [fid:1][eof:2][sti:0][err:0]

[14098.757464] [0] [L=1024] 0c cc c3 e6 b7 00 6a 6c b8 00 17 07 [fid:0][eof:0][sti:0][err:0]

[14098.761912] [0] [L=1024] 0c cc c3 e6 b7 00 c2 6c b9 00 1c 07 [fid:0][eof:0][sti:0][err:0]

[14098.766313] [0] [L=1024] 0c cc c3 e6 b7 00 6c 74 ba 00 20 07 [fid:0][eof:0][sti:0][err:0]

[14098.770759] [0] [L=1024] 0c cc c3 e6 b7 00 c3 74 bb 00 24 07 [fid:0][eof:0][sti:0][err:0]

[14098.775143] [0] [L=1024] 0c ce c3 e6 b7 00 1b 75 bc 00 29 07 [fid:0][eof:2][sti:0][err:0]

[14098.779605] [0] [L=1024] 0c ce c3 e6 b7 00 73 75 bd 00 2d 07 [fid:0][eof:2][sti:0][err:0]

[14098.784063] [0] [L= 88] 0c ce c3 e6 b7 00 1c 7d be 00 32 07 [fid:0][eof:2][sti:0][err:0]

[14098.788491] [0] [L= 12] 0c cc c3 e6 b7 00 c6 84 bf 00 36 07 [fid:0][eof:0][sti:0][err:0]

[14098.792891] [0] [L=1024] 0c cd 23 87 bf 00 1f 85 c0 00 3b 07 [fid:1][eof:0][sti:0][err:0]

[14098.797291] [0] [L=1024] 0c cd 23 87 bf 00 78 85 c1 00 3f 07 [fid:1][eof:0][sti:0][err:0]

[14098.801740] [0] [L=1024] 0c cd 23 87 bf 00 22 8d c2 00 43 07 [fid:1][eof:0][sti:0][err:0]

[14098.806243] [0] [L=2048] 0c cd 23 87 bf 00 79 8d c3 00 48 07 [fid:1][eof:0][sti:0][err:0]

[14098.810692] [0] [L=1024] 0c cf 23 87 bf 00 24 95 c4 00 4c 07 [fid:1][eof:2][sti:0][err:0]

[14098.815053] [0] [L= 76] 0c cf 23 87 bf 00 ce 9c c5 00 51 07 [fid:1][eof:2][sti:0][err:0]

[14098.819454] [0] [L= 12] 0c cd 23 87 bf 00 26 9d c6 00 55 07 [fid:1][eof:0][sti:0][err:0]

# End