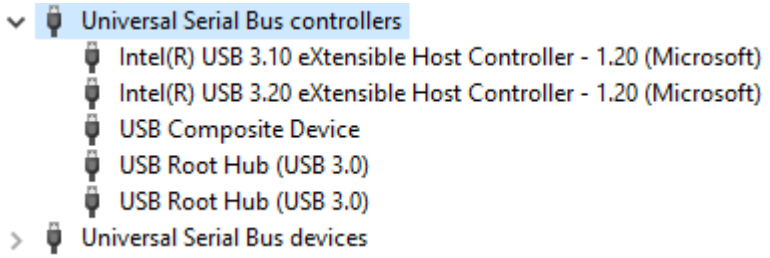
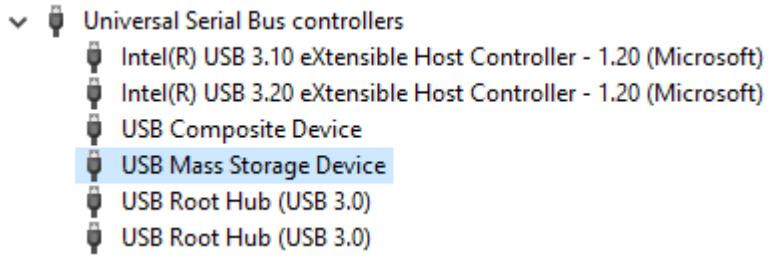
Demo USB probe using Ubuntu 22.04 and VirtualBox

Disclaimer: I am not covering VirtualBox Guest addition installation. I assume that once your USB device is connected it is detectable in VirtualBox.

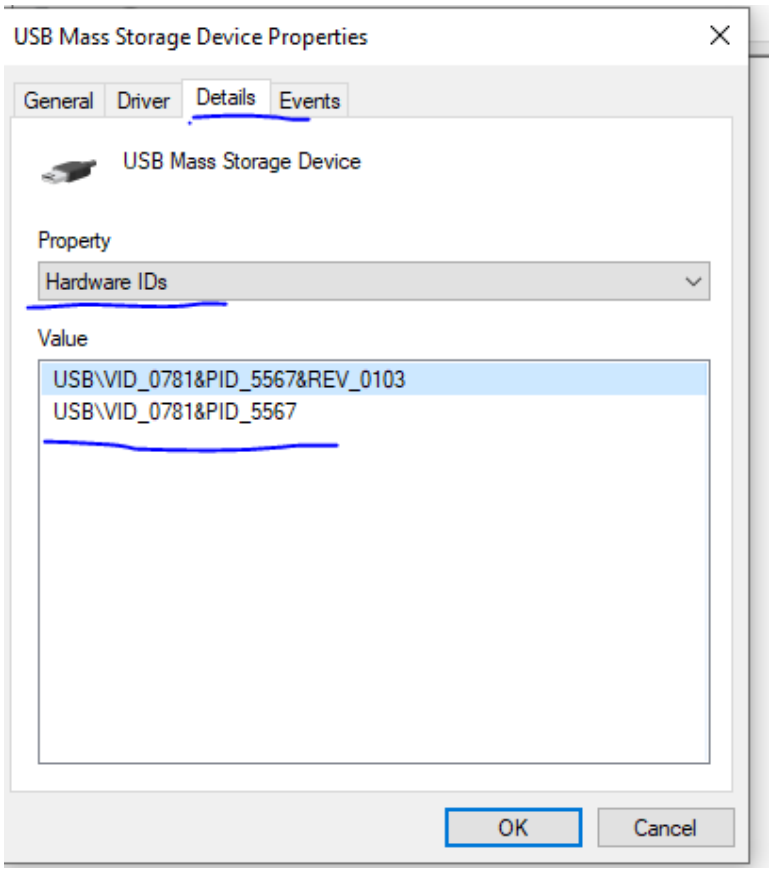
1) Depending on your host platform execute step 1 (Windows) or step 2 (Linux) to identify your USB device VendorID and DeviceID
2) Identifying USB device on WIndows using Device Manager:
   a) Open Device Manager and expand Universal System Bus (USB) Controllers



   b) Connect your device do PC and find it on the list



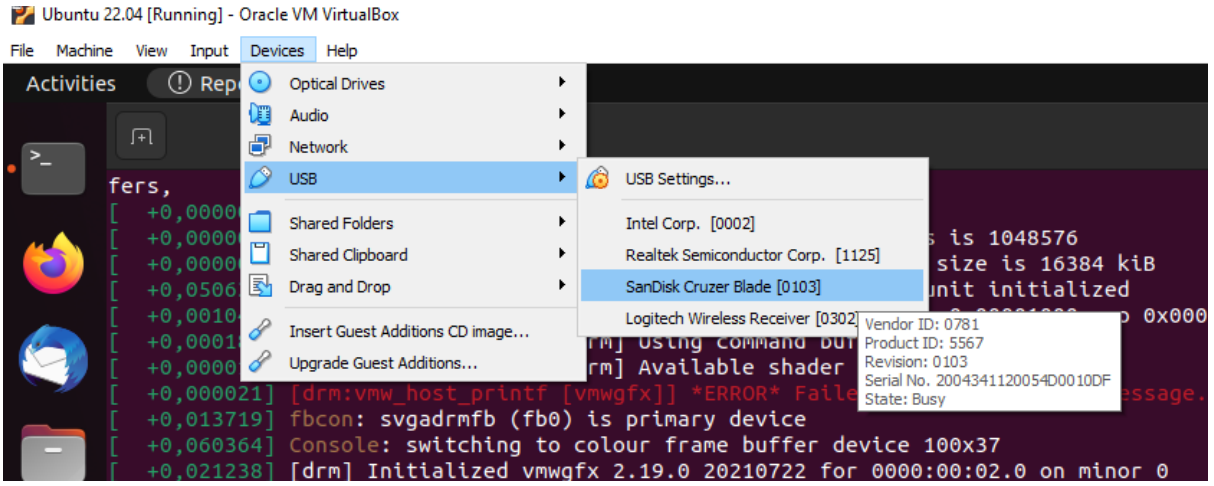
   c) Right click on your device and open Properties -> Details tab
   d) Select Hardware IDs: VendorID (VID) and DeviceID (PID) values in HEX available:



3) Identifying USB device on Linux using dmesg
   a) Simply connect your device and check dmesg output.

```
r"
[  +5,400460] usb 1-1: new high-speed USB device number 2 using ehci-pci
[  +0,665245] usb 1-1: New USB device found, idVendor=0781, idProduct=5567, bcdDevice= 1.03
[  +0,000004] usb 1-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[  +0,000002] usb 1-1: Product: Cruzer Blade
[  +0,000001] usb 1-1: Manufacturer: SanDisk
[  +0,000001] usb 1-1: SerialNumber: 2004341120054D0010DF
[  +0,061173] usb-storage 1-1:1.0: USB Mass Storage device detected
[  +0,013579] scsi host3: usb-storage 1-1:1.0
[  +0,000129] usbcore: registered new interface driver usb-storage
[  +0,023987] usbcore: registered new interface driver uas
[  +1,031948] scsi 3:0:0:0: Direct-Access     SanDisk  Cruzer Blade     1.20 PQ: 0 ANSI: 5
[  +0,080453] sd 3:0:0:0: Attached scsi generic sg2 type 0
[  +0,058359] sd 3:0:0:0: [sdb] 15633408 512-byte logical blocks: (8.00 GB/7.45 GiB)
[  +0,019253] sd 3:0:0:0: [sdb] Write Protect is off
[  +0,000008] sd 3:0:0:0: [sdb] Mode Sense: 43 00 00 00
[  +0,019579] sd 3:0:0:0: [sdb] Write cache: disabled, read cache: enabled, doesn't support DPO or FUA
[  +0,185720]  sdb: sdb1
[  +0,120586] sd 3:0:0:0: [sdb] Attached SCSI removable disk
[  +1,502177] FAT-fs (sdb1): Volume was not properly unmounted. Some data may be corrupt. Please run fsck.
```

4) Identifying USB device on Virtualbox:
   a) Simply connect your device and expand USB, once you point to your device VendorID and DeviceID (ProductID) are displayed in hex.



5) Adjust usb_device_id table with your VendorId and DeviceID

```c
//usb_device_id provides a list of different types of USB devices that the driver supports
const struct usb_device_id etx_usb_table[] = {
    { USB_DEVICE( 0x0781, 0x5567 ) },
    { } /* Terminating entry */
};
```

6) Compile software

```
make[1]: Entering directory '/usr/src/linux-headers-5.15.0-60-generic'
  CC [M]  /home/woab/usb_driver/usb_driver.o
  MODPOST /home/woab/usb_driver/Module.symvers
  CC [M]  /home/woab/usb_driver/usb_driver.mod.o
  LD [M]  /home/woab/usb_driver/usb_driver.ko
  BTF [M] /home/woab/usb_driver/usb_driver.ko
Skipping BTF generation for /home/woab/usb_driver/usb_driver.ko due to unavailability of vmlinux
make[1]: Leaving directory '/usr/src/linux-headers-5.15.0-60-generic'
root@woab-VirtualBox:/home/woab/usb_driver#
```

7) Based on my understanding drivers will probe devices in chronological order. It means that if any USB driver was loaded before yours and this already loaded driver matches your device it will take control of it. To prevent this behaviour we need to unload existing drivers and load ours first.

a) Check your kernel version and remove existing drivers. Make sure drivers are not in use. Otherwise you will face error like below:

```
root@woab-VirtualBox:/home/woab/usb_driver# uname -a
Linux woab-VirtualBox 5.15.0-60-generic #66-Ubuntu SMP Fri Jan 20 14:29:49 UTC 2023 x86_64 x86_64 x86_64 GNU/Linux
root@woab-VirtualBox:/home/woab/usb_driver#
root@woab-VirtualBox:/home/woab/usb_driver# lsmod | grep usb
usbhid                 65536  0
usb_storage            77824  2 uas
hid                   151552  2 usbhid,hid_generic
root@woab-VirtualBox:/home/woab/usb_driver# rmmod usbhid
root@woab-VirtualBox:/home/woab/usb_driver# rmmod uas
root@woab-VirtualBox:/home/woab/usb_driver# rmmod usb_storage
rmmod: ERROR: Module usb_storage is in use
root@woab-VirtualBox:/home/woab/usb_driver# rmmod usb_storage
root@woab-VirtualBox:/home/woab/usb_driver# lsmod | grep usb
root@woab-VirtualBox:/home/woab/usb_driver#
```

b) Load your driver first and then load again previously unloaded:

```
root@woab-VirtualBox:/home/woab/usb_driver# insmod ./usb_driver.ko
root@woab-VirtualBox:/home/woab/usb_driver# insmod /lib/modules/5.15.0-60-generic/kernel/drivers/usb/storage/uas.ko
insmod: ERROR: could not insert module /lib/modules/5.15.0-60-generic/kernel/drivers/usb/storage/uas.ko: Unknown symbol in module
root@woab-VirtualBox:/home/woab/usb_driver# insmod /usr/lib/modules/5.15.0-60-generic/kernel/drivers/hid/usbhid/usbhid.ko
root@woab-VirtualBox:/home/woab/usb_driver# insmod /lib/modules/5.15.0-60-generic/kernel/drivers/usb/storage/uas.ko
insmod: ERROR: could not insert module /lib/modules/5.15.0-60-generic/kernel/drivers/usb/storage/uas.ko: Unknown symbol in module
root@woab-VirtualBox:/home/woab/usb_driver# insmod /lib/modules/5.15.0-60-generic/kernel/drivers/usb/storage/usb-storage.ko
root@woab-VirtualBox:/home/woab/usb_driver# insmod /lib/modules/5.15.0-60-generic/kernel/drivers/usb/storage/uas.ko
root@woab-VirtualBox:/home/woab/usb_driver#
root@woab-VirtualBox:/home/woab/usb_driver# lsmod | grep usb
usb_storage            77824  1 uas
usbhid                 65536  0
usb_driver             16384  0
hid                   151552  2 usbhid,hid_generic
root@woab-VirtualBox:/home/woab/usb_driver#
```

c) As you can see you need to load usb-storage.ko before uas.ko which is opposite to unloading operation.In dmesg you can verify if usbcore successfully loaded drivers:

```
[mar15 09:14] usbcore: registered new interface driver EmbeTronicX USB Driver
[ +17,883491] uas: Unknown symbol usb_stor_sense_invalidCDB (err -2)
[  +0,000009] uas: Unknown symbol usb_stor_adjust_quirks (err -2)
[mar15 09:15] input: VirtualBox USB Tablet as /devices/pci0000:00/0000:00:06.0/usb2/2-1/2-1:1.0/0003:80EE:0021.0003/input/input9
[  +0,065639] hid-generic 0003:80EE:0021.0003: input,hidraw0: USB HID v1.10 Mouse [VirtualBox USB Tablet] on usb-0000:00:06.0-1/input0
[  +0,000031] usbcore: registered new interface driver usbhid
[  +0,000001] usbhid: USB HID core driver
[  +1,969245] uas: Unknown symbol usb_stor_sense_invalidCDB (err -2)
[  +0,000008] uas: Unknown symbol usb_stor_adjust_quirks (err -2)
[ +14,711229] usbcore: registered new interface driver usb-storage
[  +4,029919] usbcore: registered new interface driver uas
```

8) Now you can connect you USB device again and check dmesg output:

```
[mar15 09:21] usb 1-1: new high-speed USB device number 3 using ehci-pci
[  +0,377135] usb 1-1: New USB device found, idVendor=0781, idProduct=5567, bcdDevice= 1.03
[  +0,000005] usb 1-1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
[  +0,000001] usb 1-1: Product: Cruzer Blade
[  +0,000001] usb 1-1: Manufacturer: SanDisk
[  +0,000001] usb 1-1: SerialNumber: 2004341120054D0010DF
[  +0,004394] EmbeTronicX USB Driver 1-1:1.0: USB Driver Probed: Vendor ID : 0x781,     Product ID : 0x5567
[  +0,000003] USB_INTERFACE_DESCRIPTOR:
[  +0,000007] ----------------------------
[  +0,000001] bLength: 0x9
[  +0,000000] bDescriptorType: 0x4
[  +0,000000] bInterfaceNumber: 0x0
[  +0,000001] bAlternateSetting: 0x0
[  +0,000000] bNumEndpoints: 0x2
[  +0,000001] bInterfaceClass: 0x8
[  +0,000000] bInterfaceSubClass: 0x6
[  +0,000000] bInterfaceProtocol: 0x50
[  +0,000001] iInterface: 0x0

[  +0,000000] USB_ENDPOINT_DESCRIPTOR:
[  +0,000001] ------------------------
[  +0,000000] bLength: 0x7
[  +0,000000] bDescriptorType: 0x5
[  +0,000001] bEndPointAddress: 0x81
[  +0,000000] bmAttributes: 0x2
[  +0,000000] wMaxPacketSize: 0x200
[  +0,000001] bInterval: 0x0

[  +0,000001] USB_ENDPOINT_DESCRIPTOR:
[  +0,000000] ------------------------
[  +0,000000] bLength: 0x7
[  +0,000000] bDescriptorType: 0x5
[  +0,000001] bEndPointAddress: 0x2
[  +0,000000] bmAttributes: 0x2
[  +0,000000] wMaxPacketSize: 0x200
[  +0,000001] bInterval: 0x1
```