Everything You Need to Know About USB and Serial Interfaces

by N6TV

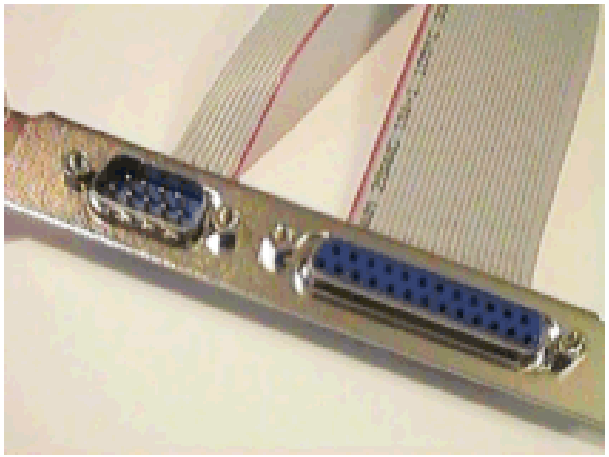
For FRC
June 8th, 2021

Presentation Overview

- Legacy PC Serial Ports
- USB Ports and Devices
- USB-to-Serial Adapters
- Using the Windows Device Manager
- Managing Serial Port Numbers
- Using Serial Ports for CW / FSK / PTT Keying
- Sharing Serial Ports
- USB Sound Cards
- Q & A

Legacy PC Serial Ports

- Originally a 25-pin male D-SUB connector (DB-25M), used with dial-up modems
- Smaller 9-pin male serial connector became standard (DE-9M) for serial, DB-25F for printers



Life was Simple

- One or two male DE-9 connectors on PC
- Accessed as COM1: or COM2:
- One DE-9 “CAT” or “RS232” connector on radio
  - Female: Elecraft IC-7700 & IC-7800

  - Male: Yaesu Kenwood

Computers “Improved”

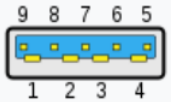
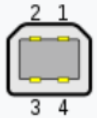
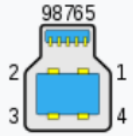
- “Real” serial and parallel ports disappear, replaced by USB ports
- Radios (until recently) still had 9-pin serial ports
- Peripherals are still using 9-pin serial ports
  - RemoteRig boxes, Rotator controllers, SteppIR antenna controllers, some band decoders, etc.
- Common Solution: USB-to-Serial adapters

USB 2.0 and 3.0 Ports

- Standard connector on most PCs and MACs

PC:

Radio:

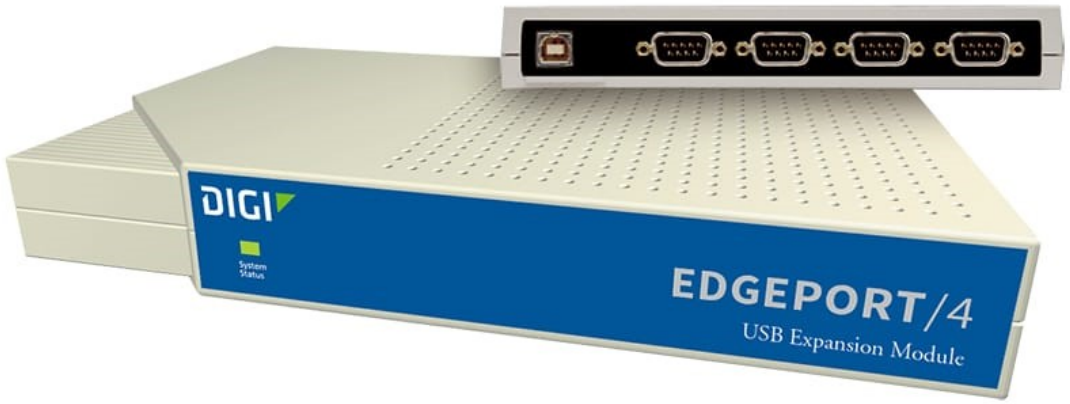
Type A  Type-A	Type A  Type-A SuperSpeed
Type B  Type-B	Type B  Type-B SuperSpeed

USB-to-Serial Adapters

Reliability and Compatibility Varies Greatly

1. Edgeport – Excellent, stable, supports MMTTY directly
2. Eltima – Included with microHAM interfaces
3. FTDI – very good, stable, requires EXTFSK for MMTTY. Used internally by Elecraft K3 & K4.
4. Silicon Labs (built in to Icom, Kenwood, Yaesu)
5. Prolific – **AVOID!** Uninstall drivers, recycle.

Digi International Edgeport/4



- One USB 2.0 Type B connector
- Four independent DE-9M serial ports
- Windows automatically finds and installs drivers

Digi International Edgeport/8

- One USB 2.0 Type B connector
- Eight independent DE-9M serial ports
- Windows automatically finds and installs drivers

StarTech.com ICUSB2324I 4-Port FTDI

- One USB 2.0 Type B connector
- Four independent FTDI DE-9M serial ports
- Separate 5V Power Supply

StarTech.com ICUSB2328I 8-Port FTDI

- One USB 2.0 Type B connector
- Eight independent FTDI DE-9M serial ports
- Separate 5V Power Supply

microHAM uses Eltima drivers

microHAM MK2R+

- One USB Type B connector
- Custom Eltima serial port device drivers
- Custom cables for transceiver ports
- Virtual serial ports created by microHAM “Router”

Recommended FTDI USB-to-Serial Adapters

FTDI CHIPI-X10 - $17

GearMo 2-port - $30

GearMo 4-port - $40

Prolific USB-to-Serial Adapters

- Widely available, cheap (but many counterfeits)
- Prolific Device Driver does *not* play well with others
- Please DO NOT USE them, ever
- Uninstall any Prolific device drivers with Device Manager
- Devices often look like this:

Connecting USB-to-Serial Adapters

- Connect FTDI, Elecraft, or Edgeport device to PC
- Windows (usually) locates and installs appropriate device driver(s)
- COM port numbers assigned sequentially
- Use Windows Device Manager to view assigned COM Port number
- COM port number will change if you connect a device to a different USB Hub (e.g. from USB 2.0 port to USB 3.0 port)

Connecting USB Radios / Devices

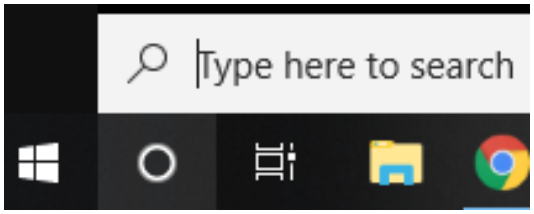
- Important: Install the manufacturer's device driver first, *then* connect the device
  - Icom, Kenwood, Yaesu, microHAM
  - (Usually not required for Elecraft / FTDI)
- If you forget and connect radio first, use Device Manager to uninstall "Unknown Device", then start over
- COM port numbers assigned sequentially
- COM port numbers can be changed

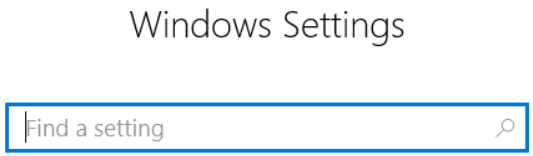
Using the Windows Device Manager

- **Right click** on Windows **Start** Button 
- Click **Device Manager**
  -or-
- Windows Key  + R (Run): **devmgmt.msc**
- Important Tip (before Windows 10):
  Always set the System Environment Variable
  devmgr_show_nonpresent_devices to **1**

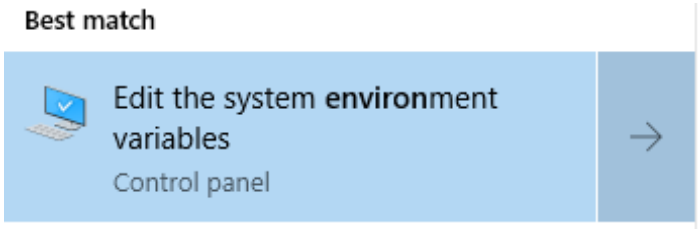
Setting System Environment Variable

- Type “Environment” in Windows Search box or Windows Settings Search box

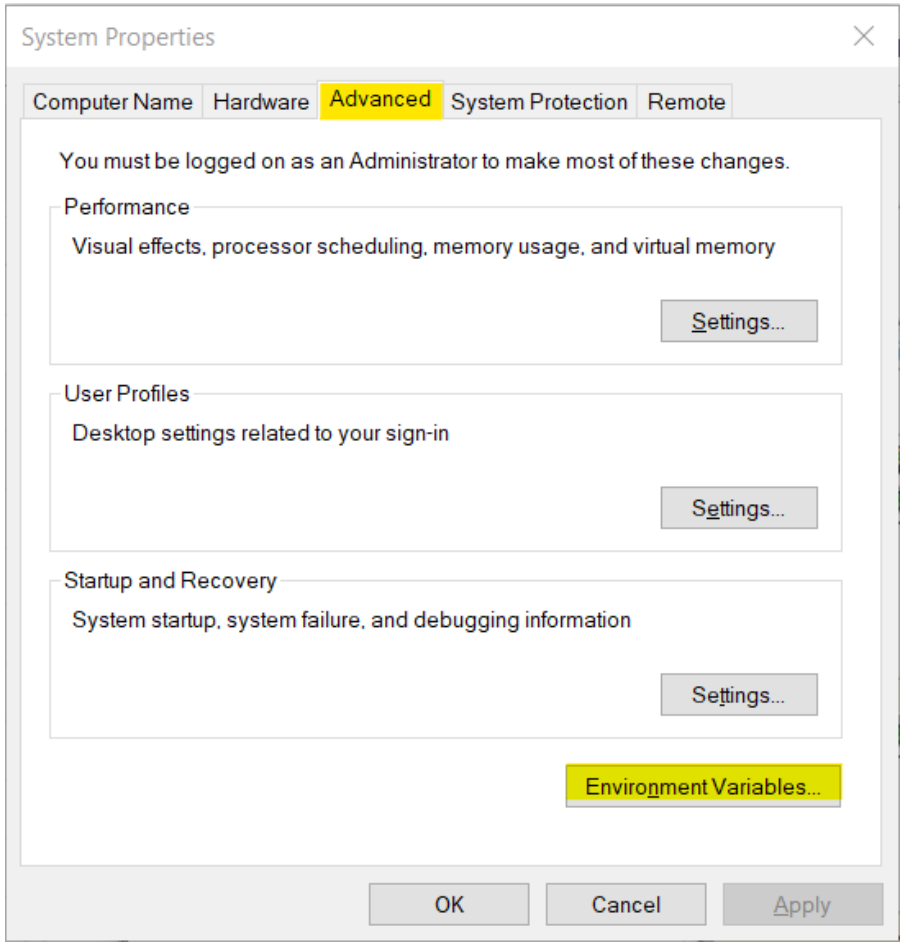




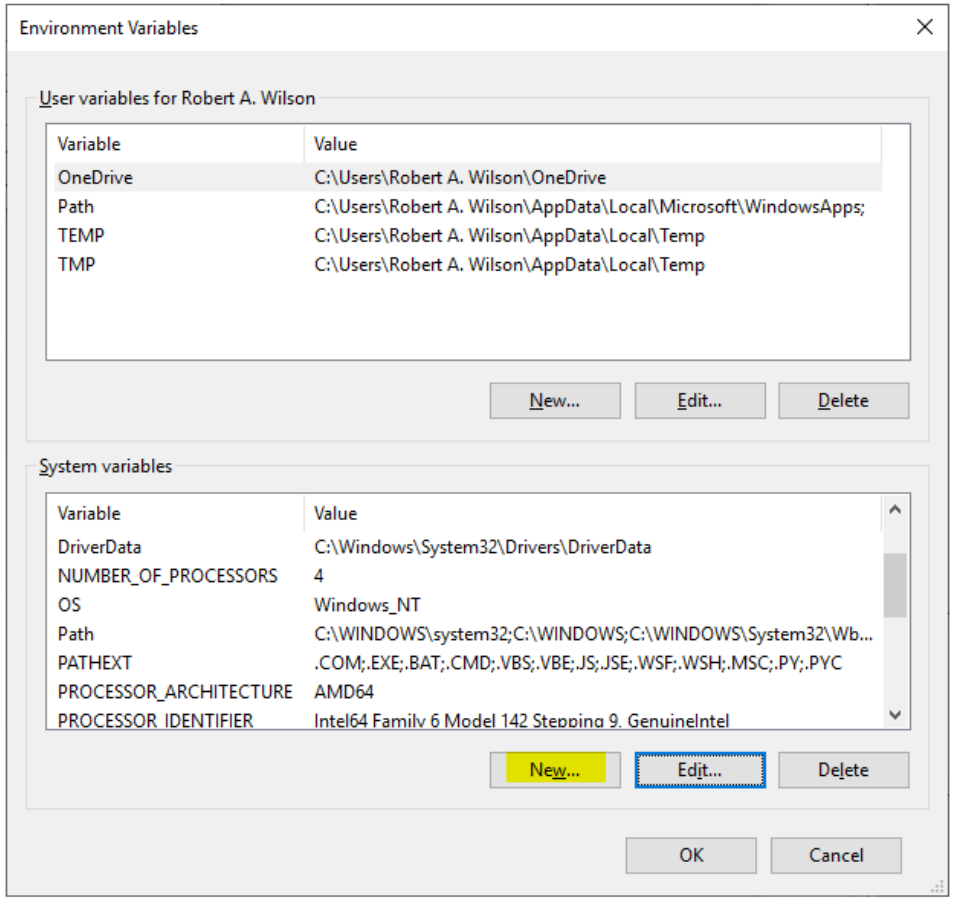
- Click “Edit the System Environment Variables”



Step 1 – Under Advanced tab click Environment Variables…

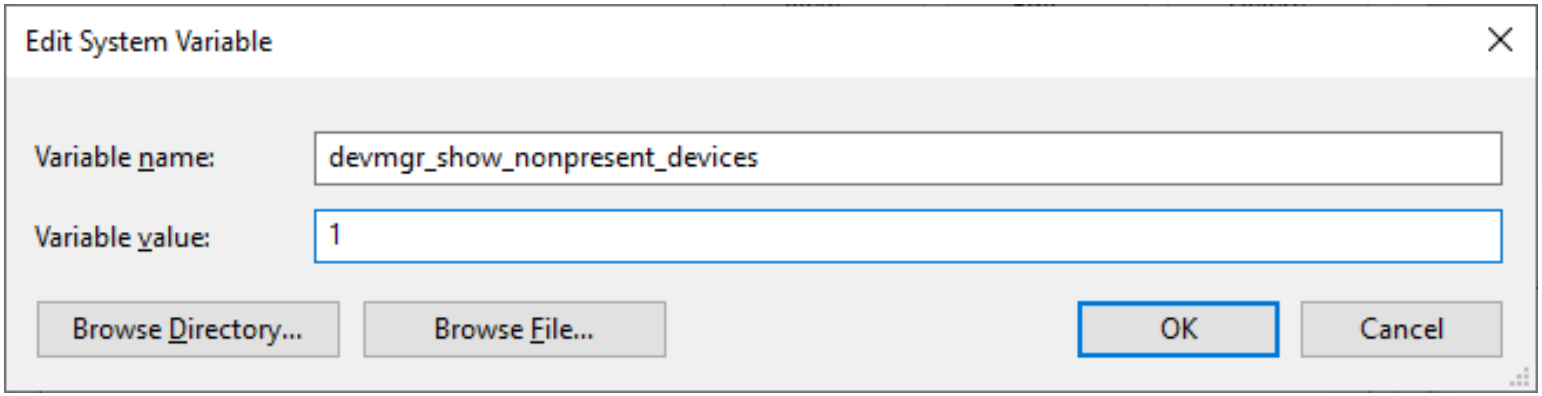


Step 2 – Under System variables, click New…



Step 3 – Add the new environment variable

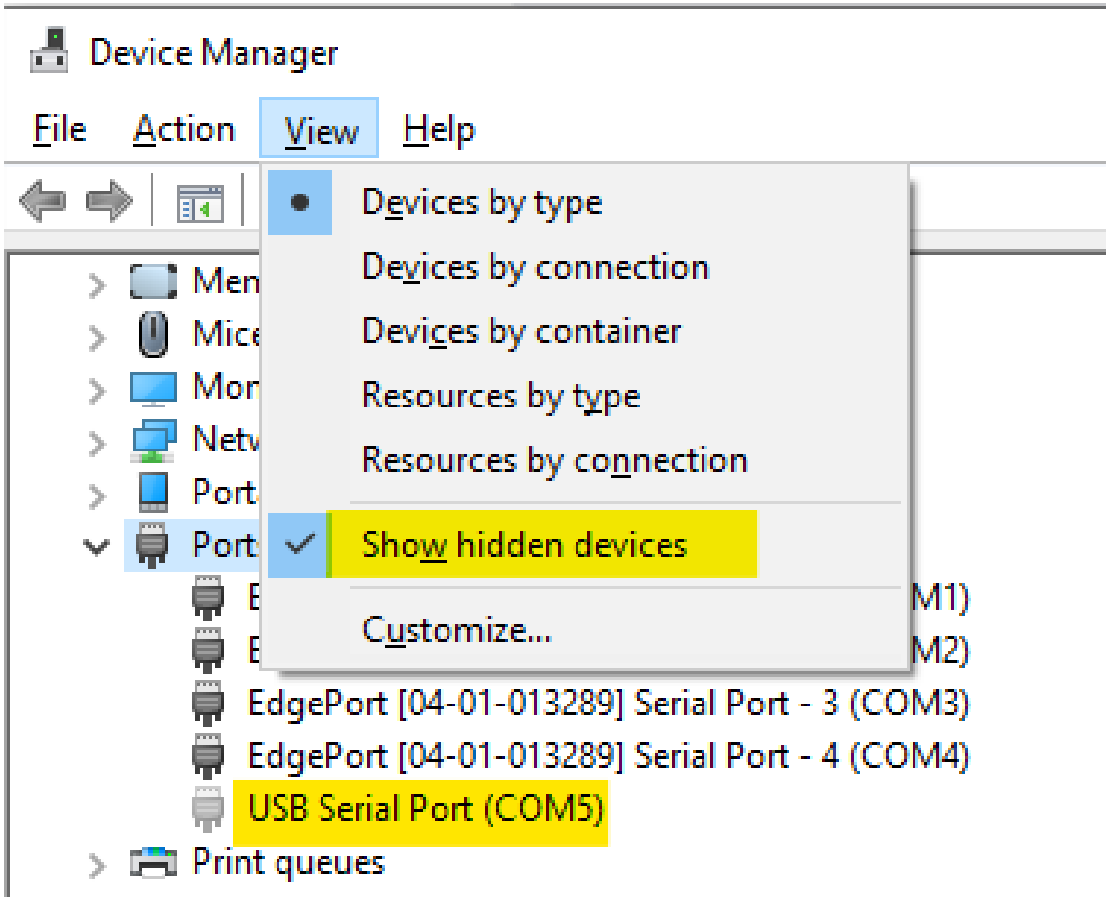
Name: **devmgr_show_nonpresent_devices**
Value: **1**



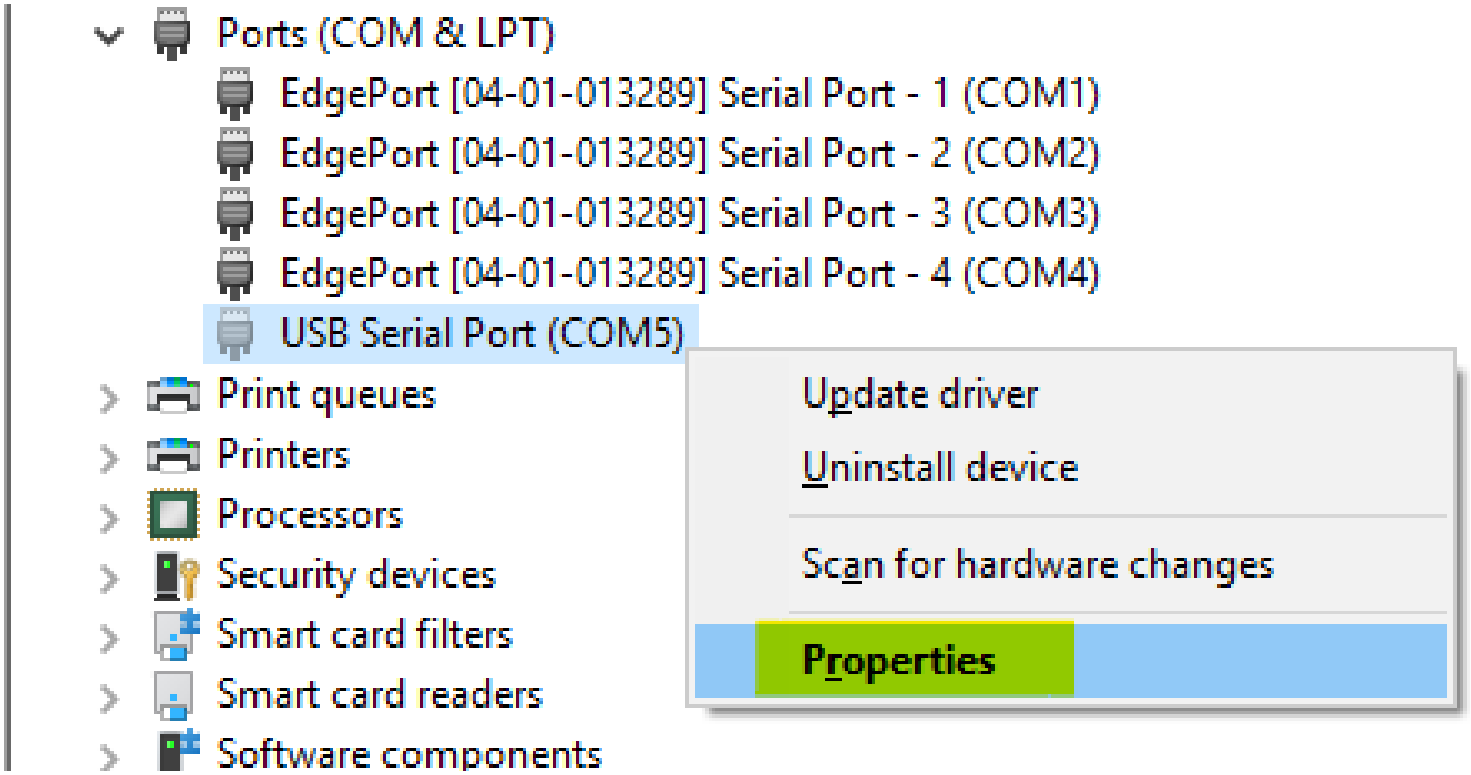
Click **OK**, *then* start Windows Device Manager

Windows Device Manager

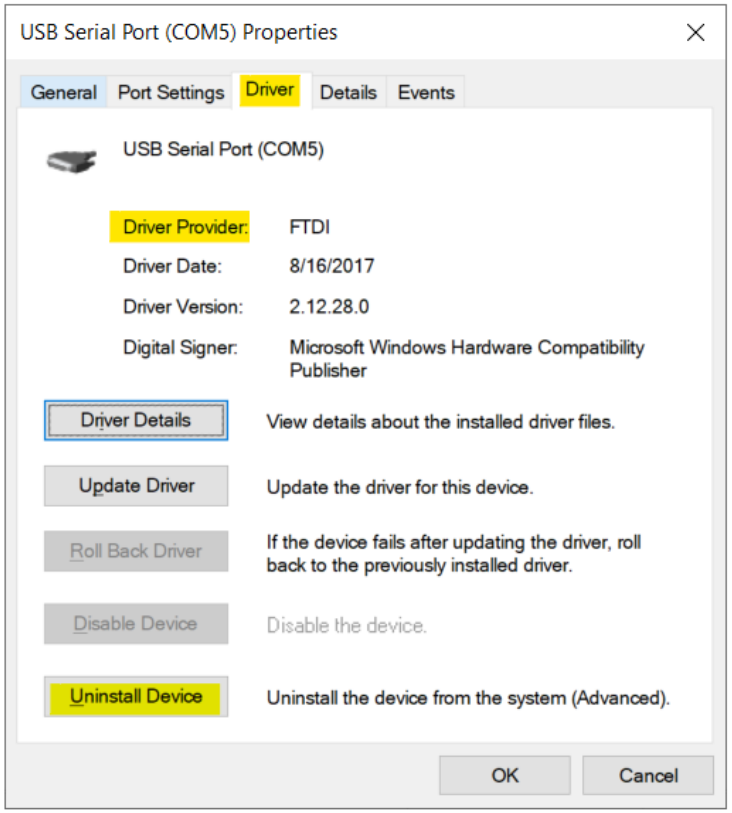
Always select **View → Show hidden devices**



Expand Ports section
Right click gray (offline) devices, Properties

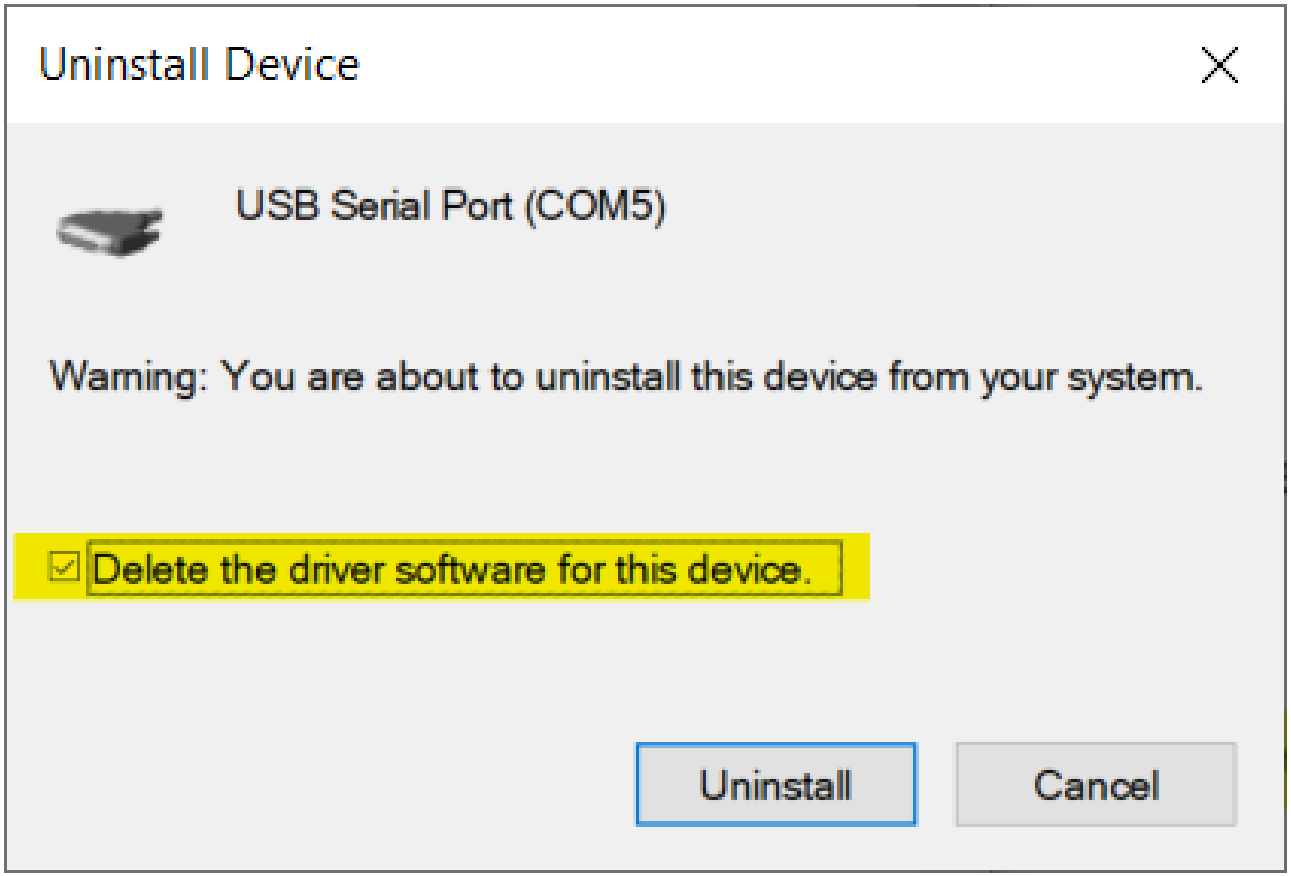


Click Driver Tab
Check that Driver Provider is *not* Prolific

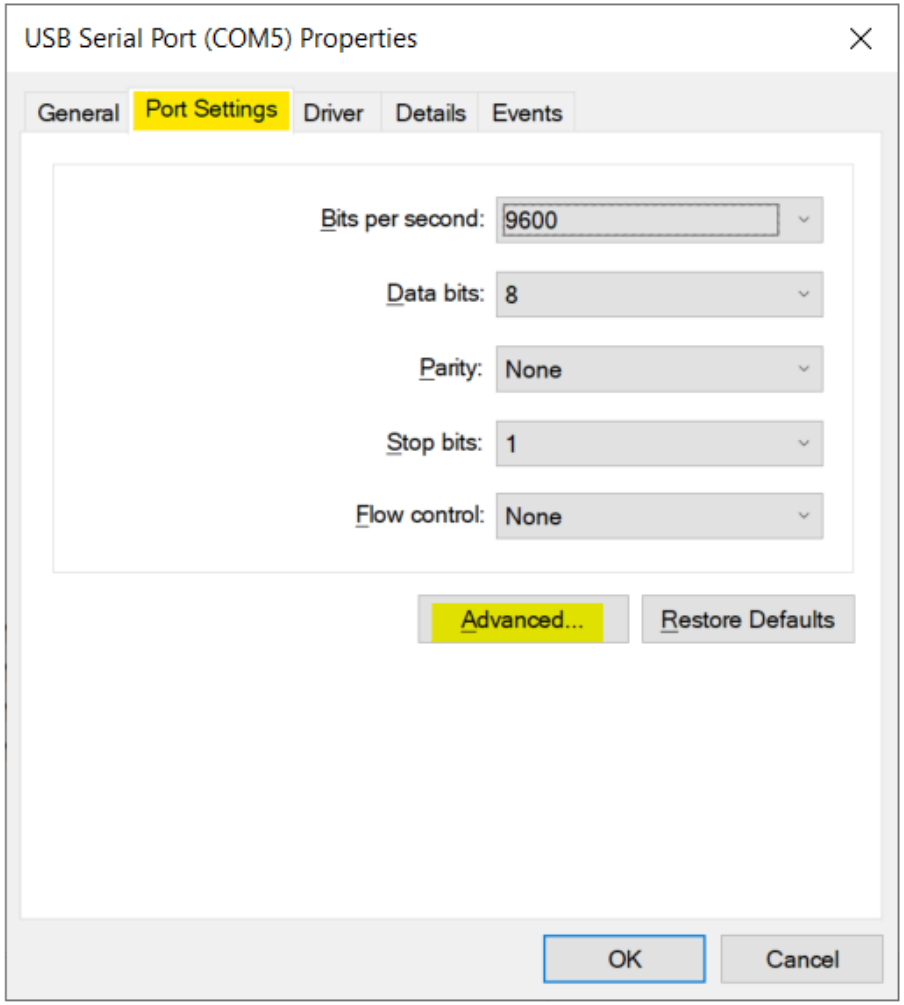


- If you see **Prolific**, click **Uninstall Device**

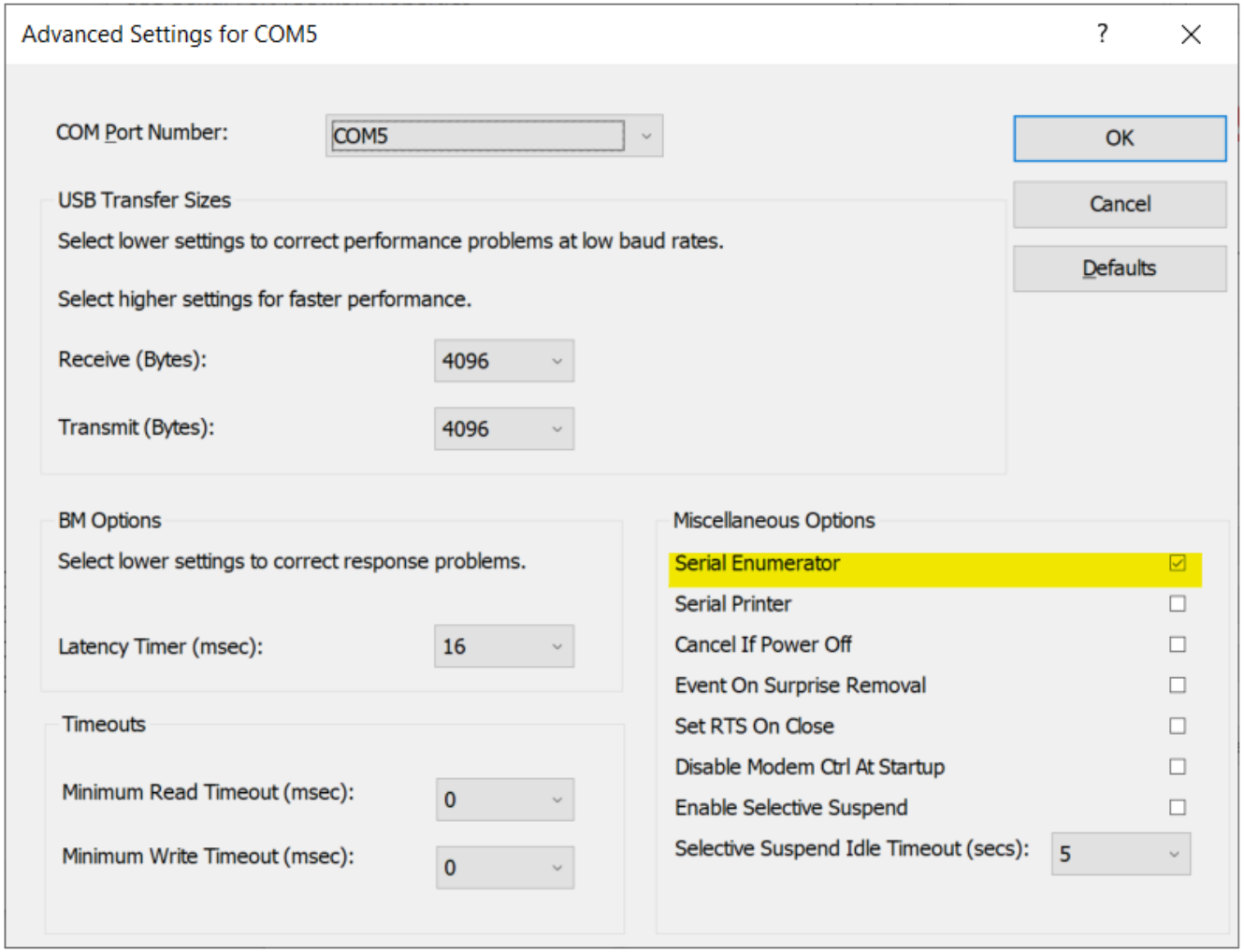
Uninstall the Prolific Device *and* Delete the Driver Software for this device



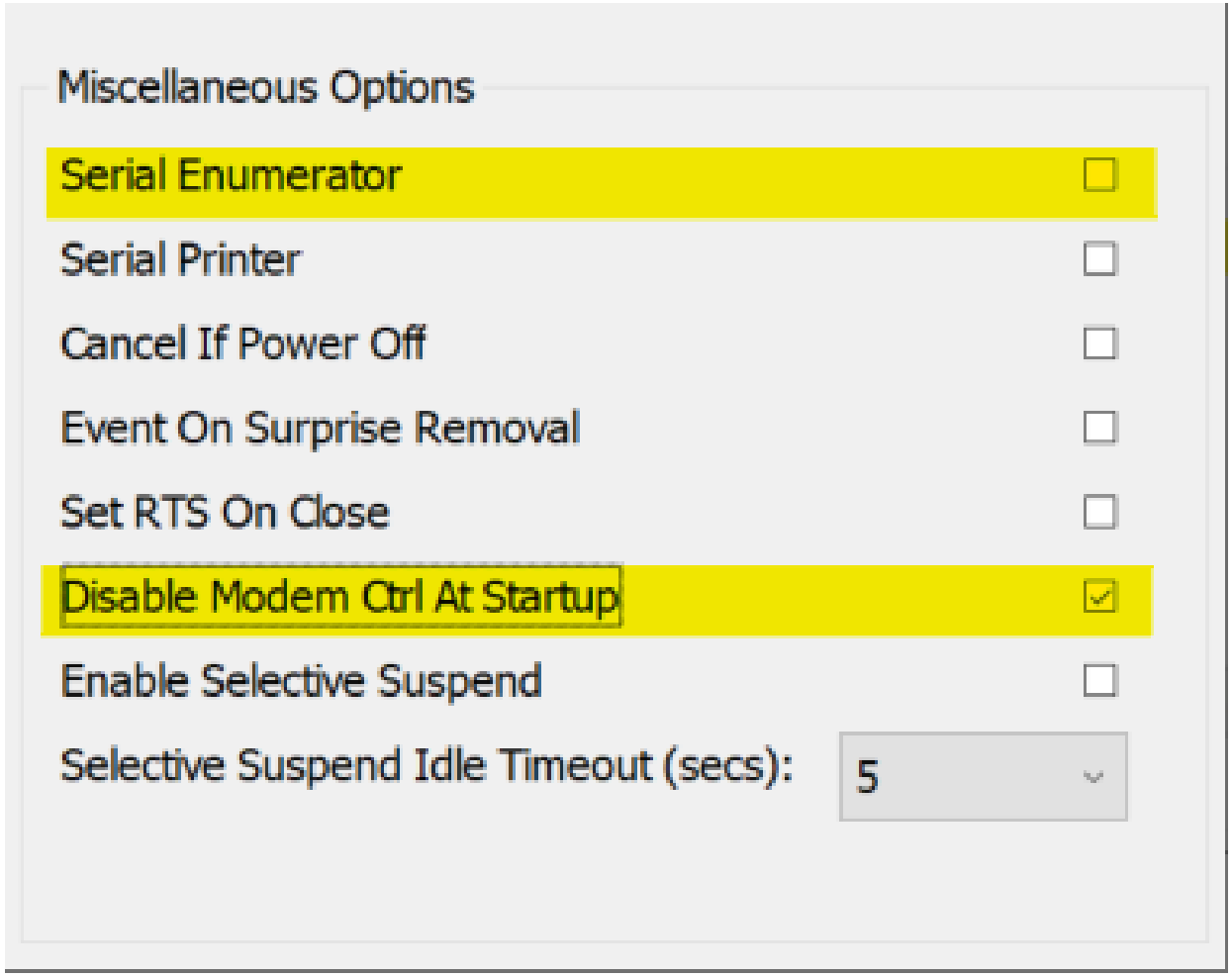
If Driver is FTDI, go to Port Settings tab
Click Advanced… button



FTDI Default Options – not good, keys radio



Change the FTDI Options To This:

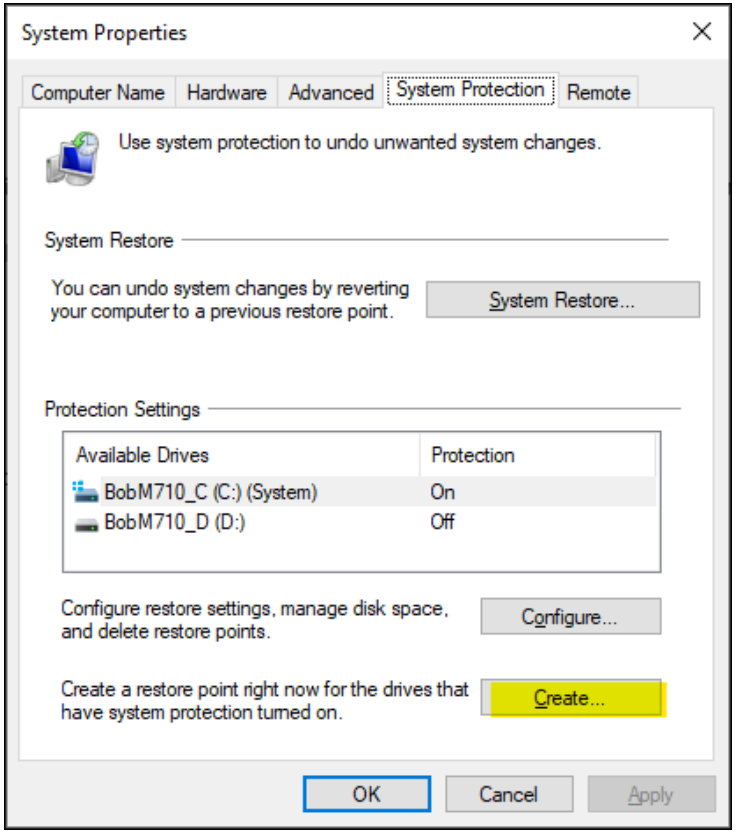


Disabling Serial Enumeration (unwanted keying) on Legacy Serial Ports (COM1:, COM2:)

- Requires Registry Edit (run regedit)
- Create a System Restore Point to allow recovery, just in case
- Locate “UpperFilter” key under HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Enum\ACPI\PNP0501\0 (or similar)
- Rename key to OldUpperFilter
- No more unwanted keying

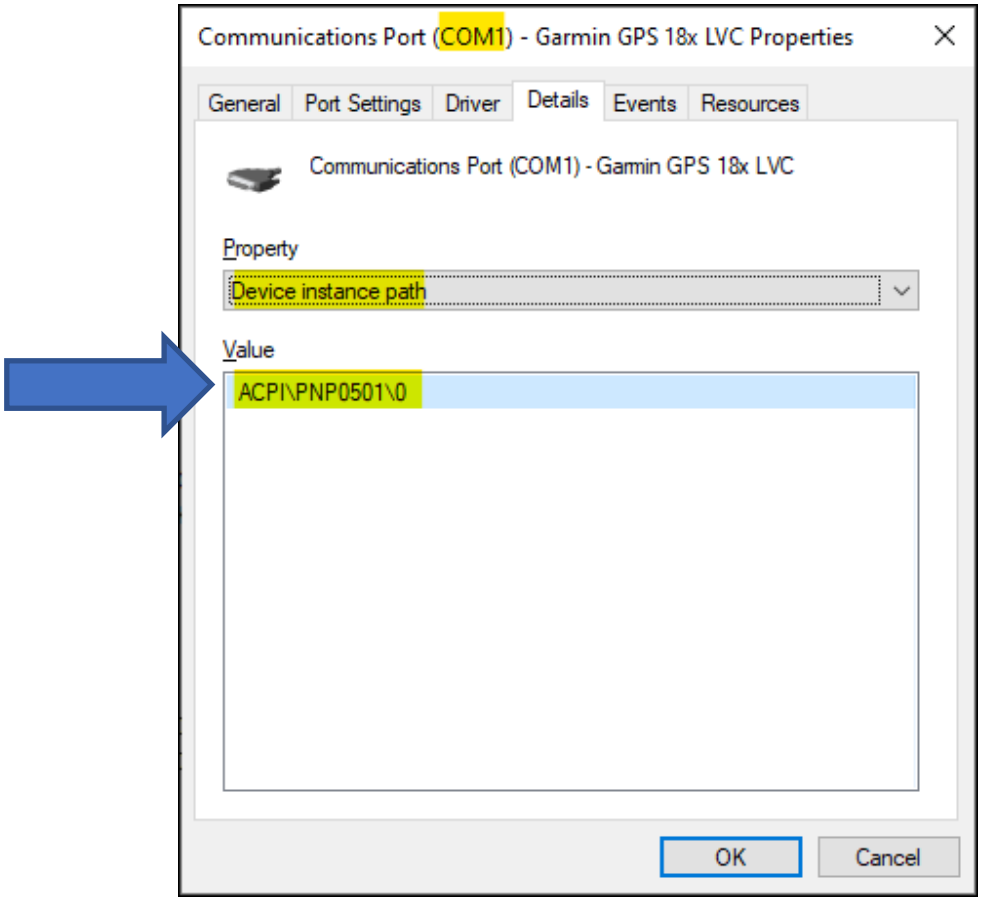
Creating a Restore Point

- System Properties, System Protection, Create (or use Windows Search box)



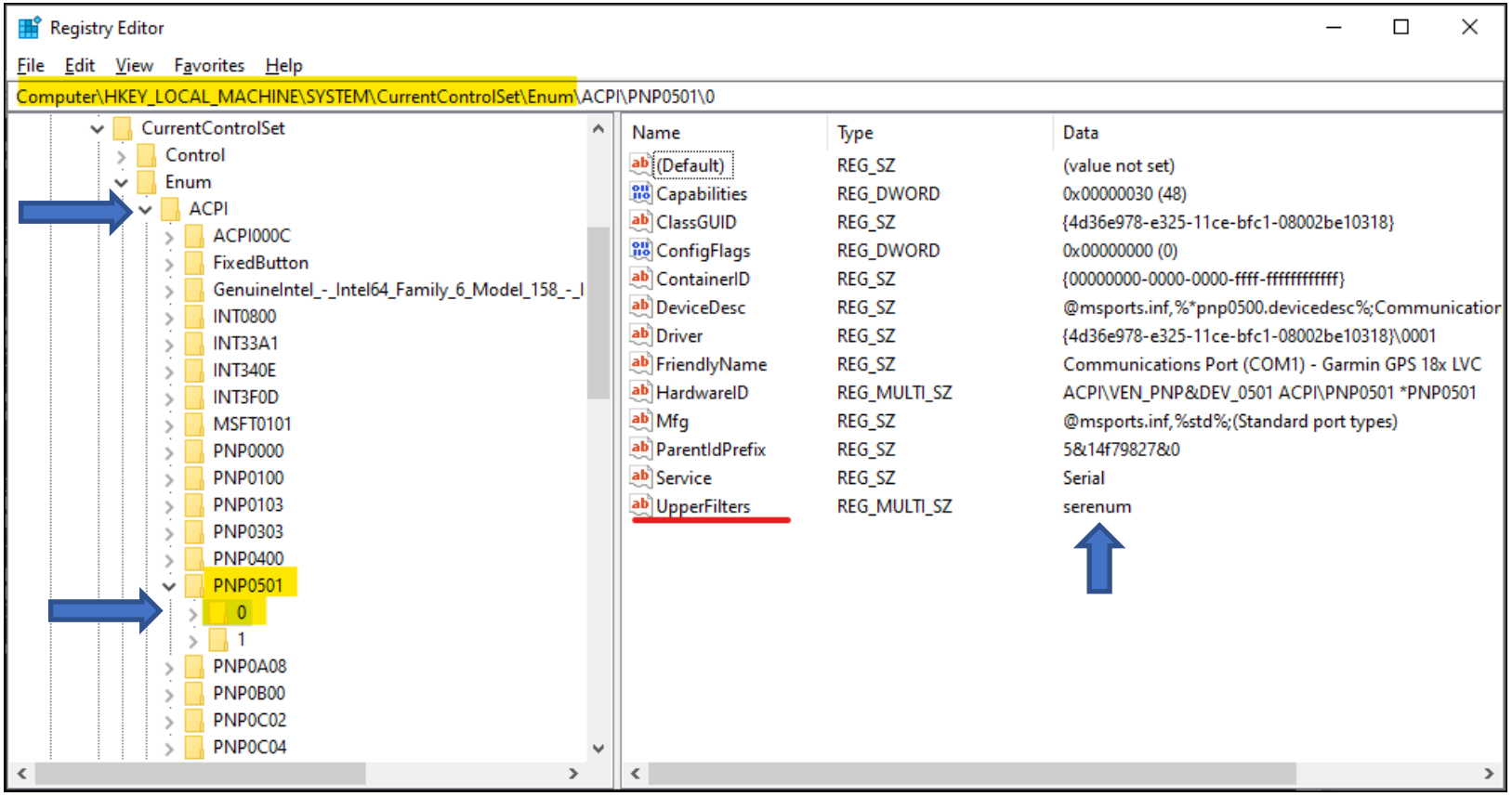
Locate Device Instance Path in Device Manager

- Device Manager (devmgmt.msc), COM1:, Properties, Details

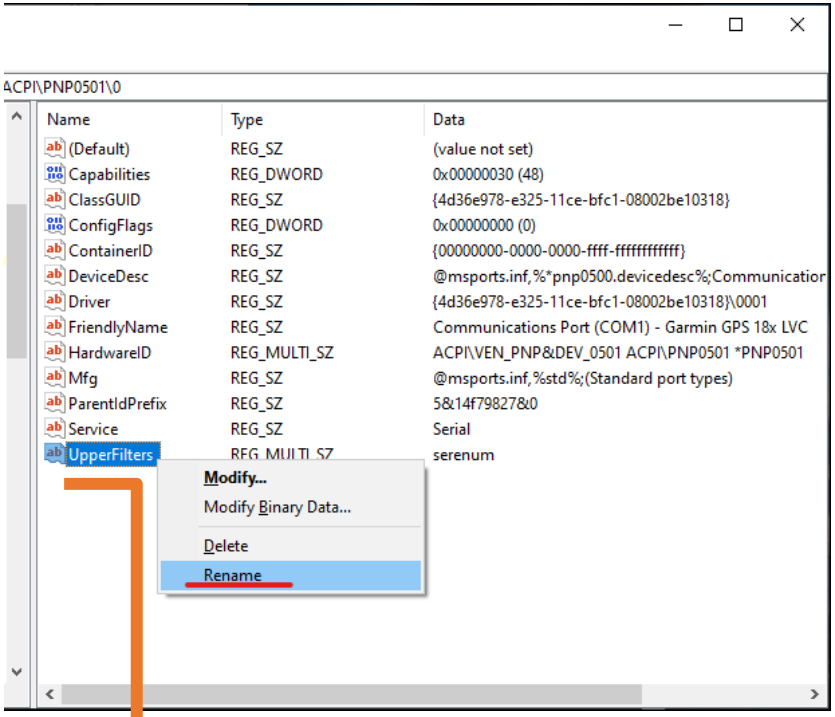


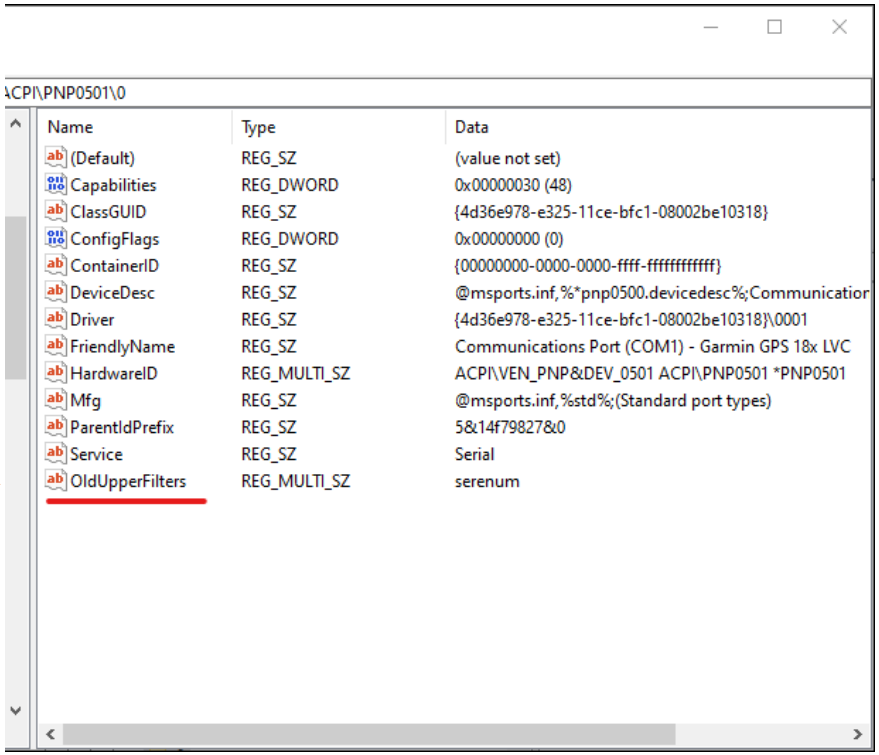
Locate Device Instance Path in Registry

- Regedit, HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Enum\

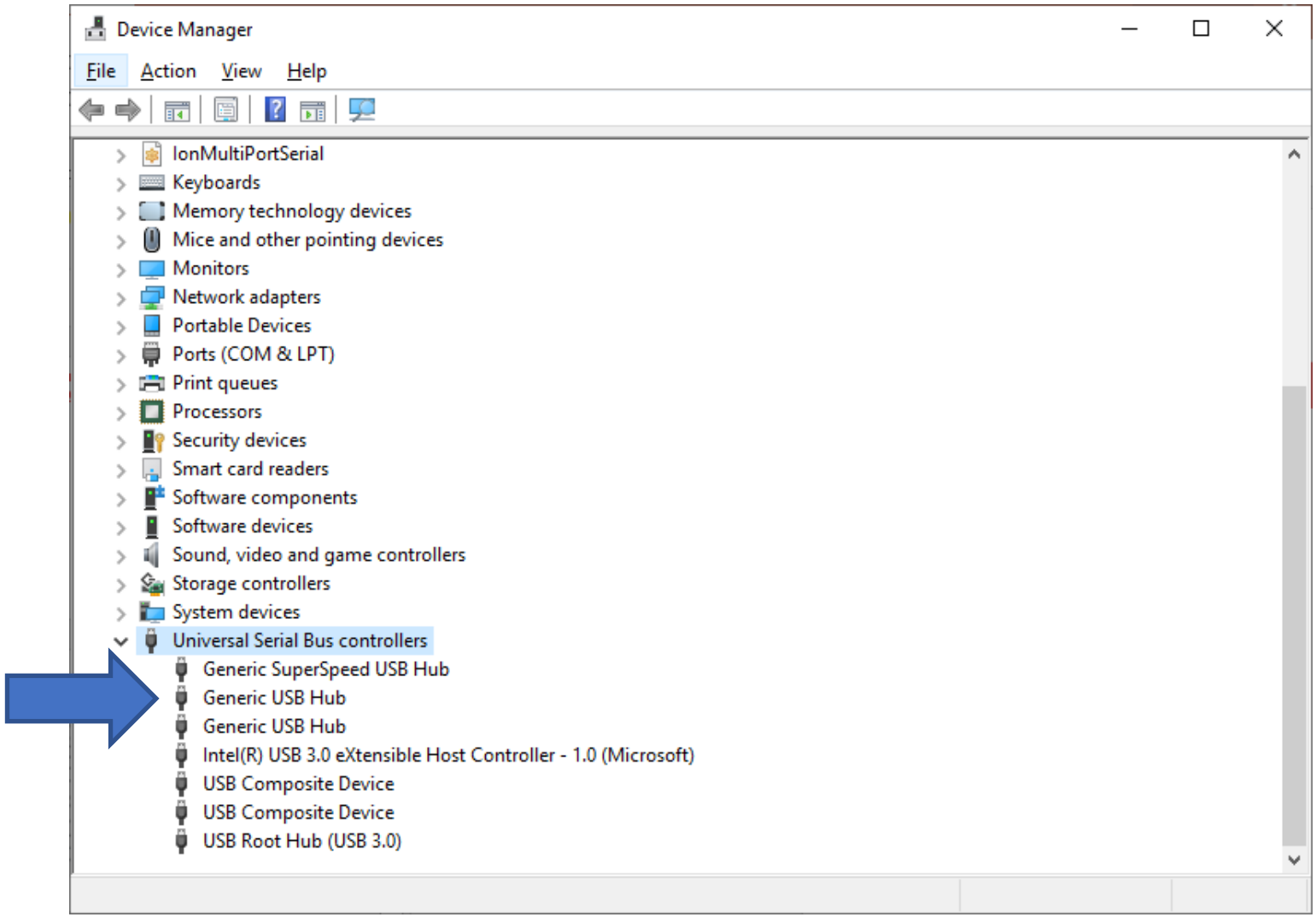


Right Click, Rename Key to OldUpperFilters

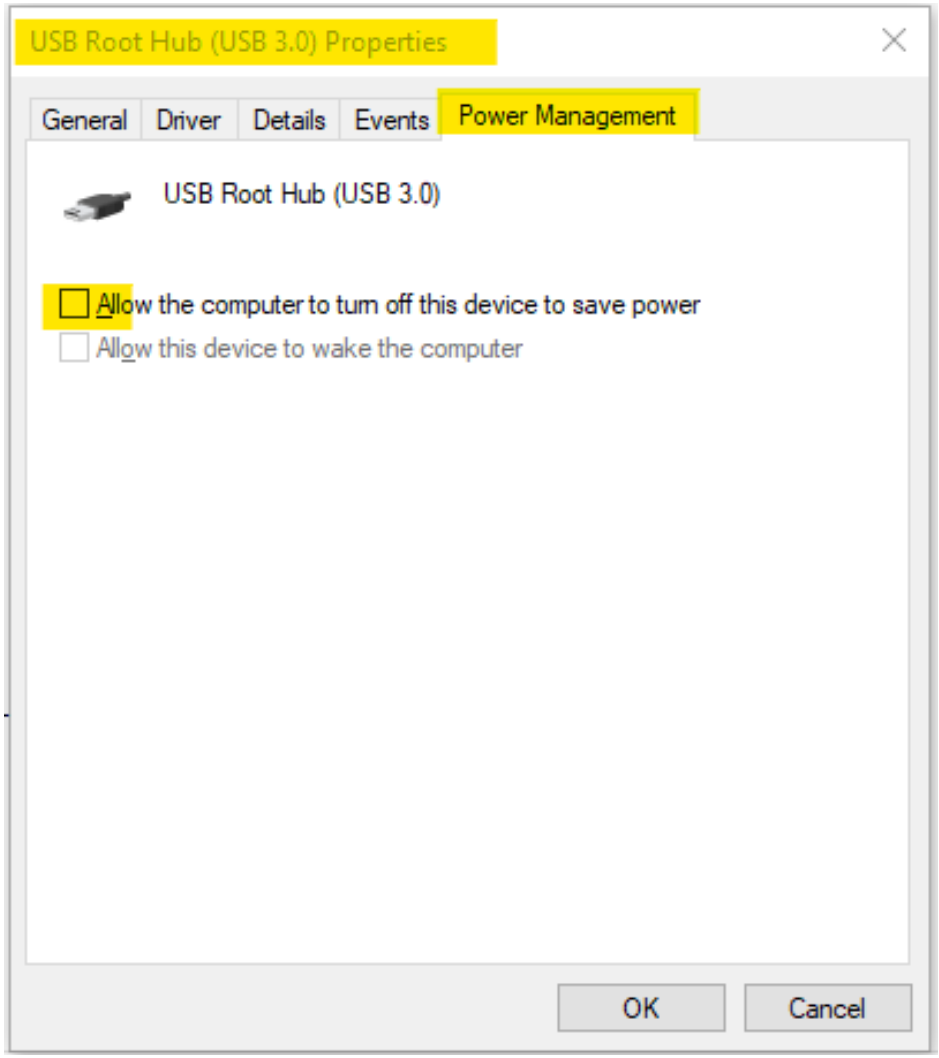




Under USB Serial Bus Controllers:
Right-Click each “Hub” device, Select Properties

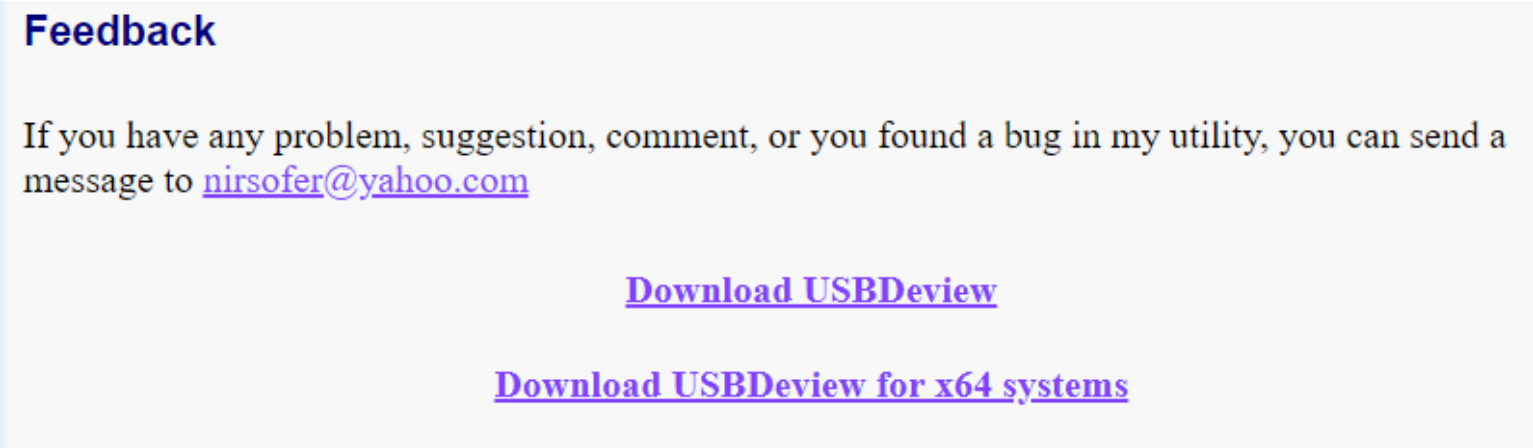


Look for Power Management Tab
Do *not* allow computer to turn off this device

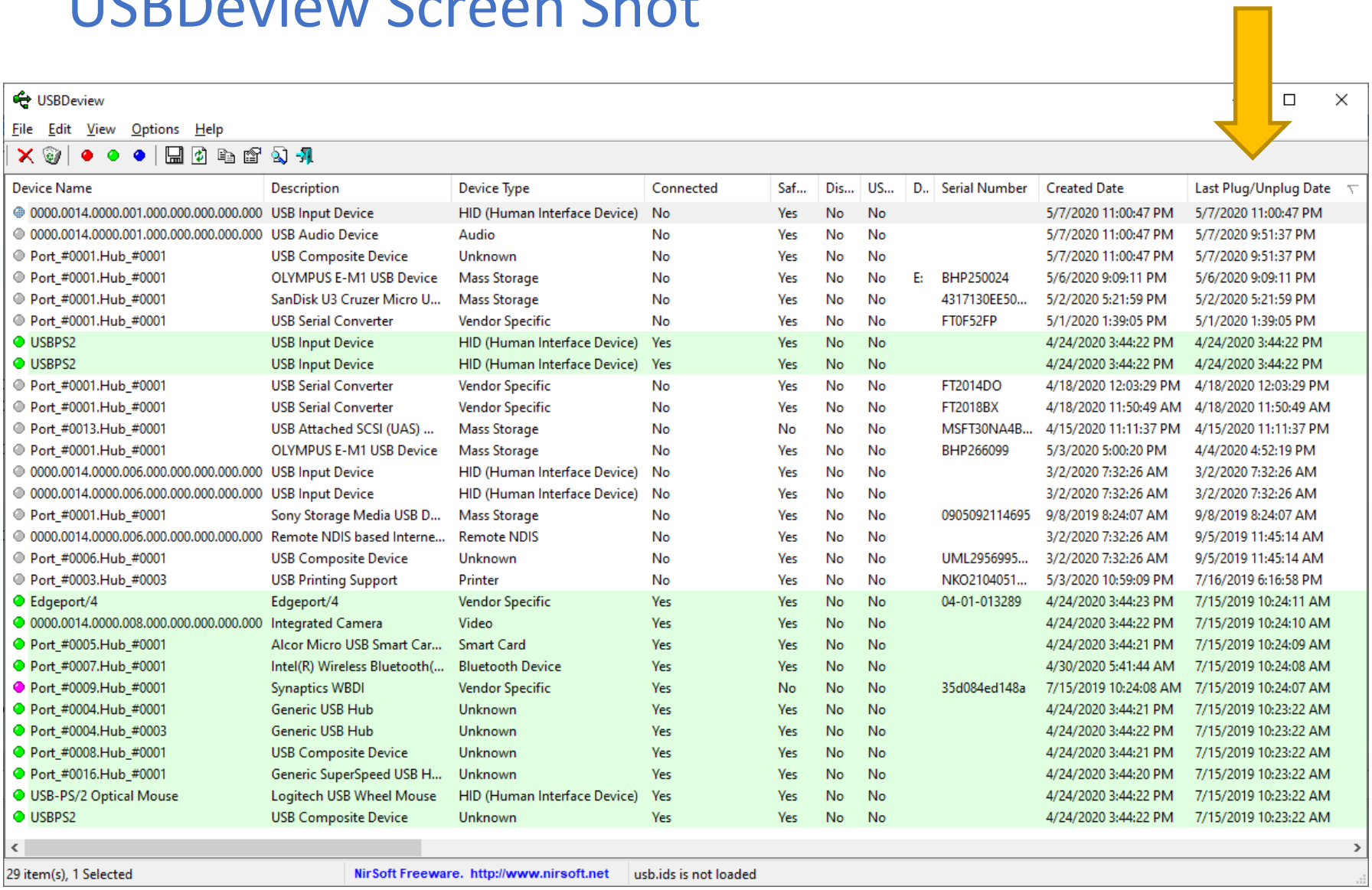


Another USB Dev. Management Tool: NirSoft's USBDeview

- Stands for USB Device View
- https://www.nirsoft.net/utils/usb_devices_view.html
- Scroll way down to the "Feedback" section to find download link:



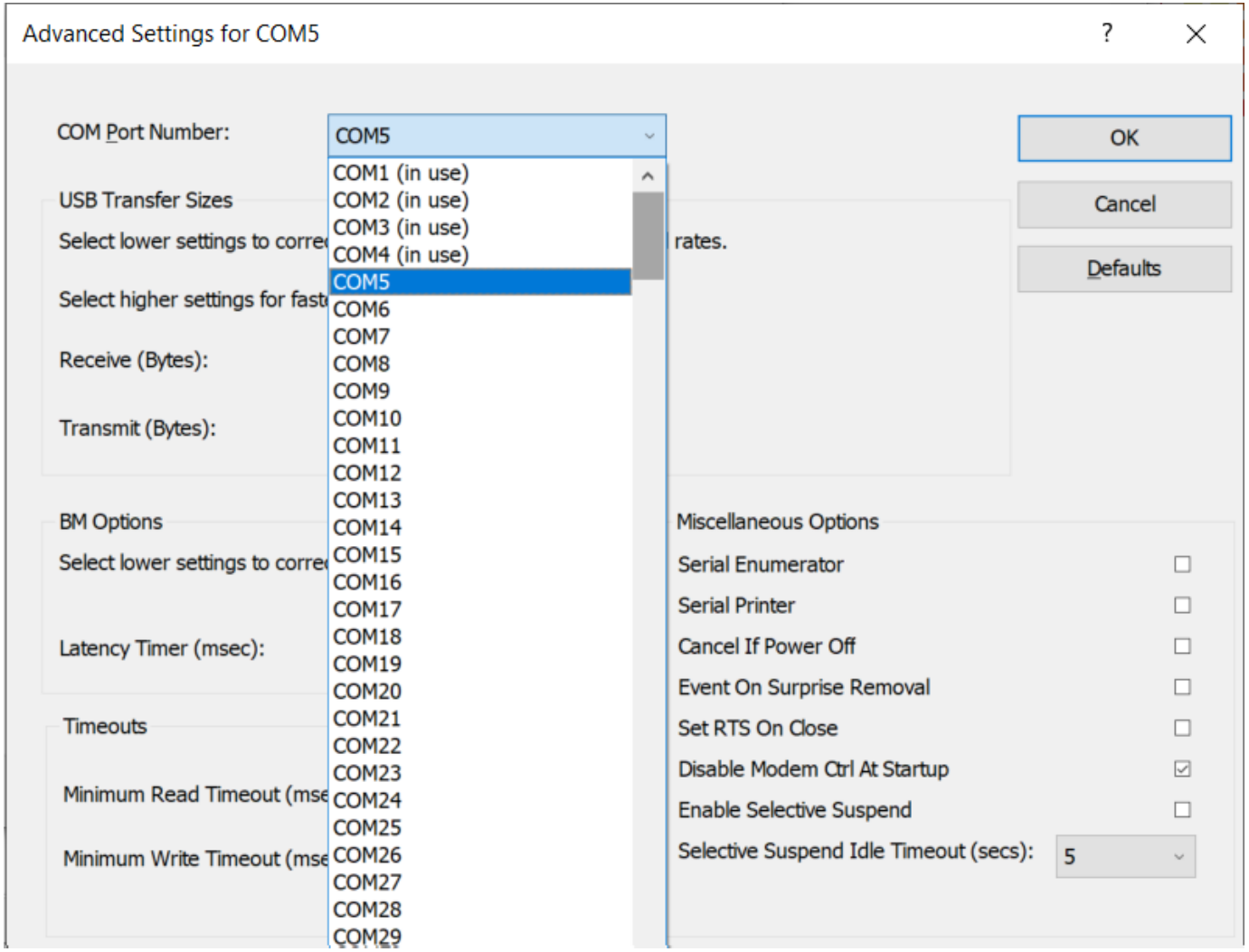
USBDeview Screen Shot



Managing COM Port Numbers

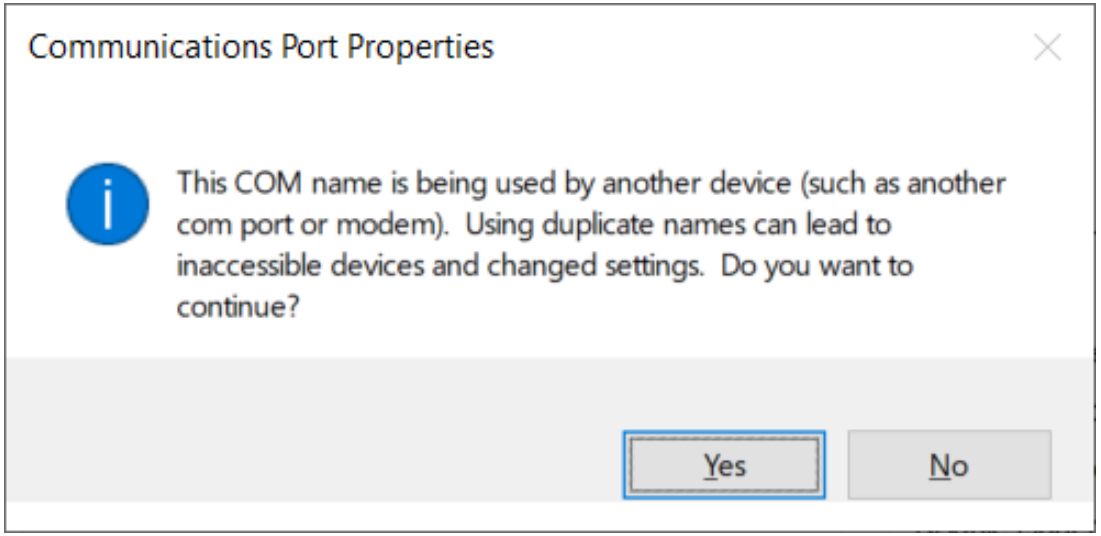
- Over time, ever increasing unique COM port numbers are assigned by Windows, difficult to keep track
- Some software doesn't support COM13: or higher
- Suggestion: renumber serial ports "left to right" to match your station layout, starting with transceivers
- First, use Windows Device Manager to uninstall all serial devices that you no longer use
- Right click on remaining COM ports, Properties, **Port Settings** tab. Click **Advanced…** button
- Renumber ports sequentially, COM3:, COM4:, COM5:, etc., "left to right"

Renumbering Serial Ports – Use Advanced Settings



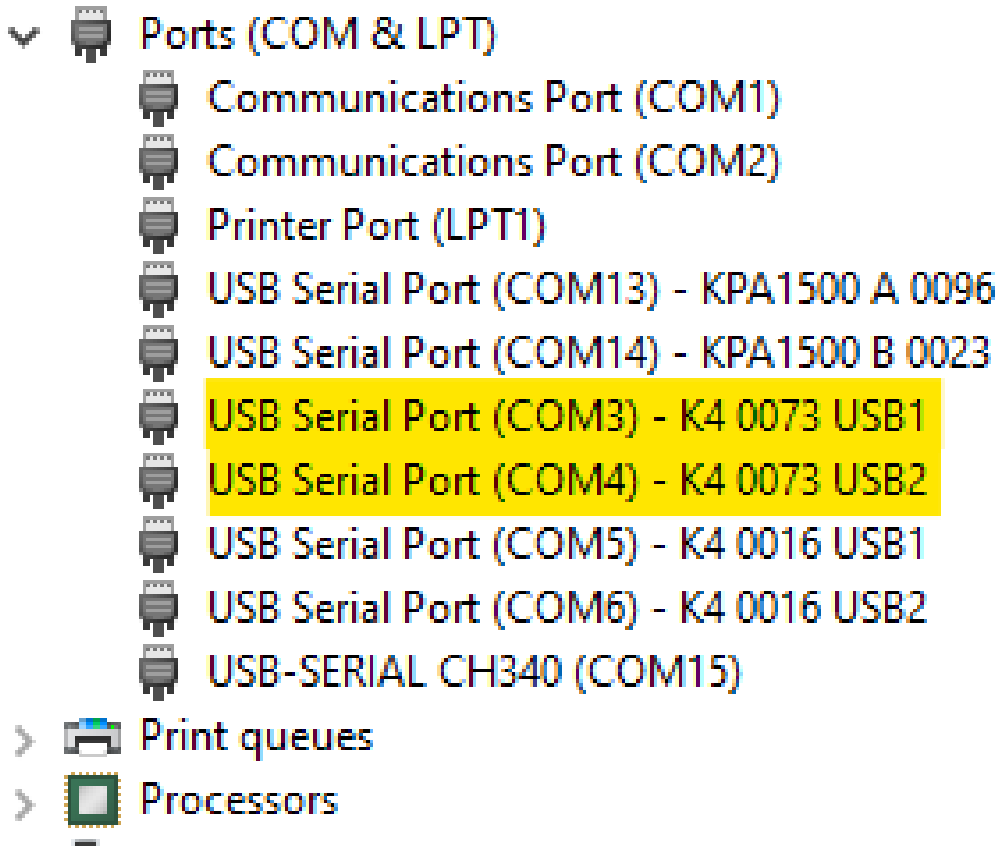
What does “In Use” Mean?

- It means this COM port number was assigned to some device, maybe years ago
- It usually does *not* mean that you can’t use it during reassignment, especially if it is “grayed out” (hidden)
- Uninstalling disconnected devices first will help
- *Usually* safe to ignore this warning and click YES:



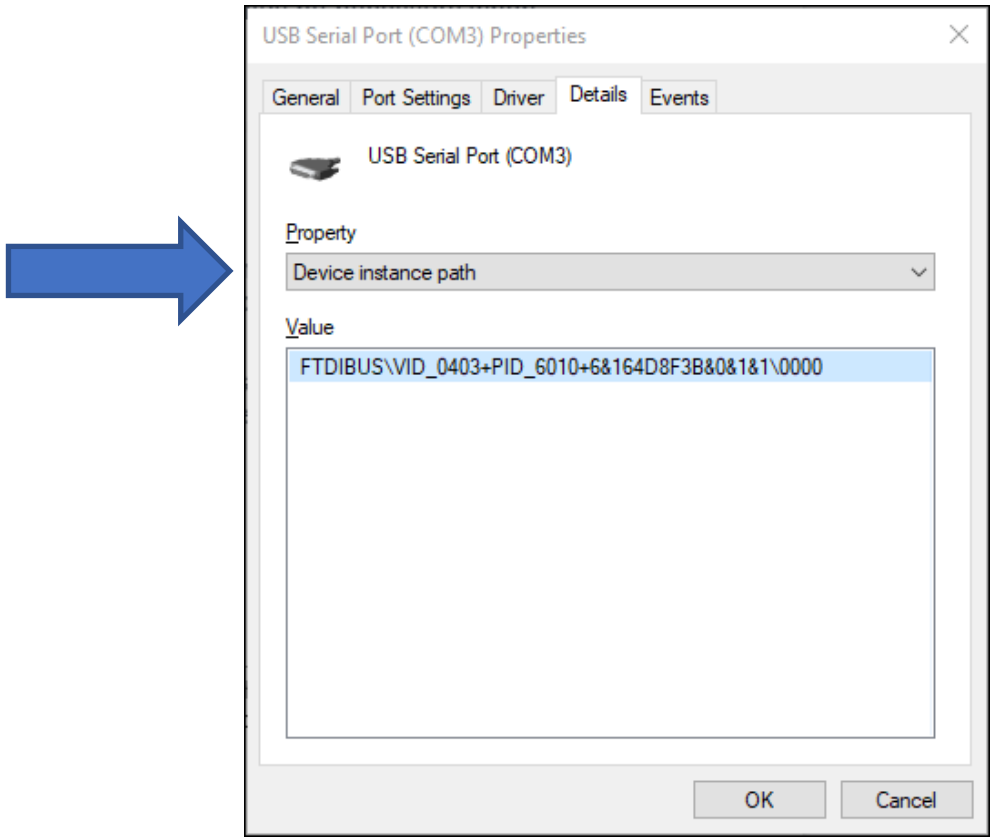
Labeling Serial Ports

- Example:



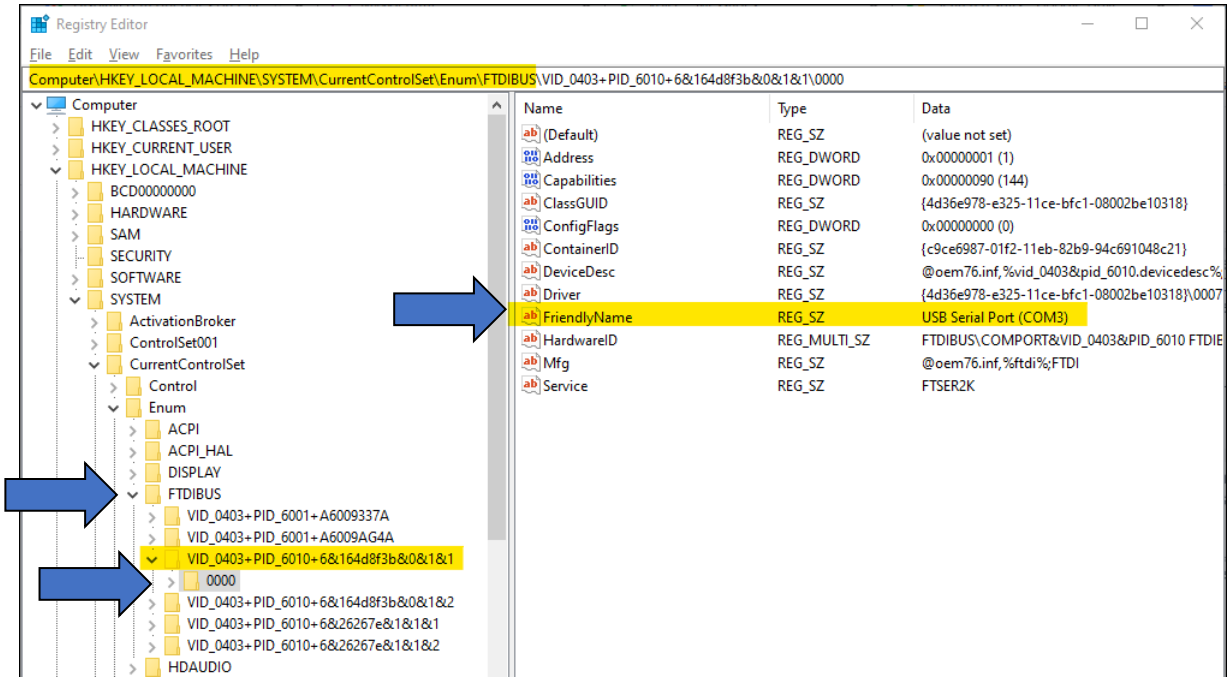
Step 1 – Note the “Device instance path”

- Right click on Serial Port, select *Properties,* select Details
- Tap “D” on keyboard to jump to “D” section of drop-down list:



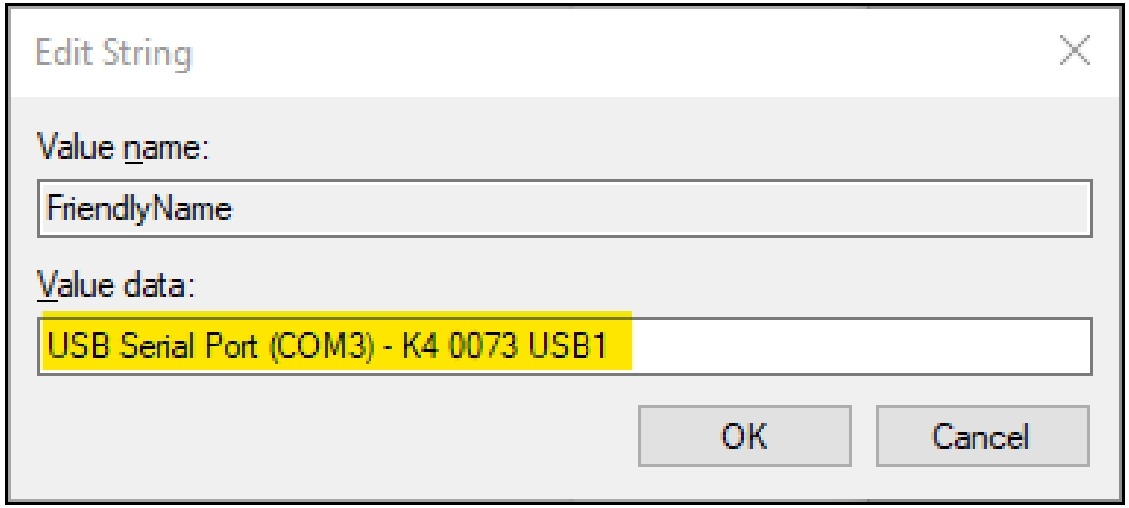
Step 2 – Use Registry Editor (regedit)

- Navigate to HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Enum
- Device Instance Path, Subkey 0000 will have the **FriendlyName**



Step 3 – Change the FriendlyName

- Double-click on **FriendlyName** (or Right-click, **Modify…**)
- Edit the FriendlyName value and click **OK**



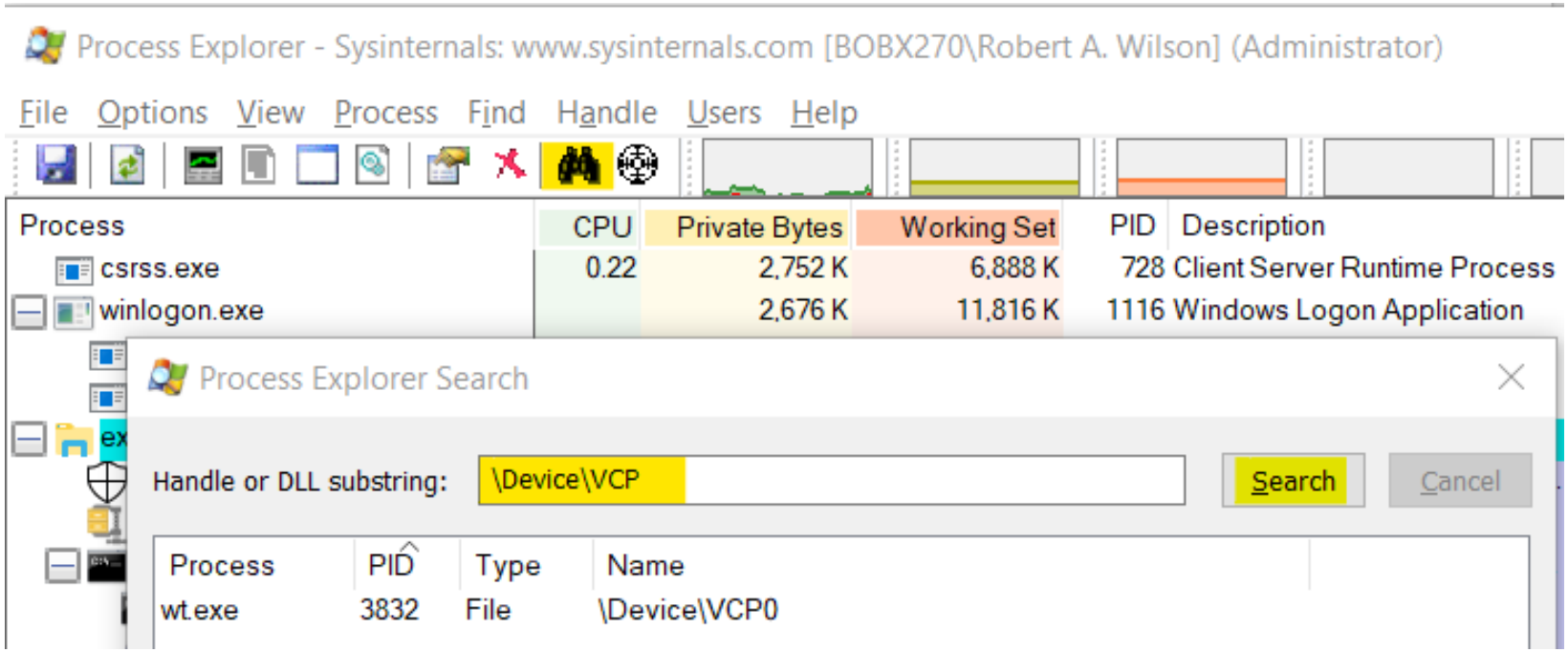
- Note: If you renumber a serial port, Windows will change the name back to the default, so renumber first, then rename

What program is currently using my serial port?

- Use Windows Process Explorer
- https://docs.microsoft.com/en-us/sysinternals/downloads/process-explorer
- On Windows 10, run **procexp64.exe** as **Administrator**
- Click Search button (binoculars icon)
- Enter one of the following partial search strings:

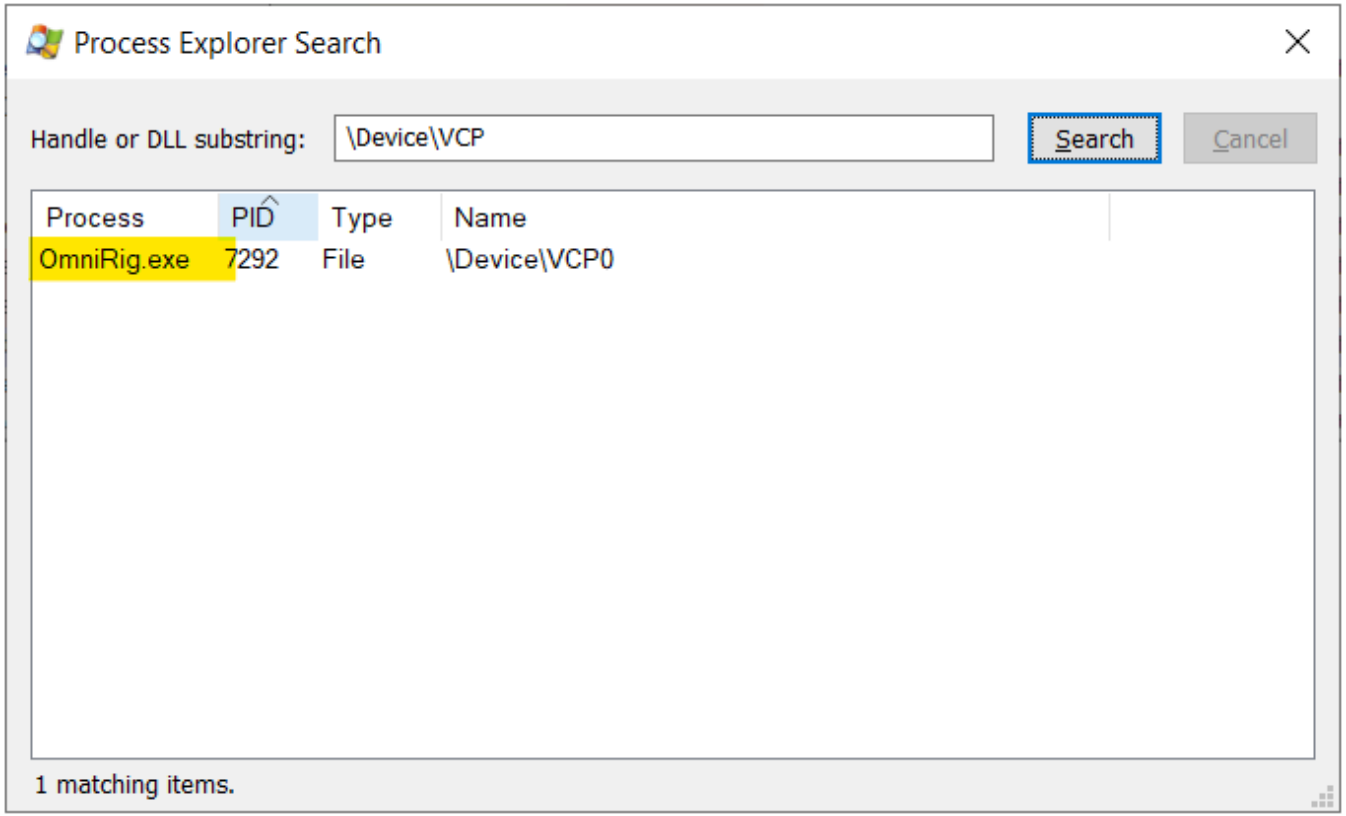
\Device\VCP – FTDI virtual serial ports
\Device\Edg – Edgeport virtual serial ports
\Device\Ser – Hardware serial ports / CH340 (Mortty)
\Device\Sil – Icom / Kenwood / Yaesu Silicon Labs ports
\Device\VSer – Eltima / vspMgr virtual serial ports

Process Explorer Search – Example 1



Win-Test (**wt.exe**) has opened the FTDI Virtual COM Port (VCP)

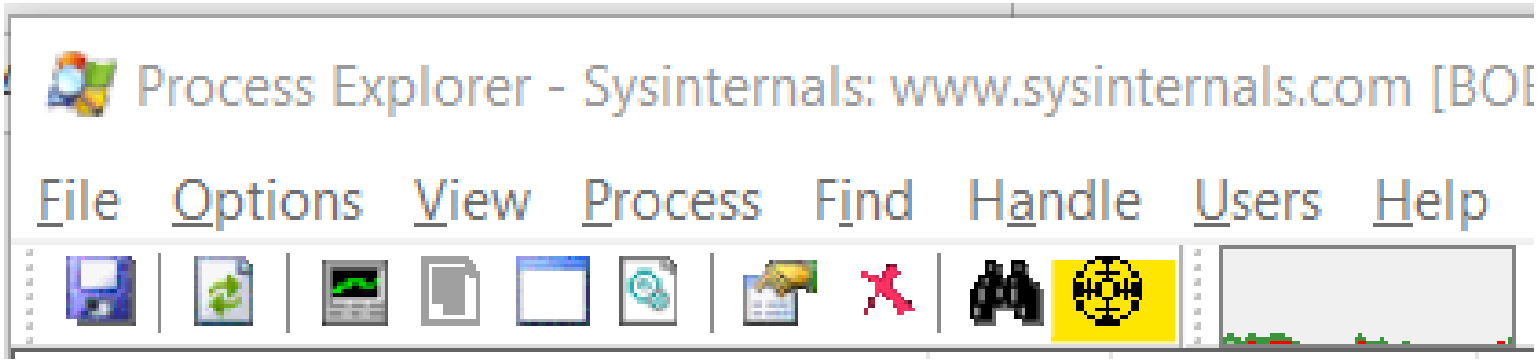
Process Explorer Search – Example 2



OmniRig.exe (e.g. WSJT-X, Log4OM) has opened the FTDI VCP

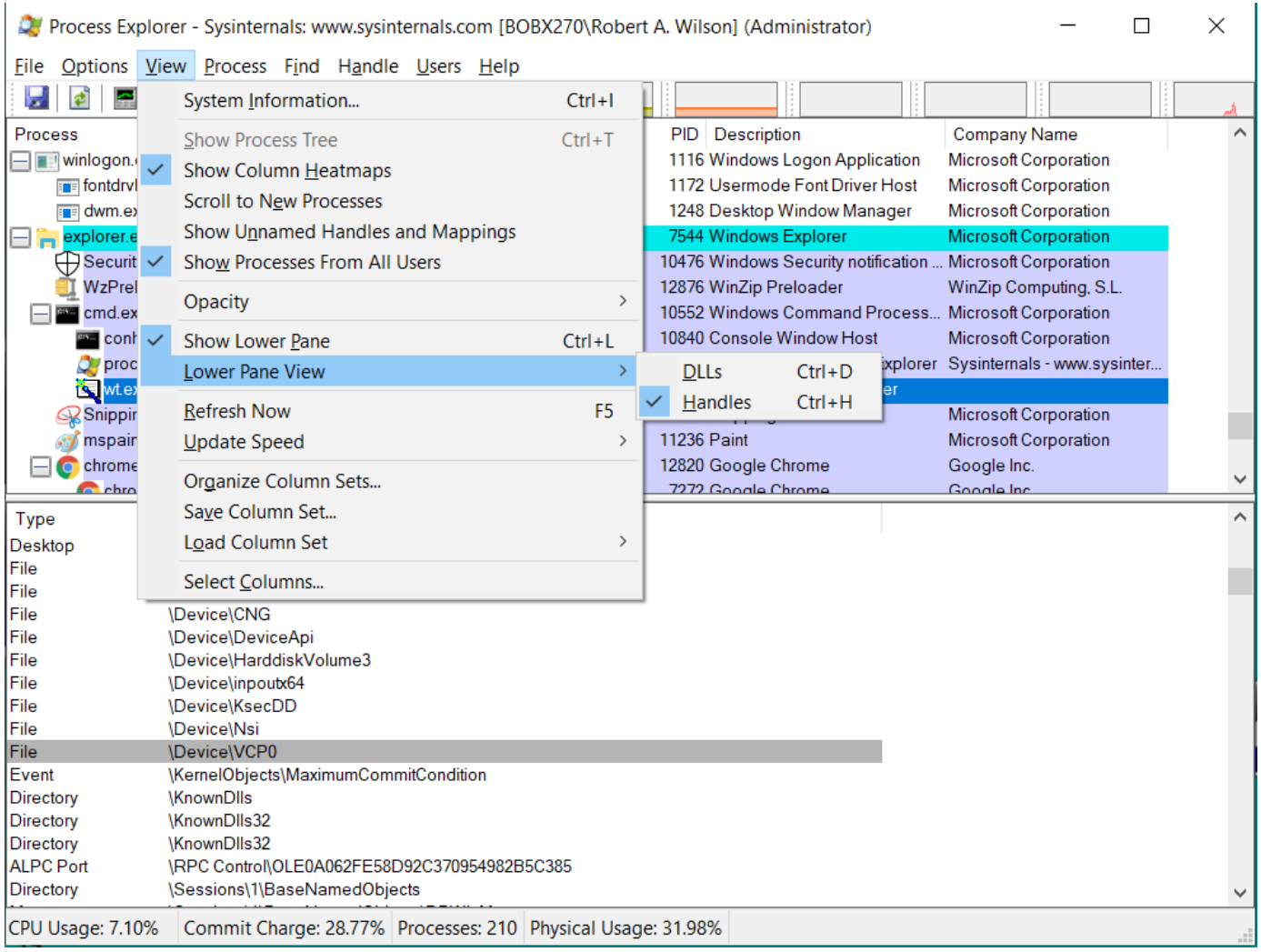
Not sure what to search for?

- Open a program known to use a particular serial port
- In Process Explorer, *drag* the “Find Windows Process” icon on top of the program window



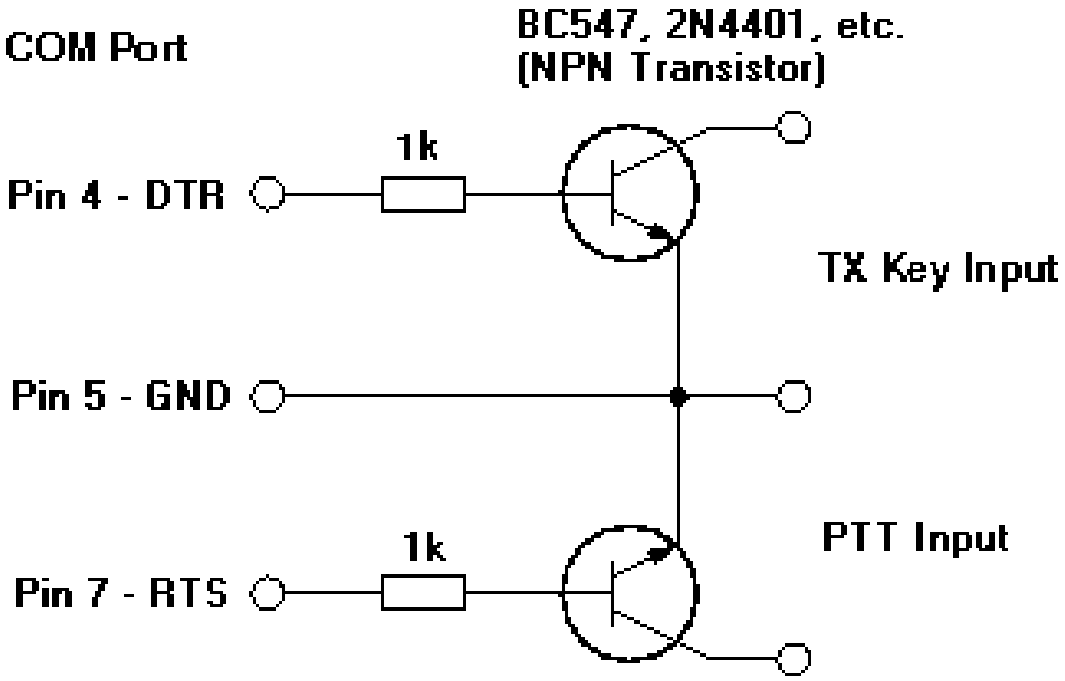
- Process Explorer will jump to the process corresponding to that program window

Select View, Lower Pane View, Handles, then sort by Name



Computer-generated CW, PTT, and FSK RTTY Keying Using Serial Port pins (DTR=CW or FSK, RTS=PTT)

- A simple hardware keying circuit, used for decades:

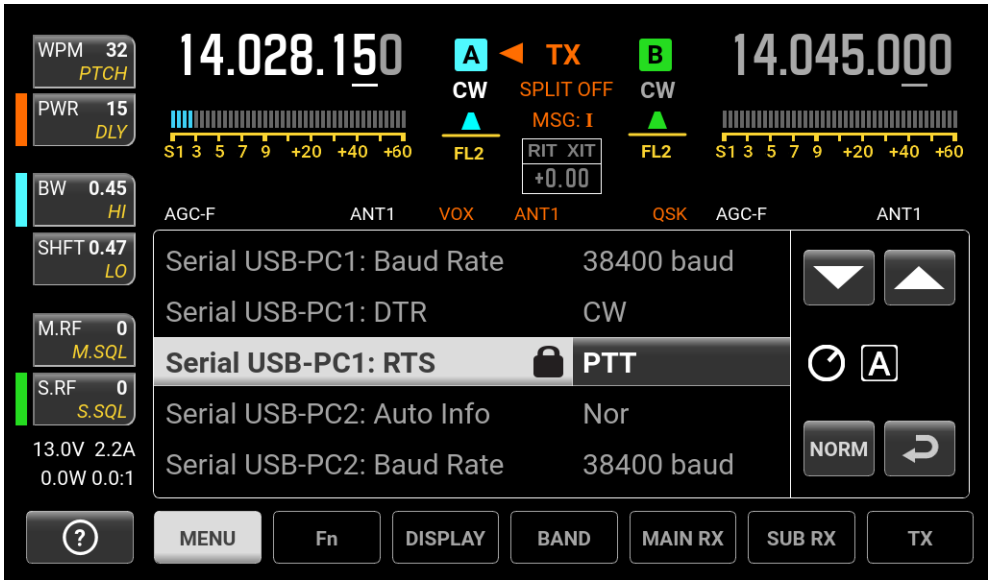


Elecraft K3 / K3S keying via serial port

- First transceiver to include computer keying circuit *inside the radio*
- Does not use RTS and DTR pins for RS232 “Handshaking”, freeing them for other purposes
- In K3, set **CONFIG:PTT-KEY** to **RTS-DTR** (vs. **OFF-OFF**)
- Works the same over a standard serial cable
  (CONFIG:RS232 = 38400)
  -or- the K3S USB connection
  (CONFIG:RS232 = USB)
- To prevent unwanted transmissions when PC reboots, change FTDI Port Settings:
  - Uncheck “Serial Enumerator”
  - Check “Disable Modem Ctrl At Startup”

Elecraft K4 keying via virtual serial port(s)

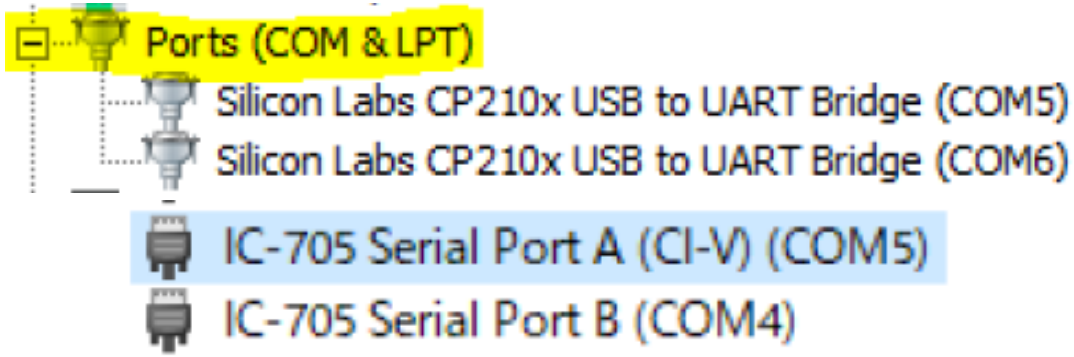
- Same as K3, but THREE (3) serial ports available for CW, PTT, and FSK keying and rig control
- In K4 menu, scroll to the **Serial**, entries, modify as shown:



- Change FTDI Port Settings:
  - Uncheck “Serial Enumerator”
  - Check “Disable Modem Ctrl At Startup”

ICOM Copies Elecraft K3, Adds FSK Keying

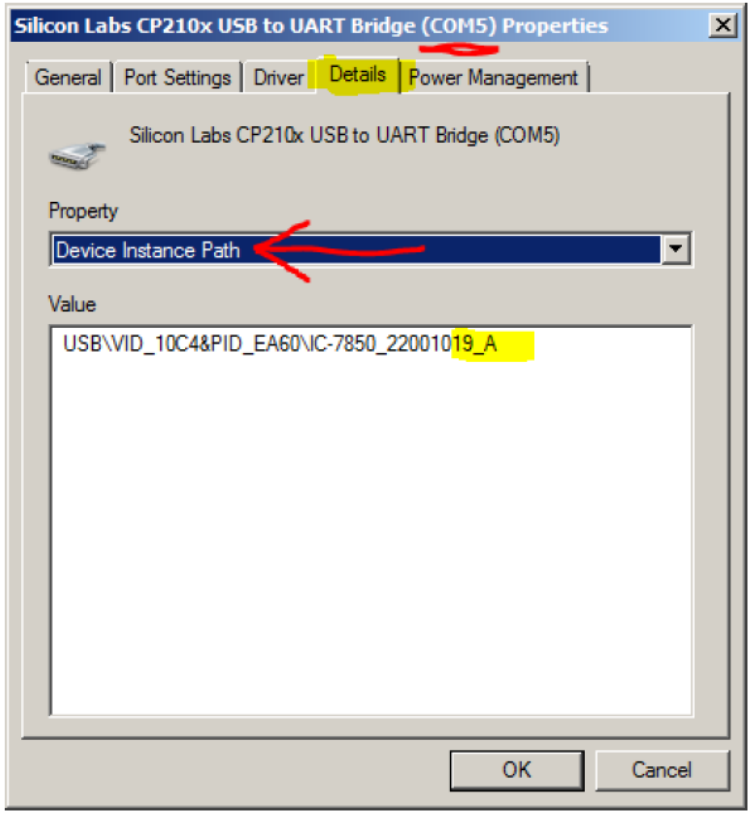
- CW, PTT, and FSK keying OK over USB virtual serial port
- Supported by IC-705, IC-7300, IC-7610, IC-7850, IC-7851
- IC-7300 generates just one virtual serial port
- IC-705, IC-7610, IC-7850, IC-7851 generate *two* virtual serial ports:



- To keep it simple use DTR pin for keying, RTS pin for PTT
- Use port “B” for MMTTY exclusively
- Mnemonic: **C**W : **D**TR : **F**SK • **P**TT : **R**TS : **S**end

ICOM: Determining COM Port A and B

- Use Windows Device Manger, right click on first COM port, Properties, Details tab, Device Instance Path, check last letter



ICOM IC-7300 Keying via USB Cable

- USB cable provides *one* virtual serial port
- In IC-7300 **SET > Connectors** menu:
  Set **USB Keying (CW)** to **DTR**
  -or-
  Set **USB Keying (RTTY)** to **DTR**
- Set **USB Send** to **RTS**
- Logging Software, rig control Port (USB), set DTR=CW, RTS=PTT
- In MMTTY, use **EXTFSK** or **EXTFSK64** to select COM port.
- Cannot use logger at same time; rig has just one serial port. But you can use the REMOTE (CI-V) connector with CT-17 or equivalent for rig control.

ICOM IC-705 Keying via USB Cable

- USB cable provides *two* virtual serial ports
- In IC-7610 **SET > Connectors > USB Send/Keying**:
  Set **USB Keying (CW)** to **USB (A) DTR**
  Set **USB Keying (RTTY)** to **USB (B) DTR**
  Set **USB Send** to **USB (A) RTS** or **USB (B) RTS**
- In Logging Software, rig control COM Port (A):
  DTR=CW, RTS=PTT
- In MMTTY, use **EXTFSK** or **EXTFSK64** to select second COM Port (B):
  FSK=DTR, PTT=RTS
- Cannot set *both* ports to use hardware PTT, so use "Software PTT" on Rig Control Port (A) if necessary.

ICOM IC-7610 Keying via USB Cable

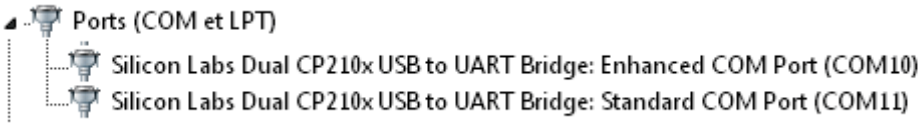
- USB cable provides *two* virtual serial ports
- In IC-7610 **SET > Connectors > USB Send/Keying**:
  Set **USB Keying (CW)** to **USB1(A) DTR**
  Set **USB Keying (RTTY)** to **USB1(B) DTR**
  Set **USB Send** to **USB1(A) RTS** or **USB1(B) RTS**
- In Logging Software, rig control COM Port (A):
  DTR=CW, RTS=PTT
- In MMTTY, use **EXTFSK** or **EXTFSK64** to select second COM Port (B):
  FSK=DTR, PTT=RTS
- Cannot set *both* ports to use hardware PTT, so use "Software PTT" on Rig Control Port (A) if necessary.

ICOM IC-7850, IC-7851 Keying via USB Cable

- USB cable provides *two* virtual serial ports
- In IC-785x **SET > Others** menu:
  Set **USB Keying (CW)** to **USB1 DTR**
  Set **USB Keying (RTTY)** to **USB2 DTR**
  Set **USB Send** to **USB1 RTS** (CW) or **USB2 RTS** (RTTY)
- In Logging Software, rig control COM Port (USB1)
  set DTR=CW, RTS=PTT
- In MMTTY, use **EXTFSK** or **EXTFSK64** to select second COM port (USB2)
  FSK=DTR, PTT=RTS
- Cannot use *both* ports for hardware PTT, so use “Software PTT” on Rig Control Port (USB1) if necessary.

Yaesu FT-991 Keying via USB Cable

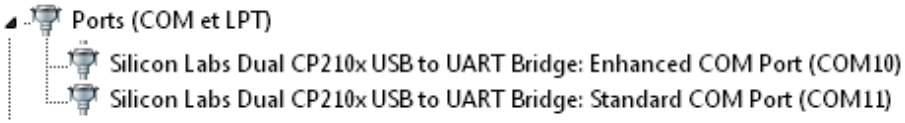
- USB cable provides *two* Silicon Labs virtual serial ports:



- In Yaesu Menu, set
  030 232C TOT: 1000 msec (default is only 10 msec)
  033 CAT RTS: Disable (Turns off RS232 handshaking)
  060 PC Keying: DTR
  071 DATA PTT SELECT: RTS
  098 RTTY SHIFT PORT: DTR
  110 SSB PTT SELECT: RTS
- In Logging Software, rig control is via the "Enhanced" COM Port, CW / PTT via "Standard" COM Port: DTR=CW, RTS=PTT
- In MMTTY, use **EXTFSK** or **EXTFSK64** with the "Standard" COM port: FSK=DTR, PTT=RTS

Yaesu FTdx101D or FTdx101MP Keying via USB

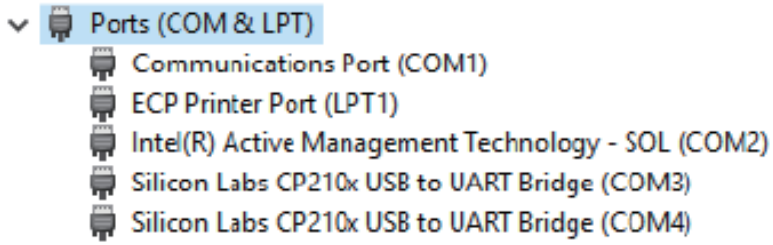
- USB cable provides *two* Silicon Labs virtual serial ports:



- In Yaesu Menu, set
  - OPERATION SETTING / GENERAL:
    232C TIME OUT TIMER: 1000 msec (default is only 10 msec)
    CAT RTS: OFF (Turns off RS232 handshaking)
  - RADIO SETTING / MODE SSB, RTTY, and PSK/DATA:
    RPTT SELECT: RTS (FSK will be by **DTR**)
  - RADIO SETTING / MODE CW:
    PC KEYING: DTR (PTT will be by RTS)
- In Logging Software, rig control is via the "Enhanced" COM Port, CW / PTT via "Standard" COM Port: DTR=CW, RTS=PTT
- In MMTTY, use **EXTFSK** or **EXTFSK64** with the "Standard" COM port: FSK=DTR, PTT=RTS

Kenwood TS-890 Keying via USB Cable

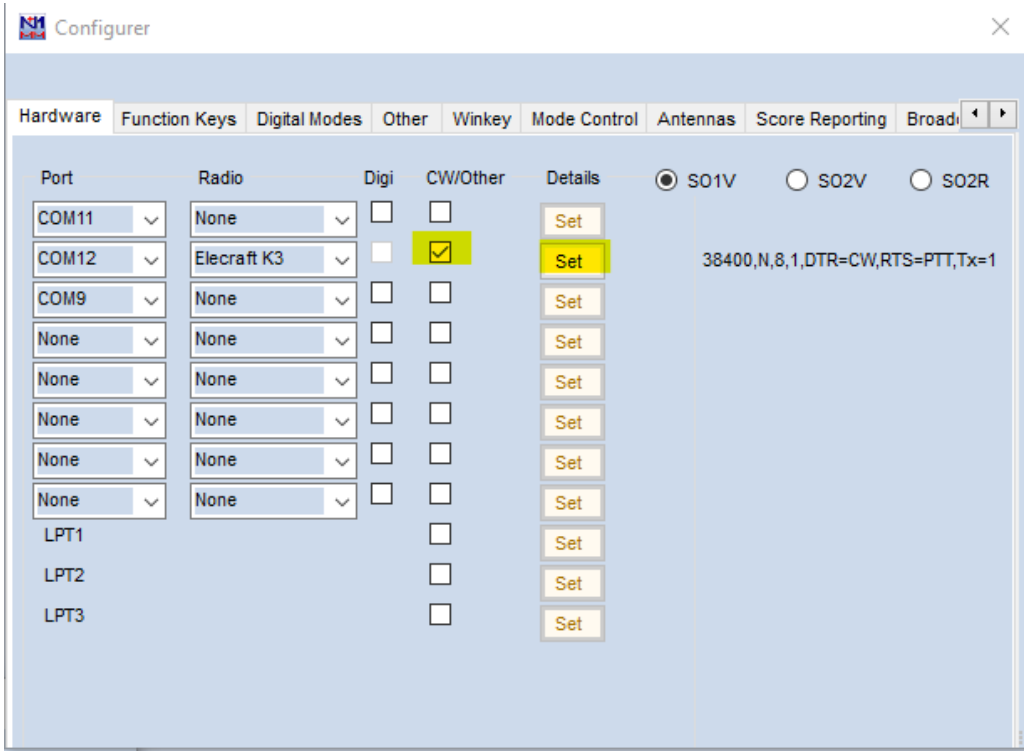
- USB cable provides *two* Silicon Labs virtual serial ports:



- Right click, Properties, Details tab, Location Path:
  USB1 is “Standard” Serial Port, USB2 is “Enhanced”
- In Logging Software, rig control is via the “Standard” COM Port
  CW / PTT / FSK keying may be assigned to DTR or RTS of either port
- **Menu 17 Virtual Standard COM Port RTS: PTT**
  Menu 18 Virtual Standard COM Port DTR: CW Keying
  Menu 19 Virtual Enhanced COM Port RTS: PTT
  Menu 20 Virtual Enhanced COM Port DTR: RTTY Keying

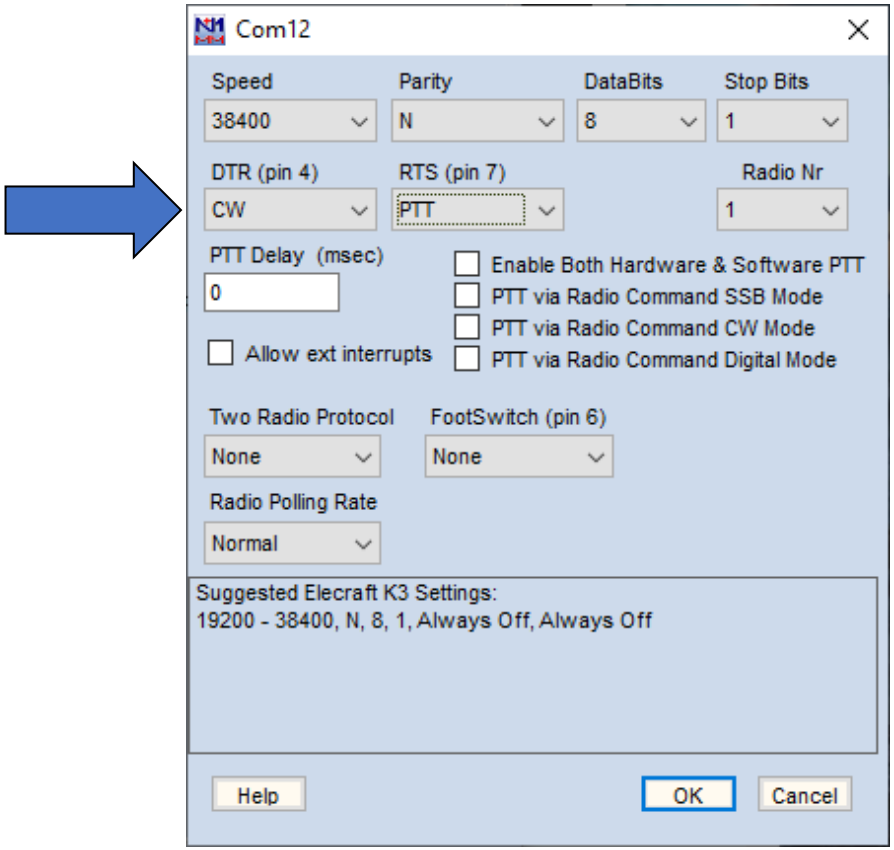
N1MM+ Contest Software Configuration

- Select Config, Configure Ports, view Hardware Tab
- Check CW/Other box next to Rig's Serial Port
- Click Set button



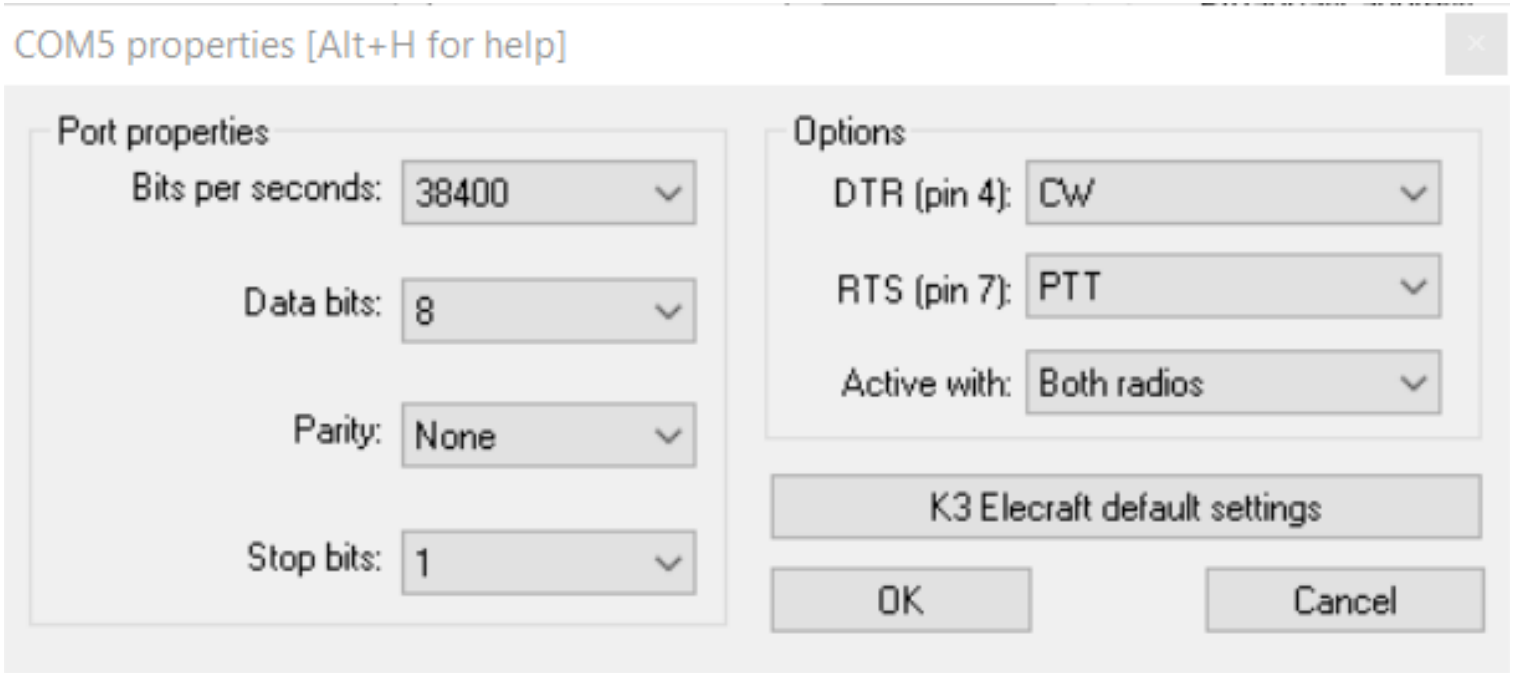
N1MM+ Contest Software Configuration (cont'd)

- Set DTR (pin 4) = CW, RTS (pin 7) = PTT



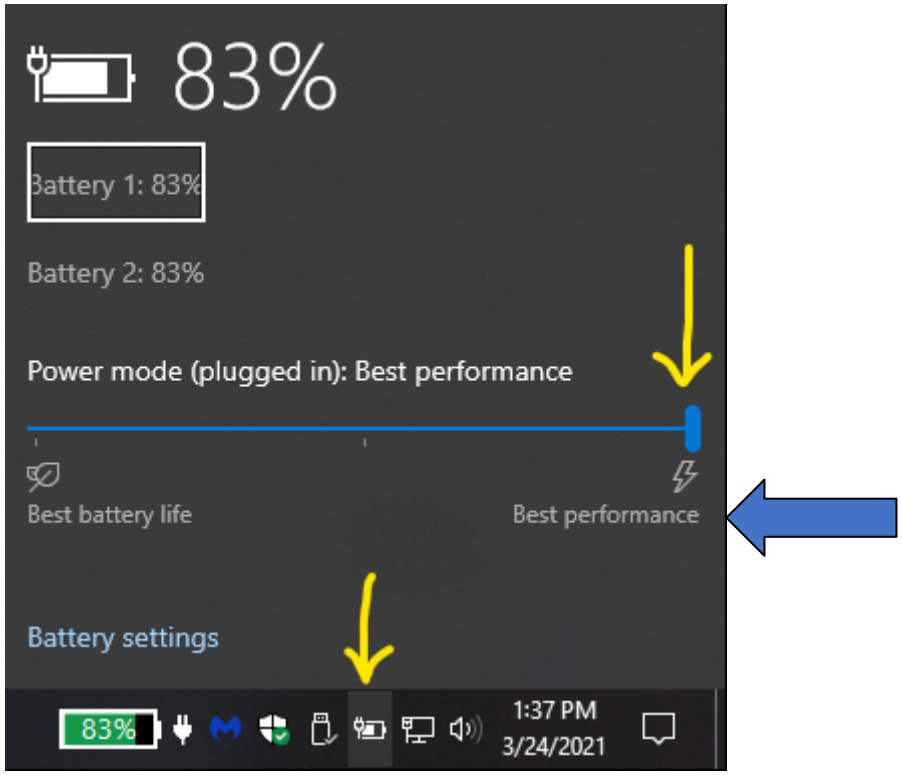
Win-Test Contest Software Configuration

- Set DTR (pin 4) = CW, RTS (pin 7) = PTT



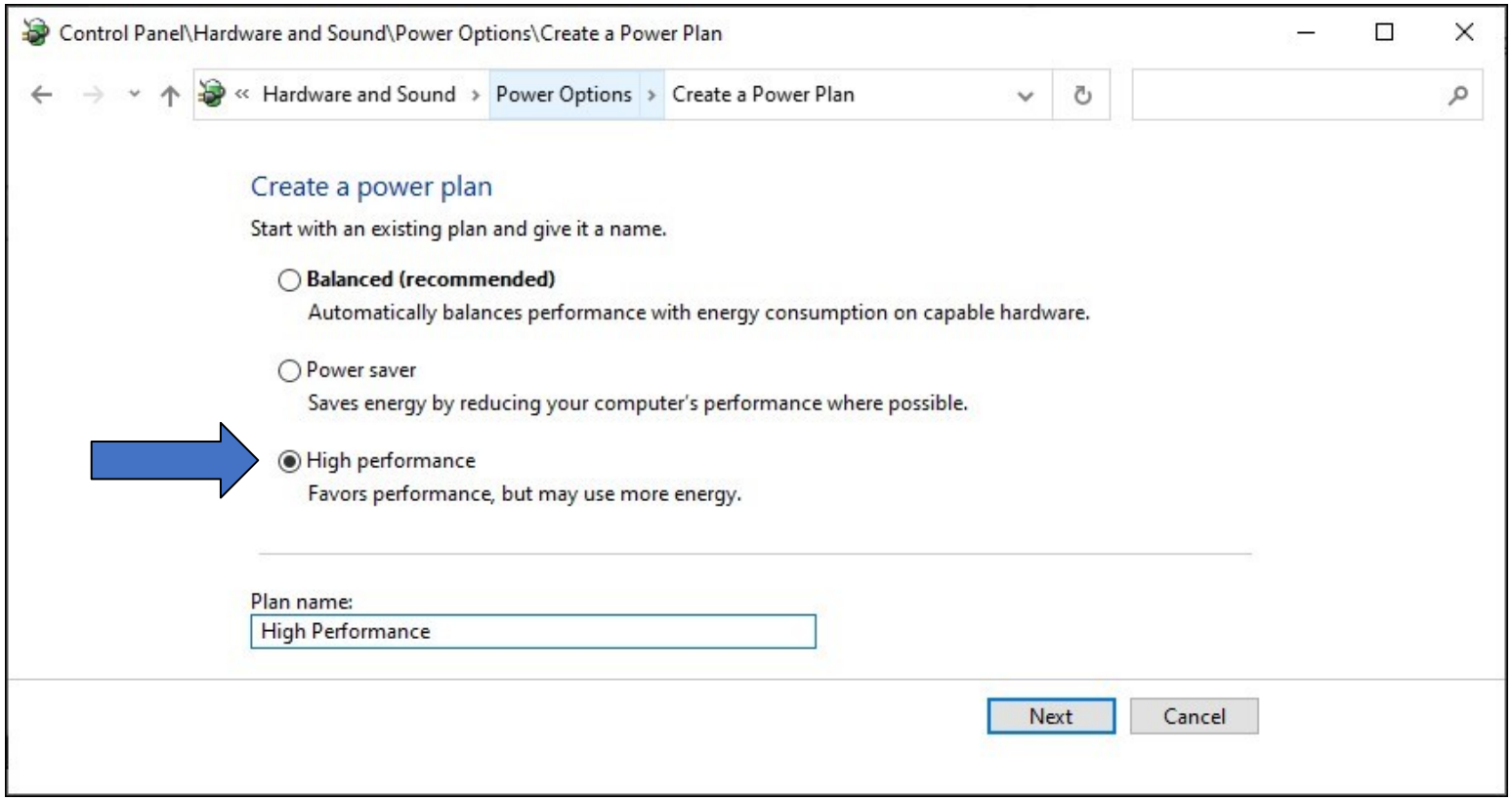
Notebook PC:
Windows Power Mode Affects Timing

- CW Timing over USB is usually very good *if* you set Windows **Power Mode** to **Best Performance**:



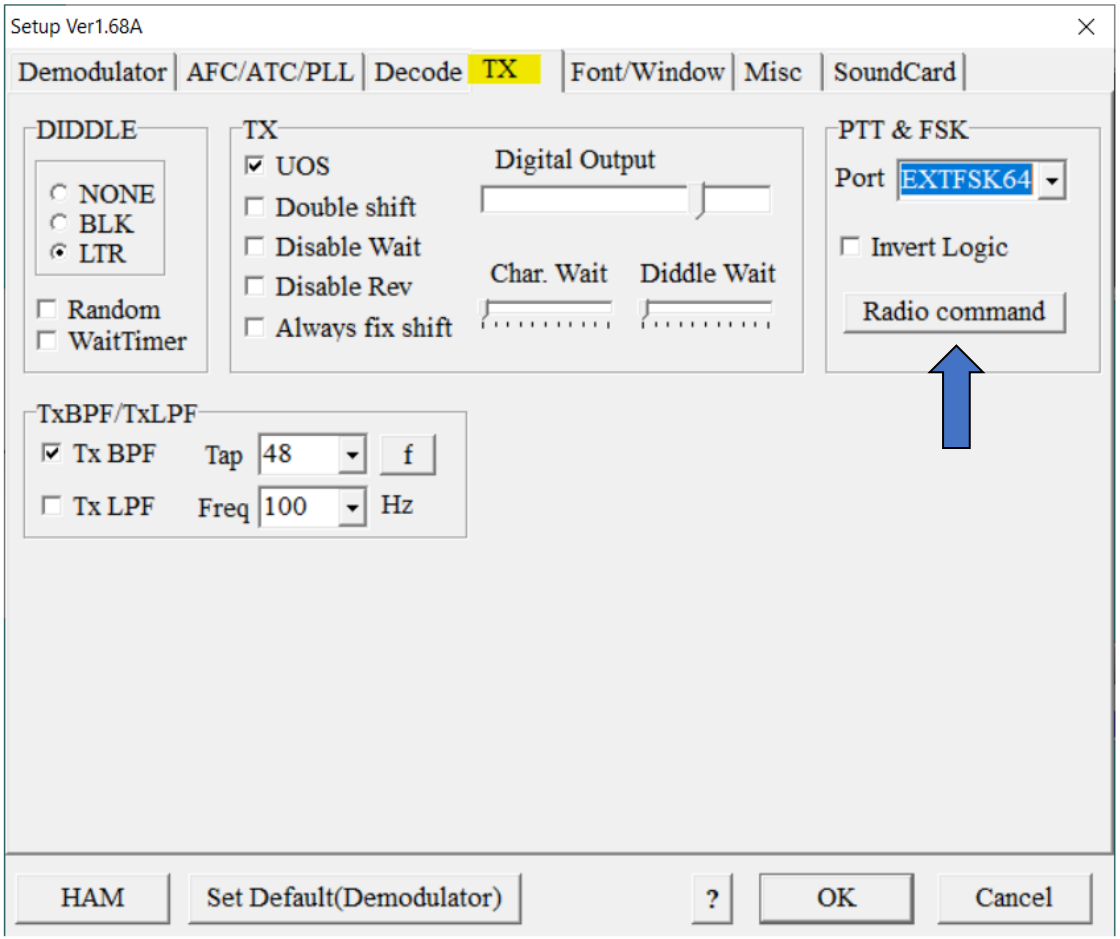
Desktop PC:
Windows Power Options Affects Timing

- CW Timing over USB is usually very good *if* you set Windows **Power Options** to **High performance**:



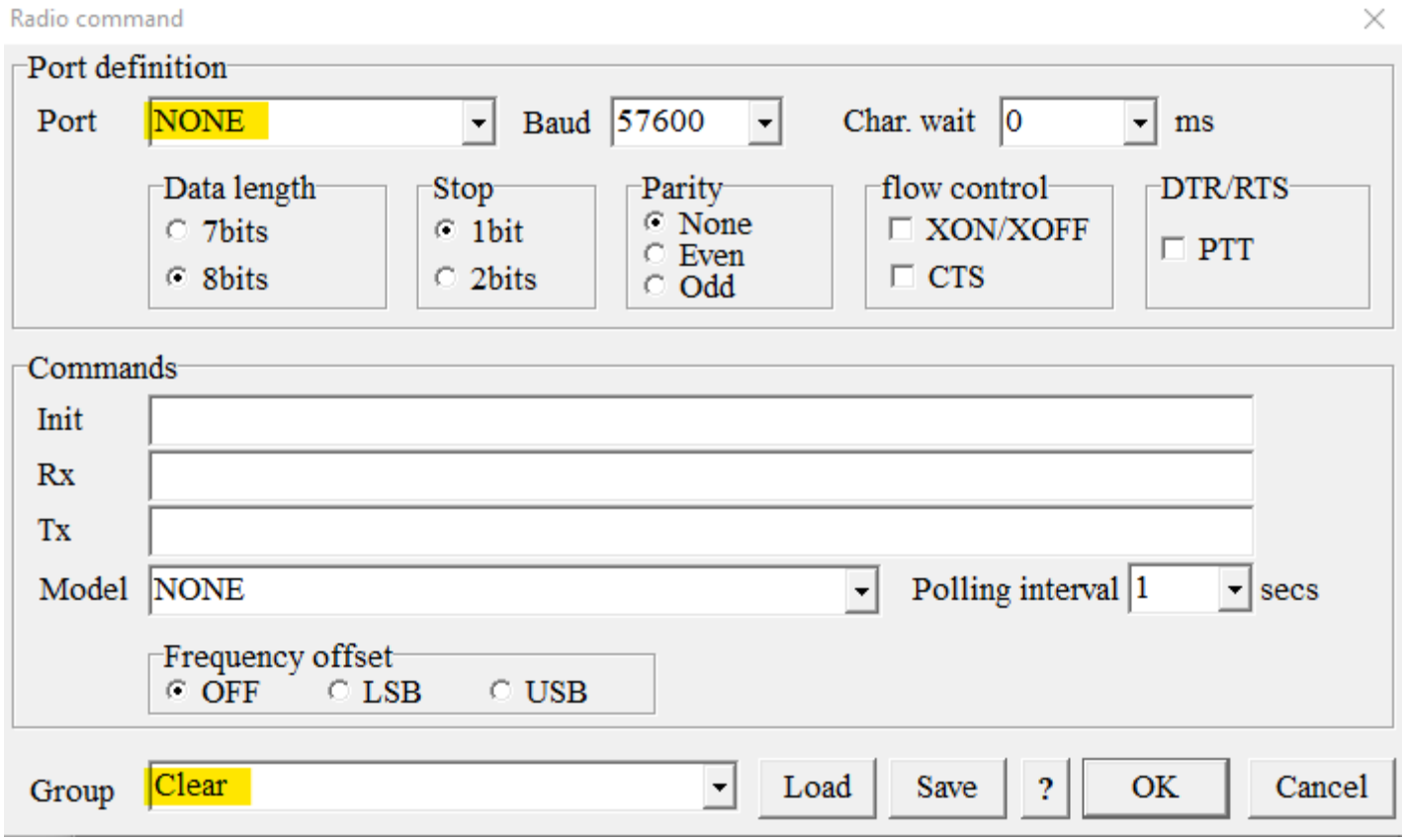
FSK RTTY keying: MMTTY Setup Menu, TX Tab

- Set **Port** to **EXTFSK64**, then click **Radio Command** button



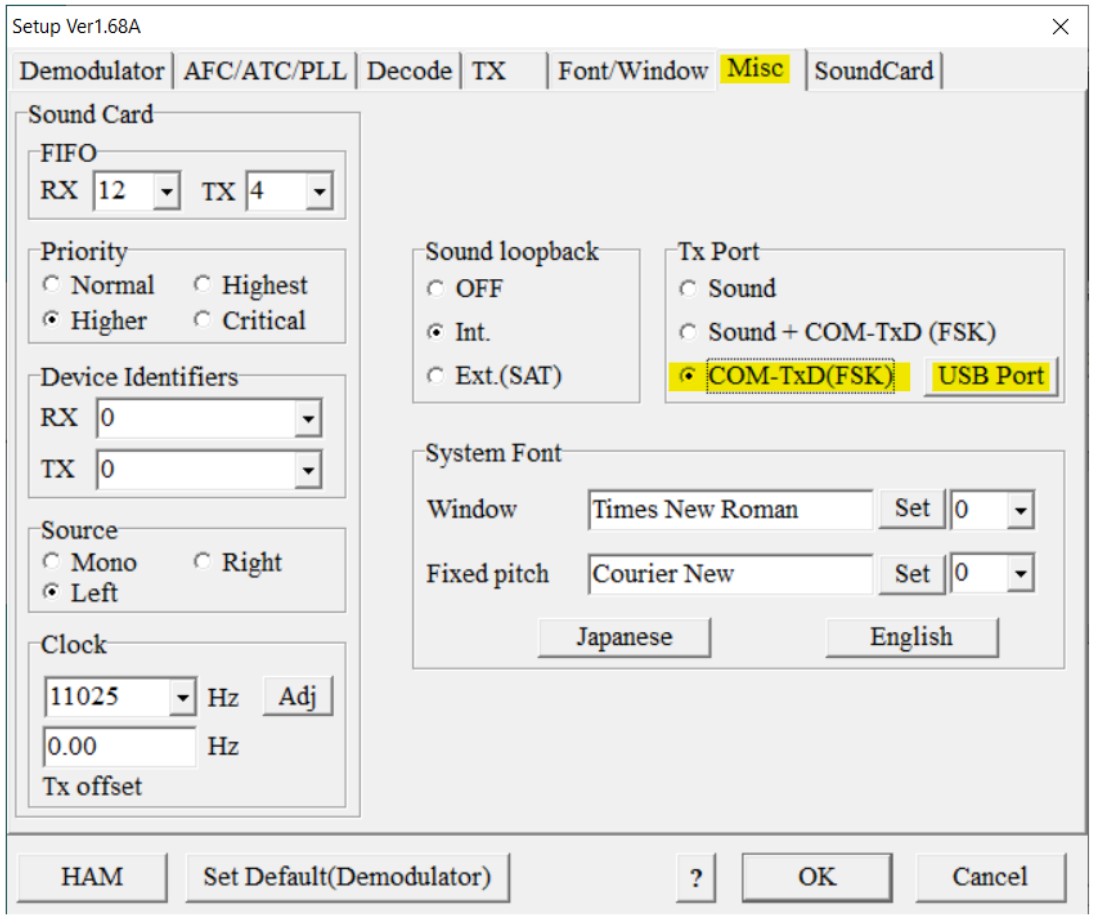
MMTTY Setup Menu, Radio command button

- Set **Port** to **NONE**, Group to **Clear**



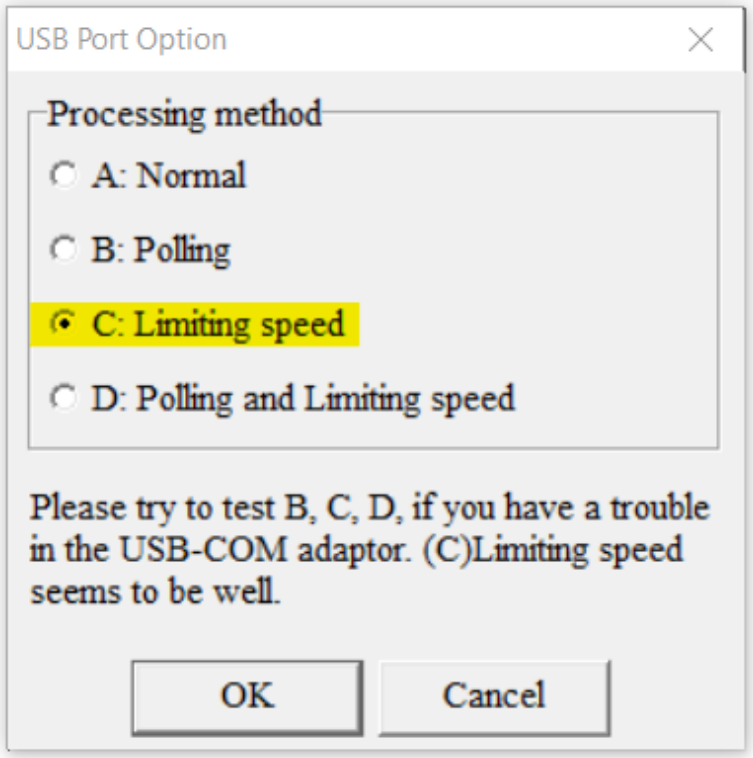
MMTTY Setup Menu, Misc Tab

- Set TX Port to **COM-TxD(FSK)**, click **USB Port**



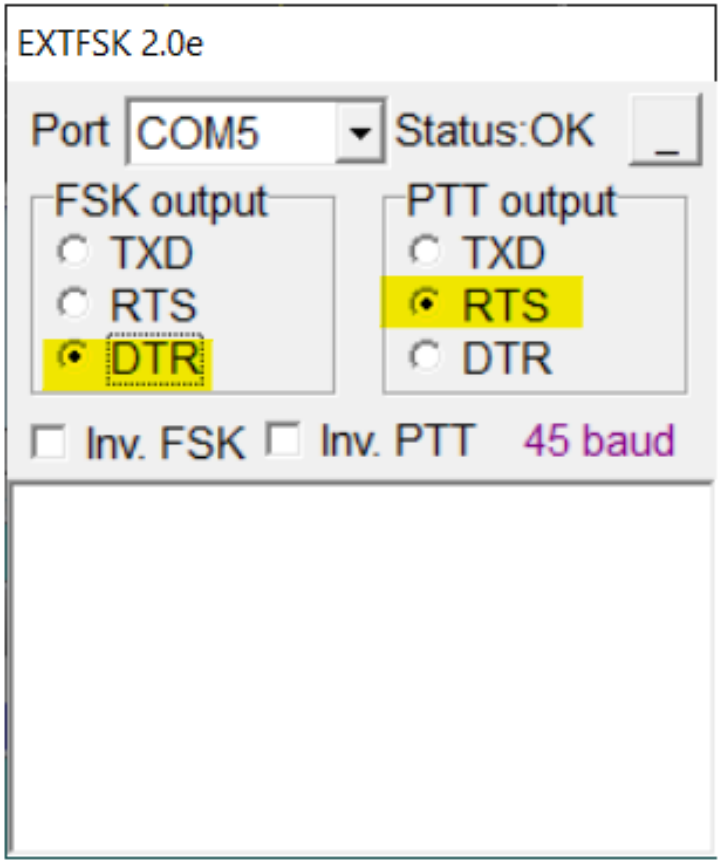
MMTTY USB Port Menu

- Set Processing Method to **C: Limiting Speed**



EXTFSK Pop-Up Menu

- Select second COM Port, FSK=DTR, PTT=RTS



Serial Port Sharing and Conflicts

- In RS232 protocol, only **one** TXD line (Pin 3) can be connected between a PC and a Radio
- No other device may connect to Pin 3 if a PC is connected
- PC polls radio using Pin 3 (TXD), Radio sends response using Pin 2 (RXD)
- AUTO INFO mode provides same output without PC polling
- Multiple devices (SteppIR & Baby Loop controllers, Band Decoders, Elecraft / ACOM / SPE amplifiers) may *monitor* the RXD line in parallel by only connecting to Pin 2
- RF-Kit amplifiers require connection to *both* Pins 2 and 3

Shameless Plug

- The N6TV “Serial Box” (S-BOX or S-BOX-USB with FTDI) provides parallel connections to RXD pin via standard D-SUB cables:

  https://bit.ly/S-BOX

- It also includes *four* NPN keying circuits for rigs that do not support CW, PTT, or FSK keying via DTR or RTS, such as: Elecraft **KX2 KX3**, Yaesu **FTdx3000 FTdx5000 FT-1000MP**, Kenwood **TS-990s TS-590s**, ICOM **IC-7600 IC-7700 IC-7800**, …

Software for Sharing Serial Ports

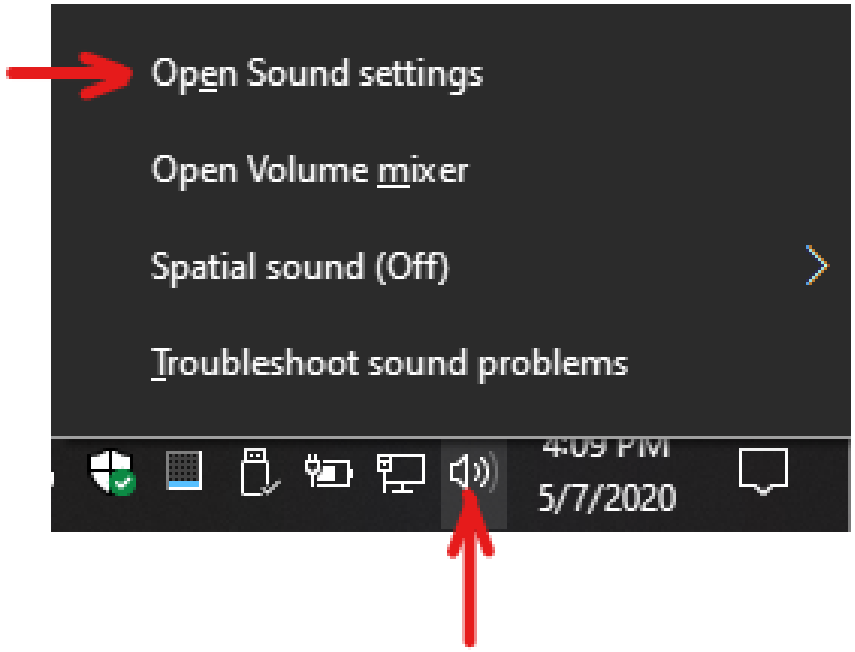
- Software sharing: multiple programs simultaneously access the radio's rig control serial port
- Implemented by VE3NEA's **OmniRig** software
- OmniRig may be used by Win-Test, Writelog, HDSDR, WSJT-X, Log4OM, etc. for rig control
- But OmniRig is NOT supported by N1MM+, N3FJP, others
- OmniRig owns the serial port, acts as traffic cop, no collisions or conflicts between applications
- CW / PTT / FSK Keying via OmniRig port is not supported
- Consider N4PY Pegasus Plus
  Allows sharing of Radio COM port with up to five other applications
- Can I use VSPE instead? vspMgr? COM0COM?
  Maybe, but command collisions or VCP driver conflicts may occur

Radios with both USB *and* DE-9 connectors

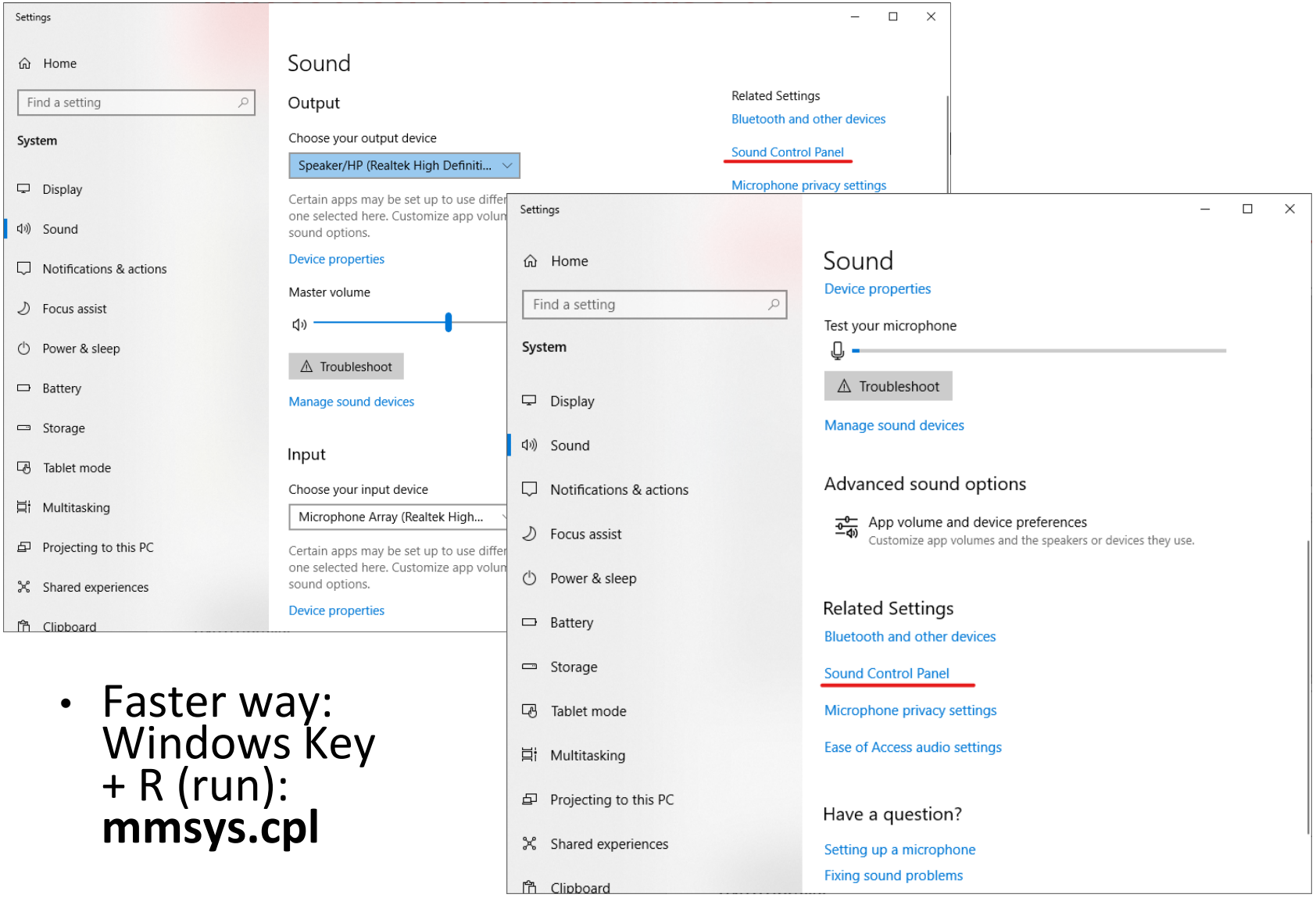
- Elecraft **K3**, Yaesu **FTdx3000**: USB and Serial Port do not operate independently (must pick one)
- USB and Serial Port *do* operate independently in:
  - Elecraft **K4**
  - Kenwood **TS-590S**, **TS-890S**
  - Yaesu **FTdx101D**, **FTdx101MP**
- ICOM USB and CI-V Ports (3.5mm, not DE-9) mostly operate independently (if you set **USB CI-V Port** to **Unlink from [REMOTE]**)
- Two devices can poll the radio at same time via independent serial ports, one USB and one DE-9 or CI-V.

USB connection to radio adds a new Windows Sound Card

- **USB Audio CODEC**
- Can be use for contest recording, voice keying, RTTY / FT8 decoding
- Multiple “USB Audio CODEC” devices, which is my radio?
- Right click on Speaker icon, then **Open Sound settings**

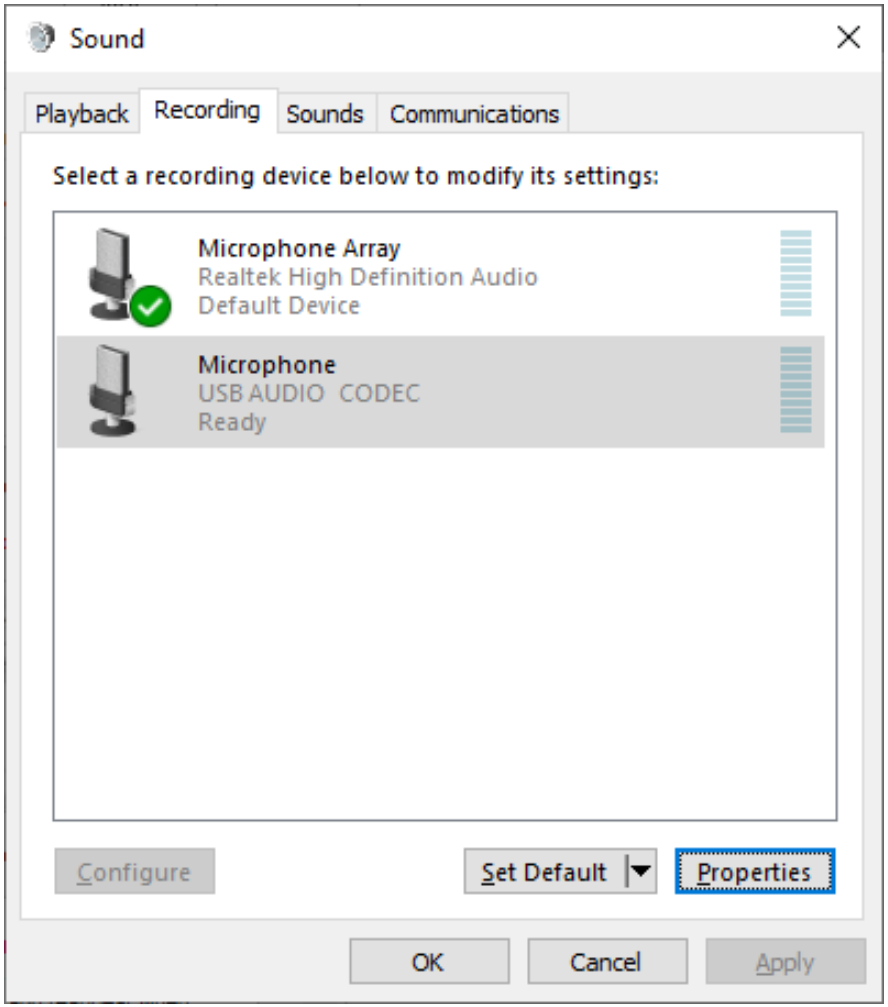


Click Sound Control Panel



- Faster way: Windows Key + R (run): **mmsys.cpl**

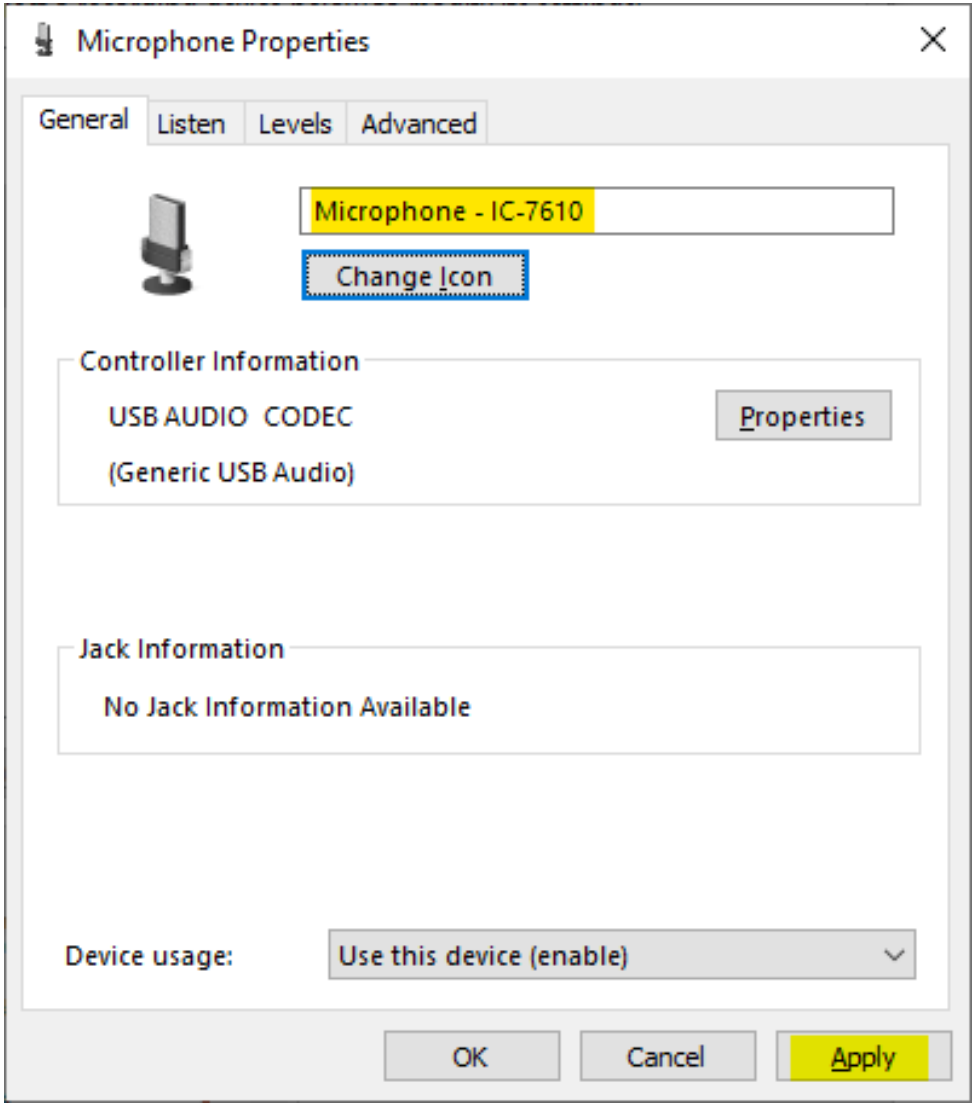
Windows Sound Control Panel, Recording Tab



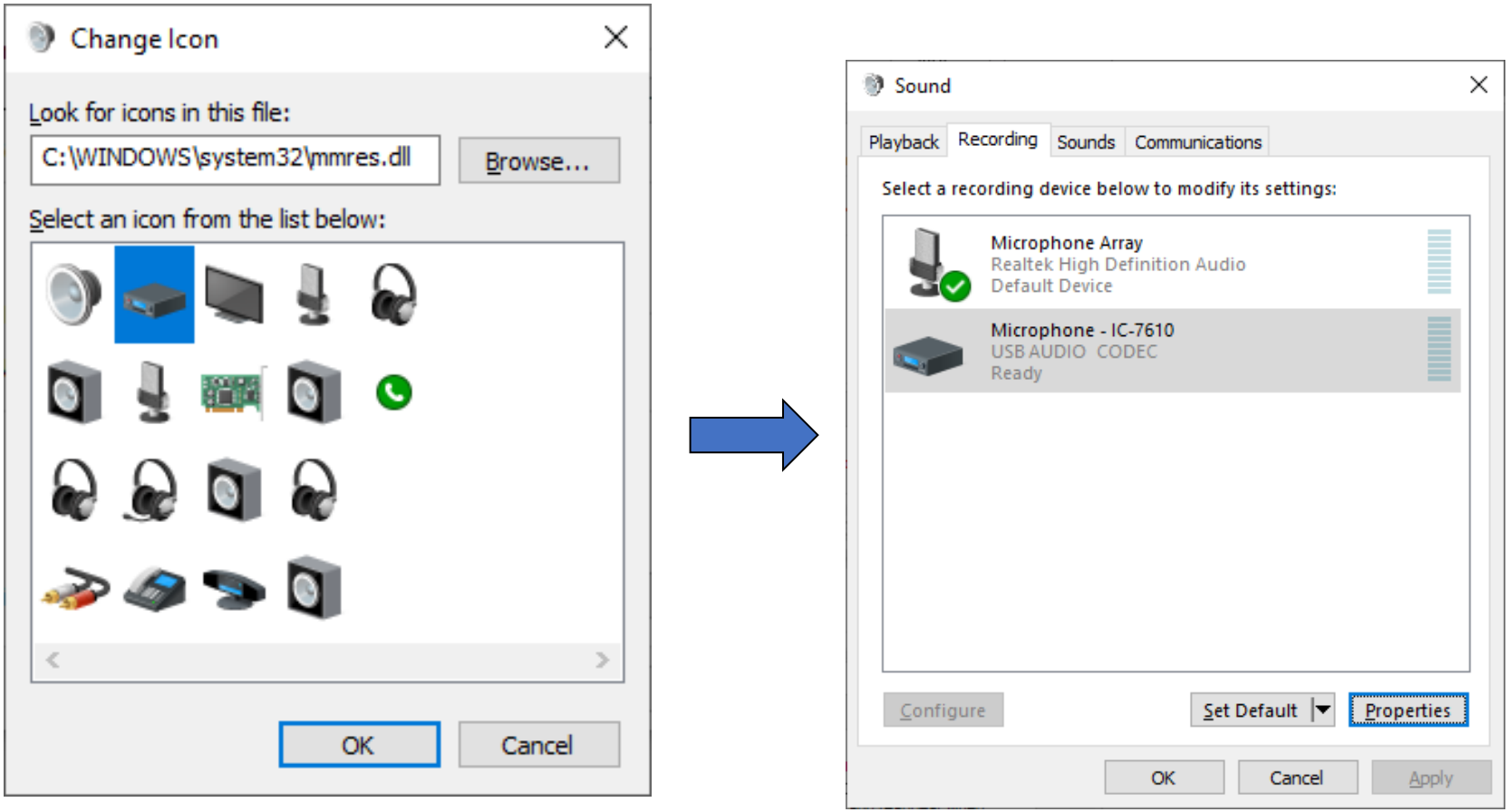
In Sound Control Panel, which sound card is my radio?

- Watch **USB AUDIO CODEC** devices
- A device will disappear and reappear when you disconnect and reconnect the USB cable from the back of the radio
- Select that device, then click **Properties** button
- Label both the **Recording** and **Playback** tabs with name of device, click **Apply**

Change Label and Icon of USB Audio CODEC



Change Icon of USB Audio CODEC Device



Key Points to Remember

- Use the Windows Device Manager to manage and renumber COM ports
- Always uninstall Prolific devices and drivers
- Always change the FTDI Default Options
- Consider labeling COM ports using Registry Editor
- Try CW, FSK and PTT keying via virtual serial port pins
- Use DTR for CW/FSK, RTS for PTT
- Understand serial port conflicts and sharing
- Label your USB Audio CODEC devices

References

- http://www.qrz.com/db/n6tv - Links to this and other presentations
- https://www.nirsoft.net/utils/usb_devices_view.html - USBDeview
- https://docs.microsoft.com/en-us/sysinternals/downloads/process-explorer - Windows Process Explorer
- https://bit.ly/S-BOX - The “Serial Box” by N6TV
- n6tv@arrl.net

Q&A