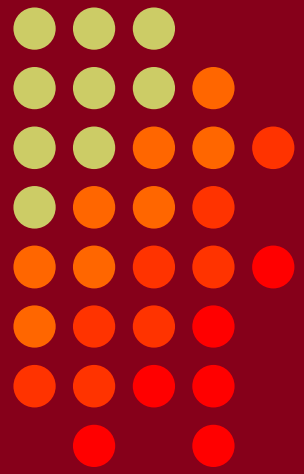
Everything You Need to Know About USB and Serial Interfaces

Presented by N6TV

n6tv@arrl.net



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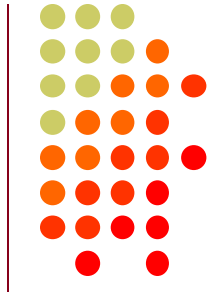
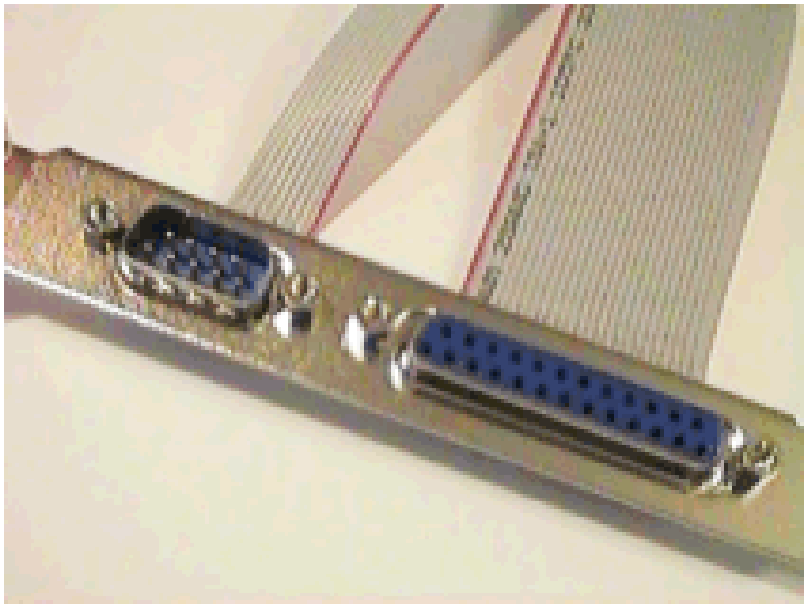
Presentation Overview



- 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

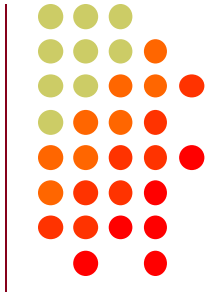


Life was Simple

- 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

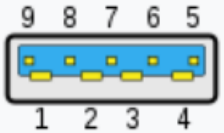
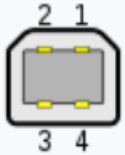
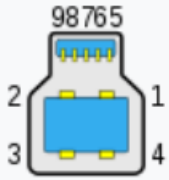
Computers “Improved”



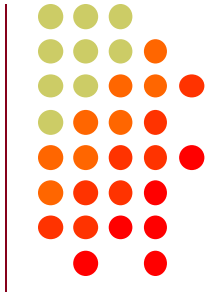
- “Real” serial and parallel ports disappear, replaced by USB ports
- Radios (until recently) still had 9-pin serial ports
- Peripherals still need to access 9-pin serial ports
  - Automatic linear amplifiers, RemoteRig boxes, rotator controllers, SteppIR antenna controllers, band decoders, etc.
- Common Solution: USB-to-Serial adapters

USB 2.0 and 3.0 Ports

- Standard connector on most PCs and MACs

PC:	Type A  Type-A	Type A  Type-A SuperSpeed
Radio:	Type B  Type-B	Type B  Type-B SuperSpeed

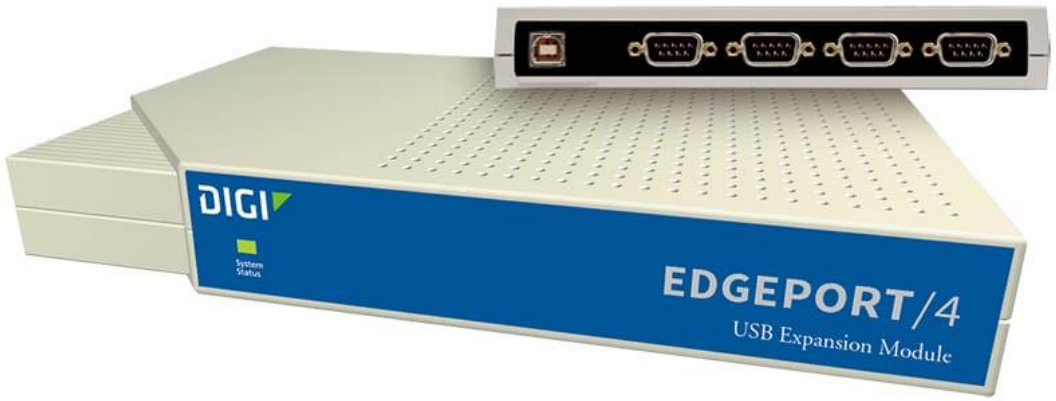
USB-to-Serial Adapters



- 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 - $20

FTDI Chip

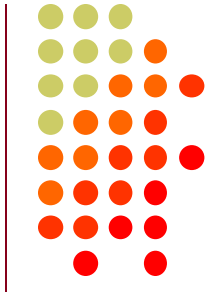
GearMo 2-port - $32

GearMo 4-port - $40

Prolific USB-to-Serial Adapters

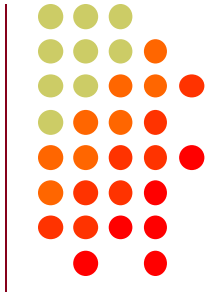
- Widely available, cheap (but many counterfeits)
- Device Driver does *not* play well with others
- Please DO NOT USE them, ever
- Uninstall any Prolific device drivers with Device Manager
- Devices often look like this:

Connecting USB-to-Serial Adapters



- Connect FTDI, Elecraft, or Edgeport device to PC
- Windows (usually) locates and installs appropriate device driver(s)
- COM ports 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



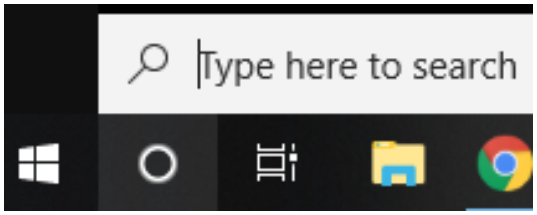
- Important: Install the manufacturer's device driver first, *then* connect the device
  - Icom, Kenwood, Yaesu, microHAM
  - (Usually not required for Elecraft / FTDI)
- If you forget and connect radio first, use Device Manager to uninstall "Unknown Device", then start over
- COM port numbers assigned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

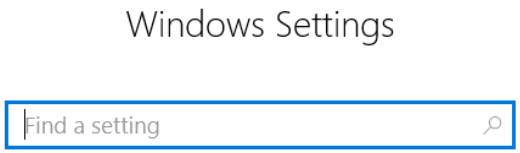
Using the Windows Device Manager

- **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**

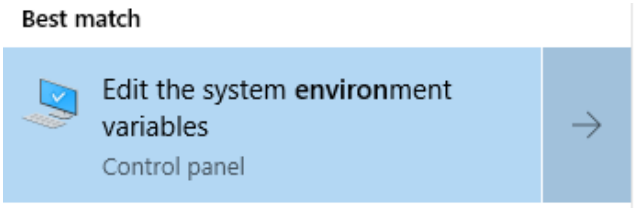
Setting System Environment Variable

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

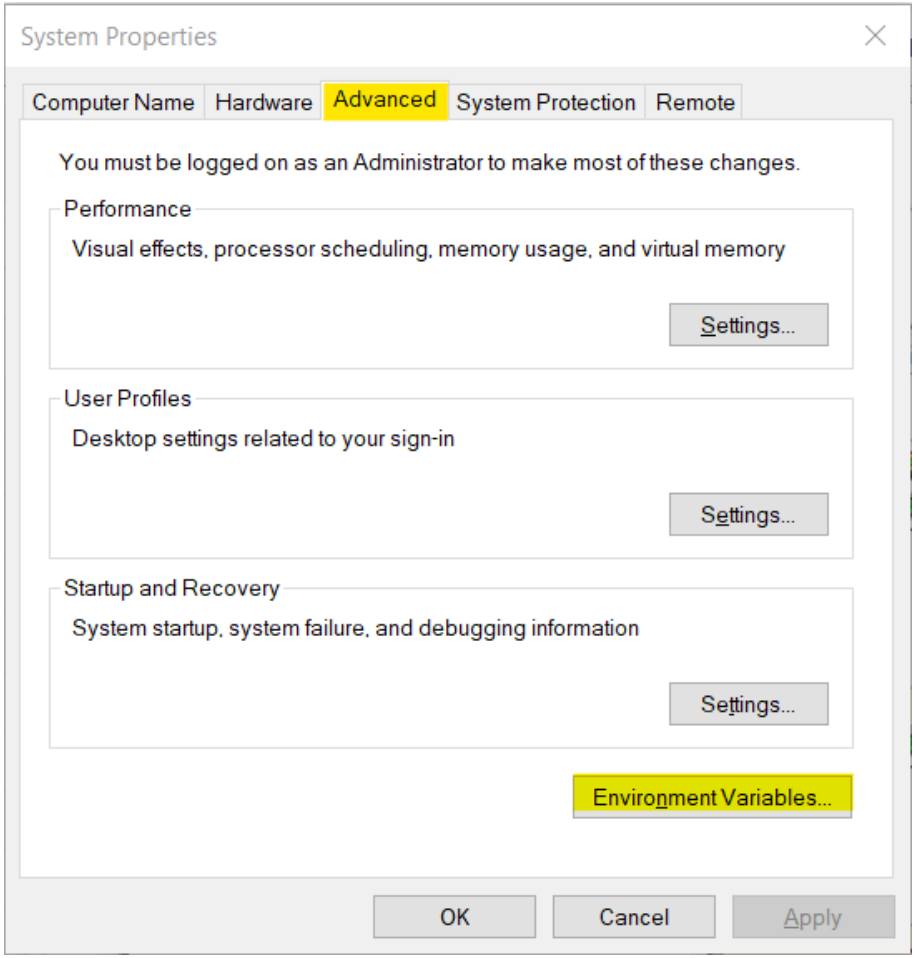




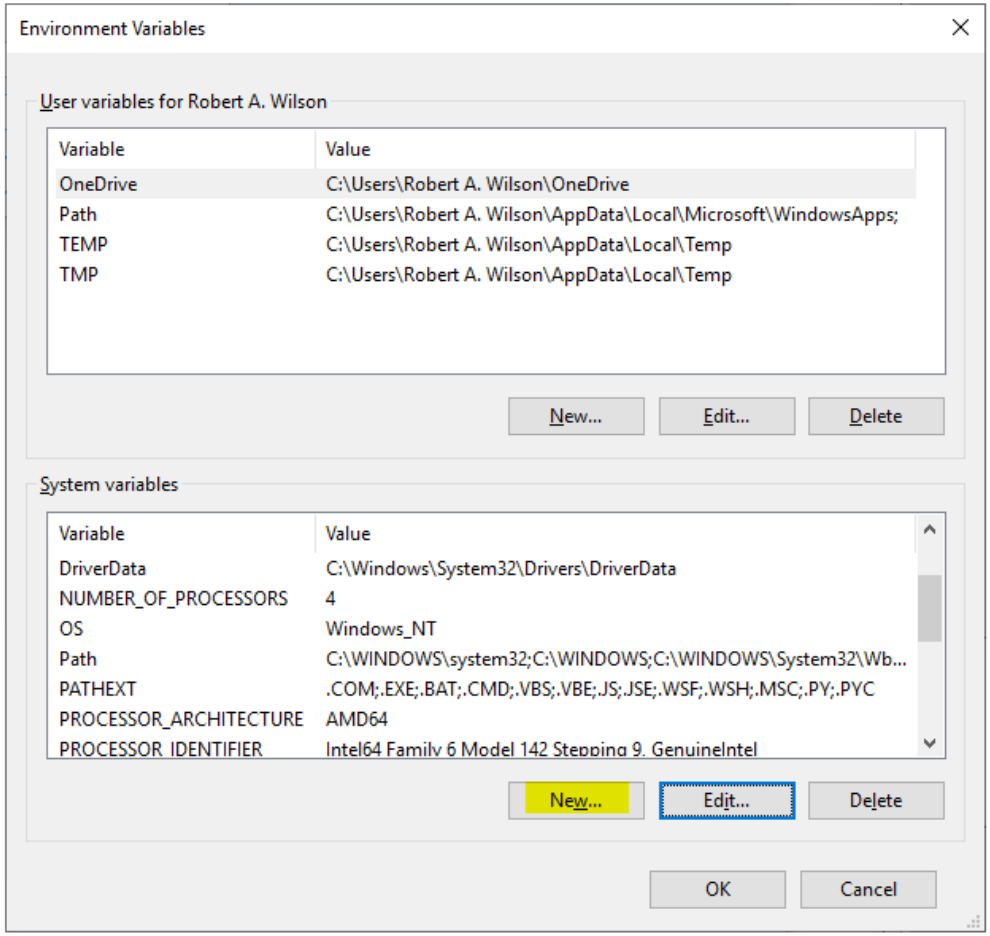
- Click “Edit the System Environment Variables”



Step 1 – Under Advanced tab click Environment Variables…

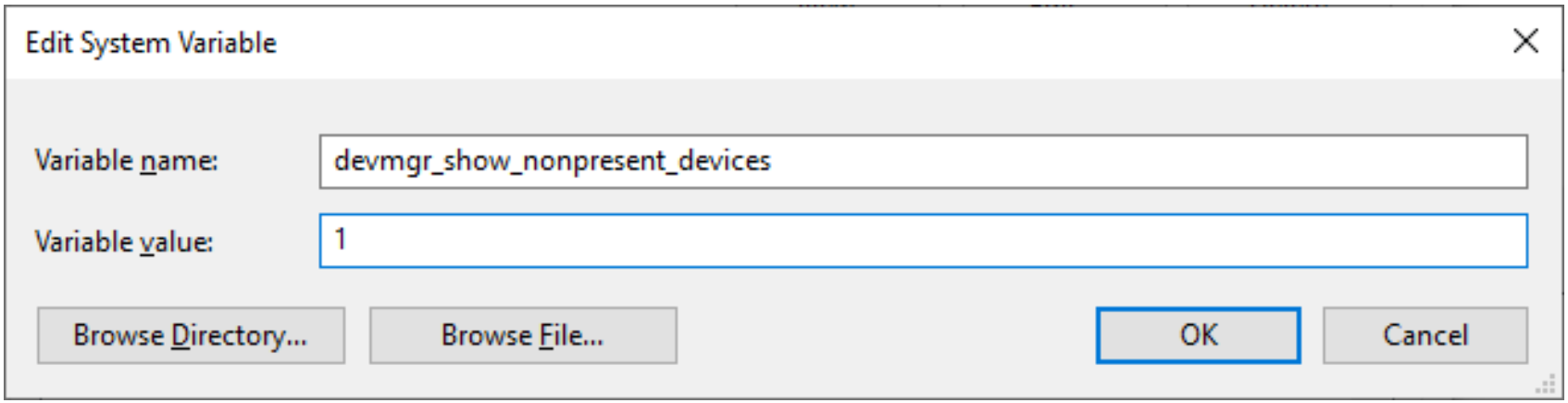


Step 2 – Under System variables, click New…



Step 3 – Add the new environment variable

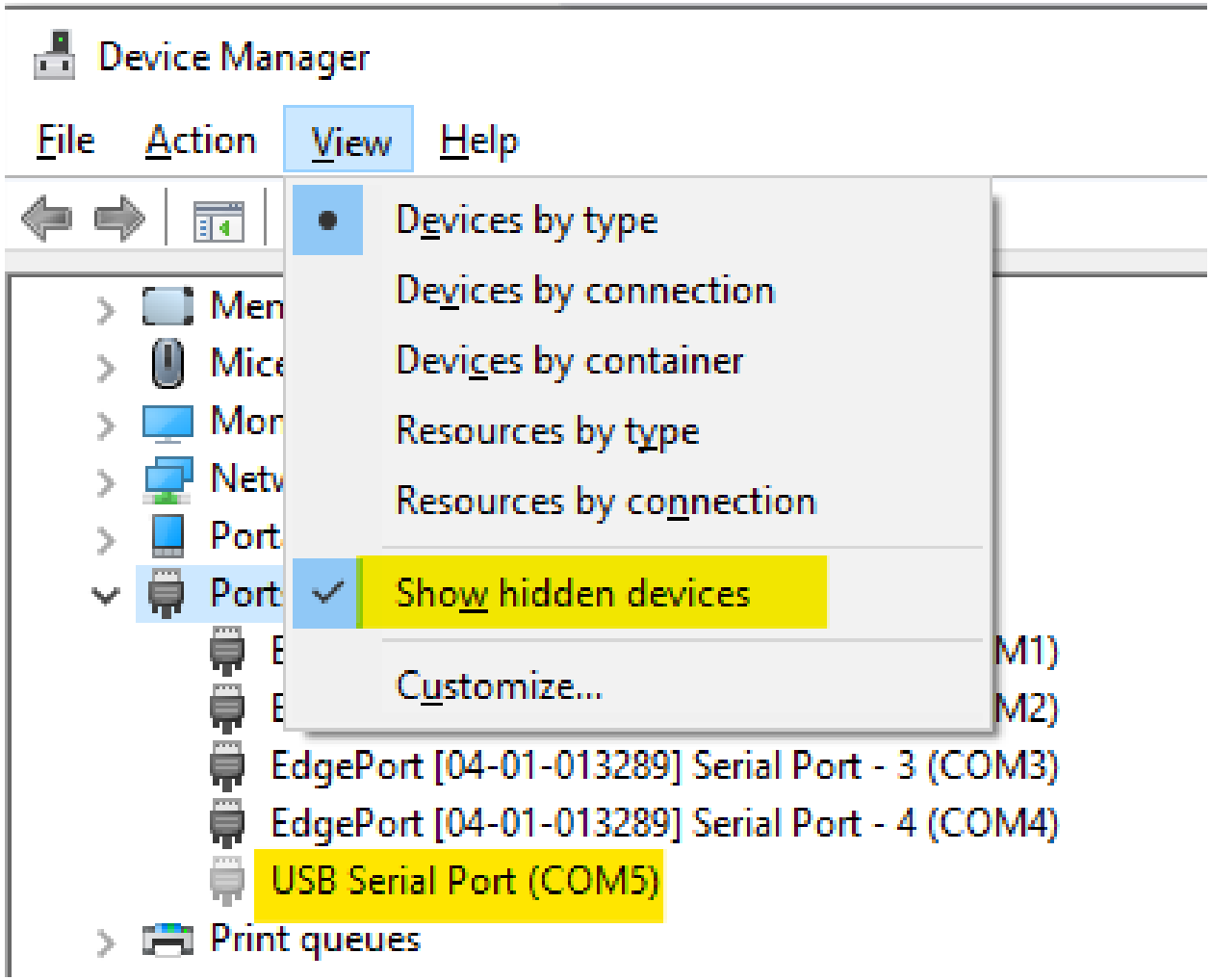
Name: **devmgr_show_nonpresent_devices**
Value: **1**



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

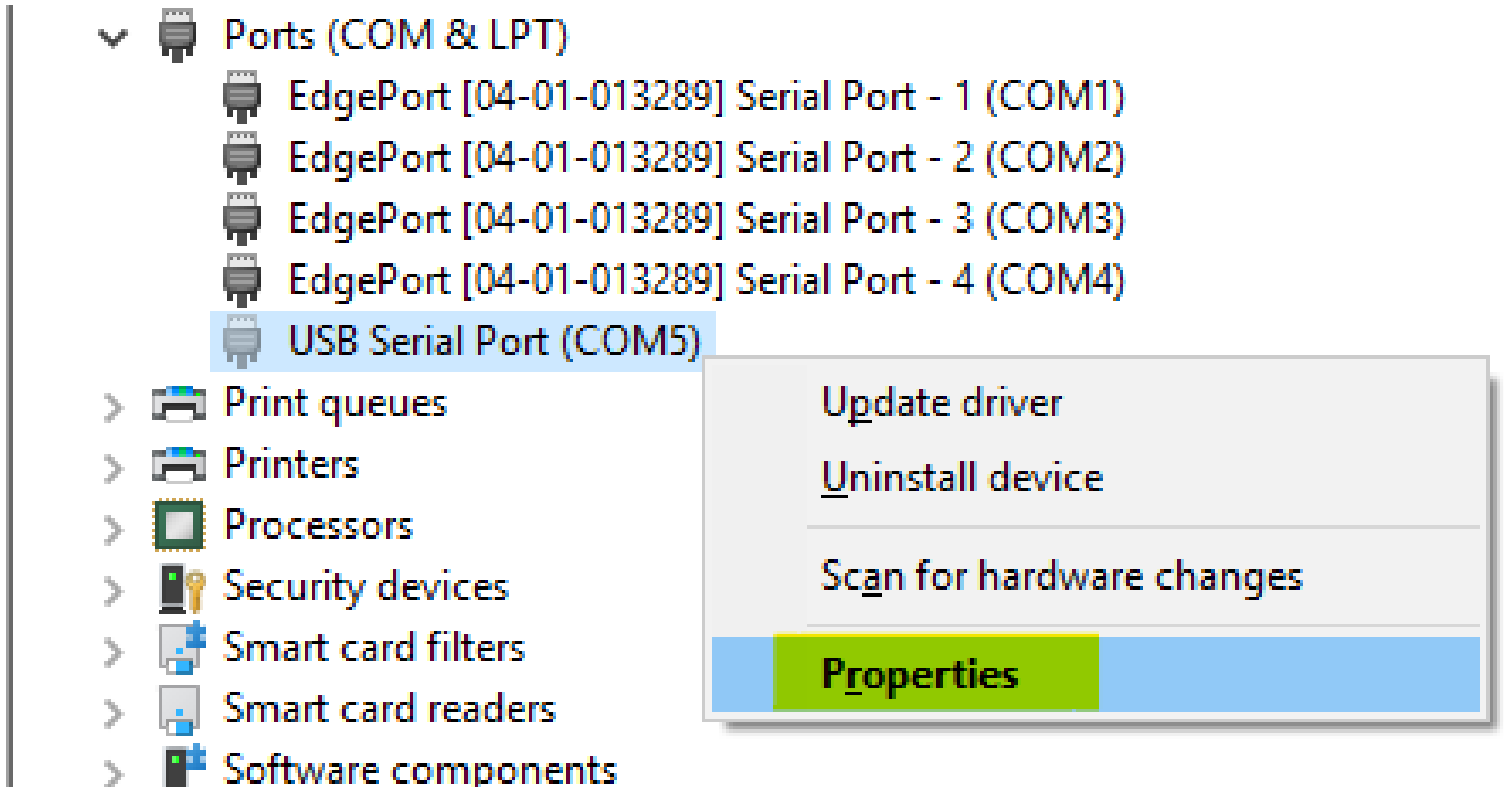
Windows Device Manager:

Always select **View → Show hidden devices**

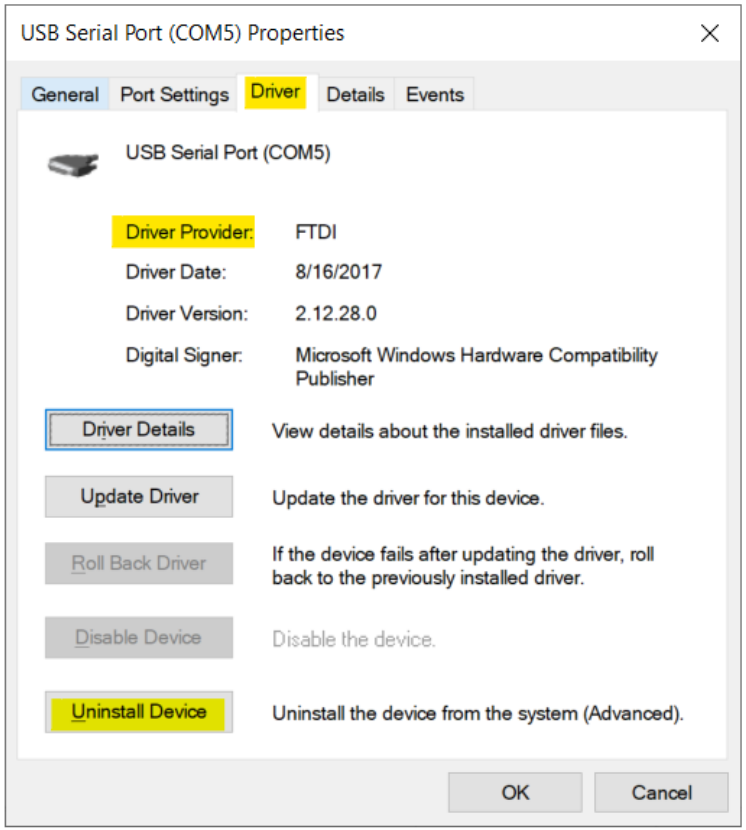


Expand Ports section

Right click gray (offline) devices, **Properties**

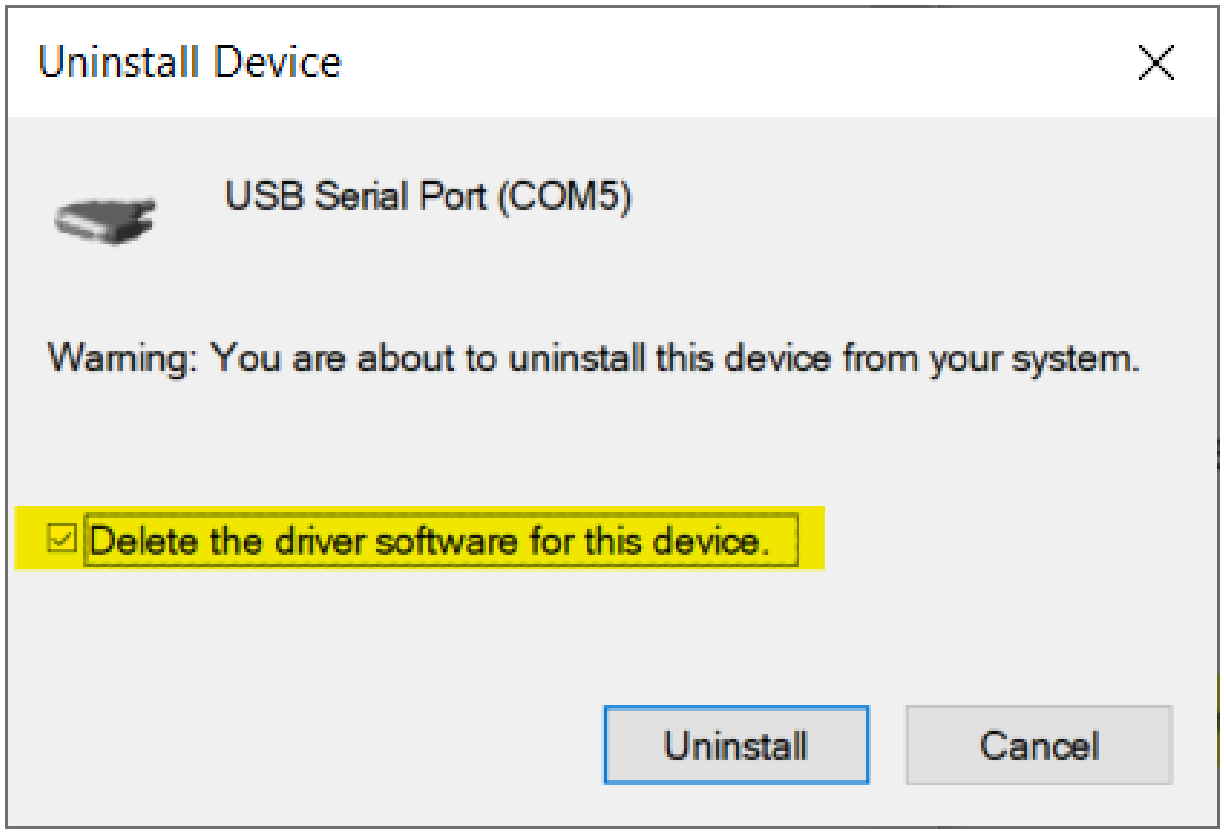


Click Driver Tab
Check that Driver Provider is *not* Prolific

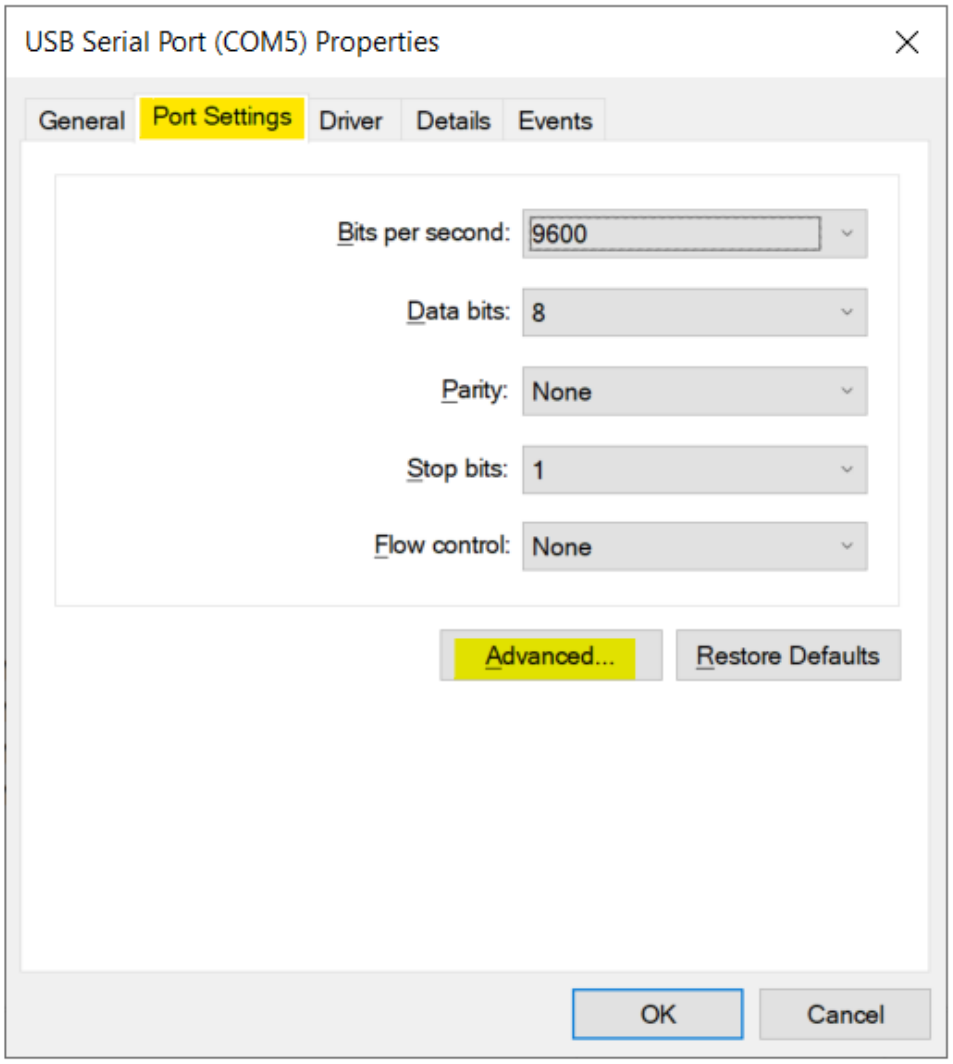


- If you see **Prolific**, click **Uninstall Device**

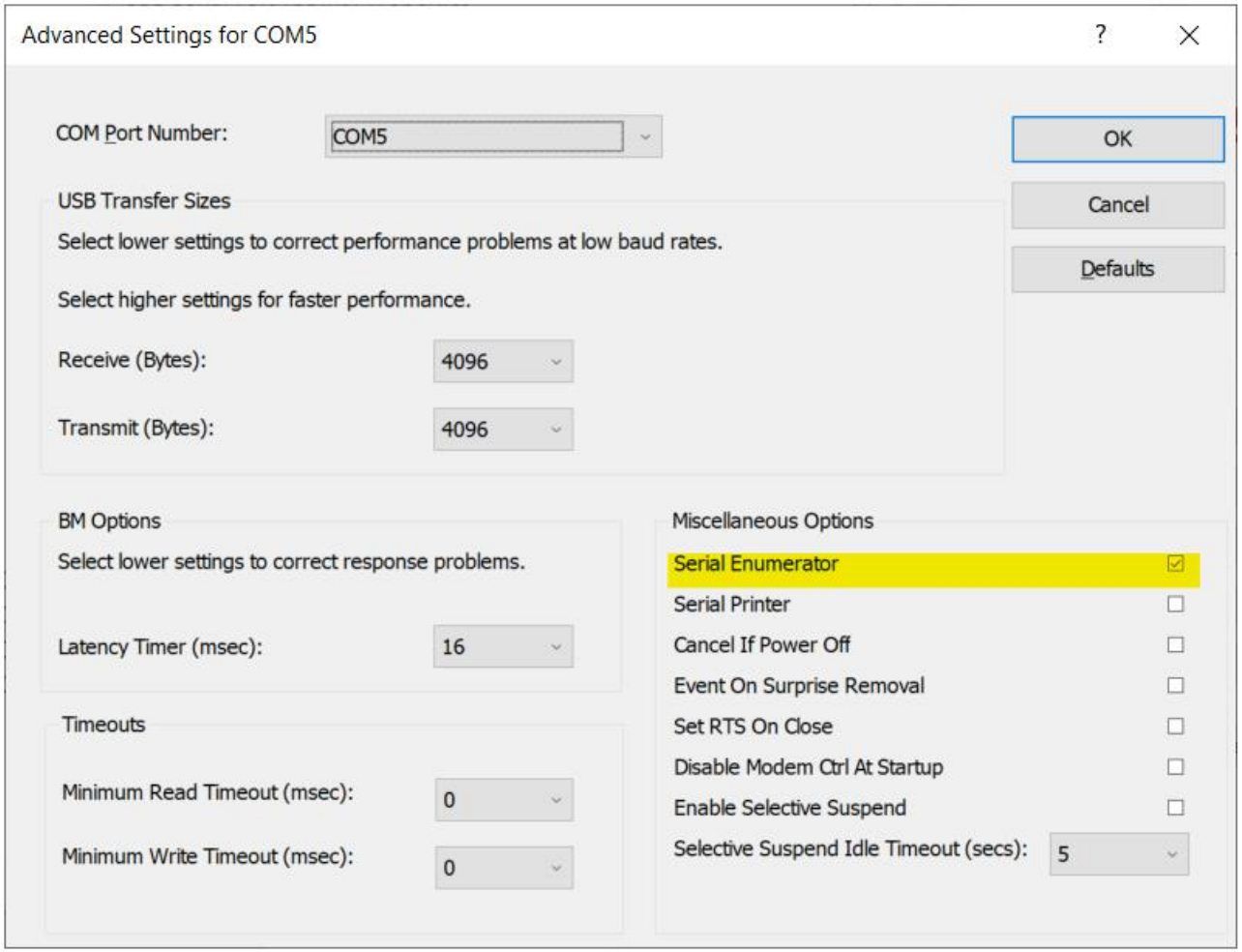
Uninstall the Prolific Device *and* Delete the Driver Software for this device.



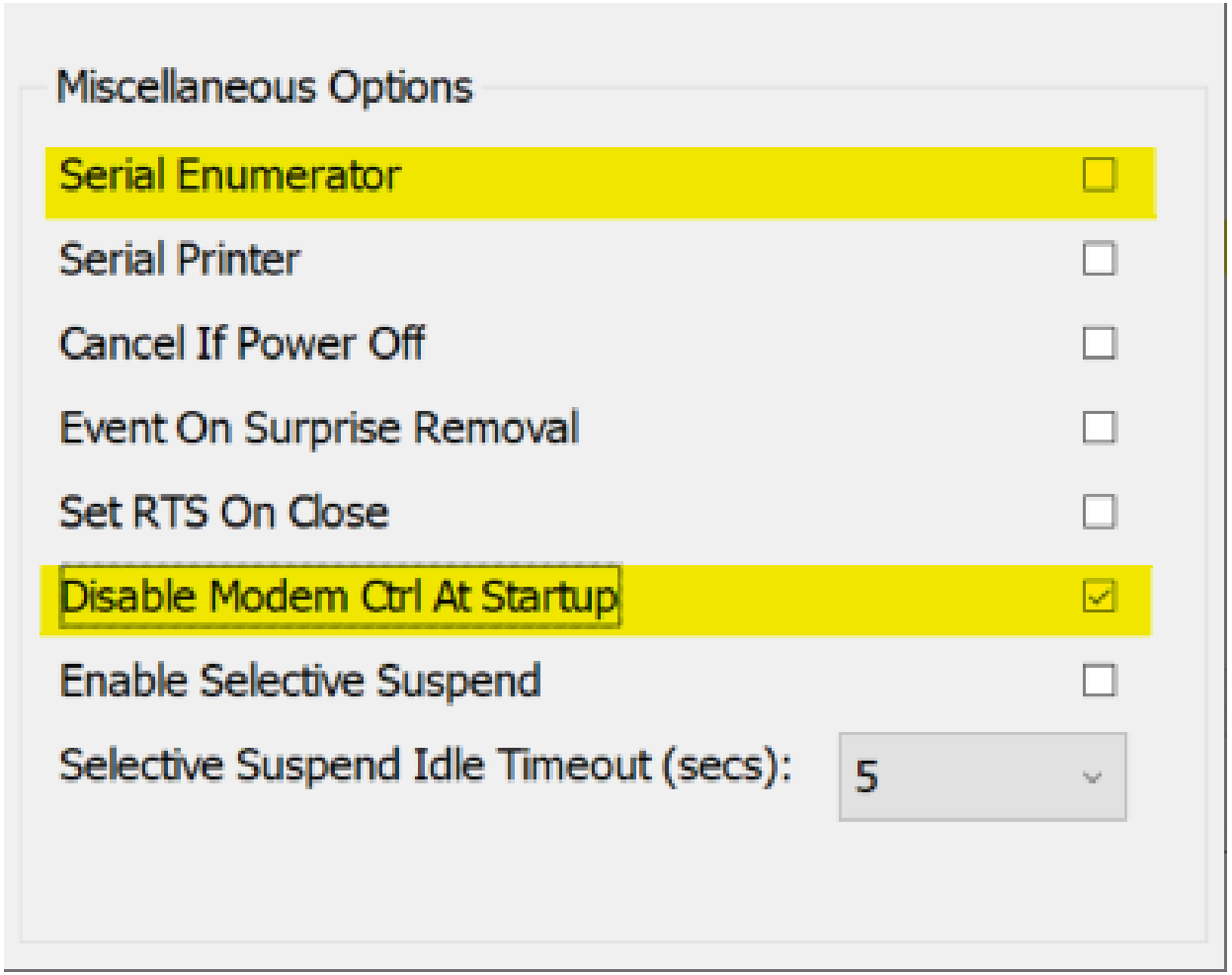
If Driver is FTDI, go to Port Settings tab
Click Advanced… button



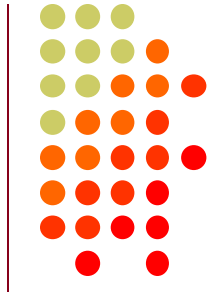
FTDI Default Options – not good, keys radio



Change the FTDI Options To This



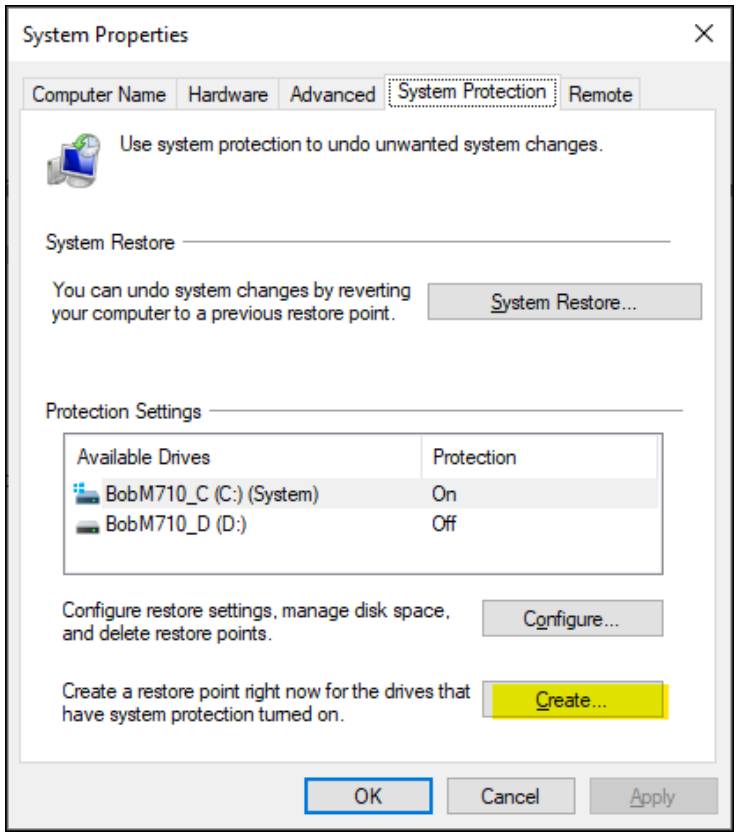
Disabling Serial Enumeration (unwanted keying) on Legacy Serial Ports (COM1:, COM2:)



- 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

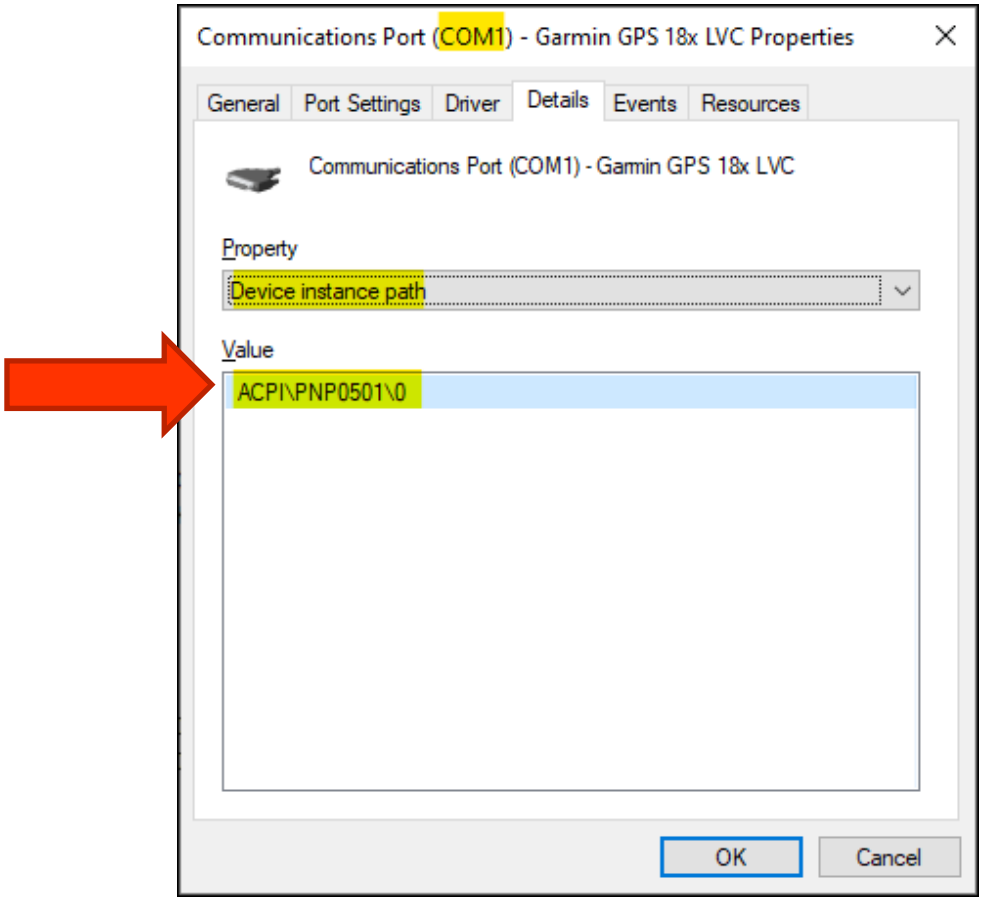
Creating a Restore Point

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



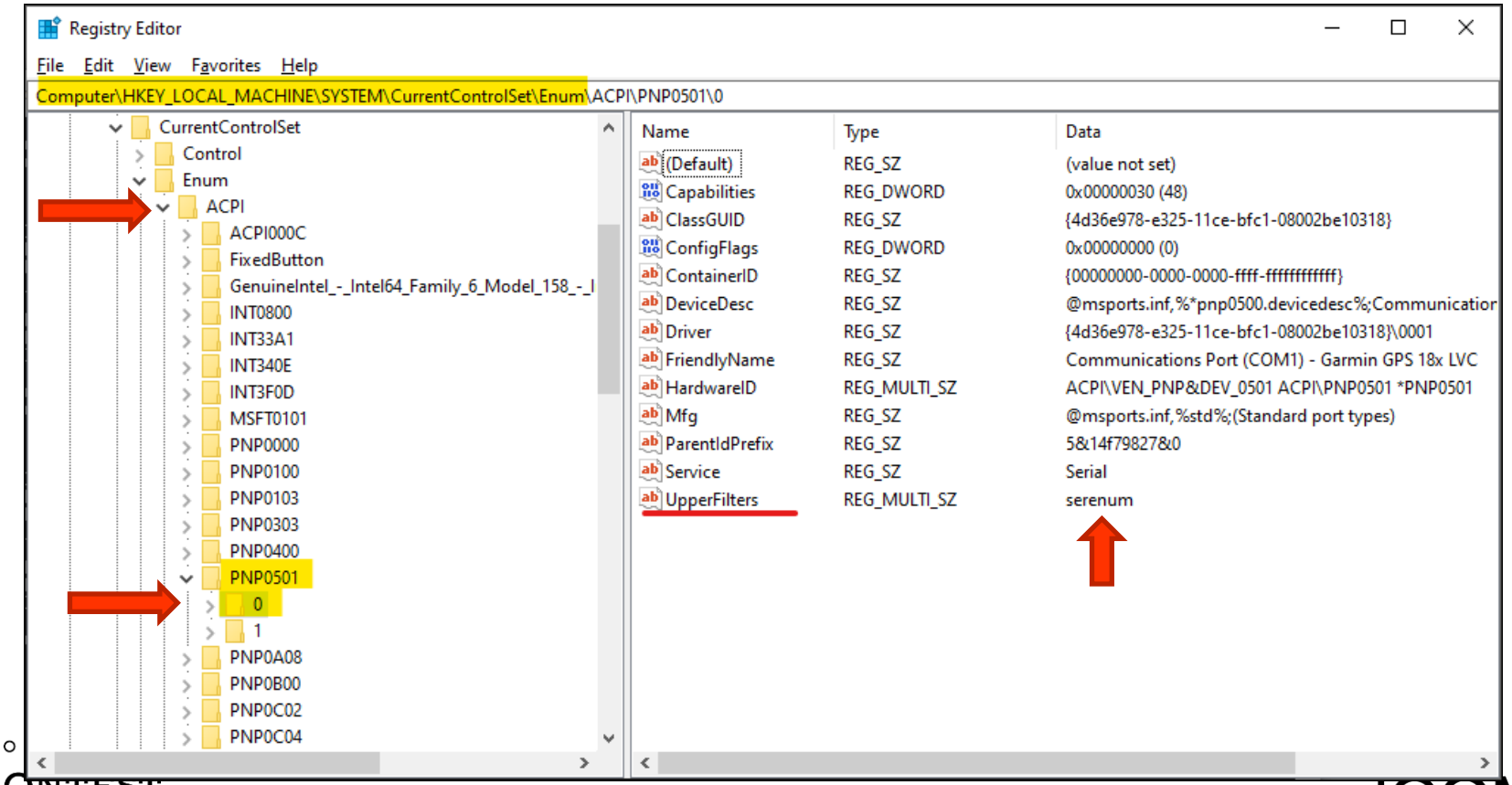
Locate Device Instance Path in Device Manager

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

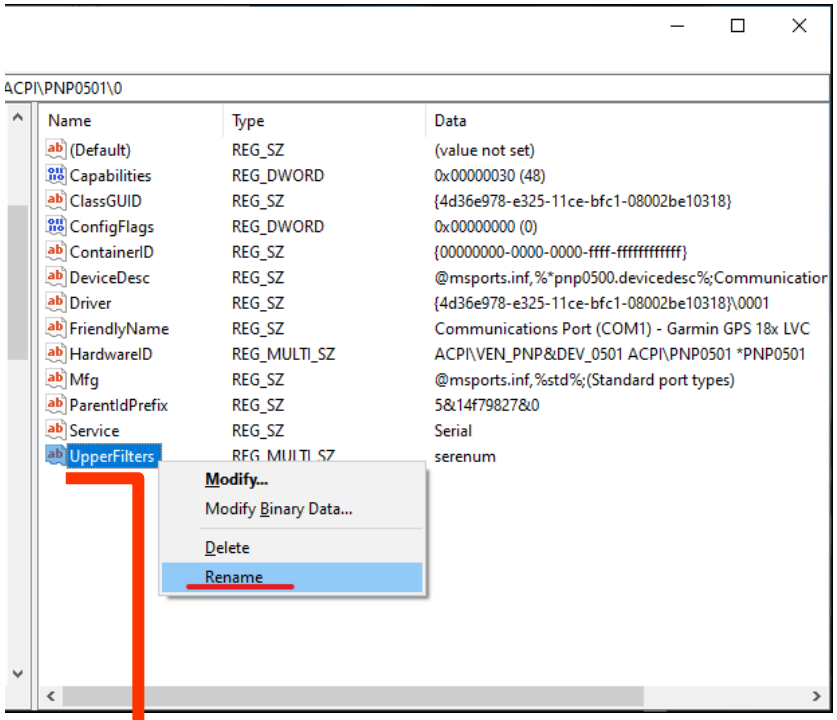


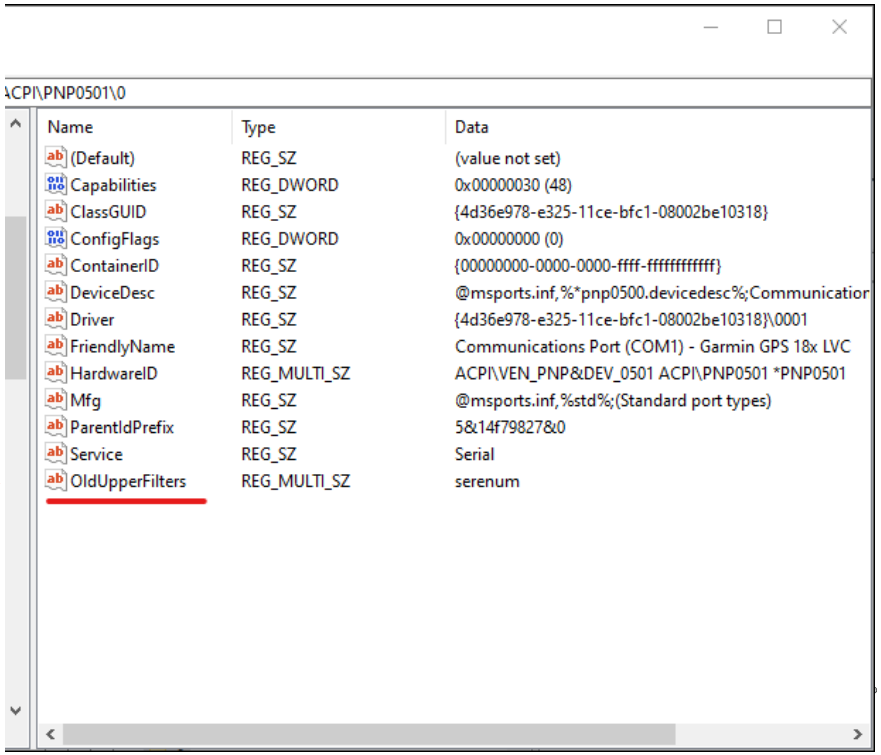
Locate Device Instance Path in Registry

- **Regedit: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Enum**

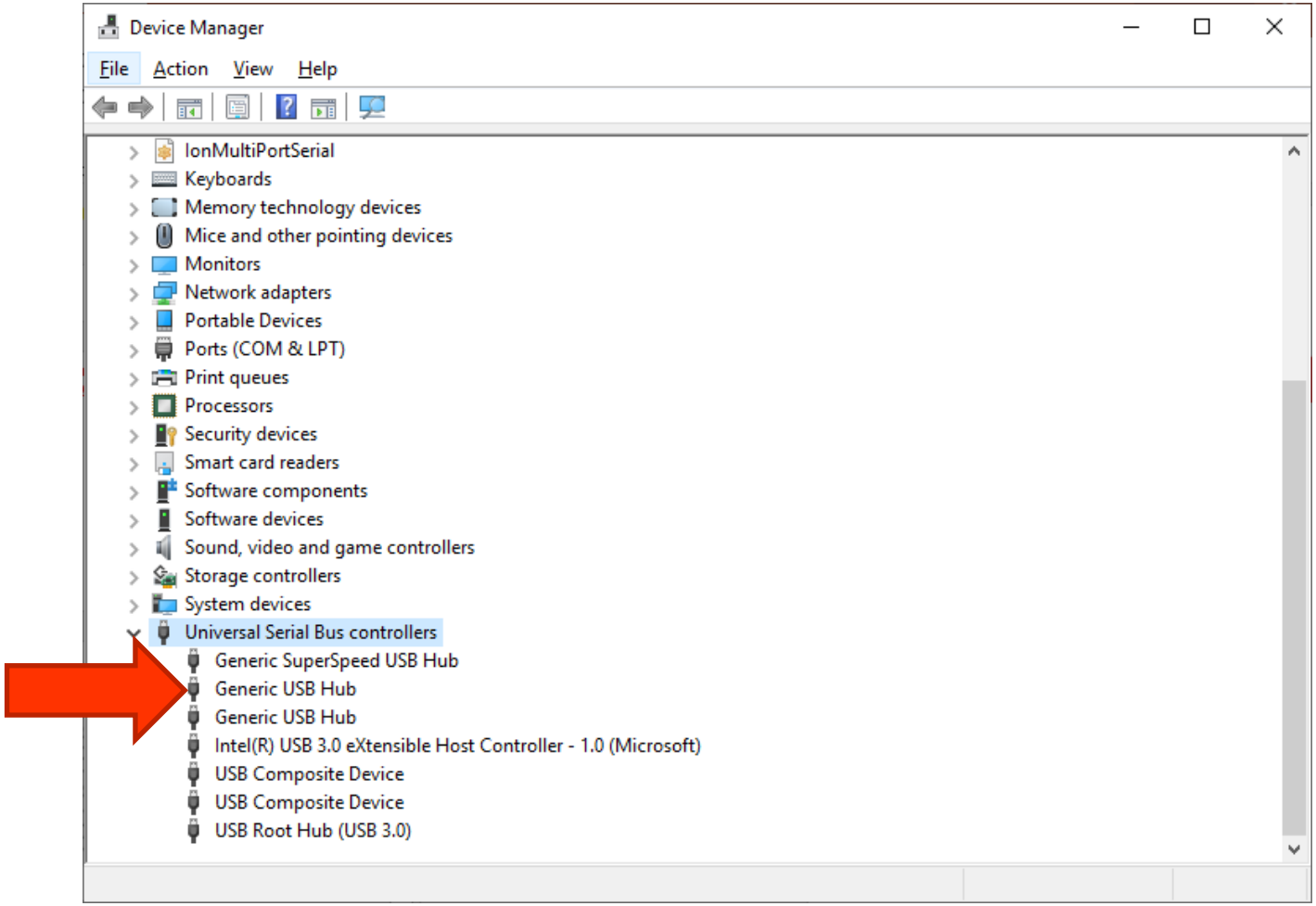


Right Click, Rename key
UpperFilters → OldUpperFilters

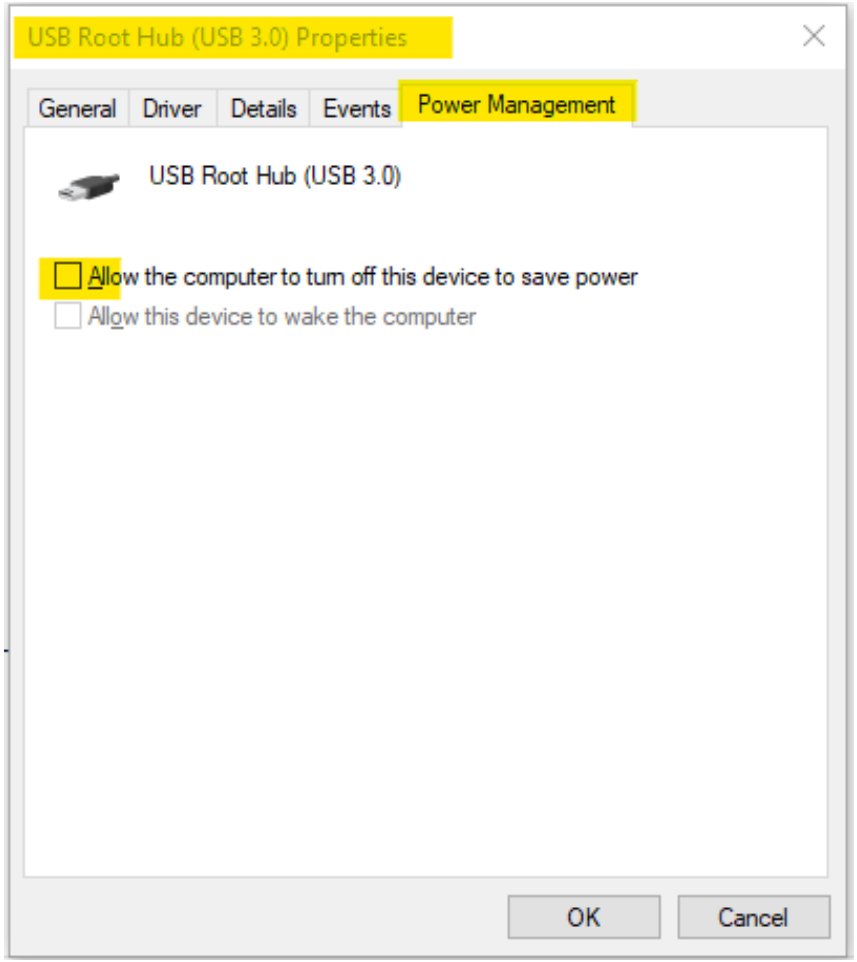




Under USB Serial Bus Controllers:
Right-Click each “Hub” device, Select Properties

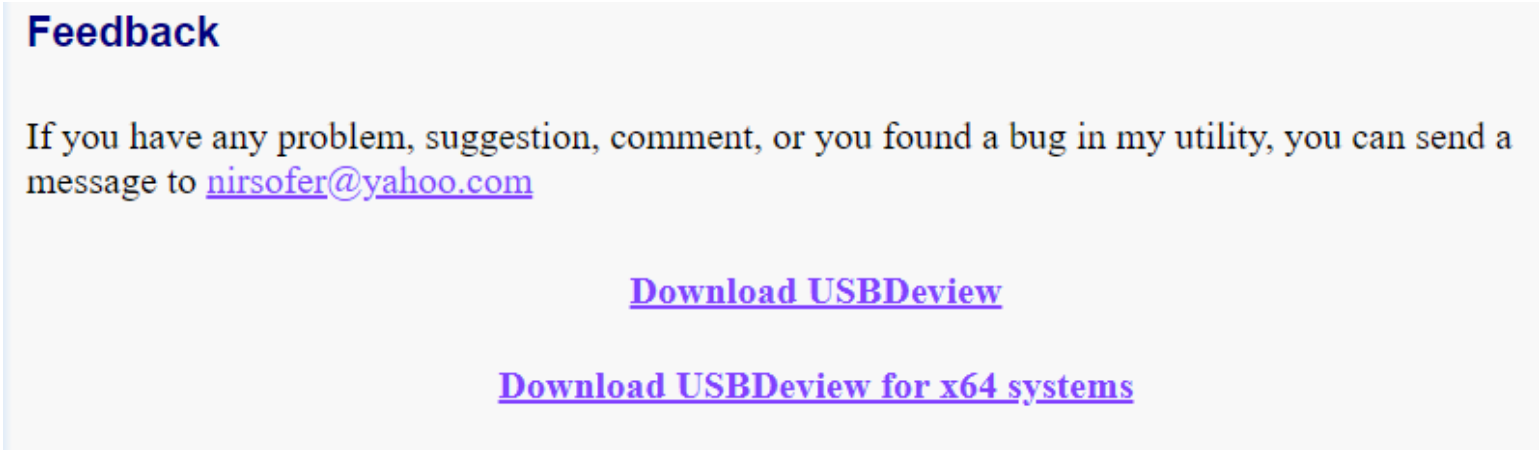


Look for Power Management Tab
Do *not* allow computer to turn off this device



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:



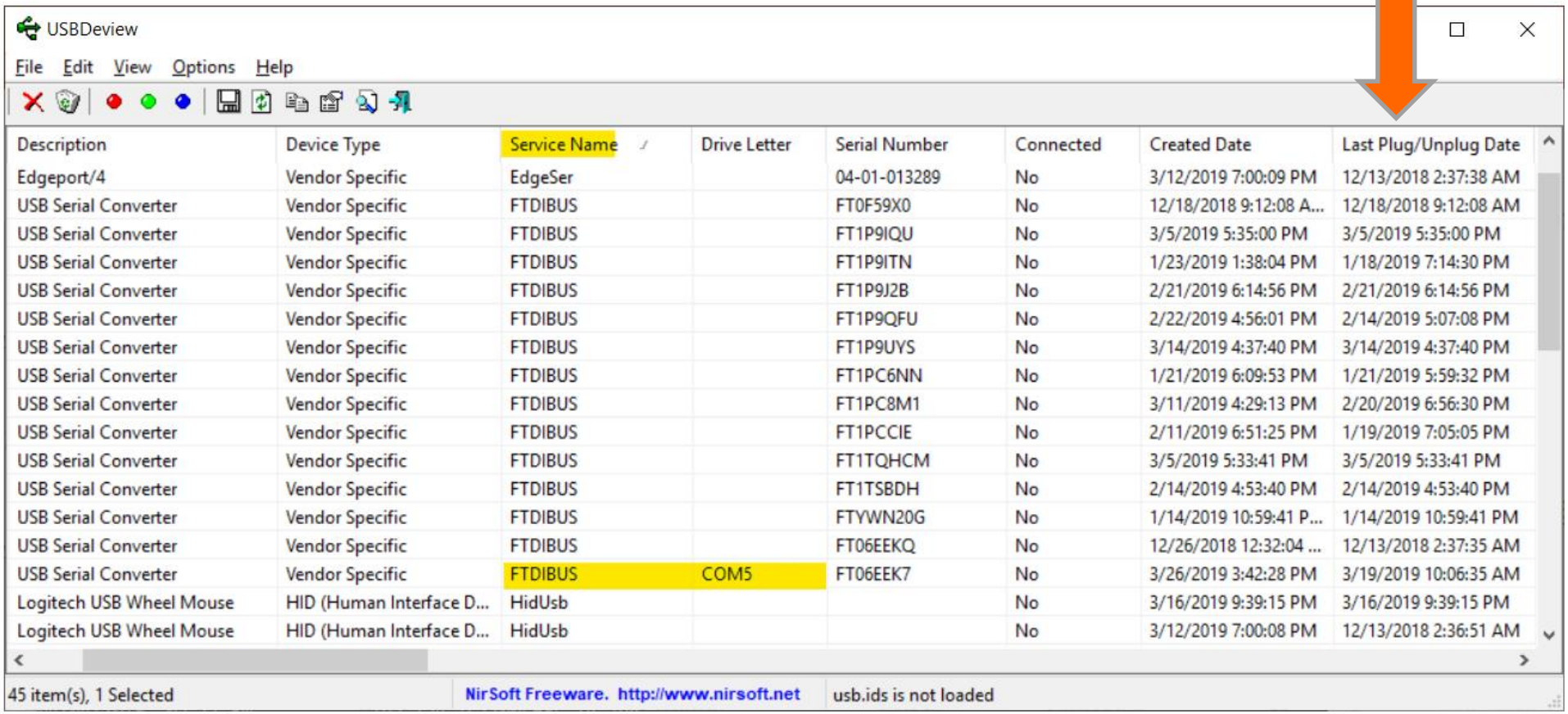
Feedback

If you have any problem, suggestion, comment, or you found a bug in my utility, you can send a message to nirsofer@yahoo.com

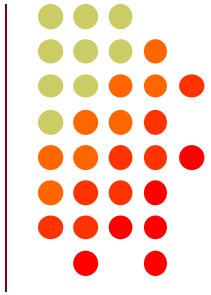
Download USBDeview

Download USBDeview for x64 systems

USBDeview Screen Shot

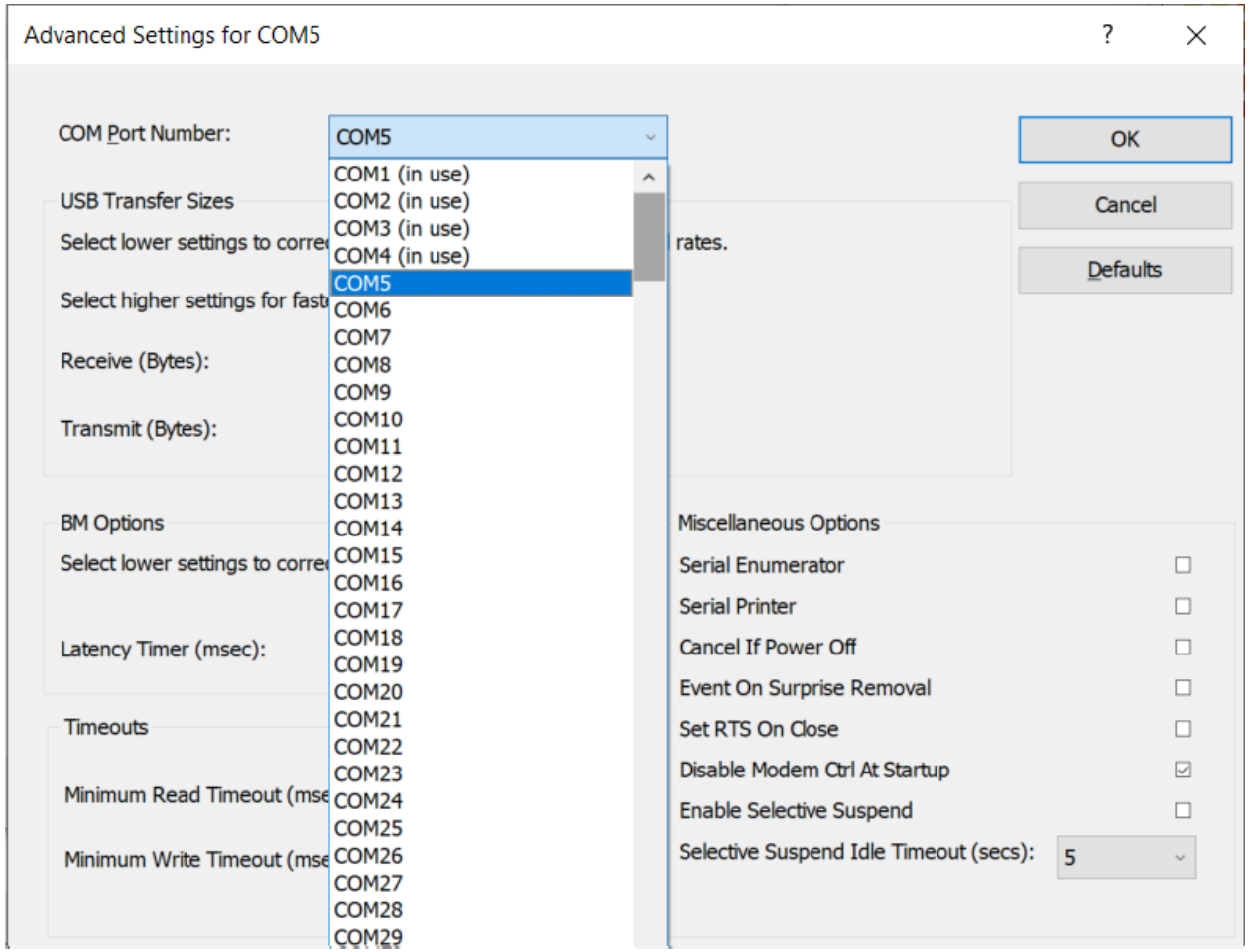


Managing COM Port Numbers



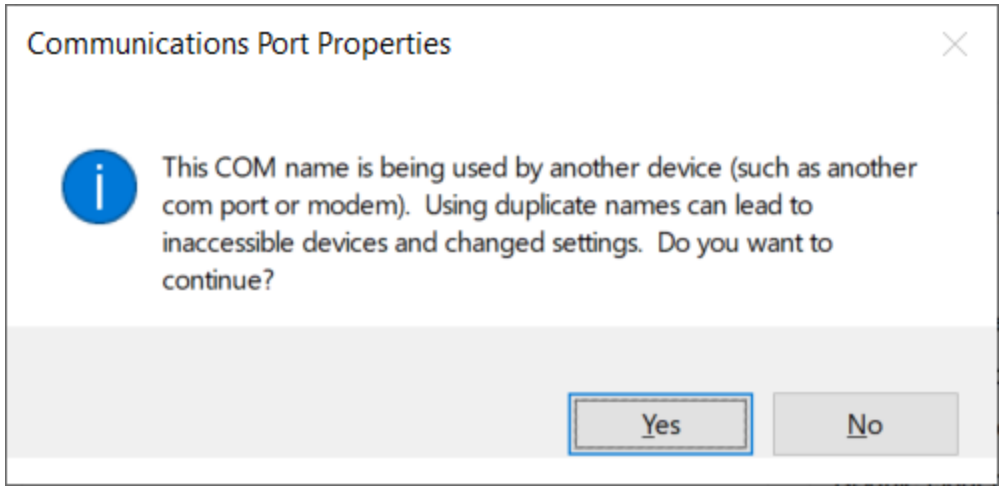
- Over time, ever increasing unique COM port numbers are assigned by Windows, difficult to keep track
- Some software doesn't support COM13: or higher
- Suggestion: renumber serial ports "left to right" to match your station layout, starting with transceivers
- First, use Windows Device Manager to uninstall 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 with Device Manager:
Right click, Properties, Port Settings tab, Advanced



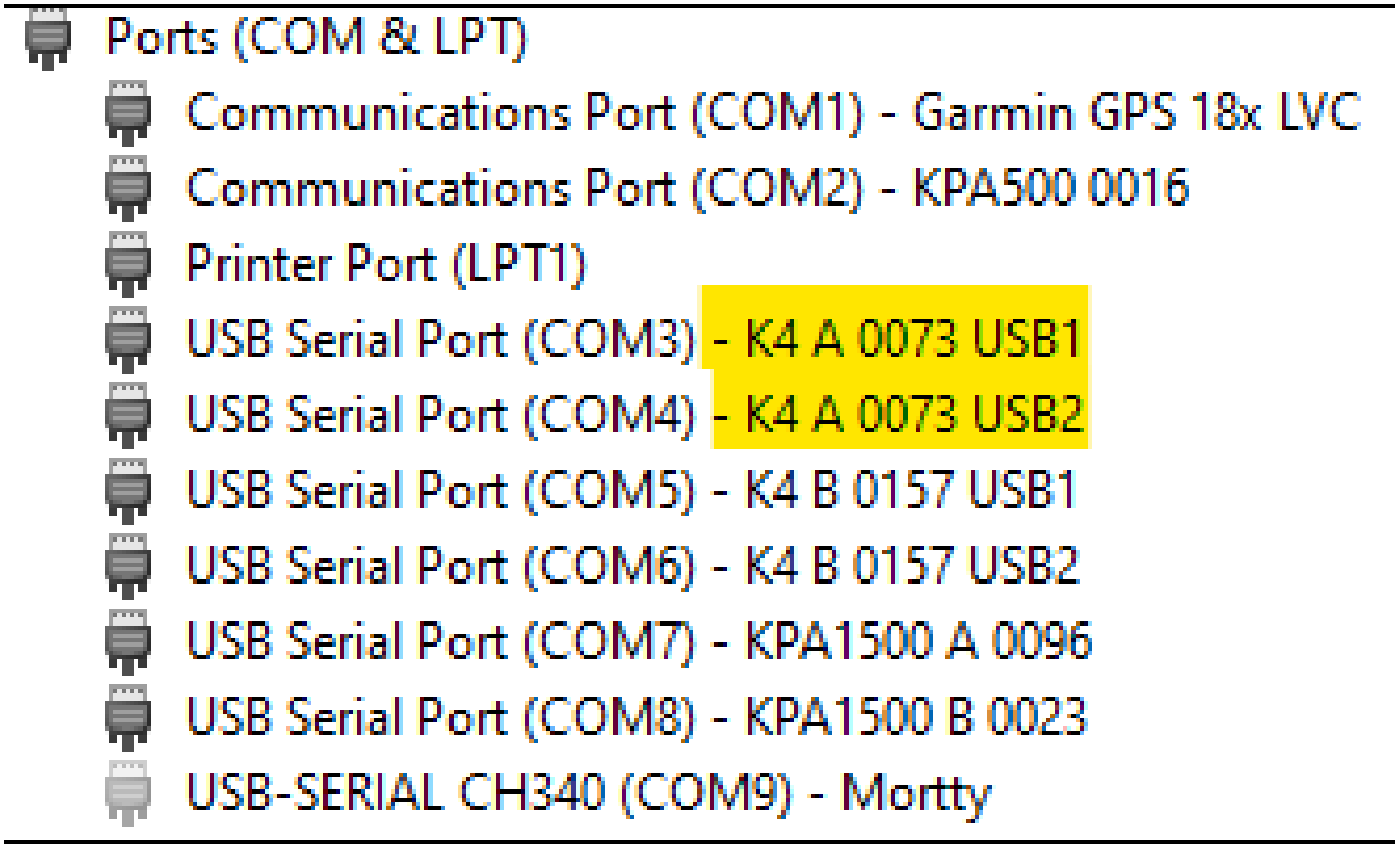
What does “In Use” Mean?

- 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:



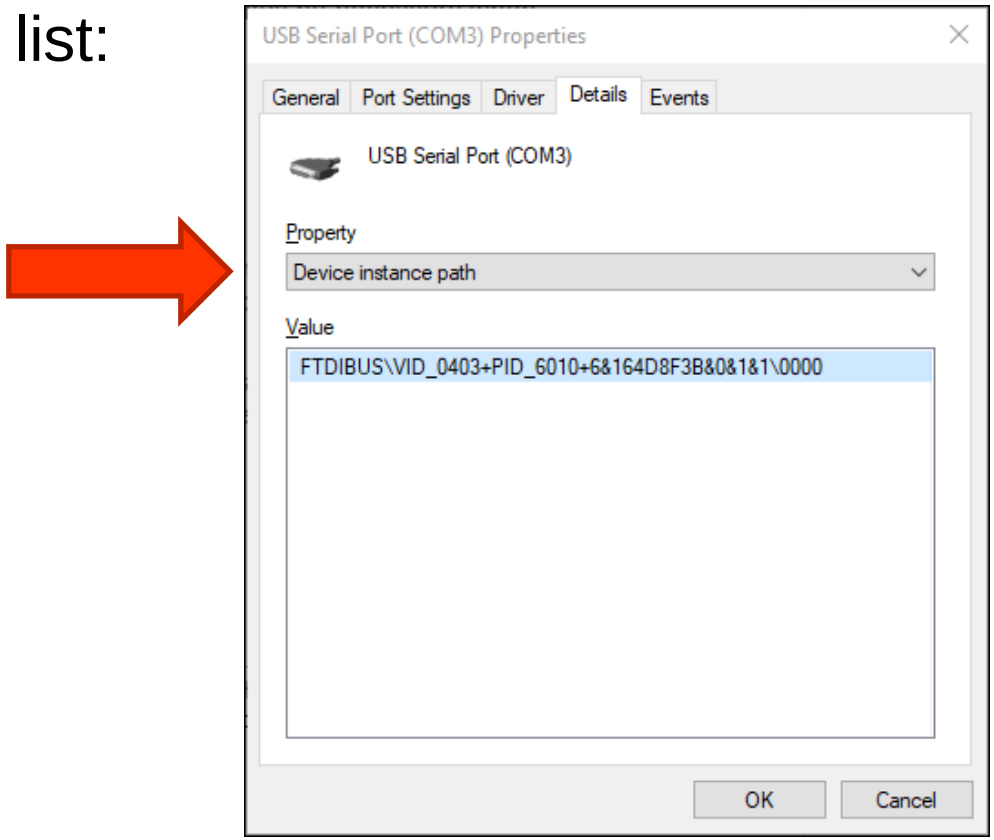
Labeling Serial Ports

- Example:



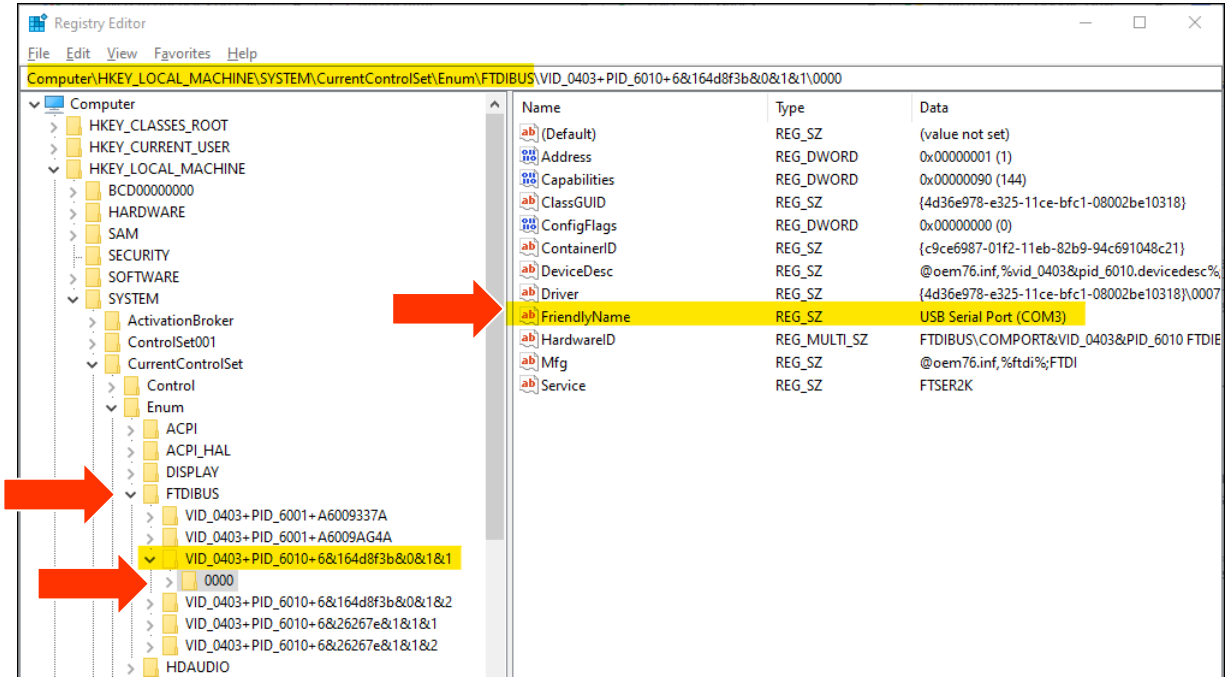
Step 1 – Note the “Device instance path”

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



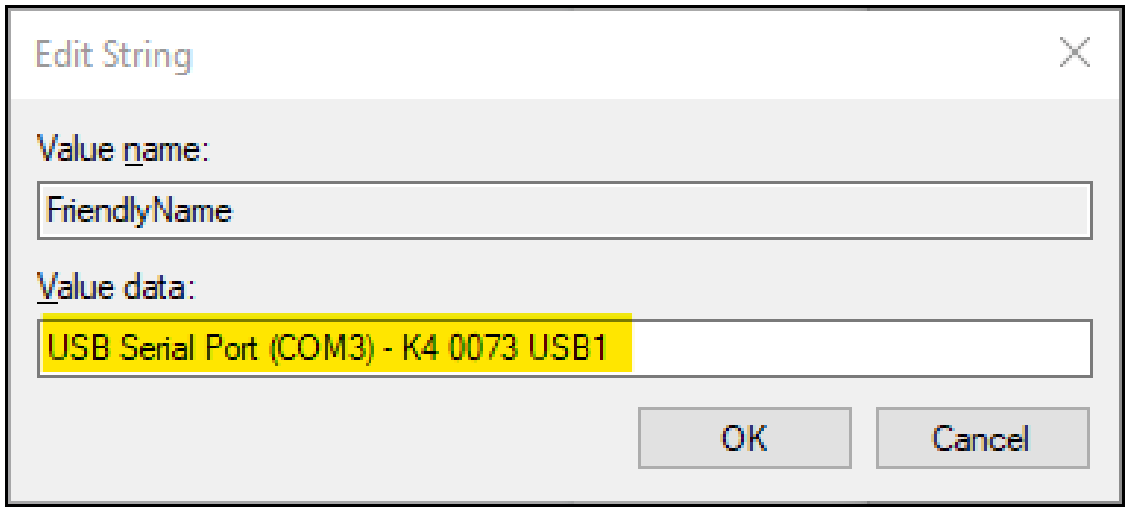
Step 2 – Use Registry Editor (regedit)

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



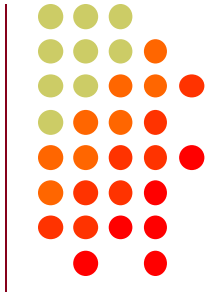
Step 3 – Change the FriendlyName

- 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

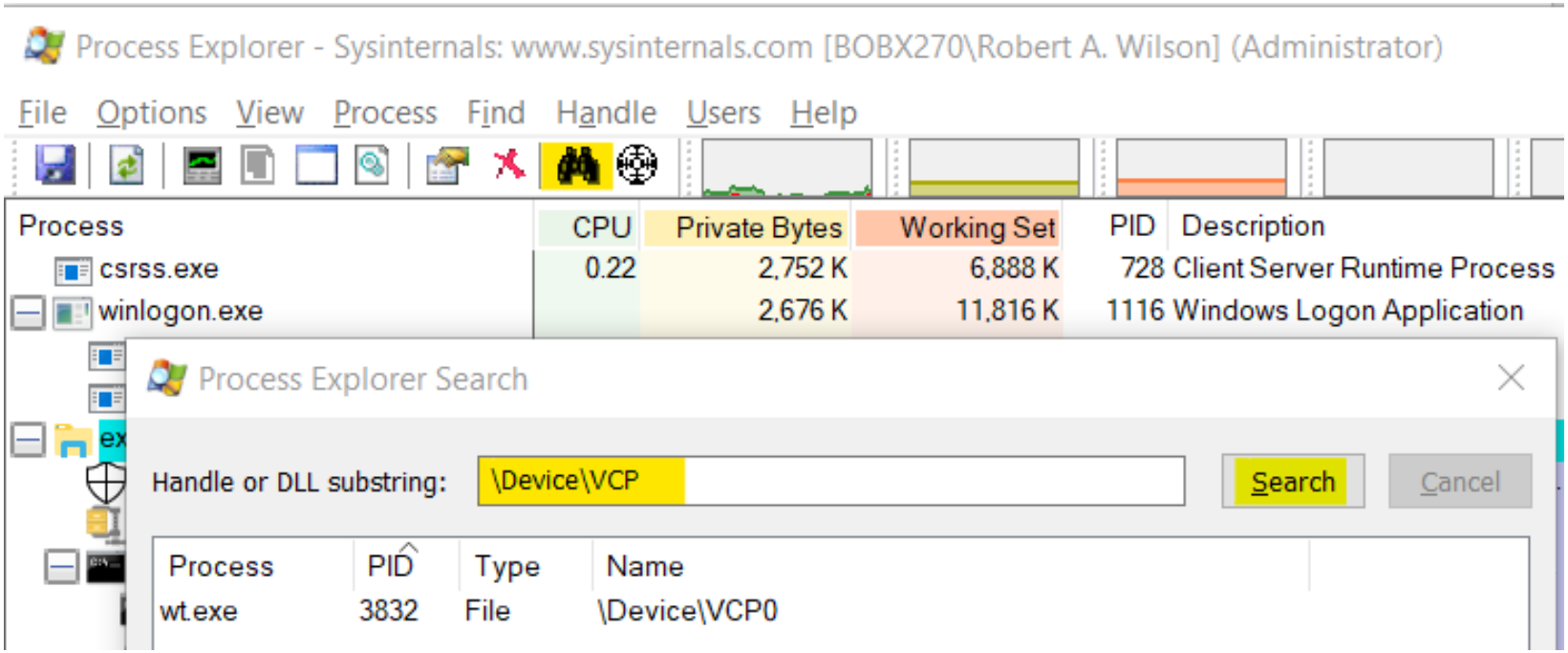
What program is currently using my serial port?



- 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:

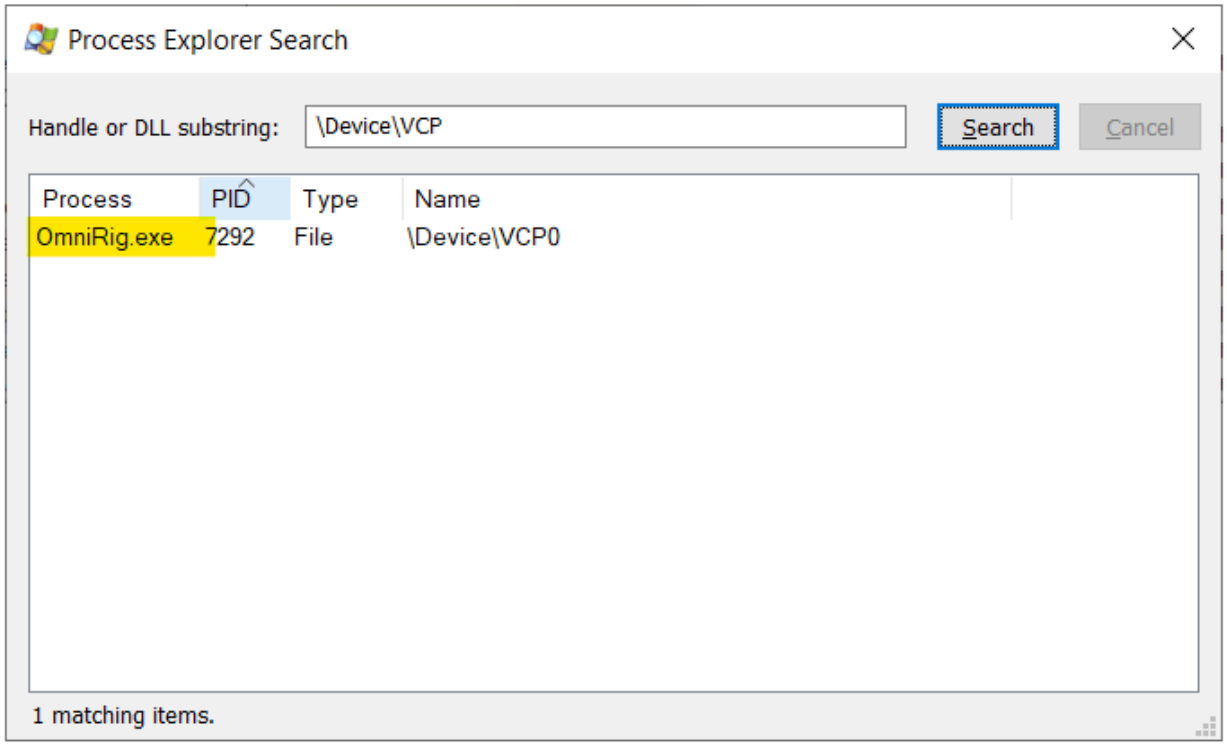
\Device\VCP	- FTDI virtual COM ports
\Device\Edg	- Edgeport devices
\Device\Ser	- Built-in (COM1:), Mortty (Arduino)
\Device\Sil	- Icom/Kenwood/Yaesu (Silicon Labs)
\Device\VSer	- Eltima / vspMgr virtual serial ports

Process Explorer Search – Example 1



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

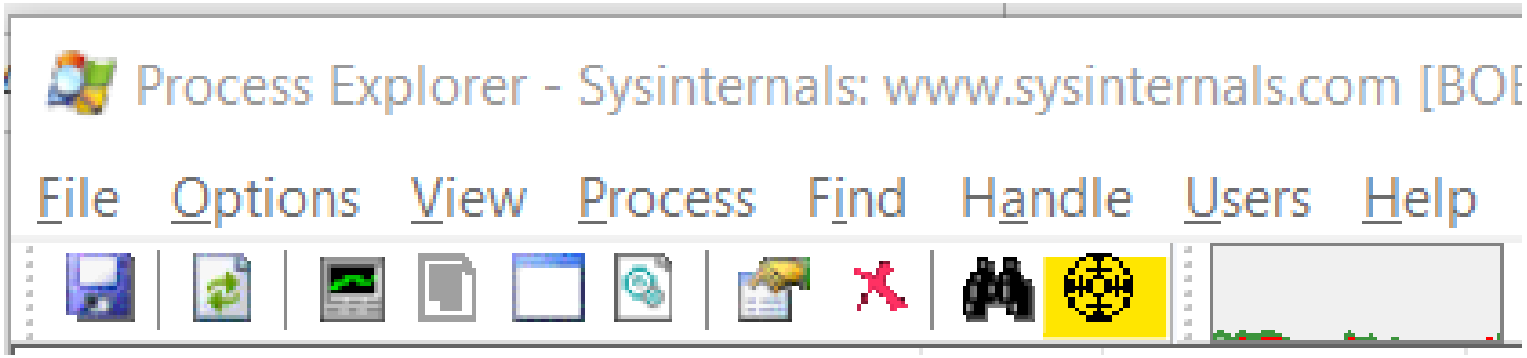
Process Explorer Search Example 2



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

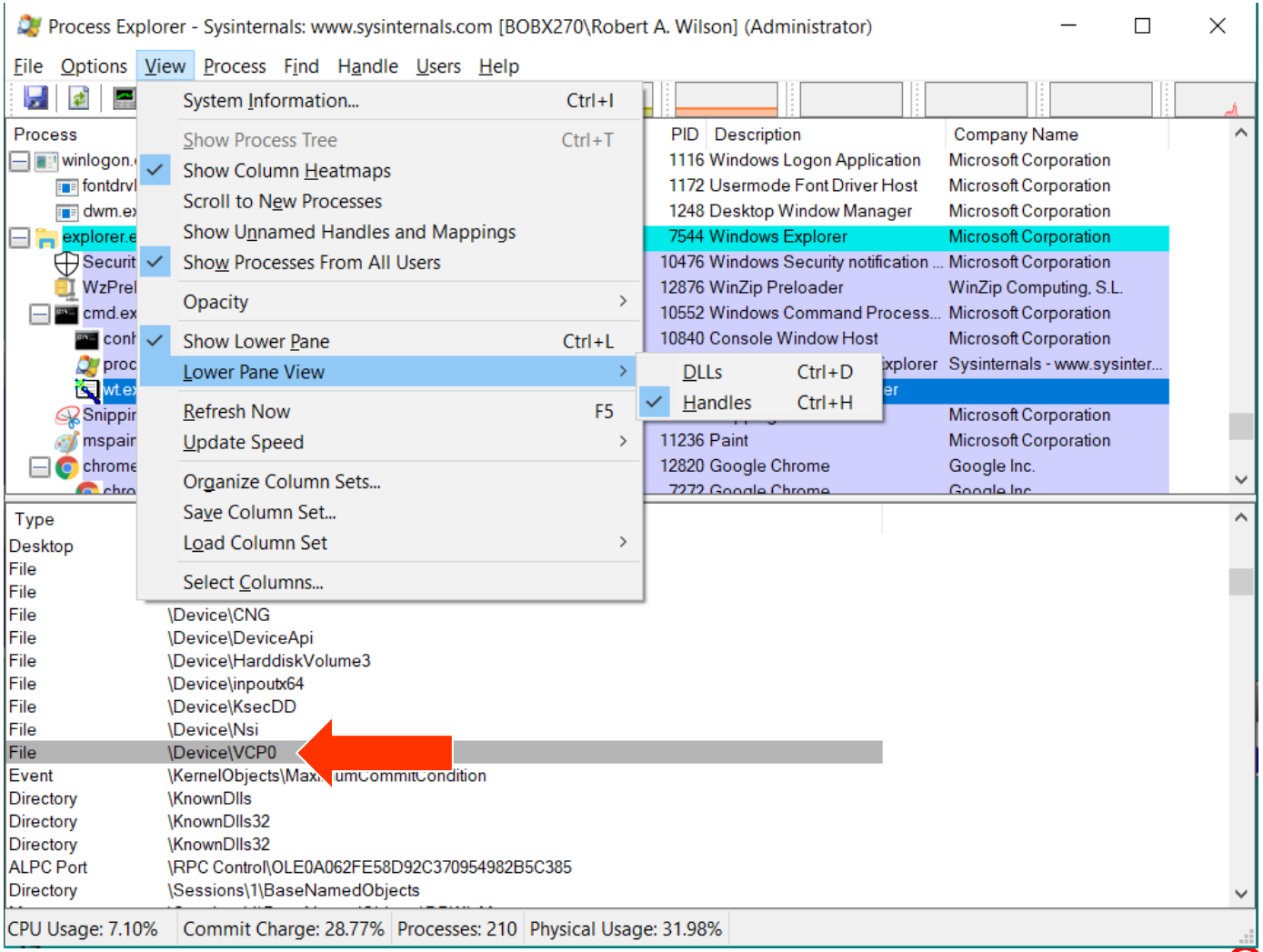
Not sure what to search for?

- 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



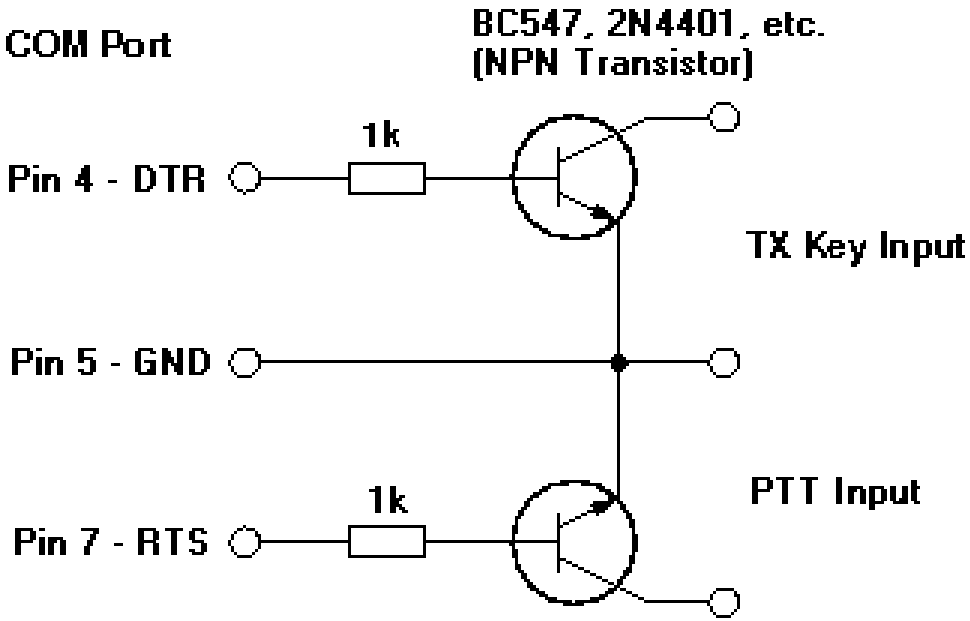
- Process Explorer will jump to the process corresponding to that program window

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

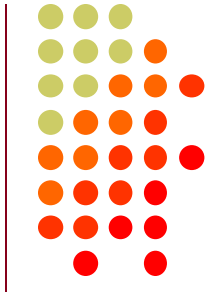


Computer CW, PTT, and FSK RTTY Keying
Using Serial Port pins (DTR=CW or FSK, RTS=PTT)

- A simple hardware “open collector” keying circuit, used for decades:



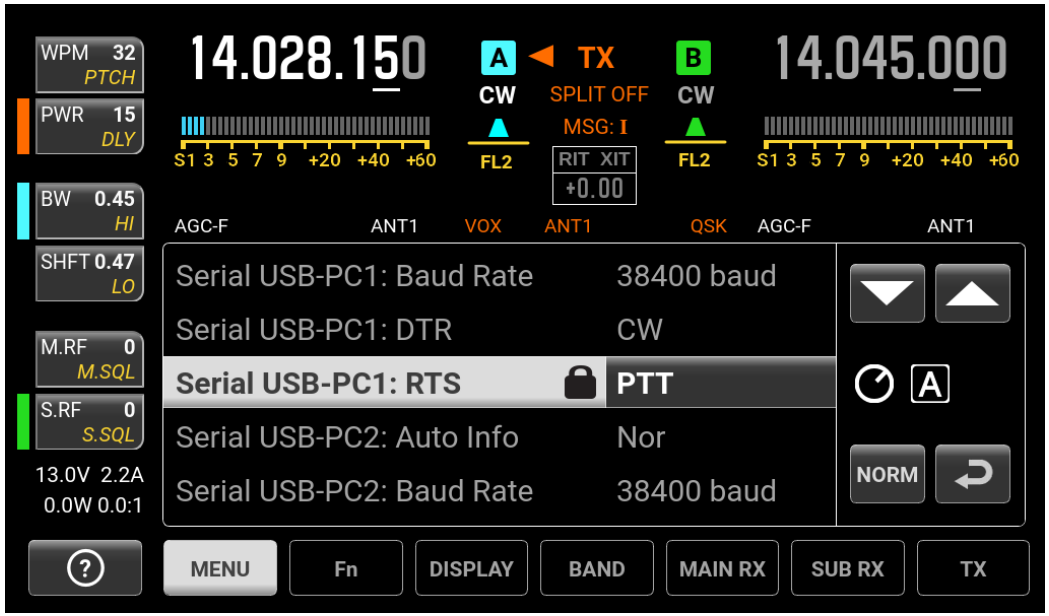
Elecraft K3 / K3S keying via serial port



- 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:RS332 = 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)

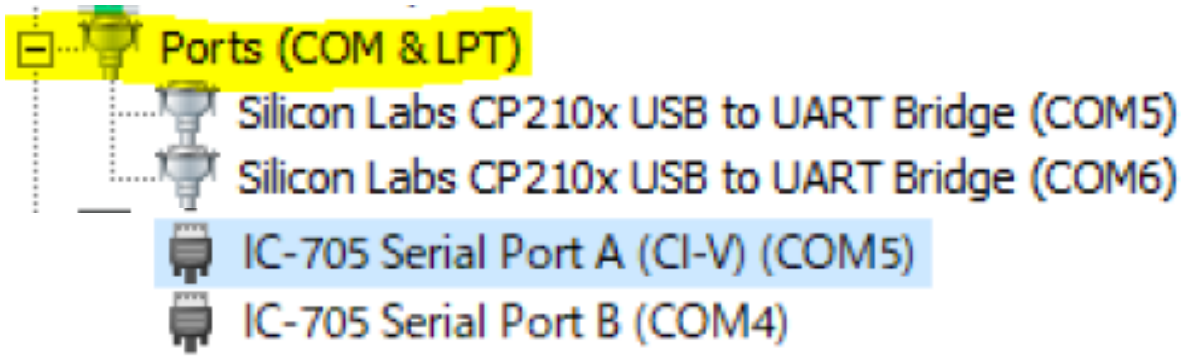
- Same as K3, but THREE (3) serial ports available for CW, PTT, and FSK keying and rig control
- In K4 menu, scroll to the **Serial**, entries, modify as shown:



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

ICOM Copies Elecraft K3, Adds FSK Keying

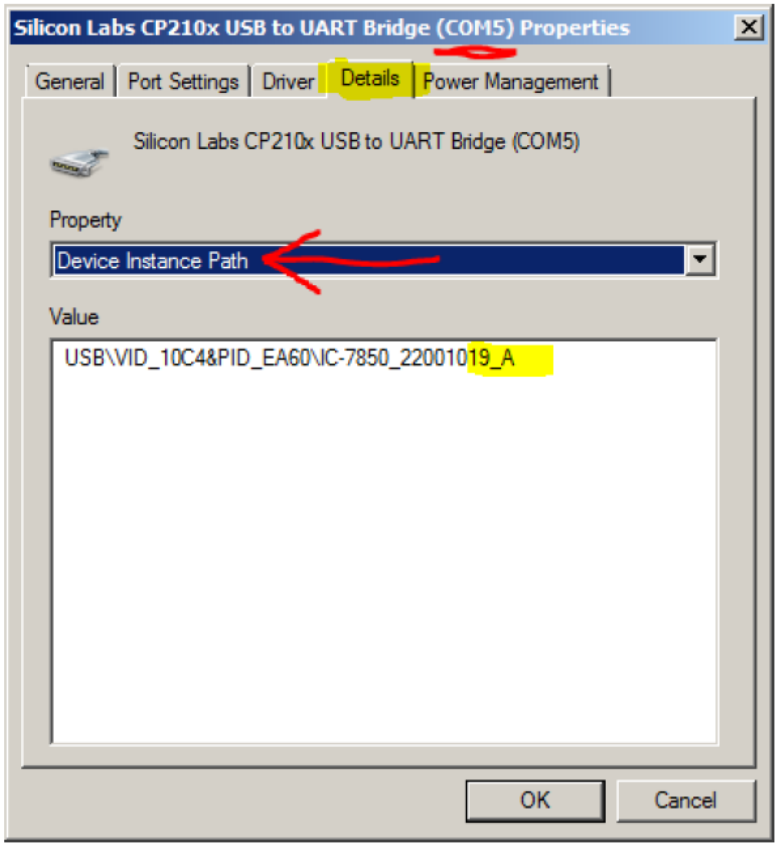
- CW, PTT, and FSK keying timing OK over USB virtual serial port
- Supported by IC-705, IC-7300, IC-7610, IC-7850, IC-7851
- IC-7300 generates just one virtual serial port
- IC-705, IC-7610, IC-7850, IC-7851 generate *two* virtual serial ports:



- 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

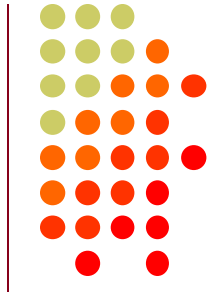
- Use Windows Device Manger, right click on first COM port, Properties, Details tab, Device Instance Path, check last letter



ICOM IC-7300 Keying via USB Cable

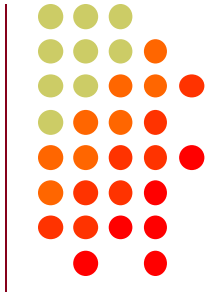
- USB cable provides *one* virtual serial port
- In IC-7300 **SET > Connectors** menu:
  Set **USB Keying (CW)** to **DTR**
  -or-
  Set **USB Keying (RTTY)** to **DTR**
- Set **USB Send** to **RTS**
- Logging Software, rig control Port (USB), set DTR=CW, RTS=PTT
- In MMTTY, use **EXTFSK** or **EXTFSK64** 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



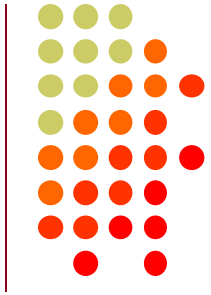
- USB cable provides *two* virtual serial ports
- In IC-7610 **SET > Connectors > USB Send/Keying**:
  Set **USB Keying (CW)** to **USB (A) DTR**
  Set **USB Keying (RTTY)** to **USB (B) DTR**
  Set **USB Send** to **USB (A) RTS** or **USB (B) RTS**
- In Logging Software, rig control COM Port (A):
  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 **ESTFSK64** 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.

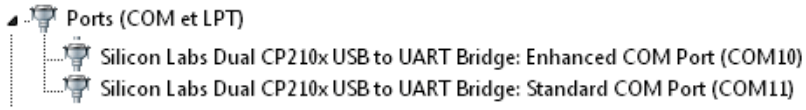
ICOM IC-7850, IC-7851 Keying via USB Cable



- 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 **ESTFSK64** 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

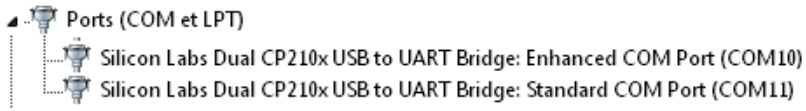
- USB cable provides *two* Silicon Labs virtual serial ports:



- 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 **ESTFSK64** with the “Standard” COM port: FSK=DTR, PTT=RTS

Yaesu FTdx101D or FTdx101MP Keying via USB

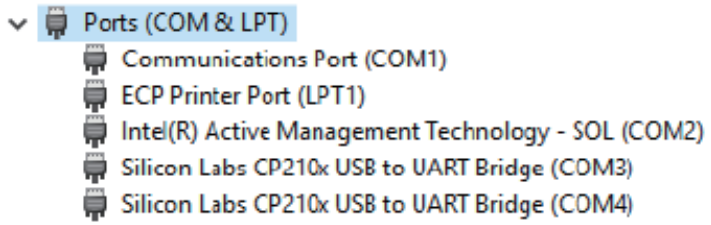
- USB cable provides *two* Silicon Labs virtual serial ports:



- 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 **ESTFSK64** with the "Standard" COM port: FSK=DTR, PTT=RTS

Kenwood TS-890

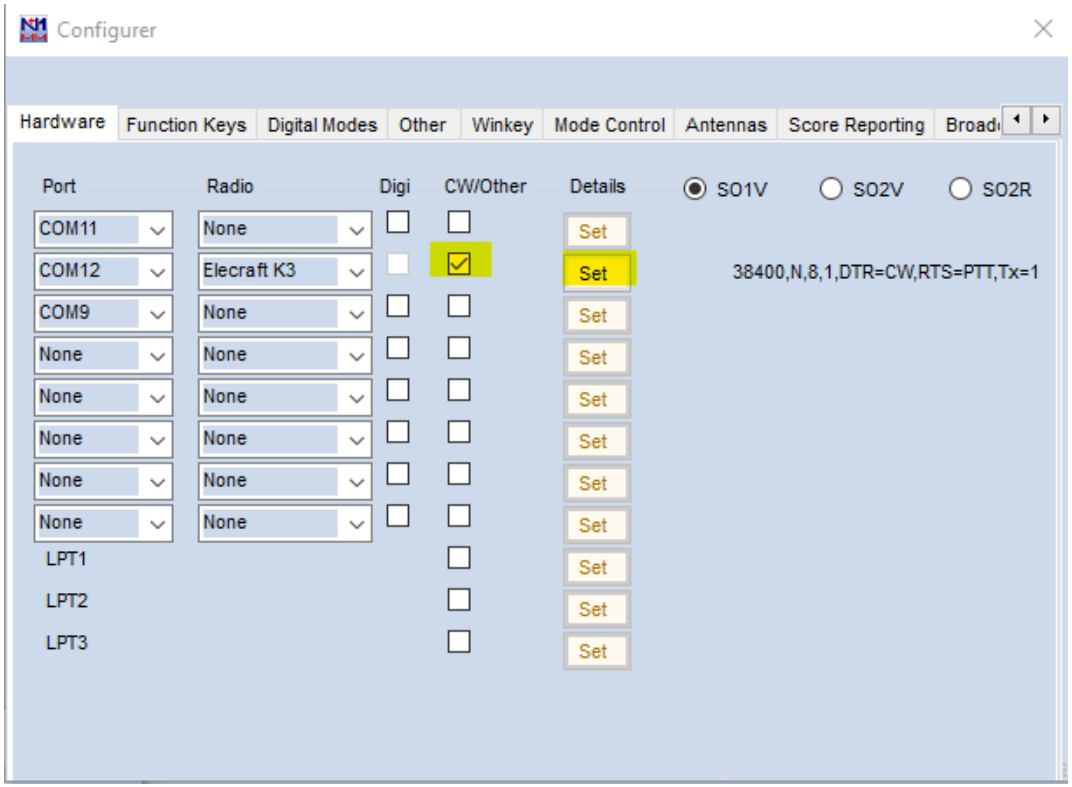
- USB cable provides *two* Silicon Labs virtual serial ports:



- 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

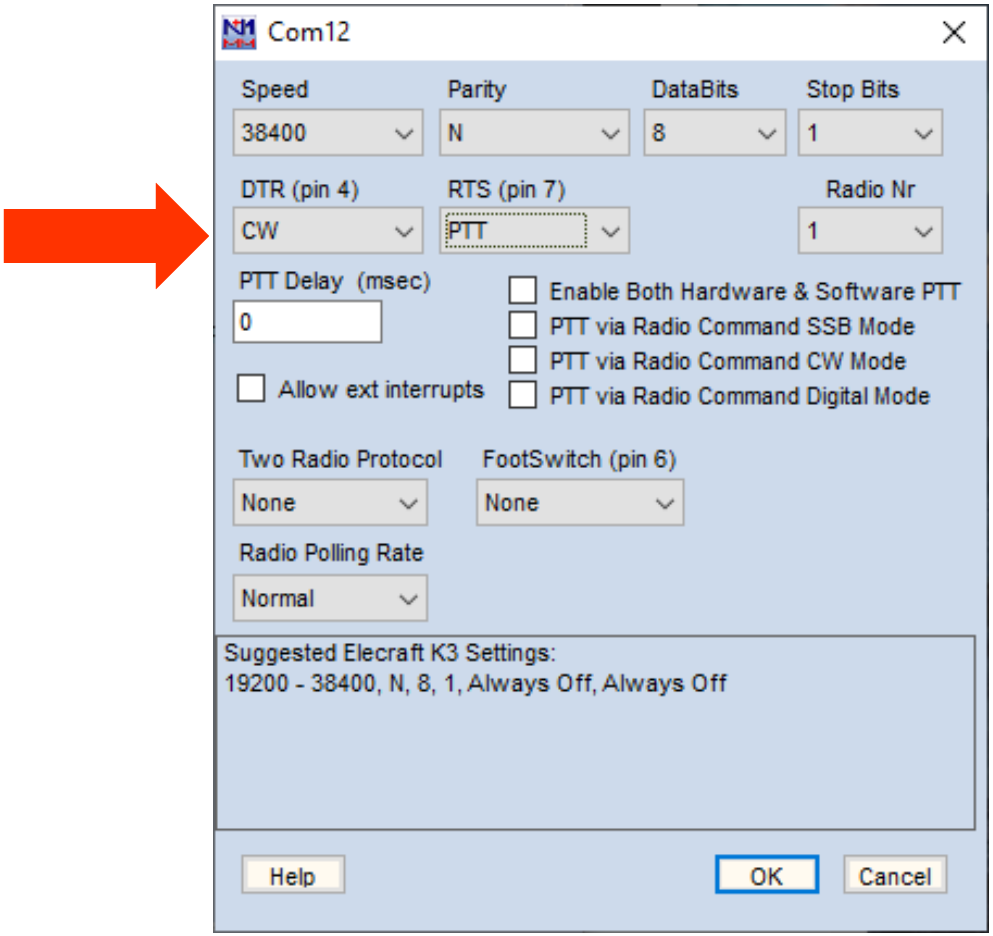
N1MM+ Contest Software Configuration

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



N1MM+ Contest Software Config. (cont'd)

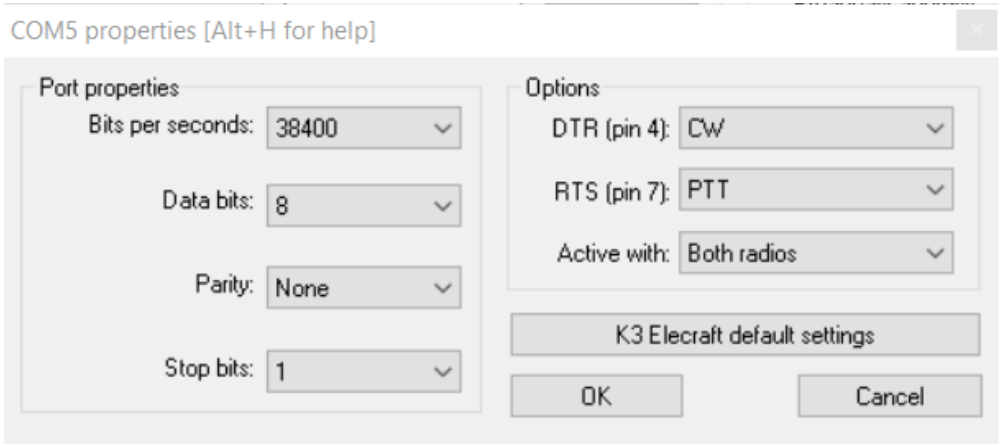
- Set DTR (pin 4) = CW, RTS (pin 7) = PTT



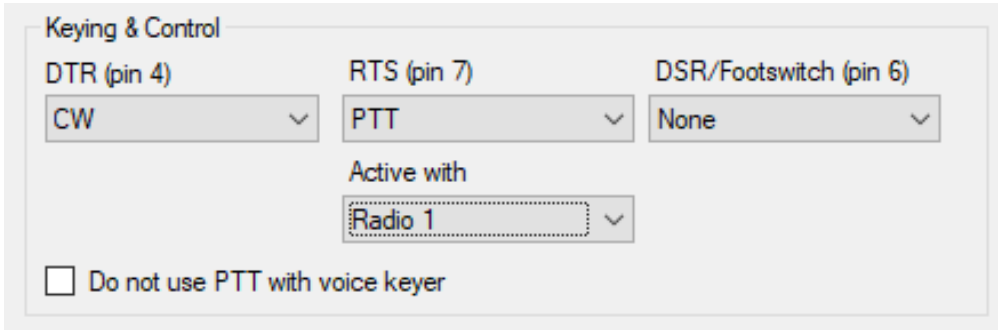
Win-Test and DXLog.net Contest Software

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

Win-Test:

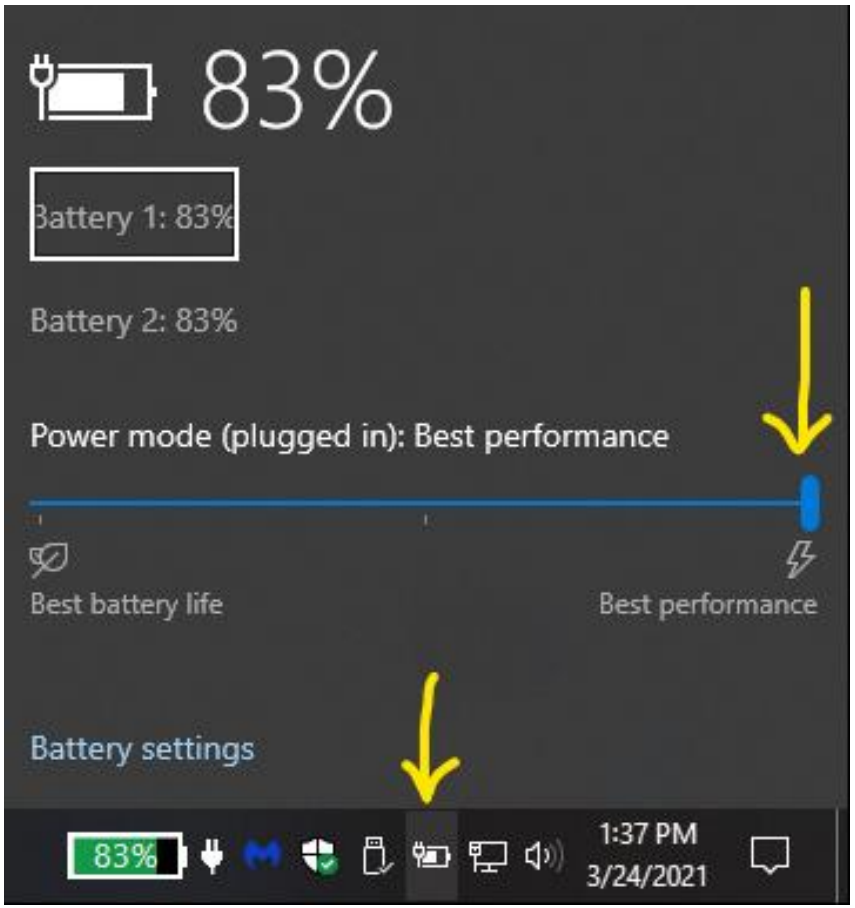


DXLog.net:



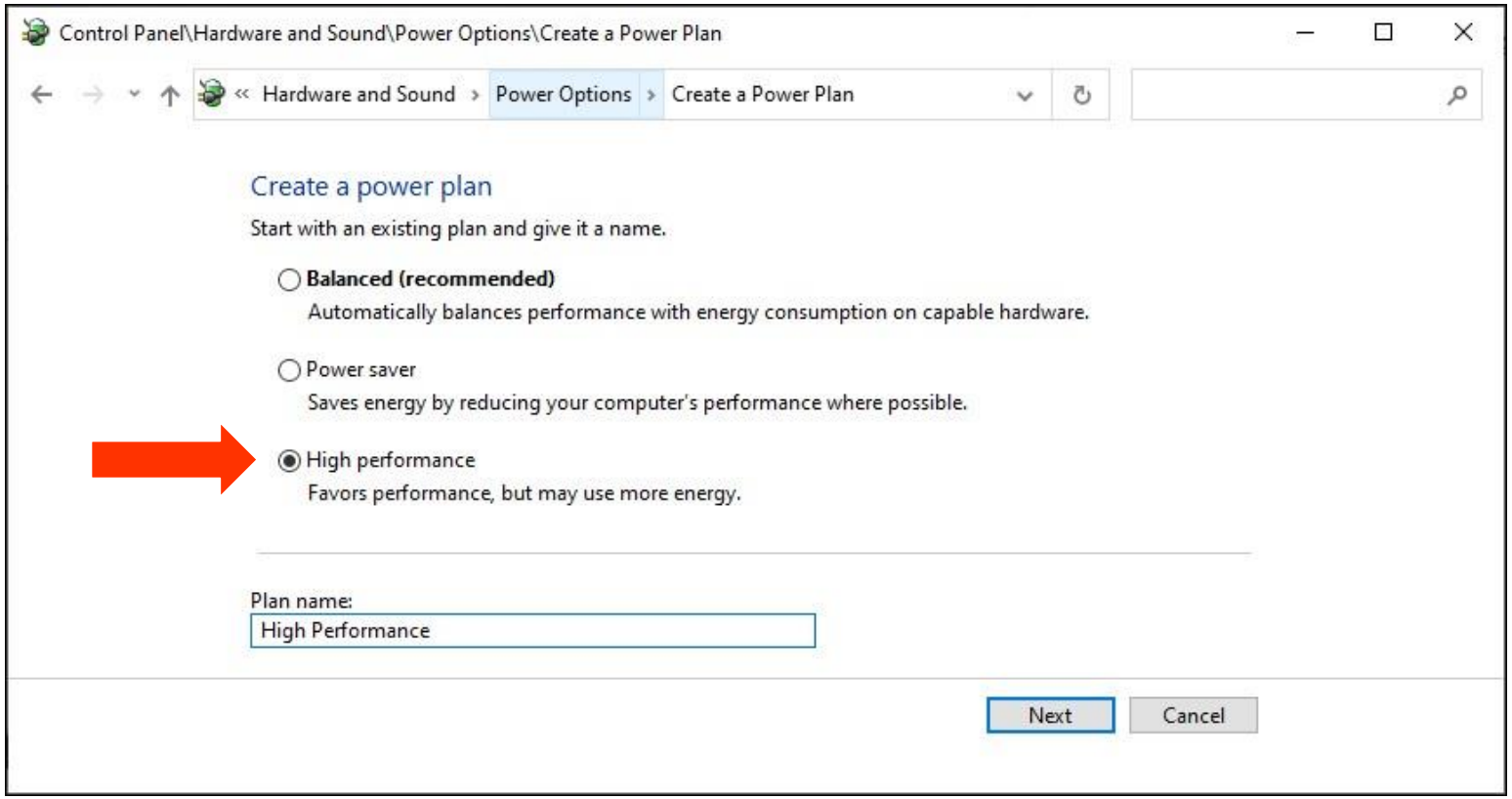
Notebook PC:
Windows Power Mode Affects CW Timing

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



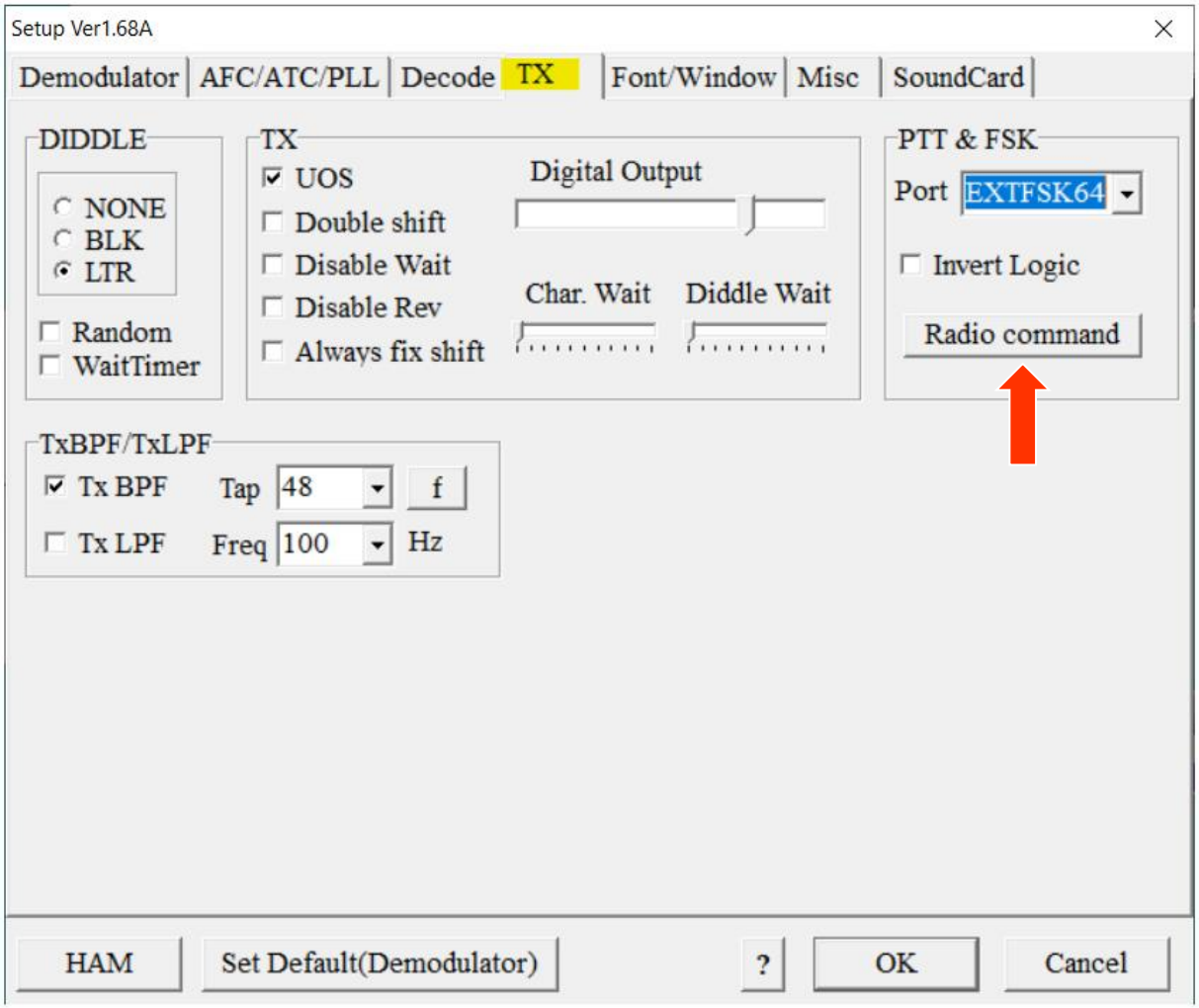
Desktop PC:
Windows Power Options Affects Timing

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



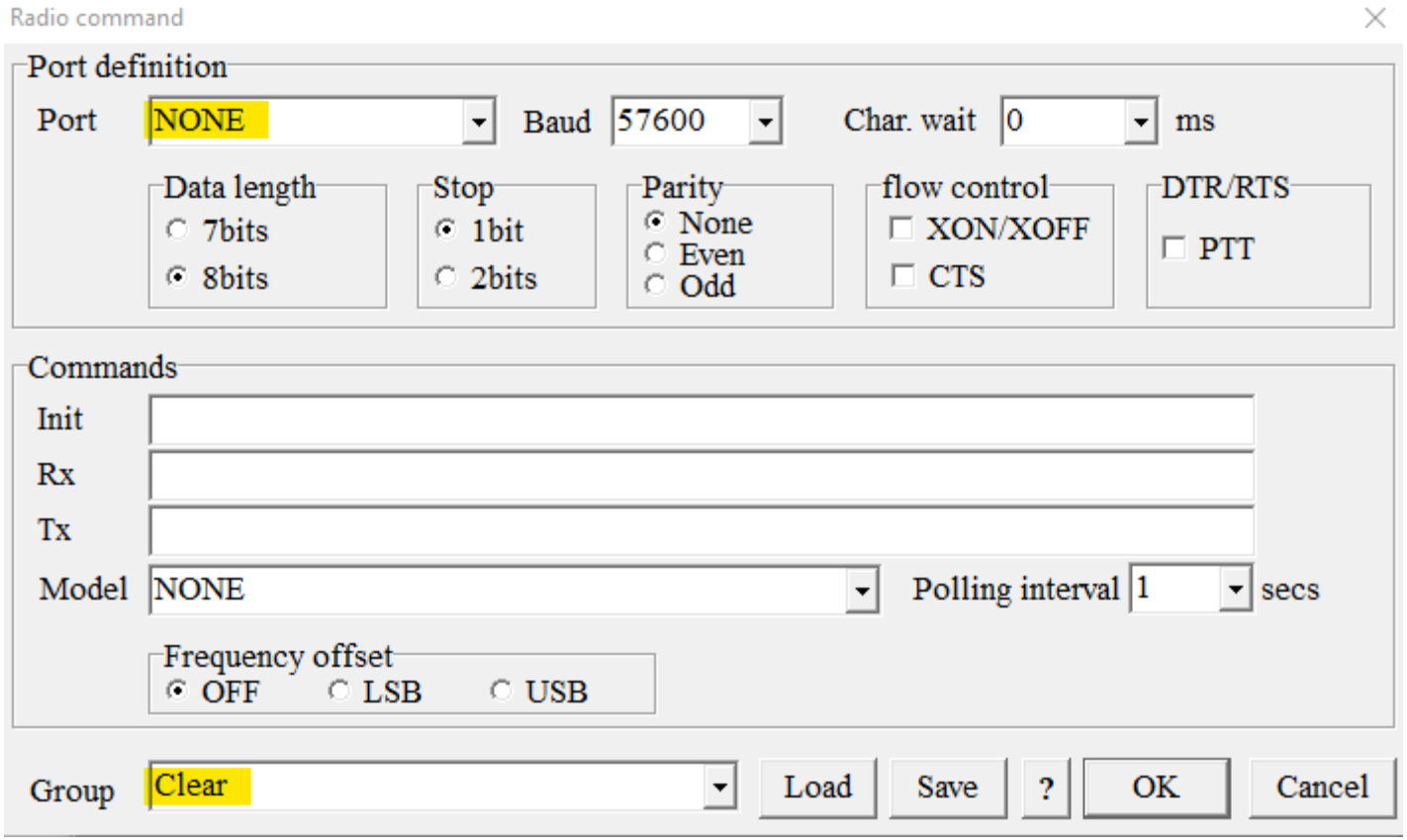
FSK RTTY Keying:
MMTTY Setup Menu, TX Tab

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



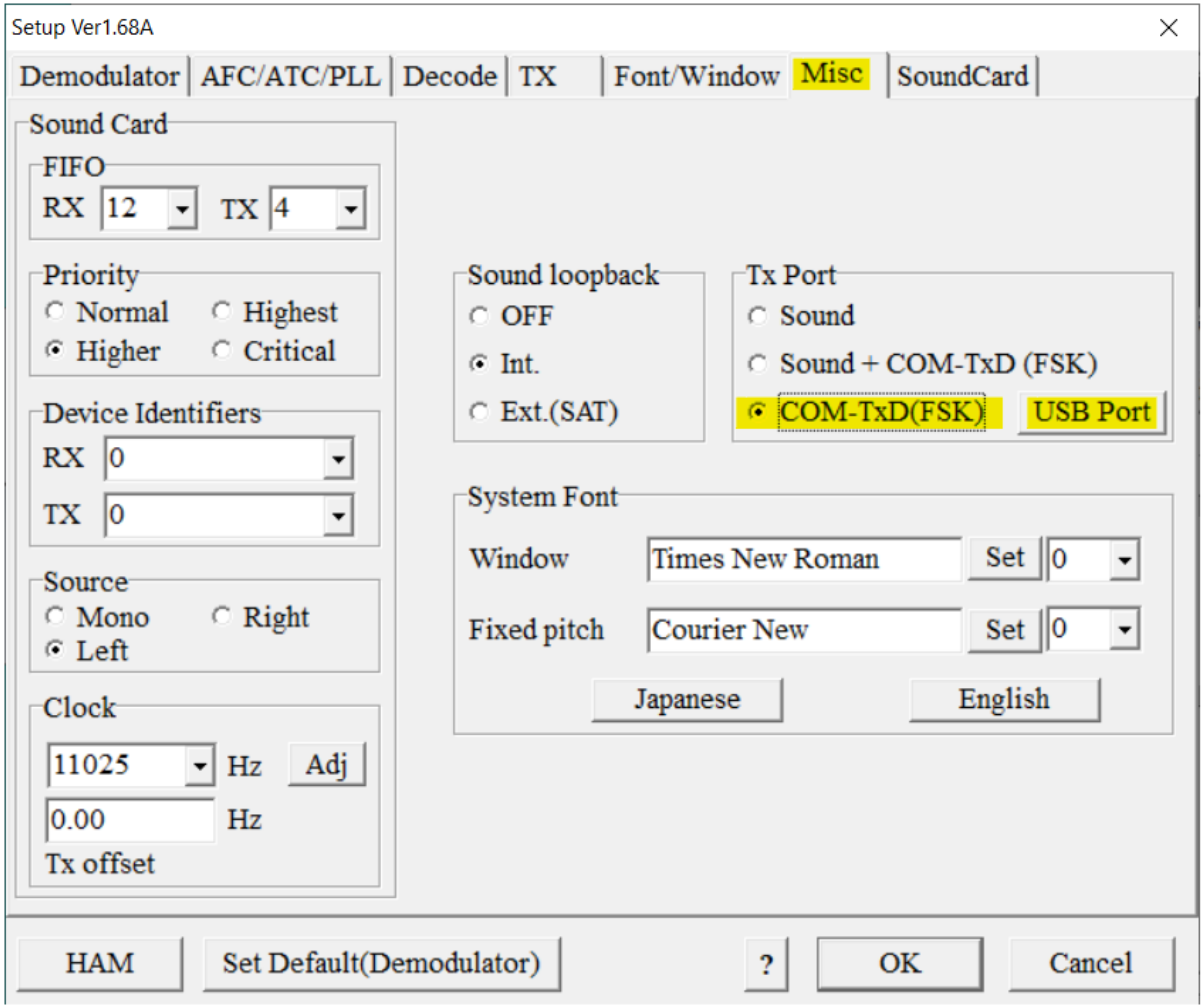
MMTTY Setup Menu
Radio command button

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



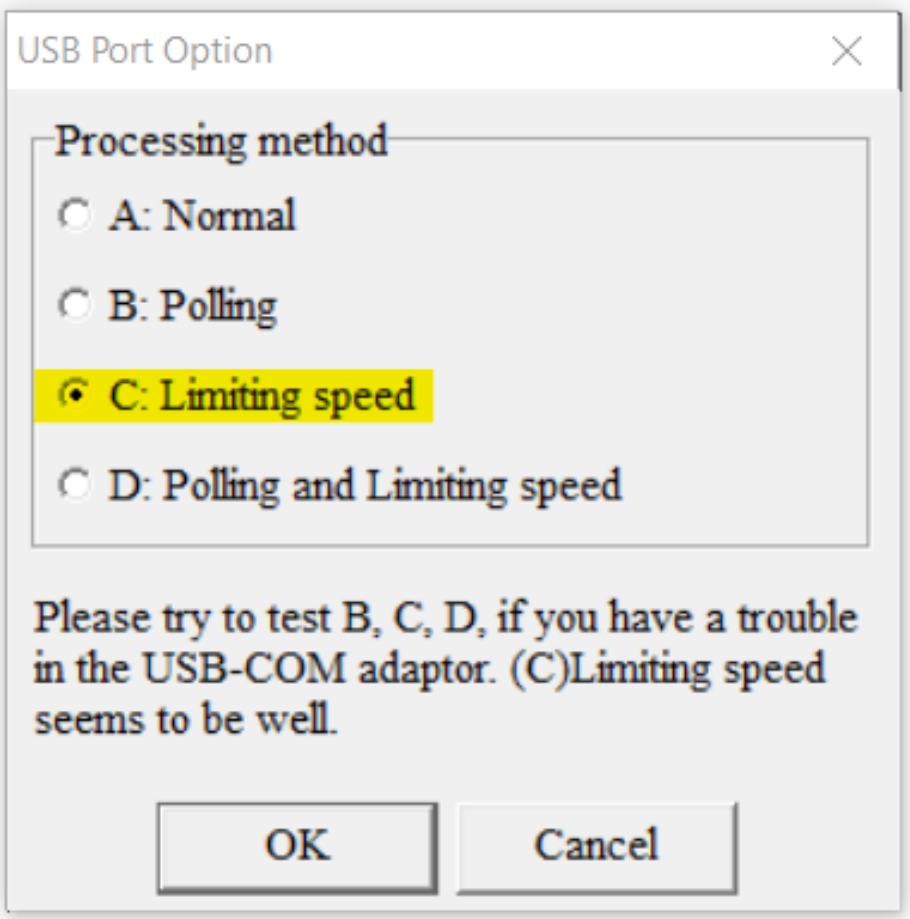
MMTTY Setup Menu, Misc Tab

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



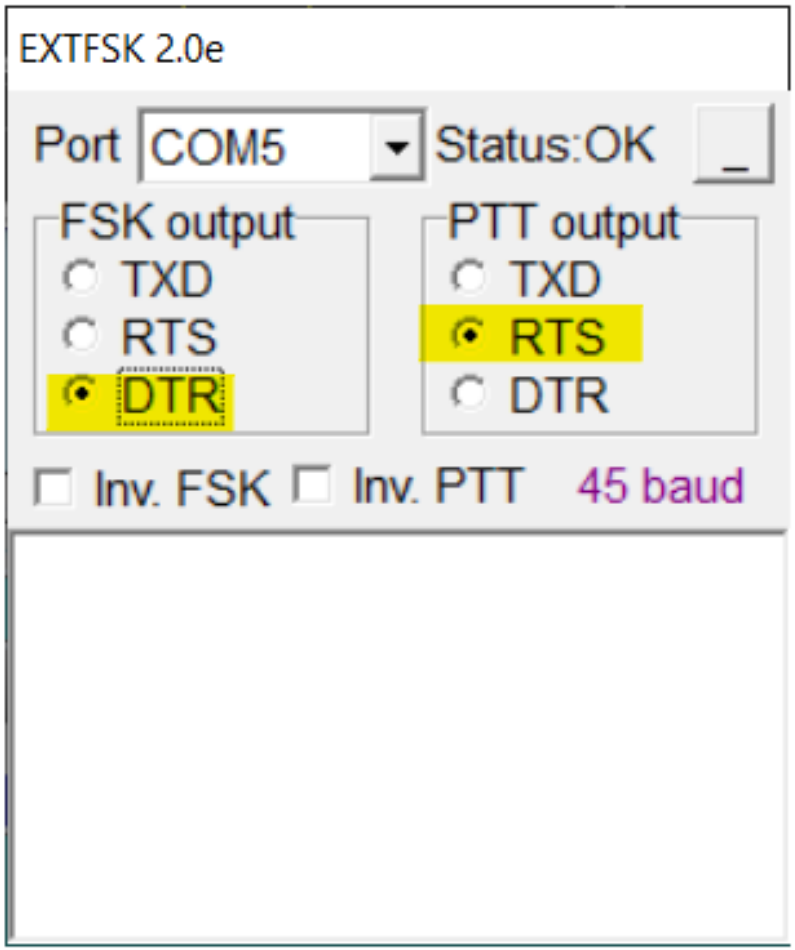
MMTTY USB Port Menu

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

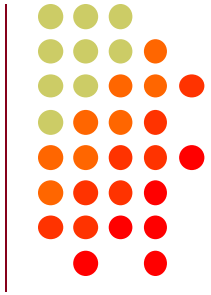


EXTFSK Pop-Up Menu

- 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 on Pin 3 (TXD), Radio sends response on 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

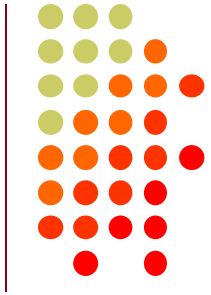
Shameless Plug

- The N6TV “Serial Box” (S-BOX and S-BOX-USB with FTDI) provides parallel connections to a rig’s serial port via standard D-SUB cables:

https://bit.ly/S-BOX

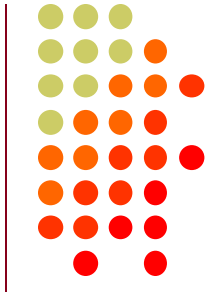
- Connects rig to SteppIR controllers, ACOM amps, SPE amps, …
- Includes *four* NPN keying circuits for rigs that do not support CW, PTT, or FSK keying via DTR or RTS, such as: Elecraft **KX2 KX3**, Yaesu **FT-1000MP FTdx3000 FTdx5000**, Kenwood **TS-590s TS-990s**, ICOM **IC-7600 IC-7700 IC-7800**, etc.

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

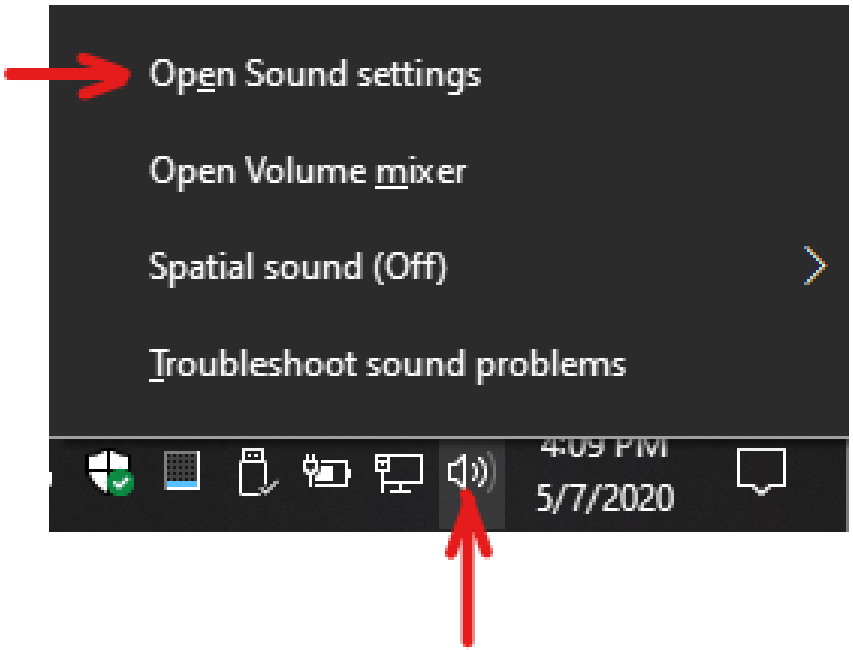
Radios with both USB *and* DE-9 connectors



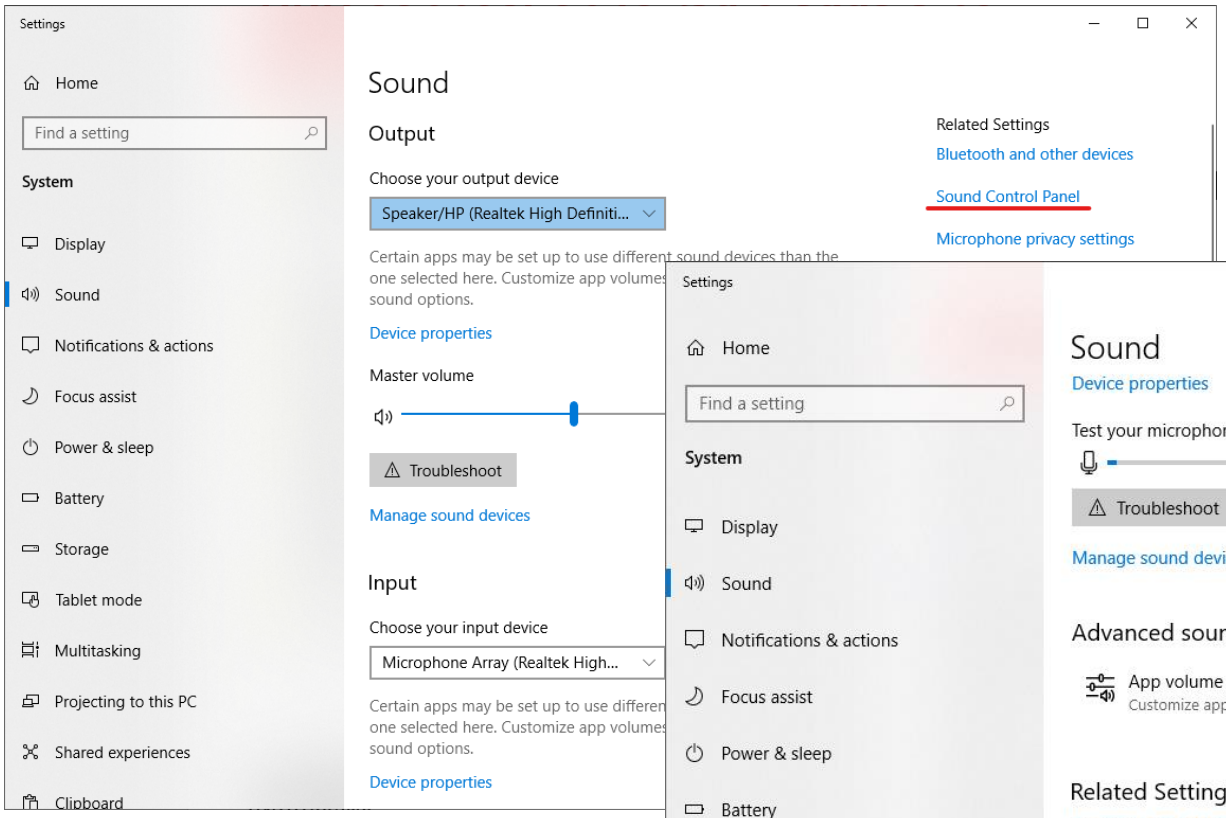
- Elecraft **K3S**, Yaesu **FTdx3000**: USB and Serial Port do not operate independently (must pick one)
- USB and Serial Port *do* operate independently in:
  - Elecraft **K4**
  - Kenwood **TS-590S**, **TS-890S**
  - Yaesu **FTdx101D**, **FTdx101MP**
- ICOM USB and CI-V Ports (3.5mm, not DE-9) mostly 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 “REMOTE” connector

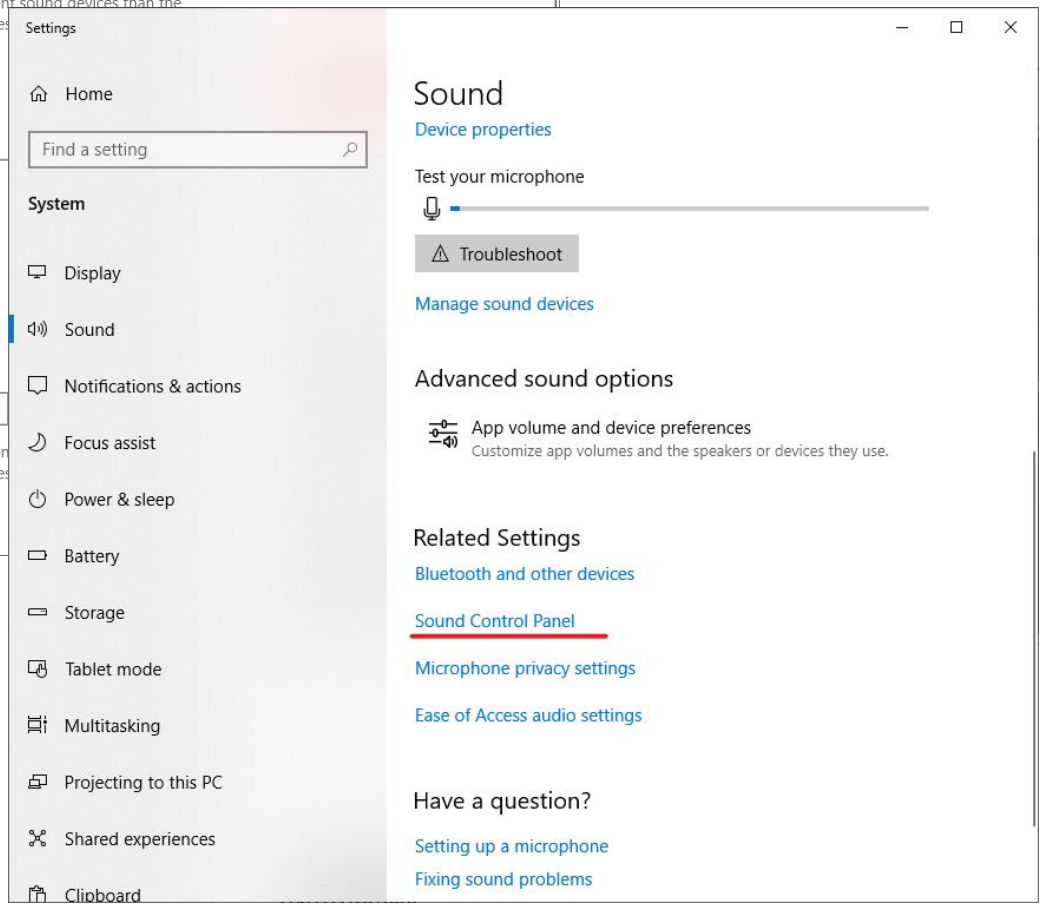
USB connection to radio adds a new Windows Sound Card

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



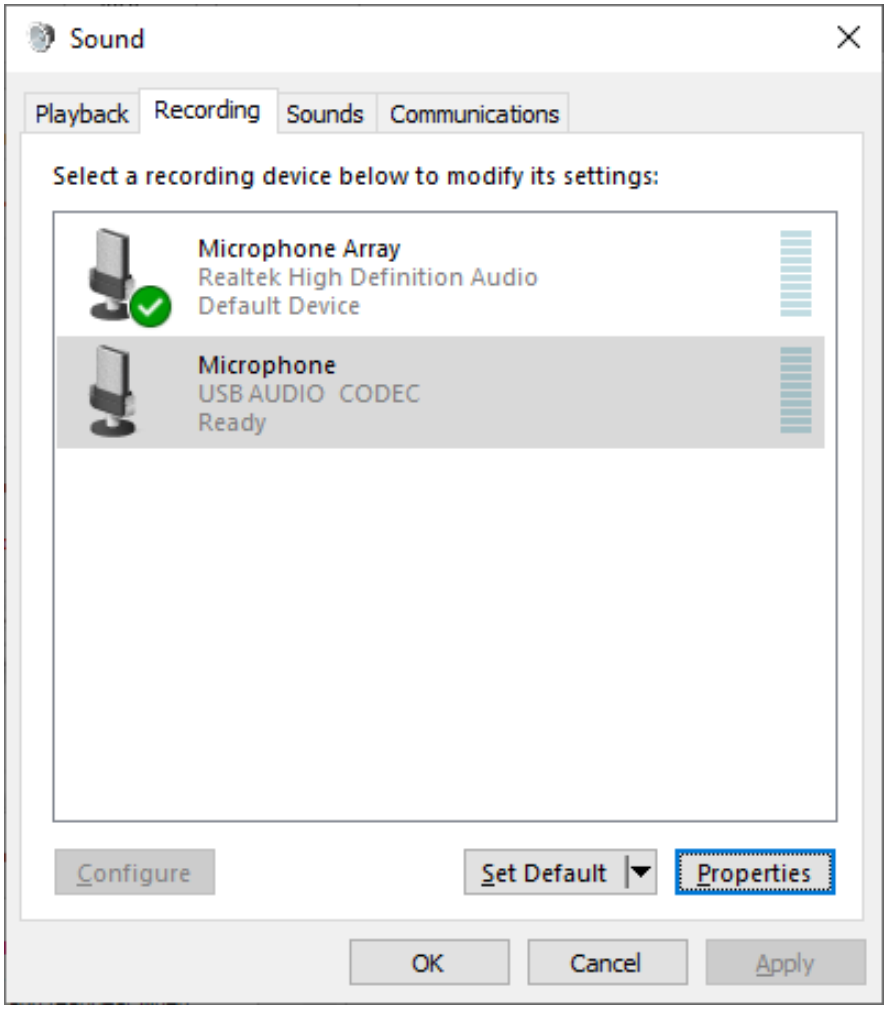
Click Sound Control Panel



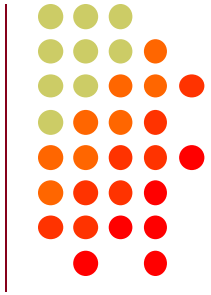


- Faster way: Windows Key + R (run): **mmsys.cpl**

Windows Sound Control Panel, Recording Tab

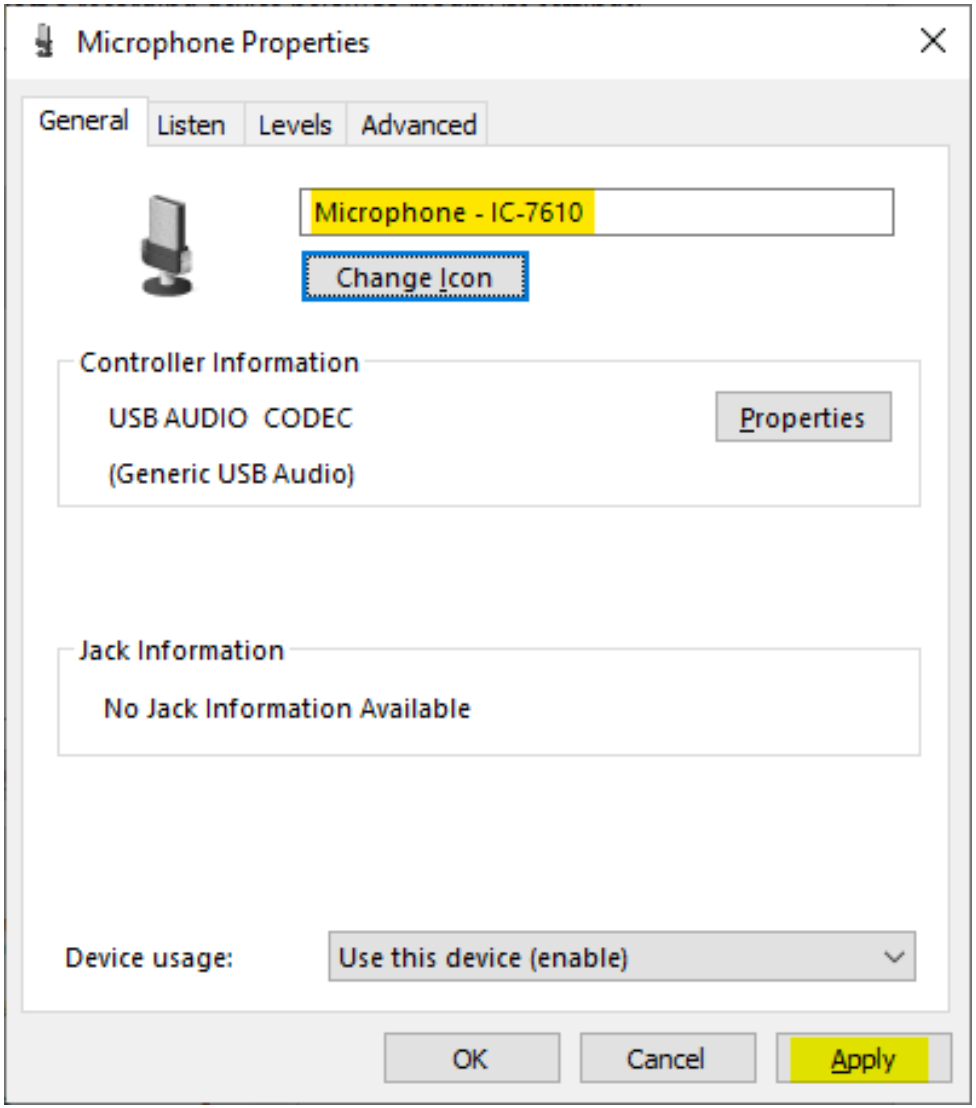


In Sound Control Panel, which sound card is my radio?

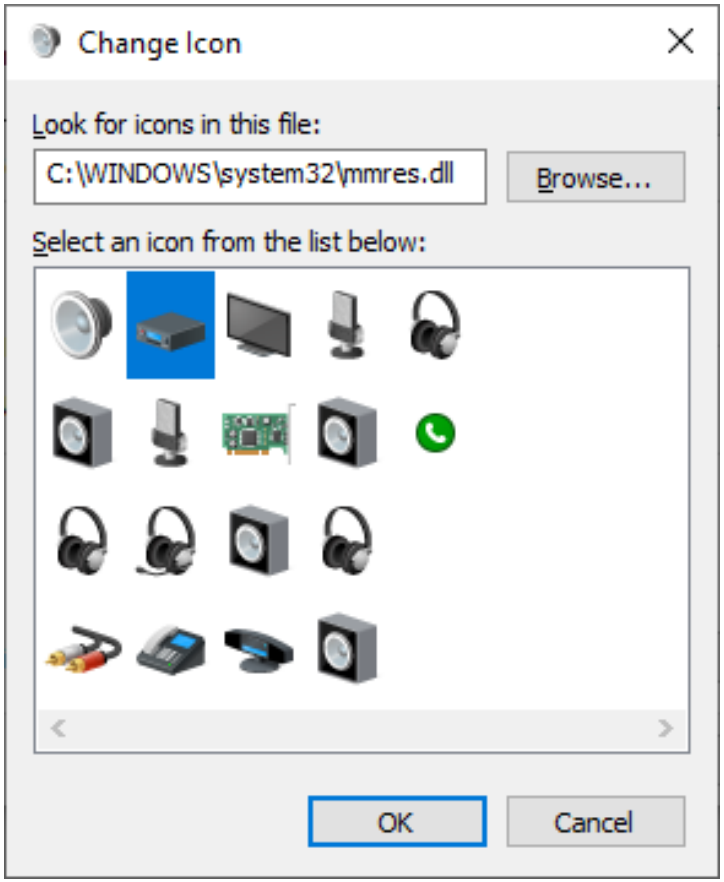


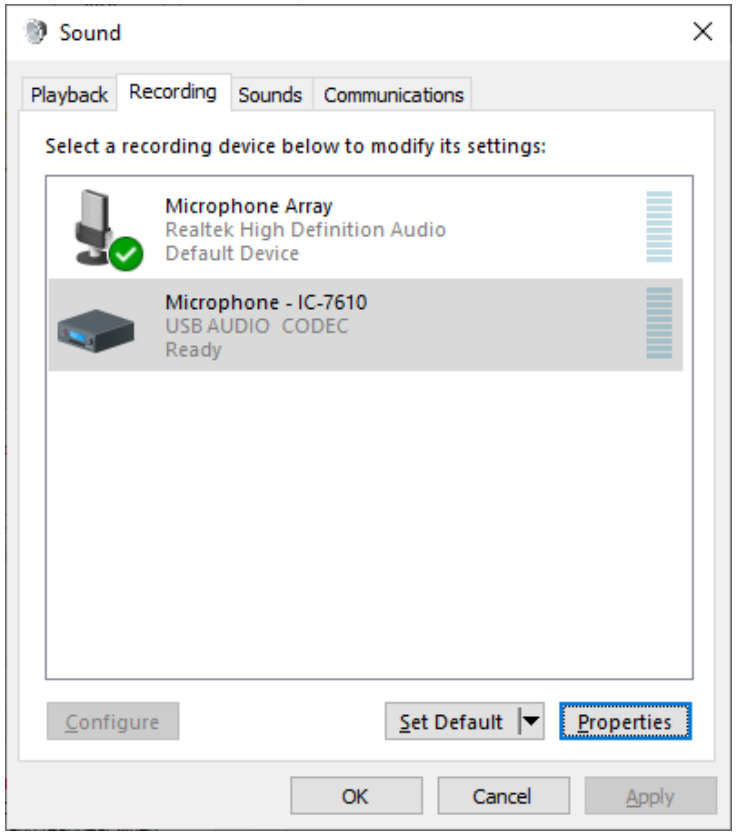
- Watch **USB AUDIO CODEC** devices
- A device will disappear and reappear when you disconnect and reconnect the USB cable from the back of the radio
- Select that device, then click **Properties** button
- Label both the **Recording** and **Playback** tabs with name of device, click **Apply**

Change Label and Icon of USB Audio CODEC

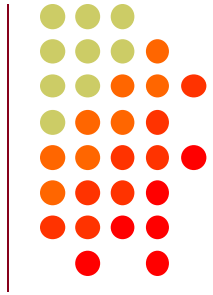


Change Icon of USB Audio CODEC Device





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 via 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 - USB Deview
- 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

Questions?