

# ADDING ADDITIONAL DISPLAY MONITORS TO YOUR MAC

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- SIDECAR/UNIVERSAL CONTROL
- EXTERNAL MONITORS

# INTRODUCTION

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- If you have a lot of windows and apps open, you may run out of room on your monitor and need additional space to work. Or you need to show something to several others and don't want to crowd around one monitor. (mirroring)
- Additional monitors will give you the extra space.
  - On a Mac Mini, Mac Pro, or the new studio computer you will need at least one external monitor. You may want additional monitors however
- First lets talk about features in the Mac OS called Sidecar and Universal control that will let you use an iPad in the first case, or a iPad or another Mac as a second display.


# SIDECAR

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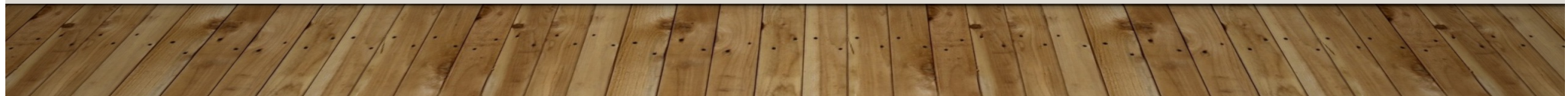
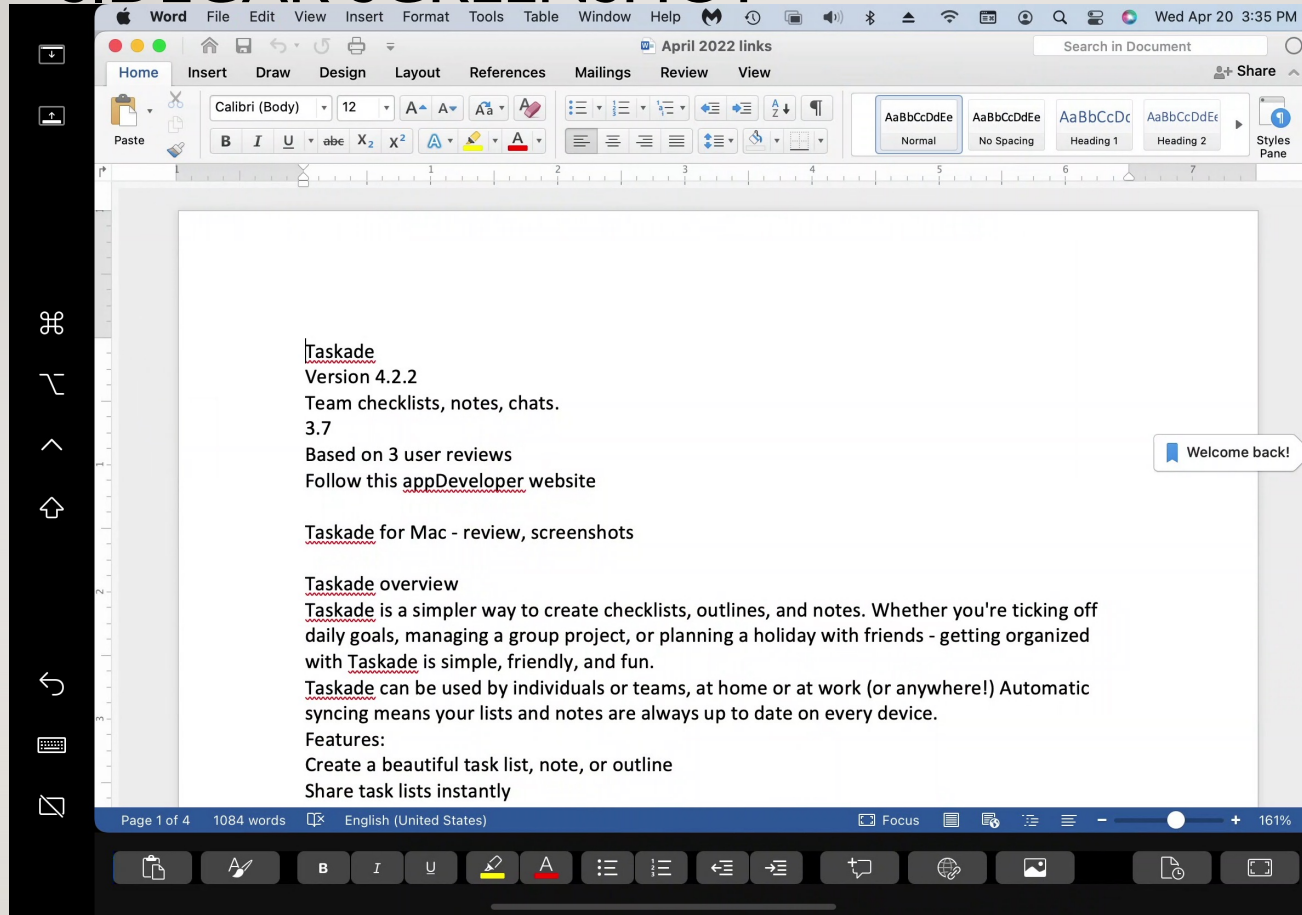
- You can use your iPad as a display that extends or mirrors your Mac desktop
- Mac Requirements: Macbook Pro 2016+, Macbook 2016+, Macbook Air 2018+, iMac 2017+, iMac 2015 27” Retina, iMac Pro, Mac Mini 2018+, Mac Pro 2019, and Mac Studio
- iPad Requirements: iPad Pro all, iPad 6<sup>th</sup> Gen, iPad Mini 5<sup>th</sup> Gen+, iPad Air 3<sup>rd</sup> Gen+
- Both Devices must be signed in with same Apple ID using two factor authentication
- Within 30 feet, Bluetooth, WiFi, and Handoff turned on.
- iPad cannot be sharing cell connection, Mac must not be sharing internet.
- Using USB cable, iPad must be set to trust your Mac.

# SIDECAR-USING

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- Have your iPad running. Bring close to your Mac.
- On your Mac move the pointer to the full screen button  of the window you want to move. Choose the Move to iPad option.
- Demo
- Zoom won't let two people (or two devices) share the screen at the same time. So the next page is a screenshot from my iPad.
- <https://support.apple.com/en-us/HT210380>

# SIDECAR SCREENSHOT



# UNIVERSAL CONTROL

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- Finally available on Mac OS 12.3 and iPad OS 15.4
- Use the keyboard, mouse, or trackpad of your Mac to control up to two other nearby Mac or iPad devices, and work seamlessly between them.
- Both Devices must be signed in with same Apple ID using two factor authentication
- Same Hardware requirements as Sidecar
- iPad cannot be sharing cell connection, Mac must not be sharing internet.
- While not strictly an additional monitor, you get the effect with additional applications open on the other device.

# UNIVERSAL CONTROL-USING

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- On your Mac: System Preferences> Displays>Universal Control
- Checkboxes selected
- Push cursor through Right or Left side of screen on Mac
- On iPad cursor becomes a dot. Use it like touch to use iPad
- On another Mac use your cursor and keyboard as if it was connected to other mac.
- Demo
- Again can't share screens on Zoom. iPad screenshot did not show dot. My Macbook air is to early to support Universal Control.

# UNIVERSAL CONTROL-MORE INFO

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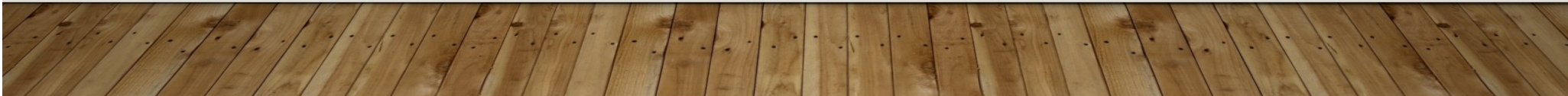
- <https://support.apple.com/en-us/HT212757>
- <https://www.macworld.com/article/609440/how-to-universal-control-mac-ipad-mouse-keyboard-settings.html>
- <https://www.macworld.com/article/611366/universal-control-sidecar-explained-mac-ipad.html>



# EXTERNAL MONITORS-INTRODUCTION

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- If sidecar or Universal control won't work for you then you will need a external monitor
- There is no way in this presentation that I can go into every detail on buying a monitor, every monitor made, what's best for you, every hookup for every Mac to every monitor etc.
- Using an external monitor can be easy or complex.
- Apple now makes only two monitors, the new Studio Monitor, and the very expensive Pro Display XDR. I'll briefly mention the discontinued Apple Thunderbolt Display 27 inch in a sample hookup guide page later in this presentation to make a point.
- In most cases you will be buying a third party monitor. There are lots of them.



# EXTERNAL MONITORS-SPECS

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- I can't go into every spec on monitors and what to look for.
- Here is a good buying guide from Tomshardware:
- <https://www.tomshardware.com/reviews/monitor-buying-guide,5699.html>
- However lets discuss a few of them
  - Size- What make sense for you
  - Refresh Rate- Gamers want faster than 60 Hz. (120,144) Note that starting with Mac OS 12 Monterey when using Displayport or USB-C you can use the variable refresh rate on third party displays that support Free Sync. Apple calls this Adaptive Sync. Smoother gameplay for a quick answer.

# EXTERNAL MONITORS-RESOLUTION

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- Monitor resolution. There are lots of them.
- Today's market:
- 1280 X 720 "HD" Just okay as a used additional monitor if you get it used at \$20
- 1920 X 1080 "Full HD" I wouldn't get this as an only monitor
- 2560 X 1440 "QHD or 2K"
- 3840 X 2160 "UHD or 4K"
- 4480 X 2520 "unofficial 4.5K" Used on the iMac 24" M1
- 5120 X 2880 "5K" used on iMac 5K, new Studio Display, others

## EXTERNAL MONITORS-RESOLUTION (CONT'D)

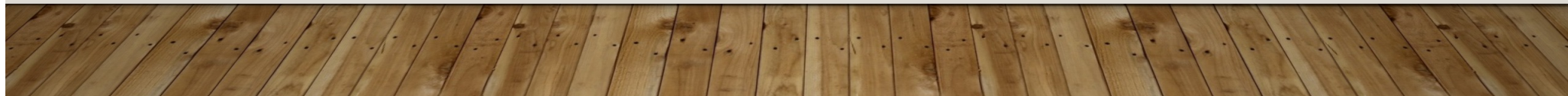
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- 6016 X 3384 Used on the Pro Display XDR
- 8K 7680 X 4320 Highest available, few monitors available and have issues with needing two separate DisplayPort inputs to drive on macs.
- Check the technical specs for your Mac computer for external displays. My 2014 Macbook Air will only output 2560 X 1600. So it would not be able to drive a 4K display at 4K
- Likewise the Monitors maximum resolution is it's maximum resolution. A 1920 X 1080 monitor will not accept a 6K setting from a Mac. You will need to set the Display resolution preference panel to 1920 X 1080.

# EXTERNAL MONITORS- CONNECTION TYPES AND CONNECTORS

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- Almost through my hands up on this topic!
  - Standards are good, so the more standards there are the better- not really true but the reality
  - If I were to go into detail on the various standards, evolving levels, connector types, and into the published standards; well this presentation would be 10's of thousand slides long, and would go over the head of most of the audience.
- Early on starting with the Mac II, Apple had video on a DB15 connector. In the the PC world there was CGA/EGA video, VGA, and later SVGA video. All mentioned were analog. Note we had multiple video standards back then.
- DVI was a early digital video computer standard.



# EXTERNAL MONITORS- CONNECTION TYPES AND CONNECTORS-HDMI

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- **High-Definition Multimedia Interface (HDMI)** is a common interface found on consumer TV's, DVD and Blu-ray Players, Satellite and Cable boxes, Apple TV, AV receivers and the like. It is found on many Apple computers.
- Many Display Monitors can accept HDMI.
- There is a Standard connector, a Mini Connector, Micro connector, plus a few more
  - From what I can tell Apple used the Standard connector on its products. Some android tablets used the smaller types.
- As HDMI standards evolved so did the cables. Standard, High Speed, Premium, and Ultra High speed. Usually the HDMI cable comes with third party monitors and will work. If you get a 4K monitor and need to get a cable, buy a premium (18Gbps).

# EXTERNAL MONITORS- CONNECTION TYPES AND CONNECTORS-DISPLAYPORT

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- **Displayport** is digital display interface by VESA. Apple began to use it in 2008
- There is a Full Size connector, and a Mini Connector,
  - Mini DisplayPort was used on Apple laptops and desktops
- As DisplayPort standards evolved so did the cables. RBR is version 1 of the spec and is really only for Full HD (1080p) monitors. The HBR2 is version 1.2 of the spec can handle 4K monitors. There are HBR3 UHBR cables, but Apple did not produce products to use them, but has gone with Thunderbolt (next slide) for 5 K monitors.

# EXTERNAL MONITORS- CONNECTION TYPES AND CONNECTORS-THUNDERBOLT



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- **Thunderbolt** is digital display interface by Intel and Apple. Apple began to use it in 2011
- Thunderbolt 1 was followed by Thunderbolt 2. Thunderbolt 2 could handle a 4K monitor. Thunderbolt 3 was even faster. Thunderbolt 4 is the same speed as thunderbolt 3 but makes optional features in 3, standard in 4.
- Thunderbolt has replaced DisplayPort on recent Apple products.
- For Thunderbolt 1 and 2 Apple used the Mini DisplayPort connector. For Thunderbolt 3 and 4 Apple uses the USB-C connector. However not all Mini DisplayPort connectors are Thunderbolt, and all USB-C connectors are not Thunderbolt either. Confused? next slide.



# EXTERNAL MONITORS- CONNECTORS- THUNDERBOLT & MINI DISPLAYPORT

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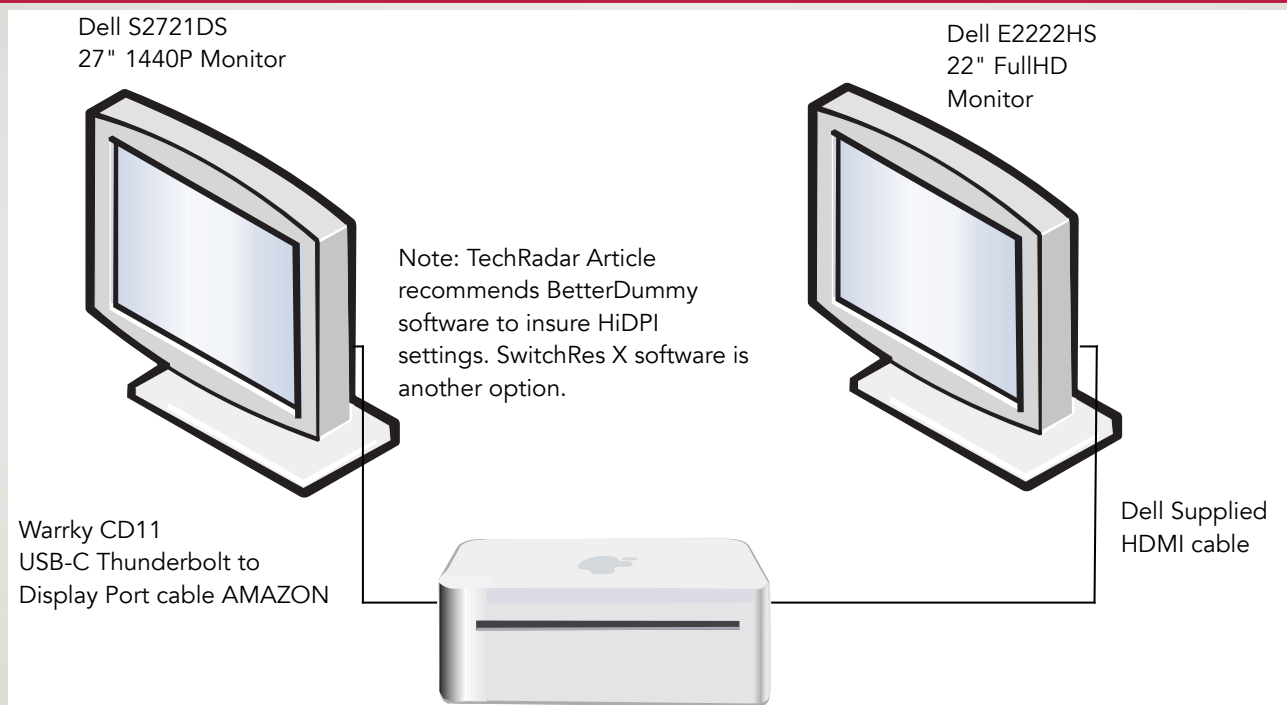
- As stated on the last slide, Mini DisplayPort connector can be Thunderbolt, but it does not have to be. How to tell apart:
  - Mini DisplayPort uses this symbol 
  - Thunderbolt will have this symbol 
- Likewise USB-C connector can be Thunderbolt, or just USB. In fact there are cables for non Apple phones using USB-C that are charging only! My iPad Pro first Gen I, 11 inch has a USB connector, but is not Thunderbolt.
- Refer to this Apple support article:
- <https://support.apple.com/en-us/HT201736>

# EXTERNAL MONITORS- SAMPLE HOOKUPS

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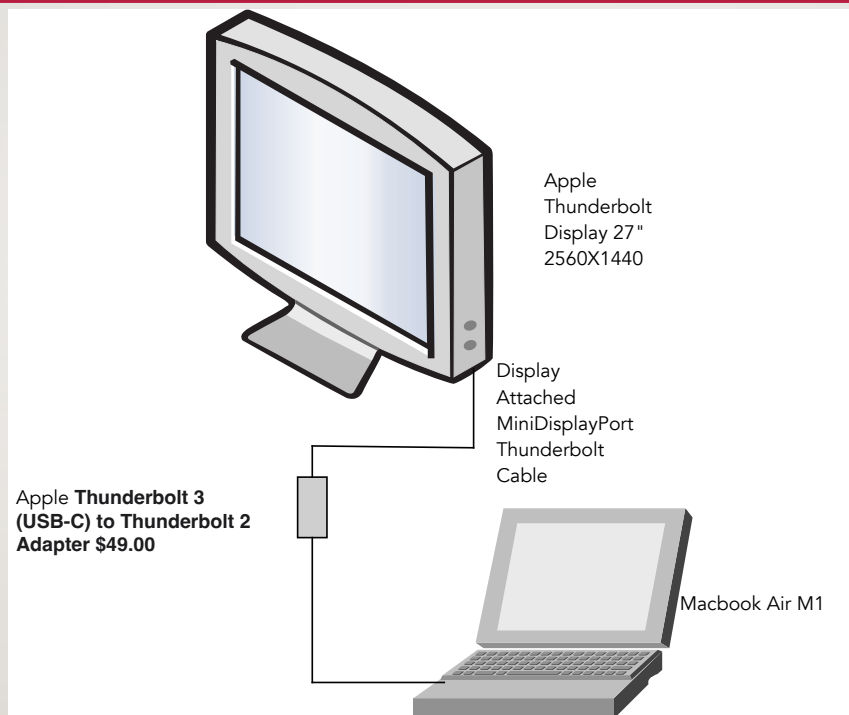
- Note I'm not endorsing or necessarily recommending these products. I based on reviews I read. Can't guarantee that you won't get a defective product out of the box
- Again not able to show hookups for all Apple computers and every Apple and third party monitor out there.
- I've read about issues with external monitors. Some seems to be re-using old cables that are not to latest specs (original HDMI 1.0 cable for example on 4K display). Some may be due to incompatibilities
- Search on the internet and YouTube for your specific Mac computer and a possible candidate monitor and see what shows up. If many claim success than likely you will too.

# EXTERNAL MONITORS- SAMPLE HOOKUPS MAC MINI



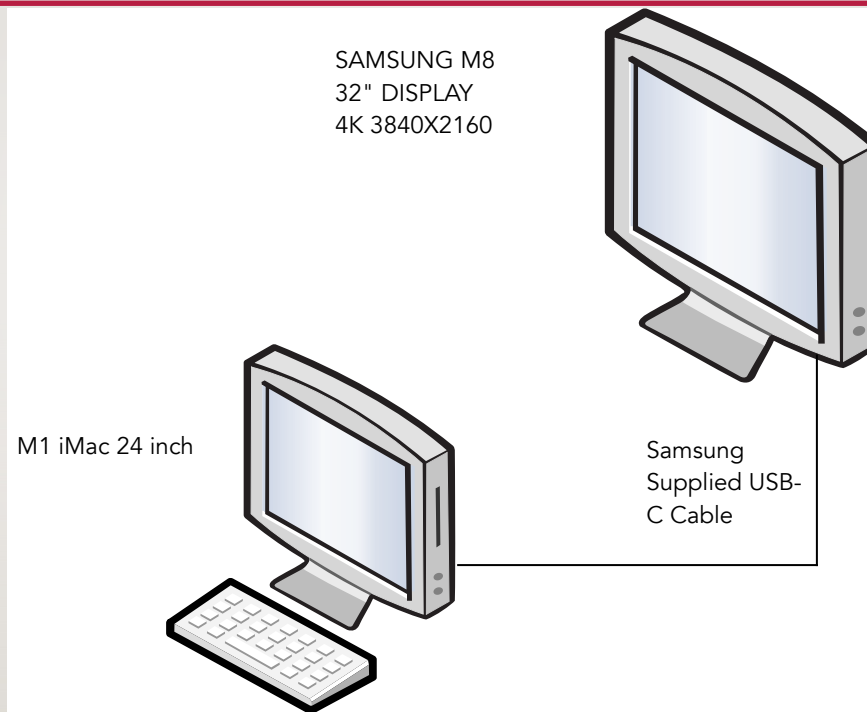
# EXTERNAL MONITORS- SAMPLE HOOKUPS MACBOOK AIR M1

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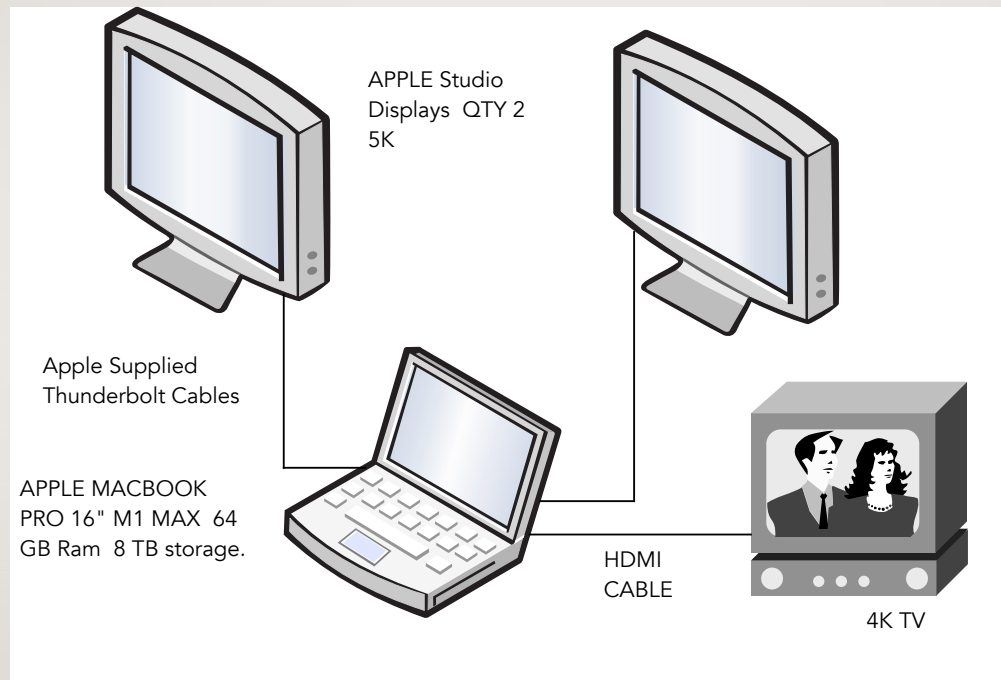
# EXTERNAL MONITORS- SAMPLE HOOKUPS IMAC 24" M1

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# EXTERNAL MONITORS- SAMPLE HOOKUPS MACBOOK PRO

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# REFERENCE DOCUMENTS AND LINKS:

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- From George Wilde:
  - **Thunderbolt adapter guide: How to connect anything to a USB-C Mac:**
    - <https://www.macworld.com/article/229045/thunderbolt-3-adapter-m1-imac-macbook-pro-mac-mini-usb-displayport-hdmi-ethernet.html>
  - **Learn to untangle USB and Thunderbolt:**
    - <https://www.macworld.com/article/628968/learn-to-untangle-usb-and-thunderbolt.html>
- <https://www.techradar.com/best/monitors-for-the-mac-mini>
- <https://www.techradar.com/best/monitors-for-macbook-pro>

## REFERENCE DOCUMENTS AND LINKS (CONT'D):

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- DisplayPort Wikipedia: <https://en.wikipedia.org/wiki/DisplayPort>
  - Mini DisplayPort: [https://en.wikipedia.org/wiki/Mini\\_DisplayPort](https://en.wikipedia.org/wiki/Mini_DisplayPort)
  - Audio not on first Apple products: <https://support.apple.com/en-us/HT202079>
- HDMI Wikipedia: <https://en.wikipedia.org/wiki/HDMI>
- Thunderbolt Wikipedia: [https://en.wikipedia.org/wiki/Thunderbolt\\_\(interface\)](https://en.wikipedia.org/wiki/Thunderbolt_(interface))
- List of Common resolutions Wikipedia:  
[https://en.wikipedia.org/wiki/List\\_of\\_common\\_resolutions](https://en.wikipedia.org/wiki/List_of_common_resolutions)
- Use Adaptive Sync: <https://support.apple.com/en-us/HT212232>



## REFERENCE DOCUMENTS AND LINKS (CONT'D):

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- Better Dummy: <https://www.macworld.com/article/549493/how-to-m1-mac-1440p-display-hidpi-retina-scaling.html>
- SwitchResX: <https://www.madrau.com>
- Best Buy buying guide. Thought Tomshardware was a better guide: <https://www.bestbuy.com/site/buying-guides/monitors-buying-guide/pcmcat337000050000.c?id=pcmcat337000050000>
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