FlyOnSpeed.org is now teamed with EpicOptix to bring you the Eagle 2 HUD ($1500) and several options for the HUD interface computer;

1. Our RaspiPi with our Shareware Software
2. The EpicOptix GPU & GPV-V (Graphics Processing Unit) for $800/$900

Epic Optix

INSPIRING BRILLIANCE - ILLUMINATING TECHNOLOGY

EAA Founders Innovation Prize Briefing 2021

HUD Safety Benefits

It is widely recognized in the military and commercial aviation industries that a Head-Up Display (HUD) in the cockpit brings a great deal of safety benefits. Integrating a HUD with external sensors and systems (Cameras, Synthetic Vision, etc.) brings even greater safety benefits.

Thus, a HUD system for GA is a perfect candidate to address the issue of Loss Of Control (LOC).

According to FAA AC No. 25-11B, the definition of a Head-Up Display (HUD) is a display system that projects primary flight information (for example, attitude, air data, and guidance) on a transparent screen (combiner) in the pilot's forward field-of-view (FOV), between the pilot and the windshield. This allows the pilot to simultaneously use the flight information while looking along the forward path out the windshield, without scanning the head-down displays (HDDs). The flight information symbols should be presented as a virtual image focused at **optical infinity**. Attitude and flight path symbology needs to be **conformal** (that is, aligned and scaled) with the outside view.

Innovations

- The most important innovation in bringing a HUD to GA is to be able to produce a “cheaper, better, faster” solution.
- Epic Optix achieved this by:
  - Utilizing the latest innovations in LCD and LED technology to produce a **full color** HUD that is **brighter** than a military/commercial HUD
  - Working closely with customers (including aircraft manufacturers) to find the optimal size for the HUD to fit in the most cockpits.
  - Working closely with experienced HUD trained pilots to produce the display symbology that is conformal, non-distracting and critical for creating the required level of situational awareness.
  - Selling at a price that is orders of magnitude more affordable in cost than a commercial HUD

Innovations continued

- The Eagle HUD innovations continue in the detailed design of the product…
  - Image Resolution
    - With a 1280x480 (Cropped HD) resolution and a 50Hz refresh rate the Eagle display performance is outstanding, producing the crispest of displays with ultra-smooth display animation. The Eagle 3.0 HUD will have a resolution of 1280x480 and a FoV of 30° x 12° and the Eagle 4.0 HUD will have a resolution of 1280x1028 with a FoV of 30° x 20° (meets FAA requirements for a certifiable HUD).
  - Brightness
    - At 20,000 nits full luminance, the Eagle is substantially brighter than any other HUD in this category. This is particularly important for flying in bright sunny weather. Of equal importance is the ability to switch into “Night Mode”, where the HUD is so dim it is only visible at night and therefore protects the pilot from dangerous glare in dark environments.
  - Conformal Imagery
    - For a HUD to be used to its maximum potential (overlaying real time imagery on the outside view of the real world) the optical design and generated symbology MUST work together to create a Conformal Image i.e., critical symbology such as horizon line, Flight Path Vector, Synthetic Runway etc. need to be correctly aligned to the outside world when viewed by the pilot.
    - Epic Optix spent hundreds of development hours perfecting the HUD imagery to make it conformal with the outside world even within the limited (11° x 4°) FoV of the Eagle 2.0.
    - The images on Slide 9 were taken by a customer flying the Eagle 2.0 during a test flight, and quite clearly shows the Horizon Line on the Horizon and the FPV correct placement in a conformal view.
  - Low-cost, Low-power Computing
    - Epic Optix were able to create a Graphics Processing Unit utilizing low cost and low power computing module combined with a proprietary designed interface board that is packaged in a very compact 3.75” x 2.75” x 1.75” case that makes stowing very easy. The GPU can be powered by a micro-USB interface or ships power (12v – 30v) and provides up to 5 Arinc 429 inputs and 5 RS-232 inputs for connection into any avionics system. The GPU the provides the imagery to the HUD via HDMI.

Product Evolution 2017-2022

- **EAGLE 1.0**
  - Non-certified “Carry On” HUD with Wi-Fi from Tablets and Phones. Non-Conformal display.
- **EAGLE 2.0**
  - Non-certified “Carry On” HUD. Retains Wi-Fi connections but also has HDMI direct input.
  - Incorporated “Night Mode” switch to reduce brightness to allow use at night. Brightness has variable control in both Day and Night modes.
- **GPU**
  - Non-certified “Carry On” Graphics Processing Unit. Provides hard-wired connections to aircraft avionics (Arinc 429 and/or RS232). Creates traditional HUD symbology from the data and transmits video to HUD via HDMI. Produces Conformal Display.
- **GPU-V**
  - As per GPU but with a HDMI input to allow connection to external camera for Enhanced Vision
- **GPU-Sx (TBD)**
  - As per GPU but with a built in Stratux system including AHRS, ADSB, GPS etc. Allows use of HUD without hard-wiring into avionics (AHRS and GPS based data, no Air Data)
- **Path to Certification (TBD)**
  - Started on certification path for the next generation of Eagle HUD and GPU

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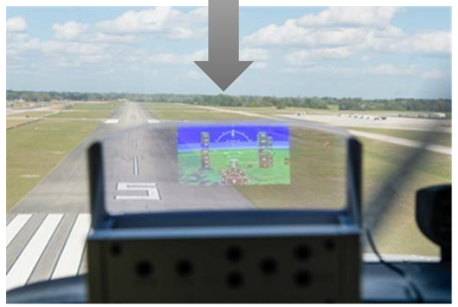
Epic Eagle HUD Overview

2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023

Eagle 1.0

Wi-Fi



Eagle 2.0

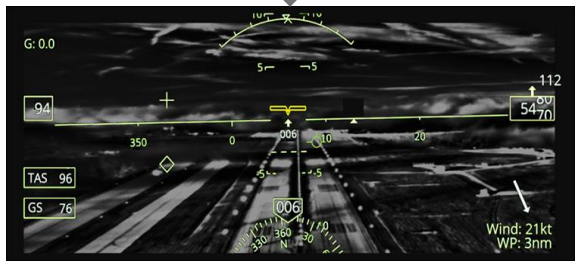
GPU

HDMI

GPU
+ Stratux

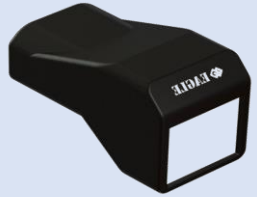
GPU-V

HDMI

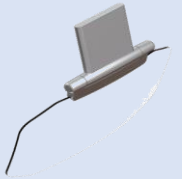


Future Concept Designs

Eagle 3.0



Eagle 4.0



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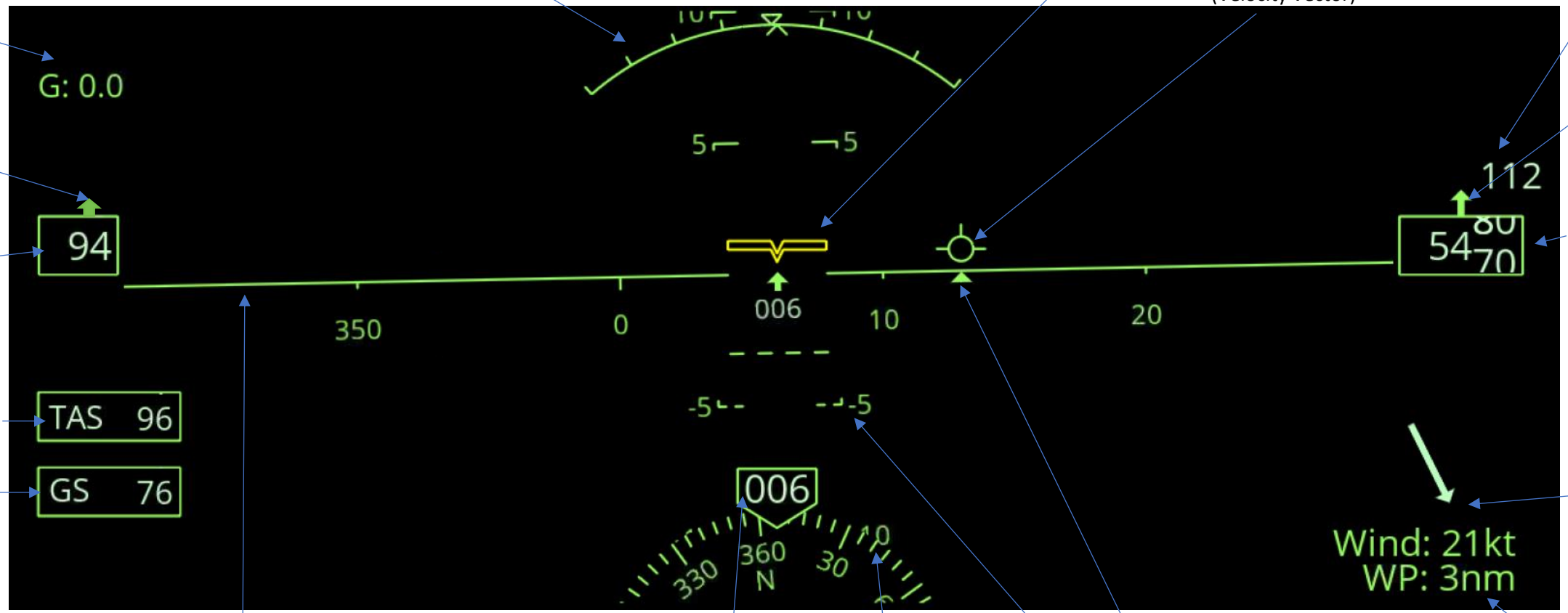
Short Term Goals

- Continue the certification effort to realize a HUD STC in the GA market
- Work with Flight Training schools to develop a “Flying with a HUD” module to be added to their curriculum.
- Continue to modify the HUD symbology to optimize flying experience
- Integrate with more avionics systems
- Investigate re-packaging the HUD body to allow fit into even more cockpits
- Continuous Improvement:
  - Epic Optix is dedicated to listening to our customers to improve the Epic Eagle platform and provide safety enhancements to the GA pilot for years to come.

Epic Eagle HUD Symbology with ADAHRS & GPS



NOTE 1:
GPS Source can also be used for Altitude and Speed Over Ground. If GPS is being used the letter "G" is placed adjacent to the instrument.

NOTE 2:
Instruments can be configured to be visible or not (e.g. Gmeter, True Airspeed, Ground Speed etc.) to give a more minimal look.

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Epic Eagle HUD in the Real World since 2017

The Epic Eagle HUD and GPU has matured into a system that is giving discerning pilots a capability previously only found in high end business / military jets and commercial carrier aircraft.

Photograph taken by Epic Optix customer, Richard Chapman, flying a RV-7A. This picture illustrates the conformal view through the Eagle 2.0.

HUD training system developed with new additional symbology to meet customer requirements.

Another photograph from Richard Chapman, flying over the Sierra Nevada mountains, CA.

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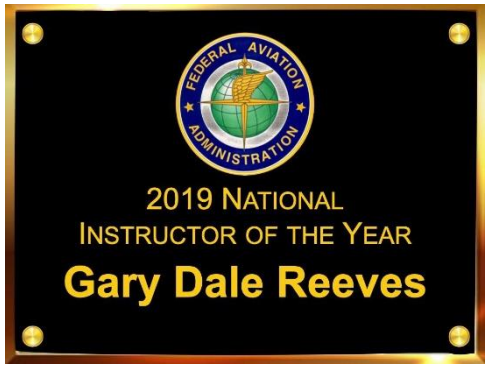
Testimonials - (Don’t just take our word for it!)

- **Gary Reeves**, FAA Flight Instructor of the Year 2019:

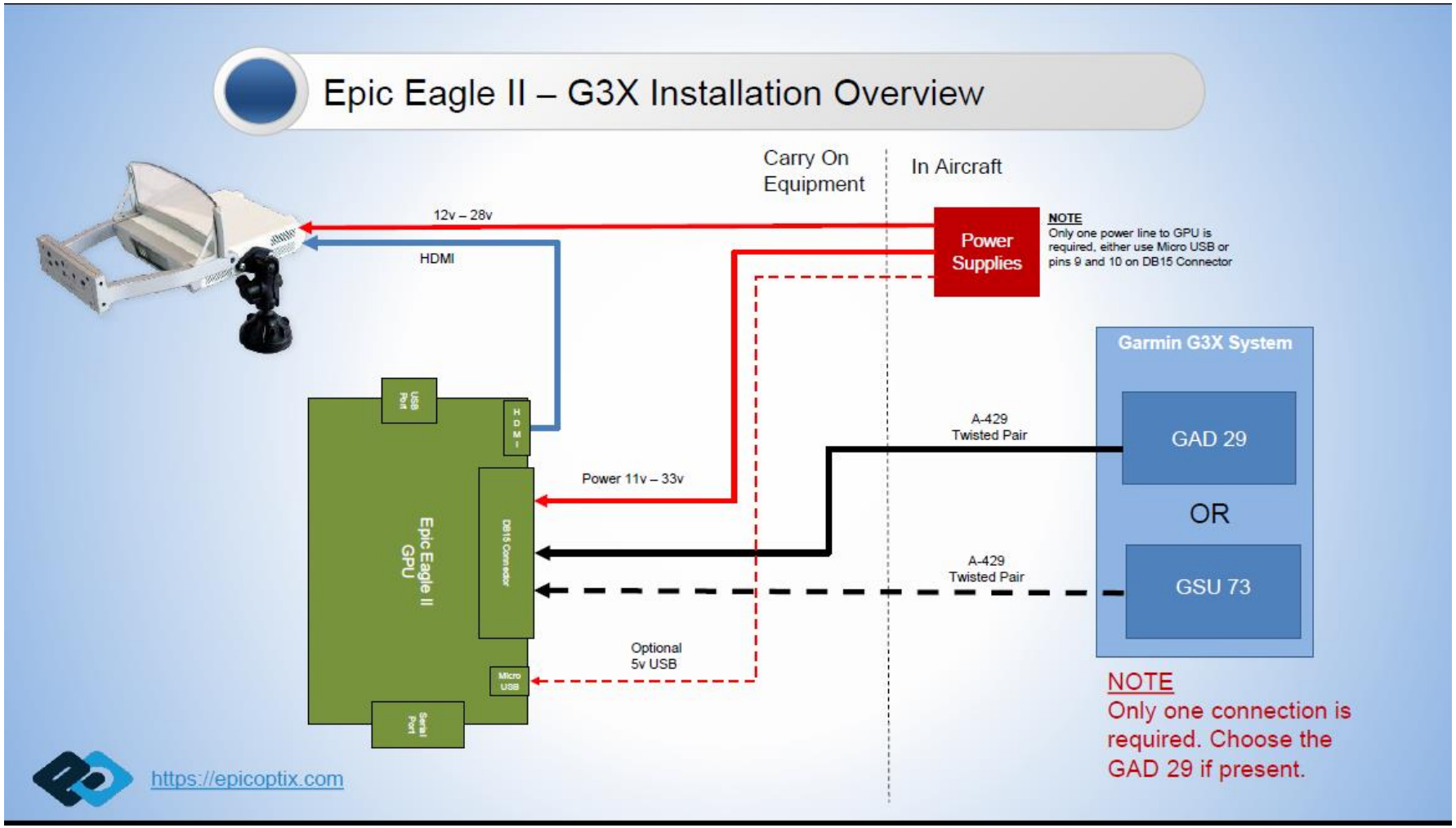
“I just had 8 hours of flying, dodging thunderstorms. My vacuum pump failed on the way to my home airport in Texas at night. I had to make an instrument landing at minimums with a 10 kt tailwind. There is NO way I could have done that without your HUD. That was the first time I had to fly hard IFR with your HUD. I always thought your HUD was great. No kidding. I would’ve had to spend the night in OK City. It just wouldn’t have been safe to even try.”



- **Rich Chapman**, Former Navy A-7 pilot and RV-7A owner:

“The weather was supposed to be clear on the way from Minden, NV to Fallbrook, CA. However, the smoke from the forest fires had not cleared even at 11,500 ft. over the Tehachapi Mountains. It was impossible to see the mountains or the horizon. I started to get vertigo, and the only way to avoid it was to stay concentrated on the HUD. Using the HUD eliminates vertigo because I can see the artificial horizon. My eyes were always outside looking forward. I could monitor airspeed, altitude, rate of descent, hold heading, and keep the descent smooth by keeping the FPV a little below the horizon bar. This went on for 20 minutes descending from 11,500’ to 1500’. Looking for the highway, I saw it at about 1000’AGL where I leveled off and in 2 minutes, I had the airport in sight. The entire descent was hard IMC because there was no visibility and no visual horizon. It’s a paradigm shift for pilots inexperienced with HUDs to really appreciate its value. If you look at accident studies, VFR pilots flying into IMC is a major cause of fatalities in GA. Spatial disorientation, although never mentioned, is usually because the pilot gets vertigo. If you’ve never had it, it can be a real killer. When I hear probable cause as a result of spatial disorientation from flying VFR into IMC, it means the pilot got vertigo trying to get back to VMC. Having a HUD and knowing how to use it will definitely reduce those fatalities.”

Wiring – G3x Installation (ARINC)



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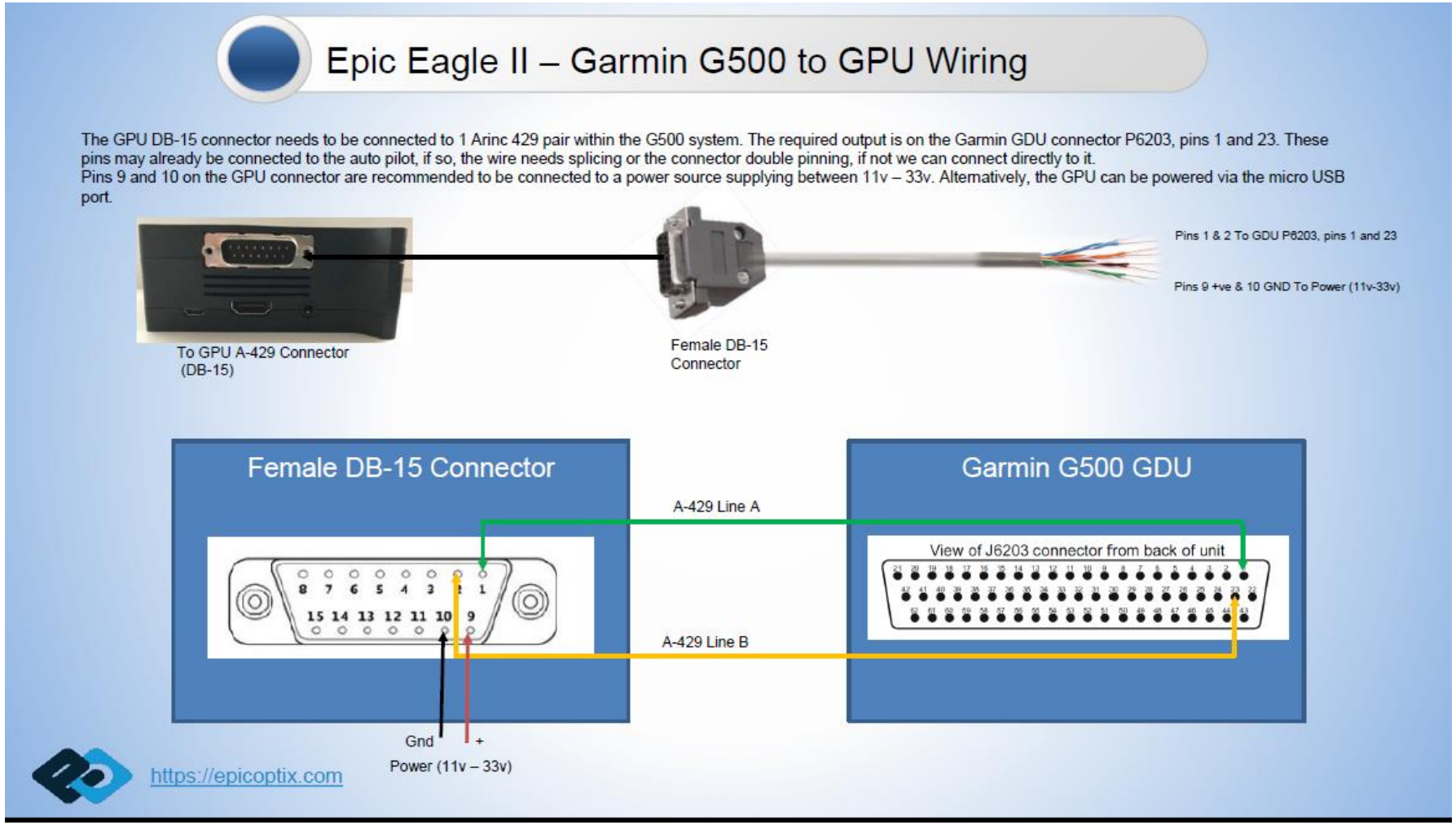
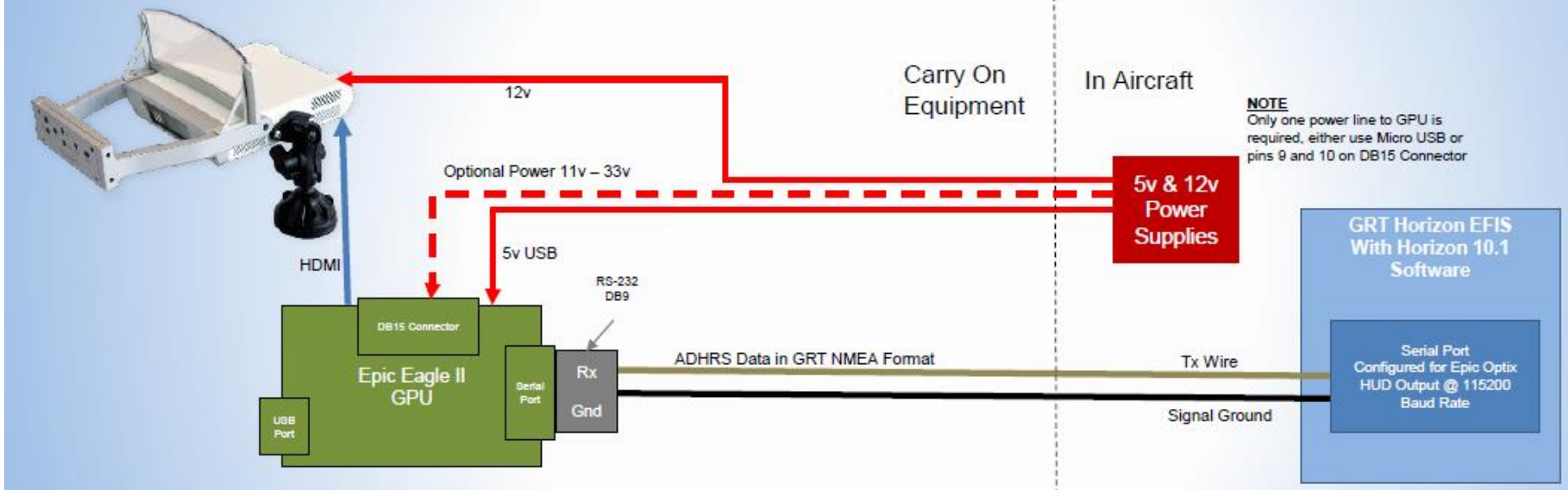
Wiring – G500 to GDU Installation (ARINC)

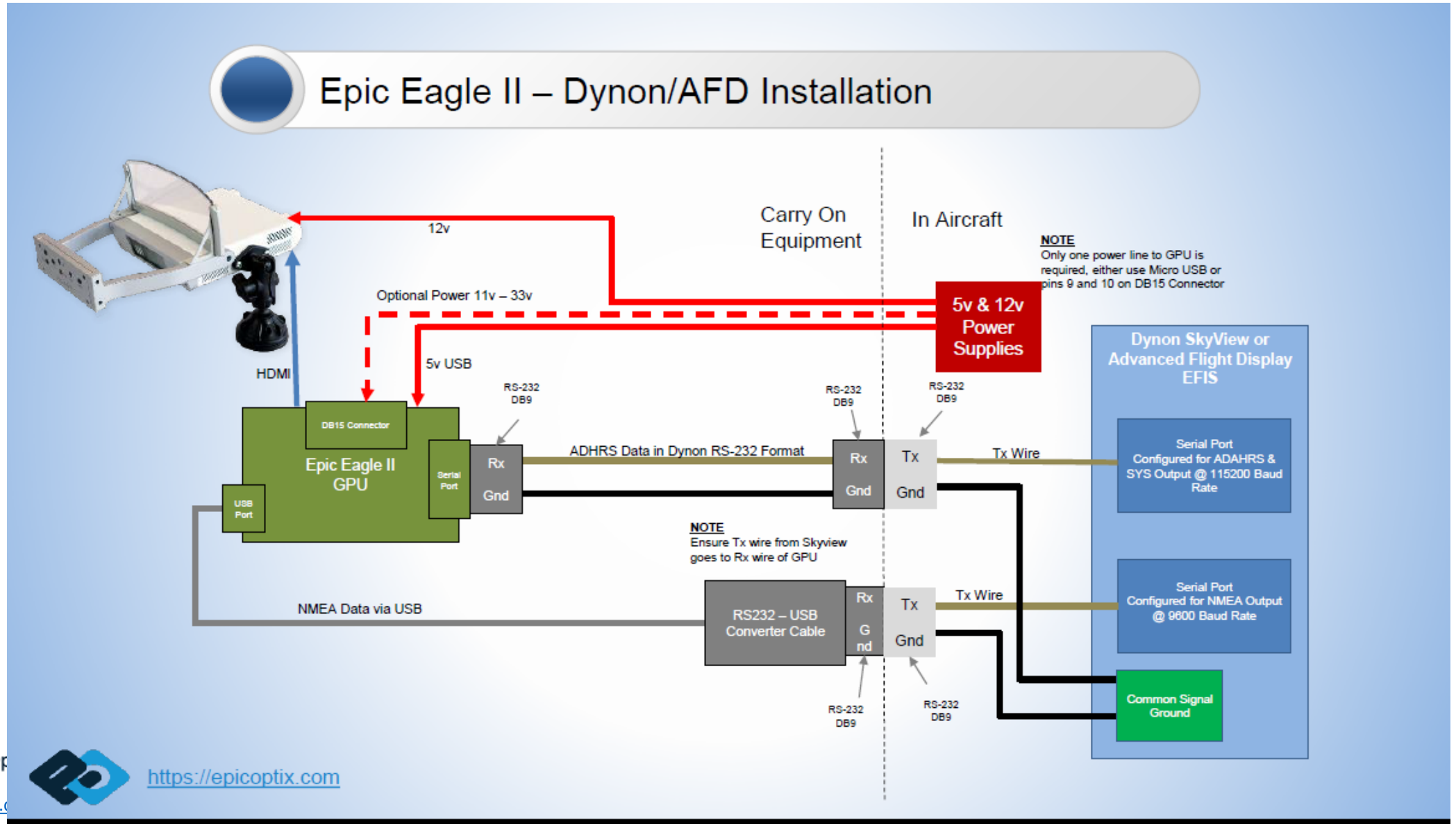


Wiring – GRT to GDU Installation (SERIAL)

Epic Eagle II – GRT Installation



Wiring – Dynon/AFD to GDU Installation (SERIAL)



Wiring – Aspen to GDU Installation (ARINC)