8. SV-GPS-250 / SV-GPS-2020 GPS Receiver Installation and Configuration

This chapter contains information that specifically applies to the installation and configuration of the Dynon Avionics SV-GPS-250 GPS Receiver and SV-GPS-2020 GPS Antenna/Receiver Module (High Integrity GPS - meets FAA 2020 ADS-B Out requirements). After reading this chapter, you should be able to determine how to prepare the installation location, mount the unit, connect the unit to a SkyView display(s), and configure it in the SkyView display. Information specific to either the SV-GPS-250, or specific to the SV-GPS-2020 references the individual unit. Information that is applicable to either unit is referenced by "SV-GPS-250/2020".

The SV-GPS-250 was part of the introduction of the SkyView system in December, 2009. From then, through December, 2015, it was the only GPS receiver available from Dynon Avionics. Thus, any aircraft built prior to January, 2016 that has "all Dynon Avionics" panel likely includes an SV-GPS-250. The SV-GPS-2020 was released for sale beginning January, 2016.

As of January, 2016, the intended use for the SV-GPS-250 in a SkyView system is:

- US pilots – secondary GPS receiver (SV-GPS-2020 is primary),

- US pilots – SV-GPS-250 was installed prior to the availability of the SV-GPS-2020 and are waiting until closer to 2020 to retrofit / add an SV-GPS-2020, or

- Non-US pilots whose aviation authorities do not require a high-integrity GPS position source for Mode-S transponder transmission – primary *or* secondary GPS receiver.

The SV-GPS-250 and SV-GPS-2020 are self-contained GPS receivers intended for use with the Dynon Avionics SkyView system. The SV-GPS-2020 provides "high integrity" GPS data to the SkyView system that is required by the FAA 2020 ADS-B Out mandate. *The SV-GPS-250 **does not** provide "high integrity" GPS data to the SkyView system that is required by the FAA 2020 ADS-B Out mandate.* Unlike similar-looking GPS units, the electronics of the GPS receiver are contained within the unit – there is no separate "electronics module" requiring a coaxial cable connection. The four 22 AWG wires provide power and ground, data to, and data from the unit. The SV-GPS-250 and SV-GPS-2020 are powered by the SkyView display(s) and thus if the SkyView display(s) are equipped with the SV-BAT-320 backup battery, the SV-GPS-250 and/or the SV-GPS-2020 can continue to provide GPS data in the event of a failure of the plane's electrical system.

If you are a US pilot and equipping your aircraft for the FAA 2020 ADS-B Out mandate, and plan to equip your aircraft with a secondary GPS (see below), the secondary GPS can be either an SV-GPS-250 (including an existing SV-GPS-250) or a second SV-GPS-2020. There is no restriction on equipping a SkyView system with a second SV-GPS-2020.

Unit	Meets FAA 2020 ADS-B Out mandate?	Data Rate	SkyView Display Refresh Rate	Receives WAAS (where available)?	Intended Use For SkyView
SV-GPS-250	No	38,400 baud	5 Hz	Yes	Secondary GPS receiver
SV-GPS-2020	Yes	115,200 baud	4 Hz	Yes	Primary GPS Receiver

Table 49 – Quick Comparison Chart SV-GPS-250 vs SV-GPS-2020

WAAS Data Reception

Like most modern GPS receivers, the SV-GPS-250 and SV-GPS-2020 include the ability to receive satellite-based Wide Area Augmentation System (WAAS) correction data (when available) to improve positional accuracy. Many pilots incorrectly conflate a GPS unit that receives WAAS data with a GPS Navigator unit that is certified for flight in Instrument Flight Rules (IFR) conditions. *To be clear, the SV-GPS-250 and SV-GPS-2020, connected to a SkyView system, do receive WAAS data (when available), but having an SV-GPS-250 and/or SV-GPS-2020 (but not an IFR or "certified" GPS) does not necessarily mean that your aircraft is properly equipped for legal flight under IFR.*

Only the SV-GPS-2020 GPS Antenna/Receiver Module (High Integrity GPS - meets FAA 2020 ADS-B Out requirements) or equivalent "high integrity" GPS unit meets the (GPS portion of the) requirements of the FAA 2020 ADS-B Out mandate. If you are equipping your plane for use in the US, compliant with the FAA 2020 ADS-B Out mandate, we recommend that you install the SV-GPS-2020, *not the SV-GPS-250 (except as a secondary GPS).*

Valid GPS data is required for time, compass calibration, moving map functionality, ADS-B IN, and ADS-B OUT, data logging, and other internal functions of the SkyView system. If your plane is already equipped with a GPS unit and it can output GPS data, SkyView can use that GPS data for its operations (other than FAA 2020 ADS-B Out mandate). However, if you decide to do so, be advised that other GPS units typically provide GPS data updates only once per second (1 Hz); this can

cause position updates for Synthetic Vision (SynVis) and map position to appear "jerky". In contrast, the SV-GPS-250 and SV-GPS-2020 provide positional updates much faster – four times per second (4 Hz) for the SV-GPS-2020, and five times per second (5 Hz) for the SV-GPS-250, which provides a superior display for SynVis and map position updates.

Use of the SV-GPS-2020 outside the US

The SV-GPS-2020 is designed to meet the requirements of the (US) FAA 2020 ADS-B Out mandate for Experimental Amateur Built (EAB), Experimental Light Sport Aircraft (E-LSA) and Special Light Sport Aircraft (S-LSA) planes flying in the US. Upon initial release of the SV-GPS-2020 (January, 2016), Dynon Avionics cannot (currently) provide information on the applicability, or requirements, or regulatory issues for the SV-GPS-2020 in any other country. As such information is received, or developed, it will be added to this section in future revisions of this document.

Considerations for converting an SV-GPS-250 to an SV-GPS-2020 in Special Light Sport Aircraft (S-LSAs)

For US SkyView pilots, modification of S-LSA aircraft, such as replacing an installed SV-GPS-250 with an SV-GPS-2020, or adding an SV-GPS-2020 to a plane with an SV-GPS-250 already installed, requires a Letter of Authorization (LOA) from the S-LSA manufacturer or a dealer specifically authorized by your S-LSA's manufacturer. Your S-LSA manufacturer *may* provide an SV-GPS-2020 kit and instructions to make an SV-GPS-2020 installation easier and faster. Upon initial release of the SV-GPS-2020 (January, 2016), Dynon Avionics cannot (currently) provide information on whether, or not, any S-LSA manufacturer and/or dealer has developed an SV-GPS-2020 kit, has a LOA available for installation of the SV-GPS-2020, or has evaluated the SV-GPS-2020 for applicability in their aircraft. Thus, if you are a US S-LSA owner interested in installing the SV-GPS-2020 in place of, or in addition to, an installed SV-GPS-250, your first query should be to your US dealer, or alternatively your S-LSA manufacturer. As such information is received, or developed, it will be added to this section in future revisions of this document.

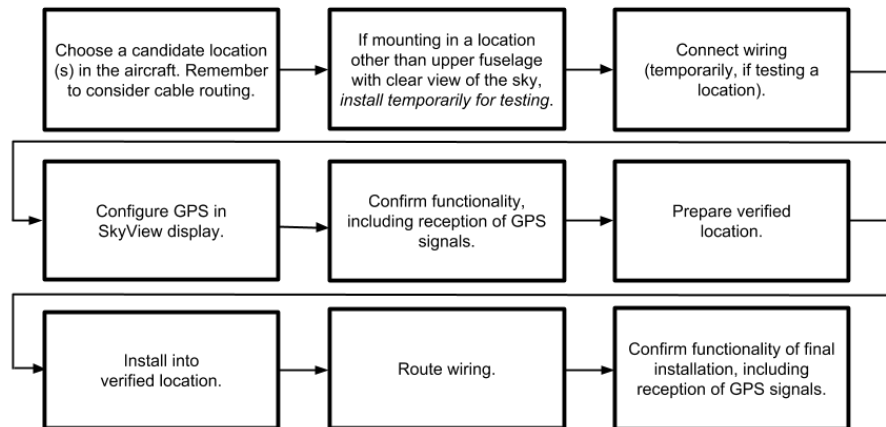Figure 55 is a high-level overview of a suggested SV-GPS-250/2020 installation and configuration procedure.

Figure 55 – Suggested SV-GPS-250/2020 Installation and Configuration Procedure

Physical Installation

Like all GPS devices, for most reliable performance, the SV-GPS-250/SV-GPS-2020 require a clear, unobstructed "view" of the sky. The SV-GPS-250/SV-GPS-2020 are designed to be mounted on the upper fuselage of the aircraft for an unobstructed (360° view) of the sky during maneuvers. If the SV-GPS-250/SV-GPS-2020 is mounted inside the fuselage (for example, on the top of the panel or underneath a cowling), the SV-GPS-250/2020's view of the sky is partially or fully obstructed and GPS performance may be marginal in situations such as insufficient number of satellites "in view".

Observe the following guidelines when choosing a location for an SV-GPS-250/2020:

- The optimal location for the SV-GPS-250/2020 is a rigid surface on the upper fuselage of the aircraft.
- Mounting location should be relatively level (the base of the SV-GPS-250/2020 is flat).
- Do not locate the receiver within 3 feet of transmitting antennas.
- Avoid antenna shadows (i.e., obstructions that block the antenna's view of the sky).
- All four of the SV-GPS-250/2020's wires should all be connected to each SkyView system display for redundancy.

The diagram below shows the mounting dimensions of the SV-GPS-250/2020. Note that it utilizes a common bolt pattern found in much of general aviation.
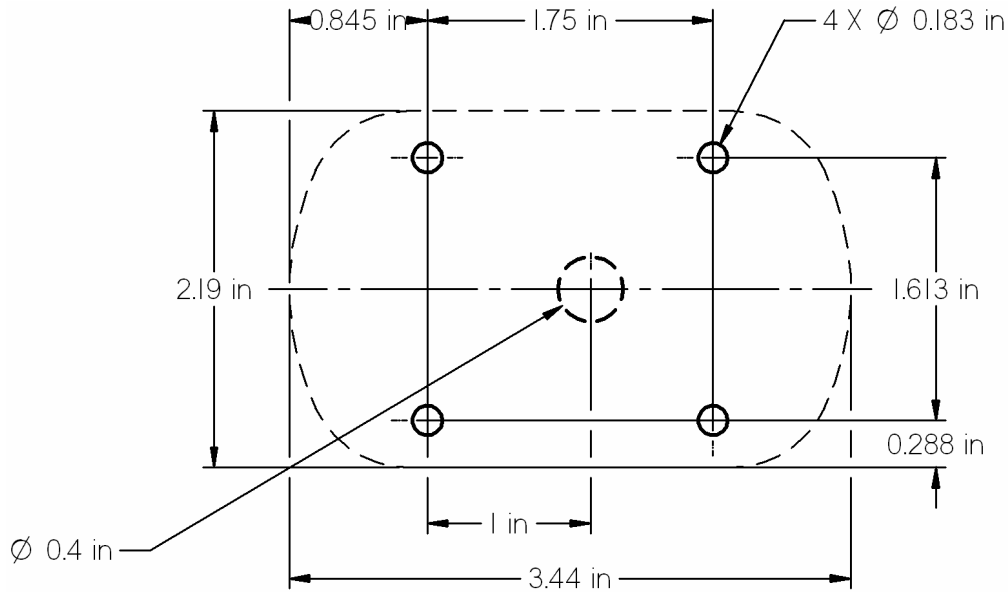
Figure 56 – SV-GPS-250/2020 Mounting Dimensions

Mounting hardware is not included. The SV-GPS-250/2020 is designed to install with #8 fasteners with 100 degree countersunk heads. The use of nut plates is recommended for convenience, but other hardware can be used if space allows. Specific hardware selection is determined by the installer.

We recommend the use of weather sealant around the fastener heads to keep moisture from entering the aircraft through the mounting holes. The module itself is sealed and includes a rubber gasket that seals the inner wire hole. It also allows the module to be mounted on *slightly* curved surfaces. For extra protection, you may use weather sealant around the outside of the SV-GPS-250/2020 where it meets the skin of the aircraft.

Considerations for installing an SV-GPS-2020 in an aircraft with an installed SV-GPS-250

Given that the SV-GPS-2020 is physically compatible (same size, same bolt pattern, etc.), and thus *can* be easily installed in place of a previously installed SV-GPS-250, it's understandably tempting to simply "swap" the SV-GPS-2020 in place of an existing SV-GPS-250. However, the High Integrity functions of the SV-GPS-2020 *may* require a different (better) installation location than the SV-GPS-250, such as installation on the upper fuselage instead of underneath the cowling or inside a composite fuselage. *Thus, it is **critical to verify the functionality of the SV-GPS-2020** at the intended installation site prior to final installation.*

In an aircraft with an installed SV-GPS-250, admittedly the simplest installation method to install an SV-GPS-2020 is:

- Remove the SV-GPS-250
- Cut the wires

- Splice the wiring into the SV-GPS-2020.
  To protect against a corroded connection if there is water leakage around the unit, use a "weathertight" splice method such as solder sleeves or heat-shrink tubing.
- Install the SV-GPS-2020
- Configure and test the SV-GPS-2020

This the most expedient method of installation if you don't wish to, or cannot, run new wiring (such as you can no longer access the portion of the aircraft where the wiring is installed).

However, the SV-GPS-250 is an ideal secondary (backup) GPS unit, thus it's worth considering leaving the SV-GPS-250 installed, and installing the SV-GPS-2020 *in addition to* the SV-GPS-250. If you wish to do so, modify the instructions for a new installation of SV-GPS-250 and SV-GPS-2020:

- Keep the SV-GPS-250 connected to Serial Port 5 (no wiring change required)
- At the SkyView display(s), splice the Orange wire of the SV-GPS-250 to the Orange wire of the SV-GPS-2020.
- At the SkyView display(s), splice the Black wire of the SV-GPS-250 to the Black wire of the SV-GPS-2020.
- Connect the SV-GPS-2020's Gray/Violet (TX) wire to Serial Port 1, 2, 3, or 4 RX wire.
- Connect the SV-GPS-2020's Gray/Orange (RX) wire to Serial Port 1, 2, 3, or 4 TX wire.
- Change configuration of the SV-GPS-250 (Serial Port 5) to POS 2.
- Configure the serial port used for the SV-GPS-2020 to POS 1.

Serial Data Connection

For its primary source of GPS data, SkyView uses the GPS data from the device set to SERIAL IN FUNCTION: POS 1.

If your installation has two or more displays, all four wires of the SV-GPS-250 and/or SV-GPS-2020 must be connected to *all displays*.

The SV-GPS-250/2020 includes 18 feet (5.49 meters) of twisted wire for a serial connection to the SkyView display via the display. This wire may be trimmed or lengthened as needed to suit the installation – the length of these wires is not critical.

The color of the SV-GPS-250/2020 wires matches the colors of the wires of the SV-HARNESS-D37 that are intended for the GPS serial connection. The following table contains information regarding the wires.

Function	SkyView Display Harness SV-GPS-250/2020 Wire Color	SkyView Display D37 Pin
SV-GPS-250/2020 TX		11

Function	SkyView Display Harness SV-GPS-250/2020 Wire Color	SkyView Display D37 Pin
SkyView display Serial Port 5 RX	Gray with Violet stripe	
SV-GPS-250/2020 RX	Gray with Orange stripe	12
SkyView display Serial Port 5 TX		
SV-GPS-250/2020 Ground	Black	24
SV-GPS-250/2020 Power	Orange	29

Table 50 – SV-GPS-250/2020 Serial Connection Details

As mentioned previously, if there are two or more displays in your SkyView system, all four of the SV-GPS-250/2020's wires must be connected to all displays in parallel. This wiring scheme is illustrated in Figure 57.
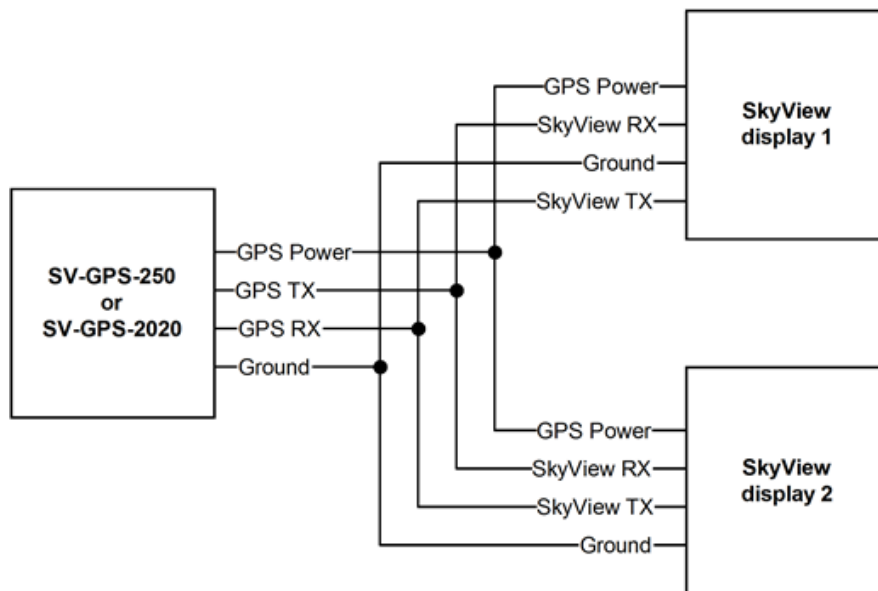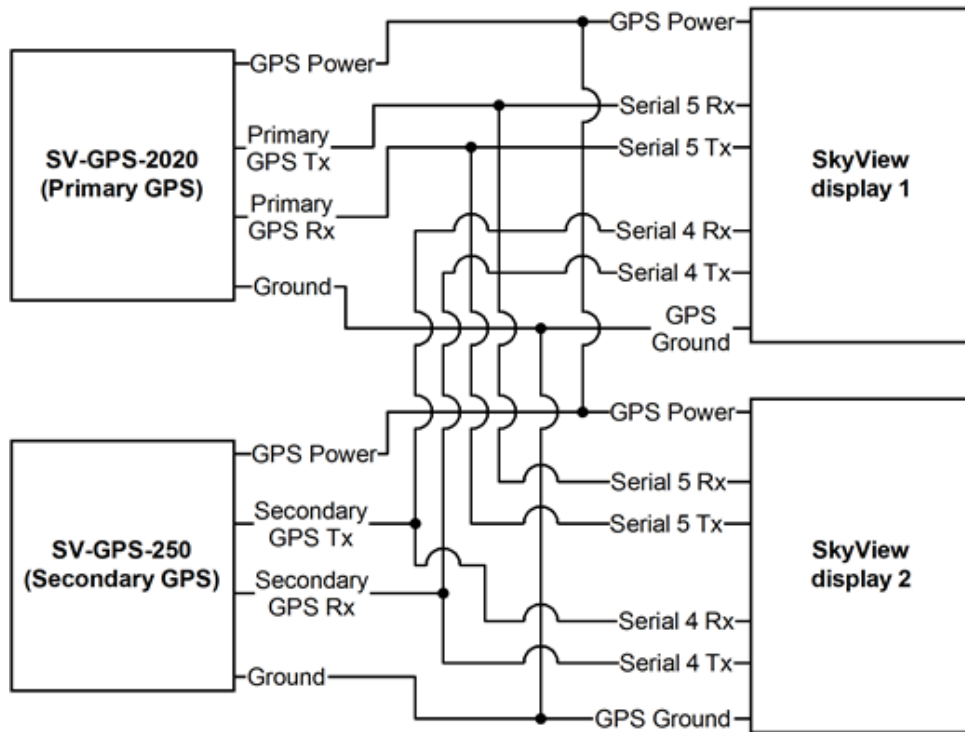

Figure 57 – SV-GPS-250/2020 Connected to Multiple SkyView Displays

If there is more than one SV-GPS-250/2020 in your system (including one SV-GPS-250 and one SV-GPS-2020, use the same scheme in Figure 57 on different display serial ports for the other SV-GPS-250/2020 modules, but connect power and ground for the other SV-GPS-250/2020 modules to the same power and ground connections (black and orange wires) that are provided in the serial port 5 wiring bundle on the display harnesses. An example of this configuration follows.

Use of Serial 4 for secondary GPS is for illustration only.
Serial 1, 2, 3, or 4 (if available) may be used for the secondary GPS.

Figure 58 – SV-GPS-2020 and SV-GPS-250 Connected to Multiple Displays

Secondary GPS Serial Connection Wire Color	Serial Port 1 Wire Color / Pin	Serial Port 2 Wire Color / Pin	Serial Port 3 Wire Color / Pin	Serial Port 4 Wire Color / Pin
Gray/Violet	Brown/Violet (Pin 3 – RX)	Yellow/Violet (Pin 5 – RX)	Green/Violet (Pin 7 – RX)	Blue/Violet (Pin 9 – RX)
Gray/Orange	Brown/Orange (Pin 4 – TX)	Yellow/Orange (Pin 6 – TX)	Green/Orange (Pin 8 – TX)	Blue/Orange (Pin 10 – TX)

Table 51 - Secondary GPS serial connection options

The SV-GPS-2020 is supported in SkyView firmware v14.0 or later. Earlier versions of SkyView firmware do not support the SV-GPS-2020. To check your firmware

version, go to SETUP MENU > LOCAL DISPLAY SETUP > DISPLAY HARDWARE INFORMATION.

Configuration – SV-GPS-2020 only, Serial Port 5

Go to the Serial Port Setup Menu (SETUP MENU > SYSTEM SETUP > SERIAL PORT SETUP > SERIAL PORT 5 SETUP) and then configure serial port 5 as follows:

SERIAL IN DEVICE: DYNON SV-GPS-2020
SERIAL IN FUNCTION: POS 1
SERIAL IN/OUT BAUD RATE: 115,200
SERIAL OUT DEVICE: NONE

Configuration – SV-GPS-2020 (Serial Port 5) and SV-GPS-250 (Serial Port 4)

The following configuration uses Serial Port 4 for the (secondary) SV-GPS-250 as shown in Figure 58 – SV-GPS-2020 and SV-GPS-250 Connected to Multiple Displays. As explained there, use of Serial Port 4 for the SV-GPS-250 (secondary GPS) is for illustration only. Serial Port 1, 2, 3, or 4 (if available) may be used for the SV-GPS-250 (secondary GPS).

Go to the Serial Port Setup Menu (SETUP MENU > SYSTEM SETUP > SERIAL PORT SETUP

Configure Serial Port 5 as follows:

SERIAL PORT 5 SETUP >
SERIAL IN DEVICE: DYNON SV-GPS-2020
SERIAL IN FUNCTION: POS 1
SERIAL IN/OUT BAUD RATE: 115,200
SERIAL OUT DEVICE: NONE

Configure Serial Port 4 as follows:

SERIAL PORT 4 SETUP >
SERIAL IN DEVICE: DYNON SV-GPS-250
SERIAL IN FUNCTION: POS 2
SERIAL IN/OUT BAUD RATE: 38,400
SERIAL OUT DEVICE: NONE

In SkyView firmware v14.0 and earlier, when a serial port's SERIAL IN DEVICE is set to DYNON SV-GPS-250 or DYNON SV-GPS-2020 (typically SERIAL PORT 5), the SERIAL OUT DEVICE for that serial port is not "auto-assigned" – it is possible to select a different serial device in SERIAL OUT DEVICE. In firmware versions later than v14.0, when a serial port's SERIAL IN DEVICE is set to DYNON SV-GPS-250 or DYNON SV-GPS-2020, SERIAL OUT DEVICE for that serial port will be "auto-assigned" to DYNON SV-GPS-250 or DYNON SV-GPS-2020 respectively. Thus, do not connect the DYNON SV-GPS-250's or DYNON SV-GPS-2020's serial TX to any device other than the SV-GPS-250 or SV-GPS-2020. This guidance is reflected in all wiring diagrams for the SV-GPS-250 and SV-GPS-2020.

If (as is possible in firmware versions through v14.0) a serial device other than an SV-GPS-250 or SV-GPS-2020 has been connected to the serial port TX on a serial port used by an SV-GPS-250 or SV-GPS-2020, that device will not function (communicate) in firmware versions later than v14.0.

Testing / troubleshooting installation of the SV-GPS-250 and/or SV-GPS-2020

The SV-GPS-250 and SV-GPS-2020 are connected to the SkyView system via "serial port", and thus will not appear on the list of SkyView Network Devices during a SkyView Network configuration.

Part 1 – basic serial port functionality

Go to Serial Port Setup for the serial port you chose to use for the SV-GPS-250 or the SV-GPS-2020 (typically Serial Port 5):

SETUP MENU > SYSTEM SETUP > SERIAL PORT SETUP > SERIAL PORT 5 SETUP

Figure 59 - Serial Port 5 Setup

On this screen, verify the following:

- SERIAL IN DEVICE matches the device connected – either SV-GPS-250 or SV-GPS-2020; if the incorrect device is selected, no GPS data will be received.
- Verify that SERIAL IN FUNCTION is set to POS 1 for the primary (or only) GPS receiver, or POS 2 for the secondary GPS receiver.
- Verify that RX COUNTER and GOOD SENTENCES are incrementing.
- SENTENCE ERRORS and GROUP ERRORS should not be (significantly) incrementing.

If POS 1 is shown in Red, another GPS device has already been set as POS 1 and that "conflict" must be resolved – only one GPS device can be set as POS 1, only one GPS device can be set as POS 2, etc.

If RX COUNTER and GOOD SENTENCES are not incrementing, check the SV-GPS-250/2020 wiring, specifically that the Gray/Violet and Gray/Orange wires were connected correctly between the unit and the SkyView display. If you have more than one SkyView display, the SV-GPS-250/2020 must be connected to *all* displays.

Part 2 – GPS Receive Performance
To verify that the SV-GPS-250/2020 can receive GPS signals acceptably, move the plane to an open area with a relatively unobstructed view of the sky. Moving the plane just out of a hangar, or between two hangars, where a significant portion of the sky is obscured from the view of the GPS may result in poor performance of the SV-GPS-250/2020.

Go to GPS FIX STATUS to verify that the SV-GPS-250 or SV-GPS-2020 is receiving GPS signals: SETUP MENU > LOCAL DISPLAY SETUP > GPS FIX STATUS
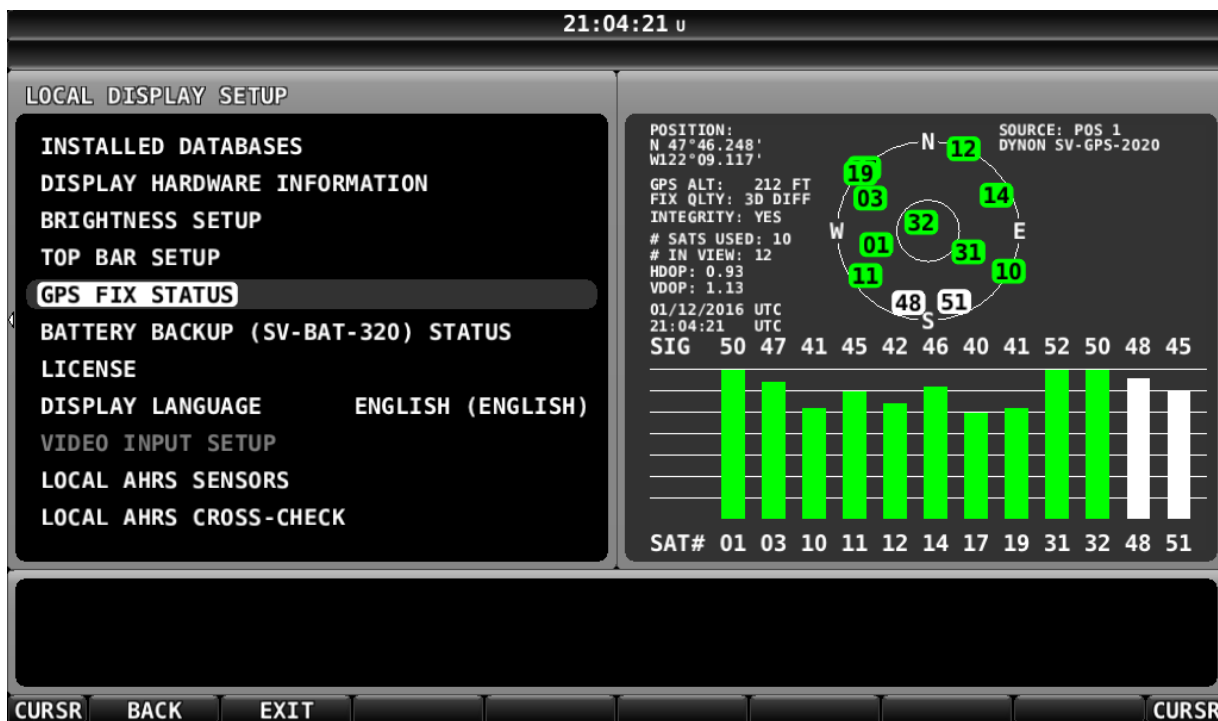

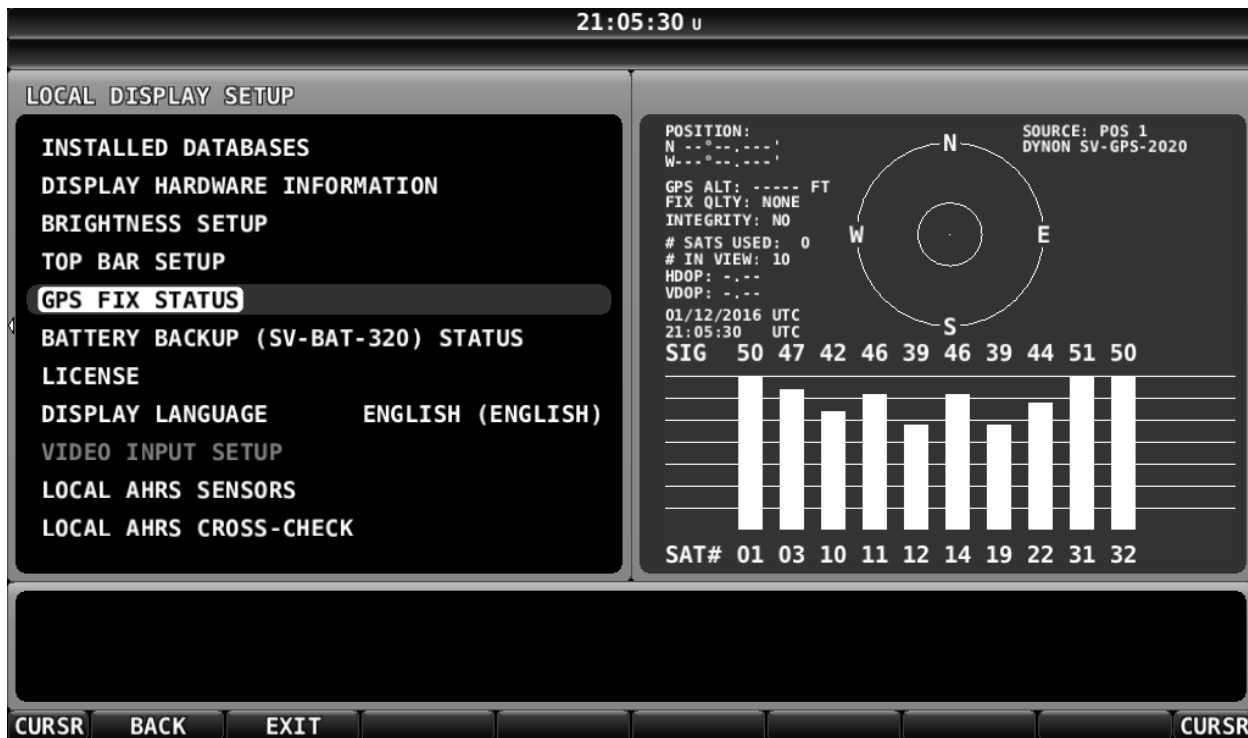
Figure 60 – GPS FIX STATUS – Very Good, 3D DIFF

Figure 61 – No GPS Fix

Note that when the SV-GPS-250/2020 is initially powered up for the first time, or is powered up after several weeks or months of not being used, the SV-GPS-250/2020 may require several minutes to acquire GPS signals.

The number of satellites in "view" of the SV-GPS-250/2020 will vary depending on the time of day, location, etc. Generally at least six satellites should be in view.

On the GPS FIX STATUS screen, verify the following:
- POSITION: (should be displayed)
- GPS ALT: (should be displayed)
- Time and date should be displayed
- FIX QLTY: is "3D" (good) or "3D DIFF" (best)
- INTEGRITY: is "YES" (SV-GPS-2020 only; SV-GPS-250 will always display "NO")
- Several of the satellites should be highlighted in Yellow (acceptable) or Green (optimal).

If any of these are not true after waiting for several minutes, as illustrated Figure 61, it may be necessary to install the SV-GPS-250/2020 in a different location on the aircraft.

Note that GPS FIX STATUS only displays information for the GPS set to POS 1. If you have a second GPS installed, temporarily set that unit to POS 1 and temporarily set the primary GPS to POS 2.

(US only) Additional configuration required for SDA/SIL=1 required for continued reception of ADS-B Traffic (early 2016)

The following is only applicable to US pilots whose aircraft is equipped with an SV-GPS-250 (but not an SV-GPS-2020), SV-XPNDR-261/262 (or other Mode-S / ES transponder), and SV-ADSB-470 (ADS-B In receiver).

Prior to 2016, the FAA transmitted TIS-B to aircraft in US airspace who transmit SIL/SDA=0 (GPS integrity), allowing those aircraft to receive targeted "ADS-B Traffic" specific to their aircraft. In early 2016, the FAA will discontinue transmitting TIS-B to aircraft in US airspace who transmit SIL/SDA=0.

Prior to SkyView firmware v14.0, SkyView systems equipped with an SV-GPS-250 transmit *only* SIL/SDA=0. In SkyView firmware v14.0 and later, SkyView can be configured to transmit SIL/SDA=1 or SIL/SDA=0. When set to SIL/SDA=1, this allows aircraft in US airspace equipped with an SV-GPS-250 to continue to receive TIS-B / ADS-B Traffic through December 31, 2019. If you are a US pilot and have an SV-GPS-250 (but not an SV-GPS-2020) on your aircraft, information on configuring your SkyView system for SIL/SDA=1 is found in SV-XPNDR-261 / 262 Installation, Configuration, and Testing.

Additional configuration required for compliance with FAA 2020 ADS-B Out mandate

This section deals with installation and configuration of the SV-GPS-250 and SV-GPS-2020 *only*. However, installing the SV-GPS-2020 is only part of what is required to be compliant with the FAA 2020 ADS-B Out mandate. For the remainder of installation and configuration required for compliance with FAA 2020 ADS-B Out mandate, see SV-XPNDR-261 / 262 Installation, Configuration, and Testing.