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CNX80 User Newsletter

Fourth Edition for the CNX80
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Common Installation Problems with GPS/VHF Systems

This topic is not really specific to the CNX80. However it bears putting forth some of this information as the CNX80 installations we have seen can and have been affected by some of these common installation problems. If you are in the process of installing your CNX80, you may wish to discuss these issues with your installer, or if you are a distributor, be aware of these types of issues.

In almost all cases, the majority of problems are related to the Radio Frequency (RF) signals used by the VHF Nav/Comm and GPS signals from the GPS satellites. Serial data connections between systems typically are less problematic, as they tend to either work or not work at all in which case wiring, poor seating of the unit in the tray, or a bent or broken pin is usually the cause.

Reuse of Old Coax and Connectors

If it's not broken don't fix it, right? Most of the time this approach works, but reliability of reused coax and connectors tend to be hit and miss. Old coax and connectors that are reused in a retrofit upgrade with new equipment usually result in an acceptable installation, but it's a common point of failure and complaint that we hear.

Coax is not expensive and frayed/chafed coax or marginal crimps on the connectors will substantially degrade system performance or drive you crazy with intermittent or complete loss of function problems. If the airplane is open and the coax accessible it is far cheaper to replace it than leave what's been in the airplane for many years and hope for the best.

The CNX80 install manual states that the typical loss at a connector crimp is 0.2 db. However we have seen many where the loss due to an old crimp that has worked loose or was poor quality to begin with can be 10 times this number, significantly degrading the Nav/Comm or GPS performance. In all cases, it is best to check the antenna and coax using an antenna analyzer as discussed below.

Installation Problems

This is one of the reasons Garmin requires IFR capable systems to be installed by a Garmin distributor using proper tools and techniques. To offer a bad example, a few years back I was helping a friend install new GPS equipment in his Sky King vintage 310.

We were in the process of installing the GPS coax to the antenna and lacked the appropriate crimping tool. The A&P told him to "make it flat" using whatever device was at hand to achieve the goal. He did so using a vise grip, mangling the $25 connector in the process. The end result was a very poor crimp with ground shield poking out in several directions, potentially causing stray ground problems.

Miraculously it did work to some degree and the GPS was able to track position. I gave it a couple of months before it gave him problems. Shortly after the airplane was returned to service he began receiving numerous RAIM error messages and total loss of the GPS navigation position on occasion. He complained to me about the performance of the system. I reminded him of the less than acceptable coax install, which was replaced after the GPS was checked by the service department and verified to be performing within limits. The problem disappeared and the performance and reliability of the GPS increased greatly.

Remember that GPS consists of 24 satellites (plus the two WAAS satellites that are geosynchronous orbit) each producing roughly as much energy as a household light bulb. Tracking the equivalent of several light bulbs in earth orbit is not a straightforward task. As a result there are numerous criteria that each satellite must pass to be used as a part of the navigation solution, such as signal strength, mask angle, frequency interference checks, etc. Any degradation of the signal will affect the overall reliability of the GPS system. The same can be said for VHF Nav/Comm performance.

Another concern is the reuse of old antennas. Generally this is a rarer problem, but older antennas can suffer damage over time that is not physically apparent and results in significant performance degradation. Inadequate bonding between the antenna and the ground plane of the aircraft is also a common problem for VHF Nav/Comms.

Another item to watch is the use of signal splitters. Generally these work fine, so long as you remain within the total signal loss budget, but a splitter with a marginal crimp coupled to a long run of coax (even new) can cause substantial signal loss.

You can also verify the performance of the antenna by checking it with an antenna analyzer that measures antenna impedance through the coax and the VSWR (voltage standing wave ratio). The impedance should be very close to 50 ohms and the VSWR in the 2:1 to 3:1 range.

If any part of this chain fails to show a 50 ohm impedance due to bad connections, incorrect antenna length, etc., the maximum power will not be radiated from the antenna. Instead part (or all) of the wave is reflected back down the line. The amount of the wave reflected back depends on how bad the mismatch is. The same can be said for received signals during an ILS approach or VOR navigation.

The combination of the original wave traveling down the coaxial cable (towards the antenna during transmit or opposite during receive) and the reflecting wave is called a standing wave. The ratio of the two above described waves is known as the Standing Wave Ratio.

The result is presented as a figure describing the power absorption of the antenna. A value of 2:1 VSWR, which is equal to 90% power absorption, is considered very good for a small antenna: 3:1 is considered acceptable, which is equal to 75% power absorption which for aviation is approaching marginal capability. From this point, the higher the VSWR ratio the more rapidly antenna performance falls off.

Hopefully reviewing some of these common problems will help you avoid them in the future.

GTX 32 and 33 Interface

The GTX 32 and 33 are remote mounted Mode C and Mode S transponders respectively. Both of these will be integrated to the CNX80 in V2.0 software and can be used as the SL70R is used today, allowing for significant space savings in your cockpit panel.

In addition the GTX 33 Mode S transponder will provide TIS traffic service as the GTX 330 does, which will be displayed on the CNX80 traffic page that will be implemented in V2.0. You may also tie this traffic source into your MX20 and be able to display traffic on either display. A separate STC will be done to accommodate these installations. We will notify CNX80 users when this STC is complete.

Auto Suspend In Holding

We've found a minor problem in V1.x software that occurs occasionally in course reversals in a holding pattern during approach.

As mentioned in our first newsletter, if you are performing a course reversal in a holding pattern in lieu of a procedure turn, the database is constructed in such a way as to accomplish the course reversal and perform one turn in holding. This allows for altitude

loss if required before commencing the approach. If you do not need to lose altitude and just want to complete the course reversal for the approach, then you would press the SUSP key once established inbound. This eliminates the one turn in holding and allows the system to sequence to the final approach leg.

The problem occurs when you attempt to sequence to the FAF by pressing SUSP prior to the system sequencing to the hold leg type on the FROM-TO-NEXT line on the bottom of the flight plan or map page, which may result in not being able to un-SUSPend the system (i.e. the SUSP annunciator remains on.)

So long as the system indicates the type of hold entry it is currently performing (i.e. TEARDROP, PARALLEL), do not press the SUSP key. Wait until established on the inbound course and the system sequences to show "course to fix {*name of fix*} hold ONCE" before pressing SUSP to sequence. This resolves the problem and the system will not SUSPend again.

Should you press the button early and this problem occurs, hit the SUSP key until the SUSP annunciation clears. This may require several keystrokes. Always make sure the SUSP annunciation is not displayed after checking the FAF.

We will resolve and enhance this operation in V2.0.

Operating on the Fringes of WAAS Coverage

You may see an increase in Loss of Integrity messages when operating on the very fringes of WAAS coverage. If your aircraft operations are limited to the continental US, you will be unaffected. The lower 48 states and Canada are covered except for the northern extremes of Canada. This may also occur in European operations where the easternmost WAAS satellite is in view of the western European continent or in Australia, where the westernmost WAAS satellite is in view.

This is due in part to the requirements in TSO C146a for the selection of satellites. Primary consideration is given to satellites that the receiver has valid WAAS correction data for. For instance if you are in Europe you may be receiving data on the WAAS data stream that covers satellites on the far western horizon in Europe and no data on those directly overhead or to your east.

If the number of WAAS corrected satellites drops below five, then the engine will revert to a non-WAAS mode of operation and select other satellites and will begin using a GPS satellite fault detection scheme. In this instance you will not be able to fly precision approaches without WAAS corrections in use (V2.0 software with precision approach capability). Non-precision approaches will still be possible so long as the GPS constellation is sufficient to allow the engine to calculate a horizontal protection limit of at least 0.3 NM. Of course the embedded VHF Nav receiver will still allow for ILS precision approaches as well.

You may also have temporary instances of LOI due to the fact that the engine is operating with a marginal constellation until it changes operational modes to fault detection only. We are considering methods to make this fringe operation more robust without sacrificing operational capability. This will require review of the existing TSO requirements with the FAA and their concurrence. We're currently collecting data and will let you know how this engineering effort progresses.

We have also been asked about reception of EGNOS signals in Europe as they periodically transmit test signals as they approach full deployment of EGNOS. The CNX80 does not use EGNOS or any other space based GPS augmentation signals other than WAAS at this time. When those systems come into service, we will evaluate the CNX80 engine with those systems and determine compatibility with those systems at that time.

Meggitt Magic Interface

I recently had the chance to fly a new Meggitt Magic EFIS install in a Twin Commander with dual CNX80s and an MX20 with WSI datalinked weather. In general, the install went very well and the overall performance was very good with the autopilot. We do not currently cover this specific interface in the STC data, but this can typically be accomplished through field approval without significant difficulty. The CNX80s and MX20s may be installed via STC as well as the Magic EFIS, and only the connection between the systems needs to be field approved. For distributors wishing to do these installs, please advise us and we'll support you as necessary.

Other Topics

Please let us know if you have any questions or comments. Several of you have and we do appreciate the feedback allowing us to directly address your questions, concerns, and providing you with the best customer service we can.

Please feel free to contact us by visiting www.garmin.com and send your comments to the technical support group (support.salem@garmin.com): Attention Paul Damschen, Flight Test.

This Newsletter along with the first three editions can be found on the web at:

http://www.garmin.com/products/manual.jsp?product=013-00104-01