GX 450 Complete Guide

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Abstract

This guide covers everything you need to know about your PPN RTK system. It will help you install; setup and trouble shoot your GX450 Modem

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Table of Contacts

Introduction:

Congratulations on your purchase of Prairie Precision Network GX 450 RTK modem. This is our 4th generation of RTK network communication devices that work with John Deere Receivers in Canada. Your GX 450 modem allows a John Deere SF6000 receiver to easily and reliably connect to any Internet GPS/GNSS correction source and is managed remotely without any interaction required by the end user.

The goal of this Document is to provide you with an installation guide, technical information and basic troubleshooting. We want to get you started sooner and keep you running longer with less fatigue using PPN RTK corrections.

If you have any questions about this guide, please contact your local PPN reseller for further information
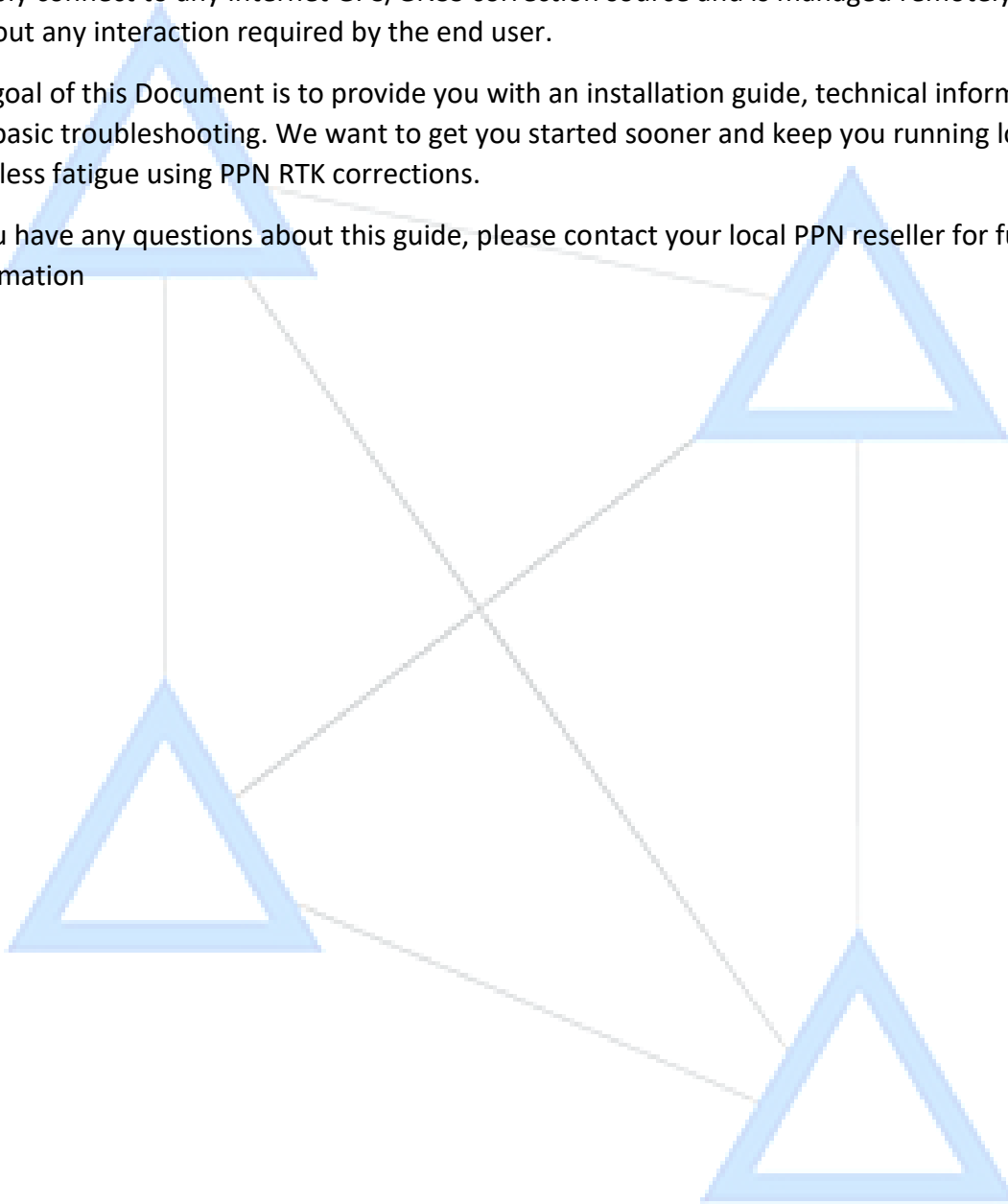
Key Features for a basic user

- LTE, 4G and 3G Connection for the best signal reception in remote areas. Modem can roam on any GSM or CDMA carrier network.
- High performance separate GPS receiver that will typically achieve a position fix in under 10 seconds this way PPN can supply you with an RTK correction signal faster.
- Create an automatic Wi-Fi hotspot so you can use data on other wi-fi enabled devices.
- IP 64 rated, which means GX 450 is dust proof and splash resistant. Modem is also military Spec MIL-STD-810G for shock, vibration, thermal shock and humidity which means it can handle bouncing through a rough field in dusty cab with no problem.

Key Features for an advanced user

- Connects to NTRIP Casters to retrieve DGPS and RTK corrections.
- Connects to direct TCP/IP port streams to retrieve DGPS and RTK corrections
- Supports NTRIP authentication.
- Supports Single Base Corrections and network corrections such as: Geo++'s Pseudo 52 Reference Stations (PRS), Trimble's Virtual Reference Station (VRS), Topcon's Modeled 53 Reference Station (MRS), Geo++'s Flat Plane Correction (FKP), RTCM 3.1's Master Auxiliary 54 Concept (MAC), and Leica's MAX/iMAX.
- Compatible with all external radios and GPS receivers (cables are required).

Disclaimer

While every effort has been made to ensure the completeness and accuracy of this document (GX450 Complete Guide), PPN assumes no responsibility for omission and errors. Nor is any liability assumed for losses or damages resulting for the user of the information contained herein. As with all wireless communication devices and GPS systems, numerous factors affect the availability and accuracy of these systems (e.g. obstructions, interference, system maintenance, availability, etc.).

Therefore, Prairie Precision Network, your cellular provider, your GPS/GNSS corrections provider and even the manufacturer of your GPS system cannot guarantee the accuracy, continuity, or availability of the complete system due to the numerous variables. Being well educated on these many factors will improve your ability to plan, troubleshoot, and overcome these limitations insuring maximum productivity with our equipment. Contact your local PPN reseller regarding education classes on your complete equipment.
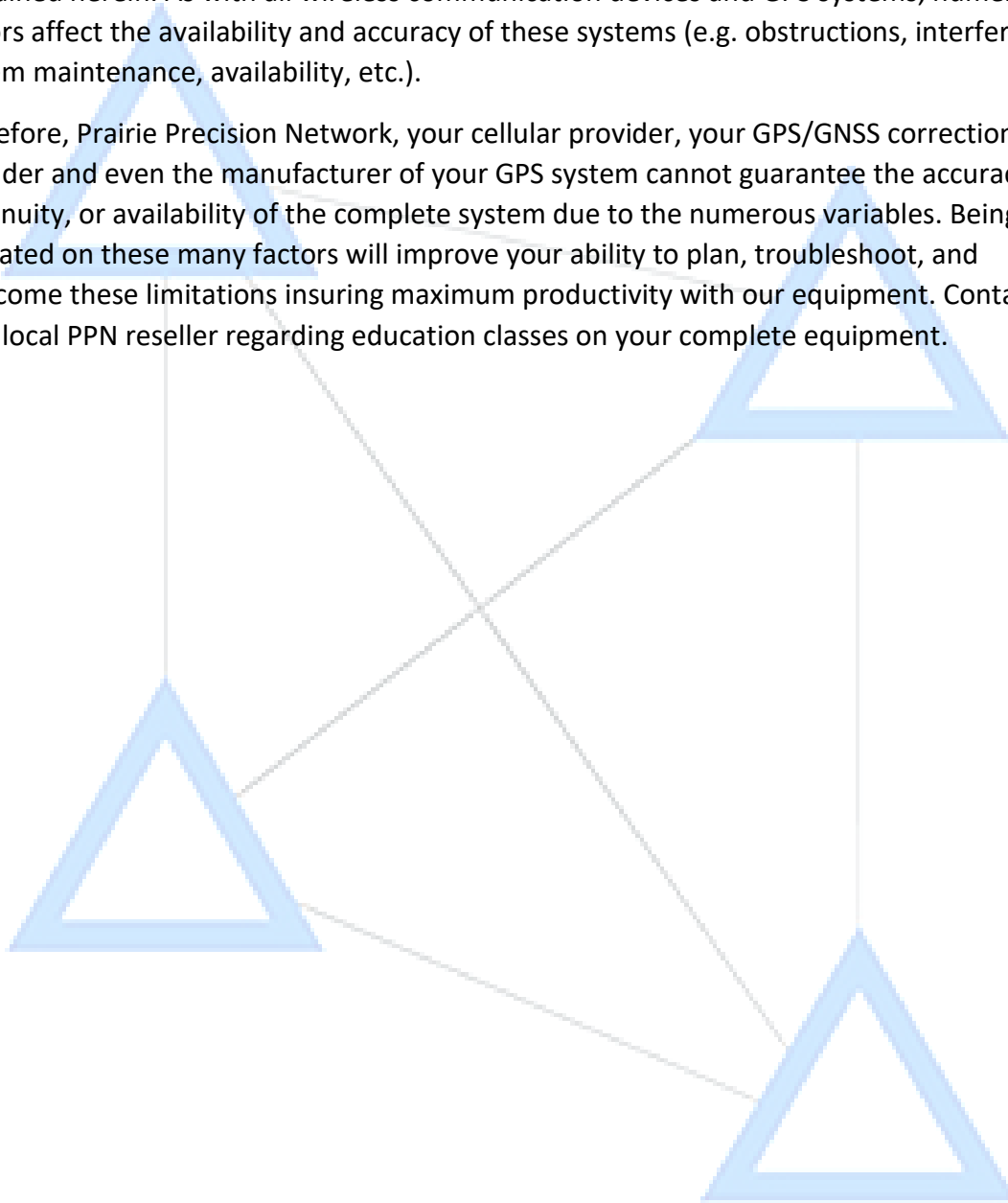
INSTALLATION INSTRUCTIONS

What you need to install and use PPN RTK

- John Deere SF6000/3000 Receiver
- Autotrac Activation
- Standard size SIM card with active data plan
  - If you do not use the Wi-Fi hotspot feature 30-40 MB will be used for RTK network corrections. Means 1-2 GB monthly plan is more than enough.
  - If you use Wi-Fi hotspot feature, usage depends on your other Wi-Fi enabled devices connected to it. We recommend an unlimited plan for no surprises.
- PPN GX-450 and mounting kit (high gain antenna/ gps antenna)
- PPN network subscription

Deciding if you should use a cell booster:

If you are operating in areas of questionable cellular coverage (ex. In a valley, deep depressions or simply an area with weak signal). We strongly suggest using a cellular booster. In valleys the sightlines to GNSS satellites become limited, by reducing the number of satellites used in your positioning solution your dilution of precision (DOP) in your position will increase. This makes it even more important to have timely quality RTK corrections for the remaining satellites used to calculate your position. Using a booster will help keep your cell signal in consistent LTE reception, meaning you have the fastest and most stable RTK corrections available for use in calculating your position. If you are worried about cell coverage talk to your dealer about purchasing a cell booster.

INSTALLING THE HARDWARE

Step 1: Install Standard SIM card into modem

Before you go out to the field or shop to install the system in an implement, you need to install the standard size SIM card with an active data plan into the modem.

1. Remove screws on top of modem and remove the brass nut and washer on SMA connector of front of modem. See figure 1
2. Lift off cover. See figure 2
3. Install SIM card in slot using a standard size SIM. See figure 3
4. Replace the cover, top screws and the brass washer and nut

Note: SIM Card Data Usage, the PPN modem does have a Wi-Fi antenna that can create local hotspots. You can choose to turn this on or off.

- **With Wi-Fi off** you can expect 30-40 mb used for RTK network corrections. This means 1-2 Gb data plan will be enough for this.
- **With Wi-Fi on** usage depends on what you connect to the hotspot.

Figure 1

Figure 2

Figure 3

Step 2: Setup the connections on the roof

Decide where to mount the antenna's: Generally, install mount plates on the RH and LH sides of the cab roof bolts and attach the GPS and High gain cell antennas to them respectively. **See figure 4**. read the following information if you can not conform to this setup.

>**High gain cell antenna:** Most high gain antennas require a "Ground Plane" for optimal operation. If you're not using the provided antenna please refer to your antenna's documentation on the size of the plane, generally bigger is safer. Mounting the antenna as high and as perpendicular to the surface as possible is ideal.

>**External GPS Antenna:** PPN must know the approximate position of the modem to provide RTK corrections. The main requirement for the GPS antenna is that it has a **clear view of the sky** and is **located at least a foot away from the high gain cell antenna**. The high gain cell antenna will cause interference with an unshielded external GPS antenna. The longer it takes for the Modem to achieve a GPS fix, the longer it will take to start receiving RTK corrections. The GX450 **Power light will Flash Amber/Green when the modem has achieved a GPS fix.**
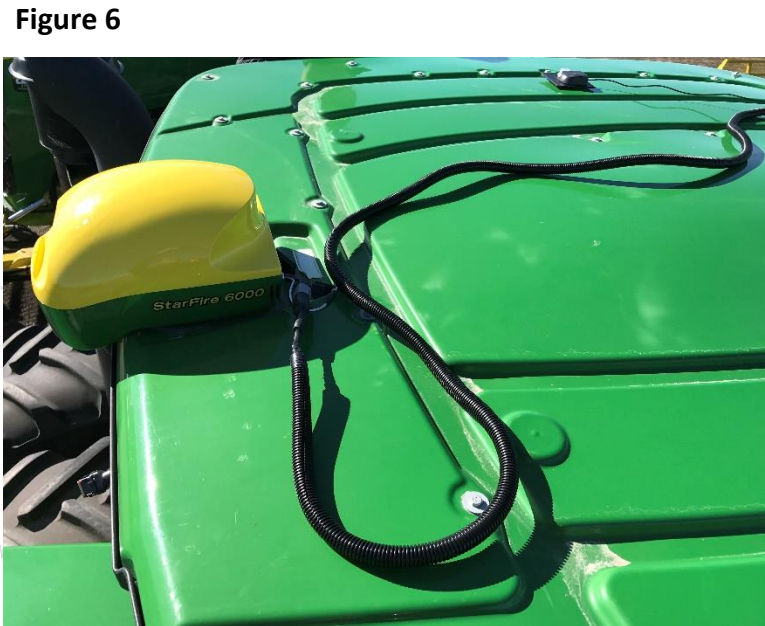

External GPS antenna

High gain cell antenna

Figure 4

Connect the modem harness to the SF receiver: Run the Modem harness (Figure 5) through the back-rubber grommet and connect it to the SF receiver and close the receiver (Figure 6)

Figure 5

Figure 6

Step 3: Mount and connect the modem in the cab

1. Modem **MUST** be installed inside the cab
2. Attach the Modem to the Cab bracket (see figure 7 & 8)
3. Attach the: High gain cell antenna, GPS antenna and modem harness to the back of the modem (see figure 9)
4. Mount the cab bracket to the back-corner post of the cab with M8x20 bolt and washer (see figure 10)

Figure 7 (Cab bracket)

Figure 8 (Modem on Cab bracket)

Figure 9

Figure 10
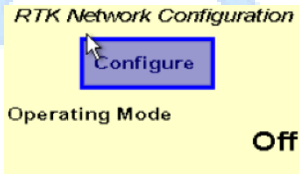

Cell

GPS   **SF Receiver**

Note: The serial connection to the SF receiver has some play in it and will occasionally come loose even when it is threaded in from vibrations/etc. If there is trouble this serial cable connection is a good one to check first.

Step 4: Tidy up the cables: Congratulations all the PPN hardware is where it is supposed to be. Now you can make it look as good as you like. I recommend tying the cables together until they are on the roof of the cab. It makes the system look nice and clean.

SETUP THE SOFTWARE

This is an example of what to do. It will vary depending on the display and its firmware. Talk to your local dealer if you need assistance setting up RTK.

1. Press

2. Press

3. Press

4. Press the Receiver on a tripod

5. Press Configure, to access the network RTK configuration

6. Select the box under "Operating Mode" that will say "OFF" and set this to "Vehicle"

Select vehicle
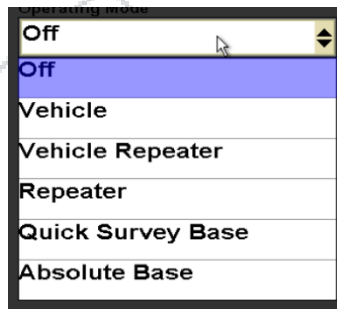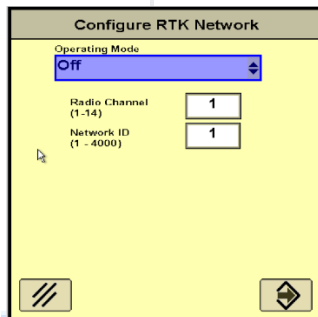
7. You will be returned to the "Configure RTK Network screen. Leave the Radio and Channel ID at "1" then press

8. Your now ready to go,

   Screen should look something like this
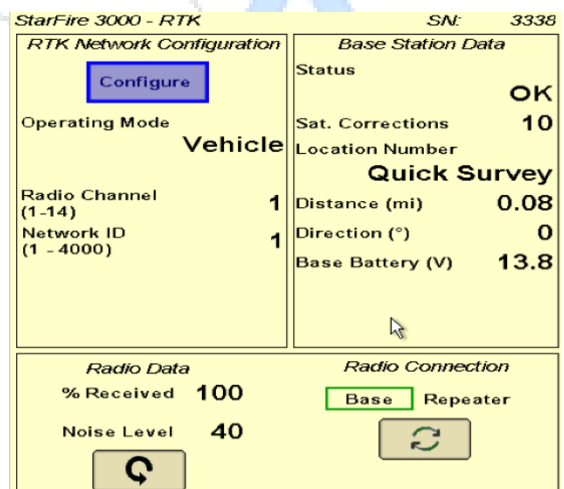
Checking RTK Status

1. Press to view more information on the RTK Status

2. If you are in a sparse area of the network, the Deere receiver may take a little longer to initialize to an RTK solution

3. Correction age gives an indication of RTK network coverage. If this starts to count up your vehicle is moving out of network coverage.

4. PDOP is a calculation of the overall quality of your GNSS solution. The lower the number the better your solution. This number entirely depends on satellite geometry and how many satellites are visible
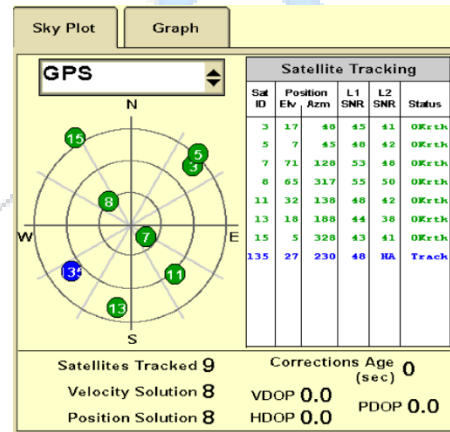
RTK Homepage (Starfire – G)

When properly connected to the PPN RTK Network you will typically see 50% data received and likely a distance around 9.2 miles or less to the base station. The Data received % will vary based on the network providers Hz rate. DO NOT WORRY, 30% to 100% are all the same. Deere duplicates the RTK correction message 10x to improve performance in poor RF environments. So there is no loss in accuracy between 10% and 100%. Values less than 30% will cause some systems to switch between base and repeater in some firmware versions.
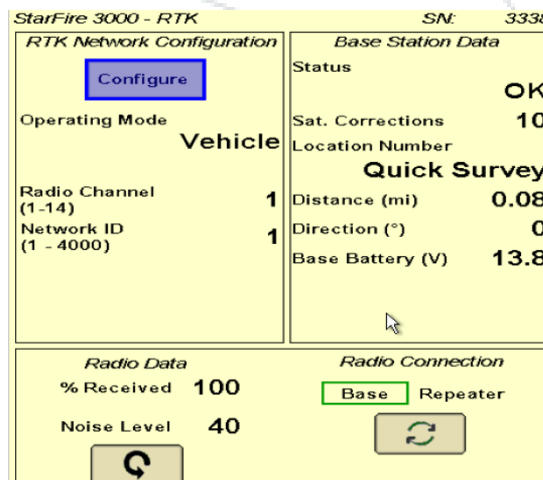
Starfire Homepage (Starfire – F)

1. The main Starfire page will show the current Position Mode as well as your accuracy and GPS Signal%
2. These values may change depending on the day, but should remain around 90 – 100% if you are within proper RTK network coverage
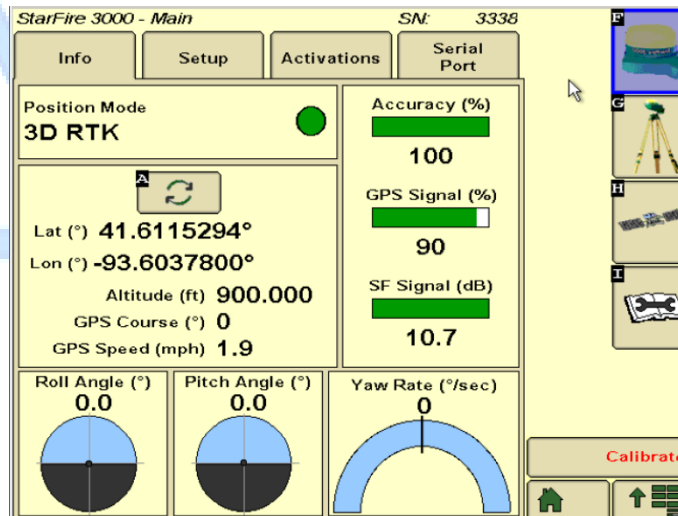
RTK Diagnostics (I)

1. Press while in the Starfire menu to enter diagnostics menu

2. For RTK select the dropdown in the middle of the page and choose RTK System to be taken to the RTK diagnostics menu
3. First line shows the firmware version and the letter behind the firmware version shows your system status
   - X: no cell or WiFi connection
   - C: Cell or WiFi connected but no RTK data
   - N: Receiving RTK data and everything is good
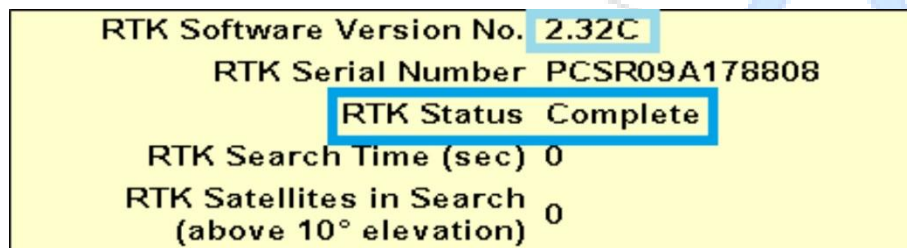
4. Only the last 6 digits of the RTK serial number relates to the PPN Modem serial number. In this case 178808 are the last 6 digits of the PPN modem, the rest of the RTK Serial Number does not correspond to anything

Power-up and Reboot:

On power-up or reboot, all LEDs turn red, then amber, then green. They then go through a blinking sequence that ends with the Power LED green and all the other LEDs off. Once the rest of the LEDs resume normal behaviour the power-up or reboot is complete.

Power light behaviour (Shows if you have a GPS fix)

OFF	No power supplied between 36 VDC and 9 VDC
Solid Green	Modem is connected to power and has finished power up
Flashing Amber/ Green	Modem has a GPS Fix, and can receive RTK corrections
Solid Red	Gateway is not operational (failed or low power mode)

Signal light Behaviour (shows how strong your cell signal is)

Solid Green	Good cell signal (better than -85 dBm)
Solid Amber	Marginal cell signal (between -85 dBm and -100 dBm)
Solid Red	Poor cell signal (worse than -100 dBm)
Flashing Red	No cell signal reception

Network light Behaviour (Shows if you are connected to a cellular provider)

Solid Green	Receiving LTE from your provider
Flashing Amber/Green	Receiving 3G from your provider
Flashing Amber	No cellular service from provider available
Solid Amber	Currently connecting to the cellular network
Solid Red	SIM card error or there is no cell network.

Activity light Behaviour (shows if modem is talking with receiver/ PPN server)

Flashing Red	Modem is talking with SF receiver (being developed)
Flashing Green	Modem is using cell data (Indicates talking to PPN server)
Flashing Amber	The modem is using cell data and talking to the SF receiver at the same time. (being developed)

Normal operation of the LED Indicators when receiving RTK corrections

- **Power light will be Flashing Amber/ Green** (means modem has a GPS fix so we can send the right RTK corrections to you, check the PPN GPS antenna connection if this is not flashing after the modem has finished booting up)
- **Signal light solid Green or Amber** (means you have a decent cellular signal)
- **Network light solid green or flashing amber/green** (there are other behaviours of these lights regarding network roaming, but this is what you should see)
- **Activity light flashing red, green and occasionally amber**, this feature is currently under development and should be finished soon. Currently the activity light only flashes green.

Cellular Connection

One of the most difficult problems with network RTK is the need to maintain a reliable and constant cellular connection. While LTE networks have helped improve speed and coverage, your first check when diagnosing RTK is cellular connection. There are a few ways to check your cellular connection.

Check with the display:

You can quickly check your connection by looking at the noise level on the RTK homepage. Optimal operating range is between 60-90. The lower the number the better signal you have.
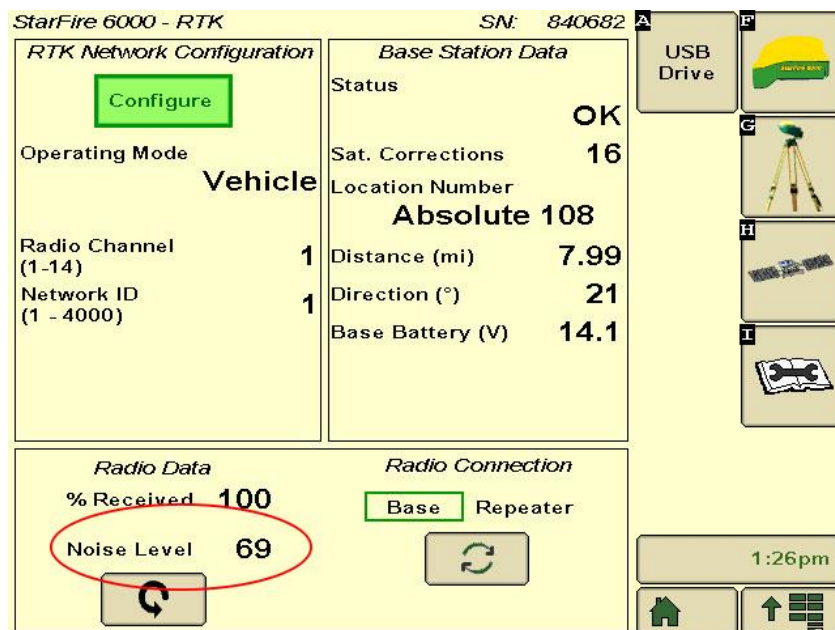
Ensure all Connections are secure:

Make sure All connections between the PPN modem and antenna are tight. Check to make sure the Antenna base is tight and any set screws on the antenna whip are tight as well.

Check using modem status light indicators:

See appendix A, the signal light should be solid green or amber

Check through the GX450 admin tool:

Your dealer has access to a tool that allows them to see a variety of information about your modem remotely. Please contact them and they will be able to assist you.
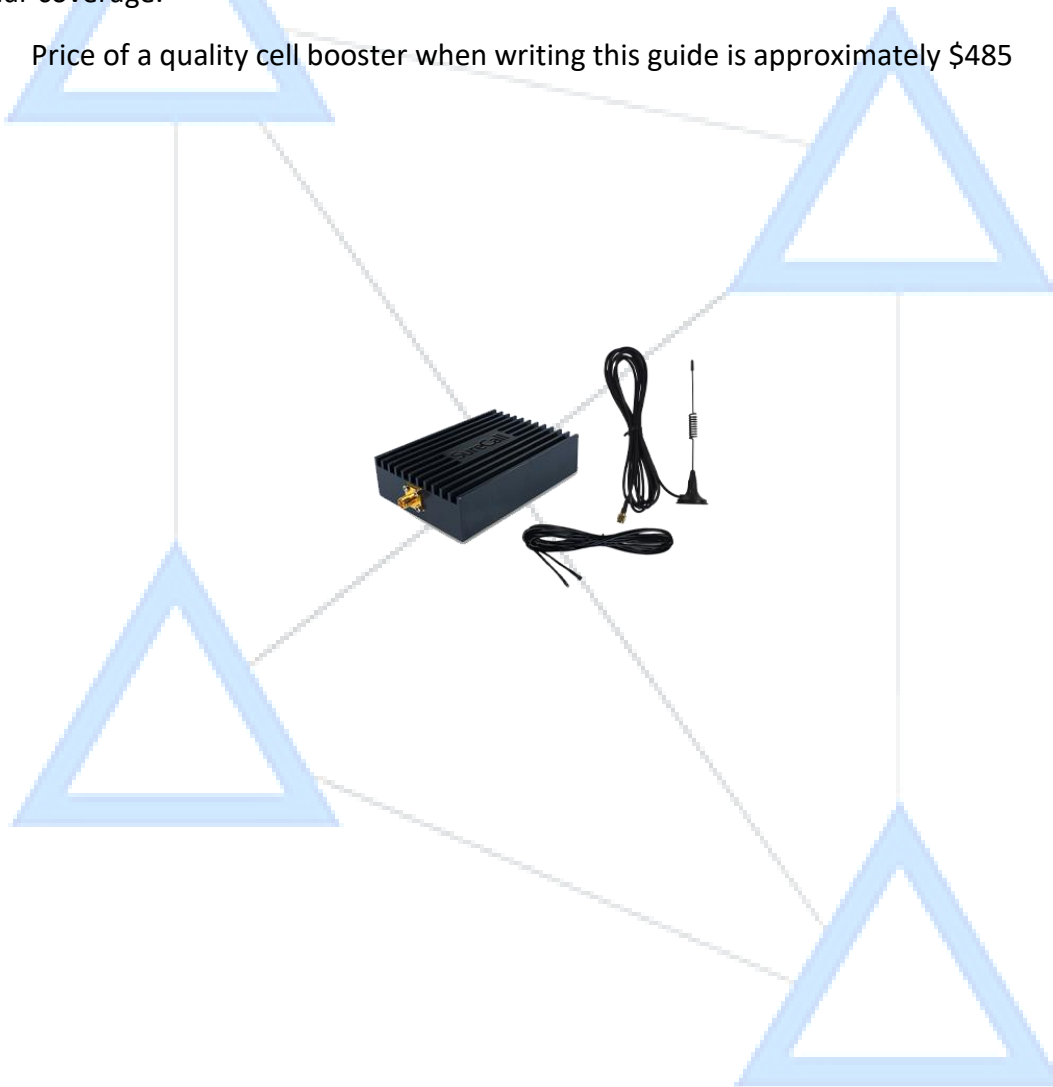
Still unhappy with the connection?

If you are still entering RTK-X often, you should purchase and install a cellular amplifier. See appendix C

If you've checked all the connections on your modem and are dropping to RTK-X a little more often than you like, or you see the signal light solid red at times. Consider purchasing a cellular amplifier.

Here at PPN we carry a very good 'direct connect' amplifier. We only recommend using a direct connect amplifier with our PPN RTK system. Direct connect amplifiers experience less signal loss and latency when compared to alternative booster types. We change the model we supply regularly to stay current, so you can be confident your have one of the best 'direct connect' boosters on the market to cruise through areas with weak cellular coverage.

Price of a quality cell booster when writing this guide is approximately $485

	Specification		Specification
CELLULAR WAN	North American Model (Sierra Wireless MC7354) • Carrier Approvals: Verizon, AT&T, Sprint, T-Mobile USA, US Cellular, Rogers, Bell, Telus • Supported Frequency Bands - LTE: 1900(B2), AWS(B4), 850(B5), 700(B13), 700(B17), 1900(B25) - WCDMA: 2100(B1), 1900(B2), AWS(B4), 850(B5), 900(B8) - EV-DO/CDMA: 800(BC0), 1900(BC1), 1700(BC10) - GSM/GPRS/EDGE: Quad-band • Industry Approvals: FCC, IC, PTCRB • SIM Interface (2FF) International Model (Sierra Wireless MC7304) • Supported Frequency Bands - LTE: 2100(B1), 1800(B3), 2600(B7), 900(B8), 800(B20) - WCDMA: 2100(B1), 1900(B2), 850(B5), 900(B8) - GSM/GPRS/EDGE: Quad-band • Industry Approvals: CE, RCM, GCF, R&TTE • Automatic SIM based network operator switching • SIM Interface (2FF)	SECURITY	Remote Authentication (LDAP, RADIUS and TACACS+) DMZ Inbound and Outbound Port filtering Inbound and Outbound Trusted IP MAC Address Filtering PCI DSS V3.0 compatible
		SATELLITE NAVIGATION (GNSS)	12 Channel GPS and GLONASS Receiver Acquisition Time: 1s Hot Start Accuracy: <2m (50%), <5m (90%) Tracking Sensitivity: -145dBm GNSS Watchdog Reports: NMEA 0183 V3.0, TAIP, RAP, XORA Multiple Redundant Servers Reliable Store and Forward
		EVENTS ENGINE	Custom event triggers and reports Configurable interface, no programming Event Types: Digital Input, Network Parameters, Data Usage, Timer, Power, Device Temperature Report Types: RAP, SMS, Email, SNMP Trap, TCP (Binary, XML, CSV) Event Actions: Drive Relay Output
HOST INTERFACES	10/100 Base-T RJ45 Ethernet port (Ethernet option includes 3 ports) RS-232 Serial Port on DB-9 Connector (I/O option includes additional Serial Port) USB 2.0 Client (Micro-B Connector) 3 SMA antenna connectors (Primary, Secondary/Diversity, GPS) Active GPS antenna support	AIRLINK MANAGEMENT SERVICE	Secure cloud-based device management application Remote provisioning and airtime activation Gateway configuration and template management Configurable monitoring and alerting Over the air software and radio module firmware updates Auto configuration
INPUT/OUTPUT	Configurable I/O pin on power connector • Digital Input ON Voltage: 3.3 to 30 VDC • Digital Input OFF Voltage: 0 to 1.2 VDC • Digital Output > 200mA @ 30VDC I/O Model Only • 5 configurable digital I/O • 4 configurable analog input (input voltage 0 to 30 VDC) Vehicle Telemetry • OBD-II with Telemetry Accessory Kit (requires Serial Port)	MANAGEMENT INTERFACES	Web-Based User Interface Device Configuration Templates Over-the-air software and radio module firmware updates AT Command Line Interface (Telnet/SSH/Serial) SMS Commands SNMP
		APPLICATION FRAMEWORK	ALEOS Application Framework (AAF) LUA Scripting Language Eclipse-based IDE Integrated with AirVantage®
LAN (ETHERNET/USB)	DNS, DNS Proxy DHCP Server IP Passthrough VLAN Host Interface Watchdog PPPoE	POWER	Analog Ignition Sense and Power Management Input Voltage: 9 to 36 VDC Low Power mode triggered on low voltage, timer delay (ignition sense), or periodic timer
SERIAL	TCP/UDP PAD Mode Modbus (ASCII, RTU, Variable) PPP Reverse Telnet Garmin FMI	ENVIRONMENTAL	Operating Temperature: -30°C to +70°C / -22°F to +158°F Storage Temperature: -40°C to +85°C / -40°F to +185°F Humidity: 90% RH @ 60°C Military Spec MIL-STD-810G conformance to shock, vibration, thermal shock, and humidity IP64 rated ingress protection
WI-FI	On Wi-Fi Model Only • IEEE 802.11 b/g/n • Adjustable output power (Max:15dBm) • Access point for up to 8 clients • Simultaneous access point/client mode • WEP, WPA-PSK, WPA2-PSK Security	INDUSTRY CERTIFICATIONS	Safety: IECEE Certification Bodies Scheme (CB Scheme) UL 60950 Vehicle Usage: E-Mark (2009/19/EC), ISO7637-2 Hazardous Environments: Class 1 Div 2 Environmental: RoHS, REACH, WEEE
NETWORK AND ROUTING	Network Address Translation (NAT) Port Forwarding Host Port Routing NEMO/DMNR VRRP Reliable Static Route Dynamic DNS	SUPPORT AND WARRANTY	3 year standard warranty Optional 2 year warranty extension Unrestricted device software upgrades 1-day Accelerated Hardware Replacement available through participating resellers
VPN	IPsec, GRE, and SSL VPN Client Up to 5 concurrent tunnels Split Tunnel Dead Peer Detection (DPD) Multiple Subnets VPN Failover	DIMENSIONS	142 x 98 x 41 mm (5.6 x 3.9 x 1.6 in) 397g (14oz.)