



# Real Time Kinematic

## VALUE GUIDE (US, Canada, Australia & New Zealand)

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**CLICK THE ARROW TO GET STARTED**



# Real Time Kinematic Value Guide



## John Deere Real Time Kinematic Capabilities

This guide is designed to help you learn about John Deere's Real Time Kinematic (RTK) products. Depending on your location, John Deere offers a variety of RTK options. RTK provides +/- 2.5 centimeters (1 inch) accuracy for producers requiring precision accuracy for their farming needs.

This guide highlights the value and performance of John Deere's RTK products, along with information you can use as you sell this product to producers visiting your dealership. It also provides you with the locations on how to find information on how to install, use and remove the system.



# Real Time Kinematic Value Guide Menu



**Theory of Operation**



**Features & Benefits**



**Crop Applications**



**Base Stations**



**Components,  
Subscriptions &  
Activations**



**Resources**

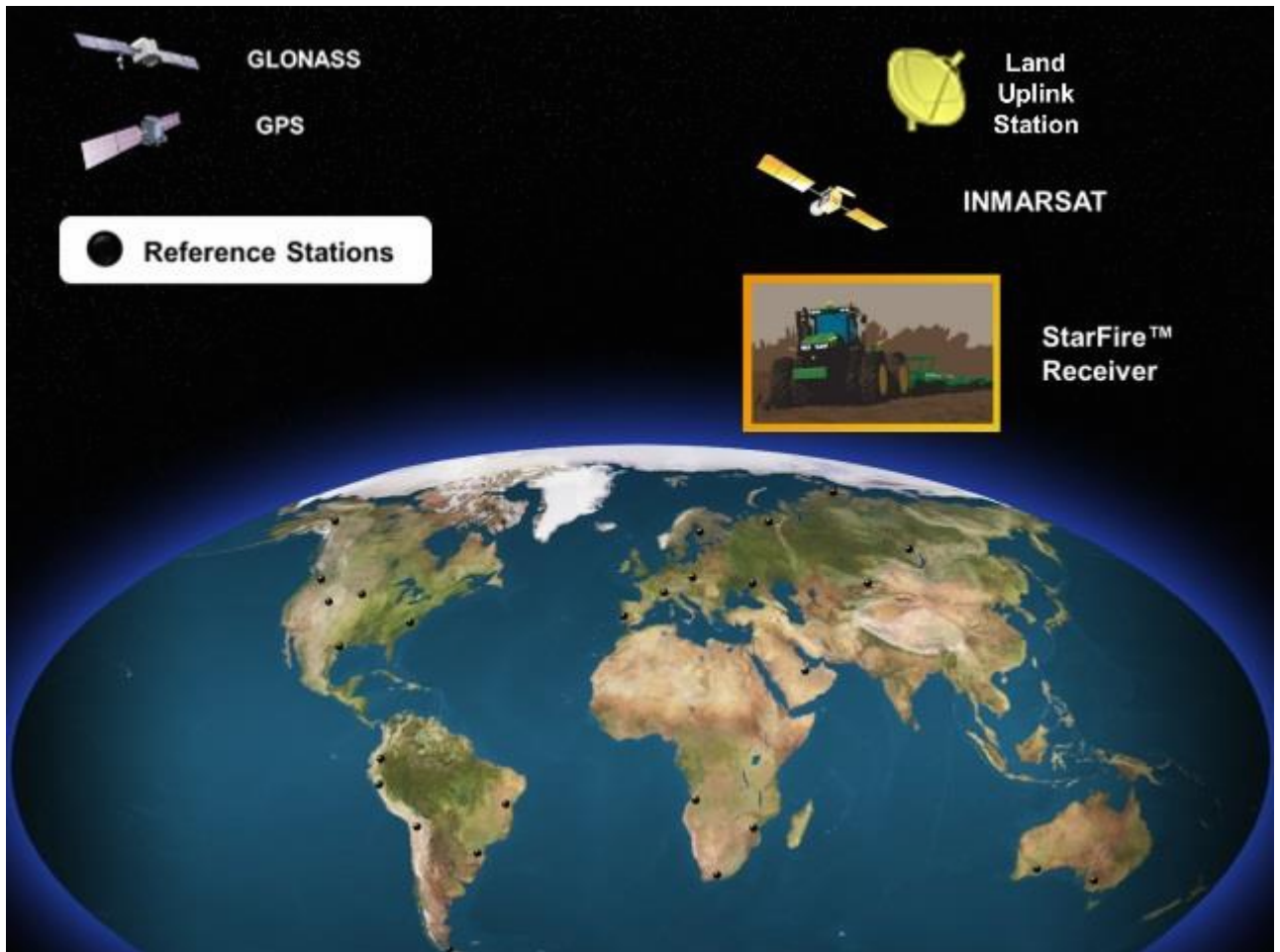


**Frequently Asked Questions**

***Please choose a section, then use the arrows below to learn about John Deere's Real Time Kinematic (RTK) product.***



# Theory of Operation (1 of 5)



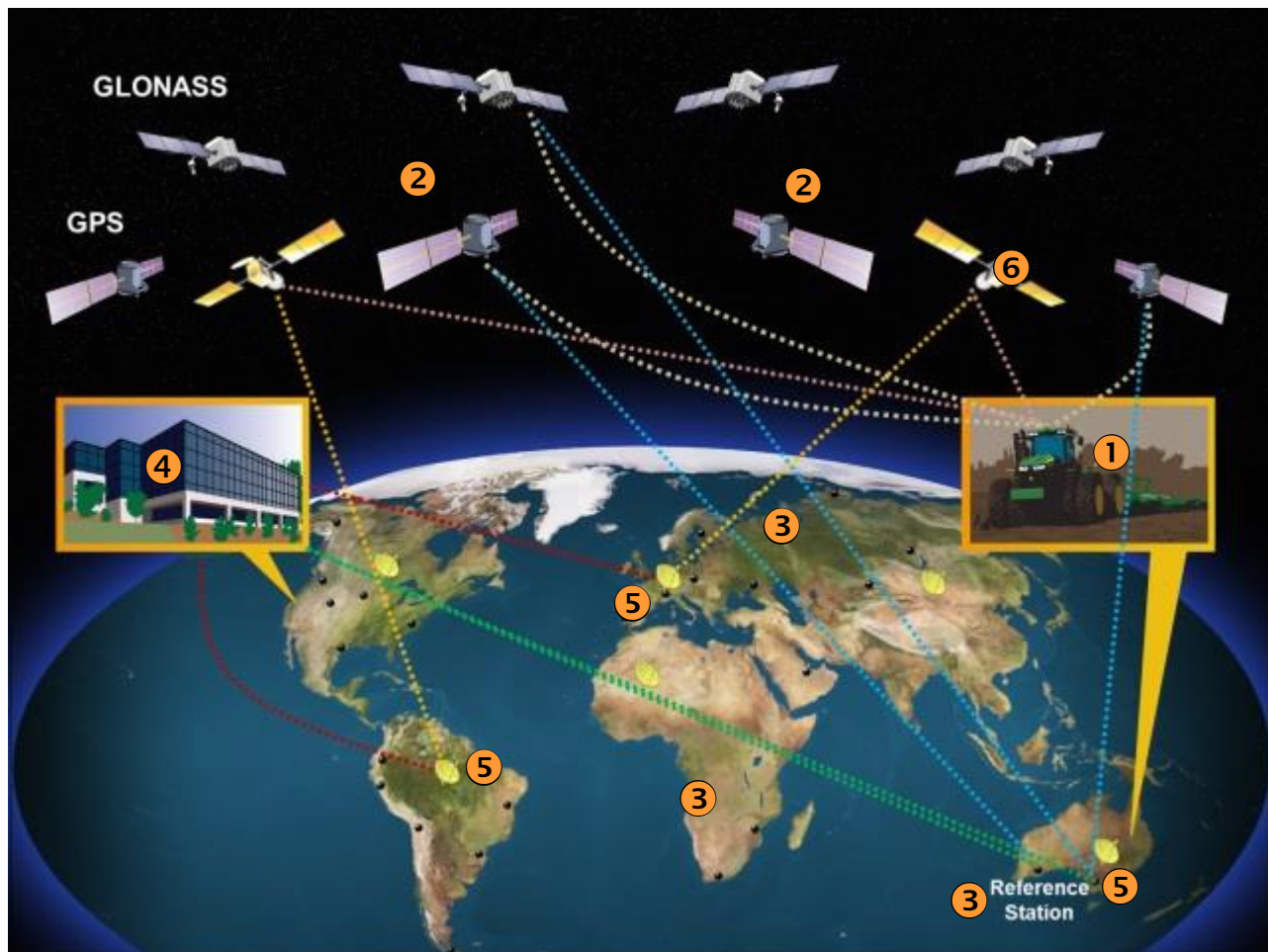
The backbone of precision agriculture & RTK is John Deere's StarFire™ Network. Without it, producers are unable to achieve the precision and accuracy they need.

Six components make up John Deere's StarFire™ Network:

1. GLONASS/GPS satellite constellations
2. Up to 60 Reference Stations
3. Two John Deere Processing Hubs
4. Six Land Uplink Stations
5. Six INMARSAT Satellites
6. A StarFire™ Receiver with the proper activations & subscriptions attached to a machine



## Theory of Operation (2 of 5)



During operation, the StarFire™ Receiver ① picks up satellite information from the GPS and/or GLONASS satellite constellations ②. At the same time, Reference Stations ③ pick up the same signal that the machine's StarFire™ Receiver ① picks up from the satellite constellations ②. These stations record each satellite's path, then send that information to one of two John Deere Processing Hubs ④. The Processing Hubs take the Reference Station information and create mathematical equations to correct the drift of the constellation's satellites. Once created, the Processing Hubs ④ send that data to Land Uplink Stations ⑤ which transmit those correction equations to the INMARSAT satellites ⑥. The INMARSAT satellites send the corrections to the StarFire™ Receiver ①.

The satellite signal information & corrections provide SF1 or SF2 level accuracy depending upon receiver activation. SF1 provides an accuracy level of +/- 23 centimeters (9 inches) while SF2 provides an accuracy level of +/- 5 centimeters (2 inches).



## Theory of Operation (3 of 5)



Most John Deere dealers offer radio RTK to achieve the +/- 2.5 centimeters/1 inch accuracy\* required by many producers.

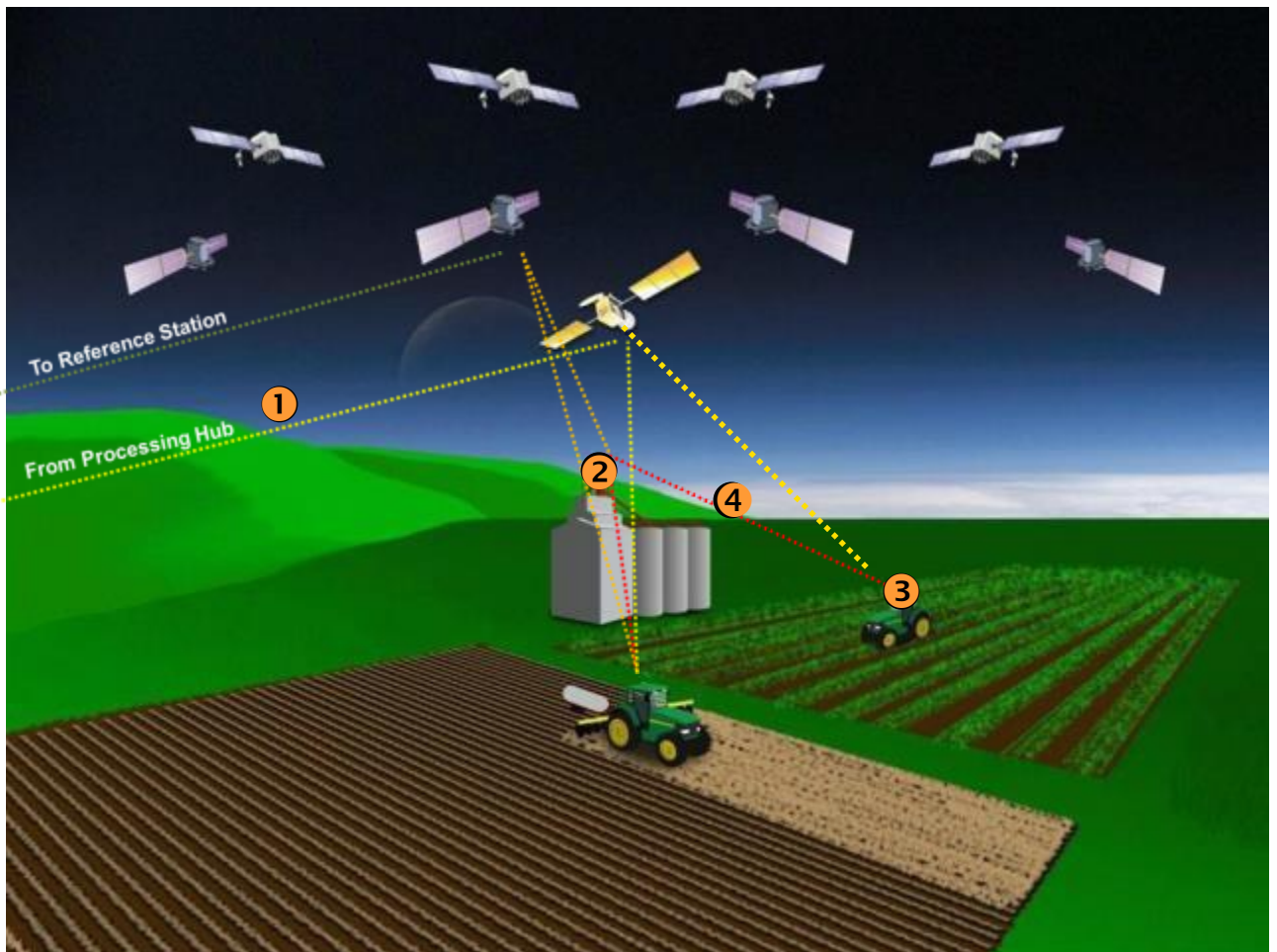
Along with the StarFire™ network this radio based RTK system utilizes the following components. A:

- ① Local, ground-based reference station or base station.
- ② StarFire™ receiver and John Deere radio transmitter connected to the producer/dealer owned base station.
- ③ Base Station Power Source
- ④ John Deere receiving radio connected to the StarFire™ receiver on the machine with the proper RTK activations and subscriptions.

\* Radio RTK accuracy is maintained within a 12 mile radius of the base station.



## Theory of Operation (4 of 5)

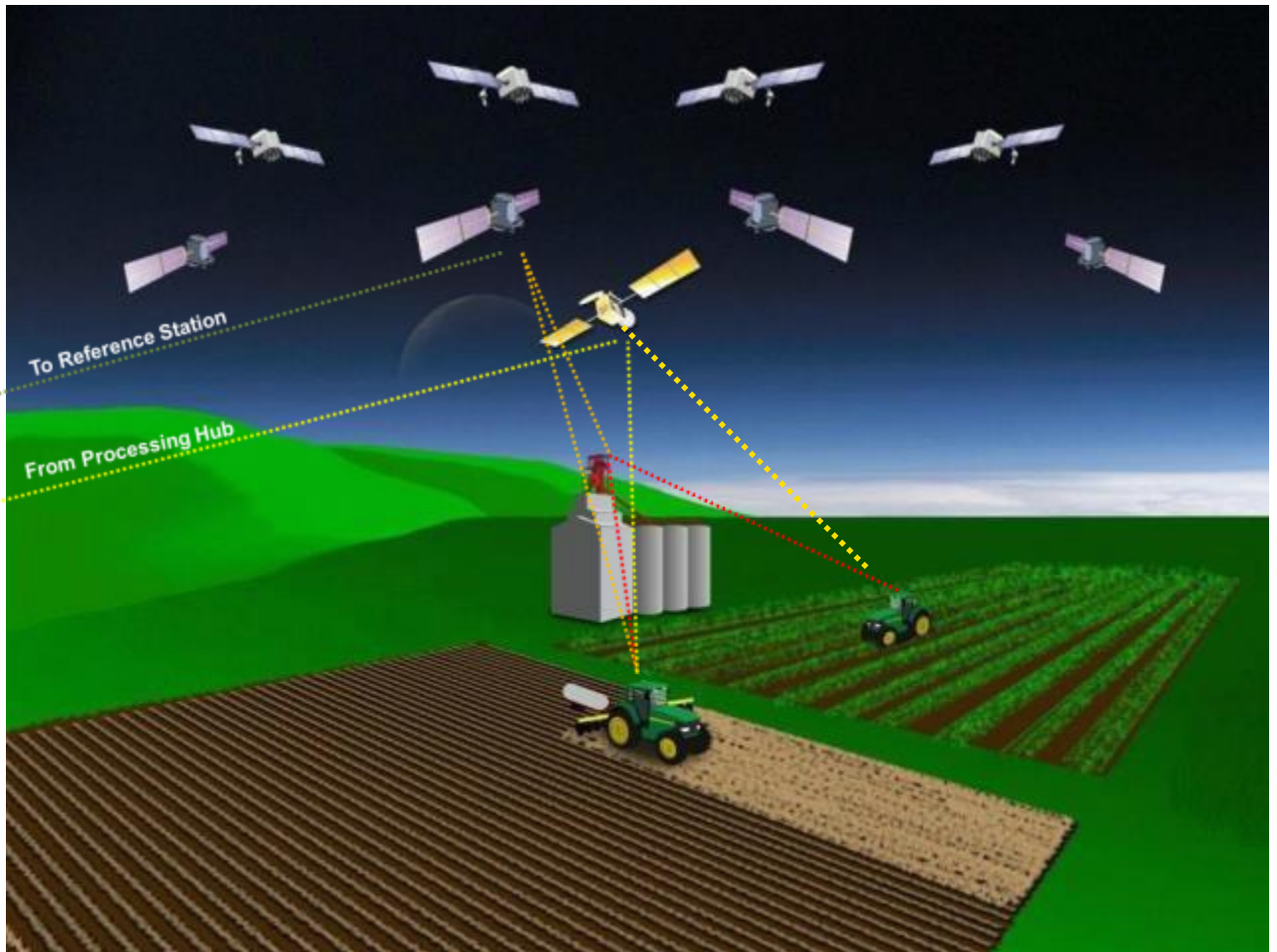


The StarFire™ Network ① sends an SF2 signal to the base station's StarFire™ Receiver ② & the machine's StarFire™ Receiver ③. The base station further refines the SF2 signal to account for local variances in atmospheric & environmental conditions (i.e. magnetic fields, variances in solar activity, etc.).

The base station ② transmits a highly-accurate satellite correction ④ from the RTK radio transmitter to the machine's StarFire™ receiver via the receiving radio. This satellite correction virtually eliminates most if not all satellite drift as well as the local atmospheric & environmental conditions. It also may provide a highly repeatable position depending on the kind of base station in use.



# Theory of Operation (5 of 5)



In order for radio RTK to work correctly the machine & base station must:

1. First see a minimum of the same five satellites for start up and a minimum of the same four satellites during operation.
2. There must be a direct line of sight between the radio transmitter on the base station and the radio receiver on the machine.

Radio RTK:

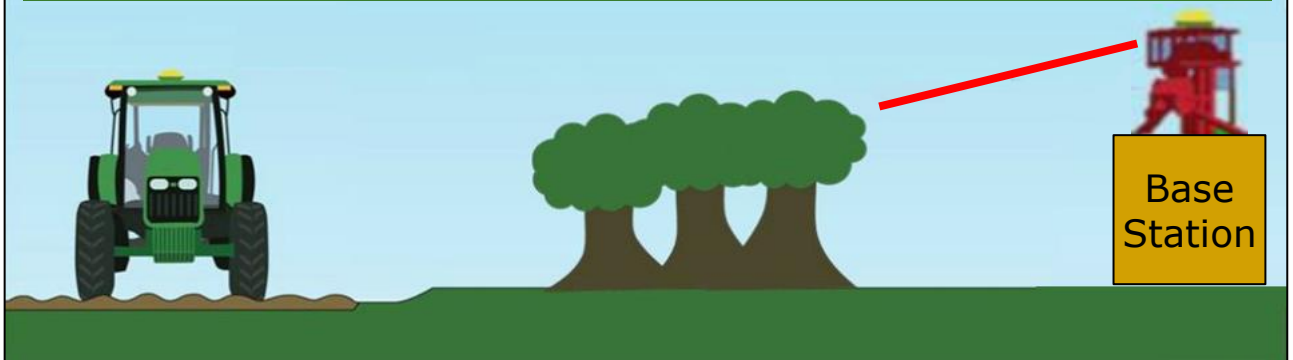
- Provides highly accurate corrections of +/- 2.5 centimeters (1 inch) up to a 20 kilometer/12 mile radius of the base station (depending on setup and topography).
- May have the 20 kilometer (12 mile) radius reduced due to topographical changes & vegetation.





## Features & Benefits (1 of 4)

- RTK switches to RTK Extend when a producer's machine loses the RTK correction signal for more than 10 seconds.
- RTK Extend runs for up to 15 minutes



No matter the RTK option used, producers may use RTK Extend, a John Deere industry exclusive feature.

RTK Extend helps producers when their machine occasionally loses the RTK correction signal from the base station due to topographical anomalies like trees, mountains, hills or buildings

RTK may switch to the RTK Extend mode when the machine loses contact with the radio correction signal for more than 10 seconds.

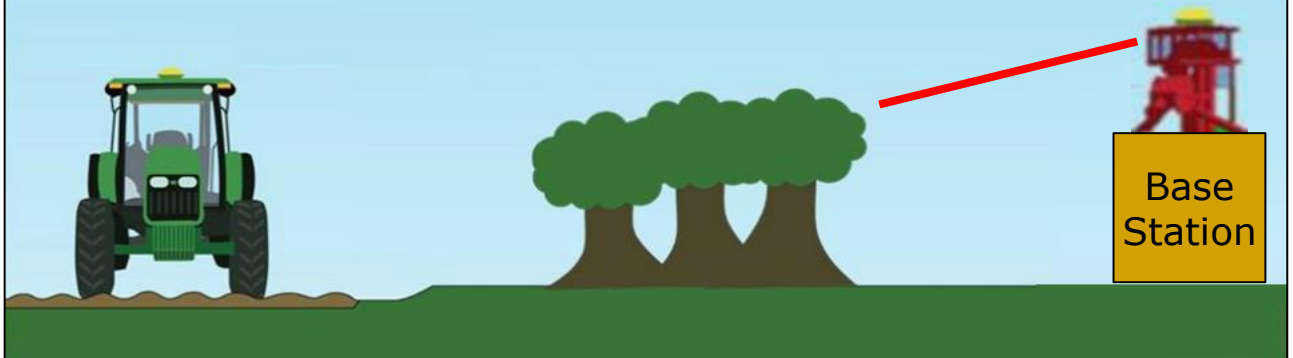
RTK Extend runs for a maximum of 15 minutes for radio RTK.



## Features & Benefits (2 of 4)

- RTK Extend shifts to SF2 when it times out if producers enable SF2 on their GreenStar™ display.
- RTK operates in SF2 mode for up to two weeks/14 days without an SF2 subscription.

**CAUTION** – SF2 does not equal RTK accuracy.



RTK Extend automatically shifts to SF2 when RTK Extend times out if the producer enables SF2 on the GreenStar™ display. SF2 operates without the need for a producer to purchase an SF2 subscription for up to two weeks/14 days after RTK Extend times out.

A word of caution on the switch to SF2...SF2 does not equal the RTK accuracy of +/- 2.5 centimeters (1 inch). Producers who require RTK accuracy for effective operations should not use this capability.

However, SF2 provides an accuracy level of +/- 5 centimeters (2 inches). This accuracy level allows producers the option to continue operation in AutoTrac™ mode for applications such as tillage or broad-acre spraying.

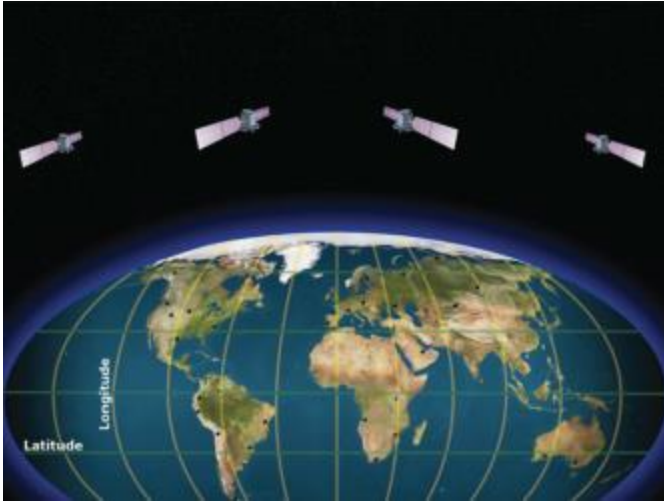


# Features & Benefits (3 of 4)

Accuracy and Repeatability sets RTK apart from SF1 and SF2 corrections.

## Accuracy

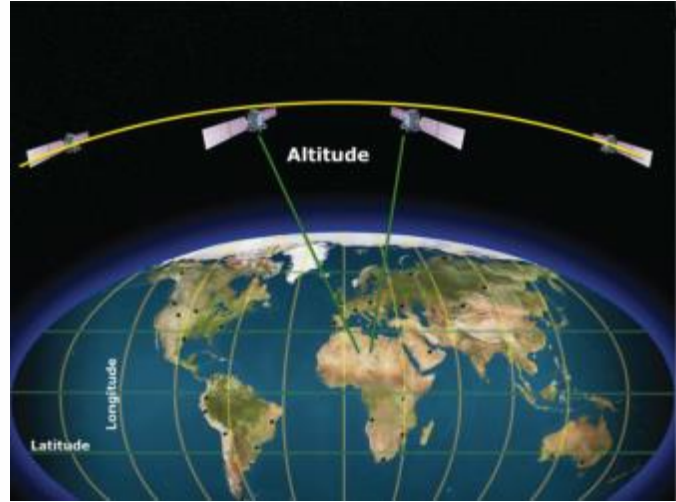
RTK operates in both a horizontal and a vertical plane. Within these two planes, the dimensions of Latitude, Longitude & Altitude are factored into RTK operation.



### Horizontal Accuracy

Horizontal Accuracy encompasses latitude and longitude. By using the latitude and longitude measurements, John Deere's advertised horizontal accuracy is +/- 2.5 cm (1 inch) pass to pass over a 15 minute period at 20 km (12 miles) from the base station, assuming correct base station setup.

**Note:** Horizontal RTK accuracy increases when machines operate closer to a base station. This occurs because both the machine's environment and the base station's environment better match each other.



### Vertical Accuracy

Vertical Accuracy encompasses the remaining dimension of altitude. Altitude is important for land and water management products that require vertical accuracy as a primary function.

To achieve a consistent vertical accuracy of +/- 4 cm (2 inches) or below, Radio RTK must be used with a base station no farther than 1.6 km (1 mile) from the machine. As a general rule, error in the vertical plane is double of what can be expected of the horizontal plane.



## Features & Benefits (4 of 4)

Accuracy and Repeatability sets RTK apart from SF1 and SF2 corrections.

### Repeatability



Producers using RTK, can guarantee the same A-B guidance lines year in and year out from season to season no matter what the condition.

For example, potato producers require RTK repeatability to increase crop yield. Because satellite-based guidance systems drift every minute of every day, RTK removes drift from the equation. No matter when producers operate the machine and implement in the field, it always travels on the same guidance lines.



# Crop Applications (1 of 2)



## Standing Row Crops

- Producers who plant corn, beans, cotton, and many other row crops use RTK to improve the accuracy of their seeding, plant husbandry, spraying and harvest operations, thus reducing costs.



## Bedded Crops

- Certain crops need to be planted in a built up bed of soil. This bed helps manage moisture and prevents erosion. Bedded plants require a higher level of guidance, accuracy, or repeatability. RTK allows the producer to create and follow straight beds.



## Controlled Traffic

- Controlled traffic farming is a practice that is quickly gaining support. It allows the machine and implements to use the same tracks for as many operations as possible. Producers who use controlled traffic farming may see increased yields due to lower soil compaction, lower horse power requirements and reduced fuel costs. With RTK the producer travels over the same path from year to year.



## Crop Applications (2 of 2)

### Relay Intercropping



- Relay intercropping is the practice where producers plant two or more crops in the same field. For example, producers plant soybeans in the rows between wheat so that they can produce two crops during the same crop year. Without the precision and accuracy of RTK, the wheat and soybeans may restrain the growth of each other.

### Strip Tillage



- With input costs increasing, many producers are using strip tillage. Because this farming method requires exact placement of the seed and fertilizer in the appropriate soil or tillage zone, RTK is the perfect tool to help gain the full advantages of strip tillage.

### Drip Irrigation



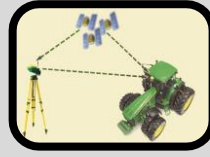
- Many producers who irrigate reduce their irrigation expenses by installing drip-tape irrigation lines. To properly access the water, producers have to plant the seeds next to the drip-tape. Without RTK, producers run the chance of having inconsistencies in width across a field. To compensate for that producers may have to set 50 or more A/B lines per field. RTK allows producers who use drip tape to set the lines once & reference them the following years.



# Base Stations



**Types**



**Base  
Station  
Setup**

***Please choose a section, then use the arrows below to learn about John Deere's Real Time Kinematic (RTK) product.***



# Base Station Types (1 of 2)

There are two types of base stations used for Radio RTK



## Quick Survey Base Station

A Quick Survey base station is a movable station.

Producers use this kind of base station when they need +/- 2.5 cm (1 inch) accuracy and DO NOT need to store implement and machine guidance tracks for future use.

Producers can also use a quick survey base station when they are not within range of an absolute survey base station.



## Absolute Survey Base Station

An Absolute Survey base station is permanently mounted to a fixed position, such as a building or post mounted into concrete.

Some producers own absolute survey base stations.

However, the most common absolute survey base station is part of a dealer owned network. Producers who require the exact location of guidance tracks for future guidance applications should use the absolute survey base station.

Absolute survey base stations normally have an increased coverage area because they are mounted higher than quick survey base stations.





# Base Station Types (2 of 2)

Dealers and producers have the option to secure access to a base station.



**Quick Survey Base Station**



**Absolute Survey Base Station**

## **A public base station:**

- Does not restrict RTK enabled machines from receiving correction signals as long as the machine has the same network ID as the base station.
- Is great for conducting an RTK demo for potential customers, field days and other demonstrations of the technology.

## **A secure base station:**

- Allows RTK enabled machines that have a serial number entered into the base station receiver to receive correction signals.
- Can have up to 300 machines entered into each base station.



# Base Station Setup (1 of 2)

Take the following three considerations into account when selecting a base station locations



## Rigidity

Because the base station provides RTK corrections to the machine's StarFire™ SF2 ready receiver that is RTK activated, it's important to attach the base station to a fixed and sturdy position.

Any motion of the base station impacts the machine's accuracy. Base station motion may be caused by a number of factors including wind, expansive soil types which allow receivers to move with a change in soil moisture and buildings that expand unevenly with temperature changes during the day.



## Good View of the Sky

Because the satellite constellations orbit the earth and send data to the base stations, they need to have a clear view of the sky. Base stations with a good view of the sky are much more reliable.

For example, installing an absolute survey base station on the side of a radio tower or a Quick Survey base station next to a grove of trees is not recommended.



## Avoid Reflective Objects

Take care to keep the base station away from metal buildings and structures, chain link fences and bodies of water.

These objects reflect the satellite signals and make the base station less reliable.



# Base Station Setup (2 of 2)

Correct base station setup is vital to proper operation. Incorrect set-up can result in two issues:



**Shading**

Shading occurs when the RTK base station and StarFire™ receiver do not have a clear view of the sky in all directions above 5 degrees off the horizon.

If the RTK base station is unable to see a shaded satellite, none of the machines operating on that base station will be able to use that satellite.

Trees, buildings, towers, poles and grain elevator legs can cause shading.



**Multipathing**

Multipathing happens when an object close to the base station reflects the GPS and/or GLONASS satellite transmissions.

This reflection causes a temporary inaccurate measurement at the receiver.

Metal buildings and roofs, chain link fences, vehicles parked too close to a quick survey base station and bodies of water can cause multipathing.



# Components, Subscriptions & Activations



**Quick Survey  
Base Station**



**Absolute Survey  
Base Station**



**Machine**

***Please choose a section, then use the arrows below to learn about John Deere's Real Time Kinematic (RTK) product.***



# Quick Survey Base Station



## StarFire™ Receiver\*

- 450 MHz\*\* and/or or 900 MHz Radio
- 30 cm/12 inch Antenna (Standard)
- High Gain Antenna (Optional)
- Tripod or universal receiver mount



## Power Source

- Battery
- Base Station Harness



## Activations (One time access fee):

- RTK
- SF2 Ready

\* StarFire™ 3000 and/or newer receivers.

\* StarFire™ iTC Receiver

\*\* Requires an operating license from a governing authority



# Absolute Survey Base Station



## StarFire™ Receiver\*

- 450 MHz\*\* and/or or 900 MHz radio
- 30 cm/12 inch Antenna (Standard)
- High Gain Antenna (Optional)

## Power Source



- Requires a continuous DC 12V, source supplied with a standard 110V/220V connection.
- Use a 3 AMP power source (with battery backup) for:
  - 450 MHz
  - 900 MHz
- Use a 10 AMP power source for:
  - 450 MHz (with amplifier)
  - Dual 450 MHz (with amplifier) and 900 MHz base station
  - Dual 450 MHz and 900 MHz base station



## Amplifier (optional 450 MHz only)

- Requires a DC 12V 10 Amp source.
- Does not require battery backup.



## Cables

- RS232 to connect the radio to the StarFire™ Receiver when placing the radio in a different location than the receiver.
- Base Station Extension Harness



## Activations (One time access fee):

- RTK
- SF2 Ready

\* StarFire™ 3000 and/or newer receivers.

\* StarFire™ iTC Receiver

\*\* Requires an operating license from a governing authority



# Machine



## StarFire™ Receiver\*

- 450 MHz or 900 MHz Radio
- 30 cm/12 inch Antenna (Standard)
- High Gain Antenna (Optional)



## GreenStar™ Display

- GreenStar™ 2 1800\*\*
- GreenStar™ 2 2600\*\*
- GreenStar™ 3 CommandCenter
- GreenStar™ 3 2630
- Gen 4 CommandCenter



## Activations (One time access fee):

- SF2 Ready Activation
- RTK Activation for the StarFire™ 3000 Receiver
- AutoTrac™ Activation for the GreenStar™ Display.



## Subscriptions (On-going annual fee)

- RTK Subscription (Dealer Managed) to allow access to a John Deere Dealer Radio Network

\* StarFire™ 3000 and/or newer receivers.

\* StarFire™ iTC Receiver

\*\* Currently supported, no software updates planned.



# Resources

## Dealer Corner on Stellar Support:

- ❑ [https://stellarsupport.deere.com/StellarSupport/en\\_US/Dealer/](https://stellarsupport.deere.com/StellarSupport/en_US/Dealer/)
- ❑ The Information and Updates section on this page lists numerous, current resources to help keep you up-to-date with RTK information.

## StarFire RTK Activation:

- ❑ [http://stellarsupport.deere.com/en\\_US/products/starfire\\_rtk/](http://stellarsupport.deere.com/en_US/products/starfire_rtk/)
- ❑ This page lists a number of resources to keep you up-to-date on RTK and RTK related information including:
  - ❑ Technical Publications
  - ❑ The StarFire Configurator
  - ❑ StarFire Network links

## Ag Sales Manual:

- ❑ [http://dlrdoc.deere.com/sales/salesmanual/en\\_NA/ams/2014/subcategory/displays\\_receivers.html](http://dlrdoc.deere.com/sales/salesmanual/en_NA/ams/2014/subcategory/displays_receivers.html)

## Quick Reference Guide:

- ❑ [http://stellarsupport.deere.com/en\\_US/support/pdf/qrg/en/PFP10073\\_450mhz.pdf](http://stellarsupport.deere.com/en_US/support/pdf/qrg/en/PFP10073_450mhz.pdf)

The screenshot shows the John Deere website's 'Sales Manual' page for '2014 Displays, Receivers, and RTK'. The page features a navigation bar with 'Home', 'Announcements', 'Archives', 'Attachments Search', 'Help', and 'Feedback'. Below the navigation bar, there is a search box and a dropdown menu for 'Go to other model year/series...'. The main content area includes a paragraph about the GreenStar™ 3 family of displays and the GreenStar™ 2 1800 Display, and another paragraph about the StarFire™ family of receivers. There are also sections for 'Marketing Tools' with links to 'Manuals', 'Animations', 'Support', and 'Calculators'. The page is divided into four columns: 'Displays' with links to 'GreenStar 2 1800 Display' and 'GreenStar 3 2630 Display'; 'Receivers' with a link to 'StarFire 3000 Receiver'; 'RTK Corrections' with links to 'John Deere RTK Activation', 'John Deere RTK Radio 450', and 'John Deere RTK Radio 900'; and 'Gen 4 CommandCenter' with a link to '4100 to 4600 CommandCenter™ Upgrade'. The John Deere logo is visible in the top right corner.





## Frequently Asked Questions (1 of 2)

### **What is a better solution for me, 900MHz or 450MHz?**

This will depend on the topography which you will be performing your application. If you are in relatively flat terrain with few trees, a 900MHz network will likely meet your needs. With a 450MHz network, you still need line of sight, but you are able to transmit signal through thick trees and foliage. You are also legally allowed to amplify this signal, as long as you approved for a license through the FCC. It is not legal to amplify 900MHz signal.

### **What is the difference in the range at which this signal will transmit?**

Even though the signal is capable of transmitting further distances, it will get weaker at outer extremities. RTK accuracy (+/-1" or 2.5 cm) and repeatability is only advertised within a 12 mi (20km) range. This is true for 900 or 450MHz systems.

### **My base station went down in a lightning storm, are the components warrantable or able to be fixed?**

No, damage to the RTK equipment, caused by lightning (or in most cases, physical damage), will not be covered by warranty. These will need to be processed through an insurance claim. It is always recommended to use proper John Deere harnessing and grounding equipment to minimize the potential for lightning (or electric surge) related failures. If you are in an area of high lightning activity, you will want to consult with a local communication company for additional protection.

### **Why do I get varying levels of accuracy and or data received throughout the year?**

As the Earth and the Satellites rotate, this can affect the quality of signal that the base is receiving. If you'd be experiencing multi-pathing or shading at the base station, this degraded data can get processed and transmitted to the rovers. This can affect all, or one rover, depending on the orientation. To minimize the possibility of this, you'll want to install the Base Receiver (and/or GPS Antenna) in an unobstructed area, and pointed toward the equator (this allows for higher percentage of satellite signal). Your RTK antenna should be mounted on a different vertical plane than any other antenna's in the area.



## Frequently Asked Questions (2 of 2)

### **How high do I need to mount the antenna to get out 12mi (20km)?**

You will need line of site, so it will depend on the terrain. In 450MHz networks, many people think that they can amplify the signal at a lower height, and transmit through dirt. This is not the case. It will be more important to have height (or a repeater) if you are trying to get signal over a hill. If you are in flat terrain, but contending with trees, you can likely achieve your goals with an amplifier.

### **Why don't I get signal at the outer extremities?**

It is likely that you do not have enough power at the base. This can be a result of failing power supply, faulty harness connections (corrosion), or the wrong gauge wire for transmitting longer distances.

### **How do I diagnose issues with the radio?**

Please reference the Quick Reference Guide:

[http://stellarsupport.deere.com/en\\_US/support/pdf/qrg/en/PFP10073\\_450mhz.pdf](http://stellarsupport.deere.com/en_US/support/pdf/qrg/en/PFP10073_450mhz.pdf)

