RX370P

INSTALLATION MANUAL

TeeJet® TECHNOLOGIES

A Subsidiary of Spraying Systems Co.®

RX370P

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CHAPTER 1 INTRODUCTION

The RX370p is a smart antenna that tracks GPS and SBAS (WAAS and EGNOS) signals. The RX370p provides sub-meter performance with 4.9 ft (1.5 m) accuracy 95% of the time. It utilizes COAST™ technology during differential outages. The RX370p is also capable of using e-Dif® and L-Dif® technology.

FEATURES

The RX370p has several new features that will enhance the product's performance.
The primary features include:

- 2 RS232 serial ports
- LED
- Radar-simulated pulse output
- CAN communication

LED

The RX370p uses one tri-colored LED:

- *Red* indicates the power is on
- *Amber* indicates a GPS lock
- *Flashing Green* indicates DGPS is being acquired
- *Green* indicates a DGPS solution

Radar-Simulated Pulse Output

The radar-simulated pulse output provides accurate ground speed. The RX370p uses pin 12 for the speed out pin. Pin 12 will output a square wave with a 50% duty cycle. The frequency of the square wave varies directly with speed. 94 Hz represents a speed of 1 meter per second, or a 28.65 pulse per foot traveled.

NOTE: Pin 12 does not have any form of isolation or surge protection. It is STRONGLY RECOMMENDED to incorporate some form of isolation circuitry into the supporting hardware if Speed Radar Pulse output is to be utilized.

CAN

The RX370p features Controller Area Network (CAN) to handle communication between CAN-based devices. The RX370p supports a selection of NMEA 2000 messages that can be broadcast on a CAN bus. The following table provides a listing of the NMEA 2000 commands that are used.

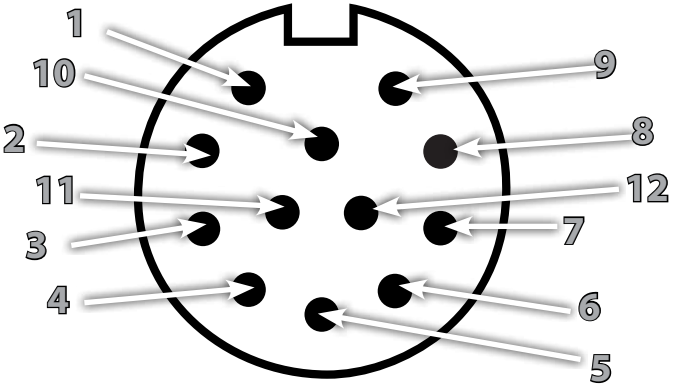
Table 1-1: NMEA 2000 Commands

PNG 129029	GNSSPositionData
PNG 129025	GNSSPositionRapidupdate
PNG 129026	NMEACogSogData

INSTALLATION

The following figure provides a front view of the Deutsche connector receptacle's numbering.

Figure 1-1: Deutsche Connector Receptacle Numbering



The following table provides the Deutsche connector's pin-outs.

Table 1-2: Deutsche Connector's Pin-Outs

Pin-Out	Function	Pin-Out	Function
1	Manual mark in	7	One PPS
2	TxB	8	RxA
3	RxB	9	CAN Low
4	CAN High	10	Power in (12V)
5	Signal Ground	11	Power Ground
6	TxA	12	Speed Out

The RX370p is preset to the following settings:

Port A 4800 Baud, GGA 1 Hz, VTG 1 Hz

Port B 19200 Baud, GGA 5 Hz, VTG 1 Hz

Cable Interface

The cable options include:

- DB9 Serial
- Speed
- CAN
- Power

Additional extension cables may be purchased, as necessary, for other installations. This allows the RX370p to be quickly and easily moved from one installation to another. If an extension cable is damaged in the field, it can be replaced without returning the complete RX370p system.

Extension Power/Data Cable

The RX370p system is quickly installed with one of the various extension cables. When choosing aroute for the RX370p extension cable:

- Avoid running cables in areas of excessive heat
- Keep cables away from corrosive chemicals
- Do not run the extension cable through door or window jams
- Keep cables away from rotating machinery
- Do not bend excessively or crimp the cables
- Avoid placing tension on the cables
- Remove unwanted slack from the extension cable at the receiver end
- Secure along the cable route using plastic ties or wraps

WARNING! Cables improperly installed near machinery can be dangerous.

RX370p Placement

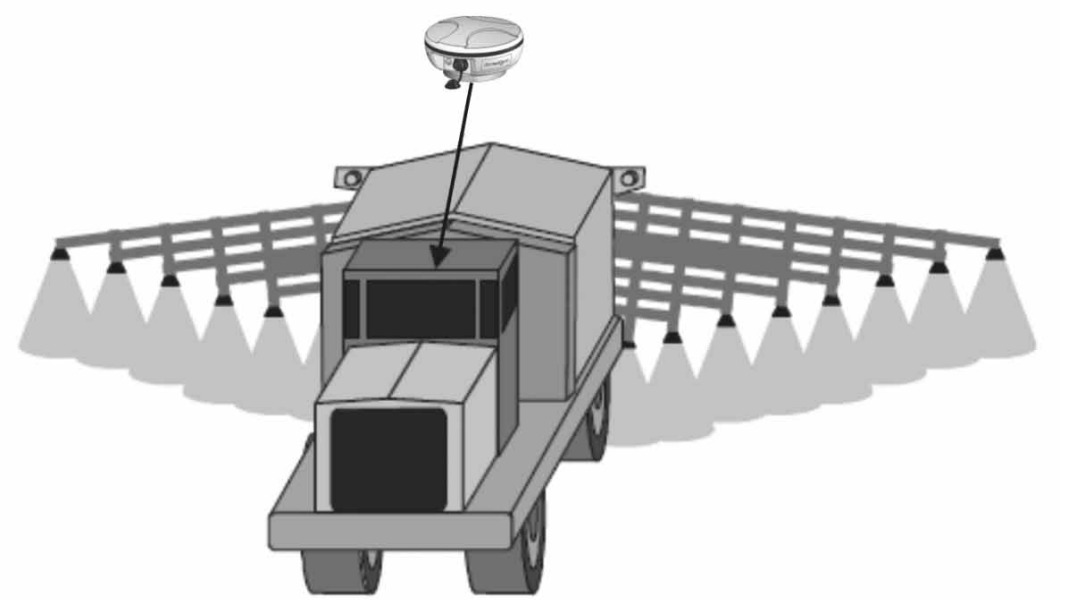
Placement of the RX370p is crucial to the system's operation. The GPS engine inside the RX370p computes a position based upon measurements from each satellite to the internal GPS antenna unit. Mount the RX370p to the identified point of interest. When choosing a location, make certain there is an unobstructed view of the sky available to the smart antenna. This will ensure that the GPS satellites are not masked by obstructions, which can potentially reduce system performance.

To place the RX370p:

1. Mount the RX370p on, or as close to the center of the point of measurement.
2. Position the RX370p as high as possible.

The following illustration provides an example of the ideal location for vehicle placement.

Figure 1-2: RX370p Vehicle Placement



MOUNTING

The RX370p can be mounted in several ways Magnetic Mount, Surface Mount or Pole Mount.

Magnetic Mount

The magnetic mount can be screwed into the bottom of the RX370p and mounts to metal surfaces. A metal disc and foam adhesive are included with each magnetic mount. Use the foam adhesive to bond the metal disc to the desired mounting location if there are no metal surfaces. To use the metal disc and foam adhesive:

1. Clean and dry the mounting surface on the vehicle.
2. Remove the backing from one side of the foam adhesive and press the metal plate onto the mounting surface on the vehicle.
3. Remove the backing from the other side of the foam adhesive.
4. Press the metal plate onto the mounting surface of the vehicle.
5. Apply firm pressure to ensure good adhesion.
6. Place the RX370p on top of the metal disc.

Surface Mount

As an alternative to the magnetic mount, the antenna is easily attached to the surface with fourmachine screws (not included). To surface mount the antenna:

1. Photocopy the bottom of the antenna and use it as a template to plan the mounting hole locations, or use the template located in Appendix C of this document.

WARNING! Make sure the photocopy is scaled ONE TO ONE with the mounting holes on the bottom of the antenna!

2. Mark the mounting hole centers as necessary on the mounting surface.
3. Place the antenna over the marks to ensure that the planned hole centers agree with the true hole centers. Adjust as necessary.
4. Use a center punch on the hole centers in order to guide the drill bit.
5. Drill the mounting holes with a 3/16 in (4.7625 mm) bit appropriate for the surface mount.
6. Place the antenna over the mounting holes and insert the mounting screws through the bottom of the mounting surface and into the antenna.

WARNING! Install the antenna only hand-tight. Damage resulting from overtightening the antenna is not covered by warranty.

Pole Mount

The center thread of the antenna is 5/8 in (15.875 mm) for compatibility with a survey pole (notincluded).

POWERING THE RX370P

Connect the RX370p to a TeeJet Technologies guidance system or a 12 volt DC source with a power connector. Refer to Appendix D for illustrations. Choosing the appropriate connector will depend on specific installation requirements.

NOTE: It is recommended that a weather-tight connection and connector be used if the connection will be located outside.

WARNING! Be careful not to provide a voltage higher than the input range. This will damage the antenna.

The RX370p accepts an input voltage between 7 and 36 VDC via the cable. For best performance, the supplied power should be continuous and clean.

WARNING! Do not apply a voltage higher than 36 VDC. This will damage the receiver and void the warranty.

The RX370p features reverse polarity protection to prevent excessive damage if the power leads are accidentally reversed. With the application of power, the RX370p will automatically proceed through an internal start-up sequence. However, it will be ready to communicate immediately.

NOTE: The initial start-up can take from 5 to 15 minutes depending upon location.

NOTE: The RX370p can take up to five (5) minutes for a full ionospheric map to be received from SBAS. Optimum accuracy will be obtained once the RX370p is processing corrected positions using complete ionospheric information.

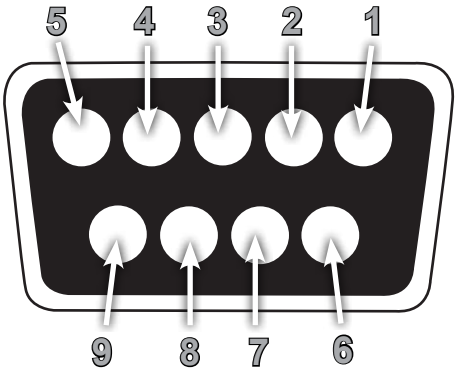
EXTERNAL DEVICE CONNECTIONS

The serial ports of the RX370p operate at the RS-232C interface level to communicate with external data loggers, navigation systems, and other devices. The serial ports are accessible via the extension cable that features a DB9 female data connector. The serial ports are also used for firmware updates.

NOTE: For successful communication, the baud rate of the RX370p serial port must be set to match that of the devices to which they are connected.

The following figure illustrates the numbering for the extension cable's DB9 socket connector (female). The associated numbering for the plug connector (male) is a mirror reflection of the scheme illustrated.

Figure 1-3: DB9 Socket Numbering



NOTE: Other pins on the serial ports may be active depending on the optional cable selection.

Table 1-3: Extension Cable Pin-Out, DB9

Pin Number	Function
2	Transmit RX370p NMEA 0183, binary and RTCM
3	Receive RX370p NMEA 0183, binary and RTCM input
5	Signal Ground

Factory Parameters

Table 1-4: DGPS Options

Application	
Application 1	SBAS (WAAS, EGNOS, etc.)
Application 2	e-Dif (unsubscribed)

Table 1-5: Serial Port Settings

Serial Port	Baud Rate	Data Bits	Parity	Stop Bits	Interface Level
Serial Port A and B	4800	8	None	1	R2-232C
	9600	8	None	1	R2-232C
	19200	8	None	1	R2-232C
	57600	8	None	1	R2-232C

Table 1-6: GPS Message Output Options

GPS Message	Update Rate	Max GDPS Age	Elavation Mask
GPS Binary	From 1 Hz to 20 Hz	259,200 seconds	5°
NMEA 0183	From 1 Hz to 20 Hz	259,200 seconds	5°
NMEA 2000 (CAN)	From 1 Hz to 20 Hz	259,200 seconds	5°

The CAN port will automatically output the NMEA 2000 messages according to Figure 1-10.

Table 1-7: NMEA 2000 Commands

NMEA 2000 Message	Function
GNNSPositionData	1 Hz
GNNSPositionRapidUpdate	20 Hz with updates based on the subscribed rate (i.e., every other message will be a copy of the previous on a 10 Hz receiver)
NMEACogSogData	20 Hz with updates based on the subscribed rate (i.e., every other message will be a copy of the previous on a 10 Hz receiver)

Custom Configuration

All aspects of the RX370p may be configured through the serial port with the use of GPS commands. The user can configure the following items:

- Selecting one of the two on-board applications
- Selecting the baud rate
- Choosing which NMEA 0183 data message to output on the dual serial ports and the update rate of each message

NOTE: The changes made to the RX370p will not be saved to memory for subsequent power-up unless a save command is issued.

NOTE: Contact your local TeeJet Technologies dealer for information regarding the use of GPS commands to customize configuration.

Environmental Considerations

The RX370p is designed to withstand various outdoor environments. However, there are specific environmental limits that should be met when using the RX370p. Refer to Appendix B for additional information.

CHAPTER 2 GPS OVERVIEW

For operator convenience, both the GPS and differential correction of the RX370p are pre-configured. The receiver will work out of the box, and for most applications, little user setup is required. When powered for the first time, the RX370p will perform a “cold start” which involves acquiring the available GPS satellites in view and the SBAS differential service.

GPS OPERATION

The GPS engine is always operating, regardless of the DGPS mode of operation. The following sections describe the general operation of the RX370p’s internal GPS engine.

Automatic Tracking

The GPS engine within the RX370p automatically searches for GPS satellites, acquires the signals, and manages the navigation information required for positioning and tracking. This is a hands-free mode of operation.

Receiver Performance

The RX370p works by finding four or more GPS satellites in the visible sky and uses the information those satellites provide to compute an appropriate position (typically within 7-10 ft (2-3 m).) Since there is some error in the GPS data calculations, the RX370p also tracks a differential correction. The RX370p uses these corrections to improve its position to less than 3 ft (1 m).

There are two main aspects of GPS receiver performance:

- Positioning
- Satellite acquisition quality

GPS is essentially a timing system. When the RX370p is properly positioned on the vehicle, the satellites transmit coded information to the antenna in a specific frequency that allows the receiver to calculate a range to each satellite. The ranges are calculated by timing how long it takes for the GPS signal to reach the GPS antenna.

The GPS receiver uses a complex algorithm incorporating satellite locations and ranges to each satellite to calculate the geographic location. Reception of any four or more of these signals allows a GPS receiver to compute 3-dimensional coordinates.

Differential Operation

The Radio Technical Commission of Marine services (RTCM) has a differential service intended for correction services. This includes the Space Based Augmentation Systems (SBAS), such as the Wide Area Augmentation System (WAAS) and the European Geo-stationary Navigation Overlay System (EGNOS). The RX370p is compatible with each of these differential services in addition to e-Dif.

SBAS

The SBAS enabled RX370p operates automatically anywhere within the coverage areas of WAAS, EGNOS, or other SBAS programs.

The Basics

WAAS is a free services of the FAA that allows regular GPS positions to be improved to a DGPS level of accuracy. Tests using an RX370p have shown better than 3 ft (1 m) accuracy. WAAS is available everywhere in the United States, including Alaska, Hawaii, and Puerto Rico. It can also be picked up in some of the border areas of Mexico and Canada. There are no subscription charges incurred when using WAAS. EGNOS is a similar service that is available in Europe and Western Russia.

Automatic SBAS Tracking

The RX370p will automatically scan and track the satellite signals. This automatic tracking allows the operator to focus on other aspects of differential operation without the need to tune the receiver. The RX370p features two-channel SBAS tracking that provides an enhanced ability to maintain a lock on a SBAS satellite when more than one satellite is in view. This redundant tracking approach results in more consistent tracking of an SBAS signal when in an area where signal blockage of a satellite is possible.

e-Dif

An RX370p that is equipped with e-Dif capabilities can operate anywhere in the world where normal GPS signals can be viewed. e-Dif can be used anywhere on the globe where a GPS lock can be achieved. e-Dif was developed for customers who are not able to receive other types of differential signals due to location or budget. e-Dif requires a subscription. Once the e-Dif capable RX370p computes a differential correction, the user can operate for unlimited time and provide good relative accuracy. Alternatively, the operator can regularly update e-Dif to maintain absolute accuracy (typically less than 3 ft (1 m) over 40 minutes).

APPENDIX A - TROUBLESHOOTING

The following table provides a checklist to troubleshoot common problems and their solutions for the RX370p.

Table 1-8: Troubleshooting

Problem	Possible Solution
Receiver fails to power	• Verify polarity of power leads • Check integrity of power cable connections • Check power input voltage (7 - 36 VDC) • Check current restrictions imposed by power source (maximum is 250 mA)
No data from RX370p	• Check receiver power status (LED) • Check integrity and connectivity of power and data cable connections • The volume of data requested to be output by the RX370p could be higher than what the current baud rate supports. Try using 19,200 or higher as the baud rate for all devices.
No GPS lock	• Check integrity of cable connections • Verify RX370p's unobstructed view of the sky
No SBAS lock	• Check integrity of cable connections • Verify RX370p's unobstructed view of the sky • Check SBAS visibility map

APPENDIX B - SPECIFICATIONS

The following tables provide the power, mechanical, communication, environmental and DGPS specifications for the RX370p.

Table 1-9: Power Specifications

Item	Specification
Input Voltage	7-36 VDC
Power Consumption	< 2 W @ 12 VDC (typical)
Current Consumption	150 mA 12 VDC (typical)
Power Connector	Cable mount environmentally sealed

Table 1-10: Mechanical Specifications

Item	Specification
Height	2.2 in (54.7 mm)
Width	5.1 in (129.5 mm)
Weight	1.45 lb (0.66 kg)
Mounting Options	Magnetic Mount, Fixed Mount -low or high pole

Table 1-11: Communication Specifications

Item	Specification
Serial Ports	2 full duplex RS232
CAN	NMEA 2000 broadcast
Pulse Output	1 PPS (HCMOS, active high, rising edge sync)
Baud Rates	4800-57600
Differential Correction I/O Protocol	RTCM SC-104
Data I/O Protocol	NMES 0183, SLX binary and NMEA 2000
Ground Speed Output	Range: 0.5 - > 200 mph (0.8 - > 322 Km/h) Signal: Opto-isolated pulse out Frequency Conversion: 28.65 pulse per ft traveled (94 Hz/m/s)
Event Mark Output	HCMOS, active low, falling edge sync, 10 k-ohm, 10 pF load

Table 1-12: Environmental Specifications

Item	Specification
Operating Temperature	-22°F to 158°F (-30°C to 70°C)
Storage Temperature	-40°F to 185°F (-40°C to 85°C)
Humidity	100%
Enclosure	Waterproof and dust proof
Compliance	FCC, CE
Shock	IEC 68-2-27
Vibration	ISO 16750-1
EMI Certification	FCC part 15, E-Mark

Table 1-13: Sensor Specification

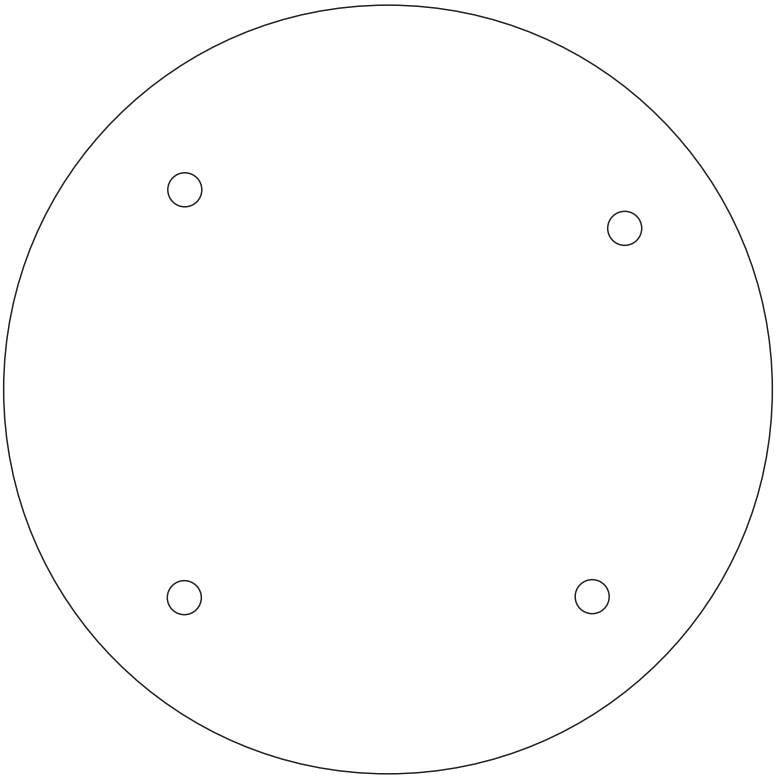
Item	Specification
Receiver Type	L1, C/A code with carrier phase smoothing (Patented COAST technology during differential signal outage)
Channels	12-channel, parallel tracking (10-channel when tracking SBAS)
Update Rate	1-20 Hz positions
Horizontal Accuracy	< 8.2 ft (2.5 m) 95% confidence *autonomous ** < 1.9 ft (0.6 m) 95% confidence DGPS *
Differential Options	SBAS, e-Dif, L-Dif
SBAS Tracking	2-channel, parallel tracking
Start-up Time	60 s (no almanac and RTC)
Satellite Reacquisition	< 1 s

* Depends on multipath environment, number of satellites in view, satellite geometry, baseline length (for local services) and ionospheric activity.

** Depends on multipath environment, number of satellites in view, satellite geometry, and ionospheric activity.

APPENDIX C - SURFACE MOUNT TEMPLATE

The following template should be used to plan for the location of the mounting holes when surface mounting the RX370p.



APPENDIX D - ILLUSTRATIONS

Table 1-14: CenterLine with SmartPad II with RX370p System Configuration

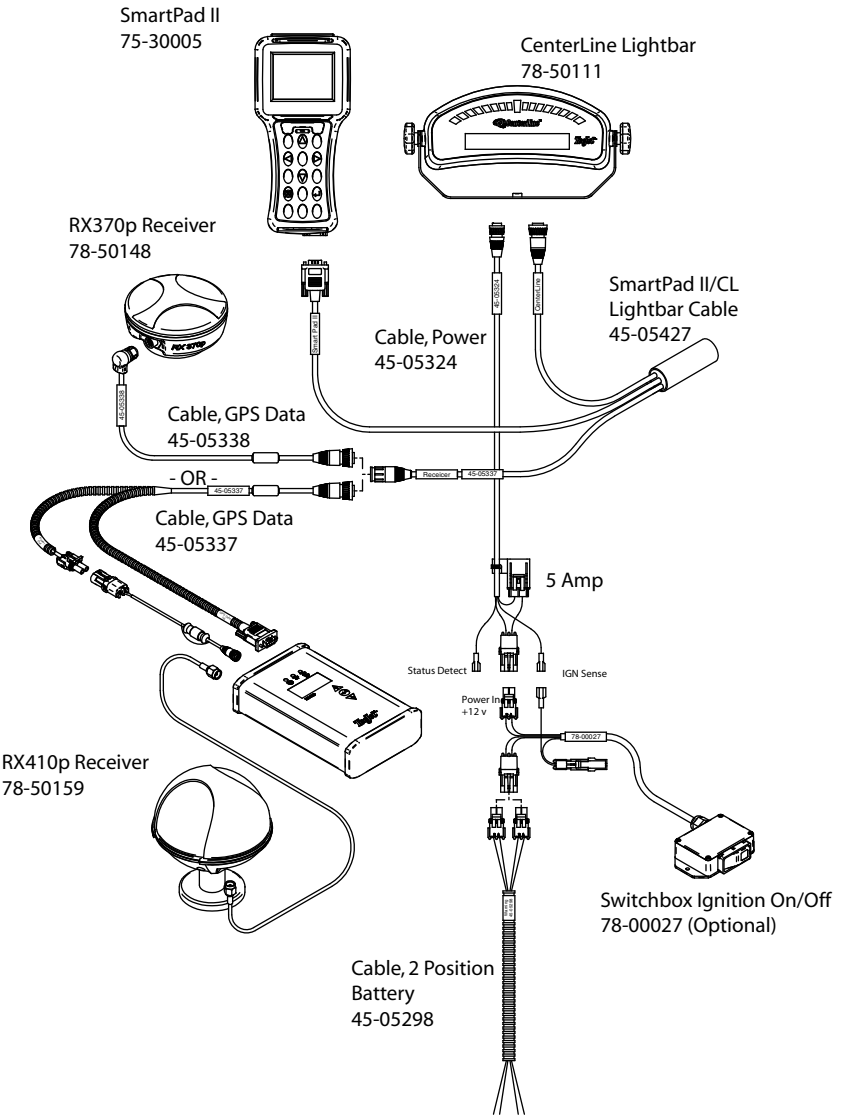


Table 1-15: Standard CenterLine System Configuration with RX370p

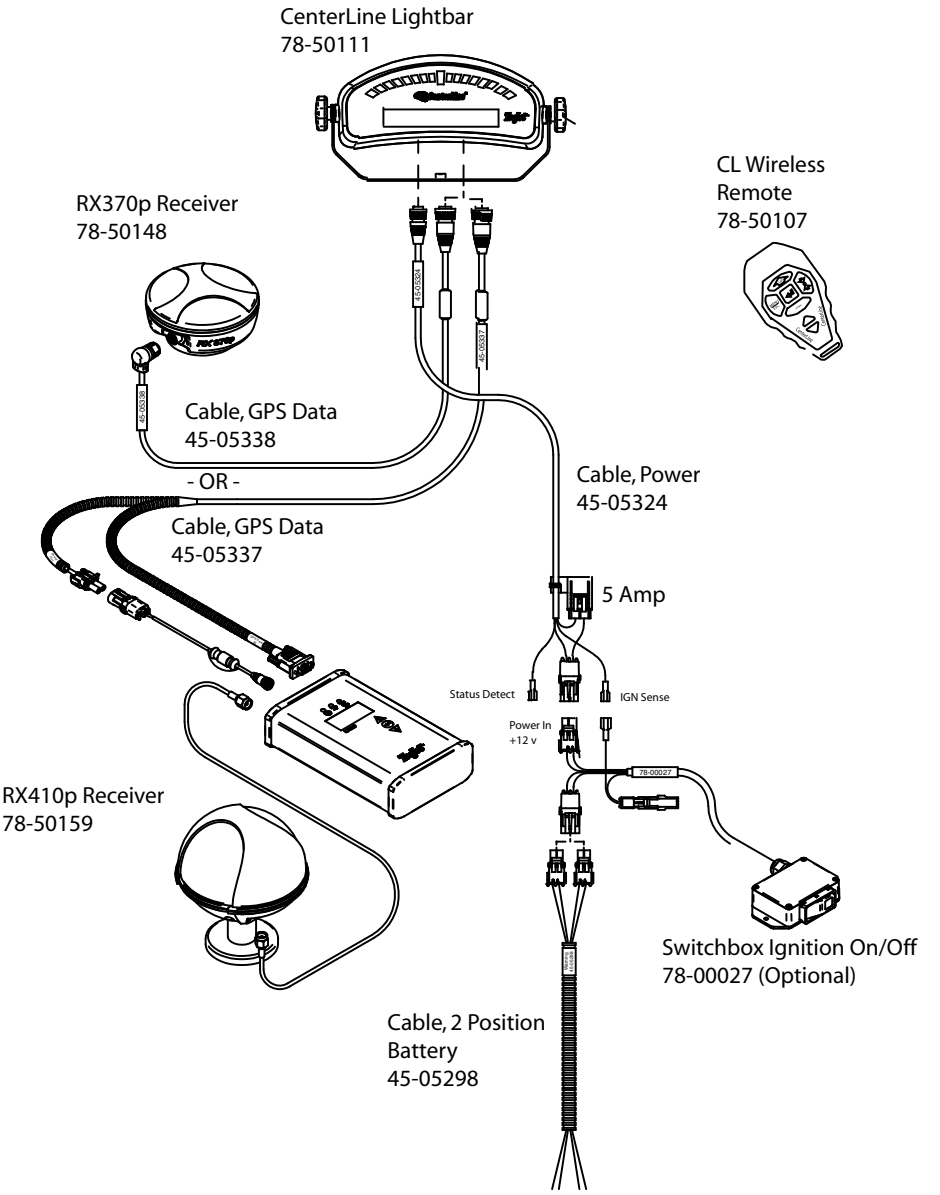
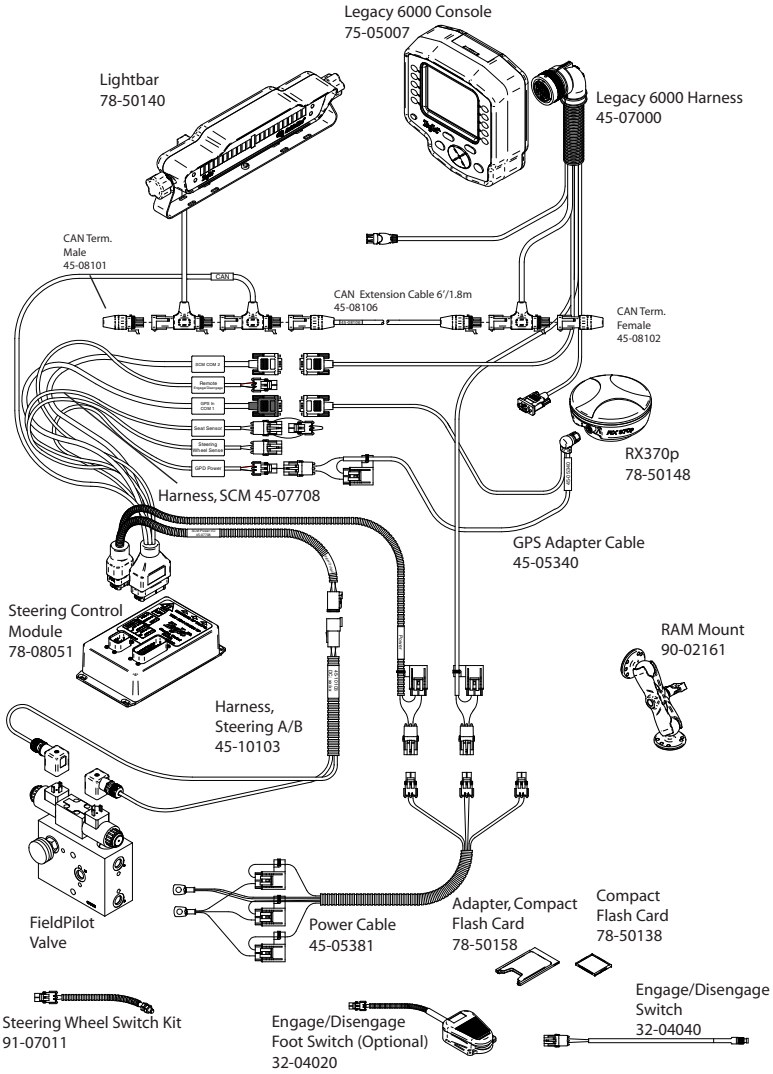


Figure 1-4: FieldPilot Assisted Steering with RX370p System Configuration



Part Number	Description
78-50148	Receiver, RX370p GPS SBAS w/o cables
78-50152	Receiver, RX370p w/ Autonomous mode
78-50154	Receiver, RX370p, e-Dif

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