SATLOC®

LiteStar IV

User Guide

Part No. 875-0359-000 Rev C

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(1) This device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

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Chapter 1: Introduction

What Can I Do with LiteStar IV?
What's in this Guide?
Positioning Accuracy: GPS vs. DGPS
Aerial Guidance Terms and LiteStar IV

⚠WARNING: *GPS approved for VFR use only.*

What Can I Do with LiteStar IV?

LiteStar IV provides guidance in flying and spraying your field. You select a pattern to fly along with other setup options and LiteStar IV guides you along each row (or swath) in your pattern. The pattern and all other setup options you select comprise a job. Each time you use LiteStar IV you can fly the most recent job (if you fly the same field each time) or start a new job. LiteStar IV includes a USB port through which you can export log data (such as to verify work has been completed) to a USB drive.

What's in this Guide?

In this guide:

- Chapter 2, "System Overview and Setup" describes how to power your system on/off and use the controller and lightbar to set up your system.
- Chapter 3, "Using LiteStar IV" covers patterns (and how to fly them), starting a job, and using navigation marks.
- Chapter 4, "GPS Data" describes GPS data and exporting logs to a USB drive.
- Appendix "Additional Information" presents a crosstrack sensitivity chart and answers frequently asked questions.

Positioning Accuracy: GPS vs. DGPS

GPS (Global Positioning System) is a system of U.S. satellites that provides positioning data. GPS has come to mean a general term of satellite positioning technology around the world, so this manual uses GPS in this manner. GPS accuracy can be affected by atmospheric interference, timing errors, and satellite orbit errors. Differential GPS (DGPS) is GPS with an additional correction signal that improves GPS accuracy—referred to as differential corrections. Your LiteStar IV system supports the following two DGPS technologies:

- WAAS

  WAAS (Wide Area Augmentation System) is the North American version of an SBAS system, a satellite-based service that provides differential corrections for users of standard GPS systems. Similar SBAS systems exist in Europe (EGNOS), India (GAGAN), and China (EGNOS). SBAS systems use GPS data from a network of reference stations spanning a wide geographic area to compute corrections and provide more accurate positioning.

- e-Dif

  Hemisphere GNSS' e-Dif® (extended-Differential) technology provides precision guidance without a broadcast differential signal. e-Dif requires a lock on at least four satellites and typically maintains less than a three-foot drift over 40 minutes in relation to your original reference point. Because it does not use a broadcast differential signal, you can use e-Dif anywhere—making e-Dif an ideal solution in areas where SBAS is unavailable or unreliable.

Aerial Guidance Terms and LiteStar IV

LiteStar IV uses common aerial guidance terms on the lightbar. This section provides a brief summary of these common terms and how they are used in LiteStar IV and in this manual. The remaining sections of this chapter and the chapters that follow provide detailed information on how these terms apply to using LiteStar IV.

Pattern - Order (sequence) in which, on demand, LiteStar IV guides you to the swaths that make up the area to be sprayed. Guidance comprises heading and crosstrack. The swath array to which LiteStar IV applies the pattern's sequence is generated by the creation of an A|B line. LiteStar IV includes several built-in patterns. For example, in a Back-to-Back pattern you fly consecutive swaths parallel to the A|B line. There are two types of patterns in LiteStar IV—an open pattern (requires only A and B points) where you can fly an unlimited (open) number of swaths because the pattern is not dependent on the size of the field, and a closed pattern (requires A, B and C points) where the number of swaths you can fly is limited (closed) because you define the width of the field. See "Patterns Overview" on page 22.

Job - Flown (and typically sprayed) pattern.

Log - Set of data that includes spray on/off locations, precise time/date record, flight speed, altitude, pattern flown, and GPS position quality. LiteStar IV records this data in the log when you are above the minimum airspeed of 2.2 mph (3.6 kph).

Swath - Strip or row of a field that you fly.

A|B line - Initial guideline of a pattern. Each subsequent swath of the pattern is based on this initial guideline. You set points A and B and a line (A|B line) extends through both points.

Crosstrack - Perpendicular distance between you and the target swath line.

Heading angle - Angle of flight needed to intercept the target swath line. In terms of flying a pattern, the heading angle represents the direction you need to turn to intercept your target swath line.

Mark - Point to which you want to return, such as a last sprayed point. LiteStar IV saves only one mark at a time; therefore, saving a mark overwrites the previously saved mark.

Chapter 2: System Overview and Setup

System Components
Powering the System On and Off
Components Overview
Two Modes - Setup and Guidance
Setting Up Your System

System Components

Figure 2-1 shows the main components of the LiteStar IV system (cabling and installation hardware not shown).

Controller

Antenna

Note: Cabling and installation hardware not shown. See LiteStar IV installation guide for details.

Lightbar

Figure 2-1: LiteStar IV components

Powering the System On and Off

Before using LiteStar IV, you need to know how to power the system on and off.

Powering On the LiteStar IV

Before powering on the LiteStar IV make sure your power source is uninterrupted and your system is well grounded. To power on the LiteStar IV, flip the controller toggle switch up into the ON position.

Upon startup:

- Controller buttons are illuminated blue

- Lightbar performs its startup sequence (random LED flashing followed by the product name)

Random LED flashing

Product name

- If this is the first time you are powering on your LiteStar IV or have reset the system to factory defaults, Job / New Job appears. For more information on factory defaults see “Resetting Factory Defaults” on page 19.

If you previously started a job, Job / Old Job appears. For more information see “Starting a Job” on page 25.

Powering Off the LiteStar IV

⚠WARNING: *Power off the LiteStar IV before turning off the aircraft or main power source to ensure your data is saved.*

To power off the LiteStar IV, flip the controller toggle switch down into the OFF position. The lightbar and controller go dark.

Components Overview

This section briefly describes each system component (including cockpit cabling).

Controller

Satloc recommends mounting the controller inside the cockpit within reach to enable you to perform such tasks as powering your system on/off, setting options, and adjusting lightbar brightness. Figure 2-2 shows the controller's components and Table 2-1 describes component functionality.

Figure 2-2: Controller functions

Table 2-1: Controller functionality

Button/Control	Function
Lightbar dimmer (DIM knob)	Rotate clockwise/counterclockwise to increase/decrease lightbar brightness. Using the Dim menu (setup mode) overrides/disables the DIM knob (see “Setting the Lightbar Brightness” on page 14).
Circuit breaker	Protection against power surges from the aircraft.
Power switch	Flip up /down to power the system on/off.
USB port	Export log files from the controller to a USB drive. Logging data to the controller (creating the log files) requires a minimum airspeed of 2.2 mph (3.6 kph).
Menu button	Switch from swath guidance mode to setup mode (see “Two Modes - Setup and Guidance” on page 10) or cycle through menu items. *Note: Written as “Press menu” in the procedures in this guide.*
Enter button	Confirm menu item selection or switch to swath guidance mode from setup mode (only after you set/confirm swath width and pattern). *Note: Written as “Press enter” in the procedures in this guide.*
Scroll buttons	Move up or down menu item lists/options. *Note: Written as “Scroll up/down” in the procedures in this guide.*

Lightbar

The lightbar, mounted on the front of the aircraft (outside the cockpit but in clear view of the operator) displays key information needed for guidance, such as crosstrack distance, GPS status, speed, heading, and navigation cues.

The LEDs on the lightbar are separated into sections (Figure 2-3):

- Upper LED bars show crosstrack distance and direction to the target swath.
- Lower LED bars show the heading (angle of intercept) to your target swath.
- Center LED column shows target swath alignment or warning cues (see “Troubleshooting” on page 30).
- Status LEDs - indicators for spray on (first LED in from left/right edge) and console logging errors (third LED in from left/right edge, see “Troubleshooting” on page 30).
- Display fields (Disp 1-4) are user-defined and display such parameters as speed, heading, and sprayed area.

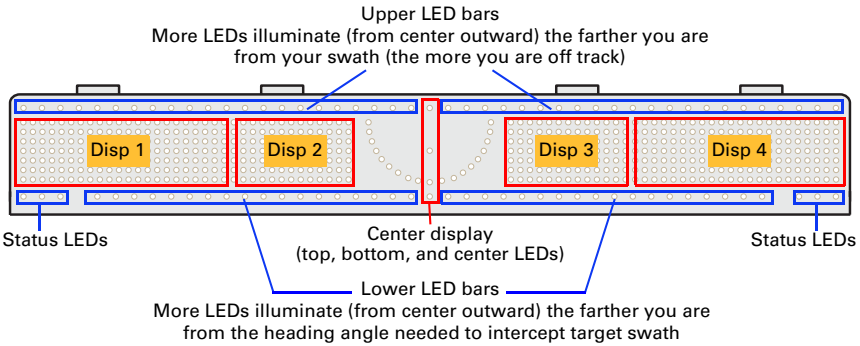


Figure 2-3: Lightbar sections

See “Setting Lightbar Options” on page 14 for general lightbar information, “Setting the Lightbar Display Fields” on page 16 for setting what appears in the four display fields, and “Flying a Pattern” on page 27 for a detailed example of what the lightbar displays at different stages of flying a pattern.

Cockpit Cable Connections

LiteStar IV includes a set of wires you can connect in your cockpit to the joystick, or (for the SPRAY ON/OFF wire) to a boom pressure switch or to a micro switch activated by the manual spray valve. Refer to the installation guide included with your LiteStar IV kit for all connections.

Table 2-2: Joystick cabling functions

Cable/Wire	Function
SPRAY ON/OFF	Indicates to the controller whether spray is on or off for use in logging and to illuminate the lightbar spray LEDs.
SWATH ADVANCE	Set pattern points (A, B, and optionally C) during setup and receive guidance to next swath when in swath guidance mode.
SWATH DECREMENT	Decrement to a previous swath.
MANUAL MARK	Set (‘mark’) a location as a navigation mark or a mark to which you want to return.

Two Modes - Setup and Guidance

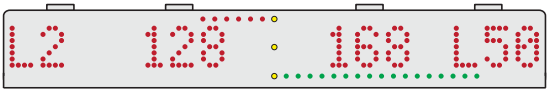
There are two modes in LiteStar IV: setup mode and guidance mode.

- Setup mode refers to using the controller to navigate the menu system to select options that appear on the lightbar. You can set such options as swath width, pattern, local time, and lightbar field displays. See "Controller" on page 8 for an overview of the controller and "Menu Overview" (next section) for information on what you can set using the menu.

  The figure below shows the lightbar in setup mode (Units menu option).

- Guidance mode refers to 1) using the buttons on the controller or using the four cable wires (typically connected to your cockpit joystick) to set your pattern points (A, B, and optionally C), and 2) flying your pattern. The lightbar shows your status while flying your pattern and spraying a field.

  The figure below shows the lightbar in guidance mode.



The options you enter in setup mode are saved with the current job. Some options (such as units, local time, and differential type) you may want to set only once for all jobs. However, you may set other options (such as swath width and pattern) more often depending on the field.

Menu Overview

When you power on your system the lightbar displays its startup sequence followed by Job / New Job—this is the first option of the main menu (shown at right). The last option is not actually an option, but an indicator that you did not reset factory defaults on the previous menu option.

You can set all the options (or leave the defaults); however, LiteStar IV requires you to set only the swath width and pattern before providing guidance—thus, you do not have to scroll through the entire menu to start a job.

Figure 2-4 at the top of the next page shows the complete menu map for LiteStar IV.

Tip! *Satloc recommends that you become comfortable navigating the menu before flying your first pattern.*

Main	
>Job	New Job
>SWidth	50.0
>Patrn	BK_BK R
>Dim*	UseKnob
>Disp 1	SwthNum
>Disp 2	Speed
>Disp 3	Acres
>Disp 4	X-Track
>LBar	Sens 3
>GPS	Menu
>UTC	0:00
>Units	Feet
>DifTyp	WAAS
>SBASR	Off
>LS4LB	3.001c
>SetFac	Defalts
DefsNOT	Reset

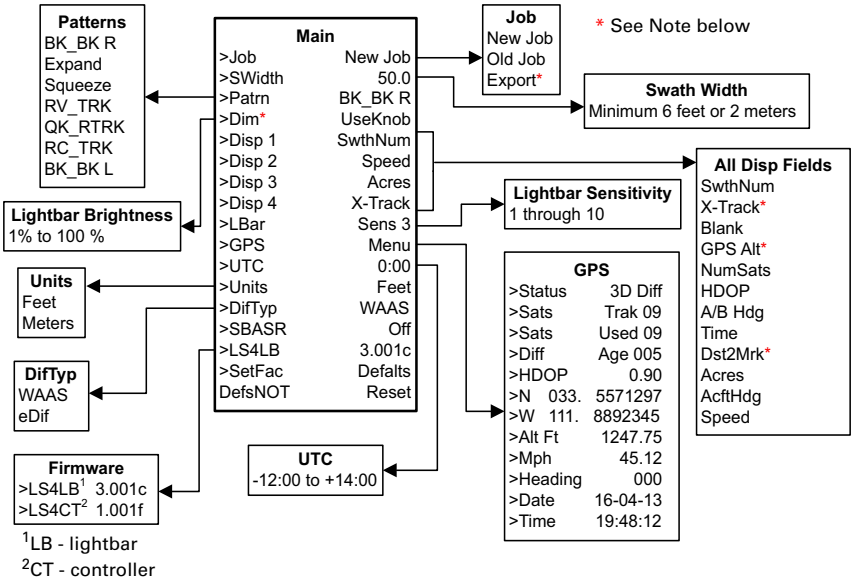
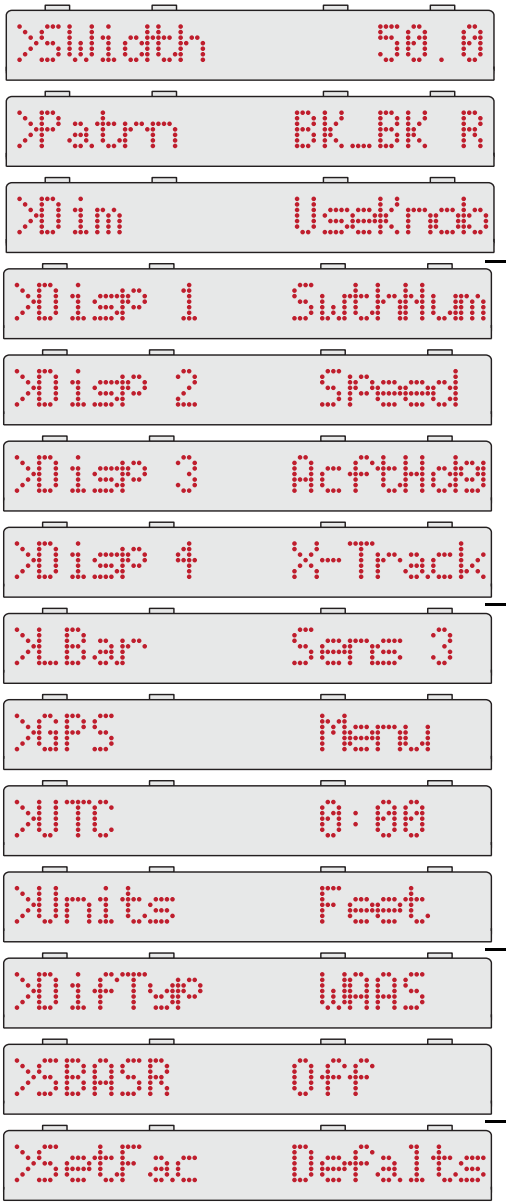


Figure 2-4: LiteStar IV menu map

Note: If Dim is set at or below 100%, the set value appears on the main menu; otherwise, the main menu shows UseKnob (as shown above). The Export option is available only after 1) inserting a USB drive in the controller, and 2) logs are available for export. X-Track, GPS Alt, and Dst2Mrk are available for display only in the far left (Disp 1) and far right (Disp 4) fields on the lightbar.

Main Menu Sequence

The figures below show the sequence of main menu options. Each time you start a new job, SWidth (swath width) is your first option. When you press menu, the next item in the sequence appears (from top bottom as shown below).



See “Setting the Swath Width” on page 26.

See “Available Pattern Types” on page 23.

See “Setting the Lightbar Brightness” on page 14.

See “Setting the Lightbar Display Fields” on page 16.

See “Setting the Crosstrack Sensitivity” on page 15.

See “Viewing GPS Data” on page 40.

See “Setting the UTC Offset” on page 13.

See “Setting the Units of Measurement” on page 13.

See “Selecting a Differential Corrections Source” on page 18.

See “Resetting Factory Defaults” on page 19.

Note: The menu options for firmware (LS4LB/LS4CT) and defaults not reset (DefsNOT) are not covered here as they are read-only information.

Setting Up Your System

LiteStar IV is shipped with default factory settings. While the default settings are suitable for many users, you can change the following options as needed. After changing any options, you can restore factory defaults.

- Units of measurement
- UTC offset (ensures correct local time)
- Lightbar brightness, crosstrack sensitivity, and display field values
- DGPS setting (WAAS or e-Dif)

Once you finalize your settings you can fly patterns using LiteStar IV. See Chapter 3, “Using LiteStar IV.”

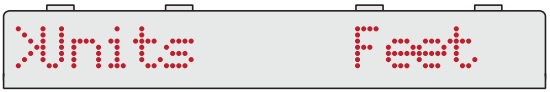
Setup tasks assume you are in setup mode. If you are in swath guidance mode press menu (at right) to switch to setup mode. If you previously set a mark, pressing menu displays ‘(Return) To Mark’— press menu again to cancel guidance to the mark and switch to setup mode (see “Using Navigation Marks” on page 37 for information on marks).

Setting the Units of Measurement

By default, units are set to feet. To use metric units, change this setting.

To set the units of measurement:

1. Press menu repeatedly until Units appears, showing the current setting (Feet below).



2. Scroll up/down to select the other units option (Meters below).

Setting the UTC Offset

Coordinated Universal Time (UTC) is similar to, but more precise than, Greenwich Mean Time (GMT). UTC is the time zone from which all other time zones are calculated and these time zones range from -12:00 (hours) to +14:00 (hours)—referred to as the UTC offset. Negative numbers increase as you move farther west from UTC; positive numbers increase as you move farther east from UTC. For example, the time zone for Dallas, Texas (USA) is -6:00.

Set the UTC offset to display the correct time for your system—this is the Time value on the GPS menu. See "Viewing GPS Data" on page 40 for more information on the GPS menu.

Note: If you live in an area that observes daylight savings (DST), set the UTC offset in LiteStar IV twice a year.

To set the local time (UTC offset):

1. Press menu repeatedly until UTC appears, showing the current setting (0:00 below).

2. Scroll up/down until you select the appropriate UTC offset—scroll up to select a positive UTC offset or scroll down to select a negative UTC offset (example below shows the UTC offset for Dallas, TX USA).

Setting Lightbar Options

LiteStar IV enables you to set lightbar brightness, crosstrack sensitivity, and display fields.

Setting the Lightbar Brightness

Under certain conditions you may want to adjust the lightbar brightness (such as brighter during the day or dimmer at night). LiteStar IV provides two methods (below) to adjust the brightness.

Using the Dim setting on the main menu

Using the DIM knob

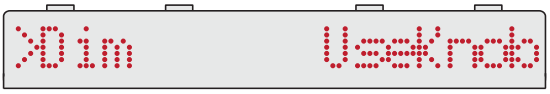
Use Table 2-3 to determine how and when to use the menu or the knob based on the current setting.

Table 2-3: Lightbar brightness options

Current Setting	Menu	Knob
UseKnob (default)	Scroll down to display 100%, then scroll up/down to adjust level	Use knob to adjust level
1% to 100%	Scroll up/down to adjust level	Cannot use knob until you scroll up to set level to 100% then scroll up again to display UseKnob

To set the lightbar brightness:

1. If using LiteStar IV for the first time, you can use the knob to adjust the brightness. Any time you use LiteStar IV after that, if you turn the knob and nothing happens, Dim is set anywhere from 1% to 100%. Proceed to step 2 to verify the level and set the brightness.
2. Press menu repeatedly until Dim appears, showing the current setting (UseKnob below).



Use Table 2-3 (previous page) to set the brightness. The example below shows the lightbar brightness set to 20% using the menu.

or

Note: You can use the knob to set the lightbar brightness to a similar level to any level you set using the menu; however, the lightbar will always display 'UseKnob' when using the knob with the Dim setting visible.

Setting the Crosstrack Sensitivity

Crosstrack (X-Track) is the perpendicular distance between you and the target swath line. Crosstrack sensitivity refers to the relationship between how far you are from your swath line and how this distance is represented by the upper LED bar on the lightbar.

The lightbar has 21 crosstrack LEDs and 10 available sensitivity levels (1 through 10, where 1 is the most sensitive and 10 is the least sensitive). Each LED represents a distance greater than the previous LED, with the first few LEDs representing small increases in distance and subsequent LEDs representing distances that increase at a greater rate.

The default sensitivity level is 3. Using this as an example, the first LED illuminates when the crosstrack reaches 3 ft, the second LED illuminates when crosstrack reaches 6 ft, the third LED represents 9 ft, but the tenth LED represents 550 ft. To reset the sensitivity level to its default value of 3, set the value to 3 or restore all factory default settings (see "Resetting Factory Defaults" on page 19).

Note: Before changing the sensitivity level, refer to "Crosstrack Sensitivity Chart" on page 44 to understand the impact.

To set the crosstrack sensitivity:

1. Press menu repeatedly until LBar appears, showing the current setting (Sens 3 below).

2. Scroll up/down until you select the appropriate sensitivity level—scroll up to increase the level or scroll down to decrease the level.

   The example below shows the sensitivity set to level 5.

Setting the Lightbar Display Fields

The lightbar includes four user-defined fields (Disp 1-4) that can display such parameters as speed, heading, and sprayed area. Table 2-4 lists the options for each display field and Table 2-5 on the next page describes each option.

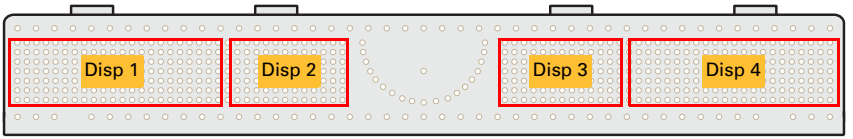


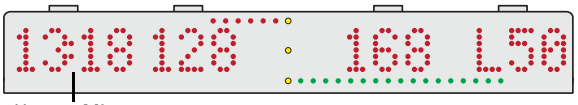
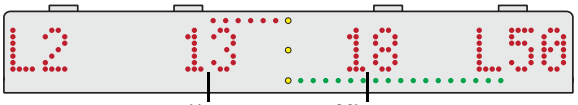
Figure 2-5: Lightbar display fields (four)

Table 2-4: Lightbar display fields order of menu items

Disp 1	Disp 2	Disp 3	Disp 4
SwthNum	SwthNum	SwthNum	SwthNum
X-Track	Blank	Blank	**X-Track**
Blank	NumSats	NumSats	Blank
GPS Alt	HDOP	HDOP	GPS Alt
NumSats	A/B Hdg	A/B Hdg	NumSats
HDOP	Time	Time	HDOP
A/B Hdg	Acres or Hectare	Acres or Hectare	A/B Hdg
Time	AcftHdg	**AcftHdg**	Time
Dst2Mrk	**Speed**	Speed	Dst2Mrk
Acres or Hectare			Acres or Hectare
AcftHdg			AcftHdg
Speed			Speed

Note: Bold/red items indicate default values. X-Track, GPS Alt, and Dst2Mrk are available for display only in the far left (Disp 1) and far right (Disp 4) fields.

Table 2-5: Display field menu item descriptions

Item	Description
SwthNum	Current swath number.
X-Track	Crosstrack distance (see "Setting the Crosstrack Sensitivity" on page 15).
Blank	Nothing appears in the display field.
GPS Alt	Aircraft altitude. ***Caution:*** *For logging purposes only; do not substitute this reading for the aircraft's altimeter.*
NumSats	Number of tracked satellites.
HDOP	Horizontal dilution of precision, a numeric value expressing the confidence factor of the position solution based on current satellite geometry (the lower the HDOP value, the greater the confidence level).
A/B Hdg	Heading angle of A|B line.
Time	Local time (see "Setting the UTC Offset" on page 13). • Setting either Disp 1 or Disp 4 to Time displays the time in that field in the format HH:MM (hours:minutes).  Hours : Minutes • Setting both Disp 2 and Disp 3 to Time displays hours and minutes (HH in Disp 2; MM in Disp 3). With your UTC offset set correctly, the time is 1:18 pm (13:18).  Hours Minutes
Dst2Mrk	Distance to mark (see "Using Navigation Marks" on page 37).
Acres or Hectare	Sprayed area (when SPRAY is on), in acres or hectares (see "Cockpit Cable Connections" on page 9 for information on the SPRAY ON/OFF wire).
AcftHdg	Heading angle of aircraft, where heading is the direction from True North—North is 0°/360°; South 180°.
Speed	Aircraft speed. ***Caution:*** *For logging purposes only; do not substitute this reading for the aircraft's airspeed indicator.*

To set a display field:

1. Press menu until the preferred display field appears (Disp 2 below).

2. Scroll up/down until you see the desired display item (Disp 2 set to A|B heading below).

Selecting a Differential Corrections Source

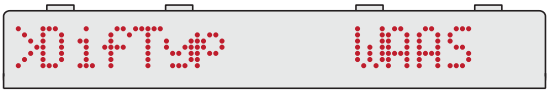
You have two differential corrections options for LiteStar IV: WAAS and e-Dif.

- WAAS—Wide Area Augmentation System that covers all of North America (this is the default selection in LiteStar IV)
- e-Dif—extended Differential technology that uses internally generated differential corrections to enable you to achieve differential accuracy where there is no SBAS coverage or where differential coverage is unreliable

When you select the other differential source, allow enough time for the system to adjust—this may take several minutes ('wait' appears on the lightbar during this time), similar to how long it may take at startup.

To select a differential corrections source:

1. Press menu repeatedly until DifTyp appears, showing the current setting (WAAS below).



2. Scroll up/down to select the other differential corrections source. Before the selected differential type appears, the right side of the lightbar 1) briefly displays "(wait)" then 2) briefly goes dark.

   The example below shows e-Dif as the new differential corrections selection.

3. (Optional) Press menu to display SBASR, then scroll up/down to set SBASR to On or Off.

   - For areas where WAAS corrections are limited, set to Off.

   - For areas where WAAS corrections are available, set to On to receive the differential part of the signal.

Resetting Factory Defaults

Factory defaults are the preprogrammed setup options that enable you to begin using LiteStar IV right after installation. If you change any settings, you can quickly restore your system to its factory default settings.

Note: Resetting factory defaults deletes the previous (old) job and all log files stored in internal memory. Export log files you want to keep before performing a factory reset.

To reset factory defaults:

1. Press menu until SetFac appears.

2. Press enter. Defalts / Reset appears briefly...

...then after the reset process is complete Job / New Job appears.

Chapter 3: Using LiteStar IV

Patterns Overview
Available Pattern Types
Lightbar Basics
Starting a Job
Flying a Pattern
Flying the Available Pattern Types
Using Navigation Marks

This chapter describes patterns (types, how to set, and how to fly), starting a job, and navigation marks (return points).

Patterns Overview

You can fly two types of patterns using LiteStar IV:

- Open pattern—where you can fly an unlimited (open) number of swaths because the pattern is independent of the size of the field
- Closed pattern—where the number of swaths you can fly is limited (closed) because you define the width of the field

Patterns require an initial guideline on which to base the pattern's GPS coordinates—this initial guideline is called the A|B line (a straight line defined by two points A and B). Closed patterns need an additional defined point—point C. Table 3-1 describes how A|B lines are used in open and closed patterns.

Table 3-1: A|B lines in open and closed patterns

A/B Line Characteristics	Open Pattern	Closed Pattern
LiteStar IV prompts you to set the points for the pattern you select.	Yes (points A and B)	Yes (points A, B, and C)
Point A is the beginning of the line.	Yes	Yes
Point B is the end of the line.	Yes	Yes
The A|B line may be inside or outside the field. Points A and B should be as far apart as possible to ensure the accuracy of the line. Establishing A and B points too close together may result in a small error that creates a larger divergence the longer the distance.	Yes	Yes
You define the width of your field by setting a third (C) point.	No	Yes
All swaths you fly will be parallel to this initial A|B line.	Yes	Yes

After setting system and job parameters (see Chapter 2, "System Overview and Setup") you are ready to fly a pattern (that is, fly a job) with LiteStar IV.

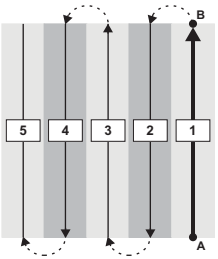
Note: There are several tasks you can perform in more than one way. For example, to set point A (first point) in an A|B line, you can use any of the following methods:

- *Press enter on the LiteStar IV console*
- *Use the cockpit joystick (SWATH ADVANCE wire set connected directly to the stick)*

For the instructions in this manual where multiple methods are available the most common and practical method is described. For example, "Flying a Pattern" on page 27 describes using SWATH ADVANCE on the cockpit stick (instead of pressing enter on the console) when setting an A|B line).

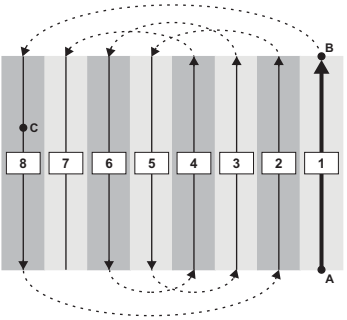
Available Pattern Types

LiteStar IV supports the following pattern types (both open and closed), providing the flexibility to fly any field shape. This section describes these patterns and how you fly them.



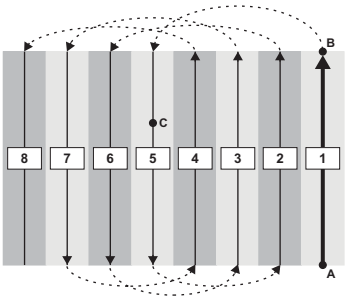
Back-to-Back Right (BK_BK R)
Back-to-Back Left (BK_BK L)

Fly consecutive swaths parallel to the A|B line.



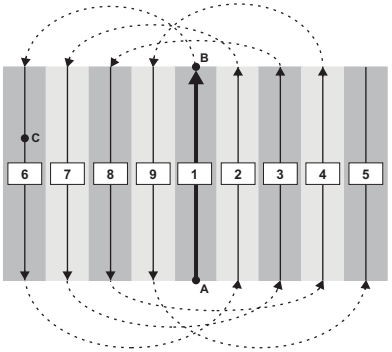
Racetrack (RC_TRK)

Useful for flying wide, smooth turns. Fly each side of a field, then alternately work from swath #2 to the middle, and from the middle toward the other end of the field.



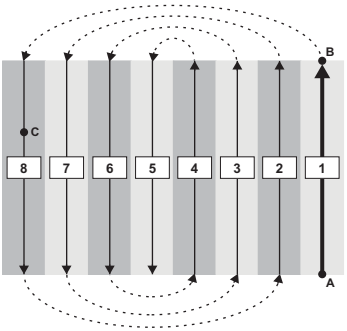
Quick Racetrack (QK_RTRK)

Fly a pattern similar to the Racetrack, but set your C point in the middle of the field.



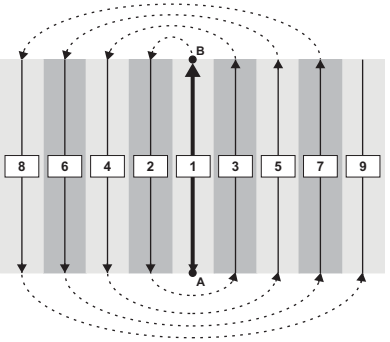
Reverse Racetrack (RV_TRK)

Fly a pattern similar to the Racetrack. This is called the “Reverse” Racetrack because you are flying in one direction, but swaths are incrementing in the opposite direction. In this pattern, you set your A|B line in the center of the field. This pattern is useful for flying circular fields or other fields where the center line is clearly visible.



Squeeze (Squeeze)

Fly loops of decreasing size, from the outside of the field to the middle of the field. This pattern allows you to make wide turns at the beginning of a job when carrying a heavy load, and narrower turns as your load becomes lighter.

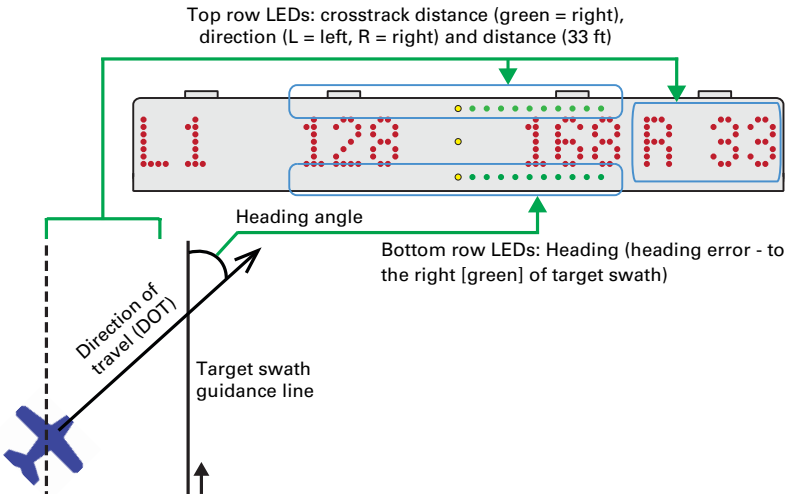


Expand (Expand)

Fly successive swaths outward from the center of the field. This pattern is useful for fields with a visible center line or a long, irregular shape.

Lightbar Basics

The top and bottom rows of LEDs represent distance (linear or angular) and direction (by color where red is left, green is right).

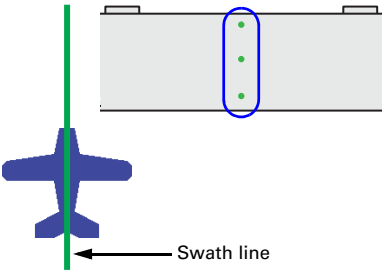


Each LED represents a certain linear or angular distance.

- Crosstrack distance (top LED row)—the greater your perpendicular distance from the target swath, the more LEDs are illuminated; fewer LEDs are illuminated as you get closer to the target swath. When you are at the target swath, no top LEDs are illuminated. The color of the LEDs indicates the direction of the target swath—the direction to steer to it.
- Heading angle (bottom LED row)—the greater the heading error (90° is maximum), the more LEDs are illuminated. When you are on or parallel to the

target swath, no bottom LEDs are illuminated. The color of the bottom row LEDs indicates the direction of the heading error relative to the target swath in the direction of travel (DOT).

When the center vertical row of lightbar LEDs is illuminated, you are on the target swath with zero crosstrack and zero heading error (shown at right).



Starting a Job

Each time you want to fly a new job, you must verify/select the swath width and pattern before you can switch to guidance mode. To fly the previous job (Old Job), you do not need to verify the swath width and pattern, as they are associated with that job. Table 3-2 outlines the steps to start a job.

Table 3-2: Starting a Job

New Job	Old Job	See Section for More Information
1. If you are in guidance mode (see "Two Modes - Setup and Guidance" on page 10), press menu to switch to setup mode. However, if you previously set a mark, pressing menu displays '(Return) To Mark' and you need to press menu again to cancel the mark (see page 37) and switch to setup mode. or If you are already in setup mode, press menu (as needed) to display Job.		
2. Scroll up/down to select New Job.	2. Scroll up/down to select Old Job.	See "Selecting the Job Type" on the next page
3. Press menu then scroll up/down to set the swath width. Repeat to select the pattern.	N/A - swath width and pattern are preset (from previous job)	See "Setting the Swath Width" and "Setting the Pattern" starting on the next page
4. Set optional parameters.	3. Set optional parameters.	"Setting Up Your System" on page 13
5. Press enter to switch to guidance mode.	4. Press enter to switch to guidance mode.	
6. Fly your pattern.	5. Fly your pattern.	"Flying a Pattern" on page 27

Selecting the Job Type

To select a new job or the previous (old) job:

1. In setup mode (when selecting the swath width, pattern, and optional parameters), press menu repeatedly until you return to Job (the top main menu option).

   or

   In guidance mode, press menu to immediately return to Job (the top main menu option).

2. If necessary, scroll up/down to select the other job type.

Setting the Swath Width

A swath is a row in an area you want to spray. LiteStar IV uses your swath width to calculate and provide guidance to subsequent swaths in the selected pattern.

When starting a new job, you must verify/set the swath width and the pattern before switching to guidance mode.

Note: You can set the swath width only when starting a new job. When selecting the previous job (Old Job), you cannot change the swath width and pattern for that job—thus, the first option you see on the main menu (after selecting Old Job) is Dim.

To set the swath width:

1. Press menu until SWidth appears. When starting a new job, SWidth appears as the first setup option.

2. Scroll up/down until you set the preferred swath width—scroll up to increase the value or scroll down to decrease the value.

   The example below shows the swath width set to 35.0.

Setting the Pattern

LiteStar IV includes seven pattern types. When starting a new job, you must verify/set the swath width and the pattern before switching to guidance mode.

To set the pattern type:

1. Press menu until Patrn appears, showing the current setting (BK_BK R below).

2. Scroll up/down to select a different pattern.

   The example below shows racetrack (RC_TRK) as the new pattern selection.

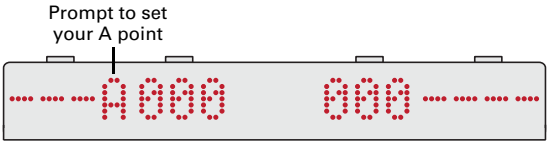
See the following section (“Flying a Pattern”) to start flying your job.

Flying a Pattern

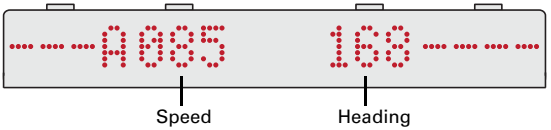
This section steps you through setting up and continuing to fly a pattern. In the example starting on the next page:

- The pattern is open pattern Left Back-to-Back (BK_BK L)—although setting a C point for a closed pattern is mentioned—with display field default settings of Disp 1 = swath width, Disp 2 = speed, Disp 3 = aircraft heading, and Disp 4 = crosstrack.
- Where there are two ways to execute a particular command (for example ‘Press enter’ or ‘Advance one swath’, that is, by using either the enter button on the controller or the remote swath advance button) the example only mentions the command—use the option convenient for you.
- Steps 4, 6, and 9 (regarding spraying) provide only an example of how you may fly the field—follow your own procedures.

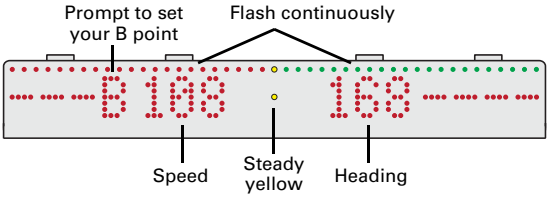
1. Set your job parameters then press enter to switch to guidance mode—'A' appears in Disp 1, prompting you to set point A of the A|B line.



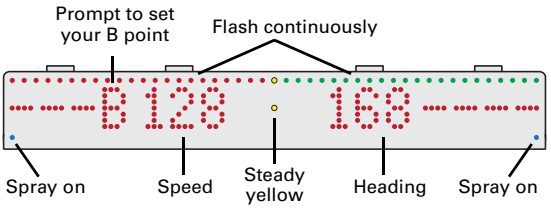
2. Begin flying and navigate to the start of your A|B line. As you fly Disp 2 shows aircraft speed (085) and Disp 3 shows aircraft heading (168).



3. Press SWATH ADVANCE (joystick) to set point A. 'B' appears in Disp 1, prompting you to set point B. The upper LED row (left side red, right side green) flashes continuously and the center LED is steady yellow.

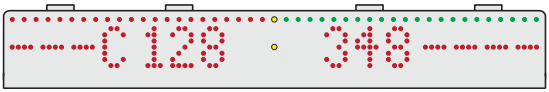


4. Turn on spray as you enter the field. The far left/right bottom LEDs illuminate to indicate spraying is on (top LED row continues to flash and the center LED stays illuminated).

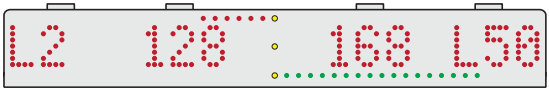


5. Press SWATH ADVANCE (joystick) to set point B. Disp 1 shows the pattern direction (L, left) and swath number (1) and Disp 4 shows the crosstrack (0).

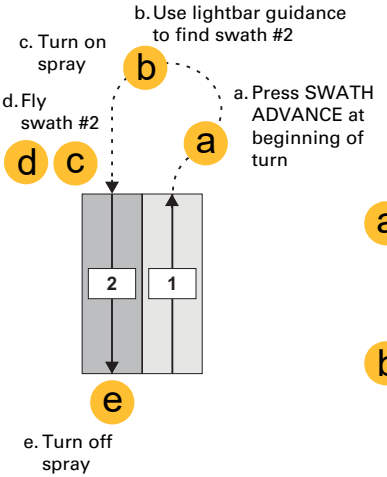
If flying a closed pattern, the lightbar next prompts you to set point C ('C' appears in Disp 1). Press SWATH ADVANCE (joystick) to set point C.



6. Turn off spray as you leave the field. The far left/right bottom LEDs are no longer illuminated.
7. Press SWATH ADVANCE (joystick) to advance to swath #2. The lightbar indicates the following:
   - Disp 1 shows swath #2 is to the left
   - Disp 4 shows you need to go 50 ft to the left to get to swath #2 (50 ft is the crosstrack distance—the perpendicular distance off your swath line)
   - Upper LED row shows the crosstrack distance in graphical terms (the more LEDs illuminated, the larger the crosstrack distance)
   - Lower LED row illustrates the heading angle—all LEDs (to one side) are illuminated when you are at or near perpendicular to your target heading (indicating you need to turn 90° to reach your target heading).



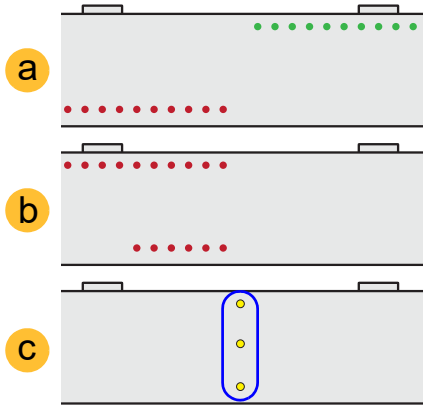
8. Make the turn to get onto swath #2 using the lightbar for guidance.



Lightbar guidance:
Top row of LEDs shows crosstrack distance and direction to the target swath.

Bottom row of LEDs shows the heading (angle of intercept) to the target swath.

Center LEDs illuminated indicate you are lined up on the target swath.

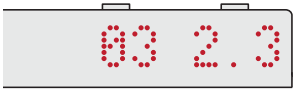
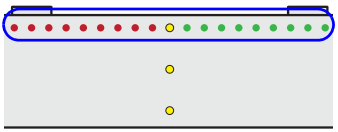
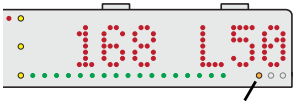


9. Turn on spray as you enter the field then fly swath #2 using lightbar guidance.
10. Continue to fly your swaths using lightbar guidance.

Troubleshooting

The lightbar displays helpful information when an error condition occurs, such as a no GPS signal indicator or a double-spray warning. Table 3-3 describes each error condition. When LiteStar IV generates a warning while in guidance mode your active guidance display disappears from the lightbar—in its place you see flashing LEDs and/or additional error information.

Table 3-3: Errors displayed on lightbar

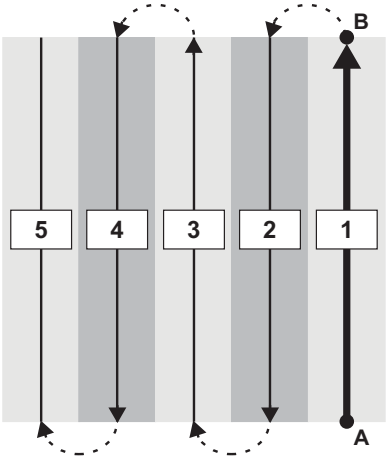
Lightbar Display	Error Message
 Left side (Disp 1 and Disp 2)  Right side (Disp 3 and Disp 4)	*Acquiring/re-acquiring a GPS signal* Upon 1) losing your GPS signal in guidance mode, or 2) when changing your DGPS source (WAAS to e-Dif or vice versa) in setup mode, LiteStar IV attempts to acquire/re-acquire the signal. During this time, the lightbar displays: • 'WaitGPS' in Disp 1/Disp 2 • Number of tracked satellites in Disp 3 (03 at left) • Horizontal dilution of precision (HDOP) in Disp 4 (2.3 at left)
	*Swath double spray* Upper LED row flashes when spray on is detected on a previously sprayed swath. The flashing continues until you change (increment) the swath number.
 Console error (flashing)  Console error (flashing)	*Console logging error* Status LEDs (shown at left) blink orange as the error occurs, continuing for 3-4 seconds after the error condition stops. Error conditions are: • Communication issues between lightbar and controller • Cannot access internal memory • Corrupt or missing log file • Full, corrupt, damaged, or unmounted internal memory • Timeout writing data to memory If the error condition persists, Satloc recommends power cycling the controller, exporting log files, or starting a new job.

Flying the Available Pattern Types

This section reinforces the main points about each pattern and describes how to fly the patterns.

Back-to-Back Pattern (BK_BK)

In a Back-to-Back (open) pattern, you fly consecutive swaths parallel to the A|B line. You can fly this pattern either left-to-right (BK_BK R) or right-to-left (BK_BK L, shown below).



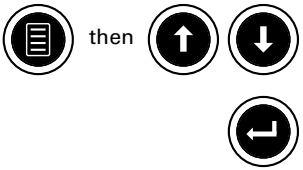
To fly a Back-to-Back pattern:

1. Set the swath width.
2. Set the pattern type as BK_BK R or BK_BK L.
3. Press enter to begin guidance.

   or

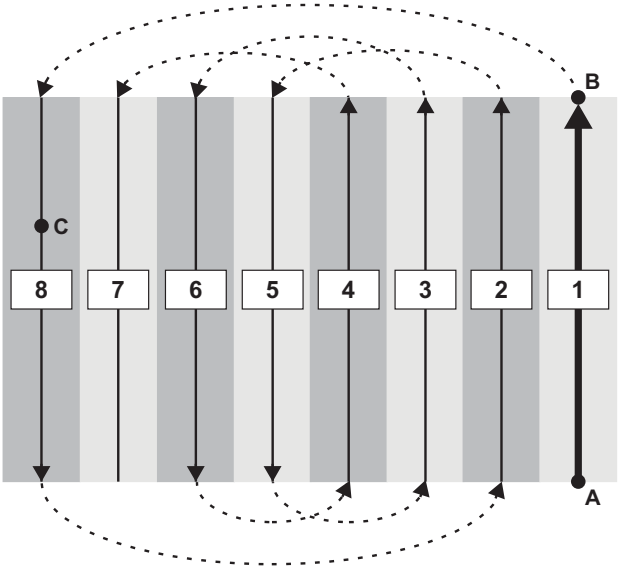
   Press menu to move to the next main menu item then scroll up/down to set the value—repeat this sequence for each additional menu item you want to set.
   Then press enter to begin guidance.

4. Set your A|B line (see “Flying a Pattern” on page 27).
5. Fly swaths consecutively: 1, 2, 3, etc.

Racetrack Pattern (RC_TRK)

The Racetrack (closed) pattern consists of a series of loops (or racetracks) resulting in wider, smoother turns. In this pattern, you first fly each side of a field, then alternately work from swath #2 to the middle, and from the middle toward the other end of the field.



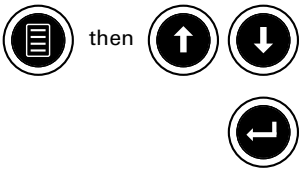
To fly a Racetrack pattern:

1. Set the swath width.
2. Set the pattern type as RC_TRK.
3. Press enter to begin guidance.

   or

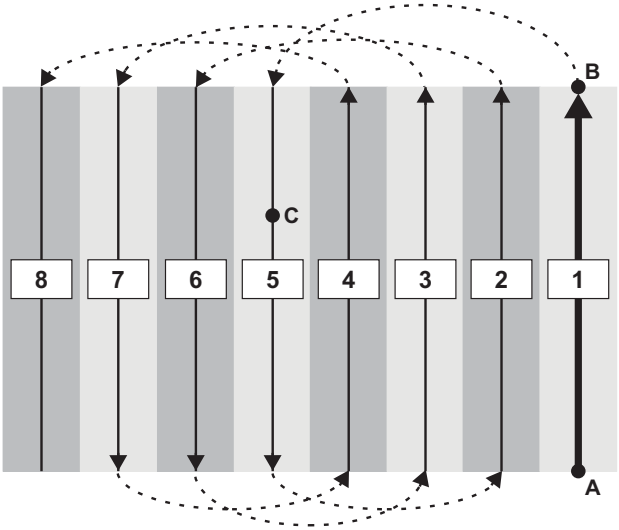
   Press menu to move to the next main menu item then scroll up/down to set the value—repeat this sequence for each additional menu item you want to set.
   Then press enter to begin guidance.

4. Set your A|B line (see “Flying a Pattern” on page 27).
5. For example, for an 8-swath Racetrack pattern, fly swaths in the following order: 1, 8, 2, 5, 3, 6, 4, 7.

Quick Racetrack Pattern (QK_RTRK)

The Quick Racetrack (closed) pattern is similar to the Racetrack pattern; however, in a Quick Racetrack pattern you set your C point in the center of the field, not at the end. This is called a 'Quick' Racetrack because you do not have to fly to the end of the field to set the C point. In the Quick Racetrack pattern you fly a constant size loop after setting the A, B, and C points. Point C is the swath on or after the field center line.

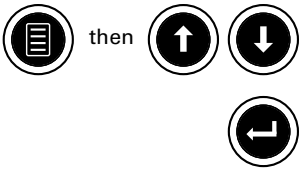


To fly a Quick Racetrack pattern:

1. Set the swath width.
2. Set the pattern type as QK_RTRK.
3. Press enter to begin guidance.

or

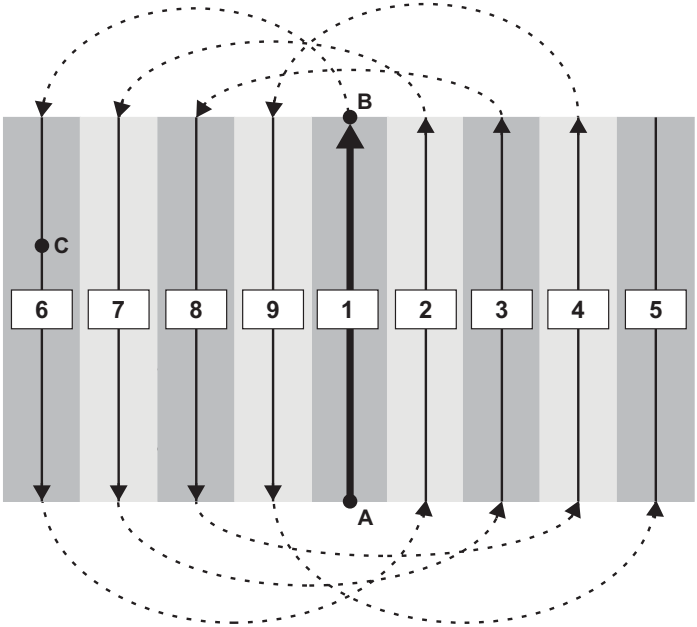
Press menu to move to the next main menu item then scroll up/down to set the value—repeat this sequence for each additional menu item you want to set.
Then press enter to begin guidance.



4. Set your A, B, and C points (see "Flying a Pattern" on page 27).
5. For example, for an 8-swath Quick Racetrack pattern, fly swaths in the following sequence: 1, 5, 2, 6, 3, 7, 4, 8.

Reverse Racetrack Pattern (RV_TRK)

The Reverse Racetrack (closed) pattern is similar to the Racetrack pattern; however, you fly in one direction but swaths increment in the opposite (reverse) direction. In the example below, as you fly to the left the swaths increment to the right. Unlike the Racetrack pattern, in the Reverse Racetrack pattern you set your A|B line in the middle of the field. Point C is still on the edge of the field. This pattern is recommended for circular fields or other fields where the center line is clearly visible.



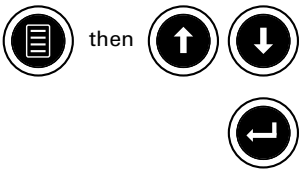
To fly a Reverse Racetrack pattern:

1. Set the swath width.
2. Set the pattern type as RV_TRK.
3. Press enter to begin guidance.

   or

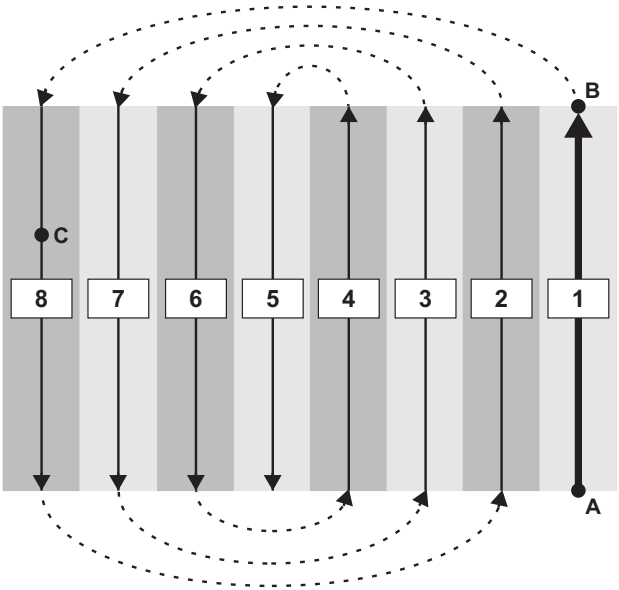
   Press menu to move to the next main menu item then scroll up/down to set the value—repeat this sequence for each additional menu item you want to set.
   Then press enter to begin guidance.

4. Set your A|B line (see “Flying a Pattern” on page 27).
5. For example, for a 9-swath right Reverse Racetrack pattern, spray the swaths in the following sequence: 1, 6, 2, 7, 3, 8, 4, 9, 5.

Squeeze Pattern (Squeeze)

The Squeeze (closed) pattern consists of loops of decreasing size, from the outside of the field to the middle of the field. You define the outside edges of your field (the largest loop) by your A|B|C points. You make wide turns at the beginning of your spray job when your load is heavy then make narrower turns as your load lightens.



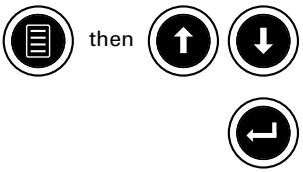
To fly a Squeeze pattern:

1. Set the swath width.
2. Set the pattern type as Squeeze.
3. Press enter to begin guidance.

   or

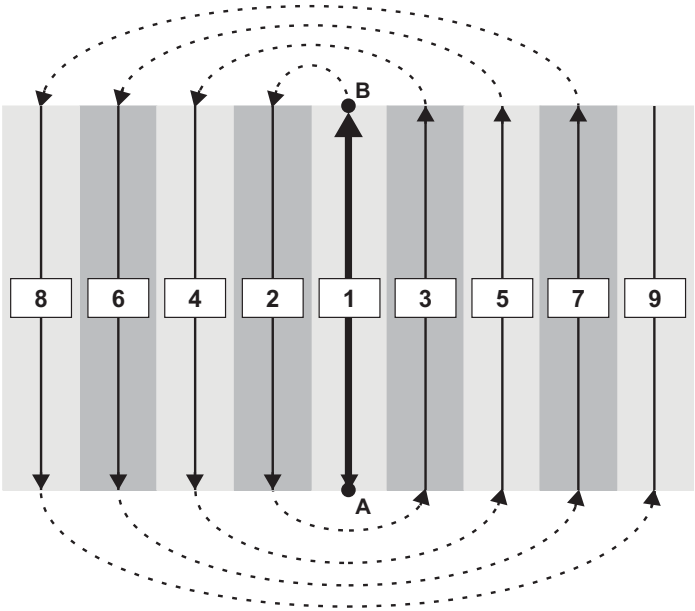
   Press menu to move to the next main menu item then scroll up/down to set the value—repeat this sequence for each additional menu item you want to set.
   Then press enter to begin guidance.

4. Set your A|B line (see “Flying a Pattern” on page 27).
5. For example, for an 8-swath Squeeze pattern, spray the swaths in the following sequence: 1, 8, 2, 7, 3, 6, 4, 5

Expand Pattern (Expand)

The Expand (open) pattern begins with the A|B line in the center of the field and successive swaths increase outward. Expand patterns are useful for fields with a visible center line or with a long, irregular shape. You can fly this pattern either right-to-left or left-to-right.



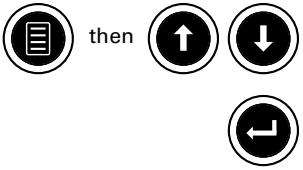
To fly an Expand pattern:

1. Set the swath width.
2. Set the pattern type as Expand.
3. Press enter to begin guidance.

   or

   Press menu to move to the next main menu item then scroll up/down to set the value—repeat this sequence for each additional menu item you want to set.
   Then press enter to begin guidance.

4. Set your A|B line (see “Flying a Pattern” on page 27).
5. For example, for a 9-swath left Expand pattern, spray the swaths in the following sequence: 1, 2, 3, 4, 5, 6, 7, 8, 9

Using Navigation Marks

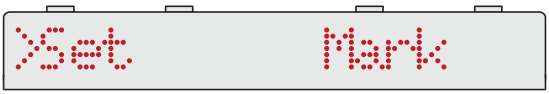
LiteStar IV enables you to set a mark, return to a mark, and cancel guidance to a mark.

Setting a Mark

A mark is a location you set that you want to fly back to—when you save a mark you are saving the GPS coordinates of that point. You can set one mark. Each time you set a mark or when you start a new job, LiteStar IV deletes the previous mark.

To set a mark:

1. In guidance mode press MANUAL MARK (joystick). This sets the GPS coordinates of the mark and Set / Mark appears.



2. Press enter or SWATH ADVANCE (joystick) to confirm the mark and return to guidance mode.

Returning to a Mark

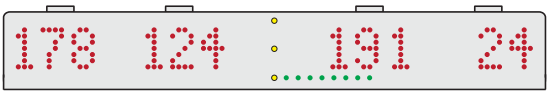
When you return to a mark, LiteStar IV calculates the shortest distance between where you recalled the mark and the mark, and provides guidance back to the mark. When you enter 'return to mark' mode, the lightbar displays the following (regardless of the field settings before receiving guidance to a mark):

Disp 1: Bearing Disp 2: Speed Disp 3: Aircraft Heading Disp 4: Distance to Mark

To return to a mark:

1. Press menu. (Return) / To Mark appears.

2. Press enter or SWATH ADVANCE (joystick). You return to guidance mode with guidance to the mark. The example below shows (from left to right): bearing: 178°, speed: 124 mph, heading: 191°, and distance to mark: 24 ft. As you get closer to the mark, the distance-to-mark value (Disp 4) decreases; when you reach the mark, this value is zero.



Canceling Guidance to a Mark

Note: Canceling guidance to a mark does not delete the mark. To delete a mark: 1) set a new mark to overwrite the existing mark, or 2) start a new job.

To cancel guidance to a mark, press enter or SWATH ADVANCE (joystick). You return to swath guidance mode.

Chapter 4: GPS Data

Viewing GPS Data

Exporting Logs to a USB Drive

You can view GPS data and export logged data to a USB drive.

Viewing GPS Data

The GPS menu provides access to the following read-only LiteStar IV GPS information (with an example menu to the right of the bulleted list).

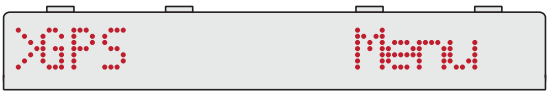
GPS	
>Status	3D Diff
>Sats	Trak 09
>Sats	Used 09
>Diff	Age 005
>HDOP	0.90
>N	033. 5571297
>W	111. 8892345
>Alt Ft	1247.75
>Mph	45.12
>Heading	000
>Date	16-04-13
>Time	19:48:12

- Status (signal status)
  - '3D Diff' indicates a three-dimensional differentially corrected signal (if you do not have a DGPS signal, you cannot view the GPS menu).
  - 'NoFixes' indicates you have no GPS signal
- Sats
  - Number of satellites tracked (Trak 09)
  - Number of satellites used (Used 09)

  You need to track at least four satellites to obtain an accurate GPS position.
- Diff (differential age, in seconds)—time since last differential correction. If this value is zero, you are not receiving differential corrections.
- HDOP (horizontal dilution of precision)—the lower the value the better the GPS precision.
- Latitude (N or S), longitude (W or E), altitude (feet or meters), speed (mph or kph), and heading of aircraft (degrees). For altitude and speed, see "Setting the Units of Measurement" on page 13 to set your units as feet or meters.
- Date/Time—local date and time based on UTC offset. See "Setting the UTC Offset" on page 13.

To view GPS status:

1. Press menu repeatedly until GPS / Menu appears.



2. Scroll up/down until you see the desired GPS menu item.

   The example below shows the (DGPS) Status as 3D Diff (after scrolling down once).

Exporting Logs to a USB Drive

The LiteStar IV controller has built-in storage for logged data.Satloc recommends exporting logs at regular intervals (such as daily or weekly) to keep the export process as short as possible.

When you insert a USB drive in the controller and log data is available for export, an Export option is added to the Job menu (Export appears along with New Job and Old Job).

Note: The lightbar may display '>Export Needed' when entering setup mode to remind you to export log data soon.

Key points on logging data:

- When you export log data, all stored log files are exported to the USB drive and are deleted from the controller. You cannot re-export the same log files.
- Log file format is: YYMMDDxx.LOG, where:

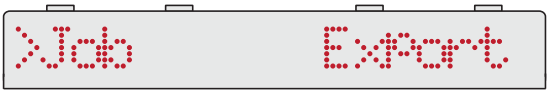
  YY is the two-digit year (00-99)
  MM is the two-digit month (01-12)
  DD is the two-digit day of month (01-31)
  xx is the two--digit log sequence number (00-99)

  Example: 16041331 is the 32nd log file from April 13, 2016 (00 is the first log of the day, so 31 represents the 32nd log).
- Exported log files require a third-party application (such as Satloc MapStar) to view log data.

To export log data to a USB drive:

1. Insert a USB drive into the USB port on the controller.
2. Press menu. Job / Old Job appears.

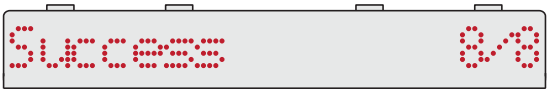
3. Scroll up/down until Export appears.



4. Press enter. The lightbar displays the following sequence:

   The LEDs on the left side of the lightbar illuminate to display a progress bar that increases in size (to the right) as the percentage on the right side increases.

When the export completes successfully, a success message appears with the number of log files exported.



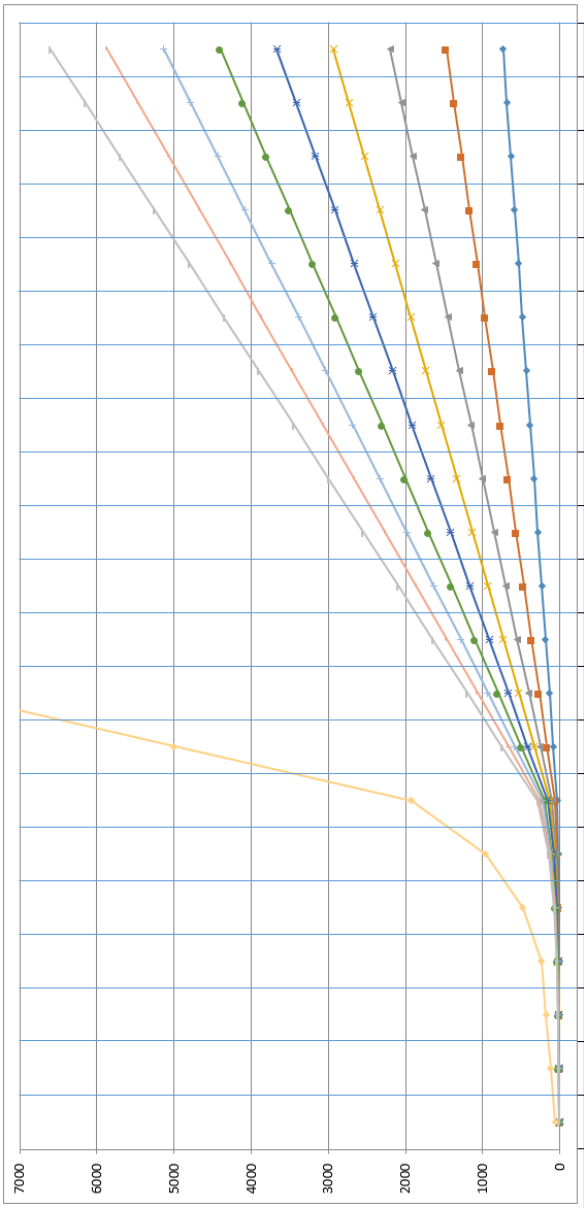
5. Remove the USB drive from the controller.

Appendix: Additional Information

Crosstrack Sensitivity Chart
Frequently Asked Questions

Crosstrack Sensitivity Chart

The chart below illustrates how the different crosstrack sensitivity settings affect how the LEDs are illuminated.



Sensitivity Level	LED 1	LED 2	LED 3	LED 4	LED 5	LED 6	LED 7	LED 8	LED 9	LED 10	LED 11	LED 12	LED 13	LED 14	LED 15	LED 16	LED 17	LED 18	LED 19	LED 20	LED 21
1	1	2	3	4	8	16	32	83	133	183	233	283	333	383	433	483	533	583	633	683	733
2	2	4	6	8	16	32	64	166	266	366	466	566	666	766	866	966	1066	1166	1266	1366	1466
3	3	6	9	12	24	48	96	250	400	550	700	850	1000	1150	1300	1450	1600	1750	1900	2050	2200
4	4	8	12	16	32	64	128	333	533	733	933	1133	1333	1533	1733	1933	2133	2333	2533	2733	2933
5	5	10	15	20	40	80	160	416	666	916	1166	1416	1666	1916	2166	2416	2666	2916	3166	3416	3666
6	6	12	18	24	48	96	192	500	800	1100	1400	1700	2000	2300	2600	2900	3200	3500	3800	4100	4400
7	7	14	21	28	56	112	224	583	933	1283	1633	1983	2333	2683	3033	3383	3733	4083	4433	4783	5133
8	8	16	24	32	64	128	256	666	1066	1466	1866	2266	2666	3066	3466	3866	4266	4666	5066	5466	5866
9	9	18	27	36	72	144	288	750	1200	1650	2100	2550	3000	3450	3900	4350	4800	5250	5700	6150	6600
10	60	120	180	240	480	960	1920	5000	8000	11000	14000	17000	20000	23000	26000	29000	32000	35000	38000	41000	44000

Frequently Asked Questions

Q: My system will not power on when I flip the power switch ON.

A: When you power on the system the LiteStar IV controller buttons have a blue illuminated border and the lightbar runs through the startup sequence (see “Powering On the LiteStar IV” on page 6).

If there is no power to the system:

1. Verify there is power to the controller and controller circuit breaker (see “Controller” on page 8).
2. Check the circuit breaker. If you trip (over current) the controller (‘3’ button pops outward), push the circuit breaker back in.

   ⚠WARNING: *Disconnect the power source from controller when checking the circuit breaker.*

3. Check for other aircraft-related issues:
   - Aircraft battery state (common problem)
   - Aircraft-LiteStar IV cable installation
   - Aircraft-LiteStar IV grounding connections
   - Aircraft battery charging system components (such as alternator or regulator)
4. Check all wiring connections and terminal strips.

   ⚠WARNING: *Avoid shorts to ground that may damage the controller.*

Q: Why don’t I have guidance?

A: You may have lost differential GPS. Press menu until GPS appears, then scroll up/down to display the following settings.

- Status: Will display ‘3D Diff’ when you are receiving DGPS corrections.
- Sats Trak: You need at least four satellites to obtain an accurate GPS position.
- Diff Age: If the differential age is zero, you are not receiving differential corrections.

Q: How do I know which mode I am in?

A: If no LEDs are illuminated in the upper and lower bars, you are in setup mode. If there are upper or lower bar LEDs illuminated and all four display fields (Disp 1 - Disp 4) show data, you are in guidance mode. See “Two Modes - Setup and Guidance” on page 10.

Q: How do I select a pattern?

A: Press menu until Patrn appears, then scroll up/down to select your pattern.

Q: I made a mistake entering my B point: Do I have to restart at point A?

A: If you have already set your B point, you must reset point A (by starting a new job and pattern).

Q: What is crosstrack distance?

A: Crosstrack (X-Track) is the perpendicular distance between you and the target swath line. You can use Disp 1 or Disp 4 to display your crosstrack distance (Disp 4 shows crosstrack by default)—you cannot display crosstrack distance in Disp 2 and Disp 3.

Q: How does the weather affect the GPS signal?

A: Weather such as rain, sleet, snow, thunderstorms, and wind normally does not affect the GPS signal.

Q: How do I change my swath width?

A: You can set your swath width only when you start a new job. Upon selecting a new job, LiteStar IV first displays the SWidth option. You can accept the current value or select a different value.

Q: I've just finished spraying my field. How do I save my work? How do I start a new job?

A: LiteStar IV automatically saves data associated with each job., including the total sprayed area and any mark you entered during the job.

Q: Should my spray be turned on or off when creating the A|B line?

A: That depends. You can create your A|B line inside or outside of the field to meet your needs. If you create the A|B line outside of your field, you will want your spray turned off.

The most common scenario, however, is to create the A|B line with the spray turned on when you fly your first swath.

Q: My field is not an even width. How will this affect my swath guidance?

A: Most fields will not be exactly divisible by your selected swath width. Typically, you will have a portion of a swath remaining when flying a closed pattern. LiteStar IV will provide guidance to the next highest swath number—you may want to ignore this guidance and make a visual pass to spray the remainder of the field.

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18. PROPRIETARY RIGHTS INDEMNITY. Satloc shall indemnify, defend and hold harmless Licensee from and against any and all actions, claims, demands, proceedings, liabilities, direct damages, judgments, settlements, fines, penalties, costs and expenses, including royalties and attorneys' fees and related costs, in connection with or arising out of any actual infringement of any third party patent, copyright or other intellectual property right by the Software or by its use, in accordance with this Agreement and documentation, PROVIDED THAT: (a) Satloc has the right to assume full control over any action, claim, demand or proceeding, (b) Licensee shall promptly notify Satloc of any such action, claim, demand, or proceeding, and (c) Licensee shall give Satloc such reasonable assistance and tangible material as is reasonably available to Licensee for the defense of the action, claim, demand or proceeding. Licensee shall not settle or compromise any of same for which Satloc has agreed to assume responsibility without Satloc's prior written consent. Licensee may, at its sole cost and expense, retain separate counsel from the counsel utilized or retained by Satloc.
19. INFRINGEMENT. If use of the Software may be enjoined due to a claim of infringement by a third party then, at its sole discretion and expense, Satloc may do one of the following: (a) negotiate a license or other agreement so that the Product is no longer subject to such a potential claim, (b) modify the Product so that it becomes non- infringing, provided such modification can be accomplished without materially affecting the performance and functionality of the Product, (c) replace the Software, or the Product, with non-infringing software, or product, of equal or better performance and quality, or (d) if none of the foregoing can be done on a commercially reasonable basis, terminate this license and Licensee shall stop using the Product and Satloc shall refund the price paid by Licensee less an amount on account of amortization, calculated on a straight-line basis over a deemed useful life of three (3) years.

    The foregoing sets out the entire liability of Satloc and the sole obligations of Satloc to Licensee in respect of any claim that the Software or its use infringes any third party rights.

20. INDEMNIFICATION. Except in relation to an infringement action, Licensee shall indemnify and hold Satloc harmless from any and all claims, damages, losses, liabilities, costs and expenses (including reasonable fees of lawyers and other professionals) arising out of or in connection with Licensee's use of the Product, whether direct or indirect, including without limiting the foregoing, loss of data, loss of profit or business interruption.

21. TERMINATION. Licensee may terminate this Agreement at any time without cause. Satloc may terminate this Agreement on 30 days notice to Licensee if Licensee fails to materially comply with each provision of this Agreement unless such default is cured within the 30 days. Any such termination by a party shall be in addition to and without prejudice to such rights and remedies as may be available, including injunction and other equitable remedies. Upon receipt by Licensee of written notice of termination from Satloc or termination by Licensee, Licensee shall at the end of any notice period (a) cease using the Software; and (b) return to Satloc (or destroy and provide a certificate of a Senior Officer attesting to such destruction) the Software and all related material and any magnetic or optical media provided to Licensee. The provisions of Sections 6), 7), 8), 9), 10), 15), 21), 26) and 27) herein shall survive the expiration or termination of this Agreement for any reason.

22. **EXPORT RESTRICTIONS**. Licensee agrees that Licensee will comply with all export control legislation of Canada, the United States, Australia and any other applicable country's laws and regulations, whether under the Arms Export Control Act, the International Traffic in Arms Regulations, the Export Administration Regulations, the regulations of the United States Departments of Commerce, State, and Treasury, or otherwise as well as the export control legislation of all other countries.

23. **PRODUCT COMPONENTS.** The Product may contain third party components. Those third party components may be subject to additional terms and conditions. Licensee is required to agree to those terms and conditions in order to use the Product.

24. **FORCE MAJEURE EVENT.** Neither party will have the right to claim damages as a result of the other's inability to perform or any delay in performance due to unforeseeable circumstances beyond its reasonable control, such as labor disputes, strikes, lockouts, war, riot, insurrection, epidemic, Internet virus attack, Internet failure, supplier failure, act of God, or governmental action not the fault of the non-performing party.

25. **FORUM FOR DISPUTES**. The parties agree that the courts located in the State of Texas and the courts of appeal there from will have exclusive jurisdiction to resolve any disputes between Licensee and Satloc concerning this Agreement or Licensee's use or inability to use the Software and the parties hereby irrevocably agree to attorn to the jurisdiction of those courts. Notwithstanding the foregoing, either party may apply to any court of competent jurisdiction for injunctive relief.

26. **APPLICABLE LAW**. This Agreement shall be governed by the laws of the State of Texas, exclusive of any of its choice of law and conflicts of law jurisprudence.

27. **CISG.** The United Nations Convention on Contracts for the International Sale of Goods will not apply to this Agreement or any transaction hereunder.

28. **GENERAL.** This is the entire agreement between Licensee and Satloc relating to the Product and Licensee's use of the same, and supersedes all prior, collateral or contemporaneous oral or written representations, warranties or agreements regarding the same. No amendment to or modification of this Agreement will be binding unless in writing and signed by duly authorized representatives of the parties. Any and all terms and conditions set out in any correspondence between the parties or set out in a purchase order which are different from or in addition to the terms and conditions set forth herein, shall have no application and no written notice of same shall be required. In the event that one or more of the provisions of this Agreement is found to be illegal or unenforceable, this Agreement shall not be rendered inoperative but the remaining provisions shall continue in full force and effect.

Warranty Notice

COVERED PRODUCTS: This warranty covers all products manufactured by Satloc. (**"Satloc"**) and purchased by the end purchaser (the **"Products"**), unless otherwise specifically and expressly agreed in writing by Satloc.

LIMITED WARRANTY: Satloc warrants solely to the end purchaser of the Products, subject to the exclusions and procedures set forth below, that the Products sold to such end purchaser and its internal components shall be free, under normal use and maintenance, from defects in materials, and workmanship and will substantially conform to Satloc's applicable specifications for the Product, for a period of 24 months (Satloc products) or 12 months (all other Transland products) from delivery of such Product to such end purchaser (the **"Warranty Period"**). Repairs and replacement components for the Products are warranted, subject to the exclusions and procedures set forth below, to be free, under normal use and maintenance, from defects in material and workmanship, and will substantially conform to Satloc's applicable specifications for the Product, for 90 days from performance or delivery, or for the balance of the original Warranty Period, whichever is greater.

EXCLUSION OF ALL OTHER WARRANTIES. The LIMITED WARRANTY shall apply only if the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Satloc's relevant User's Manual and Specifications, AND the Product is not modified or misused. The Product is provided "AS IS" and the implied warranties of MERCHANTABILITY and FITNESS FOR A PARTICULAR PURPOSE and ALL OTHER WARRANTIES, express, implied or arising by statute, by course of dealing or by trade usage, in connection with the design, sale, installation, service or use of any products or any component thereof, are EXCLUDED from this transaction and shall not apply to the Product. The LIMITED WARRANTY is IN LIEU OF any other warranty, express or implied, including but not limited to, any warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, title, and non-infringement.

LIMITATION OF REMEDIES. The purchaser's EXCLUSIVE REMEDY against Satloc shall be, at Satloc's option, the repair or replacement of any defective Product or components thereof. The purchaser shall notify Satloc or an Satloc approved service center immediately of any defect. Repairs shall be made through an Satloc approved service center only. Repair, modification or service of Satloc products by any party other than an Satloc approved service center shall render this warranty null and void. The remedy in this paragraph shall only be applied in the event that the Product is properly and correctly installed, configured, interfaced, maintained, stored, and operated in accordance with Satloc's relevant User's Manual and Specifications, AND the Product is not modified or misused. NO OTHER REMEDY (INCLUDING, BUT NOT LIMITED TO, SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL OR CONTINGENT DAMAGES FOR LOST PROFITS, LOST SALES, INJURY TO PERSON OR PROPERTY, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL LOSS) SHALL BE AVAILABLE TO PURCHASER, even if Satloc has been advised of the possibility of such damages. Without limiting the foregoing, Satloc shall not be liable for any damages of any kind resulting from installation, use, quality, performance or accuracy of any Product.

SATLOC IS NOT RESPONSIBLE FOR PURCHASER'S NEGLIGENCE OR UNAUTHORIZED USES OF THE PRODUCT. IN NO EVENT SHALL SATLOC BE IN ANY WAY RESPONSIBLE FOR ANY DAMAGES RESULTING FROM PURCHASER'S OWN NEGLIGENCE, OR FROM OPERATION OF THE PRODUCT IN ANY WAY OTHER THAN AS SPECIFIED IN SATLOC'S RELEVANT USER'S MANUAL AND SPECIFICATIONS. Satloc is NOT RESPONSIBLE for defects or performance problems resulting from (1) misuse, abuse, improper installation, neglect of Product; (2) the utilization of the Product with hardware or software products, information, data, systems, interfaces or devices not made, supplied or specified by Satloc; (3) the operation of the Product under any specification other than, or in addition to, the specifications set forth in Satloc's relevant User's Manual and Specifications; (4) damage caused by accident or natural events, such as lightning (or other electrical discharge) or fresh/salt water immersion of Product; (5) damage occurring in transit; (6) normal wear and tear; or (7) the operation or failure of operation of any satellite-based positioning system or differential correction service; or the availability or performance of any satellite-based positioning signal or differential correction signal.

THE PURCHASER IS RESPONSIBLE FOR OPERATING THE VEHICLE SAFELY. The purchaser is solely responsible for the safe operation of the vehicle used in connection with the Product, and for maintaining proper system control settings. UNSAFE DRIVING OR SYSTEM CONTROL SETTINGS CAN RESULT IN PROPERTY DAMAGE, INJURY, OR DEATH. The purchaser is solely responsible for his/her safety and for the safety of others. The purchaser is solely responsible for maintaining control of the automated steering system at all times. THE PURCHASER IS SOLELY RESPONSIBLE FOR ENSURING THE PRODUCT IS PROPERLY AND CORRECTLY INSTALLED, CONFIGURED, INTERFACED, MAINTAINED, STORED, AND OPERATED IN ACCORDANCE WITH SATLOC'S RELEVANT USER'S MANUAL AND SPECIFICATIONS. Satloc does not warrant or guarantee the positioning and navigation precision or accuracy obtained when using Products. Products are not intended for primary navigation or for use in safety of life applications. The potential accuracy of Products as stated in Satloc literature and/or Product specifications serves to provide only an estimate of achievable accuracy based on performance specifications provided by the satellite service operator (i.e. US Department of Defense in the case of GPS) and differential correction service provider. Satloc reserves the right to modify Products without any obligation to notify, supply or install any improvements or alterations to existing Products.

GOVERNING LAW. This agreement and any disputes relating to, concerning or based upon the Product shall be governed by and interpreted in accordance with the laws of the State of Texas.

OBTAINING WARRANTY SERVICE. In order to obtain warranty service, the end purchaser must bring the Product to an Satloc approved service center along with the end purchaser's proof of purchase. Satloc does not warrant claims asserted after the end of the warranty period. For any questions regarding warranty service or to obtain information regarding the location of an Satloc approved service center, contact Satloc at the following address:

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1206 Hatton Rd
Wichita Falls, TX, USA 76302
Phone: (800) 388-2511
Sales email: Sales@translandllc.com
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