

User Manual

TinySurveyor

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1 Introduction

Welcome to the user manual for TinyMobileRobots' TinySurveyor.

1.1 What it can do

Congratulations on your purchase of the TinySurveyor. With this machine, marking and surveying will be easier than it's ever been before!

TinySurveyor is an autonomous robot that replaces manual marking and surveying. The robot utilizes GNSS position technology and smart integrated software, to make marking and surveying fully autonomous!

TinySurveyor can use data from CAD or GIS tools already prepared or it can collect points out in the field. The user can interact with the robot using a remote control tablet. On the tablet, planned jobs are visualized and settings can be changed.

1.2 Reading instructions

Knowing TinySurveyor's features can help you obtain the best marking and surveying results and the most effective use of TinySurveyor. We recommend that you read this user manual thoroughly to gain a better understanding of the TinySurveyor's capabilities.

For more information and FAQ about TinySurveyor, visit the TinyMobileRobots website.

www.tinymobilerobots.com

IMPORTANT INFORMATION

Be aware that the user is responsible for any accidents or risks involving people or property.



At TinyMobileRobots, we are constantly working to improve and develop our products; hence, TinyMobileRobots reserves the right without notice to change the appearance and/or features of the robot and the tablet.

In this manual, the following fonts styles and symbols are used:

- Text with *Italic* font is used when referring to names in the TinySurveyor app or referring to other sections in the manual.



Indicates useful information and tips about the use of the product.



Indicates a warning that must be understood and followed.

1.2.1 Safety

For the safety of the user and TinySurveyor's working environment, the listed safety instructions must be followed:

IMPORTANT INFORMATION

Read the user manual thoroughly before using TinySurveyor in order to understand the content and the way in which TinySurveyor operates.

WARNING

Incorrect operation and misuse of TinySurveyor can create dangerous situations!



TinyMobileRobots can never be held responsible for any harm or damage done by TinySurveyor.

TinySurveyor must be fully stopped if children or animals enter the workspace.

Never use TinySurveyor to transport people, animals or objects. Never place any objects on TinySurveyor, as doing so could lead to the fatal damage of TinySurveyor, people, animals or other objects.

An emergency STOP button is placed on top of TinySurveyor. This button will stop all TinySurveyor driving activity. Push the emergency STOP button if a dangerous situation is about to occur.

Whenever TinySurveyor is in automatic driving mode, a STOP button will appear in the TinySurveyor app. Use this STOP button to stop TinySurveyor if a dangerous situation is about to occur.

Both the emergency STOP button on the robot and the STOP button on the tablet will force TinySurveyor into manual mode, and the user must ensure that the situation is safe before restarting operation.

The TinySurveyor app enables the remote control of TinySurveyor. The user is at all times responsible for the safety of all persons, animals and things within TinySurveyor's workspace.

Always turn off TinySurveyor when performing inspections or maintenance. To turn off TinySurveyor, turn the battery key counterclockwise.

Only an authorized technician may open and conduct service inside TinySurveyor's electronic box.

TinySurveyor must be turned off when not in use and during transportation.

During transportation, TinySurveyor must always stand on the three wheels, and it must never be placed on the side or upside-down.

TinySurveyor is designed to be resistant to rain and similar weather. Never cover the entire robot, or parts of the robot, with water, as this may cause fatal damage to the device.

Do not use high-pressure cleaning devices on the robot, as this will damage the robot.



2 Robot overview

2.1 Components



1 - Structural overview of the robot.

- | | |
|---|------------------------------------|
| 1. GNSS antenna (only included for per-installed internal GNSS) | 7. 5/8" GNSS mount |
| 2. Tool carrier (picture shows spray tool mounted) | 8. Electronic box |
| 3. Motor wheels | 9. USB connector |
| 4. Status light | 10. Caster wheel |
| 5. Emergency stop button | 11. Robot battery charger |
| 6. Replaceable battery | 12. Tablet charger |
| | 13. Tablet |
| | 14. Side mount and extension cable |

Not included:

NTRIP RTK service 14

INFO

The TinySurveyor is delivered without GNSS receiver and antenna, the user can mount a GNSS receiver on the 5/8" GNSS mount. The TinyPreMarker is delivered with a built-in GNSS receiver and external GNSS antenna.



2.2 Specifications

Specification	Value	
Dimensions		
Weight (without battery)	18 kg	40 lbs
Length	804 mm	31.7 in
Width	688 mm	27.1 in
Height	491 mm	19.3 in
Electrical components		
Battery type	Replaceable li-ion	
Battery weight	4 kg	8.8 lbs
Capacity	36 v, 17.4 Ah	
Charger voltage	100-240 v	
Charging time*	5 hours	
Battery operation time*	8 hours	
Voltage range inside robot	12-24 VDC	
Performance		
Maximum driving speed	8 km/h	5.0 mph
Maximum spraying speed	4 km/h	2.5 mph
Driving accuracy	<20 mm	<0.8 in
Equipment		
Compatible can sizes	Diameter: Ø65 mm	Diameter: Ø 2.56 in
	Body height min: 157 mm	Body height min: 6.18 in
	Body height max: 300 mm	Body height max: 11.81 in

*Depends on use of the robot and health of the battery.

3 Setup TinySurveyor

3.1 Preparing the robot

Be sure to correctly prepare TinySurveyor and its components; otherwise, the robot may not function as desired, or at all. Failure to comply with the following instructions may cause serious damage to the robot and/or personnel.

3.1.1 Battery

Two batteries are necessary to operate TinySurveyor: one removable battery for the robot and one internal battery in the tablet.

3.1.2 Robot battery

Charging the robot battery:

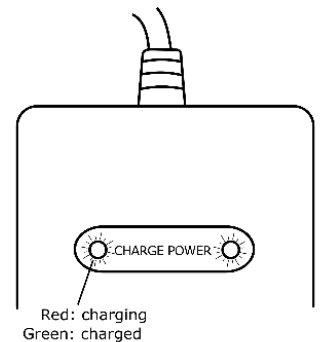
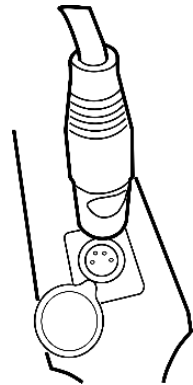
1. Plug the power cable into the power adaptor. Then, plug the *round* charging jack into the battery. The connector is located next to the battery handle.
2. Plug the power cable into an electrical socket.
3. When fully charged, disconnect the battery. First remove the power jack from the electrical socket; then, remove the round charging jack from the battery.

WARNINGS

Only charge the battery with the supplied charger. The charger must be connected to 100-230 VAC, 50-60 Hz. The battery must not be charged while it is connected to the robot.

The battery must only be charged indoors at normal room temperature, and it should always be supervised while recharging. Do not charge the battery unattended or overnight.

Do not charge batteries that have been exposed to blows, shocks and other forms of external damage. There is a risk that the battery could explode if this safety measure is not obeyed.



2 - Light shows red when charging, and green when charged



The battery must be fully charged when stored and every third month if stored for a longer period.

INFO

The battery charger shows two red diodes when the battery is charging and one green and one red diode when the battery is fully charged.

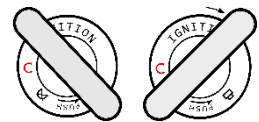
Please contact your dealer if you need a spare battery.

Please contact your dealer for information about safe disposal of the battery.



Attaching the robot battery

1. Slide the battery into the battery rack in the front end of the robot
2. Lock the battery by turning the key 90 degrees clockwise. The battery is locked when it makes a “click” sound.



3 - Key position of unlocked and locked battery

INFO

Make sure the battery rack is cleared, i.e. no dirt or objects are blocking inside the rack.

If the battery is not pushed sufficiently into the battery rack, the key cannot lock the battery correctly.



Detaching robot battery

1. Turn off TinySurveyor.
2. Unlock the battery by pushing the key inwards while turning it 90 degrees counterclockwise.
3. Pull out the battery. The key can stay in, while it is charging/stored.

3.1.3 Tablet battery

Charging the tablet battery:

1. Connect the USB-A end of the charger cable into the USB power adaptor.
2. Plug the power adaptor into an electrical socket.

3. Plug the USB-C end of the charger cable into the tablet. The socket is located at the bottom of the tablet.
4. Disconnect the tablet from the charger when fully charged. First, unplug the micro USB from the tablet. Then, unplug the USB power adaptor from the electrical socket.

WARNINGS

Always use chargers, cables and batteries approved by TinyMobileRobots when charging the robot battery and tablet. Unapproved chargers may cause the battery to explode or damage the devices.



3.1.4 Insert SIM card

A SIM card is needed to allow for remote services. For the pre-installed internal GNSS configuration, the SIM card is needed for access to the RTK correction signal.

To insert a SIM card, please follow these steps

- 1) Remove the pin code from the SIM card.
- 2) Remove the lid of the electronic box.
- 3) Insert the SIM card (Mini SIM) into the modem, a click will be heard when the SIM card is mounted correctly.
- 4) Mount the lid of the electronic box.



4 - Orientate SIM card as illustrated

When the SIM card has been inserted, the setup process will be performed automatically with the next startup of the robot. For some countries, the IMEI number is needed. This number is displayed on the tablet app, *Settings>Communication>Modem*.

INFO

TinySurveyor with pre-installed internal GNSS receiver will not work without a functioning SIM card, as it is needed for the RTK correction signal.

TinySurveyor without pre-installed GNSS works with an external GNSS receiver and can work without a SIM card, but this will limit the support options.



3.1.5 Set up NTRIP RTK (pre-installed internal GNSS)

The TinySurveyor with the pre-installed internal GNSS configuration needs correction data, which can be provided by a base station or an RTK service provider. The robot can receive the data via NTRIP (Network Transport of RTCM via Internet Protocol). When using a base station, it must be connected to an NTRIP server.

The ip-address (or URL), port number, username, password and mountpoint of the base station or the NTRIP RTK service can be entered using the tablet app, *Settings>Communication>NTRIP*.

INFO

To obtain a green light on the robot, make sure that the GNSS antenna is mounted, the SIM card is installed, and the robot has a clear view to the sky.



3.2 Spray tool

The spray tool is used when marking points or lines. The spray tool is mounted on the bottom side of the tool carrier using four bolts. The power cable must be plugged into the rear of the electronic box.

3.2.1 Spray cans

The spray tool is compatible with most standard aerosol spray cans, see table below for the compatible sizes. Ensure that the top plate is in contact with the bottom of the spray can, when the can is mounted. The top plate can be adjusted by loosening three bolts.

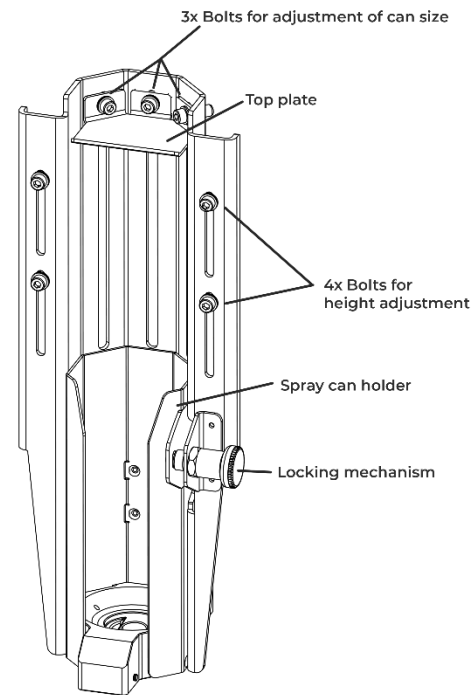
The four bolts allow adjustment of the distance from the spray nozzle to the ground, which in turn adjusts the width of the spray marking on the ground. These bolts must be tightened properly so that the mechanism sprays in a vertical downwards direction. This ensures the best spray result.

Diameter [mm]	Body height [mm]
Ø65	157
Ø65	195
Ø65	240
Ø65	300

INFO

The tool height parameter should be set to 0.0 m (default value) when using the spray tool.

Settings>Robot behaviour>Tool height



5 - Adjustment of spray tool



3.2.2 Spray nozzle

TinySurveyor is delivered with nozzles, which allows for the most common spray cans to be used in the spray tool.

The white tipped nozzle can spray a point of 3-4 cm / 1-1.5" diameter, in the lowest height setting of the spray tool.

The black tipped nozzle can spray a point of 6-8 cm / 2-3" diameter, in the lowest height setting of the spray tool.



6 - White and black tipped nozzles

3.2.3 Spray nozzle washer

In the case that the spray mechanism does not initiate the nozzle, try adding a washer to the nozzle as seen on the picture. Washers are supplied with TinySurveyor.

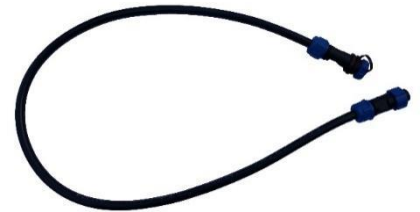


7 - Washer mounted on nozzles

3.2.4 Side mount for spray tool

The side mount allows the spray tool to be mounted on the left or right side of the robot, if driving close to curbs or similar is necessary.

1. Dismount the top plate and the spray tool by loosening the eight M5 bolts attaching the parts.
2. Mount the side mount plate using four M5 bolts. The end with five holes must be placed at the center of the robot.
3. Mount the spray tool in the other end of the side mount plate using four M5 bolts.
4. Use the 75 cm extension cable provided with the side mount to connect the spray tool to the electronic box. Fasten the cable using cable ties to ensure that the cable will not conflict with the wheels.
5. The GNSS receiver/antenna must be mounted in the center of the robot as before.
6. Choose the tool side and the length of the side mount (the side mount is 0.42 m) in the tablet app: *Settings>Robot behavior>Robot geometry*.

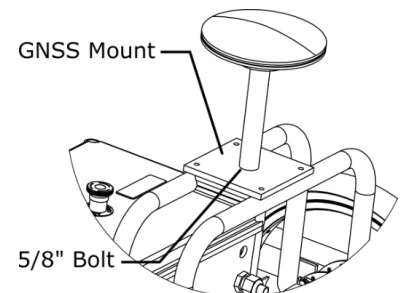
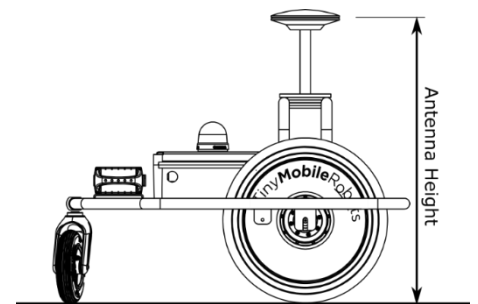
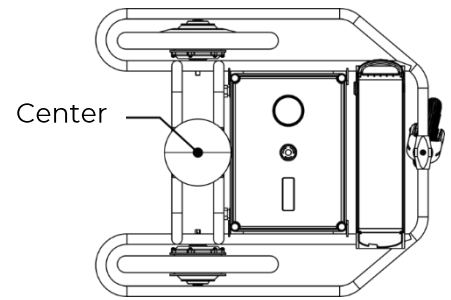


8 - Side mount plate and 75 cm extension cable

3.3 Setup with external GNSS receiver

The TinySurveyor needs an external GNSS receiver for providing position data. The TinySurveyor works with most brands and receiver types. Setup the TinySurveyor with the external GNSS receiver by following these instructions:

1. Setup GNSS receiver to output position data. Setup process differs depending on the receiver, but for all receivers the following is required:
 - Output data continuously via RS232 or Bluetooth
 - Enable only NMEA GGA output min. 10 Hz (0.1s).
 - (Only RS232) Baudrate 115200, 8 bits (1 byte), 1 stop bit, no parity bit
 - (Only RS232) RTS/CTS is off
2. Mount the GNSS receiver on the mounting plate using a distance rod and a 5/8" bolt.
3. Connect the GNSS receiver to the robot using the male RS232 port found in the back of the electronic box. Contact your distributor of the GNSS receiver to acquire a suitable cable. Or connect to the robot via Bluetooth with Bluetooth name and an initialization message (manufacturer specific), *Settings>Communication>Bluetooth*.
4. Measure the antenna height and input the correct value in the tablet app, *Settings>Robot behavior>Robot geometry*. The antenna height is used for tilt compensation, when the robot drives on inclining surfaces.



9 - Setup of internal/external GNSS receiver

3.4 Setup with total station

Instead of using an internal/external GNSS receiver, a robotic total station can be used to provide position data to the robot. The position data can be transmitted using a direct Bluetooth connection or using the total station controller.

3.4.1 Setup total station

The total station must be setup with following configuration.

- Output min. 8 Hz position data (every 0.125 sec), i.e. continuous data stream (10 Hz or more is recommended)
- Position data format must be: Pseudo NMEA, GDM or CSV
- Data output must be sent via Bluetooth or the COM port on the total station controller

Setup differs between different brands, call the supplier for setup details.

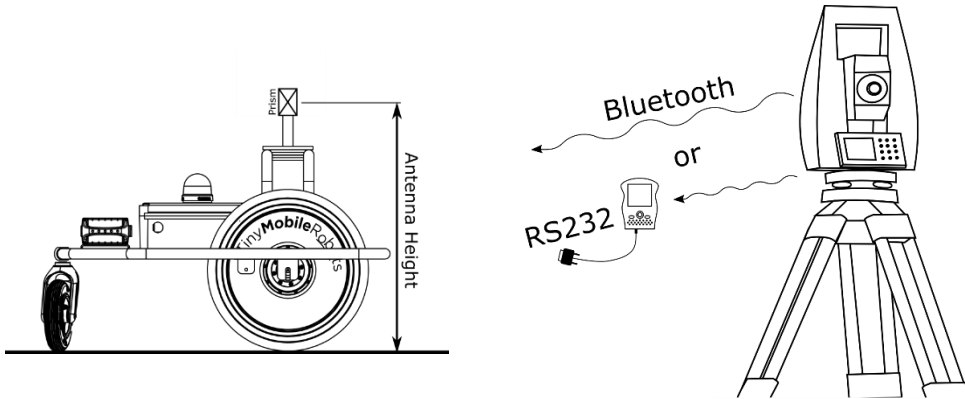
3.4.2 Setup TinySurveyor

TinySurveyor must be setup correctly to work with a total station.

1. Mount a 360 degree prism on top of the GNSS mount
2. Establish connection to the total station/data collector
 - a. Bluetooth: Go to *Settings>Communication>Bluetooth name*, and type the Bluetooth name of the total station
 - b. RS232 cable: Plug the cable from the total station controller into the RS232 plug found in the of back of TinySurveyor
 - i. The total station controller must output data with baudrate 115200, 8 bits (1 byte), 1 stop bit, no parity bit, RTS/CTS is off
3. Set projection: none, Go to *Settings>Projection* and input *none*
4. Set prism height, Go to *Settings>Robot behavior>Antenna height*, input measured height of prism

5. (Optional) Set robot tool height, Go to *Settings>Robot behavior>Tool height*

- If the purpose is to measure heights using the prism, the prism height should be the tool height
- If the purpose is to mark on the ground using the spray tool, the tool height should be set to 0.0



10 - Mount prism on GNSS plate and setup total station to transmit position data.

Warning

When driving with low frequency of position data, the precision might get worse.



INFO

The total station must be a robotic total station that can automatically track the prism.

The total station should be set up to log/save the position as often as possible. At least 10 Hz (every 0.1 second) is recommended, but lower frequencies can work in many cases. Reduce allowed minimum frequency in *settings>Robot behavior>NMEA frequency min*.

Delays reduce precision of the robot, e.g. delays introduced by the Bluetooth connection. Determine the delay and input it in *settings>Robot behavior>Position time delay*.

In some cases, data from the total station is rounded to cm. This will reduce the precision of the robot. Set up the total station to transmit mm data or better, to achieve a higher precision. You will often find there is a tradeoff between frequency of data and precision of the data from the total station.

Expected precision is 2 cm / 0.8"; in most cases, 1 cm / 0.4" precision can be obtained.

Integration with a total station can be done using a Bluetooth radio handle mounted on top of the total station or mounting a Bluetooth transceiver using the RS232 serial port found on the total station. Available connection methods differ between total station manufacturers.

Do not connect a data collector to the total station when using a direct Bluetooth connection to transmit position data to the robot. This may hinder position data to be transmitted to the robot.

The mac address or name of the Bluetooth device will often show up when searching for Bluetooth devices using a smartphone.

Make sure the controller sends data with a baud rate of 115200 8N1 through the RS232 serial output. No RTS/CTS or other control signals.



4 Operating TinySurveyor

4.1 Turning on and off

4.1.1 Turning on the robot and tablet

When the battery is attached and locked, you can turn on the TinySurveyor by turning the battery key clockwise from the locked position. The Signal light will light up when TinySurveyor starts. It can take up to several minutes from turning on TinySurveyor before the robot can navigate in automatic mode, as the robot must retrieve sufficient position data.

Turn on the supplied tablet by pressing and holding the power key until the tablet briefly vibrates. The TinySurveyor app automatically starts when the tablet is on.



11 – Key position of robot turned on

4.1.2 Turning off the robot and tablet

Turn off TinySurveyor by turning the battery key counterclockwise.

Shut down the tablet by pressing and holding the Power button until the shutdown screen appears. Then press Shut down on the tablet screen. Shutting down the tablet while TinySurveyor is not in use will preserve the battery.

WARNING

The tablet must always be turned on when TinySurveyor is operating in automatic mode.



4.1.3 Restarting the robot and tablet

If an unexpected error occurs, it may be resolved by restarting the software. In order to restart the software, restart the robot. Restarting the tablet may also resolve the error.

Restart the robot by turning it off using the battery key. Wait two seconds, and then turn the robot on again.

Restart the tablet by pressing and holding the Power button for three seconds. Then press Restart on the tablet screen when the option appears.

4.2 Automatic and manual mode

TinySurveyor has two operation modes:

Manual mode: TinySurveyor will always start in manual mode when it is first turned on. In manual mode, the user can manually drive the robot and control its action (e.g., Test spray).

Automatic mode: TinySurveyor switches to automatic mode when it is programmed to do an action autonomously (e.g., using the *Drive to*, *Test* and *Start* functions in the TinySurveyor app). The user can stop the robot at any time in automatic mode by using either the TinySurveyor app or the emergency STOP button placed on top of the robot.

WARNING

No people or animals may be within the workspace when TinySurveyor is being operated in manual or automatic mode.



4.3 Status lights

The signal light on the top of TinySurveyor provides the robot's status information.

Signal type	Mode	Control
Flashing light	Automatic mode	Only emergency stop and stop is available
Constant light	Manual mode	Robot can be navigated using the joystick in the TinySurveyor app

	TinySurveyor is operating without any errors and the GNSS signal is good. $HDOP \leq 0.9$.
	TinySurveyor is operating without any errors, but the GNSS signal is weaker. TinySurveyor can still be used for marking/surveying. $HDOP > 0.9$.
	Operation stopped because of an error (the error message is shown in the TinySurveyor app) or an overly weak GNSS signal. The GNSS signal can often be retrieved and automatic driving will continue.
	The robot has received a command from the user and has begun executing it. The light also briefly turns blue when the robot has finished a job.

The color of the light has the same meaning in automatic and manual mode.

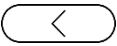
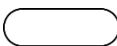
4.4 TinySurveyor app and tablet

All manoeuvring and controlling of TinySurveyor is done using the TinySurveyor app, which is preinstalled on the included tablet. In this section, you'll learn how to use the app.

To facilitate use of the TinySurveyor app, most normal functions of the tablet have been disabled. This user manual only addresses major features of the tablet and the TinySurveyor app.

4.4.1 Tablet

The included tablet has five keys:

Tablet Keys	Location	Function
Power key 	On the side	Press to turn on/off screen. Press and hold three seconds to turn on/off or restart tablet.
Volume key 	On the side	Press to adjust the sound level.
Activate key 	On the side	Not in use.
Back key 	Front bottom	Press to go back one step.
Home key 	Front bottom	Press to turn on screen or to go to tablet home screen.
Recent key 	Front bottom	Not in use.

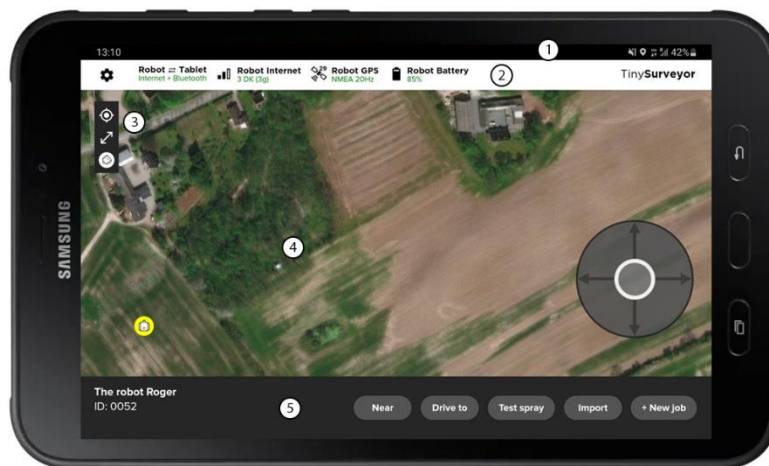
Tablet information symbols (Top bar of tablet)

Function	Symbol
Tablet GPS activated	
Tablet Bluetooth activated	
Tablet internet service activated	LTE  Can also be H+, H, 3G, E or G, depending on the internet speed.
Mobile network signal strength	
Tablet battery power level	

4.4.2 TinySurveyor app

When the robot is connected to the TinySurveyor app, the user can see the main screen shown beneath. You can access all features and information from this screen.

- 1) Top bar of tablet
- 2) Top bar of app
- 3) Navigation panel
- 4) Background map
- 5) Bottom bar of app



2) Top bar of app: Robot information and settings key

Function	Symbol	Explanation
Robot – Tablet connection	Robot = Tablet Bluetooth, Internet	Shows the connection status between the robot and tablet. The communication ways can be Bluetooth, internet or both.
Robot Internet	or	Shows connection method, WiFi or Cellular, and connection status of the robot internet
Robot GNSS/TS	or	Shows status on the position input, GNSS or Total station. Number of visible satellites are shown in top of the satellite icon.
Robot Battery		Indicates TinySurveyor battery status in %.
Settings		Press to enter settings for TinySurveyor app and the TinySurveyor

3) Navigation panel: Keys for map navigation

Function	Symbol	Explanation
Tablet position		Press  to locate the tablet position on the map.
Fit to screen		Press  to fit the job and robot position to the visible map.
Robot position		Press  to locate the robot position on the map.

4) Background map: Symbols and keys on map

Function	Symbol	Explanation
Robot position		Appears on the map and shows where the connected robot is located.
Tablet position		Appears on the map and shows where the tablet is located.
Joystick		When in manual mode, the joystick is available and can be used to manoeuvre the TinySurveyor.
STOP		When in automatic mode, the joystick is replaced with a STOP button. Press  to make TinySurveyor stop driving and exit automatic mode.

5) Bottom bar of app: Keys on bottom bar of app (No job selected)

Function	Symbol	Explanation
Near		Find the nearest point on the nearest line/point. The robot will start marking from this point.
Drive to		<i>Drive to</i> function allows the user to easily move TinySurveyor in a straight line without using the joystick. Press  and then press the desired position on the map. TinySurveyor will start automatic drive mode when the user is pressing  .
Test spray		<i>Test spray</i> function allows the user to spray manually to inspect the nozzle performance and spray settings. Press  to activate the spray with an impulse.

Import		Press  to show the files that can be imported from the USB or from the connected desktop computer.
+New job		<i>New job</i> function allows the user to create and design a new job. Press  to start the design procedure. More information is available in section: 4.5 <i>How to . . .</i>

5 App functionalities

5.1 Settings menu

This section contains a description of the settings pages found under Settings (gear icon). Only the overall purpose and major features for each settings page will be described in this user manual.

5.1.1 General

This page displays a range of app related settings for the background map, visual options for jobs, default way to import files, language and unit.

5.1.2 Position

This page shows an overview of the position input and allows users to change the projection used.

The *Summary* section shows GNSS related information.

The *Projection* section allows you to search and apply projections. The TinySurveyor app holds a projection list of various regional projections. Many projections have been named for easy use. The TinySurveyor app supports projections from the EPSG/ESRI data base which allows you to search for an EPSG/ESRI code and search for this number. Several websites provide search options for projections and their EPSG/ESRI codes.

The *Manage Projections* sections let you create your own projection, either by loading and editing a projection from the projection list or by importing a PRJ file containing the projection information.

The input section (e.g. *NMEA*) shows a detailed overview of the position input used by the robot. You can see the most recently sent position string with the button *Raw NMEA*.

5.1.3 Robot Behavior

This page shows the current values of the TinySurveyor robot parameters. From here, you can change the robot related parameter.

A description of each parameter is listed in the tables below.

Robot velocities	
Parameter name	Description
Manual velocity	Velocity while driving in manual mode, i.e. Joystick velocity.
Drive velocity	Velocity while driving to waypoints in automatic mode.
Spray velocity	Velocity while spraying lines. It is not recommended to use values indicated with red, as this will make the TinySurveyor's driving unstable

Line parameters	
Parameter name	Description
Line length	Length of the marked dashes, when the TinySurveyor is marking lines.
Line space	Length of the space between the marked dashes when the robot is marking lines.
Paint ramp up	Distance the robot uses to start correctly on a line. The longer the ramp up, the better start on lines.
Paint ramp down	Distance the robot drives after the line ends. This distance allows the robot to de-accelerate after the line instead of on the line.

Point parameters	
Parameter name	Description
Spray duration	Amount of time the spray is activated when the robot marks a point. Longer time, more paint.
Default Wait	Amount of time the robot waits at each point after the spray tool has been activated.
Approach distance	Distance used to slow down before a point. Increase this distance to ensure precise marking.

Robot geometry	
Parameter name	Description
Antenna height	Height of the GNSS Antenna relative to the ground. This value is used for tilt compensation.
Tool height	Height of the tool position relative to the ground. Set to 0 when using the spray tool. When doing height measurements with a prism, the tool height should be the prism height relative to the ground. This value is used for tilt compensation.
Tool side	Position of the tool. Default is <i>Center</i> , but with a side shift mount it should be <i>Left</i> or <i>Right</i> .
Tool side shift	Length of which the tool is side shifted. This value is not used when the tool side is <i>Center</i> .
Caster front	Choose the driving direction of the robot. Default is Caster front Yes.

Calibration	
Parameter name	Description
Tool calibration x	Adjustment of mechanical tolerance of the spray tool in the x-direction. Robot driving direction. Refer to the Calibration Guide for

	further information. Factory calibration performed by TinyMobileRobots.
Tool calibration y	Adjustment of mechanical tolerance of the spray tool in the y-direction. Robot sideways direction. Refer to the Calibration Guide for further information. Factory calibration performed by TinyMobileRobots.
Linepaint spray offset start	Adjust when the spray tool should begin to activate. This will account for the delay in the spray tool system, to make the TinySurveyor start marking at the beginning of the line. Refer to the Calibration Guide for further information. Factory calibration performed by TinyMobileRobots.
Linepaint spray offset stop	Adjust when the spray tool should stop activating. This will account for the delay in the spray tool system, to make the TinySurveyor stop marking at the end of the line. Refer to the Calibration Guide for further information. Factory calibration performed by TinyMobileRobots.
Position time offset	Size of the time delay, from external equipment measures position to when the robot receives it. Bluetooth communication often introduces noticeable time delays. Different equipment may have different Position time offset. Refer to the Calibration Guide for further information.

Advanced	
Parameter name	Description
Min. position frequency	Threshold for the minimum number of position inputs per second that the TinySurveyor will accept. When position frequency is below minimum, it will throw an error, e.g.: <i>Low GNSS rate</i> Recommended threshold value is 7.5 Hz for optimal precision.
Position freq. Estimation window	To allow the robot to drive behind narrow columns (i.e. without new position input), the position freq. estimation window can be increased. Default value is 1 sec.
Auto Resume on error	Choose whether the TinySurveyor should automatically resume its current task after being interrupted by an error.
Left wheel is Bafang motor	Change driving direction of the Left wheel motor. Yes will allow driving with the Bafang wheel motor
Right wheel is Bafang motor	Change driving direction of the Right wheel motor. Yes will allow driving with the Bafang wheel motor

5.1.4 Layers

Only visible when a DXF file with more than one layer has been imported.

Allow the user to hide and show individual layers.

5.1.5 Communication

Control all external communication for the robot.

On this page, you can setup your NTRIP account details (only relevant for TinySurveyor with pre-installed internal GNSS receiver) and get the robot to connect to external equipment via Bluetooth.

5.1.6 Internet

Dashboard and actions for tablet and robot internet.

This page shows the status of the internet route and connection for both tablet and robot. The page also allows

you to connect the tablet and/or the robot to a nearby WiFi network (e.g. a smartphone WiFi hotspot).

For the robot modem, you can *Search for Operators* to select a specific operator. This can help get a better connection in some areas.

5.1.7 Templates

Overview of all available templates.

This page allows you to hide and show groups of templates or specific templates. All groups/specific templates that are enabled will be shown in *+New Job*, found at the main screen.

5.1.8 Help

This page gives support information and from here, you can start up various support tools.

Only start up support tools when requested by the support staff.



5.1.9 About

This page shows tablet and robot serial number and software versions.

You can *Check for Updates* to check if a new update of the TinySurveyor app is available.

5.2 TinySurveyor app features

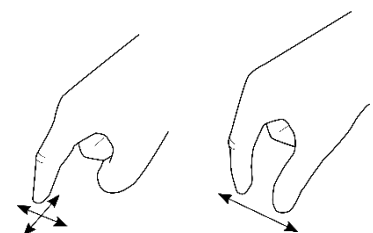
This section explains some of the commonly used features in the TinySurveyor app. You'll also find user tips for TinySurveyor and the TinySurveyor app.

5.2.1 Navigate on the map

Use one or two fingers to navigate on the map in the TinySurveyor app.

Use one finger to drag the map around.

Use two fingers to zoom in and out on the map.



13 – Left: Moving Map,
Right: Zoom in/out
(arrows do not appear
on map)

5.2.2 Use the joystick

Use the joystick by pressing and holding one finger in the middle of the joystick. Push the finger in the desired driving direction.

5.2.3 Use the tablet keyboard

Press one finger inside the text field and the keyboard will appear.

After typing the text, you can make the keyboard disappear by pressing ↵ on the tablet.

5.2.4 Create a new job using templates (with robot)

One way of creating a new job is by collecting points using TinySurveyor (only works when robot is connected to the internet).

1. Press  and a pop-up window will appear allowing you to pick the desired job type. Remember to name the new job.
2. Press *With robot*. A new window will appear, and you can choose how points are to be collected. The number of points and their positions vary between the different job templates. Choose an option and press *Create job*.
3. You can now use the joystick to navigate TinySurveyor. Follow the instructions on the screen to collect the points in the correct order. When you press  the position beneath the nozzle is collected.
4. When all points have been collected, the new job will appear on the map and can be marked.

WARNING

Do not lift or push TinySurveyor when collecting points as that would disturb the position sensors and could make the collected position incorrect.



INFO

When collecting points, the user can press . This feature slows down the driving speed and allows more precise point collection.

New job cannot be chosen when USB has been imported. Start a new session by exiting the app, then press  on the tablet.

Points collected using the *Geometry point* template, can be converted to different line types, *select Point Job>Modify>Edit>Advanced*



5.2.5 Create a new job using templates (on map)

You can create a new job by using the map. This can be helpful when the job must be aligned with existing jobs.

1. Press  and a pop-up window will appear allowing you to select a template and use that to create a job. Remember to name the new job. *New job* cannot be chosen when a USB is imported.
2. Press *On map* and then press *Create job*. The pop-up window will disappear and the selected job type will appear on the map. The new job is equipped with handles to rotate, move and adjust the dimensions.
3. Press one of the side-line handles . You can now enter the job width in the bottom bar.
4. Press one of the end-line handles . You can now enter the job length in the bottom bar.
5. Press  and input rotation angle in the bottom bar.
6. Press  and input values in the bottom bar to move the transversal and longitudinal lines.
7. Alternatively, press and drag the handles to move, rotate or adjust the field dimensions. You can interchange the order of the described adjustments.

INFO

A snap feature is available for easy alignment of new job. When the new job is close to an existing job, it will snap to the existing job when the user rotates, moves or adjusts dimensions using the handles.

5.2.6 Select a job on the map

You can select a job, previously designed or imported from a USB, by pressing anywhere inside the desired job. Additional options will appear when the job is selected.

A selected job will appear with yellow lines on the map.

5.2.7 Deselect a job on the map

You can deselect a job by pressing anywhere outside the selected job area. Press another job to select it.

An unselected job will appear with white lines on the map.

5.2.8 Start marking a job

You can select and mark previously designed or imported jobs appearing on the map.

To mark a job, you must first select the job. When selected, you can press **Start** and TinySurveyor will begin to mark the selected job.

5.2.9 Copy/offset/edit a job using Modify

You can make several modifications to an existing job.

- 1) Select the job you'd like to modify.
- 2) Press **Modify**.
- 3) Select the modification you'd like to do. See examples below and follow instruction on the screen.

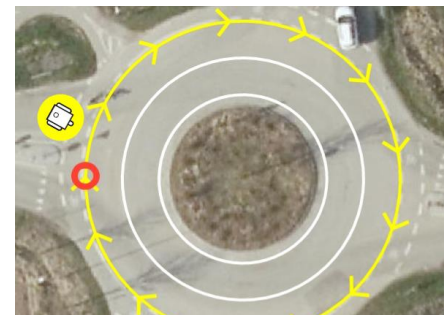
Edit

Several edit options are available, e.g.:

- Change job name
- Reverse driving direction
- Enable/disable split of the job. Complex geometry often requires split enabled to do marking as desired



14 - No job is selected if all entities are white



15 - Selected job appears yellow on tablet screen

- Enter advanced feature, e.g. skip lines/points

Copy

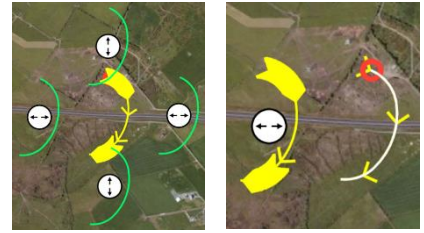
- Press & drag  to set copy distance, or
- Press  and input the value in box found at bottom bar
- Press one of the four copy options, shown in green
- Press Save

Offset

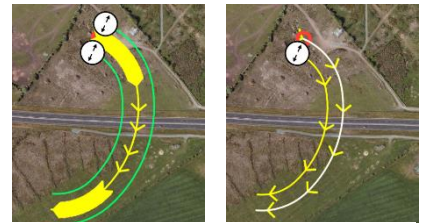
- Press & drag  to set offset distance, or
- Press  and input the value in box found at bottom bar
- Press one of the two offset options, shown in green
- Press Save

Delete

- Delete the selected job



16 - Left: Four copy options, Right: Selected copy



17 - Left: Two offset options, Right: Selected offset

5.2.10 Define Normal/Transport/Ignored/Tree filter line/point

Every point or line can be driven by TinySurveyor in four different ways:

- Normal (yellow) – The spray tool will be activated while driving the line/point and it will be marked.
- Transport (purple) – The spray tool will NOT be activated while driving the line/point. The line/point is used to define a transport path of the robot
- Ignored (red) – The line/point will be ignored, and the robot will not drive to it.
- Tree filter (orange) – If activated, an algorithm will monitor the GNSS position to mitigate effects of multipath from e.g. trees or buildings. This will improve the accuracy in multipath conditions. Multipath should be determined before activating the Tree filter.

The different line/point modes can be set for all or individual lines/points. This can be done in *modify>edit>advanced*.

6 Robot Functionalities

6.1 Driving points and lines

TinySurveyor does driving in automatic mode in two ways, depending on whether the task is a point or a line.

Understanding the behavior when driving to points and lines will help prepare and perform jobs. When the spray tool is mounted, it will be activated at each point and line, and thereby marking can be performed.

6.1.1 Points

When driving to a point, TinySurveyor will drive in a straight line towards the first point in the job list. When approaching a point, the robot will slow down to make sure the tool point hits the point in the job list.

Parameters affecting the behavior when driving to a point:

Drive velocity (m/s):	Velocity driven in between points in the job list. Automatic mode
Approach distance (m):	Distance, before a point, which TinySurveyor slows down to accurately hit the point.
Spray duration (sec):	Time which the spray tool is activated when marking a point
Default wait (sec):	Time TinySurveyor pauses at the point

6.1.2 Lines

When driving lines, TinySurveyor will drive in a straight line towards the starting point of the line. The starting point will be a given distance to the actual line, this allows TinySurveyor to steer itself onto the line more precisely.

Parameters affecting the behavior when driving along lines:

Drive velocity (m/s):	Velocity driven in between lines in automatic mode
Spray velocity (m/s):	Velocity driven along the line when marking

Ramp up (m):	Distance between the starting point and the actual beginning of the actual line, allows the robot to steer correctly towards the line
Approach distance (m):	Distance which TinySurveyor slows down to accurately hit the starting point.
Line length (m):	Length which the spray tool is activated. Length of marked dashes.
Space length (m):	Length which the spray tool is deactivated. Length of space between dashes.

6.2 Predefined job

TinySurveyor is able to drive automatically using predefined job data, e.g. previously collected points or a drawing of a new highway. Data files containing predefined jobs can be saved on a USB drive, SD card or in the tablet storage and imported to the TinySurveyor app. Press in the app to  browse files in the tablet storage, USB drive, SD card. TinySurveyor supports listed file formats:

6.2.1 CSV

Comma separated file (e.g. *filename.csv*) containing a point list of easting (x), northing (y) coordinates which TinySurveyor must drive to. Only points can be defined in a CSV file.

TinySurveyor by default reads a CSV file coordinate in the order *Pointname,Easting,Northing,,,,,,* ,

e.g.:

```
Point1,506614.00,6206796.00
```

```
Point2,506615.02,6206797.02
```

```
Point2,506616.04,6206798.04
```

TinySurveyor can read a CSV file in a user defined order, by adding the reading order on the first line of the CSV file, e.g.:

```
y,x,name
6206796.00,506614.00 ,Point1,,,,...
6206797.02 ,506615.02,Point2,,,,...
6206798.04 ,506616.04,Point2,,,,...
```

Each point in the CSV file can be set as a transport point and *Default wait* can be set for individual lines as well. This is done by adding *spray* and/or *delay* to the first line.

Define no-spray points: 1 = spray (default), 0 = no spray

Define default wait: *Default wait* in *Robot behavior* is used for all points. Any value in the delay column will overwrite the *Default wait* value.

E.g.:

```
y,x,name,spray,delay
6206796.00,506614.00 ,Point1,0,3,...
6206797.02 ,506615.02,Point2,1,0,...
6206798.04 ,506616.04,Point2,0,2,...
```

6.2.2 DXF

Cad drawing (*filename.dxf*) containing lines or points which TinySurveyor must drive along or drive to. TinySurveyor can read various cad entities: spline, line, polyline, circle, arc, ellipse, point. Entities defined in a block are NOT read. All layers in a DXF file are imported.

The entities must be placed in desired easting (x) and northing (y) position for TinySurveyor to drive to the correct point or line.

6.3 Creating new job

If no predefined data exists, the user may use TinySurveyor to create a new job. A new job is created by collecting points on the job site using TinySurveyor.

Various job types can be created using the templates in the TinySurveyor app. Follow the instruction in the app to collect the points correctly.

7 Maintenance

7.1 Main components

You must regularly maintain some of TinySurveyor's components to maintain performance. You'll find maintenance guidelines in this section.

Use original spare parts when replacing any components. For information about, and the purchase of, spare parts, contact your local TinySurveyor distributor.

The TinySurveyor must be stored at room temperature (20-27°C / 68-80°F).

WARNING

Turn off the TinySurveyor using the battery key before maintenance or component replacement.



7.2 Motor and caster wheels

TinySurveyor has three wheels: one caster wheel at the front and two motor wheels at the rear. Make sure that these wheels fulfil the guidelines listed here at all times.

The caster wheel is fixed with two bolts. One bolt fixes the wheel to the aluminum frame, the other fixes the wheel itself. Make sure that you sufficiently tighten both bolts before operating TinySurveyor.

The air pressure of the caster wheel must be 36 PSI/250 kPa/2.5 bar.

Each motor wheel is fixed using two M15 nuts. Make sure that you tighten all four nuts with 30 Nm before operating TinySurveyor. Use a thread locking fluid to lock the nuts properly.

Both motor wheels must be aligned with the vertical plane.

The air pressure of the motor wheels must be 35 PSI/240 kPa/2.4 bar.

7.3 Battery

The battery is TinySurveyor's only energy source.

Consequently, careful maintenance is crucial for prolonged performance. The battery will drop capacity over time and depending on the way it's used. After two years, the battery will have 70% capacity or greater if users abide by the listed guidelines.

- The battery must be fully charged when stored.
- The battery must be charged every third month if stored for a longer period.
- The battery must be stored at room temperature (20-27°C / 68-80°F).
- If the battery has not been used for a long period of time, recharge it completely before connecting it to the robot.

7.4 GNSS antenna (pre-installed internal GNSS configuration)

The GNSS antenna is attached to the top of TinySurveyor. The GNSS antenna is essential for marking precision and it must be handled with care.

Ensure that the plug is always firmly connected to the GNSS antenna.

The cable from the antenna must always be sufficiently tightened along the aluminum frame to avoid dangerous situations.

WARNING

Do not put any load on the GNSS antenna (e.g., when tilting TinySurveyor), as it could damage the GNSS antenna.



INFO

Do not cover the GNSS antenna while operating TinySurveyor.
Keep a distance from tall objects (e.g., trees, buildings) while operating TinySurveyor.



7.5 Cleaning the Robot

In addition to the cleaning procedure that must be performed after the end of each marking job, you must regularly make sure that the robot is clean of paint, grass and dirt. Paint, grass and dirt may reduce TinySurveyor's performance and the lifetime of parts.

For best results, use a soft dish brush and clean water to clean TinySurveyor.

WARNING

Never clean TinySurveyor with a high-pressure cleaner.



Always clean the wheels to ensure the best grip between wheels and ground. Remove any grass and dirt that is sticking to the wheels.

Regularly clean off any paint, grass and dirt accumulated around the spray tool (for best results, clean right after use). Detach the spray tool if necessary and use a soft dish brush to remove grass and dirt.

8 Trouble shooting

8.1 Error messages

During use, different error messages can appear on the tablet screen. This table provides a list of the error messages, the possible causes, and the solutions.

Message	Cause	Solution
No motor controller	The motor controller is not visible for TinySurveyor, meaning that the motor wheels cannot be controlled and TinySurveyor cannot drive.	Restart TinySurveyor (using the battery key). Contact your local TinySurveyor distributor if the error message still occurs.
Motor controller not responding	The motor controller is not responding to input from TinySurveyor, meaning that the motor wheels cannot be controlled and TinySurveyor cannot drive.	Restart TinySurveyor (using the battery key). Contact your local TinySurveyor distributor if error message still occurs.
Overheat	An electronic component inside TinySurveyor has overheated and has stopped working.	Let TinySurveyor cool down for 30 minutes before driving again. If the error message appears again, a longer cool-down time is needed.
Overvoltage	An overly high voltage has been detected inside TinySurveyor. This can be caused by a battery issuing incorrect voltage. Always use original spare parts for TinySurveyor!	Check voltage specification of the battery. Voltage must be 36 V. Replace the battery if necessary.
Short circuit	One of the motor wheels has stopped working due to a short circuit.	Restart TinySurveyor (using the battery key). If the problem still occurs, the affected motor wheel must be replaced. Contact your local TinySurveyor distributor for information about spare parts.

Emergency stop	The emergency STOP button has been pushed on TinySurveyor.	Release the emergency STOP button by twisting it clockwise.
Left motor stall / Right motor stall	The software in TinySurveyor has detected that the left/right motor wheel might be stuck.	Ensure that nothing is hindering the motor wheel from moving. Remove obstacles.
Left motor amp error / Right motor amp error	An unusual amount of energy is needed to propel the left/right motor wheel. This may be caused by TinySurveyor hitting an obstacle, or anything that makes TinySurveyor use a lot of energy.	Check whether an obstacle is blocking TinySurveyor's path. Remove the obstacle. Otherwise, check whether any of TinySurveyor's components need tightening (e.g. caster wheel, motor wheel).
Error message not described above	This is very unusual. A possible reason is that the software has been updated since this user manual version.	Restart TinySurveyor (using the battery key). Contact your local TinySurveyor distributor if error message still occurs.

8.2 Symptoms and solutions

In this section, you'll find general symptoms, likely problems, and possible solutions.

Symptoms	Likely problem	Possible solution
During a marking job, TinySurveyor stops and the signal light turns red.	The GNSS/correction signal is weak in the area in which the job is placed.	Wait a few minutes to see if the signal is retrieved and the marking job continues. On a site with poor position signal, TinySurveyor may stop several times and the marking job may take longer than usual.
TinySurveyor stops driving and the error message Right/Left motor amp error appears on the tablet screen.	A mechanical issue is making TinySurveyor use more energy than needed, resulting in a faulty error message.	Check that the caster wheel and motor wheels are sufficiently tightened with a torque of 30 N m and use of mild Loctite. Also, check for other loose components that are incorrectly placed.
Nozzle does not spray correctly.	Dry paint inside the nozzle could be blocking the opening. Nozzle could be broken.	Try to rinse the nozzle with water and a small dish brush.
The battery cannot lock. The key cannot be turned clockwise.	Grass, dirt or objects on the battery rack may be blocking the battery. Battery is not being pushed far enough into the battery rack.	Check for grass, dirt and objects on the battery rack. Regularly empty grass, dirt and objects from the battery rack. Make sure the battery is correctly inserted into the battery rack.
Connection between the battery and the socket is loose.	The battery clamps may have become loose during use.	Use an appropriate tool to tighten the clamp grip.

The joystick appears on the tablet but TinySurveyor does not move when navigating. If this appears with the tablet within 30 feet / 9 meters of the robot, it is an error.	An unexpected software error could be affecting the joystick.	Restart Tinysurveyor app or restart TinySurveyor. After restart, the joystick should work.
While marking a straight line, TinySurveyor suddenly deviates from the desired path.	The GNSS signal may have temporarily become imprecise or unstable, which may be caused by tall tree(s) or building(s) close to the marked line.	Move the job further away from the tall tree(s) or building(s), or try marking the line again.
Data files are not imported from the USB connector.	Misspelled file name or data is saved in unsupported file format.	The data file must end with .dxf or .csv.
The spray tool does not spray.	Spray nozzle cannot be activated because lever is blocked by paint and dirt, or top plate is not sufficiently pushed down on aerosol spray can.	Make sure that the spray tool is clean around its moving parts. Push the top plate further down towards the aerosol spray can.
"Internet connecting" for a long time	Problem with the SIM card or the modem setup.	Restart the robot to check if it was a temporary error. Check that there is a SIM card in the robot. Check that the APN is correct. Check if the PIN code has been removed from the SIM card.
The symptoms listed above do not correspond to the problems I'm experiencing.	The symptom may be yet unknown or uncommon.	Restart TinySurveyor (using the battery key) and the tablet. If the problem still persists after restart or is experienced multiple times, contact your local TinySurveyor distributor.

9 Warranty

TinyMobileRobots ApS guarantee that this product will be covered by our warranty for one year from the day of purchase. The warranty covers serious errors in components and manufacturing errors. During the time covered by the warranty, TinyMobileRobots ApS will repair or replace the product if the following is fulfilled:

- The product has been handled according to the instructions described in this manual.
- The user or any unauthorized technicians must not attempt to repair the product.
- In case of a claim regarding the robot battery, TinyMobileRobots' support team will connect to the battery and analyse its use history. Warranty is not applicable for the battery if instructions provided in this user manual were not followed.

Examples of situations where the warranty would not apply:

- Damage due to large amounts of water—e.g., the use of high-pressure cleaner, a prolonged stay in rain, or other exposure to large amounts of water.
- Damage caused by lightning.
- Damage due to misuse or incorrect use of product. Instructions provided in this user manual must be followed.
- Use of spare parts not approved by TinyMobileRobots ApS.
- Use of battery and adaptors not approved by TinyMobileRobots ApS.
- Faults due to wear or wearing of parts caused by a failure to replace in time.
- Lack of cleaning of spray parts after usage.

Contact your local TinySurveyor distributor to make use of the warranty. Remember to provide the distributor with the serial number (found on the robot) and documentation of the purchase date.

10 Environmental information

TinySurveyor consists of a robot, a removable battery and a tablet. Recycle all product parts according to the laws applicable in your region.

Detach the removable robot battery and recycle it separately according to the laws applicable in your region.

The robot contains electronic components. Recycle them according to the applicable laws in your region.

The tablet contains electronic components and a removable battery. Recycle them according to the laws applicable in your region.

The owner is responsible for recycling the product correctly. Proper recycling will ensure that negative impact on the environment is minimised. Incorrect recycling may have negative environmental impact.

11 Other Information

Serial number:	Can be found on the label attached to TinySurveyor
Manufacturer details:	TinyMobileRobots ApS Sofienlystvej 9 8340 Malling Denmark
Support:	Contact dealer

12 Appendix 1 – Detailed robot status description

The below table displays the values for the robot statuses.

- **Tablet ⇌ Robot communication**
- **Robot internet**
- **Robot GNSS**
- **Robot battery**

Title	Icon and status	Description
Robot<-> tablet communication	Robot ⇌ Tablet No connection	No connection between robot and tablet. The robot will stop driving.
	Robot ⇌ Tablet Bluetooth	Robot and tablet are connected using Bluetooth only.
	Robot ⇌ Tablet Internet	Robot and tablet are connected using internet only.
	Robot ⇌ Tablet Bluetooth, Internet	The connection between robot and tablet working optimal using both Bluetooth and internet.
Robot Internet	Robot internet  No connection	No internet data to the robot.
	Robot internet  Connecting	No internet data to the robot, Connecting using cellular modem.
	Robot internet  O2-UK	Internet data received, Weak signal.
	Robot Internet  O2-UK	Internet data received, Medium signal.
	Robot Internet  O2-UK	Internet data received, Strong signal.
	Robot Internet  WiFi name connecting	Trying to connect to hotspot/WiFi.
	Robot Internet  WiFi name no internet	Connected to WiFi, but no internet.
	Robot internet  WiFi name	Connected to WiFi, Weak signal.
	Robot internet  WiFi name	Connected to WiFi, Medium signal.
	Robot Internet  WiFi name	Connected to WiFi, Strong signal.
GNSS input (internal or RS232)	Robot GNSS  No antenna	No antenna detected, probably due to cable failure. Only shown for internal GNSS receiver.
	Robot GNSS  No input	No data received from GNSS receiver. Check whether the external GNSS receiver is setup to output data. For serial, RS232, connection check the baud rate.

	Robot GNSS Invalid input 	No position input, the robot is unable to parse position from received input. Check that the external GNSS receiver output supported position data (NMEA GGA or GMP).
	Robot GNSS No NMEA position 	No NMEA position. No position info in the NMEA GGA string. Check it the GNSS receiver have satellite connection. The value can be <i>NMEA</i> or <i>GMP</i> .
	Robot GNSS No satellites 	No satellites are seen by GNSS receiver. Make sure the robot has a clear view to open sky.
	Robot GNSS Low NMEA rate 	Low NMEA rate. Position input frequency below threshold. Optimal operation requires 10 Hz of position input. The value can be <i>NMEA</i> or <i>GMP</i> .
	Robot GNSS Multiple inputs 	Position conflict. Multiple position inputs are received. e.g. NMEA GGA and CSV from same receiver.
	Robot GNSS No fix 	No fix, GNSS quality: 0. No RTK data received.
	Robot GNSS SPS fix 	SPS fix, GNSS quality: 1. No RTK data received.
	Robot GNSS RTK server 	RTK Server not available. Check internet connection, server URL/IP and Mountpoint. Only shown for internal GNSS receiver.
	Robot GNSS RTK login 	RTK Login not working. Check username and password. Only shown for internal GNSS receiver.
	Robot GNSS RTK in use 	RTK client already in use. Ensure that no one else is using the NTRIP RTK client. Only shown for internal GNSS receiver.
	Robot GNSS DGPS fix 	DGPS fix (means RTK is working), GNSS quality 2. New RTK data is missing. Check RTK settings.
	Robot GNSS Float fix 	Float fix, GNSS quality 5. Position data is RTK corrected. Position accuracy is not yet good enough. Drive around with the robot to increase position accuracy.
	Robot GNSS NMEA fix: 20 Hz 	Fix, GNSS quality 4. The robot is working with high accuracy and receives the number of Hz indicated. The value can be <i>NMEA</i> or <i>GMP</i> .
Total station input (Bluetooth or RS232)	Robot TS ED invalid 	"TS invalid" unable to parse TS/ED input.
	Robot TS Low ED rate 	"Low TS rate". Position input below threshold. The value can be <i>ED</i> , <i>GDM</i> or <i>CSV</i> .
	Robot TS ED: 12 Hz 	Input rate above "min input freq." The value can be <i>ED</i> , <i>GDM</i> or <i>CSV</i> .
Robot Battery	Robot  78 %	Percentage status of the robot battery.

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