SKYBRUSH

Skybrush Sidekick User Guide

CollMot Robotics Ltd.

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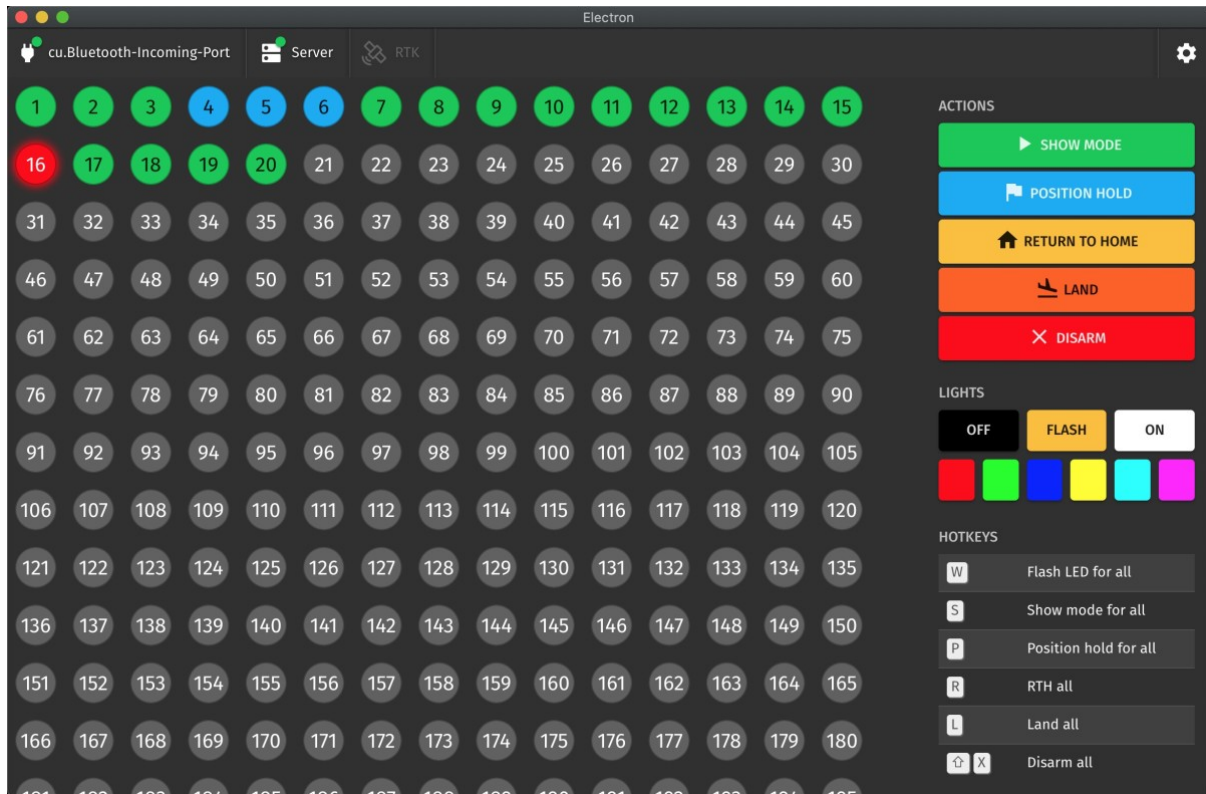
Table of Contents

Skybrush Sidekick

This is the main documentation of **Skybrush Sidekick**, a companion app to be used along with **Skybrush Live** as an independent fallback control interface for safe drone fleet operations.

Before you fly with **Skybrush Sidekick**, make sure you have read the entire documentation carefully. Use the left sidebar for browsing and we also encourage you to contact us in case of any questions.

Remember, drone swarms are great fun but only if you know how to handle them!

Chapter 1. Overview

Skybrush Sidekick is part of **Skybrush** suite, an integrated software solution for the design, visualisation, testing and delivery of both indoor and outdoor drone light shows. Skybrush was built from the ground up on a rock solid platform-independent architecture and a clean and intuitive user interface, incorporating our experiences gathered during ten plus years of research in drone swarms as well as all the lessons we have learned while operating drone shows regularly since 2015.

Skybrush is a modular software suite, consisting of the following modules, each of which may be operated on its own or as part of the whole suite:

- **Skybrush Studio** - drone show designer framework
- **Skybrush Viewer** - 3D drone show visualiser for testing and presentation purposes
- **Skybrush Live** - drone show management and fleet control framework
- **Skybrush Sidekick** - companion app to **Skybrush Live** that operates an independent, fallback communication channel
- **Skybrush Backstage** - drone inventory and log management framework

In this manual our focus is on **Skybrush Sidekick**.

Chapter 2. Feature highlights

Philosophy

- Our mindset is based on decade long world-leading drone swarm research plus drone show services since 2015

- We only sell software that we test and use actively ourselves

- Skybrush Suite and our professional team guides you through the whole process of drone shows from design to execution and beyond

Platform

- Platform-independent modular design - Linux, macOS and Windows 10 versions available

- Server-client architecture for flexible support of customer needs

Drone compatibility

- Latest stable ArduCopter codebase with dedicated show flight mode

- Compatible with most of the show drones built on autopilots of the Pixhawk family

- DJI Matrice series support for non-show applications on request

- CollMot's FlockCtrl support for onboard swarm level intelligence (e.g. automatic swarm-level path planning and collision avoidance)

- Modular and clean structure enables simple integration of new drone types upon request

Layout

- Clean GUI with mouse and touch screen support

- Handy keyboard shortcuts enable quick individual or fleet control

Dedicated features

- RTK correction transmission through the secondary radio link

- Plug-and-play compatiblility with **Skybrush Server** for enhanced status feedback

Safety

- Independent secondary communication channel running on independent GCS hardware

- Individual and fleet-level control features

- Operator can interrupt show any time with fleet-level Land / Return-to-home / Halt (kill switch) buttons

Chapter 3. Hardware requirements

A full hardware setup needed for **Skybrush Sidekick** to control drone fleets consists of the following components:

Mandatory requirements

- A laptop or desktop machine running **Skybrush Sidekick**

- Compatible drone fleet

- 433/868/900 MHz radio (depending on local regulatory requirements) connected to both the GCS laptop and the drones

Optional requirements

- A laptop or desktop machine or dedicated hardware that runs **Skybrush Server**. This can be the same device running **Skybrush Sidekick** or an independent one, although a separate machine is recommended to provide a truly independent connection that remains operational even if your main laptop malfunctions.

- Wifi network to which both **Skybrush Server** and **Skybrush Sidekick** can be connected in order to receive drone status feed in **Skybrush Sidekick** from the active **Skybrush Server**.

- RTK base station or NTRIP-based RTK correction source connected to **Skybrush Server**. If present, corrections can be sent to the drones through the secondary communication channel from **Skybrush Sidekick**.

3.1. Recommended GCS configuration

The recommended configuration for the ground control device (laptop) running **Skybrush Sidekick** is the following:

- at least an Intel Core i5 or equivalent CPU

- At least 2 GB of RAM (4 GB preferred)

- Supported OS: Windows 10, Linux or macOS 10.14 or later

3.2. Communication with drones

- **Skybrush Sidekick** communicates with the drones on a 433/866/900 MHz radio channel with unidirectional messages being sent from **Skybrush Sidekick** towards the drones. Note that telemetry or any kind of response from the drones towards **Skybrush Sidekick** is *NOT* available on this channel.

- **Skybrush Sidekick** may receive status messages from the drones through **Skybrush**

Server and the primary wifi network behind. This allows for visual status indication in **Skybrush Sidekick** as an optional enhancement, but the core functionality of **Skybrush Sidekick** *DOES NOT* depend on the state of the **Skybrush Server**.

3.3. Supported drones

Skybrush Sidekick supports the same drones as **Skybrush Live**. Please see the full list there.

3.4. Supported radio hardware

The default radio that can be used as a secondary communication channel is the 3DR SiK Telemetry Radio.

However, several fully functional clones are also available, including, e.g., these:

- mRobotics SiK Telemetry Radio V2 Air/Ground Bundle
- Holybro Transceiver Telemetry Radio V3
- RFDesign RFD 868+ Modem
- RFDesign RFD 900+ Modem

The custom firmware we provide for these radios may be compatible with other radios based on the SiLabs Si10xx chipsets. Contact us for details in case you wish to use a radio not listed here.

3.5. Supported RTK base stations

Skybrush Sidekick supports RTK base stations through **Skybrush Server**. Please check out the related documentation of **Skybrush Live** for more details.

Chapter 4. Software installation

Skybrush Sidekick comes in an installation package. Installation is very straightforward and takes only a short time. Please follow the guide below according to your preferred operating system.

4.1. Installation on Windows

On Windows 10, **Skybrush Sidekick** comes in an installation package. Click on the received single executable (.exe) and follow the steps of the installation.

Select whether you would like to install **Skybrush Sidekick** for the current user or for all users on your system, select the destination of the installation and press the **[Install]** button.

The installation creates a shortcut icon on your Desktop and adds **Skybrush Sidekick** to the list of applications in your Start Menu.

4.2. Installation on Linux

On Linux platforms, **Skybrush Sidekick** comes as a single AppImage executable that can be executed from the command line or by double-clicking on it in the file manager of your choice. No installation is needed.

4.3. Installation on macOS

On macOS platforms (10.15 or later) **Skybrush Sidekick** comes as a single disc image file (.dmg) that you need to open in Finder by double-clicking on it. Then you need to drag the new **Skybrush Sidekick** icon over the Applications folder to install it. **Skybrush Sidekick** can then be invoked from the Applications folder.

> **Skybrush Sidekick** has no digital signature at the moment. As a consequence, the Gatekeeper security mechanism built into recent macOS versions may prevent the application from starting up. If this happens, *right-click* on the icon of **Skybrush Live** (or hold down the ⌃ key while clicking), and then select **Open from the pop-up menu, then confirm your choice by clicking on the › Open** button again in the pop-up dialog. This will allow **Skybrush Live** to bypass Gatekeeper security checks in the future.

4.4. Uninstalling components

4.4.1. Uninstallation on Windows

If you need to uninstall Skybrush components from your system for any reason, follow the official instructions from the Windows 10 support page to remove them.

4.4.2. Uninstallation on Linux

Simply remove the AppImage file from your system ot uninstall **Skybrush Sidekick**.

4.4.3. Uninstallation on macOS

Simply drag the **Skybrush Sidekick** icon from your Applications folder to the Bin on the Dock at the bottom of the screen to uninstall **Skybrush Sidekick**.

Chapter 5. Operations

Skybrush Sidekick is a secondary, independent safety fallback option besides our main GCS software **Skybrush Live**. **Skybrush Sidekick** provides access to the drone fleet with specific individual or fleet level commands through a preferably long-range, independent radio channel.

Skybrush Sidekick is designed as a fallback control option, so it can run on hardware completely independent from the main GCS that hosts **Skybrush Server** and **Skybrush Live**.

5.1. Basic usage

Skybrush Sidekick has a fixed single screen layout with connection and preferences widgets at the top, drone IDs on the left and a control panel on the right.
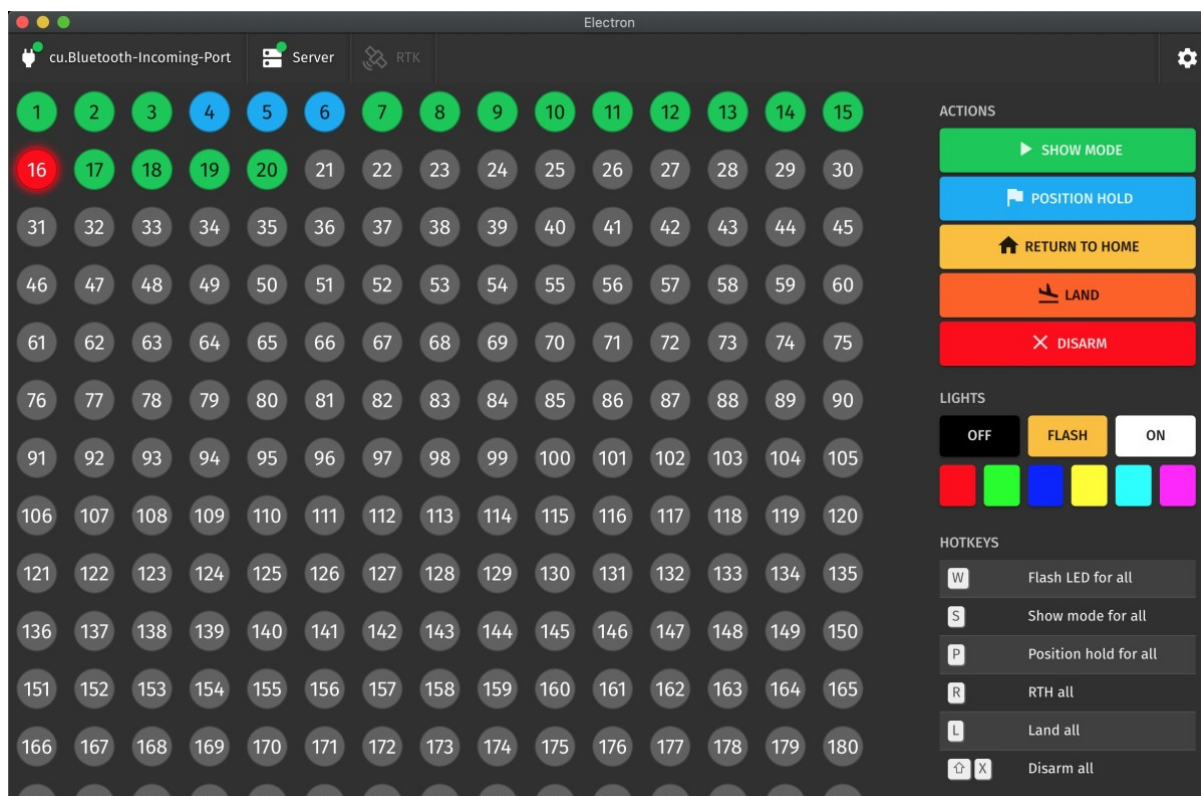
The operation of **Skybrush Sidekick** is quite simple:

1. Connect to your radio device (and optionally **Skybrush Server**)

2. Select the drone you wish to control or unselect to control all drones

3. Send the desired command to the selected drones

Note that the communication channel **Skybrush Sidekick** uses is uni-directional, which means that there is no feedback from the drones towards **Skybrush Sidekick** about

command acknowledgement, neither can they send telemetry data directly to **Skybrush Sidekick**. Telemetry data is only available through the active **Skybrush Server** if **Skybrush Sidekick** is connected to it. To ensure a reliable delivery of commands over an unreliable radio link without feedback, **Skybrush Sidekick** repeats each command several times in short bursts. You can control the length of these bursts in the Preferences.

5.2. Connection widgets

There are three connection widgets on the top left corner of the main window. Each of them has a LED indicator to show their overall status with the following color codes:

red	error
yellow	warning
green	status OK

For a more detailed connection status move your cursor over the connection widgets and wait for the tooltips to appear.

5.2.1. Output device connection

The only strictly required hardware component for **Skybrush Sidekick** is a radio module connected to the computer running **Skybrush Sidekick**. Please check our the Hardware requirements section for the list of supported radio modules.

If you click on the output device connection widget, a popup dialog appears to setup the connection.

It is assumed that the output device is connected though a serial or USB-serial port with a given port name and baud rate. Set these up properly and press the `CONNECT` button to connect to the device. The green status LED on the bottom left corner indicates connection status.

Skybrush Server connection

Connection to **Skybrush Server** is optional but it is recommended, as it feeds useful status information from the drones to **Skybrush Sidekick**. It is also needed if you wish to send RTK correction data through **Skybrush Sidekick** as well.

The connection details can be setup in the SERVER page of the `Preferences` dialog. **Skybrush Server** typically listens on port 5002 for incoming **Sidekick** connections. The IP address of the machine running **Skybrush Server** has to be specified explicitly. If the server and **Sidekick** are running on the same machine, the IP address can be set to 127.0.0.1 (localhost).

RTK connection

if **Skybrush Server** is connected and **Skybrush Live** is configured to send RTK correction data to the drones on the primary wi-fi connection, these corrections can also be forwarded to **Skybrush Sidekick** to send them to the drones simultaneously on its secondary communication channel as a means of redundancy.

No explicit configuration is needed in **Skybrush Sidekick** to enable RTK corrections, and enabling them will not interfere with the same corrections sent over the primary channel, but the probability that the corrections with reach the drones will increase.

5.3. Drones

5.3.1. Drone IDs

While **Skybrush Server** can handle basically any number of drones, a single instance of **Skybrush Sidekick** can handle only up to 255 drones, which comes from a hard limitation in the MAVLink protocol (the communication protocol used by the radio channel). Drones with ArduCopter-based firmware versions (including ours) are therefore associated with a single physical drone ID stored in the `SYSID_THISMAV` parameter, ranging between 1 and 255. This ID corresponds to the IDs listed in the main screen of **Skybrush Sidekick**.

In practice, drone IDs larger than 250 are typically reserved for ground stations and other equipment that need a MAVLink ID. However, since nothing prevents you to use numbers between 251 and 255 as a drone ID, **Skybrush Sidekick** allows you to set the visible range of drone IDs to include the full MAVLink range (except system ID zero, which is reserved for broadcasts).

IF you wish to operate swarms with more than 255 drones, you need to separate them into subgroups of up to 255 drones, bind different radios to the different groups (with different `NETID` parameter in the radio firmware) and use multiple instances of **Skybrush Sidekick** in parallel for each subgroup.

5.3.2. Modes of operation

There are two modes of operation in **Skybrush Sidekick**. You can either select a single drone or remove the selection and broadcast commands to all drones associated with the used radio.

In broadcast mode commands are sent to *ALL* drones associated with the given radio, regardless of the drone ID filter specified in the Display preferences.

5.3.3. Drone selection

The selection is always visible in the list of drone IDs, while hotkey descriptions in the bottom right corner of the window also update their labels based on the actual selection.
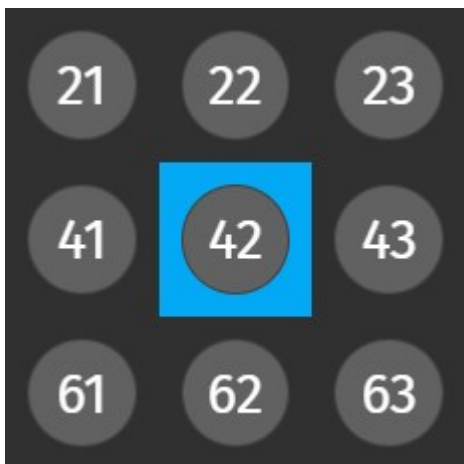
The selection can be updated by clicking on the button of the drone that you wish to control, or by pressing `Esc` to clear the selection. Please see the Hotkeys section for details on how to select drones from the keyboard.

5.3.4. Drone status information

If **Skybrush Server** is connected to **Skybrush Sidekick**, overall status of the drones will be indicated with different colors around their IDs, following the general coloring scheme of the **Skybrush Suite**:

- **green** means OK

- **blue** represents and informational message (typically prearm checks, takeoff, landing or any other event that does not require special attention)

- **yellow** for drones with a condition that warrants a warning signal

- **red** for drones with error conditions that require immediate action

- **flashing red** for drones with critical error conditions

5.4. Control panel

The control panel on the left side of the main window enables you to send commands to the selected drone or to all drones.

5.4.1. Actions

The actions group contains big colorful buttons for each available command to send. The coloring of the buttons indicate the severity of the command execution.
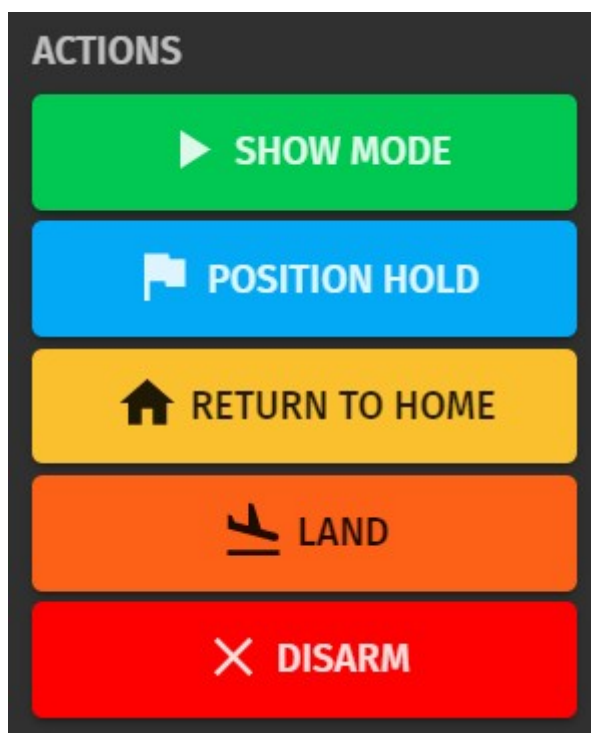
The following control commands are available from **Skybrush Sidekick**:

Show mode

Activate the SHOW flight mode on the selected drones. This is a required step as part of the prearm preparations for drone shows (but can be automated in **Skybrush Live**). Since drone shows managed by the **Skybrush Suite** are preprogrammed from takeoff to landing, if SHOW mode is activated in mid-air, it will act as a simple position hold mode.

Position hold

Activate the LOITER flight mode on the selected drones. This will stop the motion of selected drones and will enable manual control for the pilot.

Return to home

Activate the RTH flight mode on the selected drones. This will bring selected drones home as defined by their RTH-related firmware parameters.

Land

Activate the LAND flight mode on the selected drones. This will land selected drones with the speed defined by the related firmware parameters.

Disarm

Disarm motors on the selected drones. This will stop motors even if drones are in mid-air. Use it only as an emergency kill switch.

Using these buttons might cause mid-air collisions if operated on multiple drones simultaneously. Use them only as a proper and determined emergency action! Full responsibility is with the operator.

5.4.2. Lights

Lights of selected drones can be overridden by **Skybrush Sidekick** by clicking on the desired color.


The **[FLASH]** button is special in the sense that it is only a temporary override with a quick black and white rapid flashing to be able to identify a single drone quickly on the field.

The rest of the buttons will cause a color override that is sustained for one minute. After that the coloring will be controlled onboard again (light show in show flight mode, solid color in other flight modes etc.).

5.4.3. Hotkeys

The hotkeys group lists the hotkeys associated with the available command actions.
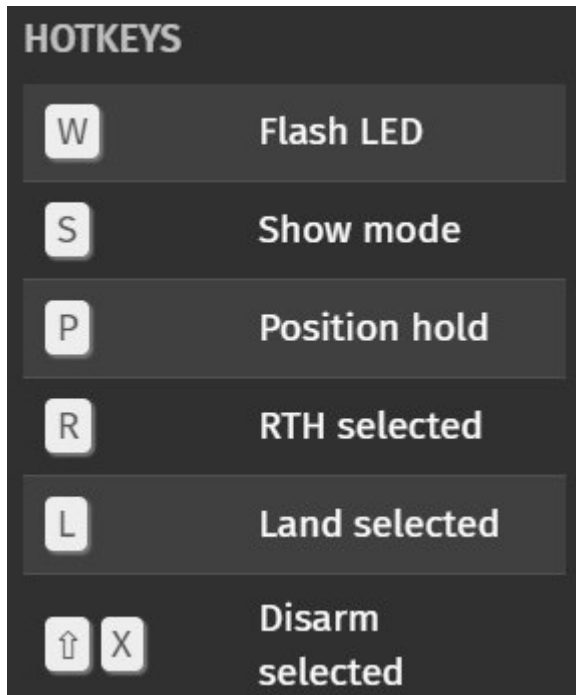
The text descriptor of the hotkeys explicitely states whether the actual command is applicable for a single selected drone or for all drones.

Read more about hotkeys in the Hotkeys section.

Chapter 6. Preferences

The **Preferences** widget enables you to setup **Skybrush Sidekick** according to your custom needs.

Choose the group of settings on the header of the popup dialog window (DISPLAY, COMMANDS, SERVER) and setup parameters as you wish.

6.1. Display preferences

Theme

    set light mode or dark mode depending on external light conditions

Visible UAV IDs

    Setup the list of IDs to appear on the main screen. Use ranges or individual values between 1 and 255.

6.2. Command preferences

6.2.1. Command repetition

Repeat every command

Enable to send every command several times in a row

Repeat count

This value defines how many times each command is sent

Delay between attempts

This value defines the delay between the repetitions

6.2.2. Confirmations

In this section you can customize confirmations when sending commands to individual drones or broadcasting them to all drones.

Enabled confirmations raise the safety of GCS usage by potentially preventing an accidental execution of a command, but at the same time they also increase the reaction time of the control personnel in situations to be handled from the GCS.

6.3. Server preferences

Skybrush Sidekick can receive telemetry data from the drones through **Skybrush Server**. The settings in this panel (hostname and port) control where **Skybrush Sidekick** is looking for the server on the net to communicate with.

The LED indicator in the bottom left corner shows the status of the connection to **Skybrush Server**.

To connect to **Skybrush Server** with the given settings, press the `CONNECT` button.

To save the desired configuration, press the `SAVE` button.

Chapter 7. Hotkeys

The keyboard input of **Skybrush Sidekick** is optimised to reduce reaction time of fleet control as much as possible through the following handy features:

- To select a single drone, just type in its numeric ID and press `Enter`. Alternatively, you can also use the arrow keys or the cursor (with a mouse, touchpad or touchscreen) to navigate to the desired drone ID.

- To switch to broadcasting mode without explicit selection, just press `Esc`

- To send commands to the selected drones (or all drones in the absence of a selection), press the hotkeys listed at the bottom of the control panel.

- The hotkeys for selecting a single drone *and* subsequently sending a command can be merged and the `Enter` key at the end of the drone selection keyboard sequence can be omitted in this case; for instance, typing `1` `4` `7` `L` will land drone 147 immediately.

Table 1. Control command hotkeys

Keyboard shortcut	Function
`W`	Flash LED of selected/all drones
`S`	Activate *show* flight mode on selected/all drones
`P`	Activate *position hold* flight mode on selected/all drones
`R`	Activate *return to home* flight mode on selected/all drones
`L`	Activate *land* flight mode on selected/all drones
`Shift` + `X`	Disarm motors of selected/all drones

⚠️ The hotkey descriptions on the control panel explicitly define whether the hotkeys refer to the selection or all drones. A confirmation dialog prevents the accidental activation of a command in broadcast mode by default, but these confirmations can be turned off. Always double check that you send commands to only those drones that you really want to control.

Glossary

Drone ID

The drone ID is a fixed unique physical ID that allows the permanent identification of the drone in the swarm. In ArduCopter based drones it is the *MAVLink system ID* stored in the `SYSID_THISMAV` parameter.

Flight mode

The low level firmware of the drones provides different flight modes, which determine the overall behaviour of the drones. Such flight modes are position hold, return to home, land, or show (which is our custom mode for executing drone shows).

GCS

Ground control station

MAVLink

The communication protocol used by drones and radio modules operated with the ArduCopter firmware. See more at https://mavlink.io/en/.

Physical ID

See **Drone ID**.

RTH

Return to home

RTK

Real-time kinematic (positioning)

Show flight mode

The custom flight mode in which drone shows are executed.

Skybrush Server

Skybrush Server is the backend part of **Skybrush** that connects to your drones, your RTK base station and other hardware accessories that might be needed for your missions. It ensures the smooth communication between all hardware elements and the connected **Skybrush Live** or **Skybrush Sidekick** clients. **Skybrush Server** is either running on the same computer as one of the clients or on a dedicated local HW device or in the cloud.