Boston Dynamics

Spot® Instructions for Use

Safety and Operations Manual

Version 2.3 Original Instructions
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1. Introduction

1.1. About this document

This document contains critical safety information for the Spot robot.

Responsible use of Spot is crucial to prevent dangerous conditions for those in close proximity to Spot. Read, understand, and comply with this document before initial use of Spot to decrease the risk of injuries or damage to yourself, Spot, or other property.

Boston Dynamics performed a risk assessment and derived the Instructions about residual risks based on the reasonably foreseeable use of Spot within its declared intended uses and in conditions subject to limitations. We recommend that you complete your own risk assessment concerning the integration and commissioning of Spot in your particular environment and conditions. Any deviation from the intended uses of Spot and the conditions in which Boston Dynamics estimated and evaluated risks (see Risk assessment) could be addressed by supplemental actions to further reduce application-specific residual risks.

Keep a copy of this document in a readily accessible location. Complete user and developer documentation on the Spot robot platform, including a digital version of this document, is available online in the Boston Dynamics Support Center (see Appendix A: Supplemental information).

This document is valid for the following designations of Spot:

Hardware model (P/N):	04-00143531-001 04-00143531-401 04-00143531-601 04-00143531-611
Software version:	5.0

1.2. Manufacturer information

Spot is manufactured by:

Boston Dynamics, Inc.
200 Smith St.
Waltham, MA 02451
USA

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1.3. Key terminology

Term	Definition	
Spot	A legged robot capable of mobility on a variety of terrains. Spot uses multiple sensors and three motors in each leg to navigate in indoor and outdoor environments, maintain balance and attain postures. Spot is capable of carrying and powering attachments.	
Operator	Any person trained and authorized to manually operate, repair, handle, or supervise the automatic operation of Spot. This definition corresponds to the terms “Qualified person” and “Authorized person” as defined in ISO/TR 22053:2021, Clause 3.4.	
Bystander	Any person who can be reasonably expected to be near Spot, but is not an operator. This definition corresponds to the term “Affected person” as defined in ANSI B11.0-2020, Clause 3.4.	
Task	An activity performed by a person, including manual operation of Spot.	
Operation	An activity performed by Spot, whether as a result of manual or automatic operation.	
Mission	A set of instructions and map data that allows Spot to navigate automatically along a known route while performing data capture actions and other operations. The features that allow Spot to record and replay missions are collectively called “Autowalk”.	
Action	A predefined operation that can be performed during a mission. The Spot software includes several preset Actions, such as capturing images from robot cameras and docking with a Spot Dock. Custom Actions can be created using Spot’s software development tools.	
Attachment	Any device or piece of hardware that is affixed to Spot to enhance or expand Spot’s functionality. Attachments for Spot are commonly called “payloads”.	
Fiducials		Specially designed images similar to QR codes that Spot uses to match its internal map to the world around it. Fiducials are required at the beginning of every mission. Spot recognizes AprilTag fiducials that meet the following requirements: • AprilTags in the Tag36h11 set. • The default Image size: 146 mm square. • Printed on white non-glossy U.S. letter-size sheets (preferably rigid).

1.4. Legend of Hazard Labels

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

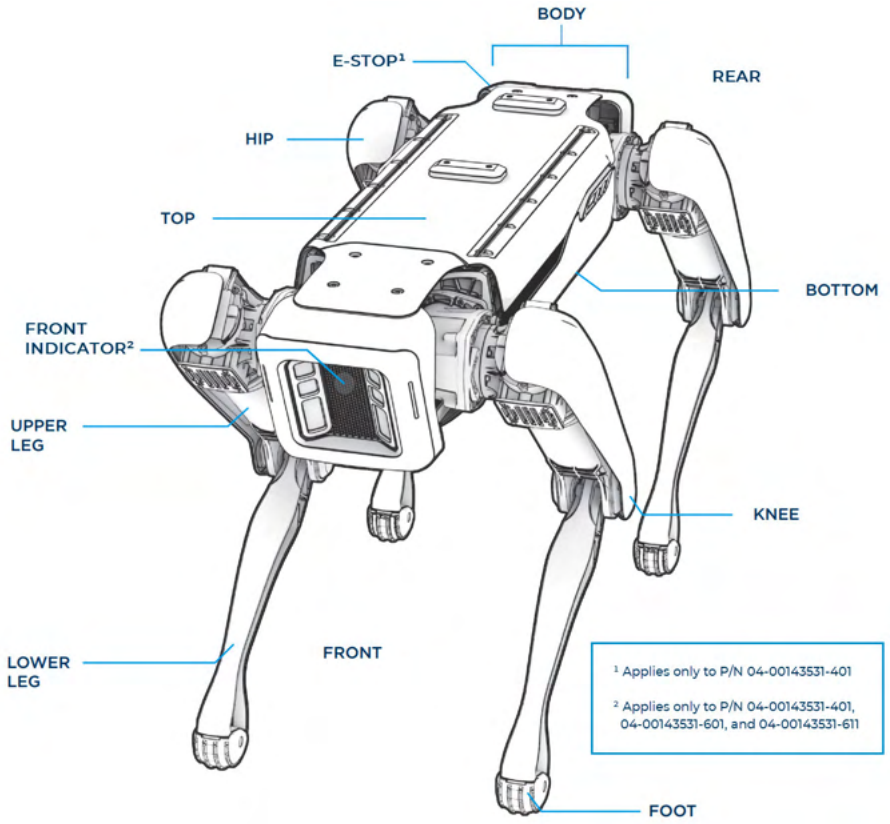
Indicates information considered important, but not hazard related.

REQUIRED READING

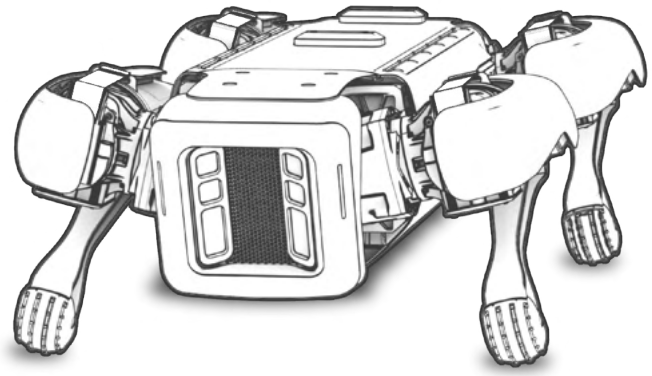
Indicates a mandatory reading of Instructions for Use or other safety-related documentation.

1.5. About the Spot Robot

1.5.1. Spot Anatomy



Spot in the "stand" pose.



Spot in the "sit" pose. The body and all four feet rest on the ground.

Spot's body is an oblong rectangular box that houses computers, cameras, and other components. Each of Spot's four legs includes a ball joint at the hip where the upper leg connects to the body, a hinged knee connecting the upper and lower leg sections, and a rounded foot with a rubberized pad.

Spot model 04-00143531-401 includes a red emergency stop (E-Stop) button located at the top rear right corner of the body.

1.5.2. Spot Specifications

Physical properties

Specification	Value
Length	1100 mm
Width	500 mm
Default height (walking)	610 mm
Height (sitting)	191 mm
Max height (walking)	700 mm
Min height (walking)	520 mm
Net mass/weight (with Battery)	33.8 kg
Degrees of freedom	12
Max nominal speed[1]	1.6 m/s

[1]Max nominal speed refers to the forward velocity of Spot's body, and is determined against nominal environmental/navigational conditions. The motion of individual legs during locomotion can be faster. See Restrictions on the Environment.

Power

Specification	Value
Battery capacity	564 Wh
Max battery voltage	58.8 V
Typical runtime	Approximately 90 minutes[1]
Standby time (Spot powered, motors off)	180 minutes
Spot Power Supply power output	400 W
Max charge current	7 A

Specification	Value	
Time to charge (Spot Dock ambient temp. 25°C)	Approximately 50 minutes for 80% charge	Approximately 2 hours for 100% charge
Time to charge (Spot Dock ambient temp. 35°C)	Approximately 2.5 hours for 80% charge	Approximately 3.5 hours for 100% charge
Time to charge (Spot Power Supply)	Approximately 1 hour	
Battery mass/weight	5.2 kg	

[1]Approximately 60 minutes when powering attachments

Cameras

Specification	Value
Camera functions	Black-and-white or color fisheye, range (depth), infrared
Number of optical cameras(for image capture, fiducial recognition, displaying surroundings)	5 (front-left, front-right, left, right, rear)
Overall optical field of view (FOV)	360 degrees
Number of depth cameras (for robot perception, obstacle avoidance)	5 stereo pairs (front-left, front-right, left, right, rear)
Overall depth camera field of view (FOV)	Approximately 90 degrees in each direction[1]
Depth camera range	Approximately 2 meters

[1]There are gaps near the hips where the depth camera field of view does not overlap. See Obstacle Avoidance.

Attachments

Specification	Value
Max weight	14 kg
Max power per port	150 W
Payload ports (attachment I/Os)	2 (mirrored)
T-slot rail bolt size	M5 x 1.0

Connectivity

Specification	Value
Enterprise WiFi	2.4Ghz and 5Ghz 802.11b/g/n and 802.11ac
Ethernet	1000Base-T

2. Product Safety Overview

2.1. General principles

Spot is a legged robot capable of mobility on a variety of terrains. Spot uses multiple sensors and three motors in each leg to navigate in indoor and outdoor environments, maintain balance, and attain postures. Spot is capable of carrying and powering attachments.

CAUTION

Spot's behavior while in motion is dynamic and can be subject to local conditions that may generate unexpected motion.

2.2. Intended use

Spot is intended for the professional use of its locomotion and carrying capabilities in either industrial, restricted, or supervised environments.

Spot is intended to be used in dedicated areas, where its possible presence is clearly demarcated or indicated. The limits of locomotion and environments are detailed in Restrictions on the Environment.

Spot can carry attachments intended for sensing, monitoring, or other non-contact interaction. The integration of an attachment could in fact result in additional hazards or different risks when the attachment compromises the stability of Spot, includes dangerous materials, or creates hazardous emissions of all types. For the limits and conditions in which the integration of an attachment is considered a substantial modification, see Integrate attachments.

Spot is not intended for uses involving concurrent human-robot activities sharing the same space or the same equipment to complete an assigned task/mission (sometimes known as "collaborative applications"). People can be occasionally present in the same space as Spot for purposes unrelated to Spot operations (see "Bystander" in Key terminology). The limits of occasional exposure are detailed in Risk assessment.

Any use outside of the intended use is subject to a risk assessment and reduction by the final user. Boston Dynamics recommends that you perform a specific risk assessment to verify:

- the finalized layout of deployment, the setup, and any training activity dedicated to illustrate Spot's working zones;
- the verification of the conditions of the environment, with particular attention to obstacles affecting Spot's navigation that may become apparent after the initial commissioning;
- any additional safeguards or other risk reduction measures;
- potential unplanned maintenance and troubleshooting.

NOTICE

Several additional software licenses are available that make it possible to issue low-level API commands to Spot's joints. Operating Spot this way always falls outside the intended use defined in this section, and must be subject to a separate risk assessment. See Appendix B: Use of low-level API control

Explicitly prohibited uses include:

- Underwater and airborne applications.
- Use as a weapon or to enable any weapon.
- Any use as – or enabling the use of – a Certified Medical Device. Access and operation in healthcare facilities subject to limitations.
- Use in personal care, medical treatment or life-critical applications.
- Use in home environments.
- Transportation of persons or animals.
- Transportation of hazardous materials or substances.
- Intentionally harming any person with Spot or by using attachments mounted on Spot.
- Use for any illegal purpose.
- Use as a climbing aid.
- Interfering with Spot's sensors so as to impair their functioning, intentionally altering the environmental conditions so as to impair the functioning of Spot's sensors, or intentionally altering the environmental conditions so as to impair Spot's locomotion.

DANGER

Any misuse of Spot can potentially cause severe personal injuries or result in significant material hazards.

2.3. Modes of operation

Spot can be operated in various modes.

- **Manual:** Direct operation of Spot by displaying images from Spot's cameras on a remote controller. See Remote controllers and Drive Spot with remote control. All Spot operations are supervised and executed by a human driver who is responsible for verifying the surrounding conditions.
- **Automatic:** Autowalk missions can be recorded and replayed by Spot. During replay Spot operates automatically. See Automatic operation.

The frequency and duration of Spot operations in either manual or automatic modes varies greatly depending on the specific use of Spot.

For example, foreseeable uses in applications including routine inspections of industrial assets can be configured along a route in manual mode and then be repeated and completed largely in automatic

mode. While operating in automatic mode, Spot is expected to encounter bystanders not involved in its operations for very brief moments along routes. While operating in manual mode, interactions with bystanders are expected to be longer, although limited in time, and may include people attending to their own tasks in the operating environment.

A complete analysis of foreseeable exposure to Spot is reported in Risk assessment.

CAUTION

Spot should always be remotely controlled by properly trained operators, or execute automatic operations configured or programmed by a trained professional.

Failure to properly verify programmed applications may result in unexpected hazards during operations.

2.4. Locomotion

Spot has several built-in gaits that allow it to move dynamically in a variety of environments. Spot uses multiple sensors and three motors in each leg to navigate indoor and outdoor terrain and maintain balance through slips and disturbances.

2.4.1. Primitives: Gaits and specialized modes

2.4.1.1. Walk (“trot”)

Spot’s default gait. Spot moves at variable speed on alternating pairs of legs (front-right/hind-left, front-left/hind-right).

On a firm flat surface such as concrete, wood floor, or thin carpet, Spot's movement while walking is a regular cadence of each pair of legs swinging and touching the ground together. The body remains approximately stable at the same height and attitude.

Spot will change body posture, the pose of the legs, and gait pattern when necessary to perform programmed actions (e.g. pointing an attachment in a given direction) or to maintain balance under disturbances, including irregular or unstable surfaces.

2.4.1.2. Crawl

Spot moves slower than trot and keeps three feet on the ground at all times to improve stability on low-friction, irregular, or unstable surfaces.

2.4.1.3. Quick-step slip prevention

In the Walk gait, Spot may take extremely rapid steps while recovering from a slip. This greatly reduces the chance of falls on ice, wet or oily floors, and other slippery surfaces.

2.4.1.4. Stairs Mode

During both manual and automatic operations, when Spot detects a stairway in its path, its default behavior is to automatically adjust its gait to a moderate speed and pitch its body to adjust to the slope

of the stairway. Spot will automatically align itself with the center of the stairway to avoid colliding with walls or railings.

Spot models that are equipped with an A/V warning system will display a unique light pattern while navigating in stairs mode. See Auditory and Visual (A/V) Warning System.

Stair locomotion involves sophisticated control and use of sensors. For the best and most reliable performance in these conditions, keep Spot's software fully updated.

WARNING

Failures on stairs cannot be completely eliminated. To minimize the probability of failures, do not interfere with the automatic stair behavior by suspending, altering, or making rapid changes in manual commands. Actively stopping Spot on stairs has negative effects on stability (see Hazards associated with stopping or other powerless motion).

Spot can climb up and down most staircases found in typical residential, office, and industrial environments. See Restrictions on the Environment.

For more information about driving Spot on stairs, see Navigate Stairs.

2.4.2. Velocity limitation

When operating Spot manually in the Walk gait, Spot's maximum speed is adjustable up to 1.6 m/s. To switch between the following maximum speed settings, see Manual mode controls.

Speed setting	Maximum velocity
Fast	1.6 m/s
Med (default)	0.9 m/s
Slow	0.5 m/s

CAUTION

Changes to speed settings take effect immediately. Spot may change speed mid-stride.

Speed settings limit the maximum speed that can be commanded by the controller. Spot's actual speed can be briefly higher or lower than the commanded speed based on a combination of factors including:

- The current speed setting.
- The current Ground Friction setting (see Spot App Menus and General Controls under "Robot Controls panel").
- Variable inputs from locomotion controls, such as the amount of tilt applied to the joysticks on the tablet controller when driving in manual mode.
- Disturbances that cause Spot to alter its gait so as to maintain balance.

- Disturbances or hardware failures that result in a fall, during which Spot's body or legs may briefly exceed the maximum speed before being de-energized and/or coming to rest.

In general, alterations that increase speed are likely to be limited to the motion of the legs, while the body is unlikely to exceed the nominal speed for the current gait.

On a firm flat surface such as concrete, wood floor, or thin carpet, most adults can easily outpace Spot at its default walking speed. The kinetic energy associated with Spot's forward motion at the maximum velocity for each speed setting can be estimated based on the robot's mass, including the battery and any attachments.

2.5. Stopping Functions

2.5.1. Operational stop

Spot monitors its sensors and can automatically pause movement or remove power from motors in certain situations:

- Signal loss: After 3 seconds without controller communication, Spot will sit. After 8 seconds without communication, Spot will turn off its motors. See Loss of Connection to the Controller.
- Fall detection: When Spot detects a fall, motors are immediately de-energized. Legs will not actively flail or remain stiff under contact.
- Low battery: When Spot's batteries reach critically low levels, Spot will sit and turn off its motors.
- Controller input: Commands to stop or de-energize Spot can be sent from a robot control device. See Remote controllers and Stop and Restart Spot's Motors.

WARNING

If Spot is on stairs when an operational stop would occur, it may attempt to exit the staircase before performing the operational stop depending on the settings in the Robot Controls panel (see Spot App Menus and General Controls). This may result in automatic locomotion up or down the staircase, overriding other locomotion commands.

Do not stand on stairs, below open rails, or within 2 meters of the bottom of a staircase where Spot is active.

NOTICE

Spot can detect falls that unexpectedly occur. De-energization of legs during falls minimizes damage from the fall and prevents new hazards or bigger risks, such as further stumbling. This behavior is called “smart freeze.”

2.5.2. Safety-related stop

Spot can be stopped by interfacing an external safe input signal to the payload port.

The stopping function will result in a de-energization of all motors (Stop Cat. 0 EN IEC 60204-1).

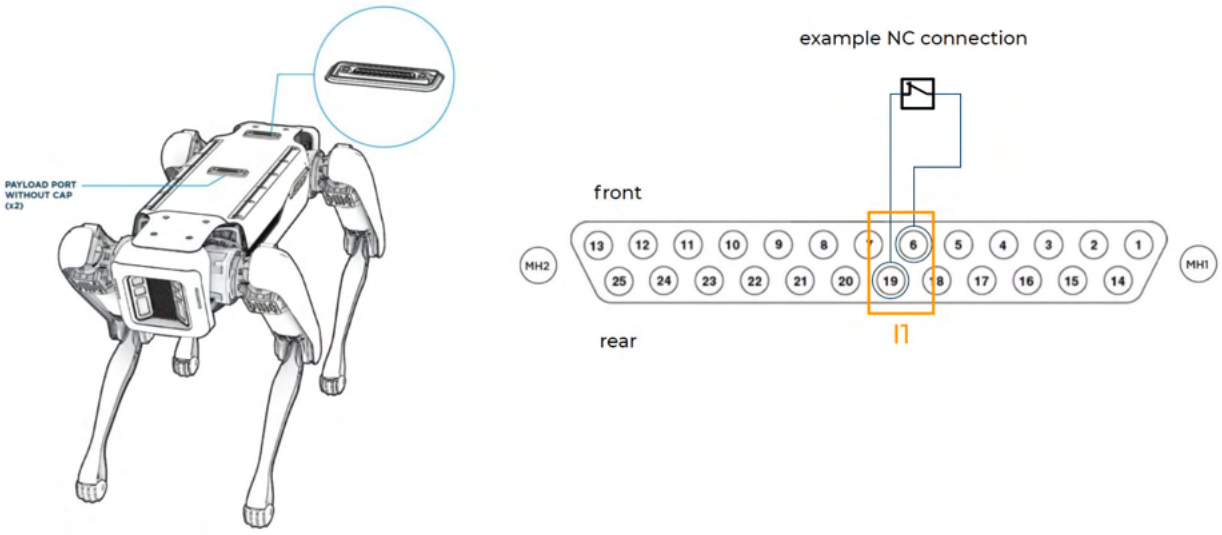
WARNING

When motors are de-energized, Spot will lose its ability to stand and balance. On flat ground, Spot will lower its body. On inclined surfaces or stairs, Spot may tip over.

The maximum response time for the stopping function is 200 ms.

Safe inputs for activating and triggering the stopping function are located on the payload ports as follows:

Item	Description
Safe input location (See figure below)	I1 = pin 19
Interface	Use only one port, either front or rear. See example in figure below. Spot will not work without a cap or a properly configured attachment connected to each port. When a cap is used, the stopping function is disabled.
Safe input default connection	6-19 pair normally closed (NC).
Type of stop	Stop Category 0 (IEC 60204-1) when contact on I1 is opened.
Stopping safety function	Implemented in accordance with ISO 13849-1:2023, of Category 1 and performance level c. The PFHD is 1.1E-6/hr.
Reset	6-19 pair is closed.
Restart	Enable power following commands on the manual controller or issued from programs.
Environment	The safety-related part of the control system operates within the same environment limits established for Spot.



Payload port external signal interface for protective stop.

WARNING

Use safety-related inputs only for connection to safeguards or emergency stop devices. Do not interface with non safety-related signals.

2.5.3. Stopping distance

On flat ground, a safety-related stop will result in a maximum stopping distance of 1 meter. On uneven or sloped surfaces, the stopping distance could be augmented by Spot's motion under gravity and will depend on factors such as the slope or unevenness of the walking surface. For more information, see Hazards associated with stopping or other powerless motion.

2.5.4. Emergency Stop (E-Stop)

NOTICE

The E-Stop button applies only to Spot model number 04-00143531-401. Information about additional Emergency Stop devices applies to all models.

Spot's E-Stop button. Press firmly to activate; twist clockwise to release (unlatch).

Spot includes an Emergency Stop (E-Stop) button located at the top right rear corner of its body.

When pressed, the E-Stop button triggers the Safety-related stop, resulting in an Emergency Stop function compliant with ISO 13850. Spot will not resume operations until a deliberate reset and restart procedure is initiated (see Stop and Restart Spot's Motors).

Spot can be optionally fitted with additional Emergency Stop devices that comply with the same standard. Any additional Emergency Stop input device must meet the requirements of the safe input interface on the payload port as described in Safety-related stop.

The Emergency Stop function is NOT a primary protective measure in any situation, and is manually activated. It should be used only when an immediate emergency cannot otherwise be resolved, for instance in case of accidental entrapment or insufficient clearances.

WARNING

The Emergency Stop function must be used only when you have full visibility of Spot and its surroundings. A manually activated Emergency Stop will override any active control, and therefore could determine additional hazards if it causes a forced loss of stability (see also Hazards associated with stopping or other powerless motion).

CAUTION

Always try to anticipate and escape entrapment conditions.

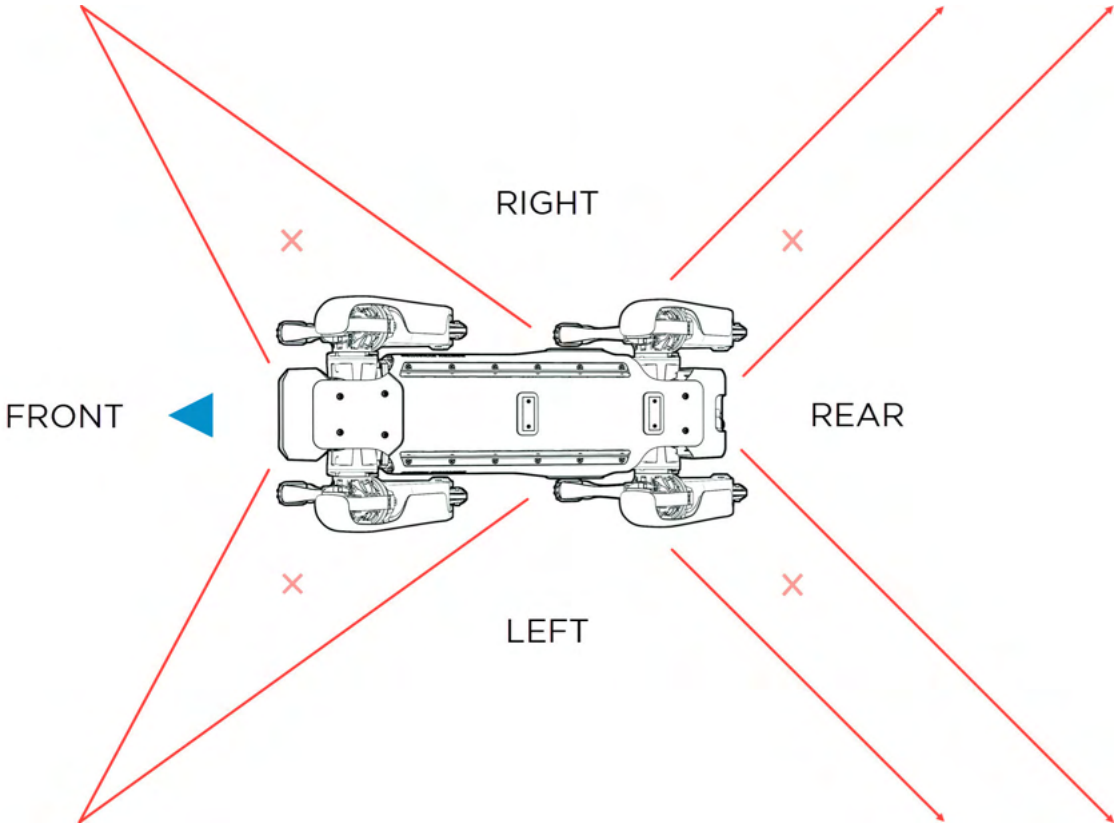
Do not activate the Emergency Stop function for routine interventions or as a means for a normal stop.

2.6. Obstacle Avoidance

Spot uses its perception system to automatically avoid collisions with obstacles. The perception system consists of five depth cameras: two at the front, one at the rear, and one on each side of Spot.

NOTICE

Although the camera images displayed to an operator may show an overlapping field of view, the perception system has gaps, especially at the rear corners of Spot.



Approximation of gaps in the obstacle avoidance field of view.

Obstacles are mapped and remembered even when Spot's movement brings the obstacle into one of the gaps. However, Spot may fail to detect:

- Moving obstacles.
- Obstacles that are hard to detect until Spot is very close. (For details on the limits of the perception system, refer to Restrictions on the Environment).
- Obstacles that remain in a gap in Spot's field of view during its entire approach path.

By default, Spot tries to keep a minimum distance of about 7.5 cm between itself and nearby obstacles. You can set an additional cushion of up to 50 cm using the controls in the Robot Controls panel (see Spot App Menus and General Controls). The obstacle avoidance cushion may prevent Spot from traversing doorways and other confined spaces.

CAUTION

Spot may collide with people or objects, even with its obstacle detection system enabled.

Operators and bystanders should assume that Spot may move unexpectedly at any time.

2.7. Auditory and Visual (A/V) Warning System

NOTICE

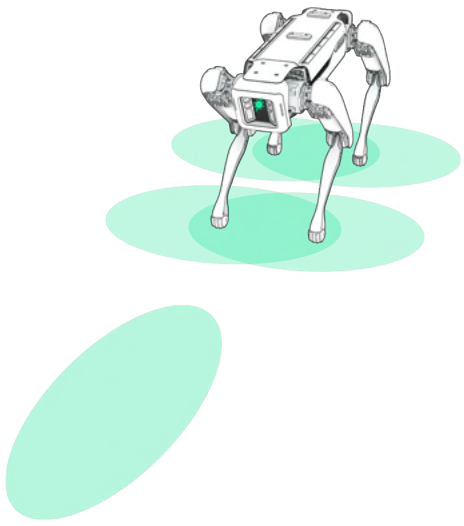
This information applies only to Spot model numbers 04-00143531-401, 04-00143531-601, and 04-00143531-611. To find your model number, check the label inside Spot's battery compartment.

Spot is equipped with an auditory and visual (A/V) warning system to alert nearby people of Spot's presence and operational status.

The warning system consists of five indicators that project colored light onto the ground to the front and sides of Spot's body, a buzzer, and a speaker. When the warning system is enabled, signal patterns activate automatically when specific operating conditions are met.

The warning system is disabled by default. For instructions on enabling and configuring it, see Configure the A/V warning system. The most recent configuration will persist across operating sessions and reboots.

2.7.1. Indicators



Areas illuminated by the indicators.

Each indicator can emit multiple colors. Brightness is adjustable and automatically adapts to ambient light conditions.

The indicators are located:

- On the front body panel (1 indicator).
- On the bottom body panel between the front hips (2 indicators).
- On the bottom body panel between the rear hips (2 indicators).

The indicators are angled to illuminate the ground in front, beneath, and to the sides of Spot. This is intended to maximize surface reflections and improve visibility from around corners, behind small obstacles, beneath grated surfaces such as stairs and walkways, and other directions where Spot might not be directly or easily visible.

The brightness and the intended maximum exposure to direct eyesight are in compliance with IEC 62471. To further reduce direct eye exposure, the indicators automatically power off when Spot tilts or rolls more than 90 degrees from the horizontal (neutral) position, and when it rolls onto its back.

Indicator location	**Max lux**[1]
Front panel	1030 lux
Front and rear hips	1010 lux

[1]Lux measured by light projected onto the floor when Spot is in the stand position.

2.7.2. Buzzer

The buzzer produces a tone of 5,333 Hz. The high pitch is intended to make the buzzer distinct from other common tones.

The buzzer volume is adjustable and can produce a maximum sound pressure level of 110 dBA at 1 meter in front of Spot.

WARNING

At higher volumes, prolonged exposure to the noise produced by the buzzer can be harmful.

See Noise.

2.7.3. Speaker

Spot is equipped with a speaker that can produce a wide range of sounds.

The speaker volume is adjustable up to 80 dB (measured 1 meter in front of Spot).

2.7.4. Warning system light and sound patterns

Each light and sound pattern produced by the warning system corresponds to a specific Spot behavior or operational status. Two color palettes are available: **DEFAULT** and **ALTERNATE**.

For instructions on configuring the warning system during Spot operation, see Configure the A/V warning system.

Default color palette

Color	Pattern	Buzzer	Robot status	Example
Green	Slow blink[1]	Off	Normal operations, motor power ON.	Most locomotion during manual and automatic operation.
	Fast blink[2]	Off	Normal operations, while starting or changing motion.	Docking and undocking.
	Pulse[3] (front indicator off)	Off	Normal operations, waiting for an automated response (not for human intervention).	Waiting to regain sufficient clearance with respect to other moving objects along or near Spot's path during automatic operation.[4]
Amber	Slow blink[1]	Slow beep[1]	Normal operations with an increased level of warning.	Traversing a crosswalk area during automatic operation.[4]
	Fast blink[2]	Fast beep[2]	Normal operations, before starting activities with an increased level of warning.	About to traverse a crosswalk area during automatic operation.[4]
	Flash[5] (front indicator off)	Slow beep[1]	Normal operations with an increased level of warning (special cases).	Traversing stairs.
	Solid	Off	Activation of safety response.	Motors powering off as a result of an operator command or protective stop.
Red	Fast blink[2]	Off	Failure or emergency situation.	Emergency Stop pressed, or safety input interface not properly configured.
White	Pulse[3]	Off	Normal operations, waiting for human intervention or during processes of variable length.	No or minimal apparent motion while capturing sensor data during automatic operation.

[1]Alternate on/off at 0.7 Hz

[2]Alternate on/off at 1.4 Hz

[3]Continuous oscillation of brighter and dimmer light

[4]Requires additional equipment.

[5]Brief flash at 1.4 Hz

Alternate color palette

Color	Pattern	Buzzer	Robot status	Example
Blue	Slow blink[1]	Off	Normal operations, motor power ON.	Most locomotion during manual and automatic operation.
	Fast blink[2]	Off	Normal operations, while starting or changing motion.	Docking and undocking.
	Pulse[3] (front indicator off)	Off	Normal operations, waiting for an automated response (not for human intervention).	Waiting to regain sufficient clearance with respect to other moving objects along or near Spot's path during automatic operation.[4]
Red	Slow blink[1]	Slow beep[1]	Normal operations with an increased level of warning.	Traversing a crosswalk area during automatic operation.[4]
	Fast blink[2]	Fast beep[2]	Normal operations, before starting activities with an increased level of warning.	About to traverse a crosswalk area during automatic operation.[4]
	Flash[5] (front indicator off)	Slow beep[1]	Normal operations with an increased level of warning (special cases).	Traversing stairs.
	Solid	Off	Activation of safety response.	Motors powering off as a result of an operator command or protective stop.
	Fast blink[2]	Off	Failure or emergency situation.	Emergency Stop pressed, or safety input interface not properly configured.
White	Pulse[3]	Off	Normal operations, waiting for human intervention or during processes of variable length.	No or minimal apparent motion while capturing sensor data during automatic operation.

[1]Alternate on/off at 0.7 Hz

[2]Alternate on/off at 1.4 Hz

[3]Continuous oscillation of brighter and dimmer light

[4]Requires additional equipment.

[5]Brief flash at 1.4 Hz

2.8. Restrictions on the Environment

Spot is designed for dynamic mobility in a variety of environments and terrains. The following tables describe the nominal environmental conditions in which Spot is expected to work as intended. Spot is assumed to be in like-new condition with no attachments or other modifications. Before using Spot with attachments, payloads, or modifications (including Spot Arm), it is your responsibility to assess how your specific combination of equipment affects Spot's physical characteristics and its potential interactions with the operating environment.

When walking at default speed on a firm flat surface such as concrete, wood floor, or thin carpet, Spot's motion resembles that of a dog or other quadruped and it can easily be outpaced by most adults (see Locomotion.

WARNING

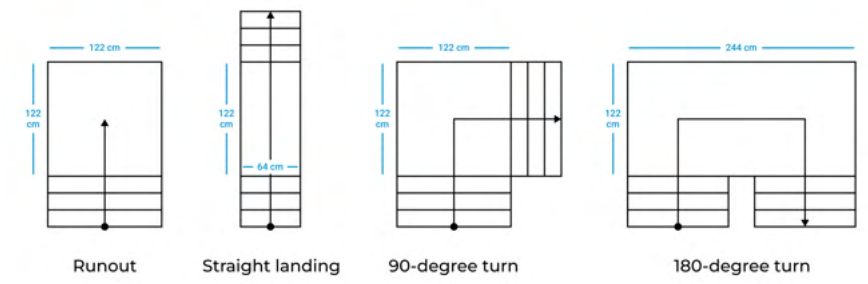
The listed environmental constraints are treated as independent variables, but will intersect in real-world conditions. For instance, assume Spot is operated on a sloped surface that is also covered in debris: Even if the slope and the debris are each within nominal tolerances, Spot's performance may degrade in ways that would not happen if the same slope was uncluttered or if the debris was on flat ground.

Any use in an unintended environment (i.e. outside limits) is not recommended. Boston Dynamics recommends that you perform a specific evaluation of environmental conditions using the guidance provided in Risk assessment.

2.8.1. Environmental Conditions

Environment	Nominal conditions
Surface	• Minimum coefficient of friction: 0.4 • Debris and/or uneven surfaces: height variations up to 25 cm • Avoid soft or pliable surfaces: minimum force 8 kN/m.
Space	• Minimum height of obstacles overhanging the walking surface: 70 cm • Minimum doorway, gap, or corridor width (forward/reverse direction of travel): 60 cm • Minimum space to turn around (rotate in place): 122 cm L x 122 cm W
Slopes	• Maximum pitch: +/- 30 degrees
Elevated Ground	• Maximum height of negative obstacles (step up or down): 35 cm • Stable (unmoving) surfaces: less than 5 cm lateral motion

Environment	Nominal conditions

Stairways	• Minimum width: 64 cm
	• Maximum pitch: +/- 45 degrees
	• Maximum step height: 22 cm
	• Barriers at least 50 cm high at the sides, with gaps no more than 30 cm wide.
	• Straight direction of travel (no curvature or turns except on flat landings).
	• Minimum landing dimensions[1]:
	  ○ Runout space at top and bottom of stairs: 122 cm L x 122 cm W
	  ○ Straight landing (no turn between flights): 122 cm L x 64 cm W
	  ○ 90-degree turn between flights: 122 cm L x 122 cm W
	  ○ 180-degree turn between flights: 122 cm L x 244 cm W
	 

Lighting	• Dynamic range of ambient light: 68 dB • Minimum ambient light for clear visuals from robot cameras: 50 lux • High-contrast light that includes IR wavelengths (e.g. sunlight) may interfere with obstacle detection.

Climate/ Ingress	• Ingress protection: IP54
	• Ambient temperature range for operation:
	  ○ -20°C to 45°C (serial numbers BD-80010001 to BD-93650001 and BD-00010001 to BD-41199999)[2]
	  ○ -20°C to 55°C (serial numbers BD-41200001 and higher)
	• Maximum non-condensing humidity: 99% relative humidity

[1]For stair landings, length (L) matches the robot's direction of travel as it enters the landing from the stairs.

[2]Note that the first digit of Spot serial numbers is the year of production, beginning in 2018, so serial numbers beginning with 8 or 9 are prior to serial numbers beginning with 0 (indicating robots produced in 2020).

Any deviation from the nominal environmental conditions (Surface, Space, Slopes, Elevated Ground, Stairways) may increase the occurrence of total or partial loss of stability (see Unintended contacts and other hazards related to locomotion). Effects of instability may include, but are not limited to:

- Falls
- Erratic movements for regaining balance
- Inability to proceed with locomotion

Exceeding the Climate/Ingress conditions may have a significant effect on the reliability of Spot hardware:

- Extreme temperatures or submersion in water may cause failures in various Spot components dedicated to perception and control (cameras, joints, CPU, etc.)
- Quick transitions (“thermal shock”) may cause condensation on internal components, leading over time to corrosion.
- Intermittent, but frequent, exceeding of temperature or ingress limits may lead to latent damages that are not immediately visible but can originate failures over time.

2.8.2. Navigational Conditions

Category	Spot capabilities/conditions
Obstacle sensing ranges/limitations	• Camera sensing range: 2 meters • Although the body camera images on the controller show an overlapping field of view, the perception system has gaps, especially at the rear corners of Spot. • Cannot detect obstacles directly above Spot (e.g. if Spot is sitting under a table and then attempts to stand, the top of Spot will hit the table).
Obstacle height	• Objects shorter than 30 cm: Spot will attempt to step on or over the obstacle. • Objects taller than 30 cm: Spot will attempt to avoid the obstacle.
Obstacle area/ width	• Minimum area/width: 3 cm
Surfaces that interfere with navigation	• Reflective (mirrored) surfaces • Transparent objects/barriers • Under bright ambient light or dark matte surfaces • Repeating patterns of vertical lines
Energy sources that interfere with navigation	• Near-IR (780-2500 nm) light sources pointed at Spot or its surroundings. • High-contrast light that includes IR wavelengths (e.g. sunlight).

Any deviation from the nominal navigational conditions may:

- Increase the occurrence of failures in obstacle detection and avoidance.
- Impair Spot's ability to recognize features and fiducials.
- Impair Spot's ability to complete navigation as planned.

2.9. Risk assessment

Boston Dynamics has assessed and evaluated risks within the intended use of Spot (see Intended use). Review also Declarations and marking for compliance with regulations, if applicable.

The following paragraphs provide guidance about the additional risk assessment that is always recommended when using Spot. Refer to ISO 12100 for the general methodology of risk assessment.

Risks are the transformation of potential hazards into actual harms. To estimate risks it is necessary to combine a measure of:

- The severity of the effect of hazards.
- The occurrence of hazards (how often, how likely, how predictably, how well-anticipated).

2.9.1. Before starting a risk assessment

When completing your own risk assessment, consider:

1. **Intended use**: All the elements that correspond to the specified intended applications for the equipment when used by the expected users within a designated environment.
2. **Foreseeable misuse**: Anything that does not pertain to the intended use and appears as a form of misconduct. The occurrence of misuses can be estimated to be less likely than intended uses.
3. **Non-task-based interactions**: People can be close to Spot as a mere result of sharing the same facility. The occurrence of unrelated interactions is uncommon, infrequent, typically not permanent, and rarely known in advance. The intended and foreseeable hazardous exposures are limited in time, typically:
    a. *Less* than 1 minute per interaction when Spot is operating in automatic mode.
    b. *Less* than 10% of the total usage time when Spot is operating in areas with restricted access.
    c. Several minutes, up to 1 hour, when Spot is being operated in manual mode (recording missions, remotely-controlled operations). Manual-mode events are longer than automatic-mode events, but happen much less frequently.
4. Role and type of **personnel**.
    a. *Affected*: People can be occasionally present in the same space as Spot for purposes unrelated to Spot operations. This is the most generic class of exposed people.
    b. *Qualified*: People assigned to operate Spot (e.g. programming missions, occasional manual driving). The frequency of these tasks depends on the application. Spot is commonly dedicated to automatic operations.

5. **Environment of operation**: The intended aspects of the actual space where Spot operates must be analyzed with respect to the generic conditions specified in Restrictions on the Environment. The final environment of Spot applications can significantly alter the conditions for the severity of hazards and alter (normally worsen) the probability of occurrence of failures or hazardous conditions. Important elements for the assessment of the environment include:
    a. *Surfaces*: Material, texture, friction, stiffness, presence of contaminants or dirt or particles, etc., on walking surfaces.
    b. *Spaces*: Layout, areas open to access.
    c. *Slopes*: Length, inclination, material.
    d. *Elevated grounds*: Highest points reachable with respect to ground levels.
    e. *Stairways*: Type, run/rise dimensions, type of risers and treads, handrails, wear conditions, presence of landings, frequency of sharing with personnel.
    f. *Lighting*: Diffuse ambient, collimated, visible/infrared.
    g. *Climate*: Temperature and humidity, presence of condensation.
    h. *Obstacles*: Size, shape, clusters of objects and their stability, free space over and under obstacles, firmness of objects.

NOTICE

Spot can walk over objects.

2.9.2. Electrical hazards

Spot uses a separated extra low-voltage (SELV) power supply design (<60 VDC), meeting the requirements in IEC 60204-1 for electrical equipment and IEC 62133 for batteries. There are no known significant residual risks associated with shocks, either apparent or as a result of faults.

CAUTION

Do not touch or operate Spot if any damage is noticed and wet parts of the body are exposed to contact.

Contact Boston Dynamics Support in case of apparent damage of parts.

Spot is not intended to be used in operating environments subject to high voltage conditions that may compromise the original SELV design:

- Presence of high voltage equipment that may be in range of any physical contact with Spot.
- Presence of potential low impedance paths, for example due to contaminants or low-conductance materials, in contact with high-voltage equipment.
- Presence of apparent faults in any electrical equipment that Spot may interact with. Report such conditions immediately to management.

WARNING

Exposure to severe electrical and electromagnetic environments may determine non-apparent damages or latent failures of Spot. Using Spot after exposure to high voltage or indirect contact may result in unexpected failure of the electrical system.

High voltage in the environment increases the otherwise negligible probability of accidental shocks because non-SELV conditions may become possible.

2.9.2.1. Charging equipment

Spot uses a series of approved accessories for charging.

REQUIRED READING

When assessing risks related to charging equipment, review the following documents in the Boston Dynamics Support Center (see Appendix A: Supplemental information):

- *Spot Power Supply Information for Use*
- *Spot Dock Information for Use*

2.9.3. Hazards due to non-ionizing radiation

Spot has no known significant residual risks associated with non-ionizing radiation within the limits of intended use. Risks are reduced by design using components or solutions compliant with all the relevant technical standards.

Boston Dynamics recommends that you review the following factors if using additional equipment (out of the scope of the intended use):

- Unintentional electromagnetic (EM) radiation: Most powered electronics components emit and are subject to the effects of electromagnetic radiation.
- Intentional radiation (radio frequencies): If wireless communications are used.
- Light sources, for example in attachments projecting visible lights.
- Laser sources, for example in attachments using measurement or pointing.

2.9.3.1. EM radiation considerations

Spot meets the requirements for unintentional radiators according to electromagnetic compatibility (EMC) standards related to heavy industrial environments (IEC 61000-6-4) and is able to withstand EM disturbances typically found in industrial environments (immunity) within standardized limits.

Test	Level (IEC 61000-6-2)
ESD	+/- 4 KV direct contact, +/ -8 KV air discharge
RF Immunity	10 V/m 80 - 1000 MHz, 3 V/m 1 - 6 GHz

WARNING

Using Spot in environments with exceptionally high EM disturbances, or integrating high-emission attachments, may result in unexpected behavior from Spot.

2.9.3.2. Radio Frequencies (RF)

Spot uses a WiFi radio module and meets the requirements for intentional radiators set in the relevant international technical standards.

You should estimate the probability of augmented influence of RF that could affect or compromise the conditions for immunity of Spot from:

- The integration and configuration of attachments that can intentionally emit powerful RF.
- The proximity to equipment capable of powerful RF emission.

Additionally, the availability of the networking infrastructure and its potential failures may also affect the probability of unexpected loss of communication or alteration of the nominal wireless protocols.

2.9.3.3. Laser

Spot contains five stereo camera systems that contain a Class 1 laser projection system.

This product is classified as a Class 1 Laser Product under the EN/IEC 60825-1, Edition 2 (2007) and Edition 3 (2014).

CAUTION

Do not tamper with or make adjustments to any of Spot's laser components. Doing so may result in hazardous radiation exposure. Use of controls or adjustments or performance of procedures other than those specified herein may also result in hazardous radiation exposure.

2.9.3.4. Bright lights

NOTICE

This information applies only to Spot model numbers 04-00143531-401, 04-00143531-601, and 04-00143531-611. To find your model number, check the label inside Spot's battery compartment.

Prolonged direct exposure to the light from Spot's warning system indicators could cause irritation or damage to the eye, similar to any bright light source in the visible spectrum. Under normal operating conditions, such exposure is limited to short time intervals due to the intermittent nature of warning patterns. The warning system is intended for indirect projection of lights. A direct, persistent gaze is easily avoidable. The indicators comply with IEC 62471 and will automatically power off when Spot tilts or rolls more than 90 degrees from the horizontal (neutral) position, and when it rolls onto its back.

People with a medically diagnosed light sensitivity condition should exercise additional caution and use PPE to avoid prolonged exposure to the light from the indicators.

2.9.4. Noise

The airborne noise generated by Spot is determined by the environment Spot is operating in. For instance, Spot will generate much less noise walking across a padded carpet floor than it will walking up metal stairs.

Before putting Spot into regular use, work with your Environmental Health and Safety team to determine if additional Personal Protective Equipment (PPE) is required due to the noise Spot generates in its working environment.

WARNING

At higher volumes, prolonged exposure to the noise generated by the warning system buzzer can be harmful.

The maximum volume may be necessary only for very loud background environments. Recommended level is not higher than 80 dBA.

CAUTION

Verify the ability of affected personnel to hear the buzzer and that use of the buzzer complies with local noise requirements.

NOTICE

In environments where hearing protection is required, the buzzer's default tone is still audible by affected personnel wearing auditory PPE.

2.9.5. Fire, Explosion, and Hazardous Materials

There are no known significant risks associated with Spot's lubricants.

The Spot battery pack contains cells that have electrolytes. All cells are fully enclosed in a sealed enclosure that has passed UN 38.3 transportation testing. In addition, the pack has CB Certification to IEC 62133 and has passed drop testing with no leakage of electrolyte.

DANGER

In the unlikely event of damage with visible breakage of any part of Spot or its batteries, **DO NOT** touch or attempt any recovery.

It is extremely unlikely that the battery generates fire under normal conditions of use and environment. If the battery catches fire, do not try to put it out. Evacuate to a safe area and call the fire department. Battery fires create toxic fumes and cannot be put out with conventional fire extinguishers or water.

2.9.6. Unintended contacts and other hazards related to locomotion

Spot is a legged robot: It maintains balance and moves using dynamic control principles. Spot uses sensors (not strictly necessary for locomotion) for improving the perception of the ground and the surrounding environment.

The conditions of the environment are the main, if not the only, reason for instability and the possibility of failures during locomotion.

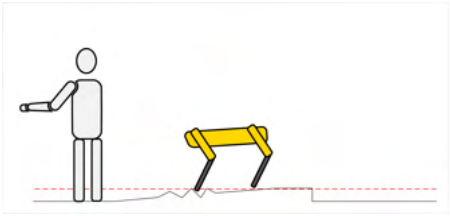
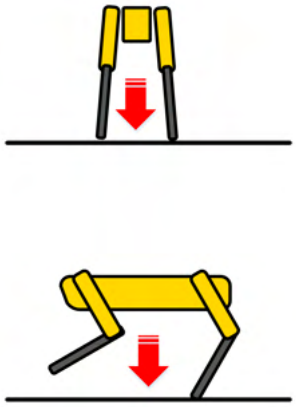
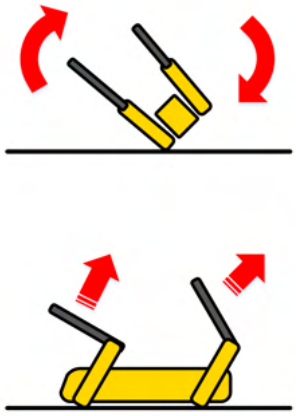
WARNING

Hazards during Spot locomotion happen in the form of unintended behaviors:

- Unpredictable movements of the legs, following a temporary loss of stability and consequent recovery attempts.
- Large deviations from planned and expected paths.
- Sudden accelerations of either the legs or the entire robot as a reaction to external disturbances, like physical impact or the appearance of obstacles.
- Unpredictable movements following a tripping event.
- Sliding or tumbling following a fall or tip-over.
- Any combination of the above.

Review the following paragraphs for information about the estimated risk in the intended use. Additional assessment may be necessary: Use the guidelines to estimate the severity and occurrence of the hazards related to locomotion.

2.9.6.1. Accidental impacts during normal locomotion on flat, non-elevated grounds

Reference situations		
 Elevation <300 mm	 (a)	 (b)

Considerations for the severity of hazards

When Spot is actively moving, accidental minor impacts may occur only with the lower body (feet and lower legs). While Spot is moving and balancing on legs, any accidental impact with Spot would be a short event (<100 ms), followed by a recoiling movement that will not sustain any pressure on the human body. The severity of impacts is in general low.

Even in case of a loss of stability, Spot would remain mostly in the same location.

- A sudden, mostly vertical collapse of Spot or a forced stop (a) is almost invariably associated with low or negligible risk.
- A tip-over on a predominantly flat surface rarely results in more than a half turn (b). In case of a tip-over, the legs are powered off. Legs can extend by the effect of inertia after motor power is disabled during the fall event. The severity associated to this situation is in general low due to the very limited energy of the residual motion (powerless legs).

Additional or unintended conditions

Alteration factors for the estimation of severity may include:

- Accidental collisions with lower human limbs from lateral or rear directions of approach may affect the reaction of human knees differently.
- Unforeseeable, indirect hazards caused by secondary effects (e.g. becoming entangled with and pulling on overhanging equipment).
- Unintended integration of very tall attachments.

When reviewing a risk assessment, always consider the position and the direction of approach of Spot with respect to an affected person to estimate the severity of hazardous conditions.

Considerations for the occurrence of hazards

Frequency and duration of exposure

Foreseeable hazardous exposures are limited in time, typically:

- Less than 1 minute per interaction when Spot is operating in automatic mode.
- Less than 10% of the total usage time when Spot is operating in areas with restricted access.
- Several minutes, up to 1 hour, when Spot is being operated in manual mode (recording missions, remotely-controlled operations). Manual-mode events are longer than automatic-mode events, but happen much less frequently.

Low frequency leads invariably to low occurrence of collision hazards when associated with regular skills and high awareness of affected people.

NOTICE

The condition of low occurrence does not hold when:

- Qualified personnel are present for more than 25 percent of the total usage time.
- Affected people are present for up to 25 percent of the total usage time.
- Spot is operated in shared areas used by many people, increasing the total exposure

Probability of failure (lack of availability)

Spot normally activates its collision avoidance capability (see Obstacle Avoidance).

A low occurrence of collision hazards holds even if failures in detection of obstacles are possible, when all other factors are valid (low severity, regular skills, and high awareness of affected people).

Using Spot outside environmental limitations (see Restrictions on the Environment) may compromise the availability of obstacle detection or downgrade the performance of sensors in ways that are insufficient to generate complete failures but could determine a delay in the detection of obstacles.

Sudden appearance of obstacles from blind directions decreases the probability that Spot reacts in time to avoid such obstacles.

CAUTION

Downgraded perception may determine irregular, possibly fast, movements in non-travel directions.

Avoidability of potential collisions

When used as intended, Spot allows for high avoidability:

- Spot is in general distinctively visible.

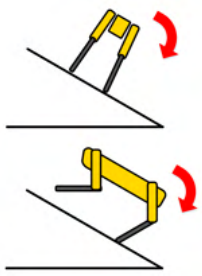
  For P/N 04-00143531-401, 04-00143531-601, and 04-00143531-611 only: Use of the A/V warning system (indicators and buzzer) increases awareness of Spot's presence even in noisy and high-traffic environments.
- Missions follow very regular and repeatable paths.
- Spot's size makes it possible to easily maintain clearances.
- Standard human walking speed matches the fastest settings and exceeds the default settings of Spot velocity.
- Qualified, but also affected personnel are normally familiar with other Autonomous Mobile Robots (AMRs).
- Anticipation of Spot's behavior is always assumed after initial training. Failures to maintain balance are normally anticipated by short irregular walking patterns.
- Sudden falls (not anticipated by some progressive instability) or unexpected lateral movements happen only under rare circumstances.
- Accelerations and any change of pattern do not occur in a timeframe shorter than 1 second.

Unforeseeable conditions that lower the avoidability of hazards are:

- Frequent and combined blind corners and/or cluttered environments, which may result from unanticipated changes in layout.
- Unsignalled concurrent presence on stairs when staircases are blind and narrow.
- Unprotected open edges or elevated surfaces where the environment has not been prepared.
- Failure to maintain training programs that ensure familiarity with the presence of Spot.
- Unintended uses of Spot, specifically when untrained or not properly informed affected people may encounter Spot in unsupervised circumstances.
- Use of Spot outside of intended limitations (very slippery ground, intrinsically weak or unmaintained walking surfaces with sudden structural collapse, almost invisible tripping hazards like ropes or rebar too thin to be distinguished from the background, etc.).

2.9.6.2. Loss of stability and falls

Spot stands up and keeps balancing only with active control. However, active control does not ensure that stable balancing is always attained.

Reference conditions		
	 *Elevation <1100 mm*	 *Elevation >1100 mm*

Considerations for the severity of hazards

As a result of a loss of stability, Spot will de-energize its legs to avoid additional hazards during potential uncontrolled tip-over movements. If residual motion under gravity can occur (see also Hazards associated with stopping or other powerless motion), the severity will depend on the starting conditions:

- Elevation <1100 mm: Low-severity minor impacts with the lower human body (feet and lower legs);
- Elevation >1100 mm: High severity if impacts can affect the full human body, which is possible only for full-drop (almost vertical) falls or tumbles that originate in the upper region of the elevation.

Additional or unintended conditions

Alteration factors for the estimation of severity may include:

- Type of terrain, which may amplify or attenuate the effects of the event.
- Unintended exposure of children as affected persons (Spot's starting elevation does not correlate to body size, so the upper body could be exposed to danger).

Considerations for the occurrence of hazards

Loss of stability in elevated or inclined surfaces may occur. Spot's ability to maintain stability is based on state-of-the-art methods and the best practical implementation of control. The occurrence is not further reducible.

Additional or unintended conditions

The occurrence of instability is more likely in unintended uses out of limitations:

- Movable, tilting, or floating platforms or portions of walking surfaces in the area of operation that occur after the preparation of the environment.
- Areas of the environment such as the walking surface that are rendered weak, fragile, or unstable by changes in the operational layout (e.g. construction or excavation).
- Lubricants or other hazardous or slippery materials that occur in the operational environment and are not detected and resolved by site management.
- Undetected damage such as broken pipes, cords, or unstable materials in the operational environment.

2.9.6.3. Hazards associated with stopping or other powerless motion

Spot will automatically disable motor power in the following cases:

- As a result of a detected failure or a detected fall.
- As a result of a safety-related stopping function forcing a de-energized state.

Spot’s legs will not be locked during and after a motor de-energization.

NOTICE

A random locked configuration of the legs would likely result in an unbalanced condition for the whole robot.

A random locked configuration of the legs during a tip-over or fall event would increase the likelihood of accidental impact with rigid objects (and increase severity).

During a stop event, Spot will attempt to lower its body in control before full de-energization. However, Spot may occasionally not finish reaching a safe state because the ground conditions (friction, firmness, etc.) may force Spot to iterate its gait to secure its footing. Spot will eventually de-energize but could have passive residual motion (e.g. slide down an incline).

Residual risks of passive residual motion are limited to the following conditions:

- Residual motion without power happens solely under gravity and elevated grounds.
- Residual motion is very unlikely to happen if an elevated ground has no inclines in proximity to Spot.
- Flat or slippery surfaces increase the likelihood of residual motion because they do not offer natural obstacles to stop Spot. Rough and uneven terrain may reduce sliding effects. Stairs, however, offer few and small contact points, making sliding and/or tumbling more likely to occur.
- High inclination of surfaces (out of specifications) will increase the likelihood of tumbling instead of simple sliding.
- The presence of tall attachments significantly increases the likelihood of tumbling.
- Residual motion can last longer when there is a long distance from the point where the de-energization happens to the next sufficiently large landing point.

The configuration of Spot (body attitude, configuration of legs, forward/backward swing direction of each leg, inclination with respect to the main direction of a slope) during a sudden stop or fall event is entirely unpredictable.

2.9.7. Pinch points during motion

Pinch points are present around the joints and legs (see Safe Handling) and cannot be entirely eliminated without compromising the mobility of the legs, or the ability to walk and maintain balance.

Spot pinch points are situated in areas that are not normally reached in situations other than handling and transportation (while Spot is powered off). When motors are active, there is no foreseeable use that would require access to legs and joints.

The reference risk estimation for hazards associated with pinch points is:

Location	Severity	Occurrence
Hip pivot joint	The potential pinch point is located in the turning element of the hip, approximately 5 cm beneath the external surface elements of the hips and legs, with a single finger-size gap. Up to partial laceration or minor fracture, unlikely to reach amputation level. Severity is moderate.	Very unlikely to reach the joint in normal situations or other than misuse. Occurrence is low.
Hip rolling joint	The potential pinching surface is wide (Spot's hip and large parts of the upper leg). There are no edges sharp or small enough to cause lacerations or cuts. Severity is low.	Possible but unlikely to reach the pinching state. The pinching would affect the hand or palm while grabbing the entire robot body to unduly interfere with balancing while Spot is powered (misuse). Overall occurrence is low.

WARNING

Do not try to recover Spot by grasping or holding it up during an apparent loss of stability.

2.10. General warnings

- Attachments can alter the stability and the overall energy of an accidental loss of stability.
- While Spot is paused, the sudden appearance of an obstacle could cause Spot to move away from the obstacle to maintain a sufficient or predetermined separation distance. Spot could accelerate in a direction different from the main locomotion direction.
- When traversing stairs or uneven surfaces, Spot could accelerate in any direction or change body attitude in an attempt to maintain balance.
- Previous observations are not a guarantee of future performance. The behavior of Spot while in motion can be variable or unexpected with respect to planned trajectories or movements already observed in similar conditions or during previous executions of the same operations.
- When the environment presents narrow passages, corners, or cluttered layouts combined with ground obstacles, Spot could use high-speed movements to maintain or regain balance. Spot could accelerate in a direction different from the main locomotion direction.
- Check the availability of sufficient clearances or determine the need for signaling low-clearance locations.

- Survey the environment to determine any deviations from the nominal conditions described in Restrictions on the Environment that can increase the chances of failures. Prepare the operating environment and layouts to reduce those identified risks.
- Consider introducing or upgrading guards in locations potentially exposed to falls from elevated grounds to best fit Spot's navigation capabilities (e.g. use dense mesh guards, avoid transparent materials, avoid ropes or thin elements).

3. Transport, Handling, and Storage

3.1. Transport

Spot is transported in a customized case designed exclusively for Spot and its accessories. The Spot battery and charger, attachments, and other equipment are transported separately and in their own specially designed cases where applicable.

NOTICE

Do not discard the case after removing Spot and its accessories. The case is designed for transporting Spot and its accessories, and for returning them to Boston Dynamics for service when necessary.

3.1.1. Robot Shipping Case Specifications

The robot shipping case holds the Spot robot and the Spot tablet controller.

Specification	Value
Length	927 mm
Width	546 mm
Height	464 mm
Empty case weight	20.4 kg
Combined weight (case and robot)	47.6 kg

3.1.2. Power Supply Shipping Case Specifications

The Spot Power Supply shipping case holds the charger and up to two batteries.

Specification	Value
Length	559 mm
Width	432 mm
Height	432 mm
Empty case weight	9.2 kg
Combined weight (case, charger, and one battery)	18.1 kg

Specification	Value
Combined weight (case, charger, and two batteries)	22.7 kg

3.2. Safe Handling

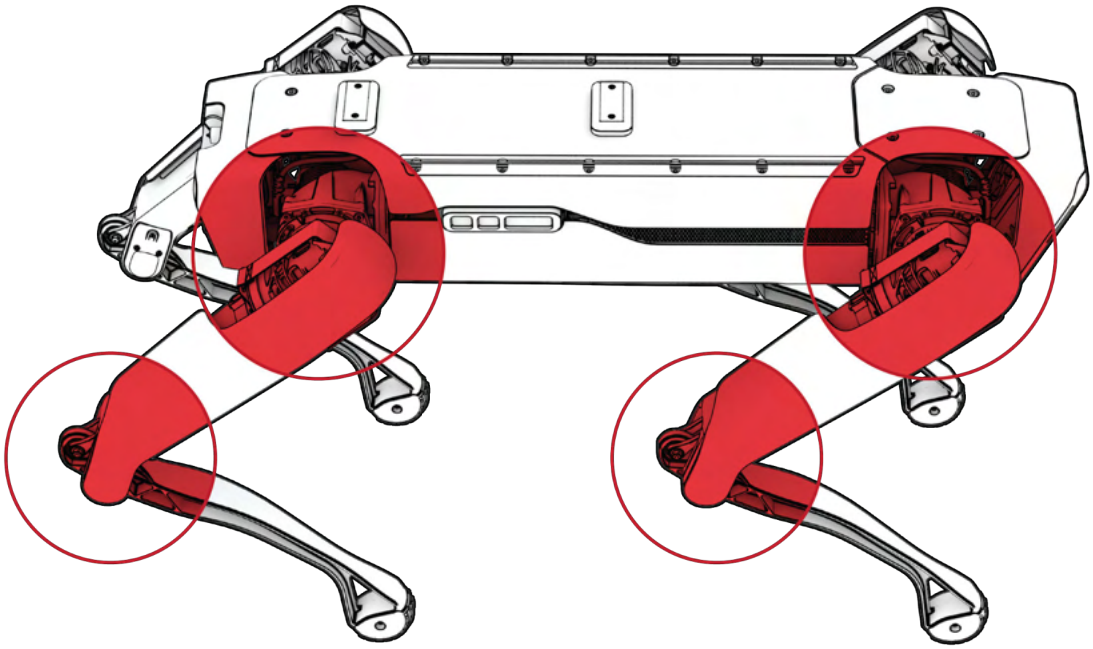
Power off Spot before handling, moving, or lifting.

> **WARNING**
> Handling, moving, or lifting Spot without powering off Spot may result in unexpected motion and injury, as Spot may flail its legs in an attempt to control its balance.

For information about safely turning off Spot, see Turn Off Spot.

3.2.1. Pinch Points

While Spot is powered off, loose legs and joints can still pinch fingers and other body parts and entangle clothing, long hair, and jewelry. Pinch point risk areas are highlighted below in red:



Spot pinch points.

CAUTION

Always keep hands away from knee joints. Use caution when rearranging or closing the legs.

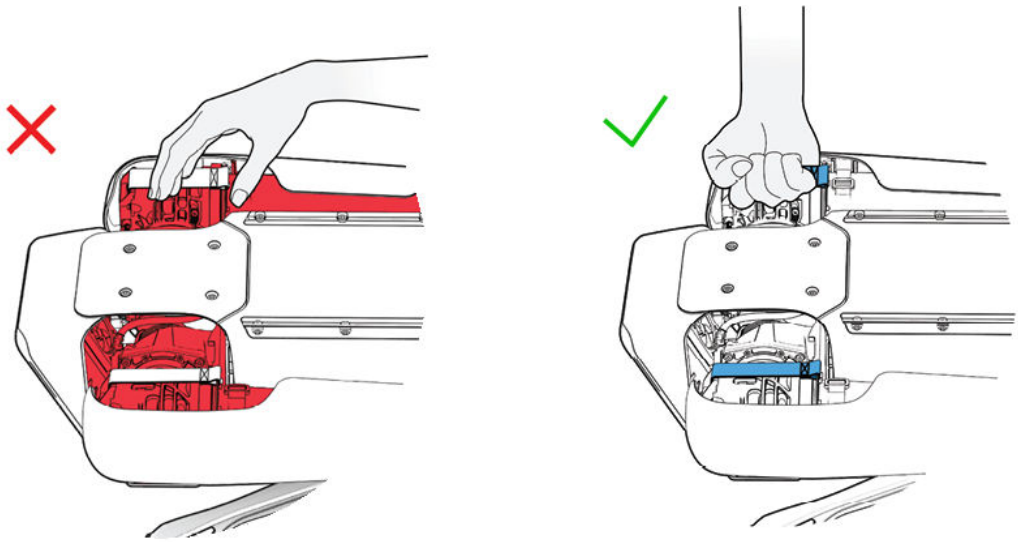
Always keep hands away from hip joints, except when grabbing the handles.

3.2.2. Handles

There is a handle at each hip joint to lift, carry, and roll Spot. Hands and fingers may still be pinched when using the handles.

WARNING

Always make a fist when gripping handles to keep your fingers away from pinch points. Never carry Spot with fingers extended.



Use of handles for lifting Spot.

3.2.3. Lift Spot

Always use two people to lift Spot, one at the front and one at the rear.

Lift Spot by the handles while it is sitting upright, or by the lower legs if Spot is flipped on its back. Always grab the handles or legs with clenched fists.

Lifting Spot by the handles.

Lifting Spot by the lower legs.

> **CAUTION**
>
> Spot is not a rigid single body, and its legs may be lose during lifting.
>
> Sudden loss of grip while lifting will result in a sudden impact that may damage feet or equipment directly under Spot.

3.2.4. Personal Protective Equipment (PPE)

While handling Spot, it is recommended to wear safety footwear. If the A/V warning system is in use, hearing protection may be recommended based on the configured volume of the buzzer (see Noise). Check for additional PPE that may be required in the application environment.

3.3. Storage

Spot is best stored in the case or at a Spot Dock when not in use. Store Spot in a dry location with temperatures between -40°C and 75°C, with relative humidity between 30% and 70%.

3.3.1. Battery Storage

The Spot Battery should be stored at temperatures between -30°C and 25°C. It is recommended to develop a battery storage and charging safety policy consistent with industry standards and local regulations.

NOTICE

Always remove the battery when Spot is not in use unless Spot is connected to the Spot Power Supply or sitting on a powered Spot Dock. Batteries left in Spot while not in use will continue to discharge, even when Spot is powered off. Batteries left in a powered off robot for more than 24 hours may be damaged beyond repair.

CAUTION

When shipping the battery, make sure it has been discharged to a 30% or less State Of Charge (SOC). US and international transportation regulations require that lithium-ion batteries of this size be at no greater than a 30% SOC when shipped, regardless of the shipping method (air, ground, rail, or sea). To determine the SOC of the Spot battery, push the button on the battery and read the led indicators. When the indicator shows 1 bar, it means it has less than 30% SOC.

4. Setup

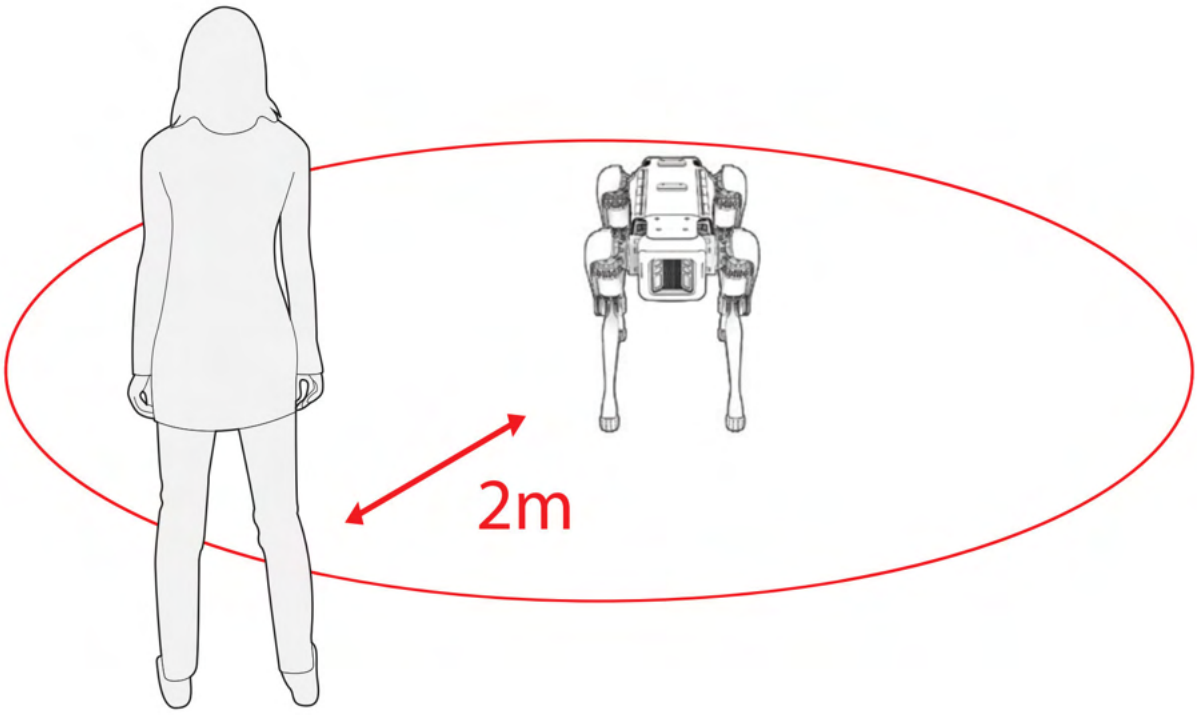
4.1. Before setting up Spot

Spot does not require any special installation fixtures, such as anchoring mechanisms, anti-vibration pads, etc. Setup can be done in any location.

Consider the following typical conditions for initial setup:

- Attachments may change the balance of Spot and must be configured for optimal control.
- Charging devices and cords may be present in the setup area. See also Charge the battery.

In general, initial power-ups, standing, and movements of legged robots may be unfamiliar to first users. Ensure that all bystanders are trained in the use of Spot and about the residual risks of Spot applications.



2-meter safety zone around Spot.

CAUTION

Before setting up or operating Spot, ensure there is at least 2 meters of clearance around Spot in all directions.

Prepare Spot on a flat, stable, and clean surface.

4.2. Integrate attachments

Attachments are often essential components to further specify the intended use of a particular application of Spot. Attachments may substantially change the estimation of risks for the assembly of Spot and attachments, including:

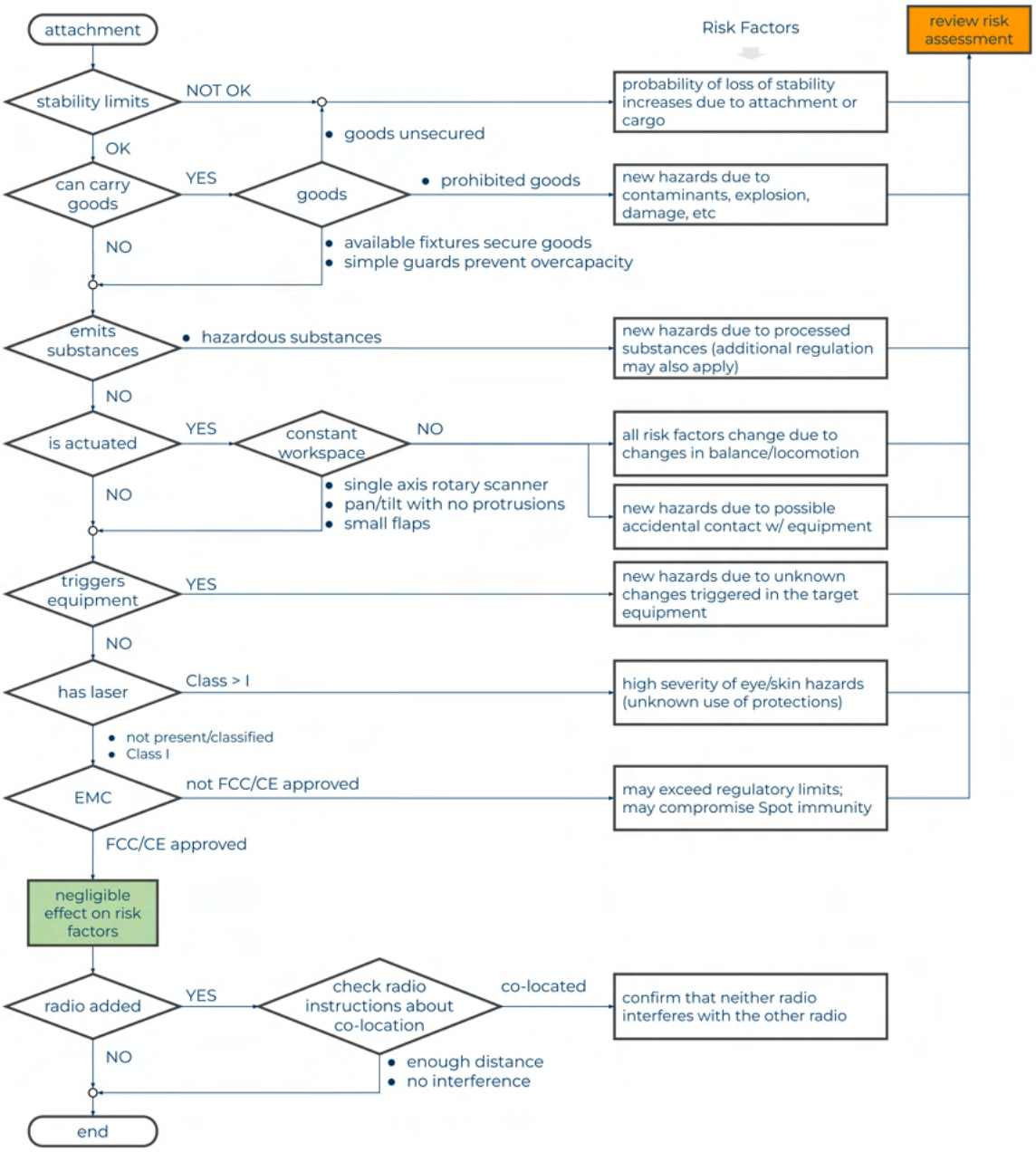
- Introducing new hazards to Spot applications.
- Changing the risks associated with Spot's intended use.
- Changing the conditions for compliance with standards or local regulations.

4.2.1. Analysis of attachments

You must complete your own risk assessment for the use of the assembly of Spot and attachments (see the full procedure in Risk assessment for Spot's baseline risk estimation), considering the following elements that will affect the risk factors:

a. An attachment is outside the mounting limits established in Attachment Mount Points and Dimensions to ensure stability.
b. If an attachment can carry goods, the transported loads are:
    - Hazardous substances (chemicals, explosive and corrosive materials) either carried or dispersed (e.g. sprayed)
    - Non-hazardous materials that are not secured so that they cause a change in the physical properties of the load, are ejected, or accidentally come in contact with equipment or people.
    - Non-hazardous materials that, once loaded, exceed the stability limits in terms of rated mass or center of mass.
c. An attachment is actuated and capable of independent mobility, unless the movement is limited to one axis and/or does not exceed the geometry of the attachment (e.g. rotary cameras or scanners, pan/tilt cameras). Mobile attachments may in fact determine unforeseeable conditions for Spot:
    - Intentional or accidental contact with equipment or people.
    - Physical interaction or manipulation tasks that can have a direct or indirect effect on the touched objects.
    - Changes in stability conditions due to the disturbance introduced by physical contact with the environment.
d. An attachment emits light or collimated/amplified light like in lasers, unless classified as an IEC 60825-1 Class 1 device.
e. An attachment emits electro-magnetic (EM) radiation (unintentional emitter) and could have effects on the electromagnetic compatibility (EMC) of Spot.
    - If the attachment is not approved under local EMC regulations, Spot's conformity to EMC regulations does not extend to the attachment and the combination of Spot and the attachment is not in conformity to EMC regulations.
    - If the attachment is independently approved under local EMC regulations, you are still responsible for the EMC of the combination of Spot and the approved attachment, typically verified through testing.

f. An attachment has provisions for remotely triggering other equipment or processes, for example interfacing with components that start or stop processes or motion in target equipment.



Flowchart of the process for analyzing attachments.

NOTICE

Radio equipment on attachments

Attachments may include radio devices. It is necessary to review installation conditions and approvals of radio modules.

- If the additional radio equipment is NOT an approved module for local radio regulation, the conformity to local radio regulation of Spot is invalidated and not extended to the attachment.
- If the additional radio equipment is an approved module for local radio regulation, multiple radio modules must still not be co-located (i.e. antennas are more than 20 cm apart). If co-located, testing must be performed according to the co-located radio device requirements for the local radio regulation.

Additionally, radiated emissions will need to be repeated with all radio modules enabled and activated to ensure that EMC has been maintained by the entire system (Spot and attachment). This applies to co-located and non co-located radio devices.

WARNING

Attachments that:

- emit ionizing radiation
- include laser equipment designated as IEC 60825-1 Class greater than 1
- carry or disperse hazardous substances

can be potentially very dangerous. Users and integrators will be responsible for providing additional safeguards.

WARNING

Spot has been tested to EMC Industrial standards. Attachments that emit radiation in excess of the levels Spot has been tested to may cause harm to Spot and degrade its performance in a dangerous manner.

Boston Dynamics is not responsible for any damage caused by radiating attachments.

You must also verify the presence of specific local regulations about the technology and materials used in attachments.

Spot Arm is an actuated, variable-configuration attachment, and every solution integrating Spot Arm requires a risk assessment for the intended manipulation application.

REQUIRED READING

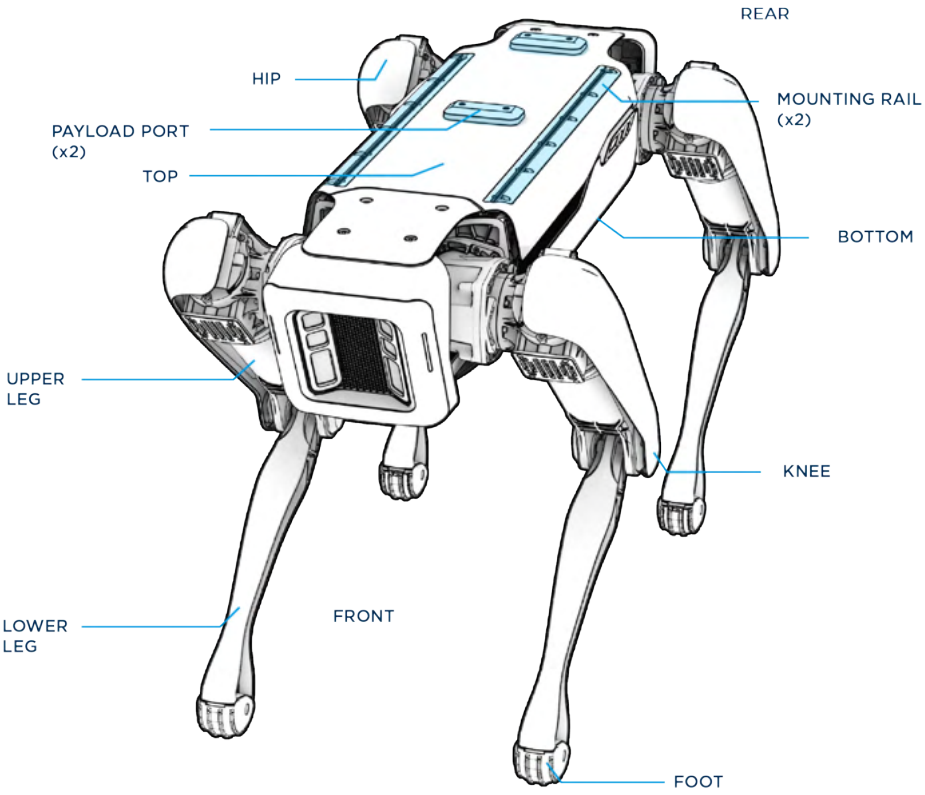
For additional instructions and safety information about Spot Arm, review *Spot Arm Information for Use* in the Boston Dynamics Support Center (see Appendix A: Supplemental information).

All other attachments produced and sold by Boston Dynamics cause little or no modification in the risk estimation of Spot if used without further customization.

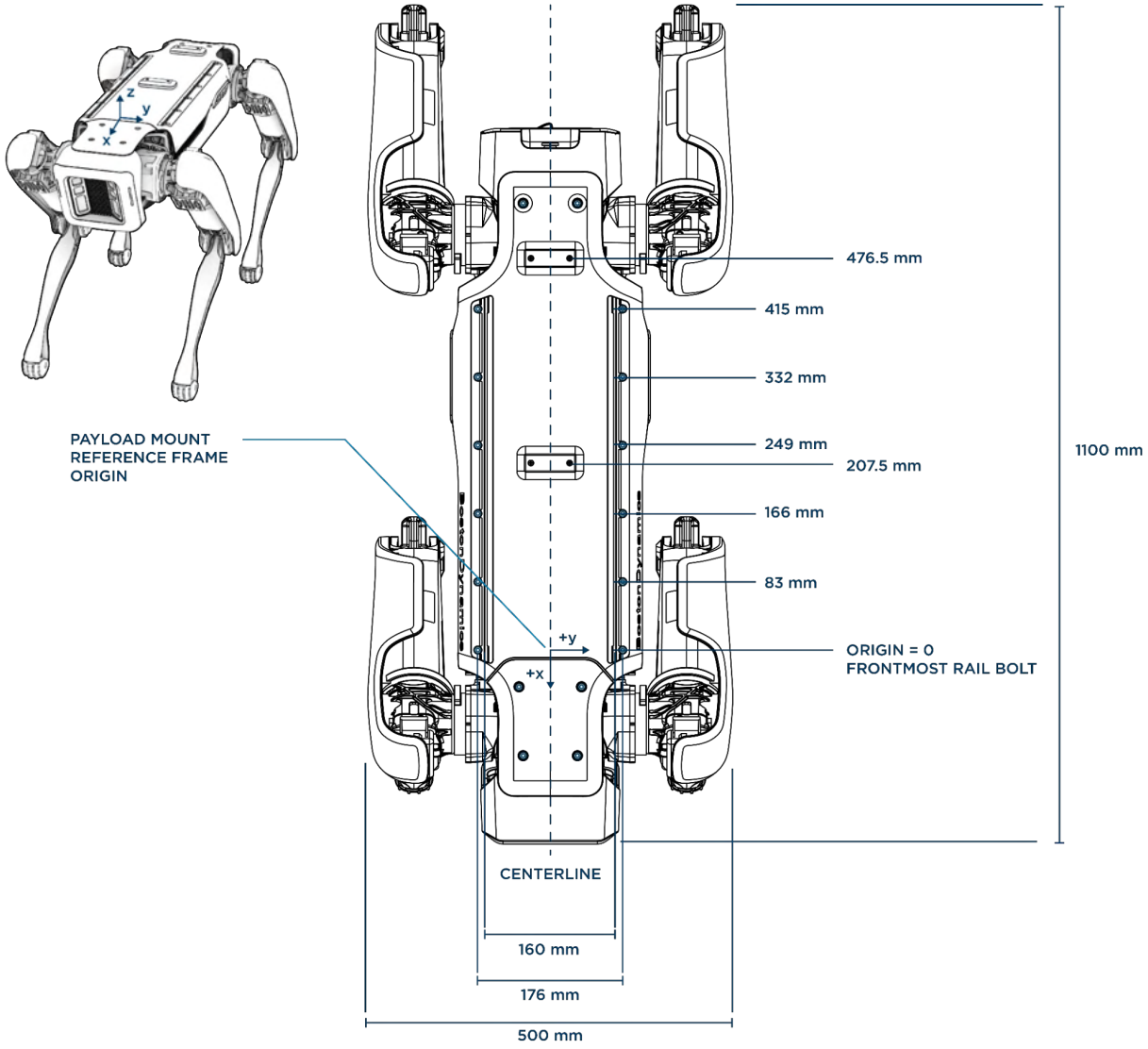
4.2.2. Attachment Mount Points and Dimensions

Attachments can be affixed to the aluminum mounting rails located along the top left and top right edges of Spot's body. The rails accept T-slot nuts such as Misumi HNTR5-5.

Attachments can receive power and data through Spot's forward and rear payload ports.

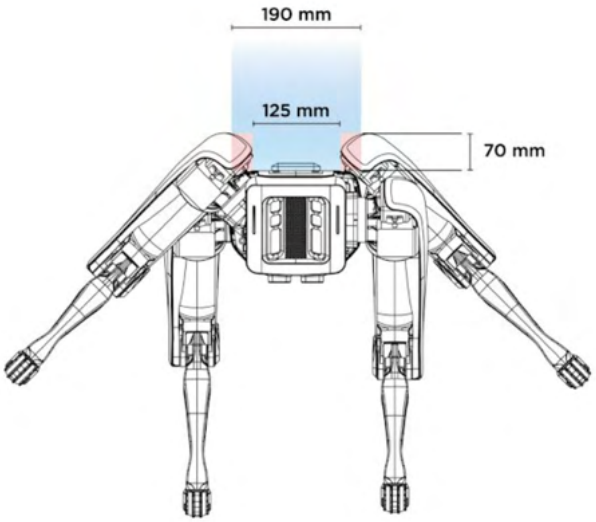


Spot mounting rails and payload ports (highlighted in light blue).



Spot dimensions with respect to mounting attachments.

The maximum recommended width for a body-mounted attachment is 190 mm. Attachments should avoid interference with the legs in the areas immediately adjacent to the hips, as illustrated below.

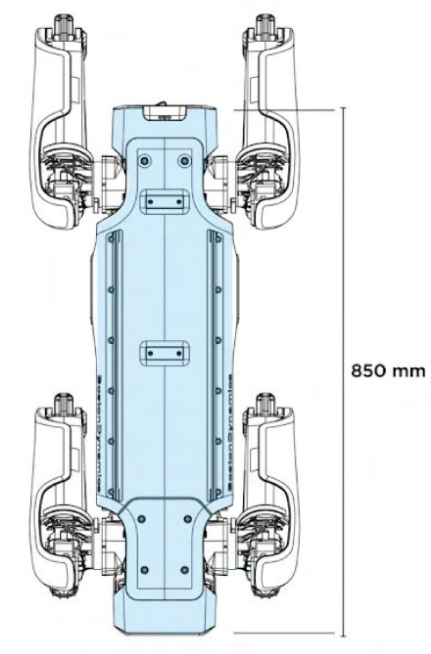


Attachment limit dimensions (lateral).

CAUTION

Attachments that exceed width limits will result in reduced overall mobility and significant interference with the legs, causing unintended loss of stability.

The maximum recommended length for a body-mounted attachment is 850 mm.

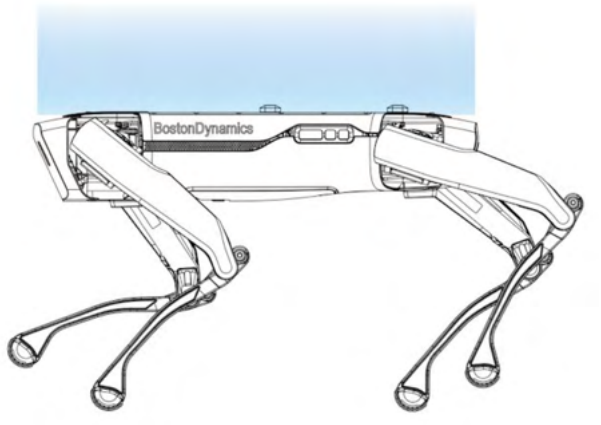


Attachment limit dimensions (longitudinal).

CAUTION

Attachments that overhang Spot's body to the front or rear will reduce maneuverability, increasing the probability of unintended movements to maintain stability or continue along a planned path.

The height of attachments impacts Spot's ability to self-right and increases the height of the center of mass. Keep the center of mass low, as Spot may not self-right if top heavy.



Vertical attachment zone (side view).

Spot can support 14 kg total combined capacity distributed over the top of its body. This total attachment capacity must include all attachments. Spot can better handle attachment mass if the combined center of mass lies between the front and rear hips. Spot will be more agile and less likely to fall if the total attachment mass is centered on the middle of its body.

4.2.3. Mount and Configure Attachments

This document provides generic instructions for how to attach an attachment to Spot and configure Spot's software to enable use of the attachment. Consult the documentation for each individual attachment for specific instructions.

WARNING

Each attachment must be both securely affixed to Spot and correctly configured in Spot's system software before use.

Mounting or configuring attachments incorrectly may cause failures in balancing and potential loss of stability, impaired functionality, and unforeseen hazards.

NOTICE

Attachments vary in size, shape, functionality, and configuration. The instructions in this section are a general guide. Refer to documentation specific to the attachment for instructions that add to or modify this procedure.

4.2.3.1. Mount an Attachment

Attachments must meet the mass restrictions and dimensional guidelines described in Attachment Mount Points and Dimensions.

To mount an attachment on Spot:

1. Start with Spot powered off in the sit position on a stable work surface.

2. Position the attachment over Spot to identify where it will be bolted to the mounting rails and payload ports.

> **NOTICE**
> Some attachments can only be mounted in a front or rear configuration.

3. For each point where the attachment will be bolted to a mounting rail, insert one T-slot nut into the mounting rail. Position the T-slot nut along the rail, then gently tighten the set screw to hold the T-slot nut in place.
4. Insert the included machine screws through the holes in the attachment and into the T-slot nuts in the mounting rails, then tighten to 5 N·m of torque. Do not over-tighten.
5. If the attachment requires a power or data interface with Spot:
   a. Loosen the screws holding the payload port cap in place, then remove the cap with the screws still attached. Store the cap and screws in a secure location.

> **NOTICE**
> Spot cannot be operated with an exposed payload port.

   b. Insert the connector at the end of the attachment's ribbon cable into the payload port. Fasten the connector with the included screws.

4.2.3.2. Configure an Attachment

Attachments must be configured in Spot's system software before use. This ensures that Spot will adjust its locomotion to account for the added mass and volume of the attachment, and that any data and network connections can be shared between Spot and the attachment.

To configure an attachment for Spot:

1. Mount the attachment to Spotas described in Mount an Attachment.
2. Log in to Spot's Admin Console as described in Admin Console.
3. Select **Payloads**.
4. Some attachments will auto-register with Spot to streamline setup. If your attachment already appears on the page:
   a. Select **AUTHORIZE**.
   b. Select the configuration that matches your attachment (model and front or rear mount location), then select **AUTHORIZE**.
   c. To modify the default settings, select the attachment name. Configure settings for the attachment, then select **APPLY**.
5. If your attachment does not appear on the page:
   a. Select **ADD PAYLOAD**.
   b. Select an attachment type from the list.
   c. Select **APPLY**.

4.2.4. Swap or Remove an Attachment

Attachments can be swapped or removed to adapt Spot for different applications and environments. In addition to physically removing or rearranging attachments, Spot's software configuration must reflect the combination of attachments that is currently mounted.

4.2.4.1. Physically Remove an Attachment

> **NOTICE**
> Attachments vary in size, shape, functionality, and configuration. The instructions in this section are a general guide. Refer to documentation specific to the attachment for instructions that add to or modify this procedure.

Removing an attachment usually means reversing the steps you used to mount it on Spot.

To physically remove an attachment from Spot:

1. Start with Spot powered off in the sit position on a stable work surface.
2. If the attachment payload is connected to one of Spot's payload ports with a ribbon cable, loosen the screws in the connector with a phillips-head screwdriver and remove it from the payload port. If the port will not be used by another attachment , insert a payload port cap into the port and fasten it with the included screws.

   > **NOTICE**
   > Spot cannot be operated with an exposed payload port.

3. Use a 4 mm hex wrench or allen key to remove the M5 machine screws holding the attachment to the mounting rails, then lift the attachment off of Spot.

   > **NOTICE**
   > Some attachments include mounting pins that slot into holes in Spot's top panel. Lift the attachment straight up until these pins are clear and avoid snagging them on other attachments or equipment.

4. Remove any T-slot nuts from the mounting rails if they will not be used to affix another attachment to Spot.
5. Check for any remaining equipment or fasteners that should be removed from Spot. Check the area where the attachment was mounted for any signs of excessive wear or damage.

4.2.4.2. Configure an Attachment as "Detached"

Spot's software settings must always reflect the combination of attachments that is currently mounted. You can mark an attachment as "attached" or "detached" in the main menu of the Spot App on the Spot tablet controller, or on the **Payloads** page of the Admin Console.

WARNING

Incorrectly configuring attachments may cause failures in balancing and potential loss of stability, impaired functionality, and unforeseen hazards.

To configure an attachment as "detached" in the Spot App main menu:

1. Start with Spot powered on as described in Start Spot.
2. On the Spot tablet controller, open the Spot App and connect to Spot.
3. Navigate to ≡ **Menu** > **UTILITIES** > **ATTACH PAYLOADS**
4. Locate the attachment you removed from Spot and toggle it to **DETACHED**.

To configure an attachment as "detached" in the Admin Console:

1. Start with Spot powered on as described in Start Spot.
2. Log in to the Admin Console as described in Admin Console, then navigate to the **Payloads** page.
3. Locate the attachment you removed from Spot, then tap the green checkbox labeled **Attached** to deselect it and mark the attachment as detatched.

NOTICE

You do not need to delete ("forget") the attachment. Spot stores the settings of all previously configured attachments that are not currently mounted, so you will not have to repeat the full configuration process if you remount an attachment later. Instead, mount the attachment to Spot and mark it as "attached" using either method described here.

4.2.4.3. Swap In Another Attachment

If you are removing an attachment to make room to mount a different attachment on Spot, you can now mount and configure that attachment. See Mount and Configure Attachments or refer to documentation specific to the attachment you are swapping in.

NOTICE

If the attachment you are swapping in has been configured for Spot before, its settings may be stored in the Admin Console. In this case, you do not have to reconfigure the attachment . Instead, mount the attachment on Spot and mark it as "attached" using either method described here.

4.3. Battery setup and charging

Spot is powered by a removable lithium-ion battery pack.

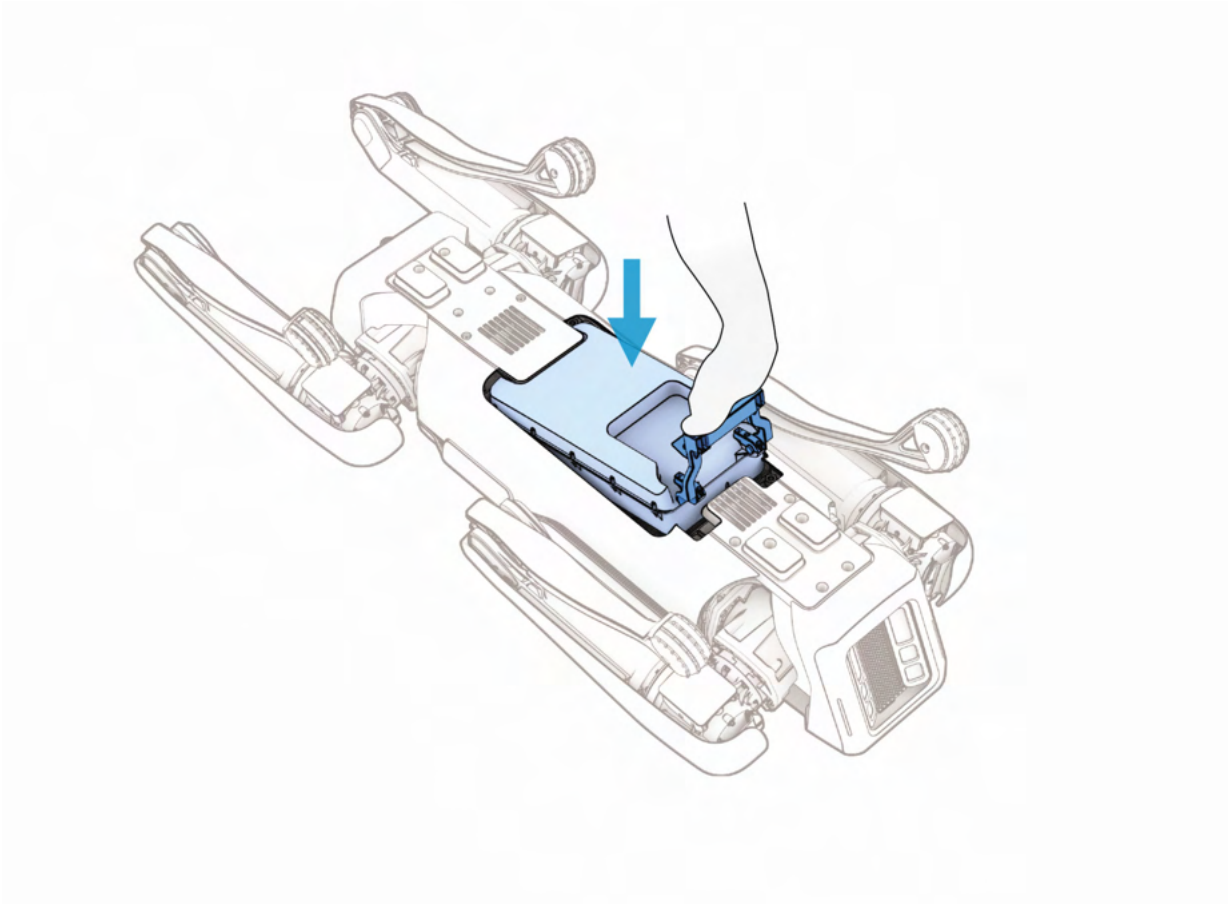
WARNING

- Do not short or contact battery pads.
- Do not burn, disassemble, submerge, puncture, crush, drop, or damage the battery.
- Do not dispose of the battery with household waste. Refer to local electric waste regulations.
- Do not charge, or operate Spot with, a battery that is cracked or otherwise damaged. For assistance with damaged batteries, contact Boston Dynamics Support.

DANGER

It is extremely unlikely that the battery generates fire under normal conditions of use and environment. If the battery catches fire, do not try to put it out. Evacuate to a safe area and call the fire department. Battery fires create toxic fumes and cannot be put out with conventional fire extinguishers or water.

4.3.1. Insert the battery

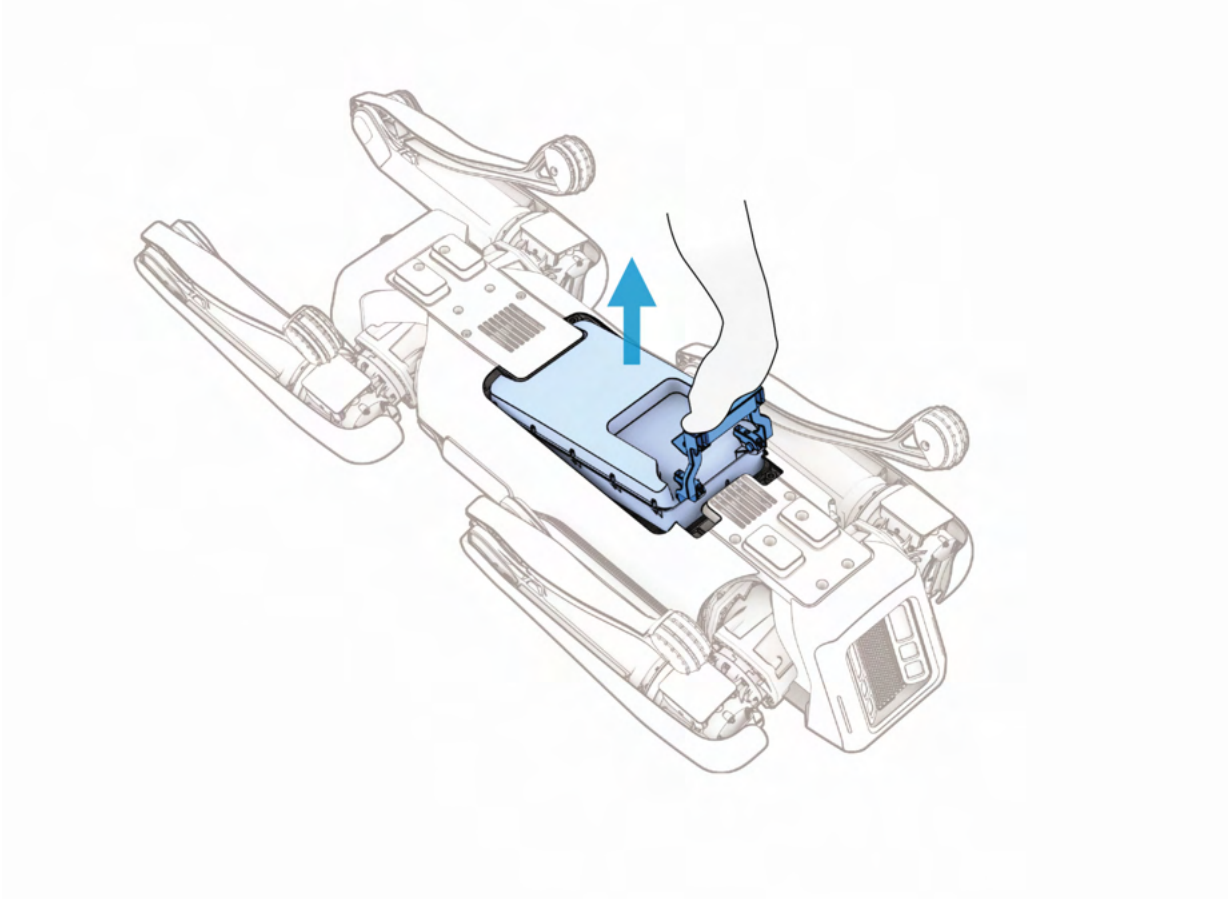


Insert the battery.

To insert the battery:

1. With Spot on its back or side and disconnected from power and Ethernet cables, slide the battery's non-handle side into the rear of Spot's battery compartment and latch the handle.
2. Ensure the battery is properly latched.

4.3.2. Remove the battery



Remove the battery.

To remove the battery:

1. Ensure Spot is powered off and disconnected from power and Ethernet cables.
2. With Spot on its back, lift the battery handle and slide the battery out of the battery compartment.

4.3.3. Charge the battery

Spot's battery can be charged in several ways:

- Removed from Spot, using the Spot Power Supply.
- While installed in Spot, using the Spot Power Supply.
- While installed in Spot, using the Spot Dock.

REQUIRED READING

Before charging a battery with the Spot Power Supply, review *Spot Power Supply Information for Use* in the Boston Dynamics Support Center.

Before charging a battery with the Spot Dock, review *Spot Dock Information for Use* in the Boston Dynamics Support Center.

See Appendix A: Supplemental information

Only charge the battery with the Spot Dock or the Spot Power Supply provided by Boston Dynamics.

Charging a battery with the Spot Power Supply.

Charging a battery in Spot with the Spot Power Supply.

Charging a battery in Spot with the Spot Dock.

DANGER

To reduce the risk of electric shock and fire:

- Use a properly grounded outlet. Do not use ground adapters or replace plugs.
- Do not touch uninsulated parts of the output connector or battery terminals.
- Do not open or disassemble the Spot Power Supply or Spot Dock.
- Do not use the Spot Power Supply or Spot Dock if any power cord is damaged.

WARNING

Power cords present tripping hazards and may cause the Spot Power Supply to fall from an elevated position.

- Place the Spot Power Supply on a dry floor, out of the path of people or robots, while charging.
- Do not operate Spot while connected to the Spot Power Supply. Doing so could damage Spot or the Spot Power Supply. Dragging cords could become entangled with Spot, people, or objects in the environment.

4.4. Spot Dock setup

The Spot Dock is a recharging station for Spot. The Spot Dock can also provide a pass-through connection for Spot's Ethernet port.

Before using the Spot Dock, check that the following conditions are met:

- The Spot Dock is securely installed on level ground.
- Clear space is available around the dock.
  - Front: 1200 mm
  - Sides: 600 mm
  - Rear:
- The Spot Dock is undamaged.

REQUIRED READING

For installation instructions and safety information about the Spot Dock, review *Spot Dock Information for Use* in the Boston Dynamics Support Center (see Appendix A: Supplemental information).

4.5. Admin Console

The Admin Console is a web server hosted locally on Spot, which provides a browser-based interface for accessing Spot's system settings. You can access it from within the Spot App on the tablet controller, or on any device by using the Chrome browser to navigate to Spot's IP address.

Access to the Admin Console requires a user account. Default user-level and admin-level credentials are printed on a label in Spot's battery compartment. Boston Dynamics recommends you change these defaults as soon as possible.

4.5.1. Log in to the Admin Console

To log in to the Admin Console from the tablet controller:

1. Start with Spot powered on as described in Start Spot.
2. Connect the tablet controller as described in Pair the tablet controller with Spot.
3. Navigate to ≡ **Menu** > **ADMIN CONSOLE**.
4. Log in with the admin username and password printed on the label in Spot's battery compartment, or using credentials provided by your system administrator.

To log in to the Admin Console from a computer:

1. Start with Spot powered on as described in Start Spot.
2. Connect a computer to Spot using the information in Network Configuration, or the current network settings as determined by your Spot system administrator.

3. Open the Chrome browser and navigate to Spot's IP address. For the default network configuration, the address is `https://192.168.80.3` when connected by WiFi and `https://10.0.0.3` when connected by Ethernet.
4. Log in with the admin username and password printed on the label in Spot's battery compartment, or using credentials provided by your system administrator.

4.5.2. Spot system settings

Settings page	Description
User Management[1]	Create and manage operator and admin accounts. **NOTICE** Spot's default usernames and passwords are printed on a label in the battery compartment. Boston Dynamics strongly recommends changing the default passwords.
Network Setup	• Configure Spot's network settings, including WiFi and Ethernet. • Run network diagnostics to check that Spot's network settings are configured correctly and that Spot can connect to various network endpoints. • See Network Configuration.
Software Update[1]	• Review current software version information. • Upload and install new Spot software and monitor update progress. • See Software Updates.
Spot License	View and install license files required for Spot operation.
Logs	• Manage log files saved on Spot. • Upload logs directly to Boston Dynamics Support or download and send them from your own device. • Enable or disable image logging. **NOTICE** Disabling image logging will prevent images from being collected in future log files. It will not remove images from existing log files.

Settings page	Description
About	• Rename Spot. • Review software version. • Check cumulative runtime data. • Review legal information.
Payloads	• Add and configure new attachments. • Review attachment settings.
General Settings	• Enable/disable automatic upload of log files to Boston Dynamics servers. • Configure fiducial image size and applicable ranges. • Reset Spot to factory settings.
Battery	• View battery health metrics. • Clear battery logs.
WiFi Dashboard	Access a history of WiFi network connections to Spot.
Visualizer	Visualize the position and orientation of Spot's limbs and attached payloads.

[1]Admin users only.

4.6. Network Configuration

Spot requires an active network connection for remote controlled operation and remote supervision of automatic operation (see Loss of Connection to the Controller). Communication requirements will vary based on where and how Spot is used.

Loss of communications may trigger an operational stop as described in Stopping Functions.

Supported network types:

- *WiFi* – Spot can host its own WiFi access point, allowing controllers and other devices to connect directly to Spot. Spot can also join enterprise WiFi networks.
- *Ethernet* – There is one Ethernet port at the rear of Spot. Spot can also receive “pass-through” Ethernet while docked on a Spot Dock.

NOTICE

Spot supports only one Ethernet interface at a time. Connect Spot using either the Spot Dock's Ethernet passthrough or the Ethernet port on Spot's rear panel, but not both. These interfaces are electrically identical, and using both at once will cause networking issues for Spot.

- *LTE* – Requires additional hardware.
- *Mesh radio* – Requires additional hardware.

Before operating Spot, ensure that Spot's network configuration is appropriate for your use case and operating environment.

4.6.1. Default network configuration

Default networking information is printed on the label inside Spot's battery compartment.

Network protocol	Setting	Default value
WiFi	Network type	Access Point (Spot hosts its own WiFi network)
	Network name (SSID)	See label in battery compartment
	Password	
	Robot IP address	`192.168.80.3`
Ethernet (Direct wired connection between computer and Spot)	Robot IP address	`10.0.0.3`
	Netmask	`255.255.255.0`

4.6.2. Change Spot's network configuration

To change Spot's network configuration:

1. Log in to the Admin Console.
2. Select **Network Setup**.
3. Navigate between the tabs to access settings.
4. For each tab, make changes and then select **APPLY**.

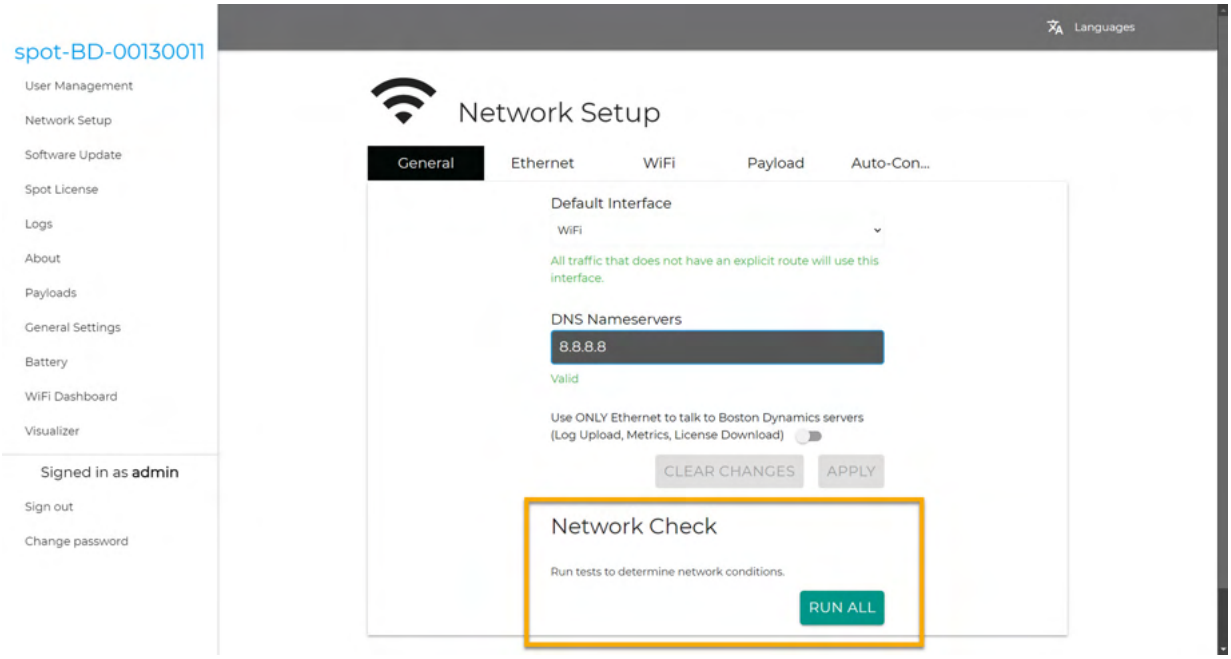
NOTICE

To quickly switch Spot's WiFi configuration from Client mode (Spot joins your site's WiFi network) to Access Point mode (Spot hosts its own WiFi network), press the motor lockout button 6 times in a row. If Spot is already in Access Point mode, this will reboot the access point, briefly interrupting any active connections.

WARNING

Changing Spot's network configuration during operation may trigger signal-loss behaviors, which could result in falls or unsupervised automatic movements. See Stopping Functions and Loss of Connection to the Controller.

4.6.3. Network Check



Spot Network Setup

Spot can run a suite of network checks to confirm that it is configured correctly to be able to connect with various network endpoints, such as DNS servers.

To run Network Check:

1. Log in to the Admin Console.
2. Select **Network Setup**.
3. Under **Run Network Check**, select **RUN ALL**.
4. If any test fails:
    a. Review the failures to determine if any are expected based on your Spot setup and your organization's network configuration. For example, if your organization has decided not to allow connections to Boston Dynamics log and metrics servers, then DNS tests related to those servers would be expected to fail.
    b. For unexpected failures, confirm that Spot's network settings are correct.
    c. Consult with your IT team to confirm that the failures are not the result of a current network outage.
    d. Run Network Check again. If the failure persists, contact Boston Dynamics Support and include the details from the **Raw Results** field in your message.

4.7. Software Updates

For the best and most reliable performance, keep software fully updated on Spot and related equipment.

Boston Dynamics recommends that you:

- Update Spot and each controller to the latest software version as soon as it becomes available.
- Keep each attachment updated to the latest available software version for that attachment.
- Keep each controller's operating system and firmware up to date.

CAUTION

Version mismatches between Spot and controller software can result in unexpected or hazardous behavior. Always match the software versions between Spot and its controller.

To check the current software version:

- In the Admin Console, navigate to the **Software Update** page.
- In the Spot App, navigate to ≡ **Menu** > **ABOUT**.

NOTICE

Skipping over intermediate major or minor releases may cause the update to fail. Always install the most up-to-date version of the major or minor software release that immediately follows your current software.

Major and minor releases correspond to the first and second numerals of the software version number.

4.7.1. Update Spot Robot Software via the Admin Console

To download updated Spot robot software:

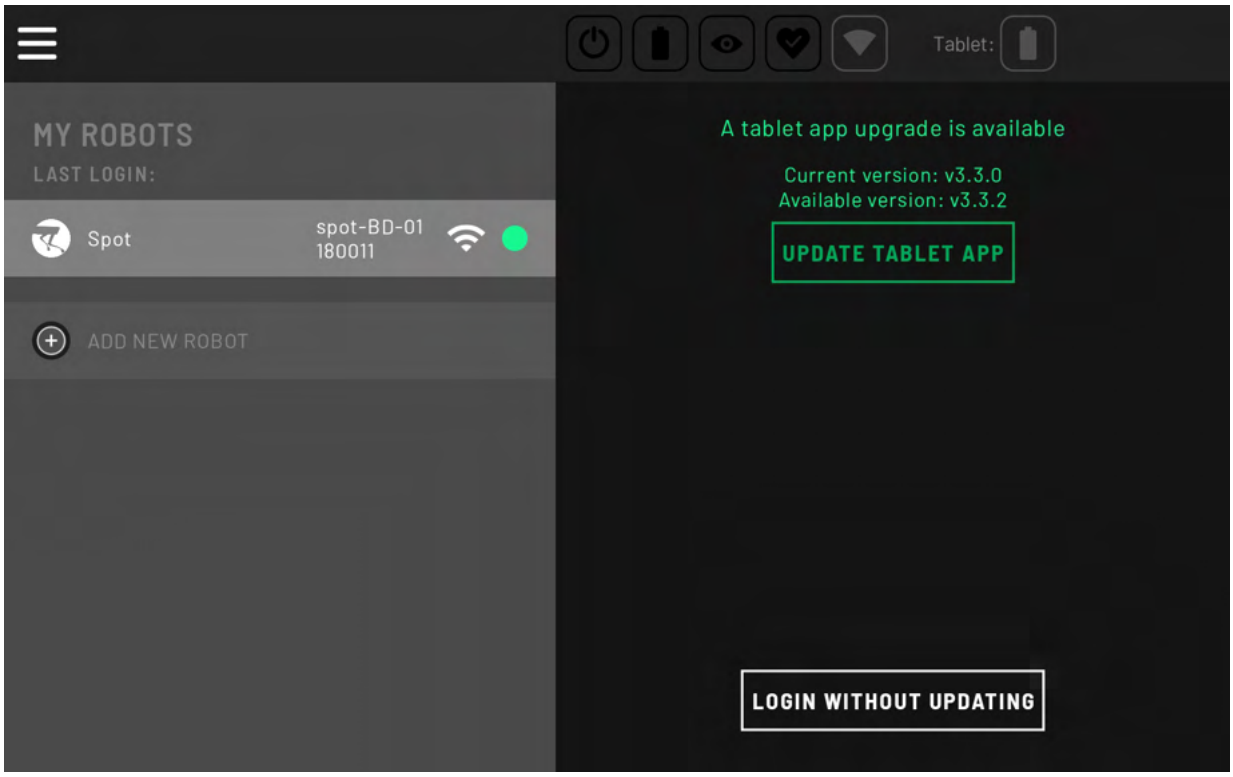
1. Visit https://support.bostondynamics.com/s/spot/downloads and log in with your customer account.
2. Download the .bde file for the Spot base platform.

To update the Spot robot software via the Admin Console:

1. Connect Spot to a power source (i.e. a Spot Dock or the Spot Power Supply).
2. Power on Spot as described in Start Spot.
3. Connect a computer to Spot using the information in Network Configuration, or the current network settings as determined by your Spot system administrator.
4. Log in to the Admin Console as described in Admin Console, then navigate to **Software Update**.
5. Drag-and-drop the .bde file, or select **CHOOSE FILE** and select the .bde file from the file browser.
6. Select **UPLOAD**, then wait for the file to upload.
7. Select **INSTALL AND REBOOT**.
8. Wait for the software to install and for Spot to reboot. When Spot has finished rebooting, you may need to reload the page to verify that the update was successful.

4.7.2. Update Spot Tablet Controller Software

Updates to the Spot tablet controller software (the Spot App) are bundled with updates to the Spot robot software. The Spot App will recommend an update when you connect to an updated Spot robot.



A tablet app upgrade is available.

To update tablet software from within the Spot App:

1. Select a robot from the **MY ROBOTS** list.
2. When prompted, select **UPDATE TABLET APP**.
3. Follow the prompts to install the update, then reopen the app.

If you prefer manual installation, the tablet software (.apk) can be downloaded directly by visiting https://support.bostondynamics.com/s/spot/downloads and logging in with your customer account. Download the file directly to the tablet or use a USB cable to transfer it to the tablet's internal storage, then open it with the tablet's file browser and follow the prompts to complete the installation or update. Wait for the process to finish before reopening the Spot App.

Boston Dynamics recommends that you also keep the operating system and firmware of the controller up to date. To update the operating system and firmware, follow manufacturer instructions.

NOTICE

Changing system settings or installing third-party software (e.g. custom keyboards) on the tablet controller may interfere with the performance of the Spot App. Boston Dynamics recommends that you keep the tablet controller in its default configuration whenever possible.

4.7.3. Update Spot Attachment Software

To download software updates for Spot attachments, visit https://support.bostondynamics.com/s/spot/downloads and log in with your customer account. Refer to the compatibility chart on that page to select the appropriate version for your attachment.

The software update process varies from attachment to attachment. Refer to instructions specific to your attachment.

4.8. Fiducials

To begin operating in automatic mode, Spot requires at least one fiducial for initial localization. Additional fiducials can be placed in the operating environment to supplement Spot's baseline navigation capabilities and reduce the probability of loss of localization, which could result in Spot entering undesired or prohibited zones.

Verify the correct placement of fiducials when completing your own risk assessment. You must give special consideration to intersections, locations where it is critical to avoid routing errors, egress paths, emergency exits, and major negative obstacles such as holes in the floor or cliff edges.

4.8.1. Download and Print Fiducials

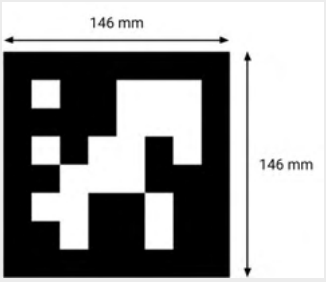
To download fiducials in a printable format, visit the Spot Downloads page: https://support.bostondynamics.com/s/spot/downloads

For outdoor use, Boston Dynamics recommends printing fiducials onto acrylic adhesive-backed white vinyl with matte laminate, which can be affixed to any flat rigid surface or backing material. Avoid reflective and low-contrast print surfaces.

Printing each fiducial without changing the scale of the image should yield the default size (146 mm square); verify the dimensions after printing. If the printed size does not match the default, you must configure the fiducial size in the Admin Console under **General Settings**.

NOTICE

The dimensions of a fiducial are based on the size of the image itself, not the size of the material it is printed on.



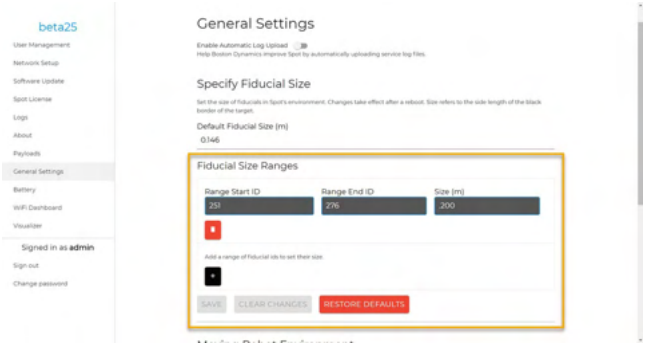
Fiducial dimensions.

4.8.2. Configure Custom Fiducial Sizes

Boston Dynamics strongly recommends that you use fiducials printed to the default size (146 mm square). However, in some circumstances other sizes may be required. For instance, you

may need to use larger sizes for improved detection in a location where fiducials cannot be mounted close to the mission route.

You can define custom dimensions for a range of AprilTag fiducials in the Admin Console.



A range of fiducials with a custom image size.

To define a custom size for a range of fiducials:

1. Log in to the Admin Console.
2. Navigate to the **General Settings** page.
3. Under **FIDUCIAL SIZE RANGES**, select the **+** button to add a new range, or modify existing ranges. You must specify a start ID, end ID, and image size for each range of fiducials.
4. Select **SAVE**.
5. Reboot the robot to apply your changes.

4.8.3. Place Fiducials

You must place navigation fiducials in Spot's operating area before recording or replaying Autowalk missions, and to enable certain automatic or semi-automatic features. Fiducials are not required for manual operation.

Do:

- Place one fiducial at each Autowalk mission's starting location. Multiple missions can start at the same fiducial.
- Affix fiducials to flat surfaces such as a smooth floor or wall, in locations that will be visible to the robot. For wall-mounted fiducials, the ideal position is 45 to 60 cm above the ground.
- Place fiducials were they are likely to remain unmoved, undamaged, and unobstructed for as long as you plan to replay the mission.
- Place fiducials every 3 meters in areas with limited recognizable features, such as long hallways or open fields.
- Place a fiducial at each intersection where a robot may cross or return to its previous mission path.

Do not:

- Place multiple copies of any fiducial in Spot's operational area. Each fiducial in a mission must be unique, however the same unique fiducial can be used in multiple missions.

- Place fiducials in areas with inconsistent lighting. Shadowed or unevenly lit fiducials may not be detected reliably.
- Place fiducials so that they are backlit by a bright background, such as on a window.
- Place fiducials where they will be blocked, damaged, moved, or removed.
- Place 500-series fiducials as general robot navigation markers. 500-series fiducials are reserved for use with the Spot Dock only.

Areas with intersecting walls, corners, railings, pillars, equipment, and other permanent fixtures or visually distinguishing features generally do not require a fiducial (unless the mission starts in that location).

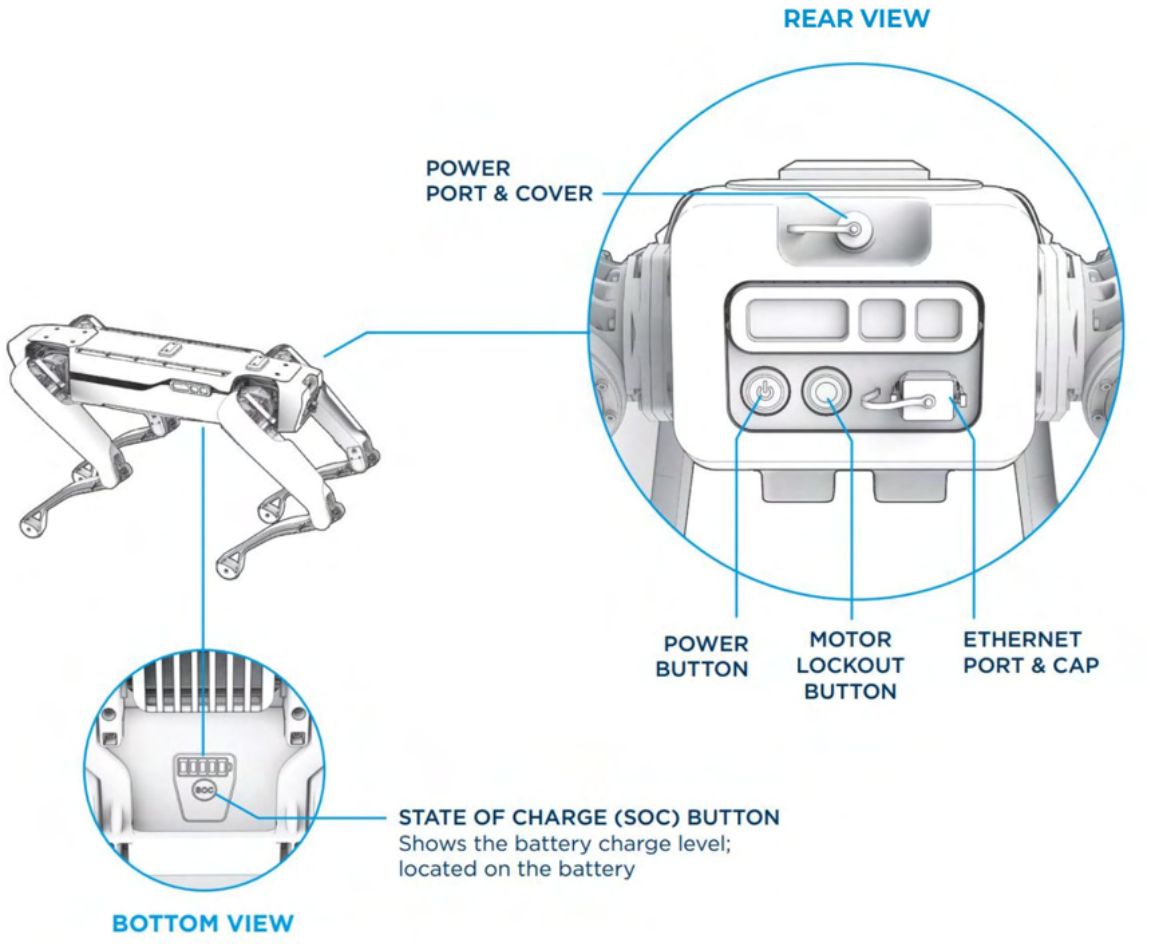
Certain types of attachments (such as lidars) may replace or supplement vision-based sensors for navigation, and may require fewer fiducials. Refer to documentation specific to each attachment for instructions.

WARNING

Consider the failure modes of attachments before removing or reducing the number of fiducials. Backup navigation systems, including Spot's baseline navigation, could be affected by an unexpectedly insufficient number of fiducials.

5. Use of the Machine

5.1. Controls and Interfaces on Spot



Battery and power controls.

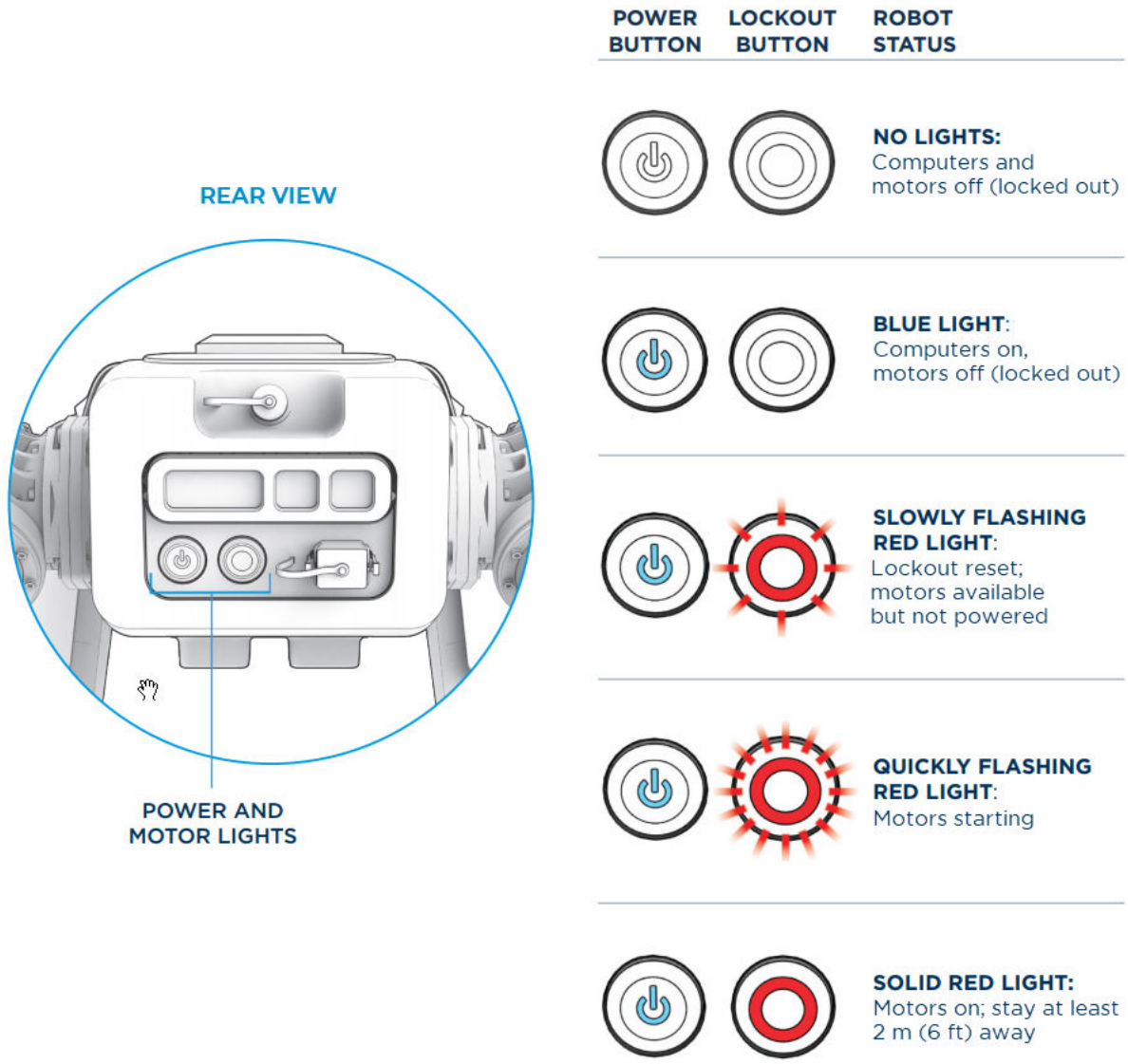
Spot's charging port, with attached cover, is at the top-center of the rear body panel.

Along the lower portion of the rear body panel, from left to right, are Spot's power button, motor lockout button, and Ethernet port with attached cap.

The Spot Battery is inserted into a compartment in Spot's bottom panel, and a State of Charge (SoC) button with five LED indicators is centered in the exposed face of the battery.

5.1.1. Power and Motor Status Lights

The power and motor lockout buttons are located on Spot’s rear body panel. The power button illuminates blue when Spot’s computers are on. The motor lockout button illuminates red when the motor lockout is reset.

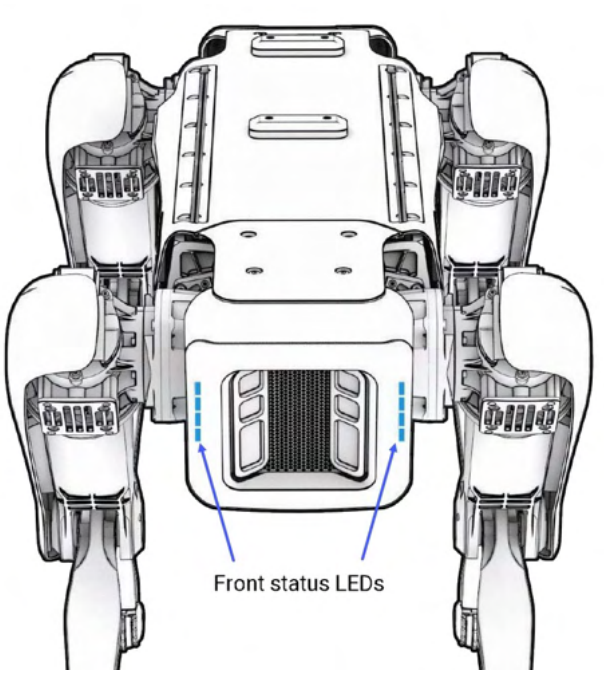


Power and motor status lights.

When Spot is powered on and motors are locked out (blue light only), motion commands are disabled. Spot will not move until the motor lockout is reset and Spot receives a start command as described in Start Spot.

5.1.2. Robot Status Lights

Spot's LED status lights are located on the front body panel.



Status light location.

Light pattern	Description	Robot status
	Yellow	System booting up
	Moving rainbow	Powered on, ready to connect
	Solid blue	Lockout button engaged; Spot is safe to handle
	Filling blue	Charging, dots indicate percentage of charge
	Solid blue with gap	Plugged in or docked, no battery
	Slow blink green	Controller connected; motors may turn on
	Fast blink green	Motors turning on

Light pattern	Description	Robot status
	Solid green	Motors on
	Draining orange	Low battery
	Blinking orange	Serious error or perception fault; operation degraded

NOTICE

When the A/V warning system is active, the status light color will match the color of the front and bottom indicators. See Auditory and Visual (A/V) Warning System.

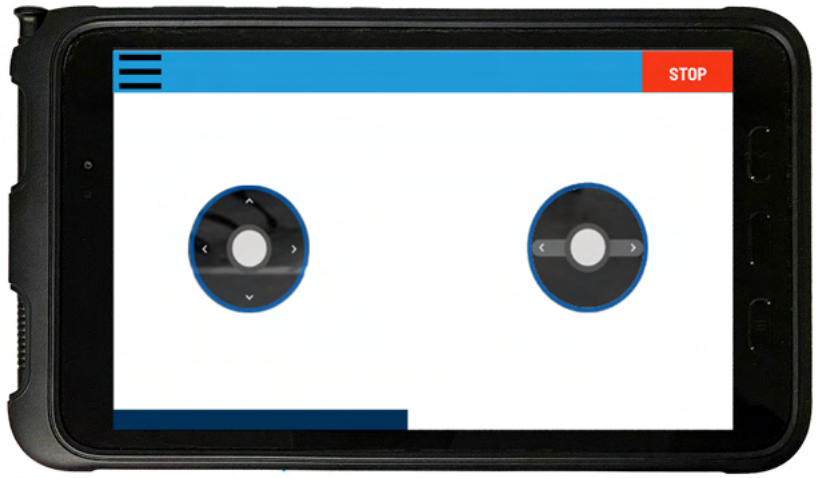
5.2. Remote controllers

Spot can be operated with the tablet controller that ships with Spot, or from a computer running the Orbit browser application. This document describes the use of the tablet controller. For instructions on using Orbit, refer to documentation in the Boston Dynamics Support Center (see Appendix A: Supplemental information).

Control can be passed from one controller to another while Spot is in use. See Pair the tablet controller with Spot.

Spot may be compatible with other control devices and software. Only use controllers provided or approved by Boston Dynamics to operate Spot.

5.2.1. Spot Tablet Controller



Spot tablet controller.

The Spot tablet controller is a wireless device for manually operating Spot robots.

The controller that ships with Spot is a handheld touchscreen computer running the Android operating system and the Spot App. The controller can be integrated with hardware devices that include buttons and joysticks.

Spot can be operated without the tablet controller, but the tablet controller or another compatible device running the Spot App is required to record missions.

NOTICE

The first time you open the Spot App, you may be prompted to select one of several profiles that tailor the user interface to how you plan to use Spot. This document assumes you are using the "Advanced" profile.

5.2.2. Pair the tablet controller with Spot

Pairing the tablet controller with Spot links them via Spot's current network connection so you can operate the robot. The Spot App remembers previously paired robots so you can reconnect easily.

Multiple controllers can pair with Spot simultaneously to observe what the robot is doing and access some settings, but only one controller can operate Spot at any time. Operational control can pass from one paired controller to another.

To pair the tablet controller with a Spot robot for the first time:

1. Start with Spot and the tablet controller powered on. See Start Spot.

2. On the tablet controller, open the Spot App.
3. Select **+ ADD NEW ROBOT**.
4. Select the network that matches the information in Network Configuration, or that matches Spot's current network settings as determined by your Spot system administrator.
    a. If you are taken to the Android network settings screen, select the correct network and enter the password if required.
    b. If you see a message about the network having no Internet access, select **Always connect**.
    c. Press the tablet controller's back button to return to the Spot App.
5. If Spot appears in the **NEW ROBOTS** list, select it. Otherwise, select **+ ADD ROBOT** and enter Spot's IP address. (For the default network configuration, the address is `192.168.80.3`)
6. Log in with the admin username and password printed on the label in Spot's battery compartment, or using credentials provided by your Spot system administrator.
7. When prompted, press the **Cut Motor Power** button combination.
8. Select a start command as described in Start Spot, or select **OBSERVE** to access cameras, menus, and settings without starting Spot's motors.

To pair the tablet controller with a known Spot robot:

1. Start with Spot and the tablet controller powered on. See Start Spot.
2. On the tablet controller, open the Spot App.
3. Select a robot from the **MY ROBOTS** list. The tablet will automatically join the appropriate WiFi network to pair with Spot.

> **NOTICE**
> A robot may appear multiple times in the list based on past pairings. For instance, you might see a listing to pair via the robot's WiFi access point and a separate listing to pair via your site's network. Select the method that matches Spot's current network configuration.

4. Log in with the admin username and password printed on the label in Spot's battery compartment, or using credentials provided by your Spot system administrator.
5. When prompted, press the **Cut Motor Power** button combination.
6. Select a start command as described in Start Spot, or select **OBSERVE** to access cameras, menus, and settings without starting Spot's motors.

5.2.2.1. Take control of Spot from another controller

If you see the **HIJACK** button when pairing with Spot, Spot has already been started and is operating in automatic mode or under the control of another operator.

When you take control, Spot will come to a standstill and control will transfer to you in manual mode. Motors will not power off when control is transferred.

NOTICE

Taking control of Spot during an Autowalk mission will cause the mission to end prematurely.

To take control of Spot from another controller:

1. Select **HIJACK**.
2. If prompted, open the **Motor Status panel** and toggle **Motor Power** to **ON**.

WARNING

Avoid taking control while Spot is traversing a staircase. Interrupting stair navigation can have negative effects on stability.

CAUTION

Taking control of Spot during operation does not require the permission of other operators and may cause disorientation or attempts to troubleshoot a surprising situation. Always carefully assess the situation and communicate with other operators before taking control of Spot.

5.2.3. Loss of Connection to the Controller

By default, Spot maintains a connection to a remote controller during both manual and automatic operation. If the connection is lost, you cannot manually control Spot or monitor and intervene in automatic operation.

Possible reasons for loss of connection include:

- Poor network performance.
- Weak or intermittent signal strength.
- The controller powering off, entering a sleep or standby mode (such as turning off the screen), or changing its network settings.
- The Spot App crashing, being backgrounded, or being closed.

5.2.3.1. Signal-loss behaviors

When Spot loses its connection to the controller, it will select one of the following behaviors:

If the connection is lost during manual operation:

- Spot will come to a halt with motors powered on and wait for the controller to reconnect.
- If AutoReturn is enabled, Spot will begin backtracking automatically within a configurable radius to attempt to restore the connection. For details, see AutoReturn.

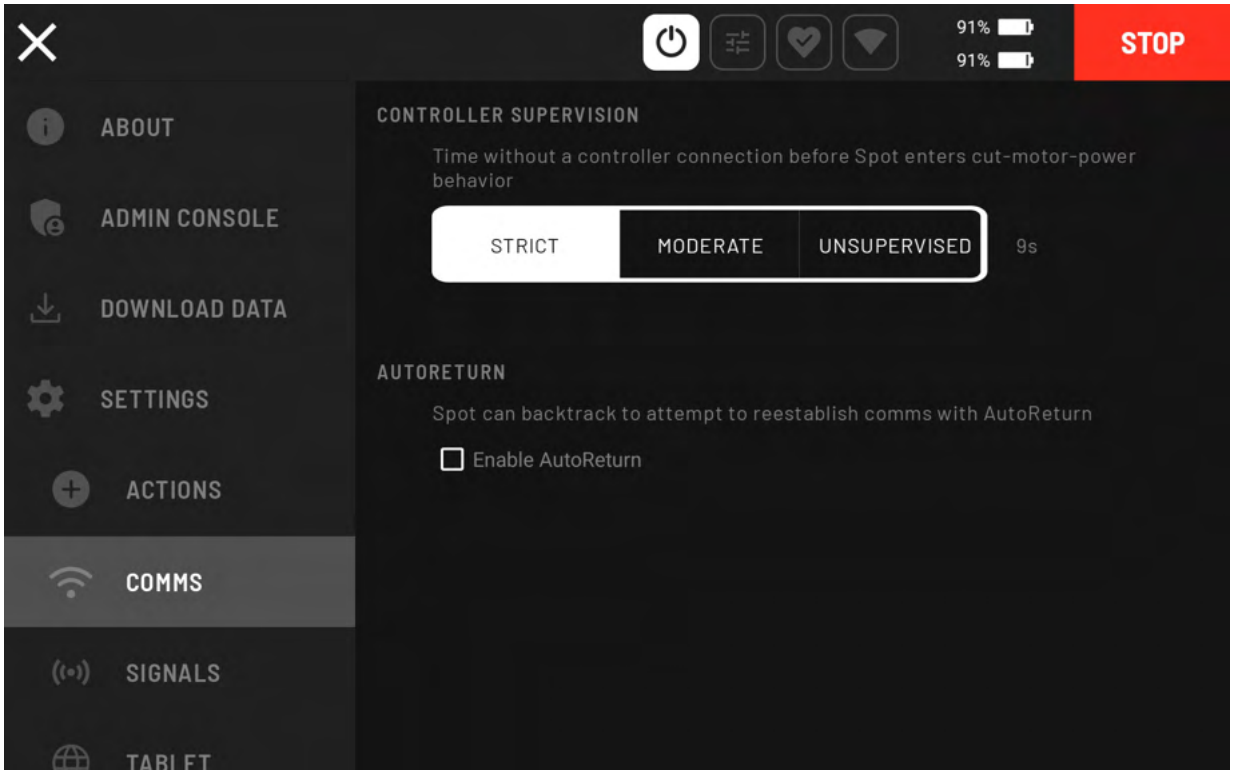
If the connection is lost during automatic operation:

- Spot will continue operation. Typically, this means continuing an Autowalk mission.

All signal-loss behaviors are limited in duration by the controller supervision setting.

5.2.3.2. Controller Supervision

The controller supervision setting determines how long Spot can continue operating without a connection to a remote controller. After the set duration, Spot will perform an "operational stop" (sit and power off its motors) as described in Stopping Functions.



Controller supervision settings in the Spot App.

Supervision setting	Duration of unsupervised operation before stopping
STRICT (default)	9 seconds
MODERATE	30 seconds
UNSUPERVISED	18.2 hours

WARNING

When Spot is operating "unsupervised", it may not be possible to stop the robot quickly. Use this setting only after carefully assessing the operating environment and the risks of unsupervised operation.

To change controller supervision:

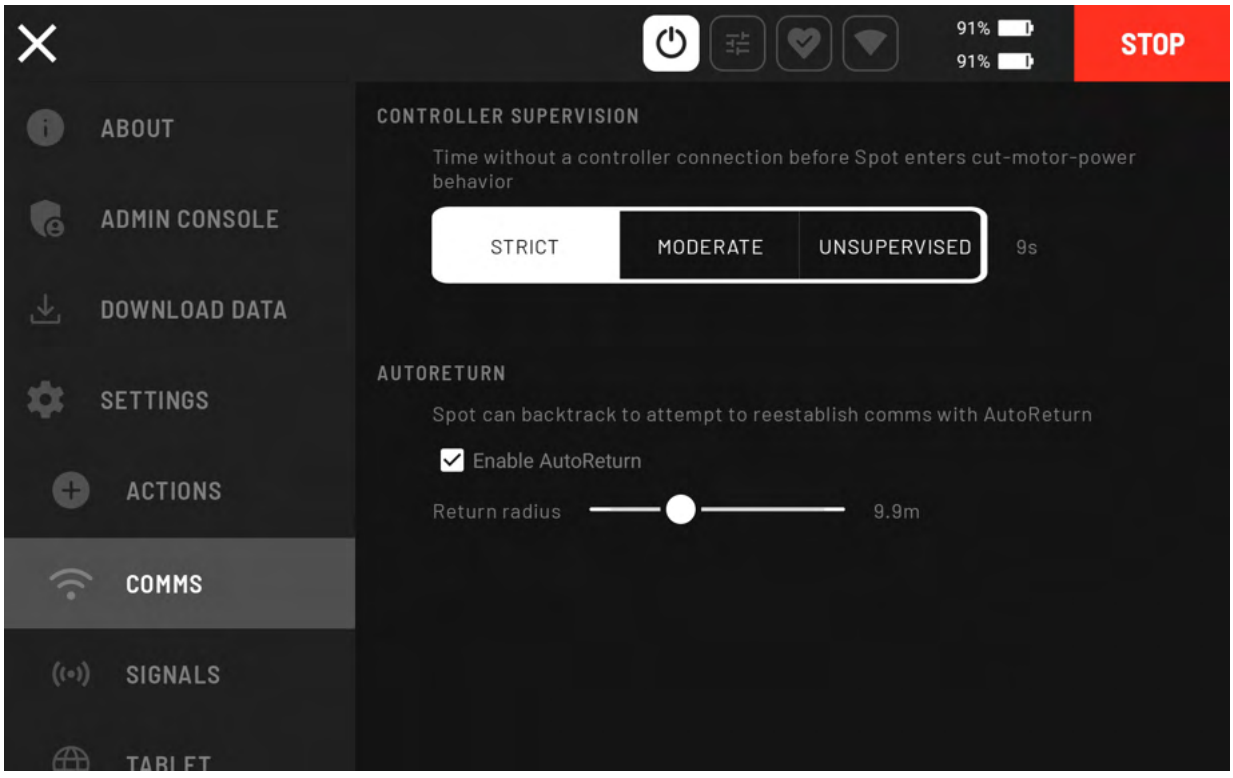
1. In the Spot App, Navigate to ≡ **Menu** > **SETTINGS** > **COMMS**.
2. Select a supervision setting.

5.2.3.3. AutoReturn

When enabled, AutoReturn allows Spot to backtrack automatically to a location within a configurable radius (up to 20 meters) as it attempts to restore its connection to the controller. When the connection is restored, you can resume operation. If the connection is not restored after backtracking up to the configured distance, Spot will sit and power off its motors.

AutoReturn is disabled by default.

> **NOTICE**
>
> AutoReturn applies only to manual operation. It will not trigger while Spot is performing an Autowalk mission.
>
> The controller supervision setting also applies during AutoReturn and may cause Spot to sit and power off its motors before it has walked the full AutoReturn distance.

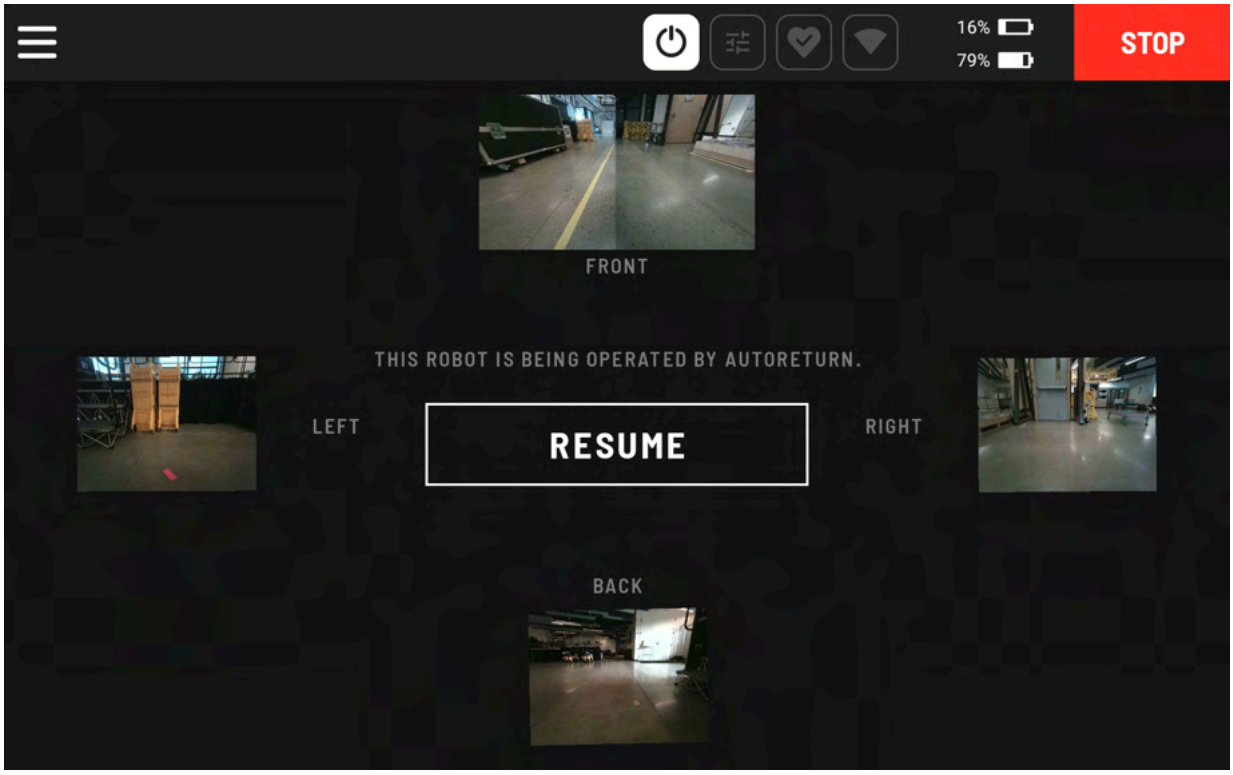


AutoReturn settings in the Spot App.

To enable AutoReturn:

1. Navigate to ≡ **Menu** > **COMMS**.
2. Toggle the **Enable AutoReturn** checkbox.

3. Drag the **Return radius** slider to change how far Spot can backtrack when AutoReturn is triggered.



Resuming control after AutoReturn

To resume manual control after AutoReturn is triggered:

1. Wait for the controller to reconnect to Spot. You may need to take action to re-establish the connection, such as reconnecting the tablet to WiFi or reopening the Spot App.
2. If the Spot App was closed, reconnect to Spot as described in Pair the tablet controller with Spot. Otherwise, select **RESUME**.
3. Spot will come to a halt with motors powered on, and manual control will transfer to you.

CAUTION

During AutoReturn, Spot will generally walk in reverse with the same gait that was in use before the connection to the controller was lost (see Locomotion). Speed, height, and other settings may differ during AutoReturn.

If the path Spot is backtracking during AutoReturn includes a Spot Dock, Spot may automatically perform docking behaviors. See Dock and Undock Spot.

WARNING

AutoReturn involves sudden automatic movement. When a controller is not connected to Spot, it may not be possible to stop Spot quickly. Use this setting only after carefully assessing the operating environment and the risks of automatic operation.

5.3. Start Spot

Before starting Spot, make sure that it:

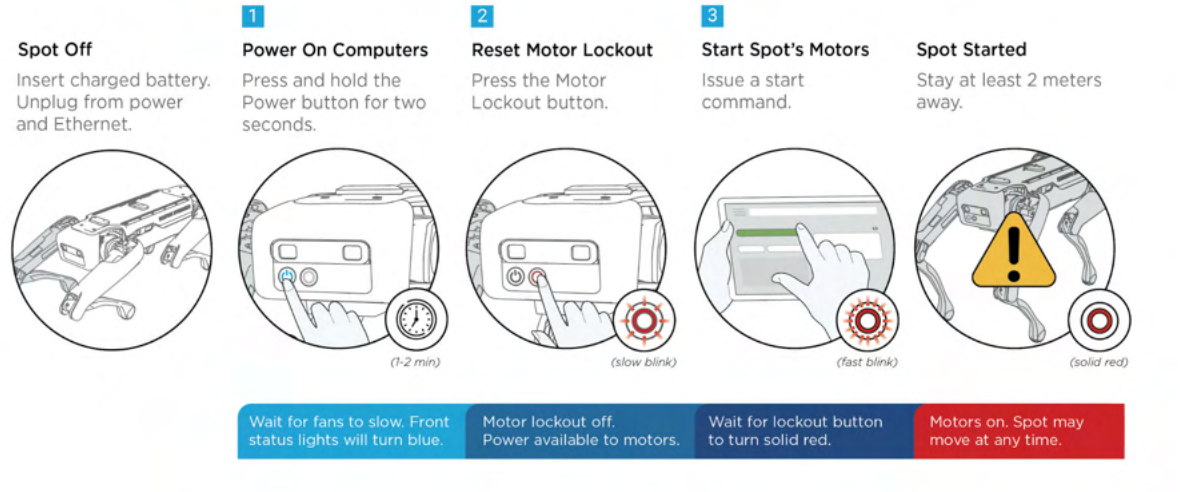
- Has a charged battery.
- Is unplugged from power and Ethernet.
- Has its power plug cover and Ethernet port cover inserted.

CAUTION

Before setting up or operating Spot, ensure there is at least 2 meters of clearance around Spot in all directions.

Starting Spot involves three steps:

1. Power on Spot. This boots up Spot's computers, but does not deliver power to Spot's motors.
2. Reset the motor lockout. The motor lockout prevents motor power. Once reset, power is available to motors but no motion command is enabled or allowed yet.
3. Start Spot's motors. This step is done on a remote controller. Motors are energized and Spot may move at any time.



Spot startup sequence.

NOTICE

There may be additional power-up procedures for attachments that are installed on Spot and use one of the two payload ports on Spot's top.

5.3.1. Power on Spot’s computers

To power on Spot's computers:

1. Press and hold the Power button for 2 seconds.
2. The fans will turn on and spin for approximately 2 minutes. During this time, Spot's computers are booting and its WiFi is coming online.
3. When the noise of the fans is audibly lower and the status lights at the front of Spot change to solid blue, Spot’s computers are powered on.

5.3.2. Reset the motor lockout

To reset the motor lockout:

1. Press the Motor Lockout button on the rear of Spot.
2. If Spot’s computers are already powered on, the button will illuminate red and slowly blink to indicate that the lockout is reset.

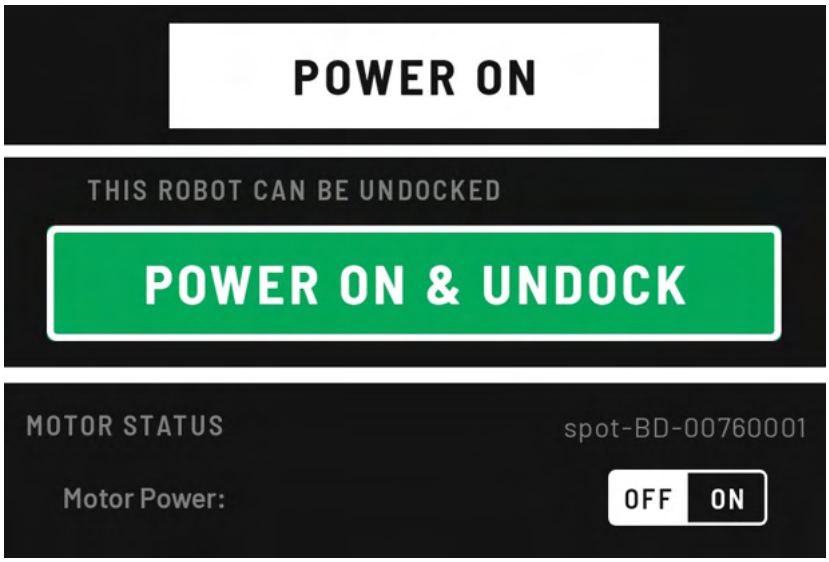
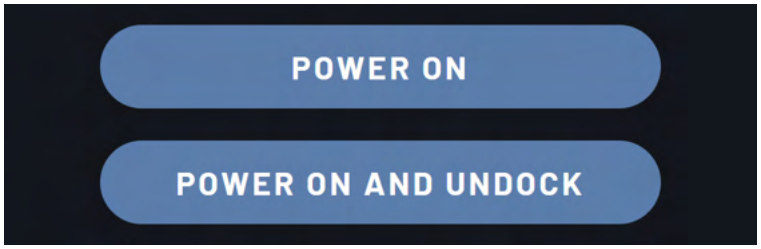
Spot will not start yet. A deliberate start command is necessary from an externally connected control device.

CAUTION

If a software command to start Spot is pending when the motor lockout is reset, Spot may immediately start its motors and begin moving.

5.3.3. Start Spot’s motors

Start commands vary depending on mode of operation, controller type, and robot state. Examples:

<table>
<tr><th>Mode</th><th>Controller</th><th>Start commands</th></tr>
<tr><td rowspan="2">Manual</td><td>Spot App</td><td> 
</td></tr>
<tr><td>Orbit</td><td> 
</td></tr>
<tr><td>Automatic</td><td colspan="2">Spot’s motors may start automatically, remain started, or re-start automatically to replay scheduled or looping Autowalk missions.</td></tr>
</table>

The motor lockout button will blink quickly for several seconds while motors are starting. When motors are fully started, the button will glow steady red.

CAUTION

Once started, Spot may move suddenly and unexpectedly.

5.4. Stop and Restart Spot's Motors

During normal operations, when a tablet controller running the Spot App is connected to Spot, two stop commands are available:

- **STOP**: Immediately suspends all robot motion.
- **CUT POWER**: Fully de-energizes Spot’s motors.

When **STOP** or **CUT POWER** is commanded, it takes precedence over all active commands on the controller. When **CUT POWER** is commanded, motors cannot be turned on until the stop is canceled.

An operational stop can be triggered:

- Manually by an operator.
- Automatically by Spot's internal control system.
- By additional software or attachments.

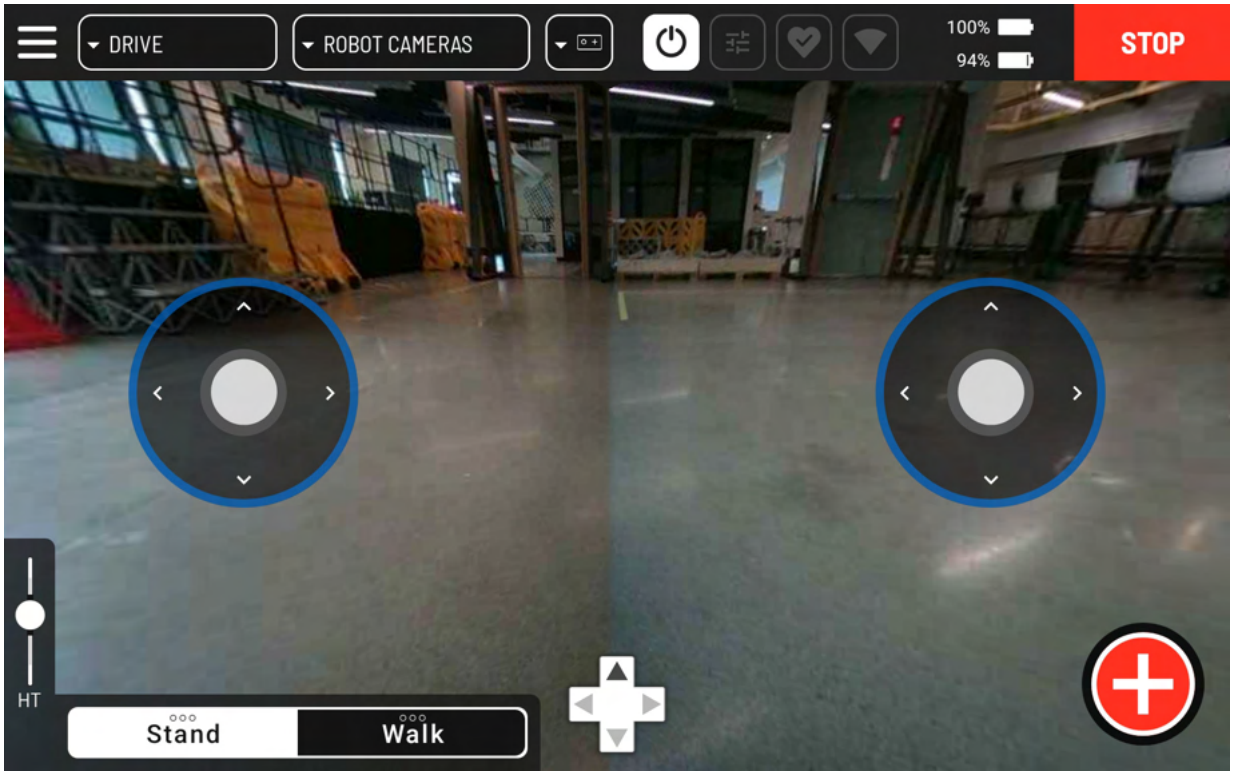
> **NOTICE**
> Many Spot behaviors can also be paused or canceled with on-screen controls or physical button shortcuts, however this document only describes the general stop function.

5.4.1. Manual stop using the tablet controller

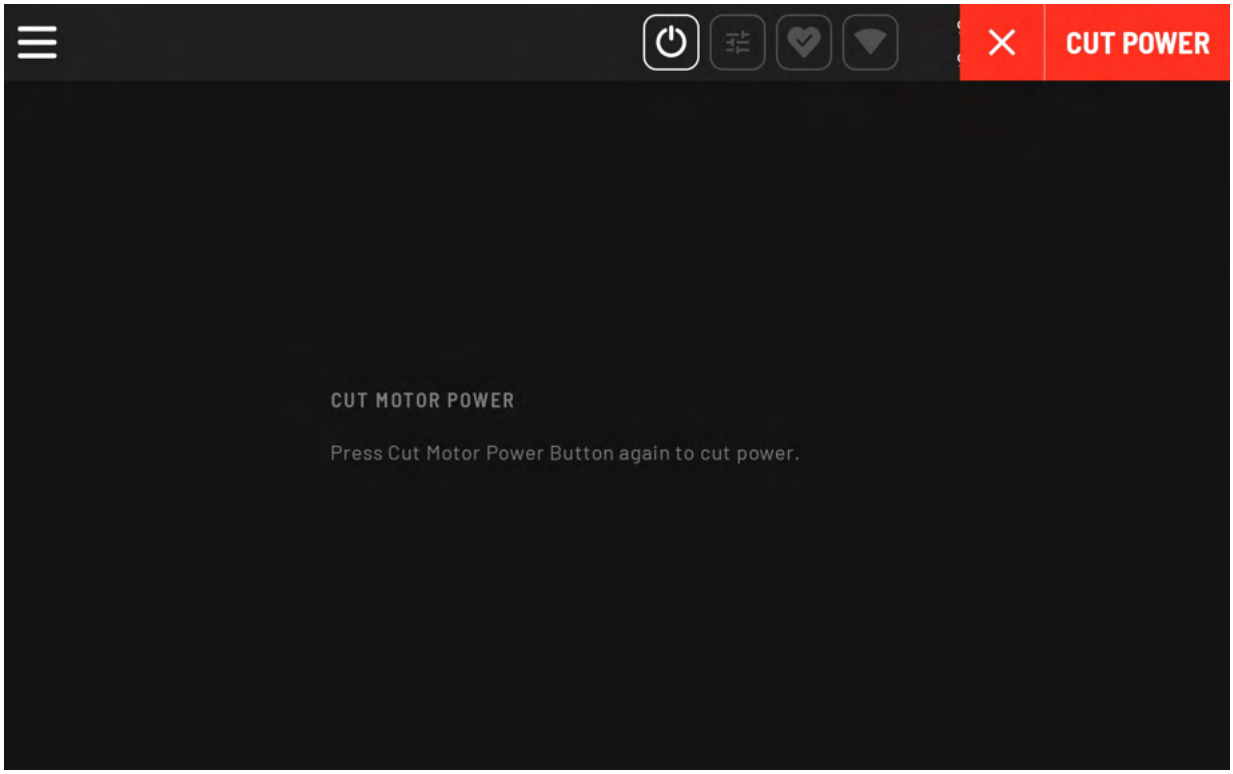
To suspend robot motion while driving Spot with the tablet controller and the Spot App, select **STOP**. Spot will pause and stand in place. If Spot is seated, it will remain seated.

To de-energize Spot's motors, use either of these methods:

- Press a shortcut combination of physical buttons to **Cut Motor Power**. This shortcut differs depending on the controller configuration and is displayed in the Spot App when you connect to Spot.
- In the Spot App, select **STOP** twice in quick succession. The first selection will suspend robot motion and change the button label to **CUT POWER**. The second selection will de-energize the motors.



*The Spot App's **STOP** button.*



*The Spot App's **CUT POWER** button.*

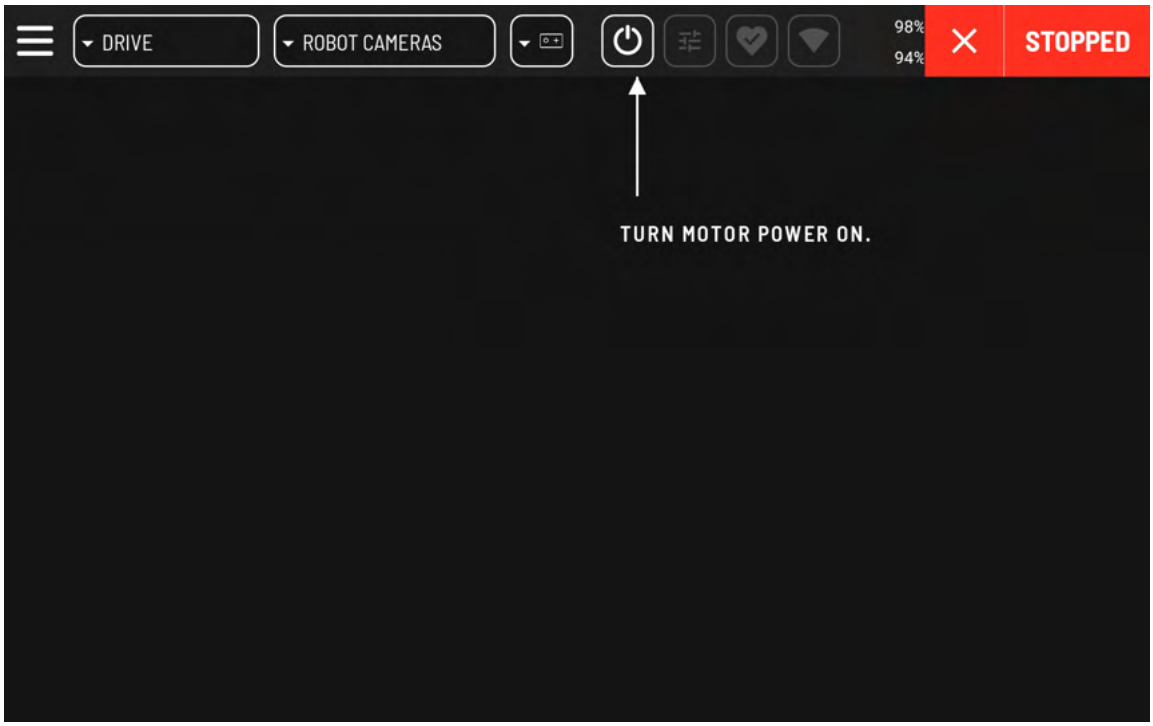
> **WARNING**
> When motors are de-energized, Spot will lose its ability to stand and balance. On flat ground, Spot will lower its body. On inclined surfaces or stairs, Spot may tip over.

5.4.2. Restart after a stop using the tablet controller

To resume operation with the tablet controller after a stop:

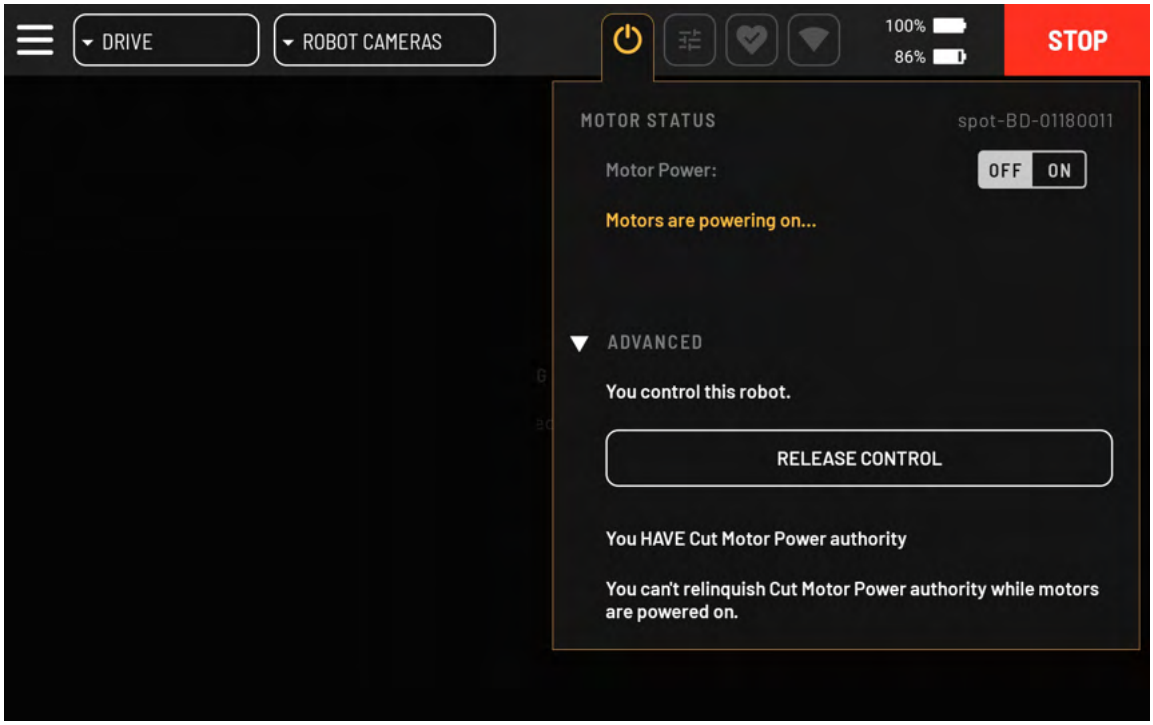
1. First make sure safety conditions are met, and sufficient clearance is maintained.

2. In the Spot App on the tablet controller, select the red ✕ to clear the stop (if applicable).



Spot App during a stop.

3. Open the **Motor Status panel** and toggle **Motor Power** to **ON**.



Spot App Motor Status panel.

4. Resume operation. If Spot continues to stop unexpectedly, contact Boston Dynamics Support.

5.5. Change Spot's mode of operation

In most situations, Spot can be switched between manual and automatic modes of operation without powering off motors.

If Spot is running an Autowalk mission unsupervised or under the supervision of another remote controller, you will be prompted to power off and restart Spot's motors as part of the mode change.

CAUTION

Changing modes will bring any current robot motion to a standstill, and may cause Spot to immediately begin moving along a new trajectory.

5.5.1. Switch to automatic mode

Spot enters automatic mode whenever it begins to replay an Autowalk mission, or whenever AutoReturn is triggered. This may be the result of:

- A direct command from an operator.
- A mission that was scheduled to run at a specific time.
- A command from software running on Spot, an attachment, or an external networked device such as a computer or server.
- Signal loss between Spot and a remote controller, if Spot is configured to use AutoReturn.

Spot remains in automatic mode during a mission and between looping or scheduled missions, including while stationary or docked, until any of the following occurs:

- The Autowalk mission ends, and there is no looping or scheduled mission pending.
- Spot is stopped by any stopping function described in Stopping Functions.
- Spot receives a command to switch to manual mode as described in Switch to manual mode.
- Spot regains its connection to a remote controller as a result of AutoReturn.
- Spot is powered off.

NOTICE

While in automatic mode, Spot's motors may start automatically, remain started, or re-start automatically. For more information, see Start Spot and Automatic operation.

5.5.2. Switch to manual mode

Spot enters manual mode whenever an operator takes direct control of Spot via a remote controller. This may be the result of:

- Connecting a remote controller to Spot and issuing a start command as described in Start Spot.
- Pausing an Autowalk mission replay, for instance by selecting **Pause** in the Spot App.

- Exiting Autowalk mode, for instance by selecting **EXIT AUTOWALK** in the Spot App.
- Canceling an upcoming scheduled mission, for instance by selecting **CANCEL MISSION** in the Spot App.
- A restored connection between Spot and a remote controller as a result of AutoReturn.

Spot will remain in manual mode until it is switched to automatic mode or powered off, or until AutoReturn is triggered.

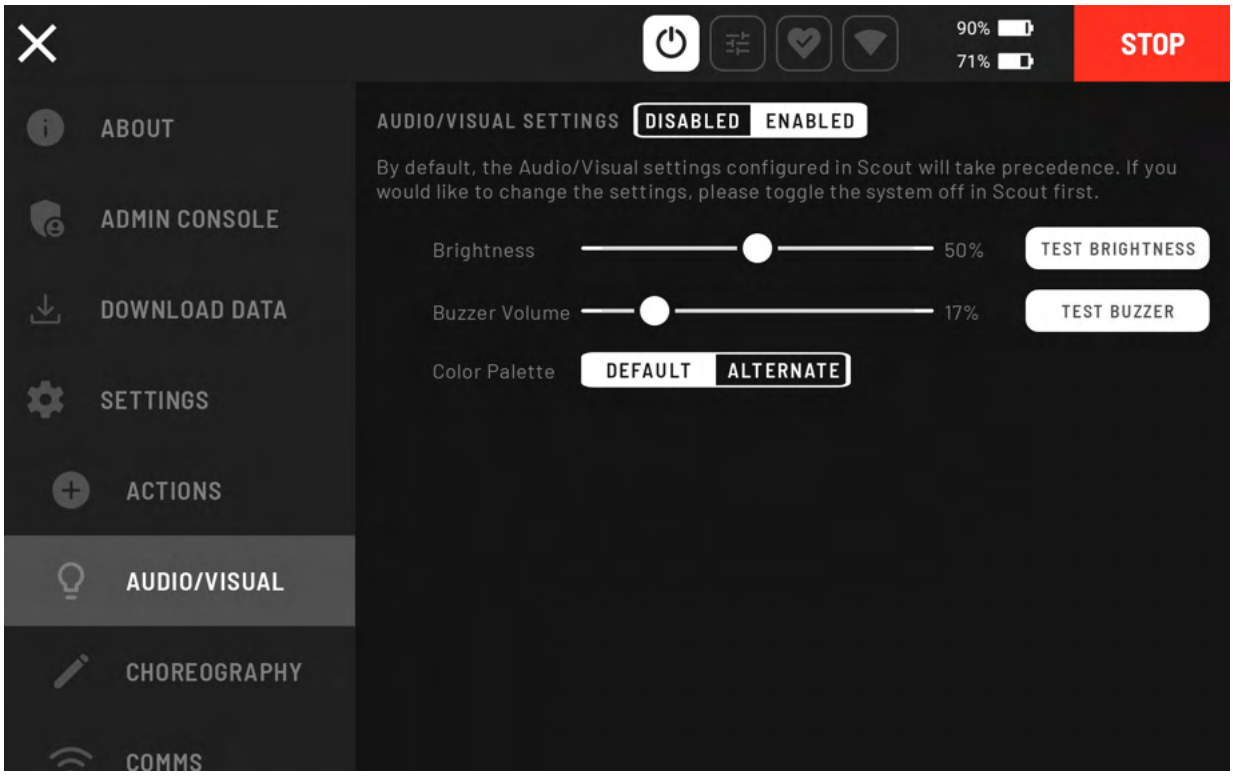
5.6. Configure the A/V warning system

> **NOTICE**
> This information applies only to Spot model numbers 04-00143531-401, 04-00143531-601, and 04-00143531-611. To find your model number, check the label inside Spot's battery compartment.

When enabled, the warning system produces preset light and sound patterns to alert nearby people of Spot's presence and operational status. For details, see Auditory and Visual (A/V) Warning System.

To configure the A/V warning system:

- In the Spot App, navigate to ≡ **Menu** > **SETTINGS** > **AUDIO/VISUAL**.



A/V warning system settings in the Spot App.

Control	Description
AUDIO/VISUAL SETTINGS	Enable or disable the A/V warning system.
Brightness	Set the brightness of the indicators.
Buzzer Volume	Set the volume of the buzzer. **WARNING** At higher volumes, prolonged exposure to the noise generated by the buzzer may lead to severe damage or loss of hearing. Hearing protection is recommended.
Color Palette	Switch between available color palettes.

5.7. Dock and Undock Spot

During docking, Spot:

1. Orients itself in front of the Spot Dock with its rear facing the dock.
2. Walks backward to position itself over the dock.
3. Aligns its body with dock fixtures.
4. Lowers its body to connect to the charging pins on the rear tower.
5. Lifts its legs and powers off its motors.

During undocking, Spot:

1. Starts its motors, if they are not already started.
2. Slowly unfolds and lowers its legs, then stands up.
3. Walks forward until its rear legs are clear of the Spot Dock.

Spot uses its perception system to recognize the Spot Dock and navigate automatically during docking and undocking.

NOTICE
Before docking or undocking Spot, ensure that the Spot Dock has been installed correctly and is in usable condition. See Spot Dock setup.

The Spot Dock may become damaged during docking and undocking. Periodically check the dock for signs of damage, including the pins that connect Spot to power and Ethernet.

CAUTION

Do not operate Spot with a visibly damaged Spot Dock. For details on what to do with a damaged dock, refer to *Spot Dock Information for Use* in the Boston Dynamics Support Center (see Appendix A: Supplemental information).

Docking and undocking involve automatic robot locomotion and physical contact between Spot and the Spot Dock.

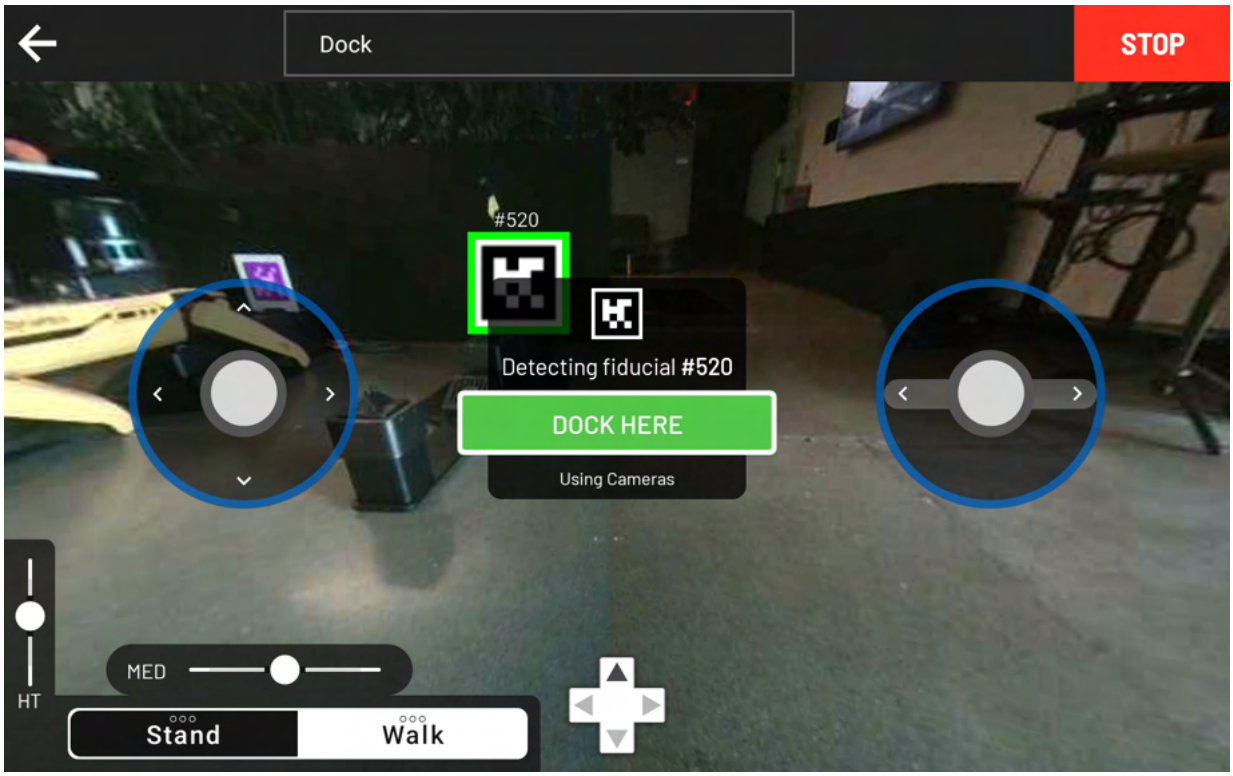
WARNING

- Spot could trip on the Spot Dock and fall.
- The layout of the Spot Dock and its surroundings (e.g. inclines, etc.) could cause Spot to be unstable.
- In case of a fall or lateral displacement, sensitive equipment could be damaged.

Ensure the area around the Spot Dock is clear and remove any sensitive electrical equipment.

Do not try to recover Spot from any instability. Do not approach Spot in any circumstance to attempt any troubleshooting during docking and undocking.

5.7.1. Dock and undock in manual mode



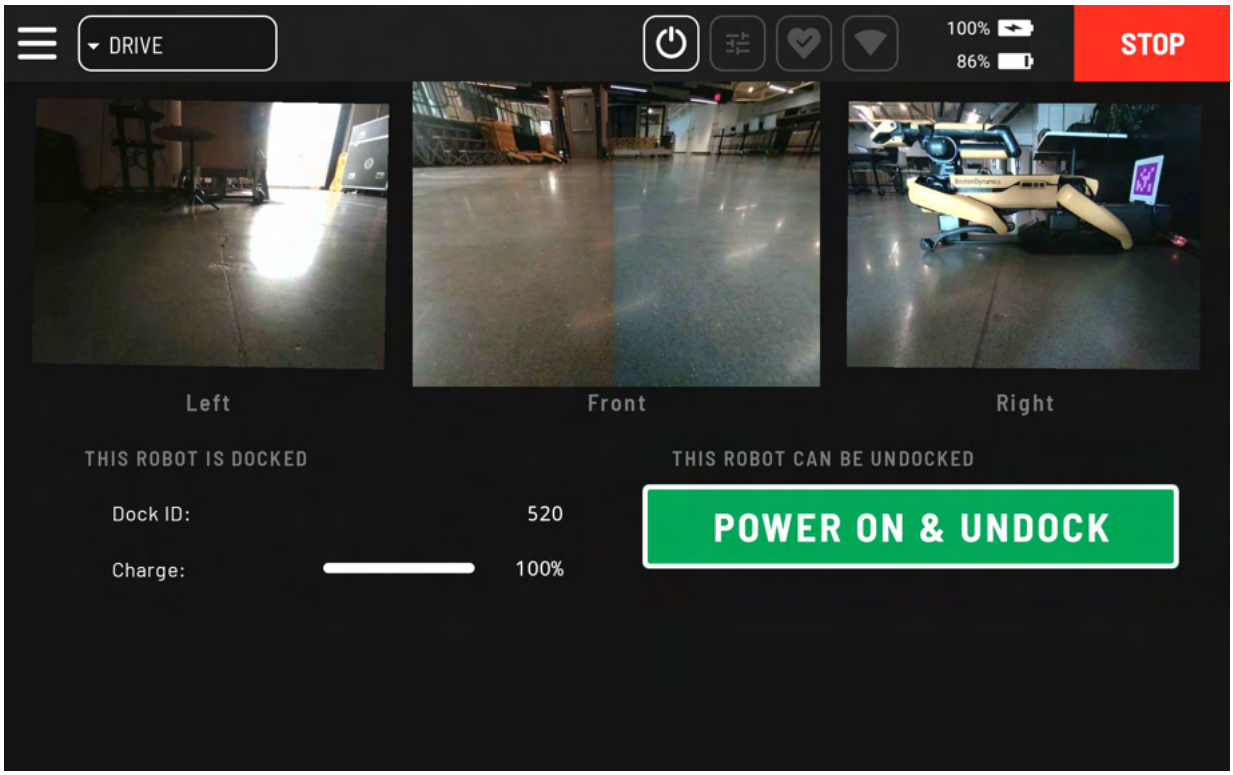
Docking Spot with the Spot App.

To dock Spot using the Spot App:

1. Drive Spot toward an unoccupied Spot Dock.

> **CAUTION**
> Ensure that you have a clear and complete view of the surroundings of the Spot Dock. If your ability to observe the operation remotely is compromised, abort docking.

2. When Spot is close enough, the dock fiducial will be highlighted in purple on the controller screen. Generally, this happens within 4 meters of the dock.
3. In the Spot App, select **Add Action**.
4. Select **ACTIONS** > **Dock**.
5. Select the docking fiducial, which will now be highlighted in green.
6. Select **DOCK HERE**.
7. Spot will automatically dock.



Preparing to undock Spot.

To undock Spot using the Spot App:

1. Select the Undock button.
   - If Spot's motors are running, the undocking button reads: **UNDOCK**
   - If Spot's motors are off, the undocking button reads: **POWER ON & UNDOCK**
2. Spot will automatically undock.

5.7.2. Dock and undock during Autowalk missions

If an Autowalk mission includes one or more docks, Spot can:

- Start and end the mission from any included dock.
- Automatically recharge between looping or scheduled missions.
- Automatically return to a dock to recharge if its battery runs low during a mission.

You can set target charge levels for automatic recharging when configuring the mission replay. For details, see Configure Autowalk Mission Replay Options.

Docks can be added at any time during mission recording. For instructions on recording a mission, see Record an Autowalk Mission.

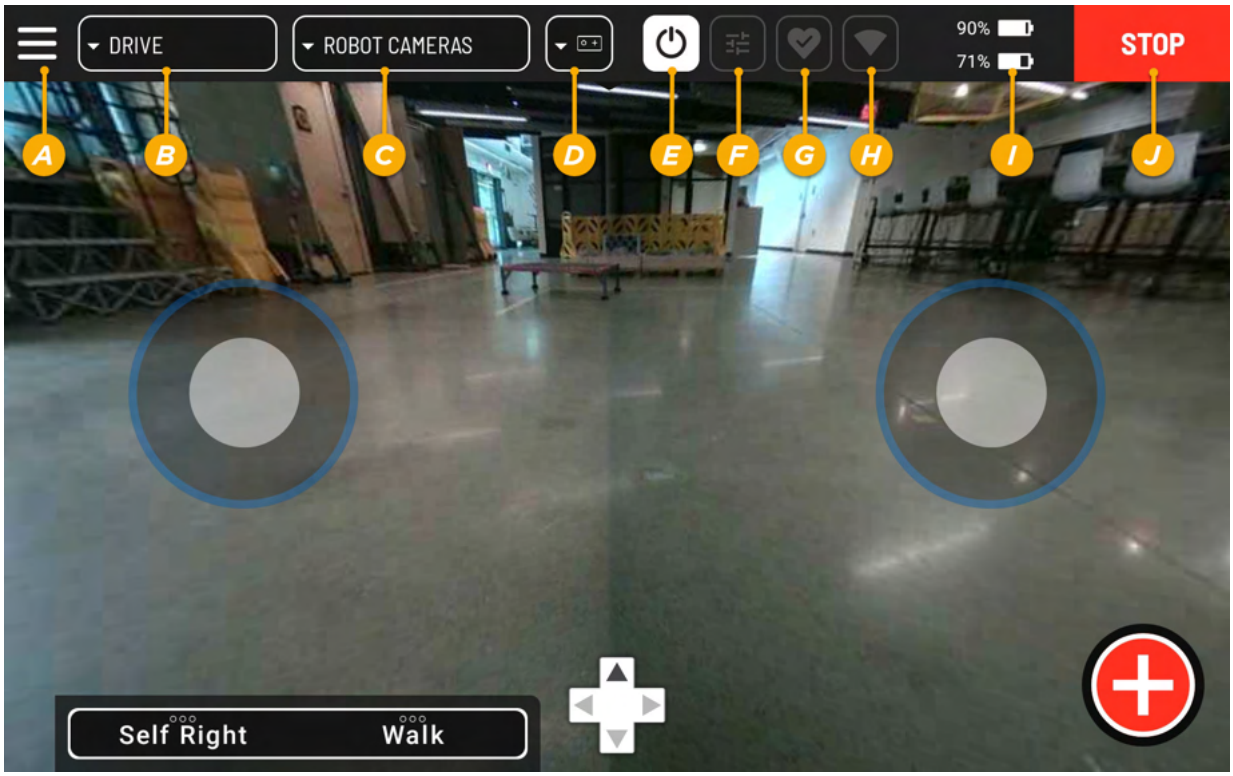
5.8. Drive Spot with remote control

When driving with remote control, you are in direct control of Spot's movements and behaviors.

5.8.1. Spot App Menus and General Controls

The Spot App is an Android application for remotely controlling Spot with the Spot Tablet Controller or another compatible device. It is the primary way to drive Spot, especially when a sitewide network is not available, and is required to create Autowalk recordings.

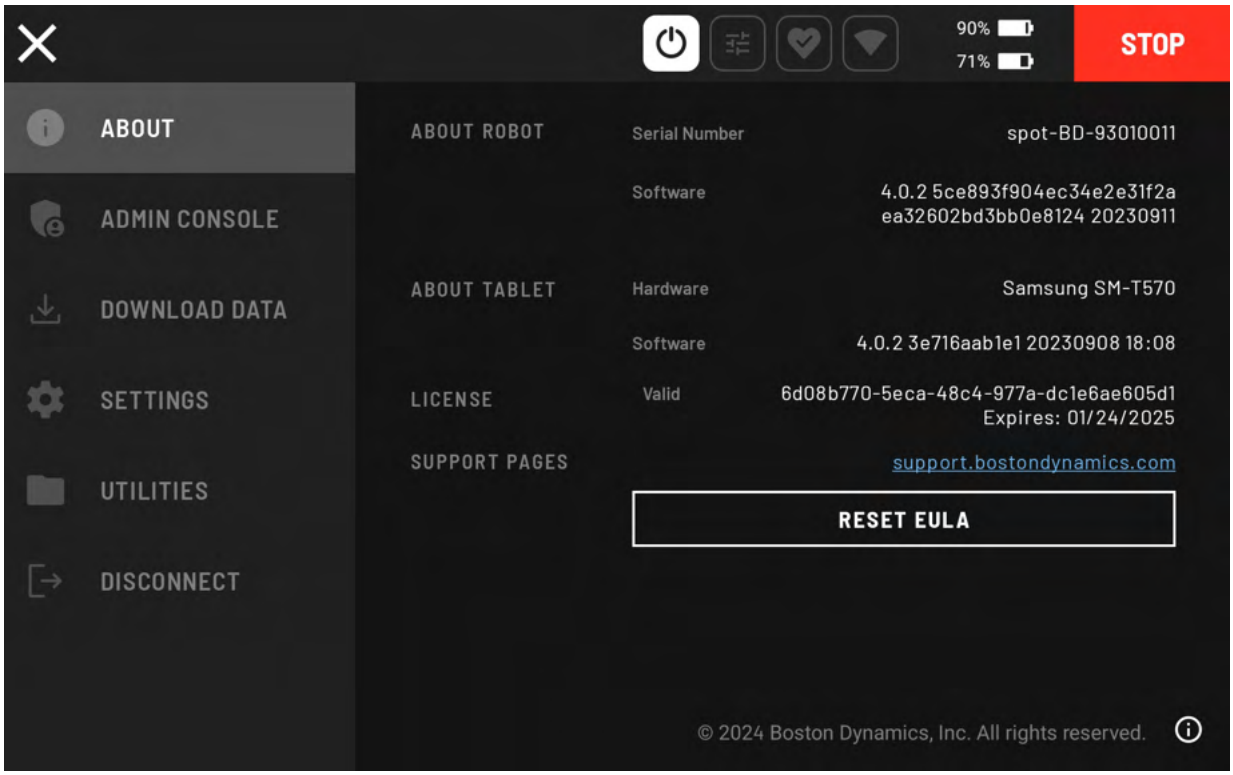
5.8.1.1. Menu bar



The Spot App's menu bar.

Label	Control	Description
A	≡ **Menu**	Access app-wide settings and features.
B	**Modes dropdown**	Switch between Drive mode, Autowalk mode, and other modes when available.
C	**Cameras dropdown**	Select from available camera views.
D	**Controller dropdown**	Select the gamepad to drive with joysticks. Select the hand to drive with Touch-to-Go.
E	**Motor Status panel**	Access motor power controls.
F	**Robot Controls panel**	Access obstacle avoidance and navigation controls.
G	**Robot Health panel**	View robot faults and create log entries.
H	**Comms Status panel**	See information about Spot's current network configuration and performance.
I	**Battery Status panel**	See information about Spot and tablet controller battery levels, and trigger Spot's Roll Over behavior.
J	**STOP**	Suspend all robot motion. See Stop and Restart Spot's Motors.

5.8.1.2. Main Menu



The main menu of the Spot App.

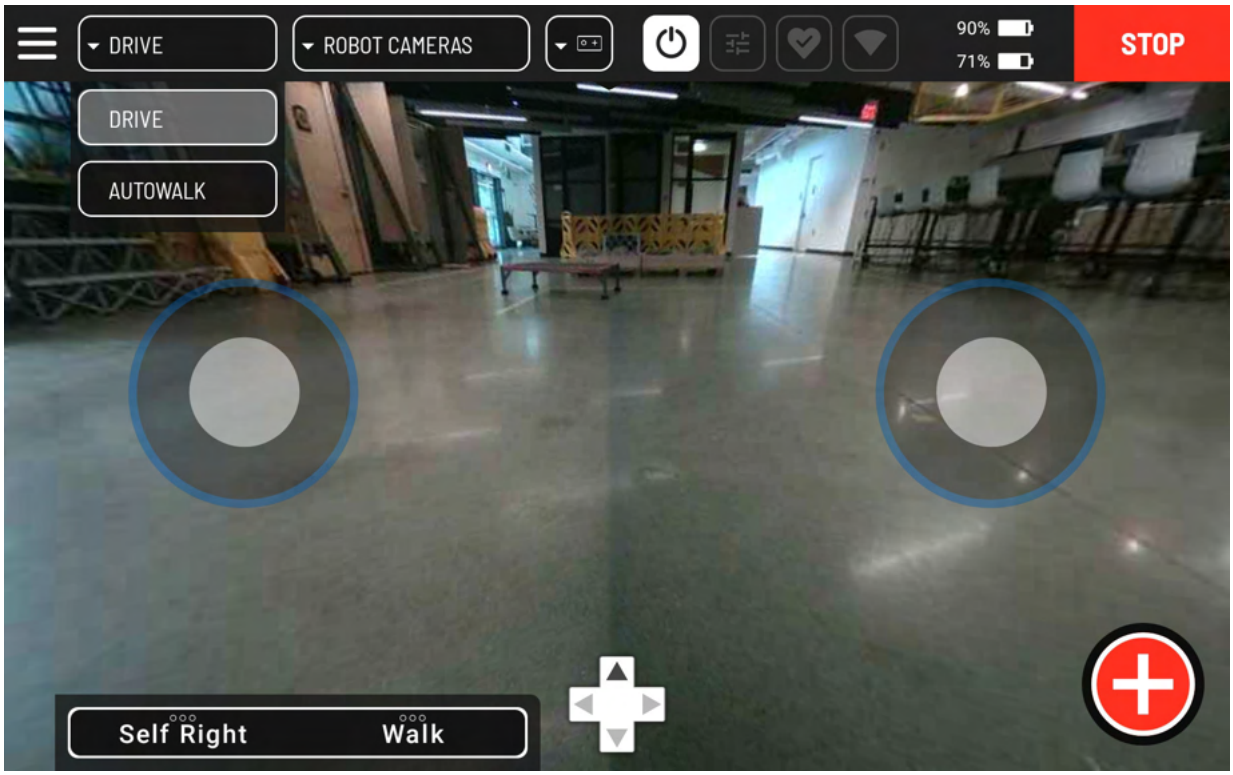
Menu item		Description
ABOUT		View Spot's serial number, current robot and tablet software, and Spot license.
ADMIN CONSOLE		Access Spot's Admin Console without leaving the Spot App.
DOWNLOAD DATA		Transfer images and other data generated by Actions during Manual or Automatic operation from Spot to the tablet.
SETTINGS	**ACTIONS**	Configure the default Actions and Inspections to show in the Actions menu, and create custom Inspections. See also: Record an Autowalk Mission.
	COMMS	Configure how Spot will react to a loss of signal between itself and the controller.
	TABLET	Change the language and temperature units of the Spot App.

Menu item		Description
	Profiles	Switch between several customizable profiles that tailor the user interface to how you plan to use Spot. This document assumes you are using the "Advanced" profile.
UTILITIES	**ATTACH PAYLOADS**	Turn on or off the flow of power to Spot's payload ports, and set previously configured attachments as attached or detached from Spot.
	ODOMETER	View cumulative operating statistics such as steps taken and distance traveled.
	SPOTCHECK	Run self-diagnostic routines on Spot's joints and cameras. For details, see SpotCheck (Joint and Camera Calibration).
	SPOTMETRICS	Review, upload, and configure options for the basic performance data Spot generates to help Boston Dynamics improve our products.
DISCONNECT		Select **SIGN OUT** to disconnect from Spot. If motor power is off, options to power off or reboot Spot will also be available.

NOTICE

Other options may be available depending on your Spot license and the presence of additional attachments or software.

5.8.1.3. Modes dropdown



The Modes dropdown.

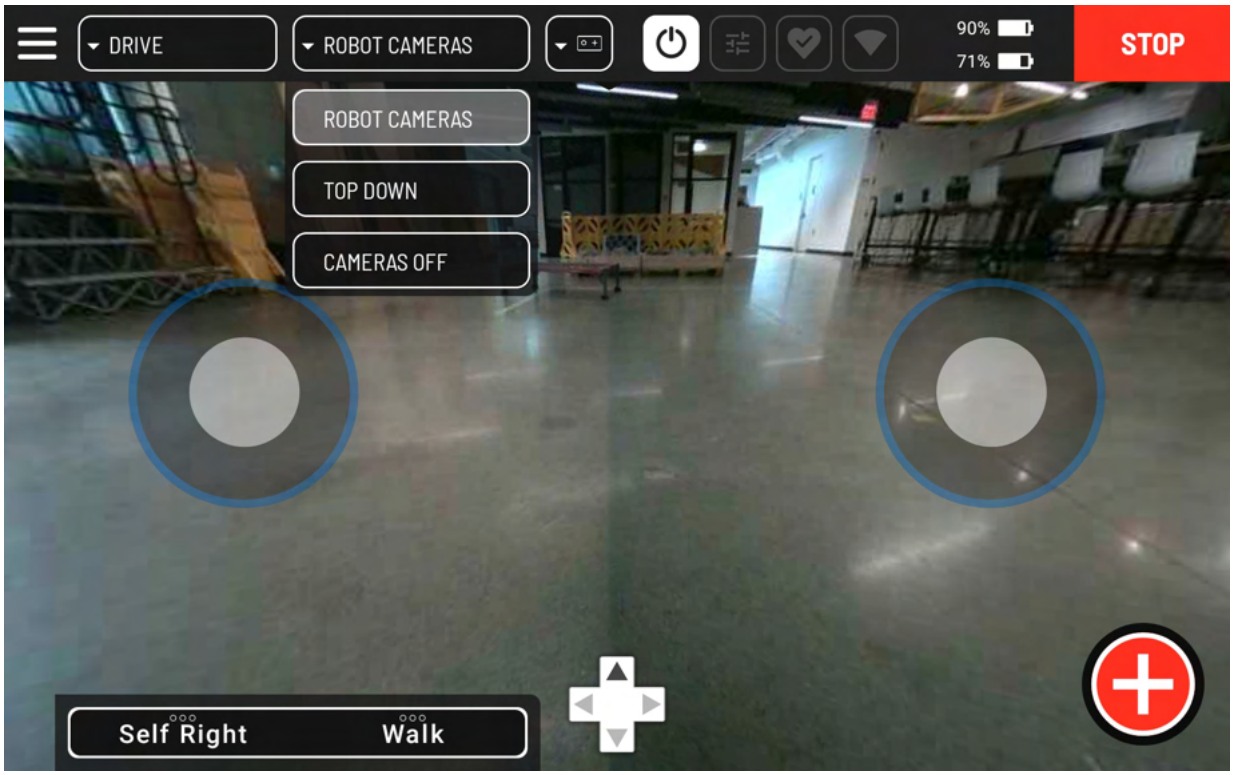
To change modes:

- Select **DRIVE** to operate Spot in Manual mode.
- Select **AUTOWALK** to record or replay Autowalk missions.

NOTICE

Other options may be available depending on your Spot license and the presence of additional attachments or software.

5.8.1.4. Cameras dropdown



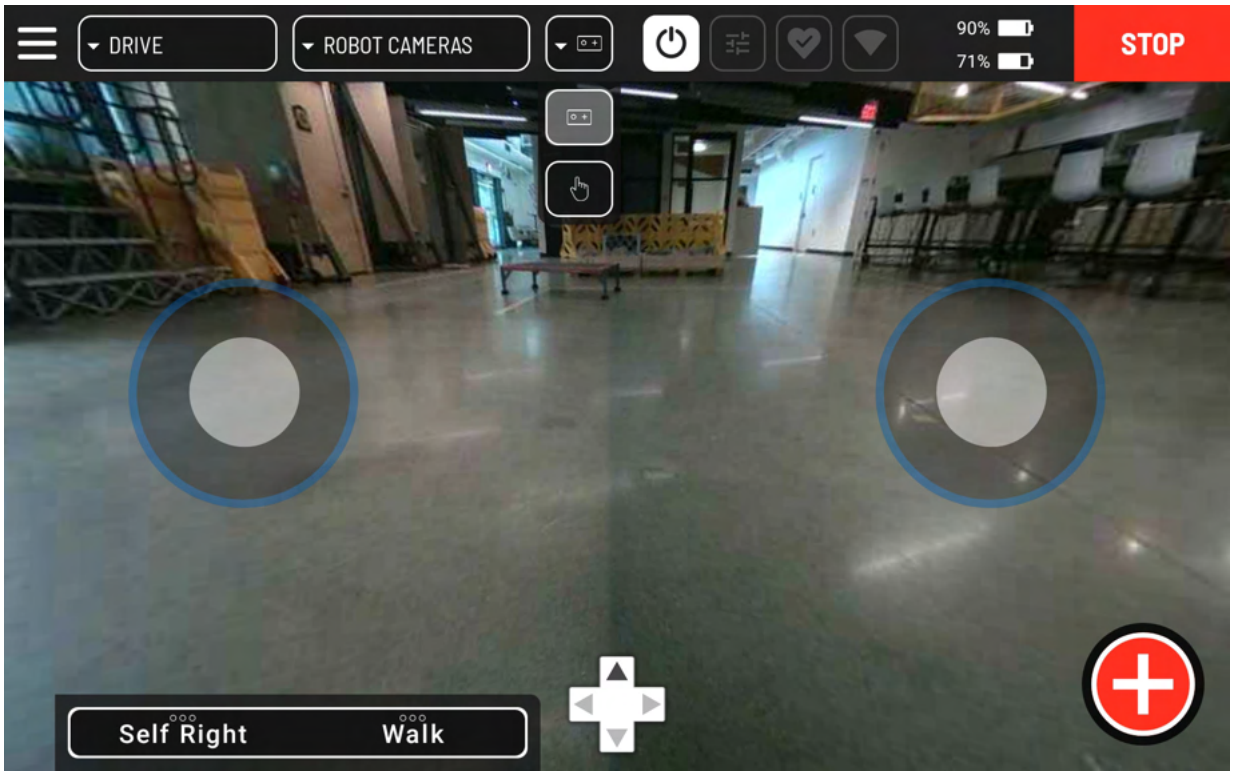
The Cameras dropdown

To change camera views:

- Select **ROBOT CAMERAS** to see the live feed from any of Spot's body cameras.
- Select **TOP DOWN** to see a simulation of Spot's environment from above, using images and depth data from the body cameras.
- Select **CAMERAS OFF** to disable the viewscreen.

> **NOTICE**
> Other options may be available depending on the presence of additional attachments or software.

5.8.1.5. Controller dropdown



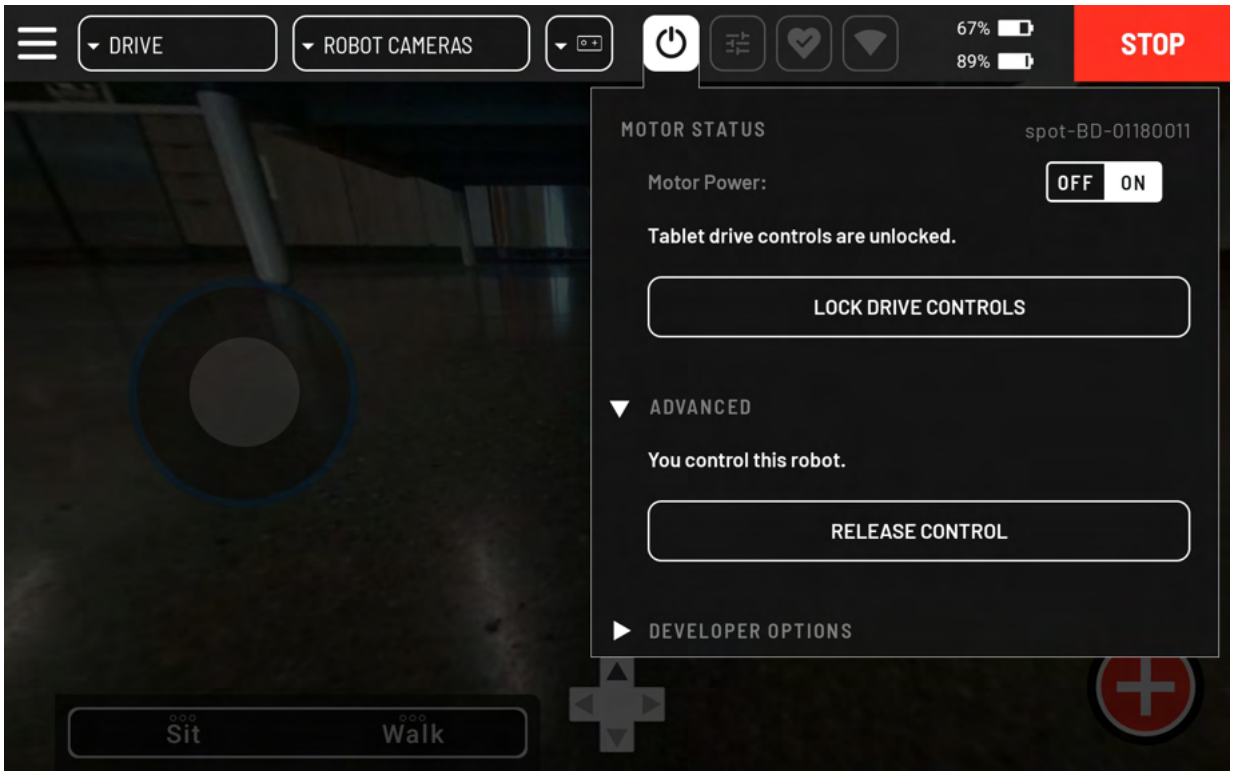
The Controller dropdown.

To switch between control schemes:

- Select the gamepad to drive with joysticks.
- Select the hand to drive with Touch-to-Go.

For a full list of drive controls, see Manual mode controls.

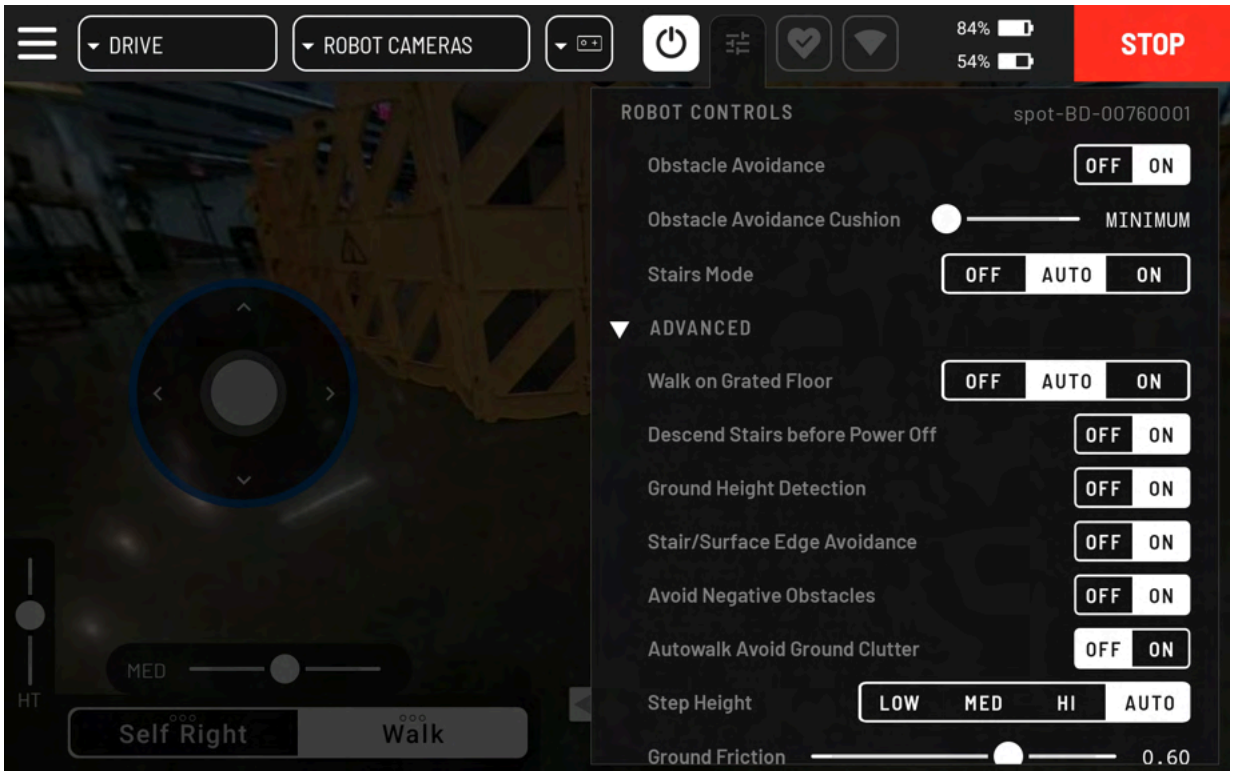
5.8.1.6. Motor Status panel



The Motor Status panel.

Control	Description
Motor Power	Turn Spot's motors on and off.
Lock or Unlock Drive Controls	Prevents accidental inputs that would cause Spot to move. Only affects your controller.
Take or Release Control	Control is required to issue drive commands to Spot. See also: Pair the tablet controller with Spot. **CAUTION** Taking control of Spot during operation does not require the permission of other operators and may cause disorientation or attempts to troubleshoot a surprising situation. Always carefully assess the situation and communicate with other operators before taking control of Spot.

5.8.1.7. Robot Controls panel

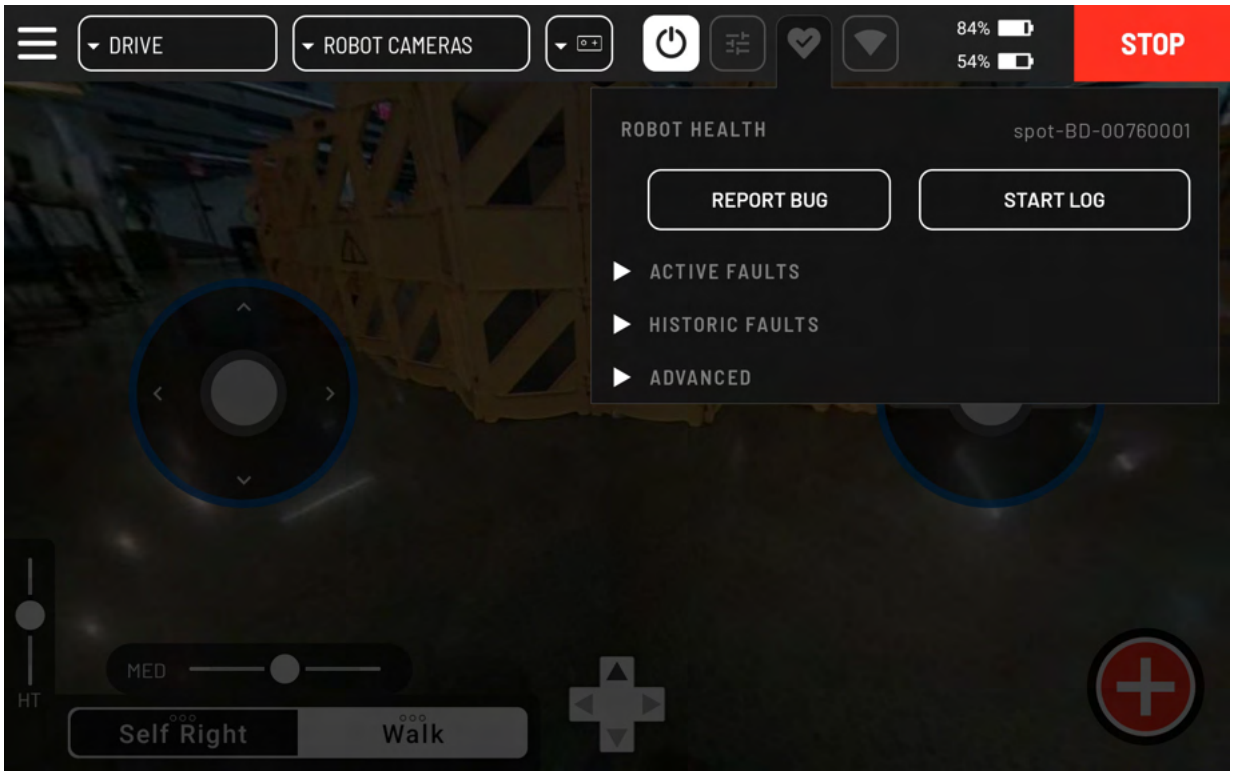


The Robot Controls panel.

Control	Description
Obstacle Avoidance	Turn Spot's obstacle avoidance system on and off. See also: Obstacle Avoidance. **CAUTION** Turning off obstacle avoidance will increase the likelihood of collisions with people and objects in the environment.
Obstacle Avoidance Cushion	Slide to adjust how much distance Spot will try to keep between itself and obstacles. See also: Obstacle Avoidance.
Stairs Mode	By default, Spot automatically detects stairs and adjusts its gait. Turning this on or off will force or prevent this behavior. See also: Locomotion and Navigate Stairs

Control	Description
Walk on Grated Floor	By default, Spot automatically detects grated floors and adjusts its perception system to more accurately model the ground surface. Turning this on or off will force or prevent this behavior.
Descend Stairs Before Power Off	Spot will automatically exit stairs in cases where it would otherwise attempt to sit, such as in the event of a communications loss, critically low battery power, or receiving a command to turn off motor power. The direction of travel will generally be to descend the stairs, unless Spot has already reached the top landing. See also: Locomotion and Navigate Stairs
Ground Height Detection	Helps Spot navigate over obstacles approximately 30 cm or less in height.
Stair/Surface Edge Avoidance	Prevents Spot from navigating too close to edges.
Avoid Negative Obstacles	Prevents Spot from stepping into pits, trenches, potholes, or other similar terrain.
Autowalk Avoid Ground Clutter	When replaying an Autowalk mission, makes Spot less willing to step on or over objects on the ground that were not present during recording.
Step Height	Control the height of Spot's step.
Ground Friction	Slide to adjust Spot's step height and speed to compensate for different surface types. Lower settings result in slower, smaller steps which may improve stability on slipperier surfaces.

5.8.1.8. Robot Health panel

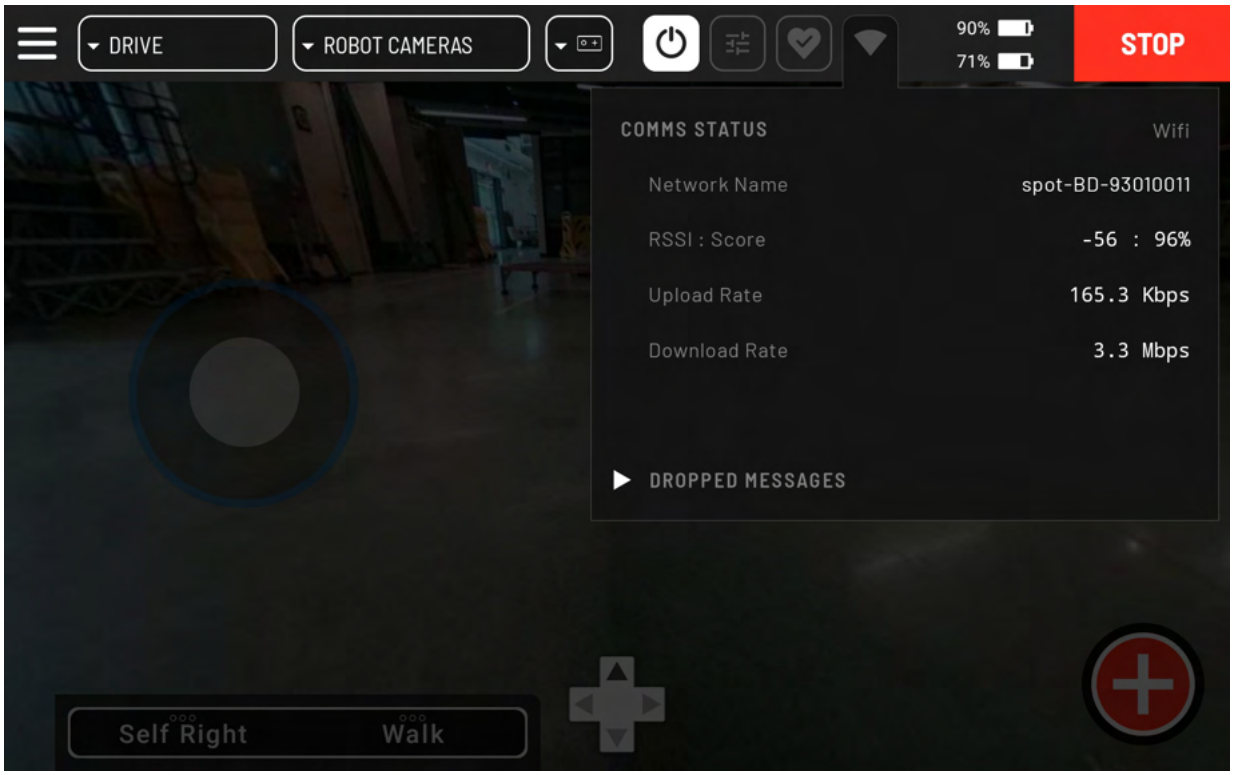


The Robot Health panel.

Control	Description
REPORT BUG	Generates a log entry including the previous 30 seconds of operational data. Use this option to quickly note that something unexpected happened.
START LOG[1]	Generates a log entry by recording up to 10 minutes of new operational data. Use this option to document repeatable issues that occur over time or require a specific sequence of steps to reproduce.

[1]Experiment logs require a continuous connection to the controller that initiated the log. If the connection is lost, the log recording will continue for up to 21 seconds before ending automatically.

5.8.1.9. Comms Status panel

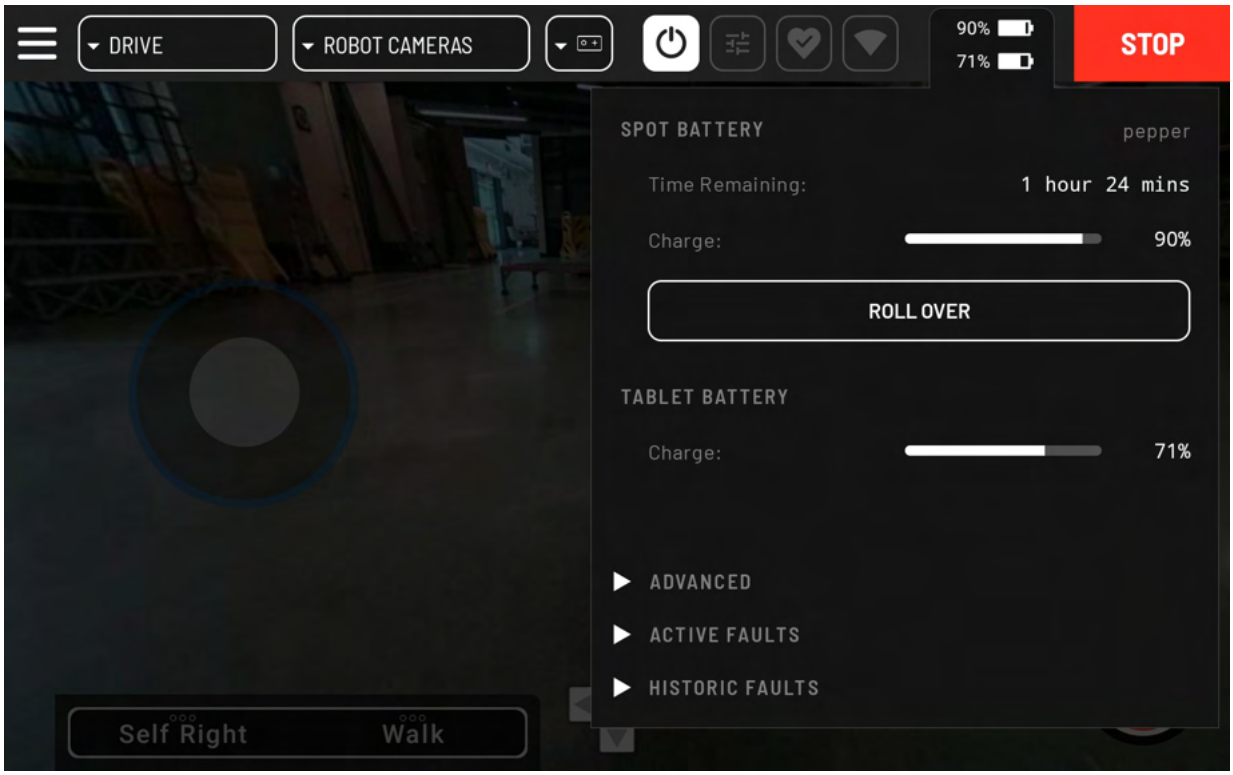


The Comms Status panel.

The Comms Status panel provides information about the network connection between the tablet controller and Spot.

> **NOTICE**
>
> The **Comms Status panel** icon will flash yellow to indicate a poor connection between the controller and Spot.

5.8.1.10. Battery Status panel



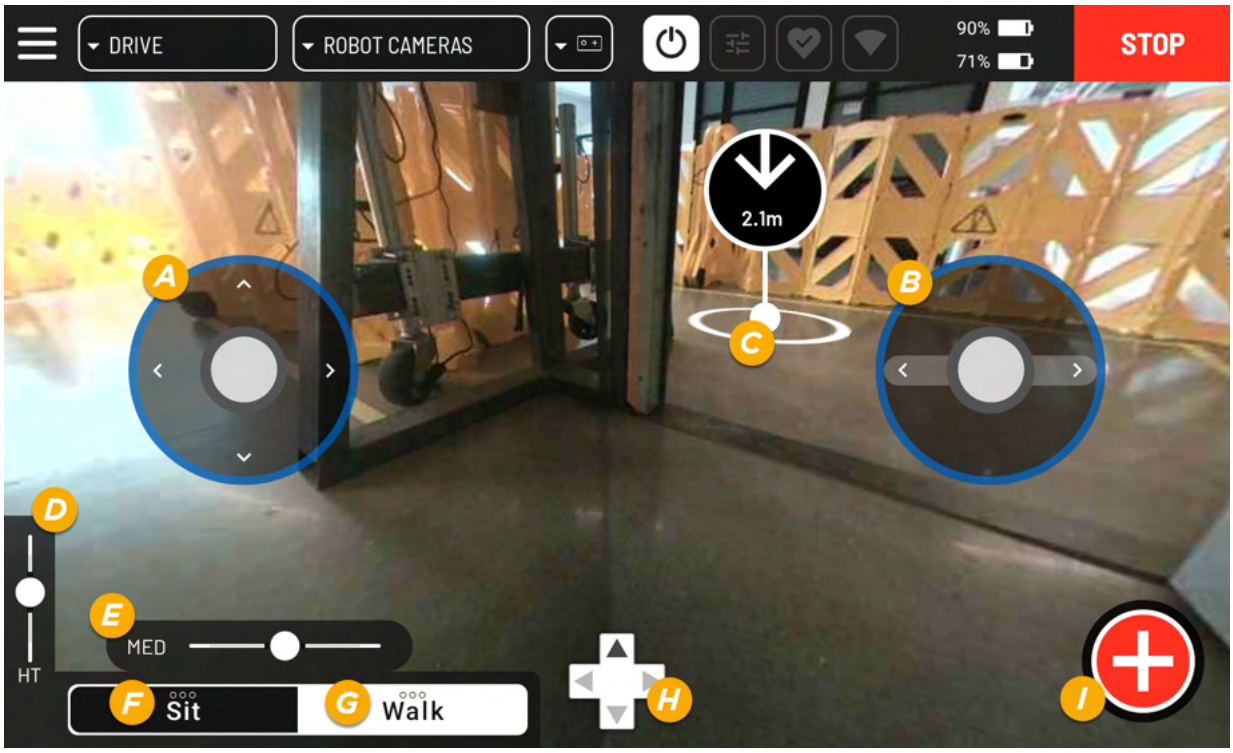
The Battery Status panel.

The Battery Status panel provides information about the state and performance of the Spot Battery.

5.8.2. Manual mode controls

The Spot App has two main modes for manual operation: Drive mode (general operation) and Autowalk mode (recording missions).

5.8.2.1. Drive mode

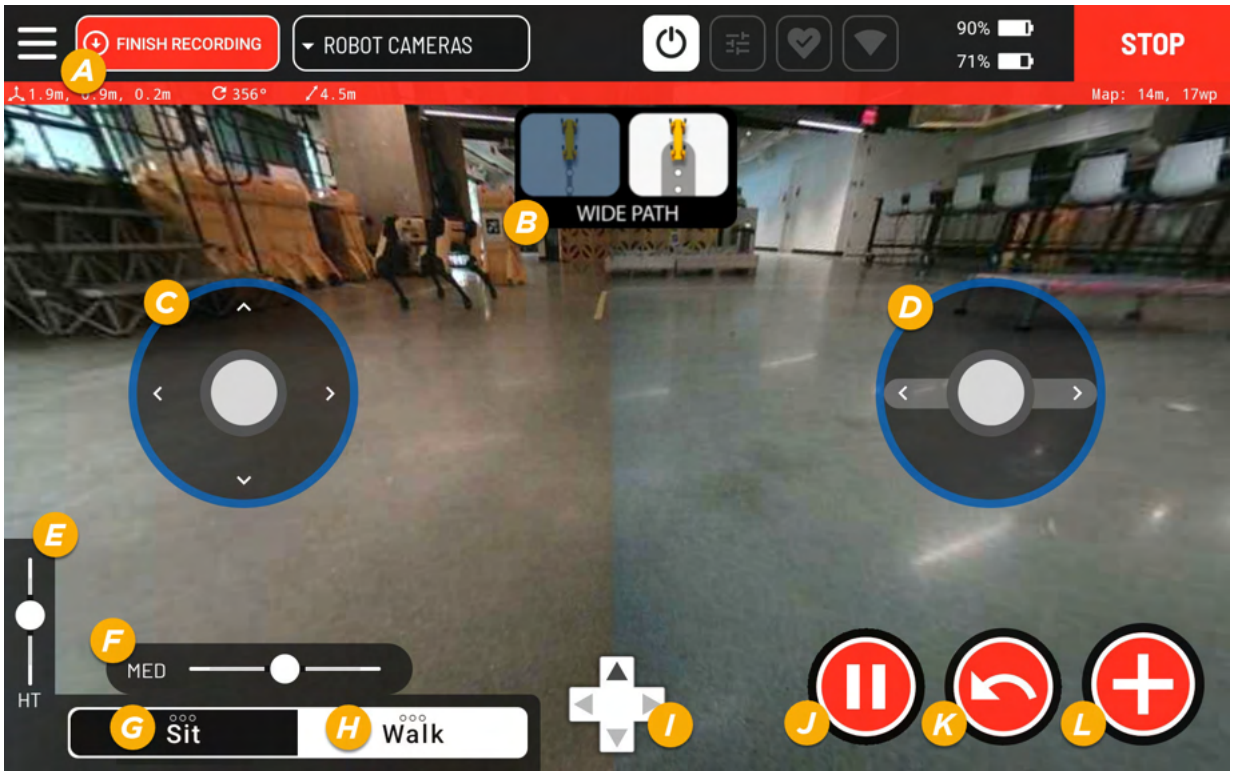


Spot App Drive mode controls.

Label	Control	Description
A	Left joystick	Move Spot forward, backward, left, and right.
B	Right joystick	Rotate Spot clockwise or counterclockwise.
C	Touch-to-Go	Spot will walk to the location you select. Select ⊗ to cancel.
D	Height slider	Adjust Spot's walking height.
E	Speed slider	Switch between three maximum speed settings (**SLOW**, **MED**, **FAST**).
F	Pose selector	Long-press, then select an option: • **Sit**: Spot lowers its body to the ground. • **Stand**: Spot stands in place. Joysticks control height, roll, pitch, and yaw. • **Self Right**: Spot attempts to reach a sitting position with its body flat on the ground, moving its legs and body as needed to flip or reorient itself. See ???TITLE???.
G	Gait selector	• Long-press, then select **Walk** (regular speed) or **Crawl** (slow speed) to enable movement controls.

Label	Control	Description
H	Directional arrows	Switch camera views.
I	Add Action	Perform programmable behaviors like capturing an image or docking with a Spot Dock.

5.8.2.2. Autowalk mode

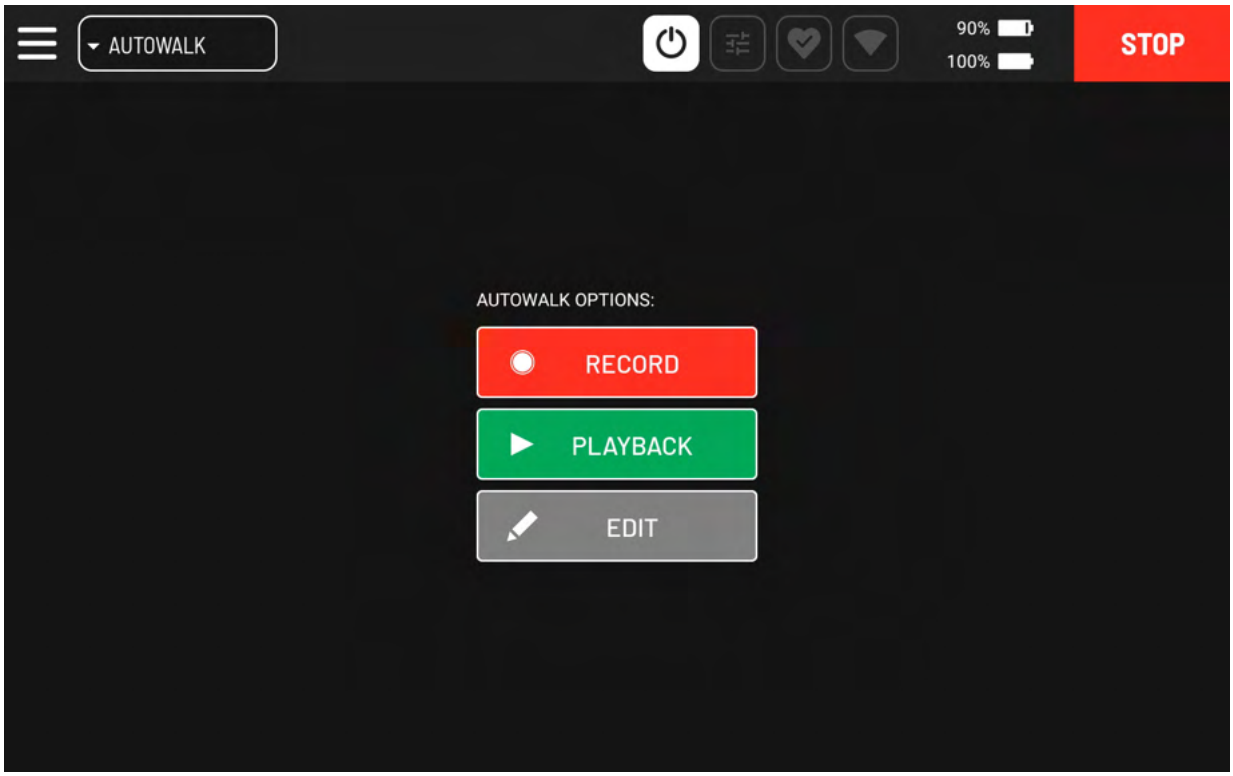


Spot App Autowalk mode controls.

Label	Control	Description
A	Finish recording	End recording and save the mission.
B	Path following tolerance	Determine how closely Spot should adhere to the recorded mission route on replay. This setting is recorded separately for each path segment. • **WIDE PATH** (default): Spot may deviate up to 3 meters from the recorded mission route to avoid obstacles. • **STRICT PATH**: Spot will adhere closely to the recorded mission route, keeping the center of its body within a 25 cm corridor along the recorded path.

Label	Control	Description
C	Left joystick	Move Spot forward, backward, left, and right.
D	Right joystick	Rotate Spot clockwise or counterclockwise.
E	Height slider	Adjust Spot's walking height.
F	Speed slider	Switch between three maximum speed settings (**SLOW**, **MED**, **FAST**).
G	Pose selector	Long-press, then select an option: • **Sit**: Spot lowers its body to the ground. • **Stand**: Spot stands in place. Joysticks control height, roll, pitch, and yaw. • **Self Right**: Spot attempts to reach a sitting position with its body flat on the ground, moving its legs and body as needed to flip or reorient itself. See ???TITLE???.
H	Gait selector	• Long-press, then select **Walk** (regular speed) or **Crawl** (slow speed) to enable movement controls.
I	Directional arrows	Switch camera views.
J	Pause	Pause the recording. This allows you to reposition Spot without recording duplicate paths. For details, see Record an Autowalk Mission.
K	Undo	Select-and-hold to undo recent activity. For details, see Record an Autowalk Mission.
L	Add Action	Perform programmable behaviors like capturing an image or docking with a Spot Dock.

5.8.3. Record an Autowalk Mission



The Autowalk menu in the Spot App.

Autowalk missions can be recorded manually using the Spot App. During recording, Spot creates a map of the route you drive and any actions you perform along the way.

NOTICE

Many incidental operations during recording, such as standing idle or switching camera views, are not included in the mission and will not be repeated by Spot during replay.

To start a mission recording, at least one fiducial marker must be placed in the operating environment.

To record an Autowalk mission:

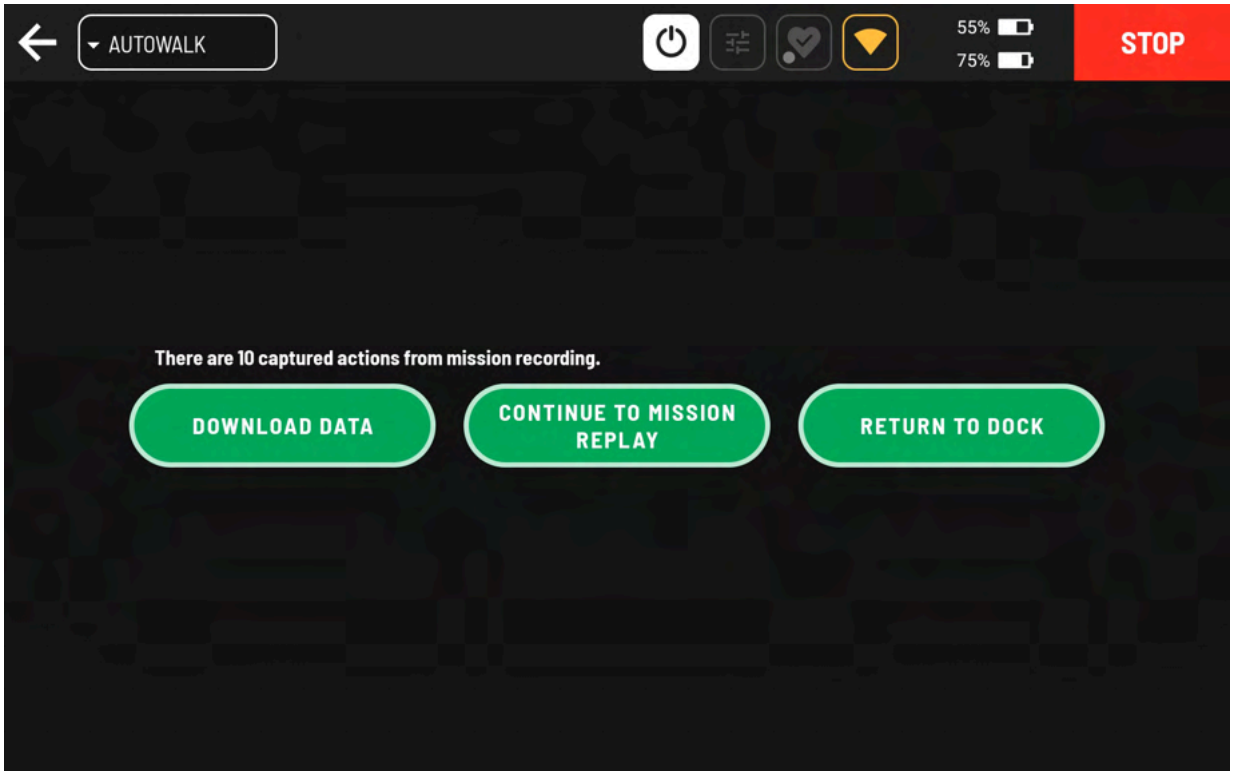
1. In the Spot App, open the Modes dropdown and select **AUTOWALK**.
2. Select **RECORD**.
3. Enter a name for the mission map, then select **CONTINUE**. If you leave this blank, it will be named with the date and time of recording.
4. Select **START RECORDING**.

5. Drive Spot and perform actions. See Manual mode controls.

> **NOTICE**
> To allow Spot to start and end the mission at a Spot Dock and recharge as needed during the mission, you must include one or more docking actions in the recording.

6. Select **FINISH RECORDING**, then select **YES**. The mission is stored on the controller.

After recording:



Post-recording options.

- Select **CONTINUE TO MISSION REPLAY** to validate the recorded route. Configure the mission to run on a loop with the appropriate settings (see Configure Autowalk Mission Replay Options), then observe as it plays repeatedly to confirm that Spot can reliably complete the route.
- Select **RETURN TO DOCK** to send Spot back to one of the docks you recorded.

> **NOTICE**
> **RETURN TO DOCK** will send Spot on a unique one-time mission with the sole goal of navigating to and docking with the dock you select. If the path to that dock is blocked, Spot will automatically reroute to another available dock.

- Select **DOWNLOAD DATA** to transfer data captured from actions or inspections during recording to the local memory on the tablet controller. You can then select **SIT & VIEW DATA** to exit the Spot App and view the data using the tablet's built-in file browser, for instance to confirm that the recorded inspections captured the data in the way you expected.

5.8.3.1. Add an Action during Autowalk recording

To add an Action to an Autowalk mission:

1. While recording an Autowalk mission, navigate Spot to the location where the action will be performed.

   NOTICE
   During mission replay, Spot's position and orientation may differ slightly from the way the action was recorded.

2. In the Spot App, select **Add Action**.
3. Select an option from the **INSPECTIONS** tab or the **ACTIONS** tab.
4. Follow any prompts to create the action. When complete, the action is added to the mission.

CAUTION
Actions may cause Spot or its payloads to move in ways that a bystander might not predict from observing normal locomotion, and that could cause collisions with objects in the environment. Ensure the location where the action is recorded will have sufficient clearances when the mission is replayed.

5.8.3.2. Add a dock during Autowalk recording

An Autowalk mission will contain every dock Spot interacts with during recording, including:

- The dock Spot started on, if the recording began while Spot was docked.
- Any dock Spot docks with during the mission, if you use the **Add Dock to Mission** action.
- The dock Spot ends the mission on, if you use the **Dock & Finish Recording** action to end the recording.

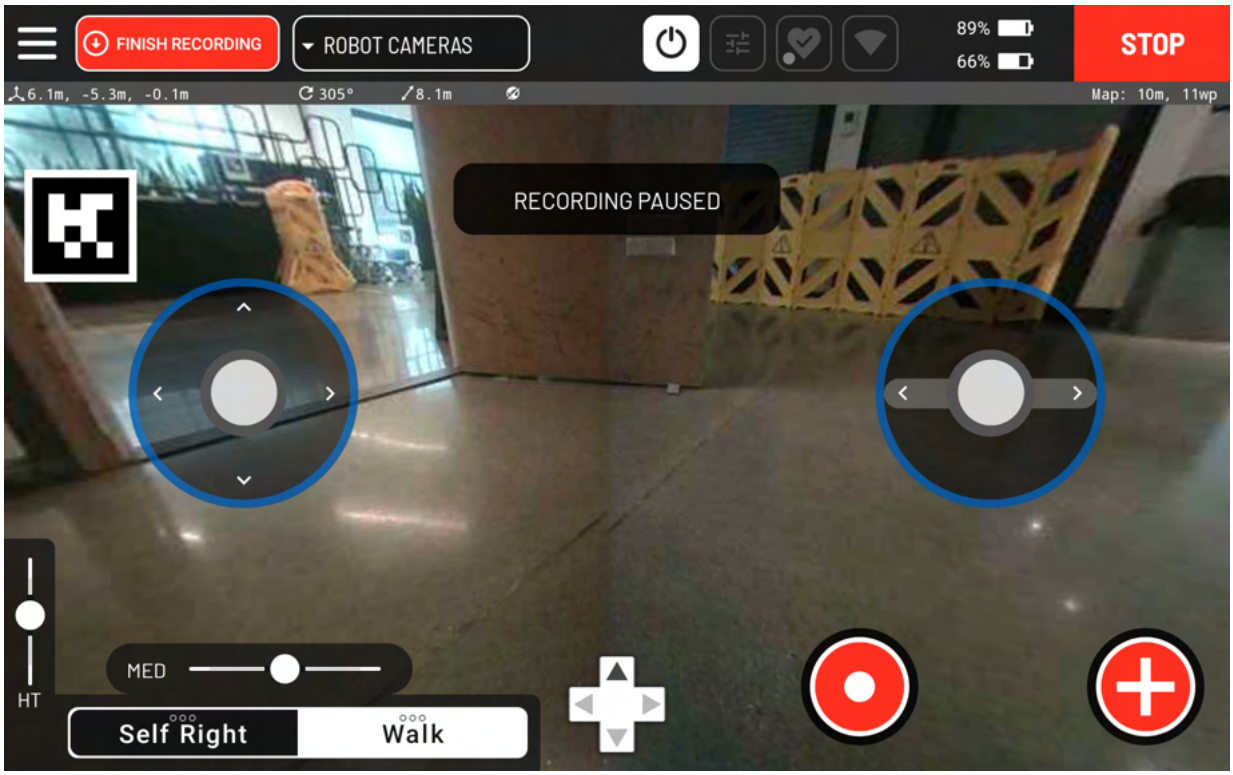
You can include any number of docks in a mission, but each dock can be recorded only once per mission. Adding more than one dock provides Spot with options for where to start or end the mission, and where to recharge if its battery runs low when replaying the mission.

See Dock and Undock Spot for details of the docking behavior.

When you select Add Dock to Mission:

1. Spot will automatically dock on the selected dock, and then undock. This allows Spot to record the navigational data it will need to begin or continue a mission replay from that dock.
2. When Spot finishes undocking, the mission recording will be paused. Select **Record** to continue.

5.8.3.3. Pause and resume during recording

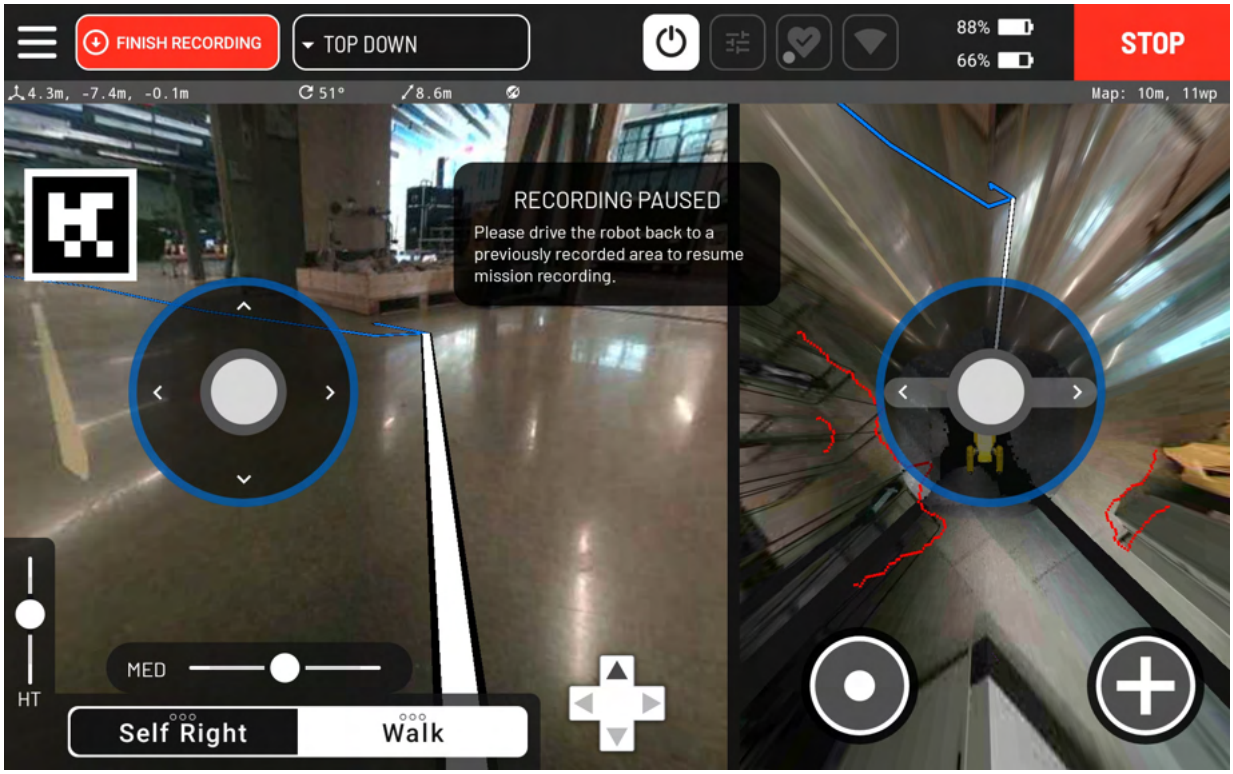


An Autowalk recording session that has been paused.

Select **Pause** at any time to pause a recording session. Press **Record** to resume.

When a recording is paused, you can reposition Spot or backtrack along the mission route without creating new path segments or duplicating previously recorded paths.

To resume the recording, Spot must be positioned along a previously recorded path segment. If Spot is too far from the recorded path, a white line will appear indicating the approximate direction Spot needs to move before recording can resume.

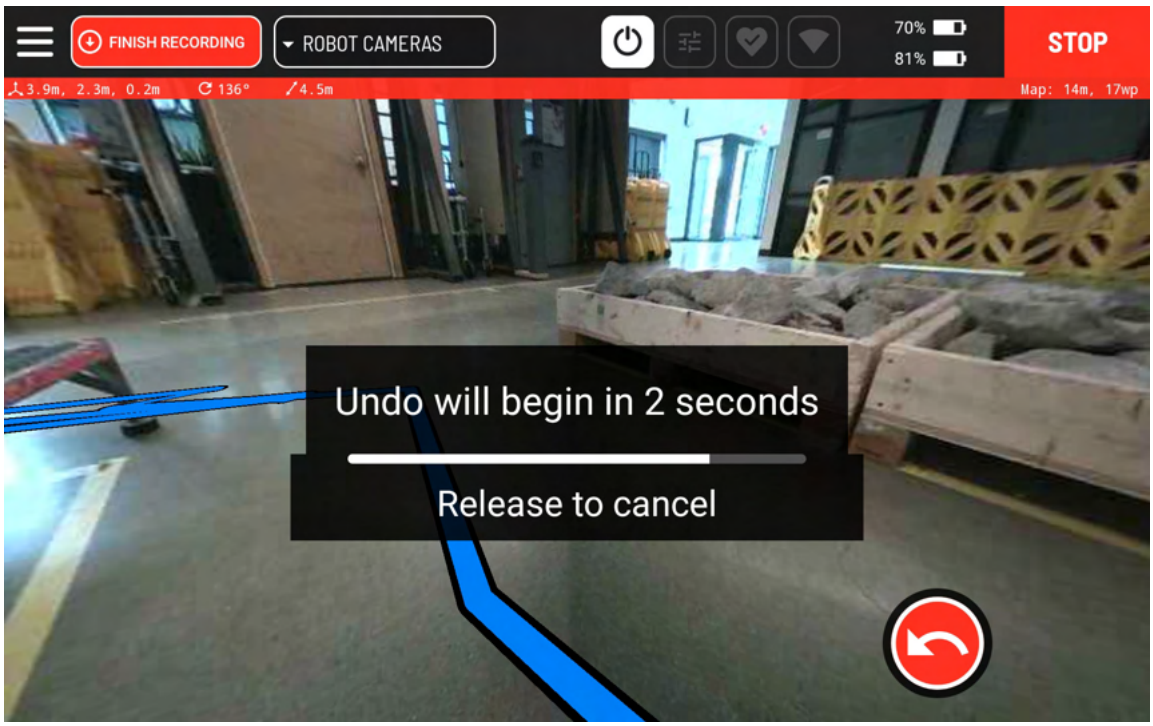


A paused recording session that cannot resume from Spot's current location.

5.8.3.4. Undo during Autowalk recording

To undo part of an Autowalk recording:

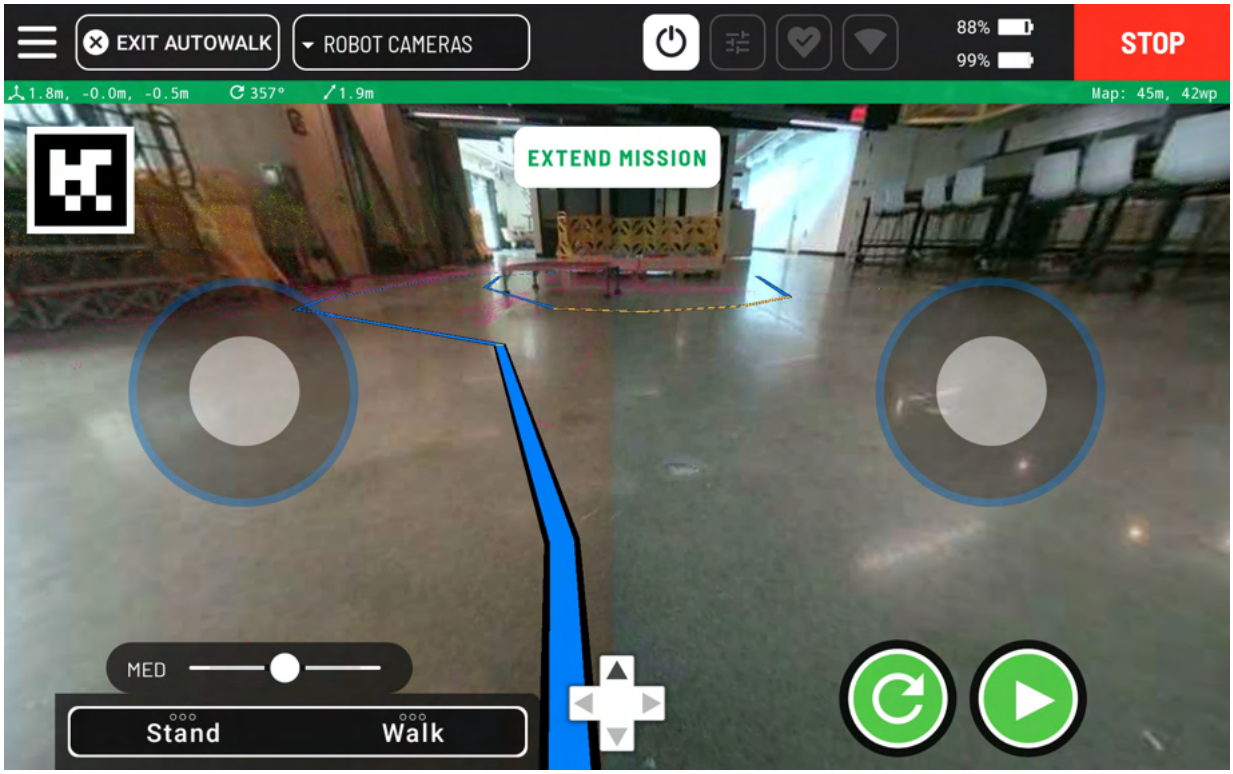
1. While recording or extending an Autowalk mission, tap-and-hold ↶ **Undo**. A 2-second timer will appear before undo begins.



2. Continue to hold ↶ **Undo** while Spot backtracks along the mission route. At any location where an action was recorded, another 2-second timer will appear before the action is deleted.
3. Release ↶ **Undo** to finalize the process. Spot will position itself at the closest waypoint in the mission map. All path segments that were added to the current recording past that point will be deleted.

> **NOTICE**
>
> Undo is not reversible.
>
> Undo can only affect path segments and actions that were added during the current recording session.
>
> Undo cannot remove a dock from the recording. It is not possible to undo past the point at which a dock was added.

5.8.4. Extend an Autowalk Mission



Pausing an Autowalk mission replay reveals the option to extend the mission.

Extending an Autowalk mission adds new path segments and Actions to a previously recorded mission map. Use this to create complex missions with branching paths and loops.

To extend a previously recorded Autowalk mission:

1. Replay the mission as described in Replay an Autowalk mission.
2. Select **Pause** at the point where you want to extend the mission route.
3. Select **EXTEND MISSION**.

4. When prompted, select **EXTEND MISSION**.
5. Drive Spot and perform Actions.
6. Select **FINISH RECORDING**, then select **YES**. The extension is added to the mission and the replay ends.

5.8.4.1. Add an Action to a previously recorded Autowalk mission

Actions can be added to Autowalk missions along paths you have previously recorded.

To add an Action to a previously recorded Autowalk mission:

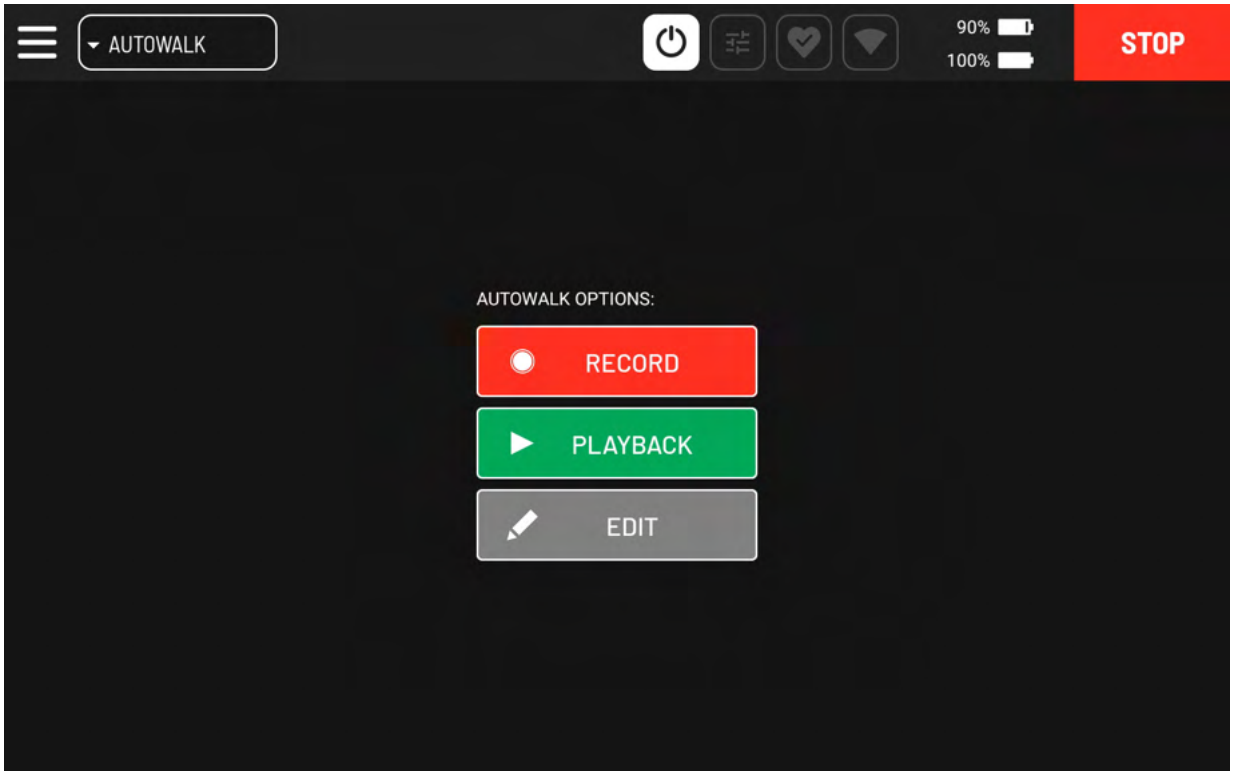
1. Replay the mission as described in Replay an Autowalk mission.
2. Select **Pause** at the point where you want to extend the mission route.
3. Select **EXTEND MISSION**.
4. When prompted, select **ADD ACTION**.
5. Follow any prompts to create the Action. When complete, the Action is added to the mission.
6. To resume the mission replay, select **Play**. To end the replay, select **EXIT AUTOWALK**.

5.9. Automatic operation

During automatic operation, Spot follows the route set by a pre-recorded Autowalk mission, performs Actions, and attempts to resolve navigation challenges according to mission replay settings.

5.9.1. Replay an Autowalk mission

Autowalk missions can be replayed from the Spot App immediately, or scheduled to play later. Missions can also be configured to run once or on a loop.



The Autowalk main screen.

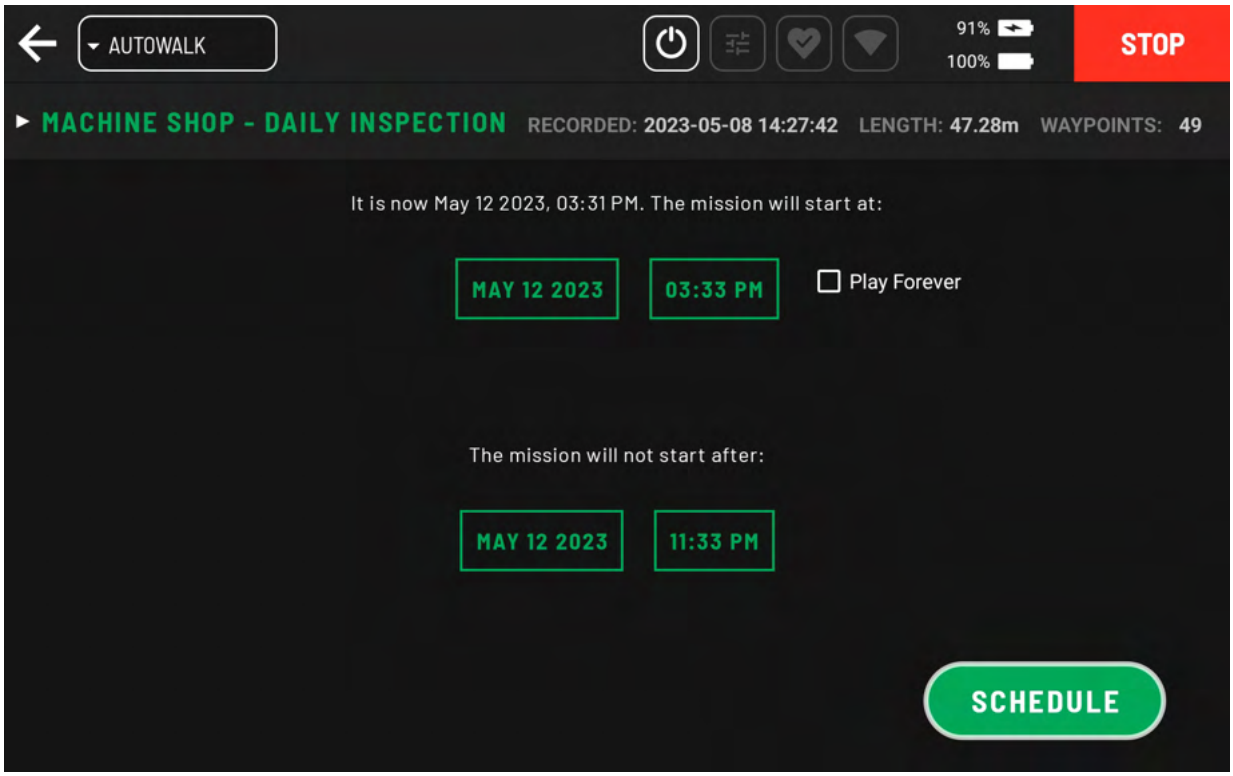
5.9.1.1. Play now

To replay a mission now:

1. If the mission includes one or more Spot Docks, ensure Spot is on one of the included docks. Otherwise, ensure Spot is within sight of at least one fiducial that was recognized during mission recording.
2. In the Spot App, open the Modes dropdown and select **AUTOWALK**.
3. Select **PLAYBACK**.
4. Select a mission to replay, then select **CONTINUE**.
5. Confirm action and route parameters, then select **CONTINUE** and confirm mission replay options. For details on these settings, see Configure Autowalk Mission Replay Options.
6. Check the Supervision setting. For details, see .
7. When finished, select **PLAY NOW**.
8. If prompted, select **INITIALIZE**.
9. Select **Play**. Spot carries out the mission.

5.9.1.2. Play later

To be eligible for scheduling, a mission must include at least one Spot Dock.



Scheduling an Autowalk mission.

To schedule a mission to play later:

1. Ensure Spot is on a Spot Dock that is included in the mission.

2. Select and configure the mission as described previously. When finished, select **PLAY LATER**.
3. Enter the date and time when the mission will begin. If the mission is configured to loop, enter an end time or select **Play forever**.
4. Select **SCHEDULE**.
5. A countdown to the next scheduled mission start appears. At the scheduled time, Spot carries out the mission.

> **NOTICE**
> The tablet controller must remain on and connected to Spot via the Spot App to launch the mission.

To cancel a scheduled mission:

1. Select **CANCEL MISSION**.
2. Select **EXIT AUTOWALK** to exit Autowalk mode.

5.9.1.3. Pause and resume

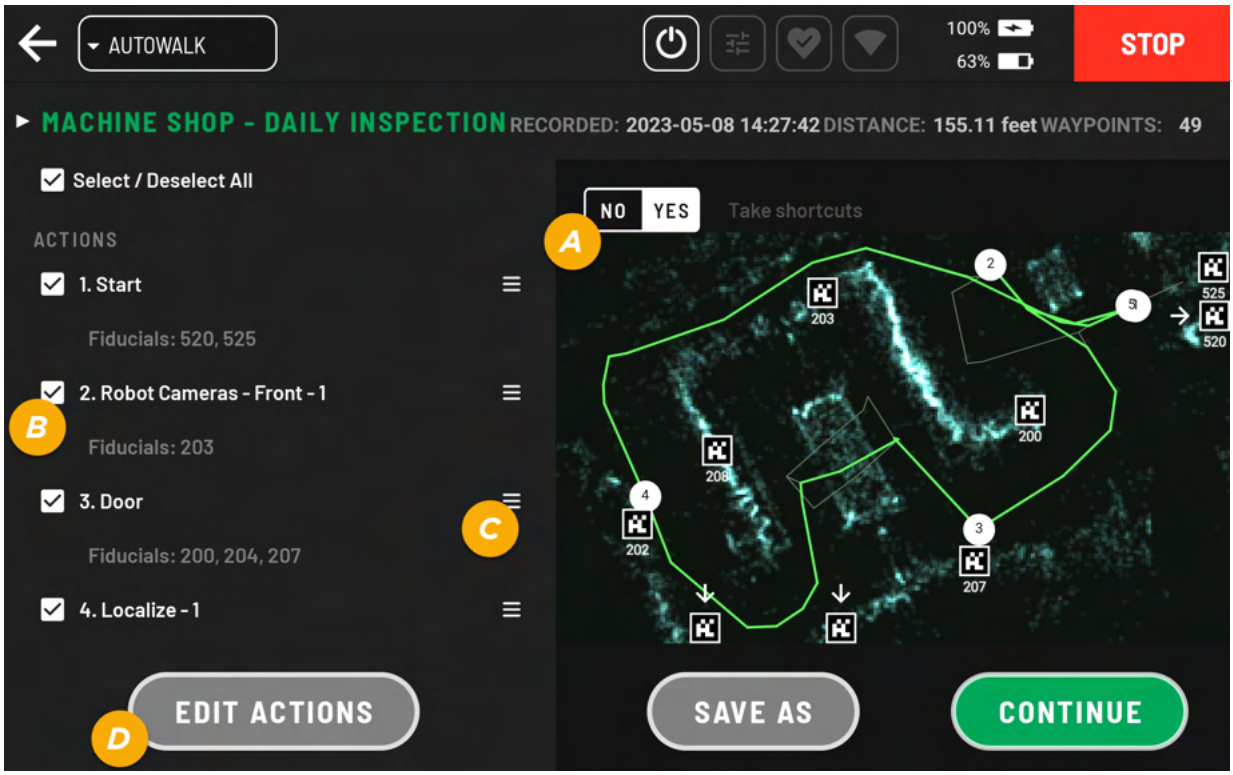
At any time during mission replay, select **Pause** to pause the mission and switch Spot to manual control. The Spot App will remain in Autowalk mode.

To resume the mission, select **Play**.

5.9.2. Configure Autowalk Mission Replay Options

Mission replay options modify Spot's behavior as it carries out an Autowalk mission. Options are configured in the Spot App at the time playback is initiated.

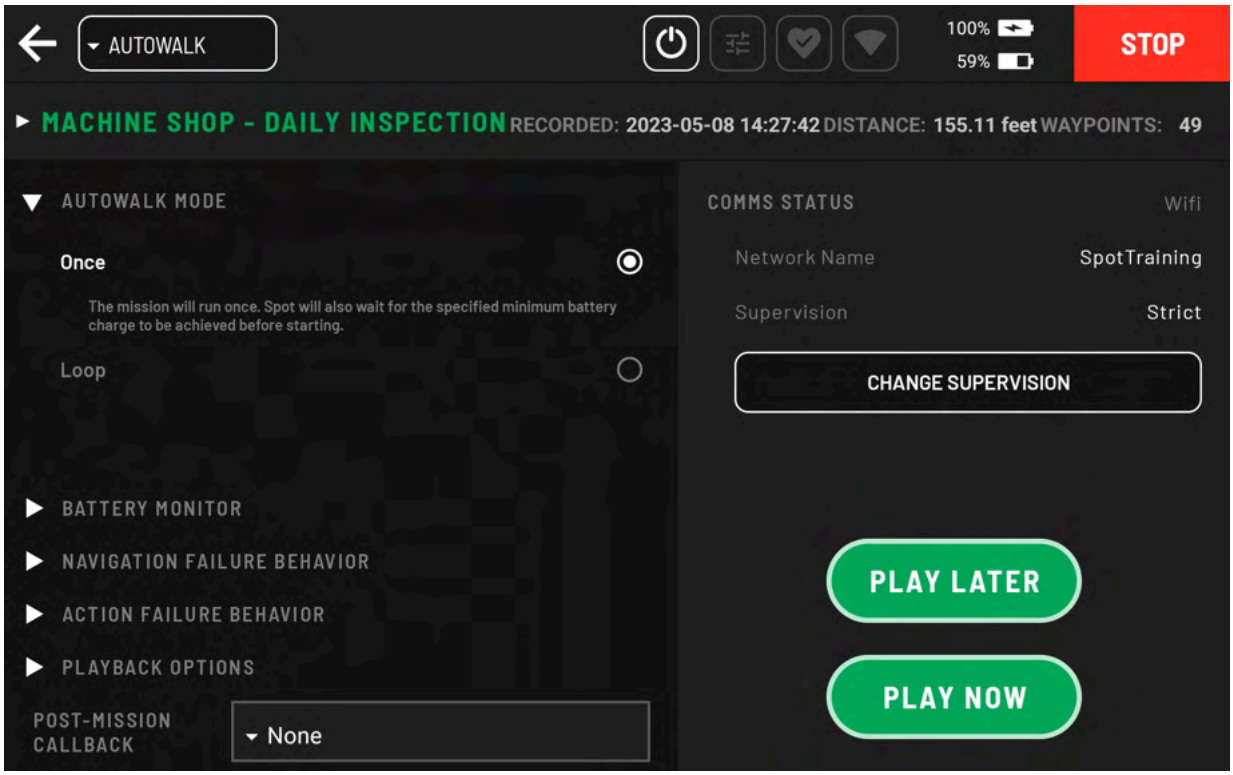
5.9.2.1. Mission route settings



Autowalk mission route preview.

Label	Control	Description
A	Take shortcuts	To use the most efficient mission route that includes all enabled actions, set **Take shortcuts** to **YES**. Otherwise, Spot will follow the mission route as recorded.
B	Enable/Disable Actions	To enable or disable an action, toggle its checkbox. Disabled actions will be skipped during replay.
C	Re-order Actions	Drag-and-drop to change the order in which actions will be performed. This may cause Spot to backtrack along the mission route.
D	Edit Actions	If an action includes parameters that can be edited after recording, select **EDIT ACTIONS** to modify those settings.

5.9.2.2. Mission replay options



Autowalk mission replay options.

LOOP BEHAVIOR

Option	Description
Once	The mission will run once.
Loop	The mission will run repeatedly at the specified time interval.

DOCKING BEHAVIOR

Option	Description
Minimum charge for undocking	If Spot is docked, it will not start or resume a mission until the minimum charge is reached.
Charge to return to dock	During a mission, if the battery charge drops below this level, Spot will return to the nearest dock included in the mission map. When the battery reaches the **Minimum charge for undocking**, Spot will automatically resume the mission. **NOTICE** **Charge to return to dock** should always be set significantly lower than **Minimum charge for undocking**. It is possible to configure these two settings in ways that cause Spot to recharge too frequently or not at all.

NAVIGATION FAILURE BEHAVIOR

Option	Description
Prompt timeout	If no operator responds to the prompt within the allotted time, the mission will continue automatically. See also: Mission Prompts and Operator Intervention
Retry count	When a prompt times out, Spot will attempt navigation again until it either succeeds or reaches the specified retry limit.
Navigation failure behavior	When there are no more retries, Spot will perform the specified operation.

ACTION FAILURE BEHAVIOR

Option	Description
Prompt timeout	If no operator responds to the prompt within the allotted time, the mission will continue automatically. See also: Mission Prompts and Operator Intervention
Retry count	When a prompt times out, Spot will attempt navigation again until it either succeeds or reaches the specified retry limit.
Navigation failure behavior	When there are no more retries, Spot will perform the specified operation.

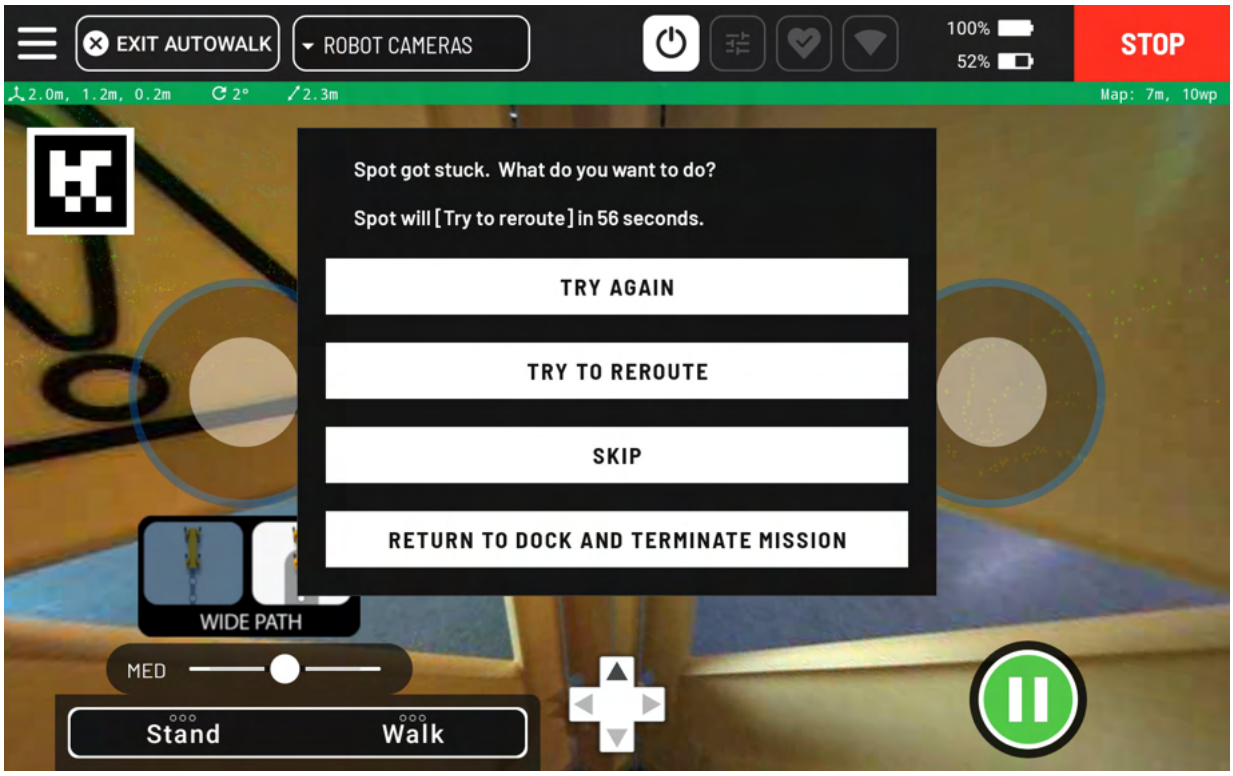
PLAYBACK OPTIONS

Option	Description
Replace Actions with short sleeps	Spot will walk the mission route, but no actions will be performed. Useful for confirming Spot's ability to navigate the mission route, and when extending previously recorded missions.
Force strict path following	If checked, Spot will attempt to follow the recorded path exactly without navigating around obstacles, even for parts of the mission route where wide path following was enabled during recording.
Path Planner	The range that Spot uses to navigate around obstacles can be increased to allow Spot to navigate around large obstacles that were not present during Autowalk mission recording. • **Short range (default)** – The path planner will use data within 2 meters of Spot. Spot can deviate 1.5 meters from the mission route if its path is blocked. • **Long range (use live data only)** – The path planner will use data within 8 meters of Spot. Spot can deviate 3 meters from the mission route if its path is blocked. This option is best for dynamic environments where obstacles may change frequently. • **Long range (use live and recorded data)** – The path planner will use data within 8 meters of Spot and will also attempt to predict and fill in areas of the map Spot has not seen yet based on the recorded map. Spot can deviate 3 meters from the mission route if its path is blocked. This option is best for static environments that are unlikely to change.
Patience	If people or other obstacles are blocking the mission route, Spot will wait for the specified interval before attempting to reroute.
Force ground clutter avoidance	If checked, Spot will attempt to detect and avoid low obstacles during playback, unless the objects were stepped on during mission recording. If unchecked, Spot may step on or over low obstacles.
Goal distance	Spot will perform each action when it is within the specified distance of the location where the action was recorded. Increase the distance if Spot frequently gets stuck trying to reach the action location and the action doesn't require precise positioning.
Self-right attempts	When Spot falls, it can autonomously self-right. To prevent Spot from falling repeatedly, you can cap the number of times this happens. See also: Mission Prompts and Operator Intervention

5.9.3. Mission Prompts and Operator Intervention

Spot may prompt you for input during automatic operation, for instance to respond to a navigation challenge which is preventing it from progressing in a mission.

If you don't respond to the prompt, Spot will abort or continue the mission according to the mission replay options. Prompt timeouts and Spot's behavior if no input is received are configurable as described in Configure Autowalk Mission Replay Options.



Autowalk mission prompt asking for Spot App operator input.

Mission prompt response	Description
TRY AGAIN	Spot will attempt to continue along the mission route. If the obstacle has been removed, the mission will continue as recorded.
TRY TO REROUTE	Spot will attempt to compute an alternate path to the next Action based on the recorded mission route. If successful, Spot will continue the mission.
SKIP	Spot will skip the next Action and attempt to continue the mission by performing any subsequent Actions.
RETURN TO DOCK AND TERMINATE MISSION	Spot will immediately return to the nearest dock and abort the mission.

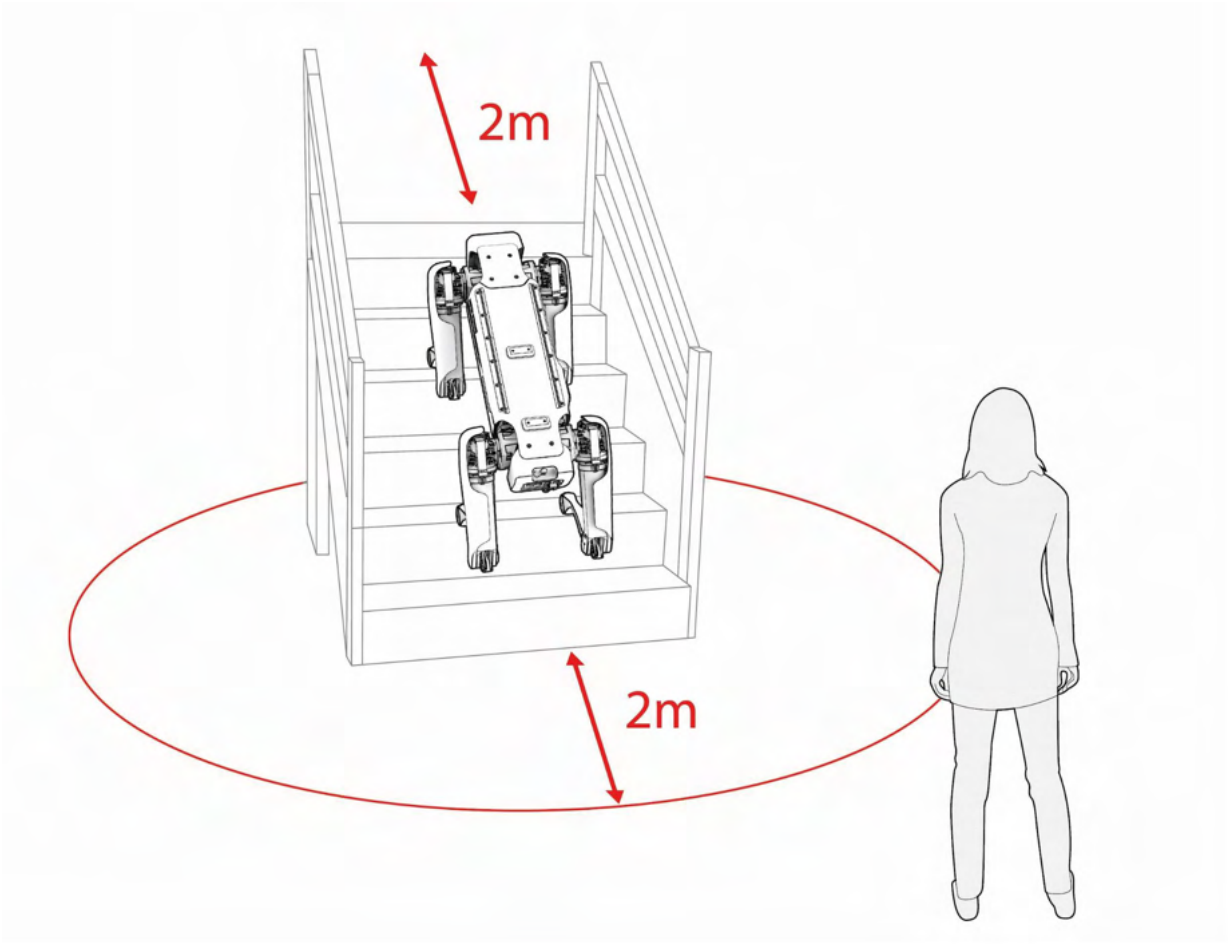
5.10. Navigate Stairs

Stairs are very particular environments that can be shared by both Spot and humans. Staircases are always associated with fall hazards and residual risks. You must review the layout and restrict access

to areas with stairs as much as practically possible when preparing your site for Spot operations, and mark the areas with visual signs.

When manually controlling Spot on stairs or recording an Autowalk mission that includes stairs, follow these guidelines:

1. To climb stairs, position Spot at the base of the staircase, and push the Left joystick forward to walk Spot straight up the stairs.
2. To descend stairs, always operate Spot in reverse, pushing the Left joystick backward so that Spot descends rear-first.



Stair safety.

The following conditions and/or actions are critical for safe stairway navigation and must be checked whether manually controlling Spot or recording/replaying an Autowalk mission:

- Grated stairs, open-riser stairs, or partially transparent stairways pose significant perception challenges during stair locomotion.
- Spot should always descend stairs rear-first.

DANGER

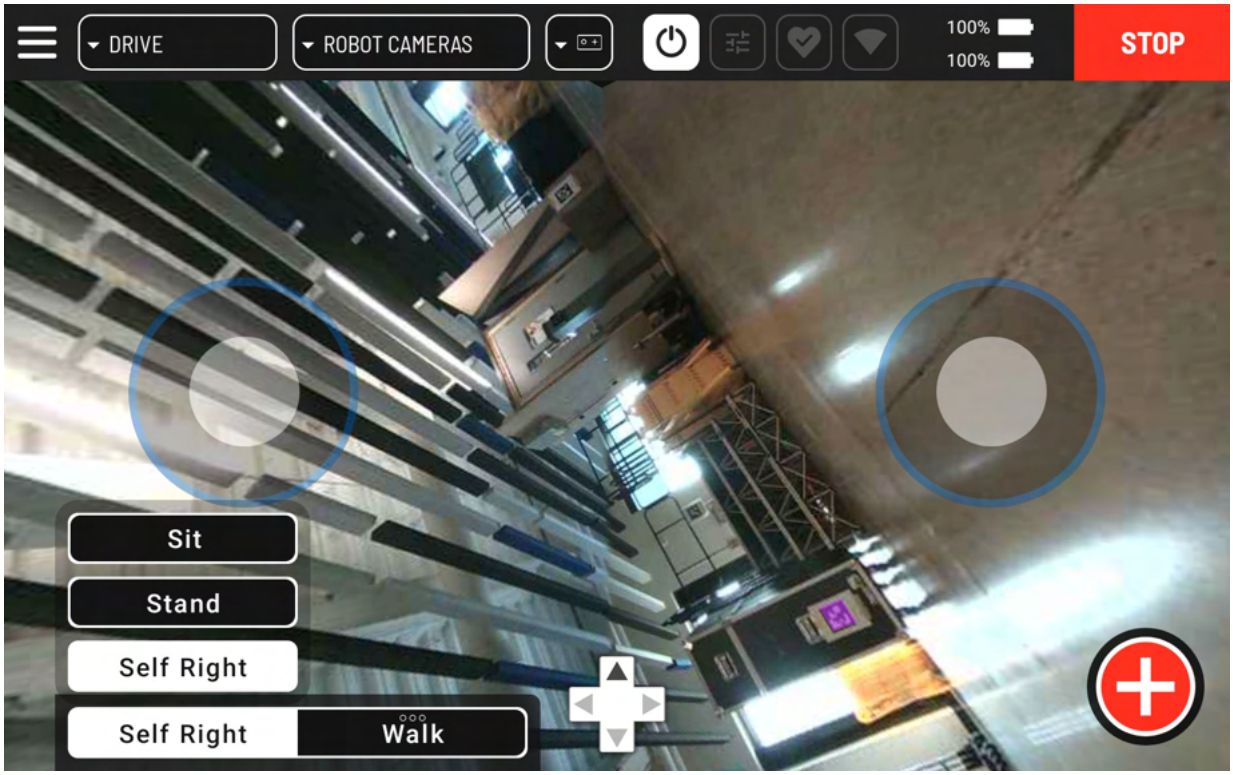
Spot could fall from stairs and cause personal injuries or material hazards.

Do not stand beneath or downhill of Spot when it is on an elevated surface, such as a staircase or elevated platform. Stay at least 2 meters away from the bottom of any staircase or incline where Spot is active.

When manually controlling Spot or recording an Autowalk mission:

- Position yourself at the top or 2 meters away from the bottom of the staircase before driving Spot onto the stairs.
- Do not follow Spot up the stairs until it has come to a standstill on a flat landing with sufficient clearance.
- Avoid turning Spot on stairs. Wait for Spot to reach a complete landing and secured zone before turning.
- Do not attempt to command Spot to climb or descend stairs by side-stepping.

5.11. Self Right



The Self Right command in the Spot App.

The semi-automatic Self Right behavior helps Spot shift into the "sit" position when it is lying on its side or back. You may be prompted to use this feature if Spot is lying on its side or back when you command Spot to stand or perform behaviors that require standing.

To command Spot to self-right:

1. Confirm there is at least 1 meter of clear space around Spot.
2. In the Spot App, long-press on the Pose selector and then select **Self Right**. Spot will begin moving immediately.

> **NOTICE**
>
> If you instead try a command that requires Spot to stand, you will see a screen that reports the fault `Robot has fallen`. This is the expected message whenever Spot is lying on its back or side.
>
> Select **CLEAR FAULTS AND SELF-RIGHT** to continue.

3. Spot will move its legs and body as needed to flip or reorient itself. This may include fully extending one of its front legs, rolling any or all of its legs at the hip, and other movements. Wait for Spot to come to a complete stop before selecting additional commands.

> **CAUTION**
>
> On uneven, sloped, or loose terrain, self-right could destabilize Spot or cause the surface underneath Spot to shift in ways that lead to instability. Use this feature only when Spot is resting stably on a level surface.

5.12. Recover From a Fall

Under nominal environmental conditions and proper operation of Spot, falls are rare. When a fall does occur, the following steps are recommended to assess the situation and safely resume operation.

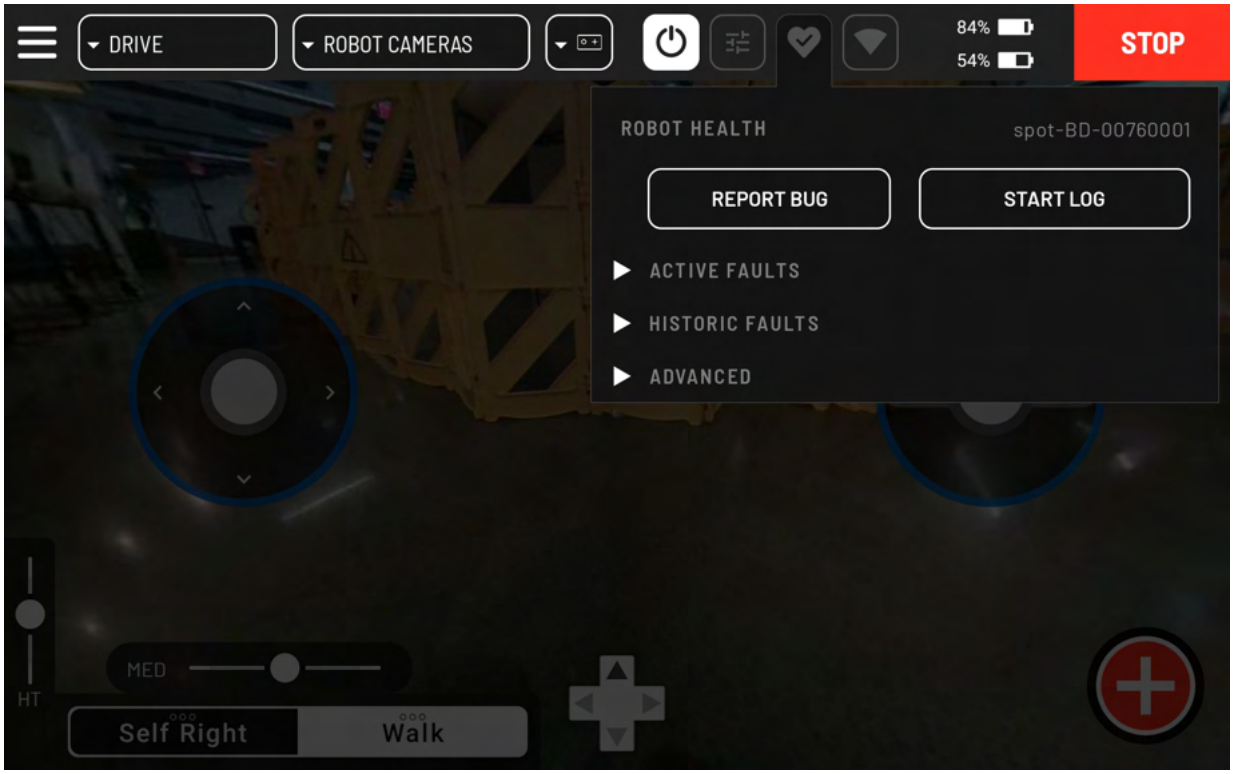
> **WARNING**
>
> Before recovery, perform a risk assessment of any conditions in the environment which may have contributed to the fall and/or could potentially make Spot fall again.

To help Spot recover from a fall during remote controlled or manual operation:

1. Wait for Spot to come to a complete stop.
2. Check for visible damage to Spot's legs, actuators, battery, and battery compartment. If any of these components appear damaged, cease operation immediately and contact Boston Dynamics support. If Spot is only cosmetically damaged or appears undamaged, continue with this procedure.
3. If Spot is resting stably on a level surface:
   a. Clear a 1-meter radius around Spot.
   b. Follow the instructions in Stop and Restart Spot's Motors.
   c. Activate Self Right as described in Self Right.

4. If Spot is not resting stably on a level surface or if Spot fails to self-right:
    a. Press the motor lockout button.
    b. Move Spot by hand so it is resting stably on a level surface in the “sit” position.
    c. Reset the motor lockout as described in Start Spot.
    d. Follow the instructions in Stop and Restart Spot's Motors.
5. As you resume operation, watch for erratic or unexpected behavior that could indicate damage. If you suspect Spot is damaged, cease operation immediately and contact Boston Dynamics Support.

5.13. Create a Log Entry with the Tablet Controller



Creating a log entry during Spot operation.

If you experience unexpected behavior from Spot, an attachment, or related software, you can create a log entry to help Boston Dynamics Support diagnose and address the issue.

Log type	Description
Bug Report	Generates a log entry including the previous 30 seconds of operational data. Use this option to quickly note that something unexpected happened.

Log type	Description
Experiment Log[1]	Generates a log entry by recording up to 10 minutes of new operational data. Use this option to document repeatable issues that occur over time or require a specific sequence of steps to reproduce.

[1]Experiment logs require a continuous connection to the controller that initiated the log. If the connection is lost, the log recording will continue for up to 21 seconds before ending automatically.

To create a bug report:

1. In the Spot App, open the ❤ **Robot Health panel** and select **REPORT BUG**. The resulting log will include the previous 30 seconds of operational data.
2. A message will appear with details about the new log entry and how to transmit it to Boston Dynamics for analysis. To continue Spot operation, select **Dismiss**.

To generate an experiment log:

1. In the Spot App, open the ❤ **Robot Health panel** and select **START LOG**.
2. Recreate the sequence of events that produced the unexpected behavior.
3. Re-open the ❤ **Robot Health panel** and select **STOP LOG**.
4. A message will appear with details about the new log entry and how to transmit it to Boston Dynamics for analysis. To continue Spot operation, select **Dismiss**.

NOTICE

Depending on Spot's network configuration and other settings, logs may be automatically uploaded to Boston Dynamics. You can also download logs to your own device from the Admin Console (see Admin Console).

5.14. Turn Off Spot

When you are finished operating Spot, return it to a Spot Dock as described in Dock and Undock Spot or follow the procedure below.

To turn off Spot:

1. Drive Spot to a charging, storage, or transport location. Drive Spot instead of carrying it whenever possible.
2. Sit Spot.
3. Open the ⏻ **Motor Status panel** and toggle **Motor Power** to **OFF**.
4. Press Spot's motor lockout button. This will set the motor lockout.
5. Power off Spot by pressing and holding the power button for 2 seconds.
6. In the Spot App on the tablet controller, open the ≡ **Menu** and select **DISCONNECT**, then select **SIGN OUT**.

7. Connect Spot to the Spot Power Supply to charge the battery in the robot, or remove the battery and charge it with the Spot Power Supply.

> **NOTICE**
> Always remove the battery when Spot is not in use unless Spot is connected to the Spot Power Supply or sitting on a powered Spot Dock. Batteries left in Spot while not in use will continue to discharge, even when Spot is powered off. Batteries left in a powered off robot for more than 24 hours may be damaged beyond repair.

5.15. Recommended practices during Spot operation

When you are near Spot during robot operations, observe the following precautions:

- Stay at least 2 meters away from Spot at all times.
- Always give Spot the right of way, especially during automatic operation.
- Do not stand beneath or downhill of Spot when it is on an elevated surface, such as a staircase or elevated platform. Stay at least 2 meters away from the bottom of any staircase or incline where Spot is active.
- Do not enter a staircase where Spot is active. If Spot enters a staircase you are already using, exit the staircase and stay at least 2 meters away until Spot has exited the staircase.
- Do not enter confined spaces where Spot is active, such as hallways, if you cannot stay at least 2 meters away while passing or avoiding Spot.
- Do not touch, move, power off, or otherwise interact with Spot when you are not operating it, even if Spot appears inactive.
- Do not move, alter, damage, or block fiducials.
- Do not intentionally block mission paths, place objects in Spot's way, or otherwise alter the operating environment in ways that deliberately interfere with robot operation.

6. Maintenance

6.1. Service and repair

Do not attempt to service or repair Spot yourself. If errors or other issues persist during robot operation, Spot may need attention from Boston Dynamics Support engineers. Include the following information when contacting Support:

- Spot serial number
- Description of the issue

To contact Boston Dynamics Support, visit: https://support.bostondynamics.com/s/contactsupport.

6.2. Clean and Maintain Spot

Spot requires regular cleaning and basic preventive maintenance.

While conducting cleaning or maintenance operations, always follow safe handling guidance as described in Safe Handling.

DANGER

Damage or ingress of foreign objects to charging ports and connectors may result in electrical hazards. Do not operate Spot or plug in any electrical equipment to Spot if there is visible damage or foreign objects are present.

CAUTION

- Dirty or damaged camera windows may impair Spot's obstacle detection and navigation capabilities, and may prevent remote operators from assessing the condition of the environment around Spot. Do not operate Spot if cameras are obscured or damaged.
- Damage to Spot's legs or ingress of foreign objects to Spot's joints may result in unpredictable motion and falls. Do not operate Spot if legs are damaged or foreign objects have infiltrated Spot's joints.
- Worn foot treads may result in an increased chance of slips and falls, especially on low-friction surfaces. Regularly inspect Spot's foot treads and replace any that show excessive wear.
- Turn Spot off before touching it or performing maintenance inspections.

6.2.1. Exterior cleaning

When cleaning Spot's exterior:

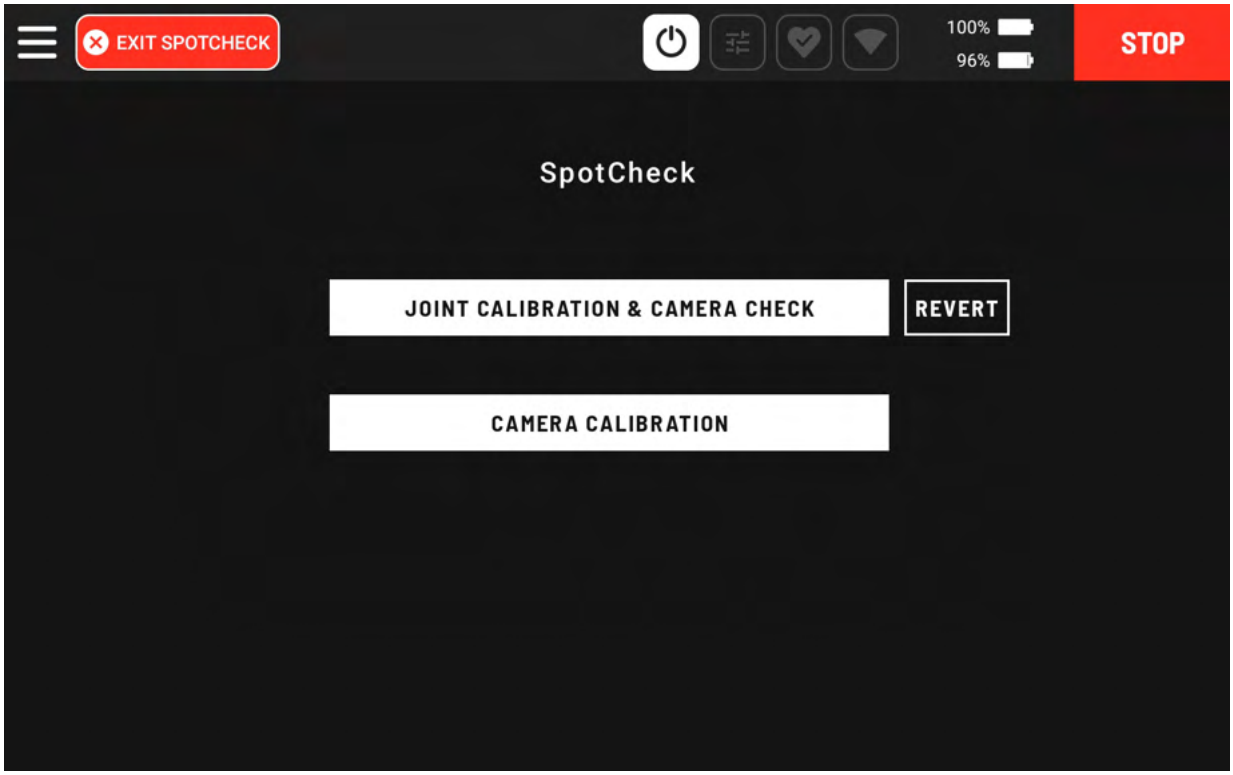
- Use a non-abrasive cloth dampened with glass cleaner to clean camera windows. If highly abrasive particles are present, remove them with an anti-static soft lens brush before wiping the windows.
- Use a magic eraser or a mild detergent to clean superficial scuffs on Spot's body or leg panels.
- Do not use bleach.
- Do not use strong solvents.
- Do not submerge Spot. Spot is resistant to light sprays of water but should not be sprayed forcibly with water jets or submerged in water. Submerging Spot will permanently damage it.
- Consider ordering new body panels if they become overly damaged/scuffed.

6.2.2. Preventive maintenance

Performing monthly inspections for Spot will help to identify preventive maintenance items for successful and safe operation. For example, if Spot's cooling fans are clogged with dirt, an overheating fault may be generated and Spot may not be safe for operation.

If any damage is found during periodic inspection, contact Boston Dynamics Support.

6.3. SpotCheck (Joint and Camera Calibration)



The SpotCheck menu.

SpotCheck is a set of self-diagnostic routines that can correct calibration issues with Spot's leg joints and body cameras. Calibration issues may occur after Spot falls or as a result of normal usage over time.

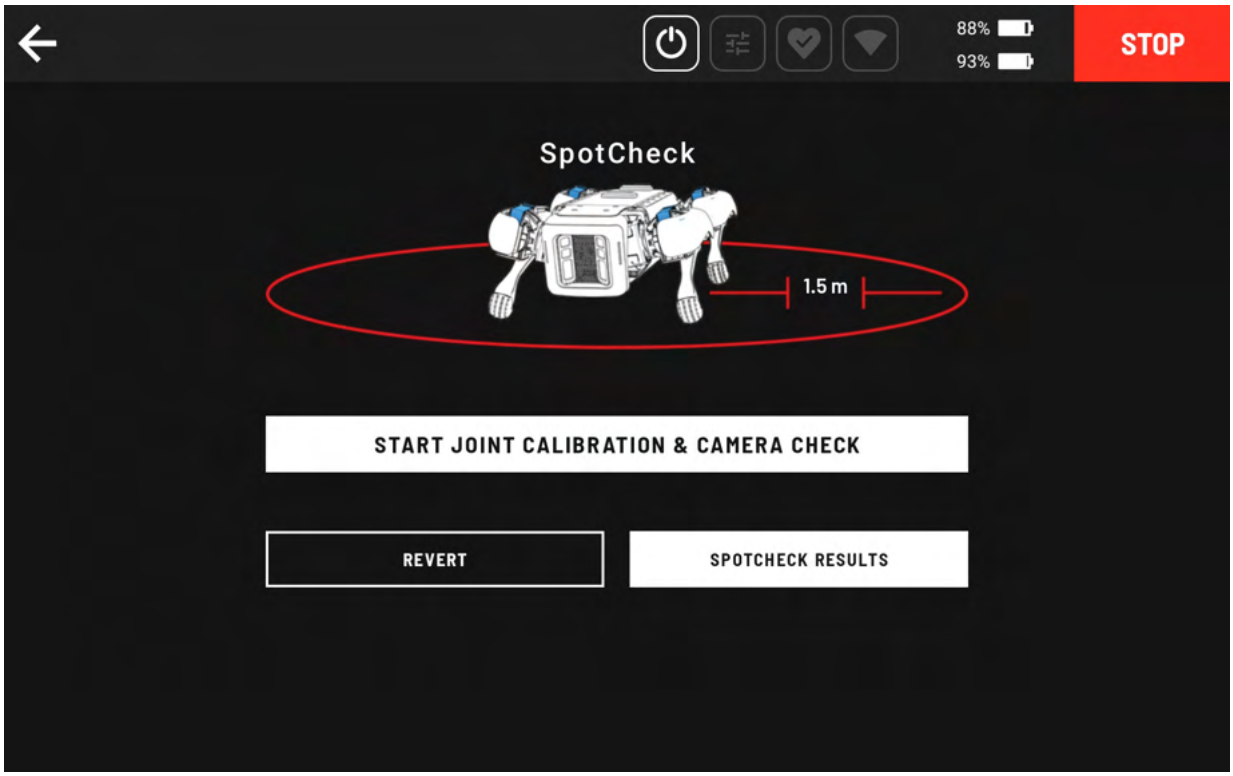
SpotCheck routine	Description	Indications	When to run
Joint calibration and camera check	• Tests and recalibrates the load cell sensor for hip and knee joints. • Tests and recalibrates the joint position sensor for hips and knees. • Checks body cameras to identify potential issues that may require camera calibration.	Problems with Spot's gait, such as unexpected stumbling or limping.	Every 30 days (as measured in robot operational time, not calendar days) or whenever Spot exhibits signs of joint or camera calibration issues. **NOTICE** After 30 days of operational time without joint recalibration, Spot will display a fault that can only be cleared by running a joint calibration and camera check.
Camera calibration[1]	• Recalibrates each of Spot's body cameras.	Problems with Spot's obstacle detection, such as unexpected failure to avoid obstacles.	When indicated by the results of a joint calibration and camera check.

[1]Requires the camera calibration panel that is shipped with Spot.

CAUTION

Poor calibration of Spot's joints and/or cameras increases the likelihood of falls, collisions, and other hazards. Run SpotCheck diagnostics promptly when calibration issues are indicated, and on the preventive schedule recommended by Boston Dynamics.

6.3.1. Joint Calibration and Camera Check



Starting a joint calibration and camera check in the Spot App.

Joint calibration and camera diagnostics are sensitive processes that require careful setup in a suitable environment including:

- Flat, manufactured, non-reflective floor.

  NOTICE
  Outdoor environments may not be flat enough for this procedure.

- No objects within a 1.5-meter radius around Spot.
- No bright lights, including overhead lights and windows with direct or bright indirect sunlight.

NOTICE
Misconfigured attachments may result in poor joint calibration values. Before running joint calibration, check that attachments are affixed securely and correctly configured.

This process takes 2 to 3 minutes.

To recalibrate Spot's leg joints and identify potential calibration issues with Spot's body cameras:

1. Start with Spot in the Sit pose.
2. In the Spot App, navigate to ≡ **Menu** > **UTILITIES** > **SPOTCHECK**.
3. Select **JOINT CALIBRATION & CAMERA CHECK**.
4. Confirm that the environment is suitable, and then select **START JOINT CALIBRATION & CAMERA CHECK**.
5. Wait for Spot to complete the recalibration process.

> **CAUTION**
>
> During recalibration, movement controls are disabled. Spot will automatically stand up and move its legs and body, but will not walk around.
>
> To stop this process and power off Spot's motors, select **ABORT**. Calibration will revert to previous values.

6. When recalibration is complete, Spot will sit and power off motors. Results of the calibration process and camera check will be displayed in the Spot App.
7. If the camera check detects any performance issues, run camera calibration.

6.3.1.1. Revert to Previous Joint Calibration

In rare cases, joint calibration may result in degraded performance. This may be the result of running the calibration in an unsuitable environment, or an indication of mechanical failures that cannot be fixed via calibration.

To allow you to revert an incorrect calibration, Spot stores the previous joint calibration as a backup.

To revert Spot to the previous joint calibration:

1. In the Spot App, navigate to ≡ **Menu** > **UTILITIES** > **SPOTCHECK**.
2. Select **REVERT**. Spot will power off its motors.
3. Wait for the previous calibration to be applied.

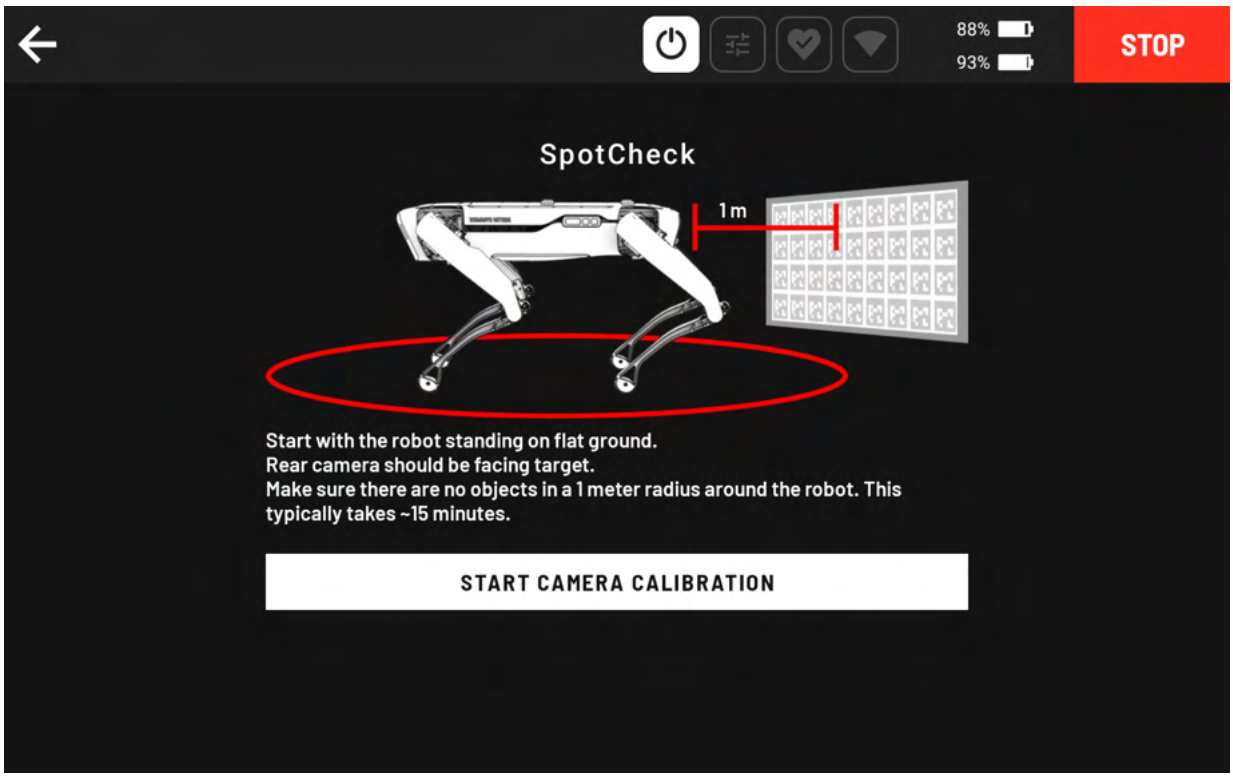
After reverting, attempt joint calibration again in a more suitable environment. If performance issues persist, contact Boston Dynamics Support.

> **NOTICE**
>
> Spot only stores a backup of the last joint calibration it ran. Earlier calibrations are deleted. Always test the results of joint calibration by observing Spot's performance before running additional calibrations.

6.3.2. Camera Calibration

CAUTION

Running camera calibration when it is not needed may cause or exacerbate camera calibration issues that can significantly degrade Spot's performance. Run camera calibration only when prompted by the results of a joint calibration and camera check.



Starting a camera calibration in the Spot App.

Camera calibration is a sensitive process that requires careful setup in a suitable environment including:

- Flat, manufactured, non-reflective floor.

  NOTICE

  Outdoor environments may not be flat enough for this procedure.

- No objects within a 1.5-meter radius around Spot.
- No bright lights, including overhead lights and windows with direct or bright indirect sunlight.

Camera calibration requires the calibration panel that is shipped with Spot. The calibration panel is a flat board approximately 118.5 cm x 50 cm that shows a set of 18 fiducials spaced evenly on a black background and a pair of arrows labeled "Up".

NOTICE

Folds, creases, or damage to the camera calibration panel can cause the calibration operation to fail or produce unexpected results. Do not store or use the panel in a way that would cause it to warp over time.

This process takes about 15 minutes.

To recalibrate Spot's body cameras:

1. Position the calibration panel.
   - The panel may be mounted vertically with the bottom edge no more than 5 cm from the floor, or leaned against a support within 5 degrees of vertical.
   - The arrows must point up.
   - The panel must be adequately and evenly lit throughout the calibration process, with no glare.
   - No other calibration panel should be visible to Spot.
2. Perform a visual inspection to confirm that Spot's body cameras are undamaged and unobstructed, and to wipe the lenses clean.

   CAUTION

   While conducting cleaning or maintenance operations, always follow safe handling guidance as described in Safe Handling.
3. Position Spot in the Stand pose about 1 meter in front of the panel, with the rear body camera directly facing the panel.
4. In the Spot App, navigate to ≡ **Menu** > **UTILITIES** > **SPOTCHECK**.
5. Select **CAMERA CALIBRATION**.
6. Confirm that the environment is suitable, then select **START CAMERA CALIBRATION**.
7. Wait for Spot to complete the recalibration process.

   CAUTION

   During camera recalibration, movement controls are disabled. Spot will automatically reposition itself to view the calibration panel at various angles, but will not leave the area immediately in front of the calibration panel.

   To stop this process and power off Spot's motors, select **ABORT**. Calibration will revert to previous values.
8. When recalibration is complete, Spot will sit and power off motors. Results of the calibration process will be displayed in the Spot App.

Camera calibration provides small corrections to camera misalignments. It will not repair physical damage to cameras or mitigate network connectivity or latency issues with camera feeds. If performance issues persist after recalibration, contact Boston Dynamics Support.

6.3.3. SpotCheck with Spot Arm

For Spot with Spot Arm, the joint calibration and camera check will additionally:

- Open and close the gripper several times to recalibrate it.
- Move the arm through several positions to check that joint sensors are working properly.

CAUTION

During SpotCheck, the arm will fully extend above and to the front and side of Spot. Ensure 2 meters of clearance around and above the robot before beginning this process.

NOTICE

SpotCheck does not check or recalibrate the gripper camera.

7. Declarations and marking

7.1. EU Declaration of Conformity

This is a copy of the signed document prepared in accordance with Machinery Directive 2006/42/EC, Annex II 1-A and supplied separately.

Manufacturer
Boston Dynamics, Inc. 200 Smith Street Waltham, MA 02451 USA

Person authorised to compile the Technical File, established in the Community
Alura Group BV Kroonwiel 2 6003 BT Weert The Netherlands

Description and designation of the machinery		
Description and identification of the machinery		
Product and function: Legged robot (multiple-axes machine that uses articulated limbs for locomotion) intended for professional use of its locomotion and carrying capabilities in either industrial, restricted, or supervised environments.		
Designation		
Spot	Model (P/N): 04-00143531-001 04-00143531-401 04-00143531-601 04-00143531-611	s/n: BD-33390001 or higher

For a full description of intended use and limitations, see Intended use.

For a full description of scope and validity of the conditions when Spot is assembled with attachments, see Integrate attachments.

Declarations
It is declared that the above product, for what is supplied, fulfills all the relevant provisions of the following directives, according to which the product is CE marked: Machinery Directive 2006/42/EC as amended (“MD”), EMC Directive 2014/30/EU as amended ("EMCD"), Radio Equipment Directive 2014/53/EU as amended ("RED"). It is declared that the relevant technical documentation has been compiled in accordance with Part A of Annex VII of the MD.
Harmonized Standards Used, as referred to in: MD: EN ISO 12100:2010, EN 60204-1:2018, EN IEC 62133-2:2017, EN IEC 60825-1:2014/A11:2020 EMCD: EN 61000-6-4:2007/A1:2011, EN 61000-6-2:2005/AC:2005 RED: ETSI EN 301 489-1 V2.2.3 (2019-11), ETSI EN 301 489-17 V3.2.4 (2020-09), EN 55032:2012
This declaration of conformity is issued under the sole responsibility of the manufacturer.

Authorised Representative
Jason P. Fiorillo, Chief Legal Officer
Waltham, MA (USA) Jan 9, 2024

7.2. Labels

The following labels and nameplates appear on Spot. Labels are located inside the battery compartment and are visible before installation.

The year of production is the first digit of the serial number (S/N) following “BD-”. For instance, the serial number BD-3####### indicates a Spot produced in 2023.

Spot nameplate and label.

8. Appendix A: Supplemental information

Additional information and resources about Spot are available online at the following URLs:

Resource	Section	URL
Spot Power Supply Information for Use	2.9.2.1 4.3.3	https://support.bostondynamics.com/s/spot-product-safety
Spot Dock Information for Use	2.9.2.1 4.3.3 4.4 5.7	https://support.bostondynamics.com/s/spot-product-safety
Spot Arm Information for Use	4.2.1	https://support.bostondynamics.com/s/spot-product-safety
Prepare Your Site for Spot Operation	2.9	https://support.bostondynamics.com/s/article/Prepare-Your-Site-for-Spot-Operation-49914
Payload Developer Guide	4.2	https://dev.bostondynamics.com/docs/payload/readme
Electrical Interface	2.5 4.2	https://dev.bostondynamics.com/docs/payload/robot_electrical_interface.html
Prepare Your Network for Spot	4.6	https://support.bostondynamics.com/s/article/Spot-Network-Configuration-49943
Spot Controller Configurations	5.2.1	https://support.bostondynamics.com/s/article/Spot-Controller-Configurations-72071
About the Spot Industrial Inspection Package	5.2	https://support.bostondynamics.com/s/article/About-the-Spot-Industrial-Inspection-Package-72008
Orbit Administration and Settings	5.2 5.9.1 5.9.2	https://support.bostondynamics.com/s/article/Orbit-Administration-and-Settings-71290
Orbit Operator controls	5.3 5.8.2	https://support.bostondynamics.com/s/article/Orbit-Operator-Controls-71298

Resource	Section	URL
Upload Autowalk Data to Orbit	5.9.1	https://support.bostondynamics.com/s/article/Upload-Autowalk-Data-to-Orbit-49967
Run Autowalk Missions with Orbit	5.9.1 5.9.2 5.9.3	https://support.bostondynamics.com/s/article/Run-Autowalk-Missions-With-Orbit-72050
What Is Autowalk?	5.5 5.8.2 5.8.3 5.9	https://support.bostondynamics.com/s/article/What-Is-Autowalk-49934
Extend an Autowalk Mission	5.8.4	https://support.bostondynamics.com/s/article/Extend-an-Autowalk-Mission-78579
Configure Autowalk Mission Replay Options	5.9.2	https://support.bostondynamics.com/s/article/Configure-Autowalk-Mission-Replay-Options-49958
How to Record Optimal Autowalk Routes	5.8.3 5.8.4 5.9.2	https://support.bostondynamics.com/s/article/How-to-Record-Optimal-Autowalk-Routes-121348
Spot Robot Logs	5.13	https://support.bostondynamics.com/s/article/Spot-Robot-Logs-74250
Spot Battery Shipping Guidance	3.3.1	https://support.bostondynamics.com/s/article/Spot-Battery-Shipping-Guidance-49921

9. Appendix B: Use of low-level API control

Spot includes an API (Application Programming Interface) through which third-party applications can control Spot, read sensor information, and communicate between Spot and attachments (see dev.bostondynamics.com).

The API makes it possible to develop your own software for operating Spot, instead of using software provided by Boston Dynamics. Use of certain API commands requires additional Spot software licenses (joint-level control, choreography).

Some API commands or combinations of commands involve low-level control of the joints and/or coordinated full-body movements beyond the range of Spot's normal locomotion and balancing. These commands may cause Spot's motion to become unpredictable or unstable, and may not trigger obstacle-avoidance behaviors unless you specifically program them into your application.

Operating Spot by low-level API control always falls outside the intended use defined in Intended use and inherently increases risk beyond the scope of the risk assessment detailed in Risk assessment. Before using Spot with low-level API control, you must perform your own risk assessment based on your intended use of Spot and the conditions of the operating environment.

When Spot is operated with low-level API control, the regulatory declarations in Declarations and marking no longer apply. Spot does not meet the definition of a complete machine because most of the fundamental actuation controls could be completely replaced or superseded by external motor drive commands, becoming equivalent to e.g. a motor. You must commission Spot as a final completed machine, complement it with identified safeguards, and provide additional Information for Use for your application of low-level API control. It is your responsibility to determine whether any behaviors or applications you create for Spot are in compliance with local regulations.

9.1. Joint-level API

The joint-level API is intended for use as a research tool in a laboratory environment. It provides direct access to low-level robot controls for operating Spot's joints.

DANGER

Even with skilled robotics researchers, use of joint-level controls may result in unpredictable behaviors and unstable movements of Spot. Observe the following safety precautions as well as any additional precautions indicated by your risk assessment:

- Use joint-level control to operate Spot only in controlled laboratory environments.
- Do not use joint-level control to operate Spot without first setting up and connecting full-separation safeguards that prevent whole-body access to Spot from a minimum distance of 2 meters.
- On inclines, stairs, and elevated surfaces the probability of the occurrence of hazards may be dramatically increased.
- If Spot has an E-Stop button on board the robot, do not approach Spot or attempt to use the E-Stop while a trained RL policy is running. Use other means to stop Spot, such as integrating a wireless E-Stop device.

9.2. Choreography API

The choreography API is intended for use in recorded or live performances for entertainment or demonstration purposes. It provides access to a library of preset moves with adjustable parameters, plus a framework for defining custom animations.

WARNING

Even with skilled robot operators, use of choreography controls may result in unpredictable behaviors and unstable movements of Spot. Observe the following safety precautions as well as any additional precautions indicated by your risk assessment:

- Use choreography controls to operate Spot only on flat, stable, high-friction surfaces where it is possible to maintain least 2 meters of clear space around Spot in all directions.
- Ensure that the entire area in which Spot will perform is inaccessible to bystanders (including any audience) for the duration of the performance.
- If Spot has an E-Stop button on board the robot, do not approach Spot or attempt to use the E-Stop while a choreography sequence is running. Use other means to stop Spot, such as integrating a wireless E-Stop device.