



USER MANUAL

MODEL HC-1

V1.6

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Introduction

Guardhat is intended for use by industrial workers in the field. In addition to all the physical protection provided by standard personal protective equipment such as hard hats, Guardhat provides the additional features of dangerous condition detection and user notification as well as two-way communication, video recording, and image capture.

The Guardhat HC-1 model detects and communicates the following safety-related events:

- Evacuation notification
- Geofence breached
- Fall detected
- SOS / distress-alert manually initiated by the user
- Network disconnected
- Hat-not-worn detected
- Blackout zone entry or exit
- High ambient noise levels
- High/low ambient temperature
- Proximity detection to moving objects (requires additional Bluetooth beacons or tags to be installed on the moving objects)



Figure 1: Guardhat Model HC-1

CONTACT INFORMATION

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DISCLAIMERS

FCC

“Changes or modifications not expressly approved by the manufacturer could void the user’s authority to operate the equipment”. “This device complies with Part 15 of the FCC rules.

Operation is subject to the following two conditions:

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

FCC Interference Statement (Part 15.105 (b))

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

Reorient or relocate the receiving antenna.

Increase the separation between the equipment and receiver.

Connect the equipment into an outlet on a circuit different from that to which the receiver is connected. Consult the dealer or an experienced radio/TV technician for help.

IC

“This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

This device may not interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.”

“Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.”

For the USA

Contains Transmitter Modules:

FCC ID: N7NHL7588

FCC ID: 2AFDI-ITCOQ626S

FCC ID: 2AR6OGHP2470

For Canada:

Contains Transmitter Modules:

IC: 2417C-HL7588

IC: 9049A-ITCOQ6265

IC: 24751-GHP2470

Product Specifications

Wireless Connectivity	UWB, Zigbee, Wifi, LTE, NFC, BLE, Bluetooth
Multimedia Options	LEDs, Audio Speakers, Microphones, 13MP Camera (video and still image), PTT, VOIP, Video Uplink
3-D Location Accuracy	< 1 meter
Sensors	Temperature, Humidity, Pressure, Noise Level, Hat Not Worn, Fall Detection, Proximity Danger
Battery Capacity (dual cell)	4800 mAH (typically 8 -12 hours)
Maximum Weight (with suspension)	800 g / 1 lb, 12.2 oz
Operating Temperature HC-1	-20° C to 60° C / -4° F to 140° F
Operating Temperature HC-1 w/ LIP109-2GHA Battery	-20° C to 57° C / -4° F to 134° F
Storage Temperature	-20° C to 60° C / -4° F to 140° F
Recommended Battery Storage Temperature	20° C ± 5° C / 68° F ± 9° F

Table 1: Product Specifications

SAFETY

This device is to be used only as intended. The stated purposes are to act as a hard hat, provide location services, and communicate events. Use outside of this scope constitutes inappropriate usage, will void the warranty, and may cause safety hazards to personnel.

The hat is certified IP65 with the battery pack properly installed. The battery terminals on the hat and the battery pack are not protected from dust and moisture when the battery pack is not installed. Hence, prior to installing a battery pack, both the hardhat battery terminals and the battery pack terminals must be inspected and cleaned to ensure no accumulation of debris or moisture.

The HC-1 and battery packs should not be disassembled at any time. Doing so will void the warranty and may cause harm to the user. The HC-1 or battery pack should not be used thereafter.

If an HC-1 or battery under warranty becomes damaged, cease use and contact Guardhat immediately

Only dispose of a battery (damaged or otherwise) at a properly rated hazardous waste or recycling location.

To prevent possible hearing damage, do not listen at high volume levels for long periods.



IEC 60417-6044

Battery

CAUTION
RISK OF EXPLOSION IF BATTERY IS REPLACED
BY AN INCORRECT TYPE.
DISPOSE OF USED BATTERIES ACCORDING
TO THE INSTRUCTIONS.

This device contains a **Lithium-Ion (Li-ion) Rechargeable Battery**. This battery may be forbidden aboard passenger aircraft and is not to be transported via air with a charge greater than 30% capacity per ICAO Packing Instructions 965.

Damage to a Li-ion battery may result in a flammability hazard.

Only batteries manufactured by Guardhat are safe to use with this model.

Only a Guardhat charger should be used to charge the batteries. Charging must take place only in an environmentally safe location because any intrinsic safety or ingress protection ratings held by the hard hat assembly are not applicable to a battery with exposed terminals.

Fit

The hat must be worn snugly to prevent slipping off. Always adjust the suspension to fit the user before wearing into a work zone. (see Wearing the Hard Hat, page 13)

WHAT'S INSIDE?

Each Guardhat shipping box includes:

- **Hard Hat.** Type I, Class G.
- **Adjustable Suspension.** HC-1 should only be used with the suspension provided by Guardhat.
- **Battery Pack.** May be a single-cell or dual-cell Lithium-Ion battery.

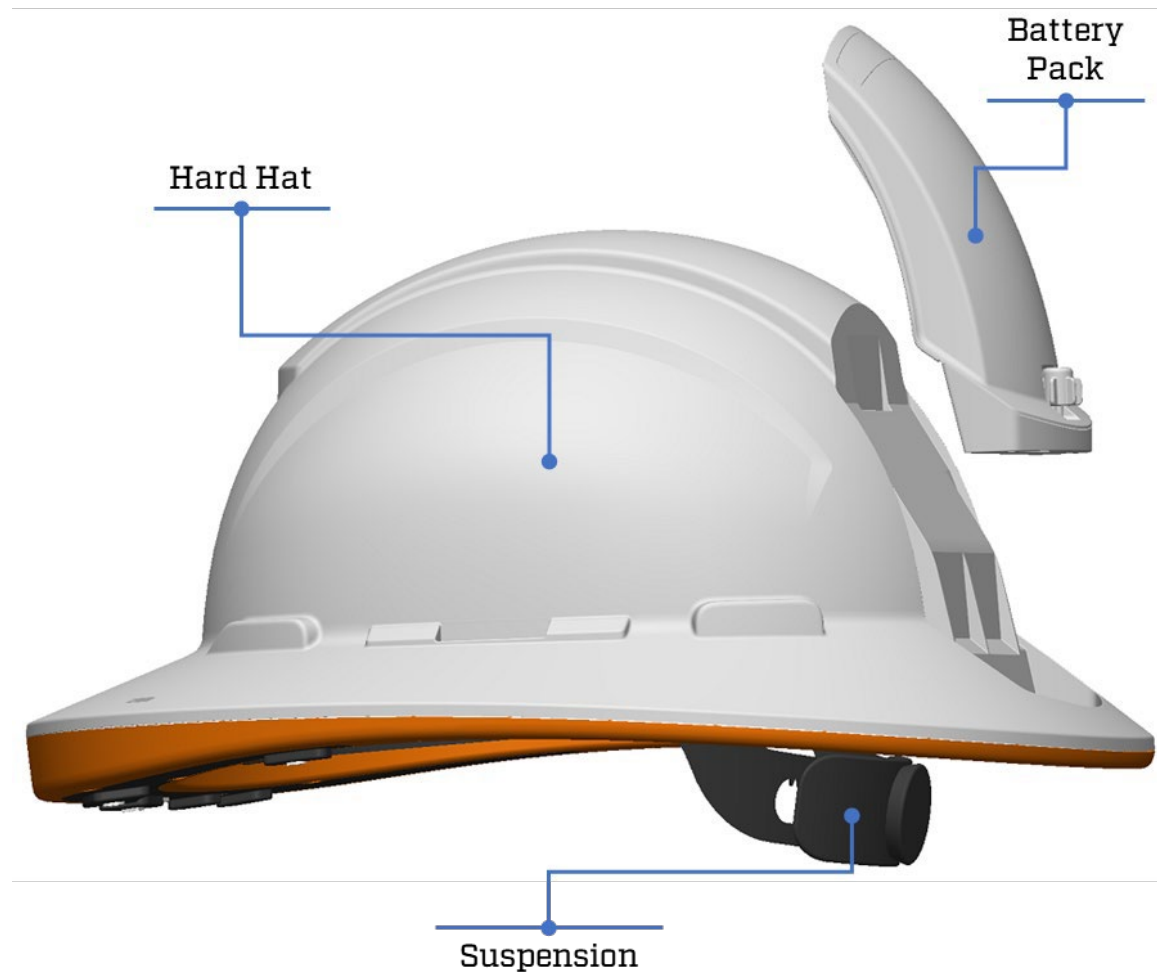


Figure 2: Hard Hat Components

Battery Charging Station. Can charge up to 4 battery packs simultaneously and is supplied separately.

Additional Battery Packs. May be procured through Guardhat to allow for extended hard hat use.

USER INTERFACE

Wearing the Hard Hat

Before wearing the hard hat, loosen the suspension by turning the ratchet mechanism knob counterclockwise (see *Figure 3*). Put the hard hat on your head and tighten the suspension as necessary by turning the knob clockwise.



Figure 3: Suspension Adjustment

There are five aspects to the hat's user interface.

Buttons are pressed by the user in order to communicate, both with the Safety Control Center (SCC) and with other users.

LEDs indicate to the user when there is an event or pending communication.

The **speakers** play standard and custom messages to be heard by the user. They also enable two-way communication with the SCC and/or other users.

The **microphone** allows the user to communicate directly with the SCC and/or other users as well as to capture audio to accompany a video recording.

The **camera** is capable of capturing both still images and video, which are transmitted to the SCC. It also allows for video calling to show the Safety Operator what the user sees in real time.

Buttons

There are 7 buttons on the underside of the brim (see *Figure 5*) and 1 button on the top (see *Figure 4*).



Figure 4: Top Button

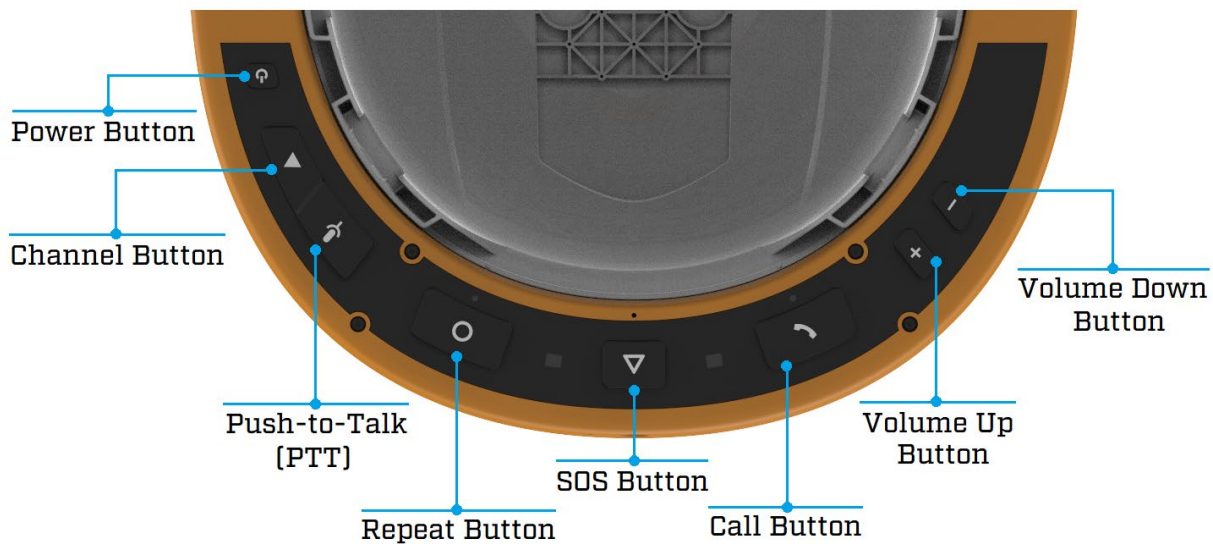


Figure 5: Brim Buttons

- **Power Button.** Used to turn the hard hat on (3 second press) and off (5 second press).
- **Channel Button.** Used to change the channel for communication using PTT.
- **Push-to-Talk (PTT).** Used to communicate directly with all users tuned to the current channel. No dialing is required for this portable-radio style communication.
- **Repeat Button.** Used to recall the last event and replay the audio associated with it.
- **SOS Button.** Used to initiate (5 second press) or cancel an SOS Event (3 second press). If an SOS event is initiated, an alert will be sent to the Safety Control Center (SCC) and nearby users.
- **Call Button.** Used to place a call to the SCC or to answer an incoming call.
- **Volume Up & Volume Down Buttons.** Used to adjust the volume level of the hard hat's speakers. Note that, for safety purposes, the volume cannot be completely muted.
- **Camera Button.** Used to capture still images and video recordings which are transmitted to the SCC.

LED Indicators

There are 5 LEDs on the underside of the brim, visible to the user (see *Figure 6*) and two LEDs on the outside of the hat, visible to nearby personnel (see *Figure 7*).

The LEDs light up with various colors and frequencies depending on the event / message (see **TABLE** for a full list of LED indicators and the associated events).

The visual indicator of the LEDs is a key communication method that responds to events triggered by the user, by the SCC, and by the hat / the software that powers it. These lights alert users even in situations where ambient noise is too high to accurately hear audio communication.

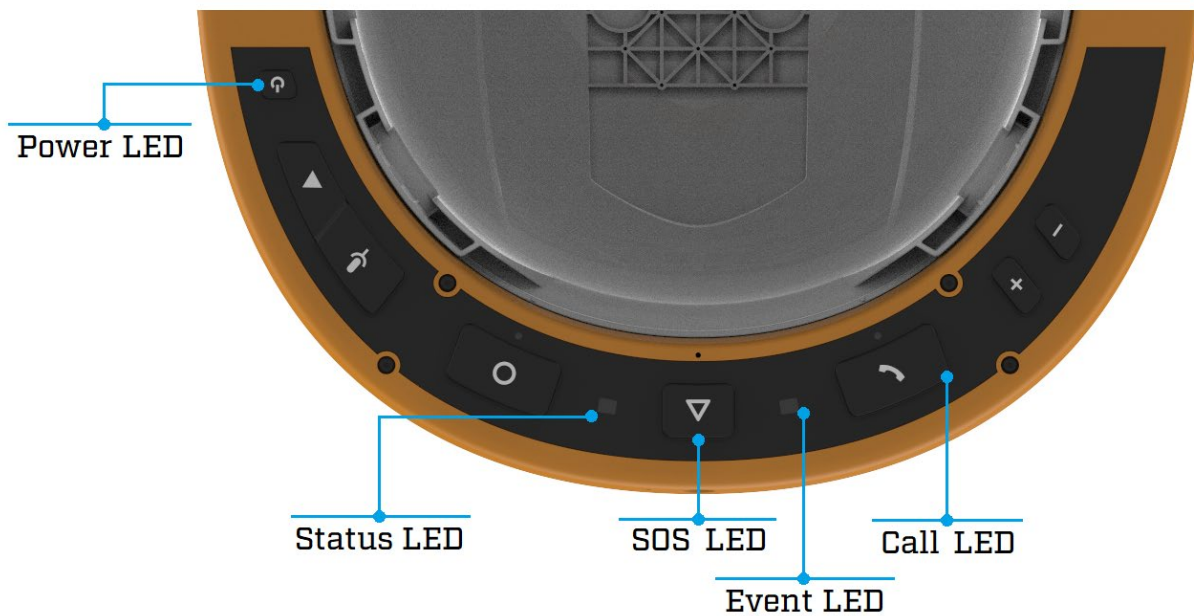


Figure 6: LED Indicators (Under the Brim)

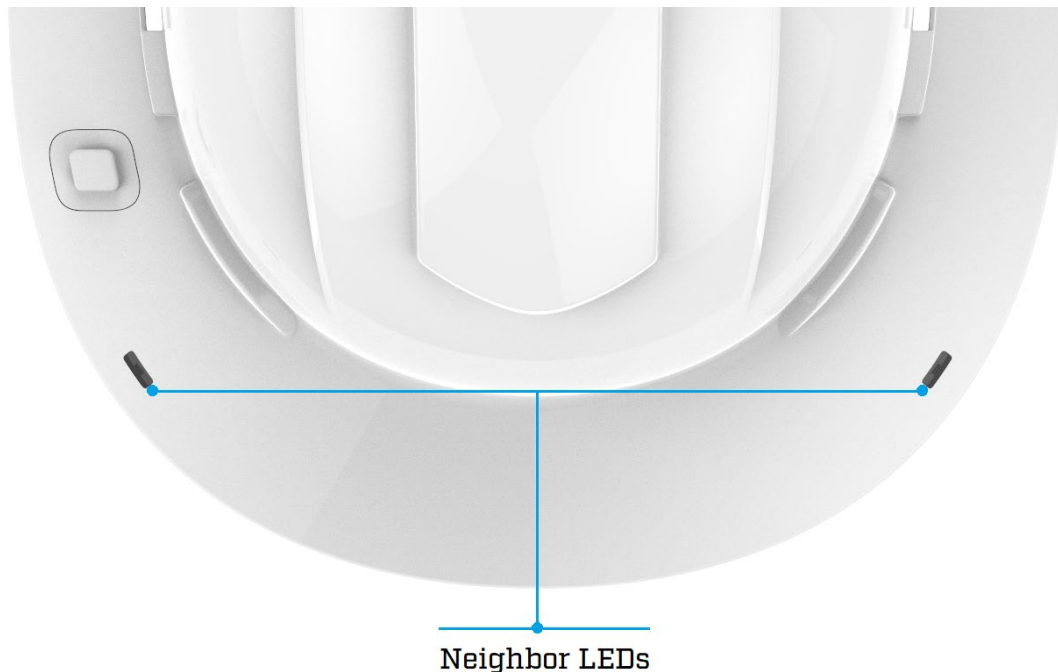


Figure 7: Neighbor LEDs

Communication: Microphone, Speakers, & Camera

The speakers allow communication to be extremely specific. While the same color might light up for multiple events, each audio alert is unique and can provide detailed notifications.

Additionally, the SCC can communicate to users via the speakers and users can communicate with each-other using Push-to-Talk for CB-Style communication.

There are two speakers, one located on each side of the hard hat brim, and two microphones; one under the brim and one next to the camera (see *Figure 8* & *Figure 9*). The speaker volume can be adjusted up or down by pressing the **+** or **-** button as shown in *Figure 8*. Note that the volume cannot be completely muted.

Messages conveyed via the speakers may be standard (e.g. “Hat not worn”) or may be custom / real time as determined by the SCC.

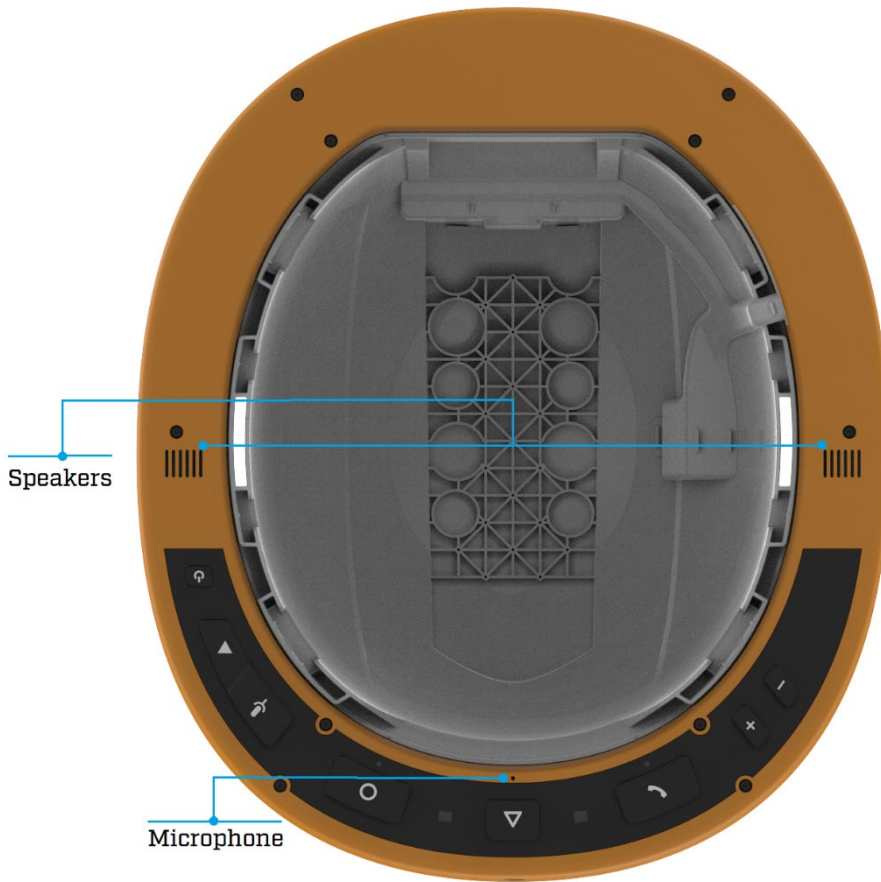


Figure 8: Communication (Bottom View)

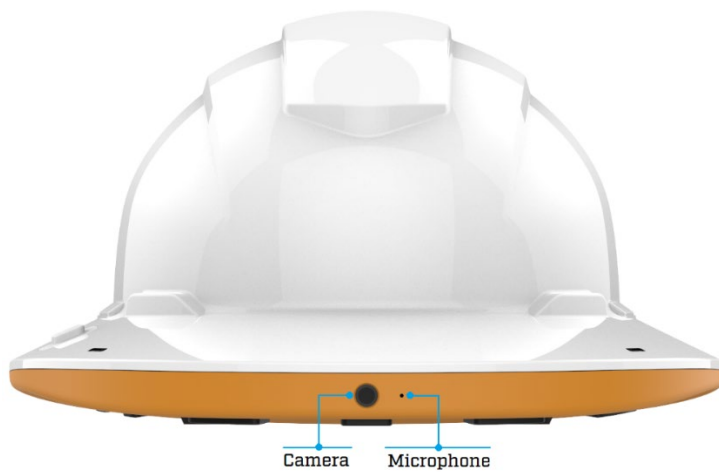


Figure 9: Communication (Front View)

EVENTS

Guardhat model HC-1 detects a number of safety-related conditions and communicates these conditions known as events to multiple recipients, including the SCC. Your company may choose to customize which events are detected as well as the priority ranking of each event.

Event Audio is listed in English however, the audio can be configured to multiple languages depending upon the country and language of the users.

The priority of each event is only relevant if multiple events happen simultaneously. When this is the case, the event with a higher priority will be indicated first. Additional events may be queued for subsequent communication once the high priority event is resolved. “Critical” is the highest priority, followed by “non-critical” and “informational”.

Note that the Event & SOS LEDs are on the underside of the brim and are visible to the User wearing the hat (see *Figure 6*). The Neighbor LEDs are on the outside of the brim and are visible to nearby users (see *Figure 7*).

The following events are described in the subsequent tables. Figures are included for those events which include LED alerts.

- Evacuation
- SOS
- Fall
- Geofence Breach
- Network Disconnect
- Blackout Zone
- Hat Not Worn
- Elevated Noise
- High Temperature
- Low Temperature
- Acceleration
- Proximity

Evacuation

An Evacuation Event occurs when an area is deemed unsafe or needs to be cleared of personnel for any reason. The evacuation area can include any part of the worksite, including the entire site. The SCC Operator draws a three-dimensional area in the web application to initiate an evacuation.



Figure 10: Evacuation Event

Item	Description
Event Initiated By	SCC Operator
Reason for the Event	Evacuation Required
Event LED	Flashing Red Event LED Flashing Red Neighbor LEDs
Event Audio (English)	“Emergency evacuation. Please leave the area.”
User Response	Evacuate the area and proceed to a designated evacuation assembly point.
Event Resolution	Event is resolved when (1) User exits the evacuation area, or (2) SCC operator cancels the evacuation.
Resolution Audio	“Outside of evacuation zone.”
Event Priority	Critical

Table 2: Evacuation Event

SOS

An SOS Event occurs when a user is in danger and/or requires immediate assistance. In addition to the SCC Operator, nearby users will be notified of the SOS request and can find the user who initiated it by the flashing LEDs visible on the outside of the hat.



Figure 11: SOS Event

Item	Description
Event Initiated By	User
Reason for the Event	Urgent help required
Event LED	Flashing Red SOS LED Flashing Red Neighbor EDs
Event Audio (English)	“SOS Initiated.”
User Response	Wait for help. Cancel the event if help no longer needed.
Event Resolution	Event is resolved if (1) User cancels the event, or (2) SCC operator cancels the event.
Resolution Audio	“SOS canceled.”
Event Priority	Critical

Table 3: SOS Event

Fall Detection

A Fall event is initiated when the hat detects a fall, indicated by a rapid drop in altitude greater than 4 feet. This setting can be customized depending upon the specifics of the worksite and situation.

Item	Description
Event Initiated By	Hat / Software
Reason for the Event	Fall detected (rapid drop in altitude greater than 4 ft).
Event LED	None
Event Audio (English)	“Fall detected.”
User Response	Wait for help. Contact SCC operator if no help needed.
Event Resolution	Event is resolved only by SCC operator after confirming that User is no longer in danger.
Resolution Audio	none
Event Priority	Critical

Table 4: Fall Detection Event

Geofence Breach

Geofences are defined by the SCC Operator and can be customized to allow specific personnel into the defined locations at specific times. A breach occurs when a user who is not permitted to be in the zone passes through the invisible barrier. The user will receive warnings about approaching the geofenced area before a breach occurs.



Figure 12: Geofence Breach Event

Item	Description
Event Initiated By	Hat / Software
Reason for the Event	Unauthorized User has entered a geofenced zone.
Event LED	Flashing Red Event LED Flashing Red Neighbor LEDs
Event Audio (English)	“Geofence violation.”
User Response	Exit the geofenced area.
Event Resolution	Event is resolved if (1) User exits the geofenced zone, or (2) SCC operator cancels the geofence.
Resolution Audio	“You have exited the geofence.”
Event Priority	Critical

Table 5: Geofence Breach Event

Network Disconnect Event

The hat may use one of many networks including Ultra-wideband, Wifi, LTE, & Bluetooth. If there is an interruption to the network that prevents the hat from connecting to it, the network disconnect event will notify the user. If the hat is equipped with a camera, video and still images can still be recorded during the disconnect but the files will not be transmitted to the SCC until the network connection is re-established.



Figure 13: Network Disconnect Event

Item	Description
Event Initiated By	Hat / Software
Reason for the Event	Network signal lost
Event LED	Solid Amber Event LED
Event Audio (English)	"No network connection."
User Response	Wait for connection to establish. Move as necessary.
Event Resolution	Event is resolved when network is reconnected
Resolution Audio	"Network connected."
Event Priority	Non-critical

Table 6: Network Disconnect Event

Blackout Zone Event

Blackout zones are defined by the SCC Operator. These are areas where no location data or media may be transmitted from the hat. Although defined by each worksite, blackout zones likely include restrooms, locker rooms, and other locations where privacy is expected.



Figure 14: Blackout Zone Event

Item	Description
Event Initiated By	Hat / Software
Reason for the Event	Network signal lost
Event LED	Solid Amber Event LED
Event Audio (English)	"No network connection."
User Response	Wait for connection to establish. Move as necessary.
Event Resolution	Event is resolved when network is reconnected
Resolution Audio	"Network connected."
Event Priority	Non-critical

Table 7: Blackout Zone Event

Hat Not Worn Event

When the hat is powered on but is not in use, it triggers the hat not worn event. This reminds a user to wear the hat if on the worksite or to power the hat down if it is not in use.



Figure 15: Hat Not Worn Event

Item	Description
Event Initiated By	Hat / Software
Reason for the Event	Hard hat is powered on but is not being worn by a user.
Event LEDs	Flashing Amber Neighbor LEDs
Event Audio (English)	"Hat not worn."
User Response	Wear hat or power off if not in use.
Event Resolution	Hat is worn or powered off.
Resolution Audio	none
Event Priority	Non-critical

Table 8: Hat Not Worn Event

Elevated Noise Event

Sensors in the hat respond to ambient noise over a set decibel level by providing a warning that the noise level is high enough to potentially cause hearing damage. This noise level can be customized for a worksite by the SCC Operator.



Figure 16: Elevated Noise Event

Item	Description
Event Initiated By	Hat / Software
Reason for the Event	Ambient noise is at a level that may damage hearing.
Event LEDs	Flashing Red Event LED
Event Audio (English)	"Noise level high."
User Response	Move to a quieter area if possible or engage hearing protection.
Event Resolution	Noise level returns to within normal parameters
Resolution Audio	none
Event Priority	Critical

Table 9: Elevated Noise Event

Low / High Temperature Event

Sensors in the hat respond to ambient temperatures below and above set temperatures by providing a warning that the temperature is too cold or too hot. These minimum and maximum temperatures may be customized for a worksite by the SCC Operator.



Figure 17: Low / High Temperature Event

Item	Description
Event Initiated By	Hat / Software
Reason for the Event	Temperature is detected to be lower or higher than a set limit.
Event LEDs	Flashing Red Event LED
Event Audio (English)	"Ambient temp low." "Ambient temp high."
User Response	Move to a warmer / cooler area if possible.
Event Resolution	Temperature returns to within normal parameters
Resolution Audio	none
Event Priority	Critical

Table 10: Low / High Temperature Event

Acceleration Event

Sensors in the hat respond to acceleration over a set limit by providing a warning that the acceleration is high, indicating that a dangerous situation may be at hand. This maximum rate of acceleration may be customized for a worksite by the SCC Operator.

Item	Description
Event Initiated By	Hat / Software
Reason for the Event	Heightened acceleration detected.
Event LEDs	none
Event Audio (English)	"High acceleration detected."
User Response	Seek help / report conditions to SCC.
Event Resolution	Acceleration returns to within normal parameters or SCC cancels event
Resolution Audio	none
Event Priority	Critical

Table 11: Acceleration Event

Proximity Event

A Proximity event is triggered when a user is approaching an object that has been tagged with a beacon, for example, dangerous and/or moving equipment.



Figure 18: Proximity Event

Item	Description
Event Initiated By	Hat / Software / Beacon
Reason for the Event	Hat / User is close to a Beacon
Event LEDs	Flashing Red Event LED
Event Audio (English)	"Proximity Danger."
User Response	Move away from the dangerous situation / location if possible to do so safely.
Event Resolution	User moves away from danger or SCC cancels event.
Resolution Audio	none
Event Priority	Critical

Table 12: Proximity Event

POWER & CONNECTIVITY

The included battery is a dual-cell 4800 mAH Lithium Ion battery, which is suitable for an eight to 12-hour shift. Multiple batteries may be purchased separately in order to extend the hat's working life before recharging.

Installing and Removing the Battery

Only a Guardhat battery may be used with this device.

To install the battery, lower the battery pack into the compartment on the back of the hard hat and tighten the thumbscrew by turning it clockwise until it is finger-tight. (see *Figure 19*)

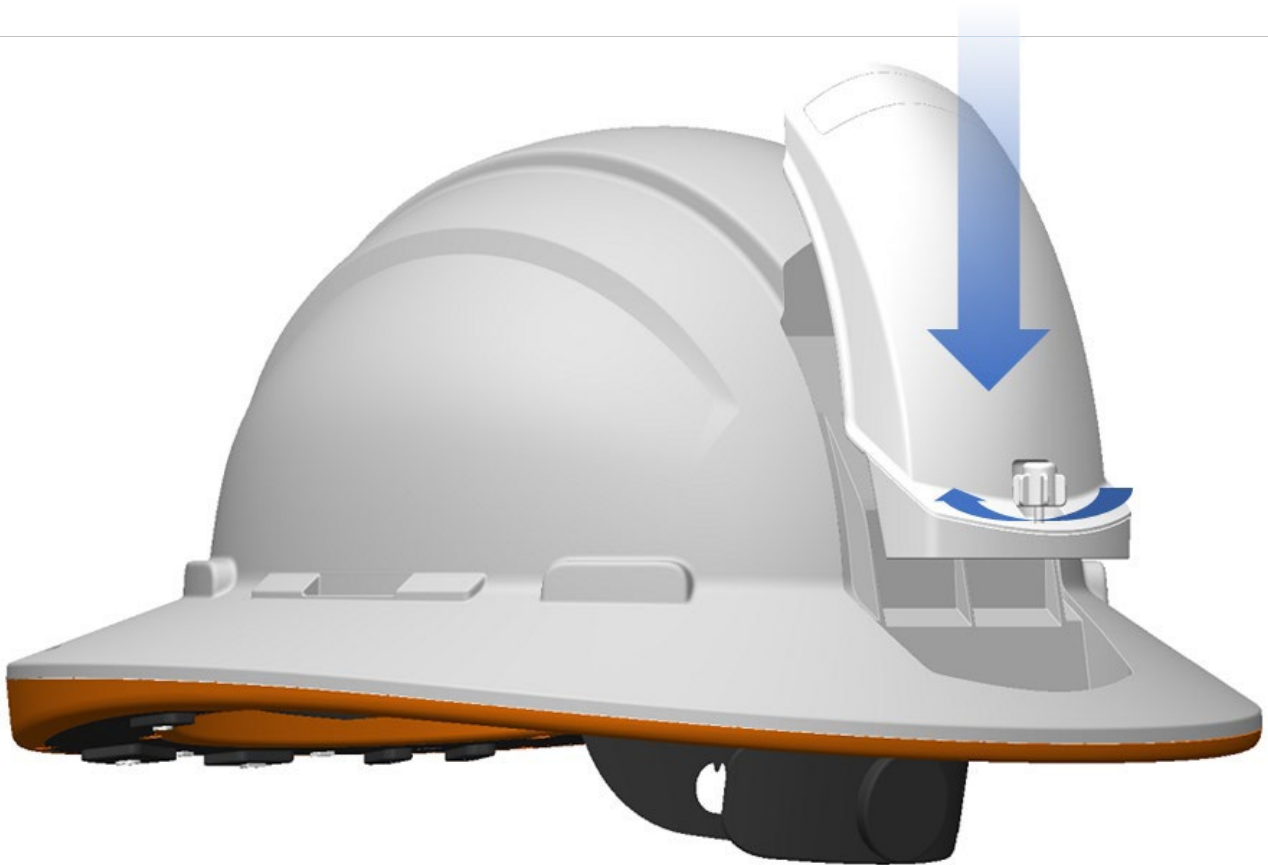


Figure 19: Battery Installation

To remove the battery, loosen the thumbscrew by turning it counterclockwise until the head of the screw reaches the top of the thumbscrew cavity and lift the battery pack straight up. (see *Figure 20*)

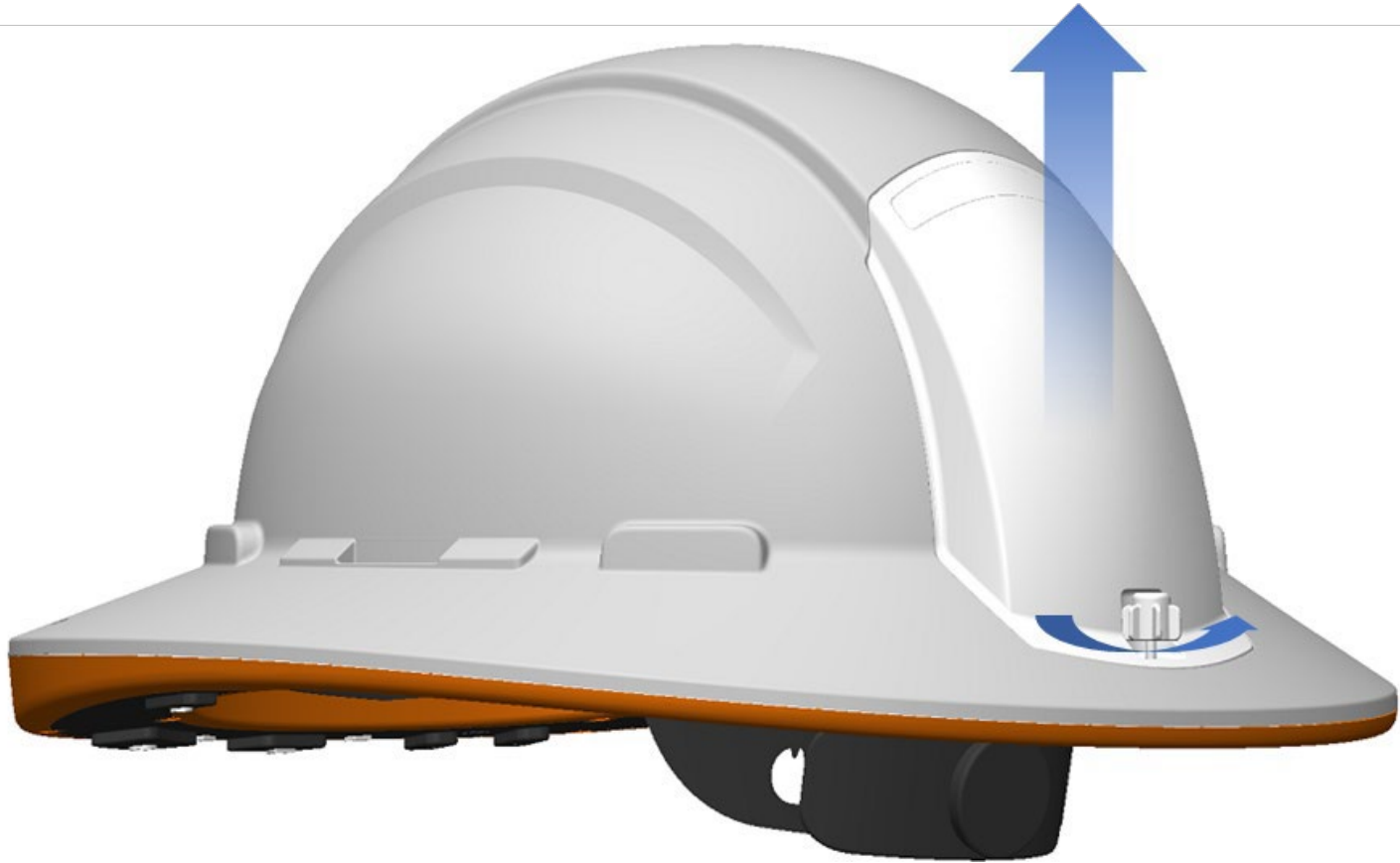


Figure 20: Battery Removal

Charging the Battery

The battery can be charged using Battery Charging Station (supplied separately) which can charge up to 4 batteries at once. Only use a Guardhat charger in a safe environment (see SAFETY, page 10).



Figure 21: Battery Charger

When an empty charging port is ready and functional, both lights in front of it will be **Solid Green**.

To charge a Battery Pack, disengage the Battery Pack from the hard hat as in *Figure 20* and place it into a charging port.

When a battery is charging:

- A battery pack charged to less than 50% capacity will be indicated by **Solid Amber** on the left and No Light on the right. (see *Figure 22*)
- A battery pack charged between 50% and 100% capacity will be indicated by **Solid Green** on the left and **Solid Amber** on the right. (see *Figure 23*)
- A fully charged battery pack will be indicated by **Solid Green** on both LEDs. (see *Figure 24*)

- Any **Red** LEDs indicate a fault in the battery. A faulty battery should be returned if under warranty or appropriately discarded.



Figure 22: Low Charge



Figure 23: Charging



Figure 24: Fully Charged

Turning the Hard Hat ON and OFF

When the hard hat is powered off, no LEDs are illuminated.

To turn **ON** the hard hat, press and hold the Power Button for 3 seconds. After hard hat has booted up, you will hear starting tone and the Status LED (see *Figure 6*) will light up. The color and flash pattern of the Status LED will indicate the power level of the battery and network connection status (see *Table 13*).

To turn **OFF** the hard hat, press and hold the Power Button for 5 seconds. The Power LED will **Flash Green** while hard hat is powering down.

Hard Hat Status LED

The Status LED will indicate battery level and network connection status.

		Network Connection Status		Audio
		Online	Offline	
Battery Status	Greater than 2/3 of battery capacity	Solid Green	Slow Glowing Green	none
	Between 1/3 and 2/3 of battery capacity	Solid Amber	Slow Glowing Amber	none
	Less than 1/3 of battery capacity	Solid Red	Slow Glowing Red	"Battery Low."
	Less than 2 minutes of battery life	Flashing Red	Flashing Red	"Battery critical. Power down initiated."

Table 13: Status LED

USER INTERFACE REFERENCE

LED Indicators

LED	Light	Audio	Meaning	Response
Event LED 	Flashing Red	“Emergency Evacuation. Please leave the area.”	Evacuation initiated	Evacuate the area
		“Geofence violation.”	Unauthorized geofence entry	Exit restricted area
		“Noise level high.”	Noise level is too high	Move to a quieter area or engage hearing protection.
		“Ambient temp high.”	Temperature is too high.	Move to a cooler area
		“Ambient temp low.”	Temperature is too low.	Move to a warmer area
		“Proximity danger.”	Proximity danger	Move to a safe location
	Solid Amber	“No network connection.”	Network disconnected	Wait for reconnection
		“Inside blackout zone.”	Blackout enter	None required
SOS LED 	Flashing Red	“SOS initiated.”	SOS Initiated	Wait for help / Cancel if help no longer needed

Table 14: LED Indicators (Event & SOS)

LED	Light	Audio	Meaning	Response
Status LED 	Solid Green	none	Battery full; Online	none
	Solid Amber	none	Battery medium; Online	none
	Solid Red	"Battery low."	Battery low; Online	Replace battery soon
	Slow Glowing Green	none	Battery full; Offline	Be aware of surroundings
	Slow Glowing Amber	none	Battery medium; Offline	Be aware of surroundings
	Slow Glowing Red	"Battery low."	Battery low; Offline	Be aware of surroundings Replace battery soon
	Flashing Red	"Battery critical. Power down initiated."	Battery Critical	Replace battery ASAP
	Flashing Green	"Power down initiated."	Power down initiated	none
	Flashing Blue	"Ready to pair."	Bluetooth pairing	Pair Bluetooth device.

Table 15: LED Indicators (Status)

LED	Light	Audio	Meaning	Response
Call LED P	Single Amber Flash	camera shutter sound	Picture taken	none
	Solid Amber	“Video recording started.”	Video recording in progress	none
	Green / Blue	Dial tone (until connected)	Outbound audio call	none
		Ring tone (until answered)	Inbound audio call	Answer by pressing Call Button
	Flashing Blue	Dial tone (until connected)	Outbound video call	none
		Ring tone (until answered)	Inbound video call	Answer by pressing Call Button
	Solid Green	call audio	Audio call in progress	none
	Solid Blue	call audio	Video call in progress	none
		channel audio	PTT active	Release button to hear response(s)
Neighbor (not visible to User) – Response is for those nearby	Flashing Red	n/a	SOS initiated	Help user if possible
		n/a	Evacuation initiated	Evacuate the area
		n/a	Unauthorized geofence entry	Contact SCC
	Flashing Amber	n/a	Hat not worn	Remind User to wear or power down hat

Table 16: LED Indicators (Call & Neighbor)

Buttons

Button	Press	Reason	Result	Audio
Volume Down —	Short press	Decrease speaker volume	Volume decreases	single beep at new audio level (if nothing else playing)
Volume Up +	Short press	Increase speaker volume	Volume increases	single beep at new audio level (if nothing else playing)
SOS △	Hold for 5 sec	User needs help	SOS alert sent to SCC & nearby users	“SOS initiated.”
	Hold for 3 sec	Cancel active SOS	Active SOS is canceled	“SOS canceled.”
Call P	Press	Make audio call to SCC	Audio call placed	Dial tone (until connected)
	Hold for 3 sec	Make video call to SCC	Video call placed	Dial tone (until connected)
	Press (when ringing)	Answer call	Audio or video call answered	call audio
	Press (when connected)	End call	Audio or video call ends	single beep
Push to Talk »	Press and hold	Communicate with group	Broadcast over current channel	None (User talks)

Table 17: Buttons (Repeat, Power, & Picture)

Button	Press	Reason	Result	Audio
Repeat ○	Press	Repeat needed	Replays all messages in active event queue (in order of priority)	
Power ?	Hold for 3 sec	Turn ON the hat	Hat powers on	“Device started.”
	Hold for 5 sec	Turn OFF the hat	Hat powers off	“Power down initiated.”
Camera	Press	Take still image	Captures image	camera shutter sound
	Hold for 3 sec	Begin video recording	Begins recording	“Video recording started.”
	Press (while recording)	End video recording	Ends recording	“Video recording ended.”

Table 18: Buttons (Repeat, Power, & Camera)