# Intel® Shooting Star Mini™

## Quick Start Guide

*October 23, 2018*

## Intel Confidential

# Revision History

| Revision Number | Description | Revision Date |
|---|---|---|
| 0.0 | • First draft. | March 28 2018 |
| 1.0 | • Incorporated changes to ILT sections based on feedback from engineering | May 2 2018 |
| 1.1 | • Updated cover sheet with revision dates | May 3 2018 |
| 1.2 | • Updated ILT hardware schematic, added "NM" to terminology, updated IT requirements | May 17 2018 |
| 1.3 | • Incorporated Safety information | July 22 2018 |
| 1.4 | • Warnings and Regulatory Statements added<br>• Handling and Storage Instructions added<br>• Appendix removed | Aug 17 2018 |
| 1.5A | • Added 'Information to the user statements' of FCC Part §15.21 and §15.105 to section 4 | Sept 21 2018 |
| 1.5B | • Added Anchor power supply statement to section 4 | Sept 24 2018 |
| 1.5C | • Removed Confidential in footer | Sept 25 2018 |
| 1.6 | • Unclear reference to Geofence levels removed in section 4 | Sept 27 2018 |
| 1.6A | • Added indoor use only statement on cover page | Oct 23 2018 |

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WARNING

READ SAFETY INFORMATION
IN SECTION 4!

# Introduction

This document will help the operator understand the technical requirements and operational procedures essential to performing a basic flight with the Intel® Shooting Star Mini™ system. It will describe the hardware and software interfaces of the system and assist in getting the system operational.

## Goals

After reading this quick start guide and getting familiarized with the system, the operator will be able to power on the system, have access to the Intel® Shooting Star Mini™ Drones and perform a simple test flight.

### This document:

1. Describes the setup of the Intel® Shooting Star Mini™ Launchpads.
2. Provides guidance on how to set up and use the Indoor Location Technology system.
3. Demonstrates the basic features of the Intel® Shooting Star Mini™ Control Center software.
4. Walks through a test flight of the Intel® Shooting Star Mini™ Drone.

### This document does not:

1. Cover each feature in detail.
2. Provide in-depth training.

## Terminology

**CC**: The Intel® Shooting Star Mini™ Control Center is the software required to operate the system.

**Drone**: The Intel® Shooting Star Mini™ Drone is the aerial unit of the system.

**Launchpad**: Intel® Shooting Star Mini™ Launchpad is the ground unit of the system, used to charge the Drones.

**ILT**: The Indoor Location Technology system defines the 3-D coordinates of each drone, enabling indoor and outdoor navigation as well as wireless data transfer.

**NM:** Intel® ILT Network Manager

# 1     Infrastructure

Note:        This chapter describes the requirements and the setup of the Intel® Shooting Star Mini™ infrastructure, including spatial, electrical and network requirements.

## 1.1     Requirements

**Electrical**:    100-240VAC with 50-60Hz and GFCI protection

**Hardware**:    5V Rechargeable batteries (for anchors)
                USB to Micro USB cables (for anchors)
                USB cable (for sniffer)
                Ethernet cable (for NUC)

## 1.2     Launchpad Overview

The Intel® Shooting Star Mini™ Launchpad represents the ground station of the system. It is used to transport and charge the Drones, in addition to serving as a take-off platform for them. There are two powerCON connectors on the Launchpad, one to supply power to the Launchpad and another to daisy-chain power to additional Launchpads.

## 1.3     Spatial Setup

The Intel® Shooting Star Mini™ system is very dynamic and can be setup in any desired shape with the desired number of Drones and Launchpads. Each Launchpad carries 15 Drones and measures 114cm x 64cm (38cm tall).

## 1.4     Electrical Wiring

The Intel® Shooting Star Mini™ Launchpads are powered by alternating current (AC) and are able to run on 100-240V with 50-60Hz. A three-wire connection with a ground fault circuit interrupter (GFCI) is required. Each Launchpad features 2 powerCON True1 connectors and can be individually connected to a power outlet or grouped together. The number of hubs connected to a power outlet is determined by the maximum rating of the circuit breaker and cables.

**Power Draw**: up to 100W per Launchpad, i.e. 0.8A @ 120V or 0.4A @ 230V

## 1.5     ILT setup

In addition to determining the 3-D location of each drone, the ILT system is also used to transmit new animation files and firmware updates to the Intel® Shooting Star Mini™ Drones.

The ILT system includes: a laptop, a network server, a sniffer device, and several anchors. There are 4 preset roles for the devices in the network: **anchor**, **tag**, **sniffer**, and **coordinator**. **Anchors** are deployed within the space to provide a coordinate frame for **tags** that move within the network. The **sniffer** device receives and monitors all network events and feeds this data to the network server, it also publishes the location of each anchor and supports two-way communication between the ILT network clients. The first anchor to join the network is designated as a **coordinator**, which manages the network context, global timing across the network, all requests to join or disconnect from the network, and other network options. Both the sniffer and anchor must be in the direct line of site of all other devices in the network for the system to work properly.

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**Figure 1- 1. ILT hardware schematic**
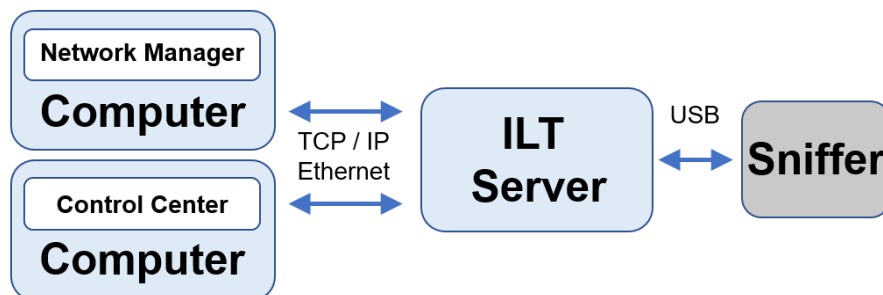


The following items are recommended for a temporary installation or system testing:

- Tripods (useful for positioning anchors in a temporary space)
- Gaffer Tape – 1" width (useful for securing anchors and batteries in a temporary place, without leaving behind an adhesive residue)
- Batteries with USB Type B to Micro USB cables (for powering anchors) – Output Voltage must be 5V, capable of outputting current of at least 1 Amp. We recommend a capacity of at least 5000 mA-Hours.
- USB cable Type A to type B (for connection between the sniffer and the Intel NUC)
- Ethernet cable (for connection between computer and Intel NUC)

For a long-term installation, you may require additional materials which should be determined on a case-by-case basis.

To place the ILT anchors, use the following guidelines:

- The minimum space that the ILT system can operate in with stable performance is 5 meters along each dimension (X, Y, Z).
- Anchors should be positioned every 30 – 35 meters.  The current build will support anchors placed with a maximum distance between all anchors of 100 meters.
- Anchors should bound the perimeter of the 3-D space where the drones will travel.
- Anchors should be placed on the highest plane closest to the ceiling and on the floor (ground plane). Anchors placed in between the ceiling and floor are optional.
- Avoid placement of anchors near metallic objects and if possible, leave a clearance of 15cm between the anchor and the wall or ceiling.
- The coordinator (first anchor to join the network) and sniffer must be in the direct line of sight of all anchors.
- The coordinate frame follows the right-hand rule.  Anchor 1 defines the origin of the ILT spatial coordinates. The line between Anchor 1 and Anchor 2 defines the X-axis, and the plane that runs through Anchors 1, 2 and 3 defines the X-Y plane (where Z = 0).

**Figure 1- 2. Anchor orientation**
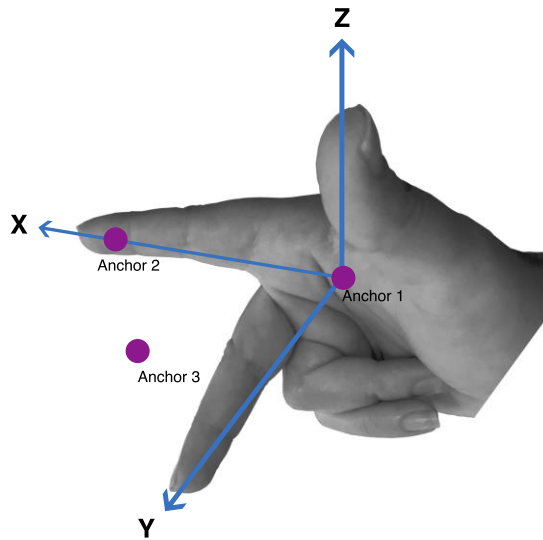


- The placement of a particular anchor should be chosen to maximize the line of sight between this anchor and as many other anchors as possible. All anchors must also maintain line of sight with coordinator and sniffer.
- In general, a minimum of 6 anchors is needed to enable the 3-D localization of a drone within your space, but you may need to install more anchors to improve the accuracy and redundancy of your network.
- When placing anchors on the ceiling and floor planes, we recommend choosing the placement so as to diversify the X and Y coordinates of anchors in the network. (See the below figure for an anchor placement example).

**Figure 1- 3. Optimal placement of anchors**
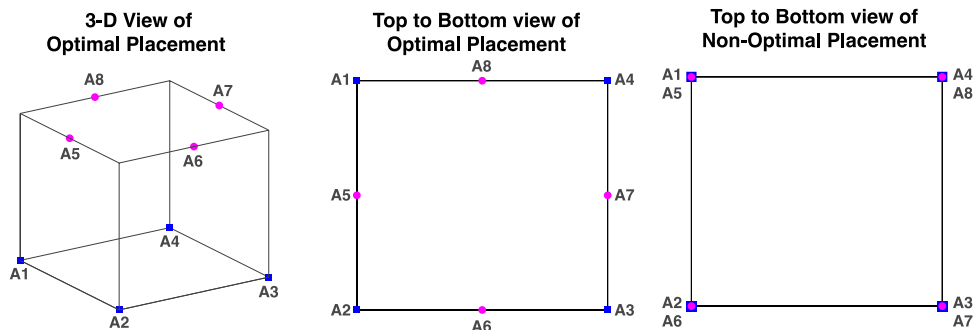


The left image is a three-dimensional rendering of a square room with anchors optimally placed (to diversify the X, Y, and Z coordinates of the anchors in the network). Blue squares represent anchors on the floor, pink circles represent anchors on the ceiling.The center image shows the top to bottom view of the same room. The right image shows a non-optimal placement of anchors on the floor and ceiling.

- We recommend that the anchors be installed vertically, with the anchors on the ground antennas pointing up and anchors on the ceiling antennas pointing down.

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# 2 Software

Note: This chapter describes the IT requirements for the Intel® Shooting Star Mini™ system.

## 2.1 IT Requirements

In order to use the Intel® Shooting Star Mini™ system, the operator must provide basic IT equipment, such as a PC with the Windows 10 operating system. An uninterrupted power supply, which protects the PC from a power surges and outages, is also recommended.

**Table 2-1. Hardware Requirements**

| Component | Minimum | Recommended |
|-----------|---------|-------------|
| **Processor** | 64-bit Dual-Core | 64-bit Quad-Core |
| **Memory** | 8GB | 16GB |
| **Hard Drive** | 200GB | 500GB |
| **Screen** | 1920x1080 | 1920x1080 (touch sensitive) |

**Table 2-2. Software Requirements**

| Component | Minimum | Recommended |
|-----------|---------|-------------|
| **OS** | Windows 10 64-bit | Windows 10 64-bit |
| **Framework** | Microsoft Visual C++ 2017 Redistributable | |

## 2.2 ILT Configuration

The ILT network is needed in order for Control Center to communicate to the Drones. This communication link can be established via Ethernet once the ILT network has been configured.

1. Plug in and turn on the Network Server and then attach the sniffer device using a USB cable that is no more than 5 meters long.
2. Plug in and turn on the Computer and connect it to the Intel NUC using an Ethernet cable that is no more than 100 meters long.
3. Open the ILT Network Manager. The first time you open this application, it will prompt you to add the IP address and serial port for the network. After that, the application will default to the saved network settings and automatically detect and map the anchors that are powered on in the room. This configuration can be changed by clicking on "System Config" in the Menu. After a few minutes, the network will automatically detect and display the location of all anchors in the GUI tab.
4. You will need to examine the monitoring page and click on the red anchor and link cards, to view recommendations for optimizing the network set-up.

5. In order to ensure that the network is calibrated properly, we suggest that you perform a static and a dynamic test using the anchor and tag tracking tool in the GUI. A static test can be used to check the network quality over time. You will turn on the tracking tool and allow the system to track the anchor locations for at least 15 minutes.
6. After the network has converged to produce a stable static test, you may proceed to the dynamic test. The tracking tool allows the user to highlight a particular anchor or tag in a different color; you can use this feature to perform a dynamic test of the network. Power on a tag. The system will automatically detect the tag and show it in the GUI. Next, turn on the tracking feature and select the tag that is powered on. The GUI will automatically highlight this tag in a different color. Now carry the tag around the room. You should see a highlighted path on the screen that corresponds with your trajectory.
7. After your system has successfully passed the static and dynamic tests, you are ready to begin using your network.
8. Set IP address of wired Ethernet connection via **Control Panel/Network and Internet/Network Connections** and disable Firewalls.

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## 2.3  Control Center

After installing the Intel® Shooting Star Mini™ Control Center software, the operator will be able to access and control the Drones. The following content will provide information on a few key features and commands, but does not cover all features of the Control Center.

### 2.3.1 User Interface

The following picture shows the user interface (UI) of the Control Center. There are four main groups.

**Figure 2-1. Control Center UI Layout**
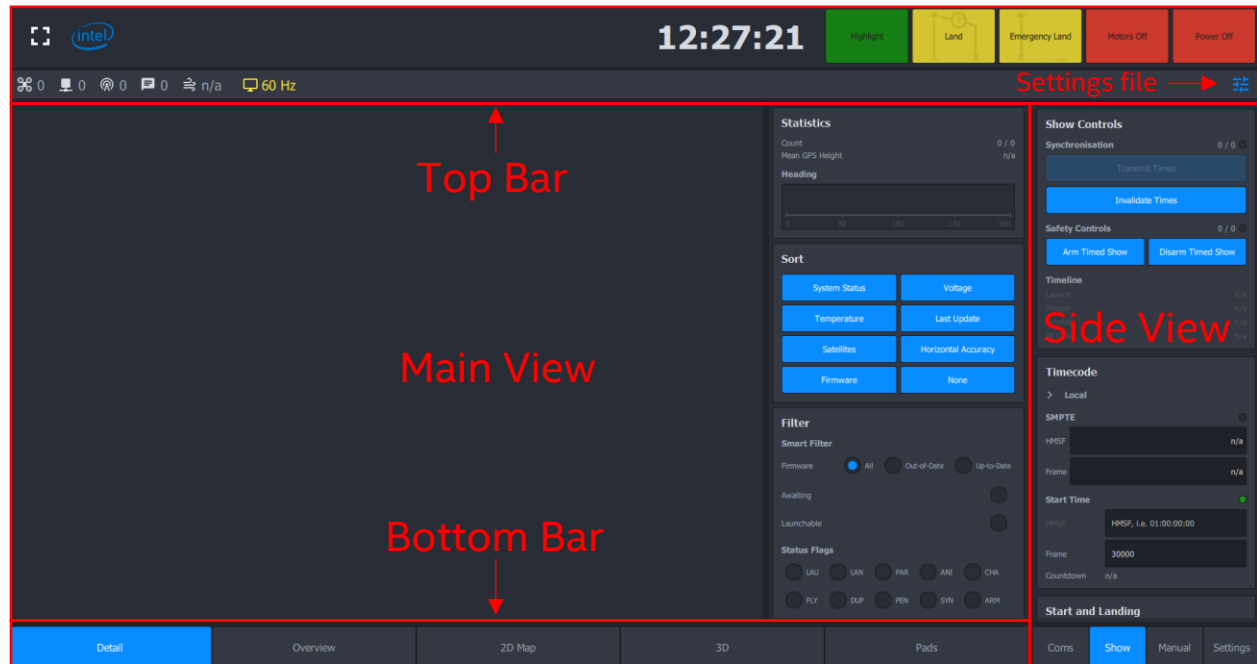


### 2.3.1.1     Top Bar

The Top Bar provides access to key commands, such as Land, Emergency Land and Power Off.  It also displays the total number of Drones available, and provides a button on the right-hand side to upload .JSON settings files which can pre-load settings into the **Show** tab found in the **Side View**.

### 2.3.1.2     Bottom Bar

The Bottom Bar tabs can be used to switch between different Main View modes.

### 2.3.1.3     Main View

The Main View will show data regarding the fleet as specified by the Bottom Bar, such as the status of each Drone in **Detail** mode and a general overview of the Drones in **Overview** mode.

#### 2.3.1.3.1     Detail

In this mode of the Main View, all Drones will be shown in a list. Each Drone is represented by a box, which expands if it is selected. It will collapse again if it is unselected.

**Last Update**: The time passed since an update was received from the Drone.

**Voltage**: The voltage is the battery voltage at the time the last update was received.

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**Temperature**: The current temperature of the Drone at the time the last update was received.

**Version Patch**: The current firmware version of the Drone.

### 2.3.1.4    Side View

Within the Side View, the operator will be able to access key commands for the Intel® Shooting Star Mini™ system.

#### 2.3.1.4.1    Periphery

Currently, the functions featured on this tab are only used for outdoor drone light shows.

#### 2.3.1.4.2    Show

**Audio / Load:** This will load an audio file to be used during the animation.

**Audio / Start:** This function allows for manual start of audio playback.

**Animation / Load**: This will load an animation file to be used for a flight.

**Animation / Upload**: This will upload the animation file to be used for a flight via network to the Drones.

**Parameters / Transmit Parameters**: This will transmit the previously loaded parameters to the Drones via ILT.

**Start and Landing / Compute**: This will initiate the optimisation algorithm and allocate the specific Drones to be used for the flight.

**Start and Landing / Transmit Optimisation**: This will transmit the optimisation data to the Drones via ILT.

**Timecode / Start**: Starts timecode

**Show Controls / Transmit Times**: This transmits timecode synchronization data to Drones via ILT.

**Show Controls / Arm Timed Show**: Arms the Drones for launch.

#### 2.3.1.4.3    Manual

**Flight Commands / Launch and Hover Selected**: This command will power on the Drone's motors and cause it to take-off vertically to 2m height above ground. The Drone will remain in this position until a landing command has been sent.

#### 2.3.1.4.4    Settings

**Indoor Positioning / Try Reconnect**: This command will connect the Drones to the ILT network.

**Indoor Positioning / Reset Localization Time**: This command will synchronize timing of drones with Control Center.

**Firmware / Load**: This will load a firmware to upload to Drones.

**Firmware / Upload / Stars**: This will upload firmware to Drones.

# 3     Basic Operations

Note:         This chapter provides a basic understanding of the operations of the Intel® Shooting Star Mini™ system.

## 3.1     Simple Test Flight

The simplest way to have an Intel® Shooting Star Mini™ Drone flying is to perform a test flight. A test flight is a flight to a fixed height, straight above its take-off point. All commands are initiated manually within the Control Center.

1. Under **Settings / Indoor Positioning** select **Try Reconnect** to connect to the ILT network.
2. Power on the Drone to be flown using the on-board switch.
3. Verify that the Drone appears in the Control Center Main View (Detail).
4. Select the Drone.
5. In the Side View under **Manual / Maintenance / Calibration** select the **Launch and Hover Selected** command with a sustained click/press.
6. In the Side View under **Manual / Maintenance / Calibration** select the **Launch and Hover Selected** command with a sustained click/press.
7. The Drone's motors should turn on and it should take off vertically to a height of 2m above ground. The Drone will hold its position until a landing command has been sent.
8. In the Top Bar, perform the Land All command. The Drone will now land.

## 3.2     Basic Animation Flight

In order to perform an automated animation flight, the operator is required to have a complete setup of the Intel® Shooting Star Mini™ system. This section will not describe in detail how to perform a light show, but it will describe the basic steps to perform a flight, if the animation file and the parameters file for the specific location have been provided.

1. Under **Settings / Indoor Positioning** select **Try Reconnect** to connect to the ILT network.
2. Power on the fleet of Drones to be flown.
3. Load the provided settings file (.JSON format) located under **C:/ShootingStar/Parameters/**.
4. Verify that all Drones have appeared in the Control Center Main View (Detail or Overview).
5. Verify that correct animation and audio files were loaded as specified by settings file.
6. Set start frame of audio playback as needed for animation sync.
7. Upload the animation file to the Drones with the **Show / Animation / Upload** command.
8. Verify that all Drones have received the animation file and have successfully rebooted after the upload has completed.
9. Transmit the parameters with the **Show / Parameters / Transmit Parameters** command.
10. Verify that all Drones have received the parameters.
11. Set Optimisation priority and compute optimization with the **Show / Start and Landing / Optimisation / Compute** command.
12. Transmit optimization with the **Show / Start and Landing / Live / Transmit Optimisation** command
13. Verify that the required number of Drones have received the optimization (i.e. as many Drones as are needed for animation).
14. Set start frame of animation under **Show / Timecode / Start Time / Frame**.
15. Expand Timecode start button by clicking **">"** symbol next to **Show / Timecode / Local**.

16. Start Timecode by clicking **Show / Timecode / Local / Start**.
17. Sync Drones with CC with the **Settings / Indoor Positioning / Server / Reset Localization Time** command.
18. Transmit times to Drones with the **Show / Show Controls / Synchronisation / Transmit Times** command.
19. Verify that necessary number of Drones have received times.
20. Arm Drones for flight with the **Show / Show Controls / Safety Controls / Arm Timed Show** command.
21. Verify that necessary number of Drones have been armed.
22. Supervise the launch and verify that all Drones have launched successfully.
23. Supervise the animation flight and watch for any Warning/Error flags during show.
24. After the Drones have returned to the Launchpad area, use the **Highlight All** command to confirm that all Drones have now landed.
25. Disarm the Drones using the **Show / Show Controls / Safety Controls / Disarm Timed Show** command.
26. Stop timecode using the **Show / Timecode / Local / Stop** command.
27. Return Drones to Launchpads.
28. Disconnect power to Launchpads.
29. Power off Drones using the **Power Off All** command.

# 4 Regulatory and Safety Information

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.

This equipment may only be operated indoors. Operation outdoors is in violation of 47 U.S.C. 301 and could subject the operator to serious legal penalties.

## Warnings

☝ **Read manual before use!**

☝ **Do not disassemble drone, anchor or launch pad.**

☝ **The anchors must be powered by battery pack for safety reasons (power outages)!**

☝ **Avoid to handle drones when powered:**
   o When illuminated the drone is active and should not be handled manually without wearing safety gloves (PSE)!

☝ **Li-Ion Battery – risk of fire! Do not open, crush or heat!**
   o The battery may explode or cause burns, if disassembled, crushed or exposed to fire or high temperatures. Do not short or install with incorrect polarity!
   o The battery should not be opened, destroyed or incinerate, since they may leak or rupture and release to the environment the ingredients that they contain in the hermetically sealed container!
   o Do not short circuit battery terminals, or over charge the battery, forced over-discharge, throw to fire!
   o Do not crush or puncture the battery, or immerse in liquids!
   o Precautions to be taken in handling and storing the battery: Avoid mechanical or electrical abuse. Storage preferably in cool, dry and ventilated area, which is subject to little temperature change. Storage at high temperatures should be avoided. Do not place the battery near heating equipment, nor expose to direct sunlight for long periods!

FCC Part 15.21 Warning:

"CAUTION: Changes or modifications not expressly approved by Intel could void the user's authority to operate the equipment."

FCC Part 15.105(b) Warning & Interference Statement:

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 or more 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.

## Instructions

### Unpacking, Packing, Transport, Storage
- Safety of work training and safety briefing is mandatory
- Personnel is required to wear safety gloves (PSE) when handling items
- Continuous monitoring and event reporting is to be implemented and conducted
- Safety Audits shall be conducted

### Preparation, Post-Operation
- Crew Training is required
- Safety of work training is mandatory
- First aid kit (automobile grade) and trained first aid personnel to be at site
- Enforcement of safety area with restricted access (crew only; no exposure to third party)
- Drones shall be handled by trained and qualified personnel only
  - Drones are not operated on ground when out off launch pad, nor launched or captured by hand
- Ensured carefree passing through adjacent items by established minimum distance

- - Cable routes shall be guarded by use of railings, industrial safety gates, floor hole covers or toe-boards
  - Minimal passing between items shall take place once initial setup is complete. Launch pads can be directly next to each other.
- Continuous monitoring and event reporting shall be implemented and conducted
- A Battery Maintenance Plan shall be implemented and adhered to
- Replace all mechanical parts that have been damaged or have been subject to known over load
- Safety Audits shall be conducted

## Operation

- Operational safety and safety of work training is mandatory
  - Crew shall be trained to perform typical tasks and to operate safely
  - Safety Briefing and safety training is mandatory
  - If interacting with performers a choreography shall be developed and trained, and rehearsals shall be conducted
- Regular inspection before commission according to checklist shall be conducted and documented
- Geo fence to terminate flight within pre-defined safety area must be defined and implemented.
- Limit operational altitude to 50m AGL; implement 1:1 rule to audience when flying more than 50m AGL
- Operations shall be suspended when adequate level of safety cannot be maintained
- If required due to an inability to control environmental conditions, enforcement of safety area with restricted access (here: crew only; no exposure to third party) shall be conducted
- Avoid passing between items on the ground

# 5 Drone Battery Handling – Precautions and Guidelines

## Charging temperature

The drone battery shall be charged within 10℃~45℃ range in the Product Specification.

## Discharging temperature

Drone battery discharge temperature is -20℃~60℃.

5℃~45℃ environment is suggested when discharging with high current, small current discharge is suggested under 5℃ and above 45℃.

Discharge under too low or too high temperatures could lead to drone battery failure or other conditions.

## Storage

When voltage is 3.7V~3.9V, the drone battery could be stored for long term in the environment humidity ≤75%RH temperature -20~35℃. Activate the drone battery once every three months, so as to keep voltage within 3.7V~3.9V.

When voltage is over 3.9V, the drone battery should be stored in the environment humidity ≤75%RH, temperature -20~35℃. Storage time should be less than 7 days.