Commercial Building Installation Guide

Avi-on Pro Bluetooth® Lighting Controls

avi-on™

Simple Bluetooth® Controls

FCC Compliance

This device complies with part 15 of the FCC and Industry Canada license-exempt RSS standard(s). 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.

Important note: No change to the antenna or the device is permitted. Any change to the antenna or the device could void user's authority to operate the device and result in the device exceeding the RF exposure requirements.

Other Information

Product information is subject to change without notice. Check the Avi-on support website for the latest information.

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All trademarks are recognized as the property of their respective owners.

To ensure optimal reliability and to meet warranty requirements, Avi-on products must be installed according to the instructions in this manual.

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Audience

This manual is intended for use by skilled professional installation and maintenance personnel. Safety and shock hazards may be present during installation.

Table of Contents

Important Safety Information

Read this First

This manual contains important instructions for use during installation and maintenance of Avi-on Pro Bluetooth® Lighting Controls solutions.

Safety and Advisory Symbols

To reduce electric shock risk and to support safe installation and operation of the Avi-on Labs lighting control solution, safety symbols appear throughout this document to highlight important safety conditions and instructions.

⚡	DANGER:	Indicates a hazardous situation which could result in serious injury or death.
⚠	WARNING:	Indicates a situation in which failure to follow instructions may result in a safety hazard or equipment malfunction. Use caution and follow all instructions.
📝	NOTE:	Indicates very important information for optimal system operation. Follow instructions closely.

Safety Instructions

⚡	DANGER: Risk of Electric Shock	Only qualified personnel should install, troubleshoot, or replace AC-powered Avi-on components.
		Do not install AC components without first switching off AC power at the breaker.
		Ensure that all AC and DC wiring is correct and that none of the AC or DC wires are pinched or damaged before applying power.
		Always de-energize AC circuits before servicing.
⚠	WARNING: Risk of Equipment Damage	Before installing Avi-on components, read all instructions and cautionary markings on the products and in this manual.
📝	NOTE: Ensure Optimal Performance	To ensure optimal performance and meet warranty requirements, the Avi-on system must be installed according to the instructions in this manual.

Solution Overview

This section summarizes the Avi-on Pro Bluetooth® Lighting Controls solution and Bluetooth technology in preparation for system installation and commissioning.

Avi-on Pro Bluetooth® Lighting Controls Solution

Figure 1 shows a simple representation of an Avi-on Pro Bluetooth Lighting Controls system. The Avi-on App manages the user account on a phone or tablet called the Mobile, and is used to set up the network by commissioning system components such as high-bay luminaires, wall switches and occupancy sensors. Once the system is set up with the Avi-on App, a Remote Access Bridge may also be added to remotely control the system across the Internet.
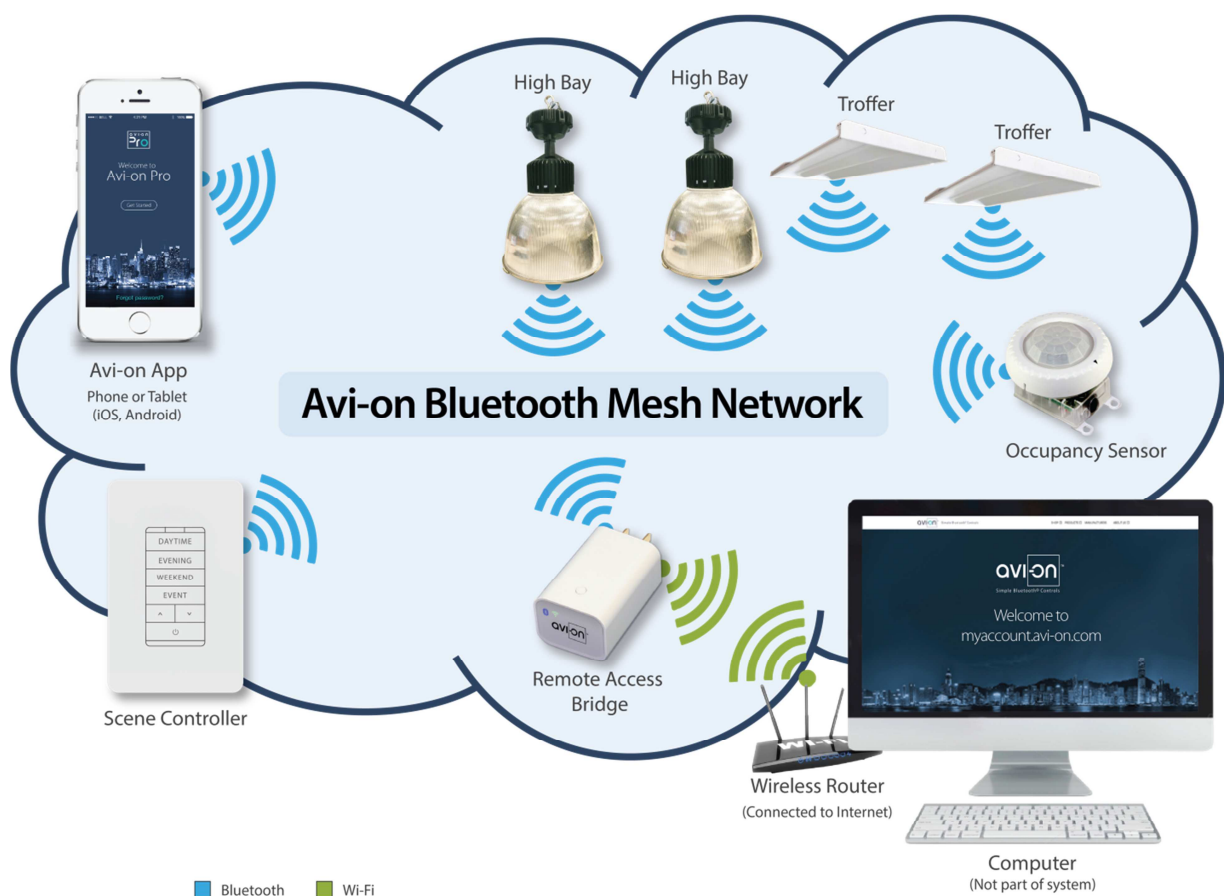

Figure 1. Simple Avi-on Pro Bluetooth Lighting Controls System

Key Solution Features and Benefits

The Avi-on Pro Bluetooth Lighting Controls solution provides simple, easy to use, lighting controls for warehouses, light-industrial spaces, and other commercial building lighting. Avi-on Pro Bluetooth Lighting Controls offer professional-grade features and benefits, including:

- Every device, switch, and sensor is individually addressable and can interact together without a central gateway or controller.
- Components install just like a regular fixtures and switches—no special wiring, panels or repeaters.
- Lighting can be reconfigured on the fly to accommodate changing workflows and events without special programming or expense.
- Enhanced usability with schedules, lighting groups, timers, ambience scenes, occupancy sensors and ambient light sensors.
- Supports DLC, ASHRAE 20.9, and Title 24 compliant installations.
- The system may be operated locally, with or without Internet access, using the Avi-on App or with a variety of wall switches and dimmers.
- Remote operation via the Internet is available, but optional.
- Available wireless switches may be used to expand control without additional wiring, simplifying reconfiguration of work spaces.

The Avi-on Pro Bluetooth Lighting Controls also provide energy efficiency benefits and enhancement to workflow management by controlling lighting use, intensity and color (as individual products are enabled).

Energy Efficiency Benefits

Avi-on Pro Bluetooth Lighting Controls enable energy efficiency by providing capabilities to target lighting to the needed workflow or operating conditions. The Avi-on Pro Bluetooth Lighting Controls solution supports DLC, ASHRAE 20.9, and Title 24 compliant installations. Many Avi-on compatible devices are Energy Star rated as well, including <0.5 Watt standby power.

With proper planning, scheduling, grouping, and use of sensors, the Avi-on Pro Bluetooth Lighting Controls solution can significantly increase lighting energy efficiency and may enable other efficiencies in process and workflow.

Operations Support

The Avi-on Pro Bluetooth Lighting Controls solution provides multiple effective means to support commercial building operations, workflows and energy efficiency including, grouping, scheduling, scenes, sensors, and remote monitoring. These capabilities can be used in conjunction with each other to create standard lighting scenarios for prescribed workflows while supporting the flexibility to adjust lighting to immediate and changing needs.

Grouping

The Avi-on Pro Bluetooth Lighting Controls solution allows devices to be grouped to support coordinated functions of multiple devices. For example, in a warehouse scenario, the lighting around a loading dock may be grouped to be able to fully illuminate the area when unloading a truck, and then dim the lighting when activity has decreased, yet retaining safe lighting levels.

Grouping is managed in the Avi-on App, allowing any device to be part of multiple groups and enabling changes in grouping at the user's convenience. Each group may also have associated schedules and scenes for automated management. Grouping definitions are retained in memory of each device and do not need to be reprogrammed on power cycles, or when adding/removing individual devices.

Manual lighting control in the Avi-on App is supported using dimming sliders. In the case of multiple color devices, one slider allows dimming adjustment while the other slider(s) and/presets adjust the color. These adjustments can be applied to Groups and Scenes as well as individual fixtures.

Group displays do not show device status. Devices may belong to multiple groups with multiple schedules, and when used in complex configurations, a group may contain devices that are in different states.

Scheduling

The Avi-on App scheduling feature allows for creation of schedules on a time of day and days of week basis. The scheduling function is available on each and every device, and runs autonomously once programmed. Additionally, multiple schedules per device and multiple schedules per group may be created, allowing for complete flexibility in system scheduling. Up to 20 schedules can be defined for an individual network (actual number depends on account license package). These schedules may be applied to an unlimited number of Devices, Groups, or Scenes. The schedule is retained in non-volatile memory and is preserved through power cycles. Clock time needs to be reset after a power cycle by opening the Avi-on App on the mobile phone and connecting to the network, or placing a Remote Access Bridge within the network. Scheduling functionality includes: Single on/off time per day, day select, Sunrise until xx time. Sunset until xx time, Turn on at 100%, turn on at last saved dimming level, and other options (see detailed scheduling documentation).

Scenes

The Avi-on scenes capability allows the combination of scheduling with custom dimming, light colors, lighting intensity and color time transitions. Transitions allow a smooth migration to a desired scene over a given period of time from one second to 12 hours. Scenes may be programmed to transition between already programmed scenes, from the previous status of selected devices to the current scene, or from the off state to the current scene being programmed. Adding transitions creates a more customized and intelligent lighting experience for applications such as compensating for daylight transitions and event breaks or shift changes, while supporting energy efficiency.

How It Works

Avi-on Pro Bluetooth Lighting controls employ low-power, long-range Bluetooth technology, and secure patented networking (U.S. Patent 9781245) to provide an efficient, programmable and reconfigurable lighting experience.

Bluetooth with Mesh

Bluetooth Low Energy is a standardized radio technology used in billions of devices worldwide, notably cell phones, tablets, automobiles and wireless headphones. Bluetooth Low Energy Radios have much longer range (100+feet) and lower power, and better security options than conventional Bluetooth radios. As a result, Bluetooth has a growing base in commercial and industrial applications including building automation and lighting controls. Bluetooth operates in the 2.4GHz unlicensed industrial, scientific, and medical (ISM) frequency band meaning that devices can be used as certified by the manufacturer without license.

Avi-on Pro Bluetooth Lighting Controls use high quality Bluetooth Low Energy radios in a mesh topology developed by Qualcomm and Avi-on (CSR Mesh™) resulting in very low power, but highly reliable long range operation with much higher security than either standard Bluetooth or Bluetooth Low Energy. The many-to-many device communication of the mesh topology optimizes the creation of large-scale networks for full-building coverage capability in lighting and building automation solutions. The Avi-on network does not require a central gateway or controllers.

Network Functions

The Avi-on Pro Bluetooth Lighting Controls solution leverages Bluetooth Mesh technology to create a "cloud" of coverage around each component in the system. Once components are commissioned during the installation process, the components self-configure into a network, connecting the individual components to create a system cloud. Any

component within the system may then communicate with any other component forming a completely distributed network. If a component, an Avi-on Movable Switch for example, is moved, it will seamlessly reintegrate with the new adjacent components with no required updates of gateway, routing tables, or interaction with other devices. As a result, the network can be reconfigured at will without change in operation as long as individual component ranges are not exceeded. Components typically achieve a 60 to 100 foot point to point range in office, hospitality, and residential settings, with double or triple that in open air settings like warehouse, outdoor, or manufacturing. Because all components work in concert, there is no limit to the range of the entire system Cloud as long as individual component ranges are not exceeded. Figure 2 conceptually demonstrates complete building coverage using the Avi-on Pro Bluetooth Lighting Controls solution.

Figure 2. Conceptual Avi-on Pro Bluetooth Lighting Controls Building Coverage

System Security

Bluetooth mesh networks support commercial/industrial grade security, and Avi-on implements stringent security procedures and precautions to provide a highly secure network for commercial applications. Security is implemented both at the mesh network level, mobile phone, and at all points connecting to the Internet/Cloud. Key security features of the Avi-on Pro Bluetooth Lighting Controls solution are listed in Table 1. The Avi-on platform has been subject to multiple independent third party security reviews for operation in corporate and industrial environments and has been found fully secure. In addition to embedded security measures, appropriate physical access security and account management practices must be maintained to ensure a secure system. Additional detailed information on Avi-on security is available on request.

Table 1. Avi-on Network Security

Mesh Network	Mobile/Bridge/Cloud
• All Bluetooth messages encrypted with AES 128-256. • Overlapping Networks in the same area cannot "cross" or be access by other users, even if they have the Avi-on app. • Network keys never shared over the air (expiring token only). • No IP traffic over lighting system. • All services removed from Bluetooth that could support a direct attack or as a platform for remote attacks. • No way to use standard Bluetooth connection tools in phones or others to communicate with devices. • Threats cannot learn how to connect to devices by sniffing packets. • Chipset configuration tools will not work to update firmware.	• Access password protected with secure email password reset. • All traffic is HTTPs encrypted. Passwords use SHA256 or better. • Remote Access Bridge passwords are unique and not available to users or factory. • No use of special or dedicated access LAN ports. • No VPN required, works with standard corporate firewall. • No way to connect to Bridge from outside with methods that can load malicious firmware (e.g. SSH, Telnet). Restricted access even inside local network, even if you have a password. • Components may only be registered to a single Avi-on account using a Mobile in close proximity to the Bluetooth network.

Avi-on Cloud Service

The Avi-on cloud service is an integral component of the Avi-on Pro Bluetooth Lighting Controls platform, but is largely invisible to installers and users. The cloud service manages user access, platform and network security, device management, account features, network configuration backup, device firmware management, and enterprise reporting. Web based access is available through http://myaccount.avi-on.com and may be used to reset password and username, request voluntary firmware updates, view configured devices, groups, scenes, and schedules.

Typical Solution Components

Typical Avi-on-powered components for commercial building solutions are listed here for ease of identification and basic feature summaries. All components may not be applicable to every system design. Components not listed may also be available, and all components are subject to manufacturer availability. Please check the Avi-on website for current product offerings.

Avi-on App

The Avi-on iOS/Android App enables mobile phone and tablet users to easily set up and change the system, using schedules, scenes, groups, sensors and more, with no wires, complex programming or central controller. The mobile phone or tablet running the Avi-on App is called the Mobile in this guide. The Mobile must support Bluetooth Low Energy (Bluetooth 4.0 or later) and an Internet connection via WiFi or cellular. The Mobile runs the Avi-on App and forms a bridge to the Bluetooth mesh system. The Mobile only connects to (generally) the closest system component and can "see" and control every element in the network.

Switches, Dimmers and Scene Controllers

Avi-on Pro and partner In-wall switches and dimmers, and Scene Controllers are available to replace traditional in-wall switches and dimmers. Additionally, Movable Switches may be mounted anywhere—including glass and metal surfaces—allowing workspace designers to add convenience or expand the reach of switching and scene management without any additional wiring.

Remote Access Bridge

The Avi-on Remote Access Bridge (RAB) provides the power to use an Avi-on network from anywhere simply by connecting the RAB to an Internet-connected WiFi router.

The Bridge creates a secure connection to the Avi-on Pro Bluetooth Lighting Controls system and enables the security of always knowing what lights are on or off. The RAB may also be used for remotely updating schedules and other system parameters, and it keeps the timers in the Avi-on system synchronized with global clocks.

Sensors

Bi-level Dimming Occupancy and Ambient Light Sensors are available for situational system configuration and for improved safety, worker convenience, and energy savings. PIR, Microwave, and Ultrasonic models are available in a variety of lens and beam angle options. All Sensors visible to the Avi-on App act as system controllers.

Avi-on Ready Integrated Fixtures and Drivers

Avi-on-powered luminaires are shipped from the factory with Avi-on communications already built in. A wide array of Avi-on-Ready high bay, track, outdoor, office, downlight, horticulture, other fixtures, and LED drivers are available from leading manufacturers. Check with Avi-on for the latest list of Avi-on compatible devices.

Installation Planning

Proper planning of the Avi-on Pro Bluetooth Lighting Controls system deployment will reduce the likelihood of need to troubleshoot the system, and shorten and simplify the installation and commissioning process.

Retain all Component Documentation

The documentation for each Avi-on compatible component should be retained throughout the installation process. Individual components may have specific information about LED indicators and procedures for component reset, in addition to usage instructions.

Develop an Installation Plan

The Avi-on Pro Bluetooth Lighting Controls system is easy for ordinary personnel to update and manage after installation. However, defining how the system will be used in daily operation and establishing workflows prior to system installation is critical to assure that the right equipment is specified, and to greatly help in commissioning devices and capabilities quickly and easily.

Define the Desired Functionality

Define the system features and functions that will be used for regular operation. Contact Avi-on for a helpful system planning tool useful for generating takeoffs and ensuring system compatibility. Key examples of functionality that should be planned include:

- Where to apply dimming and non-dimming controls.
- Individual fixture vs circuit/room-level control.
- Motion sensor needs, and under what lighting conditions they should operate.
- Define grouping for switches and sensors.
- Define schedules for fixtures and groups.
- Define scenes.
- Number and types of fixtures, switches, and sensors.
- Determine what functions will be performed remotely (over the Internet), if any.
- Plan which users will be accessing the system and what features should they have/not have.
- Ensure proper supply voltage is available for all fixtures, switches, and sensors.
- Determine regulatory and utility program compliance requirements.

Plan Avi-on Accounts

Each Avi-on Pro Bluetooth Lighting Controls system location is registered to a unique Avi-on account. A project may use multiple accounts (for example, a multi-building, multi-floor project), but each component may belong to only one account. Using more than one Avi-on account may be useful for large or distributed installations where the physical separation of components and group functions will be easier to manage separately. Multiple accounts may also be useful for operational workflows and for security management of the system. The Avi-on account structure should be part of installation planning. Although account creation is discussed in the System Installation section, it is recommended, especially for large installations, to create and validate accounts prior to physical installation of system components.

Define a Commissioning Plan

Creating an installation plan is critical to accurately pricing installation services for the project, determining the project schedule, and assuring a low risk, smooth project installation.

For smaller networks (under 50 devices) the components will typically be shipped preconfigured from the factory. All that will be needed it to install the components and power on the system. For larger systems it will be critical to work with a professional lighting control commissioning company, or work with Avi-on, to define a commissioning plan for the installation. For large systems, it is important to define a workflow to capture and associate the component radio address (MAC address) with the component's installed location. All other aspects of the commissioning can be applied either locally or remotely, independent of the physical installation.

Network Size Limits

In general, there is no limit to the size of project, size of building, number of floors or number of buildings in an Avi-on system. The only practical limit to network size is that local network switch or sensor control will be limited to working with devices on the same network (sharing the same network key). Multiple networks may be combined within the Avi-on App and Cloud tools for enterprise and multi-site control and management. So, in practice, this is not a constraint if installations are planned as prescribed in this guide.

For convenience of navigation in the Avi-on App, and to assure optimal performance in all configurations, the size of any individual network should be limited to less than 1000 devices, preferably 300-600 devices. This size will make it easier to locate individual fixtures, and to manage the system using the Mobile user interface.

Installation Documentation

Start the documentation of the installation with an Installation Map. An Installation Map is a helpful tool for installation planning, ensuring that lighting and controls are deployed to meet the functional requirements of the project. System components may be mapped to the physical space allowing for groups and scene areas to be identified. An Installation Map will also support installation zoning compliance with regulatory requirements around system layout. An Installation Map may consider components on multiple floors of a building, but generally will be developed on a floor by floor basis as the most common method for managing and grouping of devices. If a CAD lighting layout is available this is an excellent baseline document for an Installation Map.
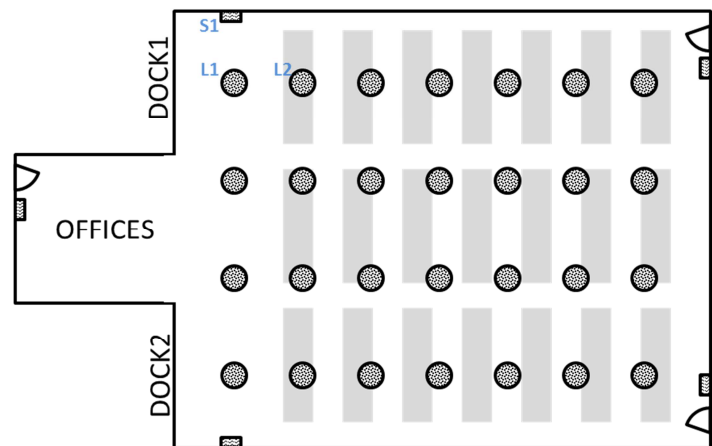
Figure 3. High Bay Installation Map Example

Avi-on-powered Lighting resources may be laid out on a floorplan as with any traditional installation, to ensure desired illumination per the luminaire specification. Switches and other lighting controls should also be marked on the floorplan. The example Installation Map in Figure 3 shows luminaires arrayed above shelving and four switches on the walls around the warehouse area. There is also a switch at the exterior door to the offices. Components on the Installation Map should each be given a label (Only 3 components, S1, L2, and L2, have been labeled for clarity.)

	NOTE: Component Spacing	Avoid large groups of devices (over 30) with very close spacing (<1 foot). Switches and sensors may be adjacent as required for proper use, but when possible, large numbers of components should be a minimum of 1 foot apart. Multi gang switch placements are not a concern.
	NOTE: Component Naming	Take time to plan a component naming scheme to facilitate use in the Avi-on App. Keep names short, but descriptive. Example: Building/floor/area/row/column. E.g. Building 1 floor 3 area 27 Row 16 Column 8 might have a name of: B1F3A27R16C8

Master Component List

In addition to an Installation Map, create a Master Component List. If components are numbered on the Installation Map, the critical component information: MAC address, component type, planned group(s) and scene(s), etc. can be listed for easier review and check-off during installation. Component naming is very important to ease of installation and commissioning, and should be descriptive of the component and its location. Ideally the Master Component List should be a computer-readable file (e.g. .CSV). Table 2 shows a partial example of a Master Component List. A Master Component List template is provided near the end of this guide.

Table 2. Example Master Component List

Component ID	MAC Address	Type	Zone/ Location	Group(s)	Scene(s)
B1A16 S1	MM:MM:MM:SS:SS:SS	Controller	2	All, Dock1	n/a
B1A16 L1	MM:MM:MM:SS:SS:SS	Device	2	All, Dock1	Unloading
B1A16 L2	MM:MM:MM:SS:SS:SS	Device	3	All, Dock1	Unloading

Plan Groups and Scenes

Consideration should be made for device groups that are planned and how those groups might be separately scheduled or scenes managed within them. If are areas in which a single device will be a member of two or more groups which might have conflicting schedules or scenes, take care when setting the group and scene definitions to avoid conflicts. Each device can be a member of up to 20 groups (depends on license tier).

Log Component MAC Addresses

It is recommended to make note of the MAC address of each device during to physical installation along with the defined fixture location. This will make it easier to identify devices during commissioning. It is possible to use the bar code on Avi-on radio modules to identify the MAC address easily. When combined with a commissioning tool that links the installation location and the MAC address, the grouping and labeling of the system can be done remotely through a file import process.

Differentiate Avi-on Devices from Controllers

Avi-on system components are designated as being a "device" or a "controller." In simple terms, a device switches on/off, or dims—such as a luminaire, and a controller controls the function of devices via Bluetooth, such as an occupancy sensor or wall switch. The distinction may be overlooked in daily usage of the Avi-on Pro Bluetooth Lighting Controls system, but it does have some importance in commissioning the system. Therefore, it is advised that the system components on the Installation Map be marked as being either a device or a controller.

✎	NOTE: Component	Either of an Avi-on Device or Controller.

✎	NOTE: Device	A device is a component that electrically switches on/off, or dims, such as a luminaire. Schedules, scenes and groups are stored in device memory.

✎	NOTE: Controller	A controller is a component that controls the function of devices via Bluetooth, without electrically changing the device, such as an Avi-on Movable Switch or motion sensor.

Installation Zones

Applying installation zones to an Installation Map and Master Component List will ensure that the Avi-on Pro Bluetooth Lighting Controls system has sufficient Bluetooth radio connectivity for optimal performance. Apply zones to the Installation Map with grid spacing to best suit the floorplan. Rooms or other existing partitions may be treated as zones rather than overlaying a grid. Each zone formed should have at least one device to avoid a segmented network. The purpose of these zones is to assure installation of a fully "meshed" network. In Avi-on, component control zones are called Groups, which can be applied completely independent of the physical installation zone layout. While radio range varies with device type and antenna, the following general guidelines apply for planning zones.

- In open spaces, such as outdoor or warehouse/manufacturing, device to device range capability should be well over 100 feet.
- Built out areas such as office locations or other areas with walls should have at least one device per room, and 50-80 feet between fixtures maximum.

✎	NOTE: Switch Placement	Switches should be placed within 60-100 feet of the nearest Avi-on compatible light. This spacing may cross zone boundaries.

✎	NOTE: Critical Network Links	If there are critical network links with larger spacing, call these out as part of the design. Selection of alternative antennas or possibly adding a device to serve as a repeater will assure solid network connectivity.

Figure 4 shows an example of a high bay warehouse floor segmented into installation zones. Within the shelved warehouse area, the luminaires and wall switches are distributed fairly uniformly across zones, showing no likely gaps in network connectivity. However, Zone 7 has only one device, a wall switch, to the far edge of the building almost two zones from the next device, the luminaire in Zone 8. The switch in Zone 7 might be unable to connect with the rest of the network if the switch was more than 60-100 feet from the nearest light or other switch.

Figure 4. High Bay Installation Zoning Example

Segmented Networks

A segmented network results from one or more devices or installation zones being out of range to connect with the rest of the network. The wall switch in Zone 7 of Figure 4 may result in a segmented network. Zones that are lightly populated with devices or that have physical barriers such as walls separating them from other zones should be reviewed and provision made to adjust device placement, or add one or more devices to ensure optimal network functionali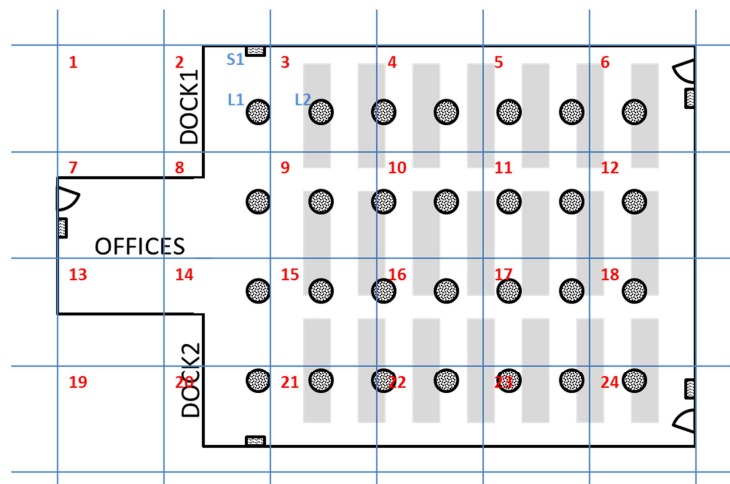ty. In the zoning example of Figure 4, adding a wall switch, either an Avi-on in-wall or plug-in switch, on the boundary of Zones 7/8 or Zones 13/14 will likely eliminate any segmentation. In most installations standard lighting spacing (20-60 feet) will be more than enough to assure a solid network.

Spanning Floors and Buildings

For large installations, it will be most common to define each floor as a separate network. Accessing multiple floors or aggregated controls is accomplished by switching between floors in the app, or the use of enterprise control tools. If there are multiple floors or spans across buildings desired in a system and there is a desire to maintain a single network, the Installation Map must provide for sufficient device connectivity across the gap(s). For example, if multiple floors (levels) are to be networked, the same consideration for sufficient device count and placement must occur across the level in at least one pair of corresponding floor zones to avoid a segmented network.

Planning for Regulatory Compliance

California's Title 24 building energy code, DLC specification, and ASHRAE 20.9 may require lighting controls in nonresidential spaces to meet specific lighting and control standards and capabilities, with formal certification testing of minimum requirements. Avi-on is qualified with multiple utility Tier 3 rebate programs and has applied for DLC control system certification

Within California, and at times elsewhere, certified lighting controls acceptance testing technicians are required to perform an acceptance test for certification and issuance of an occupancy permit. To best comply with regulatory and rebate requirements and facilitate acceptance testing, the lighting controls plan, similar to the Installation Map described, should be prepared during installation planning so that it can be reviewed in advance with the proper review authorities, and so support submission of pre and post installation documentation. Detailed planning of the Avi-on Pro Bluetooth Lighting Controls system will better enable electricians and the system commissioning agent, as well as any acceptance testing technician, to install, commission and test the system.

System Installation

System installation comprises physical installation of the Avi-on Pro Bluetooth Lighting Controls system devices, commissioning of the devices in the Avi-on App, and final commissioning of the system to ensure operation according to specification.

Physical Installation of the System

The physical installation process is straightforward, and generally does not require anything other than physical installation and powering of the devices and controllers.

	DANGER: Risk of Electric Shock	Only qualified personnel should install, troubleshoot, or replace AC-powered Avi-on components.
		Do not install AC components without first switching off AC power at the breaker.
	WARNING: Risk of Equipment Damage	Before installing Avi-on components, read all instructions and cautionary markings on the products and in this manual.

Physical installation of the system should be done by a qualified installer knowledgeable in the appropriate electrical and building codes, and safety procedures. Most AC-powered Avi-on components used in commercial building applications, e.g. wall switches and luminaires, will be installed in the same manner as their traditional counterparts. The installation instructions included with each component should be followed.

Parts and Tools Required

Tools required for installation of are listed in the individual component instructions.

Additionally, for commissioning of components, it may be useful to have an extra Avi-on Plug-in Switch, movable switch, and remote access bridge for troubleshooting and resolving segmented network situations that may arise during installation.

If the system will use a Remote Access Bridge (RAB), have an Avi-on Plug-in Switch available for installation. If the WiFi connection to an Internet router is uncertain, a portable Internet hot spot (in addition to the Mobile used for the Avi-on App) may be useful for troubleshooting.

	NOTE: Helpful Components	Have extra Avi-on components to aid in installation. Recommended components:
		• Plug-in Switch
		• Movable Switch
		• Remote Access Bridge
	NOTE: Remote Access Bridge Tools	Have a portable Internet hot spot available for Remote Access Bridge installation if the WiFi connection to the Internet is uncertain.

Network Size Considerations

For small networks with less than 50 components, it is often more convenient to add devices as they are installed, setting device names one at a time, and then applying grouping and schedules after the devices are installed and added to the network. For networks larger than 50 components, it is best to physically install components and then commission them.

	NOTE: Small Network Physical Installation	If performing a small network installation and adding devices as they are physically installed, review Component Commissioning section first.
	NOTE: Large Network Physical Installation	Do not add components as they are installed. Wait until all components are installed and then proceed to commissioning.

Install System Components

Use a regular electrical install method as with normal lighting fixtures, switches and sensors per the included installation instructions

Documentation at Time of Physical Installation

During physical installation it is critical that either a unique location name is manually applied to the fixture (by selectively turning fixtures on and off to find the appropriate location) or capturing the MAC address from the radio bar code on the fixture and mapping that with the defined fixture location in a machine readable file, such as a .CSV file. Ensure all information is captured on the Master Component List.

Component Commissioning

Component commissioning entails adding all Avi-on components to one or more accounts in the Avi-on App using the ADD (+) function. Components may then be grouped, scheduled and managed in scenes, or operated manually, as planned.

	NOTE: Stable Power	Ensure stable AC power, and fresh batteries, as appropriate for all devices in the test environment.

Internet Connection

When first creating an Avi-on account and logging into the Avi-on App, the Mobile requires a connection to the Internet for user authentication and to retrieve account capabilities. After this initial setup, the Avi-on App may be used to make changes to the system without the Mobile being connected to the Internet, but this practice is not recommended for installation and commissioning. An Internet connection is required to synchronize and permanently retain any changes made to the Avi-on system in the app. The Mobile(s) running the Avi-on App should be synchronized on the Internet at least daily.

	NOTE: Stable Internet Connection	It is important to ensure a stable connection to the Internet for the Mobile (i.e. mobile phone or tablet) during component commissioning. This will eliminate the risk of data loss and assure that all components are properly programmed if multiple users are working at the same time. If WiFi or is unavailable or unstable, use of a portable Internet hot spot is recommended.

If multiple Mobiles are used at the same time to commission the system without an Internet connection it is possible to incorrectly configure devices. While not recommended, if it is necessary to commission without access to the Internet, it can work properly by:

- Only have one Mobile commissioning in a single area at a time
- Do not log out of the Avi-on App until it has resynchronized with the Cloud. The Mobile app will prevent a logout if not synchronized, but be sure to reconnect to the internet as soon as possible after commissioning, and no less frequently than daily when changes are made in the app. Failure to re-sync, logging out without synchronizing, or Mobile phone failures/breakage, will cause all component network settings to be lost since the last Cloud sync and will require re-commissioning of the full circuit of components that were commissioned during that period.

⚠	WARNING: Data Loss	Data loss may occur in the Avi-on system if changes made in the Avi-on App are not properly synchronized to the Cloud via the Internet. Always ensure that a stable Internet connection is available to the Mobile before attempting to close the Avi-on App or power down the Mobile. Always ensure a full battery on a Mobile being used to make changes to the Avi-on system, if working remotely.

Install the Avi-on App

To begin installation, download and install the Avi-on App on a reliable iOS or Android mobile device (Mobile) to be used throughout the installation and commissioning process. For best results set the Mobile to perform automatic updates of the Avi-on App to assure you always have the latest version.

📝	NOTE: Mobile Radio Quality	Bluetooth and Wi-Fi radio performance varies dramatically across different Mobiles. Installation performance relies on the quality of the Mobile radio and antenna that is used to set up and operate the network.
📝	NOTE: Bluetooth Low Energy	The Mobile used for system commissioning and management must support Bluetooth Low Energy (Bluetooth 4.0 or greater). Most high quality Mobiles available since 2013 support Bluetooth Low Energy.
📝	NOTE: Mobile Compatibility	Use an iOS Mobile or a high quality Android Mobile for installing new networks.

Create an Account

Create an account on the Avi-on App. In some cases, multiple accounts may be desirable to separate access to sub-networks within a building for access security, workflow partitioning, or physical partitioning, such as across levels. Refer to Installation Planning for planned accounts. Be sure to maintain strong security practices with account passwords. Depending on your specific account needs, it may be necessary to contact Avi-on to apply the necessary account capabilities to access all of the contracted functions. For best results:

- Establish the accounts before the start of installation.
- Verify the account capabilities match those required for the job by contacting Avi-on or using plug-in test device and view the capabilities on the Avi-on App.

✎	NOTE: Account Validation	The account will require email validation before it can be used. Be sure the email address used to establish the account can receive the confirmation email, and that validation is completed before commissioning begins. For validation problems, contact Avi-on support at http://support.avi-on.com.

Commission Components in the Avi-on App

With the Avi-on App downloaded and account(s) created, power should be applied to all installed components to proceed with adding components to the account(s). Components may have visible blue LEDs which will double-flash when ready; all components will automatically turn on when powered. For very large networks, contact Avi-on for support in adding components to an account by means other than direct input in the Avi-on App.

✎	NOTE: Isolate Electrical Circuits	When performing manual component commissioning, de-energize electrical circuits adjacent to the zones being added, if possible. This will simplify visibility of components in the app during commissioning.

Add by Installation Zone

The best practice for commissioning devices is to follow the installation zone map from one zone to an adjacent zone, ensuring that each zone contains at least one component, until all components are commissioned. See Figure 5. By ensuring that adjacent zones are commissioned, the likelihood of inadvertently creating a segmented network will be greatly reduced. Component commissioning order may be developed in advance on the Master Component List to speed the commissioning process.

Add Devices then Controllers

Within each zone, add the Devices prior to adding Controllers. This practice reduces the likelihood of a "sparse network" condition (see Troubleshooting) in which there are too many controllers seeking to connect to too few devices which can lead to connection issues during commissioning with the Mobile running the Avi-on App.

Adding Components

To add a component to the Avi-on Pro Bluetooth Lighting Controls system, ensure that the component is powered and within about 100 feet of the Mobile running the Avi-on App.
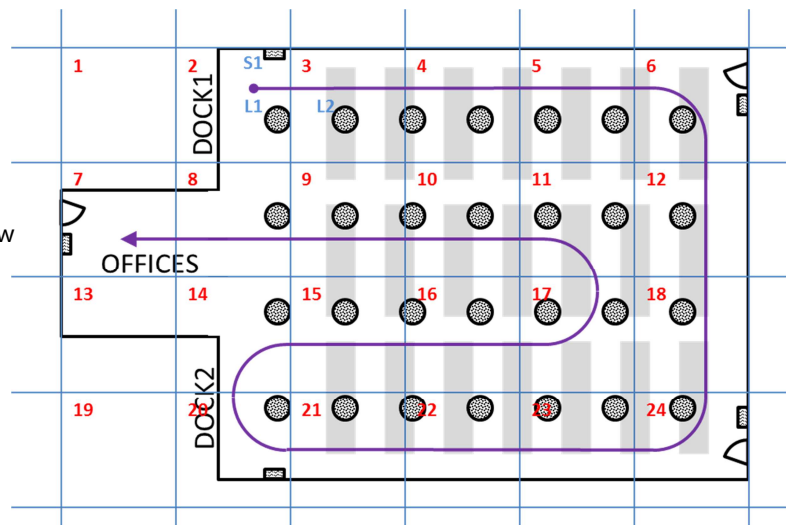
Figure 5. Zoned Installation Map with Commissioning Path

If the device has an indicator LED, it is powered and ready to be added if the LED is double flashing. If the (typically blue) LED is either a solid color or turned off, then the Avi-on device has already been added to another account, and will need to be removed in the "owner" account prior to adding to the new account, to ensure system security. See the Troubleshooting section for information on this process.

	NOTE: Commission the RAB Last	If a Remote Access Bridge is used in the system, commission it last to avoid potential effects from being too far from a Bluetooth component and sparse networks due to multiple controllers.

To add devices to an Avi-on account, press the "ADD Device" or "+" button on the Device screen of the Avi-on App. Available devices in range will be displayed in the app. Add all components that are visible in the app which are part of the network and account being commissioned. After completing the commissioning of one or more components, the Devices menu will list of all Avi-on devices that have been added to the account and controllers will appear in on the controllers menu. For small networks, exercise each device by turning it on and off in the Avi-on App, and add the descriptive component name that was planned on the Master Component List or Installation Map. For larger networks, the device names should have been implemented during the Installation Planning phase.

	NOTE: Device and Controller Lists	Although Avi-on controllers can be commissioned using the ADD function from the Devices screen, they will not appear in the list of devices. Controllers will be shown in their own respective menus that can be accessed through the app drawer.

Create an "All Devices" Group

After completing the commissioning of all components, create an "All Devices" group in the Avi-on App, and add all devices to the group. To avoid mistakes in large deployments, it is suggested to add 10 devices to the All Devices group at a time and save the group, repeating this process until all devices have been added.

Using each controller in the Master Component List, exercise the All Devices group to ensure that all (applicable) devices respond to all controllers.

	NOTE: All Devices Testing	When testing controllers on the All Devices group, • Switches should cause all devices to switch on and off. • Dimmers will only affect dimmable devices.
	NOTE: Controllers are not Grouped	Controllers act upon groups but are not included in groups.

Install the Remote Access Bridge (RAB)

Install the Remote Access Bridge last.

1. Ensure a reliable Internet connection. If the connection to the WiFi router is in question, use a cellular hotspot for commissioning.
2. Place the RAB about 5 to 10 feet from the WiFi router.
3. Ensure that the nearest Avi-on switch is no more than 30 feet from the RAB.

	NOTE: RAB Installation Distances	While point-to-point distances for Avi-on Bluetooth devices can be as much as 100 feet, getting a solid, reliable connection to the RAB is important

4. Optionally, use an Avi-on plug-in switch for setting up the RAB. Power the plug-in switch in the same room as the RAB to create an instant Bluetooth bridge for the RAB to assure better communication.

	NOTE: RAB Bluetooth Bridge	Use an Avi-on plug-in switch to create an instant Bluetooth bridge for the RAB.
		Do not use another RAB or an Avi-on Movable Switch as a bridge for RAB installation, as they do not offer the type of communication needed to commission a RAB.

5. Plug in the RAB, and wait for both the Blue Bluetooth light and the Green WiFi light to start flashing before adding the RAB. This may take 60-90 seconds from power on.
6. Configure the RAB to the Wi-Fi network on the desired router using the Avi-on App.
7. Turn off Bluetooth on the Mobile so that it connects to the Internet via WiFi only. Test control the system via the Internet. If the system operates, the RAB is correctly installed. It may take 1-3 minutes for the Cloud registration to complete and remote access to enable.
8. If the RAB is not properly controlling the Avi-on devices, check the Internet connection and repeat the installation process after a reset of the RAB.

	NOTE: RAB Reset	The RAB button has two reset functions. Short-press (~5s) to reboot the unit, and long-press (~15-20 seconds) to remove the RAB from the present account and reset the WiFi connection information.
		If the button is inadvertently pressed for longer than 30s, the RAB may enter debug mode and not respond. If "unknown device" appears on the Mobile ADD screen the RAB is in debug mode. If this happens, unplug the RAB for a Power Cycle Reset and add it back to the network. It may require two power cycles to restore fully.

9. Take a photograph of the specifications, make, model, type of router, and note the Internet service (e.g. Comcast) for your records.

Commissioning the System

With all components added and tested with the All Devices group, final system commissioning can be completed. System commissioning comprises the testing of planned groups, scenes, and schedules, and may also include certification testing to rebate and permit requirements.

Create Groups

Using the same process as done for the All Devices group, create and populate any other planned groups for the system that should be tested for commissioning. Groups may also be created and adjusted after commissioning.

Create Scenes

Using the Avi-on App, create any scenes that are planned for testing at commissioning. Scenes may also be created and adjusted after commissioning.

Create Schedules

Using the Avi-on App, create any schedules that are planned for testing at commissioning. Scheduling may be performed on individual devices, groups or scenes. Schedules may also be created and adjusted after commissioning. To simplify scheduling, the Avi-on App supports reusable schedule templates. Create the schedule templates in the schedules area in the app drawer. Then apply the schedules to the desired groups, scenes, and devices.

System Testing

Functionally test all desired combinations of devices, controllers, groups, scenes and schedules. It is recommended to create a test plan and test matrix to support check-off of the desired scenarios. If there are other requirements for test, such as measurement of illumination or Title 24 compliance, these should be performed in conjunction with the appropriate Avi-on group/scene/schedule combination(s).

Account Management

The Avi-on Pro Bluetooth Lighting Controls system that is now installed and commissioned may be managed at any time in the Avi-on App. The network of components is associated with the account on the Avi-on App and may not be used by another account unless decommissioned from the current account (see Troubleshooting for the component removal procedure).

Security Management Practices

Multiple control devices may be used to control the Avi-on system, but each will require the same account to be used in the Avi-on App. Therefore, it is recommended that the authority in charge of the Avi-on Pro Bluetooth Lighting Controls system, who manages the account password, be responsible for allocation of the password to other individuals and to ensure the password is changed when there are staffing changes. The number of Mobiles that can be used at one time is limited only to the number of devices in the network to avoid a sparse network condition.

For added network security, ensure that component firmware updates are completed whenever available, although firmware updates tend to be quite infrequent. A notification icon will appear on the component control in the Avi-on App when an update is available. Available updates may be accessed at any time by logging into myaccount.avi-on.com and checking the "request firmware updates box."

Web-based Account Management

Avi-on accounts are part of the Avi-on cloud services and may also be accessed and administered via the Internet at https://myaccount.avi-on.com. The Avi-on cloud services provide a wealth of information which is available to support 100% off-site diagnostics, remote system management, and remote resolution of project issues including:

- 100% of all device configuration information, including installed devices with firmware version and device ID.
- Manage key account information including:
    - Email Address
    - Password
    - Name
    - Phone Number
    - Update email subscription preferences
    - Resend account verification email
- Customer Service Support Tech screens with complete diagnostic information are available for Avi-on support technicians and selected partners service reps.
- Turn on and off devices remotely (requires Remote Access Bridge)
- Manage group schedule and scene definitions, with remote updating capability (Requires Remote Access Bridge).
- History of all changes ever made to the system configuration with time stamps.
- Flexible and remote configuration of individual user account capabilities, features, and functions accessible to the mobile app, updatable in real time.
- Listing of all mobile phone connections, including phone model, operating system, and Avi-on application version.
- Alexa Smart Home Skill Interface.
- Partner API access.

Troubleshooting

Use the Troubleshooting Guide in Table 3 to find issues being experienced and the procedures to resolve them. Detailed procedures follow the Troubleshooting Guide or may be found at support.avi-on.com.

Table 3. Troubleshooting Guide

Issue	Resolution
Managing Components	
Remove a Registered Component.	Components should be decommissioned using the Avi-on App while connected to the Bluetooth network. Always turn a device on and off using the app prior to decommissioning to ensure the proper target is reachable. Decommission components by selecting to REMOVE the component from its details page in the Avi-on App.
	If attempting to remove a device that is not connected through the Bluetooth mesh, the app will reply with "can't find device" and present the option to select "my device is broken" to remove it anyway. Do not select this option unless certain the device will be replaced in the network, as this will disassociate the device from the account without resetting it and it will no longer be accessible.
	If the component account is no longer available, the component may be removed from the account by performing a hard reset. Refer to the Hard Reset procedure in Detailed Procedures.
Component is to be used with a different account.	Decommission the component by selecting to REMOVE the component from its details page in the Avi-on App. If it is not possible to remove the component from the account to which it is currently registered, Hard Reset the component, making it usable in a new account.
Component is no longer desired in the system.	Decommission the component by selecting to REMOVE the component from its details page in the Avi-on App. If it is not possible to remove the component from the account to which it is currently registered, Hard Reset the component, making it usable in a new account.
Component Issues	
Component appears to be malfunctioning.	Power cycle the component by de-energizing the circuit at the breaker for 3-5 seconds. Some switches have a pull tab to cycle the power.

Issue	Resolution
Component was working but no longer responds to the Avi-on App even after power-cycling.	Ensure that the correct account is being used to view the details of the component in question.
	Ensure that the component in question has not been added to a different account.
	Ensure the component is properly powered.
	Stand near the device before opening the app to assure connectivity to the device.
	Power cycle the component or circuit as necessary (See Power Cycle detailed procedure).
Network Connectivity Issues	
Components are powered on but do not appear in the "Add a Device" screen of the app during initial installation.	Ensure that the component has not already been added to a different account. If it has, remove the device from that account or Hard Reset it if access to other account is not available.
	Possibility of a segmented network. Refer to Segmented Network Evaluation.
Difficulty with Bluetooth connectivity.	Refer to Bluetooth Radio Connectivity Evaluation.
Not all devices respond when turning them on/off in the app.	Possibility of a segmented network. Refer to Segmented Network Evaluation.
	Possibility that some devices are not yet added to the network. Check the + button (device add screen) in the Avi-on App to see if there are devices yet to be added.
Moving the Mobile around the site changes the devices that can be operated.	Possibility of a segmented network. Refer to Segmented Network Evaluation.
Inability to program certain devices.	Possibility of a segmented network. Refer to Segmented Network Evaluation.
Using multiple Mobiles and one or more will not connect to the Bluetooth network	Possibility of a sparse network. Refer to Sparse Network Evaluation.
	Possibility of a radio connection issue. Refer to Bluetooth Radio Connectivity Evaluation.
Operational Issues	
Devices not responding to schedules programmed in the Avi-on App	Two or more schedules applied to the device may be overlapping, leading to unexpected behavior. Review schedules and correct overlaps. This may be easiest to view on the web at myaccount.avi-on.com.
	The device might not be in the expected group, or the group was not programmed with the correct schedule.
	The schedules were applied but the device was not in range to receive them. Try the schedule repair function in the Avi-on App, first assuring connectivity to the devices by turning them on and off.

Detailed Procedures

Reset a Component

Hard Reset and Power Cycle are the two types of component reset that may be performed depending on the device and reason for reset.

To Hard Reset a Component:

Recovering a device that was inadvertently left in the wrong account is the only common scenario that will require a hard reset. Review the Troubleshooting Guide and consider a Power Cycle prior to a Hard Reset.

✎	NOTE: Hard Reset	A Hard Reset is sometimes initiated by a press of the reset button on a component. Components vary, review product-specific instructions for exact procedures.
		Once a component is hard reset, it will no longer belong to an account. The component will need to be added to an Avi-on account before it can be used again.
		The hard reset erases any schedules, groups or programs stored in the memory.
⚠	WARNING: Impact to Other Components	A Hard Reset is sometimes initiated by cycling power multiple times. For lights and other devices that are out of normal reach and often on the same electrical circuit, initiating a Hard Reset on one device (by cycling the circuit) will force all components on that circuit to be Hard Reset.
✎	NOTE: Avi-on App Actions	A Hard Reset will not remove the device from the Avi-on App account. That must be done manually by pressing the "my device is broken" button while removing it from the app.
⚠	WARNING: Loss of Device Control	If a device is Hard Reset, but not removed manually from the app, the device will still appear on the app but not be controllable. If this occurs, re-add the device to the network using the + button. Checking the device add screen (+button) is a good way to see if any devices that have been Hard Reset.

1. Plug-in or power the device.
2. Consult the device specific install guide for the reset procedure for that device. It may be a button push sequence or power cycle sequence depending on the device.
3. The device's LED (if applicable) will blink in sets of two to acknowledge the reset. If the light does not blink-- repeat this process--hold the button longer.

To Power Cycle a Component:

1. Remove power from the component at the power supply. For in-wall devices, remove power at the circuit breaker. Simply unplug plug-in components.
2. Wait 5 seconds.
3. Reapply power by closing the circuit breaker for in-wall components, or re-plug plug-in components.

Bluetooth Radio Connectivity Evaluation

Bluetooth radio designs are selected by the specific phone/tablet manufacturer, so Bluetooth and Wi-Fi radio performance varies dramatically across different devices. Apple® is the only iOS operating system manufacturer and

has generally performed well with Avi-on solutions. There are dozens of Android device manufacturers leading to a wide performance variance across these devices. Because Avi-on relies on the quality of the Mobile's radio and antenna, the quality of the Mobile directly impacts the performance of Avi-on compatible products.

If the Mobile is having trouble connecting to Avi-on compatible components, follow these suggestions:

1. Use an iOS device or a high quality Android device for installing new networks. Download the app, and login with the SAME username and password used on the previous Android device.

2. Place the Mobile on a table instead of in your hand when using the Avi-on app (this might help with radio interference which may be caused by your hand.

3. Ensure that the component to be connected is nearby. At first attempt to connect to a component, send the Avi-on App to the background on the Mobile and then bring it to the foreground before any other apps, and let it reconnect. This will make sure that the closest device is the one connecting.

4. Use an Avi-on Movable Switch for operation of the Avi-on device if the Mobile has trouble connecting to the network. The switch will not experience range or connection problems and the device can be managed without a Mobile.

Segmented Network Evaluation

A segmented network occurs when there are two separate sub-network "clouds" of coverage that cannot communicate with each other. This is usually caused when there is too much distance between devices. Symptoms of a segmented network include:

- Units are powered on, but do not show up in the "adding a device" screen during initial installation.
- Not all units respond when turning on/off in the app.
- Moving around the site changes the devices that can be operated.
- Inability to program certain devices.

Following the zoned installation and commissioning procedure will greatly reduce the likelihood of a segmented network. When a segmented network is suspected, the addition of one or more devices in the suspected gap area should help to join the two sub-networks. Avi-on Plug-in switches or Avi-on Fixture Adapters placed in ceiling areas may be used for this purpose.

Sparse Network Evaluation

A sparse network occurs when there are too many Mobiles seeking to connect to too few devices. Each Mobile seeks to connect with a device, and if there are not enough devices in range, multiple Mobiles may not be able to connect to the mesh network at the same time. In a commercial deployment, a sparse network is unlikely during normal use, but may occur during commissioning if too many Mobiles are used in an installation zone before a sufficient number of devices are added.

For example, an installation zone with one light and 5 Mobiles is a sparse network. One Mobile will "take" the light, leaving the other Mobiles with no device for connection. If there were 5 or more devices in the zone and 5 Mobiles there would be no problem. The main indicator for a sparse network is that the network functions properly until one or more Mobiles are added.

Troubleshoot a possible sparse network by doing the following:

1. If more than one Mobile is in use for control of the system, log out of the Avi-on App on all Mobiles except one, and disconnect any Remote Access Bridge.

2. Try connecting the logged-in Mobile to the Avi-on device network. If it works, too many Mobiles were connected at once and the number of Mobiles must be reduced, or the number of devices in the system increased.

Master Component List Template

Project:		Account Name:			User:		Version:		Date:		

Commis-sioning Order	Compo-nent ID	MAC Address	Type (Device/ Controller)	Zone	Location	Group(s)	Scene(s)	Installed ✓	Commis-sioned ✓	"All Devices" Function ✓

Installation Notes

Simple Bluetooth® Controls

Avi-on Headquarters

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Commercial Building Installation Guide, v 1.0