

# Aperio® Online Mechanical Installation Manual

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# 1 Introduction

## Purpose

The main purpose of this manual is to provide necessary information to plan and perform the mechanical installation of Aperio communication hubs. Intended reader is installation personnel, project managers and people with similar responsibilities.

## Scope

This manual covers information and instructions for a complete mechanical installation of Aperio online products.

After completing the mechanical installation of the Aperio communication hubs, refer to ST-001322-Aperio Online Quick Installation Guide and ST-001321-Aperio Online Programming Application Manual software for setup of Aperio products for final use with an EAC.

## Applicable products

This manual can be used for all versions of communication hubs

## Product availability

The products included in this manual may not be available on all markets. Please check your local ASSA ABLOY company for details.

## Aperio support in the EAC system

Note that the Aperio support may vary depending on the Aperio communication hub used and the level of integration. Please contact your OEM for details.

## Abbreviations and definitions

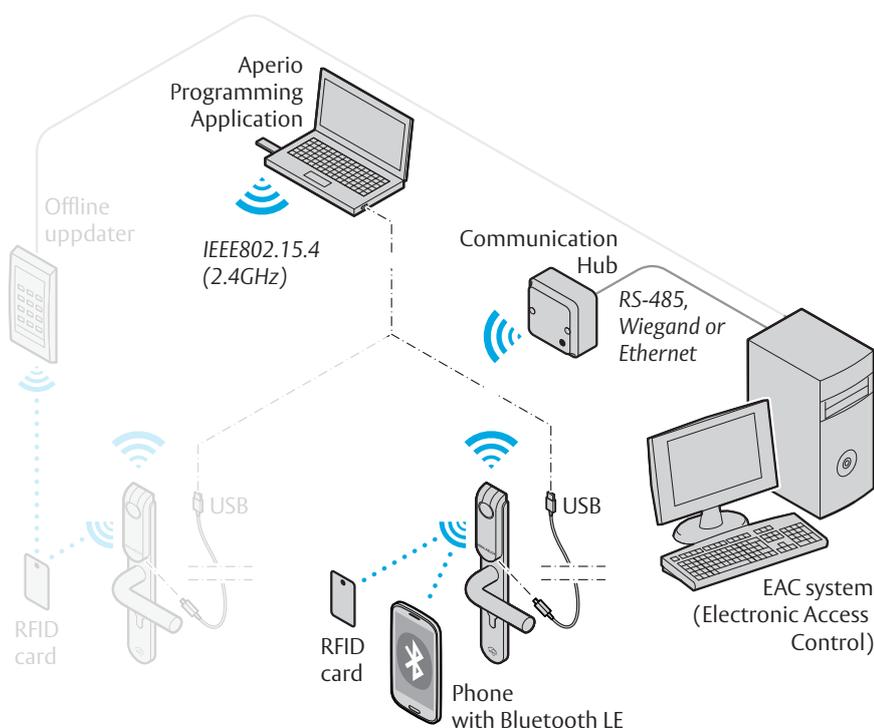
Abbreviation	Definition
<b>EAC</b>	Electronic Access Control. The system controlling access decisions.
<b>DIP</b>	Dual in-line Package. A manual electric switch used for settings on the communication hub.
<b>RFID</b>	Radio Frequency Identification. The credential technology used.

## References

[1]	ST-001322-Aperio Online Quick Installation Guide
[2]	ST-001321-Aperio Programming Application Manual

## 2 System Overview

Figure 1. Aperio technology overview



### The Aperio system

The Aperio system is used in the following way: The user holds an RFID credential in front of an online or offline lock.

- **Aperio Online:** An online lock sends card credentials wirelessly to the communication hub which in turn communicates with an EAC (Electronic Access Control) system (wired through RS-485, Wiegand or TCP/IP). The EAC system makes the access decision. The decision is sent via the communication hub to the lock and access is granted or denied.
- **Aperio Offline:** Refer to the Programming Application manual for more information, ref [1].

### Regulatory and security information

Refer to the Programming Application manual for regulatory and security information.

### The Aperio Programming Application

The Programming Application is used for the configuration of a door installation. It is normally installed on a laptop and is used with an Aperio USB radio dongle connected to one of the USB ports.

The USB radio dongle enables the programming application to connect to a communication hub and an online lock (via the communication hub) or directly to an offline lock. V3 locks can also be connected to with a USB cable.

### Communication hub versions and EAC interface

There are four communication hub types according to the table below:

Version	Interface	Maximum number of locks/sensors
AH15	Wiegand/RS 485*	1
AH20	Wiegand (Adv., Std)	1
AH30	RS-485	8/16***
AH40	IP (Ethernet)	8/16**/64***

\* The firmware type loaded into the communication hub controls what interface is enabled.

\*\* Applicable for release 3.0.0 and onwards.

\*\*\* Applicable for GEN5 communication hubs.

### 3 Planning the Installation

#### Aperio wireless range

Performance will vary from installation to installation based on exact placement and RF environment. ASSA ABLOY recommends the installer perform an RF site survey before installing hub and selecting Aperio channels.

In difficult environments (e.g. heavy radio interference is expected), it is recommended to keep the distance between the device and the communication hub well below the maximum recommended distance. There is no minimum distance. Aperio Communication hubs are not rated to be installed in the plenum space.

#### Mounting position for AH20/30/40

The AH20/30/40 communication hub is designed so that it can establish a reliable radio link regardless of the mounting position (horizontal or vertical) of the communication hub and the type of lock being used.

For hubs using the internal antenna, it is recommended that the device to hub distance be limited to 25 meters/80 feet, depending on the environment. Maximum Aperio hub to reader distances stated are based on typical applications with the signal between Aperio hub and reader going through a maximum of two standard inner walls. Line of sight without obstruction *may* provide longer range but *cannot* be guaranteed.

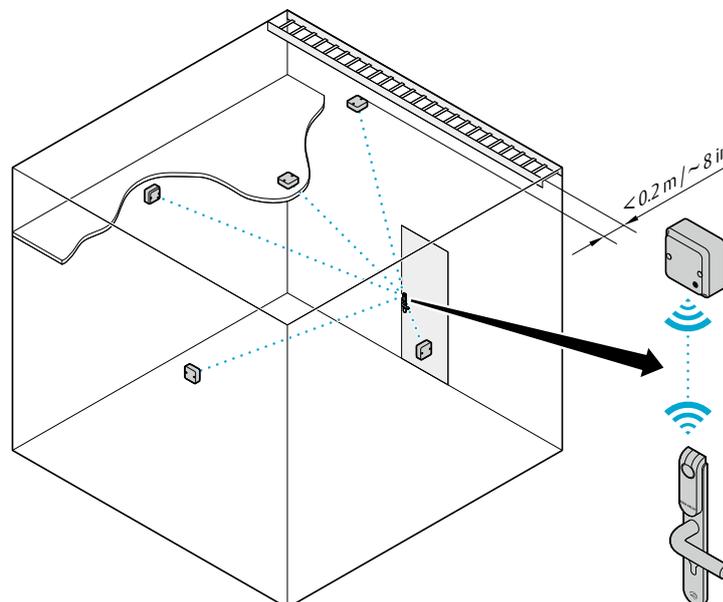
**i** When installing in difficult environments with radio interference or with the presence of metal objects that can attenuate the signal, it is recommended to test the radio signal before mounting the communication hub permanently.

This chapter includes guidelines for selecting the correct installation place for communication hubs in an Aperio online EAC system. This manual also describes how to connect the communication hubs to the power supply.

The AH20/30/40 communication hub can be mounted according to the following figure.

	AH20/30/40 Communication hub with internal antenna, installed on a wall.
	AH20/30/40 Communication hub with internal antenna, installed in the ceiling.
	AH20/30/40 Communication hub with external antenna, installed in the ceiling.
	Door with Aperio lock

#### Placement options for AH20/30/40 communication hub



## Placement options for communication hub

It is very important to find the best possible placement of the communication hub, in order to get a stable and reliable radio link. Depending on the floor plan of the installation site, type of communication hubs used, use of external antenna and presence of disturbances will all affect the positioning of communication hubs. Follow these guidelines to find the best installation placement, also see the following chapter for installation examples.

### General installation guidelines

- Try to install so that locks and communication hub “see” each other with the LED on the communication hub “pointing” towards the lock. This is only applicable when using internal antenna.
- If this is not possible, find a placement so that there are no concrete and metal objects in between the lock and the communication hub.
- Avoid installing the communication hub in a low position, where radio waves can be blocked by objects or people passing by during operation.
- The lock and the communication hub should be placed on the same side of the door. Shorter distance and “light” materials in the walls also permits placement on opposite sides.
- Be aware of that nearby metallic sheet or mesh will attenuate the radio signal. Inner ceiling, for example, is sometimes covered with foil or metallic mesh.
- Always evaluate the installation site for possible sources of disturbance. Follow these installation guidelines regarding disturbances to ensure adequate functionality:

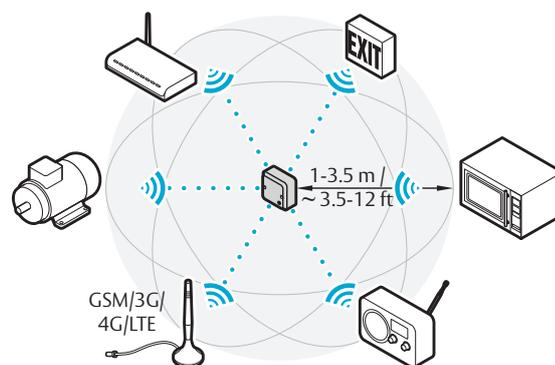


Figure 2. Minimum distance to radio emitting devices

- Possible sources of interference include WiFi/WLAN routers and other radio transmitters operating in the 2.4 GHz band, microwave ovens, electric motors, wireless emergency exit signs, mobile network antennas and other high power electrical equipment. Depending on the nature of the equipment, frequencies, and power levels, keep the communication hub and lock at a distance of at least 1-3.5 meters (3.5 - 12 feet) from these sources.

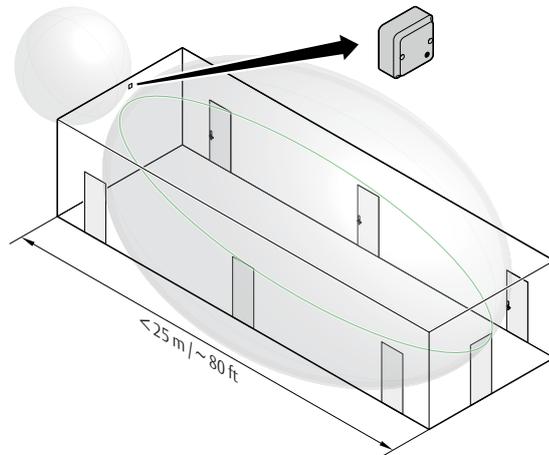
### Radio coverage for internal and external antenna

For hubs using the internal antenna, it is recommended that the device to hub distance be limited to **25 meters/80 feet**, depending on the environment. The internal antenna has an oblong coverage area (shown below) and is most appropriate for applications where the hub is directly facing the device(s), e.g. mounting on the wall at the end of a hallway of doors.

The radio coverage backwards is limited to 3 m/10 ft for AH20/30/40. The coverage also depends on the type of wall it is installed on.

For hubs using the external antenna, it is recommended that the device to hub distance be limited to **12.5 m/40 ft**. The external antenna has a torus shaped coverage area (shown below) and is most appropriate for applications where the devices are surrounding the hub, e.g. mounting on the ceiling less than 5m/16ft high in a room or hallway.

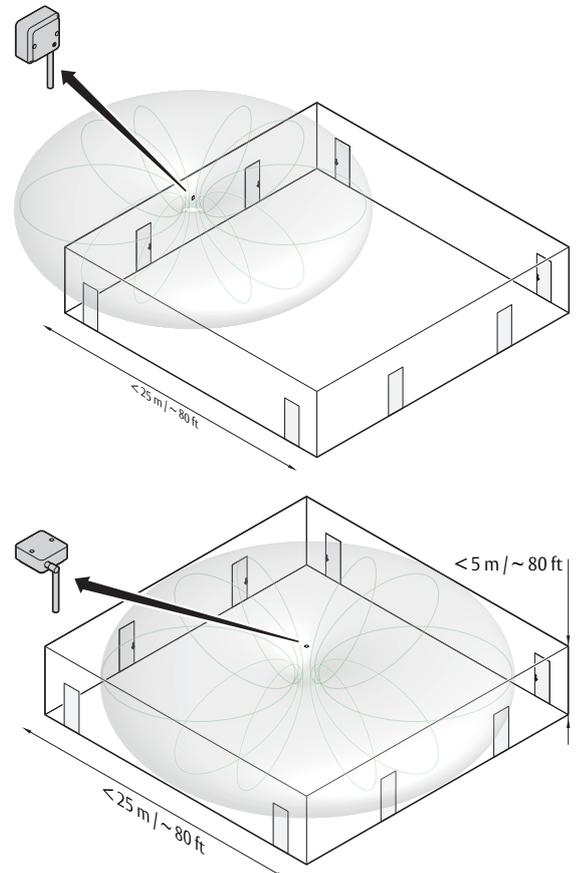
An example of a situation where external antenna could be used is when the placement options are limited for the communication hub.



Examples of environments that may affect range include:

- Close proximity to devices such as Wi-Fi access points, Mobile network antennas, microwave ovens, high power electrical equipment, cable ladders and emergency exit signs.
- Concrete wall with rebar, multiple inner walls and glass windows (especially with metalized film) located between Aperio hub and the Aperio reader.

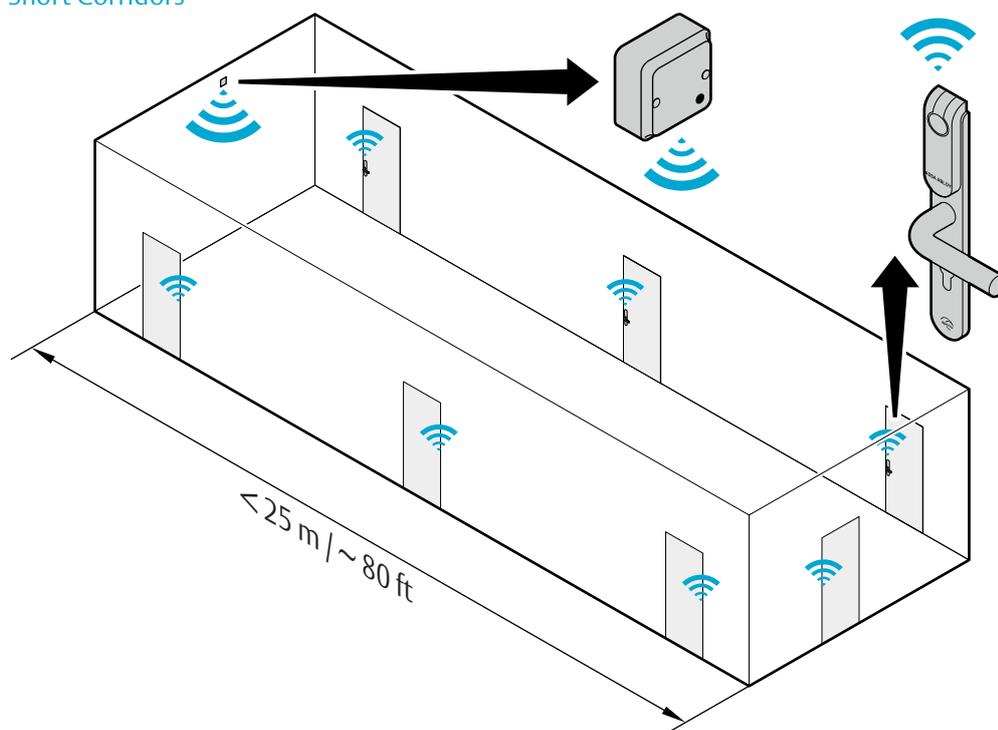
The following figures illustrates the difference in radio pattern for external and internal antenna. (Note that this is only an simplified picture of the radio reception for each antenna, showing the theoretical characteristics. The real radio coverage also vary for each installation site.)



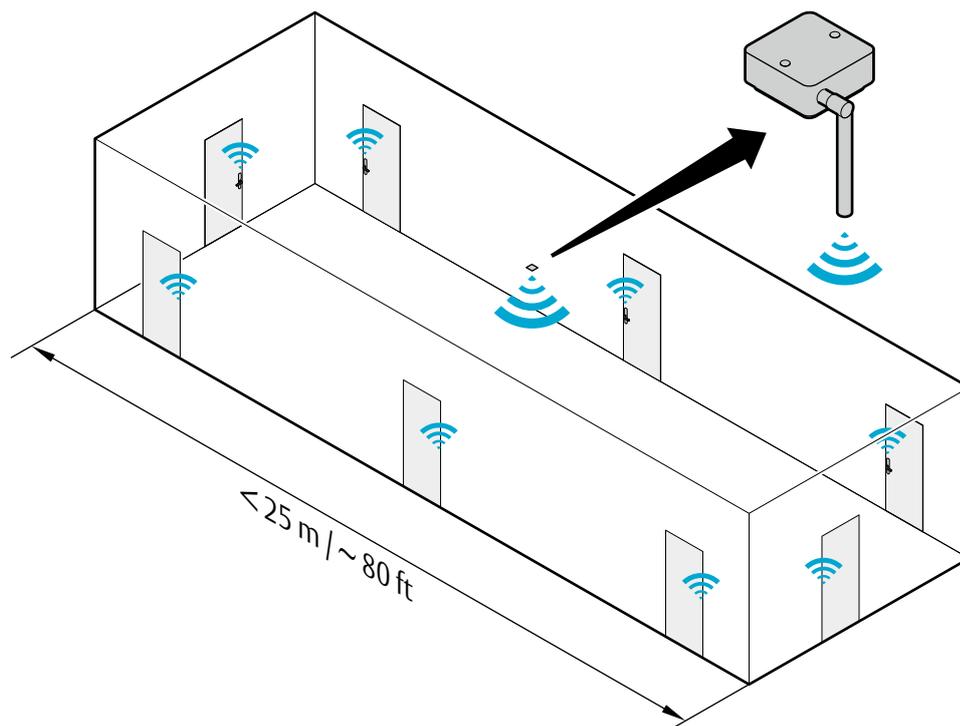
## 4 Installation examples for AH20/30/40 communication hub

The following pages shows typical installations based on field experience that will give a good result for radio link quality. The colors indicate which hubs and Aperio door locks that belong together.

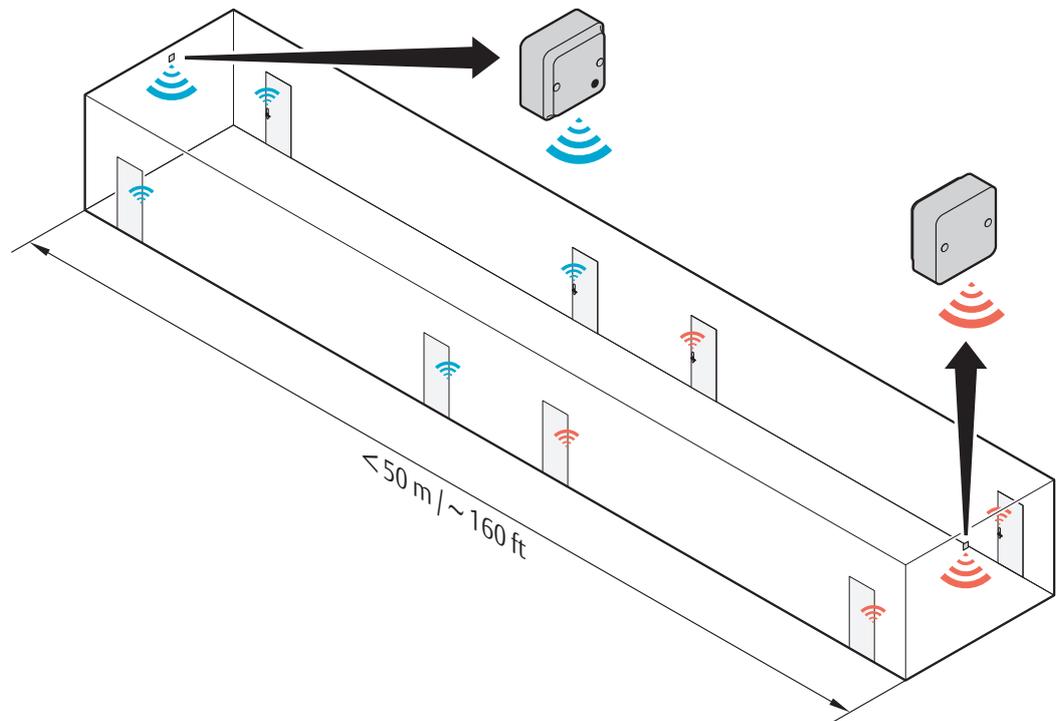
### Short Corridors



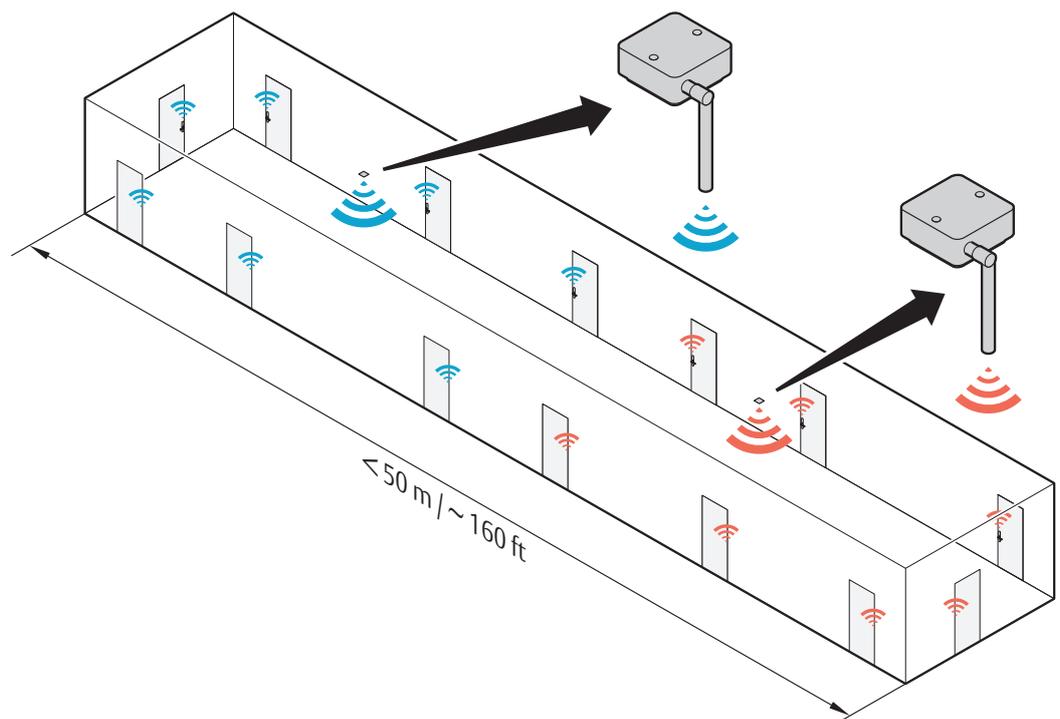
Alternate installation:



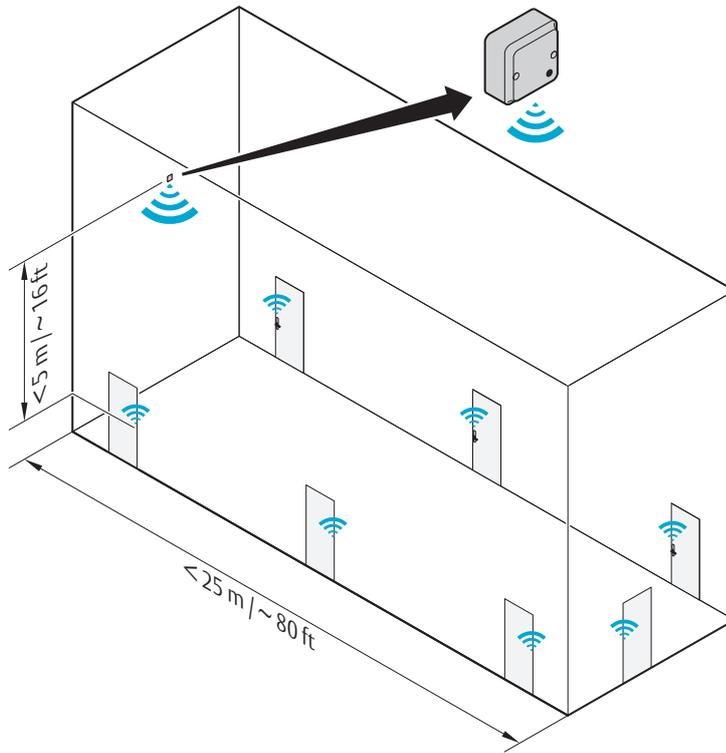
Long corridors



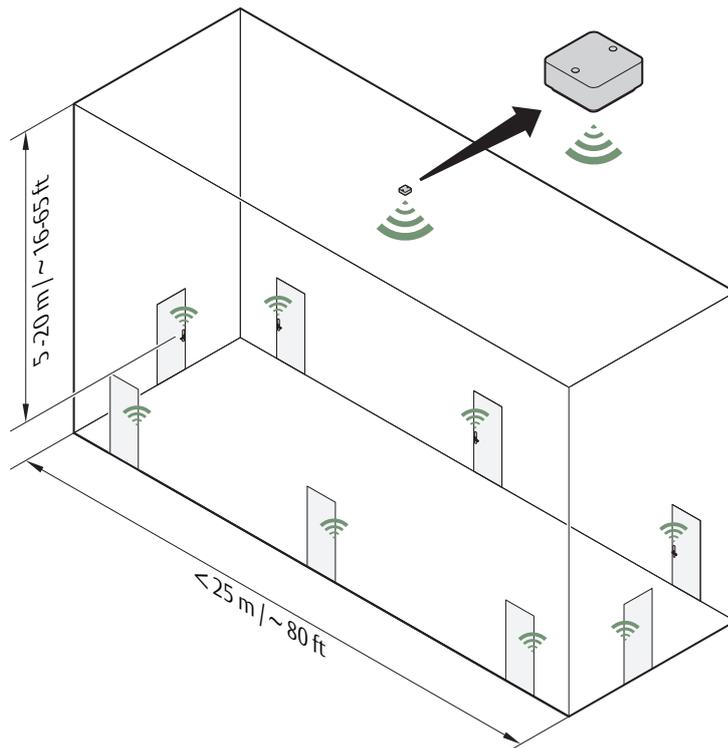
Alternate installation:



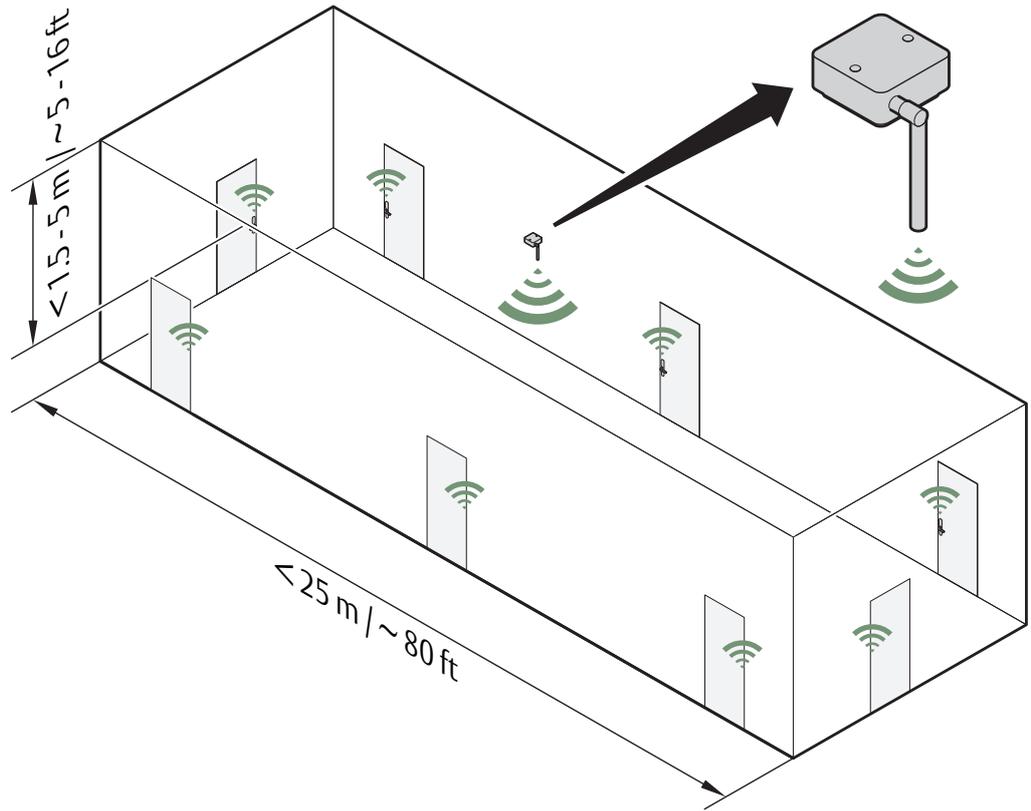
High ceiling



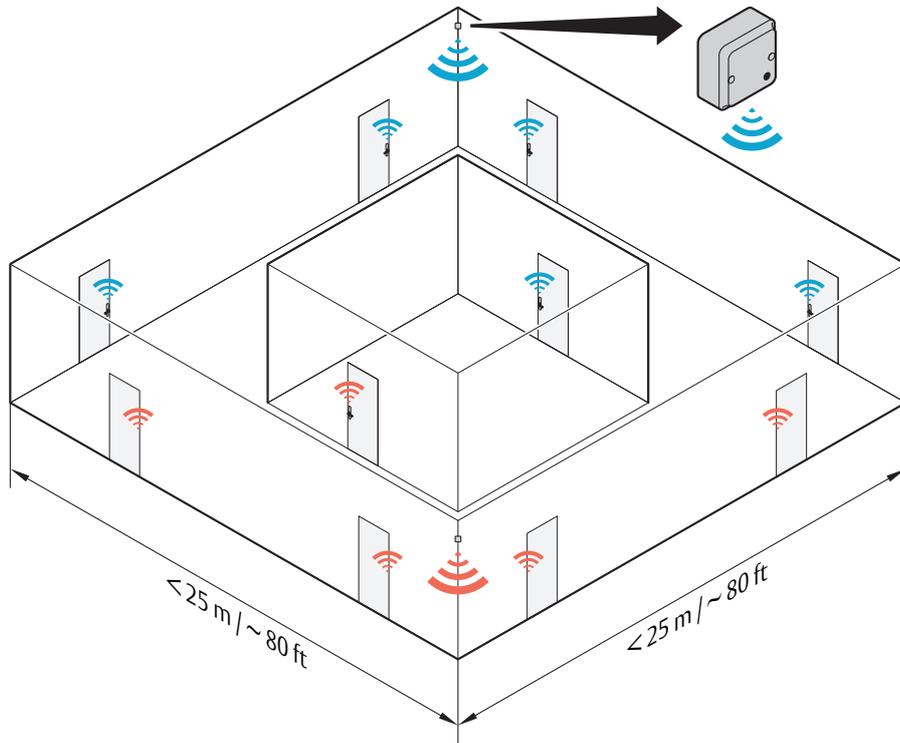
Alternate installation:



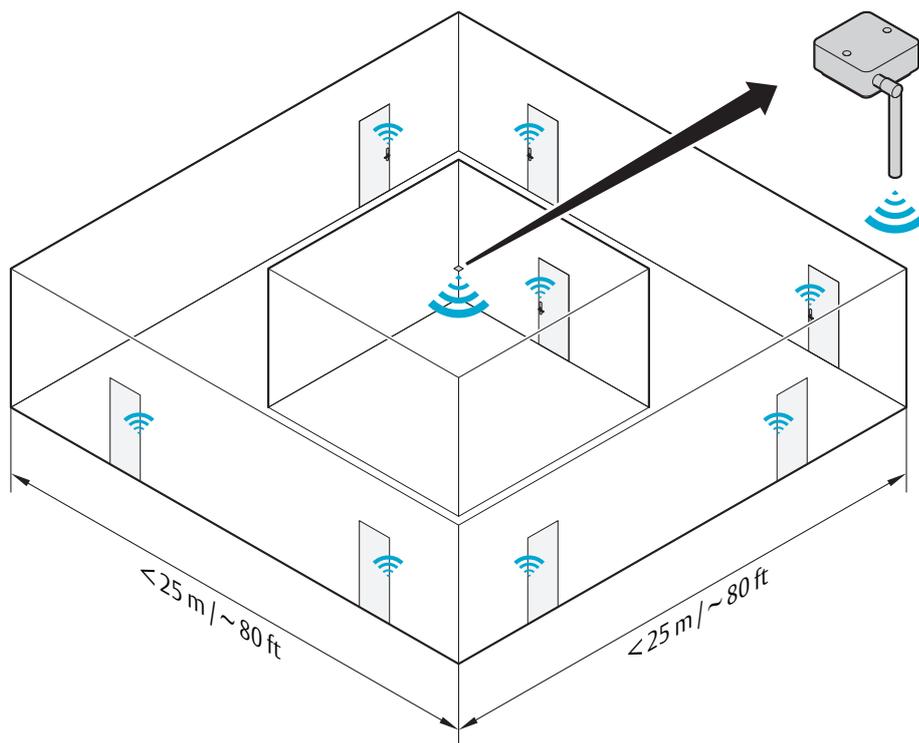
Low ceiling



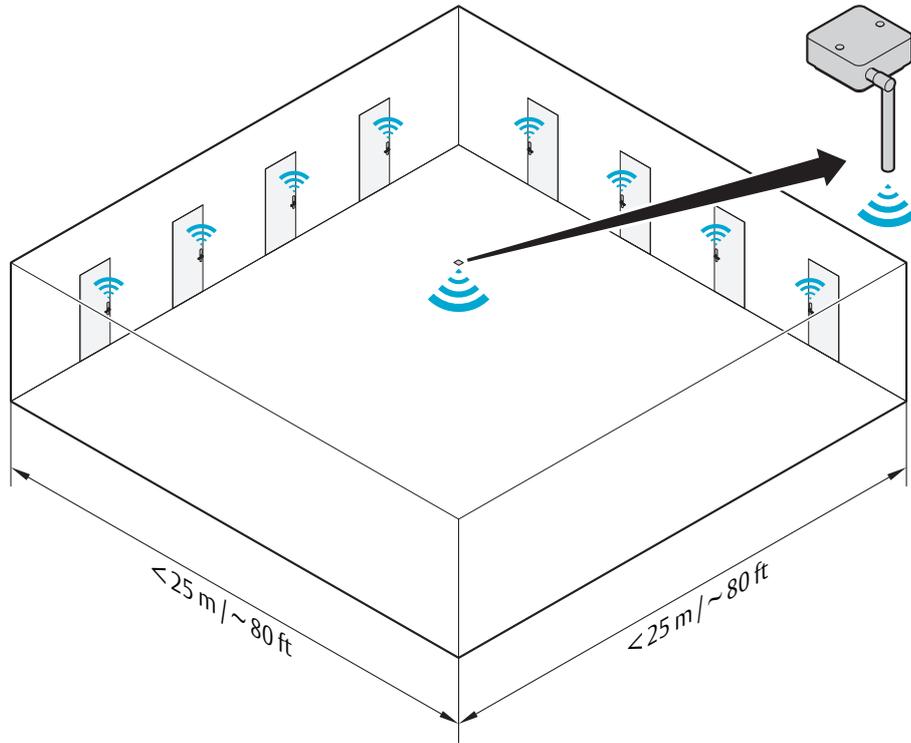
Square rooms



Alternate installation with "light" wall material:



Open space environments

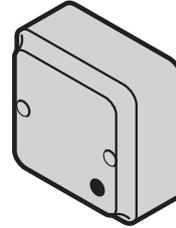


# 5 Configuration and Connection of Cables

## AH20 (Standard and Advanced Wiegand)

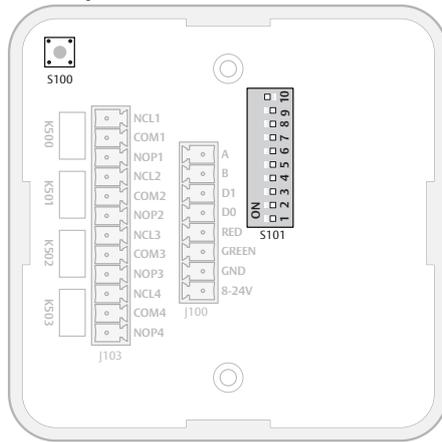
AH20 communication hub is available in two versions, Standard and Advanced Wiegand. The Advanced version is equipped with relays.

Configuring and connecting the communication hub to the EAC includes setting the DIP switches, connecting it to the Wiegand interface bus and connecting it to power supply, according to the applicable section below.



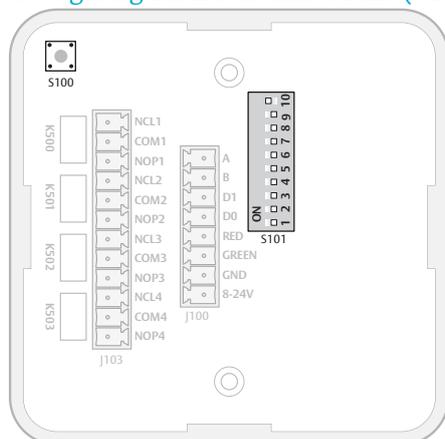
### Configuring the DIP switch

Details for the Wiegand interface signals (Relays are only available for AH20 Advanced Wiegand):



DIP	Abbr.	Description
10	INT/EXT	Internal/external antenna
9		Not used
8	TERM	Not applicable for Wiegand. Set to OFF.
7	UP	Not applicable for Wiegand. Set to OFF.
6	DOWN	Not applicable for Wiegand. Set to OFF.
5	A4	ON = Starts in pairing mode. OFF = Normal use.
4	A3	Controls byte order of transmitted credentials. OFF => The byte order is left as is. ON => The byte order is reversed compared to what is received as input to the Hub Wiegand EAC interface component.
3	A2	Controls addition of parity bits on transmitted credentials. One even parity bit before and one odd parity bit after the actual credentials. OFF => Addition of parity is disabled. Credentials are transmitted as received. ON => Addition of parity bits is enabled.
2	A1	Set to OFF. Reserved for future use.
1	A0	Controls use of Red LED signal for access decision. ON = Red LED is used. OFF = Red LED is ignored.

### Configuring the DIP switch - AH20 (GEN5)



DIP	Abbr.	Description
8	INT/EXT	Internal/External Antenna Use, ON = Internal
6-7		Not applicable (only used for AH30).
8	TERM	Not applicable for Wiegand. Set to OFF.
7	UP	Not applicable for Wiegand. Set to OFF.
6	DOWN	Not applicable for Wiegand. Set to OFF.
5	A4	Used in "Pairing Mode". ON => Starts in pairing mode. OFF => Normal use. Note: If the DIP switch is moved from ON to OFF within 10 seconds from boot up and the Hub LED is lit, all paired devices will be unpaired.
4	A3	Controls byte order of transmitted credentials. ON => The byte order is reversed on the Wiegand interface compared to what is received from the Aperio® lock. OFF => The byte order is left as is.
3	A2	Controls addition of parity bits if required. ON => Addition of parity bits is enabled. OFF => Addition of parity bits is disabled. Credentials are transmitted as received.
2	A1	Set to OFF by default. Reserved for future use.
1	A0	Controls use of Red LED signal for access decision. ON => Red LED is used. OFF => Red LED is ignored..

#### Default configuration

According to the figure, DIP switches 1-9 in position OFF and DIP switch 10 in ON (Internal antenna) on the communication hub will give a default Wiegand configuration that will fit most EAC systems. However, customizing the configuration can result in better performance.

- Shorter response time at a denied access.
- Possibility to use override credentials in the lock.

#### DIP 1 - Selecting LED input signals and access decision

If the EAC system can send a signal that actively asserts an access denied decision (Red LED), DIP 1 should be set to ON.  
This will give:

The flowcharts below explain how the LED input signals are used to derive an access decision. The OFF and ON variants are depicted.

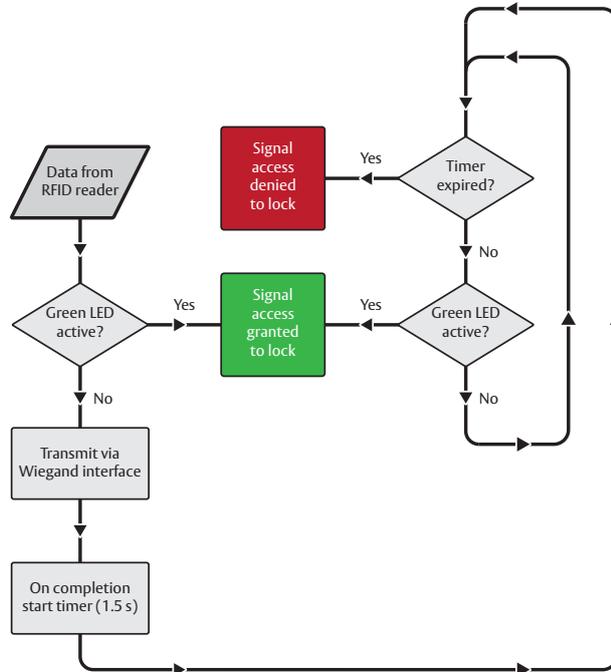


Figure 3. Dip Switch 1 – OFF: Access decision logic with single LED signal

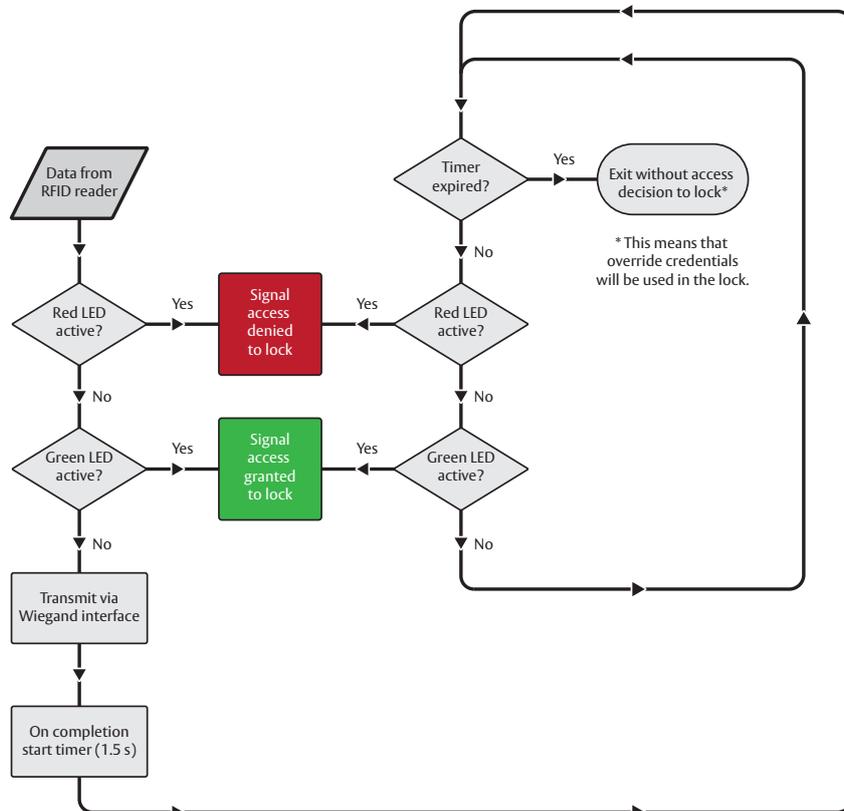


Figure 4. Dip Switch 1 – ON: Access decision logic with two LED signals



The communication hub must be power cycled after any changes on the DIP switch, since the state of the DIP switch is read only at startup. If the EAC system is using output signal Red LED for other purposes than to control the lock, then this signal should not be connected to the communication hub. Set DIP switch 1 in position OFF in this case.

If the EAC system is using output signal Green LED for other purposes than to control the lock, then this signal should not be connected to the communication hub. Use a lock relay output or another similar lock control output from the EAC system instead.

Use of override credential is not possible if DIP switch 1 is in position OFF. The reason is that the communication hub produces an “access denied” decision based on time out in this case.

#### **DIP 2 (Future use)**

Note! This DIP must always be set to OFF.

#### **DIP 3 - Parity bit**

Note! Transmitted credentials may include parity anyway, although addition of parity is disabled in the Hub Wiegand EAC interface component.

The reason is that parity bits are usually already included on the credential.

#### **DIP 4 - Byte Order**

Note! This setting is ignored if the credential length does not make up complete bytes.

Note! The byte order received as input to the Hub Wiegand EAC interface component in the case of a 32 bit MIFARE UID credential is UID[3], UID[2], UID[1], UID[0]. This means that the byte order is already reversed earlier in the chain compared to the order specified in RFID interface standard ISO 14443-3.

#### **DIP 5 - Pairing mode**

If DIP switch 5 is set to ON, pairing mode will be activated. This means that after powering the communication hub it will automatically try to pair with locks within reach. Automatic pairing will only be made with unpaired locks. See ref [2] Aperio Online Programming Application manual for instructions on how to perform the pairing.

### Connecting to the Wiegand bus (AH20 Standard Wiegand)

The AH20 communication hub has four Wiegand signals plus ground. Purpose and connection of these signals are described in the table below.

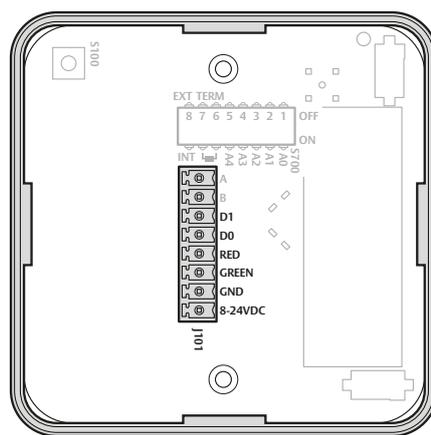
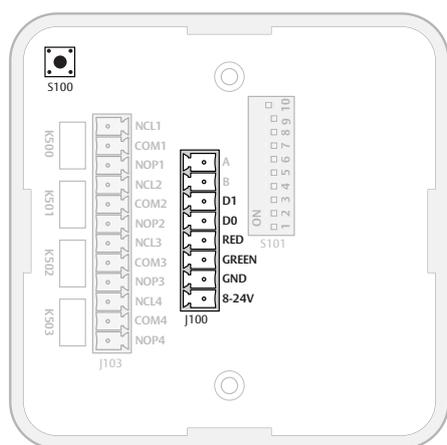


Figure 5. AH20 (GEN5) communication hub

Hub connector designation	Description	Connect to...
A	NOT APPLICABLE	-
B	NOT APPLICABLE	-
DATA1	Wiegand Data 1 signal. Output from communication hub. Used to transmit credentials.	Wiegand Data 1 on EAC system.
DATA0	Wiegand Data 0 signal. Output from communication hub. Used to transmit credentials.	Wiegand Data 0 on EAC system.
RED	Wiegand Red LED signal. Input to communication hub. Used for access decision.	Wiegand Red LED output on EAC system. Alternatively, leave unconnected if signal is selected not to be used by DIP switch 1.
GREEN	Wiegand Green LED signal. Input to communication hub. Used for access decision.	Wiegand Green LED output on EAC system. Alternatively, connect to a lock control relay output on EAC system.
GND	Ground	EAC system ground.
8-24V	Positive voltage	EAC power supply.

### Connecting the relays (AH20 Advanced Wiegand)

The four form C relays on the AH20 version can be used by the EAC to supervise door position status, handle position, battery alarm output, and tamper alarm output.

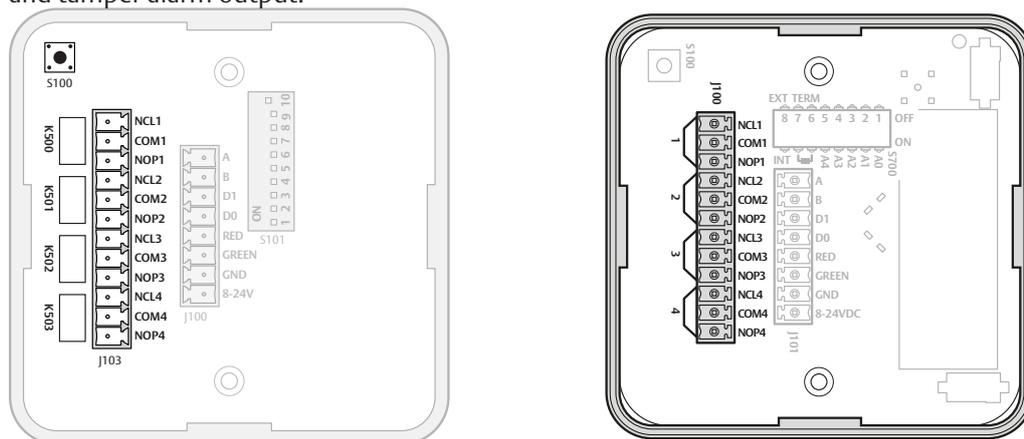


Figure 6. AH20 (GEN5) communication hub

Relays	Description
Relay 1/K500	DPS (Door Position Sensor)
Relay 2/K501	RX (Request to exit)
Relay 3/K502	Battery Alarm Output
Relay 4/K503	Tamper Alarm Output/Lock Jammed
Relay Contacts	Description
NCL	Normal Closed
COM	Common
NOP	Normal Open

**Relay max voltage:** 30 VDC, 15 W resistive load

**Relay max current:** 1 A resistive load

### Connecting to supply voltage

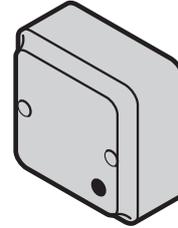
Connect the wires to 8-24 VDC, 2 W and GND (ground) on the communication hub.

Note! The power supply shall be a Limited Power Source (LPS) according to EN 60950-1. The power supply shall be 3 A over current protected. Wire requirements 16-22 AWG.

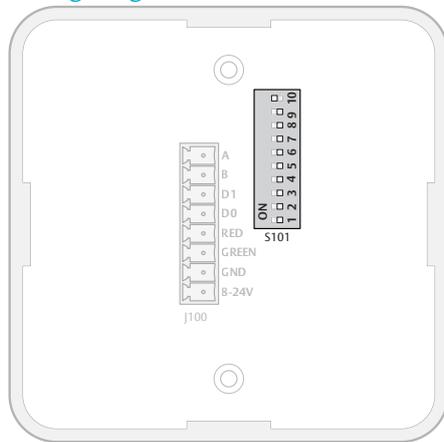
## AH30 (RS-485)

This chapter describes how to perform a default configuration of an AH30 communication hub using the RS-485 interface.

Configuration of the communication hub to the EAC includes setting the DIP switches and, if not done earlier, connecting it to the RS-485 bus and to power supply, according to the applicable section below.



### Configuring the DIP switches



DIP	Abbr.	Description
10	INT/EXT	Internal/external antenna
9		Not used
8	TERM	Activates termination of EAC bus
7	UP	Activation of pull up resistor
6	DOWN	Activation of pull down resistor
5	A4	Manual EAC Address
4	A3	Manual EAC Address
3	A2	Manual EAC Address
2	A1	Manual EAC Address
1	A0	Manual EAC Address/Automatic pairing (DIP 1-5 = OFF)

### DIP 1-5 – Selecting the EAC address/Automatic pairing

The DIP 1-5 has two functions, either automatic pairing mode, or manual selection of EAC address on the RS485. Default configuration is to select an address according to below. By doing so automatic pairing will be deactivated.

#### • DIP 1-5 – Pairing mode

If DIP 1-5 are set to OFF, pairing mode will be activated. This means that after powering on the communication hub it will automatically try to pair with locks within range. Automatic pairing will only be made with unpaired locks. The automatic pairing procedure is described in ref [2], Aperio Online Programming Application manual.

#### • DIP 1-5 – Selecting EAC address

It is possible to select an address 1-31 for the AH15 communication hub using the DIP switch. For mixed modes, see section "Selecting the correct EAC address (AH15/AH30)" on page 28 for more details and advanced options.

Select a unique EAC address 1-15 for each communication hub by use of the DIP switch according to the table below. (The resulting lock addresses for each communication hub address are shown to the right):

DIP 4 – DIP 1	AH30 Hub address	Lock addresses
0000		Reserved
0001	0x01	0x01, 0x11, 0x21, 0x31, 0x41, 0x51, 0x61, 0x71
0010	0x02	0x02, 0x12, 0x22, 0x32, 0x42, 0x52, 0x62, 0x72
0011	0x03	0x03, 0x13, 0x23, 0x33, 0x43, 0x53, 0x63, 0x73
0100	0x04	0x04, 0x14, 0x24, 0x34, 0x44, 0x54, 0x64, 0x74
0101	0x05	0x05, 0x15, 0x25, 0x35, 0x45, 0x55, 0x65, 0x75
0110	0x06	0x06, 0x16, 0x26, 0x36, 0x46, 0x56, 0x66, 0x76
0111	0x07	0x07, 0x17, 0x27, 0x37, 0x47, 0x57, 0x67, 0x77
1000	0x08	0x08, 0x18, 0x28, 0x38, 0x48, 0x58, 0x68, 0x78
1001	0x09	0x09, 0x19, 0x29, 0x39, 0x49, 0x59, 0x69, 0x79
1010	0x0A	0x0A, 0x1A, 0x2A, 0x3A, 0x4A, 0x5A, 0x6A, 0x7A
1011	0x0B	0x0B, 0x1B, 0x2B, 0x3B, 0x4B, 0x5B, 0x6B, 0x7B
1100	0x0C	0x0C, 0x1C, 0x2C, 0x3C, 0x4C, 0x5C, 0x6C, 0x7C
1101	0x0D	0x0D, 0x1D, 0x2D, 0x3D, 0x4D, 0x5D, 0x6D, 0x7D
1110	0x0E	0x0E, 0x1E, 0x2E, 0x3E, 0x4E, 0x5E, 0x6E, 0x7E
1111	0x0F	0x0F, 0x1F, 0x2F, 0x3F, 0x4F, 0x5F, 0x6F, 0x7F

For other EAC addressing examples go to "6 Appendix" on page 28.



The communication hub must be power cycled after changing the address, since the state of the DIP switch is read only at startup.

bus which must have DIP switches 6-8 in ON position. The RS-485 bus must be terminated on the EAC side.

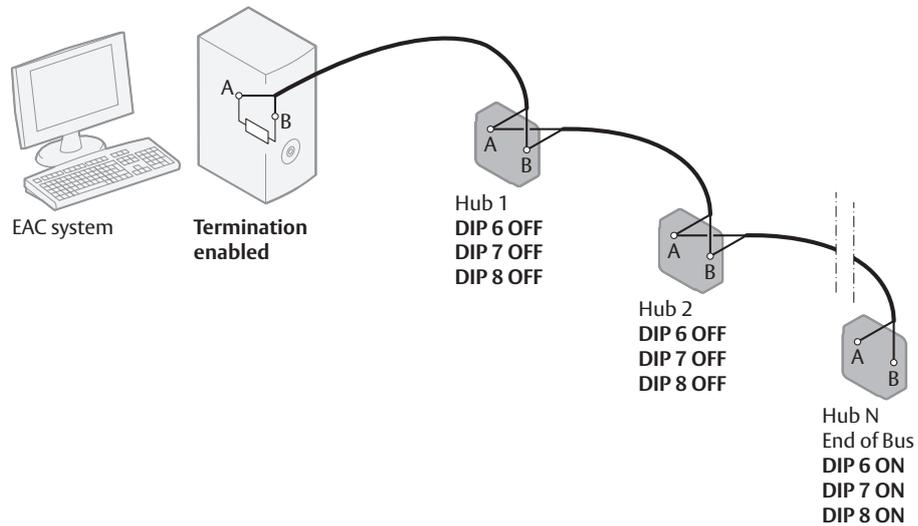
#### **DIP 6-8 – RS-485 bus settings**

DIP switch 6 and 7 activate pull up and pull down-resistors, which must be enabled once per bus. Either in the EAC system (see the EAC documentation for use of pull up or pull down on the EAC side), or on one communication hub on the RS-485-bus.

DIP 8 is used to terminate the bus, which is activated for the communication hub connected in end position on the bus.

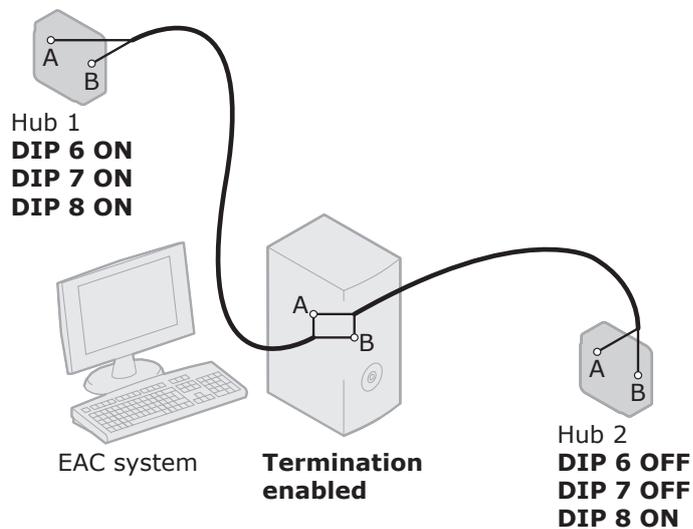
If there is more than one communication hub to connect they should be connected in a daisy chain. In this case, set DIP switches 6-8 in OFF position for all communication hubs, except for the communication hub at the end of the

Figure 7. Daisy chain connected communication hubs, set DIP 6 and 7 in ON position for one communication hub



For a star connection, set DIP 6 and 7 in ON position for one communication hub. DIP 8 must be in ON position for all communication hubs. The RS-485 bus can not be terminated on the EAC side.

Figure 8. Star connected communication hubs, DIP 6 and 7 in ON position for one communication hub



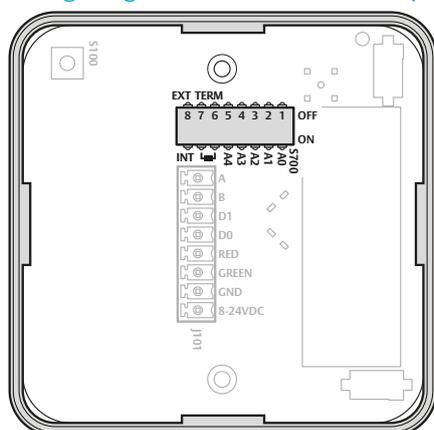
### DIP 9

This DIP switch is not used.

### DIP 10 – Internal/external antenna

Normally the internal antenna of the communication hub is sufficient. In a difficult installation environment or if the radio signal needs to be amplified for extended range, an external antenna can be used. Set the DIP 10 to OFF to use an external antenna.

## Configuring the DIP switches AH30 (GEN5)



DIP	Abbr.	Description
8	INT/EXT	Controls use of external antenna if required. ON => Selects use of internal antenna. OFF => Selects use of external antenna.
6-7	TERM	Control use of termination resistor between RS485 A and RS485 B. For termination to be enabled, both switches must be set to ON. ON => 120 Ohm termination resistor connected/enabled. OFF => 120 Ohm termination resistor disconnected/disabled.
1-5	A0-A4	Controls RS485 addressing BIT 0-BIT 4. ON => Address bit set. OFF => Address bit NOT set. See AH30 - RS485 Addressing Reference.

### DIP 1-5 – Selecting the EAC address/Automatic pairing

The DIP 1-5 has two functions, either automatic pairing mode, or manual selection of EAC address on the RS485. Default configuration is to select an address according to below. By doing so automatic pairing will be deactivated.

#### • DIP 1-5 – Pairing mode

If DIP 1-5 are set to OFF, pairing mode will be activated. This means that after powering on the communication hub it will automatically try to pair with locks within range. Automatic pairing will only be made with unpaired locks. The automatic pairing procedure is described in ref [2], Aperio Online Programming Application manual.

#### • DIP 1-5 – Selecting EAC address

It is possible to select an address 1-31 for the AH15 communication hub using the DIP switch. For mixed modes, see section "Selecting the correct EAC address (AH15/AH30)" on page 28 for more details and advanced options.

Select a unique EAC address 1-15 for each communication hub by use of the DIP switch according to the table below. (The resulting lock addresses for each communication hub address are shown to the right):

DIP 4 – DIP 1	AH30 Hub address	Lock addresses
0000		Reserved - Automatic pairing
0001	0x01	0x01, 0x11, 0x21, 0x31, 0x41, 0x51, 0x61, 0x71, 0x81, 0x91, 0xA1, 0xB1, 0xC1, 0xD1, 0xE1, 0xF1
0010	0x02	0x02, 0x12, 0x22, 0x32, 0x42, 0x52, 0x62, 0x72, 0x82, 0x92, 0xA2, 0xB2, 0xC2, 0xD2, 0xE2, 0xF2
0011	0x03	0x03, 0x13, 0x23, 0x33, 0x43, 0x53, 0x63, 0x73, 0x83, 0x93, 0xA3, 0xB3, 0xC3, 0xD3, 0xE3, 0xF3
0100	0x04	0x04, 0x14, 0x24, 0x34, 0x44, 0x54, 0x64, 0x74, 0x84, 0x94, 0xA4, 0xB4, 0xC4, 0xD4, 0xE4, 0xF4
0101	0x05	0x05, 0x15, 0x25, 0x35, 0x45, 0x55, 0x65, 0x75, 0x85, 0x95, 0xA5, 0xB5, 0xC5, 0xD5, 0xE5, 0xF5
0110	0x06	0x06, 0x16, 0x26, 0x36, 0x46, 0x56, 0x66, 0x76, 0x86, 0x96, 0xA6, 0xB6, 0xC6, 0xD6, 0xE6, 0xF6
0111	0x07	0x07, 0x17, 0x27, 0x37, 0x47, 0x57, 0x67, 0x77, 0x87, 0x97, 0xA7, 0xB7, 0xC7, 0xD7, 0xE7, 0xF7
1000	0x08	0x08, 0x18, 0x28, 0x38, 0x48, 0x58, 0x68, 0x78, 0x88, 0x98, 0xA8, 0xB8, 0xC8, 0xD8, 0xE8, 0xF8
1001	0x09	0x09, 0x19, 0x29, 0x39, 0x49, 0x59, 0x69, 0x79, 0x89, 0x99, 0xA9, 0xB9, 0xC9, 0xD9, 0xE9, 0xF9
1010	0x0A	0x0A, 0x1A, 0x2A, 0x3A, 0x4A, 0x5A, 0x6A, 0x7A, 0x8A, 0x9A, 0xAA, 0xBA, 0xCA, 0xDA, 0xEA, 0xFA
1011	0x0B	0x0B, 0x1B, 0x2B, 0x3B, 0x4B, 0x5B, 0x6B, 0x7B, 0x8B, 0x9B, 0xAB, 0xBB, 0xCB, 0xDB, 0xEB, 0xFB
1100	0x0C	0x0C, 0x1C, 0x2C, 0x3C, 0x4C, 0x5C, 0x6C, 0x7C, 0x8C, 0x9C, 0xAC, 0xBC, 0xCC, 0xDC, 0xEC, 0xFC
1101	0x0D	0x0D, 0x1D, 0x2D, 0x3D, 0x4D, 0x5D, 0x6D, 0x7D, 0x8D, 0x9D, 0xAD, 0xBD, 0xCD, 0xDD, 0xED, 0xFD
1110	0x0E	0x0E, 0x1E, 0x2E, 0x3E, 0x4E, 0x5E, 0x6E, 0x7E, 0x8E, 0x9E, 0xAE, 0xBE, 0xCE, 0xDE, 0xEE, 0xFE
1111	0x0F	0x0F, 0x1F, 0x2F, 0x3F, 0x4F, 0x5F, 0x6F, 0x7F, 0x8F, 0x9F, 0xAF, 0xBF, 0xCF, 0xDF, 0xEF, 0xFF



If any of the A0-A4 DIP switches are moved from OFF to ON within 10 seconds from boot up and the Hub LED is lit, all paired devices will be unpaired.

For other EAC addressing examples go to "6 Appendix" on page 28.

**DIP 6-7 – RS-485 bus settings**

DIP switch 6 and 7 activate pull up and pull down-resistors, which must be enabled once per bus. Either in the EAC system (see the EAC documentation for use of pull up or pull down on the EAC side), or on one communication hub on the RS-485-bus.

DIP 7 is used to terminate the bus, which is activated for the communication hub connected in end position on the bus.

If there is more than one communication hub to connect they should be connected in a daisy chain. In this case, set DIP switches 6-7 in OFF position for all communication hubs, except for the communication hub at the end of the bus which must have DIP switches 6-7 in ON position. The RS-485 bus should be terminated on the EAC side.

Figure 9. Daisy chain connected communication hubs, set DIP 6 and 7 in ON position for one communication hub

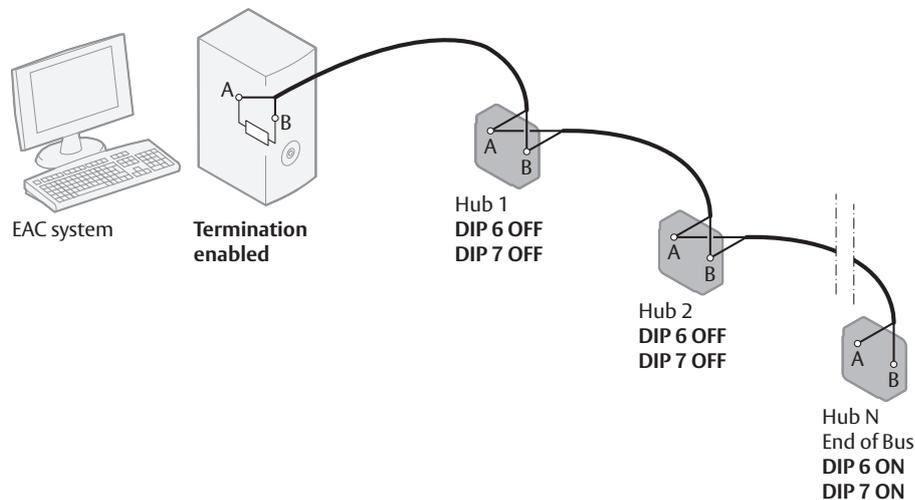
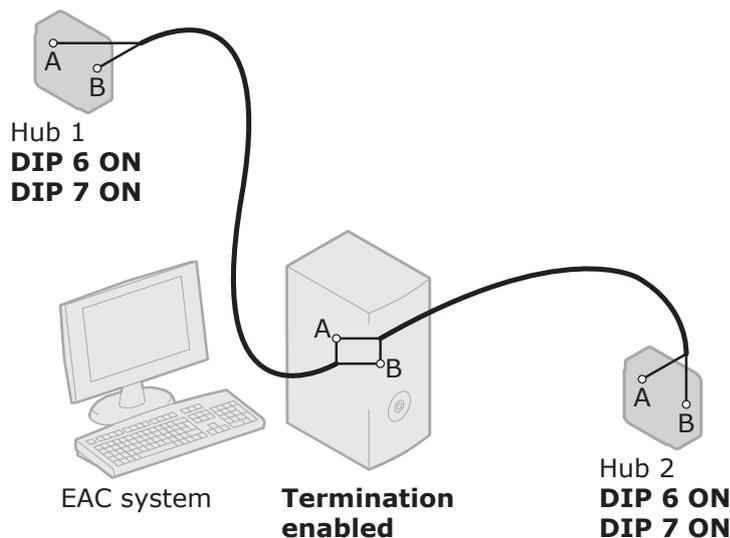


Figure 10. Star connected communication hubs, DIP 6 and 7 in ON position for one communication hub



**DIP 8 – Internal/external antenna**

Normally the internal antenna of the communication hub is sufficient. In a difficult installation environment or if the radio signal needs to be amplified for extended range, an external antenna can be used. Set the DIP 8 to OFF to use an external antenna.

### Connecting to the RS-485 bus

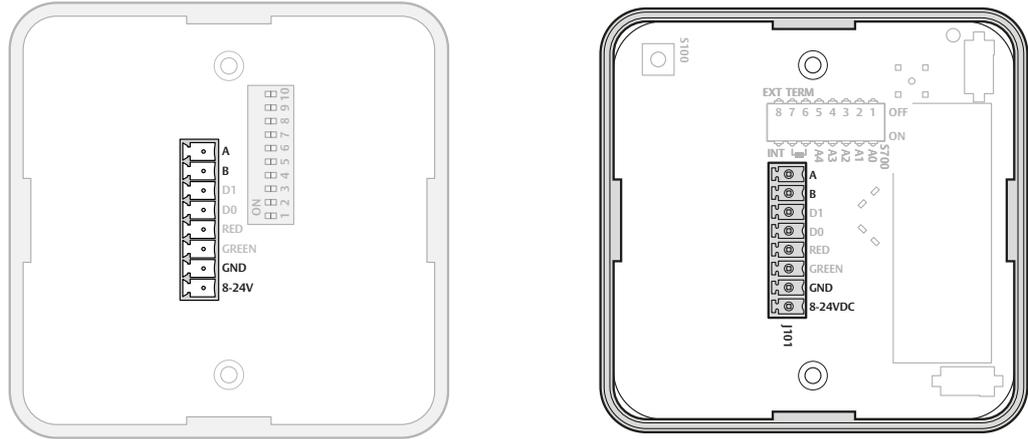


Figure 11. AH30 (GEN5) communication hub

The RS-485 bus should be made up of a twisted-pair cable with characteristic impedance between 90 Ohm and 120 Ohm. Maximum bus length is about 1000 m. Depending on the EAC system, a maximum of 32 units (31 communication hubs plus the EAC, when using the DIP Switch for RS-485-addressing) can be connected to the same bus.

Connect all RS485 A connectors together and all RS485 B connectors together, depending on connection type, see *Figure 8* and *Figure 9* on page 22.

### Connecting to supply voltage

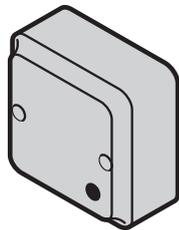
Connect the wires to 8-24 VDC, 1.1 W and GND (ground) on the communication hub.

**Note!** The power supply shall be a Limited Power Source (LPS) according to EN 60950-1. The power supply shall be 3A over current protected. Wire requirements 16-22 AWG.

## AH40 (Ethernet)

This chapter describes how to perform a default configuration of an AH40 communication hub using the Ethernet interface.

Configuration of the communication hub to the EAC includes setting jumpers, connecting it to Ethernet and connecting it to power supply, according to applicable section below.



### Setting jumper for internal/external antenna

Normally the communication hub's internal antenna is sufficient. In a difficult installation environment or if the radio signal needs to be amplified in a certain direction, an external antenna can be used. Connect the two pins ("EXT") with the jumper to use an external antenna.

### Setting jumper for pairing mode

To activate automatic pairing, connect the two pins ("PAIR") with the jumper, see figure.

### Connect to supply voltage

Connect the power and ground to the "+" and the "-" terminals of the connector marked "8V-24V".

Note! Power supply input, 8-24 VDC, 3.5 W. The power supply shall be a Limited Power Source (LPS) according to EN 60950-1. The power supply shall be 3 A over current protected. Wire requirements 16-22 AWG.

### Connecting Ethernet

Connect an Ethernet cable to the Hub and make sure that the Ethernet "LINK" LED is green, which indicates that the Ethernet link level is established. The Hub supports 10/100 Mbit/s half and full duplex with auto-negotiation.

## Using Power over Ethernet (PoE)

The communication Hub can also be powered using Power over Ethernet by connecting it to an Ethernet switch or other equipment that supports this.



Due to EMC regulations, do not connect any other power supply when PoE is used.

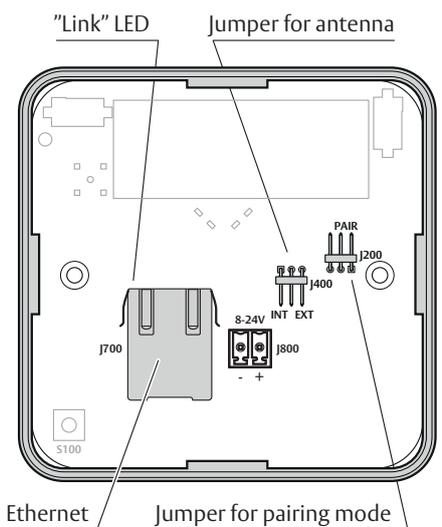
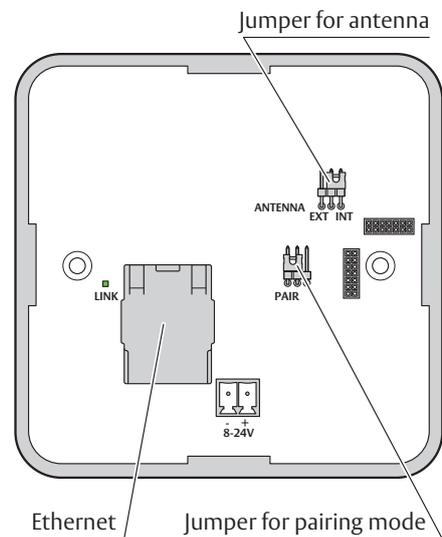


Figure 12. AH40 (GEN5) communication hub

## 6 Appendix

### Selecting the correct EAC address (AH15/AH30)

Selecting EAC addresses for communication hubs and locks correctly during installation is important in order not to cause address conflicts in your installation.

The communication hubs can use different address ranges depending on the installation:

- **Address 1-15:** For AH30 communication hubs with one or several locks paired and AH15 communication hubs. Address is selected by DIP Switch or the Programming Application.

- **Address 16-31:** For AH30/AH15 communication hubs in single device mode (only one lock paired). Address is selected by DIP Switch or the Programming Application.

- **Address 32-63:** For AH30/AH15 communication hubs in single device mode (only one lock paired). Address is selected only by the Programming Application.

The final lock EAC address depends on the communication hub address. For AH15 communication hubs the lock address is equal to the hub address. For AH30 communication hubs the lock address is decided by the addressing table.

#### Addressing table – normal address offset

An AH30 communication hub can pair with up to 8 locks. When pairing several locks to a communication hub, the following addresses are used for the address range 1-15. Above this range only one lock can be paired.

DIP 4 – DIP 1	AH30 Hub address	Lock addresses
0000		Reserved
0001	0x01	0x01, 0x11, 0x21, 0x31, 0x41, 0x51, 0x61, 0x71
0010	0x02	0x02, 0x12, 0x22, 0x32, 0x42, 0x52, 0x62, 0x72
0011	0x03	0x03, 0x13, 0x23, 0x33, 0x43, 0x53, 0x63, 0x73
0100	0x04	0x04, 0x14, 0x24, 0x34, 0x44, 0x54, 0x64, 0x74
0101	0x05	0x05, 0x15, 0x25, 0x35, 0x45, 0x55, 0x65, 0x75
0110	0x06	0x06, 0x16, 0x26, 0x36, 0x46, 0x56, 0x66, 0x76
0111	0x07	0x07, 0x17, 0x27, 0x37, 0x47, 0x57, 0x67, 0x77
1000	0x08	0x08, 0x18, 0x28, 0x38, 0x48, 0x58, 0x68, 0x78
1001	0x09	0x09, 0x19, 0x29, 0x39, 0x49, 0x59, 0x69, 0x79
1010	0x0A	0x0A, 0x1A, 0x2A, 0x3A, 0x4A, 0x5A, 0x6A, 0x7A
1011	0x0B	0x0B, 0x1B, 0x2B, 0x3B, 0x4B, 0x5B, 0x6B, 0x7B
1100	0x0C	0x0C, 0x1C, 0x2C, 0x3C, 0x4C, 0x5C, 0x6C, 0x7C
1101	0x0D	0x0D, 0x1D, 0x2D, 0x3D, 0x4D, 0x5D, 0x6D, 0x7D
1110	0x0E	0x0E, 0x1E, 0x2E, 0x3E, 0x4E, 0x5E, 0x6E, 0x7E
1111	0x0F	0x0F, 0x1F, 0x2F, 0x3F, 0x4F, 0x5F, 0x6F, 0x7F

When configuring installations that differ from the default configuration described in section "DIP 1-5 – Selecting the EAC address/Automatic pairing" on page 21, use this table to keep track

of what addresses are used by the locks/sensors in your installation in order to avoid addressing conflicts according to section "Installation examples" on page 30 for mixed installations.

### Addressing table – legacy address offset

Legacy addressing mode is an alternative addressing mode that can be set by the Programming Application in the configuration wizard.

The lock addresses in this mode are set consecutively. For example, if communication hub has address 1, the locks will get address 1-8, 9-16, 17-24 etc.

DIP 5 – DIP 1	AH30 Hub address	Lock addresses
0000		Reserved
0001	0x01	0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07, 0x08
0010	0x02	0x09, 0x0A, 0x0B, 0x0C, 0x0D, 0x0E, 0x0F, 0x10
0011	0x03	0x11, 0x12, 0x13, 0x14, 0x15, 0x16, 0x17, 0x18
0100	0x04	0x19, 0x1A, 0x1B, 0x1C, 0x1D, 0x1E, 0x1F, 0x20
0101	0x05	0x21, 0x22, 0x23, 0x24, 0x25, 0x26, 0x27, 0x28
0110	0x06	0x29, 0x2A, 0x2B, 0x2C, 0x2D, 0x2E, 0x2F, 0x30
0111	0x07	0x31, 0x32, 0x33, 0x34, 0x35, 0x36, 0x37, 0x38
1000	0x08	0x39, 0x3A, 0x3B, 0x3C, 0x3D, 0x3E, 0x3F, 0x40
1001	0x09	0x41, 0x42, 0x43, 0x44, 0x45, 0x46, 0x47, 0x48
1010	0x0A	0x49, 0x4A, 0x4B, 0x4C, 0x4D, 0x4E, 0x4F, 0x50
1011	0x0B	0x51, 0x52, 0x53, 0x54, 0x55, 0x56, 0x57, 0x58
1100	0x0C	0x59, 0x5A, 0x5B, 0x5C, 0x5D, 0x5E, 0x5F, 0x60
1101	0x0D	0x61, 0x62, 0x63, 0x64, 0x65, 0x66, 0x67, 0x68
1110	0x0E	0x69, 0x6A, 0x6B, 0x6C, 0x6D, 0x6E, 0x6F, 0x70
1111	0x0F	0x71, 0x72, 0x73, 0x74, 0x75, 0x76, 0x77, 0x78

This mode is used for older EAC systems that cannot handle high EAC addresses where the limit for example is 32 or 64.

### Addressing table – normal address offset - AH30 (GEN5) communication hub

An AH30 (GEN5) communication hub can pair with up to 16 locks. When pairing several locks to a communication hub, the following

addresses are used for the address range 1-15. Above this range only one lock can be paired.

DIP 4 – DIP 1	AH30 Hub address	Lock addresses
0000		Reserved - Automatic pairing
0001	0x01	0x01, 0x11, 0x21, 0x31, 0x41, 0x51, 0x61, 0x71, 0x81, 0x91, 0xA1, 0xB1, 0xC1, 0xD1, 0xE1, 0xF1
0010	0x02	0x02, 0x12, 0x22, 0x32, 0x42, 0x52, 0x62, 0x72, 0x82, 0x92, 0xA2, 0xB2, 0xC2, 0xD2, 0xE2, 0xF2
0011	0x03	0x03, 0x13, 0x23, 0x33, 0x43, 0x53, 0x63, 0x73, 0x83, 0x93, 0xA3, 0xB3, 0xC3, 0xD3, 0xE3, 0xF3
0100	0x04	0x04, 0x14, 0x24, 0x34, 0x44, 0x54, 0x64, 0x74, 0x84, 0x94, 0xA4, 0xB4, 0xC4, 0xD4, 0xE4, 0xF4
0101	0x05	0x05, 0x15, 0x25, 0x35, 0x45, 0x55, 0x65, 0x75, 0x85, 0x95, 0xA5, 0xB5, 0xC5, 0xD5, 0xE5, 0xF5
0110	0x06	0x06, 0x16, 0x26, 0x36, 0x46, 0x56, 0x66, 0x76, 0x86, 0x96, 0xA6, 0xB6, 0xC6, 0xD6, 0xE6, 0xF6
0111	0x07	0x07, 0x17, 0x27, 0x37, 0x47, 0x57, 0x67, 0x77, 0x87, 0x97, 0xA7, 0xB7, 0xC7, 0xD7, 0xE7, 0xF7
1000	0x08	0x08, 0x18, 0x28, 0x38, 0x48, 0x58, 0x68, 0x78, 0x88, 0x98, 0xA8, 0xB8, 0xC8, 0xD8, 0xE8, 0xF8
1001	0x09	0x09, 0x19, 0x29, 0x39, 0x49, 0x59, 0x69, 0x79, 0x89, 0x99, 0xA9, 0xB9, 0xC9, 0xD9, 0xE9, 0xF9
1010	0x0A	0x0A, 0x1A, 0x2A, 0x3A, 0x4A, 0x5A, 0x6A, 0x7A, 0x8A, 0x9A, 0xAA, 0xBA, 0xCA, 0xDA, 0xEA, 0xFA
1011	0x0B	0x0B, 0x1B, 0x2B, 0x3B, 0x4B, 0x5B, 0x6B, 0x7B, 0x8B, 0x9B, 0xAB, 0xBB, 0xCB, 0xDB, 0xEB, 0xFB
1100	0x0C	0x0C, 0x1C, 0x2C, 0x3C, 0x4C, 0x5C, 0x6C, 0x7C, 0x8C, 0x9C, 0xAC, 0xBC, 0xCC, 0xDC, 0xEC, 0xFC
1101	0x0D	0x0D, 0x1D, 0x2D, 0x3D, 0x4D, 0x5D, 0x6D, 0x7D, 0x8D, 0x9D, 0xAD, 0xBD, 0xCD, 0xDD, 0xED, 0xFD
1110	0x0E	0x0E, 0x1E, 0x2E, 0x3E, 0x4E, 0x5E, 0x6E, 0x7E, 0x8E, 0x9E, 0xAE, 0xBE, 0xCE, 0xDE, 0xEE, 0xFE
1111	0x0F	0x0F, 0x1F, 0x2F, 0x3F, 0x4F, 0x5F, 0x6F, 0x7F, 0x8F, 0x9F, 0xAF, 0xBF, 0xCF, 0xDF, 0xEF, 0xFF

### Addressing table – legacy address offset AH30 (GEN5) communication hub

DIP 5 – DIP 1	AH30 Hub address	Lock addresses
0000		Reserved
0001	0x01	0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07, 0x08, 0x09, 0x0A, 0x0B, 0x0C, 0x0D, 0x0E, 0x0F, 0x10
0010	0x11	0x11, 0x12, 0x13, 0x14, 0x14, 0x16, 0x17, 0x18, 0x19, 0x1A, 0x1B, 0x1C, 0x1D, 0x1E, 0x1F, 0x20
0011	0x21	0x21, 0x22, 0x23, 0x24, 0x24, 0x26, 0x27, 0x28, 0x29, 0x2A, 0x2B, 0x2C, 0x2D, 0x2E, 0x2F, 0x30
0100	0x31	0x31, 0x32, 0x33, 0x34, 0x34, 0x36, 0x37, 0x38, 0x39, 0x3A, 0x3B, 0x3C, 0x3D, 0x3E, 0x3F, 0x40
0101	0x41	0x41, 0x42, 0x43, 0x44, 0x44, 0x46, 0x47, 0x48, 0x49, 0x4A, 0x4B, 0x4C, 0x4D, 0x4E, 0x4F, 0x50
0110	0x51	0x51, 0x52, 0x53, 0x54, 0x54, 0x56, 0x57, 0x58, 0x59, 0x5A, 0x5B, 0x5C, 0x5D, 0x5E, 0x5F, 0x60
0111	0x61	0x61, 0x62, 0x63, 0x64, 0x64, 0x66, 0x67, 0x68, 0x69, 0x6A, 0x6B, 0x6C, 0x6D, 0x6E, 0x6F, 0x70
1000	0x71	0x71, 0x72, 0x73, 0x74, 0x74, 0x76, 0x77, 0x78, 0x79, 0x7A, 0x7B, 0x7C, 0x7D, 0x7E, 0x7F, 0x80
1001	0x81	0x81, 0x82, 0x83, 0x84, 0x84, 0x86, 0x87, 0x88, 0x89, 0x8A, 0x8B, 0x8C, 0x8D, 0x8E, 0x8F, 0x90
1010	0x91	0x91, 0x92, 0x93, 0x94, 0x94, 0x96, 0x97, 0x98, 0x99, 0x9A, 0x9B, 0x9C, 0x9D, 0x9E, 0x9F, 0xA0
1011	0xA1	0xA1, 0xA2, 0xA3, 0xA4, 0xA4, 0xA6, 0xA7, 0xA8, 0xA9, 0xAA, 0xAB, 0xAC, 0xAD, 0xAE, 0xAF, 0xB0
1100	0xB1	0xB1, 0xB2, 0xB3, 0xB4, 0xB4, 0xB6, 0xB7, 0xB8, 0xB9, 0xBA, 0xBB, 0xBC, 0xBD, 0xBE, 0xBF, 0xC0
1101	0xC1	0xC1, 0xC2, 0xC3, 0xC4, 0xC4, 0xC6, 0xC7, 0xC8, 0xC9, 0xCA, 0xCB, 0xCC, 0xCD, 0xCE, 0xCF, 0xD0
1110	0xD1	0xD1, 0xD2, 0xD3, 0xD4, 0xD4, 0xD6, 0xD7, 0xD8, 0xD9, 0xDA, 0xDB, 0xDC, 0xDD, 0xDE, 0xDF, 0xE0
1111	0xE1	0xE1, 0xE2, 0xE3, 0xE4, 0xE4, 0xE6, 0xE7, 0xE8, 0xE9, 0xEA, 0xEB, 0xEC, 0xED, 0xEE, 0xEF, 0xF0

### Installation examples

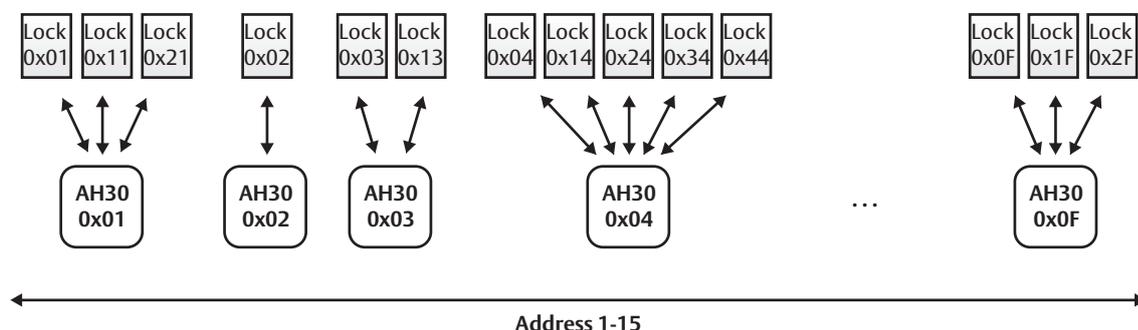
See below for examples of the most common installations and how the addressing is made and how possible address conflicts are avoided.

#### One-to-several installation

This is the default installation as described in section "DIP 1-5 – Selecting the EAC address/ Automatic pairing" on page 20, with up to 15 AH30 communication hubs paired with one or several locks. Only the addresses 1-15 are used.

The addressing table above does not need to be consulted in this type of installation, since all the lock addresses used are unique. Addressing is simply made by selecting a unique address for each communication hub.

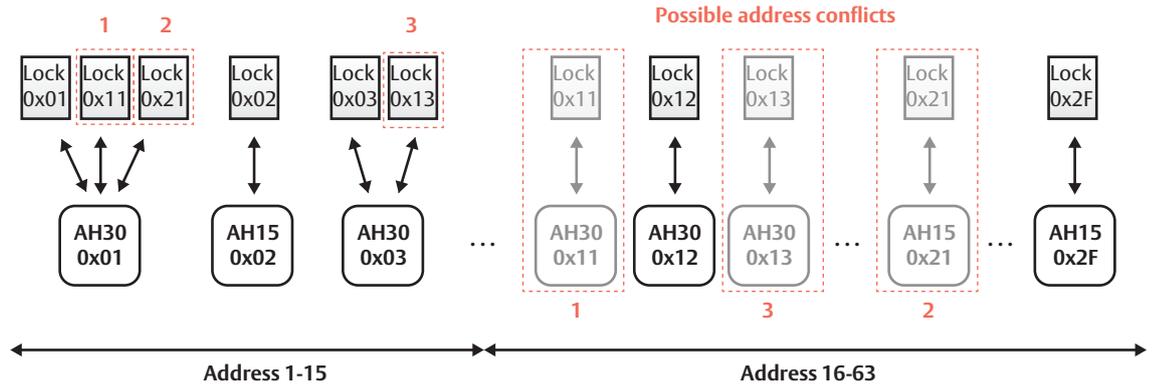
Figure 13. One-to-several installation



**Mixed installation**

A mixed installation uses both AH15 and AH30 communication hubs with the address range from 1 to 63, according to this figure:

Figure 14. Mixed installation



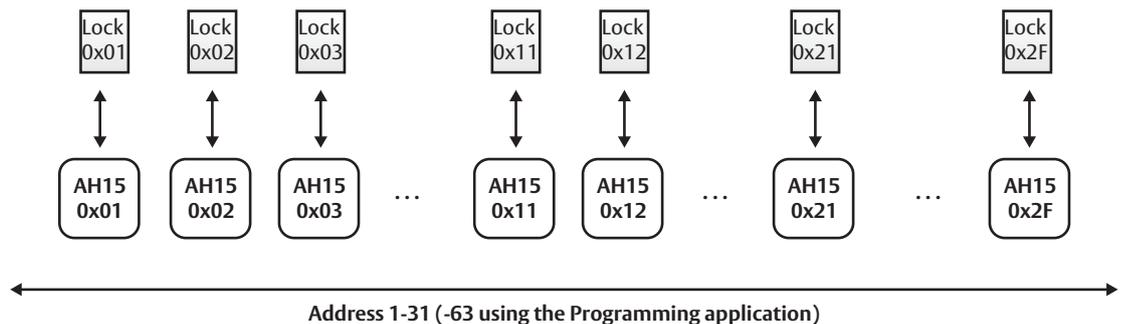
In the address range 1-15, AH30 communication hubs can be used to pair several locks. In the address range 16-63 only AH15 or AH30 communication hubs in single device mode can be used to pair with only one lock. Some

of these locks create possible address conflicts: 0x11, 0x21 and 0x13. These conflicts are simply avoided by selecting the closest “free” address, in this case 0x12.

**Single device installation**

A single device installation uses only AH15 communication hubs with the address range from 1 to 63, according to this figure:

Figure 15. Single device installation



In this installation example, no address conflicts will occur since the lock address is equal to the communication hub address (and provided that the DIP Switches are set correctly with a unique address for each communication hub).

### Upgrading existing installations

When upgrading existing installations with new locks or/and communication hubs or replacing old hardware a general guideline is to first write down the EAC addresses used originally in the installation and consult the addressing table when adding AH30 communication hubs.

- 3) If address conflicts occur you must change the EAC address of one or several existing AH15 communication hubs. Also make sure that all communication hubs are using a unique address.

### Replacement of communication hubs in single device mode

When replacing AH15/AH30 communication hubs that are paired with one lock with a new/reused communication hub, always make sure that the replacement communication hub does not have any locks paired. If so use the Programming Application to unpair any locks.

### Upgrading firmware in AH30 communication hubs

The latest firmware (2.6.0 or later) for AH30 communication hubs adds the functionality to use DIP Switch addresses in the range of 16-31 (DIP switch 5).

Before upgrading make sure that your existing AH30 communication hubs do not have DIP 5 activated. If DIP 5 is activated and the communication hub is paired with only one lock, the firmware upgrade will result in that the EAC address is changed according to DIP 5, for both the communication hub and the lock.

### Upgrading an AH15 installation with one-to-several AH30 communication hubs

If a maximum of 15 communication hubs will be used after the upgrade, no address conflict will occur, provided that all communication hubs use a unique address. If more than 15 communication hubs are used in the resulting installation, address conflicts can occur when adding AH30 communication hubs in the address range of 1-15 with several locks paired.

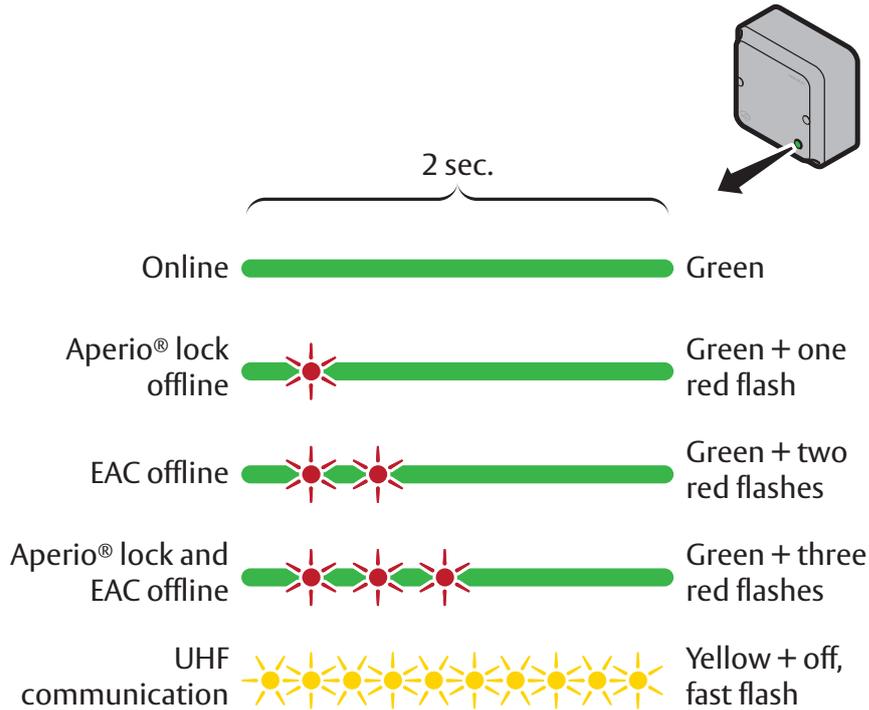
- 1) Note the EAC addresses used in existing installation.
- 2) Consult the AH30 addressing table and select an EAC address that is not in conflict with already installed AH15 communication hubs in the address range 15-63.

## 7 LED Indications

### Communication Hub LED indications

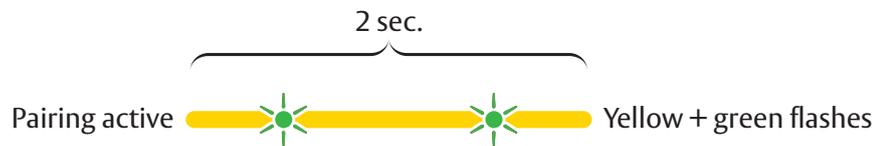
The communication hub has a single LED. It supports an optical scheme with red, green, and yellow. The indication scheme is described by the two figures below:

Figure 16. Communication hub normal operation LED indication



Some special LED indication schemes are used during lock maintenance actions:

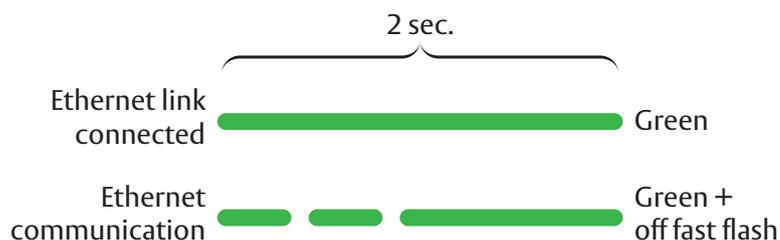
Figure 17. Communication Hub maintenance LED indication



### AH40 Ethernet LED indication

The LED on the AH40 communication hub indicates both the status of the Ethernet link level and ethernet communication:

Figure 18. AH40 Communication hub Ethernet LED indication



### Lock LED indications

The lock has three LEDs. They support an optical scheme with red, yellow, and green. The indication scheme is described by the figures below:

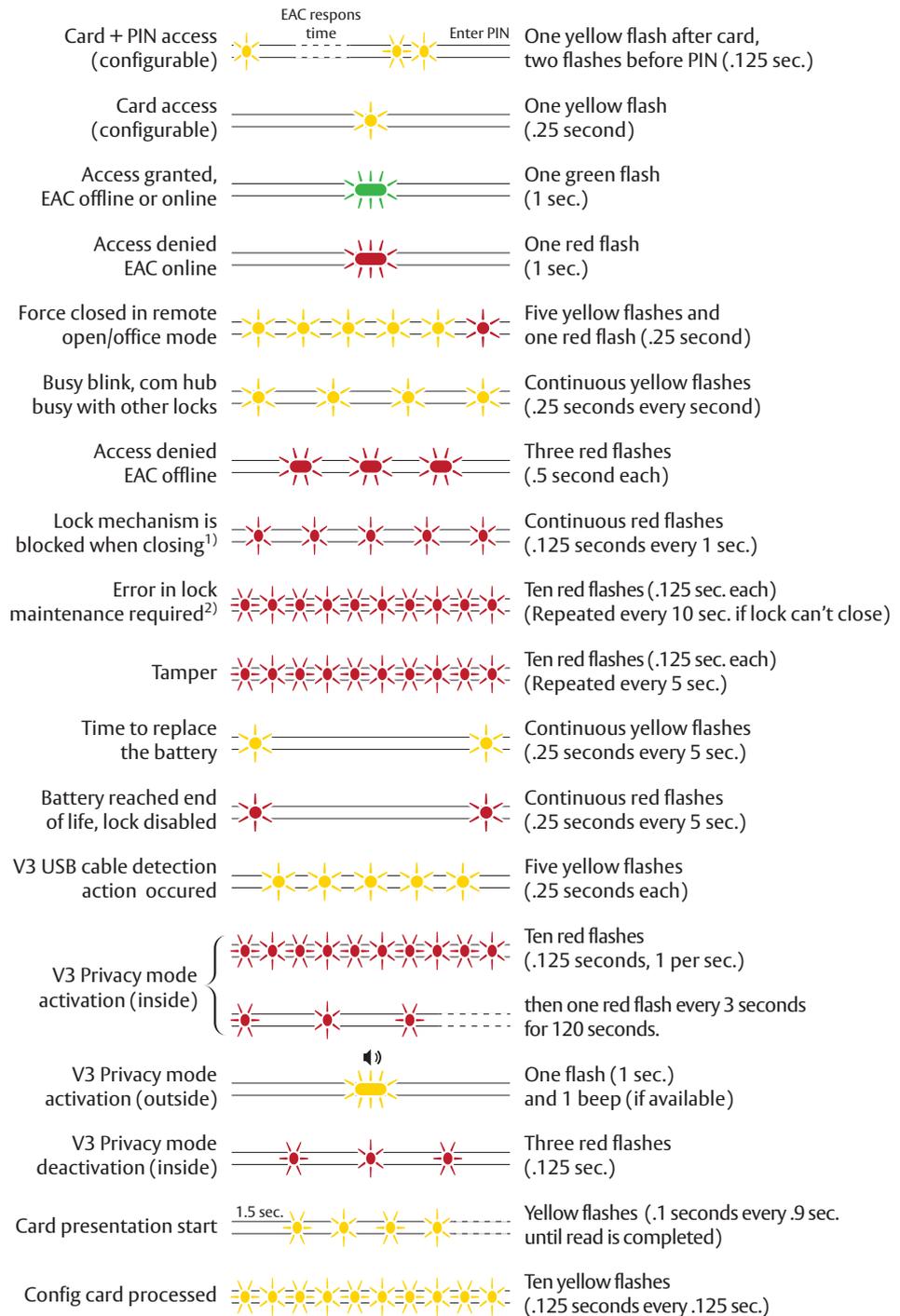
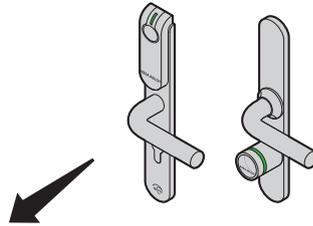


Figure 19. Lock normal operation LED indication

-  1) When the lock mechanism is blocked (lock jammed) the knob must be turned/handle released, to release the lock mechanism.
-  2) The “Error in lock” indication is also shown instead of the POST flashes if the battery is not accepted as new after a power-on-reset.

Some special LED indication schemes are used during lock maintenance actions:

Figure 20. Lock hub normal operation LED indication

Enter configuration mode  Five yellow flashes (.125 second each)









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