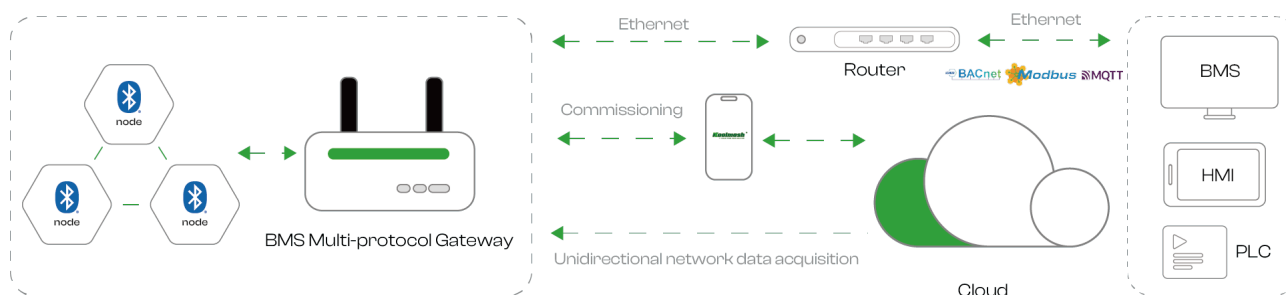




This manual guides installers, commissioning engineers and BMS integrators through mounting, power-up, network setup, local administration and protocol integration of HBGW04/R. Complete the installation and Koolmesh commissioning steps before configuring a BMS protocol.

System overview

HBGW04/R links one commissioned Koolmesh BLE Mesh network to BACnet/IP, Modbus TCP and MQTT. The protocols share the same project configuration, device-state cache and BLE Mesh control path and may operate concurrently. Local MQTT supports LAN operation without Koolmesh Cloud; an outbound connection to a customer LAN or cloud Broker is optional.



Gateway integration example. The remote Broker may be on the customer LAN or in the cloud; TLS or plaintext TCP can be selected.

Refer to the accompanying Product Specification for product selection and detailed technical parameters. Before commissioning, verify the firmware version and supported functions for your application.

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Getting Started

Install & Power Up	Sections 1–3
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BMS Integration	Sections 5–7
Verify & Handover	Section 8

1 Safety and preparation

1.1 Safety precautions

- Use the gateway only as described in this manual. Check that all parts are genuine, present and undamaged.
- Verify that the power source matches the product rating: USB-C, 5 VDC, 3 A.
- Keep the gateway dry and do not expose it to rain, snow or frost. Keep power sockets clean and free of dust.
- Do not carry or lift the gateway by its cables. Only authorised service personnel may repair it.
- Installation, BMS configuration, network security and handover must be completed by the appointed installer or system integrator.

1.2 Site and equipment checks

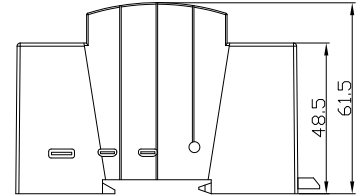
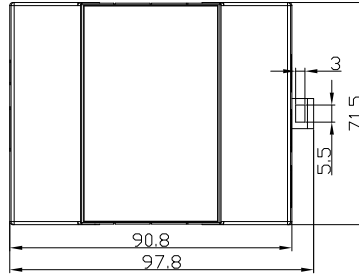
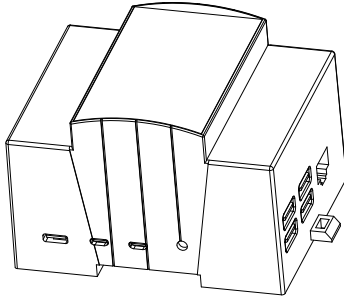
Check	Requirement
Environment	Ambient 0°C to +50°C; humidity 20% to 80%; IP20. Storage: -10°C to +60°C.
Mounting	Standard 35 mm DIN rail or wall/flat-surface mounting.
Power adapter	Included USB-C adapter; UK and EU versions are available.
Optional PoE	Use external HAPOE/C PoE splitter; it is not included.
SD card	Check correct insertion before connecting power.
Network	Ethernet is recommended for commissioning and permanent BMS integration.

1.3 Koolmesh project and site network

- Create and commission the Koolmesh BLE Mesh lighting network before BMS integration. Add the gateway to the corresponding project in the Koolmesh App. One Koolmesh network is supported per gateway.
- Keep the commissioning phone or tablet within Bluetooth range of the target device. After commissioning, access to any active mesh node allows communication with devices in the mesh network.
- Connect the gateway and BACnet/Modbus client to the same local IP network unless routing and protocol-specific configuration are provided.
- Provide Internet access for cloud-dependent functions such as project synchronisation and OTA firmware updates.
- Prepare a controlled BMS or management LAN. Do not expose the local Web interface, BACnet, Modbus TCP or MQTT Broker directly to the Internet.

2 Mounting and connections

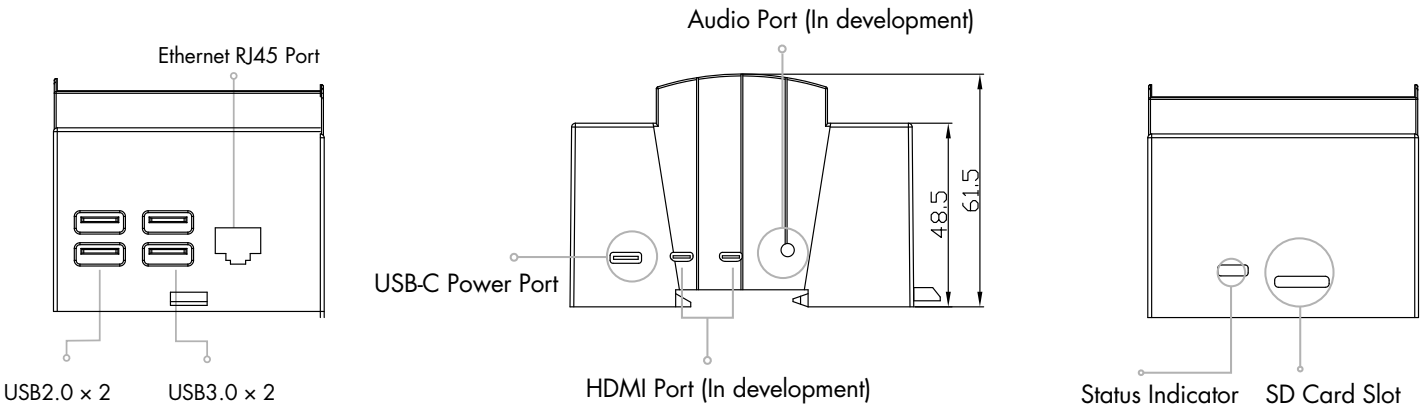
2.1 Mechanical installation



Wall or flat-surface mounting and 35 mm DIN rail mounting

1. Select a location within the environmental limits in Section 1.
2. For DIN rail installation, clip the gateway securely onto a standard 35 mm DIN rail inside the control panel or distribution board.
3. For wall or flat-surface installation, secure it using the rear mounting points or the supplied mounting accessory.
4. Ensure the gateway is securely mounted and the power connection, Ethernet port and SD card slot remain accessible. Check Bluetooth connectivity after installation, as the enclosure and nearby obstacles may reduce wireless range.

2.2 Interface identification



USB-C power, RJ45 Ethernet, USB ports, SD card slot and status indicator

Connection	Use
USB-C	Connect the 5 VDC, 3 A power supply.
Ethernet RJ45	Connect to the local IP network.
SD card slot	Check that the SD card is correctly inserted before power-up.
USB ports	2 x USB 2.0 and 2 x USB 3.0.
HDMI and audio	Reserved / not for user access.

2.3 Optional PoE connection

The HAPOE/C splitter separates Ethernet power and data for the gateway. Connect its data output to RJ45 and its power output to USB-C. The splitter is a separate accessory; direct PoE power at the gateway RJ45 port is not specified.

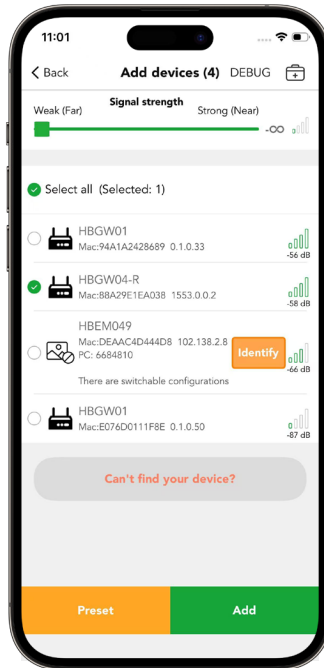


Example connection using an external PoE splitter

3 Startup and network setup

3.1 Power on and add the gateway

1. Ensure that the SD card is correctly inserted, then connect the power supply.
2. Check startup: the red LED flashes and three short beeps indicate that the initial startup sequence has completed. If the green LED remains continuously on, power off and check the SD card.
3. Open Koolmesh App and tap the + icon. Select HBGW04/R, tap Add devices and assign it to the required installation area.
4. Verify that HBGW04/R appears in the Devices list.



Koolmesh App device addition screen

3.2 Ethernet connection

1. Connect the RJ45 port to the local network and power on the gateway.
2. Check the assigned IP address and ensure the commissioning computer is on the same local network. DHCP is enabled by default.
3. For permanent integration, configure a static IP address or DHCP reservation according to the site network plan.
4. Open <https://<gateway-ip>> in a browser to access local administration.

Use Ethernet for stable BACnet/IP and Modbus TCP integration. The management service uses HTTPS on TCP 443; HTTP port 80 is not open.

Wi-Fi is supported but is not recommended for permanent BMS integration because site conditions may affect connection stability.

3.3 Network ports and protection

Service	Port and direction	Protection
Local Web	TCP 443; inbound LAN	HTTPS; administrator login
BACnet/IP	UDP 47808; inbound BMS LAN	Network ACL and BMS VLAN
Modbus TCP	TCP 1502; inbound BMS LAN	Network ACL and management VLAN
MQTT LAN	TCP 1883; inbound management LAN	Account + topic ACL; no TLS
Customer remote Broker	<broker-host>:<port>; outbound	TLS or plaintext TCP; Broker account + topic ACL

A topic ACL controls access to MQTT topics. A network ACL restricts source networks, IP addresses and ports at the switch or router. BACnet and Modbus have no protocol authentication and depend on network isolation and ACLs.

4 Local Web and project configuration

4.1 First access and security

1. Open <https://<gateway-ip>> from the local LAN. Default username: admin; Default password: koolmesh.
2. Change the default username and password immediately after the first login.
3. Check the device-specific HTTPS certificate. A self-signed certificate is automatically maintained for hostname and valid IPv4 changes; administrators may import an enterprise certificate.
4. Restrict management access to authorised site networks. The Web API supports the gateway administration interface and is not a public third-party integration API.

4.2 Project import and protocol preparation

1. Synchronise or import the final Koolmesh project configuration. The imported project determines the BACnet objects and Modbus registers generated.
2. Verify light, sensor, group, zone, scene and network counts against the commissioned project. People-count points are not currently generated.
3. Confirm protocol identifiers: BACnet Device ID, Modbus Unit ID and MQTT Gateway ID/topic root. Enable the required services and configure the required accounts and permissions.
4. Export or record the BACnet object list, project-specific Modbus reg.csv and MQTT topic catalog.
5. After a project structure change, synchronise or re-import the configuration and export fresh point lists. Restart only when required by the commissioning procedure or Web interface.

4.3 Time settings

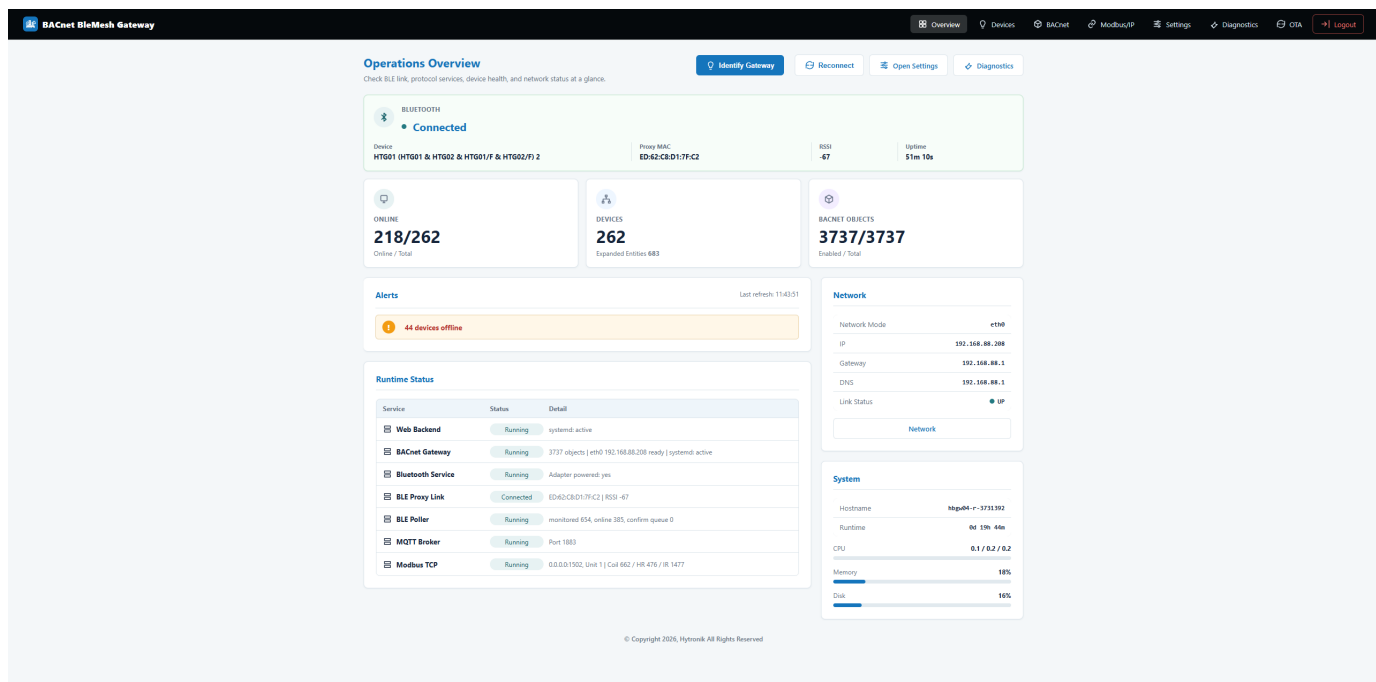
Use system/DHCP NTP unless customer NTP servers are configured; configured servers are exclusive. BLE RTC is the fallback only when NTP is unavailable. Web pages use the site time zone; protocol timestamps remain UTC.

4.4 Service architecture

Browser traffic enters through HTTPS 443 and is proxied by Nginx to the internal FastAPI backend at 127.0.0.1:8000. The backend is not exposed externally. Local Web administration must not be exposed directly to the public Internet.

4.5 Local Web functions

Page	Purpose
System Dashboard	View BLE, BACnet, Modbus, MQTT, network, host and system status.
Device Control	Control supported lights, RGB/RGBW, zones, groups, scenes and network entities.
BACnet Objects	Inspect type, instance, name, current value and enabled status; search objects.
Modbus/IP	View service status and register mapping; export project-specific reg.csv.
System Settings	Configure network, BACnet Location and Foreign Device, GATT provisioning, MQTT/Broker/Bridge, authorisation, passwords, BLE polling and HTTPS certificates. Inspect Foreign Device registration, renewal and retry status.
OTA Update	Check, download and apply updates; view progress, release notes and version history. Supports staged upgrades, resumable downloads, atomic switching and automatic rollback, depending on the installed firmware version.
Diagnostics	Inspect services and BLE Mesh messages; export source/destination, SEQ, IV Index, Opcode, DSPID and raw PDU information.



Local Web administration example

Screen labels and available functions may vary depending on the installed firmware version.

5 BACnet/IP commissioning

The gateway operates as a BACnet/IP Server/Device on UDP 47808. It supports BACnet/IPv4 Normal and an optional Foreign Device Client. The documented implementation uses Protocol Revision 23.

Capability	Behaviour
Discovery	Who-Is / I-Am; Who-Has / I-Have
Read	ReadProperty and ReadPropertyMultiple
Write	WriteProperty on whitelisted writable Present_Value properties
Device management	DeviceCommunicationControl (DCC)
Object services	COV for AI/BI/ACC/LAV; ReadRange for emergency Trend Logs; priority arrays for AO/BO
Not provided	BBMD Server, Router, IPv6, BACnet/SC, MS/TP, segmentation, alarms, schedules or BACnet time synchronisation

5.1 Connection and discovery

1. Select BACnet/IP in the BMS or commissioning tool. Bind to a reachable network interface and use UDP 47808.
2. Send Who-Is and confirm I-Am. Record the Device ID and ensure it is unique within the BACnet internetwork.
3. Discover the Device object and Object_List. Read Object_Name, Description, Units and Present_Value for target objects.
4. For routed discovery, obtain the remote BBMD's address, port, and TTL, then configure the gateway to act as a Foreign Device. Note that the gateway does not function as a BBMD.
5. Verify the supported object type, write permission and value range before performing a controlled write. Check subsequent actual device feedback. Foreign Device operation distributes BACnet broadcasts across IP subnets; it does not add encryption or identity authentication. Continue to protect UDP 47808 with network ACLs.

5.2 Recommissioning after changes

After project configuration or address-plan changes, rediscover the affected BACnet objects and update the point list in the connected BMS. Recommission the affected points as required.

5.3 Object instance plan

instance = (type_id << 17) | (index << 6) | offset

type_id	Entity	Base instance
1	Light	131072
2	Lux	262144
3	Motion	393216
4	People count - reserved	524288
5	Scene	655360
6	Zone	786432
7	Group	917504
8	Network	1048576
9	Emergency	1179648
10	Emergency Group	1310720

The address plan reserves up to 2,048 indices per entity type and 64 offsets per entity, with up to 8,192 business objects. These allocations are not physical-device capacity. People-count objects are not generated.

5.4 Object types

Type	Meaning and behaviour
AI / BI	Read-only continuous / binary actual values.
AO - Analog Output	Writable analogue target with a priority array and NULL relinquishment.
BO - Binary Output	Writable on/off command with a priority array and NULL relinquishment
ACC	Unsigned cumulative count; use counter_epoch to detect resets.
LAV	Double-precision accumulated value; energy in kWh.
STRG / CSV	Character String Value: membership metadata / emergency mode and test events.
BSV	32-bit combined fault state with per-bit Bit_Text.
TL	Trend Log: latest 128 emergency records, read using ReadRange.
BV action objects	One-shot action request. Each Active write triggers one request; Present_Value then automatically returns to Inactive (Idle).

5.5 General lighting object offsets

Type	Offset	Point	Meaning
BI	0	sw_read	Actual on/off
BO	1	sw_write	On/off target
AI	2	Bri_read	Actual brightness, %
AO	3	Bri_write	Target, minLightness..maxLightness
AI / AO	4 / 5	cct_read / cct_write	Actual / target CCT, K
BI	6	occupied	0 unoccupied; 1 occupied
STRG	7	Zones/Groups	Compact JSON membership
LAV	8	energy_total	Accumulated energy, kWh
BI	9	fault	0 normal; 1 driver/lamp fault
BV	10	return_auto	Each Active write triggers one request; then Inactive (Idle)
AO	11..14	red/green/blue/white_level	RGB 0..255; white 0..100%
BI	15	manual_override	0 automatic; 1 manual

BV actions return to Inactive (Idle) after each Active write triggers a request. Lux uses AI; motion uses ACC trigger_count_total plus AI counter_epoch. Scene recall is a one-shot action using the sceneId metadata. Zone/Group values aggregate members; Network commands affect the whole network. Optional colour points depend on device capability.

5.6 Read and write example

For light index 0, read BI:131072 Present_Value. Write brightness 72 to AO:131075 Present_Value. To turn the light off, write BO:131073 = Inactive; brightness zero does not replace an off command.

5.7 Emergency object offsets

Type	Offset	Point and behaviour
BSV	0	fault_bitmap: 32-bit fault map
CSV	1	operating_state: English mode; Unknown if unavailable
BV	2..5	enter_inhibit / function_test / duration_test / stop_test
CSV	6	test_event: English test event; reference codes in Appendix A
TL	7 / 8	test_history / fault_history; latest 128 entries; fault 0 is recovery
AO	9..11	function_test_time / duration_test_time / inhibit_time; seconds in 10-second steps; non-DALI only

- ReadProperty returns the latest stored gateway state and does not necessarily trigger a new device query. Check communication status as well as the value.
- Successful WriteProperty means the gateway accepted the command. Use later device feedback to confirm physical completion.
- AO/BO targets support standard priority arrays and NULL release. Confirm site control priority before writing.
- RGBW objects store control targets, not measured mixed-colour feedback. White is generated only for RGBW-capable entities.
- On communication failure, actual-input objects retain their last value and set Reliability = communication-failure. Do not treat that retained value as a fresh reading.
- Zone, Group and Network objects may affect many lights. Confirm the intended scope before writing.

5.8 Emergency interpretation

Fault bits and test-event codes are listed in Appendix A.

Current emergency state comes from device queries. Historical records use timestamps stored in device logs. Test events do not distinguish manual, button or automatic initiation. DALI logs provide a reliable completion time only.

The non-DALI emergency time parameters are shared by Web administration and all protocols. One-shot actions use BV objects.

5.9 BACnet integration checks

1. Verify discovery and uniqueness of Device ID.
2. Check actual object types, Present_Value, Units and permissions.
3. Perform a supported read and controlled write on one device.
4. Observe real device response and subsequent actual-state feedback.
5. Verify aggregate object scope and export the final point list.

6 Modbus TCP commissioning

Connect to the gateway IP using TCP port 1502 and Unit ID 1 by default. The documented service supports up to 32 concurrent connections and closes idle connections after 300 seconds.

Table	Function codes	Use
Coil	FC01 / FC05 / FC15	On/off and one-shot actions
Holding Register	FC03 / FC06 / FC16	Brightness, CCT, RGBW and emergency times
Discrete Input	FC02	Occupied, fault and manual-override status
Input Register	FC04	Lux, energy, counts, status and emergency states

6.1 Export the project map

1. Enable Modbus TCP and permit TCP 1502 from the authorised client network.
2. Export the target gateway point list in the Web interface using the reg.csv export at /api/modbus/reg.csv.
3. Create points using the table, zero-based PDU address and data type from that export.
4. Read a known device state, perform a supported control and check actual device feedback.
5. Export again after importing new JSON or changing the address plan.

Addresses in this manual and reg.csv are zero-based PDU addresses. HMI labels such as 40001 for HR 0 or 30001 for IR 0 must not be sent as the PDU address.

6.2 Data types and units

Type	Width	Encoding
bool	1 bit	Coil/DI; 0 or 1
uint16	1 register	Unsigned 16-bit
uint32	2 registers	High word first, then low word
uint64	4 registers	High word first; aggregate energy in Wh

Energy is stored internally in kWh and exposed as integer Wh: 12.345 kWh becomes 12345. Read status alongside business values, including online, stale, partial, configuration error, sensor absent, configured and field-valid indications.

address = base + index * step + offset
 Network address = 65504 + offset

Table	Entity base and step
Coil	Light 0/4; Zone 8192/4; Group 16384/4; Emergency Group 20480/4; Scene 24576/2; Emergency 28672/4; Network 65504
DI	Light 0/4; Zone 8192/4; Group 16384/4
HR	Light 0/8; Zone 20480/8; Group 36864/8; Emergency 45056/8; Network 65504
IR	Light 0/8; Lux 16384/2; Motion 20480/4; Emergency 28672/8; People Count 36864/8 reserved; Zone 40960/6; Group 49152/6; Network 65504

The notation base/step is used above. Address allocations are 2,048 each for Light, Lux, Motion and Scene; 1,024 each for Zone, Group, Emergency and Emergency Group; and one each for Network and System. These are not device connection limits. Reserved ranges do not generate usable points.

6.3 System information

IR 57344..57359 is the fixed System Info range. It exposes register_map_major = 2, register_map_minor = 3, Gateway ID, configuration_revision and mapping_crc32. Use these values to detect when a point list needs re-importing. FC43/14 Read Device Identification supplies Vendor, Product Code and version Basic Identification objects.

6.4 Entity points

Entity	Principal points
Light	sw, return_auto, occupied, fault, manual_override, brightness/CCT commands and actuals, RGBW targets, energy and status
Lux / Motion	Lux and status / trigger_count_total, status and counter_epoch
Scene	recall_Scene momentary Coil trigger
Zone / Group	sw, return_auto, occupied, brightness/CCT/RGBW commands, energy and status
Emergency / Group	Emergency test actions, saved times and states / group function, duration and stop actions
Network	sw, return_auto, brightness/CCT/RGBW commands, energy and status

Example: Light index 3 has HR brightness_command 24, cct_command 25 and RGBW 26..29; Coil sw 12; IR brightness 24; IR energy 25..26. Zone index 2 has Coil sw 8200, HR brightness_command 20496 and IR energy 40972..40975.

6.5 Emergency map

Area	Zero-based address	Meaning
Coil	$28672 + \text{index} \times 4 + 0..3$	Function / duration / stop / inhibit; write 1 to trigger; readback 0
IR	$28672 + \text{index} \times 8 + 0..1$	fault_bitmap; uint32, high word first
IR	$28672 + \text{index} \times 8 + 2$	Emergency operating state (numeric status code)
IR	$28672 + \text{index} \times 8 + 3$	Reserved; do not create a point
IR	$28672 + \text{index} \times 8 + 4$	test_event; codes 1..9
IR	$28672 + \text{index} \times 8 + 5$	Status bitmap: bit 0 = online; bit 1 = stale; bit 2 = partial; bit 3 = configuration error; bit 4 = sensor absent; bit 5 = configured.
HR	$45056 + \text{index} \times 8 + 0..5$	Three uint32 time values: function / duration / inhibit; seconds in 10-second steps; non-DALI only

Note: The numeric mapping of the emergency operating state is not yet defined in this manual. Refer to Appendix A for fault bit definitions and test-event codes.

6.6 Write behaviour and exceptions

- To turn a light off, write Coil sw = 0. Brightness zero is not a substitute.
- Writing 1 to return_auto triggers the action and immediately resets to 0. Writing 0 succeeds without dispatch.
- RGB targets are 0..255; white is 0..100. Readback gives control targets, not actual mixed-colour feedback.
- Modbus TCP has no protocol authentication or encryption. Restrict client access using VLANs and network ACLs.

Exception	Meaning
0x02 Illegal Data Address	Missing address, read-only address or invalid quantity
0x03 Illegal Data Value	Value outside the business range

Emergency history uses device-log timestamps. A successful write does not prove that a test completed; verify subsequent device state and logs.

7 MQTT connection and subscriptions

The local Broker supports MQTT 3.1.1 and MQTT 5.0. Connect to `mqtt://<gateway-ip>:1883` using a configured username, password and topic permissions. The LAN connection does not use TLS and is intended for a trusted management network.

7.1 Topic catalog

Topic root: `hbgw04/{gateway_id}/v1/`. Replace `gateway_id` and `entity_id` with values from the commissioned gateway.

Suffix under the topic root	Retain	Purpose
<code>gateway/availability</code>	Yes	online / offline
<code>gateway/state</code>	Yes	Gateway JSON state
<code>entity/{entity_id}/meta</code>	Yes	Entity metadata and capabilities
<code>entity/{entity_id}/reported</code>	Yes	Current state snapshot
<code>entity/{entity_id}/set</code>	No	QoS 1 control command
<code>command/{request_id}/ack</code>	No	Short-lived command result

```
mosquitto_sub -h <gateway-ip> -p 1883 \
-u '<username>' -P '<password>' -q 1 \
-t 'hbgw04/<gateway_id>/v1/#' -v
```

A root subscription immediately receives retained snapshots. ACKs are non-retained and arrive only after the subscription is active. Subscribe to `command/+/ack` before publishing control commands.

7.2 Gateway state fields

Field	Meaning
<code>schema / ts / version</code>	Message schema; UTC timestamp; firmware version
<code>ble_connected</code>	Current GATT Proxy link state, not the state of every device
<code>device_count</code>	Valid physical devices in the imported configuration
<code>online_count</code>	Physical devices with at least one monitored child online
<code>entity_count</code>	MQTT entities actually generated
<code>object_count</code>	BACnet business objects

```
{
  "schema": 1,
  "ts": "<current-UTC-time>",
  "version": "<firmware-version>",
  "ble_connected": true,
  "device_count": 15,
  "online_count": 13,
  "entity_count": 72,
  "object_count": 352
}
```

7.3 Sending a control

1. Subscribe to the relevant reported and ACK topics. Read meta.capabilities and writable to confirm the action is supported.
2. Generate a new request_id and a current UTC ISO 8601 timestamp. Replace all example placeholders with actual values.
3. Publish to entity/{entity_id}/set with QoS 1 and retain disabled.
4. Read the ACK and subsequent reported state. Confirm actual device feedback before treating the operation as complete.

```
{
  "schema": 1,
  "request_id": "f33826c8-68c7-4aa4-a89e-f8d11a83ee82",
  "ts": "<current-UTC-time>",
  "ttl_ms": 5000,
  "action": "set_brightness",
  "value": 72
}
```

This example illustrates the MQTT command message structure. Replace all placeholders with the appropriate values for the commissioned gateway. A copied old timestamp may cause expiration. The client generates request_id; UUID v4 is recommended. Length is 8..64 ASCII letters, digits, dot, underscore or hyphen. Use a new ID for each new operation; QoS retransmission of the same operation must use the same ID and identical payload.

- Controls must not be retained; retained controls are rejected.
- ttl_ms is at most 60000. Expired commands are not sent to BLE.
- Local and remote Broker paths are each limited to 3 new commands per second; 1 per second is recommended. QoS retransmissions using the same request_id do not consume the new-command quota.

7.4 ACK interpretation

Status	Meaning
dispatched	Accepted and sent; no reliable direct feedback
confirmed	Matching real-state feedback received
rejected	Validation, permission, rate or state check failed
expired	ttl_ms elapsed before execution
timeout	Expected confirmation was not received in time

ACK fields include schema, request_id, status, reason, entity_id, action, value and ts. For example, confirmed with reason state_match means matching state feedback was received. dispatched does not mean an emergency test has completed.

7.5 State quality

quality	Meaning
confirmed	Actual BLE feedback from an online physical entity
optimistic	Aggregate value calculated from currently valid members
stale	Entity is offline; last real value is retained
unavailable	No valid feedback yet; values are empty.

7.6 Reported values

Entity	Fields and semantics
light	onoff 0/1; brightness %; cct K; occupied boolean; energy_kwh; fault boolean
lux / motion	lux in lx / trigger_count_total cumulative count
zone / group	onoff: any member on; occupied: any member occupied; energy_kwh: member sum
network	Whole-network accumulated energy_kwh; command fields are targets
emergency	fault_bitmap: unsigned 32-bit fault bitmap encoded as a JSON integer; operating_state and test_event: predefined English strings; time parameters: seconds

7.7 Supported general actions

Action	Value and scope
set_onoff	0 off; 1 on
set_brightness	Brightness percent; zero does not replace off
set_cct	Kelvin; permitted range comes from meta
set_red / set_green / set_blue	0..255; RGB capability required
set_white	0..100%; RGBW capability required
return_auto	No value; leave manual override
trigger_scene	Scene only; value = 1; sceneId comes from meta

General actions other than trigger_scene apply to light, zone, group and network entities where declared. Use meta.capabilities and writable; do not send undeclared actions. People-count entities are not currently generated.

7.8 Emergency entities

Emergency topics use entity/emergency-{index:04d}/reported and entity/emergency-{index:04d}/set under the gateway topic root. The index is zero-padded to at least four digits. The operating_state and test_event payloads are predefined English strings.

Action	Meaning
start_function_test	No value; uses saved function-test time
start_duration_test	No value; uses saved duration-test time
stop_test	No value; stops the current test
enter_inhibit	No value; uses saved inhibit time; DALI uses fixed 15 minutes
set_function_test_time	Seconds in 10-second steps; non-DALI only
set_duration_test_time	Seconds in 10-second steps; non-DALI only
set_inhibit_time	Seconds in 10-second steps; non-DALI only

Use subsequent reported state and device logs for test results. Current state comes from queries; historical timestamps come from device logs. Test events do not distinguish manual, button or automatic initiation. DALI logs provide a reliable completion time only.

7.9 Optional customer remote Broker

- The gateway connects to a customer LAN or cloud Broker at <broker-host>:<port> using MQTT 3.1.1 / 5.0. Select TLS or plaintext TCP; TLS is not mandatory.
- Configure the customer Broker account and topic ACL. Credentials for the gateway local Broker do not automatically apply to the customer Broker.
- Only approved topics are forwarded: state, metadata and command results upstream, and supported basic controls downstream. Arbitrary topic forwarding, firmware updates, licence management and custom Bluetooth commands are not supported through the Bridge.
- Remote control is disabled by default. Verify Broker ACLs, address, port and control scope. When using TLS, also verify the certificate chain, hostname and system time.

8 Operation and maintenance

8.1 Protocol selection and command coordination

Requirement	Protocol
Standard BMS discovery and object semantics	BACnet/IP
PLC or conventional register polling	Modbus TCP
Event-driven integration, JSON and optional cloud	MQTT
Multiple systems at one site	Concurrent protocols with coordinated control

- All protocols share device state updated through Bluetooth feedback and queries. An immediate read may show a target value; use subsequent actual feedback to confirm physical completion.
- If multiple systems write the same entity, a later command may overwrite an earlier target. Define the controlling system, schedule or interlock. Confirm interaction with BACnet priorities for the installed firmware.
- BLE Mesh bandwidth is limited. Avoid excessive polling and batch writes. For MQTT, a rate of 1 new command per second is recommended, with a maximum of 3 commands per second for each local or remote Broker path. Higher rates require project validation.
- Authorise the scope of Zone, Group and Network commands before use.

8.2 Project changes and OTA

After changing the Koolmesh project, re-import or synchronise the configuration, verify counts, export fresh BACnet/Modbus lists and record the MQTT topic catalog. Restart only if instructed by the commissioning workflow or Web interface. Check the OTA release notes and available update in local Web administration; Internet access is required for cloud-dependent OTA functions.

After firmware upgrades, check the release notes for any changes to BACnet Object Instance IDs or point mappings. If changes are identified, clear outdated cached objects in the connected BMS, rediscover the affected points and recommission as required.

8.3 Operating resources

Koolmesh App and Web tools provide project, device and scene management. Shared platform functions such as groups, scenes, schedules, astro timer, network sharing, permission management, floorplans, device replacement and OTA depend on the relevant devices and platform configuration; they are not all standalone gateway functions.

Koolmesh operating guidance: <http://faq.koolmesh.com/faq/en/index.html>

Lighting control feature information: <https://hytronik.com/solutions/lighting-control-features>

8.4 Troubleshooting

Symptom	Checks
Green LED continuously on	Power off and check SD card insertion.
Local Web unavailable	Confirm IP and local reachability; use HTTPS TCP 443, not HTTP 80; check network ACL.
BACnet discovery fails	Check UDP 47808, interface binding and subnet broadcast. On routed networks verify BBMD/Foreign Device.
BACnet read works but write fails	Check object type, permissions, range, DCC and Bluetooth state. Use BO for on/off commands and BV for one-shot actions.
Modbus connection fails	Use TCP 1502, Unit ID 1; enable the service and permit it in the ACL.
Modbus values shifted	Check zero-based address, table, high-word-first order and a fresh reg.csv.
MQTT authentication fails	Check TCP 1883, username, password and topic permissions.
No MQTT state or ACK	Check subscription root and retained state. Subscribe to command/+/ack before control; verify QoS 1, non-retained publish, request_id and ttl_ms.
Customer Broker disconnected	Check Broker address, port, TCP/TLS selection, account and topic ACL. For TLS, also check CA, hostname and time. Local protocols should remain available.
Command sent but no response	Check BLE GATT Proxy, entity online/quality, address, capability, command rate and actual BLE feedback.

Troubleshoot in this order: gateway and service state, connectivity, objects/topics, command results, then Bluetooth communication. Immediate readback is not proof of completion.

8.5 Handover checklist

- Verify normal power-up, network access and local Web access.
- Verify the correct Koolmesh project and all required status/control points.
- Test each enabled protocol with a read, controlled write and feedback check.
- Change the default administrator username and password; verify network ACLs, MQTT topic ACLs and ensure public access is disabled.
- Record firmware, project configuration, protocol IDs, point lists, certificates and the agreed controlling system.

Appendix A Emergency reference values

fault_bitmap is a 32-bit combined map. Zero means no current fault; multiple bits may be set. Do not interpret the entire decimal or hexadecimal value as a single fault code.

Bit	Meaning	Bit	Meaning
0	Load open circuit	10	Battery charge over-temperature
1	Load short circuit	11	Battery charge under-temperature
2	Battery open circuit	12	Battery communication fault
3	Battery short circuit	13	DALI emergency circuit fault
4	Driver fault / load open circuit	14	DALI emergency battery fault
5	Driver fault / load short circuit	15	DALI emergency lamp fault
6	Charging circuit fault	16	Function-test timeout
7	Insufficient battery capacity	17	Duration-test timeout
8	Battery discharge over-temperature	18	Function-test failure
9	Battery discharge under-temperature	19	Duration-test failure
20..31	Reserved		

Test event codes

Code	Meaning	Code	Meaning
1	No test event	6	Duration test completed
2	Function test started	7	Duration test failed
3	Function test completed	8	Test stopped
4	Function test failed	9	Unknown test event
5	Duration test started		

Operating modes

The emergency operating modes include Normal, Manual duration test, Emergency, Button function test, Rest, Button duration test, Inhibit, Automatic function test, Extended emergency, Automatic duration test, Manual function test and Unknown.

Appendix B Legal notice and disclaimer

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