

# ZIGBEE/BLUETOOTH LED CONTROLLER LD6

## REFERENCE MANUAL



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## 1. Overview

Thank you for purchasing the ubisys Zigbee and Bluetooth LED Controller LD6.

You have decided for a high-quality product with first-rate support!

This reference manual provides operating and maintenance instructions, interface specifications, command references and more. It is primarily intended for system integrators, not end-users.

An installation guide specific to your region is available as a separate document and is included in printed form in the product package.

If you have any questions or need additional support, please visit the support pages that best fit your background:

If you are a consumer (private household) or installer, please visit the Smart Home support pages at <http://www.ubisys.de/en/smarthome/support.html> for contact details.

As a commercial customer, please visit the Engineering support pages at <https://www.ubisys.de/en/business-customers/> for contact details.

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## 2. Features

- Zigbee 3.0 constant-voltage LED controller with six configurable outputs and three configurable inputs
- World's first device to feature Zigbee Direct, the unique combination of Bluetooth and Zigbee (since the firmware version 1.1.1 and later). The ubisys Zigbee Direct solution has been rewarded Golden Unit Designation by the Connectivity Standards Alliance
- Featuring ubisys Versalight™ universal light engine with unparalleled flexibility
  - Supports versatile configurations from one up to six primary LEDs per light endpoint
  - Supports one to six light endpoints in different setups: monochromatic/dimmable, CCT, RGB, RGBW, RGB+CCT, RGBA, RGBWA, etc.
  - Countless configuration options with the 23 most important profiles provided in the ubisys Smart Home App for iOS version 2.1.1 or higher at the touch of your fingertips.  
Notice: With the Zigbee Direct feature built into LD6 you can configure it with just the app and no gateway hardware and then add it to the hub of your choosing – or just use it without a hub for simple use-cases
  - Support for fine-tuning primary information if desired: Specify chromaticity and relative luminous flux for the LED strips or LED spots that are wired to the LD6 when this information is available from data sheets or chromaticity test reports
  - Advanced color mixing and improved color fading for visually pleasing transitions
  - Ability to apply output configuration changes on-the-fly (no reboot/power-cycle required any more). Endpoints and clusters are simply reconfigured dynamically as needed
- Suitable for decorative lighting (full color light strips) and general lighting (tunable white or monochromatic)
- Three configurable 3.3V inputs, one pre-configured for operating the first local output. Individually reconfigurable as on/off, level control, color temperature control, scene selector or automation switches. Profiles supporting momentary or stationary switches
- Zigbee Green Power Combined Device including Proxy and Sink functionality, supports on/off, level control and generic switches
- Local control even works when the device has not joined to a network (not commissioned yet)
- Supports groups, scenes, bindings, and reporting
- Reliable, unattended, maintenance-free operation; LD6 is designed for installation in false ceilings, behind mirrors, inside furniture, etc.
- Employs solid state switching for highest efficiency and durability
- Over-temperature, over-load, over-current, and short-circuit protected outputs
- Current limit: 6A per output, 12A in total (all outputs combined)
- 12/24V= supply voltage
- 3.3V regulated output provided to power sensors (touch, PIR, temperature, light-level etc.)
- Ready for I2C sensors (feature will be unlocked in a future firmware release)
- Made in Germany using high-quality, enduring parts for many years of life expectancy
- Leverages ubisys Zigbee stack for best-in-class reliability and performance

- Supports all channels in the 2.4 GHz band, i.e. channels 11-26 as per IEEE 802.15.4:
  - Primary = { 11, 15, 20, 25 };
  - Secondary = { 12, 13, 14, 16, 17, 18, 19, 21, 22, 23, 24, 26 }
- Supports joining centralized and distributed security networks as router
- Supports forming simple centralized security networks as Coordinator and Trust Center
- Supports forming distributed security networks as router
- Three pre-configured Trust Center Link-Keys for joining:
  - Global Default Trust Center Link-Key (“ZigbeeAlliance09”)
  - Zigbee 3.0 Global Distributed Security Link-Key
  - Device-individual link-key derived from installation code - also printed as text and QR barcode
- Extended neighbor table with up to 26 entries for routers and end-devices
- Extended routing table with up to 96 entries for ad hoc and many-to-one routes - nearly ten times the capacity required by the standard (10)
- Extended buffering for sleepy end-devices with up to 24 buffers - 24 times the capacity required by the standard (1)
- Extended APS duplicate rejection table with up to 64 slots - 64 times the capacity required by the standard (1)
- Extensive transmit and receive queues for optimum through-put and minimum packet drop rate
- Reliable and scalable network-wide broadcasts featuring passive acknowledgments
- Reliable packet forwarding with automatic network-level retries
- Very sophisticated routing algorithm for reliable ad hoc routing - avoids routing loops even in case of concurrent route requests with overlapping source/destination; detects and breaks routing loops in environments with third-party stacks
- Firmware upgradable over-the-air during normal operation using Zigbee OTA Upgrade Cluster; with a suitable Zigbee Virtual Device that contains an OTA server, this is also possible via Bluetooth. The ubisys Smart Home App for iOS version 2.1 or later includes this feature, for example
- Man-Machine-Interface: A push-button and a LED for network steering, factory reset etc.
- Flame retardant housing (V-0); black, RAL 9005

### 3. Installation

The ubisys LD6 is designed for installation in ceilings, inside walls, behind mirrors, in furniture, caravans, and other places where a 12/24V DC supply is available. When the 24V supply is a safety low voltage (SELV), installation can be carried out without advanced professional skills according to the wiring diagrams provided in the leaflet of LD6.

## 4. Initial Device Start-Up

The device will search for an open Zigbee network to join when you first apply power to it.

Open the Zigbee network for joining and then power-up the device.

LD6 will blink quickly to indicate a search in progress. Once a search cycle is complete, it will either blink five times slowly to indicate it has joined a network, or keeps blinking quickly to indicate a joining failure - for example no network found, not permitted onto the network, etc. It will continue to search for a network in case of failure.

When the LD6 joins a new network, it blinks once, i.e. turns the output on to 100% for half a second, then off for half a second.

After joining a network, the device will prolong the joining window by three minutes via a fresh ZDO permit joining request.

Subsequently, when the device is power-cycled, it will blink five times slowly to indicate it is operating as a router on the network, ten times slowly to indicate that it is operating as a coordinator and trust center or blink quickly to indicate it is searching for a network to join. When commissioned, the router's LED will remain off after the five/ten blink cycles during normal operation. Afterwards, it will turn on only for as long as it is permitting other devices to join the network.

After reboot, if the device is properly commissioned, it resumes operation doing a "silent rejoin", i.e. it does not broadcast a device announcement in this case.

The device also starts advertising via Bluetooth such that Bluetooth central devices may discover it and connect via Bluetooth GATT. Refer to the Zigbee Direct specification for a detailed description of the commissioning and tunneling services provided by the LD6.

The device may turn on the load to a specific dimming level automatically after power is applied, based on the settings of the [StartupOnOff](#) and [StartupLevel](#) attributes. The default behavior is to return to the state prior to cutting power to the device.



## 5. Man-Machine interface (MMI)

LD6 offers a push-button behind a tiny hole in the front-face of the device, as well as a LED right next to it <sup>[1]</sup>. This man-machine interface provides access to a menu. In addition, it provides a handy shortcut to factory reset the device.



To factory reset the device, keep the button pressed for approximately 10 seconds until the LED starts to flash. This is equivalent to selecting menu item #5. Notice that the device also supports a power-cycle sequencing factory reset as detailed in [Section 5.1](#)

To enter the menu, press and hold the push-button for more than a second until you see three short flashes followed by a sequence of one blink, pause, one blink, pause, etc. This indicates that you have successfully entered the menu. With each short button press (less than a second), you advance through the menu. For example, pressing the button once brings you to the second menu item, which LD6 indicates by two blinks, pause, two blinks pause, etc. Once you have reached the menu item that you want to run, press and hold the button for more than a second to execute the selected item. The exact meaning of each menu item depends on the particular device and may vary from firmware version to firmware version.

Menu Item #	Operation
1	<b>Zigbee Commissioning: Network Steering</b> While in this mode a single press on the button instigates Zigbee Network Steering (“EZ-mode”). If the device is on a network it will open the network for new devices for three minutes, otherwise it will attempt to join an open network. If the network is already open, the device will close the network instead such that repetitive presses toggle the network permit joining state. The LED is on, when the network is open for new devices, and off otherwise.
2	<b>Zigbee Commissioning: Finding &amp; Binding</b> Instigates the Zigbee Finding & Binding procedure (“EZ-mode”) on an initiator or target endpoint. Target endpoints will enter identify mode for three minutes. Initiator endpoints will query targets and create suitable bindings to these targets. After leaving the menu in this mode, the first button press starts the selection of the endpoint and each subsequent press (within half a second) increments the endpoint number. Once the desired endpoint is reached, wait for the LED to blink the selected number of times. Then, press a single time to accept the selection or wait for three seconds to cancel the command. The LED will blink one time to confirm an affirmative choice, or two times to indicate the request has been cancelled.
3	<b>Zigbee Commissioning: Clear Bindings</b> Clears bindings on an initiator endpoint. Select this menu item and leave menu mode. Afterwards the device expects the selection of an initiator endpoint. The first button press starts the selection of the endpoint and each subsequent press (within half a second) increments the endpoint number. Once the desired endpoint is reached, wait for the LED to blink the selected number of times. Then, press a single time to accept the selection or wait for three seconds to cancel the command. The LED will blink one time to confirm an affirmative choice, or two times to indicate the request has been cancelled. This mode is active for one round only. Afterwards the device reverts to mode #1.
4	<b>Zigbee Commissioning: Set Device Role and Factory Reset</b> Selects the Zigbee device role for this device on the network, resets the remaining settings to factory defaults and restarts the device. Select this menu item and leave menu mode. Afterwards the device expects the selection of an option. The first button press starts the selection of the option and each subsequent press (within half a second) increments the option number. Once the desired option is reached, wait for the LED to blink the selected number of times. Then, press a single time to accept the selection or wait for three seconds to cancel the command. The LED will blink one time to confirm an affirmative choice, or two times to indicate the request has been cancelled. The following options are available: Option #1: Join an existing Zigbee network as router Option #2: Form a new distributed security network as the first router Option #3: Form a new centralized security network as the coordinator and trust center
5	<b>Factory Reset</b> Put the device into the same state as it was when it left the factory, then reboot. The only exception is the outgoing network security frame counter, which is preserved across factory resets. The device will broadcast a network leave indication .

Menu Item #	Operation
6	<p><b>Zigbee Commissioning: Advanced Commands</b></p> <p>Provides a number of advanced Zigbee commissioning command options. Select this menu item and leave menu mode. Afterwards the device expects the selection of an option. The first button press starts the selection of the option and each subsequent press (within half a second) increments the option number.</p> <p>Once the desired option is reached, wait for the LED to blink the selected number of times. Then, press a single time to accept the selection or wait for three seconds to cancel the command. The LED will blink one time to confirm an affirmative choice, or two times to indicate the request has been cancelled. The following options are available:</p> <p>Option #1: Perform a simple reset (reboot), then continue operating seamlessly (silent re-join)</p> <p>Option #2: Perform a simple reset (reboot), then re-join the network</p> <p>Option #3: Perform a full factory reset, including security frame counters and preserved settings</p>
7	Reserved for internal use. Do not leave the menu in this mode.

## 5.1. Power-Cycle Sequencing Factory Reset

It is possible to instigate a factory reset using a special power-cycle sequence. This is equivalent to selecting menu item #5, with the advantage that you need no access to the device itself (only to its power supply).

1. Power the device for at least four seconds.
2. Interrupt the power supply for at least a second.
3. Reapply power for less than two seconds but more than half a second.  
Notice that at the end of this cycle, the device is off and should remain off for at least a second.
4. Repeat the previous step two more times, for a total of three short power cycles.
5. Apply power to the device and leave it powered on.

The device will now factory reset and reboot.

After above sequence, the dimmer will flash the connected light three times to indicate the factory reset sequence is in progress. This is the default reset sequence, equivalent to selecting menu item #5 as described above, or keeping the menu button pressed for more than 10 seconds, or removing the device from the network using a leave request.

[1] The high-voltage inputs of LD6 do not count as an MMI feature.

## 6. Zigbee Interface

Please refer to the following IEEE and Zigbee Alliance documents, which apply to this product:

- [R1] IEEE Standard 802 - Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)
- [R2] ZigBee Specification, Revision 23, Document No. 05-3474-23
- [R3] Zigbee 2015 Layer PICS and Stack Profiles, Revision 6, Document No. 08-0006-06
- [R4] ZigBee Cluster Library Specification, Revision 8, Document No. 07-5123-08
- [R5] Zigbee Base Device Behavior Specification, Revision 13, Document No. 13-0402-13
- [R6] Zigbee PRO Green Power Feature Specification, Revision 26, Document No. 09-5499-26
- [R7] Zigbee Home Automation Public Application Profile 1.2, Revision 29, Document No. 05-3520-29
- [R8] Zigbee Smart Energy Standard 1.1b, Revision 18, Document No. 07-5356-18
- [R9] Zigbee Device Library Specification, Revision 6, Document No. 19-02016-006
- [R10] Zigbee WWAH ZCL Cluster Definition, Version 1.0, Document No. 17-01067-024
- [R11] Zigbee Direct Specification, Version 1.0, Document No. 20-27688-037
- [R12] Zigbee QR Code Requirements, Revision 9, Connectivity Standards Alliance Document 18-01000-009

### 6.1. Device Anatomy

The LD6 provides 6 controllable output PWM channels for a rated voltage of 12V or 24V and a current of up to 12A combined or 6A per channel. It combines state-of-the-art solid-state technology with advanced firmware for a unique feature set. In addition, three inputs are available for local control or remote control of other on/off, level control or color control target devices or groups. Being a constantly powered device, LD6 also acts as a Zigbee router improving network connectivity and meshing capabilities as well as serving as a connection point (“parent”) for sleepy end-devices, Green Power Devices, and Zigbee Virtual Devices (Bluetooth).

LD6 provides up to twelve Zigbee application endpoints:

Endpoint #	Profile	Application
0 (0x00)	0x0000: Zigbee Device Profile	Zigbee Device Object (ZDO) - standard management features
1 (0x01)	0x0104: Common Profile (HA)	This is the first out of up to six lighting endpoints that provide control of a light connected to one or more output channels via on/off, level control or color control clusters. It supports groups and scenes, as well as reporting for on/off state, level and color feedback. The identify cluster allows for push-button commissioning as a target (finding & binding). In addition, the ballast configuration cluster provides additional control over the dimming behavior.  Depending on the specific output configuration settings currently in use, the LD6 chooses an appropriate device type for this endpoint: Dimmable Light (0x0101), Color Temperature Light (0x010C), or Extended Color Light (0x010D). Consequently, the application endpoint has the ability to enable a suitable set of inbound and outbound clusters. Notice that the endpoint is dynamic, i.e. if no output channel is assigned to this endpoint, it will not be present. Please check <a href="#">Section 6.13.3.3</a> for details.
2 (0x02)	0x0104: Common Profile (HA)	Dimmer Switch (0x0104) Based on the input configurations set via the manufacturer-specific Device Setup Cluster (0xFC00) on endpoint #232, this application endpoint has the capability to transmit commands such as on/off, level control, color control, or manufacturer-specific automation switch/button commands. These commands are activated in response to local high-voltage inputs.

Endpoint #	Profile	Application
3 (0x03)	0x0104: Common Profile (HA)	Dimmer Switch (0x0104) Based on the input configurations set via the manufacturer-specific Device Setup Cluster (0xFC00) on endpoint #232, this application endpoint has the capability to transmit commands such as on/off, level control, color control, or manufacturer-specific automation switch/button commands. These commands are activated in response to local high-voltage inputs.
4 (0x04)	0x0104: Common Profile (HA)	Dimmer Switch (0x0104) Based on the input configurations set via the manufacturer-specific Device Setup Cluster (0xFC00) on endpoint #232, this application endpoint has the capability to transmit commands such as on/off, level control, color control, or manufacturer-specific automation switch/button commands. These commands are activated in response to local high-voltage inputs.
5 (0x05)	0x0104: Common Profile (HA)	This endpoint provides the same functionality as endpoint 1, and allows independent control of a second light. This is a dynamic endpoint which may or may not be present, depending on the output configuration. Please refer to <a href="#">Section 6.13.3.3</a> for details.
6 (0x06)	0x0104: Common Profile (HA)	This endpoint provides the same functionality as endpoint 1, and allows independent control of a third light. This is a dynamic endpoint which may or may not be present, depending on the output configuration. Please refer to <a href="#">Section 6.13.3.3</a> for details.
7 (0x07)	0x0104: Common Profile (HA)	This endpoint provides the same functionality as endpoint 1, and allows independent control of a fourth light. This is a dynamic endpoint which may or may not be present, depending on the output configuration. Please refer to <a href="#">Section 6.13.3.3</a> for details.
8 (0x08)	0x0104: Common Profile (HA)	This endpoint provides the same functionality as endpoint 1, and allows independent control of a fifth light. This is a dynamic endpoint which may or may not be present, depending on the output configuration. Please refer to <a href="#">Section 6.13.3.3</a> for details.
9 (0x09)	0x0104: Common Profile (HA)	This endpoint provides the same functionality as endpoint 1, and allows independent control of a sixth light. This is a dynamic endpoint which may or may not be present, depending on the output configuration. Please refer to <a href="#">Section 6.13.3.3</a> for details.
232 (0xE8)	0x0104: Common Profile (HA)	Device Management Applied Device Type is Physical Devices (0x0507). This endpoint provides a series of device management settings, including input configurations and output configurations. This endpoint supports Over-The-Air firmware upgrade.
242 (0xF2)	0xA1E0: Green Power Profile	GP Combo Basic (0x0066) This endpoint supports Zigbee Green Power Combined Proxy and Sink.

The ubisys Zigbee manufacturer code is **0x10F2**. This manufacturer code can be used to identify OTA upgrade images, for accessing manufacturer-specific ZCL attributes and commands etc.



Depending on the currently applied specific output configuration settings, the endpoints #1, #5, #6, #7, #8, and #9 may be either present (visible) or absent. Please check [Section 6.13.3.3](#) for details.

## 6.2. Installation Code

This device has a pre-configured link key, which is derived from the installation code printed on the back of the device's housing in text format and as a two-dimensional barcode (QR code). The format specified in [\[R5\]](#), section 5.4.8.1.1 is used with a full 128-bit installation code + 16-bit CRC. The QR code uses the recommended encoding as per [\[R12\]](#), as illustrated in the following example:

```
Z:001FEE0000009508$I:A160CF46F73495D921740180A9A72F8CF6C6%G$M:LD6%M:10F2
```

## 6.3. Application Endpoint #0 - Zigbee Device Object

Please refer to the Zigbee Specification [\[R2\]](#) for details on the Zigbee Device Object (ZDO) and the protocol used for over-the-air communication, called the Zigbee Device Profile (ZDP). Notice that the ZDP is fundamentally different from typical application endpoints, which build on the Zigbee

foundation framework and the Zigbee Cluster Library (ZCL).

The ubisys Zigbee LD6 supports the following ZDO services:

Primitive	Description
nwk_addr_req/ nwk_addr_rsp	<b>Network address request/response</b> Translates a 64-bit IEEE address into a 16-bit network short address. Use only when really required, because this message employs a network-wide broadcast (flooding)
ieee_addr_req/ ieee_addr_rsp	<b>IEEE address request/response</b> Translates a 16-bit network short address into a 64-bit IEEE address.
node_desc_req/ node_desc_rsp	<b>Node descriptor request/response</b> Returns information such as the manufacturer ID, power supply, etc.
power_desc_req/ power_desc_rsp <sup>[2]</sup>	<b>Power descriptor request/response</b> Returns information such as the power source and mode.
active_ep_req/ active_ep_rsp	<b>Active endpoints request/response</b> Returns a set of available application endpoints on the device.
simple_desc_req/ simple_desc_rsp	<b>Simple descriptor request/response</b> Returns a descriptor for a certain application endpoint with a list of available services (clusters).
match_desc_req/ match_desc_rsp	<b>Match descriptor request/response</b> Searches for a certain cluster or set of clusters and returns the matching endpoints, if any.
device_annce	<b>Device announcement</b> Advertises the presence of a new device in the network.
parent_annce/ parent_annce_rsp <sup>[3]</sup>	<b>Parent announcement/response</b> This is part of the Zigbee 2015 end-device child management feature.
bind_req/ bind_rsp	<b>Bind request/response</b> Creates an application binding
unbind_req/ unbind_rsp	<b>Unbind request/response</b> Removes an application binding
mgmt_lqi_req/ mgmt_lqi_rsp	<b>Management: Neighbor table request/response</b> Returns information about neighboring devices, including the link quality, device type etc.
mgmt_bind_req/ mgmt_bind_rsp	<b>Management: Binding table request/response</b> Returns information about application bindings on the device.
mgmt_leave_req/ mgmt_leave_rsp	<b>Management: Leave request/response</b> Makes the device leave the network or removes one of its end-device children.
mgmt_permit_joining_req/ mgmt_permit_joining_rsp	<b>Management: Permit joining request/response</b> Opens the network for new devices to join.

## 6.4. Application Endpoint #1

This is a Finding & Binding target endpoint.

### 6.4.1. Supported Device Types

The LD6 supports the following pre-defined Device types on endpoint #1:

Device Type	Description
0x0101	<b>Dimmable Light</b> Supports on/off control Supports light level control
0x010C	<b>Color Temperature Light</b> Supports on/off control Supports light level control Supports color temperature control (tunable white)
0x010D	<b>Extended Color Light</b> Supports on/off control Supports light level control Supports full color (CIE 1931 xy or hue/saturation) and color temperature control.

The LD6 will adapt the device type, the clusters, and capabilities (where applicable) to reflect the

output configuration as specified by the user. Please refer to [Section 6.13.3.3](#) for details.

#### 6.4.1.1. Dimmable Light Device Type

When the endpoint represents a dimmable light, it exposes the following seven inbound clusters:

Cluster	Direction	Description
0x0000	Inbound (Server)	<b>Basic</b> Provides basic information about the device, such as the manufacturer, vendor and model name, stack profile, ZCL version, production date, hardware revision etc. Allows a factory reset of attributes, without the device leaving the network.
0x0003	Inbound (Server)	<b>Identify</b> Allows to put the endpoint into identify mode. Useful for identifying/locating devices and required for Finding & Binding.
0x0004	Inbound (Server)	<b>Groups</b> Allows adding this endpoint to one or more groups. Afterwards the endpoint can be addressed using the group address. This is also a prerequisite for scenes. You may also query group membership and delete group associations.
0x0005	Inbound (Server)	<b>Scenes</b> Allows storing one or more scenes per group, where each scene consists of a pre-set on/off state value. You may either store the current values as a scene, or provide scene settings when adding a scene, or delete scenes.
0x0006	Inbound (Server)	<b>On/off</b> Provides on/off control of the attached light source.
0x0008	Inbound (Server)	<b>Level Control</b> Provides level control of the attached light source.
0x0301	Inbound (Server)	<b>Ballast Configuration</b> Provides a means to configure the minimum and maximum levels for the attached light source.

#### 6.4.1.2. Color Temperature Light Device Type

When the endpoint represents a color temperature (tunable white) light, it exposes the following eight inbound clusters:

Cluster	Direction	Description
0x0000	Inbound (Server)	<b>Basic</b> Provides basic information about the device, such as the manufacturer, vendor and model name, stack profile, ZCL version, production date, hardware revision etc. Allows a factory reset of attributes, without the device leaving the network.
0x0003	Inbound (Server)	<b>Identify</b> Allows to put the endpoint into identify mode. Useful for identifying/locating devices and required for Finding & Binding.
0x0004	Inbound (Server)	<b>Groups</b> Allows adding this endpoint to one or more groups. Afterwards the endpoint can be addressed using the group address. This is also a prerequisite for scenes. You may also query group membership and delete group associations.
0x0005	Inbound (Server)	<b>Scenes</b> Allows storing one or more scenes per group, where each scene consists of a pre-set on/off state value. You may either store the current values as a scene, or provide scene settings when adding a scene, or delete scenes.
0x0006	Inbound (Server)	<b>On/off</b> Provides on/off control of the attached light source.
0x0008	Inbound (Server)	<b>Level Control</b> Provides level control of the attached light source.
0x0301	Inbound (Server)	<b>Color Control</b> Provides color temperature control of the attached light source.
0x0301	Inbound (Server)	<b>Ballast Configuration</b> Provides a means to configure the minimum and maximum levels for the attached light source.

### 6.4.1.3. Extended Color Light Device Type

For application of extended color light device type, the application endpoint #1 exposes the following eight inbound clusters:

Cluster	Direction	Description
0x0000	Inbound (Server)	<b>Basic</b> Provides basic information about the device, such as the manufacturer, vendor and model name, stack profile, ZCL version, production date, hardware revision etc. Allows a factory reset of attributes, without the device leaving the network.
0x0003	Inbound (Server)	<b>Identify</b> Allows to put the endpoint into identify mode. Useful for identifying/locating devices and required for Finding & Binding.
0x0004	Inbound (Server)	<b>Groups</b> Allows adding this endpoint to one or more groups. Afterwards the endpoint can be addressed using the group address. This is also a prerequisite for scenes. You may also query group membership and delete group associations.
0x0005	Inbound (Server)	<b>Scenes</b> Allows storing one or more scenes per group, where each scene consists of a pre-set on/off state value. You may either store the current values as a scene, or provide scene settings when adding a scene, or delete scenes.
0x0006	Inbound (Server)	<b>On/off</b> Provides on/off control of the attached light source.
0x0008	Inbound (Server)	<b>Level Control</b> Provides level control of the attached light source.
0x0301	Inbound (Server)	<b>Color Control</b> Provides full color and color temperature control of the attached light source.
0x0301	Inbound (Server)	<b>Ballast Configuration</b> Provides a means to configure the minimum and maximum levels for the attached light source.

### 6.4.2. Basic Cluster (Server)

The basic cluster might be accessible via more than one endpoint. Most of its attributes are singleton attributes, i.e. all instances of the cluster share the same attribute value storage.

Attributes supported:

Attribute	Type	Description
0x0000	unsigned8, read-only	<b>ZCLVersion</b> The version of the cluster library
0x0001	unsigned8, read-only	<b>ApplicationVersion</b> The application version
0x0002	unsigned8, read-only	<b>StackVersion</b> The stack version
0x0003	unsigned8, read-only	<b>HWVersion</b> Specifies the hardware revision number
0x0004	string, read-only	<b>ManufacturerName</b> "ubisys"
0x0005	string, read-only	<b>ModelIdentifier</b> "LD6"
0x0006	string, read-only	<b>DateCode</b> "YYYYMMDD-XX-FBV", where YYYY = year, MM = month, DD = day of production (hardware), XX = production facility, V = factory block version. For example, "20220412-DE-FB1" refers to a device built April 12, 2022 in Germany and programmed with factory block format version 1.
0x0007	enum8, read-only	<b>PowerSource</b> Always set to mains-powered, single phase (regardless of the connected supply voltage)



Attribute	Type	Description
0x0008	enum8, read-only	<b>GenericDeviceClass</b> Specifies the field of application of the <a href="#">GenericDeviceType</a> attribute. Mostly for compatibility with Zigbee Light Link. Always set to "0" indicating Lighting class
0x0009	enum8, read-only	<b>GenericDeviceType</b> "Unspecified" by default. Mostly for compatibility with Zigbee Light Link.
0x000A	raw binary, read-only	<b>ProductCode</b> Specifies the GTIN (EAN) code for the product.
0x000B	string, read-only	<b>ProductURL</b> Specifies a link to a web page containing specific product information. "www.ubisys.de/products/ld6"
0x0010	string, persistent	<b>LocationDescription</b> Empty string by default. Might be set by commissioning software during installation
0x0011	unsigned8, persistent	<b>PhysicalEnvironment</b> "Unspecified" by default. Might be set by commissioning software during installation
0x4000	string, read-only	<b>SWBuildID</b> Firmware Build ID. Human readable string that represents the application's firmware image version. This is the preferred version identifier to be used when identifying a version, e.g. when contacting customer support
0xFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

Cluster commands supported:

None

### 6.4.3. Identify Cluster (Server)

In identify mode, the output will be toggled, dimmed, undergo a color change or other visual effect.

Attributes supported:

Attribute	Type	Description
0x0000	unsigned16	<b>IdentifyTime</b> The remaining time, in seconds, the device will be identifying itself. Notice that LD6 will toggle the connected light in identify mode fully on and fully off once per second.
0xFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

Cluster commands supported:

Command	Description
0x00	<b>Identify</b> Puts the device into identify mode, or terminates identify mode.
0x01	<b>Query Identify</b> Determines whether the device is currently identifying, and returns the remaining time if so.
0x40	<b>Trigger Effect</b> Instigates a visual effect.

### 6.4.4. Groups Cluster (Server)

Attributes supported:

Attribute	Type	Description
0x0000	bitmap8, read-only	<b>NameSupport</b> Always set to 0: This implementation does not support storing names for groups.

Attribute	Type	Description
0xFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

Cluster commands supported:

Command	Description
0x00	<b>Add Group</b> Adds the endpoint to a group.
0x01	<b>View Group</b> Determines whether the device belongs to a group and returns the group name, if supported.
0x02	<b>Get Group Membership</b> Returns the set of groups this endpoint belongs to.
0x03	<b>Remove Group</b> Removes this endpoint from the specified group. Also removes all scenes that refer to this group.
0x04	<b>Remove All Groups</b> Removes this endpoint from all groups. Also removes all scenes that refer to any of the existing groups.
0x05	<b>Add Group if Identifying</b> Adds this endpoint to the group, if the endpoint is identifying.

### 6.4.5. Scenes Cluster (Server)

Attributes supported:

Attribute	Type	Description
0x0000	unsigned8, read-only	<b>SceneCount</b> Holds the total number of scenes (across all groups) currently stored on the device.
0x0001	unsigned8, read-only	<b>CurrentScene</b> If the <a href="#">SceneValid</a> attribute is true, this attribute, together with the <a href="#">CurrentGroup</a> attribute, indicates the currently active scene.
0x0002	unsigned8, read-only	<b>CurrentGroup</b> If the <a href="#">SceneValid</a> attribute is true, this attribute, together with the <a href="#">CurrentScene</a> attribute, indicates the currently active scene.
0x0003	bool, read-only	<b>SceneValid</b> If true, the scene identified by <a href="#">CurrentGroup</a> and <a href="#">CurrentScene</a> is currently active, i.e. all device attribute values match the values in the scene field set.
0x0004	bitmap8, read-only	<b>NameSupport</b> Always set to 1: This implementation DOES support storing names for scenes.
0xFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

Cluster commands supported:

Command	Description
0x00	<b>Add Scene</b> Adds a scene with or without a scene field set
0x01	<b>View Scene</b> Returns the scene field set, name and transition times for a scene.
0x02	<b>Remove Scene</b> Removes a scene from the scene table.
0x03	<b>Remove All Scenes</b> Removes all scenes that belong to a particular group.
0x04	<b>Store Scene</b> Stores the device's current state as a scene or updates a previously stored scene accordingly.
0x05	<b>Recall Scene</b> Reverts the device's current state using the values from the previously stored field set.
0x06	<b>Get Scene Membership</b> Returns the set of scenes (within the scope of the specified group) currently stored on the device.

Command	Description
0x40	<b>Enhanced Add Scene</b> Similar to Add Scene with higher transition time resolution (10ths of a second instead of once second)
0x41	<b>Enhanced View Scene</b> Similar to View Scene with higher transition time resolution (10ths of a second instead of once second)
0x42	<b>Copy Scene</b> Copies a scene in a single operation as an alternative to (Enhanced) View Scene, (Enhanced) Add Scene

#### 6.4.6. On/off Cluster (Server)



This cluster uses the binding table for managing reporting targets.

Attributes supported:

Attribute	Type	Description
0x0000	bool, read-only, reportable	<b>OnOff</b> Indicates the current state of the output relay, either on = "true" or off = "false".
0x4000	bool, read-only	<b>GlobalSceneControl</b> Determines whether the next "Off with Effect" command will store the global scene.
0x4001	unsigned16, read-only	<b>OnTime</b> Time, in tenths of a second, the device remains on, before it automatically turns off. This value is set by the "On with timed off" command. This is a "live" down counter.
0x4002	unsigned16, read-only	<b>OffWaitTime</b> Time, in tenths of a second, the device ignores "On with timed off" commands. This is a "live" down counter.
0x4003	enum8, persistent	<b>StartupOnOff</b> Determines the start-up behavior of the device after reboot. Either always turn off (0x00) or turn on (0x01) the device; or restore the previous setting (0xFF) or invert the previous setting (0x02)
0xFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

Cluster commands supported:

Command	Description
0x00	<b>Turn off</b> Turns the output off. The attached load will be disconnected from the mains.
0x01	<b>Turn on</b> Turns the output on. The attached load will be connected to the mains.
0x02	<b>Toggle</b> Turns the output off, if it was turned on or turns the output on, if it was turned off.
0x40	<b>Off with effect</b> Turns the output off after having stored the current setting as the global scene and rejects further global scene storage requests by the "On with recall global scene" command, until the device is turned on again or the global scene has been restored.
0x41	<b>On with recall global scene</b> Restores the global scene. Despite the name of this command, it does not always turn the device "on"; rather, it just recalls the previously stored setting.
0x42	<b>On with timed off</b> Turns the output on and then automatically turns it off after the specified time has elapsed.

#### 6.4.7. Level Control Cluster (Server)



This cluster uses the binding table for managing reporting targets.

Attributes supported:

Attribute	Type	Description
0x0000	unsigned8, read-only, reportable	<b>CurrentLevel</b> Indicates the current level of the dimmable light output, between 1 and 254.
0x0001	unsigned16, read-only	<b>RemainingTime</b> Specifies the amount of time, in units of 0.1 seconds, required to reach the specified target level
0x000F	bitmap8, persistent	<b>Options</b> Specifies the default command options for commands that support options; these are applied either when the option value and mask are not included in the command payload, or the mask indicates that certain default option bits apply. Factory default setting for bit0: "1" = Enable execute if off and bit1: "0" = Disable LevelControlForLighting
0x0010	unsigned16, persistent	<b>OnOffTransitionTime</b> Specifies the amount of time, in units of 0.1 seconds, which will be used during a transition to either the on or off state, when an on/off/toggle command of the on/off cluster is used to turn the light on or off
0x0011	unsigned8, persistent	<b>OnLevel</b> Specifies the level that shall be applied, when an on/toggle command causes the light to turn on. By default this attribute is set to the invalid value (0xFF), the light will return to the previously active level (before it was turned off), when it is turned on again.
0x4000	unsigned8, persistent	<b>StartupLevel</b> Specifies the initial level to be applied after reboot. By default this attribute is set to the invalid value (0xFF), the light will return to the previously active level (before power was cut), when it is turned on again. Otherwise the current level will be set to the value specified here subject to range limitations imposed by the ballast configuration cluster on this endpoint.
0xFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

#### Manufacturer-specific attributes supported:

Attribute	Type	Description
0x0000	unsigned8,	<b>MinimumOnLevel</b> <sup>[4]</sup> Specifies the minimum level that shall be applied, when an on/toggle command causes the light to turn on. When the attribute is configured with the invalid value (0xFF), the corresponding feature becomes inactive, and the standard rule takes effect: the light will revert to its previous active level (prior to being turned off) if the "OnLevel" attribute is set to the invalid value (0xFF). Alternatively, it will adopt the specified value from the "OnLevel" attribute which falls within the range of 0x00 to 0xFE. If the "MinimumOnLevel" attribute value is within the range of 0x00 to 0xFE, the light will be set to the higher value between its previous active level and the "MinimumOnLevel" attribute value. For example, if the previous level was 0x30 and the <a href="#">MinimumOnLevel</a> was 0x40, then the light should turn on and move to the level 0x40. Conversely, if the previous level was 0x50, and the <a href="#">MinimumOnLevel</a> was 0x40, then the light should turn on and move to level 0x50. By default the value is set to 0x33 = 20%. By default the attribute is set to 0x1a = 10%.

#### Cluster commands supported:

Command	Description
0x00	<b>Move To Level</b> Moves the current level to a certain target level within a specified transition time. Supports command options.
0x01	<b>Move</b> Moves the level either up or down at a specified rate. Supports command options.
0x02	<b>Step</b> Increments or decrements the level by a certain amount within a specified transition time. Supports command options.
0x03	<b>Stop</b> Stops any level change in progress due to a move, move to level, step or recall scene command.

Command	Description
0x04	<b>Move To Level with on/off</b> Moves the current level to a certain target level within a specified transition time. Maintains the companion on/off cluster's OnOff attribute.
0x05	<b>Move with on/off</b> Moves the level either up or down at a specified rate. Maintains the companion on/off cluster's OnOff attribute.
0x06	<b>Step with on/off</b> Increments or decrements the level by a certain amount within a specified transition time. Maintains the companion on/off cluster's OnOff attribute.
0x07	<b>Stop</b> Stops any level change in progress due to a move, move to level, step or recall scene command.

## 6.4.8. Color Control Cluster (Server)



This cluster uses the binding table for managing reporting targets.

Attributes supported:

Attribute	Type	Description
0x0000	unsigned8, read-only, reportable	<b>CurrentHue</b> Contains the current hue value of the light. It is updated as fast as practical during commands that change the hue.
0x0001	unsigned8, read-only, reportable	<b>CurrentSaturation</b> Contains the current saturation value of the light. It is updated as fast as practical during commands that change the saturation.
0x0002	unsigned16 read-only	<b>RemainingTime</b> Contains the time remaining, in 1/10ths of a second, until the currently active command will be complete.
0x0003	unsigned16, read-only, reportable	<b>CurrentX</b> Contains the current value of the normalized chromaticity value x, as defined in the CIE xyY Color Space. It is updated as fast as practical during commands that change the color.
0x0004	unsigned16 read-only, reportable	<b>CurrentY</b> Contains the current value of the normalized chromaticity value y, as defined in the CIE xyY Color Space. It is updated as fast as practical during commands that change the color.
0x0007	unsigned16, read-only, reportable	<b>ColorTemperatureMireds</b> Contains a scaled inverse of the current value of the color temperature in Kelvins.
0x0008	Enum8, read-only	<b>ColorMode</b> Indicates which attributes are currently determining the color of the device. The value of the <a href="#">ColorMode</a> attribute cannot be written directly - it is set upon reception of any supported command listed in <a href="#">Table 1</a> to the appropriate mode for that command.
0x000f	Bitmap8, persistent	<b>Options</b> A bitmap that determines the default behavior of some cluster commands. It specifies the default command options for commands that support options; these are applied either when the option value and mask are not included in the command payload, or the mask indicates that certain default option bits apply. Factory default setting for "execute if off" = "1".
0x4000	unsigned16, read-only, reportable	<b>EnhancedCurrentHue</b> Represents non-equidistant steps along the CIE 1931 color triangle, and provides 16-bits precision. The <a href="#">CurrentHue</a> attribute contains a hue value in the range 0 to 254, calculated from the <a href="#">EnhancedCurrentHue</a> attribute.
0x4001	Enum8, read-only	<b>EnhancedColorMode</b> Specifies which attributes are currently determining the color of the device. If the <a href="#">ColorMode</a> attribute is changed, e.g., due to one of commands listed in <a href="#">Table 1</a> , its new value is copied to the <a href="#">EnhancedColorMode</a> attribute.
0x4002	unsigned8, read-only	<b>ColorLoopActive</b> Specifies the current active status of the color loop.
0x4003	unsigned8, read-only	<b>ColorLoopDirection</b> Specifies the current direction of the color loop.

Attribute	Type	Description
0x4004	unsigned16, read-only	<b>ColorLoopTime</b> Specifies the number of seconds it takes to perform a full color loop, i.e., to cycle all values of the <a href="#">EnhancedCurrentHue</a> attribute.
0x4005	unsigned16, read-only	<b>ColorLoopStartEnhancedHue</b> Specifies the value of the <a href="#">EnhancedCurrentHue</a> attribute from which the color loop is started.
0x4006	unsigned16, read-only	<b>ColorLoopStoredEnhancedHue</b> Specifies the value of the <a href="#">EnhancedCurrentHue</a> attribute before the color loop was started. Once the color loop is complete, the <a href="#">EnhancedCurrentHue</a> attribute is restored to this value.
0x400A	Bitmap16, read-only	<b>ColorCapabilities</b> Specifies the color capabilities of LD6 supporting the color control cluster. "0x001F"
0x400B	unsigned16, read-only	<b>ColorTempPhysicalMinMireds</b> Indicates the minimum mired value supported by the device.
0x400C	unsigned16, read-only	<b>ColorTempPhysicalMaxMireds</b> Indicates the maximum mired value supported by the device.
0x400D	unsigned16, read-only	<b>CoupleColorTempToLevelMinMireds</b> Specifies a lower bound on the value of the <a href="#">ColorTemperatureMireds</a> attribute for the purposes of coupling the <a href="#">ColorTemperatureMireds</a> attribute to the <a href="#">CurrentLevel</a> attribute when the <a href="#">CoupleColorTempToLevel</a> bit of the <a href="#">Options</a> attribute of the Level Control cluster is equal to 1. By default the <a href="#">CoupleColorTempToLevel</a> bit of the <a href="#">Options</a> attribute of the Level Control cluster is set to 0 on LD6, see <a href="#">Section 6.4.7</a> .
0x4010	unsigned16, persistent	<b>StartupColorTemperatureMireds</b> Specifies the desired startup color temperature value LD6 uses when it is supplied with power and this value is reflected in the <a href="#">ColorTemperatureMireds</a> attribute.
0x0010	unsigned8, read-only	<b>NumberOfPrimaries</b> Holds the number of color primaries implemented on this device. "5"
0x0011	unsigned16, read-only	<b>Primary1X</b> Contains the normalized chromaticity value x for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary1X</a> attribute by the relationship.
0x0012	unsigned16, read-only	<b>Primary1Y</b> Contains the normalized chromaticity value y for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary1Y</a> attribute by the relationship.
0x0013	unsigned8, read-only	<b>Primary1Intensity</b> Contains a representation of the maximum intensity of this primary as defined in the Dimming Light Curve in the Ballast Configuration cluster (see 5.3 in <a href="#">[R4]</a> ), normalized such that the primary with the highest maximum intensity contains the value 0xfe.
0x0015	unsigned16, read-only	<b>Primary2X</b> Contains the normalized chromaticity value x for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary2X</a> attribute by the relationship.
0x0016	unsigned16, read-only	<b>Primary2Y</b> Contains the normalized chromaticity value y for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary2Y</a> attribute by the relationship.
0x0017	unsigned8, read-only	<b>Primary2Intensity</b> Contains a representation of the maximum intensity of this primary as defined in the Dimming Light Curve in the Ballast Configuration cluster (see 5.3 in <a href="#">[R4]</a> ), normalized such that the primary with the highest maximum intensity contains the value 0xfe.
0x0019	unsigned16, read-only	<b>Primary3X</b> Contains the normalized chromaticity value x for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary3X</a> attribute by the relationship.
0x001a	unsigned16, read-only	<b>Primary3Y</b> Contains the normalized chromaticity value y for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary3Y</a> attribute by the relationship.
0x001b	unsigned8, read-only	<b>Primary3Intensity</b> Contains a representation of the maximum intensity of this primary as defined in the Dimming Light Curve in the Ballast Configuration cluster (see 5.3 in <a href="#">[R4]</a> ), normalized such that the primary with the highest maximum intensity contains the value 0xfe.
0x0020	unsigned16, read-only	<b>Primary4X</b> Contains the normalized chromaticity value x for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary4X</a> attribute by the relationship.

Attribute	Type	Description
0x0021	unsigned16, read-only	<b>Primary4Y</b> Contains the normalized chromaticity value y for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary4Y</a> attribute by the relationship.
0x0022	unsigned8, read-only	<b>Primary4Intensity</b> Contains a representation of the maximum intensity of this primary as defined in the Dimming Light Curve in the Ballast Configuration cluster (see 5.3 in [R4]), normalized such that the primary with the highest maximum intensity contains the value 0xfe.
0x0024	unsigned16, read-only	<b>Primary5X</b> Contains the normalized chromaticity value x for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary5X</a> attribute by the relationship.
0x0025	unsigned16, read-only	<b>Primary5Y</b> Contains the normalized chromaticity value y for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary5Y</a> attribute by the relationship.
0x0026	unsigned8, read-only	<b>Primary5Intensity</b> Contains a representation of the maximum intensity of this primary as defined in the Dimming Light Curve in the Ballast Configuration cluster (see 5.3 in [R4]), normalized such that the primary with the highest maximum intensity contains the value 0xfe.
0x0028	unsigned16, read-only	<b>Primary6X</b> Contains the normalized chromaticity value x for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary6X</a> attribute by the relationship.
0x0029	unsigned16, read-only	<b>Primary6Y</b> Contains the normalized chromaticity value y for this primary, as defined in the CIE xyY Color Space. The value of x is related to the <a href="#">Primary6Y</a> attribute by the relationship.
0x002a	unsigned8, read-only	<b>Primary6Intensity</b> Contains a representation of the maximum intensity of this primary as defined in the Dimming Light Curve in the Ballast Configuration cluster (see 5.3 in [R4]), normalized such that the primary with the highest maximum intensity contains the value 0xfe.
0xFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

Cluster commands supported:

Table 1. Table of supported commands of color control cluster

Command	Description
0x00	<b>Move to Hue</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and then moves from its current hue to the value given in the Hue field.
0x01	<b>Move Hue</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and then moves from its current hue in an up or down direction in a continuous fashion.
0x02	<b>Step Hue</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and then moves from its current hue in an up or down direction by one step.
0x03	<b>Move to Saturation</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and then moves from its current saturation to the value given in the Saturation field.
0x04	<b>Move Saturation</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and then moves from its current saturation in an up or down direction in a continuous fashion.
0x05	<b>Step Saturation</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and then moves from its current saturation in an up or down direction by one step.
0x06	<b>Move to Hue and Saturation</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and then moves from its current hue and saturation to the values given in the Hue and Saturation fields.
0x07	<b>Move to Color</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x01 and then moves from its current color to the color given in the <a href="#">ColorX</a> and <a href="#">ColorY</a> fields.

Command	Description
0x08	<b>Move Color</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x01 and then moves from its current color in a continuous fashion according to the rates specified.
0x09	<b>Step Color</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x01 and then moves from its current color by the color step indicated.
0x0A	<b>Move to Color Temperature</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x02 and then moves from its current color to the color given by the Color Temperature Mireds field.
0x40	<b>Enhanced Move to Hue</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and sets the <a href="#">EnhancedColorMode</a> attribute to the value 0x03. LD6 then moves from its current enhanced hue to the value given in the Enhanced Hue field.
0x41	<b>Enhanced Move Hue</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and sets the <a href="#">EnhancedColorMode</a> attribute to the value 0x03. LD6 then moves from its current enhanced hue in an up or down direction in a continuous fashion.
0x42	<b>Enhanced Step Hue</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and sets the <a href="#">EnhancedColorMode</a> attribute to the value 0x03. LD6 then moves from its current enhanced hue in an up or down direction by one step.
0x43	<b>Enhanced Move to Hue and Saturation</b> On receipt of this command, LD6 sets the <a href="#">ColorMode</a> attribute to the value 0x00 and sets the <a href="#">EnhancedColorMode</a> attribute to the value 0x03. LD6 then moves from its current enhanced hue and saturation to the values given in the enhanced hue and saturation fields.
0x44	<b>Color Loop Set</b> Allows a color loop to be activated such that the color lamp cycles through its range of hues.
0x47	<b>Stop Move Step</b> Allows Move to and Step commands to be stopped.
0x4B	<b>Move Color Temperature</b> Allows the color temperature of a lamp to be moved at a specified rate. On receipt of this command, LD6 sets both the <a href="#">ColorMode</a> and <a href="#">EnhancedColorMode</a> attributes to 0x02. LD6 then moves from its current color temperature in an up or down direction in a continuous fashion.
0x4C	<b>Step Color Temperature</b> Allows the color temperature of LD6 to be stepped with a specified step size. On receipt of this command, LD6 sets both the <a href="#">ColorMode</a> and <a href="#">EnhancedColorMode</a> attributes to 0x02. LD6 then moves from its current color temperature in an up or down direction by one step.

### 6.4.9. Ballast Configuration Cluster (Server)

The ballast configuration cluster is used for configuring a lighting ballast. It allows configuration of e.g. a minimum and maximum level.

Attributes supported:

Attribute	Type	Description
0x0000	unsigned8, read-only	<b>PhysicalMinLevel</b> The minimum dimming level supported by the hardware. "0x01"
0x0001	unsigned8, read-only	<b>PhysicalMaxLevel</b> The maximum dimming level supported by the hardware. "0xFE"
0x0002	bitmap8, read-only	<b>BallastStatus</b> This attribute is 8 bits in length and specifies the activity status of the ballast functions. LD6 supports fully operational ballast and all connected lamps in socket. "0x00"



Attribute	Type	Description
0x0010	unsigned8, persistent	<b>MinLevel</b> The minimum dimming level supported by the attached load. This can be set to a higher value to account for loads (such as CFLs), which cannot operate below a certain dimming level. It can also be used to make sure that an incandescent bulb emits visible light, such that a minimum on level is not confused with the "off" state. "0x01"
0x0011	unsigned8, persistent	<b>MaxLevel</b> The maximum dimming level supported by the attached load. This can be set to a lower value to enforce power saving in an office or public environment, e.g. in the hospitality sector. "0xFE"
0xFFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

## 6.5. Application Endpoint #2 Primary Dimmer Switch

This is a Finding & Binding initiator endpoint.

### 6.5.1. Supported Device Types

Endpoint #2 is a Dimmer Switch (device type 0x0104):

#### 6.5.1.1. Dimmer Switch Device Type

Application endpoint #2 exposes the following inbound and outbound clusters:

Cluster	Direction	Description
0x0000	Inbound (Server)	<b>Basic</b> Provides basic information about the device, such as the manufacturer ID, vendor and model name, stack profile, ZCL version, production date, hardware revision etc. Allows a factory reset of attributes, without the device leaving the network.
0x0003	Inbound (Server)	<b>Identify</b> Allows to put the endpoint into identify mode. Useful for identifying/locating devices and required for Finding & Binding.
0x0003	Inbound (Server)	<b>Identify</b> Allows sending cluster-specific commands to target devices during Finding & Binding as initiator.
0x0005	Outbound (Client)	<b>Scenes</b> Allows sending cluster-specific commands to target devices as required by the application.
0x0006	Outbound (Client)	<b>On/off</b> Allows to send cluster-specific commands to target devices as required by the application.
0x0008	Outbound (Client)	<b>Level Control</b> Allows to send cluster-specific commands to target devices as required by the application.
0x0300	Outbound (Client)	<b>Color Control</b> Allows to send cluster-specific commands to target devices as required by the application.
0xfc02	Outbound (Client)	<b>Managed Input Cluster</b> This is a manufacturer-specific cluster (ubisys proprietary). Allows to send cluster-specific commands to target devices as required by the application. Used for Matter-like automation buttons and automation switches.

### 6.5.2. Basic Cluster (Server)

Please refer to [Section 6.4.2](#) for details.

### 6.5.3. Identify Cluster (Server)

Please refer to [Section 6.4.3](#) for details.



The identify cluster instance on this endpoint does **NOT** provide any visual or audible feedback. It is mainly present to comply with standards requirements.

#### 6.5.4. Identify Cluster (Client)

The Identify cluster client takes on the role of the Finding & Binding initiator. Once activated, LD6 initiates the identification process by broadcasting identify query request command to detect target(s) operating in identify mode.

Cluster commands supported:

Command	Description
0x00	<b>Identify</b> Puts the remote device into identify mode, or terminates identify mode.
0x01	<b>Query Identify</b> Determines whether the remote device is currently identifying, and returns the remaining time if so.

#### 6.5.5. Scenes Cluster (Client)



This cluster does not use the binding table for managing command targets. Instead, recall scene command templates include the group address and scene number to recall. The Device Setup cluster on the Device Management endpoint #232 can be used to configure the behavior of the cluster, i.e. which identifiers will be sent in the message body, when the input state changes. Using the device setup cluster, you can configure this endpoint either to be used with a push-button or a switch.

This cluster instance is intended for recalling scenes on the local and/or remote devices using the local inputs and is not bound when factory fresh.

Cluster commands transmitted:

Command	Description
0x05	<b>Recall Scene</b> Recalls a scene. The group address in the recall scene command payload is also used as the target for the command.

#### 6.5.6. On/off Cluster (Client)



This cluster uses the binding table for managing command targets. When factory fresh, this cluster is bound to endpoint #1 to enable local control. This works even when the device is not commissioned yet. In addition, the Device Setup cluster on the Device Management endpoint #232 can be used to configure the behavior of this cluster, i.e. which of the commands mentioned below will actually be sent, when the input state changes. Using the Device Setup cluster, you can configure this endpoint either to be used with a push-button (momentary switch, one stable position) or a rocker switch (two stable positions).

Cluster commands transmitted:

Command	Description
0x00	<b>Turn off</b> Turns the target device or group of devices off.
0x01	<b>Turn on</b> Turns the target device or group of devices on.
0x02	<b>Toggle</b> Toggles the target device state. Should not be used to control groups.

### 6.5.7. Level Control Cluster (Client)



This cluster uses the binding table for managing command targets. When factory fresh, this cluster is bound to endpoint #1 to enable local control. This works even when the device is not commissioned yet. In addition, the Device Setup cluster on the Device Management endpoint #232 can be used to configure the behavior of the cluster, i.e. which of the commands mentioned below will actually be sent, when the input state changes. Using the Device Setup cluster, you can configure this endpoint to be used either with one or with two push-buttons.

Cluster commands transmitted:

Command	Description
0x05	<b>Move with on/off</b> Moves the level either up or down at a specified rate. Maintains the companion on/off cluster's OnOff attribute.
0x07	<b>Stop with on/off</b> Stops any level change in progress due to a move, move to level, step or recall scene command. Maintains the companion on/off cluster's OnOff attribute.

### 6.5.8. Color Control Cluster (Client)



This cluster uses the binding table for managing command targets. When factory fresh, this cluster is not bound to any target device. The Device Setup cluster on the Device Management endpoint can be used to configure the behavior of this cluster, i.e. which of the commands mentioned below will actually be sent, when the input state changes. Using the Device Setup cluster, you can configure this endpoint to be used with one push-button.

Cluster commands transmitted:

Command	Description
0x0a	<b>Move To Color Temperature</b> Requires the remote device to move from its current color temperature in Mireds to the color specified by the ColorTemperatureMireds field within the given TransitionTime.
0x47	<b>Stop Move Step</b> Allow Move to and Step commands to be stopped.
0x4b	<b>Move Color Temperature</b> Requires the remote device to move the color temperature in Mireds either up or down at a specified rate.

### 6.5.9. Managed Input Cluster (Client)

This is a ubisys manufacturer-specific (manufacturer code = 0x10f2) outbound cluster. It is used to send commands for automation buttons and automation switches that mimic the Matter command set for generic switches.

These are the manufacturer-specific commands generated:

*Table 2. Actions supported by automation button*

Action	Manufacturer Command Code
Button Initial press	0x01 (payload 01)
Button Long press	0x02 (payload 01)
Button Short release	0x03 (payload 01)
Button Long release	0x04 (payload 01)

*Table 3. Actions supported by automation switch*

Action	Manufacturer Command Code
Switch position '0'	0x00 (payload 00)
Switch position '1'	0x00 (payload 01)

## 6.6. Application Endpoint #3 - Secondary Dimmer Switch

Similar to Endpoint #2, see [Section 6.5](#) for details.

## 6.7. Application Endpoint #4 - Tertiary Dimmer Switch

Similar to Endpoint #2, see [Section 6.5](#) for details.

## 6.8. Application Endpoint #5

Similar to Endpoint #1, see [Section 6.4](#) for details.

## 6.9. Application Endpoint #6

Similar to Endpoint #1, see [Section 6.4](#) for details.

## 6.10. Application Endpoint #7

Similar to Endpoint #1, see [Section 6.4](#) for details.

## 6.11. Application Endpoint #8

Similar to Endpoint #1, see [Section 6.4](#) for details.

## 6.12. Application Endpoint #9

Similar to Endpoint #1, see [Section 6.4](#) for details.

## 6.13. Application Endpoint #232 - Device Management

This endpoint provides device management functions using standard Zigbee foundation paradigms and the Zigbee Cluster Library [R4]. You may use the standard ZCL frames to enumerate, read and write attributes, configure attribute reporting, invoke commands, etc.

The application endpoint exposes the following clusters:

Cluster	Direction	Description
0x0000	Inbound (Server)	<b>Basic</b> Provides basic information about the device, such as the manufacturer, vendor and model name, stack profile, ZCL version, production date, hardware revision etc. Allows a factory reset of attributes, without the device leaving the network.
0x003D	Inbound (Server)	<b>Zigbee Direct Configuration</b> Provides an interface for configuring Zigbee Direct to enable Zigbee Direct behavior on platforms that support Bluetooth and IEEE 802.15.4 concurrently (or quasi-concurrently).
0xFC00	Inbound (Server)	<b>Device Setup</b> This is a manufacturer-specific cluster that provides basic configuration capabilities: It contains both the configuration of inputs and associated actions and the configuration of outputs.  The cluster allows the LD6 to assign up to 3 physical inputs associated with 3 endpoints and to control the behavior of inputs (i.e. permanent switches, push-button switches, normally open vs. normally closed, on/off, level control, scene selection, setting or adjusting color temperature , etc.). The cluster also allows LD6 to configure light devices with up to 6 output channels that can be controlled individually or combined as a tunable white or multi-colored light.
0xFC57	Inbound (Server)	<b>Works With All Hubs</b> This is a manufacturer-specific cluster with the manufacturer code 0x1217. It provides the proprietary functionality of the Amazon Works With All Hubs (WWAH) server cluster. The goal of this cluster is to enable hubs to provide improved security, interoperability, and customer experience for devices supporting this cluster [R10].
0x0003	Outbound (Client)	<b>Identify</b> Allows to identify targets during Finding & Binding push-button commissioning.
0x0019	Outbound (Client)	<b>OTA Upgrade</b> Pull-oriented firmware upgrade. Searches the network for a suitable server and allows the server to control all stages of the upgrade process, including which image to download, when to download, at what rate and when to install the downloaded image.

### 6.13.1. Basic Cluster (Server)

Please refer to [Section 6.4.2](#) for details.

### 6.13.2. Zigbee Direct Configuration Cluster (Server)



On centralized security networks, the Zigbee Direct Configuration cluster requires APS encryption with the trust center link-key

Use unicast transmissions when sending commands to this cluster instance.

Attributes supported:

Attribute	Type	Description
0x0000	Bitmap8, read-only, persistent	<b>InterfaceState</b> The least significant bit of the attribute allows to disable the Zigbee Direct feature under application control, i.e. enabled when LSB = '1', disabled otherwise. All other bits are reserved.
0x0001	Unsigned24, read-only, persistent	<b>AnonymousJoinTimeout</b> Represents the timeout, in seconds, after a power-cycle or local manufacturer-specific stimulus during which a ZVD may establish a secure provisioning session with the ZDD using the Anonymous Well-Known Secret "ZigBeeAlliance18" when the Zigbee Network is open to accept new devices. See [R11] for details.
0xFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

Cluster commands supported:

Command	Description
0x00	<b>Configure Zigbee Direct Interface</b> Enables or disables the Zigbee Direct Interface on the device.

Command	Description
0x01	<b>Configure Zigbee Direct Anonymous Join Timeout</b> Sets the anonymous join timeout.

### 6.13.3. Device Setup Cluster (Server)

This cluster is a manufacturer-specific cluster with the cluster identifier 0xFC02 and the manufacturer code 0x10F2. It allows to change advanced device setup options, which are not covered by standard clusters defined in the Zigbee Cluster Library.

This ubisys-proprietary cluster provides two basic sets of configuration capabilities:

- Input Configuration
- Output Configuration

LD6 supports both, input and output configurations.

#### 6.13.3.1. Input Configuration

The Input Configuration set contains the manufacturer attributes summarized below.

*Table 4. Manufacturer Specific Attributes of the Input Configuration Set:*

Attribute	Type	Description
0x0000	Array of data8, persistent	<b>InputConfigurations</b> This array of 8-bit data holds exactly one entry per physical device input and allows disabling the input or inverting the "normal" signal level (normally closed vs. normally open).
0x0001	array of raw data, persistent	<b>InputActions</b> This array of raw data strings maps physical inputs to application endpoints on the device (for example, an on/off switch application) and translates action changes to appropriate cluster commands (e.g. on/off/toggle or move/stop).

##### 6.13.3.1.1. InputConfigurations Attribute

The *InputConfigurations* attribute is an array (ZCL data type: 0x48) of 8-bit data (ZCL data type: 0x08). It is readable and writable and retains its value across reboots (persistent storage); when being written, the size of the attribute is not allowed to change, and the entries must be of the same type "8-bit data" (0x08). Each physical device input line has a one-to-one relation to a slot in this array.

Each entry of the array can take a combination of the following bit flags as input configurations:

*Table 5. Each Entry in InputConfigurations Array*

Flag	Bit(s)	Description
Disable	#7 (0x80)	When this bit is set, the input is disabled.
Invert	#6 (0x40)	Determines the "active" level. The default is active-high, meaning that a high voltage level (within 10% of the supply voltage) translates to an active input, and a low voltage level translates to an inactive signal. If this bit is set, the input is "active-low", instead. For normally open circuits, leave this bit clear; for normally closed circuits make sure this bit is set.
RFU	#5..#0 (0x3F)	All other bits are reserved for future use and must be written as 0 and ignored when read.

For LD6 up to three physical device inputs are supported, and this relation is as follows: an array with three entries

Table 6. *InputConfigurations* Entries on LD6

Entry	Description
0x00	<b>Configuration options for high/low-voltage physical input #1</b> Defines the configuration for the physical input marked with a switch symbol and the digit "1". Factory default value of input configurations: 0x00
0x01	<b>Configuration options for high/low-voltage physical input #2</b> Defines the configuration for the physical input marked with a switch symbol and the digit "2". Factory default value of input configurations: 0x00
0x02	<b>Configuration options for high/low-voltage physical input #3</b> Defines the configuration for the physical input marked with a switch symbol and the digit "3". Factory default value of input configurations: 0x00

For LD6 in connection with three physical inputs, this example shows the *InputConfigurations* attribute value:

```

48      Data type: 0x48 (array)
08      Element type: 0x08 (8-Bit Data)
03 00  Elements number: 0x0003 (3 entries)

00      Entry #0: 0x00 (default value: enable input #1)
00      Entry #1: 0x00 (default value: enable input #2)
00      Entry #2: 0x00 (default value: enable input #3)

```

### 6.13.3.1.2. *InputActions* Attribute

This *InputActions* attribute is an array (ZCL data type: 0x48) of raw binary data (ZCL data type: 0x41). It is readable and writable and retains its value across reboots (persistent storage); when being written, the elements must be of the same type "raw data" (0x41).

This attribute contains instructions, a kind of micro-code, which allow flexible reconfiguration of the commands sent in response to activity on the physical inputs.

Each entry of the array takes the following form:

Table 7. *Each Entry in InputActions* Array

Field	Data Type	Description
InputAndOptions	unsigned8	A four-bit input index in the LSBs and four option flags in the MSBs
Transition	unsigned8	Specifies the action transition to which this particular instruction applies
Endpoint	unsigned8	Each instruction must be assigned to a suitable source endpoint in the local device. Acceptable endpoints for LD6 are Endpoints #2, #3 and #4.
ClusterID	unsigned16	The 16-bit cluster ID that will be used to transmit the ZCL command payload. e.g. 0x0006 for the On/Off cluster.
CommandTemplate	raw data	A variable length ZCL command template, which will be sent from the source endpoint specified above, using the cluster ID specified above. e.g. for the On/Off cluster, the command temple can be a simple Off (0x00), On (0x01) or Toggle (0x02) command. There might be code in the device that modifies the command template according to intrinsic rules or option flag settings. A manufacturer-specific command template in terms of automation switch and automation push button is also supported. Notice that this is the raw payload and does not include a leading length byte.

- *InputAndOptions* Field

The 4 LSBs of this field contains the physical input number, while the 4 MSBs of this field includes the input and option flags.

Field	Bit(s)	Description
RFU	#7...#5 (0xE0)	These bits are reserved for future use and must be written as 0 and ignored when read.
flagManufacturerSpecific	#4 (0x10)	When this bit is set, the instructions for one of the two manufacturer-specific input configurations: - Automation Button - Automation Switch will be selected accordingly. Please refer to <a href="#">Section 6.5.9</a> for the related manufacturer-specific Cluster ID and supported commands.
inputMask	#3...#0 (0x0f)	In the lower four bits, the physical input number is contained, which indexes into the InputConfigurations array. For example, a value of 0 identifies the first physical input. For LD6, this field may take the values 0, 1 and 2: - 0x00: the first physical input - 0x01: the second physical input - 0x02: the third physical input

- *Transition Field*

The Transition field specifies when (i.e. under which conditions/circumstances) this particular instruction shall be executed.

Field	Bit(s)	Description
HasAlternate	#7 (0x80)	When this bit is set, there is another instruction that shall be executed in alternating order with the current one, each time the other conditions are met. In this case two entries must exist, one with the Alternate bit clear, and one with the Alternate bit set.
Alternate	#6 (0x40)	If this bit is set, this is the alternate instruction of a pair of two instructions which are executed in alternating order. If this flag is set, "HasAlternate" must be set as well.
RFU	#5...#4 (0x30)	These bits are reserved for future use and must be written as 0 and ignored when read.
Initial State	#3...#2 (0x0C)	These bits indicate the initial state of the input: 00b: Ignore: Don't care 01b: Pressed: The input was initially active (for less than a second) 10b: Kept pressed: The input has initially been active (for more than a second) 11b: Released: The input was initially inactive
Final State	#1...#0 (0x03)	These bits indicate the final state of the input: 00b: Ignore: Don't care 01b: Pressed: The input is active (for less than a second) 10b: Kept pressed: The input is still active (for more than a second) 11b: Released: The input is inactive

The "Ignore: Don't care" states are no real states, but rather placeholders for **any** other state. At any given time the input is either released, pressed or kept pressed.

- *Endpoint Field*

Identifies the source endpoint that will be used in the outgoing ZCL command frame. Notice, that you should only use an endpoint, which hosts a cluster with the appropriate cluster ID and role (client vs. server).

The acceptable endpoints for LD6 are Endpoints #2, #3 and #4.

- *ClusterID Field*

Specifies the cluster ID that will be used in the outgoing ZCL command frame. The cluster ID must be an "operational" cluster, according to ZCL definitions.

LD6 supports following clusters for *InputActions* attribute configuration:

- 0x0005: the Scenes cluster



- 0x0006: the On/Off cluster
- 0x0008: the Level Control cluster
- 0x0300: the Color Control cluster
- 0xFC02: the manufacturer-specific Managed Input cluster
- etc.

- *CommandTemplate* Field

This is the template of a ZCL command frame payload, which will be sent to the target device once the instruction is selected for execution by the universal input logic unique to ubisys Zigbee devices. This can be a simple toggle command, a more complex move or recall scene command, or a manufacturer-specific command (See [Section 6.5.9](#)).

Notice that LD6 will use its binding table to determine the target for the command. The command may be sent to one or more targets, each being a group (specified as a group address) or a single application instance (specified as IEEE EUI-64 address and endpoint number)

### 6.13.3.2. Input Configuration Patterns and Examples

Currently LD6 supports a diverse set of switch usage patterns. Please refer to the [Zigbee Device Physical Input Configurations - Integrator's Guide](#) for more details and examples.

Below is an example input configuration for LD6, as stored in the *InputActions* attribute. This configuration illustrates three use-cases: single-button dimming and on/off, single-button color temperature control, and single-button scene recall for two scenes.

```

41          element type: 0x41 (raw data)
0a 00      element count: 0x000a (10 entries)

06          element #1: six bytes
00          InputAndOptions: 0x00 (the first physical input)
07          Transition: pressed -> released
02          Source: Endpoint #2 (hosts primary on/off client cluster on LD6)
06 00      Cluster ID: 0x0006 (On/Off Cluster)
02          ZCL Command Template: Toggle

08          element #2: eight bytes
00          InputAndOptions: 0x00 (the first physical input)
86          Transition: pressed -> kept pressed, has alternate
02          Source: Endpoint #2 (hosts primary level control client cluster
on LD6)
08 00      Cluster ID: 0x0008 (Level Control Cluster)
05 00 32   ZCL Command Template: Move with on/off, upwards, rate = 50

08          element #3: eight bytes
00          InputAndOptions: 0x00 (the first physical input)
C6          Transition: pressed -> kept pressed, is alternate
02          Source: Endpoint #2 (hosts primary level control client cluster
on LD6)
08 00      Cluster ID: 0x0008 (Level Control Cluster)
05 01 32   ZCL Command Template: Move with on/off, downwards, rate = 50

06          element #4: six bytes

```

```

00      InputAndOptions: 0x00 (the first physical input)
0B      Transition: kept pressed -> released
02      Source: Endpoint #2 (hosts primary level control client cluster
        on LD6)
08 00   Cluster ID: 0x0008 (Level Control Cluster)
07      ZCL Command Template: Stop with on/off

0a      element #5: ten bytes
01      InputAndOptions: 0x01 (the second physical input)
07      Transition: pressed -> released
03      Source: Endpoint #3 (hosts secondary color control client cluster
        on LD6)
00 03   Cluster ID: 0x0300 (Color Control)
0a      ZCL Command Template: Move to Color Temperature,
fa 00           ColorTemperatureMireds = 250,
0a 00           TransitionTime = 10s

0d      element #6: thirteen bytes
01      InputAndOptions: 0x01 (the second physical input)
86      Transition: pressed -> kept pressed, has alternate
03      Source: Endpoint #3 (hosts secondary color control client cluster
        on LD6)
00 03   Cluster ID: 0x0300 (Color Control)
4b      ZCL Command Template: Move Color Temperature,
01           MoveMode = Up
19 00           MoveRate = 25
00 00           ColorTemperatureMinimumMireds = 0x0000
00 00           ColorTemperatureMaximumMireds = 0x0000

0d      element #7: thirteen bytes
01      InputAndOptions: 0x01 (the second physical input)
C6      Transition: pressed -> kept pressed, is alternate
03      Source: Endpoint #3 (hosts secondary color control client cluster
        on LD6)
00 03   Cluster ID: 0x0300 (Color Control)
4b      ZCL Command Template: Move Color Temperature,
03           MoveMode = Down
19 00           MoveRate = 25
00 00           ColorTemperatureMinimumMireds = 0x0000
00 00           ColorTemperatureMaximumMireds = 0x0000

06      element #8: six bytes
01      InputAndOptions: 0x01 (the second physical input)
0B      Transition: kept pressed -> released
03      Source: Endpoint #3 (hosts secondary color control client cluster
        on LD6)
00 03   Cluster ID: 0x0300 (Color Control)
47      ZCL Command Template: Stop Move Step

09      element #9: nine bytes
02      InputAndOptions: 0x02 (the third physical input)
0d      Transition: released, -> pressed
04      Source: Endpoint #4 (hosts tertiary scenes client cluster on LD6)
05 00   Cluster ID: 0x0005 (Scenes)
05      ZCL Command Template: Recall Scene
02 00           GroupID = 0x0002
00           SceneID = 0x00

```

```

09      element #10: nine bytes
02      InputAndOptions: 0x02 (the third physical input)
03      Transition: any -> released
04      Source: Endpoint #4 (hosts tertiary scenes client cluster on LD6)
05 00   Cluster ID: 0x0005 (Scenes)
05      ZCL Command Template: Recall Scene
02 00   GroupID = 0x0002
01      SceneID = 01

```

For the first physical input (**InputAndOptions: 0x00**), the configuration *Single Momentary Switch (Push Button) as Dimmer Switch* is applied that allows to control a dimmer with one push button. A short press will toggle the light on/off, while a longer press starts dimming up or down (alternating) in order to allow adjusting the brightness with the button. Dimming stops, when the button is released.

For the second physical input (**InputAndOptions: 0x01**), the configuration *Single Momentary Switch (Push Button) as White Tone Button* is applied that allows to control a tunable white light with one push button. A short press will transition the color temperature to the specified value in mireds, whereas a longer press starts moving color temperature up or down (alternating) in order to allow adjusting the white tone between cool and warm. When the button is released the color temperature will stop changing.

For the third physical input (**InputAndOptions: 0x02**), the configuration *Single Stationary Switch as Scene Selector Switch* is applied that allows to recall a previously stored scene. The input is as a stationary switch with two stable positions, each stable position is assigned to a scene. Two separate scenes may be recalled from a single button. For the LD6, a scene setting would comprise on/off, level and color states. Other products, including things that are no lights, could be added to the same scene, e.g. window blings, power sockets, or other lights etc.

The ubisys Smart Home app for iOS and Android recognizes and generates a certain set of instructions, and lets users pick those easily. You may request an up-to-date list of optimized instructions by mailing [support@ubisys.de](mailto:support@ubisys.de) and asking for these recommended instructions for typical use cases. But avoid using other instructions.

### 6.13.3.3. Output Configuration

The Output Configuration is used to inform the LD6 about the light sources that are attached and the way they are intended to be used and partitioned.

In general the Output Configuration set contains the manufacturer-specific attributes summarized below.

Table 8. Manufacturer Specific Attributes of the Output Configurations Set:

Attribute	Type	Description
0x0010	Array of raw data, persistent preserve	<b>OutputConfigurations</b> This array of raw data strings maps physical outputs to application endpoints on the device and specifies output configurations e.g. color or temperature color settings depending on the supported device type on the associated endpoints.
0x0011	Bitmap16, read-only	<b>OutputEndpoints</b> Each bit of the attribute denotes a dynamic output application endpoint that can be enabled/assigned via the output configuration.

The LD6 is a multi-channel dimmer with six output channels that can be controlled individually or combined as tunable white (brightness or color temperature) or full color lights. Depending on the

light output configuration, the LD6 creates up to six individual lighting application endpoints to represent the lights attached to its six output channels.

### 6.13.3.3.1. *OutputConfigurations* Attribute

The *OutputConfigurations* attribute is an array (ZCL data type 0x48) of raw binary data (ZCL data type 0x41). It is readable and writable and retains its value across reboots (persistent storage); when being written, the entries must be of the same type “raw data” (0x41).

Each entry of the *OutputConfigurations* array contains the configuration of one channel. It defines the light application endpoint and functionality of the channel including details about the primary, i.e. x, y position in the CIE 1931 color space and the (relative/normalized) luminous flux Y.

It is possible to use more than one channel, e.g. to achieve higher output power. Note that these channels act as a single channel from the Zigbee side. To control multiple channels individually, create an additional *ApplicationConfiguration* element.

Each entry of the the array shall take the following form:

Table 9. Each Entry in *OutputConfigurations*

Field	Data Type	Description
EndpointAndFunction	unsigned8	Bit fields for an associated end-point and the assigned function/mode. 4 MSBs of this field: Endpoint mask 4 LSBs of this field: Function/Mode mask.
Primary-Intensity	unsigned8	The intensity of the primary for full color and tunable white lights.
Primary-X	unsigned16	The x coordinate of the primary in the CIE 1931 xy space.
Primary-Y	unsigned16	The y coordinate of the primary in the CIE 1931 xy space.

The LD6 is a multi-channel LED controller with six output channels. The number of entries of the *OutputConfigurations* array is therefore always equal to six.

- *EndpointAndFunction* Field

The *EndpointAndFunction* field is used to assign the physical output channel to logical light endpoint; in addition, it also tells the ubisys Versalight engine what kind of primary is attached.

Field	Bit(s)	Description
Endpoint	#7...#4 (0xF0)	An endpoint mask that indicates the application endpoint of this channel 0001b(1): endpoint #1 0101b(5): endpoint #5 0110b(6): endpoint #6 0111b(7): endpoint #7 1000b(8): endpoint #8 1001b(9): endpoint #9 Other values on the 4 MSBs of <i>EndpointAndFunction</i> must not be used.
Function	#3...#0 (0x0F)	A function mask that specifies the function of this channel 0000b(0): M - mono 0001b(1): CW - first (or only) white, typically cool white or neutral white 0010b(2): WW - second white (typically, warm White) 0011b(3): R - Red 0100b(4): G - Green 0101b(5): B - Blue 0110b(6): A - Amber 0111b(7): T - Turquoise 1000b(8): V - Violet 1001b(9): F - other arbitrary "free" color Other values on the 4 LSBs of <i>EndpointAndFunction</i> are void, i.e. unused.

- *Primary-Intensity* Field

The *Primary-Intensity* Field contains a representation of the maximum intensity of this primary for full color lights or tunable white lights (color temperature). The range of this field is 0..0xFE.

The normalized intensity value  $i$  SHALL be related to the *Primary-Intensity* value by the relationship

$$i = \text{Primary-Intensity} / 254 \text{ (Primary-Intensity in the range 0 to 254 inclusive)}$$

If equal to `UINT8_MAX`, it denotes either an invalid value or not applicable value. A value of 0 indicates that the primary information is void, i.e. not used.

- *Primary-X* Field

The *Primary-X* field contains the value of the primary y coordinate in the CIE1931 xyY space. The range is 0 to 65279 inclusive.

The normalized x chromaticity value of the primary SHALL be related to the *Primary\_X* value by the relationship

$$x = \text{Primary}_X / 65536 \text{ (Primary}_X \text{ in the range 0 to 65279 inclusive)}$$

If equal to `UINT16_MAX`, it denotes an invalid/unknown value.

- *Primary-Y* Field

The *Primary-Y* field contains the value of the primary y coordinate in the CIE1931 xyY space. The range is 0 to 65279 inclusive.

The normalized y chromaticity value of the primary SHALL be related to the *Primary\_Y* value by the relationship

$$y = \text{Primary}_Y / 65536 \text{ (Primary}_Y \text{ in the range 0 to 65279 inclusive)}$$

If equal to `UINT16_MAX`, it denotes an invalid/unknown value.

### 6.13.3.3.2. *OutputEndpoints* Attribute

The manufacturer-specific attribute *OutputEndpoints* is a bitmap attribute that indicates dynamic output application endpoints that can be enabled/assigned via the output configuration. This is useful for sharing a single client side application logic that can be used configure the light output configuration for various products that employ the ubisys Versalight engine, including the LD6, but also the M7B-Q95 module, white-label products, etc.

LD6 has the default *OutputEndpoints* value 0x03e2 with details:

Bitmap	Endpoint
Bit 1	Endpoint #1
Bit 5	Endpoint #5
Bit 6	Endpoint #6
Bit 7	Endpoint #7
Bit 8	Endpoint #8

Bitmap	Endpoint
Bit 9	Endpoint #9

These are the six endpoints that are configurable to represent one up to six individually addressable logical lights.

### 6.13.3.4. Output Configurations Patterns and Examples

The LD6 supports a diverse set of output configurations. Bear in mind that the Versalight engine assumes a certain order of primaries and deviations might result in false color reproduction. It is recommended that users choose one of the configurations provided below to implement their use-case:

- Output Configuration: One Light Source

Item	Device Type	Description
1	<b>Endpoint #1:</b> Dimmable Light	<b>1 x Dimmable (mono)</b> Endpoint #1 - Output Channel 1:M  <b>Reference Configuration:</b> 48 41 06 00 06 10 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff
2	<b>Endpoint #1:</b> Color Temperature Light	<b>1 x White (Cool/Warm)</b> Endpoint #1 - Output Channel 1:C, Output Channel 2:W  <b>Reference Configuration:</b> 48 41 06 00 06 11 fe 42 50 d9 52 06 12 fe b9 75 1d 69 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff
3	<b>Endpoint #1:</b> Extended Color Light	<b>1 x Color</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B  <b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff
4	<b>Endpoint #1:</b> Extended Color Light	<b>1 x Color and White</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B, Output Channel 4:W  <b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 11 fe 64 61 72 60 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff

Item	Device Type	Description
5	<b>Endpoint #1:</b> Extended Color Light	<b>1 x Color and White (Cool/Warm)</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B, Output Channel 4:C, Output Channel 5:W  <b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 11 fe 42 50 d9 52 06 12 fe b9 75 1d 69 06 00 ff ff ff ff
6	<b>Endpoint #1:</b> Extended Color Light	<b>1 x Extended Color Gamut</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:A, Output Channel 3:G, Output Channel 4:T, Output Channel 5:B, Output Channel 6:V  <b>Reference Configuration:</b> 48 41 06 00 06 13 45 86 b1 ef 4e 06 16 c6 59 9a 80 65 06 14 fe 39 1d 82 d3 06 17 b4 9e 0b 83 4b 06 15 4d c6 1f cc 0e 06 18 6c 2d 2c 3a 01

In the case listed above, the endpoints #5, #6, #7, #8, #9 shall be disabled or hidden.

- Output Configuration Pattern: Two Light Sources

Item	Device Type	Pattern Description
1	<b>Endpoint #1, #5:</b> Dimmable Light	<b>2 x Dimmable (mono)</b> Endpoint #1 - Output Channel 1:M Endpoint #5 - Output Channel 2:M  <b>Reference Configuration:</b> 48 41 06 00 06 10 ff ff ff ff 06 50 ff ff ff ff 06 00 ff ff ff ff 06 00 ff ff ff ff 06 00 ff ff ff ff 06 00 ff ff ff ff
2	<b>Endpoint #1, #5:</b> Color Temperature Light	<b>2 x White (Cool/Warm)</b> Endpoint #1 - Output Channel 1:C, Output Channel 2:W Endpoint #5 - Output Channel 3:C, Output Channel 4:W  <b>Reference Configuration:</b> 48 41 06 00 06 11 fe 42 50 d9 52 06 12 fe b9 75 1d 69 06 51 fe 42 50 d9 52 06 52 fe b9 75 1d 69 06 00 ff ff ff ff 06 00 ff ff ff ff

Item	Device Type	Pattern Description
3	<p><b>Endpoint #1:</b> Extended Color Light</p> <p><b>Endpoint #5:</b> Color Temperature Light</p>	<p><b>1 x RGBW and 1 x White(Cool/Warm)</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B, Output Channel 4:W Endpoint #5 - Output Channel 5:C, Output Channel 6:W</p> <p><b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 11 fe 64 61 72 60 06 51 fe 42 50 d9 52 06 52 fe b9 75 1d 69</p>
4	<p><b>Endpoint #1:</b> Extended Color Light</p> <p><b>Endpoint #5:</b> Color Temperature Light</p>	<p><b>1 x Color and 1 x White(Cool/Warm)</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B Endpoint #5 - Output Channel 5:C, Output Channel 6:W</p> <p><b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 00 ff ff ff ff ff 06 51 fe 42 50 d9 52 06 52 fe b9 75 1d 69</p>
5	<p><b>Endpoint #1:</b> Extended Color Light</p> <p><b>Endpoint #5:</b> Dimmable Light</p>	<p><b>1 x Color and 1 x Dimmable (Mono)</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B Endpoint #5 - Output Channel 4:M</p> <p><b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 50 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff</p>
6	<p><b>Endpoint #1:</b> Extended Color Light</p> <p><b>Endpoint #5:</b> Dimmable Light</p>	<p><b>1 x RGBW and 1 x Dimmable (Mono)</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B, Output Channel 4:W Endpoint #5 - Output Channel 5:M</p> <p><b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 11 fe 64 61 72 60 06 50 ff ff ff ff ff 06 00 ff ff ff ff ff</p>
7	<p><b>Endpoint #1:</b> Extended Color Light</p> <p><b>Endpoint #5:</b> Dimmable Light</p>	<p><b>1 x RGBCW and 1 x Dimmable (Mono)</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B, Output Channel 4:C, Output Channel 5:W Endpoint #5 - Output Channel 6:M</p> <p><b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 11 fe 42 50 d9 52 06 12 fe b9 75 1d 69 06 50 ff ff ff ff ff</p>



Item	Device Type	Pattern Description
8	<b>Endpoint #1:</b> Extended Color Light  <b>Endpoint #5:</b> Extended Color Light	<b>2 x Color</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B Endpoint #5 - Output Channel 4:R, Output Channel 5:G, Output Channel 6:B  <b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 53 47 06 b1 ef 4e 06 54 a0 39 1d 82 d3 06 55 42 c6 1f cc 0e

In the case listed above, the endpoints #6, #7, #8, #9 shall be disabled or hidden.

- Output Configuration Pattern: Three Light Sources

Item	Device Type	Pattern Description
1	<b>Endpoint #1, #5, #6:</b> Dimmable Light	<b>3 x Dimmable (mono)</b> Endpoint #1 - Output Channel 1:M Endpoint #5 - Output Channel 2:M Endpoint #6 - Output Channel 3:M  <b>Reference Configuration:</b> 48 41 06 00 06 10 ff ff ff ff ff 06 50 ff ff ff ff ff 06 60 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff
2	<b>Endpoint #1, #5, #6:</b> Color Temperature Light	<b>3 x White (Cool/Warm)</b> Endpoint #1 - Output Channel 1:C, Output Channel 2:W Endpoint #5 - Output Channel 3:C, Output Channel 4:W Endpoint #6 - Output Channel 5:C, Output Channel 6:W  <b>Reference Configuration:</b> 48 41 06 00 06 11 fe 42 50 d9 52 06 12 fe b9 75 1d 69 06 51 fe 42 50 d9 52 06 52 fe b9 75 1d 69 06 61 fe 42 50 d9 52 06 62 fe b9 75 1d 69
3	<b>Endpoint #1:</b> Extended Color Light  <b>Endpoint #5, #6:</b> Dimmable Light	<b>1 x Color and 2 x dimmable (mono)</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B Endpoint #5 - Output Channel 4:M Endpoint #6 - Output Channel 5:M  <b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 50 ff ff ff ff ff 06 60 ff ff ff ff ff 06 00 ff ff ff ff ff

Item	Device Type	Pattern Description
4	<b>Endpoint #1:</b> Extended Color Light  <b>Endpoint #5:</b> Color Temperature Light  <b>Endpoint #6:</b> Dimmable Light	<b>1 x Color, 1 x White(Cool/Warm) and 1 x Dimmable (mono)</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B Endpoint #5 - Output Channel 5:C, Output Channel 6:W Endpoint #6 - Output Channel 4:M  <b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 60 ff ff ff ff ff 06 51 fe 42 50 d9 52 06 52 fe b9 75 1d 69
5	<b>Endpoint #1:</b> Extended Color Light  <b>Endpoint #5, #6:</b> Dimmable Light	<b>1 x RGBW and 2 x Dimmable</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B, Output Channel 4:W Endpoint #5 - Output Channel 5:M Endpoint #6 - Output Channel 6:M  <b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 11 fe 64 61 72 60 06 50 ff ff ff ff ff 06 60 ff ff ff ff ff

In the case listed above, the endpoints #7, #8, #9 shall be disabled or hidden.

- Output Configuration Pattern: Four Light Sources

Item	Device Type	Pattern Description
1	<b>Endpoint #1, #5-#7:</b> Dimmable Light	<b>4 x Dimmable (mono)</b> Endpoint #1 - Output Channel 1:M Endpoint #5 - Output Channel 2:M Endpoint #6 - Output Channel 3:M Endpoint #7 - Output Channel 4:M  <b>Reference Configuration:</b> 48 41 06 00 06 10 ff ff ff ff ff 06 50 ff ff ff ff ff 06 60 ff ff ff ff ff 06 70 ff ff ff ff ff 06 00 ff ff ff ff ff 06 00 ff ff ff ff ff
2	<b>Endpoint #1:</b> Extended Color Light  <b>Endpoint #5-#7:</b> Dimmable Light	<b>Color and 3 x Dimmable</b> Endpoint #1 - Output Channel 1:R, Output Channel 2:G, Output Channel 3:B Endpoint #5 - Output Channel 2:M Endpoint #6 - Output Channel 3:M Endpoint #7 - Output Channel 4:M  <b>Reference Configuration:</b> 48 41 06 00 06 13 47 06 b1 ef 4e 06 14 a0 39 1d 82 d3 06 15 42 c6 1f cc 0e 06 50 ff ff ff ff ff 06 60 ff ff ff ff ff 06 70 ff ff ff ff ff

In the case listed above, the endpoints #8, #9 shall be disabled or hidden.

- Output Configuration Pattern: Five Light Sources

Item	Device Type	Pattern Description
1	<b>Endpoint #1, #5-#8:</b> Dimmable Light	<b>5 x Dimmable (mono)</b> Endpoint #1 - Output Channel 1:M Endpoint #5 - Output Channel 2:M Endpoint #6 - Output Channel 3:M Endpoint #7 - Output Channel 4:M Endpoint #8 - Output Channel 5:M  <b>Reference Configuration:</b> 48 41 06 00 06 10 ff ff ff ff 06 50 ff ff ff ff 06 60 ff ff ff ff 06 70 ff ff ff ff 06 80 ff ff ff ff 06 00 ff ff ff ff

In the case listed above, the endpoint #9 shall be disabled or hidden.

- Output Configuration Pattern: Six Light Sources

Item	Device Type	Pattern Description
1	<b>Endpoint #1, #5-#9:</b> Dimmable Light	<b>6 x Dimmable (mono)</b> Endpoint #1 - Output Channel 1:M Endpoint #5 - Output Channel 2:M Endpoint #6 - Output Channel 3:M Endpoint #7 - Output Channel 4:M Endpoint #8 - Output Channel 5:M Endpoint #9 - Output Channel 6:M  <b>Reference Configuration:</b> 48 41 06 00 06 10 ff ff ff ff 06 50 ff ff ff ff 06 60 ff ff ff ff 06 70 ff ff ff ff 06 80 ff ff ff ff 06 90 ff ff ff ff

Below are some application examples demonstrating relevant output configurations.

- Example 1: One light source - 1 x Dimmable (mono)

Following output configurations define the relation of 1 application endpoint to 1 output channel. The supported application endpoint of LD6 is attached to a monochromatic (M) and dimmable light source, the other 5 output channels are not configured, i.e. unused.

```

48      Data Type: 0x48 (array)
41      Elements Type: 0x41 (raw data)
06 00   Elements count: 0x0006 (6 entries)

06      element #1: six bytes
10      EndpointAndFunction: 0x10 - endpoint #1, mono (dimnable)
ff      Intensity: 0xff
ff ff   Primary_X: 0xffff
ff ff   Primary_Y: 0xffff

06      element #2: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #3: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #4: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #5: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #6: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

```

Note that for an output channel  $n$  ( $n=2, \dots, 6$ ), which is not specified with the light output configuration, the associated entry is set as follows

```

06      element #n: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

```

- Example 2: One light source - 1 x White (Cool/Warm)

Following output configurations define the relation of 1 application endpoints to the 2 output channels. The endpoint is attached to a tunable white(CW/WW) light source. The other 4 output channels are not configured, i.e. unused.

```

48      Data Type: 0x48 (array)
41      Elements Type: 0x41 (raw data)
06 00   Elements count: 0x0006 (6 entries)

06      element #1: six bytes
11      EndpointAndFunction: 0x11 - endpoint #1, cool white (CW)
fe      Intensity: 0xfe = 254 (254/254 = 1.0)
42 50   Primary_X: 0x5042 (x_CW = 20546/65536 = 0.31352)
d9 52   Primary_Y: 0x52d9 (y_CW = 21209/65536 = 0.32363)

06      element #2: six bytes
12      EndpointAndFunction: 0x12 - endpoint #1, warm white (WW)
fe      Intensity: 0xfe = 254 (254/254 = 1.0)
b9 75   Primary_X: 0x75b9 (x_WW = 30137/65536 = 0.45986)
1d 69   Primary_Y: 0x691d (y_WW = 26909/65536 = 0.41060)

06      element #3: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #4: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #5: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #6: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

```

- Example 3: One light source - 1 x Color

Following output configurations define the relation of 1 application endpoints to the 3 output channels and the endpoint is attached to a multi-colored(RGB) light source. The other 3 output channels are not configured, i.e. unused.

```

48      Data Type: 0x48 (array)
41      Elements Type: 0x41 (raw data)
06 00   Elements count: 0x0006 (6 entries)

06      element #1: six bytes
13      EndpointAndFunction: 0x13 - endpoint #1, red (R)
47      Intensity: 0x47 = 71 (71/254 = 0.28)
06 b1   Primary_X: 0xb106 = 45318 (x_R = 45318/65536 = 0.69147)
ef 4e   Primary_Y: 0x4eef = 20207 (y_R = 20207/65536 = 0.3083)

06      element #2: six bytes
14      EndpointAndFunction: 0x14 - endpoint #1, green (G)
a0      Intensity: 0xa0 = 163 (163/254 = 0.63)
39 1d   Primary_X: 0x1d39 = 7481 (x_G = 7481/65536 = 0.1146)
82 d3   Primary_Y: 0xd382 = 54146 (y_G = 54146/65536 = 0.8262)

06      element #3: six bytes
15      EndpointAndFunction: 0x15 - endpoint #1, blue (B)
42      Intensity: 0x42 = 66 (66/254 = 0.26)
c6 1f   Primary_X: 0x1fc6 = 8134 (x_B = 8134/65536 = 0.1241)
cc 0e   Primary_Y: 0x0ecc = 3788 (y_B = 3788/65536 = 0.0578)

06      element #4: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #5: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #6: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

```

- Example 4: One light source - 1 x Color and neutral white

Following output configurations define the relation of 1 application endpoints to the 4 output channels and the endpoint is attached to a light source supporting both multi-color(RGB) and tunable white(Brightness) as well. The other 2 output channels are not configured, i.e. unused.

```

48      Data Type: 0x48 (array)
41      Elements Type: 0x41 (raw data)
06 00   Elements count: 0x0006 (6 entries)

06      element #1: six bytes
13      EndpointAndFunction: 0x13 - endpoint #1, red (R)
47      Intensity: 0x47 = 71 (71/254 = 0.28)
06 b1   Primary_X: 0xb106 = 45318 (x_R = 45318/65536 = 0.69147)
ef 4e   Primary_Y: 0x4eef = 20207 (y_R = 20207/65536 = 0.3083)

06      element #2: six bytes
14      EndpointAndFunction: 0x14 - endpoint #1, green (G)
a0      Intensity: 0xa0 = 163 (163/254 = 0.63)
39 1d   Primary_X: 0x1d39 = 7481 (x_G = 7481/65536 = 0.1146)
82 d3   Primary_Y: 0xd382 = 54146 (y_G = 54146/65536 = 0.8262)

06      element #3: six bytes
15      EndpointAndFunction: 0x15 - endpoint #1, blue (B)
42      Intensity: 0x42 = 66 (66/254 = 0.26)
c6 1f   Primary_X: 0x1fc6 = 8134 (x_B = 8134/65536 = 0.1241)
cc 0e   Primary_Y: 0x0ecc = 3788 (y_B = 3788/65536 = 0.0578)

06      element #4: six bytes
11      EndpointAndFunction: 0x11 - endpoint #1, first/only white (W)
fe      Intensity: 0xfe = 254 (254/254 = 1.0)
64 61   Primary_X: 0x6164 (x_NW = 24932/65536 = 0.38043)
72 60   Primary_Y: 0x6072 (y_NW = 24690/65536 = 0.37673)

06      element #5: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

06      element #6: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

```

- Example 5: One light source - 1 x Color and White (Cool/Warm)

Following output configurations define the relation of 1 application endpoints to to the 5 output channels and the endpoint is attached to a light source supporting both multi-color(RGB) and color-temperature tunable white. The other 1 output channel is not configured, i.e. unused.

```

48      Data Type: 0x48 (array)
41      Elements Type: 0x41 (raw data)
06 00   Elements count: 0x0006 (6 entries)

06      element #1: six bytes
13      EndpointAndFunction: 0x13 - endpoint #1, red (R)
47      Intensity: 0x47 = 71 (71/254 = 0.28)
06 b1   Primary_X: 0xb106 = 45318 (x_R = 45318/65536 = 0.69147)
ef 4e   Primary_Y: 0x4eef = 20207 (y_R = 20207/65536 = 0.3083)

06      element #2: six bytes
14      EndpointAndFunction: 0x14 - endpoint #1, green (G)
a0      Intensity: 0xa0 = 163 (163/254 = 0.63)
39 1d   Primary_X: 0x1d39 = 7481 (x_G = 7481/65536 = 0.1146)
82 d3   Primary_Y: 0xd382 = 54146 (y_G = 54146/65536 = 0.8262)

06      element #3: six bytes
15      EndpointAndFunction: 0x15 - endpoint #1, blue (B)
42      Intensity: 0x42 = 66 (66/254 = 0.26)
c6 1f   Primary_X: 0x1fc6 = 8134 (x_B = 8134/65536 = 0.1241)
cc 0e   Primary_Y: 0x0ecc = 3788 (y_B = 3788/65536 = 0.0578)

06      element #4: six bytes
51      EndpointAndFunction: 0x51 - endpoint #5, first white (CW)
fe      Intensity: 0xfe = 254 (254/254 = 1.0)
42 50   Primary_X: 0x5042 (x_CW = 20546/65536 = 0.31352)
d9 52   Primary_Y: 0x52d9 (y_CW = 21209/65536 = 0.32363)

06      element #5: six bytes
52      EndpointAndFunction: 0x52 - endpoint #5, second white (WW)
fe      Intensity: 0xfe = 254 (254/254 = 1.0)
b9 75   Primary_X: 0x75b9 (x_WW = 30137/65536 = 0.45986)
1d 69   Primary_Y: 0x691d (y_WW = 26909/65536 = 0.41060)

06      element #6: 0x06 (6 bytes)
00      EndpointAndFunction: 0x00 - not mapped to an endpoint/function
ff      Primary-Intensity: 0xff (invalid value)
ff ff   Primary-X: 0xffff (invalid value)
ff ff   Primary-Y: 0xffff (invalid value)

```

- Example 6: One light source - 1 x Extended Color Gamut

Following output configurations define the relation of 1 application endpoint to all six output channels and the endpoint is attached to a multi-colored light source (R/G/B/A/T/V).



```

48      Data Type: 0x48 (array)
41      Elements Type: 0x41 (raw data)
06 00   Elements count: 0x0006 (6 entries)

06      element #1: six bytes
13      EndpointAndFunction: 0x13 - endpoint #1, red (R)
45      Intensity: 0x45 = 69 (69/254 = 0.27)
86 b1   Primary_X: 0xb186 = 45446 (x_R = 45446/65536 = 0.69345)
ef 4e   Primary_Y: 0x4eef = 20207 (y_R = 20207/65536 = 0.3083)

06      element #2: six bytes
16      EndpointAndFunction: 0x16 - endpoint #1, amber (A)
c6      Intensity: 0xc6 = 198 (198/254 = 0.78)
59 9a   Primary_X: 0x9a59 = 39513 (x_A = 39513/65536 = 0.6029)
80 65   Primary_Y: 0x6580 = 25984 (y_A = 25984/65536 = 0.39648)

06      element #3: six bytes
14      EndpointAndFunction: 0x14 - endpoint #1, green (G)
fe      Intensity: 0xfe = 254 (254/254 = 1.0)
39 1d   Primary_X: 0x1d39 = 7481 (x_G = 7481/65536 = 0.1146)
82 d3   Primary_Y: 0xd382 = 54146 (y_G = 54146/65536 = 0.8262)

06      element #4: six bytes
17      EndpointAndFunction: 0x17 - endpoint #1, turquoise (T)
b4      Intensity: 0x64 = 180 (180/254 = 0.71)
9e 0b   Primary_X: 0x0b9e = 2974 (x_T = 2974/65536 = 0.04538)
83 4b   Primary_Y: 0x4b83 = 19331 (y_T = 19331/65536 = 0.294968)

06      element #5: six bytes
15      EndpointAndFunction: 0x15 - endpoint #1, blue (B)
4d      Intensity: 0x4d = 77 (77/254 = 0.30)
c6 1f   Primary_X: 0x1fc6 = 8134 (x_B = 8134/65536 = 0.1241)
cc 0e   Primary_Y: 0x0ecc = 3788 (y_B = 3788/65536 = 0.0578)

06      element #6: six bytes
18      EndpointAndFunction: 0x18 - endpoint #1, violet (V)
6c      Intensity: 0x6c = 108 (108/254 = 0.43)
2d 2c   Primary_X: 0x2c2d = 11309 (x_V = 11309/65536 = 0.17256)
3a 01   Primary_Y: 0x013a = 314 (y_V = 314/65536 = 0.00479)

```

- Example 7: Three light sources - 1 x Color, 1 x White(Cool/Warm) and 1 x Dimmable (mono)

Following output configurations define 3 application endpoints to the 6 output channels respectively:

- the endpoint #1 attached to a color (RGB) light source,
- the endpoint #5 attached to a color temperature light source or white(CW/WW) light source,
- the endpoint #6 attached to a monochromatic (M) and dimmable light source.

i.e., up to 3 different light sources are controllable depending on this output configurations.

```

48      Data Type: 0x48 (array)
41      Elements Type: 0x41 (raw data)
06 00   Elements count: 0x0006 (6 entries)

06      element #1: six bytes
13      EndpointAndFunction: 0x13 - endpoint #1, red (R)
47      Intensity: 0x47 = 71 (71/254 = 0.25)
06 b1   Primary_X: 0xb106 = 45318 (x_R = 45318/65536 = 0.69147)
ef 4e   Primary_Y: 0x4eef = 20207 (y_R = 20207/65536 = 0.3083)

06      element #2: six bytes
14      EndpointAndFunction: 0x14 - endpoint #1, green (G)
a0      Intensity: 0xa0 = 163 (163/254 = 0.63)
39 1d   Primary_X: 0x1d39 = 7481 (x_G = 7481/65536 = 0.1146)
82 d3   Primary_Y: 0xd382 = 54146 (y_G = 54146/65536 = 0.8262)

06      element #3: six bytes
15      EndpointAndFunction: 0x15 - endpoint #1, blue (B)
42      Intensity: 0x42 = 66 (66/254 = 0.26)
c6 1f   Primary_X: 0x1fc6 = 8134 (x_B = 8134/65536 = 0.1241)
cc 0e   Primary_Y: 0x0ecc = 3788 (y_B = 3788/65536 = 0.0578)

06      element #4: six bytes
60      EndpointAndFunction: 0x60 - endpoint #6, mono (dimnable)
ff      Intensity: 0xff
ff ff   Primary_X: 0xffff
ff ff   Primary_Y: 0xffff

06      element #5: six bytes
51      EndpointAndFunction: 0x51 - endpoint #5, first white (CW)
fe      Intensity: 0xfe = 254 (254/254 = 1.0)
42 50   Primary_X: 0x5042 (x_CW = 20546/65536 = 0.31352)
d9 52   Primary_Y: 0x52d9 (y_CW = 21209/65536 = 0.32363)

06      element #6: six bytes
52      EndpointAndFunction: 0x52 - endpoint #5, second white (WW)
fe      Intensity: 0xfe = 254 (254/254 = 1.0)
b9 75   Primary_X: 0x75b9 (x_WW = 30137/65536 = 0.45986)
1d 69   Primary_Y: 0x691d (y_WW = 26909/65536 = 0.41060)

```

- Example 8: Six light sources - 6 x Dimmable (Mono)

Following output configurations define 6 application endpoints to the 6 output channels. Each supported application endpoint of LD6 is attached to a monochromatic (M) and dimmable light source respectively. i.e. up to 6 light sources are controllable depending on the output configurations.

```

48      Data Type: 0x48 (array)
41      Elements Type: 0x41 (raw data)
06 00   Elements count: 0x0006 (6 entries)

06      element #1: six bytes
10      EndpointAndFunction: 0x10 - endpoint #1, mono (dimmbable)
ff      Intensity: 0xff
ff ff   Primary_X: 0xffff
ff ff   Primary_Y: 0xffff

06      element #2: six bytes
50      EndpointAndFunction: 0x50 - endpoint #5, mono (dimmbable)
ff      Intensity: 0xff
ff ff   Primary_X: 0xffff
ff ff   Primary_Y: 0xffff

06      element #3: six bytes
60      EndpointAndFunction: 0x60 - endpoint #6, mono (dimmbable)
ff      Intensity: 0xff
ff ff   Primary_X: 0xffff
ff ff   Primary_Y: 0xffff

06      element #4: six bytes
70      EndpointAndFunction: 0x70 - endpoint #7, mono (dimmbable)
ff      Intensity: 0xff
ff ff   Primary_X: 0xffff
ff ff   Primary_Y: 0xffff

06      element #5: six bytes
80      EndpointAndFunction: 0x10 - endpoint #8, mono (dimmbable)
ff      Intensity: 0xff
ff ff   Primary_X: 0xffff
ff ff   Primary_Y: 0xffff

06      element #6: six bytes
90      EndpointAndFunction: 0x10 - endpoint #9, mono (dimmbable)
ff      Intensity: 0xff
ff ff   Primary_X: 0xffff
ff ff   Primary_Y: 0xffff

```



The LD6 allows free configuration of primary colors. The primaries must be properly arranged. Specifically, primaries on the convex hull of the gamut must be provided first, counter-clock-wise along the perimeter, starting with the red primary. White primaries, i.e. warm white, cool white or neutral white must be provided last. Errors in the ordering of primaries in the xy space will result in poor color reproduction and, in the worst case, flicker or unpleasant intensity fluctuations (beyond what is technically necessary due to intensity variations in primaries) while changing color. Therefore, we encourage integrators to use the set of configurations supported in the ubisys Smart Home app and provided here for reference.

The ubisys Smart Home app for iOS recognizes and generates a certain set of configurations, and lets users pick those easily. You may request an up-to-date list of optimized configurations by mailing [support@ubisys.de](mailto:support@ubisys.de) and asking for these recommended configurations for typical use cases. It is recommended to avoid using other configurations.

#### 6.13.3.4.1. Default color temperature to CIE xy mappings

The ubisys Versalight Engine incorporated into the LD6 uses the following reference points for neutral, cool, warm and super warm white:

**cool:**  $x = 0.31352, y = 0.32363$  (corresponds to 6500K)

**neutral:**  $x = 0.38044, y = 0.37675$  (corresponds to 4000K)

**warm:**  $x = 0.45986, y = 0.41060$  (corresponds to 2700K)

Other white tones can be specified using the xy parameters (note these need to be converted to Zigbee fixed-point numbers):

**super-warm:**  $x = 0.48614, y = 0.41467$  (corresponds to 2400K)

**ultra-warm:**  $x = 0.54924, y = 0.40823$  (corresponds to 1800K)

For other CCT to xy mappings you may use a look-up table, an online calculator or similar converter application.

Notice that the defaults offered in the ubisys iOS app have warm-white and cool-white set to the same intensities, whereas typical light strips have a higher intensity cool-white primary compared to the warm-white primary. For best results use the CIE 1931 information provided in the datasheet of the LED light-strip or other light source, including relative intensities.

#### 6.13.4. Works With All Hubs (Server)

Works With All Hubs cluster is a manufacturer-specific cluster from Amazon, identifiable through the cluster identifier [0xfc57](#) and manufacturer code [0x1217](#) and can exist at most only once on each device node [\[R9\]](#). This cluster provides an interface for enabling various features of the Works With All Hubs cluster on LD6.

Manufacturer-specific attributes supported:

Attribute	Type	Description
0x0002	Boolean, read-only, persistent	<b>DisableOTADowngrades</b> Set the attribute to TRUE if the OTA client shall prohibit downgrades to an earlier version
0x0003	Boolean, read-only, persistent	<b>MGMTLeaveWithoutRejoinEnabled</b> Set the attribute to FALSE, the node SHALL ignore Management Leave Without Rejoin commands that do not include APS encryption using the TC link key.
0x0004	Unsigned8, read-only	<b>NWKRetryCount</b> Number of network-level retries that will be made, in a row, in case that a MAC data request fails. "3"
0x0005	Unsigned8, read-only	<b>MACRetryCount</b> Number of MAC Level Retries the device performs when sending a unicast command, not including APS retries. "3"
0x0006	Boolean, read-only, persistent	<b>RouterCheckInEnabled</b> set to TRUE if the router's check-in algorithm has been enabled through the 'Enable Periodic Router Check-Ins' command. "FALSE"
0x0007	Boolean, read-only, persistent	<b>TouchlinkInterpanEnabled</b> set the attribute to FALSE if support for Touchlink Interpan messages has been disabled On the device. "TRUE"

Attribute	Type	Description
0x0008	Boolean, read-only, persistent	<b>WWAHParentClassificationEnabled</b> Set the attribute to TRUE, then the device SHALL enable the WWAH Parent Classification Advertisements feature. "FALSE"
0x0009	Boolean, read-only, persistent	<b>WWAHAppEventRetryEnabled</b> Set the attribute to TRUE if the WWAH Application Event Retry Algorithm is enabled. "FALSE"
0x000A	Unsigned8, read-only, persistent	<b>WWAHAppEventRetryQueueSize</b> This attribute is the queue size for re-delivery attempts in the WWAH Application Event Retry Algorithm. "32"
0x000B	Boolean, read-only, persistent	<b>WWAHRejoinEnabled</b> Set this attribute TRUE if the WWAH Rejoin Algorithm (described below) is enabled. "FALSE"
0x000C	Unsigned8, read-only, persistent	<b>MACPollFailureWaitTime</b> This attribute describes the time in seconds the device waits before retrying a data poll when a MAC level data poll fails for any reason. "2"
0x000D	Boolean, read-only, persistent	<b>ConfigurationModeEnabled</b> Set the attribute TRUE, the device will accept all ZDO commands without APS encryption. Set the attribute FALSE, all ZDO commands except those specified in [R9] should be disabled (unless sent encrypted using the Trust Center Link Key)
0x000E	Unsigned8, read-only	<b>CurrentDebugReportID</b> This attribute depicts the ID of the current debug report stored on the node. A value of 0x00 indicates that no debug report is available. "0"
0x000F	Boolean, read-only, persistent	<b>TCSecurityOnNwkKeyRotationEnabled</b> Set the attribute TRUE, the node processes network key rotation commands, specifically APS Transport Key, which are sent via unicast and are encrypted by the Trust Center Link Key.
0x0010	Boolean, read-only, persistent	<b>WWAHBadParentRecoveryEnabled</b> Set the attribute TRUE, the end device enables the WWAH Bad Parent Recovery feature described as in [R9]. "FALSE"
0x0011	Unsigned8, read-only, persistent	<b>PendingNetworkUpdateChannel</b> This attribute describes the channel number of the only channel the device accepts in a ZDO Mgmt Network Update command (and/or a Mgmt Network Enhanced Update command).
0x0012	Unsigned16, read-only, persistent	<b>PendingNetworkUpdatePANID</b> This attribute contains the only short PAN ID the device SHALL accept in a NLME Network Update command.
0x0013	Unsigned16, read-only, persistent	<b>OTAMaxOfflineDuration</b> This attribute describes the maximum time in seconds the device may be unavailable after completing its OTA download (while restarting, etc). "60"
0xFFFFD	unsigned16	<b>ClusterRevision</b> The version of the cluster specification that this implementation adheres to.

#### Cluster commands supported:

Command	Description
0x00	<b>Enable APS Link Key Authorization</b> This command enforces that all cluster commands for the cluster have APS level security.
0x01	<b>Disable APS Link Key Authorization</b> This command removes the enforcement of APS level security on cluster commands.
0x02	<b>APS Link Key Authorization Query</b> On receipt of this command, a device generates an appropriate <a href="#">APS Link Key Authorization Query Response command</a> and unicast it to the requestor.
0x03	<b>Request New APS Link Key</b> On receipt of this command, a device requests a new Trust Center Link Key from the Trust Center.

Command	Description
0x04	<b>Enable WWAH App Event Retry Algorithm</b> This command enables using the WWAH App Event Retry Algorithm to increase reliability of these events when the device temporarily loses contact with the hub.
0x05	<b>Disable WWAH App Event Retry Algorithm</b> This command disenables using the WWAH App Event Retry Algorithm.
0x06	<b>Request Time</b> This command enables a device to obtain the current values of Time Cluster attributes from the Time Cluster Server.
0x07	<b>Enable WWAH Rejoin Algorithm</b> This command enables applying WWAH Rejoin Algorithm on end devices to recover and reconnect to the Zigbee network faster when connection is lost.
0x08	<b>Disable WWAH Rejoin Algorithm</b> This command disables applying WWAH Rejoin Algorithm and devices are supposed to go back to the default behavior.
0x09	<b>Set IAS Zone Enrollment Method</b> This command is used to dynamically change among the 3 enrollment methods of an IAS Zone Server specified in ZCL specification.
0x0A	<b>Clear Binding Table</b> On receipt of this command, a device clears its binding table.
0x0B	<b>Enable Periodic Router Check-Ins</b> This command enables the Periodic Router Check-in WWAH functionality with the Check-In Interval specified.
0x0C	<b>Disable Periodic Router Check-Ins</b> This command disables the router periodic check-in behavior (if enabled).
0x0D	<b>Set MAC Poll Failure Wait Time</b> This command enables to update the MACPollFailureWaitTime attribute with the Wait Time value passed.
0x0E	<b>Set Pending Network Update</b> This command enables updating the PendingNetworkUpdateChannel and PendingNetworkUpdatePANID attributes with the Channel and PAN ID values passed, to protect the device from unauthorized Network Update.
0x0F	<b>Require APS ACKs on Unicasts</b> This command enforces that all unicast commands have APS ACKs enabled.
0x10	<b>Remove APS ACKs on Unicasts Requirement</b> This command enables to roll back any changes caused by the <a href="#">Require APS ACKs on Unicasts</a> command. The device can default back to its normal settings.
0x11	<b>APS ACK Requirement Query</b> This command is meant to query the current <a href="#">Require APS ACKs on Unicasts</a> settings.
0x12	<b>Debug Report Query</b> This command enables requesting the debug report based on the specified Debug Report ID.
0x13	<b>Survey Beacons</b> On receipt of this command, the device performs a scan for beacons advertising the device's network (using the default scan duration), generate a Survey Beacons Response command and unicast it to the requestor.
0x14	<b>Disable OTA Downgrades</b> On receipt of this command, a device disallows downgrades of all components of its firmware.
0x15	<b>Disable MGMT Leave Without Rejoin</b> On receipt of this command, a device responds with <code>NOT_AUTHORIZED</code> to Management Leave Without Rejoin commands that have not been APS encrypted with the trust center link key.
0x16	<b>Disable Touchlink Interpan Message Support</b> On receipt of this command, a device ignores Touchlink interpan messages.
0x17	<b>Enable WWAH Parent Classification</b> On receipt of this command, a device enables the WWAH Parent Classification Advertisements feature.
0x18	<b>Disable WWAH Parent Classification</b> On receipt of this command, a device disables the WWAH Parent Classification Advertisements feature.
0x19	<b>Enable TC Security On Nwk Key Rotation</b> On receipt of this command, a device processes only network key rotation commands, specifically APS Transport Key, which are sent via unicast and are encrypted with the Trust Center Link Key.
0x1A	<b>Enable WWAH Bad Parent Recovery</b> On receipt of this command, a device enables the WWAH Bad Parent Recovery feature.
0x1B	<b>Disable WWAH Bad Parent Recovery</b> On receipt of this command, a device disables the WWAH Bad Parent Recovery feature.

Command	Description
0x1C	<b>Enable Configuration Mode</b> This command enables to protect the device from unauthorized configuration changes during normal operation, i.e., to put a device back into its default state where configuration changes are allowed.
0x1D	<b>Disable Configuration Mode</b> On receipt of this command, a device disables processing of all ZDO commands that have not been encrypted using the Trust Center Link key.
0x1E	<b>Use Trust Center for Cluster</b> This command forces the device to use ONLY the Trust Center as the cluster server for the set of clusters specified and persists this configuration across reboots.
0x1F	<b>Trust Center for Cluster Server Query</b> On receipt of this command, a device generates an appropriate <a href="#">Trust Center for Cluster Server Query Response</a> command and unicasts it to the requestor.

### 6.13.5. Identify Cluster (Client)

The Identify cluster client takes on the role of the Finding & Binding initiator. Once activated, LD6 initiates the identification process by broadcasting identify query request command to detect target(s) operating in identify mode.

Cluster commands transmitted:

Command	Description
0x00	<b>Identify</b> Puts the remote device into identify mode, or terminates identify mode.
0x01	<b>Query Identify</b> Determines whether the remote device is currently identifying, and returns the remaining time if so.

### 6.13.6. Over-the-Air Upgrade Cluster (Client)

The image type for LD6 is **0x7B2C**. You may request the latest firmware in Zigbee OTA image format to upgrade devices in the field using your own OTA server and back-end. If you operate the LD6 with the Zigbee/Ethernet Gateway ubisys G1, the latest firmware for LD6 will always be available automatically and you do not need to request it explicitly. Notice that you may also upgrade the device over Bluetooth using a suitable Zigbee Virtual Device (ZVD) with associated OTA server. The ubisys Smart Home app for iOS version 2.2.0 or later supports this feature. You might have to download the corresponding OTA file from the ubisys OTA repository web-site and put it into the "ota" folder of the Smart Home app on your iPhone or iPad.

## 6.14. Application Endpoint #242 - Zigbee Green Power

This endpoint provides the Zigbee Green Power feature according to the 2015 edition of the specification, i.e. including support for Green Power Devices with IEEE EUI-64 and bidirectional commissioning. The Zigbee traffic between Proxies and Sinks utilizes standard Zigbee foundation paradigms and the Zigbee Cluster Library [R4]. You may use the standard ZCL frames to enumerate, read and write attributes, invoke commands, etc. The application endpoint exposes the following clusters:

Cluster	Direction	Description
0x0021	Inbound (Server)	<b>Zigbee Green Power Sink</b> Allows pairing the dimmer with Zigbee Green Power switches. The sink can directly receive Green Power frames but can also utilize proxies in the network.
0x0021	Outbound (Client)	<b>Zigbee Green Power Proxy</b> Allows sinks on the network to configure this device as a "Proxy", i.e. access point for Zigbee Green Power Devices into the Zigbee mesh network.

### 6.14.1. Green Power Cluster (Server)

The server-side of the Green Power cluster provides the Zigbee Green Power Sink functionality, i.e. provides the ability to process Green Power frames. The device can receive those frames directly if they are in radio range; or it can process frames tunneled over the Zigbee network via other Green Power Proxies. This implementation supports unidirectional and bidirectional33 GPDs. Attributes supported:

Attribute	Type	Description
0x0000	unsigned8, read-only	<b>gpsMaxSinkTableEntries</b> The number of sink table entries supported by this device
0x0001	extended raw binary, read-only, persistent	<b>SinkTable</b> Entries in the sink table create a pairing between the sink and a Green Power Device. For an operational pairing, one or more entries in the translation table are also required
0x0002	bitmap8	<b>gpsCommunicationMode</b> Determines the default communication mode between sink and proxies for new entries added by the sink to the sink table when paired with a GPD
0x0003	bitmap8	<b>gpsCommissioningExitMode</b> Specifies under which circumstances the sink should leave commissioning mode
0x0004	unsigned16	<b>gpsCommissioningWindow</b> Time, in seconds, before a commissioning session expires
0x0005	bitmap8, persistent	<b>gpsSecurityLevel</b> Determines the minimum security level a GPD is required to support as well as whether or not the Trust Center needs to be involved into the commissioning process
0x0006	bitmap24, read-only	<b>gpsFunctionality</b> Indicates Green Power features and building blocks supported by this device
0x0007	bitmap24, read-only	<b>gpsActiveFunctionality</b> Allows to disable certain Green Power features on this device
0x0020	bitmap8, persistent	<b>gpSharedSecurityKeyType</b> Determines the security key type to use for devices with bidirectional commissioning capabilities, i.e. out-of-the-box individual key, shared GP key, etc.
0x0021	key128, persistent	<b>gpSharedSecurityKey</b> The 128-bit AES-CCM* key that is being used to secure Green Power data frames
0x0022	key128, persistent	<b>gpLinkKey</b> The 128-bit AES-CCM* key that is being used to deliver keying material to Green Power devices

Cluster commands supported:

Command	Description
0x00	<b>GP Notification</b> Tunnels GP frames from a Green Power Device to one or more sinks or groups of sinks
0x04	<b>GP Commissioning Notification</b> Tunnels GP frames from a Green Power Device to a sink in commissioning mode
0x05	<b>GP Sink Commissioning Mode</b> Makes the sink enter or leave commissioning mode for a particular endpoint or all endpoints
0x09	<b>GP Pairing Configuration</b> Creates, updates or removes pairings by modifying the sink and translation table entries accordingly
0x0A	<b>GP Sink Table Request</b> Allows to query the sink table for a certain Green Power Device or read out the table in chunks

Cluster commands transmitted:

Command	Description
0x01	<b>GP Pairing</b> Creates, updates or removes proxy table entries
0x02	<b>GP Proxy Commissioning Mode</b> Makes the proxy enter commissioning mode for a particular sink, or leave commissioning mode



Command	Description
0x06	<b>GP Response</b> Tunnels GP data frames from a sink to a bidirectional Green Power Device
0x0A	<b>GP Sink Table Response</b> Conveys a set of sink table entries to a management application

### 6.14.1.1. Green Power Device Interaction

#### 6.14.1.1.1. Commissioning a Green Power Switch

The LD6 can be put in commissioning mode either by using a suitable commissioning tool (for example the ubisys Network Manager) or by instigating Finding & Binding as a target. Once in commissioning mode, the device is ready to pair with Green Power switches.

#### 6.14.1.1.2. Supported Device Types

The LD6 can be paired with the following pre-defined Green Power Device types:

Device Type	Description
0x02	<b>On/off Switch</b> Default command set: on, off and toggle commands
0x03	<b>Level Control Switch</b> Default command set: move, step and stop commands (with and without on/off)
0x07	<b>Generic Switch</b> Default command set: press and release (up to eight buttons)

In addition, any Green Power device that sends at least one of the supported commands listed in the next section can also be paired with LD6.

#### 6.14.1.1.3. Supported Green Power Commands

The following Green Power commands are supported by default translations:

Command	Description
0x10	<b>Recall scene #1</b>
0x11	<b>Recall scene #2</b>
0x12	<b>Recall scene #3</b>
0x13	<b>Recall scene #4</b>
0x14	<b>Recall scene #5</b>
0x15	<b>Recall scene #6</b>
0x16	<b>Recall scene #7</b>
0x17	<b>Recall scene #8</b>
0x18	<b>Store scene #1</b>
0x19	<b>Store scene #2</b>
0x1A	<b>Store scene #3</b>
0x1B	<b>Store scene #4</b>
0x1C	<b>Store scene #5</b>
0x1D	<b>Store scene #6</b>
0x1E	<b>Store scene #7</b>
0x1F	<b>Store scene #8</b>
0x20	<b>Turn Off</b>
0x21	<b>Turn On</b>
0x22	<b>Toggle</b>
0x30	<b>Move up</b>

Command	Description
0x31	<b>Move down</b>
0x32	<b>Step up</b>
0x33	<b>Step down</b>
0x34	<b>Stop</b>
0x35	<b>Move up with on/off</b>
0x36	<b>Move down with on/off</b>
0x37	<b>Step up with on/off</b>
0x38	<b>Step down with on/off</b>
0x69	<b>Generic Press</b>
0x6A	<b>Generic Release</b>

### 6.14.1.2. Generic Switch Commissioning

This product provides enhanced support for latest generation Green Power generic switches with the ability to distinguish short (< 1 second) and long (> 1 second) presses. In fact, a generic switch behaves like a physical switch directly connected to the high-voltage input lines, resulting in a consistent user experience. Each contact of a switch is commissioned separately, such that the desired button layout can be achieved on any generic switch. First commission button A, then button B, then C and so forth. Depending on the number of commissioned contacts, the behaviour is different. The following Green Power commands are supported by default translations:

Number of Commissioned Contacts	Behavior
1	<p><b>Short Press</b> Toggles the light on and off</p> <p><b>Long Press</b> Dims the light up or down while pressed. The direction alternates on each subsequent press</p>
2	<p><b>Short Press Button A</b> Turns the light on</p> <p><b>Long Press Button A</b> Dims the light up while pressed</p> <p><b>Short Press Button B</b> Turns the light off</p> <p><b>Long Press Button B</b> Dims the light down while pressed</p>
3	<p><b>Press Button A</b> Turns the light on</p> <p><b>Press Button B</b> Turns the light off</p> <p><b>Press Button C</b> Dims the light up or down while pressed. The direction alternates on each subsequent press</p>
4	<p><b>Press Button A</b> Turns the light on</p> <p><b>Press Button B</b> Turns the light off</p> <p><b>Press Button C</b> Dims the light up while pressed</p> <p><b>Press Button D</b> Dims the light down while pressed</p>

### 6.14.2. Green Power Cluster (Client)

The client-side of the Green Power cluster provides the Zigbee Green Power Proxy functionality, i.e. makes the device act as an “access point” for Green Power Devices (GPDs). This implementation supports unidirectional and bidirectional<sup>34</sup> GPDs.

Attributes supported:

Attribute	Type	Description
0x0010	unsigned8, read-only	<b>gppMaxProxyTableEntries</b> The number of proxy table entries supported by this device
0x0011	extended raw binary, read-only, persistent	<b>ProxyTable</b> Entries in the proxy table create a link between Green Power Devices and Green Power Sinks
0x0016	bitmap24, read-only	<b>gppFunctionality</b> Indicates Green Power features and building blocks supported by this device
0x0017	bitmap24, read-only	<b>gppActiveFunctionality</b> Allows to disable certain Green Power features on this device
0x0020	bitmap8, persistent	<b>gpSharedSecurityKeyType</b> Determines the security key type to use for devices with bidirectional commissioning capabilities, i.e. out-of-the-box individual key, shared GP key, etc.
0x0021	key128, persistent	<b>gpSharedSecurityKey</b> The 128-bit AES-CCM* key that is being used to secure Green Power data frames
0x0022	key128, persistent	<b>gpLinkKey</b> The 128-bit AES-CCM* key that is being used to deliver keying material to Green Power devices

Cluster commands supported:

Command	Description
0x01	<b>GP Pairing</b> Creates, updates or removes proxy table entries
0x02	<b>GP Proxy Commissioning Mode</b> Makes the proxy enter commissioning mode for a particular sink, or leave commissioning mode
0x06	<b>GP Response</b> Tunnels GP data frames from a sink to a bidirectional Green Power Device
0x0B	<b>GP Proxy Table Request</b> Allows to query the proxy table for a certain Green Power Device or read out the table in chunks

Cluster commands transmitted:

Command	Description
0x00	<b>GP Notification</b> Tunnels GP frames from a Green Power Device to one or more sinks or groups of sinks
0x04	<b>GP Commissioning Notification</b> Tunnels GP frames from a Green Power Device to a sink in commissioning mode
0x0B	<b>GP Proxy Table Response</b> Conveys a set of proxy table entries to a sink or management application

[2] Available in ZigBee stack version 1.60 and above. Legacy ZCP requirement – do not use in applications

[3] Available in Zigbee stack version 1.56 and above.

[4] Since the application version 1.4.0. Prior, the minimum on level was unsupported, i.e. the behavior equivalent to its value being set as the invalid value (0xFF).

## 7. Physical Dimension

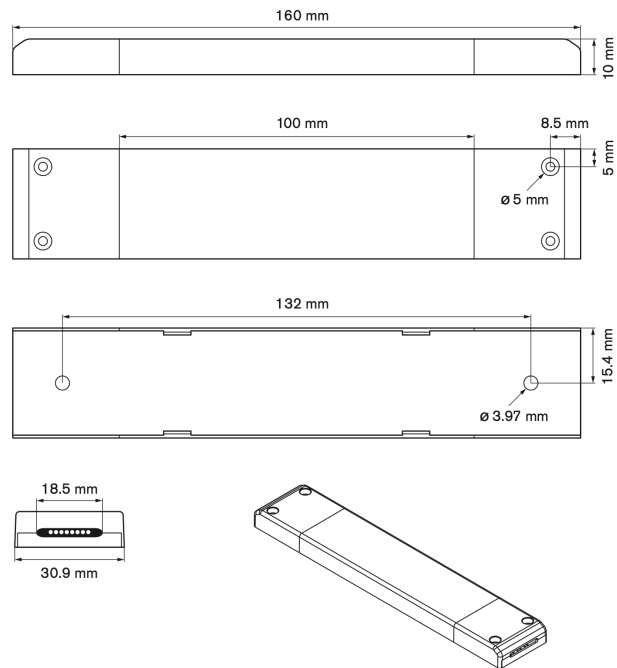


Figure 1. Zigbee/Bluetooth LED controller LD6 – Dimensions

## 8. Ordering Information

The following table lists the product variants available. Use the specified order code for your orders.

Orders for products sold under different brand names need to be placed with the respective vendor.

For any customized versions, please contact ubisys sales. OEM customers can always contact [ubisys](#) for more information.

<b>Vendor/Brand</b>	<b>Order Code</b>	<b>Description</b>
ubisys	1472	Zigbee Driver LD6 For Luminaires

## 9. General Terms & Conditions Of Business

When placing your order you agree to be bound by our General Terms & Conditions of Business, "Allgemeine Geschäftsbedingungen", which are available for download here:

[www.ubisys.de/en/smarthome/terms.html](http://www.ubisys.de/en/smarthome/terms.html)

## 10. Declaration Of Conformity



We – ubisys technologies GmbH, Neumannstraße 10, 40235 Düsseldorf, Germany – declare under our sole responsibility that the ubisys Zigbee/Bluetooth LED Controller LD6 with order codes as detailed in [Chapter 8](#) under the trade name “ubisys” to which this declaration relates are in conformity with the following directives and standards:

Directive/Standard	Description/Scope
2014/53/EU	Radio Equipment Directive (RED)
2014/30/EU	Electromagnetic Compatibility Directive (EMC)
2014/35/EU	Low Voltage Directive (LVD)
2012/19/EU	Waste Electrical and Electronic Equipment Directive (WEEE)
2011/65/EU	Restriction of Hazardous Substances Directive (RoHS)
EN 300 328 V2.2.2	ERM; Wideband transmission systems; 2.4 GHz ISM band
EN 300 440 V2.2.1	ERM; Radio equipment to be used in the 1 GHz to 40 GHz frequency range
EN 301 489-1 V2.1.1	EMC
IEEE 802.15.4:2020	IEEE Standard 802 – Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)
Zigbee 3.0	Zigbee 2023 with Zigbee Direct and Green Power
Bluetooth	Bluetooth 4.2

Düsseldorf, Germany

September 16, 2021

Place of issue

Date of issue

Dr.-Ing. Arasch Honarbacht

Managing Director, Head of Research & Development

Full name of Authorized Signatory

Title of Authorized Signatory

Signature

Seal



## 11. Revision History

<b>Revision</b>	<b>Date</b>	<b>Remarks</b>
0.1	10/01/2021	Initial draft
0.2	09/01/2024	Update according to the application firmware 1.4.0
1.0	01/18/2024	Initial public version
1.1	03/08/2024	Editorials and additional information regarding Versalight engine defaults and behavior
1.2	03/11/2024	Minor corrections and editorial changes

## 12. Contact

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