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EMI 2 – LED - EMIZB-141

Technical manual

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RoHS CE

1 Cautionary notes

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2 Features

2.1 EMI 2 – EMIZB-141

Real-time measurement and reporting of power consumption

The External Meter Interface 2 serves as a Zigbee interface for your customers' electronic meters. The External Meter Interface 2 will collect readings and information from other meters and send data via the Zigbee communication to appliances in the building. Your customer will then be able to follow their energy consumption through a display, their computer or mobile phone

Cooperation with any other meters

The External Meter Interface 2 can be used with most electronic power meters. It is compatible with all meters with an LED indicating power consumption. The External Meter Interface 2 cannot be used in installations with power production such as PV systems or similar. All data can be collected by an external gateway and stored in a normal data flash. The Zigbee profile ensures high security in order to protect data and prevent hacking.

The External Meter Interface 2 comes with an optical probe, which is easily attached by a magnet. The cable length is approximately 800 mm.

2.2 Key features

- LED sensor
- ZigBee OTA cluster for firmware upgrades
- ZigBee 3.0 certified

Endpoints

The device implements the following standard HA devices on different end points.

2.3 Zigbee Device Object (ZDO)

- End point number 0x00
- Application profile Id 0x0000
- Application device Id 0x0000
- Supports all mandatory clusters.

2.4 Onics Utility

- Application profile Id 0xC0C9 (Onics (Formerly Develco Products) private profile)
- Application device Id 0x0001
- Manufacturer code for Onics (Formerly Develco Products) is 0x1015.
- Private profile for internal Onics (Formerly Develco Products) uses only.

2.5 Metering Device

- Application profile Id 0x0104 (Home Automation)
- Application device Id 0x0053 (Meter Interface)

3 Supported Clusters

3.1 Metering cluster for EP 0x02

3.1.1 Basic – Cluster id 0x0000 (Server)

Only the first set has mandatory attributes, also the optional attributes that can be relevant to a Onics (Formerly Develco Products) device are all in set 0x000.

3.1.1.1 Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	ZCLVersion	Uint8	0x00 to 0xFF	M	
0x0004	Manufacturer Name	String	0-32 bytes	O	3.1.1.1.1
0x0005	Model Identifier	String	0-32 bytes	O	3.1.1.1.2
0x0006	Date Code	String	0-32 bytes	O	
0x0007	Power Source	Enum8	0x00 to 0xFF	M	ZCL 3.2.2.2.8

3.1.1.1.1 Manufacturer Name

“Onics A/S” (Formerly “Develco Products A/S”) or “frient A/S”

3.1.1.1.2 Model Identifier

“EMIZB-141”

3.1.1.2 Manufacture Specific Attribute

Id#	Name	Type	Man/Opt	Relevance and ref.
0x8000	Primary SW Version	OctetString	M	Read only
0x8010	Primary Bootloader SW Version	OctetString	M	Read only
0x8020	Primary HW Version	OctetString	M	Read only

0x8050	Primary SW Version 3rd Party	OctetString	M	Read only
0x8100	LED Control	Bitmap8	O	Bit0 – MMI Fault flash enabled, Bit1 – Application LED enabled
0x8101	Tx Power	Enum8	O	0 – CE (10 dBm), 1 – FCC(19 dBm)

ZCL header setting – Manufacturer code for Onics (Formerly Develco Products) is 0x1015.

3.1.2 Power Configuration - Cluster id 0x0001 (Server)

The power configuration cluster is described in ZigBee Cluster Library Specification (ZCL) section 3.3.

3.1.2.1 Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0020	Battery Voltage	Uint8	0x00 - 0xFF	O	In 100 mV
0x0021	Battery Percentage Remaining	Uint8	0x00 - 0xFF	O	
0x0031	Battery Size	Enum8	Desc	O	ZCL 3.3.2.2.4.2
0x0033	Battery Quantity	Uint8	0x00 - 0xFF	O	
0x0034	Battery Rated Voltage	Uint8	0x00 - 0xFF	O	
0x0036	Battery Voltage Min Threshold	Uint8	0x00 - 0xFF	O	
0x003E	Battery Alarm State	Bitmap32	Desc	O	ZCL 3.3.2.2.4.11

3.1.3 Identify – Cluster id 0x0003 (Server & Client)

The identify cluster is described in ZCL section 3.5,

3.1.3.1 Attribute

Id#	Name	Type	Range	Man/Opt
0x0000	Identify Time	Uint16	0x0000 to 0xFFFF	M

3.1.3.2 Commands

The identify cluster has 2 commands as server.

Id#	Name	Payload	Man/Opt	Relevance and ref.
0x00	Identify	Uint16 - Identify Time (seconds)	M	ZCL 3.5.2.3
0x01	Identify Query	None	M	ZCL 3.5.2.3

The identify cluster has 1 command as client.

Id#	Name	Payload	Man/Opt	Relevance and ref.
0x00	Identify Query Response	Uint16 - Identify Time (seconds)	M	ZCL 3.5.2.4

3.1.4 Poll Control - Cluster id 0x0020 (Server)

The poll control cluster is described in ZCL section 3.16

This cluster provides a mechanism for the management of an end device's MAC Data Request rate. For the purposes of this cluster, the term "poll" always refers to the sending of a MAC Data Request from the end device to the end device's parent.

This cluster can be used for instance by a configuration device to make an end device responsive for a certain period of time so that the device can be managed by the controller.

3.1.4.1 Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	Check-in Interval	Uint32	0x00 to 0x6E0000	M	Default value is 1 hour

0x0001	Long Poll Interval	Uint32	0x04 to 0x6E0000	M	Default value is 7.5 sec
0x0002	Short Poll Interval	Uint16	0x01 to 0xFFFF	M	Default value is 3 seconds
0x0003	Fast Poll Timeout	Uint16	0x01 to 0xFFFF	M	Default value is 5 minutes

3.1.4.2 Commands

The poll control cluster support sending 1 command.

Id#	Name	Man/Opt	Relevance and ref.
0x00	Check-in	M	ZCL 3.16.4.3

The poll control cluster support receiving 4 commands.

Id#	Name	Man/Opt	Relevance and ref.
0x00	Check-in Response	M	ZCL 3.16.5.2
0x01	Fast Poll Stop	M	ZCL 3.16.5.2
0x02	Set Long Poll Interval	O	ZCL 3.16.5.2
0x03	Set Short Poll Interval	O	ZCL 3.16.5.2

Start up, auto scan for client poll control cluster on the coordinator. If it is support on the coordinator an auto bind is created and the EMI 2 will send a check-in command in the interval specified in attribute “Check-in Interval. The coordinator has to reply with a check-in response.

If it doesn’t find a poll client, it will search again periodically.

3.1.5 Metering – Cluster id 0x0702 (Server)

The metering cluster is described in ZCL section 10.4.

3.1.5.1 0x00 Reading Information attribute set

Id#	Name	Type	Range	Man/Opt	Note
0x00	Current Summation Delivered	Uint48	0x000000000000 to 0xFFFFFFFFFFFF	M	
0x02	Current Max Demand Delivered	Uint48	0x000000000000 to 0xFFFFFFFFFFFF	O	
0x07	Reading Snapshot Time	UTC		O	
0x08	Current Max Demand Delivered Time	UTC		0	
0x0F	Profile Interval Period	Enum8	0x00 to 0xFF	O	ZCL 10.4.2.3.1.1.1

3.1.5.2 0x02 Meter Status attribute set

Id#	Name	Type	Range	Man/Opt	Note
0x00	Status	Bitmap8	0x00 to 0xFF	M	

Meter Status cover low battery detection of the External Meter Interface.

The following table describe the meter status bits per metering type:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Not supported	Not supported	Not supported	Not supported	Not supported	Low Battery	Check Meter

Check Meter: Is set if communication problems with meter is experienced.

Low Battery: Set to true when the battery needs maintenance ~ 2.2V

3.1.5.3 0x03 Formatting attribute set

The following set of attributes provides the ratios and formatting hints required to transform the received summations, consumptions, or demands/rates into displayable values. If the Multiplier and Divisor attribute values are non-zero, they are used in conjunction with the *Summation Formatting,* and *Demand Formatting* attributes. Equations required to accomplish this task are defined below:

Summation = Summation Delivered * Multiplier / Divisor
(formatted using *Summation Formatting*)

Demand = Demand received * Multiplier / Divisor
(formatted using *Demand Formatting*)
If the Multiplier and Divisor attribute values are zero, just the formatting hints.
defined in *Summation Formatting* and *Demand Formatting* attributes are used.

The following set of attributes provides the ratios and formatting hints required to transform the received summations, consumptions, or demands/rates into displayable values. If the Multiplier and Divisor attribute values are non-zero, they are used in conjunction with the *Summation Formatting, Consumption Formatting*, and *Demand Formatting* attributes.

Id#	Name	Type	Range	Man/Opt	Note
0x00	Unit of Measure	Enum8	0x00 to 0xFF	M	MFG attribute id 0x0302 – Interface mode (kWh)
0x01	Multiplier	Uint24	0x000000 to 0xFFFFFF	O	Fixed to 1
0x02	Divisor	Uint24	0x000000 to 0xFFFFFF	O	Fixed to 1000
0x03	Summation Formatting	Bitmap8	0x00 to 0xFF	M	
0x04	Demand Formatting	Bitmap8	0x00 to 0xFF	O	

0x06	Metering Device Type	Bitmap8	0x00 to 0xFF	M	Depends on Interface Mode

Above attribute description is to be found in section 10.4.2.2.4 “Formatting” in the ZCL provided by the CSA.

3.1.5.4 0x04 Historical attribute set

Id#	Name	Type	Range	Man/Opt	Note
0x00	Instantaneous Demand	Int24	-8,388,607 to 8,388,607	O	ZCL configure reporting is supported

Above attribute description is to be found in section 10.4.2.2.5 “Historical Consumption” in ZCL provided by the CSA

3.1.5.5 Manufacture Specific Attributes

Onics (Formerly Develco Products) Manufacture code is 0x1015.

Table 1 : Formatting Attribute Set (Manufacture Specific)

Identifier	Name	Type	Range	Access	Default
0x0300	Pulse Configuration	Uint16	0x0000 to 0xFFFF	Read/ Write	0x03E8
0x0301	Current Summation	Uint48	0x000000 to 0xFFFFFFF	Write Only	0x0000
0x0302	Interface Mode	Enum16	0x0000 to 0xFFFF	Read/ Write	0x0000

3.1.5.5.1 Pulse Configuration

Pulse Configuration represents the number of pulses the meter outputs per unit.
Default value is 1000 imp/kWh, 0x03E8 = 1000 dec.

3.1.5.5.2 Current Summation

Current Summation represents the present value for current summation delivered send to the display.
The value must be scaled according to divider and multiplier.

MFG attribute id 0x0302 – Interface mode	
Attribute value	Description
0x0000	Pulse counting on an Electricity meter – Unit KWh Typically LED probe is used
0xFFFE	Unknown – Probe not detected
0xFFFF	Disabled

Example: Preset value = 0,570 kWh
Divider = 1000
Multiplier = 1
That give a *Current Summation* value of 570

It is important that the *Pulse Configuration* attribute has been configured correctly before sending the *Current Summation* setting because *Pulse Configuration* is used when calculating the total amount of detected pulses.

3.1.5.6 Commands

The metering cluster support sending 1 command.

Id#	Name	Man/Opt	Relevance and ref.
0x00	Get Profile Response	O	ZCL 10.4.2.3.1

The metering cluster support receiving 1 command.

Id#	Name	Man/Opt	Relevance and ref.
0x00	Get Profile	O	ZCL 10.4.3.3

3.1.6 Meter Identification – Cluster id 0x0B01

The Meter Identification cluster is described in ZCL section 10.13.

3.1.6.1 Attribute

Id#	Name	Type	Range	Man/Opt
0x0000	Company Name	String	0 to 16 Octets	M
0x0001	Meter Type ID	Uint16	0x0000 to 0xFFFF	M
0x0004	Data Quality ID	Uint16	0x0000 to 0xFFFF	M
0x000C	POD	String	0 to 16 Octets	M
0x000D	Available Power	Int24	0x000000 to 0xFFFFFFFF	M
0x000E	Power Threshold	Int24	0x000000 to oxFFFFFFFF	M

3.1.7 Diagnostics – Cluster id 0x0B05

The diagnostics cluster is described in ZCL section 3.15,

3.1.7.1 Attribute

Id#	Name	Type	Range	Man/Opt
0x0000	Number Of Resets	Uint16	0x000 to 0xFFFF	M
0x0100	Mac Rx Bcast	Uint32	0x00000000 to 0xFFFFFFFF	O
0x0101	Max Tx Bcast	Uint32	0x00000000 to 0xFFFFFFFF	O
0x0102	Mac Rx Ucast	Uint32	0x00000000 to 0xFFFFFFFF	O
0x0103	Mac Tx Ucast	Uint32	0x00000000 to 0xFFFFFFFF	O
0x0104	Mac Tx Ucast Retry	Uint16	0x0000 to 0xFFFF	O
0x0105	Mac Tx Ucast Fail	Uint16	0x0000 to 0xFFFF	O
0x0106	APS RX Bcast	Uint16	0x0000 to 0xFFFF	O

0x0107	APS Tx Bcast	Uint16	0x0000 to 0xFFFF	O
0x0108	APS Rx Ucast	Uint16	0x0000 to 0xFFFF	O
0x0109	APS Tx Ucast Success	Uint16	0x0000 to 0xFFFF	O
0x010A	APS Tx Ucast Retry	Uint16	0x0000 to 0xFFFF	O
0x010B	APS Tx Ucast	Uint16	0x0000 to 0xFFFF	O
0x010C	Route Disc Initiated	Uint16	0x0000 to 0xFFFF	O
0x0112	NWK FC Failure	Uint16	0x0000 to 0xFFFF	O
0x0113	APS FC Failure	Uint16	0x0000 to 0xFFFF	O
0x0114	APS Unauthorized Key	Uint16	0x0000 to 0xFFFF	O
0x0115	NWK Decrypt Failures	Uint16	0x0000 to 0xFFFF	O
0x0116	APS Decrypt Failures	Uint16	0x0000 to 0xFFFF	O
0x0117	Packet Buffer Allocate Failure	Uint16	0x0000 to 0xFFFF	O
0x011A	Packet Validate Drop Count	Uint16	0x0000 to 0xFFFF	O
0x011B	Average Mac Retry Per APS Message Sent	Uint16	0x0000 to 0xFFFF	O
0x011C	Last Message LQI	Uint8	0x00 to 0xFF	O
0x011D	Last Message RSSI	Int8	-127 to 127	O

3.1.8 Time – Cluster id 0x000A (Client)

The time cluster is described in ZCL section 3.12.

The device will use this clusters as a client – provided that a suitable Time Server is available on the network (most likely on the Gateway).

3.1.9 OTA Upgrade – Cluster id 0x0019 (Client)

The cluster provides a ZigBee standard way to upgrade devices in the network via OTA messages.

When the devices have joined a network it will automatically auto scan for a OTA upgrade server in the network. If it finds a server an auto bind is created and ones every 6 hour it will automatically send its “current file version” to the OTA upgrade server. It is the server that initiate the firmware upgrade process.

3.1.9.1 Attributes

Id#	Name	Type	Range	Man/Opt
0x0000	Upgrade Server ID	IEEE Address	-	M
0x0001	File Offset	Uint32	all	O
0x0002	Current File Version	Uint32	all	O
0x0004	Downloaded File Version	Uint32	all	O
0x0006	Image Upgrade Status	Enum8	all	O
0x0007	Manufacturer ID	Uint16	all	O
0x0008	Image Type ID	Uint16	all	O
0x0009	Minimum Block Request Delay	Uint16	0x0000 to 0xFFFE	O

3.1.9.2 Commands

The OTA Client cluster can send 3 commands.

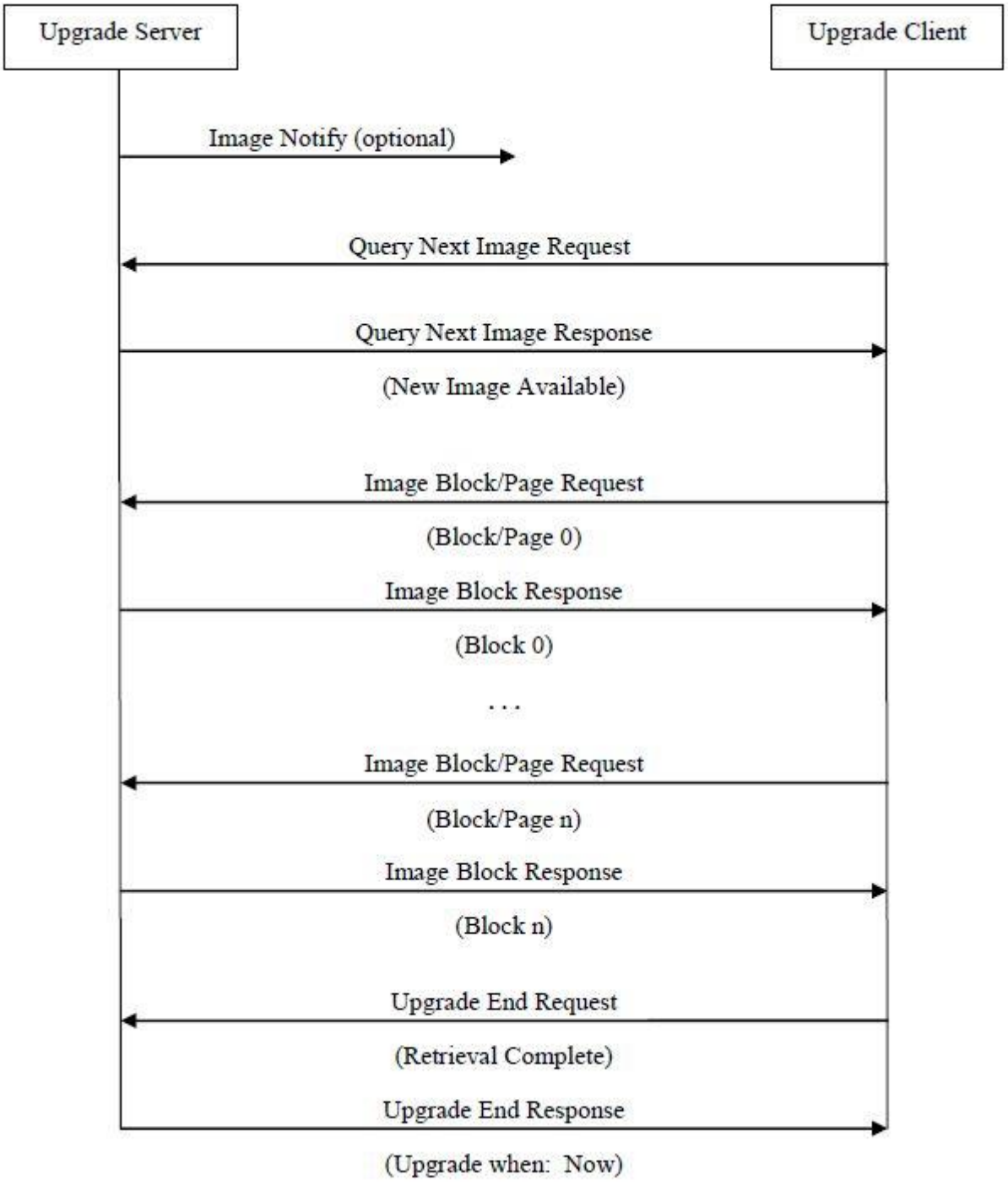
Id#	Name	Man/Opt	Relevance and ref.
0x01	Query Next Image request	M	ZCL 11.13.1
0x03	Image Block Request	M	ZCL 11.13.1
0x06	Upgrade End Request	M	ZCL 11.13.1

The OTA Client cluster can receive 4 commands.

Id#	Name	Man/Opt	Relevance and ref.
0x00	Image Notify	O	ZCL 11.13.1
0x02	Query Next Image Response	M	ZCL 11.13.1

0x05	Image Block Response	M	ZCL 11.13.1
0x07	Upgrade End Response	M	ZCL 11.13.1

3.1.9.3 OTA Upgrade Messages Diagram



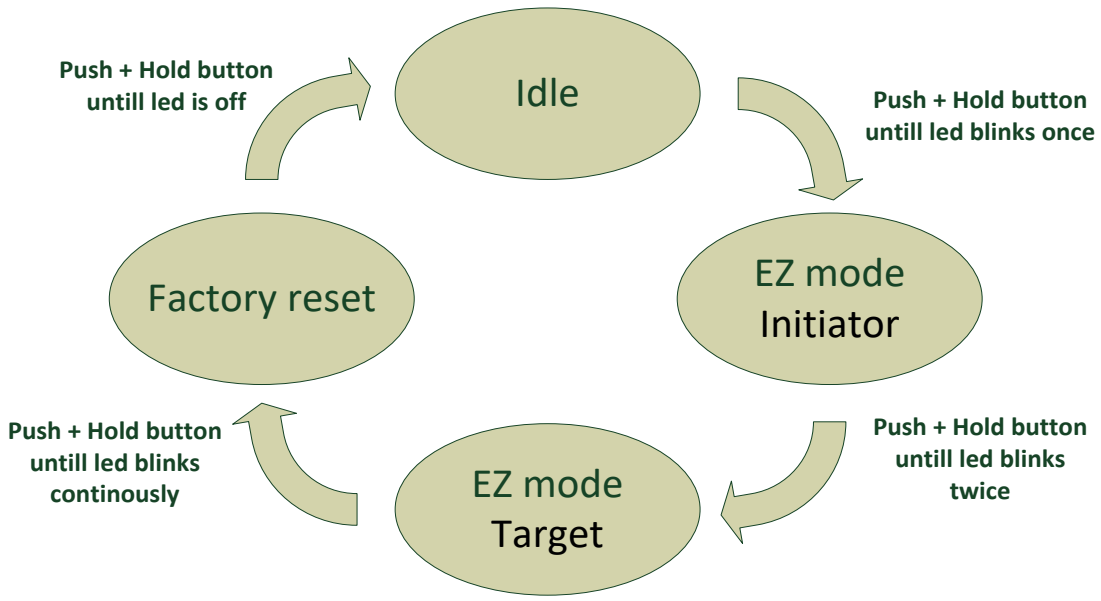
4 MMI user guide

4.1 Menu button

How to get access to the menu button on the EMI:
Open the casing of the device by. The menu button is placed on the PCB.

Pushing the button on a device provides the user with several possibilities.

Pushing the button for longer (push, hold for a few seconds, and release) allows the user to set the device into a desired mode. A mode change happens at 5 second interval. Below, these modes are illustrated in a state chart.



When cycling through the menu modes, the state is indicated by a number of blinks on the LED. The device is supporting the ZigBee standardized EZ- mode Commissioning.

4.1.1 EZ mode - Initiator

If the device is not on the network EZ-Mode Network Steering is invoked when the user enters this menu. The led blinks once every 1 sec until the device has joined the network. If the device was already on the network, it will broadcast the PermitJoin messages. It is the trust center policy that decides if the device is allowed to join the network.

When the device has joined the network EZ-Mode Finding and Binding is invoked, and the device start to blink every 3 sec until a cluster match is found. When a match is found, or the cluster examine is finished the blinking stops and the device sends a message to the target device to stop the identify time.

The following clusters are support in EZ-mode finding and binding:

- Power configuration cluster
- Metering

The EZ-mode time is hard coded to 3 minutes. This is the Minimum and recommended PermitJoin time broadcast for EZ-Mode Network Steering and minimum IdentifyTime set for EZ-Mode Finding and Binding. If the user enters the menu again another 3 minutes is started.

4.1.2 EZ mode - Target

If the device is not on the network EZ-Mode Network Steering is invoked when the user enters this menu. The led blinks twice every 1 sec until the device has joined the network. If the device was already on the network it will broadcast the PermitJoin messages. It is the trust center policy that decides if the device is allowed to join the network.

When the device has joined the network identify mode is invoke and the device start to blink twice every 3 sec until identify mode is stopped or after the EZ-mode time has expired. If the user enters the menu again another 3 minutes is started.

4.1.3 Factory reset

To allow a device to join a network, one either has to power up a device that has not previously joined a network or push the button until the Reset To Factory default mode is indicated – and subsequently release the button. This will cause the device to reset to its factory default state and scan for a suitable coordinator.

4.2 Action on Power On

Generally, all end devices that have not previously joined a network (or have been reset to factory default) will start up and search for a network with join permit open. In this mode, the Yellow LED will flash while searching for a network to join.
Once the device has joined the network, is will start scanning for an OTA server, Time server, Poll control client and a metering client.

If a device has joined a network and is powered down, it will attempt to rejoin this network upon power up. For the first 30 seconds hereafter, the device will be available for communication. This time can be expanded using the poll control cluster functionality.

5 General network behaviour

5.1 Installation

When the device is factory new and powered for the first time it will start looking for a ZigBee PAN Coordinator or router to join. The device will scan each ZigBee channel starting from 11 to 26. The LED will flash once every second until it joins a device.

#Scan mode - 1	**#Sleep mode**	**#Scan mode - 2**	**#Sleep mode**	**#Scan mode - 2**
Scan all 16 ZigBee channel until join network or 15 minutes.	MCU is in sleep mode (Radio off) 15 minutes	Scan all 16 ZigBee ch x 1 or until join network. ~ 30 seconds	MCU is in sleep mode (Radio off) 15 minutes	Scan all 16 ZigBee ch x 1 or until join network. ~ 30 seconds

The device will start up using scan mode 1. To increase battery lifetime when the device is joining a network for the first time a scan mode 2 will be used after scan mode 1 has expired. Scan mode 1 it will only be executed one time when the device is powered. If the user invokes EZ-mode it will start scanning the next 3 minutes

In section 5 “MMI” it is explained how to put the device into a join or leave network mode.

Network settings are stored in NV-memory are after a power cycle the device re-join the same network.

If the device has to join a new PAN coordinator the MMI menu supports a **“Reset To Factory Fresh Settings”** mode. This will erase all current network information.

5.2 Normal – Keep alive

The device is sending a “keep alive” message to the PAN coordinator every 15 minute to verify that the device is still connected to the network.

5.2.1 Network lost

If no "keep alive" responses are received 5 times in a row (Worst case 1h15m), the devices will start scanning as specified in the table below.

When the device is in scan mode the YELLOW LED will flash once every second until it re-joins the network.

According to the ZigBee specification TX is NOT allowed to be enabled all the time and a TX silent period must be defined.

#Scan mode - 1	**#Sleep mode**	**#Scan mode - 2**	**#Sleep mode**	**#Scan mode - 2**
Scan current channel 3 times Scan remaining 15 channel 1 time Scan all 16 ch 3 times	MCU is in sleep mode (Radio off) 15 minutes	Scan current ch 3 times Scan remaining 15 channel 1 time	MCU is in sleep mode (Radio off) 15 minutes	Scan current channel 3 times Scan remaining 15 channel 1 time

5.3 Low battery

The current battery voltage can be read from the power configuration cluster described in section 3.3.2.2.4. The attribute "*BatteryVoltage*" is measuring the battery voltage, in units of 100mV.

Low batt LED indication – YELLOW LED will blink twice every 60 second.

6 Specifications

General	
Dimensions (L x B x H)	Sensor: 95 x 65 x 22,3 mm Probe: 25.4 x 28,4 x 11,6 mm
Colour	White
Battery	Battery: 2 x AA Alkaline
Battery life	2 years, updating every 5 seconds, at room temperature. Battery level and low battery warning can be reported
Radio	Sensitivity: -100 dBm
	Output power: 10 dBm (EU), 19 dBm (US)
Environment	For indoor use. IP class: IP22
	Operation temperature -20 to +60°C Relative humidity 5% - 85%, non-condensing
Function	
Meter reading	Via a probe that reads LED
Interfaces	Supports LED pulses (configurable pulse range from 50 to 10 000 pulses per kWh)
Communication	
Wireless protocol	ZigBee 3.0
	ZigBee end-device
Certifications	
	Conforming to CE, UKCA, FCC, IC, ISED, RED and RoHS directives Zigbee 3.0 certified

7 Contact Information

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