Vibration Sensor - WISZB-13x

Technical manual

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RoHS   CE

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1   Cautionary notes

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2 Features

2.1   Vibration Sensor - WISZB-13x

The Zigbee-based Vibration Sensor detects and reports vibrations making it ideal for use in home care, smart security, and building management solutions. Home and business owners can have the peace of mind that they will be notified of any shattered windows or glass counters, helping them prevent break-ins and burglaries.

Home care solutions can keep an eye on their patients' health by placing the sensor on furniture at home. Placed underneath a bed, the Vibration sensor can monitor how long patients are in bed and how well they sleep, giving insights into their well-being and recognizing potential illnesses. Similarly, the Vibration Sensor can be installed on chairs and appliances to monitor activity.

Building managers can use the Vibration Sensor to keep an eye on hard-to-reach piping, helping them detect vibration in pipings. This way, they can quickly identify blockages, abnormal water pressure, among other issues.

2.2 IAS Zone

The Vibration Sensor is implemented as a IAS Zone ZigBee end point according to ZigBee Home Automation profile „IAS Zone".

2.3 Temperature

The temperature sensor measures temperature with a resolution of 0.1°C.
It supports standard ZigBee reporting (on change or interval).
The end point is configured as the Home Automation profile "Temperature Sensor"

2.4 Key features

Key features are:
- Alarm sensor – IAS Zone
- Support 15 sensitivity levels
- Temperature sensor
- ZigBee OTA cluster for firmware upgrades
- ZigBee 3.0 Certified application profile
- Standard ZigBee Home Automation security and stack settings are used

3 Endpoints

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

3.1 ZigBee Device Object (ZDO)

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

3.2 Temperature Sensor

- End point number 0x26
- Application profile Id 0x0104 (Home Automation)
- Application device Id 0x0302

3.3 IAS Zone

- End point number 0x2D
- Application profile Id 0x0104 (Home Automation)
- Application device Id 0x0402

3.4 Onics Utility

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

Reference documents:

[Z1]   Zigbee Specification Rxx

[Z2]   Zigbee Cluster Library Specification Rx

[Z3]   Base Device Behavior Specification

[Z4]   PRO Base Device Behavior Specification

They can all be downloaded from:

https://csa-iot.org/developer-resource/specifications-download-request/

4 Supported Clusters

4.1 Common clusters for each end point

The ZCL "General Function Domain" clusters in this section are implemented as server clusters. Refer to ZigBee Cluster Library Specification Rx.

https://csa-iot.org/developer-resource/specifications-download-request/

4.1.1 Basic – Cluster id 0x0000

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.

4.1.1.1 Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0	ZCLVersion	Uint8	Type range	M	
0x4	ManufacturerName	String	0-32 byte	O	4.1.1.1.1
0x5	ModelIdentifier	String	0-32 byte	O	4.1.1.1.2
0x6	DateCode	String	0-32 byte	O	
0x7	PowerSource	8 bit enum	Type range	M	

4.1.1.1.1 ManufacturerName

"Onics A/S" (Formerly "Develco Products A/S")

4.1.1.1.2 ModelIdentifier

"WISZB-137"

4.1.1.1.3 Manufacture Specific Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x8000	PrimarySwVersion	OctetString		M	SW version
0x8010	PrimaryBootloaderSWVersion	OctetString		M	SW version
0x8020	PrimaryHwVersion	OctetString		M	HW version

ZCL header setting – Manufacture code for Onics (Formerly "Develco Products") is 0x1015

4.1.2 Identify – Cluster id 0x0003

4.1.2.1   Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	IdentifyTime	Uint16	Type range	M	

4.1.2.2   Commands

The identify cluster has 2 commands as server.

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

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	0x00

4.2 IAS Zone Device – EP 0x2D

4.2.1 IAS Zone - Cluster id 0x0500

The IAS Zone cluster is described in ZigBee Cluster Library Specification Rx.

4.2.1.1   Attribute

Id#	Name	Type	Man/Opt	Relevance and ref.
0x0000	Zone State	8-bit Enumeration	M	
0x0001	Zone Type	16-bit Enumeration	M	Hard coded to 0x002D Vibration Movement Sensor
0x0002	Zone Status	Uint16	M	The following bits are supported: Bit0: Alarm 1 (Movement)

				Bit1: Alarm 2 (Vibration)
				Bit3: Battery
				Bit4: Supervision reports
				Bit5: Restore reports
0x0010	IAS CIE Address	Valid 64-bit IEEE address	M	
0x0011	ZoneID	Uint8	M	
0x0012	Number Of Zone Sensitivity Levels Supported	Uint8	O	
0x0013	Current Zone Sensitivity Level	Uint8	O	Default level is 10
0x8000	Zone Status Interval	Uint16	O	Pre-defined to 300 sec

4.2.1.1.1 Zone State

The device will automatically start to scan the network for an IAS Zone client in a predefine interval. When the client is found it will automatically attempt to enrol. When it has successfully enrolled the Zone Status command is send every 5 minutes.

The attribute value will change from not enrolled (0x00) to Enrolled (0x01).

4.2.1.1.2 IAS CIE Address

Attribute specifies the address that commands generated by the server shall be sent to.

To un-enrol the device the back end system has to write a new address into this attribute. Any value is valid. If the back end system writes an IEEE address then it will try to enrol to this devices represented by the IEEE address.

4.2.1.1.3 ZoneID

A unique reference number allocated by the CIE at zone enrolment time.

Used by IAS devices to reference specific zones when communicating with the CIE. The *ZoneID* of each zone stays fixed until that zone is un-enrolled.

4.2.1.1.4 Number of Zone sensitivity levels supported

The vibration sensor supports 15 different pre-defined vibration sensitivity levels.

4.2.1.1.5   Current Zone sensitivity levels

Attribute to read/write a user defined sensitivity level.

4.2.1.2   Commands

The IAS Zone cluster has 2 commands as server.

Id#	Name	Payload			Man/Opt	Relevance and ref.
0x00	Zone Status Change Notification	Uint16 – bit mask			M	The status is report to the coordinator every 5 min
0x01	Zone Enroll Request	Bits	16	16	M	
		Data type	16 bit enum	UINT16		
		Field name	Zone type	Manufacturer code		

Init sequence – when the device has join the network it start to scan for an IAS zone client cluster. If a client is found a Zone enroll request command is send and a Zone Enroll response is expected. If it doesn't receive a response within 15 sec it gives up and will continue to scan x number of attempts. When the init sequence is over it will enter a state where it scans for a client every 12 hour.

The following bits are supported in Zone status:
Bit0: Alarm 1, Bit1: Alarm 2, Bit3: Battery, Bit4: Supervision reports, Bit5: Restore reports

Alarm bit
Bit0, Alarm1 – Movement – Since last position
Bit1, Alarm2 – Vibration – Acceleration trigger
The sensor will report Zone status when there are new events or every 5 min (default).
The sensitivity of the Accelerometer trig settings is listed in the table below.

Level	Alarm 2 (Vibration - acc int trigger)			Alarm 1 (Movement - since last position)
	ODR (Output data rate) [Hz]	Duration	Wakeup TH [mg]	Movement TH
1	25	2	32	36
2	25	2	16	32
3	25	2	8	28
4	25	2	4	24
5	25	2	2	20
6	25	2	1	16
7	25	0	32	36
8	25	0	16	32
9	25	0	8	28
10	25	0	4	24
11	25	0	2	20
12	25	0	1	16
13[1]	50	0	1	16
14[1]	100	0	1	16
15[1]	200	0	1	16

"Vibration" is more sensitive the lower the "Duration" and the "WU TH".

"Movement" is more sensitive the lower the "Movement TH", it is set when an absolute change is detected from last reading larger than the TH.

Note: How to clear an alarm in the "Zone status"

The sensor requests ZCL Default Response on the Zone Status Change notification, if any new Alarm bit has been set. Until the IAS CIE has acknowledged the received alarm by sending the mandated Default Response, the Alarm bits are not cleared – even if there is no longer an alarm situation. When the Default Response is received, a new Zone Status Change notification is sent with the Alarm bits cleared, if the alarm situation has disappeared since sending the Zone Status message with alarm set.

Bit3: When the battery is below **2.2 VDC**. Battery bit is set high and "Zone Status" is transmitted to the coordinator.

4.2.2 Power Configuration - Cluster id 0x0001

The power configuration cluster is described in ZigBee Cluster Library Specification Rx.

4.2.2.1   Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0020	BatteryVoltage	Uint8	0x00 - 0xFF	O	ZCL configure reporting is supported
0x0031	BatterySize	enum8	AAA (0x04)	O	
0x0033	BatteryQuantity	Uint8	2	O	
0x0034	BatteryRatedVoltage	Uint8	**1500**	O	Unit is in 100 mV
0x0036	BatteryVoltageMinThreshold	Uint8	25		Unit is in 100 mV
0x003E	BatteryAlarmState	Map32		O	Bit0: BatteryVoltageMinThreshold Is set if BatteryVoltage has been below BatteryVoltageMinThreshold or other internal circuits has deemed the supply to be inadequate. This bit will only reset after a power cycle. The condition will also be shown on the MMI LED, see MMI description. Reportable. Default Min 12 hours, max 12 hours

Note: The attribute "*BatteryVoltage*" is measuring the battery voltage, in units of 100mV.

4.2.3 Poll Control - Cluster id 0x0020

The poll control cluster is described in ZigBee Cluster Library Specification Rx.

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.

4.2.3.1   Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	Check-inInterval	Uint32	0x00 - 0xFF	M	Default value is 1 hour
0x0001	LongPoll Interval	Uint32		M	Default value is disabled
0x0002	ShortPollInterval	Uint16		M	Default value is 0.5 seconds
0x0003	FastPollTimeout	Uint16		M	Default value is 10 seconds

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 smoke sensor will send a check-in command in the interval specified in attribute "Check-inInterval. The coordinator has to reply with a check-in response. The sensor supports the following commands send from the client (Typically the coordinator).

- 0x00 Check-in Response,
- 0x01 Fast Poll Stop,
- 0x02 Set Long Poll Interval,
- 0x03 Set Short Poll Interval,

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

4.2.4 Acceleration Measurement Cluster - Cluster id 0xFC04

The Vibration Sensor includes a manufacturer specific cluster for reading the XYZ acceleration/orientation of the sensor. The cluster is under the manufacturer code for Onics (Formerly "Develco Products") (0x1015).

All measurements are in the value of **g** where **g** is referred to as the acceleration of gravity. Its value is **9.8 m/s2** on Earth. The resolution is in mg = g/1000.

4.2.4.1   Attribute

Id#	Name	Type	Unit	Man/Opt	Relevance and ref.
0x0000	Measured Value X	Int16	Unit g/1000	O	Value in mg (g/1000)
0x0001	Measured Value Y	Int16	Unit g/1000	O	Value in mg
0x0002	Measured Value Z	Int16	Unit g/1000	O	Value in mg
0x0003	Min Measured Value XYZ	Int16	Unit g/1000	O	-2000 mg
0x0004	Max Measured Value XYZ	Int16	Unit g/1000	O	+2000 mg
0x0005	Resolution XYZ	Uint16	Unit g/1000	O	1 mg

The XYZ readings are read /updated on vibration interrupt and again 5 seconds after. If no vibrations are detected for 30 seconds,

Then XYZ is also read. as a result, it may take up to 30 seconds to detect movement if the vibration TH is set high and the movement is slow.

The attributes on the Acceleration measurement cluster, is meant to have given indication about the sensor positions/orientation, and as development support. And the attributes can be setup to report changes using standard ZigBee attribute reporting.

It is recommended that reporting of XYZ is configured with reasonable parameters, to avoid over transmitting data. Example report configuration (min report 1-5, max report 60-600, change >20).

4.3 Temperature Sensor Device – EP 0x26

The ZCL "Measurement and Sensing" cluster in this section is implemented as a server cluster. Refer to ZigBee Cluster Library Specification Rx.

4.3.1 Temperature Measurement – Cluster id 0x0402

The temperature measurement cluster is described in ZigBee Cluster Library Specification Rx section 4.4.

4.3.1.1   Attribute

Id#	Name	type	Range	Man/Opt	Relevance and ref.
0x0000	MeasuredValue	Sint16	MinValue to MaxValue	M	ZCL Reporting is support Onics (Formerly Develco Products) default is configured
0x0001	MinMeasuredValue	Sint16	0	M	
0x0002	MaxMeasuredValue	Sint16	5000	M	

4.3.1.1.1   MeasuredValue

The attribute is configured with the following default "ZCL configure reporting" setting.

- Min Reporting Interval: 0x003C [60 sec]
- Max Reporting Interval: 0x0258 [600 sec]
- Reportable Change: 0x000A [0.1 °C]

If the temperature value is stable it will be send every 10 minutes.

If the temperature changes more than 0.1 °C it will be reported but not faster than every 1 minute since last reporting value.

Note: Min reporting interval 0 sec is invalid when reportable change is configured.

4.3.1.1.2   MinMeasuredValue

The temperature sensor is NOT supporting temperature measurements below 0 degrees Celsius.

4.3.1.1.3   MaxMeasuredValue

The temperature sensor is NOT supporting temperature measurements above 50 degrees Celsius.

4.3.2 OTA Upgrade – Cluster id 0x0019

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

When the devices has 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 24 hour it will automatically send its "current file version" to the OTA upgrade server. It is the server that initiate the firmware upgrade process.

4.3.2.1   Attributes

| Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	UpgradeServerID	IEEE Address	-	M	
0x0001	FileOffset	Uint32	Type range	O	
0x0002	CurrentFileVersion	Uint32	Type range	O	
0x0003	CurrentZigBeeStackVersion	Uint16	Type range	O	
0x0004	DownloadedFileVersion	Uint32	Type range	O	
0x0005	DownloadedZigBeeStackVersion	Uint16	Type range	M	
0x0006	ImageUpgradeStatus	8 bit enum	0x00 to 0xFF	O	
0x0007	Manufacturer ID	Uint16	Type range	O	
0x0008	Image Type ID	Uint16	Type range	O	
0x0009	MinimumBlockRequestDelay	Uint16	Type range	O	

Above attribute description is to be found in section 6.7 "OTA Cluster Attributes" in ZigBee document – "Zigbee Cluster Library OTA Cluster (0x0019) Test Specification" provided by the Connectivity Standards Alliance.

4.3.2.2   Commands

The OTA Client cluster can send the following commands

Id#	Name	Man/Opt	Relevance and ref.
0x01	Query Next Image request	M	6.10.1 OTA Cluster Command Identifiers
0x03	Image Block Request	M	6.10.1 OTA Cluster Command Identifiers
0x06	Upgrade End Request	M	6.10.1 OTA Cluster Command Identifiers

4.3.2.3 OTA Upgrade Messages Diagram
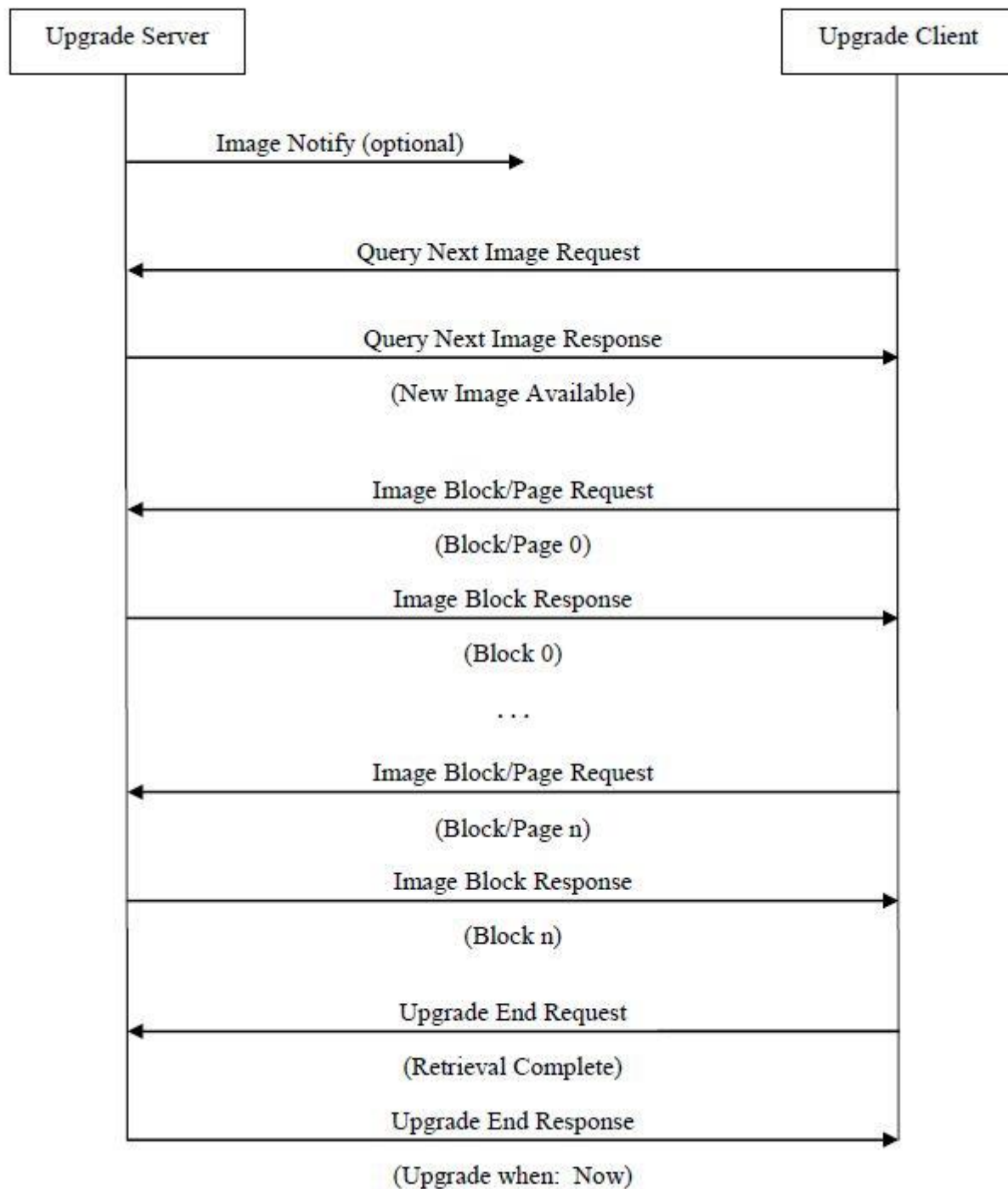
4.3.3 Time – Cluster id 0x000A

The Time cluster is a general cluster for time it is based on a UTC time in seconds since 0 hrs 0 mins 0 sec on 1st January 2000. Refer to [Z2] for ZigBee specification of the time cluster.

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).

4.3.3.1   Attribute

Id#	Name	type	Range	Man/Opt	Relevance and ref.
0x0000	Time	UTCTime (Uint32)	Type range	M	The module will periodically update its clock by synchronizing through this cluster
0x0001	TimeStatus	8 bit bitmap	00000xxx	M	

5 MMI user guide

5.1 Push Button Menu

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.
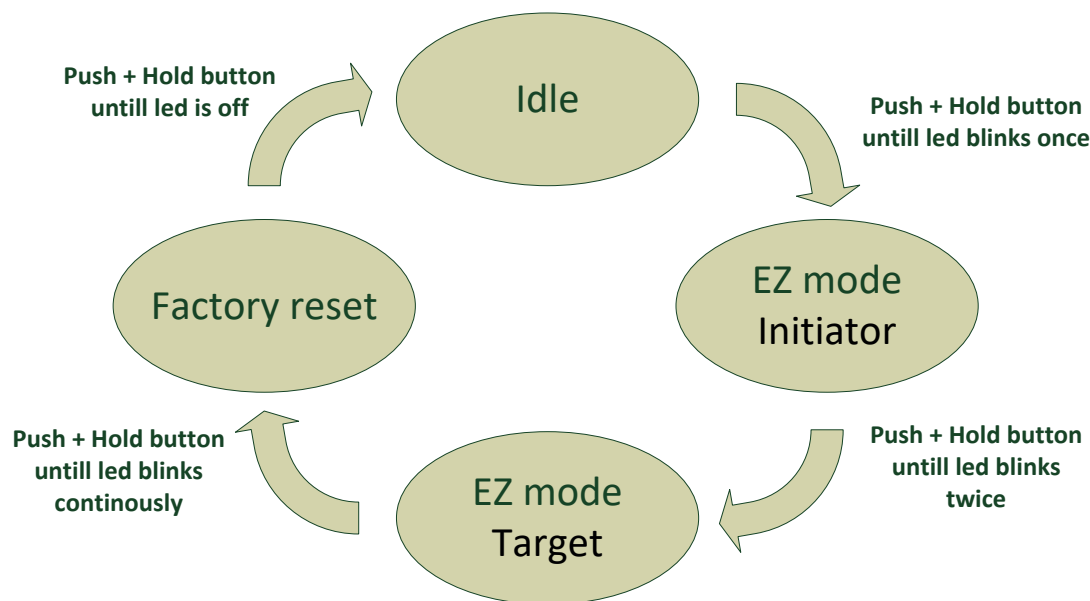
When cycling through the menu modes, the state is indicated by a number of 100ms blinks on the LED. The device is supporting the ZigBee standardized EZ- mode Commissioning.

5.1.1 EZ mode - Initiator

If the devices is not on the network EZ-Mode Network Steering is invoked when the user enter this menu. The led blinks once every 1 sec until the devices 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 messages to the target device to stop the identify time.

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

- Temperature cluster
- Power configuration cluster

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.

5.1.2 EZ mode - Target

If the devices is not on the network EZ-Mode Network Steering is invoked when the user enter this menu. The led blinks twice every 1 sec until the devices 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.

5.1.3 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.

5.2 Action on Power On

As a general rule, all end devices and routers 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 LED will flash once every second.

Once the device has joined the network, is will start scanning for an OTA server, Time server, Poll control client and an IAS Zone 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.

6 General network behaviour

6.1 Installation

When the device is virgin 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 24. 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 4 or until join network ~ 30 seconds	MCU is in sleep mode (Radio off) 15 minutes	Scan all 16 ZigBee ch x 4 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.

6.2 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.

6.2.1 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 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 has to be defined.

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

6.3 Low battery

The current battery voltage can be read from the power configuration cluster described in section 4.3.1. The attribute "*BatteryVoltage*" is measuring the battery voltage, in units of 100mV.

Low batt LED indication – RED LED will blink twice every 60 seconds.

7 Specifications

General	
Dimensions (L x B x H)	76 x 25 x 17 mm (Sensor part)
Colour	White
Power supply	Battery: 2 x AAA, exchangeable Battery life: Up to 2 years Battery level and low battery warning can be reported
Radio	Sensitivity: -100 dBm Output power: +10 dBm
Environment	IP class: IP40 Operation temperature 0 to +50°C Relative humidity 5% - 85%, non condensing
Function	
Temperature sensor	Range: 0 to +50°C Resolution: 0.1°C (accuracy Typ ±0.5°C and Max ±2°C) Sample time: config.: 2 s -65,000 s Reporting: configurable
Vibration	15 sensitivity levels based on duration, g-force, and sample rate Reporting: configurable or every 5 mins (default)
Accelerometer	3-axis, 16-bit resolution
Communication	
Wireless protocol	Zigbee 3.0, Zigbee end device
Certifications	
	Conforming to CE, FCC, IC, ISED, RED, RoHS and REACH directives

8 Contact Information

Technical support: Please contact Onics for support.

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