

Air Quality Sensor - AQSZB-110

Technical manual

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2 Features

2.1 Air Quality Sensor - AQSZB-110

Since most of today's people spend most of their time indoors, the quality of indoor air is critical to human health, work performance, and comfort. By monitoring the levels of volatile organic compounds (VOCs), the battery-driven Air Quality Sensor will enable your customers to monitor indoor air quality and ensure that the air inside a room is clean and healthy. The Air Quality Sensor provides your customers with real-time detection of VOCs and information on the VOC levels in order to prevent the negative health effects.

2.2 VOC

The VOC sensor measures VOC's in parts per billion with a resolution of 1 – 32 ppb. Range 0 to 60000 ppb.

It supports standard ZigBee reporting (on change or interval).

The VOC sensor cluster is located on the temperature sensor end point.

Level	Hygienic Rating	Recommendation	TVOC [µg/m ³]	TVOC [ppb]
Unhealthy	Situation not acceptable	Intense ventilation necessary	10000 - 25000	2200 - 5500
Poor	Major objections	Intensified ventilation/ airing necessary	3000 - 10000	660 - 2200
Moderate	Some objections	Intensified ventilation recommended	1000 - 3000	220 - 660
Good	No relevant objections	Ventilation/airing recommended	300 - 1000	65 - 220
Excellent	No objections	Target value	0 - 300	0 - 65

Table 1 VOC level interpretation ref Sensirion_Gas_Sensors_SGP3x_TVOC_Concept.pdf

2.3 Humidity

The humidity sensor measures humidity with a resolution of 1% RH (accuracy 3%, 20-80% RH). Range 0 to 100% RH.

It supports standard ZigBee reporting (on change or interval).

The humidity sensor cluster is located on the temperature sensor end point.

2.4 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”.

2.5 Key features

Key features are:

- VOC Sensor
- Humidity sensor
- Temperature sensor
- ZigBee HA 1.2 compliant
- ZigBee OTA cluster for firmware upgrades

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 Onics Utility

- Application profile Id 0xC0C9 (Onics (Formerly Develco Products) private profile)
- Application device Id 0x0001
- Manufacturer code 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

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 Temperature Sensor Device – EP 0x26

4.1.1 Basic – Cluster id 0x0000

4.1.1.1 Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	ZCLVersion	UInt8	Type range	M	
0x0004	ManufacturerName	String	0-32 byte	O	4.1.1.1.1
0x0005	ModelIdentifier	String	0-32 byte	O	4.1.1.1.2
0x0006	DateCode	String	0-32 byte	O	
0x0007	PowerSource	8 bit enum	Type range	M	

4.1.1.1.1 ManufacturerName

“frient A/S” or “Develco Products A/S” – depending on the product version.

4.1.1.1.2 ModelIdentifier

“AQSZB-110”

4.1.1.2 Manufacture Specific Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x8000	PrimarySwVersion	OctetString		M	SW version

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

4.1.2 Power Configuration - Cluster id 0x0001

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

4.1.2.1 Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0020	BatteryVoltage	Uint8	0x00 - 0xFF	O	ZCL configure reporting is supported

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

To detect low battery the system can setup a reporting interval of 12 hour. When a voltage of **2.5V** the battery should be replaced with a new one.

4.1.3 Identify – Cluster id 0x0003

4.1.3.1 Attribute

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

4.1.3.2 Commands

The identify cluster has 2 commands as server.

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

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	

4.1.4 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.

4.1.4.1 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	Disabled
0x0002	ShortPollIntervall	Uint16		M	Default value is 3 seconds
0x0003	FastPollTimeout	Uint16		M	Default value is 5 minutes

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 humidity 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.

4.1.5 Temperature Measurement – Cluster id 0x0402

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

4.1.5.1 Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	<i>MeasuredValue</i>	Sint16	MinValue to MaxValue	M	

0x0001	<i>MinMeasuredValue</i>	Sint16	0	M	
0x0002	<i>MaxMeasuredValue</i>	Sint16	5000	M	

4.1.5.1.1 MeasuredValue

Default reporting is set to

Min reporting interval: 60 sec

Max reporting interval: 600 sec

Reportable Change: 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.

4.1.5.1.2 MinMeasuredValue

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

4.1.5.1.3 MaxMeasuredValue

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

4.1.6 Relative Humidity Measurement – Cluster id 0x0405

The relative humidity measurement cluster is described in ZigBee Cluster Library Specification Rx section 4.7

4.1.6.1 Attribute

Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	MeasuredValue	Uint16	MinValue to MaxValue	M	
0x0001	MinMeasuredValue	Uint16	0% RH	M	
0x0002	MaxMeasuredValue	Uint16	100% RH	M	
0x0003	Tolerance	Uint16	0 – 20% RH		3.5 % RH

4.1.6.1.1 MeasuredValue

Default reporting is set to

Min reporting interval: 60 sec

Max reporting interval: 600 sec

Reportable Change: 3.0% RH

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

If the humidity changes more than 3% RH 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.

4.1.6.1.2 Tolerance

The humidity sensor has a tolerance of 3.5 % RH

4.1.7 VOC Measurement – Cluster id 0xFC03

The VOC cluster is a manufacture specific cluster. So, in order to access it, the manufacturer code 0x1015 must be used.

4.1.7.1 Attribute

Id#	Name	Type	Range	Relevance and ref.
0x0000	MeasuredValue	UInt16	MinValue to MaxValue	VOC's in parts per billion
0x0001	MinMeasuredValue	UInt16	0 ppb	
0x0002	MaxMeasuredValue	UInt16	60000 ppb	
0x0003	Resolution	UInt16	1 – 32 ppb	

4.1.7.1.1 MeasuredValue

Default reporting is set to Min reporting interval: 60 sec

Max reporting interval: 600 sec

Reportable Change: 10 ppb

If the VOC value is stable it will be sent every 10 minutes.

If the VOC changes more than 10 ppb it will be reported but not faster than every 1 minute since last reporting value.

Level	Hygienic Rating	Recommendation	TVOC [µg/m ³]	TVOC [ppb]
Unhealthy	Situation not acceptable	Intense ventilation necessary	10000 - 25000	2200 - 5500
Poor	Major objections	Intensified ventilation/ airing necessary	3000 - 10000	660 - 2200
Moderate	Some objections	Intensified ventilation recommended	1000 - 3000	220 - 660
Good	No relevant objections	Ventilation/airing recommended	300 - 1000	65 - 220
Excellent	No objections	Target value	0 - 300	0 - 65

Table 2 VOC level interpretation ref Sensirion_Gas_Sensors_SGP3x_TVOC_Concept.pdf

TVOC is Total VOC and the measured values from attribute id 0x0000 can be used directly find the current level in the table above.

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

4.1.7.1.2 Resolution

Measured value	Resolution
0 – 2008	1
2009 – 11110	6
11111 - 60000	32

4.1.8 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.

4.1.8.1 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	

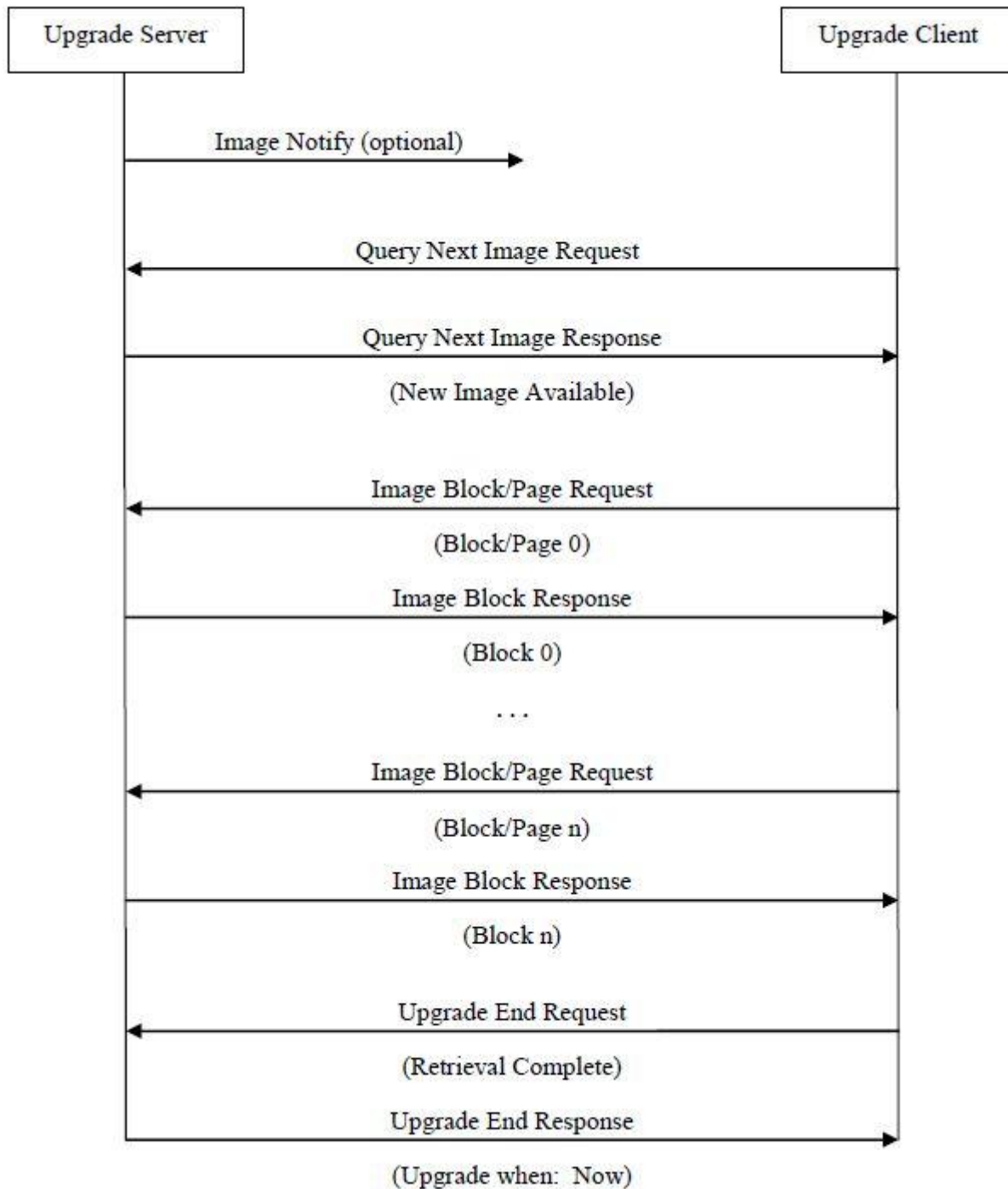
Above attribute description is to be found in section 6.7 “OTA Cluster Attributes” in ZigBee document – “Zigbee Cluster Library OTA Cluster (0x0019) Test Specification” provided by the Connectivity Standards Alliance.

4.1.8.2 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

4.1.8.3 OTA Upgrade Messages Diagram



4.1.9 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 coordinator in the network.

4.1.9.1 Attribute

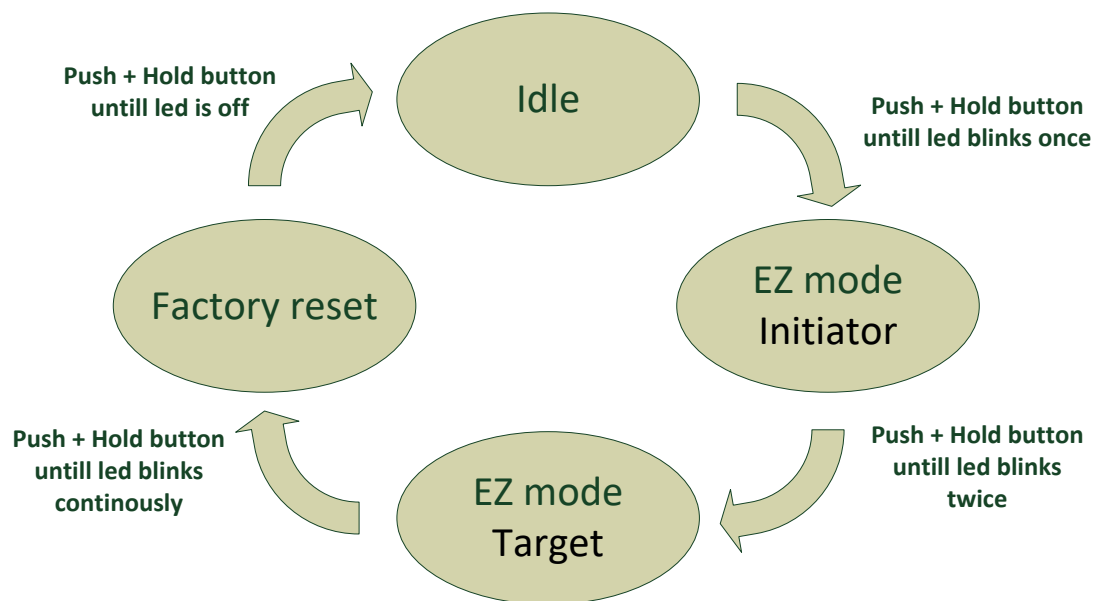
Id#	Name	Type	Range	Man/Opt	Relevance and ref.
0x0000	Time	UTCTime (UInt32)	Type range	M	The module will periodically update its clock by synchronizing through this cluster
0x0001	TimeStatus	8 bit bitmap	00000xxx	M	

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 untill 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 untill 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:

- Humidity cluster
- 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.

From SW version 3.4.2 the devices will send a network leave indication, if possible, before it starts factory resetting the devices.

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.

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 channels 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.

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	MCU is in sleep mode (Radio off) 15 minutes	Scan current ch 3 times	MCU is in sleep mode (Radio off) 15 minutes	Scan current ch 3 times
Scan remaining 15 ch 1 time		Scan remaining 15 ch 1 time		Scan remaining 15 ch 1 time
Scan all 16 ch 3 times				

6.3 Low battery

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

To detect low battery the system can monitor the *"BatteryVoltage"* by setting up a reporting interval of every 12 hour. When a voltage of **2.5V** is measured the battery should be replaced.

Low batt LED indication – RED LED will blink twice every 60 second

7 Specifications

General	
Dimensions (Ø x H)	Ø 70 x 70 x 21 mm
Colour	White
Power supply	Battery: 2 x AA exchangeable
	Battery life: up to 2 years, reporting every 5 minutes
Radio	Sensitivity: -97 dBm
	Output power: +7 dBm
Environment	IP class: IP20
	Operation temperature 0 to +50°C
	Relative humidity 10-95% non-condensing
Function	
VOC sensor	Range: 0 to 60000 ppb
	Resolution: 1 – 32 ppb
	Reporting: configurable
Humidity sensor	Range: 0 to 100% RH
	Resolution: 1% RH (accuracy typical 2%, 20-80% RH)
	Reporting: configurable
Temperature sensor	Range: 0 to +50°C
	Resolution: 0.1°C (accuracy typical: ±0.2°C)
	Sample time: config.: 2s – 65,000s
	Reporting: configurable
Communication	
Wireless protocol	ZigBee Home Automation 1.2 compliant
	ZigBee end-device

Certifications	
	RoHS compliant according to the EU Directive 2002/95/EC

8 Contact Information

Technical support: Please contact Onics for support.
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