WiSenMeshNET®

Battery Information

Wisen Innovation Co., Ltd.
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Revision History and Clarification

Rev.	Issue Date	Version Control	Written by	Revised by
V1.1	2022-07-06	Minor typo correction.	Xiaoyan Huang	Yan Wu
V1.0	2022-06-27	Establishment of the document.	Xiaoyan Huang	Yan Wu

Battery Information

Batteries are required to operate all WiSen radio mesh sensor nodes, interface nodes, camera and vision units in addition to external battery enclosures and SmartGateways (with exclusion of USB powered units).

Batteries are supplied pre-installed in units delivered by default.

WiSen Units require the following quantities of battery:

Unit Model Type	Description	Quantity of Batteries
1) 1303	WISENMESHNET® Miniaturised Dual-Axis Tilt Node	1
2) 1305	WISENMESHNET® Omni Tilt Sensor Node	1
3) 1306	WISENMESHNET® Enhanced Omni Tilt Sensor Node	1
4) 1F06	WISENMESHNET® Laser Tilt Sensor Node	1
5) 1F07 / 1F08	WISENMESHNET® Omni Tilt & Distance Sensor Node	1
6) 1A05	WISENMESHNET® 4-Channel Vibrating Wire Interface Node	2
7) 1A06	WISENMESHNET® 8-Channel Vibrating Wire Interface Node	2
8) 1A07	WISENMESHNET® 1-Channel Vibrating Wire Interface Node	1
9) 1700	WISENMESHNET® Displacement Sensor Node	1
10) 1510	WISENMESHNET® 4-Channel Laser Distance Sensor Node	4
11) 1517	WISENMESHNET® Weather Sensor Node	4
12) 1005	WISENMESHNET® C-Series Smart Gateway	4
13) M101	M101 Type - WiSen® Solar Unit	N/A[2]
14) M001 / M002	WiSen® Battery Unit	6

Notes:

1. Unit 6003 powered via 5VDC USB connection.
2. Unit M101 powered via Rechargeable Package (LiFePO4)

Battery Specification

Battery type: 3.6VDC Lithium primary D-Cell ER34615 (Li/SOCl2)

Approved supplier models:

Manufacturer	Model	Website
FORTE (Wisen Default)	ER34615	http://en.whforte.com/
SAFT	LS 33600	www.saftbatteries.com
Ultralife	UHR-ER34615-X	www.ultralifecorporation.com
TADIRAN	SL-2880	https://tadiranbatteries.de/
EVE	ER34615	www.evebattery.de

Note:
Lithium primary D-Cell ER34615 (Li/SOCl2) are dangerous goods according to UN3090 Lithium batteries and should be handled and transported with care.

Battery Life Expectancy Factors

Life of a battery in a WiSen device can be affected by the following conditions:

- Heat
  All battery expectancy tables are standardised to 20°C. For other nominal operating temperatures please contact battery manufacturer for advice. Nominal battery operating temperature is -55°C to +85°C, nominal storage temperature is ≤20°C

- Humidity
  The ideal humidity is 50%
  The main issue with humidity is that condensation can build up both inside and outside the battery. If it does so internally the unit can be permanently damaged. Externally the terminals of some battery types start to rust making it more difficult to establish a strong connection when put into use.

- Storage/Battery Age
  Passivation: Batteries kept in storage for over 3 months can have a passive resistance film on them. If such resistive film has been created, please follow instructions to depassivate the film below.
  Self-discharge: Chemicals in batteries become less active over time, this vary by manufacturer, however nominal is around 10 years.

- Mesh reading interval/Radio signal strength/Tx radio power/Mesh alive time/Relay factor
  Batteries have a finite capacity, each operation of the node requires power, thus discharging the battery. Maximum life is therefore dependant on low power good quality radio transmissions with long interval between to allow node/system hibernation.

  WiSen systems by default are configured to operate at low radio sensitivity, low Tx power and minimal Mesh alive time. Any change to this will reduce the battery life.

Battery Life Expectancy table (months)

Below are typical values of expected battery life based on manufacturers specifications for batteries and WiSen real world tests on battery aging and life expectancy.

Mesh Interval (minutes)	Miniaturised Dual-Axis Tilt Node 1303		Omni Tilt Sensor Node 1305		Enhanced Omni Tilt Sensor Node 1306		Laser Tilt Sensor Node 1F06		Omni Tilt & Distance Sensor Node 1F07	
	Min[1]	Max[2]	Min[1]	Max[2]	Max[2]	Max[2]	Min[1]	Max[2]	Min[1]	Max[2]
1	3.2	4.6	4.2	5.9	5.2	7.4	0.6	0.9	1.0	1.4
5	15.0	21.4	20.0	28.6	22.8	32.6	2.9	4.1	4.6	6.6
15	38.3	54.7	50.7	72.5	62.0	88.6	8.4	12.0	13.1	18.6
30	64.5	92.2	86.4	123.4	101.3	144.7	16.9	24.1	24.3	34.7
60	99.4	142.0	129.6	185.1	150.5	215.1	31.4	44.9	46.1	65.8

Mesh Interval (minutes)	Omni Tilt & Distance Sensor Node 1F08		4-Channel Vibrating Wire Interface Node 1A05		8-Channel Vibrating Wire Interface Node 1A06		1-Channel Vibrating Wire Interface Node 1A07		Displacement Sensor Node 1700	
	Min[1]	Max[2]	Min[1]	Max[2]	Max[2]	Max[2]	Min[1]	Max[2]	Min[1]	Max[2]
1	1.0	1.4	3.3	4.7	1.7	2.4	3.0	4.3	2.8	4.0
5	4.8	6.8	16.0	22.9	8.4	12.0	14.4	20.5	12.8	18.3
15	14.6	20.8	47.0	67.2	24.6	35.2	37.5	53.5	33.8	48.3
30	26.0	37.2	84.3	120.4	46.9	67.0	63.5	90.7	54.7	78.2
60	47.3	67.5	150.5	215.1	87.8	125.4	102.6	146.6	80.4	114.9

Mesh Interval (minutes)	4-Channel Laser Distance Sensor Node 1510		Weather Sensor Node 1517		C-Series Smart Gateway[3] 1005		Vision Unit 3002
	Min[1]	Max[2]	Min[1]	Max[2]	Min[1]	Max[2]	
1	0.6	0.8	0.216	0.1	0.3	0.4	0.1
5	2.8	4.0	0.305	0.5	0.4	0.5	0.5
15	8.6	12.3	0.327	1.8	1.1	1.6	1.8
30	16.5	23.6	0.333	3.0	2.2	3.2	3.0
60	31.9	45.6	0.335	5.4	4.5	6.5	5.4

Notes:
1. Minimum period computed based upon maximum mesh radio use, poor signal quality and maximum transmission power
2. Maximum period computed based upon minimum mesh radio use, excellent signal quality and minimum transmission power
3. Power consumption assumed with 7600G GSM Module active with standard transmission ratio (DTU=1)

Solar Unit M101	Battery unit M001 / M002
12V 5Ahr Capacity	10.8V 16Ahr/3.6V 48Ahr Capacity

Cell Passivation / Depassivation

Passivation is a phenomenon of all lithium primary cells related to the interaction of the metallic lithium anode and the electrolyte. A thin passivation layer forms on the surface of the anode at the instant the electrolyte is introduced into the cell. This layer is important because it protects the anode from reaction while the cell is dormant – resulting in a long shelf-life

Under normal conditions, the thin passivation layer does not degrade cell performance. When the layer grows too thick, however, discharge performance may be affected. The growth of the passivation layer is influenced greatly by storage conditions. Long storage periods of months or years and/or storage of the cells above room temperature (23°C) will cause the passivation layer to grow thicker. A passivated cell may exhibit voltage delay, which is the time lag that occurs between the application of a load on the cell and the voltage response. As the passivation layer thickens, the voltage delay becomes more severe. On continued discharge though, the voltage of a passivated cell will rise to a level equivalent to the load voltage of an unpassivated cell.

Do not attempt any of the depassivation procedures described in this document unless you have reviewed the Safety and Handling Guidelines for Primary Lithium Batteries as well as the Material Safety Data Sheet for the specific cell type.

Lithium Thionyl Chloride (Li/$SOCl_2$) Suggested Depassivation Procedure

1. Check Open Circuit Voltage (OCV) of single cells. Minimum acceptable OCV ≥ 3.65V
2. Apply the resistive load or constant current suggested below. Between +20°C - +25°C (+68°F - +77°F)
3. Remove the resistive load or constant current when the cell voltage reaches 3.20V cut-off, typically 30 seconds or less
4. If the cell does not reach 3.20V in 15 minutes, there is significant passivation, contact supplier for additional instruction

Constant Current	49.0 mA
Resistive Load	66 Ohms (0.50 watt)
Cut-off Voltage	3.20 V Per Cell

Notice:

The constant current and resistive loads suggested for depassivation above are based on current densities of approximately 1.0 mA / cm2 of common surface area in the cells referenced. The 1.0 mA / cm2 depassivation load level should not damage the cell or cause cathode freeze over damage at temperatures of 0°C or higher. Depassivate battery packs at room temperature +20°C ~ +25°C. Every cell manufacturer has slightly different common surface area in the cells they produce. The above depassivation loads may not be appropriate for cells produced by all manufacturers. Contact the actual cell / battery pack manufacturer for specific depassivation procedures for the cells you are depassivating. Only the manufacturer can provide exact specifications.

Caution:

All caution must be used to avoid short circuiting cells when depassivating. Cell internal heating, venting, leaking, or rupture could occur. Call the cell or pack manufacturer for any questions. Due to the heat generated at the resistor, use resistors with the minimum power rating or more for depassivation and cathode freeze over check. Wound power resistors are recommended. Ensure that the heat generated by the resistor will not short the battery pack by melting wire or connection insulation. Do not leave the constant current or resistive load on the pack unattended, failure to remove the resistor or constant current lead will deplete the pack