



## Outdoor Solar DC UPS Power System Comprehensive Comparison Tables v7

**\*\* The C-LiFePO4 Lithium battery manufacturers, each battery formulations and raw materials are not the same, so different manufacturers of lithium iron phosphate battery the battery output characteristics vary considerably, including high and low temperature tolerance and number of charge and discharge cycle life and charging and discharging efficiency will be significantly different.\*\***

No.	Item	Lead-acid Solar DC UPS	General Li-Ion Solar DC UPS	C-LiFePO4 Lithium Solar DC UPS (IO-Power)	Remark
1	Battery Management	Non	Yes, but only high level power system, general level is Non	Yes	Lead-acid battery cannot cell management charging & discharge
2	Battery cycle life (for Indoor Used)	300~450 times, Left 55% Power capacity	500~1000 times, Left 80% Power capacity	>2000 times, Left 80% Power capacity	Real outdoor to test UPS of C-LiFePO4 Lithium Batteries after 2000 times are still have 93% power capacity
3	Service life (for Indoor Used)	1~1.5 years	1.5~2.5 years	>7 years	Solar DC UPS of C-LiFePO4 Lithium Batteries for indoor used, will have more battery cycle life
4	Battery cycle life (for Outdoor Used)	150~300 times, Left 55% Power capacity	300~600 times, Left 70% Power capacity	>1500 times, Left >80% Power capacity	At the time of system design, you want plus the power attenuation and doubled the capacity of the number and replacement of time and frequency
5	Service life (for Outdoor Used)	0.3~10.8 year (need replace 6 times in 3 years)	1~1.5 year (need replace 3 times in 3 years)	>5 year	Outdoor UPS of C-LiFePO4 Lithium Batteries real outdoor tested 3 years still 95%~ power capacity
6	Operation of high and low temperature	-0 ~ 45 °C (with Housing can support -10~55°C)	-5 ~ 45 °C (with Housing can support -20~55°C)	-20 ~ 70 °C (with Housing can support -30~75°C)	The cycle life for Lead-Acid battery is 300 times @ 25 °C . When the temperature raises every 8 °C, its cycle life cuts half. Therefore, it is 150 times @ 33 °C , 75 times @ 41 °C while 30 times @ 49 °C. Working temperature over 55 °C is considered as dangerous.



7	Proportional to the design capacity plus	More than 240% (Deep cycle battery required bonus 180%)	More than 160%	More than 110%	For the sake of the system enough power capacity of the equipment operation, designs are subject to decay to add on, to cope with the operation of the system power supply enough
8	Match Solar Panel	Design wattage required bonus 250%	Design wattage required bonus 180%	Design wattage required bonus 120%	Having regard to the increase in battery capacity to match more of the solar panel, so will affect the set up costs and space used for erection and erection equipment difficulties, for the system is satisfied that requirements for the assessment of projects.
9	Set up space and erection harder	Solar panel need more wattage and size	Solar panel need more wattage and size	Solar panel wattage can match the design and area	Solar panel is too large, would create a wind pressure of an area to improve many, resulting in erection and maintenance of security risks increase, too heavy batteries, too
10	Battery low volt rescue	No	No	Yes (Electricity capacity almost no impact)	C-LiFePO4 Lithium Batteries low voltage for a short time after could charge to save back capacity. Lead-acid battery low voltage for a short time after could not charge save back capacity.
11	Security	Releasing toxic gas and explosion hazards	Have explosion hazards risk in 50~60°C	No explosion risk**	Solar DC UPS of C-LiFePO4 Lithium Batteries @short circuit conditions, maximum temperature up to 120~130°C, at the same time have the security design of the pressure relief valve, so no explosion risk (please see the test report)
12	Maintenance costs	Very higher	Higher	Lowest	General Li-Ion batteries for use in outdoor environments, will face 3 times in 3 years replacement cost ; While operation due to frequent battery replacement issues, resulting in low system properly rate
13	Battery cost	Cheap	Expensive	Very Expensive	Cost for 1 given to lead-acid battery < deep Lead-acid as 3 times< General Li-Ion as 4~5 times < C-LiFePO4 Lithium as 6~7 times
14	Green environmental protection(RoHS)	Lead pollution (No coincide)	Yes (Coincide)	Yes (Coincide)	2015 Lead Acid Battery will be disabled (in EU)
15	Charge rate (Large C Charge)	0.1C	1C	3C	What is 1C Charge? Battery 1Ah Capacity use 1A current to charge as 1C, so Battery 10Ah uses 3A Charge is 0.3C.
16	Charge time	long	short	short	Lead-acid battery use 0.1C charge, so often need to over 12 hours for charge time

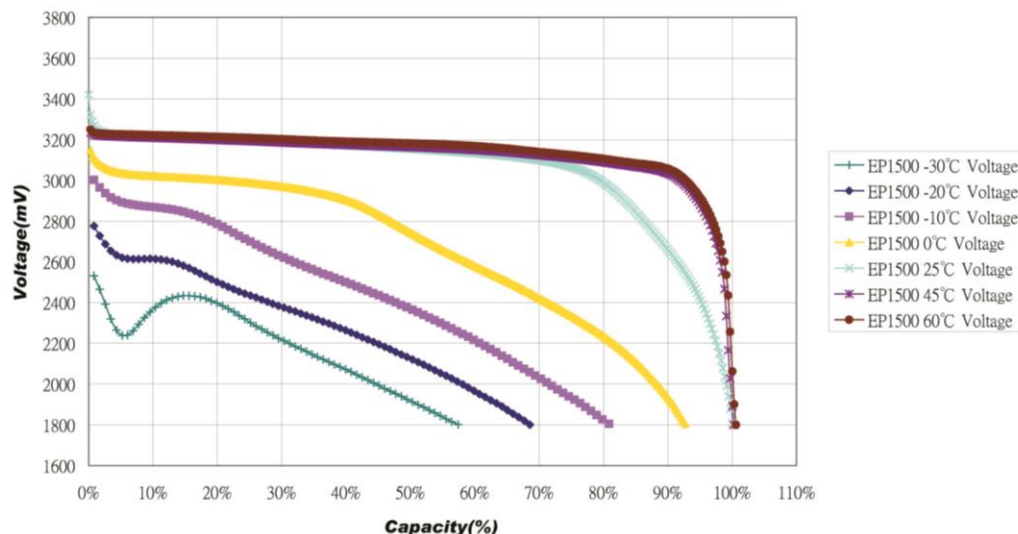
**Note1: Outdoor solar DC UPS system normally taken facing outdoor high temperature of 55~70°C operating environment requirements, Lead-acid & General Li-Ion battery will be shorten cycle life, even have explosion risk.**

**Note2: Outdoor solar DC UPS system usually need to face deep discharge and high current charging cycle operational requirements, Lead-acid & General Li-Ion battery will be shortening cycle life and even will accelerated damage.**

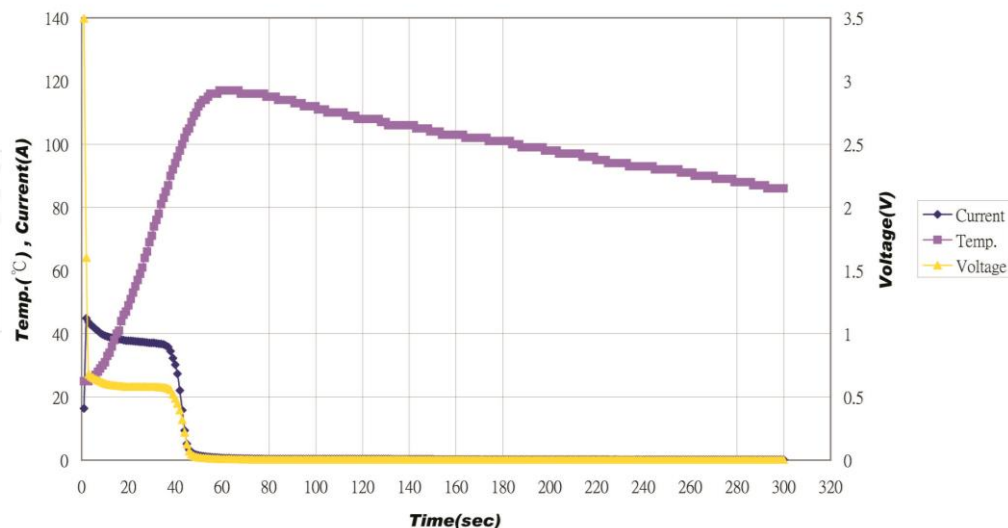


## C-LiFePO4 Lithium Batteries different temperature and short circuit test report

C-LiFePO4 Lithium Battery 1C Discharge at Different Temperature (based on 25°C Cap.)



C-LiFePO4 Lithium Battery UL-1642 Short Circuit Test Cell#1



### Life Cycle of Different Types of Batteries in High and Low Temperature Comprehensive Comparison Tables

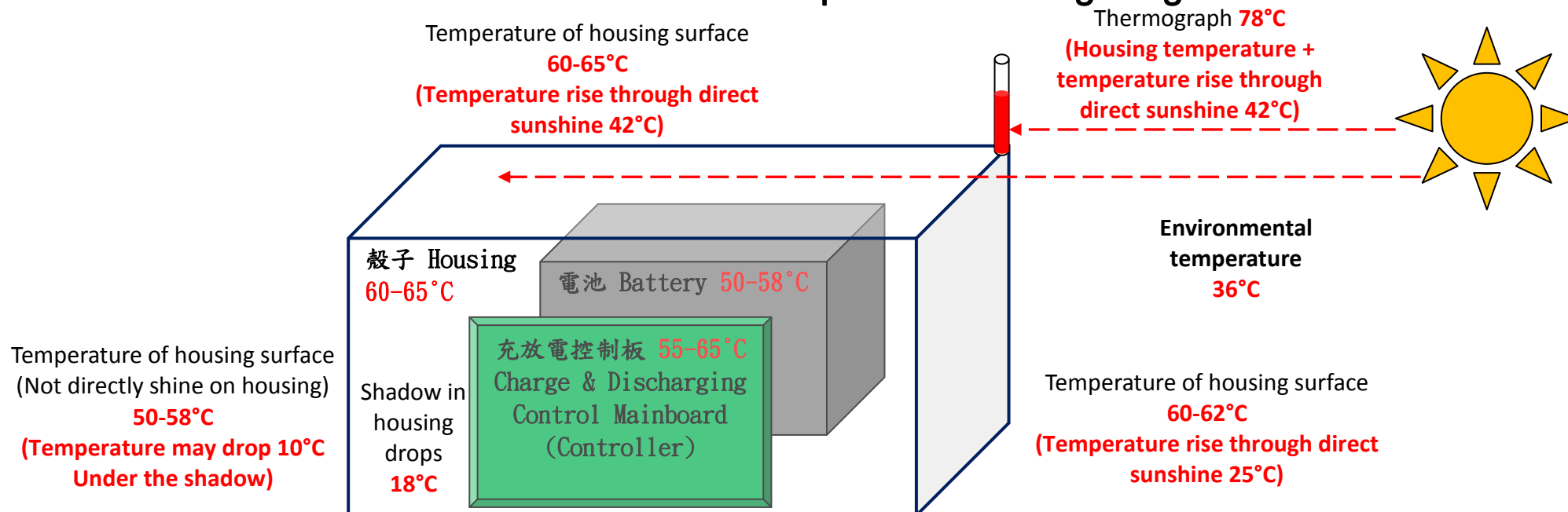
No	Temp	Lead-acid Solar DC UPS	Deep-cycle Lead-acid Solar DC UPS	General Li-Ion Solar DC UPS	C-LiFePO4 Lithium Solar DC UPS	IO-Power Product Remark
1	-30°C	Unable to work	Unable to work	Unable to work	Possible to work (able to work with housing)	Controller in the housing and mechanism design, it can work with housing @-30°C
2	-25°C	Unable to work	Unable to work	Unable to work	Able to work (able to work with housing)	It is able to work @-25°C, however, the discharging capacity is only 35-45%
3	-20°C	Unable to work	Unable to work	Unable to work	Able to work (Discharge capacity 45-55%)	
4	-15°C	Able to work (Discharge capacity 15-25%)	Able to work (Discharge capacity 15-25%)	Able to work (Discharge capacity 15-25%)	Able to work (Discharge capacity 55-60%)	



5	-10°C	Able to work (Discharge capacity 20-30%)	Able to work (Discharge capacity 20-30%)	Able to work (Discharge capacity 20-30%)	Able to work (Discharge capacity 60-80%)	
6	-5°C	Able to work (Discharge capacity 25-40%)	Able to work (Discharge capacity 30-50%)	Able to work (Discharge capacity 40-60%)	Able to work (Discharge capacity 80-90%)	
7	0°C	Able to work (Discharge capacity 30-50%)	Able to work (Discharge capacity 40-60%)	Able to work (Discharge capacity 60-80%)	Able to work (Discharge capacity 85-95%)	
8	25°C	300-500 times (Solar energy system is deep charging and discharging. Cannot refer to the transient discharging for car)	500-1000 times	500-1000 times	More than 2000 times	Working temperature is based on 25°C for both charging and discharging
9	33°C	150-250 times (life cycle cuts half when it raise every 8°C)	250-500 times (life cycle cuts half when it raise every 8°C)		More than 2000 times	
10	41°C	75-125 times	125-250 times	When it is over 45°C Life cycle diminishes obviously.	More than 2000 times	
11	49°C	33-65 times	65-125 times	When it is over 50°C Life cycle diminishes obviously and has risks of explosion.	More than 1500 times	
12	56°C	Unable to work	Unable to work	Unable to work	More than 1200 times	
13	63°C	Battery damage	Unable to work	Battery damage	More than 700 times	
14	70°C	Battery damage	Battery damage	Battery damage	Unable to work (able to work with housing)	When it is 70°C, controller takes protection and will stop discharging



## Outdoor Environmental Temperature Testing Diagram



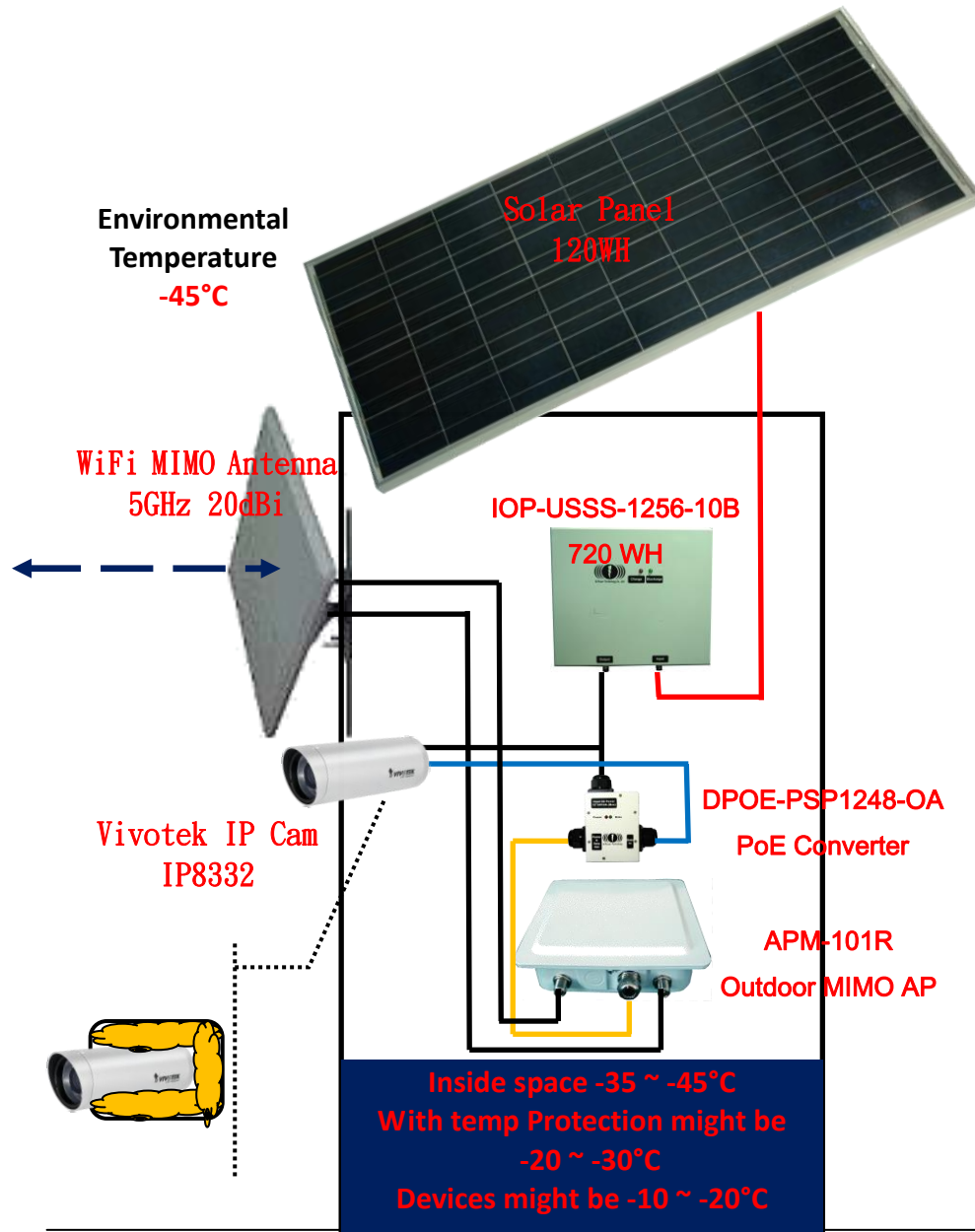
### Automobile DC UPS Power System Temp Test Report

Special Description 1: Automobile internal by too Sun penetrating sunshine and car is confined does not ventilation environment, so will produced sunshine warming effect, in outdoor temperature up to 36 °C, car within temperature by long time sunshine warming, car within will up to 60~65 °C, Sunshine direct location will up to 65~70 °C around, but as long as Sun sunshine no irradiation to of location, temperature will slightly below car within temperature about up 55~63 °C around.

Special description 2: IO-Power USMC-12V0712-II series online type does not interrupted operation power system, due to should car within environment of special high temperature requirements, used resistance high temperature roast paint package covered metal shell, in outdoor temperature up to 36 °C, car within temperature by long time sunshine warming, car within will up to 60~65 °C, in Sunshine direct products shell surface situation, shell surface temperature about 65 °C, shell within temperature about 55~58 °C, C-LiFePO4 Lithium Batteries temperature about 50~55 °C ; IOP-USMC-12V0712-II products, AM 10:00~ PM 4:00 under sunshine temperature test for a long time in the morning, all features of normal operation and provide stable DC 11.5V~14.4V+/-3% power to the cameras inside and outside the normal operation of the car.



## Outdoor Environmental Special Lowest Temperature System Diagram



### Solar Wireless Surveillance System Design

#### 1. Device Power Consumption

- 1-1. IP8332 Cam: @day 2.5W/H, @Night IR on 3.6W/H
- 1-2. Outdoor MIMO AP: APM-101R @ 6W/H (APM-102R @ 8W/H)
- 1-3. PoE Converter: 1W/H

#### 2. C-LiFePO4 Lithium Batteries Temperature Capacity

- @-40°C: Can not work, but it may work with temp keeping protection
- @-35°C: Can not work, but it may work with temp keeping protection
- @-30°C: 25%-30%, it can work, but can work better with temp keeping protection
- @-25°C: 30%-45%, it can work, but can work better with temp keeping protection
- @-20°C: 45%-50%, need to do protection.

#### 3. Solar Wireless System Power Consumption Calculation

24H, (2.5W/H\*18H+3.6W/H\*6) + 6W/H\*24 + 1W/H\*24=235W/D

Suggest design **1.5~3days** (Design 7days will waste cost and without effect)

235W/D\*3D=705W (Suggest use 720W @ 56Ah Batteries)

**(If you need more capacity for working Time, suggest use two solar system for devices)**

#### 4. Solar Panel Calculation

720W/6H=120W Solar Panel

#### 5. Enclosure Box Issues (Don't use heater solution)

- 5-1. all devices need use thick Plastic bags cover device and stuff some Thermal insulation material.
- 5-2. Enclosure Box need to stuff with some Thermal insulation material too.
- 5-3. If you can, all cable line put inside to Enclosure Box.

#### 6. Antenna & Camera & Solar Panel & Outside Cable Issues

- 6-1. Outdoor Antenna need do some protection
- 6-2. Camera: only show the lens out from the Enclosure Box
- 6-3. Solar Panel & Outside Cable need do some protection