



PHET[®]

WORLD PAT. C-LiFePO₄ Battery
Pihsiang Energy Technology Co., Ltd.
www.phet.com.tw

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A Leading Provider of Green Energy & Electric Vehicle





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Company Profile

- **Company Establishment in 1998**
- **Paid-in Capital : NT\$ 1,950 Mil (US\$ 64 Mil)**
- **Chairman & CEO : Dr.Donald Wu**
- **Business :**
 - (1) C-LiFePO₄ battery Cell**
 - (2) World patented DOSBAS[®] fault-tolerance battery pack safety system.**
 - (3) World patented DOBPCS[®] battery charging balance system.**
 - (4) Customized battery pack/module**
 - (5) Battery management and mechatronic system integration**
- **Annual Capacity: 15 mil Ah**
- **Employee : 125**

Company Overview

Battery Plant



- Land : 16,848 m²
- Space for production : 9,063 m²
- Annual Capacity: 15 mil Ah

Company Overview

Production Facilities (1)



Coating



Rolling



Slitting



Canning

Company Overview

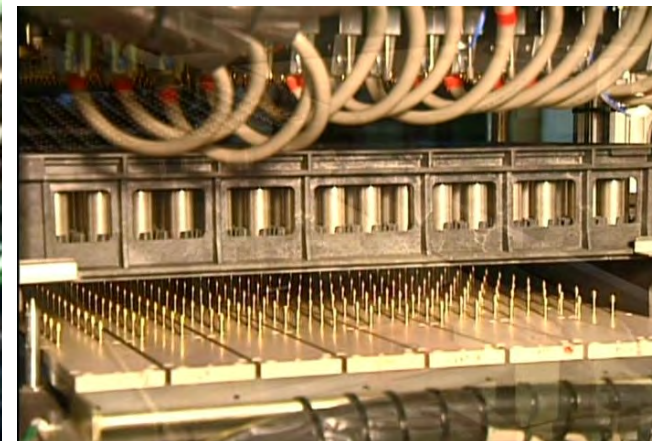
Production Facilities (2)



Automatic formation warehouse



Anti-static dry room



Automatic formation warehouse

Company Overview

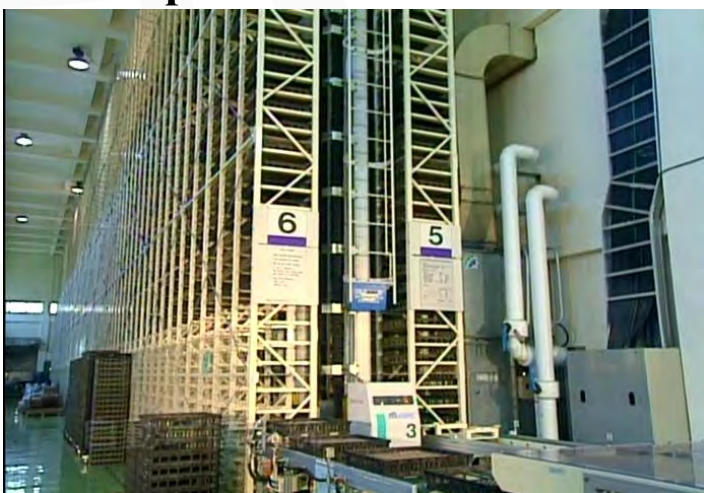
Production Facilities (3)



IC chip stock control



Automatic sorting



Automatic warehouse



Automatic warehouse

Company Overview

Snapshot

1958 - LiNiO₂ - **J.B. Goodenough**, D.G. Wickham,
J. Phys. Chem. Solids 5 (1958) 107.

1980 - LiCoO₂ - K. Mizushima, P.C. Jones, P.J.
Wiseman, J.B. **Goodenough**, *Mater. Res. Bull.*
15 (1980) 783.

1984 - LiMn₂O₄ - M.M. Thackeray, P.J. Johnson, L.A. de Piciotto,
P.G. Bruce, **J.B. Goodenough**, *Mater. Res. Bull.* 19 (1984)
179.

1991 - SONY - First Li-ion battery (cobaltite)

1997 - LiFePO₄ - A.K. Padhi, K.S. Nanjundaswamy, **J.B.**
Goodenough, *JECS* 144, 188 (1997).

2005 – PHET® - First Li-ion battery (iron phosphate)



Milestone and Main Achievement

➤2005

PHET® Dr. Donald Wu with Dr. Goodenough (USA), Hydro Quebec (Canada), CNRS of France together research and study on C-LFP.



PHET® became the first company to mass produce C-LFP battery successfully in the world and has been documented.

- 1958 - LiNiO₂ - J.B. Goodenough, D.G. Wickham, *J. Phys. Chem. Solids* 5 (1958) 107.
- 1980 - LiCoO₂ - K. Mizushima, P.C. Jones, P.J. Wiseman, J.B. Goodenough, *Mater. Res. Bull.* 15 (1980) 783.
- 1984 - LiMn₂O₄ - M.M. Thackeray, P.J. Johnson, L.A. de Picciotto, P.G. Bruce, J.B. Goodenough, *Mater. Res. Bull.* 19 (1984) 179.
- 1991 - SONY - First Li-ion battery (cobaltite)
- 1997 - LiFePO₄ - A.K. Padhi, K.S. Nanjundaswamy, J.B. Goodenough, *JECS* 144, 188 (1997).
- 2005 - PHET - First Li-ion battery (iron phosphate)

Milestone and Main Achievement

➤2006 PHET[®] has been chosen to become one of the major suppliers for space shuttle and satellite.



➤2009 Dr. Donald Wu invented DOSBAS[®] fault-tolerant safe battery system which was documented at EVS24 (the 24th Electric Vehicle Symposium) in Stavanger, Norway, being accepted for dialogue presentation by the EVS-24 Scientific Committee.

Milestone and Main Achievement

➤2010

For safety concern, PHET[®] battery and DOSBAS[®] fault-tolerant system have been chosen to provide battery solution used on the shuttle in Expo 2010 Shanghai.

Dr. Donald Wu was invited by WEC and presented battery with special formula performing on the pure EV in Hydro Quebec and demonstrated quick charging technology (full charging within 5 minutes)



Wu, Donald Pihsiang
Chairman
Pihsiang Group,
Taiwan-China

In 1969 Dr. Donald Pihsiang Wu invented the first agricultural transport vehicle for farmers of the hilly farmland in Taiwan. This invention led to a rise in living standards for the farmers of Taiwan. The farm transporter was aptly named Wu's Transport Cart. For this endeavor Dr. Donald Wu was awarded in 1977 as one of ten "Outstanding Youth" by the China Youth Corps, the Gold Award for "Innovation and Invention Award for Agricultural Improvement" from the Min-Der Culture Foundation (Formosa Plastic's president Mr. Wang Yung-Ching) and "Outstanding Merchant" by the Taiwan Ministry of Economy. Annual sales revenue at this time was rated within the top 500 in Taiwan.

In 1996 Dr. Donald Wu began his second career inventing the first four-wheel electric scooter in the world to enable the mobility challenged elder population to age gracefully, independently and with dignity. In the process of creating mobility scooters and power wheelchairs for the mobility challenged, Dr. Donald Wu has garnered more than 100 international patents. In 1989 Dr. Donald Wu started to export four-wheel electric scooters worldwide with the famous "Shopperder" brand. Annual sales revenue at this time was rated as top 1,000 in Taiwan. As the company grew, "Pihsiang" became publicly listed and its stocks began trading on the Taiwan Stock Exchange. In 2002 Pihsiang Machinery Mfg. Co., Ltd. was named—"one of the best 200 companies (under one Billion)" out of 20,000 companies outside the United States by Forbes Magazine.

In 2005 Dr. Donald Wu began his third career and founded Pihsiang Energy Technology Co., Ltd. and was the first in the world to successfully produce C-LiFePO₄ batteries in mass quantities of consistent high quality. One of the world-famous inventions contributing to the safest battery pack design was patented by Dr. Donald Wu under the trademarked DOSBAS[®] fault-tolerant safety system. At EVS24 Stravanger, Norway, the DOSBAS[®] safe battery system was accepted and documented by the EVS24 scientific committee as a safe battery pack design for electric vehicles.

Combining all the electrical and mechanical experience from designing and manufacturing agricultural transporters, electric scooters, power wheelchairs, C-LiFePO₄ batteries and DOSBAS[®] fault-tolerant safety systems, etc., in 2008 Dr. Donald Wu founded Pihsiang Electric Vehicle Mfg. Co., Ltd. and began his fourth career successfully building Battery Electric Vehicles (BEV) using C-LiFePO₄, LTO batteries. He is also cooperating with large car manufacturers in different countries to successfully electrify their automobiles as well as mid-size to full-size buses.

Dr. Donald Wu is the founder and current chairman of Pihsiang Group.

PRESENCE
Wednesday, September 15, 2010
13h15 - 14h45 Participant Issue Session 3.5: Energy for transport

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Milestone and Main Achievement

➤2012

PHET® becomes one of the major suppliers for battery to be used for pure electrical driven automobile.



➤2014

Dr. Donald Wu signed agreement with foreign government to supply the battery to the major industries.

PHET® has been appointed as the key supplier of battery for the Mars Project in the space.



➤ 2015

PHET® has been selected as a major battery supplier for the submarine.

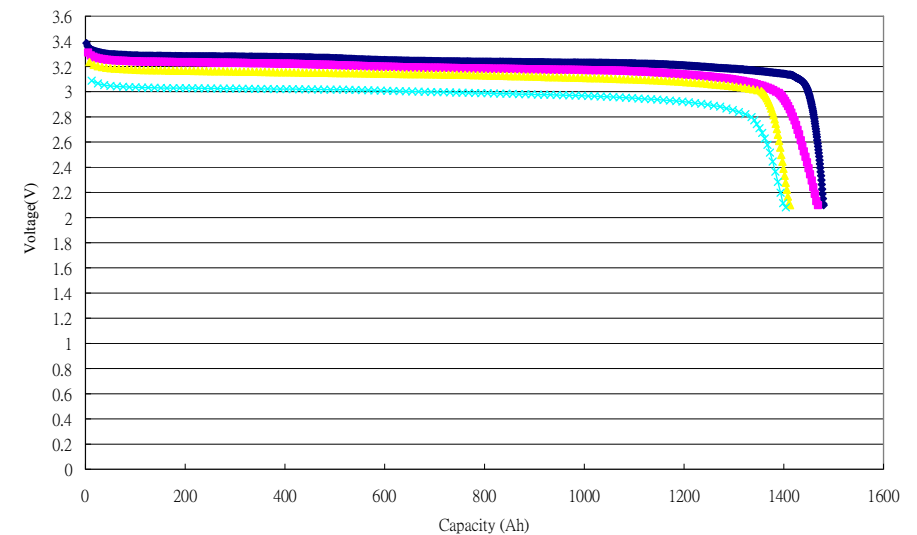
Product (Cell)



18650 Power Cell

Model Name	EP1500
Nominal Operating Voltage	3.2V
Rate Capacity	1500mAh
Constant Charging Current	4C (max.)
Constant Discharging Current	1.5C (max.)
Peak Discharging Current	30C (max.)
Operating Temperature	-45~70°C

Energy Cell EP1500 Discharging Curve



※ more than 3000 cycles still having
not less than 80% of full capacity

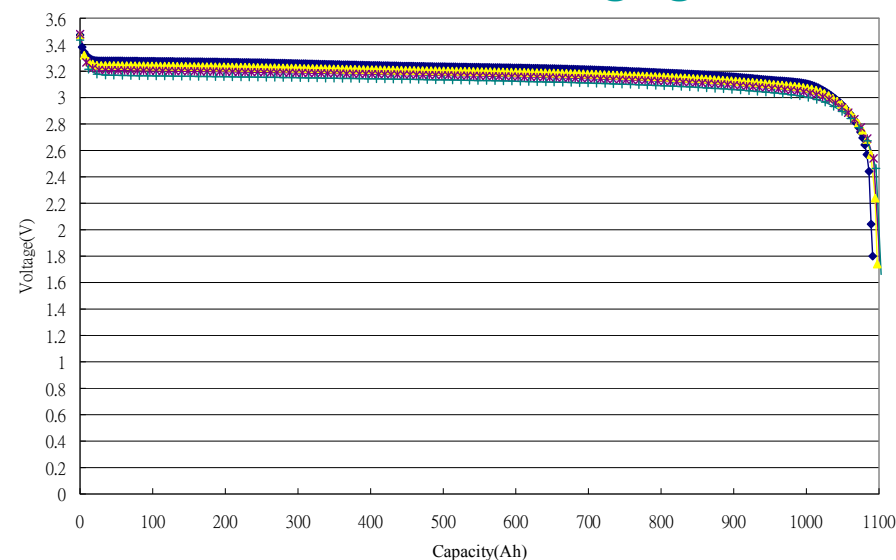
Product (Cell)



18650 Power Cell

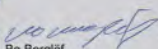
Model Name	SP1100
Nominal Operating Voltage	3.2V
Rate Capacity	1100mAh
Constant Charging Current	7C (max.)
Constant Discharging Current	10C (max.)
Peak Discharging Current	50C (max.)
Operating Temperature	-45~70°C

Power Cell SP1100 Discharging Curve



※ more than 3000 cycle still having
not less than 80% of full capacity

Product (Certificate)

		Ref. Certif. No. SE-79513
IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME SYSTEME CEI D'ACCEPTATION MUTUELLE DE CERTIFICATS D'ESSAIS DES EQUIPEMENTS ELECTRIQUES (IECEE) METHODE OC		
CB TEST CERTIFICATE		
Product Produit	Rechargeable Lithium Iron Phosphate Battery	
Name and address of the applicant Nom et adresse du demandeur	Pihsiang Energy Technology Co., Ltd. No.108, Hsin-He Road, Hsin-Feng Hsiang Hsinchu Country 30472, Taiwan	
Name and address of the manufacturer Nom et adresse du fabricant	Same as above	
Name and address of the factory Nom et adresse de l'usine Note: When more than one factory, please report on page 2 Note: Lorsque il y a plus d'une usine, veuillez utiliser la 2 ^{ème} page	Pihsiang Energy Technology Co., Ltd. No. 7, Gongyeh 5 Road, Hsinchu Industry Park, 303 Huko, Taiwan	
Ratings and principal characteristics Valeurs nominales et caractéristiques principales	3.3Vdc, 1450 mAh	
Trademark (if any) Marque de fabrique (si elle existe)		
Type of Manufacturer's Testing Laboratories used Type de programme du laboratoire d'essais constructeur	-	
Model / Type Ref. Ref. De type	IFR13N0-EP1500	
Additional information (if necessary may also be reported on page 2) Les informations complémentaires (si nécessaire, peuvent être indiquées sur la 2 ^{ème} page)	-	
A sample of the product was tested and found to be in conformity with Un échantillon de ce produit a été essayé et a été considéré conforme à la	IEC 62133:2012 (EN 62133:2013)	
As shown in the Test Report Ref. No. which forms part of this Certificate Comme indiqué dans le Rapport d'essais numéro de référence qui constitue partie de ce Certificat	150400298TWN-001	
This CB Test Certificate is issued by the National Certification Body Ce Certificat d'essai OC est établi par l'Organisme National de Certification		
Intertek Semko AB Box 1103 SE-164 22 Kista, Sweden Int +46 8 750 00 00 Date: 27 May 2015	 Signature:  Bo Berglöf	

IEC62133

CERTIFICATE OF COMPLIANCE

Certificate Number 20150916-MH27544
Report Reference MH27544-20031024
Issue Date 2015-SEPTEMBER-16

Issued to: PIHSIANG ENERGY TECHNOLOGY CO LTD
 HSINCHU INDUSTRY PARK
 7 GONGYEH 5TH RD
 HUKO
 303 TAIWAN

This is to certify that representative samples of COMPONENT - LITHIUM BATTERIES
 USR Component – Secondary, lithium-ion cells
 Model: IFR13N0

Have been investigated by UL in accordance with the
 Standard(s) indicated on this Certificate.

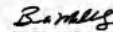
Standard(s) for Safety: UL1642, Lithium Batteries

Additional information: See the UL Online Certifications Directory at
www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's
 Certification and Follow-Up Service.

Recognized components are incomplete in certain constructional features or restricted in performance
 capabilities and are intended for use as components of complete equipment submitted for investigation rather
 than for direct separate installation in the field. The final acceptance of the component is dependent upon its
 installation and use in complete equipment submitted to UL LLC.

Look for the UL Certification Mark on the product.


 Bruce Mathewson, Director North American Certification Program
 UL LLC

Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL. For questions, please
 contact a local UL Customer Service Representative at UL@UL.com or UL.com/AboutUL



UL1642

Product (Pack)

Battery Type	Specification	Size (mm)	Weight (Kg)
	12.8V , 5.8Ah	123×63×104	0.96
	12.8V , 11.6Ah	155×105×94	1.76
	12.8V , 20.3Ah	185×77×166	2.87
	12.8V , 34.8Ah	182×128×190	4.98

Product (Pack)

Battery Type	Specification	Size (mm)	Weight (Kg)
	25.6V , 11.6Ah	235×158×63	3.14
	12.8V , 52.2Ah	199×163×190	6.77
	12.8V , 23.2Ah (with DOSBAS [®] and DOBPCS [®] system)	182×175×80	3.4
	12.8V , 34.8Ah (with DOSBAS [®] and DOBPCS [®] system)	185×180×127	5.0

Product (Pack)

World PAT. Fault-Tolerant DOSBAS® Prismatic Battery Pack E Series Prismatic Battery Pack



Item No.	E4	E5	E6	E7	E8	E10
Spec.	3.2V 5.8Ah	3.2V 7.25Ah	3.2V 8.7Ah	3.2V 10.15Ah	3.2V 11.6Ah	3.2V 14.5Ah
SIZE(mm) L W H	72 32 90	72 32 108	72 32 126	72 32 144	72 32 162	72 32 198
Weight(g)	240g	290g	350g	410g	460g	560g

Product (Pack)

World PAT. Fault-Tolerant DOSBAS® Prismatic Battery Pack

D Series Prismatic Battery Pack



Item No.	D20	D18	D15	D14	D13	D12	D11
Spec.	3.2V 116Ah	3.2V 104.4Ah	3.2V 87Ah	3.2V 81.2Ah	3.2V 75.4Ah	3.2V 69.6Ah	3.2V 63.8Ah
SIZE(mm)	L W H	158 67 435	158 67 398	158 67 345	158 67 327	158 67 309	158 67 291
Weight(kg)	4.9kg	4.55kg	3.89kg	3.77kg	3.51kg	3.21kg	2.93kg

Item No.	D10	D9	D8	D7	D6	D5
Spec.	3.2V 58Ah	3.2V 52.2Ah	3.2V 46.4Ah	3.2V 40.6Ah	3.2V 34.8Ah	3.2V 29Ah
SIZE(mm)	L W H	158 67 253	158 67 234	158 67 216	158 67 197	158 67 180
Weight(kg)	2.71kg	2.45kg	2.23kg	1.99kg	1.73kg	1.53kg

Product (Pack)

World PAT. Fault-Tolerant DOSBAS® Prismatic Battery Pack

R Series Prismatic Battery Pack



Item No.	R20	R19	R18	R17	R16	R15	R14	R13	R12
Spec.	3.2V 240Ah	3.2V 220Ah	3.2V 216Ah	3.2V 204Ah	3.2V 192Ah	3.2V 180Ah	3.2V 168Ah	3.2V 150Ah	3.2V 140Ah
SIZE(mm) L W H	172 78 400	172 78 380	172 78 363	172 78 344.5	172 78 326	172 78 307.5	172 78 289	172 78 270	172 78 252.5
Weight(kg)	8.5kg	8kg	7.6kg	7.2kg	6.8kg	6.4kg	6kg	5.5kg	5.1kg
Item No.	R11	R10	R9	R8	R7	R6	R5	R4	20
Spec.	3.2V 130Ah	3.2V 120Ah	3.2V 105Ah	3.2V 96Ah	3.2V 82Ah	3.2V 72Ah	3.2V 60Ah	3.2V 48Ah	
SIZE(mm) L W H	172 78 235	172 78 215	172 78 200	172 78 182	172 78 162	172 78 141	172 78 127	172 78 104	
Weight(kg)	4.7kg	4.3kg	3.8kg	3.4kg	3kg	2.6kg	2kg	1.7kg	

DOSBAS[®] Fault-Tolerant System

DOBPCS[®] Charging Balance System

PHET[®] world Patented DOSBAS[®] System (**Innovative Fault-Tolerant with safety device on each single cell**) prevent the whole battery pack from shutting down when there are defected cells (such as internal short circuiting) inside the pack and it keeps the battery packs safe and trouble free. (The malfunctioning cells can also be easily checked and replaced.) .

World Patented DOBPCS[®] Battery Charging System will automatically balance each battery cell when charging. Even when used old and brand new batteries can be mixed in a pack and doesn't impact the whole performance of the whole battery system.



(One of DOSBAS[®] battery pack for PHET[®])

- ※ The DOSBAS[®] Battery system isolates any over-heated (thermal runaway) cell(s) caused by internal short circuiting and prevents fire or damage the whole battery pack.
- ※ With DOSBAS[®] Fault Tolerance and DOBPCS[®] Charging Balance System, it will not be necessary to change the whole battery pack if there is any defected cell happens in the series. The new cell will be automatically merged and balance with the old cells between each battery pack.

More DOSBAS[®] test demonstration please refer to <https://www.youtube.com/watch?v=91HGv8F5M5Y>

Product –Customized Battery(I)

World Patented INFINITILINKS®

For example which we have delivered to France and Hydro Quebec as below



Nominal Voltage	12.8V to 13.2V
Nominal Capacity (@ 23 °C)	60Ah
max. continuous discharge	45A
max. peak discharge	90A
weight	11kg
dimension(L×W×H)	300mm × 160mm × 230mm

With world patented technology the battery system can be extended to achieve any expected voltage and capacity for your application.

Product –Customized Battery(II)

Cabinet Type Battery Pack

For example which we have delivered to telecommunication as below



Nominal Voltage	74.4V to 76.8V
Nominal Capacity (@ 23°C)	60Ah
max. continuous discharge	45A
max. peak discharge	150A
weight	30kg
dimension(L×W×H)	450mm × 430mm × 180mm

With world patented technology the battery system can be extended to achieve any expected voltage and capacity for your application.

Product –Customized Battery(III)

Cart Type Battery Pack

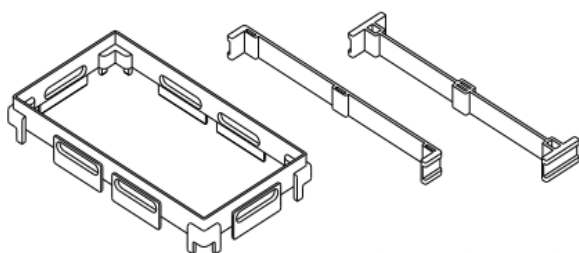
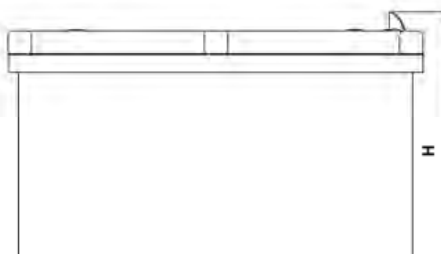
For example which we have delivered to U.S. Army as below



Nominal Voltage	49.6V to 52.8V
Nominal Capacity (@ 23°C)	240Ah
max. continuous discharge	120A
max. peak discharge	180A
weight	220kg
dimension(L×W×H)	1025mm × 705mm × 675mm

With world patented technology the battery system can be extended to achieve any expected voltage and capacity for your application.

MPLB® (Multi-Purpose Long life LFP Battery) Series
(No heavy metal, Non-toxic)



Stacking Device

Separator between the batteries can be locked up to hold each battery into a solid pack

Item	Model No.	Voltage	Capacity	Size(L x W x H mm)	WG(kg)	Remarks (capacity approximately equivalent to lead acid battery)
A.	ST07320120	12.8V	120Ah	369x214x210	16.5	162Ah
B.	ST07288108	12.8V	108Ah	359x200x200	15	146Ah
C.	ST07256096	12.8V	96Ah	350x177x212	13.5	130Ah
D.	ST07192072	12.8V	72Ah	279x175x226	10	97Ah
E.	ST07160060	12.8V	60Ah	250x175x226	8.5	81Ah
F.	ST07128046	12.8V	46Ah	219x171x198	7	62Ah
G.	ST07096035	12.8V	35Ah	203x144x188	5.5	47Ah
H.	ST07064023	12.8V	23Ah	176x120x196	4.5	31Ah
I.	ST07032011	12.8V	11Ah	187x136x125	2.8	15Ah
J.	ST07028010	12.8V	10Ah	169x85x151	2.5	14Ah

※Above (World Patent) batteries are individually equipped with DOSBAS® safety system (World Patent) and DOBPCS® self balance charging system (World Patent), which allowed the user can install in series and/or in parallel to whatever the voltage and capacity needed.

※Except the main cable for series and/or parallel for the batteries, there is no extra wires for BMS to be connected. PHET World Patented unique design allow easily install or replace. After replacing the new battery, the old and new battery will automatically merge to each other (no other system in the world can do it). Thus enhance the whole battery pack performance up to **10 years** (operating temperature range from -40°C to +80°C) .

※Charging voltage and current have to be based on PHET recommended .

※Individual battery fuel gauge is standard equipped on every battery case.

※**This unique design battery is extremely good for car cranking in winter (-40°C) or summer(+80°C, no cooling needed), and can replace all lead acid battery applying on all industry in small or large system such as UPS, solar farm, EV, PHEV and other energy storage system including military, etc.**

■ Product –Customized Battery(IV)

MPLB® (Multi-Purpose Long life LFP Battery) Series



12.8V/46Ah



12.8V/35Ah



12.8V/23Ah



12.8V/11Ah



12.8V/10Ah

Model No.	Voltage	Capacity	Size(L x W x H mm)	WG(kg)
ST07128046	12.8V	46Ah	219x171x198	7
ST07096035	12.8V	35Ah	203x144x188	5.5
ST07064023	12.8V	23Ah	176x120x196	4.5
ST07032011	12.8V	11Ah	187x136x125	2.8
ST07028010	12.8V	10Ah	169x85x151	2.5

■ Product –Customized Battery(V)

MPLB® (Multi-Purpose Long life LFP Battery) Series



12.8V/120Ah



12.8V/108Ah



12.8V/96Ah



12.8V/72Ah



12.8V/60Ah

Model No.	Voltage	Capacity	Size(L x W x H mm)	WG(kg)
ST07320120	12.8V	120Ah	369x214x210	16.5
ST07288108	12.8V	108Ah	359x200x200	15
ST07256096	12.8V	96Ah	350x177x212	13.5
ST07192072	12.8V	72Ah	279x175x226	10
ST07160060	12.8V	60Ah	250x175x226	8.5

MPLB® (Multi-Purpose Long life LFP Battery) Series



MPLB[®] (Multi-Purpose Long life LFP Battery) Series





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Thank you !

Be ready to drive with a clean energy!

