Battery Technical Report

Manufacturer's battery specification sheet and Material Safety Data Sheet are in document:
samsung-35e-datasheet-inr18650-35e.pdf

CONTACT INFORMATION

Date:	14.10.2019	**Team Number:**	660331508
Organization:	PUT Solar Dynamics	**Team Battery Contact Email:**	konradgieregowski@gmail.com
Team Email:	putsolardynamictechniczni@gmail.com	**Phone:**	507644797

MANUFACTURER INFORMATION

Manufacturer: Manufacturer URL	SAMSUNG SDI Co., Ltd.	**Type (LION, etc):**	LION
Battery Name:	SAMSUNG INR18650-35E	**Model Number:**	INR18650-35E
Battery Capacity (Ah):	95,2	**Charge Rate:**	0.5C
Battery Mass (kg):	0.05	**Cell Voltage:**	3.6V
Battery Cost (US$):	3.31	**Max Discharge Current per Cell:**	8 A

VEHICLE BATTERY PACK SPECIFICATIONS

Number of batteries in the vehicle battery pack :	1568		
Pack Mass (kg):	120	**Pack Voltage:**	100.8 V
Pack Configuration:	28S 56P		

SUPPLIER INFORMATION

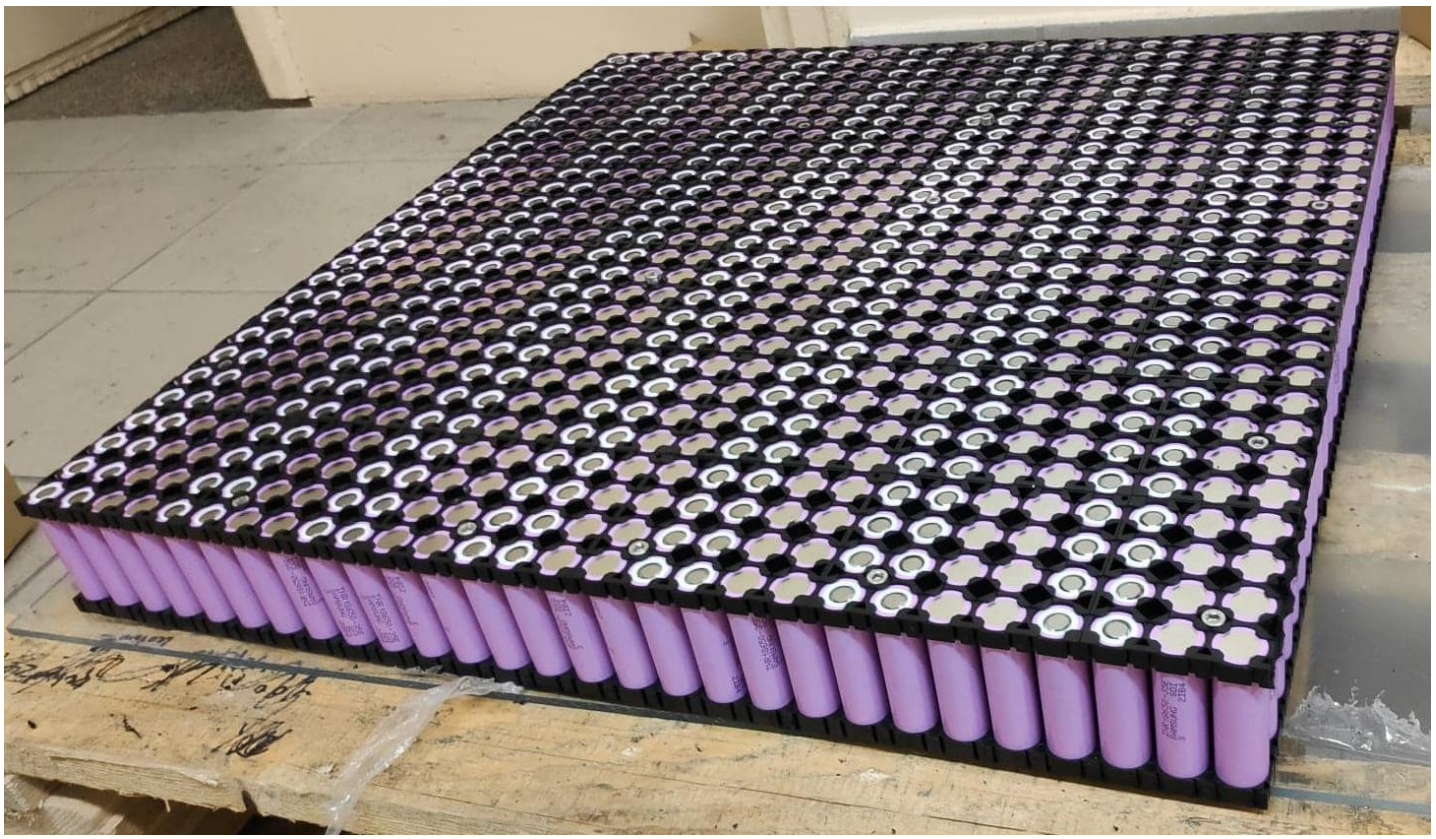
Information for the company that is supplying the batteries to the team. This may be the original manufacturer or a reseller. If the supplier uses a different model name or number than the manufacturer, please provide that information.

Supplier:	Batimex Sp. z o.o.	**Contact:**	Mon-Fri 9:00 - 17:00
Email:	batimex@batimex.pl	**Phone:**	(+48 22) 7392900
Supplier Battery Name:	SAMSUNG INR18650-35E	**Supplier Model #:**	INR18650-35E

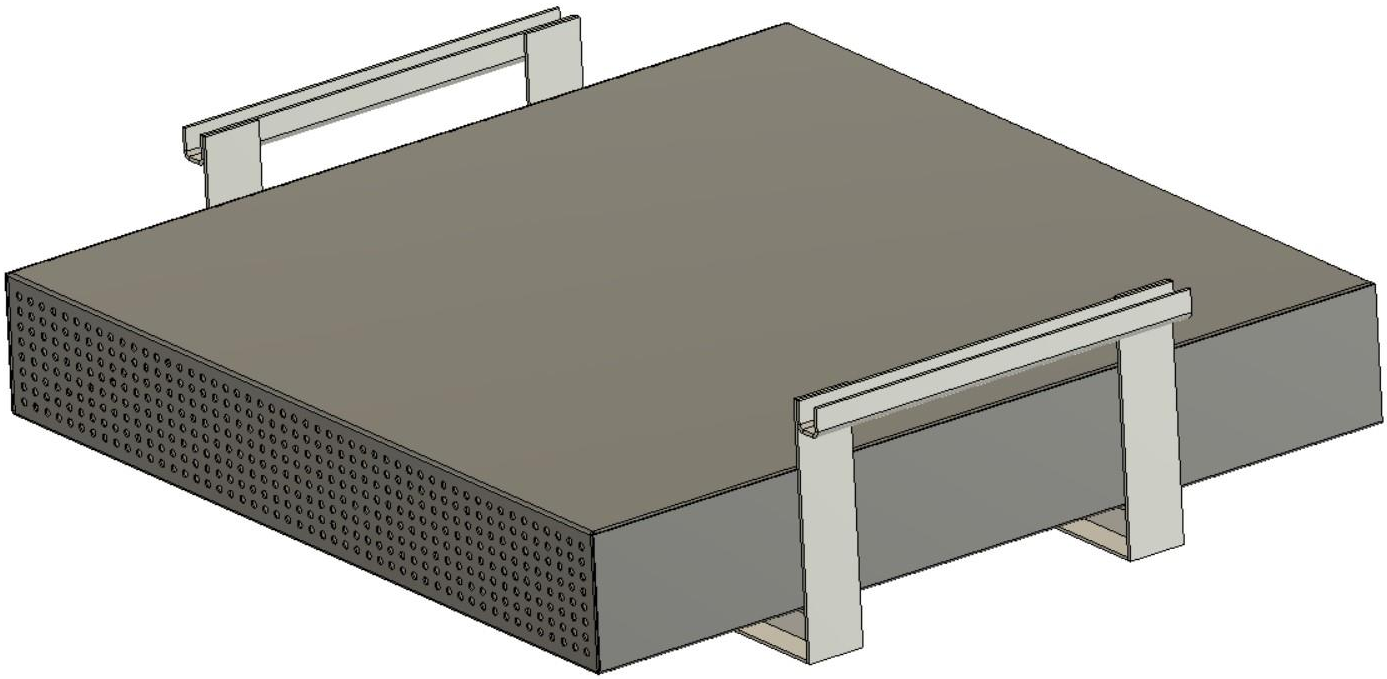
External layer made of steel, inner layer is a 1,5 cm thickness non-flammable and chemical resistive rubber protecting battery from each side. This rubber is hard material and will not flex under the pressure of the battery.

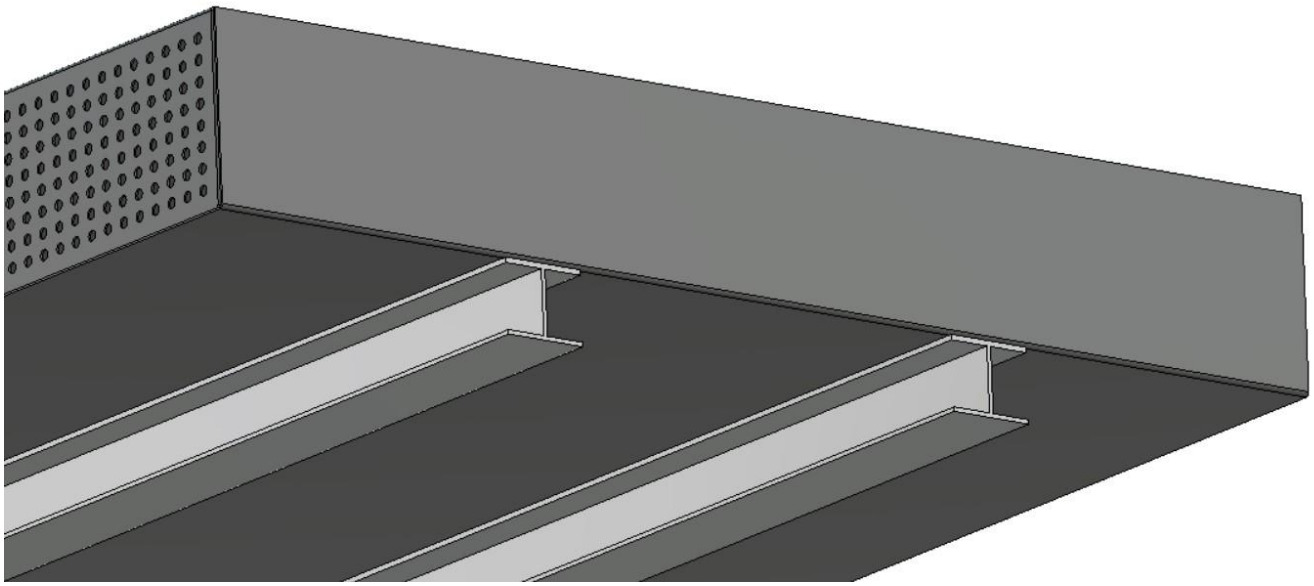
Car body is made from composite which is insulator so mounting metal battery enclosure to it with screws and nuts is safe.

Supplemental Battery is 12 V VRLA battery.



To ensure a rigidity of the construction we will add two double T shaped aluminum profiles which are screwed to the battery enclosure and car chassis.





Battery Protection Technical Report

Test the charging:

1. Turn on power to the charger.
2. Note that the BMS appears to be operational. If a digital BMS, note the cell voltages.
3. Note that current is flowing into the pack.
4. Note that the BMS is aware of the current flowing into the pack, and that the SOC value (if available) is increasing.
5. Note the cell temperatures, making sure they are not excessive. If the BMS can read temperatures, note that it is seeing the correct values.
6. Note that balancing starts occurring on the most charged cells when their voltage reaches a certain threshold (if a top balancing BMS).
7. Note that, as soon as any cell's voltage reaches the maximum threshold, charging is interrupted.
8. When the pack is fully charged, turn off power to the charger.

Test the discharging:

1. Turn on the load (e.g., the ignition).
2. Note that the BMS appears to be operational. If a digital BMS, note the cell voltages.
3. Note that current is flowing out of the pack.
4. Note that the BMS is aware of the current flowing out of the pack, and that the SOC value (if available) is decreasing.
5. Note the cell temperatures, making sure they are not excessive.
6. Note that, as soon as any cell's voltage reaches the minimum threshold, discharging is interrupted.
7. Turn off the load.

- charge voltage is limited to 4.2 volts per cell with max charge current 1.7 amps, min temp. 0 ^{o}C and max temp. 45^{o}C

- discharge voltage is limited to 2.65 volts per cell with max discharge current 8 amps, min temp. -20 ^{o}C and max temp. 60^{o}C

Battery pack configuration are 56 cells per module, 28 modules per string, and only one string – total cell count is 1568 pieces (Fig. 1).

Those black holders outside the battery will be cut off, because we use 4x5 stackable holders. There is a air gap between batteries and we want to use air flow to cool down our battery pack.

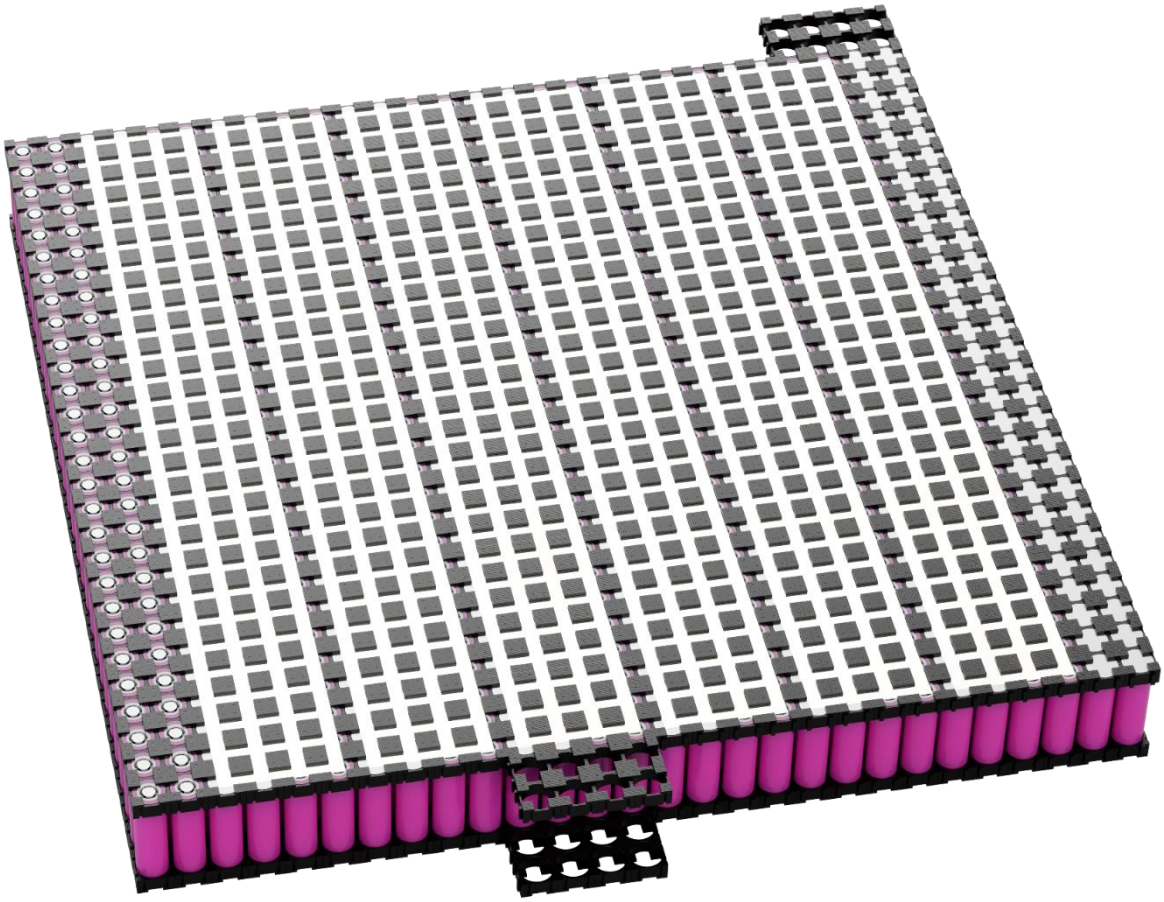


Figure 1. Half of the Battery pack (784 batteries).

Battery Management System is realized with two modules (Fig. 2) and microcontroller (Fig. 3).

Figure 2. BQ76PL536EVM-3

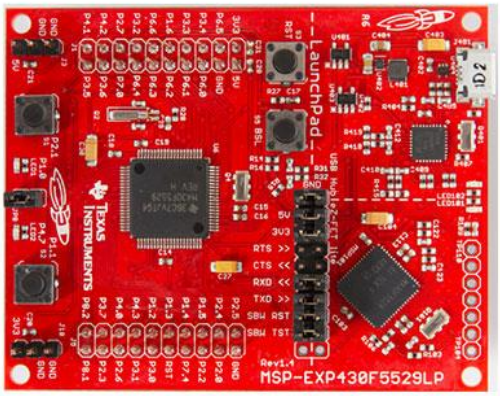


Figure 3. MSP430F5529

Main Battery Pack

BATTERY PROTECTION SYSTEM OVER VOLTAGE(OV) TEST

☑ String ☐ Module ☐ Cell – Test Level ☐ Pass ☐ Fail

Nominal Voltage: 100.8 Vnom @ 23 °C
Max Voltage: 119 Vmax @ 23 °C
BPS Max Trip: 117.6 Vmax_trip
☐ Filtering ☐ Delay

BPS V Resolution: 12 Bit
BPS V Range: 84 - 117.6 VDC
BPS Sample Rate: 2 S/s
BPS Disconnect Delay: 2 s

Notes: _____

BATTERY PROTECTION SYSTEM UNDER VOLTAGE(UV) TEST

☑ String ☐ Module ☐ Cell – Test Level ☐ Pass ☐ N/A ☐ Fail

Nominal Voltage: 100.8 Vnom @ 23 °C
Min Voltage: 82,6 Vmin @ 23 °C
BPS Min Trip: 84 Vmin_trip
☐ Filtering ☐ Delay

BPS V Resolution: 12 Bit
BPS V Range: 84 - 117.6 VDC
BPS Sample Rate: 2 S/s
BPS Disconnect Delay: 2 s

Notes: _____

BATTERY PROTECTION SYSTEM OVER CURRENT(OC) TEST

☑ String ☐ Module – Test Level ☐ Pass ☐ N/A ☐ Fail

Max Current (charge): 112 A Imax @ 23 °C
Max Current (discharge): 448 A Imax @ 23 °C
BPS I Trip: 120 A Imax_trip
☐ Filtering ☐ Delay

BPS I Resolution: 12 Bit
BPS I Range: 0 - 12 VDC
BPS Sample Rate: 10 S/s
BPS Disconnect Delay: 2 s

Notes: _____

BATTERY PROTECTION SYSTEM OVER TEMPERATURE(OT) TEST

☑ String ☐ Module ☐ Cell – Test Level ☐ Pass ☐ N/A ☐ Fail

(Charge) / (Discharge)
Max Operating Temperature: 45 / 60 °C
BPS T Trip: 40 °C Tmax_trip_charge
BPS T Trip: 45 °C Tmax_trip_discharg

BPS T Resolution: 12 Bit
BPS T Range: -10 - 60 °C
BPS Sample Rate: 2 S/s
BPS Disconnect Delay: 2 s

Notes: _____

Supplemental battery

BATTERY PROTECTION SYSTEM OVER VOLTAGE(OV) TEST

☑ String ☐ Module ☐ Cell – Test Level ☐ Pass ☐ Fail

Nominal Voltage: 12 Vnom @ 25 °C
Max Voltage: 15 Vmax @ 25 °C
BPS Max Trip: 13,8 Vmax_trip
☐ Filtering ☐ Delay

BPS V Resolution: 12 Bit
BPS V Range: 0 - 16 VDC
BPS Sample Rate: 1 S/s
BPS Disconnect Delay: 2 s

Notes: _____

BATTERY PROTECTION SYSTEM UNDER VOLTAGE(UV) TEST

☑ String ☐ Module ☐ Cell – Test Level ☐ Pass ☐ N/A ☐ Fail

Nominal Voltage: 12 Vnom @ 23 °C
Min Voltage: 10,5 Vmin @ 23 °C
BPS Min Trip: 10,5 Vmin_trip
☐ Filtering ☐ Delay

BPS V Resolution: 12 Bit
BPS V Range: 0 - 16 VDC
BPS Sample Rate: 1 S/s
BPS Disconnect Delay: 2 s

BATTERY PROTECTION SYSTEM OVER CURRENT(OC) TEST

☑ String ☐ Module – Test Level ☐ Pass ☐ N/A ☐ Fail

Max Current (charge): (0.3C) 8 A Imax @ 23 °C
Max Current (discharge): (1C) 55 A Imax @ 23 °C
BPS I Trip: 45 A Imax_trip
☐ Filtering ☐ Delay

BPS I Resolution: 12 Bit
BPS I Range: 0 - 12 VDC
BPS Sample Rate: 1 S/s
BPS Disconnect Delay: 2 s

Notes: _____

BATTERY PROTECTION SYSTEM OVER TEMPERATURE(OT) TEST

☑ String ☐ Module ☐ Cell – Test Level ☐ Pass ☐ N/A ☐ Fail

(Charge) / (Discharge)
Max Operating Temperature: 40 / 45 °C
BPS T Trip: 35 °C Tmax_trip_charge
BPS T Trip: 40 °C Tmax_trip_discharg

BPS T Resolution: 12 Bit
BPS T Range: -10 - 60 °C
BPS Sample Rate: 1 S/s
BPS Disconnect Delay: 2 s

When External Cutoff switch is pushed the supply circuit for main battery contactor coil is disconnected. Then the driver can see a fault indicator on the dashboard. Additionally external lights will strobe. Those lights are supplied by supplemental 12 V VRLA battery.

Discription of how the BPS will operate for start-up and fault conditions for each battery type is presented in:

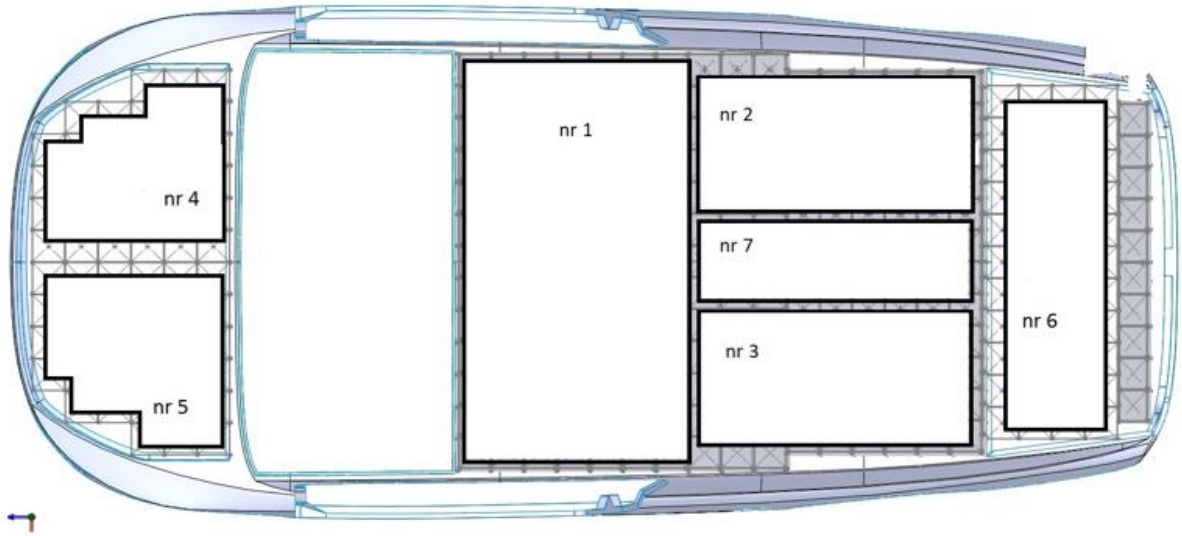
PolitechnikaPoznanska_ASC2020VDR_ElectricalSystemTechnicalReport.pdf

Monitoring of the electrochemical cells

We have 2 printed circuits with a total number of battery supervising systems. They monitor 28 series connected packets and send information to the microcontroller, which in the event of incorrect voltages decides to disconnect the battery from the car. In addition, the driver can monitor all on-screen information about the battery. In the event of a short circuit, safety is ensured by fuses and the current sensor when it detects a high current consumption, which is not expected at the moment. The battery is disconnected in this case.

Technical documentation of photovoltaic panels

1) Design of the area intended for the installation of photovoltaic panels with dimensions.



2) Models of the photovoltaic panels used with their cost estimate.

- The vehicle will be fitted with Solbian panels with the following models:

Panels number 4, 5: Solbian SP 97

Panel number 6: Solbian SP 144

Panel number 1: Sunport

Panel number 7: Solbian SP 52L

Panel number 2: Solbian SP 100

Panel number 3: Sungold

3) Parameters of the panels used, the way of their connection and division.

Panel	Max power [Wp]	Rated voltage [Vmp]	Voltage [Voc]	Current [A]	Dimensions [mm]	Mass [kg]	Thickness [mm]	Location	Number of cells
Solbian SP 144	144	25,3	30	5,7	1490*546	1,9	2	Car trunk	44
Solbian SP 97	97	17 - 17,2	20,5 - 20,7	5,7	850*783	-	2	Hood	30
Solbian SP 97	97	17 - 17,2	20,5 - 20,7	5,7	850*783	-	2	Hood	30
Solbian SP 100	102	18	21,8	5,7	1109*546	1,5	2	Rear window	32
Sungold	100	17,6	20,8	5,68	1200*560	-	3	Rear window	32
Solbian SP 52L	52	9,1	10,9	5,7	1109*292	0,8	2	Rear window	16
Sunport	315	33	40,1	9,55	1660*990	4	1,4	Roof	60

Datasheet

	SP 144	SP 130	SP 118 L	SP 118 Q	SP 104	SP 78	SP 52 L	SP 52 Q
Maximum power (±5%) [W]	144	130	118	118	104	78	52	52
Length Y [mm]	1490	1363	1236	855	1109	855	1109	601
Width X [mm]	546	546	546	800	546	546	292	546
Thickness [mm]	2	2	2	2	2	2	2	2
Weight [kg]	1.90	1.70	1.60	1.60	1.40	1.10	0.80	0.80
Max power Voltage Vmp [V]	25.3	22.8	20.7	20.7	18.2	13.7	9.1	9.1
Max power Current Imp [A]	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Open circuit voltage Voc [V]	30.0	27.3	24.5	24.5	21.8	16.4	10.9	10.9
Short circuit current Isc [A]	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
NOCT [°C]	45 ± 2	45 ± 2	45 ± 2	45 ± 2	45 ± 2	45 ± 2	45 ± 2	45 ± 2
Operating temperature [°C]	-40/+85	-40/+85	-40/+85	-40/+85	-40/+85	-40/+85	-40/+85	-40/+85
Temp. coeff. Pmax [%/°C]	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35
Temp. coeff. Voc [%/°C]	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28
Temp. coeff. Isc [%/°C]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Columns x Rows (cells n°)	4x11 (44)	4x10 (40)	4x9 (36)	6x6 (36)	4x8 (32)	4x6 (24)	2x8 (16)	4x4 (16)
Maximum system voltage [V]	1000 V	1000 V	1000 V	1000 V	1000 V	1000 V	1000 V	1000 V
Maximum reverse current [A]	12 A	12 A	12 A	12 A	12 A	12 A	12 A	12 A
Safety class	A	A	A	A	A	A	A	A

* Values at STC = Standard Test Conditions: (a) light Spectrum for an Air Mass of 1.5; (b) irradiance of 1000 W/m² with perpendicular incidence and (c) cell temperature of 25 °C. Measurements carried out according to the Standard IEC 61215 requirements.

For SP 100 :

Specification

Specyfikacja

Moc szczytowa (+/- 5%) - Pmax	102 W
Napięcie znamionowe — Vmp	18,0 V
Prąd znamionowy - Imp	5,7
Napięcie w obwodzie otwartym - Voc	21,8 V
Prąd zwarciowy - Isc	6 lat
Temp. współcz. Pmax	-0,38%/°C
Temp. współcz. Voc	-0,27%/°C
Temp. współcz. Isc	0,05%/°C
Długość	43,66" (1109 mm)
Szerokość	21,50" (546 mm)
Grubość	0,079" (2 mm)
Waga	3,3 funta (1,5 kg)
Liczba komórek	32

Peak power (+/- 5%) – Pmax	102 W
Rated voltage - Vmp	18,0 V
Rated current - Imp	5,7
Open circuit voltage - Voc	21,8 V
Short-circuit current	6 lat
Temp. coeff. Pmax	-0,38%/˚C
Temp. coeff. Voc	-0,27%/˚C
Temp. coeff. Isc	0,05%/˚C
Lenght	43,66” (1109 mm)
Width	21,50” (546 mm)
Thickness	0,079” (2 mm)
Mass	3,3 pounds (1,5 kg)
Number of cells	32

The panels will be divided into three groups, in each of them the cells will be connected in series so that each group of panels has a system voltage within the range of 45-85 [V]. The current of the entire system will not exceed the threshold of 10 [A].

4) Cell area calculations

Dimensions of cells:

Solbian (in every model) – square 125x125 mm

Sunport – square 159x159 mm

Sungold – square 125x125 mm

Solbian cell area = 125*125 = 15625 mm^2

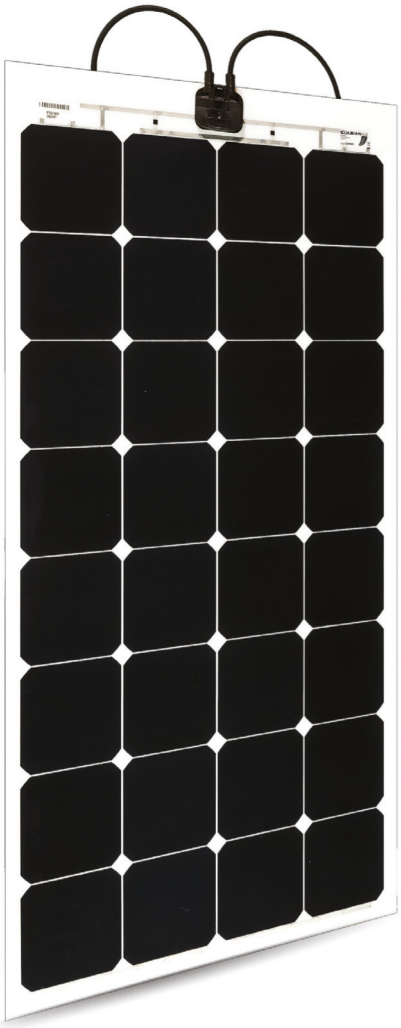
Sunport cel area = 159*159 = 25281 mm^2

Sungold cel area = 125*125 = 15625 mm^2

Total cel area = (44 + 30 + 30 + 32 + 16)*15625 + 60*25281 + 32*15625 =

= 2375000 + 1516860 + 500000 =

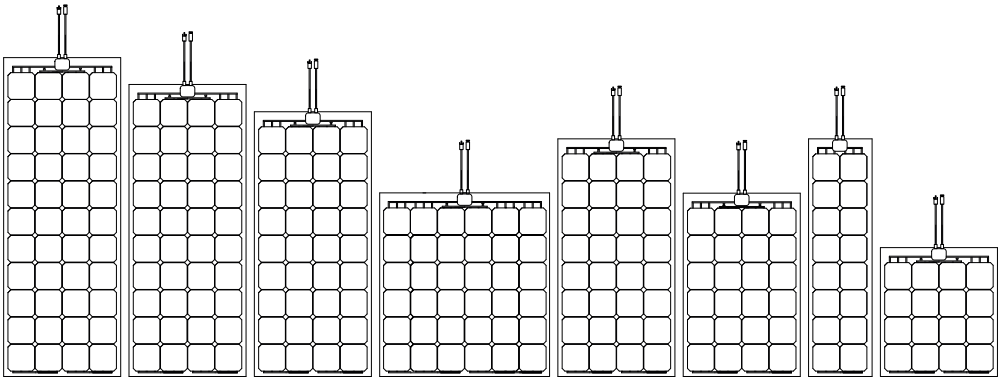
= 4391860 mm^2 = **4,391860 m^2**



Power at the highest level.

SP series

MADE IN ITALY

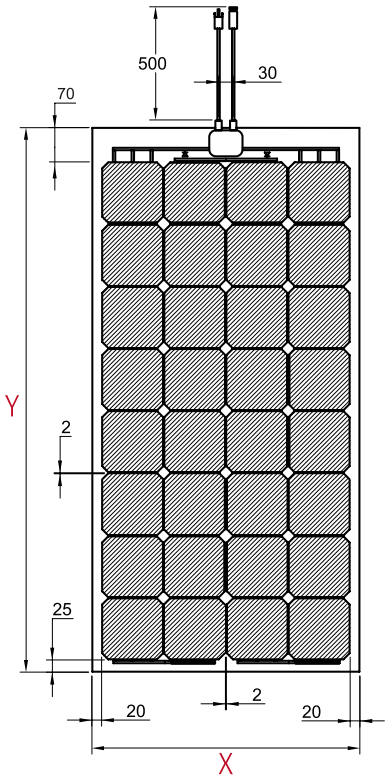


SP series is at the the top of the range, thanks to the use of selected SunPower™ monocrystalline silicon cells, reaching a record 24% conversion of sunlight into electricity and with a pleasant appearance thanks to the electrical contacts hidden on the back. SunPower™ cells represent the most advanced technology on the market, and make the SP Solbian panels the highest-efficiency flexible panels.

Flexible, powerful and robust, the panels of the SP series are recommended for all installations where maximum reliability and power are required, and the appearance of these cells is one of the symbols of photovoltaic modules. They can be used in all situations and are a best seller in marine applications.

Features

- ✓ The most efficient flexible modules on the market
- ✓ Flexible and lightweight (2.2 kg/m^2)
- ✓ Completely waterproof and resistant to salt water
- ✓ Thin (less than 2 mm)
- ✓ IEC 61215, IEC 61730 and IEC 61701 certified
- ✓ 5 year warranty against manufacturing defects
- ✓ Integrated bypass diodes to minimise output losses associated with partial shading
- ✓ Available with different front sheets, many fixing and electrical wiring options
- ✓ White, black or transparent back sheet
- ✓ Adaptable to any battery: from 5 to 48 volt, lead-acid or lithium
- ✓ Designed and manufactured in Italy



SP series SUNPOWER® inside

SunPower™ cells used in SP series panels are high efficiency monocrystalline cells (the highest available on the market). The electric contacts create a thick pattern resembling two interpenetrating combs on the rear of the cell, this guarantees an optimal management of micro fractures, without power loss. Back-contact cells are also the best choice when it comes to efficiency in low light and sensitivity at higher temperatures. In fact the temperature coefficient is 25% lower than the other cristalline cells.

Back-contact Cell

No grid lines on front of cell means no obstacles to the absorption of sunlight.
Maximum efficiency and great aesthetics.

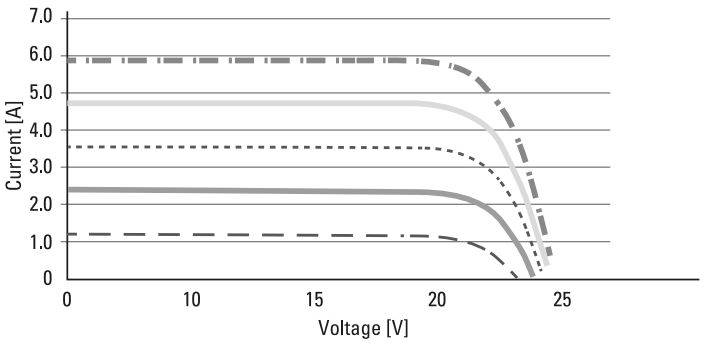
Solid copper backing.
Massive strength and resistance to corrosion.

Datasheet

	SP 144	SP 130	SP 118 L	SP 118 Q	SP 104	SP 78	SP 52 L	SP 52 Q
Maximum power (±5%) [W]	144	130	118	118	104	78	52	52
Length Y [mm]	1490	1363	1236	855	1109	855	1109	601
Width X [mm]	546	546	546	800	546	546	292	546
Thickness [mm]	2	2	2	2	2	2	2	2
Weight [kg]	1.90	1.70	1.60	1.60	1.40	1.10	0.80	0.80
Max power Voltage Vmp [V]	25.3	22.8	20.7	20.7	18.2	13.7	9.1	9.1
Max power Current Imp [A]	5.7	5.7	5.7	5.7	5.7	5.7	5.7	5.7
Open circuit voltage Voc [V]	30.0	27.3	24.5	24.5	21.8	16.4	10.9	10.9
Short circuit current Isc [A]	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
NOCT [°C]	45 ± 2	45 ± 2	45 ± 2	45 ± 2	45 ± 2	45 ± 2	45 ± 2	45 ± 2
Operating temperature [°C]	-40/+85	-40/+85	-40/+85	-40/+85	-40/+85	-40/+85	-40/+85	-40/+85
Temp. coeff. Pmax [%/°C]	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35
Temp. coeff. Voc [%/°C]	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28	-0.28
Temp. coeff. Isc [%/°C]	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Columns x Rows (cells n°)	4x11 (44)	4x10 (40)	4x9 (36)	6x6 (36)	4x8 (32)	4x6 (24)	2x8 (16)	4x4 (16)
Maximum system voltage [V]	1000 V	1000 V	1000 V	1000 V	1000 V	1000 V	1000 V	1000 V
Maximum reverse current [A]	12 A	12 A	12 A	12 A	12 A	12 A	12 A	12 A
Safety class	A	A	A	A	A	A	A	A

* Values at STC = Standard Test Conditions: (a) light Spectrum for an Air Mass of 1.5; (b) irradiance of 1000 W/m² with perpendicular incidence and (c) cell temperature of 25 °C. Measurements carried out according to the Standard IEC 61215 requirements.

Electrical Characteristics



Certifications

SOLBIAN

Sailectron GmbH | Graz, AUSTRIA | DE: +49 1520 4096530 | AT: +43 650 5709366 | info@solbian.solar | www.solbian.solar

Sunport

Flex Series

S6 · 305-325W High Efficiency Flexible PV Module
Mono 60 Cells

19.8%

Module efficiency up to 19.8%

Flexible PV Module

Light, Thin Design
1.4mm thickness, 4kg weight, leading level in PV industry

BIPV Application
Further integrate with buildings in terms of shape and installation for BIPV application

High Reliability
Conductive back sheet 2D encapsulation without soldering, resulted lower degradation under multiple extreme testing condition

Ultra Flexible
Ultra-thin silicon wafers with advanced organic polymer encapsulation materials, minimum bending radius reach 0.25m

High Efficiency
MWT back contact cell and modules with busbar-free design and higher efficiency

Lead Free
Eco-friendly PV design achieves Lead-free MWT module without soldering materials

MWT Back Contact Solar Cell

- New cell structure and different manufacturing process.
- No busbar on the front 3% less shadow and better use of sunlight.
- Effectively avoid the micro crack caused by the pressure between cell edge and ribbon.
- Compatible with other cell types including TOPCON, PERC, HIT, etc.

Comprehensive Qualifications & Certifications

★ ISO 9001: 2015 Quality Management System
★ ISO 14001: 2015 Environment Management System
★ ISO 45001: 2018 Occupation Health Safety Management System

Insured by PICC

PICC

Jiangsu Sunport Power Corp., Ltd
Add: No.20, Xishi Road, Xinwu District, Wuxi, China 214028 Email: info@sunportpower.com Web: www.sunportpower.com

Electrical Characteristics at Standard Test Conditions(STC)

Spec/Model	Unit	SPP305M60S	SPP310M60S	SPP315M60S	SPP320M60S	SPP325M60S
Max-Power(Pm)	W	305	310	315	320	325
Power Tolerance	W			0~+5		
Max-Power Voltage(Vm)	V	32.6	32.8	33.0	33.2	33.4
Max-Power Current(Im)	A	9.36	9.45	9.55	9.64	9.73
Open-Circuit Voltage(Voc)	V	39.7	39.9	40.1	40.3	40.5
Short-Circuit Current(Isc)	A	9.75	9.83	9.90	9.99	10.08
Module Efficiency(ηm)	%	18.6	18.9	19.2	19.5	19.8
STC: AM=1.5, Irradiation 1000W/m², Module Temperature 25°C						

Electrical Characteristics at Nominal Module Operating Temperature (NMOT)

Spec/Model	Unit	SPP305M60S	SPP310M60S	SPP315M60S	SPP320M60S	SPP325M60S
Max-Power(Pm)	W	228	232	236	240	244
Max-Power Voltage(Vm)	V	29.8	30.0	30.2	30.4	30.6
Max-Power Current(Im)	A	7.64	7.73	7.81	7.89	7.97
Open-Circuit Voltage(Voc)	V	36.4	36.5	36.6	36.7	36.8
Short-Circuit Current(Isc)	A	7.94	8.05	8.12	8.20	8.30
NMOT: Irradiation 800W/m², ambient temperature 20°C, Wind Speed 1m/s						

Temperature Coefficient

Nominal Module Operating Temperature	43±2°C
Temperature coefficient of Pmax	-0.36%/°C
Temperature coefficient of Voc	-0.28%/°C
Temperature coefficient of Isc	0.06%/°C

Operating Conditions

Max. system voltage	DC1000V(IEC)
Max. series fuse rating	15A
Operating temperature range	-40°C～+85°C
Bending radius	⩾0.20m

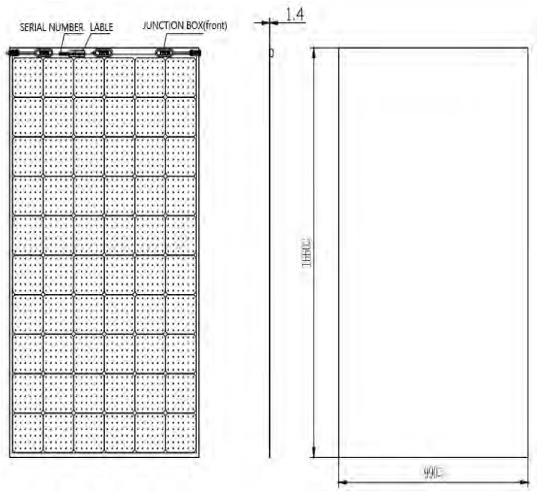
Mechanical Characteristics

Dimension(L×W×H)	1660mmx990mmx1.4mm
Weight	4.0 kg
Back material	Back Sheet(white, transparent, black)
Cell (quantity / material / type / dimensions)	60(10x6) / Monocrystalline / 158.75mm
Encapsulant	EVA
Frame	None
Junction box(protection degree)	IP68
Cable (length/cross-section area)	customizable / 4mm²
Connector	MC4 Compatible

Package

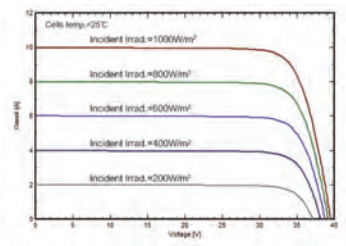
Container Size	Quantity(pcs)	Quantity(per pallet)
40' HC	1196	46

Module Size

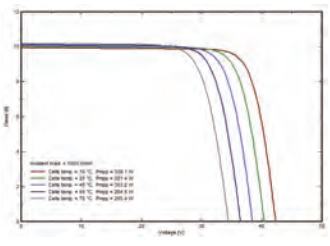


I-V Curve

I-V Curves of SPP320M60S at different irradiance



I-V Curves of SPP320M60S at different cell temperature

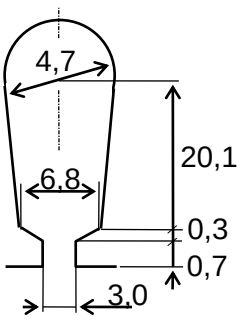


Typ:	Moc P_N	Rodzaj pracy	Napięcie U_N	Częst. f_N	Prędkość nN	Prędkość n_{max}	Prąd I_N	cos φ	Spraw η	I_l/I_N	T_l/T_N	T_{max}
Sm160-10out	kW	---	V	Hz	obr./min	obr./min	A	---	%	---	---	Nm
	2,0	S1	96Y	60	720	1000	13,4	1,00	90	---	---	72

Wyszczególnienie	*Stojan*	*Wirnik*
Gatunek blachy	M350 50A	
Średnica żelaza	227,6/155	260/229
Szczelina	0,7	
Długość żelaza	40	
Liczba żłobków	60	---
Rysunek blachy		
Wysięg połączeń czoł.		---
Rodzaj uzwojenia	dwuwarstwowe	magnesy trwałe
Klasa izolacji	F	---
Poskok uzwojenia	5	---
Liczba zwojów/fazę	160	liczba magnesów 20
Wymiary drutu	Ø1,40 i 1,50	magnesy wymiary 26,5 x 3,0 x 40 [szer. wys. dł.]
Izolacja drutu	DN2E	typ magnesów N40SH
Izolacja żłobkowa	0,20 mm	---
Wsp. zapełnienia żłobka	75%	---
Izolacja czół		---
Połączenia		---
Liczba obw. równol.	1	---
Liczba drutów równol.	2	---
Liczba przew. szer. w żł	16	---
Liczba drutów w żłobku	32	---
Masa miedzi	3,73 kg	---
Połączenie faz	Y	---
Rezyst. fazy przy 20°C	0,228 Ω	---
Schemat połączeń		---
Rysunek cewki		---
Rysunek uzwojenia		---
Średnia długość zwoju		---
Napięcie próbne	1,2 kV	---

Wymiary wykroju żłobków

Stojan:



Wirnik:

Uwagi:

- kierunek magnesowania magnesów wzdłuż wysokości
- zakupić min. 25 magnesów
- w jarzmie stojana nie robić otworów, ew. otwory robić w wypustkach pod jarzmem stojana
- do wirnika przykręcić z obu stron blachy z materiału niemagnetycznego zabezpieczające magnesy przed wysuwaniem się
- połączenie czołowe stojana: dł. części prostoliniowej 6,0 mm; promień gięcia 6,0 mm

Opracował:	25.07.2018	
Sprawdził:	25.07.2018	
Zatwierdził:	25.01.2018	

Zmiany:

Maciej Gwoździewicz

Sm160-10out