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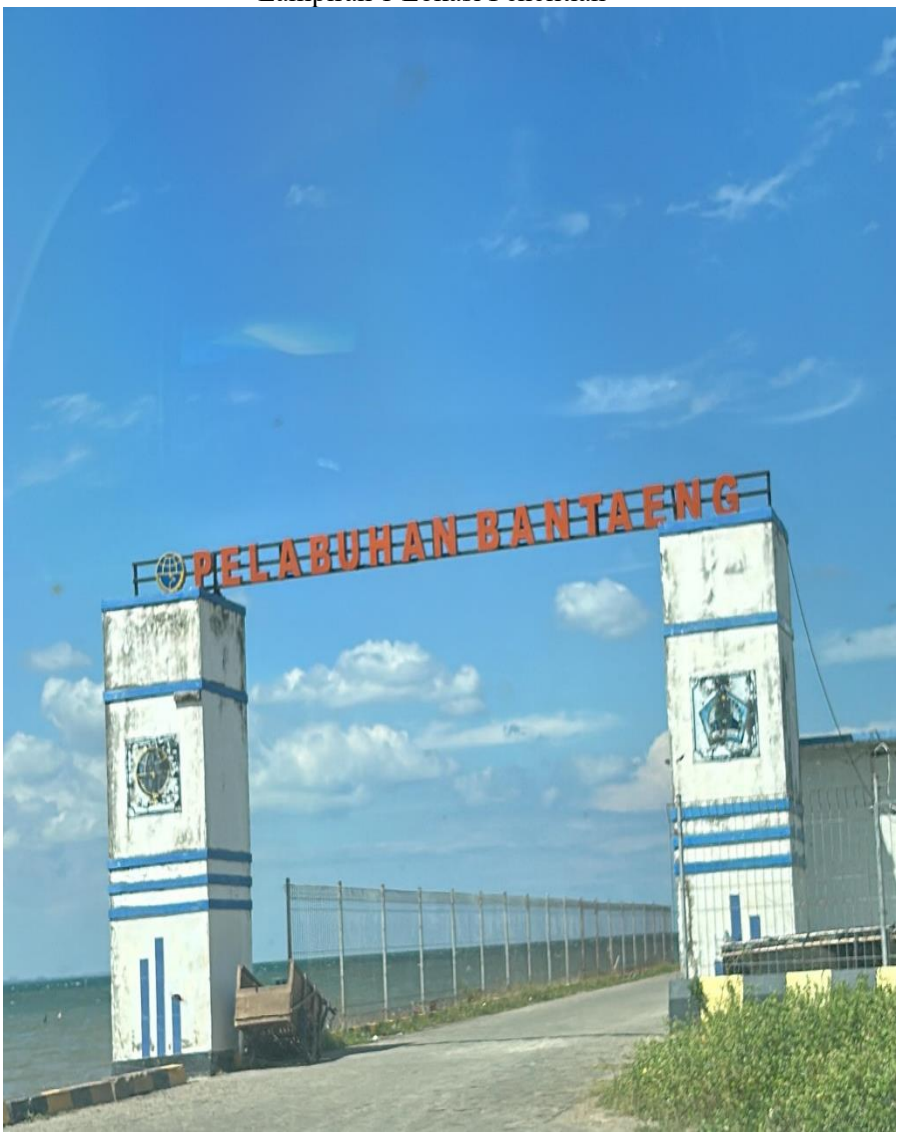
LAMPIRAN

Lampiran 1 Lokasi Penelitian



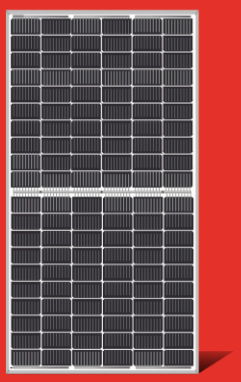
Lampiran 2 Terminal Penumpang

Lampiran 3 Spesifikasi Modul Surya

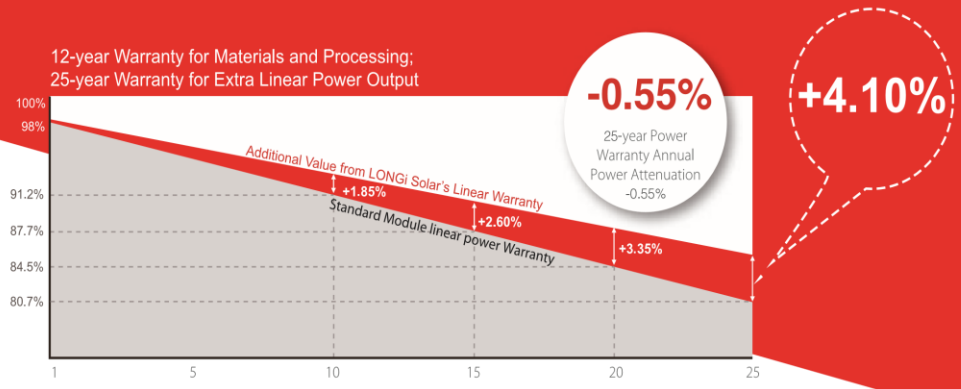
LR4-60HPH
350~380M

Hi-MO 4m
NEW

High Efficiency
Low LID Mono PERC with
Half-cut Technology



*Both 6BB & 9BB are available



Complete System and Product Certifications

IEC 61215, IEC 61730, UL 61730

ISO 9001:2008: ISO Quality Management System

ISO 14001: 2004: ISO Environment Management System

TS62941: Guideline for module design qualification and type approval

OHSAS 18001: 2007 Occupational Health and Safety

* Specifications subject to technical changes and tests.
LONGi Solar reserves the right of interpretation.

Positive power tolerance (0 ~ +5W) guaranteed

High module conversion efficiency (up to 20.9%)

Slower power degradation enabled by Low LID Mono PERC technology: first year <2%, 0.55% year 2-25

Solid PID resistance ensured by solar cell process optimization and careful module BOM selection

Reduced resistive loss with lower operating current

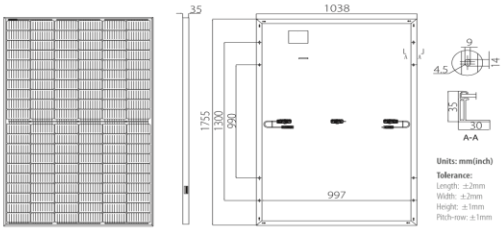
Higher energy yield with lower operating temperature

Reduced hot spot risk with optimized electrical design and lower operating current

Lampiran 4 *Datasheet* Modul Surya

LR4-60HPH 350~380M

Design (mm)



Mechanical Parameters

Cell Orientation: 120 (6×20)
Junction Box: IP68, three diodes
Output Cable: 4mm², 300mm in length, length can be customized
Glass: Single glass 3.2mm coated tempered glass
Frame: Anodized aluminum alloy frame
Weight: 19.5kg
Dimension: 1755×1038×35mm
Packaging: 30pcs per pallet
180pcs per 20'GP
780pcs per 40'HC

Operating Parameters

Operational Temperature: -40 ℃ ~+85 ℃
Power Output Tolerance: 0 ~ +5 W
Voc and Isc Tolerance: ±3%
Maximum System Voltage: DC1500V (IEC/UL)
Maximum Series Fuse Rating: 20A
Nominal Operating Cell Temperature: 45±2 ℃
Safety Class: Class Ⅱ
Fire Rating: UL type 1 or 2

Electrical Characteristics

Test uncertainty for Pmax: ±3%

Model Number	LR4-60HPH-350M		LR4-60HPH-355M		LR4-60HPH-360M		LR4-60HPH-365M		LR4-60HPH-370M		LR4-60HPH-375M		LR4-60HPH-380M	
Testing Condition	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax/W)	350	261.4	355	265.1	360	268.8	365	272.6	370	276.3	375	280.0	380	283.8
Open Circuit Voltage (Voc/V)	40.1	37.6	40.3	37.8	40.5	38.0	40.7	38.2	40.9	38.3	41.1	38.5	41.3	38.7
Short Circuit Current (Isc/A)	11.15	9.02	11.25	9.10	11.35	9.17	11.43	9.25	11.52	9.32	11.60	9.38	11.69	9.45
Voltage at Maximum Power (Vmp/V)	33.6	31.3	33.8	31.5	34.0	31.7	34.2	31.8	34.4	32.0	34.6	32.2	34.8	32.4
Current at Maximum Power (Imp/A)	10.42	8.35	10.51	8.43	10.59	8.49	10.68	8.56	10.76	8.63	10.84	8.69	10.92	8.76
Module Efficiency(%)	19.2		19.5		19.8		20.0		20.3		20.6		20.9	

STC (Standard Testing Conditions): Irradiance 1000W/m², Cell Temperature 25 ℃, Spectra at AM1.5

NOCT (Nominal Operating Cell Temperature): Irradiance 800W/m², Ambient Temperature 20 ℃, Spectra at AM1.5, Wind at 1m/S

Temperature Ratings (STC)

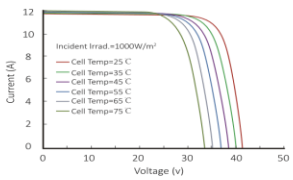
Temperature Coefficient of Isc	+0.048%/ ℃
Temperature Coefficient of Voc	-0.270%/ ℃
Temperature Coefficient of Pmax	-0.350%/ ℃

Mechanical Loading

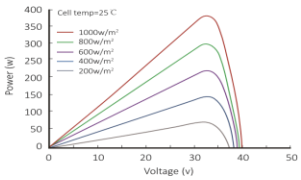
Front Side Maximum Static Loading	5400Pa
Rear Side Maximum Static Loading	2400Pa
Hailstone Test	25mm Hailstone at the speed of 23m/s

I-V Curve

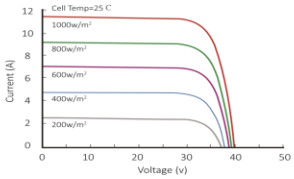
Current-Voltage Curve (LR4-60HPH-365M)



Power-Voltage Curve (LR4-60HPH-365M)



Current-Voltage Curve (LR4-60HPH-365M)



Lampiran 5 Spesifikasi Inverter

Lampiran 6 *Datasheet* Inverter

Technical Data	Sunny Tripower X 12	Sunny Tripower X 15	Sunny Tripower X 20	Sunny Tripower X 25
Input (DC)				
Max. PV array power	18000 Wp, STC	22500 Wp, STC	30000 Wp, STC	37500 Wp, STC
Max. input voltage	1000 V			
MPP voltage range	210 V to 800 V	260 V to 800 V	345 V to 800 V	430 V to 800 V
Rated input voltage	580 V			
Min. input voltage / initial input voltage	150 V / 188 V			
Max. usable input current per MPP tracker	24 A			
Max. short-circuit current per MPP tracker	37.5 A			
Number of independent MPP trackers / strings per MPP tracker	3 / 2			
Output (AC)				
Rated power (at 230 V, 50 Hz)	12000 W	15000 W	20000 W	25000 W
Rated apparent power / max. apparent power	12000 VA / 12000 VA	15000 VA / 15000 VA	20000 VA / 20000 VA	25000 VA / 25000 VA
Nominal AC voltage	220 V / 380 V; **230 V / 400 V**; 240 V / 4 15 V			
Voltage range	176 V to 275 V / 304 V to 477 V			
Grid frequency / range	50 Hz / 44 Hz to 56 Hz 60 Hz / 54 Hz to 66 Hz			
Rated grid frequency / rated grid voltage	50 Hz / 230 V			
Rated output current / max. output current	17.4 A / 20 A	21.7 A / 25 A	29 A / 36.6 A	36.2 A / 36.6 A
Feed-in phases / AC connection	3 / 3-(N)-PE			
Power factor at rated power / adjustable displacement power factor	1 / 0 overexcited to 0 underexcited			
Harmonic (THD)	< 3 %			
Efficiency				
Max. efficiency / European efficiency	98.2 % / 97.6 %	98.2 % / 97.8 %	98.2 % / 97.9 %	98.2 % / 98.0 %
Protective devices				
Protection class (according to IEC 62109-1) / overvoltage category (according to IEC 62109-1)	I / AC: III; DC: II			
General data				
Dimensions (W/H/D)	728 mm / 762 mm / 266 mm (28.7 in / 30.0 in / 10.5 in)			
Weight	35 kg (77 lbs)			
Operating temperature range	-25°C to +60°C (–13°F to +140°F)			
Noise emission, maximum (1 m)	59 dB(A)			
Self-consumption (night)	< 5 W			
Topology / cooling concept	No galvanic isolation / OptiCool			
Max. permissible value for relative humidity (non-condensing)	100 %			
System manager function				
Total number of supported devices – of which:	6			
Maximum number of supported SMA inverters / charging stations	5			
Maximum number of supported energy meters	1			
Maximum nominal system power of PV inverters (nominal AC power)	135 kVA			

Lampiran 7 Spesifikasi Baterai

victron energy
BLUE POWER

12,8 & 25,6 Volt Lithium-Iron-Phosphate Batteries Smart
With Bluetooth

www.victronenergy.com

12,8 V 330 Ah LiFePO4 Battery

VictronConnect App

Victron Energy Lithium Battery Smart batteries are Lithium Iron Phosphate (LiFePO4) batteries and are available in 12.8 V or 25.6 V in various capacities. They can be connected in series, parallel and series/parallel so that a battery bank can be built for system voltages of 12 V, 24 V or 48 V. The maximum number of batteries in one system is 20, which results in a maximum energy storage of 84 kWh in a 12 V system and up to 102 kWh in a 24 V[1)] and 48 V[1)] system.

A single LFP cell has a nominal voltage of 3.2 V. A 12.8 V battery consists of 4 cells connected in series and a 25.6 V battery consists of 8 cells connected in series.

Lampiran 8 *Datasheet* Baterai

Battery specification								
VOLTAGE AND CAPACITY	LFP-Smart 12,8/50	LFP-Smart 12,8/100	LFP-Smart 12,8/160	LFP-Smart 12,8/180	LFP-Smart 12,8/200	LFP- Smart 12,8/330	LFP- Smart 25,6/100	LFP-Smart 25,6/200-a
Nominal voltage	12,8 V	12,8 V	12,8 V	12,8 V	12,8 V	12,8 V	25,6 V	25,6 V
Nominal capacity @ 25 °C*	50 Ah	100 Ah	160 Ah	180 Ah	200 Ah	330 Ah	100 Ah	200 Ah
Nominal capacity @ 0 °C*	40 Ah	80 Ah	130 Ah	150 Ah	160 Ah	260 Ah	80 Ah	160 Ah
Nominal capacity @ -20 °C*	25 Ah	50 Ah	80 Ah	90 Ah	100 Ah	160 Ah	50 Ah	100 Ah
Nominal energy @ 25 °C*	640 Wh	1280 Wh	2048 Wh	2304 Wh	2560 Wh	4220 Wh	2560 Wh	5120 Wh
Capacity loss	(per 100 cycles, @ 25 °C, 100 % DoD): <1 %							
Energy loss	(per 100 cycles, @ 25 °C, 100 % DoD): <1 %							
Round trip efficiency	92 %							
*Discharge current ≤1C								
CYCLE LIFE (capacity ≥ 80 % of nominal)								
80 % DoD	2500 cycles							
70 % DoD	3000 cycles							
50 % DoD	5000 cycles							
DISCHARGE								
Maximum continuous discharge current	100 A	200 A	320 A	360 A	400 A	400 A	200 A	400 A
Recommended continuous discharge current	≤50 A	≤100 A	≤160 A	≤180 A	≤200 A	≤300 A	≤100 A	≤200 A
End of discharge voltage	11.2 V	11.2 V	11.2 V	11.2 V	11.2 V	11.2 V	22.4 V	22.4 V
Internal resistance	2 mΩ	0.8 mΩ	0.9 mΩ	0.9 mΩ	0.8 mΩ	0.8 mΩ	1.6 mΩ	1.5 mΩ
OPERATING CONDITIONS								
Operating temperature	Discharge: -20 °C to +50 °C Charge: +5 °C to +50 °C							
Storage temperature	-45 °C to +70 °C							
Humidity (non-condensing)	Max. 95 %							
Protection class	IP 22							
CHARGE								
Charge voltage	Between 14 V/28 V and 14,4 V/28,8 V (14,2 V/28,4 V recommended)							
Float voltage	13,5 V/27 V							
Maximum charge current	100 A	200 A	320 A	360 A	400 A	400 A	200 A	400 A
Recommended charge current	≤30 A	≤50 A	≤80 A	≤90 A	≤100 A	≤150 A	≤50 A	≤100 A
MOUNTING								
Can be placed on their sides	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	No[3]	Yes[2]	Yes[2]
OTHER								
Max storage time @ 25°C[1]	1 year							
BMS connection	Male + female cable with M8 circular connector, length 50 cm							
Max batteries per BMS	20 (102 kWh per BMS[4])							
Power connection (threaded inserts)	M8	M8	M8	M8	M8	M10	M8	M8
Dimensions (hxwxd) mm	199 x 188 x 147	197 x 321 x 152	237 x 321 x 152	237 x 321 x 152	237 x 321 x 152	265 x 359 x 206	197 x 650 x 163	237 x 650 x 163
Weight	7 kg	14 kg	18 kg	18 kg	20 kg	29 kg	28 kg	39 kg
STANDARDS								
Safety	Cells: UL1973 + IEC62619:2017 + UL9540A		Cells: IEC62133:2012		Cells: UL1973 + IEC62619:2017 + UL9540A Battery: IEC62619:2017 + IEC62620:2014	Cells: UL1642	Cells: UL1973 + UL9540A	Cells: UL1973 + IEC62619:2017 + UL9540A Battery: IEC62620:2014
	EN 60335-1:2012/AC:2014, EN-IEC 62368-1: 2020, IEC 61427-1:2013							
EMC	EN-IEC 61000-6-3:2007/A1:2011/AC:2012 - EN 55014-1:2017/A11:2020							
Automotive	ECE R10-6							

[1] When fully charged
[2] The lithium battery can be mounted upright and on its side, but not with the battery terminals facing down
[3] The 12,8V/330Ah lithium battery may only be mounted in an upright position
[4] Up to 5 BMS-es can be paralleled. For more info, please see the official release notes

Lampiran 9 SCC

Lampiran 10 *Datasheet* SCC

SmartSolar Charge Controller	MPPT 250/60	MPPT 250/70	MPPT 250/85	MPPT 250/100
Battery voltage	12 / 24 / 48V Auto Select (software tool needed to select 36V)			
Rated charge current	60A	70A	85A	100A
Nominal PV power, 12V 1a,b)	860W	1000W	1200W	1450W
Nominal PV power, 24V 1a,b)	1720W	2000W	2400W	2900W
Nominal PV power, 48V 1a,b)	3440W	4000W	4900W	5800W
Max. PV short circuit current 2)	35A (max 30A per MC4 conn.)		70A (max 30A per MC4 conn.)	
Maximum PV open circuit voltage	250V absolute maximum coldest conditions 245V start-up and operating maximum			
Maximum efficiency	99%			
Self-consumption	Less than 35mA @ 12V / 20mA @ 48V			
Charge voltage 'absorption'	Default setting: 14,4 / 28,8 / 43,2 / 57,6V (adjustable with: rotary switch, display, VE.Direct or Bluetooth)			
Charge voltage 'float'	Default setting: 13,8 / 27,6 / 41,4 / 55,2V (adjustable: rotary switch, display, VE.Direct or Bluetooth)			
Charge algorithm	multi-stage adaptive			
Temperature compensation	-16 mV / -32 mV / -64 mV / °C			
Protection	Battery reverse polarity (fuse, not user accessible) PV reverse polarity / Output short circuit / Over temperature			
Operating temperature	-30 to +60°C (full rated output up to 40°C)			
Humidity	95%, non-condensing			
Data communication port	VE.Direct or Bluetooth			
Remote on/off	Yes (2 pole connector)			
Programmable relay	DPST AC rating: 240VAC / 4A DC rating: 4A up to 35VDC, 1A up to 60VDC			
Parallel operation	Yes (not synchronized)			
ENCLOSURE				
Colour	Blue (RAL 5012)			
PV terminals 3)	35 mm² / AWG2 (Tr models) Two sets of MC4 connectors (MC4 models 250/60 and 250/70) Three sets of MC4 connectors (MC4 models 250/85 and 250/100)			
Battery terminals	35 mm² / AWG2			
Protection category	IP43 (electronic components), IP22 (connection area)			
Weight	3 kg		4,5 kg	
Dimensions (h x w x d) in mm	Tr models: 185 x 250 x 95 MC4 models: 215 x 250 x 95		Tr models: 216 x 295 x 103 MC4 models: 246 x 295 x 103	

Lampiran 11 kWh Meter Exim

Lampiran 12 Spesifikasi kWh Meter Exim

General Specifications

Voltage AC (Un)	230V
Voltage Range	100-240V(L~N)
Base Current (Ib)	10A
Max. Current (Imax)	100A
Mini Current (Imin)	0.5A
Starting Current	0.4% of Ib
Power Consumption	<2W/10VA
Frequency	50/60Hz(±10%)
AC Voltage Withstand	4KV for 1 minute
Impulse Voltage Withstand	6KV-1.2uS waveform
Overcurrent Withstand	30 Imax for 0.01s
Display	LCD with white backlit
Max. Reading	999999.9 kWh/kVArh

Accuracy

Voltage	0.5% of range maximum
Current	0.5% of nominal
Frequency	0.2% of mid-frequency
Power factor	1% of Unity
Active power	1% of range maximum
Reactive power	1% of range maximum
Apparent power	1% of range maximum
Active energy	Class 1 IEC62053-21
Reactive energy	Class 2 IEC62053-23

Environment

Operating temperature	-25℃ to +55℃

Lampiran 13 *Run Simulation* PVSyst