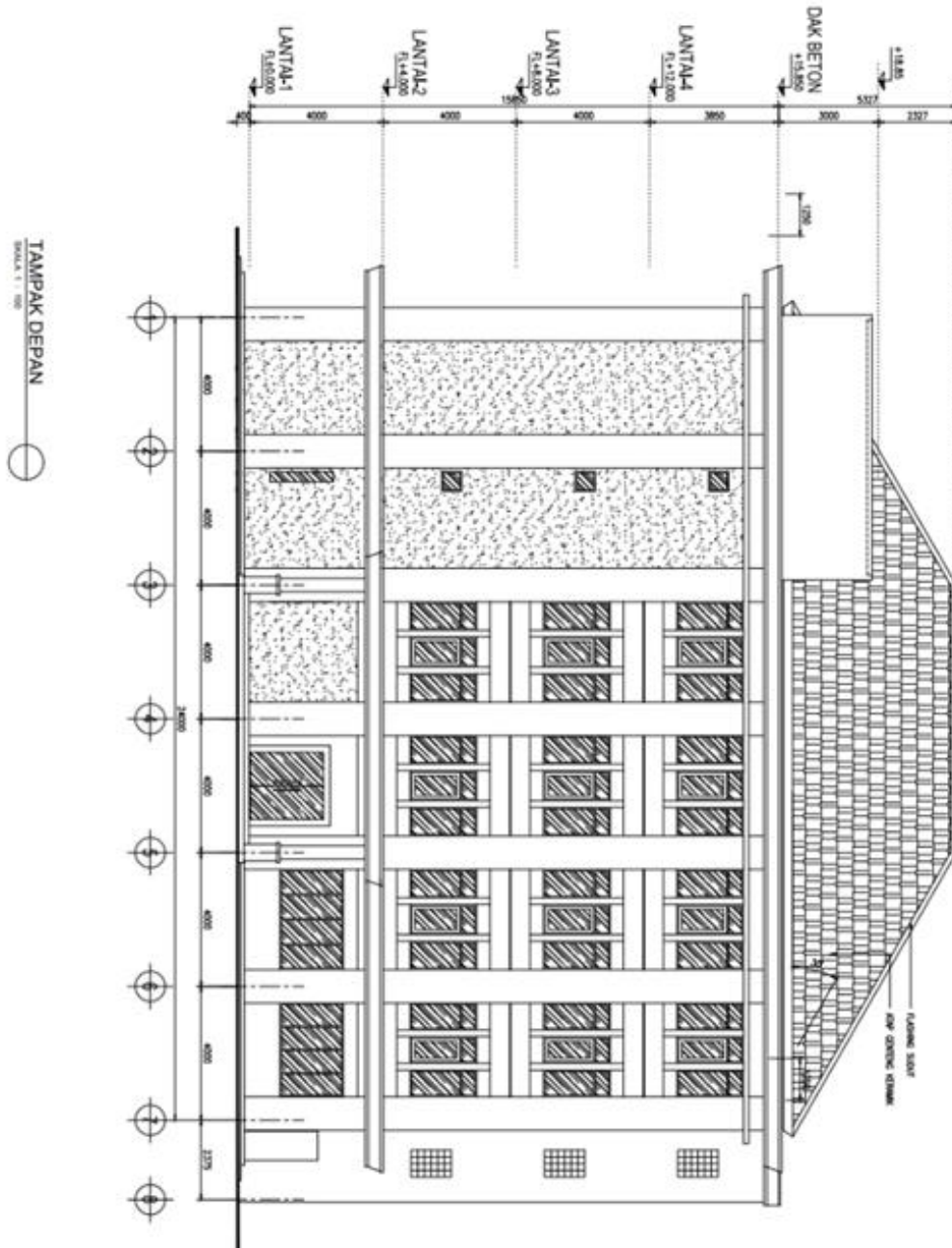


# LAMPIRAN

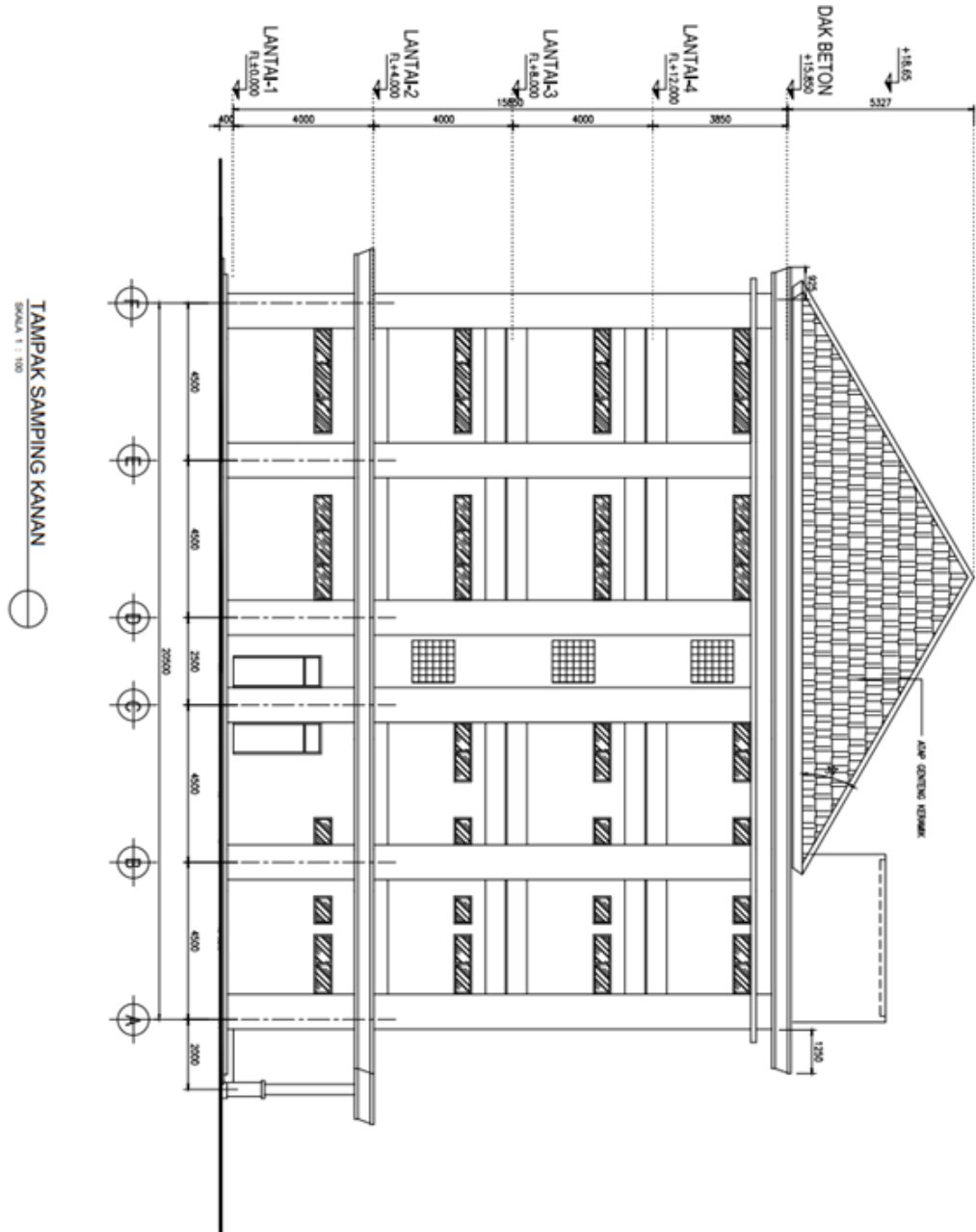
## Lampiran 1

### DATA LOKASI PENELITIAN

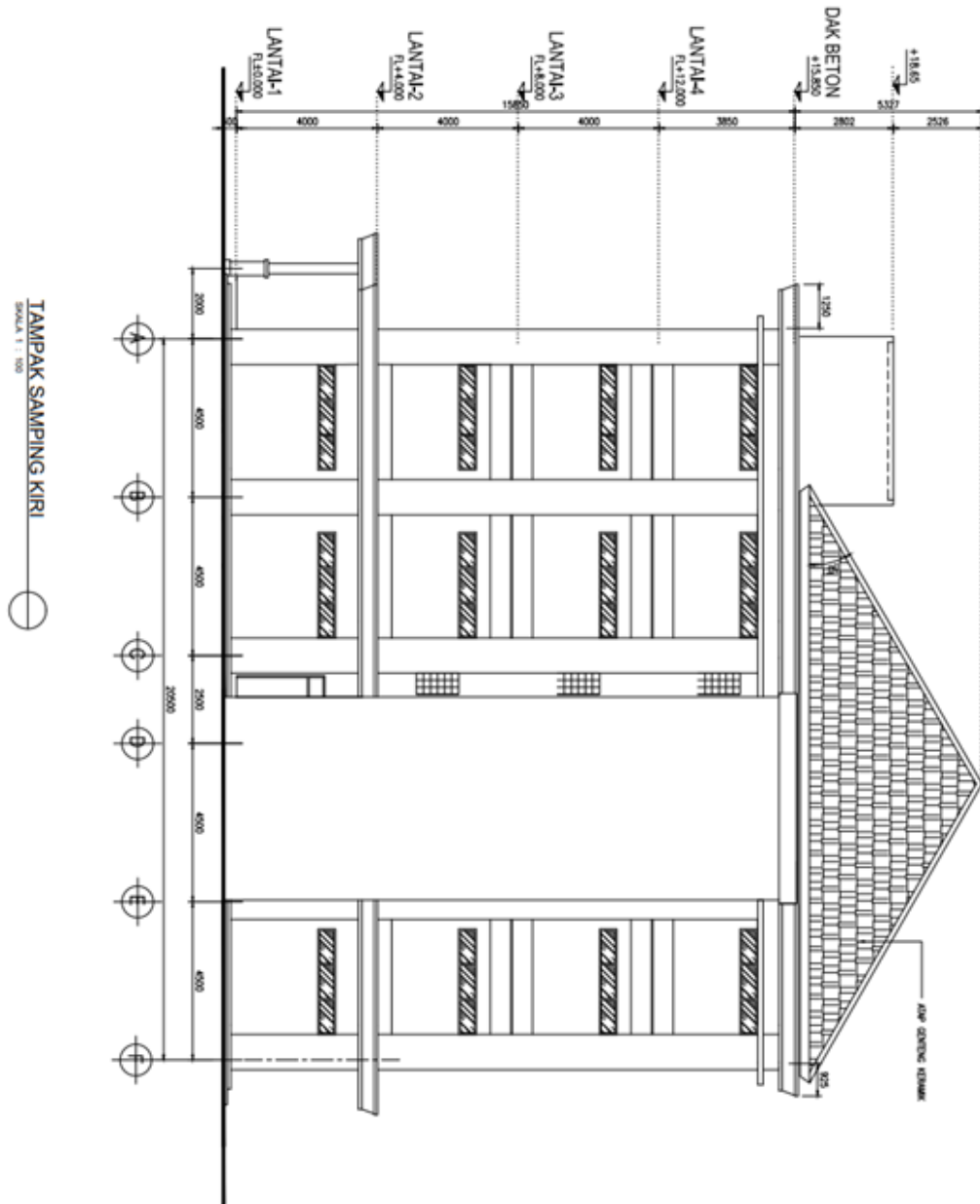
Tampak Depan Gedung Fakultas Pertanian Universitas Siliwangi Mugarsari



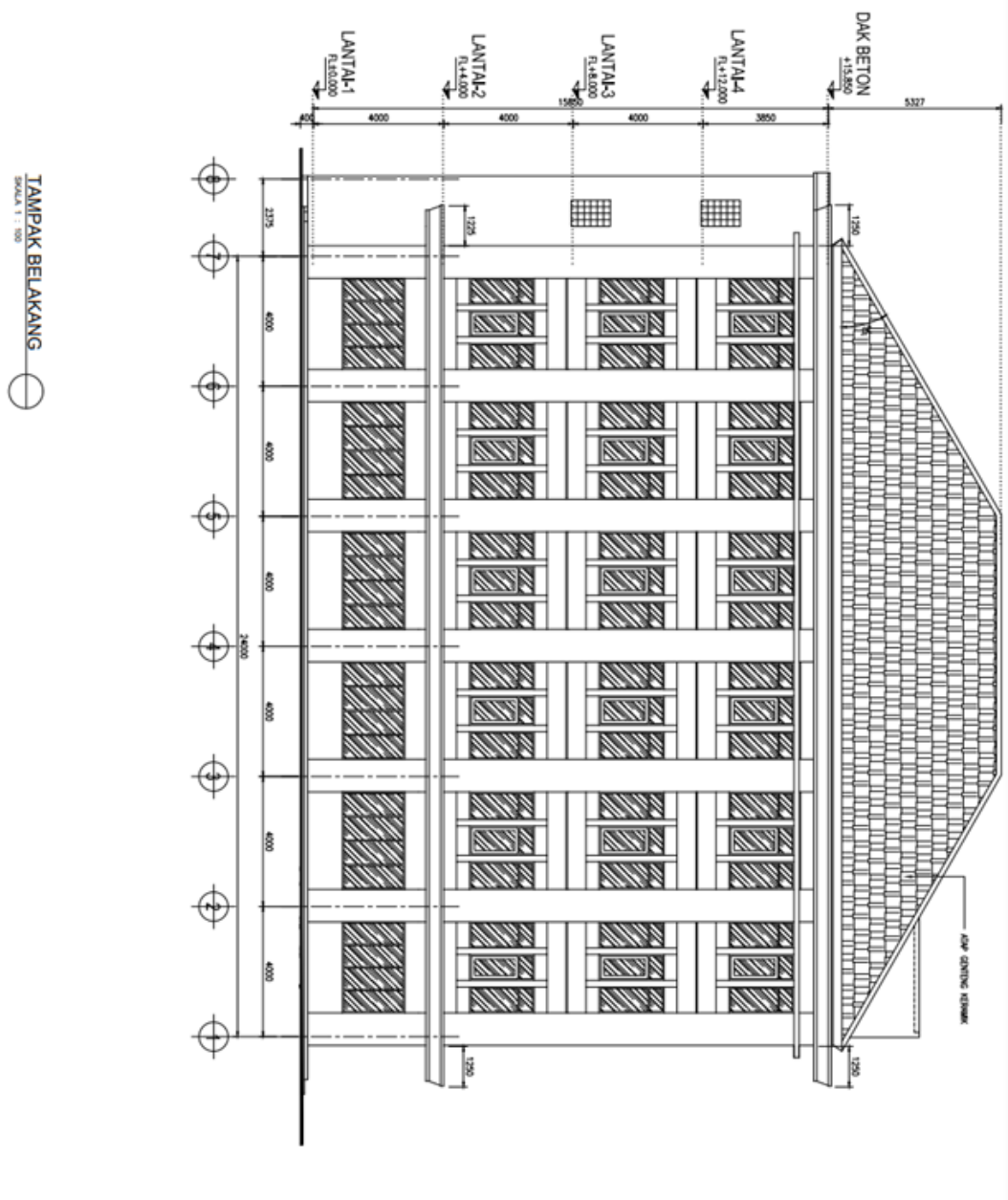
Tampak Samping Kanan Gedung Fakultas Pertanian Universitas Siliwangi  
Mugarsari



Tampak Samping Kiri Gedung Fakultas Pertanian Universitas Siliwangi  
Mugarsari

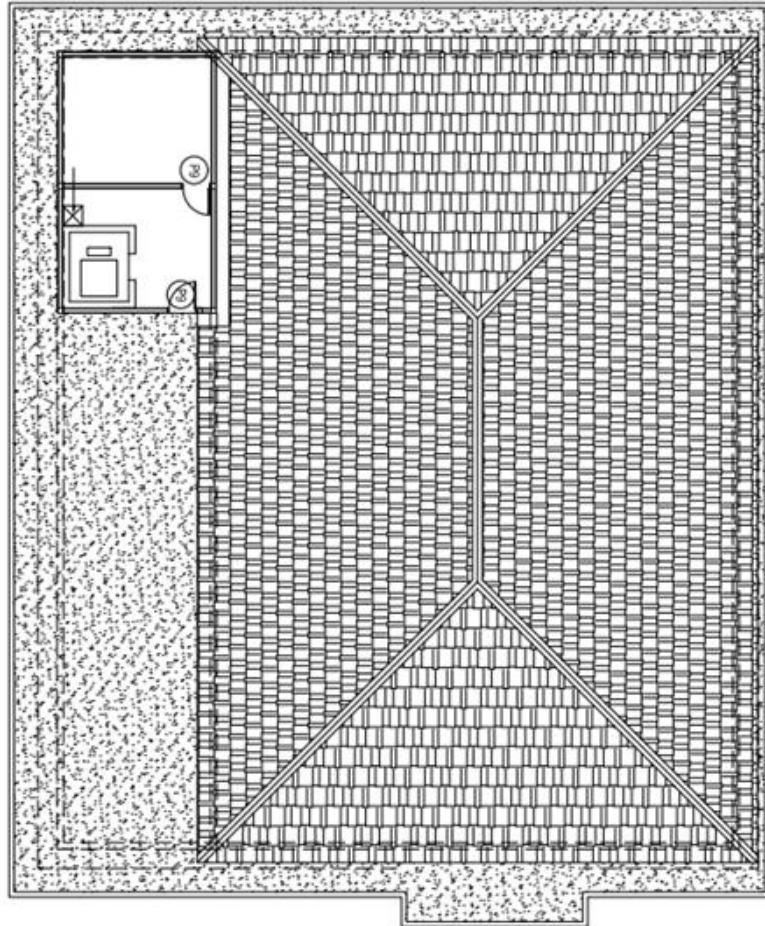


Tampak Belakang Gedung Fakultas Pertanian Universitas Siliwangi Mugarsari



Denah Lantai Atap Gedung Fakultas Pertanian Universitas Siliwangi Mugarsari

DENAH LANTAI ATAP  
SKALA 1 : 150



## Lampiran 2

**DATA PENGUKURAN PENGGUNAAN ENERGI HARIAN GEDUNG  
FAKULTAS PERTANIAN UNIVERSITAS SILIWANGI MUGARSARI**

<b>Data Pengukuran Penggunaan Energi Harian (Wh)</b>					
<b>Waktu</b>	<b>Hari</b>				
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
0.00	150430	380430	14002	94744	279290
1.00	160220	387910	17068	97214	281470
2.00	169810	395090	20554	99579	283930
3.00	178900	402020	23799	102400	285940
4.00	187330	408420	26419	104860	288170
5.00	196210	415670	29465	107580	289840
6.00	204070	421850	31901	110190	291490
7.00	212140	428100	34603	112200	293330
8.00	222930	432650	36985	113560	295600
9.00	236660	437930	42274	115760	303660
10.00	251000	443150	47776	117750	313660
11.00	265930	447880	53307	119930	324380
12.00	280370	452660	57878	121970	336100
13.00	293810	457900	63820	124360	345280
14.00	305830	461250	69195	126810	352350
15.00	314560	464080	72502	129170	359530
16.00	321890	467420	74657	131650	363180
17.00	328240	471200	76643	134320	365710
18.00	334930	474940	78733	136630	368580

19.00	342220	478790	81721	139850	372170
20.00	349810	482490	84523	143270	375650
21.00	357710	486370	87334	146600	379750
22.00	365150	491088	89514	149930	383300
23.00	372890	495869	91970	153220	387530
<b>Rata-Rata (Wh)</b>	<b>266793,3</b>	<b>445215</b>	<b>54443,5</b>	<b>122231</b>	<b>329995</b>

### Rata-rata harian penggunaan energi Listrik

$$\begin{aligned}
 &= \frac{\text{jumlah rata - rata per hari}}{\text{jumlah hari}} \\
 &= \frac{266793,3 + 445215 + 54443,5 + 122231 + 329995}{5} \\
 &= \frac{1.218.677,8}{5} \\
 &= 243.735,56 \text{ Wh/hari} \\
 &= 243,73 \text{ kWh/hari}
 \end{aligned}$$

### Rata-rata tahunan penggunaan energi Listrik

$$\begin{aligned}
 &= \text{rata - rata harian} \times \text{banyaknya hari kerja} \\
 &= 243,73 \times 172 \text{ hari} \\
 &= 41.922,51 \text{ kWh/tahun} \\
 &= 41,922 \text{ MWh/tahun}
 \end{aligned}$$

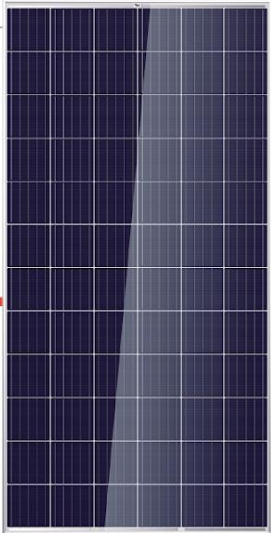
Lampiran 3

SPESIFIKASI PANEL SURYA

Mono **Multi** Solutions

# THE TALLMAX

FRAMED 72-CELL MODULE



**72 CELL**  
MULTICRYSTALLINE MODULE

---

**320-340W**  
POWER OUTPUT RANGE

---

**17.5%**  
MAXIMUM EFFICIENCY

---

**0~+5W**  
POSITIVE POWER TOLERANCE

**Ideal for large scale installations**

- High power footprint reduces installation time and BOS costs
- 1000V UL/1000V IEC certified

---

**One of the industry's most trusted modules**

- Field proven performance
- Strong, reliable supplier

---

**Highly reliable due to stringent quality control**

- Over 30 in-house tests (UV, TC, HF, and many more)
- In-house testing goes well beyond certification requirements
- PID resistant
- 100% EL double inspection




---




**Certified to withstand the most challenging environmental conditions**

- 2400 Pa wind load
- 5400 Pa snow load
- 35 mm hail stones at 97 km/h

**Comprehensive Products And System Certificates**

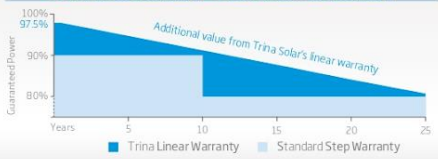
IEC61215/IEC61730/UL1703/IEC61701/IEC62716  
 ISO 9001: Quality Management System  
 ISO 14001: Environmental Management System  
 ISO 14064: Greenhouse gases Emissions Verification  
 OHSAS 18001: Occupation Health and Safety Management System






**LINEAR PERFORMANCE WARRANTY**

10 Year Product Warranty - 25 Year Linear Power Warranty



Years	Standard Step Warranty (%)	Trina Linear Warranty (%)
0	100%	100%
5	100%	97.5%
10	90%	95%
15	90%	92.5%
20	90%	90%
25	90%	80%







Lampiran 4

SPESIFIKASI INVERTER

The heart of the photovoltaic system

01 Maximum flexibility

With the Fronius GEN24 Plus as the heart of the photovoltaic system, you will do a whole lot more than launch your own personal energy revolution; you will also gain access to all the possibilities and benefits of solar energy.

02 Backup power for every situation

Your energy supply must be reliable: with the Fronius GEN24 Plus, you can choose either "PV Point" or "Full Backup", a backup power supply for the entire household.

03 Easy installation

Save time and money: fast and safe installation with 180° quick-fastener screws, push-in spring terminals, and a well-designed wall assembly system.

04 Support and tools

Never-ending support: free and efficient Fronius solutions are available for planning, installation, and system monitoring. This increases customer satisfaction and minimizes maintenance effort.

Fronius GEN24 Plus\* | Backup power versions | Battery connection

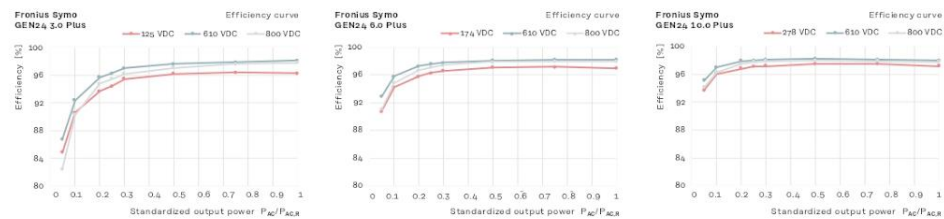
\* The Full Backup option is available for the Primo GEN24 3.0–6.0 Plus and the Symo GEN24 6.0–10.0 Plus.



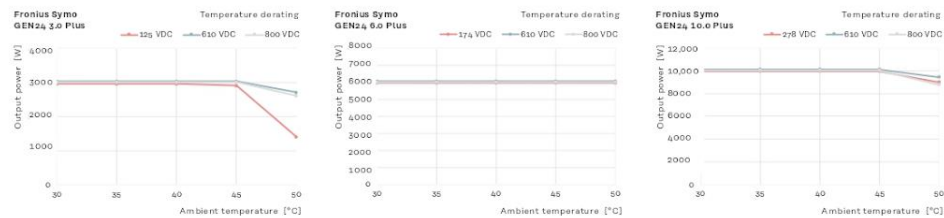
Impressive power data

The Fronius GEN24 Plus impresses with premium efficiency and maximum power at high temperatures.

Efficiency



Power derating



## Technical data

### 3.0 / 4.0 / 5.0 kW

			Symo GEN24 Plus							
			3.0		4.0		5.0			
Input data	Number of MPP trackers		2		2		2			
	DC input voltage range ( $U_{dc\ min} - U_{dc\ max}$ )	V	80 - 1,000		80 - 1,000		80 - 1,000			
	Nominal input voltage ( $U_{dc,r}$ )	V	610		610		610			
	Feed-in start-up input voltage ( $U_{dc\ start}$ )	V	80		80		80			
	Usable MPP voltage range	V	80 - 800		80 - 800		80 - 800			
			MPPT1	MPPT2	MPPT1	MPPT2	MPPT1	MPPT2		
	Max. usable input current ( $I_{dc\ max}$ )	A	12.5	12.5	12.5	12.5	12.5	12.5		
	Max. array short circuit current ( $I_{sc\ pv}$ ) <sup>1</sup>	A	20	20	20	20	20	20		
	Number of DC connections		2		1		2		1	
			MPPT1	MPPT2	Total	MPPT1	MPPT2	Total	MPPT1	MPPT2
Max. usable DC power	W	3,150	3,150	3,150	4,180	4,180	5,200	5,200	5,200	
Max. PV generator output	W <sub>peak</sub>	4,500	4,500	4,500	6,000	6,000	6,000	6,500	6,500	7,500
Output data	AC rated power ( $P_{ac,r}$ )	W	3,000		4,000		5,000			
	Apparent power	VA	3,000		4,000		5,000			
	Max. output power	VA	3,000		4,000		5,000			
			380 V <sub>AC</sub>	400 V <sub>AC</sub>	380 V <sub>AC</sub>	400 V <sub>AC</sub>	380 V <sub>AC</sub>	400 V <sub>AC</sub>		
	Nom. AC output current (@ 220/230 V)	A	4.5	4.3	6.1	5.8	7.6	7.2		
	Grid connection ( $U_{ac,r}$ )	V	3- EN 400/230 or 3- EN 380/220 (+20%/-30%)							
	Frequency (frequency range $f_{min} - f_{max}$ )	Hz	50/60 (45 - 65)							
	Total harmonic distortion	%	< 3.5							
Power factor ( $\cos \varphi_{ac,r}$ )		0.7 - 1 ind./cap.								
Output data PV Point	Nom. output power PV Point	VA	3,000		3,000		3,000			
	Grid connection PV Point	V	1- EN 220/230							
	Switching time	sec.	< 20							
Output data Full Backup <sup>2</sup>	Nom. output power Full Backup	VA	The Full Backup backup power function is available for the Symo GEN24 6.0-10.0 Plus.							
	Nominal phase power Full Backup	VA								
	Grid connection Full Backup	V								
	Switching time	sec.								
Battery connection	Number of DC inputs		1		1		1			
	Max. input current ( $I_{dc\ max}$ )	A	12.5		12.5		12.5			
	DC input voltage range ( $U_{dc\ min} - U_{dc\ max}$ )	V	160 - 531		160 - 531		160 - 531			
	DC battery connection technology		1x BATT+ and 1x BATT- push-in spring terminals 2.5 - 10 mm <sup>2</sup>							
	Max. DC input/output power <sup>3</sup>	W	3,150		4,180		5,200			
	Max. charging power for AC coupling <sup>3</sup>	W	3,000		4,000		5,000			
	Compatible batteries <sup>4</sup>		BYD Battery-Box Premium HVS/HVM <sup>5</sup> & LG RESU FLEX							

<sup>1</sup>  $I_{sc\ pv} = I_{sc\ max} \approx I_{sc} (STC) \times 1.25$  according to e.g. IEC 60364-7-712, NEC 2020, AS/NZS 5033:2021.

<sup>2</sup> The Full Backup option is available for the Symo GEN24 6.0-10.0 Plus. Additional external components for grid switchover are required for the Full Backup. See the Operating Instructions for further details.

<sup>3</sup> Depending on connected battery

<sup>4</sup> Depending on the country-specific certification and availability

<sup>5</sup> Excluding BYD Battery-Box Premium HVS 12.8 and HVM 8.3

Fronius GEN24 Plus. Designed to empower.

		Symo GEN24 Plus			
		3.0	4.0	5.0	
General data	Dimensions (height × width × depth)	mm	530 × 474 × 165		
	Weight (inverter/with packaging)	kg	15.6/19.4	15.6/19.4	15.6/19.4
	Protection class		IP 66	IP 66	IP 66
	Safety class		1	1	1
	Night consumption	W	<10	<10	<10
	Overvoltage category (DC/AC)*		2/3	2/3	2/3
	Inverter concept		Transformerless		
	Cooling		Active Cooling Technology		
	Installation		Indoor and outdoor installation		
	Ambient temperature range	°C	-25 to +60	-25 to +60	-25 to +60
	Permissible humidity	%	0 - 100	0 - 100	0 - 100
	Noise emissions	dB (A)	< 36	< 36	< 36
	Max. altitude above sea level	m	3,000/4,000 (unrestricted/restricted voltage range)		
	DC connection technology PV		3x DC+ and 3x DC- push-in spring terminals 2.5 - 10 mm <sup>2</sup>		
	AC connection technology		5-pin AC push-in spring terminals 1.5 - 10 mm <sup>2</sup> 3-pin backup power push-in spring terminals 1.5 - 10 mm <sup>2</sup> 5x PE screw terminals 2.5 - 16 mm <sup>2</sup>		
	Certificates and compliance with standards <sup>§</sup>		IEC 62109, IEC 62116, IEC 61727, IEC 62909, VDE 0126, VDE AR-N4105, AS/NZS 4777.2, EN 50549, CEI 0-21, G98/G99, R25		
Backup power functions		PV Point			
Country of manufacture		Austria			
Life cycle analysis		In accordance with ÖNORM EN ISO 14040 and 14044 (checked by employees from Fraunhofer IZM)			
Efficiency	Max. efficiency	%	98.1	98.2	98.2
	Euro. efficiency (η <sub>EU</sub> )	%	96.7	97.2	97.5
	MPP adaptation efficiency	%	> 99.9	> 99.9	> 99.9
Protection devices	DC isolation measurement		Integrated		
	Overload performance		Operating point shift, power limiter		
	DC disconnecter		Integrated		
	Reverse polarity protection		Integrated		
Interfaces	WLAN / 2 × Ethernet LAN		Fronius Solar.web, Modbus TCP SunSpec, Fronius Solar API (JSON)		
	6 digital inputs 6 digital inputs/outputs		Connection to ripple control receiver, energy management		
	Emergency shut-off (WSD)		Integrated		
	Datalogger and web server		Integrated		
	2 × RS485		Modbus RTU SunSpec (third-party provider)/Fronius Smart Meter, battery, Fronius Ohmpilot		

<sup>§</sup> In line with IEC 62109-1. Option to retrofit surge protection device DC SPD type 1+2 for 2 MPP trackers available under the following item number: 4,240,313,CK

<sup>†</sup> You can find the current certificates under [www.fronius.com/symo-gen24-plus-cert](http://www.fronius.com/symo-gen24-plus-cert)

For further information on the availability of the inverters in your country, please visit [www.fronius.com](http://www.fronius.com).

## Technical data

### 6.0 / 8.0 / 10.0 kW

		Symo GEN24 Plus									
		6.0			8.0			10.0			
Input data	Number of MPP trackers		2			2			2		
	DC input voltage range (U <sub>dc min</sub> - U <sub>dc max</sub> )	V	80 - 1,000			80 - 1,000			80 - 1,000		
	Nominal input voltage (U <sub>dc,r</sub> )	V	610			610			610		
	Feed-in start-up input voltage (U <sub>dc start</sub> )	V	80			80			80		
	Usable MPP voltage range	V	80 - 800			80 - 800			80 - 800		
			MPPT1	MPPT2	Total	MPPT1	MPPT2	Total	MPPT1	MPPT2	Total
	Max. usable input current (I <sub>dc max</sub> )	A	25	12.5		25	12.5		25	12.5	
	Max. array short circuit current (I <sub>sc pv</sub> ) <sup>1</sup>	A	40	20		40	20		40	20	
	Number of DC connections		2	1		2	1		2	1	
			MPPT1	MPPT2	Total	MPPT1	MPPT2	Total	MPPT1	MPPT2	Total
Max. usable DC power	W	6,220	6,000	6,220	8,260	6,000	8,260	10,300	6,000	10,300	
Max. PV generator output	W <sub>peak</sub>	7,500	6,500	9,000	10,000	7,000	12,000	12,500	7,500	15,000	
Output data	AC rated power (P <sub>ac,r</sub> )	W	6,000			8,000			10,000		
	Apparent power	VA	6,000			8,000			10,000		
	Max. output power	VA	6,000			8,000			10,000		
			380 VAC	400 VAC		380 VAC	400 VAC		380 VAC	400 VAC	
	Nom. AC output current (@ 220/230 V)	A	9.1	8.7		12.1	11.6		15.2	14.5	
	Grid connection (U <sub>ac,r</sub> )	V	3~ NPE 400/230 or 3~ NPE 380/220 (+20%/-30%)								
	Frequency (frequency range f <sub>min</sub> - f <sub>max</sub> )	Hz	50/60 (45 - 65)								
	Total harmonic distortion	%	< 3.5								
Power factor (cos φ <sub>ac,r</sub> )		0.7 - 1 ind /cap									
Output data PV Point	Nom. output power PV Point	VA	3,000			3,000			3,000		
	Grid connection PV Point	V	1~ NPE 220/230								
	Switching time	sec.	< 20								
Output data Full Backup <sup>2</sup>	Nom. output power Full Backup	VA	6,000			8,000			10,000		
	Nominal phase power Full Backup	VA	3,680			3,680			3,680		
	Grid connection Full Backup	V	3~ NPE 400/230 or 3~ NPE 380/220								
	Switching time	sec.	< 35								
Battery connection	Number of DC inputs		1			1			1		
	Max. input current (I <sub>dc max</sub> )	A	22			22			22		
	DC input voltage range (U <sub>dc min</sub> - U <sub>dc max</sub> )	V	160 - 531			160 - 531			160 - 531		
	DC battery connection technology		1x BATT+ and 1x BATT- push-in spring terminals 2.5 - 10 mm <sup>2</sup>								
	Max. DC input/output power <sup>3</sup>	W	6,220			8,260			10,300		
	Max. charging power for AC coupling <sup>3</sup>	W	6,000			8,000			10,000		
Compatible batteries <sup>4</sup>		BYD Battery-Box Premium HVS/HVM <sup>5</sup> & LG RESU FLEX									

<sup>1</sup> I<sub>sc pv</sub> = I<sub>sc max</sub> ≥ I<sub>sc (STC)</sub> x 1.25 according to e.g. IEC 60364-7-712, NEC 2020, AS/NZS 5033:2021.

<sup>2</sup> The Full Backup option is available for the Symo GEN24 6.0-10.0 Plus. Additional external components for grid switchover are required for the Full Backup. See the Operating Instructions for further details.

<sup>3</sup> Depending on connected battery

<sup>4</sup> Depending on the country-specific certification and availability

<sup>5</sup> Excluding BYD Battery-Box Premium HVS 12.8 and HVM 8.3

Fronius GEN24 Plus. Designed to empower.

			Symo GEN24 Plus		
			6.0	8.0	10.0
<b>General data</b>	Dimensions (height × width × depth)	mm	595 × 529 × 180		
	Weight (inverter/with packaging)	kg	23.4/28.5		
	Protection class		IP 66	IP 66	IP 66
	Safety class		1	1	1
	Night consumption	W	<10	<10	<10
	Overvoltage category (DC/AC)*		2/3	2/3	2/3
	Inverter concept		Transformerless		
	Cooling		Active Cooling technology		
	Installation		Indoor and outdoor installation		
	Ambient temperature range	°C	-25 to +60	-25 to +60	-25 to +60
	Permissible humidity	%	0 - 100	0 - 100	0 - 100
	Noise emissions	dB (A)	< 47	< 47	< 47
	Max. altitude above sea level	m	3,000/4,000 (unrestricted/restricted voltage range)		
	DC connection technology PV		3x DC+ and 3x DC- push-in spring terminals 2.5 - 10 mm <sup>2</sup>		
	AC connection technology		5-pin AC push-in spring terminals 1.5 - 10 mm <sup>2</sup> 3-pin backup power push-in spring terminals 1.5 - 10 mm <sup>2</sup> 5x PE screw terminals 2.5 - 16 mm <sup>2</sup>		
	Certificates and compliance with standards <sup>7</sup>		IEC 62109, IEC 62116, IEC 61727, IEC 62909, VDE 0126, VDE AR-N4105, AS/NZS 4777.2, EN 50549, CEI 0-21, G98/G99, R25		
Backup power functions		PV Point			
Country of manufacture		Austria			
Life cycle analysis		In accordance with ÖNORM EN ISO 14040 and 14044 (checked by employees from Fraunhofer IZM)			
<b>Efficiency</b>	Max. efficiency	%	98.2	98.2	98.2
	Euro. efficiency (η <sub>EU</sub> )	%	97.7	97.8	97.9
	MPP adaptation efficiency	%	> 99.9	> 99.9	> 99.9
<b>Protection devices</b>	DC isolation measurement		Integrated		
	Overload performance		Operating point shift, power limiter		
	DC disconnect		Integrated		
	Reverse polarity protection		Integrated		
<b>Interfaces</b>	WLAN / 2 × Ethernet LAN		Fronius Solarweb, Modbus TCP SunSpec, Fronius Solar API (JSON)		
	6 digital inputs 6 digital inputs/outputs		Connection to ripple control receiver, energy management		
	Emergency shut-off (WSD)		Integrated		
	Datalogger and web server		Integrated		
	2 × RS485		Modbus RTU SunSpec (third-party provider)/Fronius Smart Meter, battery, Fronius Ohmpilot		

\* In line with IEC 62109-1. Option to retrofit surge protection device DC SPD type 1+2 for 2 MPP trackers available under the following item number: 4.240.313.CK

<sup>7</sup> You can find the current certificates under [www.fronius.com/symo-gen24-plus-cert](http://www.fronius.com/symo-gen24-plus-cert)

For further information on the availability of the inverters in your country, please visit [www.fronius.com](http://www.fronius.com).

For further information, please visit [www.fronius.com/gen24-residential](http://www.fronius.com/gen24-residential)

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