

Stringing report

A planning estimate for the electrician · Exempelvägen 2, Stockholm

1. Summary

3 strings · all 30 panels wired · voltages OK in cold and heat · 77 m cable

- 3 strings · all 30 panels wired
- Voltages OK in cold and heat
- DC cable about 77 m · AC cable 3 m

30 panels · 12.60 kWp

- south-west roof · pitch 33° · 13 panels
- north-east roof · pitch 31° · 8 panels
- south-east roof · pitch 31° · 5 panels
- north-west roof · pitch 31° · 4 panels

Inverter: 2 × 6 kW three-phase (example)

String	Panels	Roof	Input	Voc cold (−25 °C)	Vmp hot (+70 °C)	Isc	DC cable
 S1	13	south-west	1	556 V	362 V	17.3 A	24.6 m
 S2	8	north-east	2	342 V	223 V	17.3 A	24.9 m
 S3	9	south-east + north-west	3	385 V	250 V	17.3 A	27.2 m

- The south-east and north-west panels share one string. They give about 16.4 % less. Optimizers or micro-inverters avoid this.

2. Module and inverter

Default module profile

Power (STC)	420 W
Voc	38.0 V *
Vmp	32.0 V *
Isc	13.8 A *
Imp	13.1 A *
β Voc	−0.25 %/K *
β Vmp	−0.29 %/K *
α Isc	0.05 %/K *
Cells	108
Bypass diodes	3

Values marked * are the default module profile, not the installer's datasheet.

Inverter

Inverter	2 × 6 kW three-phase (example)
Source	an example that meets the requirements
Inverters	2

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Max DC voltage	1100 V
MPPT window	140–980 V
Start voltage	200 V
MPPT inputs	2
Strings per input	1
Max current per input	16.0 A
Short-circuit rating per input	22.0 A
Rated AC power	6000 W
phases	3

Inverter: 2×6 kW three-phase (example) · max 1100 V · 4 MPPT inputs · DC/AC 1.05 · 12.6 kWp

Module: 420 W · Voc 38.0 V · Vmp 32.0 V · Isc 13.8 A · $-0.25\text{ \%/K}$ (Voc) · design $-25 / +70\text{ }^{\circ}\text{C}$

DC cable: about 77 m, 7 m less than a simple row order. String lengths 6–25 panels for this inverter.

3. Strings

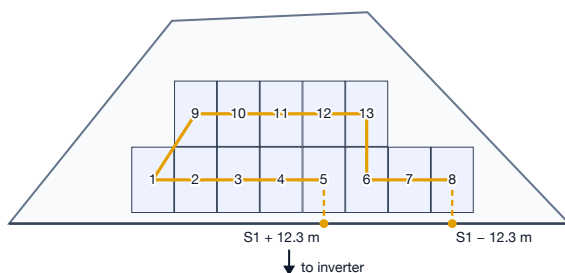
■ S1, orange

13 panels · south-west · Input 1

Series order (from the + end)

- | | |
|--|---|
| 1. panel 5 · south-west roof · row 1 · column 5 | 8. panel 11 · south-west roof · row 2 · column 3 |
| 2. panel 4 · south-west roof · row 1 · column 4 | 9. panel 12 · south-west roof · row 2 · column 4 |
| 3. panel 3 · south-west roof · row 1 · column 3 | 10. panel 13 · south-west roof · row 2 · column 5 |
| 4. panel 2 · south-west roof · row 1 · column 2 | 11. panel 6 · south-west roof · row 1 · column 6 |
| 5. panel 1 · south-west roof · row 1 · column 1 | 12. panel 7 · south-west roof · row 1 · column 7 |
| 6. panel 9 · south-west roof · row 2 · column 1 | 13. panel 8 · south-west roof · row 1 · column 8 |
| 7. panel 10 · south-west roof · row 2 · column 2 | |

+ end: panel 5 · – end: panel 8 · home runs 12.3 m and 12.3 m



S1: 13 panels, + end panel 5, – end panel 8 · row 1: 5–1 · row 2: 9–13 · row 1: 6–8 · home runs 12.3 m and 12.3 m

13 × Voc at –25 °C (open circuit)	556 V
13 × Vmp at –25 °C (vs MPPT max)	476 V
13 × Vmp at 70 °C cell (vs MPPT min)	362 V
I _{mp} at 70 °C cell	13.4 A
Current 1.25 × I _{sc}	17.3 A

Check	Value	Limit	Margin	State
Cold –25 °C, Voc	556 V	≤ 1 100 V	544 V (49 %)	✓ pass
Cold –25 °C, Vmp vs MPPT max	476 V	≤ 980 V	504 V (51 %)	✓ pass
Hot 70 °C, Vmp	362 V	≥ 140 V	222 V (158 %)	✓ pass
Current 1.25 × I _{sc}	17.3 A	≤ 22 A	4.8 A (22 %)	✓ pass
Current at MPP (hot)	13.4 A	≤ 16 A	2.6 A (16 %)	✓ pass

- Peak Voc of the weather year: 489 V on Feb 15 15:00 (clear sky).
- Vmp over the production hours: mean 386 V · ±1σ 16 V · ±2σ 32 V · ±3σ 48 V · min 323 V · max 408 V
- Production hours below the MPPT window: 0.0 % · above it: 0.0 % · Voc over the max DC voltage: 0 h per year
- Start in December: 07:00 (sunrise 07:00) · in June: 07:00
- Mismatch loss: 0.0 %

	Volts	Amps	W	State
Sunny June noon	381 V	12.8 A	4.9 kW	OK
December start hour	323 V	0.0 A	5 W	OK

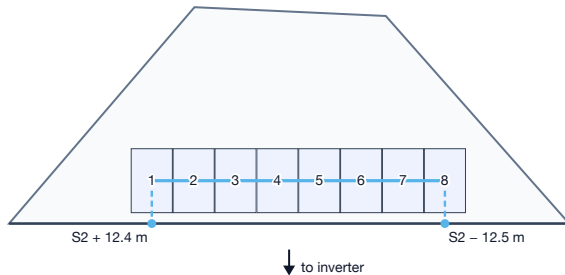
S2, sky blue

8 panels · north-east · Input 2

Series order (from the + end)

- | | |
|---|---|
| 1. panel 1 · north-east roof · row 1 · column 1 | 5. panel 5 · north-east roof · row 1 · column 5 |
| 2. panel 2 · north-east roof · row 1 · column 2 | 6. panel 6 · north-east roof · row 1 · column 6 |
| 3. panel 3 · north-east roof · row 1 · column 3 | 7. panel 7 · north-east roof · row 1 · column 7 |
| 4. panel 4 · north-east roof · row 1 · column 4 | 8. panel 8 · north-east roof · row 1 · column 8 |

+ end: panel 1 · – end: panel 8 · home runs 12.4 m and 12.5 m



S2: 8 panels, + end panel 1, – end panel 8 · row 1: 1–8 · home runs 12.4 m and 12.5 m

8 × Voc at –25 °C (open circuit)	342 V
8 × Vmp at –25 °C (vs MPPT max)	293 V
8 × Vmp at 70 °C cell (vs MPPT min)	223 V
I _{mp} at 70 °C cell	13.4 A
Current 1.25 × I _{sc}	17.3 A

Check	Value	Limit	Margin	State
Cold –25 °C, Voc	342 V	≤ 1 100 V	758 V (69 %)	✓ pass
Cold –25 °C, Vmp vs MPPT max	293 V	≤ 980 V	687 V (70 %)	✓ pass
Hot 70 °C, Vmp	223 V	≥ 140 V	83 V (59 %)	✓ pass
Current 1.25 × I _{sc}	17.3 A	≤ 22 A	4.8 A (22 %)	✓ pass
Current at MPP (hot)	13.4 A	≤ 16 A	2.6 A (16 %)	✓ pass

- Peak Voc of the weather year: 297 V on Mar 15 12:00 (typical day).
- Vmp over the production hours: mean 234 V · ±1σ 10 V · ±2σ 20 V · ±3σ 30 V · min 199 V · max 249 V
- Production hours below the MPPT window: 0.0 % · above it: 0.0 % · Voc over the max DC voltage: 0 h per year
- Start in December: 07:00 (sunrise 07:00) · in June: 07:00
- Mismatch loss: 0.0 %

	Volts	Amps	W	State
Sunny June noon	240 V	6.3 A	1.5 kW	OK
December start hour	212 V	0.0 A	10 W	OK

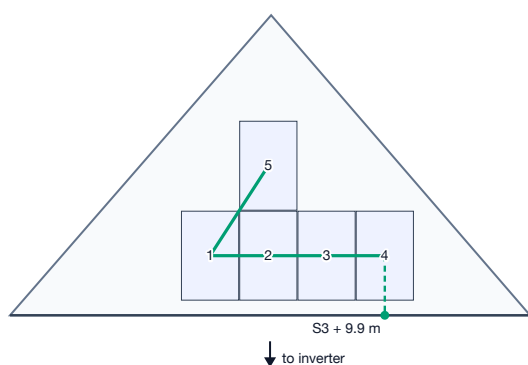
S3, green

9 panels · south-east + north-west · Input 3

Series order (from the + end)

- | | |
|---|---|
| 1. panel 4 · south-east roof · row 1 · column 4 | 6. panel 4 · north-west roof · row 2 · column 1 |
| 2. panel 3 · south-east roof · row 1 · column 3 | 7. panel 3 · north-west roof · row 1 · column 3 |
| 3. panel 2 · south-east roof · row 1 · column 2 | 8. panel 2 · north-west roof · row 1 · column 2 |
| 4. panel 1 · south-east roof · row 1 · column 1 | 9. panel 1 · north-west roof · row 1 · column 1 |
| 5. panel 5 · south-east roof · row 2 · column 1 | |

+ end: panel 4 · – end: panel 1 · home runs 9.9 m and 9.3 m



S3: 5 panels, + end panel 4, – end panel 5 · row 1: 4–1 · row 2: 5 · home runs 9.9 m and 9.3 m

9 × Voc at –25 °C (open circuit)	385 V
9 × Vmp at –25 °C (vs MPPT max)	330 V
9 × Vmp at 70 °C cell (vs MPPT min)	250 V
I _{mp} at 70 °C cell	13.4 A
Current 1.25 × I _{sc}	17.3 A

Check	Value	Limit	Margin	State
Cold –25 °C, Voc	385 V	≤ 1 100 V	715 V (65 %)	✓ pass
Cold –25 °C, Vmp vs MPPT max	330 V	≤ 980 V	650 V (66 %)	✓ pass
Hot 70 °C, Vmp	250 V	≥ 140 V	110 V (79 %)	✓ pass
Current 1.25 × I _{sc}	17.3 A	≤ 22 A	4.8 A (22 %)	✓ pass
Current at MPP (hot)	13.4 A	≤ 16 A	2.6 A (16 %)	✓ pass

- Peak Voc of the weather year: 337 V on Mar 15 14:00 (clear sky).
- Vmp over the production hours: mean 230 V · ±1σ 66 V · ±2σ 131 V · ±3σ 197 V · min 141 V · max 303 V
- Production hours below the MPPT window: 0.0 % · above it: 0.0 % · Voc over the max DC voltage: 0 h per year
- Start in December: 07:00 (sunrise 07:00) · in June: 07:00
- Mismatch loss: 16.4 %

	Volts	Amps	W	State
Sunny June noon	285 V	7.6 A	2.2 kW	OK
December start hour	267 V	0.0 A	4 W	OK

4. Design conditions

Cold morning · –25 °C cell · full sun · inverter off (open circuit)

String	Volts	Amps	Limit	Margin	State
S1	556 V	0.0 A	≤ 1 100 V	544 V (49 %)	OK
S2	342 V	0.0 A	≤ 1 100 V	758 V (69 %)	OK
S3	385 V	0.0 A	≤ 1 100 V	715 V (65 %)	OK

Hot noon · 70 °C cell · full sun

String	Volts	Amps	Limit	Margin	State
S1	362 V	13.4 A	≥ 140 V	222 V (158 %)	OK
S2	223 V	13.4 A	≥ 140 V	83 V (59 %)	OK
S3	250 V	13.4 A	≥ 140 V	110 V (79 %)	OK

Standard test conditions · 25 °C · 1 000 W/m²

String	Volts	Amps	Limit	Margin	State
S1	416 V	13.1 A	140–980 V		OK
S2	256 V	13.1 A	140–980 V		OK
S3	288 V	13.1 A	140–980 V		OK

Sunny peak of the weather year: S1 489 V on Feb 15 15:00. The cold-morning value is higher: it stays the limit.

Vmp stays inside the MPPT window (140–980 V) in every production hour, and Voc stays under the max DC voltage (1 100 V).

Rules: the inverter's max DC voltage is a hard limit. Swedish installers check it at –25 °C (colder in the north) by the standard SS-EN IEC 62548. The hot check protects your yield, not your safety.

The weather has one temperature per month and no cold nights. The cold-day design value stays the safe limit.

$\pm 1\sigma$ / $\pm 2\sigma$ / $\pm 3\sigma$: 68 % / 95 % / 99.7 % of production hours fall inside.

5. Shade and the plan

The plain plan is already the best for this roof (shade costs 4.8 %).

Strings	Lengths	Energy	Mismatch	Start in Dec	Voc at –25 °C	
► 3	13 + 8 + 9	best	4.8 %	07:00	556 V	Recommended
4	7 + 6 + 8 + 9	0 %	4.8 %	09:00	385 V	late start

Energy is relative to the recommended option.

Optimizers or micro-inverters would recover about 4.8 %.

6. Cables

- DC cables, panels → inverter: about 77 m
- AC cable, inverter → electricity box: about 3 m
- Battery cable, inverter → battery: about 3 m
- EV charger cable: about 14 m (wall 8 m, trench 6 m)
- House height: 3.5 m

7. What the inverter must have

Your installer selects a suitable inverter for 30 panels in this layout. It needs:

- 3 strings (13 + 8 + 9) on 3 MPPT inputs
- start voltage ≤ 250 V · MPPT window from ≤ 140 V to ≥ 480 V · max DC voltage ≥ 600 V
- ≥ 14 A per input (≥ 18 A short-circuit rating)
- 12.6 kWp DC · 9.7–12.6 kW AC · three-phase

2 inverters of 6 kW three-phase are an example that meets these. The 3D shows one of them.

8. Assumptions and method

- Design temperatures for this latitude: cold -25 °C (open-circuit voltage), hot 70 °C cell (MPP voltage).
- Cell temperature: Faiman (IEC 61853-2), flush roof $U_0 = 25$ W/(m²K), $U_1 = 0$.
- Hourly voltages: a single-diode model per bypass-diode band with the inverter's MPPT window and start voltage.
- Weather: PVGIS 5.3 (PV-yield dataset) (version anchored/se-2026.10/1); the sunny peaks use a clear-sky day.
- Not modelled: cable voltage drop, snow, soiling, bifacial gain, measured extreme temperatures.

9. Standards referenced

- SS-EN IEC 62548-1:2023 — Photovoltaic (PV) arrays — Part 1: Design requirements
- SS 436 40 00, part 712 — Electrical installations for low voltage: solar photovoltaic (PV) power supply systems
- SEK Handbok 457 — Solcellsanläggningar: installation och säkerhet
- IEC 62446-1 — Photovoltaic (PV) systems: requirements for testing, documentation and maintenance
- IEC 61853-2 — PV module performance: Faiman module temperature model (Faiman 2008)
- De Soto, Klein, Beckman 2006 — Improvement and validation of a model for photovoltaic array performance

10. Disclaimer

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