

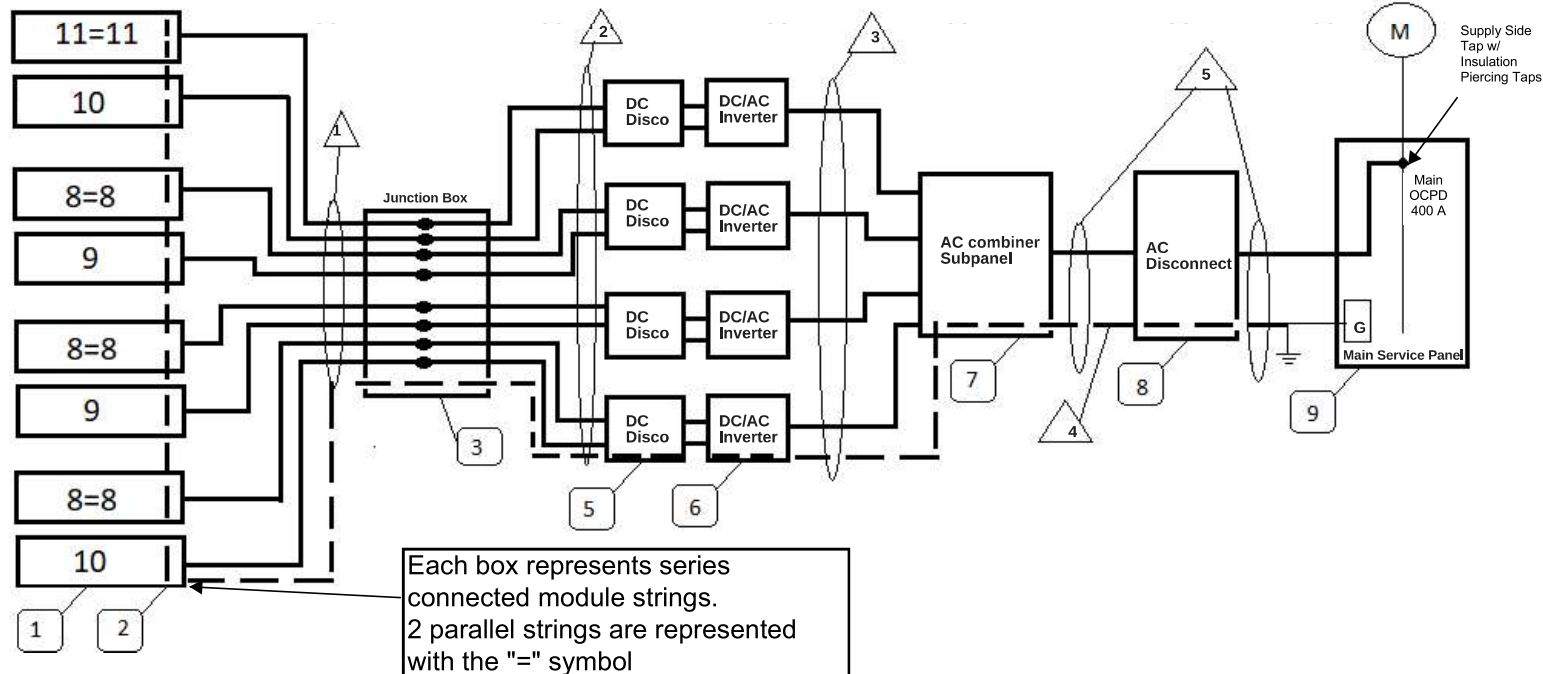
STANDARD STRING SYSTEM ELECTRICAL DIAGRAM

**REVIEWED
FOR
CODE
COMPLIANCE
10/07/2022**



EQUIPMENT SCHEDULE

| TAG | DESCRIPTION | PART NUMBER | NOTES |
|-----|-------------------------|------------------|--|
| 1 | SOLAR PV MODULE | Hanwha Qcell 400 | Hanwha Qcell 400 10.a+ |
| 2 | PV ARRAY | Hanwha Qcell 400 | (108) Hanwha Qcell 400W Panels, 43.2kW |
| 3 | J-BOX (IF USED) | Fronius Quattro | Fronius Quattro rapid shutdown combiner box |
| 4 | COMBINER (IF USED) | N/A | |
| 5 | DC DISCONNECT | Fronius Symo | (4) Fronius Symo 10.0 |
| 6 | DC/AC INVERTER | Fronius Symo | (4) Fronius Symo 10.0 |
| 7 | AC SubPanel | Square D | Square D |
| 8 | AC DISCONNECT (IF USED) | HU364RB | Square D HU364RB Heavy Duty Safety Switch, 150 A Fuses |
| 9 | SERVICE PANEL | | 208 VAC, 400 A MAIN, 400 A BUS Supply Side Taps/NEC 705.11 |
| | | | (SEE NOTE 5 FOR INVERTER OCPDs, ALSO SEE GUIDE SECTION 9) |



CONDUIT AND CONDUCTOR SCHEDULE

| TAG | DESCRIPTION OR CONDUCTOR TYPE | COND. GAUGE | NUMBER OF CONDUCTORS | CONDUIT TYPE | CONDUIT SIZE |
|-----|---|-------------|----------------------|--------------|--------------|
| 1 | USE-2 <input type="checkbox"/> or PV WIRE <input checked="" type="checkbox"/> | 10 | 24 | N/A | N/A |
| | BARE COPPER EQ. GRD. COND. (EGC) | 6 | 2 | N/A | N/A |
| 2 | THWN-2 <input type="checkbox"/> or XHHW-2 <input checked="" type="checkbox"/> or RHW-2 <input type="checkbox"/> | 10 | 16 | EMT | 1.25" |
| 3 | THWN-2 <input checked="" type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> | 8 | 12 | EMT | 2" |
| | INSULATED EGC | 10 | 1 | EMT | 2" |
| 4 | DC GROUNDING ELECTRODE COND. | 1/0 | 1 | EMT | 3" |
| 5 | THWN-2 <input checked="" type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> | 6 | 6 | EMT | 3" |
| 6 | INSULATED EGC | N/A | | | |

Contractor Name,
Address and Phone:

Brightside Solar

P.O. Box 773115

Steamboat Springs, CO 80477

97-879-1707

One-Line Standard Electrical Diagram for Small-Scale, Single-Phase PV Systems

Site Name: Vista Verde Ranch Main Lodge

Site Address: 58000 Cowboy Way, Clark, CO

System AC Size: 40 kW

Drawn By: W. Firestone

Checked By:

| SIZE | FSCM NO | DWG NO | REV |
|-------|---------|--------|-------|
| SCALE | NTS | Date: | SHEET |

NOTES FOR STANDARD STRING SYSTEM ELECTRICAL DIAGRAM

**REVIEWED
FOR
CODE
COMPLIANCE
10/07/2022**

PV MODULE RATINGS @ STC (Guide Section 5)

| | |
|--|-------------------------|
| MODULE MAKE | Hanwha |
| MODULE MODEL | Qcell Q.peak 400W 10.a+ |
| MAX POWER-POINT CURRENT (I_{MP}) | 10.77 A |
| MAX POWER-POINT VOLTAGE (V_{MP}) | 37.13 V |
| OPEN-CIRCUIT VOLTAGE (V_{OC}) | 45.30 V |
| SHORT-CIRCUIT CURRENT (I_{SC}) | 11.14 A |
| MAX SERIES FUSE (OCPD) | 20 A |
| MAXIMUM POWER (P_{MAX}) | 400 W |
| MAX VOLTAGE (TYP 600V _{DC}) | 1000 V |
| VOC TEMP COEFF (mV/°C <input type="checkbox"/> or %/°C <input checked="" type="checkbox"/>) | -0.27%/ C |
| IF COEFF SUPPLIED, CIRCLE UNITS | |

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTION DEVICE
NATIONAL ELECTRICAL CODE® REFERENCES
SHOWN AS (NEC XXX.XX)

INVERTER RATINGS (Guide Section 4)

| | |
|--------------------|-----------|
| INVERTER MAKE | Fronius |
| INVERTER MODEL | Symo 10.0 |
| MAX DC VOLT RATING | 600 V |
| MAX POWER @ 40°C | 10,000 W |
| NOMINAL AC VOLTAGE | 208 V |
| MAX AC CURRENT | 27.7 A |
| MAX OCPD RATING | 35 A |

SIGNS—SEE GUIDE SECTION 7

SIGN FOR DC DISCONNECT

| | |
|---------------------------|--------|
| PHOTOVOLTAIC POWER SOURCE | |
| RATED MPP CURRENT | 23.5 A |
| RATED MPP VOLTAGE | 408 V |
| MAX SYSTEM VOLTAGE | 566 V |
| MAX CIRCUIT CURRENT | 23 A |

WARNING: ELECTRICAL SHOCK
HAZARD—LINE AND LOAD MAY BE
ENERGIZED IN OPEN POSITION

SIGN FOR INVERTER OCPD AND AC DISCONNECT (IF USED)

| | |
|---|-------|
| SOLAR PV SYSTEM AC POINT OF CONNECTION | |
| AC OUTPUT CURRENT | 110 A |
| NOMINAL AC VOLTAGE | 208 V |
| THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR) | |

NOTES FOR ARRAY CIRCUIT WIRING (Guide Section 6 and 8 and Appendix D):

- 1.) LOWEST EXPECT AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. LOWEST EXPECTED AMBIENT TEMP -25 °C
- 2.) HIGHEST CONTINUOUS AMBIENT TEMPERATURE BASED ON ASHRAE HIGHEST MONTH 2% DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. HIGHEST CONTINUOUS TEMPERATURE 30 °C
- 2.) 2005 ASHRAE FUNDAMENTALS 2% DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE UNITED STATES (PALM SPRINGS, CA IS 44.1°C). FOR LESS THAN 9 CURRENT-CARRYING CONDUCTORS IN ROOF-MOUNTED SUNLIT CONDUIT AT LEAST 0.5" ABOVE ROOF AND USING THE OUTDOOR DESIGN TEMPERATURE OF 47°C OR LESS (ALL OF UNITED STATES),
 - a) 12 AWG, 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH I_{sc} OF 7.68 AMPS OR LESS WHEN PROTECTED BY A 12-AMP OR SMALLER FUSE.
 - b) 10 AWG, 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH I_{sc} OF 9.6 AMPS OR LESS WHEN PROTECTED BY A 15-AMP OR SMALLER FUSE.

NOTES FOR INVERTER CIRCUITS (Guide Section 8 and 9):

- 1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☒ NO ☐ N/A ☐
- 2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒
- 3) SIZE PHOTOVOLTAIC POWER SOURCE (DC) CONDUCTORS BASED ON MAX CURRENT ON NEC 690.53 SIGN OR OCPD RATING AT DISCONNECT
- 4) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Guide Section 9)
- 5) TOTAL OF 1 INVERTER OCPD(s), ONE FOR EACH INVERTER. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR EXCEPTION IN 690.64(B)(2)(a)? YES ☒ NO ☐

Contractor Name,
Address and Phone:

Brightside Solar
P.O. Box 773115
Steamboat Springs, CO 80477
97-879-1707

Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems

Site Name: Vista Verde Ranch Main Lodge

Site Address: 58000 Cowboy Way, Clark, CO

System AC Size: 40 kW

Drawn By: W. Firestone

| | | | |
|------|---------|--------|-----|
| SIZE | FSCM NO | DWG NO | REV |
|------|---------|--------|-----|

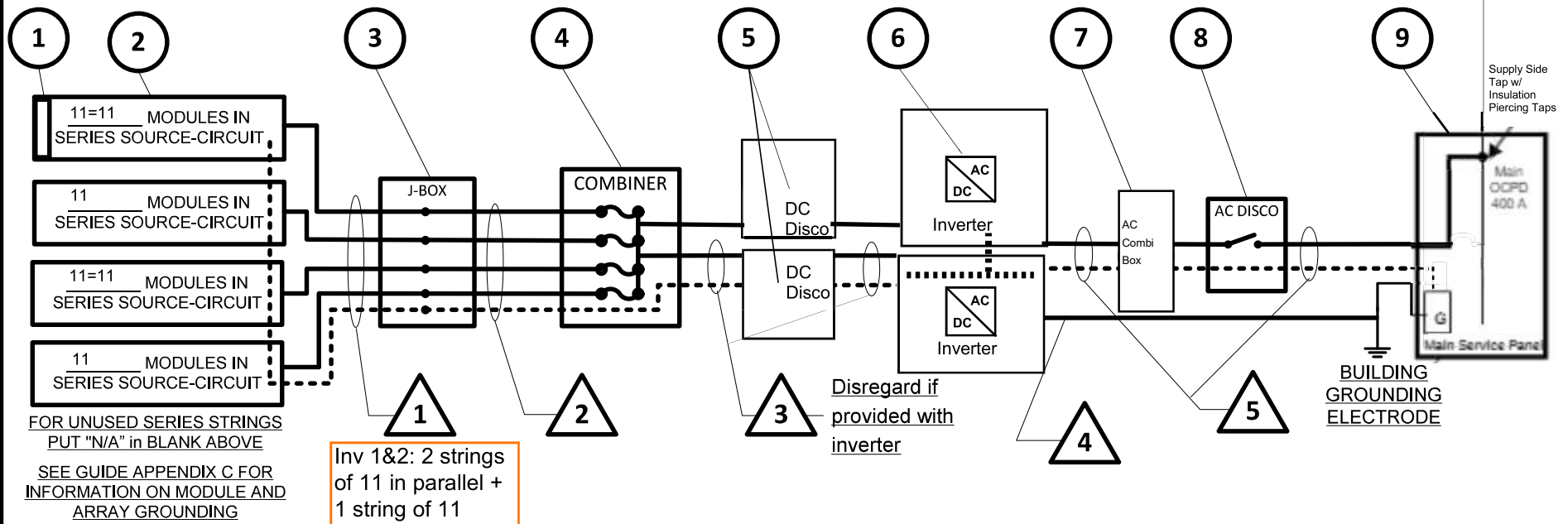
Checked By:

| | | | |
|-------|-----|-------|-------|
| SCALE | NTS | Date: | SHEET |
|-------|-----|-------|-------|

STANDARD STRING SYSTEM ELECTRICAL DIAGRAM

**REVIEWED
FOR
CODE
COMPLIANCE**
10/07/2022

| EQUIPMENT SCHEDULE | | | |
|---|-------------------------|------------------|--|
| TAG | DESCRIPTION | PART NUMBER | NOTES |
| 1 | SOLAR PV MODULE | Hanwha Qcell 400 | Hanwha Qcell 400 10.a+ |
| 2 | PV ARRAY | Hanwha Qcell 400 | (66) Hanwha Qcell 400W Panels, 26.6kW |
| 3 | J-BOX (IF USED) | Fronius Quattro | Fronius Quattro rapid shutdown combiner box |
| 4 | COMBINER (IF USED) | N/A | |
| 5 | DC DISCONNECT | Fronius Symo | (2) Fronius Symo 12.0 |
| 6 | DC/AC INVERTER | Fronius Symo | (2) Fronius Symo 12.0 |
| 7 | AC SubPanel | Square D | Square D |
| 8 | AC DISCONNECT (IF USED) | HU363RB | Square D HU363RB Heavy Duty Safety Switch, 100 A Fuses |
| 9 | SERVICE PANEL | 3 phase 208 V | 208 VAC, 400 A MAIN, 400 A BUS Supply Side Taps/NEC 705.11 |
| (SEE NOTE 5 FOR INVERTER OCPDs, ALSO SEE GUIDE SECTION 9) | | | |



| CONDUIT AND CONDUCTOR SCHEDULE | | | | | |
|--------------------------------|---|-------------|----------------------|--------------|--------------|
| TAG | DESCRIPTION OR CONDUCTOR TYPE | COND. GAUGE | NUMBER OF CONDUCTORS | CONDUIT TYPE | CONDUIT SIZE |
| 1 | USE-2 <input type="checkbox"/> or PV WIRE <input checked="" type="checkbox"/> | 10 | 12 | N/A | N/A |
| | BARE COPPER EQ. GRD. COND. (EGC) | 6 | 1 | N/A | N/A |
| 2 | THWN-2 <input type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> | N/A | | | |
| 3 | THWN-2 <input checked="" type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> | 10 | 8 | EMT | 2" |
| | INSULATED EGC | 10 | 1 | EMT | 2" |
| 4 | DC GROUNDING ELECTRODE COND. | 1/0 | 1 | EMT | 3" |
| 5 | THWN-2 <input checked="" type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> | 6 | 3 | EMT | 3" |
| 6 | URD Cable Aluminum | N/A | | | |

| | | | |
|---|-----------------------------|--|--|
| Contractor Name, Address and Phone: Brightside Solar P.O. Box 773115 Steamboat Springs, CO 80477 97-879-1707 | | One-Line Standard Electrical Diagram for Small-Scale, Single-Phase PV Systems | |
| Site Name: Vista Verde Ranch Arena Site Address: 58000 Cowboy Way, Clark, CO System AC Size: 24kW | | | |
| Drawn By: W. Firestone | SIZE: FSCM NO: DWG NO: REV: | | |
| Checked By: | SCALE: NTS Date: SHEET: | | |

NOTES FOR STANDARD STRING SYSTEM ELECTRICAL DIAGRAM

**REVIEWED
FOR
CODE
COMPLIANCE
10/07/2022**

PV MODULE RATINGS @ STC (Guide Section 5)

| | | |
|--|-------------------------|---|
| MODULE MAKE | Hanwha | |
| MODULE MODEL | Qcell Q.peak 400W 10.a+ | |
| MAX POWER-POINT CURRENT (I_{MP}) | 10.77 | A |
| MAX POWER-POINT VOLTAGE (V_{MP}) | 37.13 | V |
| OPEN-CIRCUIT VOLTAGE (V_{OC}) | 45.30 | V |
| SHORT-CIRCUIT CURRENT (I_{SC}) | 11.14 | A |
| MAX SERIES FUSE (OCPD) | 20 | A |
| MAXIMUM POWER (P_{MAX}) | 400 | W |
| MAX VOLTAGE (TYP 600V _{DC}) | 1000 | V |
| VOC TEMP COEFF (mV/°C <input type="checkbox"/> or %/°C <input checked="" type="checkbox"/>) | -0.27%/C | |
| IF COEFF SUPPLIED, CIRCLE UNITS | | |

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTION DEVICE
NATIONAL ELECTRICAL CODE® REFERENCES
SHOWN AS (NEC XXX.XX)

INVERTER RATINGS (Guide Section 4)

| | | |
|--------------------|-----------|---|
| INVERTER MAKE | Fronius | |
| INVERTER MODEL | Symo 12.0 | |
| MAX DC VOLT RATING | 600 | V |
| MAX POWER @ 40°C | 12,000 | W |
| NOMINAL AC VOLTAGE | 208 | V |
| MAX AC CURRENT | 33.3 | A |
| MAX OCPD RATING | 45 | A |

SIGNS—SEE GUIDE SECTION 7

SIGN FOR DC DISCONNECT

| | |
|---------------------------|--------|
| PHOTOVOLTAIC POWER SOURCE | |
| RATED MPP CURRENT | 23.5 A |
| RATED MPP VOLTAGE | 448 V |
| MAX SYSTEM VOLTAGE | 566 V |
| MAX CIRCUIT CURRENT | 23 A |

WARNING: ELECTRICAL SHOCK
HAZARD—LINE AND LOAD MAY BE
ENERGIZED IN OPEN POSITION

SIGN FOR INVERTER OCPD AND AC DISCONNECT (IF USED)

| | |
|---|--------|
| SOLAR PV SYSTEM AC POINT OF CONNECTION | |
| AC OUTPUT CURRENT | 66.6 A |
| NOMINAL AC VOLTAGE | 208 V |
| THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR) | |

NOTES FOR ARRAY CIRCUIT WIRING (Guide Section 6 and 8 and Appendix D):

- 1.) LOWEST EXPECT AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. LOWEST EXPECTED AMBIENT TEMP -25 °C
- 2.) HIGHEST CONTINUOUS AMBIENT TEMPERATURE BASED ON ASHRAE HIGHEST MONTH 2% DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. HIGHEST CONTINUOUS TEMPERATURE 30 °C
- 2.) 2005 ASHRAE FUNDAMENTALS 2% DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE UNITED STATES (PALM SPRINGS, CA IS 44.1°C). FOR LESS THAN 9 CURRENT-CARRYING CONDUCTORS IN ROOF-MOUNTED SUNLIT CONDUIT AT LEAST 0.5" ABOVE ROOF AND USING THE OUTDOOR DESIGN TEMPERATURE OF 47°C OR LESS (ALL OF UNITED STATES),
 - a) 12 AWG, 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH I_{sc} OF 7.68 AMPS OR LESS WHEN PROTECTED BY A 12-AMP OR SMALLER FUSE.
 - b) 10 AWG, 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH I_{sc} OF 9.6 AMPS OR LESS WHEN PROTECTED BY A 15-AMP OR SMALLER FUSE.

NOTES FOR INVERTER CIRCUITS (Guide Section 8 and 9):

- 1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☒ NO ☐ N/A ☐
- 2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒
- 3) SIZE PHOTOVOLTAIC POWER SOURCE (DC) CONDUCTORS BASED ON MAX CURRENT ON NEC 690.53 SIGN OR OCPD RATING AT DISCONNECT
- 4) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Guide Section 9)
- 5) TOTAL OF 1 INVERTER OCPD(s), ONE FOR EACH INVERTER. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR EXCEPTION IN 690.64(B)(2)(a)? YES ☒ NO ☐

Contractor Name,
Address and Phone:

Brightside Solar
P.O. Box 773115
Steamboat Springs, CO 80477
97-879-1707

Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems

Site Name: Vista Verde Ranch Arena

Site Address: 58000 Cowboy Way, Clark, CO

System AC Size: 24kW

Drawn By: W. Firestone

| | | | |
|------|---------|--------|-----|
| SIZE | FSCM NO | DWG NO | REV |
|------|---------|--------|-----|

Checked By:

| | | | |
|-------|-----|-------|-------|
| SCALE | NTS | Date: | SHEET |
|-------|-----|-------|-------|

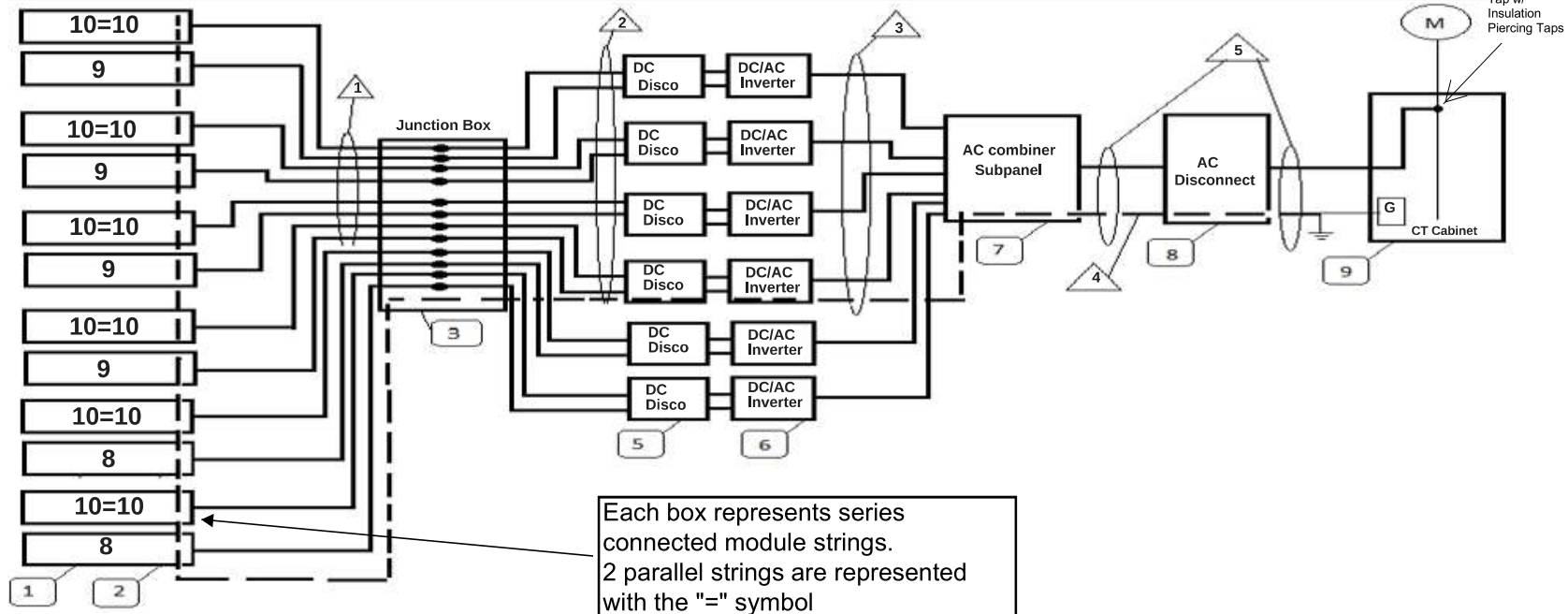
STANDARD STRING SYSTEM ELECTRICAL DIAGRAM

**REVIEWED
FOR
CODE
COMPLIANCE
10/07/2022**



EQUIPMENT SCHEDULE

| TAG | DESCRIPTION | PART NUMBER | NOTES |
|---|-------------------------|------------------|---|
| 1 | SOLAR PV MODULE | Hanwha Qcell 400 | Hanwha Qcell 400 10.a+ |
| 2 | PV ARRAY | Hanwha Qcell 400 | (172) Hanwha Qcell 400W Panels,, 68.8 kW |
| 3 | J-BOX (IF USED) | Fronius Quattro | Fronius Quattro rapid shutdown combiner box |
| 4 | COMBINER (IF USED) | N/A | |
| 5 | DC DISCONNECT | Fronius Primo | (6) Fronius Primo 10.0 |
| 6 | DC/AC INVERTER | Fronius Primo | (6) Fronius Primo 10.0 |
| 7 | AC SubPanel | Square D | Square D |
| 8 | AC DISCONNECT (IF USED) | GF225NRA | Siemens Heavy Duty Safety Switch, 400A Fuses |
| 9 | SERVICE PANEL | CT Cabinet | 240 VAC, N/A A MAIN, N/A A BUS, Supply Side Taps/NEC 705.11 |
| (SEE NOTE 5 FOR INVERTER OCPDs, ALSO SEE GUIDE SECTION 9) | | | |



CONDUIT AND CONDUCTOR SCHEDULE

| TAG | DESCRIPTION OR CONDUCTOR TYPE | COND. GAUGE | NUMBER OF CONDUCTORS | CONDUIT TYPE | CONDUIT SIZE |
|-----|---|-------------|----------------------|--------------|--------------|
| 1 | USE-2 <input type="checkbox"/> or PV WIRE <input checked="" type="checkbox"/> | 10 | 36 | N/A | N/A |
| | BARE COPPER EQ. GRD. COND. (EGC) | 6 | 1 | N/A | N/A |
| 2 | THWN-2 <input type="checkbox"/> or XHHW-2 <input checked="" type="checkbox"/> or RHW-2 <input type="checkbox"/> | 10 | 24 | PVC | 2" |
| 3 | THWN-2 <input checked="" type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> | 4 | 18 | EMT | 3" |
| | INSULATED EGC | 10 | 1 | EMT | 2" |
| 4 | DC GROUNDING ELECTRODE COND. | 1/0 | 1 | PVC | 3" |
| 5 | THWN-2 <input checked="" type="checkbox"/> or XHHW-2 <input type="checkbox"/> or RHW-2 <input type="checkbox"/> | 2/0 | 6 | PVC | 3" |
| 6 | INSULATED EGC | N/A | | | |

Contractor Name,
Address and Phone:

Brightside Solar
P.O. Box 773115
Steamboat Springs, CO 80477
97-879-1707

One-Line Standard Electrical Diagram for Small-Scale, Single-Phase PV Systems

Site Name: Vista Verde Ranch Shop & Laundry

Site Address: 58000 Cowboy Way, Clark, CO

System AC Size: 68.8 kW

Drawn By: W. Firestone

Checked By:

| SIZE | FSCM NO | DWG NO | REV |
|-------|---------|--------|-------|
| SCALE | NTS | Date: | SHEET |

NOTES FOR STANDARD STRING SYSTEM ELECTRICAL DIAGRAM

**REVIEWED
FOR
CODE
COMPLIANCE
10/07/2022**

PV MODULE RATINGS @ STC (Guide Section 5)

| | |
|--|-------------------------|
| MODULE MAKE | Hanwha |
| MODULE MODEL | Qcell Q.peak 400W 10.a+ |
| MAX POWER-POINT CURRENT (I_{MP}) | 10.77 A |
| MAX POWER-POINT VOLTAGE (V_{MP}) | 37.13 V |
| OPEN-CIRCUIT VOLTAGE (V_{OC}) | 45.30 V |
| SHORT-CIRCUIT CURRENT (I_{SC}) | 11.14 A |
| MAX SERIES FUSE (OCPD) | 20 A |
| MAXIMUM POWER (P_{MAX}) | 400 W |
| MAX VOLTAGE (TYP 600V _{DC}) | 1000 V |
| VOC TEMP COEFF (mV/°C <input type="checkbox"/> or %/°C <input checked="" type="checkbox"/>) | -0.27%/ C |
| IF COEFF SUPPLIED, CIRCLE UNITS | |

NOTES FOR ALL DRAWINGS:

OCPD = OVERCURRENT PROTECTION DEVICE
NATIONAL ELECTRICAL CODE® REFERENCES
SHOWN AS (NEC XXX.XX)

INVERTER RATINGS (Guide Section 4)

| | |
|--------------------|------------|
| INVERTER MAKE | Fronius |
| INVERTER MODEL | Primo 10.0 |
| MAX DC VOLT RATING | 1000 V |
| MAX POWER @ 40°C | 10,000 W |
| NOMINAL AC VOLTAGE | 240 V |
| MAX AC CURRENT | 41.6 A |
| MAX OCPD RATING | 60 A |

SIGNS—SEE GUIDE SECTION 7

SIGN FOR DC DISCONNECT

| | |
|---------------------------|--------|
| PHOTOVOLTAIC POWER SOURCE | |
| RATED MPP CURRENT | 23.5 A |
| RATED MPP VOLTAGE | 408 V |
| MAX SYSTEM VOLTAGE | 512 V |
| MAX CIRCUIT CURRENT | 23 A |

WARNING: ELECTRICAL SHOCK
HAZARD—LINE AND LOAD MAY BE
ENERGIZED IN OPEN POSITION

SIGN FOR INVERTER OCPD AND AC DISCONNECT (IF USED)

| | |
|---|---------|
| SOLAR PV SYSTEM AC POINT OF CONNECTION | |
| AC OUTPUT CURRENT | 249.6 A |
| NOMINAL AC VOLTAGE | 240 V |
| THIS PANEL FED BY MULTIPLE SOURCES (UTILITY AND SOLAR) | |

NOTES FOR ARRAY CIRCUIT WIRING (Guide Section 6 and 8 and Appendix D):

- 1.) LOWEST EXPECT AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. LOWEST EXPECTED AMBIENT TEMP -25 °C
- 2.) HIGHEST CONTINUOUS AMBIENT TEMPERATURE BASED ON ASHRAE HIGHEST MONTH 2% DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. HIGHEST CONTINUOUS TEMPERATURE 30 °C
- 2.) 2005 ASHRAE FUNDAMENTALS 2% DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE UNITED STATES (PALM SPRINGS, CA IS 44.1°C). FOR LESS THAN 9 CURRENT-CARRYING CONDUCTORS IN ROOF-MOUNTED SUNLIT CONDUIT AT LEAST 0.5" ABOVE ROOF AND USING THE OUTDOOR DESIGN TEMPERATURE OF 47°C OR LESS (ALL OF UNITED STATES),
 - a) 12 AWG, 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH I_{sc} OF 7.68 AMPS OR LESS WHEN PROTECTED BY A 12-AMP OR SMALLER FUSE.
 - b) 10 AWG, 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH I_{sc} OF 9.6 AMPS OR LESS WHEN PROTECTED BY A 15-AMP OR SMALLER FUSE.

NOTES FOR INVERTER CIRCUITS (Guide Section 8 and 9):

- 1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? YES ☒ NO ☐ N/A ☐
- 2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? YES ☐ NO ☐ N/A ☒
- 3) SIZE PHOTOVOLTAIC POWER SOURCE (DC) CONDUCTORS BASED ON MAX CURRENT ON NEC 690.53 SIGN OR OCPD RATING AT DISCONNECT
- 4) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMPERE RATING. (See Guide Section 9)
- 5) TOTAL OF 1 INVERTER OCPD(s), ONE FOR EACH INVERTER. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR EXCEPTION IN 690.64(B)(2)(a)? YES ☒ NO ☐

| | | | |
|---|-------|---|-------------|
| Contractor Name, Address and Phone: Brightside Solar P.O. Box 773115 Steamboat Springs, CO 80477 97-879-1707 | | Notes for One-Line Standard Electrical Diagram for Single-Phase PV Systems | |
| Site Name: <u>Vista Verde Ranch Shop & Laundry</u> | | Site Address: <u>58000 Cowboy Way, Clark, CO</u> | |
| System AC Size: <u>68.8 kW</u> | | | |
| Drawn By: <u>W. Firestone</u> | SIZE | FSCM NO | DWG NO |
| Checked By: | SCALE | NTS | Date: SHEET |

Q.PEAK DUO BLK ML-G10+ 385-405

ENDURING HIGH
PERFORMANCE



BREAKING THE 20% EFFICIENCY BARRIER

Q.ANTUM DUO Z Technology with zero gap cell layout boosts module efficiency up to 20.9%.



THE MOST THOROUGH TESTING PROGRAMME IN THE INDUSTRY

Q CELLS is the first solar module manufacturer to pass the most comprehensive quality programme in the industry: The new "Quality Controlled PV" of the independent certification institute TÜV Rheinland.



INNOVATIVE ALL-WEATHER TECHNOLOGY

Optimal yields, whatever the weather with excellent low-light and temperature behavior.



ENDURING HIGH PERFORMANCE

Long-term yield security with Anti LID Technology, Anti PID Technology¹, Hot-Spot Protect and Traceable Quality Tra.Q™.



EXTREME WEATHER RATING

High-tech aluminum alloy frame, certified for high snow (5400 Pa) and wind loads (4000 Pa).



A RELIABLE INVESTMENT

Inclusive 25-year product warranty and 25-year linear performance warranty².

¹ APT test conditions according to IEC / TS 62804-1:2015, method A (–1500 V, 96 h)

² See data sheet on rear for further information.

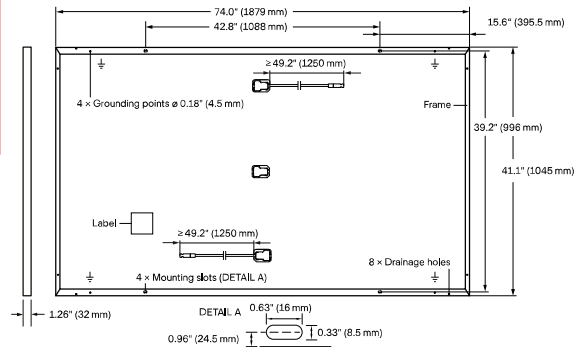


THE IDEAL SOLUTION FOR:



Rooftop arrays on
residential buildings

| | |
|--------------|---|
| Format | 74.0in × 41.1in × 1.26in (including frame) (1879mm × 1045mm × 32mm) |
| Weight | 48.5lbs (22.0kg) |
| Front Cover | 0.13in (3.2mm) thermally pre-stressed glass with anti-reflection technology |
| Back Cover | Composite film |
| Frame | Black anodized aluminum |
| Cell | 6 × 22 monocrystalline Q.ANTUM solar half cells |
| Junction Box | 2.09-3.98in × 1.26-2.36in × 0.59-0.71in (53-101mm × 32-60mm × 15-18mm), IP67, with bypass diodes |
| Cable | 4mm ² Solar cable; (+) ≥ 49.2in (1250mm), (-) ≥ 49.2in (1250mm) |
| Connector | Stäubli MC4; IP68 |



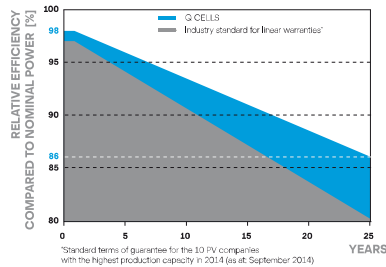
ELECTRICAL CHARACTERISTICS

| POWER CLASS | | 385 | 390 | 395 | 400 | 405 |
|---|------------------------------------|----------------------|--------|--------|--------|--------|
| MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC ¹ (POWER TOLERANCE +5W / -0W) | | | | | | |
| Minimum | Power at MPP ¹ | P _{MPP} [W] | 385 | 390 | 395 | 400 |
| | Short Circuit Current ¹ | I _{SC} [A] | 11.04 | 11.07 | 11.10 | 11.14 |
| | Open Circuit Voltage ¹ | V _{OC} [V] | 45.19 | 45.23 | 45.27 | 45.30 |
| | Current at MPP | I _{MPP} [A] | 10.59 | 10.65 | 10.71 | 10.77 |
| | Voltage at MPP | V _{MPP} [V] | 36.36 | 36.62 | 36.88 | 37.13 |
| | Efficiency ¹ | η [%] | ≥ 19.6 | ≥ 19.9 | ≥ 20.1 | ≥ 20.4 |
| MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT ² | | | | | | |
| Minimum | Power at MPP | P _{MPP} [W] | 288.8 | 292.6 | 296.3 | 300.1 |
| | Short Circuit Current | I _{SC} [A] | 8.90 | 8.92 | 8.95 | 8.97 |
| | Open Circuit Voltage | V _{OC} [V] | 42.62 | 42.65 | 42.69 | 42.72 |
| | Current at MPP | I _{MPP} [A] | 8.35 | 8.41 | 8.46 | 8.51 |
| | Voltage at MPP | V _{MPP} [V] | 34.59 | 34.81 | 35.03 | 35.25 |

¹Measurement tolerances P_{MPP} ± 3%; I_{SC}; V_{OC} ± 5% at STC: 1000W/m², 25 ± 2°C, AM 1.5 according to IEC 60904-3 • 800W/m², NMOT, spectrum AM 1.5

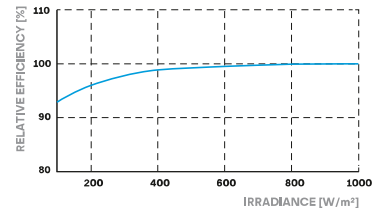
Q CELLS PERFORMANCE WARRANTY

PERFORMANCE AT LOW IRRADIANCE



At least 98% of nominal power during first year. Thereafter max. 0.5% degradation per year. At least 93.5% of nominal power up to 10 years. At least 86% of nominal power up to 25 years.

All data within measurement tolerances. Full warranties in accordance with the warranty terms of the Q CELLS sales organisation of your respective country.



Typical module performance under low irradiance conditions in comparison to STC conditions (25°C, 1000W/m²)

TEMPERATURE COEFFICIENTS

| | | | | | |
|---|-----------|-------|--|-----------|----------------------|
| Temperature Coefficient of I _{SC} | α [% / K] | +0.04 | Temperature Coefficient of V _{OC} | β [% / K] | -0.27 |
| Temperature Coefficient of P _{MPP} | γ [% / K] | -0.34 | Nominal Module Operating Temperature | NMOT [°F] | 109 ± 5.4 (43 ± 3°C) |

PROPERTIES FOR SYSTEM DESIGN

| | | | | |
|--|-----------|----------------------------|---|---|
| Maximum System Voltage V _{sys} | [V] | 1000 (IEC)/1000 (UL) | PV module classification | Class II |
| Maximum Series Fuse Rating | [A DC] | 20 | Fire Rating based on ANSI / UL 61730 | TYPE 2 |
| Max. Design Load, Push / Pull ³ | [lbs/ft²] | 75 (3600Pa) / 55 (2660Pa) | Permitted Module Temperature on Continuous Duty | -40°F up to +185°F (-40°C up to +85°C) |
| Max. Test Load, Push / Pull ³ | [lbs/ft²] | 113 (5400Pa) / 84 (4000Pa) | | |

³ See Installation Manual

QUALIFICATIONS AND CERTIFICATES

UL 61730, CE-compliant,
Quality Controlled PV - TÜV Rheinland,
IEC 61215:2016, IEC 61730:2016,
U.S. Patent No. 9,893,215 (solar cells),
QCPV Certification ongoing.



PACKAGING INFORMATION

| | | | | | | | |
|----------------------|------------------|------------------|------------------|------------------|---------------|---------------|---------------|
| | | | | | | | |
| Horizontal packaging | 76.4in 1940mm | 43.3in 1100mm | 48.0in 1220mm | 1656lbs 751kg | 24 pallets | 24 pallets | 32 modules |

Note: Installation instructions must be followed. See the installation and operating manual or contact our technical service department for further information on approved installation and use of this product.

Hanwha Q CELLS America Inc.

400 Spectrum Center Drive, Suite 1400, Irvine, CA 92618, USA | **TEL** +1 949 748 59 96 | **EMAIL** inquiry@us.q-cells.com | **WEB** www.q-cells.us

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RAPID SHUTDOWN BOX

/ The convenient rapid shutdown solution for Fronius inverters.

EASY AND COST-EFFECTIVE NEC 2014 COMPLIANCE

/ The Fronius Rapid Shutdown Box (RSB) provides a convenient solution for NEC 2014 (690.12) compliance, while enhancing overall rooftop and firefighter safety. Low-profile design, a small foot print installer-friendly mounting and wiring, make the Fronius Rapid Shutdown Box the ultimate solution for all Fronius SnapINverters* in systems up to 600 V. Directly connected to the inverter through the same conduit as the DC homeruns and powered by the array, the Fronius solution minimizes the number of components and eliminates the need for an external power supply and control button.

/ The low-profile design allows for installation underneath the modules, ensuring a clean system look. Thanks to the NEMA 4X rating, the box is built for severe outdoor conditions. MC4 connectors, spring loaded terminals and generous wiring space make wiring easy. Rapid Shutdown is triggered when AC is not present at the inverter, rapidly discharging the DC lines to the inverter. An optional method is to install an emergency stop button to open the signal loop.

SLEEK DESIGN

- / Low-profile design that fits underneath a module for clean system look
- / Mounting bracket with multiple mounting options for maximum flexibility
- / NEMA 4X rated for severe outdoor conditions

EASY WIRING

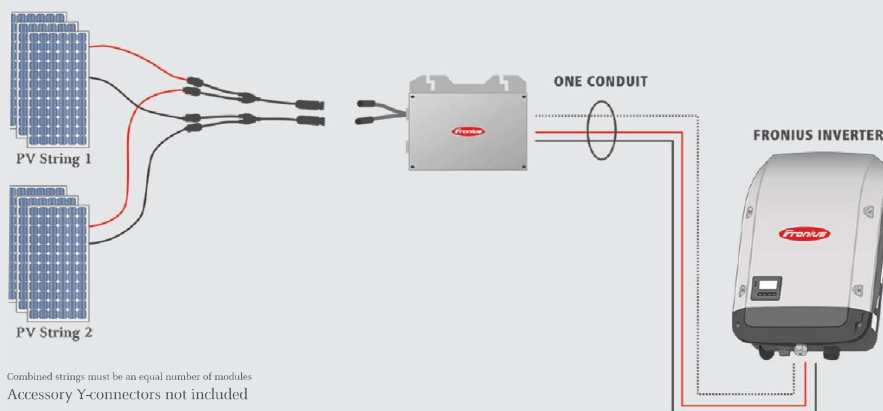
- / MC4 connectors, spring loaded terminals and external equipment ground lug make wiring easy
- / 25A rated inputs for up to two strings per input channel (via MC4 "Y" connectors, not included)

SMALL NUMBER OF COMPONENTS

- / Rapid Shutdown Box replaces your junction box
- / PV-powered: no extra power supply needed
- / No additional control button needed



SAMPLE CONFIGURATION DUO

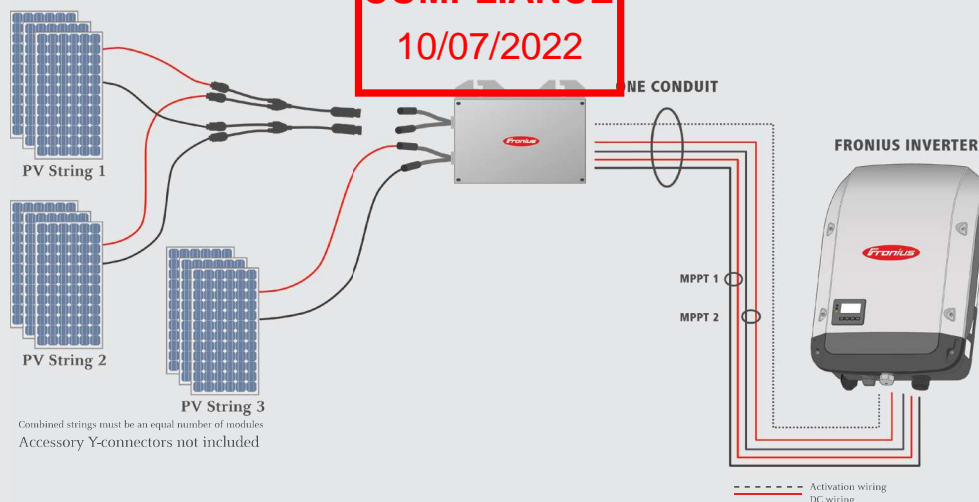


* Excluding the Fronius Symo 15.0-3 208

--- Activation wiring
--- DC wiring

SAMPLE CONFIGURATION QUATTRO

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TECHNICAL DATA

| GENERAL DATA | RAPID SHUTDOWN BOX-DUO | RAPID SHUTDOWN BOX-QUATTRO |
|---|---|---|
| Maximum voltage | 600 VDC | |
| Start voltage | 80 VDC | |
| Maximum input current | 25A | 25A/ 25A |
| Power Supply | DC (from the PV array) | |
| Typ. self-consumption during operation | 2 W | |
| Input Circuits- MC-4 | 1(2 if used with MC-4 Y connector) | 2(4 if used with MC-4 Y connectors) |
| Max. number of strings | 2 | 4 |
| Max. output current | 25A | 25A/ 25A |
| Output circuits-Spring clips | 1 | 2 |
| Max. DC homerun wire size | AWG 8 | |
| Max. communication wire size | AWG 14 | |
| Number of conduit ports | 2 | |
| Conduit size | 3/4in. and 1in. | |
| For use with Amphenol H4/other connectors | Remove MC-4 connectors and replace with UL listed connectors | |
| External hardware required | Appropriate "Y" connectors if combining two strings | |
| Permissible operating temperature range | -40F to +149F (-40C to +65C) | |
| Rel. humidity | 0 ... 100% (non condensing) | |
| Maximum installation elevation | 13123 ft (4000m) | |
| Enclosure Type | Type 4X | |
| Unit dimensions | 11.3 x 9.7 x 2.8 inch (286 x 246.5 x 71.5 mm) | 13.8 x 11.5 x 2.8 inch (351 x 293 x 71.5 mm) |
| Unit weight | 4 lbs. (1.8 kg) | 6 lbs. (2.7 kg) |
| Compliance | UL1741; LTR AE-004-2015; FCC 15 Class B | |
| Compatible inverters | Fronius Galvo, Fronius Primo**, Fronius Symo (excluding the Fronius Symo 15.0-3 208) up to 600V | |

** Note: If Fronius Rapid Shutdown Box is added to an existing system with a Fronius Primo 10.0 to 15.0, make sure that inverter software is up to date. Updates are available through software update file version fro27350.upd and can be easily downloaded at www.fronius-usa.com/Primo-Update and installed via USB stick or remote update via Fronius Solarweb. Updates are available through software update file version fro27350.upd and can be easily downloaded at www.fronius-usa.com/Primo-Update and installed via USB stick or remote update via Fronius Solarweb.



/ Perfect Welding / Solar Energy / Perfect Charging

THREE BUSINESS UNITS, ONE GOAL: TO SET THE STANDARD THROUGH TECHNOLOGICAL ADVANCEMENT.

What began in 1945 as a one-man operation now sets technological standards in the fields of welding technology, photovoltaics and battery charging. Today, the company has around 3,800 employees worldwide and 1,242 patents for product development show the innovative spirit within the company. Sustainable development means for us to implement environmentally relevant and social aspects equally with economic factors. Our goal has remained constant throughout: to be the innovation leader.

Further information about all Fronius products and our global sales partners and representatives can be found at www.fronius.com

v08 Aug 2017 EN

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Portage, IN 46368

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FRONIUS PRIMO



/ SnapINverter
mounting system



/ Wireless
monitoring



/ Open data
communication



/ Smart Grid
Ready



/ Arc Fault Circuit
Interruption



The transformerless Fronius Primo is the ideal compact single-phase inverter for residential and small-scale commercial applications with power categories from 3.8 to 8.2 kW. In accordance with ESA rules for residential applications, the Fronius Primo can operate efficiently at a maximum input voltage of 600 V. And for increased efficiency and additional cost savings for commercial applications, the Fronius Primo can operate at the maximum input voltage of 1,000 V. Industry-leading features now come standard with the Fronius Primo, including: dual maximum power point tracking, arc fault protection, integrated wireless monitoring and SunSpec Modbus interfaces for seamless monitoring and datalogging via Fronius' online and mobile platform, Fronius Solar.web.

TECHNICAL DATA FRONIUS PRIMO

| GENERAL DATA | FRONIUS PRIMO 3.8 - 8.2 | FRONIUS PRIMO 10.0-15.0 |
|--|---|---|
| Dimensions (width x height x depth) | 16.9 x 24.7 x 8.1 in. / 42.9 x 62.7 x 20.6 cm | 20.1 x 28.5 x 8.9 in. / 51.1 x 72.4 x 20.6 cm |
| Weight | 47.4 lb. / 21.5 kg | 82.5 lbs. / 37.4 kg |
| Degree of protection | NEMA 4X | |
| Night time consumption | < 1 W | |
| Inverter topology | Transformerless | |
| Cooling | Controlled forced ventilation, variable speed fan | |
| Installation | Indoor and outdoor installation | |
| Ambient operating temperature range | -40 to 131 F / -40 to 55 C | -40 to 140 F / -40 to 60 C |
| Permitted humidity | 0 - 100 % | |
| DC connection terminals | 2x DC+1, 2x DC+2 and 4x DC- screw terminals for solid: copper and aluminium stranded / fine stranded: copper and aluminium | 4x DC+1, 2x DC+2 and 6x DC- screw terminals for copper (solid / stranded / fine stranded) or aluminium (solid / stranded) |
| AC connection terminals | Screw terminals 12 - 6 AWG | |
| Revenue Grade Metering | Optional (ANSI C12.1 accuracy) | |
| Certificates and compliance with standards | UL 1741-2015, UL1998 (for functions: AFCI, RCMU and isolation monitoring), IEEE 1547-2003, IEEE 1547.1-2003, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC 2014 Article 690, C22. 2 No. 107.1-01 (September 2001), UL1699B Issue 2 -2013, CSA T1L M-07 Issue 1 -2013 | UL 1741-2015, UL1998 (for functions: AFCI, RCMU and isolation monitoring), IEEE 1547-2003, IEEE 1547.1-2003, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC Article 690-2014, C22. 2 No. 107.1-01 (September 2001), UL1699B Issue 2 -2013, CSA T1L M-07 Issue 1 -2013 |

| PROTECTIVE DEVICES | STANDARD WITH ALL PRIMO MODELS |
|--|--------------------------------|
| AFCI | Yes |
| Ground Fault Protection with Isolation Monitor Interrupter | Yes |
| DC disconnect | Yes |
| DC reverse polarity protection | Yes |

| INTERFACES | AVAILABILITY | AVAILABLE WITH ALL FRONIUS PRIMO MODELS |
|---|--------------|---|
| USB (A socket) | Standard | Datalogging and inverter update via USB |
| 2x RS422 (RJ45 socket) | Standard | Fronius Solar Net, interface protocol |
| Wi-Fi*/Ethernet/Serial/Datalogger and webserver | Optional | Wireless standard 802.11 b/g/n / Fronius Solar.web, SunSpec Modbus TCP, JSON / SunSpec Modbus RTU |
| 6 inputs or 4 digital inputs/outputs | Optional | External relay controls |

*The term Wi-Fi® is a registered trademark of the Wi-Fi Alliance.

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TECHNICAL DATA FRONIUS PRIMO 3.8-1 TO 8.2-1

| INPUT DATA | PRIMO 3.8-1 | PRIMO 5.0-1 | PRIMO 6.0-1 | PRIMO 7.6-1 | PRIMO 8.2-1 |
|---|----------------|-------------|-------------|-------------|-------------|
| Max. permitted PV power (kWp) | 5.7 kW | 7.5 kW | 9.0 kW | 11.4 kW | 12.3 kW |
| Max. usable input current (MPPT 1/MPPT 2) | 18 A / 18 A | 18 A / 18 A | 18 A / 18 A | 18 A / 18 A | 18 A / 18 A |
| Total max. DC current | 36 A | | | | |
| Max. admissible input current (MPPT 1/MPPT 2) | 27 A | | | | |
| Operating voltage range | 80 V - 1,000 V | | | | |
| Max. input voltage | 1,000 V | | | | |
| Nominal input voltage | 410 V | 420 V | 420 V | 420 V | 420 V |
| Admissible conductor size DC | AWG 14 - AWG 6 | | | | |
| MPP voltage range | 200 - 800 V | 240 - 800 V | 240 - 800 V | 250 - 800 V | 270 - 800 V |
| Number of MPPT | 2 | | | | |

| OUTPUT DATA | | PRIMO 3.8-1 | PRIMO 5.0-1 | PRIMO 6.0-1 | PRIMO 7.6-1 | PRIMO 8.2-1 |
|--------------------------------------|-------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Max. output power | 240 V | 3,800 W | 5,000 W | 6,000 W | 7,600 W | 8,200 W |
| | 208 V | 3,800 W | 5,000 W | 6,000 W | 7,600 W | 7,900 W |
| Max. output fault current / Duration | 240 V | 584 A Peak / 154 ms | 584 A Peak / 154 ms | 584 A Peak / 154 ms | 584 A Peak / 154 ms | 584 A Peak / 154 ms |
| Max. continuous output current | 240 V | 15.8 A | 20.8 A | 25.0 A | 31.7 A | 34.2 A |
| | 208 V | 18.3 A | 24.0 A | 28.8 A | 36.5 A | 38.0 A |
| Recommended OCPD/AC breaker size | 240 V | 20 A | 30 A | 35 A | 40 A | 45 A |
| | 208 V | 25 A | 30 A | 40 A | 50 A | 50 A |
| Max. efficiency (Lite version) | | 97.9 % | | | | |
| CEC efficiency (Lite version) | 240 V | 95.5 % | 96.5 % | 96.5 % | 97.0 % | 97.0 % |
| Admissible conductor size AC | | AWG 14 - AWG 6 | | | | |
| Grid connection | | 208 / 240 V | | | | |
| Frequency | | 60 Hz | | | | |
| Total harmonic distortion | | < 5.0 % | | | | |
| Power factor (cos $\varphi_{ac,r}$) | | 0.85 - 1 ind./cap. | | | | |

TECHNICAL DATA FRONIUS PRIMO 10.0-1 TO 15.0-1

| INPUT DATA | | PRIMO 10.0-1 | PRIMO 11.4-1 | PRIMO 12.5-1 | PRIMO 15.0-1 |
|---|--|--|--------------|--------------|--------------|
| Max. permitted PV power (kWp) | | 15.00 kW | 17.10 kW | 18.75 kW | 22.50 kW |
| Max. usable input current (MPPT 1/MPPT 2) | | 33.0 A / 18.0 A | | | |
| Total max. DC current | | 51 A | | | |
| Max. admissible input current (MPPT 1/MPPT 2) | | 49.5 A / 27.0 A | | | |
| Operating voltage range | | 80 V - 1,000 V | | | |
| Max. input voltage | | 1,000 V | | | |
| Nominal input voltage | | 655 V | 660 V | 665 V | 680 V |
| Admissible conductor size DC | | AWG 14 - AWG 6 copper direct, AWG 6 aluminum direct, AWG 4 - AWG 2 copper or aluminum with optional input combiner | | | |
| MPP Voltage Range | | 220 - 800 V | 240 - 800 V | 260 - 800 V | 320 - 800 V |
| Number of MPPT | | 2 | | | |

| OUTPUT DATA | | PRIMO 10.0-1 | PRIMO 11.4-1 | PRIMO 12.5-1 | PRIMO 15.0-1 |
|--------------------------------------|-------|--|----------------------|----------------------|----------------------|
| Max. output power | 240 V | 9,995 W | 11,400 W | 12,500 W | 15,000 W |
| | 208 V | 9,995 W | 11,400 W | 12,500 W | 13,750 W |
| Max. output fault current / Duration | 240 V | 916 A Peak / 6.46 ms | 916 A Peak / 6.46 ms | 916 A Peak / 6.46 ms | 916 A Peak / 6.46 ms |
| Max. continuous output current | 240 V | 41.6 A | 47.5 A | 52.1 A | 62.5 A |
| | 208 V | 48.1 A | 54.8 A | 60.1 A | 66.1 A |
| Recommended OCPD/AC breaker size | 240 V | 60 A | 60 A | 70 A | 80 A |
| | 208 V | 60 A | 70 A | 80 A | 90 A |
| Max. efficiency (Lite version) | | 97.9 % | | | |
| CEC efficiency (Live version) | 240 V | 96.5 % | 96.5 % | 96.5 % | 97.0 % |
| Admissible conductor size AC | | AWG 10 - AWG 2 copper (solid / stranded / fine stranded) , AWG 6 - AWG 2 copper (solid / stranded) | | | |
| Grid connection | | 208 / 240 V | | | |
| Frequency | | 60 Hz | | | |
| Total harmonic distortion | | < 2.5 % | | | |
| Power factor (cos $\varphi_{ac,r}$) | | 0-1 ind./cap. | | | |

/ Perfect Welding / Solar Energy / Perfect Charging

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FRONIUS SYMO ADVANCED

Powering three-phase projects that last - now with integrated SunSpec PLC



/ PC Board Replacement



/ SnapInverter Mounting System



/ Integrated Data Communication



/ Design Flexibility



/ Smart Grid Ready



/ Power Line Communication integrated



Featuring ten models ranging from 10 kW to 24 kW, the Fronius Symo Advanced is the ideal inverter for commercial applications. The new Advanced versions combine the benefits of the Fronius Symo with additional value for states with Module Level Shutdown requirements including integrated PLC transmitter for SunSpec Rapid Shutdown communication standard, compliance with NEC pre-2014, 2014 and 2017, zero tilt mounting, light weight and field serviceability.

TECHNICAL DATA FRONIUS SYMO (208-240V VERSIONS)

| INPUT DATA | | SYMO 10.0-3 208-240 | SYMO 12.0-3 208-240 |
|---|-------|---|---------------------|
| Recommended PV power (kWp) | | 8.0 - 13.0 | 9.5 - 15.5 |
| Max. usable input current (MPPT1/MPPT 2) | | | 25.0 A / 16.5 A |
| Max. usable input current total (MPPT 1 + MPPT 2) | | | 41.5 A |
| Max. array short circuit current | | | 37.5 A / 24.8 A |
| Nominal input voltage | 208 V | 350 V | 350 V |
| | 240 V | 370 V | 370 V |
| | 480 V | N/A | N/A |
| Operating voltage range | | | 200-600 V |
| DC startup voltage | | | 200 V |
| MPP Voltage range | | | 300-500 V |
| Max. input voltage | | | 600 V |
| Admissible conductor size DC | | AWG 14-AWG 6 copper direct, AWG 6 aluminum direct, AWG 4-AWG 2 copper or aluminum with input combiner | |
| Integrated DC string fuse holders | | | NA |
| Max (Isc) input terminal rating | | | 33A |
| Number of MPPT | | | 2 |

| OUTPUT DATA | | SYMO 10.0-3 208-240 | SYMO 12.0-3 208-240 |
|--------------------------------|-------|---------------------|---|
| Max. output power | 208 V | 9995 VA | 11995 VA |
| | 240 V | 9995 VA | 11995 VA |
| | 480 V | NA | NA |
| Output configuration | | | 208/240 V |
| Frequency range (adjustable) | | | 45-65 Hz |
| Nominal operating frequency | | | 60 Hz |
| Admissible conductor size AC | | | AWG 14-AWG 6 |
| Total harmonic distortion | | <1.5 % | <1.75 % |
| Power factor range | | | Adjustable 0.85 leading to 0.85 lagging |
| Max. continuous output current | 208 V | 27.7 A | 33.3 A |
| | 240 V | 24.0 A | 28.9 A |
| | 480 V | NA | NA |
| OCPD/AC breaker size | 208 V | 35 A | 45 A |
| | 240 V | 30 A | 40 A |
| | 480 V | NA | NA |
| Max. Efficiency | | 97.0 % | 97.0 % |
| CEC Efficiency | 208 V | 96.5 % | 96.5 % |
| | 240 V | 96.5 % | 96.5 % |
| | 480 V | NA | NA |

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TECHNICAL DATA FRONIUS SYMO (208-240V VERSIONS)

| GENERAL DATA | STANDARD WITH ALL FRONIUS SYMO MODELS |
|--|---|
| Dimensions (width x height x depth) | 20.1 x 28.5 x 8.9 inches |
| Protection Class | NEMA 4X |
| Night time consumption | < 1 W |
| Inverter topology | Transformerless |
| Cooling | Variable speed fan |
| Installation | Indoor and outdoor installation, tilt from 0 - 90 degrees* |
| Ambient operating temperature range | -40°F - + 140 °F (-40 -- +60 °C) |
| Permitted humidity | 0 - 100 % (non-condensing) |
| Elevation | 2000 m (6562 ft) with a max. input voltage of 1000 V / 3400 m (11155 ft) with a max. input voltage of 850 V |
| DC connection terminals | 6x DC+ and 6x DC- screw terminals for copper (solid / stranded / fine stranded) or aluminum (solid / stranded) |
| AC connection terminals | Screw terminals 14-6 AWG |
| Certificates and compliance with standards | UL 1741-2010 Second Edition (incl. UL1741 Supplement SA 2016-09 for California Rule 21 and Hawaiian Electric Code Rule 14H), UL1998 (for functions: AFCI, RCMU and isolation monitoring), IEEE 1547-2003, IEEE 1547a-2014, IEEE 1547.1-2003, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC 2017 Article 690, C22. 2 No. 107.1-16, UL1699B Issue 2-2013, CSA TIL M-07 Issue 1 -2013 |

| GENERAL DATA | SYMO 10.0-3 208-240 | SYMO 12.0-3 208-240 |
|--------------|---------------------|---------------------|
| Weight | 91.9 lbs. | |

| PROTECTIVE DEVICES | STANDARD WITH ALL FRONIUS SYMO MODELS |
|--|---|
| DC reverse polarity protection | Yes |
| Anti islanding | Internal; in accordance with UL 1741-2010, IEEE 1547-2003 and NEC |
| Over temperature protection | Output power derating /Active cooling |
| AFCI | Yes |
| Rapid shutdown compliant | Yes |
| Ground Fault Protection with Isolation Monitor Interrupter | Yes |
| DC disconnect | Yes |

| INTERFACES | AVAILABLE WITH ALL FRONIUS SYMO MODELS |
|--|---|
| USB (A socket) | Datalogging and inverter update possible via USB |
| 2x RS422 (RJ45 socket) | Fronius Solar Net, interface protocol |
| AVAILABLE WITH THE FRONIUS DATAMANAGER 2.0 CARD (ONLY ONE CARD REQUIRED FOR UP TO 100 INVERTERS) | |
| Wi-Fi/Ethernet/Serial/ Datalogger and webserver | Wireless standard 802.11 b/g/n / Fronius Solar.web, SunSpec Modbus TCP, JSON / SunSpec Modbus RTU |
| 6 inputs and 4 digital I/Os | Load management; signaling, multipurpose I/O |
| Power Line Communication (PLC) | Yes – SunSpec Rapid Shutdown communication standard |
| Compatible Module Level Electronic | Tigo TS4-F based on SunSpec PLC (pending testing) |

TECHNICAL DATA FRONIUS SYMO (480V VERSIONS)

| INPUT DATA | SYMO 15.0-3 480 | SYMO 20.0-3 480 | SYMO 22.7-3 480 | SYMO 24.0-3 480 |
|---|---|-----------------|-----------------|-----------------|
| Recommended PV power (kWp) | 12.0 – 19.5 | 16.0 - 26.0 | 18.0 - 29.5 | 19.0 - 31.0 |
| Max. usable input current (MPPT1/MPPT 2) | 33.0 A / 25.0 A | | | |
| Max. usable input current total (MPPT 1 + MPPT 2) | 51 A | | | |
| Max. array short circuit current (MPPT 1/MPPT 2) | 49.5 A / 37.5 A | | | |
| Nominal input voltage 480 V | 685 V | 710 V | 720 V | |
| Operating voltage range | 200-1000 V | | | |
| DC startup voltage | 200 V | | | |
| MPP-voltage range | 350-800 V | 450-800 V | 500-800 V | |
| Max. input voltage | 1000 V | | | |
| Admissible conductor size DC | AWG 14 - AWG 6 copper direct, AWG 6 aluminum direct, AWG 4 - AWG 2 copper or aluminum with input combiner | | | |
| Integrated DC string fuse holders | NA | 6- and 6+ | | |
| Max (Isc) input terminal rating | 33A | 15A | | |
| Number of MPPT | 2 | | | |

* Fronius Shade Cover required for installation angles less than 15 degrees

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TECHNICAL DATA FRONIUS SYMO (480V VERSIONS)

| OUTPUT DATA | | SYMO 15.0-3 480 | SYMO 20.0-3 480 | SYMO 22.7-3 480 | SYMO 24.0-3 480 |
|--------------------------------|-------|---|-----------------|-----------------|-----------------|
| Max. output power | 480 V | 14995 VA | 19995 VA | 22727 VA | 23995 VA |
| Output configuration | | 480 V Delta +N** | | | |
| Frequency range (adjustable) | | 45-65 Hz | | | |
| Nominal operating frequency | | 60 Hz | | | |
| Admissible conductor size (AC) | | AWG 14-AWG 6 | | | |
| Total harmonic distortion | | <1.5 % | <1.0 % | <1.25 % | <1.0 % |
| Power factor range | | Adjustable 0.85 leading to 0.85 lagging | | | |
| Max. continuous output current | 480 V | 18.0 A | 24.0 A | 27.3 A | 28.9 A |
| OCBP/AC breaker size | 480 V | 25 A | 30 A | 35 A | 40 A |
| Max. Efficiency | | 98.0 % | | | |
| CEC Efficiency | 480 V | 97.0 % | 97.5 % | 97.5 % | 97.5 % |

| GENERAL DATA | STANDARD WITH ALL FRONIUS SYMO MODELS |
|--|---|
| Dimensions (width x height x depth) | 20.1 x 28.5 x 8.9 inches |
| Protection Class | NEMA 4X |
| Night time consumption | < 1 W |
| Inverter topology | Transformerless |
| Cooling | Variable speed fan |
| Installation | Indoor and outdoor installation, tilt from 0 - 90 degree* |
| Ambient operating temperature range | -40°F - + 140 °F (-40 ~+60 °C) |
| Permitted humidity | 0 - 100 % (non-condensing) |
| Elevation | 2000 m (6562 ft) with a max. input voltage of 1000 V / 3400 m (11155 ft) with a max. input voltage of 850 V |
| DC connection terminals | 6x DC+ and 6x DC- screw terminals for copper (solid / stranded / fine stranded) or aluminum (solid / stranded) |
| AC connection terminals | Screw terminals 14-6 AWG |
| Certificates and compliance with standards | UL 1741-2010 Second Edition (incl. UL1741 Supplement SA 2016-09 for California Rule 21 and Hawaiian Electric Code Rule 14H), UL1998 (for functions: AFCI, RCMU and isolation monitoring), IEEE 1547-2003, IEEE 1547a-2014, IEEE 1547.1-2003, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC 2017 Article 690, C22. 2 No. 107.1-16, UL1699B Issue 2-2013, CSA T1L M-07 Issue 1 -2013 |

| GENERAL DATA | SYMO 15.0-3 480 | SYMO 20.0-3 480 | SYMO 22.7-3 480 | SYMO 24.0-3 480 |
|--------------|-----------------|-----------------|-----------------|-----------------|
| Weight | 95.7 lbs. | | | |

| PROTECTIVE DEVICES | STANDARD WITH ALL FRONIUS SYMO MODELS |
|--|---|
| DC reverse polarity protection | Yes |
| Anti islanding | internal; in accordance with UL 1741-2010, IEEE 1547-2003 and NEC |
| Over temperature protection | Output power derating/Active cooling |
| AFCI | Yes |
| Rapid shutdown compliant | Yes |
| Ground Fault Protection with Isolation Monitor Interrupter | Yes |
| DC disconnect | Yes |

| INTERFACES | AVAILABLE WITH ALL FRONIUS SYMO MODELS |
|--|---|
| USB (A socket) | Datalogging and inverter update possible via USB |
| 2x RS422 (RJ45 socket) | Fronius Solar Net, interface protocol |
| AVAILABLE WITH THE FRONIUS DATAMANAGER 2.0 CARD (ONLY ONE CARD REQUIRED FOR UP TO 100 INVERTERS) | |
| Wi-Fi/Ethernet/Serial/ Datalogger and webserver | Wireless standard 802.11 b/g/n / Fronius Solar.web, SunSpec Modbus TCP, JSON / SunSpec Modbus RTU |
| 6 inputs and 4 digital I/Os | Load management; signaling, multipurpose I/O |
| Power Line Communication (PLC) | Yes – SunSpec Rapid Shutdown communication standard |
| Compatible Module Level Electronic | Tigo TS4-F based on SunSpec PLC (pending testing) |

**+N for sensing purposes - no current carrying conductor.

* Fronius Shade Cover required for installation angles less than 15 degrees

Product data sheet

Characteristics

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Main

| | |
|------------------------------|---------------------------------------|
| Product | Single Throw Safety Switch |
| Current Rating | 200 A |
| Number of Poles | 3 |
| Voltage Rating | 600 V AC/DC |
| Disconnect Type | Non-fusible disconnect |
| Short Circuit Current Rating | 200 kA maximum |
| Mounting Type | Surface |
| Factory Installed Neutral | None |
| Electrical Connection | Lugs |
| Duty Rating | Heavy duty |
| Certifications | UL listed file E2875 |
| Enclosure Rating | NEMA 3R galvanized steel |
| Wire Size | AWG 6...250 kcmil copper or aluminium |

Complementary

| | |
|----------------------------|--|
| Short-circuit withstand | 200 kA |
| Maximum Horse Power Rating | 15 Hp 240 V AC 50...60 Hz 1 phase NEC 430.52 60 Hp 240 V AC 50...60 Hz 3 phase NEC 430.52 50 Hp 480 V AC 50...60 Hz 1 phase NEC 430.52 125 Hp 480 V AC 50...60 Hz 3 phase NEC 430.52 50 Hp 600 V AC 50...60 Hz 1 phase NEC 430.52 150 Hp 600 V AC 50...60 Hz 3 phase NEC 430.52 40 Hp 250 V DC 50 hp 600 V DC |
| Tightening torque | 275 lbf.in (31.07 N.m) 0.02...0.20 in ² (13.3...127 mm ²) AWG 6...250 kcmil) |
| Width | 18.63 in (473.20 mm) |
| Height | 29.25 in (742.95 mm) |
| Maximum Depth | 8.5 in (215.90 mm) |

Ordering and shipping details

| | |
|-----------------------|----------------------------------|
| Category | 00009 - H&HU SW,2&3P,N3R,30-200A |
| Discount Schedule | DE1 |
| GTIN | 00785901505631 |
| Nbr. of units in pkg. | 1 |
| Package weight(Lbs) | 42 lb(US) (19.05 kg) |
| Returnability | Yes |
| Country of origin | US |

Packing Units

| | |
|------------------------------|---------------------------|
| Unit Type of Package 1 | PCE |
| Package 1 Height | 8.30 in (21.082 cm) |
| Package 1 width | 19.30 in (49.022 cm) |
| Package 1 Length | 30.80 in (78.232 cm) |
| Unit Type of Package 2 | PAL |
| Number of Units in Package 2 | 15 |
| Package 2 Weight | 671.00 lb(US) (304.36 kg) |

Product data sheet

Characteristics

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Main

| | |
|------------------------------|---|
| Product | Single Throw Safety Switch |
| Current Rating | 100 A |
| Number of Poles | 3 |
| Voltage Rating | 600 V AC/DC |
| Disconnect Type | Non-fusible disconnect |
| Short Circuit Current Rating | 200 kA maximum |
| Mounting Type | Surface |
| Factory Installed Neutral | None |
| Electrical Connection | Lugs |
| Duty Rating | Heavy duty |
| Certifications | UL listed file E2875 |
| Enclosure Rating | NEMA 3R galvanized steel |
| Wire Size | AWG 12...AWG 1/0 aluminium AWG 14...AWG 1/0 copper |

Complementary

| | |
|----------------------------|---|
| Short-circuit withstand | 200 kA |
| Maximum Horse Power Rating | 20 Hp 240 V AC 50...60 Hz 1 phase NEC 430.52 40 Hp 240 V AC 50...60 Hz 3 phase NEC 430.52 40 Hp 480 V AC 50...60 Hz 1 phase NEC 430.52 75 Hp 480 V AC 50...60 Hz 3 phase NEC 430.52 40 Hp 600 V AC 50...60 Hz 1 phase NEC 430.52 100 Hp 600 V AC 50...60 Hz 3 phase NEC 430.52 20 Hp 250 V DC 50 hp 600 V DC |
| Tightening torque | 50 Lbf.in (5.65 N.m) AWG 1...AWG 3/0 45 Lbf.in (5.08 N.m) AWG 6...AWG 4 40 Lbf.in (4.52 N.m) 0.01 in ² (8.367 mm ²) AWG 8 35 Lbf.in (3.95 N.m) 0.00...0.01 in ² (2.06...5.261 mm ²) AWG 14...AWG 10 |
| Width | 10.25 in (260.35 mm) |
| Height | 21.25 in (539.75 mm) |
| Maximum Depth | 6.38 in (162.05 mm) |

Ordering and shipping details

| | |
|-----------------------|----------------------------------|
| Category | 00009 - H&HU SW,2&3P,N3R,30-200A |
| Discount Schedule | DE1 |
| GTIN | 00785901505624 |
| Nbr. of units in pkg. | 1 |
| Package weight(Lbs) | 17.2 lb(US) (7.80 kg) |
| Returnability | Yes |
| Country of origin | US |

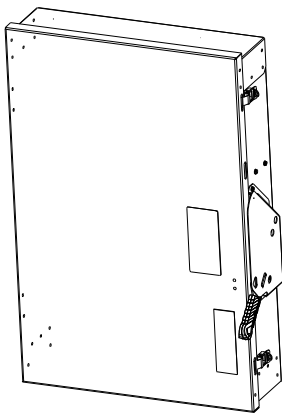
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Data Sheet

General Duty Safety Switch

400A 240V, Type 3R

usa.siemens.com/switches



Standards and Ratings

- UL listed under file #E4776
- CSA listed under file #154852
- Meets NEMA Standard KS-1 for enclosed switches
- Meets NEC wire bending space requirements
- Rated 10,000 AIC with Class H fuses or 100,000 AIC with Class R, J and T fuses
- Suitable for use as service entrance equipment

Features

- Quick-make and break switching action
- Visible blade design
- Highly visible ON/OFF indication
- Modular design allows quick and easy replacement of parts
- Single cover interlock
- Lay in Lugs for easy wiring
- Can utilize either one large or two small wires
- Spring loaded heat sink fuse clip
- One piece line and load base for consistent phase-to-phase alignment
- Extra ground lug on neutral
- Tangential knock out

Product Specifications

General Duty 400A 240V, Type 3R

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General Information

| Catalog Number | Description | Shipping Weight |
|----------------|--|-----------------|
| GF225NRA | General Duty Fused 2 Pole 240V 400A Neutral Type 3R, Outdoor | 91.1 |
| GF325NRA | General Duty Fused 3 Pole 240V 400A Neutral Type 3R, Outdoor | 94.6 |

Maximum Horsepower Ratings

| Catalog Number | 1 Phase, 240V AC | 3 Phase, 240V AC | 1 Phase, 480V AC | 3 Phase, 480V AC | 1 Phase, 600V AC | 3 Phase, 600V AC | 250V DC | 600V DC |
|----------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------|---------|
| GF225NRA | — | 125 | — | — | — | — | 50 | — |
| GF325NRA | — | 125 | — | — | — | — | 50 | — |

Accessories & Hub Kits

| Catalog Number | Description |
|----------------|-----------------------------|
| HA161234 | Aux. Switch (1NO -1NC) |
| HA261234 | Aux. Switch (2NO - 2NC) |
| HN656A | Neutral |
| HG656A | Ground Lug |
| HR65A | R Fuse (400A) |
| HT25A | T Fuse (400A, 300V) |
| HVGK | Hub Gasket Kit |
| ECHV250 | 2.50" Type "HV" Outdoor Hub |
| ECHV300 | 3.00" Type "HV" Outdoor Hub |
| ECHV350 | 3.50" Type "HV" Outdoor Hub |
| HCU656A | Copper Lug Kit ① |
| ECHV400 | 4.00" Type "HV" Outdoor Hub |

Replacement Parts

| Catalog Number | Description |
|-------------------------|-------------------------------|
| HFB65A | Line Base Fused 400A |
| HBB65A | Load Base Fused 400A |
| HL656A | Lug Cap Kit (AL) 400-600A |
| HM656A | Mechanism 400A-600A |
| HH656A | Handle/Handle Guard 400A-600A |
| Catalog Number + "DOOR" | Door |

Mechanical Lug Wire Ranges

| Description | Wire Range with Wire Bending Space per NEC® requirements | Lug Wire Range |
|-----------------------------------|---|---|
| Line and Load Terminals (Fusible) | (1) 1/0 AWG - 600 kcmil or (1) 1/0 AWG- 500 kcmil | (1) 1/0 AWG - 750 kcmil or (2) 1/0 AWG - 500 kcmil |
| Description | Wire Range | |
| 100% Neutral | (1) 1/0 - 600 kcmil or (1) 6 - 300 kcmil | |
| 200% Neutral | (2) 1/0 - 600 kcmil or (2) 6 - 300 kcmil | |
| Equipment Ground | (2) 14 - 2/0 AWG | |

① Purchase field replacement kit along with lugs. (See Speedfax pg. 4-20)