

PROJECT DESCRIPTION

THIS 9.24 KWSTC, ROOF MOUNTED PHOTOVOLTAIC (PV) SYSTEM IS TO BE INSTALLED AT THE SINGLE-FAMILY DWELLING IN LA VETA, COLORADO. THE ENERGY PRODUCED BY THE PV SYSTEM SHALL BE INTERCONNECTED WITH THE EXISTING ON-SITE ELECTRICAL EQUIPMENT VIA A BACK-FED BREAKER IN THE MAIN SERVICE PANEL. THIS PROJECT INCLUDES (2) ENERGY STORAGE BATTERIES.

SHEET INDEX

- T1.0 COVER
- E1.0 ELECTRICAL DIAGRAM
- E1.1 ELECTRICAL CALCULATIONS
- E2.0 SAFETY PLACARDS
- E3.0 ELECTRICAL DETAILS

SCOPE OF WORK

- (28) PV MODULES (TOTAL: x,xxx SQ. FT.)
- (1) 7.7 kW INVERTER
- (2) 8.0 kW, 12.0 kWh BATTERIES

CONSTRUCTION NOTES

- 1.) CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS PRIOR TO INITIATING CONSTRUCTION.
- 2.) CONTRACTOR SHALL REVIEW ALL MANUFACTURER INSTALLATION DOCUMENTS PRIOR TO INITIATING CONSTRUCTION.
- 3.) ALL EQUIPMENT SHALL BE LISTED BY U.L. (OR EQUAL) AND LISTED FOR ITS SPECIFIC APPLICATION.
- 4.) ALL EQUIPMENT SHALL BE RATED FOR THE ENVIRONMENT IN WHICH IT IS INSTALLED.
- 5.) ALL EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- 6.) ACCESS TO ELECTRICAL COMPONENTS OVER 150 VOLTS TO GROUND SHALL BE RESTRICTED TO QUALIFIED PERSONNEL.
- 7.) ALL CONDUCTORS SHALL BE COPPER, RATED FOR 600 VOLTS AND 90°C WET ENVIRONMENT, UNLESS OTHERWISE NOTED.
- 8.) WHERE SIZES OF JUNCTION BOXES, RACEWAYS, AND CONDUITS ARE NOT SPECIFIED, CONTRACTOR SHALL SIZE THEM ACCORDING TO APPLICABLE CODES.
- 9.) PV MODULE FRAMES SHALL BE BONDED TO RACKING RAIL OR BARE COPPER G.E.C. PER THE MODULE MANUFACTURER'S LISTED INSTRUCTION SHEET.
- 10.) PV MODULE RACKING RAIL SHALL BE BONDED TO BARE COPPER G.E.C. VIA WEEB LUG, ILSCO GBL-4DBT LAY-IN LUG, OR EQUIVLENT LISTED LUG.
- 11.) GROUNDING ELECTRODE CONDUCTOR (G.E.C.) SHALL BE CONTINUOUS AND/OR IRREVERSIBLY SPLICED/WELDED.
- 12.) ALL JUNCTION BOXES, COMBINER BOXES, AND DISCONNECTS SHALL BE INSTALLED IN AN ACCESSIBLE LOCATION.
- 13.) ROOF ACCESS POINTS SHALL BE AT A STRONG POINT ON THE BUILDING AND NOT REQUIRE THE PLACEMENT OF LADDERS OVER EXTERIOR WALL OPENINGS.
- 14.) WORKING SPACE AROUND ELECTRIAL EQUIPMENT SHALL COMPLY WITH NEC 110.26

SITE SPECIFICATIONS

OCCUPANCY CATEGORY: II
DESIGN WIND SPEED: 106 MPH
EXPOSURE CATEGORY: C

GOVERNING CODES

- 2017 NATIONAL ELECTRICAL CODE
- 2015 INTERNATIONAL BUILDING CODE
- 2015 INTERNATIONAL MECHANICAL CODE
- 2012 INTERNATIONAL FIRE CODE
- W/ COLORADO STATE BUILDINGS PROGRAM AMENDMENTS
- UNDERWRITERS LABORATORIES (UL) STANDARDS
- OSHA 29 CFR 1910.269

Project:

LA VETA, CO 81055

Project Details:

9.24 kWstc, 7.7 kW AC

Engineering Approval:

REVISIONS		
DESCRIPTION	DATE	REV
ONE LINE	6/26/2017	1
WIRING DIAGRAM	7/10/2017	A
SONNEN ECO12	4/11/2018	B

Sheet Title:

COVER


Sheet Number:


T1.0


Sheet Size:

ANSI B - 17" x 11"

DESIGN & DRAFTING BY:

 RICHARD DOBBINS
PV-102216-011268



 **SepiSolar**
POWER BY DESIGN

Reviewed & Approved by:

EH

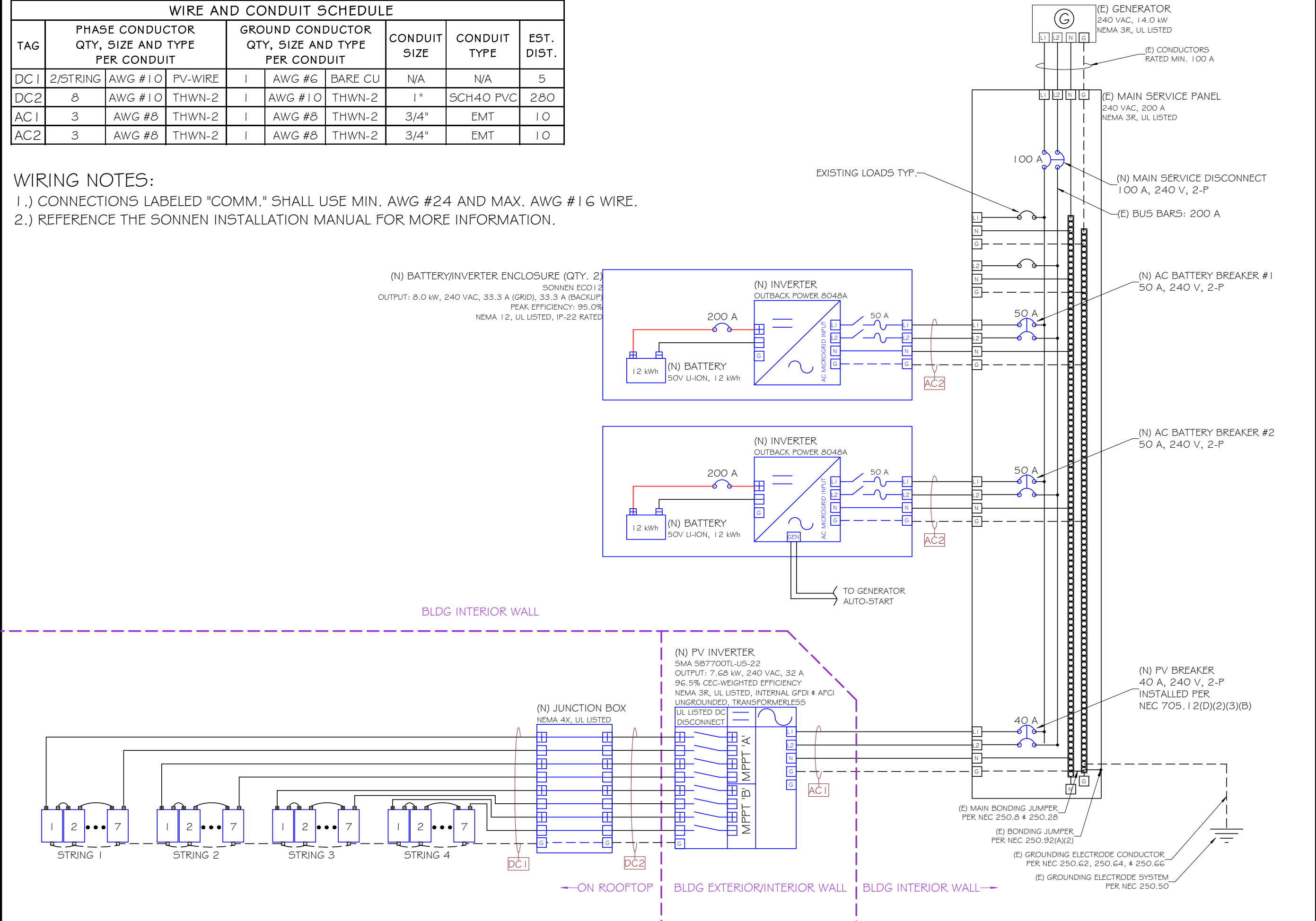
— = EQUIP. GROUNDING CONDUCTOR — = CIRCUIT CONDUCTOR — = FUSE — = CIRCUIT BREAKER (N) = NEW EQUIP. (E) = EXISTING EQUIP. L1 = LINE 1 (BLACK) L2 = LINE 2 (RED) N = NEUTRAL (WHITE) G = GROUND (GREEN) + = POSITIVE (RED) - = NEGATIVE (BLACK)

WIRE AND CONDUIT SCHEDULE

TAG	PHASE CONDUCTOR QTY, SIZE AND TYPE PER CONDUIT				GROUND CONDUCTOR QTY, SIZE AND TYPE PER CONDUIT				CONDUIT SIZE	CONDUIT TYPE	EST. DIST.
DC1	2/STRING	AWG #10	PV-WIRE		1	AWG #6	BARE CU	N/A	N/A	N/A	5
DC2	8	AWG #10	THWN-2		1	AWG #10	THWN-2	1"	SCH40 PVC	280	
AC1	3	AWG #8	THWN-2		1	AWG #8	THWN-2	3/4"	EMT	10	
AC2	3	AWG #8	THWN-2		1	AWG #8	THWN-2	3/4"	EMT	10	

WIRING NOTES:

- 1.) CONNECTIONS LABELED "COMM." SHALL USE MIN. AWG #24 AND MAX. AWG #16 WIRE.
- 2.) REFERENCE THE SONNEN INSTALLATION MANUAL FOR MORE INFORMATION.



Project:
LA VETA, CO 81055

Project Details:
9.24 kWstc, 7.7 kW AC

Engineering Approval:

REVISIONS		
DESCRIPTION	DATE	REV
ONE LINE	6/26/2017	1
WIRING DIAGRAM	7/10/2017	A
SONNEN ECO12	4/11/2018	B

Sheet Title:
**ELECTRICAL
DIAGRAM**

Sheet Number:
E1.0

Sheet Size:
ANSI B - 17" x 11"

DESIGN & DRAFTING BY:
RICHARD DOBBINS
PV-102216-011268
SepiSolar
POWER BY DESIGN

Reviewed & Approved by:
EH

Array Configuration		
System: 9.24 kWstc, 7.7 kW AC		
Total PV Module Qty: 28		
Inverter I.D. #		Inv #1
Inverter AC Power (kW):		7.68
PV Power (kWstc):		9.24
Inverter DC:AC Ratio		1.20
Module Total Qty:		28
MPPT "A"	String Qty:	2
	String Length:	7
	Max Open Circuit Voltage	555
	Operating Voltage:	402
	Max Short Circuit Current	15.2
	Operating Current:	11.4
MPPT "B"	String Qty:	2
	String Length:	7
	Max Open Circuit Voltage	555
	Operating Voltage:	402
	Max Short Circuit Current	15.2
	Operating Current:	11.4

PV Inverter Specifications			
Model Number:	SMA SB7700TL-US-22		
Power Rating:	7.68	kW AC	
Nominal Voltage:	240	Volts AC	
Max Output Current:	32.0	Amps	
CEC Weighted Efficiency:	96.5%		
Maximum DC Voltage:	600		
DC Start Voltage:	150		
Max. MPPT Voltage:	480	Max Current MPPT A:	18.0
MPPT Quantity:	2	Max Current MPPT B:	12.0
Inverter Quantity:	1	Max Current MPPT C:	N/A

PV Module Specifications		
Model Number:	PANASONIC VBHN330SA16	
Weight:	40.8	lbs
Dimensions:	62.6 x 41.5 x 1.4	(in)
Power @ STC:	330	Watts
Voc:	69.7	Volts DC
Vmp:	58.0	Volts DC
Isc:	6.07	Amps
Imp:	5.70	Amps
Voc Temp Coeff:	-0.25	%/°C
Max DC Voltage:	600	Volts DC

Battery Inverter Specifications			
Model Number:	SONNEN ECO12		
Power Rating (W AC):	8000	Max Utility Input Current (A):	33.3
Nominal Voltage (VAC):	240	Backup Output Current (A):	33.3
DC Charge Current (A):	30	Max Surge Current (A)*:	100
Nominal Voltage (VDC):	48	CEC Efficiency:	92.5%
Voltage Range (VDC):	48-56	Inverter Quantity:	2
*Surge current is typically only seen in off-grid (backup) mode and is limited to 20ms. Consult manufacturer's specifications for more information.			

Load Schedule						
Description		Amps	Volts	Watts	Hours of operation per day	Watt-hours per day
Refrigerator		1.5	120	180	12	2160
				0		0
				0		0
Sq. ft. of dwelling	W/sq. ft. of lighting	Lighting load calculations per NEC 220.42			Hours of operation per day	
220	10	0 - 3000 W @ 100%		12	26400	
Total watts of lighting		3001 - 12,000 W @ 35%			0	
2200		12,001 W and up @ 25%			0	
Total:						28560

PV System Maximum Voltage Calculation per NEC 690.7(A)			
Local Record Low Temp:		-30 °C	Data Source: ALAMOSA SAN LUIS VALLEY RGNL
Voc Temp Coefficient	25°C - Record Low Temp.	Voc + 1 = Correction Factor	Max # of Modules in Series = Temperature Corrected Open Circuit Voltage
0.25%/°C	x 55°C	+ 1 =	1.138
1.138	x 69.7	x 7	= 555.0 Volts DC

TAG	CIRCUIT ORIGIN	CIRCUIT DESTINATION	CONDUCTOR SPECIFICATIONS				REQUIRED CONDUCTOR AMPACITY						AMPACITY CHECK #1		VOLTAGE DROP					
			MATERIAL	TEMP. RATING	TRADE SIZE	AMPACITY @ 30°C PER 310.15(B)(16)	MAX CURRENT 690.8(A)(1)	I_{sc} (Amps)	# OF COMBINED STRINGS	=	MAX CURRENT PER 690.8(A)(1)	125% PER 690.8(B)(1)	=	MAX CURRENT PER 690.8(B)(1)	MAX CURRENT PER 690.8(B)(1)	CONDUCTOR AMPACITY	EST. ONE-WAY DISTANCE	VOLTAGE DROP		
DC1	PV STRING	JUNCTION BOX	COPPER	90°C	AWG #10	40 Amps	1.25	x	6.07	x	1	=	7.6 Amps	x	1.25	=	9.5 Amps	9.5 Amps < 40.0 Amps	5 ft	0.02%
DC2	JUNCTION BOX	INVERTER	COPPER	75°C	AWG #10	35 Amps	1.25	x	6.07	x	1	=	7.6 Amps	x	1.25	=	9.5 Amps	9.5 Amps < 35.0 Amps	280 ft	1.04%

TAG	CONDUCTOR TEMPERATURE DERATING						CONDUIT FILL DERATING		CORRECTED AMPACITY CALCULATION				AMPACITY CHECK #2	
	CIRCUIT ENVIRONMENT	LOCAL 2% AVG. HIGH TEMP (°C)	HEIGHT ABOVE ROOF (in)	TEMP. ADDER PER 310.15(B)(3)(c)	OPERATING TEMP (°C)	AMPACITY CORRECTION 310.15(B)(2)(a)	# OF UNGROUND CONDUCTORS	AMPACITY CORRECTION 310.15(B)(3)(a)	AMPACITY x	TEMP DERATE	CONDUIT FILL DERATE	DERATED CONDUCTOR AMPACITY	MAX CURRENT PER 690.8(B)(2)	DERATED CONDUCTOR AMPACITY
DC1	OUTDOORS, SHADED (+10°C)	29	-	N/A	39	0.91	N/A	1.00	40	x 0.91	x 1.00	= 36.4 Amps	7.6 Amps < 36.4 Amps	7.6 Amps < 24.5 Amps
DC2	UNDERGROUND (+0°C)	29	-	N/A	29	1	8	0.70	35	x 1	x 0.70	= 24.5 Amps	7.6 Amps < 24.5 Amps	

TAG	CIRCUIT ORIGIN	CIRCUIT DESTINATION	CONDUCTOR SPECIFICATIONS				REQUIRED CONDUCTOR AMPACITY					AMPACITY CHECK #1	VOLTAGE DROP	
			MATERIAL	TEMP. RATING	TRADE SIZE	AMPACITY @ 30°C PER 310.15(B)(16)	INVERTER OUTPUT CURRENT	# OF INVERTERS	MAX CURRENT PER 690.8(A)(3)	125% PER 690.8(B)(1)	MAX CURRENT PER 690.8(B)(1)	MAX CURRENT PER < 690.8(B)(1)	EST. ONE-WAY DISTANCE	VOLTAGE DROP
AC1	INVERTER	MAIN PANEL	COPPER	75°C	AWG #8	50 Amps	32.0	x 1	= 32.0 Amps	x 1.25	= 40.0 Amps	40.0 Amps < 50 Amps	10 ft	0.21%
AC2	SONNEN ECO12	MAIN PANEL	COPPER	75°C	AWG #8	50 Amps	33.3	x 1	= 33.3 Amps	x 1.25	= 41.6 Amps	41.6 Amps < 50 Amps	10 ft	0.22%

TAG	CONDUCTOR TEMPERATURE DERATING				CONDUIT FILL DERATING		CORRECTED AMPACITY CALCULATION				AMPACITY CHECK #2	
	CIRCUIT ENVIRONMENT	LOCAL 2% AVG. HIGH TEMP (°C)	EXPECTED OPERATING TEMP (°C)	AMPACITY CORRECTION 310.15(B)(2)(a)	# OF UNGROUND CONDUCTORS	AMPACITY CORRECTION 310.15(B)(3)(a)	CONDUCTOR AMPACITY	x	TEMP DERATE	CONDUIT FILL DERATE	DERATED CORRECTED AMPACITY	MAX CURRENT PER 690.8(B)(2)
AC1	EXT. BLDG. WALL (+15°C)	29	44	0.87	2	1.00	50	x	0.87	x 1.00	= 43.5 Amps	32.0 Amps < 43.5 Amps
AC2	INDOORS (+0°C)	29	29	1.00	2	1.00	50	x	1	x 1.00	= 50 Amps	33.3 Amps < 50.0 Amps

Project:

LA VETA, CO 81055

Project Details:

9.24 kWstc, 7.7 kW AC

Engineering Approval:

REVISIONS		
DESCRIPTION	DATE	REV
ONE LINE	6/26/2017	I
WIRING DIAGRAM	7/10/2017	A
SONNEN ECO12	4/11/2018	B

Sheet Title:

ELECTRICAL CALCULATIONS


Sheet Number:

E1.1

Sheet Size:

ANSI B - 17" x 11"

DESIGN & DRAFTING BY:
RICHARD DOBBINS
Professional Engineer
PV-102216-011268


SepiSolar
POWER BY DESIGN

Reviewed & Approved by:

EH

WARNING
ELECTRIC SHOCK HAZARD.
DO NOT TOUCH
TERMINALS. TERMINALS ON
BOTH THE LINE AND LOAD
SIDES MAY BE ENERGIZED
IN THE OPEN POSITION.

REQ'D BY: NEC 690.17
APPLY TO:
DISCONNECTS
PV LOAD CENTERS
COMBINER BOXES

1

PHOTOVOLTAIC POWER SOURCE

REQ'D BY: NEC 690.31(E)(3)
APPLY TO:
EXPOSED RACEWAYS, CABLE TRAYS
COVERS OR ENCLOSURES OF JUNCTION BOXES
CONDUIT BODY W/ AVAILABLE CONDUIT OPENING

2

THIS SITE CONTAINS A
STAND-ALONE ELECTRICAL
POWER SYSTEM.

REQ'D BY: NEC 690.56(A)
APPLY TO:
ELECTRICAL PANEL(S)

3

WARNING
INVERTER OUTPUT
CONNECTION. DO NOT
RELOCATE THIS
OVERCURRENT DEVICE

REQ'D BY: NEC 705.12(D)(7)
APPLY TO:
PV SYSTEM BREAKER

4

SOLAR AC DISCONNECT

REQ'D BY: NEC 690.14(C)(2)
APPLY TO:
PV SYSTEM AC DISCONNECTS

5

SOLAR DC DISCONNECT

REQ'D BY: NEC 690.13(B)
APPLY TO:
PV SYSTEM DC DISCONNECTS

6

WARNING
ELECTRIC SHOCK HAZARD.
THE DC CONDUCTORS OF
THE PV SYSTEM ARE
UNGROUND AND MAY BE
ENERGIZED.

REQ'D BY: NEC 690.35(F)
APPLY TO:
JUNCTION BOXES, COMBINER BOXES
DC DISCONNECTS, INVERTERS

7

WARNING
IF A GROUND FAULT IS
INDICATED, THE NORMALLY
GROUNDED CONDUCTORS
MAY BE ENERGIZED AND
UNGROUND.

REQ'D BY: NEC 690.5(C)
APPLY TO:
INVERTER

8

GRID TIED PHOTOVOLTAIC
POWER SOURCE
MPPT 'A' SPECIFICATIONS:
OPERATING CURRENT: 11.4 A
OPERATING VOLTAGE: 402 V
MAX SYSTEM VOLTAGE: 555 V
MAX SYSTEM CURRENT: 15.2 A
MPPT 'B' SPECIFICATIONS:
OPERATING CURRENT: 11.4 A
OPERATING VOLTAGE: 402 V
MAX SYSTEM VOLTAGE: 555 V
MAX SYSTEM CURRENT: 15.2 A
MAX INVERTER OUTPUT:
7.7 kW, 32 A, 240 VAC

REQ'D BY: NEC 690.53
APPLY TO:
INVERTER

9

SIGNAGE REQUIREMENTS

- 1.) RED BACKGROUND
- 2.) WHITE LETTERING
- 3.) MIN. 3/8" LETTER HEIGHT
- 4.) ALL CAPITAL LETTERS
- 5.) ARIAL OR SIMILAR FONT
- 6.) WEATHER RESISTANT MATERIAL, PER UL 969

Project:

LA VETA, CO 81055

Project Details:

9.24 kW_{stc}, 7.7 kW AC

Engineering Approval:

REVISIONS

DESCRIPTION	DATE	REV
ONE LINE	6/26/2017	1
WIRING DIAGRAM	7/10/2017	A
SONNEN ECO12	4/11/2018	B

Sheet Title:

SAFETY
PLACARDS

Sheet Number:

E2.0

Sheet Size:

ANSI B - 17" x 11"

DESIGN & DRAFTING BY:

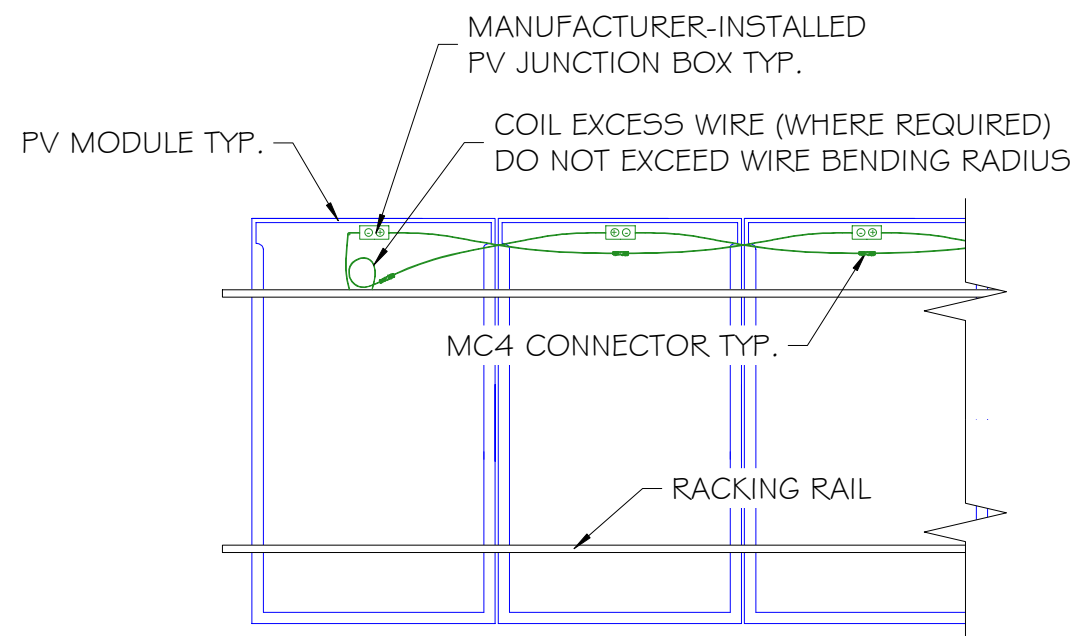
 RICHARD DOBBINS
PV-102216-011268



Reviewed & Approved by:

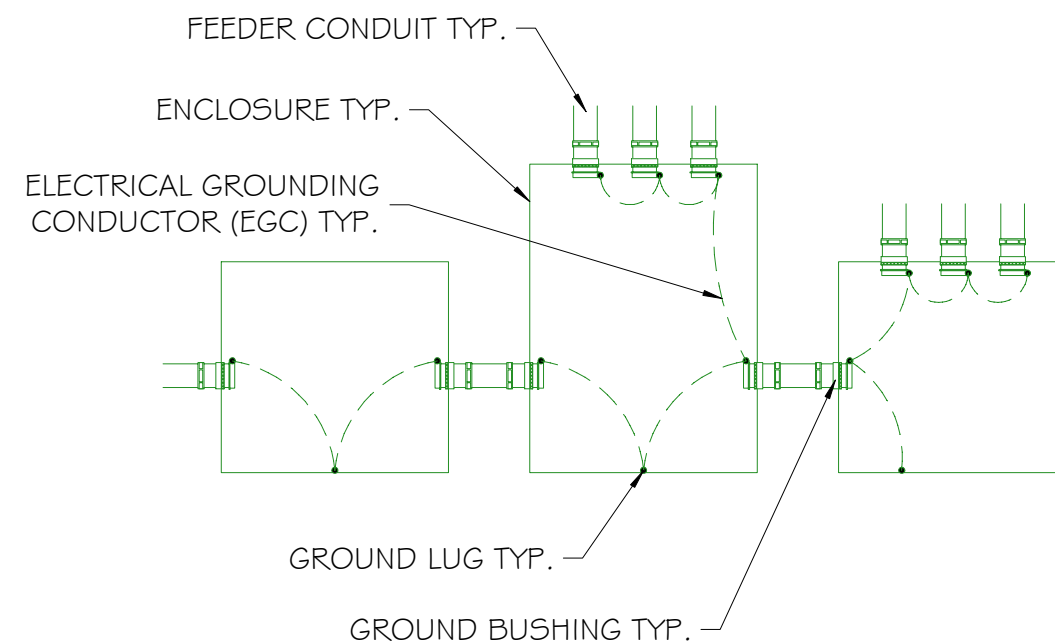
EH

SCALE: 1" = 4"



MODULE SKIP STRINGING

SCALE: NTS





TYPICAL
EQUIPMENT GROUNDING
SCALE: NTS

REVISIONS		
DESCRIPTION	DATE	REV
ONE LINE	6/26/2017	1
WIRING DIAGRAM	7/10/2017	A
Sonnen ECO 12	4/11/2018	B

Sheet Title:
ELECTRICAL
DETAILS

Sheet Number: E3.0

Sheet Size:
ANSI B - 17" x 11"

DESIGN & DRAFTING BY:
 RICHARD DOBBINS
 PV Installation # PV-102216-011268 



Reviewed & Approved by:
EH