Renewable Development Fund
Project EP3-12

Milestone 1 Report

PUBLIC

Gerardo Ruiz, Project Manager
freEner-g LLC
www.mysolarlease.com
2740 – 31st Avenue South
Minneapolis, MN 55406
T: 612.605.5228 – F: 612-677-3967

Legal Notice

Project Title: A Solar Electric Solution for Residential Markets

Contract Number: EP3-12 Milestone Number: 1 Report Date: 2009/10/29

Principal Investigator: Gerardo Ruiz
612-605-5228

Contract Contact: Gerardo Ruiz
612-605-5228

Congressional District for Corporate office: 5
Congressional Districts for Project location (distributed in Twin Cities): 4 & 5 plus partly in 3

Executive Summary

The goal of this project, as stated in the proposal that freEner-g submitted on July 17, 2007, is "to demonstrate the commercial viability of providing solar-generated electricity to homes and small businesses based on a leasing and service package". In addition, the "project will provide distribute residential solar energy through rooftop-mounted photovoltaic solar panels" and the importance of the project is to overcome pricing and capitalization barriers in this market, which have been documented by various studies to be the biggest obstacles to solar expansion.

This would be accomplished with the following objectives:

1. Conduct a market study and pricing sensitivity analysis.
2. Provide private funding to complement the grant from RDF.
3. Install 280 KW (nameplate capacity) of roof-top mounted and grid-connected PV systems on homes and small businesses.
4. Produce monthly reports and final project summary.
5. Produce long-term statistical data.
6. Invite City of Minneapolis and other parties to participate in a Task Force initiative to define Best Practices for the process of permitting and inspections.

For completion of Milestone 1, freEner-g finished items 1 & 2 above and made progress in items 3, 4 and 6 (item 5 will be delivered over time, since it relates to long-term statistical data). In particular, and per the RDF contract language, Milestone 1 requires the following deliverables:

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a. "One-line Diagrams and Material Lists with technical specifications for all three System templates that will be used as design patterns for residential installations." Included in Appendix A of this report.

b. "Complete list of all 1,000 prospect participant homeowners with their contact information and the results of the preliminary site assessments of each prospective customer, which includes aerial assessment data, street assessment data and phone assessment data". The list is omitted from Appendix B due to its confidential nature. All participants in the list volunteered their information via the freEner-g website www.mysolarlease.com or via phone. The participants expressed interest as a result of Xcel Energy announcing the grant award and other local media mentions of freEner-g. The criteria and methodology applied to the selection process was as follows:

Methodology – Assessment steps	**Criteria applied**
Aerial Assessment	Xcel Energy customer? Twin Cities area? South orientation? Shading? Accessibility to roof?
Phone Assessment	Residential/Commercial? Owner/renter? Part of an association? Roof condition? Roof area? Intent to stay long term?
Street Assessment	Preliminary estimate of panels Preliminary shading estimate
Document Assessment	Proper insurance docs? One year of electrical bills? Energy audit? Association approval?
Site Assessment	Full solar site assessment with a written report (structural, electrical and solar parameters)
Credit Assessment	Approved credit report?

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c. "Standard documentation packages required to present to the City of Minneapolis (for building permits and zoning approvals), State of Minnesota (for electrical permit) and Xcel Energy (for interconnection agreement)". Technical data sheets from a standard documentation package have been included in Appendix C to document this deliverable.

d. "Results of the web-based study and pricing sensitivity analysis". Included in the next Section "Technical Progress"

e. "Documentation confirming receipt of financing by Guarantor, in a form acceptable to NSP, which shall provide all necessary co-funding in the amount of no less than $971,507". Administrative deliverable, which is submitted separately.

f. "Milestone Report satisfactory to RDF representative" – the present document.

Technical Progress

The main technical task involved in Milestone 1 was design, since the construction phase will start in November 2009.

The design work entailed One-line Diagrams and Material Lists with tech specs for three System Design models, which were selected for 2.8 KW, 4.2 KW and 5.6KW solar PV standard systems. These templates will be easily customized for each installation. Complete documentation for these design templates has been included in Appendix A of this report.

The design work is not complex for small residential systems of that size. Consequently, there were no major challenges, breakthroughs or any such events to report.

Another technical progress to report is the completion of a web-based pricing sensitivity survey. This was conducted in order to determine the viability of solar leasing and the pricing sensitivity ('willingness-to-pay') of the Twin Cities market. With that goal, freEner-g conducted a customer survey from February 2008 to June 2008. This survey focused on willingness to pay in relation to their current electric bill. A copy of the survey has been enclosed in Appendix D.

These results are based on 218 surveys completed:

- The average electricity bill is $80 a month
- 94% of respondents understand that conventional electricity has a negative environmental impact (thus an understanding of the benefits of solar electricity)
- 95% of respondents are interested in solar PV for their home
- Based on the benefits of a monthly lease program, the average respondent is willing to pay 1.49 times their current electric bill
- If a commitment to leasing solar *today* would result in a decreasing lease rate over five years, respondents would be willing to pay 1.65 times their current electric bill

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The willingness to pay of 49% over the current electric bill is the guiding pricing parameter for the solar leases offered in this project.

No particular survey methodology was applied, since those that chose to participate did so via the web, and no verification was made of the representation of the survey group. This survey was not conducted with the rigorous methods that yield results that are meant to be published in academic journals. It did, however, provide useful business data for this project.

Project Benefits

Project benefits are:

1. Demonstration of the viability of 'solar-as-a-service'
2. Delivery of 280KW of generating capacity, which will count towards the Xcel Energy goal for Renewable Energy Standard
3. Green job generation
4. Generation of clean electricity for a minimum of 15 years

So far, benefits one and three have been achieved in part, which is sensible given that this is Milestone 1 of the project. In particular, benefit 1, demonstration of the viability of 'solar-as-a-service', has been partially achieved in that the response to the program has been much greater than expected: over 1,000 parties interested for a potential number of 50 installations or less. This is arguably a demonstration of available market demand for 'solar-as-a-service'.

In reference to benefit 3, green job generation, we report five Full-Time-Equivalent green jobs have been generated: Project Manager, Project Administrator, Project IT development and support, Crew Supervisor, and Site Assessor/Installer. Additional installers and electricians will be sub-contracted as dictated by the project workload, budget and schedule.

Project Lessons Learned

As stated above, it became apparent very early on that the market response towards solar leasing was excellent. We foresee no trouble generating an increasing number of leads for any future expansions of the program as PV costs continue to decline and thus leasing prices do accordingly. It is also quite clear that customers value green electricity and are willing to pay a premium, based on our own customer survey and other green marketing studies, such as those published by the Natural Marketing Institute. The challenge is to finance such a program, not

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because of difficulties in financing solar PV in particular, but because the current state of the financial markets.

Usefulness of Project Findings

Project findings are limited so far, given that only Milestone 1 has been completed. However, Milestone 1 has proven to be unexpectedly difficult Milestone to complete in the current financial markets: co-funding or additional project financing to complement the RDF grant took longer than expected. That was a significant finding.

Additional more detailed findings are expected as we enter into the construction phase of this project. These findings will be documented in subsequent Milestone Reports.

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Appendix A – One-Line Diagrams and Material Lists for PV Design Templates: 2.8 KW, 4.2 KW and 5.6 KW

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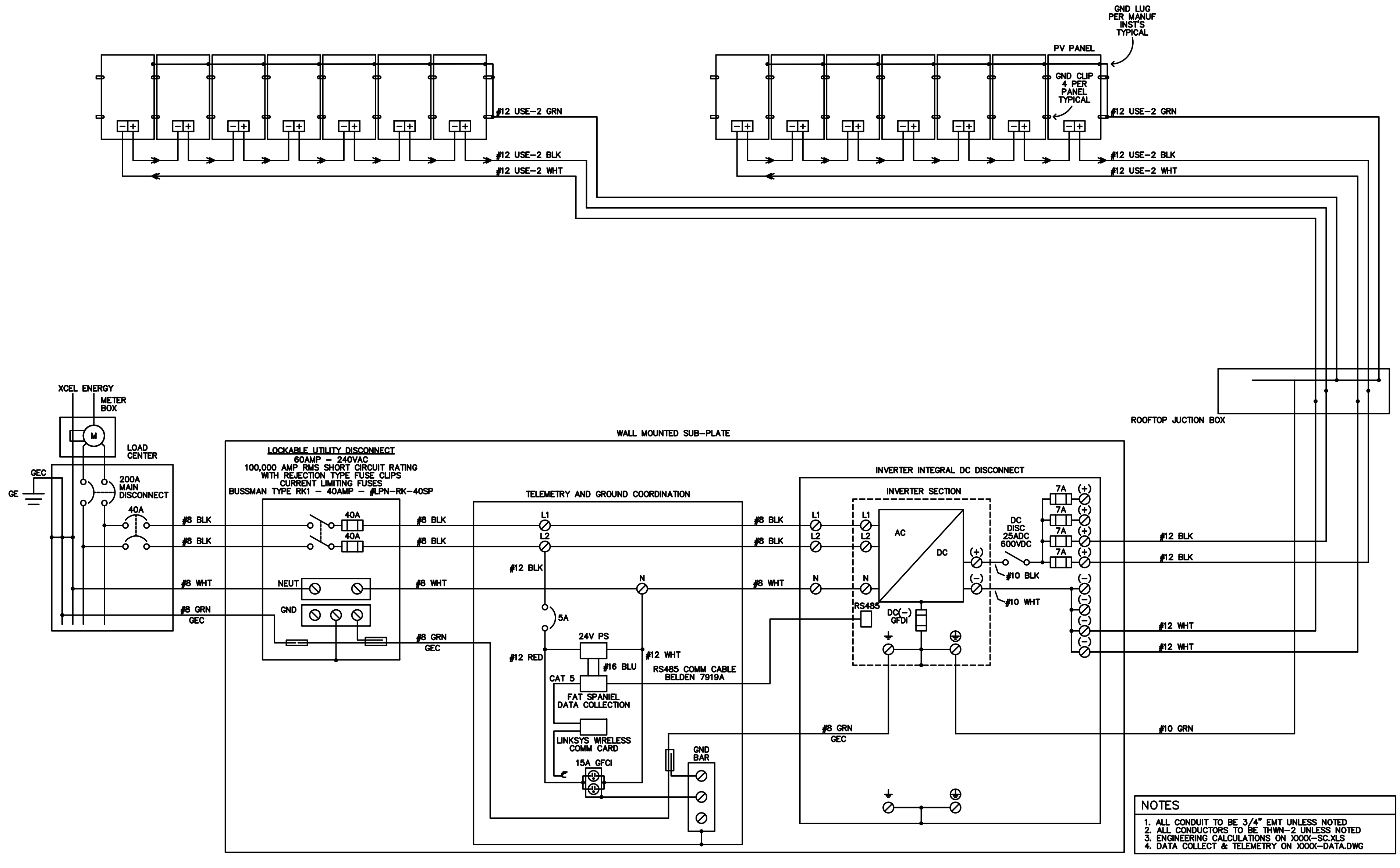


NOTES
1. ALL CONDUIT TO BE 3/4" EMT UNLESS NOTED
2. ALL CONDUCTORS TO BE THWN-2 UNLESS NOTED
3. ENGINEERING CALCULATIONS ON XXXX-SC.XLS
4. DATA COLLECT & TELEMETRY ON XXXX-DATA.DWG

NO.	REVISIONS	DATE	INITIAL	NO.	REVISIONS	DATE	INITIAL
1	ORIGINAL						

DRAWING SCALE: NONE WHEN PLOTTED AS "D" SIZE SHEET

DRAWING TITLE
2.8KW PV SYS ONE-LINE DIAG
SE LOAD SIDE CONNECTED
PROTOTYPE
VERSION 20080814

DRAWING NO.
XXXX-OL

FREENER-G

2740 31ST AVE S
MINNEAPOLIS, MN 55406
612-605-5228

NOTE: ENTER BOXED-IN AND BLUE-HIGHLIGHTED DATA

PV PANEL Nameplate Data for:	SANYO HIP-200BA3			
55.80	Vpm	MAXIMUM POWER VOLTAGE	at 25	deg C
3.59	Ipm	MAXIMUM POWER CURRENT		
68.70	Voc	OPEN CIRCUIT VOLTAGE		
3.83	Isc	SHORT CIRCUIT CURRENT		
600	V	MAXIMUM SYSTEM VOLTAGE		
15	A	SERIES FUSE RATING		
-0.172	Voc/deg C	TEMPERATURE COEFFIECIENT		
0.00088	A Isc/deg C	TEMPERATURE COEFFIECIENT		
79.02	Voc max	OPEN CIRCUIT VOLTAGE	at -35	deg C
4.79	Isc max	SHORT CIRCUIT CURRENT	at X	deg C

NOTE: CRITICAL OUTPUT DATA IS BOXED-IN AND RED-HIGHLIGHTED

7	: QTY OF PV PANELS IN EACH STRING			
390.60	Vpm string	MAXIMUM POWER VOLTAGE	at 25	deg C
3.59	Ipm string	MAXIMUM POWER CURRENT		
480.90	Voc string	OPEN CIRCUIT VOLTAGE		
3.83	Isc string	SHORT CIRCUIT CURRENT		
600	V string	MAXIMUM SYSTEM VOLTAGE		
15	A string	SERIES FUSE RATING		
-0.172	(Voc/deg C) string	TEMPERATURE COEFFIECIENT		
0.00088	(A Isc/deg C) string	TEMPERATURE COEFFIECIENT		
553.14	Voc max string	OPEN CIRCUIT VOLTAGE	at -35	deg C
4.79	Isc max string	SHORT CIRCUIT CURRENT	at X	deg C

2	: QTY OF PV STRINGS IN PARALLEL			
390.60	Vpm array	MAXIMUM POWER VOLTAGE	at 25	deg C
7.18	Ipm array	MAXIMUM POWER CURRENT		
480.90	Voc array	OPEN CIRCUIT VOLTAGE		
7.66	Isc array	SHORT CIRCUIT CURRENT		
600	V array	MAXIMUM SYSTEM VOLTAGE		
NA	A array	SERIES FUSE RATING		
-0.172	(Voc/deg C) array	TEMPERATURE COEFFIECIENT		
0.00088	(A Isc/deg C) array	TEMPERATURE COEFFIECIENT		
553.14	Voc max array	OPEN CIRCUIT VOLTAGE	at -35	deg C
9.58	Isc max array	SHORT CIRCUIT CURRENT	at X	deg C

NOTE: ENTER BOXED-IN AND BLUE-HIGHLIGHTED DATA

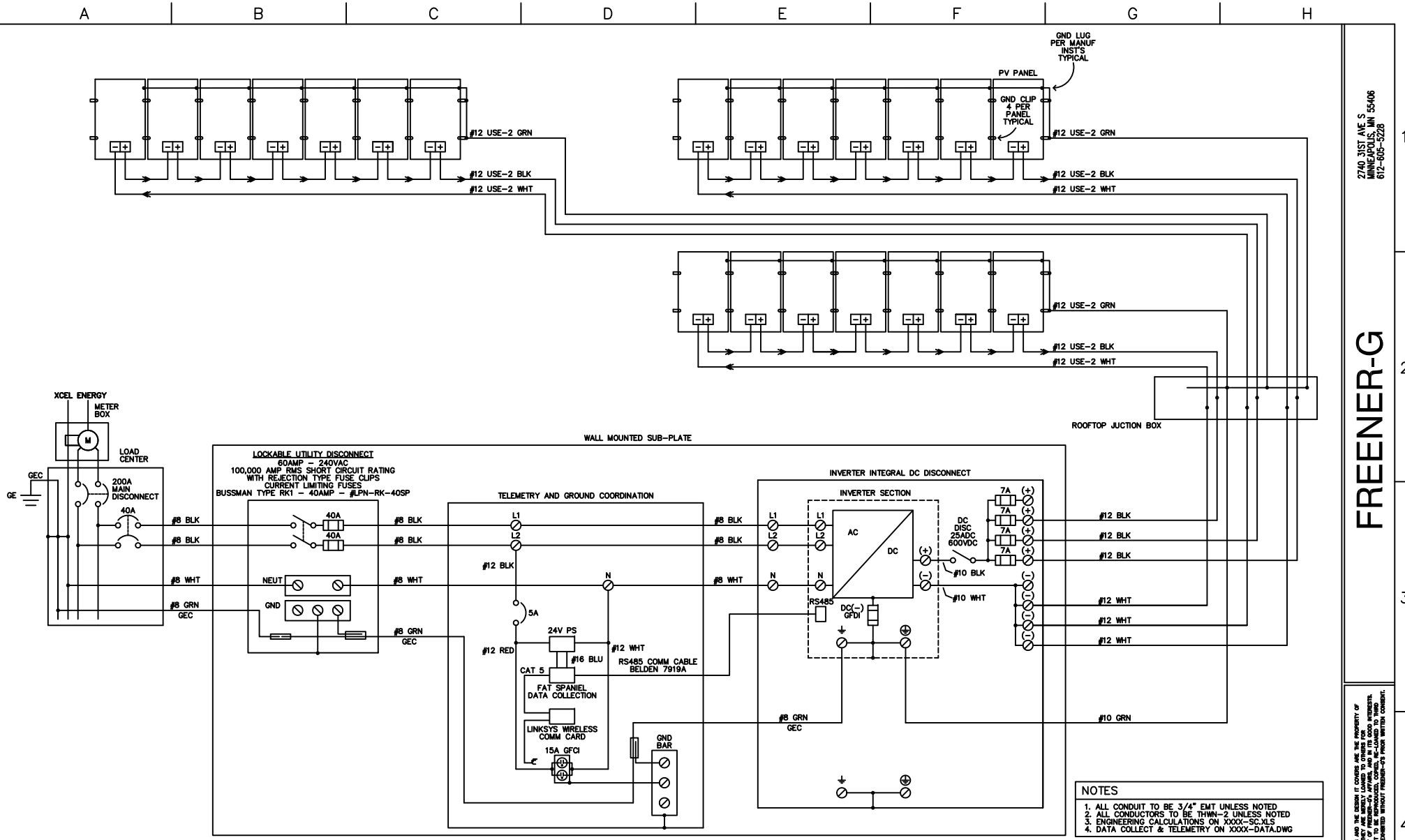
INVERTER Nameplate Data for:	SUNNY BOY 4000US	
200-480	Vdc	PEAK POWER TRACKING VOLTAGE
200-600	Vdc	INPUT OPERATING VOLTAGE
230	Vdc	PV START VOLTAGE
17	Adc	MAX DC INPUT CURRENT
211-264	Vac	AC OPERATING VOLTAGE RANGE
240	Vac	AC OPERATING VOLTAGE NOMINAL
15	Aac	MAX AC OUTPUT CONTINUOUS CURRENT
30	Aac	MAX AC OUTPUT FAULT CURRENT
30	Aac	MAX AC OUTPUT OVERCURRENT PROTECTION

5.98	Adc string	MIN DC STRING CONDUCTOR AMPERAGE
7	Adc	DC STRING OVERCURRENT PROTECTION
11.97	Adc array	MIN DC ARRAY CONDUCTOR AMPERAGE
18.75	Aac output	MIN AC OUTPUT CONDUCTOR AMPERAGE
20	Aac	AC OUTPUT OVERCURRENT PROTECTION

NOTE: CRITICAL OUTPUT DATA IS BOXED-IN AND RED-HIGHLIGHTED

NOTES:	1. ALL COMPONENTS SHALL BE LABELED/LISTED BY A THIRD-PARTY TESTING AGENCY ACCEPTABLE TO THE STATE OF MINNESOTA								
	2. INVERTER SUBPLATE ASSEMBLY SHALL BE LABELED AS AN ASSEMBLY								
			LAYOUT						
			DRAWING		SUPPLIED BY				
QTY	$/EA	$/LN	REF #	freEner-g	Panel Shop	Contractor	MFG	PART #	DESCRIPTION
1	20.00	20.00				1			CIRCUIT BREAKER: 40A, 250VAC, 2-POLE, BACK-FEEDABLE
									DETERMINED PER PROJECT FOR EXISTING CIRCUIT BREAKER PANEL
1			3		1		SQUARE D	SEE BELOW:	UTILITY DISCONNECT: FUSIBLE, LOCKABLE, 60A, 240VAC, WITH FEED-THRU NEUTRAL AND GROUND BUS
1			3		1		SQUARE D	H222NRB	SWITCH (INCLUDES NEUTRAL BUS), NEMA 3R
1			3		1		SQUARE D	GTK0610	GROUND BUS
1			3		1		SQUARE D	RFK03L	CLASS R FUSE KIT
2			3		1		BUSSMANN	LPN-RK-40SP	40A, 250VAC, CLASS RK1 FUSE
0			3		1		BUSSMANN	263-R	FUSE REDUCER, FOR LPN-RK FUSE, 60A CLIP SIZE TO 30A FUSE SIZE
1			17		1		PANEL SHOP	PANEL	INVERTER COMPONENTS SUBPLATE: 44.5"W X 40.75"T, FOR OUTDOOR INSTALLATION
1			18		1		PANEL SHOP	LABEL	PV SYSTEM UTILITY DISCONNECT
1			19		1		PANEL SHOP	LABEL	PV SYSTEM ELECTRICAL SPEC'S, APPROX 10 LINES OF 20 CHARACTERS PER LINE
1			20		1		PANEL SHOP	LABEL	UL LABEL
MISC			21		1		PANEL SHOP	MISC	BONDING BUSHINGS, FITTINGS, 3/4" EMT CONDUIT, ETC., NEEDED FOR A COMPLETE ASSEMBLY
1			15		1		HOFFMAN	UU504020	INVERTER PANEL JUNCTION BOX: FIBERGLASS, 16.26"W X 20.2"T X 8.97"D, NEMA 3R
1			16		1		HOFFMAN	A20P16G	BACK PANEL, CONDUCTIVE, 12.99"W X 17.0"T
5			13		1		ALLEN-BRADLEY	1492-J6	TERMINAL BLOCK: 50A, 300VAC, 75degC WITH CU CONDUCTORS
			13		1		ALLEN-BRADLEY	MISC	WITH END 2 BARRIERS AND 2 JUMPERS
1			8		1		SQUARE D	60106	CIRCUIT BREAKER: 5A, 250VAC, 1-POLE, DIN-RAIL MOUNTABLE
1			4	1			Mean Well	DR-60-24	POWER SUPPLY: 120VAC INPUT, 24VDC, 2A CLASS II OUTPUT
1			9	1			FAT SPANIEL	COMM GATEWAY	DATA LOGGER: 24VDC, 0.25A INPUT
1			10	1			FAT SPANIEL	DB9 ADAPTOR CARD	DATA LOGGER COMMUNICATION CARD
1			11		1		BELDEN	7919A	RS485 COMMUNICATION CABLE
1			12		1			>= CAT 5	12" ETHERNET STRAIGHT-THROUGH CABLE
1			7		1		HUBBELL	DRUBGFI15	15A 120VAC GFCI DUPLEX RECEPTACLE, DIN RAIL MOUNTABLE
1			5	1			LINKSYS	WET54G	ANTENNA MODULE: 120VAC, 0.25A INPUT
1			6		1		SQUARE D	PK7GTA	GROUND BAR: 10-HOLE, 12AWG THRU 8AWG, 75degC WITH CU CONDUCTORS
1			14		1				1"W X 2"T PLASTIC SLOTTED WIRE DUCT WITH COVER
1			1	1			SUNNY BOY	4000US	INVERTER: 250-600VDC, 25ADC INPUT; 240VAC, 29AAC OUTPUT
1			2	1			SUNNY BOY	DC-DISCONU	DC DISCONNECT: 25ADC, 600VDC, 4-POLE, EACH POLE FUSIBLE TO 15ADC MAX, 75degC WITH CU CONDUCTORS
1				1			READY WATT	PTWB, EXTRA LARGE	4 STRING PASS-THRU JUNCTION BOX: 12"W X 14"T X 4"D, NEMA 3R
8							WILEY ELECTRONICS, LLC	ACE-4P	TERMINAL BLOCK/POWER DISTRIBUTION BLOCK: 30ADC, 600VDC, 90degC WITH CU CONDUCTORS
							WILEY ELECTRONICS, LLC	ACE MOUNTING BRACKET	MOUNTING BRACKET FOR ANY RAIL SYSTEM
14				1			SANYO	HIP-200BA3	PV PANEL: 79VDC Voc max @ -35degC, 4.8ADC Isc max
									ARRAY OF 4 STRINGS OF 7 PV PANELS EACH: 553VDC Voc max @ -35degC, 19.2ADC Isc max
8				1			WILEY ELECTRONICS, LLC	WEEB-LUG	GROUND LUG: 6AWG-12AWG WITH DIMPLED STAINLESS STEEL WASHER TO PIERCE ANODIZATION, 90degC
64				1			WILEY ELECTRONICS, LLC	WEEB-UGC-1	GROUND CLIP FOR UNIRAC RAIL: STAINLESS STEEL PLATE WITH DIMPLES TO PIERCE ANODIZATION
	0.92	0.00				1	VIKING (SUPPLIER)		3/4" EMT WT CONNECTOR
	1.12	0.00				1	VIKING (SUPPLIER)		3/4" EMT WT COUPLER
	0.64	0.00				1	VIKING (SUPPLIER)		3/4" EMT CONDUIT
	11.10	0.00				1	VIKING (SUPPLIER)		3/4" LB WITH GASKETED CLAMP COVER
	18.29	0.00				1	VIKING (SUPPLIER)		3/4" LR WITH GASKETED CLAMP COVER
	18.35	0.00				1	VIKING (SUPPLIER)		3/4" LL WITH GASKETED CLAMP COVER
	21.13	0.00				1	VIKING (SUPPLIER)		3/4" T WITH GASKETED CLAMP COVER
	23.25	0.00				1	VIKING (SUPPLIER)		3/4" TB WITH GASKETED CLAMP COVER
	0.52	0.00				1	VIKING (SUPPLIER)		3/4" EMT MINI
	1.09	0.00				1	CADDY	AOL12P	3/4" EMT CONDUIT HANGER STANDOFF BRACKET
							MINERALLAC	RS75	

	4.94	0.00					1	VIKING (SUPPLIER)		3/4" SEALTITE STRAIGHT CONNECTOR	
	8.32	0.00					1	VIKING (SUPPLIER)		3/4" SEALTITE 90 CONNECTOR	
	8.49	0.00					1	VIKING (SUPPLIER)		3/4" SEALTITE 45 CONNECTOR	
	1.40	0.00					1	VIKING (SUPPLIER)		3/4" SEALTITE FLEXIBLE CONDUIT	
48					1			WILEY ELECTRONICS, LLC	ACC	CLIPS FOR USE-2 12AWG-10AWG CABLE SUPPORT	
48							1			UV-RESISTANT CABLE TIES	
	0.13	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, BK	
	0.13	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, RD	
	0.13	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, WT	
	0.13	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, GN	
	0.21	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		10AWG THWN-2, BK	
	0.21	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		10AWG THWN-2, WT	
	0.21	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		10AWG THWN-2, GN	
	0.36	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		8AWG THWN-2, BK	
	0.36	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		8AWG THWN-2, WT	
	0.36	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		8AWG THWN-2, GN	
	0.33	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG USE-2, BK	
	0.33	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG USE-2, WT	
	0.33	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG USE-2, GN	
					1					15' 12AWG USE-2, BK, WITH MC CONNECTOR, MALE	
					1					15' 12AWG USE-2, BK, WITH MC CONNECTOR, FEMALE	
4					1					25' 12AWG USE-2, BK, WITH MC CONNECTOR, MALE	
4					1					25' 12AWG USE-2, BK, WITH MC CONNECTOR, FEMALE	
					1					35' 12AWG USE-2, BK, WITH MC CONNECTOR, MALE	
					1					35' 12AWG USE-2, BK, WITH MC CONNECTOR, FEMALE	
					1					UNI-RAIL OR OTHER PV PANEL SUPPORT HARDWARE	
	4.00	0.00			1		1			CAULK	
	0.34	0.00					1	HILLMAN	812074	1/4 X 3" LAG BOLT, HOT DIP GALVANIZED	
	0.02	0.00					1	ROCKFORD	P3003-242	1/4-20 X 1.5" STAINLESS ROUND PHILLIPS HEAD MACHINE SCREW	
	2.19	0.00					1	APPROVED VENDOR	5NA28	1/4-20 X 1.5" STAINLESS HEX HEAD MACHINE SCREW	
	0.10	0.00					1	APPROVED VENDOR	2WA20	1/4-20 STAINLESS NUT	
	0.14	0.00					1	APPROVED VENDOR	2DNZ5	1/4 STAINLESS STANDARD WASHER	
	0.11	0.00					1	BOLT DEPOT		1/4 STAINLESS FENDER WASHER	
	0.04	0.00					1	BOLT DEPOT		1/4 STAINLESS LOCK WASHER	
	0.04	0.00					1	BOLT DEPOT		1/4 STAINLESS STAR WASHER	
	3.50	0.00					1	MISC		5/16 SIMILAR MOUNTING HARDWARE AS ABOVE	
	4.00	0.00					1	MISC		3/8 SIMILAR MOUNTING HARDWARE AS ABOVE	
		20.00								SUBTOTAL # FOR ALL LINES	
		1.30								TAX	
										SHIPPING	
		21.30								TOTAL	



2740 31ST AVE S
MINNEAPOLIS, MN 55406
612-605-5228

FREENER-G

DRAWING SCALE: NONE WHEN PLOTTED AS "D" SIZE SHEET	NO.	REVISIONS	DATE	INITIAL	NO.	REVISIONS	DATE	INITIAL
	1	ORIGINAL						

DRAWING TITLE: 4.2KW PV SYS ONE-LINE DIAG
SE LOAD SIDE CONNECTED
PROTOTYPE
VERSION 20080814

DRAWING NO.
XXXX-OL

NOTE: ENTER BOXED-IN AND BLUE-HIGHLIGHTED DATA

PV PANEL Nameplate Data for:	SANYO HIP-200BA3				
55.80	Vpm	MAXIMUM POWER VOLTAGE	at	25	deg C
3.59	Ipm	MAXIMUM POWER CURRENT			
68.70	Voc	OPEN CIRCUIT VOLTAGE			
3.83	Isc	SHORT CIRCUIT CURRENT			
600	V	MAXIMUM SYSTEM VOLTAGE			
15	A	SERIES FUSE RATING			
-0.172	Voc/deg C	TEMPERATURE COEFFIECIENT			
0.00088	A Isc/deg C	TEMPERATURE COEFFIECIENT			
79.02	Voc max	OPEN CIRCUIT VOLTAGE	at	-35	deg C
4.79	Isc max	SHORT CIRCUIT CURRENT	at	X	deg C

7	: QTY OF PV PANELS IN EACH STRING				
390.60	Vpm string	MAXIMUM POWER VOLTAGE	at	25	deg C
3.59	Ipm string	MAXIMUM POWER CURRENT			
480.90	Voc string	OPEN CIRCUIT VOLTAGE			
3.83	Isc string	SHORT CIRCUIT CURRENT			
600	V string	MAXIMUM SYSTEM VOLTAGE			
7	A string	DESIGNED SERIES FUSE TO INSTALL			
-0.172	(Voc/deg C) string	TEMPERATURE COEFFIECIENT			
0.00088	(A Isc/deg C) string	TEMPERATURE COEFFIECIENT			
553.14	Voc max string	OPEN CIRCUIT VOLTAGE	at	-35	deg C
4.79	Isc max string	SHORT CIRCUIT CURRENT	at	X	deg C

3	: QTY OF PV STRINGS IN PARALLEL				
390.60	Vpm array	MAXIMUM POWER VOLTAGE	at	25	deg C
10.77	Ipm array	MAXIMUM POWER CURRENT			
480.90	Voc array	OPEN CIRCUIT VOLTAGE			
11.49	Isc array	SHORT CIRCUIT CURRENT			
600	V array	MAXIMUM SYSTEM VOLTAGE			
NA	A array	SERIES FUSE RATING			
-0.172	(Voc/deg C) array	TEMPERATURE COEFFIECIENT			
0.00088	(A Isc/deg C) array	TEMPERATURE COEFFIECIENT			
553.14	Voc max array	OPEN CIRCUIT VOLTAGE	at	-35	deg C
14.36	Isc max array	SHORT CIRCUIT CURRENT	at	X	deg C

NOTE: CRITICAL OUTPUT DATA IS BOXED-IN AND RED-HIGHLIGHTED

NOTE: ENTER BOXED-IN AND BLUE-HIGHLIGHTED DATA

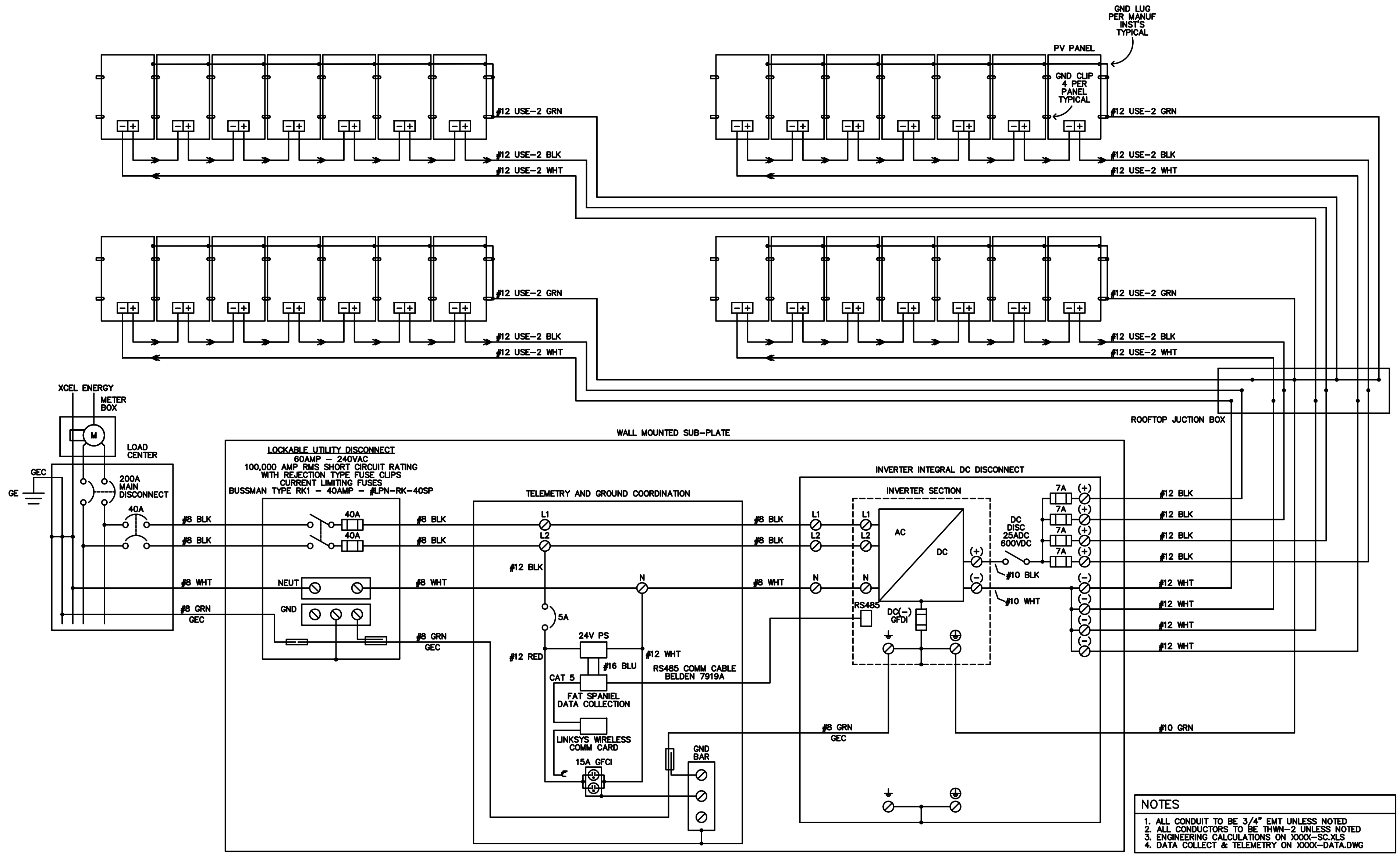
INVERTER Nameplate Data for:	SUNNY BOY 5000US	
250-480	Vdc	PEAK POWER TRACKING VOLTAGE
250-600	Vdc	INPUT OPERATING VOLTAGE
300	Vdc	PV START VOLTAGE
25	Adc	MAX DC INPUT CURRENT
211-264	Vac	AC OPERATING VOLTAGE RANGE
240	Vac	AC OPERATING VOLTAGE NOMINAL
29	Aac	MAX AC OUTPUT CONTINUOUS CURRENT
57.6	Aac	MAX AC OUTPUT FAULT CURRENT
50	Aac	MAX AC OUTPUT OVERCURRENT PROTECTION

5.98	Adc string	MIN DC STRING CONDUCTOR AMPERAGE
7	Adc	DC STRING OVERCURRENT PROTECTION
17.95	Adc array	MIN DC ARRAY CONDUCTOR AMPERAGE
36.25	Aac output	MIN AC OUTPUT CONDUCTOR AMPERAGE
40	Aac	AC OUTPUT OVERCURRENT PROTECTION

NOTE: CRITICAL OUTPUT DATA IS BOXED-IN AND RED-HIGHLIGHTED

NOTES:	1. ALL COMPONENTS SHALL BE LABELED/LISTED BY A THIRD-PARTY TESTING AGENCY ACCEPTABLE TO THE STATE OF MINNESOTA															
	2. INVERTER SUBPLATE ASSEMBLY SHALL BE LABELED AS AN ASSEMBLY															
				LAYOUT												
				DRAWING		SUPPLIED BY										
QTY	$/EA	$/LN		REF #	freEner-g	Panel Shop	Contractor		MFG	PART #	DESCRIPTION					
1	20.00	20.00					1				CIRCUIT BREAKER: 40A, 250VAC, 2-POLE, BACK-FEEDABLE					
												DETERMINED PER PROJECT FOR EXISTING CIRCUIT BREAKER PANEL				
1				3		1			SQUARE D	SEE BELOW:	UTILITY DISCONNECT: FUSIBLE, LOCKABLE, 60A, 240VAC, WITH FEED-THRU NEUTRAL AND GROUND BUS					
1				3		1			SQUARE D	H222NRB		SWITCH (INCLUDES NEUTRAL BUS), NEMA 3R				
1				3		1			SQUARE D	GTK0610		GROUND BUS				
1				3		1			SQUARE D	RFK03L		CLASS R FUSE KIT				
2				3		1			BUSSMANN	LPN-RK-40SP		40A, 250VAC, CLASS RK1 FUSE				
0				3		1			BUSSMANN	263-R		FUSE REDUCER, FOR LPN-RK FUSE, 60A CLIP SIZE TO 30A FUSE SIZE				
1				17		1			PANEL SHOP	PANEL	INVERTER COMPONENTS SUBPLATE: 44.5"W X 40.75"T, FOR OUTDOOR INSTALLATION					
1				18		1			PANEL SHOP	LABEL		PV SYSTEM UTILITY DISCONNECT				
1				19		1			PANEL SHOP	LABEL		PV SYSTEM ELECTRICAL SPEC'S, APPROX 10 LINES OF 20 CHARACTERS PER LINE				
1				20		1			PANEL SHOP	LABEL		UL LABEL				
MISC				21		1			PANEL SHOP	MISC		BONDING BUSHINGS, FITTINGS, 3/4" EMT CONDUIT, ETC., NEEDED FOR A COMPLETE ASSEMBLY				
1				15		1			HOFFMAN	UU504020	INVERTER PANEL JUNCTION BOX: FIBERGLASS, 16.26"W X 20.2"T X 8.97"D, NEMA 3R					
1				16		1			HOFFMAN	A20P16G		BACK PANEL, CONDUCTIVE, 12.99"W X 17.0"T				
5				13		1			ALLEN-BRADLEY	1492-J6		TERMINAL BLOCK: 50A, 300VAC, 75degC WITH CU CONDUCTORS				
				13		1			ALLEN-BRADLEY	MISC			WITH END 2 BARRIERS AND 2 JUMPERS			
1				8		1			SQUARE D	60106		CIRCUIT BREAKER: 5A, 250VAC, 1-POLE, DIN-RAIL MOUNTABLE				
1				4	1				Mean Well	DR-60-24		POWER SUPPLY: 120VAC INPUT, 24VDC, 2A CLASS II OUTPUT				
1				9	1				FAT SPANIEL	COMM GATEWAY		DATA LOGGER: 24VDC, 0.25A INPUT				
1				10	1				FAT SPANIEL	DB9 ADAPTOR CARD		DATA LOGGER COMMUNICATION CARD				
1				11		1			BELDEN	7919A		RS485 COMMUNICATION CABLE				
1				12		1				>= CAT 5		12" ETHERNET STRAIGHT-THROUGH CABLE				
1				7		1			HUBBELL	DRUBGFI15		15A 120VAC GFCI DUPLEX RECEPTACLE, DIN RAIL MOUNTABLE				
1				5	1				LINKSYS	WET54G		ANTENNA MODULE: 120VAC, 0.25A INPUT				
1				6		1			SQUARE D	PK7GTA		GROUND BAR: 10-HOLE, 12AWG THRU 8AWG, 75degC WITH CU CONDUCTORS				
1				14		1						1"W X 2"T PLASTIC SLOTTED WIRE DUCT WITH COVER				
1				1	1				SUNNY BOY	5000US	INVERTER: 250-600VDC, 25ADC INPUT; 240VAC, 29AAC OUTPUT					
1				2	1				SUNNY BOY	DC-DISCONU	DC DISCONNECT: 25ADC, 600VDC, 4-POLE, EACH POLE FUSIBLE TO 15ADC MAX, 75degC WITH CU CONDUCTORS					
1					1				READY WATT	PTWB, EXTRA LARGE	4 STRING PASS-THRU JUNCTION BOX: 12"W X 14"T X 4"D, NEMA 3R					
8									WILEY ELECTRONICS, LLC	ACE-4P		TERMINAL BLOCK/POWER DISTRIBUTION BLOCK: 30ADC, 600VDC, 90degC WITH CU CONDUCTORS				
									WILEY ELECTRONICS, LLC	ACE MOUNTING BRACKET		MOUNTING BRACKET FOR ANY RAIL SYSTEM				
21					1				SANYO	HIP-200BA3	PV PANEL: 79VDC Voc max @ -35degC, 4.8ADC Isc max					
												ARRAY OF 4 STRINGS OF 7 PV PANELS EACH: 553VDC Voc max @ -35degC, 19.2ADC Isc max				
8					1				WILEY ELECTRONICS, LLC	WEEB-LUG	GROUND LUG: 6AWG-12AWG WITH DIMPLED STAINLESS STEEL WASHER TO PIERCE ANODIZATION, 90degC					
64					1				WILEY ELECTRONICS, LLC	WEEB-UGC-1	GROUND CLIP FOR UNIRAC RAIL: STAINLESS STEEL PLATE WITH DIMPLES TO PIERCE ANODIZATION					
	0.92	0.00					1		VIKING (SUPPLIER)		3/4" EMT WT CONNECTOR					
	1.12	0.00					1		VIKING (SUPPLIER)		3/4" EMT WT COUPLER					
	0.64	0.00					1		VIKING (SUPPLIER)		3/4" EMT CONDUIT					
	11.10	0.00					1		VIKING (SUPPLIER)		3/4" LB WITH GASKETED CLAMP COVER					
	18.29	0.00					1		VIKING (SUPPLIER)		3/4" LR WITH GASKETED CLAMP COVER					
	18.35	0.00					1		VIKING (SUPPLIER)		3/4" LL WITH GASKETED CLAMP COVER					
	21.13	0.00					1		VIKING (SUPPLIER)		3/4" T WITH GASKETED CLAMP COVER					
	23.25	0.00					1		VIKING (SUPPLIER)		3/4" TB WITH GASKETED CLAMP COVER					
	0.52	0.00					1		VIKING (SUPPLIER)		3/4" EMT MINI					
	1.09	0.00					1		CADDY	AOL12P	3/4" EMT CONDUIT HANGER STANDOFF BRACKET					
									MINERALLAC	RS75						

	4.94	0.00					1	VIKING (SUPPLIER)		3/4" SEALTITE STRAIGHT CONNECTOR	
	8.32	0.00					1	VIKING (SUPPLIER)		3/4" SEALTITE 90 CONNECTOR	
	8.49	0.00					1	VIKING (SUPPLIER)		3/4" SEALTITE 45 CONNECTOR	
	1.40	0.00					1	VIKING (SUPPLIER)		3/4" SEALTITE FLEXIBLE CONDUIT	
48					1			WILEY ELECTRONICS, LLC	ACC	CLIPS FOR USE-2 12AWG-10AWG CABLE SUPPORT	
48							1			UV-RESISTANT CABLE TIES	
	0.13	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, BK	
	0.13	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, RD	
	0.13	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, WT	
	0.13	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, GN	
	0.21	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		10AWG THWN-2, BK	
	0.21	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		10AWG THWN-2, WT	
	0.21	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		10AWG THWN-2, GN	
	0.36	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		8AWG THWN-2, BK	
	0.36	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		8AWG THWN-2, WT	
	0.36	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		8AWG THWN-2, GN	
	0.33	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG USE-2, BK	
	0.33	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG USE-2, WT	
	0.33	0.00					1	AKOTA SUPPLY GROUP (SUPPLIER)		12AWG USE-2, GN	
					1					15' 12AWG USE-2, BK, WITH MC CONNECTOR, MALE	
					1					15' 12AWG USE-2, BK, WITH MC CONNECTOR, FEMALE	
4					1					25' 12AWG USE-2, BK, WITH MC CONNECTOR, MALE	
4					1					25' 12AWG USE-2, BK, WITH MC CONNECTOR, FEMALE	
					1					35' 12AWG USE-2, BK, WITH MC CONNECTOR, MALE	
					1					35' 12AWG USE-2, BK, WITH MC CONNECTOR, FEMALE	
					1					UNI-RAIL OR OTHER PV PANEL SUPPORT HARDWARE	
	4.00	0.00			1		1			CAULK	
	0.34	0.00					1	HILLMAN	812074	1/4 X 3" LAG BOLT, HOT DIP GALVANIZED	
	0.02	0.00					1	ROCKFORD	P3003-242	1/4-20 X 1.5" STAINLESS ROUND PHILLIPS HEAD MACHINE SCREW	
	2.19	0.00					1	APPROVED VENDOR	5NA28	1/4-20 X 1.5" STAINLESS HEX HEAD MACHINE SCREW	
	0.10	0.00					1	APPROVED VENDOR	2WA20	1/4-20 STAINLESS NUT	
	0.14	0.00					1	APPROVED VENDOR	2DNZ5	1/4 STAINLESS STANDARD WASHER	
	0.11	0.00					1	BOLT DEPOT		1/4 STAINLESS FENDER WASHER	
	0.04	0.00					1	BOLT DEPOT		1/4 STAINLESS LOCK WASHER	
	0.04	0.00					1	BOLT DEPOT		1/4 STAINLESS STAR WASHER	
	3.50	0.00					1	MISC		5/16 SIMILAR MOUNTING HARDWARE AS ABOVE	
	4.00	0.00					1	MISC		3/8 SIMILAR MOUNTING HARDWARE AS ABOVE	
		20.00								SUBTOTAL # FOR ALL LINES	
		1.30								TAX	
										SHIPPING	
		21.30								TOTAL	



NOTES
1. ALL CONDUIT TO BE 3/4" EMT UNLESS NOTED
2. ALL CONDUCTORS TO BE THWN-2 UNLESS NOTED
3. ENGINEERING CALCULATIONS ON XXXX-SC.XLS
4. DATA COLLECT & TELEMETRY ON XXXX-DATA.DWG

DRAWING SCALE: NONE WHEN PLOTTED AS "D" SIZE SHEET	NO.	REVISIONS	DATE	INITIAL	NO.	REVISIONS	DATE	INITIAL
	1	ORIGINAL						

DRAWING TITLE
5.6KW PV SYS ONE-LINE DIAG
SE LOAD SIDE CONNECTED
PROTOTYPE
VERSION 20080814

DRAWING NO.
XXXX-OL

FREENER-G

2740 31ST AVE S
MINNEAPOLIS, MN 55406
612-605-5228

NOTE: ENTER BOXED-IN AND BLUE-HIGHLIGHTED DATA

PV PANEL Nameplate Data for:	SANYO HIP-200BA3			
55.80	Vpm	MAXIMUM POWER VOLTAGE	at 25	deg C
3.59	Ipm	MAXIMUM POWER CURRENT		
68.70	Voc	OPEN CIRCUIT VOLTAGE		
3.83	Isc	SHORT CIRCUIT CURRENT		
600	V	MAXIMUM SYSTEM VOLTAGE		
15	A	SERIES FUSE RATING		
-0.172	Voc/deg C	TEMPERATURE COEFFIECIENT		
0.00088	A Isc/deg C	TEMPERATURE COEFFIECIENT		
79.02	Voc max	OPEN CIRCUIT VOLTAGE	at -35	deg C
4.79	Isc max	SHORT CIRCUIT CURRENT	at X	deg C

NOTE: CRITICAL OUTPUT DATA IS BOXED-IN AND RED-HIGHLIGHTED

7	: QTY OF PV PANELS IN EACH STRING			
390.60	Vpm string	MAXIMUM POWER VOLTAGE	at 25	deg C
3.59	Ipm string	MAXIMUM POWER CURRENT		
480.90	Voc string	OPEN CIRCUIT VOLTAGE		
3.83	Isc string	SHORT CIRCUIT CURRENT		
600	V string	MAXIMUM SYSTEM VOLTAGE		
7	A string	DESIGNED SERIES FUSE TO INSTALL		
-0.172	(Voc/deg C) string	TEMPERATURE COEFFIECIENT		
0.00088	(A Isc/deg C) string	TEMPERATURE COEFFIECIENT		
553.14	Voc max string	OPEN CIRCUIT VOLTAGE	at -35	deg C
4.79	Isc max string	SHORT CIRCUIT CURRENT	at X	deg C

4	: QTY OF PV STRINGS IN PARALLEL			
390.60	Vpm array	MAXIMUM POWER VOLTAGE	at 25	deg C
14.36	Ipm array	MAXIMUM POWER CURRENT		
480.90	Voc array	OPEN CIRCUIT VOLTAGE		
15.32	Isc array	SHORT CIRCUIT CURRENT		
600	V array	MAXIMUM SYSTEM VOLTAGE		
NA	A array	SERIES FUSE RATING		
-0.172	(Voc/deg C) array	TEMPERATURE COEFFIECIENT		
0.00088	(A Isc/deg C) array	TEMPERATURE COEFFIECIENT		
553.14	Voc max array	OPEN CIRCUIT VOLTAGE	at -35	deg C
19.15	Isc max array	SHORT CIRCUIT CURRENT	at X	deg C

NOTE: ENTER BOXED-IN AND BLUE-HIGHLIGHTED DATA

INVERTER Nameplate Data for:	SUNNY BOY 6000US	
250-480	Vdc	PEAK POWER TRACKING VOLTAGE
250-600	Vdc	INPUT OPERATING VOLTAGE
300	Vdc	PV START VOLTAGE
25	Adc	MAX DC INPUT CURRENT
211-264	Vac	AC OPERATING VOLTAGE RANGE
240	Vac	AC OPERATING VOLTAGE NOMINAL
29	Aac	MAX AC OUTPUT CONTINUOUS CURRENT
57.6	Aac	MAX AC OUTPUT FAULT CURRENT
50	Aac	MAX AC OUTPUT OVERCURRENT PROTECTION

5.98	Adc string	MIN DC STRING CONDUCTOR AMPERAGE
7	Adc	DC STRING OVERCURRENT PROTECTION
23.94	Adc array	MIN DC ARRAY CONDUCTOR AMPERAGE
36.25	Aac output	MIN AC OUTPUT CONDUCTOR AMPERAGE
40	Aac	AC OUTPUT OVERCURRENT PROTECTION

NOTE: CRITICAL OUTPUT DATA IS BOXED-IN AND RED-HIGHLIGHTED

NOTES:	1. ALL COMPONENTS SHALL BE LABELED/LISTED BY A THIRD-PARTY TESTING AGENCY ACCEPTABLE TO THE STATE OF MINNESOTA								
	2. INVERTER SUBPLATE ASSEMBLY SHALL BE LABELED AS AN ASSEMBLY								
			LAYOUT						
			DRAWING		SUPPLIED BY				
QTY	$/EA	$/LN	REF #	freEner-g	Panel Shop	Contractor	MFG	PART #	DESCRIPTION
1	20.00	20.00				1			CIRCUIT BREAKER: 40A, 250VAC, 2-POLE, BACK-FEEDABLE
									DETERMINED PER PROJECT FOR EXISTING CIRCUIT BREAKER PANEL
1			3		1		SQUARE D	SEE BELOW:	UTILITY DISCONNECT: FUSIBLE, LOCKABLE, 60A, 240VAC, WITH FEED-THRU NEUTRAL AND GROUND BUS
1			3		1		SQUARE D	H222NRB	SWITCH (INCLUDES NEUTRAL BUS), NEMA 3R
1			3		1		SQUARE D	GTK0610	GROUND BUS
1			3		1		SQUARE D	RFK03L	CLASS R FUSE KIT
2			3		1		BUSSMANN	LPN-RK-40SP	40A, 250VAC, CLASS RK1 FUSE
0			3		1		BUSSMANN	263-R	FUSE REDUCER, FOR LPN-RK FUSE, 60A CLIP SIZE TO 30A FUSE SIZE
1			17		1		PANEL SHOP	PANEL	INVERTER COMPONENTS SUBPLATE: 44.5"W X 40.75"T, FOR OUTDOOR INSTALLATION
1			18		1		PANEL SHOP	LABEL	PV SYSTEM UTILITY DISCONNECT
1			19		1		PANEL SHOP	LABEL	PV SYSTEM ELECTRICAL SPEC'S, APPROX 10 LINES OF 20 CHARACTERS PER LINE
1			20		1		PANEL SHOP	LABEL	UL LABEL
MISC			21		1		PANEL SHOP	MISC	BONDING BUSHINGS, FITTINGS, 3/4" EMT CONDUIT, ETC., NEEDED FOR A COMPLETE ASSEMBLY
1			15		1		HOFFMAN	UU504020	INVERTER PANEL JUNCTION BOX: FIBERGLASS, 16.26"W X 20.2"T X 8.97"D, NEMA 3R
1			16		1		HOFFMAN	A20P16G	BACK PANEL, CONDUCTIVE, 12.99"W X 17.0"T
5			13		1		ALLEN-BRADLEY	1492-J6	TERMINAL BLOCK: 50A, 300VAC, 75degC WITH CU CONDUCTORS
			13		1		ALLEN-BRADLEY	MISC	WITH END 2 BARRIERS AND 2 JUMPERS
1			8		1		SQUARE D	60106	CIRCUIT BREAKER: 5A, 250VAC, 1-POLE, DIN-RAIL MOUNTABLE
1			4	1			Mean Well	DR-60-24	POWER SUPPLY: 120VAC INPUT, 24VDC, 2A CLASS II OUTPUT
1			9	1			FAT SPANIEL	COMM GATEWAY	DATA LOGGER: 24VDC, 0.25A INPUT
1			10	1			FAT SPANIEL	DB9 ADAPTOR CARD	DATA LOGGER COMMUNICATION CARD
1			11		1		BELDEN	7919A	RS485 COMMUNICATION CABLE
1			12		1			>= CAT 5	12" ETHERNET STRAIGHT-THROUGH CABLE
1			7		1		HUBBELL	DRUBGFI15	15A 120VAC GFCI DUPLEX RECEPTACLE, DIN RAIL MOUNTABLE
1			5	1			LINKSYS	WET54G	ANTENNA MODULE: 120VAC, 0.25A INPUT
1			6		1		SQUARE D	PK7GTA	GROUND BAR: 10-HOLE, 12AWG THRU 8AWG, 75degC WITH CU CONDUCTORS
1			14		1				1"W X 2"T PLASTIC SLOTTED WIRE DUCT WITH COVER
1			1	1			SUNNY BOY	6000US	INVERTER: 250-600VDC, 25ADC INPUT; 240VAC, 29AAC OUTPUT
1			2	1			SUNNY BOY	DC-DISCONU	DC DISCONNECT: 25ADC, 600VDC, 4-POLE, EACH POLE FUSIBLE TO 15ADC MAX, 75degC WITH CU CONDUCTORS
1				1			READY WATT	PTWB, EXTRA LARGE	4 STRING PASS-THRU JUNCTION BOX: 12"W X 14"T X 4"D, NEMA 3R
8							WILEY ELECTRONICS, LLC	ACE-4P	TERMINAL BLOCK/POWER DISTRIBUTION BLOCK: 30ADC, 600VDC, 90degC WITH CU CONDUCTORS
							WILEY ELECTRONICS, LLC	ACE MOUNTING BRACKET	MOUNTING BRACKET FOR ANY RAIL SYSTEM
28				1			SANYO	HIP-200BA3	PV PANEL: 79VDC Voc max @ -35degC, 4.8ADC Isc max
									ARRAY OF 4 STRINGS OF 7 PV PANELS EACH: 553VDC Voc max @ -35degC, 19.2ADC Isc max
8				1			WILEY ELECTRONICS, LLC	WEEB-LUG	GROUND LUG: 6AWG-12AWG WITH DIMPLED STAINLESS STEEL WASHER TO PIERCE ANODIZATION, 90degC
64				1			WILEY ELECTRONICS, LLC	WEEB-UGC-1	GROUND CLIP FOR UNIRAC RAIL: STAINLESS STEEL PLATE WITH DIMPLES TO PIERCE ANODIZATION
	0.92	0.00				1	VIKING (SUPPLIER)		3/4" EMT WT CONNECTOR
	1.12	0.00				1	VIKING (SUPPLIER)		3/4" EMT WT COUPLER
	0.64	0.00				1	VIKING (SUPPLIER)		3/4" EMT CONDUIT
	11.10	0.00				1	VIKING (SUPPLIER)		3/4" LB WITH GASKETED CLAMP COVER
	18.29	0.00				1	VIKING (SUPPLIER)		3/4" LR WITH GASKETED CLAMP COVER
	18.35	0.00				1	VIKING (SUPPLIER)		3/4" LL WITH GASKETED CLAMP COVER
	21.13	0.00				1	VIKING (SUPPLIER)		3/4" T WITH GASKETED CLAMP COVER
	23.25	0.00				1	VIKING (SUPPLIER)		3/4" TB WITH GASKETED CLAMP COVER
	0.52	0.00				1	VIKING (SUPPLIER)		3/4" EMT MINI
	1.09	0.00				1	CADDY	AOL12P	3/4" EMT CONDUIT HANGER STANDOFF BRACKET
							MINERALLAC	RS75	

	4.94	0.00					1		VIKING (SUPPLIER)		3/4" SEALTITE STRAIGHT CONNECTOR
	8.32	0.00					1		VIKING (SUPPLIER)		3/4" SEALTITE 90 CONNECTOR
	8.49	0.00					1		VIKING (SUPPLIER)		3/4" SEALTITE 45 CONNECTOR
	1.40	0.00					1		VIKING (SUPPLIER)		3/4" SEALTITE FLEXIBLE CONDUIT
48					1				WILEY ELECTRONICS, LLC	ACC	CLIPS FOR USE-2 12AWG-10AWG CABLE SUPPORT
48							1				UV-RESISTANT CABLE TIES
	0.13	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, BK
	0.13	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, RD
	0.13	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, WT
	0.13	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		12AWG THWN-2, GN
	0.21	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		10AWG THWN-2, BK
	0.21	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		10AWG THWN-2, WT
	0.21	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		10AWG THWN-2, GN
	0.36	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		8AWG THWN-2, BK
	0.36	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		8AWG THWN-2, WT
	0.36	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		8AWG THWN-2, GN
	0.33	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		12AWG USE-2, BK
	0.33	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		12AWG USE-2, WT
	0.33	0.00					1		AKOTA SUPPLY GROUP (SUPPLIER)		12AWG USE-2, GN
					1						15' 12AWG USE-2, BK, WITH MC CONNECTOR, MALE
					1						15' 12AWG USE-2, BK, WITH MC CONNECTOR, FEMALE
4					1						25' 12AWG USE-2, BK, WITH MC CONNECTOR, MALE
4					1						25' 12AWG USE-2, BK, WITH MC CONNECTOR, FEMALE
					1						35' 12AWG USE-2, BK, WITH MC CONNECTOR, MALE
					1						35' 12AWG USE-2, BK, WITH MC CONNECTOR, FEMALE
					1						UNI-RAIL OR OTHER PV PANEL SUPPORT HARDWARE
	4.00	0.00			1		1				CAULK
	0.34	0.00					1		HILLMAN	812074	1/4 X 3" LAG BOLT, HOT DIP GALVANIZED
	0.02	0.00					1		ROCKFORD	P3003-242	1/4-20 X 1.5" STAINLESS ROUND PHILLIPS HEAD MACHINE SCREW
	2.19	0.00					1		APPROVED VENDOR	5NA28	1/4-20 X 1.5" STAINLESS HEX HEAD MACHINE SCREW
	0.10	0.00					1		APPROVED VENDOR	2WA20	1/4-20 STAINLESS NUT
	0.14	0.00					1		APPROVED VENDOR	2DNZ5	1/4 STAINLESS STANDARD WASHER
	0.11	0.00					1		BOLT DEPOT		1/4 STAINLESS FENDER WASHER
	0.04	0.00					1		BOLT DEPOT		1/4 STAINLESS LOCK WASHER
	0.04	0.00					1		BOLT DEPOT		1/4 STAINLESS STAR WASHER
	3.50	0.00					1		MISC		5/16 SIMILAR MOUNTING HARDWARE AS ABOVE
	4.00	0.00					1		MISC		3/8 SIMILAR MOUNTING HARDWARE AS ABOVE
		20.00									SUBTOTAL # FOR ALL LINES
		1.30									TAX
											SHIPPING
		21.30									TOTAL

Appendix B – List of 1,000+ prospect participants – OMITTED FROM THIS PUBLIC REPORT

Project funding provided by customers of Xcel Energy through a grant from the Renewable Development Fund

Appendix C – Technical Documentation for PV permitting

Project funding provided by customers of Xcel Energy through a grant from the Renewable Development Fund

SLK60P6L

205 W - 240 W

Poly-Crystalline Solar Modules

Real World Tested • Globally Trusted

Siliken california

- Manufactured in the USA (San Diego, CA)
- Excellent Power Tolerance +3/0 %
- Outstanding Low-Light Performance
- 25 Year Power Output Warranty
- UL and TÜV Certified for Worldwide Applications
- High Performance Modules with Efficiency up to 14.8%

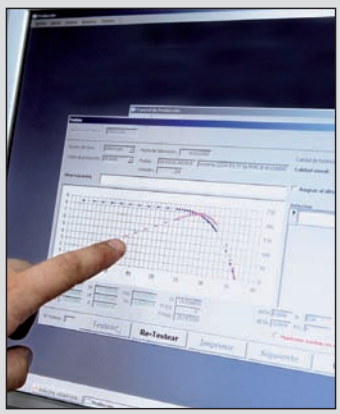
Why Siliken?

- Our U.S. operation is built on an 8 year track record in the European markets.
- Our global success has established a solid foundation to service the long-term needs of the solar industry.
- With over 160 MW installed worldwide, we have built a respected brand by consistently providing a quality product with proven performance.
- Our investment in R&D illustrates our commitment to reduce costs and improve efficiencies.

Siliken Reliability

The Siliken modules are certified according to UL and TÜV standards. The high quality and reliability ensure the prompt return of investment for any PV installation, including residential, commercial or utility scale.

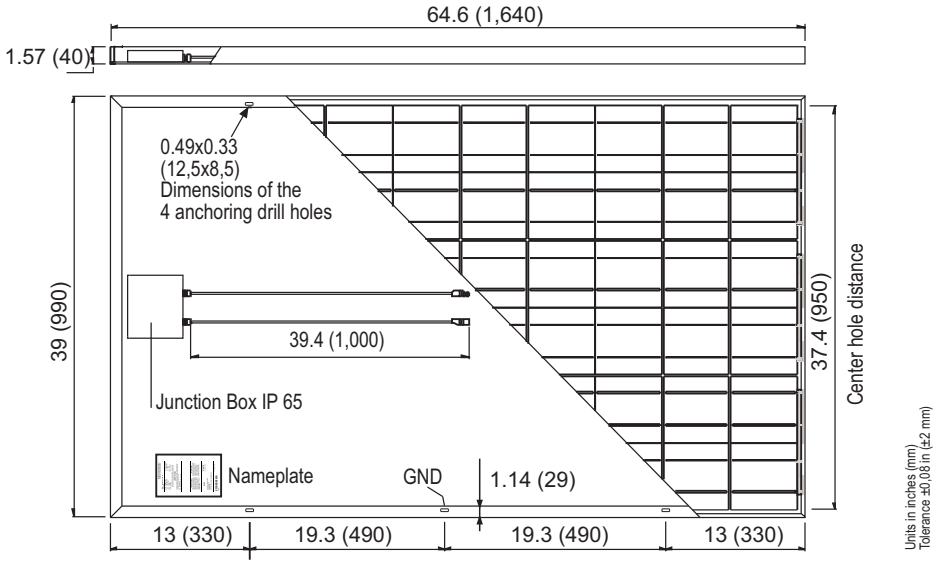
Each module goes through its testing phases, including strict power production verification and resistance tests in radiation simulators. With innovative products and solutions successfully implemented around the world, Siliken is a recognized global leader in solar power.

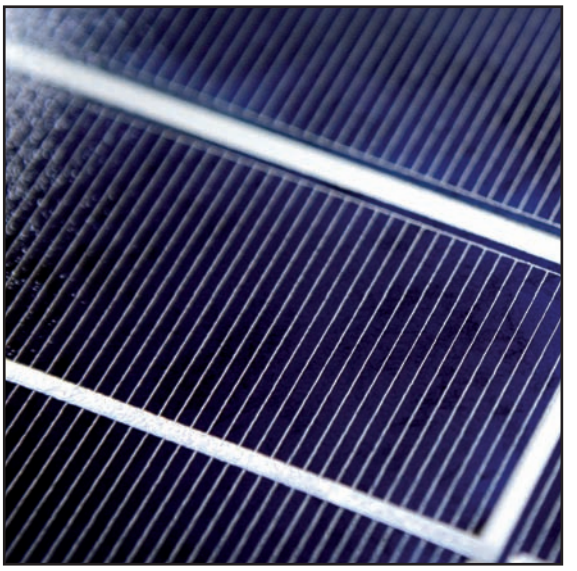


SLK60P6L

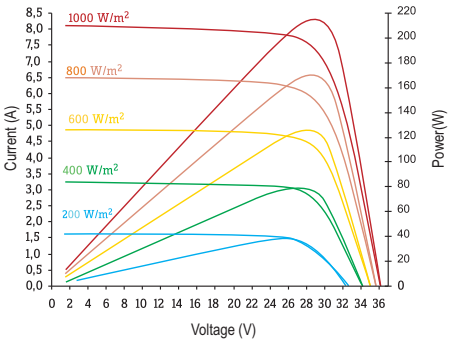
205 W - 240 W

Poly-Crystalline Solar Modules

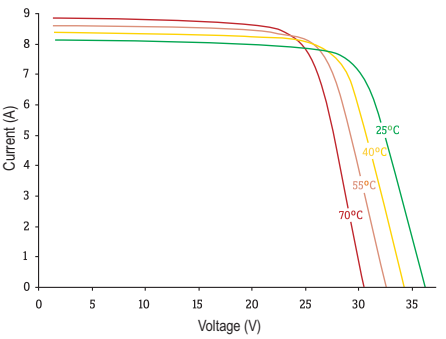




SLK60P6L - 225W
I-V and Pmax characteristics with a variety of radiation levels at 77ºF (25ºC)

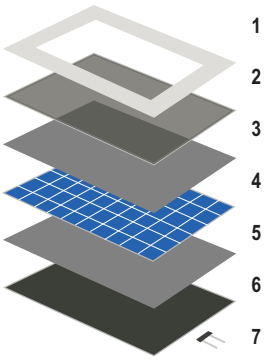


SLK60P6L - 225W
I-V characteristics with a variety of cell temperatures at 92.94W/ft² (1,000 W/m²)



Constructive Characteristics

1 FRAME
2 GLASS PLATE
3 & 5 EVA
4 CELLS
6 BACKSIDE FOIL
7 JUNCTION BOX



Mechanical Data

Dimensions (LxWxD)	64.6 x 39 x 1.57 in (1640 x 990 x 40 mm)
Weight	41.9 lbs (19 kg)
Output Cables	RHW-2 AWG# 10 (5.2 mm²) Symmetrical length cable 39.4 in (1 m) Multi-Contact connectors
Junction Box	IP-65 rated with bypass diodes
Frame	Anodized aluminum alloy type 6063 T6
Front Glass	0.125 in (3.2 mm) low iron tempered glass with high transmissivity
Solar Cells	60 Poly-crystalline cells 6 x 6 in (156 x 156 mm)

Electrical Data

Maximum power at STC (+3/0 %)	P_{mp} (W)	205	210	215	220	225	230	235	240
Efficiency at STC	η (%)	12.6	12.9	13.2	13.6	13.9	14.2	14.5	14.8
Power per Unit Area	P_{SqFt} (Wp/SqFt)	11.7	12.0	12.3	12.6	12.9	13.2	13.4	13.7
CEC PTC* Rating	P_{PTC} (W)	183.8	188.4	192.4	197	201.5	206.1	210.7	216.1
Voltage at Maximum Power	V_{mp} (V)	28.7	28.9	29.0	29.2	29.3	29.5	29.5	29.6
Current at Maximum Power	I_{mp} (A)	7.15	7.30	7.41	7.54	7.68	7.79	7.97	8.12
Open Circuit Voltage	V_{oc} (V)	36.4	36.5	36.6	36.7	36.8	36.9	36.9	37.0
Short Circuit Current	I_{sc} (A)	7.90	8.00	8.02	8.10	8.20	8.32	8.47	8.61
Maximum Voltage UL / IEC	V_{max} (V) UL/IEC	600 / 1000							
Temperature Coefficient of Pmp	T_kP_{mp} (%/ºC)	-0.43							
Temperature Coefficient of Voc	T_kV_{oc} (%/ºC)	-0.356							
Temperature Coefficient of Isc	T_kI_{sc} (%/ºC)	+0.062							
Normal Operating Cell Temperature	NOCT (ºF)/(ºC)	120.2±3.2 (49±2)							

Values at Standard Test Conditions STC: Irradiance 92.94 W/ft² (1,000 W/m²), Air Mass AM 1.5 and cell temperature 77ºF (25ºC)
*PTC refers to PVUSA (Photovoltaics for Utility Scale Applicattions) Test Conditions. Irradiance 92.94 W/ft² (1,000 W/m²), 68ºF (20ºC) Air Temperature, Wind Speed 3.2 ft/s (1 m/s) at 32 ft (10 m) above ground level.

WARNING: Read the instruction manual carefully before using this product
NOTE: Siliken California Corp. reserves the right to modify this product without prior notice

Certifications

UL Listed	UL 1703
Fire Rating	Class C
TÜV Certified	IEC 61215 / IEC 61730
EC Declaration of conformity (CE Mark)	
CEC (California Energy Commision) Program Registered	
FSEC (Florida Solar Energy Center) PV Module Certification	

Tested Operating Conditions

Temperature	-40 ºF to +185 ºF (-40 ºC to +85 ºC)
Static Load	50 psf (2400 Pa)
Max Load	112.8 psf (5400 Pa)
Impact Resistance	Hailstone impact Ø1 in at 52 mph (Ø25 mm at 23 m/s)

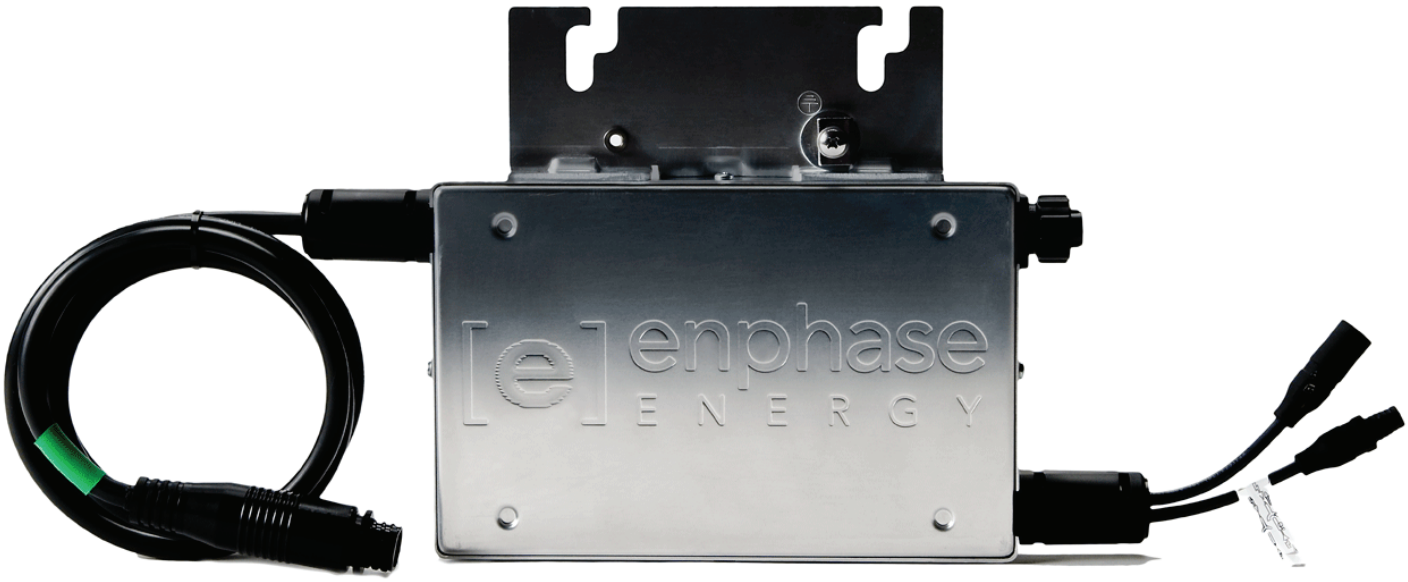
Warranty

25 year limited warranty of 80% output power
10 year limited warranty of 90% output power
5 year limited warranty of materials and workmanship

MANUFACTURED IN THE USA
Siliken California, Corp.
1225 Exposition Way, Ste 160 • San Diego, CA 92154 USA

USA HEADQUARTERS
Siliken Renewable Energy, Inc
5901 Priestly Drive, Suite 170 • Carlsbad CA 92008 USA
Tel.: (760) 448-2080 • Fax: (760) 931-1085
siliken.usa@siliken.com • www.silikenusa.com

ENPHASE MICROINVERTER



The Enphase Energy Microinverter System improves energy harvest, increases reliability, and dramatically simplifies design, installation and management of solar power systems. The Enphase System includes the microinverter, the Envoy Communications Gateway, and the web-based Enlighten monitoring and analysis website.

PRODUCTIVE

- Maximum energy production
- Resilient to dust, debris and shading
- Performance monitoring per module

RELIABLE

- MTBF of 331 years
- System availability greater than 99.8%
- No single point of system failure

SMART

- Quick & simple design, installation and management
- 24/7 monitoring and analysis

C US

MICROINVERTER TECHNICAL DATA

60 and 72 Cell Modules		
Input Data (DC)	M190-72-208-S11/2	M190-72-240-S11/2
Recommended input power (STC)	230W	230W
Maximum input DC voltage	54V	54V
Peak power tracking voltage	22V – 40V	22V – 40V
Max. DC short circuit current	12A	12A
Max. input current	10A	10A
Output Data (AC)		
Maximum output power	190W	190W
Nominal output current	920mA	800mA
Nominal voltage/range	208V/183V-229V	240V/211V-264V
Extended voltage/range	208V/179V-232V	240V/206V-269V
Nominal frequency/range	60.0/59.3-60.5	60.0/59.3-60.5
Extended frequency/range	60.0/59.2-60.6	60.0/59.2-60.6
Power factor	>0.95	>0.95
Maximum units per branch	21	15
Efficiency		
Peak inverter efficiency	95.5%	95.5%
CEC weighted efficiency	95.0%	95.0%
Nominal MPP tracking	99.6%	99.6%
Mechanical Data		
Operating temperature range	-40°C to +65°C	-40°C to +65°C
Night time power consumption	30mW	30mW
Dimensions (WxHxD)	8” x 5.25” x 1.25”	
Weight	4.4 lbs	
Cooling	Natural Convection – No Fans	
Enclosure environmental rating	Outdoor – NEMA 6	
Features		
Communication	Powerline	
Warranty	15 Years	
Compliance	UL1741/IEEE1547 FCC Part 15 Class B	

Enphase Energy, Inc.
201 1st Street, Suite 300, Petaluma, CA 94952
877 797 4743 enphaseenergy.com

142-00005 REV 03

Quick Mount PV®

Your *Solution* in Mounting Products

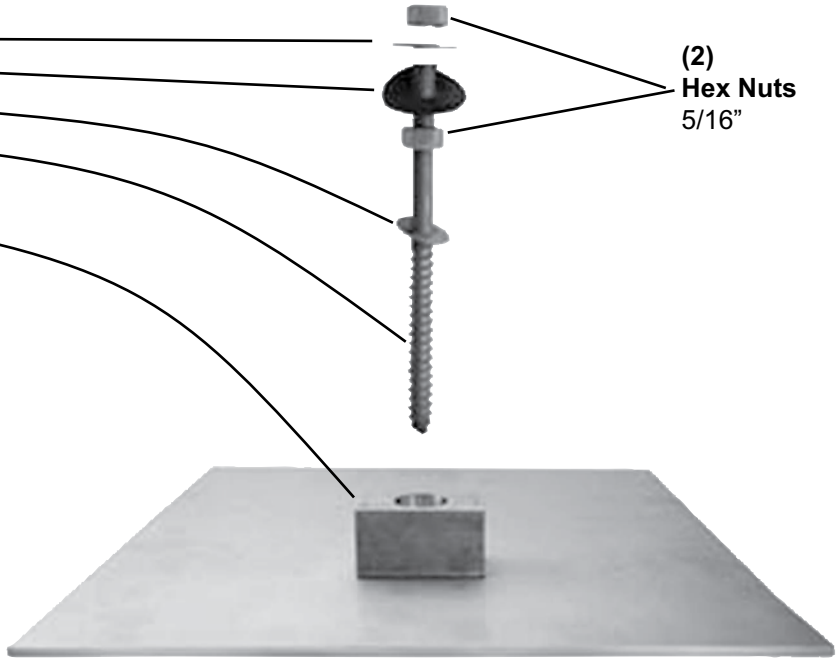
Solar • H_2O • Conduit • HVAC • Custom

Composition Mount Specifications

Quick Mount PV ® is an all-in-one waterproof flashing and mount to anchor photovoltaic racking systems, solar thermal panels, air conditioning units, satellite dishes, or anything you may need to secure to a new or existing roof. It is made in the USA of all aluminum and includes stainless steel hardware. It works with all standard racks, installs seamlessly and saves labor by not needing to cut away any roofing, will out live galvanized 2 to 1, and is a better low-profile mount.

Flat Washer 1" x 5/16"
EPDM Rubber Washer 60 Durometer
Sealing Washer 3/4" x 5/16"
Hanger Bolt 5/16" x 6"
1-1/2" Machine, 1-1/2" Spacer, 3" Lag
Mount & Flashing Aluminum
Mount 2-1/4"l x 1-1/4"w x 1-1/4"h
Flashing .05" thick
For standard composition roofs: flashing is 12" x 12", mount is attached 3" off center

(2) Hex Nuts 5/16"



Lag pull-out (withdrawal) capacities (lbs) in typical lumber:

	Specific gravity	Lag Bolt Specifications: 5/16" shaft per 3" thread depth	Lag Bolt Specifications: 5/16" shaft per 1" thread depth
Douglas Fir, Larch	.50	798	266
Douglas Fir, South	.46	705	235
Engelmann Spruce, Lodgepole Pine (MSR 1650 f & higher)	.46	705	235
Hem, Fir	.43	636	212
Hem, Fir. (North)	.46	705	235
Southern Pine	.55	921	307
Spruce, Pine, Fir	.42	615	205
Spruce, Pine, Fir (E of 2 million psi and higher grades of MSR and MEL)	..50	798	266

Sources: Uniform Building Code; American Wood Council
Notes: 1) Thread must be embedded in a rafter or other structural roof member.
2) Pull-out values incorporate a 1.6 safety factor recommended by the American Wood Council.
3) See IBC for required edge distances.

936 Detroit Ave Suite D, Concord, CA. 94518
Phone: (925) 687-6686 Fax: (925) 687-6689
Email: info@quickmountpv.com www.quickmountpv.com

Know Your Roof

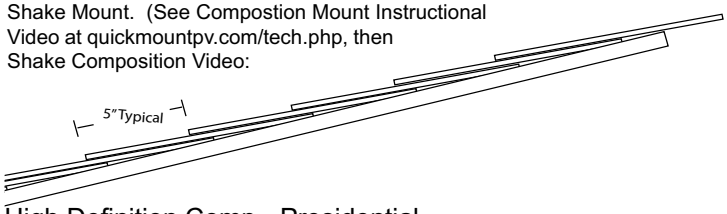
It is a good idea to do a thorough roof evaluation prior to your project installation. At this time you should do a layout on the roof confirming everything on the drawing will fit as it is intended. Any irregularities should be noted now, so that you can deal with them simply on install day. The quality of the roofing should be determined, so that any repairs or replacement can happen before or in conjunction with the installation. On a composition roof it is important to know as much as possible about: the manufacturer, the age of roof, the type of substrate (plywood or oriented strand board [OSB]), the rafter size, the spacing and span, the age of roof structure, who roofed it, who built it, etc.

Photos should be taken of all of the roof variables and associated with the job file for any future reference either short term or long. Typically the building owner can look in a file and find the composition manufacturer. If not, take a piece to the roofing yard, they can usually recognize the maker and the rough vintage. It is then easy to obtain the written manufacturer's installation instructions for the roofing materials you are dealing with. The manufacturer's instructions will spell out exactly what does and does not void the warranty of their roofing product. Most have a clause about roof temperature. This is commonly missed, but can easily be noted if you read the instructions. Officially, the roofing manufacturer's instructions supersede our instructions, as our product is weaving into theirs. It is also important to have their instructions in the job file, for any future reference. If the manufacturer cannot be found, there is obviously no warranty in place.

On a roof that has a material and labor warranty in place (new roof), it is recommended to at least consult the roofer of record. Often the roofing contractor will void the labor portion of their warranty if another trade modifies their work. Give the roofing contractor the option of handling the roofing modifications, or at least give them the opportunity to inspect and approve the modifications you make. There will be fees to this roofer, but if it maintains the labor warranty it should be good money spent.

Product Selection

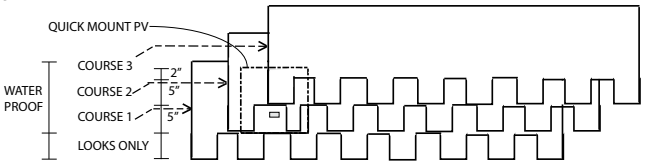
The Composition Mount is intended to fit within most composition and wood shingle roof systems, but not all. Specifically it is sized to fit within a standard 5" to 5 1/2" row or course. To confirm that the Comp Mount will match your roof, measure the course exposure of your roof. The "exposed" surface course height should measure no more than 5 3/4". If it turns out the roof tiles are a non-standard size greater than 5 3/4", the alternative method is to use a Quick Mount Shake Mount instead. In this case, follow the directions for the Quick Mount Shake Mount. (See Compostion Mount Instructional Video at quickmountpv.com/tech.php, then Shake Composition Video:



High Definition Comp - Presidential

Irregular surface - If the penetration lands in a low between two highs, it is best to shim the low under the flashing with extra asphalt to level out the surface.

Irregular tooth pattern - If the shingles have a tooth pattern wherein the bottom edge jogs up and down to give it a higher profile look, it is important to understand that the excess shingle that hangs lower than the rest of the shingle is for looks only. The 5" rule starts at the top of the tooth. If a tooth interferes with the mount block, cut the tooth off.



How Many Mounts Per Module?

There are two questions that must be asked when adding anything to a roof.

1. Can the roof / building / foundation handle the additional load?
2. What is to keep the new load from blowing away?

It is assumed that a licensed solar installer can answer these questions. If he / she can't, he / she will need to find somebody that can. A licensed engineer is the easiest solution. Some of the racking manufacturers have guides to calculating a code compliant install as well. Many variables must be considered and determined to complete the calculation. The spacing between mounts has the variables of: strength of rail, distance between parallel rails, cantilever of modules over rails, pull out strength of mount, slope of roof, height of roof, wind zone, roof type, structural integrety of roof framing, etc. The only values in the variables above that we can provide is pull out strength and shear of mount. We provide structural test reports on all of our mounts as needed. You will need to do the calculation of variables as you are the only one who knows them all.

Further Resources

In the process of all the research we have done, we came up with what we call the "Wheel of Accountability". It is a graphical look at the many official entities that govern how waterproofing should be done. At our web site you can click on any wedge of the wheel and get the code snippets that pertain to that entity's focus on roof penetrations.

Please don't hesitate to use it to your advantage. And of course if you have any feed back pro or con, let us have it. Take photos of your jobs using Quick Mount Products and submit them to us at info@quickmountpv.com, we'll put them up in our web gallery. Put Photo Gallery in the Subject line.

Product Includes

The units are sold in 12 packs. Each 12 pack includes the mounting hardware and the mount with flashing to install 12 mounts, with written instructions.

Alternative Attachment Methods

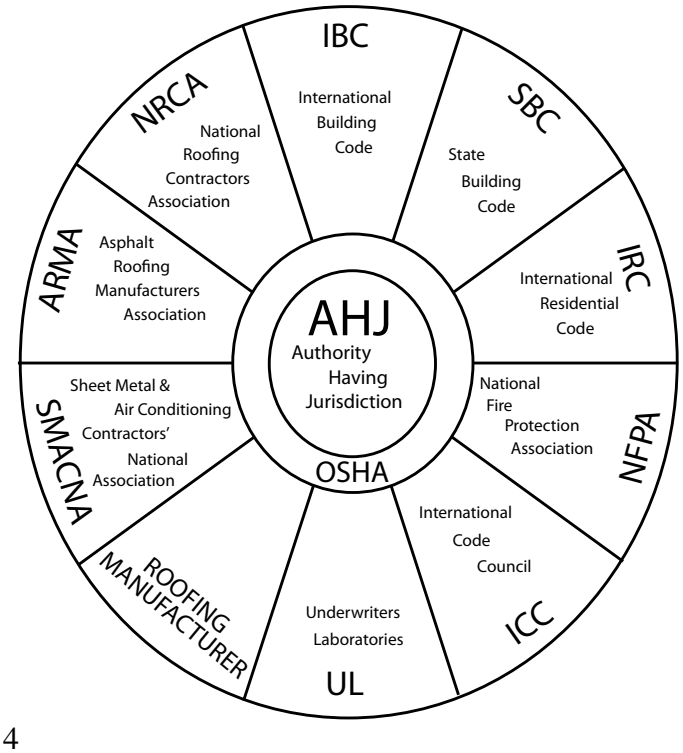
The Composition Mount is intended to be attached into a lumber rafter. Mounts are usually laid out based on the location of the rafters. In some cases it is desired to place a mount where there is no rafter. In this case it is possible to place a block between rafters, then lag into the block. In the case of metal rafters, lumber blocking the rafters is a solution, but should be done per the building's engineer of record.

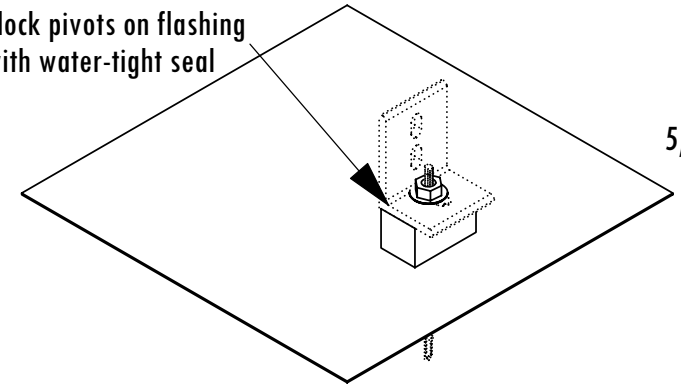
Shared Rail & 5" Rule

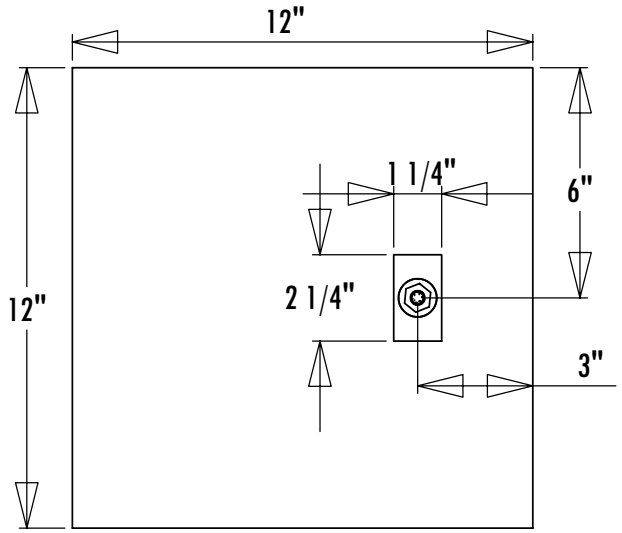
On a shared rail system, where the mounts must be in an exact spot, it is important to make sure the unit is flashed properly. Normally the vertical placement is guided by the exposed front edge of the shingle. If (on a 5" exposure comp) the flashing is flush with this, then you have 5" of flashing over course 1, 5" of flashing under course 2, and 2" of flashing under courses 2 and 3. This is important because if there is a vertical joint in course 2 the water cannot find its way under the flashing because it extends under course 3. When the flashing must be shifted to catch a shared rail, it is advised to shift the mount up the roof only, leaving less flashing over course 1, and more flashing under course 3. If it is necesary to shift downward, it is advised to move down a whole course and then shift up accordingly.

Sealants

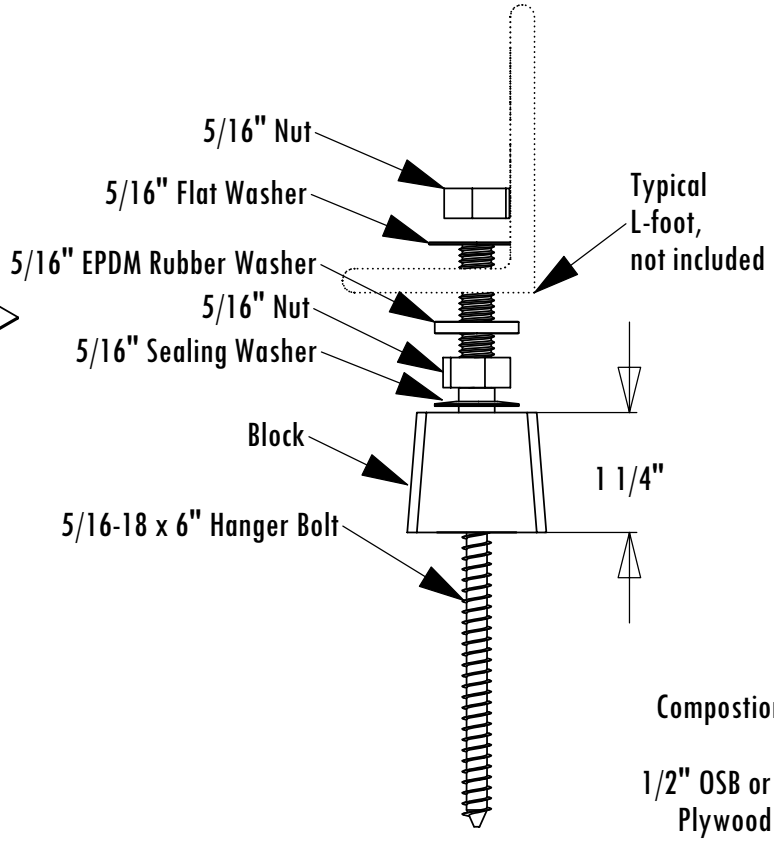
It is important to put a compatible sealant into any and all holes drilled into a roof. We have been recommending Geocell 2300, but there are many that are compatible with: asphalt, wood, aluminum, and stainless steel. In the freeze-thaw zones, it is important to follow the manufacturers' rules for freeze-thaw conditions.

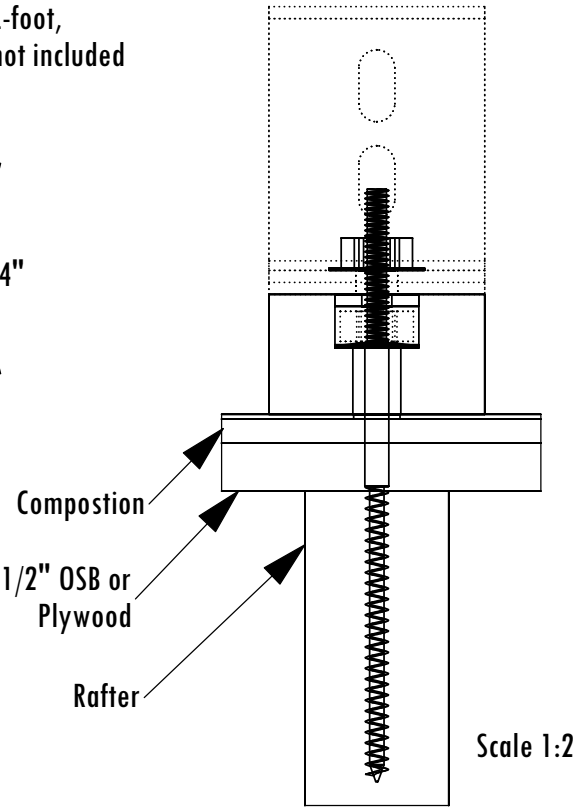






Scale 1:5





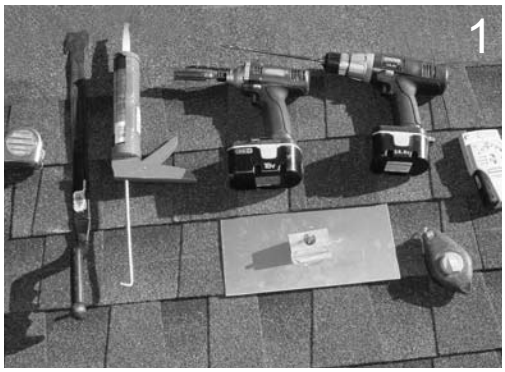
Scale 1:2

TITLE:	QM-PV-Comp - 5/16"		
COMMENTS		FILE NAME	QMSC3125_EXP
DATE	8/08/08	Quick Mount PV®	
REVISION	2	Your Solution in Mounting Products	
DRAWN BY	A.B.K.	Solar • H_2O • Conduit • HVAC • Custom	

Quick Mount PV®

COMPOSITION MOUNTING INSTRUCTIONS 5/16”

Installation Tools Required: Tape Measure, Roofers Bar / Shingle Ripper, Chalk Line, Stud Finder, Caulking Gun, 1 Tube of Appropriate Sealant, Drill with 1/4” long bit, Drill or Impact Gun with 1/2” Deep Socket.



Locate, choose, and mark centers of rafters to be mounted. Select each row course of roofing for Mount placement of Quick Mounts.

Lift Composition roof shingle with Roofers Bar, just above placement of Quick Mount.

Slide Mount into desired position. Remove any nails that conflict with getting Mount flush with front edge of shingle course. Mark center for drilling.

Using drill with 1/4” long bit, drill pilot hole into roof and rafter, taking care to drill square to the roof.

Clean off any saw dust, and fill hole with Sealant.

Slide Mount back into position. Prepare Hanger Bolt with 1 Hex Nut and 1 Sealing Washer, insert through Block into hole and drive Hanger until Block is tight.

Insert EPDM Rubber Washer over Hanger Bolt into Block.

Using the Racking Hardware, secure the rack of your choice. Tighten to 16 foot pounds.

You are now ready for the rack of your choice. Follow all the directions of the rack manufacturer as well as the module manufacturer.

All roofing manufacturers’ written instructions must also be followed by anyone modifying a roof system. Please consult the roof manufacturers’ specs and instructions prior to touching the roof.

Quick Mount PV®

Installation Guide 703: QMCS CLICKSYS Mount

This product is intended to flash into a new or existing asphalt or wood shingle roof systems with a maximum shingle exposure of 5 1/2”

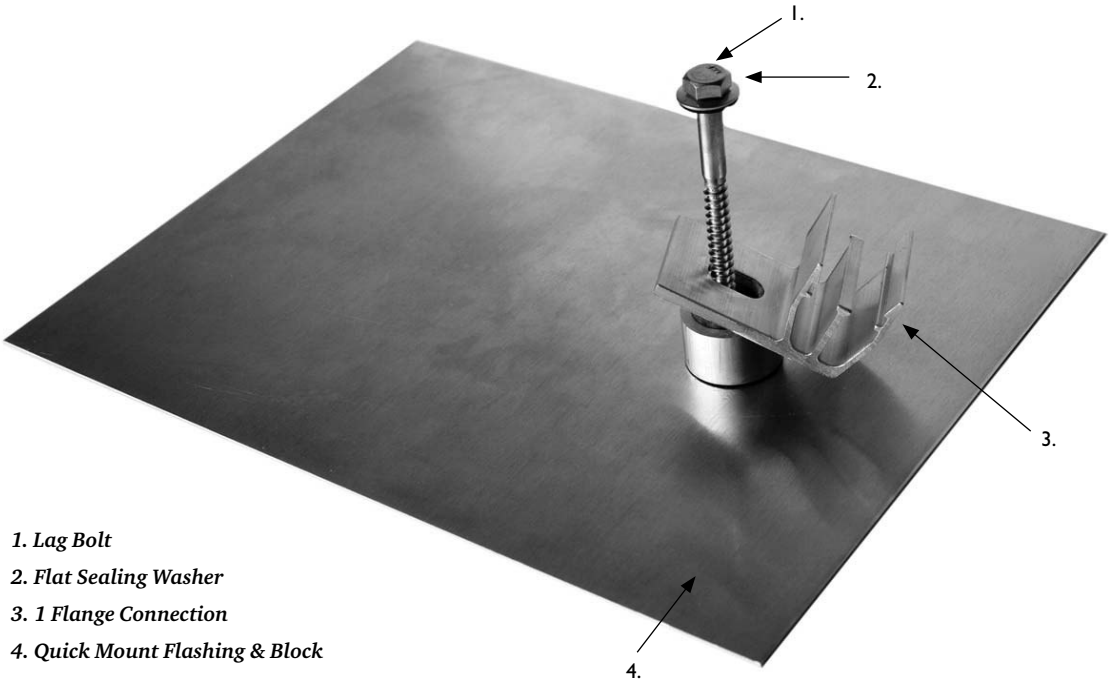
Quick Mount PV is an all-in-one waterproof flashing and mount to anchor CLICKSYS™ systems to a new or existing asphalt or wood shingle roof. It is made in the USA of all aluminum and includes stainless steel hardware. It installs seamlessly and saves labor by not needing to cut away any roofing. Quick Mount PV will also out-live galvanized 2 to 1, and is a better low-profile mount.

UNIRAC®
Bright Thinking in Solar

Unirac welcomes input concerning the accuracy and user-friendliness of this publication. Please write to **publications@unirac.com.**

Unirac Installation Manual

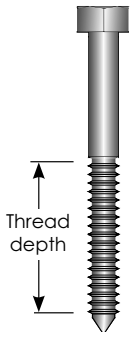
Pub 090429-1ii
April 2009



1. Lag Bolt
2. Flat Sealing Washer
3. 1 Flange Connection
4. Quick Mount Flashing & Block

Table 1. Lag pull-out (withdrawal) capacities (lbs) in typical roof lumber (ASD)

		Lag screw specifications
	Specific gravity	*5/16" shaft,* per inch thread depth*
Douglas Fir, Larch	0.50	266
Douglas Fir, South	0.46	235
Engelmann Spruce, Lodgepole Pine (MSR 1650 f & higher)	0.46	235
Hem, Fir, Redwood (close grain)	0.43	212
Hem, Fir (North)	0.46	235
Southern Pine	0.55	307
Spruce, Pine, Fir	0.42	205
Spruce, Pine, Fir (E of 2 million psi and higher grades of MSR and MEL)	0.50	266



Sources: American Wood Council, NDS 2005, Table 11.2A, 11.3.2A.

Notes: (1) Thread must be embedded in the side grain of a rafter or other structural member integral with the building structure.

(2) Lag bolts must be located in the middle third of the structural member.

(3) These values are not valid for wet service.

(4) This table does not include shear capacities. If necessary, contact a local engineer to specifiy lag bolt size with regard to shear forces.

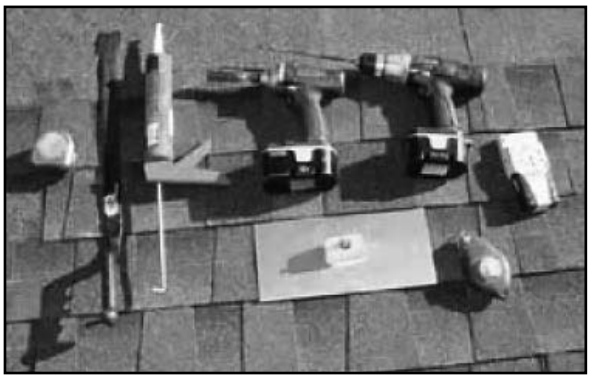
(5) Install lag bolts with head and washer flush to surface (no gap). Do not over-torque.

(6) Withdrawal design values for lag screw connections shall be multiplied by applicable adjustment factors if necessary. See Table 10.3.1 in the American Wood Council NDS for Wood Construction.

**Use flat washers with lag screws. Flat washers are not necessary with concealor screws.*

Tools Needed:

measuring tape
roofer's flat bar
chalk line
stud finder
caulking gun with roofing sealant
drill with 1/4" diameter bit
drill with 1/2" deep socket



Installation:

1. LOCATE RAFTER

Using horizontal and vertical chalk lines to align hole for placement of each Quick Mount QMCS to rafter.

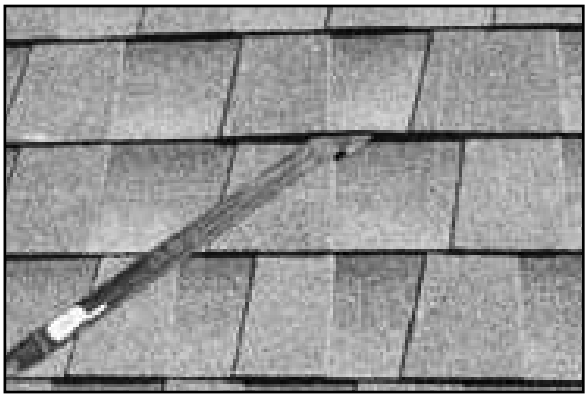
2. DRILL PILOT HOLE

Using drill with ¼" long bit, drill pilot hole through roof and rafter, taking care to drill square to the roof.

* *Do not use the flashing as a drill guide*

3. LIFT SHINGLE

Lift composition roof shingle with roofers flat bar, just above placement of Quick Mount QMCS.



4. SEAL HOLE

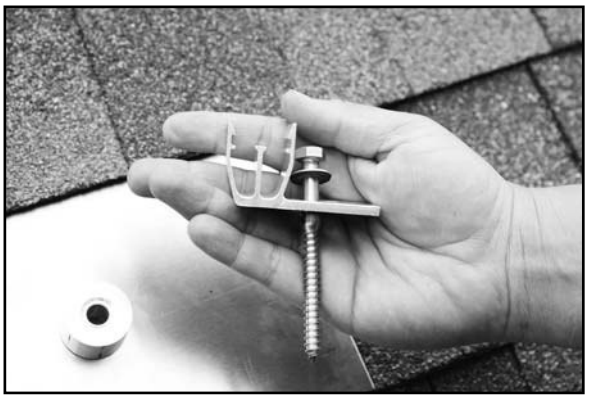
Using caulking gun with roofing sealant, squeeze a dab of roofing sealant that is compatible with the roof type into the hole.

5. SLIDE QUICK MOUNT QMCS INTO PLACE

Lift comp shingle and slide Quick Mount QMCS into place.

6. ASSEMBLE AND ATTACH LAG BOLT ATTACHMENT

Assemble lag bolt with flat washer, 1 Flange Connection as shown in the picture. Use drill with ½" deep socket to tighten flashing into place.



10 year limited Product Warranty, 5 year limited Finish Warranty

Quick Mount PV, warrants to the original purchaser ("Purchaser"), of product QMCS ClickSys Mount which it manufactures ("Product"), that at the original installation site the Product shall be free from defects and/or failures due to materials, workmanship, and manufacturing for a period of ten (10) years, except for the anodized finish, if anodized. Quick Mount PV, warrants to the original Purchaser that the Product finish ("Finish Warranty") shall be free from visible peeling, or cracking or chalking under normal atmospheric conditions for a period of five (5) years, from the earlier of either, 1) the date the installation of the Product is completed, or 2) 30 days after the purchase of the Product by the original Purchaser. The Finish Warranty does not apply to any foreign residue deposited on the finish. All installations in corrosive atmospheric conditions are excluded. The Quick Mount PV Warranty is VOID if the practices specified by AAMA 609 & 610-02 – "Cleaning and Maintenance for Architecturally Finished Aluminum" (www.aamanet.org) are not followed by Purchaser. This warranty does not cover direct or incidental damage to the Product that occurs during its transport, storage, or installation.

The following are not covered in this warranty and shall void this warranty; non-observance of Quick Mount PV's written installation instructions; improper installation, application, and/or removal of the Product; installation of the Product in an environment for which it was not designed; modification(s), repair(s), alteration(s), and/or manipulation(s) of the Product in a manner not previously authorized by Quick Mount PV IN WRITING; misuse and/or abuse of the Product; use with any rack other than ClickSys.

Under no circumstances shall Quick Mount PV be liable for any damages, including and not limited to contingent, special, indirect, consequential, or incidental damages, arising out of or related to the use of the Product by Purchaser. If the Product is reasonably proven to be defective within the specified Warranty periods, then Quick Mount PV shall repair or replace the defective Product, or any part thereof, at Quick Mount PV's sole discretion. Such repair or replacement shall completely satisfy and discharge all of Quick Mount PV's liability with respect to this limited Warranty.

Manufacturers of related items, such as PV modules and racking, may provide written warranties of their own. Quick Mount PV's limited Warranty covers only its Product, and not any related or unrelated items.

UNIRAC
1411 Broadway Boulevard NE
Albuquerque NM 87102-1545 USA

Appendix D – Pricing Sensitivity survey

Project funding provided by customers of Xcel Energy through a grant from the Renewable Development Fund

freenerg
a progressive solar venture

A typical household electricity use in the Minneapolis is 7,200 kilowatt hours per year. This is equivalent to 12,240 pounds of coal, or 8,000 pounds of CO2 per year. By fully converting to solar electricity, your coal use and your CO2 pollution will be eliminated.

SOLAR SURVEY

How would you rate your understanding of solar electricity?

1 — I don't understand solar electricity at all
2
3
4
5 — I am very familiar with solar electricity

How much is your electric bill per month, typically?

☐ $10-30/mo ☐ $31-60/mo ☐ $61-90/mo ☐ $91-120/mo ☐ $121+/mo

Do you own-☐ or rent -☐ your home?

Are you aware that the electricity currently offered by the power companies is generated primarily by burning coal which creates harmful CO2 emissions and is a major contributor to global warming?

☐ yes ☐ no, I was not aware of this

Are you interested in having solar electricity provided to your home which has no CO2 emissions and does not contribute to global warming?

☐ yes ☐ no

If no, please state the reason so we better understand your beliefs and perceptions:

_____

_____

Please consider these factors before answering the following questions:
If you could choose to lease a full solar electricity system for your home on an annual basis and in doing so; 1) eliminate the up front costs associated with purchasing, 2) eliminate your electric bill, 3) know that your decision to convert to solar electricity will have a positive impact on the environment, 4) know your decision will reduce our reliance on foreign oil - improving national & international security, and 5) know that your decision will help drive down the costs of solar technology ... **how much are you willing to pay each month for leasing your solar electric system?**

☐ Less than what I am paying now to my current power company
☐ The same that I am paying now
☐ Twice the amount I'm paying now
☐ Three times more than what I'm paying now
☐ _____ times what I'm paying to my current power company

In addition to the considerations listed above, if you knew that your commitment to choose solar electricity today will result in your lease rate decreasing consistently over five years, ultimately reaching the same amount per month that you currently pay the power company **... how much will you be willing to pay for your lease payment at this time?** Example: your current electric bill is $70 per month and in five years your lease payment for your solar system would be $70 per month, how much per month would you be willing to pay for your lease payment at this time?

☐ Less than what I am paying now to my current power company
☐ The same that I am paying now
☐ Twice the amount I'm paying now
☐ Three times more than what I'm paying now
☐ _____ times what I'm paying to my current power company

☐ **I would like to be contacted by Freenerg to learn more about solar electricity for my home.**

Providing your contact information is optional. Please be assured that freenerg will not be sharing your contact information. If you provide this, we will use it only to contact you about solar electricity options through freenerg.

NAME _____
STREET ADDRESS _____
CITY/STATE/ZIP _____
EMAIL _____ **PHONE** _____

Thank you!
click to submit

Gerardo Ruiz, President 612.605.5228 gerardo@freenerg.com

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