



String Sizer Tool

v2.1.0

Feb 2020

Overview



CPS AMERICA Solar PV String Sizing Tool v2.1.0

Project Name Test Project - 3/19/2020	Design Date 3/19/2020
GEOGRAPHICAL SITE CONFIGURATION	PV MODULE OPERATIONAL SPECIFICATIONS
Equipment Selection ARRAY AND INVERTER SELECTION	Inverter Specifications INVERTER OPERATIONAL SPECIFICATIONS
System Design Parameters ARRAY AND INVERTER CONFIGURATION	
Array Design Options STRING/MPPT CONFIGURATION	Terms and Conditions TOOL USE TERMS AND CONDITIONS

String Sizing | Custom Module | +

CUSTOM MODULE CONFIGURATION

Design Location and Temperature



Design Location and Temperatures
 Option 1: To use ASHRAE data, select Country, State and Airport
 Option 2: Select Manual Entry and enter desired temperatures.

Choose your region: North_America
 Temperature Data Source: ASHRAE 2% High Temp
 Country: United_States
 State/Province: Kentucky
 ASHRAE Weather Station: LOUISVILLE STANDIFORD FIELD
 ZIP Code: 30132
 Weather Information: Solar ABC's, Weather.com
 ASHRAE Extreme Low Temp: -17.3 °C
 ASHRAE 2% High Temp: 33.6 °C

ASHRAE 2% High Temp
 ASHRAE .4% High Temp
 Manual Entry

Canada
 Mexico
 Latin_America
 United_States

STATE/STATION DISCREPANCY - HIGHLIGHT

Design Location and Temperatures
 Option 1: To use ASHRAE data, select Country, State and Airport
 Option 2: Select Manual Entry and enter desired temperatures.

Choose your region: North_America
 Temperature Data Source: ASHRAE 2% High Temp
 Country: United_States
 State/Station Mismatch: New_Jersey
 ASHRAE Weather Station: MANCHESTER AIRPORT
 ZIP Code: 97333
 Weather Information: Solar ABC's, Weather.com
 ASHRAE Extreme Low Temp: -6.6 °C
 ASHRAE 2% High Temp: 25.0 °C

Design Location and Temperatures
 Option 1: To use ASHRAE data, select Country, State and Airport
 Option 2: Select Manual Entry and enter desired temperatures.

Choose your region: North_America
 Temperature Data Source: ASHRAE 2% High Temp
 Country: Latin_America
 State/Province: Puerto Rico
 ASHRAE Weather Station: AQUADILLA/BORINQUEN
 ZIP Code: 30132
 Weather Information: Solar ABC's, Weather.com
 ASHRAE Extreme Low Temp: N/A °C No ASHRAE Data - Manual Entry -->
 ASHRAE 2% High Temp: 30.9 °C

0.0 °F -17.8 °C

LATIN AMERICAN COUNTRIES ADDED

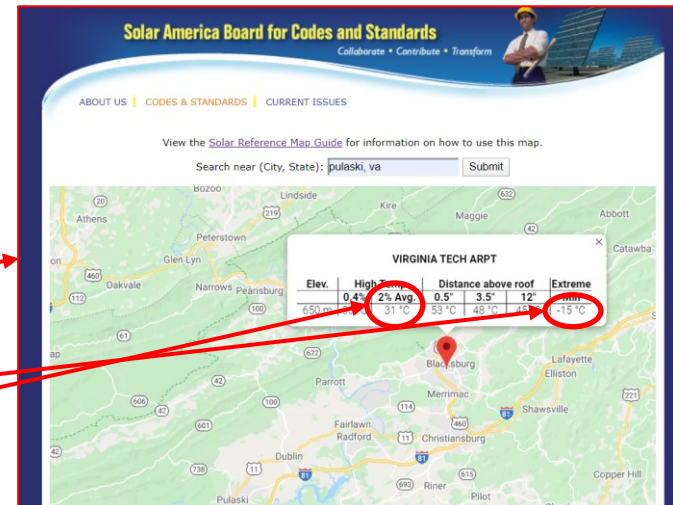
SOME HAVE INCOMPLETE ASHRAE DATA
 MANUAL ENTRY NEEDED

SELECTABLE TEMPERATURE UNITS °F OR °C
 MANUAL ENTRY FACILITATED BY LINKS TO WEATHER DATA

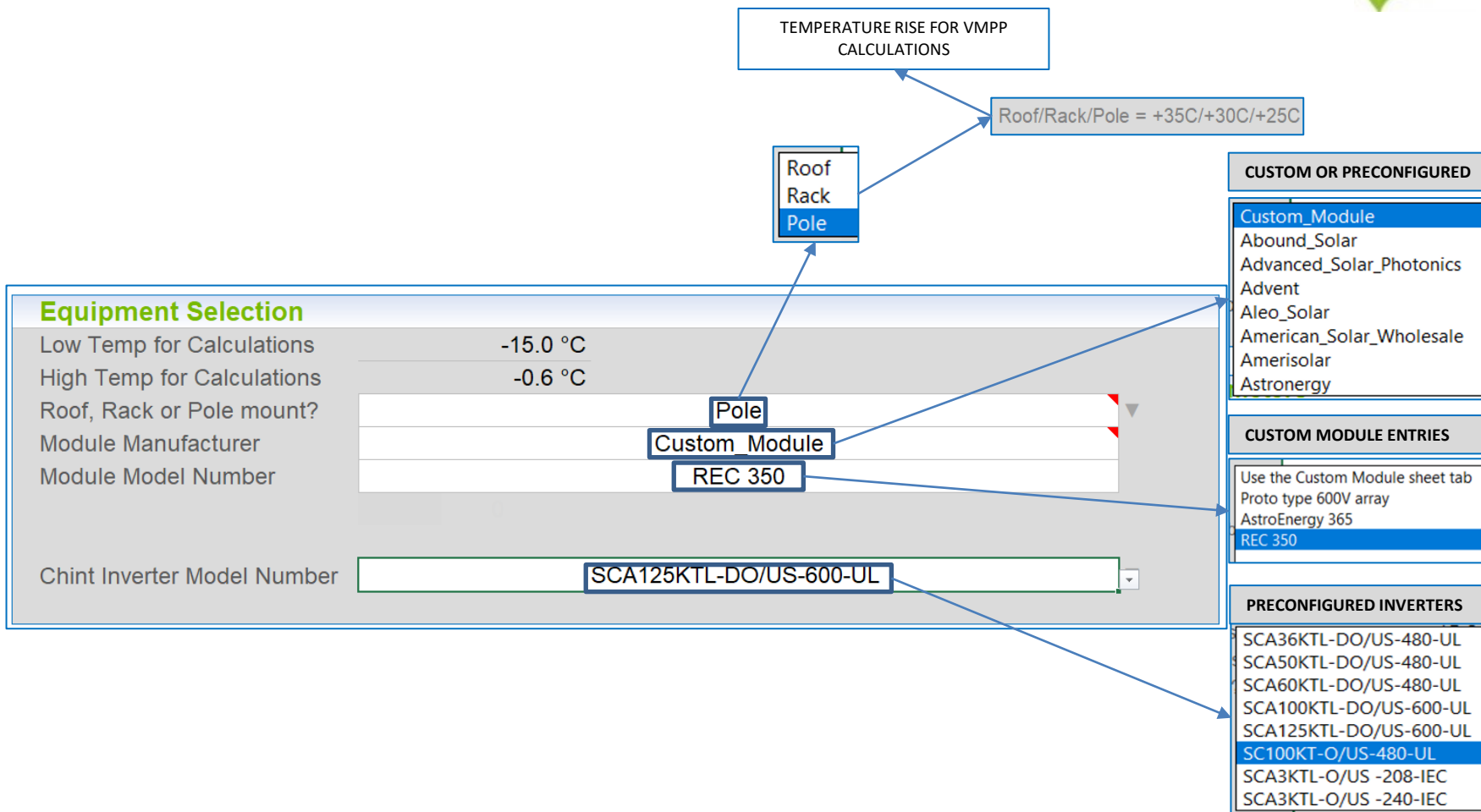
Design Location and Temperatures
 Option 1: To use ASHRAE data, select Country, State and Airport
 Option 2: Select Manual Entry and enter desired temperatures.

Choose your region: North_America
 Temperature Data Source: Manual Entry
 ZIP Code: 30132
 Weather Information: Solar ABC's, Weather.com
 Manually Entered Extreme Low: -15.0 °C
 Manually Entered Record High: 31.0 °F

-15.0 °C -15.0 °C
 31.0 °F -0.6 °C



Equipment Selection



Equipment Selection – Module Selection



Equipment Selection

Low Temp for Calculations: -15.0 °C
 High Temp for Calculations: -0.6 °C
 Roof, Rack or Pole mount?: Pole

Manfact/Model Mismatch: Abound_Solar
 Manfact/Model Mismatch: REC 350

Chint Inverter Model Number: SCA125KTL-DO/US-600-UL

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#N/A

#N/A

#N/A

MANUFACTURER – MODEL MISMATCH

LOOKUP ERRORS
#N/A

RESELECT MODULE

Module Specifications

Module Name			
Rated Power (STC)	#N/A	W	#N/A @T _{MAX}
Max System Voltage	#N/A	#N/A	#N/A
Module Voc	#N/A	VDC	
Module Vmp	#N/A	VDC	
Module Imp	#N/A	ADC	
Module Isc	#N/A	ADC	#N/A OCPD Min. (1.56x)
Module Series Fuse Rating	#N/A	ADC	#N/A
Voc Correction (%/°C)	#N/A		
Vmp Correction (%/°C)	#N/A		
<hr/>			
Bifacial (Y/N)	#N/A		
Adjusted Module Voc @ Low Temp	#N/A	VDC	
Adjusted Module Vmp @ High Temp	#N/A	VDC	Roof/Rack/Pole = +35C/+30C/+25C
Adjusted Module Vmp @ Low Temp	#N/A	VDC	

Equipment Selection – Thin Film Modules



Equipment Selection

Low Temp for Calculations -15.0 °C
 High Temp for Calculations -0.6 °C

Roof, Rack or Pole mount? Pole

Module Manufacturer Custom_Module

Module Model Number FS FS6420 Test-Thin Film

Additional Parallel Modules? Special Fuse Spacing may apply above 20A fuse

Chint Inverter Model Number SCA15KTL-DO/US-600-UL

THIN FILM MODULES REQUIRE SPECIAL PARALELL COMBINING THIS OPTIONAL ALLOW FOR *ADDITIONAL* PARALLEL MODULES.

IN THIS EXAMPLE THERE ARE 5 ADDITIONAL PARALLEL MODULES FOR A TOTAL OF 6 PARALLEL MODULES

SPECIAL SPACE REQUIREMENTS FOR FUSES >20A

Module Specifications

Module Name	FS FS6420 Test-Thin Film	
Rated Power (STC)	2520 W	2726 W @T _{MAX}
Max System Voltage	1500 VDC	
Module Voc	218.50 VDC	
Module Vmp	180.40 VDC	
Module Imp	13.98 ADC	
Module Isc	15.24 ADC	
Module Series Fuse Rating	5 ADC	
Voc Correction (%/°C)	-0.28%	
Vmp Correction (%/°C)	-0.32%	
Bifacial (Y/N)	N	
Adjusted Module Voc @ Low Temp	242.97 VDC	
Adjusted Module Vmp @ High Temp	180.72 VDC	Roof/Rack/Pole = +35C/+30C/+25C
Adjusted Module Vmp @ Low Temp	203.49 VDC	

23.8 Adc OCPD Min. (1.56x)
 6x

Custom Module Input Tab



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Fill out the blanks below to add your own equipment.

Modules

Manufacturer and Model	Rated power @ STC (W)	Rated power tolerance (%)	Max. System Voltage Rating	Max. power voltage (Vmp)	Max. power current (Imp)	Open-circuit voltage (Voc)	Short-circuit current (Isc)	Pmp/Vmp temp. coefficient (%/°C)	Voc temp. coefficient (%/°C)	Bifacial (Y/N)	Series fuse rating (A)
Module Example	250	+3/3	1000	30.34	8.24	37.47	8.76	-0.440	-0.340		20
Proto type 600V array	280	+3/3	600	31.9	7.83	37.2	8.44	-0.480	-0.340	N	20
AstroEnergy 365	365		1500	39.38	9.27	47.82	9.75	-0.376	-0.282	N	15
REC 350	350		1500	38.9	9	46.7	9.72	-0.360	-0.300	N	25
Test Bifacial	350		1500	38.9	9	46.7	9.72	-0.360	-0.300	Y	20
FS FS6420 Test-Thin Film	420	+5/-0	1500	180.4	2.33	218.5	2.54	-0.320	-0.280	N	5

String Sizing

Custom Module

TRIGGERS WARNING IF Voc IS TOO HIGH

IF $I_{sc} \times 1.56 < 15A$ TRIGGERS THIN FILM OPTIONS

IF $I_{sc} \times 1.56 < 15A$ TRIGGERS THIN FILM OPTIONS

Equipment Selection – Inverter Selection



Design Location and Temperatures

Option 1: To use ASHRAE data, select Country, State and Airport
Option 2: Select Manual Entry and enter desired temperatures.

Choose your region	North_America
Temperature Data Source	ASHRAE 2% High Temp
Country	United_States
State/Province	Virginia
ASHRAE Weather Station	FARMVILLE
ZIP Code	30132
Weather Information	Solar ABC's Weather.com
ASHRAE Extreme Low Temp	-16.0 °C
ASHRAE 2% High Temp	34.2 °C

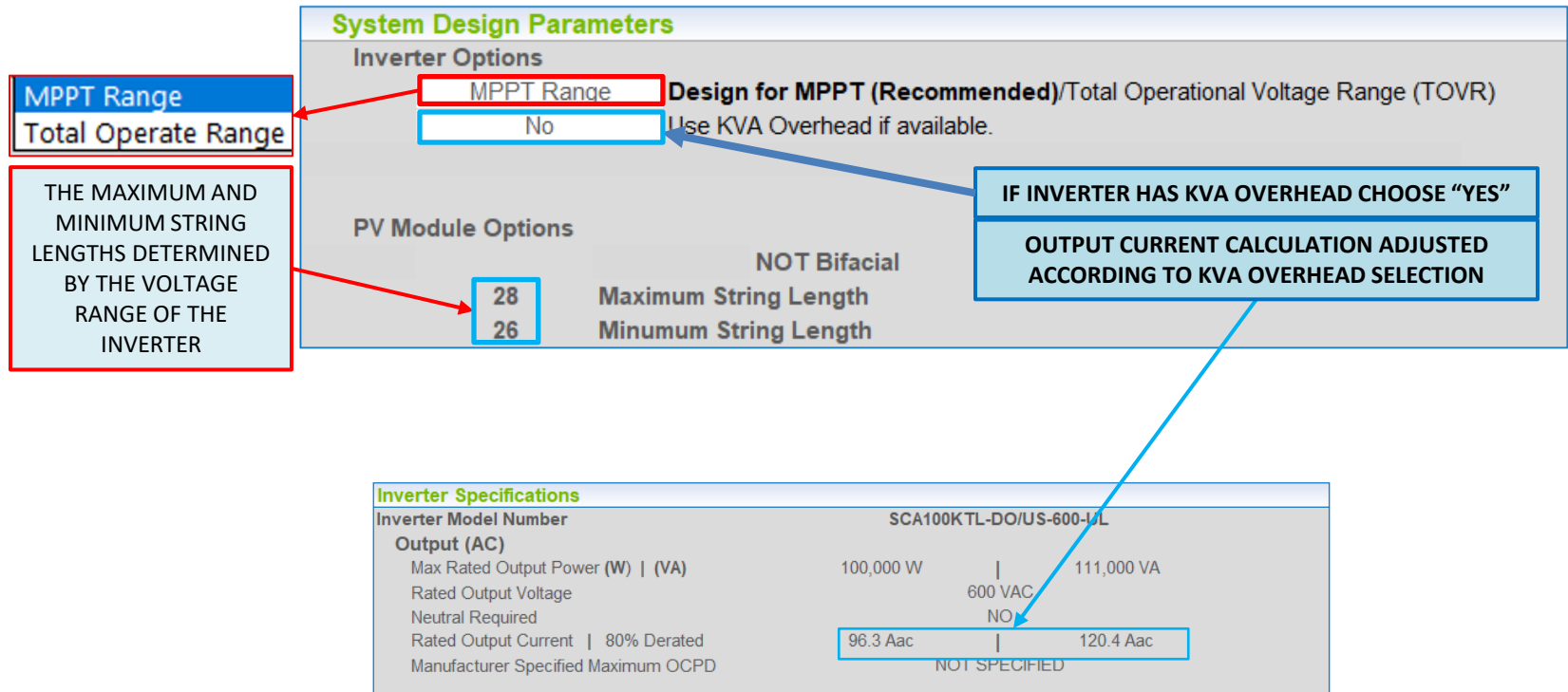
Equipment Selection

Low Temp for Calculations	-16.0 °C
High Temp for Calculations	34.2 °C
Roof, Rack or Pole mount?	Pole
Module Manufacturer	Custom_Module
Module Model Number	REC 350
Chint Inverter Model Number	SCA3KTL-O/US -208-IEC

MUST SELECT UL INVERTERS FOR UNITED STATES

Must use UL inverter in the USA

SYSTEM DESIGN – Inverter Configuration



SYSTEM DESIGN – Inverter Configuration



IF INVERTER HAS MULTIPLE MPPTs – A PARALLEL MPPT OPTION IS AVAILABLE

THE 50/60KW INVERTERS REQUIRE SPECIAL (NOT RECOMMENDED) HARDWARE MODIFICATIONS

System Design Parameters

Inverter Options

MPPT Range	Design for MPPT (Recommended) /Total Operational Voltage Range (TOVR)
No	Use KVA Overhead if available.
Yes	Parallel MPPTs??

CPS Technician Must Parallel - Do Not Parallel in Wire box - Service Fee to Parallel Inverters

PV Module Options

NOT Bifacial

19	Maximum String Length
16	Minumum String Length

System Design Parameters

Inverter Options

MPPT Range	Design for MPPT (Recommended) /Total Operational Voltage Range (TOVR)
No	Use KVA Overhead if available.
Yes	Should not Parallel Strings of Different Lengths

CPS Technician Must Parallel - Do Not Parallel in Wire box - Service Fee to Parallel Inverters

PV Module Options

NOT Bifacial

19	Maximum String Length
16	Minumum String Length

MPPTs WITH DIFFERENT STRING LENGTHS SHOULD NOT BE PARALLELED

Array Design Options

String Length	18	18	17	Different
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SYSTEM DESIGN – BIFACIAL MODULES



System Design Parameters

Inverter Options

MPPT Range	Design for MPPT (Recommended) /Total Operational Voltage Range (TOVR)
No	Use KVA Overhead if available.
No	Parallel MPPTs??

PV Module Options

	4 %	Bifacial Gain
19		Maximum String Length
16		Minumum String Length

CPS not responsible for gain calculations.

IF THE MODULE IS BIFACIAL – THE EXPECTED BIFACIAL GAIN MUST BE ENTERED HERE

THE ENGINEER OF RECORD IS RESPONSIBLE FOR THE CALCULATION OF BIFACIAL GAIN



ARRAY DESIGN - FUNDAMENTALS

ENTER STRING LENGTH ACCORDING THE THE RECOMMENDATIONS

IF NUMBER OF STRING IMBALANCE IS GREATER THAN 1

PARAMETERIC LIMIT VIOLATIONS ARE HIGHLIGHTED

19	Maximum String Length		
16	Mininum String Length		

Array Design Options

String Length	19	19	18	
Number of Strings	2	4	5	<-Unbalanced
	MPPT1	MPPT2	MPPT3	TOTALS
Connected Wdc _{STC}	15960	31920	37800	85680
Connected Isc _{STC}	23.3	46.7	58.3	128.3
Connected Voc @T _{MIN}	996	996	944	

Limits	
MPPT	Total
33000	90000
59.8	163.2
	1000

PARAMETERIC RESULTS DISPLAYED HERE

PARAMETERIC LIMITS DISPLAYED HERE



ARRAY DESIGN

STRING LENGTH SELECTION (MPPT RANGE)

MINIMUM STRING LENGTH CREATES UNDER MPPT RANGE

MAXIMUM STRING LENGTH CREATES OVER-VOLTAGE

System Design Parameters

Inverter Options

MPPT Range	Design for MPPT (Recommended)/Total Operational Voltage Range (TOVR)
No	Use KVA Overhead if available.
No	Parallel MPPTs??

PV Module Options

NOT Bifacial

19	Maximum String Length	Exceeded - Inverter and/or module voltage exceeded
16	Minimum String Length	Consider TOVR Analysis

Array Design Options

String Length	20	15	17	Consider TOVR Analysis		
Number of Strings	3	4	4	Limits		
	MPPT1	MPPT2	MPPT3	TOTALS	MPPT	Total
Connected $W_{dc_{STC}}$	21000	21000	23800	65800	33000	90000
Connected $I_{sc_{STC}}$	29.2	38.9	38.9	106.9	59.8	163.2
Connected $V_{oc} @ T_{MIN}$	1049	787	892			1000

ARRAY DESIGN

STRING LENGTH SELECTION (TOTAL OPERATING RANGE)



System Design Parameters

Inverter Options

Total Operate Range Total Operational Voltage Range (TOVR)
 No Use KVA Overhead if available.
 No Parallel MPPTs??

PV Module Options

NOT Bifacial

19 Maximum String Length
 6 Minimum String Length

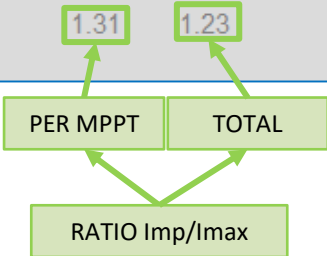
Array Design Options

String Length	19	15	18	Limits	
Number of Strings	4	5	5	MPPT	Total
Connected Wdc_{STC}	26600	26250	31500	33000	90000
Connected ISC_{STC}	38.9	48.6	48.6	59.8	163.2
Connected $Voc @ T_{MIN}$	996	787	944	1000	
Connected $Vmp @ T_{MAX}$	648	512	614		
$Pmp @ T_{MAX}$	25716	25377	30453	81546	
$Imp @ T_{MAX}$	39.7	49.6	49.6	138.9	
I_{MAX} Inverter	37.8	37.8	37.8	113.4	

IN MPPT RANGE
MIN IS 16

Vmp IS BELOW
MPPT RANGE

$Imp @ Tmax$ IS GREATER THAN
MAXIMUM INPUT CURRENT I_{max}





Overview – Interactive Optimization

- INPUT I_{sc} @STC TOO HIGH
 - TOTAL
 - PER MPPT
- INPUT ARRAY POWER @STC TOO HIGH
 - TOTAL
 - PER MPPT
- MODULE RATED VOLTAGE TOO LOW
- TOO MANY STRINGS – COMBINER NEEDED
- INPUT ARRAY VOLTAGE TOO HIGH
- STATE/WEATHER STATION INCOMPATIBILITY
- MPPT STRING IMBALANCE GREATER THAN 1 STRING DIFFERENCE
- COST WARNING FOR 50/60KW PARALLEL MPPTs
- STRING LENGTH BELOW MPPT WINDOW
- NEC 80% DERATE OUTPUT CURRENT CALCULATION
 - WITH KVA OVERHEAD
- DC/AC RATIO CALCULATION
- I_{MP} CALCULATIONS FOR 600V RETROFIT
- MODULE MANUFACTURER/MODEL MISMATCH
- IF USA and NONE UL INVERTER WILL BE FLAGGED

Overview – Tool Use Terms and Conditions



Terms and Conditions

THE USER OF THIS SIZING TOOL HAS ACKNOWLEDGED:

The Solar PV String Sizing Tool is being offered free of charge as a guide only.

Chint Power Systems, make no representation or warranty regarding the output of the Solar PV String Sizing Tool or any claim to the actual performance of your system.

It is the responsibility of the system design engineer to ensure that the PV module selection and array configuration are appropriate for the system being considered.

The user agrees to use this Solar PV String Sizing Tool spreadsheet at their own risk and with the knowledge that Chint Power Systems will not be liable to the user for any damages, injury or death as a result of use of the Solar PV String Sizing Tool.

Determination of Bifacial gain is the sole responsibility of the site design Engineer of Record.