See Instructions.

Energy Management Service

Residential Wire Sizing Worksheet (Gauges, Lengths & Voltage Drop)

Ver. 1

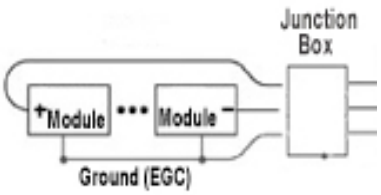
Use link below to get local high temperature.

Solar ABC's

2% Avg temp recommended.

Step 1: Size the source circuit conductors.

This calculation applies to PV or USE-2 wire between the array and the junction/combiner box. Do not use this step to size wire for microinverters.



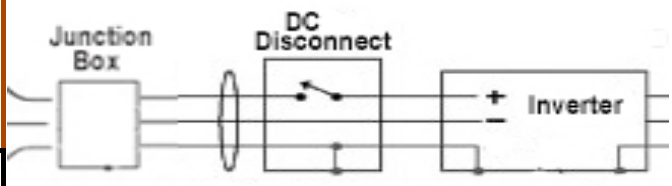
Max. High Temperature (Celsius)	38
Temperature Correction Factor	**0.91**

Module Brand / Model #	Acme QJJJ55555555		**Defaults:** Max Temp=45. Module Wire Gauge=10. (You can change these.)		
Module Isc	8.59	Module (**Ipm**) operating current	8.06	Inverter Model	Acme 6000
Check box if inverter is positive grounded			☐	Worksheet designed for a grid-tied system with one inverter. Use only 90°C rated conductors, minimum gauge 12. Conduit is assumed to carry wire for this PV system only.	
Type only in the black outlined boxes		**Ampacity Calculation**	**14.73**		
Minimum Wire Gauge for Conductors			**12**		

Step 2: Size PV Output circuit conductors.

Conductor gauges may be changed in later steps.

This calculation applies to THWN-2 or other approved wire that's run through conduit between a junction box/combiner and the inverter.



Check here if using a combiner box	☐				
Number of Array Strings	3	Inches btw conduit & roof	6.0	Check here if no conduit on roof	☐
Circuit Isc	**8.59**	Conduit Adjustment	**80%**	Temp Adder	**17**
Conductors Exiting Box	**6**	**Ampacity Calculation**	**22.04**	Temp Correction Factor	**0.76**
Minimum Wire Gauge for Conductors		**12**	Enter Wire Type:		THWN-2
Job Name:	14555 Gorthian Road Alameda CA 95555		**Scroll to the right for Page 2...**		

Do not remove these tables.

Free Air Conductor Ampacities for PV Wire, USE-2 and THWN-2 Copper at 30 degrees Celsius

1	220
2	190
3	165
4	140
6	105
8	80
10	55
12	40

40	12
55	10
80	8
105	6
140	4
165	3
190	2
220	1

In Conduit Conductor Ampacities for PV Wire, USE-2 and THWN-2 Copper at 30 degrees Celsius

1	150
2	130
3	110
4	95
6	75
8	55
10	40
12	30

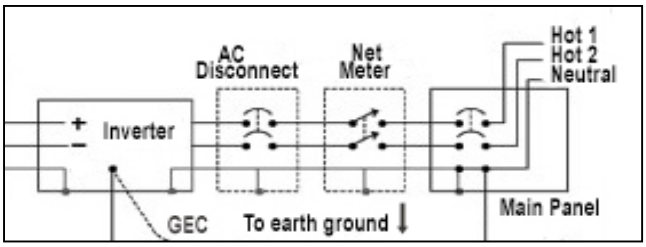
30	12
40	10
55	8
75	6
95	4
110	3
130	2
150	1

Residential Wire Sizing Worksheet

See Instructions.

Page 2

Scroll right for Page 3.



Type only in the black outlined boxes

Step 3: Size Inverter Out conductors.

Inverter AC Output Current (**Imax**)	18.7				
Check box if inverter will be indoors.	☐	If indoors, estimate highest Celsius temp. (Default = 35.)	35		
Check box if conduit will carry more than 3 conductors. (Max=6)	☐	**Conduit Adjustment**	**Indoor Temp Correction**		**0.96**
Ampacity Calculation	**25.69**	**100%**	Check here if using a transformerless inverter	☒	
Minimum Gauge for Conductors		**12**	Wire Type	THWN-2	

Step 4: Measure wire lengths.

An array EGC will be shorter if grounding clips are used on the modules.

Source Circuit: (Use feet only.)	**String 1**	**2**	**3**	**4**	Length for Ground Wire(EGC)	15
Distance of home run (i.e. from array far end to junction box)	40	40	30	30		
Distance of near-end run to box if not connecting by module cable	5	5	10	10		
Check here if home run is the positive wire	☒					

When measuring wire runs, be sure to factor in obstacles, wide turns and an extra foot for wiring inside electrical boxes. Enter one-way travel distances only. No roundtrips.

PV Output Circuit:					
Distance between junction box/combiner and inverter	250	**Inverter Out Circuit**		Distance of inverter EGC	
		Wire distance between inverter and main panel	25		30
Distance of EGC (if different from conductors)					100

Calculations:

Source	**Positive**	**140**	**Neg.**	**30**	**EGC**	**15**	**All lengths in feet.**	
PV Output		**Positive**	**750**	**Negative**		**750**	**EGC**	**100**
Inverter Out		**Hot**	**50**	**Neutral**		**25**	**EGC**	**30**

Residential Wire Sizing Worksheet

See Instructions.

Step 5: Perform voltage drop calculations. *Enter the number of modules in the array(s).*

Module Operating Volts **Vpm**	30.0		Module Cable Length in **inches**		48		Module Count	36
Source Circuit	**Operating Current**	**8.06**	*Provide length of one cable only. (Default is 48.)*				**Array Strings**	**3**
All distances in feet.	**Distance**	**458**	**Conductor gauge**	**12**	**Ohms per kft**		**1.96**	
PV Output Circuit	**Operating Current**	**8.06**	**Combiner Box?**	**NO**	*Selected in Step 2.*		**Scroll left for Pages 1 & 2.**	
	Distance	**500**	**Conductor gauge**	**12**	**Ohms per kft**		**1.96**	
Inverter Out Circuit	**AC Maximum Current**	**18.7**			***Type only in the black outlined boxes.***			
	Distance	**75**	**Conductor gauge**	**12**	**Ohms per kft**		**1.96**	

Calculations:

Circuit:	**Source**	**PV Output**	**Inverter Out**
Voltage Drop	**7.2 V**	**7.9 V**	**5.5 V**
Circuit	**360 V**	**360 V**	**120 V**
Percentage	**2.0%**	**2.2%**	**4.6%**
Check box to use the next beefier wire gauge for this circuit.	☐	☐	☒
	New size	New size	New Size
	Same	**Same**	**10**
Conductor Gauge	**12**	**12**	**10**
New Voltage Drop/%	**Same**	**Same**	**1.7 V** / **1.4%**

Maximum voltage drop should be under 3%. If necessary, select the next beefier wire gauge. You can change gauges again in Step 6.

Scroll right for Overcurrent Protection Ampacity Check and Ground Wire Sizing

Do not remove these tables.

Voltage Drop Resistance for Stranded Wire

Gauge	Ohms per kft
1	0.154
2	0.194
3	0.245
4	0.308
6	0.491
8	0.778
10	1.24
12	1.98

Wire Sizing Worksheet

After completing this page, click on the Report tab below to view your results.

Step 6: Check minimum wire gauges against overcurrent device ratings.

Note: Overcurrent protection in the PV Source and PV Output circuits may be optional when you use less than 3 strings. Check the NEC or ask a qualified expert for guidance.

Circuit	Overcurrent Ampacity Calculation	Enter O.C. Rating (if any)	Conductor Gauge	Derated Wire Ampacity	Is the wire ampacity equal to or greater than the O.C. rating?
PV Source	13.40		12	36.4	OK (No overcurrent protection)
PV Output	13.40	15	12	18.24	OK
Inverter Out	23.38	30	10	36.4	*OK*

Fill in each box if you plan to use O.C. protection for that circuit. An O.C. device is rated in amps. Enter the number only (e.g. 30). Use the size nearest to, but not less than, the Overcurrent Ampacity Calculation. **Click the Resources tab below for links to O.C. device sizes.** A dual-pole, backfed breaker is required at the main panel (inverter output circuit), usually 20, 30 or 40 amps. Next, if the Derated Wire Ampacity is greater than the O.C. Rating, a beefier wire gauge may be required. (It's not required when the O.C. rating is the next highest available for the Derated Wire Ampacity.) *NOTE: Per NEC 690.8(B)(1)(c), for any O.C. device subject to an ambient temperature more than 40˚C, you must implement the fuse or breaker's manufacturer temp correction factors when selecting a size.*

Conductor Gauges	Enter final minimum conductor gauges based on the results above.					
	PV Source	12	PV Output	12	Inverter Out	10

Step 7: Choose a ground wire and gauge for each circuit.

Transformerless inverter selected. *See Step 3*

*If a transformerless inverter is used, the EGC (ground wire) for all circuits must be rated to carry **twice** the highest upstream O.C. ampacity. For a normal inverter: If an O.C. device is used, then pick a gauge based on the O.C. rating you chose above and NEC Table 250.122. Otherwise, the EGC should be the same gauge as the conductors, or beefier. For bare copper, the minimum gauge is 6. Click the Resources tab below to learn more.*

High Ampacity	23.38	Source	PV Output	Inverter Out
Minimum Gauge		6	10	10
Wire Type:		Bare Copper	THWN-2	THWN-2

Most commonly used wire type in the Source circuit is Bare Copper #6. PV and Inverter Output wire types are picked in Steps 2-3.

NEC Table 250.122

AWG	Max Amps	
12	=	20
10	E	30
10	G	40
10	C	60
8	=	100