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JOE UTASI – Cinci Home Solar
www.cincihomesolar.com
Residential Solar DIY Consultant
Career BSEE, MBA, CPM
NABCEP PV & Tech Sales Certs

LETS TALK SOLAR!

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LETS PICK A TOPIC!

SOLAR BASICS – why solar? what it does, how it works, and the difference between CENTRAL and MICRO Inverters.

BACKUP SYSTEMS (for when power is Off!)

PAPERWORK – permits, applications, inspections, zoning, State Utility app, GATS app.

MOUNTING SYSTEMS – Ground Mount/Roof Mount differences in design, cost and engineering

HOW TO SAVE MONEY – shopping, purchasing, sweat equity and more.

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SOLAR BASICS

Reasons for going Solar

- Utility installation cost for long service runs from street cost too much
- Frequent power outages due to rural location/weather
- Save money by subsidizing or eliminating your electric bill
- Prepare for Zombie Armageddon, Doomsday, EMP, Marshall law, etc…

Considerations

- Cost, how to pay, maintenance, service and repair
- Location and impact on performance
- Installation and servicing
- Paperwork: zoning, utility, neighborhood permitting and applications

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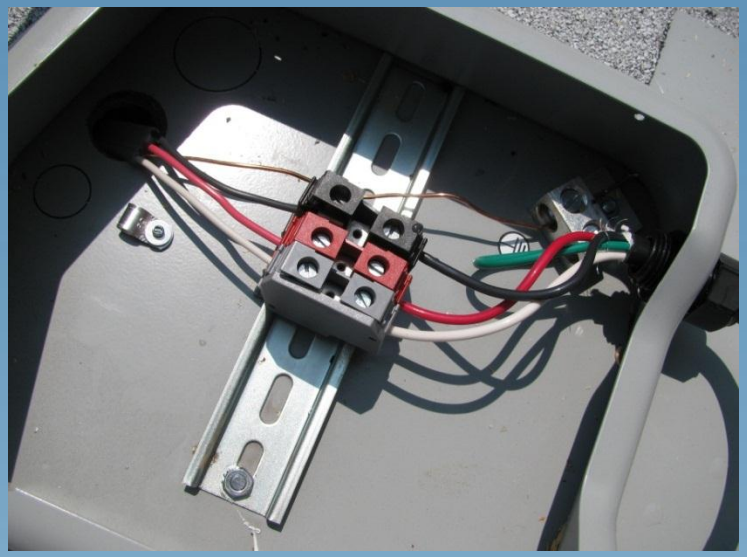
Typical Micro-inverter installation

Weather proof J-box



Micro inverter plugged into trunk line

Racking and micros in place. Ready for panels

Panels going up to roof

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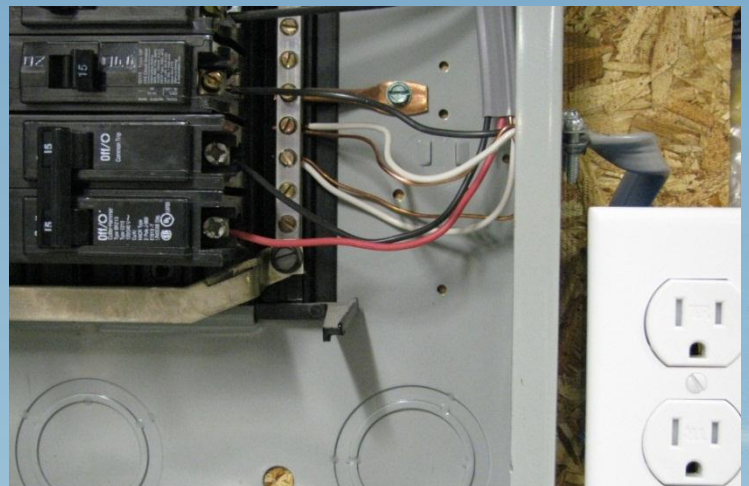
Always use strain reliefs!

Typical performance monitor

Monitor must install close to breakers



Typical reporting display

Microinverter

HW Part Num	Installed	HW Serial Num	Status	Running Image - Updated	Assembly Part Num	Controller Part Num	Last Report
800-00103-r04	07/13/11 11:05:08	121119705369	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:40
800-00103-r04	07/13/11 11:07:48	121119702390	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:59
800-00103-r04	07/13/11 11:04:55	121119705408	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:39
800-00103-r04	07/13/11 11:07:48	121119705613	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:58
800-00103-r04	07/13/11 11:04:48	121120716489	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:38
800-00103-r04	07/13/11 11:07:39	121119705527	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:55
800-00103-r04	07/13/11 11:07:25	121119705594	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:54
800-00103-r04	07/13/11 11:06:56	121119701255	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:53
800-00103-r04	07/13/11 11:06:12	121118698242	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:51
800-00103-r04	07/13/11 11:06:06	121119705382	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:50
800-00103-r04	07/13/11 11:05:52	121119692393	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:45
800-00103-r04	07/13/11 11:11:50	121119705628	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:48:05
800-00103-r04	07/13/11 11:05:46	121119702382	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:44
800-00103-r04	07/13/11 11:10:46	121120716174	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:48:04
800-00103-r04	07/13/11 11:05:20	121119705406	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:47:43
800-00103-r04	07/13/11 11:10:25	121119704383	OK	520-00040-01-v00.03.26 - 02/11/11 13:41:23	ffffffff-ffffffff	480-00009-01-v02.02.13	07/13/11 16:48:03

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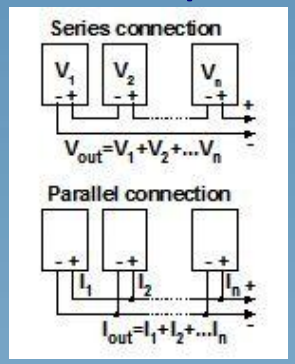
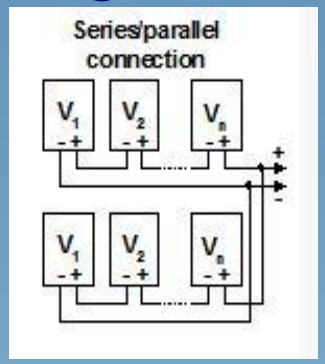
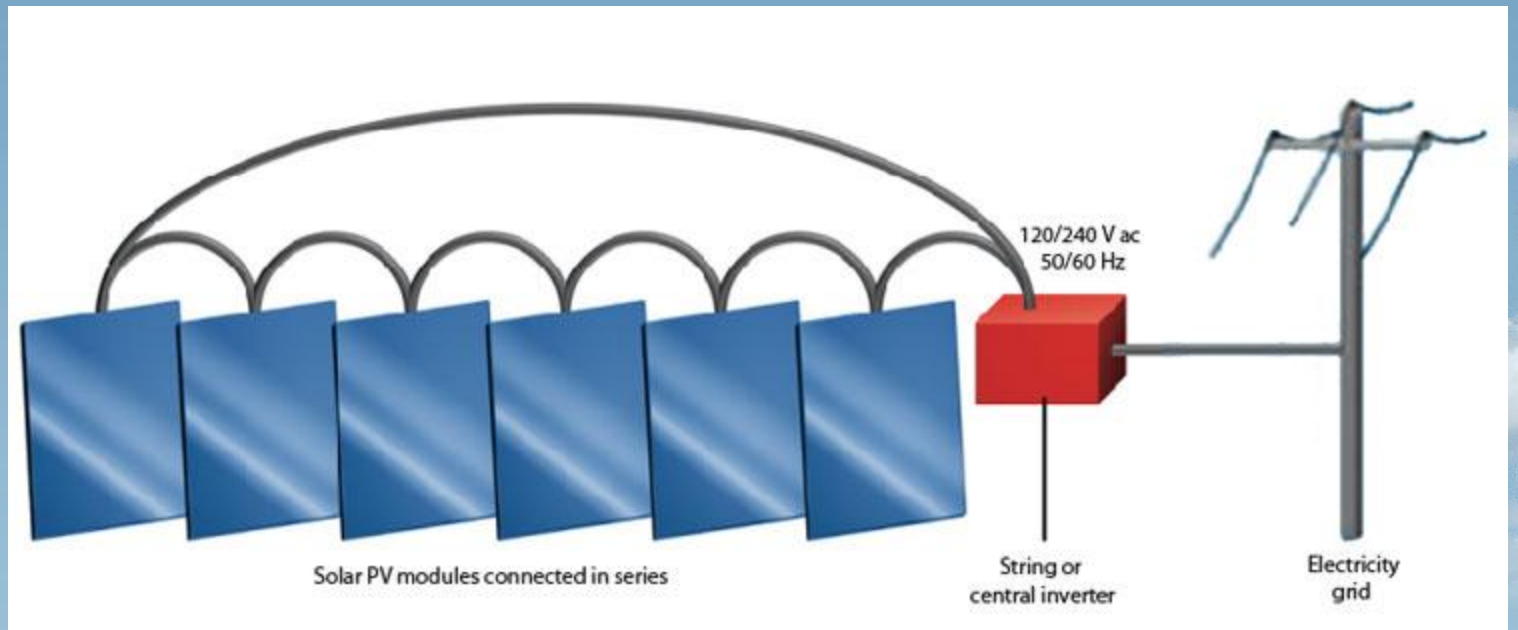
String PV Panel wiring (aka CENTRAL Inverter)

Total panel count depends on inverter input requirements – usually 10 to 14 panels. Each panel can be as much as 50 volts “open” circuit. NEC imposes a voltage limit of 600 volts total.







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Typical Central Inverter installation

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Inverter comparisons: String vs Micro

String: Dangerous high voltage, impact of series shading, requires add-ons to monitor or improve performance, requires use of rigid metal conduit for all DC leads from roof to inverter. Also needs an exterior disconnect for DC from roof, as well as special (expensive) crimp tool for the extra pieces of High Voltage cable.

Micro: lower voltage (40 volts dc), each panel performs independently, wiring is standard *branch circuit* from roof to breaker box using regular #12 ROMEX. No DC disconnect required. Not impacted as much as a string by single panel shading. Less stress on components since power levels are lower. 25 year warrantee vs 6, 8, or 12 years for a string type CENTRAL inverter.

End Basics

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BACKUP SYSTEMS

- The magic “one box” solution…
- Simple Battery/Inverter option for short power outages (1 day of battery power)
- Generator/Solar combos (Sunny Island)
- AC Coupling of any brand solar grid-tie system to a battery/inverter setup

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The elusive magic inverter!

6000 watt low frequency inverter 110/220Vac Split Phase

Battery Priority Selector

Terminal Block

GFCI

Marine Coated and Protected

Multi Stage Smart charger 60 Amp

MPPT solar charge controller - PV in 15-30Vdc

remote panel available

auto gen start

auto frequency

10msec typical transfer time

optional 25W power save mode

7 battery type settings for 24 Vdc charger

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Typical battery backup inverter installation

4 series, 3 parallel connection to 24 VDC inverter

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Backup System in my “bunker”…

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Fresh off the freight truck

Inverter, plate, panel, smart switch

#4/0 flexible copper handles 250 amps!

Whole house smart switch

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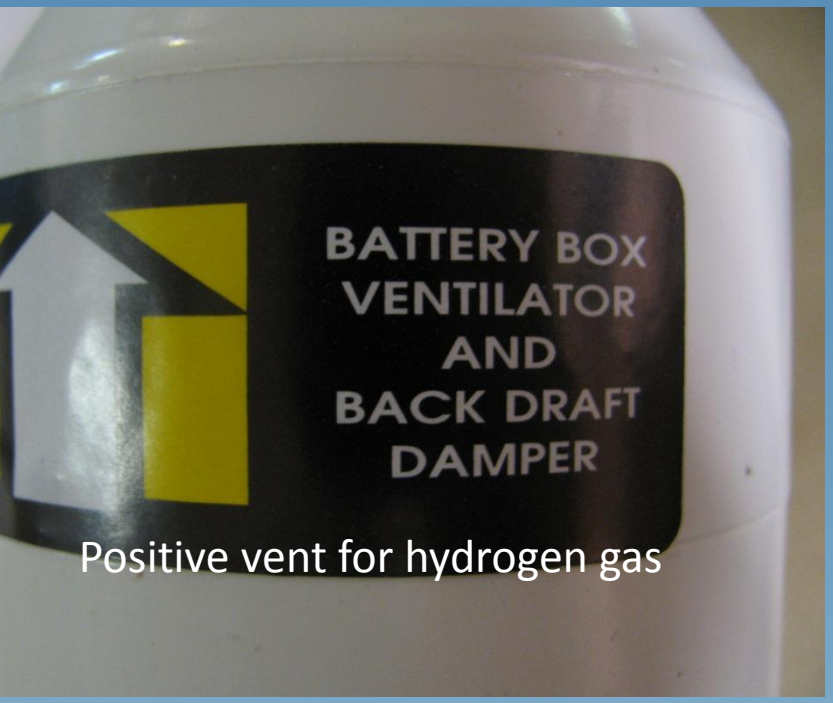

Positive vent for hydrogen gas

e/panel simplifies Magnum installation!

Magnum inverter mounts on white
Plate above breaker box/control panel

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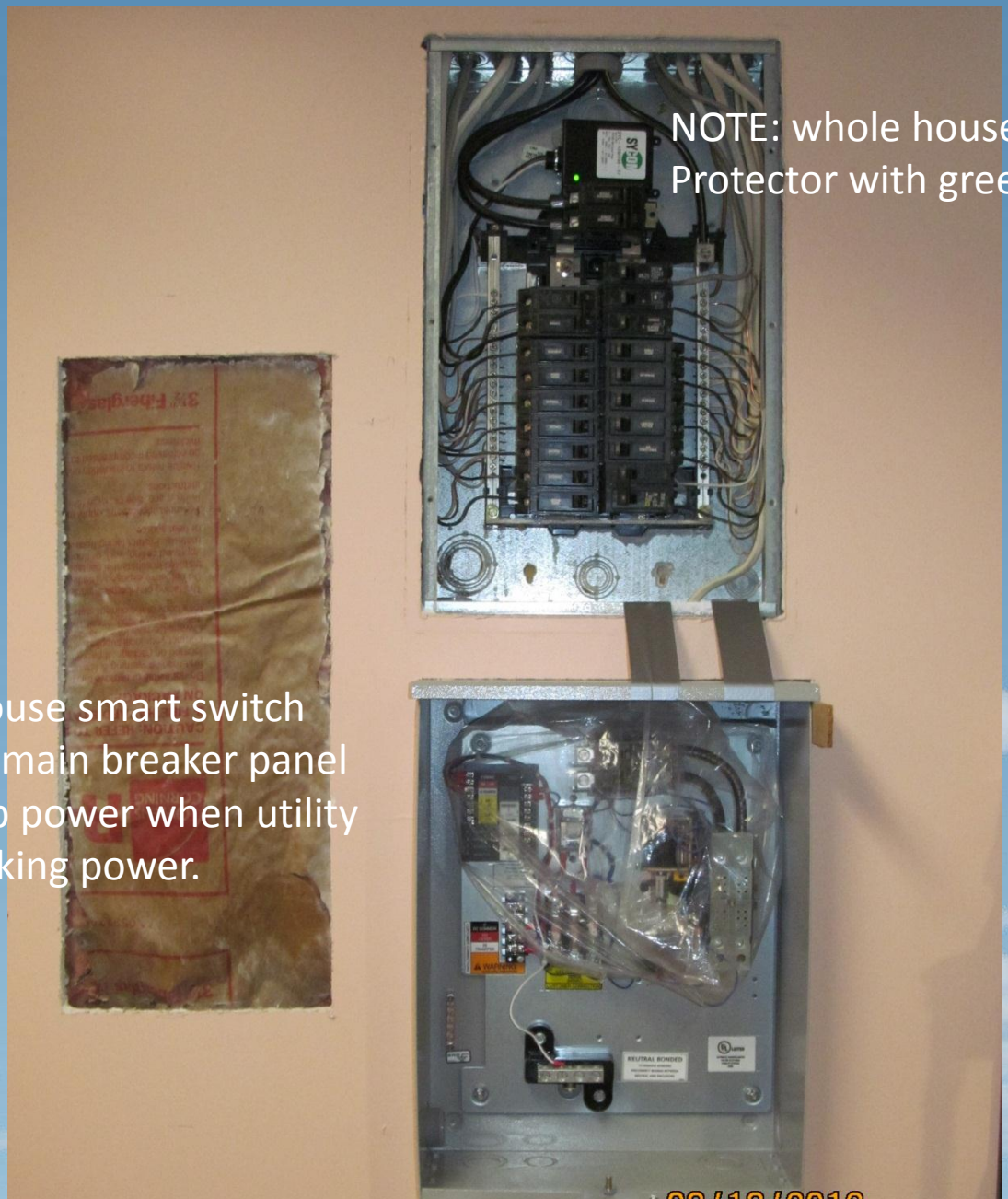
Service Interconnect layout



NOTE: whole house surge Protector with green LED.

Whole house smart switch
Transfers main breaker panel
To backup power when utility is not making power.

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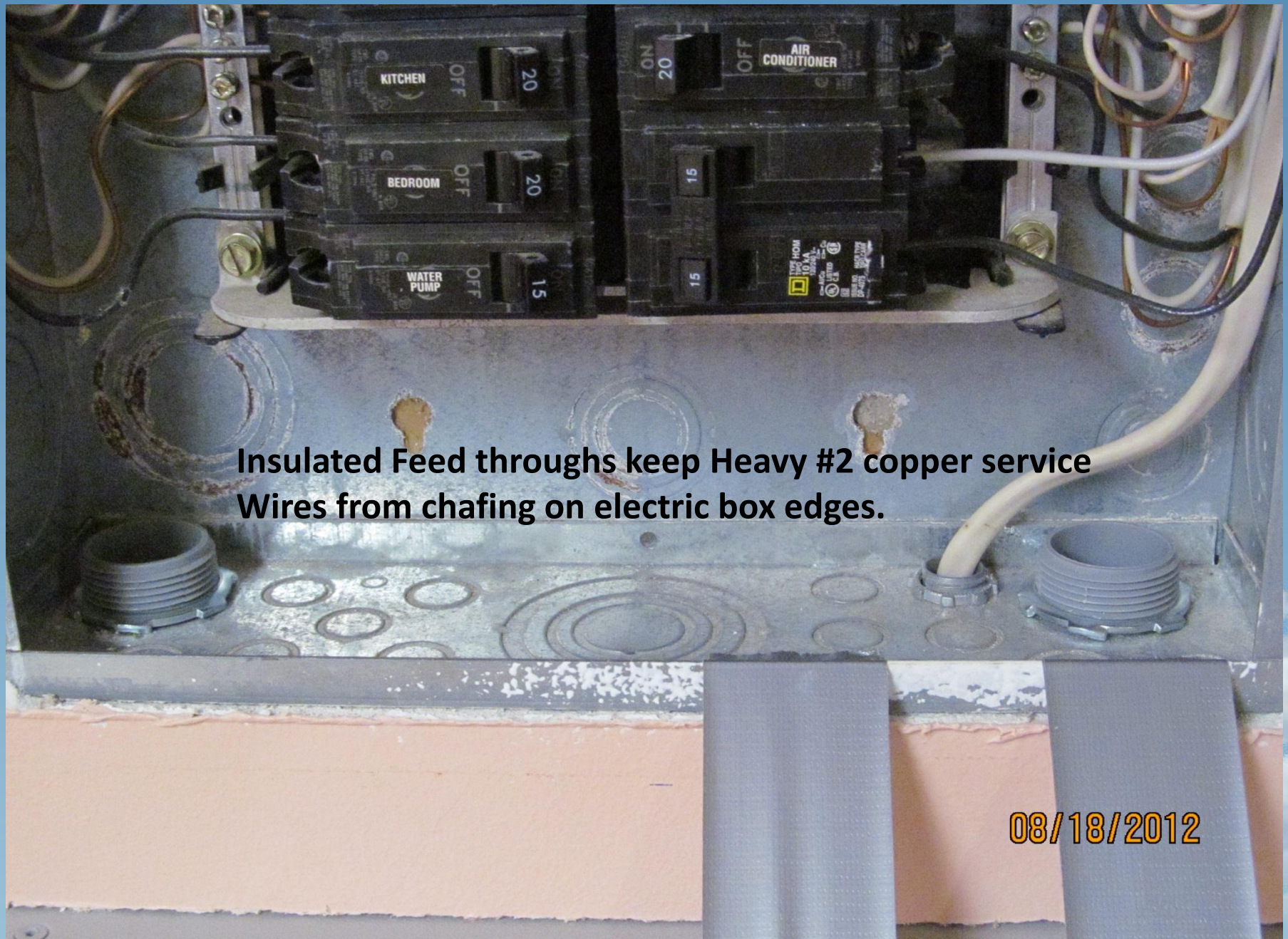
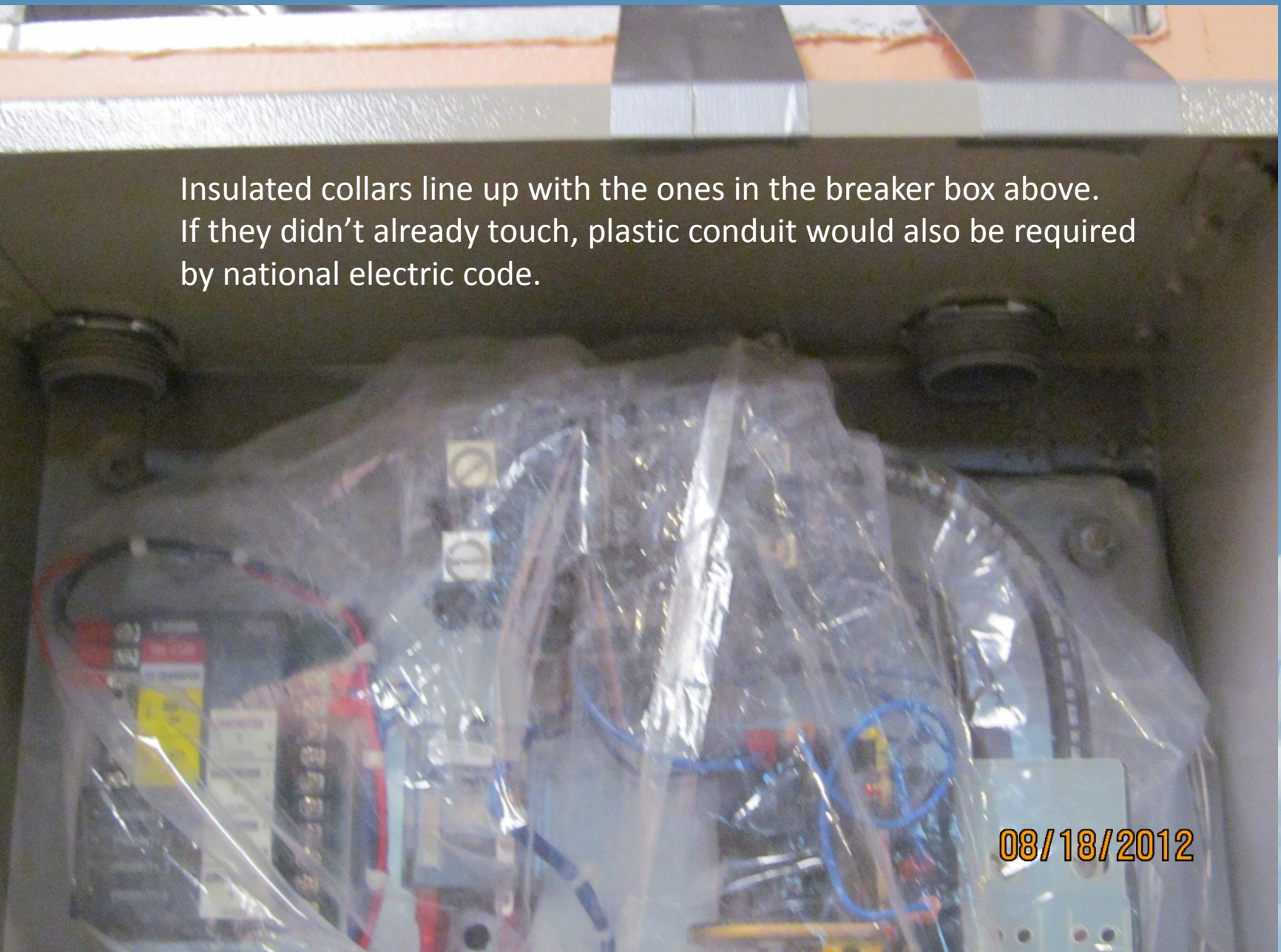


Insulated Feed throughs keep Heavy #2 copper service Wires from chafing on electric box edges.



Insulated collars line up with the ones in the breaker box above. If they didn't already touch, plastic conduit would also be required by national electric code.

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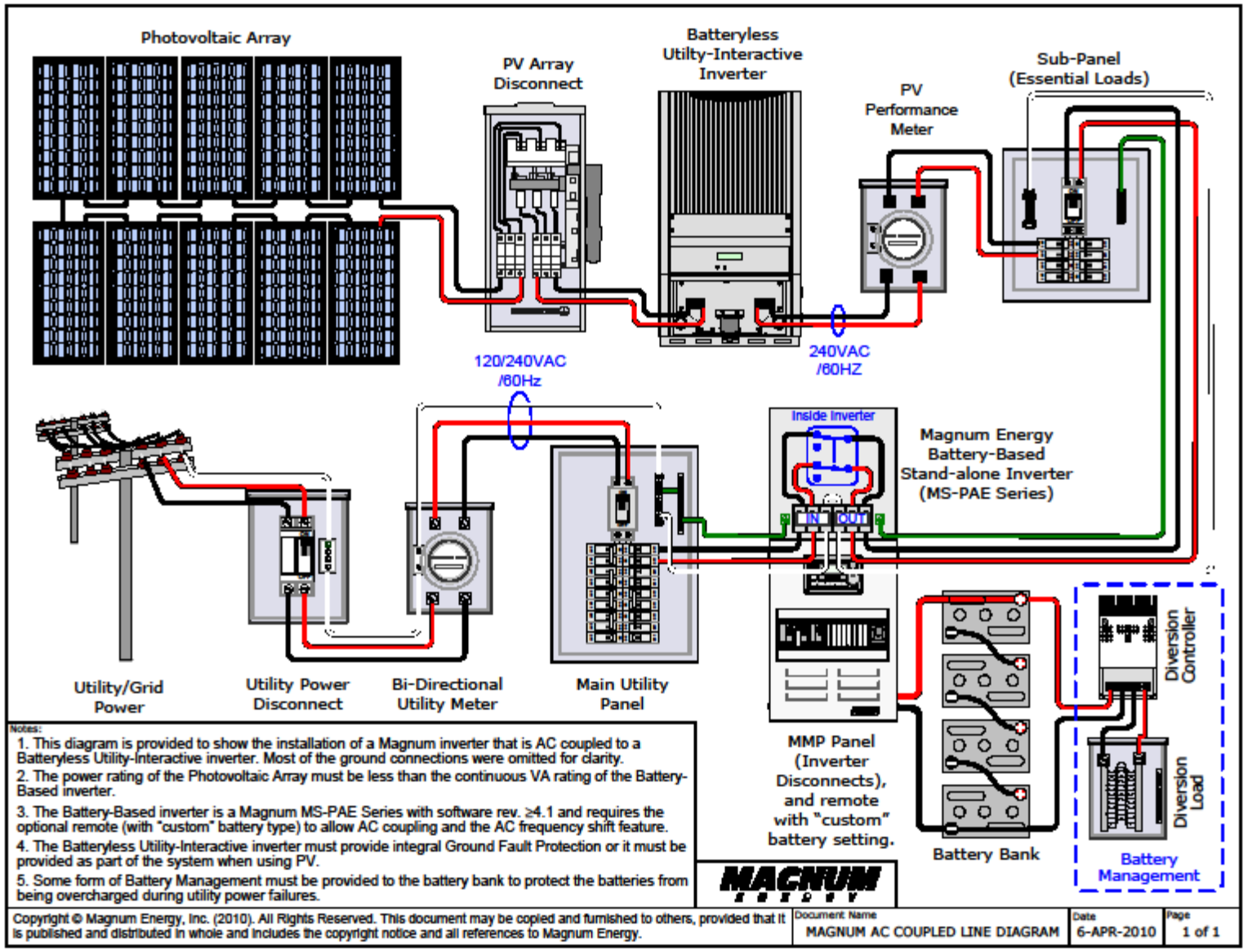
AC coupling diagram for a typical system with the Magnum inverter




The big black caps are called RECOMBINATION CAPS and turn the hydrogen gas back into water. This minimizes outgassing and reduces the need for frequent "watering."
09/04/2012

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PAPERWORK!!!

City, Town, County PERMITS

Structural Mounting Analysis (roof or ground)

PE statement for older structures (pre 1960)

Neighborhood Association rules

Electrical Permit if required

Utility Connection Approval

State Public Utility Renewable Facility License

GATS registration (to sell your SRECs)

Labeling of installed components

Final Inspection if needed

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Photo of proposed solar locations

Zoomed and cropped Google Earth shot

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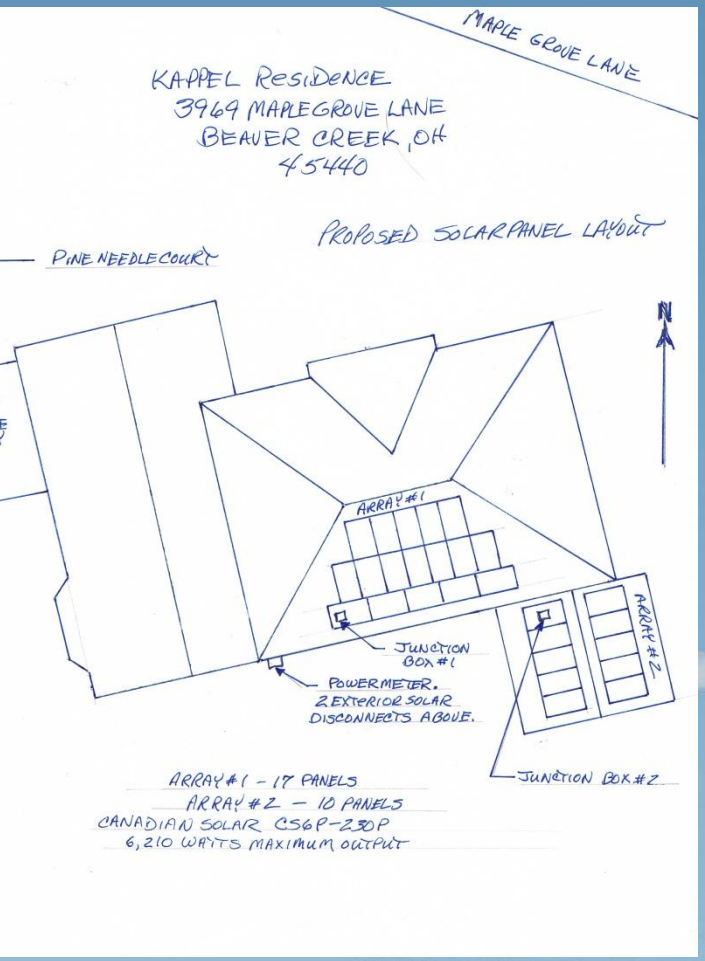
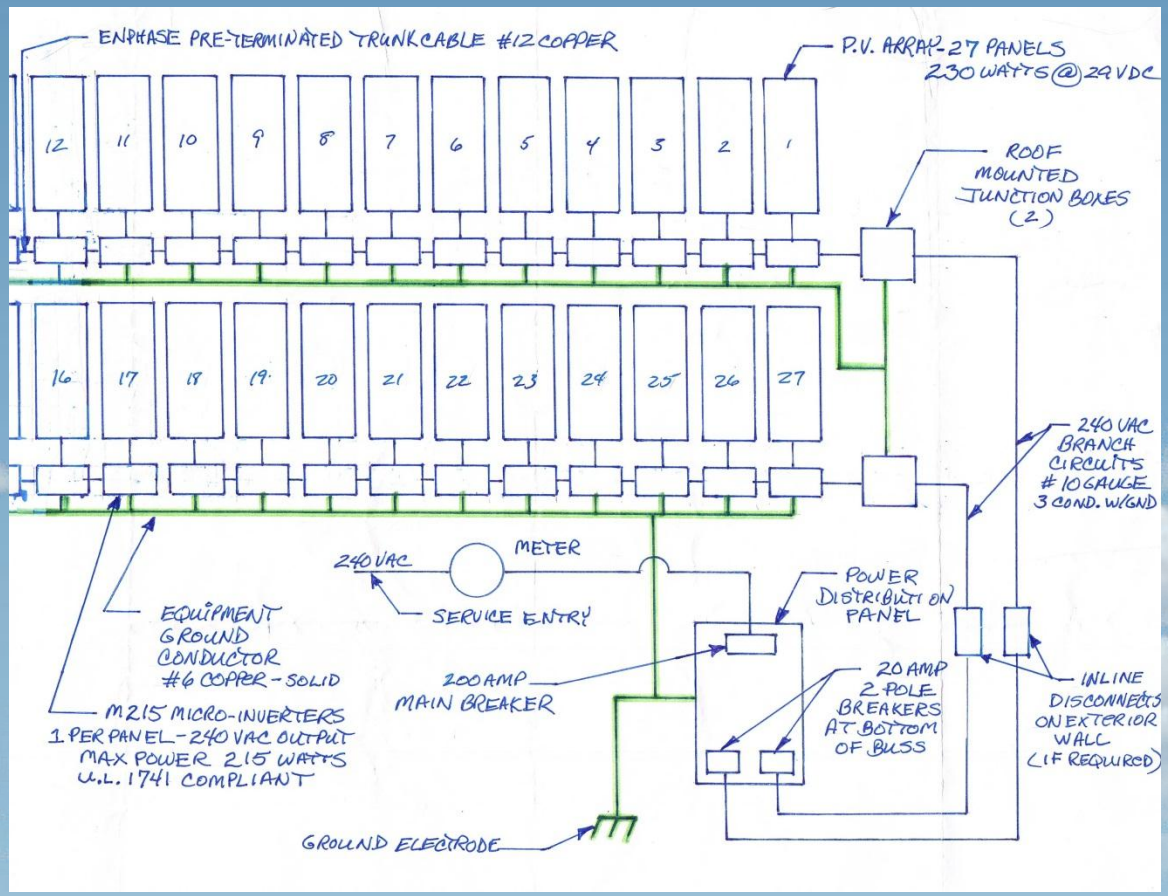
Site Plan with PV layout



1 line drawing



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Product DATA SHEETS for all equipment

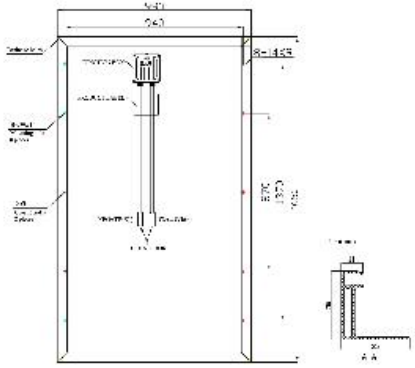
Rendgy

The Future of Clean Energy

Polycrystalline Type

Cell Type: 156X156 (6 inches) Polycrystalline Cell

RNG-XXXP 230/235/240



Key Features

- Top Ranked PTC Rating
- High Module Conversion Efficiency
- Guaranteed Positive Output Tolerance (0~3%)
- Maximizes System Output by Reducing the Mismatch Loss
- Delivered Ready for Connection
- Fast and Inexpensive Mounting
- Withstand High Wind (2400Pa) And Snow Loads (5400Pa)
- Excellent Performance in Low Light Environments

Qualification

• UL Listed	UL1703
• Fire Rating	Class C

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Mounting system structural analysis

SolarMount I-Series, 1.0 Beam Engineering Report, Page 1 of 2

90 mph Wind Chart

Module Size	Ground Snow 0	Max Span (inches) Point Loads (pounds): Up/ Down/ Side 20	30	40
52" x 35"	56 229/ 262/ 54	52 211/ 305/ 96	48 197/ 327/ 123	44 177/ 364/ 140
65" x 40"	49 250/ 286/ 58	44 222/ 321/ 101	41 207/ 345/ 129	37 186/ 384/ 148
77" x 51"	40 238/ 273/ 56	35 212/ 307/ 96	33 198/ 329/ 123	30 178/ 366/ 141

110 mph Wind Chart

Module Size	Ground Snow 0	20	30	40
52" x 35"	49 305/ 323/ 47	48 295/ 334/ 88	45 277/ 356/ 113	42 261/ 377/ 136
65" x 40"	41 321/ 340/ 49	40 311/ 352/ 92	38 292/ 375/ 119	36 275/ 397/ 143
77" x 51"	33 306/ 325/ 47	32 297/ 336/ 88	30 278/ 358/ 113	29 263/ 379/ 136

120 mph Wind Chart

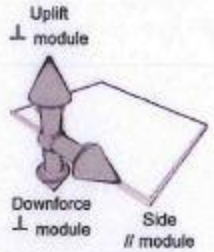
Module Size	Ground Snow 0	20	30	40
52" x 35"	45 337/ 350/ 43	45 334/ 353/ 83	42 315/ 374/ 107	40 299/ 394/ 130
65" x 40"	38 355/ 369/ 45	38 352/ 372/ 87	36 332/ 394/ 113	34 315/ 415/ 137
77" x 51"	31 339/ 352/ 43	30 336/ 355/ 83	29 317/ 376/ 108	27 301/ 396/ 130

150 mph Wind Chart

Module Size	Ground Snow 0	20	30	40
52" x 35"	37 432/ 427/ 35	37 432/ 427/ 68	37 432/ 432/ 93	35 415/ 449/ 114
65" x 40"	31 455/ 450/ 37	31 455/ 450/ 71	31 455/ 455/ 98	30 438/ 473/ 120
77" x 51"	25 434/ 429/ 35	25 434/ 429/ 68	25 434/ 434/ 93	24 418/ 452/ 114

Installation of products related to this engineering report is subject to the requirements below:

- Flush roof installations only; modules must be < 10" from roof surface
- The building has either a flat roof, a gable roof ≤ 45°, or a hip roof ≤ 27°



Know your limits!
Check attachment load limits.

6-30-10

Wilson & Company, Inc.,
Engineers & Architects.
F-1677

6-30-10

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PROPERTY ZONING

CITY OF BEAVERCREEK ZONING CODE

158.102 SOLAR ENERGY.

Solar panels, as defined in this section, shall be permitted, provided that the panels conform to the following provisions:

(A) *General provisions for panels visible from street.* Solar panels and related equipment mounted on roofs clearly visible from the street shall conform to the following:

(1) The collectors shall be generally mounted parallel with the roof pitch;

(2) The distance between the roof and the uppermost portion of the solar panels shall not exceed 18 inches; and

(3) Roof penetration shall be used to conceal supply/return heating/cooling water lines and/or electrical wiring from public visibility.

(B) *General provisions for panels not visible from street.* Solar panels and related equipment mounted on roofs not clearly visible from the street shall….

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Local power company application example

FirstEnergy Short Application Form

or Interconnection of Certified Inverter Based Generation Equipment (Fifty Kilowatts or Smaller)

o the Electric Distribution System of the First Energy Power Co.

ntended to be completed & approved prior to procurement & installation.[1] An application is a complete application when it provides all applicable and correct information required below. Additional information to evaluate a request for Interconnection may be required pursuant to the application process after the application is deemed complete.

USTOMER GENERATOR CONTACT INFORMATION

egal Name and Mailing Address of Customer-Generator: (if an Individual, Individual's Name)

ame: ___

lailing Address: _____

ty: _____ State: ___ Zip Code: _____

ontact Person (If other than Above): _____

lailing Address (If other than Above): _____

elephone (Daytime): _____ (Evening): _____

acsimile Number: ___ E-Mail Address: _____

tc. etc. etc……..

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TEST PLAN (if needed)

TEST PLAN – Residential Solar Install at 116 Hawthorne Drive, Washington CourtHouse, OH

1) Install 2 branch circuits and 2 pole (non-directional) breakers in sub panel located in garage. Run romex with appropriate support to roof junction box locations.
2) Verify that appropriate ground rod is installed and connected to sub panel.
3) With both breakers de-activated and tagged as such, make connection between branch circuits and Enphase "Trunk" lines inside roof mounted J-box.
4) Mount and connect Enphase micro-inverters per Enphase installation instructions via provided UL rated weatherproof connectors.
5) Mount solar panels in compliance with manufacturer's instructions and make up DC connections using provided MC-4 Connectors.
6) Install Enphase "ENVOY" system monitor in nearby 110VAC outlet (must be NON GFCI type to allow communication signal over neutral line).
7) Visually verify all connections.
8) Turn both breakers to ON position and observe ENVOY display.
9) After 5 minute wait period (per UL1741) Envoy will begin to acknowledge power-up of each micro-inverter.
10) If, after 30 minutes, all inverters have not reported in, system will undergo troubleshooting using AC Voltmeter to locate problem. As each micro-inverter serial number is "mapped" to a physical location, those NOT reporting as "active" will be easily located.

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Public Utility Generating License Application

Ohio | Public Utilities Commission

Filing Instructions for an EL-REN Application for Certification as an Ohio Renewable Energy Resource Generating Facility

Filing an Application:
In order to become a renewable energy resource generating facility that is eligible to create Renewable Energy Credits (RECs) used to comply with Ohio's alternative energy portfolio requirement, a facility must be certified by the Public Utilities Commission of Ohio (PUCO). The filing process is comprised of two parts: (A) creation of the certification application using the PUCO's online REN form, and (B) electronically filing (E-filing) the completed certification application in a PUCO case using the PUCO's Docketing Information System (DIS). If you are applying for more than one resource or technology, you must complete a separate application for each. A certified facility must be registered with an approved tracking system (i.e., GATS, M-RETS) in order to generate RECs that may be used for compliance with Ohio's alternative energy portfolio standard. Registration with a tracking system is completed after the facility is certified by the PUCO.

Before beginning the application process, applicants who do not already have a PUCO E-filing account (a username and password), and profile must first complete the steps depicted in sections 1-4 of the PUCO's Electronic Filing Manual which is available on the DIS website (http://dis.puc.state.oh.us) by clicking on "Electronic Filing Information & Links." The same account (username and password) must be used for completing the online REN form and for E-filing your completed application with DIS. The same account should also be used if you file multiple applications for different facilities. Applicants who are not familiar with the E-filing process should review the steps depicted in sections 5-6 of the Electronic Filing Manual, but note that instead of creating an official PDF file yourself, the PUCO's online REN form will create the PDF of your REN application for you to E-file in your case.

1. **Reserve a Case Number**

   All applications must be electronically filed in DIS using the "EL" (electric) industry code and "REN" (renewable) purpose code. To obtain a case number, log into DIS and click on the "Reserve a case number" link. You will need this case number before you can begin to fill out the online REN form.

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GATS Signup page online

w.pjm-eis.com/getting-started.aspx

arted

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- FAQs
- How do I sell RECs?
- REC Creation
- Who's Who?

PJM EIS Home > Getting Started

Getting Started

Regardless of the size of your generator- rooftop solar, to a large windfarm- to begin receiving credits in the GATS, you must first be enrolled through at least one participating state RPS program. Once enrolled, the state program will issue your generator a state certification number.

It is important to begin the state certification process as early as possible, as some state programs have deadlines. These deadlines can potentially affect how many months backward your generator is eligible to receive credits. We recommend that you touch base with the individual state program of your preference for understanding their specific processes and deadlines.

Once a certification number has been obtained for your generator, you can get started on collecting credits. Getting set-up is a two-step process. First you need to register for a GATS account if you do not already have one established. Next, you will need to register your generator. In all, it generally takes about 1-2 weeks for the processing to commence.

GATS Login

Login Name:

Password:

Login

Remember My Login Name

Forgot your password?
Trouble logging in?

Not a Member? Register Here

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MOUNTING SYSTEMS

ROOF MOUNT

GROUND MOUNT

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Basic roof mount components

3 ½ inch stainless lag screws

Brackets mounted to base

J-box for romex to solar hookup

Plastic tubing to protect romex from sun

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J-Box clearly marked

Rails ready for panels

#6 copper equipment ground

Whiz-bang shading tester

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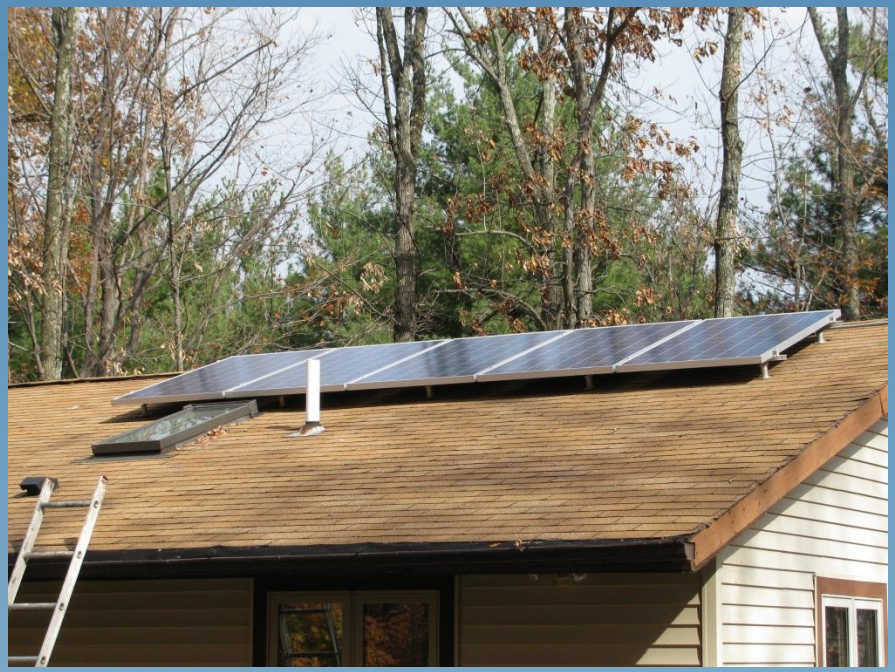
FINISHED INSTALL



WIRES NEATLY DRESSED

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Roof racking basic info

- Brackets (mounting feet) can be 1, 2, or even 4 screw mount. Each 5/16 lag screw can provide 100 pounds of PULL force PER INCH. 1 screw is good. 2 is better, per leg. If using just 1 screw per leg, use a 4 inch length for max pull-out resistance.
- There is no substitute for CARE in installation. That, and plenty of pure silicon caulk, applied IN the pilot screw hole and between the mount base and shingle.
- Base mounts are available with FLASHING for enhanced long term rain resistance, but require more time and effort, as well as a bit more cost.
- Rails can be I-beam, U-channel or L profiles. Lengths can vary from 8 to 16 feet.
- Rails are spliced together mechanically AND Electrically with special straps
- The rail/panel system MUST have an “Equipment Ground” wire going directly to a copper ground rod, driven into the ground. This provides GROUND FAULT protection in case an electrical component fails. It also provides a small measure of lighting protection.
- Panel mounting clamp nuts only need about 20 foot pounds to hold them down securely. Any more force and you risk breaking the glass and ruining your panel!
- EVERY roof mount vendor has ON LINE CALCULATORS that should be used to create a list of required materials as well as the WIND/SNOW LOAD calculations you will need to provide to your permitting Authority!! These are generally FREE

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Different types of Ground Mounts

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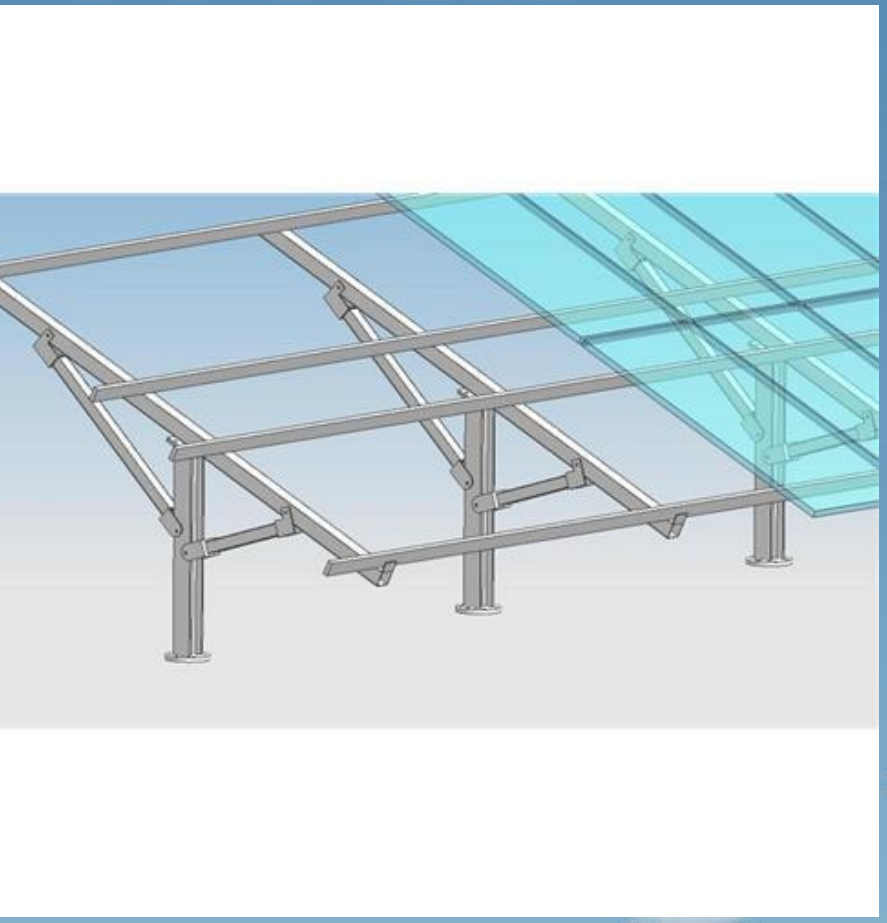

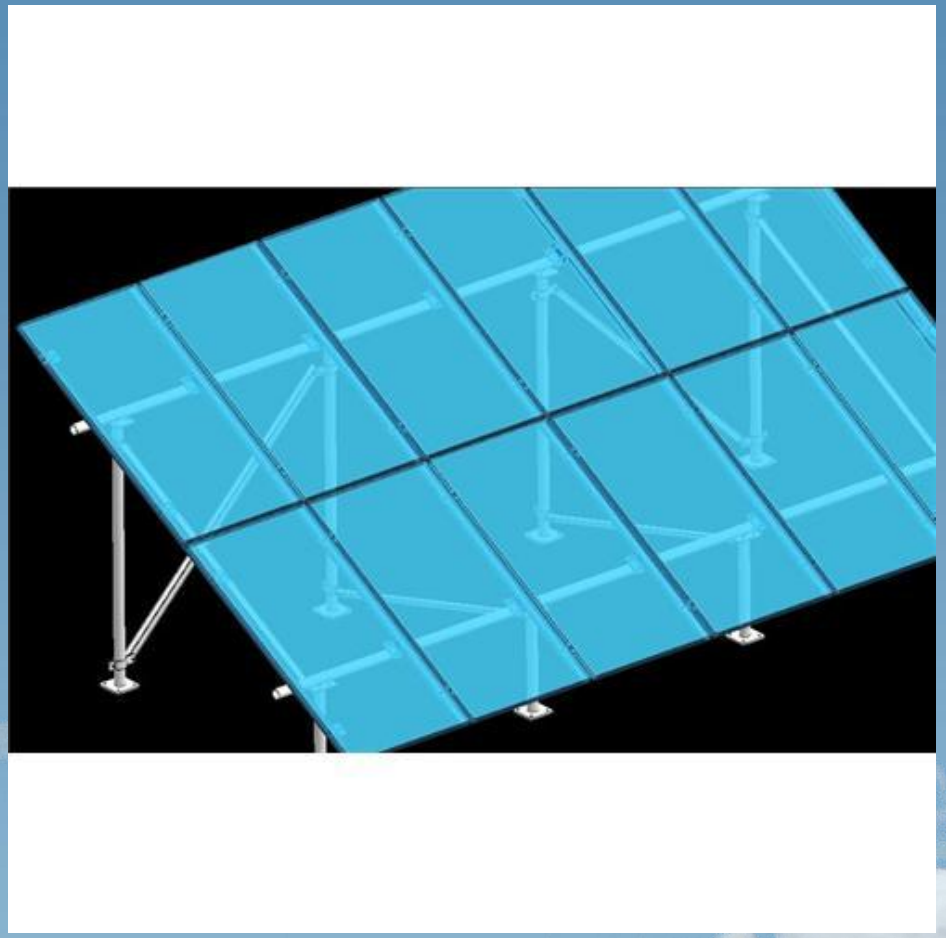

Number of footers affects the overall time/cost and effort required!! Don’t forget to consider this when looking at a ground mounting system. Ground mounting hardware also costs about 30 to 40 percent more since there’s just more


Single Axis Tracker
09/11/2012

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Renewable Energy
POWERWAY
PowerScrew
100%
recyclable,
low cost and
minimum installation time.
Green Source Tec ology
09/12/2012

Closest thing to “home made” using SPEED RAIL components from Grainger catalog. Parts also available on ebay. 3 inch galvanized steel pipe with Threaded ends for easy splicing and flange hookup.

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Partial list of ground mount providers

- www.apalternatives.com
- www.solarflexrack.com
- www.schletter.us
- www.ironridge.com
- www.rbisolar.com
- www.technometalpostusa.com
- www.platipus-anchors.us
- www.idealfoundationsystems.com
- www.abchance.com
- www.mounting-systems.us
- www.metalfoundationscorp.com
- http://unirac.com/commercial/commercial-products/u-la-commercial

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HOW TO SAVE (SOLAR) Money

Time is Money. Take your time, research your needs, WAIT for pricing opportunities!

Sign up for solar seller's EMAIL SPECIALS lists. BE PATIENT

Don't be afraid to ASK FOR A DEAL!

Partner with neighbors or friends. Since panels and most parts are shipped via TRUCK FREIGHT, it makes sense to buy by the PALLET, and combine shipping costs for BIG SAVINGS.

PLAN AHEAD. If you're short on cash, you can still start with a smaller system and expand later, when you find better pricing.

UNDERSTAND what you're buying. Unless you really know

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How to save money, continued…

Research EVERY aspect of your project. Things like: what does concrete cost? How many yards of concrete does it take to fill a 12 inch diameter hole 6 feet deep? (ground mounts…)

Am I capable of doing the work myself? Am I afraid of heights?

Is my house old or historic? If not using modern roof trusses, you will VERY likely need a written "Opinion" from a Professional Licensed Structural Engineer (Starts at $1000!)

Does my roof face SE, S, or SW? Maybe a ground

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Saving money, continued

- heck local codes – do you have enough land for a ound mount?
- onsider a carport or patio shade roof – there are anels with transparent backing and double sided olar panels that make an attractive shade roof!
- Y whenever possible, but DON'T take chances. If ou're not comfortable/experienced working with ectricity (residential wiring) hire a pro.
- OMPLY WITH ALL LOCAL LAWS. Going "rogue" may ve money short term, but if caught, you could ave far greater costs!