



Off-Grid CyboInverter User Guide

For CIM-1200H or H Model Twin Pack for Electric Water Heaters



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Safety Info and Symbols

Read This First

- This guide contains important safety instructions to follow during the installation and maintenance of CyboInverters.
- The following safety symbols are used throughout this guide to indicate dangerous conditions and important instructions.



Warning: Indicates a situation where failure to follow the instructions may cause lethal injury or hardware damage.



Attention: Indicates that a part or process requires your special attention to meet the requirement.



Note: Indicates information that may be useful for you to achieve optimal system performance.



Safety Instructions - 1



⚠ Never connect the Off-Grid CyboInverter to the AC grid. Doing so will damage the unit and void the warranty.



⚠ Only qualified personnel should install or replace CyboInverters.



⚠ Perform electrical installations in accordance with NEC, ANSI/NFPA 70, and local electrical codes and practices.



⚠ The aluminum enclosure of the CyboInverter can reach 85°C (185°F). Do not touch!



⚠ The CyboInverter must be earth-grounded in accordance with national and local electrical standards.



⚠ Never connect or disconnect any DC or AC connectors of the inverter without first disconnecting the AC loads.



Safety Instructions - 2



• Build a separate “Off-Grid AC Circuit” for connecting to a heating element of the electric water heater.



• **Use this CyboInverter for powering electric water heaters or heating elements only.**



• The Off-Grid CyboInverter may send a small test signal periodically to the “Off-Grid AC Circuit”.



• Special protection against lightning strike may be required to meet certain local and national standards.



• Do not attempt to repair the CyboInverter. It contains no user-serviceable parts.



• If the solar panel is in the sun, there will be DC voltage output. Be careful.



Rapid Shutdown Instructions



• This photovoltaic rapid shutdown equipment (PVRSE) does not perform all of the functions of a complete photovoltaic rapid shutdown system (PVRSS). This PVRSE must be installed with other equipment to form a complete PVRSS that meets the requirements of NEC (NFPA 70) section 690.12 for controlled conductors outside the array. Other equipment installed in or on this PV system may adversely affect the operation of the PVRSS. It is the responsibility of the installer to ensure that the completed PV system meets the rapid shutdown functional requirements. This equipment must be installed according to the manufacturer's installation instructions.



• For roof mount PV systems, install the inverter within 1 foot of the PV solar panel array. The Inverter enclosure to panel substrate must have at least 0.5 inch (12.7 mm) open space.

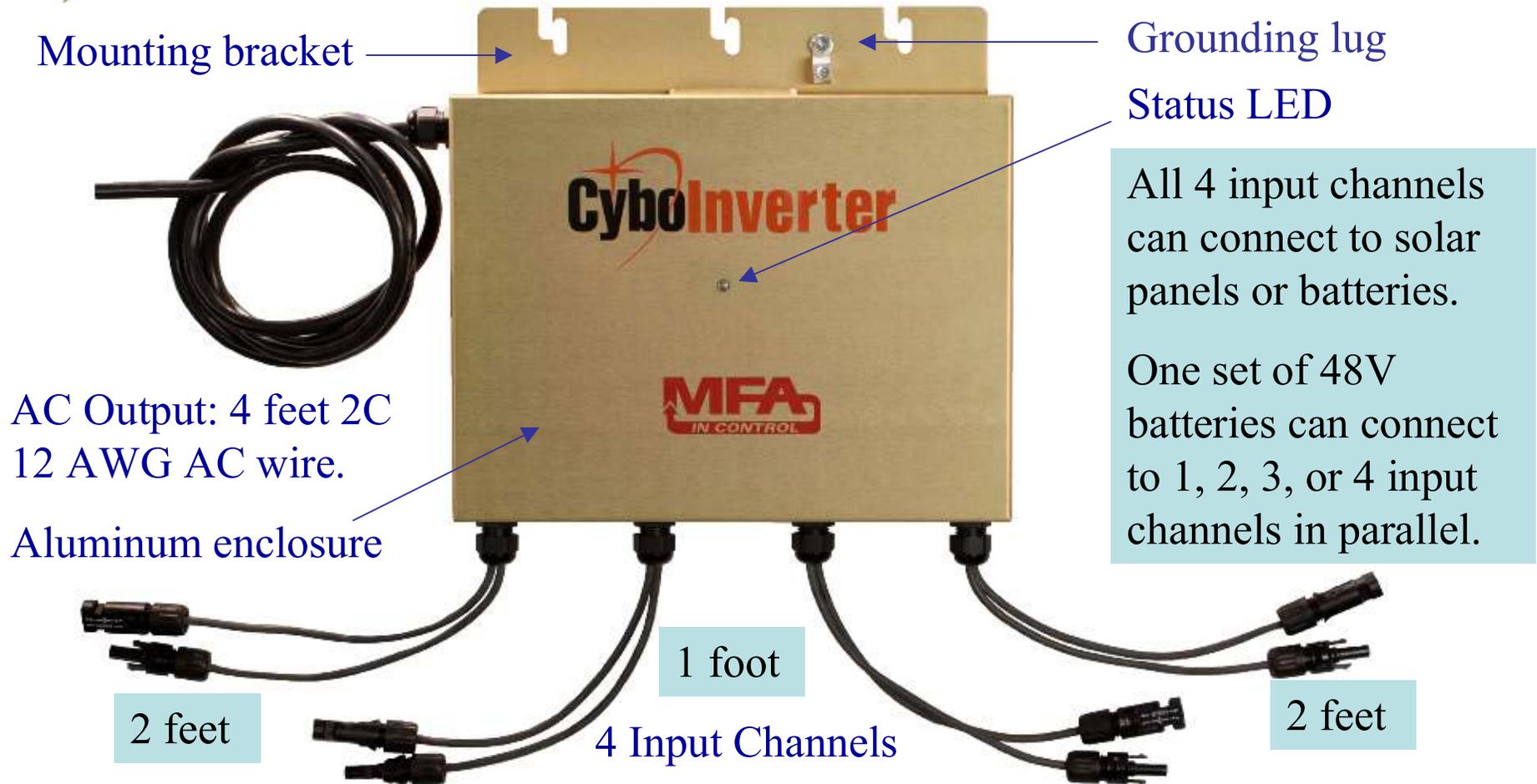


CyboInverter H Model Q & A - 1

No	Question	Answer
1	Can I use the H model for single-element electric water heaters?	Yes. You have to disconnect the grid AC from the heater. Otherwise, the grid AC can damage the CyboInverter.
2	My heater has 2 elements but only 1 thermostat. What can I do?	You should add a thermostat. This will allow you to switch off the grid power. Contact us for more detailed suggestions.
3	How do I set the temp setpoints for the upper and lower thermostat?	The following settings are examples: Upper Thermostat = 98-100°F (37-38 °C) Lower Thermostat = 135-140°F (57-60°C) Hot water circulates upwards so the Upper Element does not turn on if temp is higher than the setpoint, resulting in electricity savings.
4	Can I use this for tankless electric water heaters?	Yes. Just make sure the inverter output and grid AC are not connected.



Off-Grid CyboInverter View



Each CyboInverter's input channel has its own control and MPPT mechanism so that solar power harvest is maximized.



Popular CyboInverter Models

Part No.	Inverter Type	Application
CIM-1200H	100V-240V, 50/60Hz	Off-Grid CyboInverter for electric water heaters and heating elements.
CIM-1200Na	120V, 60Hz	AC Assisted Off-Grid CyboInverter to run mini-splits, appliances, and all 120V loads.
CIM-1200Ya	240V, 60Hz	AC Assisted Off-Grid CyboInverter to run larger mini-splits, pool pumps, EV chargers.
CIM-1200H/N	H Port: 100-240V N Port: 120V, 60Hz	Dual-Output Off-Grid CyboInverter for electric water heaters and 120V loads.
CIM-1200Qa, Sa, Ta, Wa	110V-240V / 50/60Hz	AC Assisted Off-Grid CyboInverters for international markets.

CyboInverters are patented, UL1741 certified, NEMA6 (IP67) rated and made in the USA. Each unit can produce upto 1.25KW AC power.



CIM-1200H, H1, H2 Tech Data - 1

DC Input (per Channel)	60, 66 / 72 Cell Panel*	Battery
Recommended Input Power	250W – 450W	48V, 50AH – 300AH
Operating Input DC Voltage Range	18V – 60V	47V – 60V
Peak Power Performance Range	30V – 60V	48V – 60V
Maximum Input Voltage / Current	60V / 10.5A	60V / 10.5A
Maximum Input Power	330W	330W

AC Output	Data
Rated Output Power / Peak Power	960W / 1250W
Maximum Output Current (RMS)	10.5A (CyboInverter dictates the max current)
Nominal Output Voltage	100V – 240V (Single-Phase)
Operating Output Voltage Range	10V – 264V (Single-Phase)
Nominal Frequency / Range	50Hz / 60Hz (49.5Hz – 60.5Hz)

* Don't use 72-cell panels where temp can be below -10 deg F (-23 deg C).



CIM-1200H, H1, H2 Tech Data - 2

Efficiency	Data	
Peak Efficiency / MPPT Tracking	96% / 99%	
Mechanical Data	SI	U.S.
Ambient Temperature Range	-40°C to +65°C	-40°F to +149°F
Internal Operating Temp Range	-40°C to +88°C	-40°F to +190°F
Dimensions without the mounting bracket (L x H x W)	32cm x 24cm x 5.8 cm	12.5" x 9.5" x 2.3"
Weight	6.5 kg	14.25 lbs
Cooling / Enclosure	Natural Convection, No fan / Potted	
DC Connectors / Wires	MC-4 or compatible / 14 AWG and 1 / 2 feet	
AC Wires	4 Feet AC Wires (THHN), Copper	
Solar Panel Compatibility	Most 60-cell, 66-cell, and 72-Cell PV Solar Panels	
Battery Compatibility	48V Lead-Acid Deep-Cycle AGM or Lithium-Ion Pack	



CIM-1200H, H1, H2 Tech Data - 3

Features and Compliance	Data
DC Source for Input Channel	Solar or Battery Auto-Detection
Battery Over Discharge Protection	Low Voltage Disconnect on Battery Channels
Standard Warranty	3 Years (Extended Warranty Available)
Safety and EMC Compliance	UL1741 and IEEE1547 (E113426), CSA107.1, FCC Part 15 Class A 
Rapid Shutdown	Complies with NEC 2014/2017 690.12.
Enclosure Environmental Rating	Outdoor – NEMA 6 (IP67)
Ground Fault Detector Interrupter	(GFDI) Built-In



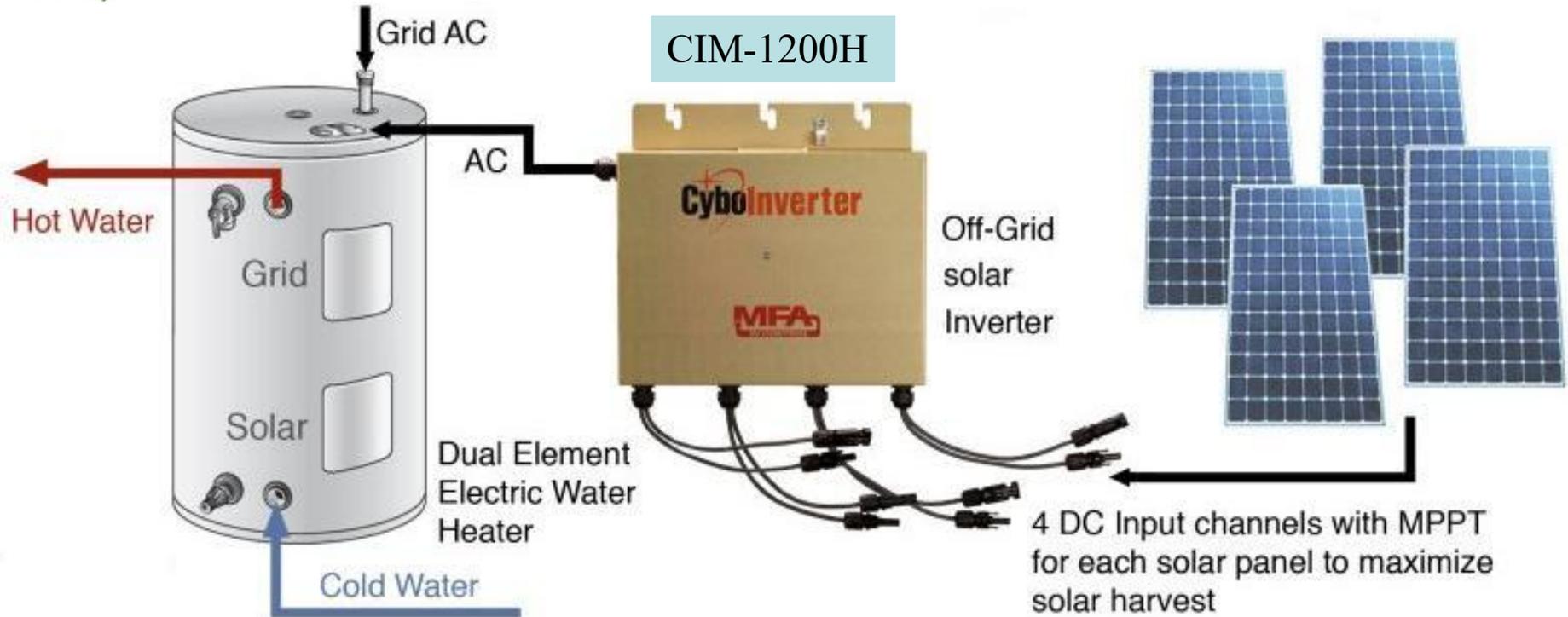
This product is specially designed for powering dual-element or single-element electric water heaters, electric heating elements, electric hot plates for cooking, heating cables, etc.



To power lights, fans, TV, PC, phone-chargers, food processors, small appliances, etc., please use regular off-grid CyboInverters.



H Model for Electric Water Heaters

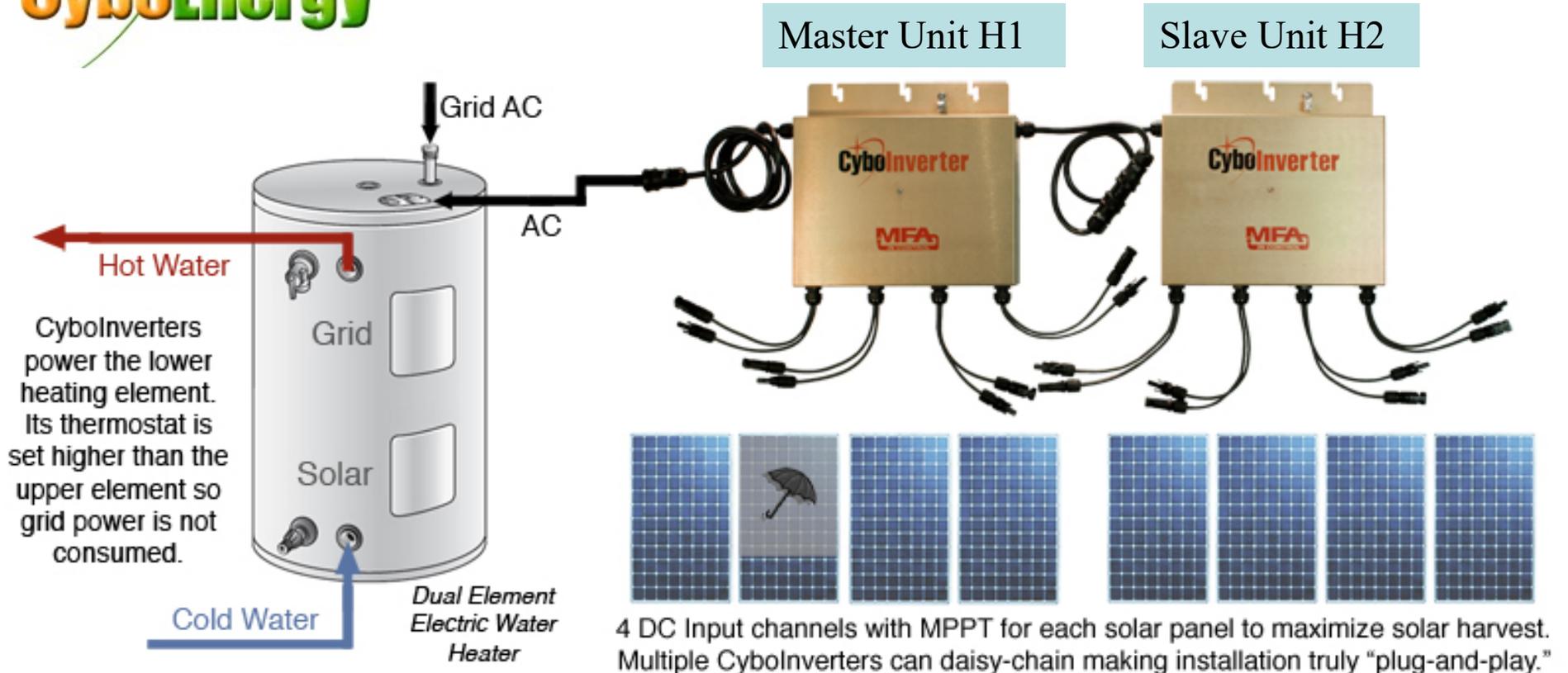


CyboInverter powers the lower heating element. Its thermostat is set higher than the upper element.

- ❖ No need to deal with local utility companies, yet avoid high tier rates and reduce electricity bills.
- ❖ A very simple system and much easier to install than thermal solar water heaters.
- ❖ For 240V, 1.5KW - 4.5KW heating elements.



CyboInverter H Model Twin Pack



- Total of 8 DC Input Channels for 8 Solar Panels with MPPT.
- For 240V, 2.5KW - 4.5KW heating elements.

Multiple H model twin packs, H model triple packs, or quad packs can be used for larger systems such as swimming pools.



Installation Procedure – 8 Steps

No	Step	Note
1	Know your water heater	Understand the wiring change.
2	Install an Outdoor AC Switch	One switch per AC circuit.
3	Wire AC to the Heater	(a) Inside, or (b) Outside.
4	Set Thermostat Setpoints	To save electricity.
5	Mount CyboInverter	Hang on a wall or mount on rails.
6	Ground the System	Run a bare grounding wire.
7	Connect to Solar Panels	Make DC connections.
8	Commission the System	Inspect and turn on.



Parts Included: an Off-Grid CyboInverter H model or a Twin Pack.

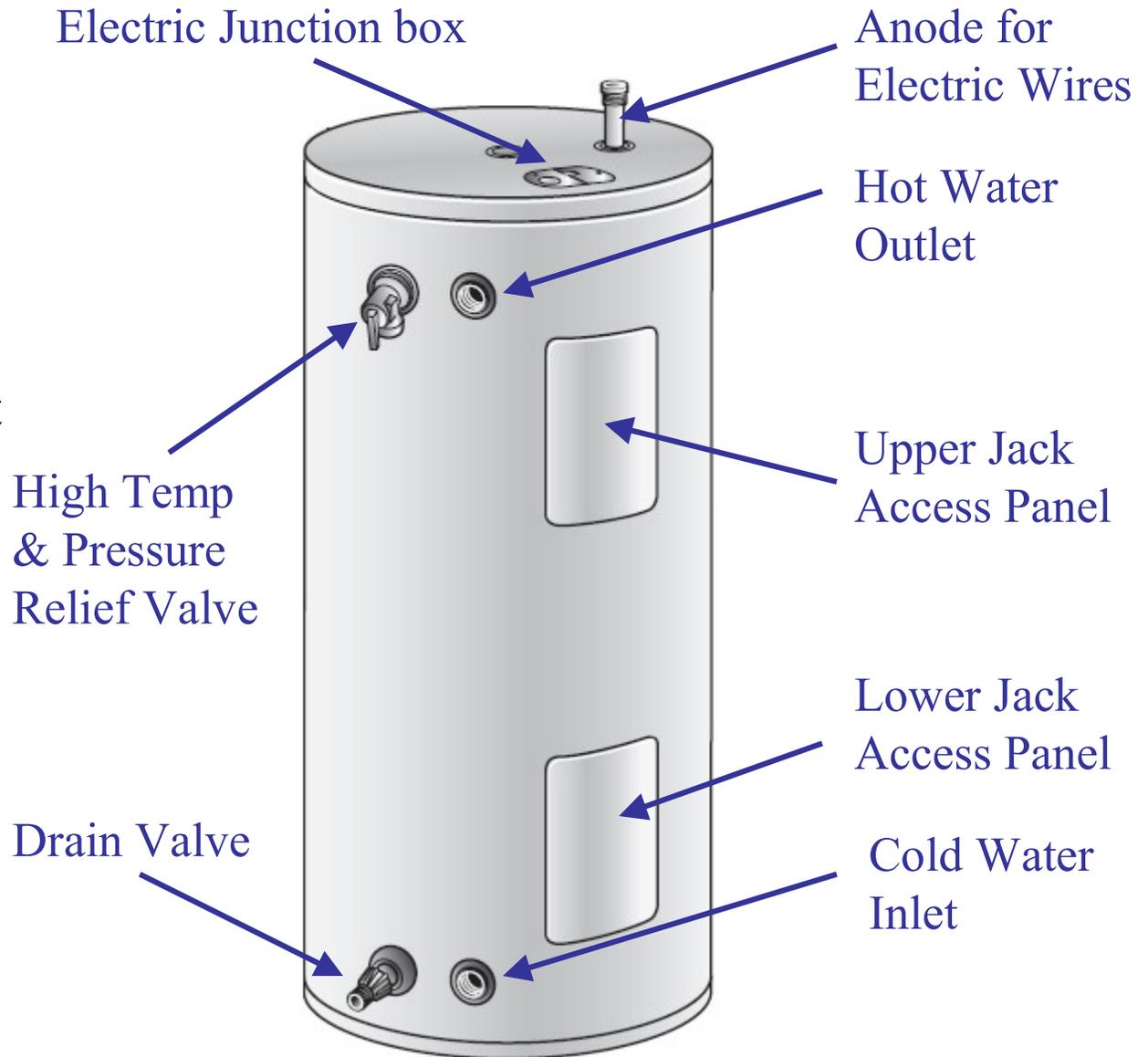
Parts Required: a switchable AC junction box with outlet or an AC switch, an 8 AWG bare grounding wire, screws and nuts, and basic tools. If the CyboInverter is mounted outside, an outdoor AC junction box is required.



Step 1. Know Your Water Heater

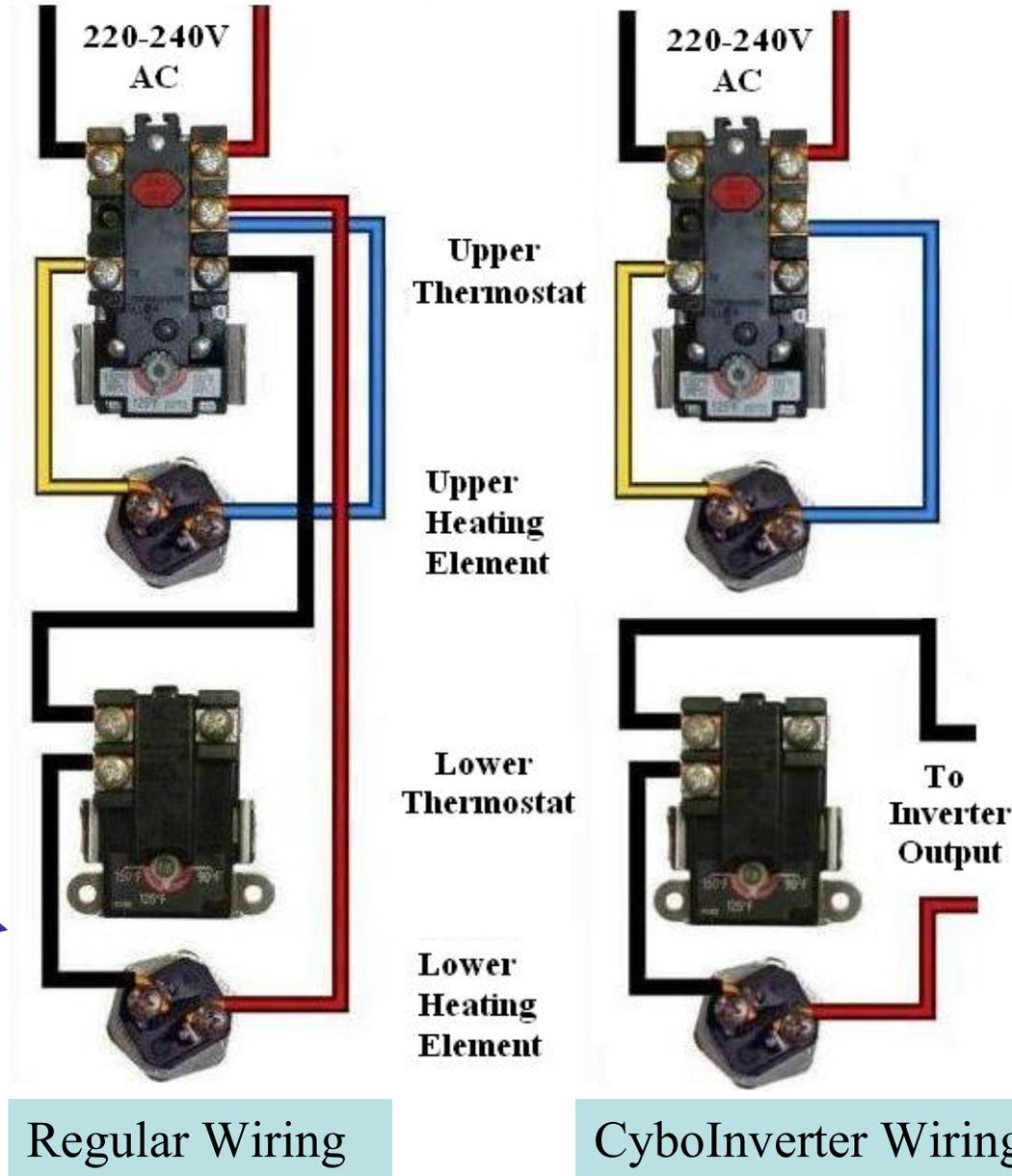
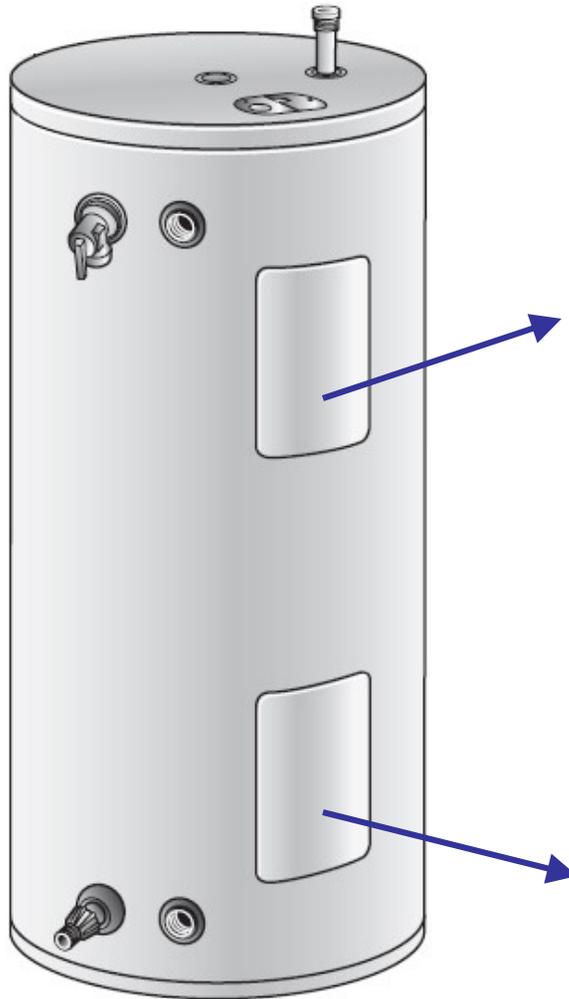


- As an example, this is a GE dual-element side mount electric water heater.
- Its Use & Care Manual can be found and downloaded online.





Required Wiring Change



Step 2. Install an Outdoor AC Switch



• A number of states in the US may have adopted the NEC 2014 / 2017 690.12 codes.



• NEC 2014/2017 690.12 codes require Rapid Shutdown of PV Systems. This switch can shutdown the inverter immediately once it is moved to its Off position.



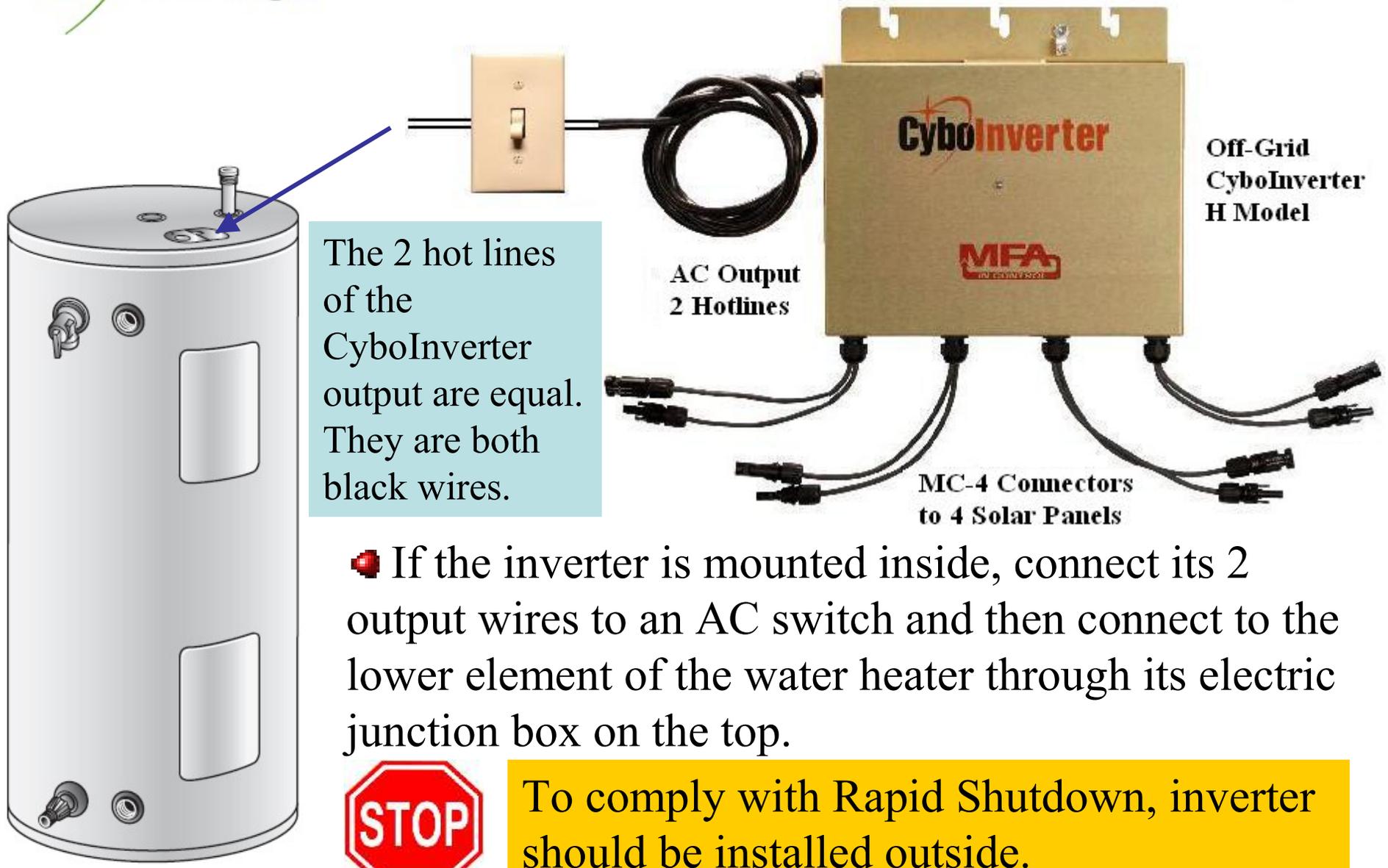
Install an Outdoor AC Switch Box

- Install an outdoor AC Switch at a suitable location, typically on the wall near the Electric Service Panel.
- Connect the AC output of the inverter to the AC switch and then run the AC wire to the load of your off-grid circuit.
- Label the AC Switch accordingly.

**RAPID SHUTDOWN SWITCH
FOR SOLAR PV SYSTEM**

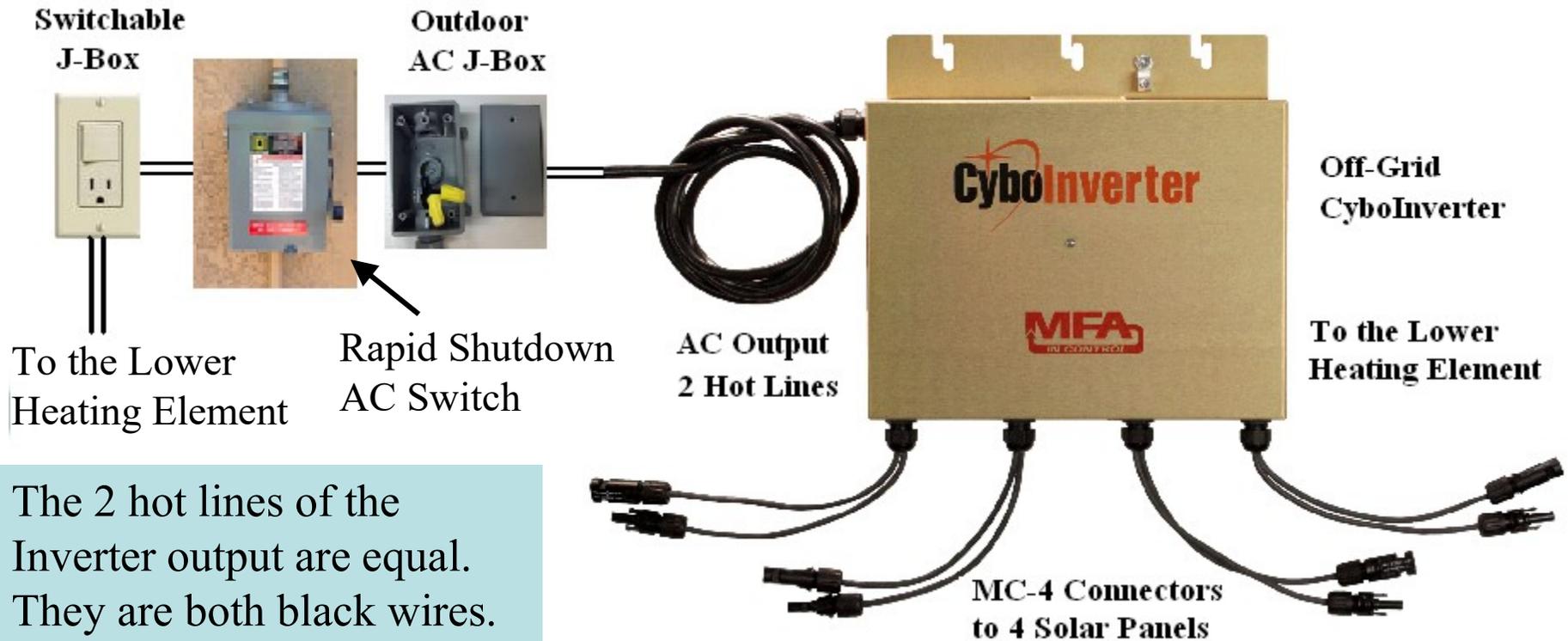


Step 3a. Wire AC to the Heater





Step 3b. Wire AC to the Heater

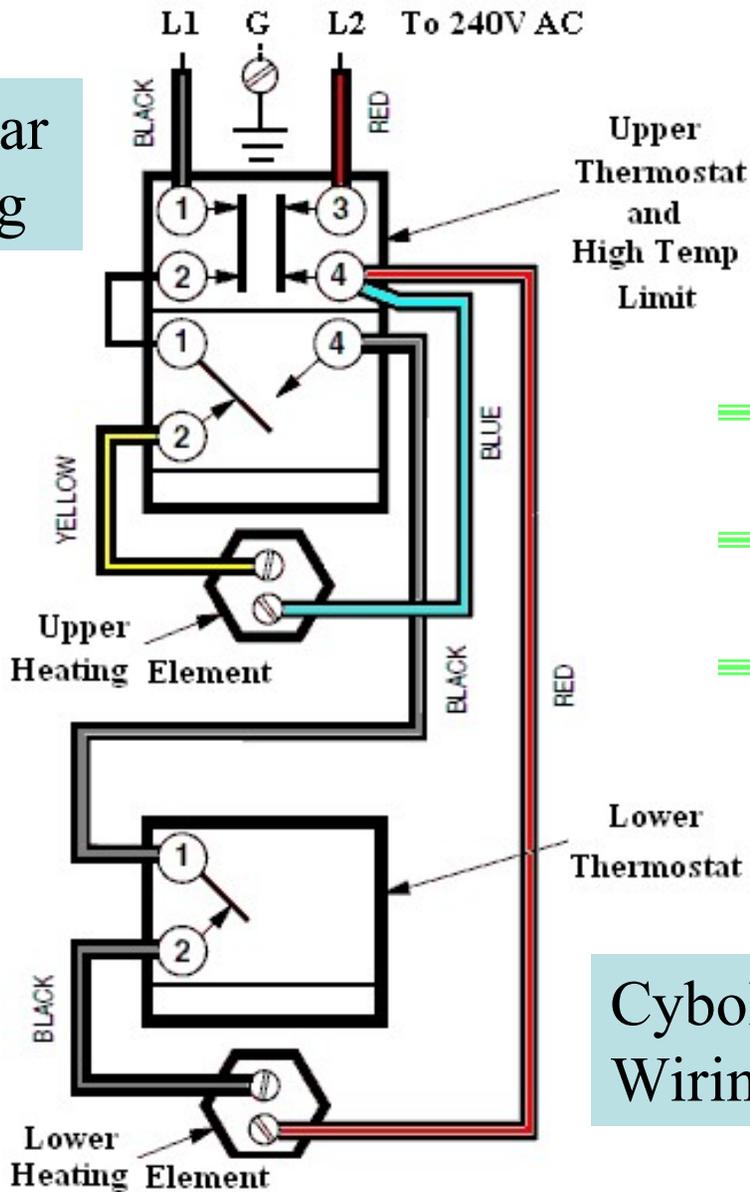


The 2 hot lines of the Inverter output are equal. They are both black wires.

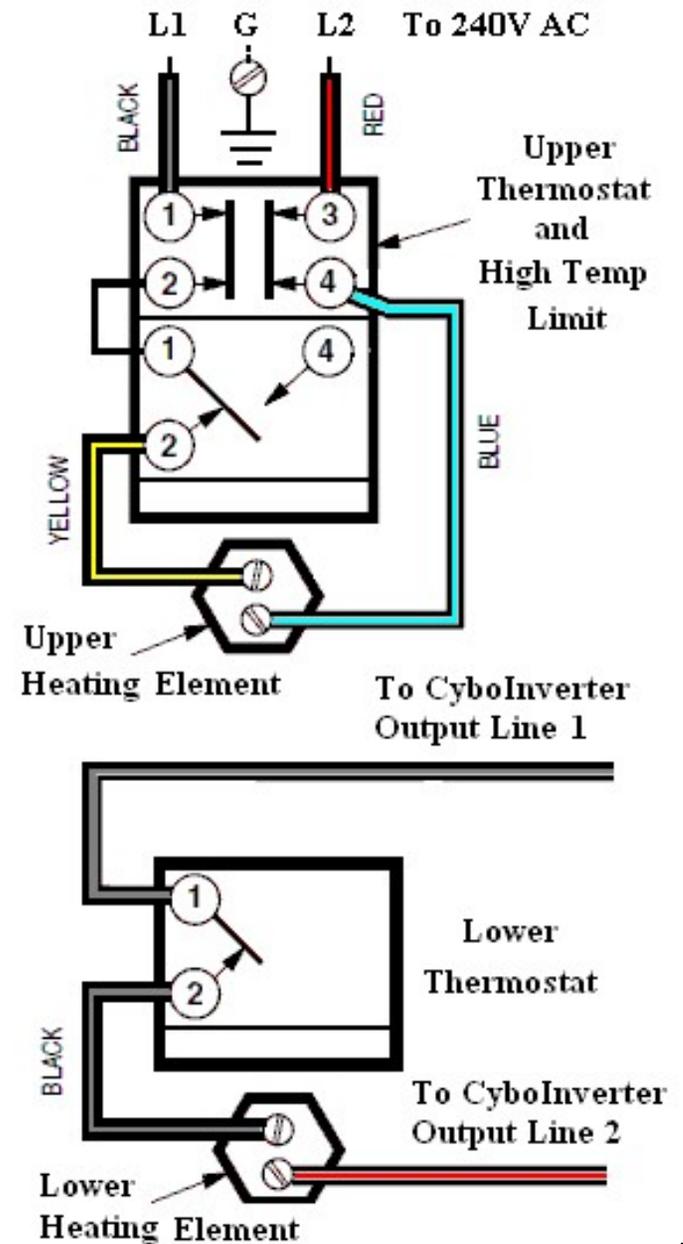
● If the CyboInverter is mounted outside, connect its 2 output lines to an outdoor AC J-box and connect to the Outdoor AC Switch for Rapid Shutdown. Then, connect the AC wires to a switchable AC outlet or an AC switch installed inside. Finally, connect the output wires to the lower heating element of the electric water heater.

Wiring Change Diagram

Regular Wiring



CyboInverter Wiring



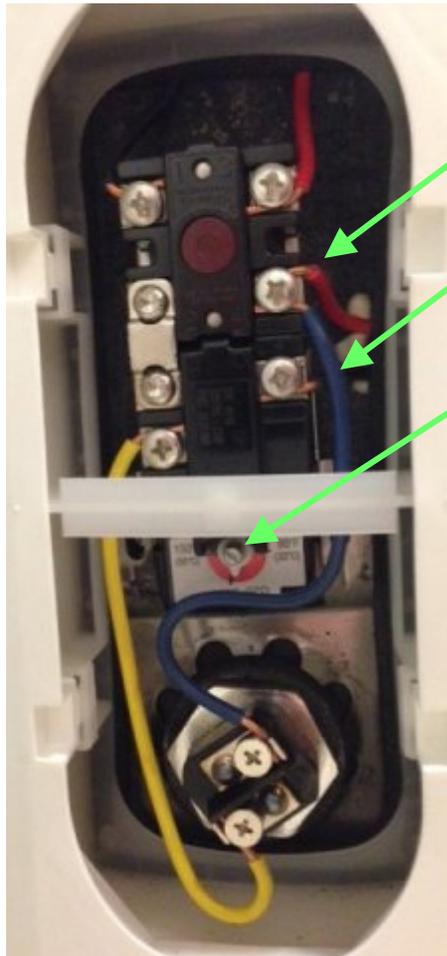
Step 4. Set Thermostat Setpoint

Unscrew the Red Wire, Connect CyboInverter Output Line 1 to it. Either output line is OK.

Unscrew the Black Wire, Connect CyboInverter Output Line 2 to it.

Set the Upper Thermostat to 98°-100°F (37°-38°C).

Set the Lower Thermostat to 135°-140°F (57°- 60°C).



Upper Thermostat and Setpoint Unit



These setpoints are example figures. Setpoints must be set based on health regulations of your country or region.



Lower Thermostat and Setpoint Unit



Step 5a. Mount CyboInverter

Hang on a Wall or Solar Rack

● For the areas where “Rapid Shutdown” is not required, it is a good idea to hang the inverter on a wall inside the garage or under the eaves outside. The CyboWire (CW-5F-2P) can be used to connect the solar panels to the inverter input channels.

● For flat roof or ground mount, hang inverter on a solar rack. 5/16” - 18 x 1/2” long stainless steel screws and nuts recommended.

CyboWire is a pre-assembled 5-foot trunk cable connected with an outdoor junction box and an indoor junction box, 2 pairs of MC-4 Connectors on each side for connecting 2 solar panels on the roof to a CyboInverter inside.





Step 5b. Mount CyboInverter

Install on the Rooftop

● For a roof-mount system in the areas where “Rapid Shutdown” is required, you need to install the inverter under the solar panels on a solar rack. You may use a support leg (CSL-01) to balance the weight.



CSL-01, CyboInverter Support Leg

● You need to install the inverter within 10 feet of the PV solar panel array to comply with NEC 2014 rapid shutdown requirements, and within 1 foot of the PV array to comply with NEC 2017 rapid shutdown requirements.

● The Inverter enclosure to panel substrate must have at least 0.5 inch (12.7 mm) open space.



Step 6. Ground the System

Ground CyboInverters

- Tighten an 8 AWG bare grounding wire to the grounding lug that is attached to the mounting bracket of the CyboInverter. Run the wire through each CyboInverter to the NEC approved AC grounding rod, typically near the service panel.
- A grounding lug with screw is attached on the CyboInverter.
- As an option, you may ground the solar panel and inverter together using WEEB or similar products.





Step 7. Connect to Solar Panels



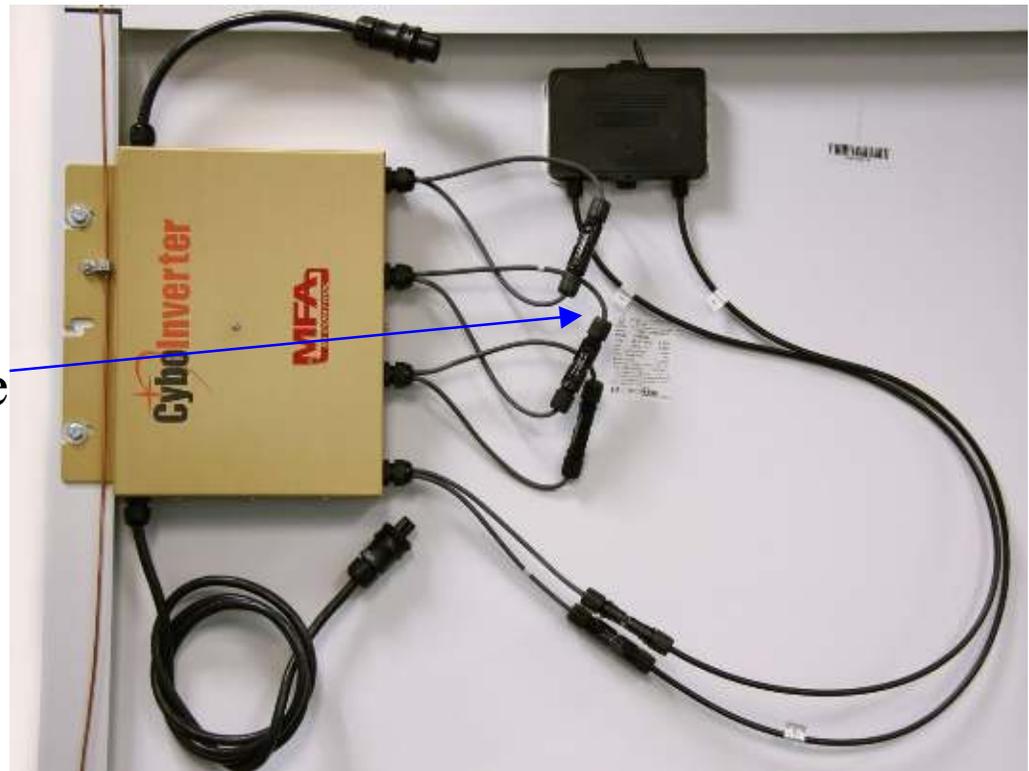
Connecting panels with $>60V$ DC can damage the inverter. Warranty voided.



Each CyboInverter has 4 pairs of MC-4 DC connectors. The red labeled wire is “+”. Plug in each pair of the MC-4 connectors to its corresponding solar panel.

If a channel has no solar panel, connect its male and female connectors to each other.

Solar panels having non MC-4 connectors must be changed to MC-4 with correct wire polarity.



Step 8. Commission the System



- Only qualified personnel should perform this work.
- Make sure the wiring to the electric water heater is properly done.

Inspection

- Make sure no wires are pinched or damaged and the AC junction boxes are properly closed.



Commissioning the System

- Turn the AC Switches to ON position.
- CyboInverter should send test signals to the off-grid circuit to assure that there are appropriate loads and there is no AC power.
- If all is OK, CyboInverter will send power to the water heater. Use an AC meter to check the voltage. 10V to 264V is normal.

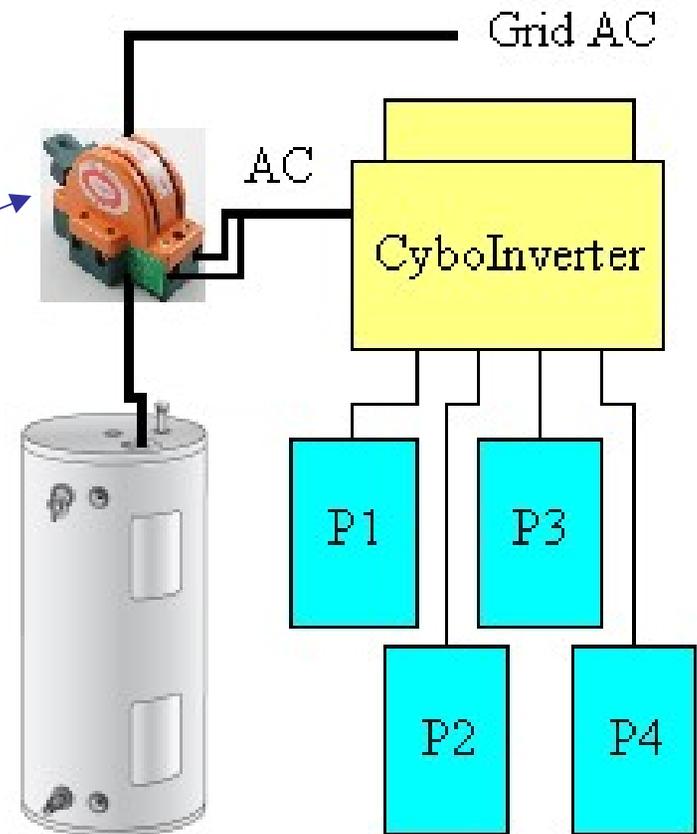




For Single-Element Water Heaters

4 Solar Panels and 1 CyboInverter H Model

- Use a CyboInverter H model for water heaters, electric cookware, hot plates, slab heaters, heating cables, etc.
- If needed, use a double-pole double-throw switch (On-Off-On type) to switch between the grid power and CyboInverter output.





For PV Solar Cooking and Heating



Switchable J-Box



AC Output
2 Hot Lines



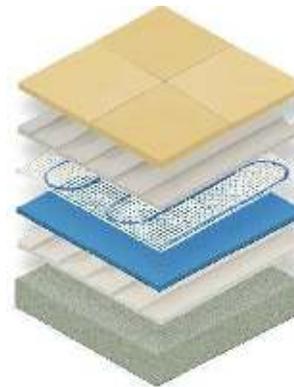
Off-Grid
CyboInverter



Universal Power Strip
with 5A or 6A
Circuit Breaker



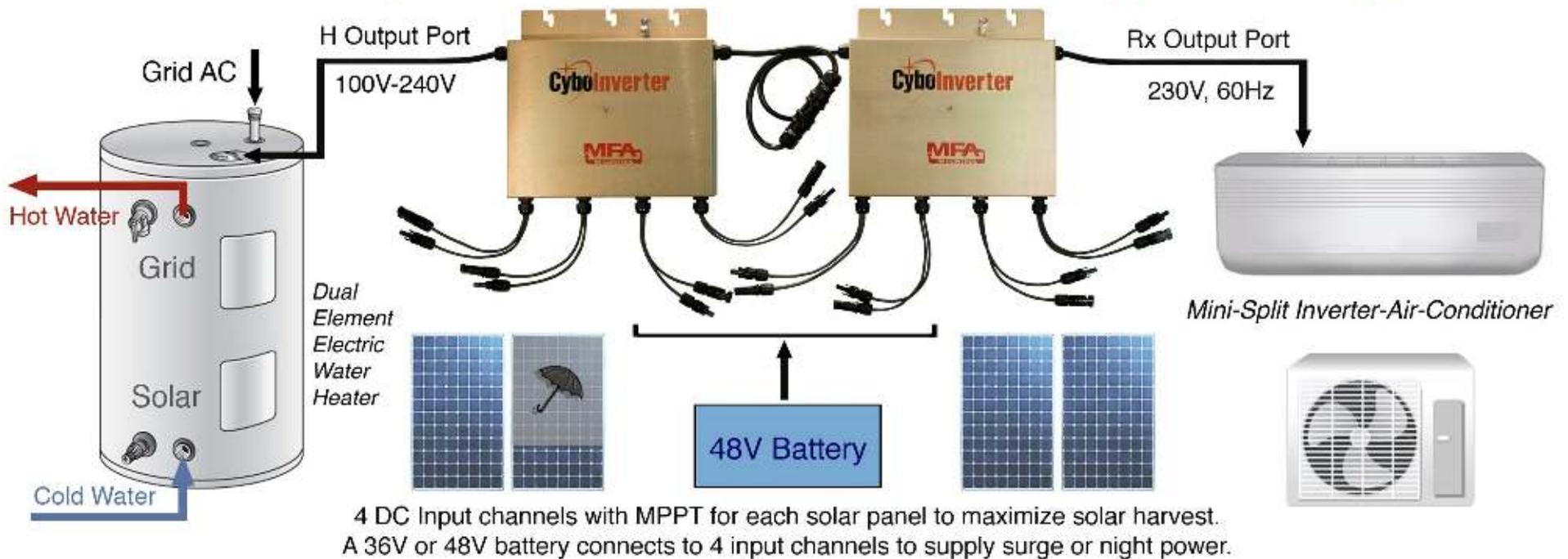
MC-4 Connectors
to 4 Solar Panels





Dual-Output Off-Grid CyboInverter

Dual-Output Off-Grid Inverter for Heating & Cooling



In off-grid mode 1, the system sends solar power to an electric water heater or heating elements.

In off-grid mode 2, the system can run an inverter-air-conditioners (IAC) with solar panels only. No battery nor base load is required.



Off-Grid CyboInverter LED Status

No	Observation	Status
1	Solid green.	CyboInverter is generating power.
2	Blinking green.	CyboInverter is starting.
3	Off.	No DC is connected or no sunlight.
4	Blinking red for 3 seconds and green for 1 second.	Low Load. The AC loads are not sufficient or it is an open circuit. This is normal state.
5	Blinking red for 1 second and green for 3 seconds.	High Load. The AC loads are too high for the CyboInverter to power. Remove some load.
6	Blinking red every 1 sec.	AC is detected in the off-grid AC circuit.
7	Blinking red every 3 seconds.	CyboInverter is damaged due to lightning or other reasons.
8	Blinking red for 1 sec and green for 10 seconds.	CyboInverter triggered the over discharge protection for the battery.



CyboInverter Troubleshooting

No	Symptom	Why and What to Do
1	LED blinking Red every 1 sec, no power generation.	AC is detected, which can damage the inverter. Disconnect AC from the CyboInverter.
2	Solar panels are in the sun but LED is not ON.	a. DC wired wrong. Correct it. b. LED may be broken.
3	LED is solid Red indicating GFDI Fault.	Ground Fault has to be physically resolved before CyboInverter can start to work.
4	LED is blinking Green, but no power generation.	CyboInverter is starting or sending testing signals to the load.
5	LED is solid Green but AC power seems to be low.	Measure solar panel's open circuit voltage (Voc) and check its performance.
6	LED is blinking orange.	At least one DC input is over the 60V limit. Disconnect the high voltage DC source(s). Solar panels in cold weather can generate much higher voltage than rated Voc.



About CyboEnergy

- Founded in 2011, CyboEnergy is a Delaware company with its headquarters in Rancho Cordova, California, offering technologies and products in the renewable energy field.
- CyboEnergy and its affiliate CyboSoft have over 40 US patents, international patents and other pending patents.
- CyboEnergy is a leading solar inverter company in the world and recipient of many awards and recognitions, including the “2017 Global Solar Inverter Technology Innovation Award” by Frost and Sullivan.

