CyboInverters - For a Green World

Battery-Less Off-Grid Solar System Design Guide

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A Solar Power System

A Solar Power System

Solar Panels

A Solar Inverter

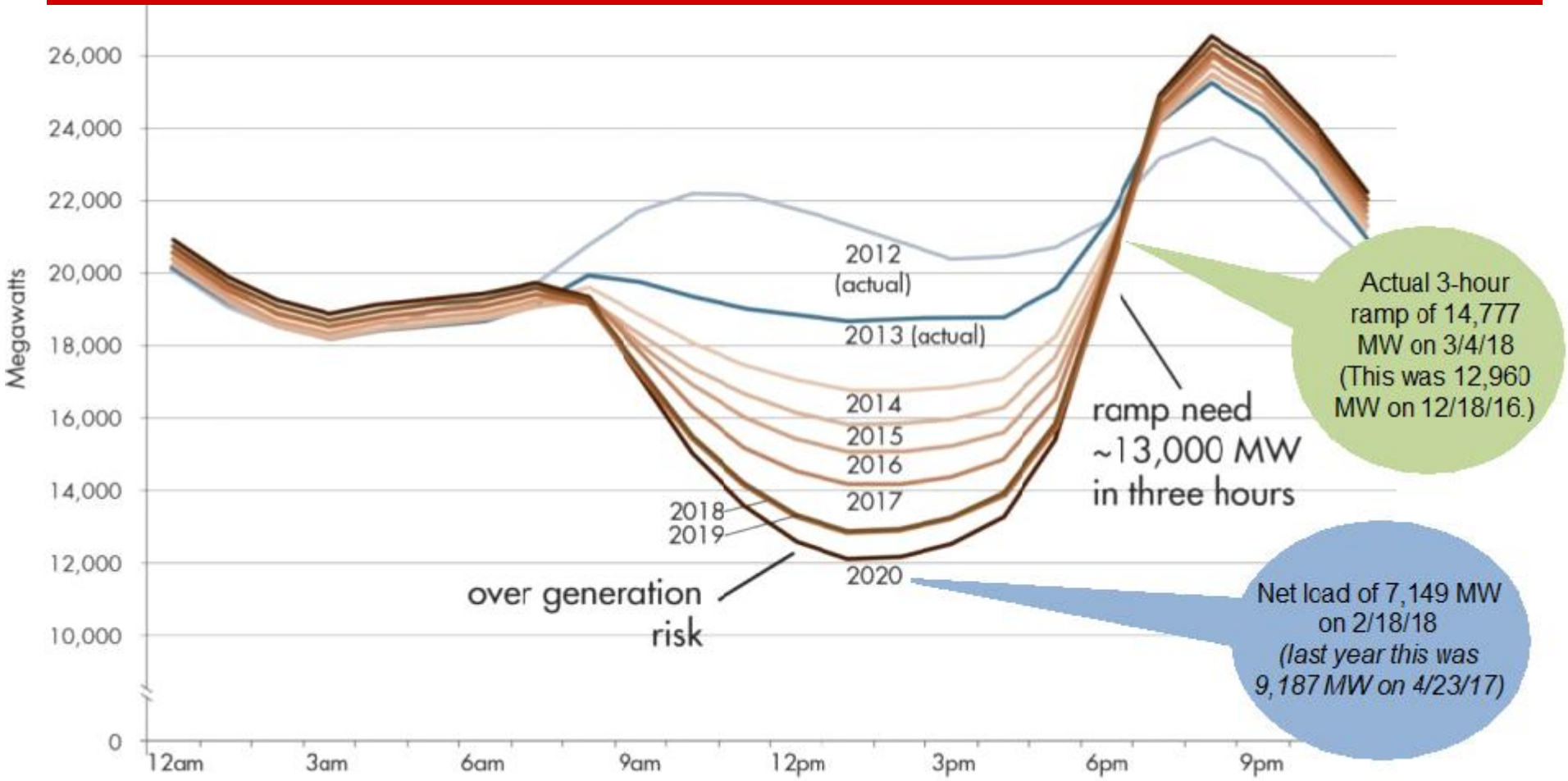
Solar Power System

- Comprising: sun light, solar panels, **inverter**, power grid or load.
- A solar power inverter inverts the DC (direct-current) power from the solar panel to AC (alternating-current) power.

Solar panels and inverters work together to collect solar energy and convert it into usable electricity.

Power Duck Curve by California ISO

The Duck Curve Shows Steep Ramping Needs and Over-Generation Risks



It indicates how much more on-grid solar power can be taken by the grid.

Market Trend – a Dilemma

- New California building codes require that all newly built residential homes incorporate rooftop solar, starting in Jan 2020.

- Based on the Duck Curve by ISO, California can no longer take much more on-grid solar power as it creates grid stability problems.

- When batteries are incorporated into the on-grid solar system, it can mitigate the Duck Curve problem. But, batteries dramatically increase the prices of solar systems. And batteries have other drawbacks, including: (a) fire and explosion risks, (b) serious E-waste problems, and (c) stringent regulations for transporting batteries, etc.

- Utility companies may pay little for the solar power sent to the grid, and grid connection monthly fees may be required.

When the grid goes down due to wild fire alerts or bad weather, all on-grid solar systems shutdown. No power is available.

CyboEnergy Unique Solutions

Key Offerings

- Off-Grid Solar PV Water Heating.
- Off-Grid Solar for Zone Cooling or Heating, and Leave Central A/C Off.
- AC Assisted Off-Grid Solar System for Heavy Loads.

CyboEnergy's Design Strategy

- Go Off the Grid.
- Use No Batteries.
- Modular and Scalable.
- Provide Power when Grid is Down.
- Keep It Simple.
- Affordable and Cost-Effective.

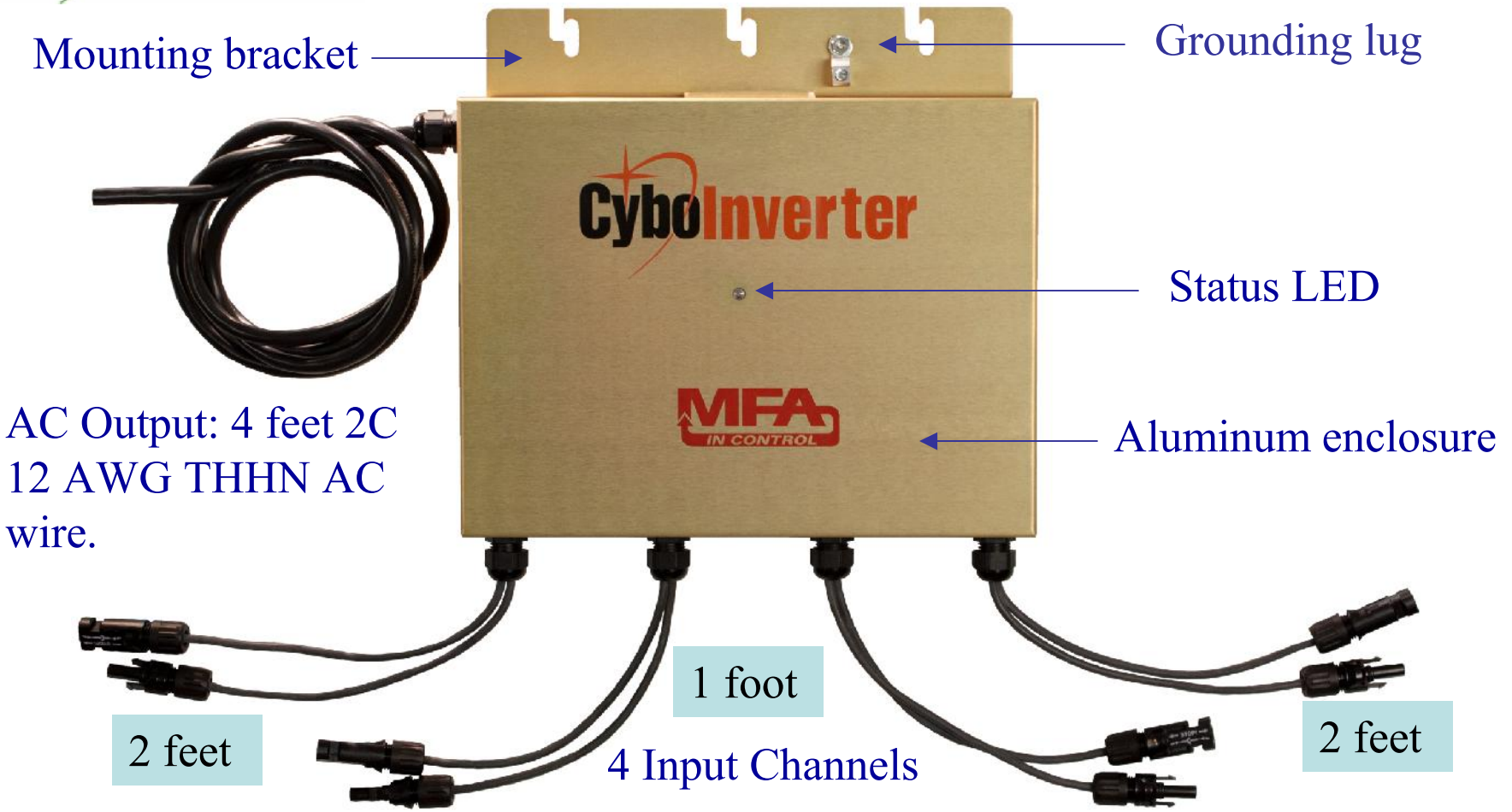
We offer battery-less off-grid solar systems that can take major loads off the grid. Lowest system cost, easy to install and maintain, no batteries, and can still run when the grid is down.

CyboInverters for New Homes

Part No.	Inverter Type	Application
CIM-1200H	100V-240V, 50/60Hz	Off-Grid CyboInverter for Electric Water Heaters
CIM-1200Na	120V, 60Hz	AC Assisted Off-Grid CyboInverter to support a 20A Branch Circuit
CIM-1200Ya	240V, 60Hz	AC Assisted Off-Grid CyboInverter to support a 30A Branch Circuit
CIM-1200Ha	240V, 60Hz	AC Assisted Off-Grid CyboInverter for Electric Water Heaters
CIM-1200Qa, Sa, Ta, Wa	110V-240V / 50/60Hz	AC Assisted Off-Grid CyboInverters for International Markets

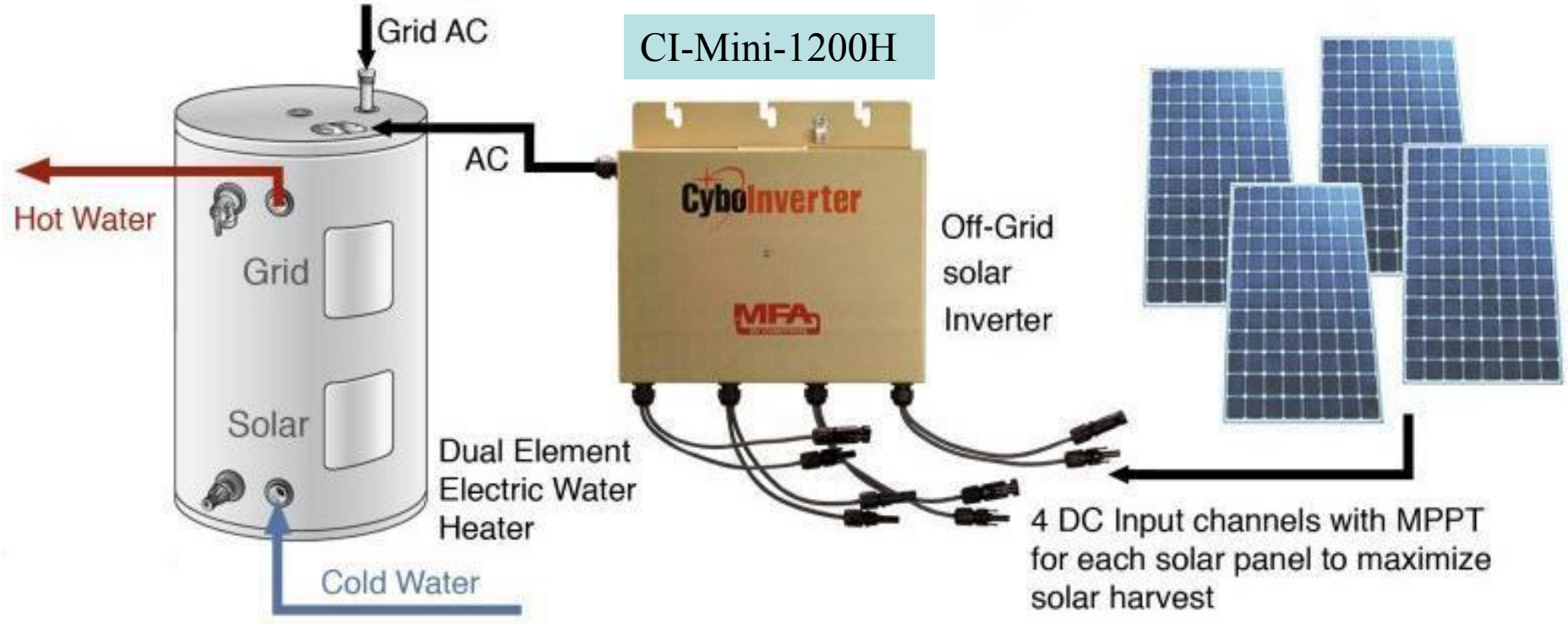
CyboInverters are patented, UL1741 certified, NEMA6 (IP67) rated and made in the USA. Each unit can produce up to 1.25KW AC power.

Off-Grid CyboInverter View



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

H Model for Electric Water Heaters



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

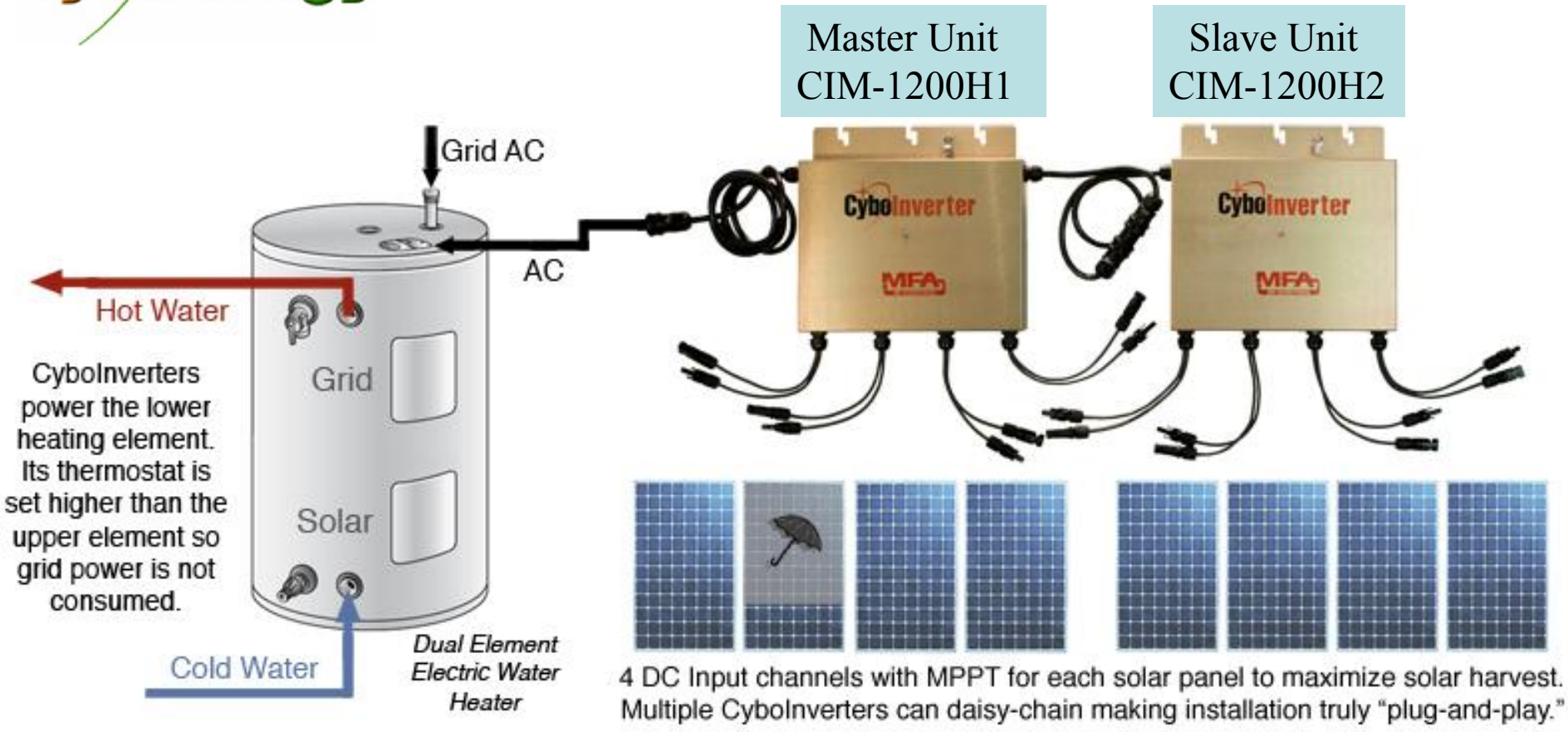
- No need to deal with local utility companies, yet avoid high tier rates and save electricity bills.
- A very simple system and much easier to install than thermal solar water heaters.

Do not need batteries to operate.

CyboInverter H Model Q & A

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 = 98-100ºF (37-38 ºC) Lower Thermostat = 135-140ºF (57-60ºC) 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.

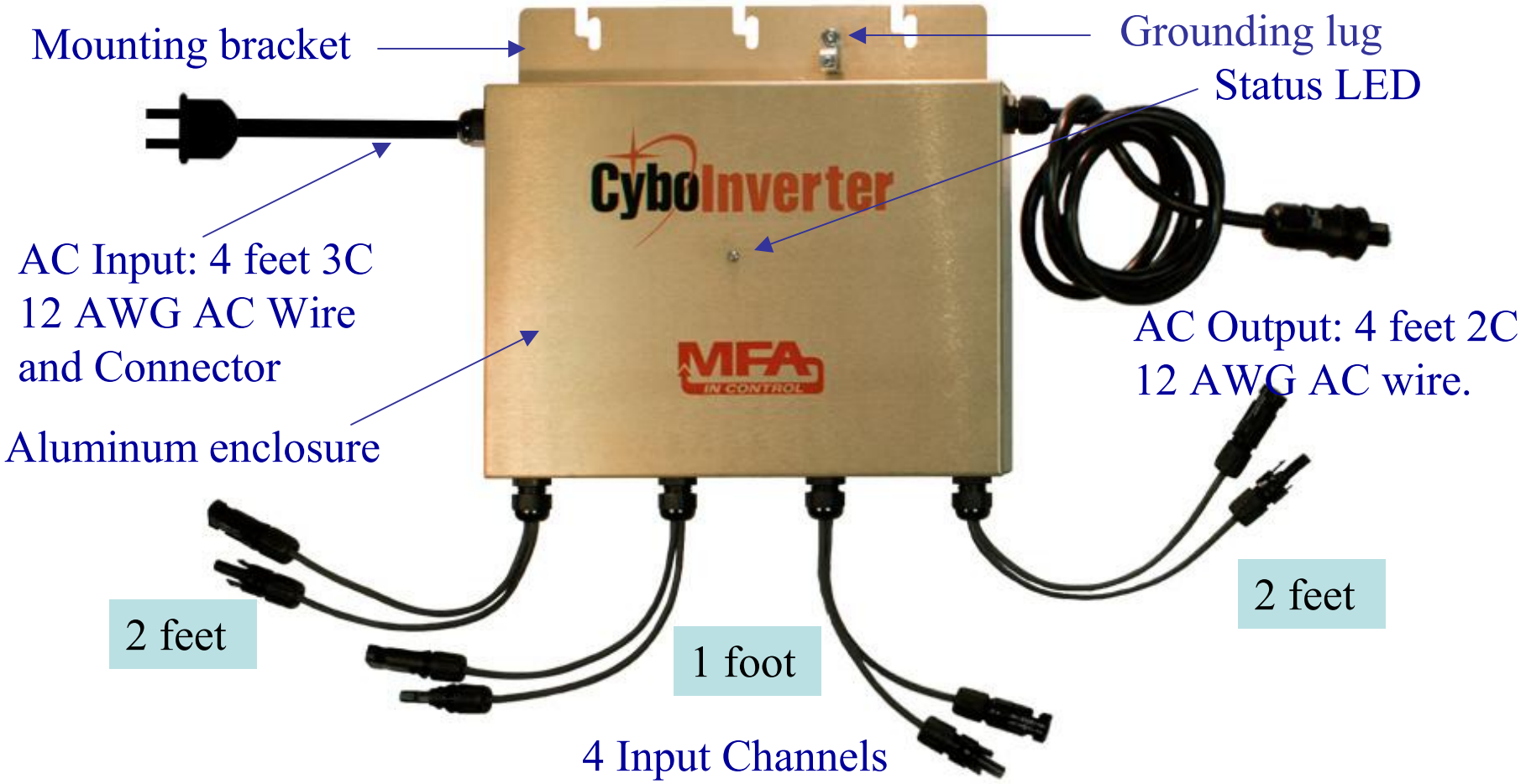
CyboInverter H Model Twin Pack



- Total of 8 DC Input Channels for 8 Solar Panels with MPPT.

This "water battery" solution is simple, green, and cost-effective. Can help level the Duck Curve and improve grid stability.

AC Assisted Off-Grid CyboInverter View



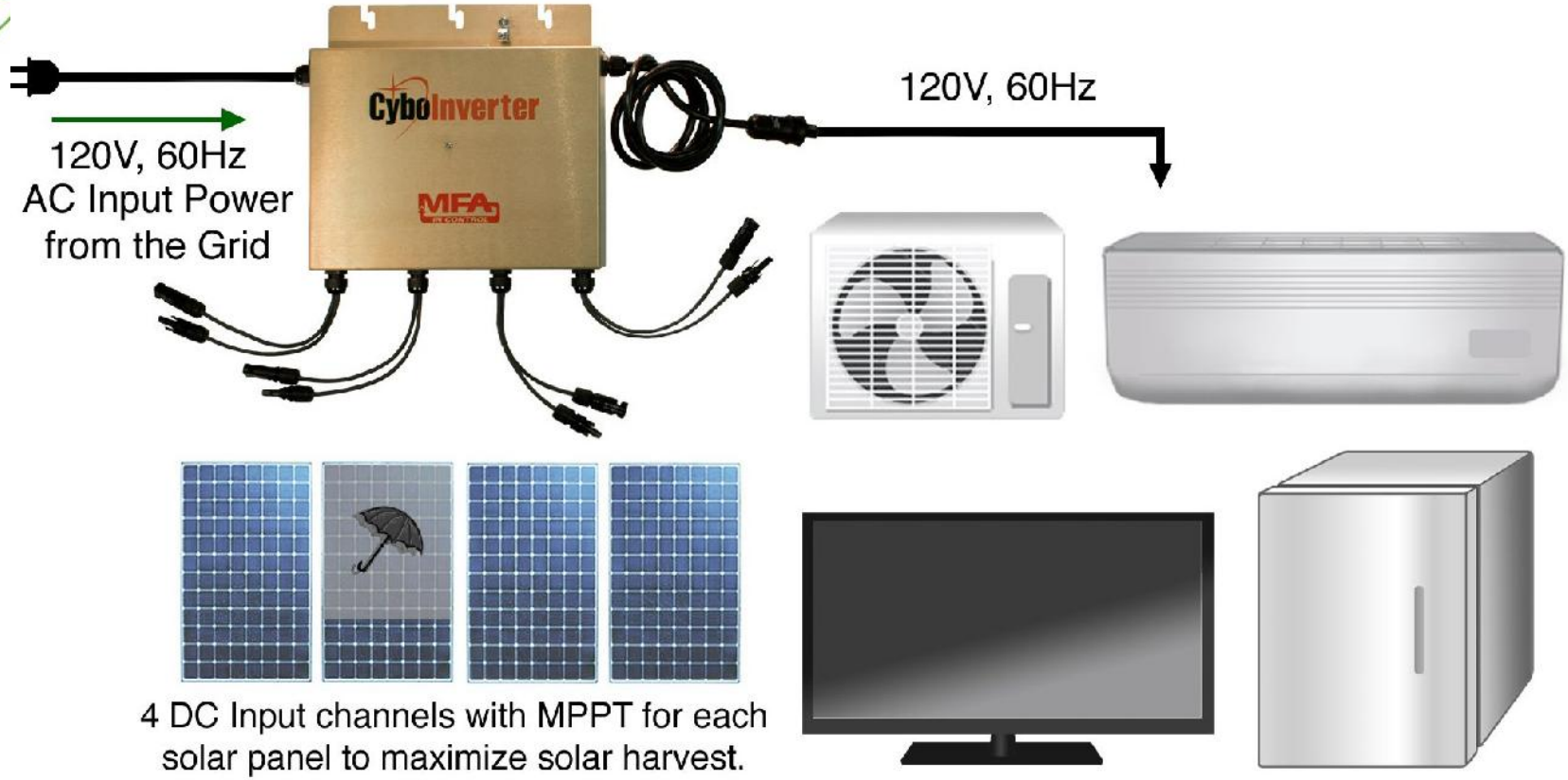
- Each CyboInverter's input channel has its own control and MPPT mechanism so that solar power harvest is maximized.

AC Assisted Off-grid CyboInverters

Part No.	Off-Grid	Market
CIM-1200Na	120V Single-phase, 60Hz	US, Canada, Mexico
CIM-1200Xa	208V Single-phase, 60Hz	US, Canada, Mexico
CIM-1200Ya	240V Single-phase, 60Hz	US, Canada, Mexico
CIM-1200Qa	110V Single-phase, 50Hz	Jamaica, Lebanon
CIM-1200Sa	220V Single-phase, 50Hz	Asia, China
CIM-1200Ta	230V Single-phase, 50Hz	Africa, Europe, India
CIM-1200Wa	220V Single-phase, 60Hz	Korea, Philippines, Brazil, Peru
CIM-1200Ha	100V-240V Single-phase, 50/60Hz	For Electric Water Heaters, Area Heaters, and Heating Elements

The CyboInverter product family supports almost all AC electric standards of the world allowing global rollout for key partners.

AC Assisted Off-Grid CyboInverter



The world's first AC assisted off-grid solar inverter. Run AC loads with solar power only, grid power only, or combined power.

The system can run almost all 120V, 60Hz loads such as mini-split air-conditioners, refrigerators, TV, computer, lights, fans, appliances, etc.

CIM-1200Na Tech Data - 1

DC Input (per Channel)	60 / 72 Cell Panel	Battery
Recommended Input Power	250W – 430W	48V, 50AH – 300AH
Operating Input DC Voltage Range	20V – 58V	47V – 58V
Peak Power Performance Range	30V – 58V	48V – 58V
Maximum Input Voltage / Current	58V / 10.5A	58V / 10.5A
Maximum Input Power	330W	330W
AC Input	Data	
AC Input for Assisted AC Power	120V, 60Hz AC from the Grid	
AC Output	Data	
Rated Output Power / Peak Power	960W / 1250W	
Maximum Combined AC Output	2500W for an Na or its twin pack based system	
Nominal Output Current (RMS)	8A (RMS – Root Mean Square)	
Output Voltage / Range	120V (102V – 132V, Single-Phase)	
Nominal Frequency / Range	60Hz (57Hz – 62Hz)	

CIM-1200Na 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 (THHN), Copper, 30A	12 AWG, 4 ft, Twin Pack has AC connectors	

Battery Compatibility	48V Lead-Acid Deep-Cycle AGM or Lithium-Ion Pack
Low Voltage Disconnect	Over Discharge Protection for 48V Lead-Acid Batteries

CIM-1200Na Tech Data - 3

Features and Compliance	Data
Compatibility	Most 60-Cell and 72-Cell PV Solar Panels
Standard Warranty	3 Years (Extended Warranty Available)
Safety and EMC Compliance (Amendment Pending)	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

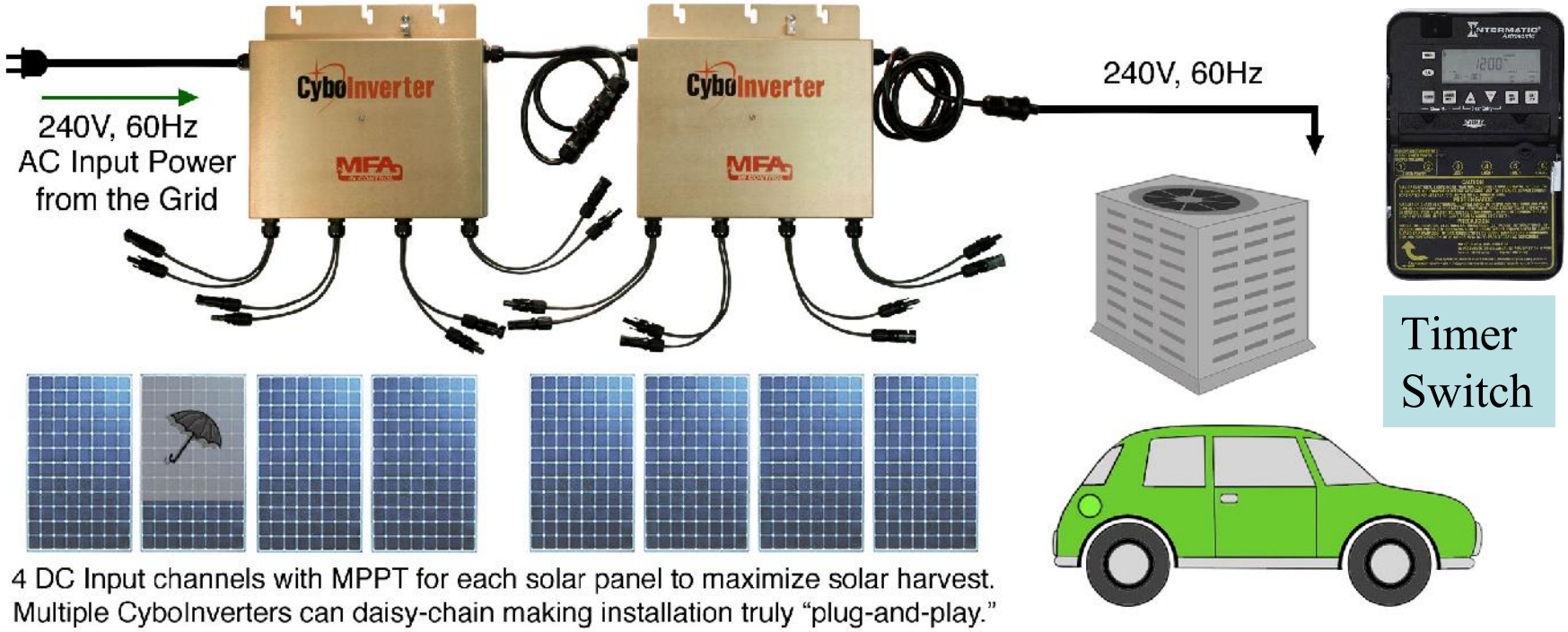
To power 220V-240V, 60Hz loads, use CyboInverter CIM-1200Ya or its twin pack.

Each CyboInverter (CIM-1200Na) can connect to 4 solar panels and produce up to 1250W, 120V, 60Hz AC. With assisted AC power from the grid, it can support a 120V, 20A branch circuit (max combined power 2500W) and run AC loads including: air-conditioners, EV chargers, chillers, swimming pool pumps, motors, heaters, etc.

Operating Modes

No.	Mode	Features
1	Solar Power Only	The AC input port of the inverter is not connected to the grid or the grid is down and the inverter will work like a regular off-grid CyboInverter.
2	Grid Power Only	The input AC power from the grid can run the AC loads directly and the inverter is not even turned on. For instance, when the inverter is down at night, the AC loads can operate normally with the grid power.
3	Combined Power	The AC power generated by the inverter is combined with the input power from the grid, and the combined power runs the AC loads. In this case, solar production is maximized and grid power consumption is minimized. If solar has more power than the AC loads need, the system will not consume any grid power, and the inverter will reduce power production to assure that no power is sent to the grid.

Special Off-Grid Applications



4 DC Input channels with MPPT for each solar panel to maximize solar harvest.
Multiple CyboInverters can daisy-chain making installation truly "plug-and-play."

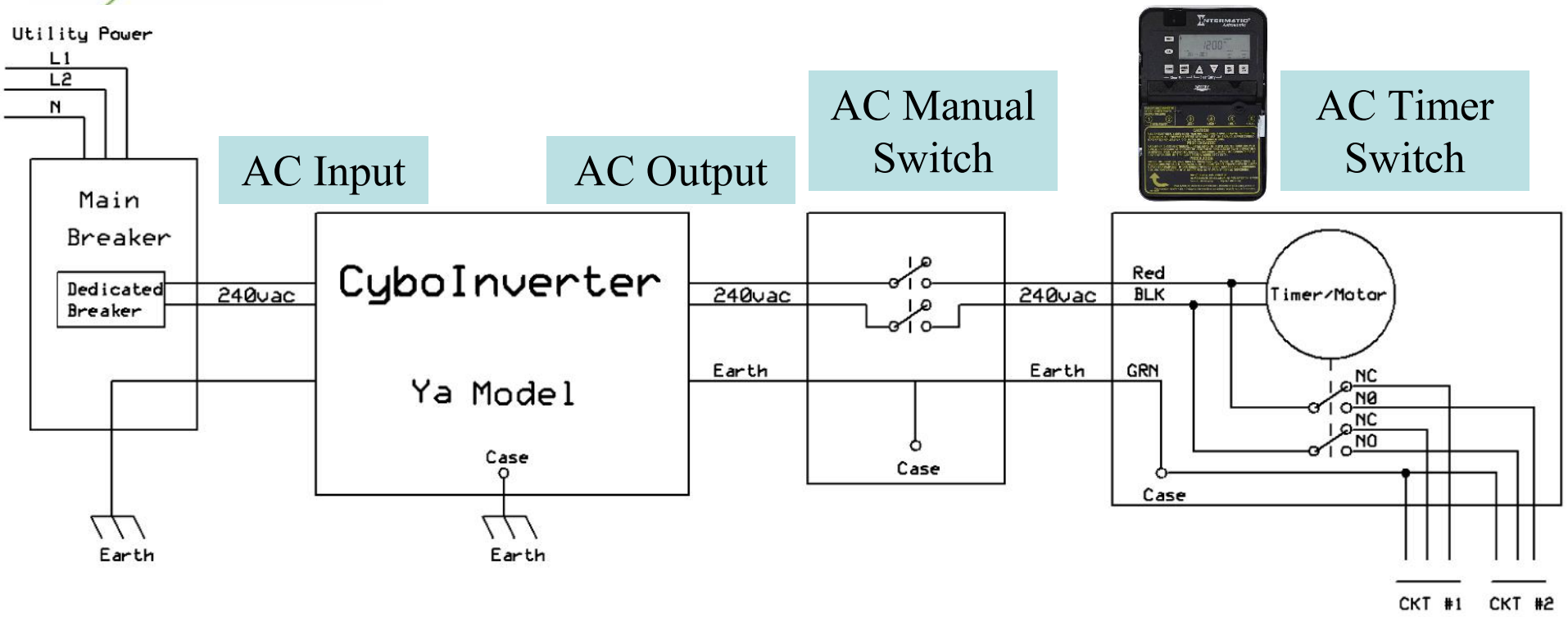
The Master and Slave CyboInverters (Ya model twin pack) can daisy-chain producing up to 2300W, 240V, 60Hz AC.

The system can support a 240V 30A branch circuit. With a 30A dual-circuit or triple circuit timer, it can run heavy AC loads such as air-conditioners, swimming pool pumps, and EV chargers individually.

CIM-1200Ya Tech Data - 1

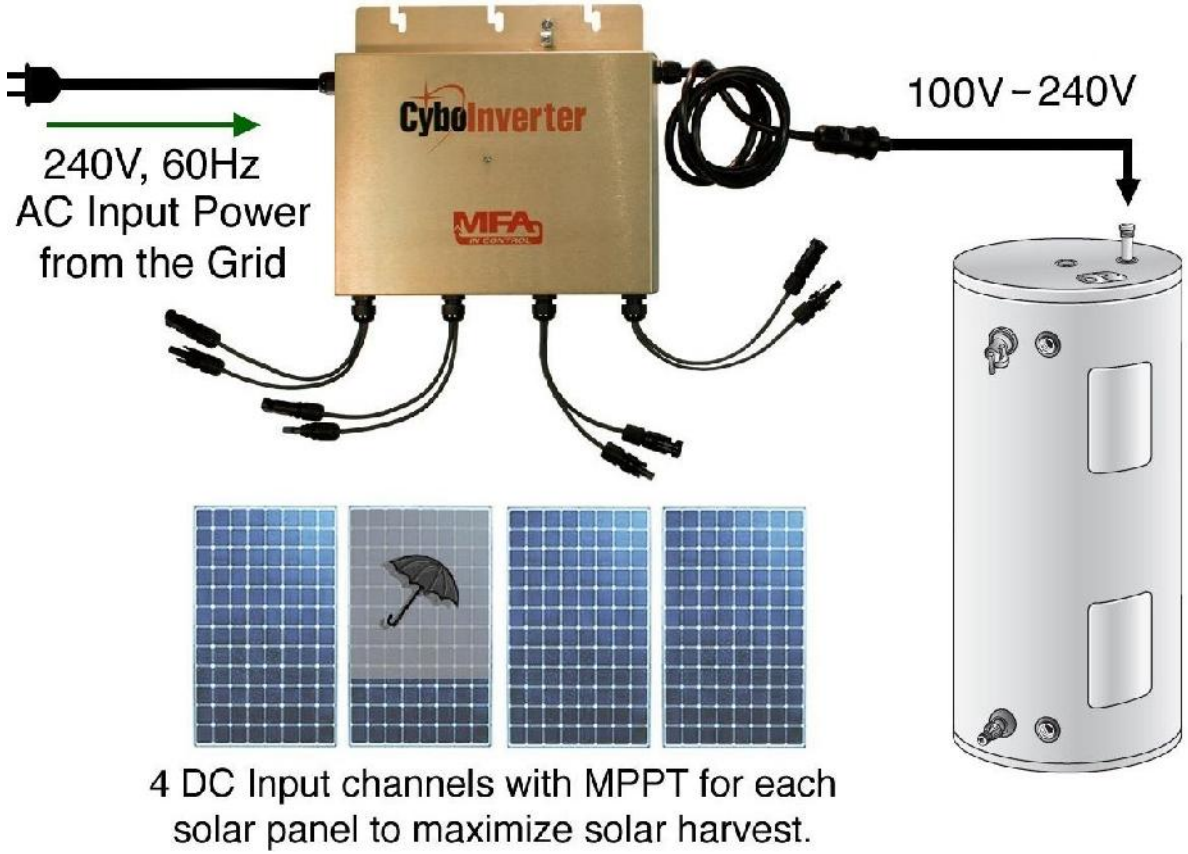
DC Input (per Channel)	60 / 72 Cell Panel	Battery
Recommended Input Power	250W – 430W	48V, 50AH – 300AH
Operating Input DC Voltage Range	20V – 58V	47V – 58V
Peak Power Performance Range	30V – 58V	48V – 58V
Maximum Input Voltage / Current	58V / 10.5A	58V / 10.5A
Maximum Input Power	330W	330W
AC Input	Data	
AC Input for Assisted AC Power	230V-240V, 60Hz AC from the Grid	
AC Output	Data	
Rated Output Power / Peak Power	960W / 1250W	
Maximum Combined AC Output	4500W for a Ya or its twin pack based system	
Nominal Output Current (RMS)	4A (RMS – Root Mean Square)	
Output Voltage / Range	240V (204V – 264V, Single-Phase)	
Nominal Frequency / Range	60Hz (57Hz – 62Hz)	

Wiring to the Timer for Dual Loads



- The recommended Timer is Intermatic ET8415C.
- Its user guide can be downloaded online www.intermatic.com.
- The wiring diagram shows the CyboInverter Ya model output is connected to the Timer AC input port.

AC Assisted Off-Grid CyboInverter for Electric Water Heaters



4 DC Input channels with MPPT for each solar panel to maximize solar harvest.

The inverter AC output connects to the water heater AC outlet. No re-wiring of the water heater is required. A regular single or dual element electrical water heater can be used.

The world's first AC assisted off-grid solar inverter for electric water heaters. The system can disconnect the grid AC during the day and harvest solar power with MPPT to heat the water.

Key Applications at a Glance

- Solar PV Water Heating with CyboInverter H model or using the products offered by CyboEnergy's strategic partners.

- 1KW to 5KW off-grid solar systems for areas where on-grid solar is no longer welcomed due to the Duck Curve problem or due to the lack of Net-Metering program. The AC assisted off-grid CyboInverters can run electric water heaters, IAC, central A/C, pool pumps, EV chargers, and other heavy loads.

- AC assisted off-grid solar systems to run IAC and walk-in cooler for chain restaurants to avoid demand charges, soft-drink coolers and vending machines, zone cooling with IAC for new homes, etc.

- Small and mobile microgrids (1KW to 5KW) in remote areas to provide electrification and to run IAC, coolers, and water heaters.

Value Proposition

- It is an off-grid solar system and there is no high voltage DC with plug-and-play installation.
- No need to lock in a long term on-grid solar contract with local utility companies.
- Can power conventional electric water heaters, central air conditioners, mini-split IAC, EV chargers, pool pumps, home appliances, etc.
- With no batteries, the system cost is much less than a battery-based system. No fire or other risks, nor maintenance headaches.

Our battery-less off-grid solar system is the simplest and most cost-effective way to save electricity for homeowners, and avoid demand charges for businesses.

Can provide hot water and backup power when the grid is down.

About CyboSoft / CyboEnergy

- CyboEnergy is a subsidiary of CyboSoft in California, focusing on the clean energy field.
- Core technologies - MFA control, smart & scalable solar power inverters, 34 US patents and international patents.
- “CyboEnergy’s unique and patented battery-less off-grid CyboInverters for electric water heaters, and for Inverter-Air-Conditioners (IAC) can change the landscape of the solar industry” quoted by Frost & Sullivan.