Planning an Enphase Storage System Installation

This document guides site surveyors and design engineers in evaluating a site and planning for the installation of the Enphase Storage System.

Enphase Storage System

The Enphase Storage System includes the Enphase AC Battery™ with integrated Enphase Microinverter™. The system also requires an Enphase Envoy-S Metered™ to measure photovoltaic (PV) production and home energy consumption. You can install the Enphase Storage System with any PV system, even with non-Enphase inverters. The system allows consumers to shift the use of solar PV production from daytime hours to evening, night, and/or morning hours. The system senses when it is optimal to charge or discharge the battery so that renewable energy is stored when it is abundant and used when scarce.

Two key applications of the Enphase Storage System are ***Self Consumption*** and **Time of Use** (***ToU***) bill management.

Self Consumption

In ***Self Consumption*** scenarios, a homeowner's PV system stores the energy it generates in the AC Batteries for use later in the day when higher loads can consume it. In this situation, exporting PV generated energy to the grid is allowed, but the homeowners have an economic benefit from consuming the onsite-generated energy themselves. This is the case when net energy metering is no longer in place, when the grid supplied kWh rates are higher than the cost of the PV generated kWh, and when any PV-generated kWh exported to the utility grid is compensated at a much lower rate.

A special case of ***Self Consumption***, called ***Zero Export***, is supported for applications where the utility does not allow a homeowner to export energy back into the grid (e.g., Hawaii self-supply). ***Zero Export*** requires a PV system with Enphase S-Series Microinverters™ to perform export limitation (curtailment) as needed for this application.

Time of Use Bill Management

With ***ToU*** bill management, the system stores energy generated by the PV system during the day when electricity rates are low to use at a later time when electricity rates are higher. This way, a homeowner can shift their energy demand away from utility provided electricity when it costs the most and use more affordable PV generated electricity.

The Enphase Storage System is **not** designed to provide backup power during electrical outages, but you can pair it with an AC-coupled storage system or back-up generator system to provide power during outages. This document does not cover these applications.

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AC Battery

The AC Battery contains Lithium Iron Phosphate (LFP) battery cells, a utility-interactive inverter, and a battery management system (BMS) in a single component.

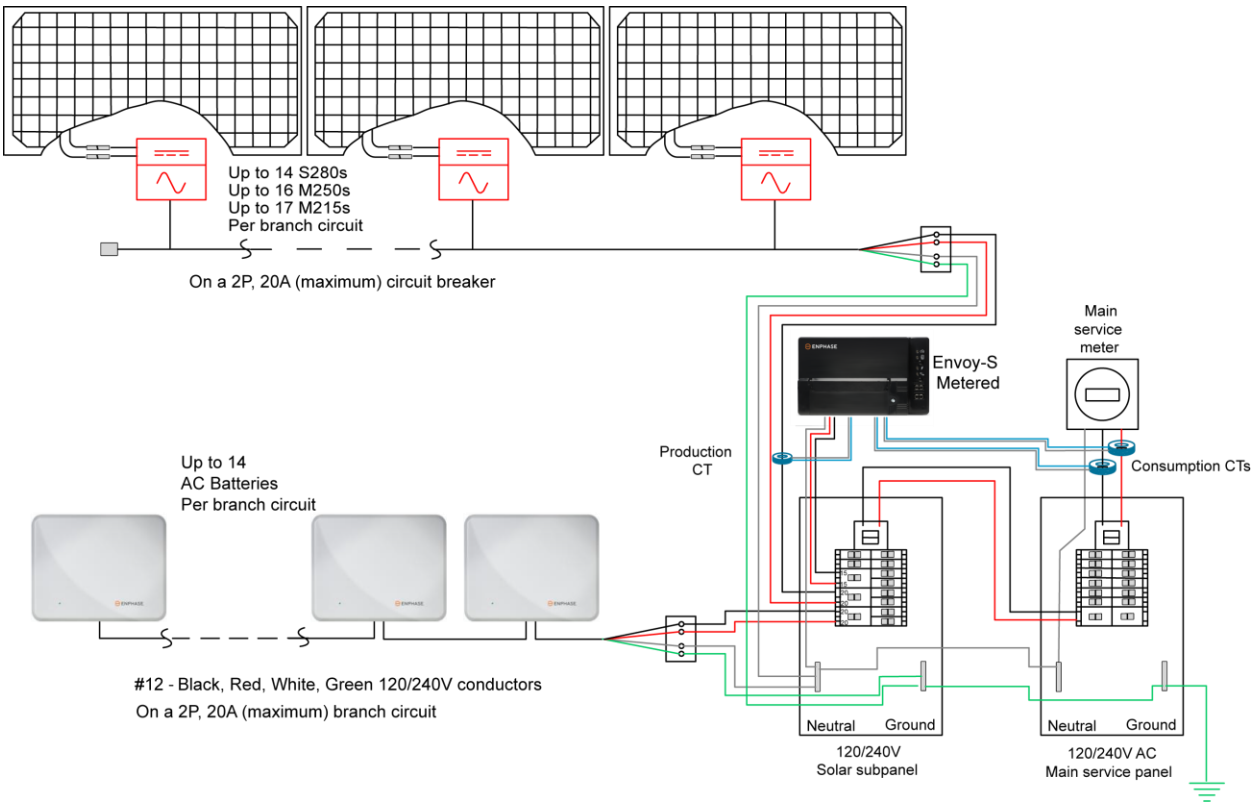
For specifications, download the AC Battery data sheet at enphase.com/en-us/support.

Key Enphase System Components

- AC Battery
- Wall mount bracket for the AC Battery
- Envoy-S Metered with production and consumption CTs installed

Enphase Storage System Example Schematic

The following schematic depicts an example Enphase Storage System with one AC Battery circuit and one PV branch circuit. The system includes a subpanel located near the main AC distribution panel for connection of the Envoy-S Metered, the AC Battery(ies), and PV circuits.



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Key Planning Considerations

To ensure best power line communication and cleanest installation, take into account these key planning considerations:

1. Ensure that the Envoy-S Metered with **all** CTs can be installed at the site.
2. Identify a suitable environment and indoor wall area for secure mounting of the required number of AC Batteries.
3. Keep the total wire length between the Envoy-S Metered and the AC Batteries to 15.2 M (50 feet) or less to ensure good power line communications.
4. Determine the electrical interconnection points and available breaker spaces for the AC Battery circuit, PV branch circuits, and the Envoy-S Metered.
5. If an AC Battery system is installed on a PV system that uses non-Enphase inverters, you **must** install the production CT on the combined PV inverter output circuit L1 and locate the Envoy-S Metered within 1.5 m (4.9 feet) of that CT location.

The following sections detail each of these considerations:

1. Ensure that the Envoy-S Metered with all CTs can be installed at the site

A site electrical service includes the utility meter and main service panel. You must install an Envoy-S Metered with production and consumption CTs for the AC Battery system to function and to measure the total building load.

Check the following:

- ☐ There is access to main service conductors or busbars between the utility meter and main service panel for consumption CT installation.
- ☐ Enough room exists for the consumption CTs to fit around the main service conductors or busbars.

If there is not enough room for the consumption CTs, see the ***Technical Brief: Assessing a Site for Installing Consumption CTs*** for alternative approaches to locating the CTs at enphase.com/en-us/support.

NOTE: If consumption CTs cannot be installed at a site to measure full home consumption, the AC Battery system cannot operate properly. Consider whether additional electrical work is possible to gain access to the main service conductors for consumption CT installation. Examples include upgrading or moving the main AC service panel and installing new main service conductors or adding an access box between the utility meter or main AC service panel or moving the utility meter to a new location and adding an access box on the load side of the meter.

2. Identify an area for secure mounting of the AC Batteries

The AC Battery housing is an IP20 / NEMA type 2 metallic enclosure for indoor installation. Each AC Battery must be securely mounted to the wall using the included Enphase wall mount bracket. Use anchors that are sufficient to carry the weight of the bracket plus the AC Battery. You can mount multiple AC Batteries in close proximity, but you must anchor each wall mount plate separately. As the installer, you are responsible for the secure mounting of the wall mount bracket. Make sure that a solid structure is available for secure anchoring and weight support, and that enough wall space is available to mount the required number of AC Batteries with required clearances.

NOTE: See detailed dimensions and weights in the appendix.

Check the following:

- ☐ Identify a wall in a readily accessible, well-ventilated, indoor location that is cool and dry (like a garage), which is out of direct sunlight and where the ambient temperature and humidity are within -20° C to 45° C (-4º F to 113º F) and 5% to 95% relative humidity, non-condensing.
- ☐ Identify a suitable wall area for the required number of AC Batteries. Remember to keep a minimum of 30.5 cm (12 inches) between the floor and bottom of the lowest row of batteries and 30.5 cm (12 inches) between each row of batteries for ventilation and electrical wiring. The table in the Appendix shows the wall area required including minimum spacing requirements for a variety of configurations.
- ☐ Ensure that the structure can support the weight of the required number of AC Batteries with wall mount brackets. The total weight of one AC Battery and one 16-inch wall mount bracket is 28.5 kg (62.7 lbs.). See the Appendix for more details.

NOTE: If the wall is not structured in a way that allows wall mount brackets to be attached directly to the studs, a substructure is required, such as 1) metal strut, 6.4 mm (¼ inch) spring nuts, and 6.4 mm (¼ inch) bolts or 2) horizontally mounted wood studs or strong plywood.

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3. Limit the total wire length between Envoy-S and AC Battery

The Envoy-S Metered communicates via the AC Battery system using power line communication (PLC). To ensure good, PLC keep the wire length between the Envoy-S Metered and the AC Battery to a minimum of 15.2m (50 feet).

Check the following:

- ☐ Identify a suitable mounting location for the Envoy-S Metered.
- ☐ Make sure an enclosure can be mounted for the Envoy-S Metered. You can also install an Enphase AC Combiner Box (which includes the Envoy-S Metered).

NOTE: If installed outdoors, you must install the Envoy-S Metered in an NRTL Certified NEMA type 3R (or better) enclosure with conduit attachment. Do not drill holes in the top of the enclosure or anywhere that allows moisture ingress. If installed indoors, you must install the Envoy-S in a suitable indoor enclosure.

- ☐ Connect the Envoy-S Metered so the wire length between the Envoy-S Metered and the AC Batteries is fewer than 15.2 m (50 feet).

4. Determine electrical interconnection points and available breaker spaces

Terminate the branch circuit(s) feeding the AC Batteries at the same electrical panel that also feeds the Envoy-S Metered and the combined solar circuits. Do this on a circuit breaker in the existing main AC service panel or in a dedicated AC subpanel. The Enphase Storage System does not export AC Battery output to the grid. However, you must consider and add the sum of the AC Battery output current to the total PV inverter output current when calculating the ampacity for NEC 705.12 Point of Connection electrical considerations.

It is a best practice to use a dedicated solar / storage subpanel as shown in the above example. However, if an existing PV system is in place, you may use service interconnections on a breaker in the main AC service panel or connect directly to the main service conductors.

Check the following, making sure at least one of the options can be met:

Option 1:

☐ You are planning the system to use a dedicated AC subpanel for connection of the AC Battery branch circuit, PV branch circuits, and Envoy-S Metered. If **NOT**, continue on to Option 2. If **YES**, confirm the following:

- There are enough spaces to fit a 2-pole breaker for the Envoy-S Metered, a 2-pole breaker for the AC Battery circuit, and 2-pole breakers for each PV branch circuit.
- **EITHER** the combined AC Battery and PV inverter output current of the AC subpanel can be interconnected to a backfeed breaker in the main AC service panel (NEC 705.12) **OR** there is space for a line side (of the main breaker) connection, including space for placement of the Envoy-S Metered consumption CTs.

Option 2:

☐ An existing Enphase PV System using an Envoy-S Metered with production and consumption CTs is already installed and interconnected to either the main AC service panel via a backfeed breaker or line side (of main breaker) connection. If **NOT**, continue on to Option 3. If **YES**, confirm the following:

- There are enough spaces to fit a new 2-pole breaker in the main AC service panel for the AC Battery branch circuit.
- The combined AC Battery current and PV inverter output current can be connected to the main AC service panel (NEC 705.12).

Option 3:

☐ An existing PV System (Enphase or other) is already installed and interconnected to the either the main AC service panel via a backfeed breaker or line side (of main breaker) connection. Confirm the following:

- There are enough spaces to fit a new 2-pole breaker in the main AC service panel for the AC Battery branch circuit.
- There are enough spaces to fit a new 2-pole breaker in the main AC service panel for the Envoy-S Metered.
- The combined AC Battery current and PV inverter output current can be connected to the main AC service panel (NEC 705.12).

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5. An Enphase AC Battery system is on a non-Enphase PV system

You can install the Enphase Storage System on systems with non-Enphase inverters. However, the Envoy-S Metered must measure the total PV system output using the included production CT. You must install the production CT on the combined PV inverter output circuit L1, and locate the Envoy-S Metered within 1.5 m (4.9 feet) of that CT location.

Check the following:

☐ The Envoy-S Metered can be installed in a location that allows the 1.5 m (4.9 foot) production CT wires to reach L1 of the combined PV output circuits. The production CT wires cannot be extended.

Electrical Installation Requirements

For full installation instructions, refer to the following documents:

- *Enphase AC Battery Quick Install Guide*
- *Enphase AC Battery Installation Manual*

Complete the electrical wiring of the wall mount bracket before mounting the AC Battery. The wall mount bracket includes knockouts for 12.7 mm (½ inch) or 19.1 mm (¾ inch) electrical fittings. You can install a maximum of 14 AC Batteries on a 20A branch circuit. Terminate the branch circuit(s) feeding the AC Batteries at the same electrical panel that also feeds the Envoy-S and the combined solar circuits.

Since the AC Battery operation relies upon powerline communication signals from the Envoy-S, it is unlikely that the AC Battery branch circuit will be very long. It may be adequate to run #12 conductors for the AC Battery branch circuit, but you may need to upsize for voltage drop in some applications.

It is critical that installers correctly configure the Envoy-S Metered, with the combined solar PV output passing through the production CT. The production CT monitors **only** the PV output circuit(s), and must not have AC Battery circuit(s) installed on it. Install the AC Battery circuit(s) on the load side of the production CTs. If the system uses an Enphase AC Combiner box, install the AC Battery on a different electrical panel on the line side of the Enphase AC Combiner Box's production CT.

Installers may extend the consumption monitoring CTs, but not the production CTs. Therefore, it is best to locate the Envoy-S close to the inverter output circuits and then run CL3R (or other control wires) between the Envoy-S and the main service entrance conductors. Refer to the *Envoy-S Installation and Operations Manual* when installing and/or extending consumption CTs.

Voltage Drop Considerations

The AC Battery contains a utility-interactive microinverter that converts the stored energy from DC to AC and from AC to DC. When the AC Battery is charging, the AC Battery acts like a load and the voltage decreases at the terminals of the battery based upon Ohm's law and wire resistance. When the AC Battery is discharging to feed loads, the AC Battery behaves like a source, and the voltage increases at the terminals of the battery.

The currents in and out of the AC Battery are the same regardless of whether the battery is charging or discharging. Fortunately, the calculation is the same for both. Simply multiple the number of AC Batteries times the 1.17A current rating of the battery.

Voltage Drop/Rise on AC Battery Branch Circuit from First Battery to Branch Circuit Breaker

	1	2	3	4	5	6	7	8	9	10	11	12	13
AWG	**Maximum one-way wire length (in feet) to maintain 1% voltage rise**												
#12	539	269	180	135	108	90	77	67	60	54	49	45	41
#10	860	430	287	215	172	143	123	108	96	86	78	72	66
#8	1371	686	457	343	274	229	196	171	152	137	125	114	105

When upsizing the branch circuit homerun larger than #12, you must downsize to #12 or use a crimp-on ferrule at the AC Battery to terminate into the push terminals of the all mount bracket junction box.

Use #12 conductors for the AC Battery interconnect wiring, as that is the largest conductor accepted by the push terminals on the wall mount bracket junction box.

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Temperature Considerations

Place the AC Battery in a location that does not get significantly warmer than the outdoor ambient temperatures during summer days (see “2. Identify an area for secure mounting of the AC Batteries”) for specific temperature requirements. The AC Battery contains an internal temperature sensor near the air vent on the bottom that monitors the temperature of the battery.

When selecting the appropriate location to install the AC Battery, carefully consider the ventilation of the indoor space. Inside an enclosed garage, the temperature may be five to ten degrees higher (Celsius) than the outdoor ambient temperatures depending on location, exposure, and ventilation. Measure the garage temperature in the afternoon on a sunny day. If the garage is eight or more degrees (Celsius) warmer than the outdoor temperature, install additional ventilation to meet the warranty requirements.

The AC Battery does not require any ventilation for battery-cell-related off-gassing, which does not occur with Lithium Iron Phosphate (LFP) chemistry.

Appendix

Wall Mount Brackets and AC Battery Mechanical Specifications

The wall mount bracket is available for structures with 40.6 cm (16 inch) on-center (OC) stud spacing, or you can attach the battery directly to a suitable load-bearing wall.

AC Battery Mechanical Specifications (B280-1200-LL-I-US00-RF0)

Specification	Description
Dimensions	390 mm (W) x 325 mm (H) x 220 mm (D) / 15.4 in (W) x 12.8 in (H) x 8.7 in (D) (without bracket)
Weight	25kg (55 lbs)
Installation	Wall mounted in an indoor space using standard AC wiring in conduit or in wall, where allowed
Enclosure	Indoor – IP20 / NEMA 2
Cooling	Natural convection – no active or passing cooing required

16-Inch Wall Mount Bracket Mechanical Specifications (BWM-16IN-B)

Specification	Description
Dimensions	487 mm (W) x 356 mm (H) / 19.2 in (W) x 14.0 in (H)
Mounting slot	Maximum 6.4 mm (¼ in) mounting hardware
Electrical knockouts	12.7 mm (½ in) or 19.1 mm (¾ in) trade size
Weight	3.65 kg (8.05 lbs.)

* The wall mount bracket holds the AC Battery one inch from the wall.

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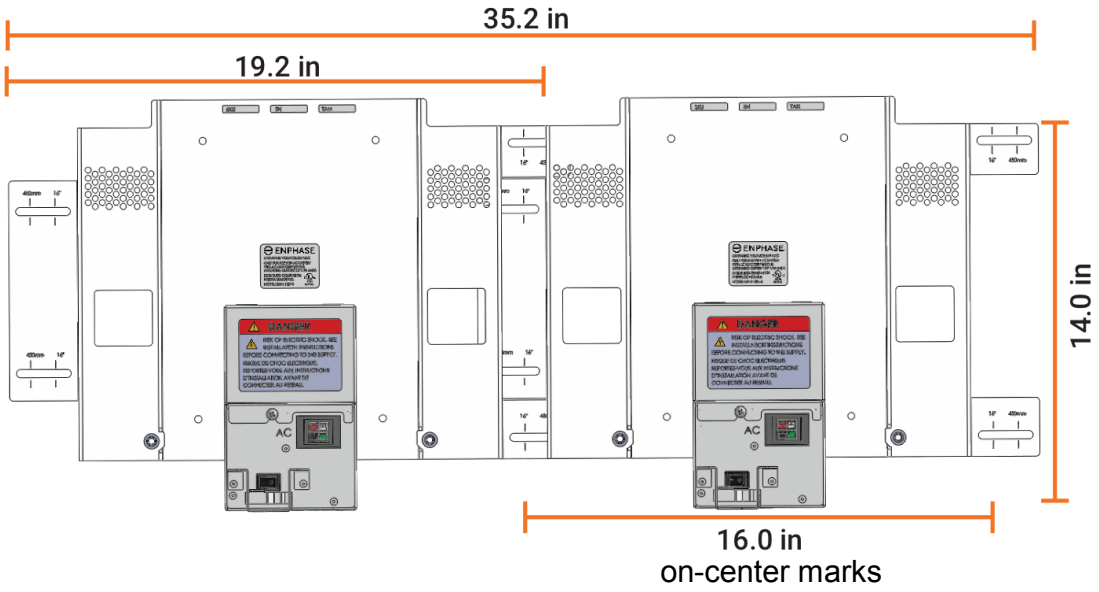
16-Inch Wall Mount Bracket



Wall Area Required for Number of Batteries with 16-Inch Wall Mount Brackets

		# of Columns					
		1	**2**	**3**	**4**	**5**	**6**
# of Rows	**Min. Distance**	48.8 cm (19.2 in)	89.4 cm (35.2 in)	130 cm (51.2 in)	170.7 cm (67.2 in)	211.3 cm (83.2 in)	252 cm (99.2 in)
1	96.5 cm (38 in)	1 x 1 48.8 x 96.5 cm (19.2 x 38 in)	2 x 1 89.4 x 96.5 cm (35.2 x 38 in)	3 x 1 130 x 96.5 cm (51.2 x 38 in)	4 x 1 170.7 x 96.5 cm (67.2 x 38 in)	5 x 1 211.3 x 96.5 cm (83.2 x 38 in)	6 x 1 252 x 96.5 cm (99.2 in x 38 in)
2	162.6 cm (64 in)	1 x 2 48.8 x 162.6 cm (19.2 x 64 in)	2 x 2 89.4 x 162.6 cm (35.2 x 64 in)	3 x 2 130 x 162.6 cm (51.2 x 64 in)	4 x 2 170.7 x 162.6 cm (67.2 x 64 in)	5 x 2 211.3 x 162.6 cm (83.2 x 64 in)	6 x 2 252 x 162.6 cm (99.2 x 64 in)
3	228.6 cm (90 in)	1 x 3 48.8 x 228.6 cm (19.2 x 90 in)	2 x 3 89.4 x 228.6 cm (35.2 x 90 in)	3 x 3 130 x 228.6 cm (51.2 x 90 in)	4 x 3 170.7 x 228.6 cm (67.2 x 90 in)	5 x 3 211.3 x 228.6 cm (83.2 x 90 in)	6 x 3 252 x 228.6 cm (99.2 x 90 in)

The tables above include a 12-inch clearance above and below each AC Battery to meet the clearances required.

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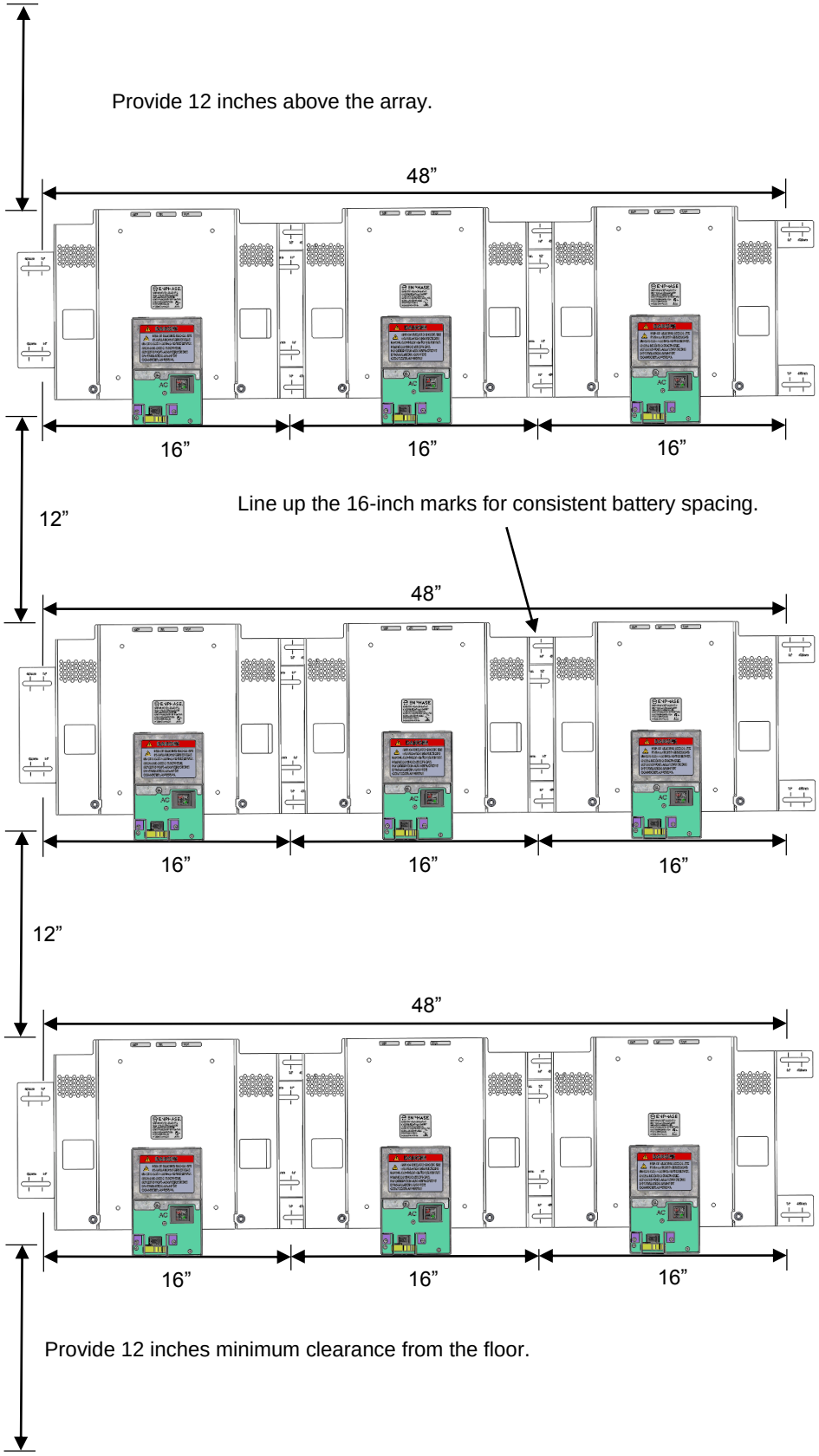
Example Layout for 9 AC Battery Wall Mount Brackets

This example layout requires a 121.92 cm by 213.36 cm (four foot by seven foot) wall space. Provide 30.5 cm (12 inches) of clearance above and below the array. Wall mount brackets overlap slightly when installed on walls with 16-inch stud spacing.



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