

# Technical Brief – Energy Storage System Design Examples

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## Introduction

This document provides site surveyors and design engineers with the information required to evaluate a site and plan for the Enphase Ensemble™ energy management system. The information provided in the documents supplements the information in the data sheets, quick install guides and product manuals. Diagrams are included are illustrative of example system configurations and installations. They should be used for reference only. The information provided is only generic and shall be adapted to project specific requirements and installed according to state and local codes.

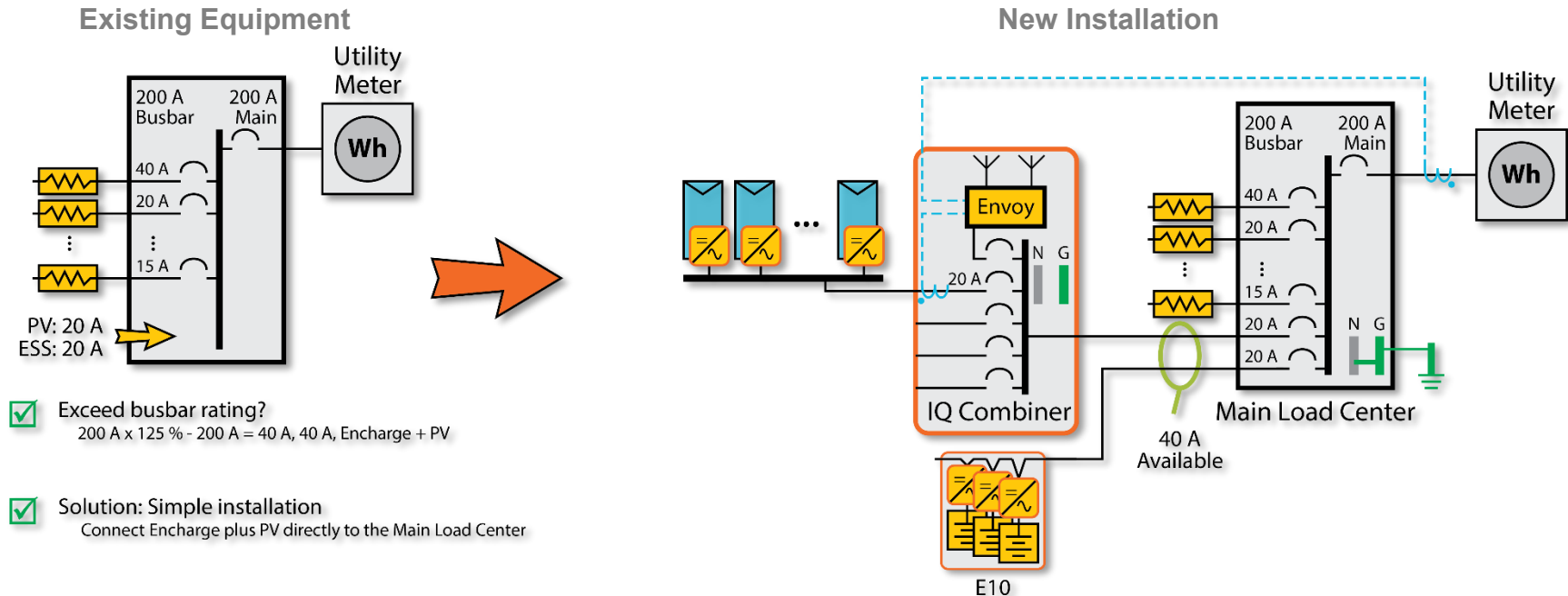
## Design and Installation Considerations for Non-Backup Systems

Simple Installation with no backup loads served.	
Explanation	Will the combined current from Encharge + PV exceed the busbar ampacity described in NEC 705.12?
Solution	<p><b>Solution A)</b> Simple Installation – No Main Panel Rework Needed. Encharge plus PV current does not exceed the “<b>120% rule</b>” in 705.12<sup>1</sup>. Connect Encharge + PV directly to the Main Load Center</p> <p><b>Solution B)</b> Simple Installation - Downsize the Main Encharge plus PV current exceeds the “<b>120% rule</b>” in 705.12</p> <ul style="list-style-type: none"> <li>i. Main panel upgrade. Increase the size of the busbar rating while maintaining the same main breaker size will allow for more connected Encharge plus PV.</li> <li>ii. Downsize the main breaker.</li> </ul>

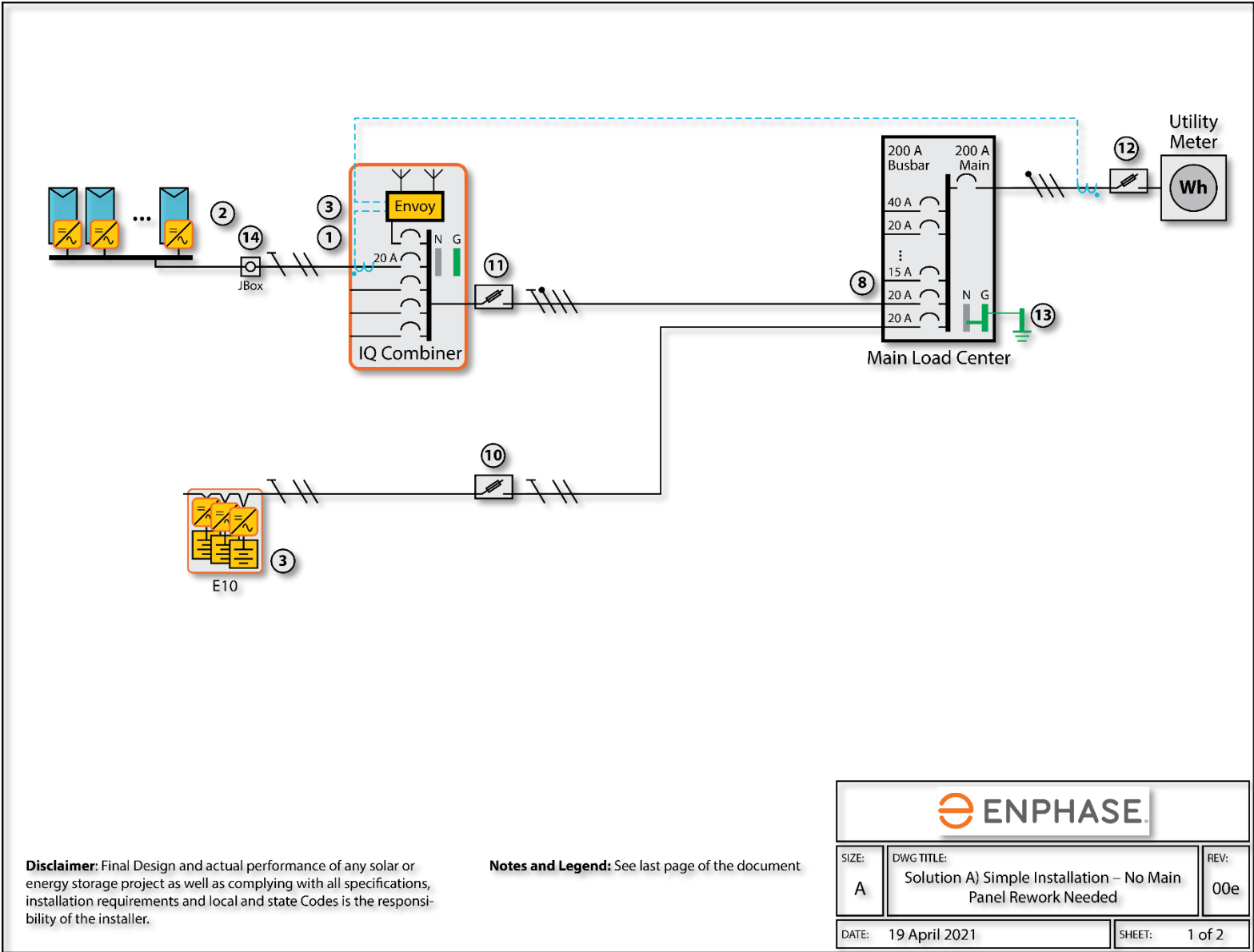
<sup>1</sup> **120% rule**, 2017 NEC, 705.12(B)(2)(3)(b) Where two sources, one a primary power source and the other another power source, are located at opposite ends of a busbar that contains loads, the sum of 125 percent of the power source(s) output circuit current and the rating of the overcurrent device protecting the busbar shall not exceed 120 percent of the ampacity of the busbar.

## Solution A) Simple Installation – No Main Load Center Rework Needed

For simple installations with no backup Enphase storage can save customers money by optimizing power consumption based on time of use tariffs. Here is an example of a main load center that allows up to 40 A of backfeed. Since Enphase solar + storage is 40 A, it is directly connected to the main load center.

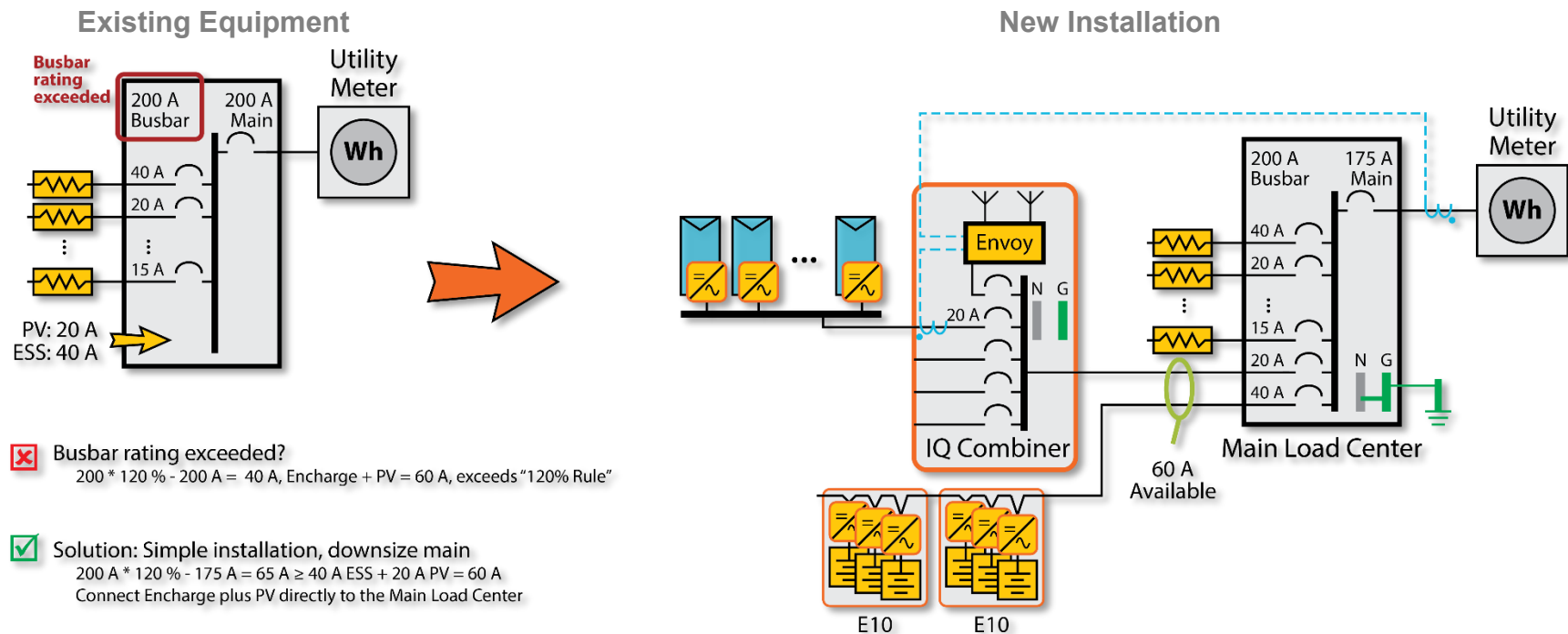


Single Line Diagram for a Simple Installation with No Main Load Center Rework

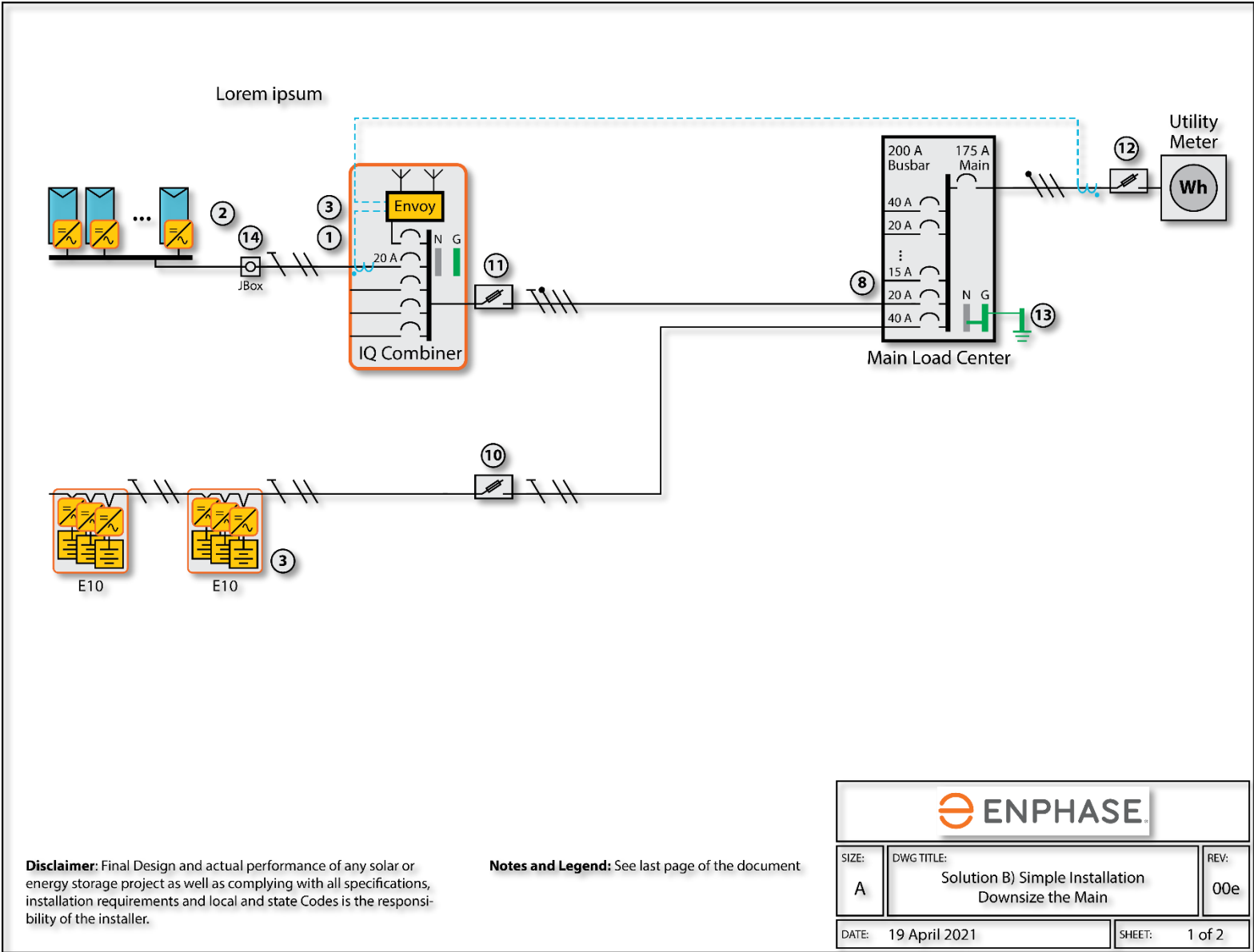


## Solution B) Simple Installation - Downsize the Main

For simple installations with no backup Enphase storage can save customers money by optimizing power consumption based on time of use tariffs. Here is an example of a main load center that allows up to 40 A of backfeed. Enphase solar + storage is 60 A and is higher than the amount of backfeed allowed. The main breaker has been downsized to 175A so that up to 65A of backfeed can be supported. This allows the 60A of solar + storage to be connected to the load center.



Single Line Diagram for a Simple Installation with Main Breaker Downsized



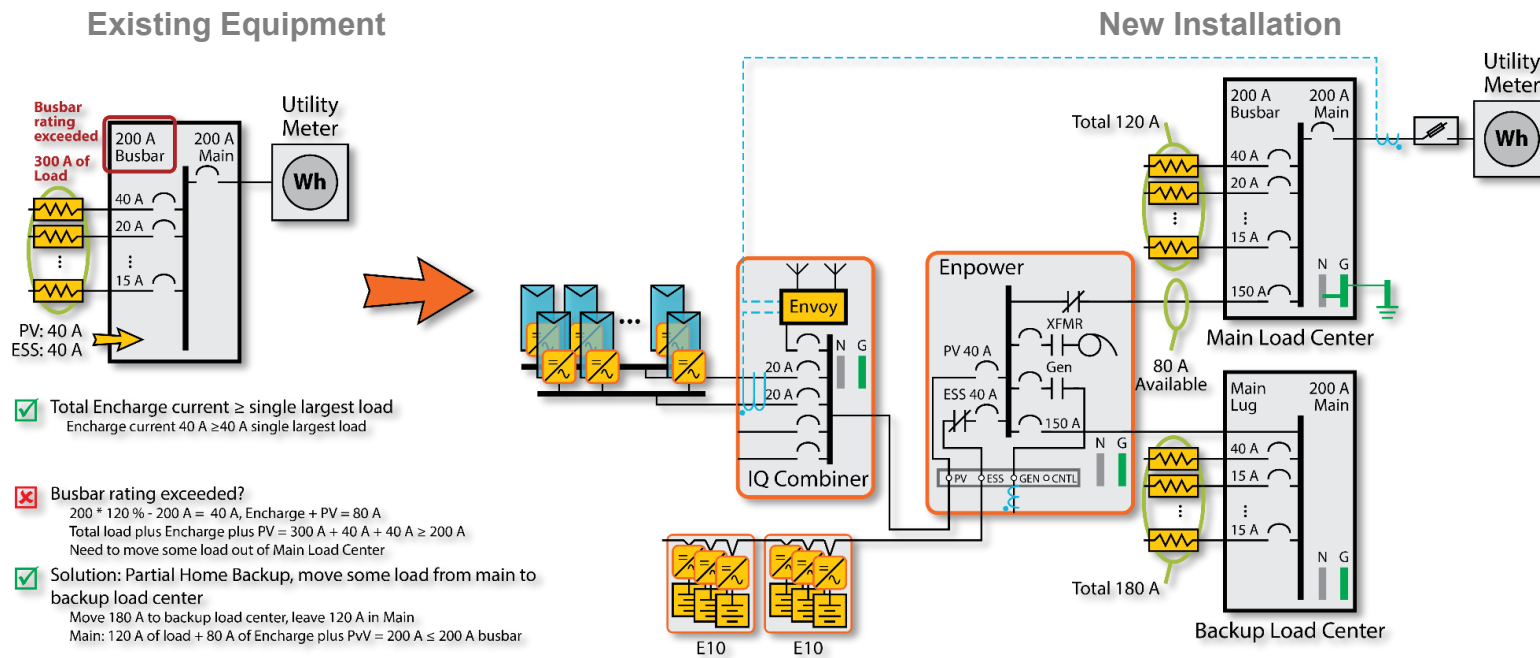
## Design and Installation Considerations for Backup Systems

Whole and Partial Home Backup while managing the busbar limitation.	
Explanation	<ul style="list-style-type: none"> <li>Partial Home Backup is a good way to increase the amount of connected Encharge + PV particularly when the “<b>120% Rule</b>” cannot be met.</li> <li>When configuring the system with backup loads, the ESS must be sized to be greater than or equal to the single largest load.</li> </ul>
Solution	<p><b>Solution A)</b> Partial Home Backup: Only some of the loads in the Mains Load Center are backed up. Move loads to backup load center to meet “sum of the breakers (excluding main)” 705.12<sup>2</sup> where sum of all sources and loads do not exceed the busbar rating.</p> <p>Note: If the sum of breakers (excluding main) approach is not viable changing the main load center to one with a higher busbar rating while maintaining the same main breaker size will allow for more connected Encharge + PV.</p> <p><b>Solution B)</b> Whole Home Backup: Connect Ensemble in a configuration that backs up the main load center.</p>

<sup>2</sup> **Sum of the breakers (excluding main)**, 2017 NEC, 705.12(B)(2)(3)(c) The sum of the ampere ratings of all overcurrent devices on panelboards, both load and supply devices, excluding the rating of the overcurrent device protecting the busbar, shall not exceed the ampacity of the busbar. The rating of the overcurrent device protecting the busbar shall not exceed the rating of the busbar.

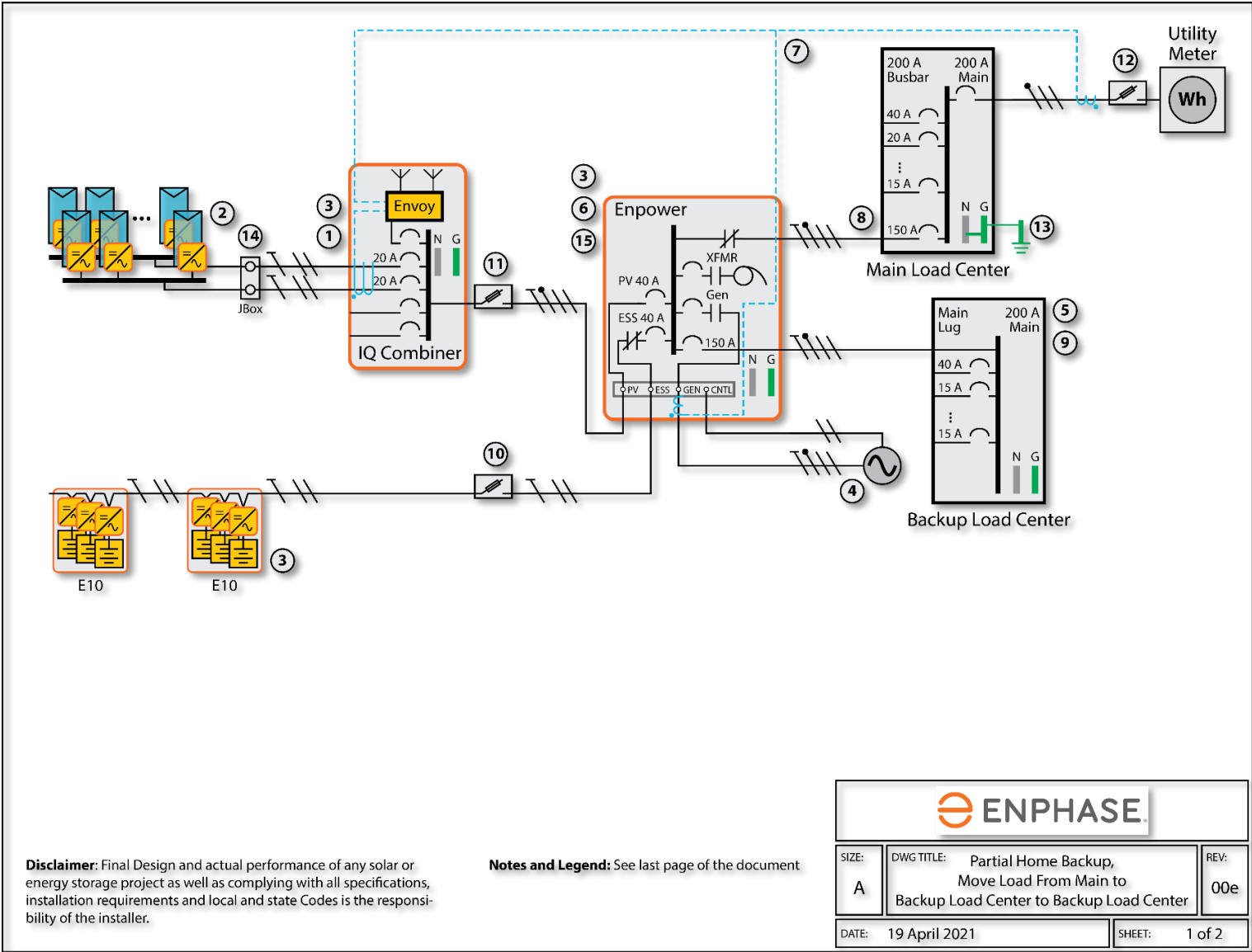
## Solution A) Partial Home Backup: Move Load From Main to Backup Load Center

In a partial home backup system, some of the home loads i.e., the essential loads are moved to a backup load center. These are the only loads that are backed up when the system goes off-grid. In this scenario if the “120% Rule” cannot be met for the main load center an alternate option is to ensure the main load center complies under the “sum of all breakers (excluding main)” 705.12<sup>2</sup> where sum of all sources and loads do not exceed the busbar rating. In the example below after installation the main load center has 80A of solar + storage. Loads have been moved to the backup load center to ensure that the main load center is left with 120A of loads, leading to a total of 200A sum of all breakers (excluding main). This does not exceed the 200A busbar rating of the main load center, therefore the main load center is compliant under the sum of all breakers (excluding main) 705.12<sup>2</sup> article in NEC.

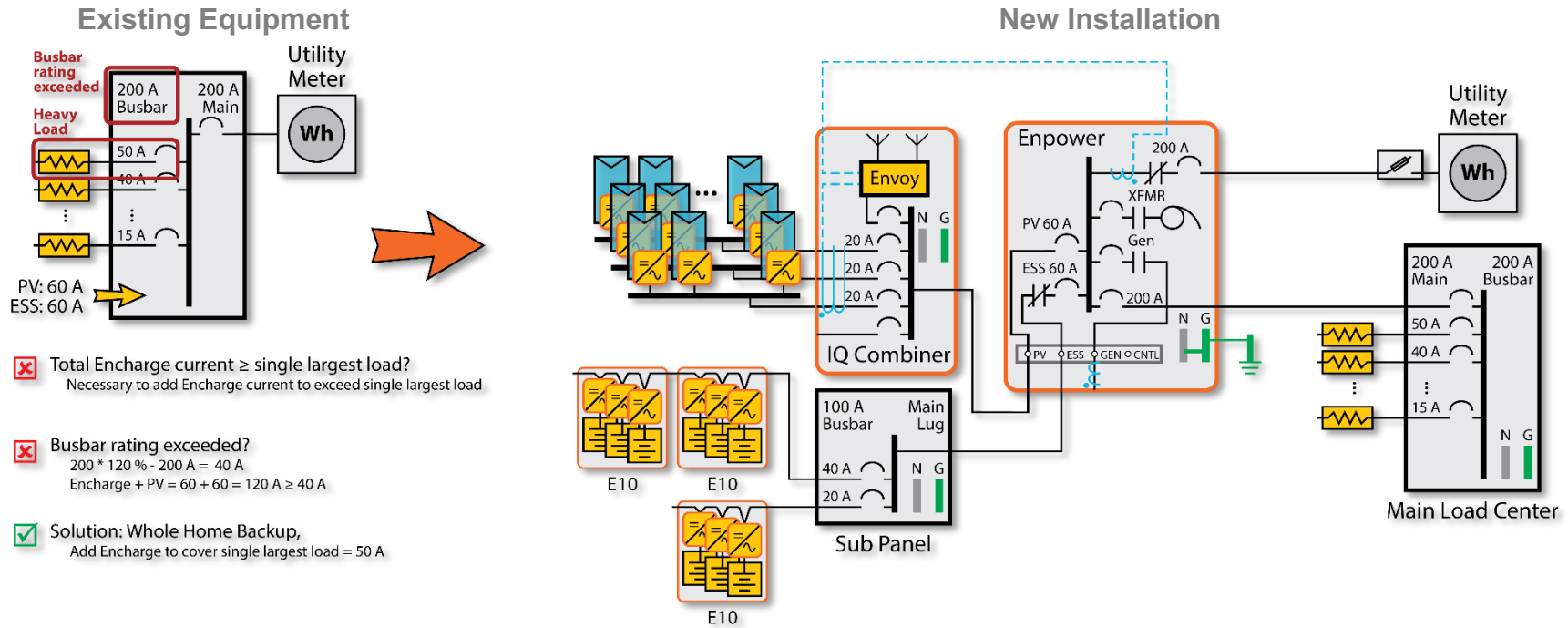




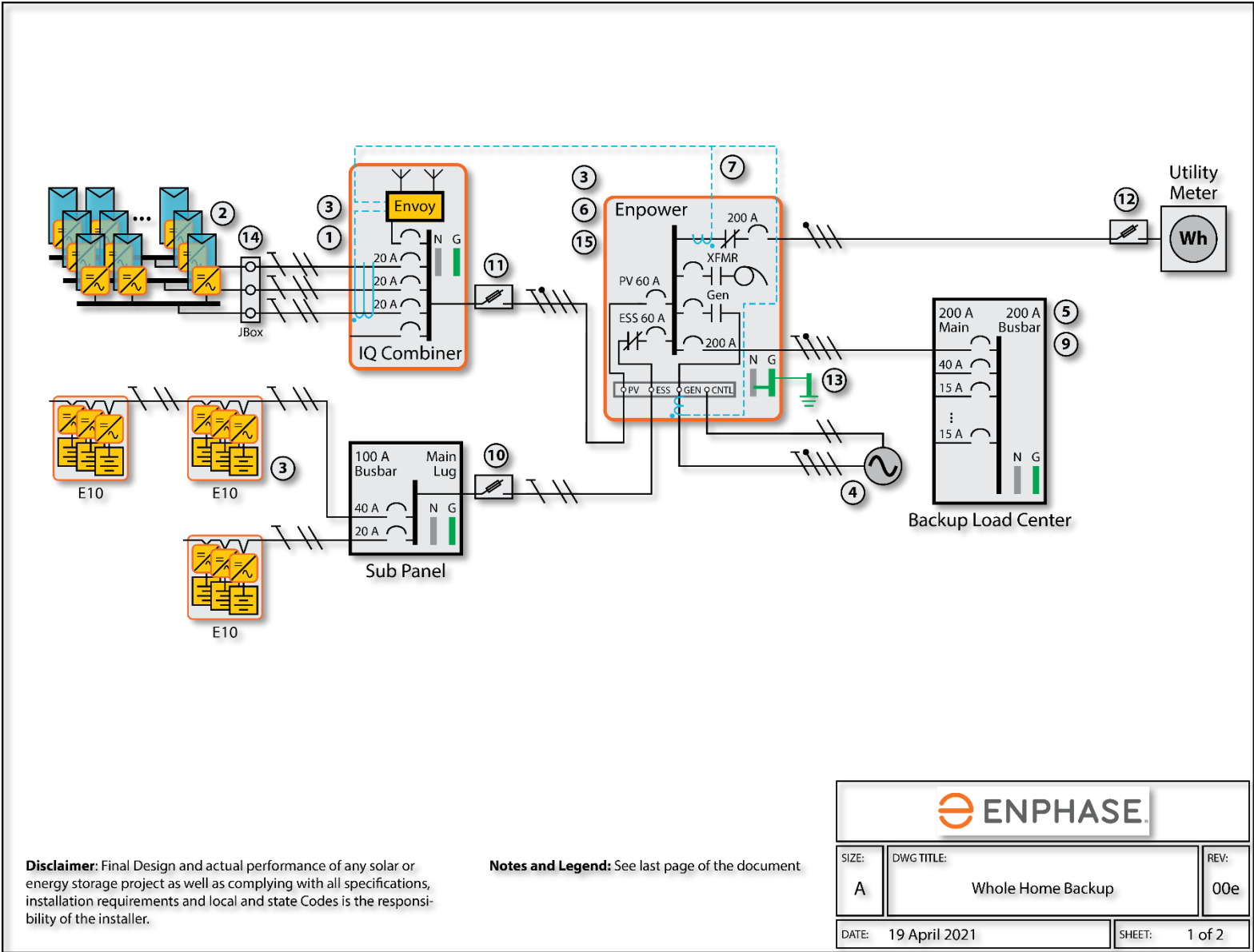
Single Line Diagram for Partial Home Backup with Loads Moved from Main to Backup Load Center



## Solution B) Whole Home Backup

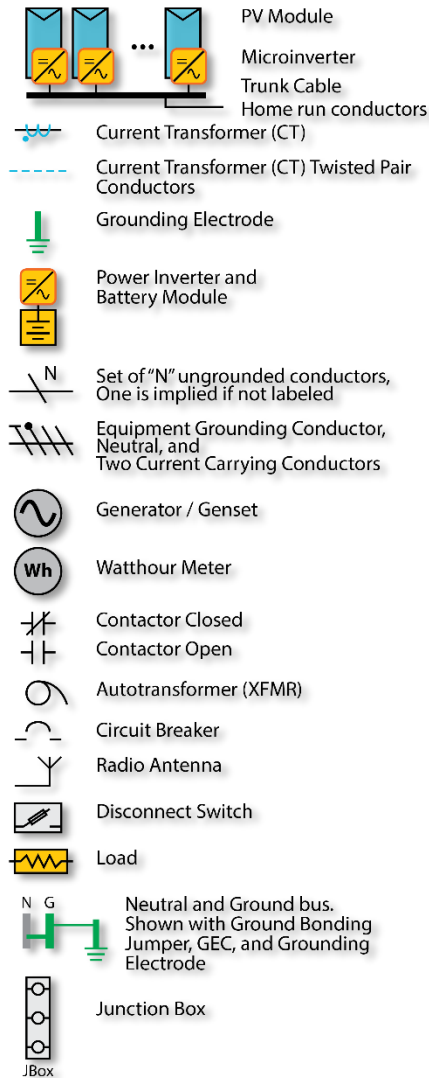


Single Line Diagram for Whole Home Backup



# Notes and Legend

## Legend



## Notes:

- ① Production CT includes L1 conductors only. Single CT.
- ② IQ-Series microinverters required for Ensemble microgrid.
- ③ Indicates NEMA 3R Enclosure.
- ④ Optional generator shown with control wires. See Generator Tech Brief for details.
- ⑤ Total Encharge current shall be greater than or equal to the single largest load. See Encharge data sheets for rated and peak current.
- ⑥ Enpower 200G  
Shown with typical breaker configuration.
- ⑦ Consumption CTs shall measure all load at site. Up to two sets can be connected in parallel per terminal connection, one set for the grid and one set for the optional generator.
- ⑧ Ensure interconnection ampacity of combined PV plus Encharge current complies with NEC 705.12.
- ⑨ If combined interconnection ampacity of PV plus Encharge exceeds busbar rating, main breaker must protect backup loads panel. Breaker can be installed in Enpower, or backup panel.
- ⑩ Verify if additional AC disconnect is required 2017 NEC 706.7
- ⑪ Rapid Shutdown initiator may be either AC disconnect or AC breaker(s) in IQ Combiner or Enpower. Consult local and state Code for initiator location.
- ⑫ The Utility may require an AC disconnect per the interconnection agreement. Optionally, this disconnect can aid in servicing Enpower when necessary. If provide, the GEC system bonding jumper should be installed in one location, at the first disconnecting means.
- ⑬ Neutral to Ground Bonding Jumper, GEC, and Grounding Electrode.
- ⑭ Junction box 600 V, NEMA 4, UL Listed
- ⑮ NEC 710 requires hold down kit (BRHDK125) for ESS Breaker.



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## Additional Information

Please refer to the Enphase website to find additional information.

Technical Brief – North America: “Planning an Enphase Ensemble™ Energy Management Technology System”

[https://enphase.com/sites/default/files/2021-05/Ensemble\\_Storage\\_System\\_Planning\\_Guide\\_Tech\\_Brief\\_NA\\_0\\_0.pdf](https://enphase.com/sites/default/files/2021-05/Ensemble_Storage_System_Planning_Guide_Tech_Brief_NA_0_0.pdf)

Technical Brief – North America: “PCS Integration in Enphase Storage System”

<https://enphase.com/sites/default/files/2021-05/PCS-Tech-Brief.pdf>

Technical Brief – North America: “Load and Solar Circuit Control using Enpower Auxiliary Contacts”

<https://enphase.com/sites/default/files/2021-05/Load-and-Solar-Circuit-Control-Technical-Brief.pdf>

Quick Install Guide: “Install the Enphase Enpower™ Smart Switch”

<https://www4.enphase.com/en-us/support/enpower%E2%84%A2-smart-switch-quick-install-guide>

Data Sheet: “Enpower™ Smart Switch Data Sheet”

<https://enphase.com/sites/default/files/downloads/support/Enpower-DS-EN-US.pdf>

Data Sheet: “Encharge 3™ Data Sheet”

<https://enphase.com/sites/default/files/downloads/support/Encharge-3-DS-EN-US.pdf>

Data Sheet: “Encharge 10™ Data Sheet”

<https://enphase.com/sites/default/files/downloads/support/Encharge-10-DS-EN-US.pdf>

Quick Install Guide: “Encharge™ Storage System Quick Install Guide”

<https://enphase.com/sites/default/files/downloads/support/Encharge3-10-QIG-EN-US.pdf>

Data Sheet: “Enphase IQ Combiner 3/3C-ES Data Sheet”

<https://enphase.com/sites/default/files/IQ-Combiner-3-ES-and-3C-ES-DS-EN-US.pdf>

Quick Install Guide: “Enphase IQ Combiner 3/3C-ES Quick Install Guide”

<https://enphase.com/sites/default/files/2021-05/IQ-Comb-3C-ES-QIG-EN-US-08-11-2020.pdf>