Export Limiting – HEI Self-Supply Compliance

Background

The high penetration of distributed energy resources, namely rooftop PV, in Hawaii have led to a number of changes to existing grid interconnection programs. As of October 12, 2015 the Net Energy Metering (NEM) program was fully subscribed and all applications submitted after this date are required to be filed under two replacement interconnection programs: Customer Grid Supply (CGS) and Customer Self Supply (CSS). The Enphase S-Series Microinverters™ are approved for both of these programs.

Customer Self Supply systems have a requirement to limit the export of power from the PV system to the grid. Essentially, all power produced by the system must be consumed on site instead of being exported to the grid in return for credits. To comply with the needs of the Hawaiian market and interconnection requirements, some inverter technologies are advanced enough to be certified as limiting production of the PV system to match the site consumption needs, thus limiting the amount of energy exported to compliant levels.

HEI's CSS program makes a case for on-site storage, creating a compelling reason to install Enphase S-Series Microinverters that are not only CSS compliant, but storage-ready as well. This system requires installation of the Enphase Envoy-S Metered™ gateway with consumption CTs, which handles the control of the self-supply functionality and the near-future Enphase AC Battery upgrades.

Timeline

- **October 1, 2015**: As of this date all applications submitted require PV inverters to be certified and capable of complying with Transient Overvoltage/ultra-fast trip (Tr-OV-2) and Frequency/Voltage Ride-Through (FVRT) requirements set forth by the Hawaiian Electric Companies.
- **October 12, 2015**: NEM is fully subscribed and no longer offered to new customers. Current NEM Agreements and customers with pending applications submitted prior to 10/12/2015 continue under NEM.
- **October 13, 2015**: All new applications for interconnection to be submitted under either Customer Grid Supply (CGS) or Customer Self-Supply (CSS) programs.
- **January 1, 2016**: All new PV system applications require advanced inverters capable of a fixed power factor of 0.95. Advanced inverters must also be capable of being updated to comply with all 11 advanced inverter functions within one year of UL1741 Supplement A being approved.

Customer Grid Supply

Complying with the requirements of the CGS program requires no special configurations for an Enphase system. Systems approved for CGS are approved for backfeed. However, energy delivered to the grid is credited at a pre-determined rate. Enphase Microinverters installed within the CGS program must comply with the Tr-OV2, FVRT, and AGF requirements set forth by Hawaiian utilities. An Envoy-S is required for the application and verification of these settings.

System Requirements:

- S-Series Microinverters (S230 or S280)
- Envoy-S Standard or Metered gateway
- Implementation of HEI-compliant profile: HEI 2015 Oahu-Maui-Hawaii Full
- Submittal of proof that inverters comply with advanced inverter interconnection requirements

Customer Self Supply

Customers wishing to apply for the CSS program can receive the benefit of an expedited interconnection process. However, these systems must comply with the rules that are specific to this program. Systems installed under the CSS program are not credited for any power that is exported to the utility. The following rules limit the duration and cumulative amount of exported energy. Inverters certified for installation under this program have demonstrated compliance with all the export rules in place.

Inadvertent Export Rules

Event Duration Limit: Systems may export power. However, the duration of export shall be less than 30 seconds for any single event.

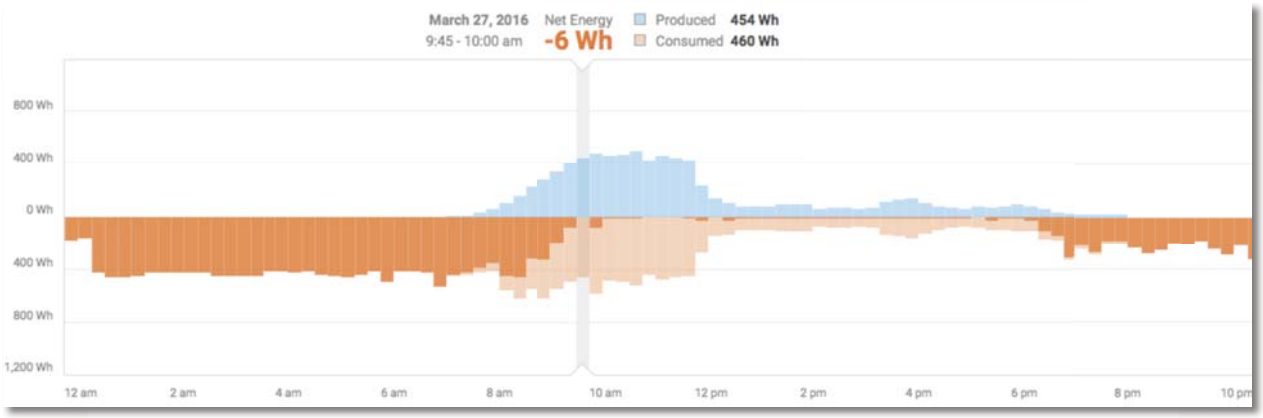
Event frequency: There are no limits on the frequency of exports in any given period.

Net Export Limit: Systems shall not export more than the generating facilities nameplate rating (kW gross) multiplied by one hour per customer billing cycle. **For example,** the inadvertently exported energy of a 5kW system shall not exceed 5kWh per billing cycle

Control System Failure: In the event that a system exports real power to the grid for longer than the acceptable event duration of 30 seconds, the system shall cease to energize within two seconds and will enter a safe operating mode until real power output control has been reestablished.

Enphase Export Limiting Performance

The following screenshot was taken from an active system in Enlighten with zero-export settings enabled. Since there is no storage installed at the site, the PV system curtails power production if the production of the system exceeds the consumption needs of the site. From 9:45 am until 6:00 pm, the Envoy-S was actively controlling the output of the system to match the site consumption and limit export. Systems equipped with the Enphase AC Battery will be capable of storing excess energy produced to further offset energy consumption outside of solar production hours.

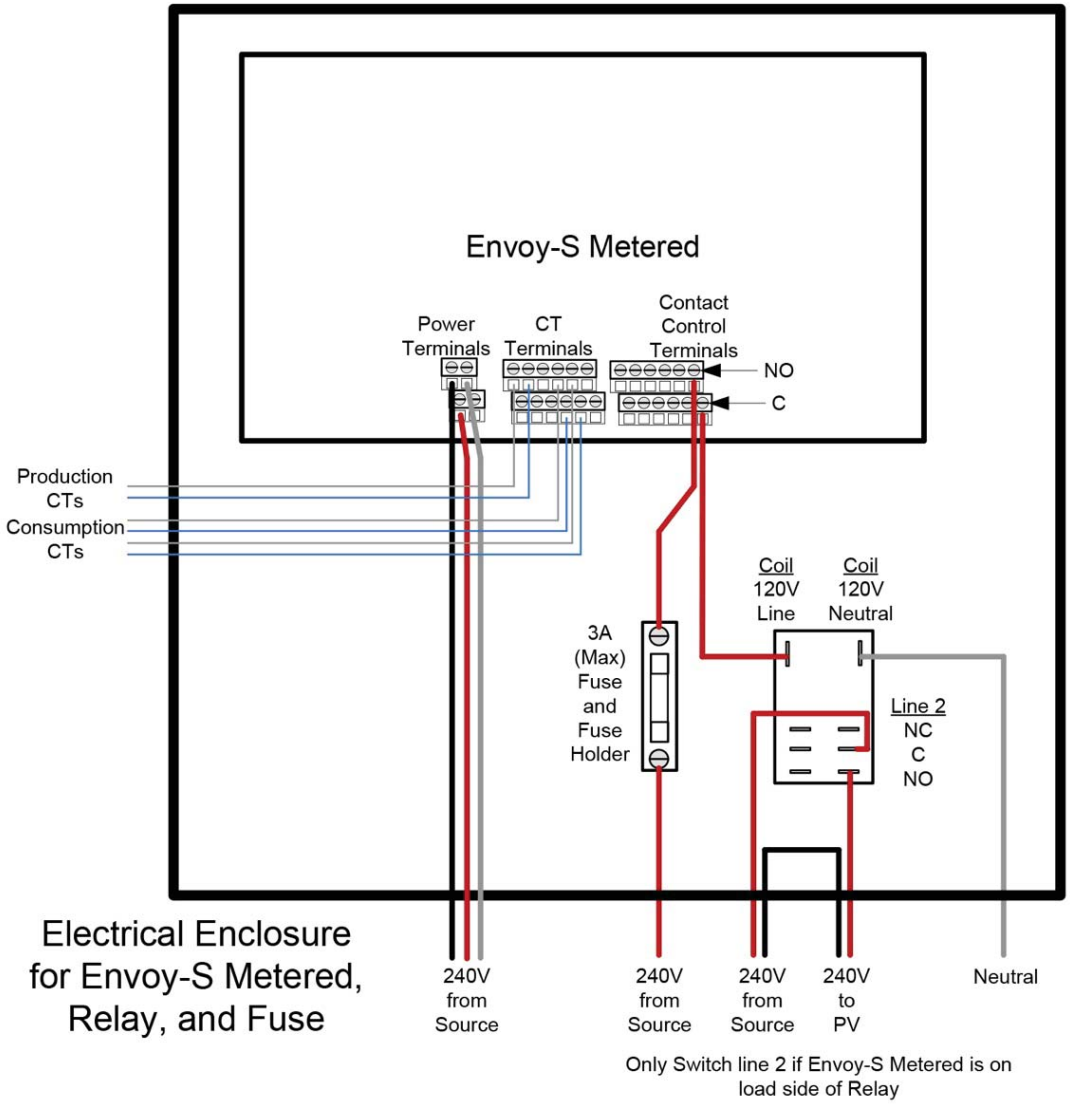


The Enphase Energy Management System uses data collected by the Envoy-S consumption and production meters and automatically adjusts the output of the microinverters whenever the output of the PV system exceeds consumption needs for the site. This power curtailment functionality is essential to maximize the system output while limiting the export of power to the grid. These adjustments to microinverter power output are sent from the Envoy-S over the powerline, so there is no need to install external communications. Pulling data from the consumption meter every 500ms and making adjustments to microinverter output at 1.5s intervals, an Envoy-S, with self-consumption enabled, consistently reacts to inadvertent export events within two to four seconds — well within the 30 seconds allotted by the utility.

In some instances, there may be drastic fluctuations in net loads at a site, and while the Enphase systems react quickly to these changes, there may be an inadvertent export of power. The above image offers a more detailed view and illustrates how the PV system will adapt power output to match the consumption needs of the site. In this scenario, the reduction in system power output was a direct result of the drop in net consumption at the site and inadvertent export duration was limited to less than three seconds.

System Requirements:

- S-Series Microinverters (S230 or S280)
- Envoy-S Metered gateway with production and consumption metering enabled
- Normally Open, Double Pole, Single Throw (NO-DPST) or Double Pole, Single Throw (DPST) relay
- Implementation of HEI-compliant profile: HEI 2015 Oahu-Maui-Hawaii Full, Self Supply



Conclusion

An Enphase S-Series system has all of the functionality required to comply with the CSS requirements and does not rely on external communications to limit inadvertent export. Refer also to our document describing additional site-specific equipment needed to allow systems to comply with the CSS requirements for a loss of communication scenario.