



Smart Energy Designed in California

Advantages of Enphase's Microinverter



Reliable

- **0.07%** failure rate, with no single point of failure in the system.
- One million power-on hours of testing per product.
- **No moving parts** in our inverters, meaning lesser failures.
- Highest quality with **IP67 Class II** enclosure.



Safe

- **Self-Extinguishing AC arc fault.**
- **Built-in DC arc fault mitigation.** No high voltage DC on the roof.
- Enphase Microinverters are **Rapid Shutdown compliant.**



Powerful

- Burst-Mode technology allows for energy generation even at lower irradiance levels. **Generates more power** during the life of the system compared to any other inverter system.
- Maximum Power Point Tracking (MPPT) per microinverter allows for **per module energy harvest optimization.**



Scalable

- Modular system allows for **PV system expansion possibilities** based on your personal energy needs.
- IQ7 is compatible with Ensemble (Coming Soon).



Smart

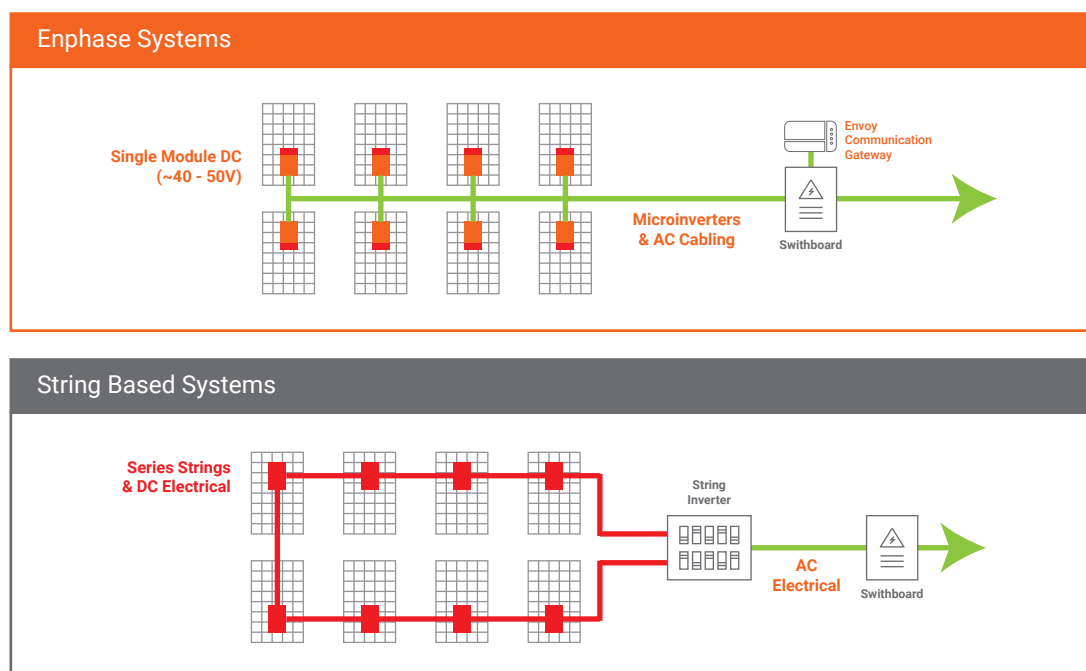
- Enphase cloud services shows **per-panel energy production.**
- **Advanced Grid Function ready.** Comes with power export limiting.
- Software defined architecture (ASIC integration) **allows Over-the-Air software upgrades and remote troubleshooting.**
- **Plug-N-Play architecture lowers cost** with faster and easier installations

Fire Safety with Enphase's Microinverter

Be Safe.*

Safety concerns for solar are primarily related to the DC voltage and current. At low levels, they are relatively harmless. However, as the DC voltage level increases, so does the risk of harm associated with it, including dangerous fire hazards.

With old fashioned string inverters (whether they have optimizers on them or not), the PV modules are wired in series configuration (see figure below). Every panel added to the series increases the DC voltage in the circuit. Large systems can have between 600-1000 volts, and small systems can have around 350-400 volts DC, which can be potentially dangerous. Not only is this dangerous for homeowners, but also for the crews installing and maintaining the systems.



The problem with High Voltage DC on your roof is the fact that it can lead to an arc fault. Small gaps (those between 10-20mm) in the wiring will allow for the electrical current to jump the gap creating an arc fault. The arc of a DC can get hot enough to melt tungsten! This proves how dangerous it can be to have a high voltage DC system on your roof. A small sustained arc can lead to dangerous fires. Enphase Systems attaches a microinverter under each individual module. The DC is converted to AC at the module level by the microinverter, and therefore the DC voltage remains low. The rest of the system then operates in the AC domain (see figure above).

Want to learn more about the fire safety of Enphase microinverters? Contact your account manager or call us for a conversation and an even more elaborate document about our safety.

*Refer to the Enphase fire safety whitepaper for more information.

Competitive Analysis

	Enphase Microinverter Systems	Competition Microinverter Systems	Optimizer based String Inverter Systems	String Inverter Systems
Base Inverter Warranty	25 Years	10 Years ¹	12 Years ¹	5 Years ¹
Reliability ²	HIGHLY RELIABLE	LESS RELIABLE	LESS RELIABLE	LESS RELIABLE
System Architecture	AC-coupled	AC-coupled	DC-coupled	DC-coupled
Fire Safety	SAFE ³	NOT-AS-SAFE ⁴	NOT-AS-SAFE ⁵	NOT-AS-SAFE ⁶
Communication Gateway Limited Warranty	5 Years	3 Years	5 Years	5 Years
No Single Point of Failure	✓	✓	✗	✗
Burst-Mode Technology ⁷	✓	✗	✗	✗
DC to AC efficiency	97%	96%	97% ⁸	97%
Maximum Power Point Tracking	✓	✓	✓	✗
Energy Optimization per Panel	✓	✓	✓	✗
Panel level Monitoring	✓	✓	✓	✗
Shading and Soiling Losses	NIL	NIL	NIL	HIGH
Ease of Installation	AC-ONLY DESIGN	AC-ONLY DESIGN	DC + AC DESIGN	DC + AC DESIGN
Modular/ Scalable	✓	✓	✗	✗
Rapid Shutdown Compliant	✓	✓ ⁹	✓	✗
No Moving Parts ¹⁰	✓	✗	✗	✗
Storage Portfolio	✓	✗	✓ ¹¹	✗
Product Rating	IP67	IP67	IP67 (Optimizer) NEMA3R (Inverter)	NEMA3R
System Downtime for Replacement	NIL	POSSIBLE ¹²	YES ¹³	YES
High Voltage DC Arc Mitigation	✓	✓	✓	✗
Low Voltage DC Arc Mitigation	✓	✓	✗	✗
App Store Rating of the SW Application ¹⁴	HIGH (4.6 / 5)	LOW (<2.5 / 5)	HIGH (> 4/ 5)	LOW (<3/ 5)
Min # of PV Modules Required	1	2	8	8
System Configuration	Parallel	Parallel	Series	Series
Weight	LIGHT WEIGHT	HEAVIER ¹⁵	HEAVIER	HEAVIER
Noiseless Inverter	YES	RELAY INSIDE	RELAY INSIDE	RELAY & FAN INSIDE
DC Design	NOT REQUIRED	NOT REQUIRED	REQUIRED	REQUIRED
Module Mismatch Losses	NIL	NIL	YES	YES
Light Induced Degradation	LESSER IMPACT	LESSER IMPACT	YES	YES
Potential Induced Degradation	LESSER IMPACT	LESSER IMPACT	YES	YES
Thermal Dissipation Issues	NIL	YES	YES	NIL

¹ May be extended for an additional cost

² Assuming base inverter warranty period indicative of reliability

³ Capable of mitigating low voltage DC arc; no thermal dissipation issues

⁴ Thermal dissipation issues make it prone to fire hazards

⁵ Failure of even one Optimizer will deteriorate the safety factor of the system because the DC will leak through when the inverter is not functioning/ has failed. This invariably increases the risk of DC arc fault

⁶ High Voltage DC in the string. Highly susceptible to DC arc fault

⁷ Power generation under low light condition. No inverter wakes up as early as an Enphase microinverter and sleeps as late as an Enphase microinverter

⁸ DC to AC Efficiency = OE * IE, where, OE = Optimizer Efficiency = 99% (Not verified by any agency), and IE = Inverter Efficiency = 98%

⁹ Requires an external device. Not built-in

¹⁰ Moving parts lead to higher chances of failure (Ex: Fan, Switches, Relays, ...)

¹¹ Do not have batteries of their own. Compatible with 3rd party DC storage solution

¹² In a 1kW system, if one microinverter fails, the entire system is down. This plays a major role in case of Social Housing applications

¹³ When the Inverter fails, not when Optimizer fails

¹⁴ As of Jan. 29, 2020

¹⁵ Heavier microinverters add substantial stress on the mounting frames