

# 2013

INVOLAR corporation Ltd.

# INVOLAR

MICROINVERTERS

Imagination is the limit

# Microinverter

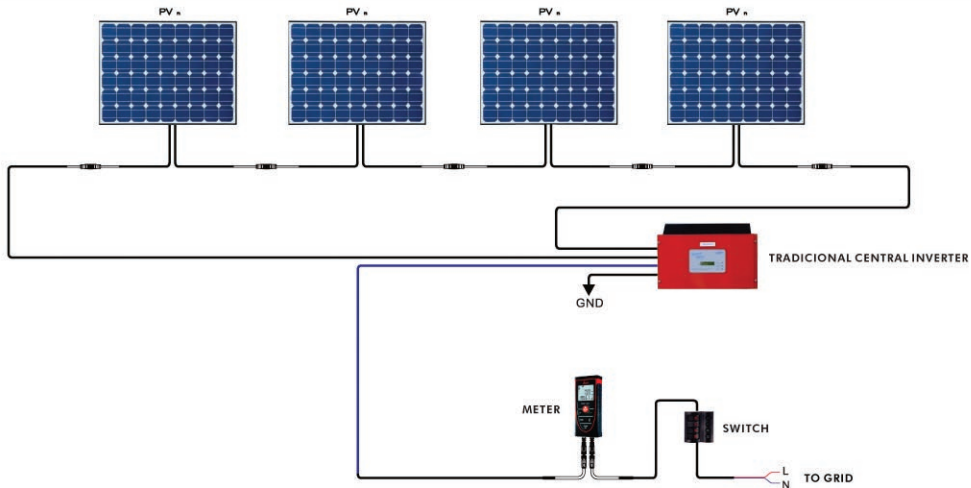
The new PV technology upgrade



A **Microinverter** is a device that is connected to a single photovoltaic panel and converts the DC power from that panel into grid-compliant AC power.

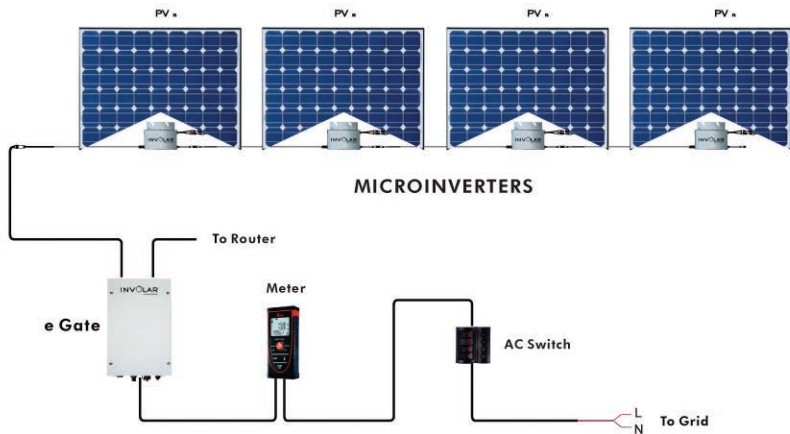
# Traditional inverter

## System Configuration



# Microinverter

## System Configuration



Increased **lifetime** and **reliability** (double lifetime)

No single-point failure with system **availability** of **100%**

Maximized **energy harvest** (average +16%)

Reduced power loss with shade, dust and debris

**Simple** design, with **Plug and Play** installation

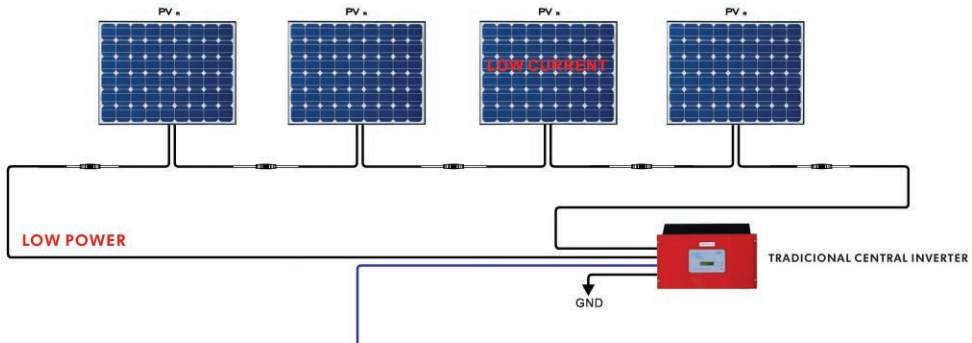
Improved **safety** with no high voltage hazards

No bulky and noisy inverter unit

Internet **24h** smart monitoring for each PV module

# Traditional Inverter

Series connection



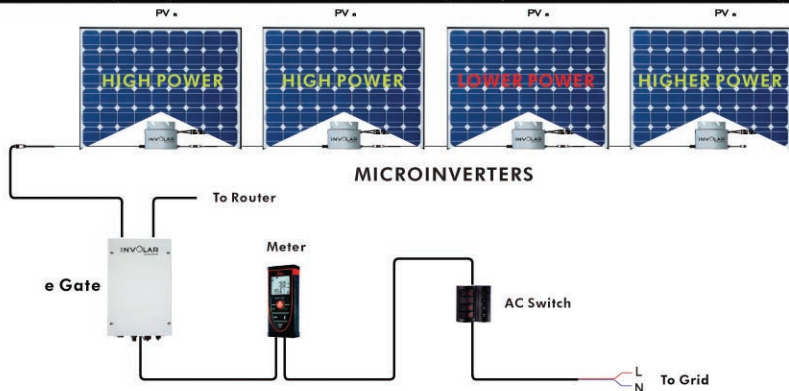
Current is equal in a series circuit

Lowest performing module determines the current for the string (**Christmas light effect**)

If **shading** occurs, production can be reduced by **60%**

# Microinverter System

Single panel optimization and parallel connection



Parallel connection - One panel underperforming does not affect production of other panels.

Power optimization at single panel level.

# Microinverter

Increased lifetime and reliability

## Warranty

Traditional central Inverter – **5 Years**  
(replacement is certain during the panel  
lifetime of 20 years)

Involar Microinverter - **15 to 25  
years** (match panel warranty)

Microinverter system longer lifetime,  
allows upgraded end customer  
warranty, giving microinverter installers  
an edge in competitive markets.

## How can Microinverter lifetime be so long?

Each microinverter deals with low  
power, component are not  
subjected to high operating stress.  
No moving parts.

Involar microinverters are completely  
isolated from dust and humidity,  
fully covered in silicon material,  
inside an ambient resistant,  
aluminum casing.



# Microinverter

Increased lifetime and reliability

No single-point failure with system availability of **100%**

If a central inverter fails all panels will be stopped and production will be lost

Even if one microinverter fails the other units keep producing power.



# Microinverter

Maximized energy harvest

Shade, dust and debris – **up to 54% power loss reduced** by optimization of each panel, and parallel system connection



Involar Instalation - Italy

# Microinverter

Maximized energy harvest

Different roof orientations, for maximum space utilization **possible!**  
No power loss.



Involar Instalation - Belgium

### Commercial Solar Design

"A micro inverter individualized solar panel harvest will **supply somewhere between 5%-25% increase in electricity output** when compared to a string inverter configuration."

### ENERGYINFORMATIVE

"Micro-inverters perform **5-25 % better through the use of MPPT** compared to systems using central inverters."



Involar Instalation - Sweden

# Publication studies

Increased Power Production

## RenewableEnergyWorld.com

"The per-module micro-inverter also eliminates the problem of reduced energy harvest due to module mismatch. **Tests have shown an increase in energy harvest in the order of 5 to 25%.**"

## Green World Investor

"Shading of as little as 9% of the entire surface array of a PV system can, in some circumstances, **lead to a system-wide power loss of as much as 54%**"



Involar Instalation - Germany

### SOLARLINE

"...modern micro inverter has resulted in a **5% to 25%** increase in energy harvest and a **13% to 15%** balance-of-system saving. These savings more than compensate for the 20¢ extra per watt it costs to integrate a micro inverter into a small solar power system."

### SolarEnergyExplorer.com

"Microinverters can improve the amount of power harvested by **5% to 30%**."



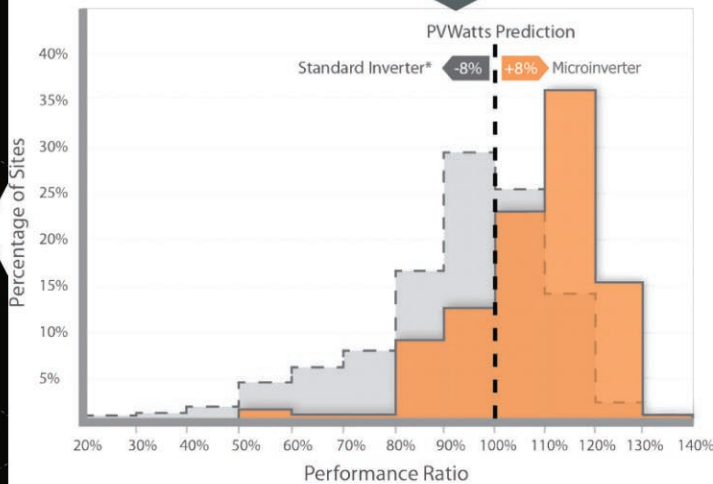
Involar Instalation - Barbados

# Field Measurements

Increased Power Production

143 Field Installations  
compared

16% more power  
compared  
to traditional inverter



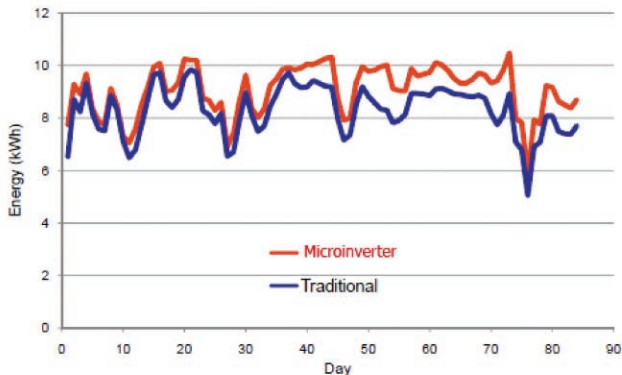
\* Source: Gostein, et al., 2009

# Field Measurements

## Increased Power Production



- ⇒ Installation in Petaluma, CA
- ⇒ 24 Suntech 175W modules in checker board pattern
- ⇒ Traditional string inverter
  - CEC efficiency – 94.5%
- ⇒ *Independent meter – 1%*



Power production in real field measurements (143 installations), on average **16% more power** compared to traditional central inverter.



University of North Carolina –  
Controlled study measured  
**21%** more power compared to  
traditional inverter (**26.3%**  
more power with only 0.8%  
panel shading)

39

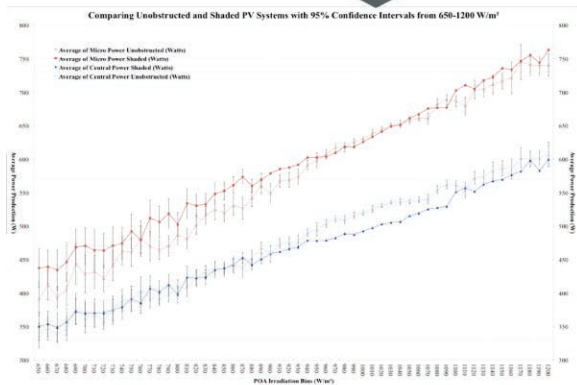


Figure 11. Chart comparing the power outputs of microinverters and central inverters. Error bars indicate 95% confidence intervals. Notice the bar overlap at 650 W/m<sup>2</sup>, were comparative results become statistically insignificant.

\*David Meriwether Lee, A DIRECT COMPARISON BETWEEN A CENTRAL INVERTER AND MICROINVERTERS IN A PHOTOVOLTAIC ARRAY

# INVOLAR microinverters

Plug and Play - Simple, Quick installation

- No string sizing calculations and DC wiring.
- Cables between microinverters already included, the simplest plug and play "chain" cable system on the market.
- Expensive additional "BUS" cables not necessary.



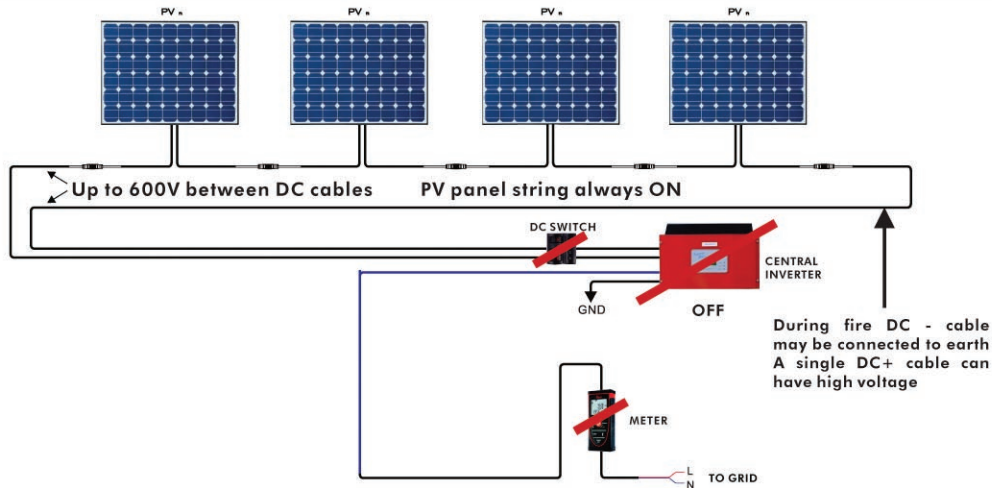
# Central Inverter VS Microinverter

**Fire Safety**



# Central Inverter System

Fire safety



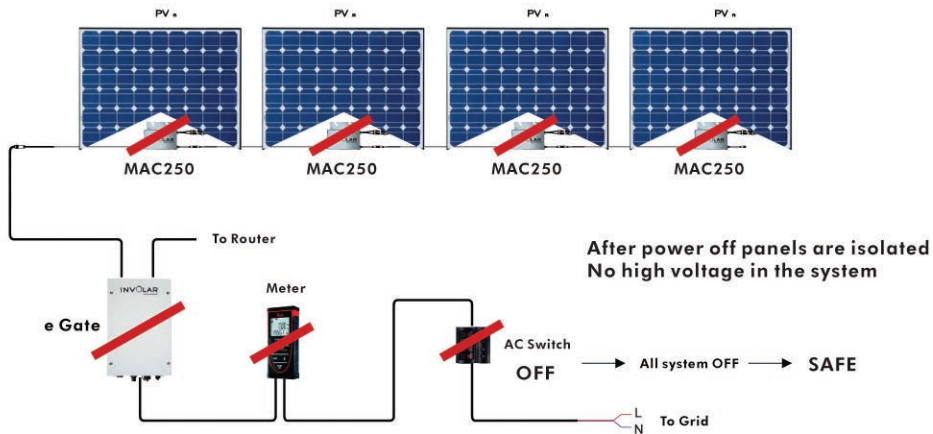
With normal central inverters, even if all power and devices are turned off, the PV Panels will still be connected in series producing high DC voltage.

Burned DC cables carrying of up to 600V will be exposed in the roof.

Contact with these wires can be lethal for fire fighters and construction workers.

# Microinverter System

Fire safety



## Microinverter System

## Fire safety



When operating normally, each cable carries the normal 230V AC.

When power is disconnected, all the microinverters attached to each panel will turn off, and there will be no high voltage in the cables.

Each panel will be isolated and the system is completely safe.

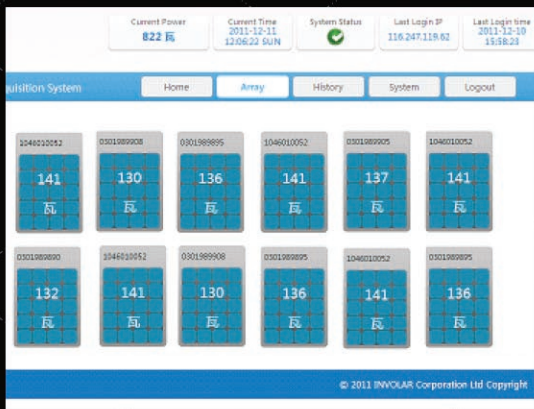
# Central Inverter

Bulky, Noisy, Dangerous

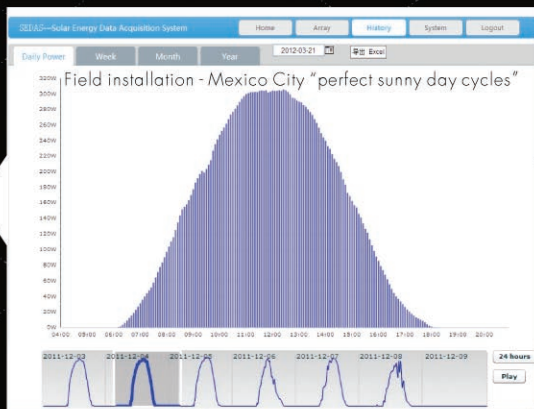


- **Dangerous** DC cables carrying of up to **600V** easily accessible!
- Traditional Inverter cooling fans are **noisy**.... Not the best neighbor!
- Solar belongs on the roof!





Individual panel performance and failure detection



Online , 24h, Smart system monitoring

- With INVOLAR **online (Sedas)** monitoring system information is displayed in **real time**.
- Any underperforming panel can be replaced by the manufacturer, under the 20 year panel warranty.

- With a **traditional central system** it is difficult to know if some panel is moderately underperforming and affecting the entire system.
- **Power production losses** over a long period (years) can cost more the inverter unit itself!

# Central Inverter VS Microinverter

- **Central inverter will need to be replaced** at least once (expected lifetime **10 years**) during the 20 year panel warranty, this will **add substantially to the inverter costs**.

- **Microinverter** (tested life time **+30 years**) under strict, life acceleration testing, also used for PV panel lifetime prediction, with **warranty 3 times** longer than traditional inverters and matching the warranty for PV panels. !!!!

## ROI (Return On Investment)

Despite many advantages, sometimes **its all about the money!**

- Initial cost of microinverter system full PV system, including panels and installation costs. **10% higher**
- **Smart monitoring** system **prevents high long term production losses** due to continuous single panel underperformance, affecting the entire system.
- **16%** average more power output, quickly repays the cost difference, and pays for itself. (higher difference if there is any shading)

The highly compatible **MAC250** microinverter, allows for low inventory and quick deployment in different project types, with the same type of device.

Highly flexible units can adapt to most customers around the world, therefore there is always available stock for quick deliveries. this allows for the **shortest delivery lead times** out of any manufacturer.

The most **flexible** microinverter available. The **MAC250** is compatible with the all of the most common modules on the market.

**MAC250** can operate with the majority of **crystalline modules**, for example 60 or 72 cells, covering most of panel power ranges available.

The **most cost effective** microinverter, total solution, on the market.

Involar has the most **worldwide** distributed microinverter (over 30 countries), compatible with all grid types and requirements.

The manufacturer with **most safety and quality, international standard certifications.**



AUSTRALIA - BELGIUM - BRAZIL - BARBADOS - CANADA - CHILE - CHINA - COLOMBIA - CYPRUS - CZECH REPUBLIC  
DENMARK - FINLAND - FRANCE - GERMANY - GREECE - HOLLAND - ITALY - JAMAICA - JAPAN - KOREA - MALAYSIA - MALTA  
MEXICO - NEW ZEALAND - PORTUGAL - RUSSIA - SPAIN - SWEDEN - SOUTH AFRICA - TURKEY - UNITED KINGDOM - USA



Lombardia, Italy, 1st microinverter technology installation in Italy **14 MAC250 - 3.5 KW**



Topbio – 1st Microinverter installation technology in Czech Republic 24 MAC250 - 5.6 Kw





Huddinge, Sweden - 1st microinverter technology installation in Sweden 21 MAC250 - 5 KW



Wodecq , Belgium – Advanced installation -3 independent roofs connected **42 MAC250 - 10 Kw**



**JA SOLAR, factory, Shanghai. 4 MW. Largest Microinverter installation in the world**

More power production

Longer warranty

Higher Return On  
Investment!

The simplest, real, plug  
and play installation

Smart 24h monitoring

Safer, silent, discrete

# INVOLAR

Microinverters



Smart Technology!  
Smart Choice!