

**LUMEL**

**PHOTOVOLTAIC  
POWER FREQUENCY ANALYSIS  
WITH THE HELP OF LUMEL IED ND45  
(INTELLIGENT ELECTRONIC DEVICES)**



## Introduction

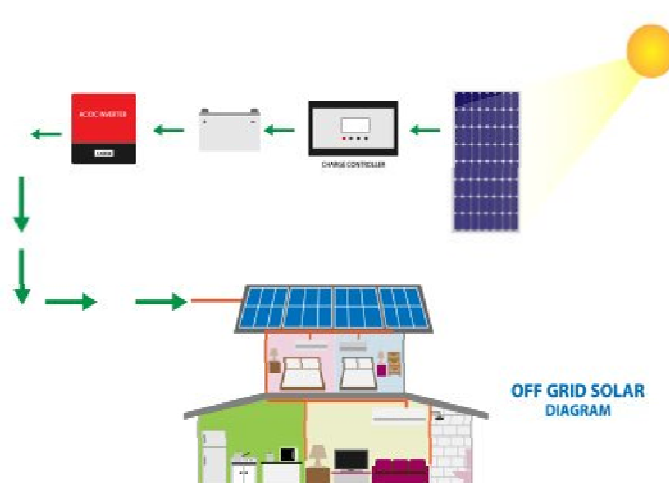
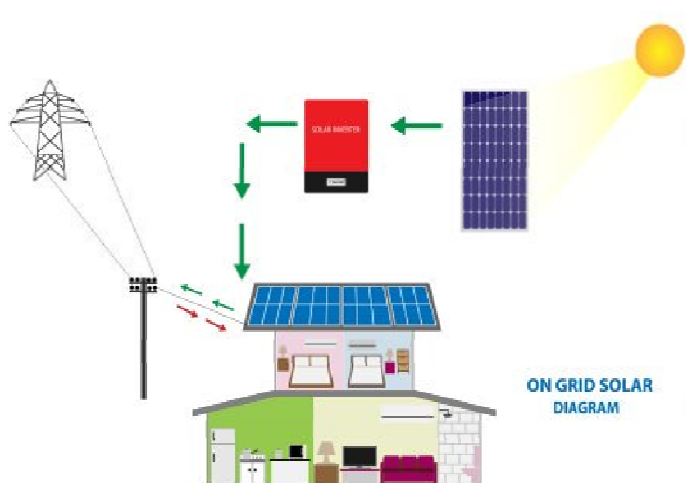
Solar power is quickly gaining popularity all over the globe. It is growing at a rate of 2% per year, and if the figures continue to grow, solar energy will be the preferred source of energy worldwide. Most modern nations are encouraging people to rely on this renewable resource so that they can save more and help conserve the environment. Worldwide [growth of photovoltaic](#) is extremely dynamic and varies strongly by country. By the end of 2019, a cumulative amount of 629 GW of solar power was installed throughout the world. By early 2020, the leading country for solar power was China with 208 GW, accounting for one-third of global installed solar capacity. As of 2020, there are at least 37 countries around the world with a cumulative PV capacity of more than one gigawatt.

Alongside Higher Generation Now Solar Power associated with National Grid and dealing with gigantic issue in power recurrence steadiness because of inconsistent accessibility of Sun Rays over the course of the day. Additionally because of inconsistent Load , voltage dip , Sag and Harmonics issues are emerges which need to Analyze and Nullify with appropriate activities to make productive solar operation as well as increment the life expectancy.

## Photovoltaic Operation System.

1) On Grid

2) Off Grid

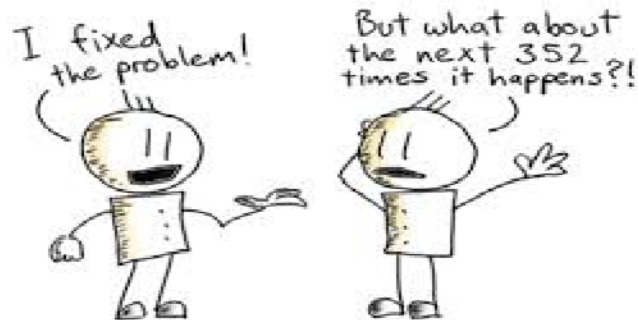


## ON-GRID

ON-GRID SYSTEMS ARE SOLAR PV SYSTEMS THAT ONLY GENERATE POWER WHEN THE UTILITY POWER GRID IS AVAILABLE. THEY MUST CONNECT TO THE GRID TO FUNCTION. THEY CAN SEND EXCESS POWER GENERATED BACK TO THE GRID WHEN YOU ARE OVERPRODUCING SO YOU CREDIT IT FOR LATER USE.

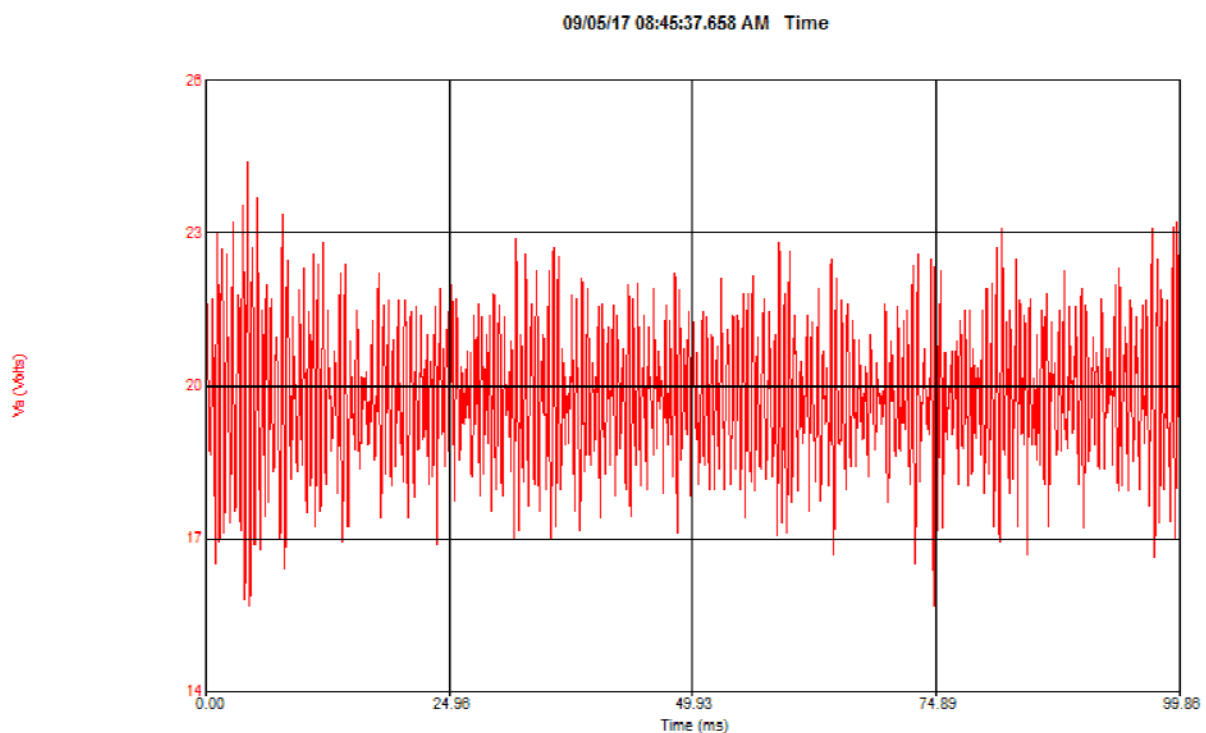
## OFF-GRID

THESE SYSTEMS ALLOW YOU TO STORE YOUR SOLAR POWER IN BATTERIES FOR USE WHEN THE POWER GRID GOES DOWN OR IF YOU ARE NOT ON THE GRID. HYBRID SYSTEMS PROVIDE POWER TO OFFSET THE GRID POWER WHENEVER THE SUN IS SHINING AND WILL EVEN SEND EXCESS POWER TO THE GRID FOR CREDIT FOR LATER USE.



## Power quality issues that arise with solar energy:

When solar systems are attached to the grid, we may see power quality problems occur for both the solar site and the utility. The output of a solar panel is always fluctuating. This output goes through an inverter in order to convert the DC to AC. An unconditioned AC voltage can create various power quality issues.



### 1) High voltage Issue :

High voltage is a power quality issue that can be faced when using solar panels. When the solar array is placed on a location, that location can experience higher voltage than normal, depending on the voltage conditioning equipment. Standard recommendations for low voltage systems in both Europe and the United States should

be within +/-10% of the nominal voltage for 95% of the time. It is also important that the voltage does not exceed +10% or -15% of nominal for 100% of the time.

## **2) Unbalance and transients in solar equipment:**

Unbalance in voltage or between phases is another problem utilities will face when solar is used. If the solar array is not connected to the phases, then an unbalanced voltage condition can occur. The more single phase solar arrays connected to the grid, the worse the problem becomes.

Transients are yet another issue that can arise when using solar power. Solar panels react nearly instantaneously to changes in solar radiation. The bandwidth of the solar radiation that effects solar panels is wider than our visual range, meaning even on clear days, the solar panels can be changing rapidly due to pollutants we do not see. If the solar system does not have proper voltage conditioning, this can create high-speed transients. These high-speed transients can have adverse impacts on residential and commercial electronics.

## **3) The problem with harmonics:**

Harmonics are yet another area to be looked at when using solar energy. Inverters convert the DC current to AC current. These non-linear devices can create harmonics. Inverters tend to operate at relatively higher frequencies in order to maximize their efficiency. However, the higher the frequency the inverter functions at, the higher order harmonics it creates. It is not uncommon to see harmonic orders up above the 40th order.

## **4) Distributed power generation and power reversal issues :**

Power reversal can also cause issues when using solar panels. The standard distribution power grid was designed in a radial fashion, meaning it was designed with the assumption that power would always flow from the source to the load. With the spread of distributed energy resources (DER), like solar, this no longer is true.

## LOOKING FOR SOLUTION



To resolve this **LUMEL** come up with All in one solution with **ND45** an Intelligent Electronic device with Data logging and report generating facility. ND45 have Measurement and recording of over 500 electric energy quality parameters, class A for selected parameters, harmonics and inter harmonics up to 51st, energy measurement in 4 tariffs, recording of measurements before and after events (dips and swells), configurable display and web server.





## Measurement with LUMEL ND45 :

In order to combat the numerous power quality issues that could arise with the use of solar panels, a power quality analyzer should be considered by users. The analyzer should be programmed to capture power RMS, power and energy, unbalance, voltage dip/sag, voltage swell, voltage sub-cycle events, phase angle deviation, rapid voltage change, total harmonic distortion (THD), total demand distortion (TDD), gap less harmonics, gap less inter-harmonics frequency, and flicker. Once all of this data has been captured, it is important to analyze it and understand the implications of the data gathered.

### 01) Determining dips/sags

With the help of ND45 we can easily Examine any voltage dips that fall from 90% to 0% of nominal voltage as well as log data in Memory card for data visualization and report generation These can be associated with both fluctuations in voltage and with loads turning on. When a load turns on it will draw an inrush of current. This sudden inrush of current can trigger the voltage to dip, causing lights to dim or equipment to trip off line. In residential applications it is not uncommon to see voltage dips occur when cooling systems turn on and off.

## 02) Examine swells.

In ND45 any voltage swells that rise from 100 % to 500% of nominal can be monitor and log in memory card. These can be caused by poor regulation from solar panels and also from loads turning off. Look at the current during a swell. When a load turns off a drop in current will be seen. In solar systems with poor voltage conditioning, over voltage conditions can be seen. This can cause light outputs to swell or breakers to trip off line. Over voltages can also cause motor cores to saturate.

## 03)Flicker and light fluctuation.

Flicker is another measurement of light fluctuations. The flicker measurement examines the voltage variations and applies a weighted curve to the measured variations. This weighted curve is based on incandescent lights. If these lights are flickering, then examine the Pst and Plt levels. If the Pst level exceeds 1.0 or the Plt level exceeds 0.8, then the voltage variations may be the cause of the incandescent light flicker.

## 04)Harmonics and Inter-harmonics.

Estimation of Harmonics and Inter harmonics up to 51st is conceivable with ND45 alongside THD , TDD estimation and come by result in Graphical , even and Chart design. Harmonics result to heating the device by decreasing voltage and increasing current.

## 05) Data Visualization and logging.

For data logging ND45 is come up with 8GB memory card which is expandable up to 32 GB along side ND45 have WWW server for data visualization and to archive the recorded file. With the assistance of Power vis programming you can undoubtedly Analyze the Archive record information in waveform and even table format and produce report in Excel as well as PDF.

Ref :

01 )Solar world : <https://www.solarpowerworldonline.com/>

02)Wikipedia: [https://en.wikipedia.org/wiki/Solar\\_power\\_by\\_country](https://en.wikipedia.org/wiki/Solar_power_by_country)

03) Electrical Engineering portal



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