

# POWER ENGINEERING

## HYBRID POWER SYSTEMS



ENERGY GENERATION



## HYBRID POWER SYSTEMS

With the Hybrid Power System product line PRAMAC intend propose electrical power supply solutions which allow integrate power sources such as conventional diesel generators sets, renewables and/or electricity grid with an energy storage system.

Hybrid Power System can be easily configured to meet a broad range of power needs coming from several market segments/applications.

Business Area:

POWER

TELECOM

AC Genset + Hybrid  
Module



DC Genset



Variable Speed diesel engine  
+ PMG alternator + Hybrid  
Box

RENTAL &  
MOBILE



Power  
Pack  
Power  
electronics+  
Battery pack



Hybrid  
Power  
Generator  
Diesel  
genset +  
Batteries

## TELECOM

To meet the increasing demand for operating expenses reduction PRAMAC has developed hybrid power solutions dedicated to the Telecom business which allows coupling diesel generating with energy storage system and, if present or required, solar a power plant and main electrical grid.

The proposal is made through two main solutions based on the technology used for diesel generating set (AC constant speed or DC variable speed)

### System configuration

- **AC Diesel Generator** assembling constant speed engine and synchronous brushless alternator
- **Hybrid Power Module** integrating:
  - ✓ Energy and battery management system
  - ✓ Power electronics
  - ✓ Lithium batteries pack

*Possible integration for solar and/or electrical grid*

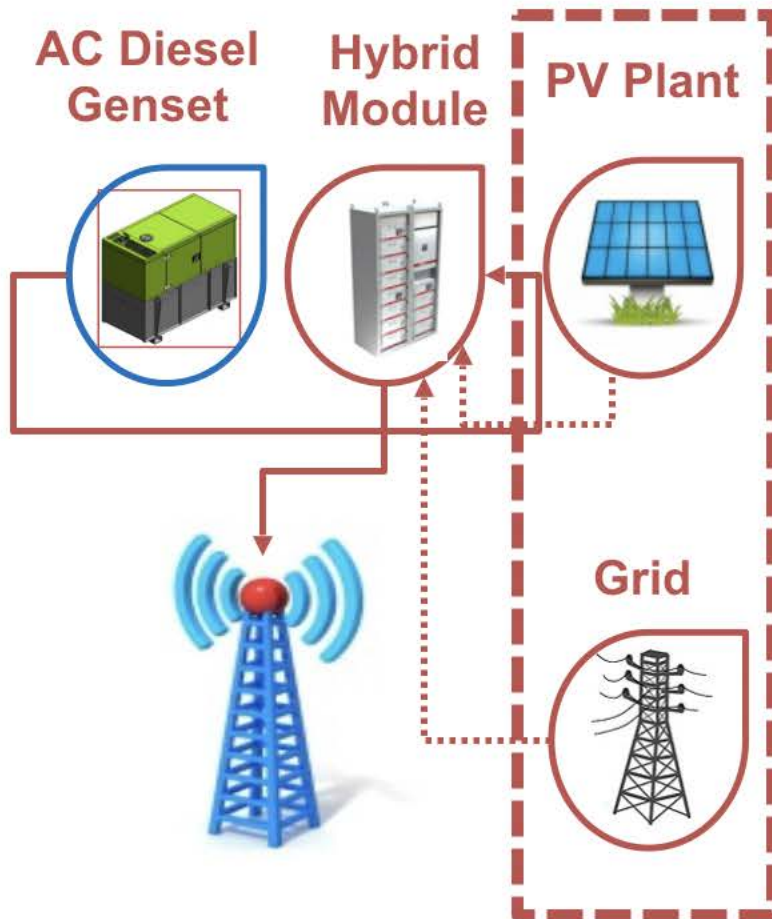
### System configuration

- **DC Diesel Generator** assembling variable speed engine and PMG alternator
- **Hybrid Power Box** complete with:
  - ✓ AC-DC converter
- **Energy storage system** made up of lead-acid or VRLA batteries

*Possible integration for solar and/or electrical grid*



## TELECOM – Hybrid Power System with AC Genset



PRAMAC has developed this new solution which allow coupling a traditional AC diesel genset with an energy storage system. If required can be also possible integrate solar power supply and/or electrical grid.

At the heart of the system there is the **Hybrid Module** which integrate power electronics and batteries all compiled in a single cabinet.

The system can be configured to have different voltage outputs such as -48VDC, 230/400VAC or both of them according to customer needs.

The power electronics have last-generation technology which control and manage the energy storage system and the BTS power supply.

The energy storage system is proposed with Lithium batteries.

Thanks to the clever plug-in system it is possible use this solution for new-made installations or to hybridize and retrofit existing standard AC diesel generators.

## TELECOM – Hybrid Power System with AC Genset

With this configuration there are two main system design proposed:

### AC Genset + Hybrid Module

Modular system suitable for indoor and outdoor installations.



AC diesel genset  
*Possible integrated  
extended fuel tank*



Hybrid Module

### HYBRID POWER QUBE

All-in-one design which allow have single robust and vandal proof enclosure suitable for remote and outdoor installations.



AC Genset



Large fuel tank



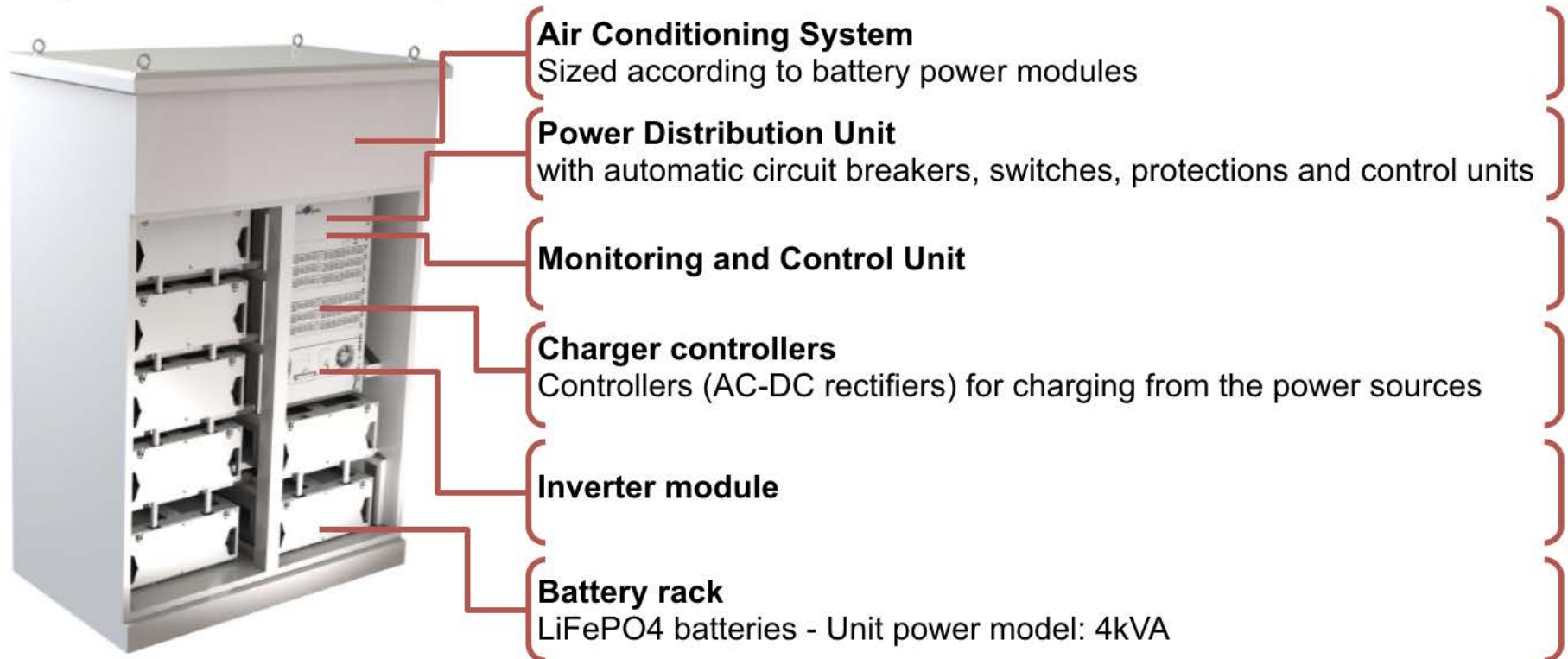
Hybrid Module

## TELECOM – Hybrid Power System with AC Genset

### Hybrid Module

It is the heart of the system and can vary as mechanical design according to the power, the sources to be managed and the final installation (indoor or outdoor).

As general overview the Hybrid Module consist of:



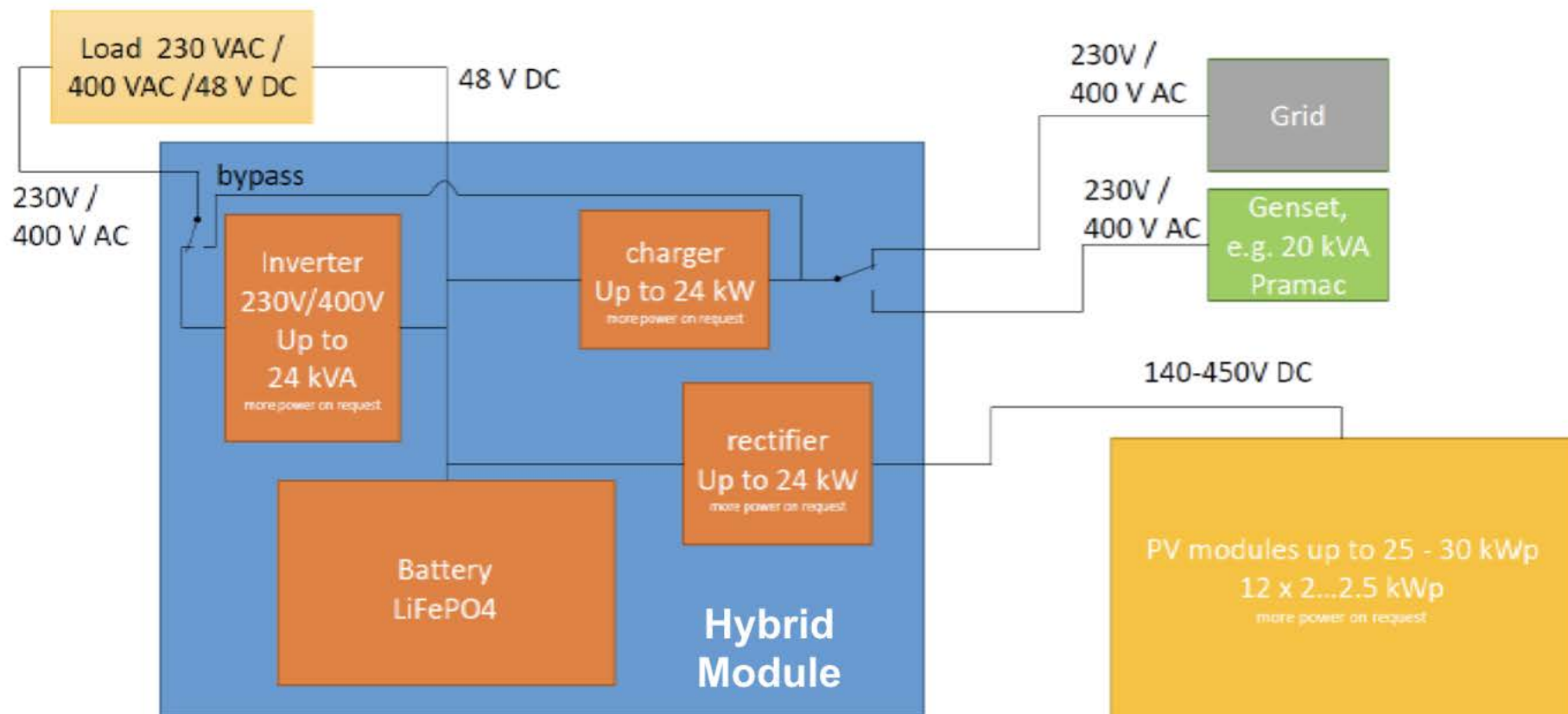
*The Hybrid Module combines effectively the power from different energy sources like diesel genset, renewables and/or grid. The power supply to the load is every time trough the batteries which store the energy generated from the power sources.*



## TELECOM – Hybrid Power System with AC Genset

## Hybrid Module

## Block Diagram



## TELECOM – Hybrid Power System with AC Genset

### AC Genset + Hybrid Module Standard Sizes

In order to standardize the basic proposal for Telecom business as BTS power supply it has been defined two sizes that cover two different average load range.

It refers to a system configuration which combine diesel generator set and energy storage system with 48VDC output, which is large demand for remote located BTS in the Telecom business. Other configuration can be proposed according to customer needs.

#### BTS with average load up to 3kWe

- Generating set: 7kWe Prime Power
- Hybrid Module HM12-250-48:
  - ✓ 12kW Power Electronics
  - ✓ 250Ah LiFePO4
  - ✓ 48VDC voltage output



#### BTS with average load from 3kWe up to 7kWe

- Generating set: 7kWe Prime Power
- Hybrid Module HM12-250-48:
  - ✓ 24kW Power Electronics
  - ✓ 500Ah LiFePO4
  - ✓ 48VDC voltage output



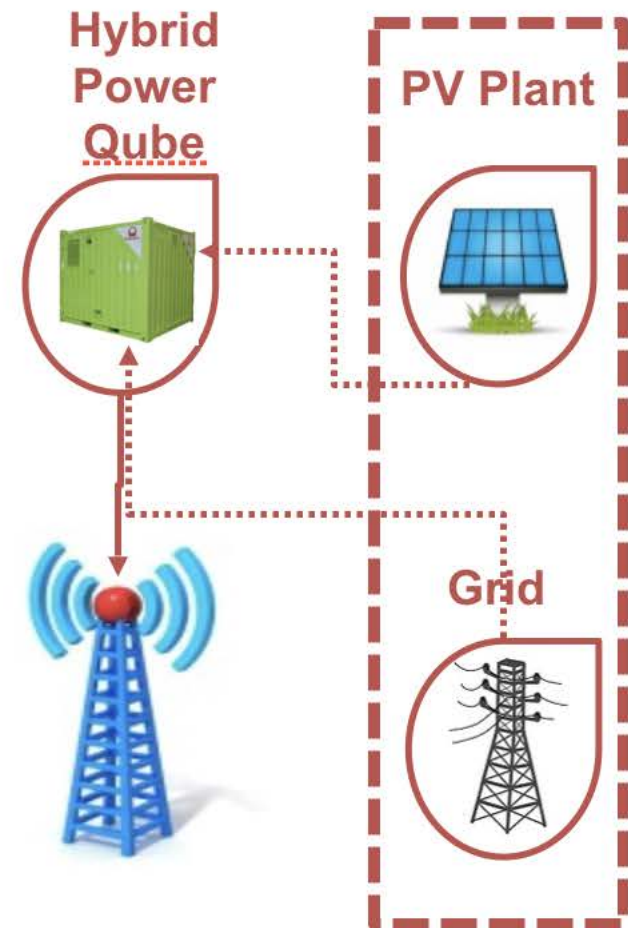
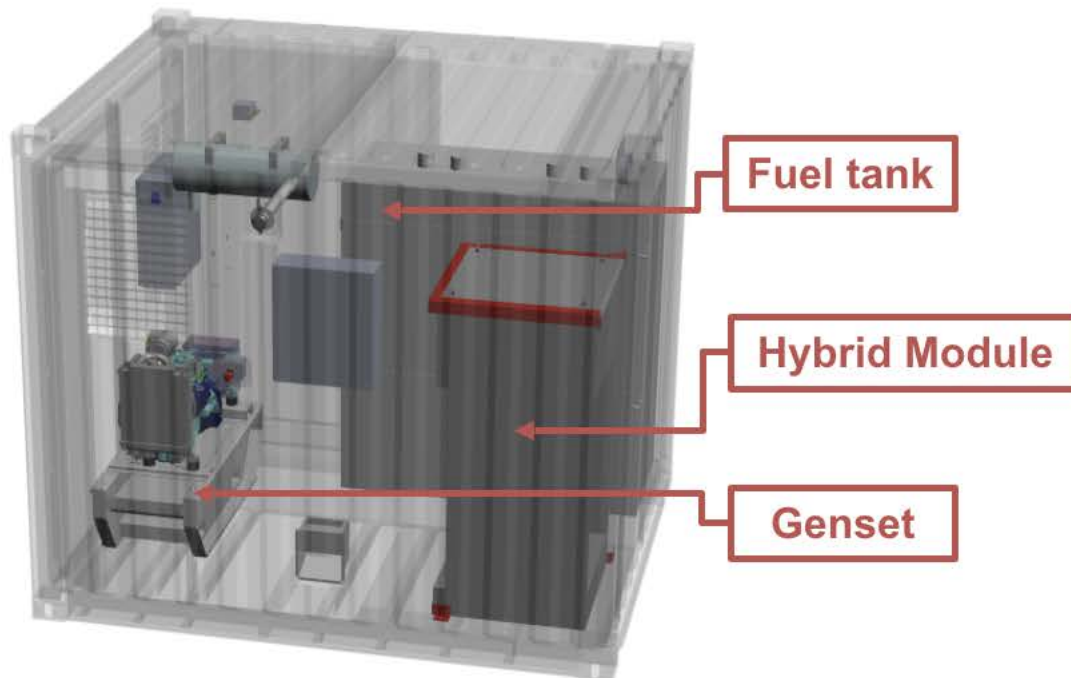


## TELECOM – Hybrid Power System with AC Genset

### HYBRID POWER QUBE

Hybrid Power Qube is a complete system integrating diesel genset and hybrid module fir inside a robust and vandal proof enclosure:

- AC diesel generator, open type
- Hybrid module (Power electronics + batteries)
- 1500l double wall fuel tank
- Automatic lube oil top-up system (option)



## TELECOM – Hybrid Power System with AC Genset

### HYBRID POWER QUBE

Following the sizes for Hybrid Module there are available two main models of Hybrid Power Qube



#### HPQ10Y-250Li

- Generating set: 7kW Prime Power
- Hybrid Module HM12-250-48:
  - ✓ 24kW Power Electronics
  - ✓ 500Ah LiFePO4
  - ✓ 48VDC voltage output
- 1500l fuel tank

#### HPQ22Y-500Li

- Generating set: 14kW Prime Power
- Hybrid Module HM24-500-48:
  - ✓ 24kW Power Electronics
  - ✓ 500Ah LiFePO4
  - ✓ 48VDC voltage output
- 1500l fuel tank

## TELECOM – Hybrid Power System with AC Genset

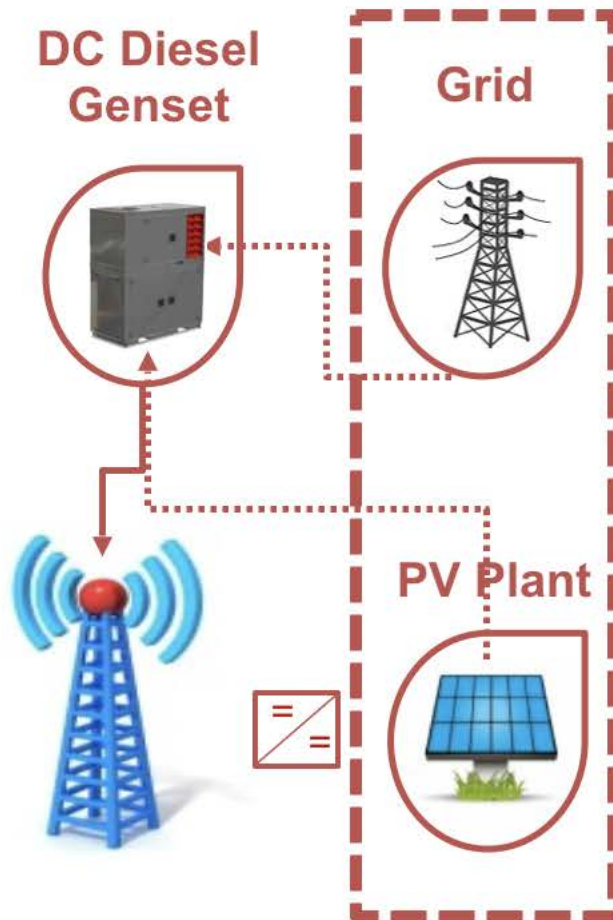
### Advantages

- Up to 68% fuel reduction\*
  - Genset life-time increased up to 5 times\*
  - Up to 77% OPEX reduction\*
  - Pay-back less than 1 year\*
- 
- Standard AC genset which can be easily sold as second-hand unit into the market
  - Possible Retrofit for existing conventional diesel genset
  - With Hybrid Power Qube design all-in-one system set inside a fully vandal proof enclosure

*\*Best cases*



## TELECOM – Hybrid Power System with DC Genset



PRAMAC is developing this new solution which allow coupling a DC diesel generator with an energy storage system (as single compact modular design) If required can be also possible integrate solar power supply and/or electrical grid.

The DC diesel genset consist of a **variable speed engine** coupled with a **PMG alternator**. Integrated in the same genset enclosure are assembled the **Hybrid Power Box** and the **lead-acid batteries**.

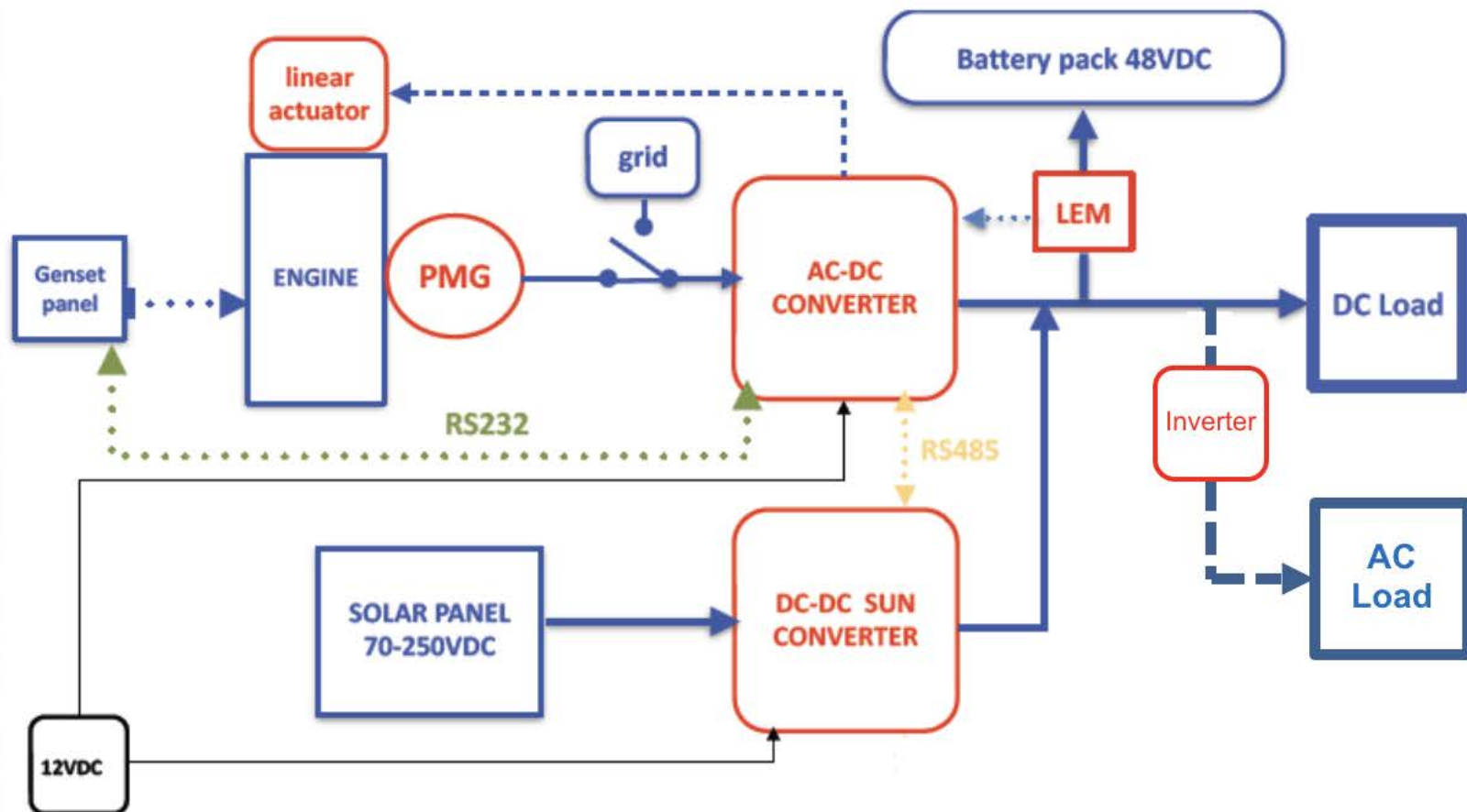
The system works at variable speed which means the engine speed is adjusted basing on the load and battery charging level.

Therefore the engine performances are optimized with relevant savings in terms of fuel consumptions, refueling time and noise reduction.

DC diesel genset can be integrated with solar panels connected to the system through a DC-DC sun converter and/or electrical Grid connected to Hybrid Power Box AC input.

## TELECOM – Hybrid Power System with DC Genset

## Block Diagram



## TELECOM – Hybrid Power System with DC Genset

### Lay-out

DC Genset lay-out composed by two modules which can be separated for logistic and/or maintenance purposes.



Soundproof enclosure where are fit inside:

- Variable speed DC genset
- Genset control and protection panel
- Hybrid Box

Weatherproof enclosure where is located:

- Diesel fuel tank
- Battery cells with rack
- Air conditioning system (optional)



## TELECOM – Hybrid Power System with DC Genset

### Preliminary Program

#### A) 9kWe DC genset

Battery pack: 400Ah

- Battery type: lead-acid (

Fuel tank: 350l

Suitable for average load 3,5-4kWe

Options:

- 48 VDC Air Conditioning for battery box
- Automatic Lube Oil Top up System
- DC/AC Inverter 50Hz - 60Hz for utilities

#### B) 16kWe DC genset

Battery pack size: 500Ah

Fuel tank: 450l

Suitable for average load 7-8kWe

Options:

- 48 VDC Air Conditioning for battery box
- Automatic Lube Oil Top up System
- DC/AC Inverter 50Hz - 60Hz for utilities

#### C) 21kWe DC genset

Fuel tank: 550l

Battery pack size: 600Ah

Suitable for average load 10-11kWe

Options:

- 48 VDC Air Conditioning for battery box
- Automatic Lube Oil Top up System
- DC/AC Inverter 50Hz - 60Hz for utilities

## RENTAL & MOBILE – Power Pack

Power Pack is a solution to meet Zero Emissions power generation demand required mainly from urban and events application



### **Power electronics**

To allow have 3 phase AC voltage output and manage battery charging from external energy source (diesel genset / grid and/or solar)

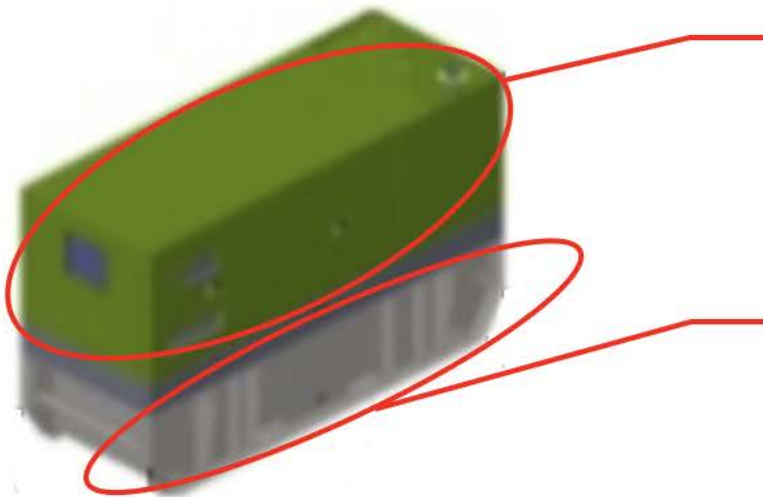
### **Battery rack**

Lithium or VRLA batteries up to 48kWh



## RENTAL & MOBILE – Hybrid Power Generator

Hybrid Power Generator to integrate in a single frame diesel genset and batteries with possibility management of additional external source suchas gris and/or solar plant.



### Genset enclosure

Diesel generator complete with command/control panel and power electronics for hybrid system management.

### Extended Baseframe

Integrate fuel tank (8h autonomy 75% PRP only diesel) and battery pack (ideally sized as 25% of nominal genset power)

### HPG Green socket

**10-50kVA**

Three phase diesel generator with additional battery pack able to manage only single phase loads (up to 32A)

### HPG

**10-250kVA**

Three phase diesel generator with max power output from diesel genset + battery  
Battery pack as 25% of diesel genset to cover low loads and peak load demands (ideally with autonomy 1h each load profile)