

Hybridizing Solar PV with AC Generation: Inverters and Control Systems

ACEF Deep Dive Workshop on Minigrids
ADB Manila, 15 June 2015

Presented by Javier Ferrer
Zigor HK Ltd.

on-grid solar plants

mid voltage solar plants

hybrid generation

energy saving

telecom back up

wind energy



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Hybrid Inverters for Micro/Mini-grids

HIT3Centralized



Hybrid Inverters for Micro-Grids, Rural Electrification, Load Shedding and Renewable UPS

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hybrid generation

energy saving

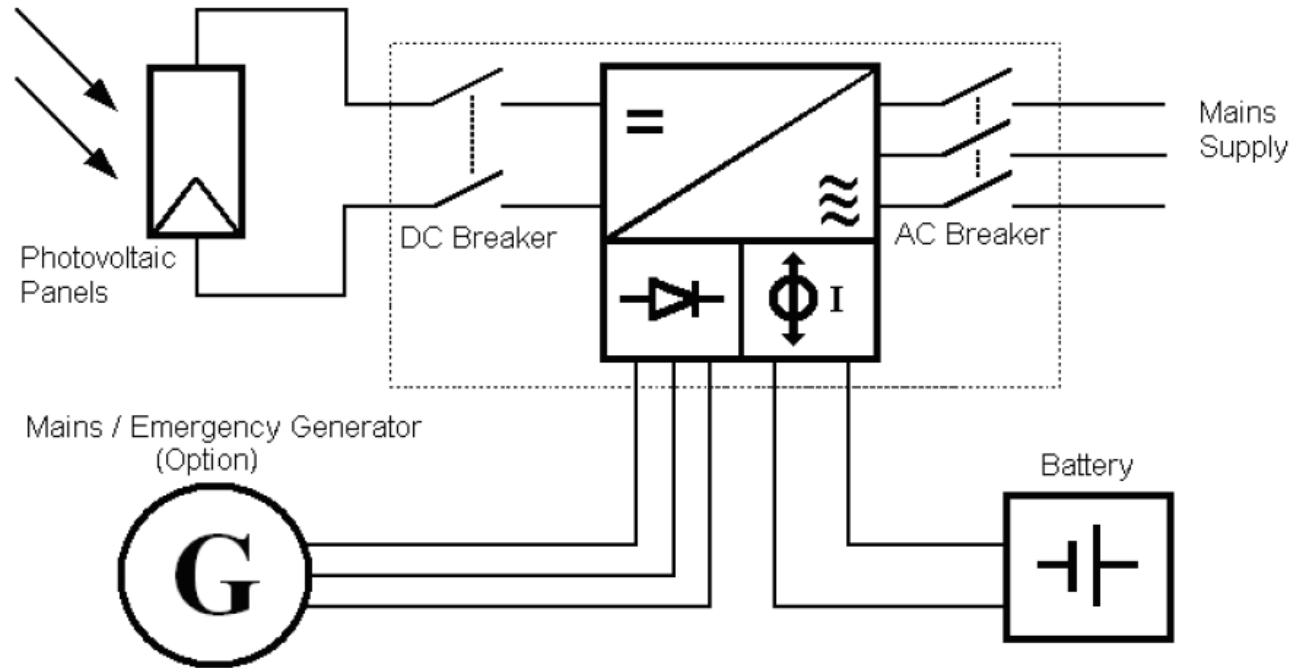
telecom back up

wind energy

Centralized Hybrid Inverters for Microgrids

HIT3C:

30kW,
50kW,
100kW,
150kW



Centralized Hybrid Inverters

are designed for a high PV penetration in a single power system

HIT3C: Architecture and Configurations

PV Panel:

xSi, Thin Film, others

MPPT Voltage range: 420-700Vdc

Capacity: [30 kWp ... 150 kWp]



Micro Grid 3L+ N



AC Input:

AC Grid, GenSet, Hydro, others

Voltages:

[3L+N x 400V – 50/60 Hz]

[3L+N x 220V – 50/60 Hz]



Battery Bank @ 350Vdc

AGM, OPzS, OPzV, NiCd, Li-ion

Energy: [20kWh to 400KWh]

AC Distribution Line:

Full isolation from PV, AC and Battery

[3L+N x 400V/380V – 50/60 Hz]

[3L+N x 220V – 50/60 Hz]



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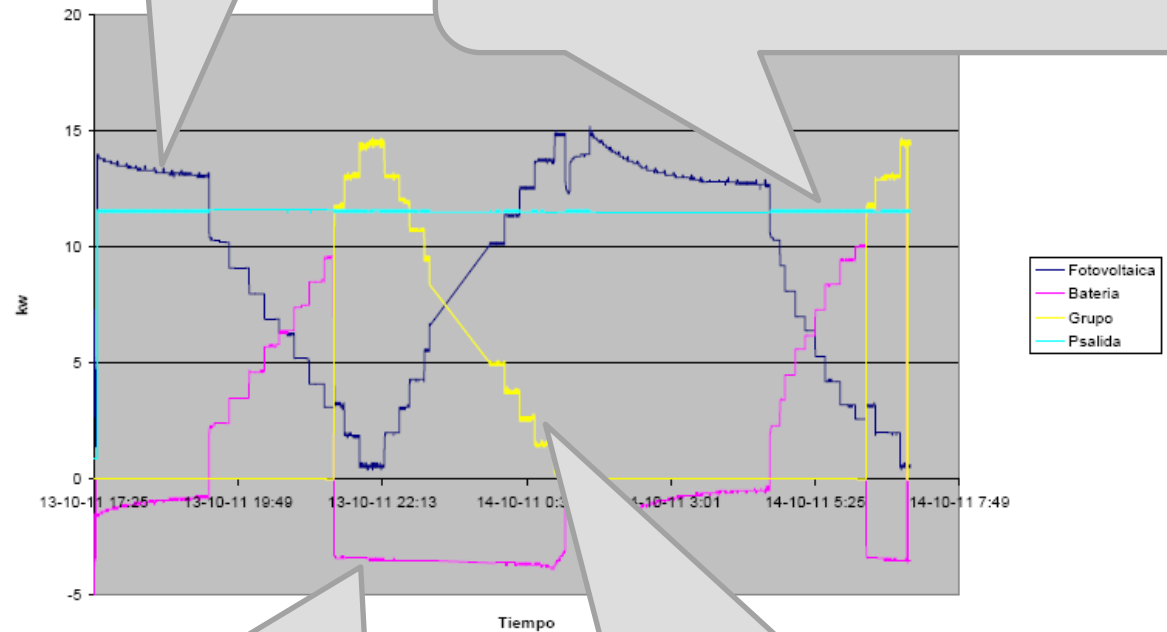
wind energy

Centralized hybridization of input energies



The PV production

The HIT3C gives priority to PV, filling the peak demand with the battery and lastly with the AC source (GenSet or Grid).



When the PV is higher than the demand, then HIT3C charges the battery.

When the Genset enters only provides the needed balance of energy

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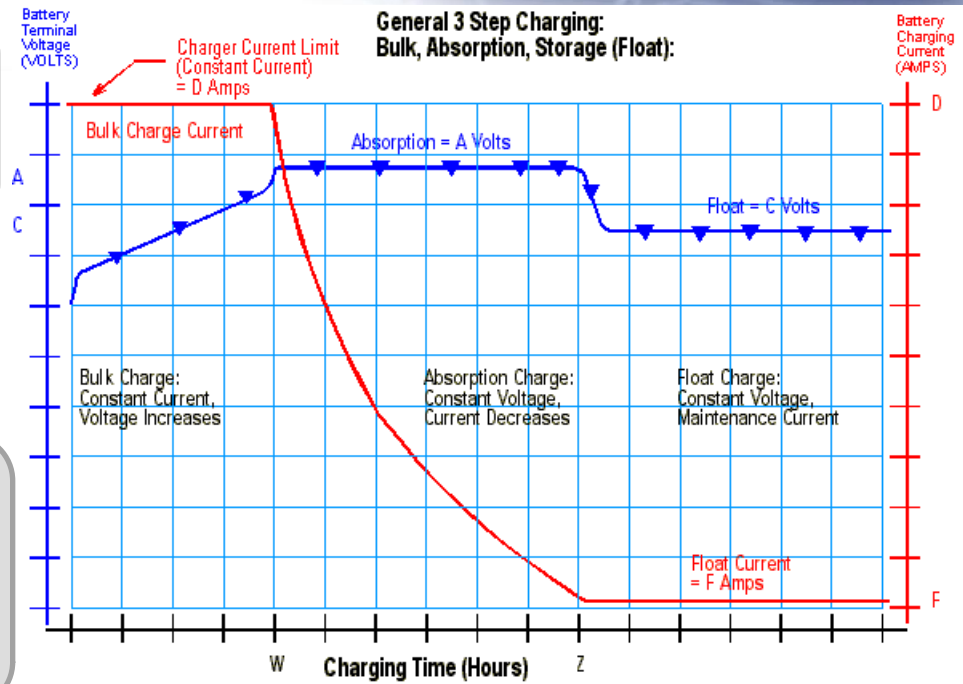


Centralized Battery Charger function

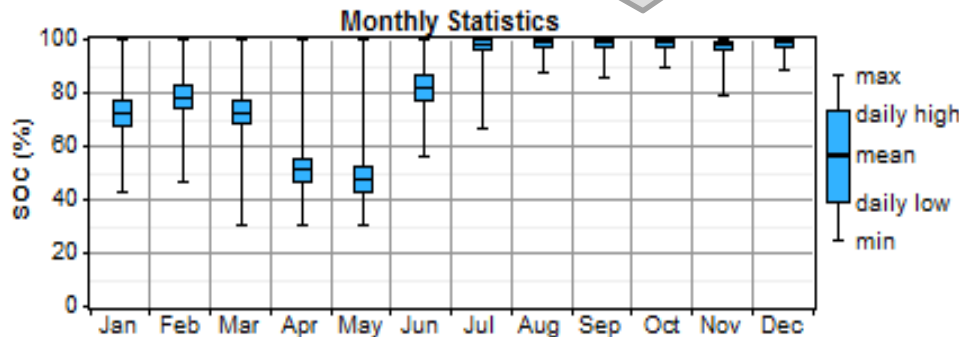
The HITC embedded battery charger is compatible with Lead Acid, NiCd and Li-ion Batteries.



Selectable discharge strategies: Silent (Night Mode), Peak Shaving, etc

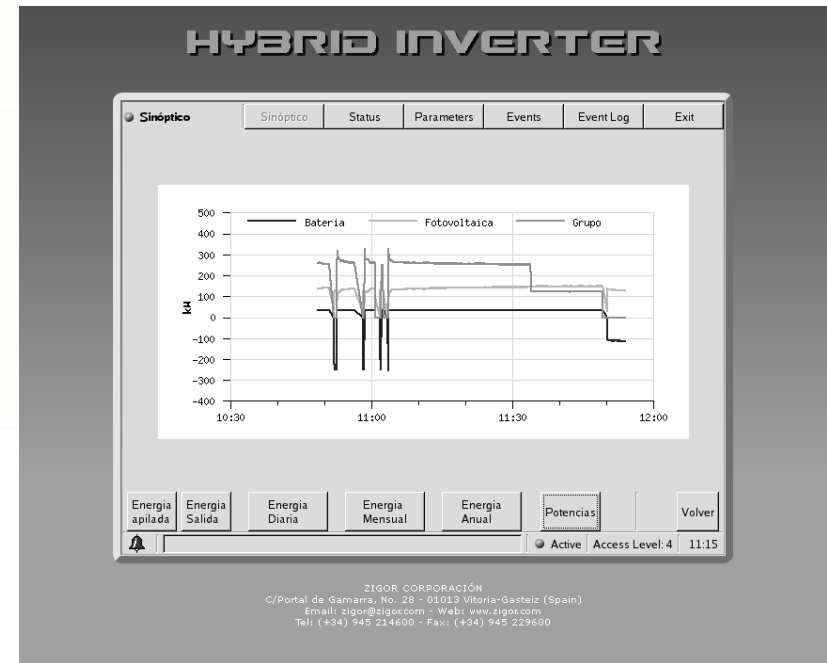
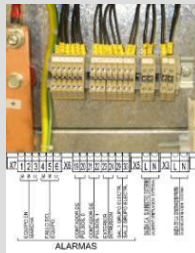


Offers an **easy and flexible** setting mode to fit the correct charging method.



GenSet Control System:
Start/Stop
Reduction of fuel consumption

Manual, Local or
remote Start/Stop



The **HITC Alarm Delivery** Screen offers flexible SMS, emailing system for remote control and to facilitate the corrective maintenance

HYBRID INVERTER

Parametros Sinóptico Estado Parametros Eventos Histórico Sair

Sistema

- Senhas
- Comunicações
- HIT Equipamento
 - Carregador
- Ventiladores
- Eventos
 - Níveis
 - Notificações
- Calibração
- MET

Nome	Valor
Endereço IP	192.168.69.5
Máscara de rede	
Gateway	192.168.2.250
PIN do Modem	****
Número 1 para envio SMS	
Número 2 para envio SMS	
Número 3 para envio SMS	
Porto TCP acesso HTTP	80
Porto TCP aplicação através de HTTP	5901
DNS	
Envio email: Servidor de e-mail SMTP	
Envio email: Usuário	
Envio email: Senha	
Envio email : endereço de e-mail (@=*)	
Envio email: Autenticação (NO/SSL/TLS)	
Email 1 para envio de alarmes ((@=*)	

Endereço IP 192.168.69.5 OK

Guardar Cancelar Fábrica Idioma

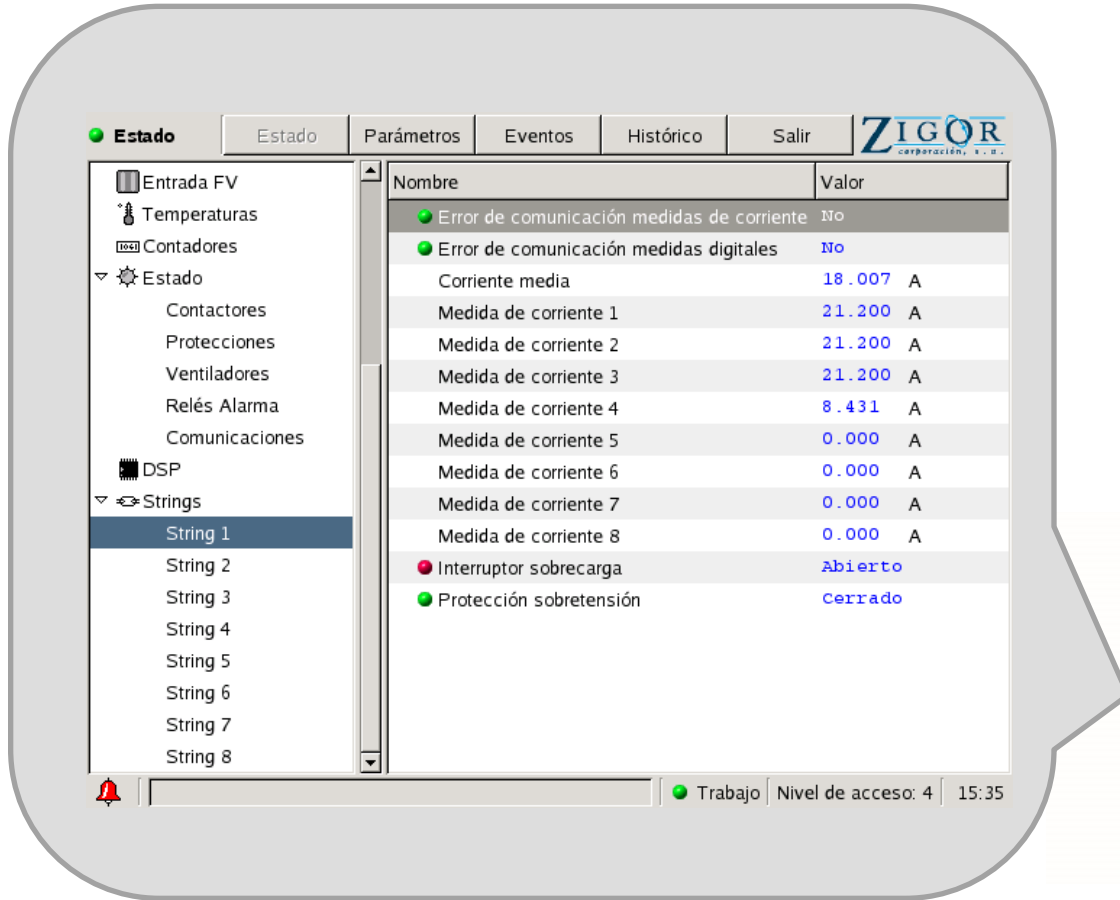
Trabalho Nível de acesso: 4 09:28

Able to:

- send SMS (Modem GSM option).
- send e-mails (Ethernet network)



Centralized PV String Supervision (Option)



The screenshot displays the ZIGOR software interface for centralized PV string supervision. The interface includes a navigation menu on the left, a main data table, and a status bar at the bottom.

Navigation Menu:

- Entrada FV
- Temperaturas
- Contadores
- Estado
 - Contactores
 - Protecciones
 - Ventiladores
 - Relés Alarma
 - Comunicaciones
- DSP
- Strings
 - String 1
 - String 2
 - String 3
 - String 4
 - String 5
 - String 6
 - String 7
 - String 8

Main Data Table:

Nombre	Valor
● Error de comunicación medidas de corriente	No
● Error de comunicación medidas digitales	No
Corriente media	18.007 A
Medida de corriente 1	21.200 A
Medida de corriente 2	21.200 A
Medida de corriente 3	21.200 A
Medida de corriente 4	8.431 A
Medida de corriente 5	0.000 A
Medida de corriente 6	0.000 A
Medida de corriente 7	0.000 A
Medida de corriente 8	0.000 A
● Interruptor sobrecarga	Abierto
● Protección sobretensión	Cerrado

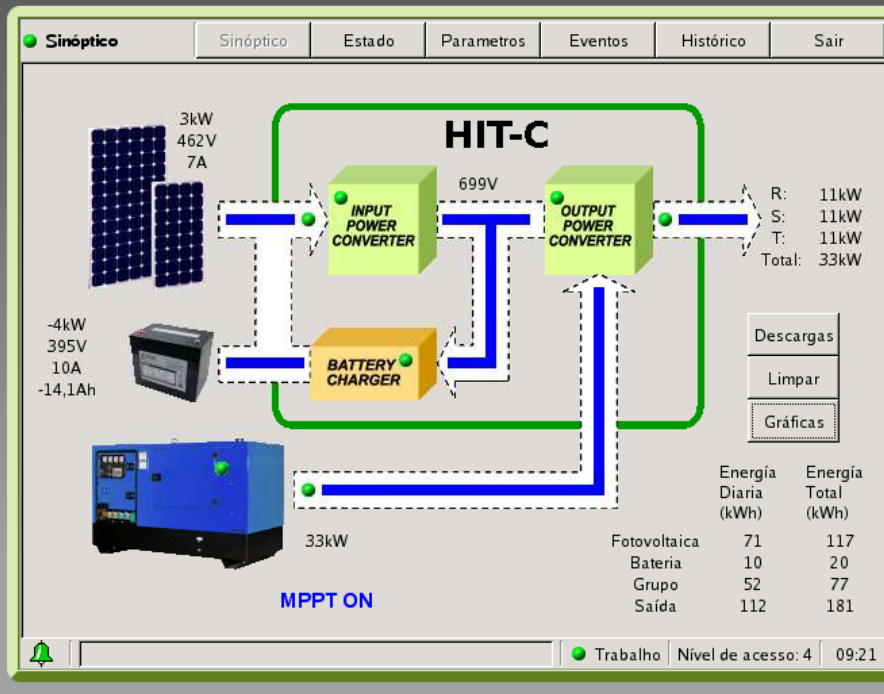
Status Bar: ● Trabajo | Nivel de acceso: 4 | 15:35



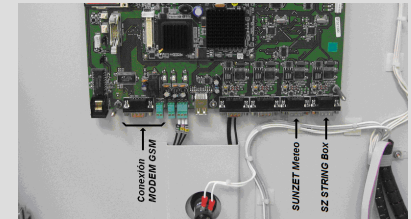
Centralized Monitoring System

The **Embedded SCADA** web server offers a powerful monitoring and control tooling:

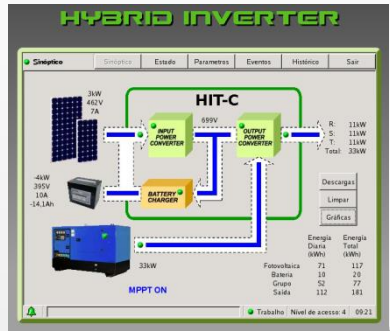
HYBRID INVERTER



- Intuitive interface.
- Multilanguage Platform.
- Friendly use.
- Real Time Energy Monitoring.
- Easy Parameterization.
- Logging Capability.
- Multi-Comm: TCP/IP, MODEM, etc.
- Remote firmware update

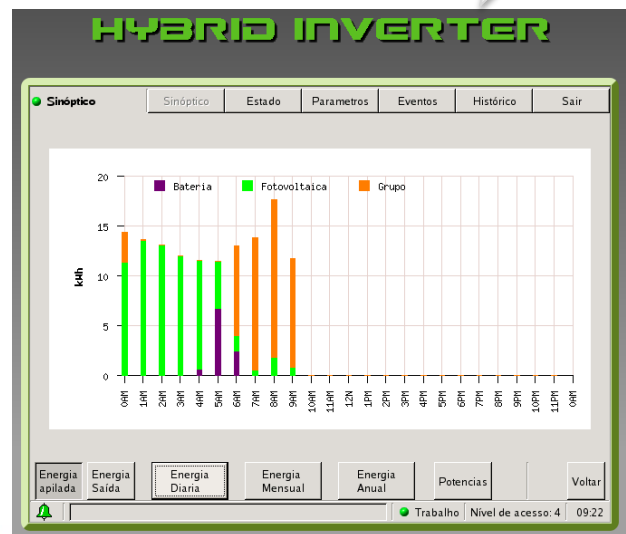
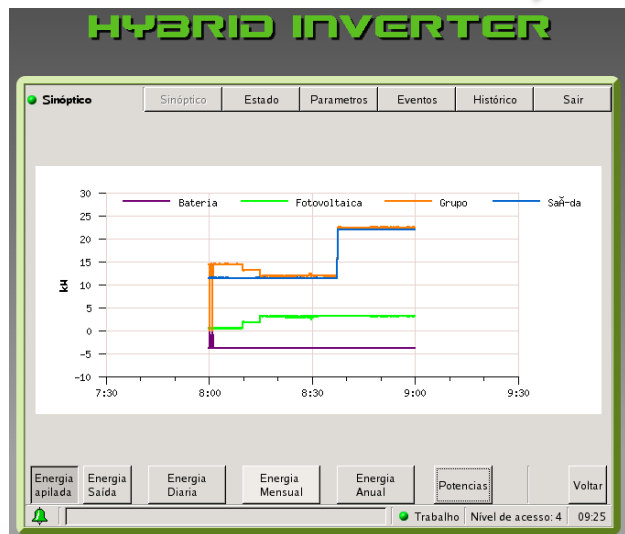


Centralized Historical Graphs



PV
Battery
AC Source
Demand

Daily
Monthly
Yearly
Cumulative



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Off-grid PV Project PV + Hybrid Inverter + Batteries



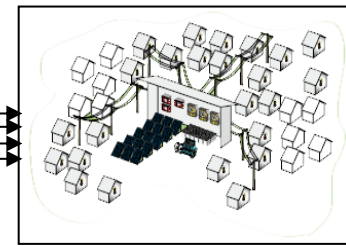
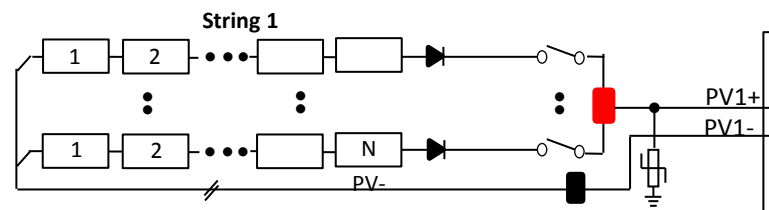
Celagen Island – Indonesia

CENTRALIZED HYBRID INVERTER DIAGRAM

80 kWp Solar array, of Polycrystalline 250 W PV modules

ZIGOR HIT3C
100KW Hybrid
Inverter

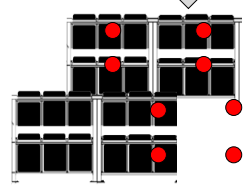
AC Output to
Load



HITC
output :
3PH+N

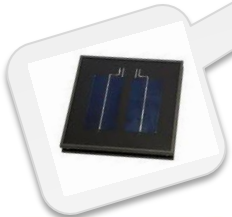
output : 3PH+N

DC Bus



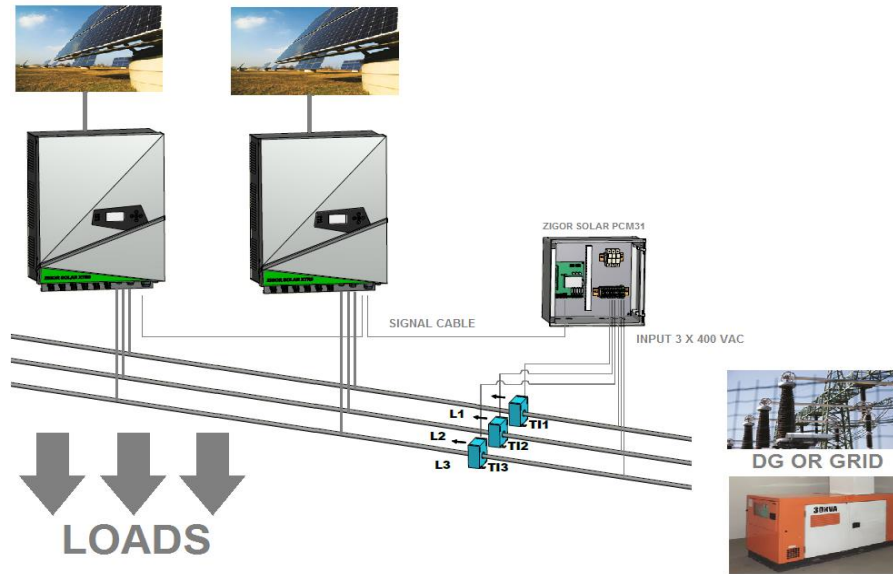
Battery Bank 1000AH @ 350V :
175pcs x OPzV 1000Ah

Meteorological Station
irradiance + temperature



Power Control Systems for Micro/Mini-grids

PCM31



Power Control Modules for Grid Interactive Applications (Bill / Fuel saving) and Rural Electrification

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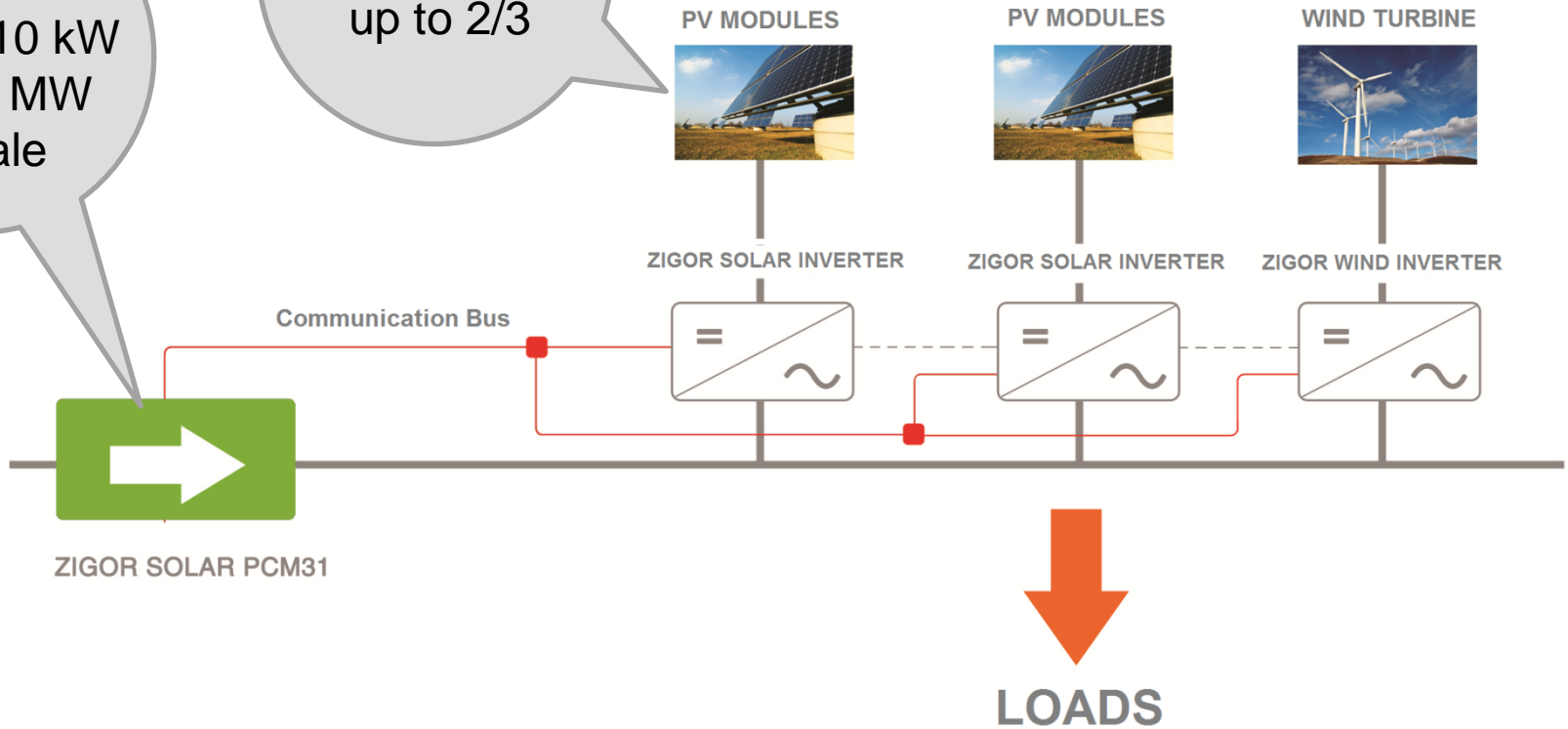
Power Control Module for Hybrid Mini-grids

PCM31:
From 10 kW
up to MW
scale

PCM31:
RE penetration
up to 2/3

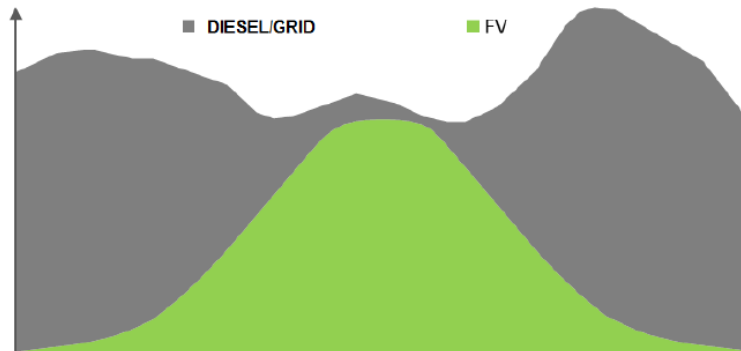
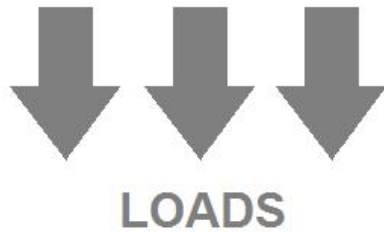
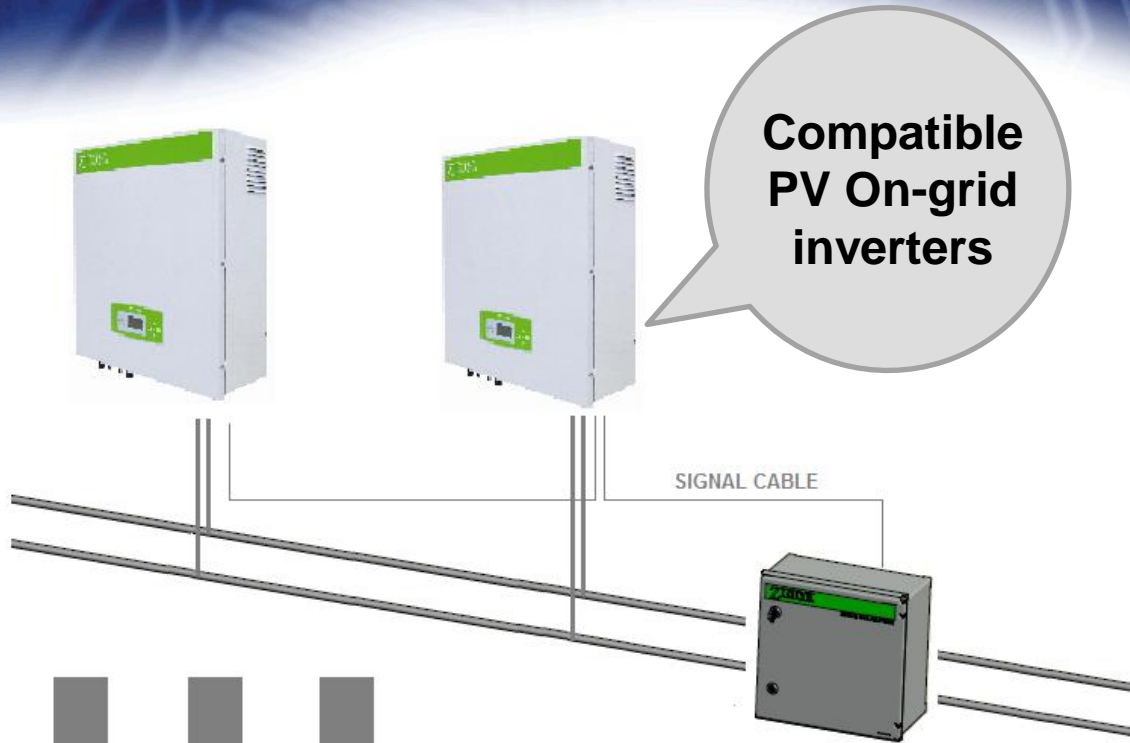


Gen Set or
Electricity Grid



Power Control Modules combined with **On-grid Inverters** are designed to hybridize energy flows from different inputs with a medium level of RE penetration

■ Power Control Module for Hybrid Mini-grids



DG/GRID



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PV-Grid Hybrid Project

PV + Grid + Power Control Module + Inverter



Astra Honda Motors – Cikampek (Jakarta) – Indonesia

POWER CONTROL MODULE PROJECT

105 kWp
PV



100 kW
On-Grid
Inverter

AC Bus
Bar

PCM31:
1 MVA
400Vac 50Hz



Thank You.

