iPPC

Adaptable and powerful Power Plant Control with a comprehensive set of algorithm and communication capabilities.

- Master / Slave architecture, with multiple simultaneous slaves
- **Different generation technologies** in the same plant, including Energy Storage Systems
- Ensures **grid code compliance**
- **Full range of protocols (DNP3.0, IEC 61850, IEC 60870-5...)** for many kinds of electrical applications to communicate with all devices and control centers.

IEC 61850 compliant

The power plant controller (PPC) handles the regulation of active and reactive power while also contributing towards voltage and frequency support, among other services. The fast and stable control at the point of interconnection (POI) is enabled by an accurate power quality analyzer that records the relevant point of interconnection and power plant data/measurements during this process.

The PV plant and its grid connection (LV/MV substation) can be tied to a Supervisory Control and Data Acquisition (SCADA) system. This allows the visualization of the collected data, providing the plant operators with a Human Machine Interface (HMI) to monitor and control the plant.

Thanks to the versatile and advanced functions that the PPC has (total and real time control of the PV plant, automated management, unlimited real time data storage and analysis and many others) there are no hidden losses.

08/2022

MASTER-SLAVE ARCHITECTURE FOR HYBRID POWER PLANTS

iGrid's iPPC algorithm features a master-slave architecture. This allows its operation in hybrid power plants, where the energy generated by the PV part may be different from that generated in the wind part. To optimize operation of hybrid plants each segment (PV, wind, ...) is controlled by its own PPC, which behaves as a slave PPC receiving orders from a master PPC. The master PPC will receive a global setpoint from the AGC algorithm, distribute the setpoint among the different slave PPC algorithms and control overall output from the complete plant while the slave PPC will control its segment of the hybrid plant only.

COMMUNICATION PROTOCOLS

iGComms was designed to use a high number of protocols and communicate with several control centers at once.

The stack includes newer protocols such as IEC 61850 MMS or GOOSE (A-level certified by DNV-KEMA), but also older standard and proprietary protocols e.g. ModbusRTU/TCP, Profibus, SpaBus, Mlink or Procome. Other supported downstream protocols for meters and protection relays are IEC 60870-5-102/-103, IEC 62056-21 and DLMS, while upstream **protocols for control centers also include IEC 60870-5-101/-104 or DNP3.0 serial/TCP.**

ENERGY STORAGE

iGrid's iPPC allows control of energy storage systems, thus contributing to frequency control by increasing/reducing the amount of active power delivered to the grid even in PV plants. The PPC algorithm will retrieve/store energy from the energy storage system thus contributing to a more accurate tracking of the setpoints regardless of the energy instantaneously generated by the PV/wind parts of the plant.

IP NETWORKING

iGComms software is equipped with transparent TCP bridging and configurable IP routing to tunnel any serial protocol (such as *Modbus*) over a TCP/IP connection and facilitate the data transfer through complex IP networks.

Its VLAN and VPN support allow to improve the network's performance, simplifying its traffic management, design and deployment and also helping to secure communications through particularly hazardous networks.

SCALABILITY

iGrid's PPC master-slave architecture makes it suitable for operation in large generation plants scattered in large geographical areas, where the power generated by one segment may be different from the power generated by a different segment even if they are the same technology (e.g. some parts of a PV plant may be temporarily in the shadow). Also this architecture makes it easy to stop some segments of the plant for maintenance while keeping others in operation.).

CYBER SECURITY – IEC 62351

iGrid enforces several layers of security measures guided by the propositions of the IEC 62531 standard to protect its devices from all kinds of threats.

The iGW is a hardened device featuring Role Based Access Control (RBAC) to avoid intrinsic risks such as security holes and unauthorized actions by authenticated users.

Beyond encryptions via TSL/SSL, HTTPS, SSH and VPN support (e.g. OpenVPN), its communication can also be secured with network control methods such as firewalls, IP filters, ACL or TCP port blocks.

Platform

iGrid's PPC works on several iGrid platforms :

- Embedded solutions : iBU, iRTU, iGW and iRTUcompact
- Server solutions : iGW-VM, both in Windows and Linux
- SCADA system : iControl

Customization

All the different services provided by the PPC are developed modularly, making it easy to add or modify them depending on the requirements of each grid code and power plant.

Variables used by the PPC are parametric and configurable with iGrid's iConf software, meaning that all elements of the control algorithm can be customized to fit specific needs, using a simple and user-friendly environment.

More specifications on the back

Algorithms

There are different algorithms that can be used to obtain the reactive power setpoint depending on a series of conditions. Currently implemented reactive power regulation algorithms are:

- Reactive power as a function of voltage
- Power factor as a function of active power output
- Reactive power as a function of voltage: reactive power output is regulated as a function of Voltage at POI (point of interconnection) following a Reactive Power – Voltage Droop curve.

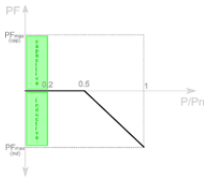
Active power control

There are different modes for controlling the active power:

- Active power ramp (ramp rate control): limits the fluctuation of the active power output, fitting it to a % of the power plant's rated power
- Management of active power reserves: it maximizes the power plant's energy output with a secured supply of active power reserves (APR) when necessary. Sometimes reserves are a Grid Code requirement related to under-frequency support.
- Active power output limitations: can be applied in emergency situations (excessive over-frequency deviations, over-voltage situations) or curtailment events

Reactive Power and Power Factor Control

There are different modes for controlling the reactive power and their implementation can be adapted to grid code requirements and power plant specifications. The services are self-exclusive, only one of them can run at a time. Reactive power and power factor regulation are different modes for the same service.

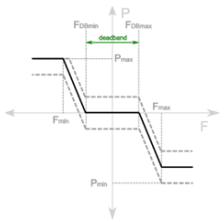


Power factor as a function of active power output

This works in similar way to power factor setpoint, but in this case the Power factor is not constant. This algorithm calculates the target power factor as a function of active power output and tension.

Voltage support / Q-V

Over voltage active power limitation: When the over-voltage at the POI goes over a pre-defined threshold, active power output is limited accordingly.



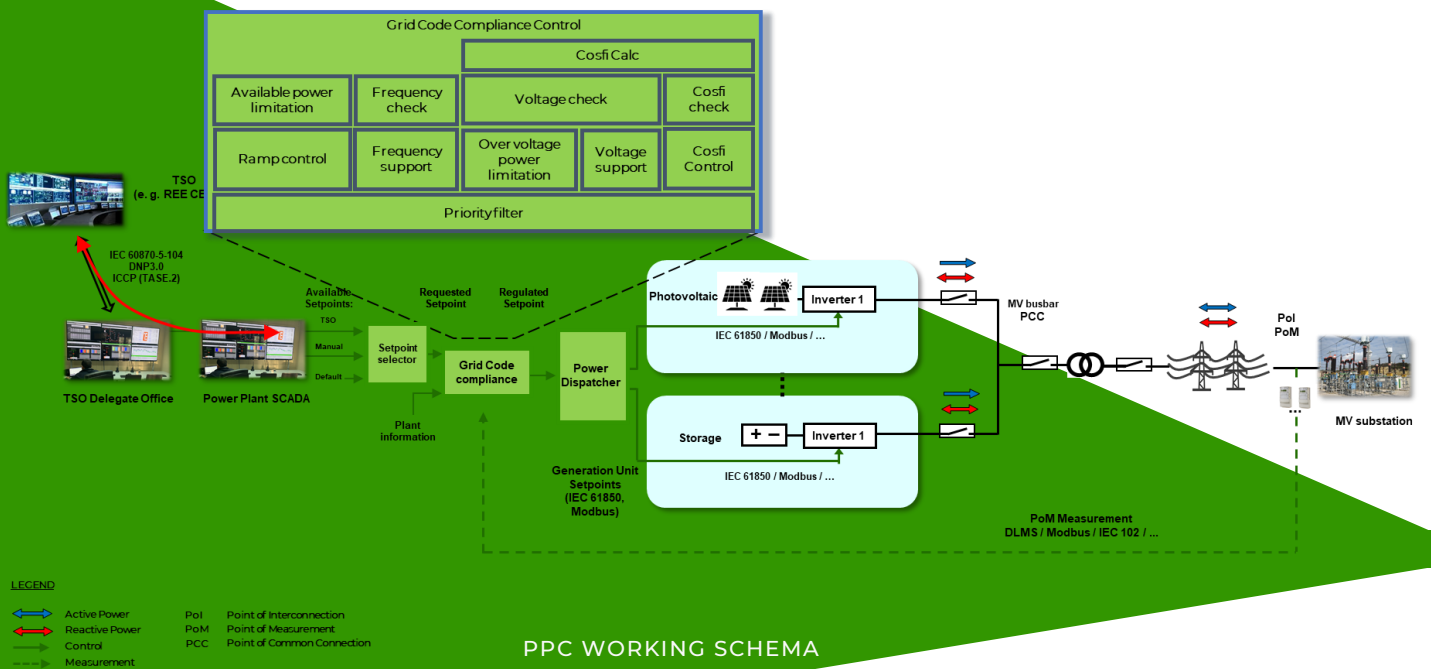
Frequency support / Frequency Droop

Frequency support is done through a frequency droop algorithm, which varies the active power output depending on the frequency deviation at the POI (under frequency, increase output; over frequency, decrease output).

Under frequency power reserves management can be included in order to guarantee the availability of the under-frequency frequency support service.

Simple Setpoint

Two different set points can be used for regulating reactive power: reactive power setpoint and power factor set point. The first one defines the reactive power value, while the second one defines the reactive power output depending on the power factor setpoint and the current active power output.



PPC WORKING SCHEMA

IGCOMMS PROTOCOL STACK

Master/Slave IEC 60870-5-101	Master/Slave IEC 60870-5-104
Master/Slave Modbus TCP/UDP and JBUS (master)	Master/Slave ModbusRTU
Master/Slave DNP3.0 (serial, UDP, TCP)	Master IEC 60870-5-103
Master IEC 60870-5-102	Master DLMS
Master Profibus DP	Master Spabus, Mlink, Procome
Master IEC 62056-21	SNMP Agent/Manager
IEC 61850 MMS Client/Server & GOOSE Publisher/	TASE 2.0 / ICCP

ALGORITHMS

- Active power control
- Reactive power and Power factor control
- Multiple Setpoint sources
- Voltage support
- Frequency support / Frequency Droop

SUPPORTED PLATFORMS

Embedded Devices : iRTU, iRTUcompact, iGW

Server : iGW-VM

SCADA : iControl

EMC STANDARDS FOR EMBEDDED PLATFORMS

IEC 60950-1, IEC 60255-5:2000, IEC 60255-22:2000, EN 55022, IEC 61000-6-4, IEC 61000-6-5, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-9, IEC 61000-4-10, IEC 61000-4-12, IEC 61000-4-16, IEC 61000-4-17, IEC 61000-4-18, IEC 61000-4-29

ARCHITECTURES

- **Hybrid Renewable Energy Plants**
- **Master-Slave architecture** with mutiple PPCs to control different technologies: PV, Wind, mechanically switches units...
- **Line losses calculation (in case of no meter availability at the PoI)**
- **Multiple metering devices for redundancy**
- **Energy Storage integration**

EASY CONFIGURATION WITH iCONF

iConf has been specifically developed for electrical applications, saving you lots of time and money throughout the control system set-up and maintenance tasks, whilst also minimizing your project risks. Upload and download your configurations, import or scan SCL files (**IEC 61850**) and create.
PLC automation, based on **IEC 61131-3**, allowing users to create their own automation

MAINTENANCE

Internal web server, allowing real time monitoring of the system and all its internal parameters

Command console with full information on packet exchanges, with all available protocols

Local or remote maintenance via USB or Ethernet port

ORDERING INFORMATION

iControl#PPC	PPC functionality in iControl platform
iGW-VM#PPC	PPC functionality in iGW-VM platform
iRTU#PPC	PPC functionality in iRTU platform
iRTUcompact#PPC	PPC functionality in iRTUcompact platform
iGW#PPC	PPC functionality in iGW platform

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