



ingelectus

Innovative electrical solutions

Power Plant Controller

Renewable plant controller
to improve grid integration.

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1. ¿Qué es? What is it?

The Ingelectus PPC is a flexible and robust solution that allows the control of the different devices present in a photovoltaic, wind or hybrid plant to meet the requirements of the transmission system operator (TSO) or distribution system operator (DSO) at the point of connection to the grid (PCR).

2. Why is a PPC necessary?

The rise and inclusion of renewable energy plants in the global electricity market creates the need to control their generation and guarantee the stability of the electricity system. This makes indispensable the use of a plant controller adaptable according to the requirements and needs taking into account the following considerations:

- Each country and/or power system operator has a **different grid code**.
- Depending on each plant there may be **different elements to control**: inverters, wind turbines, batteries, STATCOM, capacitor banks, tap changers, etc.
- Each manufacturer uses **different equipment and communication protocols**, not only in different plants, but also within the same plant they could coexist.
- Each customer can request **specific extra** functionalities other than the network code.

3. How do we meet all needs?

Our controller meets the strictest international requirements imposed by the different grid codes and is adaptable thanks to the fact that it has been developed entirely by Ingelectus, without the need for third-party software or specific requirements, relying on a team of high-level professionals from both the electrical sector and the communications and software sector.

4. What features does it have?

- **Active power control and curtailment**, with or without ramp limitation.
- **Active power response to frequency variations. PFR (primary frequency control)**
- **Voltage control**, AVR (automatic voltage control).
- **Reactive power and power factor** control.
- **Reactive power response to voltage variations.**
- **Evacuation transformer tap control.**

In addition, our controller offers high availability, both in hardware and software, thanks to its redundant structure adding robustness and reliability.

5. How does it work?

This system is compatible with all renewable generation plants, regardless of the manufacturer and/or installed devices, such as **inverters**, **BESS** (Battery Storage Systems), STATCOM, **turbines**, tap changers, etc. It is also compatible with hybrid renewable plants (solar, wind and storage).

Additionally, our PPC is compatible with all standard industrial **protocols**, such as **MODBUS**, **DNP3**, OPC-UA, **IEC 60870-5-104**, **IEC 60870-5-101**, etc.

It should be noted that the Ingelectus PPC has been certified according to the new NTS 631 in its latest version (NTS 2.1). This certificate guarantees that the PPC complies with the technical requirements of the Technical Supervision Standard (NTS), which is in accordance with the standards of the European grid code, thus allowing the interconnection of power plants in Spain. This certificate has been issued by CERE, which in turn has provided the PPC model certificate in PSS/E and DigSilent.

6. Experience is the best guarantee

Ingelectus, has performed in the last 4 years the commissioning of more than **20 plant controllers** in different countries such as **Spain, Mexico, Chile, United States and Canada**, with a total power of **around 2 GW of power** and complying with the most demanding grid codes.

Likewise, the Ingelectus team has personnel with **more than 10 years of experience** in energy control systems working with the main system operators: REE, REN, PREPA, CENACE, ERCOT, AEMO, etc.



Example of solar plants controlled by the Ingelectus PPC





Locations of plants controlled by the Ingelectus PPC

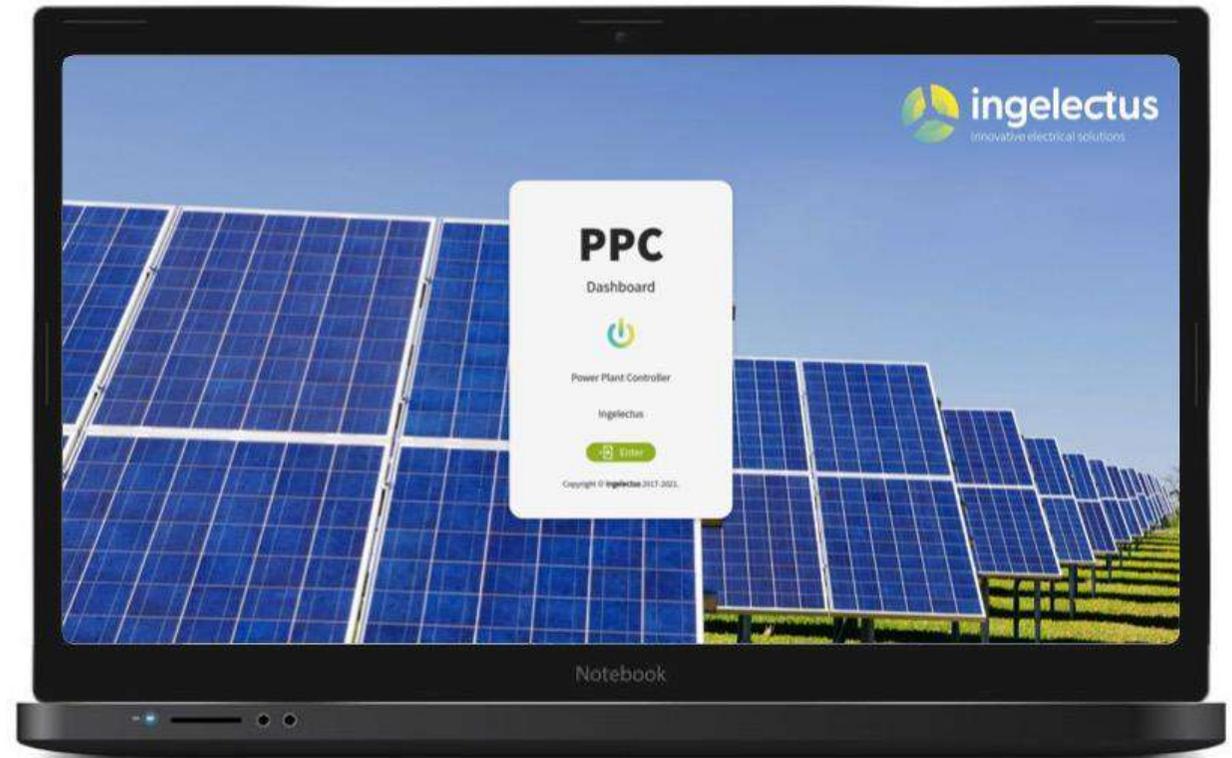
At Ingelectus we have worked with dozens of different inverter and turbine manufacturers, as well as other elements such as tap changers or capacitor banks.

All this variability of plants and devices shows that our controller is a flexible and homogeneous PPC that adapts to the needs of each customer supported by a highly qualified team.

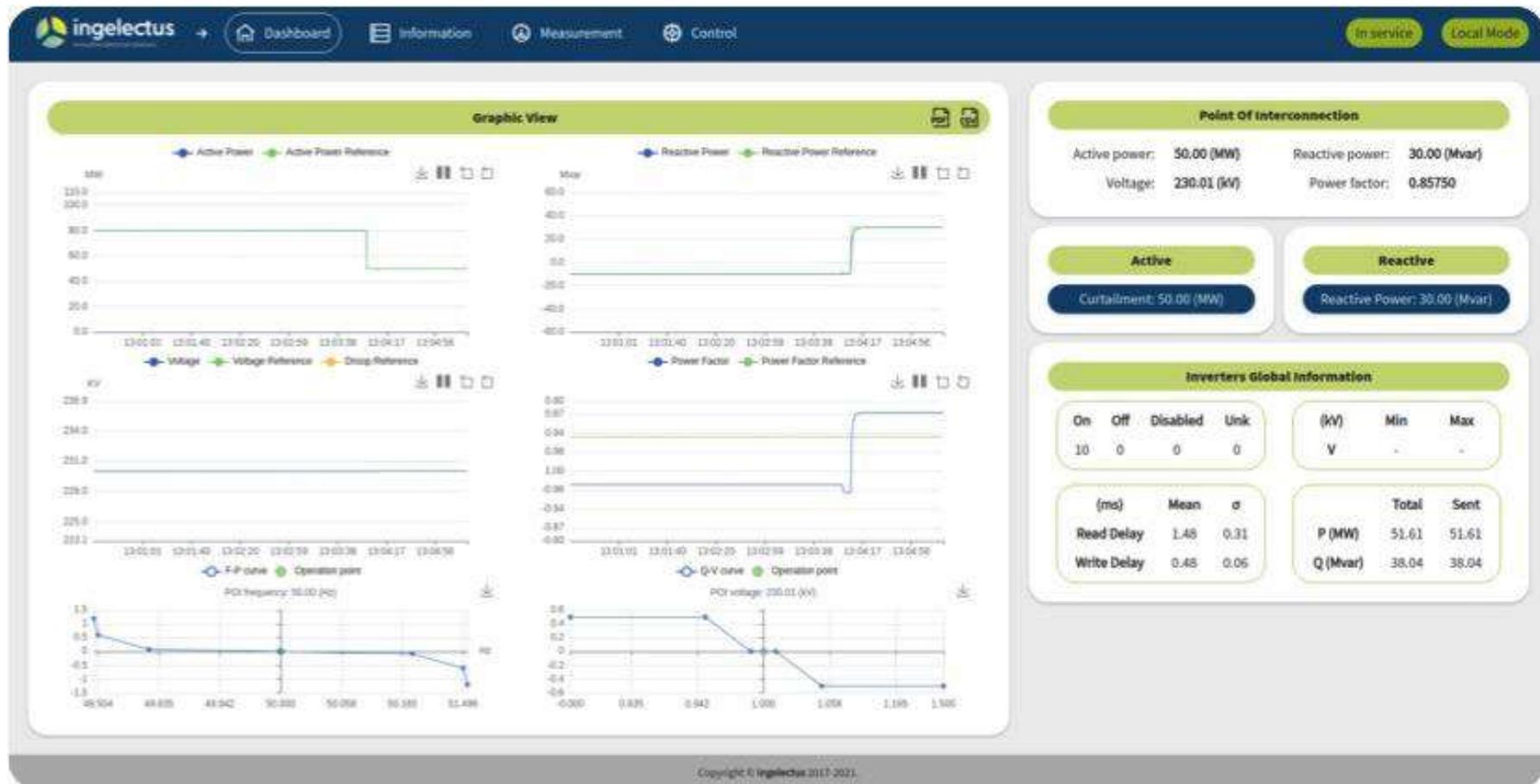
7. Continuous renovation

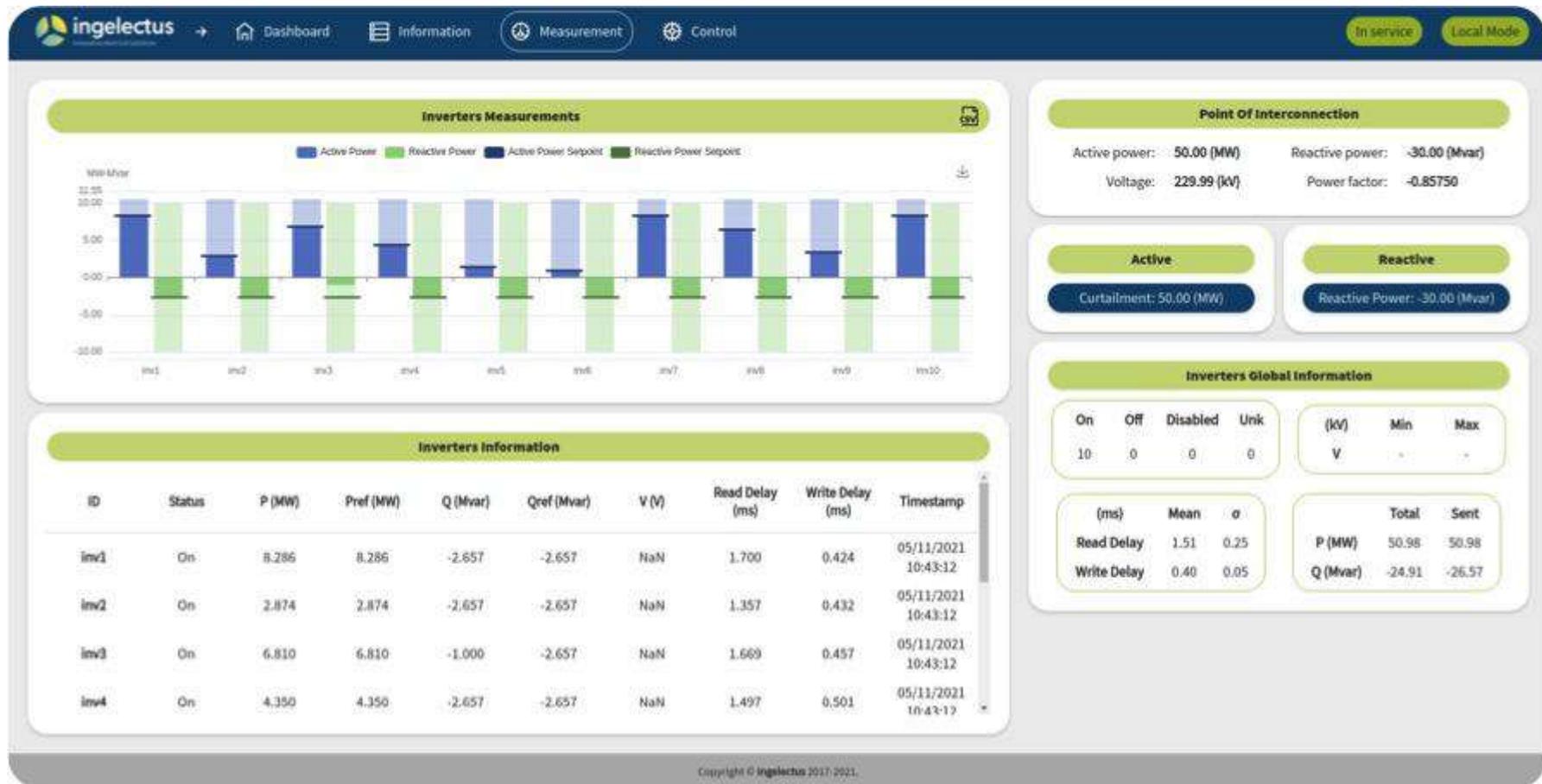
In Ingelectus we are aware of how fast the industry evolves and, therefore, we are continuously working on including improvements that offer a better user experience.

- User-friendly interface that helps to more easily identify active controls and alarms.
- Real-time graphs with more than 20 samples per second that allow to know in detail the operation of the plant, even zooming on them.
- Real-time report generation and data download at the push of a button.
- Agility in start-up.



PPC monitoring interface design





8. Real-time simulator

Ingelectus is able to minimize plant start-up times by developing a digital twin of the plant in a HIL (Hardware in the Loop) system at its offices.

This way the PPC is tested before being taken to the field, reducing the time needed for testing with the real PPC, avoiding unnecessary power movements and helping to deliver the plant to the customer in the shortest possible time.

The real-time simulator developed by Ingelectus allows, among others, to simulate the following situations:

- The possibility of emulating **communication failures with the devices** in real time.
- **Triggering and connection of an inverter** in real time.
- The possibility of emulating **random frequency events** in real time.
- Possibility to emulate the presence of **clouds** in real time.
- Possibility to emulate **voltage dips** in real time.
- Possibility to emulate element **setpoint delays**.
- Possibility to emulate **active and reactive power ramps** in inverters.