

eXPert Ecosystem

eXPert PPC for

Renewable Power Plants

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eXPert PPC (Power Plant Controller), based on eXPert Ecosystem designed and produced by SDI, is a component for managing Active Power (P) and Reactive Power (Q) resources in Renewable Power Plants, in compliance with the major grid codes worldwide.

Renewable Power Plants can be composed of sub-parks of different technologies:

- Wind
- Solar
- Storage
- Biomass

Active Power from sub-parks is used to regulate Active Power at Point of Interconnection (POI) and optionally to implement Primary Frequency Response.

Reactive Power from sub-parks is used to regulate Reactive Power, Power Factor or Voltage at POI, depending on required Control Mode.

Regulation functionalities are based on accurate measurement at POI, provided by a meter included in the supply.

Active Power and Reactive Power control logics are executed independently, according to sub-parks capability.

FUNCTIONALITIES

Active Power Control

- P Regulation (Curtailment)
- Primary Frequency Response (PFR)

Reactive Power Control

- Q Regulation
- Cosphi Regulation
- V Regulation / V Droop

PPC ARCHITECTURES

- MASTER PPC
- MASTER and SLAVE PPC
- Blended PPC

COMMUNICATION PROTOCOLS

- IEC 60870-5-101
- IEC 60870-5-104
- IEC 61850
- Modbus RTU/TCP
- OPC UA
- DNP3
- ...

PLATFORMS

- eXPert STAR DualBus
 - eXPert cSTAR
 - eXPert vSTAR
- Single or Redundant configuration

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Benefits

- **Flexibility in facing complex contexts**
eXPert PPC, designed and produced by SDI, is the ideal solution for the regulation in the complex context of the Renewable Power Plants with diverse sources. Communication with Plant SCADA and sub-parks control systems, accurate electric measurement at the POI, regulation and allocation of set points, real-time data export to DSO/TSO, are in fact customizable in terms of used protocols, types of sub-parks, DSO/TSO specifications.
- **Certified compliance**

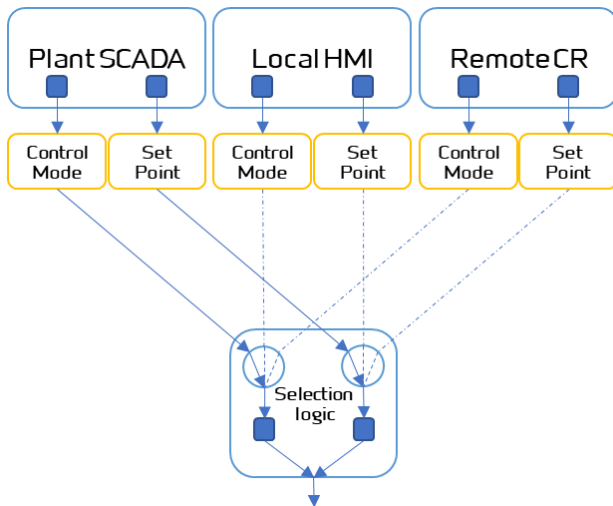


eXPert PPC has obtained the Compliance Certification for Spain according to the NTS EU 2016/631 standards, a European framework that can be adapted by individual countries with specific additions. This certification is particularly relevant for island management, regulated by the NTS P.O.12.2 SENP standards, and demonstrates SDI's adherence to Spanish regulations, serving as a paradigm case within the European context.

- **Proven reliability**
Since 2018, eXPert PPC has been successfully implemented in various configurations across numerous projects in Europe, North America and South America, totaling more than 5GW. It already interfaces a wide range of generation units from various manufacturers, including Santerno, SIEL, SMA, HUAWEI, Power Electronics, NIDEC, Ingeteam, Fluence, Wartsila, Vestas, Nordex Acciona, Siemens Gamesa, Goldwind.
- **Native expandability thanks to the modularity of the eXPert Ecosystem**
Supplied as a component that can be hosted on different hardware platforms, eXPert PPC exploits the modularity and flexibility characteristics of the eXPert Ecosystem. It allows the addition of I/O, both by protocol and wired, and the implementation of additional logics to what is provided in the standard package. SCADA functionalities as advanced HMI, historicization and presentation in automatic Reports - e.g. collecting regulation data from a post-analysis point of view - can be easily added to eXPert PPC, picking some of the many functionalities available in eXPert Ecosystem.

General features

Control Mode and Set Points can be sent from 3 different higher-level sources, Plant SCADA, Local HMI or Remote Control Room (CR), depending on a logical selector.



[1] - Control Mode and Set Point selector

All control logics have a minimum time step of 10 ms.

All regulation parameters are stored on a flash driver, to maintain values after CPU restart.

Both Inputs (from meters, external Plant SCADA, sub-parks, remote CR) and Outputs (to sub-parks and Slave PPCs) are exchanged through configurable standard data protocols, such as IEC-60870-5-101/104, IEC 61850, Modbus, OPC UA, DNP3 etc. For protocols that include them, extended cybersecurity functionalities are available.

Automation logics have different levels of emergency lock and bump-less mode transitions.

Set Points can be managed through configurable power ramps.

Final Set Points to sub-parks are allocated and limited with a set of pre-defined modes established during design phase.

Active Power Control Logic

Active Power resource is used to regulate Active Power at POI. The control logic is based on:

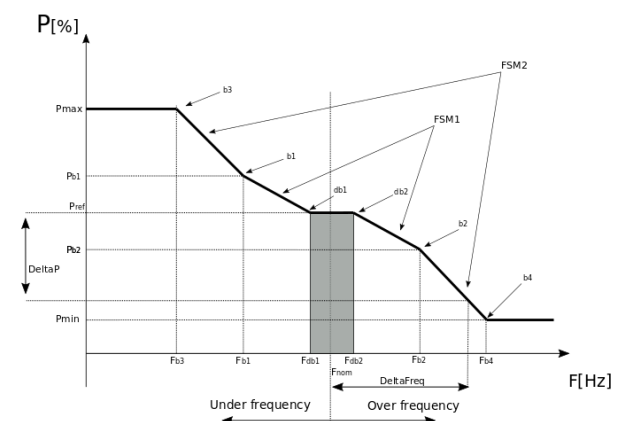
- Active Power Set Point
- Primary Frequency Response

Active Power Set Point

Set Points can be sent from 3 different higher-level sources, Plant SCADA, Local HMI or Remote CR, depending on a logical selector.

Primary Frequency Response

According to a configurable Droop curve, when frequency exits the dead band, PFR decreases Active Power in case of over-frequency and decreases it in case of under-frequency.



[2] - Primary Frequency Response Droop curve

Reactive Power Control Logic

Depending on Control Mode, Reactive Power resource is used to implement one of the following regulations at POI:

- Reactive Power Regulation
- Power Factor Regulation
- Voltage Regulation/Droop

Reactive Power Set Point

Reactive Power Set Point can be sent from 3 different higher-level sources, Plant SCADA, Local HMI or Remote CR, depending on a logical selector.

Power Factor Set Point

Power Factor Set Point can be sent from 3 different higher-level sources, Plant SCADA, Local HMI or Remote CR, depending on a logical selector.

Voltage Regulation/Droop

Voltage Set Point can be sent from 3 different higher-level sources, Plant SCADA, Local HMI or Remote CR, depending on a logical selector.

Reactive Power Set Point is calculated to stabilize Voltage through a Regulator or a Droop Q/V curve.

Available Architectures

eXPert PPC has the capability to control Plant sub-parks of the following technologies:

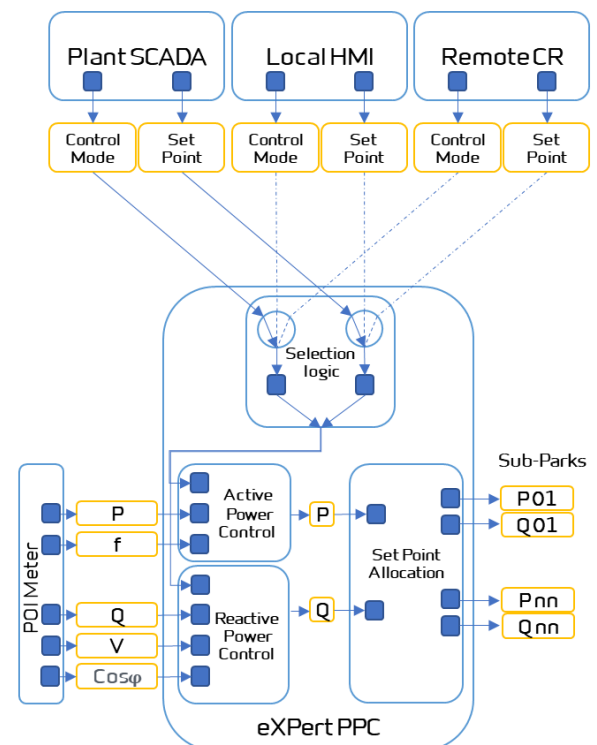
- Wind
- Solar
- Storage
- Biomass

Available architectures of eXPert PPC are the following:

- eXPert PPC
- eXPert Master and Slave PPC
- eXPert Blended PPC

eXPert PPC

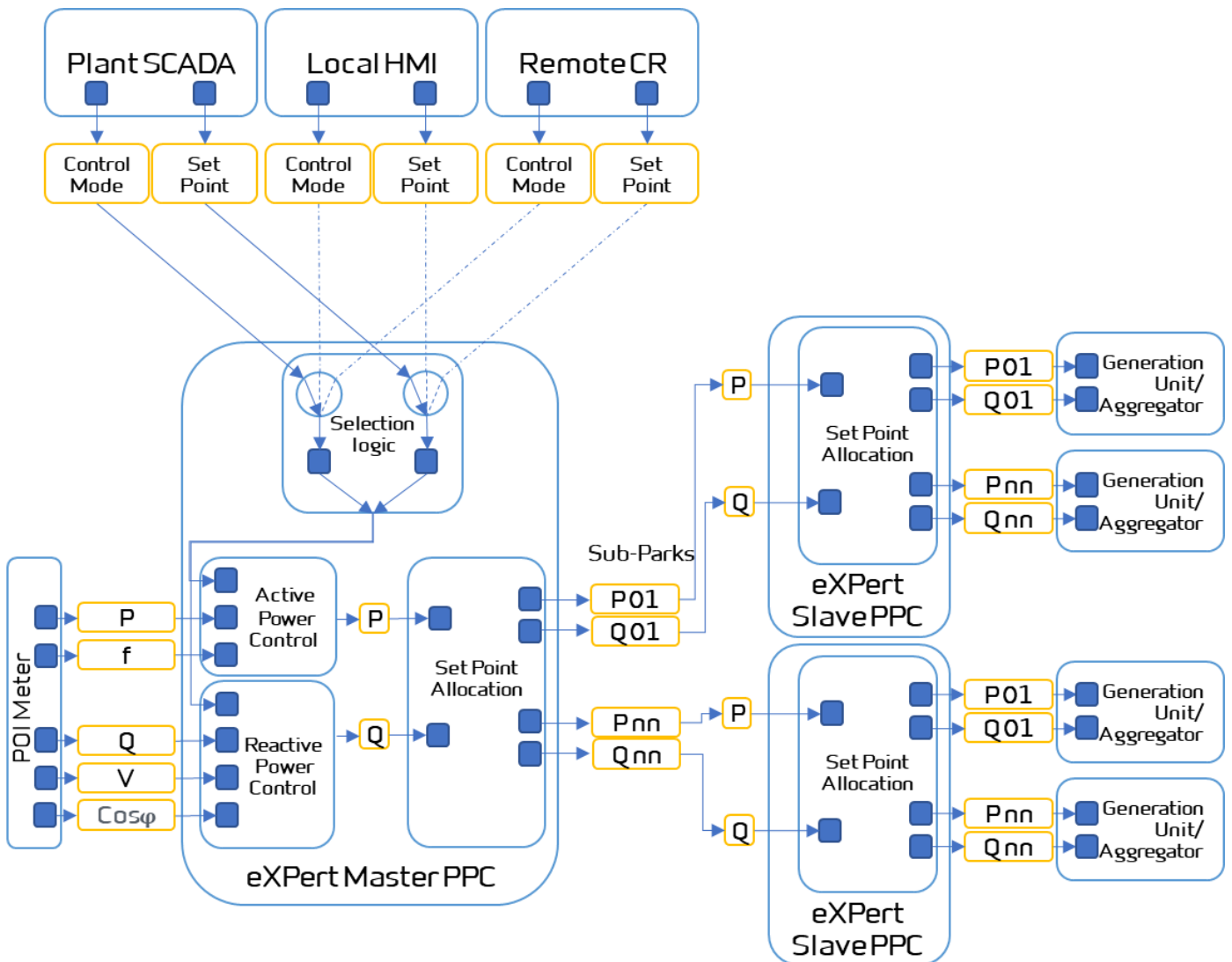
Power Plant Controller for a specific plant technology.



[3] - eXPert PPC

eXPert Master and Slave PPC architecture

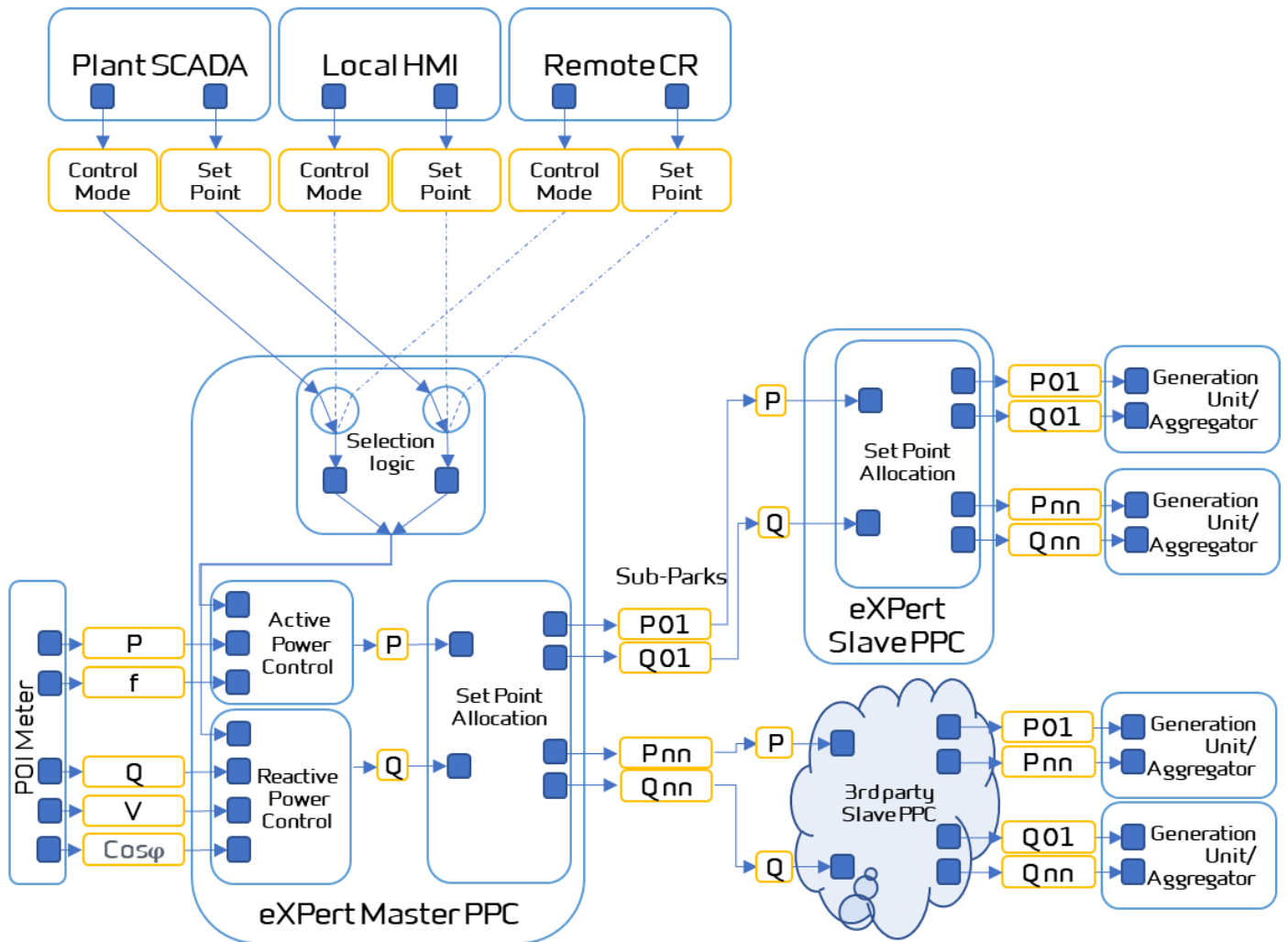
eXPert PPC can be designed in a multi-level architecture, with an eXPert Master PPC which coordinates several eXPert Slave PPCs, globally compliant with local grid code and received Set Points.



[4] - eXPert Master and Slave PPC architecture

eXPert Blended PPC architecture

In the eXPert Blended PPC multi-level architecture, it is possible to integrate also third part slave PPCs.



[5] - eXPert Blended PPC architecture

Certifications



Object	Certification
eXPert PPC	<p>Compliance for Spain according to NTS EU 2016/631 standards, Revision 2.1 of 07/09/2021 and error correction of 10/08/2021, related to the mainland</p> <p>Certificate n. 230239-1-CER</p>
	<p>Compliance for Spain according to NTS P.O.12.2 SENP standards, Revision 1.1 of 07/09/2021 and error correction of 10/08/2021, related to the islands</p> <p>Certificate n. 230239-2-CER</p>
Simulation Model of eXPert PPC	<p>Compliance for Spain according to NTS EU 2016/631 standards, Revision 2.1 of 07/09/2021 and error correction of 10/08/2021, related to the mainland</p> <p>Certificate n. 230239-1-CER-VM</p>
	<p>Compliance for Spain according to NTS P.O.12.2 SENP standards, Version 1.1 of 07/09/2021 and error correction of 10/08/2021, related to the islands</p> <p>Certificate n. 230239-2-CER-VM</p>

Related Products and Modules of eXPert Ecosystem

- **eXPert STAR DualBus**
to host the eXPert PPC in a performing, scalable and redundant RTU produced by SDI. Wired I/O boards available for management in customizable logic
- **eXPert cSTAR**
to host the eXPert PPC in a redundant, compact RTU produced by SDI. Wired I/O boards available for management in customizable logic
- **eXPert vSTAR**
to host the eXPert PPC in an easily deployable virtualized environment
- **eXPert SCADA**
to provide advanced SCADA functionalities, to manage more than 1'500'000 tags in single, redundant or disaster recovery configuration
- **eXPert HMI oE (of Everything)**
to provide advanced HMI functionalities through an innovative interface
- **eXPert IEC 61131 Engine**
to implement additional features such as interface to weather forecast and energy prices providers, costs and scheduling management

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About SDI

Since 1973, SDI is the main Italian company in the field of automation, supervision, control and remote control of highly critical industrial plants.

SDI develops, builds and supplies complete DCS, SCADA systems and special application equipment to main Italian players like Eni, SNAM and ENEL Green Power.

More than 50 years of experience grant the know-how for continue innovation and evolution of SDI's offer.

Our value: ahead on Automation path

Flexibility & Integration at first place: we can provide a completely custom solution that meets every control, monitoring and remote control needs.

Field-proven reliability: hundreds of applications in the field of oil & gas, power production and distribution, public utilities, water, renewables, transport.

Our commitment in development: we invest every day in improving our solutions, thus creating a strong relationship with the customer.

Valuable data, everywhere: we can provide the information you need on every device, anytime.

For years, we have had a certified Management System in accordance with ISO 9001 (Quality), ISO 14001 (Environment), ISO 45001 (Occupational Health and Safety), and ISO/IEC 27001 (Information Security) standards. DNV - one of the leading global certification bodies - periodically verifies its effectiveness.



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