



POWER DISTRIBUTION SOLUTIONS

Ingeteam

INGETEAM

POWER DISTRIBUTION SOLUTIONS



Ingeteam has been offering a **wide range of products and solutions** with the latest technology for the automation of electrical distribution grids for **more than 50 years**, within the context of the development of **Smart Grids**, in sectors such as the **transmission and distribution** of energy or the generation of **renewable energy**.

Ingeteam makes available to our clients a **network of professionals**, covering **4 continents** to offer both service and assistance during each phase of their projects, from the initial project definition phase to the end of the useful life of the devices.

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DISTRIBUTION AUTOMATION

The automation of the secondary distribution network is a key factor in the construction of **smart grids**, optimizing the **operation** and **reliability** of the power supply provided by electricity companies.

The secondary distribution network is comprised of both **aerial and underground lines**, which link up the distribution substations with the electric power transformer stations that carry power supply to the end user.

Automating the distribution network enables all elements and parameters of the secondary network to be **monitored in real time**. This supervision allows processes that reduce and eliminate power outage times to be automatically executed and provides the necessary information and tools to minimize maintenance tasks.

Ingeteam has **long-standing experience** in designing devices, applications and systems for electric distribution automation.

This experience, together with the rollout of new telecommunications technologies has helped us to develop a **range of flexible solutions** that can operate autonomously or be integrated into **DMS systems**.

The solutions developed by Ingeteam **adapt to any scenario**, from urban areas with underground distribution to rural areas with aerial distribution, regardless of the type of distribution grid (ring, radial, mesh, etc.).

Benefits

- Provides real-time information on secondary network elements and measurement points.
- Rapidly and automatically minimizes the number of customers affected by a power outage.
- Increases the precision of fault location, which reduces the time it takes for maintenance teams to take the necessary corrective measures.
- Provides accurate information on the fault to help the post-fault analysis.
- Improves reliability of supply quality indicators (SAIDI, SAIFI, Caidi, etc.), reducing possible penalties due to regulatory breaches.
- Reduces maintenance costs due to early detection of wear and tear in switches or overloading in transformers and, thereby, increases the useful life of the RMU.



FUNCTIONS



The **secondary distribution network** is responsible for the power supply reaching the end user and in recent years it has grown significantly due to the major rise in electricity demand. This has called for increasing **automation, control and remote supervision** in the management thereof.

Ingeteam has powerful solutions for **monitoring and automating** any protection and maneuvering element on this secondary network.

Measurement and monitoring

Supervising the status of the installations allows, on the one hand, the necessary **information** to be availed of in the **DMS** in order to view and **control the status** of the secondary network and, on the other hand, in the event of an incident, provides **all the necessary data** for the maintenance teams to take suitable action quickly and effectively.

Incorporating **digital devices** in combination with the **communication network** enables the substation status to be monitored while also **detecting** situations that could affect the integrity of the installation, such as fires, floods or the presence of unauthorized persons. They can also detect and report the parameters and status of the electric infrastructure itself, such as the status of the **transformer** or the **cells** it comprises.

Automation

The monitored data gathered by the devices and solutions designed by Ingeteam enables actions to be **programmed** and executed **automatically**, which **minimizes or avoids interruptions** in the power supply to the end user.

These include **automatic transfer of supply**, which enables the **location and direction of the electrical fault to be detected** and a series of actions coordinated in the elements, facilitating an alternative electricity flow path so that the interruption can be minimized, both in terms of duration and number of users affected.



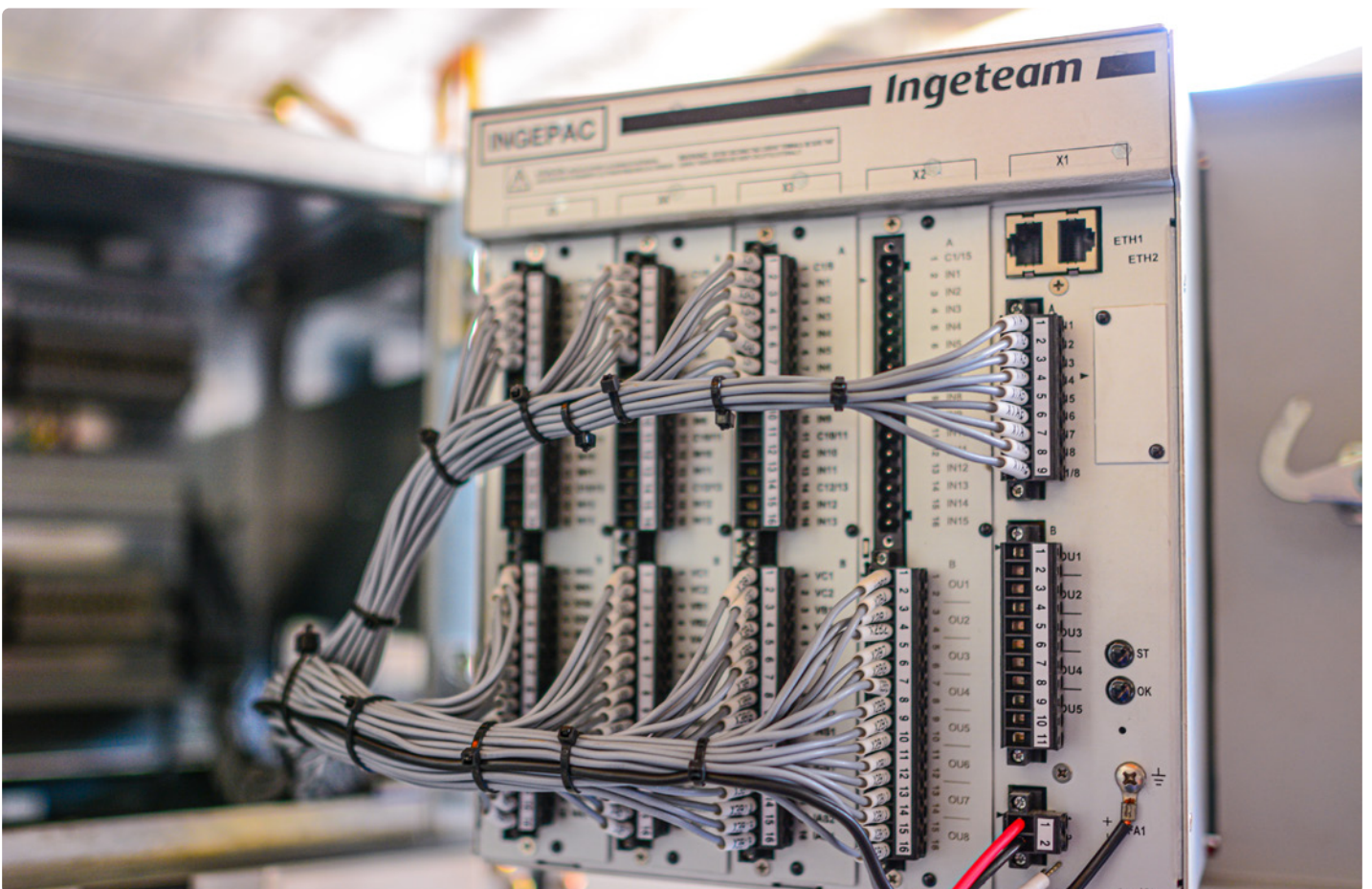
Protection

Ingeteam provides electric protection devices, which guarantee the **detection of parameters** outside normal operating limits, protecting the infrastructures of the network itself, as well as the users and their assets.

Communications

Ingeteam devices incorporate the main **communication protocols** generally used in the electricity sector, as well as the communication capacities for their use both **locally** and **remotely** (remote control offices, DMS, etc.)

The **RTU** function allows **information to be sent** on electrical parameters, status of elements or alarms and **orders can be sent** to operate elements remotely.

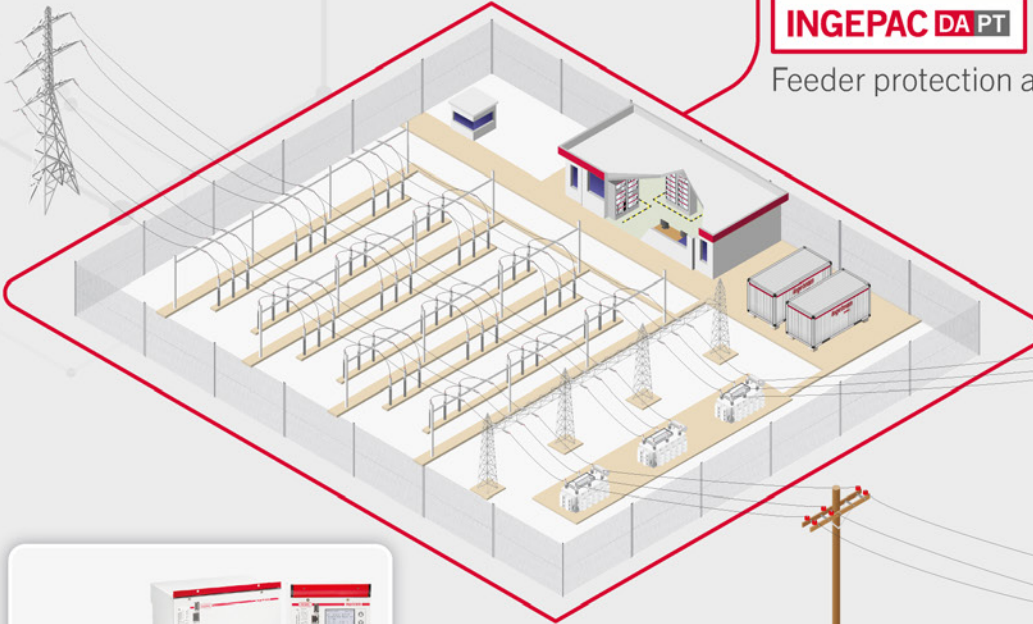


SECONDARY GRID NETWORK

PRIMARY DISTRIBUTION SUBSTATION

INGEPAC DA PT

Feeder protection and control



SECONDARY DISTRIBUTION SUBSTATION

INGEPAC DA

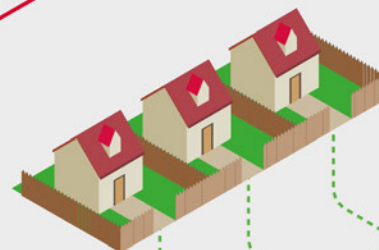
Substation automation and control

INGEPAC DA PT

Protection relay

INGEPAC SR

Low-power instrument transformers



RECLOSER

INGEPAC DA PT

Control, protection and automation

INGEPAC SR

Low-power instrument transformers

LOAD-BREAK SWITCH

INGEPAC DA

Control, monitoring and automation

INGEPAC SR

Low-power instrument transformers

RING MAIN UNIT

INGEPAC DA

Control, monitoring and automation

INGEPAC SR

Low-power instrument transformers



Ingeteam's product range includes control, protection, automation and sensor devices for the secondary distribution network.



INGEPAC DA PTS

INGEPAC DA PTS is a remote terminal unit (RTU) that allows data acquisition, programmable automation and the integration of IEDs with different protocols.

Its high performance and compact design, including solutions for DIN rail or chassis integration, make it the ideal solution for small installations.

INGEPAC DA PTS acts as a communications gateway between the installation and the company's higher centers, allowing the remote monitoring of signals, measurements, and alarms.

The device handles the main remote control protocols and has **IEC 61850** certification, as well as mechanisms and functions that comply with the latest advances in cybersecurity.



RTU and gateway for small substations

Functions	· RTU and substation gateway
Automatisms	· Using logic programming
Logics	· IEC 61131
Enclosure	· 1/3 or 2/3 19" chassis (flush or backplate surface mounting) · Compact housing (front or DIN rail mounting)
Power supply	· 24 / 48 / 125 / 220 Vdc
Buttons (optional)	· In front panel format, there is a Local / Remote button and Open / Close control buttons
LEDs	· Depending on the selected format
1, 2 or 4 slots for I/Os	· I/O (different configurations) · 8 EA (mA and/or V) (different configurations)
Data acquisition	· Events log in non-volatile memory
Communication ports	· Front: RJ45 + USB · Rear: 2 Ethernet + 1 RS232/485 serial
Redundancy (IEC 62439-3)	· PRP / HSR
Synchronization	· SNTP / IEEE 1588 v2 (PTP) / IRIG-B
MMS and GOOSE messages	· Yes, according to IEC 61850-8-1
Webpage	· HTML5 and CSS3 web application
Cybersecurity	· The device follows IEC 62351, IEEE 1686 and IEC 62443 standards · Authentication against LDAP and RBAC · Firewall and port control · Firmware verification and encryption (CMS/PKCS#7) · Cryptography and secure protocols: HTTPs, sFTP, LDAPs, Rsyslog with TLS · Audit log against Syslog
Protocols	· Master / Client: IEC 61850, Modbus RTU serial · Server / Slave: IEC 61850, DNP3, IEC 60870-5-104, IEC 60870-5-101, IEC 60870-5-103, Modbus

INGEPAC DA PT

The multifunction devices of the INGEPAK DA PT product range offer a compact design on a **native IEC 61850 platform** to control, monitor, protect and automate **aerial medium-voltage lines**.

The devices incorporate the main functions of protection, detection, isolation and location of faults, as well as automations such as sectionalizing and service restoration (loop automation), which makes them **comprehensive and reliable** solutions for aerial lines, with LBS or reclosers with voltage measurement on one or both ends of the switch.

INGEPAC DA PT offers a powerful **logical programming** capacity, voltage inputs from conventional transformers or voltage sensors, quality parameter measurement, including holes and overvoltages, as well as communication functions that enable **remote operation** through the main **remote control protocols** implemented by electricity companies.



The device has spontaneous sending of oscillations and fault reports via FTP/sFTP, as well as a simulation mode for analog inputs and I/O for testing.



INGEPAC DA PT installed in a cabinet

Recloser control, monitoring, protection and automation

	INGEPAC DA PT4	INGEPAC DA PT5
Features	Recloser protection and control (3 voltages)	Recloser protection and control (6 voltages)
Protection functions	67, 67N, 67NS, 67NA/NC, 50/51, 50N/51N, 50NS/51NS, 67Q, 46FA, 49, 59, 27, 59N, 47, 81M/m, 81R, CLP, HCL, Hot Line Tag HLT, 68FF, 74TC/CC, 50BF, 32, 78, Fault locator	67, 67N, 67NS, 67NA/NC, 50/51, 50N/51N, 50NS/51NS, 49, 67Q, 46FA, SECC, 59, 27, 59N, 47, 81M/m, 81R, 59 (side B), 27 (side B), 32, 78, CLP, HCL, Hot Line Tag HLT, 68FF, 74TC/CC, 50BF, Fault locator
Automatisms	79: the device allows up to 4 reclosures 25: synchronism Fault detection Sectionalizer (fault isolation)	79: the device allows up to 4 reclosures 25: synchronism Fault detection Sectionalizer (fault isolation) Loop automation / service restoration
Analog channels	4 voltages (sensor or VT) and 4 currents	6 voltages (sensor) and 4 currents
Enclosure	1/3 19" chassis with o without display (front or surface)	
Power supply	24 / 48 / 125 / 220 Vdc	
Leds	24 programmable LEDs + 1 status LED	
Slot 1	Analog board: 4 V + 4 I + 13 DI / 4 V + 4 I + 4 DI + 5 DO *VT or sensor (LP VT) inputs *I neutral or I SEF * Optional: high speed outputs	1 analog board (A side): 3 V + 4 I + 13 DI / 3 V + 4 I + 4 DI + 5 DO * Voltage sensor (LP VT) inputs * I neutral or I SEF * Optional: high speed outputs
Slot 2	Optional: 15 DI & 8 DO / 24 DI & 16 DO / 8 AI DC (mA or V)	Analog Board (B side): 3 V + 13 DI * Voltage sensor inputs
Measures (class 0.2 for direct measurements)	Currents; voltages; frequency; active, reactive and apparent power; active and reactive energy counter; power factor; maximeters; harmonics	
Quality	Sags and swells, CBEMA curve, THD overexcitation, individual measurements of voltage and current harmonics, interruptions	
Breaker information	KL2 sum, reclosure counter, breaker opening counter, last current opened	
Reliability index	SAIFI, SAIDI, MAIFI, CAIDI, ASAI; duration of all interruptions; total number of long and short interruptions	
Data acquisition	Events and faults recording in non-volatile memory, COMTRADE files	
Communication ports	Front: RJ45 + USB / Rear: 2 Ethernet + 1 serial RS232/485	
Redundancy (IEC 62439-3)	PRP / HSR	
Synchronization	SNTP / IEEE 1588 v2 (PTP) / IRIG-B	
MMS and GOOSE messages	Yes, according to IEC 61850-8-1	
Cybersecurity	The device complies with IEC 62351, IEEE 1686 and IEC 62443 standards Authentication against LDAP and RBAC Firewall and port control Firmware verification and encryption (CMS/PKCS#7) Cryptography and secure protocols: HTTPs, sFTP, LDAPs, Rsyslog with TLS Audit log against Syslog	
Protocols	IEC 61850, DNP3, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, Modbus	

INGEPAC DA AUC offers **line automation** solutions for both aerial (LBS) and underground (RMU) applications, with fault pass indication (FPI), voltage detection, service restoration automation to reduce the system average interruption duration (SAIDI) and communication capacities that provide real-time information on the network status and the installation to the company's remote control offices and asset management team.

The **modular design** of INGEPA DA AUC, which comes in different formats depending on the application, from compact designs for one single position to those that allow up to 5 contact breakers/isolators to be operated locally.



RMU automation

Feeder control, measurement and automation

Functions	Control, supervision and measurement of up to 5 medium voltage feeders
Automatisms	- Voltage presence - Directional pass fault detection - Fault isolation
Protection functions	67, 67N, 67NS
Enclosure	1/3 or 2/3 19" chassis (front or surface) - Compact (front or DIN rail)
Power supply	12 / 24 / 48 / 125 / 220 Vdc
Pushbuttons (optional)	For front panel mounting: L/R and Open/Close/Automatism for every supervised feeder
LEDs	Depending on the selected format
1, 2 or 4 slots for I/Os	- ED/SD (several options) 4 V + 4 I (from sensors or VT) 8 I 8 EA (mA and/or V) (several options)
Measures for each monitored feeder (class 0.2 for direct measures)	- Currents - Voltages - Frequency - Active, reactive and apparent power - Active and reactive energy counter - Power factor
Breaker supervisions (for each monitored feeder)	- Breaker opening counter (trips or commands) - Faults counter
Data acquisition	Events and faults recording in non-volatile memory, COMTRADE files
Communication ports	Front: RJ45 + USB / Rear: 2 Ethernet + 1 serial RS232/485
Synchronization	SNTP / IRIG-B
MMS and GOOSE messages	Yes, according to IEC 61850-8-1
Web page	HTML5 and CSS3
Protocols	IEC 61850, DNP3, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, Modbus

INGEPAC DA PT

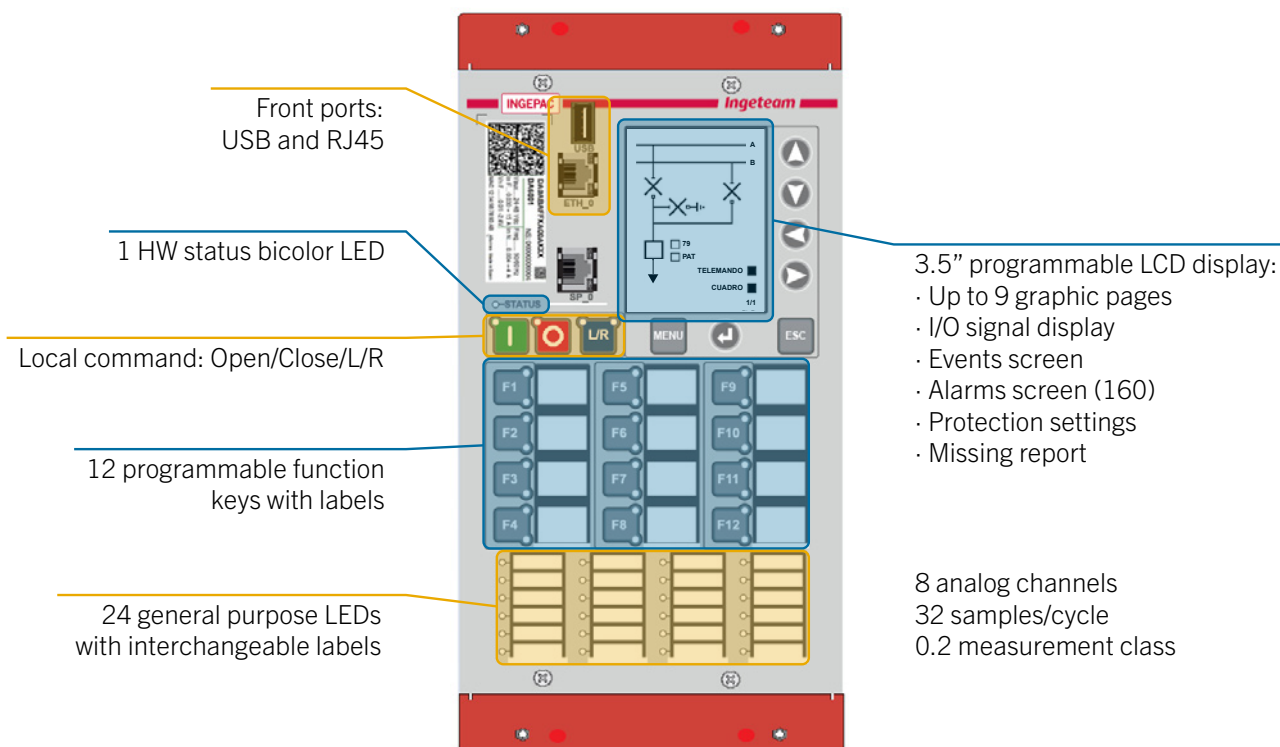
INGEPAC DA PTC

The multifunction devices of the INGEPAK DA PT product range offer a compact design on a **native IEC 61850 platform** to control and protect medium-voltage lines and positions.

INGEPAC DA PTC is a remote position unit with a modular design and different hardware options, which allows different **digital input and output modules** to be incorporated for full position control, as well as analog card modules to capture the key electrical figures.

INGEPAC DA PT1 facilitates **control, measurement and protection** functions in a single device, providing all functionalities required for an MV feeder.

Both product ranges have a powerful logical programming capability based on the **IEC 61131** standard and incorporate the main communication protocols to communicate with the installation control system.



Bay control

	INGEPAC DA PT1	INGEPAC DA PTC
Features	Bay protection and control	Bay control
Protection functions	67, 67N, 67NS, 67NA/NC, 50/51, 50N/51N, 50NS/51NS, 67Q, 46FA, 49, 59, 27, 59N, 47, 81M/m, 81R, CLP, HCL, Hot Line Tag HLT, 68FF, 79, 25, 74TC/CC, 50BF, 32, 78, Fault locator	N/A
Automatisms	79: up to 4 reclosures / 25: synchrocheck	Programmable logic
Logics	IEC 61131	
Analog channels	4 voltages and 4 currents	Optional (4 voltages and 4 currents)
Enclosure	1/3 19" chassis	1/3 or 2/3 19" chassis (front or surface)
Power supply	24 / 48 / 125 / 220 Vdc	
LEDs	24 programmable LEDs + 1 status LED	LEDs number depends on the enclosure
I/O slots	1 slot for I/O selectable: 15 DI & 8 DO / 24 DI & 16 DO / 8 AI DC (mA or V)	2 or 4 slots for I/O selectable: 15 DI & 8 DO / 24 DI & 16 DO / 13 DI / 8 AI DC (mA or V)
AI inputs resolution	15 bits + 1 sign	
Measures (class 0.2 for direct measurements)	Currents; voltages; frequency; active, reactive and apparent power; active and reactive energy counter; power factor; maximeters; harmonics	Currents; voltages; frequency; active, reactive and apparent power; active and reactive energy counter; power factor; maximeters; harmonics (only for models with analog board)
Quality	Sags and swells, CBEMA curve, THD overexcitation, individual measurements of voltage and current harmonics, interruptions	N/A
Breaker information	KL2 sum, reclosure counter, breaker opening counter, last current opened	Breaker status supervision
Data acquisition	Events and faults recording in non-volatile memory, COMTRADE files	Events recording in non-volatile memory,
Communication ports	Front: RJ45 + USB / Rear: 2 Ethernet + 1 serial RS232/485	
Redundancy (IEC 62439-3)	PRP / HSR	
Synchronization	SNTP / IEEE 1588 v2 (PTP) / IRIG-B	
MMS and GOOSE messages	Yes, according to IEC 61850-8-1	
Cybersecurity	The device complies with IEC 62351, IEEE 1686 and IEC 62443 standards Authentication against LDAP and RBAC Firewall and port control Firmware verification and encryption (CMS/PKCS#7) Cryptography and secure protocols: HTTPs, sFTP, LDAPs, Rsyslog with TLS Audit log against Syslog	
Protocols	IEC 61850, DNP3, IEC 60870-5-101, IEC 60870-5-103, IEC 60870-5-104, Modbus	

INGEPAC SR LPVT and **INGEPAC SR LPCT** sensors offer an alternative solution to conventional instrument transformers in a reduced space and at a competitive cost. They provide a low-voltage, high-power analog output signal that can be applied directly to measuring devices without preconditioning. These measuring devices are installed in medium-voltage automation and monitoring systems in networks with nominal voltages up to 36 kV.

The **INGEPAC SR LPCT** current sensors meet the requirements defined in the **IEC 61869-10** standard, guaranteeing a multipurpose measurement and protection accuracy class of 0.2 S | 5P10 for the indoor model and 0.2 S | 5P20 for the outdoor model.

INGEPAC SR LPVT voltage sensors meet the requirements defined in the **IEC 61869-11** standard, guaranteeing a multipurpose measurement and protection accuracy class of 0.5 P.

INGEPAC SR LPVT sensors can be used with IEDs with sensor inputs or combined with an **INGEPAC SR VA signal amplifier** with IEDs with conventional analog inputs. The INGEPA SR VA module transparently amplifies up to **3 voltage sensor signals** to values equivalent to those provided by a conventional instrument transformer.

INGEPAC SR sensors are subjected to the **same accuracy and surge tests** as conventional transformers, following **IEC 61869-1** and **IEC 61869-6** standards.



Benefits

- Measurement and protection accuracy
- Smaller size and weight
- Good accuracy
- Very safe
- Extensive dynamic range
- Lower cost
- Ease of installation
- More sustainable (less amount of raw material needed)



All devices are individually tested to guarantee precision

Voltage and current sensors

INGEPAC SR LPCT current sensors

	Application	Measuring range / Insulation level	Transformation ratio	Connector	Accuracy
	Indoor	(500 A Kpcr 1.5) / (0.72 / 3 kV)	500 A / 225 mV	Female RJ45	0.2 S / 5P10
	Outdoor	(500 A Kpcr 1.5) / (0.72 / 3 kV)	500 A / 225 mV	M12 "A-coded" (8 poles)	0.2 S / 5P20

INGEPAC SR LPVT voltage sensors

	Application	Measuring range / Insulation level	Transformation ratio	Connector	Accuracy
	Indoor	30 kV (36 / 70 / 170 kV) 11 kV ... 20 kV (24 / 50 / 125 kV)	30000 V / 3,25 V 20000 V / 3,25 V	RJ45 o M12 "A-coded" (8 poles)	0.5 P
	Outdoor	11 kV ... 20 kV (24 / 50 / 125 kV)	20000 V / 3,25 V	M12 "A-coded" (8 poles)	0.5 P
	Indoor / Outdoor	30 kV (36 / 70 / 170 kV) 11 kV ... 20 kV (24 / 50 / 125 kV)	30000 V / 3,25 V 20000 V / 3,25 V	M12 "A-coded" (8 poles)	0.5 P

INGEPAC SR VA signal amplifier

INGEPAC SR VA is a **signal conditioning** module that allows the transparent connection of **3 INGEpac SR LPVT voltage sensors** to multifunction devices equipped with conventional instrument transformer analog inputs.

It works with a transformation ratio of $3.25/\sqrt{3}$ V to 110/ $\sqrt{3}$ V and 125 Vcc supply voltage.

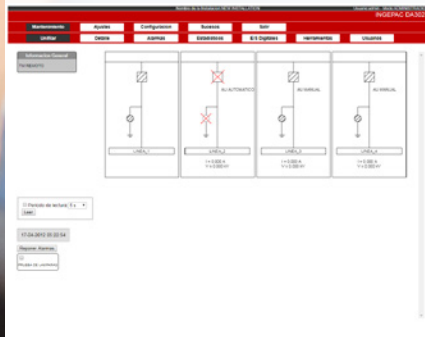
INGEPAC SR VA enables the use of **UNE-EN 61869-11** LPVT sensor technology to any IED, meter, energy meter, or protection relay.



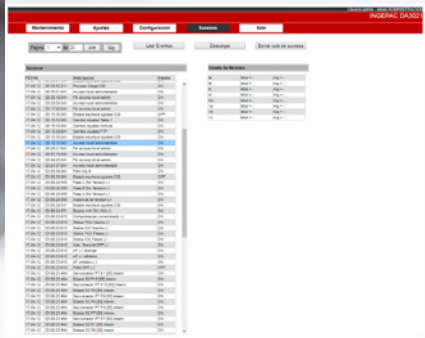
WEB ACCESS



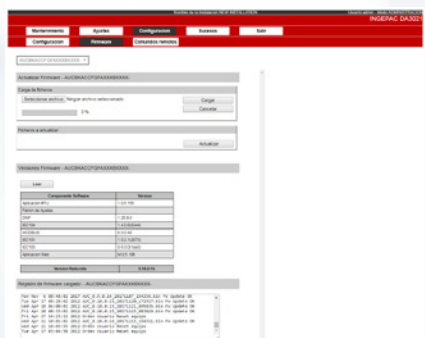
General configuration



Monitored positions status



Event list



Firmware update

Ingeteam devices have a powerful **embedded web server** compatible with computers, smartphones and tablets, which allows access, configuration and updating of the device without any software installed on the device.

Access can be made from anywhere with an Internet connection, following rigorous **cybersecurity** measures that guarantee the security and integration of the application:

- Access through encrypted algorithm for passwords and protocols
- RBAC access with different access levels depending on the permissions given to the user
- Use of authentication certificates
- Configuration update based on encrypted and signed firmware

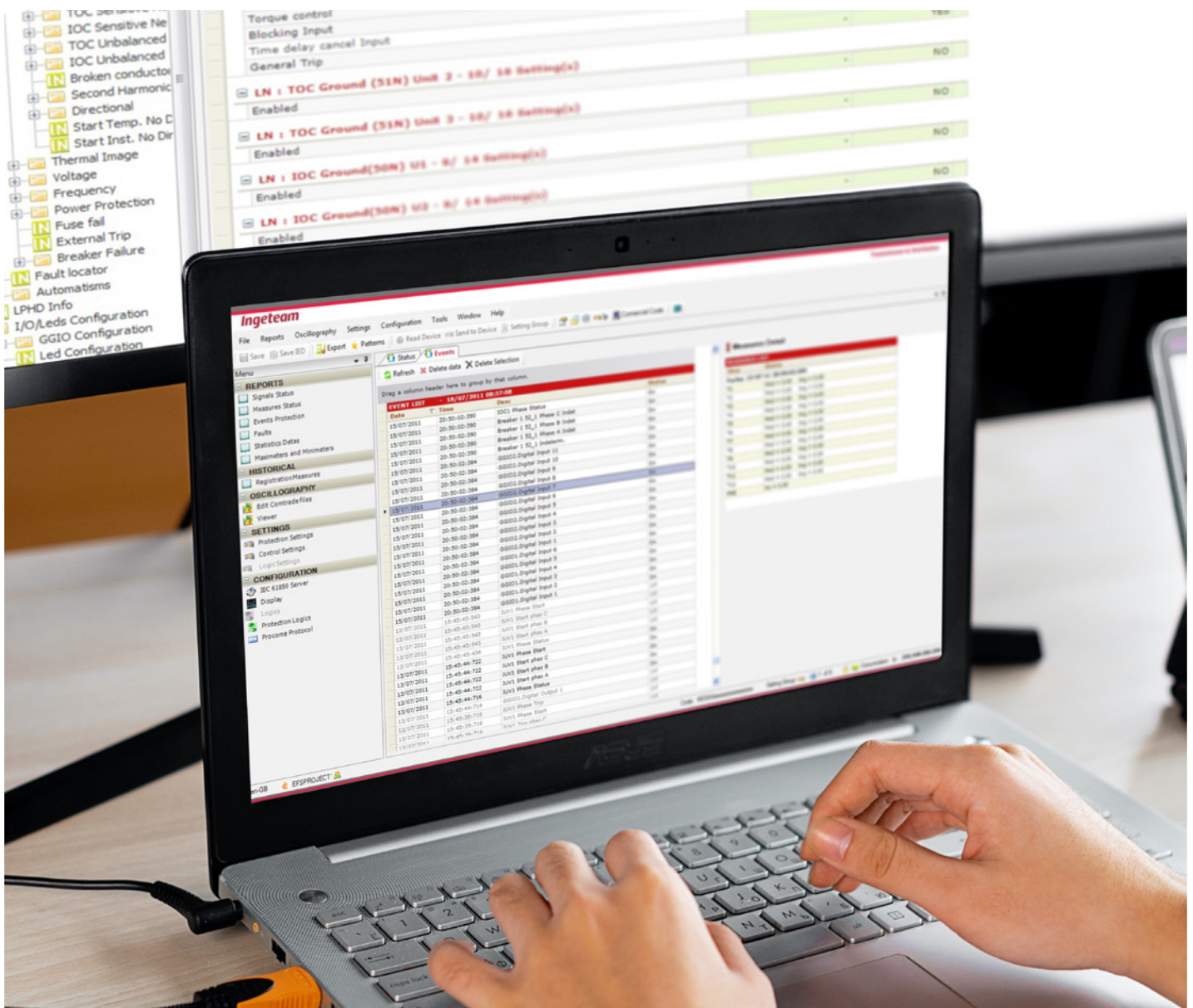


DEVICE ACCESS AND CONFIGURATION TOOLS

All Ingeteam devices are configurable using the free **INGESYS eFS pacFactory** software tool, which is a powerful tool for device configuration and management through a highly intuitive interface.

The tool enables among other functionalities:

- Auto-detection of IEDs connected to the network
- Configuration settings and parameters
- Logic programming under IEC 61131 standard
- Management and export of measurement files, events and alarms
- Protocol configuration



STANDARDS AND CERTIFICATION



Design

As part of its commitment to quality and customer satisfaction, Ingeteam applies these processes and conducts comprehensive tests on all the devices it manufactures to ensure compliance with the highest quality standards and regulations.

Ingeteam devices are certified by **independent external laboratories** in compliance with **international standards** for electric, climatic and mechanical testing, thereby ensuring optimal performance.

The INGEPAC DA product range meets the following directives and standards:

- Low Voltage Directive 2006/95/EC
- EMC Directive 2004/108/EC
- IEC 60255-1
- IEC 60255-26
- IEC 60255-27

The INGEPAC SR product range complies with the following directives:

- IEC 61869-1
- IEC 61869-6



Quality

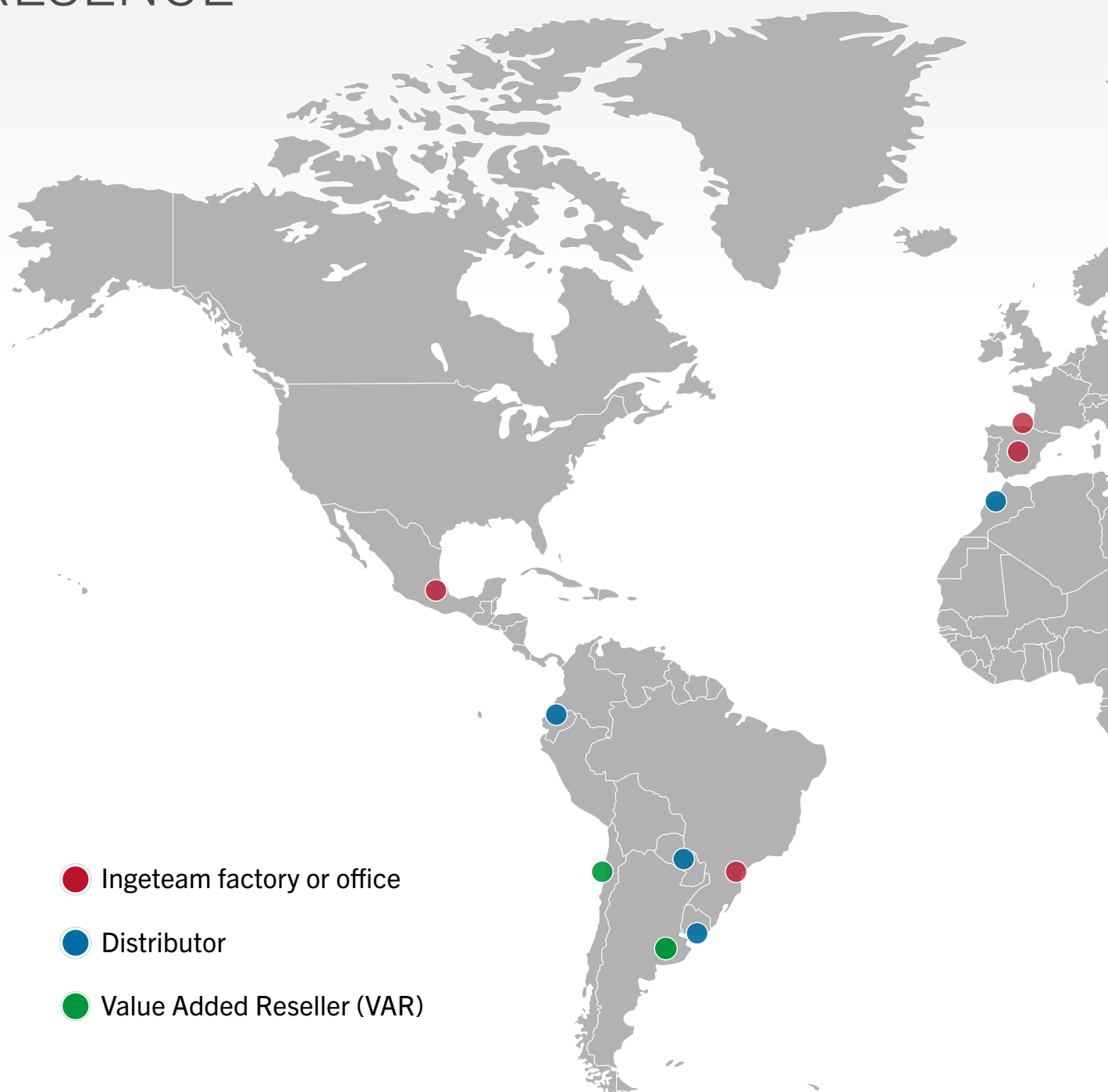
Ingeteam Power Technology, S. A. holds the **ISO 9001** certification, which guarantees that it meets applicable legal and regulatory requirements and implements **continuous improvement** processes.

It also holds the **ISO 14001** certification, which specifies **environmental management** requirements and attests to Ingeteam's commitment to protection of the environment.

Ingeteam has the **ISO 27001** certification on information security and privacy, which guarantees the **assurance, confidentiality** and **integrity** of all the data managed by the company.



INTERNATIONAL PRESENCE



- Ingeteam factory or office
- Distributor
- Value Added Reseller (VAR)

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Vast network of **offices, factories, distributors** and **VARs** to serve the customer closely



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Ingeteam contributes to a safer, more reliable and sustainable electrical network





Ingeteam

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