



FLEX FAMILY

PROTECTION & CONTROL IEDS FOR
DIGITAL SUBSTATIONS



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▶ 1. ZIV FLEX FAMILY RELAYS

TECHNOLOGY, ENGINEERING AND LONG-TERM PARTNERSHIP

The ZIV Flex Family provides a complete portfolio of protection, control and automation IEDs covering the main applications found in modern transmission and distribution substations.

Since the development of its first digital protection relay in 1993, ZIV has continuously evolved its technology to meet the changing requirements of electrical networks and the expectations of utilities worldwide. Over more than three decades, the company has incorporated new protection functions, communication technologies, digital substation architectures and cybersecurity capabilities, ensuring alignment with industry standards and operational best practices.

APPLICATION

From distribution substations to EHV transmission systems, including conventional and digital architectures, centralized and distributed protection schemes, Process Bus implementations, highly available communication networks and advanced cybersecurity environments.

PORTFOLIO

DBF

Busbar Differential Protection

with Ethernet HSR or PRP Redundant communication between the central and bay units, based on process bus.

DLF

Line Differential Protection with Distance Backup

Both units are suitable for lines of any voltage level, overhead or underground, multiterminal, and single or parallel circuits.

ZLF

Distance Protection

suitable for lines of any voltage level, single or double circuit breaker with any configuration: overhead or underground, single or parallel circuits.

IDF

Transformer Protection

for two, three or four winding transformers or autotransformers, of any voltage level, with single or double circuit breaker.

IRF

MV Feeder Protection & HV BCU

for distribution feeders, transformers and generators, transmission line backup, and BCU (Bay Control Unit for single or double circuit breaker).

RTF

Automatic Voltage Regulator AVR

for up to 5 power transformers in parallel.

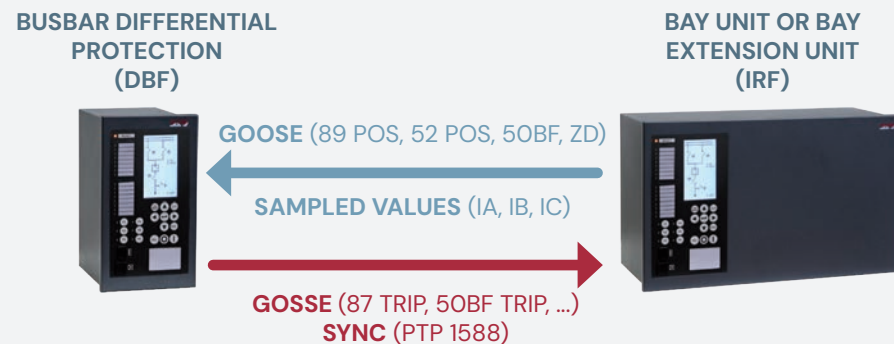
+ ENGINEERING SERVICES

Beyond equipment, ZIV complements its technology offering with a comprehensive range of engineering and lifecycle services, including system engineering, IEC 61850 integration, FAT and SAT support, commissioning, training and long-term technical assistance.

This combination of technology, expertise and customer proximity enables utilities, EPCs and system integrators to rely on a trusted partner throughout the entire lifecycle of their projects.

▷ DBF: BUSBAR DIFFERENTIAL PROTECTION

Busbar Differential Protection with Ethernet HSR or PRP Redundant communication based on Process Bus, enabling both distributed schemes between the busbar protection and control units, and centralized schemes between the busbar protection and bay extension units.



COMMUNICATION BETWEEN CENTRAL AND BAY UNITS

IEC 61869-9SV & IEC 61850-8-1 GOOSE Standards.

SYNCHRONIZATION

PTP IEC-61850-9-3

- **DBF-A: DISTRIBUTED BUSBAR PROTECTION**

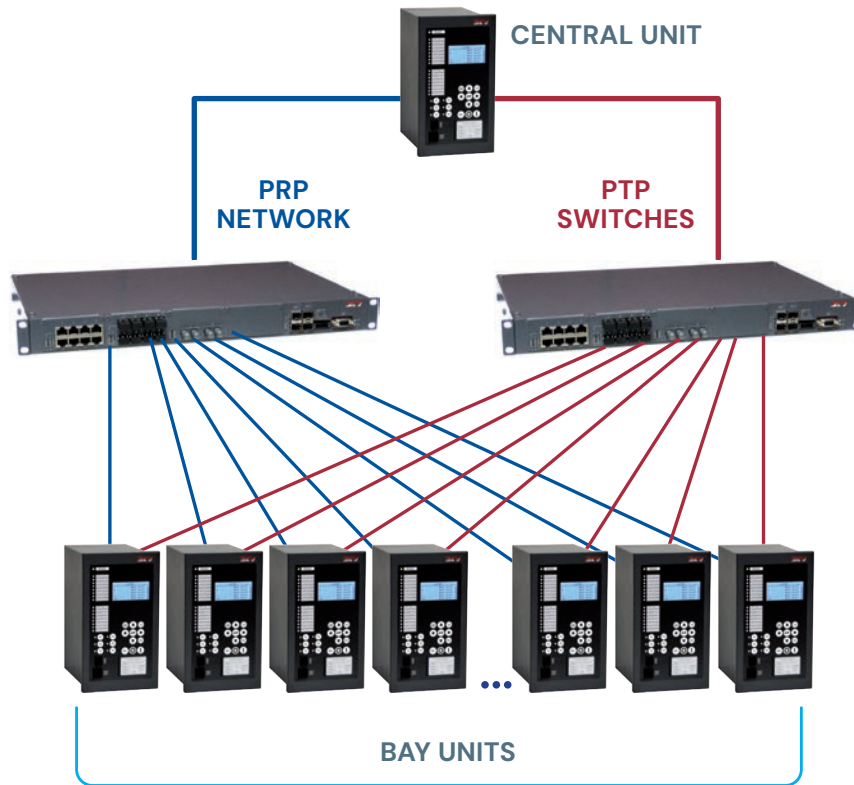
For up to 24 bays and 4 buses.

- **DBF-B: CENTRALIZED BUSBAR PROTECTION**

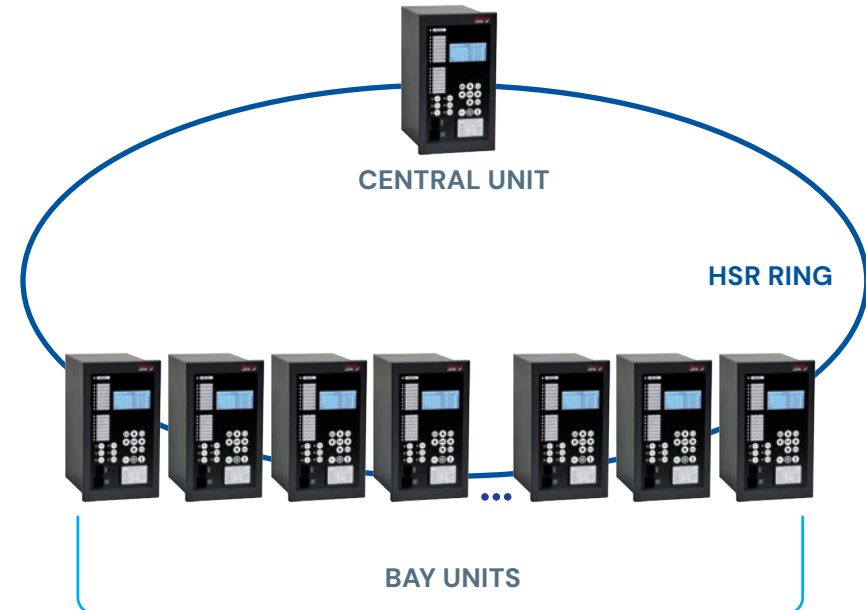
For up to 24 bays, 4 buses, voltage supervision*.

DBF-A: DISTRIBUTED BUSBAR PROTECTION

HSR REDUNDANCY BETWEEN CENTRAL AND BAY UNITS



PRP NETWORK BETWEEN CENTRAL AND BAY UNITS



DBF-B: CENTRALIZED BUSBAR PROTECTION

≤ 10 BAYS W/O V. SUPERVISION



DBF-B

DBF-B: CENTRALIZED BUSBAR PROTECTION

≤ 15 OR 18 BAYS W/ V. SUPERVISION



DBF-B

IEC 61850 &
IEC 61869 (GOOSE & SV)



IRF-F or IRF-G

DBF-B: CENTRALIZED BUSBAR PROTECTION

UP TO 20 BAYS W/O V. SUPERVISION



DBF-B

IEC 61850 &
IEC 61869 (GOOSE & SV)



IRF-E

DBF-B: CENTRALIZED BUSBAR PROTECTION

UP TO 24 BAYS W/ V. SUPERVISION



▷ DLF: LINE DIFFERENTIAL PROTECTION WITH DISTANCE BACKUP

Both functions are suitable for lines of any voltage level, overhead or under ground, multiterminal, and single or parallel circuits.

COMMUNICATIONS
87L communication speed: from 64 kbit/s to 2 Mbit/s (C37.94).
Communication via SDH multiplexers (C37.94) or through a converter with G.703 output.
Ethernet Interface for 87L Communications

- **DLF-A**

For single breaker.

- **DLF-B**

For double breaker or breaker-and-a-half, when CTs are at the line side or the current summation is performed externally (1 single set of 3 CTs).

- **DLF-C**

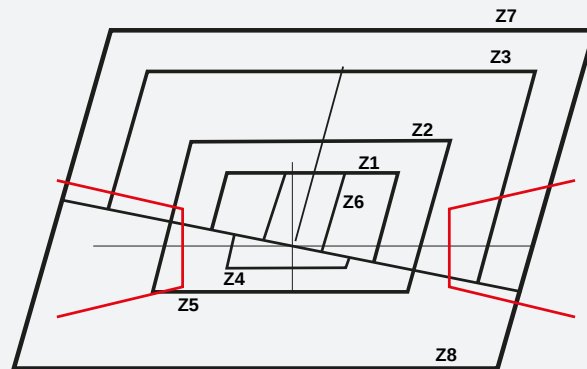
For double breaker or breaker-and-a-half (2 sets of 3 CTs).



▷ ZLF: DISTANCE PROTECTION

Suitable for lines of any voltage level, single or double circuit breaker with any configuration: overhead or underground, single or parallel circuits.

COMMUNICATIONS
Direct communication speed: from 64 kbit/s to 2 Mbit/s (C37.94).
Communication via SDH multiplexers (C37.94) or through a converter with G.703 output.



Distance zones with
Quadrilateral Characteristic and Load Limiters

- **ZLF-B**
For single breaker.
- **ZLF-C**
For double breaker or breaker-and-a-half.

▷ IDF: TRANSFORMER PROTECTION

For two, three or four winding transformers or autotransformers, of any voltage level, with single or double circuit breaker.

COMMUNICATIONS
Direct communication speed: from 64 kbit/s to 2 Mbit/s (C37.94).
Communication via SDH multiplexers (C37.94) or through a converter with G.703 output.



- **IDF-A**

For **two** windings transformers.

- **IDF-B**

For up to **three** windings transformers.

- **IDF-E**

For up to **four** windings transformers, or three windings' transformers with one winding on breaker-and-a-half.

▷ IRF: MV FEEDER PROTECTION & HV BCU

For MV distribution feeders, transformers and generators, transmission line backup, and BCU (Bay Control Unit for single or double circuit breaker).

COMMUNICATIONS
Direct communication speed: from 64 kbit/s to 2 Mbit/s (C37.94).
Communication via SDH multiplexers (C37.94) or through a converter with G.703 output.
SYNCHRONIZATION
PTP IEC-61850-9-3

- IRF-A: MV MODULAR FEEDER PROTECTION
- IRF-B: DOUBLE BREAKER OR BREAKER-AND-A-HALF BCU.
- IRF-C: GENERAL ALARMS BCU / I/O BOX
- IRF-D: SINGLE BREAKER BCU
- IRF-E/F/G: EXPANSION UNITS FOR CENTRALIZED BUSBAR PROTECTION*

▷ RTF: AUTOMATIC VOLTAGE REGULATOR (AVR)

Voltage regulation in power transformers in configurations with up to 5 transformers in parallel

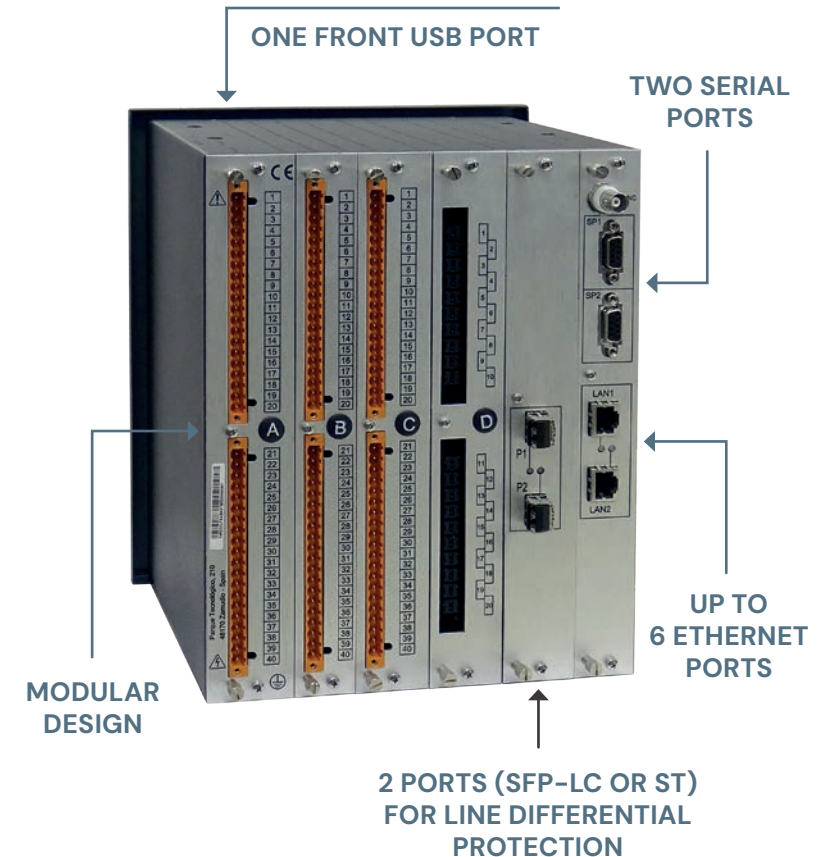
Enables parallel transformer regulation using master/slave, circulating current, and negative reactance methods.

It also includes line Voltage Drop Compensation functions.



▷ GENERAL FEATURES

- Powerful programable logic. 2000 event log. Up to 100 oscillography seconds.
- Alphanumeric or graphic display.
- Combinations of up to 216 DI or up to 177 DO.
- PRP, HSR, RSTP and Bonding Redundancy.
- IEC 61850 Ed.2, IEC 61850 Ed.2.1* DNP3.0, Modbus RTU, PROCOME, Syslog, SNMP* Protocols.
- Process Bus according to IEC 61850-9-2 and IEC61869-9.
- Cybersecurity in accordance with IEC 62351, IEC 62443 and IEEE 1686-2013 standards. RBAC, secure keys, physical & logical port disabling, cybersecurity event log, securing of management protocols, remote authentication (LDAP, RADIUS) and digital firmware securitization.
- Time synchronization by IRIG-B, SNTP and PTP.
- Enhanced Web Page*.
- Synchrophasors according to IEEE C37.118.1-2011 (2014 Amendment), IEC 60255-118-1-2018 & IEEE 118.2-2011.



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2. PHYSICAL ARCHITECTURE

Easy Modular Extension
 HW Model Auto-Detection
 Self-Configurable FW
 Easy Maintenance

- 1 Graphic / Alphanumeric Display.
- 2 31 or 23 LEDs (depending on the model).
- 3 6 or 12 configurable Command Buttons (depending on the model) with configurable LEDs.
- 4 Navigation Buttons.

Models with Standard Display feature 6 configurable bicolor LEDs (green/red) associated with the command buttons P1-P6.

Models with Extended Buttons Display feature 12 configurable bicolor LEDs (green/red) associated with the command buttons P1-P12, plus other 2 configurable LEDs (fixed red) associated with the Local/Remote (L/R) button. For this model, only the alphanumeric display option is available.



▷ 6U MODELS: 1/3, 1/2 & 1 RACK

The equipments are made up of the following modules:

- Processor module CPU.
- Analog inputs module (up to three).
- Power Supply, combined with digital inputs and outputs.
- Redundant Power Supply*.
- Digital inputs, outputs and transducers inputs modules.
- Communications module between relays (eg. for 87L).

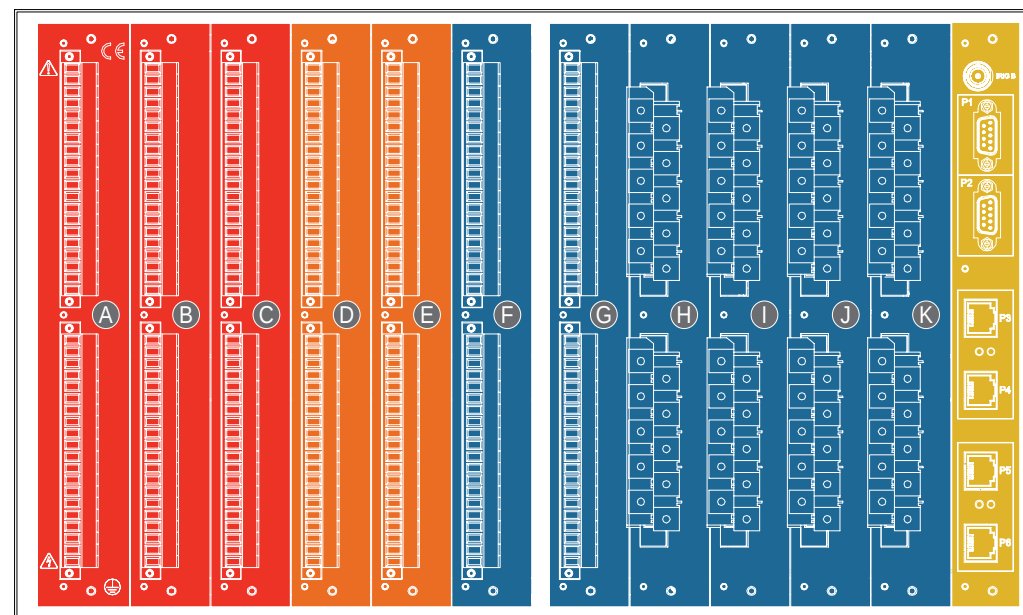
CHARACTERISTICS
Removable vertical modules with rear plug-in terminal blocks for easy wiring.
Supports ring lugs for analog and selectable pointed / ring terminals for I/Os.
Shorting connectors for analog inputs (optional).

Following pictures represent the external appearance of the IEDS for 1/3, 1/2 and full rack of 19" and 6U standard height.

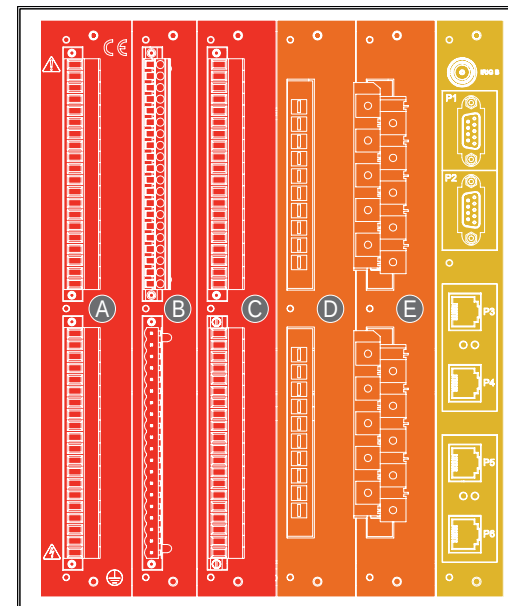
▷ SLOTS

SLOT A 1/3, 1/2 & 1 RACK	2 TERMINAL BLOCKS OF 20 TERMINALS FOR RELAY AUXILIARY POWER SUPPLY, DIGITAL INPUTS AND OUTPUTS, INCLUDING THE INTERNAL RELAY IN ANOMALY OUTPUT.
SLOT B 1/3, 1/2 & 1 RACK	2 TERMINAL BLOCKS OF 20 TERMINALS TO CONNECT DIGITAL INPUTS AND OUTPUTS.
SLOT C 1/3, 1/2 & 1 RACK	1/3 RACK: 2 TERMINAL BLOCKS OF 10 TERMINALS TO CONNECT 10 ANALOG CHANNELS OR 2 TERMINAL BLOCKS OF 20 TERMINALS TO CONNECT DIGITAL INPUTS AND OUTPUTS. 1/2 RACK AND 1 RACK: 2 TERMINAL BLOCKS OF 20 TERMINALS TO CONNECT DIGITAL INPUTS AND OUTPUTS.
SLOT D 1/2 & 1 RACK	2 TERMINAL BLOCKS OF 10 TERMINALS TO CONNECT 10 ANALOG CHANNELS OR 2 TERMINAL BLOCKS OF 20 TERMINALS TO CONNECT DIGITAL INPUTS AND OUTPUTS.
SLOT E 1/2 & 1 RACK	
SLOT F 1 RACK	2 TERMINAL BLOCKS OF 10 TERMINALS TO CONNECT 10 ANALOG CHANNELS OR 2 TERMINAL BLOCKS OF 20 TERMINALS TO CONNECT DIGITAL INPUTS AND OUTPUTS.
SLOT G 1 RACK	
SLOT H 1 RACK	
SLOT I 1 RACK	
SLOT J 1 RACK	
SLOT K 1 RACK	
SLOT CPU	COMMUNICATIONS PORTS AND SYNCHRONIZATION (IRIG-B, 2 SERIAL PORTS, UP TO 4 LAN PORTS).

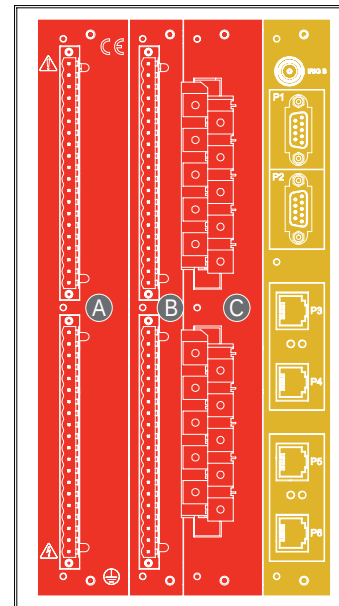
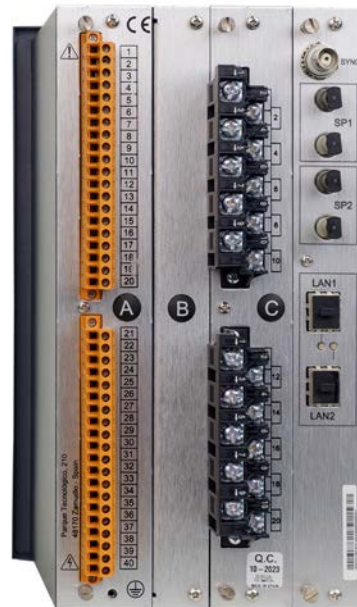
1 RACK MODEL: CPU + 11 FREE SLOTS



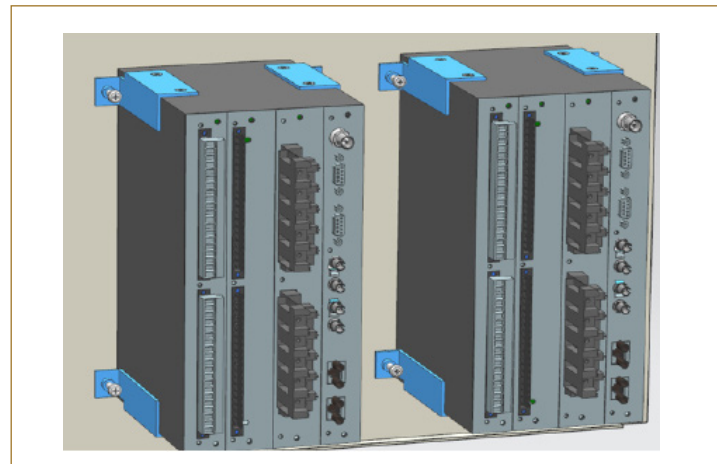
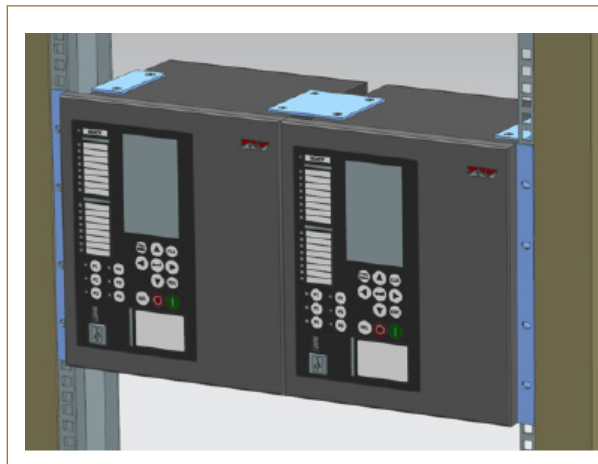
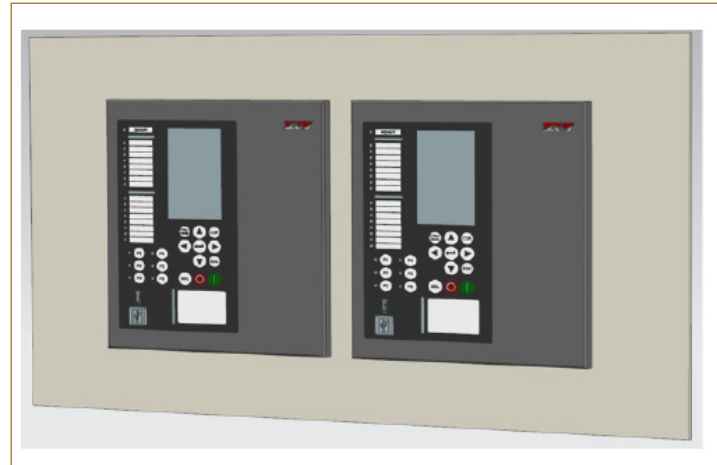
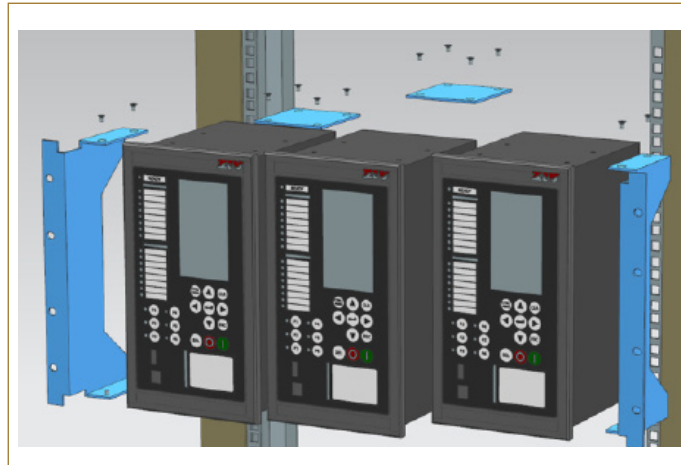
1/2 RACK MODEL: CPU + 5 SLOTS

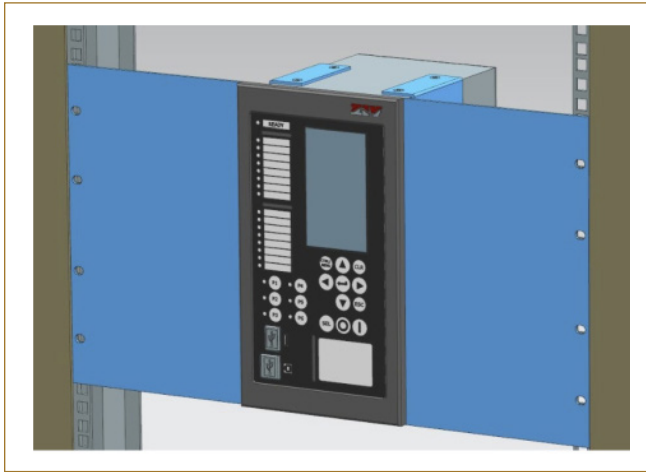


1/3 RACK MODEL: CPU + 3 SLOTS

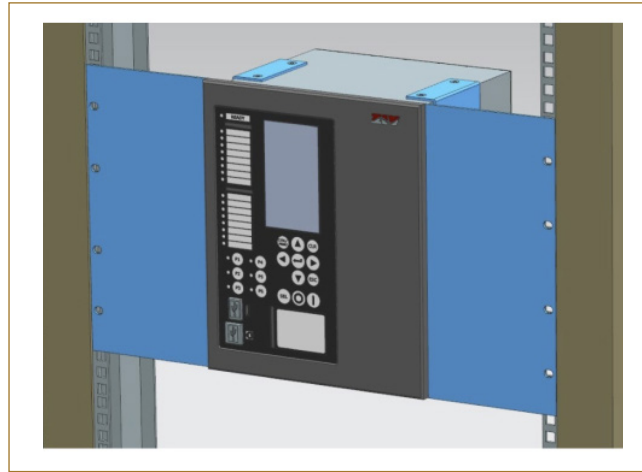


▷ PANEL MOUNTING SOLUTIONS

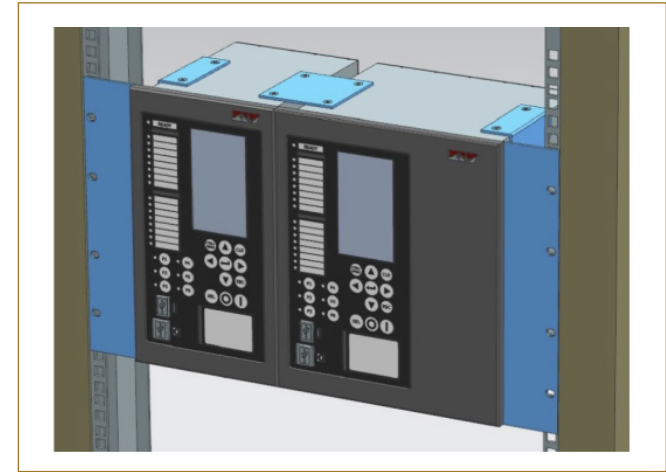




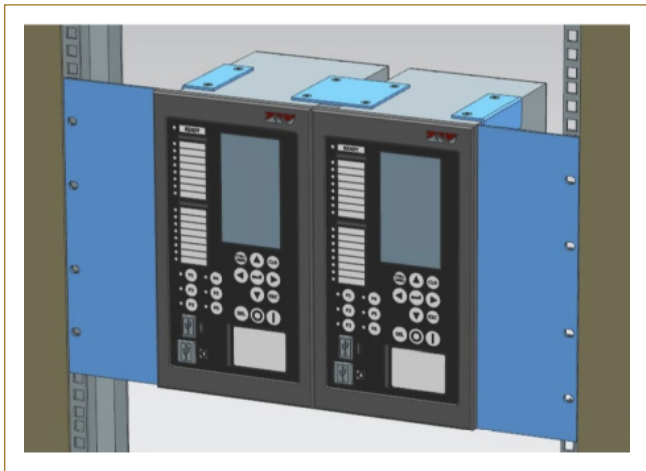
Mounting a 6U and 1/3 Rack



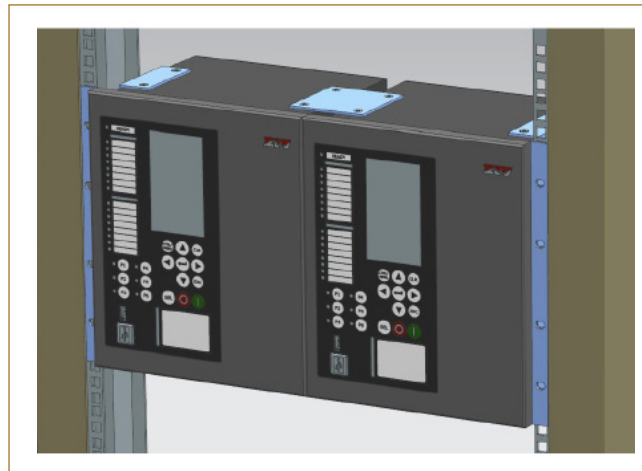
Mounting a 6U and 1/2 Rack



Mounting a 6U and 1/3 Rack with a 1/2 Rack



Mounting of two 6U and 1/3 Rack



Mounting of two 6U and 1/2 Rack

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3. TECHNICAL DATA

POWER SUPPLY	
Range	24 – 60 Vdc ($\pm 20\%$) 90 – 250 Vdc/Vaa ($\pm 20\%$) & 100 – 240 Vac ($-15\%+10\%$)
Consumption	<26W (1 rack) <21 W (1/2 rack) <15 W (1/3 rack) (DOs activated)

CURRENT ANALOG INPUTS	
Phase, Neutral and Polarization Currents	
Frequency Range	50 Hz, 60 Hz
Nominal Value	In = 5 A or 1 A (selectable in the IED)
Measurement Range	0 – 40 A x In
Thermal Withstand Capability	4 A x In (continuously) 30 A x In (for 10 s) 100 A x In (for 1 s)
Current Circuits Burden	<0.2 VA (In = 5 A or 1 A)
Ungrounded and Sensitive Ground Currents	
Frequency Range	50 Hz, 60 Hz
Nominal Value	In = 20 mA
Measurement Range	0 – 3.5 A
Thermal Withstand Capability	4 A x In (continuously) 62.5 A (for 3 s) 125 A (for 1 s)
Current Circuits Burden	<0.05 VA

VOLTAGE ANALOG INPUTS	
Frequency Range	50 Hz, 60 Hz
Nominal Value	Un = 50 to 230 VCA (selectable in the IED)
Measurement Range	0 – 300 V
Thermal Withstand Capability	300 VAC (continuously) 400 VAC (for 10 s)
Voltage Circuits Burden	<0.1 VA (110/120 VAC)

FREQUENCY	
Operating Range	15 – 80 Hz
Accuracy	0,005 Hz

BREAKER TRIP & CLOSE OUTPUTS AND AUXILIARY OUTPUTS	
Outputs (electromechanical relay)	
I DC maximum limit*	60 A 1s
I DC continuous service*	16 A
Close	5000 W
Breaking capability*	72 W (1.5 A – 48 VDC) 60 W (0.5 A – 125 VDC) 75 W (0.3 A – 250 VDC)
Break (L/R = 0.04 s)	60 W at 125VDC
Switching voltage	250 VDC
Momentary close time trip contacts remain closed	100 ms
Break delay	<150 ms
Fast Outputs HSHD (High Speed High Duty)	
I DC maximum limit*	60 A 1s
I DC continuous service*	16 A
Close	5000 W
Breaking capability*	10 A (for 250/125/48/24VDC)
Break (L/R = 0.04 s)	10 A (for 250/125/48/24VDC)
Switching voltage	250 VDC
Momentary close time trip contacts remain closed	100 ms
Break delay	<150 ms

(*) With resistive load.

DIGITAL INPUTS	
Activation threshold	Configurable by software or by ordering code
Consumption	0.075 W (48 Vdc) 0.195 W (125 Vdc) 0.39 W (250 Vdc)

INPUT TRANSDUCERS	
–20mA to 20mA Input Transducers	
Input impedance	196 Ω $\pm$ 5%
Measurement accuracy	$\pm$ 0.2 % or $\pm$ 10 μ A (the greater)
10V to 350V Voltage Transducer	
Input impedance	150 k Ω $\pm$ 10%
Measurement accuracy	$\pm$ 0.2 % or $\pm$ 0.2 V (the greater)

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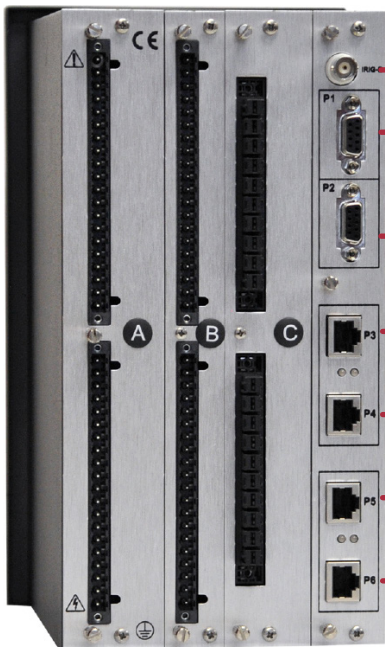
4. COMMUNICATIONS

DIFFERENT TYPES OF PORTS
1 Front Local Port USB-B type for local configuration (PROCOME Protocol)
Up to 2 Serial Remote Ports Remote Port 1 (SP1): GFO (ST connector) interface or RS232 Full Modem electric interface. Remote Port 2 (SP2): GFO (ST connector) interface or RS232 / RS485 electric interface.
Up to 6 LAN Ports. They can operate independently or as redundant ports (LAN 1 & LAN 2 and LAN 3 & LAN 4) in PRP, HSR, RSTP, and Bonding modes.

COMMUNICATIONS PORTS – MODEL LIST OPTIONS			
19	Communication Interface 1–2 for Remote Communication (PROCOME, MODBUS, DNP3)		
A	RS232 Full Modem – RS232/RS485	C	GFO ST – RS232/RS485
B	RS232 Full Modem – GFO ST	D	GFO ST – GFO ST
21	ETHERNET Interfaces 1 and 2		
1	10/100/1000BASE–T Connectors (RJ45).	3	100BASE–FX Connectors (Multimode GFO ST).
2	Slot (socket) for SFP* (1000BASE–SX/LX & 100BASE–FX Connectors Multimode GFO LC).		
22	ETHERNET Interfaces 3 and 4		
0	None	2	Slot (socket) for SFP* (1000BASE–SX/LX & 100BASE–FX Connectors Multimode GFO LC).
1	10/100/1000BASE–T Connectors (RJ45).	3	100BASE–FX Connectors (Multimode GFO ST).

(*) SFP interfaces are considered as accessories, and they must be additionally ordered.

▷ COMMUNICATIONS PORTS



BNC Connector: Synchronization IRIGB-OOX, IRIGB-B12X, IRIGB-23X, PPS	
REMOTE PORT 1	
GFO or RS232 Full Modem	PROCOME, DNP3, MODBUS
REMOTE PORT 2	
GFO or RS232 / RS485	PROCOME, DNP3, MODBUS
LAN 1 & 2 (Independent or Redundant*)	
RJ45 or GFO LC / ST	PROCOME, DNP3, MODBUS, MMS (IEC61850)
(*) PRP, HSR, RSTP, Bonding (Hot Stand By)	
LAN 3 & 4 (Independent or Redundant*)	
RJ45 or GFO LC / ST	PROCOME, DNP3, MODBUS, MMS (IEC61850)
(*) PRP, HSR, RSTP, Bonding (Hot Stand By)	
LAN 5 & 6 (Independent) Ports available in models with the new CPU.	
RJ45 or GFO LC / ST	PROCOME, DNP3, MODBUS, MMS (IEC61850)

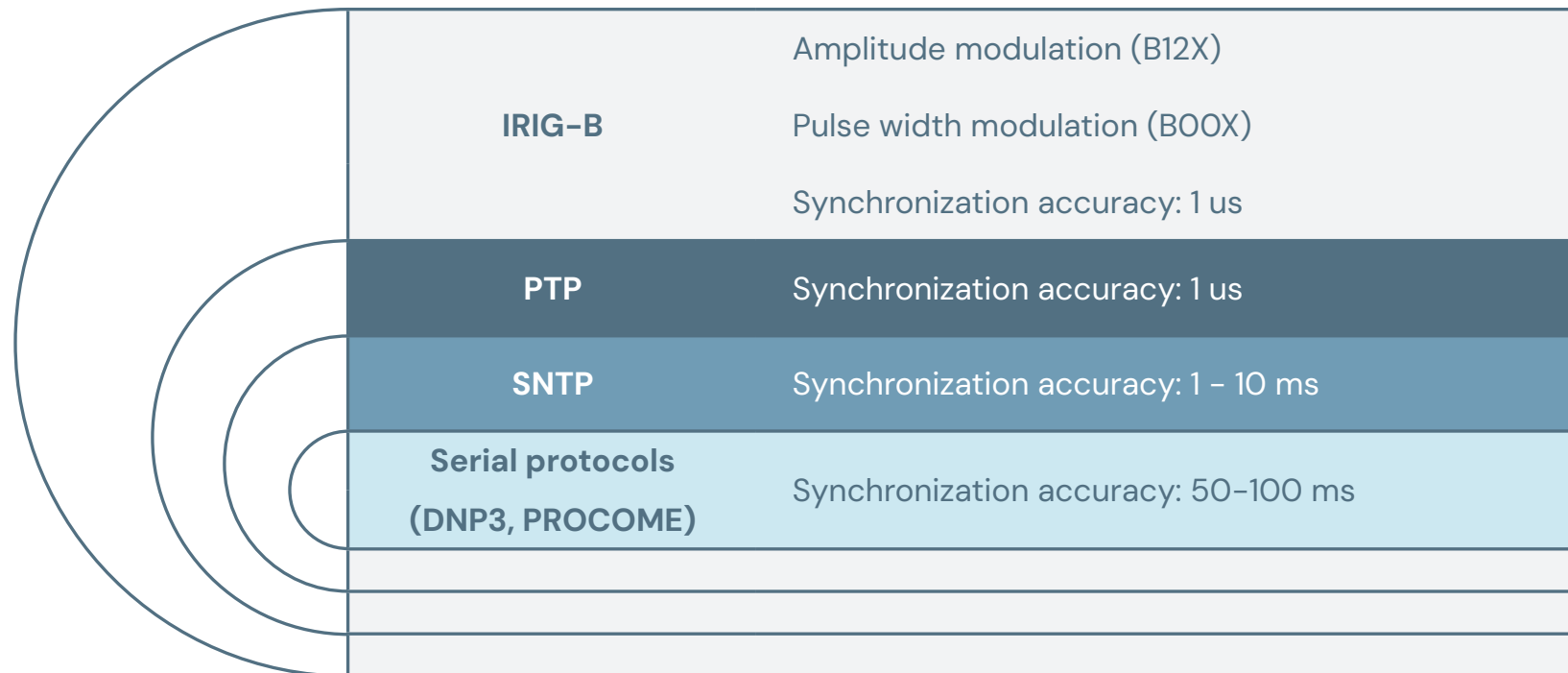


1 LOCAL USB PORT

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5. TIME SYNCHRONIZATION



▷ PTP TIME SYNCHRONIZATION

GENERAL FEATURES OF PTP

- Ethernet layer 2
- Multicast messages
- Peer to peer calculation (path delay correction)
- Best master clock calculated with the announce message broadcasted by all master clocks (the one with better time quality will be selected. It will maintain the announce message to inform the others who is the best master clock and as a life sign)
- Best master clock broadcast the Sync message which will be compensated with the peer to peer delay and with the residence delay

PTP FEATURES (RELAY)

- Power Utility Profile IEC61850-9-3 (compatible with C37.238-2017)
- Clock modes: Transparent Clock, Ordinary clock.
- Compatible with 1 and 2 step clocks (path delay through P2P in 2 steps)





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6. RECORDS

OSCILLOGRAPHIC RECORDING

- 4800 Hz.
- 100 s recording capability (64 files maximum). Ocillo max. 0.5 s (prefault) and 14.5 s (fault).
- 160 digital signals + 16 analog quantities.
- 400 digital signals + 96 analog quantities (DBF Models).
- Stored in circular non-volatile memory (flash). COMTRADE format.

SEQUENCE OF EVENTS (SoE)

- Up to 2000.
- 12 analog quantities selectable.
- Stored in circular non-volatile memory (flash).

FAULT REPORTS

- Up to 25.
- Stored in circular non-volatile memory (flash).

METERING LOGS

- Up to 168.
- 12 analog quantities selectable.

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7. IEC 61850 EDITION 2.0 & EDITION 2.1*

- **Data Model.**

Dynamic Data Model allows:

- Reorganizing the IEC 61850 information, this is, create or delete LDs, LNs or DOs or moving LNs from one LD to another LD or DOs from one LN to another LN.
- Carrying out internal mappings (relating IEC 61850 data to the internal data in the relay).
- The possibility of renaming LDs, LNs (prefix and/or instance) and Control Blocks (flexible naming).
- Adding new LNs according to the LNClass defined in the standard.

- **Datasets:**

35 static datasets.

Up to 500 elements/dataset can be included, both data (FCDs) and attributes (FCDAs).

- **Setting Groups:**

1 setting group control block, 8 setting groups.

Read and change of setting group value and setting group change (active setting group).

- **Reports:**

20 report control block: 10 buffered and 10 unbuffered.

Trigger options: data-change, quality-change, integrity and general-interrogation.

Optional fields: sequence-number, report-time-stamp, reason-for-inclusion, data-set-name, data-reference, buffer-overflow, entryID, conf-revision.

ClientLN to reserve the Report.

- **Logs:**

3 logs and 3 log control blocks.



GOOSES

- **Publication**
10 Goose Control Blocks.
Capability to send GOOSEs with data (FCDs) and attributes (FCDAs).
- **Subscription**
Up to 100 LGOS for GOOSE supervision.
Based on Input data (ExtRef): GIGGIO node with 400 ExtRef.
Subscribed to attributes (FCDAs) boolean (200), double point (100), integer (50), float (50), q and t.
- **Validation**
GoCBRef, GoID, MAC, APPID, to accept or reject Goose.
DatSet, ConfRev, to inform about Goose errors.

CONTROL

- **4 modes**, configurable for each command:
Direct with normal security.
Select Before Operate (SBO) with normal security.
Direct with enhanced security (info about success or failure).
Select Before Operate (SBO) with enhanced security (info about success or failure).
- **Access control** based on data Loc (local), LocMntnc (maintenance) y LocSta (station/remote): command hierarchy based on Originator Category (origin).

FILES TRANSFER

- Files recovery.
- For CID, COMTRADE files and logs downloading.

▷ CONFIGURATION FILES (ICD, CID & IID)

ONE CONFIGURATION FILE (CID)

- Includes almost 100% of the settings.
- Includes programable logic in its private part.
- MMS changes, updated in CID.

UPLOAD/DOWNLOAD

- ACSI (file transfer MMS), FTP, and local USB-B.
- *SCL directory:*
 - Validated (active):* active CID.
 - notvalidated:* new CID.
- Automatic validation and activation.



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8. CYBERSECURITY

CERTIFICATIONS: IEC 62443-4-1 & IEC 62443-4-2*

Role Based Access Control (RBAC).

Strong and encrypted passwords.

Remote authentication.

Secure sockets.

Disabling of communication ports/services.

Digital securization of firmware.

Cybersecurity audit log.





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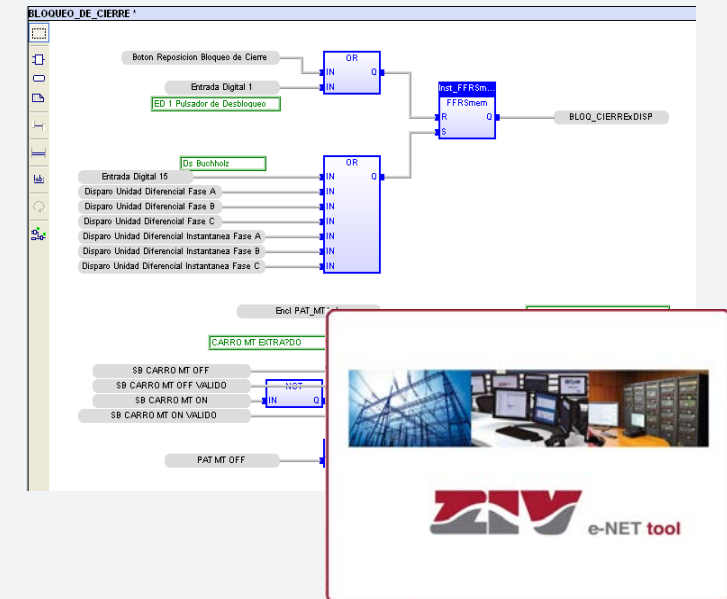


9. **CONFIGURATION TOOL**

9. CONFIGURATION TOOL

Unique Tool for the complete IED configuration:

- SLD edition.
- Programmable logic in graphical environment with off-line simulation.
- OPCODES: AND, OR, XOR, FFRS, FFD, NOT, Pulse, etc.
- Commands and signals configuration (Protocols).
- Setting management: Downloading, uploading, lists creation.
- CID generation and edition (logic, settings, gooses, etc.).
- Files and records download (oscilo, events, etc.).
- Automatic generation of configuration documentation (DXF, XLS).



ZIV LOCATIONS

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NOTE:
Throughout this document,
the * symbol indicates a
coming soon feature.



For more information, please
consult our website:
www.zivautomation.com

