Sensors & Couplers

Sensors and Couplers for MV and LV Applications

ZIV PORTFOLIO FOR PLC AND MEASUREMENT

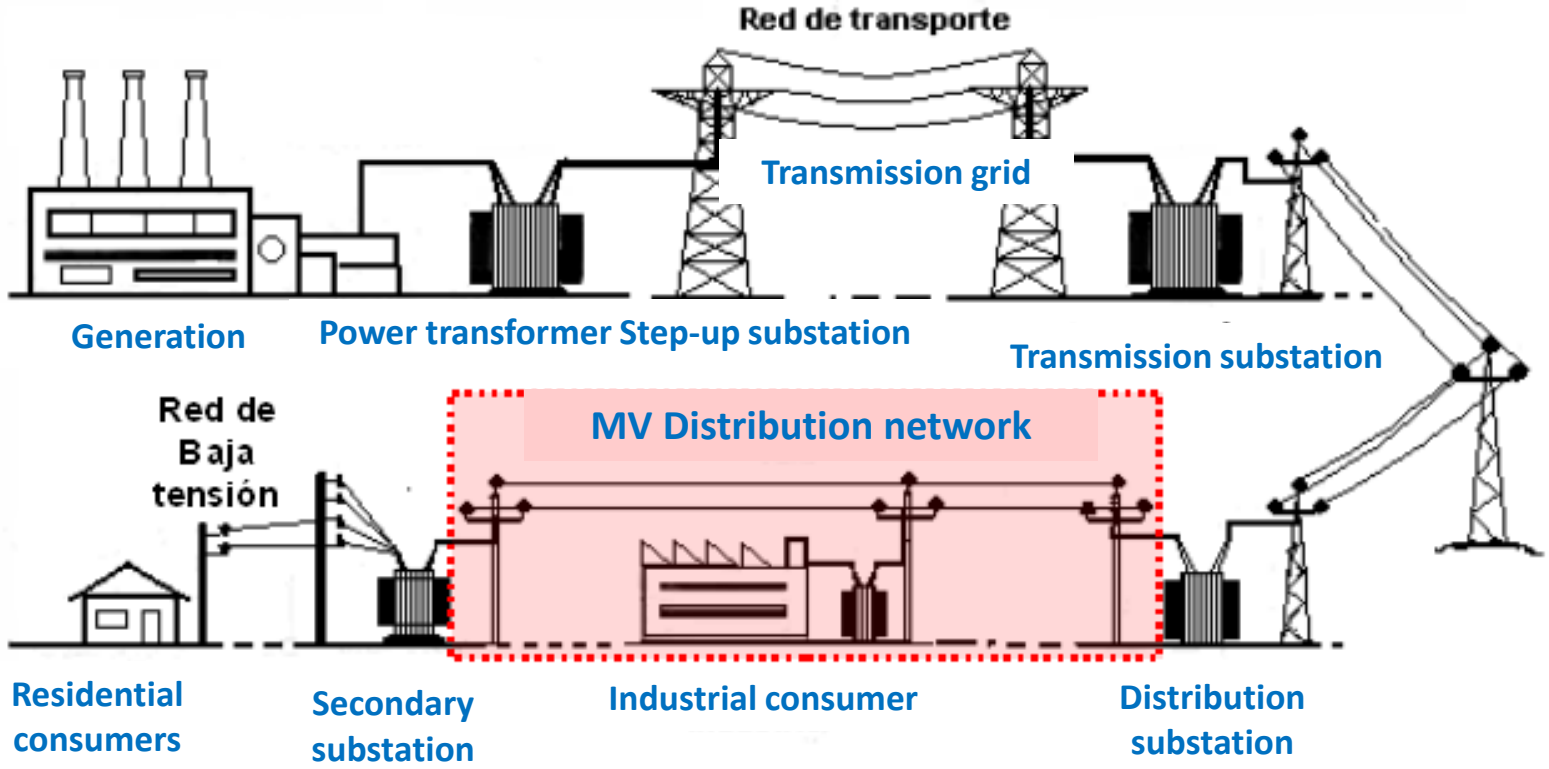
PLC COUPLERS	VOLTAGE SESORS (LPVT)	CURRENT SENSORS (LPCT)	COMBINED SENSORS
Capacitive	**GIS SF6** swithgear	INDOORS GIS	PLC /Voltage Measurement
CAMT-5/LSR & ACA-500	ACA-1/R 10K + ACA-05/ R6K (UD)	LPCT-I-80 (UD)	ACA-1/RC &CAMS-10K
Inductive	AIS Switchgear/Outdoor		Current/Voltage Measurement
AIMT-4, AIBZ & MVCD	DRMO-1/10K/05		ICVS-36 (PROTOTYPE)

(UD) = Under development

Monitoring MV distribution:

Need

- Defect detection (fault, loss of neutral, blown fuses…)
- Measurement of electrical parameters with sensors and/or instrument Transformers (CT, VT)
- Device status
- Alarms



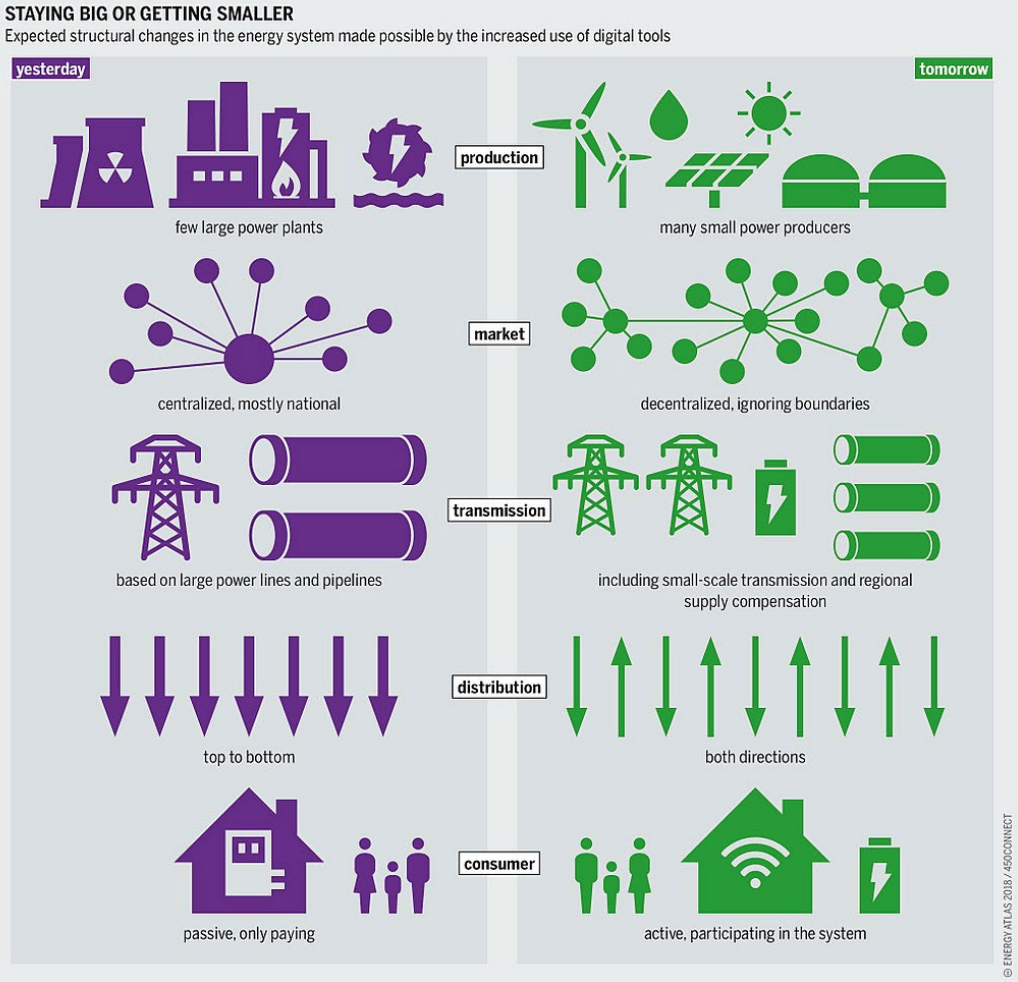
- **PLC couplers** → Communications
- **Sensors** → Measurement
- **Combined Sensors** → Both functions

Distributed Generation

FROM

Conventional power plants:

- Gas
- Coal-fired power plants
- Hidroelectric dams
- Nuclear power plants



TO

Distributed energy resources:

- Solar Photovoltaic (PV)
- Wind turbines
- Small Hidro
- Biomass
- Biogas
- Geothermal power

Making the Smart Grid Real

SENSORS (LPIT)

Companies in the utility industry want to reach MV supervision and automation

Sensor (LPIT) has three main functions or roles:

- Adapting the high voltage/current value of the lines to lower values that might be managed by the equipment
- Power grid insulation for Protection, Control and Measurement devices
- Measurement the electrical parameters (Voltage, current, phase shift..) with linearity in a range of temperature

Application

GIS SF6 swithgear

AIS Switchgear/Outdoor

SENSORS (LPIT)
new IEC-61869 scenario

This product is currently being applied to a changing scenario with some new standards. The IEC-61869 is the standard that describes all the characteristics of Low Power Instrument Transformers (also known as voltage/current sensors).

The LPIT (Low Power Instrument Transformers) **are an alternative of traditional transformers:**

LPVT Low Power Voltage Transformer
LPCT Low Power Current Transformer

PROS:

1. Size
2. Cost
3. Linearity
4. Different Shapes

GIS SF6 swithgear

ACA-1/R 10K + ACA-05/ R6K (UD)

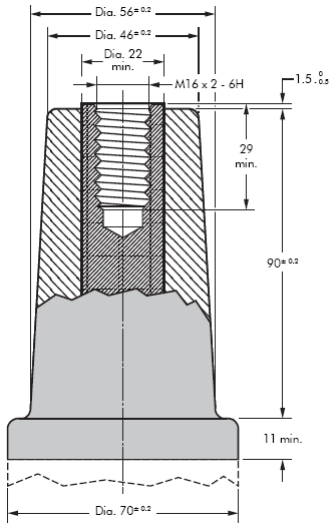
AIS Switchgear/Outdoor

DRMO-1/10K/05

VOLTAGE SENSORS (LPVT)

We have two products depending on the point of installation:

A) For GIS SF6 SWICTHGEAR



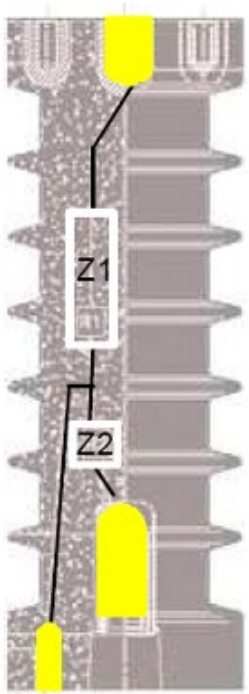
Interface C

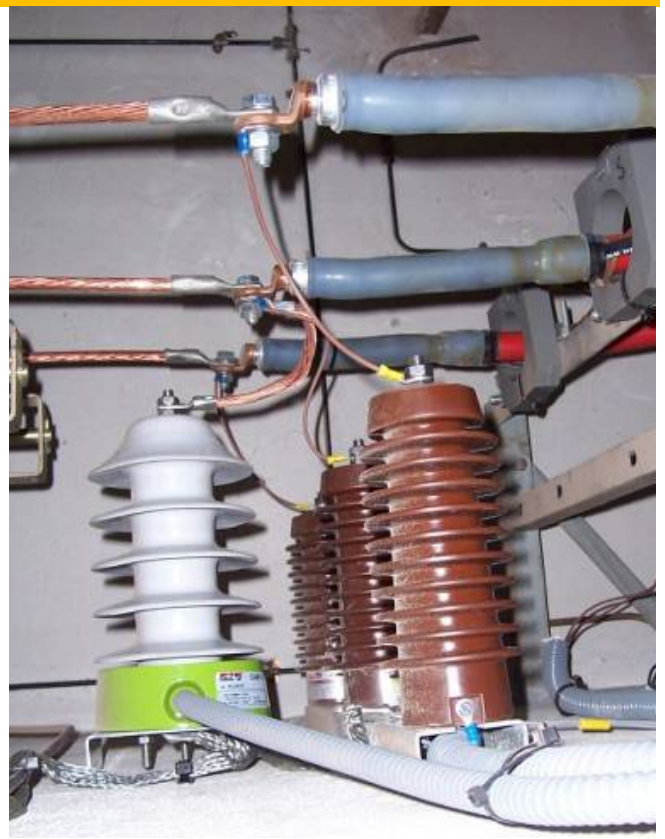
CENELEC EN-50180 and **EN-50181**

VOLTAGE SENSORS (LPVT)

We have two products depending on the point of installation:

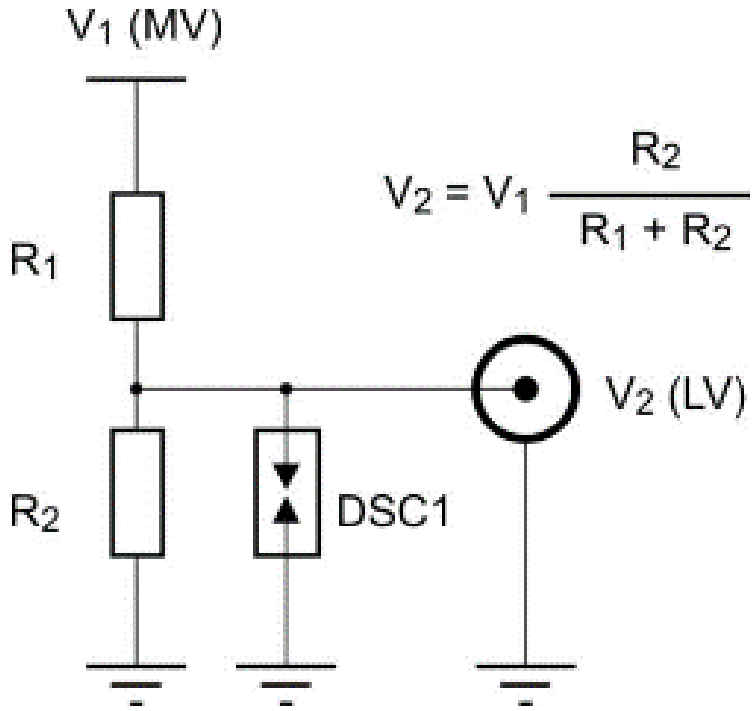
B) For Overhead lines or AIS SWITCHGEAR





VOLTAGE SENSORS (LPVT)

The voltage measurement is carried out by a RESISTIVE DIVIDER

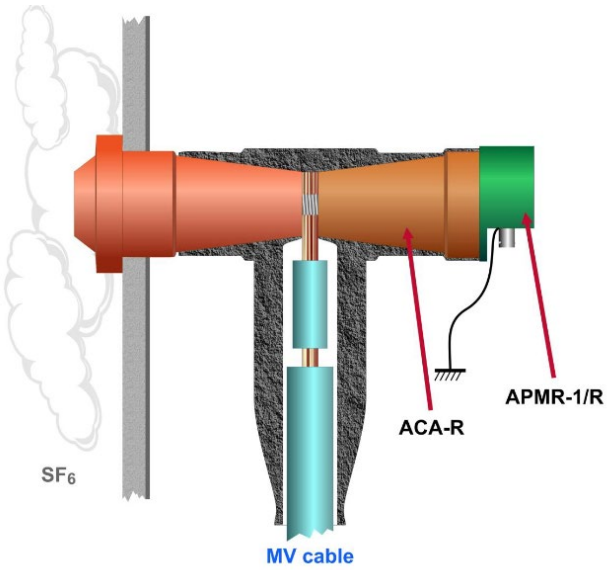


- Linearity
- Low power consumption
- Accuracy class 1%, 0.5%
- Low drift with temperature (<100 ppm/ºC)
- Easy installation and integration
- Size vs traditional transformer

Note: it could be carry out also by capacitive divider

ACA-1/R 10K
VOLTAGE SENSOR

FOR SYMMETRICAL SEPARABLE TEE CONNECTOR



Electrical Characteristics:

Connection type: Phase-to-ground

Use: Indoors

Um: 24kVrms

TYPE: Interface C for Symmetrical Tee connector

Voltage sensor characteristics:

Nominal Ratio: 10000 ± 1%

Phase shift:< 1°

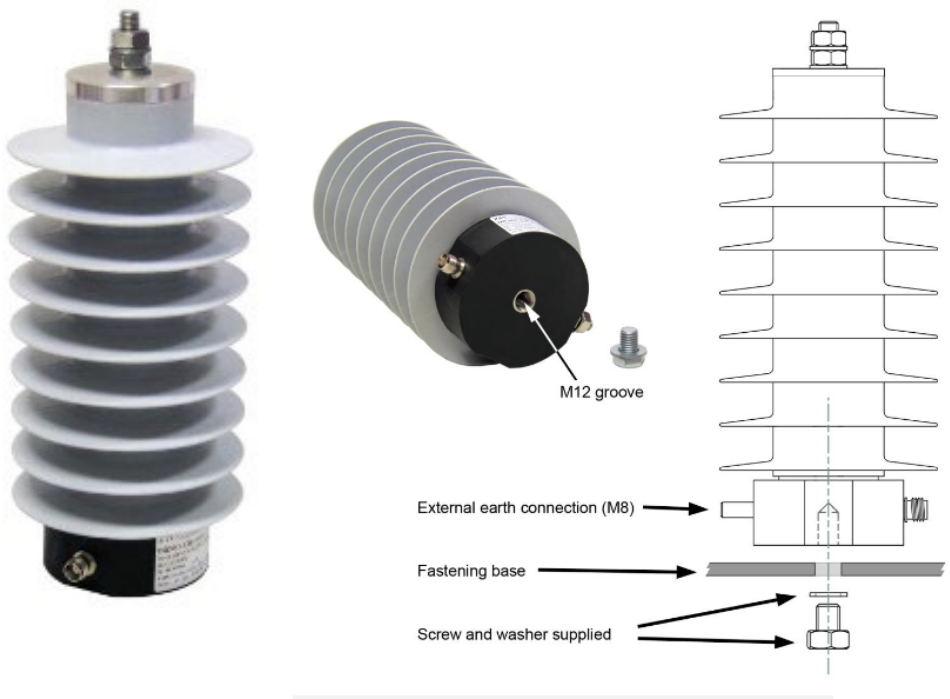
Load impedance: ZL≥10MΩ and CL≤800pF

Temperature range: -10°C to +60°C

LV connection: BNC connector

DRMO-1/10K/05 10K
VOLTAGE SENSOR

INTENDED FOR
MV DISTRIBUTION LINES



Electrical Characteristics:

Connection type: Phase-to-ground

Use: Outdoor

Um: 24kVrms

Creepage distance:685mm

Dimensions: 249mm (Height), 110mm (shed diameter),

Weight: 1.6kg

Voltage sensor characteristics:

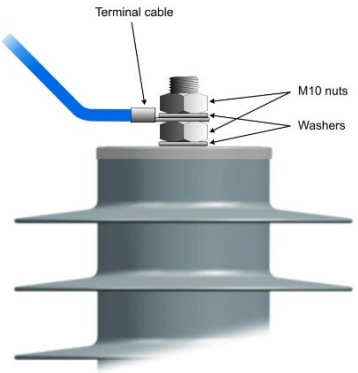
Nominal Ratio: 10000 ± 0.5%

Phase shift:< 0.33°

Load impedance: ZL≥10MΩ and CL≤800pF

Temperature range: -25˚C to +50˚C

LV connection: TNC connector



ACA-05/R 6K
VOLTAGE SENSOR

FOR SYMMETRICAL SEPARABLE TEE CONNECTOR

Improvements: **Under development, indust stage**

According to IEC 61869 (output connector, ratio)
One piece.
Better accuracy class.

Electrical Characteristics:

Connection type: Phase-to-ground

Use: Indoors

Um: 24kVrms

TYPE: Interface C for Symmetrical Tee connector

Voltage sensor characteristics:

Nominal Ratio: 20kV : 3.25vrms ± 0.5%

Phase shift:< 0.33°

Accuracy class: 0.5P

Load impedance: ZL≥2MΩ and CL≤50pF

Temperature range: -10°C to +60°C

LV connection: RJ45 connector

Summary table voltaje sensors LPTV

Characteristics	GIS SWITCHGEAR	AIS SWITCHGEAR / OUTDOOR	GIS SWITCHGEAR
	ACA-1/10K 	DRMO-1/10K 	ACA-05/R6K 
Um	24kV	24kV	24kV
Divider type	Resistive	Resistive	Resistive
Accuracy	±1%	±0.5%	±0.5P
Ratio	10000:1	10000:1	6153
Burden	ZL≥10MΩ and CL≤800pF	ZL≥10MΩ and CL≤800pF	ZL≥2MΩ and CL≤50pF

Note: Under study the development of models for Um 36kV for GIS app.

CURRENT SENSORS (LPCT)

CURRENT SENSORS (LPCT)

The current measurement is carried out by a:

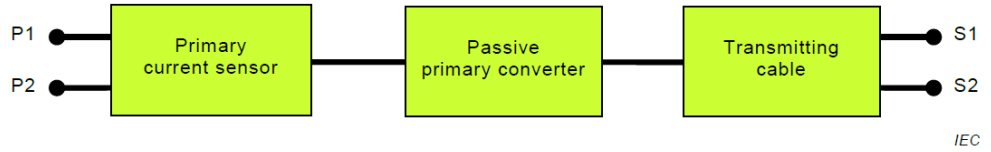
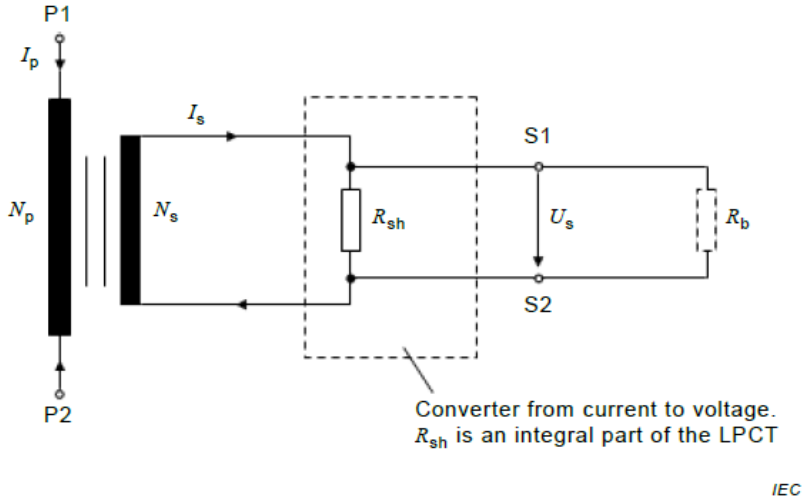
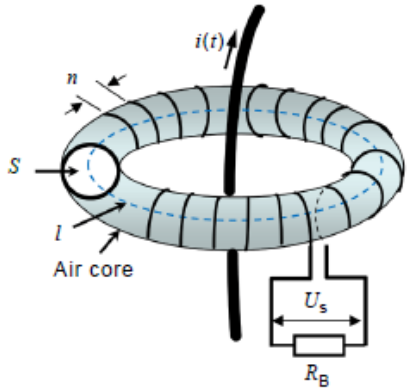


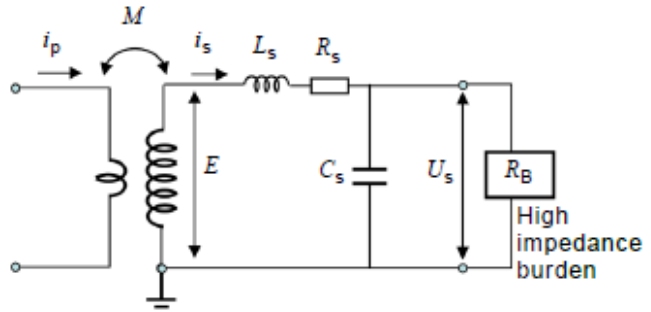
Figure 1001 – General block diagram of a single-phase low-power passive current transformer

MAGNETIC TOROID



ROGOWSKI COIL





Source of pictures IEC 61869-10

LPCT-I-080
CURRENT SENSOR

FOR UNDERGROUND MV CABLE

Schedule availability - end 2024

Electrical Characteristics:

Connection type: Over Underground MV cable

Use: Indoors GIS

Um: 0.72kVrms

TYPE: Toroidal magnetic type

Voltage sensor characteristics:

Nominal Ratio: 500A : 225mV

Phase shift:< 0.16°

Accuracy class: 0.2S and 5P20

Load impedance: ZL≥2MΩ and CL≤50pF

Temperature range: -10°C to +60°C

LV connection: RJ45 connector

According to IEC 61869-10 (output connector, ratio)

One piece.

PLC COUPLERS

PLC: It is the acronym of a communication protocol that is known as **Power Line Communications** (PLC) or Broadband over Power Line (BPL).

That consist in the Data transmission over power distribution cables using the PLC coupling units as interface.

Different types of couplers allow the physical connection of the modems/equipment to the power lines to be carried out, achieving the required electrical security and safety for the communication equipment.

Application

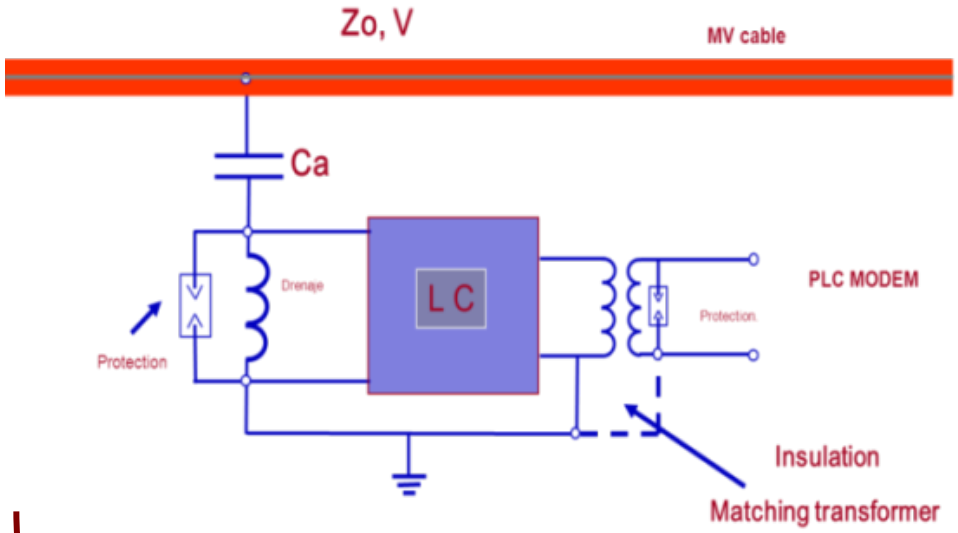
PLC grids provide different Smartgrid services such as:

- **Telecontrol**
- **Fault detection**
- **Automatic metering**
- **…**

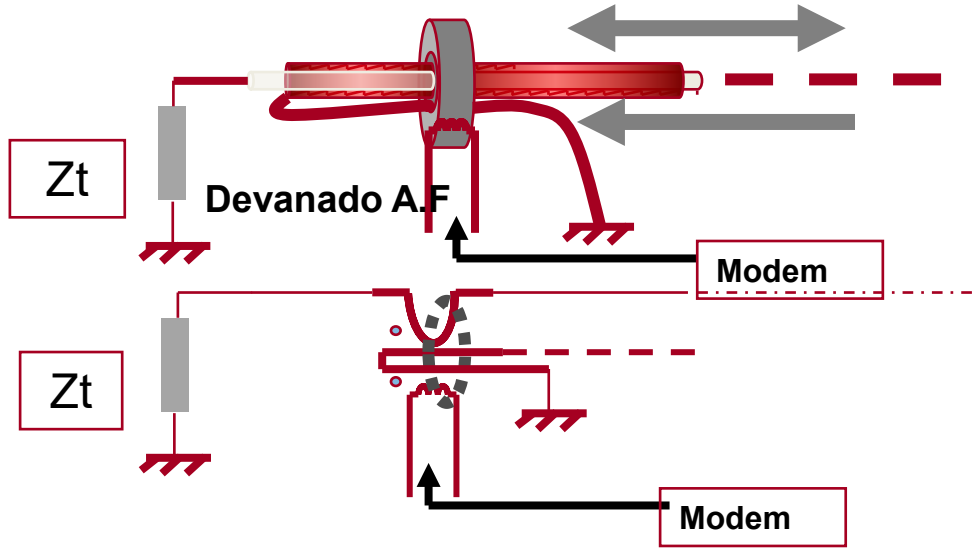
PLC COUPLERS

There are two main technologies for couplers: **capacitive and inductive.**

CAPACITIVE COUPLER.



INDUCTIVE COUPLER.



Uses

1. Matching impedance Line-equipment
2. Electrical insulation
3. Having low impedance for high frequency signal

ACA-500
PLC COUPLER

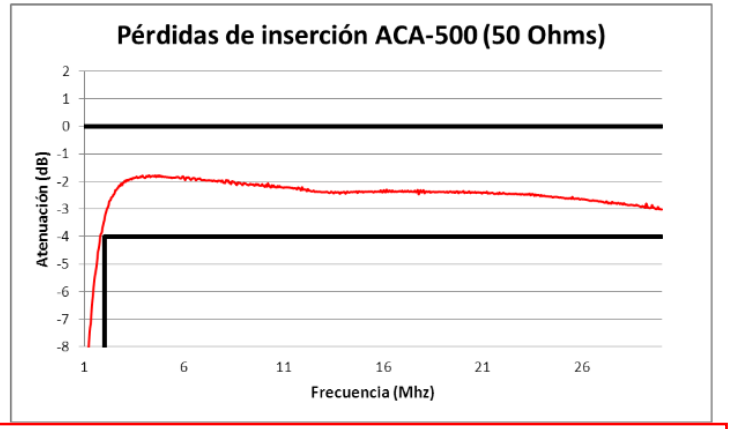
FOR SYMMETRICAL SEPARABLE TEE CONNECTOR
CAPACITIVE FOR GIS SWITCHGEAR

Electrical Characteristics:

Connection type: Phase-to-ground
Use: Indoors
Um: 24kVrms
TYPE: Interface C for Symmetrical Tee connector

PLC

Coupler capacitance: 500pF ± 20%
Bandwidth: 2MHz-30MHz (insertion losses <4dB for line impedance 20Ω)
Temperature range: -10°C to +60°C
LV connection: BNC connector

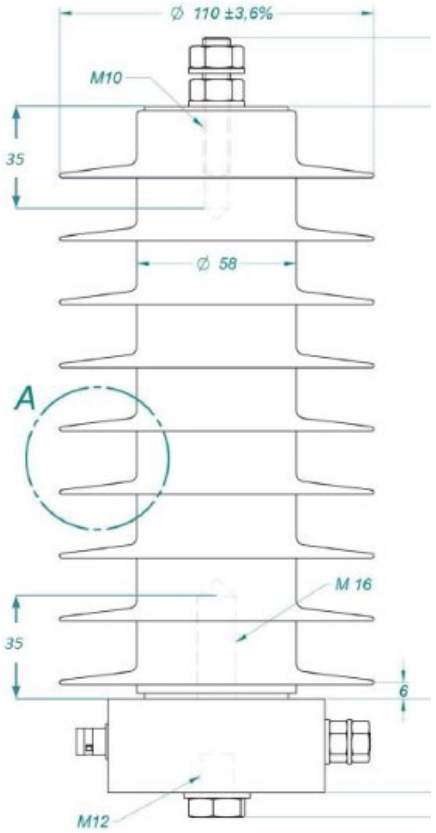


NOTE FOR Um 36kVrms → ACA-36

CAMT-5/LSR
PLC COUPLER

OVER MEDIUM-VOLTAGE LINES

CAPACITIVE FOR AIS SWITCHGEAR / OUTDOOR

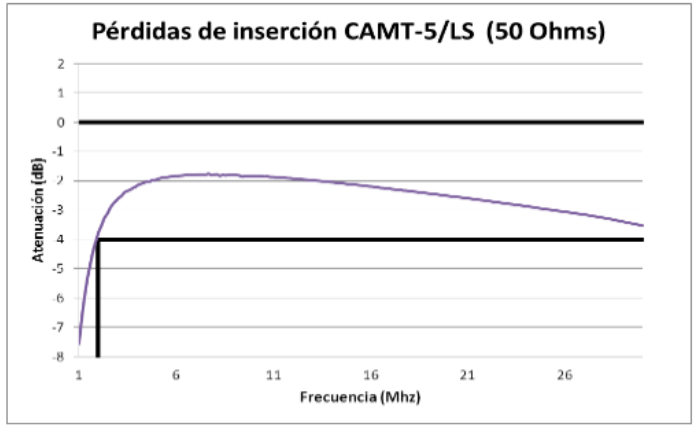


Electrical Characteristics:

Connection type: Phase-to-ground
Use: Indoors / Outdoor
Um: 24kVrms
Creepage distance:685mm

PLC

Coupler capacitance: 500pF
Bandwidth: 2MHz-30MHz (insertion losses <4dB)
Temperature range: -10°C to +60°C
LV connection: BNC connector

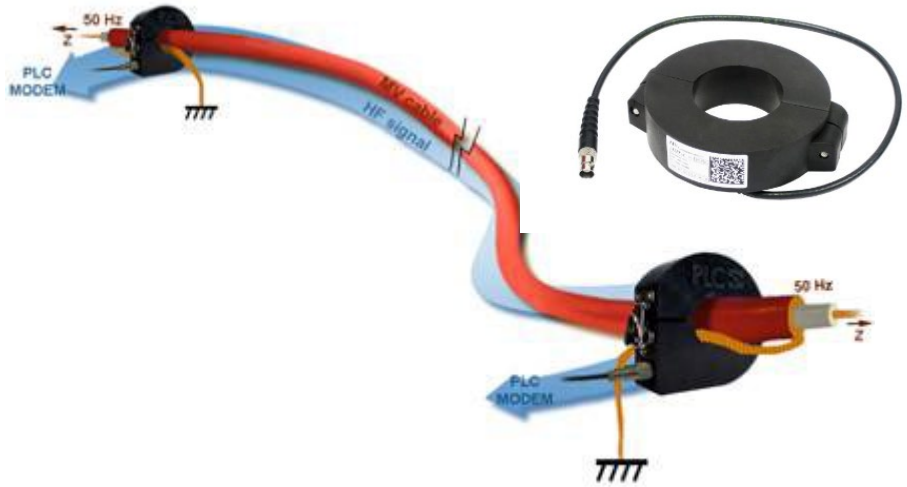


NOTE FOR Um 36kVrms →CAMT-6

Making the Smart Grid Real

AIMT-4
INDUCTIVE COUPLER

INDUCTIVE COUPLER OVER MEDIUM-VOLTAGE POWER LINES



Electrical Characteristics:

Connection type: Phase-to-ground
Use: Indoor. Over insulated cables
Dielectric strenght: 5kVrms
Dimensions: Internal diameter 55mm; external 111mm; thickness: 31mm

PLC

Connection type: Phase-to-ground
Use: Indoor. Over insulated cables
Dielectric strenght: 5kVrms
Dimensions: Internal diameter 55mm; external 111mm; thickness: 31mm

Summary table PLC COUPLERS

Characteristics	CAPACITIVE				INDUCTIVE		
	ACA 500 	CAMT-5LSR 	ACA-36 	CAMT-6 	AIMT-4 	AIBZ-1 	MVSD-1 
Um(The highest r.m.s. phase-to-phase voltage)	24kV	24kV	36kV	36kV	36kV	36kV	36kV
Installation Point	GIS Switchgear. Symmetrical T connector	AIS Switchgear /Overhead lines Outdoor	GIS Switchgear Symmetrical T connector	AIS Switchgear /Overhead lines Outdoor	Insulated MV Undercable lines	MV cable shield	MV cable shield
Bandwidth	Wide band 2-30MHz <4dB	Wide band 2-30MHz <4dB	Wide band 2-30MHz <4dB	Wide band 2-30MHz <4dB	Wide band 2-30MHz <5.5dB	Narrowband 100kHz to 5MHz <10dB	Narrowband <10 dB from 500 kHz to 2 MHz. < 4 dB from 2 MHz to 30 MHz

COMBINED SENSORS

These devices combine in one piece some characteristics of the two previous families (sensors and couplers). For instance, voltage sensor and coupler.

As equal of sensors are classified depending on the installation point.

- **For underground lines for installation in SF6 switchgear → ACA-1/RC**
- **For overhead lines outdoor → CAMS-10k**

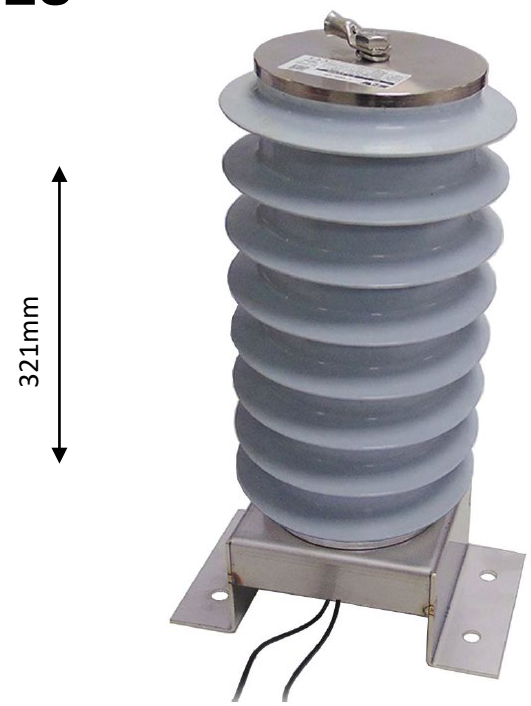
Application

The combined sensor might be used for **fault detection** in medium voltage lines

In one piece, the PLC and Voltage Sensor **can communicate and measure simultaneously**.

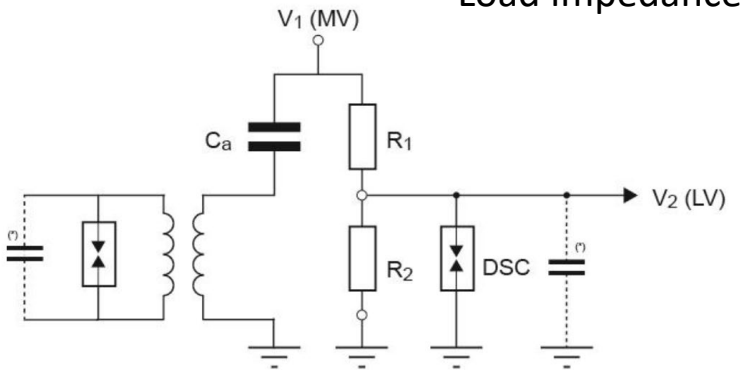
CAMS-10K
COMBINED SENSOR & PLC COUPLER

OVER MV POWER LINES



NOTE: The prefabricated metallic structure is not supplied with the CAMS-10K

Figure 1 External appearance of the CAMS-10K



(*) These capacitors are not necessarily used

Electrical Characteristics:

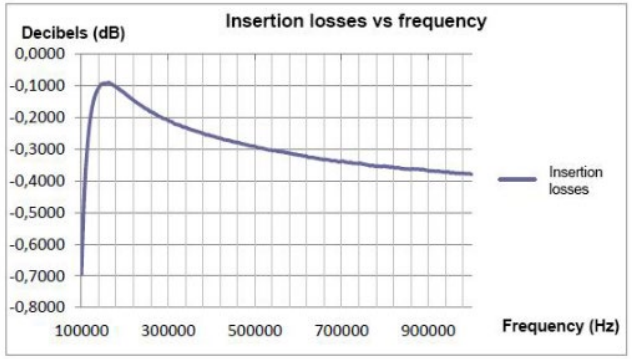
Connection type: Phase-to-ground
Use: Indoors and Outdoors (Salt fog test)
Um: 24kVrms
Creepage distance: 625mm
Dimensions: 176mm (shed diameter)

PLC

Coupler capacity: 10nF ± 20%
Bandwidth: 100kHz-10MHz (insertion losses <2dB for line impedance 200Ω)

Voltage sensor characteristics:

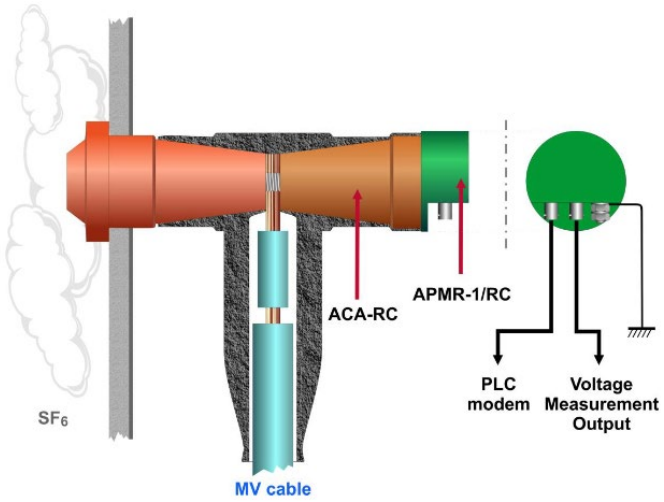
Nominal Ratio: 10000 ± 1%
Phase shift:< 1°
Load impedance: ZL≥1MΩ and CL≤400pF



Making the Smart Grid Real

ACA-1/RC
COMBINED SENSOR & PLC COUPLER

FOR SYMMETRICAL SEPARABLE TEE CONNECTOR



Electrical Characteristics:

Connection type: Phase-to-ground

Use: Indoors

Um: 24kVrms

TYPE: Interface C for Symmetrical Tee connector

PLC

Coupler capacity: 500pF ± 20%

Bandwidth: 2MHz-30MHz (insertion losses <4dB for line impedance 20Ω)

Voltage sensor characteristics:

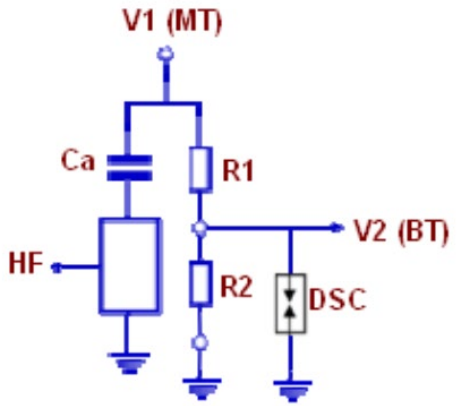
Nominal Ratio: 10000 ± 1%

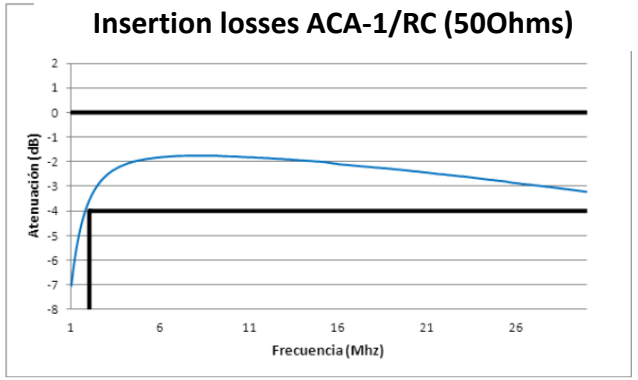
Phase shift:< 1°

Load impedance: ZL≥10MΩ and CL≤800pF

Temperature range: -10°C to +60°C

LV connection: BNC connector



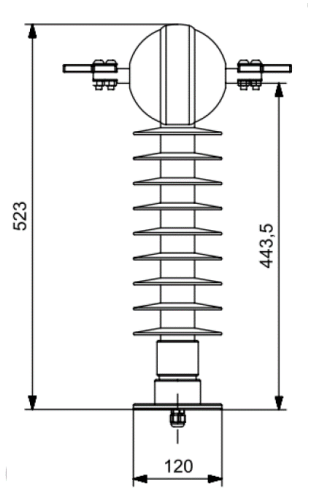


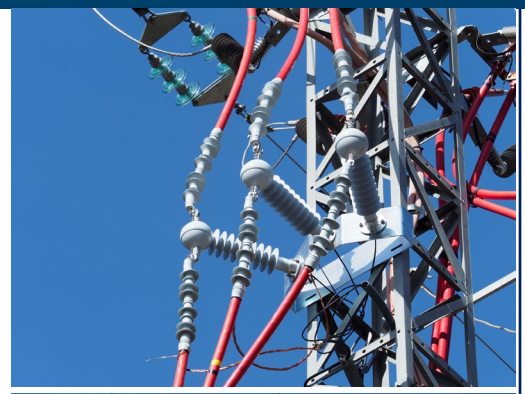
Making the Smart Grid Real

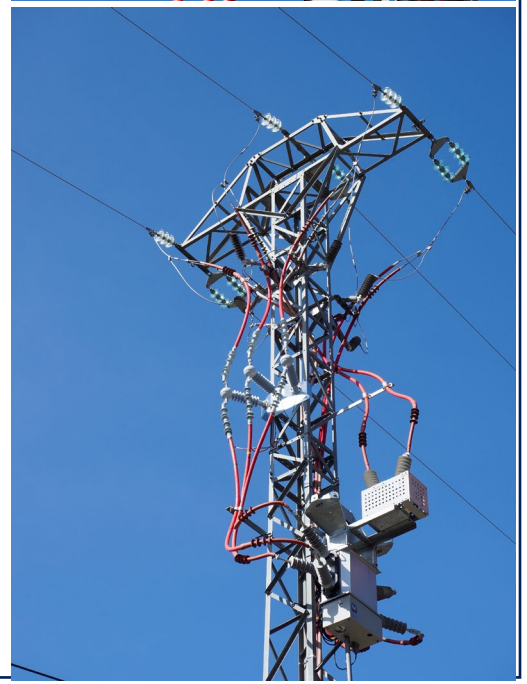
ACA-1/RC

COMBINED SENSOR & PLC COUPLER

FOR SYMMETRICAL SEPARABLE TEE CONNECTOR







Electrical Characteristics:

Connection type: Phase-to-ground
Use: Outdoor. Overhead lines
Um: 36kVrms
Ipn:630A
Type: Active; 12Vdc

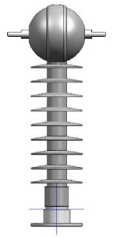
Voltage sensor characteristics:

Nominal Ratio: 10000 ± 1%
Phase shift:< ± 1°
Type: Capacitive divider
Load impedance: ZL≥1MΩ and CL≤800pF
Temperature range: -20°C to +60°C
LV connection: RJ45

Current sensor characteristics:

Nominal Ratio: 1250 ± 1%
Phase shift:< ± 1°
Type: Rogowski coil
Load impedance: ZL≥10kΩ
Temperature range: -20°C to +60°C
LV connection: RJ45

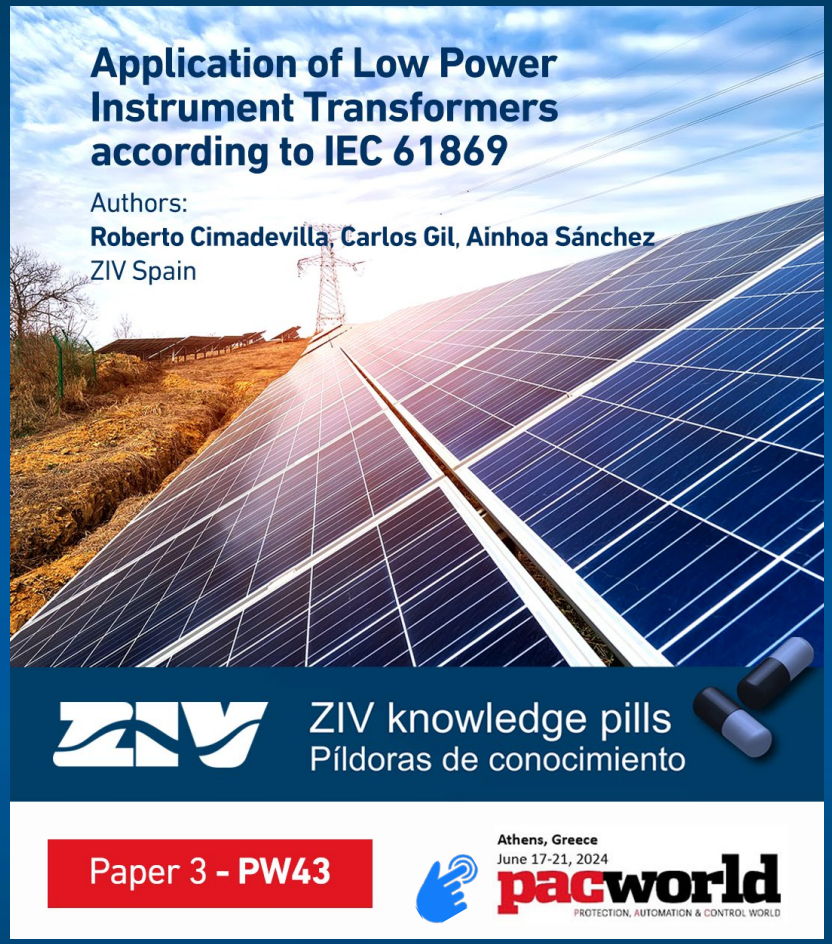
Summary table COMBINED SENSORS

Characteristics	Voltage sensor & PLC coupler		Voltage sensor & Current sensor
	ACA-1/RC 	CAMS-10K 	ICVS-36 (PROTOTYPE) 
Um	24kV	24kV	36kV
Installation Point	GIS SWITCHGEAR	AIS SWITCHGEAR / OUTDOOR OVERHEAD LINES	AIS SWITCHGEAR / OUTDOOR OVERHEAD LINES
Bandwidth	Wideband 2MHz-30MHz <4dB	Narrowband 100kHz-10MHz <2dB	Not applicable
Accuracy class	±1%	±1%	±1% (Voltage and Current measurement)
Divider type	Resistive divider	Resistive divider	Capacitive divider Rogowski coil

ANEX 1 – DOCUMENTACION & PACWORLD 2024 PAPER

- **ACA-1R/10K** / product brochure
- **DRMO-1/10K** / product brochure
- **ACA-05/R6K (ES)**

- **ACA 500** / product brochure
- **CAMT-5LSR**
- **ACA-36**
- **AIMT-4**
- **AIBZ-1**
- **MVSD-1**



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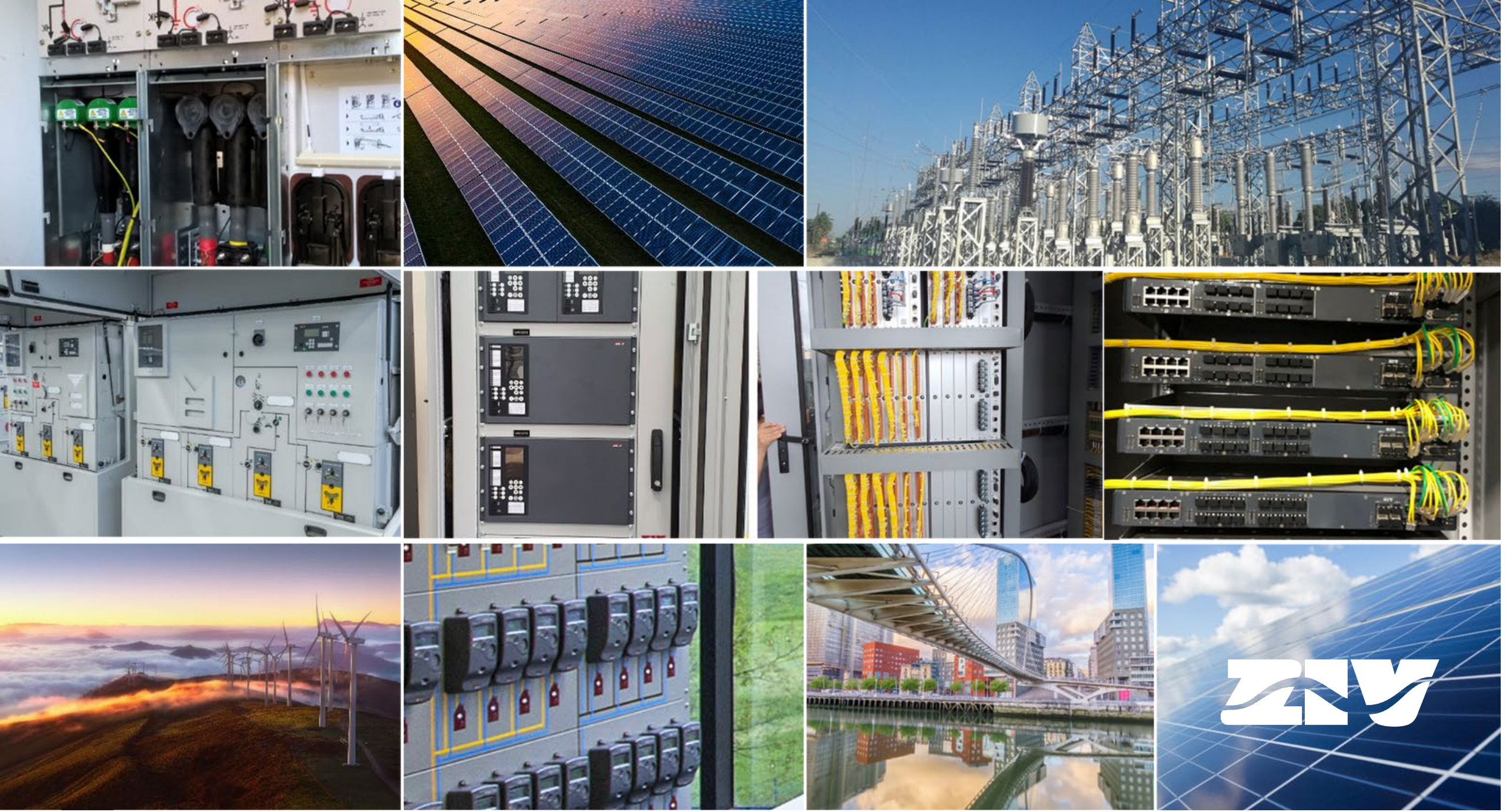

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