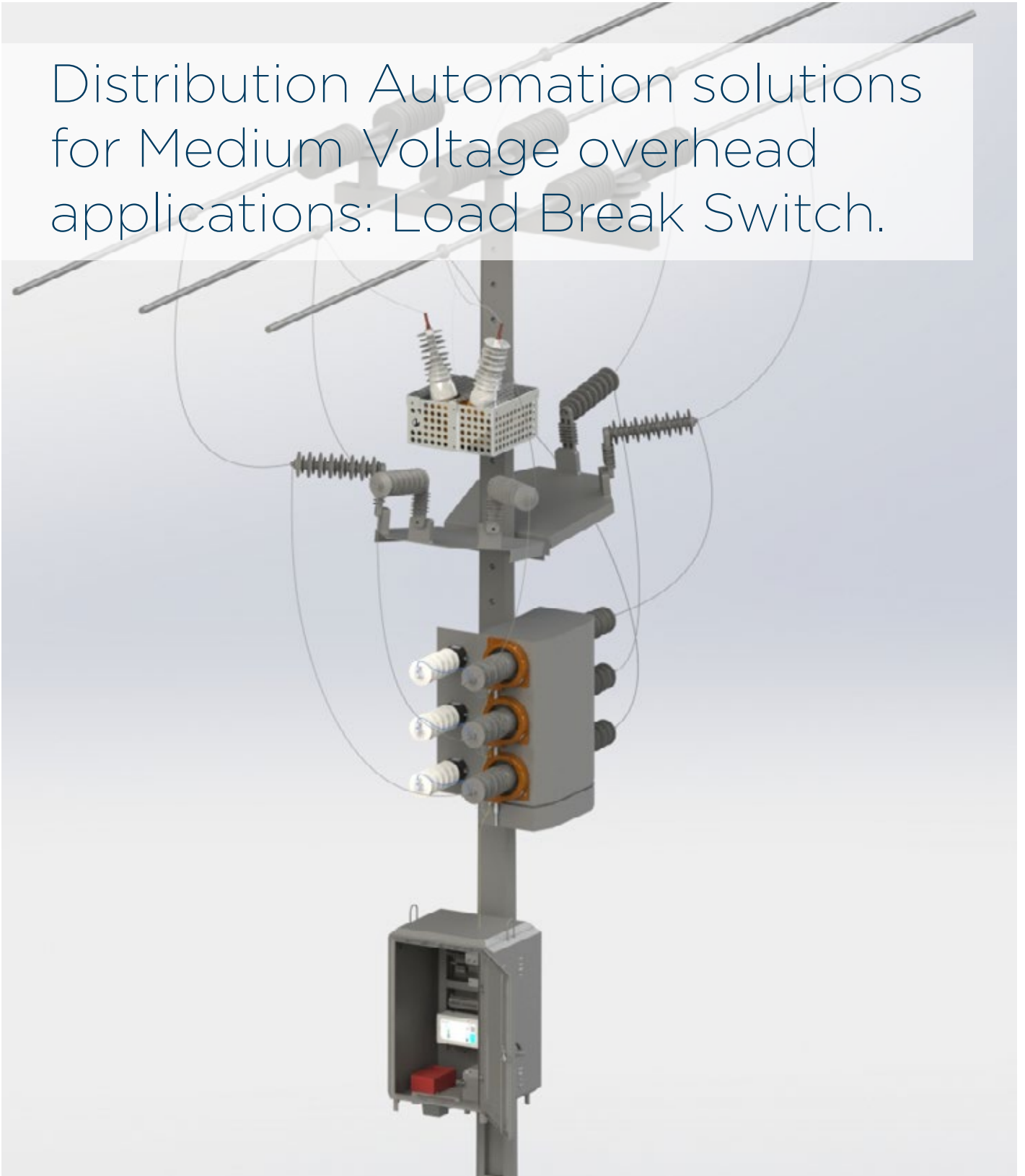


Distribution Automation solutions for Medium Voltage overhead applications: Load Break Switch.



This document is subject to possible changes. Please contact ARTECHE to get confirmation regarding the characteristics and availability described here.

# Moving together

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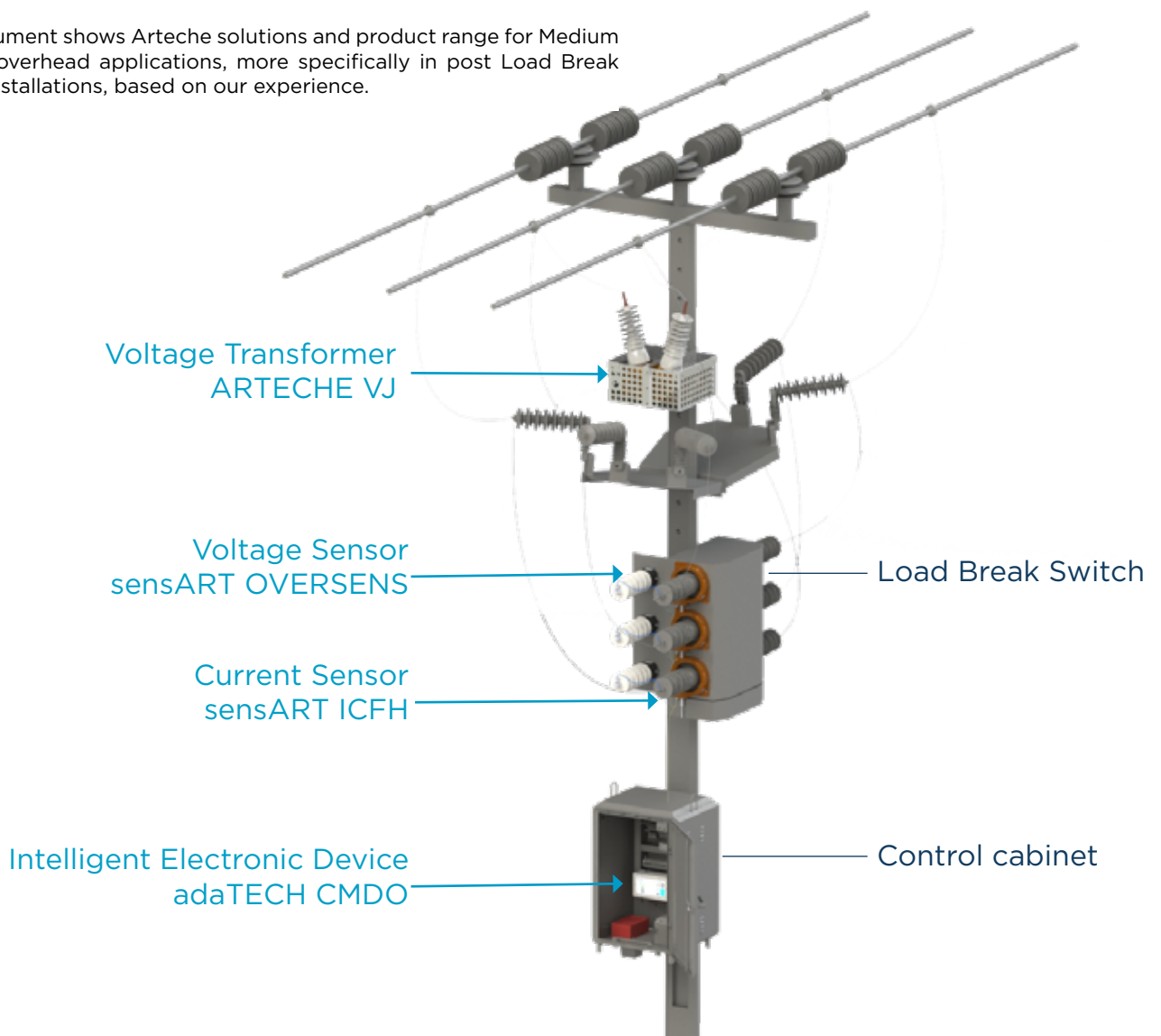
# 1. Introduction

Nowadays the operational management of electricity distribution network is evolving due to the increase of distributed generation resources, more demanding quality of service/grid code requirements, the injection of new loads like electrical vehicles and storage integration. High performance monitoring, automation and remote control are required closer to the grid edge, reaching new nodes and introducing new challenges for system operators. Smart Grids development, involving the modernization of the grid deploying new technologies, is a key driver for addressing the main issues the distribution network is facing.

Taking advantage of more than 70 years of experience in manufacturing high and medium voltage instrument transformers up to 800kV, we have developed a wide range of low power instrument transformers, also called sensors, and IEDs (Intelligent Electronic Devices) to enable Distribution System Operators (DSO) and Medium Voltage (MV) power equipment manufacturers to deploy modern distribution automation functionalities over power grids.

Arteche modern IEDs combined with instrument transformers and sensors improve system visibility and enhance grid operation management.

This document shows Arteche solutions and product range for Medium Voltage overhead applications, more specifically in post Load Break Switch installations, based on our experience.



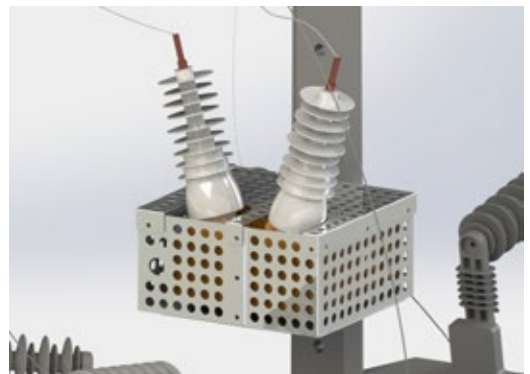
## 2. Application

For managing Medium Voltage overhead lines, Load Break Switches (LBS) are installed to provide the capability to disconnect part of overhead MV lines. These switches cannot operate in a fault situation, as they cannot open a circuit while there is an overcurrent. Therefore, after the current has been interrupted by a recloser or a substation switchgear, the main purpose of the Load Break Switch is to isolate the fault by opening the circuit. This device leaves out of service the damaged power grid section downstream, which allows restoring the service in the rest of the line.

Concerning the compliance with quality regulation and to ensure power supply reliability, Distribution System Operators require this functionality to reduce the duration of electric blackouts and the number of affected areas.

Arteche Smart Grid solutions help DSO in reliable directional fault location and reduce even more service restoration time, providing accurate information of the grid and greater management capability. For the post Load Break Switch installation application proposal, Arteche solution includes the following devices:

- › **Intelligent Electronic Device:** The Load Break Switch receives open/close commands (local or remote) from the associated IED, which collects and processes all the measurement information of the point and enables to determine when the Load Break Switch needs to be opened or closed among other functionalities that lead to a smart solution.
- › **Voltage Transformer:** provides power supply to the Load Break Switch electrical and electronic equipment, converting the line voltage level to the required LV value.
- › **Sensors or Low Power Instrument Transformers:** provide accurate current and voltage measurement signals to the IED placed inside the control cabinet. Sensors present a light and compact solution for Medium Voltage installations.



Voltage Transformer

### ARTECHE VJ

Provides power supply to the Load Break Switch.

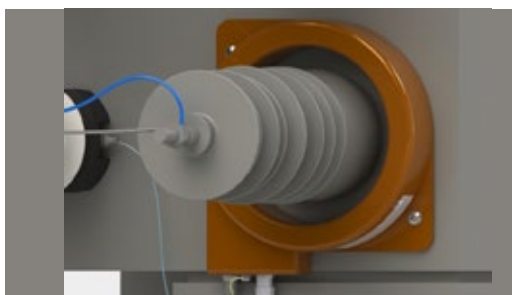


Control cabinet

Contains the IED and additional devices such as battery, charger and communication modem.

### adaTECH CMDO

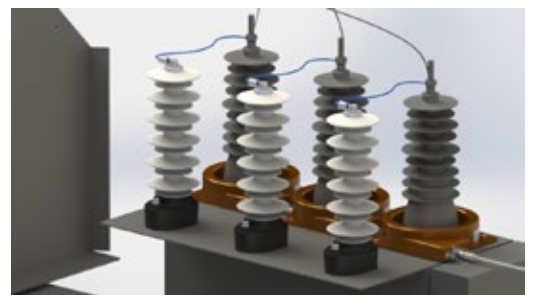
Device for monitoring and tele-controlling of Load Break Switch.



Current Sensor

### sensART ICFH

Provides line current measurement.



Voltage Sensor

### sensART OVERSENS

Provides line voltage measurement.

## 3. Intelligent Electronic Device (IED).

Arteche provides a Distribution Automation device for monitoring and tele-controlling Load Break Switches (LBS).

Receiving voltage and current measurements as an analog input, the IED runs the operation of several protection and surveillance function units that allow to have a continuous aware of the situation of the grid (regarding voltage, current, switch status, alarms, etc) and to operate local and remote control of the switch. All these signals and the configuration settings of the device can be visualized and modified in an embedded web server.

### adaTECH CMDO

The adaTECH CMDO allows control and supervision for one MV line, which means up to 3 voltage sensors (LPVT) and up to 4 current sensors (LPCT) - three for phases and one for homopolar if needed- can be connected as analog inputs. The device receives voltage and current measurement values through the FTP cable.

With the information provided by the device, the management of the grid can be operated more efficiently and the control of the line can be executed by the open and close of the Load Break Switch.

The switch operation can be performed manually (local or remote) or automatically through configured Fault Isolation Algorithms, making it possible to implement advanced features such as fault location isolation and service restoration (FLISR) schemes. This functionality allows reconfiguring the grid after overcurrent faults or for a more effective management of the grid.



› adaTECH CMDO

#### Basic features

- › Switch commands (Telecontrol RTU)

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- › IEC 60870-5-104 or DNP3 communication protocol

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- › Directional Fault Passage Detection (adjustment 50, 51, 50N and 51N)

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- › Second harmonic restraint

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- › Voltage presence and absence

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- › Fault isolation algorithm

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- › Web server

#### Additional features

- › Cybersecurity features

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- › SNTP synchronization

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- › Web services

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- › User management under LDAP

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- › Oscillographic fault recording and display

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- › Load curve recording and display



## 4. Voltage and current sensors.

Arteche offers comprehensive sensor solutions for varied topologies, according to the new IEC 61869 standard. Sensors or Low Power Instrument Transformers (LPIT), combined with modern intelligent electronic devices, improve system visibility and enhance grid operation management.

Voltage sensors or Low Power Voltage Transformers (LPVT) are core-less transformers, usually built as dividers that provide an accurate low power voltage measurement signal. Arteche provides sensors built as resistive dividers that present a light, compact and accurate solution for voltage measurement which can be directly connected to the Medium Voltage line.

Low Power Current Transformers (LPCT) are built as conventional Current Transformers (CT) whose secondary side is loaded with a high accuracy shunt resistor, providing the current measurement output as an accurate very low voltage signal. Compared to conventional CTs, current sensors present a safer solution allowing leaving the secondary circuit open. Also, installing current sensor together with voltage sensors a full set of low voltage signal inputs can be provided to the electronics. These sensors offer a multipurpose solution using the same current sensor for measuring and protection functions and for a wide range of currents.

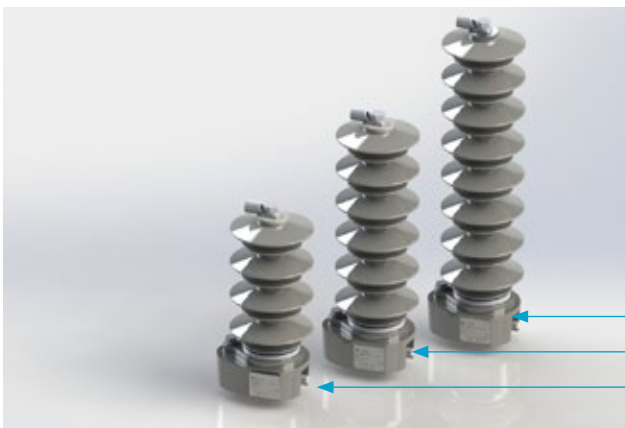
Arteche provides current and voltage passive sensors for a wide range of voltage levels and applications. These devices present compact and light solutions for measurement and without requiring on site calibration.

### sensART OVERSENS.

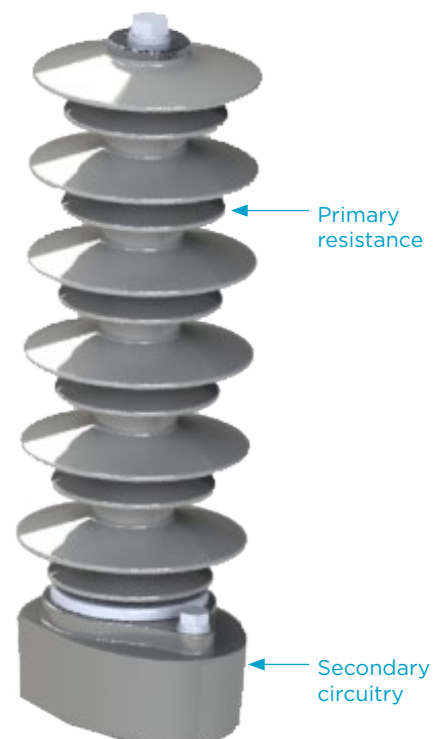
The **sensART OVERSENS** is a voltage sensor specifically designed for MV overhead line voltage measure applications of up to 36 kV. The primary resistance of the divider is housed in a silicone element that provides insulation and the second resistance in a polyamide box. The following models are available, according to the highest voltage of the equipment ( $U_m$ ):

- › **OVERSENS-17** ( $U_m = 17$  kV).
- › **OVERSENS-25** ( $U_m = 24$  kV).
- › **OVERSENS-36** ( $U_m = 36$  kV).

Each highest voltage value is related to certain insulation levels according to the standard (IEC 61869-1 5.2).



› OVERSENS models



› OVERSENS elements

When it comes to the transformation ratio of the sensor, the rated secondary voltage can be  $3,25/\sqrt{3}$  V (standard rated value) or the value that corresponds to a 10,000/1 transformation ratio to the rated primary voltage (IEC 61869-11 5.1101.2).

The accuracy of the sensors, related to measurement ratio and phase error, can be up to class 0.5P according to the standard for multipurpose Low Power Instrument Transformers (IEC 61869-11 5.6.1104).

Accuracy class	Ratio error					Phase error				
	( $\pm\%$ ) at voltage (% of rated)					$\pm$ minutes at voltage (% of rated)				
	2	20	80	100	Fv x100	2	20	80	100	Fv x100
0.5P	2	1	0,5	0,5	0,5	80	40	20	20	20
1P	4	2	1	1	1	160	80	40	40	40

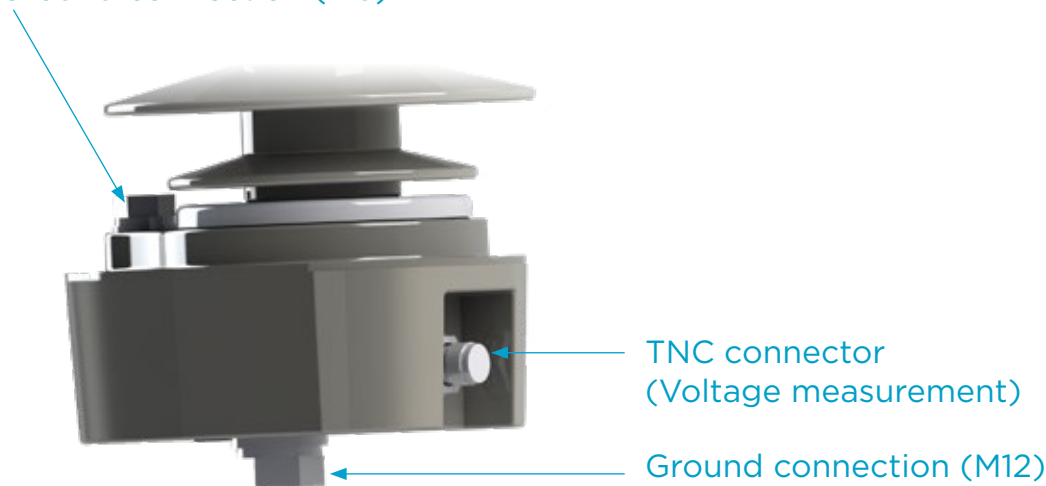
Highest voltage for equipment Um (kV)	Rated power-frequency withstand voltage (kV)	Rated lightning withstand voltage (kV)
17,5	38	95
24	50	125
36	70	170

The rated burden has a standard defined value (IEC 61869-6 5.5.601), which includes a resistance in parallel with a capacitance, although Arteche sensors can meet other values upon request. The cable is considered as part of the burden, as it has a direct impact on its value. Therefore, it is important to keep the cable supplied with the sensor in order to preserve the specified characteristics of the sensor, such as accuracy.

Rated burden	
Resistance	Capacitance
2 M $\Omega$	50 pF

The output signal containing the voltage measurement is provided through a RG 223 coaxial cable connected to a TNC connector in the polyamide box of the sensor. The TNC, a connector specially designed for outdoor connections, reduces electromagnetic disturbance. Ground connection is accessible through M8 and M12 - electrically joined - connectors.

Ground connection (M8)



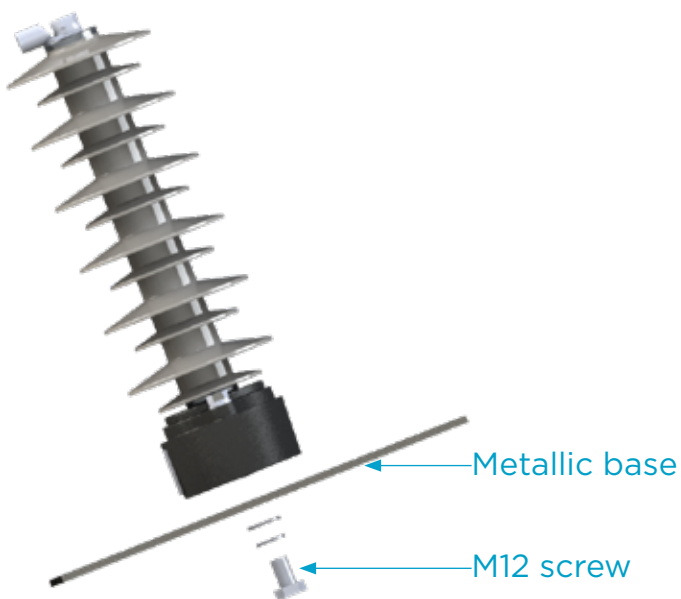


The sensor output can be directly connected to the associated IED or previously combined with the current sensor signal, transmitting both signals grouped to the IED. The second possibility allows connecting a single wire to the IED with both measurement signals and avoids wiring mistakes.

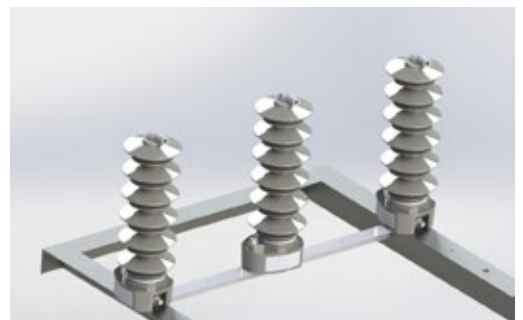
The sensART OVERSENS sensors are usually installed as a sensor trio (one for each phase) by fixing them to a metallic base attached to the pole. The sensor is fixed to the metallic surface through the M12 screw at the bottom of the sensor. This metallic surface, which is fixed to the metallic structure that holds the switchgear, also ensures the ground connection.



› TNC connector



› OVERSENS installation elements



› OVERSENS trio installation scheme



› OVERSENS installation

## sensART ICFH-2 and ICFH-4

Arteche provides Low Power Current Transformer (LPCT) suited for current measuring over switch bushings in MV overhead lines and providing smart grid applications solutions under IEC 61869-10 standard. The bushing of the Load Break Switch provides an installation area insulated from the Medium Voltage line where a low voltage sensor can be installed, which enables a light and compact solution for current measurement that can be easily installed.

The accuracy of sensART ICFH sensors for measuring purposes can be up to class 0,5S according to IEC 61869-10, regarding ratio and phase error. For protective device errors, accuracy can be up to class 5P according to the standard. As multipurpose (measuring and protection) Low Power Current Transformers, these features define Arteche sensors accuracy as CI 0,5S/5P 100,000 A (IEC 61869-10 5.6).



> ICFH-2



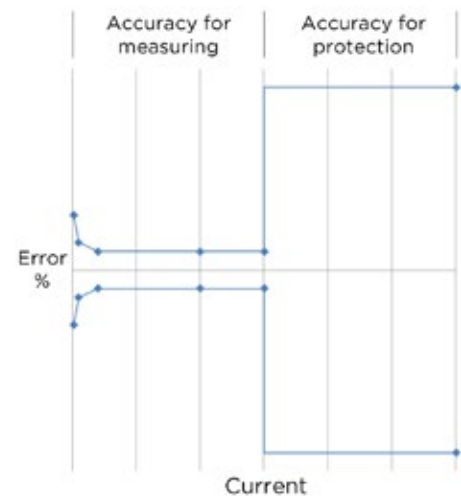
> ICFH-4

Accuracy class	Ratio error					Phase error at primary current				
	± %					± Minutes				
	0.01 I <sub>pr</sub>	0.05 I <sub>pr</sub>	0.2 I <sub>pr</sub>	I <sub>pr</sub>	K <sub>pcr</sub> x I <sub>pr</sub>	0.01 I <sub>pr</sub>	0.05 I <sub>pr</sub>	0.2 I <sub>pr</sub>	I <sub>pr</sub>	K <sub>pcr</sub> x I <sub>pr</sub>
0.5S	1.5	0.75	0.5	0.5	0.5	90	45	30	30	30

I<sub>pr</sub> : Rated primary current

K<sub>pcr</sub>: Rated extended primary current factor

Accuracy class	Ratio error at primary current (± %)	Phase error at primary current (± Minutes)	Composite error at rated accuracy limit primary current (%)
5P	1	60	5

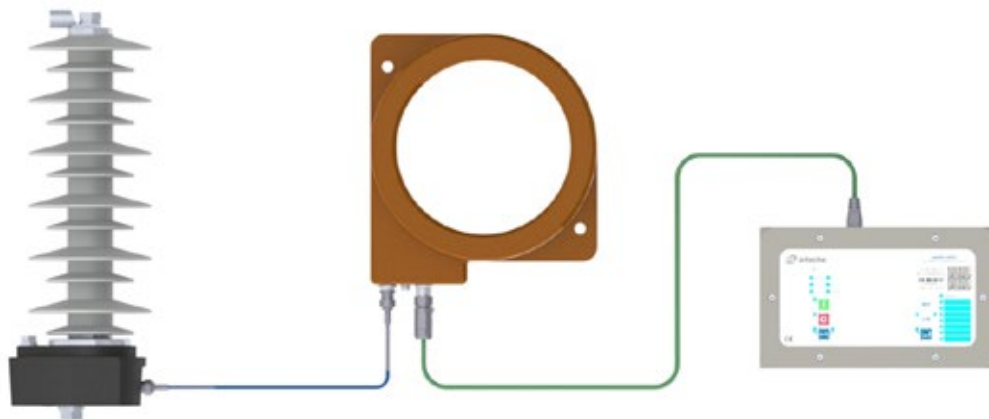


The output voltage signal provided by the Low Power Current Transformer is proportional to the input primary current. For Arteche sensors the rated transformation ratio is 500 A / 225 mV at 0° phase offset (IEC 61869-10 5.1004).

According to Arteche solution proposal, the current sensor can collect the voltage sensor measurement signal through the TNC connector. The output of the current sensor is connected to the associated IED through FTP cable with a M12 connector, allowing voltage and current measurement input in the IED with a single wire for each phase. In order to preserve the defined features of the sensor, the cable included shall be maintained.



› ICFH signal cable connectors

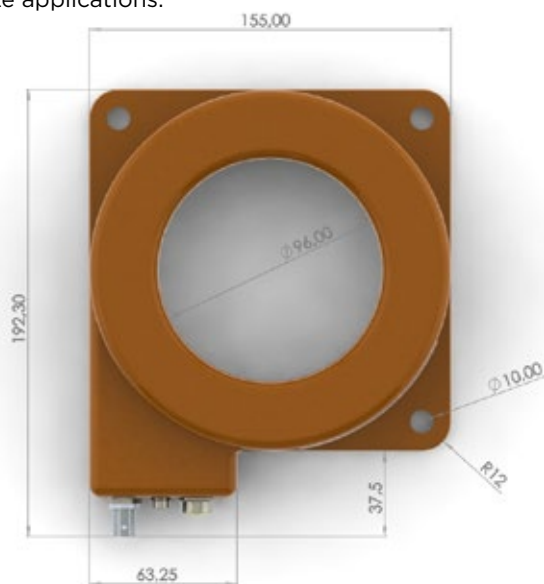


› OVERSENS, ICFH and CMDO Arteche solution connection scheme

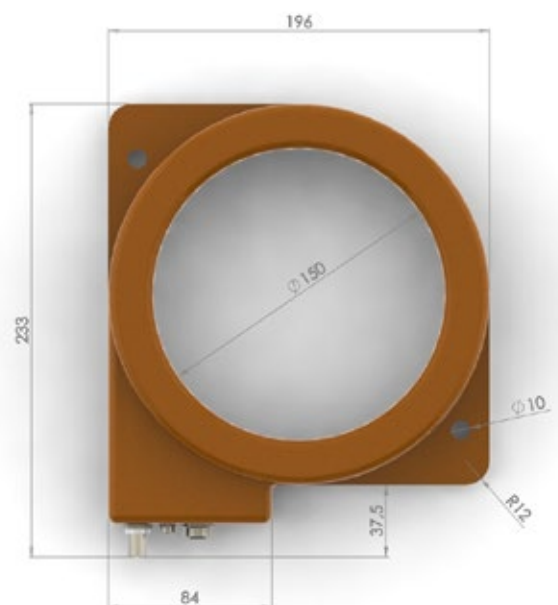
For the connection with the associated IED, the pin out of the RJ45 connector is defined in the following table (IEC 61869-10 6.602.1):

RJ45 Pin out	PIN:	1	2	3	4	5	6	7	8
Passive LPCT		S1	S2						
Passive LPVT							a		n

Arteche provides current sensors with the same features for different size applications:



› ICFH-2 dimensions



› ICFH-4 dimensions

## 5. Voltage Transformer

Voltage transformers are designed to provide a scaled down replica of the voltage in the MV line and isolate the measuring instruments, meters, relays, etc. from the power circuit.

For outdoor service, voltage transformers have several applications:

- › Power supply for switching equipment in distribution automation (reclosers, disconnects or switches).
- › Power supply for auxiliary services.
- › Revenue metering.
- › Protection for substations and distribution lines.
- › Protection for capacitor banks.
- › Discharge of lines and capacitor banks.

Arteche provides a wide variety of designs for greater adaptation to client needs. These transformers ensure a very high exact and invariable accuracy (up to 0.1%) for the service life of the equipment.

### VJL and VJN

VJ Voltage transformers provide auxiliary power supply for switching equipment in distribution automation. VJ model are two-phase transformers with epoxy resin internal insulation and a metal covered main body. The poles have external silicone rubber insulation with superior resistance to elements.

The following models are available:

- › **VJL-24** (Um = 24 kV)
- › **VJN-36** (Um = 36 kV)



- › 24 kV Voltage transformer (VJ). Auxiliary power supply for switching equipment



- › VJL-24

## 6. Summary.

As described along the document, Arteche provides an optimal solution for Load Break Switch installation. Regarding potential future developments for higher voltage levels (up to 52 kV), Intelligent Electronic Devices (CMDO) and current sensors (ICFH) previously described are ready to fit such requirements; and voltage sensors (OVERSENS) are suitable to reach such voltage levels in the coming years.



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Updates: CT\_DA-solutions-MV-overhead-apps-LBS\_EN  
Version: 1.0