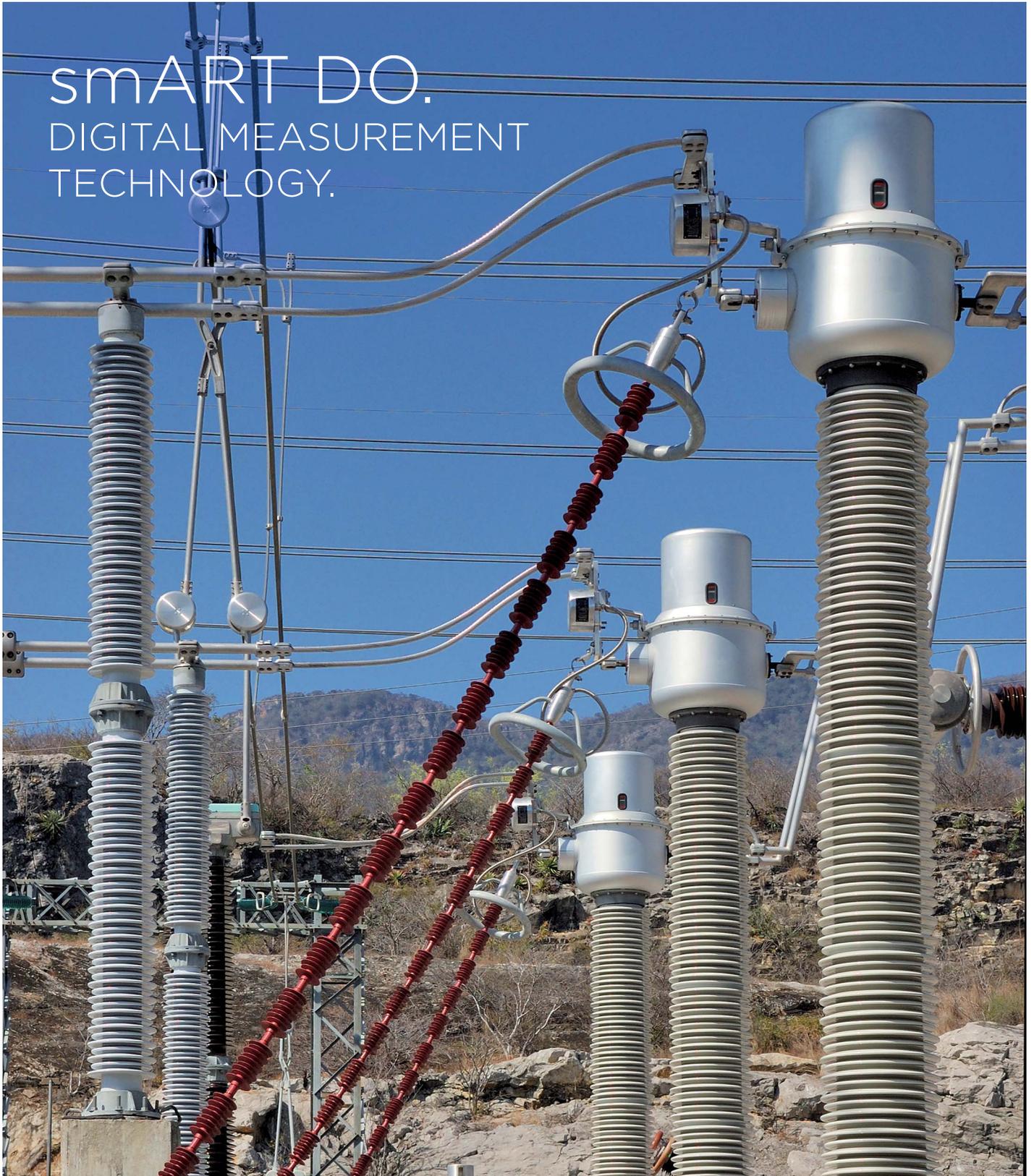


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smART DO.  
DIGITAL MEASUREMENT  
TECHNOLOGY.



This document may be subject to changes.  
Contact ARTECHE to confirm the characteristics and  
availability of the products described here.



# Moving together

# 1. INTRODUCTION

The new smART DO Digital Measurement solution is ARTECHE's advanced technology for metering and protection applications.

The core of the smART DO Digital Measurement solution is the MU-X3 Merging Unit, which is able to handle inputs from up to 3 optical current transformers (OCT), one additional analogue current input (neutral) and up to 4 (three phases plus neutral) conventional Voltage Transformers (VT). The MU-X3 provides a digital output compatible with the IEC 61850-9-2 LE protocol, allowing for the implementation of Process Bus technology within the substation.

Complementary equipment to the MU-X3 is the SH-X3 a faraday effect interferometric current sensor incorporating the patented Network Independent Interrogation Technique (NIMI)

The SH-X3 can measure both AC and DC currents in HV and UHV applications with high accuracy over a wide dynamic range.



› Merging unit (smART MU-X3).



› Routine tested in ARTECHE's laboratory.

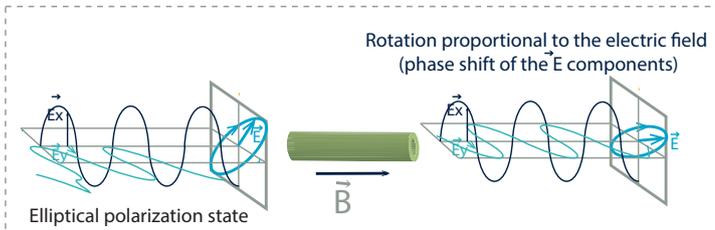
## 2. HOW THE OPTICAL TRANSFORMER WORKS

The operation of the smART DO OCT is based on the Faraday Effect. The polarization state of a linearly polarized optical signal is rotated as it travels through a magnetic field.

For an optical signal which travels along a closed path, the angle of rotation is proportional to the current enclosed by the path.

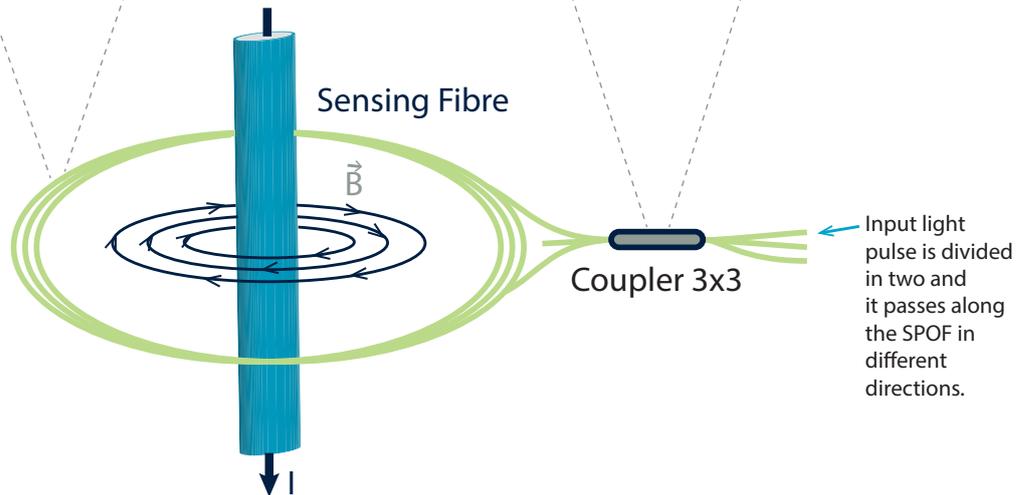
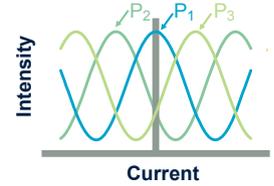
The rotation of the polarization state of the light is measured interferometrically as the phase difference between circularly polarized optical signals which travel in opposite directions around a coil of fibre that encloses the primary.

### FARADAY EFFECT



### INTERFEROMETER

The two pulses return to the coupler with an opposite polarization rotation. Here the electric fields of the light are superposed.



## 3. SYSTEM COMPONENTS

### SH-X3 SENSOR HEAD

- › The only element installed in HV.
- › Fully passive sensor based on optical fibres.
- › No maintenance required. Long life-span.
- › Full galvanic insulation. No risk of having open secondaries.
- › Smaller in size and lighter for easier integration in the substation, leading to compact infrastructure designs and overall cost reductions.



› Sensor head (smART SH-X3).

### INSULATOR

- › No use of oil or SF6. Dry solid insulation.
- › Incorporates standard 9/125 single mode connectorized optical fibres used in telecom applications. Using off the shelf optical components does not require specialized personnel and equipment for installation and maintenance.
- › Designed according to the insulation coordination requirements determined by the utility.



› Post insulator.

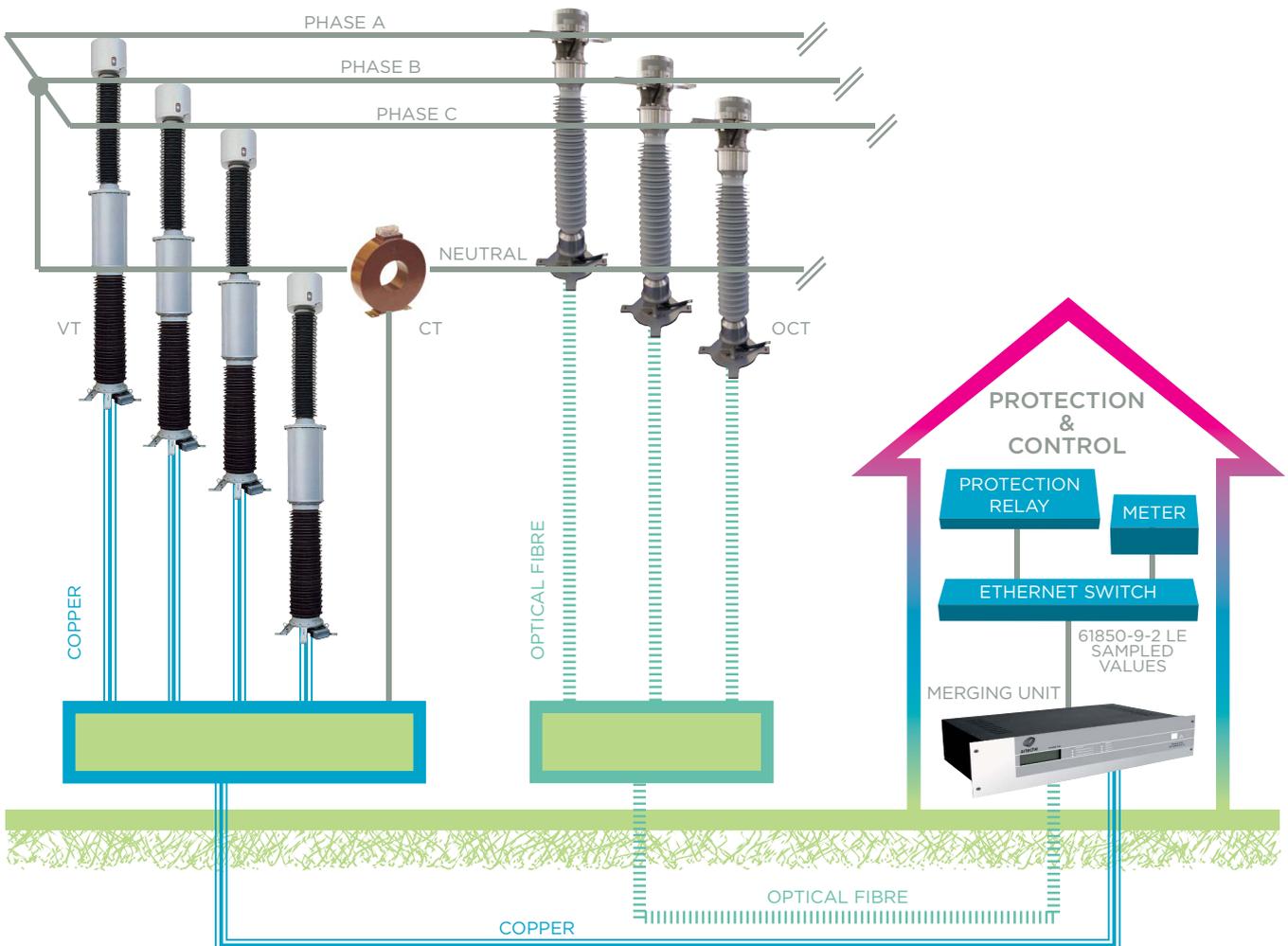
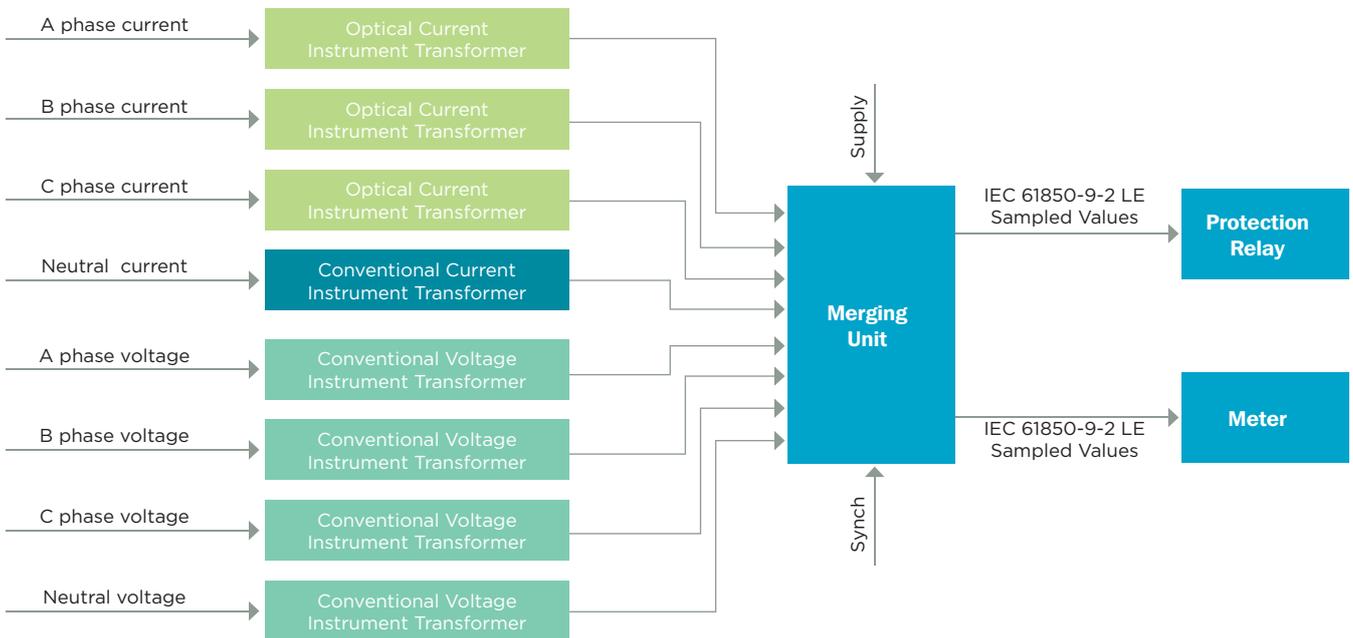
### MU-X3 MERGING UNIT

- › Signal processing unit for managing the SH-X3 OCTs.
- › Able to receive inputs of analogue measurement signals coming from up to 4 voltage transformers or voltage sensors and 1 current transformer or sensor.
- › Provides a digital output compatible with the IEC 61850-9-2 LE protocol.
- › Proven interoperability with major protection manufacturers in the industry.
- › MTBF equivalent to that of digital protection relays.
- › Independent from the SH-X3 sensor head.



› Merging unit (smART MU-X3).

# 4. PROPOSED ARCHITECTURE



## 5. MAIN BENEFITS OF USING OPTICAL SENSING AND DIGITAL MEASUREMENT TECHNOLOGIES



**TECHNOLOGY:** passive sensor based on optical fibres, resulting in a long life time with no maintenance requirements. Not using magnetic cores eliminate saturation limitations. Digital output interface compatible with the IEC 61850-9-2 LE Process Bus protocol.



**DESIGN:** considerably smaller size and lighter weight for an easier integration in the substation, leading to compact infrastructure designs and overall cost reductions. Standardized common telecommunication duplex single mode optical fibre is used for the connection between the sensor head and the merging unit, so that in-field installation requirements can be fulfilled by personnel having basic skills, regular components and tools.



**PERFORMANCE:** broad bandwidth, measuring both DC and AC currents (50-60 Hz) up to the 128th harmonic (at 256 samples per cycle) with high metering accuracy over an unlimited dynamic range.



**APPLICABILITY:** Universal Current Transformer. The utility will specify a single sensing device for the whole network that will be used both for metering and protection, in combination with the appropriate insulator according to the system's voltage.



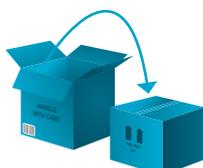
**ENVIRONMENT:** solid and dry insulation, avoiding the use of oil or SF6.



**SAFETY:** full galvanic insulation by default with no risk of having open secondary terminals or explosive failure modes.



**BUDGET:** cost reduction during commissioning and in operation.

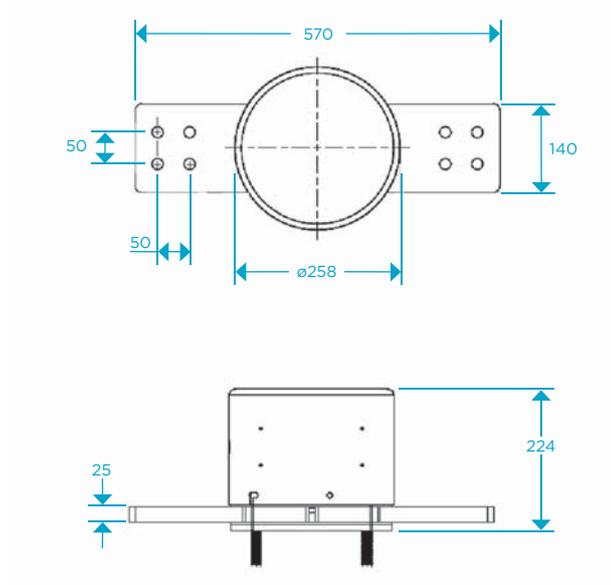


**PROCUREMENT:** spare requirements would be reduced to a single optical sensor and normally no more than 3 or 4 types of insulators for the corresponding voltage levels existing in the grid, allowing for keeping a stock and considerably reducing lead times considerably.

# 6. TECHNICAL SPECIFICATIONS

## SH-X3 SENSOR HEAD

### PHYSICAL



Dimensions\*

\* Subject to change.

Weight	15 Kg.
IP	IP66
Primary palm connection	Aluminum
Optical connectors	2xSC/APC

### ELECTRICAL

Metering accuracy	IEC Class 0.2/0.2s
Nominal current range	Standard: 100 - 5,000 Amps AC

### ENVIROMENTAL

Operating temperature range	-40°C / +85°C
Storage temperature range	
Operating humidity range	100%
Storage humidity range	

## INSULATOR

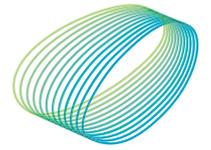
The below specified ratings are provided for the post type insulator as a reference only. The required ratings will be provided by the customer and the insulator will be custom manufactured accordingly. Suspension type flexible HV links can also be provided if required.

ELECTRICAL							
	145 kV	245 kV	300 kV	420 kV	550 kV	765 kV	1,200 kV
BIL (kV)	550	650-1,050	859-1,050	1,050-1,425	1,175-1,550	1,675-2,100	TBD
Withstand voltage /50 Hz/60 s (kV)	230	275-460	750	850-950	950	1,175	TBD
Creepage distance (mm)	4,150	5,200-10,700	6,700- 11,400	7,900-14,300	8,300-15,200	11,000-19,500	TBD
Flashover distance (mm)	1,140	1,300-2,100	1,700-2,100	2,100-2,850	2,350-3,100	3,350-4,200	TBD

MECHANICAL							
Height (mm)	2,070	2,300-3,100	2,700-3,100	3,100-3,850	3,350-4,100	4,350-5,200	TBD
Weight with filling incl. (kg)	100	212/257	294/327	411/487	644/762	809/943	TBD
Maximum mechanical load - MML (kN)	6	8-12	10-16	10-16	25-32	25-32	TBD
Max. deflection @MML (mm)	20	20	20	20	20	20	TBD
Specified mechanical load - SML (kN)	15	20-30	25-40	25-40	62-80	62-80	TBD
Seismic	0.5 g	0.5 g	0.5 g	0.5 g	0.5 g	0.5 g	0.5 g

## MU-X3 MERGING UNIT

PHYSICAL	
Dimensions	19" Rack - 3U
ELECTRICAL / OPTICAL	
Power supply	95 - 270 VAC/DC /24W
Time synchronization	1PPS or (IEEE-1588 available optionally )
User configuration	10/100 Base T Ethernet Port
Optical CT input interface	3xDuplex SC-APC
Analogue VT input interface	4x 110 / $\sqrt{3}$
IEC 61850-9-2 LE digital output	2 x SC type connectors with duplex multimode optical fibre.
Sampling rate	80 or 256 samples per cycle
Bandwidth	Up to 128th harmonic
Alarms	4 digital outputs, 3 of them User Configurable
ENVIRONMENTAL	
Operating temperature range	0°C - +50°C
Storage temperature range	-40°C - +85°C
Operating humidity	90% non-condensing
Storage humidity	90% non-condensing
Operating vibration	0.5g
Storage vibration	1g



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