Artesis

e-PCM

Wind Turbine and Generator Condition Monitoring

Plant Condition Monitor for Generators
e-PCM

The Artesis e-PCM is an AI based online condition monitoring system for wind turbine and generators. e-PCM uses patented technology to offer a unique solution that safeguards generators from electrical and mechanical faults.

e-PCM continuously identifies existing and developing faults on generators and their prime movers, effectively using the generator itself a sophisticated transducer. e-PCM utilizes an intelligent, model-based approach to provide anomaly detection by measurring the current and voltage signals from the electrical supply from the generator. It is permanently mounted, generally in the generator control center and is applicable to 3- phase AC generators. Accompanying Artesis Enterprise Server Software and IoT Portal are used to view the data.

Applications

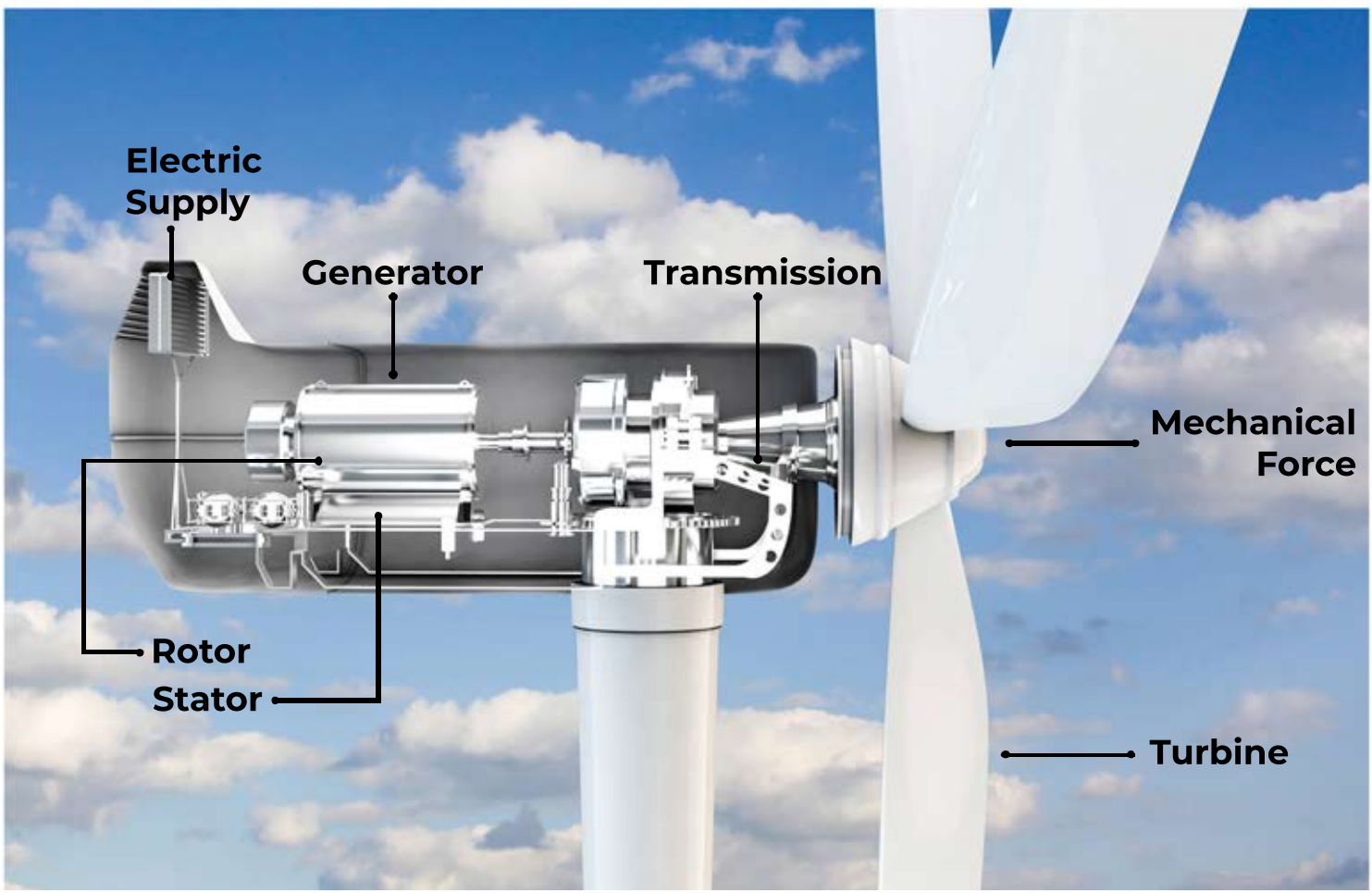
e-PCM is applicable to wide range of equipment, including wind turbines, turbo alternators, diesel generators and hydro generators, and is particulary valuable for equipment in inaccessible or hazardous environments.

e-PCM can be used across many industries including the chemical and petrochemical, metal processing, power generation, pulp and paper, water, utilities, cement, food and beverage, automotive, textile, and maritime sectors.

Working Principle

e-PCM creates a digital twin of generators and their prime movers such as wind turbines. The digital twin is built up during self-learning phase of operation. During this phase the three voltages and three currents are continuously measured and processed using system identification algothims which determine the model parameters under a full range of operating states.

When a fault starts to develop in either the generator or the prime mover, this has an effect on the current waveform, making the real system behave differently from the model system. This allows e-PCM to use the generator as a sensor that can detect faults in both the generator and the prime mover. e-PCM continuously compares model parameters with those held in the reference model.



Continuous Monitoring for Wind Turbines

e-PCM monitors the following parameters continuously:

Turbine blades
- Misalignment
- Mechanical damages

Gear box
- Wear, crack in gears
- Looseness
- Eccentricity

Generator bearings
- Ring and ball damage
- Crack
- Corrosion
- Lubrication problems

Alternator
- Unbalance
- Axial misalignment
- Cracks in the rotor bars
- Short circuit and insulation problems in wound rotors
- Rotor eccentricity
- Short circuit, insulation weakening and looseness in stator windings
- Heating problems at motor terminal connection points
- Current unbalance and voltage unbalance
- Cable damages and connection faults

Energy production information
- Instant active power (kW)
- Instantaneous reactive power (kVAr)
- Total active power (kWh)
- Total reactive power (kVArh)

Working hours information
- Total working hours
- Last working hour
- Previous working hour

Energy statistics on equipment or group basis in monthly and daily periods
- Active power demand graph
- Day and month summary

Harmonic Analysis
- THD
- Odd harmonics - 3,5,7,9,11,13

Frequency

Current and voltage imbalances

Power factor

3 phase current and voltage rms values

Continuous Monitoring for Your Generators

e-PCM monitors the following parameters continuously:

Mechanical Faults:
- Loose Foundation,
- Loose Components,
- Unbalance,
- Misalignment,
- Coupling,
- Bearing,
- Transmission Element,
- Rotor faults

Electrical Faults:
- Loose Windings,
- Stator,
- Short Circuit,
- Internal Electrical,
- External Electrical,

Electrical parameters:
- Power factor
- Active power
- Reactive power
- Vrms (3 phase)
- Irms (3 phase)
- V Imbalance
- I Imbalance
- Frequency
- Total Harmonic distortion
- 3rd Harmonic
- 5th Harmonic
- 7th Harmonic
- 9th Harmonic
- 11th Harmonic
- 13th Harmonic

Key Features

e-PCM simplifies condition monitoring while increasing maintenance efficiency.

- Easy installation from a single point with alternator current and voltage information without sensors.
- Maintenance planing information including diagnostic and time to failure
- Easy to use and no need for interpretation by a highly trained person
- Detects and diagnoses exsisting and develoing faults
- Verifies effectiveness of the maintenance action taken
- Unlimited trend recording* (*According to database size)
- PSD -Power Spectral Density- Curve recording for advance analysis
- E-Mail tool for diagnostic alerts
- Sending data to the host without the need for static IP
- User authorization on the basis of facility or equipment
- Electrical parameter values can be transferred to other systems with Modbus TCP.
- With OPC DA 2.0, both electrical parameters and diagnostic parameters can be transferred to other systems.

Alarm Types and Diagnostics

e-PCM constantly takes measurements and compares them with its reference condition, in order to assess the severity and type of any developing fault. It is able to recognise abnormalities in a wide range of operating states, and is even able to extend its self-learning process when it recognises that it has moved beyond its original learning limits. This allows e-PCM to achieve very sensitive detection of faults without false alarms.

- Normal
- Watch Line
- Watch Load
- Examine 1
- Examine 2

Green: Normal operation

Yellow: The situation is developing outside of normal working conditions.

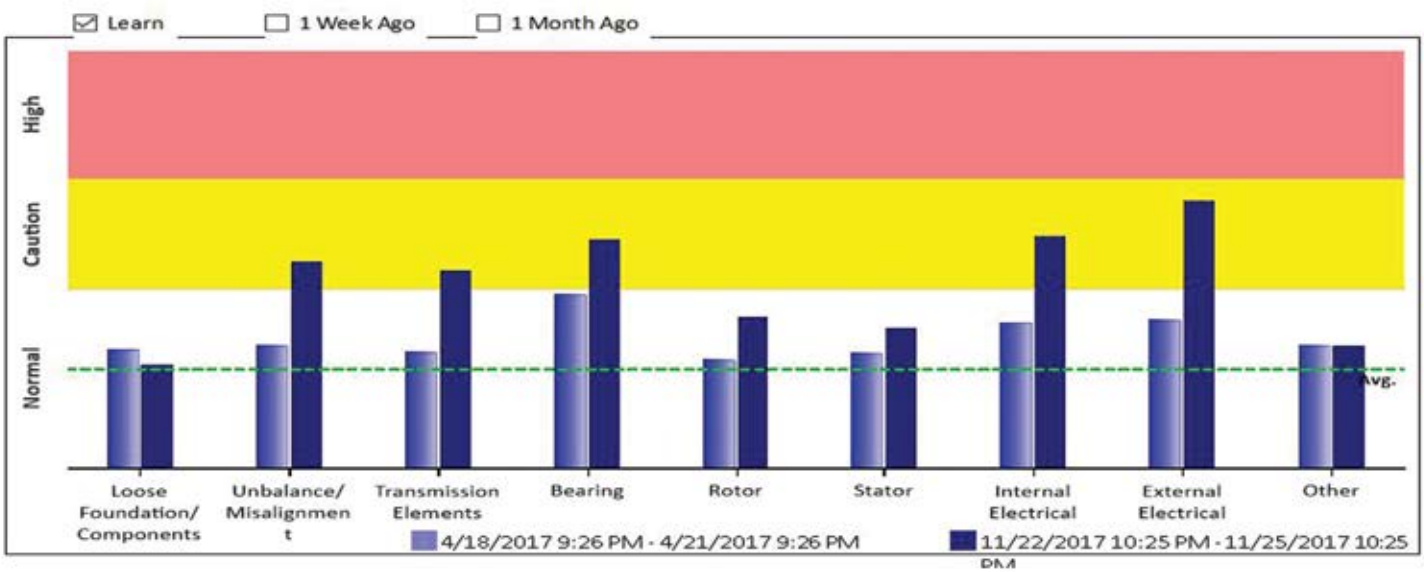
Red: There is a developing fault

EQUIPMENT STATUS REPORT

Artesis

Device Name	MPT-PM-418A	**Nominal Voltage (L-N)**	3810 V
Equipment Type	Pump	**Nominal Current**	385 A
Frequency	50 Hz	**Motor Speed**	1494 rpm

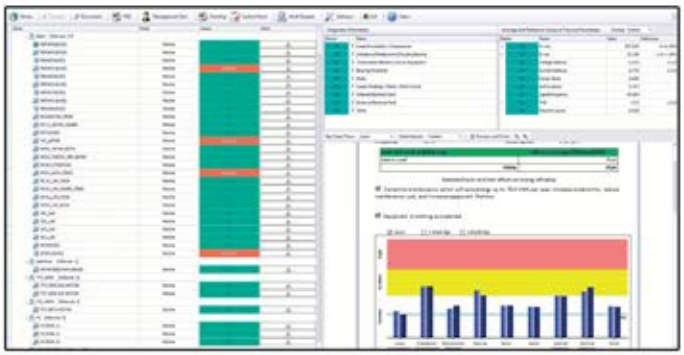
☑ Equipment is working as expected.



Monitoring Software

E-PCM supports various remote monitoring options.

- Artesis Enterprise Software
- Artesis IoT Software
- 3rd party Software integration*



Artesis Enterprise Software

Artesis IoT Software

*Both electrical parameters and diagnostic parameters can be transferred to other systems via Modbus TCP or OPC DA 2.0

Electrical Faults

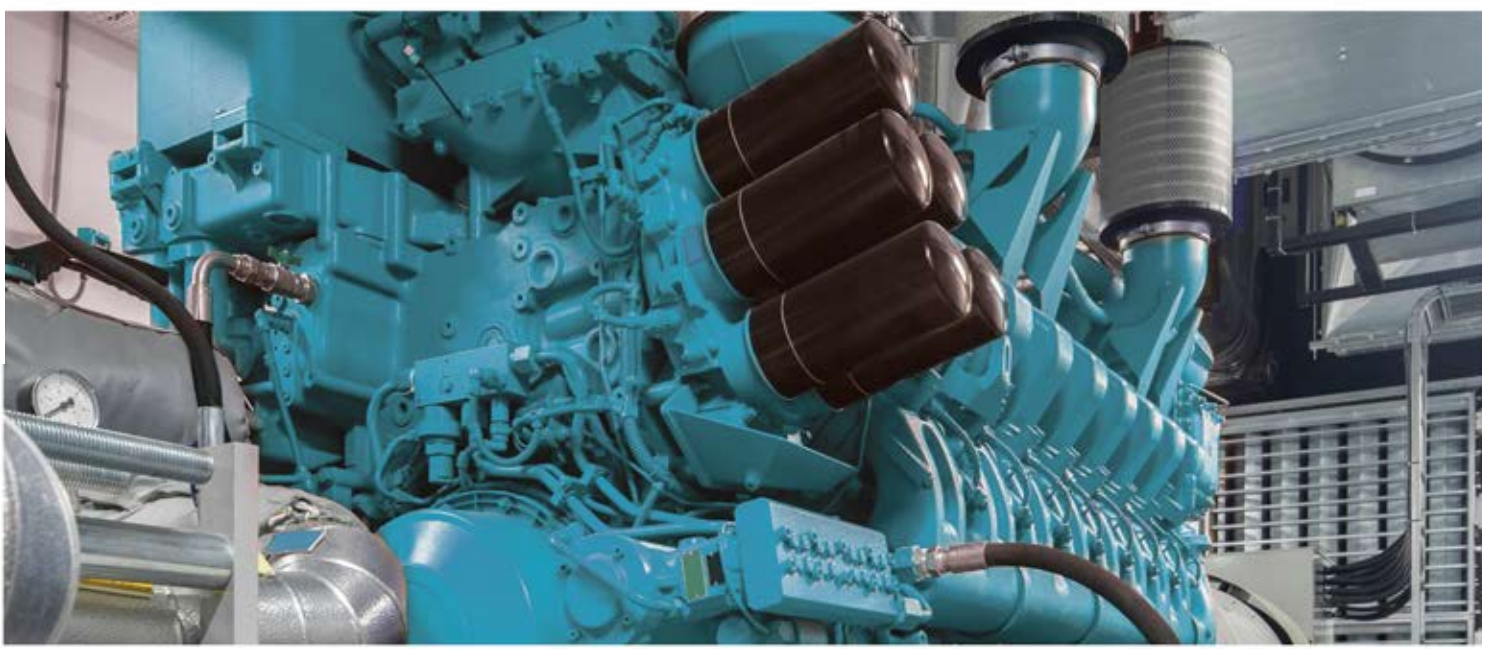
Fault type	Causes	Effects
Voltage or current imbalance	Failing windings or capacitors, loose connections	Mechanical damage, reduced efficiency, breakdowns
Insulation breakdown	Thermal effects, contamination, moisture, wear	Shorts, major damage, reinsulation
Rotor and stator damage	Excessive movement, bad rewind	Loss of power, severe damage,

Mechanical Faults

Fault type	Causes	Effects
Foundation or component looseness	Bad design, installation, deterioration	Distortion leads to bearing and seal failures
Unbalance,misalignment	Bad installation or maintenance, fouling	Mechanical damage, efficiency loss
Bearings and transmission problems including loose belts	Bad installation, bad lubrication, wear	Progressive damage, secondary damage
Rotor damage	Physical damage, corrosion, windings get grounded or short circuited	Loss of process efficiency, power consumption

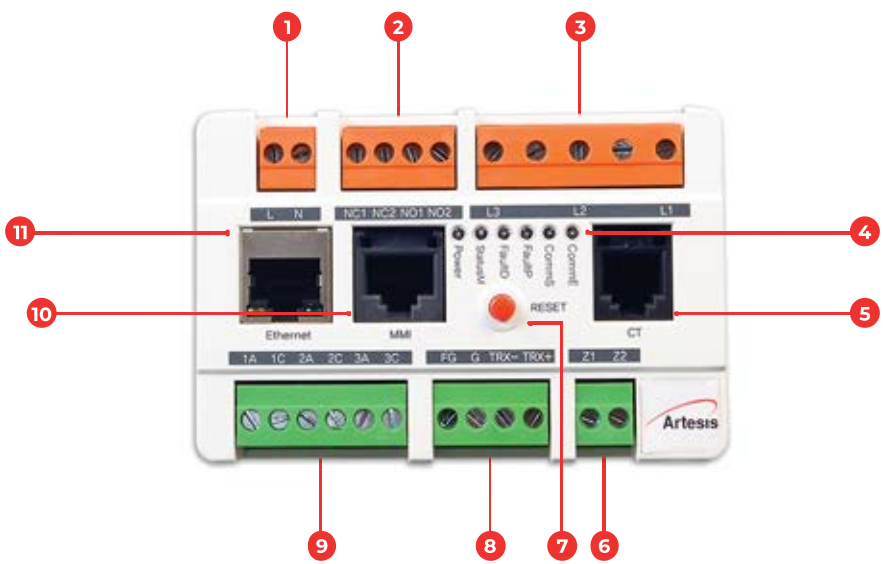
Operational Faults

Fault type	Causes	Effects
Winding heat up	Overloading causes the flow of high currents which causes the stator heat up.	
Lubrication problems	Greasing schedules, bad lubrication system, oil ageing	Loss of efficiency, progressive damage to bearings, trans
Reverse power	This occurs due to failure of the prime mover and insufficient torque supplied to the generator.	
Underexcitation	Underexcitation occurs when the excitation to the generator is cut off and the Power factor goes to the leading side.	This can lead to the failure of the diodes on the rotor and pole slipping.
Negative Phase Sequence	Alternator is loaded in an unbalanced manner. That is, the current on the three phases are not balanced.	Heating of the Alternator rotor.
Overvoltage	Failure of the excitation control system. If the excitation input to the alternator does not match the voltage.	Voltage rising above normal levels and the risk of the winding insulation getting damaged.
Overspeeding	Speed controller regulating the speed of the prime mover fails. When the speed of the alternator rises above the nominal speed, the centrifugal forces developed within the Alternator are so enormous that the poles of a salient pole rotor can get damaged and can come out of the rotor.	Hit the stator and the alternator will be severely damaged.



Motor Condition Monitoring System

No	Name	Function
1	Supply voltage terminal	Terminal for operational power (AC 100- 240V, DC 120-370V)
2	Relay output terminal	Alarm triggering
3	Motor voltage input	Terminal for motor input voltage (Max 690V)
4	Status LED	Indicates Power status, Module status, etc.
5	CT connection port	Terminal for 3 phase CT connection (RJ12) (Max 100mA)
6	ZCT connection port	Terminal for ground CT connection
7	Reset button	Trip Relay Reset Button
8	RS-485 terminal	Terminal for RS-485 communication
9	Empty terminal	No function
10	HMI terminal	Terminal for connecting with HMI (RJ45)
11	Ethernet port	Terminal for ethernet communication (RJ45)



- Predictive diagnosis of electrical and mechanical faults (3-phase AC motor) Energy meter function
- Power monitoring
- Touch screen display monitor (4.3 “TFT LCD monitor)
- RS485 serial communication and Ethernet communication support
- EN 60255-26: 2013, EN 61010-1:2010, EN61326-1: 2006
- Compact size (94 mm x 64 mm x 110 mm)
- DIN rail mount available

e-PCM Datasheet

Rated Specifications

General Information	
Genetator Type	3-phase generators
Ambient Conditions	
Operating Temperature	-10° to 50 °C
Humidity	%80, Relative Humidity, non-condensing
Pollution Degree	2
Altitude	2000m (6562ft)
IP Rating	IP40
Input Supply Voltage	
Rated Voltage	100-240 Vac 120-370 DC
Allowable Input Voltage	90% - 110% (of rated voltage)
Frequency	50/60Hz
Power Consumption	5W
Over Voltage Category	IEC61010 Cat III
Measurement Voltage Inputs	max 690Vac (Line to Line)
Measurement Current Inputs	Up to 2500A with three Cat III Current Transformers: 0.5% accuracy
Frequency Range	20-120 Hz
Communication	
Network	RS485 - Modbus-RTU | TCP/IP - Modbus-TCP
Display	
4.3" LED	Displays electrical measurement, failure information, and setting values
Status LEDs	Displays power status, module status, comm status, alarm for diagnosis
Dimensions WxHxL	120 mm x 105 mm x 15 mm
Physical	
Weight	450 g (1 lb)
Dimensions WxHxL	94 mm x 64 mm x 110 mm
Mounting	Front Panel Mounting (indoor)
Compliance & Certifications	
EMC	EMC Directive 2004/108/EC, EN61326-1, IEC61326-1
Safety	Electrical Safety Directive 2006/95/EC, EN61010-1,IEC61010-1

Measurement Functions

Voltage	3 phase voltage (line-line), unbalance [%]
Current	3 phase current, unbalance [%], THD [%]
Active Power	Measuring active power [kW]
Reactive Power	Measuring reactive power [kVAr]
Frequency	Measuring Frequency [Hz]
Power factor	Measuring Power factor
Energy	Total Whr, Today Whr, Prev day Whr
Data and Time	Year, month, day, hour, minute, second

Auxiliary Functions

Password	Password Secure configuration
Communication	Serial/ethernet communication for monitoring status and event history
Total Running-Hour	Record of total running from installation which cannot be modified or cleared
Alarm	Output alarm signal to 3 output relays
Fault History	30(diagnosis) fault history to the flash memory
Limitation Of Auto Reset Attempt	Block auto-reset if the reset count exceeds the pre-set count within 30 minutes
Date/Time Information Setting	Save date/time to provide exact time of motor failure

Motor Condition Monitor and Diagnostic Functions

Status	
OK	Motor and driven system is working as expected.
Watch Line	Watch Line is usually temporary in nature and generally the user does not need to take any action. However, it is recommended that when this status level occurs, the user should at least assess the extent of the change in the line conditions, as significant changes in the line voltages and currents may be dangerous to the motor. If the line status change is persistent, the user should assess the root cause of this change. For instance, it may be due to a problem in the contactors or for inverter driven motors the settings of the inverter may have been changed. In any case, if the root cause cannot be remedied easily and quickly and the new voltage supply condition presents no danger to the motor, the user has the option to send e-PCM to the UPDATE mode. This will allow e-PCM to learn the new voltage supply conditions, after which the status will eventually return to normal.
Watch Load	If the process load has not been altered deliberately, check for leakage, valve & vane adjustment, pressure gauge faults, manometer, dirty filters (fans, compressors). If the process is altered deliberately, device should be updated.
Examine 1	Plan Maintenance (First Level Alarm): There are developing mechanical and/or electrical fault(s).
Examine 2	Do Maintenance (Second Level Alarm): There are developing mechanical and/or electrical fault(s).

Accessory-Split Core Current Transformers

AC25R-10-100mA -E	3x10A	| Splitcore current transformers set, (Ø25mm) 10A:100mA
AC25R-20-100mA -E	3x20A	| Splitcore current transformers set, (Ø25mm) 20A:100mA
AC25R-30-100mA -E	3x30A	| Splitcore current transformers set, (Ø25mm) 30A:100mA
AC25R-30-100mA -E	3x60A	| Splitcore current transformers set, (Ø25mm) 60A:100mA
AC25R-100-100mA -E	3x100A	| Splitcore current transformers set, (Ø25mm) 100A:100mA
AC25R-200-100mA -E	3x200A	| Splitcore current transformers set, (Ø25mm) 200A:100mA

AC35R-300-100mA -E	3x300A	| Splitcore current transformers set, (Ø35mm) 300A:100mA

AC51R-400-100mA -E	3x400A	| Splitcore current transformers set, (Ø51mm) 400A:100mA
AC51R-600-100mA -E	3x600A	| Splitcore current transformers set, (Ø51mm) 600A:100mA
AC51R-800-100mA -E	3x800A	| Splitcore current transformers set, (Ø51mm) 800A:100mA

AC80R-1000-100mA -E	3x1000A	| Splitcore current transformers set, (Ø80mm) 1000A:100mA
AC80R-1500-100mA -E	3x1500A	| Splitcore current transformers set, (Ø80mm) 1500A:100mA

AC105R-1200-100mA -E	3x1200A	| Splitcore current transformers set, (Ø105mm) 1200A:100mA
AC105R-2000-100mA -E	3x2000A	| Splitcore current transformers set, (Ø105mm) 2000A:100mA

Artesis Technology Systems

Headquarter

Kemal Nehrozoğlu Cad. GOSB Teknoparkı
Hightech Binası No:B10, 41480
Gebze/Kocaeli, TURKEY

+90-262-678-8860

+90-262-678-8855

enquiry@artesis.com

US Office

58 Thomas St, #4 New York,
NY 10013,USA

+1 (201) 793-7150

usa@artesis.com

www.artesis.com

@artesisglobal