



# **PCA2** On-load Protection Condition Analyser

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## **Concept introduction:**

PCA2 is a new system test approach intended to save test time while maintaining system stability where traditional testing has been cut to a minimum due to cost savings.

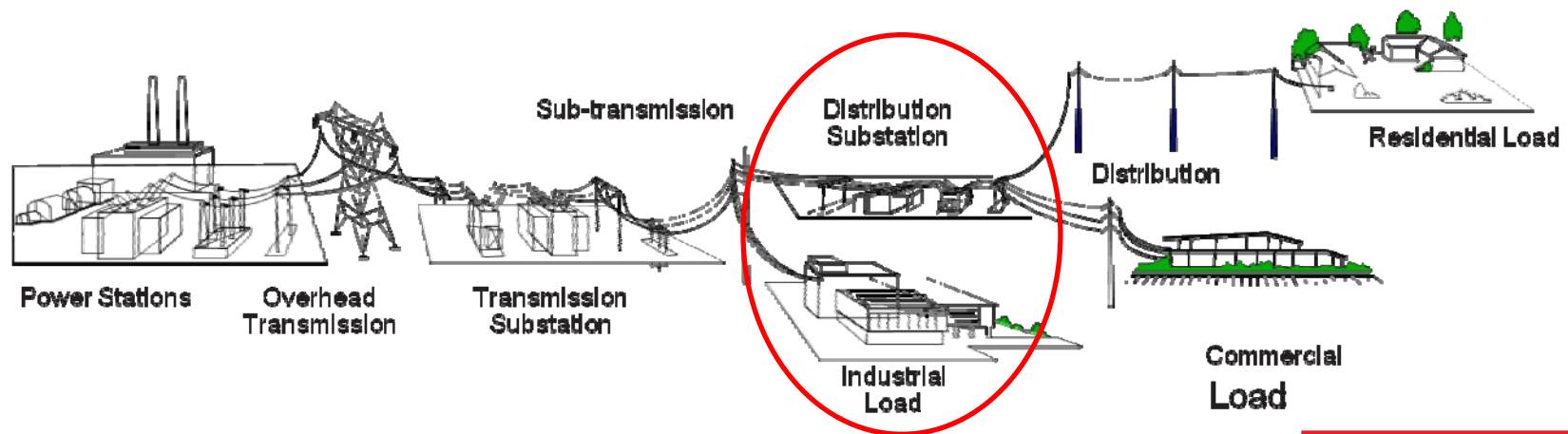
It is important to realize that this new system protection approach may require test routine changes before the PCA2 advantages can be fully utilised.

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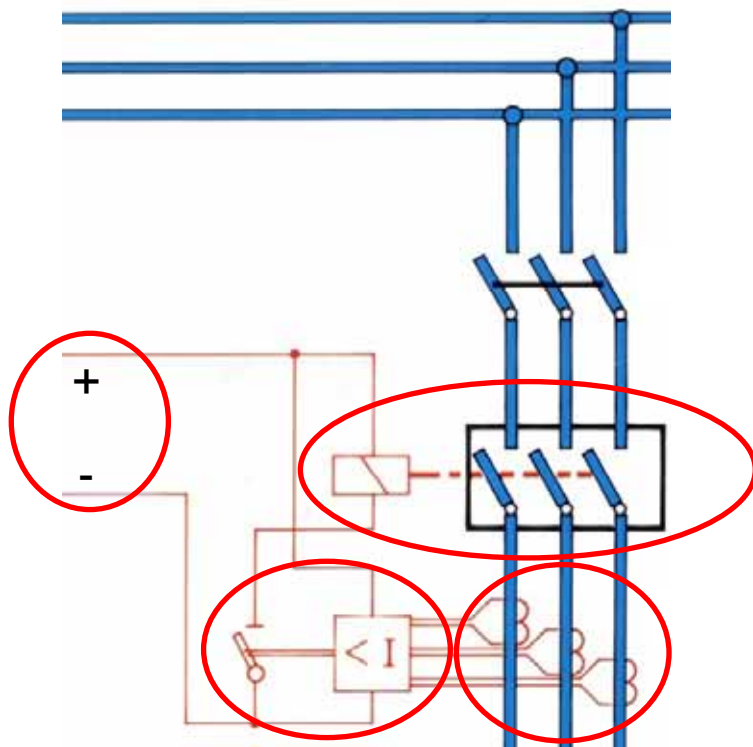
## PCA2 online testing concept

## PCA2 Target

- Protection circuits of Medium Voltage installations
- Substation engineers in electrical utilities
- Electrical contractors and service companies
- Heavy industries



# PCA2 online testing concept



## Conventional testing – offline

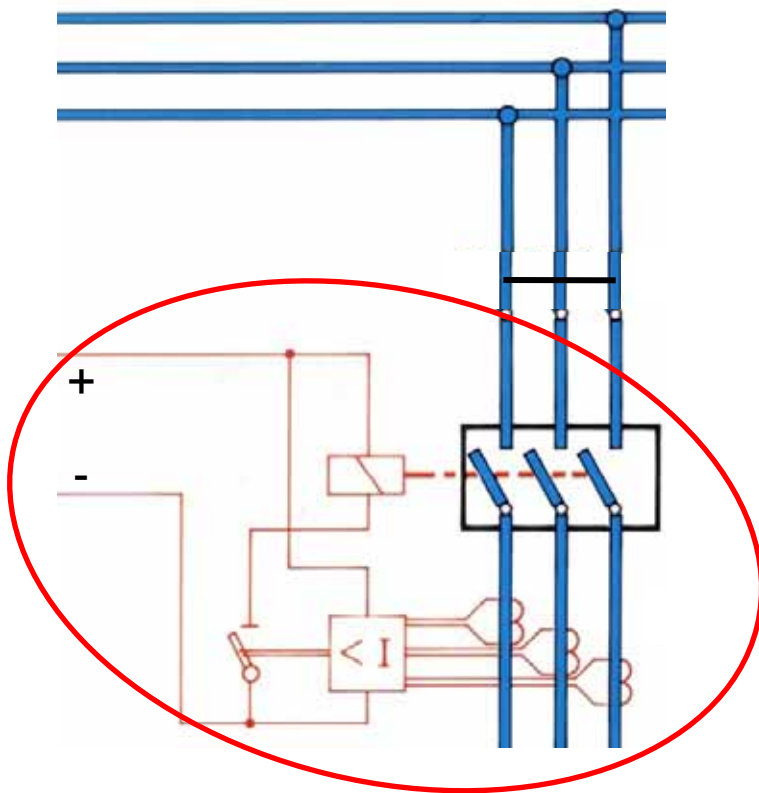
- Re-route load through a parallel circuit
- Disconnect and isolate the test objects
- Test the relay\*
- Test the circuit breaker\*
- Test CT's\*
- Test the battery system\*
- Test connections
- Put objects back in service

\*Traditionally different persons

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# PCA2 online testing concept



## PCA2 testing – online

- Re-route load through a parallel circuit
- **Do not disconnect the test objects**
- Perform a system test
  - Test the relay, circuit breaker, CT's, Trip circuits, battery voltage and wiring in one test
- Put the objects back in service
- If test data indicate problems, schedule a complete test of only the affected bay

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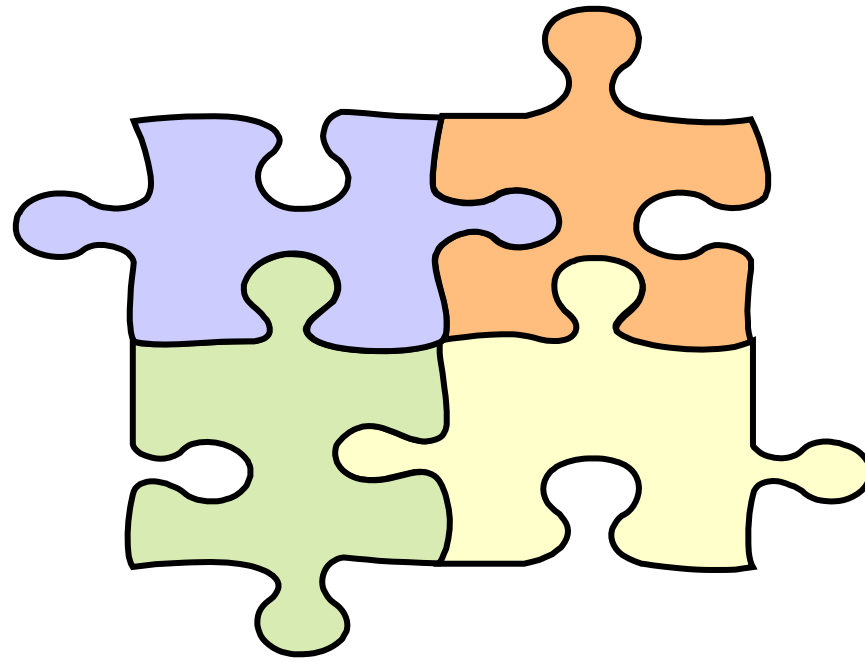
# PCA2 online testing concept

## PCA2 Online Pros

- Shorter outage
- Save several hours
  - No time to isolate the test object
  - Simple connection
  - One test to test all objects
- The valuable 'First Trip' recorded
- Protection remains active to point of trip
- Only one person needed to test breaker and protection

## PCA2 Online Cons

- Limited amount of test data on individual components
- Test method for over-current relay protection only
- Automatic breaker analysis only in the phase where fault current is injected



PCA2 – several tests in one test

# Application

## What does PCA2 test?

### ■ Full protection system test – ‘Snapshot’ of actual, live operation

- Relay Op-Time (over-current)
- Breaker Op-Time
- Auxiliary contacts Op-Time
- Trip coil current profile
- Battery Condition
- CT circuit
- Wiring Integrity

Relay



Circuit Breaker



Current Transformer



DC Supply



Wiring



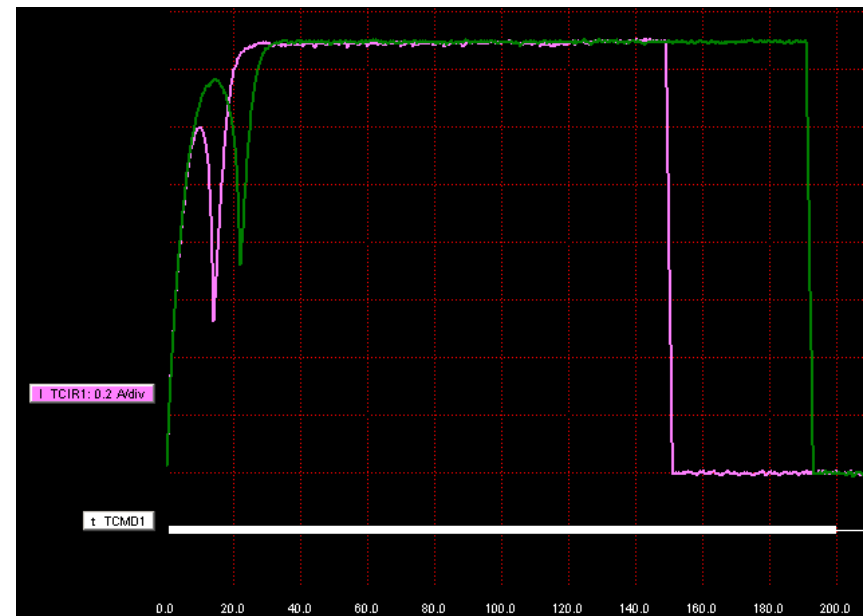
The complete Switchgear protection chain including wiring





## First trip advantages

- Time saving test – performed online
- Circuit breaker may have been in closed position for a long time
- Poor lubrication and/or dirt may delay breaker operation time during first operation
- Operation time and coil current profile can then be different in subsequent tests
- Real case simulation



## First trip advantages

Problem	Detection method
Sticky trip latch components in the mechanism	Trip coil current graph comparison
Loose connections in the control wiring	Trip / close coil current graph comparison
Delay in trip or close initiations	Auxiliary contact timing measurement
Battery charger / battery / cable connection issues	Coil voltage graph

## Typical faults or impending faults identified

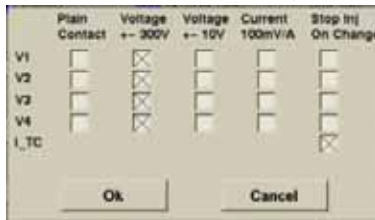
Problem	Detection method
Relay performance	Relay Op-times vs settings
CT connections / wire issues	Relay Op-times vs settings
Trip contact problems	Excessive bounce / resistance
Faulty Trip Coil / Shorted turns	Current magnitude / profile shape
Mechanical problems in breaker and mechanism	Main contact time, aux contact time, trip latch friction etc.



## PCA2 – product description

## PCA2 Panel

1. Trip coil I sensor
2. Current out
3. Relay I sensor
4. COM; RJ45, USB
5. INPUTS V1-V4; User Configurable



6. Touch screen Colour LCD
7. Printer



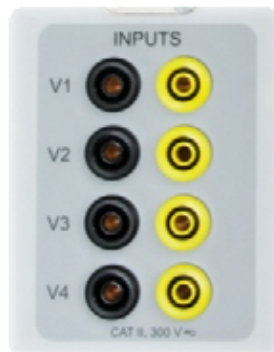
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# User configurable analogue channels

## Monitored part

- Auxilliary contacts
- Adjacent phases
- DC system voltage
- Additional coil currents



## Channel setting

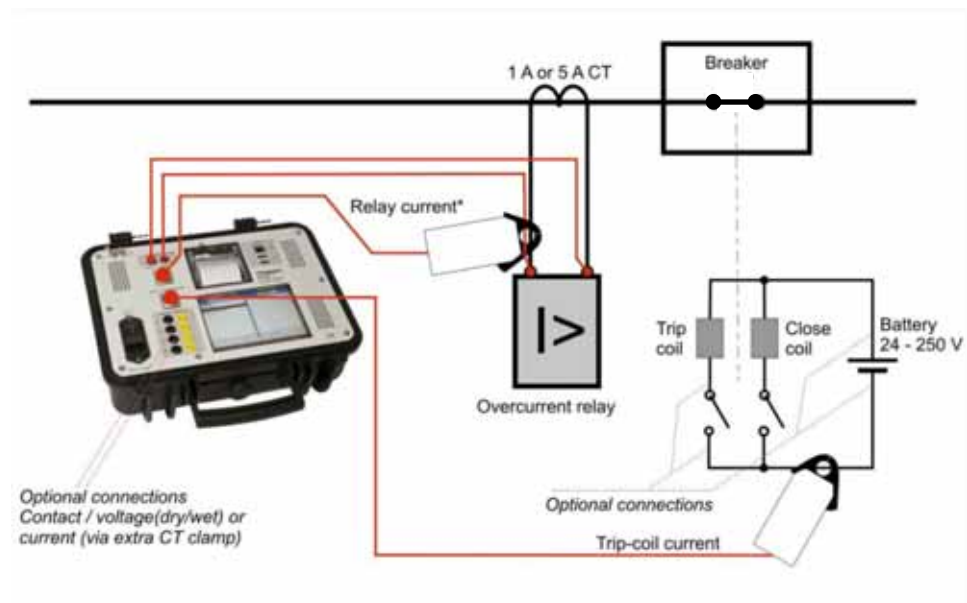
- Voltage sense or plain contact
- Current clamp
- Voltage
- Current clamp

	Plain Contact	Voltage +- 300V	Voltage +- 10V	Current 100mV/A	Stop Inj On Change
V1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
V2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
V3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
V4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I_TC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Ok Cancel

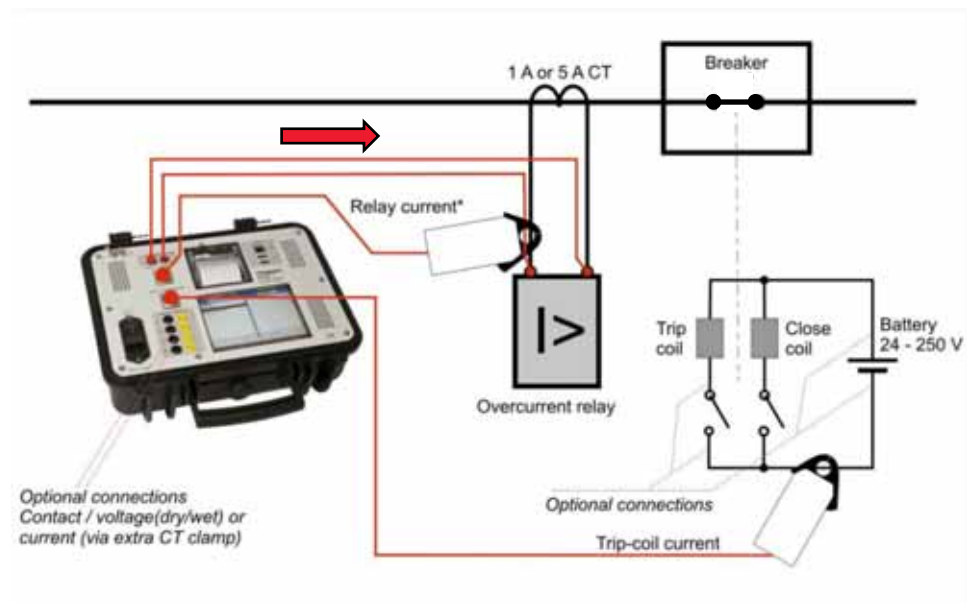
# Connections

- Via alligator clips and clamp-on sensors
- Test blocks not needed
- No connections broken or removed
- More connections gives more info



## Trip test example

- Fault current is added in parallel to existing current
- Total relay current measured via relay current sensor
- Breaker coil current measured via trip-coil current sensor
- Breaker trip time, relay operation time and total system time recorded

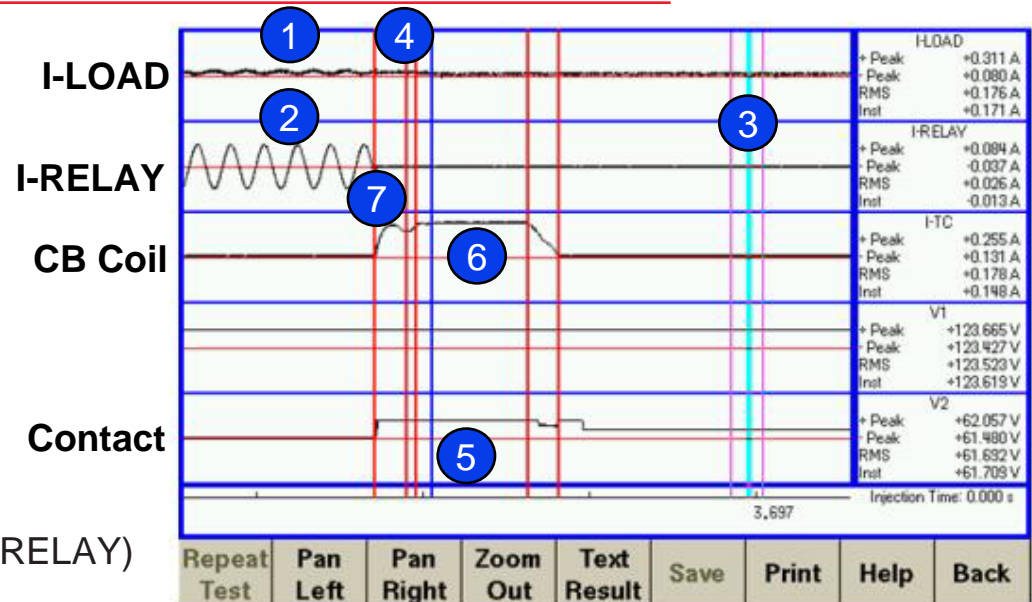




# Results from a test cycle

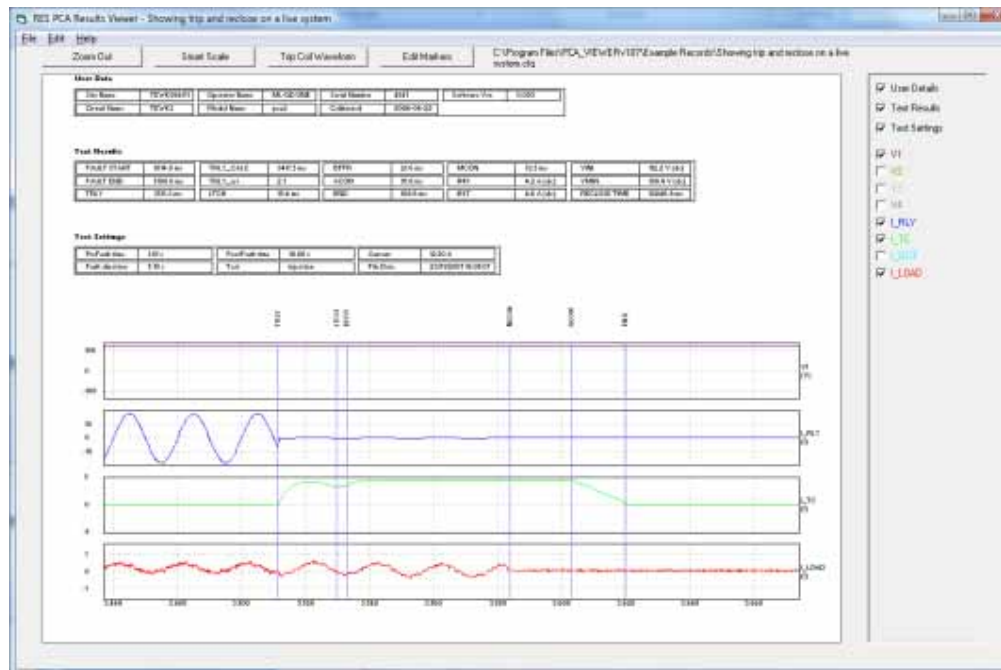
## Examples of measurement results

- Relay Op time (measured)
- CB Main Contact time
- Minimum battery voltage



1. Load current in the CT circuit (I-LOAD)
2. Injected current from PCA2+ I-LOAD(I-RELAY)
3. Cursor (movable)
4. Load current collapses (when the breaker trips)
5. Contact closes (V2 was connected to the relay trip contact)
6. Trip coil current waveform
7. End of injection marker

# Results PCA viewer software tool for PC



- Save files in standardised COMTRADE format [www.artec-ingenieria.com](http://www.artec-ingenieria.com)

## Summary of PCA2

- Ideal for Distribution networks – Medium Voltage
- Saves time while maintaining good system reliability
  - Saves several hours per bay compared to conventional testing
  - Performs test online
  - System condition test – all in one test
    - Main relay and circuit breaker parameters
    - DC supply, CT circuit and wiring integrity
- Offers first trip advantages