Autoreclosers

Switch module

OVX 120 – 12/15kV
OVX 240 – 24/27kV
OVX 380 – 38/40kV

Protection relay

FTU R200

- ✓ Directional/Non Over current fault
- ✓ Negative Phase Sequence fault
- ✓ Ground fault
- ✓ SEF Ground fault
- ✓ 3Io Cos Active detection
- ✓ Ground fault window ±30 - ±90^0
- ✓ Intermittent(>150µs) Ground fault
- ✓ Protection

Communication

- ✓ Protocols: IEC 60870-5-101, IEC 60870-5-104 , IEC 61850, DNP3 and MODBUS.
- ✓ Communication via Radio, TETRA, Fiber and GSM/3G/4G

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AUTORECLOSERS in OVERHEAD NETWORKS

Autoreclosers have been around since 1941 and were invented by Kyle corporation in US. Autoreclosers have always been considered to be one of the "workhorses" of distribution system overcurrent protection.

A distribution autorecloser is designed to interrupt both overload and fault current. Also, per its term, it is designed to "reclose" on the fault repeatedly in a predefined sequence in an attempt to clear the fault.

Autoreclosers are predominantly located on the distribution feeder, though as the continuous and interrupting current ratings increase, they are more likely now to be seen in substations, where a circuit breaker would be located traditionally .

Autoreclosers have two basic functions on the system, reliability and overcurrent protection. While one of the philosophies for the use of autoreclosers is to increase reliability. In the past their use for many utilities was determined mainly due to the fact that feeder breaker did not have protective reach to the end of the feeder. The reason for that was the fact that high load currents forced the minimum trip setting to a higher value than the fault level at the end of the feeder.

Nowadays, Autoreclosers are more frequently applied for reliability reasons, mainly due to three of their benefits: Fault clearance capability, Remote control and Smart grid capabilities.

AUTORECLOSERS as SUBSTATION BREAKERS and in KIOSKS

Autoreclosers are the modern way to refurbish small substations. The cost reduction benefits are big, due to following reasons: There are no need of any building to install traditional panel breakers, Reduction of construction time and Reduction of engineering costs.

Autoreclosers installed in kiosks are a viable way to protect underground cable networks. It is also a intelligent solution to protect zones between underground cable networks and overhead line systems.

Autoreclosers is a powerful building block in a modern smart grid network. It quickly reduce the SAIFI and SAIDI figures and have a very short pay-of time.

PRODUCT INTRODUCTION in brief

The ACR series of automatic circuit reclosers are designed for use in dynamic Smart Grid overhead line distribution networks, secondary substations (transformer kiosks) and in distribution substations.

The **switch modules** are designed for all voltage classes up to 40kV. The vacuum bottles are of AMF up to 24/28kV and of RMF type from 28kV to 40kV. The vacuum interrupters switches can handle many high current faults as high as 42kA with less contact erosion.

The **bushings** for 12/15kV and 24/28kV have an epoxy core, coated with silicone for extra UV protection and mechanical stress during installation and vandalism. The bushings for 38/40kV are made of solid Hydrophobic Cycloaliphatic Epoxy (HCEP).

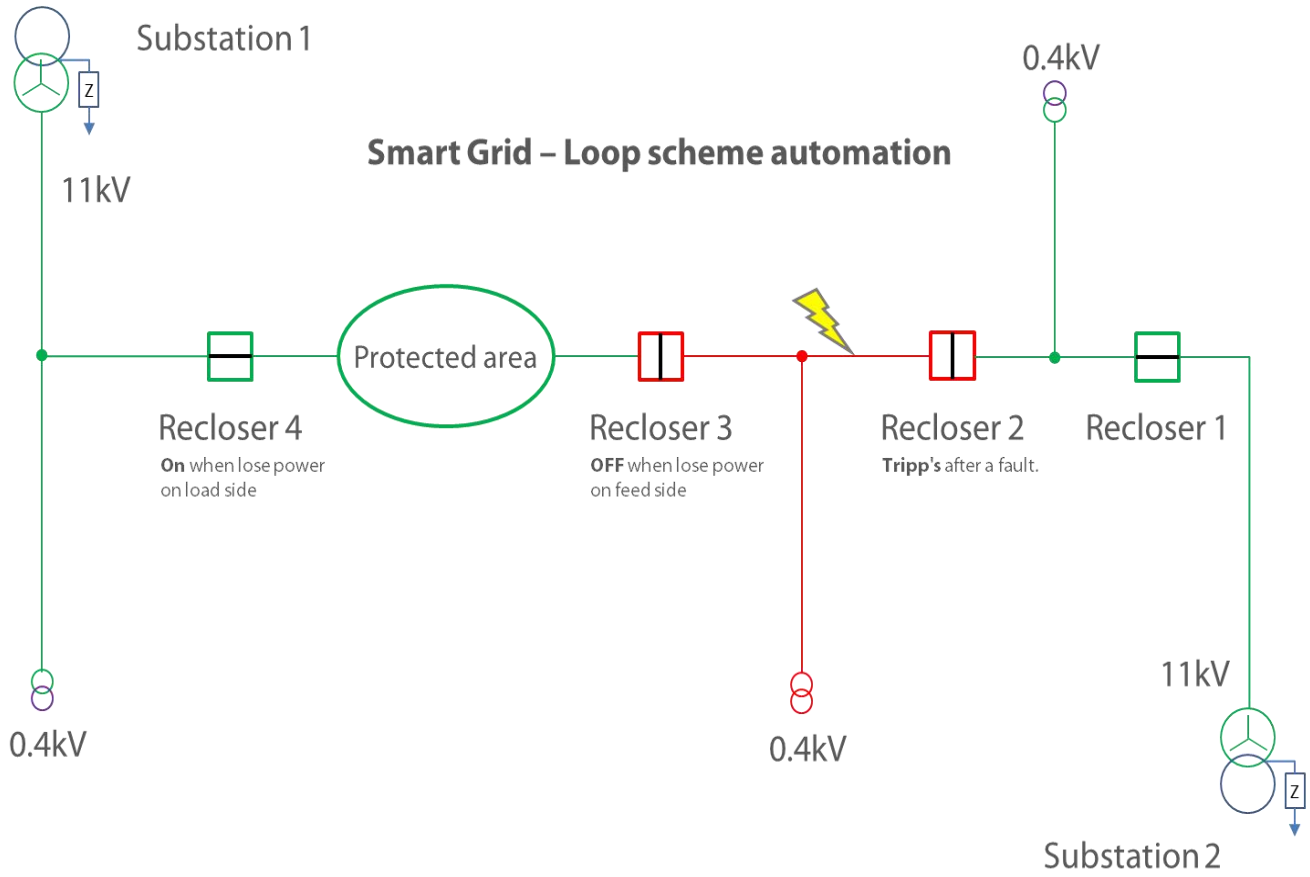
The **switch module frames** are manufactured out of 5mm 2333 type of stainless steel for the best mechanical stability and corrosion proof. All metal parts are carefully selected to avoid electro chemical corrosion as well as long problem free operation.

It is of the latest Swedish design and uses components of the latest generation to ensure a low operating and maintenance costs.

ACR 120 for 12/15kV

ACR 240 for 24/27kV

ACR 380 for 38/40kV



Typical autorecloser application for an overhead line network with FeAl, Cu and isolated lines. Autoreclosers in trunk and spure lines.

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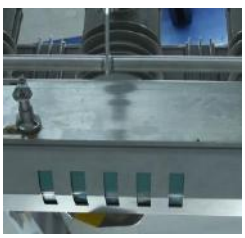
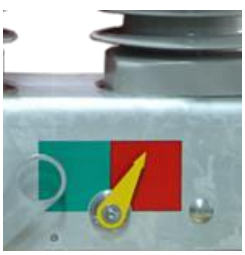
SWITCH MODULE

The ARC series are solid insulated, environmental friendly, free of sulphur hexa fluoride gas (SF6) and oil for isolation. As it is solid insulated in the free air space, the phase elements has no metal cover. This design prevents from flash overs between phases, phase to earth and tank expositions in a failure situation.
The switch module is normally fitted with a synchronized air break switch for extra operational and personal safety. The air break switch gives visible open points at all phases and can be operated by a hook stick or a fix down pole operating handle.
The switch module can be tailored with different current transformer arrangements. It can be fitted with only two phase CT's to power an internal electronic circuit and act as a "line fuse". It can be tailored without any CT's as a Time Voltage Sectionaliser to three phase CT's and one core balance CT for extreme low earth current reading and protection.

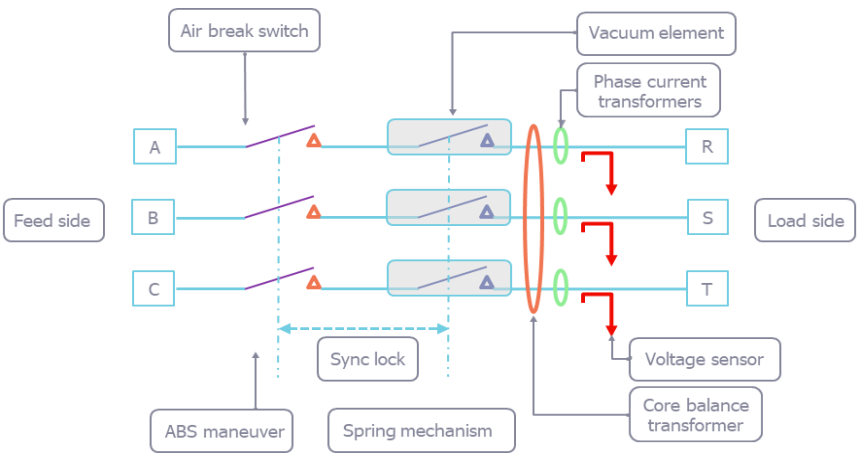
The switch module is operated by steel springs. The mechanism allows for manual trip and close and trip(3 operations) without any electric power for long and risk free operation.

The status Open/Close of the vacuum interrupters are reflected by a multi cam rotary switch for extra safety. The switch module has a safe visible mechanical indication of the vacuum interrupters positions. The switch module has an optional mounting frame for easy installation of surge arrestors. To ensure long and maintenance free life of operation, the frame has an integrated filter protecting ventilation and heating system.





Bottom and side switch position indicator



The switch module principle *

*The principle differs for different versions

DOWN POLE cabinet

The down pole cabinet contains all the electronics, battery and a temperature compensated battery charger for the sectionalizer or protection relay for the autorecloser. The cabinet has space and power for a communication unit and a lightning protected gland for an antenna or fibre cable. The cabinet can be fitted with 2 x 12V 17AH or 4 x 12V 17AH batteries.

The cabinet is made of 2.0 mm type 2333 thick stainless steel for extra corrosion protection. The size is 400x570x230mm. All metal parts are carefully selected to minimize the risk for electro chemical corrosion in a hazardous outdoor environment.

The connection to the switch head is made via a Harting type heavy duty IP65/NMEA4 connector for easy and safe installation. The auxiliary power is fed into the cabinet via a 20mm cable gland and is installed to a standard cable screw terminal.

The cabinet has a internal filter protected ventilation and heating system to prevent condensation and to give the electronics a long life and a good working environment.

The cabinet can be fitted with a door alarm to notify the main control room personnel in case the cabinet door is open.

The door can be locked with a standard pad-lock.

The cabinet is fitted with a rain/sun protection roof and can be fitted with different mounting arrangements for mounting on: walls, wood poles, concrete poles and steel structures.

400x570mm stainless steel cabinet
with FTU-R200 protection relay

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LOCAL CONTROL with TABLET COMPUTERS and SECURE WIRELESS LAN

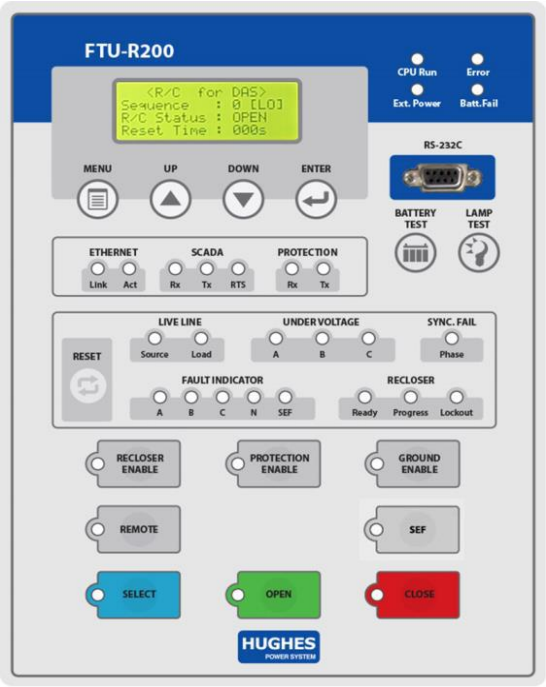
Hughes Protection Relay App is an unique tool for a modern Electrical Utility Linesman. It is used to control and download relay data and voltage/current curves. The App is designed to interface to Hughes FTU-R200 protection relay via a secure WiFi wireless LAN (option). The range of the WiFi device is normally 50 to 100M depending on the surrounding terrain.

The App will automatically connect to the protection relay as soon as the Tablet computer with the Hughes App is in range. It will communicate over a secure WPA2 encrypted wireless radio link. All active actions, such as; Operate the breaker, change relay parameters etc. are secured with an extra password to separate different personnel categories.

PROTECTION RELAY

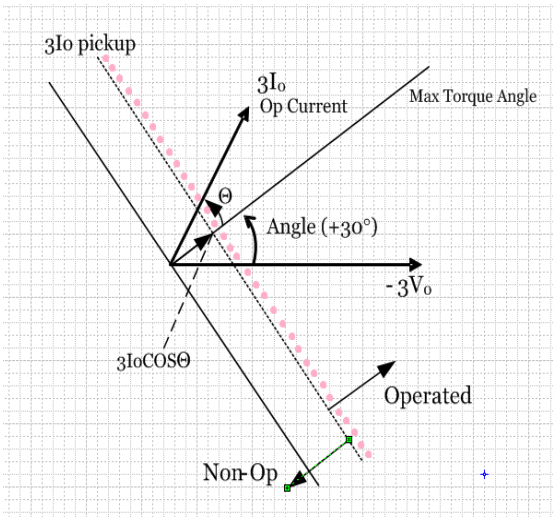
Switch control

- Operator place : Remote, Local (Front Panel/PC Tool)
- Interlocks : Control Lock, Password, Mechanical Lock
- Current Switch status
- Close interlock conditions (Selective) : Live load, Phase sync. fail
- SBO (Select before Operate)
- Secure switch operation
- SBO timeout (settable)
- Auto reclosing
- Recloser On/Off
- Protection On/Off
- Ground protection On/Off
- Battery Test, Reset Indicators



Protection function

- Fault passage indicator
- 3-stage over current protection (directional or non-directional)
- Fast and delayed TC trip elements for phase and earth fault
- 54 types of built-in TC Curves (IEC, ANSI, Recloser curves) and 4 Customized TC Curves
- Definite time over-current element
- Definite time HCT (High Current Trip)
- Negative sequence over-current protection
- Earth fault detection Directional or Non directional
- SEF (Sensitive earth fault) detection 3Io
- 3Io Cos detection active earth fault detection
- Intermittent earth fault protection (>150μs min peak)
- Adjustable protection zone ±30 - 90°
- Cold load protection (pickup adjustment)
- Magnetizing inrush restraints
- Sequence coordination
- Open line detection
- Phase sync. fail detection
- Over voltage, under voltage, under /over frequency
- Auto reclosing (up to 4 shots) Operated
- Auto sectionalizing
- 4 setting groups, automatic setting group change depending on power flow



3Io Cos Protection principle

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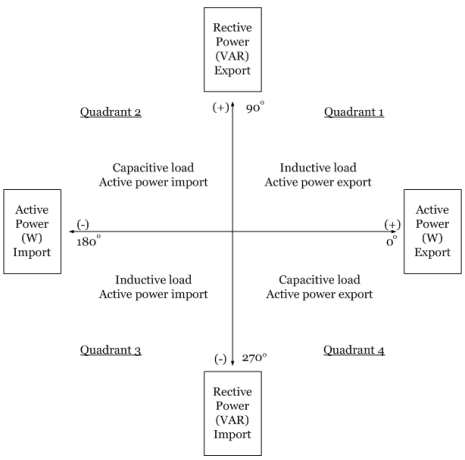
PROTECTION RELAY

Metering

- 128 Samples per cycle
- Galvanic isolation through Aux. CT & Aux. PT
- Secondary of 1000:1 CT ~ 12.5A > 12.5kA in short circuit current
- Up to 200% of rated input voltage
- Currents (A,B,C,N), Voltages (A,B,C/R,S,T) : RMS, Phasors, Sequence components, Harmonics
- Power : Apparent (kVA), Active (kW), Reactive (kVar), Power factor
- Energy : 4-quadrant metering, import / export active energy, inductive / capacitive reactive energy.
- Frequency
- Demand Profile
- Report value by dead band

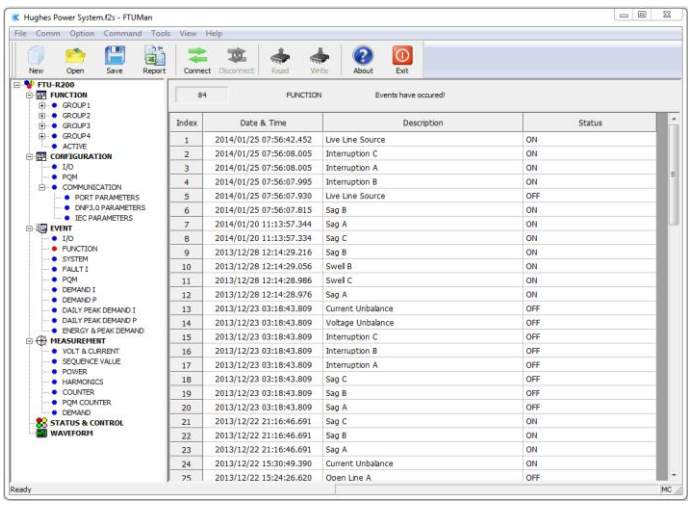


Metering quadrant

Event / Fault log

- SOEs are stored on non-volatile memory with 1ms time-stamp
- Event history buffers are categorized by group
  - ✓ I/O Events, Function Events, System Events
  - ✓ Fault current Events
  - ✓ PQM Events
  - ✓ Demand I,P,Q
  - ✓ Daily Max. I,P,Q
  - ✓ Counter : Switch open, Fault, Restart

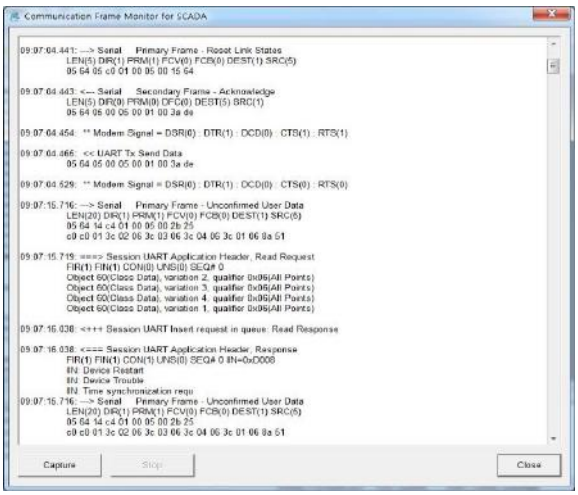
- Fault waveform recording
  - ✓ 8 faults, 6 PQM waveforms can be stored on non-volatile memory
  - ✓ 1 Manual triggered waveform
  - ✓ 128 samples/cycle, 20 cycles
  - ✓ Waveforms are stored as COMTRADE file format through PC maintenance software
  - ✓ Memory size : 2 Mbytes



Event /Fault log

Communication

- Supports DNP3.0 Subset level 3, DNP over TCP/IP
- IEC60870-5-101, IEC60870-5-104 TCP/IP
- MODBUS RTU TCP/IP
- IEC 61850 optional
- Index mapping & class assignment
- SMS to Cell phone
- Built-in protocol monitor
- Built in SCADA master simulator

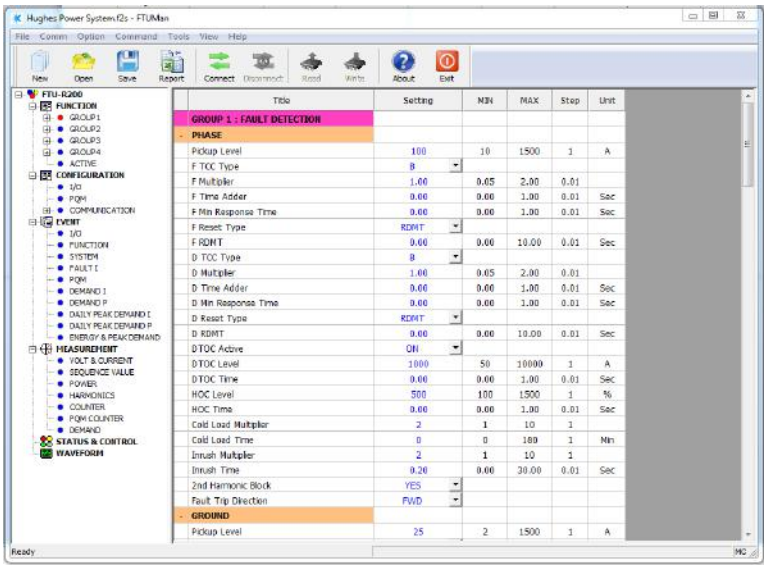


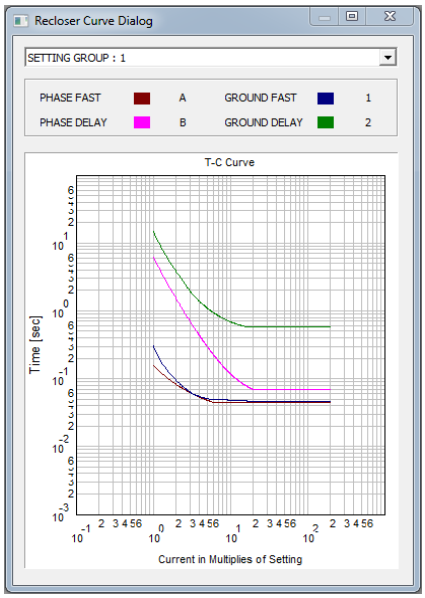
Communication monitor – protocol analyzer

Power Quality Monitoring

- Sag, Swell, Interruption Detection
  - ✓ Status
  - ✓ Events : Time-stamp, Magnitude, Duration
  - ✓ Counters : Statistics for each phase, duration classified by IEEE 1159.
  - ✓ Accumulated interruption time
  - ✓ Waveform recording on events
- Harmonics
  - ✓ THD (Total harmonic distortion)
  - ✓ Each components up to 31th harmonics
  - ✓ Events by threshold setting, Counter

Protection curves





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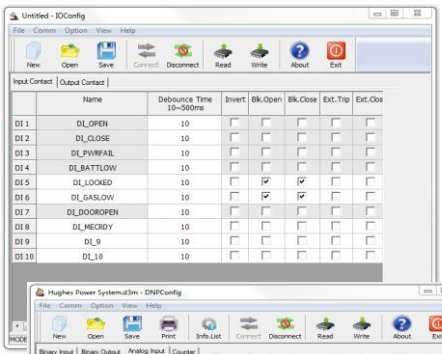
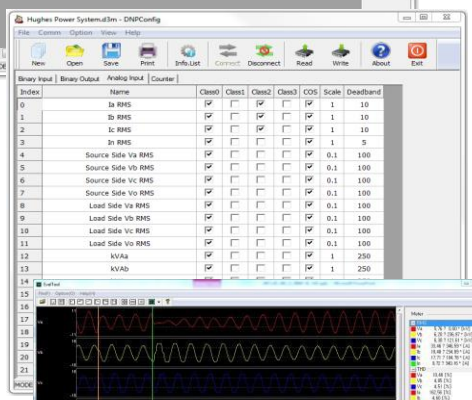
PROTECTION RELAY

Maintenance software structure

←— Read/Wright

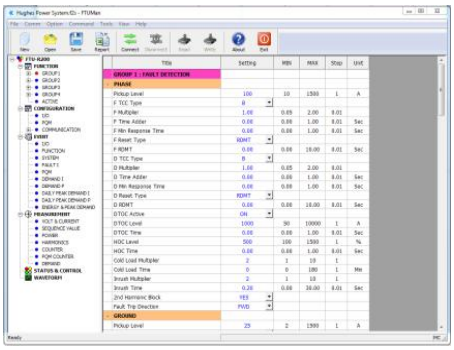


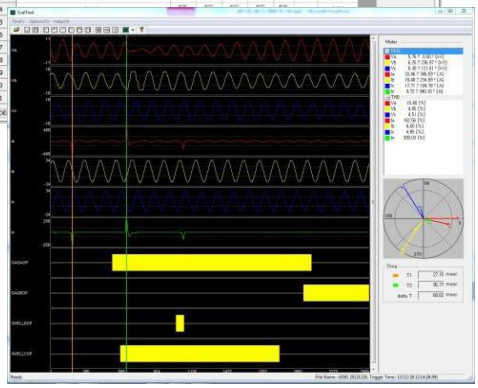
I/O configurering



Protocol configurering

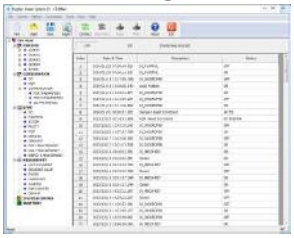
Configurering



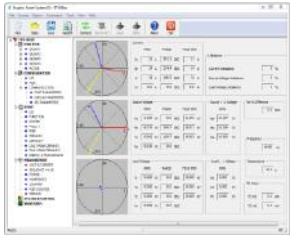


Wave form analyse tool

Log

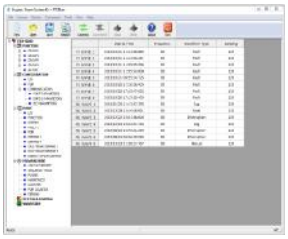


Metering



Status

Wave forms

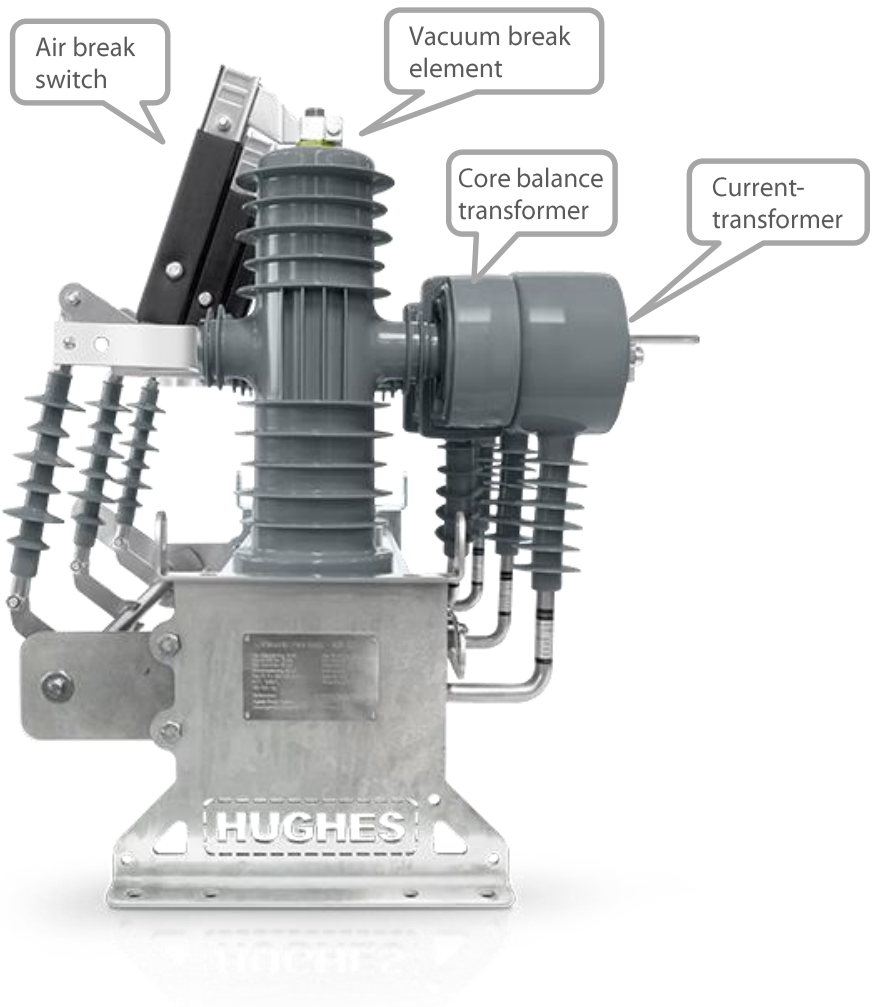


MECHANICS

The OVX series of switch module components are mainly made out of 2333 type of stainless steel, plated cupper, hot dip galvanized mild steel, epoxy and silicone rubber. All metals are carefully selected to avoid electro chemical corrosion as well as for a long problem free operation.

The bushings has a core of epoxy and have an extra layer of silicone to protect from UV light and mechanical stress during installation and vandalism.

The switch frame has a synchronized air break switch mounted on the feed side for visible open points of all three phases. This feature gives extra operational and personal safety. The air break switch is operated by a hook stick or via a operating rod with a handle down at the pole.



VACUUM INTERRUPTER MODULE (OVX) building blocks

The OVX series of switch module components are a modular building system for easy tailored switches for different qualified solutions. The base is a Vacuum Interrupter Module as can take a multiple selection of options. The Air break Switch option and Earth Switch option can not be combined on the same OVX.

AIRBREAK SWITCH*

The air break switch gives visible open points of all three phases for extra safety. The air break switch is synchronised with the vacuum interrupter and can not be open or closed when the vacuum interrupter is closed.

EARTH SWITCH*

The earth switch is synchronised with the vacuum interrupter and can not be closed when the vacuum interrupter is closed.

PHASE CURRENT TRANSFORMERS

The Vacuum Interrupter module can be fitted with a combination of non, two or three phase current transformers with different winding ratio and with multiple tapings.

COREBALANCE CURRENT TRANSFORMER*

An addition to the phase current transformers is the core balance current transformer as measure and detect extreme low earth currents. It is suitable for all networks with isolated neutral point.
This solution gives a secure detection of extreme low earth currents as the CCT unit combines all three phases in one winding.

**Available for ACR120 and ACR240 series*

Electrical data	**ACR 120**	**ACR 240**	**ACR 380**
Rated maximum voltage	12/15kV	24/28kV	38/40kV
Rated basic impulse level, P>P	85kV	145kV	185kV
Rated basic impulse level, P>E	75kV	125kV	170kV
Power frequency withstand, Dry >1min 50kV	60kV	60kV	70kV
Power frequency withstand, Wet >10 sec	45kV	50kV	60kV
Rated continuous current	630A/1250A	630/1250A	1200A
Rated fault breaking current	20kA/25kA	20/25kA	16kA
Rated fault making current	50kA/50kA	50/50kA	42kA
Rated fault duration time	3s/3s	3s/3s	3s
Line charging current	5/10A	5/10A	5A
Cable charging current	20/40A	20/40A	40A
Contact resistance, VCB	< 35μΩ/< 35μΩ	<35μΩ/< 35μΩ	<40μΩ
Contact resistance, ABI	< 60μΩ/< 60μΩ	<65μΩ/< 65μΩ	NA
Network frequency	50/60Hz	50/60Hz	50/60Hz
Phase CT tap 1	200/1	200/1	600/1
Phase CT tap 2	400/1	400/1	NA
Phase CT tap 3	600/1	600/1	NA
Core balance CT	20/1	20/1	NA
Voltage sensor	Resistive or Capacitive		Capacitive
Rated operation voltage	220/110VAC	24-48-110VDC	
Rated power	40W	40W	40W
Mechanical data			
Ambient temperature C	-45 - +70°C	-45 - +70°C	-45 - +70°C
Humidity	100% at 25°C	100% at 25°C	100% at 25°C
Bushing type	Epoxy core with silicone surface		HCEP*
Creep distance to ground(air break switch isolator)	400mm	800mm	n/a
Creep distance to ground,(interrupter isolator)	650mm	1250mm	1310mm
Max installation altitude at rated BIL	3000M	3000M	3000M
Design min mechanical/electrical	20.000	20.000	15.000
Mass (weight) without air break switch – kg	75	101	155
Mass (weight) with air break switch – kg	98	125	NA
Design specification	IEC 62271-111		
Marking specification	IEEE std C37.60		
Operational sequence, no charge :	25ms Open - 50ms Close - 25ms Open		

*Hydrophobic Cycloaliphatic Epoxy (HCEP)

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