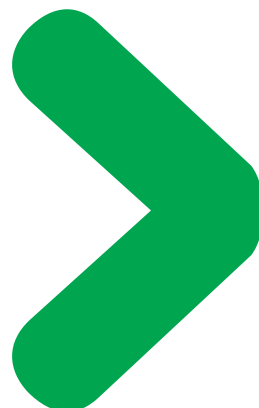


Medium Voltage Distribution

DVCAS

36 kV switchgears for transformer substations in wind farms

Catalogue
2009



A new path for achieving your electrical installations

A comprehensive offer

The DVCAS range is part of a comprehensive offer of products that are perfectly coordinated to meet all medium voltage electrical distribution requirements. All of these products have been designed to work together: electrical, mechanical and communication compatibility.

The electrical installation is thus both optimised and has improved performance:

- better service continuity,
- increased personnel and equipment safety,
- guaranteed upgradeability,
- efficient monitoring and control.

You therefore have all the advantages at hand in terms of know-how and creativity for achieving optimised, safe, upgradeable and compliant installations.

Tools for facilitating the design and installation

With Schneider Electric, you have a complete range of tools to help you get to know and install the products whilst complying with current standards and good working practices. These tools, technical sheets and guides, design software, training courses, etc are regularly updated.

Schneider Electric is associating itself with your know-how and your creativity to produce optimised, safe, upgradeable and compliant installations

For a real partnership with you

A universal solution doesn't exist because each electrical installation is specific. The variety of combinations on offer allows you to truly customise the technical solutions. You are able to express your creativity and put your know-how to best advantage when designing, manufacturing and exploiting an electrical installation.

General overview

Field of application	2
Experience	3
Environment and certification	4
General description	5

Functional units

Modular functions	6
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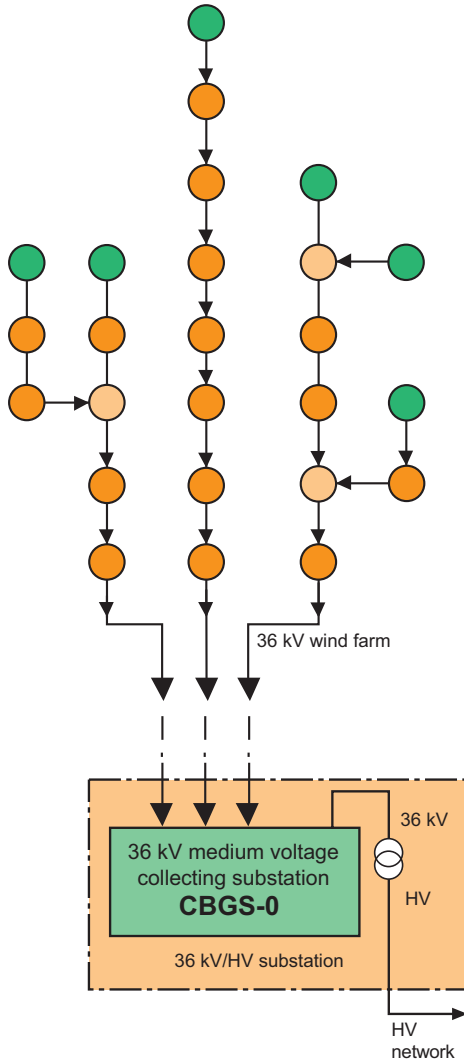
Functional groups

Recommended functional groups	7
Protection function D	8
Outgoing line function 0	10
Incoming line function I	11

Components

Phase protection - Protection relay VIP 35	13
Earth protection - Protection relay VIP 35	14
Fault detection and/or motorization	15
MV cable compartment	16

DE58790EN



Wind farms

DVCAS switchgears functional groups have been designed as compact units, and built as the union of modular switchgears.

Each functional unit contains all the necessary equipment for the protection and connection of the transformer of each wind generator to the MV network of the wind farm.

DVCAS

DVCAS switchgears have been specifically designed to meet all the needs of networks up to 36 kV, inside wind farms.

These DVCAS switchgears can be installed in wind farms up to 2000 m over the sea level.

PES7351



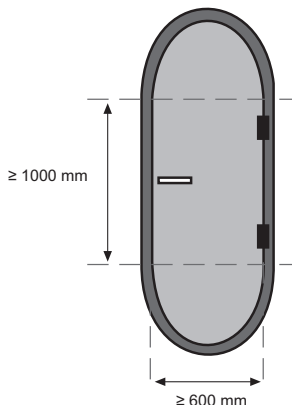
CBGS-0

36 kV CBGS-0 switchgears are the perfect complement for DVCAS, in the MV/HV collecting substations of wind farms.

PES7352



DE58791



New wind farms 36 kV x Multi MW

The continuous technological development in wind farms leads to new challenges, for which DVCAS is the best solution.

- **Rated power of wind generators: constant growth**
- **Medium voltage networks: 36 kV is the dominant trend**
- **Installation inside the towers: size restrictions.**

Wind farms present special erecting conditions, and a critical aspect in their design is the size of the doors which give access to wind generators.

Medium voltage switchgears are usually installed inside the wind generators, so their design must allow enough access through the door in case replacement was needed.

DVCAS switchgears can go through doors only 600 mm wide.

Wind farms

Star Fish	Cinseiro
Comodoro	Salajones
Arklow	Almendarache
Krtolin	Puntanza
Zafarana	La Muela
El Pical	Sotavento
El Cerro	Gatún
Penouta	Gamoneda
Alcarama	Castelo
Saso Plano	Gavilanes
Malpica	Tarayuela
Ameixeiras	Moraleja
El Aguila	Pedregoso
Muras	Viveiro
Hedroso Aciberos	Carrasquillo
Lubian	Viana
Yerga	Sigean
Meira	Tir Mostyn
Cabanillas	Forrest Moor
Préjano	Fenlands
Coscojar	Ffynnon Oer
Minsca	Megas Lakos
Tholen	Movar
Piano di Corda	Kealkill
Serrapelata	Trapanni
Hallet	Vizzini
Capital Hill	Ochiri
Sabina	Alogarachi
Rincón del Cabello	Colle Della Selva
Mulaton	Serra Do Marrocco
Tanger	Itho
Cerradilla	Puck
Carrascal	Vergao...
Caramonte	

Countries

Australia	Holland
Argentina	Ireland
Croatia	Italy
Egypt	Japan
France	Morocco
Germany	Mexico
Great Britain	Poland
Greece	Portugal
Hungary	Spain...

World-wide leadership... and still growing

DVCAS switchgears benefit from the accumulated experience gathered by Schneider Electric for more than 60 years in the design and manufacturing of MV and HV equipment.

Schneider Electric has supplied MV switchgears for more than 450 wind farms all over the world.

Gamesa, Vestas, Suzlon, Nordex, Siemens, Alstom, Acciona... are some of the main manufacturers of wind generators who already equip their wind turbines with switchgears made by Schneider Electric.

Such references place Schneider Electric as the world leader in wind power application for MV switchgears.

Experience in wind farms

- More than 8200 transformer substations
- More than 450 collecting substations
- More than 10500 MW.

Advantages of the DVCAS range

- Maximum availability: service continuity
- Minimum width: < 600 mm
- Maximum safety conditions for staff personnel
- Environment insensitivity: SF6 insulation
- Certificates: IEC
- Approved quality: ISO 9001:2000
- Environmentally friendly: ISO 14001:2004
- Simple installation
- Economical.

Choosing DVCAS switchgears ensures the experience of a world leader in the field of wind power.



Environment

A strict policy of materials management throughout the whole manufacturing process, allows the traceability of the product and ensures that no pollutants are released into the environment.

No emissions

Schneider Electric is highly committed to the protection of the environment. As a part of this compromise, DVCAS switchgears have been designed to be environmentally friendly.

Due to the level of tightness of the cubicles, DVCAS switchgears may be classified as "sealed pressure systems" according to the definition established in the standards.

All the materials used, that is, the conductors, as well as the insulators, can be clearly identified and easy-to-separate.

At the end of their life, DVCAS switchgears can be processed, recycled and their components recovered, following the directions given by the European legislation regarding end-of-life of electrical and electronic products.

The environmental management system followed by Schneider Electric is certified according to the established requirements of the ISO 14001:2004 standard.

Quality

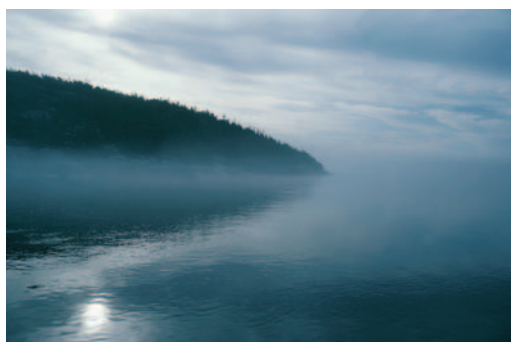
PE57356



PE57357



PE57354



International standards

Design: certified as per IEC standards

DVCAS switchgears have been designed and certified according to the following standards, some of which are at present being updated:

- Common specifications for switchgears IEC 62271-1, IEC 62271-200
- Circuit breakers IEC 62271-100
- Disconnectors and earthing switches IEC 62271-102
- Switch-disconnectors IEC 62271-103.

Manufacturing: accurate and systematic control

The quality system followed for the design and manufacturing of DVCAS switchgears has been certified in accordance with the requirements of the ISO 9001:2000 quality standard.

For quality control purposes, each DVCAS switchgear undergoes systematic routine tests during its manufacturing process.

The results of all these controls are recorded and are a part of the test certificate which each switchgear has available.

PE57358



PEE7359



Compact and modular

For their standard wind power application, DVCAS switchgears can be composed of up to 4 interconnected modular functional units, thus forming the most commonly used wind power functional groups.

Each of the modular functions is composed of:

- Metal base frame
- Operating mechanism and relay compartment
- MV cable compartment
- Stainless steel, gas-tight cubicle which uses SF6 gas as insulating medium and houses the busbar system and the breaking devices.

One of the advantages of DVCAS switchgears design is the low pressure of SF6 gas inside the cubicle.

The busbar system is interconnected between functions by means of single-phase coupling bushings made of screened elastomeric insulation.

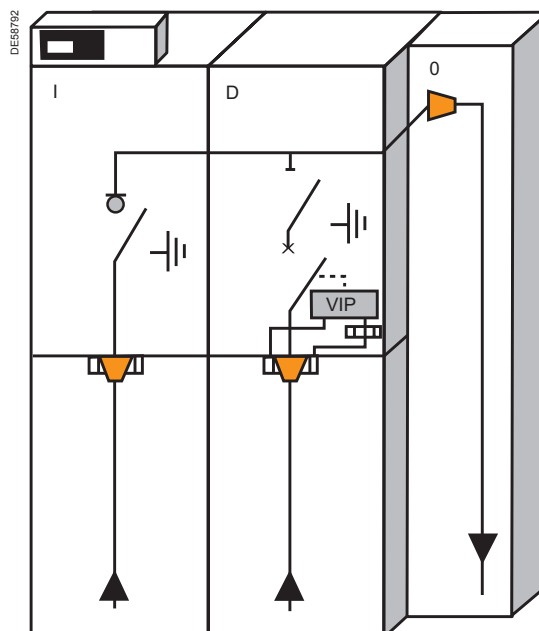
DVCAS switchgears are supplied as complete functional groups, the different functional units being assembled on factory.

Such configuration provides the user with the advantages of a compact architecture and modularity at the same time.

General electrical/Constructive data

Frequency	Hz	50
Rated voltage	kV	36
Insulation level		
Power frequency withstand voltage	kV	70
Lightning impulse withstand voltage	kV peak	170
Rated current of the main busbar	A	630
Short time withstand current	kA/s	20/3
Short circuit breaking current capacity	kA	20
Short circuit making capacity	kA peak	50
Internal arc withstand IAC AFL	kA/1s	20
Degree of protection		
HV compartment	IP	67
LV and operating mechanism compartment	IP	3X
SF6 gas pressure at 20°C	bar	0.3

For other values, please consult Schneider Electric.



Definition depending on the type of switchgear

- D** Circuit breaker
- I** Three position switch-disconnector
- T** Riser with earthing switch
- 0** Rigid riser to busbar system

Definition depending on the coupling possibilities

- NE** Non extensible
- LE** Extensible on the left
- RE** Extensible on the right
- DE** Extensible on both sides



Connection of plug-in connectors into bushings



Switchgears interconnection

Modular functions

Considering the special characteristics of the MV collecting networks most commonly used in wind farms, the units that are going to be installed must provide the following functions:

- 0** Outgoing line to the following wind generator (*)
- I** Incoming line from the preceding wind generator (**)
- D** Transformer protection

The union of the different functional units creates a series of standard configurations. Such configurations represent the whole range of specific solutions for wind farms usual needs.

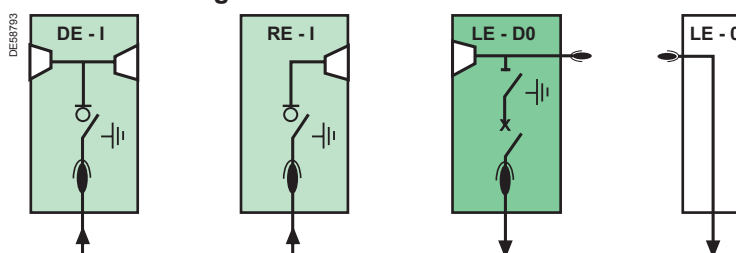
(*) The following wind generator is the nearest to the substation.

(**) The preceding wind generator is the farthest from the substation.

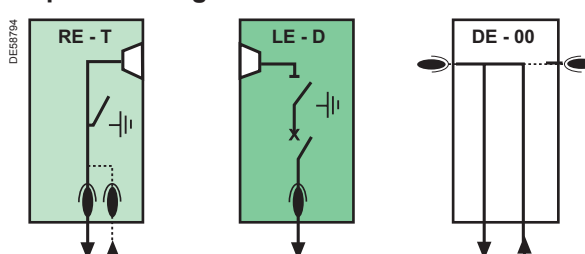
Range of modular switchgears

The combination of functional units and coupling possibilities form the particular range of functional units, with different versions depending on their performance.

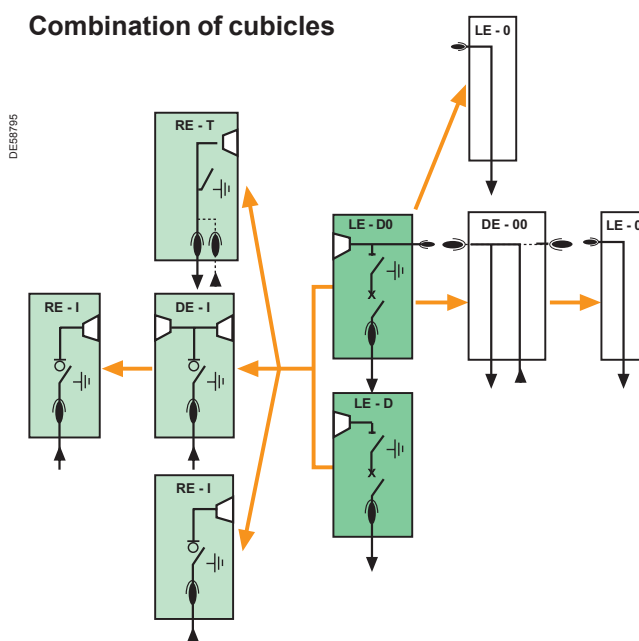
Standard configurations

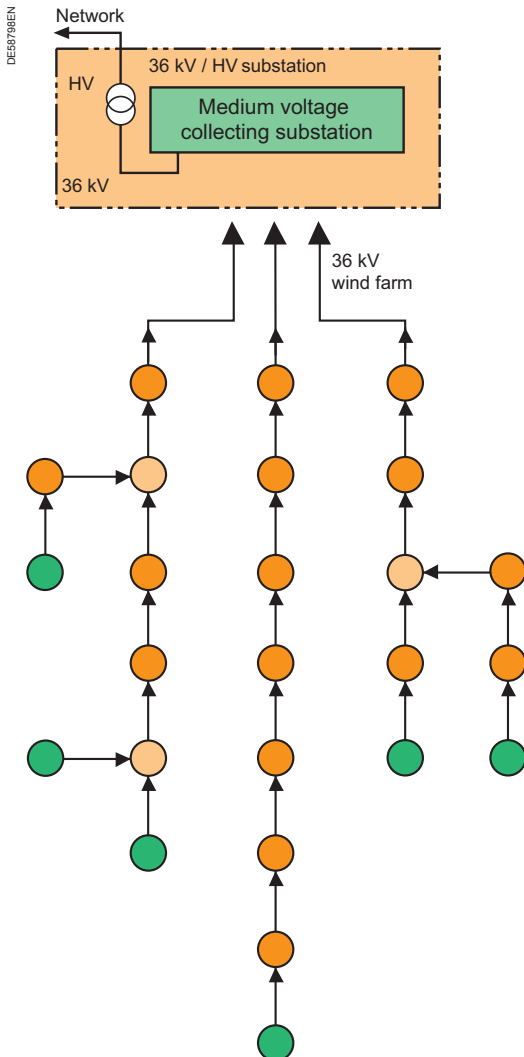


Special configurations



Combination of cubicles

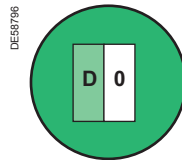




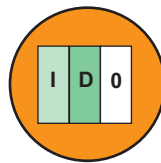
Combination of functions

Depending on the number of entrances or exits in each wind turbine, they will be necessary different functional groups.

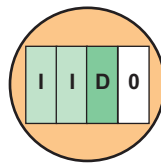
Recommended functional groups



DVCAS-36 kV NE (D + 0)
Transformer protection + Outgoing line



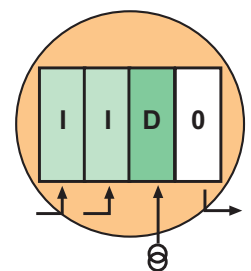
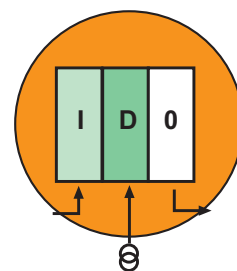
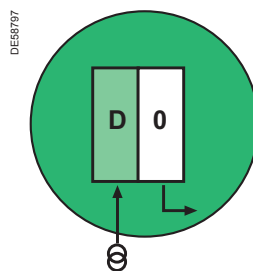
DVCAS-36 kV NE (I + D + 0)
Incoming line + Transformer protection + Outgoing line

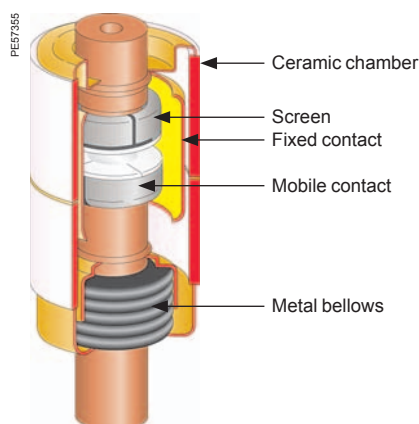
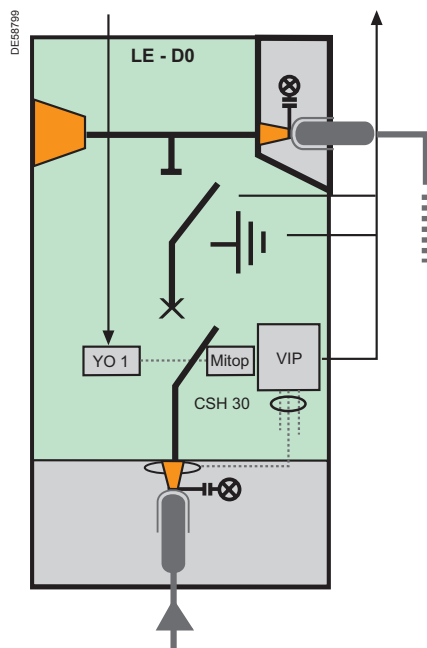


DVCAS-36 kV NE (I + I + D + 0)
2 x Incoming line + Transformer protection + Outgoing line

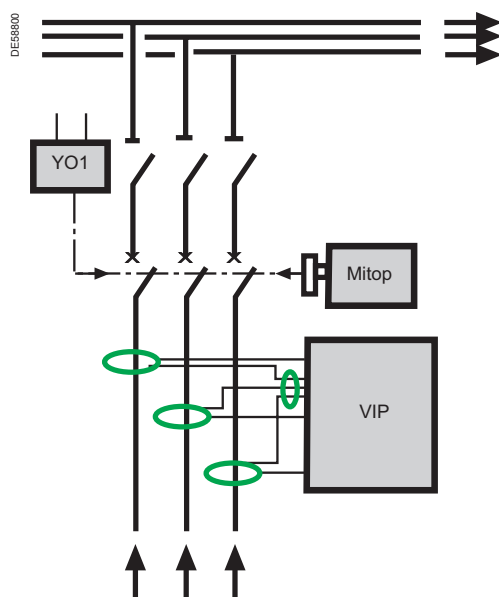
A rigid riser of cables is recommended for the outgoing line to the following wind generator (0).

For the incoming line from the preceding wind generators, a three position switch-disconnector is advised (I), which is better for the maintenance and the commissioning of wind farms.





Components of the vacuum circuit breaker



Relay and coils diagram

Each modular switchgear with protection function D is composed of:

- Metal base frame
- Operating mechanism and relay compartment
 - disconnector operating mechanism
 - operating mechanism of the circuit breaker
 - protection relay VIP
 - zero sequence current transformer CSH 30
 - motor for the operating mechanism of the circuit breaker (optional)
- MV cable compartment
 - bushings for cable connection
 - 3 CRc current sensors per phase
- Stainless steel, gas-tight tank:
 - busbar system
 - three position disconnector
 - circuit breaker.

There are two options, depending on the possibility of riser to busbars through bushings.

Any connection of functional units, type I or T, is always performed on the left.

In case of no connection on the left of function D, the inner cones must be provided with insulating caps.

DVCAS switchgears are supplied with a vacuum circuit breaker which complies with the requirements of IEC 62271-100 standard.

Electrical data of circuit breakers

Frequency	Hz	50
Rated voltage	kV	36
Insulation level		
Power frequency withstand voltage (50-60 Hz/1 min)	kV	70
Lightning impulse withstand voltage (1.2/50 µs)	kV peak	170
Rated current	A	630
Short time withstand current	kA/s	20/3
Short circuit breaking current capacity	kA	20
Short circuit making capacity	kA peak	50
Operation sequence		
Electrical endurance	Class	E2
Mechanical endurance	Class /Op	M1/2000

Protection chain

Protection systems characteristics

For their usual wind power application, DVCAS switchgears are provided with a protection system which allows operation with no need of auxiliary power supply.

The system comprises:

- **3 CRc current sensors per phase** which are toroidal type.
- **Homopolar current sensor CSH 30** which is toroidal-shaped and it is fitted on the rear part of the VIP relay.
- **Electronic relay VIP**
It is fitted on the front operating mechanism panel and is protected by a transparent cover which gives the unit a degree of protection IP 54.
Main electrical characteristics:
 - protection against phase to phase faults
 - protection against earth faults
 - no need of auxiliary power supply.

Tripping coils

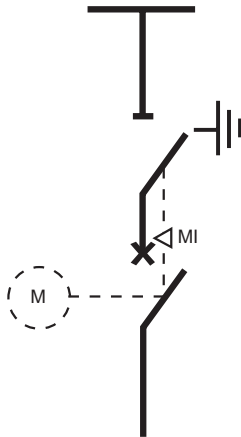
DVCAS switchgears with circuit breaker are standard equipped with 2 tripping coils:

- Mitop coil: self-powered through relay
- YO1 coil for external tripping.

Indications: reliability

The indication system for the disconnector position is highly reliable as it complies with the specifications of IEC 62271-102 standard. That is why it needs no windows or any other device for visual checking of the position of the main contacts.

DE58801



Synoptic

Interlocks

In the design of both the circuit breaker and the disconnector, all possible operating conditions have been taken into account, in order to assure maximum safety for the operators and the installation. Adequate interlockings are provided to prevent the possibility of maloperation.

Combination of circuit breaker and disconnector

Whenever the selector of the disconnector is not in neutral position, any mechanical or electrical operations on the circuit breaker are not possible.

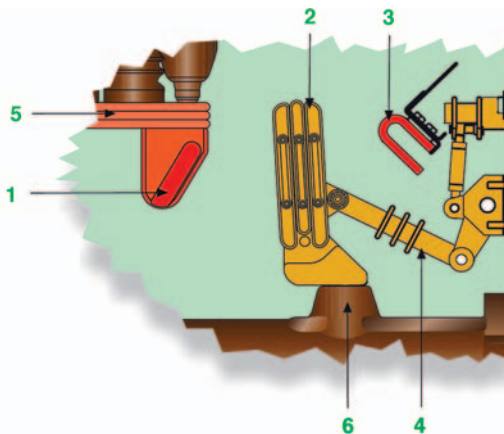
Also, when the disconnector is earthed, no electrical operations on the circuit breaker can be performed. Moreover, any operation on the three position disconnector is not possible whenever the circuit breaker is closed.

Access to MV cables and transformer compartment

Protection function has, as an option, a key that is free when this function is earthed. Moreover, access to MV compartment is not allowed, while protection function is not earthed.

Secondly, there are specific internal interlocks which block any operation on the circuit breaker or on the earthing switch. They also work when the MV cable panel is removed.

PE57360



- 1 Fixed contact "disconnecter closed"
- 2 Mobile contact fingers
- 3 Fixed contact "disconnecter earthed"
- 4 Insulating rod
- 5 Upper internal bars
- 6 Circuit breaker

Three position disconnector

DVCAS switchgears are provided with a three position disconnector, which meets the requirements of IEC 62271-102 standard for disconnectors and earthing switches.

Electrical data

Rated voltage	kV	36
Insulation level		
Power frequency withstand voltage (50 Hz/1 min)	kV	70
Lightning impulse withstand voltage (1.2/50 μ s)	kV peak	170
Rated current	A	630
Short time withstand current	kA/s	20/3
Disconnecter		
Electrical endurance	Class	E0
Mechanical endurance	Class /Op	M0/1000
Earthing switch (through circuit breaker)		
Short circuit making capacity	kA peak	50
Mechanical endurance	Class /Op	M0/1000

The speed of all opening and closing operations depends on the operator's performance. The short circuit making capacity is performed by means of the circuit breaker on both extreme positions of the disconnector, that is, busbar and earth.

Operation

The three position disconnector is always manually operated by means of a handle. The function (admissible operation on the disconnector) is selected by means of a flag type selector.

DE58802



Rising function: 0

For safe access to MV cables in the 0 function, the earthing-switch of the following wind generator must be previously earthed.

The modular switchgear DE-0 can also be used as an outgoing line using two MV cables per phase.

Every modular switchgear with outgoing line function 0, consists of:

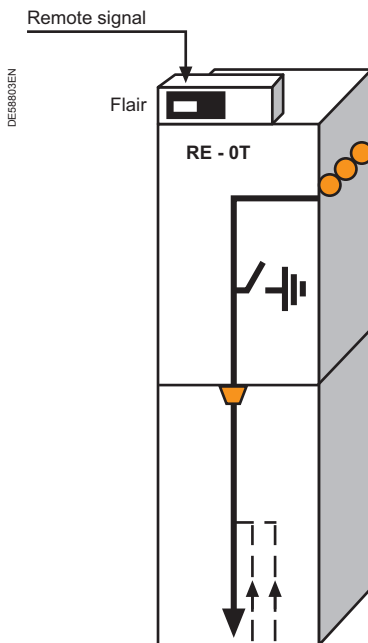
- Metal base frame
- Voltage presence indicator
- MV cable compartment
- bushings for cable connection
- clamps for MV cable fastening.

Rising function with earthing switch 000T (0T + 0T + 0T)

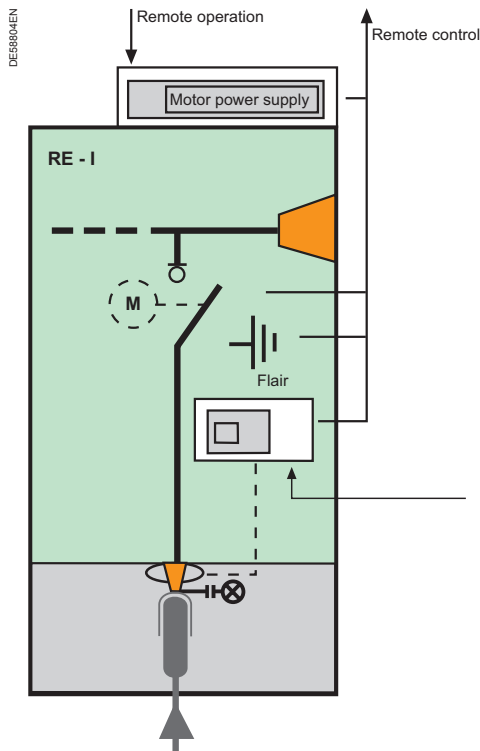
In some cases, an earthing switch is required for the incoming-outgoing lines of the wind generator. A functional module DVCAS RE-0T can be used. This module permits the connection of up to three cables per phase for incoming and outgoing lines.

Adequate interlocks must be used in order to avoid any unintentional earthing of the whole MV circuit being under voltage.

The components of this module are the same as those of the incoming line function I, except for the associated elements to the switch function, which is not included in this unit.



DE58803EN



Fault detectors type Flair fitted on the incoming line, provide an advanced management of the MV network in wind power plants. Maximum efficiency is achieved when IM switch-disconnectors incoming lines are motor operated. In this way, faults can be detected and service conditions immediately restored in the unaffected part of the network.

Switch-disconnector function I

A modular DVCAS switchgear with a three position switch-disconnector is recommended for the incoming line function from the preceding wind generator in MV networks of wind farms I, because of:

- reduces breakdown time caused by faults
- helps fault detection
- reduces interruptions due to maintenance work
- improves energization works.

Each modular switchgear with line function I consists of:

- metal base frame
- operating mechanism compartment
- operating mechanism of the switch-disconnector
- motor for the operating mechanism (optional)
- MV cable compartment
- bushings for cable connection
- stainless steel, gas-tight tank
- busbar system
- three position switch-disconnector.

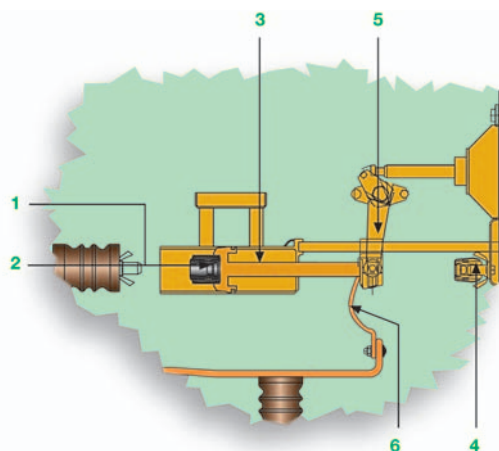
There are two options, depending on their interconnection possibilities: RE-I, and DE-I. Function I is always connected to protection function D on the right by means of single phase coupling bushings made of elastomeric screened insulation.

Characteristics

DVCAS switchgears are provided with a three position switch-disconnector, which meets the requirements of IEC 60265-1 standard for switches and IEC 62271-102 standard for disconnectors and earthing switches.

Electrical data		
Frequency	Hz	50
Rated voltage	kV	36
Insulation level		
Power frequency withstand voltage (50 Hz/1 min)	kV	70
Lightning impulse withstand voltage (1.2/50 µs)	kV peak	170
Switch-disconnector		
Rated current	A	630
Electrical endurance	Class /Op	E3/100
Mechanical endurance	Class /Op	M1/1000
Short time withstand current	kA/s	20/3
Short circuit making capacity	kA peak	50
Electrical endurance	Class /Op	E3/5
Earthing switch		
Short time withstand current	kA/s	20/3
Short circuit making capacity	kA peak	50
Electrical endurance	Class /Op	E2/5
Mechanical endurance	Class /Op	M0/1000

PE57361



- 1 Fixed contact "switch in closed position"
- 2 Mobile contact fingers
- 3 Switch chamber
- 4 Fixed contact "earthing switch in closed position"
- 5 Handle
- 6 Flexible connection

Switch-disconnector

The breaking system uses the autopneumatic "puffer" technique of SF6 gas onto the contacts separation area.

Operation

The speed of all opening and closing operations is independent of the operator's action (except for the earthing switch opening).

The three position switch-disconnector is always manually operated by means of a handle.

Optionally, the operating mechanism of the switch function can be motorized and the handle can be anti-reflex type.

The optional motorization kit can also include a battery charger-rectifier in order to allow switch-disconnector operation even in case of lack of auxiliary voltage.

This function, combined with the fault detectors Flair and the protections in the collecting substation, permits remote fault isolation and gradual service restoration.

Indication: reliability

The indication system for the switch-disconnector position is highly reliable as it complies with the specifications of IEC 62271-102. That is why it needs no windows or any other device for visual checking of the position of the main contacts.

Interlockings

In the design of the switch-disconnector, all possible operating conditions have been taken into account to ensure maximum safety for the operators and the installation.

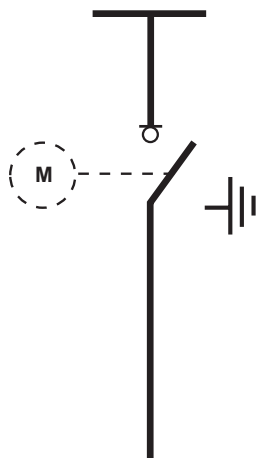
The architecture of the switch-disconnectors used in DVCAS switchgears is of the 3 position type (closed/opened/earthed), which, by design, avoids the possibility of maloperation.

Access to MV cable compartment

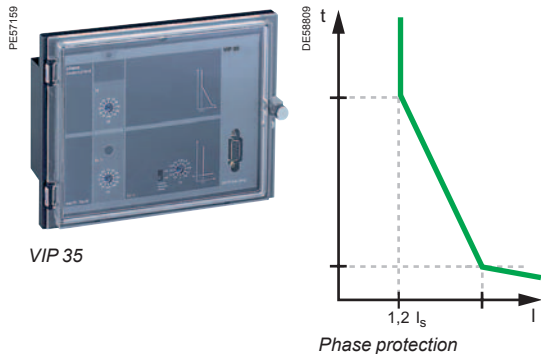
It is always interlocked with the switch-disconnector earthed. So the cover of this compartment can only be opened in this position.

An interlock by key lock can be supplied optionally, where the key is released with the earthing switch in closed position.

DE58805



Synoptic



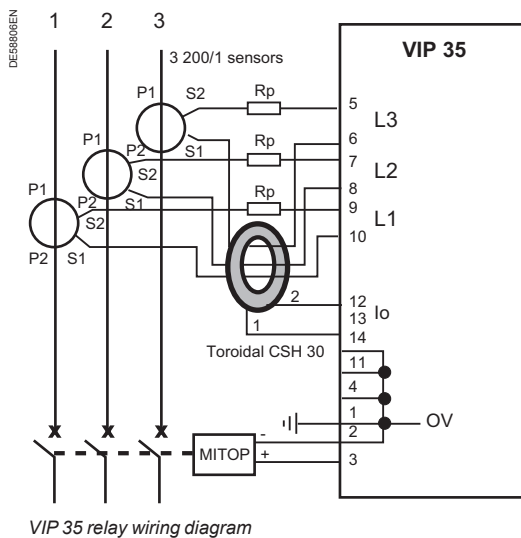
General description

VIP 35 relays have the optimum design for transformer protection in transformer substations of wind farms. They are provided with phase functions (50-51) and earth functions (50N).

They are self-powered relays (no external auxiliary voltage is required), which are fed by toroidal current sensors, CRc type, fitted on the bushings for MV outgoing cables to the transformer.

The VIP 35 relay operates on the circuit breaker by means of a tripping (coil), Mitop type.

The relay is usually placed on the operating mechanism front panel of the DVCAS switchgear, protected by a transparent cover which can be lead-sealed. The whole assembly has a degree of protection IP 54.



Phase protection Is (50-51)

Phase protection is provided by a time-dependent curve which operates as of 1.2 times the operating current (Is).

Phase current is measured by means of three CRc toroidal sensors which are usually fitted on the bushings for MV cable connection.

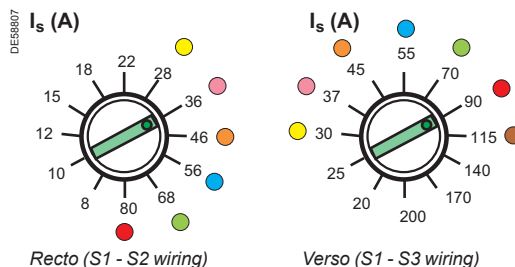
Phase operating current is adjusted on the front, using rotary switches.

Settings are done according to the transformer rating and the operating voltage.

Operating threshold can be adjusted from 8 A to 80 A or from 20 A to 200 A.

$$I_s (A) \geq \frac{\text{Transformer rating (kW)}}{\sqrt{3} \times \text{operating voltage (kV)}}$$

Is regulation



S1-S2 (200/1)

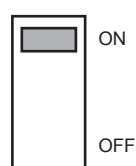
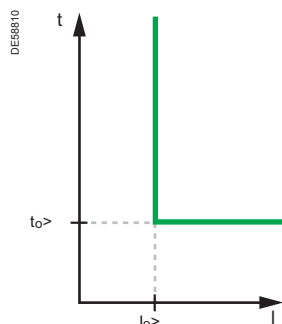
Voltage (kV)		Rating of the transformer to be protected (kVA) (*)															
Rated	Service	1500	1750	2000	2250	2500	2750	3000	3250	3500	3750	4000	4250	4500	4750	5000	
36	30	29	34	39	43	48	53	58	63	67	72	77	82	87	92	96	
36	33	26	31	35	39	44	48	53	57	61	66	70	74	79	83	88	

(*) It might be considered only the generation power transformer.

S1-S3 (500/1)

Voltage (kV)		Rating of the transformer to be protected (kVA) (*)															
Rated	Service	1500	1750	2000	2250	2500	2750	3000	3250	3500	3750	4000	4250	4500	4750	5000	
36	30	29	34	39	43	48	53	58	63	67	72	77	82	87	92	96	
36	33	26	31	35	39	44	48	53	57	61	66	70	74	79	83	88	

(*) It might be considered only the generation power transformer.



Tripping timer

I_o (50N)

Earth protection works by means of a curve at independent time.

Measurement is carried out by a CSH 30 core balance CT, mounted on the back of the VIP 35. This toroidal measures the residual current based on the sum of the sensor secondary currents.

Time delay to can be set in a range between 0.1 s and 1 s.

Phase current (I_o) and time delay settings are done on the front of the relay, with the corresponding rotary switches.

The VIP 35 relay is supplied with a selector switch (ON-1s) which starts up the inrush current delay. This time delay prevents tripping from the earth protection when the transformer is energized if I_o and t_o settings are low.

When this selector switch is in "ON" position and 1s after the transformer has been energized, earth protection is time delayed as per the selected setting to.

Although VIP 35 relays can perform an adequate protection function in wind farms, DVCAS switchgears can be optionally supplied with other relays, like the VIP 300 or any of the models of the Sepam range.

VAP 6

Relay tester

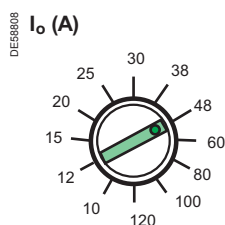
VIP relays have a test plug for VAP 6 unit connection. This testing unit allows:

- injecting an electrical stimulus, two pushbuttons are used to check that the short-circuit and zero sequence fault current protection devices are operating.
- An extra push-button may be supplied to inhibit tripping of the circuit breaker.

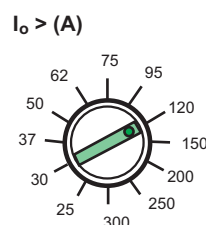
I_s regulation



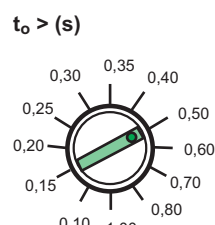
VAP 6

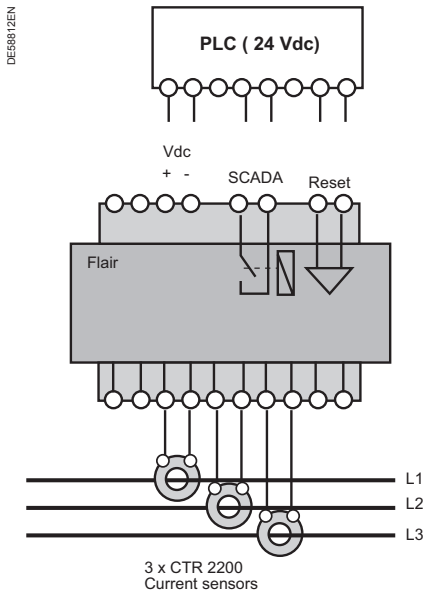


Recto (S1 - S2 wiring)

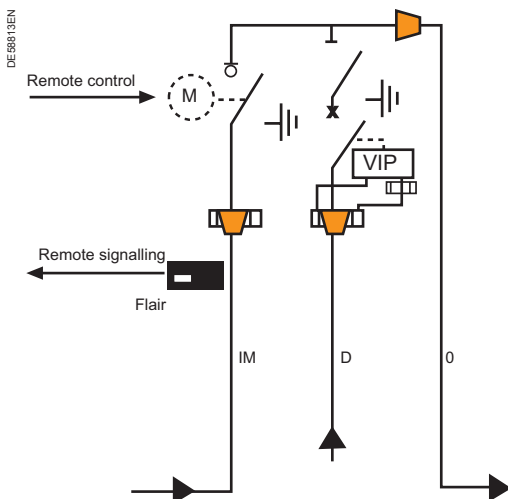


Verso (S1 - S3 wiring)





Flair fault detector



Synoptic IM + D + 0



Easergy Flair



CTR 2200 current sensors

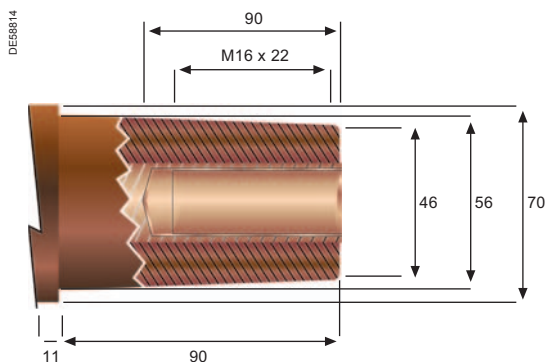
Advanced management of wind farms

The use of fault indicators, Flair type, provide an advanced management of the MV network in wind power plants.

Flair indicators, due to their quick fault detection function in MV networks, reduce the breakdown time required for fault reparation purposes.

When an incoming line, apart from the Flair indicator, has got added a battery charger-rectifier and a motor, the switch-disconnector will be able to insulate a fault remotely.

By the time the fault is insulated, the affected wind farm line will be ready for reconnection to the grid.



C type bushing in compliance with the EN 50181 standard

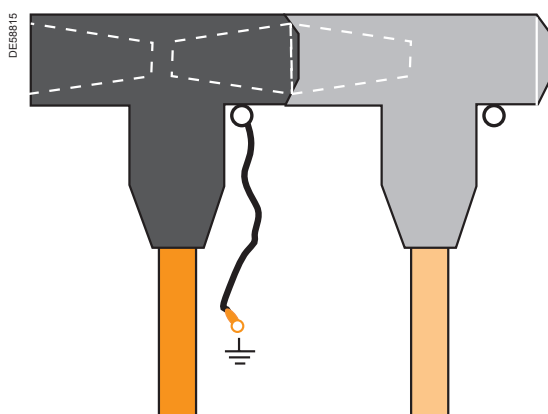
The MV cable compartment contains the following elements:

- panel for access to the compartment
- warning signal for electrical hazard
- voltage presence indicators
- 3 C type bushings (630 A/25 kA/screwed M16)
- fastening system (clamps) for MV cables
- earth busbar.

Apart from the visual safety elements (voltage indicators and electrical hazard signal), the access panel of the MV cable compartment is provided with the necessary interlockings to ensure safe operating conditions.

For all functions (D + I + T), the panel can only be removed when the corresponding earthing switch is in closed position.

With respect to 0 functions, as there is no associated earthing switch, tools are required to remove the panel. Optionally, other specific interlockings with key lock associated to other earthing switches of the installation can be provided.



Connectors

Bushings

Particularly, the bushing used in all the functions of DVCAS switchgears is type C with an M16 thread, in compliance with the EN 50181 standard. Values are 630 A rated current and 25 kA/1 s (62.5 kA peak value) short circuit current.

All the bushings made of epoxy resin undergo routine dielectric tests at power frequency as well as partial discharge tests.

Connectors

DVCAS switchgears have been designed with bushings that can only be connected by "T" type screwed connectors of the range 36 kV/630 A/20 kA.

Although in their most common application in wind farms, DVCAS switchgears are supplied with an only MV cable per phase, they allow the connection of two cables per phase in all cases.

Selection chart of connectors

General characteristics		
Geometry	"T" shaped	
Screened	Earthed	
Inner profile	C type	
Screwed connection	M16	
Rated and testing voltage	36/70/170 kV	
Rated current	630 A	
Short time withstand current	20 kA/3 s	

Manufacturer (examples)	Range	Section (max.)
Nkt	CB-36/630(1250)	630 mm ²
Prysmian	PMA-5/400/36 AC	240 mm ²
Euromold	M440/400-TB/G	630 mm ²

For a more specific definition of the MV connector to be used in each case, it is necessary to make a precise description of the cable that is going to be connected.

The following data may be required:

- kind of conductor: aluminium or copper
- cross section of the conductor in mm²
- insulation diameter
- cable composition: single core or three core
- type of insulation: dry or paper impregnated
- type of screen
- armature...

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*This document has been printed
on ecological paper*

Publishing: Schneider Electric Industries SAS
Design: Schneider Electric Industries SAS
Printing: Imprimerie du Pont de Claix/JPF - Made in France