Electrical network protection

# Sepam series 20
# Sepam series 40
# Sepam series 80

Catalogue

2005

a brand of Schneider Electric

Merlin Gerin

Courtesy of Steven Engineering, Inc. ● 230 Ryan Way, South San Francisco, CA 94080-6370 ● General Inquiries: (800) 670-4183 ● www.stevenengineering.com

## The Guiding System, the new way to create your electrical installations

### A comprehensive offer of products with consistent design

The Guiding System is first and foremost a Merlin Gerin product offer covering all electrical distribution needs. However, what makes all the difference is that these products have been designed to operate together: mechanical and electrical compatibility, interoperability, modularity, communication.
Thus the electrical installation is both optimised and more efficient: better continuity of supply, enhanced safety for people and equipment, guaranteed upgradeability, effective monitoring and control.

### Tools to simplify design and implementation

With the Guiding System, you have a comprehensive range of tools - the Guiding Tools - that will help you increase your product knowledge and product utilisation. Of course this is in compliance with current standards and procedures.
These tools include technical booklets and guides, design aid software, training courses, etc. and are regularly updated.

# The Guiding System, combined with the know-how and creativity, allows optimised, reliable, open-ended and standard compliant installations

### For a genuine partnership with you

Because each electrical installation is unique, there is no standard solution. With the Guiding System, the variety of combinations allows for genuine customisation solutions. You can create and implement electrical installations to meet your creative requirements and design knowledge.
You and Merlin Gerin's Guiding System form a genuine partnership.

**For more details on the Guiding System, consult www.merlin-gerin.com**

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## A consistent design of offers from Medium Voltage to Ultra terminal

*Discrimination guarantees co-ordination between the operating characteristics of serial-connected circuit-breakers. Should a fault occurs downstream, only the circuit-breaker placed immediately upstream from the fault will trip.*

*Prefabricated and tested solutions, upstream and downstream from the device complying with the IEC 60439-1 switchboard standard.*

Transparent Ready

*Thanks to the use of standard Web technologies, you can offer your customers intelligent Merlin Gerin switchboards allowing easy access to information: follow-up of currents, voltages, powers, consumption history, etc.*

## Guiding Tools for more efficient design and implementation of your installations.

**All Merlin Gerin offers are designed according to electrical, mechanical and communication consistency rules.**
**The products express this consistency by their overall design and shared ergonomics.**

**Electrical consistency:**

Each product complies with or enhances system performance at co-ordination level: breaking capacity, Isc, temperature rise, etc. for more safety, continuity of supply (discrimination) or economic optimisation (cascading).
The leading edge technologies employed in Merlin Gerin's Guiding System ensure high performance levels in discrimination and cascading of protection devices, electrodynamic withstand of switches and current distributors, heat loss of devices, distribution blocks and enclosures.
Likewise, inter-product ElectroMagnetic Compatibilty (EMC) is guaranteed.

**Mechanical consistency:**

Each product adopts dimensional standards simplifying and optimising its use within the system.
It shares the same accessories and auxiliaries and complies with global ergonomic choices (utilisation mode, operating mode, setting and configuration devices, tools, etc.) making its installation and operation within the system a simpler process.

**Communication consistency:**

Each product complies with global choices in terms of communication protocols (Modbus, Ethernet, etc.) for simplified integration in the management, supervision and monitoring systems.



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## SM6

Medium voltage switchboard system from 1 to 36 kV

## Sepam

Protection relays

## Masterpact

Protection switchgear from 100 to 6300 A

**Trihal**

MV/LV dry cast resin transformer from 160 to 5000 kVA

**Evolis**

MV vacuum switchgear and components from 1 to 24 kV.

## The Technical guide

These technical guides help you comply with installation standards and rules i.e.:
The electrical installation guide, the protection guide, the switchboard implementation guide, the technical booklets and the co-ordination tables all form genuine reference tools for the design of high-performance electrical installations.
For example, the LV protection co-ordination guide - discrimination and cascading - optimises choice of protection and connection devices while also increasing markedly continuity of supply in the installations.

## CAD software and tools

The CAD software and tools enhance productivity and safety.
They help you create your installations by simplifying product choice through easy browsing in the Guiding System offers.
Last but not least, they optimise use of our products while also complying with standards and proper procedures.



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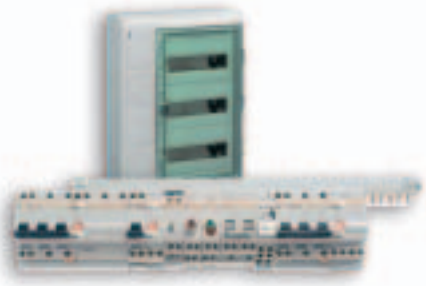
## Compact

Protection switchgear system from 100 to 630 A

## Multi 9

Modular protection switchgear system up to 125 A



## Prisma Plus

Functional system for electrical distribution switchboards up to 3200 A

**Pragma**
Enclosures for distribution switchboards up to 160 A

**Canalis**
Prefabricated Busbar Trunking from 25 to 4000 A

**PowerLogic**
Power management

## Training

Training allows you to acquire the Merlin Gerin expertise (installation design, work with power on, etc.) for increased efficiency and a guarantee of improved customer service.
The training catalogue includes beginner's courses in electrical distribution, knowledge of MV and LV switchgear, operation and maintenance of installations, design of LV installations to give but a few examples.



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# Introduction

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# Sepam for greater simplicity



PE50478

*Sepam, a consistent range of protection relays.*

## A consistent range of protection relays

The Sepam range of protection relays is designed for all protection applications on medium-voltage public and industrial distribution networks.

It is made up of three series of relays, with increasing performance levels:
- Sepam series 20 for usual applications
- Sepam series 40 for demanding applications
- Sepam series 80 for custom applications.

PE50539

*Integral equipment control by Sepam.*

## A multi-functional range of digital relays

Each Sepam series offers all the functions required for the intended application:
- effective protection of life and property
- accurate measurements and detailed diagnosis
- integral equipment control
- local or remote indications and operation.

PE50480


*A Sepam solution for every application.*

## A Sepam solution for every application

For each electrotechnical application, Sepam offers the relay suited to the protection needs of your network.
The Sepam range covers the following applications:
- substations (incomer or feeder type)
- transformers
- motors
- generators
- busbars
- capacitors.



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# Sepam network protection for your peace of mind



PE50528

*Schneider Electric, by your side in over 130 countries.*

## Schneider Electric, a global offer

### World leader in Power & Control

The future will call increasingly on electricity with growing needs, new modes of production and new applications.
The world leader in electric distribution and automation & control, Schneider Electric makes electricity safe, as well as facilitating and improving its use.

### Worldwide presence

With sites on every continent, Schneider Electric contributes to customer performance through its unique selection of products, solutions and services, as well as its dynamic policy of innovation.

**Continuous, worldwide availability**

With over 5000 points of sale in 130 countries, you can be sure of finding the range of products meeting your needs and complying perfectly with local standards.

**Technical assistance around the globe**

Our technicians are always on hand to provide solutions tailored to your needs.
Schneider Electric provides all the technical assistance you require, wherever you may be.
Visit the www.merlin-gerin.com site to find contact information for Schneider Electric in your country.

PE50529

## Schneider Electric, a manufacturer of protection relays

### Sepam, over 20 years of experience

Breaking new ground back in 1982, Merlin Gerin marketed the first multi-functional digital protection relay, the Sepam 10.
Today, with the Sepam range, you benefit from more than 20 years of experience on the part of our R&D teams.

### Installed base

- 200 000 Sepam relays in over 90 countries
- presence in every sector of activity:
  - energy: production and distribution
  - infrastructures: airports, tunnels, public transport, water treatment
  - industry: automobiles, mines, semi-conductors, metallurgy, petrochemicals
  - commercial sector: shopping centres, hospitals.

## Sepam, guaranteed quality

Protection relays must be totally reliable. That level of reliability is obtained by total quality at every step, from design on through to operation.

- design based on dependability studies and complying with the functional-safety requirements of standard IEC 61508
- development and production certified ISO 9001
- environment-friendly production, certified ISO 14001
- service quality ensured by decentralized logistics and support
- compliance with international standards and local certification.

DE51860 DE51861 DE51862



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# Sepam offers flexibility to match your needs



## Enhancement through the addition of optional modules to keep pace with your ever-changing installation

To adapt to as many situations as possible and allow for future installation upgrades, optional modules may be added to Sepam at any time for new functions.
- plug & play modules, easy to install and connect
- complete setup using software.

1 **Base unit**

2 **Parameter and protection settings saved on removable memory cartridge**

3 **42 logic inputs and 23 relay outputs** with 3 optional modules

4 **Connection to communication networks**

5 **Temperature sensors**

6 **Low-level analog output**

7 **Synchro-check module**

8 **Software tools**

PE50483


*Sepam series 80 and its optional modules.*

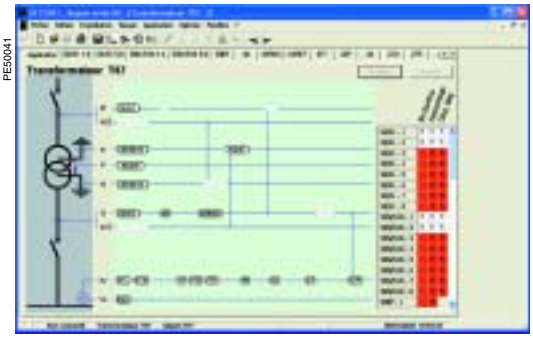
## A choice of user-machine interfaces (UMI) to meet your operating needs

- advanced UMI for all Sepam relays:
  - on front panel
  - or remote UMI installed in the most convenient location for the facility manager
- mimic-based UMI for Sepam series 80, offering local switchgear control.

## A software tool for all Sepam relays

The SFT2841 software is the setting and operating tool for Sepam series 20, series 40 and series 80.
- the ergonomics are designed to guide you in setting up Sepam
- future compatibility is ensured with all Sepam versions.

PE50041



*SFT2841: a single software tool for all Sepam relays.*



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# Sepam to boost productivity



## Easy operation

To ensure fast and effective servicing, thereby reducing the operating and maintenance costs of your electric installation, all operating and maintenance information is available:
- locally and remotely
- in your language.

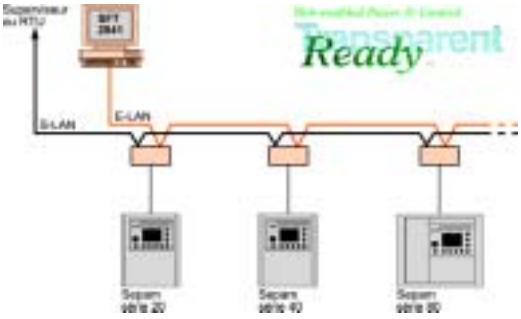
PE50025

*Customized Chinese advanced UMI.*

### Local operation

All the data required for local equipment operation are clearly displayed on the LCD screen of the UMI (User-Machine Interface).
- UMI screens can be translated to your language
- alarms can be personalized.

PE50485




*Sepam connection to two communication networks.*

### Remote operation

All Sepam relays can be connected to two types of communication networks:
- **an S-LAN (supervisory local area network)** to remotely control and monitor Sepam relays connected to a supervision system (SCADA or RTU)
- **an E-LAN (engineering local area network)**, reserved for Sepam remote parameter setting and centralized installation diagnosis using the SFT2841 software.

## Improved continuity of service

With Sepam, all data is available for optimum management and use of the electric installation.
- The clear and complete information supplied by Sepam following a fault trip enables the operator to restore power as quickly as possible.
- Preventive maintenance of switchgear is made easier by the diagnosis functions provided by Sepam.
- The predictive information supplied by the motor-protection functions optimises process control.

## Reduced maintenance costs

The Sepam range is designed to reduce maintenance time and cost for your protection system.
- Sepam modules and connectors may be removed without any particular precautions.
- The optional modules are the same for the entire Sepam range, thus reducing the stock of replacement parts.
- Sepam series 80 has a removable memory cartridge to simplify maintenance operations.

PE50253

*Sepam series 80 memory cartridge.*



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# Panorama of Sepam applications



*The selection guide proposes the Sepam types suited to your protection needs, based on the characteristics of your application.*

*The most typical applications are presented with the corresponding Sepam and each application example is described by:*
- *a single-line diagram indicating:*
  - *equipment to be protected*
  - *network configuration*
  - *position of measurement sensors*
- *standard and specific Sepam functions to be implemented to protect the application.*

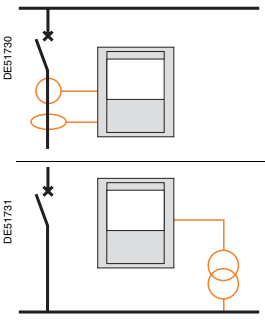
*The list of functions is given for information purposes.*

*Earthing, whether direct or via an impedance, is represented by the same pictogram, i.e. the pictogram corresponding to a direct connection.*

## Sepam series 20

**For usual applications**

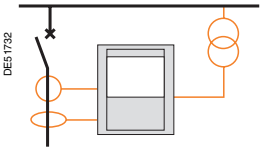

**Characteristics**
- 10 logic inputs
- 8 relay outputs
- 1 Modbus communication port
- 8 temperature-sensor inputs




## Sepam series 40

**For demanding applications**


**Characteristics**
- 10 logic inputs
- 8 relay outputs
- logical equation editor
- 1 Modbus communication port
- 16 temperature-sensor inputs

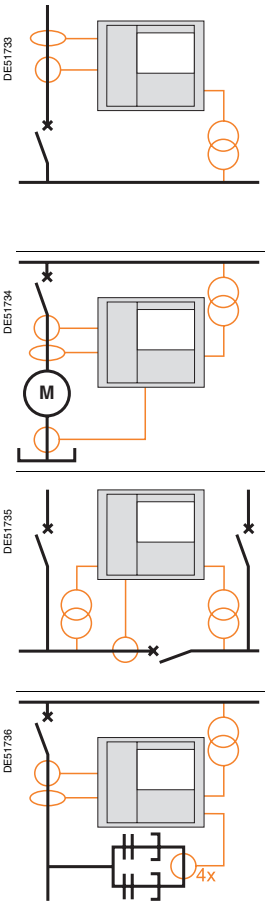



## Sepam series 80

**For custom applications**



**Characteristics**
- 42 logic inputs
- 23 relay outputs
- logical equation editor
- 2 Modbus communication ports for multi-master or redundant architectures
- 16 temperature-sensor inputs
- removable memory cartridge with parameter and protection settings for fast return to service following replacement
- battery backup to save historical and disturbance-recording data
- mimic-based UMI for local device control under safe conditions
- optional Logipam programming software to program specific functions



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# Selection guide for all applications



| Protection functions | | Applications | | | | | |
|---|---|---|---|---|---|---|---|
| **Basic** | **Specific** | **Substation** | **Busbars** | **Transformer** | **Motor** | **Generator** | **Capacitor** |
| current protection | | **S20** | | **T20** | **M20** | | |
| voltage and frequency protection | | | **B21** | | | | |
| | disconnection by "rate of change of frequency" | | **B22** | | | | |
| current, voltage and frequency protection | | **S40** | | **T40** | | **G40** | |
| | directional earth fault | **S41** | | | **M41** | | |
| | directional earth fault and phase overcurrent | **S42** | | **T42** | | | |
| current, voltage and frequency protection | | **S80** | **B80** | | | | |
| | directional earth fault | **S81** | | **T81** | **M81** | | |
| | directional earth fault and phase overcurrent | **S82** | | **T82** | | **G82** | |
| | disconnection by "rate of change of frequency" | **S84** | | | | | |
| current, voltage and frequency protection | transformer and transformer-machine unit differential | | | **T87** | **M88** | **G88** | |
| | machine differential | | | | **M87** | **G87** | |
| current, voltage and frequency protection | voltage and frequency protection for two sets of busbars | | **B83** | | | | |
| current, voltage and frequency protection | capacitor-bank unbalance | | | | | | **C86** |
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# Substation applications
## Feeder protection



| Protection functions | ANSI code | S20 | B22 | S40 | S41 | S42 | S80 | S81 | S82 | S84 |
|---|---|---|---|---|---|---|---|---|---|---|
| Phase overcurrent (1) | 50/51 | 4 | | 4 | 4 | 4 | 8 | 8 | 8 | 8 |
| Earth fault / Sensitive earth fault (1) | 50N/51N 50G/51G | 4 | | 4 | 4 | 4 | 8 | 8 | 8 | 8 |
| Breaker failure | 50BF | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Negative sequence / unbalance | 46 | 1 | | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Thermal overload for cables | 49RMS | | | | | | | 2 | 2 | 2 |
| Directional phase overcurrent (1) | 67 | | | | | 2 | | | 2 | 2 |
| Directional earth fault (1) | 67N/67NC | | | | 2 | 2 | | 2 | 2 | 2 |
| Directional active overpower | 32P | | | | 1 | 1 | | 2 | 2 | 2 |
| Directional active underpower | 37P | | | | | | | | | 2 |
| Positive sequence undervoltage | 27D | | 2 | | | | 2 | 2 | 2 | 2 |
| Remanent undervoltage | 27R | | 1 | | | | 2 | 2 | 2 | 2 |
| Undervoltage (L-L or L-N) | 27 | | 2/1 (4) | 2 | 2 | 2 | 4 | 4 | 4 | 4 |
| Overvoltage (L-L or L-N) | 59 | | 2 | 2 | 2 | 2 | 4 | 4 | 4 | 4 |
| Neutral voltage displacement | 59N | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Negative sequence overvoltage | 47 | | | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| Overfrequency | 81H | | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Underfrequency | 81L | | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Rate of change of frequency | 81R | | 1 | | | | | | | 2 |
| Recloser (4 cycles) (2) | 79 | □ | | □ | □ | □ | □ | □ | □ | □ |
| Synchro-check (3) | 25 | | | | | | □ | □ | □ | □ |

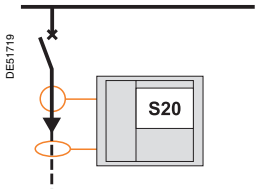
*The figures indicate the number of units available for each protection function*
■ *standard,* □ *options.*
***(1)*** *Protection functions with 2 groups of settings.*
***(2)*** *According to parameter setting and optional input/output modules.*
***(3)*** *With optional MCS025 synchro-check module.*
***(4)*** *2 undervoltage (L-L) and 1 undervoltage (L-N).*

### Feeder protection

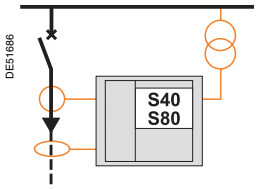
■ feeder short-circuit and overload protection.

**Protection of low-capacitance feeders in impedance earthed or solidly earthed neutral systems: Sepam S20, S40 or S80**

■ no voltage and frequency monitoring.

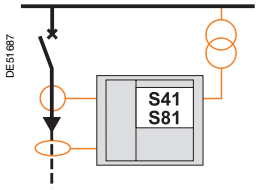



■ voltage and frequency monitoring.




**Protection of high-capacitance feeders in impedance earthed or compensated or isolated neutral systems: Sepam S41 or S81**

■ specific feeder protection: 67N/67NC.





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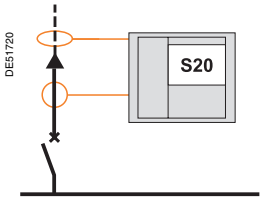
## Incomer protection

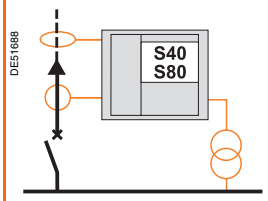
■ busbar short-circuit protection.

### Incomer protection: Sepam S20, S40 or S80

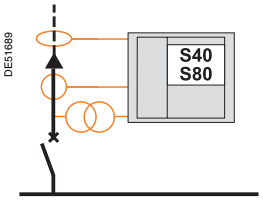
■ no voltage and frequency monitoring.




■ busbar voltage and frequency monitoring.

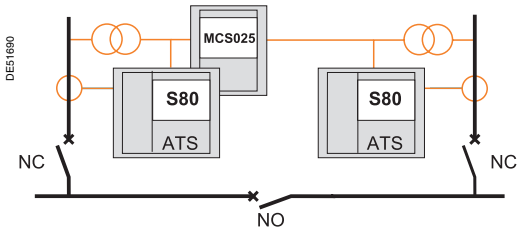



■ line voltage and frequency monitoring.



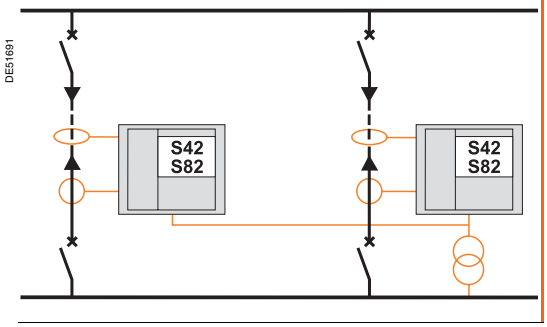

### Protection of 2 incomers: Sepam S80

■ with automatic source transfer (ATS) and synchro-check (ANSI 25).



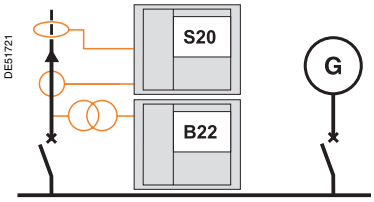

### Parallel incomer protection: Sepam S42 or S82

■ specific line or source protection: 67, 67N/67NC.

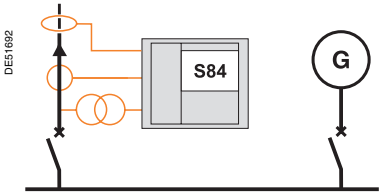



### Parallel-incomer protection with disconnection function: Sepam S20 + B22 or Sepam S84

■ disconnection-specific functions: 27,59, 59N, 81L, 81R.

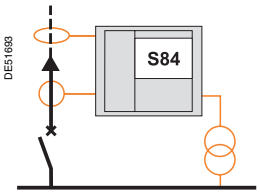


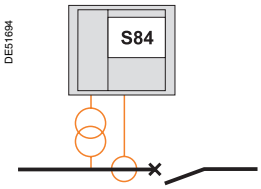

■ disconnection-specific functions: 27,59, 59N, 81L, 81R, 32P, 37P.




### Protection of an incomer or coupling circuit breaker with load shedding based on frequency variations: Sepam S84

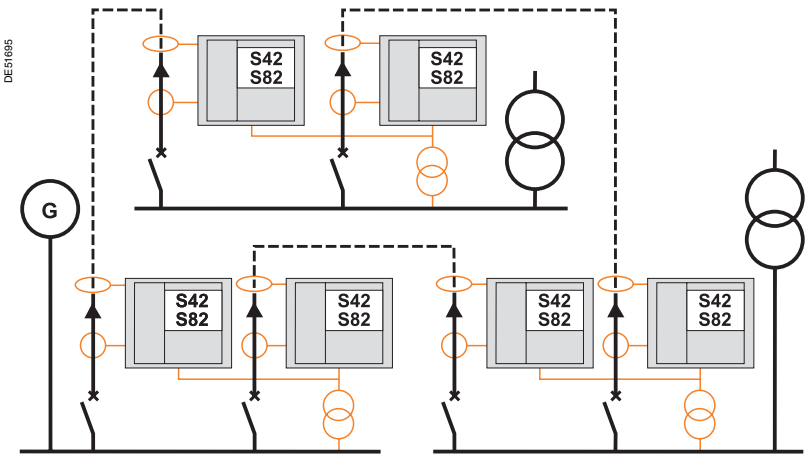
■ load-shedding-specific functions: 81L, 81R.




### Ring-incomer protection: Sepam S42 or S82

■ line or source protection: 67, 67N/67NC
■ directional logic discrimination.



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# Busbar applications



| Protection functions | ANSI code | B21 | B22 | B80 | B83 |
|---|---|---|---|---|---|
| Phase overcurrent (1) | 50/51 | | | 8 | 8 |
| Earth fault / Sensitive earth fault (1) | 50N/51N 50G/51G | | | 8 | 8 |
| Breaker failure | 50BF | | | 1 | 1 |
| Negative sequence / unbalance | 46 | | | 2 | 2 |
| Positive sequence undervoltage | 27D | 2 | 2 | 2 | 2 |
| Remanent undervoltage | 27R | 1 | 1 | 2 | 2 |
| Undervoltage (L-L or L-N) | 27 | 2/1 (3) | 2/1 (3) | 4 | 4 |
| Overvoltage (L-L or L-N) | 59 | 2 | 2 | 4 | 4 |
| Neutral voltage displacement | 59N | 2 | 2 | 2 | 2 |
| Negative sequence overvoltage | 47 | | | 2 | 2 |
| Overfrequency | 81H | 1 | 1 | 2 | 2 |
| Underfrequency | 81L | 2 | 2 | 4 | 4 |
| Rate of change of frequency | 81R | | 1 | | |
| Synchro-check (2) | 25 | | | □ | □ |

*The figures indicate the number of units available for each protection function*
■ *standard,* □ *options.*
***(1)*** *Protection functions with 2 groups of settings.*
***(2)*** *With optional MCS025 synchro-check module.*
***(3)*** *2 undervoltage (L-L) and 1 undervoltage (L-N).*


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# Busbar applications

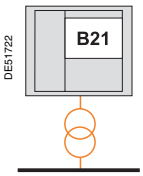


## Voltage monitoring

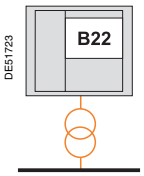
■ voltage and frequency monitoring.

**Monitoring of the 3 phase voltages and the residual voltage on busbars: Sepam B21 or B22**

■ load-shedding-specific function: 81L.



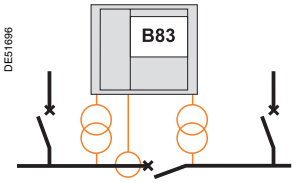

■ load-shedding-specific functions: 81L, 81R.




## Coupling circuit-breaker protection

■ busbar short-circuit protection
■ voltage and frequency monitoring.

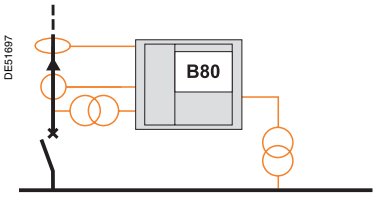
**Monitoring of the 3 phase voltages and the residual voltage on 2 both half-busbars: Sepam B83**




## Incomer protection with additional busbar voltage monitoring

■ busbar short-circuit protection
■ line voltage and frequency monitoring.

**Additional busbar voltage monitoring: Sepam B80**



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# Transformer applications



*Standard transformer application diagrams do not take voltage levels into account:*
*■ the transformer primary winding is always at the top*
*■ the transformer secondary winding is always at the bottom.*
*The transformer primary and secondary windings need to be protected.*
*The Sepam proposed can be installed on either the primary or secondary winding of the transformer.*
*The other winding can be protected by an incomer or feeder type substation application Sepam.*

| Protection functions | ANSI code | T20 | T40 | T42 | T81 | T82 | T87 |
|---|---|---|---|---|---|---|---|
| Phase overcurrent (1) | 50/51 | 4 | 4 | 4 | 8 | 8 | 8 |
| Earth fault / Sensitive earth fault (1) | 50N/51N 50G/51G | 4 | 4 | 4 | 8 | 8 | 8 |
| Breaker failure | 50BF | | 1 | 1 | 1 | 1 | 1 |
| Negative sequence / unbalance | 46 | 1 | 2 | 2 | 2 | 2 | 2 |
| Thermal overload for machines (1) | 49RMS | 2 | 2 | 2 | 2 | 2 | 2 |
| Restricted earth fault differential | 64REF | | | | 2 | 2 | 2 |
| Two-winding transformer differential | 87T | | | | | | 1 |
| Directional phase overcurrent (1) | 67 | | | 2 | | 2 | 2 |
| Directional earth fault (1) | 67N/67NC | | | 2 | 2 | 2 | 2 |
| Directional active overpower | 32P | | | | 2 | 2 | 2 |
| Overfluxing (V / Hz) | 24 | | | | | | 2 |
| Positive sequence undervoltage | 27D | | | | 2 | 2 | 2 |
| Remanent undervoltage | 27R | | | | 2 | 2 | 2 |
| Undervoltage (L-L or L-N) | 27 | | 2 | 2 | 4 | 4 | 4 |
| Overvoltage (L-L or L-N) | 59 | | 2 | 2 | 4 | 4 | 4 |
| Neutral voltage displacement | 59N | | 2 | 2 | 2 | 2 | 2 |
| Negative sequence overvoltage | 47 | | 1 | 1 | 2 | 2 | 2 |
| Overfrequency | 81H | | 2 | 2 | 2 | 2 | 2 |
| Underfrequency | 81L | | 4 | 4 | 4 | 4 | 4 |
| Thermostat / Buchholz (2) | 26/63 | □ | □ | □ | □ | □ | □ |
| Temperature monitoring (16 RTDs) (3) | 38/49T | □ 8 RTDs | □ 16 RTDs | □ 16 RTDs | □ 16 RTDs | □ 16 RTDs | □ 16 RTDs |
| Synchro-check (4) | 25 | | | | □ | □ | □ |

*The figures indicate the number of units available for each protection function*
*■ standard, □ options.*
***(1)*** *Protection functions with 2 groups of settings.*
***(2)*** *According to parameter setting and optional input/output modules.*
***(3)*** *With optional MET148-2 temperature input modules.*
***(4)*** *With optional MCS025 synchro-check module.*


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# Transformer applications
## Transformer feeder protection

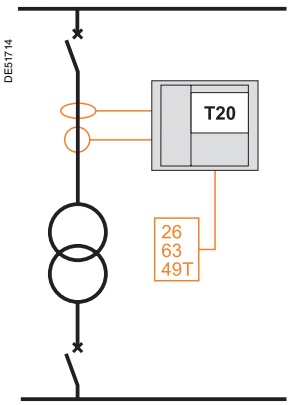


### Transformer feeder protection

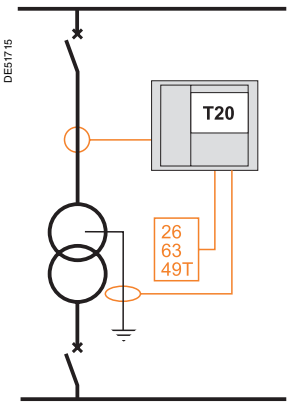
- transformer short-circuit and overload protection
- internal transformer protection: Thermostat / Buchholz (ANSI 26/63)
- RTD temperature monitoring (ANSI 49T).

**Transformer feeder protection without voltage monitoring: Sepam T20**

Earth fault protection:
- primary: 50G/51G.

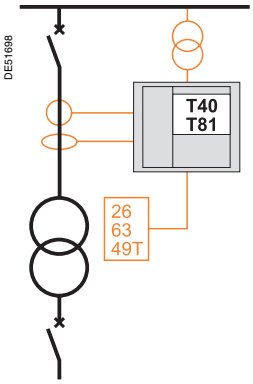



Earth fault protection:
- neutral point: 50G/51G.




**Transformer feeder protection with voltage monitoring: Sepam T40 or T81**

Earth fault protection:
- primary: 50G/51G.




***Note:*** *for long feeders, the 50G/51G function may be replaced by the 67N/67NC.*



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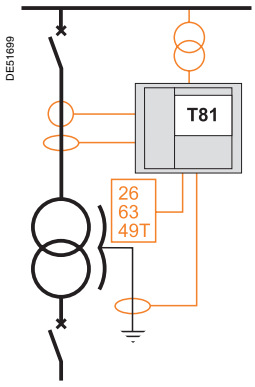
# Transformer applications
## Transformer feeder protection

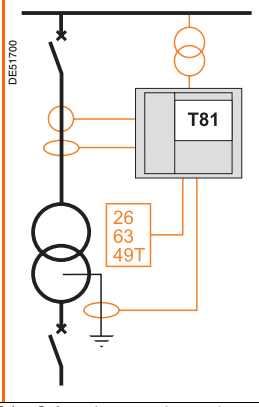


**Transformer feeder protection with voltage monitoring and additional current measurement: Sepam T81**

Earth fault protection:
- ■ primary: 50G/51G
- ■ tank earth leakage: 50G/51G.




Earth fault protection:
- ■ primary: 50G/51G
- ■ secondary: 50G/51G.

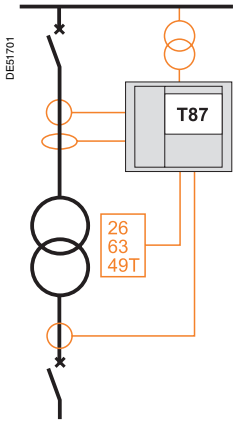



***Note:*** *for long feeders, the 50G/51G function may be replaced by the 67N/67NC.*

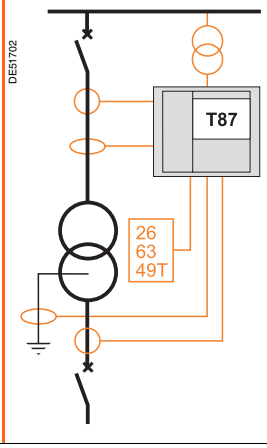
**Transformer feeder differential protection: Sepam T87**

Transformer differential protection: 87T

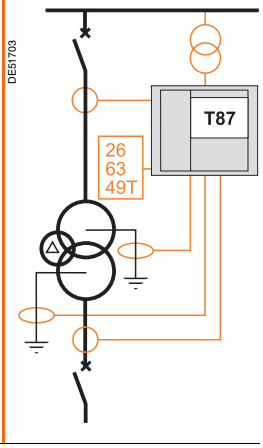
Earth fault protection:
- ■ primary: 50G/51G.




Earth fault protection:
- ■ primary: 50G/51G
- ■ secondary:
- □ 64REF
- □ 50G/51G.




Earth fault protection:
- ■ primary:
- □ 64REF
- □ 50G/51G
- ■ secondary:
- □ 64REF
- □ 50G/51G.



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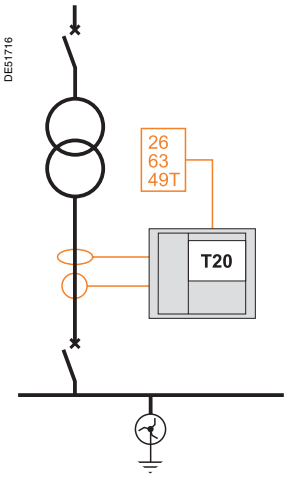
## Transformer incomer protection

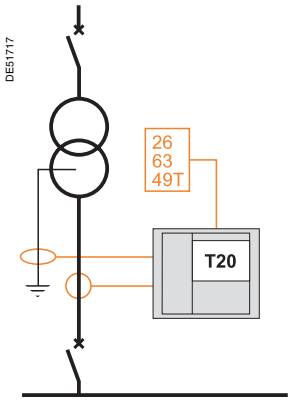
- transformer short-circuit and overload protection
- internal transformer protection: Thermostat / Buchholz (ANSI 26/63)
- RTD temperature monitoring (ANSI 49T).

### Transformer incomer protection without voltage monitoring: Sepam T20

Earth fault protection:
- secondary: 50G/51G.

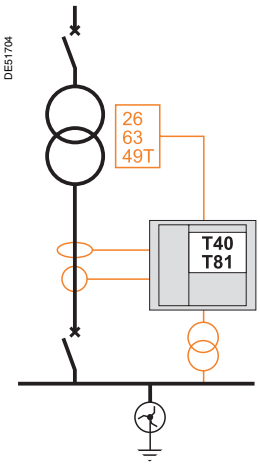



Earth fault protection:
- neutral point: 50G/51G.

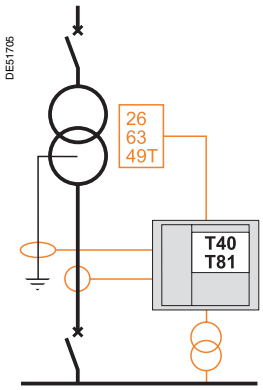



### Transformer incomer protection with voltage monitoring: Sepam T40 or T81

Earth fault protection:
- secondary: 50G/51G.




Earth fault protection:
- secondary:
  - ☐ 64REF
  - ☐ 50G/51G.



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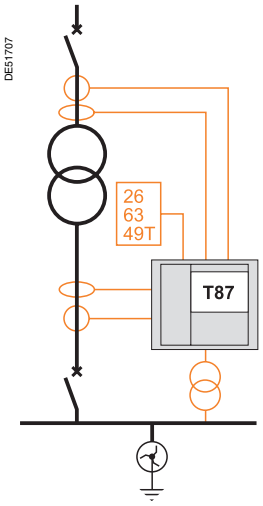
# Transformer applications
## Transformer incomer protection



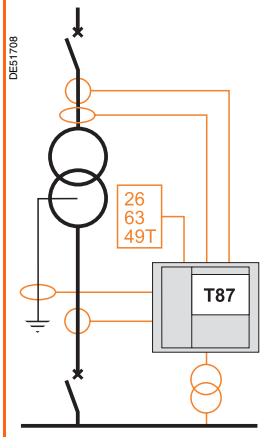
### Transformer incomer differential protection: Sepam T87

Transformer differential protection: 87T

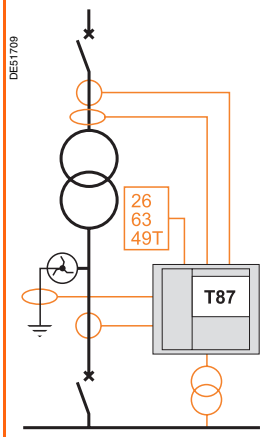
Earth fault protection:
- ■ primary: 50G/51G
- ■ secondary: 50G/51G.



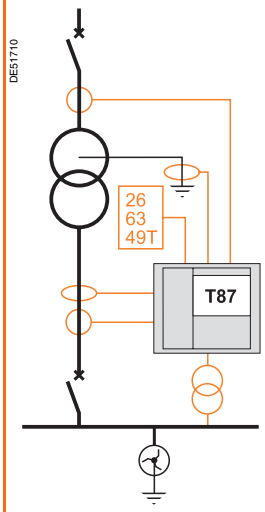

Earth fault protection:
- ■ primary: 50G/51G
- ■ secondary:
- □ 64REF
- □ 50G/51G.



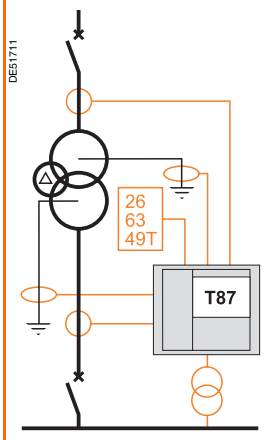

Earth fault protection:
- ■ primary: 50G/51G
- ■ secondary:
- □ 64REF
- □ 50G/51G.




Earth fault protection:
- ■ primary:
- □ 64REF
- □ 50G/51G
- ■ secondary: 50G/51G.

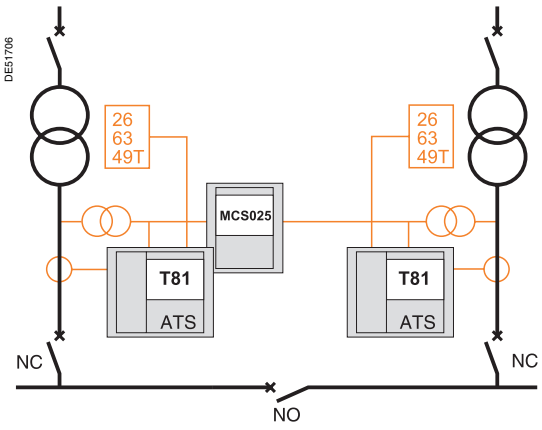



Earth fault protection:
- ■ primary:
- □ 64REF
- □ 50G/51G
- ■ secondary:
- □ 64REF
- □ 50G/51G.




### Protection of 2 non-coupled transformer incomers: Sepam T81

- ■ automatic source transfer (ATS)
- ■ synchro-check (ANSI 25).



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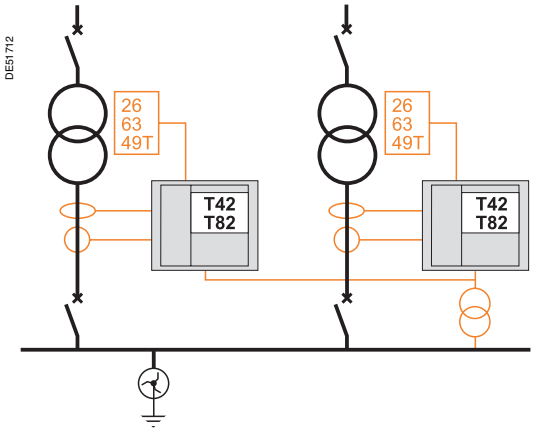
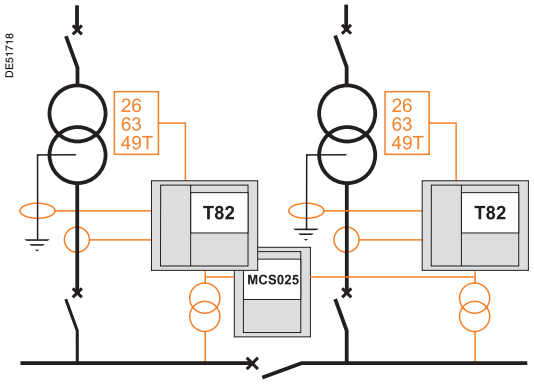
**Parallel transformer incomer protection: Sepam T42 or T82**

- transformer directional phase overcurrent protection: 67
- transformer secondary earth fault protection: 50G/51G, 59N.

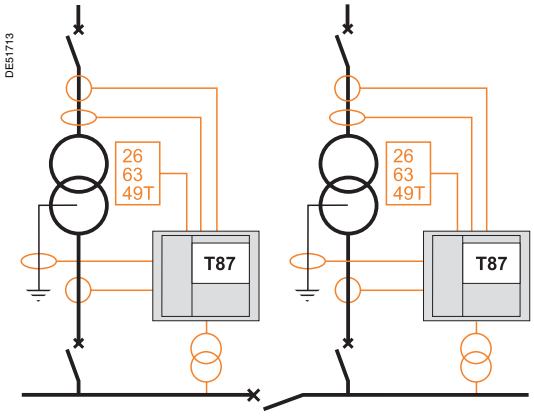



- transformer directional phase overcurrent protection: 67
- transformer secondary earth fault protection: 67N/67NC, 64REF
- with synchro-check (ANSI 25).




**Parallel incomer differential protection: Sepam T87**

- transformer differential protection: 87T
- directional transformer protection: 67
- transformer secondary earth fault protection: 50G/51G, 67N/67NC 64REF.



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# Motor applications



| Protection functions | ANSI code | M20 | M41 | M81 | M87 | M88 |
|---|---|---|---|---|---|---|
| Phase overcurrent (1) | 50/51 | 4 | 4 | 8 | 8 | 8 |
| Earth fault / Sensitive earth fault (1) | 50N/51N 50G/51G | 4 | 4 | 8 | 8 | 8 |
| Breaker failure | 50BF | | 1 | 1 | 1 | 1 |
| Negative sequence / unbalance | 46 | 1 | 2 | 2 | 2 | 2 |
| Thermal overload for machines (1) | 49RMS | 2 | 2 | 2 | 2 | 2 |
| Two-winding transformer differential | 87T | | | | | 1 |
| Machine differential | 87M | | | | 1 | |
| Directional earth fault (1) | 67N/67NC | | 2 | 2 | 2 | 2 |
| Directional active overpower | 32P | | 1 | 2 | 2 | 2 |
| Directional reactive overpower | 32Q/40 | | 1 | 1 | 1 | 1 |
| Field loss (underimpedance) | 40 | | | 1 | 1 | 1 |
| Phase undercurrent | 37 | 1 | 1 | 1 | 1 | 1 |
| Excessive starting time, locked rotor | 48/51LR/14 | 1 | 1 | 1 | 1 | 1 |
| Starts per hour | 66 | 1 | 1 | 1 | 1 | 1 |
| Loss of synchronization | 78PS | | | 1 | 1 | 1 |
| Overspeed (2 set points) (2) | 12 | | | □ | □ | □ |
| Underspeed (2 set points) (2) | 14 | | | □ | □ | □ |
| Positive sequence undervoltage | 27D | | 2 | 2 | 2 | 2 |
| Remanent undervoltage | 27R | | 1 | 2 | 2 | 2 |
| Undervoltage (L-L or L-N) | 27 | | 2 | 4 | 4 | 4 |
| Overvoltage (L-L or L-N) | 59 | | 2 | 4 | 4 | 4 |
| Neutral voltage displacement | 59N | | 2 | 2 | 2 | 2 |
| Negative sequence overvoltage | 47 | | 1 | 2 | 2 | 2 |
| Overfrequency | 81H | | 2 | 2 | 2 | 2 |
| Underfrequency | 81L | | 4 | 4 | 4 | 4 |
| Thermostat / Buchholz | 26/63 | | | □ | | □ |
| Temperature monitoring (16 RTDs) (3) | 38/49T | □ 8 RTDs | □ 16 RTDs | □ 16 RTDs | □ 16 RTDs | □ 16 RTDs |

*The figures indicate the number of units available for each protection function*
■ *standard,* □ *options.*
***(1)*** *Protection functions with 2 groups of settings.*
***(2)*** *According to parameter setting and optional input/output modules.*
***(3)*** *With optional MET148-2 temperature input modules.*



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# Motor applications

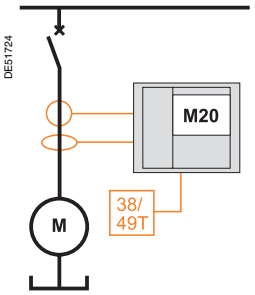


## Motor protection

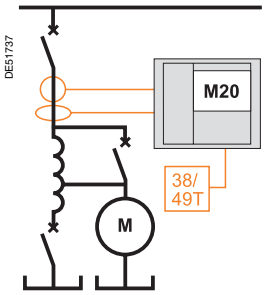
- internal motor fault protection
- power supply fault protection
- driven load fault protection
- RTD temperature monitoring (ANSI 38/49T).

### Motor protection without voltage monitoring: Sepam M20

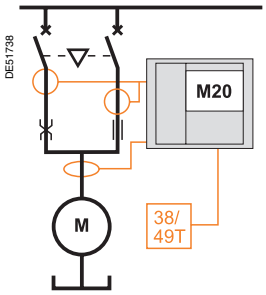
■ direct starting.




■ auto-transformer starting.

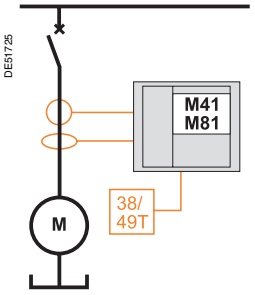



■ two-way.

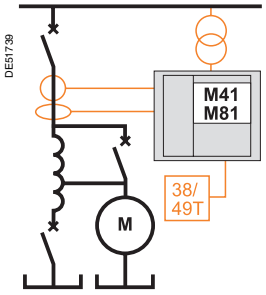



### Motor protection with voltage monitoring: Sepam M41 or M81

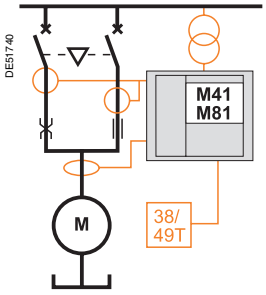
■ direct starting.




■ auto-transformer starting.



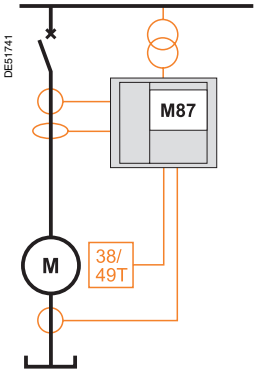

■ two-way.



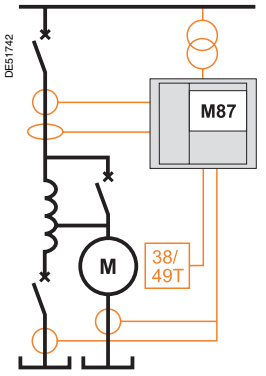

### Motor differential protection: Sepam M87

Motor differential protection: 87M.

■ direct starting.

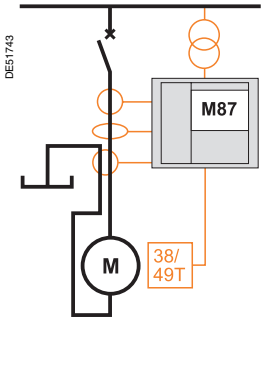



■ auto-transformer starting.




Phase protection by self-balancing-differential scheme: 50/51.

■ direct starting.



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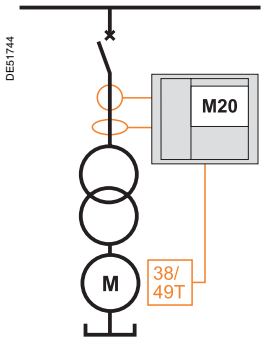
## Motor-transformer unit protection

- motor and transformer protection against internal faults
- power supply fault protection
- driven load fault protection
- internal transformer protection: Thermostat / Buchholz (ANSI 26/63)
- RTD temperature monitoring (ANSI 38/49T).

### Motor-transformer unit protection without voltage monitoring: Sepam M20

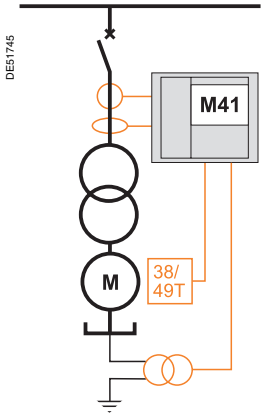
- transformer primary earth fault protection: 50G/51G.

***Note:*** *monitoring of motor insulation must be ensured by another device.*



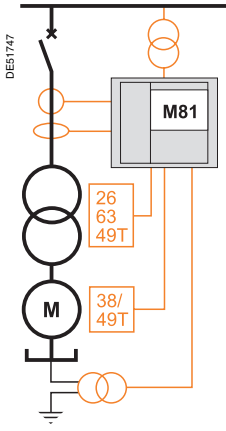

### Motor-transformer unit protection with voltage monitoring: Sepam M41

- motor earth fault protection: 59N
- transformer primary earth fault protection: 50G/51G.

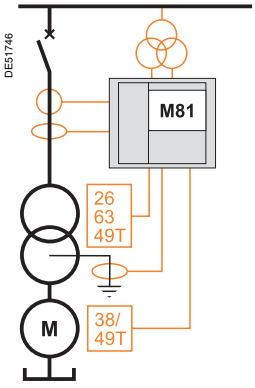



### Motor-transformer unit protection with voltage and transformer monitoring: Sepam M81

- motor earth fault protection: 59N
- transformer primary earth fault protection: 50G/51G
- transformer monitoring: Buchholz, thermostat, temperature measurement.




- motor earth fault protection: 50G/51G
- transformer primary earth fault protection: 50G/51G
- transformer monitoring: Buchholz, thermostat, temperature measurement.



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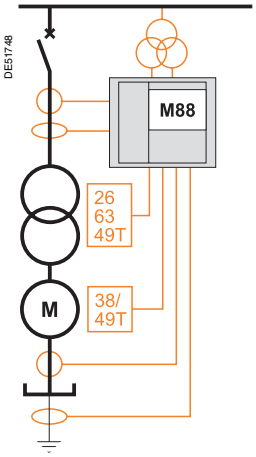
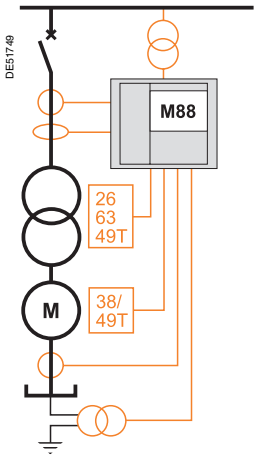
**Motor-transformer unit differential protection: Sepam M88**

Motor-transformer unit differential protection: 87T.

- motor earth fault protection: 50G/51G
- transformer primary earth fault protection: 50G/51G.




- motor earth fault protection: 59N
- transformer primary earth fault protection: 50G/51G.



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# Generator applications



| Protection functions | ANSI code | G40 | G82 | G87 | G88 |
|---|---|---|---|---|---|
| Phase overcurrent (1) | 50/51 | 4 | 8 | 8 | 8 |
| Earth fault / Sensitive earth fault (1) | 50N/51N 50G/51G | 4 | 8 | 8 | 8 |
| Breaker failure | 50BF | 1 | 1 | 1 | 1 |
| Negative sequence / unbalance | 46 | 2 | 2 | 2 | 2 |
| Thermal overload for machines (1) | 49RMS | 2 | 2 | 2 | 2 |
| Restricted earth fault differential | 64REF | | 2 | | 2 |
| Two-winding transformer differential | 87T | | | | 1 |
| Machine differential | 87M | | | 1 | |
| Directional phase overcurrent (1) | 67 | | 2 | 2 | 2 |
| Directional earth fault (1) | 67N/67NC | | 2 | 2 | 2 |
| Directional active overpower | 32P | 1 | 2 | 2 | 2 |
| Directional reactive overpower | 32Q/40 | 1 | 1 | 1 | 1 |
| Directional active underpower | 37P | | 2 | | |
| Field loss (underimpedance) | 40 | | 1 | 1 | 1 |
| Loss of synchronization | 78PS | | 1 | 1 | 1 |
| Overspeed (2 set points) (2) | 12 | | □ | □ | □ |
| Underspeed (2 set points) (2) | 14 | | □ | □ | □ |
| Voltage-restrained phase overcurrent | 50V/51V | 1 | 2 | 2 | 2 |
| Underimpedance | 21B | | 1 | 1 | 1 |
| Inadvertent energization | 50/27 | | 1 | 1 | 1 |
| Third harmonic undervoltage / 100% stator earth fault | 27TN/64G2 64G | | 2 | 2 | 2 |
| Overfluxing (V / Hz) | 24 | | 2 | 2 | 2 |
| Positive sequence undervoltage | 27D | | 2 | 2 | 2 |
| Remanent undervoltage | 27R | | 2 | 2 | 2 |
| Undervoltage (L-L or L-N) | 27 | 2 | 4 | 4 | 4 |
| Overvoltage (L-L or L-N) | 59 | 2 | 4 | 4 | 4 |
| Neutral voltage displacement | 59N | 2 | 2 | 2 | 2 |
| Negative sequence overvoltage | 47 | 1 | 2 | 2 | 2 |
| Overfrequency | 81H | 2 | 2 | 2 | 2 |
| Underfrequency | 81L | 4 | 4 | 4 | 4 |
| Thermostat / Buchholz | 26/63 | | □ | | □ |
| Temperature monitoring (16 RTDs) (3) | 38/49T | □ 16 RTDs | □ 16 RTDs | □ 16 RTDs | □ 16 RTDs |
| Synchro-check (4) | 25 | | □ | □ | □ |

*The figures indicate the number of units available for each protection function*
■ *standard,* □ *options.*
***(1)*** *Protection functions with 2 groups of settings.*
***(2)*** *According to parameter setting and optional input/output modules.*
***(3)*** *With optional MET148-2 temperature input modules.*
***(4)*** *With optional MCS025 synchro-check module.*


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# Generator applications

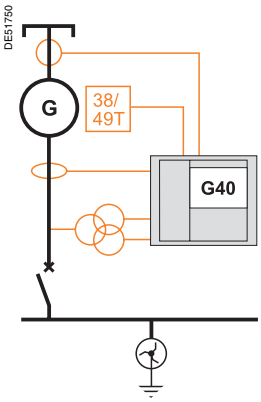


## Generator protection

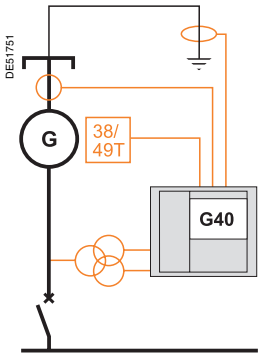
- internal generator fault protection
- network fault protection
- driving machine fault protection
- RTD temperature monitoring (ANSI 38/49T)
- voltage and frequency monitoring.

### Protection of a separate generator: Sepam G40

Earth fault protection:
- 50G/51G
- 59N.



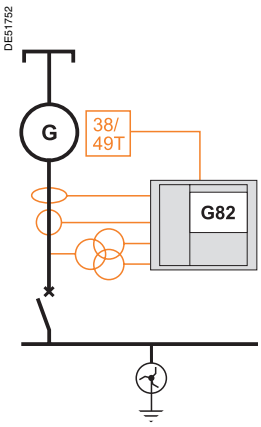

Earth fault protection:
- 50G/51G.



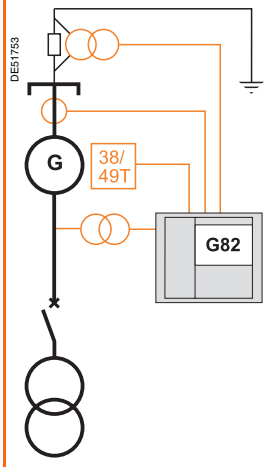

### Protection of a generator coupled to other generators or to a network: Sepam G82

Short-circuit detection on generator side: 67.
Control fault protection.

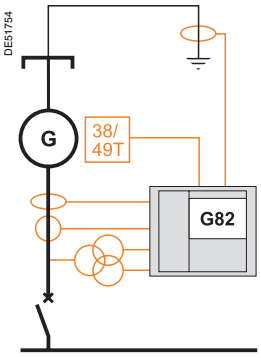
Earth fault protection:
- 50G/51G
- 59N.




Earth fault protection:
- 100 % stator earth fault 64G.




Earth fault protection:
- 64REF and 50G/51G
- 50N/51N.



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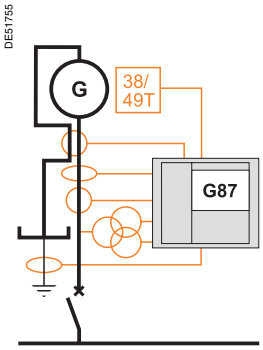
# Generator applications



## Generator differential protection: Sepam G87

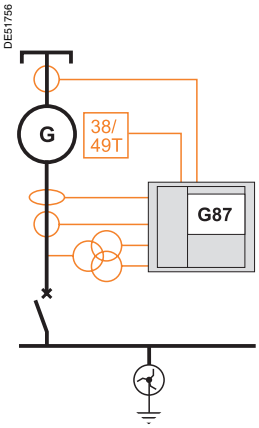
Phase protection by self-balancing differential scheme: 50/51.

Earth fault protection: 50G/51G.

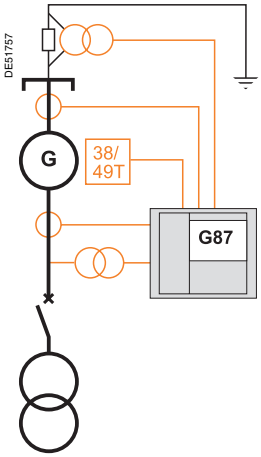



Generator differential protection: 87M.

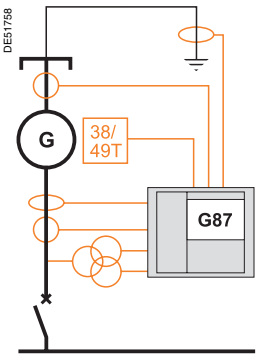
Earth fault protection:
- 50G/51G
- 59N.




Earth fault protection:
- 100 % stator earth fault 64G.




Earth fault protection:
- 50N/51N.



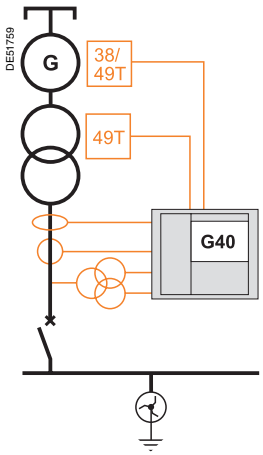

## Generator-transformer unit protection

- generator and transformer protection against internal faults
- network fault protection
- driving machine fault protection
- RTD temperature monitoring (ANSI 38/49T)
- voltage and frequency monitoring.

### Separate generator-transformer unit protection. Sepam G40

Earth fault protection:
- 50G/51G.

***Note:*** *monitoring of generator insulation must be ensured by another device.*



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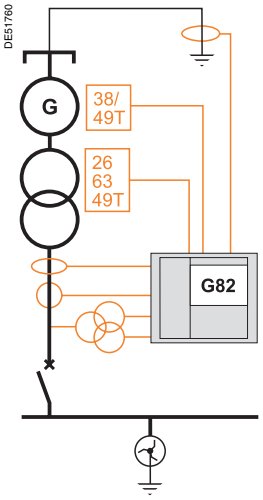
# Generator applications



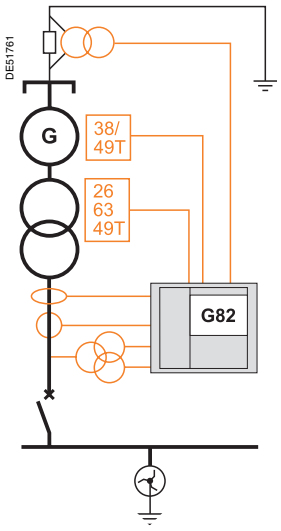
**Protection of a generator-transformer unit coupled to other generators or to a network: Sepam G82**

Short-circuit detection on generator side: 67.
Control fault protection.
Internal transformer protection: Thermostat / Buchholz (ANSI 26/63).

■ generator earth fault protection: 50G/51G
■ transformer secondary earth fault protection:
□ 50G/51G
□ 59N.



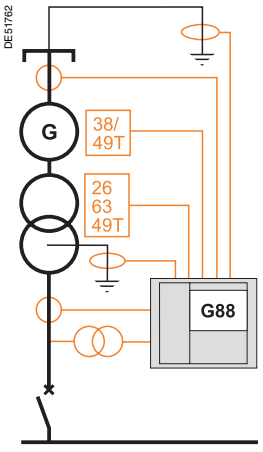

■ generator earth fault protection: 100 % stator earth fault 64G
■ transformer secondary earth fault protection:
□ 50G/51G
□ 59N.



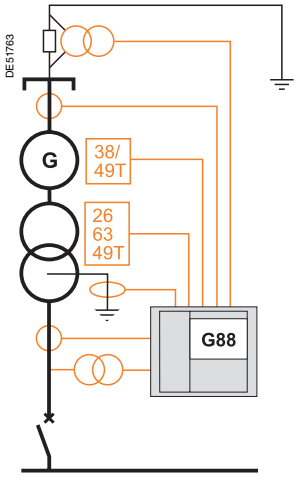

**Generator-transformer unit differential protection: Sepam G88**

Generator-transformer unit differential protection: 87T.

■ generator earth fault protection: 50G/51G
■ transformer secondary earth fault protection:
□ 50G/51G.




■ generator earth fault protection: 100% stator earth fault 64G
■ transformer secondary earth fault protection:
□ 50G/51G
□ 64REF.



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# Capacitor applications



| Protection functions | ANSI code | S20 | S40 | C86 |
|---|---|---|---|---|
| Phase overcurrent (1) | 50/51 | 4 | 4 | 8 |
| Earth fault / Sensitive earth fault (1) | 50N/51N 50G/51G | 4 | 4 | 8 |
| Breaker failure | 50BF | | 1 | 1 |
| Negative sequence / unbalance | 46 | 1 | 2 | 2 |
| Thermal overload for capacitors (1) | 49RMS | | | 2 |
| Capacitor-bank unbalance | 51C | | | 8 |
| Positive sequence undervoltage | 27D | | | 2 |
| Remanent undervoltage | 27R | | | 2 |
| Undervoltage (L-L or L-N) | 27 | | 2 | 4 |
| Overvoltage (L-L or L-N) | 59 | | 2 | 4 |
| Neutral voltage displacement | 59N | | 2 | 2 |
| Negative sequence overvoltage | 47 | | 1 | 2 |
| Overfrequency | 81H | | 2 | 2 |
| Underfrequency | 81L | | 4 | 4 |
| Temperature monitoring (16 RTDs) (2) | 38/49T | | | □ 16 RTDs |

*The figures indicate the number of units available for each protection function*
■ *standard,* □ *options.*
***(1)*** *Protection functions with 2 groups of settings.*
***(2)*** *With optional MET148-2 temperature input modules.*



Merlin Gerin
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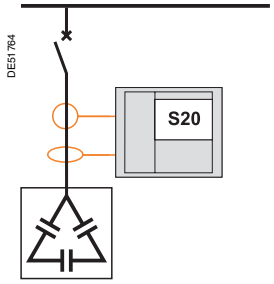
# Capacitor applications



## Capacitor bank protection

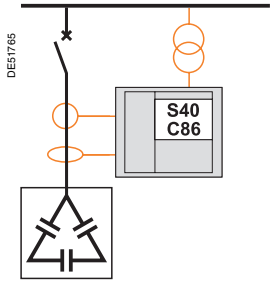
### Protection of a capacitor bank (delta connection) without voltage monitoring: Sepam S20

- capacitor bank short-circuit protection.



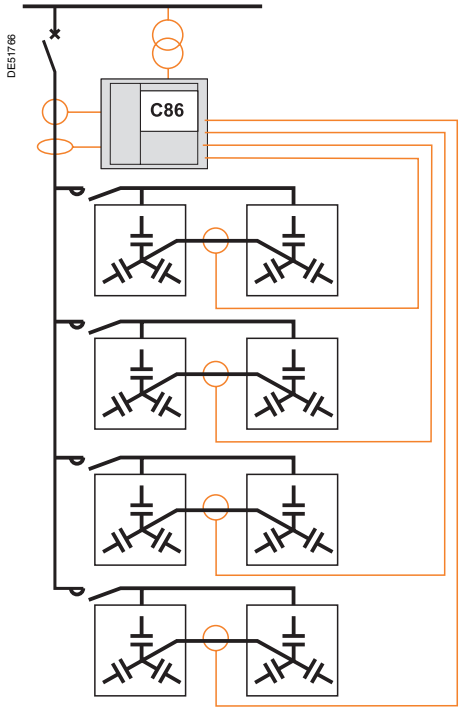

### Protection of a capacitor bank (delta connection) with voltage monitoring: Sepam S40 or C86

- capacitor bank short-circuit protection
- voltage and frequency monitoring
- overload protection: ANSI 49RMS (Sepam C86 only).




### Protection of a double-star connected capacitor bank with 1 to 4 steps: Sepam C86

- capacitor bank short-circuit protection
- voltage and frequency monitoring
- specific overload protection, self-adapted to the number of connected steps
- unbalance protection: 51C.



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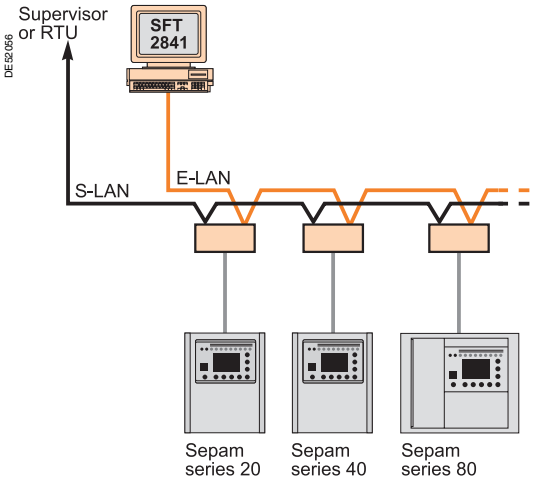
# Communication networks and protocols



*All Sepam relays communicate and can be integrated in a communication architecture. All Sepam information can be accessed remotely.*




*Sepam connection to two communication networks (S-LAN and E-LAN).*

## Two types of communication network

Sepam relays can be connected to two types of networks, thus providing access to different types of information:
- a supervisory local area network or S-LAN
- an engineering local area network or E-LAN.

Examples of communication architectures are presented on pages 36 and 37.

### Supervisory local area network (S-LAN)

An S-LAN is used for supervision functions concerning the installation and the electric network. It can be used to connect a set of communicating devices using the same communication protocol to a centralized supervision system.
Sepam can be connected to an S-LAN using one of the following communication protocols:
- Modbus RTU
- DNP3
- IEC 60870-5-103.

### Engineering local area network (E-LAN)

An E-LAN is intended for Sepam parameter-setting and operating functions. It can be used to connect a set of Sepam units to a PC running the SFT2841 software. In this configuration, the operator has remote and centralized access to all Sepam information, with no need to develop any special communication software.
The operator can easily:
- set up the Sepam general parameters and functions
- collect all Sepam operating and diagnostics information
- manage the protection system for the electric network
- monitor the status of the electric network
- run diagnostics on any incidents affecting the electric network.

## Communication protocols

### Modbus RTU

Modbus RTU is a data-transmission protocol, a de facto standard since 1979 widely used in industry and accepted by many communicating devices.
For more information on the Modbus RTU protocol, visit www.modbus.org.

### DNP3

DNP3 is a data-transmission protocol specially suited to the needs of distributors for remote control/monitoring of substations in the electric network.
For more information on the DNP3 protocol, visit www.dnp.org.

### IEC 60870-5-103

IEC 60870-5-103 is an accompanying standard for the standards in the IEC 60870-5 series. It defines communication between protection devices and the various devices in a control system (supervisor or RTU) in a substation.
For more information on the IEC 60870-5-103 protocol, visit www.iec.ch.

### Other protocols

A gateway / protocol converter must be used to connect Sepam to a communication network based on other protocols.

**Modbus TCP/IP**
Ethernet EGX Merlin Gerin gateways enable Sepam connection to Modbus TCP/IP networks.

**IEC 60870-5-101**
The CN1000 gateway developed by EuroSystem enables Sepam connection to IEC 60870-5-101 networks.
This gateway is quick and simple to implement using the supplied configuration software integrating all Sepam parameters.
For more information on the CN1000 gateway, visit www.euro-system.fr.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# Implementation



PE50930

*A complete range of Sepam communication interfaces*

## Sepam communication interfaces

### A complete range of accessories

Sepam connects to a communication network via a communication interface.
Selection of the interface depends on the communication architecture:

- ■ number of networks to be connected:
  - □ 1 network, S-LAN or E-LAN
  - □ 2 networks, S-LAN and E-LAN
- ■ communication protocol selected for the S-LAN: Modbus RTU, DNP3 or IEC 60870-5-103
- ■ network physical interface:
  - □ 2-wire or 4-wire RS485
  - □ fiber optic, with star or ring architecture.

Sepam communication interfaces are presented in detail on page 157.

### Easy implementation

The communication interfaces are remote modules that are easy to install and connect.
The SFT2841 software is used for complete setup of the communication interfaces:

- ■ protocol selection and setup of the functions specific to each protocol
- ■ setup of the physical interface.

PE50161

*Access to Sepam information via a web browser.*

## Ethernet gateways

Sepam can be connected to an Ethernet TCP/IP network in a totally transparent manner via the EGX200 gateway or the EGX400 server.

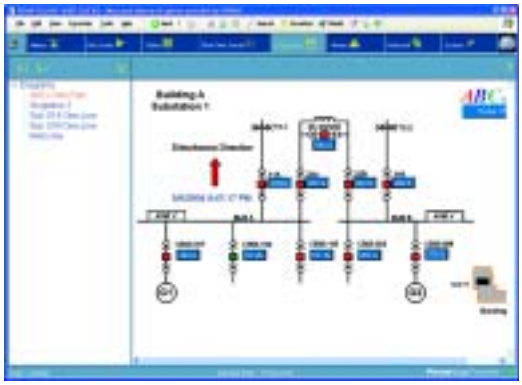
### EGX200 gateway

The EGX200 offers access to enhanced communication and multi-master architectures. It provides IP (Internet Protocol) connection for communication on all types of networks, notably intranets and internet.

### EGX400 server

In addition to Ethernet TCP/IP connection, the EGX400 offers a web server and HTML pages designed specially to present the essential Sepam information.
This information may be accessed in clear text and at no risk on any PC connected to the intranet/internet and equipped with a web browser.

PE50511



*Supervision of an electric network equipped with Sepam by means of PowerLogic SMS software.*

## SMS management software for electrical installations

The SMS management software in the PowerLogic offering draws the full benefit from the available Sepam information.
With this software, your electric installation offers greater performance.



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# Examples of architectures



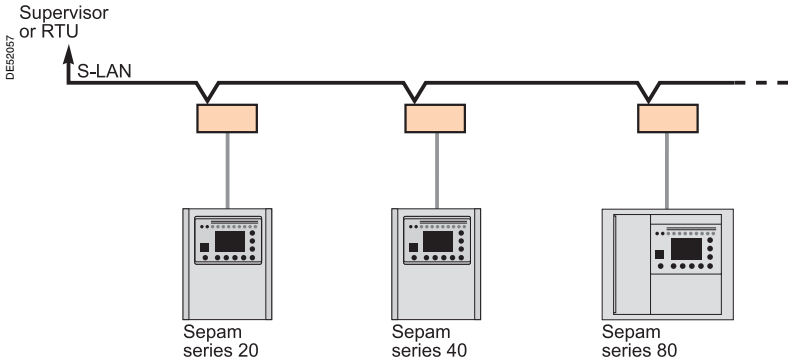
Five typical communication architectures are presented in the examples below.
Each architecture is presented with:
- a simplified diagram
- the characteristics of the implemented networks.

The physical architecture of the communication networks and the connection to networks depends on the type of network (RS485 or fiber optic) and the communication interfaces used. Sepam communication interfaces are presented in detail on page 157.

## Example 1. Single S-LAN network

**S-LAN characteristics**

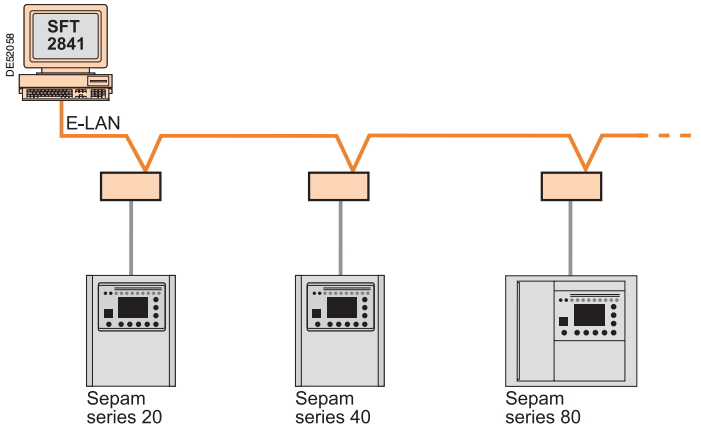
| | |
|---|---|
| Protocol | Modbus RTU<br>DNP3<br>or IEC 60870-5-103 |
| Physical medium | Twisted-pair (2-wire or 4-wire RS485)<br>or fiber optic |




## Example 2. Single E-LAN network

**E-LAN characteristics**

| | |
|---|---|
| Protocol | Modbus RTU |
| Physical medium | Twisted-pair (2-wire or 4-wire RS485)<br>or fiber optic |



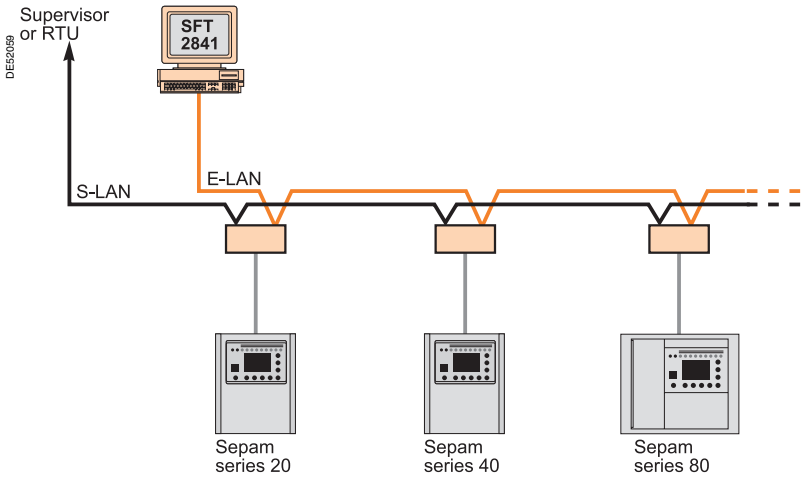

## Example 3. Parallel S-LAN and E-LAN networks

**S-LAN characteristics**

| | |
|---|---|
| Protocol | Modbus RTU<br>DNP3<br>or IEC 60870-5-103 |
| Physical medium | 2-wire RS485 (twisted-pair)<br>or fiber optic |

**E-LAN characteristics**

| | |
|---|---|
| Protocol | Modbus RTU |
| Physical medium | 2-wire RS485 (twisted-pair) |



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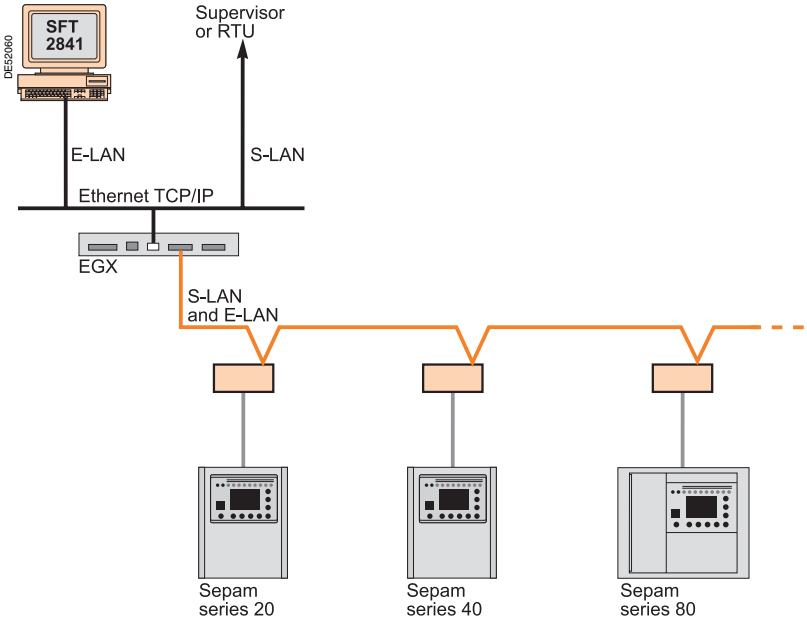
# Examples of architectures



## Example 4. S-LAN and E-LAN networks over Ethernet TCP/IP

| Characteristics of Modbus network between Sepam relays (S-LAN and E-LAN) | |
|---|---|
| Protocol | Modbus RTU |
| Physical medium | Twisted-pair (2-wire or 4-wire RS485) |

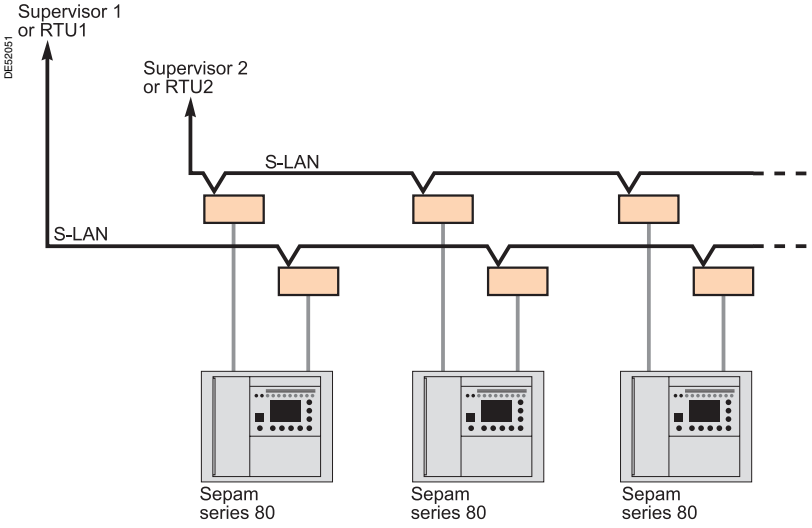
| Characteristics of Ethernet network | |
|---|---|
| Protocol | Modbus TCP/IP |
| Physical medium | Ethernet 10/100 BaseTx or 100 Base Fx |
| Functions of EGX200 or EGX400 gateway | Modbus TCP / Modbus RTU conversion<br>Multiplexing between S-LAN and E-LAN networks |




## Example 5. Two parallel S-LAN networks (Sepam series 80)

| S-LAN characteristics | |
|---|---|
| Protocol | Modbus RTU<br>DNP3<br>or IEC 60870-5-103 |
| Physical medium | Twisted-pair (2-wire or 4-wire RS485)<br>or fiber optic |

***Note:*** *the two communication ports on Sepam series 80 can also be used to create two redundant S-LANs connected to a single supervisor/RTU.*
*An E-LAN can be added to the two S-LANs.*



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# Available Sepam data
## Selection table



| | Modbus RTU protocol | | | DNP3 protocol | | | IEC 60870-5-103 protocol | | |
|---|---|---|---|---|---|---|---|---|---|
| | Series 20 | Series 40 | Series 80 | Series 20 | Series 40 | Series 80 | Series 20 | Series 40 | Series 80 |
| **Data transmitted from Sepam to the supervisor** | | | | | | | | | |
| **Metering and diagnosis** | | | | | | | | | |
| Measurements | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Energy | | ■ | ■ | | ■ | ■ | | | |
| Network diagnosis | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Machine diagnosis | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Switchgear diagnosis | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Sepam diagnosis | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Logipam counters | | | ■ | | | ■ | | | |
| **Remote indications** | | | | | | | | | |
| Alarms and internal status conditions | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Logic inputs | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Logic outputs | | ■ | ■ | | | | | | |
| LEDs | | ■ | ■ | | | | | | |
| Logic equations | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| **Data transmitted from the supervisor to Sepam** | | | | | | | | | |
| Pulse-type remote-control orders, in direct mode | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Pulse-type remote-control orders, in "Select Before Operate" mode | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Maintained remote-control orders (for Logipam) | | | ■ | | | | | | |
| Remote control security | | | ■ | | | | | | |
| **Data accessible via special functions** | | | | | | | | | |
| **Time-tagging** | | | | | | | | | |
| Time-tagged events | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Unsollicited events | | | | ■ | ■ | ■ | | | |
| Time-setting and synchronization | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **Remote setting** | | | | | | | | | |
| Selection of the protection-setting group | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Reading/writing of protection settings | ■ | ■ | ■ | | | | | | |
| Reading of general parameters | ■ | ■ | ■ | | | | | | |
| Reading/writing of analog output (MSA141) | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| **Network diagnosis** | | | | | | | | | |
| Transfer of disturbance-recording data | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Tripping contexts | | ■ | ■ | | | ■ | | | ■ |
| Out-of-sync context | | | ■ | | | | | | |
| **Miscellaneous** | | | | | | | | | |
| Identification of Sepam | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |



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# Available Sepam data
Description



## Data transmitted from Sepam to the supervisor

### Metering and diagnosis
The values measured by Sepam that may be remote accessed are divided into the following categories:
- measurements: currents, voltages, frequency, power, temperatures, etc.
- energy: calculated or pulse-type energy counters
- network diagnosis: phase displacement, tripping currents, unbalance ratio, etc.
- machine diagnosis: temperature rise, motor starting time, remaining operating time before overload tripping, waiting time after tripping, etc.
- switchgear diagnosis: cumulative breaking current, operating time and number of operations, circuit breaker charging time, etc.
- Sepam diagnosis: partial or major fault, etc.
- Logipam counters.

### Remote indications
The logic-state information that may be remote accessed are divided into the following categories:
- alarms and internal status conditions
- status of logic inputs
- status of logic outputs
- status of nine LEDs on the front panel of Sepam
- status of logic-equation output bits.

**Alarms and internal status conditions**
The alarms and internal status conditions are remote indications (TS) pre-assigned to protection and control functions.
Remote indications depend on the type of Sepam and can be re-assigned by Logipam.
The remote indications that can be accessed via the communication link include:
- all protection-function alarms
- monitoring-function alarms: CT or VT fault, control fault
- Sepam status data:
  - Sepam not reset
  - remote setting inhibited, remote-control orders inhibited
- status data on the following functions:
  - recloser: in service / inhibited, reclosing in progress / successful, permanent trip
  - disturbance recording: records inhibited / stored.

## Data transmitted from the supervisor to Sepam

### Pulse-type remote-control orders
Pulse-type remote-control orders (TC) may be carried out in two modes (selected by parameter setting):
- direct mode
- confirmed SBO (select before operate) mode.

Remote-control orders are pre-assigned to metering, protection and control functions and depend on the type of Sepam.
They are used for the following, in particular:
- to control breaking device opening and closing
- to reset Sepam and initialize peak-demand measurements
- to select the active group of settings by enabling group A or B
- to inhibit or enable the following functions: recloser, thermal overload protection, disturbance recording.

Remote-control orders can be re-assigned by Logipam.

### Maintained remote-control orders
Maintained remote-control orders (TCM) are carried out in direct mode and can be used by the Logipam program for Sepam series 80 only.
The output remains in the last state to which it was ordered and is reset if Sepam auxiliary power is lost.

### Remote-control security
Transmission of Sepam series 80 remote controls and settings over a Modbus S-LAN can be password protected.


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# Available Sepam data
Description



## Time-tagging

### Time-tagged events

The time-tagging function assigns a date and precise time to status changes (events) so that they can be accurately organized over time.
Sepam systematically time-tags the following events:
- status changes of all logic inputs
- status changes of all remote indications (TS - alarms and internal status conditions).

Each event is time-tagged to within one millisecond.

The number of stacks of time-tagged events managed by Sepam on each communication port and the volume of each stack in terms of the numbers of events depend on the communication protocol used.

| | Modbus RTU | DNP3 | IEC 60870-5-103 |
|---|---|---|---|
| Number of event stacks for each Sepam communication port | 2 | 1 | 1 |
| Number of events per stack | 64 | 100 | 100 |

Whatever the communication protocol used, Modbus RTU, DNP3 or IEC 60870-5-103, events may be used by a remote monitoring and control system for data logging and histories, for example.

### Unsollicited events

Using the DNP3 protocol, Sepam can spontaneously transmit time-tagged events to the supervisor. The transmission of unsollicited events must be activated during setup of the DNP3 protocol.

### Time-setting and synchronization

The Sepam internal clock manages the date and time.
Time-setting is possible:
- via the Sepam display
- using the SFT2841 software
- via the communication link.

To ensure long-term time stability or to coordinate a number of devices, Sepam units can be synchronized:
- by an external pulse to a dedicated logic input
- via the communication link.


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# Available Sepam data
Description



## Remote setting

### Sepam parameter and protection settings

The following remote-setting functions are available:
- selection of the protection-setting group
- reading of general parameters
- reading of protection settings (remote reading)
- writing of protection settings (remote setting).

The writing of protection settings may be inhibited by parameter setting.

### S-LAN and E-LAN networks

The availability of remote-setting functions over the S-LAN depends on the communication protocol used.
All remote-setting functions are available over the E-LAN using the SFT2841 software.

## Other data accessible via special functions

### Network diagnosis

The network diagnostic information recorded in files by Sepam can also be transmitted over the communication link:
- disturbance-recording records in COMTRADE format
- tripping contexts
- Out-of-sync context.

### Identification of Sepam

The identification function enables the supervisor to clearly identify the device connected to the S-LAN, based on the following elements of information:
- manufacturer identification
- Sepam type.

This function is available for all Sepam relays, whatever the protocol used.


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# Sepam series 20 and Sepam series 40

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2



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# Selection table
# Sepam series 20



| | | Substation | Transformer | Motor | Busbar | |
|---|---|---|---|---|---|---|
| **Protection** | **ANSI code** | **S20** | **T20** | **M20** | **B21 (3)** | **B22** |
| Phase overcurrent | 50/51 | 4 | 4 | 4 | | |
| Earth fault / Sensitive earth fault | 50N/51N<br>50G/51G | 4 | 4 | 4 | | |
| Negative sequence / unbalance | 46 | 1 | 1 | 1 | | |
| Thermal overload | 49RMS | | 2 | 2 | | |
| Phase undercurrent | 37 | | | 1 | | |
| Excessive starting time, locked rotor | 48/51LR/14 | | | 1 | | |
| Starts per hour | 66 | | | 1 | | |
| Positive sequence undervoltage | 27D/47 | | | | 2 | 2 |
| Remanent undervoltage | 27R | | | | 1 | 1 |
| Phase-to-phase undervoltage | 27 | | | | 2 | 2 |
| Phase-to-neutral undervoltage | 27S | | | | 1 | 1 |
| Phase-to-phase overvoltage | 59 | | | | 2 | 2 |
| Neutral voltage displacement | 59N | | | | 2 | 2 |
| Overfrequency | 81H | | | | 1 | 1 |
| Underfrequency | 81L | | | | 2 | 2 |
| Rate of change of frequency | 81R | | | | | 1 |
| Recloser (4 cycles) | 79 | □ | | | | |
| Thermostat / Buchholz | 26/63 | | □ | | | |
| Temperature monitoring (8 RTDs) | 38/49T | | □ | □ | | |
| **Metering** | | | | | | |
| Phase current I1, I2, I3 RMS, residual current I0 | | ■ | ■ | ■ | | |
| Demand current I1, I2, I3, peak demand current IM1, IM2, IM3 | | ■ | ■ | ■ | | |
| Voltage U21, U32, U13, V1, V2, V3, residual voltage V0 | | | | | ■ | ■ |
| Positive sequence voltage Vd / rotation direction | | | | | ■ | ■ |
| Frequency | | | | | ■ | ■ |
| Temperature | | | □ | □ | | |
| **Network and machine diagnosis** | | | | | | |
| Tripping current TripI1, TripI2, TripI3, TripI0 | | ■ | ■ | ■ | | |
| Unbalance ratio / negative sequence current Ii | | ■ | ■ | ■ | | |
| Disturbance recording | | ■ | ■ | ■ | ■ | ■ |
| Thermal capacity used | | | ■ | ■ | | |
| Remaining operating time before overload tripping | | | ■ | ■ | | |
| Waiting time after overload tripping | | | ■ | ■ | | |
| Running hours counter / operating time | | | ■ | ■ | | |
| Starting current and time | | | | ■ | | |
| Start inhibit time<br>Number of starts before inhibition | | | | ■ | | |
| **Switchgear diagnosis** | | | | | | |
| Cumulative breaking current | | ■ | ■ | ■ | | |
| Trip circuit supervision | | □ | □ | □ | □ | □ |
| Number of operations, operating time, charging time | | □ | □ | □ | | |
| **Control and monitoring** | **ANSI code** | | | | | |
| Circuit breaker / contactor control (1) | 94/69 | □ | □ | □ | □ | □ |
| Latching / acknowledgement | 86 | ■ | ■ | ■ | ■ | ■ |
| Logic discrimination | 68 | □ | □ | □ | | |
| Switching of groups of settings | | ■ (2) | ■ (2) | ■ (2) | | |
| Annunciation | 30 | ■ | ■ | ■ | ■ | ■ |
| **Additional modules** | | | | | | |
| 8 temperature sensor inputs - MET148-2 module | | | □ | □ | | |
| 1 low level analog output - MSA141 module | | □ | □ | □ | □ | □ |
| Logic inputs/outputs -<br>MES114/MES114E/MES114F (10I/4O) module | | □ | □ | □ | □ | □ |
| Communication interface -<br>ACE949-2, ACE959, ACE937, ACE969TP or ACE969FO | | □ | □ | □ | □ | □ |

■ standard, □ according to parameter setting and MES114/MES114E/MES114F or MET148-2 input/output module options.
***(1)*** *For shunt trip unit or undervoltage trip unit.*
***(2)*** *Exclusive choice between logic discrimination and switching from one 2-relay group of settings to another 2-relay group.*
***(3)*** *Performs Sepam B20 functions.*



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# Selection table
# Sepam series 40



| | | Substation | | Transformer | | Motor | | Generator |
|---|---|---|---|---|---|---|---|---|
| **Protection** | **ANSI code** | **S40** | **S41** | **S42** | **T40** | **T42** | **M41** | **G40** |
| Phase overcurrent | 50/51 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Voltage-restrained overcurrent | 50V/51V | | | | | | | 1 |
| Earth fault / Sensitive earth fault | 50N/51N<br>50G/51G | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Breaker failure | 50BF | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Negative sequence / unbalance | 46 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Directional phase overcurrent | 67 | | | 2 | | 2 | | |
| Directional earth fault | 67N/67NC | | 2 | 2 | | 2 | 2 | |
| Directional active overpower | 32P | | 1 | 1 | | | 1 | 1 |
| Directional reactive overpower | 32Q/40 | | | | | | 1 | 1 |
| Thermal overload | 49RMS | | | | 2 | 2 | 2 | 2 |
| Phase undercurrent | 37 | | | | | | 1 | |
| Excessive starting time, locked rotor | 48/51LR/14 | | | | | | 1 | |
| Starts per hour | 66 | | | | | | 1 | |
| Positive sequence undervoltage | 27D | | | | | | 2 | |
| Remanent undervoltage | 27R | | | | | | 1 | |
| Undervoltage (3) | 27/27S | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Overvoltage (3) | 59 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Neutral voltage displacement | 59N | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Negative sequence overvoltage | 47 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Overfrequency | 81H | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Underfrequency | 81L | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Recloser (4 cycles) | 79 | □ | □ | □ | | | | |
| Temperature monitoring (8 or 16 RTDs) | 38/49T | | | | □ | □ | □ | □ |
| Thermostat / Buchholz | 26/63 | | | | □ | □ | | |
| **Metering** | | | | | | | | |
| Phase current I1, I2, I3 RMS, residual current I0 | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Demand current I1, I2, I3, peak demand current IM1, IM2, IM3 | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Voltage U21, U32, U13, V1, V2, V3, residual voltage V0 | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Positive sequence voltage Vd / rotation direction<br>Negative sequence voltage Vi | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Frequency | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Active, reactive and apparent power P, Q, S<br>Peak demand power PM, QM, power factor | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Calculated active and reactive energy (±W.h, ±var.h) | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Active and reactive energy by pulse counting (±W.h, ±.varh) | | □ | □ | □ | □ | □ | □ | □ |
| Temperature | | | | | □ | □ | □ | □ |
| **Network and machine diagnosis** | | | | | | | | |
| Tripping context | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Tripping current TripI1, TripI2, TripI3, TripI0 | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Unbalance ratio / negative sequence current Ii | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Phase displacement φ0, φ1, φ2, φ3 | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Disturbance recording | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Thermal capacity used | | | | | ■ | ■ | ■ | ■ |
| Remaining operating time before overload tripping | | | | | ■ | ■ | ■ | ■ |
| Waiting time after overload tripping | | | | | ■ | ■ | ■ | ■ |
| Running hours counter / operating time | | | | | ■ | ■ | ■ | ■ |
| Starting current and time | | | | | | | ■ | |
| Start inhibit time, number of starts before inhibition | | | | | | | ■ | |
| **Switchgear diagnosis** | | | | | | | | |
| Cumulative breaking current | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Trip circuit supervision | | □ | □ | □ | □ | □ | □ | □ |
| Number of operations, operating time, charging time | | □ | □ | □ | □ | □ | □ | □ |
| CT / VT supervision | 60FL | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **Control and monitoring** | **ANSI code** | | | | | | | |
| Circuit breaker / contactor control (1) | 94/69 | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Latching / acknowledgement | 86 | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Logic discrimination | 68 | □ | □ | □ | □ | □ | □ | □ |
| Switching of groups of settings | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Annunciation | 30 | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Logic equation editor | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **Additional modules** | | | | | | | | |
| 8 temperature sensor inputs - MET148-2 module (2) | | | | | □ | □ | □ | □ |
| 1 low level analog output - MSA141 module | | □ | □ | □ | □ | □ | □ | □ |
| Logic inputs/outputs -<br>MES114/MES114E/MES114F (10I/4O) module | | □ | □ | □ | □ | □ | □ | □ |
| Communication interface -<br>ACE949-2, ACE959, ACE937, ACE969TP or ACE969FO | | □ | □ | □ | □ | □ | □ | □ |

■ standard, □ according to parameter setting and MES114/MES114E/MES114F or MET148-2 input/output module options.

***(1)*** *For shunt trip unit or undervoltage trip unit.*

***(2)*** *2 modules possible.*

***(3)*** *Exclusive choice, phase-to-neutral voltage or phase-to-phase voltage for each of the 2 relays.*



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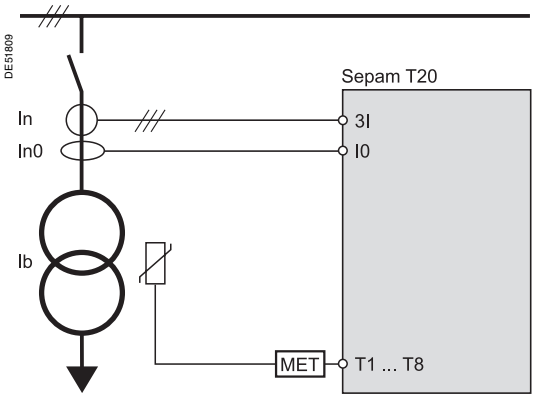
# Sensor inputs



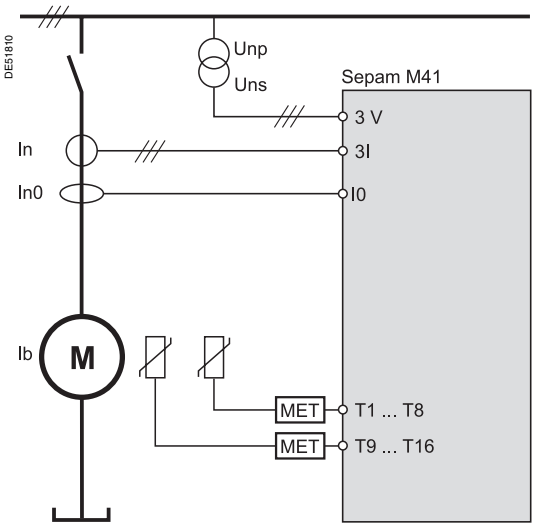
Each Sepam series 20 or Sepam series 40 has analog inputs that are connected to the measurement sensors required for the application.




*Sepam T20 sensor inputs.*

## Sepam series 20 sensor inputs

| | S20 | T20, M20 | B21, B22 |
|---|---|---|---|
| Phase current inputs | 3 | 3 | 0 |
| Residual current input | 1 | 1 | 0 |
| Phase voltage inputs | 0 | 0 | 3 |
| Residual voltage input | 0 | 0 | 1 |
| Temperature inputs (on MET148-2 module) | 0 | 8 | 0 |




*Sepam M41 sensor inputs.*

## Sepam series 40 sensor inputs

| | S40, S41, S42 | | T40, T42, M41, G40 | |
|---|---|---|---|---|
| Phase current inputs | 3 | | 3 | |
| Residual current input | 1 | | 1 | |
| Phase voltage inputs | 2 | 3 | 2 | 3 |
| Residual voltage input | 1 | 0 | 1 | 0 |
| Temperature inputs (on MET148-2 module) | 0 | | 2 x 8 | |



Merlin Gerin
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# General settings

The general settings define the characteristics of the measurement sensors connected to Sepam and determine the performance of the metering and protection functions used. They are accessed via the SFT2841 setting software "General Characteristics", "CT-VT Sensors" and "Particular characteristics" tabs.

| General settings | | Selection | Sepam series 20 | Sepam series 40 |
|---|---|---|---|---|
| In | Rated phase current (sensor primary current) | 2 or 3 CT 1 A / 5 A | 1 A to 6250 A | 1 A to 6250 A |
| | | 3 LPCTs | 25 A to 3150 A (1) | 25 A to 3150 A (1) |
| Ib | Base current, according to rated power of equipment | | 0.4 to 1.3 In | 0.4 to 1.3 In |
| In0 | Rated residual current | Sum of 3 phase currents | See In rated phase current | See In rated phase current |
| | | CSH120 or CSH200 core balance CT | 2 A or 20 A rating | 2 A, 5 A or 20 A rating |
| | | 1 A/5 A CT + CSH30 interposing ring CT | 1 A to 6250 A | 1 A to 6250 A (In0 = In) |
| | | 1 A/5 A CT + CSH30 interposing ring CT Sensitivity x10 | - | 1 A to 6250 A (In0 = In/10) |
| | | Core balance CT + ACE990 (the core balance CT ratio 1/n must be such that 50 ⩽ n ⩽ 1500) | According to current monitored and use of ACE990 | According to current monitored and use of ACE990 |
| Unp | Rated primary phase-to-phase voltage (Vnp: rated primary phase-to-neutral voltage Vnp = Unp/$\sqrt{3}$) | | 220 V to 250 kV | 220 V to 250 kV |
| Uns | Rated secondary phase-to-phase voltage | 3 VTs: V1, V2, V3 | 100, 110, 115, 120, 200, 230 V | 100, 110, 115, 120, 200, 230 V |
| | | 2 VTs: U21, U32 | 100, 110, 115, 120 V | 100, 110, 115, 120 V |
| | | 1 VT: V1 | 100, 110, 115, 120 V | 100, 110, 115, 120 V |
| Uns0 | Secondary zero sequence voltage for primary zero sequence voltage Unp/$\sqrt{3}$ | | Uns/3 or Uns/$\sqrt{3}$ | Uns/3 or Uns/$\sqrt{3}$ |
| | Rated frequency | | 50 Hz or 60 Hz | 50 Hz or 60 Hz |
| | Integration period (for demand current and peak demand current and power) | | 5, 10, 15, 30, 60 mn | 5, 10, 15, 30, 60 mn |
| | Pulse-type accumulated energy meter | Increments active energy | - | 0.1 kW.h to 5 MW.h |
| | | Increments reactive energy | - | 0.1 kvar.h to 5 Mvar.h |

***(1)*** *In values for LPCT, in Amps: 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.*



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# Metering and diagnosis
Description



## Metering

Sepam is a precision metering unit.
All the metering and diagnosis data used for commissioning and required for the operation and maintenance of your equipment are available locally or remotely, expressed in the units concerned (A, V, W, etc.).

### Phase current

RMS current for each phase, taking into account harmonics up to number 13.
Different types of sensors may be used to meter phase current:
- 1 A or 5 A current transformers
- LPCT type current sensors.

### Residual current

Two residual current values are available depending on the type of Sepam and sensors connected to it:
- residual currents I0Σ, calculated by the vector sum of the 3 phase currents
- measured residual current I0.

Different types of sensors may be used to measure residual current:
- CSH120 or CSH200 specific core balance CT
- conventional 1 A or 5 A current transformer with CSH30 interposing ring CT
- any core balance CT with an ACE990 interface.

### Demand current and peak demand currents

Demand current and peak demand currents are calculated according to the 3 phase currents I1, I2 and I3:
- demand current is calculated over an adjustable period of 5 to 60 minutes
- peak demand current is the greatest demand current and indicates the current drawn by peak loads.

Peak demand currents may be cleared.

### Voltage and frequency

The following measurements are available according to the voltage sensors connected:
- phase-to-neutral voltages V1, V2, V3
- phase-to-phase voltages U21, U32, U13
- residual voltage V0
- positive sequence voltage Vd and negative sequence voltage Vi
- frequency f.

### Power

Powers are calculated according to the phase currents I1, I2 and I3:
- active power
- reactive power
- apparent power
- power factor (cos φ).

Power calculations is based on the 2 wattmeter method.
The 2 wattmeter method is only accurate when there is no residual current and it is not applicable if the neutral is distributed.

### Peak demand powers

The greatest demand active and reactive power values calculated over the same period as the demand current.
The peak demand powers may be cleared.

### Energy

- 4 accumulated energies calculated according to voltages and phase currents I1, I2 and I3 measured: active energy and reactive energy in both directions
- 1 to 4 additional accumulated energy meters for the acquisition of active or reactive energy pulses from external meters.

### Temperature

Accurate measurement of temperature inside equipment fitted with Pt100, Ni100 or Ni120 type RTDs, connected to the optional remote MET148-2 module.


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# Metering and diagnosis
Description



## Machine diagnosis assistance

Sepam assists facility managers by providing:
- data on the operation of their machines
- predictive data to optimize process management
- useful data to facilitate protection function setting and implementation.

### Thermal capacity used

Equivalent temperature buildup in the machine, calculated by the thermal overload protection function. Displayed as a percentage of rated thermal capacity.

### Remaining operating time before overload tripping

Predictive data calculated by the thermal overload protection function.
The time is used by facility managers to optimize process management in real time by deciding to:
- interrupt according to procedures
- continue operation with inhibition of thermal protection on overloaded machine.

### Waiting time after overload tripping

Predictive data calculated by the thermal overload protection function.
Waiting time to avoid further tripping of thermal overload protection by premature re-energizing of insufficiently cooled down equipment.

### Running hours counter / operating time

Equipment is considered to be running whenever a phase current is over 0.1 Ib.
Cumulative operating time is given in hours.

### Motor starting / overload current and time

A motor is considered to be starting or overloaded when a phase current is over 1.2 Ib. For each start / overload, Sepam stores:
- maximum current drawn by the motor
- starting / overload time.

The values are stored until the following start / overload.

### Number of starts before inhibition/start inhibit time

Indicates the number of starts still allowed by the starts per hour protection function and, if the number is zero, the waiting time before starting is allowed again.

## Network diagnosis assistance

Sepam provides network power quality metering functions, and all the data on network disturbances detected by Sepam are recorded for analysis purposes.

### Tripping context

Storage of tripping currents and I0, Ii, U21, U32, U13, V0, Vi, Vd, f, P and Q values when tripping occurs. The values for the last five trips are stored.

### Tripping current

Storage of the 3 phase currents and earth fault current at the time of the last Sepam trip order, to indicate fault current.
The values are stored in the tripping contexts.

### Negative sequence / unbalance

Negative sequence component of phase currents I1, I2 and I3, indicating the degree of unbalance in the power supplied to the protected equipment.

### Phase displacement

- phase displacement φ1, φ2, φ3 between phase currents I1, I2, I3 and voltages V1, V2, V3 respectively
- phase displacement φ0 between residual current and residual voltage.

### Disturbance recording

Recording triggered by user-set events:
- all sampled values of measured currents and voltages
- status of all logic inputs and outputs
- logic data: pick-up, …

| Characteristics | Sepam series 20 | Sepam series 40 |
|---|---|---|
| Number of recordings in COMTRADE format | 2 | Adjustable from 1 to 19 |
| Total duration of a recording | 86 periods (1.72 s at 50 Hz, 1.43 s at 60 Hz) | Adjustable from 1 to 10 s. The total of all the records plus one must not be more than 20 s at 50 Hz and 16 s at 60 Hz. |
| Number of samples per period | 12 | 12 |
| Duration of recording prior to occurrence of the event | Adjustable from 0 to 86 periods | Adjustable from 0 to 99 periods |
| Recorded data | ■ currents or voltages<br>■ logic inputs<br>■ pick up<br>■ logic output O1. | ■ currents or voltages<br>■ logic inputs<br>■ pick up<br>■ logic outputs O1 to O4. |


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# Metering and diagnosis
Description



## Sepam self-diagnosis

Sepam includes a number of self-tests carried out in the base unit and optional modules. The purpose of the self-tests is to:
- detect internal failures that may cause nuisance tripping or failed fault tripping
- put Sepam in fail-safe position to avoid any unwanted operation
- alert the facility manager of the need for maintenance operations.

### Internal failure

Two categories of internal failures are monitored:
- major failures: Sepam shutdown (to fail-safe position).

The protection functions are inhibited, the output relays are forced to drop out and the "Watchdog" output indicates Sepam shutdown
- minor failures: downgraded Sepam operation.

Sepam's main functions are operational and equipment protection is ensured.

### Detection of plugged connectors

The system checks that the current or voltage sensors are plugged in. A missing connector is a major failure.

### Configuration checking

The system checks that the optional modules configured are present and working correctly.
The absence or failure of a remote module is a minor failure, the absence or failure of a logic input/output module is a major failure.

## Switchgear diagnosis assistance

Switchgear diagnosis data give facility managers information on:
- mechanical condition of breaking device
- Sepam auxiliaries

and assist them for preventive and curative switchgear maintenance actions.
The data are to be compared to switchgear manufacturer data.

### ANSI 60/60FL - CT/VT supervision

Used to monitor the entire metering chain:
- CT and VT sensors
- connection
- Sepam analog inputs.

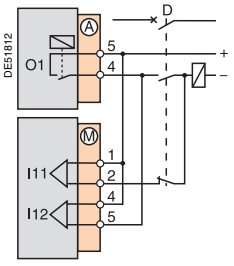
Monitoring includes:
- consistency checking of currents and voltages measured
- acquisition of phase or residual voltage transformer protection fuse blown contacts.

In the event of a loss of current or voltage measurement data, the assigned protection functions may be inhibited to avoid nuisance tripping.

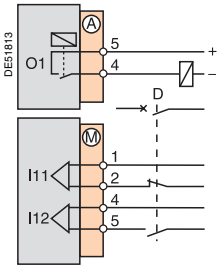
### ANSI 74 - Trip circuit supervision

To detect trip circuit circuit failures, Sepam monitors:
- shunt trip coil connection
- matching of breaking device open/closed position contacts
- execution of breaking device open and close orders.

The trip circuit is only supervised when connected as shown below.




*Connection for shunt trip coil monitoring.*




*Connection for undervoltage trip coil monitoring.*

### Cumulative breaking current

Six cumulative currents are proposed to assess breaking device pole condition:
- total cumulative breaking current
- cumulative breaking current between 0 and 2 In
- cumulative breaking current between 2 In and 5 In
- cumulative breaking current between 5 In and 10 In
- cumulative breaking current between 10 In and 40 In
- cumulative breaking current > 40 In.

Each time the breaking device opens, the breaking current is added to the cumulative total and to the appropriate range of cumulative breaking current.
Cumulative breaking current is given in $(kA)^2$.

### Number of operations

Cumulative number of opening operations performed by the breaking device.

### Circuit breaker operating time and charging time

Used to assess the condition of the breaking device operating mechanism.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# Metering and diagnosis
## Characteristics



| Functions | | Measurement range | Accuracy (1) Sepam series 20 | Accuracy (1) Sepam series 40 | MSA141 | Saving |
|---|---|---|---|---|---|---|
| **Metering** | | | | | | |
| Phase current | | 0.1 to 40 In (3) | ±1 % | ±0.5 % | ■ | |
| Residual current | Calculated | 0.1 to 40 In | ±1 % | ±1 % | ■ | |
| | Measured | 0.1 to 20 In0 | ±1 % | ±1 % | ■ | |
| Demand current | | 0.1 to 40 In | ±1 % | ±0.5 % | | |
| Peak demand current | | 0.1 to 40 In | ±1 % | ±0.5 % | | □ |
| Phase-to-phase voltage | | 0.05 to 1.2 Unp | ±1 % | ±0.5 % | ■ | |
| Phase-to-neutral voltage | | 0.05 to 1.2 Vnp | ±1 % | ±0.5 % | ■ | |
| Residual voltage | | 0.015 to 3 Vnp | ±1 % | ±1 % | | |
| Positive sequence voltage | | 0.05 to 1.2 Vnp | ±5 % | ±2 % | | |
| Negative sequence voltage | | 0.05 to 1,2 Vnp | - | ±2 % | | |
| Frequency Sepam series 20 | | 50 ±5 Hz or 60 ±5 Hz | ±0.05 Hz | - | ■ | |
| Frequency Sepam series 40 | | 25 to 65 Hz | - | ±0.02 Hz | ■ | |
| Active power | | 0.015 Sn(2) to 999 MW | - | ±1 % | ■ | |
| Reactive power | | 0.015 Sn(2) to 999 Mvar | - | ±1 % | ■ | |
| Apparent power | | 0.015 Sn(2) to 999 MVA | - | ±1 % | ■ | |
| Peak demand active power | | 0.015 Sn(2) to 999 MW | - | ±1 % | | □ |
| Peak demand reactive power | | 0.015 Sn(2) to 999 Mvar | - | ±1 % | | □ |
| Power factor | | -1 to +1 (CAP/IND) | - | ±1 % | | |
| Calculated active energy | | 0 to $2.1.10^8$ MW.h | - | ±1 % ±1 digit | | □ |
| Calculated reactive energy | | 0 to $2.1.10^8$ Mvar.h | - | ±1 % ±1 digit | | □ |
| Temperature | | -30 to +200 °C or -22 to +392 °F | ±1 °C from +20 to +140 °C | ±1 °C from +20 to +140 °C | ■ | |
| **Network diagnosis assistance** | | | | | | |
| Tripping context | | | | | | □ |
| Phase tripping current | | 0.1 to 40 In | ±5 % | ±5 % | | □ |
| Earth fault tripping current | | 0.1 to 20 In0 | ±5 % | ±5 % | | □ |
| Negative sequence / unbalance | | 10 to 500 % of Ib | ±2 % | ±2 % | | |
| Phase displacement φ0 (between V0 and I0) | | 0 to 359° | - | ±2° | | |
| Phase displacement φ1, φ2, φ3 (between V and I) | | 0 to 359° | - | ±2° | | |
| Disturbance recording | | | | | | □ |
| **Machine operating assistance** | | | | | | |
| Thermal capacity used | | 0 to 800 % (100 % for I phase = Ib) | ±1 % | ±1 % | ■ | □ |
| Remaining operating time before overload tripping | | 0 to 999 mn | ±1 mn | ±1 mn | | |
| Waiting time after overload tripping | | 0 to 999 mn | ±1 mn | ±1 mn | | |
| Running hours counter / operating time | | 0 to 65535 hours | ±1 % or ±0.5 h | ±1 % or ±0.5 h | | □ |
| Starting current | | 1.2 Ib to 24 In | ±5 % | ±5 % | | □ |
| Starting time | | 0 to 300 s | ±300 ms | ±300 ms | | □ |
| Number of starts before inhibition | | 0 to 60 | 1 | 1 | | |
| Start inhibit time | | 0 to 360 mn | ±1 mn | ±1 mn | | |
| Cooling time constant | | 5 to 600 mn | - | ±5 mn | | |
| **Switchgear diagnosis assistance** | | | | | | |
| Cumulative breaking current | | 0 to 65535 $kA^2$ | ±10 % | ±10 % | | □ |
| Number of operations | | 0 to $4.10^9$ | 1 | 1 | | □ |
| Operating time | | 20 to 100 ms | ±1 ms | ±1 ms | | □ |
| Charging time | | 1 to 20 s | ±0.5 s | ±0.5 s | | □ |

■ *available on MSA141 analog output module, according to setup.*
□ *saved in the event of auxiliary supply outage.*
***(1)*** *Under reference conditions (IEC 60255-6), typical accuracy at In or Unp, cosφ > 0.8.*
***(2)*** *Sn: apparent power, = √3.Unp.In.*
***(3)*** *Measurement up to 0.02 In for information purpose.*



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## Current protection functions

### ANSI 50/51 - Phase overcurrent

Phase-to-phase short-circuit protection, sensitive to the highest phase current measured.

**Characteristics**

- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- with or without timer hold

With Sepam series 40, tripping can be confirmed or unconfirmed, according to parameter setting:

- unconfirmed tripping: standard
- tripping confirmed by negative sequence overvoltage protection (ANSI 47, unit 1), as backup for distant 2-phase short-circuits
- tripping confirmed by undervoltage protection (ANSI 27, unit 1), as backup for phase-to-phase short-circuits in networks with low short-circuit power.

### ANSI 50N/51N or 50G/51G - Earth fault

Earth fault protection based on measured or calculated residual current values:

- ANSI 50N/51N: residual current calculated or measured by 3 phase current sensors
- ANSI 50G/51G: residual current measured directly by a specific sensor.

**Characteristics**

- 2 groups of settings
- Definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- with or without timer hold
- second harmonic restraint to ensure stability during transformer energizing, activated by parameter setting.

### ANSI 50BF - Breaker failure

If a breaker fails to be triggered by a tripping order, as detected by the non-extinction of the fault current, this backup protection sends a tripping order to the upstream or adjacent breakers.

### ANSI 46 - Negative sequence / unbalance

Protection against phase unbalance, detected by the measurement of negative sequence current:

- sensitive protection to detect 2-phase faults at the ends of long lines
- protection of equipment against temperature build-up, caused by an unbalanced power supply, phase inversion or loss of phase, and against phase current unbalance.

**Characteristics**

- Sepam series 20:
  - 1 definite time (DT) curve
  - 1 specific Schneider IDMT curve.
- Sepam series 40:
  - 1 definite time (DT) curve
  - 7 IDMT curves: 3 IEC curves, 3 IEEE curves and 1 specific Schneider curve.

### ANSI 49RMS - Thermal overload

Protection against thermal damage caused by overloads on machines (transformers, motors or generators).
The thermal capacity used is calculated according to a mathematical model which takes into account:

- current RMS values
- ambient temperature
- negative sequence current, a cause of motor rotor temperature rise.

The thermal capacity used calculations may be used to calculate predictive data for process control assistance.
The protection may be inhibited by a logic input when required by process control conditions.

**Characteristics**

- 2 groups of settings
- 1 adjustable alarm set point
- 1 adjustable tripping set point
- adjustable initial thermal capacity used setting, to adapt protection characteristics to fit manufacturer's thermal withstand curves
- equipment heating and cooling time constants.

With Sepam series 40, the cooling time constant may be calculated automatically based on measurement of the equipment temperature by a sensor.

## Recloser

### ANSI 79

Automation device used to limit down time after tripping due to transient or semi-permanent faults on overhead lines. The recloser orders automatic reclosing of the breaking device after the time delay required to restore the insulation has elapsed. Recloser operation is easy to adapt for different operating modes by parameter setting.

**Characteristics**

- 1 to 4 reclosing cycles, each cycle has an adjustable dead time
- adjustable, independent reclaim time and safety time until recloser ready time delays
- cycle activation linked to instantaneous or time-delayed short-circuit protection function (ANSI 50/51, 50N/51N, 67, 67N/67NC) outputs by parameter setting
- inhibition/locking out of recloser by logic input.


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# Directional current protection

## ANSI 67 - Directional phase overcurrent

Phase-to-phase short-circuit protection, with selective tripping according to fault current direction.
It comprises a phase overcurrent function associated with direction detection, and picks up if the phase overcurrent function in the chosen direction (line or busbar) is activated for at least one of the 3 phases.

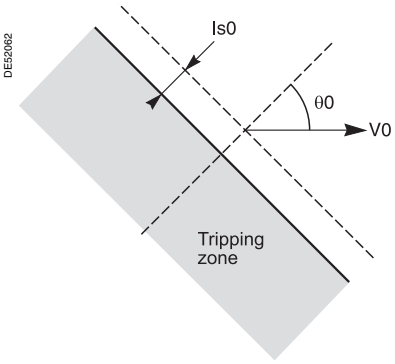
**Characteristics**
- 2 groups of settings
- instantaneous or time-delayed tripping
- choice of tripping direction
- definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- with voltage memory to make the protection insensitive to loss of polarization voltage at the time of the fault
- with or without timer hold.

## ANSI 67N/67NC - Directional earth fault

Earth fault protection, with selective tripping according to fault current direction.
3 types of operation:
- type 1: the protection function uses the projection of the I0 vector
- type 2: the protection function uses the I0 vector magnitude with half-plane tripping zone
- type 3: the protection function uses the I0 vector magnitude with angular sector tripping zone

**ANSI 67N/67NC type 1**
Directional earth fault protection for impedant, isolated or compensated neutral systems, based on the projection of measured residual current.

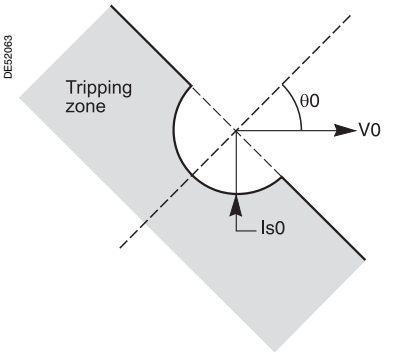
**Type 1 characteristics**
- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) curve
- choice of tripping direction
- characteristic projection angle
- no timer hold
- with voltage memory to make the protection insensitive to recurrent faults in compensated neutral systems.




*Tripping characteristic of ANSI 67N/67NC type 1 protection (characteristic angle θ0 ≠ 0°).*

**ANSI 67N/67NC type 2**
Directional overcurrent protection for impedance and solidly earthed systems, based on measured or calculated residual current.
It comprises an earth fault function associated with direction detection, and picks up if the earth fault function in the chosen direction (line or busbar) is activated.

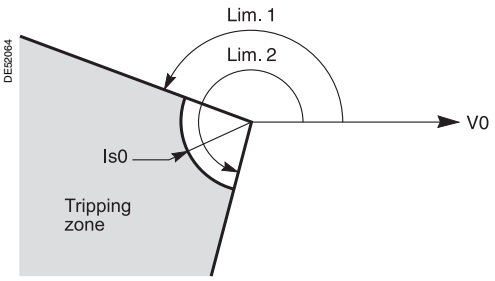
**Type 2 characteristics**
- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- choice of tripping direction
- with or without timer hold.




*Tripping characteristic of ANSI 67N/67NC type 2 protection (characteristic angle θ0 ≠ 0°).*

**ANSI 67N/67NC type 3**
Directional overcurrent protection for distribution networks in which the neutral earthing system varies according to the operating mode, based on measured residual current.
It comprises an earth fault function associated with direction detection (angular sector tripping zone defined by 2 adjustable angles), and picks up if the earth fault function in the chosen direction (line or busbar) is activated.
This protectionfunction complies with the Enel DK5600 specification.

**Type 3 characteristics**
- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) curve
- choice of tripping direction
- no timer hold




*Tripping characteristic of ANSI 67N/67NC type 3 protection.*



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## Directional power protection functions

### ANSI 32P - Directional active overpower

Two-way protection based on calculated active power, for the following applications:

- active overpower protection to detect overloads and allow load shedding
- reverse active power protection:
  - against generators running like motors when the generators consume active power
  - against motors running like generators when the motors supply active power.

### ANSI 32Q/40 - Directional reactive overpower

Two-way protection based on calculated reactive power to detect field loss on synchronous machines:

- reactive overpower protection for motors which consume more reactive power with field loss
- reverse reactive overpower protection for generators which consume reactive power with field loss.

## Machine protection functions

### ANSI 37 - Phase undercurrent

Protection of pumps against the consequences of a loss of priming by the detection of motor no-load operation.
It is sensitive to a minimum of current in phase 1, remains stable during breaker tripping and may be inhibited by a logic input.

### ANSI 48/51LR/14 - Locked rotor / excessive starting time

Protection of motors against overheating caused by:

- excessive motor starting time due to overloads (e.g. conveyor) or insufficient supply voltage.

The reacceleration of a motor that is not shut down, indicated by a logic input, may be considered as starting.

- locked rotor due to motor load (e.g. crusher):
  - in normal operation, after a normal start
  - directly upon starting, before the detection of excessive starting time, with detection of locked rotor by a zero speed detector connected to a logic input, or by the underspeed function.

### ANSI 66 - Starts per hour

Protection against motor overheating caused by:

- too frequent starts: motor energizing is inhibited when the maximum allowable number of starts is reached, after counting of:
  - starts per hour (or adjustable period)
  - consecutive motor hot or cold starts (reacceleration of a motor that is not shut down, indicated by a logic input, may be counted as a start)
- starts too close together in time: motor re-energizing after a shutdown is only allowed after an adjustable waiting time.

### ANSI 50V/51V - Voltage-restrained overcurrent

Phase-to-phase short-circuit protection, for generators. The current tripping set point is voltage-adjusted in order to be sensitive to faults close to the generator which cause voltage drops and lowers the short-circuit current.

**Characteristics**

- instantaneous or time-delayed tripping
- definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- with or without timer hold.

### ANSI 26/63 - Thermostat/Buchholz

Protection of transformers against temperature rise and internal faults via logic inputs linked to devices integrated in the transformer.

### ANSI 38/49T - Temperature monitoring

Protection that detects abnormal temperature build-up by measuring the temperature inside equipment fitted with sensors:

- transformer: protection of primary and secondary windings
- motor and generator: protection of stator windings and bearings.

**Characteristics**

- Sepam series 20: 8 Pt100, NI100 or Ni120 type RTDs
- Sepam series 40: 16 Pt100, NI100 or Ni120 type RTDs
- 2 adjustable independent set points for each RTD (alarm and trip).


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## Voltage protection functions

### ANSI 27D - Positive sequence undervoltage
Protection of motors against faulty operation due to insufficient or unbalanced network voltage, and detection of reverse rotation direction.

### ANSI 27R - Remanent undervoltage
Protection used to check that remanent voltage sustained by rotating machines has been cleared before allowing the busbar supplying the machines to be re-energized, to avoid electrical and mechanical transients.

### ANSI 27 - Undervoltage
Protection of motors against voltage sags or detection of abnormally low network voltage to trigger automatic load shedding or source transfer.
Works with phase-to-phase voltage (Sepam series 20 and Sepam series 40) or phase-to-neutral voltage (Sepem series 40 only), each voltage being monitored separately.

### ANSI 59 - Overvoltage
Detection of abnormally high network voltage or checking for sufficient voltage to enable source transfer.
Works with phase-to-phase or phase-to-neutral voltage, each voltage being monitored separately.

### ANSI 59N - Neutral voltage displacement
Detection of insulation faults by measuring residual voltage in isolated neutral systems.

### ANSI 47 - Negative sequence overvoltage
Protection against phase unbalance resulting from phase inversion, unbalanced supply or distant fault, detected by the measurement of negative sequence voltage.

## Frequency protection functions

### ANSI 81H - Overfrequency
Detection of abnormally high frequency compared to the rated frequency, to monitor power supply quality.

### ANSI 81L - Underfrequency
Detection of abnormally low frequency compared to the rated frequency, to monitor power supply quality.
The protection may be used for overall tripping or load shedding.
Protection stability is ensured in the event of the loss of the main source and presence of remanent voltage by a restraint in the event of a continuous decrease of the frequency, which is activated by parameter setting.

### ANSI 81R - Rate of change of frequency
Protection function used for fast disconnection of a generator or load shedding control. Based on the calculation of the frequency variation, it is insensitive to transient voltage disturbances and therefore more stable than a phase-shift protection function.

**Disconnection**
In installations with autonomous production means connected to a utility, the "rate of change of frequency" protection function is used to detect loss of the main system in view of opening the incoming circuit breaker to:
- protect the generators from a reconnection without checking synchronization
- avoid supplying loads outside the installation.

**Load shedding**
The "rate of change of frequency" protection function is used for load shedding in combination with the underfrequency protection to:
- either accelerate shedding in the event of a large overload
- or inhibit shedding following a sudden drop in frequency due to a problem that should not be solved by shedding.




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## Current IDMT tripping curves

Multiple IDMT tripping curves are offered, to cover most applications:
- IEC curves (SIT, VIT/LTI, EIT)
- IEEE curves (MI, VI, EI)
- usual curves (UIT, RI, IAC).

The curve equations are given page 96.

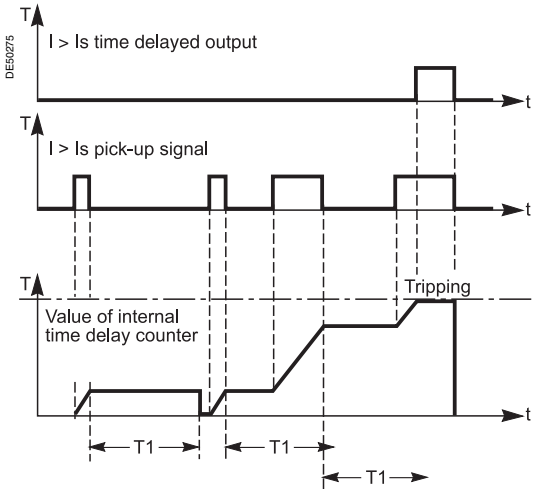
## Setting of IDMT tripping curves, time delay T or TMS factor

The time delays of current IDMT tripping curves (except for customized and RI curves) may be set as follows:
- time T, operating time at 10 x Is
- TMS factor, factor shown as T/β (see curve equation page 96).

## Timer hold

The adjustable timer hold T1 is used for:
- detection of restriking faults (DT curve)
- coordination with electromechanical relays (IDMT curve).

Timer hold may be inhibited if necessary.




*Detection of restriking faults with adjustable timer hold.*

## 2 groups of settings

### Phase-to-phase and phase-to-earth short-circuit protection

Each unit has 2 groups of settings, A and B, to adapt the settings to suit the network configuration.
The active group of settings (A or B) is set by a logic input or the communication link.

**Example of use: normal / backup mode network**
- group A for network protection in normal mode, when the network is supplied by the utility
- group B for network protection in backup mode, when the network is supplied by a backup generator.

### Thermal overload for machines

Each unit has 2 groups of settings to protect equipment that has two operating modes.

**Examples of use:**
- transformers: switching of groups of settings by logic input, according to transformer ventilation operating mode, natural or forced ventilation (ONAN or ONAF)
- motors: switching of groups of settings according to current set point, to take into account the thermal withstand of motors with locked rotors.

## Summary table

| Characteristics | Protection functions |
|---|---|
| 2 groups of settings A and B | 50/51, 50N/51N, 67, 67N/67NC |
| 2 groups of settings, operating modes 1 and 2 | 49RMS Machine |
| IEC IDMT curves | 50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2, 46 |
| IEEE IDMT curves | 50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2, 46 |
| Usual IDMT curves | 50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2 |
| Timer hold | 50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2 |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# Protection
## Setting ranges



| Functions | Settings | | Time delays |
|---|---|---|---|
| **ANSI 27 - Phase-to-phase undervoltage** | | | |
| | 5 to 100 % of Unp | | 0.05 s to 300 s |
| **ANSI 27D/47 - Positive sequence undervoltage** | | | |
| | 15 to 60 % of Unp | | 0.05 s to 300 s |
| **ANSI 27R - Remanent undervoltage** | | | |
| | 5 to 100 % of Unp | | 0.05 s to 300 s |
| **ANSI 27S - Phase-to-neutral undervoltage** | | | |
| | 5 to 100 % of Vnp | | 0.05 s to 300 s |
| **ANSI 32P - Directional active overpower** | | | |
| | 1 to 120 % of Sn (3) | | 0.1 s to 300 s |
| **ANSI 32Q/40 - Directional reactive overpower** | | | |
| | 5 to 120 % of Sn (3) | | 0.1 s to 300 s |
| **ANSI 37 - Phase undercurrent** | | | |
| | 0.15 to 1 Ib | | 0.05 s to 300 s |
| **ANSI 38/49T - Temperature monitoring (8 or 16 RTDs)** | | | |
| Alarm and trip set points | 0 to 180 °C (or 32 to 356 °F) | | |
| **ANSI 46 - Negative sequence / unbalance** | | | |
| Definite time | 0.1 to 5 Ib | | 0.1 s to 300 s |
| IDMT | 0.1 to 0.5 Ib (Schneider Electric) 0.1 to 1 Ib (CEI, IEEE) | | 0.1 s to 1 s |
| Tripping curve | Schneider Electric | | |
| | CEI: SIT/A, LTI/B, VIT/B, EIT/C (2) | | |
| | IEEE: MI (D), VI (E), EI (F) (2) | | |
| **ANSI 47 - Negative sequence overvoltage** | | | |
| | 1 to 50 % of Unp | | 0.05 s to 300 s |
| **ANSI 48/51LR/14 - Excessive starting time, locked rotor** | | | |
| | 0.5 Ib to 5 Ib | ST starting time | 0.5 s to 300 s |
| | | LT and LTS time delays | 0.05 s to 300 s |
| **ANSI 49RMS - Thermal overload** | | **Rate 1** | **Rate 2** |
| Accounting for negative sequence component | | 0 - 2,25 - 4,5 - 9 | |
| Time constant | Heating | T1: 5 to 120 mn | T1: 5 to 120 mn |
| | Cooling | T2: 5 to 600 mn | T2: 5 to 600 mn |
| Alarm and tripping set points | | 50 to 300 % of rated thermal capacity | |
| Cold curve modification factor | | 0 to 100 % | |
| Switching of thermal settings conditions | | By logic input | |
| | | By Is set point adjustable from 0.25 to 8 Ib | |
| Maximum equipment temperature | | 60 to 200 °C | |
| **ANSI 50/51 - Phase overcurrent** | | | |
| | **Tripping time delay** | **Timer hold** | |
| Tripping curve | Definite time | DT | |
| | SIT, LTI, VIT, EIT, UIT (1) | DT | |
| | RI | DT | |
| | CEI: SIT/A, LTI/B, VIT/B, EIT/C | DT or IDMT | |
| | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | |
| | IAC: I, VI, EI | DT or IDMT | |
| Is set point | 0.1 to 24 In | Definite time | Inst ; 0.05 s to 300 s |
| | 0.1 to 2.4 In | IDMT | 0.1 s to 12.5 s at 10 Is |
| Timer hold | Definite time (DT ; timer hold) | | Inst ; 0.05 s to 300 s |
| | IDMT (IDMT ; reset time) | | 0.5 s to 20 s |
| Confirmation (2) | None | | |
| | By negative sequence overvoltage | | |
| | By phase-to-phase undervoltage | | |
| **ANSI 50BF - Breaker failure** | | | |
| Presence of current | 0.2 to 2 In | | |
| Operating time | 0.05 s to 300 s | | |

***(1)*** *Tripping as of 1.2 Is.*
***(2)*** *Sepam series 40 only.*
***(3)*** *Sn = $\sqrt{3}$ .In.Unp.*


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# Protection
## Setting ranges



| Functions | Settings | | Time delays |
|---|---|---|---|
| **ANSI 50N/51N or 50G/51G - Earth fault / Sensitive earth fault** | | | |
| | **Tripping time delay** | **Timer hold** | |
| Tripping curve | Definite time | DT | |
| | SIT, LTI, VIT, EIT, UIT (1) | DT | |
| | RI | DT | |
| | CEI: SIT/A,LTI/B, VIT/B, EIT/C | DT or IDMT | |
| | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | |
| | IAC: I, VI, EI | DT or IDMT | |
| Is0 set point | 0.1 to 15 In0 | Definite time | Inst ; 0.05 s to 300 s |
| | 0.1 to 1 In0 | IDMT | 0.1 s to 12.5 s at 10 Is0 |
| Timer hold | Definite time (DT ; timer hold) | | Inst ; 0.05 s to 300 s |
| | IDMT (IDMT ; reset time) | | 0.5 s to 20 s |
| **ANSI 50V/51V - Voltage-restrained overcurrent** | | | |
| | **Tripping time delay** | **Timer hold** | |
| Tripping curve | Definite time | DT | |
| | SIT, LTI, VIT, EIT, UIT (1) | DT | |
| | RI | DT | |
| | CEI: SIT/A, LTI/B, VIT/B, EIT/C | DT or IDMT | |
| | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | |
| | IAC: I, VI, EI | DT or IDMT | |
| Is set point | 0.5 to 24 In | Definite time | Inst ; 0.05 s to 300 s |
| | 0.5 to 2,4 In | IDMT | 0.1 s to 12.5 s at 10 Is |
| Timer hold | Definite time (DT ; timer hold) | | Inst ; 0.05 s to 300 s |
| | IDMT (IDMT ; reset time) | | 0.5 s to 20 s |
| **ANSI 59 - Overvoltage** | **Phase-to-phase** | **Phase-to-neutral (2)** | |
| | 50 to 150 % of Unp | 50 to 150 % of Vnp | 0.05 s to 300 s |
| **ANSI 59N - Neutral voltage displacement** | | | |
| | 2 to 80 % of Unp | | 0.05 s to 300 s |
| **ANSI 66 - Starts per hour** | | | |
| Starts per period | 1 to 60 | Period | 1 to 6 hr |
| Consecutive starts | 1 to 60 | Time between starts | 0 to 90 mn |
| **ANSI 67 - Directional phase overcurrent** | | | |
| | **Tripping time delay** | **Timer hold** | |
| Tripping curve | Definite time | DT | |
| | SIT, LTI, VIT, EIT, UIT (1) | DT | |
| | RI | DT | |
| | CEI: SIT/A, LTI/B, VIT/B, EIT/C | DT or IDMT | |
| | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | |
| | IAC: I, VI, EI | DT or IDMT | |
| Is set point | 0.1 to 24 In | Definite time | Inst ; 0.05 s to 300 s |
| | 0.1 to 2,4 In | IDMT | 0.1 s to 12.5 s at 10 Is |
| Timer hold | Definite time (DT ; timer hold) | | Inst ; 0.05 s to 300 s |
| | IDMT (IDMT ; reset time) | | 0.5 s to 20 s |
| Characteristic angle | 30°, 45°, 60° | | |

***(1)*** *Tripping as of 1.2 Is.*
***(2)*** *Sepam series 40 only.*


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# Protection
## Setting ranges



| Functions | | Settings | | Time delays |
|---|---|---|---|---|
| **ANSI 67N/67NC type 1 - Directional earth fault, according to I0 projection** | | | | |
| Characteristic angle | | -45°, 0°, 15°, 30°, 45°, 60°, 90° | | |
| Is0 set point | | 0.1 to 15 In0 | Definite time | Inst ; 0.05 s to 300 s |
| Vs0 set point | | 2 to 80 % of Un | | |
| Memory time | | T0mem time | 0 ; 0.05 s to 300 s | |
| | | V0mem validity set point | 0 ; 2 to 80 % of Unp | |
| **ANSI 67N/67NC type 2 - Directional earth fault, according to I0 magnitude with half-plan tripping zone** | | | | |
| Characteristic angle | | -45°, 0°, 15°, 30°, 45°, 60°, 90° | | |
| | | **Tripping time delay** | **Timer hold** | |
| Tripping curve | | Definite time | DT | |
| | | SIT, LTI, VIT, EIT, UIT (1) | DT | |
| | | RI | DT | |
| | | CEI: SIT/A,LTI/B, VIT/B, EIT/C | DT or IDMT | |
| | | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | |
| | | IAC: I, VI, EI | DT or IDMT | |
| Is0 set point | | 0.5 to 15 In0 | Definite time | Inst ; 0.05 s to 300 s |
| | | 0.5 to 1 In0 | IDMT | 0.1 s to 12.5 s at 10 Is0 |
| Vs0 set point | | 2 to 80 % of Unp | | |
| Timer hold | | Definite time (DT ; timer hold) | | Inst ; 0.05 s to 300 s |
| | | IDMT (IDMT ; reset time) | | 0.5 s to 20 s |
| **ANSI 67N/67NC type 3 - Directional earth fault, according to I0 magnitude with angular sector tripping zone** | | | | |
| Angle at start of tripping zone | | 0° to 359° | | |
| Angle at end of tripping zone | | 0° to 359° | | |
| Is0 set point | CSH core balance CT (2 A rating) | 0.1 A to 30 A | Definite time | Inst ; 0.05 to 300 s |
| | 1 A CT + CSH30 (sensitive, In0 = 0.1 CT In) | 0.05 to 15 In0 (min. 0.1 A) | | |
| | Core balance CT + ACE990 (range 1) | 0.05 to 15 In0 (min. 0.1 A) | | |
| Vs0 set point | | Calculated V0 (sum of 3 voltages) | 2 to 80 % of Unp | |
| | | Measured V0 (external VT) | 0.6 to 80 % of Unp | |
| **ANSI 81H - Overfrequency** | | | | |
| Sepam series 20 | | 50 to 53 Hz or 60 to 63 Hz | | 0.1 s to 300 s |
| Sepam series 40 | | 50 to 55 Hz or 60 to 65 Hz | | 0.1 s to 300 s |
| **ANSI 81L - Underfrequency** | | | | |
| Sepam series 20 | | 45 to 50 Hz or 55 to 60 Hz | | 0.1 s to 300 s |
| Sepam series 40 | | 40 to 50 Hz or 50 to 60 Hz | | 0.1 s to 300 s |
| **ANSI 81R - Rate of change of frequency** | | | | |
| | | 0.1 to 10 Hz/s | | Inst ; 0.15 s to 300 s |

***(1)*** *Tripping as of 1.2 Is.*



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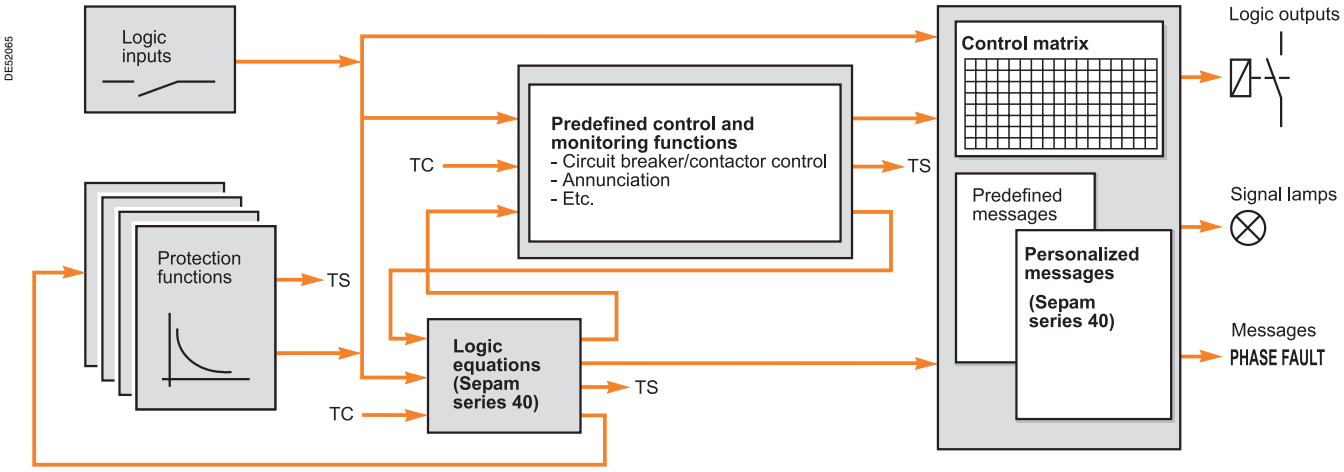
# Control and monitoring
## Description



Sepam performs all the control and monitoring functions required for electrical network operation:
■ the main control and monitoring functions are predefined and fit the most frequent cases of use. They are ready to use and are implemented by simple parameter setting after the necessary logic inputs / outputs are assigned.
■ the predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:
□ customization of the control matrix by changing the assignment of output relays, LEDs and annunciation messages
□ logic equation editor, to adapt and complete the predefined control and monitoring functions (Sepam series 40 only)
□ creation of personalized messages for local annunciation (Sepam series 40 only).

### Operating principle

The processing of each control and monitoring function may be broken down into 3 phases:
■ acquisition of input data:
□ results of protection function processing
□ external logic data, connected to the logic inputs of an optional MES114 input / output module
□ remote control orders (TC) received via the Modbus communication link
■ actual processing of the control and monitoring function
■ utilization of the processing results:
□ activation of output relays to control a device
□ information sent to the facility manager:
- by message and/or LED on the Sepam display and SFT2841 software
- by remote indication (TS) via the Modbus communication link.




### Logic inputs and outputs

The number of Sepam inputs / outputs must be adapted to fit the control and monitoring functions used.
The 4 outputs included in the Sepam base unit (series 20 or series 40) may be extended by adding one MES114 modules with 10 logic inputs and 4 output relays.
After selecting the MES114 type required by an application, the logic inputs must be assigned to functions. The functions are chosen from a list which covers the whole range of possible uses. The functions are adapted to meet needs within the limits of the logic inputs available. The inputs may also be inverted for undervoltage type operation.
A default input / output assignment is proposed for the most frequent uses.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# Control and monitoring
## Description of predefined functions



Each Sepam contains the appropriate predefined control and monitoring functions for the chosen application.

### ANSI 94/69 - Commande disjoncteur/contacteur

Control of breaking devices equipped with different types of closing and tripping coils:
- circuit breakers with shunt or undervoltage trip coils
- latching contactors with shunt trip coils

The function processes all breaking device closing and tripping conditions, based on:
- protection functions
- breaking device status data
- remote control orders
- specific control functions for each application (e.g. recloser).

The function also inhibits breaking device closing, according to the operating conditions.

With Sepam series 20, it is necessary to use an MES114 module in order to have all the required logic inputs.

### ANSI 86 - Latching / acknowledgement

The tripping outputs for all the protection functions and all the logic inputs can be latched individually. The latched information is saved in the event of an auxiliary power failure.
(The logic outputs cannot be latched.)

All the latched data may be acknowledged:
- locally, with the  key
- remotely via a logic input
- or via the communication link.

The Latching/acknowledgement function, when combined with the circuit breaker/contactor control function, can be used to create the ANSI 86 "Lockout relay" function.

### ANSI 68 - Logic discrimination

This function provides:
- perfect tripping discrimination with phase-to-phase and phase-to-earth short-circuits, on all types of network
- faster tripping of the breakers closest to the source (solving the drawback of conventional time discrimination).

Each Sepam is capable of:
- sending a blocking input when a fault is detected by the phase overcurrent and earth fault protection functions, which may or may not be directional (ANSI 50/51, 50N/51N, 67 or 67N/67NC)
- and receiving blocking inputs which inhibit protection tripping. A saving mechanism ensures continued operation of the protection in the event of a blocking link failure.

### Output relay testing

Each output relay is activated for 5 seconds, to make it simpler to check output connections and connected switchgear operation.



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# Control and monitoring
## Description of predefined functions




*Local indications on the Sepam front panel.*

### ANSI 30 - Local annunciation

**LED indication on the Sepam front panel**

■ 2 LEDs indicate the unit operating status:
□ green LED ON: Sepam on
□ red "key" LED: Sepam unavailable (initialization phase or detection of an internal failure)
■ 9 yellow LEDs:
□ pre-assigned and identified by standard removable labels
□ the SFT2841 software tool may be used to assign LEDs and personalize labels.

**Local annunciation on Sepam's advanced UMI**

Events and alarms may be indicated locally on Sepam's advanced UMI by:
■ messages on the display unit, available in 2 languages:
□ english, factory-set messages, not modifiable
□ local language, according to the version delivered (the language version is chosen when Sepam is set up)
■ the lighting up of one of the 9 yellow LEDs, according to the LED assignment, which is set using SFT2841.

**Alarm processing**

■ when an alarm appears, the related message replaces the current display and the related LED goes on.
The number and type of messages depend on the type of Sepam. The messages are linked to Sepam functions and may be viewed on the front-panel display and in the SFT2841 "Alarms" screen.
■ to clear the message from the display, press the clear key
■ after the fault has disappeared, press the reset key: the light goes off and Sepam is reset
■ the list of alarm messages remains accessible (⚠ key) and may be cleared by pressing the clear key.


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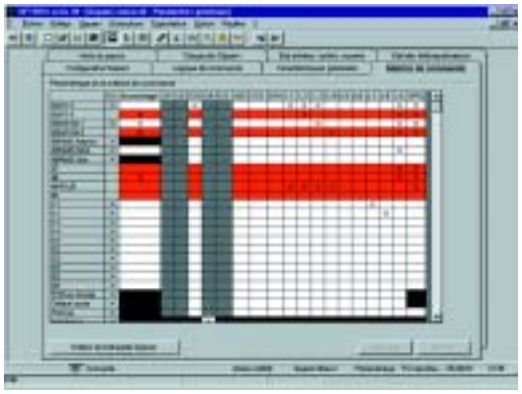
# Control and monitoring
## Adaptation of predefined functions using the SFT2841 software

The predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:
- customization of the control matrix by changing the assignment of output relays, LEDs and annunciation messages
- logic equation editor, to adapt and complete the predefined control and monitoring functions (Sepam series 40 only)
- creation of personalized messages for local annunciation (Sepam series 40 only).



PE50133



*SFT2841: control matrix.*

### Control matrix

The control matrix is a simple way to assign data from:
- protection functions
- control and monitoring functions
- logic inputs
- logic equations

to the following output data:
- output relays
- 9 LEDs on the front panel of Sepam
- messages for local annunciation
- triggering of disturbance recording.

### Logic equation editor (Sepam series 40)

The logic equation editor included in the SFT2841 software can be used to:
- complete protection function processing:
  - additional interlocking
  - conditional inhibition/validation of functions
  - etc.
- adapt predefined control functions: particular circuit breaker or recloser control sequences, etc.

A logic equation is created by grouping logic input data received from:
- protection functions
- logic inputs
- remote control orders

using the Boolean operators AND, OR, XOR, NOT, and automation functions such as time delays, bistables and time programmer.
Equation input is assisted and syntax checking is done systematically.

The result of an equation may then be:
- assigned to a logic output, LED or message via the control matrix
- transmitted by the communication link, as a new remote indication
- utilized by the circuit breaker/contactor control function to trip, close or inhibit breaking device closing
- used to inhibit or reset a protection function.

### Personalized alarm and operating messages (Sepam series 40)

The alarm and operating messages may be personalized using the SFT2841 software tool.
The new messages are added to the list of existing messages and may be assigned via the control matrix for display:
- on the Sepam display
- in the SFT2841 "Alarms" and "Alarm History" screens.



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# Base unit
## Presentation

*Base units are defined according to the following characteristics:*
- *type of User-Machine Interface (UMI)*
- *working language*
- *type of base unit connector*
- *type of current sensor connector.*



PE50492

*Sepam base unit (series 20 or series 40) with integrated advanced UMI.*

PE50493

*Sepam base unit (series 20 or series 40) with basic UMI.*

PE50494

*Customized Chinese advanced UMI.*

## User-Machine Interface

Two types of User-Machine Interfaces (UMI) are available for Sepam base units (series 20 or series 40):
- advanced UMI
- basic UMI.

The advanced UMI can be integrated in the base unit or installed remotely on the cubicle. Integrated and remote advanced UMIs offer the same functions.

A Sepam (series 20 or series 40) with a remote advanced UMI is made up of :
- a base unit with basic UMI, for mounting inside the LV compartment
- a remote advanced UMI (DSM303)
  - for flush mounting on the front panel of the cubicle in the location most suitable for the facility manager
  - for connection to the Sepam base unit using a prefabricated CCA77x cord.

The characteristics of the remote advanced UMI module (DSM303) are presented on page 151.

### Advanced UMI

**Comprehensive data for facility managers**

All the data required for local equipment operation may be displayed on demand:
- display of all measurement and diagnosis data in numerical format with units and/or in bar graphs
- display of operating and alarm messages, with alarm acknowledgment and Sepam resetting
- display and setting of all the Sepam parameters
- display and setting of all the parameters of each protection function
- display of Sepam and remote module versions
- output testing and logic input status display
- entry of 2 passwords to protect parameter and protection settings.

**Ergonomic data presentation**
- keypad keys identified by pictograms for intuitive navigation
- menu-guided access to data.
- graphical LCD screen to display any character or symbol
- excellent display quality under all lighting conditions: automatic contrast setting and backlit screen (user activated).

### Basic UMI

A Sepam with basic UMI offers an economical solution suited to installations that do not require local operation (managed by a remote monitoring and control system) or to replace electromechanical or analog electronic protections units with no additional operating needs.

The basic UMI includes:
- 2 signal lamps indicating Sepam operating status:
- 9 parameterizable yellow signal lamps equipped with a standard label
- reset button for clearing faults and resetting.

### Working language

All the texts and messages displayed on the advanced UMI are available in 2 languages:
- english, the default working language
- and a second language, which may be
  - french
  - spanish
  - another "local" language.

Please contact us regarding local language customization.

### Setting and operating software

SFT2841 setting and operating software can be used for easy setting of Sepam parameters and protection functions.

A PC containing the SFT2841 software is connected to the communication port on the front of the unit.



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# Base unit
Presentation



## Selection guide

| Base unit | With basic UMI | With integrated advanced UMI | With remote advanced UMI |
|---|---|---|---|
| |  PE50465 |  PE50466 |  PE50467 |
| **Functions** | | | |
| **Local indication** | | | |
| Metering and diagnosis data | | ■ | ■ |
| Alarms and operating messages | | ■ | ■ |
| Sepam parameter setting | | ■ | ■ |
| Protection setting | | ■ | ■ |
| Version of Sepam and remote modules | | ■ | ■ |
| Status of logic inputs | | ■ | ■ |
| **Local control** | | | |
| Alarm acknowledgement | ■ | ■ | ■ |
| Sepam reset | ■ | ■ | ■ |
| Output testing | | ■ | ■ |
| **Characteristics** | | | |
| **Screen** | | | |
| Size | | 128 x 64 pixels | 128 x 64 pixels |
| Automatic contrast setting | | ■ | ■ |
| Backlit screen | | ■ | ■ |
| **Keypad** | | | |
| Number of keys | 1 | 9 | 9 |
| **LEDs** | | | |
| Sepam operating status | 2 LEDs on front | 2 LEDs on front | ■ base unit: 2 LEDs on front<br>■ remote advanced UMI: 2 LEDs on front |
| Indication LEDs | 9 LEDs on front | 9 LEDs on front | 9 LEDs on remote advanced UMI |
| **Mounting** | | | |
| | Flush mounted on front of cubicle | Flush mounted on front of cubicle | ■ base unit with basic UMI, mounted at the back of the compartment using the AMT840 mounting plate<br>■ DSM303 remote advanced UMI module ,flush mounted on the front of the cubicle and connected to the base unit with the CCA77x prefabricated cord |



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# Base unit
Presentation



## Hardware characteristics

### Auxiliary power supply

Sepam series 20 and Sepam series 40 can be supplied by either of the following voltages:
- 24 to 250 V DC
- 110 to 240 V AC.

### Four relay outputs

The 4 relay outputs O1 to O4 on the base unit must be connected to connector (A). Each output can be assigned to a predetermined function using the SFT2841 software.
O1 and O2 are 2 control outputs with one NO contact, used by default for the switchgear control function:
- O1: switchgear tripping
- O2: switchgear closing inhibition.

O3 and O4 are 2 indication outputs:
- O3 has one NO contact
- O4 has one NO contact and one NC contact, and is used by default for the watchdog function.

### Main connector (A)

A choice of 2 types of removable, screw-lockable 20-pin connectors:
- CCA620 screw-type connector
- CCA622 ring lug connector.

### Phase current input connector

Current sensors connected to removable, screw-lockable connectors according to type of sensors used:
- CCA630 connector for 1 A or 5 A current transformers

or
- CCA670 connector for LPCT sensors.

The presence of these connectors is monitored.

### Voltage input connector

**Sepam B21 and B22**

Voltage sensors connected to the removable, screw-lockable CCT640 connector.
The presence of the CCT640 connector is monitored.

**Sepam series 40**

Voltage sensors connected to the 6-pin connector (E).
A choice of 2 types of removable, screw-lockable 6-pin connectors:
- CCA626 screw-type connector

or
- CCA627 ring lug connector.

The presence of the (E) connector is monitored.

PE50468

*Sepam unit with integrated advanced UMI and lead sealing accessory AMT852.*

## Mounting accessories

### AMT840 mounting plate

It is used to mount a Sepam with basic UMI inside the compartment with access to connectors on the rear panel.
Mounting used with remote advanced UMI module (DSM303).

### AMT852 lead sealing accessory

The AMT852 lead sealing accessory can be used to prevent unauthorized modification of the settings of Sepam series 20 and Sepam series 40 units with integrated advanced UMIs.
The accessory includes:
- a lead-sealable cover plate
- the screws required to secure the cover plate to the integrated advanced UMI of the Sepam unit.

***Note:** the AMT852 lead sealing accessory can secured only to the integrated advanced UMIs of Sepam series 20 and Sepam series 40 units with serial numbers higher than 0440000.*



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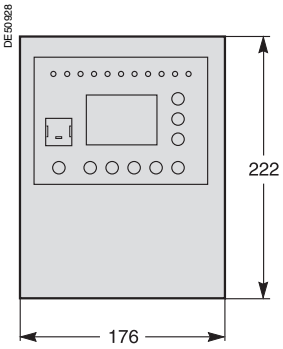
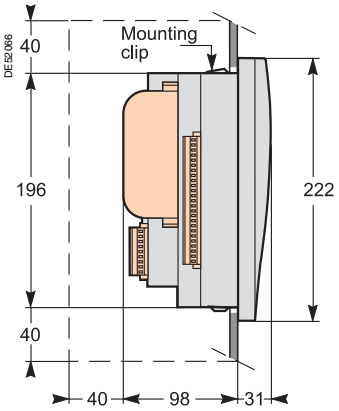
# Base unit
Dimensions



## Dimensions



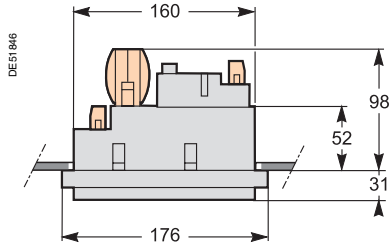

*Front view of Sepam.*




*Side view of Sepam with advanced UMI and MES114, flush-mounted in front panel.*

*Clearance for Sepam assembly and wiring.*

***(1)** With basic UMI: 23 mm.*

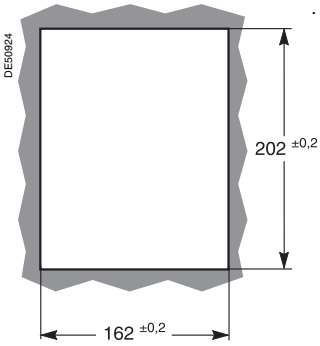



*Top view of Sepam with advanced UMI and MES114, flush-mounted in front panel.*

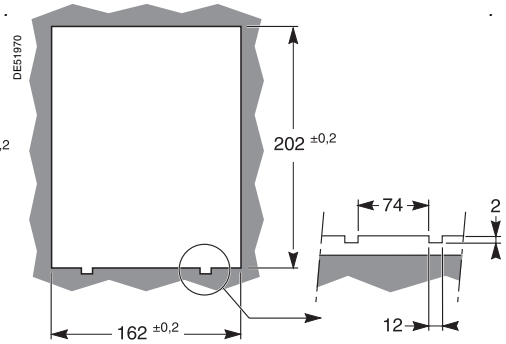
***(1)** With basic UMI: 23 mm.*

## Cut-out

Cutout accuracy must be complied with to ensure good withstand.




*Mounting plate thickness between 1.5 mm and 3 mm.*

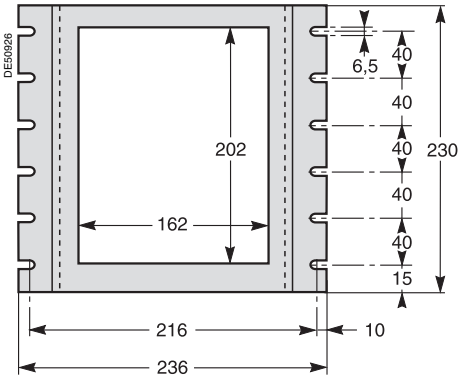



*Mounting plate thickness: 3.17 mm (0.125 inches).*

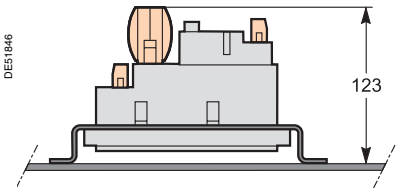
*Detailed view of notches.*

## Assembly with AMT840 mounting plate

Used to mount Sepam at the back of the compartment with access to the connectors on the rear panel.
Mounting associated with the use of the remote advanced UMI (DSM303).




*AMT840 mounting plate.*




*Sepam with basic UMI and MES114, mounted with AMT840.*
*Mounting plate: 2 mm thick.*



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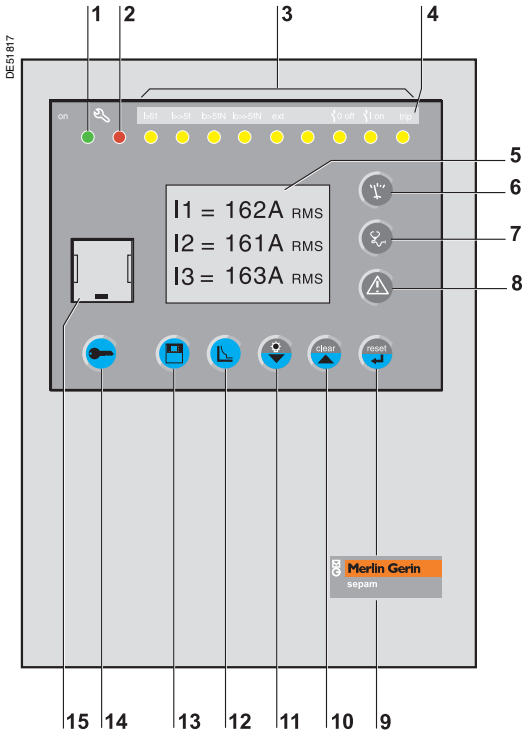
# Base unit
Description



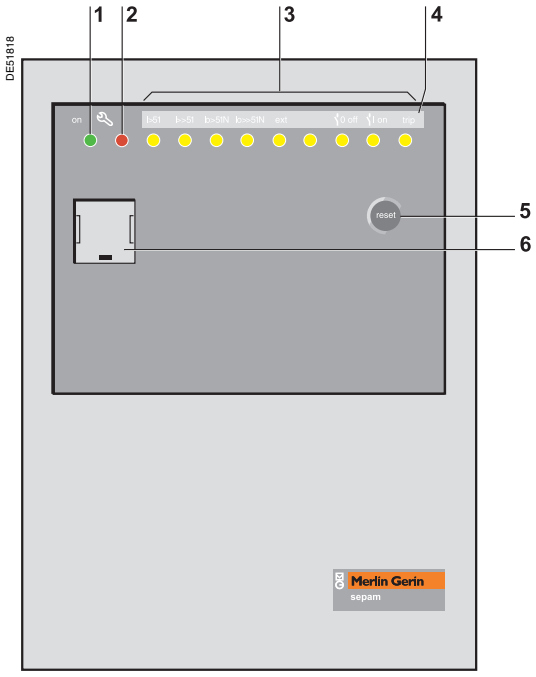
## Front panel with advanced UMI




**1** Green LED: Sepam on.
**2** Red LED: Sepam unavailable.
**3** 9 yellow indication LEDs.
**4** Label identifying the indication LEDs.
**5** Graphical LCD screen.
**6** Display of measurements.
**7** Display of switchgear, network and machine diagnosis data.
**8** Display of alarm messages.
**9** Sepam reset (or confirm data entry).
**10** Acknowledgement and clearing of alarms (or move cursor up).
**11** LED test (or move cursor down).
**12** Access to protection settings.
**13** Access to Sepam parameter setting.
**14** Entry of 2 passwords.
**15** PC connection port.

The " ↵, ▲, ▼ keys (**9**, **10**, **11**) are used to browse through the menus and to scroll through and accept the values displayed.

## Front panel with basic UMI




**1** Green LED: Sepam on.
**2** Red LED: Sepam unavailable.
**3** 9 yellow indication LEDs.
**4** Label identifying the indication LEDs.
**5** Acknowledgement / clearing of alarms and Sepam reset.
**6** PC connection port.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# Base unit
## Description



### Rear panel - Sepam series 20

**1** Base unit.

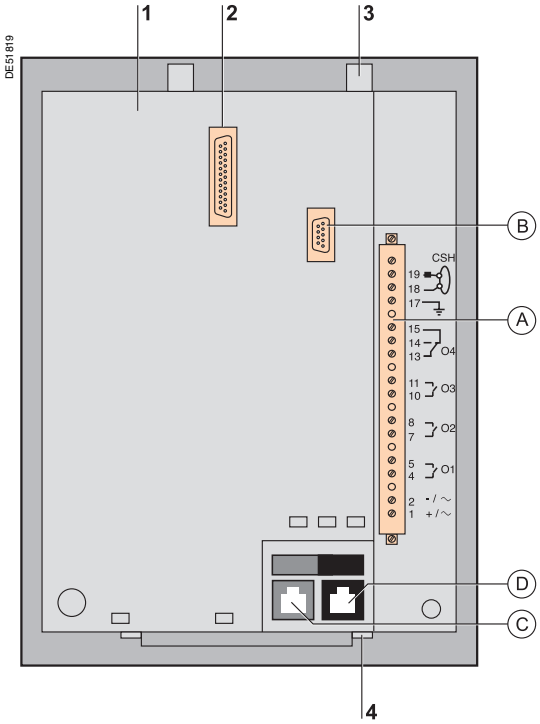
(A) 20-pin connector for:
- auxiliary power supply
- 4 relay outputs
- 1 residual current input (Sepam S20, T20, M20 only).

(B)
- Sepam S20, T20, M20: connector for 3 phase current I1, I2, I3 inputs
- Sepam B21 and B22: connector for 3 phase voltage V1, V2, V3 inputs and 1 residual voltage V0 input.

(C) Communication port.

(D) Remote module connection port.

**2** Connector for MES114 input/output module.
**3** 2 mounting clips.
**4** 2 locating nibs in flush-mounted position.




### Rear panel - Sepam series 40

**1** Base unit.

(A) 20-pin connector for:
- auxiliary poxer supply
- 4 relay outputs
- 1 residual current input.

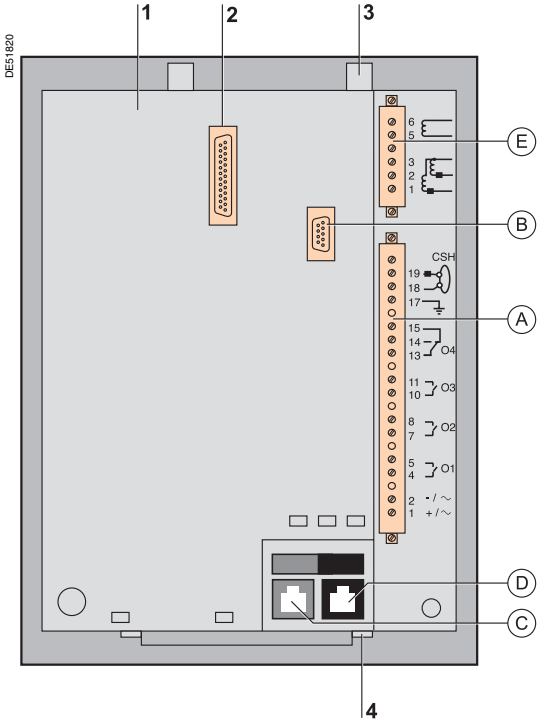
(B) Connector for 3 phase current I1, I2, I3 inputs.

(C) Communication port.

(D) Remote module connection port .

(E) 6-pin connector for 3 phase voltage V1, V2, V3 inputs.

**2** Connector for MES114 input/output module.
**3** 2 mounting clips.
**4** 2 locating nibs in flush-mounted position.





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# Base unit
## Technical characteristics



| Weight | Sepam series 20 | Sepam series 40 |
|---|---|---|
| Minimum weight (base unit with basic UMI and without MES114) | 1.2 kg | 1.4 kg |
| Maximum weight (base unit with advanced UMI and MES114) | 1.7 kg | 1.9 kg |

| Analog inputs | | | |
|---|---|---|---|
| Current transformer | Input impedance | < 0.001 Ω | |
| 1 A or 5 A CT (with CCA630) | Consumption | < 0.001 VA at 1 A | |
| 1 A to 6250 A ratings | | < 0.025 VA at 5 A | |
| | Rated thermal withstand | 4 In | |
| | 1-second overload | 100 In | |
| Voltage transformer | Input impedance | > 100 kΩ | |
| 220 V to 250 kV ratings | Input voltage | 100 to 230/√3 V | |
| | Rated thermal withstand | 240 V | |
| | 1-second overload | 480 V | |

| Temperature sensor input (MET148-2 module) | | |
|---|---|---|
| Type of sensor | Pt 100 | Ni 100 / 120 |
| Isolation from earth | None | None |
| Current injected in sensor | 4 mA | 4 mA |
| Maximum distance between sensor and module | 1 km | |

| Logic inputs | | MES114 | MES114E | | MES114F | |
|---|---|---|---|---|---|---|
| Voltage | | 24 to 250 V DC | 110 to 125 V DC | 110 V AC | 220 to 250 V DC | 220 to 240 V AC |
| Range | | 19.2 to 275 V DC | 88 to 150 V DC | 88 to 132 V AC | 176 to 275 V DC | 176 to 264 V AC |
| Frequency | | - | - | 47 to 63 Hz | - | 47 to 63 Hz |
| Typical consumption | | 3 mA | 3 mA | 3 mA | 3 mA | 3 mA |
| Typical switching threshold | | 14 V DC | 82 V DC | 58 V AC | 154 V DC | 120 V AC |
| Input limit voltage | At state 1 | ⩾ 19 V DC | ⩾ 88 V DC | ⩾ 88 V AC | ⩾ 176 V DC | ⩾ 176 V AC |
| | At state 0 | ⩽ 6 V DC | ⩽ 75 V DC | ⩽ 22 V AC | ⩽ 137 V DC | ⩽ 48 V AC |

| Relays outputs | | | | | |
|---|---|---|---|---|---|
| **Control relay outputs (O1, O2, O11 contacts) (2)** | | | | | |
| Voltage | DC | 24 / 48 V DC | 127 V DC | 220 V DC | |
| | AC (47.5 to 63 Hz) | - | - | - | 100 to 240 V AC |
| Continuous current | | 8 A | 8 A | 8 A | 8 A |
| Breaking capacity | Resistive load | 8 / 4 A | 0.7 A | 0.3 A | |
| | L/R load < 20 ms | 6 / 2 A | 0.5 A | 0.2 A | |
| | L/R load < 40 ms | 4 / 1 A | 0.2 A | 0.1 A | |
| | Resistive load | - | - | - | 8 A |
| | p.f. load > 0.3 | - | - | - | 5 A |
| Making capacity | < 15 A for 200 ms | | | | |
| **Annunciation relay output (O3, O4, O12, O13, O14 contacts)** | | | | | |
| Voltage | DC | 24 / 48 V DC | 127 V DC | 220 V DC | |
| | AC (47.5 to 63 Hz) | - | - | - | 100 to 240 V AC |
| Continuous current | | 2 A | 2 A | 2 A | 2 A |
| Breaking capacity | L/R load < 20 ms | 2 / 1 A | 0.5 A | 0.15 A | |
| | p.f. load > 0.3 | - | - | - | 1 A |

| Power supply | | | |
|---|---|---|---|
| Voltage | | 24 / 250 V DC | 110 / 240 V AC |
| Range | | -20 % +10 % | -20 % +10 % (47.5 to 63 Hz) |
| Deactivated consumption (1) | Sepam series 20 | < 4.5 W | < 6 VA |
| | Sepam series 40 | < 6 W | < 6 VA |
| Maximum consumption (1) | Sepam series 20 | < 8 W | < 15 VA |
| | Sepam series 40 | < 11 W | < 25 VA |
| Inrush current | Sepam series 20 | < 10 A for 10 ms, < 28 A for 100 ms | < 28 A for 100 ms, < 15 A for first half-period |
| | Sepam series 40 | < 10 A for 10 ms, < 28 A for 100 ms | < 28 A for 100 ms,, < 15 A for first half-period |
| Acceptable momentary outages | Sepam series 20 | 10 ms | 20 ms |
| | Sepam series 40 | 10 ms | 20 ms |

| Analog output (MSA141 module) | |
|---|---|
| Current | 4 - 20 mA, 0 - 20 mA, 0 - 10 mA |
| Load impedance | < 600 Ω (wiring included) |
| Accuracy | 0.50 % |

***(1)*** *According to configuration.*
***(2)*** *Relay outputs comply with clause 6.7 of standard C37.90 (30 A, 200 ms, 2000 operations).*


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# Base unit
## Environmental characteristics



| Electromagnetic compatibility | Standard | Level / Class | Value |
|---|---|---|---|
| **Emission tests** | | | |
| Disturbing field emission | IEC 60255-25 | | |
| | EN 55022 | A | |
| Conducted disturbance emission | IEC 60255-25 | | |
| | EN 55022 | B | |
| **Immunity tests – Radiated disturbances** | | | |
| Immunity to radiated fields | IEC 60255-22-3 | | 10 V/m ; 80 MHz - 1 GHz |
| | IEC 61000-4-3 (1) | III | 10 V/m ; 80 MHz - 2 GHz |
| | ANSI C37.90.2 (1) | | 35 V/m ; 25 MHz - 1 GHz |
| Electrostatic discharge | IEC 60255-22-2 | | 8 kV air ; 6 kV contact |
| | ANSI C37.90.3 (1) | | 8 kV air ; 4 kV contact |
| Immunity to magnetic fields at network frequency | IEC 61000-4-8 | IV | 30 A/m (continuous) - 300 A/m (13 s) |
| **Immunity tests – Conducted disturbances** | | | |
| Immunity to conducted RF disturbances | IEC 60255-22-6 | | 10 V |
| Fast transient bursts | IEC 60255-22-4 | A or B | 4 kV ; 2.5 kHz / 2 kV ; 5 kHz |
| | IEC 61000-4-4 | IV | 4 kV ; 2.5 kHz |
| | ANSI C37.90.1 (1) | | 4 kV ; 2.5 kHz |
| 1 MHz damped oscillating wave | IEC 60255-22-1 | III | 2.5 kV MC ; 1 kV MD |
| | ANSI C37.90.1 (1) | | 2.5 kV MC and MD |
| 100 kHz damped oscillating wave | IEC 61000-4-12 | | 2.5 kV MC ; 1 kV MD |
| Surges | IEC 61000-4-5 | III | 2 kV MC ; 1 kV MD |
| Voltage interruptions | IEC 60255-11 | | Series 20: 100 %, 10 ms<br>Series 40: 100 %, 20 ms |
| **Mechanical robustness** | **Standard** | **Level / Class** | **Value** |
| **In operation** | | | |
| Vibrations | IEC 60255-21-1 | 2 | 1 Gn ; 10 Hz - 150 Hz |
| | IEC 60068-2-6 | Fc | 2 Hz - 13.2 Hz ; a = ±1 mm |
| Shocks | IEC 60255-21-2 | 2 | 10 Gn / 11 ms |
| Earthquakes | IEC 60255-21-3 | 2 | 2 Gn (horizontal axes) |
| | | | 1 Gn (vertical axes) |
| **De-energized** | | | |
| Vibrations | IEC 60255-21-1 | 2 | 2 Gn ; 10 Hz - 150 Hz |
| Shocks | IEC 60255-21-2 | 2 | 27 Gn / 11 ms |
| Jolts | IEC 60255-21-2 | 2 | 20 Gn / 16 ms |
| **Climatic withstand** | **Standard** | **Level / Class** | **Value** |
| **In operation** | | | |
| Exposure to cold | IEC 60068-2-1 | Series 20: Ab<br>Series 40: Ad | -25 °C |
| Exposure to dry heat | IEC 60068-2-2 | Series 20: Bb<br>Series 40: Bd | +70 °C |
| Continuous exposure to damp heat | IEC 60068-2-3 | Ca | 10 days ; 93 % RH ; 40 °C |
| Temperature variation with specified variation rate | IEC 60068-2-14 | Nb | –25 °C to +70 °C<br>5°C/min |
| Salt mist | IEC 60068-2-52 | Kb/2 | |
| Influence of corrosion | IEC 60068-2-60 | C | 21 days ; 75 % RH ; 25 °C ;<br>0.5 ppm $H_2S$ ; 1 ppm $SO_2$ |
| Gaz test 4 | IEC 60068-2-60 | | 21 days ; 75 % RH ; 25 °C ;<br>0.01 ppm $H_2S$ ; 0.2 ppm $SO_2$ ;<br>0.02 ppm $NO_2$ ; 0.01 ppm $Cl_2$ |
| **In storage (4)** | | | |
| Exposure to cold | IEC 60068-2-1 | Ab | -25 °C |
| Exposure to dry heat | IEC 60068-2-2 | Bb | +70 °C |
| Continuous exposure to damp heat | IEC 60068-2-3 | Ca | 56 days ; 93 % RH ; 40 °C |
| **Safety** | **Standard** | **Level / Class** | **Value** |
| **Enclosure safety tests** | | | |
| Front panel tightness | IEC 60529 | IP52 | Other panels closed, except for rear panel IP20 |
| | NEMA | Type 12 with gasket supplied | |
| Fire withstand | IEC 60695-2-11 | | 650 °C with glow wire |
| **Electrical safety tests** | | | |
| 1.2/50 µs impulse wave | IEC 60255-5 | | 5 kV (2) |
| Power frequency dielectric withstand | IEC 60255-5 | | 2 kV 1 mn (3) |
| **Certification** | | | |
| CE | Harmonized standard:<br>EN 50263 | European directives:<br>■ 89/336/CEE Electromagnetic Comptability (EMC) Directive<br>□ 92/31/CEE Amendment<br>□ 93/68/CEE Amendment<br>■ 73/23/CEE Low Voltage Directive<br>□ 93/68/CEE Amendment | |
| UL - | UL508 - CSA C22.2 n° 14-95 | | File E212533 |
| CSA | CSA C22.2 n° 14-95 / n° 94-M91 / n° 0.17-00 | | File 210625 |

***(1)*** *Sepam series 40.*
***(2)*** *Except for communication: 3 kV in common mode and 1kV in differential mode*
***(3)*** *Except for communication: 1 kVrms*
***(4)*** *Sepam must be stored in its original packing.*



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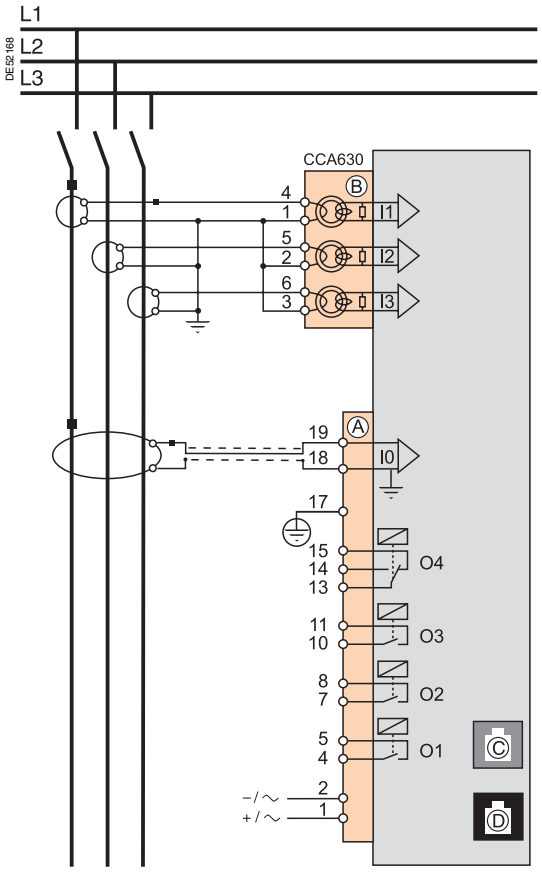
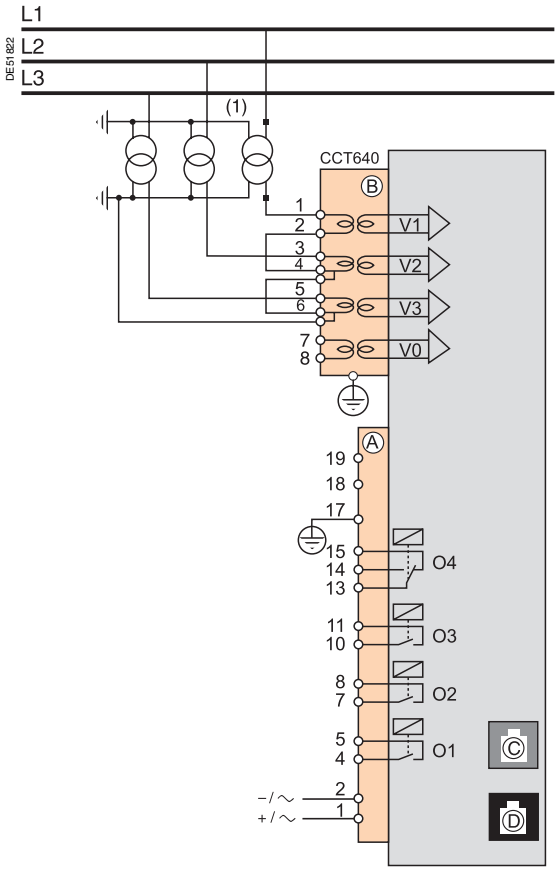
# Base unit
Sepam series 20



## Sepam S20, T20 and M20




## Sepam B21 and B22




***(1)*** *This type of connection allows the calculation of residual voltage.*

## Connection

**Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.**

| Connector | Type | Reference | Wiring |
|---|---|---|---|
| (A) | Screw type | CCA620 | ■ wiring with no fittings:<br>□ 1 wire with max. cross-section 0.2 to 2.5 mm² (≥ AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (≥ AWG 24-16)<br>□ stripped length: 8 to 10 mm<br>■ wiring with fittings:<br>□ recommended wiring with Telemecanique fittings:<br>- DZ5CE015D for 1 x 1.5 mm² wire<br>- DZ5CE025D for 1 x 2.5 mm² wire<br>- AZ5DE010D for 2 x 1 mm² wires<br>□ tube length: 8.2 mm<br>□ stripped length: 8 mm |
| | 6.35 mm ring lugs | CCA622 | ■ 6.35 mm ring or spade lugs (1/4")<br>■ maximum wire cross-section of 0.2 to 2.5 mm² (≥ AWG 24-12)<br>■ stripped length: 6 mm<br>■ use an appropriate tool to crimp the lugs on the wires<br>■ maximum of 2 ring or spade lugs per terminal<br>■ tightening torque: 0.7 to 1 Nm |
| (B) For Sepam S20,T20 and M20 | 4 mm ring lugs | CCA630, for connection of 1 A or 5 A CTs | 1.5 to 6 mm² (AWG 16-10) |
| | RJ45 plug | CCA670, for connection of 3 LPCT sensors | Integrated with LPCT sensor |
| (B) For Sepam B21 and B22 | Screw type | CCT640 | Same as wiring for the CCA620 |
| (C) | Green RJ45 plug | | CCA612 |
| (D) | Black RJ45 plug | | CCA770: L = 0.6 m<br>CCA772: L = 2 m<br>CCA774: L = 4 m |



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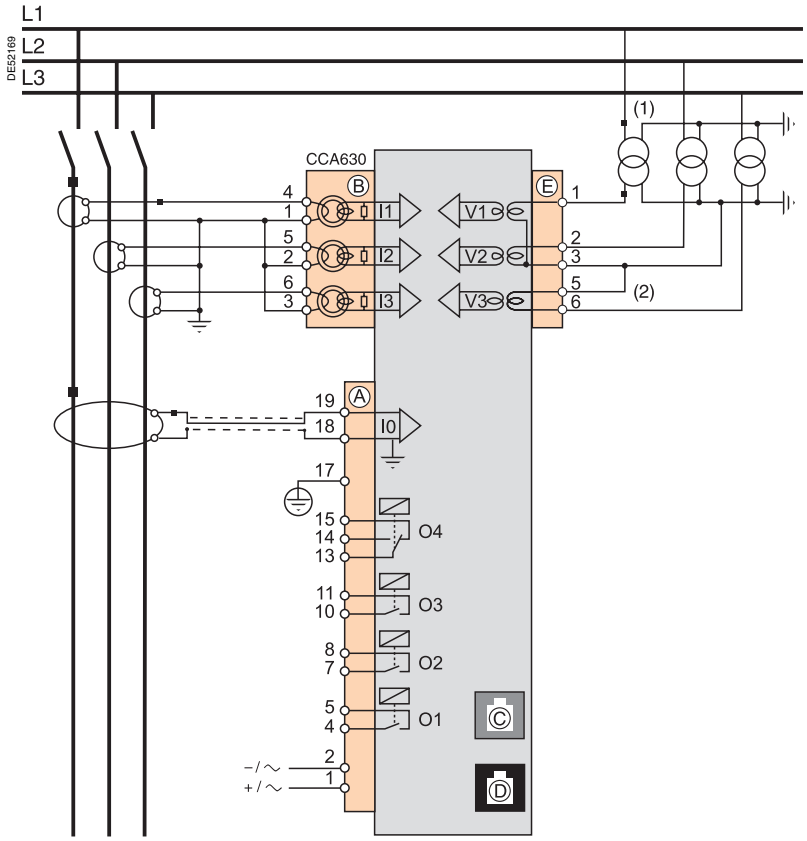
# Base unit
Sepam series 40






***(1)*** *This type of connection allows the calculation of residual voltage.*
***(2)*** *Accessory for bridging terminals 3 and 5 supplied with CCA626 connector.*

## Connection

**Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.**

| Connector | Type | Reference | Wiring |
|---|---|---|---|
| (A) | Screw type | CCA620 | ■ wiring with no fittings:<br>□ 1 wire with max. cross-section 0.2 to 2.5 mm² (≥ AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (≥ AWG 24-16)<br>□ stripped length: 8 to 10 mm<br>■ wiring with fittings:<br>□ recommended wiring with Telemecanique fittings:<br>- DZ5CE015D for 1 x 1.5 mm² wire<br>- DZ5CE025D for 1 x 2.5 mm² wire<br>- AZ5DE010D for 2 x 1 mm² wires<br>□ tube length: 8.2 mm<br>□ stripped length: 8 mm |
| | 6.35 mm ring lugs | CCA622 | ■ 6.35 mm ring or spade lugs (1/4")<br>■ maximum wire cross-section of 0.2 to 2.5 mm² (≥ AWG 24-12)<br>■ stripped length: 6 mm<br>■ use an appropriate tool to crimp the lugs on the wires<br>■ maximum of 2 ring or spade lugs per terminal<br>■ tightening torque: 0.7 to 1 Nm |
| (B) | 4 mm ring lugs | CCA630, for connection of 1 A or 5 A CTs | 1.5 to 6 mm² (AWG 16-10) |
| | RJ45 plug | CCA670, for connection of 3 LPCT sensors | Integrated with LPCT sensor |
| (C) | Green RJ45 plug | | CCA612 |
| (D) | Black RJ45 plug | | CCA770: L = 0.6 m<br>CCA772: L = 2 m<br>CCA774: L = 4 m |
| (E) | Screw type | CCA626 | Same as wiring for the CCA620 |
| | 6.35 mm ring lugs | CCA627 | Same as wiring for the CCA622 |



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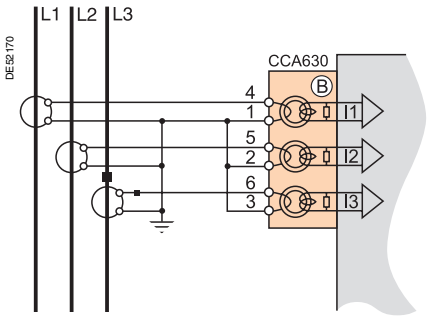
# Phase current inputs



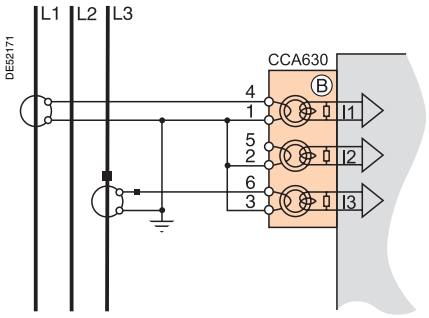
## Variant 1: phase current measurement by 3 x 1 A or 5 A CTs (standard connection)




Connection of 3 x 1 A or 5 A sensors to the CCA630 connector.

The measurement of the 3 phase currents allows the calculation of residual current.

## Variant 2: phase current measurement by 2 x 1 A or 5 A CTs

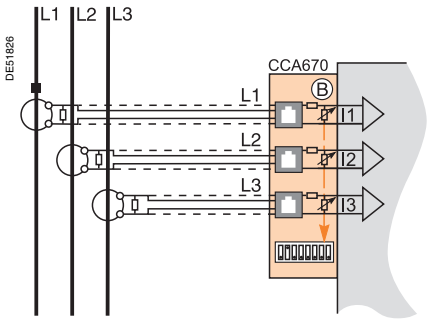



Connection of 2 x 1 A or 5 A CTs to the CCA630 connector.

The measurement of phase currents 1 and 3 is sufficient to ensure all the current-based protection functions.

This arrangement does not allow the calculation of residual current.

## Variant 3: phase current measurement by 3 LPCT type sensors




Connection of 3 Low Power Current Transducer (LPCT) type sensors to the CCA670 connector. The connection of just one or two sensors is not allowed and causes Sepam to switch to the fallback position.

The measurement of the 3 phase currents allows the calculation of residual current.

The In parameter, primary rated current measured by an LPCT, is to be chosen from the following values, in Amps: 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.
Parameter to be set using the advanced UMI and the SFT2841 software tool, to be completed by hardware setting of the microswitches on the CCA670 connector.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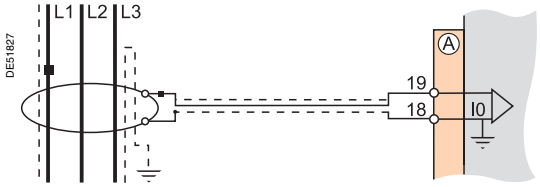
# Residual current inputs



## Variant 1: residual current calculation by sum of 3 phase currents

Residual current is calculated by the vector sum of the 3 phase currents I1, I2 and I3, measured by 3 x 1 A or 5 A CTs or by 3 LPCT type sensors.
See current input connection diagrams.

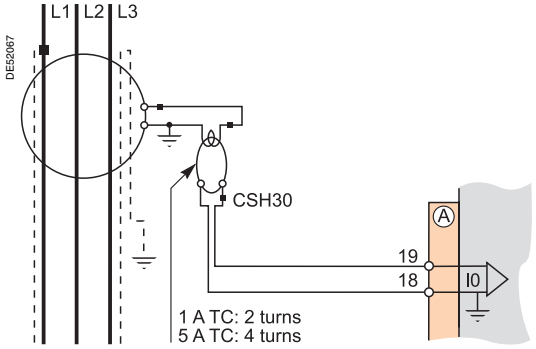
## Variant 2: residual current measurement by CSH120 or CSH200 core balance CT (standard connection)




Arrangement recommended for the protection of isolated or compensated neutral systems, in which very low fault currents need to be detected.

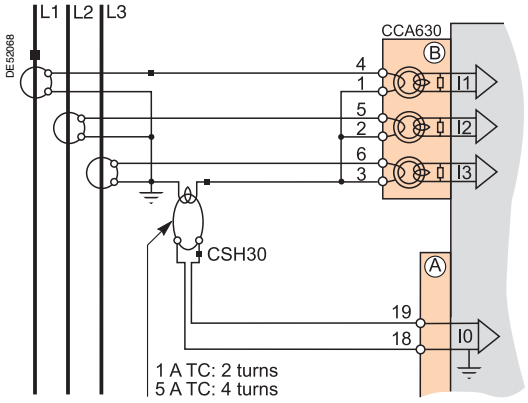
Setting range from 0.1 In0 to 15 In0,
with In0 = 2 A or 20 A (or 5 A with Sepam series 40) according to parameter setting.

## Variant 3: residual current measurement by 1 A or 5 A CTs and CSH30 interposing ring CT

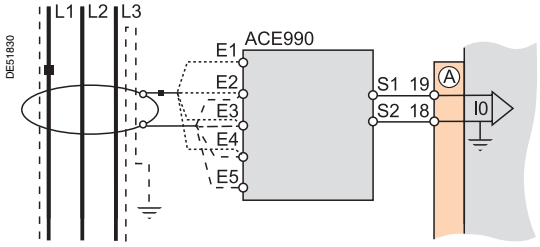



The CSH30 interposing ring CT is used to connect 1 A or 5 A CTs to Sepam to measure residual current:
- CSH30 interposing ring CT connected to 1 A CT: make 2 turns through CSH primary
- CSH30 interposing ring CT connected to 5 A CT: make 4 turns through CSH primary.
- with Sepam series 40: the sensitivity can be multiplied by 10 by parameter setting of In0 = In/10.

Setting range from 0.1 In to 15 In, or 0.01 In to 1.5 In (Sepam series 40)
with In = CT primary current.




## Variant 4: residual current measurement by core balance CT with ratio of 1/n (n between 50 and 1500)




The ACE990 is used as an interface between a MV core balance CT with a ratio of 1/n (50 ⩽ n ⩽ 1500) and the Sepam residual current input.
This arrangement allows the continued use of existing core balance CTs on the installation.

Setting range from 0.1 In0 to 15 In0, with In0 = k.n,
where n = n = number of core balance CT turns
and k = factor to be determined according to ACE990 wiring and setting range used by Sepam, with a choice of 20 discrete values from 0.00578 to 0.26316.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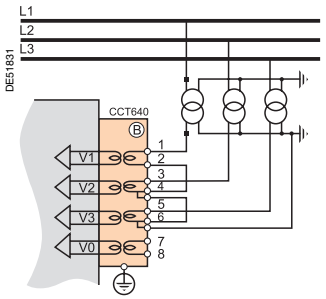
# Voltage inputs
## Sepam series 20



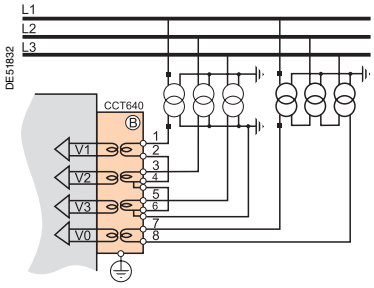
The phase and residual voltage transformer secondary circuits are connected to the CCT640 connector (item Ⓑ) on Sepam B21 and B22. The CCT640 connector contains 4 transformers which perform isolation and impedance matching of the VTs and Sepam input circuits.

### Variant 1: measurement of 3 phase-to-neutral voltages (standard connection)



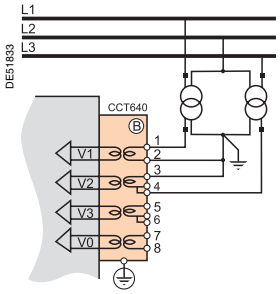

| | |
|---|---|
| Phase voltage sensor parameter setting | 3V |
| Residual voltage sensor parameter setting | 3V sum |
| Voltages measured | V1, V2, V3 |
| Values calculated | U21, U32, U13, V0, Vd, f |
| Measurements unavailable | None |
| Protection functions unavailable (according to type of Sepam) | None |

### Variant 2: measurement of 3 phase-to-neutral voltage and residual voltage



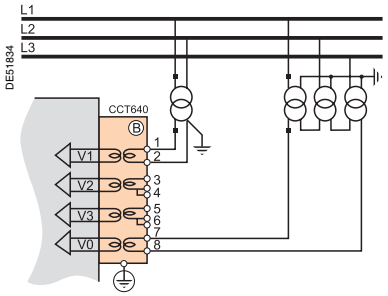

| | |
|---|---|
| Phase voltage sensor parameter setting | 3V |
| Residual voltage sensor parameter setting | External VT |
| Voltages measured | V1, V2, V3, V0 |
| Values calculated | U21, U32, U13, Vd, f |
| Measurements unavailable | None |
| Protection functions unavailable (according to type of Sepam) | None |

### Variant 3: measurement of 2 phase-to-phase voltages



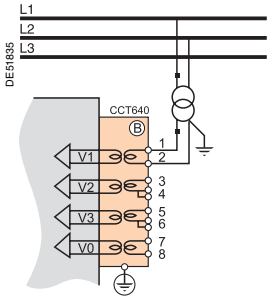

| | |
|---|---|
| Phase voltage sensor parameter setting | U21, U32 |
| Residual voltage sensor parameter setting | None |
| Voltages measured | U21, U32 |
| Values calculated | U13, Vd, f |
| Measurements unavailable | V1, V2, V3, V0 |
| Protection functions unavailable (according to type of Sepam) | 59N, 27S |

### Variant 4: measurement of 1 phase-to-phase voltage and residual voltage




| | |
|---|---|
| Phase voltage sensor parameter setting | U21 |
| Residual voltage sensor parameter setting | External VT |
| Voltages measured | U21, V0 |
| Values calculated | f |
| Measurements unavailable | U32, U13, V1, V2, V3, Vd |
| Protection functions unavailable (according to type of Sepam) | 47, 27D, 27S |

### Variant 5: measurement of 1 phase-to-phase voltage




| | |
|---|---|
| Phase voltage sensor parameter setting | U21 |
| Residual voltage sensor parameter setting | None |
| Voltages measured | U21 |
| Values calculated | f |
| Measurements unavailable | U32, U13, V1, V2, V3, V0, Vd |
| Protection functions unavailable (according to type of Sepam) | 47, 27D, 59N, 27S |



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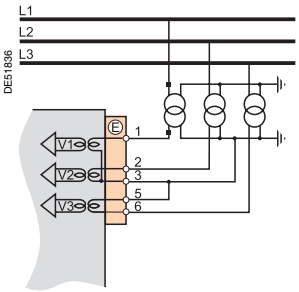
# Voltage inputs
## Sepam series 40

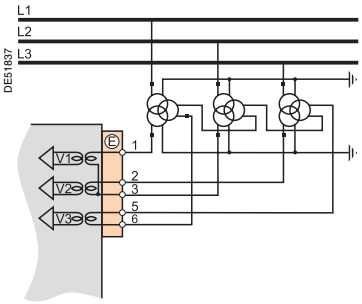
The phase and residual voltage transformer secondary circuits are connected directly to the connector marked Ⓔ.
The 3 impedance matching and isolation transformers are integrated in the Sepam series 40 base unit.

### Variant 1: measurement of 3 phase-to-neutral voltages (standard connection)



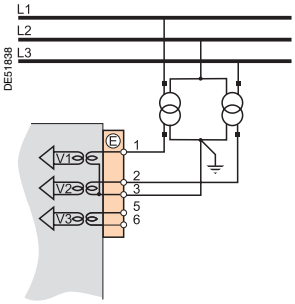

| | |
|---|---|
| Phase voltage sensor parameter setting | 3V |
| Residual voltage sensor parameter setting | 3V sum |
| Voltages measured | V1, V2, V3 |
| Values calculated | U21, U32, U13, V0, Vd, Vi, f |
| Measurements unavailable | None |
| Protection functions unavailable (according to type of Sepam) | None |

### Variant 2: measurement of 2 phase-to-phase voltages and residual voltage



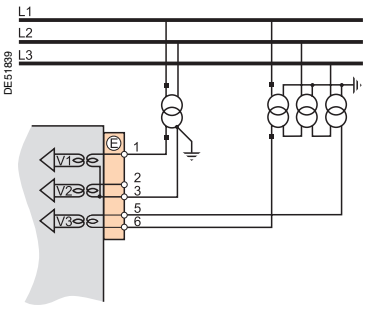

| | |
|---|---|
| Phase voltage sensor parameter setting | U21, U32 |
| Residual voltage sensor parameter setting | External VT |
| Voltages measured | U21, U32, V0 |
| Values calculated | U13, V1, V2, V3, Vd, Vi, f |
| Measurements unavailable | None |
| Protection functions unavailable (according to type of Sepam) | None |

### Variant 3: measurement of 2 phase-to-phase voltages



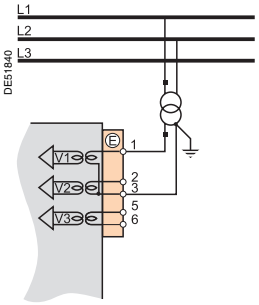

| | |
|---|---|
| Phase voltage sensor parameter setting | U21, U32 |
| Residual voltage sensor parameter setting | None |
| Voltages measured | U21, U32 |
| Values calculated | U13, Vd, Vi, f |
| Measurements unavailable | V1, V2, V3, V0 |
| Protection functions unavailable (according to type of Sepam) | 67N/67NC, 59N |

### Variant 4: measurement of 1 phase-to-phase voltage and residual voltage




| | |
|---|---|
| Phase voltage sensor parameter setting | U21 |
| Residual voltage sensor parameter setting | External VT |
| Voltages measured | U21, V0 |
| Values calculated | f |
| Measurements unavailable | U32, U13, V1, V2, V3, Vd, Vi |
| Protection functions unavailable (according to type of Sepam) | 67, 47, 27D, 32P, 32Q/40, 27S |

### Variant 5: measurement of 1 phase-to-phase voltage




| | |
|---|---|
| Phase voltage sensor parameter setting | U21 |
| Residual voltage sensor parameter setting | None |
| Voltages measured | U21 |
| Values calculated | f |
| Measurements unavailable | U32, U13, V1, V2, V3, V0, Vd, Vi |
| Protection functions unavailable (according to type of Sepam) | 67, 47, 27D, 32P, 32Q/40, 67N/67NC, 59N, 27S |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# Sepam series 80

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3



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# Selection table

| | | Substation | | | | Transformer | | | Motor | | | Generator | | | Busbar | | Cap. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Protection** | **ANSI code** | **S80** | **S81** | **S82** | **S84** | **T81** | **T82** | **T87** | **M81** | **M87** | **M88** | **G82** | **G87** | **G88** | **B80** | **B83** | **C86** |
| Phase overcurrent (1) | 50/51 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Earth fault / Sensitive earth fault (1) | 50N/51N 50G/51G | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Breaker failure | 50BF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Negative sequence / unbalance | 46 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Thermal overload for cables | 49RMS | | 2 | 2 | 2 | | | | | | | | | | | | |
| Thermal overload for machines (1) | 49RMS | | | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | |
| Thermal overload for capacitors | 49RMS | | | | | | | | | | | | | | | | 2 |
| Capacitor bank unbalance | 51C | | | | | | | | | | | | | | | | 8 |
| Restricted earth fault | 64REF | | | | | 2 | 2 | 2 | | | | 2 | | 2 | | | |
| Two-winding transformer differential | 87T | | | | | | | 1 | | | 1 | | | 1 | | | |
| Machine differential | 87M | | | | | | | | | 1 | | | 1 | | | | |
| Directional phase overcurrent (1) | 67 | | | 2 | 2 | | 2 | 2 | | | | 2 | 2 | 2 | | | |
| Directional earth fault (1) | 67N/67NC | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | |
| Directional active overpower | 32P | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | | | |
| Directional reactive overpower | 32Q | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Directional active underpower | 37P | | | | 2 | | | | | | | 2 | | | | | |
| Phase undercurrent | 37 | | | | | | | | 1 | 1 | 1 | | | | | | |
| Excessive starting time, locked rotor | 48/51LR | | | | | | | | 1 | 1 | 1 | | | | | | |
| Starts per hour | 66 | | | | | | | | 1 | 1 | 1 | | | | | | |
| Field loss (underimpedance) | 40 | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Pole slip | 78PS | | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| Overspeed (2 set points) (2) | 12 | | | | | | | | □ | □ | □ | □ | □ | □ | | | |
| Underspeed (2 set points) (2) | 14 | | | | | | | | □ | □ | □ | □ | □ | □ | | | |
| Voltage-restrained overcurrent | 50V/51V | | | | | | | | | | | 2 | 2 | 2 | | | |
| Underimpedance | 21B | | | | | | | | | | | 1 | 1 | 1 | | | |
| Inadvertent energization | 50/27 | | | | | | | | | | | 1 | 1 | 1 | | | |
| Third harmonic undervoltage / 100 % stator earth fault | 27TN/64G2 64G | | | | | | | | | | | 2 | 2 | 2 | | | |
| Overfluxing (V / Hz) | 24 | | | | | | | 2 | | | | 2 | 2 | 2 | | | |
| Positive sequence undercurrent | 27D | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 4 |
| Remanent undervoltage | 27R | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Undervoltage (L-L or L-N) | 27 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 2 |
| Overvoltage (L-L or L-N) | 59 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Neutral voltage displacement | 59N | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Negative sequence overvoltage | 47 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Overfrequency | 81H | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Underfrequency | 81L | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Rate of change of frequency | 81R | | | | 2 | | | | | | | | | | | | |
| Recloser (4 cycles) (2) | 79 | □ | □ | □ | □ | | | | | | | | | | | | |
| Thermostat / Buchholz (2) | 26/63 | | | | | □ | □ | □ | □ | | □ | □ | | □ | | | |
| Temperature monitoring (16 RTDs) (3) | 38/49T | | | | | □ | □ | □ | □ | □ | □ | □ | □ | □ | | | □ |
| Synchro-check (4) | 25 | □ | □ | □ | □ | □ | □ | □ | | | | □ | □ | □ | □ | □ | |
| **Control and monitoring** | | | | | | | | | | | | | | | | | |
| Circuit breaker / contactor control | 94/69 | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Automatic transfer (AT) (2) | | □ | □ | □ | □ | □ | □ | □ | | | | □ | □ | □ | □ | □ | |
| Load shedding / automatic restart | | | | | | | | | ■ | ■ | ■ | | | | | | |
| De-excitation | | | | | | | | | | | | ■ | ■ | ■ | | | |
| Genset shutdown | | | | | | | | | | | | ■ | ■ | ■ | | | |
| Capacitor step control (2) | | | | | | | | | | | | | | | | | □ |
| Logic discrimination (2) | 68 | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Latching / acknowledgement | 86 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Annunciation | 30 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Switching of groups of settings | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Adaptation using logic equations | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Logipam programming (Ladder language) | | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |

*The figures indicate the number of relays available for each protection function.*
■ *standard,* □ *options.*
***(1)*** *Protection functions with 2 groups of settings.*
***(2)*** *According to parameter setting and optional MES120 input/output modules.*
***(3)*** *With optional MET148-2 temperature input modules.*
***(4)*** *With optional MCS025 synchro-check module.*



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# Selection table

| | Substation | | | | Transformer | | | Motor | | | Generator | | | Busbar | | Cap. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Metering** | **S80** | **S81** | **S82** | **S84** | **T81** | **T82** | **T87** | **M81** | **M87** | **M88** | **G82** | **G87** | **G88** | **B80** | **B83** | **C86** |
| Phase current I1, I2, I3 RMS | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Measured residual current I0, calculated I0Σ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Demand current I1, I2, I3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Peak demand current IM1, IM2, IM3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Measured residual current I'0 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | |
| Voltage U21, U32, U13, V1, V2, V3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Residual voltage V0 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Positive sequence voltage Vd / rotation direction | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Negative sequence voltage Vi | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Frequency | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Active power P, P1, P2, P3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Reactive power Q, Q1, Q2, Q3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Apparent power S, S1, S2, S3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Peak demand power PM, QM | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Power factor | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Calculated active and reactive energy (±Wh, ±VARh) | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Active and reactive energy by pulse counting (2) (± Wh, ± VARh) | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Phase current I'1, I'2, I'3 RMS | | | | | | | ■ | | ■ | ■ | | ■ | ■ | | | |
| Calculated residual current I'0Σ | | | | | | | ■ | | ■ | ■ | | ■ | ■ | | | |
| Voltage U'21, V'1 and frequency | | | | | | | | | | | | | | ■ | | |
| Voltage U'21, U'32, U'13, V'1, V'2, V'3, V'd, V'i and frequency | | | | | | | | | | | | | | | ■ | |
| Residual voltage V'0 | | | | | | | | | | | | | | | ■ | |
| Temperature (16 RTDs) (3) | | | | | □ | □ | □ | □ | □ | □ | □ | □ | □ | | | □ |
| Rotation speed (2) | | | | | | | | □ | □ | □ | □ | □ | □ | | | |
| Neutral point voltage Vnt | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| **Network and machine diagnosis** | | | | | | | | | | | | | | | | |
| Tripping context | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Tripping current TripI1, TripI2, TripI3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Phase fault and earth fault trip counters | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Unbalance ratio / negative sequence current Ii | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Harmonic distortion (THD), current and voltage Ithd, Uthd | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Phase displacement φ0, φ'0, φ0Σ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Phase displacement φ1, φ2, φ3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Disturbance recording | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Thermal capacity used | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ |
| Remaining operating time before overload tripping | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ |
| Waiting time after overload tripping | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ |
| Running hours counter / operating time | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ |
| Starting current and time | | | | | | | | ■ | ■ | ■ | | | | | | |
| Start inhibit time | | | | | | | | ■ | ■ | ■ | | | | | | |
| Number of starts before inhibition | | | | | | | | ■ | ■ | ■ | | | | | | |
| Unbalance ratio / negative sequence current I'i | | | | | | | ■ | | ■ | ■ | | ■ | ■ | | | |
| Differential current Idiff1, Idiff2, Idiff3 | | | | | | | ■ | | ■ | ■ | | ■ | ■ | | | |
| Through current It1, It2, It3 | | | | | | | ■ | | ■ | ■ | | ■ | ■ | | | |
| Current phase displacement θ | | | | | | | ■ | | ■ | ■ | | ■ | ■ | | | |
| Apparent positive sequence impedance Zd | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Apparent phase-to-phase impedances Z21, Z32, Z13 | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Third harmonic voltage, neutral point or residual | | | | | | | | | | | ■ | ■ | ■ | | | |
| Difference in amplitude, frequency and phase of voltages compared for synchro-check (4) | □ | □ | □ | □ | □ | □ | □ | | | | □ | □ | □ | □ | □ | |
| Capacitor unbalance current and capacitance | | | | | | | | | | | | | | | | ■ |
| **Switchgear diagnosis** | **ANSI code** | | | | | | | | | | | | | | | |
| CT / VT supervision | 60/60FL | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Trip circuit supervision (2) | 74 | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Auxiliary power supply monitoring | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Cumulative breaking current | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Number of operations, operating time, charging time, number of racking out operations (2) | | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| **Modbus communication, IEC 60 870-5-103 or DNP3** | | | | | | | | | | | | | | | | |
| Measurement readout (4) | | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Remote indication and time tagging of events (4) | | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Remote control orders (4) | | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Remote protection setting (4) | | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| Transfer of disturbance recording data (4) | | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |

■ *standard,* □ *options.*

***(2)*** *According to parameter setting and optional MES120 input/output modules.*
***(3)*** *With optional MET148-2 temperature input modules.*
***(4)*** *With optional MCS025 synchro-check module.*
***(5)*** *With ACE949-2, ACE959, ACE937, ACE969TP or ACE969FO communication interface.*



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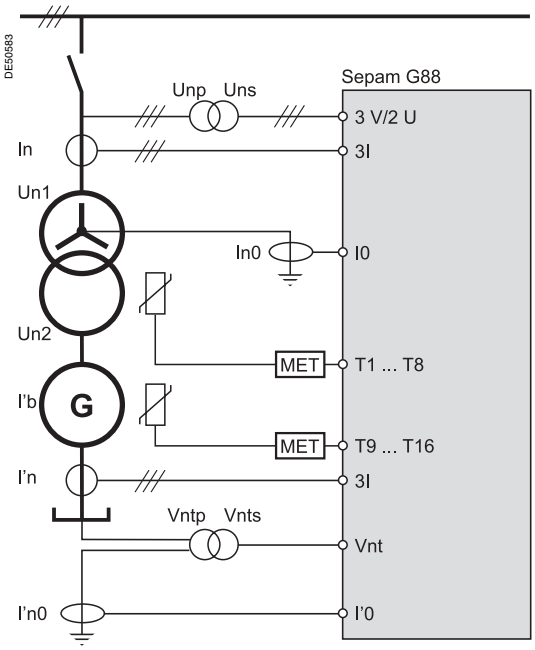
# Sensor inputs




*Sepam G88 sensor inputs.*

Sepam series 80 has analog inputs that are connected to the measurement sensors required for applications:

- ■ main analog inputs, available on all types of Sepam series 80:
  - □ 3 phase current inputs I1, I2, I3
  - □ 1 residual current input I0
  - □ 3 phase voltage inputs V1, V2, V3
  - □ 1 residual voltage input V0
- ■ additional analog inputs, dependent on the type of Sepam:
  - □ 3 additional phase current inputs I'1, I'2, I'3
  - □ 1 additional residual current input I'0
  - □ 3 additional phase voltage inputs V'1, V'2, V'3
  - □ 1 additional residual voltage input V'0

The table below lists the analog inputs available according to the type of Sepam series 80.

| | | S80, S81, S82, S84 | T81, T82, M81, G82 | T87, M87, M88, G87, G88 | B80 | B83 | C86 |
|---|---|---|---|---|---|---|---|
| Phase current inputs | Main channel | I1, I2, I3 | I1, I2, I3 | I1, I2, I3 | I1, I2, I3 | I1, I2, I3 | I1, I2, I3 |
| | Additional channels | | | I'1, I'2, I'3 | | | |
| Residual current inputs | Main channel | I0 | I0 | I0 | I0 | I0 | I0 |
| | Additional channels | I'0 | I'0 | I'0 | I'0 | | |
| Unbalance current inputs for capacitor steps | | | | | | | I'1, I'2, I'3, I'0 |
| Phase voltage inputs | Main channel | V1, V2, V3 or U21, U32 | V1, V2, V3 or U21, U32 | V1, V2, V3 or U21, U32 | V1, V2, V3 or U21, U32 | V1, V2, V3 or U21, U32 | V1, V2, V3 or U21, U32 |
| | Additional channels | | | | V'1 or U'21 | V'1, V'2, V'3 or U'21, U'32 | |
| Residual voltage inputs | Main channel | V0 | V0 | V0 | V0 (1) | V0 | V0 |
| | Additional channel | | | | | V'0 | |
| Temperature inputs (on MET148-2 module) | | | T1 to T16 | T1 to T16 | | | T1 to T16 |

***Note**: by extension, an additional measurement (current or voltage) is a value measured via an additional analog channel.*
***(1)** Available with phase voltage U21, U32.*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# General settings

The general settings define the characteristics of the measurement sensors connected to Sepam and determine the performance of the metering and protection functions used. They are accessed via the SFT2841 setting software "General Characteristics", "CT-VT Sensors" and "Particular characteristics" tabs.

| General settings | | Selection | Value |
|---|---|---|---|
| In, I'n | Rated phase current (sensor primary current) | 2 or 3 1 A / 5 A CTs | 1 A to 6250 A |
| | | 3 LPCTs | 25 A to 3150 A (1) |
| I'n | Unbalance current sensor rating (capacitor application) | CT 1 A / 2 A / 5 A | 1 A to 30 A |
| Ib | Base current, according to rated power of equipment | | 0.2 to 1.3 In |
| I'b | Base current on additional channels (not adjustable) | Applications with transformer | I'b = Ib x Un1/Un2 |
| | | Other applications | I'b = Ib |
| In0, I'n0 | Rated residual current | Sum of 3 phase currents | See In(I'n) rated phase current |
| | | CSH120 or CSH200 core balance CT | 2 A or 20 A rating |
| | | 1 A/5 A CT + CSH30 interposing ring CT | 1 A to 6250 A |
| | | Core balance CT + ACE990 (the core balance CT ratio 1/n must be such that 50 ⩽ n ⩽ 1500) | According to current monitored and use of ACE990 |
| Unp, U'np | Rated primary phase-to-phase voltage (Vnp: rated primary phase-to-neutral voltage Vnp = Unp/$\sqrt{3}$) | | 220 V to 250 kV |
| Uns, U'ns | Rated secondary phase-to-phase voltage | 3 VTs: V1, V2, V3 | 90 to 230 V |
| | | 2 VTs: U21, U32 | 90 to 120 V |
| | | 1 VT: U21 | 90 to 120 V |
| | | 1 VT: V1 | 90 to 230 V |
| Uns0, U'nso | Secondary zero sequence voltage for primary zero sequence voltage Unp/$\sqrt{3}$ | | Uns/3 or Uns/$\sqrt{3}$ |
| Vntp | Neutral point voltage transformer primary voltage (generator application) | | 220 V to 250 kV |
| Vnts | Neutral point voltage transformer secondary voltage (generator application) | | 57.7 V to 133 V |
| fn | Rated frequency | | 50 Hz or 60 Hz |
| | Phase rotation direction | | 1-2-3 oru 1-3-2 |
| | Integration period (for demand current and peak demand current and power) | | 5, 10, 15, 30, 60 min |
| | Pulse-type accumulated energy meter | Increments active energy | 0.1 kWh to 5 MWh |
| | | Increments reactive energy | 0.1 kVARh to 5 MVARh |
| P | Rated transformer power | | 100 kVA to 999 MVA |
| Un1 | Rated winding 1 voltage (main channels: I) | | 220 V to 220 kV |
| Un2 | Rated winding 2 voltage (additional channels: I') | | 220 V to 400 kV |
| In1 | Rated winding 1 current (not adjustable) | | In1 = P/($\sqrt{3}$ Un1) |
| In2 | Rated winding 2 current (not adjustable) | | In2 = P/($\sqrt{3}$ Un2) |
| | Transformer vector shift | | 0 to 11 |
| Ωn | Rated speed (motor, generator) | | 100 to 3600 rpm |
| R | Number of pulses per rotation (for speed acquisition) | | 1 to 1800 (Ωn x R/60 ⩽ 1500) |
| | Zero speed set point | | 5 to 20 % of Ωn |
| | Number of capacitor steps | | 1 to 4 |
| | Connection of capacitor steps | | Star / Delta |
| | Capacitor step ratio | Step 1 | 1 |
| | | Step 2 | 1, 2 |
| | | Step 3 | 1, 2, 3, 4 |
| | | Step 4 | 1, 2, 3, 4, 6, 8 |

***(1)*** *In values for LPCT, in Amps: 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.*





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# Metering and diagnosis
Description



## Metering

Sepam is a precision metering unit.
All the metering and diagnosis data used for commissioning and required
for the operation and maintenance of your equipment are available locally
or remotely, expressed in the units concerned (A, V, W, etc.).

### Phase current

RMS current for each phase, taking into account harmonics up to number 13.
Different types of sensors may be used to meter phase current:
- 1 A or 5 A current transformers
- LPCT type current sensors.

### Residual current

Four types of residual current values are available depending on the type of Sepam and sensors connected to it:
- 2 residual currents I0Σ and I'0Σ, calculated by the vector sum of the 3 phase currents
- 2 measured residual currents I0 and I'0.

Different types of sensors may be used to measure residual current:
- CSH120 or CSH200 specific core balance CT
- conventional 1 A or 5 A current transformer with CSH30 interposing ring CT
- any core balance CT with an ACE990 interface.

### Demand current and peak demand currents

Demand current and peak demand currents are calculated according to the 3 phase currents I1, I2 and I3:
- demand current is calculated over an adjustable period of 5 to 60 minutes
- peak demand current is the greatest demand current and indicates the current drawn by peak loads.

Peak demand currents may be cleared.

### Voltage and frequency

The following measurements are available according to the voltage sensors connected:
- phase-to-neutral voltages V1, V2, V3 and V'1, V'2, V'3
- phase-to-phase voltages U21, U32, U13 and U'21, U'32, U'13
- residual voltage V0, V'0 or neutral point voltage Vnt
- positive sequence voltage Vd, V'd and negative sequence voltage Vi, V'i
- frequency measured on the main and additional voltage channels.

### Power

Powers are calculated according to the phase currents I1, I2 and I3:
- active power
- reactive power
- apparent power
- power factor (cos φ).

According to the sensors used, power calculations may be based on the 2 or 3 wattmeter method.
The 2 wattmeter method is only accurate when there is no residual current and it is not applicable if the neutral is distributed.
The 3 wattmeter method gives an accurate calculation of 3-phase and phase by phase powers in all cases, regardless of whether or not the neutral is distributed.

### Peak demand powers

The greatest demand active and reactive power values calculated over the same period as the demand current. The peak demand powers may be cleared.

### Energy

- 4 accumulated energies calculated according to voltages and phase currents I1, I2 and I3 measured: active energy and reactive energy in both directions
- 1 to 4 additional accumulated energy meters for the acquisition of active or reactive energy pulses from external meters.

### Temperature

Accurate measurement of temperature inside equipment fitted with Pt100, Ni100 or Ni120 type RTDs, connected to the optional remote MET148-2 module.

### Rotation speed

Calculated by the counting of pulses transmitted by a proximity sensor at each passage of a cam driven by the rotation of the motor or generator shaft.
Acquisition of pulses on a logic input.

### Phasor diagram

A phasor diagram is displayed by SFT2841 software and the mimic-based UMI to check cabling and assist in the setting and commissioning of directional and differential protection functions.
According to the connected sensors, all current and voltage information can be selected for display in vector form.


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# Metering and diagnosis
Description

## Network diagnosis assistance

Sepam provides network power quality metering functions, and all the data on network disturbances detected by Sepam are recorded for analysis purposes.

### Tripping context

Storage of tripping currents and I0, Ii, U21, U32, U13, V1, V2, V3, V0, Vi, Vd, F, P, Q, Idiff, It and Vnt values when tripping occurs. The values for the last five trips are stored.

### Tripping current

Storage of the 3 phase currents and earth fault current at the time of the last Sepam trip order, to indicate fault current.
The values are stored in the tripping contexts.

### Number of trips

2 trip counters:
- number of phase fault trips, incremented by each trip triggered by ANSI 50/51, 50V/51V and 67 protection functions
- number of earth fault trips, incremented by each trip triggered by ANSI 50N/51 and 67N/67NC protection functions.

### Negative sequence / unbalance

Negative sequence component of phase currents I1, I2 and I3 (and I'1, I'2 and I'3), indicating the degree of unbalance in the power supplied to the protected equipment.

### Total harmonic distortion

Two THD values calculated to assess network power quality, taking into account harmonics up to number 13:
- current THD, calculated according to I1
- voltage THD, calculated according to V1 or U21.

### Phase displacement

- phase displacement φ1, φ2, φ3 between phase currents I1, I2, I3 and voltages V1, V2, V3 respectively
- phase displacement φ0 between residual current and residual voltage.

### Disturbance recording

Recording triggered by user-set events:
- all sampled values of measured currents and voltages
- status of all logic inputs and outputs logic data: pick-up, …

| **Recording characteristics** | |
|---|---|
| Number of recordings in COMTRADE format | Adjustable from 1 to 19 |
| Total duration of a recording | Adjustable from 1 to 11 s |
| Number of samples per period | 12 or 36 |
| Duration of recording prior to occurrence of the event | Adjustable from 0 to 99 periods |

| **Maximum recording capability** | | |
|---|---|---|
| **Network frequency** | **12 samples per period** | **36 samples per period** |
| 50 Hz | 22 s | 7 s |
| 60 Hz | 18 s | 6 s |

### Voltage comparison for synchro-check

For the synchro-check function, the MCS025 module continuously measures the amplitude, frequency and phase differences between the 2 voltages to be checked.

### Out-of-sync context

Storage of amplitude, frequency and phase differences between the 2 voltages measured by the MCS025 module when a closing order is inhibited by the synchro-check function.


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# Metering and diagnosis
Description



## Machine diagnosis assistance

Sepam assists facility managers by providing:
- data on the operation of their machines
- predictive data to optimize process management
- useful data to facilitate protection function setting and implementation.

### Thermal capacity used

Equivalent temperature buildup in the machine, calculated by the thermal overload protection function.
Displayed as a percentage of rated thermal capacity.

### Remaining operating time before overload tripping

Predictive data calculated by the thermal overload protection function.
The time is used by facility managers to optimize process management in real time by deciding to:
- interrupt according to procedures
- continue operation with inhibition of thermal protection on overloaded machine.

### Waiting time after overload tripping

Predictive data calculated by the thermal overload protection function.
Waiting time to avoid further tripping of thermal overload protection by premature re-energizing of insufficiently cooled down equipment.

### Running hours counter / operating time

Equipment is considered to be running whenever a phase current is over 0.1 Ib.
Cumulative operating time is given in hours.

### Motor starting / overload current and time

A motor is considered to be starting or overloaded when a phase current is over 1.2 Ib. For each start / overload, Sepam stores:
- maximum current drawn by the motor
- starting / overload time.

The values are stored until the following start / overload.

### Number of starts before inhibition/start inhibit time

Indicates the number of starts still allowed by the starts per hour protection function and, if the number is zero, the waiting time before starting is allowed again.

### Differential and through current

Values calculated to facilitate the implementation of ANSI 87T and 87M differential protection functions.

### Current phase displacement

Phase shift between the main phase currents and additional phase currents to facilitate implementation of ANSI 87T differential protection function.

### Apparent positive sequence impedance Zd

Value calculated to facilitate the implementation of the underimpedance field loss protection (ANSI 40).

### Apparent phase-to-phase impedances Z21, Z32, Z13

Values calculated to facilitate the implementation of the backup underimpedance protection function (ANSI 21B).

### Third harmonic neutral point or residual voltage

Values measured to facilitate the implementation of the third harmonic undervoltage / 100 % stator earth fault protection function (ANSI 27TN/64G2).

### Capacitance

Measurement, for each phase, of the total capacitance of the connected capacitor bank steps. This measurement is used to monitor the condition of the capacitors.

### Capacitor unbalance current

Measurement of the unbalance current for each capacitor bank step. This measurement is possible when the steps are connected in a double star arrangement.


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## Switchgear diagnosis assistance

Switchgear diagnosis data give facility managers information on:
- mechanical condition of breaking device
- Sepam auxiliaries

and assist them for preventive and curative switchgear maintenance actions.
The data are to be compared to switchgear manufacturer data.

### ANSI 60/60FL - CT/VT supervision

Used to monitor the entire metering chain:
- CT and VT sensors
- connection
- Sepam analog inputs.

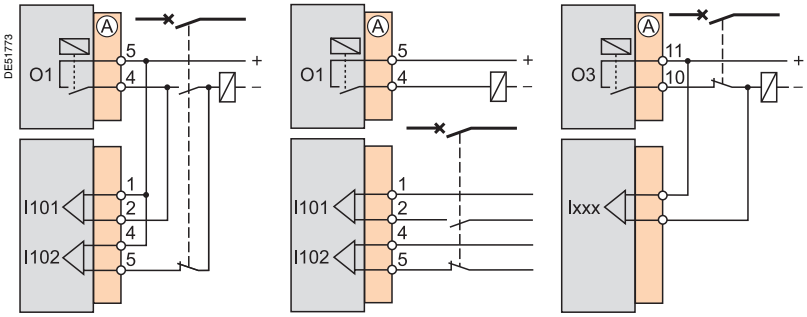
Monitoring includes:
- consistency checking of currents and voltages measured
- acquisition of phase or residual voltage transformer protection fuse blown contacts.

In the event of a loss of current or voltage measurement data, the assigned protection functions may be inhibited to avoid nuisance tripping.

### ANSI 74 - Trip/closing circuit supervision

To detect trip circuit and closing circuit failures, Sepam monitors:
- shunt trip coil connection
- closing coil connection
- matching of breaking device open/closed position contacts
- execution of breaking device open and close orders.

The trip and closing circuits are only supervised when connected as shown below.




*Connection for shunt trip coil monitoring.*

*Connection for undervoltage trip coil monitoring.*

*Connection for closing circuit supervision*

### Auxiliary power supply monitoring

The voltage rating of Sepam's auxiliary supply should be set between 24 V DC and 250 V DC.
If the auxiliary supply drifts, 2 alarms may be triggered:
- high set point alarm, adjustable from 105 % to 150 % of rated supply (maximum 275 V)
- low set point alarm, adjustable from 60 % to 95 % of rated supply (minimum 20 V).

### Cumulative breaking current monitoring

Six cumulative currents are proposed to assess breaking device pole condition:
- total cumulative breaking current
- cumulative breaking current between 0 and 2 In
- cumulative breaking current between 2 In and 5 In
- cumulative breaking current between 5 In and 10 In
- cumulative breaking current between 10 In and 40 In
- cumulative breaking current > 40 In.

Each time the breaking device opens, the breaking current is added to the cumulative total and to the appropriate range of cumulative breaking current.
Cumulative breaking current is given in $(kA)^2$.
An alarm can be generated when the total cumulative breaking current exceeds a set point.

### Number of operations

Cumulative number of opening operations performed by the breaking device.

### Circuit breaker operating time and charging time
### Number of rackouts

Used to assess the condition of the breaking device operating mechanism.





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## Sepam self-diagnosis

Sepam includes a number of self-tests carried out in the base unit and optional modules. The purpose of the self-tests is to:
- detect internal failures that may cause nuisance tripping or failed fault tripping
- put Sepam in fail-safe position to avoid any unwanted operation
- alert the facility manager of the need for maintenance operations.

### Internal failure

Two categories of internal failures are monitored:
- major failures: Sepam shutdown (to fail-safe position).

The protection functions are inhibited, the output relays are forced to drop out and the "Watchdog" output indicates Sepam shutdown
- minor failures: downgraded Sepam operation.

Sepam's main functions are operational and equipment protection is ensured.

### Battery monitoring

Monitoring of battery voltage to guarantee data is saved in the event of an outage. A battery fault generates an alarm.

### Detection of plugged connectors

The system checks that the current or voltage sensors are plugged in. A missing connector is a major failure.

### Configuration checking

The system checks that the optional modules configured are present and working correctly.
The absence or failure of a remote module is a minor failure, the absence or failure of a logic input/output module is a major failure.



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# Metering and diagnosis
## Characteristics

| Functions | | Measurement range | Accuracy (1) | MSA141 | Saving |
|---|---|---|---|---|---|
| **Metering** | | | | | |
| Phase current | | 0.02 to 40 In | ±0.5 % | ■ | |
| Residual current | Calculated | 0.005 to 40 In | ±1 % | ■ | |
| | Measured | 0.005 to 20 In0 | ±1 % | ■ | |
| Demand current | | 0.02 to 40 In | ±0.5 % | | |
| Peak demand current | | 0.02 to 40 In | ±0.5 % | | □ |
| Phase-to-phase voltage | Main channels (U) | 0.05 to 1.2 Unp | ±0.5 % | ■ | |
| | Additional channels (U') | 0.05 to 1.2 Unp | ±1 % | | |
| Phase-to-neutral voltage | Main channels (V) | 0.05 to 1.2 Vnp | ±0.5 % | ■ | |
| | Additional channels (V') | 0.05 to 1.2 Vnp | ±1 % | | |
| Residual voltage | | 0.015 to 3 Vnp | ±1 % | | |
| Neutral point voltage | | 0.015 to 3 Vntp | ±1 % | | |
| Positive sequence voltage | | 0.05 to 1.2 Vnp | ±2 % | | |
| Negative sequence voltage | | 0.05 to 1.2 Vnp | ±2 % | | |
| Frequency | Main channels (f) | 25 to 65 Hz | ±0.01 Hz | ■ | |
| | Additional channels (f') | 45 to 55 Hz (fn = 50 Hz)<br>55 to 65 Hz (fn = 60 Hz) | ±0.05 Hz | | |
| Active power (total or per phase) | | 0.008 Sn to 999 MW | ±1 % | ■ | |
| Reactive power (total or per phase) | | 0.008 Sn to 999 MVAR | ±1 % | ■ | |
| Apparent power (total or per phase) | | 0.008 Sn to 999 MVA | ±1 % | ■ | |
| Peak demand active power | | 0.008 Sn to 999 MW | ±1 % | | □ |
| Peak demand reactive power | | 0.008 Sn to 999 MVAR | ±1 % | | □ |
| Power factor | | -1 to + 1 (CAP/IND) | ±0.01 | ■ | |
| Calculated active energy | | 0 to 2.1 x $10^8$ MWh | ±1 % ±1 digit | | □ □ |
| Calculated reactive energy | | 0 to 2.1 x $10^8$ MVARh | ±1 % ±1 digit | | □ □ |
| Temperature | | -30 °C to +200 °C<br>or -22 °F to +392 °F | ±1 °C from +20<br>to +140 °C | ■ | |
| Rotation speed | | 0 to 7200 rpm | ±1 rpm | | |
| **Network diagnosis assistance** | | | | | |
| Tripping context | | | | | □ |
| Tripping current | | 0.02 to 40 In | ±5 % | | □ |
| Number of trips | | 0 to 65535 | - | | □ □ |
| Negative sequence / unbalance | | 1 to 500 % of Ib | ±2 % | | |
| Total harmonic distortion, current | | 0 to 100 % | ±1 % | | |
| Total harmonic distortion, voltage | | 0 to 100 % | ±1 % | | |
| Phase displacement φ0 (between V0 and I0) | | 0 to 359° | ±2° | | |
| Phase displacement φ1, φ2, φ3 (between V and I) | | 0 to 359° | ±2° | | |
| Disturbance recording | | | | | □ |
| Amplitude difference | | 0 to 1.2 Usync1 | ±1 % | | |
| Frequency difference | | 0 to 10 Hz | ±0.5 Hz | | |
| Phase difference | | 0 to 359° | ±2° | | |
| Out-of-sync context | | | | | □ |
| **Machine operating assistance** | | | | | |
| Thermal capacity used | | 0 to 800 %<br>(100 % for phase I = Ib) | ±1 % | ■ | □ □ |
| Remaining operating time before overload tripping | | 0 to 999 min | ±1 min | | |
| Waiting time after overload tripping | | 0 to 999 min | ±1 min | | |
| Running hours counter / operating time | | 0 to 65535 hours | ±1 % or ±0.5 h | | □ □ |
| Starting current | | 1.2 Ib to 40 In | ±5 % | | □ |
| Starting time | | 0 to 300 s | ±300 ms | | □ |
| Number of starts before inhibition | | 0 to 60 | | | |
| Start inhibit time | | 0 to 360 min | ±1 min | | |
| Differential current | | 0.015 to 40 In | ±1 % | | |
| Through current | | 0.015 to 40 In | ±1 % | | |
| Phase displacement θ1, θ2, θ3 (between I and I') | | 0 to 359° | ±2° | | |
| Apparent impedance Zd, Z21, Z32, Z13 | | 0 to 200 kΩ | ±5 % | | |
| Third harmonic neutral point voltage | | 0.2 to 30 % of Vnp | ±1 % | | |
| Third harmonic residual voltage | | 0.2 to 90 % of Vnp | ±1 % | | |
| Capacitance | | 0 to 30 F | ±5 % | | |
| Capacitor unbalance current | | 0.02 to 40 I'n | ±5 % | | |
| **Switchgear diagnosis assistance** | | | | | |
| Cumulative breaking current | | 0 to 65535 kA² | ±10 % | | □ □ |
| Number of operations | | 0 to 4 x $10^9$ | - | | □ □ |
| Operating time | | 20 to 100 s | ±1 ms | | □ □ |
| Charging time | | 1 to 20 s | ±0.5 s | | □ □ |
| Number of rackouts | | 0 to 65535 | - | | □ □ |

■ *available on MSA141 analog output module, according to setup*
□ *saved in the event of auxiliary supply outage, even without battery*
□ *saved by battery in the event of auxiliary supply outage.*
***(1)*** *Under reference conditions (IEC 60255-6), typical accuracy at In or Unp, cosφ > 0.8.*


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## Current protection functions

### ANSI 50/51 - Phase overcurrent

Phase-to-phase short-circuit protection.
2 modes:
■ overcurrent protection sensitive to the highest phase current measured
■ machine differential protection sensitive to the highest differential phase currents obtained in self-balancing schemes.

**Characteristics**
■ 2 groups of settings
■ instantaneous or time-delayed tripping
■ definite time (DT), IDMT (choice of 16 standardized IDMT curves) or customized curve
■ with or without timer hold
■ tripping confirmed or unconfirmed, according to parameter setting:
□ unconfirmed tripping: standard
□ tripping confirmed by negative sequence overvoltage protection (ANSI 47, unit 1), as backup for distant 2-phase short-circuits
□ tripping confirmed by undervoltage protection (ANSI 27, unit 1), as backup for phase-to-phase short-circuits in networks with low short-circuit power.

### ANSI 50N/51N or 50G/51G - Earth fault

Earth fault protection based on measured or calculated residual current values:
■ ANSI 50N/51N: residual current calculated or measured by 3 phase current sensors
■ ANSI 50G/51G: residual current measured directly by a specific sensor.

**Characteristics**
■ 2 groups of settings
■ definite time (DT), IDMT (choice of 16 standardized IDMT curves) or customized curve
■ with or without timer hold
■ second harmonic restraint to ensure stability during transformer energizing, activated by parameter setting.

### ANSI 50BF - Breaker failure

If a breaker fails to be triggered by a tripping order, as detected by the non-extinction of the fault current, this backup protection sends a tripping order to the upstream or adjacent breakers.

### ANSI 46 - Negative sequence / unbalance

Protection against phase unbalance, detected by the measurement of negative sequence current.
■ sensitive protection to detect 2-phase faults at the ends of long lines
■ protection of equipment against temperature build-up, caused by an unbalanced power supply, phase inversion or loss of phase, and against phase current unbalance.

**Characteristics**
■ 1 definite time (DT) curve
■ 9 IDMT curves: 4 IEC curves and 3 IEEE curves, 1 ANSI curve in $RI^2$ and 1 specific Schneider curve.

### ANSI 49RMS - Thermal overload

Protection against thermal damage caused by overloads on
■ machines (transformers, motors or generators)
■ cables
■ capacitors
The thermal capacity used is calculated according to a mathematical model which takes into account:
■ current RMS values
■ ambient temperature
■ negative sequence current, a cause of motor rotor temperature rise.
The thermal capacity used calculations may be used to calculate predictive data for process control assistance.
The protection may be inhibited by a logic input when required by process control conditions.

**Thermal overload for machines - Characteristics**
■ 2 groups of settings
■ 1 adjustable alarm set point
■ 1 adjustable tripping set point
■ adjustable initial thermal capacity used setting, to adapt protection characteristics to fit manufacturer's thermal withstand curves
■ equipment heating and cooling time constants.
The cooling time constant may be calculated automatically based on measurement of the equipment temperature by a sensor.

**Thermal overload for cables - Characteristics**
■ 1 group of settings
■ cable current carrying capacity, which determines alarm and trip set points
■ cable heating and cooling time constants.

**Thermal overload for capacitors - Characteristics**
■ 1 group of settings
■ alarm current, which determines the alarm set point
■ overload current, which determines the tripping set point
■ hot tripping time and current setting, which determine a point on the tripping curve.

### ANSI 51C - Capacitor bank unbalance

Detection of capacitor step internal faults by measuring the unbalance current flowing between the two neutral points of a step connected in a double star arrangement. Four unbalance currents can be measured to protect up to 4 steps.

**Characteristics**
■ 2 set points per step
■ definite time (DT) curve.



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## Recloser

### ANSI 79

Automation device used to limit down time after tripping due to transient or semi-permanent faults on overhead lines. The recloser orders automatic reclosing of the breaking device after the time delay required to restore the insulation has elapsed.
Recloser operation is easy to adapt for different operating modes by parameter setting.

**Characteristics**

■ 1 to 4 reclosing cycles, each cycle has an adjustable dead time
■ adjustable, independent reclaim time and safety time until recloser ready time delays
■ cycle activation linked to instantaneous or time-delayed short-circuit protection function (ANSI 50/51, 50N/51N, 67, 67N/67NC) outputs by parameter setting
■ inhibition/locking out of recloser by logic input.

## Synchro-check

### ANSI 25

This function checks the voltages upstream and downstream of a circuit breaker and allows closing when the differences in amplitude, frequency and phase are within authorized limits.

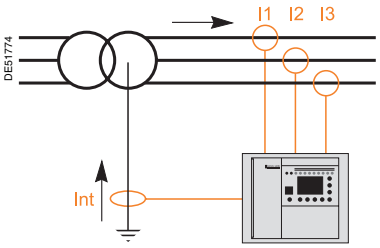
**Characteristics**

■ adjustable and independent set points for differences in voltage, frequency and phase
■ adjustable lead time to take into account the circuit-breaker closing time
■ 5 possible operating modes to take no-voltage conditions into account.

## Differential protection functions

### ANSI 64REF - Restricted earth fault differential

Detection of phase-to-earth faults on 3-phase windings with earthed neutral, by comparison of residual current calculated from the 3 phase currents and residual current measured at the neutral point.




**Characteristics**

■ instantaneous tripping
■ percentage-based characteristic with fixed slope and adjustable low set point
■ more sensitive than transformer or machine differential protection.

### ANSI 87T - Transformer and transformer-machine unit differential (2 windings)

Phase-to-phase short-circuit protection of two-winding transformers or transformer-machine units.
Protection based on phase by phase comparison of the primary and secondary currents with:
■ amplitude and phase correction of the currents in each winding according to the transformer vector shift and the voltage values set
■ clearance of zero sequence current from the primary and secondary windings (suitable for all earthing systems).

**Characteristics**

■ instantaneous tripping
■ adjustable high set point for fast tripping for violent faults, with no restraint
■ percentage-based characteristic with two adjustable slopes and adjustable low set point
■ restraint based on percentage of harmonics. These restraints prevent nuisance tripping during transformer energizing, during faults outside the zone that provoke saturation of the current transformers and during operation of a transformer supplied with excessive voltage (overfluxing).
□ self-adapting neural network restraint: this restraint analyzes the percentage of harmonics 2 and 5 as well as differential and through currents
□ restraint based on the percentage of harmonic 2 per phase or total
□ restraint based on the percentage of harmonic 5 per phase or total.
Self-adapting restraint is exclusive with respect to restraints on the percentage of harmonic 2 or on the percentage of harmonic 5.
■ restraint on energization. This restraint, based on the magnetizing current of the transformer or on a logic equation or Logipam, ensures stability of transformers that have low harmonic percentages on energization
■ fast restraint upon loss of sensor.

### ANSI 87M - Machine differential

Phase-to-phase short-circuit protection, based on phase by phase comparison of the currents on motor and generator windings.

**Characteristics**

■ instantaneous tripping
■ fixed high set point for fast tripping for violent faults, with no restraint
■ percentage-based characteristic with fixed slope and adjustable low set point
■ tripping restraint according to percentage characteristic activated by detection of:
□ external fault or machine starting
□ sensor saturation or disconnection
□ transformer energizing (harmonic 2 restraint).





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## Directional current protection

### ANSI 67 - Directional phase overcurrent

Phase-to-phase short-circuit protection, with selective tripping according to fault current direction.
It comprises a phase overcurrent function associated with direction detection, and picks up if the phase overcurrent function in the chosen direction (line or busbar) is activated for at least one of the 3 phases.

**Characteristics**

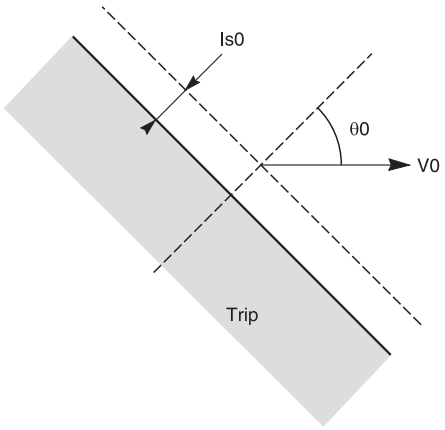
- 2 groups of settings
- instantaneous or time-delayed tripping
- choice of tripping direction
- definite time (DT), IDMT (choice of 16 standardized IDMT curves) or customized curve
- with voltage memory to make the protection insensitive to loss of polarization voltage at the time of the fault
- with or without timer hold.

### ANSI 67N/67NC - Directional earth fault

Earth fault protection, with selective tripping according to fault current direction.
2 types of operation:

- type 1, projection
- type 2, according to the magnitude of the residual current phasor.

DE51841




*Tripping characteristic of ANSI 67N/67NC type 1 protection (characteristic angle θ0 ≠ 0°).*

**ANSI 67N/67NC type 1**

Directional earth fault protection for impedant, isolated or compensated neutral systems, based on the projection of measured residual current.

**Type 1 characteristics**

- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) curve
- choice of tripping direction
- characteristic projection angle
- no timer hold
- with voltage memory to make the protection insensitive to recurrent faults in compensated neutral systems.

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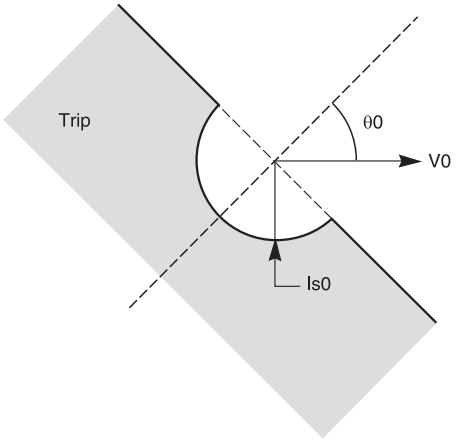


*Tripping characteristic of ANSI 67N/67NC type 2 protection (characteristic angle θ0 ≠ 0°).*

**ANSI 67N/67NC type 2**

Directional overcurrent protection for impedance and solidly earthed systems, based on measured or calculated residual current.
It comprises an earth fault function associated with direction detection, and picks up if the earth fault function in the chosen direction (line or busbar) is activated.

**Type 2 characteristics**

- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT), IDMT (choice of 16 standardized IDMT curves) or customized curve
- choice of tripping direction
- with or without timer hold.


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## Directional power protection functions

### ANSI 32P - Directional active overpower

Two-way protection based on calculated active power, for the following applications:

- active overpower protection to detect overloads and allow load shedding
- reverse active power protection:
  - against generators running like motors when the generators consume active power
  - against motors running like generators when the motors supply active power.

### ANSI 32Q - Directional reactive overpower

Two-way protection based on calculated reactive power to detect field loss on synchronous machines:

- reactive overpower protection for motors which consume more reactive power with field loss
- reverse reactive overpower protection for generators which consume reactive power with field loss.

### ANSI 37P - Directional active underpower

Two-way protection based on calculated active power Checking of active power flows:

- to adapt the number of parallel sources to fit the network load power demand
- to create an isolated system in an installation with its own generating unit.

## Machine protection functions

### ANSI 37 - Phase undercurrent

Protection of pumps against the consequences of a loss of priming by the detection of motor no-load operation.
It is sensitive to a minimum of current in phase 1, remains stable during breaker tripping and may be inhibited by a logic input.

### ANSI 48/51LR - Locked rotor / excessive starting time

Protection of motors against overheating caused by:

- excessive motor starting time due to overloads (e.g. conveyor) or insufficient supply voltage.

The reacceleration of a motor that is not shut down, indicated by a logic input, may be considered as starting.

- locked rotor due to motor load (e.g. crusher):
  - in normal operation, after a normal start
  - directly upon starting, before the detection of excessive starting time, with detection of locked rotor by a zero speed detector connected to a logic input, or by the underspeed function.

### ANSI 66 - Starts per hour

Protection against motor overheating caused by:

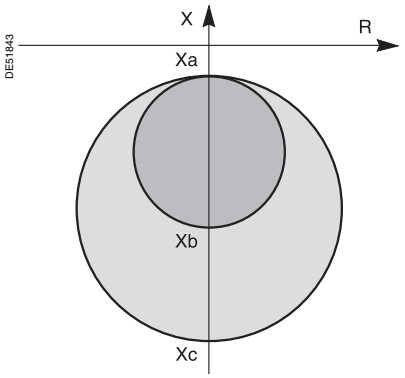
- too frequent starts: motor energizing is inhibited when the maximum allowable number of starts is reached, after counting of:
  - starts per hour (or adjustable period)
  - consecutive motor hot or cold starts (reacceleration of a motor that is not shut down, indicated by a logic input, may be counted as a start)
- starts too close together in time: motor re-energizing after a shutdown is only allowed after an adjustable waiting time.

### ANSI 40 - Field loss (underimpedance)

Protection of synchronous machines against field loss, based on the calculation of positive sequence impedance on the machine terminals or transformer terminals in the case of transformer-machine units.

**Characteristics**

- 2 circular characteristics defined by reactances Xa, Xb and Xc




*2 circular tripping characteristics of ANSI 40 protection.*

- tripping when the machine's positive sequence impedance enters one of the circular characteristics.
- definite (DT) time delay for each circular characteristic
- setting assistance function included in SFT2841 software to calculate the values of Xa, Xb and Xc according to the electrical characteristics of the machine (and transformer, when applicable).



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## ANSI 78PS - Pole slip

Protection against loss of synchronism on synchronous machines, based on calculated active power.
2 types of operation:
■ tripping according to the equal-area criterion, time-delayed
■ tripping according to power swing (number of active power swings):
□ suitable for generators capable of withstanding high electrical and mechanical constraints
□ to be set as a number of rotations.
The 2 types of operation may be used independently or at the same time.

## ANSI 12 - Overspeed

Detection of machine overspeed, based on the speed calculated by pulse-counting, to detect synchronous generator racing due to loss of synchronism, or for process monitoring, for example.

## ANSI 14 - Underspeed

Machine speed monitoring based on the speed calculated by pulse-counting:
■ detection of machine underspeed after starting, for process monitoring, for example
■ zero speed data for detection of locked rotor upon starting.

## ANSI 50V/51V - Voltage-restrained overcurrent

Phase-to-phase short-circuit protection, for generators. The current tripping set point is voltage-adjusted in order to be sensitive to faults close to the generator which cause voltage drops and lowers the short-circuit current.

**Characteristics**
■ instantaneous or time-delayed tripping
■ definite time (DT), IDMT (choice of 16 standardized IDMT curves) or customized curve
■ with or without timer hold.

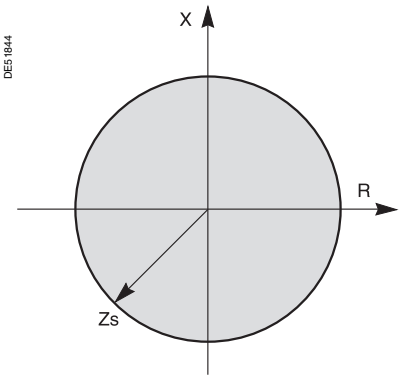
## ANSI 21B - Underimpedance

Phase-to-phase short-circuit protection, for generators, based on the calculation of apparent phase-to-phase impedance.

$$Z21 = \frac{U21}{I2 - I1},$$

apparent impedance between phases 1 and 2.

**Characteristics**
■ circular characteristic centered at origin defined by adjustable set point Zs




*Circular tripping characteristic of ANSI 21B protection.*

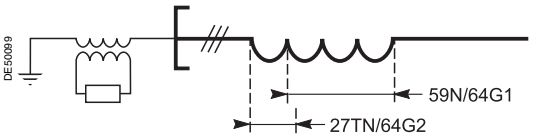
■ time-delayed definite time (DT) tripping when one of the three apparent impedances enters the circular tripping characteristic.

## ANSI 50/27 - Inadvertent energization

Checking of generator starting sequence to detect inadvertent energization of generators that are shut down (a generator which is energized when shut down runs like a motor).
Consists of an instantaneous phase overcurrent protection confirmed by a time-delayed undervoltage protection function.

## ANSI 64G - 100 % stator earth fault

Protection of generators with earthed neutral against phase-to-earth insulation faults in stator windings. This function may be used to protect generators connected to step-up transformers
100 % stator earth fault is a combination of two protection functions:
■ ANSI 59N/64G1: neutral voltage displacement, protection of 85 % to 90 % of the stator winding, terminal end.
■ ANSI 27TN/64G2: thrid harmonic undervoltage, protection of 10 % to 20 % of the stator winding, neutral point end.




*Stator winding of a generator protected 100 % by the combination of ANSI 59N and ANSI 27TN protection functions.*

## ANSI 27TN/64G2 - Third harmonic undervoltage

Protection of generators with earthed neutral against phase-to-earth insulation faults, by the detection of a reduction of third harmonic residual voltage.
Protects the 10 to 20 % of the stator winding, neutral point end, not protected by the ANSI 59N/64G1 function, neutral voltage displacement.

**Characteristics**
■ choice of 2 tripping principles, according to the sensors used:
□ fixed third harmonic undervoltage set point
□ adaptive neutral and terminal third harmonic voltage comparator set point
■ time-delayed definite time (DT) tripping.

## ANSI 26/63 - Thermostat/Buchholz

Protection of transformers against temperature rise and internal faults via logic inputs linked to devices integrated in the transformer.

## ANSI 38/49T - Temperature monitoring

Protection that detects abnormal temperature build-up by measuring the temperature inside equipment fitted with sensors:
■ transformer: protection of primary and secondary windings
■ motor and generator: protection of stator windings and bearings.

**Characteristics**
■ 16 Pt100, NI100 or Ni120 type RTDs
■ 2 adjustable independent set points for each RTD (alarm and trip).



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## Voltage protection functions

### ANSI 24 - Overfluxing (V/Hz)

Protection which detects overfluxing of transformer or generator magnetic circuits by calculating the ratio between the greatest phase-to-neutral or phase-to-phase voltage divided by the frequency.

**Characteristics**

- machine coupling to be set up
- definite time (DT) or IDMT time delays (choice of 3 curves).

### ANSI 27D - Positive sequence undervoltage

Protection of motors against faulty operation due to insufficient or unbalanced network voltage, and detection of reverse rotation direction.

### ANSI 27R - Remanent undervoltage

Protection used to check that remanent voltage sustained by rotating machines has been cleared before allowing the busbar supplying the machines to be re-energized, to avoid electrical and mechanical transients.

### ANSI 27 - Undervoltage

Protection of motors against voltage sags or detection of abnormally low network voltage to trigger automatic load shedding or source transfer.
Works with phase-to-phase or phase-to-neutral voltage, each voltage being monitored separately.

**Characteristics**

- definite time (DT) curve
- IDMT curve.

### ANSI 59 - Overvoltage

Detection of abnormally high network voltage or checking for sufficient voltage to enable source transfer.
Works with phase-to-phase or phase-to-neutral voltage, each voltage being monitored separately.

### ANSI 59N - Neutral voltage displacement

Detection of insulation faults by measuring residual voltage

- ANSI 59N: in isolated neutral systems
- ANSI 59N/64G1: in stator windings of generators with earthed neutral. Protects the 85 % to 90 % of the winding, terminal end, not protected by the ANSI 27TN/64G2 function, third harmonic undervoltage.

**Characteristics**

- definite time (DT) curve
- IDMT curve.

### ANSI 47 - Negative sequence overvoltage

Protection against phase unbalance resulting from phase inversion, unbalanced supply or distant fault, detected by the measurement of negative sequence voltage.

## Frequency protection functions

### ANSI 81H - Overfrequency

Detection of abnormally high frequency compared to the rated frequency, to monitor power supply quality.

### ANSI 81L - Underfrequency

Detection of abnormally low frequency compared to the rated frequency, to monitor power supply quality.
The protection may be used for overall tripping or load shedding.
Protection stability is ensured in the event of the loss of the main source and presence of remanent voltage by a restraint in the event of a continuous decrease of the frequency, which is activated by parameter setting.

### ANSI 81R - Rate of change of frequency

Protection function used for fast disconnection of a generator or load shedding control. Based on the calculation of the frequency variation, it is insensitive to transient voltage disturbances and therefore more stable than a phase-shift protection function.

**Disconnection**

In installations with autonomous production means connected to a utility, the "rate of change of frequency" protection function is used to detect loss of the main system in view of opening the incoming circuit breaker to:

- protect the generators from a reconnection without checking synchronization
- avoid supplying loads outside the installation.

**Load shedding**

The "rate of change of frequency" protection function is used for load shedding in combination with the underfrequency protection to:

- either accelerate shedding in the event of a large overload
- or inhibit shedding following a sudden drop in frequency due to a problem that should not be solved by shedding.





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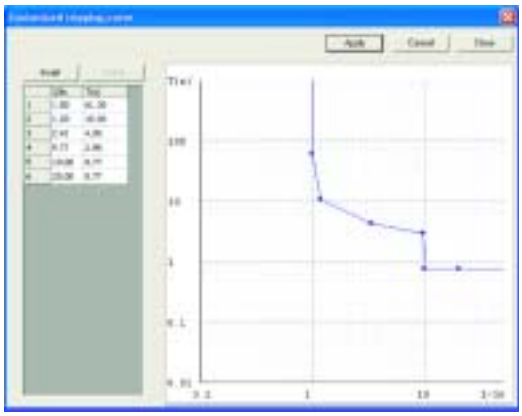
# Protection
Tripping curves



PE50551



*Customized tripping curve set using SFT2841 software.*

## Customized tripping curve

Defined point by point using the SFT2841 setting and operating software tool, this curve may be used to solve all special cases involving protection coordination or revamping.

## IDMT tripping curves

### Current IDMT tripping curves

Multiple IDMT tripping curves are offered, to cover most applications:
- IEC curves (SIT, VIT/LTI, EIT)
- IEEE curves (MI, VI, EI)
- usual curves (UIT, RI, IAC).

### IEC curves

| Equation | Curve type | Coefficient values | | |
|---|---|---|---|---|
| | | k | α | β |
| $td(I) = \frac{k}{\left(\frac{I}{Is}\right)^{\alpha} - 1} \times \frac{T}{\beta}$ | Standard inverse / A | 0.14 | 0.02 | 2.97 |
| | Very inverse / B | 13.5 | 1 | 1.50 |
| | Long time inverse / B | 120 | 1 | 13.33 |
| | Extremely inverse / C | 80 | 2 | 0.808 |
| | Ultra inverse | 315.2 | 2.5 | 1 |

### RI curve

Equation: $td(I) = \frac{1}{0{,}339 - 0{,}236\left(\frac{I}{Is}\right)^{-1}} \times \frac{T}{3{,}1706}$

### IEEE curves

| Equation | Curve type | Coefficient values | | | |
|---|---|---|---|---|---|
| | | A | B | p | β |
| $td(I) = \left(\frac{A}{\left(\frac{I}{Is}\right)^{p} - 1} + B\right) \times \frac{T}{\beta}$ | Moderately inverse | 0.010 | 0.023 | 0.02 | 0.241 |
| | Very inverse | 3.922 | 0.098 | 2 | 0.138 |
| | Extremely inverse | 5.64 | 0.0243 | 2 | 0.081 |

### IAC curves

| Equation | Curve type | Coefficient values | | | | | |
|---|---|---|---|---|---|---|---|
| | | A | B | C | D | E | β |
| $td(I) = \left(A + \frac{B}{\left(\frac{I}{Is} - C\right)} + \frac{D}{\left(\frac{I}{Is} - C\right)^2} + \frac{E}{\left(\frac{I}{Is} - C\right)^3}\right) x \frac{T}{\beta}$ | Inverse | 0.208 | 0.863 | 0.800 | -0.418 | 0.195 | 0.297 |
| | Very inverse | 0.090 | 0.795 | 0.100 | -1.288 | 7.958 | 0.165 |
| | Extremely inverse | 0.004 | 0.638 | 0.620 | 1.787 | 0.246 | 0.092 |

### Voltage IDMT tripping curves

**Equation for ANSI 27 - undervoltage**

$td(I) = \frac{T}{1 - \left(\frac{V}{Vs}\right)}$

**Equation for ANSI 59N - Neutral voltage displacement**

$td(I) = \frac{T}{\left(\frac{V}{Vs}\right) - 1}$

### Voltage/frequency ratio IDMT tripping curves

**Equation for ANSI 24 - Overfluxing (V/Hz)**

With G = V/f or U/f

$td(G) = \frac{1}{\left(\frac{G}{Gs} - 1\right)^{p}} x\, T$

| Curve type | p |
|---|---|
| A | 0.5 |
| B | 1 |
| C | 2 |



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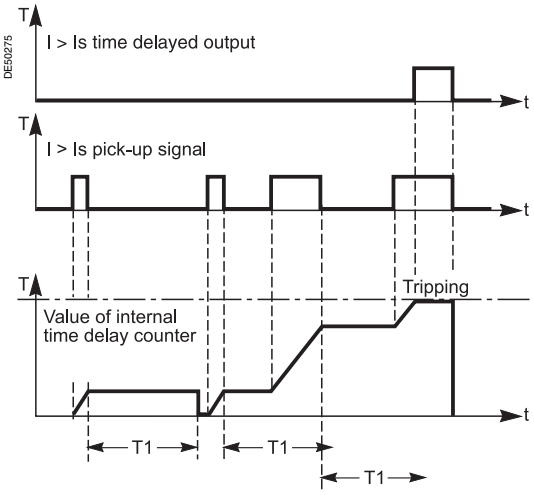
# Protection
Main characteristics



## Setting of IDMT tripping curves, time delay T or TMS factor

The time delays of current IDMT tripping curves (except for customized and RI curves) may be set as follows:
- time T, operating time at 10 x Is
- TMS factor, factor shown as T/β in the equations on the left.




*Detection of restriking faults with adjustable timer hold.*

## Timer hold

The adjustable timer hold T1 is used for:
- detection of restriking faults (DT curve)
- coordination with electromechanical relays (IDMT curve).

Timer hold may be inhibited if necessary.

## 2 groups of settings

### Phase-to-phase and phase-to-earth short-circuit protection

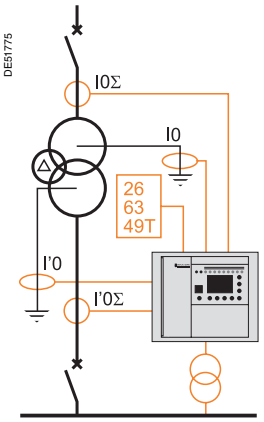
Each unit has 2 groups of settings, A and B, to adapt the settings to suit the network configuration.
The active group of settings (A or B) is set by a logic input or the communication link.

**Example of use: normal / backup mode network**
- group A for network protection in normal mode, when the network is supplied by the utility
- group B for network protection in backup mode, when the network is supplied by a backup generator.

### Thermal overload for machines

Each unit has 2 groups of settings to protect equipment that has two operating modes.

**Examples of use:**
- transformers: switching of groups of settings by logic input, according to transformer ventilation operating mode, natural or forced ventilation (ONAN or ONAF)
- motors: switching of groups of settings according to current set point, to take into account the thermal withstand of motors with locked rotors.




*Measurement origin: example.*

## Measurement origin

The measurement origin needs to be indicated for each unit of the protection functions that may use measurements of different origins.
The setting links a measurement to a protection unit and allows the protection units to be distributed optimally among the measurements available according to the sensors connected to the analog inputs.

**Example**: distribution of ANSI 50N/51N function units for transformer earth fault protection:
- 2 units linked to measured I0 for transformer primary protection
- 2 units linked to measured I'0 for transformer secondary protection
- 2 units linked to I0Σ for protection upstream of the transformer
- 2 units linked to I'0Σ for protection downstream of the transformer.

## Summary table

| Characteristics | Protection functions |
|---|---|
| 2 groups of settings A et B | 50/51, 50N/51N, 67, 67N/67NC |
| 2 groups of settings, operating modes 1 and 2 | 49RMS Machine |
| IEC IDMT curves | 50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2, 46 |
| IEEE IDMT curves | 50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2, 46 |
| Usual IDMT curves | 50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2 |
| Voltage IDMT curves | 27, 59N, 24 |
| Customized curve | 50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2 |
| Timer hold | 50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2 |



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# Protection
## Setting ranges

| Functions | Settings | | Time delays |
|---|---|---|---|
| **ANSI 12 - Overspeed** | | | |
| | 100 to 160 % of Ωn | | 1 to 300 s |
| **ANSI 14 - Underspeed** | | | |
| | 10 to 100 % of Ωn | | 1 to 300 s |
| **ANSI 21B - Underimpedance** | | | |
| Impedance Zs | 0.05 to 2.00 Vn/Ib | | |
| **ANSI 24 - Overfluxing (V/Hz)** | | | |
| Tripping curve | Definite time | | |
| | IDMT type A, B or C | | |
| Gs set point | 1.03 to 2 pu | Definite time | 0.1 to 20000 s |
| | | IDMT | 0.1 to 1250 s |
| **ANSI 25 - Synchro-check** | | | |
| Measured voltages | Phase-to-phase | Phase-to-neutral | |
| **Rated primary phase-to-phase voltage** | | | |
| Unp sync1 (Vnp sync1 = Unp sync1/$\sqrt{3}$) | 220 V to 250 kV | 220 V to 250 kV | |
| Unp sync2 (Vnp sync2 = Unp sync2/$\sqrt{3}$) | 220 V to 250 kV | 220 V to 250 kV | |
| **Rated secondary phase-to-phase voltage** | | | |
| Uns sync1 | 90 V to 120 V | 90 V to 230 V | |
| Uns sync2 | 90 V to 120 V | 90 V to 230 V | |
| **Synchro-check setpoints** | | | |
| dUs set point | 3 % to 30 % of Unp sync1 | 3 % to 30 % of Vnp sync1 | |
| dfs set point | 0.05 to 0.5 Hz | 0.05 to 0.5 Hz | |
| dPhi set point | 5 to 80° | 5 to 80° | |
| Us high set point | 70 % to 110 % Unp sync1 | 70 % to 110 % Vnp sync1 | |
| Us low set point | 10 % to 70 % Unp sync1 | 10 % to 70 % Vnp sync1 | |
| **Other settings** | | | |
| Lead time | 0 to 0.5 s | 0 to 0.5 s | |
| Operating modes: no-voltage conditions for which coupling is allowed | Dead1 AND Live2 | Dead1 AND Live2 | |
| | Live1 AND Dead2 | Live1 AND Dead2 | |
| | Dead1 XOR Dead2 | Dead1 XOR Dead2 | |
| | Dead1 OR Dead2 | Dead1 OR Dead2 | |
| | Dead1 AND Dead2 | Dead1 AND Dead2 | |
| **ANSI 27 - Undervoltage (L-L) or (L-N)** | | | |
| Tripping curve | Definite time | | |
| | IDMT | | |
| Set point | 5 to 100 % of Unp | | 0.05 to 300 s |
| Measurement origin | Main channels (U) or additional channels (U') | | |
| **ANSI 27D - Positive sequence undervoltage** | | | |
| Set point and time delay | 15 to 60 % of Unp | | 0.05 to 300 s |
| Measurement origin | Main channels (U) or additional channels (U') | | |
| **ANSI 27R - Remanent undervoltage** | | | |
| Set point and time delay | 5 to 100 % of Unp | | 0.05 to 300 s |
| Measurement origin | Main channels (U) or additional channels (U') | | |
| **ANSI 27TN/64G2 - Third harmonic undervoltage** | | | |
| Vs set point (fixed) | 0.2 to 20 % of Vntp | | 0.5 to 300 s |
| K set point (adaptive) | 0.1 to 0.2 | | 0.5 to 300 s |
| Positive sequence undervoltage | 50 to 100 % of Unp | | |
| Minimum apparent power | 1 to 90 % of Sb (Sb = $\sqrt{3}$.Un.Ib) | | |
| **ANSI 32P - Directional active overpower** | | | |
| | 1 to 120 % of Sn (2) | | 0.1 s to 300 s |
| **ANSI 32Q - Directional reactive overpower** | | | |
| | 5 to 120 % of Sn (2) | | 0.1 s to 300 s |
| **ANSI 37 - Phase undercurrent** | | | |
| | 0.05 to 1 Ib | | 0.05 s to 300 s |
| **ANSI 37P - Directional active underpower** | | | |
| | 5 to 100 % of Sn (2) | | 0.1 s to 300 s |
| **ANSI 38/49T - Temperature monitoring** | | | |
| Alarm set point TS1 | 0 °C to 180 °C or 32 °F to 356 °F | | |
| Trip set point TS2 | 0 °C to 180 °C or 32 °F to 356 °F | | |
| **ANSI 40 - Field loss (underimpedance)** | | | |
| Common point: Xa | 0.02 Vn/Ib to 0.2 Vn/Ib + 187.5 kΩ | | |
| Circle 1: Xb | 0.2 Vn/Ib to 1.4 Vn/Ib + 187.5 kΩ | | 0.05 to 300 s |
| Circle 2: Xc | 0.6 Vn/Ib to 3 Vn/Ib + 187.5 kΩ | | 0.1 to 300 s |

***(1)*** *Sn* = √3.In.Unp.



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# Protection
## Setting ranges

| Functions | Settings | | Time delays | |
|---|---|---|---|---|
| **ANSI 46 - Negative sequence / unbalance** | | | | |
| Tripping curve | Definite time | | | |
| | Schneider Electric | | | |
| | IEC: SIT/A, LTI/B, VIT/B, EIT/C | | | |
| | IEEE: MI (D), VI (E), EI (F) | | | |
| | $RI^2$ (setting constant from 1 to 100) | | | |
| Is set point | 0. to 5 Ib | Definite time | 0.1 to 300 s | |
| | 0.1 to 0.5 Ib (Schneider Electric) | IDMT | 0.1 to 1s | |
| | 0.1 to 1 Ib (IEC, IEEE) | | | |
| | 0.03 to 0.2 Ib ($RI^2$) | | | |
| Measurement origin | Main channels (I) or additional channels (I') | | | |
| **ANSI 47 - Negative sequence overvoltage** | | | | |
| Set point and time delay | 1 to 50 % of Unp | | 0.05 to 300 s | |
| Measurement origin | Main channels (U) or additional channels (U') | | | |
| **ANSI 48/51LR - Locked rotor / excessive starting time** | | | | |
| Is set point | 0.5 Ib to 5 Ib | ST starting time | 0.5 s to 300 s | |
| | | LT and LTS time delays | 0.05 s to 300 s | |
| **ANSI 49RMS - Thermal overload for cables** | | | | |
| Admissible current | 1 to 1.73 Ib | | | |
| Time constant T1 | 1 to 600 min | | | |
| **ANSI 49RMS - Thermal overload for capacitors** | | | | |
| Alarm current | | 1.05 Ib to 1.70 Ib | | |
| Trip current | | 1.05 Ib to 1.70 Ib | | |
| Positioning of the hot tripping curve | Current setting | 1.02 x trip current to 2 Ib | | |
| | Time setting | 1 to 2000 minutes (variable range depending on the trip current and current setting) | | |
| **ANSI 49RMS - Thermal overload for machines** | | | **Mode 1** | **Mode 2** |
| Accounting for negative sequence component | | 0 - 2.25 - 4.5 - 9 | | |
| Time constant | Heating | | T1: 1 to 600 min | T1: 1 to 600 min |
| | Cooling | | T2: 5 to 600 min | T2: 5 to 600 min |
| Alarm and tripping set points (Es1 and Es2) | | 0 to 300 % of rated thermal capacity | | |
| Initial thermal capacity used (Es0) | | 0 to 100 % | | |
| Switching of thermal settings condition | | by logic input | | |
| | | by Is set point adjustable from 0.25 to 8 Ib | | |
| Maximum equipment temperature | | 60 to 200 °C | | |
| Measurement origin | Main channels (I) or additional channels (I') | | | |
| **ANSI 50BF - Breaker failure** | | | | |
| Presence of current | 0.2 to 2 In | | | |
| Operating time | 0.05 s to 3 s | | | |
| **ANSI 50/27 - Inadvertent energization** | | | | |
| Is set point | 0.05 to 4 In | | | |
| Vs set point | 10 to 100 % Unp | | T1: 0 to 10 s | |
| | | | T2: 0 to 10 s | |
| **ANSI 50/51 - Phase overcurrent** | | | | |
| | **Tripping time delay** | **Timer hold** | | |
| Tripping curve | Definite time | DT | | |
| | SIT, LTI, VIT, EIT, UIT (1) | DT | | |
| | RI | DT | | |
| | IEC: SIT/A, LTI/B, VIT/B, EIT/C | DT or IDMT | | |
| | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | | |
| | IAC: I, VI, EI | DT or IDMT | | |
| | Customized | DT | | |
| Is set point | 0.05 to 24 In | Definite time | Inst; 0.05 s to 300 s | |
| | 0.05 to 2.4 In | IDMT | 0.1 s to 12.5 s at 10 Is | |
| Timer hold | Definite time (DT; timer hold) | | Inst; 0.05 s to 300 s | |
| | IDMT (IDMT; reset time) | | 0.5 s to 20 s | |
| Measurement origin | Main channels (I) or additional channels (I') | | | |
| Confirmation | None | | | |
| | By negative sequence overvoltage | | | |
| | By phase-to-phase undervoltage | | | |

***(1)*** *Tripping as of 1.2 Is.*



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# Protection
## Setting ranges



| Functions | Settings | | Time delays |
|---|---|---|---|
| **ANSI 50N/51N or 50G/51G - Earth fault** | | | |
| | **Tripping time delay** | **Timer hold** | |
| Tripping curve | Definite time | DT | |
| | SIT, LTI, VIT, EIT, UIT (1) | DT | |
| | RI | DT | |
| | CEI: SIT/A,LTI/B, VIT/B, EIT/C | DT or IDMT | |
| | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | |
| | IAC: I, VI, EI | DT or IDMT | |
| | Customized | DT | |
| Is0 set point | 0.01 to 15 In0 (min. 0.1 A) | Definite time | Inst; 0.05 s to 300 s |
| | 0.01 to 1 In0 (min. 0.1 A) | IDMT | 0.1 s to 12.5 s at 10 Is0 |
| Timer hold | Definite time (DT; timer hold) | | Inst; 0.05 s to 300 s |
| | IDMT (IDMT; reset time) | | 0.5 s to 20 s |
| Measurement origin | I0 input, I'0 input, sum of phase currents I0Σ or sum of phase currents I'0Σ | | |
| **ANSI 50V/51V - Voltage-restrained overcurrent** | | | |
| | **Tripping time delay** | **Timer hold** | |
| Tripping curve | Definite time | DT | |
| | SIT, LTI, VIT, EIT, UIT (1) | DT | |
| | RI | DT | |
| | IEC: SIT/A, LTI/B, VIT/B, EIT/C | DT or IDMT | |
| | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | |
| | IAC: I, VI, EI | DT or IDMT | |
| | Customized | DT | |
| Is set point | 0.5 to 24 In | Definite time | Inst; 0.05 s to 300 s |
| | 0.5 to 2.4 In | IDMT | 0.1 s to 12.5 s at 10 Is |
| Timer hold | Definite time (DT; timer hold) | | Inst; 0.05 s to 20 s |
| | IDMT (IDMT; reset time) | | 0.5 s to 300 s |
| Measurement origin | Main channels (I) or additional channels (I') | | |
| **ANSI 51C - Capacitor bank unbalance** | | | |
| Is set point | 0.05 A to 2 I'n | Definite time | 0.1 to 300 s |
| **ANSI 59 - Overvoltage (L-L) or (L-N)** | | | |
| Set point and time delay | 50 to 150 % of Unp | | 0.05 to 300 s |
| Measurement origin | Main channels (U) or additional channels (U') | | |
| **ANSI 59N - Neutral voltage displacement** | | | |
| Tripping curve | Definite time | | |
| | IDMT | | |
| Set point | 2 to 80 % of Unp | Definite time | 0.05 to 300 s |
| | 2 to 10 % of Unp | IDMT | 0.1 to 100 s |
| Measurement origin | Main channels (U), additional channels (U') or neutral-point voltage Vnt | | |
| **ANSI 64REF - Restricted earth fault differential** | | | |
| Is0 set point | 0.05 to 0.8 In (In ≥ 20 A) | | |
| | 0.1 to 0.8 In (In < 20 A) | | |
| Measurement origin | Main channels (I, I0) or additional channels (I', I'0) | | |
| **ANSI 66 - Starts per hour** | | | |
| Total number of starts | 1 to 60 | Period | 1 to 6 h |
| Number of consecutive starts | 1 to 60 | T time delay stop/start | 0 to 90 min |
| **ANSI 67 - Directional phase overcurrent** | | | |
| Characteristic angle | 30°, 45°, 60° | | |
| | **Tripping time delay** | **Timer hold delay** | |
| Tripping curve | Definite time | DT | |
| | SIT, LTI, VIT, EIT, UIT (1) | DT | |
| | RI | DT | |
| | IEC: SIT/A, LTI/B, VIT/B, EIT/C | DT or IDMT | |
| | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | |
| | IAC: I, VI, EI | DT or IDMT | |
| | Customized | DT | |
| Is set point | 0.1 to 24 In | Definite time | Inst; 0.05 s to 300 s |
| | 0.1 to 2.4 In | IDMT | 0.1 s to 12.5 s at 10 Is |
| Timer hold | Definite time (DT; timer hold) | | Inst; 0.05 s to 300 s |
| | IDMT (IDMT; reset time) | | 0.5 s to 20 s |

***(1)*** *Tripping as of 1.2 Is.*


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# Protection
## Setting ranges

| Functions | Settings | | Time delays |
|---|---|---|---|
| **ANSI 67N/67NC - Directional earth fault, projection (type 1)** | | | |
| Characteristic angle | -45°, 0°, 15°, 30°, 45°, 60°, 90° | | |
| Is0 set point | 0.01 to 15 In0 (mini. 0,1 A) | Definite time | Inst; 0.05 s to 300 s |
| Vs0 set point | 2 to 80 % of Unp | | |
| Memory time | T0mem time | 0; 0.05 s to 300 s | |
| | V0mem validity set point | 0; 2 to 80 % of Unp | |
| Measurement origin | I0 input, I'0 input | | |
| **ANSI 67N/67NC - Directional earth fault, according to I0 vector magnitude (type 2)** | | | |
| Characteristic angle | -45°, 0°, 15°, 30°, 45°, 60°, 90° | | |
| | **Tripping time delay** | **Timer hold delay** | |
| Tripping curve | Definite time | DT | |
| | SIT, LTI, VIT, EIT, UIT (1) | DT | |
| | RI | DT | |
| | IEC: SIT/A,LTI/B, VIT/B, EIT/C | DT or IDMT | |
| | IEEE: MI (D), VI (E), EI (F) | DT or IDMT | |
| | IAC: I, VI, EI | DT or IDMT | |
| | Customized | DT | |
| Is0 set point | 0.1 to 15 In0 (min. 0.1 A) | Definite time | Inst; 0.05 s to 300 s |
| | 0.01 to 1 In0 (min. 0.1 A) | IDMT | 0.1 s to 12.5 s at 10 Is0 |
| Vs0 set point | 2 to 80 % of Unp | | |
| Timer hold | Definite time (DT; timer hold) | | Inst; 0.05 s to 300 s |
| | IDMT (IDMT; reset time) | | 0.5 s to 20 s |
| Measurement origin | I0 input, I'0 input or sum of phase currents I0Σ | | |
| **ANSI 78PS - Pole slip** | | | |
| Time delay of the equal-area criterion | 0.1 to 300 s | | |
| Maximum number of power swings | 1 to 30 | | |
| Time between 2 power swings | 1 to 300 s | | |
| **ANSI 81H - Overfrequency** | | | |
| Set point and time delay | 50 to 55 Hz or 60 to 65 Hz | | 0.1 to 300 s |
| Measurement origin | Main channels (U) or additional channels (U') | | |
| **ANSI 81L - Underfrequency** | | | |
| Set point and time delay | 40 to 50 Hz or 50 to 60 Hz | | 0.1 to 300 s |
| Measurement origin | Main channels (U) or additional channels (U') | | |
| **ANSI 81R - Rate of change of frequency** | | | |
| | 0.1 to 10 Hz/s | | 0.15 to 300 s |
| **ANSI 87M - Machine différential** | | | |
| Ids set point | 0.05 to 0.5 In (In ≥ 20 A) | | |
| | 0.1 to 0.5 In (In < 20 A) | | |
| **ANSI 87T - Transformer differential** | | | |
| High set point | 3 to 18 In1 | | |
| **Percentage-based curve** | | | |
| Ids set point | 30 to 100 % In1 | | |
| Slope Id/It | 15 to 50 % | | |
| Slope Id/It2 | without, 50 to 100 % | | |
| Slope change point | 1 to 18 In1 | | |
| **Restraint on energization** | | | |
| Current threshold | 1 to 10 % | | |
| Delay | 0 to 300 s | | |
| **Restraint on CT loss** | | | |
| Activity | On / Off | | |
| **Retenues sur taux d'harmoniques** | **Classic** | **Self-adapting** | |
| Choice of restraint | classic | Self-adapting | |
| High set point | On | On / Off | |
| Harmonic 2 percentage set point | off, 5 to 40 % | | |
| Harmonic 2 restraint | per phase / total | | |
| Harmonic 5 percentage set point | off, 5 to 40 % | | |
| Harmonic 5 restraint | per phase / total | | |





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# Control and monitoring
## Description



Sepam performs all the control and monitoring functions required for electrical network operation:
■ the main control and monitoring functions are predefined and fit the most frequent cases of use. They are ready to use and are implemented by simple parameter setting after the necessary logic inputs / outputs are assigned.
■ the predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:
□ logic equation editor, to adapt and complete the predefined control and monitoring functions
□ creation of personalized messages for local annunciation
□ creation of personalized mimic diagrams corresponding to the controlled devices
□ customization of the control matrix by changing the assignment of output relays, LEDs and annunciation messages
■ with the Logipam option, Sepam can provide the most varied control and monitoring functions, programmed using the SFT2885 programming software that implements the Logipam ladder language.

### Operating principle

The processing of each control and monitoring function may be broken down into 3 phases:
■ acquisition of input data:
□ results of protection function processing
□ external logic data, connected to the logic inputs of an optional MES120 input / output module
□ local control orders transmitted by the mimic-based UMI
□ remote control orders (TC) received via the Modbus communication link
■ actual processing of the control and monitoring function
■ utilization of the processing results:
□ activation of output relays to control a device
□ information sent to the facility manager:
- by message and/or LED on the Sepam display and SFT2841 software
- by remote indication (TS) via the Modbus communication link
- by real-time indications on device status on the animated mimic diagram.

### Logic inputs and outputs

The number of Sepam inputs / outputs must be adapted to fit the control and monitoring functions used.
The 5 outputs included in the Sepam series 80 base unit may be extended by adding 1, 2 or 3 MES120 modules with 14 logic inputs and 6 output relays.
After the number of MES120 modules required for the needs of an application is set, the logic inputs are assigned to functions. The functions are chosen from a list which covers the whole range of possible uses. The functions are adapted to meet needs within the limits of the logic inputs available. The inputs may also be inverted for undervoltage type operation.
A default input / output assignment is proposed for the most frequent uses.

PE50249

*Maximum Sepam series 80 configuration with 3 MES120 modules: 42 inputs and 23 outputs.*


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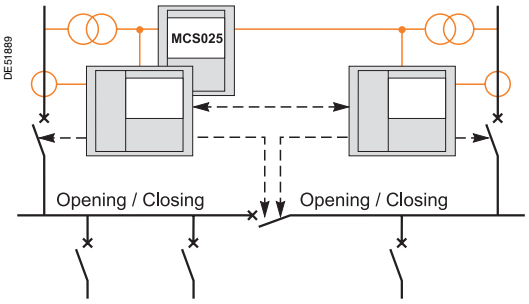
# Control and monitoring
## Description of predefined functions






*Automatic transfer with synchro-check controlled by Sepam series 80.*

Each Sepam contains the appropriate predefined control and monitoring functions for the chosen application.

### ANSI 94/69 - Circuit breaker/contactor control

Control of breaking devices equipped with different types of closing and tripping coils:
- circuit breakers with shunt or undervoltage trip coils
- latching contactors with shunt trip coils
- contactors with latched orders.

The function processes all breaking device closing and tripping conditions, based on:
- protection functions
- breaking device status data
- remote control orders
- specific control functions for each application (e.g. recloser, synchro-check).

The function also inhibits breaking device closing, according to the operating conditions.

### Automatic transfer (AT)

This function transfers busbar supply from one source to another. It concerns substations with two incomers, with or without coupling.

The function carries out:
- automatic transfer with a break if there is a loss of voltage or a fault
- manual transfer and return to normal operation without a break, with or without synchro-check
- control of the coupling circuit breaker (optional)
- selection of the normal operating mode
- the necessary logic to ensure that at the end of the sequence, only 1 circuit breaker out of 2 or 2 out of 3 are closed.

The function is distributed between the two Sepam units protecting the two incomers. The synchro-check function (ANSI 25) is carried out by the optional MCS025 module, in conjunction with one of the two Sepam units.

### Load shedding - Automatic restart

Automatic load regulation on electrical networks by load shedding followed by automatic restarting of motors connected to the network

**Load shedding**

The breaking device opens to stop motors in case of:
- detection of a network voltage sag by the positive sequence undervoltage protection function ANSI 27D
- receipt of a load shedding order on a logic input.

**Automatic restart**

The motors disconnected as a result of the network voltage sag are automatically restarted:
- after the return of network voltage is detected by the positive sequence undervoltage protection function ANSI 27D
- and a time delay has run out, so as to stagger motor restarts.

### De-excitation

Interruption of a synchronous generator's excitation supply and tripping of the generator breaking device in case of:
- detection of an internal generator fault
- detection of an excitation system fault
- receipt of a de-excitation order on a logic input or via the communication link.



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# Control and monitoring
## Description of predefined functions



### Genset shutdown
Shutdown of the driving machine, tripping of the breaking device and interruption of the generator excitation supply in case of:
- detection of an internal generator fault
- receipt of a genset shutdown order on a logic input or via the communication link.

### Control of capacitor banks
This function controls 1 to 4 switches for capacitor steps, taking into account all the closing and tripping conditions determined by the ANSI 94/69 function for control of the switchgear.
Manual or automatic control, controlled by an external reactive-energy regulator.

### ANSI 68 - Logic discrimination
This function provides:
- perfect tripping discrimination with phase-to-phase and phase-to-earth short-circuits, on all types of network
- faster tripping of the breakers closest to the source (solving the drawback of conventional time discrimination).

Each Sepam is capable of:
- sending a blocking input when a fault is detected by the phase overcurrent and earth fault protection functions, which may or may not be directional (ANSI 50/51, 50N/51N, 67 or 67N/67NC)
- and receiving blocking inputs which inhibit protection tripping. A saving mechanism ensures continued operation of the protection in the event of a blocking link failure.

### ANSI 86 - Latching / acknowledgement
The tripping outputs for all the protection functions and all the logic inputs can be latched individually. The latched information is saved in the event of an auxiliary power failure.
(The logic outputs cannot be latched.)

All the latched data may be acknowledged:
- locally, with the reset key
- remotely via a logic input
- or via the communication link.

The Latching/acknowledgement function, when combined with the circuit breaker/contactor control function, can be used to create the ANSI 86 "Lockout relay" function.

### Output relay testing
Each output relay is activated for 5 seconds, to make it simpler to check output connections and connected switchgear operation.


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# Control and monitoring
## Description of predefined functions

PE50287


*Local indications on the Sepam front panel.*

PE50274


*SFT2841: alarm history.*

### ANSI 30 - Local annunciation

**LED indication**

■ 2 LEDs, on the front and back of Sepam, indicate the unit operating status, and are visible when a Sepam without a UMI is mounted inside the LV compartment, with access to connectors:
□ green LED ON: Sepam on
□ red "key" LED: Sepam unavailable (initialization phase or detection of an internal failure)
■ 9 yellow LEDs on the Sepam front panel:
□ pre-assigned and identified by standard removable labels
□ the SFT2841 software tool may be used to assign LEDs and personalize labels.

**Local annunciation on Sepam display**

Events and alarms may be indicated locally on Sepam's advanced UMI or on the mimic-based UMI by:
■ messages on the display unit, available in 2 languages:
□ English, factory-set messages, not modifiable
□ local language, according to the version delivered (the language version is chosen when Sepam is set up)
■ the lighting up of one of the 9 yellow LEDs, according to the LED assignment, which is set using SFT2841.

**Alarm processing**

■ when an alarm appears, the related message replaces the current display and the related LED goes on.
The number and type of messages depend on the type of Sepam. The messages are linked to Sepam functions and may be viewed on the front-panel display and in the SFT2841 "Alarms" screen.
■ to clear the message from the display, press the clear key
■ after the fault has disappeared, press the reset key: the light goes off and Sepam is reset
■ the list of alarm messages remains accessible (⚠ key) and may be cleared by pressing the clear key.

3


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# Control and monitoring
## Description of predefined functions



PE50486

*Local control using the mimic-based UMI.*

### Local control using the mimic-based UMI

**Sepam control mode**

A key-switch on the mimic-based UMI is used to select the Sepam control mode. Three modes are available : Remote, Local or Test.

In Remote mode:

- remote control orders are taken into account
- local control orders are disabled, with the exception of the circuit-breaker open order.

In Local mode:

- remote control orders are disabled, with the exception of the circuit-breaker open order
- local control orders are enabled.

Test mode should be selected for tests on equipment, e.g. during preventive-maintenance operations:

- all functions enabled in Local mode are available in Test mode
- no remote indications (TS) are sent via the communication link.

The Logipam programming software can be used to customize control-mode processing.

**View device status on the animated mimic diagram**

For safe local control of devices, all information required by operators can be displayed simultaneously on the mimic-based UMI:

- single-line diagram of the equipment controlled by Sepam, with an animated, graphic indication of device status in real time
- the desired current, voltage and power measurements.

The local-control mimic diagram can be customized by adapting one of the supplied, predefined diagrams or by creating a diagram from scratch.

**Local control of devices**

All the devices for which opening and closing are controlled by Sepam can be controlled locally using the mimic-based UMI.

The most common interlock conditions can be defined be logic equations or by Logipam.

The sure and simple operating procedure is the following:

- select the device to be controlled by moving the selection window using the keys or . Sepam checks whether local control of the selected device is authorized and informs the operator (selection window with a solid line)
- selection confirmation for the device to be controlled by pressing the key (the selection window flashes)
- device control by pressing:
  - key : open order
  - or key : close order.



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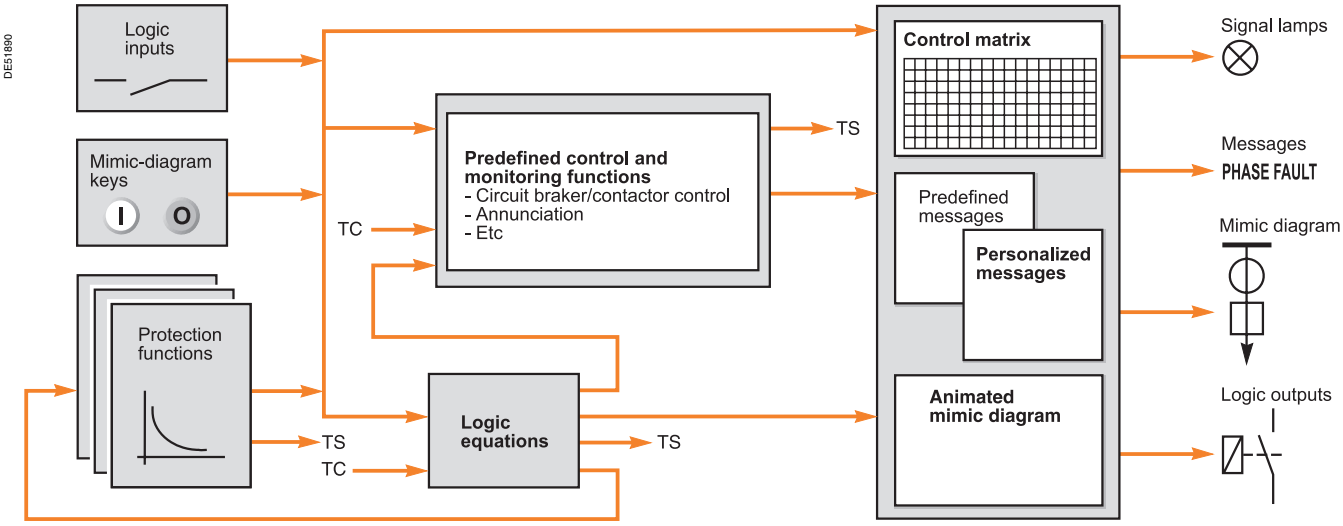
# Control and monitoring
## Adaptation of predefined functions using the SFT2841 software

The predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:
- logic equation editor, to adapt and complete the predefined control and monitoring functions
- creation of personalized messages for local annunciation
- creation of custom mimic diagrams corresponding to the controlled devices
- customization of the control matrix by changing the assignment of output relays, LEDs and annunciation messages.

### Operating principle





*SFT2841: logic equation editor.*

### Logic equation editor

The logic equation editor included in the SFT2841 software can be used to:
- complete protection function processing:
  - additional interlocking
  - conditional inhibition/validation of functions
  - etc.
- adapt predefined control functions: particular circuit breaker or recloser control sequences, etc.

Note that the use of the logic equation editor excludes the possibility of using the Logipam programming software.

A logic equation is created by grouping logic input data received from:
- protection functions
- logic inputs
- local control orders transmitted by the mimic-based UMI
- remote control orders

using the Boolean operators AND, OR, XOR, NOT, and automation functions such as time delays, bistables and time programmer.
Equation input is assisted and syntax checking is done systematically.

The result of an equation may then be:
- assigned to a logic output, LED or message via the control matrix
- transmitted by the communication link, as a new remote indication
- utilized by the circuit breaker/contactor control function to trip, close or inhibit breaking device closing
- used to inhibit or reset a protection function.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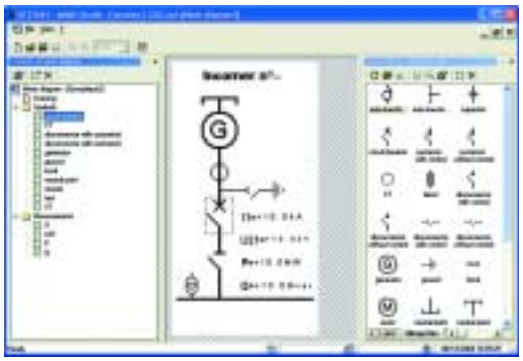
# Control and monitoring
## Adaptation of predefined functions using the SFT2841 software



### Personalized alarm and operating messages

The alarm and operating messages may be personalized using the SFT2841 software tool.
The new messages are added to the list of existing messages and may be assigned via the control matrix for display:
- on the Sepam display
- in the SFT2841 "Alarms" and "Alarm History" screens.

PE50492



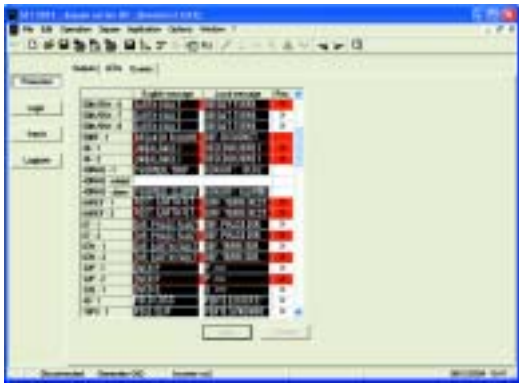
*SFT2841: mimic-diagram editor.*

### Local-control mimic diagram

The mimic-diagram editor in the SFT2841 software can be used to create a single-line diagram corresponding exactly to the equipment controlled by Sepam.
Two procedures are available:
- rework a diagram taken from the library of standard diagrams in the SFT2841 software
- creation of an original diagram : graphic creation of the single-line diagram, positioning of symbols for the animated devices, insertion of measurements, text, etc.

Creation of a customized mimic diagram is made easy:
- library of predefined symbols: circuit breakers, earthing switch, etc.
- creation of personalized symbols.

PE50490



*SFT2841: control matrix.*

### Control matrix

The control matrix is a simple way to assign data from:
- protection functions
- control and monitoring functions
- logic inputs
- logic equations or Logipam program

to the following output data:
- output relays
- 9 LEDs on the front panel of Sepam
- messages for local annunciation
- triggering of disturbance recording.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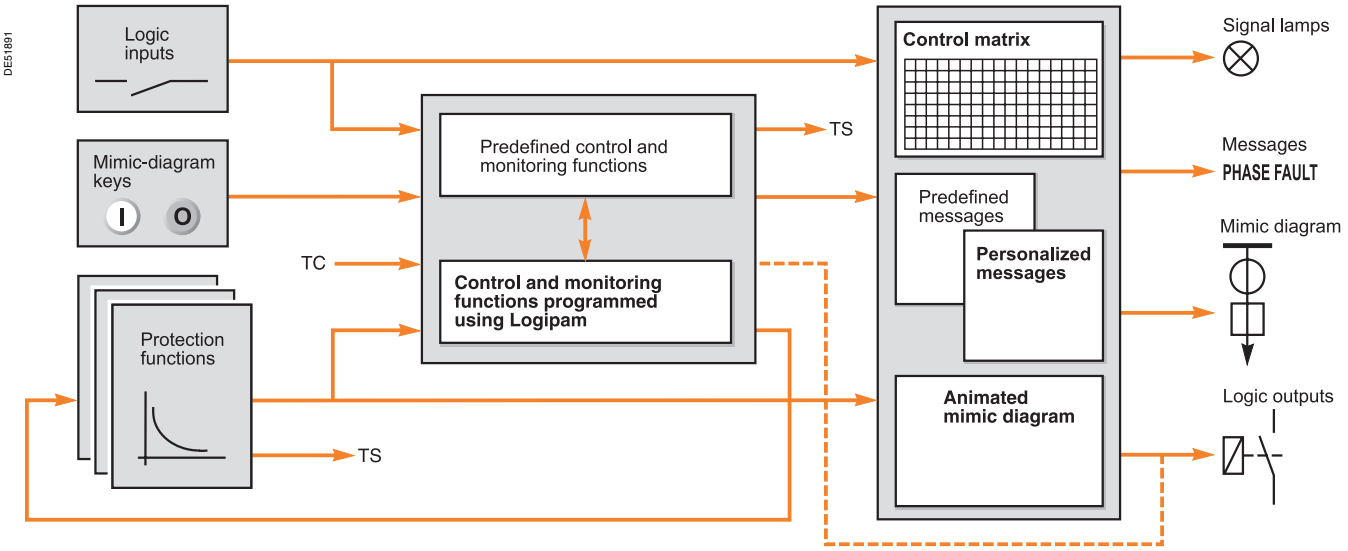
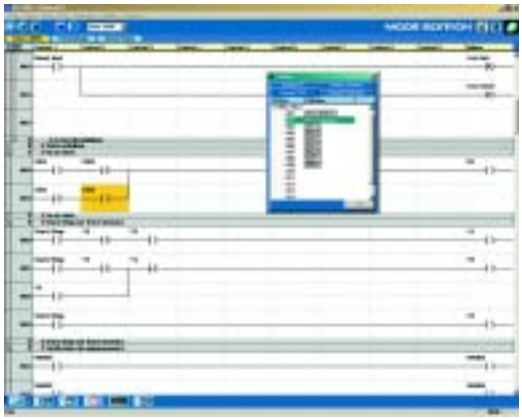
# Control and monitoring
## Customized functions using Logipam

The SFT2885 programming software (Logipam) can be used to enhance Sepam by programming specific control and monitoring functions.

**Only the Sepam series 80 with a cartridge containing the Logipam SFT080 option can run the control and monitoring functions programmed by Logipam.**

### Operating principle




*SFT2885: Logipam programming software.*

### Logipam programming software

The Logipam SFT2885 programming software can be used to:
- adapt predefined control and monitoring functions
- program specific control and monitoring functions, either to replace the predefined versions or to create completely new functions, to provide all the functions required by the application.

It is made up of:
- a ladder-language program editor used to address all Sepam data and to program complex control functions
- a simulator for complete program debugging
- a code generator to run the program on Sepam.

The ladder-language program and the data used can be documented and a complete file can be printed.

Offering more possibilities than the logic-equation editor, Logipam can be used to create the following functions :
- specific automatic transfer functions
- motor starting sequences.

It is not possible to combine the functions programmed by Logipam with functions adapted by the logic-equation editor in a given Sepam.

The Logipam program uses the input data from:
- protection functions
- logic inputs
- remote control orders
- local control orders transmitted by the mimic-based UMI.

The result of Logipam processing may then be:
- assigned to a logic output, directly or via the control matrix
- assigned to a LED or message via the control matrix
- transmitted by the communication link, as a new remote indication
- used by the predefined control and monitoring functions
- used to inhibit or reset a protection function.





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# Base unit
Presentation

*Base units are defined according to the following characteristics:*
- *type of User-Machine Interface (UMI)*
- *working language*
- *type of base unit connector*
- *type of current sensor connector*
- *type of voltage sensor connector.*



PE50472

*Sepam series 80 base unit with integrated advanced UMI.*

PE50473

*Sepam series 80 base unit with mimic-based UMI.*

PE50474

*Customized Chinese advanced UMI.*

## User-Machine Interface

Two types of User-Machine Interfaces (UMI) are available for Sepam series 80 base units:
- mimic-based UMI
- advanced UMI.

The advanced UMI can be integrated in the base unit or installed remotely on the cubicle. Integrated and remote advanced UMIs offer the same functions.

A Sepam series 80 with a remote advanced UMI is made up of:
- a bare base unit without any UMI, for mounting inside the LV compartment
- a remote advanced UMI (DSM303)
  - for flush mounting on the front panel of the cubicle in the location most suitable for the facility manager
  - for connection to the Sepam base unit using a prefabricated CCA77x cord.

The characteristics of the remote advanced UMI module (DSM303) are presented on page 151.

### Comprehensive data for facility managers

All the data required for local equipment operation may be displayed on demand:
- display of all measurement and diagnosis data in numerical format with units and/or in bar graphs
- display of operating and alarm messages, with alarm acknowledgment and Sepam resetting
- display of the list of activated protection functions and the main settings of major protection functions
- adaptation of activated protection function set points or time delays in response to new operating constraints
- display of Sepam and remote module versions
- output testing and logic input status display
- display of Logipam data: status of variables, timers
- entry of 2 passwords to protect parameter and protection settings.

### Local control of devices using the mimic-based UMI

The mimic-based UMI provides the same functions as the advanced UMI as well as local control of devices:
- selection of the Sepam control mode
- view device status on the animated mimic diagram
- local opening and closing of all the devices controlled by Sepam.

### Ergonomic data presentation

- keypad keys identified by pictograms for intuitive navigation
- menu-guided access to data
- graphical LCD screen to display any character or symbol
- excellent display quality under all lighting conditions : automatic contrast setting and backlit screen (user activated).

### Working language

All the texts and messages displayed on the advanced UMI or on the mimic-based UMI are available in 2 languages:
- English, the default working language
- and a second language, which may be
  - French
  - Spanish
  - another "local" language.

Please contact us regarding local language customization.

### Connection of Sepam to the parameter setting tool

The SFT2841 parameter setting tool is required for Sepam protection and parameter setting.
A PC containing the SFT2841 software is connected to the RS 232 communication port on the front of the unit.


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# Base unit
Presentation

## Selection guide

| Base unit | With remote advanced UMI | With integrated advanced UMI | With mimic-based UMI |
|---|---|---|---|
| |  PE50260 |  PE50262 |  PE50475 |
| **Functions** | | | |
| **Local indication** | | | |
| Metering and diagnosis data | ■ | ■ | ■ |
| Alarms and operating messages | ■ | ■ | ■ |
| List of activated protection functions | ■ | ■ | ■ |
| Main protection settings | ■ | ■ | ■ |
| Version of Sepam and remote modules | ■ | ■ | ■ |
| Status of logic inputs | ■ | ■ | ■ |
| Logipam data | ■ | ■ | ■ |
| Switchgear status on the animated mimic diagram | | | ■ |
| Phasor diagram of currents or voltages | | | ■ |
| **Local control** | | | |
| Alarm acknowledgement | ■ | ■ | ■ |
| Sepam reset | ■ | ■ | ■ |
| Output testing | ■ | ■ | ■ |
| Selection of Sepam control mode | | | ■ |
| Device open/close order | | | ■ |
| **Characteristics** | | | |
| **Screen** | | | |
| Size | 128 x 64 pixels | 128 x 64 pixels | 128 x 240 pixels |
| Automatic contrast setting | ■ | ■ | ■ |
| Backlit screen | ■ | ■ | ■ |
| **Keypad** | | | |
| Number of keys | 9 | 9 | 14 |
| Control-mode switch | | | Remote / Local / Test |
| **LEDs** | | | |
| Sepam operating status | ■ base unit: 2 LEDs visible on back<br>■ remote advanced UMI: 2 LEDs visible on front | 2 LEDs, visible from front and back | 2 LEDs, visible from front and back |
| Indication LEDs | 9 LEDs on remote advanced UMI | 9 LEDs on front | 9 LEDs on front |
| **Mounting** | | | |
| | ■ bare base unit, mounted at the back of the compartment using the AMT880 mounting plate<br>■ DSM303 remote advanced UMI module , flush mounted on the front of the cubicle and connected to the base unit with the CCA77x prefabricated cord | Flush mounted on front of cubicle | Flush mounted on front of cubicle |





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# Base unit
Presentation



MT00253

*Sepam series 80 memory cartridge and backup battery.*

## Hardware characteristics

### Removable memory cartridge

The cartridge contains all the Sepam characteristics:
- all Sepam protection and parameter settings
- all the metering and protection functions required for the application
- predefined control functions
- functions customized by control matrix or logic equations
- functions programmed by Logipam (optional)
- personalized local-control mimic diagram
- accumulated energies and switchgear diagnosis values
- working languages, customized and otherwise.

It may be made tamper-proof by lead sealing.
It is removable and easy to access on the front panel of Sepam to reduce maintenance time.
If a base unit fails, simply:
- switch off Sepam and unplug connectors
- retrieve original cartridge
- replace the faulty base unit by a spare base unit (without cartridge)
- load the original cartridge into the new base unit
- plug in the connectors and switch Sepam on again:

Sepam is operational, with all its standard and customized functions, without requiring any reloading of protection and parameter settings.

### Backup battery

Standard lithium battery, 1/2 AA format, 3.6 Volts.
It allows the following data to be stored in the event of an auxiliary power outage:
- time-tagged event tables
- disturbance recording data
- peak demands, tripping context, etc
- date and time.

The battery presence and charge are monitored by Sepam.
The main data (e.g. protection and parameter settings) are saved in the event of an auxiliary power outage, regardless of the state of the battery.

### Auxiliary power supply

DC power supply voltage from 24 to 250 V DC.

### Five relay outputs

The 5 relay outputs O1 to O5 on the base unit must be connected to connector Ⓐ.
Each output can be assigned to a predetermined function using the SFT2841 software.
O1 to O4 are 4 control outputs with one NO contact, used by default for the switchgear control function:
- O1: switchgear tripping
- O2: switchgear closing inhibition
- O3: switchgear closing
- O4: available.

O5 is an indication output used by default for the watchdog function and has two contacts, one NC and one NO.


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# Base unit
Presentation

### Main connector (A) and voltage and residual current input connector (E)
A choice of 2 types of removable, screw-lockable 20-pin connectors:
- CCA620 screw-type connectors
- or CCA622 ring lug connectors.

The presence of the (E) connector is monitored.

### Connector for additional voltage inputs (Sepam B83)
CCT640 connector, removable and screw-lockable.
The presence of the CCT640 connector is monitored.

### Phase current input connectors
Current sensors connected to removable, screw-lockable connectors according to type of sensors used:
- CCA630 connector for 1 A or 5 A current transformers
- or CCA671 connector for LPCT sensors.

The presence of these connectors is monitored.

## Mounting accessories

### Spring clips
8 spring clips are supplied with the base unit to flush-mount Sepam in mounting plates 1.5 to 6 mm thick.
Simple, tool-free installation.

### AMT880 mounting plate
It is used to mount a Sepam without UMI inside the compartment with access to connectors on the rear panel.
Mounting used with remote advanced UMI module (DSM303).

### AMT820 blanking plate
It fills in the space left when a standard model Sepam 2000 is replaced by a Sepam series 80.

## Spare base units
The following spares are available to replace faulty base units:
- base units with or without UMI, without cartridge or connectors
- all types of standard cartridges, with or without the Logipam option.




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# Base unit
Description

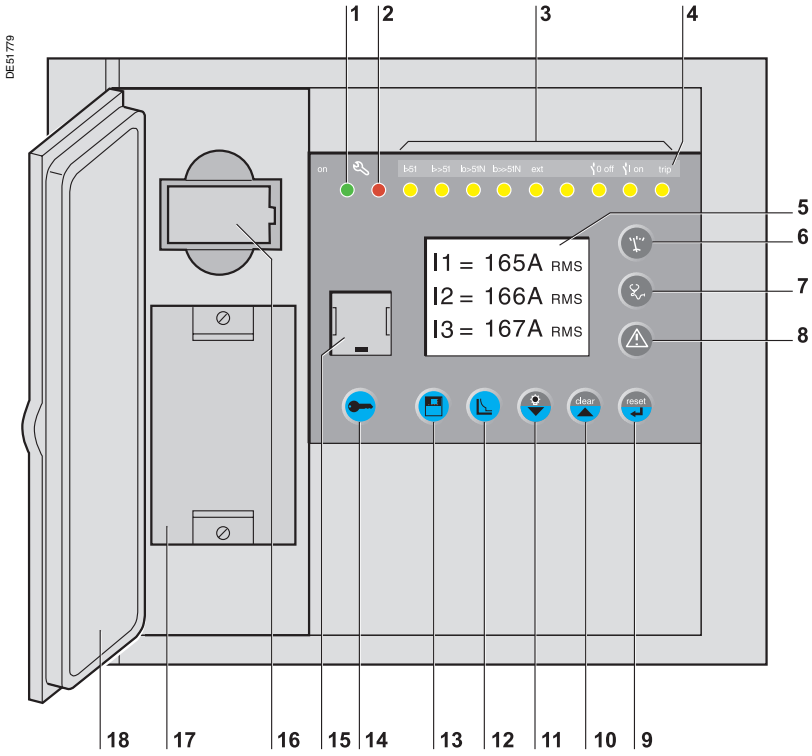


## Front panel with advanced UMI

**1** Green LED: Sepam on.
**2** Red LED: Sepam unavailable.
**3** 9 yellow indication LEDs.
**4** Label identifying the indication LEDs.

**5** Graphical LCD screen.
**6** Display of measurements.
**7** Display of switchgear, network and machine diagnosis data.
**8** Display of alarm messages.
**9** Sepam reset (or confirm data entry).
**10** Acknowledgement and clearing of alarms (or move cursor up).
**11** LED test (or move cursor down).
**12** Display and adaptation of activated protection settings.
**13** Display of Sepam and Logipam data.
**14** Entry of 2 passwords.
**15** RS 232 PC connection port.

**16** Backup battery.
**17** Memory cartridge.
**18** Door.

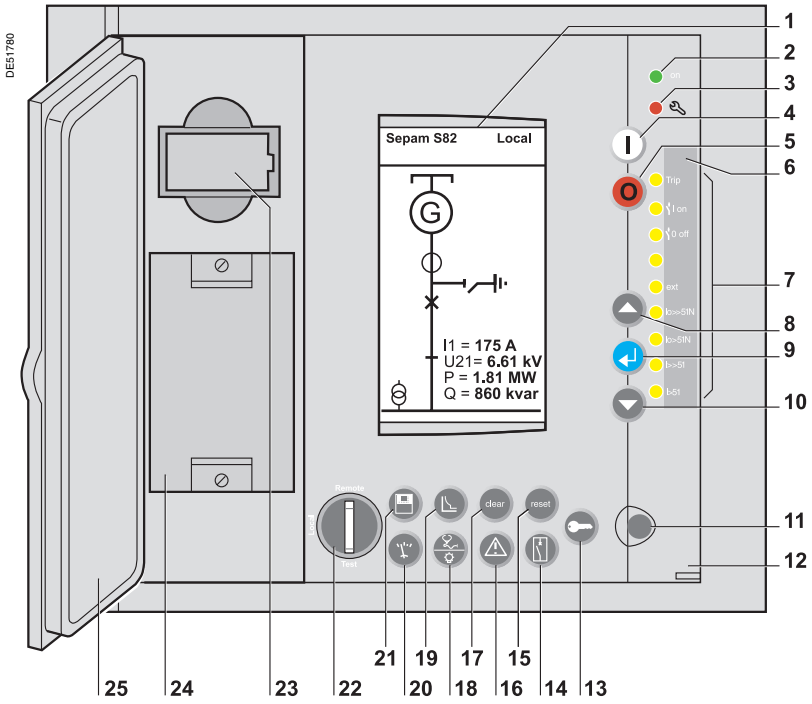



## Front panel with mimic-based UMI

**1** Graphical LCD screen.
**2** Green LED: Sepam on.
**3** Red LED: Sepam unavailable.
**4** Local close order.
**5** Local open order.
**6** Label identifying the indication LEDs.
**7** 9 yellow indication LEDs.
**8** Move cursor up.
**9** Confirm data entry.
**10** Move cursor down.
**11** RS 232 PC connection port.
**12** Transparent door.

**13** Entry of 2 passwords.
**14** Mimic-based UMI display.
**15** Sepam reset.
**16** Display of alarm messages.
**17** Acknowledgement and clearing of alarms.
**18** Display of switchgear and network diagnosis data (or LED test).
**19** Display and adaptation of activated protection settings.
**20** Display of measurements.
**21** Display of Sepam and Logipam data.
**22** Three-position key switch to select Sepam control mode.

**23** Backup battery.
**24** Memory cartridge.
**25** Door.





Merlin Gerin
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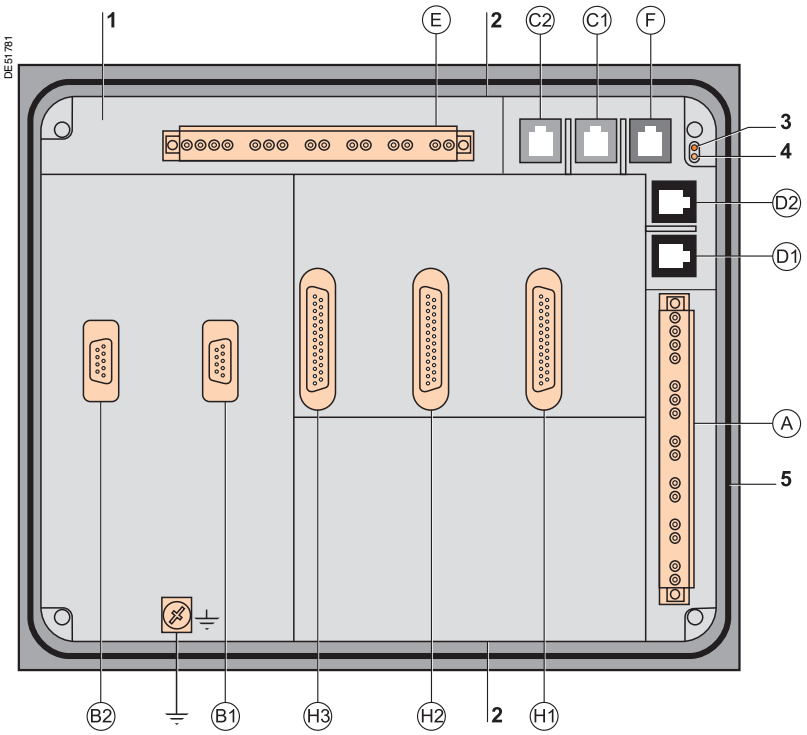
# Base unit
## Description

## Rear panel




**1** Base unit.
**2** 8 fixing points for 4 spring clips.
**3** Red LED: Sepam unavailable.
**4** Green LED: Sepam on.
**5** Gasket.

(A) 20-pin connector for:
- 24 V DC to 250 V DC auxiliary supply
- 5 relay outputs.

(B1) Connector for 3 phase current I1, I2, I3 inputs.

(B2)
- Sepam T87, M87, M88, G87, G88: connector for 3 phase current I'1, I'2, I'3 inputs
- Sepam B83: connector for
  - 3 phase voltage V'1, V'2, V'3 inputs
  - 1 residual voltage V'0 input.
- Sepam C86: connector for capacitor unbalance current inputs.

(C1) Modbus communication port 1.

(C2) Modbus communication port 2.

(D1) Remote module connection port 1.

(D2) Remote module connection port 2.

(E) 20-pin connector for:
- 3 phase voltage V1, V2, V3 inputs
- 1 residual voltage V0 input.
- 2 residual current I0, I'0 inputs.

(F) Spare port.

(H1) Connector for 1st MES120 input/output module.

(H2) Connector for 2nd MES120 input/output module.

(H3) Connector for 3rd MES120 input/output module.

⏚ Functional earth.

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# Base unit
## Electrical characteristics



| | | | | | |
|---|---|---|---|---|---|
| **Weight** | | | | | |
| | | **Base unit with advanced UMI** | | **Base unit with mimic-based UMI** | |
| Minimum weight (base unit without MES120) | | 2.4 kg | | 3.0 kg | |
| Maximum weight (base unit with 3 MES120) | | 4.0 kg | | 4.6 kg | |
| **Sensor inputs** | | | | | |
| **Phase current inputs** | | **1 A or 5 A CT** | | | |
| Input impedance | | < 0.001 Ω | | | |
| Consumption | | < 0.001 VA (1 A CT)<br>< 0.025 VA (5 A CT) | | | |
| Continuous thermal withstand | | 3 In | | | |
| 1 second overload | | 100 In | | | |
| **Voltage inputs** | | **Phase** | | **Residual** | |
| Input impedance | | > 100 kΩ | | > 100 kΩ | |
| Consumption | | < 0.015 VA (100 V VT) | | < 0.015 VA (100 V VT) | |
| Continuous thermal withstand | | 240 V | | 240 V | |
| 1-second overload | | 480 V | | 480 V | |
| **Relay outputs** | | | | | |
| **Control relay outputs O1 to O4** | | | | | |
| Voltage | DC | 24/48 V DC | 127 V DC | 220 V DC | |
| | AC (47.5 to 63 Hz) | | | | 100 to 240 V AC |
| Continuous current | | 8 A | 8 A | 8 A | 8 A |
| Breaking capacity | Resistive load | 8 A / 4 A | 0.7 A | 0.3 A | |
| | Load L/R < 20 ms | 6 A / 2 A | 0.5 A | 0.2 A | |
| | Load L/R < 40 ms | 4 A / 1 A | 0.2 A | 0.1 A | |
| | Resistive load | | | | 8 A |
| | Load p.f. > 0.3 | | | | 5 A |
| Making capacity | | < 15 A for 200 ms | | | |
| **Annunciation relay output O5** | | | | | |
| Voltage | DC | 24/48 V DC | 127 V DC | 220 V DC | |
| | AC (47.5 to 63 Hz) | | | | 100 to 240 V AC |
| Continuous current | | 2 A | 2 A | 2 A | 2 A |
| Breaking capacity | L/R load < 20 ms | 2 A / 1 A | 0.5 A | 0.15 A | |
| | Load p.f. > 0.3 | | | | 1 A |
| **Power supply** | | | | | |
| Voltage | | 24 to 250 V DC | -20 % / +10 % | | |
| Maximum consumption | | 10 to 16 W according to configuration | | | |
| Inrush current | | < 10 A 10 ms | | | |
| Acceptable ripple content | | 12 % | | | |
| Acceptable momentary outages | | 100 ms | | | |
| **Battery** | | | | | |
| Format | | 1/2 AA lithium 3.6 V | | | |
| Service life | | 10 years Sepam energized | | | |
| | | 8 years Sepam not energized | | | |


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# Base unit
## Environmental characteristics

| Electromagnetic compatibility | Standard | Level / Class | Value |
|---|---|---|---|
| **Emission tests** | | | |
| Disturbing field emission | IEC 60255-25 | | |
| | EN 55022 | A | |
| Conducted disturbance emission | IEC 60255-25 | | |
| | EN 55022 | A | |
| **Immunity tests – Radiated disturbances** | | | |
| Immunity to radiated fields | IEC 60255-22-3 | | 10 V/m; 80 MHz -1 GHz |
| | IEC 61000-4-3 | III | 10 V/m; 80 MHz - 2 GHz |
| | ANSI C37.90.2 | | 35 V/m; 25 MHz - 1 GHz |
| Electrostatic discharge | IEC 60255-22-2 | | 8 kV air; 6 kV contact |
| | ANSI C37.90.3 | | 8 kV air; 4 kV contact |
| Immunity to magnetic fields at network frequency | IEC 61000-4-8 | 4 | 30 A/m (continuous) - 300 A/m (1 - 3 s) |
| **Immunity tests – Conducted disturbances** | | | |
| Immunity to conducted RF disturbances | IEC 60255-22-6 | III | 10 V |
| Fast transient bursts | IEC 60255-22-4 | A and B | 4 kV; 2.5 kHz / 2 kV; 5 kHz |
| | IEC 61000-4-4 | IV | 4 kV; 2.5 kHz |
| | ANSI C37.90.1 | | 4 kV; 2.5 kHz |
| 1 MHz damped oscillating wave | IEC 60255-22-1 | | 2.5 kV CM; 1 kV DM |
| | ANSI C37.90.1 | | 2.5 kV; 2.5 kHz |
| Surges | IEC 61000-4-5 | III | 2 kV CM; 1 kV DM |
| Voltage interruptions | IEC 60255-11 | | 100 % during 100 ms |
| **Mechanical robustness** | **Standard** | **Level / Class** | **Value** |
| **In operation** | | | |
| Vibrations | IEC 60255-21-1 | 2 | 1 Gn; 10 Hz - 150 Hz |
| | IEC 60068-2-6 | Fc | 2 Hz - 13.2 Hz ; a = ±1 mm |
| Shocks | IEC 60255-21-2 | 2 | 10 Gn / 11 ms |
| Earthquakes | IEC 60255-21-3 | 2 | 2 Gn (horizontal axes) |
| | | | 1 Gn (vertical axes) |
| **De-energized** | | | |
| Vibrations | IEC 60255-21-1 | 2 | 2 Gn; 10 Hz - 150 Hz |
| Shocks | IEC 60255-21-2 | 2 | 27 Gn / 11 ms |
| Jolts | IEC 60255-21-2 | 2 | 20 Gn / 16 ms |
| **Climatic withstand** | **Standard** | **Level / Class** | **Value** |
| **In operation** | | | |
| Exposure to cold | IEC 60068-2-1 | Ad | -25 °C |
| Exposure to dry heat | IEC 60068-2-2 | Bd | +70 °C |
| Continuous exposure to damp heat | IEC 60068-2-78 | Cab | 10 days; 93 % RH; 40 °C |
| Salt mist | IEC 60068-2-52 | Kb/2 | 6 days |
| Influence of corrosion/Gas test 2 | IEC 60068-2-60 | | 21 days; 75 % RH; 25 °C;<br>0.5 ppm $H_2S$; 1 ppm $SO_2$ |
| Influence of corrosion/Gas test 4 | IEC 60068-2-60 | | 21 days; 75 % RH; 25 °C;<br>0.01 ppm $H_2S$; 0.2 ppm $SO_2$;<br>0.2 ppm $NO_2$; 0.01 ppm $Cl_2$ |
| **In storage** (3) | | | |
| Temperature variation with specified variation rate | IEC 60068-2-14 | Nb | -25 °C to +70 °C, 5 °C/min |
| Exposure to cold | IEC 60068-2-1 | Ab | -25 °C |
| Exposure to dry heat | IEC 60068-2-2 | Bb | +70 °C |
| Continuous exposure to damp heat | IEC 60068-2-78 | Cab | 56 days; 93 % RH; 40 °C |
| | IEC 60068-2-30 | Db | 6 days; 95 % RH; 55 °C |
| **Safety** | **Standard** | **Level / Class** | **Value** |
| **Enclosure safety tests** | | | |
| Front panel tightness | IEC 60529 | IP52 | Other panels IP20 |
| | NEMA | Type 12 | |
| Fire withstand | IEC 60695-2-11 | | 650 °C with glow wire |
| **Electrical safety tests** | | | |
| 1.2/50 µs impulse wave | IEC 60255-5 | | 5 kV (1) |
| Power frequency dielectric withstand | IEC 60255-5 | | 2 kV 1 min (2) |
| | ANSI C37.90 | | 1 kV 1 min (indication output)<br>1.5 kV 1 min (control output) |
| **Certification** | | | |
| CE | EN 50263 harmonized standard | European directives:<br>■ 89/336/EECElectromagnetic Compatibility (EMC) Directive<br>□ 92/31/EECAmendment<br>□ 93/68/EECAmendment<br>■ 73/23/EECLow Voltage Directive<br>□ 93/68/EECAmendment | |
| UL | UL508 - CSA C22.2 no. 14-95 | | File E212533 |
| CSA | CSA C22.2 no. 14-95 / no. 94-M91 / no. 0.17-00 | | File 210625 |

***(1)*** *Except for communication: 3 kV in common mode and 1 kV in differential mode.*
***(2)*** *Except for communication: 1 kVrms.*
***(3)*** *Sepam must be stored in its original packing.*



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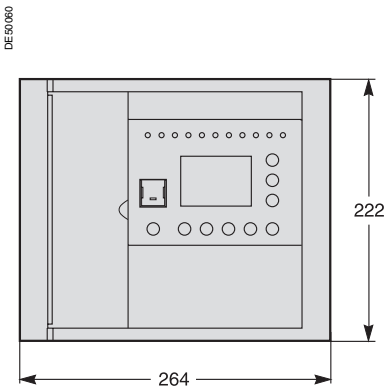
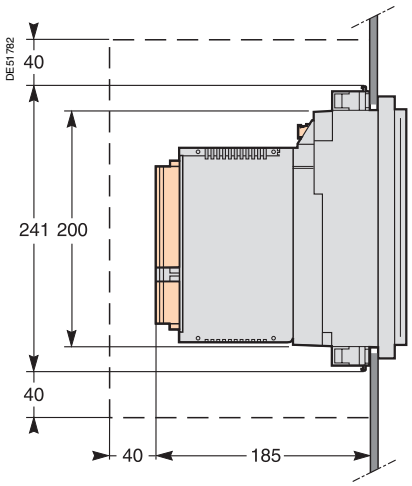
# Base unit
Dimensions



## Dimensions

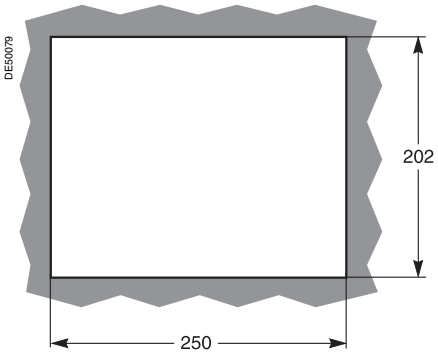



*Front view of Sepam.*

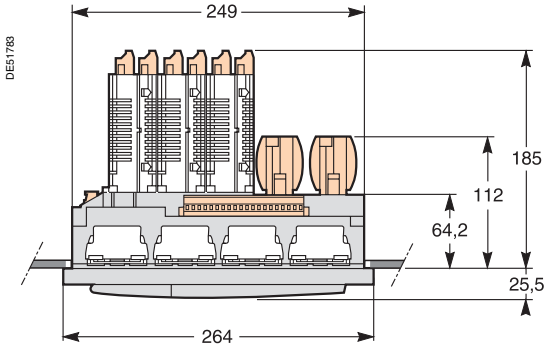



*Side view of Sepam with MES120, flush-mounted in front panel with spring clips.*
*Front panel: 1.5 mm to 6 mm thick.*

*Clearance for Sepam assembly and wiring.*

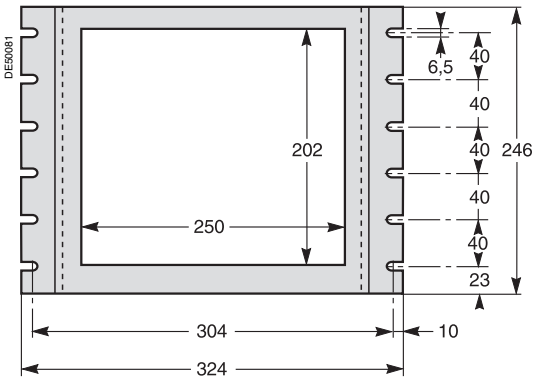



*Cut-out.*

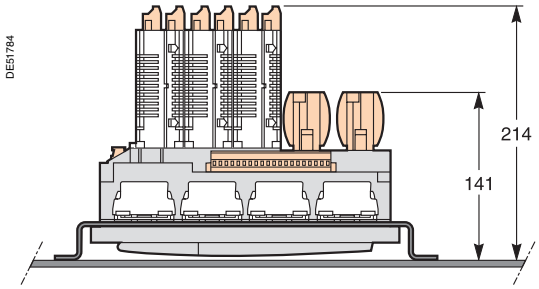



*Top view of Sepam with MES120, flush-mounted in front panel with spring clips.*
*Front panel: 1.5 mm to 6 mm thick.*

## Assembly with AMT880 mounting plate




*AMT880 mounting plate.*




*Top view of Sepam with MES120, flush-mounted in front panel with spring clips.*
*Mounting plate: 3 mm thick.*



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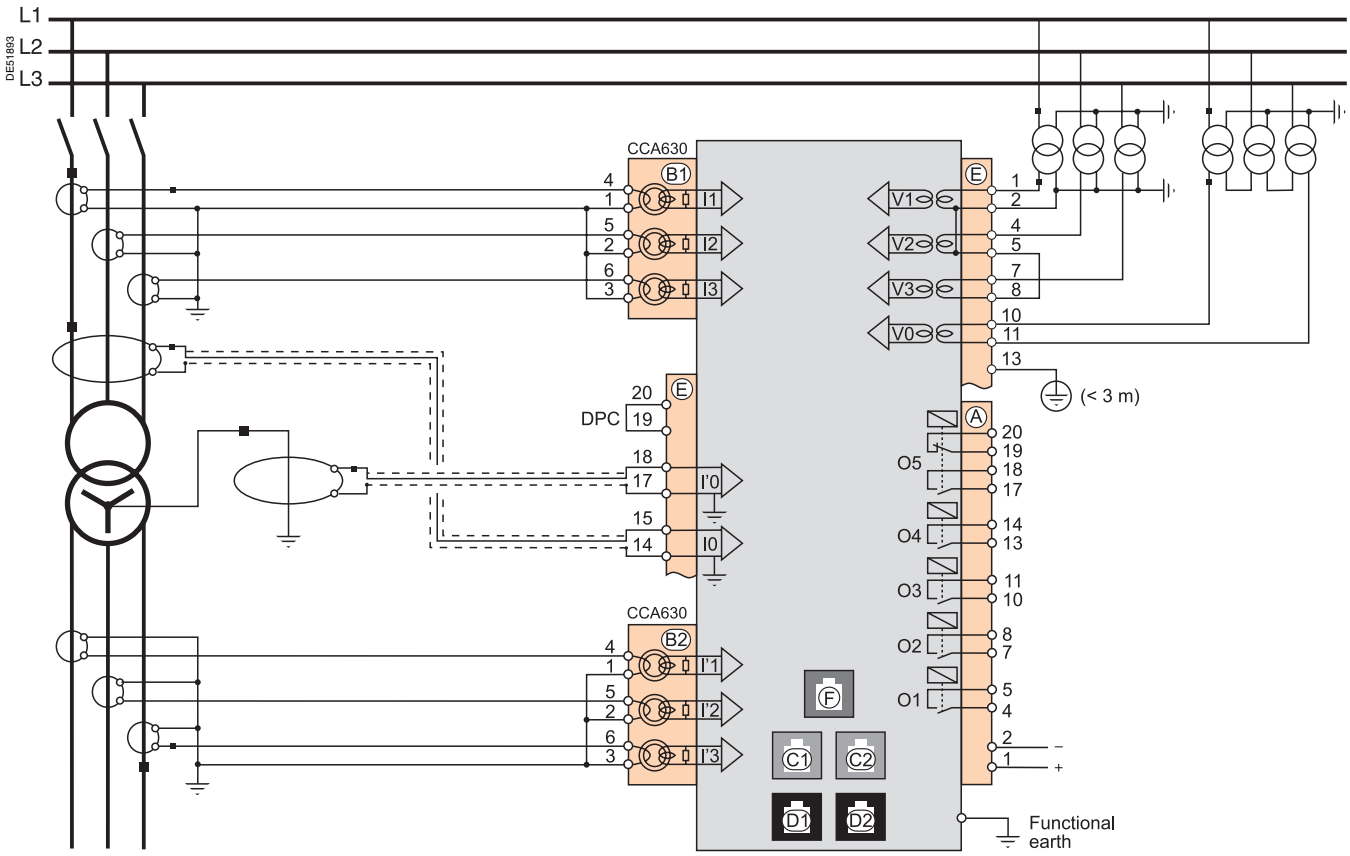
# Base unit
Sepam series 80






## Connection

**■ For Sepam to operate correctly, its functional earthing terminal must be connected to the cubicle grounding circuit.**
**■ Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.**

| Connector | Type | Reference | Wiring |
|---|---|---|---|
| (A), (E) | Screw type | CCA620 | ■ wiring with no fittings :<br>□ 1 wire with max. cross-section 0.2 to 2.5 mm² (≥ AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (≥ AWG 24-16)<br>□ stripped length: 8 to 10 mm<br>■ wiring with fittings:<br>□ recommended wiring with Telemecanique fittings:<br>- DZ5CE015D for 1 x 1.5 mm² wire<br>- DZ5CE025D for 1 x 2.5 mm² wire<br>- AZ5DE010D for 2 x 1 mm² wires<br>□ tube length: 8.2 mm<br>□ stripped length: 8 mm |
| | 6.35 mm ring lugs | CCA622 | ■ 6.35 mm ring or spade lugs (1/4")<br>■ maximum wire cross-section of 0.2 to 2.5 mm² (≥ AWG 24-12)<br>■ stripped length: 6 mm<br>■ use an appropriate tool to crimp the lugs on the wires<br>■ maximum of 2 ring or spade lugs per terminal<br>■ tightening torque: 0.7 to 1 Nm |
| (B1), (B2) | 4 mm ring lugs | CCA630, for connection of 1 A or 5 A CTs | 1.5 to 6 mm² (AWG 16-10) |
| | RJ45 plug | CCA671, for connection of 3 LPCT sensors | Integrated with LPCT sensor |
| (C1), (C2) | Green RJ45 plug | | CCA612 |
| (D1), (D2) | Black RJ45 plug | | CCA770: L = 0.6 m<br>CCA772: L = 2 m<br>CCA774: L = 4 m<br>CCA785 for MCS025 module: L = 2 m |
| DE51845 Functional earth | Ring lug | | Earthing braid, to be connected to cubicle grounding:<br>■ flat copper braid with cross-section ≥ 9 mm²<br>■ maximum length: 300 mm |



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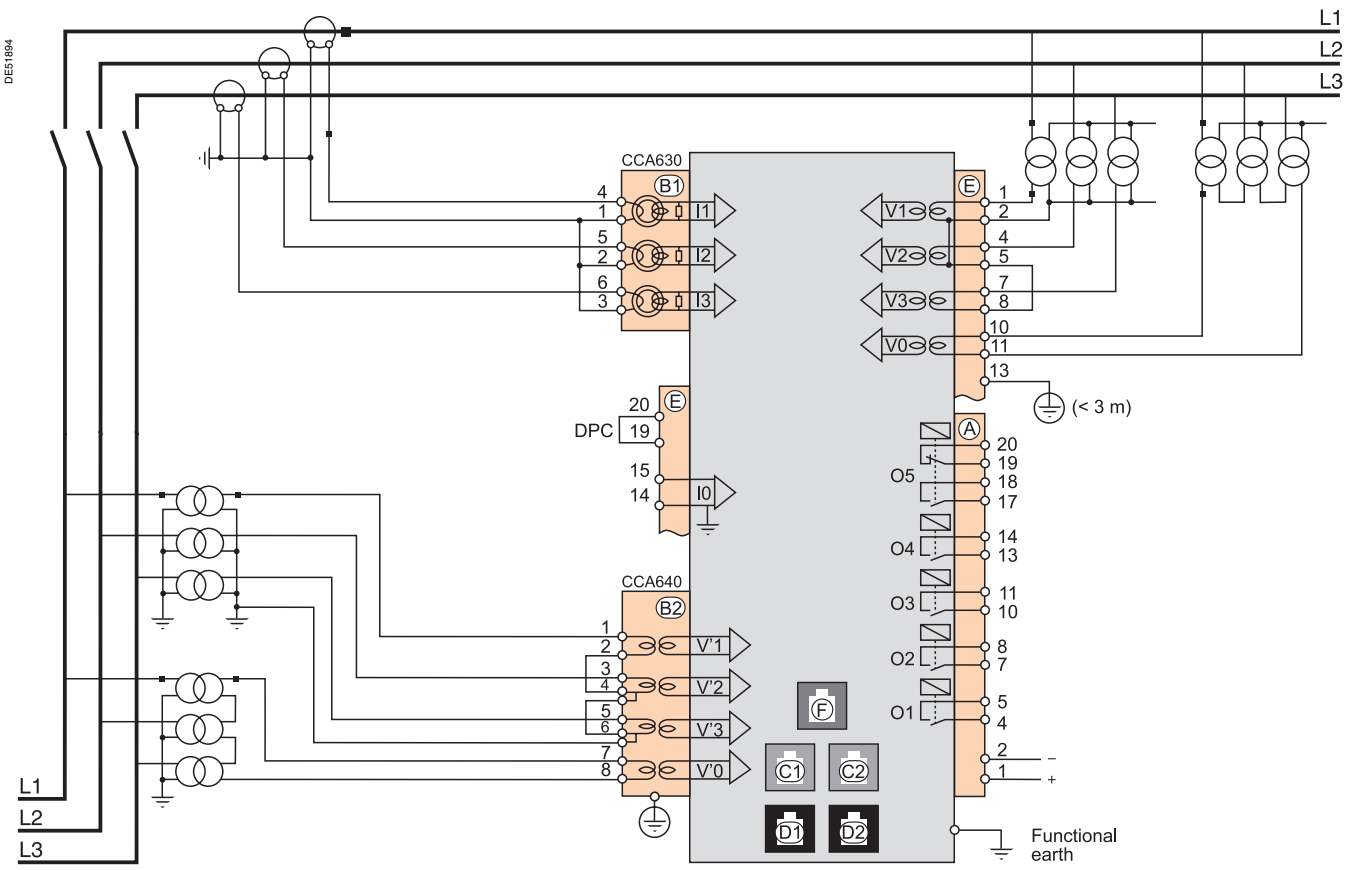
# Base unit
Sepam B83






## Connection

**■ For Sepam to operate correctly, its functional earthing terminal must be connected to the cubicle grounding circuit.**

**■ Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.**

| Connector | Type | Reference | Wiring |
|---|---|---|---|
| (A), (E) | Screw type | CCA620 | ■ wiring with no fittings :<br>□ 1 wire with max. cross-section 0.2 to 2.5 mm² (≥ AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (≥ AWG 24-16)<br>□ stripped length: 8 to 10 mm<br>■ wiring with fittings:<br>□ recommended wiring with Telemecanique fittings:<br>- DZ5CE015D for 1 x 1.5 mm² wire<br>- DZ5CE025D for 1 x 2.5 mm² wire<br>- AZ5DE010D for 2 x 1 mm² wires<br>□ tube length: 8.2 mm<br>□ stripped length: 8 mm |
| | 6.35 mm ring lugs | CCA622 | ■ 6.35 mm ring or spade lugs (1/4")<br>■ maximum wire cross-section of 0.2 to 2.5 mm² (≥ AWG 24-12)<br>■ stripped length: 6 mm<br>■ use an appropriate tool to crimp the lugs on the wires<br>■ maximum of 2 ring or spade lugs per terminal<br>■ tightening torque: 0.7 to 1 Nm |
| (B1) | 4 mm ring lugs | CCA630, for connection of 1 A or 5 A CTs | 1.5 to 6 mm² (AWG 16-10) |
| (B2) | Screw type | CCT640 | VT wiring: same as wiring for the CCA620<br>Earthing connection: by 4 mm ring lug |
| (C1), (C2) | Green RJ45 plug | | CCA612 |
| (D1), (D2) | Black RJ45 plug | | CCA770 : L = 0,6 m<br>CCA772 : L = 2 m<br>CCA774 : L = 4 m<br>CCA785 for MCS025 module: L = 2 m |
| DE51845 Functional earth | Ring lug | | Earthing braid, to be connected to cubicle grounding:<br>■ flat copper braid with cross-section ≥ 9 mm²<br>■ maximum length: 300 mm |



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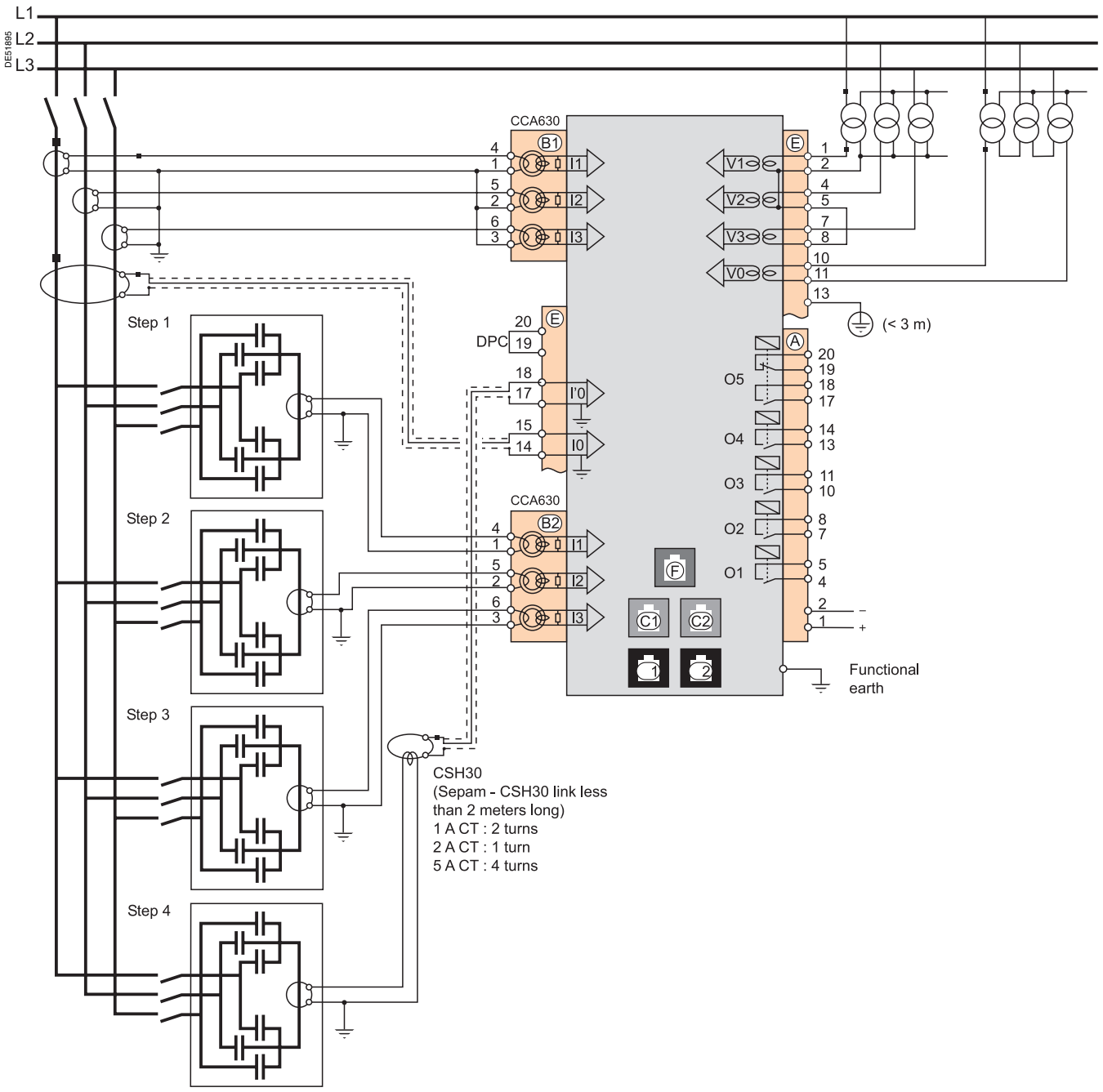
# Base unit
Sepam C86




## Connection

**■ For Sepam to operate correctly, its functional earthing terminal must be connected to the cubicle grounding circuit.**

**■ Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.**

| Connector | Type | Reference | Wiring |
|---|---|---|---|
| (B1) | 4 mm ring lugs | CCA630, for connection of 1 A or 5 A CTs | 1.5 to 6 mm² (AWG 16-10) |
| | RJ45 plug | CCA671, for connection of 3 LPCT sensors | Integrated with LPCT sensor |
| (B2) | 4 mm ring lugs | CCA630, for connection of 1 A, 2A or 5 A CTs | 1.5 to 6 mm² (AWG 16-10) |
| DE51845 Functional earth | Ring lugs | | Earthing braid, to be connected to cubicle grounding:<br>■ flat copper braid with cross-section ⩾ 9 mm²<br>■ maximum length: 300 mm |

For connectors (A), (E), (C1), (C2), (D1), (D2): see Page 119.



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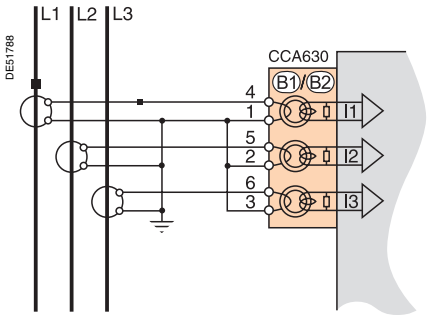
# Phase current inputs

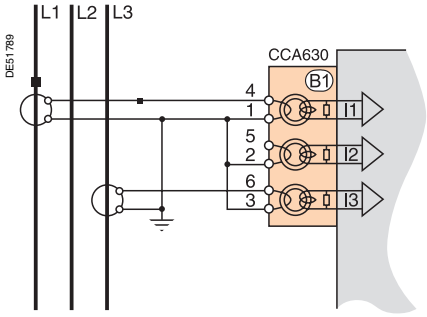
## Variant 1: phase current measurement by 3 x 1 A or 5 A CTs (standard connection)




Connection of 3 x 1 A or 5 A sensors to the CCA630 connector.

The measurement of the 3 phase currents allows the calculation of residual current.

## Variant 2: phase current measurement by 2 x 1 A or 5 A CTs

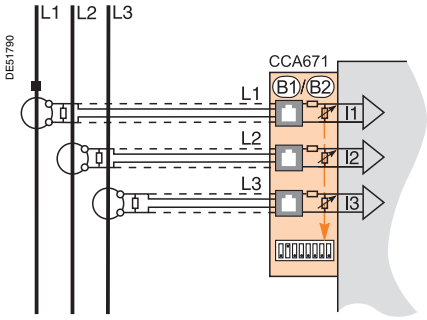



Connection of 2 x 1 A or 5 A sensors to the CCA630 connector.

Measurement of phase 1 and 3 currents is sufficient for all protection functions based on phase current.

This arrangement does not allow the calculation of residual current, nor use of ANSI 87T and 87M differential protection functions on the Sepam T87, M87, M88, G87 and G88.

## Variant 3: phase current measurement by 3 LPCT type sensors




Connection of 3 Low Power Current Transducer (LPCT) type sensors to the CCA671 connector. It is necessary to connect 3 sensors; if only one or two sensors are connected, Sepam goes into fail-safe position.

Measurement of the 3 phase currents allows the calculation of residual current.

The In parameter, primary rated current measured by an LPCT, is to be chosen from the following values, in Amps: 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.
Parameter to be set using the SFT2841 software tool, to be completed by hardware setting of the microswitches on the CCA671 connector.
It is not possible to use LPCT sensors for the following measurements:

- phase-current measurements for Sepam T87, M88 and G88 with ANSI 87T transformer differential protection (connectors B1 and B2)
- phase-current measurements for Sepam B83 (connector B1)
- unbalance-current measurements for Sepam C86 (connector B2).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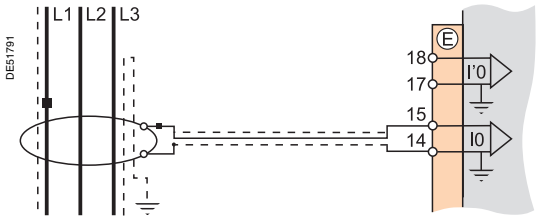
# Residual current inputs

## Variant 1: residual current calculation by sum of 3 phase currents

Residual current is calculated by the vector sum of the 3 phase currents I1, I2 and I3, measured by 3 x 1 A or 5 A CTs or by 3 LPCT type sensors.
See current input connection diagrams.

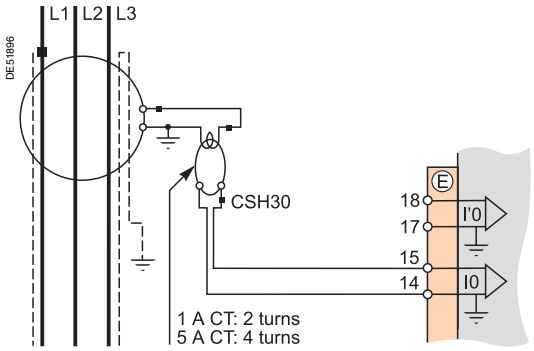
## Variant 2: residual current measurement by CSH120 or CSH200 core balance CT (standard connection)

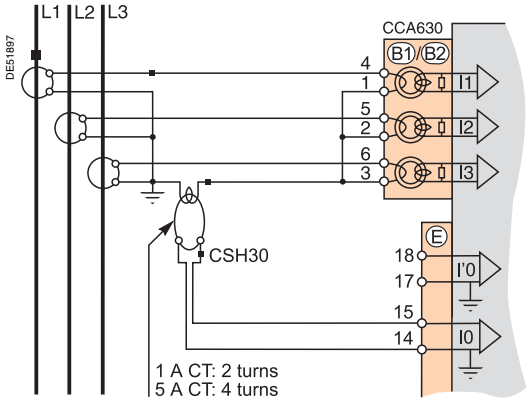



Arrangement recommended for the protection of isolated or compensated neutral systems, in which very low fault currents need to be detected.

Setting range from 0.01 In0 to 15 In0 (minimum 0.1 A), with In0 = 2 A or 20 A according to parameter setting.

## Variant 3: residual current measurement by 1 A or 5 A CTs and CSH30 interposing ring CT

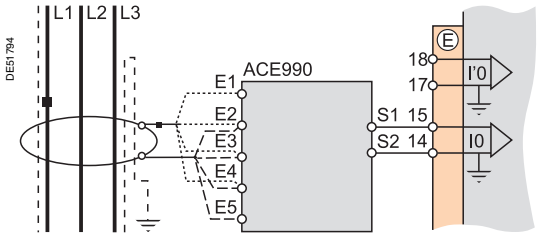



The CSH30 interposing ring CT is used to connect 1 A or 5 A CTs to Sepam to measure residual current:
- CSH30 interposing ring CT connected to 1 A CT: make 2 turns through CSH primary
- CSH30 interposing ring CT connected to 5 A CT: make 4 turns through CSH primary.

Setting range from 0.01 In to 15 In (minimum 0.1 A), with In = CT primary current.

## Variant 4: residual current measurement by core balance CT with ratio of 1/n (n between 50 and 1500)




The ACE990 is used as an interface between a MV core balance CT with a ratio of 1/n (50 ⩽ n ⩽ 1500) and the Sepam residual current input.
This arrangement allows the continued use of existing core balance CTs on the installation.

Setting range from 0.01 In0 to 15 In0 (minimum 0.1 A),
with In0 = k.n,
where n = number of core balance CT turns
and k = factor to be determined according to ACE990 wiring and setting range used by Sepam, with a choice of 20 discrete values from 0.00578 to 0.26316.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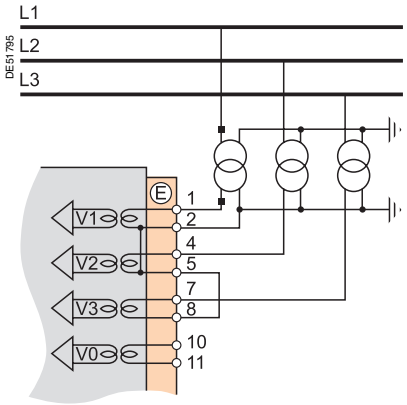
# Phase voltage inputs
# Residual voltage input
Main channels



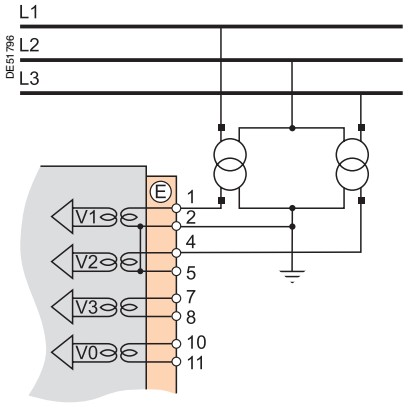
## Phase voltage input connection variants

### Variant 1: measurement of 3 phase-to-neutral voltages (3 V, standard connection)



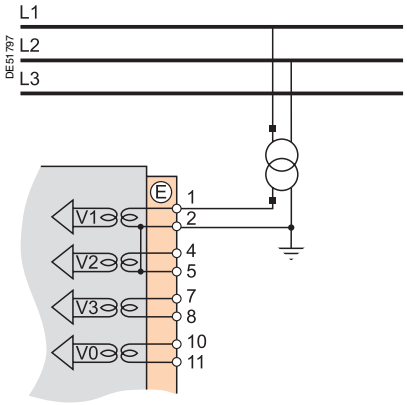

Measurement of the 3 phase-to-neutral voltages allows the calculation of residual voltage, V0Σ.

### Variant 2: measurement of 2 phase-to-phase voltages (2 U)



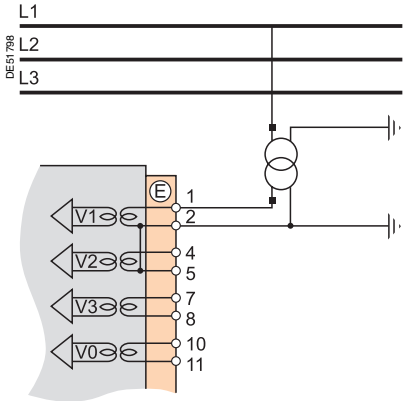

This variant does not allow the calculation of residual voltage.

### Variant 3: measurement of 1 phase-to-phase voltage (1 U)




This variant does not allow the calculation of residual voltage.

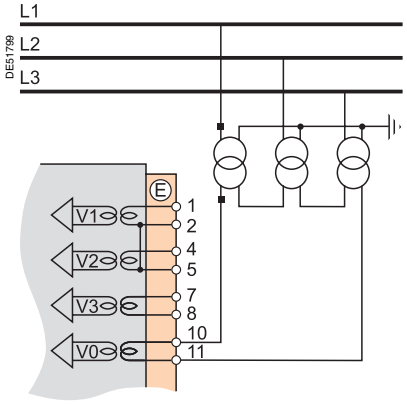
### Variant 4: measurement of 1 phase-to-neutral voltage (1 V)



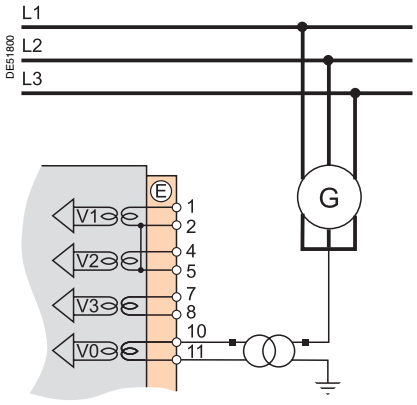

This variant does not allow the calculation of residual voltage.

## Residual voltage input connection variants

### Variant 5: measurement of residual voltage V0




### Variant 6: measurement of residual voltage Vnt in generator neutral point



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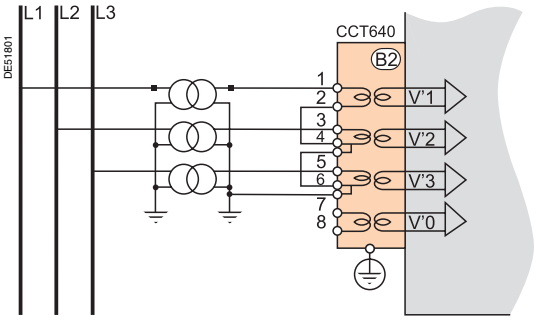
# Phase voltage inputs
# Residual voltage input
Additional channels for Sepam B83



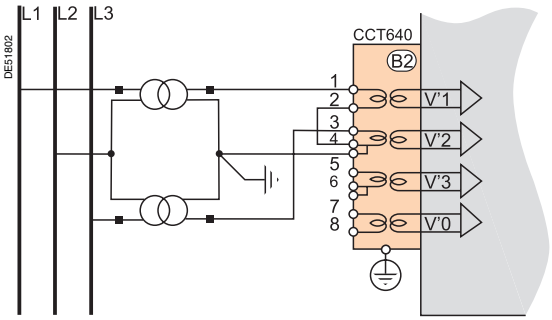
## Additional phase voltage input connection variants

### Variant 1: measurement of 3 phase-to-neutral voltages (3 V', standard connection)



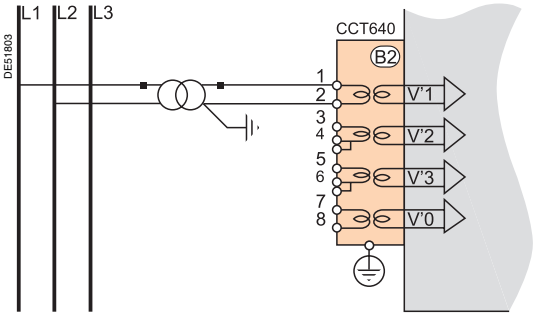

Measurement of the 3 phase-to-neutral voltages allows the calculation of residual voltage, V'0Σ.

### Variant 2: measurement of 2 phase-to-phase voltages (2 U')



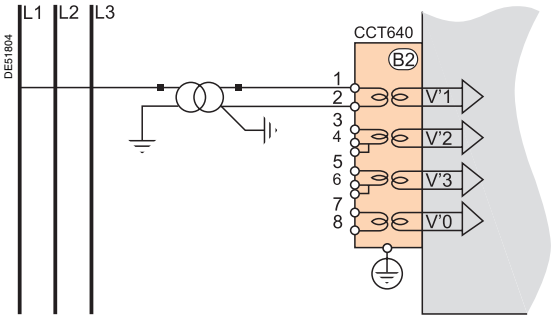

This variant does not allow the calculation of residual voltage.

### Variant 3: measurement of 1 phase-to-phase voltage (1 U')




This variant does not allow the calculation of residual voltage.

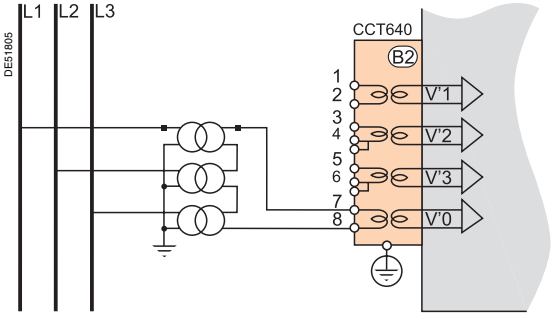
### Variant 4: measurement of 1 phase-to-neutral voltage (1 V')




This variant does not allow the calculation of residual voltage.

## Additional residual voltage input connection

### Variant 5: measurement of residual voltage V'0



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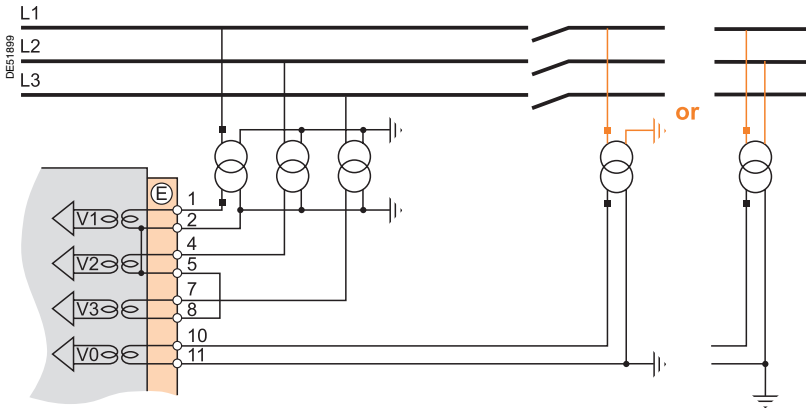
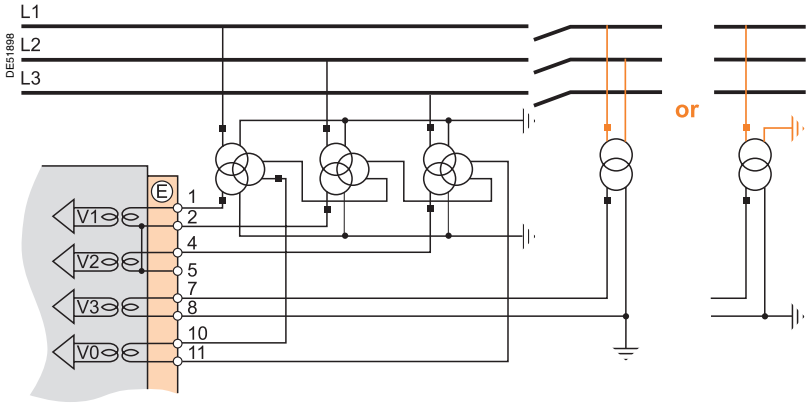
# Phase voltage inputs
Additional channel for Sepam B80



## Connection to measure one additional voltage




This connection should be used to measure:
- three phase-to-neutral voltages V1, V2, V3 on busbars no. 1
- one additional phase-to-neutral voltage V'1 (or one additional phase-to-phase voltage U'21) on busbars no. 2.




This connection should be used to measure:
- two phase-to-phase voltages U21, U32 and one residual voltage V0 on busbars no. 1
- one additional phase-to-phase voltage U'21 (or one additional phase-to-neutral voltage V'1) on busbars no. 2.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# Phase voltage inputs
# Residual voltage input
## Available functions



The availability of certain protection and metering functions depend on the phase and residual voltages measured by Sepam.

The table below gives the voltage input connection variants for which for each protection and metering function dependent on measured voltages is available.
Example:
The directional overcurrent protection function (ANSI 67N/67NC) uses residual voltage V0 as a polarization value.
It is therefore operational in the following cases:
■ measurement of the 3 phase-to-neutral voltages and calculation of V0Σ (3 V + V0Σ, variant 1)
■ measurement of residual voltage V0 (variant 5).
The protection and metering functions which do not appear in the table below are available regardless of the voltages measured.

| **Phase voltages measured** (connection variant) | | **3 V + V0Σ** (var. 1) | | | **2 U** (var. 2) | | | **1 U** (var. 3) | | | **1 V** (var. 4) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Residual voltage measured** (connection variant) | | **–** | **V0** (v. 5) | **Vnt** (v. 6) | **–** | **V0** (v. 5) | **Vnt** (v. 6) | **–** | **V0** (v. 5) | **Vnt** (v. 6) | **–** | **V0** (v. 5) | **Vnt** (v. 6) |
| **Protection functions dependent on voltages measured** | | | | | | | | | | | | | |
| Directional phase overcurrent | 67 | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Directional earth fault | 67N/67NC | ■ | ■ | ■ | | ■ | | | ■ | | | ■ | |
| Directional active overpower | 32P | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Directional reactive active overpower | 32Q | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Directional active underpower | 37P | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Field loss (underimpedance) | 40 | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Pole slip, phase shift | 78PS | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Voltage-restrained overcurrent | 50V/51V | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Underimpedance | 21B | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Inadvertent energization | 50/27 | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| 100 % stator earth fault | 64G2/27TN | | | ■ | | | ■ | | | | | | |
| Overfluxing (V/Hz) | 24 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Positive sequence undervoltage | 27D | ■ □ | ■ □ | ■ | ■ □ | ■ □ | ■ | | | | | | |
| Remanent undervoltage | 27R | ■ □ | ■ □ | ■ | ■ □ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ |
| Undervoltage (L-L or L-N) | 27 | ■ □ | ■ □ | ■ | ■ □ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ |
| Overvoltage (L-L or L-N) | 59 | ■ □ | ■ □ | ■ | ■ □ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ |
| Neutral voltage displacement | 59N | ■ □ | ■ □ | ■ | | ■ □ | ■ | | ■ □ | ■ | | ■ □ | ■ |
| Negative sequence overvoltage | 47 | ■ □ | ■ □ | ■ | ■ | ■ □ | ■ | | | | | ■ □ | |
| Overfrequency | 81H | ■ □ | ■ □ | ■ | ■ □ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ |
| Underfrequency | 81L | ■ □ | ■ □ | ■ | ■ □ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ | ■ □ ⧄ | ■ □ | ■ |
| Rate of change of frequency | 81R | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| **Measurements dependent on voltages measured** | | | | | | | | | | | | | |
| Phase-to-phase voltage U21, U32, U13 or U'21, U'32, U'13 | | ■ □ | ■ □ | ■ | ■ □ | ■ □ | ■ □ | U21, U'21 | U21 | U21 | | | |
| Phase-to-neutral voltage V1, V2, V3 or V'1, V'2, V'3 | | ■ □ | ■ □ | ■ | | ■ | | | | | V1, V'1 | V1, V'1 | V1 |
| Residual voltage V0 or V'0 | | ■ □ | ■ □ | ■ | | ■ □ | | | ■ □ | | | ■ □ | |
| Neutral point voltage Vnt | | | | ■ | | | ■ | | | ■ | | | ■ |
| Third harmonic neutral point or residual voltage | | | | ■ | | | ■ | | | ■ | | | ■ |
| Positive sequence voltage Vd or V'd / negative sequence voltage Vi or V'i | | ■ □ | ■ □ | ■ | ■ □ | ■ □ | ■ | | | | | | |
| Frequency | | ■ □ | ■ □ | ■ □ | ■ □ | ■ □ | ■ □ | ■ □ ⧄ | ■ □ | ■ □ | ■ □ ⧄ | ■ □ | ■ □ |
| Active / reactive / apparent power: P, Q, S | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Peak demand power PM, QM | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Active / reactive / apparent power per phase : P1/P2/P3, Q1/Q2/Q3, S1/S2/S3 | | ■ (1) | ■ (1) | ■ (1) | | ■ (1) | | | | | P1/ Q1/S1 | P1/ Q1/S1 | P1/ Q1/S1 |
| Power factor | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Calculated active and reactive energy (±Wh, ±VARh) | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Total harmonic distortion, voltage Uthd | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Phase displacement φ0, φ'0 | | ■ | ■ | ■ | | ■ | | | ■ | | | ■ | |
| Phase displacement φ1, φ2, φ3 | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Apparent positive sequence impedance Zd | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| Apparent phase-to-phase impedances Z21, Z32, Z13 | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |

■ *Function available on main voltage channels.*
□ *Function available on Sepam B83 additional voltage channels.*
⧄ *Function available on Sepam B80 additional voltage channel, according to the type of the additional voltage measured.*
***(1)*** *If all three phase currents are measured.*


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# Sepam software

## Presentation

Three types of Sepam PC software are available:
- SFT2841 setting and operating software
- SFT2826 disturbance recording data display software
- SFT2885 programming software for the Sepam series 80 (Logipam).

### SFT2841 and SFT2826 software

SFT2841 and SFT2826 software is provided on the same CD-ROM as the interactive presentation of the Sepam range and the Sepam documentation in PDF format.

### PC connection cord

The CCA783 PC connection cord, to be ordered separately, is designed to connect a PC to the RS 232 port on the front panel of a Sepam unit in order to use the SFT2841 software in point-to-point connected mode.

### SFT2885 software

SFT2885 is available on a separate CD-ROM.
It comes with SFT2887 software that can be used to convert Logipam programs developed for Sepam 2000.

## Minimum configuration required

| SFT2841 and SFT2826 software | |
|---|---|
| Processor | PC compatible, Pentium 133 MHz |
| Operating systems | Microsoft Windows 98/NT4.0/2000/XP |
| RAM | 64 MB (32 MB for Windows 98) |
| Space on disk | 100 MB |

| SFT2885 and SFT2887 software | |
|---|---|
| Processor | PC compatible, Pentium 400 MHz |
| Operating systems | Microsoft Windows 98/NT4.0/2000/XP |
| RAM | 64 MB |
| Space on disk | 20 MB |





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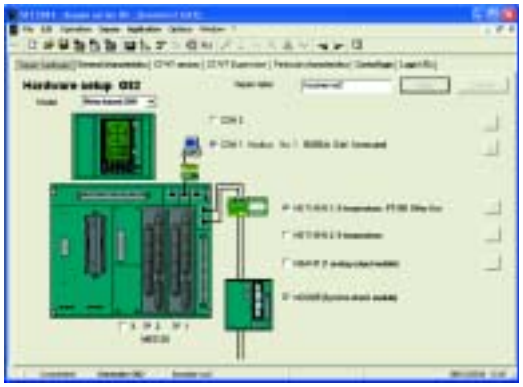
# SFT2841 setting and operating software
## Function

The SFT2841 software is the setting and operating tool for Sepam series 20, Sepam series 40 and Sepam series 80.
It may be used:
- prior to commissioning and without connection to Sepam, to prepare Sepam protection and parameter settings
- during commissioning, on a PC connected point-to-point to the front panel Sepam:
  - to load, unload and modify Sepam protection and parameter settings
  - to obtain all measurements and useful information during commissioning
- during operation, on a PC connected to a set of Sepam relays via an E-LAN multipoint communication network:
  - to manage the protection system
  - to monitor the status of the electrical network
  - to run diagnostics on any incidents affecting the electrical network.

PE50540



*SFT2841: Sepam series 80 hardware configuration.*

PE50304

*SFT2841: output testing.*

PE50274


*SFT2841: alarm history.*

### Preparation of Sepam parameter and protection settings in unconnected mode
- configuration of Sepam and optional modules, and entry of general settings
- enabling/disabling of functions and entry of protection settings
- adaptation of predefined control and monitoring functions
- creation of personalized mimic diagrams for local display.

### Sepam commissioning via a point-to-point connection to the front panel
- access to all functions available in unconnected mode, after entering the protection-setting or parameter-setting password
- transfer of Sepam parameter and protection setting file, prepared in unconnected mode (downloading function), protected by the parameter-setting password
- display of all measurements and useful information during commissioning
- display of logic input, logic output and LED status
- test of logic outputs
- display of Logipam variables
- setting of Logipam parameters (configuration bits, timers, etc.)
- modification of passwords.

### Management of protection functions and network diagnostics with an E-LAN multipoint network connection
- reading of all Sepam protection and parameter settings, modifications following entry of the protection-setting or parameter-setting password
- display of all the Sepam measurement data
- display of Sepam, switchgear and network diagnosis data
- display of time-tagged alarm messages
- retrieval of disturbance recording data.

### Efficient, easy-to-use software
- menus and icons for fast, direct access to the data required
- guided navigation to go through all the data input screens in the natural order
- all data on the same function together in the same screen
- trilingual software: English, French, Spanish
- on-line help, with all the technical information needed to use and implement Sepam
- familiar file management in Microsoft Windows environment:
  - all file management services included: copy / paste, save, etc.
  - printing of parameter and protection settings in standard layout.



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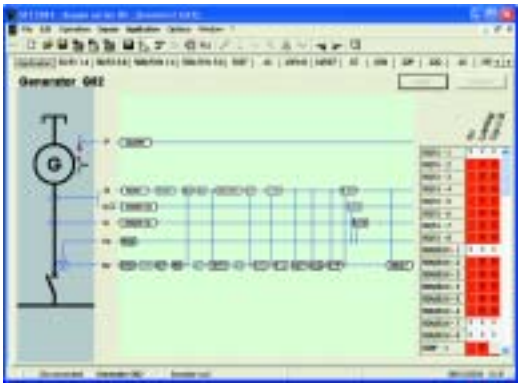
# SFT2841 setting and operating software
## Function

PE50302

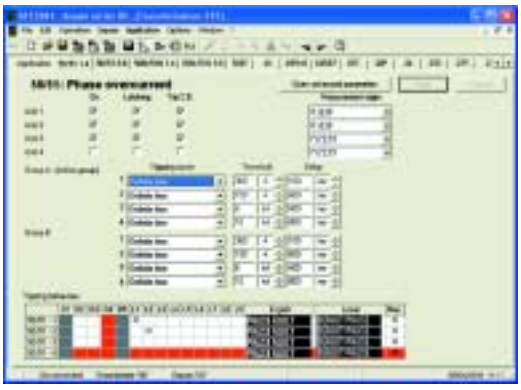
*SFT2841: Sepam series 80 sensor parameter setting.*

PE50541



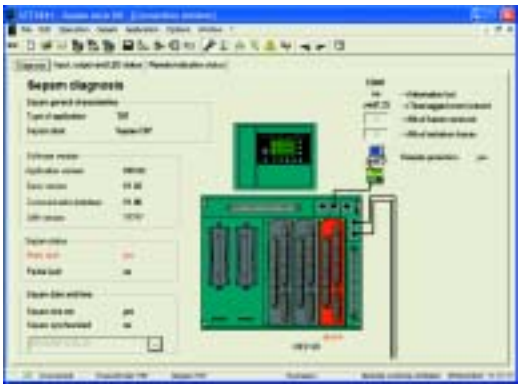
*SFT2841: Sepam series 80 application, with protection function measurement origin.*

PE50275



*SFT2841: protection settings.*

PE50276



*SFT2841: Sepam diagnosis.*

The table below gives the SFT2841 functions available for each of the 3 Sepam series: Sepam series 20, Sepam series 40 and Sepam series 80.

**NC:** *function available in unconnected mode.*

**S:** *function available with SFT2841 connected via Sepam front panel.*

**E:** *function available with SFT2841 connected to Sepam via E-LAN communication network.*

| Functions | Série 20 | | | Série 40 | | | Série 80 | | |
|---|---|---|---|---|---|---|---|---|---|
| **Management** | | | | | | | | | |
| On-line help | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Management of parameter and protection setting files: creation, saving, downloading and uploading | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Downloading and uploading of parameter and protection setting files | | ■ | ■ | | ■ | ■ (1) | | ■ | ■ |
| Exporting of parameter and protection settings in a text file | ■ | ■ | | ■ | ■ | | | | |
| Printing of parameter and protection settings | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Modification of passwords, one for parameter setting and one for protection setting | | ■ | ■ | | ■ | ■ | | | |
| **Sepam parameter setting** | | | | | | | | | |
| Display of parameter settings | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Hardware configuration and parameter entry protected by parameter setting password | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Graphical parameter setting assistance | | | | | | | ■ | ■ | ■ |
| **Protection setting** | | | | | | | | | |
| Display of protection settings | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Entry of protection settings, protected by protection setting password | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Definition of customized tripping curve | | | | | | | ■ | ■ | ■ |
| **Adaptation of the predefined functions** | | | | | | | | | |
| Display and modification of the control matrix | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Logic equation editing | | | | | ■ | ■ | ■ | ■ | ■ |
| Number of instructions | | | | 100 | | | 200 | | |
| Number of dedicated remote indications | | | | 10 | | | 20 | | |
| Display of logic equations | | | | | ■ | ■ | | ■ | ■ |
| Load the Logipam program | | | | | | | ■ | ■ | |
| Setting of Logipam parameters | | | | | | | | ■ | ■ |
| Assignment of LEDs on front | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Editing of user messages | | | | | ■ | ■ | | ■ | ■ |
| Number of user messages | | | | 30 | | | 100 | | |
| Editing of personalized mimic diagram | | | | | | | ■ | ■ | ■ |
| **Assistance in commissioning and operating the installation** | | | | | | | | | |
| Display of all the Sepam measurement data | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| Display of switchgear diagnosis assistance data | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| Display of machine operating assistance data | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| Display of time-tagged alarm messages | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| Tripping context | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| Retrieval of disturbance recording files | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| Display of Logipam variables | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| Display of logic input/output status | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| Output testing | | ■ | ■ | | ■ | ■ | | ■ | ■ |
| Sepam diagnosis | | ■ | ■ | | ■ | ■ | | ■ | ■ |

***(1)** Except for logic equations and personalized messages.*





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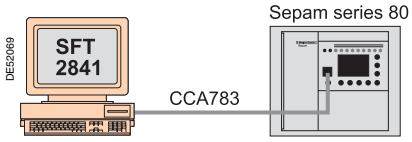
# SFT2841 setting and operating software
## SFT2841 connection to Sepam

### SFT2841 connection to the front panel of a Sepam

Connection of the PC RS232 serial port to the communication port on the front panel of Sepam series 20, Sepam series 40 or Sepam series 80 using the CCA783 cord.

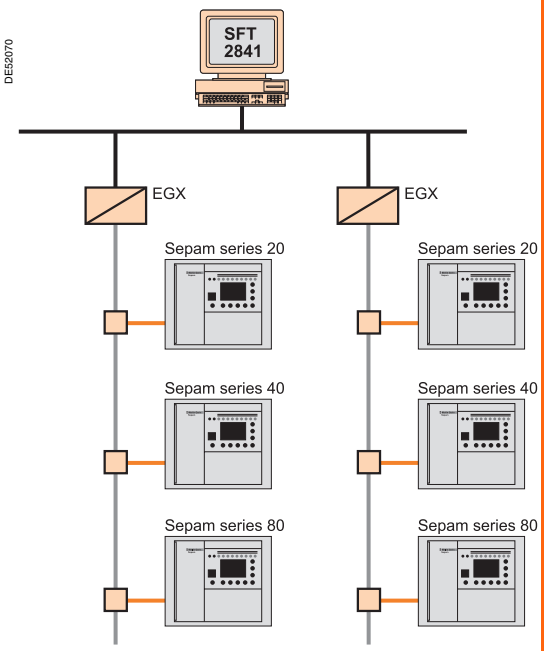



### SFT2841 connection to a set of Sepam relays

The SFT2841 can be connected to a set of Sepam relays, themselves connected to a E-LAN communication network in one of the three architectures presented below. These connections do not require any further software development work.

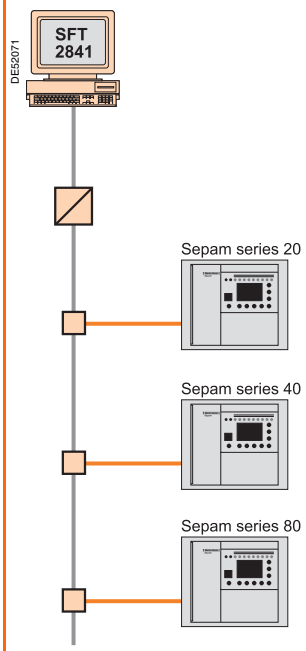
**Ethernet connection**

- connection a set of Sepam to a Modbus RS 485 network
- Ethernet RS 485 link via the EGX200 or EGX400 gateway
- connection of the PC via its Ethernet port.



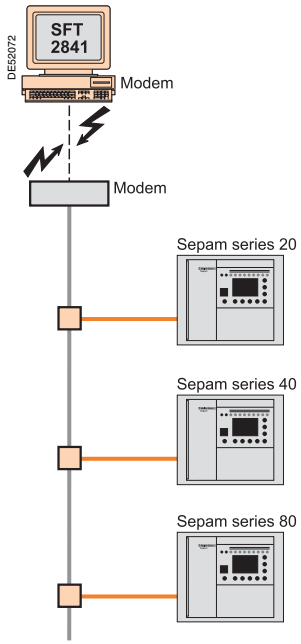

**RS 485 serial connection**

- connection a set of Sepam to a Modbus RS 485 network
- connection of the PC via its RS 232 port, using the ACE909-2 interface.




**Telephone-line connection**

- connection a set of Sepam to a Modbus RS 485 network
- RS 485-RTC link via an RS 485 modem (Wertermo TD-34 for example)
- connection of the PC via its modem port.





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# SFT2841 setting and operating software
## Adaptation of the predefined functions

The predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:
- logic equation editor, to adapt and complete the predefined control and monitoring functions
- creation of personalized messages for local display
- creation of personalized mimic diagrams corresponding to the controlled devices
- customization of the control matrix by changing the assignment of logic output, LEDs and display messages.

The availability and performance of the SFT2841 software function depend on the Sepam series.
Please refer to the function table for more information.

PE50277

*SFT2841: logic equation editor.*

### Logic equation editor (Sepam series 40 and series 80)

The logic equation editor included in the SFT2841 software can be used to:
- complete protection function processing:
  - additional interlocking
  - conditional inhibition/validation of functions
  - etc.
- adapt predefined control functions: particular circuit breaker or recloser control sequences, etc.

Note that the use of the logic equation editor excludes the possibility of using the Logipam programming software.

A logic equation is created by grouping logic input data received from:
- protection functions
- logic inputs
- local control orders transmitted by the mimic-based UMI
- remote control orders

using the Boolean operators AND, OR, XOR, NOT, and automation functions such as time delays, bistables and time programmer.
Equation input is assisted and syntax checking is done systematically.

The result of an equation may then be:
- assigned to a logic output, LED or message from the control matrix
- transmitted by the communication link, as a new remote indication
- utilized by the circuit breaker/contactor control function to trip, close or inhibit breaking device closing
- used to inhibit or reset a protection function.

### Alarms and operating messages (Sepam series 40 and series 80)

New alarm and operating messages may be created using the SFT2841 software. The new messages are added to the list of existing messages and may be assigned via the control matrix for display:
- on Sepam's advanced UMI
- in the SFT2841 "Alarms" and "Alarm History" screens





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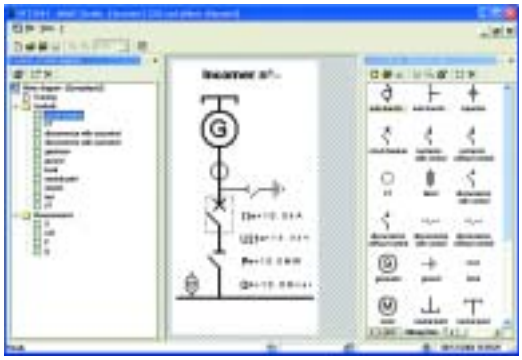
# SFT2841 setting and operating software
## Adaptation of the predefined functions

PE50542

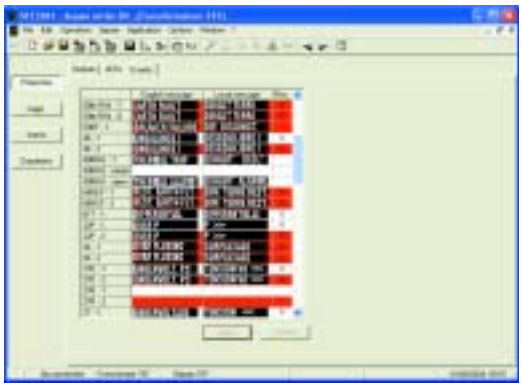


*SFT2841: mimic-diagram editor.*

### Local-control mimic diagram (Sepam series 80)

The local-control mimic diagram displayed on the UMI can be personalized by adapting one of the supplied, predefined mimic diagrams or by creating a diagram from scratch.
The mimic-diagram editor can be used to:
- create a fixed, bitmap background (128 x 240 pixels) using a standard drawing tool
- create animated symbols or use predefined animated symbols to represent the electrotechnical devices or other objects
- assign the logic inputs or internal status conditions that modify the animated symbols. For example, the logic inputs for the circuit-breaker position must be linked to the circuit-breaker symbol to enable the display of the open and closed conditions
- assign the logic outputs or internal status conditions that are activated when an opening or closing order are issued for the symbol
- display the current, voltage and power measurements on the mimic diagram.

PE50305



*SFT2841: control matrix.*

### Control matrix

The control matrix is used for simple assignment of data from:
- protection functions
- control and monitoring functions
- logic inputs
- logic equations or the Logipam program

to the following output data:
- logic outputs
- 9 LEDs on the front of Sepam
- messages for local display
- triggering of disturbance recording.

4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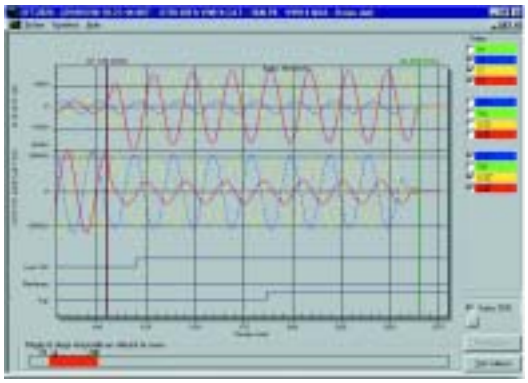
# SFT2826 disturbance recording data display software




*SFT2826: analysis of a disturbance data record.*

## Function

The SFT2826 software is used to display, analyze and print disturbance data recorded by Sepam.
It uses COMTRADE (IEEE standard: Common format for transient data exchange for power systems) files.

### Transfer of disturbance recording data

Before they are analyzed by SFT2826, the disturbance recording data must be transferred from Sepam to the PC:
- by the SFT2841 software
- or by the Modbus communication link.

### Analysis of disturbance recording data

- selection of analog signals and logic data for display
- zoom and measurement of time between events
- display of all numerical values recorded
- exporting of data in file format
- printing of curves and/or numerical values recorded.

## Characteristics

The SFT2826 software comes with the SFT2841 software:
- 4 languages: English, French, Spanish, Italian
- on-line help with description of software functions.





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# SFT2885 programming software - Logipam

## Function

The SFT2885 programming software (called Logipam) is intended exclusively for the Sepam series 80 and can be used to:
- adapt predefined control and monitoring functions
- program specific control and monitoring functions, either to replace the predefined versions or to create completely new functions, to provide all the functions required by the application.

It is made up of:
- a ladder-language program editor used to address all Sepam data and to program complex control functions
- a simulator for complete program debugging
- a code generator to run the program on Sepam.

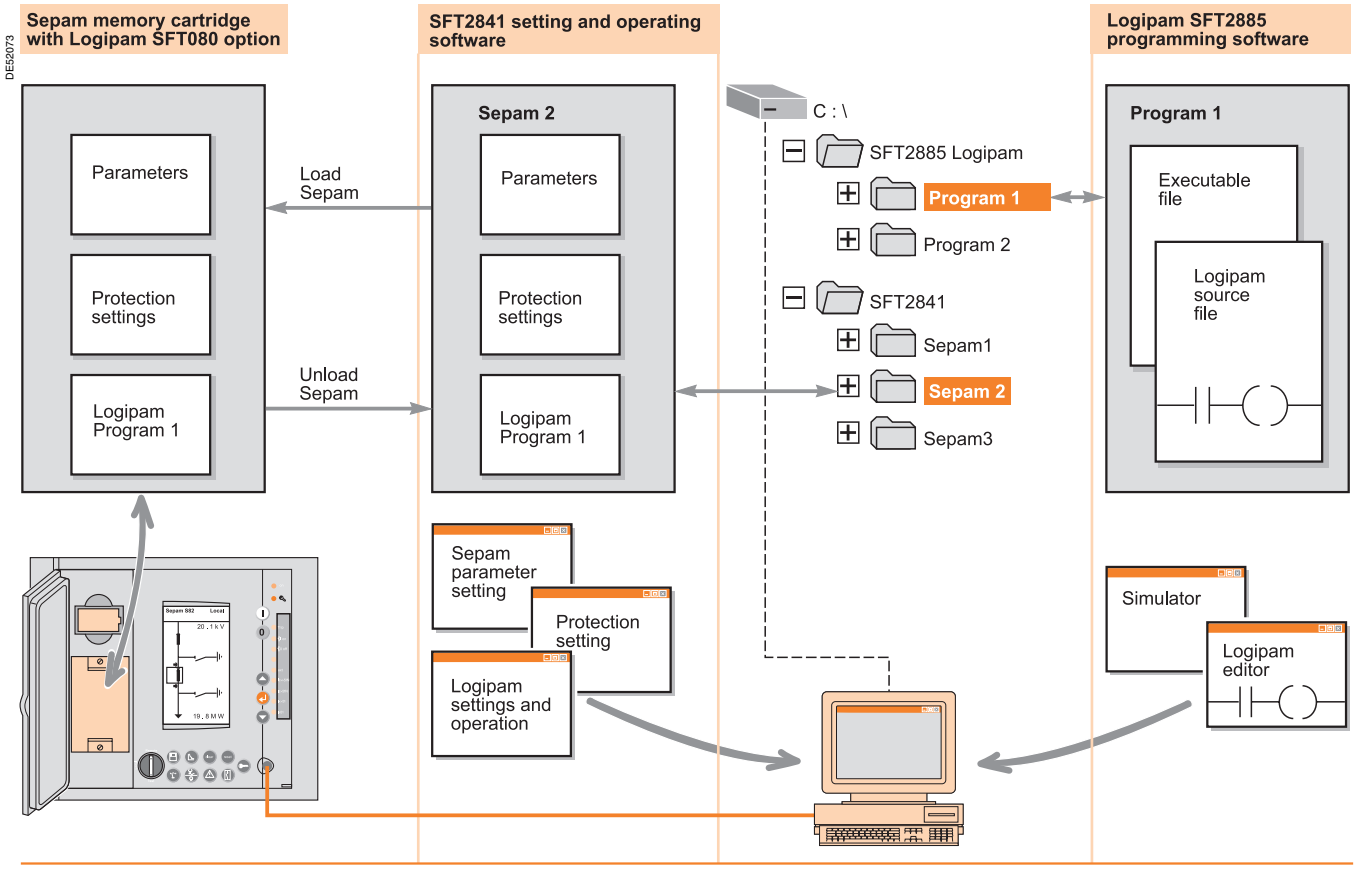
The ladder-language program and the data used can be documented and a complete file can be printed.

**Only the Sepam series 80 with a cartridge containing the Logipam SFT080 option can run the control and monitoring functions programmed by the Logipam SFT2885 software.**

The complete Logipam software is made up of the executable program run by Sepam and the source program that can be modified by the Logipam SFT2885 programming software.

The SFT2841 setting and operating software, required for implementation of the Logipam program, offers the following functions:
- association of the complete Logipam program with the Sepam parameter and protection settings
- loading and unloading of Logipam program, parameters and settings in the Sepam cartridge
- running of the functions programmed with Logipam:
  - display of the status of Logipam internal bits
  - setting of Logipam parameters: configuration bits, timers, etc.

## Operating principle





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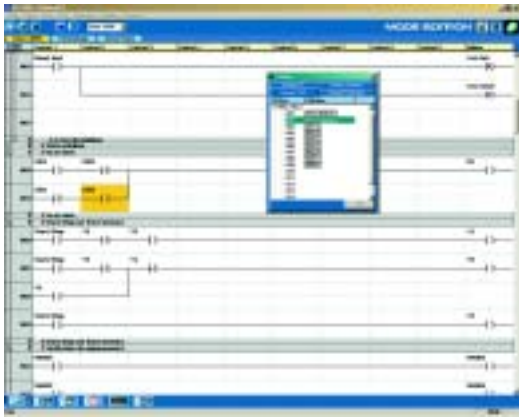
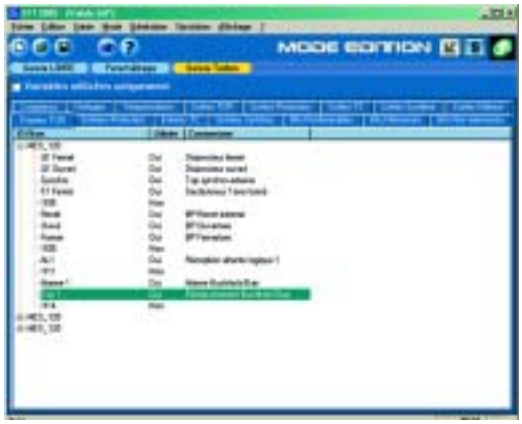
# SFT2885 programming software - Logipam

PE50257



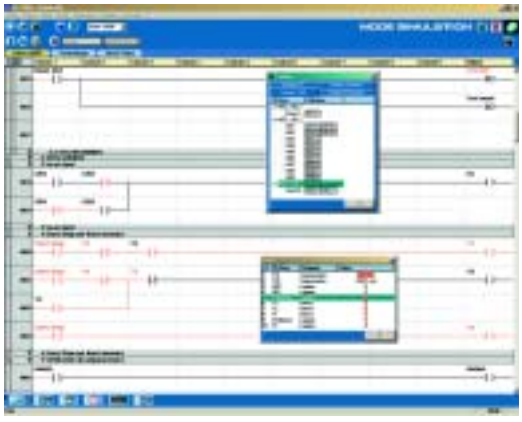
*SFT2885: ladder-language program, structured in sections.*

PE50265



*SFT2885: variable editor.*

PE50266



*SFT2885: program debugging.*

## Characteristics

### Program structure

A ladder-language program is made up of a series of rungs executed sequentially:
- maximum 1000 lines with 9 contacts and 1 coil maximum per line
- with a maximum total number of 5000 contacts and coils.

Comments may be made for each line.

**Sections**

The program can be broken down into sections and subsections to clarify the structure and facilitate reading. It is possible to set up three levels of sections.
Comments may be added for each section.
Execution of each section can be subjected to conditions.

**Variable editor**

Each variable is defined by an invariable identifier and can be linked to a name or a comment.
The programmer can decide to work directly with the identifiers or with the linked names.
The list of the variables used and the cross references may be consulted during programming.

### Graphic elements in the ladder language

The graphic elements are the instructions in the ladder language:
- NO and NC contacts
- rising and falling-edge detection contacts
- direct or negated coils
- set and reset coils
- coils and contacts linked to timers, counters and clocks.

### Available resources

**Sepam variables**

All the data used by Sepam functions can be addressed by Logipam:
- all logic inputs and outputs
- all remote-control orders and remote indications

(the remote-control orders and remote indication used in the Logipam program are no longer used by the predefined functions)
- all protection-function inputs and outputs
- all inputs and outputs for the predefined control and monitoring functions
- all inputs and outputs for symbols in the mimic-based UMI
- all system data.

**Logipam internal variables**
- 64 configuration bits to parameter program processing, settable via the SFT2841 software and the display
- 128 bits used by the control matrix to control LEDs, messages and logic outputs
- 128 internal bits that are saved
- 512 internal bits that are not saved.

**Logipam functions**
- 60 timers that can be set for a rising edge (TON) or a falling edge (TOF)
- 24 incremental counters with adjustable thresholds
- 4 clocks for a given week.

### Debugging tools

The Logipam software offers a complete set of tools for program debugging:
- step-by-step or continuous program execution to simulate the programmed functions
- color animation of the rungs and all program variables
- grouping in a table of all program variables requiring monitoring.

### Documentation

The application file can be printed in part or in whole.
The application file can be personalized : front page, title block, general description of the program, etc.





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# MES114, MES114E, MES114F
# 10 input / 4 output module
## Presentation


*10 input/4 output MES114 module.*

## Function

The 4 outputs included on the Sepam series 20 and 40 may be extended by adding an optional MES114 module with 10 inputs and 4 outputs, available in 3 versions:

- MES114: 10 DC inputs voltage from from 24 V DC to 250 V DC
- MES114E: 10 inputs, voltage 110-125 V AC or V DC
- MES114F: 10 inputs, voltage 220-250 V AC or V DC.

## Characteristics

| **MES114 module** | | | | | | |
|---|---|---|---|---|---|---|
| Weight | | 0.28 kg | | | | |
| Operating temperature | | -25 °C to +70 °C | | | | |
| Environmental characteristics | | Same characteristics as Sepam base units | | | | |
| **Logical inputs** | | **MES114** | **MES114E** | | **MES114F** | |
| Voltage | | 24 to 250 V DC | 110 to 125 V DC | 110 V AC | 220 to 250 V DC | 220 to 240 V AC |
| Range | | 19.2 to 275 V DC | 88 to 150 VV DC | 88 to 132 V AC | 176 to 275 V DC | 176 to 264 V AC |
| Frequency | | / | / | 47 to 63 Hz | / | 47 to 63 Hz |
| Typical consumption | | 3 mA | 3 mA | 3 mA | 3 mA | 3 mA |
| Typical switching threshold | | 14 V DC | 82 V DC | 58 V AC | 154 V DC | 120 V AC |
| Input limit voltage | At state 0 | ⩾ 19 V DC | ⩾ 88 V DC | ⩾ 88 V AC | ⩾ 176 V DC | ⩾ 176 V AC |
| | At state 1 | ⩽ 6 V DC | ⩽ 75 V DC | ⩽ 22 V AC | ⩽ 137 V DC | ⩽ 48 V AC |
| **O11 control relay output** | | | | | | |
| Voltage | | DC | 24 / 48 V DC | 127 V DC | 220 V DC | |
| | | AC (47.5 to 63 Hz) | | | | 100 to 240 V AC |
| Continuous current | | | 8 A | 8 A | 8 A | 8 A |
| Breaking capacity | | Resistive load | 8 / 4 A | 0.7 A | 0.3 A | 8 A |
| | | Load L/R < 20 ms | 6 / 2 A | 0.5 A | 0.2 A | |
| | | Load L/R < 40 ms | 4 / 1 A | 0.2 A | 0.1 A | |
| | | Load cos φ > 0.3 | | | | 5 A |
| Making capacity | | | < 15 A for 200 ms | | | |
| **O12 to O14 indication relay output** | | | | | | |
| Voltage | | DC | 24 / 48 V DC | 127 V DC | 220 V DC | |
| | | AC (47.5 to 63 Hz) | | | | 100 to 240 V AC |
| Continuous current | | | 2 A | 2 A | 2 A | 2 A |
| Breaking capacity | | Load L/R < 20 ms | 2 / 1 A | 0.5 A | 0.15 A | |
| | | Load cos φ > 0.3 | | | | 1 A |
| Making capacity | | | < 15 A for 200 ms | | | |



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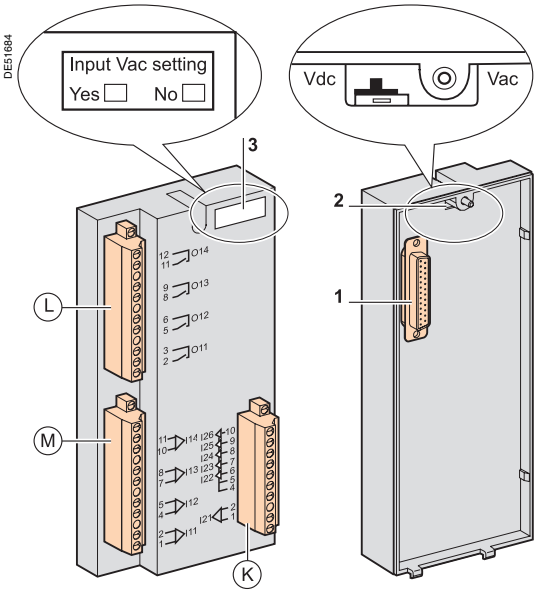
# MES114, MES114E, MES114F
# 14 input / 6 output module
## Installation




## Description

Ⓛ, Ⓜ and Ⓚ: 3 removable, lockable screw-type connectors.
Ⓛ: connectors for 4 relay outputs:
- O11: 1 control relay output
- O12 to O14: 3 indication relay outputs.

Ⓜ: connectors for 4 independent logic inputs I11 to I14
Ⓚ: connectors for 6 logic inputs:
- I21: 1 independent logic input
- I22 to I26: 5 common point logic inputs.

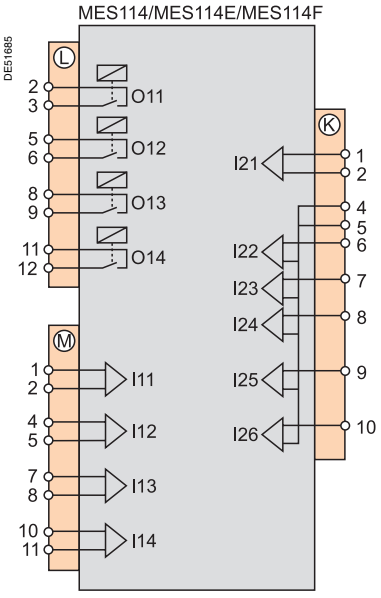
**1**: 25-pin sub-D connector to connect the module to the base unit
**2**: voltage selector switche for MES114E and MES114F module inputs, to be set to:
- ☐ V DC for 10 DC voltage inputs (default setting)
- ☐ V AC for 10 AC voltage inputs.

**3** : label to be filled in to indicate the chosen parameter setting for MES114E and MES114F input voltages.

The parameter setting status may be accessed in the "Sepam Diagnosis" screen of the SFT2841 software tool.
Parameter setting of the inputs for AC voltage (V AC setting) inhibits the "operating time measurement" function.


## Assembly

- insert the 2 pins on the MES module into the slots **1** on the base unit
- flatten the module up against the base unit to plug it into the connector **2**
- tighten the **3** mounting screws.




## Connection

**Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.**
The inputs are potential-free and the DC power supply source is external.

Wiring of connectors Ⓛ, Ⓜ and Ⓚ:
- wiring without fitting:
  - ☐ 1 wire with maximum cross-section 0.2 to 2.5 mm² (> AWG 24-12)
  - ☐ or 2 wires with maximum cross-section 0.2 to 1 mm² (> AWG 24-16)
  - ☐ stripped length: 8 to 10 mm
- wiring with fittings:
  - ☐ recommended wiring with Telemecanique fitting:
    - DZ5CE015D for one 1.5 mm² wire
    - DZ5CE025D for one 2.5 mm² wire
    - AZ5DE010D for two 1 mm² wires
  - ☐ tube length: 8.2 mm
  - ☐ stripped length: 8 mm.

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# MES114, MES114E, MES114F
# 14 input / 6 output module
## Logic input / output assignment of Sepam series 20

The use of the preset control and monitoring functions requires exclusive parameter setting and particular wiring of the inputs according to the application and type of Sepam. Input assignment and parameter setting of the control and monitoring functions may be done on the advanced UMI or using the SFT2841 software tool.
Since a current input may only be assigned to a single function, not all the functions are available at the same time.
Example: when the logic discimination function is used, the switching of groups of settings function may not be used.

### Assignment table of logic inputs by application

| Functions | S20 | T20 | M20 | B21, B22 | Assignment |
|---|---|---|---|---|---|
| **Logic inputs** | | | | | |
| Open position | ■ | ■ | ■ | ■ | I11 |
| Closed position | ■ | ■ | ■ | ■ | I12 |
| Logic discrimination, receive blocking input | ■ | ■ | | | I13 |
| Switching of groups of settings A/B | ■ | ■ | ■ | | |
| External reset | ■ | ■ | ■ | ■ | I14 |
| External tripping 4 (1) | ■ | ■ | ■ | ■ | |
| External tripping 1 (1) | ■ | ■ (2) | ■ | ■ | I21 |
| External network synchronization | ■ | ■ | ■ | ■ | |
| External tripping 2 (1) | ■ | ■ (3) | ■ | ■ | I22 |
| Motor re-acceleration | | | ■ | | |
| External tripping 3 (1) | ■ | ■ (4) | ■ | ■ | I23 |
| Buchholz alarm (1) | | ■ | | | |
| Rotor direction detection | | | ■ | | |
| Thermistor tripping (1) | | ■ | ■ | | |
| End of charging position | ■ | ■ | ■ | | I24 |
| Thermostat alarm (1) | | ■ | | | |
| Thermistor alarm (1) | | ■ | ■ | | |
| Inhibit remote control (1) | ■ | ■ | ■ | ■ | I25 |
| SF6-1 | ■ | ■ | ■ | ■ | |
| SF6-2 | ■ | ■ | ■ | ■ | I26 |
| Switching of thermal settings | | ■ | ■ | | |
| Inhibit thermal overload | | ■ | ■ | | |
| Inhibit recloser | ■ | | | | |
| **Logic outputs** | | | | | |
| Tripping | ■ | ■ | ■ | ■ | O1 |
| Inhibit closing | ■ | ■ | ■ | ■ | O2 |
| Watchdog | ■ | ■ | ■ | ■ | O4 |
| Close order | ■ | ■ | ■ | ■ | O11 |

***Note:*** *all of the logic inputs are available via the communication link and are accessible in the SFT2841 matrix for other non predefined applications.*

***(1)*** *These inputs have parameter setting with the prefix "NEG" for undervoltage type operation.*
***(2)*** *Buchholz/Gaz trip message.*
***(3)*** *Thermostat trip message.*
***(4)*** *Pressure trip message.*



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# MES114, MES114E, MES114F
# 14 input / 6 output module
## Logic input / output assignment of Sepam series 40

Inputs and outputs may be assigned to predefined control and monitoring functions using the SFT2841 software, according to the uses listed in the table below.
■ all the logic inputs, whether or not assigned to predefined functions, may be used for the SFT2841 customization functions according to specific application needs:
□ in the control matrix, to link inputs to output relays, LED indications or display messages
□ in the logic equation editor, as logic equation variables
■ the control logic of each input may be inverted for undervoltage type operation.

### Assignment table of logic inputs by application

| Functions | S40, S41 | S42 | T40, T42 | M41 | G40 | Assignment |
|---|---|---|---|---|---|---|
| **Logic inputs** | | | | | | |
| Open position | ■ | ■ | ■ | ■ | ■ | I11 |
| Closed position | ■ | ■ | ■ | ■ | ■ | I12 |
| Logic discrimination, receive blocking input 1 | ■ | ■ | ■ | | ■ | Free |
| Logic discrimination, receive blocking input 2 | | ■ | | | | Free |
| Switching of groups of settings A/B | ■ | ■ | ■ | ■ | ■ | I13 |
| External reset | ■ | ■ | ■ | ■ | ■ | Free |
| External tripping 1 | ■ | ■ | ■ | ■ | ■ | Free |
| External tripping 2 | ■ | ■ | ■ | ■ | ■ | Free |
| External tripping 3 | ■ | ■ | ■ | ■ | ■ | Free |
| Buchholz/gas tripping | | | ■ | | | Free |
| Thermostat tripping | | | ■ | | | Free |
| Pressure tripping | | | ■ | | | Free |
| Thermistor tripping | | | ■ | ■ | ■ | Free |
| Buchholz/gas alarm | | | ■ | | | Free |
| Thermostat alarm | | | ■ | | | Free |
| Pressure alarm | | | ■ | | | Free |
| Thermistor alarm | | | ■ | ■ | ■ | Free |
| End of charging position | ■ | ■ | ■ | ■ | ■ | Free |
| Inhibit remote control | ■ | ■ | ■ | ■ | ■ | Free |
| SF6 | ■ | ■ | ■ | ■ | ■ | Free |
| Inhibit recloser | ■ | ■ | | | | Free |
| External synchronization | ■ | ■ | ■ | ■ | ■ | I21 |
| Inhibit thermal overload | | | ■ | ■ | ■ | Free |
| Switching of thermal settings | | | ■ | ■ | ■ | Free |
| Motor re-acceleration | | | | ■ | | Free |
| Rotor rotation detection | | | | ■ | | Free |
| Inhibit undercurrent | | | | ■ | | Free |
| Inhibit closing | ■ | ■ | ■ | ■ | ■ | Free |
| Open order | ■ | ■ | ■ | ■ | ■ | Free |
| Close order | ■ | ■ | ■ | ■ | ■ | Free |
| Phase voltage transformer fuse melting | ■ | ■ | ■ | ■ | ■ | Free |
| Residual voltage transformer fuse melting | ■ | ■ | ■ | ■ | ■ | Free |
| External positive active energy counter | ■ | ■ | ■ | ■ | ■ | Free |
| External negative active energy counter | ■ | ■ | ■ | ■ | ■ | Free |
| External positive reactive energy counter | ■ | ■ | ■ | ■ | ■ | Free |
| External negative reactive energy counter | ■ | ■ | ■ | ■ | ■ | Free |
| **Logic outputs** | | | | | | |
| Tripping | ■ | ■ | ■ | ■ | ■ | O1 |
| Inhibit closing | ■ | ■ | ■ | ■ | ■ | O2 |
| Watchdog | ■ | ■ | ■ | ■ | ■ | O4 |
| Close order | ■ | ■ | ■ | ■ | ■ | O11 |

***Note:*** *all of the logic inputs are available via the communication link and are accessible in the SFT2841 matrix for other non predefined applications.*





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# MES120, MES120G
# 14 input / 6 output module
## Presentation


*MES120 14 input / 6 output module.*



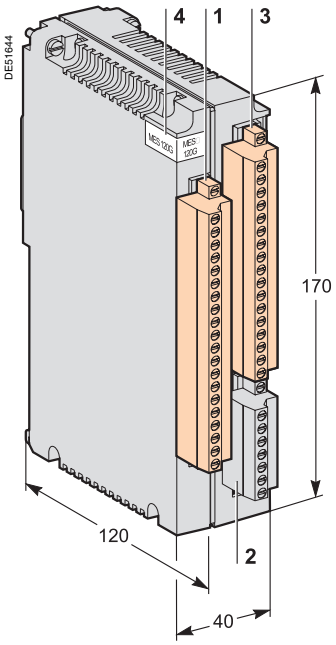
## Function

The 5 output relays included on the Sepam series 80 base unit may be extended by adding 1, 2 or 3 MES120 modules with 14 DC logic inputs and 6 outputs relays, 1 control relay output and 5 indication relay outputs.

Two modules are available for the different input supply voltage ranges and offer different switching thresholds:
- MES120, 14 inputs 24 V DC to 250 V DC with a typical switching threshold of 14 V DC
- MES120G, 14 inputs 220 V DC to 250 V DC with a typical switching threshold of 155 V DC.

## Characteristics

| **MES120 / MES120G modules** | | | | | |
|---|---|---|---|---|---|
| Weight | | 0.38 kg | | | |
| Operating temperature | | -25°C to +70°C | | | |
| Environmental characteristics | | Same characteristics as Sepam base units | | | |
| **Logic inputs** | | **MES120** | | **MES120G** | |
| Voltage | | 24 - 250 V DC | | 220 - 250 V DC | |
| Range | | 19.2 - 275 V DC | | 170 - 275 V DC | |
| Typical consumption | | 3 mA | | 3 mA | |
| Typical switching threshold | | 14 V DC | | 155 V DC | |
| Input limit voltage | At state 0 | < 6 V DC | | < 144 V DC | |
| | At state 1 | > 19 V DC | | > 170 V DC | |
| **Control relay output** | | | | | |
| Voltage | DC | 24/48 V DC | 127 V DC | 220 V DC | |
| | AC (47.5 to 63 Hz) | | | | 100 to 240 V AC |
| Continuous current | | 8 A | 8 A | 8 A | 8 A |
| Breaking capacity | Resistive load | 8 / 4 A | 0.7 A | 0.3 A | 8 A |
| | Load L/R < 20 ms | 6 / 2 A | 0.5 A | 0.2 A | |
| | Load L/R < 40 ms | 4 / 1 A | 0.2 A | 0.1 A | |
| | Load p.f. > 0.3 | | | | 5 A |
| Making capacity | | < 15 A for 200 ms | | | |
| **Indication relay output** | | | | | |
| Voltage | DC | 24/48 V DC | 127 V DC | 220 V DC | |
| | AC (47.5 to 63 Hz) | | | | 100 to 240 V AC |
| Continuous current | | 2 A | 2 A | 2 A | 2 A |
| Breaking capacity | Load L/R < 20 ms | 2 / 1 A | 0.5 A | 0.15 A | |
| | Load p.f. > 0.3 | | | | 1 A |




## Description

3 removable, lockable screw-type connectors.

**1** 20-pin connector for 9 logic inputs:
- Ix01 to Ix04: 4 independent logic inputs
- Ix05 to Ix09: 5 common point logic inputs.

**2** 7-pin connector for 5 common point logic inputs Ix10 à Ix14.

**3** 17-pin connector for 6 relay outputs:
- Ox01: 1 control relay output
- Ox02 to Ox06 : 5 indication relay outputs.

Addressing of MES120 module inputs / outputs:
- x = 1 for the module connected to H1
- x = 2 for the module connected to H2
- x = 3 for the module connected to H3.

**4** MES120G identification label (MES120 modules have no labels).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# MES120, MES120G
# 14 input / 6 output module
Installation


*Installation of the second MES120 module, connected to base unit connector H2.*

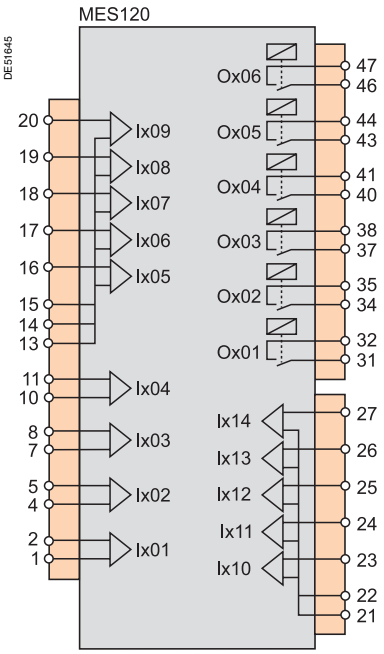
## Assembly

**Installation of an MES120 module on the base unit**

- insert the 2 pins on the MES module into the slots **1** on the base unit
- push the module flat up against the base unit to plug it into the connector **H2**
- partially tighten the two mounting screws **2** before locking them.

MES120 modules must be mounted in the following order:

- if only one module is required, connect it to connector **H1**
- if 2 modules are required, connect them to connectors **H1** and **H2**
- if 3 modules are required (maximum configuration), the 3 connectors **H1**, **H2** and **H3** are used.




## Connection

**Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.**

The inputs are potential-free and the DC power supply source is external.

**Wiring of connectors**

- wiring without fittings:
  - 1 wire with maximum cross-section 0.2 to 2.5 mm² (≥ AWG 24-12) or 2 wires with maximum cross-section 0.2 to 1 mm² (≥ AWG 24-16)
  - stripped length: 8 to 10 mm
- wiring with fittings:
  - recommended wiring with Telemecanique fittings:
    - DZ5CE015D for one 1.5 mm² wire
    - DZ5CE025D for one 2.5 mm² wire
    - AZ5DE010D for two 1 mm² wires
  - tube length: 8.2 mm
  - stripped length: 8 mm.





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# MES120, MES120G
# 14 input / 6 output module
## Logic input / output assignment

Inputs and outputs may be assigned to predefined control and monitoring functions using the SFT2841 software, according to the uses listed in the table below.
The control logic of each input may be inverted for undervoltage type operation.
All the logic inputs, whether or not assigned to predefined functions, may be used for the customization functions according to specific application needs:
- in the control matrix (SFT2841 software), to connect an input to a logic output, a LED on the front of Sepam or a message for local indication on the display
- in the logic equation editor (SFT2841 software), as logic equation variables
- in Logipam (SFT2885 software) as input variables for the program in ladder language.

### Logic output assignment table

| Functions | S80 | S81 | S82 | S84 | T81 | T82 T87 | M87 | M81 M88 | G87 | G82 G88 | B80 | B83 | C86 | Assignment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tripping / contactor control | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | O1 |
| Inhibit closing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | O2 by default |
| Closing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | O3 by default |
| Watchdog | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | O5 |
| Logic discrimination, blocking send 1 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | O102 by default |
| Logic discrimination, blocking send 2 | | | ■ | ■ | | ■ | | | ■ | ■ | | | | O103 by default |
| Genset shutdown | | | | | | | | | ■ | ■ | | | | Free |
| De-excitation | | | | | | | | | ■ | ■ | | | | Free |
| Load shedding | | | | | | | ■ | ■ | | | | | | Free |
| AT, closing of NO circuit breaker | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| AT, closing of coupling | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| AT, opening of coupling | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Tripping of capacitor step (1 to 4) | | | | | | | | | | | | | ■ | Free |
| Tripping of capacitor step (1 to 4) | | | | | | | | | | | | | ■ | Free |

***Note:*** *The logic outputs assigned by default may be freely reassigned.*

### Assignment table for logic inputs common to all applications

| Functions | S80 | S81 | S82 | S84 | T81 | T82 T87 | M87 | M81 M88 | G87 | G82 G88 | B80 | B83 | C86 | Assignment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Closed circuit breaker | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | I101 |
| Open circuit breaker | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | I102 |
| Synchronization of Sepam internal clock via external pulse | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | I103 |
| Switching of groups of settings A/B | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| External reset | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Earthing switch closed | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Earthing switch open | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| External trip 1 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| External trip 2 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| External trip 3 | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| End of charging position | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Inhibit remote control (Local) | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| SF6 pressure default | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Inhibit closing | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Open order | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Close order | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Phase VT fuse blown | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| V0 VT fuse blown | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| External positive active energy meter | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| External negative active energy meter | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| External positive reactive energy meter | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| External negative reactive energy meter | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Racked out circuit breaker | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Switch A closed | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Switch A open | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Switch B closed | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Switch B open | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |
| Closing-coil monitoring | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | Free |



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# MES120, MES120G
# 14 input / 6 output module
## Logic input / output assignment

**Assignment table of logic inputs by application**

| Functions | S80 | S81 | S82 | S84 | T81 | T82 T87 | M87 | M81 M88 | G87 | G82 G88 | B80 | B83 | C86 | Assignment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inhibit recloser | ■ | ■ | ■ | ■ | | | | | | | | | | Free |
| Inhibit thermal overload | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | Free |
| Switching of thermal settings | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | Free |
| Blocking reception 1 | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Blocking reception 2 | | | ■ | ■ | | ■ | | | ■ | ■ | | | | Free |
| Buchholz trip | | | | | ■ | ■ | | ■ | | ■ | | | | Free |
| Thermostat trip | | | | | ■ | ■ | | ■ | | ■ | | | | Free |
| Pressure trip | | | | | ■ | ■ | | ■ | | ■ | | | | Free |
| Thermistor trip | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | Free |
| Buchholz alarm | | | | | ■ | ■ | | ■ | | ■ | | | | Free |
| Thermostat alarm | | | | | ■ | ■ | | ■ | | ■ | | | | Free |
| Pressure alarm | | | | | ■ | ■ | | ■ | | ■ | | | | Free |
| Thermistor alarm | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | Free |
| Rotor speed measurement | | | | | | | ■ | ■ | ■ | ■ | | | | I104 |
| Rotor rotation detection | | | | | | | ■ | ■ | | | | | | Free |
| Motor re-acceleration | | | | | | | ■ | ■ | | | | | | Free |
| Load shedding request | | | | | | | ■ | ■ | | | | | | Free |
| Inhibit undercurrent | | | | | | | ■ | ■ | | | | | | Free |
| Priority genset shutdown | | | | | | | | | ■ | ■ | | | | Free |
| De-excitation | | | | | | | | | ■ | ■ | | | | Free |
| Close enable (ANSI 25) | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Inhibit opposite-side remote control (local) | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Inhibit remote-control coupling (local) | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Coupling open | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Coupling closed | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Opposite side open | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Opposite side closed | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Selector set to Manual (ANSI 43) | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Selector set to Auto (ANSI 43) | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Selector set to Circuit breaker (ANSI 10) | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Selector set to Coupling (ANSI 10) | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Opposite-side circuit breaker disconnected | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Coupling circuit breaker disconnected | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Coupling close order | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Opposite-side voltage OK | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Inhibit closing of coupling | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| Automatic closing order | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | | Free |
| External closing order 1 | | | | | | | | | | | ■ | ■ | | Free |
| External closing order 2 | | | | | | | | | | | ■ | ■ | | Free |
| Additional phase voltage transformer fuse blown | | | | | | | | | | | ■ | ■ | | Free |
| Additional V0 voltage transformer fuse blown | | | | | | | | | | | | ■ | | Free |
| Capacitor step 1 open | | | | | | | | | | | | | ■ | Free |
| Capacitor step 1 closed | | | | | | | | | | | | | ■ | Free |
| Capacitor step 2 open | | | | | | | | | | | | | ■ | Free |
| Capacitor step 2 closed | | | | | | | | | | | | | ■ | Free |
| Capacitor step 3 open | | | | | | | | | | | | | ■ | Free |
| Capacitor step 3 closed | | | | | | | | | | | | | ■ | Free |
| Capacitor step 4 open | | | | | | | | | | | | | ■ | Free |
| Capacitor step 4 closed | | | | | | | | | | | | | ■ | Free |
| Step 1 opening order | | | | | | | | | | | | | ■ | Free |
| Step 2 opening order | | | | | | | | | | | | | ■ | Free |
| Step 3 opening order | | | | | | | | | | | | | ■ | Free |
| Step 4 opening order | | | | | | | | | | | | | ■ | Free |
| Step 1 closing order | | | | | | | | | | | | | ■ | Free |
| Step 2 closing order | | | | | | | | | | | | | ■ | Free |
| Step 3 closing order | | | | | | | | | | | | | ■ | Free |
| Step 4 closing order | | | | | | | | | | | | | ■ | Free |
| Step 1 external trip | | | | | | | | | | | | | ■ | Free |
| Step 2 external trip | | | | | | | | | | | | | ■ | Free |
| Step 3 external trip | | | | | | | | | | | | | ■ | Free |
| Step 4 external trip | | | | | | | | | | | | | ■ | Free |
| Capacitor step 1 VAR control | | | | | | | | | | | | | ■ | Free |
| Capacitor step 2 VAR control | | | | | | | | | | | | | ■ | Free |
| Capacitor step 3 VAR control | | | | | | | | | | | | | ■ | Free |
| Capacitor step 4 VAR control | | | | | | | | | | | | | ■ | Free |
| External capacitor step control inhibit | | | | | | | | | | | | | ■ | Free |
| Manual capacitor step control | | | | | | | | | | | | | ■ | Free |
| Automatic capacitor step control | | | | | | | | | | | | | ■ | Free |





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# Selection guide and connection

## Selection guide

4 remote modules are proposed as options to enhance the Sepam base unit functions:

- the number and type of remote modules compatible with the base unit depend on the Sepam application
- the DSM303 remote advanced UMI module is only compatible with base units that do not have integrated advanced UMIs.

| | | | Sepam series 20 | | Sepam series 40 | | Sepam series 80 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | S2x, B2x | T2x, M2x | S4x | T4x, M4x, G4x | S8x, B8x | T8x, G8x | M8x C8x |
| **MET148-2** | Temperature sensor module | See page 149 | 0 | 1 | 0 | 2 | 0 | 2 | 2 |
| **MSA141** | Analog output module | See page 150 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **DSM303** | Remote advanced UMI module | See page 151 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **MCS025** | Synchro-check module | See page 152 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| **Number of sets of interlinked modules / maximum number of remote modules** | | | 1 set of 3 interlinked modules | | 1 set of 3 interlinked modules | | 5 modules split between 2 sets of interlinked modules | | |

## Connection

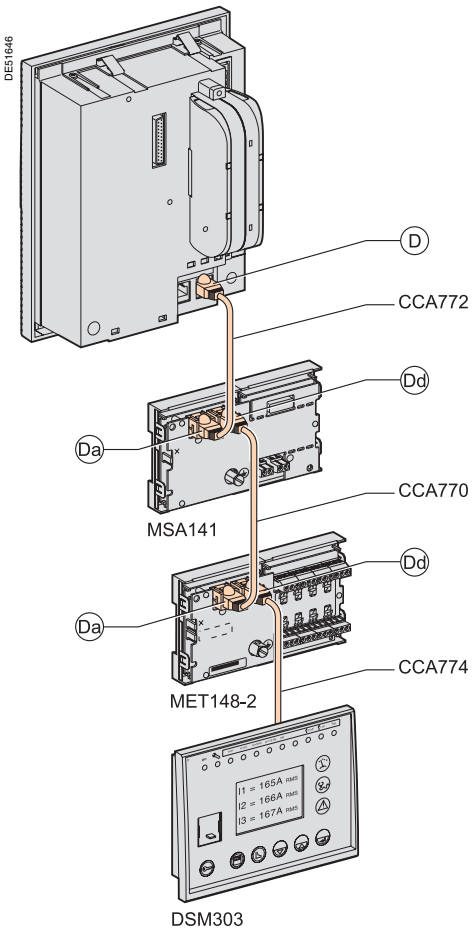
### Connection cords

Different combinations of modules may be connected using cords fitted with 2 black RJ45 connectors, which come in 3 lengths:

- CCA770: length = 0.6 m
- CCA772: length = 2 m
- CCA774: length = 4 m.

The modules are linked by cords which provide the power supply and act as functional links with the Sepam unit (connector (D) to connector (Da), (Dd) to (Da), …).

**Caution**: The MCS025 module must be connected with the special CCA785 prefabricated cord supplied with the module and equipped with one orange and one black RJ45 connector.



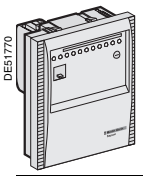
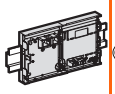
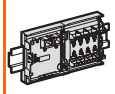

*Example of inter-module linking on Sepam series 20.*

### Rules on inter-module linking

- linking of 3 modules maximum
- DSM303 and MCS025 modules may only be connected at the end of the link.

### Maximum advisable configurations

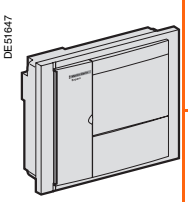
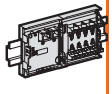
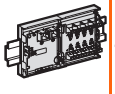
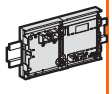
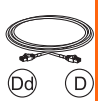
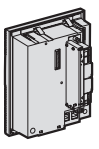
**Sepam series 20 and Sepam series 40: just 1 set of interlinked modules**

| Base | Cord | Module 1 | Cord | Module 2 | Cord | Module 3 |
|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |
| series 20 | CCA772 | MSA141 | CCA770 | MET148-2 | CCA774 | DSM303 |
| series 40 | CCA772 | MSA141 | CCA770 | MET148-2 | CCA774 | DSM303 |
| series 40 | CCA772 | MSA141 | CCA770 | MET148-2 | CCA772 | MET148-2 |
| series 40 | CCA772 | MET148-2 | CCA770 | MET148-2 | CCA774 | DSM303 |



**Sepam series 80: 2 sets of interlinked modules**

Sepam series 80 has 2 connection ports for remote modules, (D1) and (D2). Modules may be connected to either port.

| Base | Cord | Module 1 | Cord | Module 2 | Cord | Module 3 |
|---|---|---|---|---|---|---|
| Set 1 (D1) | CCA772 | MET148-2 | CCA770 | MET148-2 | CCA774 | DSM303 |
|  |  |  |  |  |  |  |
| |  |  |  |  | - | - |
| Set 2 (D2) | CCA772 | MSA141 | CCA785 | MCS025 | - | - |





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# MET148-2
# Temperature sensor module


*MET148-2 temperature sensor module.*

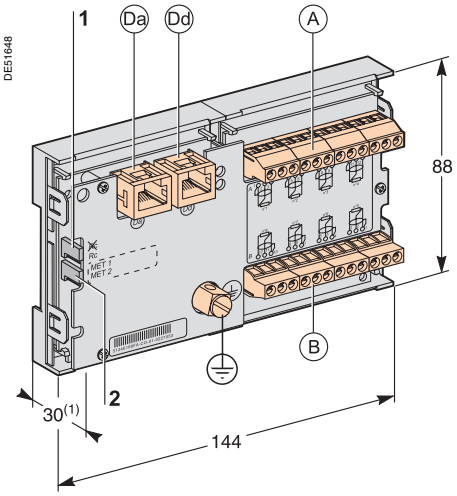
## Function

The MET148-2 module may be used to connect 8 temperature sensors (RTDs) of the same type:
- Pt100, Ni100 or Ni120 type RTDs, according to parameter setting
- 3-wire temperature sensors
- a single module for each Sepam series 20 base unit, to be connected by one of the CCA770, CCA772 or CCA774 cords (0.6, 2 or 4 meters))
- 2 modules for each Sepam series 40 or series 80 base unit, to be connected by CCA770, CCA772 or CCA774 cords (0.6, 2 or 4 meters).

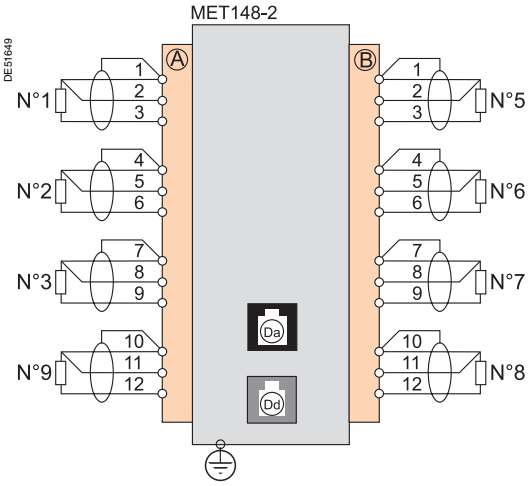
The temperature measurement (e.g. in a transformer or motor winding) is utilized by the following protection functions:
- thermal overload (to take ambient termperature into account)
- temperature monitoring.

## Characteristics

| MET148-2 module | | |
|---|---|---|
| Weight | 0.2 kg | |
| Assembly | On symmetrical DIN rail | |
| Operating temperature | -25°C to +70°C | |
| Environmental characteristics | Same characteristics as Sepam base units | |
| **RTDs** | **Pt100** | **Ni100 / Ni120** |
| Isolation from earth | None | None |
| Current injected in RTD | 4 mA | 4 mA |




***(1)*** *70 mm with CCA77x cord connected.*




## Description and dimensions

- (A) Terminal block for RTDs 1 to 4.
- (B) Terminal block for RTDs 5 to 8.
- (Da) RJ45 connector to connect the module to the base unit with a CCA77x cord.
- (Dd) RJ45 connector to link up the next remote module with a CCA77x cord (according to application).
- (⏚) Grounding/earthing terminal.

**1** Jumper for impedance matching with load resistor (Rc), to be set to:
- ~~Rc~~, if the module is not the last interlinked module (default position)
- Rc, if the module is the last interlinked module.

**2** Jumper used to select module number, to be set to:
- MET1: 1st MET148-2 module, to measure temperatures T1 to T8 (default position)
- MET2: 2nd MET148-2 module, to measure temperatures T9 to T16 (for Sepam series 40 and series 80 only).

## Connection

**Connection of the earthing terminal**
By tinned copper braid or cable fitted with a 4 mm ring lug.
Ensure correct tightening (maximum tightening torque is 2.2 Nm).

**Connection of RTDs to screw-type connectors**
- 1 wire with cross-section 0.2 to 2.5 mm² (≥ AWG 24-12)
- or 2 wires with cross-section 0.2 to 1 mm² (≥ AWG 24-16).

Recommended cross-sections according to distance:
- up to 100 m ≥ 1 mm², AWG 16
- up to 300 m ≥ 1.5 mm², AWG 14
- up to 1 km ≥ 2.5 mm², AWG 12

Maximum distance between sensor and module: 1 km.

**Wiring precautions**
- it is preferable to use shielded cables

The use of unshielded cables may cause measurement errors, which vary in degree on the level of surrounding electromagnetic disturbance
- only connect the shielding at the MET148-2 end, in the shortest manner possible, to the corresponding terminals of connectors (A) and (B)
- do not connect the shielding at the RTD end.

**Accuracy derating according to wiring**
The error Δt is proportional to the length of the cable and inversely proportional to the cable cross-section:

$$\Delta t(°C) = 2 \times \frac{L(km)}{S(mm^2)}$$

- ±2.1°C/km for 0.93 mm² cross-section
- ±1°C/km for 1.92 mm² cross-section.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# MSA141
# Analog output module


*MSA141 analog output module.*

## Function

The MSA141 module converts one of the Sepam measurements into an analog signal:

- selection of the measurement to be converted by parameter setting
- 0-10 mA, 4-20 mA, 0-20 mA analog signal according to parameter setting
- scaling of the analog signal by setting minimum and maximum values of the converted measurement.

Example: the setting used to have phase current 1 as a 0-10 mA analog output with a dynamic range of 0 to 300 A is:

- minimum value = 0
- maximum value = 3000

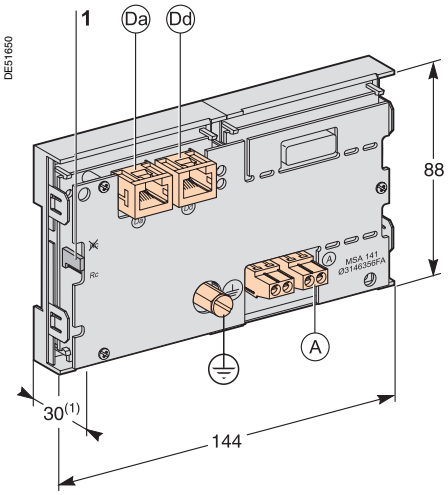
- a single module for each Sepam base unit, to be connected by one of the CCA770, CCA772 or CCA774 cords (0.6, 2 or 4 meters).

The analog output may also be remotely managed via the Modbus communication network.

## Characteristics

| MSA141 module | | | | |
|---|---|---|---|---|
| Weight | 0.2 kg | | | |
| Assembly | On symmetrical DIN rail | | | |
| Operating temperature | -25°C to +70°C | | | |
| Environmental characteristics | Same characteristics as Sepam base units | | | |
| **Analog output** | | | | |
| Current | 4-20 mA, 0-20 mA, 0-10 mA | | | |
| Scaling (no data input checking) | Minimum value | | | |
| | Maximum value | | | |
| Load impedance | < 600 Ω (wiring included) | | | |
| Accuracy | 0.5 % | | | |
| **Measurements available** | **Unit** | **Series 20** | **Series 40** | **Series 80** |
| Phase and residual currents | 0.1 A | ■ | ■ | ■ |
| Phase-to-neutral and phase-to-phase voltages | 1 V | ■ | ■ | ■ |
| Frequency | 0.01 Hz | ■ | ■ | ■ |
| Thermal capacity used | 1% | ■ | ■ | ■ |
| Temperatures | 1°C | ■ | ■ | ■ |
| Active power | 0.1 kW | | ■ | ■ |
| Reactive power | 0.1 kVAR | | ■ | ■ |
| Apparent power | 0.1 kVA | | ■ | ■ |
| Power factor | 0.01 | | | ■ |
| Remote setting via communication link | | ■ | ■ | ■ |

## Description and dimensions




***(1)*** *70 mm with CCA77x cord connected.*

Ⓐ Terminal block for analog output.

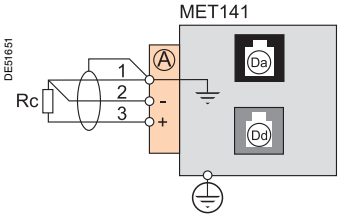
Ⓓa RJ45 connector to connect the module to the base unit with a CCA77x cord.

Ⓓd RJ45 connector to link up the next remote module with a CCA77x cord (according to application).

⏚ Grounding/earthing terminal.

**1** Jumper for impedance matching with load resistor (Rc), to be set to:
- Rc, if the module is not the last interlinked module (default position)
- Rc, if the module is the last interlinked module.

## Connection




**Earthing terminal connection**

By tinned copper braid or cable fitted with a 4 mm ring lug.
Ensure correct tightening (maximum tightening torque is 2.2 Nm).

**Connection of analog output to screw-type connector**

- 1 wire with cross-section 0.2 to 2.5 mm² (≥ AWG 24-12)
- or 2 wires with cross-section 0.2 to 1 mm² (≥ AWG 24-16).

**Wiring precautions**

- it is preferable to use shielded cables
- use tinned copper braid to connect the shielding at least at the MSA141 end.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# DSM303
# Remote advanced UMI module


*DSM303 remote advanced UMI module.*

## Function

When associated with a Sepam that does not have its own advanced user-machine interface, the DSM303 offers all the functions available on a Sepam integrated advanced UMI.
It may be installed on the front panel of the cubicle in the most suitable operating location:
- reduced depth (< 30 mm)
- a single module for each Sepam, to be connected by one of the CCA772 or CCA774 cords (2 or 4 meters).

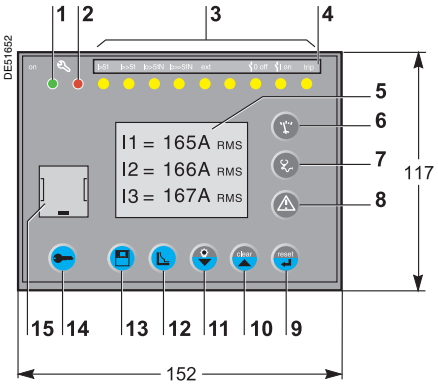
The module may not be connected to Sepam units with integrated advanced UMIs.

## Characteristics

| DSM303 module | |
|---|---|
| Weight | 0.3 kg |
| Assembly | Flush-mounted |
| Operating temperature | -25°C to +70°C |
| Environmental characteristics | Same characteristics as Sepam base units |

## Description and dimensions

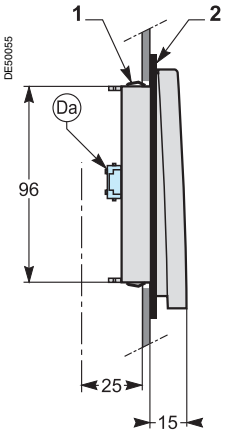
The module is flush-mounted and secured simply by its clips. No screw-type fastener is required.



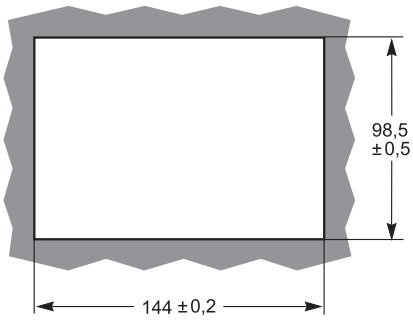

**1** Green LED: Sepam on.
**2** Red LED:
- steadily on: module unavailable
- flashing: Sepam link unavailable.

**3** 9 yellow indicator LEDs.
**4** Graphical LCD screen.
**5** Display of measurements.
**6** Display of switchgear, network and machine diagnosis data.
**7** Display of alarm messages.
**8** Sepam reset (or confirm data entry).
**9** Alarm acknowledgement and clearing (or move cursor up).
**10** LED test (or move cursor down).
**11** Access to protection settings.
**12** Access to Sepam parameters.
**13** Entry of 2 passwords.
**14** PC RS 232 connection port.

**Side view**



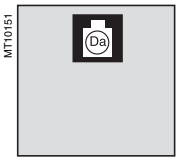

**Cut-out for flush-mounting (mounting plate thickness < 3 mm)**




(Da) RJ45 lateral output connector to connect the module to the base unit with a CCA77x cable.

**1** Mounting clip.
**2** Gasket to ensure NEMA 12 tightness
(gasket delivered with the DSM303 module, to be installed if necessary).

DSM303




## Connection

(Da) RJ45 connector to connect the module to the base unit with a CCA77x cord.
The DSM303 module is always the last interlinked remote module and it systematically ensures impedance matching by load resistor (Rc).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# MCS025
# Synchro-check module


PE50285

*MCS025 synchro-check module.*

## Function

The MCS025 module checks the voltages upstream and downstream of a circuit breaker to ensure safe closing (ANSI 25).
It checks the differences in amplitude, frequency and phase between the two measured voltages, taking into account dead line/busbar conditions.
Three relay outputs may be used to send the close enable to several Sepam series 80 units.
The circuit-breaker control function of each Sepam series 80 unit will take this close enable into account.

The settings for the synchro-check function and the measurements carried out by the module may be accessed by the SFT2841 setting and operating software, similar to the other settings and measurements for the Sepam series 80.

The MCS025 module is supplied ready for operation with:
- the CCA620 connector for connection of the relay outputs and the power supply
- the CCT640 connector for voltage connection
- the CCA785 cord for connection between the module and the Sepam series 80 base unit.

4

## Characteristics

| | | | | | |
|---|---|---|---|---|---|
| **MCS025 module** | | | | | |
| Weight | | 1.35 kg | | | |
| Assembly | | With the AMT840 accessory | | | |
| Operating temperature | | -25 °C to +70 °C | | | |
| Environmental characteristics | | Same characteristics as Sepam base units | | | |
| **Voltage inputs** | | | | | |
| Input impedance | | > 100 kΩ | | | |
| Consumption | | < 0.015 VA (VT 100 V) | | | |
| Continuous thermal withstand | | 240 V | | | |
| 1-second overload | | 480 V | | | |
| **Relay outputs** | | | | | |
| **Relay outputs O1 and O2** | | | | | |
| Voltage | DC | 24/48 V DC | 127 V DC | 220 V DC | |
| | AC (47.5 to 63 Hz) | | | | 100 to 240 V AC |
| Continuous current | | 8 A | 8 A | 8 A | 8 A |
| Breaking capacity | Resistive load | 8 A / 4 A | 0.7 A | 0.3 A | |
| | Load L/R < 20 ms | 6 A / 2 A | 0.5 A | 0.2 A | |
| | Load L/R < 40 ms | 4 A / 1 A | 0.2 A | 0.1 A | |
| | Resistive load | | | | 8 A |
| | Load cos φ > 0.3 | | | | 5 A |
| Making capacity | | < 15 ms for 200 ms | | | |
| **Relay outputs O3 and O4 (O4 not used)** | | | | | |
| Voltage | DC | 24 / 48 V DC | 127 V DC | 220 V DC | |
| | AC (47.5 to 63 Hz) | | | | 100 to 240 V AC |
| Continuous current | | 2 A | 2 A | 2 A | 2 A |
| Breaking capacity | Load L/R < 20 ms | 2 A / 1 A | 0.5 A | 0.15 A | |
| | Load cos φ > 0.3 | | | | 5 A |
| **Power supply** | | | | | |
| Voltage | | 24 to 250 V DC, -20 % / +10 % | | 110 to 240 V AC, -20 % / +10 %<br>47.5 to 63 Hz | |
| Maximum consumption | | 6 W | | 9 VA | |
| Inrush current | | < 10 A for 10 ms | | < 15 A for one half period | |
| Acceptable momentary outages | | 10 ms | | 10 ms | |


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# MCS025
# Synchro-check module

## Description

**1** MCS025 module

(A) CCA620 20-pin connector for:
- ■ auxiliary power supply
- ■ 4 relay outputs:
  - □ O1, O2, O3: close enable.
  - □ O4: not used

(B) CCT640 connector (phase-to-neutral or phase-to-phase) for the two input voltages to be synchronized

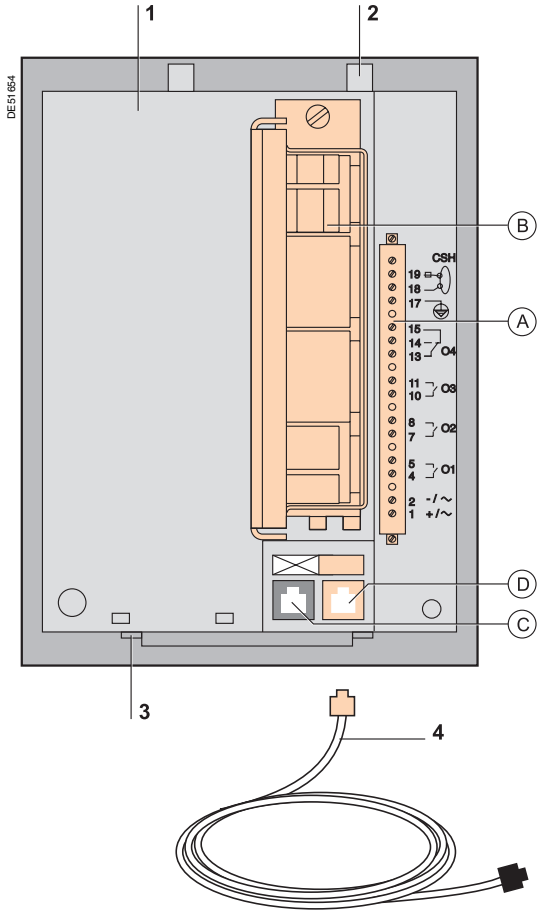
(C) RJ45 connector, not used

(D) RJ45 connector for module connection to the Sepam series 80 base unit, either directly or via another remote module.

**2** Two mounting clips

**3** Two holding pins for the flush-mount position

**4** CCA785 connection cord

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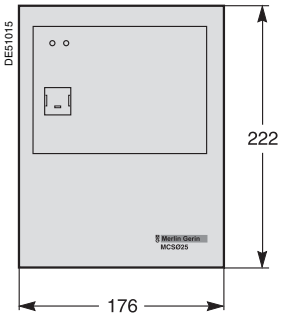
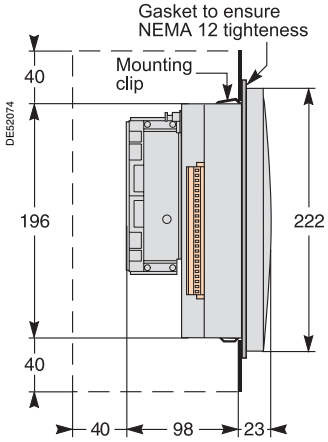
# MCS025
# Synchro-check module

## Dimensions

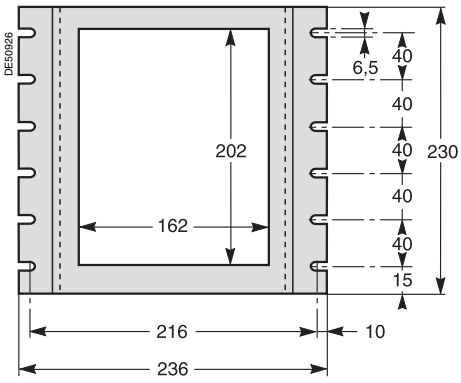



*MCS025.*

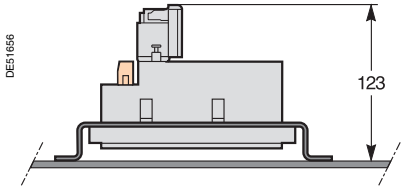



## Assembly with AMT840 mounting plate

The MCS025 module should be mounted at the back of the compartment using the AMT840 mounting plate.




*AMT840 mounting plate*




4



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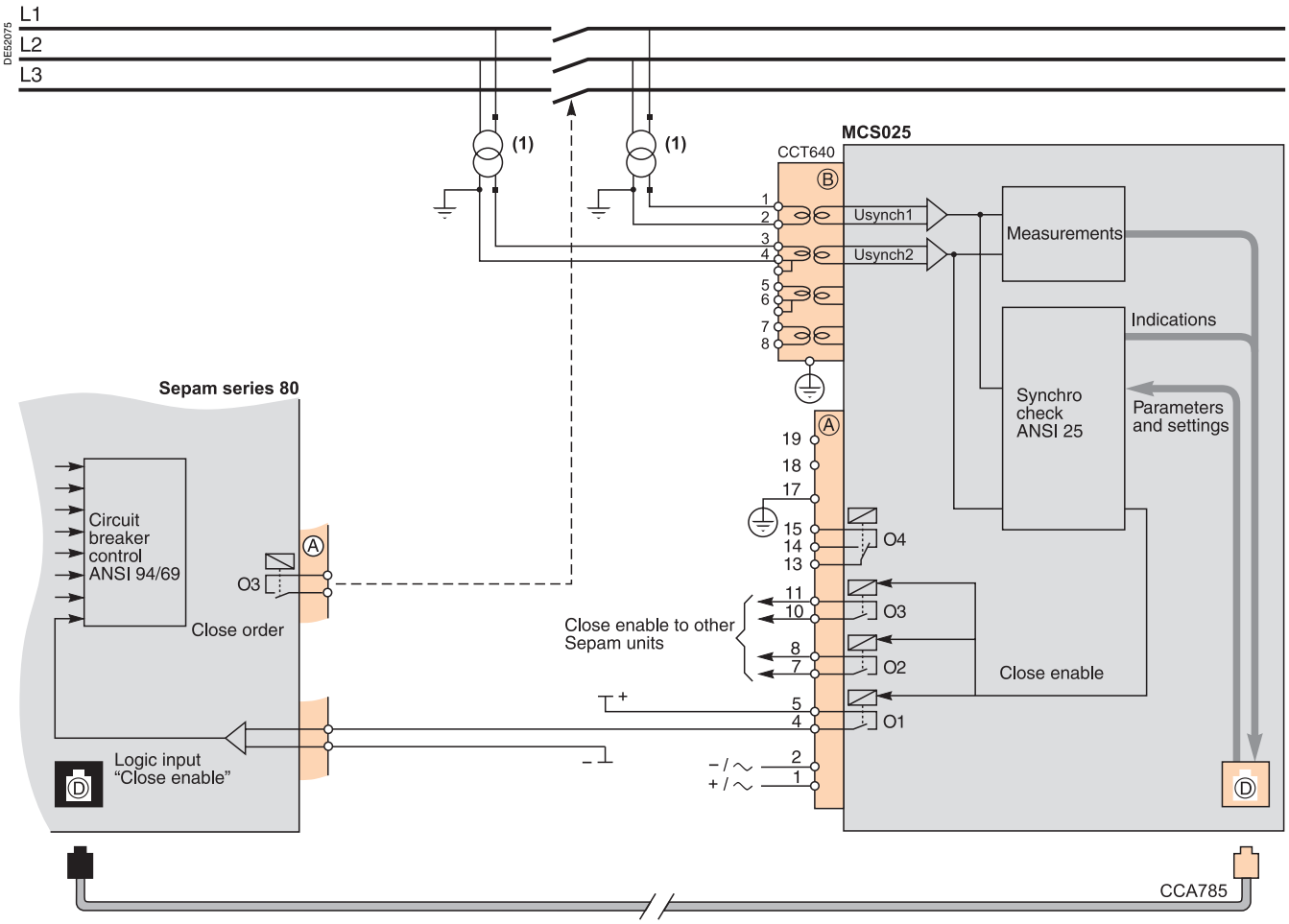
# MCS025
# Synchro-check module




*(1) Phase-to-phase or phase-to-neutral connection.*

## Connection

**■ Terminal 17 (PE) on connector (A) of the MCS025 and the functional earthing terminal of the Sepam series 80 unit must be locally connected to the cubicle grounding circuit. The two connection points must be as close as possible to one another.**

**■ Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.**

| Connector | Type | Reference | Wiring |
|---|---|---|---|
| (A) | Screw-type | CCA620 | ■ Wiring with no fittings:<br>□ 1 wire with maximum cross-section 0.2 to 2.5 mm² (> AWG 24-12)<br>or 2 wires with cross-section 0.2 to 1 mm² (>AWG 24-16)<br>□ stripped length: 8 to 10 mm<br>■ Wiring with fittings:<br>□ recommended wiring with Telemecanique fittings:<br>- DZ5CE015D for 1 wire 1.5 mm2<br>- DZ5CE025D for 1 wire 2.5 mm2<br>- AZ5DE010D for 2 x 1 mm² wires<br>□ tube length: 8.2 mm<br>□ stripped length: 8 mm |
| (B) | Screw-type | CCT640 | VT wiring: same as wiring of the CCA620<br>Earthing connection: by 4 mm ring lug |
| (D) | Orange RJ45 connector | | CCA785, special prefabricated cord supplied with the MCS025 module:<br>■ orange RJ45 connector for connection to port (D) on the MCS025 module<br>■ black RJ45 connector for connection to the Sepam series 80 base unit, either directly or via another remote module. |



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# Selection guide

There are 2 types of Sepam communication accessories:
■ communication interfaces, which are essential for connecting Sepam to the communication network
■ converters and other accessories, as options, which are used for complete implementation of the communication network.

## Communication-interface selection guide

| | | ACE949-2 | ACE959 | ACE937 | ACE969TP | | ACE969FO | |
|---|---|---|---|---|---|---|---|---|
| **Type of network** | | | | | | | | |
| | | S-LAN or E-LAN (1) | S-LAN or E-LAN (1) | S-LAN or E-LAN (1) | S-LAN | E-LAN | S-LAN | E-LAN |
| **Protocol** | | | | | | | | |
| Modbus | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| DNP3 | | | | | ■ | | ■ | |
| CEI 60870-5-103 | | | | | ■ | | ■ | |
| **Physical interface** | | | | | | | | |
| RS 485 | 2-wire | ■ | | | ■ | ■ | | ■ |
| | 4-wire | | ■ | | | | | |
| Fiber optic ST | Star | | | ■ | | | ■ | |
| | Ring | | | | | | ■ (2) | |
| **See details on page** | | **158** | **159** | **160** | **161** | | **161** | |

***(1)*** *Only one connection possible, S-LAN or E-LAN.*
***(2)*** *Except with the Modbus protocol.*

## Converter selection guide

| | ACE909-2 | ACE919CA | ACE919CC | EGX200 | EGX400 |
|---|---|---|---|---|---|
| **Converter** | | | | | |
| Port to supervisor | 1 RS232 port | 1 2-wire RS 485 port | 1 2-wire RS 485 port | 1 Ethernet port 10/100 base Tx | 1 Ethernet port 10/100 base Tx and 1 Ethernet port 100 base Fx |
| Port to Sepam | 1 2-wire RS 485 port | 1 2-wire RS 485 port | 1 2-wire RS 485 port | 2 2-wire or 4-wire RS485 ports | 2 2-wire RS 485 or 4-wire RS485 ports |
| Distributed power supply RS485 | Supplied by ACE | Supplied by ACE | Supplied by ACE | Not supplied by EGX | Not supplied by EGX |
| **Protocol** | | | | | |
| Modbus | ■ | ■ | ■ | ■ | ■ |
| CEI 60870-5-103 | ■ | ■ | ■ | | |
| DNP3 | ■ | ■ | ■ | | |
| **Alimentation** | | | | | |
| DC | | | 24 to 48 V DC | 24 V DC | 24 V DC |
| AC | 110 to 220 V AC | 11to à 220 V AC | | 100 to 240 V AC (with adapter) | 100 to 240 V AC (with adapter) |
| **See details on page** | **165** | **167** | **167** | **169** | **170** |



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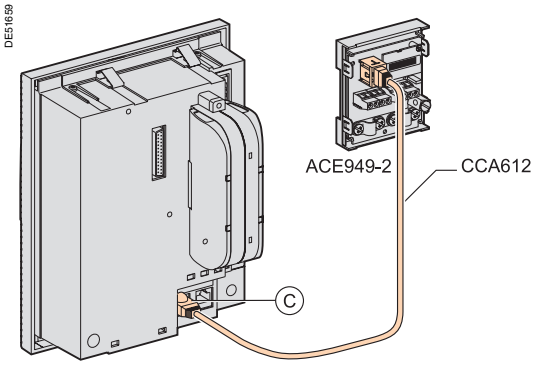
# Communication interface connection

## CCA612 connection cord

Cord used to connect a communication interface to a Sepam base unit:
- length = 3 m
- fitted with 2 green RJ45 plugs.

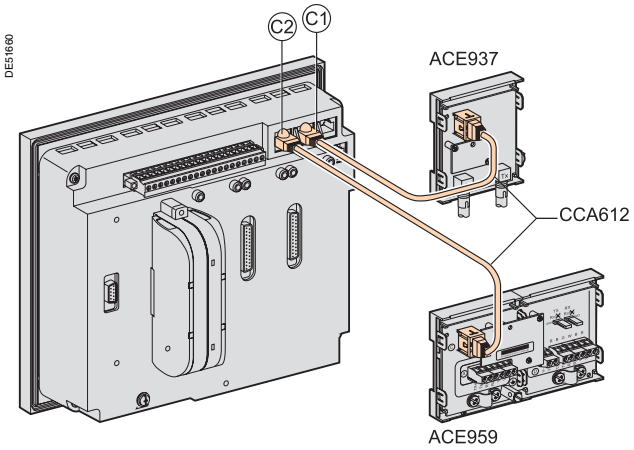
## Sepam / communication interface connection

### Sepam series 20 and Sepam series 40




*Sepam series 20 and Sepam series 40: 1 communication port.*

### Sepam series 80




*Sepam series 80: 2 communication ports.*

## RS 485 network cable

| RS 485 network cable | 2-wire | 4-wire |
|---|---|---|
| RS 485 medium | 1 shielded twisted pair | 2 shielded twisted pairs |
| Distributed power supply | 1 shielded twisted pair | 1 shielded twisted pair |
| Shielding | Tinned copper braid, coverage > 65 % | |
| Characteristic impedance | 120 Ω | |
| Gauge | AWG 24 | |
| Resistance per unit length | < 100 Ω/km | |
| Capacitance between conductors | < 60 pF/m | |
| Capacitance between conductor and shielding | < 100 pF/m | |
| Maximum length | 1300 m | |

| Fiber optic | | | | |
|---|---|---|---|---|
| Fiber type | Multimode glass | | | |
| Wavelength | 820 nm (infra-red) | | | |
| Type of connector | ST (BFOC bayonet fiber optic connector) | | | |
| **Fiber optic diameter (µm)** | **Numerical aperture (NA)** | **Maximum attenuation (dBm/km)** | **Minimum optical power available (dBm)** | **Maximum length of fiber (m)** |
| 50/125 | 0.2 | 2.7 | 5.6 | 700 |
| 62.5/125 | 0.275 | 3.2 | 9.4 | 1800 |
| 100/140 | 0.3 | 4 | 14.9 | 2800 |
| 200 (HCS) | 0.37 | 6 | 19.2 | 2600 |





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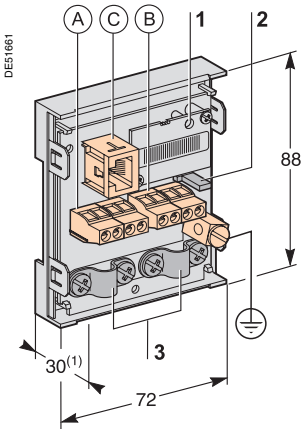
# ACE949-2
# 2-wire RS 485 network interface


*ACE949-2 2-wire RS 485 network connection interface.*




***(1)** 70 mm with CCA612 cord connected.*

## Function

The ACE949-2 interface performs 2 functions:
- electrical interface between Sepam and a 2-wire RS 485 communication network
- main network cable branching box for the connection of a Sepam with a CCA612 cord.

## Characteristics

| ACE949-2 module | |
|---|---|
| Weight | 0.1 kg |
| Assembly | On symmetrical DIN rail |
| Operating temperature | -25 °C to +70 °C |
| Environmental characteristics | Same characteristics as Sepam base units |

| 2-wire RS 485 electrical interface | |
|---|---|
| Standard | EIA 2-wire RS 485 differential |
| Distributed power supply | External, 12 V DC or 24 V DC ±10 % |
| Consumption | 16 mA in receiving mode |
| | 40 mA maximum in sending mode |

**Maximum length of 2-wire RS 485 network with standard cable**

| Number of Sepam units | Maximum length with 12 V DC power supply | Maximum length with 24 V DC power supply |
|---|---|---|
| 5 | 320 m | 1000 m |
| 10 | 180 m | 750 m |
| 20 | 160 m | 450 m |
| 25 | 125 m | 375 m |

## Description and dimensions

(A) and (B) Terminal blocks for network cable.

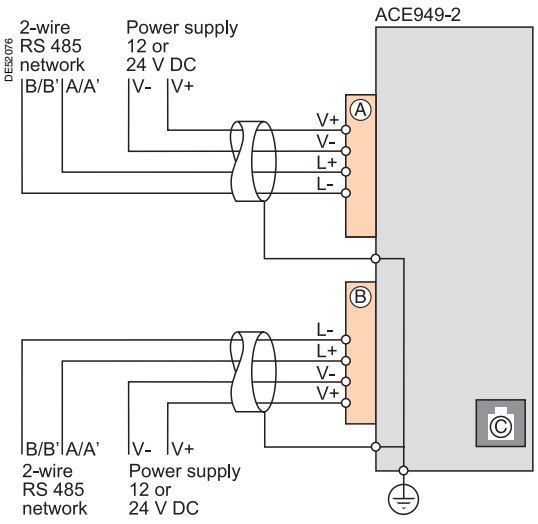
(C) RJ45 plug to connect the interface to the base unit with a CCA612 cord.

⏚ Grounding/earthing terminal.

**1** Activity LED, flashes when communication is active (sending or receiving in progress).

**2** Jumper for RS 485 network line-end impedance matching with load resistor (Rc = 150 Ω), to be set to:
- ~~Rc~~, if the module is not at one end of the RS 485 network (default position)
- Rc, if the module is at one end of the RS 485 network.

**3** Network cable clamps (inner diameter of clamp = 6 mm).




## Connection

- connection of network cable to screw-type terminal blocks (A) and (B)
- connection of earthing terminal by tinned copper braid or cable fitted with 4 mm ring lug. Ensure correct tightening (maximum tightening torque is 2.2 Nm).
- the interfaces are fitted with clamps to hold the network cable and recover shielding at the incoming and outgoing points of the network cable:
  - ☐ the network cable must be stripped
  - ☐ the cable shielding braid must be around and in contact with the clamp
- the interface is to be connected to connector (C) on the base unit using a CCA612 cord (length = 3 m, green fittings)
- the interfaces are to be supplied with 12 V DC or 24 V DC.



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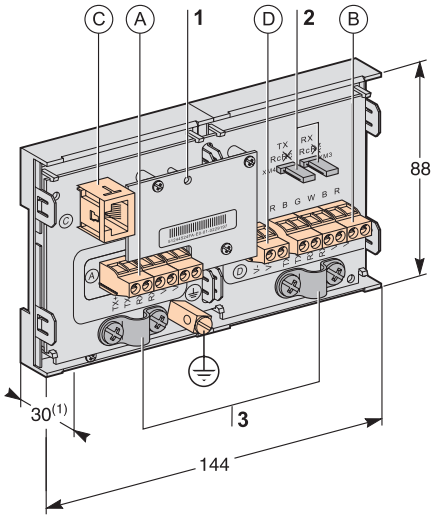
# ACE959
# 4-wire RS 485 network interface

PE50023

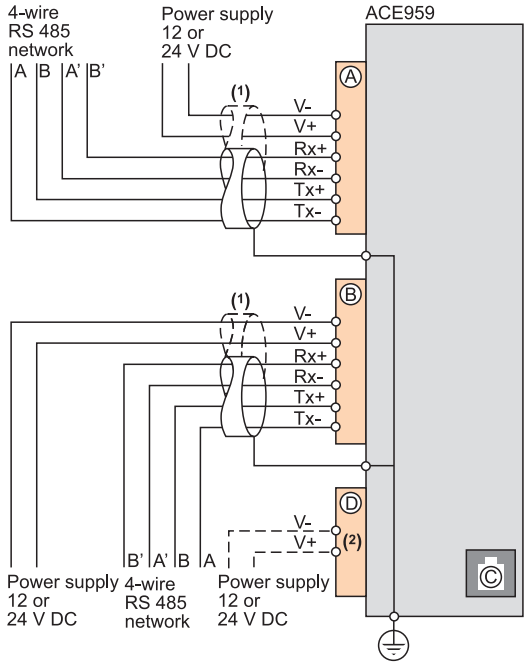
*ACE959 4-wire RS 485 network connection interface.*

DE51663




***(1)** 70 mm with CCA612 cord connected.*

DE52077




## Function

The ACE959 interface performs 2 functions:
- electrical interface between Sepam and a 4-wire RS 485 communication network
- main network cable branching box for the connection of a Sepam with a CCA612 cord.

## Characteristics

| ACE959 module | |
|---|---|
| Weight | 0.2 kg |
| Assembly | On symmetrical DIN rail |
| Operating temperature | -25 °C to +70 °C |
| Environmental characteristics | Same characteristics as Sepam base units |

| 4-wire RS 485 electrical interface | |
|---|---|
| Standard | EIA 4-wire RS 485 differential |
| Distributed power supply | External, 12 V DC or 24 V DC ±10 % |
| Consumption | 16 mA in receiving mode |
| | 40 mA maximum in sending mode |

**Maximum length of 4-wire RS 485 network with standard cable**

| Number of Sepam units | Maximum length with 12 V DC power supply | Maximum length with 24 V DC power supply |
|---|---|---|
| 5 | 320 m | 1000 m |
| 10 | 180 m | 750 m |
| 20 | 160 m | 450 m |
| 25 | 125 m | 375 m |

## Description and dimensions

(A) and (B) Terminal blocks for network cable.

(C) RJ45 plug to connect the interface to the base unit with a CCA612 cord.

(D) Terminal block for a separate auxiliary power supply (12 V DC or 24 V DC).

(⏚) Grounding/earthing terminal.

**1** Activity LED, flashes when communication is active (sending or receiving in progress).

**2** Jumper for RS 485 network line-end impedance matching with load resistor (Rc = 150 Ω), to be set to:
- ~~Rc~~, if the module is not at one end of the RS 485 network (default position)
- Rc, if the module is at one end of the RS 485 network.

**3** Network cable clamps (inner diameter of clamp = 6 mm).

## Connection

- connection of network cable to screw-type terminal blocks (A) and (B)
- connection of earthing terminal by tinned copper braid or cable fitted with 4 mm ring lug. Ensure correct tightening (maximum tightening torque is 2.2 Nm).
- the interfaces are fitted with clamps to hold the network cable and recover shielding at the incoming and outgoing points of the network cable:
  - ☐ the network cable must be stripped
  - ☐ the cable shielding braid must be around and in contact with the clamp
- the interface is to be connected to connector (C) on the base unit using a CCA612 cord (length = 3 m, green fittings)
- the interfaces are to be supplied with 12 V DC or 24 V DC
- the ACE959 can be connected to a separate distributed power supply (not included in shielded cable). Terminal block (D) is used to connect the distributed power supply module.



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# ACE937
# Fiber optic interface


*ACE937 fiber optic connection interface.*

## Function

The ACE937 interface is used to connect Sepam to a fiber optic communication star system.
This remote module is connected to the Sepam base unit by a CCA612 cord.

## Characteristics

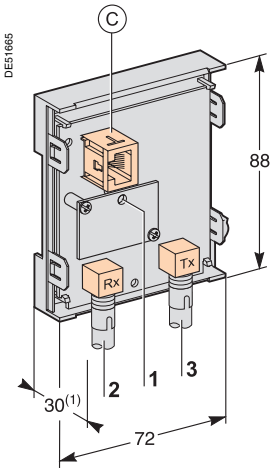
| ACE937 module | |
|---|---|
| Weight | 0.1 kg |
| Assembly | On symmetrical DIN rail |
| Power supply | Supplied by Sepam |
| Operating temperature | -25 °C to +70 °C |
| Environmental characteristics | Same characteristics as Sepam base units |

| Fiber optic interface | |
|---|---|
| Fiber type | Multimode glass |
| Wavelength | 820 nm (infra-red) |
| Type of connector | ST (BFOC bayonet fiber optic connector) |

| Fiber optic diameter (µm) | Numerical aperture (NA) | Maximum attenuation (dBm/km) | Minimum optical power available (dBm) | Maximum length of fiber (m) |
|---|---|---|---|---|
| 50/125 | 0.2 | 2.7 | 5.6 | 700 |
| 62.5/125 | 0.275 | 3.2 | 9.4 | 1800 |
| 100/140 | 0.3 | 4 | 14.9 | 2800 |
| 200 (HCS) | 0.37 | 6 | 19.2 | 2600 |

Maximum length calculated with:
- minimum optical power available
- maximum fiber attenuation
- losses in 2 ST connectors: 0.6 dBm
- optical power margin: 3 dBm (according to IEC 60870 standard).

**Example for a 62.5/125 µm fiber**
Lmax = (9.4 - 3 -0.6) / 3.2 = 1.8 km.

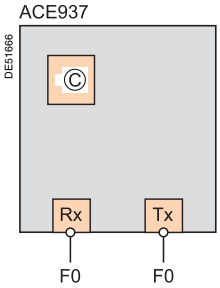



***(1)** 70 mm with CCA612 cord connected.*

## Description and dimensions

(C) RJ45 plug to connect the interface to the base unit with a CCA612 cord.

**1** Activity LED, flashes when communication is active (sending or receiving in progress).
**2** Rx, female ST type connector (Sepam receiving).
**3** Tx, female ST type connector (Sepam sending).




## Connection

- the sending and receiving fiber optics fibers must be equipped with male ST type connectors
- fiber optics screw-locked to Rx and Tx connectors
- the interface is to be connected to connector (C) on the base unit using a CCA612 cord (length = 3 m, green fittings)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# ACE969TP and ACE969FO Interfaces network

PE50470

*ACE969TP communication interface.*

PE50471

*ACE969FO communication interface.*

## Function

The ACE969 multi-protocol communication interfaces are for Sepam series 20, 40 and 80.
They have two communication ports to connect a Sepam to two independent communication networks:
■ the S-LAN (supervisory local area network) port to connect Sepam to a supervision network using one of the three following protocols:
□ IEC 60870-5-103
□ DNP3
□ RTU Modbus.
The communication protocol is selected at the time of Sepam parameter setting.
■ the E-LAN (engineering local area network) port, reserved for Sepam remote parameter setting and operation using the SFT2841 software.

There are two versions of the ACE969 interfaces that have different S-LAN ports:
■ ACE969TP (Twisted Pair), for connection to an S-LAN network using a two-wire RS485 connection
■ ACE969FO (Fiber Optic), for connection to an S-LAN network using a fiber-optic connection (star or ring).
The E-LAN port is always a two-wire RS485 connection.





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# ACE969TP et ACE969FO
# Interfaces network



## Characteristics

### ACE969 module

**Technical characteristics**

| | |
|---|---|
| Weight | 0.285 kg |
| Assembly | On symmetrical DIN rail |
| Power supply | -25 °C to +70 °C |
| Operating temperature | Same characteristics as Sepam base units |

**Power supply**

| | | |
|---|---|---|
| Voltage | 24 to 250 V DC | 110 to 240 V AC |
| Range | -20 % / +10 % | -20 % / +10 % |
| Maximum consumption | 2 W | 3 VA |
| Inrush current | < 10 A 100 µs | |
| Acceptable ripple content | 12 % | |
| Acceptable momentary outages | 20 ms | |

### 2-wire RS485 communication ports

**Electrical interface**

| | |
|---|---|
| Standard | EIA 4-wire RS 485 differential |
| Distributed power supply | External, 12 V DC or 24 V DC ±10 % |
| Consumptionn | 16 mA in receiving mode |
| | 40 mA in sending mode |
| Max. number of Sepam units | 25 |

**Maximum length of 2-wire RS 485 network**

| Number of Sepam units | With distributed power supply | |
|---|---|---|
| | 12 V DC | 24 V DC |
| 5 | 320 m | 1000 m |
| 10 | 180 m | 750 m |
| 20 | 130 m | 450 m |
| 25 | 125 m | 375 m |

### Fiber-optic communication port

**Fiber optic interface**

| | |
|---|---|
| Fiber type | Multimode glass |
| Wavelength | 820 nm (infra-red) |
| Type of connector | ST (BFOC bayonet fiber optic connector) |

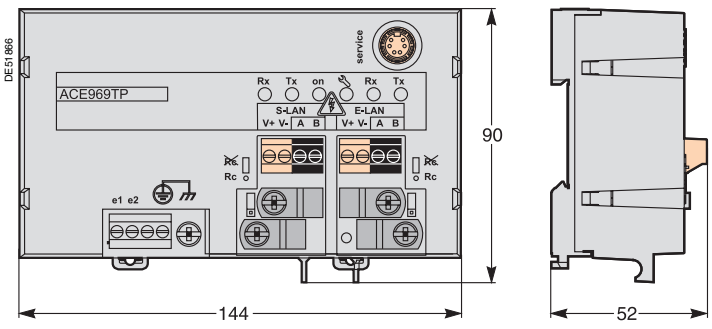
**Maximum length of fiber-optic network**

| Fiber diameter (µm) | Numerical aperture (NA) | Attenuation (dBm/km) | Minimum optical power available (dBm) | Maximum fiber length (m) |
|---|---|---|---|---|
| 50/125 | 0.2 | 2.7 | 5.6 | 700 |
| 62.5/125 | 0.275 | 3.2 | 9.4 | 1800 |
| 100/140 | 0.3 | 4 | 14.9 | 2800 |
| 200 (HCS) | 0.37 | 6 | 19.2 | 2600 |

Maximum length calculated with:
- minimum optical power available
- maximum fiber attenuation
- losses in 2 ST connectors: 0.6 dBm
- optical power margin: 3 dBm (according to IEC60870 standard).

**Example for a 62.5/125 µm fiber**
Lmax = (9.4 - 3 -0.6) / 3.2 = 1.8 km.

## Dimensions






Merlin Gerin
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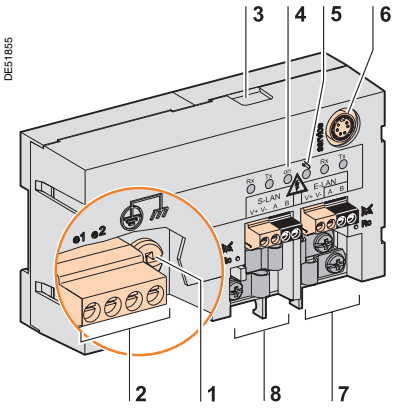
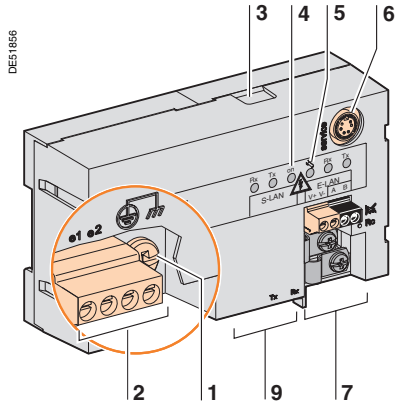
# ACE969TP et ACE969FO Interfaces network
Description

## ACE969 communication interfaces

**ACE969TP**




**ACE969FO**

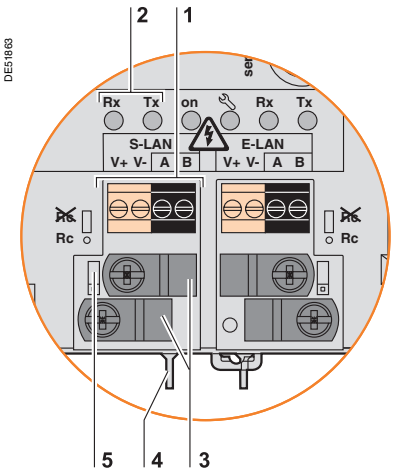



**1** Grounding/earthing terminal using supplied braid
**2** Power-supply terminal block
**3** RJ45 connector to connect the interface to the base unit with a CCA612 cord
**4** Green LED: ACE969 energized
**5** Red LED: ACE969 interface status
- LED off = ACE969 set up and communication operational
- LED flashing = ACE969 not set up or setup incorrect
- LED remains on = ACE969 has faulted

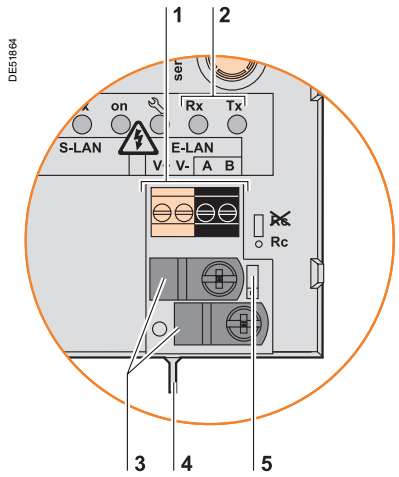
**6** Service connector: reserved for software upgrades
**7** E-LAN 2-wire RS485 communication port (ACE969TP and ACE969FO)
**8** S-LAN 2-wire RS485 communication port (ACE969TP)
**9** S-LAN fiber-optic communication port (ACE969FO).
**10**

## 2-wire RS485 communication ports

**Port S-LAN (ACE969TP)**




**Port E-LAN (ACE969TP or ACE969FO)**



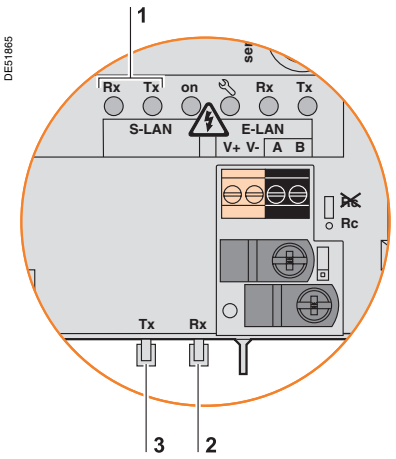

**1** 2-wire RS485 network terminal block:
- 2 black terminals: connection of RS485 twisted-pair (2 wires)
- 2 green terminals: connection of twisted-pair for distributed power supply

**2** Indication LEDs:
- flashing Tx LED: Sepam sending
- flashing Rx LED: Sepam receiving.

**3** Clamps and recovery of shielding for two network cables, incoming and outgoing (inner diameter of clamp = 6 mm)
**4** Fixing stud for network cable ties
**5** Jumper for RS485 network line-end impedance matching with load resistor (Rc = 150 Ω), to be set to:
- Rc, if the interface is not at the line end (default position)
- Rc, if the interface is at the line end.

## Fiber-optic communication port

**Port S-LAN (ACE969FO)**




**1** Indication LEDs:
- flashing Tx LED: Sepam sending
- flashing Rx LED: Sepam receiving.

**2** Rx, female ST-type connector (Sepam receiving)
**3** Tx, female ST-type connector (Sepam sending).





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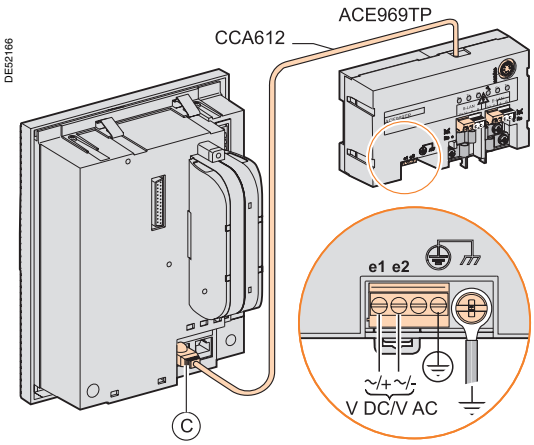
# ACE969TP et ACE969FO Interfaces network
Connection

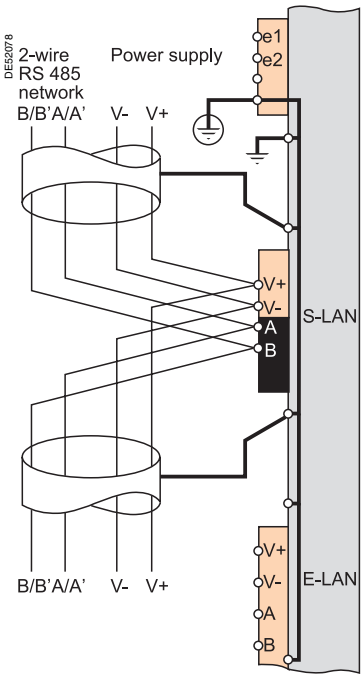



## Power supply and Sepam

■ the ACE969 interface connects to connector C on the Sepam base unit using a CCA612 cord (length = 3 m, green RJ45 fittings)
■ the ACE969 interface must be supplied with 24 to 250 V DC or 110 to 230 V AC.

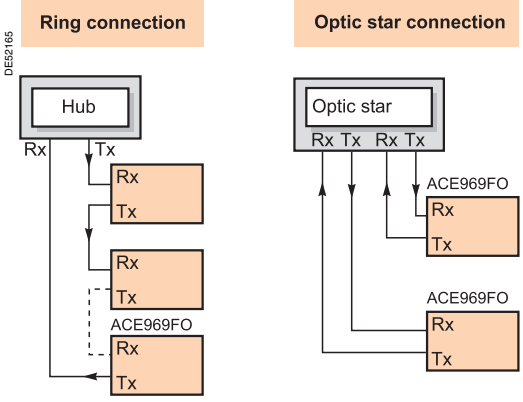
| Terminals | Type | Wiring |
|---|---|---|
| e1-e2 - supply | Screw terminals | ■ wiring without fittings:<br>□ 1 wire with max. cross-section 0.2 to 2.5 mm² (⩾ AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (⩾ AWG 24-16)<br>□ stripped length: 8 to 10 mm<br>■ wiring with fittings:<br>□ recommended wiring with Telemecanique fittings:<br>- DZ5CE015D for 1 wire 1.5 mm2<br>- DZ5CE025D for 1 wire 2.5 mm2<br>- AZ5DE010D for 2 x 1 mm² wires<br>□ tube length: 8.2 mm<br>□ stripped length: 8 mm |
| DE51962 Protective earth | Screw terminal | 1 green/yellow wire, max. length 3 m and max. cross-section 2.5 mm² |
| DE51845 Functional earth | 4 mm ring lugs | Earthing braid, supplied for connection to cubicle grounding |






## 2-wire RS485 communication ports (S-LAN or E-LAN)

■ connection of RS485 twisted-pair (S-LAN or E-LAN) to black terminals A and B
■ connection of twisted-pair for distributed power supply to green terminals V+ and V-
■ the interfaces are fitted with clamps to hold the network cable and recover shielding at the incoming and outgoing points of the network cable:
□ the network cable must be stripped
□ the cable shielding must be rolled back and in contact with the clamp
□ shielding continuity of incoming and outgoing cables is ensured by the electrical continuity of the clamps
■ all cable clamps are linked by an internal connection to the earthing terminals of the ACE969 interface (protective and functional earthing), i.e. the shielding of the RS485 cables is earthed as well
■ on the ACE969TP interface, the cable clamps for the S-LAN and E-LAN RS485 networks are earthed.




## Fiber-optic communication port (S-LAN)

The fiber-optic connection can be made:
■ point-to-point to an optic star system
■ in a ring system (active echo).
The sending and receiving fiber optics fibers must be equipped with male ST type connectors.
The fiber optics are screw-locked to Rx and Tx connectors.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# ACE909-2
# RS 232 / RS 485 converter

PE50035

*ACE909-2 RS 232 / RS 485 converter.*

## Function

The ACE909-2 converter is used to connect a master/central computer equipped with a V24/RS 232 type serial port as a standard feature to stations connected to a 2-wire RS 485 network.
Without requiring any flow control signals, after the parameters are set, the ACE909-2 converter performs conversion, network polarization and automatic dispatching of Modbus frames between the master and the stations by two-way simplex (half-duplex, single-pair) transmission.
The ACE909-2 converter also provides a 12 V DC or 24 V DC supply for the distributed power supply of the Sepam ACE949-2, ACE959 or ACE969 interfaces.
The communication settings should be the same as the Sepam and master communication settings.

## Characteristics

| **Mechanical characteristics** | | |
|---|---|---|
| Weight | 0.280 kg | |
| Assembly | On symmetrical or asymmetrical DIN rail | |
| **Electrical characteristics** | | |
| Power supply | 110 to 220 V AC ±10%, 47 to 63 Hz | |
| Galvanic isolation<br>between power supply and frame, and<br>between power supply and interface supply | 2000 Vrms, 50 Hz, 1 min | |
| Galvanic isolation<br>between RS 232 and RS 485 interfaces | 1000 Vms, 50 Hz, 1 min | |
| Protection by time-delayed fuse 5 mm x 20 mm | 1 A rating | |
| **Communication and Sepam interface distributed supply** | | |
| Data format | 11 bits: 1 start, 8 bits, 1 parity, 1 stop | |
| Transmission delay | < 100 ns | |
| distributed power supply for Sepam interfaces | 12 V DC or 24 V DC | |
| Maximum number of Sepam interfaces with distributed supply | 12 | |
| **Environmental characteristics** | | |
| Operating temperature | -5 °C to +55 °C | |
| **Electromagnetic compatibility** | **IEC standard** | **Value** |
| 5 ns fast transient bursts | 60255-22-4 | 4 kV with capacitive coupling in common mode<br>2 kV with direct coupling in common mode<br>1 kV with direct coupling in differential mode |
| 1 MHz damped oscillating wave | 60255-22-1 | 1 kV common mode<br>0.5 kV differential mode |
| 1.2 / 50 µs impulse wave | 60255-5 | 3 kV common mode<br>1 kV differential mode |





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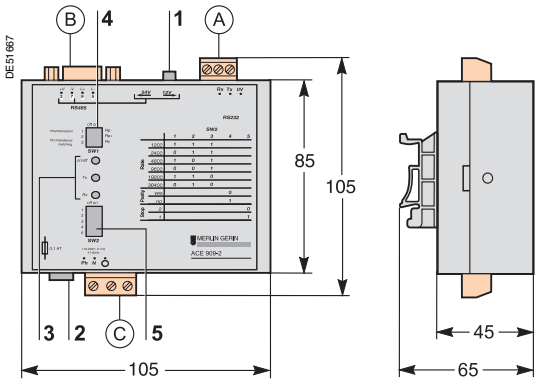
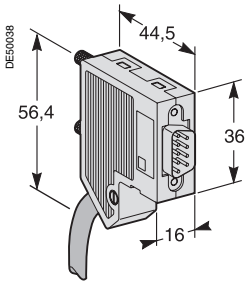
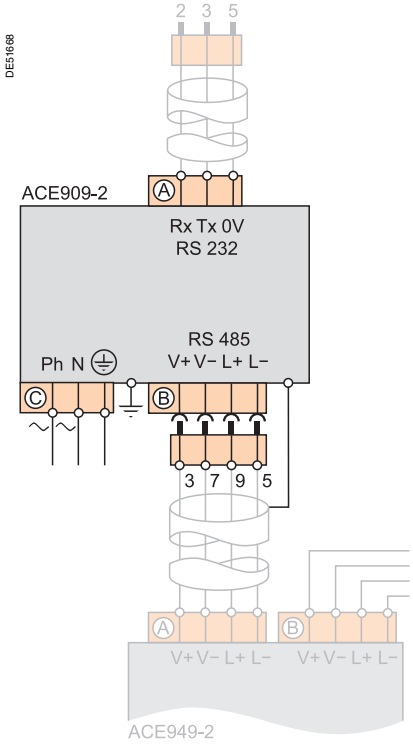
# ACE909-2
# RS 232 / RS 485 converter




*Male 9-pin sub-D connector supplied with the ACE909-2.*




## Description and dimensions

(A) Terminal block for RS 232 link limited to 10 m.

(B) Female 9-pin sub-D connector to connect to the 2-wire RS 485 network, with distributed power supply.

1 screw-type male 9-pin sub-D connector is supplied with the converter.

(C) Power supply terminal block.

**1** Distributed power supply voltage selector switch, 12 V DC or 24 V DC.
**2** Protection fuse, unlocked by a 1/4 turn.
**3** Indication LEDs:
- ON/OFF: on if ACE909-2 is energized
- Tx: on if RS 232 sending by ACE909-2 is active
- Rx on: if RS 232 receiving by ACE909-2 is active

**4** SW1, parameter setting of 2-wire RS 485 network polarization and line impedance matching resistors

| Function | SW1/1 | SW1/2 | SW1/3 |
|---|---|---|---|
| Polarization at 0 V via Rp -470 Ω | ON | | |
| Polarization at 5 V via Rp +470 Ω | | ON | |
| 2-wire RS 485 network impedance matching by 150 Ω resistor | | | ON |

**5** SW2, parameter setting of asynchronous data transmission rate and format (same parameters as for RS 232 link and 2-wire RS 485 network).

| Rate (bauds) | SW2/1 | SW2/2 | SW2/3 | | |
|---|---|---|---|---|---|
| 1200 | 1 | 1 | 1 | | |
| 2400 | 0 | 1 | 1 | | |
| 4800 | 1 | 0 | 1 | | |
| 9600 | 0 | 0 | 1 | | |
| 19200 | 1 | 1 | 0 | | |
| 38400 | 0 | 1 | 0 | | |
| **Format** | | | | **SW2/4** | **SW2/5** |
| With parity check | | | | 0 | |
| Without parity check | | | | 1 | |
| 1 stop bit (compulsory for Sepam) | | | | | 0 |
| 2 stop bits | | | | | 1 |

**Converter configuration when delivered**
- 12 V DC distributed power supply
- 11 bit format, with parity check
- 2-wire RS 485 network polarization and impedance matching resistors activated.

## Connection

**RS 232 link**
- to 2.5 mm² screw-type terminal block (A)
- maximum length 10 m
- Rx/Tx: RS 232 receiving/sending by ACE909-2
- 0V: Rx/Tx common, do not earth.

**2-wire RS 485 link with distributed power supply**
- to female 9-pin sub-D connector (B)
- 2-wire RS 485 signals: L+, L-
- distributed power supply: V+ = 12 V DC or 24 V DC, V- = 0 V.

**Power supply**
- to 2.5 mm² screw-type terminal block (C)
- reversible phase and neutral
- earthed via terminal block and metal case (ring lug on back of case).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# ACE919CA and ACE919CC RS 485 / RS 485 converters

PE50036

*ACE919CC RS 485 / RS 485 converter.*

## Function

The ACE919 converters are used to connect a master/central computer equipped with an RS 485 type serial port as a standard feature to stations connected to a 2-wire RS 485 network.
Without requiring any flow control signals, the ACE919 converters perform network polarization and impedance matching.
The ACE919 converters also provide a 12 V DC or 24 V DC supply for the distributed power supply of the Sepam ACE949-, ACE959 or ACE969 interfaces.
There are 2 types of ACE919 converters:

- ACE919CC, DC-powered
- ACE919CA, AC-powered.

## Characteristics

| **Mechanical characteristics** | | |
|---|---|---|
| Weight | 0.280 kg | |
| Assembly | On symmetrical or asymmetrical DIN rail | |
| **Electrical characteristics** | **ACE919CA** | **ACE919CC** |
| Power supply | 110 to 220 V AC ±10%, 47 to 63 Hz | 24 to 48 V DC ±20% |
| Protection by time-delayed fuse 5 mm x 20 mm | 1 A rating | 1 A rating |
| Galvanic isolation between power supply and frame, and between power supply and interface supply | | 2000 Vrms, 50 Hz, 1 min |
| **Communication and Sepam interface distributed supply** | | |
| Data format | 11 bits: 1 start, 8 bits, 1 parity, 1 stop | |
| Transmission delay | < 100 ns | |
| Distributed power supply for Sepam interfaces | 12 V DC or 24 V DC | |
| Maximum number of Sepam interfaces with distributed supply | 12 | |
| **Environmental characteristics** | | |
| Operating temperature | -5 °C to +55 °C | |

| **Electromagnetic compatibility** | **IEC standard** | **Value** |
|---|---|---|
| 5 ns fast transient bursts | 60255-22-4 | 4 kV with capacitive coupling in common mode<br>2 kV with direct coupling in common mode<br>1 kV with direct coupling in differential mode |
| 1 MHz damped oscillating wave | 60255-22-1 | 1 kV common mode<br>0.5 kV differential mode |
| 1.2 / 50 µs impulse wave | 60255-5 | 3 kV common mode<br>1 kV differential mode |





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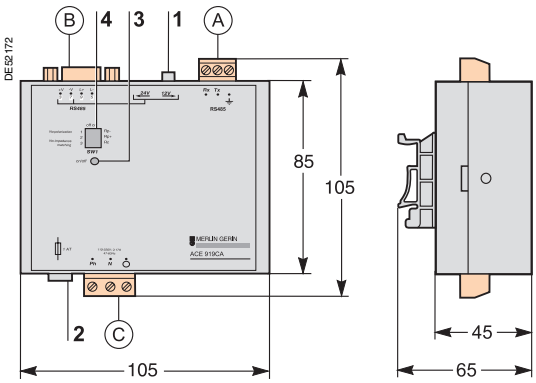
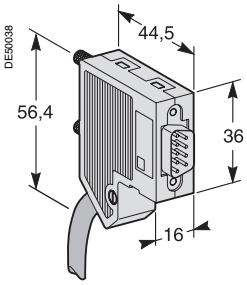
# ACE919CA and ACE919CC
# RS 485 / RS 485 converters




*Male 9-pin sub-D connector supplied with the ACE919.*

## Description and dimensions

(A) Terminal block for 2-wire RS 485 link without distributed power supply.

(B) Female 9-pin sub-D connector to connect to the 2-wire RS 485 network, with distributed power supply.

1 screw-type male 9-pin sub-D connector is supplied with the converter.

(C) Power supply terminal block.

**1** Distributed power supply voltage selector switch, 12 V DC or 24 V DC.
**2** Protection fuse, unlocked by a 1/4 turn.
**3** ON/OFF LED: on if ACE919 is energized.
**4** SW1, parameter setting of 2-wire RS 485 network polarization and impedance matching resistors.

| Function | SW1/1 | SW1/2 | SW1/3 |
|---|---|---|---|
| Polarization at 0 V via Rp -470 Ω | ON | | |
| Polarization at 5 V via Rp +470 Ω | | ON | |
| 2-wire RS 485 network impedance matching by 150 Ω resistor | | | ON |

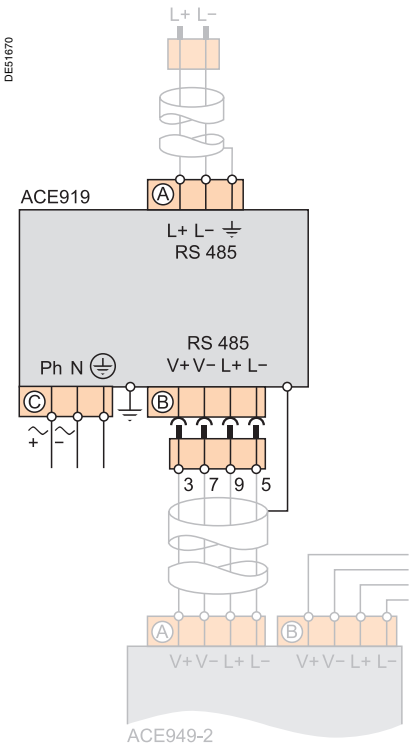
**Converter configuration when delivered**
- 12 V DC distributed power supply
- 2-wire RS 485 network polarization and impedance matching resistors activated.

## Connection

**2-wire RS 485 link without distributed power supply**
- to 2.5 mm² screw-type terminal block (A)
- L+, L-: 2-wire RS 485 signals
- ⏚ Shielding.

**2-wire RS 485 link with distributed power supply**
- to female 9-pin sub-D connector (B)
- 2-wire RS 485 signals: L+, L-
- distributed power supply: V+ = 12 V DC or 24 V DC, V- = 0 V.

**Power supply**
- to 2.5 mm² screw-type terminal block (C)
- reversible phase and neutral (ACE919CA)
- earthed via terminal block and metal case (ring lug on back of case).





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# Ethernet EGX200 gateway

PE50538


PE50269

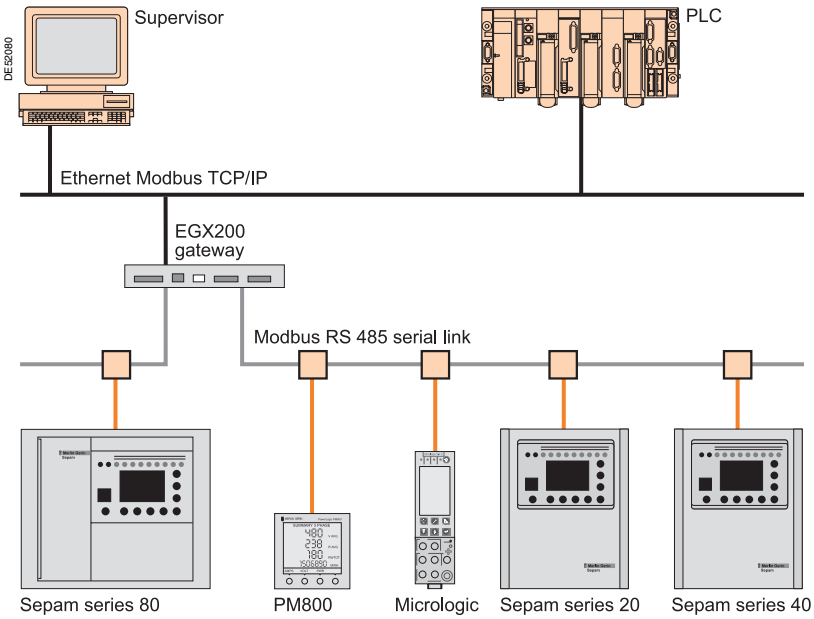
*Ethernet EGX200 gateway.*

## Function

The EGX200 gateway serves as an Ethernet coupler for Sepam, the PowerLogic devices and for any other communicating devices operating under the Modbus RS 485 protocol.
The EGX200 gateway offers complete access to all status and measurement information provided by the connected devices.

## Architecture

DE52080




## Setup

**Initial setup**
The initial setup is carried out using a PC connected to the EGX200 via an RS 232 link. This setup:
- specifies the IP address of the EGX gateway
- lists the connected products with their Modbus communication parameters.

**Setup via the Ethernet network**
Once connected to the Ethernet network, the EGX200 gateway can be accessed by a standard internet browser via its IP address to:
- create or update the list of the connected products with their Modbus communication parameters
- update the firmware.





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# Ethernet EGX400 server

PE50538


PE50270

*Ethernet EGX400 gateway.*

## Function

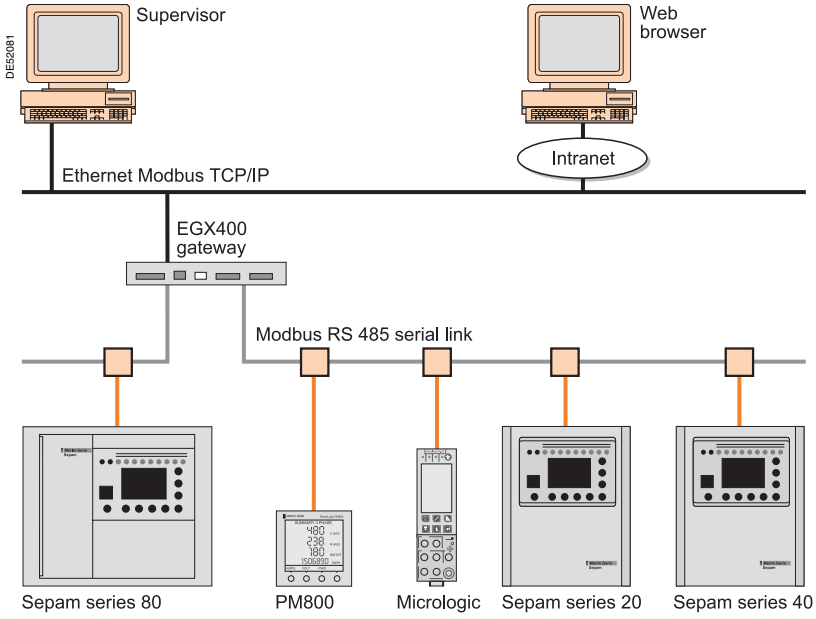
The EGX400 server is used as an Ethernet coupler for Sepam, the PowerLogic devices and for any other communicating devices operating under the Modbus RS 485 protocol.
It contains HTML pages (set up using the WPG software tool) that can be accessed using a standard internet browser. The HTML pages are used to display the information provided by the devices connected to the server.

**Supervisor and internet browser**
The EGX400 server makes it possible to implement two types of user interface:
- supervision software
- a standard internet browser providing access to the main information organised in predefined HTML pages.

These two approaches, supervisor and internet browser, are complementary:
- the supervisor offers complete access to all information, but requires specific software
- the HTML pages offer partial access to the main information via any PC connected to the network.

## Architecture

DE52081




## Setup

**Initial setup**
The initial setup is carried out using a PC connected to the EGX400 via an RS232 link. This setup:
- specifies the IP address of the EGX gateway
- selects the type of Ethernet port (wire or optic fiber)
- lists the connected products with their Modbus communication parameters.

**Setup via the Ethernet network**
Once connected to the Ethernet network, the EGX400 server can be accessed by a standard internet browser via its IP address to:
- create or update the list of the connected products with their Modbus communication parameters
- update the firmware.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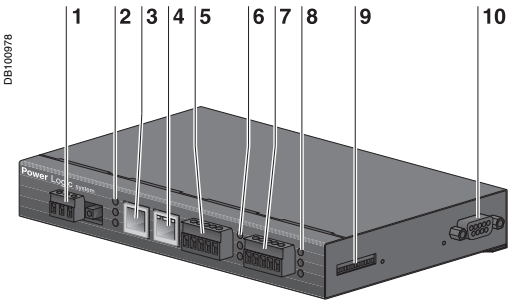
# Ethernet EGX200 gateway
# Ethernet EGX400 server



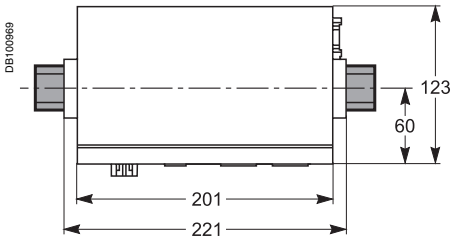

1 Power connector.
2 Ethernet indication LEDs.
3 10/100 Base TX port for connection to Ethernet via an RJ45 connector.
4 100 Base FX port for connection to Ethernet via an optic fiber (EGX400 only).
5 COM1: terminal block for RS 485 serial link.
6 COM1 indication LEDs.
7 COM2: terminal block for RS 485 serial link.
8 COM2 indication LEDs.
9 Mini-switches for setup of COM1 and COM2 ports.
10 COM2: Sub D-9 connector for connection to the RS 232 serial link.

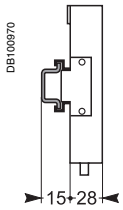
## Characteristics

| | EGX200 and EGX400 | |
|---|---|---|
| Weight | 700 g | |
| Dimensions (H x W x D) | 28 x 201 x 123 mm | |
| Mounting | Symmetrical or asymmetrical DIN rail<br>Front or side position | |
| Power supply | 24 V DC<br>100-240 V AC/24 V DC adapter supplied | |
| Operating temperature | -30 °C to +80 °C | |
| Humidity rating | 5 % to 95 % relative humidity (without condensation) at +40 °C | |
| **Compliance with standards** | | |
| Immunity in industrial environments | EN 61000-6-2<br>EN 61000-4-2/3/4/5/8/11<br>EN 55022/FCC class A<br>UL508<br>cUL (complying with CSA C22-2 no. 14-M91) | |
| **Serial ports** | | |
| Number of ports | 2 | |
| Types of ports | COM1: RS 485 (2-wire or 4-wire)<br>COM2: RS 232 or RS 485 (2-wire or 4-wire), depending on settings | |
| Protocol | Modbus | |
| Baud rate | 38400 bauds | |
| Maximum number of directly connected devices | 32 per port, 64 in all | |
| **Ethernet port** | **EGX200** | **EGX400** |
| Number of ports | 1 | 2 |
| Types of ports | One 10/100 base TX port | One 10/100 base TX port<br>One 100 base FX port (multimode optic fiber) |
| Protocol | Modbus/TCP | Modbus/TCP |
| Baud rate | 10/100 MB | 10/100 MB |
| **Web server** | | |
| Memory for custom HTML pages | None | 16 MB |

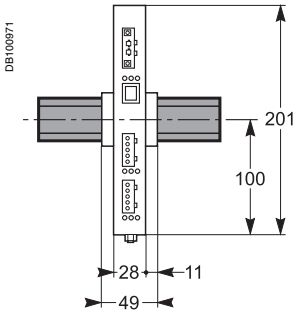
## Installation

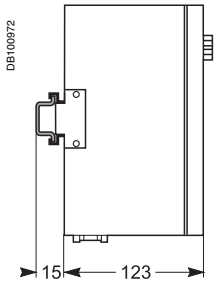
### Side mounting on DIN rail




### Front mounting on DIN rail



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# WPG software tool
# HTML-page generator


*HTML page with summary information on all the equipment in a switchboard.*


*Single device operating information HTML page.*


*Single device HTML page showing historical data.*

## Function

Very easy to use, the WPG software tool generates HTML pages for the EGX400 server. It is used to:
- select the devices connected to the server
- transfer the HTML pages corresponding to the selected devices to the server.

The WPG tool can set up HTML pages for the following devices:
- Sepam series 20, Sepam series 40, Sepam series 80 and Sepam 2000
- Masterpact equipped with Micrologic A, P and H control units
- Power Meter PM500, PM700 and PM800
- Circuit Monitor Series 2000, 3000 and 4000.

The WPG tool is PC software that can be used in three languages, French, Spanish and English.
To obtain WPG, contact your Schneider Electric representative.

## HTML pages

Following transfer, the EGX400 contains HTML pages that can be used to remotely monitor equipment under secure conditions.
- 1st service level based on the summary pages.
- 2nd service level based on specific pages for each type of device.

**Summary pages**

Five summary pages are available for overall monitoring of the switchboard. They present the main measurements recorded by the devices connected to the server.
- Page 1
  - 3-phase average rms current
  - active power
  - power factor
  - circuit-breaker position
- Page 2
  - rms current per phase
- Page 3
  - demand current per phase
- Page 4
  - demand power
  - peak power
  - time-stamping data
- Page 5
  - active power
  - reactive power
  - date and time of last reset of energy meters.

**Specific pages for each device**

A number of specific pages present detailed information on each device for in-depth analysis, e.g.:
- operating information:
  - instantaneous current per phase
  - demand current per phase
  - active and reactive power
  - average voltage (phase-to-neutral and phase-to-phase)
  - maximum unbalance
  - power factor
  - frequency
- event information:
  - minimum and maximum current values
  - maximum demand current
  - date and time of last reset
- historical data:
  - recording over 38 days of three user-selectable parameters (energy by default), every 15, 30 or 60 minutes, with graphic display and data export to an Excel file.


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# Selection guide

## Phase current sensors

Two types of sensor may be used with Sepam to measure phase current:
- 1 A or 5 A current transformers
- LPCT (Low Power Current Transducer) type current sensors.

### Selection guide

**1 A or 5 A current sensors are:**
- to be sized case by case: accuracy, electrical characteristics, etc.
- defined according to the IEC 60044-1 standard.

**The LPCT type current sensors are:**
- simple to size: a given LPCT sensor is suitable for the measurement of different rated currents: for example, the CLP1 sensor measures rated currents of 25 to 1250 A
- defined according to the IEC 60044-8 standard
(rated secondary voltage = 22.5 mV).

## Residual current sensors

The residual current value may be obtained using different sensors and assemblies, which are chosen according to the required performance (measurement accuracy and earth fault protection sensitivity).
Residual current may be:
- measured by a specific CSH120 or CSH200 core balance CT
- measured by a core balance CT with a ratio of 1/n (50 ⩽ n ⩽ 1500), with an ACE990 adapter.
- calculated by Sepam from the vector sum of the 3 phase currents.

### Selection guide

| Measurement sensors | Accuracy | Recommended minimum set point | Easy assembly |
|---|---|---|---|
| CSH120 or CSH200 core balance CT | *** | > 1 A | * |
| 1 or 3 x 1 A or 5 A CT+ CSH30 | ** | 0.10 InCT (DT)<br>0.05 InCT (IDMT) | ** |
| Core balance CT + ACE990 | ** | 0.10 InCT (DT)<br>0.05 InCT (IDMT) | ** revamping<br>* new |
| 3 phase CT<br>(I0 calculated by Sepam) | * | 0.30 InCT (DT) (1)<br>0.10 InCT (IDMT) (1) | *** |

*(1) Recommended minimum set point for ANSI 50N/51N function with H2 restraint: 0.10 InCT (DT) or 0.05 InCT (IDMT).*

It is advisable not to set the earth fault protection functions below the recommended minimum set point to avoid any risk of unwanted tripping caused by oversensitive detection of residual current or false residual current due to the saturation of a CT. Lower settings may be used to trigger alarms.



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# Voltage transformers


*VRQ3 without fuses.*


*VRQ3 with fuses.*

## Function

Sepam may be connected to any standard voltage transformer with a rated secondary voltage of 100 V to 220 V.
Schneider Electric offers a range of voltage transformers:
- to measure phase-to-neutral voltages: voltage transformers with one insulated MV terminal
- to measure phase-to-phase voltages: voltage transformers with two insulated MV terminals
- with or without integrated protection fuses.

Consult us for more information.

## Connection

The voltage transformers connect to Sepam:
- directly, for Sepam series 40 and Sepam series 80
- or via the CCT640 connector for Sepam B21, B22 and the additional voltage inputs for Sepam B83.

The table below presents the different connection possibilities for voltage transformers to Sepam.

| | Sepam B21 and B22 | Sepam series 40 | Sepam series 80 | |
|---|---|---|---|---|
| Number of voltage inputs | 4 | 3 | 4 main | 4 additional (1) |
| Intermediate connector | CCT640 | - | - | CCT640 |
| Sepam connector | B | E | E | B2 |

***(1)*** *Sepam B83 only.*

- when voltage transformers are connected directly to the E connector on Sepam, four transformers built into the Sepam base unit ensure matching and isolation between the VTs and the Sepam input circuits.

When voltage transformers are connected via the CCT640 connector, the four transformers for matching and isolation between the VTs and the Sepam input circuits are contained in the CCT640.



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# 1 A / 5 A current transformers

058731N

*ARJA1.*

058733N

*ARJP3.*

## Function

Sepam may be connected to any standard 1 A or 5 A current transformer.
Schneider Electric offers a range of current transformers to measure primary currents from 50 A to 2500 A.
Consult us for more information.

## Sizing of current transformers

Current transformers are sized so as not to be saturated by the current values they are required to measure accurately (minimum 5 In).

### For overcurrent protection functions

- with DT tripping curve:

the saturation current must be 1.5 times greater than the setting

- with IDMT tripping curve:

the saturation current must be 1.5 times greater than the highest working value on the curve.

**Practical solution when there is no information on the settings**

| Rated secondary current (in) | Accuracy burden | Accuracy class | CT secondary resistance $R_{CT}$ | Wiring resistance $R_f$ |
|---|---|---|---|---|
| 1 A | 2.5 VA | 5P 20 | < 3 Ω | < 0.075 Ω |
| 5 A | 7.5 VA | 5P 20 | < 0.2 Ω | < 0.075 Ω |

### For earth fault protection functions

**Transformer and transformer-machine unit differential protection (ANSI 87T)**
The phase current transformer primary currents must comply with the following rule:

$$0{,}1 \cdot \frac{S}{\sqrt{3}\,U\,n1} \leqslant In \leqslant 2{,}5 \cdot \frac{S}{\sqrt{3}\,U\,n1} \quad \text{for winding 1}$$

$$0{,}1 \cdot \frac{S}{\sqrt{3}\,U\,n2} \leqslant I'n \leqslant 2{,}5 \cdot \frac{S}{\sqrt{3}\,U\,n2} \quad \text{for winding 2.}$$

S is the transformer rated power.
In and I'n are the phase CT primary currents of winding 1 and 2 respectively.
Un1 and Un2 are the voltages of windings 1 and 2 respectively.

If the transformer peak inrush current (Îinrush) is less than 6.7 x $\sqrt{2}$ x In, the current transformers must be either:

- type 5P20, with an accuracy burden $VA_{CT} \geqslant R_w.in^2$
- or defined by a knee-point voltage $Vk \geqslant (R_{CT} + R_w).20.in.$

If the transformer peak inrush current (Îinrush) is greater than 6.7 x $\sqrt{2}$ x In, the current transformers must be either:

- type 5P, with an accuracy-limit factor $\geqslant 3.\frac{\hat{I}inrush}{\sqrt{2}\cdot In}$ and an accuracy burden $VA_{CT} \geqslant R_w.in^2$
- or defined by a knee-point voltage $Vk \geqslant (R_{CT} + R_w).3.\frac{\hat{I}inrush}{\sqrt{2}\cdot In}.in.$

The equations apply to the phase current transformers of windings 1 and 2.
In and in are the CT rated primary and secondary currents respectively.
$R_{CT}$ is the CT internal resistance.
$R_w$ is the resistance of the CT load and wiring.

**Machine differential (ANSI 87M)**
Current transformers must be either:

- type 5P20, with an accuracy burden $VA_{CT} \geqslant R_w.in^2$
- or defined by a knee-point voltage $Vk \geqslant (R_{CT} + R_w).20.in.$

The equations apply to the phase current transformers placed on either side of the machine.
in is the CT rated secondary current.
$R_{CT}$ is the CT internal resistance.
$R_w$ is the resistance of the CT load and wiring.





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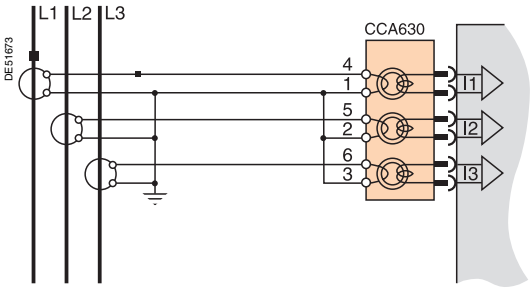
# 1 A / 5 A current transformers

**Restricted earth fault differential protection (ANSI 64REF)**
■ the primary current of the neutral point current transformer used must comply with the following rule:
**0.1 In ⩽ neutral point CT primary current ⩽ 2 In**
with In = primary current of phase CTs on the same winding

Current transformers must be either:
■ type 5P, with an accuracy-limit factor ⩾ max.$\left(20;1,6\frac{I_{3P}}{In};2,4\frac{I_{1P}}{In}\right)$ and an accuracy burden $VA_{CT} \geqslant R_w.in^2$
■ or defined by a knee-point voltage Vk ⩾ $(R_{CT} + R_w).max.\left(20;1,6\frac{I_{3P}}{In};2,4\frac{I_{1P}}{In}\right).in.$

The equations apply to the phase current transformers and the neutral-point current tranformer.
in is the CT rated secondary current.
$R_{CT}$ is the CT internal resistance.
$R_w$ is the resistance of the CT load and wiring.
$I_{3P}$ is the maximum current value for a three-phase short-circuit.
$I_{1P}$ is the maximum current value for a phase-to-earth short-circuit.




## CCA630 connector

### Function

The CCA630 connector is used to connect Sepam to 1 A or 5 A current transformer secondary windings. It contains 3 interposing ring CTs with through primaries, which ensure impedance matching and isolation between the 1 A or 5 A circuits and Sepam.
The connector may be disconnected with the power on since disconnection does not open the CT secondary circuits.


### Connection

■ open the 2 side shields for access to the connection terminals.
The shields may be removed, if necessary, to make wiring easier. If removed, they must be replaced after wiring.
■ remove the jumper, if necessary. The jumper links terminals 1, 2 and 3.
■ connect the wires using 4 mm ring lugs and check the tightness of the six screws that guarantee the continuity of the CT secondary circuits. The connector accepts wires with cross-sections of 1.5 to 6 mm² (AWG 16 to AWG 10).
■ the terminal 1, 2 and 3 jumper is supplied with the CCA630
■ close the side shields
■ plug the connector into the 9-pin inlet on the rear panel
■ tighten the 2 CCA630 connector fastening screws on the rear panel of Sepam.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# LPCT type current sensors

PE50031

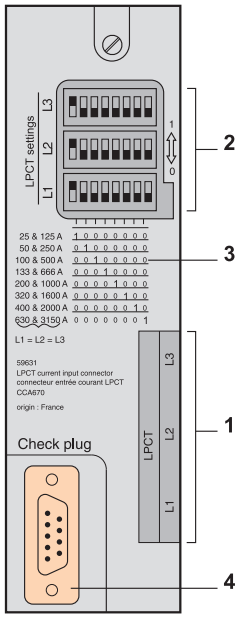
*LPCT CLP1 sensor.*

## Function

The sensors are voltage-output sensors of the Low Power Current Transducer (LPCT) type, compliant with the IEC 60044-8 standard.
The Merlin Gerin range of LPCTs includes the following sensors: CLP1, CLP2, CLP3, TLP160 and TLP190.



DE51674




## CCA670/CCA671 connector

### Function

The 3 LPCT sensors are connected to the CCA670 or CCA671 connector on the rear panel of Sepam.
The connection of just one or two LPCT sensors is not allowed and causes Sepam to go into fail-safe position.
The two CCA670 and CCA671 interface connectors serve the same purpose, the difference being the position of the LPCT sensor plugs:
- CCA670: lateral plugs, for Sepam series 20 and Sepam series 40
- CCA671: radial plugs, for Sepam series 80.

### Description

**1** 3 RJ 45 plugs to connect the LPCT sensors.
**2** 3 blocks of microswitches to set the CCA670/CCA671 to the rated phase current value.
**3** Microswitch setting / selected rated current equivalency table (2 In values per setting).
**4** 9-pin sub-D connector to connect test equipment (ACE917 for direct connector or via CCA613).

### Rating of CCA670/CCA671 connectors

The CCA670/CCA671 connector must be rated according to the rated primary current In measured by the LPCT sensors. In is the value of the current corresponding to the rated secondary voltage 22.5 mV. The possible settings for In are (in A): 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.
The selected In value should be:
- entered as a Sepam general setting
- configured by microswitch on the CCA670/CCA671 connector.

Instructions:
- use a screwdriver to remove the shield located in the "LPCT settings" zone; the shield protects 3 blocks of 8 microswitches marked L1, L2, L3
- on the L1 block, set the microswitch for the selected rated current to "1" (2 In values per microswitch)
- the table of equivalencies between the microswitch settings and the selected rated current In is printed on the connector
- leave the 7 other microswitches set to "0"
- set the other 2 blocks of microswitches L2 and L3 in the same position as the L1 block and close the shield.



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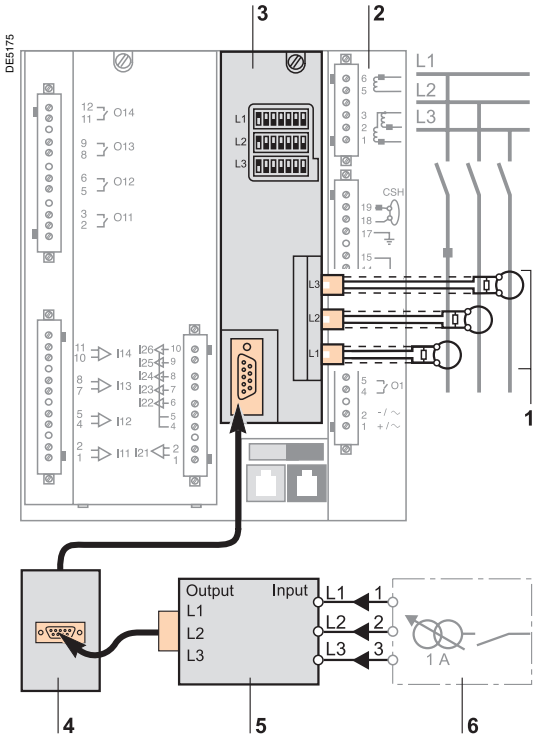
# LPCT type current sensors
## Test accessories




## Accessory connection principle

**1** LPCT sensor, equipped with a shielded cable fitted with a yellow RJ 45 plug which is plugged directly into the CCA670/CCA671 connector.

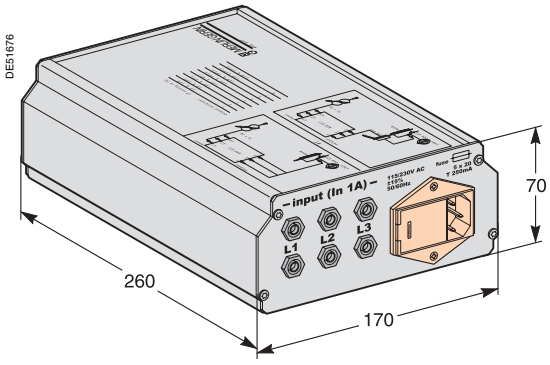
**2** Sepam protection unit.

**3** CCA670/CCA671 connector, LPCT voltage interface, with microswitch setting of rated current:
- CCA670: lateral plugs for Sepam series 20 and Sepam series 40
- CCA671: radial plugs for Sepam series 80.

**4** CCA613 remote test plug, flush-mounted on the front of the cubicle and equipped with a 3-meter cord to be plugged into the test plug of the CCA670/CCA671 interface connector (9-pin sub-D).

**5** ACE917 injection adapter, to test the LPCT protection chain with a standard injection box.

**6** Standard injection box.




## ACE917 injection adapter

### Function

The ACE917 adapter is used to test the protection chain with a standard injection box, when Sepam is connected to LPCT sensors.
The ACE917 adapter is inserted between:
- the standard injection box
- the LPCT test plug:
  - integrated in the Sepam CCA670/CCA671 interface connector
  - or transferred by means of the CCA613 accessory.

The following are supplied with the ACE917 injection adapter:
- power supply cord
- 3-meter cord to connect the ACE917 to the LPCT test plug on CCA670/CCA671 or CCA613.

### Characteristics

| | |
|---|---|
| Power supply | 115 / 230 V AC |
| Protection by time-delayed fuse 5 mm x 20 mm | 0.25 A rating |

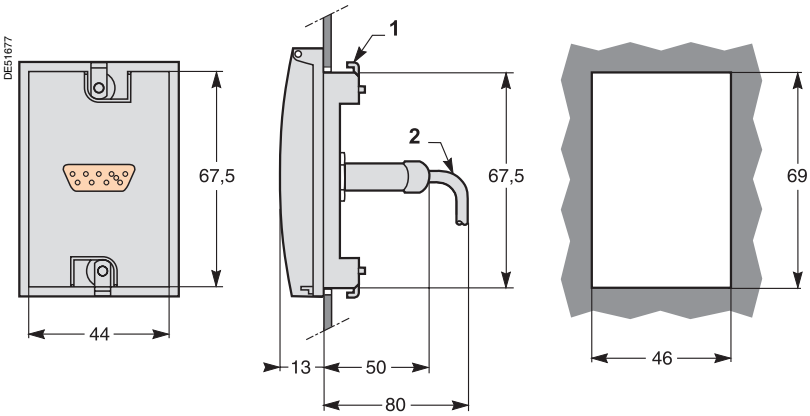
## CCA613 remote test plug

### Function

The CCA613 test plug, flush-mounted on the front of the cubicle, is equipped with a 3-meter cord to transfer data from the test plug integrated in the CCA670/CCA671 interface connector on the rear of Sepam.

### Description and dimensions

**1** Mounting lug
**2** Cord




*Front view with cover lifted.* *Right side view.* *Cutout.*



Merlin Gerin
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# CSH120 and CSH200 Core balance CTs


*CSH120 and CSH200 core balance CTs.*

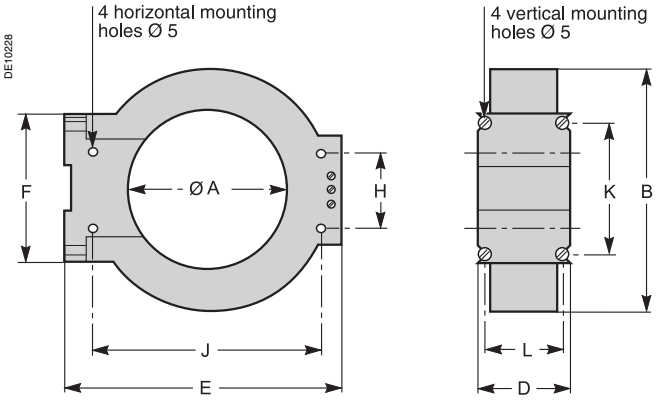
## Function

The specifically designed CSH120 and CSH200 core balance CTs are used for direct residual current measurement. The only difference between them is the diameter. Due to their low voltage insulation, they may only be used on cables.

## Characteristics

| | CSH120 | CSH200 |
|---|---|---|
| Inner diameter | 120 mm | 200 mm |
| Weight | 0.6 kg | 1.4 kg |
| Accuracy | ±5% to 20°C | |
| | ±6% max. from -25°C to 70°C | |
| Transformation ratio | 1/470 | |
| Maximum permissible current | 20 kA - 1 s | |
| Operating temperature | - 25°C to +70°C | |
| Storage temperature | - 40°C to +85°C | |

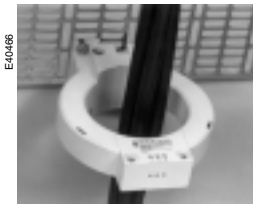
## Dimensions




| Dimensions | A | B | D | E | F | H | J | K | L |
|---|---|---|---|---|---|---|---|---|---|
| CSH120 | 120 | 164 | 44 | 190 | 76 | 40 | 166 | 62 | 35 |
| CSH200 | 200 | 256 | 46 | 274 | 120 | 60 | 257 | 104 | 37 |

**The CSH120 and CSH200 core balance CTs must be installed on insulated cables.**
**Cables with a rated voltage of more than 1000 V must also have an earthed shielding.**

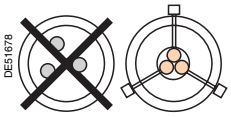

*Assembly on MV cables.*



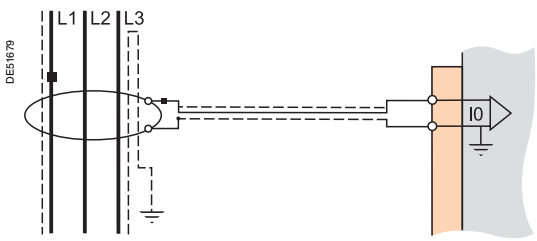

*Assembly on mounting plate.*

## Assembly

Group the MV cable (or cables) in the middle of the core balance CT.
Use non-conductive binding to hold the cables.
Remember to insert the 3 medium voltage cable shielding earthing cables through the core balance CT.




## Connection




**Connection to Sepam series 20 and Sepam series 40**

To residual current I0 input, on connector (A), terminals 19 and 18 (shielding).

**Connection to Sepam series 80**

- to residual current I0 input, on connector (E), terminals 15 and 14 (shielding)
- to residual current I'0 input, on connector (E), terminals 18 and 17 (shielding).

**Recommended cable**

- sheathed cable, shielded by tinned copper braid
- minimum cable cross-section 0.93 mm² (AWG 18)
- resistance per unit length < 100 mΩ/m
- minimum dielectric strength: 1000 V.

It is essential for the CSH30 to be installed near Sepam (Sepam - CSH30 link less than 2 m.
Flatten the connection cable against the metal frames of the cubicle.
The connection cable shielding is grounded in Sepam. Do not ground the cable by any other means.
**The maximum resistance of the Sepam connection wiring must not be more than 4 Ω.**



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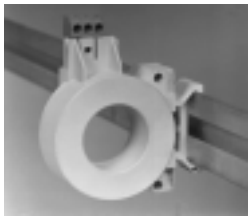
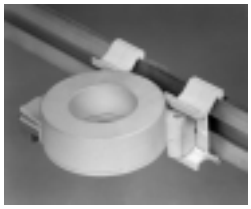
# CSH30
# Interposing ring CT




*Vertical assembly of CSH30 interposing ring CT.*




*Horizontal assembly of CSH30 interposing ring CT.*

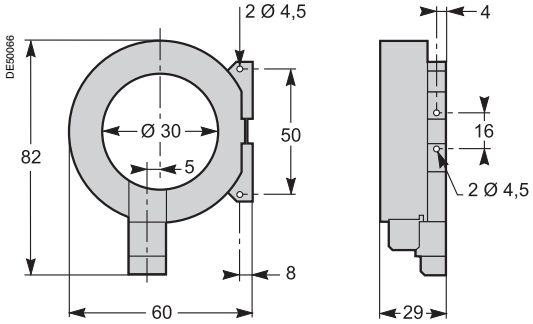
## Function

The CSH30 interposing ring CT is used as an interface when the residual current is measured using 1 A or 5 A current transformers.

## Characteristics

| | |
|---|---|
| Weight | 0.2 kg |
| Assembly | On symmetrical DIN rail<br>In vertical or horizontal position |

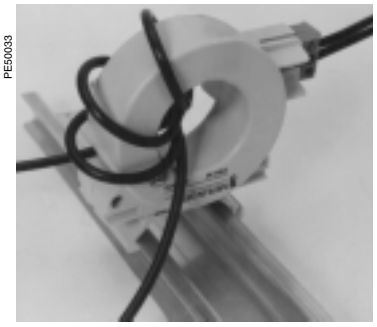
## Dimensions




## Connection

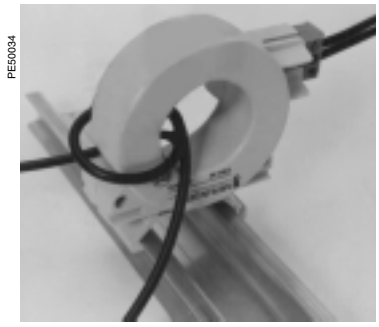
The CSH30 is adapted for the type of current transformer, 1 A or 5 A, by the number of turns of the secondary wiring through the CSH30 interposing ring CT :
- 5 A rating - 4 turns
- 1 A rating - 2 turns.

**Connection to 5 A secondary circuit**

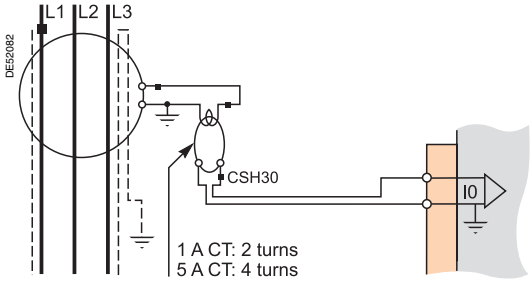



- plug into the connector
- insert the transformer secondary wire through the CSH30 core balance CT 4 times.

**Connection to 1 A secondary circuit**




- plug into the connector
- insert the transformer secondary wire through the CSH30 core balance CT twice.




**Connection to Sepam series 20 and Sepam series 40**

To residual current I0 input, on connector (A), terminals 19 and 18 (shielding).

**Connection to Sepam series 80**

- to residual current I0 input, on connector (E), terminals 15 and 14 (shielding)
- to residual current I'0 input, on connector (E), terminals 18 and 17 (shielding).

**Recommended cable**

- sheathed cable, shielded by tinned copper braid
- minimum cable cross-section 0.93 mm² (AWG 18) (max. 2.5 mm²)
- resistance per unit length < 100 mΩ/m
- minimum dielectric strength: 1000 V.

It is essential for the CSH30 to be installed near Sepam (Sepam - CSH30 link less than 2 meters long).
Flatten the connection cable against the metal frames of the cubicle.
The connection cable shielding is grounded in Sepam. Do not ground the cable by any other means.
**The maximum resistance of the Sepam connection wiring must not be more than 4 Ω.**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# ACE990
# Core balance CT interface

PE50037


*ACE990 core balance CT interface.*

## Function

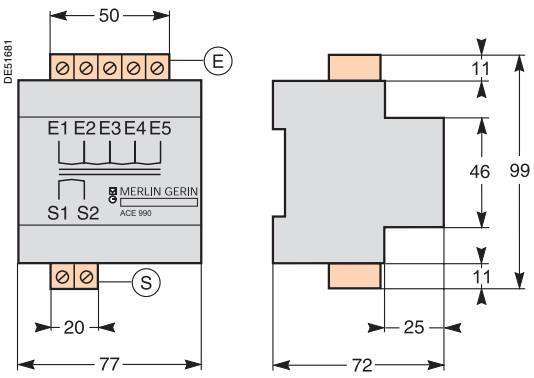
The ACE990 interface is used to adapt measurements between a MV core balance CT with a ratio of 1/n (50 ⩽ n ⩽ 1500), and the Sepam residual current input.

## Characteristics

| | |
|---|---|
| Weight | 0.64 kg |
| Assembly | Mounted on symmetrical DIN rail |
| Amplitude accuracy | ±1% |
| Phase accuracy | < 2° |
| Maximum permissible current | 20 kA - 1 s<br>(on the primary winding of a MV core balance CT with a ratio of 1/50 that does not saturate) |
| Operating temperature | -5°C to +55°C |
| Storage temperature | -25°C to +70°C |

## Description and dimensions

DE51681




(E) ACE990 input terminal block, for connection of the core balance CT.

(S) ACE990 output terminal block, for connection of the Sepam residual current input.

4



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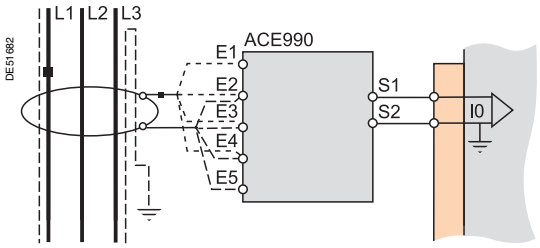
# ACE990
# Core balance CT interface




## Terminals connection

**Connection of core balance CT**
Only one core balance CT may be connected to the ACE990 interface.
The secondary circuit of the MV core balance CT is connected to 2 of the 5 ACE990 interface input terminals. To define the 2 inputs, it is necessary to know the following:
- core balance CT ratio (1/n)
- core balance CT power
- close approximation of rated current In0

(In0 is a Sepam general setting and defines the earth fault protection setting range between 0.1 In0 and 15 In0).

The table below may be used to determine:
- the 2 ACE990 input terminals to be connected to the MV core balance CT secondary
- the type of residual current sensor to set
- the exact value of the rated residual current In0 setting, given by the following formula: **In0 = k x number of core balance CT turns**

with k the factor defined in the table below.

The core balance CT must be connected to the interface in the right direction for correct operation: the MV core balance CT secondary output terminal S1 must be connected to the ACE990 input terminal with the lowest index (Ex).

| K value | ACE990 input terminals to be connected | Residual current sensor setting | Min. MV core balance CT power |
|---|---|---|---|
| 0.00578 | E1 - E5 | ACE990 - range 1 | 0.1 VA |
| 0.00676 | E2 - E5 | ACE990 - range 1 | 0.1 VA |
| 0.00885 | E1 - E4 | ACE990 - range 1 | 0.1 VA |
| 0.00909 | E3 - E5 | ACE990 - range 1 | 0.1 VA |
| **0.01136** | **E2 - E4** | **ACE990 - range 1** | **0.1 VA** |
| 0.01587 | E1 - E3 | ACE990 - range 1 | 0.1 VA |
| 0.01667 | E4 - E5 | ACE990 - range 1 | 0.1 VA |
| 0.02000 | E3 - E4 | ACE990 - range 1 | 0.1 VA |
| 0.02632 | E2 - E3 | ACE990 - range 1 | 0.1 VA |
| 0.04000 | E1 - E2 | ACE990 - range 1 | 0.2 VA |
| | | | |
| 0.05780 | E1 - E5 | ACE990 - range 2 | 2.5 VA |
| 0.06757 | E2 - E5 | ACE990 - range 2 | 2.5 VA |
| 0.08850 | E1 - E4 | ACE990 - range 2 | 3.0 VA |
| 0.09091 | E3 - E5 | ACE990 - range 2 | 3.0 VA |
| 0.11364 | E2 - E4 | ACE990 - range 2 | 3.0 VA |
| 0.15873 | E1 - E3 | ACE990 - range 2 | 4.5 VA |
| 0.16667 | E4 - E5 | ACE990 - range 2 | 4.5 VA |
| 0.20000 | E3 - E4 | ACE990 - range 2 | 5.5 VA |
| 0.26316 | E2 - E3 | ACE990 - range 2 | 7.5 VA |

***Example:***
*Given a core balance CT with a ratio of 1/400 2 VA, used within a measurement range of 0.5 A to 60 A.*
*How should it be connected to Sepam via the ACE990?*
1. *Choose a close approximation of the rated current In0, i.e. 5 A.*
2. *Calculate the ratio: approx. In0/number of turns = 5/400 = 0.0125.*
3. *Find the closest value of k in the table opposite: k = 0.01136.*
4. *Check the mininum power required for the core balance CT: 2 VA core balance CT > 0.1 VA ➡ OK.*
5. *Connect the core balance secondary to ACE990 input terminals E2 and E4.*
6. *Set Sepam up with: In0 = 0.0136 x 400 = 4.5 A. This value of In0 may be used to monitor current between 0.45 A and 67.5 A.*

*Wiring of MV core balance secondary circuit:*
- *MV core balance CT S1 output to ACE990 E2 input terminal*
- *MV core balance CT S2 output to ACE990 E4 input terminal.*

**Connection to Sepam series 20 and Sepam series 40**
To residual current I0 input, on connector (A), terminals 19 and 18 (shielding).

**Connection to Sepam series 80**
- to residual current I0 input, on connector (E), terminals 15 and 14 (shielding)
- to residual current I'0 input, on connector (E), terminals 18 and 17 (shielding).

**Recommended cables**
- cable between core balance CT and ACE990: less than 50 m long
- sheathed cable, shielded by tinned copper braid between the ACE990 and Sepam, maximum length 2 m
- cable cross-section between 0.93 mm² (AWG 18) and 2.5 mm² (AWG 13)
- resistance per unit length less than 100 mΩ/m
- minimum dielectric strength: 100 V.

Connect the ACE990 connection cable shielding in the shortest manner possible (2 cm maximum) to the shielding terminal on the Sepam connector.
Flatten the connection cable against the metal frames of the cubicle.
The connection cable shielding is grounded in Sepam. Do not ground the cable by any other means.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# Order form

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# Sepam series 20
## Ready-to-use configuration

**Number of identical Sepam configurations ordered** ☐

This order form can be used to define a complete Sepam configuration. Check the boxes ☒ that match your choices.

## Base unit, connectors and application

### Base unit and UMI

| | | | |
|---|---|---|---|
| Base unit with advanced UMI | | S10UD | **59607** ☐ |
| With lead seal accessory (1) | | AMT852 | **59639** ☐ |
| *(1) Can be used only with an advance UMI.* | | | |
| Base unit with basic UMI | | S10UX | **59603** ☐ |
| Remote advanced UMI module | | DSM303 | **59608** ☐ |
| Connection cord | L = 0.6 m | CCA770 | **59660** ☐ |
| | L = 2 m | CCA772 | **59661** ☐ |
| | L = 4 m | CCA774 | **59662** ☐ |
| Mounting plate | | AMT840 | **59670** ☐ |

### Working language

| | | | |
|---|---|---|---|
| Sepam series 20 | EN/FR | | **59609** ☐ |
| | EN/ES | | **59611** ☐ |

### Connectors

| | | | |
|---|---|---|---|
| Type | Screw-type | CCA620 | **59668** ☐ |
| | Ring-lug type | CCA622 | **59669** ☐ |

| Application | Type | | Sensor | | |
|---|---|---|---|---|---|
| Substation | S20 | **59620** ☐ | **CT** ☐ | **or LPCT** ☐ | |
| Transformer | T20 | **59621** ☐ | **CT** ☐ | **or LPCT** ☐ | |
| Motor | M20 | **59622** ☐ | **CT** ☐ | **or LPCT** ☐ | |
| Busbars | B21 | **59624** ☐ | | | **VT** ☐ |
| | B22 | **59625** ☐ | | | **PT** ☐ |
| | | | **59630** | **59631** | **59632** |
| | | | CCA630 | CCA670 | CCA640 |

## Modules, communication interfaces and core balance CTs

### Core balance CTs

| | | |
|---|---|---|
| Core balance CT, Ø 120 mm | CSH120 | **59635** ☐ |
| Core balance CT, Ø 200 mm | CSH200 | **59636** ☐ |
| Interposing ring CT | CSH30 | **59634** ☐ |
| Core balance CT interface | ACE990 | **59672** ☐ |

***Note:*** *only one core balance CT can be added.*

### Modules

#### Input / output modules

| | | |
|---|---|---|
| 10 inputs + 4 outputs, 24-250 V DC | MES114 | **59646** ☐ |
| 10 inputs + 4 outputs, 110-125 V DC / V AC | MES114E | **59651** ☐ |
| 10 inputs + 4 outputs, 220-250 V DC / V AC | MES114F | **59652** ☐ |

***Note:*** *the Sepam base unit has 4 outputs; only one input/output module can be added.*

#### Remote modules

| | | | | | |
|---|---|---|---|---|---|
| | | | **Connection cord** | | |
| 8 temperature sensor module | MET148-2 | **59641** ☐ | L = 0.6 m | CCA770 | **59660** ☐ |
| | | | L = 2 m | CCA772 | **59661** ☐ |
| | | | L = 4 m | CCA774 | **59662** ☐ |
| ***Note:*** *the MET148-2 can be used only with applications T and M.* | | | | | |
| Analog output module | MSA141 | **59647** ☐ | L = 0.6 m | CCA770 | **59660** ☐ |
| | | | L = 2 m | CCA772 | **59661** ☐ |
| | | | L = 4 m | CCA774 | **59662** ☐ |

#### Communication interfaces

| Modbus interfaces | | | Connection cord | |
|---|---|---|---|---|
| 2-wire RS 485 interface | ACE949-2 | **59642** ☐ | CCA612 | **59663** ☐ |
| 4-wire RS 485 interface | ACE959 | **59643** ☐ | CCA612 | **59663** ☐ |
| Fiber optic interface | ACE937 | **59644** ☐ | CCA612 | **59663** ☐ |
| **Multi-protocol interfaces (Modbus, DNP3 or IEC 60870-5-103)** | | | | |
| 2-wire RS 485 interface | ACE969TP | **59720** ☐ | CCA612 | **59663** ☐ |
| Fiber optic interface | ACE969FO | **59721** ☐ | CCA612 | **59663** ☐ |

***Note:*** *only one interface per application.*



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# Sepam series 40
## Ready-to-use configuration

**Number of identical Sepam configurations ordered** ☐

This order form can be used to define a complete Sepam configuration. Check the boxes ☒ that match your choices.

## Base unit, connectors and application

### Base unit and UMI

| | | | | |
|---|---|---|---|---|
| Base unit with advanced UMI | | S10MD | **59604** | ☐ |
| With lead seal accessory (1) | | AMT852 | **59639** | ☐ |
| *(1) Can be used only with an advance UMI.* | | | | |
| Base unit with basic UMI | | S10MX | **59600** | ☐ |
| Remote advanced UMI module | | DSM303 | **59608** | ☐ |
| Connection cord | L = 0.6 m | CCA770 | **59660** | ☐ |
| | L = 2 m | CCA772 | **59661** | ☐ |
| | L = 4 m | CCA774 | **59662** | ☐ |
| Mounting plate | | AMT840 | **59670** | ☐ |

### Working language

| | | | |
|---|---|---|---|
| Sepam series 40 | EN/FR | **59615** | ☐ |
| | EN/ES | **59616** | ☐ |

### Connectors

| | | | | |
|---|---|---|---|---|
| Type | Screw-type | CCA620 - **59668** and CCA626 - | **59656** | ☐ |
| | Ring-lug type | CCA622 - **59669** and CCA627 - | **59657** | ☐ |

| Application | Type | | Sensor | |
|---|---|---|---|---|
| Substation | S40 | **59680** ☐ | CT ☐ | or LPCT ☐ |
| | S41 | **59681** ☐ | CT ☐ | or LPCT ☐ |
| | S42 | **59682** ☐ | CT ☐ | or LPCT ☐ |
| Transformer | T40 | **59683** ☐ | CT ☐ | or LPCT ☐ |
| | T42 | **59684** ☐ | CT ☐ | or LPCT ☐ |
| Motor | M41 | **59685** ☐ | CT ☐ | or LPCT ☐ |
| Generator | G40 | **59686** ☐ | CT ☐ | or LPCT ☐ |
| | | | **59630** | **59631** |
| | | | CCA630 | CCA670 |

## Modules, communication interfaces and core balance CTs

### Core balance CTs

| | | | |
|---|---|---|---|
| Core balance CT, Ø 120 mm | CSH120 | **59635** | ☐ |
| Core balance CT, Ø 200 mm | CSH200 | **59636** | ☐ |
| Interposing ring CT | CSH30 | **59634** | ☐ |
| Core balance CT interface | ACE990 | **59672** | ☐ |

***Note:*** *only one core balance CT can be added.*

### Modules

#### Input / output modules

| | | | |
|---|---|---|---|
| 10 inputs + 4 outputs, 24-250 V DC | MES114 | **59646** | ☐ |
| 10 inputs + 4 outputs, 110-125 V DC / V AC | MES114E | **59651** | ☐ |
| 10 inputs + 4 outputs, 220-250 V DC / V AC | MES114F | **59652** | ☐ |

***Note:*** *the Sepam base unit has 4 outputs; only one input/output module can be added.*

#### Remote modules

| | | | Connection cord | | |
|---|---|---|---|---|---|
| 8 temperature sensor module | MET148-2 | **59641** ☐ | L = 0.6 m | CCA770 | **59660** ☐ |
| | | | L = 2 m | CCA772 | **59661** ☐ |
| | | | L = 4 m | CCA774 | **59662** ☐ |

***Note:*** *the MET148-2 can be used only with applications T, M and G. Maximum of 2 modules per application.*

| | | | | | |
|---|---|---|---|---|---|
| Analog output module | MSA141 | **59647** ☐ | L = 0.6 m | CCA770 | **59660** ☐ |
| | | | L = 2 m | CCA772 | **59661** ☐ |
| | | | L = 4 m | CCA774 | **59662** ☐ |

***Note:*** *the MSA141 can be used with all the applications.*

#### Communication interfaces

| Modbus interfaces | | | Connection cord | |
|---|---|---|---|---|
| 2-wire RS 485 interface | ACE949-2 | **59642** ☐ | CCA612 | **59663** ☐ |
| 4-wire RS 485 interface | ACE959 | **59643** ☐ | CCA612 | **59663** ☐ |
| Fiber optic interface | ACE937 | **59644** ☐ | CCA612 | **59663** ☐ |
| **Multi-protocol interfaces (Modbus, DNP3 or IEC 60870-5-103)** | | | | |
| 2-wire RS 485 interface | ACE969TP | **59720** ☐ | CCA612 | **59663** ☐ |
| Fiber optic interface | ACE969FO | **59721** ☐ | CCA612 | **59663** ☐ |

***Note:*** *only one interface per application.*





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# Sepam series 80
## Ready-to-use configuration

**Number of identical Sepam configurations ordered** ☐

This order form can be used to define a complete Sepam configuration. Check the boxes ☒ or indicate the required quantities in the appropriate spaces ☐ according to your choices.

## Sepam series 80 base unit, cartridge, connectors and application

### Base unit and UMI

| | | | |
|---|---|---|---|
| Base unit with mimic-based UMI | | SEP888 | **59705** ☐ |
| Base unit with advanced UMI | | SEP383 | **59704** ☐ |
| Base unit without basic UMI | | SEP080 | **59703** ☐ |
| Remote advanced UMI module (compulsory with SEP080) | | DSM303 | **59608** ☐ |
| Connection cord | L = 0.6 m | CCA770 | **59660** ☐ |
| | L = 2 m | CCA772 | **59661** ☐ |
| | L = 4 m | CCA774 | **59662** ☐ |
| Mounting plate | | AMT880 | **59706** ☐ |

***Note:*** *8 mounting clips included*

### Memory cartridge

| | | | |
|---|---|---|---|
| Memory cartridge | | MMS020 | **59707** ☐ |
| Logipam option | | SFT080 | **59711** ☐ |

***Note:*** *option required to use Logipam program.*

### Working language

| | | | |
|---|---|---|---|
| Sepam series 80 | EN/FR | | **59709** ☐ |
| | EN/ES | | **59710** ☐ |

### Connectors

| | | | |
|---|---|---|---|
| Type | Screw-type | CCA620 | **59668** ☐ |
| | Ring-lug type | CCA622 | **59669** ☐ |

| Application | Type | | B1 sensor | B2 sensor |
|---|---|---|---|---|
| Substation | S80 | **59729** ☐ | CT ☐ or LPCT ☐ | |
| | S81 | **59730** ☐ | CT ☐ or LPCT ☐ | |
| | S82 | **59731** ☐ | CT ☐ or LPCT ☐ | |
| | S84 | **59732** ☐ | CT ☐ or LPCT ☐ | |
| Transformer | T81 | **59733** ☐ | CT ☐ or LPCT ☐ | |
| | T82 | **59734** ☐ | CT ☐ or LPCT ☐ | |
| | T87 | **59735** ☐ | CT ☐ | CT ☐ |
| Motor | M81 | **59736** ☐ | CT ☐ or LPCT ☐ | |
| | M87 | **59737** ☐ | CT ☐ or LPCT ☐ | CT ☐ or LPCT ☐ |
| | M88 | **59738** ☐ | CT ☐ | CT ☐ |
| Generator | G82 | **59739** ☐ | CT ☐ or LPCT ☐ | |
| | G87 | **59741** ☐ | CT ☐ or LPCT ☐ | CT ☐ or LPCT ☐ |
| | G88 | **59742** ☐ | CT ☐ | CT ☐ |
| Busbar | B80 | **59743** ☐ | CT ☐ or LPCT ☐ | |
| | B83 | **59744** ☐ | CT ☐ | VT ☐ |
| Capacitor | C86 | **59745** ☐ | CT ☐ or LPCT ☐ | CT ☐ |
| | | | **59630** CCA630 / **59702** CCA671 | **59630** CCA630 / **59702** CCA671 / **59632** CCT640 |

## Modules, communication interfaces and core balance CTs

### Core balance CTs

| | | | |
|---|---|---|---|
| Core balance CT, Ø 120 mm | CSH120 | **59635** | ☐ |
| Core balance CT, Ø 200 mm | CSH200 | **59636** | ☐ |
| Interposing ring CT | CSH30 | **59634** | ☐ |
| Core balance CT interface | ACE990 | **59672** | ☐ |

***Note:*** *the total number of core balance CTs cannot exceed 2.*

### Modules

#### Input / output modules

| | | | |
|---|---|---|---|
| 14 inputs (24-250 V DC) + 6 outputs | MES120 | **59715** | ☐ |
| 14 inputs (220-250 V DC) + 6 outputs | MES120G | **59716** | ☐ |

***Note:*** *the Sepam base unit comes with 5 outputs; 3 input/output modules can be added.*

#### Remote modules

| | | | | Connection cord | | |
|---|---|---|---|---|---|---|
| 8 temperature sensor module | MET148-2 | **59641** ☐ | L = 0.6 m | CCA770 | **59660** | ☐ |
| | | | L = 2 m | CCA772 | **59661** | ☐ |
| | | | L = 4 m | CCA774 | **59662** | ☐ |

***Note:*** *the MET148-2 can be used only with applications T, M, G and C.*
*Maximum of 2 MET 148-2 modules per application.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Analog output module | MSA141 | **59647** ☐ | L = 0.6 m | CCA770 | **59660** | ☐ |
| | | | L = 2 m | CCA772 | **59661** | ☐ |
| | | | L = 4 m | CCA774 | **59662** | ☐ |

***Note:*** *the MSA141 can be used with all the applications.*

| | | | |
|---|---|---|---|
| Synchro-check module | MCS025 | **59712** | ☐ |
| Mounting plate | AMT840 | **59670** | ☐ |

***Note:*** *the MET148-2 can be used only with applications S, B, G and T.*
*Comes with connection cord CCA785 and voltage connector CCT640.*

### Communication interfaces

#### Modbus interfaces

| | | | Connection cord | | |
|---|---|---|---|---|---|
| 2-wire RS 485 interface | ACE949-2 | **59642** ☐ | CCA612 | **59663** | ☐ |
| 4-wire RS 485 interface | ACE959 | **59643** ☐ | CCA612 | **59663** | ☐ |
| Fiber optic interface | ACE937 | **59644** ☐ | CCA612 | **59663** | ☐ |

#### Multi-protocol interfaces (Modbus, DNP3 or IEC 60870-5-103)

| | | | | | |
|---|---|---|---|---|---|
| 2-wire RS 485 interface | ACE969TP | **59720** ☐ | CCA612 | **59663** | ☐ |
| Fiber optic interface | ACE969FO | **59721** ☐ | CCA612 | **59663** | ☐ |

***Note:*** *the total number of communication interfaces cannot exceed 2.*



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# Sepam accessories and spare parts

Check the boxes ☒ or indicate the required quantities in the appropriate spaces ☐ according to your choices.

| | | | |
|---|---|---|---|
| **Mounting accessories** | | | |
| **Sepam series 20, Sepam series 40 or MCS025:** | | | |
| Mounting plate | AMT840 | **59670** | ☐ |
| **Sepam series 20 and Sepam series 40 with advanced UMI** | | | |
| Mead seal accessory | AMT852 | **59639** | ☐ |
| **Sepam series 80** | | | |
| Mounting plate | AMT880 | **59706** | ☐ |
| Blanking plate | AMT820 | **59699** | ☐ |
| **Software tools** | | | |
| Sepam PC software: SFT2841 and SFT2826 (1 CD-ROM without connection cord CCA783) | SFT2841 CD | **59679** | ☐ |
| PC connection cord | CCA783 | **59664** | ☐ |
| **Input / output modules** | | | |
| **Sepam series 20 and series 40** | | | |
| 10 inputs + 4 outputs, 24-250 V DC | MES114 | **59646** | ☐ |
| 10 inputs + 4 outputs, 110-125 V DC / V AC | MES114E | **59651** | ☐ |
| 10 inputs + 4 outputs, 220-250 V DC / V AC | MES114F | **59652** | ☐ |
| **Sepam series 80** | | | |
| 14 inputs + 6 outputs, 24-250 V DC | MES120 | **59715** | ☐ |
| 14 inputs + 6 outputs, 220-250 V DC | MES120G | **59716** | ☐ |
| **Remote modules and cords** | | | |
| 8 temperature sensor module | MET148-2 | **59641** | ☐ |
| Analog output module | MSA141 | **59647** | ☐ |
| Remote advanced UMI module | DSM303 | **59608** | ☐ |
| Synchro-check module (including connection cord CCA785) | MCS025 | **59712** | ☐ |
| Remote module connection cord L = 0.6 m | CCA770 | **59660** | ☐ |
| Remote module connection cord L = 2 m | CCA772 | **59661** | ☐ |
| Remote module connection cord L = 4 m | CCA774 | **59662** | ☐ |
| Synchro-check module connection cord L = 2 m (spare parts) | CCA785 | **59665** | ☐ |
| **Communication accessories** | | | |
| **Sepam communication interfaces** | | | |
| 2-wire RS 485 Modbus interface (without CCA612) | ACE949-2 | **59642** | ☐ |
| 4-wire RS 485 Modbus interface (without CCA612) | ACE959 | **59643** | ☐ |
| Fiber optic Modbus interface (without CCA612) | ACE937 | **59644** | ☐ |
| RS 485 multi-protocol 2-wire interface (without CCA612) | ACE969TP | **59720** | ☐ |
| Fiber optic multi-protocol interface (without CCA612) | ACE969FO | **59721** | ☐ |
| Connection cord, L = 3 m | CCA612 | **59663** | ☐ |
| **Converters** | | | |
| RS 232 / RS 485 converter | ACE909-2 | **59648** | ☐ |
| RS 485 / RS 485 interface (AC) | ACE919CA | **59649** | ☐ |
| RS 485 / RS 485 interface (DC) | ACE919CC | **59650** | ☐ |
| Ethernet gateway (Merlin Gerin) | EGX200 | **EGX200MG** | ☐ |
| Ethernet webserver (Merlin Gerin) | EGX400 | **EGX400MG** | ☐ |
| **Core balance CTs** | | | |
| Core balance CT, Ø 120 mm | CSH120 | **59635** | ☐ |
| Core balance CT, Ø 200 mm | CSH200 | **59636** | ☐ |
| Interposing ring CT | CSH30 | **59634** | ☐ |
| Core balance CT interface | ACE990 | **59672** | ☐ |
| **Accessories for phase-current sensors (LPCT)** | | | |
| LPCT injection adapter | ACE917 | **59667** | ☐ |
| Remote LPCT test plug | CCA613 | **59666** | ☐ |





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# Sepam accessories and spare parts

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## Manuals

### Sepam series 20

| | | | | |
|---|---|---|---|---|
| User's manual | **PCRED301005** | **EN** ☐ | **FR** ☐ | ☐ |

### Sepam series 40

| | | | | |
|---|---|---|---|---|
| User's manual | **PCRED301006** | **EN** ☐ | **FR** ☐ | ☐ |

### Sepam series 80

| | | | | |
|---|---|---|---|---|
| Metering, protection, control and monitoring user's manual | **SEPED303001** | **EN** ☐ | **FR** ☐ | ☐ |
| Modbus communication user's manual | **SEPED303002** | **EN** ☐ | **FR** ☐ | ☐ |
| Installation and operation manual | **SEPED303003** | **EN** ☐ | **FR** ☐ | ☐ |

### Communication protocol

| | | | | |
|---|---|---|---|---|
| DNP3 protocol | **SEPED305001** | **EN** ☐ | **FR** ☐ | ☐ |
| IEC 60870-5-103 protocol | **SEPED305002** | **EN** ☐ | **FR** ☐ | ☐ |

***Note:*** *the technical manuals must be ordered separately form the CDI centre in Evreux.*

## Spare connectors

### Sepam

| | | | |
|---|---|---|---|
| 20-pin screw-type connector | CCA620 | **59668** | ☐ |
| 20-pin ring lug connector | CCA622 | **59669** | ☐ |
| 6-pin screw-type connector | CCA626 | **59656** | ☐ |
| 6-pin ring lug connector | CCA627 | **59657** | ☐ |
| 1 A / 5 A CT current connector | CCA630 | **59630** | ☐ |
| LPCT lateral current connector | CCA670 | **59631** | ☐ |
| LPCT radial current connector | CCA671 | **59702** | ☐ |
| VT voltage connector | CCT640 | **59632** | ☐ |

### MES modules

| | | | |
|---|---|---|---|
| Connectors for 2 MES114 and 2 MES120 | Kit 2640 | **59676** | ☐ |

## Spare Sepam series 80 base units

| | | | |
|---|---|---|---|
| With mimic-based UMI | SEP888 | **59705** | ☐ |
| With advanced UMI | SEP383 | **59704** | ☐ |
| Without UMI | SEP080 | **59703** | ☐ |
| 12 spring clips | | **XBTZ3002** | ☐ |

***Note:*** *the base units are supplied without connectors and without memory cartridges.*

## Spare Sepam series 80 memory cartridge

| Application | Type | | Working language 59709 | Working language 59710 | Logipam 59711 | |
|---|---|---|---|---|---|---|
| Substation | S80 | **59729** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | S81 | **59730** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | S82 | **59731** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | S84 | **59732** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| Transformer | T81 | **59733** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | T82 | **59734** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | T87 | **59735** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| Motor | M81 | **59736** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | M87 | **59737** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | M88 | **59738** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| Generator | G82 | **59739** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | G87 | **59741** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | G88 | **59742** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| Busbar | B80 | **59743** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| | B83 | **59744** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |
| Capacitor | C86 | **59745** ☐ | EN/FR ☐ | EN/SP ☐ | ☐ | ☐ |



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