

Electrical network protection

Sepam

series 60, series 80

Digital protection relays

Catalogue
2025



Schneider
Electric™

Range description

1

Sepam series 60

2

Sepam series 80

3

Additional modules and accessories

4

Order form

5

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1

Increase energy availability



Fast response

+



Maximum
dependability

=

**100% available
energy**

Your electrical equipment is under control.
With Sepam protection relays, you get
maximum energy availability for your process.

Sepam protection relays

Number one in dependability

Maximize energy availability and the profits generated by your installation while protecting life and property.

Keep informed to manage better

With Sepam, you get intuitive access to all system information in your language so that you can manage your electrical installation effectively. If a problem occurs, clear and complete information puts you in a position to make the right decisions immediately. The electrical supply is restored without delay.

Maintain installation availability

Sepam maintains high energy availability thanks to its diagnostics function that continuously monitors network status.

In-depth analysis capabilities and high reliability ensure that equipment is de-energized only when absolutely necessary.

Risks are minimized and servicing time reduced by programming maintenance operations.

Enhance installation dependability

Sepam series 80 is the first digital protection relay to deliver dependability and behaviour in the event of failure meeting the requirements of standard IEC 61508.

All Sepam series, 60 and 80 boards and electronic components are industrially conformal coated.

This manufacturing allows Sepam to be used in the most severe industrial environments including off-shore oil rigs and chemical factories (IEC 60068-2-60 and EIA 364-65A IIIA).

1982

Launch of first multi-functional digital protection relay

2018

Over 900,000 Sepam units installed around the world



Standard
IEC
60068

Standard
EIA
364-65A



Electrical utilities, petrochemical plants, hospitals, infrastructures, shopping centres, small industry.

1

Improve satisfaction



+



=

100% satisfaction

A set of simple and effective functions suited to your customer's application

Fast response from Schneider Electric: save time at every step in your project

With Sepam protection relays, you can count on simple, high-performance products and the support of top-notch Schneider Electric teams. Meet your obligations the easy way.

Sepam protection relays

Save time at every step in project development and installation to consistently meet your project deadlines.

Go for simplicity

With multi-functional Sepam protection relays, you can measure, manage, analyze and produce diagnostics for all applications in an installation. Range modularity makes it easy to select the relay corresponding exactly to your needs.

The range is structured for typical applications (substations, transformers, generators, capacitors, busbars and motors) and provides the necessary functions for each application (protection, metering, control and monitoring, etc.).

Starting with a Sepam base unit, complete solutions can be built up by adding input/output modules, sensors and communication modules.

Make configuration easily

A single PC software tool for the entire Sepam range makes system start-up and operation particularly easy. The user-friendly program guides you step by step from the initial programming on through to final commissioning. Sepam produces a detailed report on system configuration and all the activated protection functions.

On Sepam series 80, the entire setup is saved to a memory cartridge that can be accessed in front, for instance when replacing a unit.

Communicate the open way

In addition to the DNP3, IEC 60870-5-103 and Modbus standards, Sepam complies with IEC 61850 (GOOSE messages, TCP/IP redundancy) and uses the communication protocol that is today's market standard to interface with all brands of electrical-distribution devices.

1

190

Schneider Electric
does business in
190 countries



Installation



Setup



Local display



Supervision

1

What level of safety? For what applications?

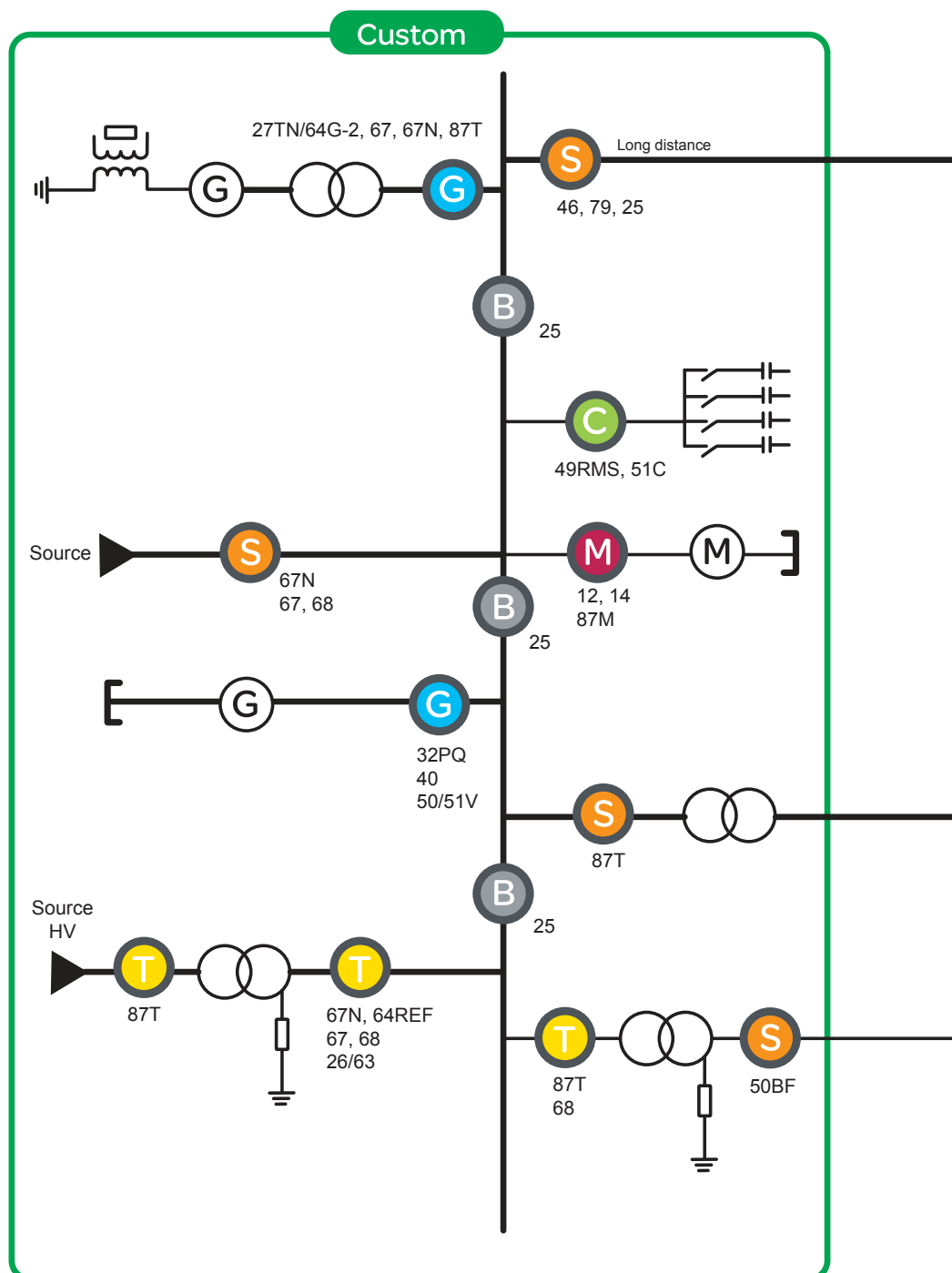
Sepam range design is based on a simple idea. All users should be able to find a solution corresponding exactly to their needs and offering the right balance between performance, simplicity and cost.

A Sepam relay for each application...

- Overcurrent
- Line differential
- Busbars
- Motors

... and different levels of protection

- > Thermal protection based on temperature rise calculation, with predictive indications to optimize process control.
- > Directional phase over-current protection for closed-loop networks.
- > Directional earth-fault protection for all types of neutral systems.
- > Fast and highly-sensitive protection of transformers, motors and generators using differential functions with restraint.



Custom applications



Sepam series 80

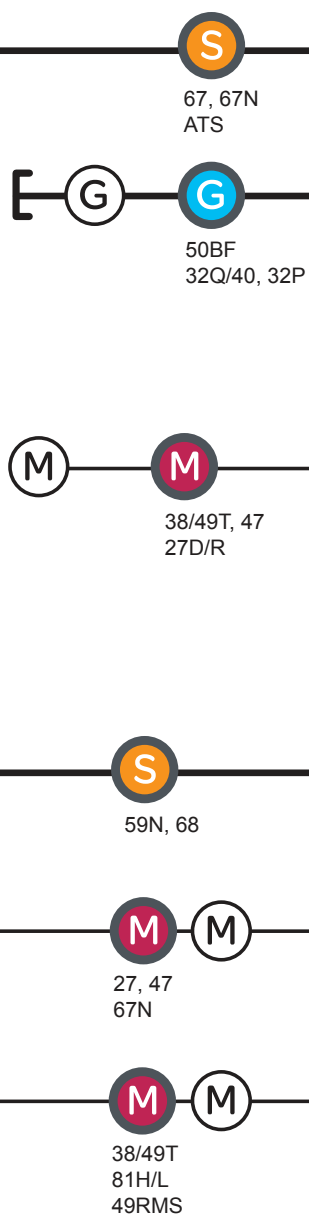
Demanding applications



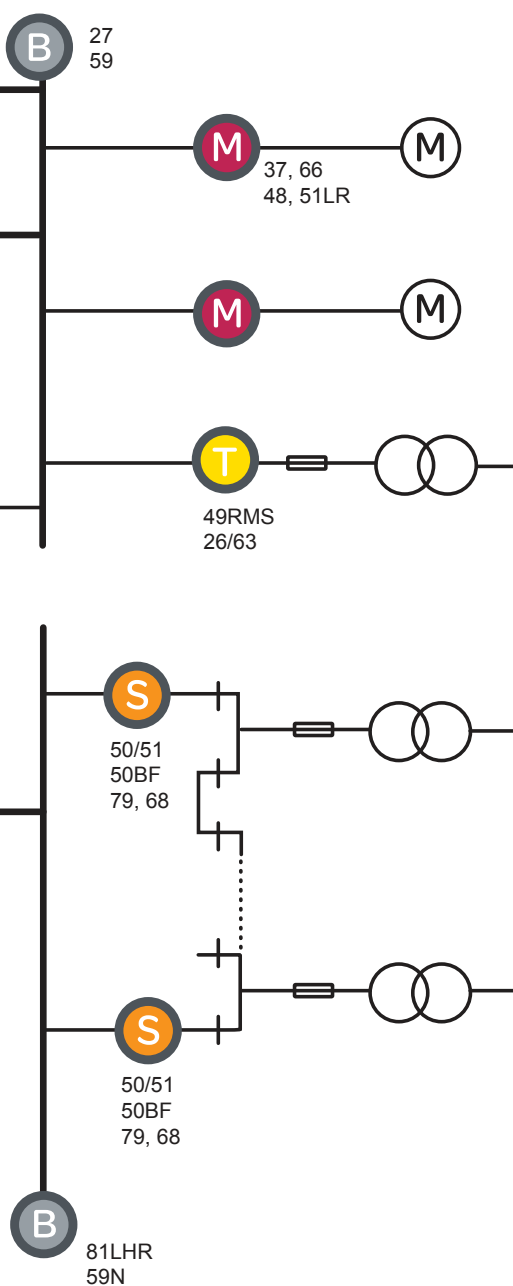
Sepam series 60

1

Demanding



Usual



1

Start-up was never so easy

The Sepam programming and operating software provides a single environment for the entire range. The result is a simple, user-friendly approach for fast commissioning.

Setup

Equipment setup

Set up the various modules (input/outputs, display, communication, sensors).

Protection setup

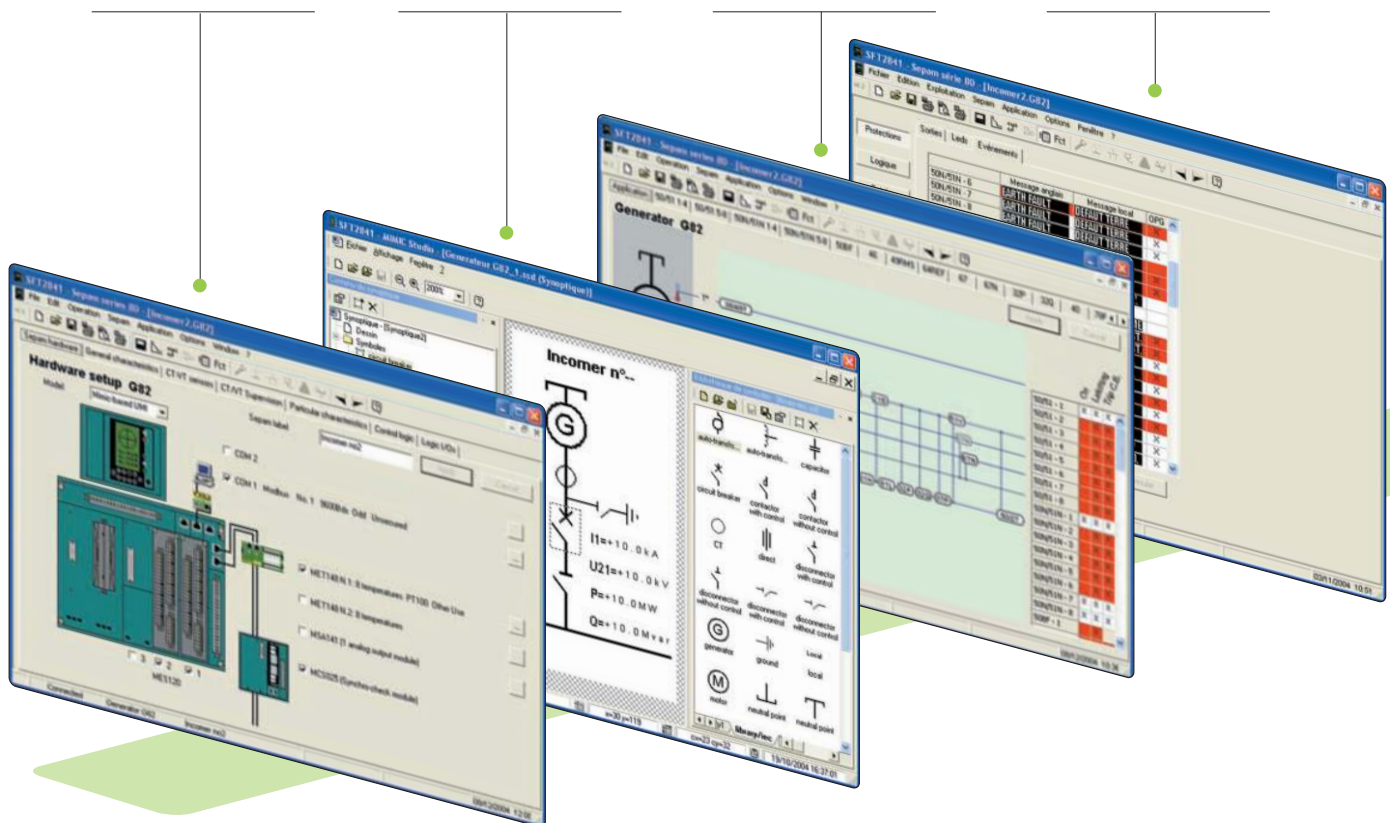
Prepare the single-line diagram either by reworking a mimic diagram from the library or by creating a new one.

Protection activation

Graphically create the links between sensors and the measurements carried out by the relays.

Summary of functions

Assign easily and quickly the various protection, control and monitoring functions.



10 minutes



5 minutes



5 minutes



40 minutes

Operation



The setup is now ready to be deployed on all the Sepam units in the installation.



Analysis of waveform capture

Display, analysis and printing of disturbance-recording data.

Real-time supervision

Supervision of the status of all the relays in the electrical installation.

Management of alarms and events



Automatic generation of the relay setup report.

15 years of peace of mind

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.

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.

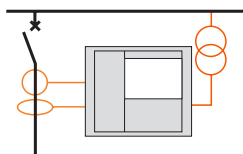
The list of functions is given for information purposes.

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

1

series 60

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Protections				
	Current	■	■	■
	Voltage	■	■	■
	Frequency	■	■	■
	Specifics		directional earth fault	directional earth fault and phase overcurrent
Applications				
	Substation P. 18	S60		S62
	Busbar P. 20			
	Transformer P. 22	T60		T62
	Motor P. 28		M61	
	Generator P. 32	G60		G62
	Capacitor P. 36	C60		
Characteristics				
Logic inputs/ outputs	Inputs	0 to 28		
	Outputs	4 to 16		
Temperature sensors		0 to 16		
Channel	Current	3I + Io		
	Voltage	3V, 2U + Vo or Vnt		
	LPCT ⁽¹⁾	Yes		
Communication ports		1 to 2		
IEC61850 Protocol		Yes		
Control	Redundancy	Yes		
	Goose message	Yes		
	Matrix ⁽²⁾	Yes		
Other	Logic equator editor	Yes		
	Logipam ⁽³⁾			
Other	Backup	Lithium battery ⁽⁴⁾		
	Front Memory cartridge with settings	Standard cartridge		

(1) LPCT: low-power current transducer complying with standard IEC 60044-8.

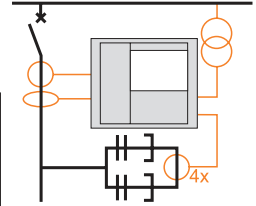
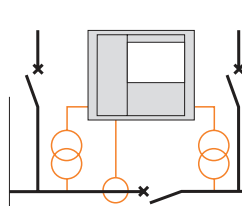
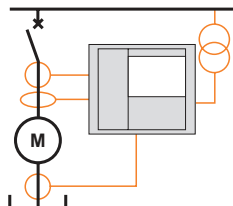
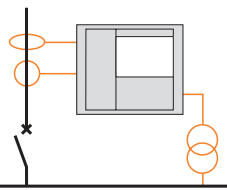
(2) Control matrix for simple assignment of information from the protection, control and monitoring functions.

(3) Logipam ladder language (PC programming environment) to make full use of Sepam series 80 functions.

(4) Standard lithium battery 1/2 AA format 3.6 V front face exchangeable.

series 80

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■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■
	directional earth fault	directional earth fault and phase overcurrent	disconnection by rate of change of frequency	transformer & transformer- machine unit differential	machine differential	voltage and frequency protection for 2 sets of busbars	capacitor-bank unbalance
S80	S81	S82	S84				
B80						B83	
	T81	T82		T87			
	M81			M88	M87		
		G82		G88	G87		
							C86
0 to 42 5 to 23				0 to 42 5 to 23		0 to 42 5 to 23	0 to 42 5 to 23
0 to 16				0 to 16		0 to 16	0 to 16
3I + 2 x Io 3V + Vo Yes				2 x 3I + 2 x Io 3V + Vo Yes		3I + Io 2 x 3V + 2 x Vo Yes	2 x 3I + 2 x Io 3V + Vo Yes
2 to 4				2 to 4		2 to 4	2 to 4
Yes				Yes		Yes	Yes
Yes				Yes		Yes	Yes
Yes				Yes		Yes	Yes
Yes				Yes		Yes	Yes
Yes				Yes		Yes	Yes
Lithium battery ⁽⁴⁾ Standard or extended cartridge				Lithium battery ⁽⁴⁾ Standard or extended cart.		Lithium battery ⁽⁴⁾ Standard or extended cart.	Lithium battery ⁽⁴⁾ Standard or extended cart.

Protection functions	ANSI code	S60	S62	S80	S81	S82	S84
Phase overcurrent ⁽¹⁾	50/51	4	4	8	8	8	8
Earth fault / Sensitive earth fault ⁽¹⁾	50N/51N 50G/51G	4	4	8	8	8	8
Earth fault cold load pick-up	CLPU 50N/51N						
Breaker failure	50BF	1	1	1	1	1	1
Negative sequence / unbalance	46	2	2	2	2	2	2
Thermal overload for cables	49RMS		1		2	2	2
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	2
Directional active underpower	37P						2
Positive sequence undervoltage	27D	2	2	2	2	2	2
Remanent undervoltage	27R	2	2	2	2	2	2
Undervoltage (L-L or L-N)	27	2	2	4	4	4	4
Overvoltage (L-L or L-N)	59	2	2	4	4	4	4
Neutral voltage displacement	59N	2	2	2	2	2	2
Negative sequence overvoltage	47	2	2	2	2	2	2
Overfrequency	81H	2	2	2	2	2	2
Underfrequency	81L	4	4	4	4	4	4
Rate of change of frequency	81R	2	2				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.

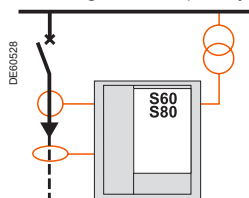
(3) With optional MCS025 synchro-check module.

Feeder protection

■ feeder short-circuit and overload protection.

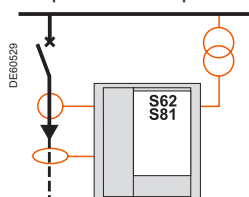
Protection of low-capacitance feeders in impedance earthed or solidly earthed neutral systems: Sepam S60 or S80

■ voltage and frequency monitoring.



Protection of high-capacitance feeders in impedance earthed or compensated or isolated neutral systems: Sepam S62 or S81

■ specific feeder protection: 67N/67NC.

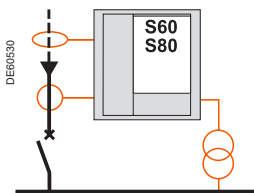


Incomer protection

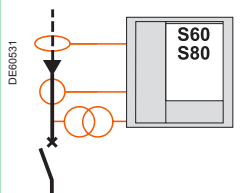
- busbar short-circuit protection.

Incomer protection: Sepam S60 or S80

- busbar voltage and frequency monitoring.

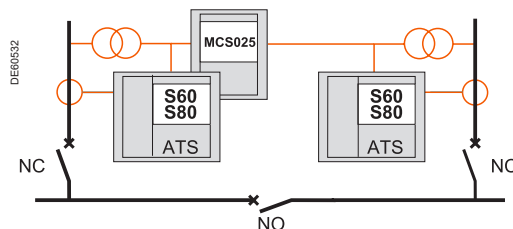


- line voltage and frequency monitoring.



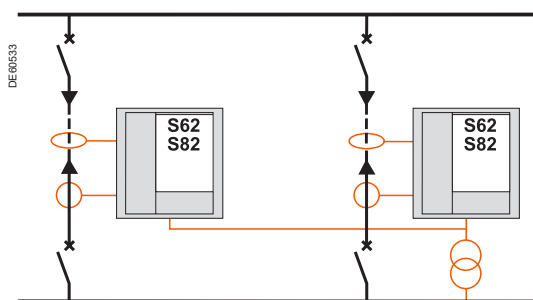
Protection of 2 incomers: Sepam S60 or S80

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



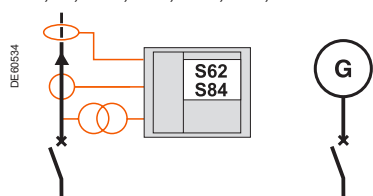
Parallel incomer protection: Sepam S62 or S82

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



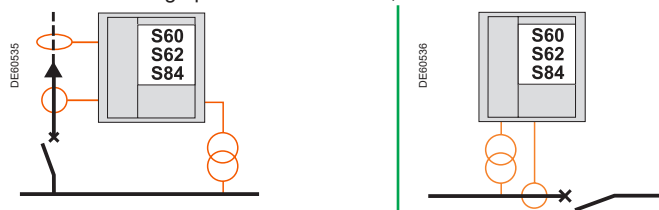
Parallel-incomer protection with disconnection function: Sepam S62 or Sepam S84

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



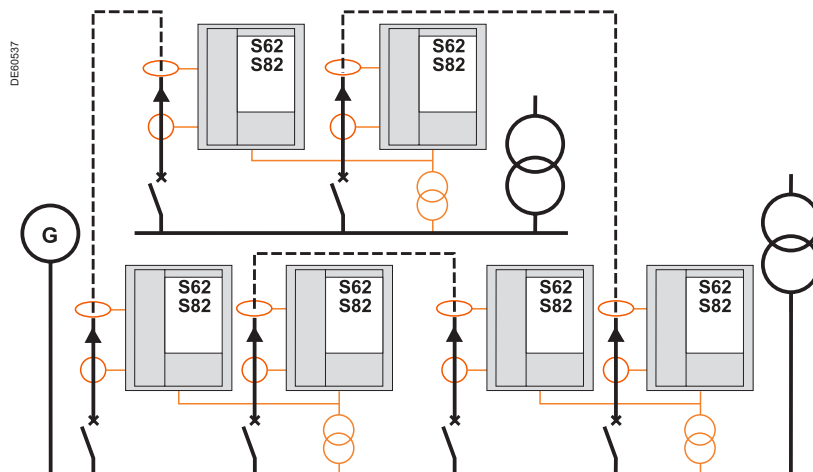
Protection of an incomer or coupling circuit breaker with load shedding based on frequency variations: Sepam S60, S62 or S84

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



Ring-incomer protection: Sepam S62 or S82

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



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Protection functions	ANSI code	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
Remanent undervoltage	27R	2	2
Undervoltage (L-L or L-N)	27	4	4
Overvoltage (L-L or L-N)	59	4	4
Neutral voltage displacement	59N	2	2
Negative sequence overvoltage	47	2	2
Overfrequency	81H	2	2
Underfrequency	81L	4	4
Synchro-check ⁽²⁾	25	□	□

The figures indicate the number of units available for each protection function
■ standard, □ options.

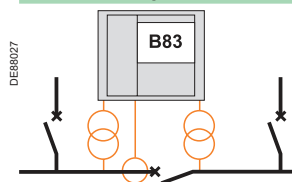
(1) Protection functions with 2 groups of settings.

(2) With optional MCS025 synchro-check module.

Coupling circuit-breaker protection

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

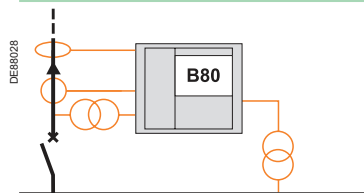
Monitoring of the 3 phase voltages and the residual voltage on 2 both half-busbars: Sepam B83



Incomer protection with additional busbar voltage monitoring

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

Additional busbar voltage monitoring: Sepam B80



1

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	T60	T62	T81	T82	T87
Phase overcurrent ⁽¹⁾	50/51	4	4	8	8	8
Phase overcurrent cold load pick-up	CLPU 50/51					
Earth fault / Sensitive earth fault ⁽¹⁾	50N/51N 50G/51G	4	4	8	8	8
Breaker failure	50BF	1	1	1	1	1
Negative sequence / unbalance	46	2	2	2	2	2
Broken conductor	46BC					
Thermal overload for machines ⁽¹⁾	49RMS	2	2	2	2	2
Restricted earth fault differential	64REF	2	2	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	2
Overfluxing (V / Hz)	24					2
Positive sequence undervoltage	27D	2	2	2	2	2
Remanent undervoltage	27R	2	2	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	2	2	2	2	2
Overfrequency	81H	2	2	2	2	2
Underfrequency	81L	4	4	4	4	4
Thermostat / Buchholz ⁽²⁾	26/63	□	□	□	□	□
Temperature monitoring (8/16 RTDs) ⁽³⁾	38/49T	□ 8/16 RTDs	□ 8/16 RTDs	□ 8/16 RTDs	□ 8/16 RTDs	□ 8/16 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.

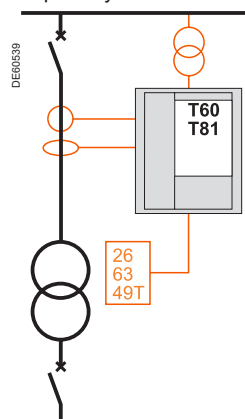
(3) With optional MET148-2 temperature input modules.

(4) With optional MCS025 synchro-check module.

Transformer feeder protection with voltage monitoring: Sepam T60 or T81

Earth fault protection:

■ primary: 50G/51G.

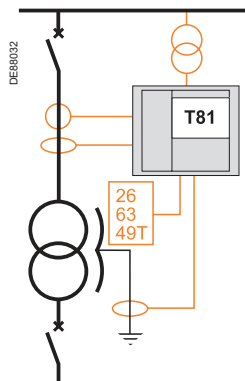


Note: for long feeders, the 50G/51G function may be replaced by the 67N/67NC.

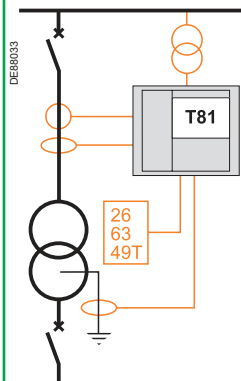
1

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.

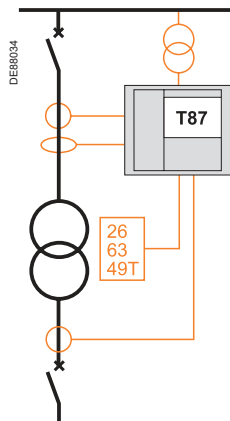


Note: for long feeders, the 50G/51G function may be replaced by the 67N/67NC.

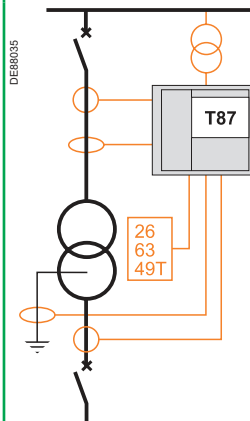
Transformer feeder differential protection: Sepam T87

Transformer differential protection: 87T

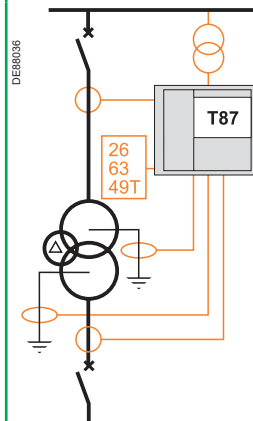
Earth fault protection:
■ primary: 50G/51G.



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



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



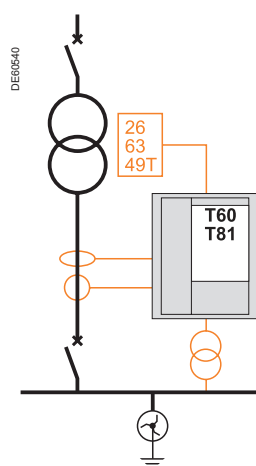
Transformer incomer protection

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

Transformer incomer protection with voltage monitoring: Sepam T60 or T81

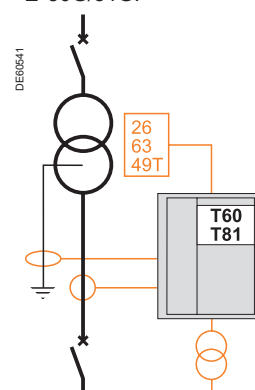
Earth fault protection:

- secondary: 50G/51G.



Earth fault protection:

- secondary:
- 64REF
- 50G/51G.

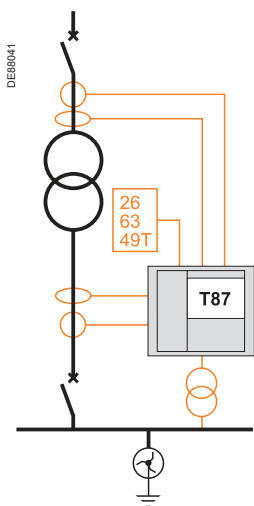


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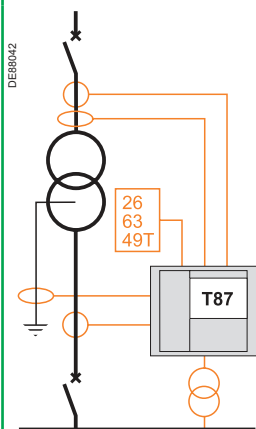
Transformer incomer differential protection: Sepam T87

Transformer differential protection: 87T

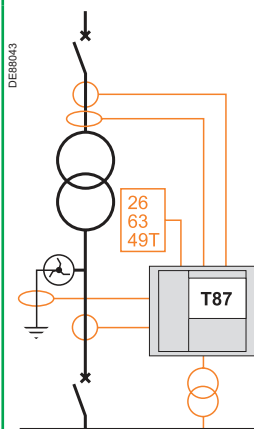
Earth fault protection:
■ primary: 50G/51G
■ secondary: 50G/51G.



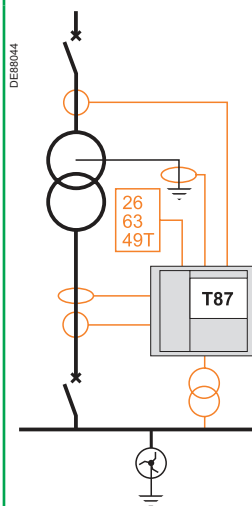
Earth fault protection:
■ primary: 50G/51G
■ secondary:
□ 64REF
□ 50G/51G.



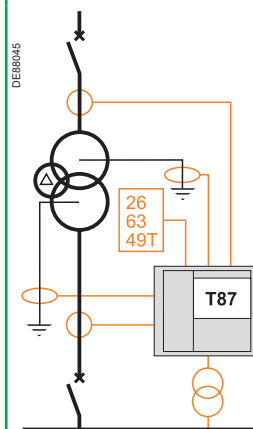
Earth fault protection:
■ primary: 50G/51G
■ secondary:
□ 64REF
□ 50G/51G.



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

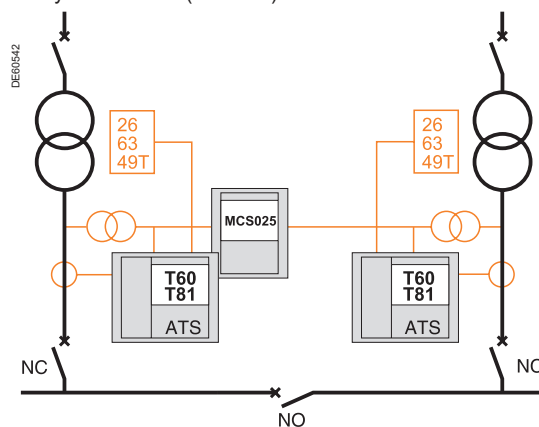


Earth fault protection:
■ primary:
□ 64REF
□ 50G/51G
■ secondary:
□ 64REF
□ 50G/51G.



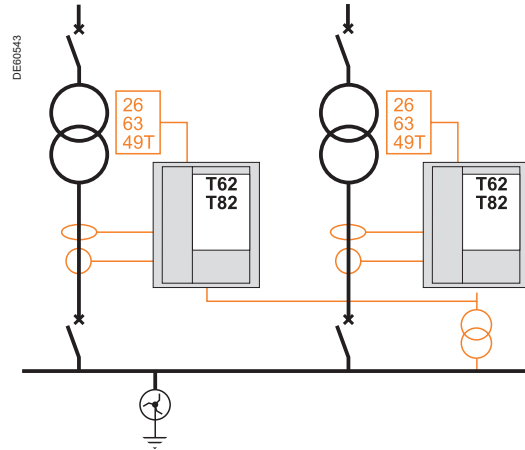
Protection of 2 non-coupled transformer incomers: Sepam T60 or T81

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

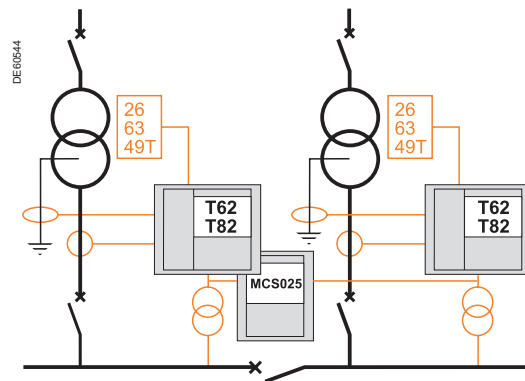


Parallel transformer incomer protection: Sepam T62 or T82

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

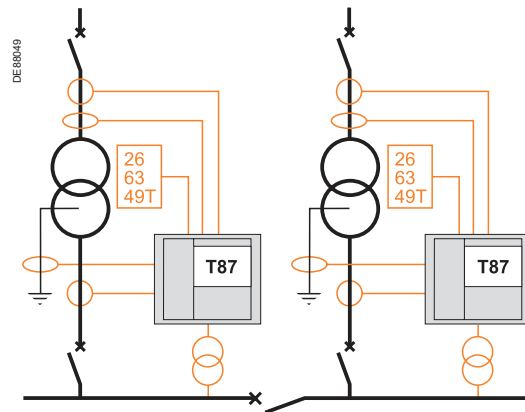


- transformer directional phase overcurrent protection: 67
- transformer secondary earth fault protection: 67N/67NC, 64REF
- with synchro-check (ANSI 25).



Parallel incomer differential protection: Sepam T87

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



Protection functions	ANSI code	M61	M81	M87	M88
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
Two-winding transformer differential	87T				1
Machine differential	87M			1	
Directional earth fault ⁽¹⁾	67N/67NC	2	2	2	2
Directional active overpower	32P	2	2	2	2
Directional reactive overpower	32Q/40	1	1	1	1
Field loss (under impedance)	40	1	1	1	1
Phase undercurrent	37	1	1	1	1
Excessive starting time, locked rotor	48/51LR/14	1	1	1	1
Starts per hour	66	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	2	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	2	2	2	2
Overfrequency	81H	2	2	2	2
Underfrequency	81L	4	4	4	4
Thermostat / Buchholz	26/63	□	□		□
Temperature monitoring (8/16 RTDs) ⁽³⁾	38/49T	□ 8/16 RTDs	□ 8/16 RTDs	□ 8/16 RTDs	□ 8/16 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.

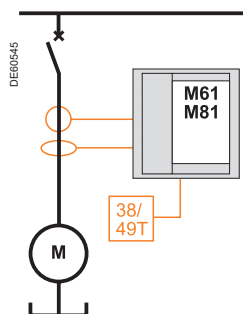
(3) With optional MET148-2 temperature input modules.

Motor protection

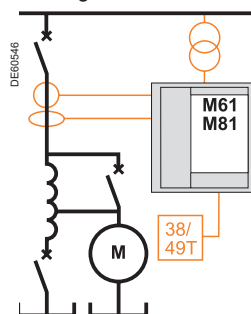
- internal motor fault protection
- power supply fault protection
- driven load fault protection
- RTD temperature monitoring (ANSI 38/49T).

Motor protection with voltage monitoring: Sepam M61 or M81

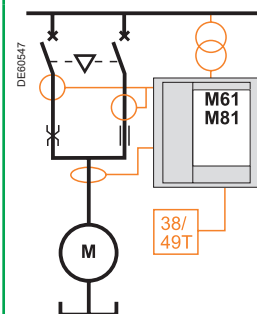
■ direct starting.



■ auto-transformer starting.



■ two-way.

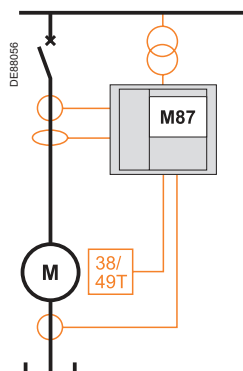


Motor differential protection: Sepam M87

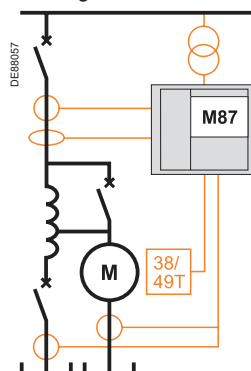
Motor differential protection: 87M.

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

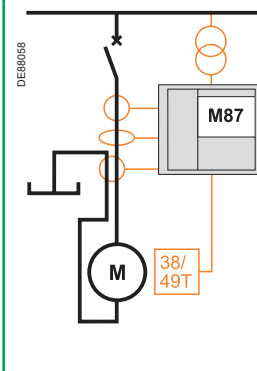
■ direct starting.



■ auto-transformer starting.



■ direct starting.

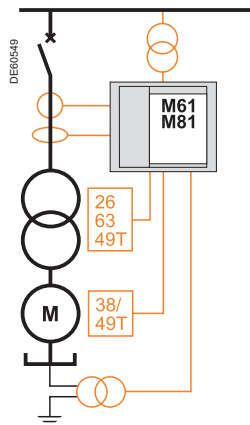


Motor-transformer unit protection

- 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).

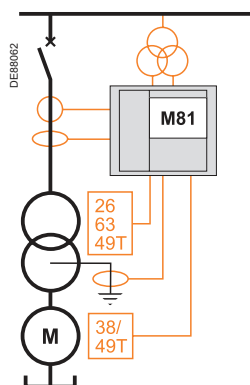
Motor-transformer unit protection with voltage and transformer monitoring: Sepam M61 or M81

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



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

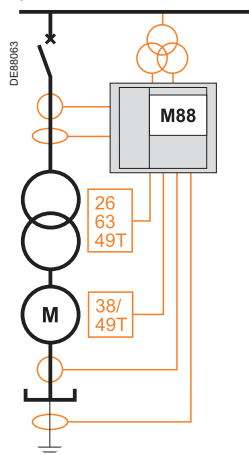
- motor earth fault protection: 50G/51G
- transformer primary earth fault protection: 50G/51G
- transformer monitoring: Buchholz, thermostat, temperature measurement.



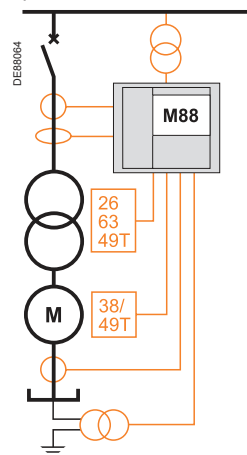
Motor-transformer unit differential protection: Sepam M88

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.



Protection functions	ANSI code	G60	G62	G82	G87	G88
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	1
Negative sequence / unbalance	46	2	2	2	2	2
Thermal overload for machines ⁽¹⁾	49RMS	2	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	2
Directional earth fault ⁽¹⁾	67N/67NC		2	2	2	2
Directional active overpower	32P	2	2	2	2	2
Directional reactive overpower	32Q/40	1	1	1	1	1
Directional active underpower	37P	2	2	2		
Field loss (underimpedance)	40	1	1	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	1	2	2	2
Underimpedance	21B	1	1	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	2	2
Remanent undervoltage	27R	2	2	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	2	2	2	2	2
Overfrequency	81H	2	2	2	2	2
Underfrequency	81L	4	4	4	4	4
Rate of change of frequency	81R	2	2			
Thermostat / Buchholz	26/63	□	□	□		□
Temperature monitoring (8/16 RTDs) ⁽³⁾	38/49T	□ 8/16 RTDs	□ 8/16 RTDs	□ 8/16 RTDs	□ 8/16 RTDs	□ 8/16 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.

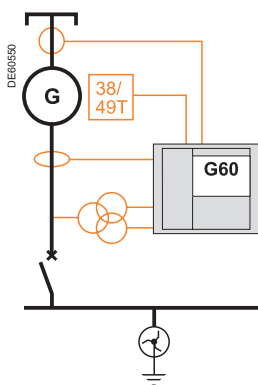
Generator protection

- 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 G60

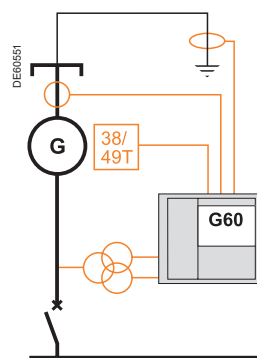
Earth fault protection:

- 50G/51G
- 59N.



Earth fault protection:

- 50G/51G.



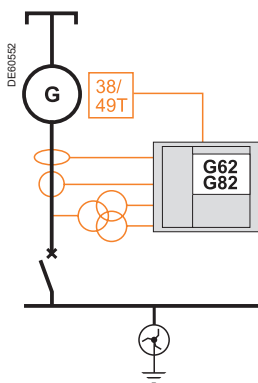
Protection of a generator coupled to other generators or to a network: Sepam G62 or G82

Short-circuit detection on generator side.

Control fault protection.

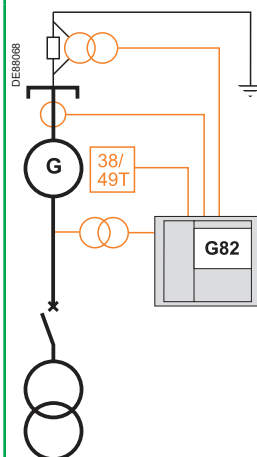
Earth fault protection:

- 50G/51G
- 59N.



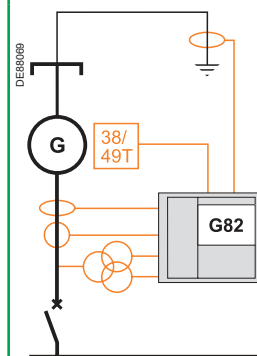
Earth fault protection:

- 100 % stator earth fault 64G.



Earth fault protection:

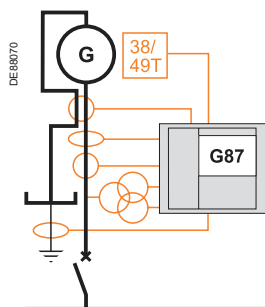
- 64REF and 50G/51G
- 50N/51N.



Generator differential protection: Sepam G87

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

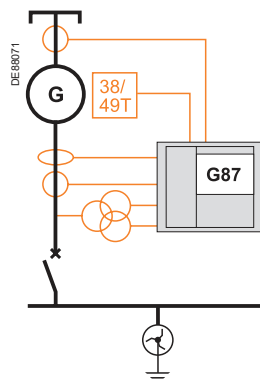
Earth fault protection: 50G/51G.



Generator differential protection: 87M.

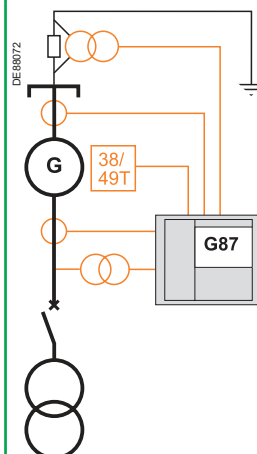
Earth fault protection:

- 50G/51G
- 59N.



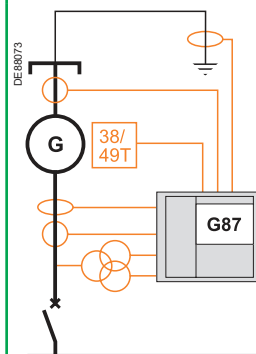
Earth fault protection:

- 100 % stator earth fault
64G.



Earth fault protection:

- 50N/51N.



Generator-transformer unit protection

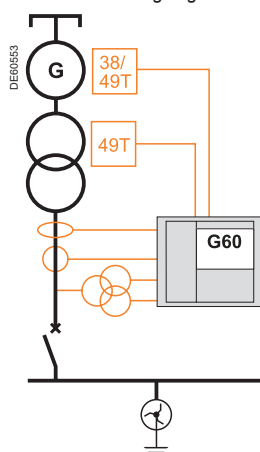
- generator and transformer protection against internal faults
- network fault protection
- driving machine fault protection
- RTD temperature monitoring (ANSI 38/49T)
- voltage and frequency monitoring.

Separate generator-transformer unit protection. Sepam G60

Earth fault protection:

- 50G/51G.

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



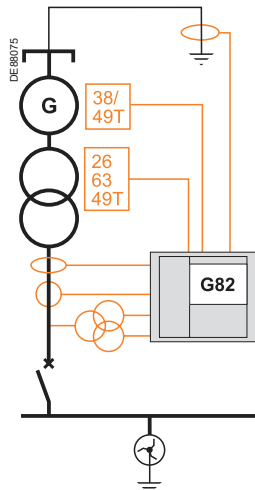
Protection of a generator-transformer unit coupled to other generators or to a network: Sepam G82

Short-circuit detection on generator side: 67.

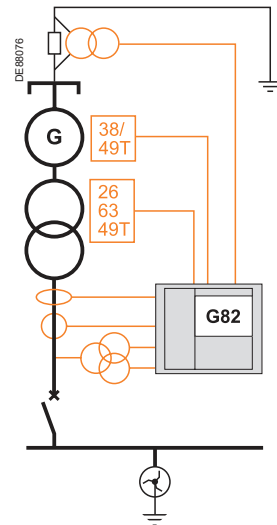
Control fault protection.

Internal transformer protection: Thermostat / Buchholz (ANSI 26/63).

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



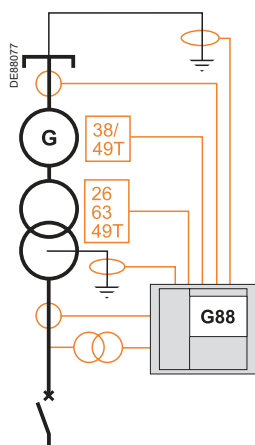
- generator earth fault protection: 100 % stator earth fault 64G
- transformer secondary earth fault protection:
 - 50G/51G
 - 59N.



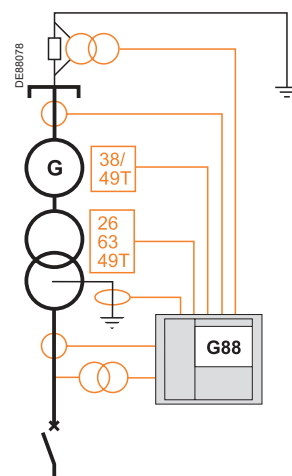
Generator-transformer unit differential protection: Sepam G88

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.



Protection functions	ANSI code	C60	C86
Phase overcurrent ⁽¹⁾	50/51	4	8
Earth fault / Sensitive earth fault ⁽¹⁾	50N/51N 50G/51G	4	8
Breaker failure	50BF	1	1
Negative sequence / unbalance	46	2	2
Thermal overload for capacitors ⁽¹⁾	49RMS	1	1
Capacitor-bank unbalance	51C		8
Positive sequence undervoltage	27D	2	2
Remanent undervoltage	27R	2	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	2	2
Overfrequency	81H	2	2
Underfrequency	81L	4	4
Temperature monitoring (8/16 RTDs) ⁽²⁾	38/49T	□ 8/16 RTDs	□ 8/16 RTDs

The figures indicate the number of units available for each protection function

■ standard, □ options.

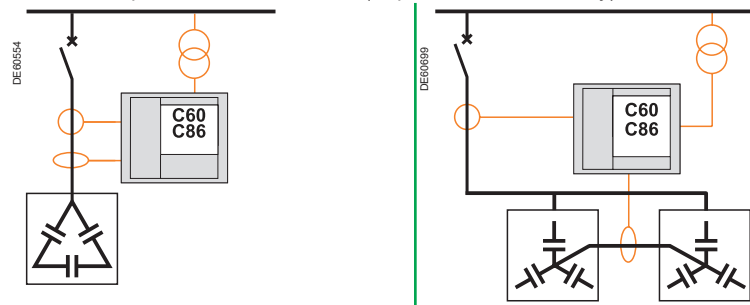
(1) Protection functions with 2 groups of settings.

(2) With optional MET148-2 temperature input modules.

Capacitor bank protection

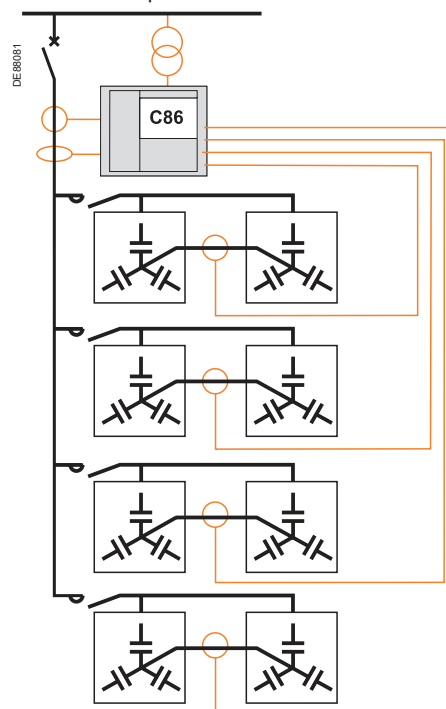
Protection of a capacitor bank with voltage monitoring: Sepam C60 or C86

- capacitor bank short-circuit protection
- voltage and frequency monitoring
- overload protection: ANSI 49RMS (Sepam C60 and 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.



Compatibility of Sepam low voltage

Protection functions

Sepam protection functions can be used with low voltage (LV) as long as the conditions below are met:

- The distribution circuit must be rated higher than 32 A.
- The installation must comply with standard IEC 60364.

For additional information about the compatibility of Sepam protection functions with low voltage, please contact Schneider Electric technical support.

The table below lists the Sepam protection functions suitable for low voltage according to the earthing system used. Sepam protection functions not listed in this table are not suitable for low voltage.

Protection functions	ANSI code	Earthing system				Comments
		TN-S	TN-C	TT	IT	
Phase overcurrent ⁽¹⁾	50/51	■	■	■	■	Neutral conductor not protected
Earth fault / Sensitive earth fault ⁽¹⁾	50N/51N	■	■	■	⁽¹⁾	
Earth fault / Sensitive earth fault ⁽³⁾	50G/51G	■	■	■	⁽³⁾	
Negative sequence / unbalance	46	■	■	■	■	Threshold to be adapted to the phase unbalance
Thermal overload for cables/ machines/capacitor ⁽¹⁾	49RMS	■	■	■	■	Neutral conductor not protected
Restricted earth fault	64REF	■	■	■	⁽³⁾	
Two-winding transformer differential	87T	■	■	■	■	
Directional phase overcurrent ⁽¹⁾	67	■	■	■	■ ⁽⁴⁾	
Directional earth fault ⁽¹⁾	67N/67NC	■	■	■	■	Incompatible with LV diagrams (4-wire)
Directional active overpower	32P	■	■	⁽²⁾	⁽²⁾	
Directional reactive overpower	32Q	■	■	⁽²⁾	⁽²⁾	
Undervoltage (L-L or L-N)	27	■	■	■	■	
Remanent undervoltage	27R	■	■	■	■	
Overvoltage (L-L or L-N)	59	■	■	■	■	
Neutral voltage displacement	59N	■	■	⁽⁴⁾	⁽⁴⁾	Residual voltage not available with 2 VTs
Negative sequence overvoltage	47	■	■	■	■	
Overfrequency (f)	81H	■	■	■	■	
Underfrequency (f)	81L	■	■	■	■	
Rate of change of frequency (f)	81R	■	■	■	■	
Synchro-check	25	■	■	■	■	

■ : Protection function suitable for low voltage

⁽¹⁾ Not recommended even on the second fault.

⁽²⁾ 2-wattmeter method not suitable for unbalanced loads.

⁽³⁾ Residual current too low in IT.

⁽⁴⁾ 2 phase-to-phase VTs.

Low voltage earthing systems

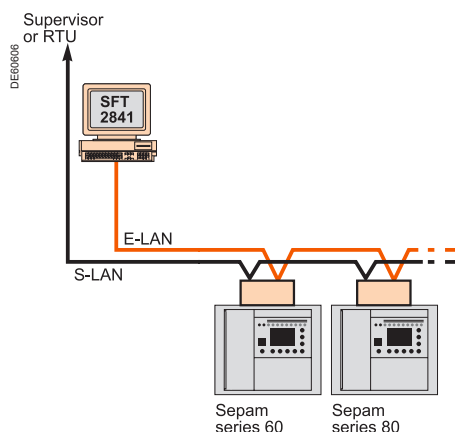
There are 4 low voltage (LV) earthing systems designated by a 2 or 3-letter acronym:

- TN-S.
- TN-C.
- TT.
- IT.

The letters making up the acronym have the following meanings:

Letter	Meaning
First letter	Transformer neutral point
I	Earthed with an impedance
T	Directly earthed
Second letter	Electrical exposed conductive parts of the consumer
T	Earthed
N	Connected to the neutral conductor
Third letter (optional)	Protective Earth conductor
S	Separate N neutral conductor and PE Protective Earth conductor
C	Combined N neutral conductor and PE Protective Earth conductor (PEN)

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 next pages.

Supervisory local area network (S-LAN)

A 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
- Modbus TCP/IP
- DNP3
- IEC 60870-5-103
- IEC 61850

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.

Modbus TCP/IP

Modbus TCP/IP communication protocol offers the same functions as Modbus RTU as well as compatibility with multi-master architectures

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.

IEC 61850

The standards in the IEC 61850 series define a protocol for communication in electrical substations. The Ethernet-based protocol offers advanced characteristics and interoperability between multi-vendor devices.

The Sepam relay handles the station bus, in compliance with standards IEC 61850-6, 7-1, 7-2, 7-3, 7-4 and 8-1 edition 1.

For more information on the IEC 61850 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.

IEC 60870-5-101 & IEC 60870-5-104

The SIS Gateway (Substation Controller) or C264 (Bay Computer) are database concentrators for industrial networks.

These gateways enable Sepam connection to IEC 60870-5-101 & IEC 60870-5-104 networks.

These gateways have a good capacity to manage high device concentration.

For more information on the SIS Gateway or C264, contact your local Schneider-Electric Support.



A complete range of Sepam communication interfaces



ACE850 communication interface

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, IEC 60870-5-103 or IEC 61850 or Modbus TCP/IP
- network physical interface:
 - 2-wire or 4-wire RS485
 - Ethernet
 - fiber optic, with star or ring architecture.

Sepam communication interfaces are presented in detail on chapter communication accessories selection guide.

Direct Sepam connection to the Ethernet network

Sepam series 60 and Sepam series 80 units can be directly connected to the Ethernet network via the ACE 850 communication interface. In this way they make full use of Ethernet network performance and all IEC 61850 functions.

- Compatible communication protocols: Modbus TCP/IP, IEC 61850
- Network physical interface:
 - 10 baseT /100 base TX (star or ring architecture)
 - 100 base FX (star or ring architecture).

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.

Advanced configuration of IEC 61850 protocol

The SFT850 software is used for advanced configuration of the IEC 61850 protocol for the ACE850 communication interface:

- complete Sepam-configuration database (.icd)
- processing of system-configuration files (.scd)
- creation and processing of ACE850 configuration files (.cid).

IEC 61850 protocol

Two levels of IEC 61850 protocol functionality are supported by the Sepam range.

Sepam IEC 61850 level 2

Sepam series 60 and Sepam series 80 units can be connected directly to an IEC 61850 system via the ACE850 communication interface.

In this way they make full use of Ethernet network performance and all IEC 61850 functions.

- Compatible communication protocols: Modbus TCP/IP, IEC 61850

- Network physical interface :

- ☐ 10 baseT /100 baseTX (star or ring architecture)

- ☐ 100 base FX (star or ring architecture).

Level 2 allows :

- Level 1 functions

- Dual port Ethernet for redundancy on Sepam series 60 and series 80 units (star or ring connection)

- GOOSE message on Sepam series 60 and Sepam series 80 (see below)

- Simultaneous Modbus TCP/IP TRA15

IEC 61850 GOOSE message

GOOSE messages allow standardized communication between Sepam units.

Sepam series 60, and series 80 and the ACE850 communication interface use GOOSE messages to provide :

- Improved system protection :

- ☐ logic discrimination

- ☐ intertripping

- ☐ load shedding

- Better system control on Sepam series 80:

- ☐ user-defined Logipam contacts

High-level safety and performance are guaranteed for these messages by :

- using fiber optic connections,

- using Ethernet switches which are compatible with IEC 61850 and, for the ring connection, RSTP 802.1d 2004, such as RuggedCom switches (e.g. RS900xx, RSG2xxx)

- choosing a fault-tolerant communication architecture.

Seven typical communication architectures are presented in the examples below. Each architecture is presented with:

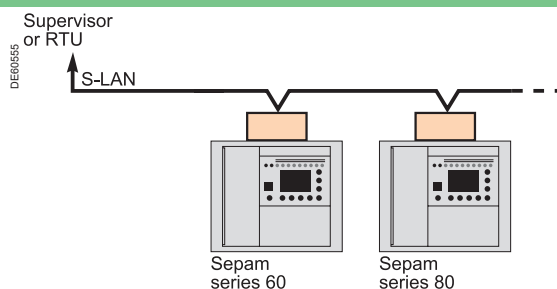
- a simplified diagram
- the characteristics of the implemented networks.

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 190.

Example 1. Single S-LAN network

S-LAN characteristics

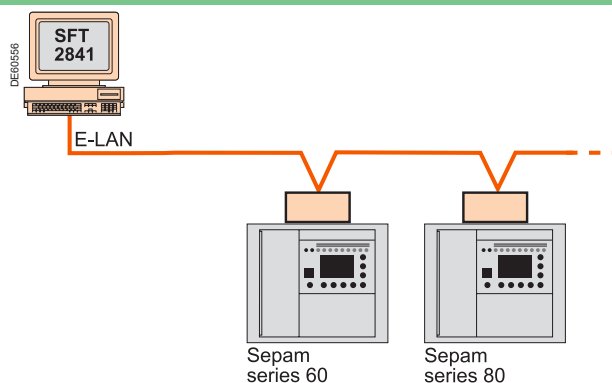
Protocol	Modbus RTU DNP3 or IEC 60870-5-103
Physical medium	Twisted-pair (2-wire or 4-wire RS485) or fiber optic



Example 2. Single E-LAN network

E-LAN characteristics

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



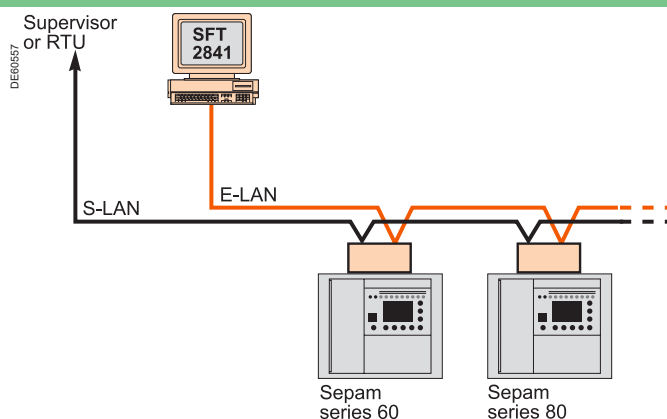
Example 3. Parallel S-LAN and E-LAN networks

S-LAN characteristics

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

E-LAN characteristics

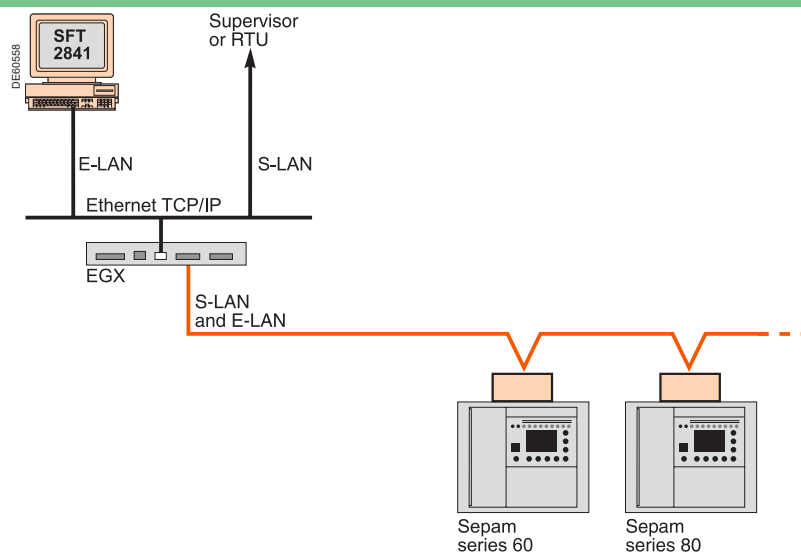
Protocol	Modbus RTU
Physical medium	2-wire RS485 (twisted-pair)



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)

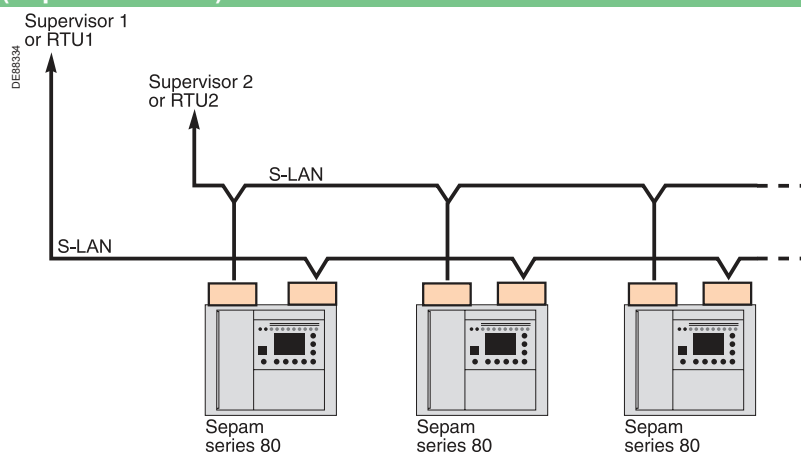


Example 5. Two parallel S-LAN networks (Sepam series 80)

S-LAN characteristics

Protocol	Modbus RTU DNP3 or IEC 60870-5-103
Physical medium	Twisted-pair (2-wire or 4-wire RS485) 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.



1

Example 6: S-LAN over IEC 61850 and E-LAN over Ethernet TCP/IP level 1**Characteristics of Modbus network between Sepam relays (S-LAN and E-LAN)**

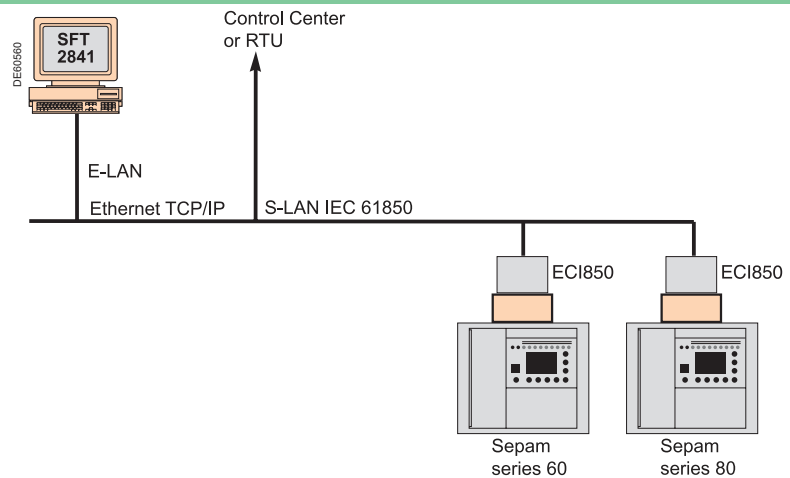
Protocol	Modbus RTU
Physical medium	Twisted-pair (2-wire or 4-wire RS485)

Characteristics of Ethernet network

Protocol	IEC 61850
Physical medium	Ethernet 10/100 BaseTx
Sepam ECI850 server functions	■ Modbus RTU / IEC 61850 conversion ■ Multiplexing between S-LAN and E-LAN networks

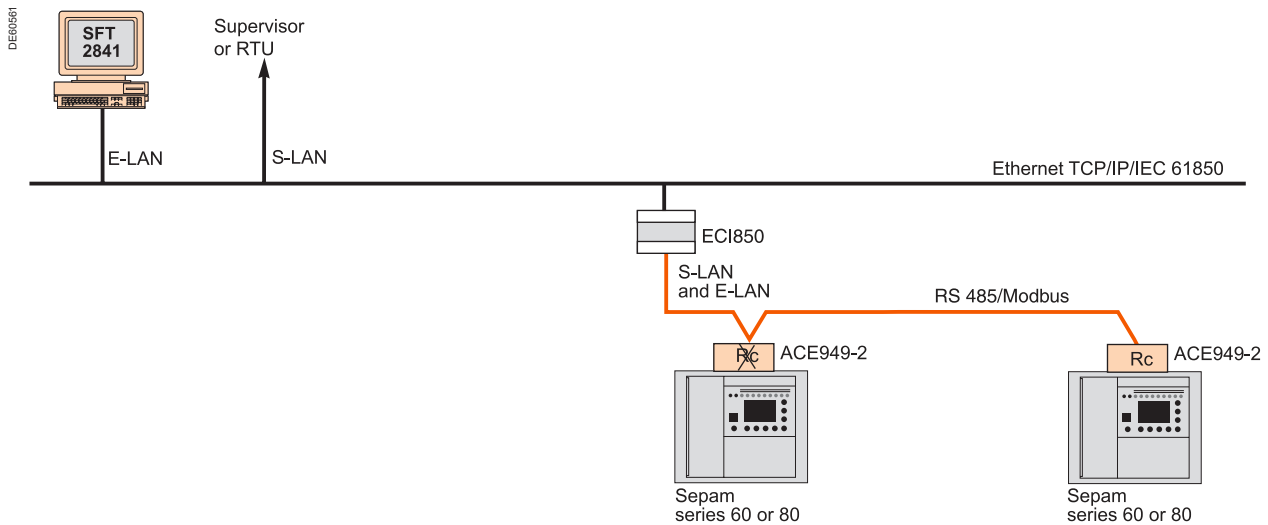
The level 1 allows:

- Upgrading of existing IEC 61850 Modbus installations on a single Ethernet port
- Supervision of electrical characteristics and Sepam status
- Circuit-breaker control
- Time-stamping, synchronization via SNTP, network diagnostics and disturbance recording



The Sepam IEC 61850 level 1 Server also enables connection of several Sepam units. The maximum Sepam configuration for a Sepam IEC 61850 level 1 server is:

- 2 Sepam Series 60 or 80 units.



Note: Rc : line impedance matching resistor.

Example 7: S-LAN over IEC 61850 and E-LAN over Ethernet TCP/IP (Sepam series 60 and series 80) level 2
Characteristics of Ethernet network

Protocol	IEC 61850
Physical medium	Ethernet 10/100 BaseTx or 100 Base Fx
Functions supported	■ Level 1 functions ■ Dual port Ethernet for redundancy on series 60 and series 80 (star or ring connection) ■ GOOSE messaging service on series 60 and series 80

ACE850TP or ACE850FO communication architecture
Performance

Redundancy performance tests have been conducted using RuggedCom switches (RS900xx and RSG2xxx ranges), compatible with RSTP 802.1d 2004. To ensure optimum performance of the protection system during communication between Sepam units via GOOSE messages, we strongly recommend setting up a fault-tolerant fiber optic ring structure as shown in the connection examples.

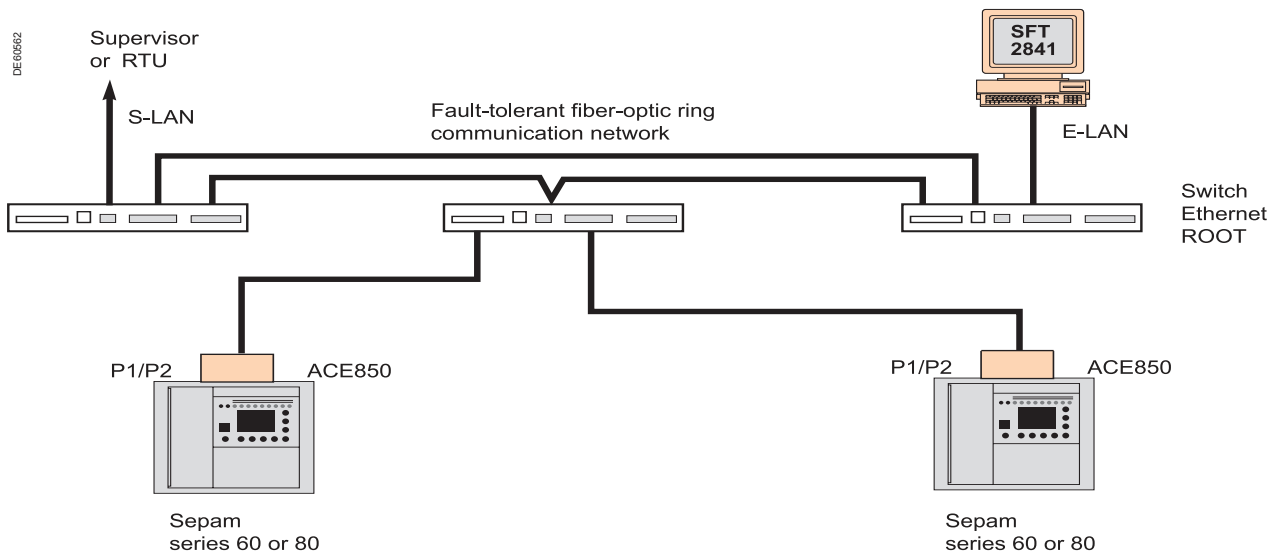
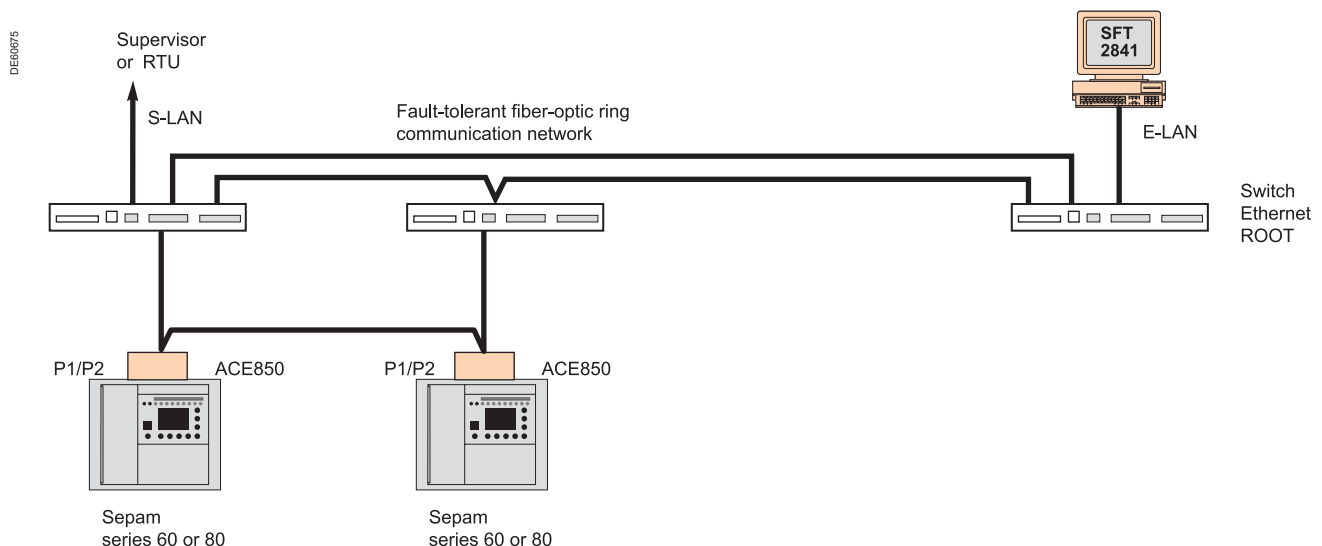
Note : Protection performance during communication between Sepam units via GOOSE messages is only ensured by using:

- fiber optic connections
- IEC 61850-compatible managed Ethernet switches.

ROOT Ethernet switch

The ROOT Ethernet switch is the master switch of the RSTP reconfiguration function:

- only one ROOT Ethernet switch is required per Ethernet network, in the main network loop.
- a Sepam unit should not be the ROOT Ethernet switch of the network.

Example of Sepam units connected in a star configuration

Example of Sepam units connected in loop configuration


Available Sepam data

Selection table

1

	Modbus RTU series		DNP3 series		IEC 60870-5-103 series	
	60	80	60	80	60	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	■	■				
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	■	■	■	■	■	■
Unsolicted 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	■	■	■	■		■

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 (when a TS is re-assigned with logipam, it is disconnected from the previous pre-assigned signification).

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.

Remote-control security

Transmission of Sepam series 60 and series 80 remote controls and settings over a Modbus S-LAN can be password protected.

Available Sepam data

Description

1

IEC 61850 logical nodes

Sepam supports IEC 61850 logical nodes as indicated in the following table. Note that the actual instantiation of each logical node depends on the application.

Nodes		Sepam series 60	Sepam series 80
L: system logical nodes			
LPHD	Physical device information	■	■
LLN0	Logical node zero	■	■
P: logical nodes for protection functions			
PDIF	Differential		■
PDOP	Directional overpower	■	■
PDUP	Directional underpower	■	■
PFRC	Rate of change of frequency		■
PHIZ	Ground detector	■	■
PMRI	Motor restart inhibition	■	■
PMSS	Motor starting time supervision	■	■
PPAM	Phase angle measuring	■	■
PSDE	Sensitive directional earth fault	■	■
PTOC	Time overcurrent	■	■
PTOF	Overfrequency	■	■
PTOV	Overvoltage	■	■
PTRC	Protection trip conditioning	■	■
PTTR	Thermal overload	■	■
PTUC	Undercurrent	■	■
PTUV	Undervoltage	■	■
PTUF	Underfrequency	■	■
PVOC	Voltage controlled time overcurrent	■	■
PVPH	Volts per Hz		■
PZSU	Zero speed or underspeed	■	■
R: logical nodes for protection related functions			
RBRF	Breaker failure	■	■
RREC	Autoreclosing	■	■
RDRE	Disturbance recorder function	■	■
RSYN	Synchronism-check or synchronizing	■	■
C: logical nodes for control			
CSWI	Switch controller	■	■
GG: logical nodes for generic references			
GGIO	Generic process I/O	■	■
M : logical nodes for metering and measurement			
MHAI	Harmonics or interharmonics	■	■
MHAN	Non phase related harmonics	■	■
MMTR	Metering	■	■
MMXU	Measurement	■	■
MSQI	Sequence and unbalance	■	■
MSTA	Metering statistics	■	■
SIML	Insulation medium supervision	■	■
X: logical nodes for switchgear			
XCBR	Circuit breaker	■	■
Z: logical nodes for further power system equipment			
ZCAP	Capacitor bank	■	■

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	IEC 61850
Number of event stacks for each Sepam communication port	2	1	1	Depending on configuration
Number of events per stack	64	100	100	Depending on configuration

Whatever the communication protocol used, Modbus RTU, DNP3, IEC 60870-5-103 or IEC 61850 events may be used by a remote monitoring and control system for data logging and histories, for example.

Unsololicited events

Using the DNP3 and IEC 61850 protocols, Sepam can spontaneously transmit time-tagged events to the supervisor. The transmission of unsolicited events must be activated during setup.

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.

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.

> TOOLS

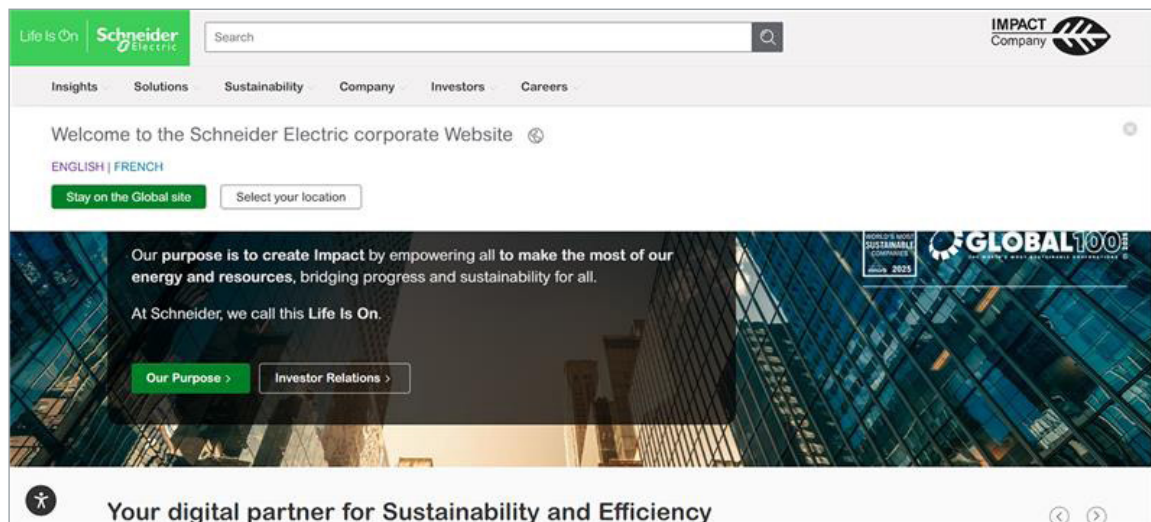
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2

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Protection	ANSI code	Substation		Transformer		Motor	Generator		Cap.
		S60	S62	T60	T62	M61	G60	G62	C60
Phase overcurrent ⁽¹⁾	50/51	4	4	4	4	4	4	4	4
Earth fault / Sensitive earth fault ⁽¹⁾	50N/51N 50G/51G	4	4	4	4	4	4	4	4
Breaker failure	50BF	1	1	1	1	1	1	1	1
Negative sequence / unbalance	46	2	2	2	2	2	2	2	2
Thermal overload for cables	49RMS		1						
Thermal overload for machines ⁽¹⁾	49RMS			2	2	2	2	2	
Thermal overload for capacitors	49RMS								1
Restricted earth fault	64REF			2	2				
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	2	2	
Directional reactive overpower	32Q					1	1	1	
Directional active underpower	37P						2	2	
Phase undercurrent	37					1			
Excessive starting time, locked rotor	48/51LR/14					1			
Starts per hour	66					1			
Field loss (underimpedance)	40					1	1	1	
Overspeed (2 set points) ⁽²⁾	12					□	□	□	
Underspeed (2 set points) ⁽²⁾	14					□	□	□	
Voltage-restrained overcurrent	50V/51V						1	1	
Underimpedance	21B						1	1	
Undervoltage (L-L or L-N)	27	2	2	2	2	2	2	2	2
Positive sequence undervoltage	27D	2	2	2	2	2	2	2	2
Remanent undervoltage	27R	2	2	2	2	2	2	2	2
Overvoltage (L-L or L-N)	59	2	2	2	2	2	2	2	2
Neutral voltage displacement	59N	2	2	2	2	2	2	2	2
Negative sequence overvoltage	47	2	2	2	2	2	2	2	2
Overfrequency	81H	2	2	2	2	2	2	2	2
Underfrequency	81L	4	4	4	4	4	4	4	4
Rate of change of frequency	81R	2	2				2	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 ⁽²⁾	94/69	□	□	□	□	□	□	□	□
Automatic transfer (AT) ⁽²⁾		□	□	□	□		□	□	
Load shedding / automatic restart ⁽²⁾						□			
De-excitation ⁽²⁾							□	□	
Genset shutdown ⁽²⁾							□	□	
Logic discrimination ⁽²⁾	68	□	□	□	□	□	□	□	□
Latching / acknowledgement	86	■	■	■	■	■	■	■	■
Annunciation	30	■	■	■	■	■	■	■	■
Switching of groups of settings		■	■	■	■	■	■	■	■
Adaptation using logic equations		■	■	■	■	■	■	■	■

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.

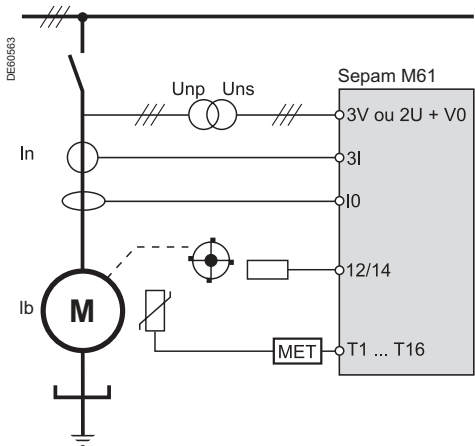
(1) Protection functions with 2 groups of settings.

	Substation		Transformer		Motor	Generator		Cap.
Metering	S60	S62	T60	T62	M61	G60	G62	C60
Phase current I1, I2, I3 RMS	■	■	■	■	■	■	■	■
Residual current Io, sum Io	■	■	■	■	■	■	■	■
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	■	■	■	■	■	■	■	■
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)	□	□	□	□	□	□	□	□
Temperature (16 RTDs) ⁽³⁾			□	□	□	□	□	
Rotation speed ⁽²⁾					□	□	□	
Network and machine diagnosis								
Tripping context	■	■	■	■	■	■	■	■
Tripping current Trip I1, Trip I2, Trip I3, Trip Io	■	■	■	■	■	■	■	■
Phase fault and earth fault trip counters	■	■	■	■	■	■	■	■
Unbalance ratio / negative sequence current li	■	■	■	■	■	■	■	■
Harmonic distortion (THD)	■	■	■	■	■	■	■	■
Current and voltage Ithd, Uthd	■	■	■	■	■	■	■	■
Phase displacement φ1, φ2, φ3	■	■	■	■	■	■	■	■
Disturbance recording recorded	■	■	■	■	■	■	■	■
Motor start report (MSR)					■			
Motor start trend (MST)					■			
Data log (DLG)	■	■	■	■	■	■	■	■
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					■			
Cable arcing fault detection	■	■	■	■	■	■	■	■
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⁾	□	□	□	□		□	□	
Switchgear diagnosis ANSI code								
CT / VT supervision 60/60FL	■	■	■	■	■	■	■	■
Trip circuit supervision ⁽²⁾ 74	□	□	□	□	□	□	□	□
Cumulative breaking current	■	■	■	■	■	■	■	■
Number of operations, operating time, charging time, number of racking out operations ⁽²⁾	□	□	□	□	□	□	□	□
Additional modules								
8 temperature sensor inputs - MET148-2 module ⁽²⁾			□	□	□	□	□	□
1 low level analog output - MSA141 module	□	□	□	□	□	□	□	□
Logic inputs/outputs - MES120/MES120G/MES120H (14I/6O) module	□	□	□	□	□	□	□	□
Communication interface - ACE949-2, ACE959, ACE937, ACE969TP-2, ACE969FO- 2, ECI850, ACE850TP or ACE850FO	□	□	□	□	□	□	□	□

■ 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.

2



Sepam M61 sensor inputs.

Sepam series 60 has analog inputs that are connected to the measurement sensors required for applications:

- main analog inputs, available on all types of Sepam series 60:
 - 3 phase current inputs I1, I2, I3
 - 1 residual current input I0
 - 3 phase voltage inputs V1, V2, V3 or 2 phase voltage and 1 residual voltage input V0.

The table below lists the analog inputs available according to the type of Sepam series 60.

		S60, S62	T60, T62, M61, G60, G62, C60
Phase current inputs	Main channel	I1, I2, I3	I1, I2, I3
Residual current inputs	Main channel	I0	I0
Unbalance current inputs for capacitor bank			I0
Phase voltage inputs	Main channel	V1, V2, V3 or U21, U32 ⁽¹⁾	V1, V2, V3 or U21, U32 ⁽¹⁾
Residual voltage inputs	Main channel	V0	V0
Temperature inputs (on MET148-2 module)			T1 to T16

(1) See VT connections diagram for Sepam series 60.

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	Rated phase current (sensor primary current)	2 or 3 1 A / 5 A CTs	1 A to 6250 A
	Unbalance current sensor rating (capacitor application)	3 LPCTs	25 A to 3150 A ⁽¹⁾
Ib	Base current, according to rated power of equipment	CT 1 A / 2 A / 5 A	1 A to 30 A
	Base current on additional channels (not adjustable)	Applications with transformer	0.2 to 1.3 I _n
In0	Rated residual current	Other applications	I' _b = I _b
		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
Unp	Rated primary phase-to-phase voltage (V _{np} : rated primary phase-to-neutral voltage V _{np} = Unp/√3)	Core balance CT + ACE990 (the core balance CT ratio 1/n must be such that 50 y n y 1500)	According to current monitored and use of ACE990
Uns	Rated secondary phase-to-phase voltage		220 V to 250 kV
Uns0	Secondary zero sequence voltage for primary zero sequence voltage Unp/√3	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
Vntp	Neutral point voltage transformer primary voltage (generator application)		Uns/3 or Uns/3
Vnts	Neutral point voltage transformer secondary voltage (generator application)		220 V to 250 kV
fn	Rated frequency		57.7 V to 133 V
P	Phase rotation direction		50 Hz or 60 Hz
	Integration period (for demand current and peak demand current and power)		1-2-3 or 1-3-2
	Pulse-type accumulated energy meter		5, 10, 15, 30, 60 min
Ωn	Rated transformer power	Increments active energy	0.1 kWh to 5 MWh
		Increments reactive energy	0.1 kVARh to 5 MVARh
R	Rated speed (motor, generator)		100 kVA to 999 MVA
R	Number of pulses per rotation (for speed acquisition)		100 to 3600 rpm
	Zero speed set point		1 to 1800 (Ωn x R/60 y 1500)
			5 to 20 % of Ωn

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

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 current IOS, calculated by the vector sum of the 3 phase currents
- measured residual current IO.

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
- 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 or neutral point voltage Vnt
- positive sequence voltage Vd and negative sequence voltage Vi
- frequency measured on the main voltage channels.

Power

Powers are calculated according to the phase currents I1, I2 and I3:

- active power
- reactive power
- apparent power
- power factor ($\cos \phi$).

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 protection functions.

According to the connected sensors, all current and voltage information can be selected for display in vector form.

Data log (DLG)

This function is used to record and back up a set of measurements (1 to 15) available in the Sepam relay. The number of backed-up files and the number of measurements per file depend on the type of cartridge installed (extended cartridge available for Sepam 80 only). The recording mode and selection of measurements can be configured by the user via the SFT2841 software.

All trip of the function results from an external event (TC for example). The stop condition and file management differ according to which of the following 2 modes is used:

- a) Limited:** the DLG function stops automatically when the end of recording time is reached or on receipt of an external event (TC for example).
- b) Circular:** the file content is managed in a FIFO memory: when the file is full, the write operation continues and starts again at the start of the file. Stopping the write operation only results from an external event (TC for example). In the absence of the stop command, recording is continuous.

Using the DLG function does not affect the quality of service of Sepam's active protection functions.

Characteristics

Configuration parameters

Content of a COMTRADE file	■ Configuration file (*.CFG) : date, variable characteristics, transformation ratio of the selected variable values ■ Samples file (*.DAT): recorded variables
Total file duration	1 s to 30 days
Sampling period	1 s to 24 hours
Variables available for recording	See the table of available data p.99/100.
Number of files	1 à 20
Number of variables per file	1 à 15
Source of starting and stopping	■ SFT 2841 software ■ Logic equation or Logipam ■ TC ■ Logic or GOOSE input
File format	COMTRADE 9

Nota : These parameters are configured with the SFT2841 software.

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 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, 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 $\phi 1$, $\phi 2$, $\phi 3$ between phase currents I1, I2, I3 and voltages V1, V2, V3 respectively
- phase displacement $\phi 0$ 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

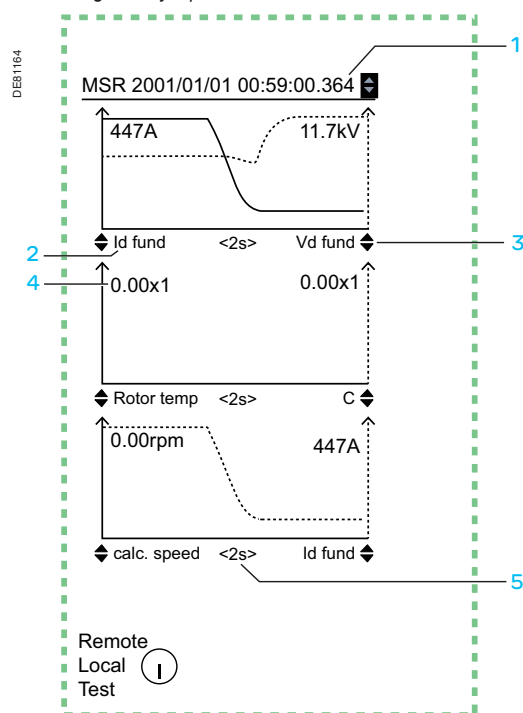
Voltage comparison for synchro-check

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.

Visualisation of 3 graphics MSR
via an integrated synoptic HMI.



- 1 Time tagging of the selected file and file selection zone
- 2 Name of the 1st variable associated with the Y-axis
- 3 Selection zone for the variable to be associated with the Y-axis
- 4 Maximum value observed for the recorded

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.
- recording data during motor start (MSR) and create trend graphics (MST).

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 lb. 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 lb. 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.

Apparent positive sequence impedance Z_d

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).

Capacitance

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

Motor Start Report (MSR)

This function, available only in motor applications, can stock during a configured duration multiple files of 144 data samples selected.

Read

The files can be viewed:

- a) after downloading, on a PC screen, using the WaveWin software
- b) on the Sepam display using the Diagnosis menu.

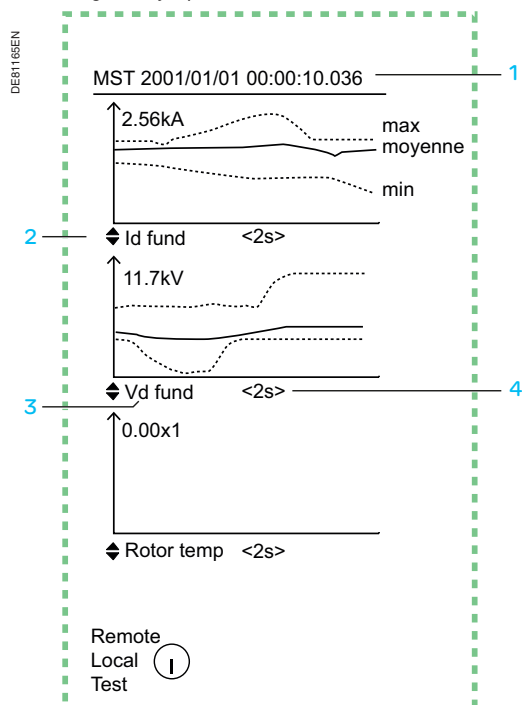
Caractéristiques

Paramètres de configuration

Content of a COMTRADE file	■ Fichier de configuration (*.CFG): date, variable characteristics, transformation ratio of the selected variable values ■ Samples file (*.DAT) : recorded variables
Total file duration	2 s to 144 s
Sampling frequency	Depends on the configured duration (144 s maximum). Example: For a duration of 144 s the frequency is 1 Hz, for a duration of 2 s the frequency is 72 Hz.
Variables available for recording	See the table of available data . p. 99 / 100
Number of files	■ 1 to 5 with standard cartridge ■ 1 to 20 with extended cartridge
Number of variables per file	■ 1 to 5 with standard cartridge ■ 1 to 10 with extended cartridge
Source of starting and stopping	■ SFT 2841 software ■ Logic equation or Logipam ■ TC ■ Logic or GOOSE input
File format	COMTRADE 97

Nota : These parameters are configured with the SFT2841 software.

Visualisation of 3 graphics MST
via an integrated synoptic HMI.



- 1 Time tagging of the current file
- 2 Selection of the variable to be associated with the Y-axis
- 3 Name of the analyzed variable
- 4 Duration of read time for each file

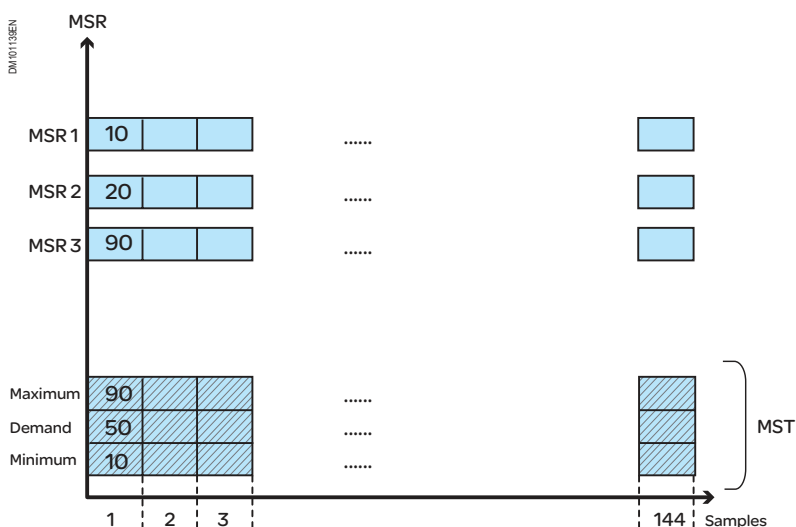
Motor Start Trend (MST)

This function, only available for motor applications, is related to the Motor start trend function. It is used to calculate and display in the form of curves the minimum, demand and maximum values for each value.

These recalculated values which are stored in a file of 144 samples covering a 30-day period. When the current 30-day period has ended, it is automatically archived in COMTRADE format and will no longer be able to be viewed on the Sepam display

The number of files available varies between 12 and 18 depending on the type of memory cartridge (standard or extended) installed on Sepam

The trends are only recalculated at the end of each Motor start report.



Calculating an MST using the available MSRs.

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.

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.

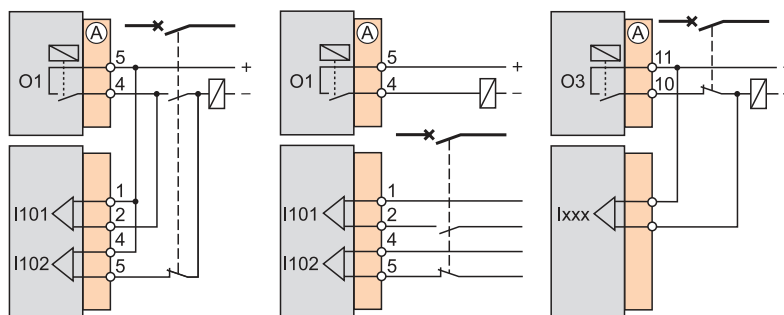
In the event of a loss of current or voltage measurement data, the assigned protection functions may be inhibited to avoid nuisance tripping.

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

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.

Functions		Measurement range	Accuracy ⁽¹⁾	MSA141	Saving	Available data MSR/MST	
						Designation	Units
Metering							
Phase current		0,02 to 40 In	±0,5 %	■		I1, I2, I3	A
Residual current	Measured	0,005 to 20 In	±1 %	■		I0m	A
	Calculated	0,005 to 40 In	±1 %	■		I0c	A
Demand current		0,02 to 40 In	±0,5 %			I1moy, I2moy, I3moy	A
Peak demand current		0,02 to 40 In	±0,5 %		□	I1max, I2max, I3max	A
Voltage metering							
Phase-to-phase voltage		0,06 to 1,2 Unp	±0,5 %	■		U21, U32, U31	V
Phase-to-neutral voltage		0,06 to 1,2 Vnp	±0,5 %	■		V1, V2, V3	V
Residual voltage		0,04 to 3 Vnp	±1 %			V0	V
Neutral point voltage		0,04 to 3 Vntp	±1 %			Vnt	V
Positive sequence voltage		0,05 to 1,2 Vnp	±2 %			Vd	V
Negative sequence voltage		0,05 to 1,2 Vnp	±2 %			Vi	V
Frequency	Main channels (f)	25 to 65 Hz	±0,02 Hz	■		F	Hz
Power metering							
Active power (total or per phase)		0,015 Sn to 999 MW	±1 %	■		P	MW
Active power per phase						P1, P2, P3	MW
Peak demand active power		0,015 Sn to 999 MW	±1 %		□	Pmax	MW
Reactive power (total or per phase)		0,015 Sn to 999 Mvar	±1 %	■		Q	Mvar
Reactive power per phase						Q1, Q2, Q3	Mvar
Peak demand reactive power		0,015 Sn to 999 Mvar	±1 %		□	Qmax	Mvar
Apparent power (total or per phase)		0,015 Sn to 999 MVA	±1 %	■		S	MVA
Apparent power per phase						S1, S2, S3	MVA
Peak demand apparent power						Smax	MVA
Power factor (cos φ)		-1 to +1 (CAP/IND)	±0,01	■		cosPhi	MVA
Apparent power	Measured (+ and -)					Eam+, Eam-	MW.h
	Calculated (+ and -)	0 to 2,1.10 ⁸ MW.h	±1 % ±1 digit		□ □	Eac+, Eac-	MW.h
Reactive power	Measured (+ and -)					Erm+, Erm-	Mvar.h
	Calculated (+ and -)	0 to 2,1.10 ⁸ Mvar.h	±1 % ±1 digit		□ □	Erc+, Erc-	Mvar.h
Other metering							
Temperature		-30 to +200 °C or -22 to +392 °F	±1 °C de +20 to +140 °C ±1,8 °F de +68 to +284 °F	■		T1 to T16	°C / °F
Rotation speed		0 to 7200 tr/mn	±1 tr/mn			Rot104	tr / mn
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 % Ib	±2 %			Ii / Ib	% Ib or % I'b
Total harmonic distortion, current		0 to 100 %	±1 %			Ithd	%
Total harmonic distortion, voltage		0 to 100 %	±1 %			Uthd	%
Phase displacement φ 0 (between V0 & I0)		0 to 359°	±2°			φ 0	°
Phase displacement φ 1, φ2, φ 3 (between V & I)		0 to 359°	±2°			φ 1, φ 2, φ 3	°
Thermal capacity used						Ech	%
Running hours counter						CH	hours
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					□		

■ 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, cos φ > 0.8..

Functions		Measurement range	Accuracy ⁽¹⁾	MSA141	Saving	Available data MSR/MST	
						Description	Units
Machine operating assistance							
Phase-to-phase voltages U21, U22, U13		0,06 to 1,2 Unp	±0,5 %	■		U21 , U22 , U13	V
I1, I2, I3		0,02 to 40 In	±0,5 %	■		I1 , I2 , I3	A
Temperature		-30 to +200 °C or -22 to +392 °F	±1 °C de +20 to +140 °C ±1,8 °F de +68 to +284 °F			T1 à T16	°C / °F
Rotor speed of rotation calculated via 49RMS motor						Rot49	tr / mn
Rotor speed of rotation measured via I104 input		0 to 7200 tr/mn	±1 tr/mn			Rot104	tr / mn
Motor thermal capacity used ⁽²⁾ 0 to 800 % (100 % for I phase = Ib)		±1 %	■	□ □		M	pu
Rotor thermal capacity used ⁽²⁾						W	pu
Rotor resistance ⁽²⁾						Rr+	Ω
Stator thermal capacity used ⁽²⁾						E	pu
Stator resistance ⁽³⁾						Rs	Ω
Positive-sequence current						Id	A
Negative-sequence current						Ii	A
Positive-sequence voltage		0,05 to 1,2 Vnp	±2 %			Vd	V
Negative-sequence voltage		0,05 to 1,2 Vnp	±2 %			Vi	V
Residual current	Measured	0,005 to 20 In	±1 %			I0	A
	Calculated	0,005 to 40 In	±1 %			I0_S	A
Measured residual voltage						V0	V
Motor torque ⁽²⁾						C	pu
Slip (calculated via 49RMS motor)						g	pu
Frequency ⁽⁴⁾						F	Hz
Remaining operating time before overload tripping		0 à 999 mn	±1 mn				
Waiting time after overload tripping		0 à 999 mn	±1 mn				
Running hours counter / operating time		0 à 65535 heures	±1 % ou ±0,5 h		□ □		
Starting current		1,2 Ib à 40 In	±5 %		□		
Starting time		0 à 300 s	±300 ms		□		
Number of starts before inhibition		0 à 60	-				
Start inhibit time		0 à 360 mn	±1 mn				
Phase displacement ϕ1, ϕ2, ϕ3 between I)		0 à 359°	±2°				
Apparent impedance Zd, Z21, Z32, Z13		0 à 200 kΩ	±5 %				
Capacitance		0 à 30 F	±5 %				
Switchgear diagnosis assistance							
Cumulative breaking current		0 à 65535 kA²	±10 %		□ □		
Number of operations		0 à 4.10⁹	-		□ □		
Operating time		20 à 100 ms	±1 ms		□ □		
Charging time		1 à 20 ms	±0,5 s		□ □		
Number of rackouts		0 à 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, cos φ > 0.8..

(2) The value used is that provided by the 49RMS motor thermal overload protection if this has been activated. The value is 0 if the 49RMS generic thermal overload protection has been activated.

(3) The value used is that for the active 49RMS protection: motor thermal overload or generic thermal overload.

(4) Only available for the main voltage channels.

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 17 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.

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.

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.

ANSI 67N/67NC type 1

Directional earth fault protection for impedance, 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.

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.

ANSI 67N/67NC type 3

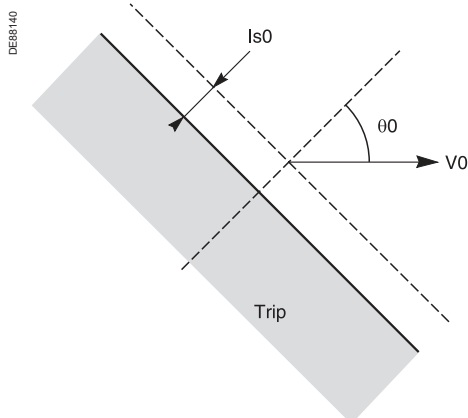
Directional overcurrent protection for distribution networks in which the neutral earthing system varies according to the operating mode, based on measured residual current.

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.

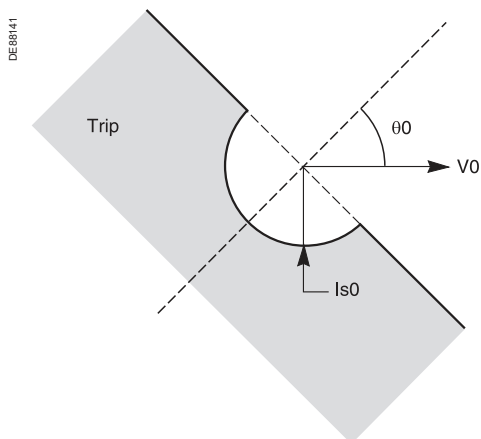
This protection function complies with the CEI 0-16 Italian specification.

Type 3 characteristics

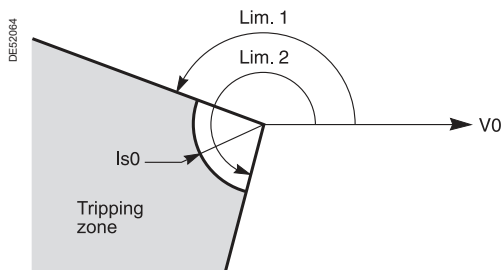
- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) curve
- choice of tripping direction
- no timer hold



Tripping characteristic of ANSI 67N/67NC type 1 protection (characteristic angle $\theta_0 \neq 0^\circ$).



Tripping characteristic of ANSI 67N/67NC type 2 protection (characteristic angle $\theta_0 \neq 0^\circ$).



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

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:

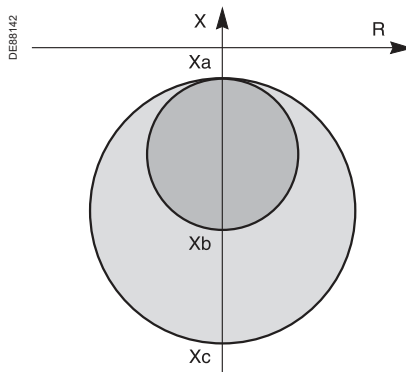
- too frequent starts: motor energizing is inhibited when the maximum allowable number of starts is reached, after counting of:
 - starts per hour (or adjustable period)
 - consecutive motor hot or cold starts (reacceleration of a motor that is not shut down, indicated by a logic input, may be counted 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 X_a , X_b and X_c



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 X_a , X_b and X_c according to the electrical characteristics of the machine (and transformer, when applicable).

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.

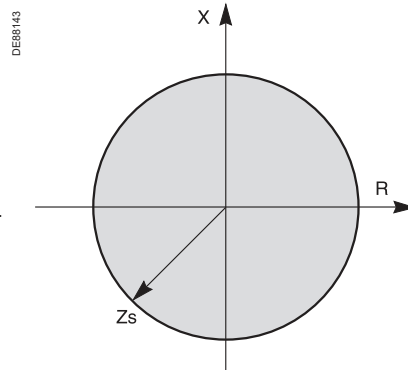
ANSI 21B - Underimpedance

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

$$Z_{21} = \frac{U_{21}}{I_2 - I_1}$$

apparent impedance between phases 1 and 2.

- circular characteristic centered at origin defined by adjustable set point Z_s



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 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).

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 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.

FRT (fault ride through)

Custom "Grid code" curve

Production installations must stay connected to the grid whenever the voltage is higher than that defined by the "Grid code" curve. The custom curve is defined point by point, with the disconnection time T_c in seconds on the X-axis and the voltage U/U_n in pu on the Y-axis.

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

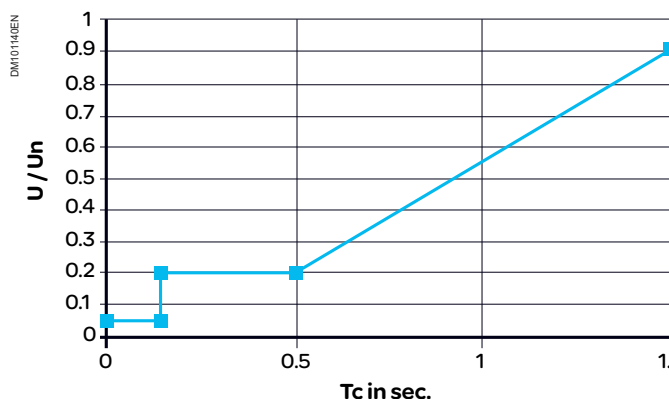
In installations with autonomous production means connected to a utility, the "rate of change of frequency" protection function is used to detect loss of the main system in view of opening the incoming circuit breaker to:

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

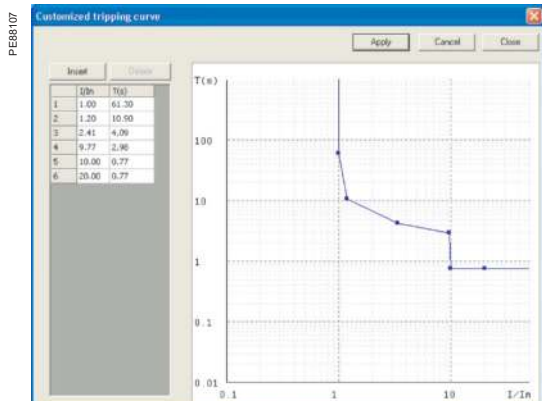
Load shedding

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.



Custom "Grid code" curve



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 IDM T 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).

Equation	Curve type	Coefficient values		
		k	α	β
$td(I) = \frac{k}{\left(\frac{I}{I_s}\right)^\alpha - 1} \times \frac{T}{\beta}$	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:

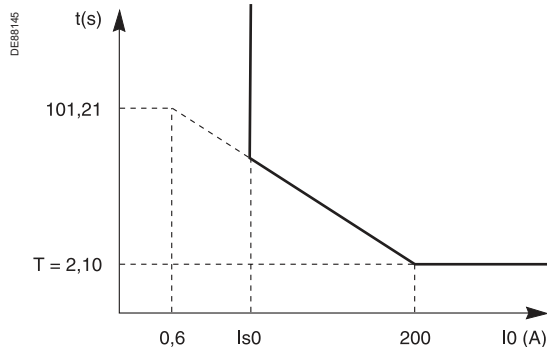
$$td(I) = \frac{1}{0.339 - 0.236\left(\frac{I}{I_s}\right)^{-1}} \times \frac{T}{3.1706}$$

IEEE curves

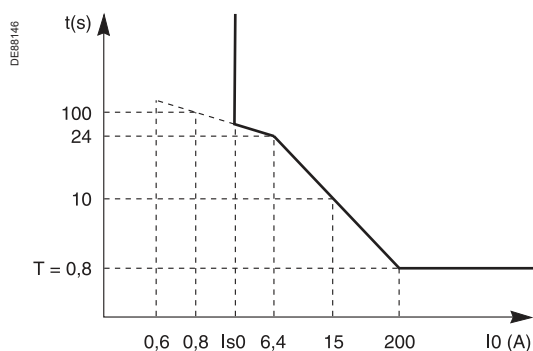
Equation	Curve type	Coefficient values			
		A	B	p	β
$td(I) = \left(\frac{A}{\left(\frac{I}{I_s}\right)^p - 1} + B \right) \times \frac{T}{\beta}$	Moderately inverse	0.010	0.023	0.02	0.241
	Very inverse	3.922	0.098	2	0.138
	Extremely inverse	5.64	0.0243	2	0.081

IAC curves

Equation	Curve type	Coefficient values					
		A	B	C	D	E	β
$td(I) = \left(A + \frac{B}{\left(\frac{I}{I_s} - C\right)} + \frac{D}{\left(\frac{I}{I_s} - C\right)^2} + \frac{E}{\left(\frac{I}{I_s} - C\right)^3} \right) \times \frac{T}{\beta}$	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



EPATR-C Standard curve (logarithmic scale).



EPATR-B Standard curve (logarithmic scale).

Equation for EPATRB, EPATRC

EPATRB

For $0,6 A \leq I_0 \leq 6,4 A$

$$td(I_0) = \frac{85\,386}{I_0^{0,975}} \times \frac{T}{0,8}$$

For $6,4 A \leq I_0 \leq 200,0 A$

$$td(I_0) = \frac{140\,213}{I_0^{0,975}} \times \frac{T}{0,8}$$

For $I_0 > 200,0 A$

$$td(I_0) = T$$

EPATRC

For $0,6 A \leq I_0 \leq 200,0 A$

$$td(I_0) = 72 \times 10^{-2,3} \times \frac{T}{2,10}$$

For $I_0 > 200,0 A$

$$td(I_0) = T$$

Voltage IDMT tripping curves

Equation for ANSI 27 - undervoltage

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

Equation for ANSI 59N - Neutral voltage displacement

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

Voltage/frequency ratio IDMT tripping curves

Equation for ANSI 27 - undervoltage

With $G = V/f$ or U/f

$$td(G) = \frac{1}{\left(\frac{G}{G_s} - 1\right)^p} \times T$$

Curve type

P

A	0.5
B	1
C	2

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 $10 \times I_s$
- TMS factor, factor shown as T/b in the equations on the left.

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

The measurement origin needs to be indicated for each unit of the protection functions that may use measurements of different origins.

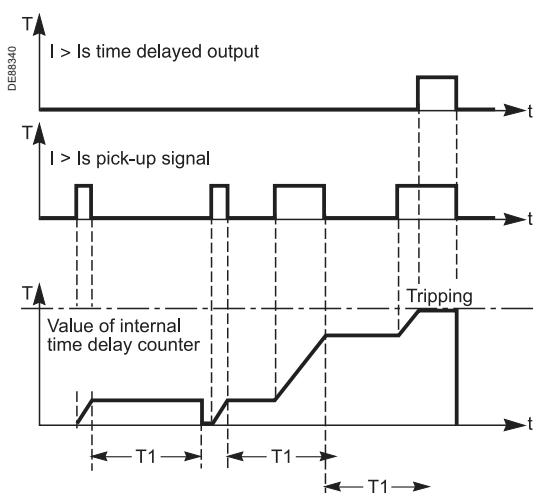
The setting links a measurement to a protection unit and allows the protection units to be distributed optimally among the measurements available according to the sensors connected to the analog inputs.

Example: distribution of ANSI 50N/51N function units for transformer earth fault protection:

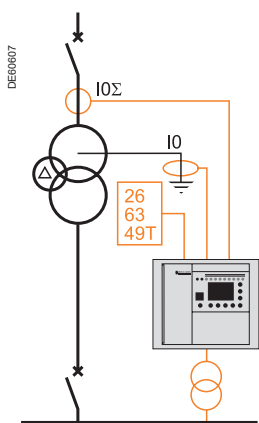
- 2 units linked to measured I0 for transformer primary protection
- 2 units linked to I0S for protection upstream of the transformer.

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
EPATR curves	50N/51N
Voltage IDMT curves	27, 59N
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



Detection of restriking faults with adjustable timer hold.



Measurement origin: example.

Functions	Settings	Time delays
ANSI 12 - Overspeed		
	100 to 160 % of Wn	1 to 300 s
ANSI 14 - Underspeed		
	10 to 100 % of Wn	1 to 300 s
ANSI 21B - Underimpedance		
Impedance Zs	0.05 to 2.00 Vn/lb	0.2 to 300 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
ANSI 27D - Positive sequence undervoltage		
Set point and time delay	15 to 60 % of Unp	0.05 to 300 s
ANSI 27R - Remanent undervoltage		
Set point and time delay	5 to 100 % of Unp	0.05 to 300 s
ANSI 32P - Directional active overpower		
	1 to 120 % of Sn ⁽¹⁾	0.1 s to 300 s
ANSI 32Q - Directional reactive overpower		
	5 to 120 % of Sn ⁽¹⁾	0.1 s to 300 s
ANSI 37 - Phase undercurrent		
	0.05 to 1 lb	0.05 to 300 s
ANSI 37P - Directional active underpower		
	5 to 100 % of Sn ⁽¹⁾	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/lb to 0.2 Vn/lb + 187.5 kΩ	
Circle 1: Xb	0.2 Vn/lb to 1.4 Vn/lb + 187.5 kΩ	0.05 to 300 s
Circle 2: Xc	0.6 Vn/lb to 3 Vn/lb + 187.5 kΩ	0.1 s to 300 s
ANSI 46 - Negative sequence / unbalance		
Tripping curve	Definite time	
	Schneider Electric	
	EC: 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	0.1 to 5 lb	Definite time
	0.1 to 0.5 lb (Schneider Electric)	IDMT
	0.1 to 1 lb (IEC, IEEE)	
	0.03 to 0.2 lb (RI ²)	

(1) $S_n = \sqrt{3} \cdot I_n \cdot Unp$.

Functions	Settings	Time delays
ANSI 47 - Negative sequence overvoltage		
Set point and time delay	1 to 50 % of Unp	0.05 to 300 s
ANSI 48/51LR - Locked rotor / excessive starting time		
Is set point	0.5 lb to 5 lb	ST starting time 0.5 to 300 s LT and LTS time delays 0.05 to 300 s
ANSI 49RMS - Thermal overload for cables		
Admissible current	1 to 1.73 lb	
Time constant T1	1 to 600 mn	
ANSI 49RMS - Thermal overload for capacitors		
Alarm current	1.05 lb to 1.70 lb	
Trip current	1.05 lb to 1.70 lb	
Positioning of the hot tripping curve	Current setting Time setting	1.02 x trip current to 2 lb 1 to 2000 minutes (variable range depending on the trip current and current setting)
ANSI 49RMS - Thermal overload for machines		
Accounting for negative sequence component		Mode 1 Mode 2
Time constant	Heating Cooling	0 - 2.25 - 4.5 - 9 T1: 1 to 600 mn T2: 5 to 600 mn T1: 1 to 600 mn T2: 5 to 600 mn
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 lb
Maximum equipment temperature		60 to 200 °C (140 °C to 392 °F)
ANSI 49RMS - Motor thermal overload		
Measurement origin	I1, I2, I3	
Choice of thermal model	2 time constants/generic (see settings associated with generic thermal overload)	
Current set point - change of thermal settings		1 to 10 pu of lb (± 0,1 pu of lb)
Characteristic times	Operating time accuracy	± 2 % or ± 1 s
Stator thermal settings		
Time constants	Motor thermal capacity used (τ long) Stator thermal capacity used (τ short) Cooling (τ cool)	1 to 600 mn ± 1 mn 1 to 60 mn ± 0,1 mn 5 to 600 mn ± 1 mn
Tripping current set point (K)	50 to 173 % of lb (± 1 % of lb)	
Alarm current set point	50 to 173 % of lb (± 1 % of lb)	
Thermal exchange coefficient between the stator and the motor (α)	0 to 1 (± 0,01)	
Current characterizing hot state	0,5 to 1 pu of lb (± 0,1 pu of lb)	
Accounting for ambient temperature	yes / no	
Maximum equipment temperature (Tmax)	70 to 250 °C (± 1 °C) or 158 to 482 °F (± 1 °F)	
Rotor thermal settings		
Locked rotor amperes (IL)	1 to 10 pu of lb (± 0,01 pu of lb)	
Locked rotor torque (LRT)	0,2 to 2 pu of nominal torque (+/- 0.01 pu of nominal torque)	
Locked rotor cold limit time (Tc)	1 to 300 s (± 0.1 s)	
Locked rotor hot limit time (Th)	1 to 300 s (± 0.1 s)	
ANSI 49RMS - Transformer thermal overload		
Measurement origin	I1, I2, I3	
Choice of thermal model	Dry-type transformer Immersed transformer Generic	
Type of dry-type transformer	Natural ventilation (AN) / Forced ventilation (AF)	
Type of oil-filled transformer	Distribution ONAN / Power ONAN / ONAF / OF / OD	
Alarm set point (θ alarm)	Immersed transformer: 98 to 160 °C (± 1 °C) or 208 to 320 °F (± 1 °F) Dry-type transformer: 95 to 245 °C (± 1 °C) or 203 to 473 °F (± 1 °F)	
Tripping set point (θ trip)	Immersed transformer: 98 to 160 °C (± 1 °C) or 208 to 320 °F (± 1 °F) Dry-type transformer: 95 to 245 °C (± 1 °C) or 203 to 473 °F (± 1 °F)	
Time constant for dry-type transformer (τ)	1 to 600 mn ± 1 mn	
Time constant for oil-filled transformer	winding (τ wdg) oil (τ oil)	1 to 600 mn ± 1 mn 5 to 600 mn ± 1 mn

Functions	Settings	Time delays	
ANSI 50BF - Breaker failure			
Presence of current	0.2 to 2 In		
Operating time	0.05 s to 3 s		
ANSI 50/51 - Phase overcurrent			
Tripping curve	Tripping time delay	Timer hold	
	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	
	IA : 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
Confirmation	None		
	By negative sequence overvoltage		
	By phase-to-phase undervoltage		
ANSI 50N/51N or 50G/51G - Earth faultt			
Tripping curve	Tripping time delay	Timer hold	
	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	
	EPATR-B, EPATR-C	DT	0.5 to 1 s
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 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 or 50G/51G - Voltage-restrained overcurrent			
Tripping curve	Tripping time delay	Timer hold	
	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 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 59 - Overvoltage (L-L) or (L-N)			
Set point and time delay	50 to 150 % of Unp or Vnp		0.05 to 300 s
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
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	Channels (I, I0)		
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 mn
(1) Tripping as of 1.2 Is.			

(1) Tripping as of 1.2 Is.

Functions	Settings	Time
ANSI 67 - Directional phase overcurrent		
Characteristic angle	30°, 45°, 60°	
Tripping curve	Tripping time delay	Timer hold delay
	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
Is set point	Customized	DT
	0.1 to 24 In	Definite time
Timer hold	0.1 to 2.4 In	IDMT
	Definite time (DT; timer hold)	Inst; 0.05 s to 300 s
	IDMT (IDMT; reset time)	0.1 s to 12.5 s at 10 Is0
		0.5 s to 20 s
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
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 or sum of phase currents I0S	
ANSI 67N/67NC - Directional earth fault, according to I0 vector magnitude (type 2)		
Characteristic angle	-45°, 0°, 15°, 30°, 45°, 60°, 90°	
Tripping curve	Tripping time delay	Timer hold delay
	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
Is0 set point	Customized	DT
	0.1 to 15 In0 (min. 0.1 A)	Definite time
Vs0 set point	0.01 to 1 In0 (min. 0.1 A)	IDMT
	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	
ANSI 67N/67NC type 3 - Directional earth fault, according to I0 vector magnitude directionalized on a tripping sector		
Tripping sector start angle	0° to 359°	
Tripping sector end angle	0° to 359°	
Is0 set point	CSH core balance CT (2 A rating)	0.1 A to 30 A
	1 A CT	0.005 to 15 In0 (min. 0.1 A)
	Core balance CT + ACE990 (range 1)	0.01 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
Time between 2 power swings	1 to 300 s	
Measurement origin	I0 input	
ANSI 81H - Overfrequency		
Set point and time delay	50 to 55 Hz or 60 to 65 Hz	0.1 to 300 s
Setting range	Main channels (U)	
ANSI 81L - Underfrequency		
Set point and time delay	40 to 50 Hz or 50 to 60 Hz	0.1 to 300 s
Setting range	Main channels (U)	
ANSI 81R - Rate of change of frequency		
	0.1 to 10 Hz/s	0.15 to 300 s

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.

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 outputs 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 4 outputs included in the Sepam series 60 base unit may be extended by adding 1 or 2 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.



Maximum Sepam series 60 configuration with 2 MES120 modules: 28 inputs and 16 outputs.

Logic inputs and outputs GOOSE

GOOSE logic inputs are used with the IEC61850 communication protocol.

The GOOSE inputs are divided between the 2 GSE virtual modules with 16 logic inputs.

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

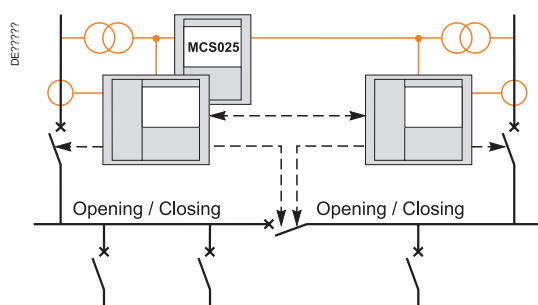
The motors disconnected as a result of the network voltage sag are automatically restarted:

- 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.



Automatic transfer with synchro-check controlled by Sepam series 60.

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.

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 Ix 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/contactors control function, can be used to create the ANSI 86 "Lockout relay" function.

Output relay testing

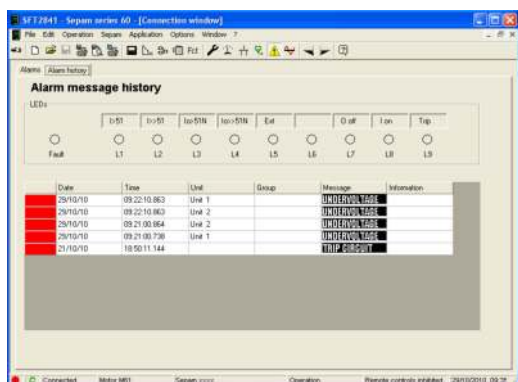
Each output relay is activated for 5 seconds, to make it simpler to check output connections and connected switchgear operation.

PE66028



Local indications on the Sepam front panel.

PE66103_SE



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 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 key

■ after the fault has disappeared, press the key : the light goes off and Sepam is reset

■ the list of alarm messages remains accessible (key) and may be cleared by pressing the key from 'Alarm' screen, but can not be cleared from 'Alarm history' screen.

PE60038



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.

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 by logic equations.

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.

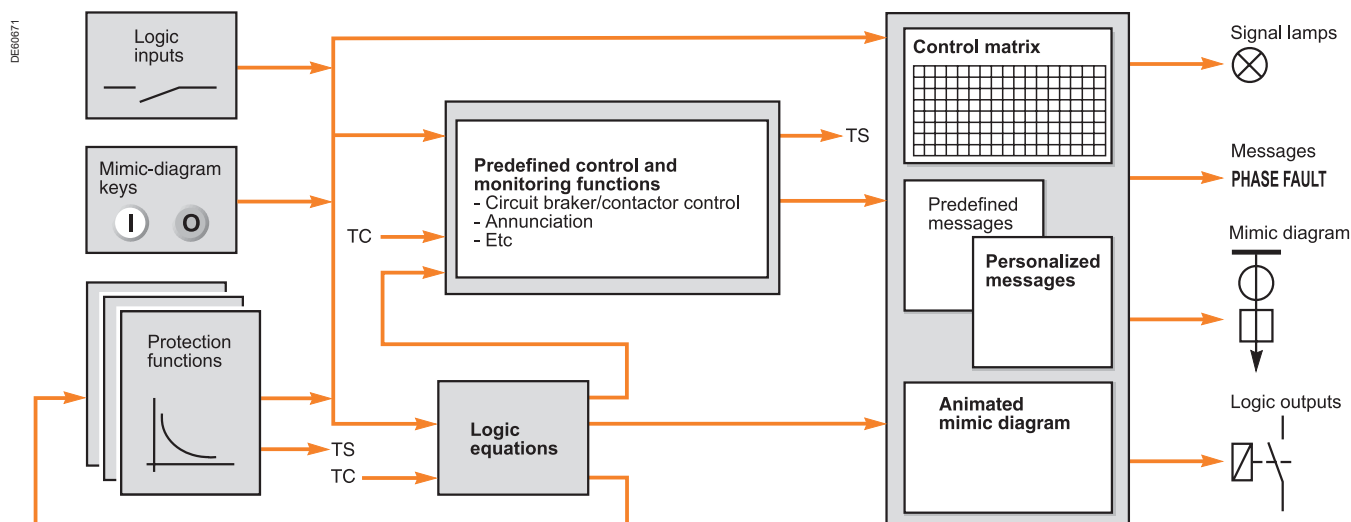
Control and monitoring

Adaptation of predefined functions using the SFT2841 software

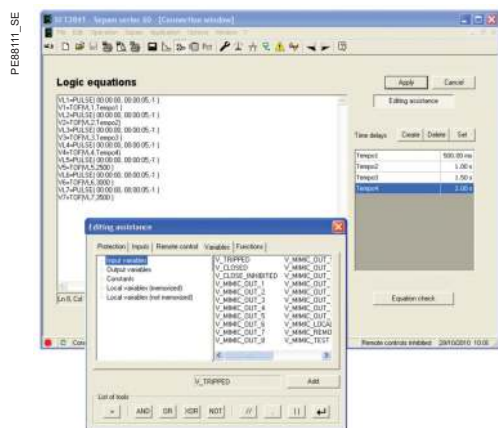
The predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:

- 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



2



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.

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/contactors control function to trip, close or inhibit breaking device closing
- used to inhibit or reset a protection function.

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.

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.

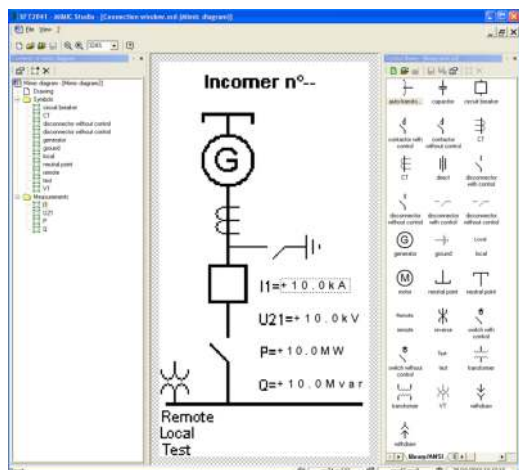
Creation of a customized mimic diagram is made easy:

- library of predefined symbols: circuit breakers, earthing switch, etc.
- creation of personalized symbols.

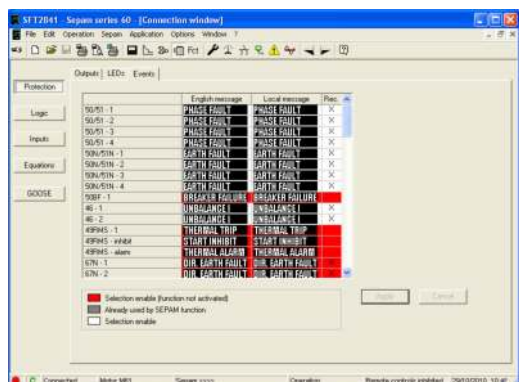
Control matrix

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.



SFT2841: mimic-diagram editor.



SFT2841: control matrix.

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.

User-Machine Interface

Two types of User-Machine Interfaces (UMI) are available for Sepam series 60 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 60 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 218.

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
- 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 adjusted 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.

APC containing the SFT2841 software is connected to the RS 232 communication port on the front of the unit or through the communication network.



Sepam series 60 base unit with integrated advanced UMI.



Sepam series 60 base unit with mimic-based UMI.



Customized Chinese advanced UMI.

Selection guide

Base unit

With remote advanced UMI

With integrated advanced UMI

With mimic-based UMI

PEG0306



PEG0307



PEG0308



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	■	■	■
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 ■ 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
- 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

PE60309



Sepam series 60 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
- 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.

Four relay outputs

The 4 relay outputs O1, O2, O3 and O5 on the base unit must be connected to connector (A). Each output can be assigned to a predetermined function using the SFT2841 software.

O1 to O3 are 3 control outputs with one NO contact, used by default for the switchgear control function:

- O1: switchgear tripping
- O2: switchgear closing inhibition
- O3: switchgear closing

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

PEG0310



Main connector and voltage and residual current input connector

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 connector is monitored.

Phase current input connectors

Current sensors connected to removable, screw-lockable connectors according to type of sensors used:

- CCA630 or CCA634 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 60.

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.

AMT852 lead sealing accessory

The AMT852 lead sealing accessory can be used to prevent unauthorized modification of the settings of Sepam series 60 units with integrated advanced UMIs.

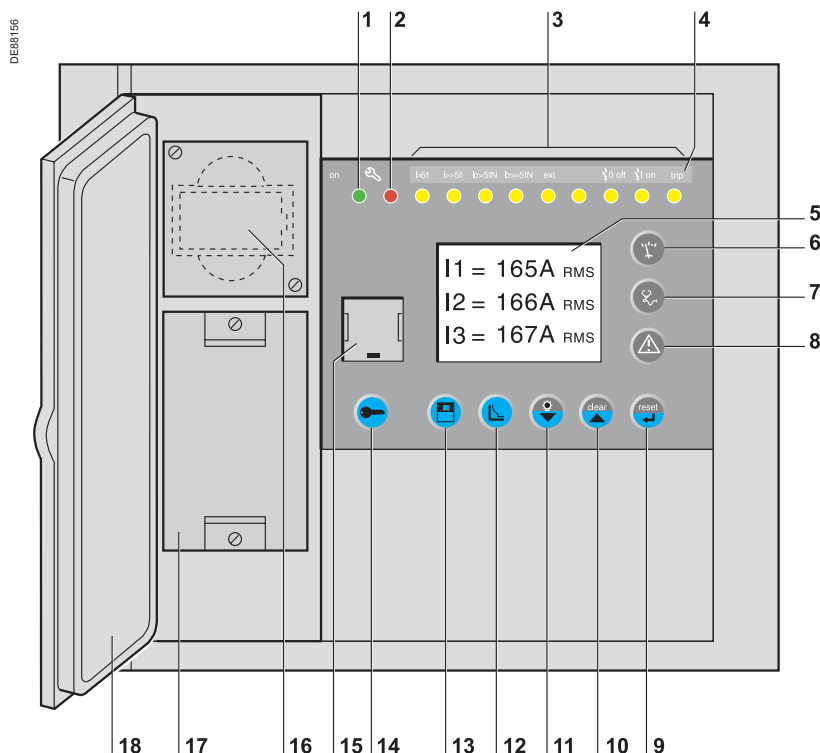
The accessory includes:

- 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 be secured only to the integrated advanced UMIs of Sepam series 60 units.

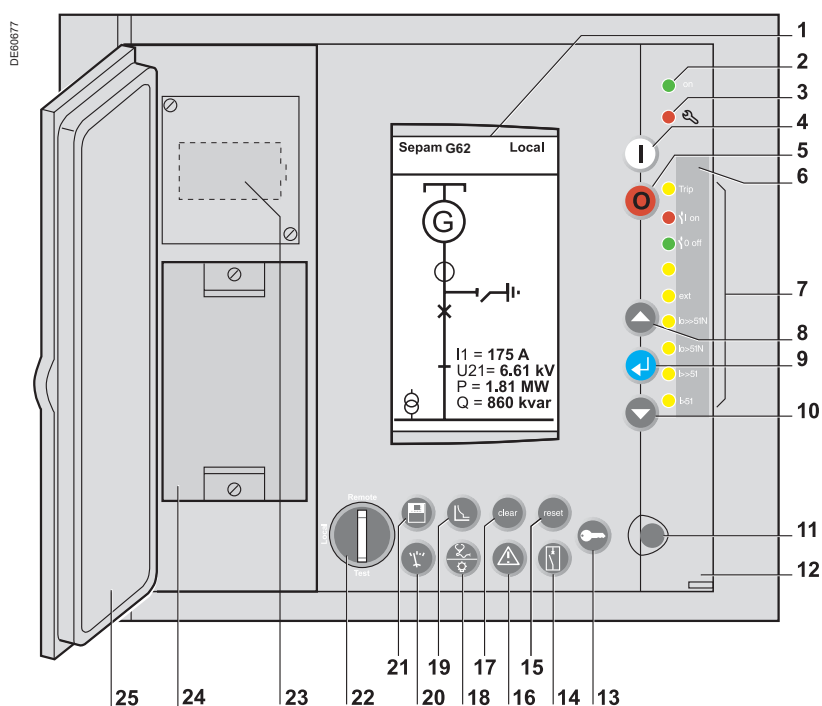
Front panel with advanced UMI

- 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.
- 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 7 yellow indication LEDs, 1 red LED (I), 1 green LED (O).
- 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.
- 22 Three-position key switch to select Sepam control mode.
- 23 Backup battery.
- 24 Memory cartridge.
- 25 Door.



- 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
 ■ 4 relay outputs.

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

(C1) Modbus communication port.

(D1) Remote module connection port.

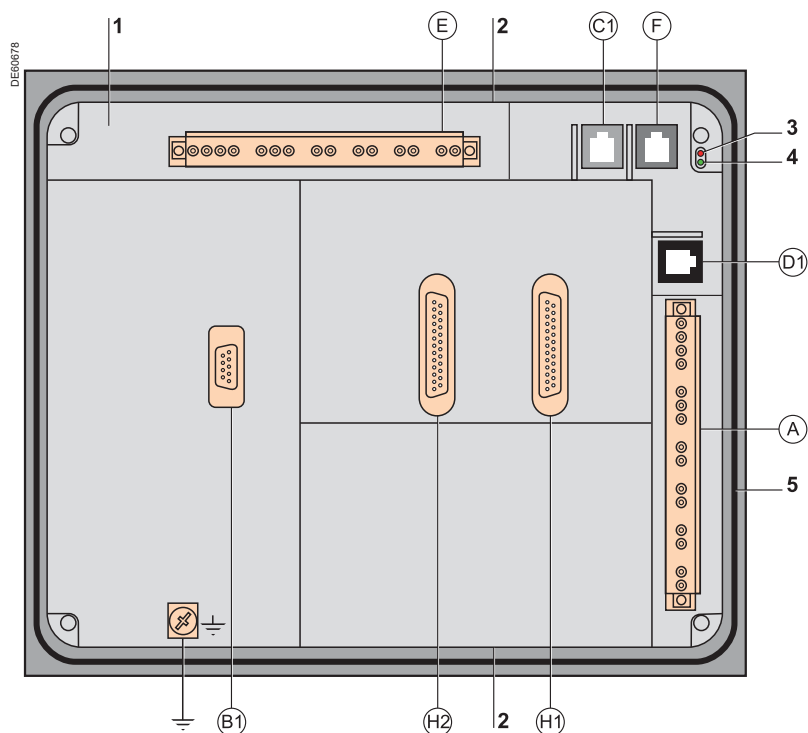
(E) 20-pin connector for:
 ■ 3 phase voltage V1, V2, V3/V0 inputs
 ■ 1 residual current I0 input.

(F) Communication port 2 for ACE850 modules only.

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

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

Rear panel



Weight

	Base unit with advanced UMI	Base unit with mimic-based UMI
Minimum weight (base unit without MES120)	2.4 kg (5.29 lb)	3.0 kg (6.61 lb)
Maximum weight (base unit with 2 MES120)	3.4 kg (7.5 lb)	4.0 kg (8.82 lb)

Sensor inputs

Phase current inputs	1 A or 5 A CT
Input impedance	< 0.02 Ω
Consumption	< 0.02 VA (1 A CT) < 0.5 VA (5 A CT)
Continuous thermal withstand	4 In
1 second overload	100 In

Voltage inputs	Phase	Residual
Input impedance	> 100 k Ω	> 100 k Ω
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
Isolation of inputs in relation to other isolated groups	Enhanced	Enhanced

Relay outputs

Control relay outputs (O1, O2, O3; and O101, O102)					
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			
Isolation of outputs in relation to other isolated groups		Enhanced			

Annunciation relay output (O5, O102 to O106, O202 to O206)					
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 p.f. > 0.3				1 A
Isolation of outputs in relation to other isolated groups		Enhanced			

Power supply

Voltage	24 to 250 V DC	-20 % / +10 %
Maximum consumption	< 16 W	
Inrush current	< 10 A 10 ms	
Acceptable ripple content	12 %	
Acceptable momentary outages	20 ms	

Battery

Format	1/2 AA lithium 3.6 V
Service life	10 years Sepam energized 3 years minimum, typically 6 years Sepam not energized

(1) Relay outputs complying with clause 6.7 of standard C 97.90 (30 A, 200 ms, 2000 operations)

Electromagnetic compatibility	Standard	Level / Class	Value
Emission tests			
Disturbing field emission	CISPR 22 EN 55022	A	
Conducted disturbance emission	CISPR 22 EN 55022	A	
Immunity tests – Radiated disturbances			
Immunity to radiated fields	IEC 61000-4-3	III	10 V/m; 80 MHz - 6 GHz 30 V/m non-modulated; 800 MHz - 2 GHz ⁽¹⁾
	ANSI C37.90.2		20 V/m; 80 MHz - 1 GHz
Electrostatic discharge	IEC 61000-4-2 ⁽¹⁾	IV	15 kV air ; 8 kV contact
	ANSI C37.90.3		15 kV air; 8 kV contact
Immunity to magnetic fields at network frequency	IEC 61000-4-8	4 ⁽²⁾	30 A/m (continuous) - 300 A/m (1-3 s)
	IEC 61000-4-8	5 ⁽³⁾	100 A/m (continuous) - 1000 A/m (3 s)
Immunity to pulsed magnetic fields ⁽¹⁾	IEC 61000-4-9	IV	600 A/m
Immunity to magnetic fields with damped oscillating waves ⁽¹⁾	IEC 61000-4-10	5	100 A/m
Immunity tests – Conducted disturbances			
Immunity to conducted RF disturbances	IEC 61000-4-6	III	10 Vrms
Electrical fast transients/burst	IEC 61000-4-4	IV	4 kV; 5 kHz and 100 kHz
1 MHz damped oscillating wave	ANSI C37.90.1		2.5 kV CM; 2.5 kV DM
100 kHz damped sinusoidal wave	IEC 61000-4-12	III IV ⁽¹⁾	2 kV MC 4 kV MC ; 2,5 kV DM
Slow damped oscillating wave (100 kHz to 1 MHz)	IEC 61000-4-18	III	
Fast damped oscillating wave (3 MHz, 10 MHz, 30 MHz)	IEC 61000-4-18	III	
Surges	IEC 61000-4-5	III	2 kV CM; 1 kV DM
	GOST R 50746-2000 ⁽¹⁾	4	200 A
Immunity to conducted disturbances in common mode from 0 Hz to 150 kHz	IEC 61000-4-16	III	
d.c. voltage dips and interruptions	IEC 61000-4-29		0% Un - 0.1 s. Crit. A; 40% Un - 0.1 s. Crit. A 70% Un - 0.5 s. Crit. A; 0% - 5 s - Crit. C
Ripple	IEC 61000-4-17		15% UDC - 100/120 Hz crit. A
Gradual Shutdown / Start-up	IEC 60255-26		60 s - 5 m - 60 s
Mechanical robustness			
	Standard	Level / Class	Value
Energized			
Vibrations	IEC 60255-21-1	2	1 Gn; 10 Hz - 150 Hz
	IEC 60068-2-6	Fc	3 Hz - 13.2 Hz; a = ±1 mm
	IEC 60068-2-64	2M1	
Shocks	IEC 60255-21-2	1	10 Gn / 11 ms
Earthquakes	IEC 60255-21-3	2	2 Gn (horizontal) 1 Gn (vertical)
De-energized			
Vibrations	IEC 60255-21-1	2	2 Gn; 10 Hz - 150 Hz
Shocks	IEC 60255-21-2	1	25 Gn / 11 ms
Jolts	IEC 60255-21-2	2	20 Gn / 16 ms
CSH30 horizontal with 2 clips; CSH120 / CSH200 horizontal with 3 plastic cable ties			
	Standard	Level / Class	Value
Operating (Energized)			
Vibrations	IEC 60255-21-1	2	0.075 mm / 1 g; 10 - 150 Hz
Shocks	IEC 60255-21-2	2	10 g / 11 ms
Earthquakes	IEC 60255-21-3	2	7.5 mm / 2 g (H); 3.5 mm / 1 g (V); 3 - 35 Hz
No Operating (De-energized)			
Vibrations	IEC 60255-21-1	2	2 g; 10 - 150 Hz
Shocks	IEC 60255-21-2	2	30 g / 11 ms
Jolts	IEC 60255-21-2	2	20 g / 16 ms

(1) Test conducted with a mimic-based HMI in the case of GOST performance testing.

(2) When protection functions 50N/51N or 67N are used and I0 is calculated on the sum of the phase currents, Is0 must be higher than 0.1In0.

(3) When protection functions 50N/51N or 67N are used and I0 is calculated on the sum of the phase currents, Is0 must be higher than 0.3In0.

Following the evolution of the IEC60255-26 standard to version 2023, the Is0 limit was revised in September 2024.

CSH30 horizontal with 1 clips; CSH120 vertical with 2 clips; CSH300 horizontal with 3 plastic cable ties			
Mechanical robustness	Standard	Level / Class	Value
Operating (Energized)			
Vibrations	IEC 60255-21-1	1	0.035 mm / 0.5 g; 10 - 150 Hz
Shocks	IEC 60255-21-2	1	5 g / 11 ms
Earthquakes	IEC 60255-21-3	1	3.5 mm / 1 g (H); 1.5 mm / 0.5 g (V); 3 - 35 Hz
No Operating (De-energized)			
Vibrations	IEC 60255-21-1	1	1 g; 10 - 150 Hz
Shocks	IEC 60255-21-2	1	15 g / 11 ms
Jolts	IEC 60255-21-2	1	10 g / 16 ms
Climatic withstand	Standard	Level / Class	Value
During operation			
Exposure to cold	IEC 60068-2-1	Ad	-25 °C (-13 °F)
Exposure to dry heat	IEC 60068-2-2	Bd	+70 °C (+158 °F)
Continuous exposure to damp heat	IEC 60068-2-78	Cab	10 days; 93% RH; 40 °C (104 °F)
Salt mist	IEC 60068-2-52	Kb/2	3 days
Influence of corrosion/2-gas test	IEC 60068-2-60	Method 1	21 days; 75% RH; 25 °C (77 °F); 0.1 ppm H ₂ S; 0.5 ppm SO ₂
Influence of corrosion/4-gas test	IEC 60068-2-60	Method 4	21 days; 70% RH; 25 °C (77 °F); 0.01 ppm H ₂ S; 0.2 ppm SO ₂ ; 0.2 ppm NO ₂ ; 0.01 ppm Cl ₂
	EIA 364-65A	IIIA	42 days; 75% RH; 30 °C (86 °F); 0.1 ppm H ₂ S; 0.2 ppm SO ₂ ; 0.2 ppm NO ₂ ; 0.02 ppm Cl ₂
In storage ⁽¹⁾			
Temperature variation with specified variation rate	IEC 60068-2-14	Nb	-25 °C to +70 °C (-13 °F to +158 °F) 5 °C/min
Exposure to cold	IEC 60068-2-1	Ab	-25 °C (-13 °F)
Exposure to dry heat	IEC 60068-2-2	Bb	+70 °C (+158 °F)
Continuous exposure to damp heat	IEC 60068-2-78	Cab	56 days; 93% RH; 40 °C (104 °F)
	IEC 60068-2-30	Db	6 days; 95% RH; 55 °C (131 °F)
Safety	Standard	Level / Class	Value
Enclosure safety tests			
Front panel tightness	IEC 60529	IP52	Other panels IP20
	NEMA	Type 12	
Resistance to mechanical stress	IEC 60255-27	IK07	2 J
Fire withstand	IEC 60695-2-11		650 °C (1200 °F) with glow wire
Electrical safety tests			
1.2/50 µs impulse wave	IEC 60255-27		5 kV ⁽²⁾
Power frequency dielectric withstand	IEC 60255-27		2 kV 1mn ⁽³⁾
	ANSI C37.90		1 kV 1 min (annunciation output) 1.5 kV 1 min (control output)
Certification			
CE	Norme harmonisée : ■ EN/IEC 60255-26 :2013 ■ EN 60255-27: 2014/IEC 60255-27:2013 ■ EN IEC 63000:2018 / IEC 63000:2016		Directives européennes : ■ EMC European Directive CEM 104/30/EU ■ Low Voltage European Directive 2014/35/EU ■ RoHS directive 2011/65/EU amended by Directive (EU) 2015/863
UK CA	BS-designated standards : ■ BS EN 60255-26 :2013 ■ BS EN 60255-27: 2013 ■ BS EN IEC 63000:2018		UK regulations (Statutory Instruments) : ■ SI 2016 No. 1101 ■ SI 2016 No. 1091 ■ SI 2012 No. 3032
UL	UL508-CSA C22.2 no. 14-95		File E212533
CSA	CSA C22.2 no. 14-95/no. 0.17-00		File 210625

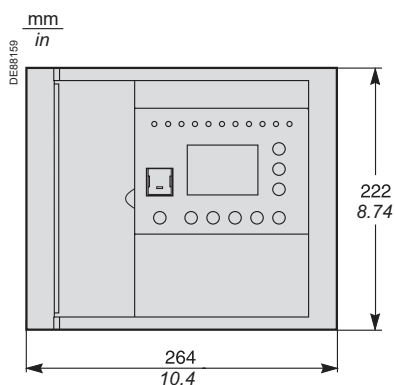
(1) Sepam must be stored in its original packaging.

(2) Except for communication: 3 kV in common mode and 1 kV in differential mode.

(3) Except for communication: 1 kVrms.

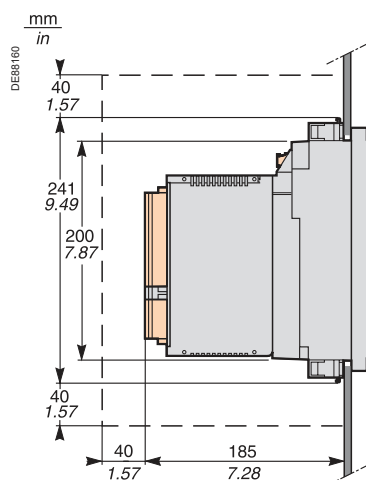
(4) See the appendix in "Installation and operation" manual SEPED303003EN, "Functional Safety" section.

2



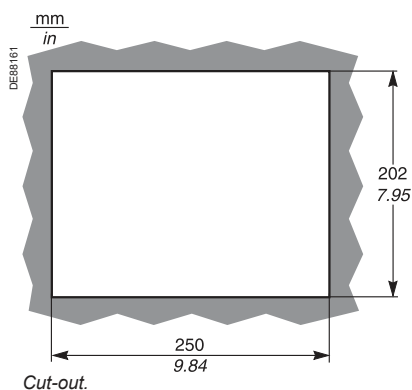
Front view of Sepam.

Dimensions

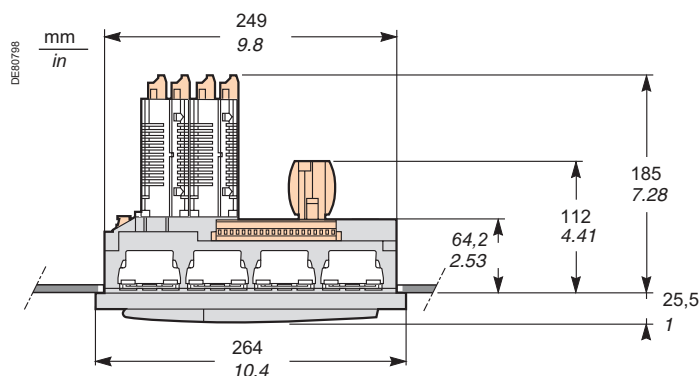


Side view of Sepam with MES120, flush-mounted in front panel with spring clips.
Front panel: 1.5 mm (0.05 in) to 6 mm (0.23 in) thick.

— — — 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 (0.05 in) to 6 mm (0.23 in) thick.

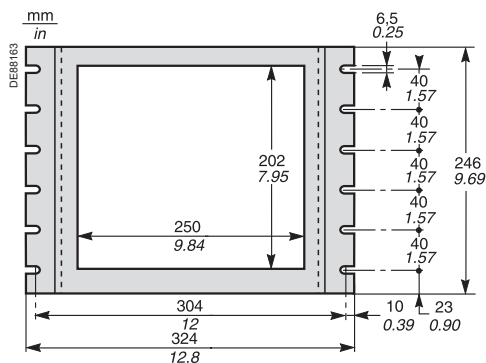
CAUTION

HAZARD OF CUTS

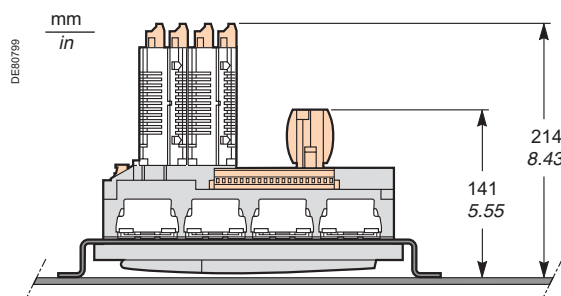
Trim the edges of the cut-out plates to remove any jagged edges.

Failure to follow this instruction can cause serious injury.

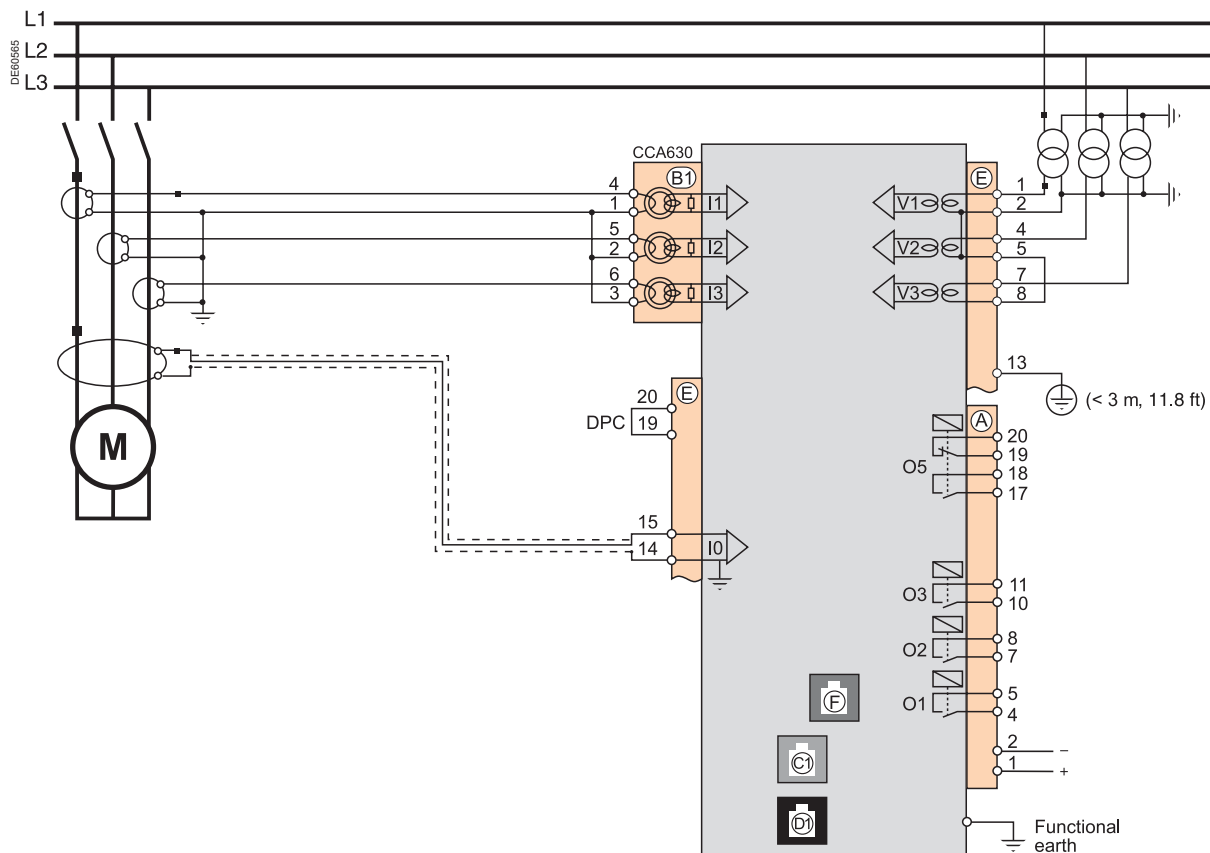
Assembly with AMT880 mounting plate



AMT880 mounting plate.



Top view of Sepam with MES120, mounted with AMT880 and spring clips.
Mounting plate: 3 mm (0.11 in) thick.



Connection characteristics

Connector	Type	Reference	Wiring
(A), (E)	Screw type	CCA620	■ wiring with no fittings : □ 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) □ stripped length: 8 to 10 mm ■ wiring with fittings: □ recommended wiring with fittings: - DZ5CE015D for 1 x 1.5 mm² wire (AWG 16) - DZ5CE025D for 1 x 2.5 mm² wire (AWG 12) - AZ5DE010D for 2 x 1 mm² wires (AWG 18) □ tube length: 8.2 mm (0.32 in) □ stripped length: 8 mm (0.31 in)
	6.35 mm ring lugs	CCA622	■ 6.35 mm ring or spade lugs (1/4") ■ maximum wire cross-section of 0.2 to 2.5 mm² (≥AWG 24-12) ■ stripped length: 6 mm ■ use an appropriate tool to crimp the lugs on the wires ■ maximum of 2 ring or spade lugs per terminal ■ tightening torque: 1.2 (13.27 lb-in)
(C1)	White RJ45 plug		CCA612
(D1)	Black RJ45 plug		CCA770: L = 0.6 m (2 ft) CCA772: L = 2 m (6.6 ft) CCA774: L = 4 m (13.1 ft) CCA785 for MCS025 module: L = 2 m (6.6 ft)
(F)	Blue RJ45 plug		CCA614
 Functional earth	Ring lug		Earthing braid, to be connected to cubicle grounding: ■ flat copper braid with cross-section ≥ 9 mm² ■ maximum length: 300 mm (11.8 in)
(B1)	4 mm ring lugs	CCA630, CCA634 for connection of 1 A or 5 A CTs	■ wire cross-section 1.5 to 6 mm² (AWG 16-10) ■ tightening torque: 1.2 Nm (13.27 lb-in)
	RJ45 plug	CCA671, for connection of 3 LPCT sensors	Integrated with LPCT sensor

CAUTION

LOSS OF PROTECTION OR RISK OF NUISANCE TRIPPING

If the Sepam is no longer supplied with power or is in fail-safe position, the protection functions are no longer active and all the Sepam output relays are dropped out. Check that this operating mode and the watchdog relay wiring are compatible with your installation.

Failure to follow this instruction can result in equipment damage and unwanted shutdown of the electrical installation.

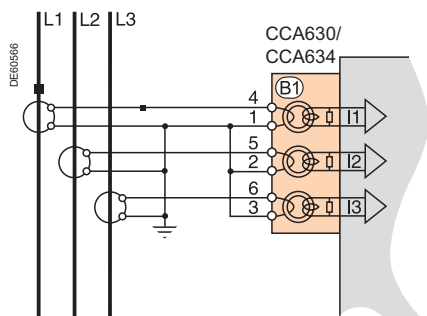
⚠ CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective earth and to the functional earth.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

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



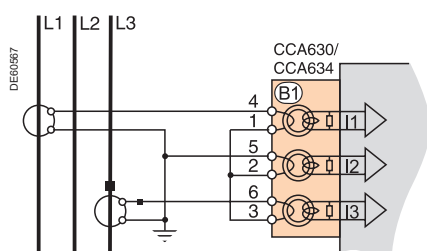
Connection of 3 x 1 A or 5 A sensors to the CCA630 connector.

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

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	I1, I2, I3
Rated current (In)	1 A to 6250 A

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



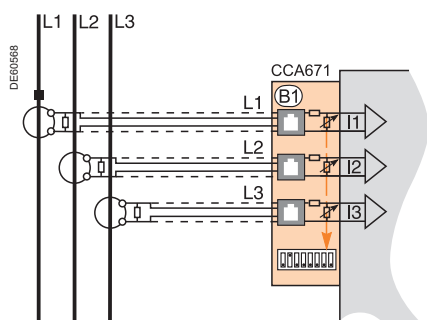
Connection of 2 x 1 A or 5 A sensors to the CCA630 connector.

Measurement of phase 1 and 3 currents is sufficient for all protection functions based on phase current.

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	I1, I3
Rated current (In)	1 A to 6250 A

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.

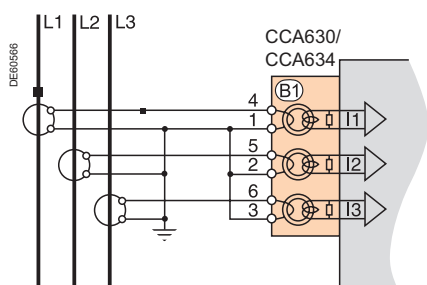
Parameters

Sensor type	LPCT
Number of CTs	I1, I2, I3
Rated current (In)	25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000 or 3150 A

Note: Parameter In must be set twice:

- Software parameter setting using the advanced UMI or the SFT2841 software tool
- Hardware parameter setting using microswitches on the CCA671 connector

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



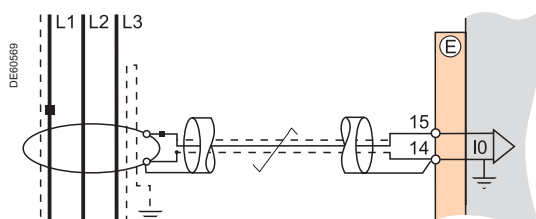
Description

Residual current is calculated by the vector sum of the 3 phase currents I_1 , I_2 and I_3 , measured by 3 x 1 A or 5 A CTs or by 3 LPCT type sensors.
See current input connection diagrams.

Parameters

Residual current	rated residual current	Measuring range
Sum of 3 Is	$I_{n0} = I_n$, CT primary current	0.01 to 40 I_{n0} (minimum 0.1 A)

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



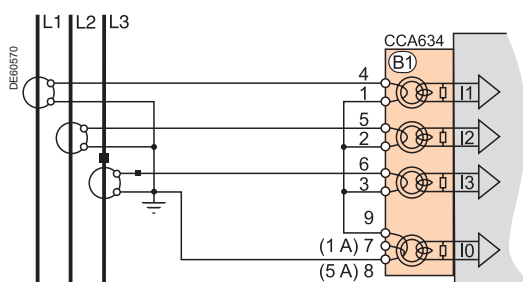
Description

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

Parameters

Residual current	rated residual current	Measuring range
2 A rating CSH	$I_{n0} = 2$ A	0.1 to 40 A
20 A rating CSH	$I_{n0} = 20$ A	0.2 to 400 A

Variant 3: residual current measurement by 1 A or 5 A CTs and CCA634



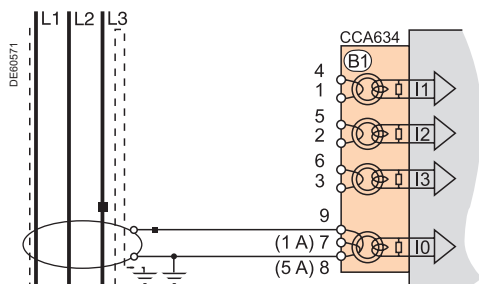
Description

Residual current measurement by 1 A or 5 A CTs

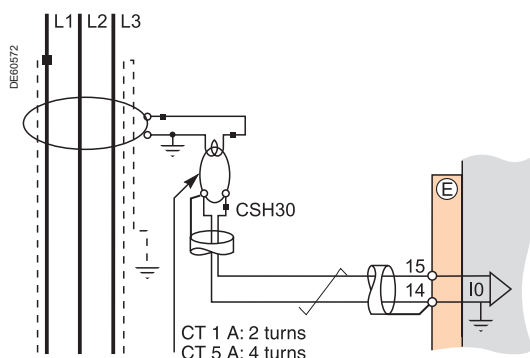
- Terminal 7: 1 ACT
- Terminal 8: 5 ACT

Parameters

Residual current	rated residual current	Measuring range
1 ACT	$I_{n0} = I_n$, CT primary current	0.01 to 20 I_{n0} (minimum 0.1 A)
5 ACT	$I_{n0} = I_n$, CT primary current	0.01 to 20 I_{n0} (minimum 0.1 A)



Variant 4: residual current measurement by 1 A or 5 A CTs and CSH30 interposing ring CT



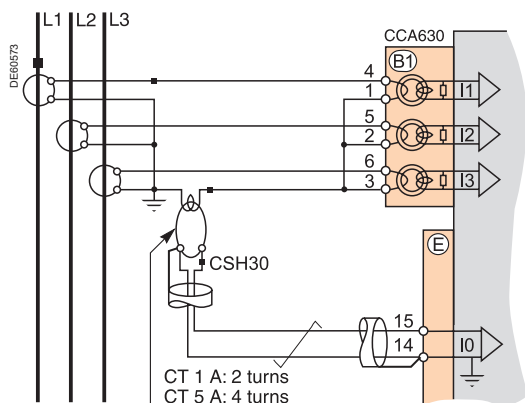
Description

The CSH30 interposing ring CT is used to connect 1 A or 5 A CTs to Sepam to measure residual current:

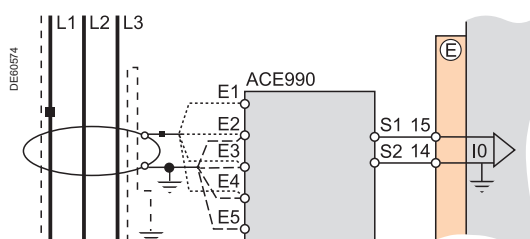
- CSH30 interposing ring CT connected to 1 A CT: make 2 turns through CSH primary
- CSH30 interposing ring CT connected to 5 A CT: make 4 turns through CSH primary.

Parameters

Residual current	rated residual current	Measuring range
1 A CT	$I_{n0} = I_n$, CT primary current	0.01 to 20 I_{n0} (minimum 0.1 A)
5 A CT	$I_{n0} = I_n$, CT primary current	0.01 to 20 I_{n0} (minimum 0.1 A)



Variant 5: residual current measurement by core balance CT with ratio of 1/n (n between 50 and 1500)



Description

The ACE990 is used as an interface between a MV core balance CT with a ratio of 1/n ($50 \leq n \leq 1500$) and the Sepam residual current input.

This arrangement allows the continued use of existing core balance CTs on the installation.

Parameters

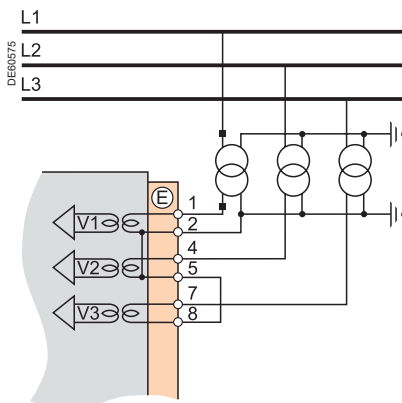
Residual current	rated residual current	Measuring range
ACE990 - range 1 ($0.00578 \leq k \leq 0.04$)	$I_{n0} = I_k \cdot n^{(1)}$	0.01 to 20 I_{n0} (minimum 0.1 A)
ACE990 - range 2 ($0.00578 \leq k \leq 0.26316$)	$I_{n0} = I_k \cdot n^{(1)}$	0.01 to 20 I_{n0} (minimum 0.1 A)

(1) n = number of core balance CT turns

k = factor to be determined according to ACE990 wiring and setting range used by Sepam

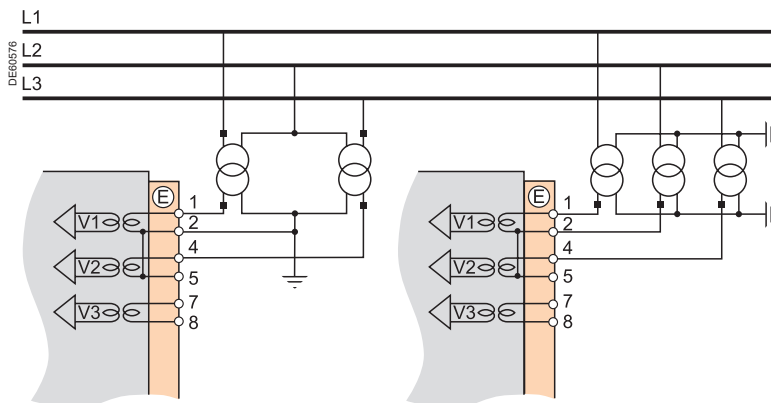
Phase voltage input connection variants

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



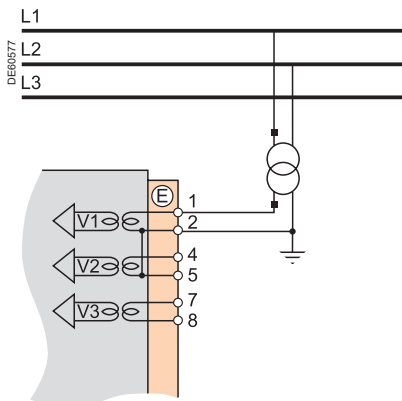
Measurement of the 3 phase-to-neutral voltages allows the calculation of residual voltage, $V0\Sigma$.

Variant 2: measurement of 2 phase-to-phase voltages (2 U)



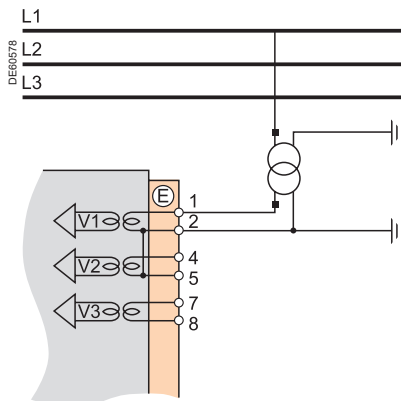
This variant does not allow the calculation of residual voltage, but $V0$ or Vnt measurement could be added as variant 5 or 6.

Variant 3: measurement of 1 phase-to-phase voltage (1 U)



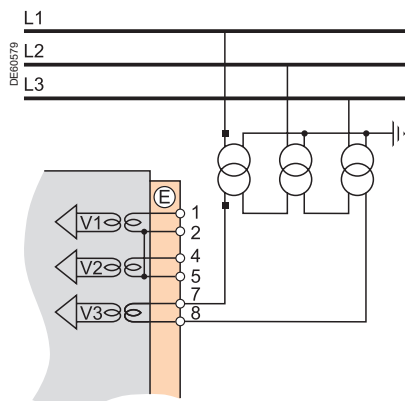
This variant does not allow the calculation of residual voltage.

Variant 4: measurement of 1 phase-to-neutral voltage (1 V)



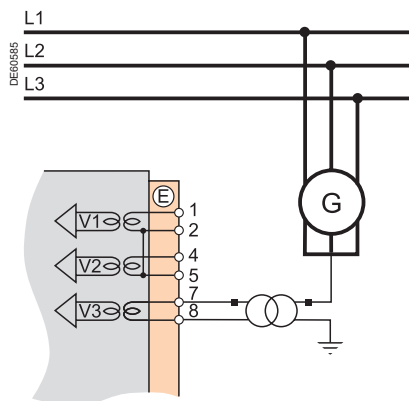
This variant does not allow the calculation of residual voltage.

Variant 5: measurement of residual voltage V_0



Residual voltage input connection variants

Variant 6 : measurement of the residual voltage V_{nt} at the neutral point of a generator



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 or calculation of V0Σ
- measurement of residual voltage V0 (variant 3,5).

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 (var. 1)	2 U (var. 2)	1 U (var. 3)	1 V (var. 4)
Residual voltage measured (connection variant)	- V0 Sum	- 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	■	■	■	■
Voltage-restrained overcurrent 50V/51V	■	■	■	■
Underimpedance 21B	■	■	■	■
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	■	■	U21, U21	U21
Phase-to-neutral voltage V1, V2, V3	■	■	■	V1 V1 V1
Residual voltage V0	■	■	■	■
Neutral point voltage Vnt	■	■	■	■
Positive sequence voltage Vd	■	■	■	■
Negative sequence voltage Vi	■	■	■	■
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)	■	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	■	■	■	■
Phase displacement φ1, φ2, φ3	■	■	■	■
Apparent positive sequence impedance Zd	■	■	■	■
Apparent phase-to-phase impedances Z21, Z32, Z13	■	■	■	■

■ Function available on main voltage channels.

(1) If all three phase currents are measured.

> TOOLS

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sheets, with direct links to:

- complete library: technical documents, catalogs, FAQs, brochures...

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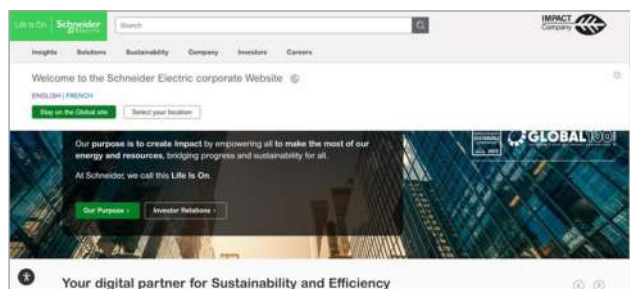
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		Substation				Transformer			Motor			Generator			Busbar		Cap.
Protection	ANSI code	S80	S81	S82	S84	T81	T82	T87	M81	M87	M88	G82	G87	G88	B80	B83	C86
Phase overcurrent ⁽¹⁾	50/51	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Earth fault / Sensitive earth fault ⁽¹⁾	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		1	1	1												
Thermal overload for machines ⁽¹⁾	49RMS					2	2	2	2	2	2	2	2	2			
Thermal overload for capacitors	49RMS																1
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			
Undervoltage (L-L or L-N)	27	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Positive sequence undercurrent	27D	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Remanent undervoltage	27R	2	2	2	2	2	2	2	2	2	2	2	2	2	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.
b standard, v options.

(1) Protection functions with 2 groups of settings.

(2) According to parameter setting and optional MES120 input/output modules.

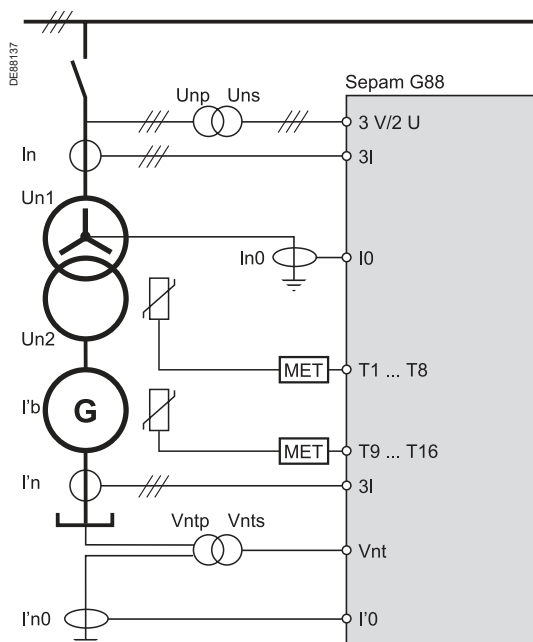
(3) With optional MET148-2 temperature input modules.

(4) With optional MCS025 synchro-check module.

(5) With ACE949-2, ACE959, ACE937, ACE969TP-2, ACE969FO-2.

(6) With ACE850TP or ACE850FO communication interface.

	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 li	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Harmonic distortion (THD), current and voltage Ithd, Uthd	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Phase displacement φ0, φ'0, φ0Σ	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Phase displacement φ1, φ2, φ3	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Disturbance recording	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Motor start report (MSR)								■	■	■							
Motor start trend (MST)								■	■	■							
Datalog (DLG)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
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⁾	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Additional modules																	
8 temperature sensor inputs - MET148-2 module ⁽²⁾					□	□	□	□	□	□	□	□	□	□	□	□	□
1 low level analog output - MSA141 module	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Logic inputs/outputs - MES120/MES120G/ MES120H (14I/6O) module	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Communication interface - ACE949-2, ACE959, ACE937, ACE969-2 TP, FO, ACE850 TP, FO or ECI850	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Modbus communication, IEC 60 870-5-103, DNP3 or IEC 61850																	
Measurement readout ⁽⁵⁾⁽⁶⁾	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Remote indication and time tagging of events ⁽⁵⁾⁽⁶⁾	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Remote control orders ⁽⁵⁾⁽⁶⁾	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Remote protection setting ⁽⁵⁾	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Transfer of disturbance recording data ⁽⁵⁾⁽⁶⁾	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
GOOSE message IEC 61850 ⁽⁶⁾	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□



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.

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 3 LPCTs	1 A to 6250 A 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 Other applications	I'b = Ib x Un1/Un2 I'b = Ib
In0, I'n0	Rated residual current	Sum of 3 phase currents CSH120 or CSH200 core balance CT 1 A/5 A CT + CSH30 interposing ring CT Core balance CT + ACE990 (the core balance CT ratio 1/n must be such that $50 \leq n \leq 1500$)	See In(I'n) rated phase current 2 A or 20 A rating 1 A to 6250 A 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 2 VTs: U21, U32 1 VT: U21 1 VT: V1	90 to 230 V 90 to 120 V 90 to 120 V 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 or 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 Increments reactive energy	0.1 kWh to 5 MWh 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 ($\Omega n \times R/60 \leq 1500$)
	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 Step 2 Step 3 Step 4	1 1, 2 1, 2, 3, 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.

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 $I_{0\Sigma}$ and $I'_{0\Sigma}$, calculated by the vector sum of the 3 phase currents
- 2 measured residual currents I_0 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 I_1 , I_2 and I_3 :

- 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 V_1 , V_2 , V_3 and V'_1 , V'_2 , V'_3
- phase-to-phase voltages U_{21} , U_{32} , U_{13} and U'_{21} , U'_{32} , U'_{13}
- residual voltage V_0 , V'_0 or neutral point voltage V_{nt}
- positive sequence voltage V_d , V'_d and negative sequence voltage V_i , V'_i
- frequency measured on the main and additional voltage channels.

Power

Powers are calculated according to the phase currents I_1 , I_2 and I_3 :

- active power
- reactive power
- apparent power
- power factor ($\cos \varphi$).

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 I_1 , I_2 and I_3 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.

Datalog (DLG)

This function is used to record and back up a set of measurements (1 to 15) available in the Sepam relay. The number of backed-up files and the number of measurements per file depend on the type of cartridge installed (extended cartridge available for Sepam 80 only). The recording mode and selection of measurements can be configured by the user via the SFT2841 software.

All trip of the function results from an external event (TC for example). The stop condition and file management differ according to which of the following 2 modes is used:

- a) **Limited:** the DLG function stops automatically when the end of recording time is reached or on receipt of an external event (TC for example).
- b) **Circular:** the file content is managed in a FIFO memory: when the file is full, the write operation continues and starts again at the start of the file. Stopping the write operation only results from an external event (TC for example). In the absence of the stop command, recording is continuous.

Using the DLG function does not affect the quality of service of Sepam's active protection functions.

Characteristics

Configuration parameters

Content of a COMTRADE file	■ Configuration file (*.CFG) : date, variable characteristics, transformation ratio of the selected variable values ■ Samples file (*.DAT): recorded variables
Total file duration	1 s to 30 days
Sampling period	1 s to 24 hours
Variables available for recording	See the table of available data p. 149/150.
Number of files	1 to 20
Number of variables per file	1 to 15
Source of starting and stopping	■ SFT 2841 software ■ Logic equation or Logipam ■ TC ■ Logic or GOOSE input
File format	COMTRADE 97

Nota : These parameters are configured with the SFT2841 software.

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 ϕ_1 , ϕ_2 , ϕ_3 between phase currents I1, I2, I3 and voltages V1, V2, V3 respectively
- phase displacement ϕ_0 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	1 s to 20 s if using a standard cartridge 1 s to 32 s if using an extended cartridge
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	
	Standard	Extended	Standard	Extended
50 Hz	22 s	35 s	7 s	11 s
60 Hz	18 s	11 s	6 s	9 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.

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.
- recording data during motor start (MSR) and create trend graphics (MST).

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 Z_d

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

Apparent phase-to-phase impedances Z_{21} , Z_{32} , Z_{13}

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).

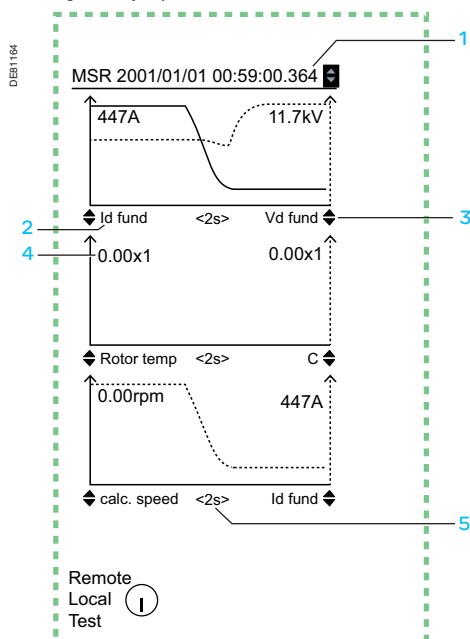
Capacitance

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

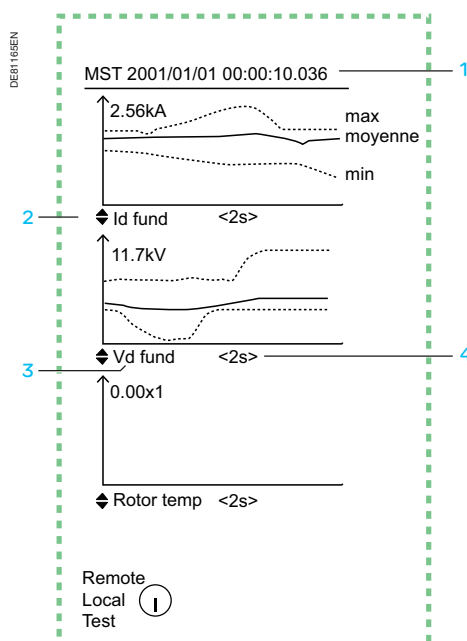
Measurement of the unbalance current for each capacitor bank step. This measurement is possible when the steps are connected in a double star arrangement.

Visualization of 3 graphics MSR
via an integrated synoptic HMI.



- 1 Time tagging of the selected file and file selection zone
- 2 Name of the 1st variable associated with the Y-axis
- 3 Selection zone for the variable to be associated with the Y-axis
- 4 Maximum value observed for the recorded variable
- 5 Duration of read time

Visualization of 3 graphics MST
via an integrated synoptic HMI.



- 1 Time tagging of the current file
- 2 Selection of the variable to be associated with the Y-axis
- 3 Name of the analyzed variable
- 4 Duration of read time for each file

Motor Start Report (MSR)

This function, available only in motor applications, can stock during a configured duration multiple files of 144 data samples selected.

Read

The files can be viewed:

- a) after downloading, on a PC screen, using the WaveWin software
- b) on the Sepam display using the Diagnosis menu.

Caractéristiques

Paramètres de configuration

Content of a COMTRADE file	■ Fichier de configuration (*.CFG): date, variable characteristics, transformation ratio of the selected variable values ■ Samples file (*.DAT): recorded variables
Total file duration	2 s to 144 s
Sampling frequency	Depends on the configured duration (144 s maximum). Example: For a duration of 144 s the frequency is 1 Hz, for a duration of 2 s the frequency is 72 Hz.
Variables available for recording	See the table of available data . p. 149 /150
Number of files	■ 1 to 5 with standard cartridge ■ 1 to 20 with extended cartridge
Number of variables per file	■ 1 to 5 with standard cartridge ■ 1 to 10 with extended cartridge
Source of starting and stopping	■ SFT 2841 software ■ Logic equation or Logipam ■ TC ■ Logic or GOOSE input
File format	COMTRADE 97

Nota : These parameters are configured with the SFT2841 software.

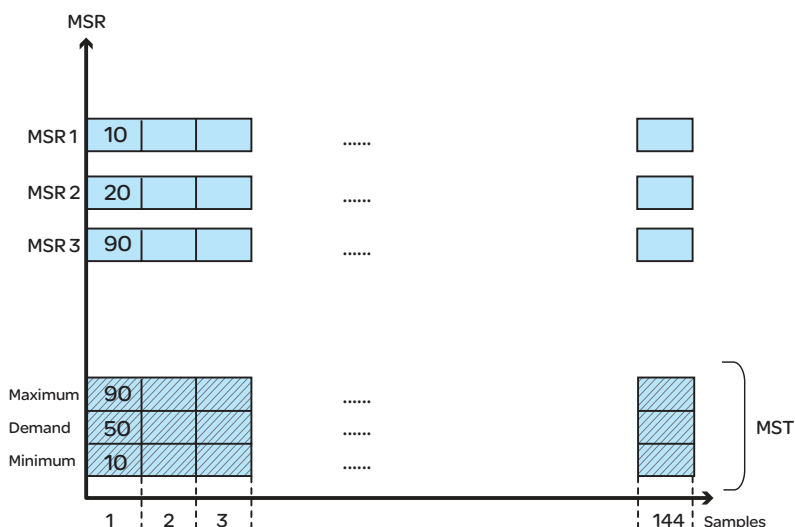
Motor Start Trend (MST)

This function, only available for motor applications, is related to the Motor start trend function. It is used to calculate and display in the form of curves the minimum, demand and maximum values for each value.

These recalculated values which are stored in a file of 144 samples covering a 30-day period. When the current 30-day period has ended, it is automatically archived in COMTRADE format and will no longer be able to be viewed on the Sepam display

The number of files available varies between 12 and 18 depending on the type of memory cartridge (standard or extended) installed on Sepam

The trends are only recalculated at the end of each Motor start report.



Calculating an MST using the available MSRs.

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

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.

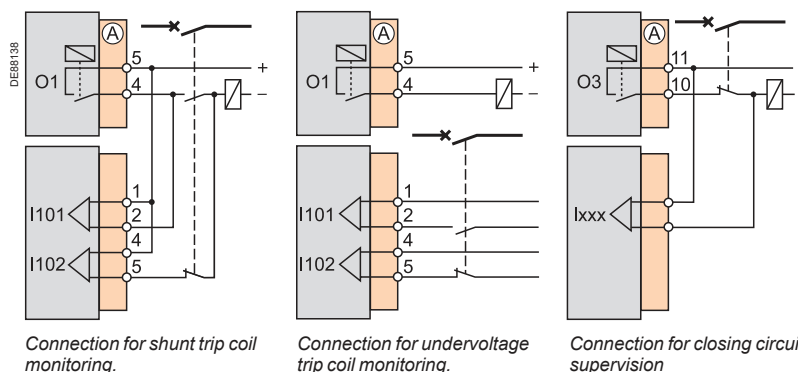
In the event of a loss of current or voltage measurement data, the assigned protection functions may be inhibited to avoid nuisance tripping

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.



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.

Functions		Measurement range	Accuracy ⁽¹⁾	MSA141	Saving	Available data	
						MSR/MST	
						Designation	Units
Metering							
Phase current		0,02 to 40 In	±0,5 %	■			
	Main channels					I1, I2, I3	A
	Additional channels					I'1, I'2, I'3	A
Residual current	Measured	0,005 to 20 In	±1 %	■		I0m, I'0m	A
	Calculated	0,005 to 40 In	±1 %	■		I0c, I'0c	A
Demand current		0,02 to 40 In	±0,5 %			I1moy, I2moy, I3moy	A
Peak demand current		0,02 to 40 In	±0,5 %		□	I1max, I2max, I3max	A
Voltage metering							
Phase-to-phase voltage	Main channels (U)	0,06 to 1,2 Unp	±0,5 %	■		U21, U32, U31	V
	Additional channels.					U'21, U'32, U'31	V
Phase-to-neutral voltage	Main channels (V)	0,06 to 1,2 Vnp	±0,5 %	■		V1, V2, V3	V
	Additional channels					V'1, V'2, V'3	V
Residual voltage		0,04 to 3 Vnp	±1 %			V0, V'0	V
Neutral point voltage		0,04 to 3 Vntp	±1 %			Vnt	V
Positive sequence voltage		0,05 to 1,2 Vnp	±2 %			Vd, V'd	V
Negative sequence voltage		0,05 to 1,2 Vnp	±2 %			Vi, V'i	V
Frequency	Main channels (f)	25 to 65 Hz	±0,02 Hz	■		F, F'	Hz
Power metering							
Active power (total or per phase)		0,015 Sn to 999 MW	±1 %	■		P	MW
Active power per phase						P1, P2, P3	MW
Peak demand active power		0,015 Sn to 999 MW	±1 %		□	Pmax	MW
Reactive power (total or per phase)		0,015 Sn to 999 Mvar	±1 %	■		Q	Mvar
Reactive power per phase						Q1, Q2, Q3	Mvar
Peak demand reactive power		0,015 Sn to 999 Mvar	±1 %		□	Qmax	Mvar
Apparent power (total or per phase)		0,015 Sn to 999 MVA	±1 %	■		S	MVA
Apparent power per phase						S1, S2, S3	MVA
Peak demand apparent power						Smax	MVA
Power factor (cos φ)		-1 to +1 (CAP/IND)	±0,01	■		cosPhi	MVA
Apparent power	Measured (+ and -)					Eam+, Eam-	MW.h
	Calculated (+ and -)	0 to 2,1.10 ⁸ MW.h	±1 % ±1 digit		□ □	Eac+, Eac-	MW.h
Reactive power	Measured (+ and -)					Erm+, Erm-	Mvar.h
	Calculated (+ and -)	0 to 2,1.10 ⁸ Mvar.h	±1 % ±1 digit		□ □	Erc+, Erc-	Mvar.h
Other metering							
Temperature		-30 to +200 °C or -22 to +392 °F	±1 °C de +20 to +140 °C ±1,8 °F de +68 to +284 °F	■		T1 to T16	°C / °F
Rotation speed		0 to 7200 tr/mn	±1 tr/mn			Rot104	tr / mn
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 % Ib	±2 %			Ii / Ib	% Ib or % I'b
Total harmonic distortion, current		0 to 100 %	±1 %			Ithd	%
Total harmonic distortion, voltage		0 to 100 %	±1 %			Uthd	%
Phase displacement φ 0 (between V0 & I0)		0 to 359°	±2°				
Phase displacement φ 0, φ'0, φ'0Σ						φ 0, φ'0, φ'0Σ	°
Phase displacement φ 1, φ2, φ 3 (between V & I)		0 to 359°	±2°			φ 1, φ 2, φ 3	°
Thermal capacity used						Ech	%
Running hours counter						CH	hours
Phase differential current						Idiff1, Idif2, Idiff3	A
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					□		

- 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, cos φ > 0.8..

Functions	Measurement range	Accuracy ⁽¹⁾	MSA141	Saving	Available data MSR/MST	
					Description	Units
Machine operating assistance						
Phase-to-phase voltages U21, U22, U13	0,06 to 1,2 Unp	±0,5 %	■		U21 , U22 , U13	V
I1, I2, I3	0,02 to 40 In	±0,5 %	■		I1 , I2 , I3	A
Temperature	-30 to +200 °C or -22 to +392 °F	±1 °C de +20 to +140 °C ±1,8 °F de +68 to +284 °F			T1 à T16	°C / °F
Rotor speed of rotation calculated via 49RMS motor					Rot49	tr / mn
Rotor speed of rotation measured via I104 input	0 to 7200 tr/mn	±1 tr/mn			Rot104	tr / mn
Motor thermal capacity used ⁽²⁾ 0 to 800 % (100 % for I phase = Ib)	±1 %	■	□ □		M	pu
Rotor thermal capacity used ⁽²⁾					W	pu
Rotor resistance ⁽²⁾					Rr+	Ω
Stator thermal capacity used ⁽²⁾					E	pu
Stator resistance ⁽³⁾					Rs	Ω
Positive-sequence current					Id	A
Negative-sequence current					Ii	A
Positive-sequence voltage	0,05 to 1,2 Vnp	±2 %			Vd	V
Negative-sequence voltage	0,05 to 1,2 Vnp	±2 %			Vi	V
Residual current Measured	0,005 to 20 In	±1 %			I0	A
Calculated	0,005 to 40 In	±1 %			I0_S	A
Measured residual voltage					V0	V
Motor torque ⁽²⁾					C	pu
Slip (calculated via 49RMS motor)					g	pu
Frequency ⁽⁴⁾					F	Hz
Remaining operating time before overload tripping	0 à 999 mn	±1 mn				
Waiting time after overload tripping	0 à 999 mn	±1 mn				
Running hours counter / operating time	0 à 65535 heures	±1 % ou ±0,5 h		□ □		
Starting current	1,2 Ib à 40 In	±5 %		□		
Starting time	0 à 300 s	±300 ms		□		
Number of starts before inhibition	0 à 60	-				
Start inhibit time	0 à 360 mn	±1 mn				
Phase displacement φ1, φ2, φ3 (between I)	0 à 359°	±2°				
Apparent impedance Zd, Z21, Z32, Z13	0 à 200 kΩ	±5 %				
Capacitance	0 à 30 F	±5 %				
Switchgear diagnosis assistance						
Cumulative breaking current	0 à 65535 kA²	±10 %		□ □		
Number of operations	0 à 4.10 ⁹	-		□ □		
Operating time	20 à 100 ms	±1 ms		□ □		
Charging time	1 à 20 ms	±0,5 s		□ □		
Number of rackouts	0 à 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, cos φ > 0.8..

(2) The value used is that provided by the 49RMS motor thermal overload protection if this has been activated. The value is 0 if the 49RMS generic thermal overload protection has been activated.

(3) The value used is that for the active 49RMS protection: motor thermal overload or generic thermal overload.

(4) Only available for the main voltage channels.

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 17 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 R^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.

Thermal overload for transformers - Characteristics

This function is used to protect a transformer against overloads, based on the measurement of the current taken. IEC standard 60076-2 proposes 2 thermal models for evaluating the winding thermal capacity used during an overload, depending on whether the transformer is dry-type or immersed.

- Taking account of harmonics

The equivalent current measured by the transformer thermal overload protection is the highest of the phase rms currents (the rms current takes account of harmonic numbers up to 13).

- Taking account of 2 operating conditions

The choice between thermal sets 1 and 2 is made by the "switching of thermal settings" logic input. This means you can have thermal set 1 for normal transformer operation and thermal set 2 for unusual transformer operation.

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.

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.

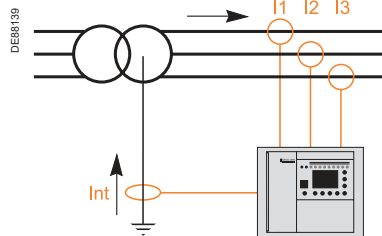
Characteristics

- 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)

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.

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.

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.

ANSI 67N/67NC type 3

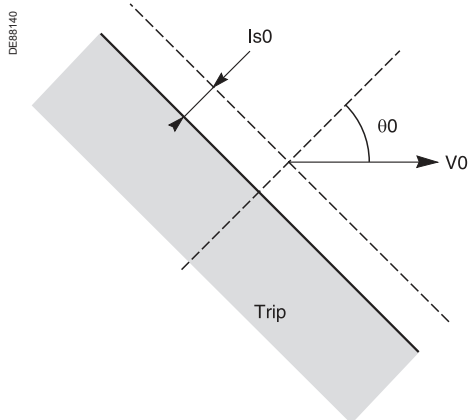
Directional overcurrent protection for distribution networks in which the neutral earthing system varies according to the operating mode, based on measured residual current.

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.

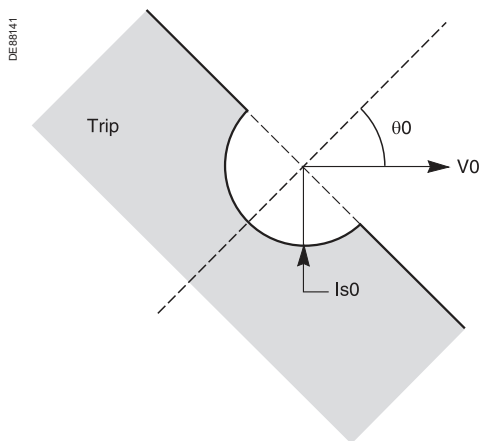
This protection function complies with the CEI 0-16 Italian specification.

Type 3 characteristics

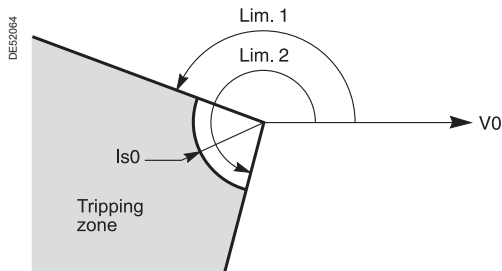
- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) curve
- choice of tripping direction
- no timer hold



Tripping characteristic of ANSI 67N/67NC type 1 protection (characteristic angle $\theta_0 \neq 0^\circ$).



Tripping characteristic of ANSI 67N/67NC type 2 protection (characteristic angle $\theta_0 \neq 0^\circ$).



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

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:

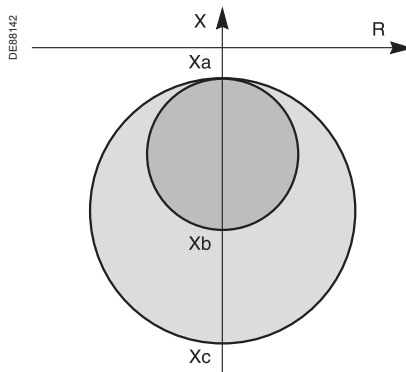
- too frequent starts: motor energizing is inhibited when the maximum allowable number of starts is reached, after counting of:
 - starts per hour (or adjustable period)
 - consecutive motor hot or cold starts (reacceleration of a motor that is not shut down, indicated by a logic input, may be counted 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 X_a , X_b and X_c



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 X_a , X_b and X_c according to the electrical characteristics of the machine (and transformer, when applicable).

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

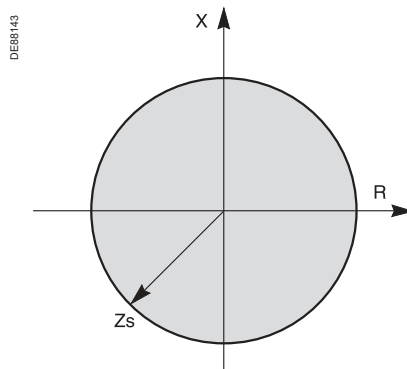
Phase-to-phase short-circuit protection, for generators, based on the calculation of apparent phase-to-phase impedance.

$$Z_{21} = \frac{U_{21}}{I_2 - I_1}$$

apparent impedance between phases 1 and 2.

Characteristics

- circular characteristic centered at origin defined by adjustable set point Z_s



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).

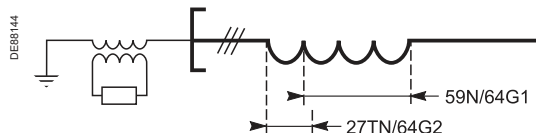
Consists of an instantaneous phase overcurrent protection confirmed by a time-delayed undervoltage protection function.

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: third 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).

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.

FRT (fault ride through)

Custom "Grid code" curve

Production installations must stay connected to the grid whenever the voltage is higher than that defined by the "Grid code" curve. The custom curve is defined point by point, with the disconnection time T_c in seconds on the X-axis and the voltage U/U_n in pu on the Y-axis.

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

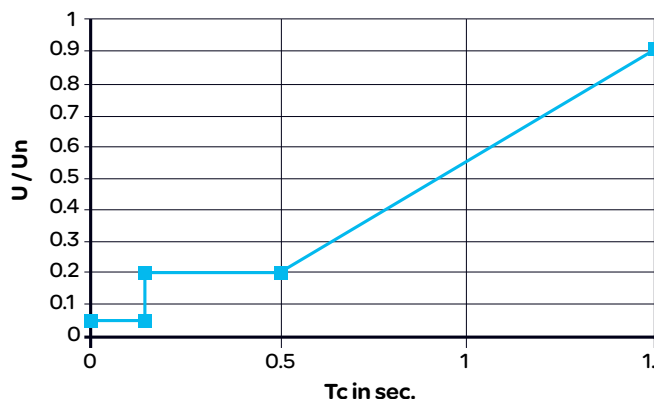
In installations with autonomous production means connected to a utility, the "rate of change of frequency" protection function is used to detect loss of the main system in view of opening the incoming circuit breaker to:

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

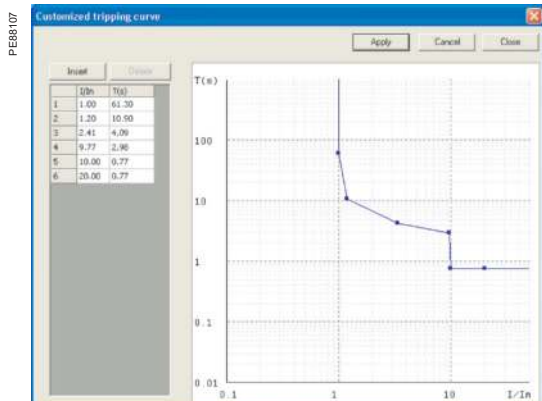
Load shedding

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.



Custom "Grid code" curve



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 IDM T 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).

Equation	Curve type	Coefficient values		
		k	α	β
$td(I) = \frac{k}{\left(\frac{I}{I_s}\right)^\alpha - 1} \times \frac{T}{\beta}$	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

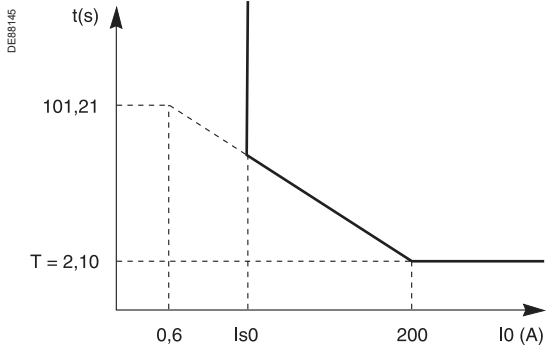
Equation: $td(I) = \frac{1}{0.339 - 0.236\left(\frac{I}{I_s}\right)^{-1}} \times \frac{T}{3.1706}$

IEEE curves

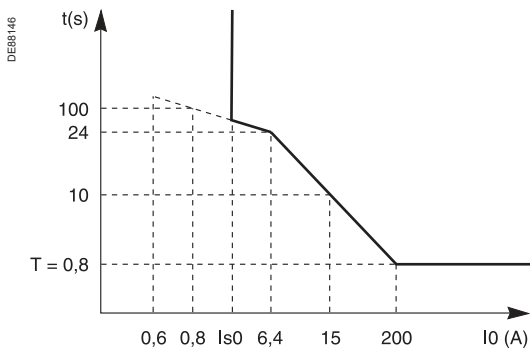
Equation	Curve type	Coefficient values			
		A	B	p	β
$td(I) = \left(\frac{A}{\left(\frac{I}{I_s}\right)^p - 1} + B \right) \times \frac{T}{\beta}$	Moderately inverse	0.010	0.023	0.02	0.241
	Very inverse	3.922	0.098	2	0.138
	Extremely inverse	5.64	0.0243	2	0.081

IAC curves

Equation	Curve type	Coefficient values					
		A	B	C	D	E	β
$td(I) = \left(A + \frac{B}{\left(\frac{I}{I_s} - C\right)} + \frac{D}{\left(\frac{I}{I_s} - C\right)^2} + \frac{E}{\left(\frac{I}{I_s} - C\right)^3} \right) \times \frac{T}{\beta}$	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



EPATR-C Standard curve (logarithmic scale).



EPATR-B Standard curve (logarithmic scale).

Equation for EPATRB, EPATRC

EPATRB
For 0,6 A ≤ I0 ≤ 6,4 A

$$td(I_0) = \frac{85\,386}{I_0^{0,975}} \times \frac{T}{0,8}$$

For 6,4 A ≤ I0 ≤ 200,0 A

$$td(I_0) = \frac{140\,213}{I_0^{0,975}} \times \frac{T}{0,8}$$

For I0 > 200,0 A
td(I0) = T

EPATRC
For 0,6 A ≤ I0 ≤ 200,0 A

$$td(I_0) = 72 \times 10^{-2,3} \times \frac{T}{2,10}$$

For I0 > 200,0 A
td(I0) = T

Voltage IDMT tripping curves

Equation for ANSI 27 - undervoltage

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

Equation for ANSI 59N - Neutral voltage displacement

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

Voltage/frequency ratio IDMT tripping curves

Equation for ANSI 27 - undervoltage

With G = V/f or U/f

$$td(G) = \frac{1}{\left(\frac{G}{G_s} - 1\right)^p} \times T$$

Curve type	P
A	0.5
B	1
C	2

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 $10 \times I_s$
- TMS factor, factor shown as T/b in the equations on the left.

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

The measurement origin needs to be indicated for each unit of the protection functions that may use measurements of different origins.

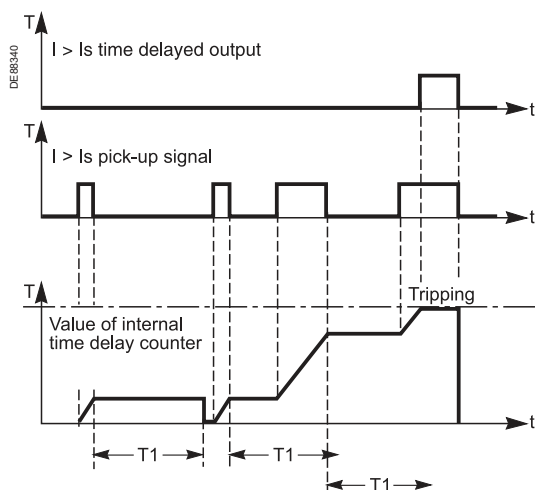
The setting links a measurement to a protection unit and allows the protection units to be distributed optimally among the measurements available according to the sensors connected to the analog inputs.

Example: distribution of ANSI 50N/51N function units for transformer earth fault protection:

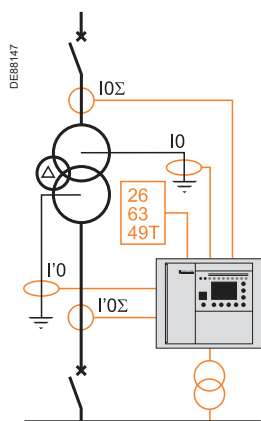
- 2 units linked to measured I0 for transformer primary protection
- 2 units linked to measured I'0 for transformer secondary protection
- 2 units linked to I0Σ for protection upstream of the transformer
- 2 units linked to I'0Σ for protection downstream of the transformer.

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
EPATR curves	50N/51N
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



Detection of restriking faults with adjustable timer hold.



Measurement origin: example.

Functions	Settings	Time delays
ANSI 12 - Overspeed		
	100 to 160 % of Wn	1 to 300 s
ANSI 14 - Underspeed		
	10 to 100 % of Wn	1 to 300 s
ANSI 21B - Underimpedance		
Impedance Zs	0.05 to 2.00 Vn/lb	
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 IDMT
		0.1 to 20000 s 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/√3)	220 V to 250 kV	220 V to 250 kV
Unp sync2 (Vnp sync2 = Unp sync2/√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 Live1 AND Dead2 Dead1 XOR Dead2 Dead1 OR Dead2 Dead1 AND Dead2	Dead1 AND Live2 Live1 AND Dead2 Dead1 XOR Dead2 Dead1 OR 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	0.05 to 300 s
K set point (adaptive)	0.1 to 0.2	0.05 to 300 s
Positive sequence undervoltage	50 to 100 % of Unp	
Minimum apparent power	1 to 90 % of Sb (Sb = 3.Un.lb)	
ANSI 32P - Directional active overpower		
	1 to 120 % of Sn ⁽¹⁾	0.1 s to 300 s
ANSI 32Q - Directional reactive overpower		
	5 to 120 % of Sn ⁽¹⁾	0.1 s to 300 s
ANSI 37 - Phase undercurrent		
	0.05 to 1 lb	0.05 to 300 s
ANSI 37P - Directional active underpower		
	5 to 100 % of Sn ⁽¹⁾	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/lb to 0.2 Vn/lb + 187.5 kΩ	
Circle 1: Xb	0.2 Vn/lb to 1.4 Vn/lb + 187.5 kΩ	0.05 to 300 s
Circle 2: Xc	0.6 Vn/lb to 3 Vn/lb + 187.5 kΩ	0.1 s to 300 s

(1) $S_n = \sqrt{3} \cdot I_n \cdot U_n$.

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	0.1 to 5 lb	Definite time
	0.1 to 5 lb (Schneider Electric)	IDMT
	0.1 to 1 lb (IEC, IEEE)	0.1 to 1 s
	0.03 to 0.2 lb (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 (I) or additional channels (I')	
ANSI 48/51LR - Locked rotor / excessive starting time		
Is set point	0.5 lb to 5 lb	ST starting time
		LT and LTS time delays
		0.5 to 300 s
		0.05 to 300 s
ANSI 49RMS - Thermal overload for cables		
Admissible current	1 to 1.73 lb	
Time constant T1	1 to 600 mn	
ANSI 49RMS - Thermal overload for capacitors		
Alarm current	1.05 lb to 1.70 lb	
Trip current	1.05 lb to 1.70 lb	
Positioning of the hot tripping curve	Current setting	1.02 x trip current to 2 lb
	Time setting	1 to 2000 minutes (variable range depending on the trip current and current setting)
ANSI 49RMS - Thermal overload for machines		
Accounting for negative sequence component	0 - 2.25 - 4.5 - 9	Mode 1 Mode 2
Time constant	Heating	T1: 1 to 600 mn T1: 1 to 600 mn
	Cooling	T2: 5 to 600 mn T2: 5 to 600 mn
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 lb	
Maximum equipment temperature	60 to 200 °C (140 °F to 392 °F)	
Measurement origin	Main channels (I) or additional channels (I')	
ANSI 49RMS - Motor thermal overload		
Measurement origin	I1, I2, I3	
Choice of thermal model	2 time constants/generic (see settings associated with generic thermal overload)	
Current set point - change of thermal settings	1 to 10 pu of lb (± 0.1 pu of lb)	
Characteristic times	Operating time accuracy	± 2 % or ± 1 s
Stator thermal settings		
Time constants	Motor thermal capacity used (T' long)	1 to 600 mn ± 1 mn
	Stator thermal capacity used (T' short)	1 to 60 mn ± 0.1 mn
	Cooling (T' cool)	5 to 600 mn ± 1 mn
Tripping current set point (K)	50 to 173 % of lb (± 1 % of lb)	
Alarm current set point	50 to 173 % of lb (± 1 % of lb)	
Thermal exchange coefficient between the stator and the motor (α)	0 to 1 (± 0.01)	
Current characterizing hot state	0.5 to 1 pu of lb (± 0.1 pu of lb)	
Accounting for ambient temperature	yes / no	
Maximum equipment temperature (Tmax)	70 to 250 °C (± 1 °C) or 158 to 482 °F (± 1 °F)	
Rotor thermal settings		
Locked rotor amperes (IL)	1 to 10 pu of lb (± 0.01 pu of lb)	
Locked rotor torque (LRT)	0.2 to 2 pu of nominal torque (+/- 0.01 pu of nominal torque)	
Locked rotor cold limit time (Tc)	1 to 300 s (± 0.1 s)	
Locked rotor hot limit time (Th)	1 to 300 s (± 0.1 s)	

(1) Tripping as of 1.2 Is.

Functions	Settings	Time delays	
ANSI 49RMS - Transformer thermal overload			
Measurement origin	I1, I2, I3 / I'1, I'2, I'3		
Choice of thermal model	Dry-type transformer Immersed transformer Generic		
Type of dry-type transformer	Natural ventilation (AN) / Forced ventilation (AF)		
Type of oil-filled transformer	Distribution ONAN / Power ONAN / ONAF / OF / OD		
Alarm set point (I _{alarm})	Immersed transformer: 98 to 160 °C (± 1 °C) or 208 to 320 °F (± 1 °F) Dry-type transformer: 95 to 245 °C (± 1 °C) or 203 to 473 °F (± 1 °F)		
Tripping set point (I _{trip})	Immersed transformer: 98 to 160 °C (± 1 °C) or 208 to 320 °F (± 1 °F) Dry-type transformer: 95 to 245 °C (± 1 °C) or 203 to 473 °F (± 1 °F)		
Time constant for dry-type transformer (τ)	1 to 600 mn ± 1 mn		
Time constant for oil-filled transfo	winding (τ wdg)	1 to 600 mn ± 1 mn	
	oil (τ oil)	5 to 600 mn ± 1 mn	
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 curve	Tripping time delay	Timer hold	
	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	
	IA : 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		
ANSI 50N/51N or 50G/51G - Earth fault			
Tripping curve	Tripping time delay	Timer hold	
	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	
	EPATR-B, EPATR-C	DT	
	Customized	DT	
	0.6 to 5 A	EPATR-B	0.5 to 1 s
	0.6 to 5 A	EPATR-C	0.1 to 3 s
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		

(1) Tripping as of 1.2 Is.

Functions	Settings	Time	
ANSI 50V/51V - Voltage-restrained overcurrent			
Tripping curve	Tripping time delay	Timer hold	
	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 0.5 to 2.4 In	Definite time IDMT	Inst; 0.05 s to 300 s 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	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 or Vnp		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, IO) or additional channels (I', IO')		
ANSI 66 - Starts per hour			
Permitted number of consecutive cold starts (Nc)	1 to 5	Delay between consecutive starts	1 to 90 mn
Permitted number of consecutive hot starts (Nh)	1 to (Nc - 1)	Delay between stop/start	0 to 90 mn
ANSI 67 - Directional phase overcurrent			
Characteristic angle	30°, 45°, 60°		
Tripping curve	Tripping time delay	Timer hold delay	
	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 0.1 to 2.4 In	Definite time IDMT	Inst; 0.05 s to 300 s 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 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	IO input, IO' input		
(1) Tripping as of 1.2 Is			

(1) Tripping as of 1.2 Is

Functions	Settings	Time		
ANSI 67N/67NC - Directional earth fault, according to I0 vector magnitude (type 2)				
Characteristic angle	-45°, 0°, 15°, 30°, 45°, 60°, 90°			
Tripping curve	Tripping time delay	Timer hold delay		
	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 IOS			
ANSI 67N/67NC type 3 - Directional earth fault, according to I0 vector magnitude directionalized on a tripping sector				
Tripping sector start angle	0° to 359°			
Tripping sector end angle	0° to 359°			
Is0 set point	CSH core balance CT (2 A rating)	0.1 A to 30 A	Definite time	Inst; 0.05 s to 300 s
	1 A CT	0.005 to 15 In0 (min. 0.1 A)		
	Core balance CT + ACE990 (range 1)	0.01 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		
Measurement origin	I0 input or I'0 input			
ANSI 78PS - Pole slip				
Stabilization delay	1 to 300 s			
Maximum variation of internal angle	100 to 1000 °			
Confirmation delay	0 to 300 ms			
Equal-area criterion				
Confirmation delay	0,1 to 300 s			
Power swings				
Number of turns	1 to 30			
Maximum time between 2 turns	1 to 300 s			
ANSI 81H - Overfrequency				
Set point and time delay	49 to 55 Hz or 59 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 51 Hz or 50 to 61 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			

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 outputs 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.

Logic inputs and outputs GOOSE

GOOSE logic inputs are used with the IEC61850 communication protocol.

The GOOSE inputs are divided between the 2 GSE virtual modules with 16 logic inputs.



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

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

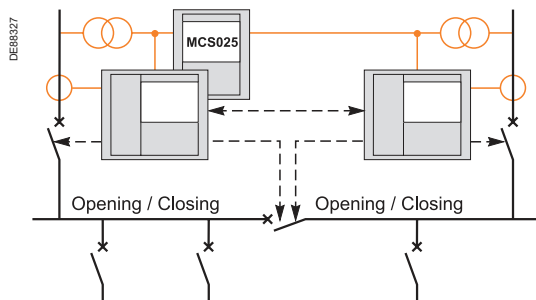
The motors disconnected as a result of the network voltage sag are automatically restarted:

- 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.



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

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 Ix 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/contactors control function, can be used to create the ANSI 86 "Lockout relay" function.

Output relay testing

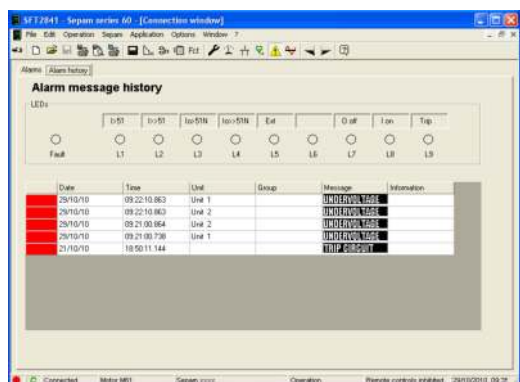
Each output relay is activated for 5 seconds, to make it simpler to check output connections and connected switchgear operation.

PEB0028



Local indications on the Sepam front panel.

PEB0103_SE



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 key

■ after the fault has disappeared, press the key: the light goes off and Sepam is reset

■ the list of alarm messages remains accessible (⏏ key) and may be cleared by pressing the ⏏ key from "Alarms" screen, but can not be cleared from "Alarm history" screen.

PE88038



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 by 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.

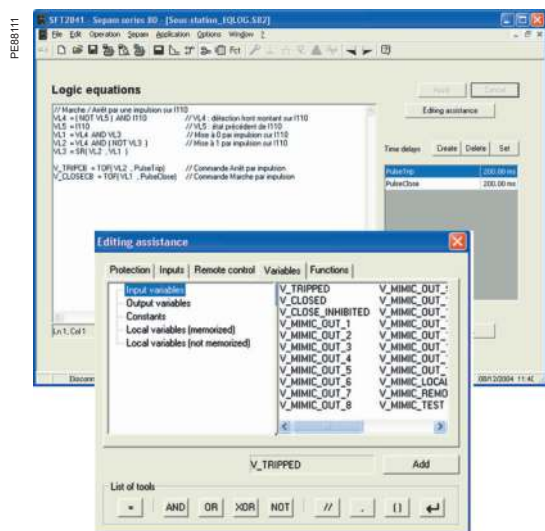
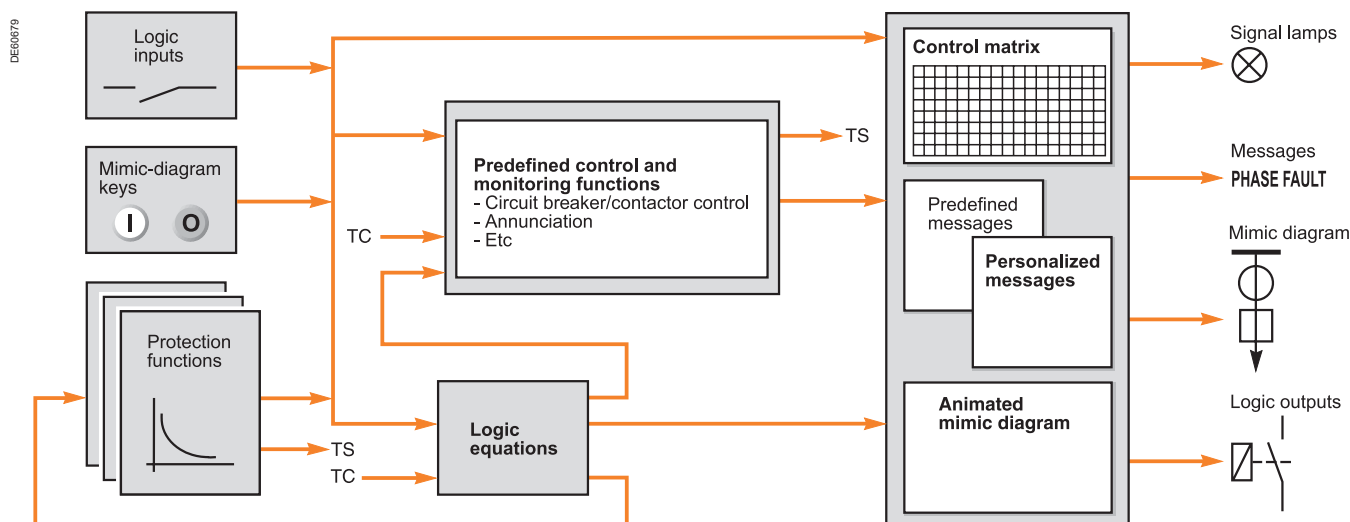
Control and monitoring

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.

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.

Local-control mimic diagram

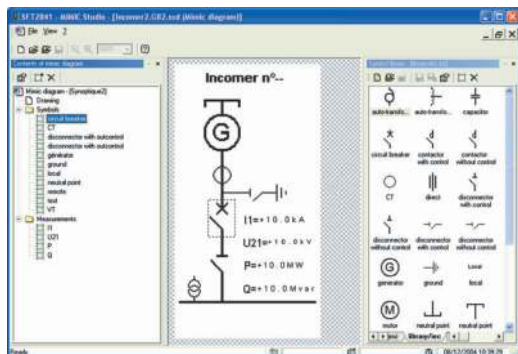
The mimic-diagram editor in the SFT2841 software can be used to create a single-line diagram corresponding exactly to the equipment controlled by Sepam.

Two procedures are available:

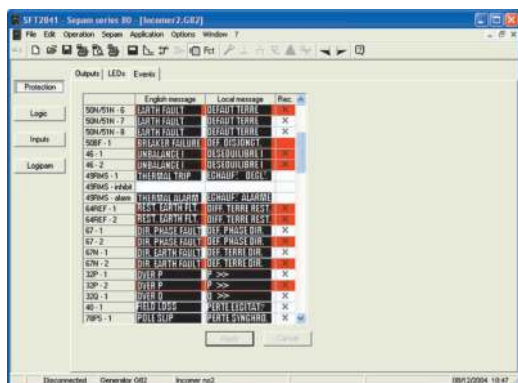
- rework a diagram taken from the library of standard diagrams in the SFT2841 software
- creation of an original diagram : graphic creation of the single-line diagram, positioning of symbols for the animated devices, insertion of measurements, text, etc.

Creation of a customized mimic diagram is made easy:

- library of predefined symbols: circuit breakers, earthing switch, etc.
- creation of personalized symbols.



SFT2841: mimic-diagram editor.

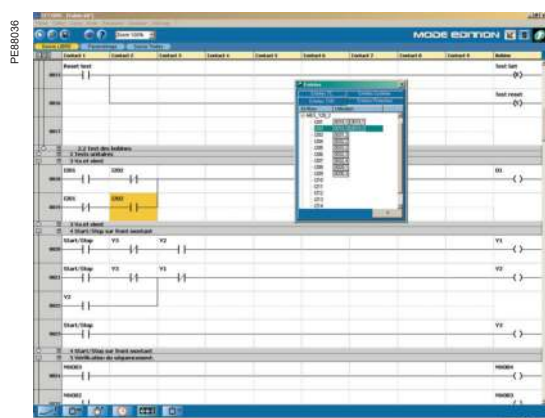
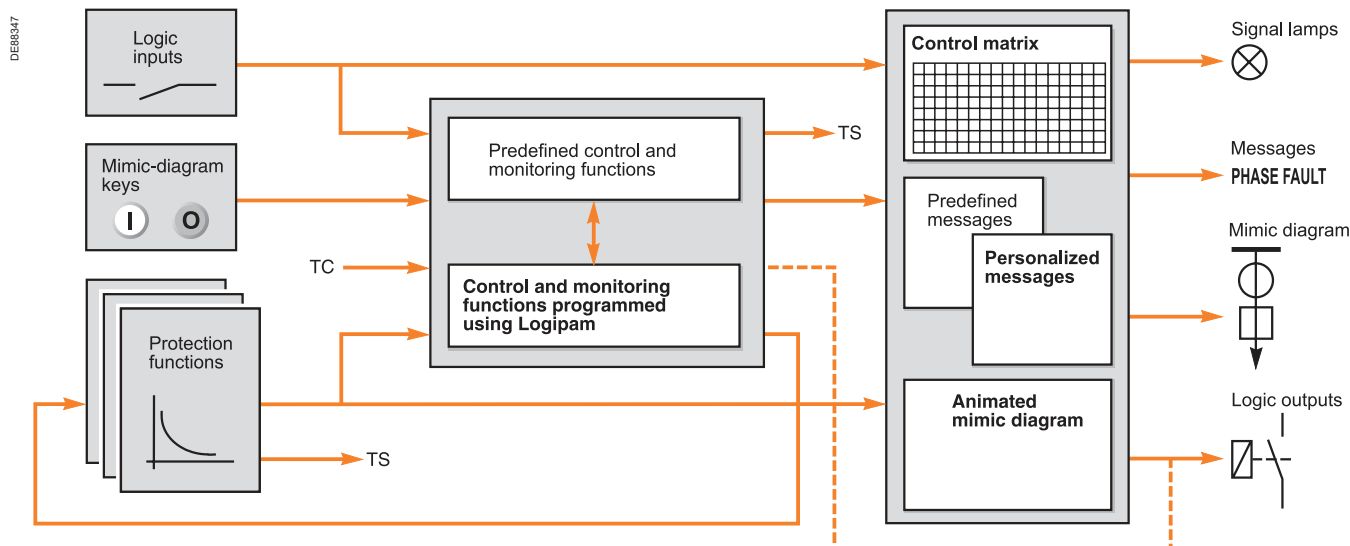


SFT2841: control matrix.

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.

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.

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 221.

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.

APC containing the SFT2841 software is connected to the RS 232 communication port on the front of the unit or through the communication network.



Sepam series 80 base unit with integrated advanced UMI.



Sepam series 80 base unit with mimic-based UMI.



Customized Chinese advanced UMI.

Selection guide

Base unit	With remote advanced UMI	With integrated advanced UMI	With mimic-based UMI
 PEB8043  PEB8040  PEB8041			
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 ■ 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 ■ 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

PE88044



Sepam series 80 memory cartridge and backup battery.

Hardware characteristics

Standard 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.

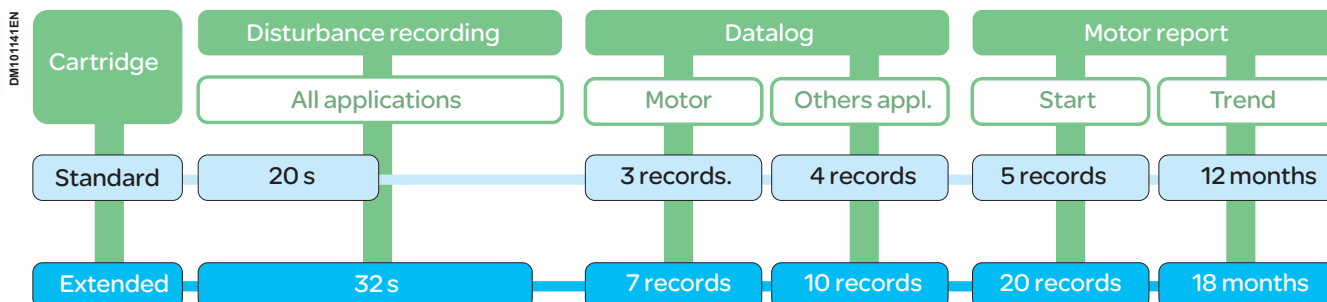
If a base unit fails, simply:

- 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.

Extended removable memory cartridge

It offers the same functions as the standard cartridge with extended storage capacity.



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 (A). 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.

PER8045



Main connector and voltage and residual current input connector

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 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 or CCA634 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.

AMT852 lead sealing accessory

The AMT852 lead sealing accessory can be used to prevent unauthorized modification of the settings of Sepam series 80 units with integrated advanced UMIs.

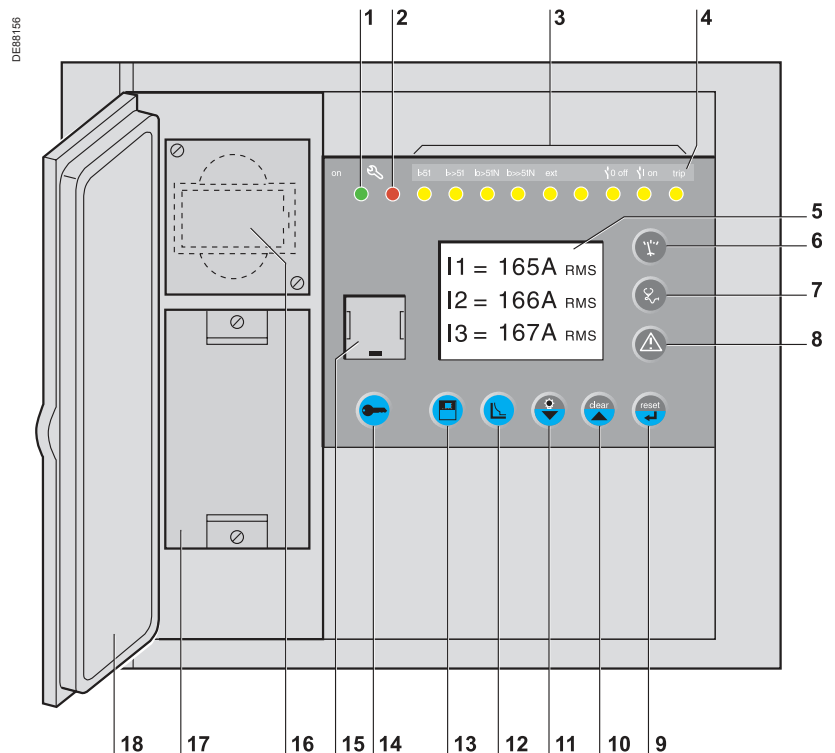
The accessory includes:

- 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 be secured only to the integrated advanced UMIs of Sepam series 80 units. Contact us to determine the serial number of the device on which you can fit the lead sealing accessory.

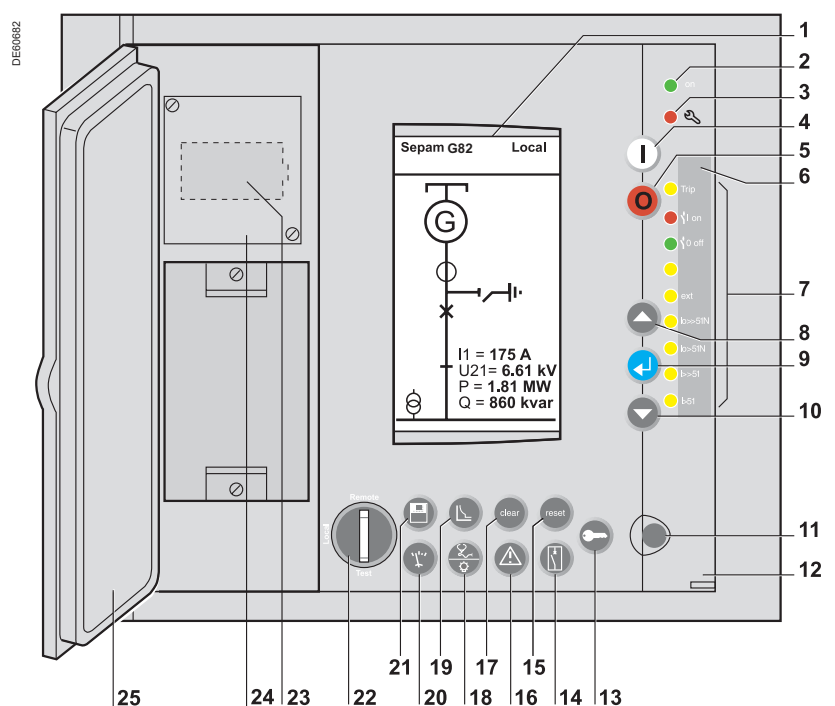
Front panel with advanced UMI

- 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.



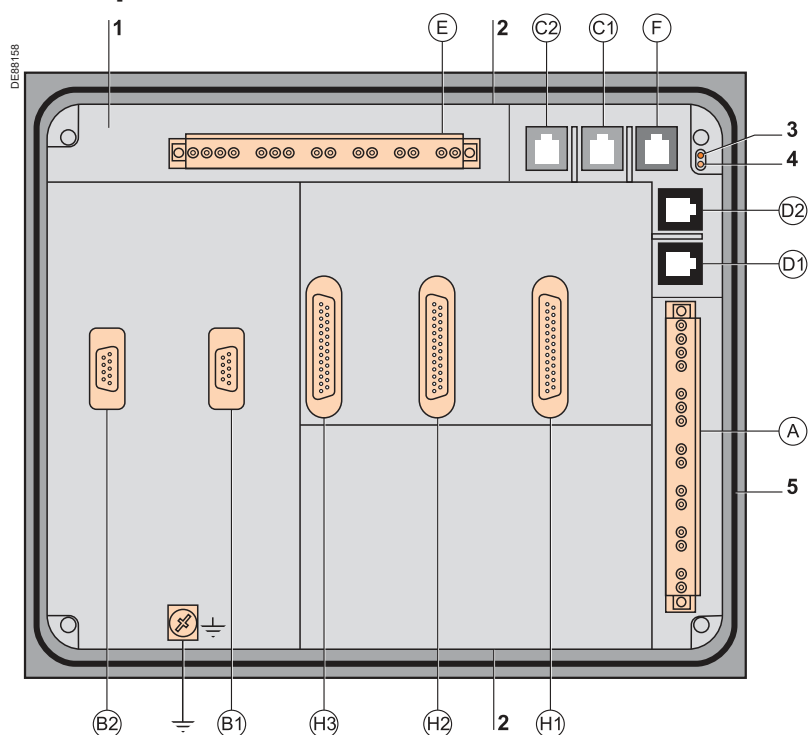
Front panel with mimic-based UMI

- 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 7 yellow indication LEDs, 1 red LED (I), 1 green LED (O).
- 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.



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:
- phase voltage V1, V2, V3 inputs
 - 1 residual voltage V0 input.
 - 2 residual current I0, I'0 inputs.
- (F) Communication port 3 for ACE850 modules only.
- (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.



CAUTION

HAZARD OF DEFECTIVE COMMUNICATION

- Never use both communication ports (C2) and (F) on a Sepam series 80 at the same time.
- The only communication ports that can be used simultaneously on a Sepam series 80 unit are ports (C1) and (C2) or ports (C1) and (F).

Failure to follow this instruction can cause equipment damage.

Weight					
		Base unit with advanced UMI		Base unit with mimic-based UMI	
Minimum weight (base unit without MES120)		2.4 kg (5.29 lb)		3.0 kg (6.61 lb)	
Maximum weight (base unit with 3 MES120)		4.0 kg (8.82 lb)		4.6 kg (10.1 lb)	
Sensor inputs					
Phase current inputs		1 A or 5 A CT			
Input impedance		< 0.02 Ω			
Consumption		< 0.02 VA (1 A CT) < 0.5 VA (5 A CT)			
Continuous thermal withstand		4 In			
1 second overload		100 In			
Voltage inputs		Phase		Residual	
Input impedance		> 100 k Ω		> 100 k Ω	
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	
Isolation of inputs in relation to other isolated groups		Enhanced		Enhanced	
Relay outputs					
Control relay outputs O101, O201 and O301					
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			
Isolation of outputs in relation to other isolated groups		Enhanced			
Annunciation relay output O5, O102 to O106, O202 to O206 and O302 to O306					
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 p.f. > 0.3				1 A
Isolation of outputs in relation to other isolated groups		Enhanced			
Power supply					
Voltage		24 to 250 V DC	-20 % / +10 %		
Maximum consumption		< 16 W			
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			
		Standard cartridge: 3 years minimum, typically 6 years Sepam not energized			
		Extended cartridge: 1.5 years minimum, typically 3 years Sepam not energized			

Electromagnetic compatibility	Standard	Level / Value	Class
Emission tests			
Disturbing field emission	CISPR 22 EN 55022	A	
Conducted disturbance emission	CISPR 22 EN 55022	A	
Immunity tests – Radiated disturbances			
Immunity to radiated fields	IEC 61000-4-3	III	10 V/m; 80 MHz - 6 GHz 30 V/m non-modulated; 800 MHz - 2 GHz ⁽¹⁾
	ANSI C37.90.2		20 V/m; 80 MHz - 1 GHz
Electrostatic discharge	IEC 61000-4-2 ⁽¹⁾	IV	15 kV air; 8 kV contact
	ANSI C37.90.3		15 kV air; 8 kV contact
Immunity to magnetic fields at network frequency	IEC 61000-4-8	4 ⁽²⁾	30 A/m (continuous) - 300 A/m (1-3 s)
	IEC 61000-4-8	5 ⁽³⁾	100 A/m (continuous) - 1000 A/m (3 s)
Immunity to pulsed magnetic fields ⁽¹⁾	IEC 61000-4-9	IV	600 A/m
Immunity to magnetic fields with damped oscillating waves ⁽¹⁾	IEC 61000-4-10	5	100 A/m
Immunity tests – Conducted disturbances			
Immunity to conducted RF disturbances	IEC 61000-4-6	III	10 Vrms
Electrical fast transients/burst	IEC 61000-4-4	IV	4 kV; 5 kHz and 100 kHz
1 MHz damped oscillating wave	ANSI C37.90.1		2.5 kV CM; 2.5 kV DM
100 kHz damped sinusoidal wave	IEC 61000-4-12	III IV ⁽¹⁾	2 kV MC 4 kV MC; 2.5 kV DM
Slow damped oscillating wave (100 kHz to 1 MHz)	IEC 61000-4-18	III	
Fast damped oscillating wave (3 MHz, 10 MHz, 30 MHz)	IEC 61000-4-18	III	
Surges	IEC 61000-4-5	III	2 kV CM; 1 kV DM
	GOST R 50746-2000 ⁽¹⁾	4	200 A
Immunity to conducted disturbances in common mode from 0 Hz to 150 kHz	IEC 61000-4-16	III	
d.c. voltage dips & interruptions	IEC 61000-4-29		0% Un - 0.1 s. Crit. A; 40% Un - 0.1 s. Crit. A 70% Un - 0.5 s. Crit. A; 0% - 5 s - Crit. C
Ripple	IEC 61000-4-17		15% UDC - 100/120 Hz crit. A
Gradual Shutdown / Start-up	IEC 60255-26		60 s - 5 m - 60 s
Mechanical robustness	Standard	Level / Value	Class
Energized			
Vibrations	IEC 60255-21-1	2	1 Gn; 10 Hz - 150 Hz
	IEC 60068-2-6	Fc	3 Hz - 13.2 Hz; a = ±1 mm
	IEC 60068-2-64	2M1	
Shocks	IEC 60255-21-2	1	10 Gn/11 ms
Earthquakes	IEC 60255-21-3	2	2 Gn (horizontal) 1 Gn (vertical)
De-energized			
Vibrations	IEC 60255-21-1	2	2 Gn; 10 Hz - 150 Hz
Shocks	IEC 60255-21-2	1	25 Gn / 11 ms
Jolts	IEC 60255-21-2	2	20 Gn / 16 ms
CSH30 horizontal with 2 clips; CSH120 / CSH200 horizontal with 3 plastic cable ties			
Mechanical robustness	Standard	Level / Value	Class
Operating (Energized)			
Vibrations	IEC 60255-21-1	2	0.075 mm / 1 g; 10 - 150 Hz
Shocks	IEC 60255-21-2	2	10 g / 11 ms
Earthquakes	IEC 60255-21-3	2	7.5 mm / 2 g (H); 3.5 mm / 1 g (V); 3 - 35 Hz
No Operating (De-energized)			
Vibrations	IEC 60255-21-1	2	2 g; 10 - 150 Hz
Shocks	IEC 60255-21-2	2	30 g / 11 ms
Jolts	IEC 60255-21-2	2	20 g / 16 ms
CSH30 vertical with 1 clips; CSH120 vertical with 2 clips; CSH 300 horizontal with 3 plastic cable ties			
Mechanical robustness	Standard	Level / Value	Class
Operating (Energized)			
Vibrations	IEC 60255-21-1	1	0.035 mm / 0.5 g; 10 - 150 Hz
Shocks	IEC 60255-21-2	1	5 g / 11 ms
Earthquakes	IEC 60255-21-3	1	3.5 mm / 1g (H); 1.5 mm / 0.5 g (V); 3 - 35 Hz

(1) Test conducted with a mimic-based HMI in the case of GOST performance testing.

(2) When protection functions 50N/51N or 67N are used and I0 is calculated on the sum of the phase currents, Is0 must be higher than 0.1In0.

(3) When protection functions 50N/51N or 67N are used and I0 is calculated on the sum of the phase currents, Is0 must be higher than 0.3In0.

Following the evolution of the IEC60255-26 standard to version 2023, the Is0 limit was revised in September 2024.

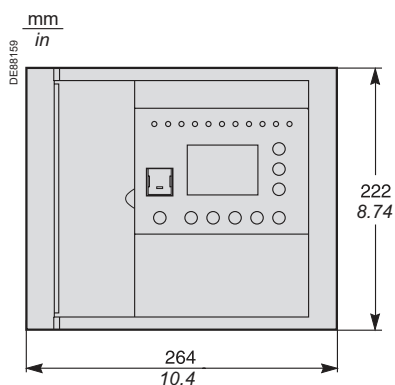
Mechanical robustness	Standard	Level / Class	Value
No Operating (De-energized)			
Vibrations	IEC 60255-21-1	1	1 g; 10 - 150 Hz
Shocks	IEC 60255-21-2	1	15 g / 11 ms
Jolts	IEC 60255-21-2	1	10 g / 16 ms
Climatic withstand	Standard	Level / Class	Value
During operation			
Exposure to cold	IEC 60068-2-1	Ad	-25 °C (-13 °F)
Exposure to dry heat	IEC 60068-2-2	Bd	+70 °C (+158 °F)
Continuous exposure to damp heat	IEC 60068-2-78	Cab	10 days; 93% RH; 40 °C (104 °F)
Salt mist	IEC 60068-2-52	Kb/2	3 days
Influence of corrosion/2-gas test	IEC 60068-2-60	Method 1	21 days; 70% RH; 25 °C (77 °F); 0.1 ppm H ₂ S; 0.5 ppm SO ₂
Influence of corrosion/4-gas test	IEC 60068-2-60	Method 4	21 days; 75% RH; 25 °C (77 °F); 0.01 ppm H ₂ S; 0.2 ppm SO ₂ ; 0.2 ppm NO ₂ ; 0.01 ppm Cl ₂
	EIA 364-65A	IIIA	42 days; 75% RH; 30 °C (86 °F); 0.1 ppm H ₂ S; 0.2 ppm SO ₂ ; 0.2 ppm NO ₂ ; 0.02 ppm Cl ₂
In storage ⁽¹⁾			
Temperature variation with specified variation rate	IEC 60068-2-14	Nb	-25 °C to +70 °C (-13 °F to +158 °F) 5 °C/min
Exposure to cold	IEC 60068-2-1	Ab	-25 °C (-13 °F)
Exposure to dry heat	IEC 60068-2-2	Bb	+70 °C (+158 °F)
Continuous exposure to damp heat	IEC 60068-2-78	Cab	56 days; 93% RH; 40 °C (104 °F)
	IEC 60068-2-30	Db	6 days; 95% RH; 55 °C (131 °F)
Safety	Standard	Level / Class	Value
Enclosure safety tests			
Front panel tightness	IEC 60529	IP52	Other panels IP20
	NEMA	Type 12	
Resistance to mechanical stress	IEC 60255-27	IK07	2 J
Fire withstand	IEC 60695-2-11		650 °C (1200 °F) with glow wire
Enclosure safety tests			
1.2/50 µs impulse wave	IEC 60255-27		5 kV ⁽²⁾
Power frequency dielectric withstand	IEC 60255-27		2 kV 1 min ⁽³⁾
	ANSI C37.90		1 kV 1 min (annunciation output) 1.5 kV 1 min (control output)
Functional safety			
Functional safety of electrical/electronic/programmable electronic safety-related systems	IEC 61508, EN 61508	SIL2 ⁽¹⁾	System architecture evaluation Hardware evaluation Software evaluation
Certification			
	En-harmonized standards		European directives
	■ EN/IEC60255-26:2013 ■ EN 60255-27:2014/IEC 60255-27:2013 ■ EN 50495:2010 ■ EN/ISO/IEC 80079-34:2018 ■ EN IEC 63000:2018/IEC 63000:2016		■ EMC European Directive CEM 2014/30/EU ■ Low Voltage European Directive 2014/35/EU ■ ATEX directive 2014/34/EU ⁽⁴⁾ ■ RoHS directive 2011/65/EU amended by Directive (EU) 2015/863
	BS-designated standards		UK statutory requirements
	■ BS 60255-26:2013 ■ BS EN 60255-27:2014 ■ BS EN 50495:2010 ■ BS EN ISO/IEC 80079-34:2020 ■ BS EN IEC 63000: 2018		■ Electromagnetic Compatibility Regulations SI 2016 No. 1091 ■ Electrical Equipment Regulations SI 2016 No. 1101 ■ Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations SI 2016 No1107 ■ Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations SI 2012 No. 3032
UL 	UL508 - CSA C22.2 no. 14-95		File E212533
CSA	CSA C22.2 no. 14-95/no. 0.17-00		File 210625

(1) Sepam must be stored in its original packaging.

(2) Except for communication: 3 kV in common mode and 1 kV in differential mode.

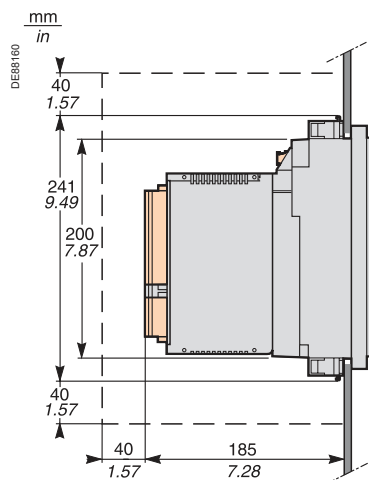
(3) Except for communication: 1 kVrms.

(4) See the appendix in "Installation and operation" manual SEPED303003EN, "Functional Safety" section.



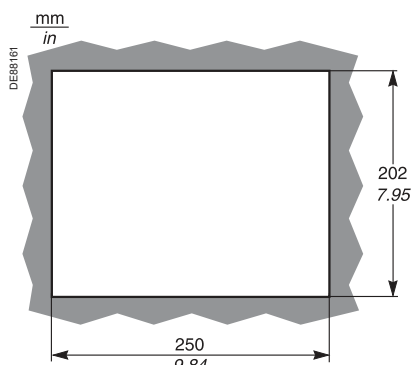
Front view of Sepam.

Dimensions

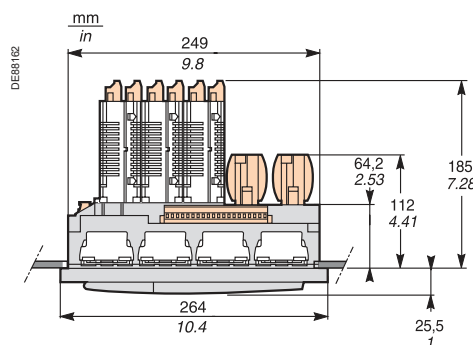


Side view of Sepam with MES120, flush-mounted in front panel with spring clips.
Front panel: 1.5 mm (0.05 in) to 6 mm (0.23 in) thick.

— | Clearance for Sepam assembly and wiring.



Cut-out.



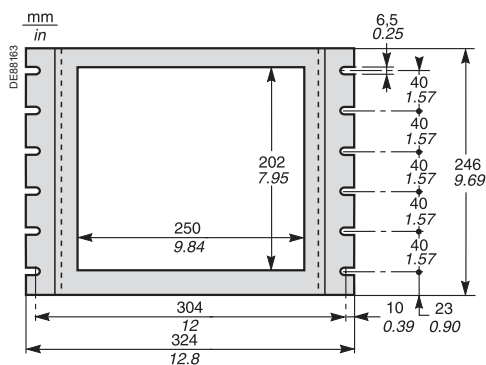
Top view of Sepam with MES120, flush-mounted in front panel with spring clips.
Front panel: 1.5 mm (0.05 in) to 6 mm (0.23 in) thick.

CAUTION

HAZARD OF CUTS

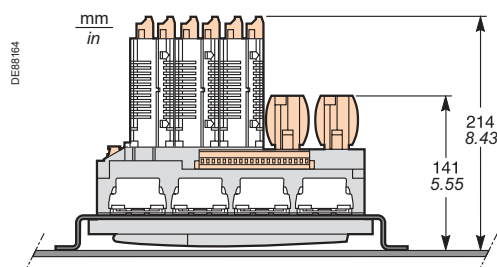
Trim the edges of the cut-out plates to remove any jagged edges.

Failure to follow this instruction can cause serious injury.

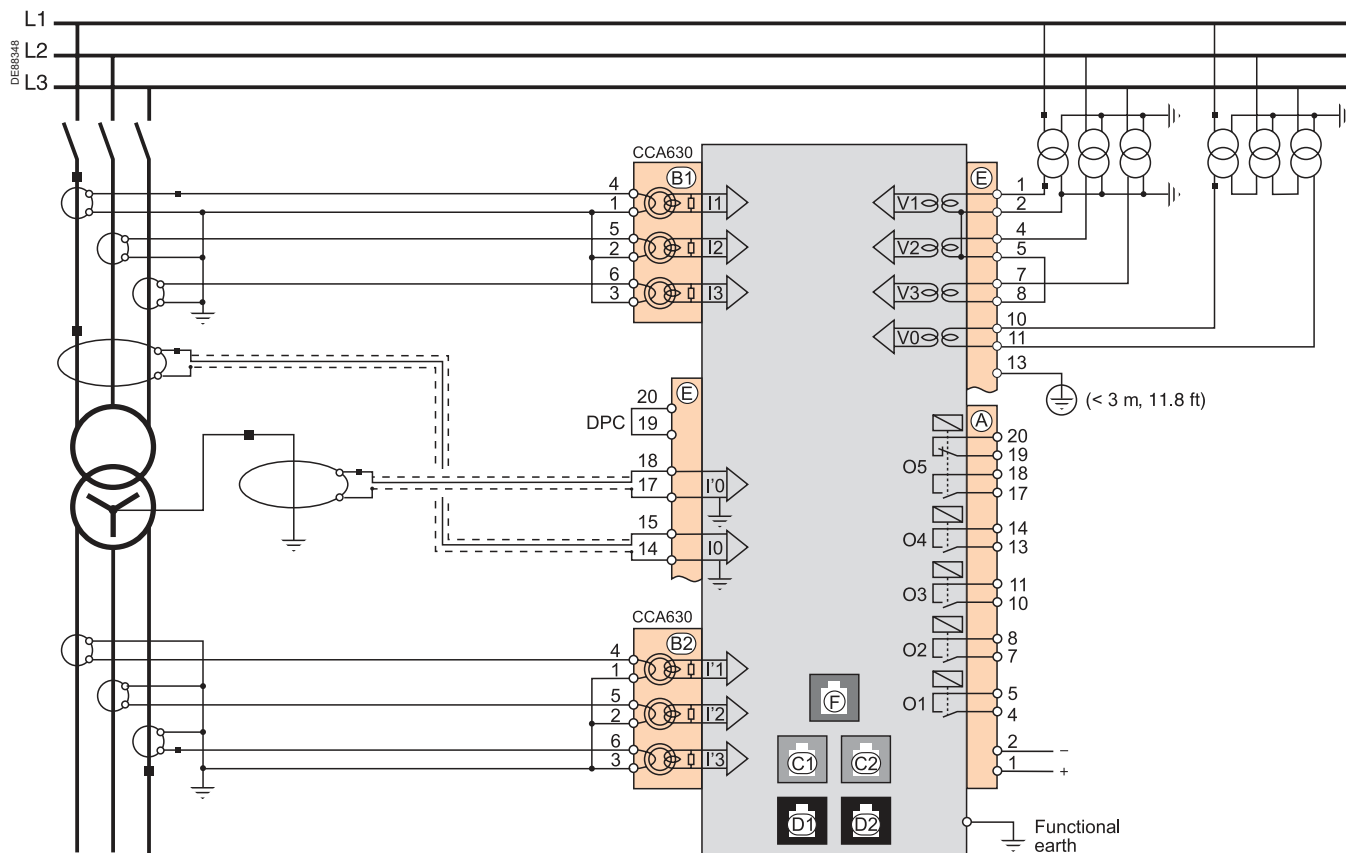


AMT880 mounting plate.

Assembly with AMT880 mounting plate



Top view of Sepam with MES120, mounted with AMT880 and spring clips.
Mounting plate: 3 mm (0.11 in) thick.



Connection characteristics

Connector	Type	Reference	Wiring
(A), (E)	Screw type	CCA620	■ wiring with no fittings : □ 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) □ stripped length: 8 to 10 mm ■ wiring with fittings: □ recommended wiring with Schneider Electric fittings: - DZ5CE015D for 1 x 1.5 mm² wire (AWG 16) - DZ5CE025D for 1 x 2.5 mm² wire (AWG 12) - AZ5DE010D for 2 x 1 mm² wires (AWG 18) □ tube length: 8.2 mm (0.32 in) □ stripped length: 8 mm (0.31 in)
	6.35 mm ring lugs	CCA622	■ 6.35 mm ring or spade lugs (1/4") ■ maximum wire cross-section of 0.2 to 2.5 mm² (≥AWG 24-12) ■ stripped length: 6 mm ■ use an appropriate tool to crimp the lugs on the wires ■ maximum of 2 ring or spade lugs per terminal ■ tightening torque: 1.2 (13.27 lb-in)
(C1), (C2)	White RJ45 plug		CCA612
(D1), (D2)	Black RJ45 plug		CCA770: L = 0.6 m (2 ft) CCA772: L = 2 m (6.6 ft) CCA774: L = 4 m (13.1 ft) CCA785 for MCS025 module: L = 2 m (6.6 ft)
(F)	Blue RJ45 plug		CCA614
 Functional earth	Ring lug		Earthing braid, to be connected to cubicle grounding: ■ flat copper braid with cross-section ≥ 9 mm² ■ maximum length: 500 mm (19.7 in)
(B1), (B2)	4 mm ring lugs	CCA630, CCA634 for connection of 1 A or 5 A CTs	■ wire cross-section 1.5 to 6 mm² (AWG 16-10) ■ tightening torque: 1.2 Nm (13.27 lb-in)
	RJ45 plug	CCA671, for connection of 3 LPCT sensors	Integrated with LPCT sensor

CAUTION

LOSS OF PROTECTION OR RISK OF NUISANCE TRIPPING

If the Sepam is no longer supplied with power or is in fail-safe position, the protection functions are no longer active and all the Sepam output relays are dropped out. Check that this operating mode and the watchdog relay wiring are compatible with your installation.

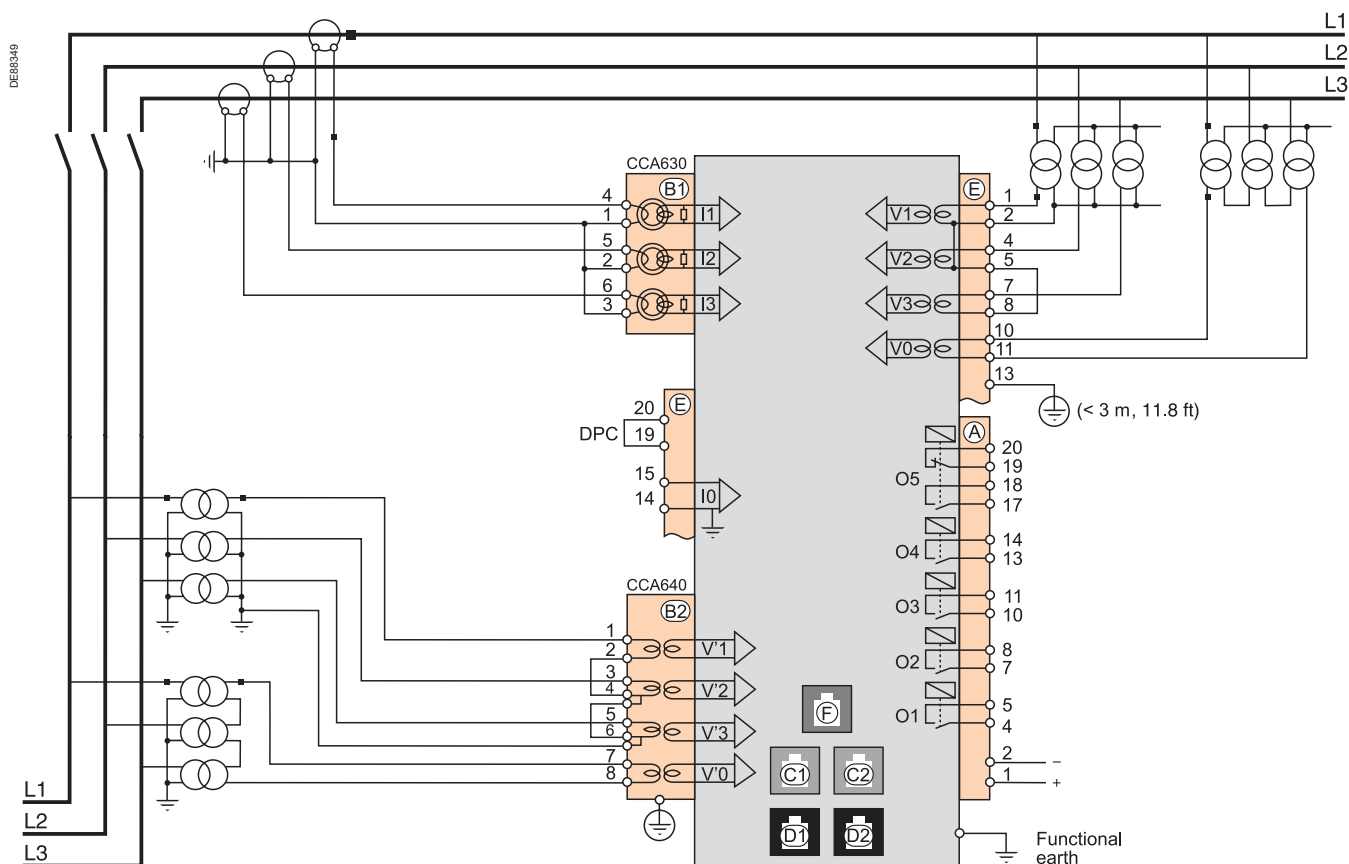
Failure to follow this instruction can result in equipment damage and unwanted shutdown of the electrical installation.

⚠ CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective earth and to the functional earth.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.



Connection characteristics

Connector	Type	Reference	Wiring
(B1)	4 mm ring lugs	CCA630, for connection of 1 A or 5 ACTs	1.5 to 6 mm ² (AWG 16-10)
(B2)	Screw type	CCT640	VT wiring: same as wiring for the CCA620 Earthing connection: by 4 mm ring lug

For connectors (A), (E), (C1), (C2), (D1), (D2), : see page 180.

CAUTION

LOSS OF PROTECTION OR RISK OF NUISANCE TRIPPING

If the Sepam is no longer supplied with power or is in fail-safe position, the protection functions are no longer active and all the Sepam output relays are dropped out. Check that this operating mode and the watchdog relay wiring are compatible with your installation.

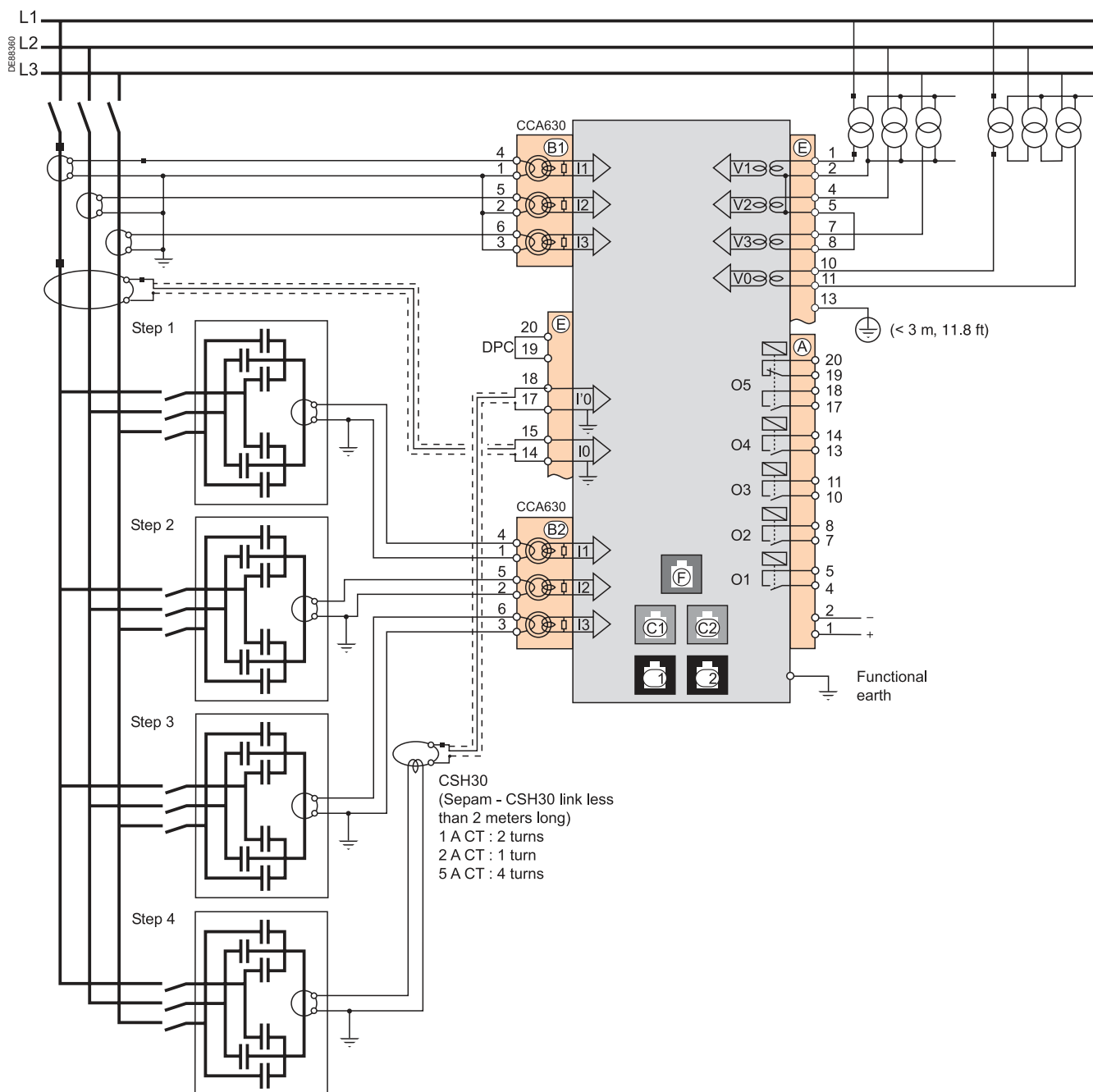
Failure to follow this instruction can result in equipment damage and unwanted shutdown of the electrical installation.

⚠ CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

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- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective earth and to the functional earth.
- Screw tight all terminals, even those not in use.

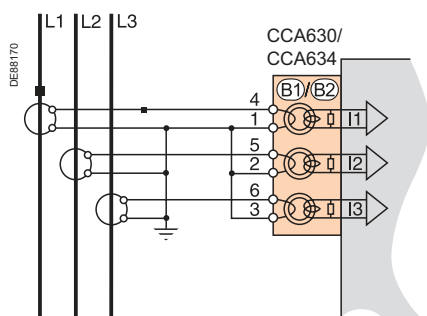
Failure to follow these instructions will result in death or serious injury.



Connector	Type	Reference	Wiring
(B1)	4 mm ring lugs	CCA630, for connection of 1 A or 5 A CTs	1.5 to 6 mm ² (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, 2 A or 5 A CTs	1.5 to 6 mm ² (AWG 16-10)
Functional earth	Ring lugs		Earthing braid, to be connected to cubicle grounding: ■ flat copper braid with cross-section ≥ 9 mm ² ■ maximum length: 500 mm

For connectors (A), (E), (C1), (C2), (D1), (D2), : see page 180.

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



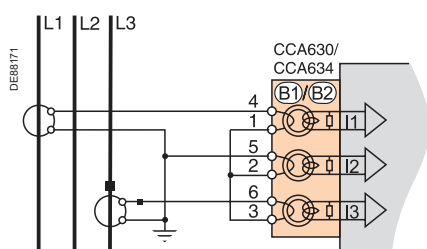
Connection of 3 x 1 A or 5 A sensors to the CCA630 connector.

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

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	I1, I2, I3
Rated current (In)	1 A to 6250 A

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.

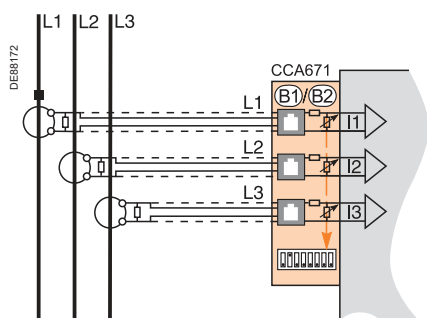
Measurement of phase 1 and 3 currents is sufficient for all protection functions based on phase current.

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.

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	I1, I3
Rated current (In)	1 A to 6250 A

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)).

Parameters

Sensor type	LPCT
Number of CTs	I1, I2, I3
Rated current (In)	25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000 or 3150 A

Note: Parameter In must be set twice:

- Software parameter setting using the advanced UMI or the SFT2841 software tool
- Hardware parameter setting using microswitches on the CCA671 connector

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

Description

Residual current is calculated by the vector sum of the 3 phase currents I_1 , I_2 and I_3 , measured by 3 x 1 A or 5 A CTs or by 3 LPCT type sensors.
See current input connection diagrams.

Parameters

Residual current	rated residual current	Measuring range
Sum of 3 Is	$I_{n0} = I_n$, CT primary current	0.01 to 40 I_{n0} (minimum 0.1 A)

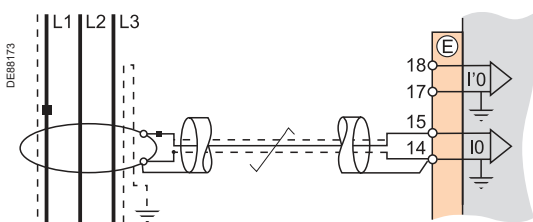
Variant 2: residual current measurement by CSH120 or CSH200 core balance CT (standard connection)

Description

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

Parameters

Residual current	rated residual current	Measuring range
2 A rating CSH	$I_{n0} = 2$ A	0.1 to 40 A
20 A rating CSH	$I_{n0} = 20$ A	0.2 to 400 A



Variant 3: residual current measurement by 1 A or 5 A CTs and CCA634

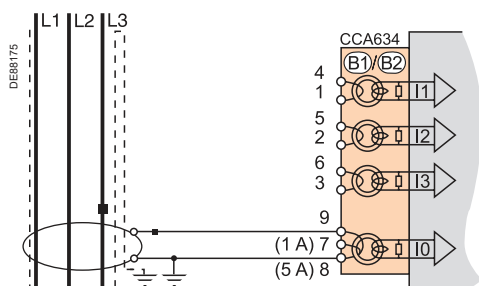
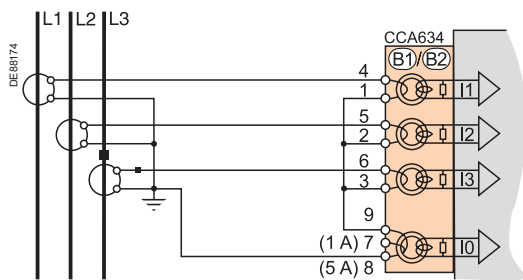
Description

Residual current measurement by 1 A or 5 A CTs

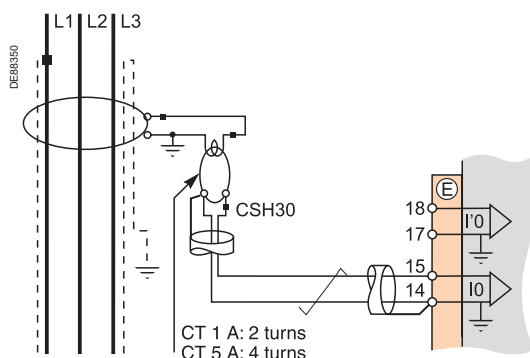
- Terminal 7: 1 A CT
- Terminal 8: 5 A CT

Parameters

Residual current	rated residual current	Measuring range
1 A CT	$I_{n0} = I_n$, CT primary current	0.01 to 20 I_{n0} (minimum 0.1 A)
5 A CT	$I_{n0} = I_n$, CT primary current	0.01 to 20 I_{n0} (minimum 0.1 A)



Variant 4: residual current measurement by 1 A or 5 A CTs and CSH30 interposing ring CT



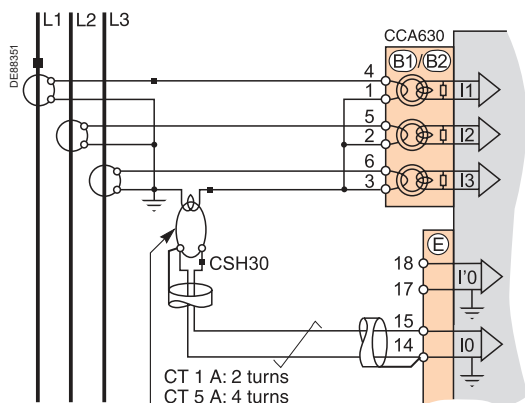
Description

The CSH30 interposing ring CT is used to connect 1 A or 5 A CTs to Sepam to measure residual current:

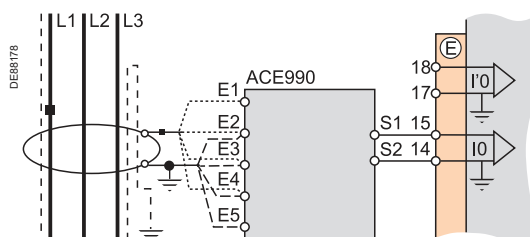
- CSH30 interposing ring CT connected to 1 A CT: make 2 turns through CSH primary
- CSH30 interposing ring CT connected to 5 A CT: make 4 turns through CSH primary.

Parameters

Residual current	rated residual current	Measuring range
1 A CT	$I_{n0} = I_n$, CT primary current	0.01 to 20 I_{n0} (minimum 0.1 A)
5 A CT	$I_{n0} = I_n$, CT primary current	0.01 to 20 I_{n0} (minimum 0.1 A)



Variant 5: residual current measurement by core balance CT with ratio of 1/n (n between 50 and 1500)



Description

The ACE990 is used as an interface between a MV core balance CT with a ratio of 1/n ($50 \leq n \leq 1500$) and the Sepam residual current input.

This arrangement allows the continued use of existing core balance CTs on the installation.

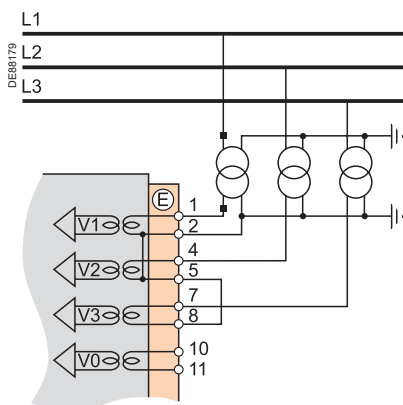
Parameters

Residual current	rated residual current	Measuring range
ACE990 - range 1 ($0.00578 \leq k \leq 0.04$)	$I_{n0} = I_k \cdot n^{(1)}$	0.01 to 20 I_{n0} (minimum 0.1 A)
ACE990 - range 2 ($0.00578 \leq k \leq 0.26316$)	$I_{n0} = I_k \cdot n^{(1)}$	0.01 to 20 I_{n0} (minimum 0.1 A)

(1) n = number of core balance CT turns

k = factor to be determined according to ACE990 wiring and setting range used by Sepam

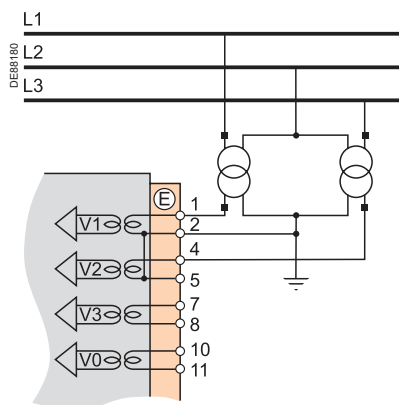
Variant 1: measurement of 3 phase-to-neutral voltages (3 V, standard connection)



Measurement of the 3 phase-to-neutral voltages allows the calculation of residual voltage, $V0\Sigma$.

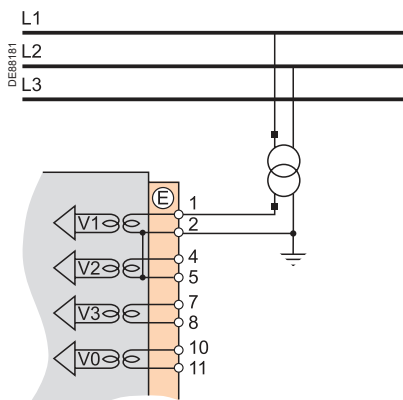
Phase voltage input connection variants

Variant 2: measurement of 2 phase-to-phase voltages (2 U)



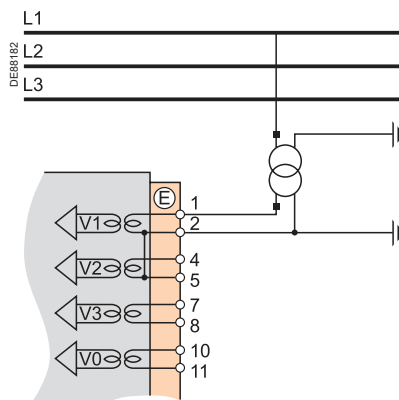
This variant does not allow the calculation of residual voltage.

Variant 3: measurement of 1 phase-to-phase voltage (1 U)



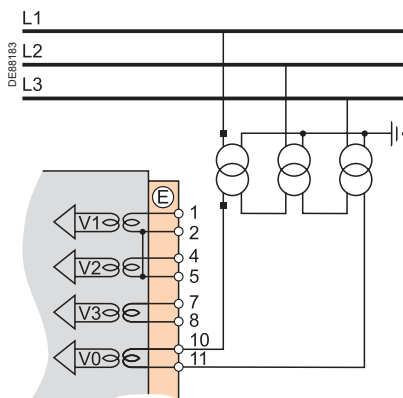
This variant does not allow the calculation of residual voltage.

Variant 4: measurement of 1 phase-to-neutral voltage (1 V)



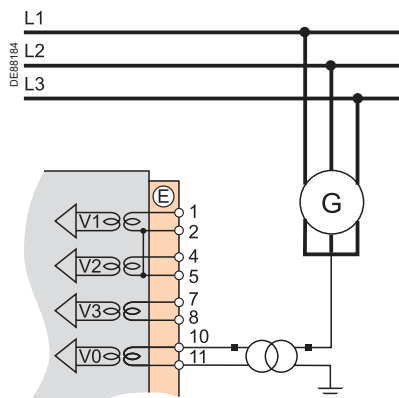
This variant does not allow the calculation of residual voltage.

Variant 5: measurement of residual voltage $V0$



Residual voltage input connection variants

Variant 6: measurement of residual voltage V_{nt} in generator neutral point

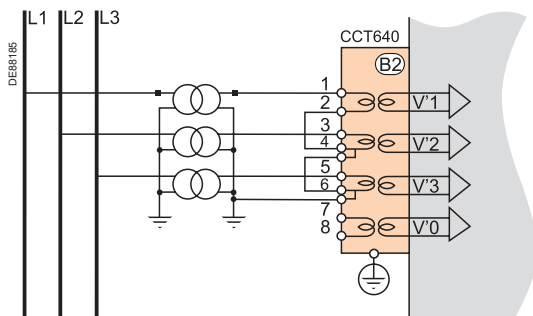


Phase voltage inputs

Residual voltage input

Additional channels for Sepam B83

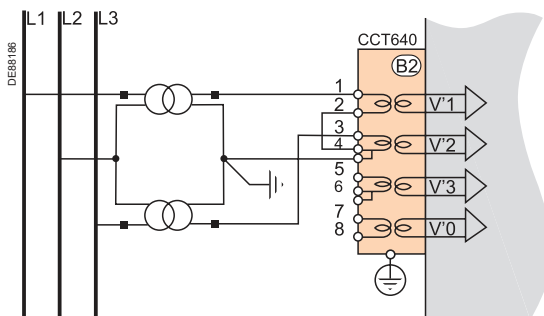
Variant 1: measurement of 3 phase-to-neutral voltages (3 V', standard connection)



Measurement of the 3 phase-to-neutral voltages allows the calculation of residual voltage, $V'0\Sigma$.

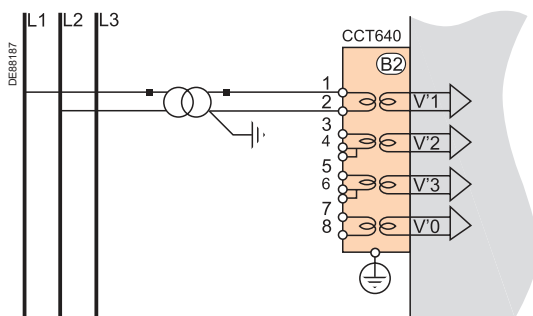
Additional phase voltage input connection variants

Variant 2: measurement of 2 phase-to-phase voltages (2 U')



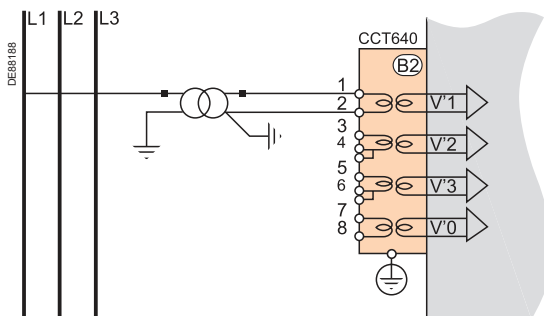
This variant does not allow the calculation of residual voltage.

Variant 3: measurement of 1 phase-to-phase voltage (1 U')



This variant does not allow the calculation of residual voltage.

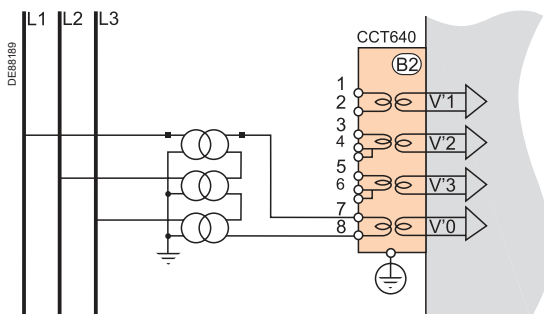
Variant 4: measurement of 1 phase-to-neutral voltage (1 V')



This variant does not allow the calculation of residual voltage.

Additional residual voltage input connection

Variant 5: measurement of residual voltage V'0

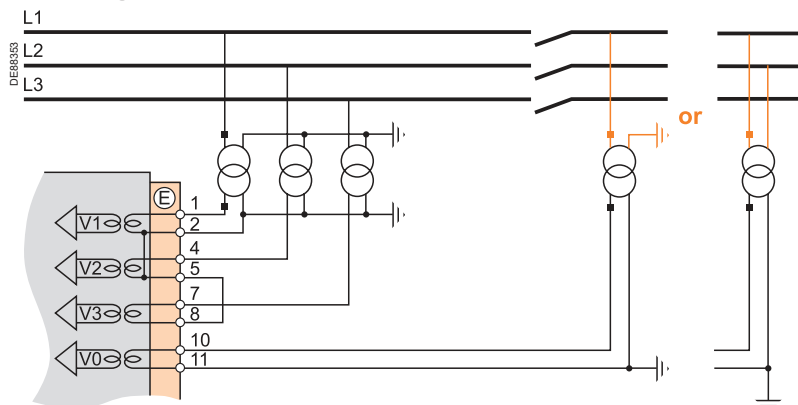


Phase voltage inputs

Residual voltage input

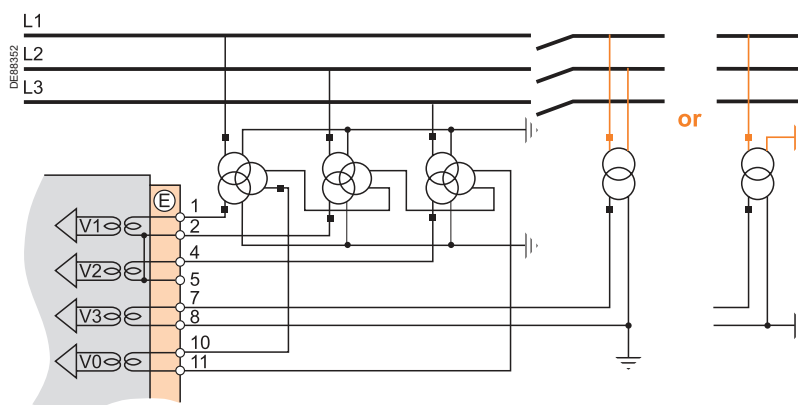
Additional channel for Sepam B80

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.

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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The electrical installation guide

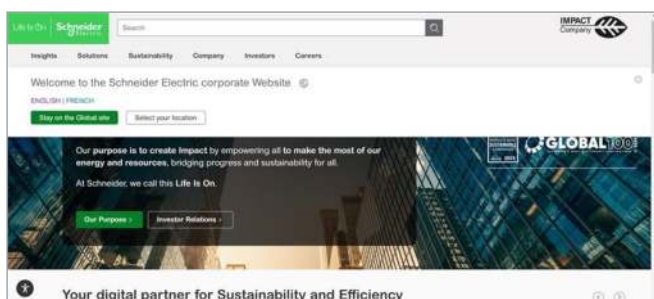
According to IEC 60364

This guide, part of the Schneider Electric offer, is the essential tool to "guide" you any time in your business:

- design office, consultant
- contractor, panelbuilder
- teacher, trainer.

Comprehensive and concrete information on:

- all the new technical solutions
- all the components of an installation from a global point of view
- all the IEC standards modifications
- all the fundamental electrotechnical knowledge
- all the design stages, from medium to low voltage.



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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)
- SFT850 advanced-configuration software for IEC 61850 protocol.

SFT2841 and SFT2826 software

SFT2841 and SFT2826 software is provided on the same CD-ROM as the Sepam documentation in PDF format.

PC connection cord

In order to use the SFT2841 software in point to point connected mode:

- 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.
- the CCA784 PC connection cord, to be ordered separately, is designed to connect a PC to the USB port on the front panel of a Sepam unit.

The USB/RS232 TSXCUSB232 converter may be used with the CCA783 connection cord for connection to a USB port.

SFT2885 software

SFT2885 is available on a separate CD-ROM.

SFT850 software

SFT850 is available on a separate CD-ROM.

Minimum configuration required

SFT2841 and SFT2826 software

Operating systems	Microsoft 2000/XP
RAM	128 MB
Space on disk	200 MB

SFT2885

Operating systems	Microsoft 2000/XP
RAM	64 MB
Space on disk	30 MB

SFT850

Operating systems	Microsoft 2000/XP
RAM	512 MB
Space on disk	200 MB

SFT2841 setting and operating software

Function

The SFT2841 software is the setting and operating tool for Sepam series 60 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.

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

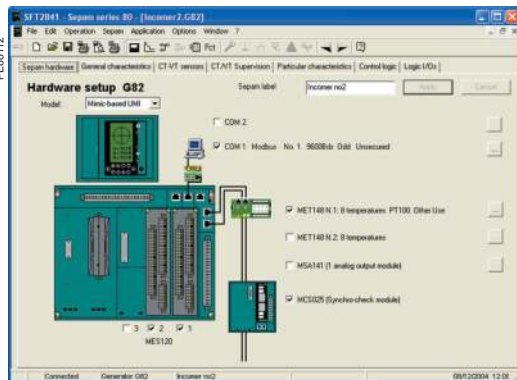
- access to all functions available in unconnected mode, after entering the protection-setting or parameter-setting password
- transfer of Sepam parameter and protection setting file, prepared in unconnected mode (downloading function), protected by the parameter-setting password
- display of all measurements and useful information during commissioning
- display of logic input, logic output and LED status
- test of logic outputs
- display of Logipam variables (Sepam series 80 only)
- setting of Logipam parameters (configuration bits, timers, etc.), (Sepam series 80 only)
- modification of passwords.

Management of protection functions and network diagnostics with an E-LAN multipoint network connection

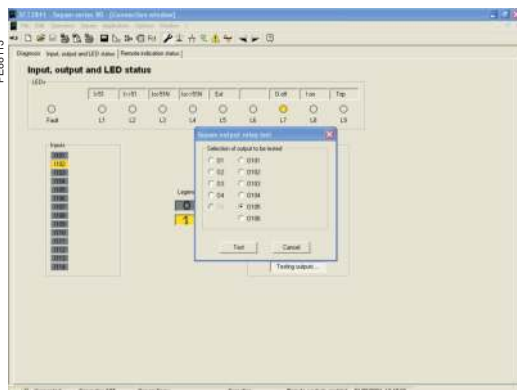
- reading of all Sepam protection and parameter settings, modifications following entry of the protection-setting or parameter-setting password
- display of all the Sepam measurement data
- display of Sepam, switchgear and network diagnosis data
- display of time-tagged alarm messages
- retrieval of disturbance recording data.

Efficient, easy-to-use software

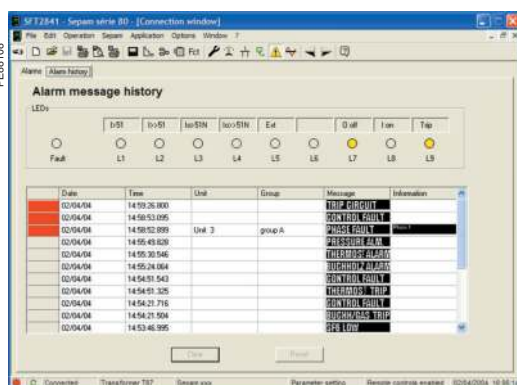
- menus and icons for fast, direct access to the data required
- guided navigation to go through all the data input screens in the natural order
- all data on the same function together in the same screen
- trilingual software: English, French, Spanish
- another local language: please contact us regarding local language customization
- 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.



SFT2841: Sepam series 80 hardware configuration.



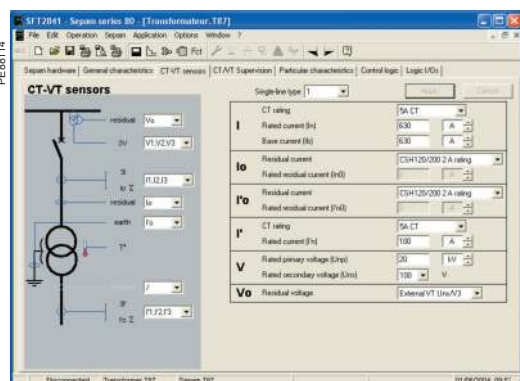
SFT2841: output testing.



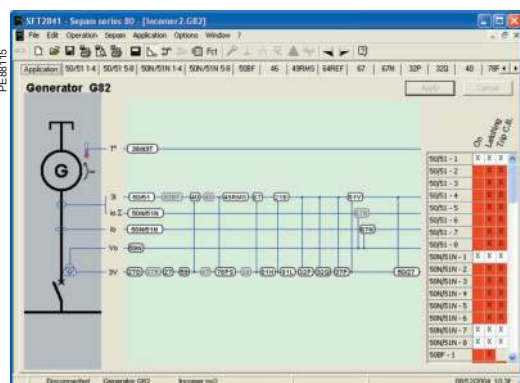
SFT2841: alarm history.

SFT2841 setting and operating software

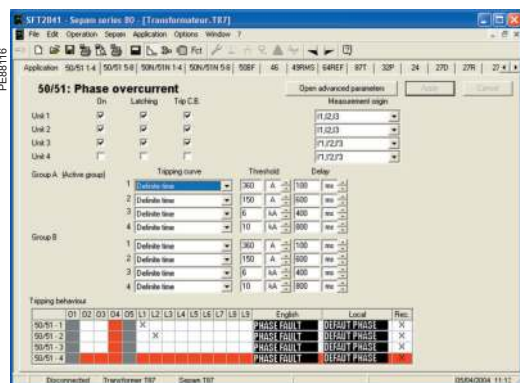
Function



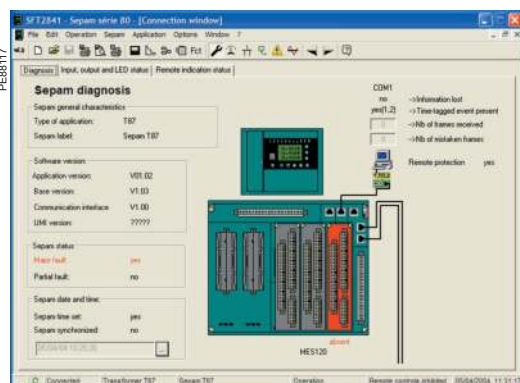
SFT2841: Sepam series 80 sensor parameter setting.



SFT2841: Sepam series 80 application, with protection function measurement origin.



SFT2841: protection settings.



SFT2841: Sepam diagnosis.

The table below gives the SFT2841 functions available for each of the 2 Sepam series: Sepam series 60 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.

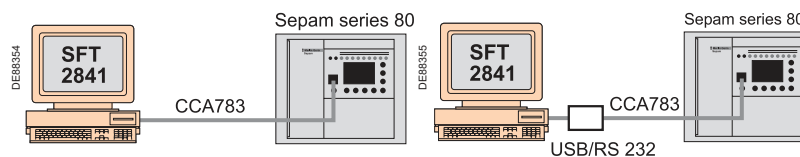
Functions	Series 60			Series 80		
	NC	S	E	NC	S	E
Management						
On-line help	■	■	■	■	■	■
Management of parameter and protection setting files: creation, saving, downloading and uploading	■	■	■	■	■	■
Downloading and uploading of parameter and protection setting files			■		■	■
Printing of parameter and 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	■	■	■		■	■
Standard configuration for IEC 61850 network	■	■	■	■	■	■
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	200			200		
Number of dedicated remote indications	20			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	100			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		■	■		■	■

SFT2841 setting and operating software

SFT2841 connection to Sepam

SFT2841 connection to the front panel of a Sepam

The SFT2841 can be connected to the front panel of Sepam series 60 or Sepam series 80 using the CCA783 or CCA784 cord or using the CCA783 + USB/RS232 (TSXCUSB232) converter .

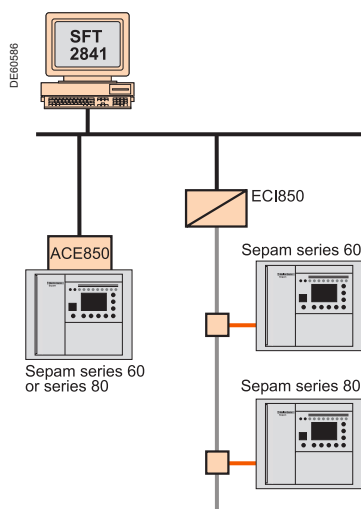


SFT2841 connection to a set of Sepam relays

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.

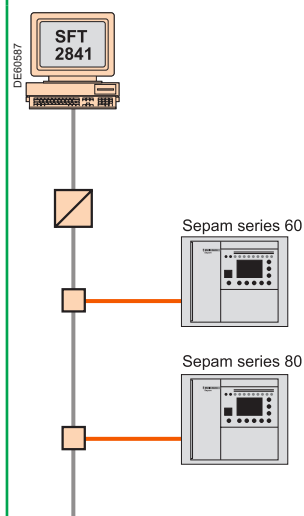
Ethernet connection

- connection a set of Sepam to a Modbus RS 485 network
- embedded Ethernet link via the ACE850 communication interface
- connection of the PC via its Ethernet port.



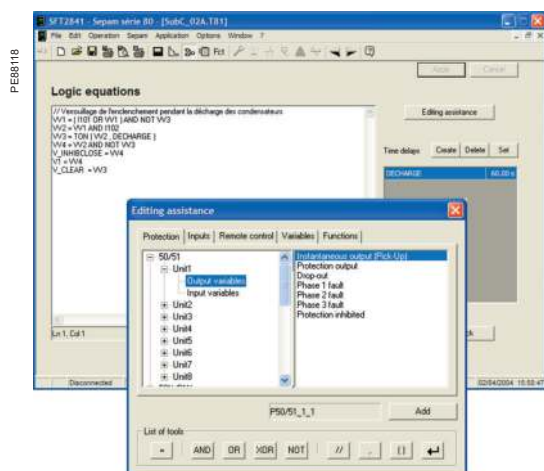
RS 485 serial connection

- 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.



SFT2841 setting and operating software

Adaptation of the predefined functions



SFT2841: logic equation editor.

Logic equation editor (Sepam series 60 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:

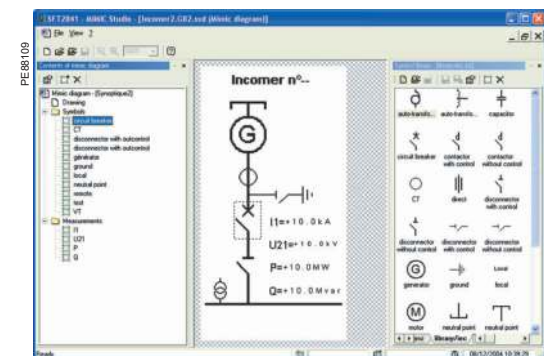
- assigned to a logic output, LED or message from the control matrix
- transmitted by the communication link, as a new remote indication
- utilized by the circuit breaker/contactors control function to trip, close or inhibit breaking device closing
- used to inhibit or reset a protection function.

Alarms and operating messages (Sepam series 60 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.



SFT2841: mimic-diagram editor.

Local-control mimic diagram (Sepam series 60 and 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.

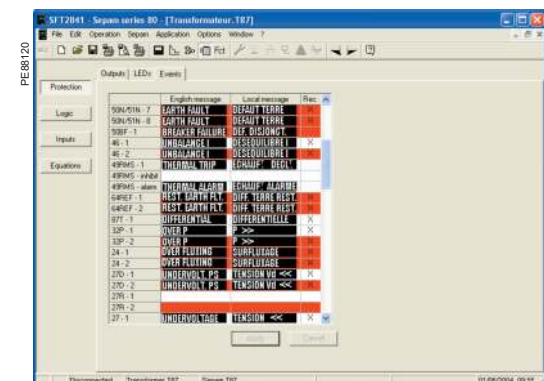
The mimic-diagram editor can be used to:

- 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.

Control matrix

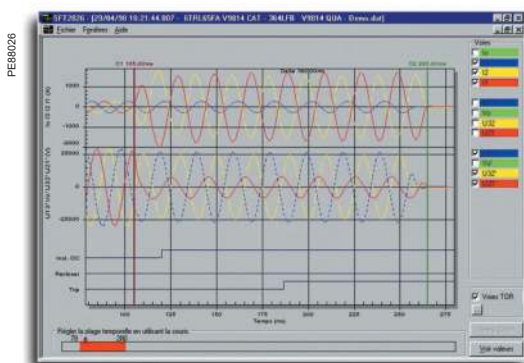
The control matrix is used for simple assignment of data from:

- 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.



SFT2841: control matrix.

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.

SFT850 configuration software for IEC 61850 protocol

Function

The SFT850 software is used to easily create, modify and consult the SCL (Substation Configuration Language) configuration files for the IEC 61850 communication protocol:

- CID (Configured IED description) file for configuration of a device connected to an IEC 61850 network
- SCD (Substation Configuration Description) file for IEC 61850 configuration of substation equipment.

The SFT850 software supplements the standard IEC 61850 configuration created with the SFT2841 software in cases where the configuration must be precisely adapted to system requirements.

Adding or deleting equipment

The SFT850 software can be used to add or delete connected equipment in the IEC 61850 configuration. If a Sepam unit is added, the software uses the supplied ICD (IED capability description) file to start configuration.

Equipment connection

The SFT850 software describes the data for equipment connection to the network.

Editing the equipment configuration

The configuration of a given device described in a CID or SCD file can be modified:

- add, modify or delete datasets. A dataset is used to group data and optimize communication
- add, modify or delete RCBs (Report Control Block). A Report Control Block defines dataset transmission conditions
- add, modify or delete GCBs (Goose Control Block). A Goose Control Block defines how data is exchanged between Sepam units
- modify dead measurement bands. This parameter is used to optimize communication in that measurements are transmitted only if they have changed significantly.

Generating CID files

The SFT850 software can generate the CID file for each device on the basis of an SCD file.

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.

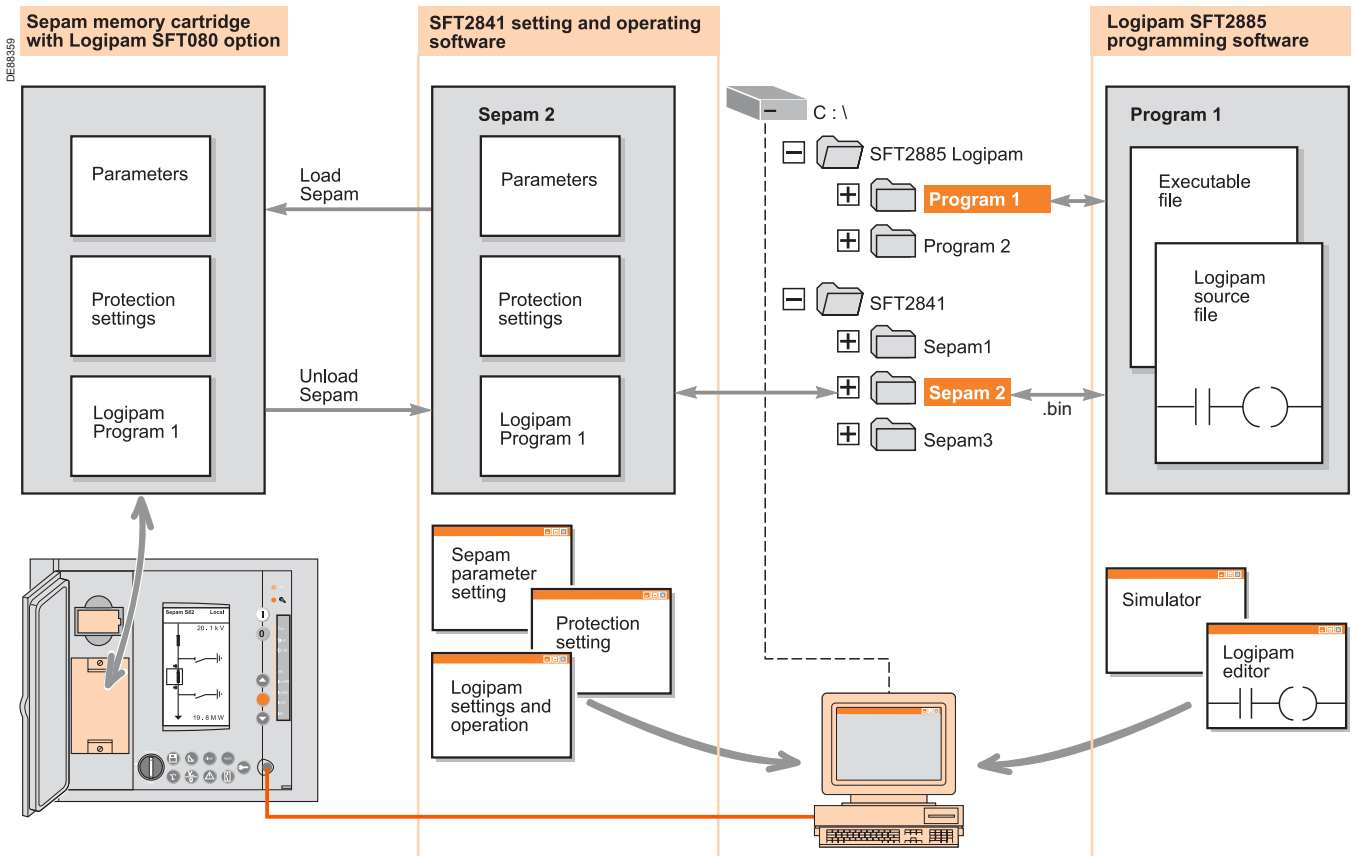
Only the Sepam series 80 with a cartridge containing the Logipam SFT080 option can run the control and monitoring functions programmed by the Logipam SFT2885 software.

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



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
- all logic inputs GOOSE

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

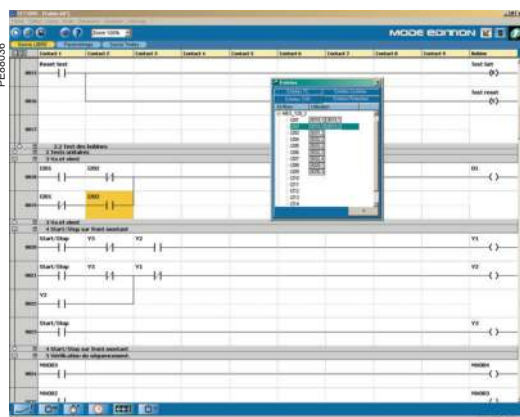
The Logipam software offers a complete set of tools for program debugging:

- 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.

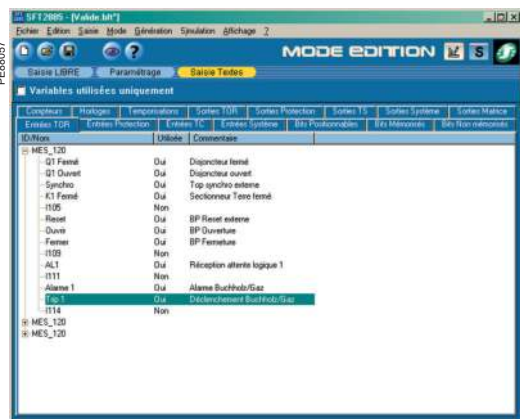
Documentation

The application file can be printed in part or in whole.

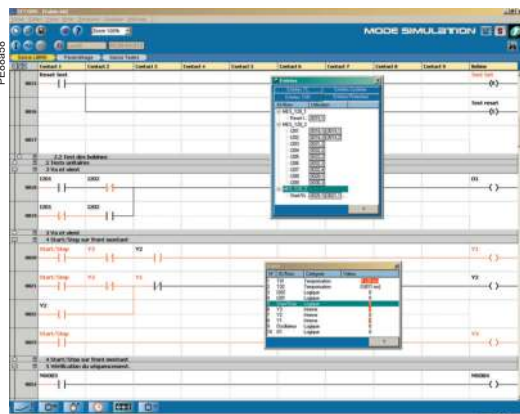
The application file can be personalized : front page, title block, general description of the program, etc.



SFT2885: ladder-language program, structured in sections.



SFT2885: variable editor.



SFT2885: program debugging.

Power Launcher

Makes it easy

Power Launcher makes it easy to have the latest version of all your software compliant with your latest device.

■ In one glance, you can see the available software for each device family:

□ Compact NSX & Masterpact circuit breakers

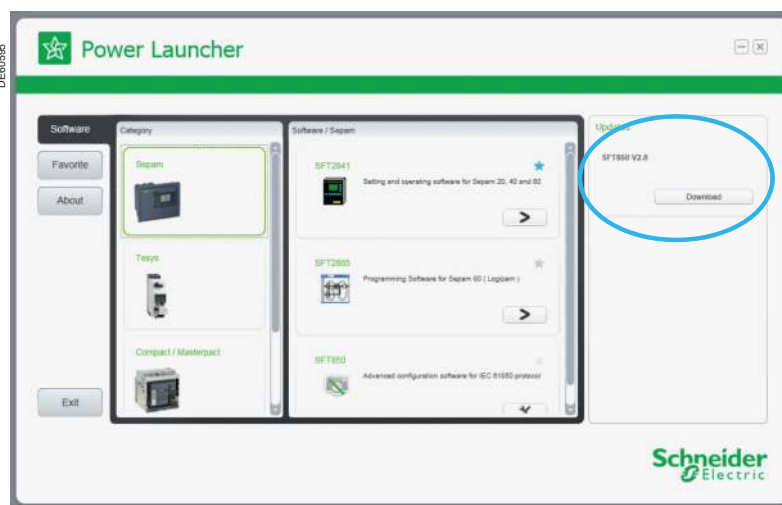
□ TeSys motor-starters

□ Sepam relays

□ ION, PM and CM meters

■ Always up to date thanks to the simple notification and download of the latest software updates.

■ Save time by customizing your own software “favorites”.



MES120, MES120G, MES120H

14 input / 6 output module

Presentation



MES120 14 input / 6 output module.

Function

The output relays included on the Sepam series 60 and 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).

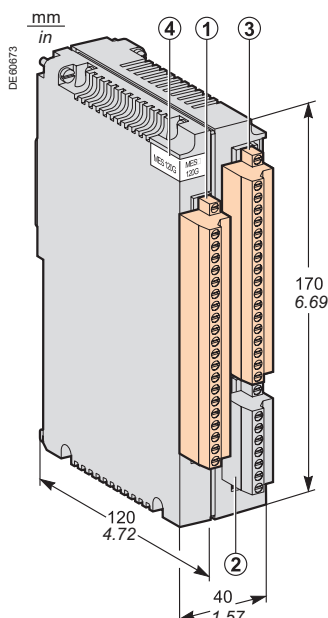
Sepam series	Output on base unit	Extendable with nb max of MES120
series 60	4	2
series 80	5	3

Three 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
- MES120H, 14 inputs 110 V DC to 125 V DC with a typical switching threshold of 82 V DC.

Characteristics

MES120 / MES120G / MES120H modules						
Weight		0,38 kg (0,83 lb)				
Operating temperature		-25 °C to +70 °C (-13 °F to +158 °F)				
Environmental characteristics		Same characteristics as Sepam base units				
Logic inputs		MES120	MES120G	MES120H		
Voltage		24 à 250 V DC	220 to 250 V DC	110 to 125 V DC		
Range		19.2 à 275 V DC	170 to 275 V DC	88 to 150 V DC		
Typical consumption		3 mA	3 mA	3 mA		
Typical switching threshold		14 V DC	155 V DC	82 V DC		
Input limit voltage	At state 0	< 6 V DC	< 144 V DC	< 75 V DC		
	At state 1	> 19 V DC	> 170 V DC	> 88 V DC		
Isolation of inputs from other isolated groups		Enhanced	Enhanced	Enhanced		
Control relay output Ox01						
Voltage	DC	24/48 V DC	127 V DC	220 V DC	250 V DC	
	AC (47.5 to 63 Hz)	-	-	-	-	100 à 240 V AC
Continuous current		8 A	8 A	8 A	8 A	8 A
Breaking capacity	Resistive load	8 / 4 A	0.7 A	0.3 A	0.2 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				
Isolation of inputs from other isolated groups		Enhanced				
Relay output Ox02 to Ox06						
Tension	Continue	24/48 V DC	127 V DC	220 V DC	250 V DC	
	Alternative (47.5 à 63 Hz)	-	-	-	-	100 to 240 V AC
Continuous current		2 A	2 A	2 A	2 A	2 A
Breaking capacity	Load L/R < 20 ms	2 / 1 A	0.5 A	0.15 A	0.2 A	-
	Load p.f > 0.3	-	-	-	-	1 A
Isolation of inputs from other isolated groups		Enhanced				



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:

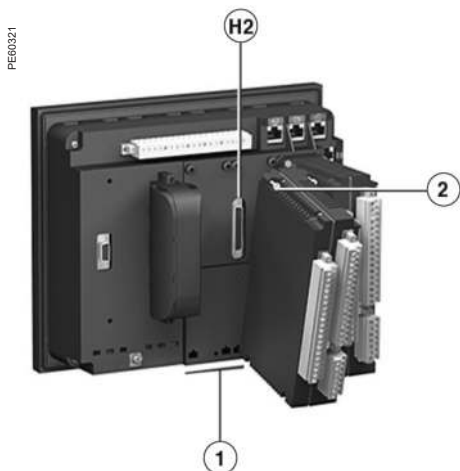
- x = 1 for the module connected to H1
- x = 2 for the module connected to H2
- x = 3 for the module connected to H3.

- ④ MES120G, MES120H identification label (MES120 modules have no labels).

MES120, MES120G, MES120H

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 ②
- 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 ①
- if 2 modules are required, connect them to connectors ① and ② (maximum configuration for Sepam series 60)
- if 3 modules are required (maximum configuration for Sepam series 80 only), the 3 connectors ①, ② and ③ are used.

Connection

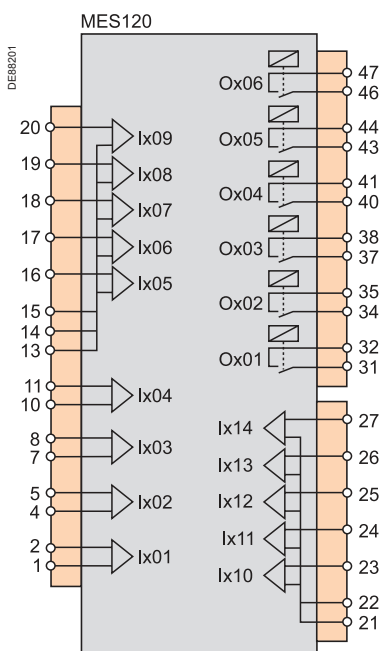
The inputs are potential-free and the DC power supply source is external.

CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.



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 (0.31 to 0.39 in)
- wiring with fittings:
 - recommended wiring with Schneider Electric fittings:
 - DZ5CE015D for one 1.5 mm² wire (AWG 16)
 - DZ5CE025D for one 2.5 mm² wire (AWG 12)
 - AZ5DE010D for two 1 mm² wires (AWG 18)
 - tube length: 8.2 mm (0.32 in)
 - stripped length: 8 mm (0.31 in).

MES120, MES120G, MES120H

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

Logic O_x output assignment table

Functions	S60	S62	T60	T62	M61	G60	G62	C60	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

Note: The logic outputs assigned by default may be freely reassigned.

Assignment table for logic I_x inputs common to all applications

Functions	S60	S62	T61	T62 T67	M67	G67	G62 G66	C66	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

MES120, MES120G, MES120H

14 input / 6 output module

Logic input / output assignment

Assignment table of logic Ix inputs by application

Functions	S60	S62	T60	T62	M61	G60	G62	C60	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

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 Ox 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 Ix 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

Assignment table of logic Ix 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

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 60			Sepam series 80		
			S6x	T6x, G6x	M6x, C6x	S8x, B8x	T8x, G8x	M8x, C8x
MET148-2	Temperature sensor module	See page 216	0	2	2	0	2	2
MSA141	Analog output module	See page 218	1	1	1	1	1	1
DSM303	Remote advanced UMI module	See page 219	1	1	1	1	1	1
MCS025	Synchro-check module	See page 221	1	1	0	1	1	0
Number of sets of interlinked modules / maximum number of remote modules			1 set of 3 interlinked modules			5 modules split between 2 sets of interlinked modules		

CAUTION

HAZARD OF NON-OPERATION

The MCS025 module must ALWAYS be connected with the special CCA785 cord, supplied with the module and equipped with an orange RJ45 plug and a black RJ45 plug.

Failure to follow this instruction can cause equipment damage.

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 (2 ft)
- CCA772: length = 2 m (6.6 ft)
- CCA774: length = 4 m (13.1 ft).

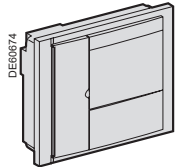
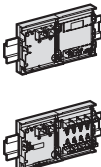
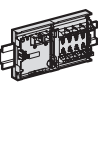
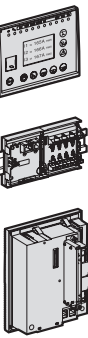
The modules are linked by cords which provide the power supply and act as functional links with the Sepam unit (connector (D) to connector (Da), (Dd) to (Da), ...).

Rules on inter-module linking

- linking of 3 modules maximum
- DSM303 and MCS025 modules may only be connected at the end of the link.

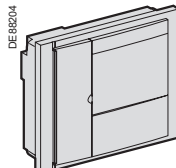
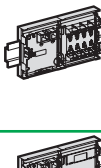
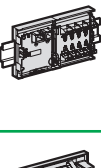
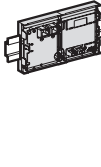
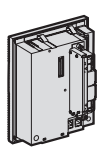
Maximum advisable configurations

Sepam series 60: just 1 set of interlinked modules

Base	Cord	Module 1	Cord	Module 2	Cord	Module 3
						
Series 60	CCA772	MSA141	CCA770	MET148-2	CCA774	DSM303
Series 60	CCA772	MSA141	CCA770	MET148-2	CCA785 ⁽¹⁾	MCS025
Series 60	CCA772	MSA141	CCA770	MET148-2	CCA772	MET148-2
Series 60	CCA772	MET148-2	CCA770	MET148-2	CCA774	DSM303
Series 60	CCA772	MET148-2	CCA770	MET148-2	CCA785 ⁽¹⁾	MCS025

Sepam series 80: 2 sets of interlinked modules

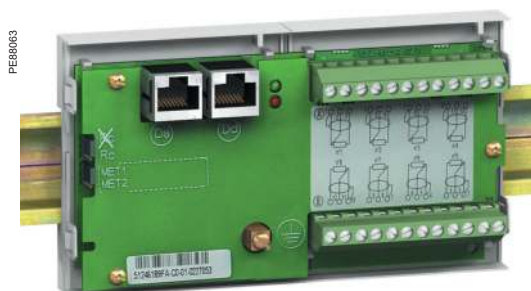
Sepam series 80 has 2 connection ports for remote modules, (D1) and (D2). Modules may be connected to either port.

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 ⁽¹⁾	MCS025	-	-

(1) CCA 785 delivered with MCS025 synchro-check module.

MET148-2

Temperature sensor module



MET148-2 Temperature sensor module.

Function

The MET148-2 module can 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
- 2 modules series 80 base unit, to be connected by CCA770 (0.6 or 2 ft), CCA772 (2 m or 6.6 ft) or CCA774 (4 m or 13.1 ft) cords

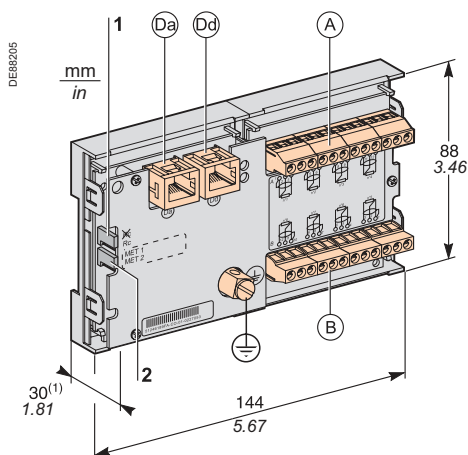
The temperature measurement (e.g. in a transformer or motor winding) is utilized by the following protection functions:

- Thermal overload (to take ambient temperature into account)
- Temperature monitoring.

Characteristics

MET148-2 module

Weight	0.2 kg (0.441 lb)	
Assembly	On symmetrical DIN rail	
Operating temperature	-25 °C to +70 °C (-13 °F to +158 °F)	
Environmental characteristics	Same characteristics as Sepam base units	
Temperature sensors	Pt100	Ni100 / Ni120
Isolation from earth	None	None
Current injected in RTD	4 mA	4 mA



(1) 70 mm (2.8 in) 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 (R_c), to be set to:
 - R_c , if the module is not the last interlinked module (default position)
 - R_c , 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 60 and series 80 only).

MET148-2

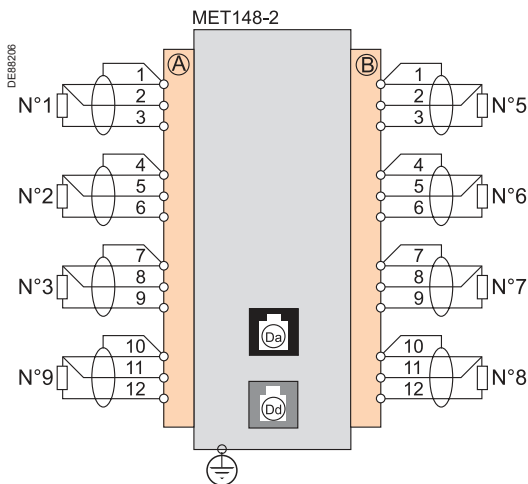
Temperature sensor module

Connection

⚠ CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
 - NEVER work alone.
 - Check that the temperature sensors are isolated from dangerous voltages.
- Failure to follow these instructions will result in death or serious injury.**



Connection of the earthing terminal

By tinned copper braid with cross-section $\geq 6 \text{ mm}^2$ (AWG 10) or cable with cross-section $\geq 2.5 \text{ mm}^2$ (AWG 12) and length $\leq 200 \text{ mm}$ (7.9 in), fitted with a 4 mm (0.16 in) ring lug.

Check the tightness (maximum tightening torque 2.2 Nm or 19.5 lb-in).

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 24-18).

Recommended cross-sections according to distance:

- Up to 100 m (330 ft) $\geq 1 \text{ mm}^2$ (AWG 18)
- Up to 300 m (990 ft) $\geq 1.5 \text{ mm}^2$ (AWG 16)
- Up to 1 km (0.62 mi) $\geq 2.5 \text{ mm}^2$ (AWG 12)

Maximum distance between sensor and module: 1 km (0.62 mi).

Wiring precautions

- It is preferable to use shielded cables.

The use of unshielded cables can cause measurement errors which vary in degree according to 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:

$$\Delta t(^{\circ}\text{C}) = 2 \times \frac{L(\text{km})}{S(\text{mm}^2)}$$

- $\pm 2.1^{\circ}\text{C/km}$ for 0.93 mm² cross-section (AWG 18)
- $\pm 1^{\circ}\text{C/km}$ for 1.92 mm² cross-section (AWG 14).

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
- 0-1 mA, 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:

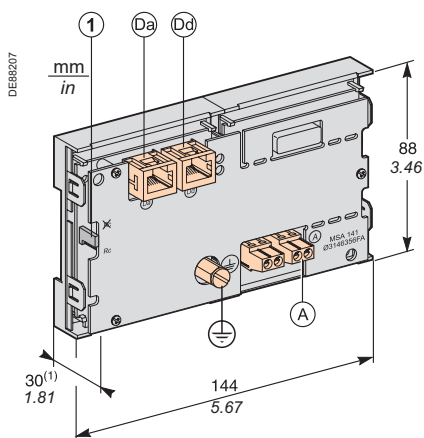
- minimum value = 0
- maximum value = 3000

■ a single module for each Sepam base unit, to be connected by one of the CCA770 (0.6m or 2 ft), CCA772 (2m or 6.6 ft) or CCA774 (4m or 13.1 ft) cords.

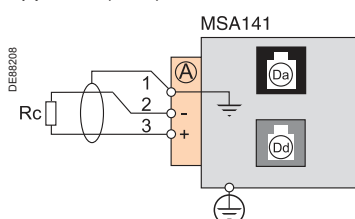
The analog output can also be remotely managed via the communication network.

Characteristics

MSA141 module			
Weight	0.2 kg (0.441 lb)		
Assembly	On symmetrical DIN rail		
Operating temperature	-25 °C to +70 °C (-13 °F to +158 °F)		
Environmental characteristics	Same characteristics as Sepam base units		
Analog output			
Current	0-1 mA, 4-20 mA, 0-20 mA, 0-10 mA		
Scaling	Minimum value		
(no data input checking)	Maximum value		
Load impedance	< 600 Ω (including wiring)		
Accuracy	0.5 %		
Measurements available	Unit	series 60	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		■	■



(1) 70 mm (2.8 in) with CCA77x cord connected.



Description and dimensions

- (A) Terminal block for analog output.
- (Da) RJ45 socket to connect the module to the base unit with a CCA77x cord.
- (Dd) RJ45 socket to link up the next remote module with a CCA77x cord (according to application).
- (⊕) Earthing terminal.
- (1) Jumper for impedance matching with load resistor (Rc), to be set to:
 - R_c , if the module is not the last interlinked module (default position)
 - Rc, if the module is the last interlinked module.

Connection

Connection of the earthing terminal

By tinned copper braid with cross-section $\geq 6 \text{ mm}^2$ (AWG 10) or cable with cross-section $\geq 2.5 \text{ mm}^2$ (AWG 12) and length $\leq 200 \text{ mm}$ (7.9 in), equipped with a 4 mm (0.16 in) ring lug.

Check the tightness (maximum tightening torque 2.2 Nm or 19.5 lb-in).

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 24-18).

Wiring precautions

- It is preferable to use shielded cables
- Use tinned copper braid to connect the shielding at least at the MSA141 end.

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 can be installed on the front panel of the cubicle in the most suitable operating location:

- reduced depth < 30 mm (1.2 in)
- a single module for each Sepam, to be connected by one of the CCA772 (2 m or 6.6 ft) or CCA774 (4 m or 13.1 ft) cords.

The module cannot be connected to Sepam units with integrated advanced UMIs.

Characteristics

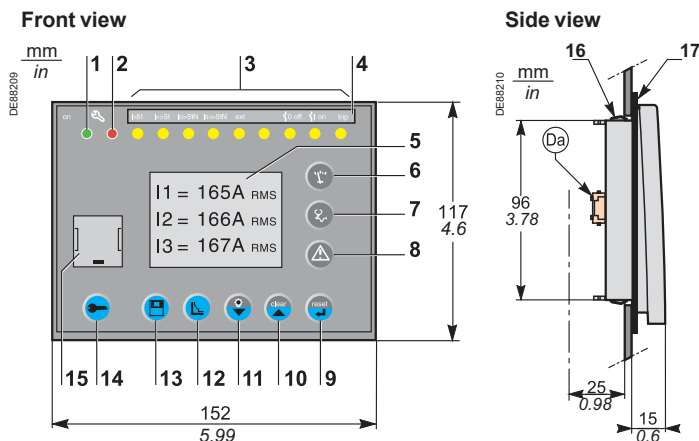
DSM303 module	
Weight	0.3 kg (0.661 lb)
Assembly	Flush-mounted
Operating temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Environmental characteristics	Same characteristics as for Sepam base units

DSM303

Remote advanced UMI module

Description and dimensions

The module is simply flush-mounted and secured by its clips. No additional screw-type fastening is required.



- 1 Green LED: Sepam on.
 - 2 Red LED:
 - steadily on: module unavailable
 - flashing: Sepam link unavailable.
 - 3 9 yellow LEDs.
 - 4 Label identifying the LEDs.
 - 5 Graphic 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 Alarm acknowledgment and clearing (or move cursor up).
 - 11 LED test (or move cursor down).
 - 12 Access to protection settings.
 - 13 Access to Sepam parameters.
 - 14 Entry of 2 passwords.
 - 15 PC connection port.
 - 16 Mounting clip.
 - 17 Gasket to ensure NEMA 12 tightness (gasket supplied with the DSM303 module, to be installed if necessary).
- (Da) RJ45 lateral output connector to connect the module to the base unit with a CCA77x cord.

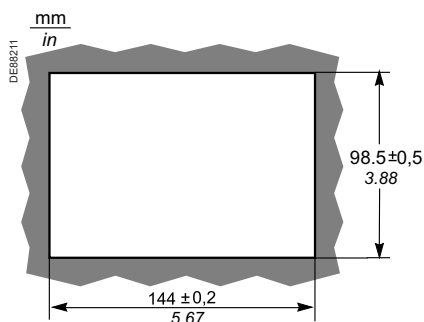
CAUTION

HAZARD OF CUTS

Trim the edges of the cut-out plates to remove any jagged edges.

Failure to follow this instruction can cause serious injury.

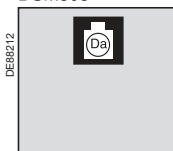
Cut-out for flush-mounting (mounting plate thickness < 3 mm or 0.12 in)



Connection

- (Da) RJ45 socket 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).

DSM303



MCS025

Synchro-check module



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 60 and 80 units.

The circuit-breaker control function of each Sepam series 60 and 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 60 and 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 60 and 80 base unit.

Characteristics

MCS025 module

Weight	1.35 kg (2.98 lb)
Assembly	With the AMT840 accessory
Operating temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Environmental characteristics	Same characteristics as Sepam base units

Voltage inputs

Input impedance	> 100 kΩ
Consumption	< 0.015 VA (VT 100 V)
Tenue thermique permanente	240 V
Surcharge 1 second	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 à 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			
Isolation of outputs from other other isolated groups		Enhanced			

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 p.f. > 0.3				5 A
Isolation of outputs from other other isolated groups		Enhanced			

Power supply

Voltage	24 to 250 V DC, -20 % / +10 %	110 to 240 V AC, -20 % / +0 % 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

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

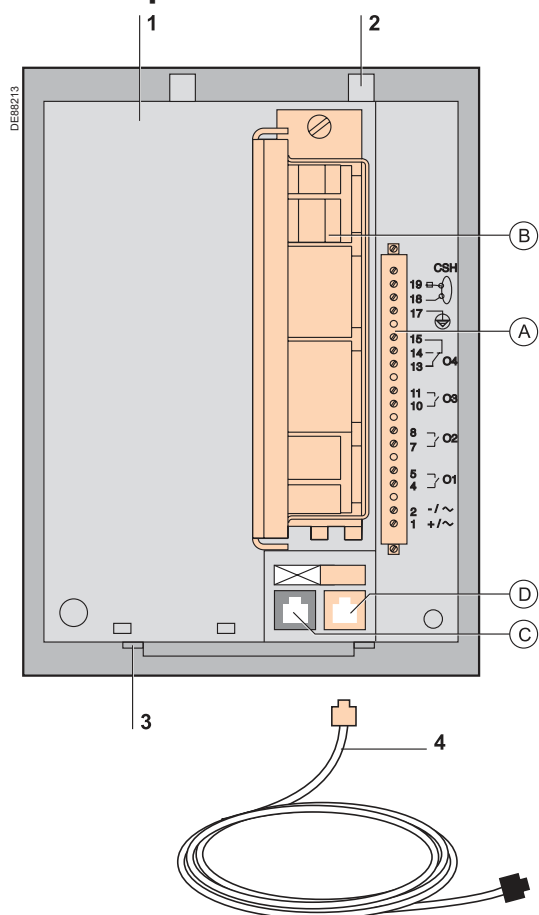
(C) RJ45 connector, not used

(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

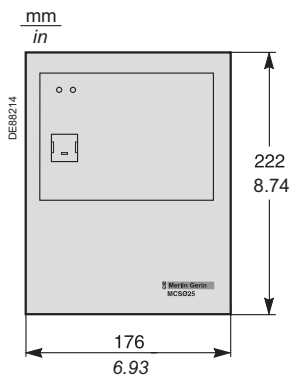
4 CCA785 connection cord



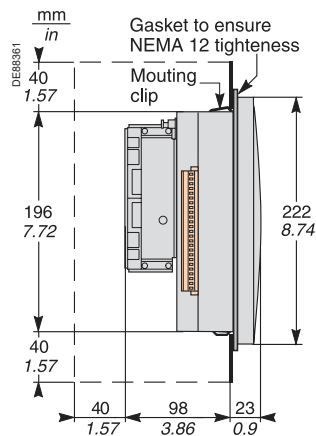
MCS025

Synchro-check module

Dimensions

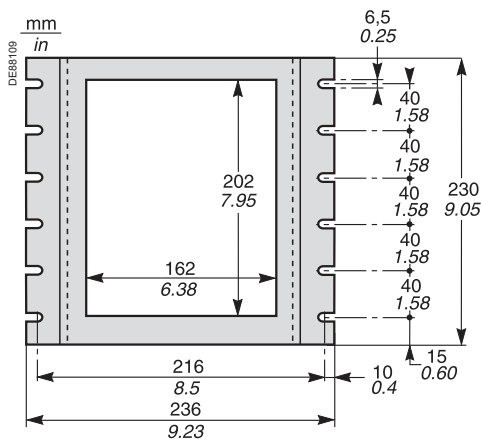


MCS025.

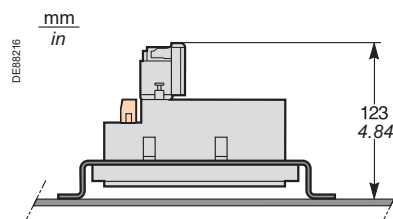


Assembly with AMT840 mounting plate

The MCS025 module should be mounted at the back of the compartment using the AMT840 mounting plate.



AMT840 mounting plate.

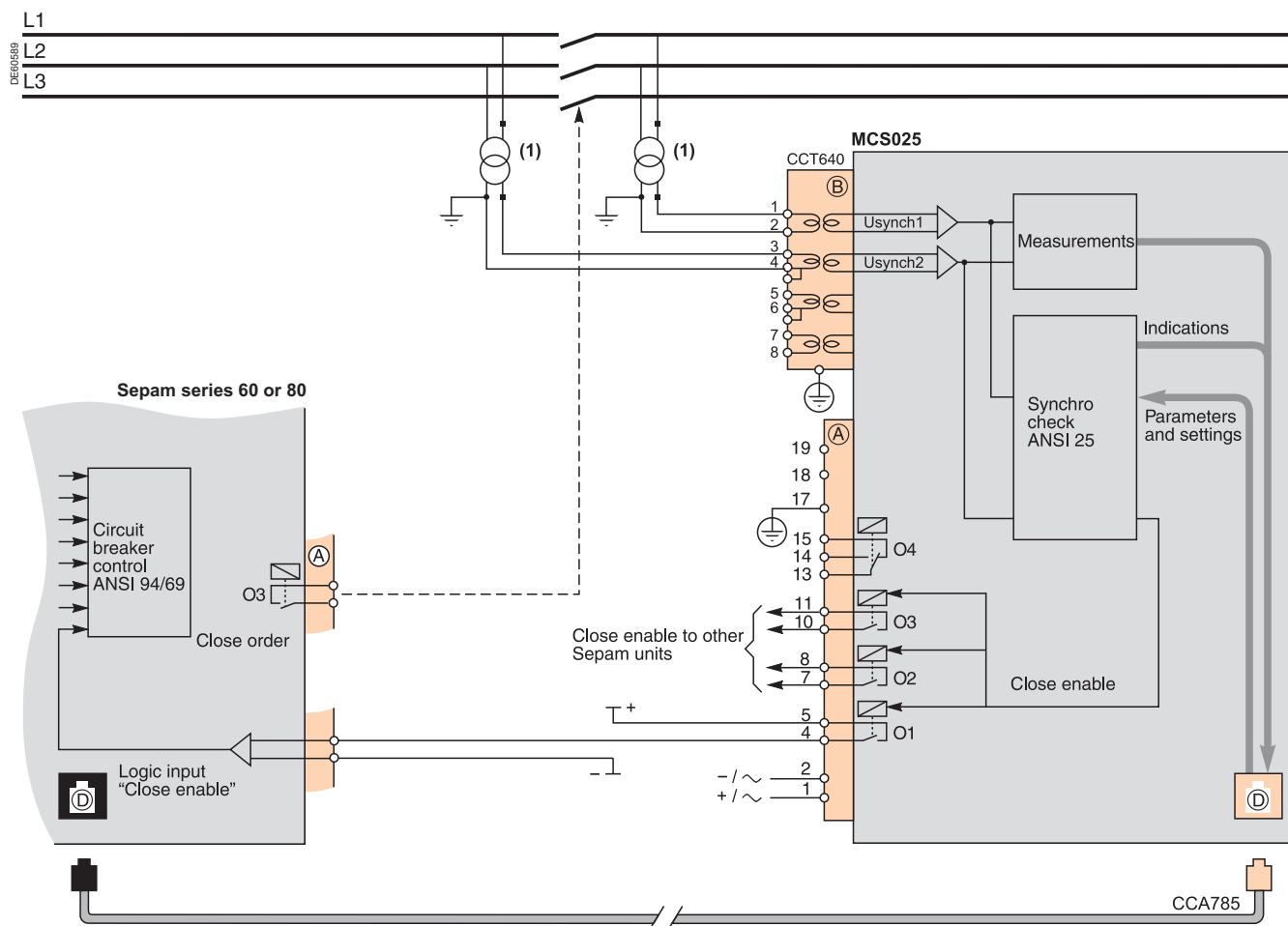


Connection characteristics

Connector	Type	Reference	Wiring
(A)	Screw-type	CCA620	■ Wiring with no fittings: □ 1 wire with maximum 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) □ stripped length: 8 to 10 mm (0.31 à 0.39 in) ■ Wiring with fittings: □ recommended wiring with Schneider Electric fittings: - DZ5CE015D for 1 wire 1.5 mm² (AWG 16) - DZ5CE025D for 1 wire 2.5 mm² (AWG 12) - AZ5DE010D for 2 x 1 mm² wires (AWG 18) □ tube length: 8.2 mm (0.32 in) □ stripped length: 8 mm (0.31 in)
(B)	Screw-type	CCT640	VT wiring: same as wiring of the CCA620 Earthing connection: by 4 mm (0.15 in) ring lug
(D)	Orange RJ45 connector		CCA785, special prefabricated cord supplied with the MCS025 module: ■ orange RJ45 connector for connection to port (D) on the MCS025 module ■ black RJ45 connector for connection to the Sepam series 60 and 80 base unit, either directly or via another remote module.

MCS025

Synchro-check module



CAUTION

HAZARD OF NON-OPERATION

The MCS025 module must ALWAYS be connected with the special CCA785 cord, supplied with the module and equipped with an orange RJ45 plug and a black RJ45 plug.

Failure to follow this instruction can cause equipment damage.

⚠ CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

■ Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.

■ NEVER work alone.

■ Turn off all power supplying this equipment before working on or inside it.

■ Consider all sources of power, including the possibility of backfeeding.

■ Always use a properly rated voltage sensing device to confirm that all power is off.

■ Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

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-2	ACE969FO-2	ACE850TP	ACE850FO
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	S-LAN and E-LAN	S-LAN and E-LAN
Protocol							
Modbus RTU	■	■	■	■ ⁽³⁾	■ ⁽³⁾	■	
DNP3				■ ⁽³⁾	■ ⁽³⁾		
IEC 60870-5-103				■ ⁽³⁾	■ ⁽³⁾		
Modbus TCP/IP						■	■
IEC 61850						■	■
Physical interface							
RS 485	2-wire			■	■	■	
	4-wire	■					
Fiber optic ST	Star		■		■		
	Ring				■ ⁽²⁾		
10/100 base Tx	2 ports					■	
100 base Fx	2 ports						■
Power supply							
DC	Provided by Sepam	Provided by Sepam	Provided by Sepam	24 to 250 V	24 to 250 V	24 to 250 V	24 to 250 V
AC				110 to 240 V	110 to 240 V	110 to 240 V	110 to 240 V
See details	Catalogue page 236	Catalogue page 237	Catalogue page 238	Catalogue page 239	Catalogue page 239	Catalogue page 244	Catalogue page 244

(1) Only one connection possible, S-LAN or E-LAN.

(2) Except with the Modbus protocol.

(3) Not simultaneously (1 protocol per application).

Converter selection guide

	ACE909-2	ACE919CA	ACE919CC
Converter			
Physical interface	1 port RS 232	1 port RS 485 port 2-wire	1 port RS 485 port 2-wire
Modbus RTU	■ ⁽¹⁾	■ ⁽¹⁾	■ ⁽¹⁾
IEC 60870-5-103	■ ⁽¹⁾	■ ⁽¹⁾	■ ⁽¹⁾
DNP3	■ ⁽¹⁾	■ ⁽¹⁾	■ ⁽¹⁾
Modbus TCP/IP			
IEC 61850			
To Sepam			
Physical interface	1 port RS 485 2-wire	1 port RS 485 2-wire	1 port RS 485 2-wire
Distributed power supply RS 485	■	■	■
Modbus RTU	■ ⁽¹⁾	■ ⁽¹⁾	■ ⁽¹⁾
IEC 60870-5-103	■ ⁽¹⁾	■ ⁽¹⁾	■ ⁽¹⁾
DNP3	■ ⁽¹⁾	■ ⁽¹⁾	■ ⁽¹⁾
Alimentation			
DC			24 to 48 V
AC	110 to 220 V AC	110 to 220 V AC	
See details	Catalogue page 248	Catalogue page 250	Catalogue page 250

(1) The supervisor protocol is the same as the Sepam protocol.

Note: all these interfaces accept the E-LAN protocol.

CCA612 connection cord

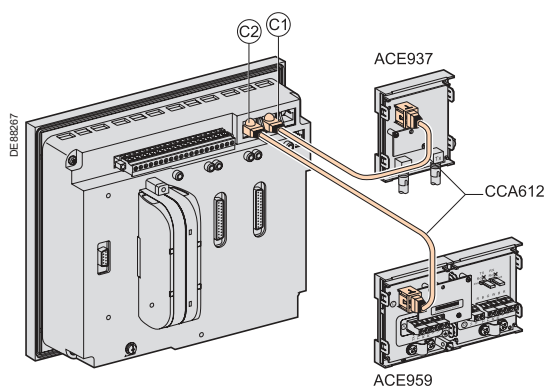
Function

The CCA612 prefabricated cord is used to connect ACE942-2, ACE959, ACE937, ACE969TP-2 and ACE969FO-2 communication interfaces:

- to the white communication port (C1) on a Sepam series 60 base unit.
- to the white communication port (C1) or (C2) on a Sepam series 80 base unit.

Characteristics

- Length = 3 m (9.8 ft)
- Fitted with 2 white RJ45 plugs.



Sepam series 80 : 2 communication ports.

CAUTION

HAZARD OF DEFECTIVE COMMUNICATION

- Never use both communication ports (C2) and (F) on a Sepam series 80 at the same time.
- The only communication ports that can be used simultaneously on a Sepam series 80 unit are ports (C1) and (C2) or ports (C1) and (F).

Failure to follow this instruction can result in equipment damage.

CCA614 connection cord

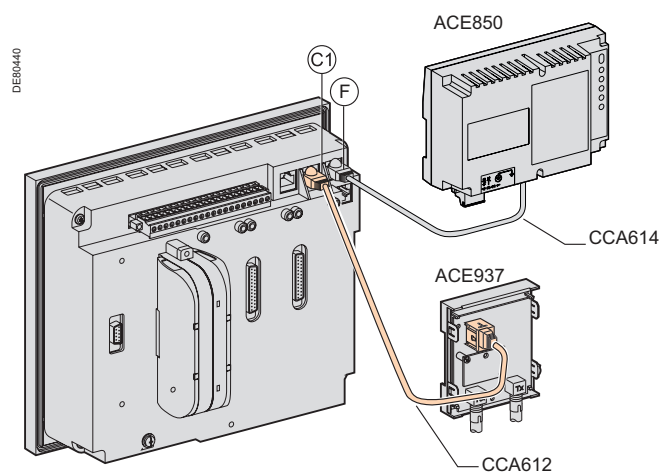
Function

The CCA614 prefabricated cord can be used to connect ACE850TP and ACE850FO communication interfaces:

- to the blue communication port (F) on a Sepam series 60 or series 80 base unit.

Characteristics

- Length = 3 m (9.8 ft)
- Fitted with 2 blue RJ45 connectors
- Minimum curvature radius = 50 mm (1.97 in)



Sepam series 80

Communication interface connection

Connection to the communication network

RS485 network for ACE949-2, ACE959 and ACE969TP-2 interfaces

RS 485 network cable	2-wire	2-wire
RS 485 medium	1 shielded twisted pair	2 shielded twisted pairs
Distributed power supply ⁽¹⁾	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 (62.1Ω/mi)	
Capacitance between conductors	< 60 pF/m (18.3 pF/ft)	
Capacitance between conductor and shielding	< 100 pF/m (30.5 pF/ft)	
Maximum length	1300 m (4270 ft)	

Fiber-optic network for ACE937 and ACE969FO-2 interfaces

Fiber optic				
Fiber type	Graded-index multimode silica			
Wavelength	820 nm (invisible 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 fiber length
50/125	0,2	2,7	5,6	700 m (2300 ft)
62,5/125	0,275	3,2	9,4	1800 m (5900 ft)
100/140	0,3	4	14,9	2800 m (9200 ft)
200 (HCS)	0,37	6	19,2	2600 m (8500 ft)

Fiber optic Ethernet network for the ACE850FO communication interface

Fiber optic communication port					
Fiber type	Multimode				
Wavelength	1300 nm				
Type of connector	SC				
Fiber optic diameter (μm)	Minimum optical power TX (dBm)	Maximum optical power TX (dBm)	Sensitivity RX (dBm)	Saturation RX (dBm)	Maximum distance
50/125	-22,5	-14	-33,9	-14	2 km (1,24 mi)
62,5/125	-19	-14	-33,9	-14	2 km (1,24 mi)

Wired Ethernet network for the ACE850TP communication interface

Wired communication port			
Type of connector	Data	Medium	Maximum distance
RJ45	10/100 Mbps	Cat 5 STP or FTP or SFTP	100 m (328 ft)

ACE949-2

2-wire RS 485 network interface



ACE949-2 2-wire RS 485 network connection interface.

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

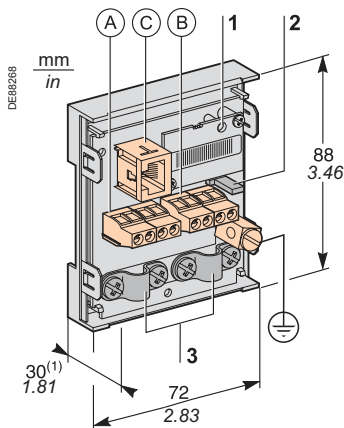
Weight	0.1 kg (0.22 lb)
Assembly	On symmetrical DIN rail
Operating temperature	-25°C to +70°C (-13°F to +158°F)
Environmental characteristics	Same characteristics as Sepam base units

2-wire RS 485 electrical interface

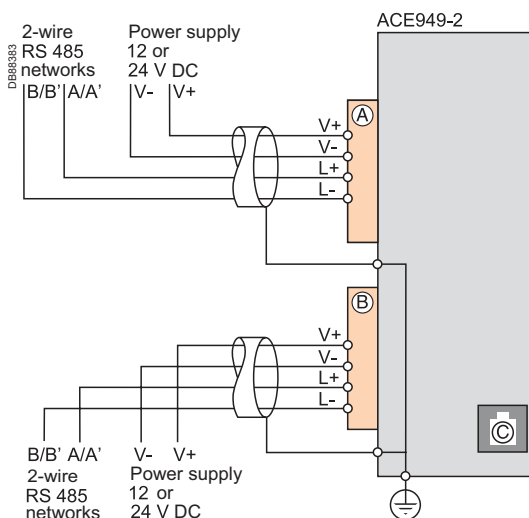
Standard	EIA 2-wire RS 485 differential
Distributed power supply	External, 12 V DC or 24 V DC $\pm 10\%$
Power consumption	16 mA in receiving mode 40 mA maximum in sending mode

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 ft)	1000 m (3300 ft)
10	180 m (590 ft)	750 m (2500 ft)
20	160 m (520 ft)	450 m (1500 ft)
25	125 m (410 ft)	375 m (1200 ft)



(1) 70 mm (2.8 in) with CCA612 cord connected.



Description and dimensions

- (A) and (B) Terminal blocks for network cable
- (C) RJ45 socket to connect the interface to the base unit with a CCA612 cord
- (⊕) Grounding/earthing terminal

- 1 Link 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 ($R_c = 150 \Omega$), to be set to:
 - R_c , if the module is not at one end of the network (default position)
 - R_c , if the module is at one end of the network.
- 3 Network cable clamps (inner diameter of clamp = 6 mm or 0.24 in).

Connection

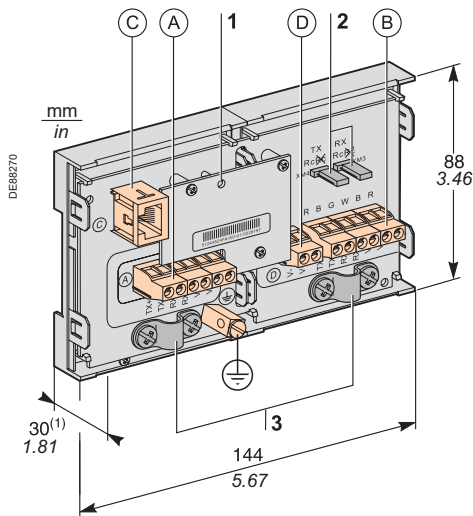
- Connection of network cable to screw-type terminal blocks (A) and (B)
- Connection of the earthing terminal by tinned copper braid with cross-section $\geq 6 \text{ mm}^2$ (AWG 10) or cable with cross-section $\geq 2.5 \text{ mm}^2$ (AWG 12) and length $\leq 200 \text{ mm}$ (7.9 in), fitted with a 4 mm (0.16 in) ring lug. Check the tightness (maximum tightening torque 2.2 Nm or 19.5 lb-in).
- 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 or 9.8 ft, white fittings)
- The interfaces are to be supplied with 12 V DC or 24 V DC.

ACE959

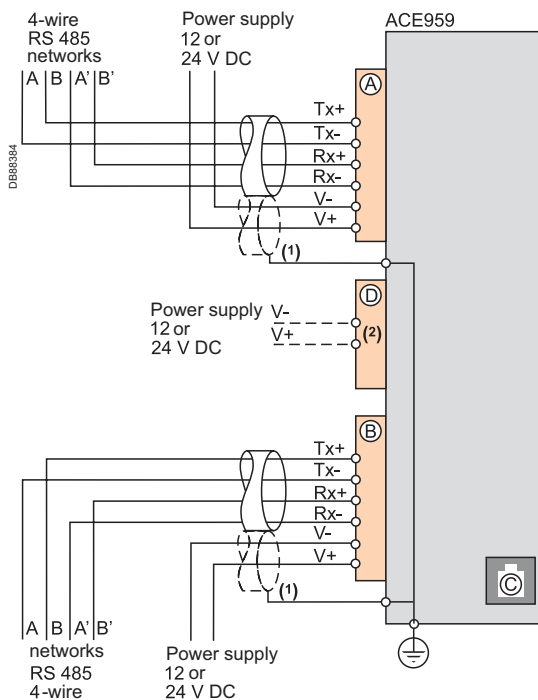
4-wire RS 485 network interface



ACE959 4-wire RS 485 network connection interface.



(1) 70 mm (2.8 in) with CCA612 cord connected.



(1) Distributed power supply with separate wiring or included in the shielded cable (3 pairs).

(2) Terminal block for connection of the distributed power supply module.

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 (0.441 lb)
Assembly	On symmetrical DIN rail
Operating temperature	-25°C to +70°C (-13°F to +158°F)
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 $\pm 10\%$
Power 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 ft)	1000 m (3300 ft)
10	180 m (590 ft)	750 m (2500 ft)
20	160 m (520 ft)	450 m (1500 ft)
25	125 m (410 ft)	375 m (1200 ft)

Description and dimensions

- (A) and (B) Terminal blocks for network cable
- (C) RJ45 socket 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 Link activity LED, flashes when communication is active (sending or receiving in progress).
- 2 Jumper for 4-wire RS 485 network line-end impedance matching with load resistor ($R_c = 150 \Omega$), to be set to:
 - R_c , if the module is not at one end of the network (default position)
 - R_c , if the module is at one end of the network.
- 3 Network cable clamps (inner diameter of clamp = 6 mm or 0.24 in).

Connection

- Connection of network cable to screw-type terminal blocks (A) and (B)
- Connection of the earthing terminal by tinned copper braid with cross-section $\geq 6 \text{ mm}^2$ (AWG 10) or cable with cross-section $\geq 2.5 \text{ mm}^2$ (AWG 12) and length $\leq 200 \text{ mm}$ (7.9 in), fitted with a 4 mm (0.16 in) ring lug. Check the tightness (maximum tightening torque 2.2 Nm or 19.5 lb-in).
- 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 or 9.8 ft, white 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.



ACE937 fiber optic connection interface.

CAUTION**HAZARD OF BLINDING**

Never look directly into the end of the fiber optic.

Failure to follow this instruction can cause serious injury.

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 (0.22 lb)
Assembly	On symmetrical DIN rail
Power supply	Supplied by Sepam
Operating temperature	-25°C to +70°C (-13°F to +158°F)
Environmental characteristics	Same characteristics as Sepam base units

Fiber optic interface

Fiber type	Graded-index multimode silica
Wavelength	820 nm (invisible 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 fiber length
50/125	0.2	2.7	5.6	700 m (2300 ft)
62.5/125	0.275	3.2	9.4	1800 m (5900 ft)
100/140	0.3	4	14.9	2800 m (9200 ft)
200 (HCS)	0.37	6	19.2	2600 m (8500 ft)

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).

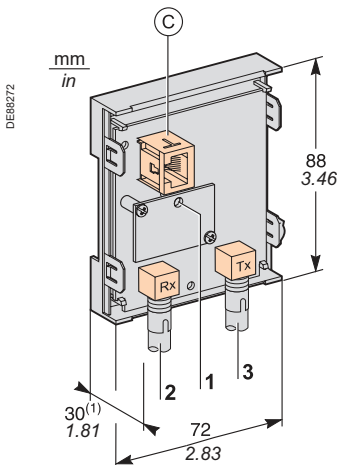
Example for a 62.5/125 μm fiber

$$L_{\max} = (9.4 - 3 - 0.6) / 3.2 = 1.8 \text{ km (1.12 mi)}$$

Description and dimensions

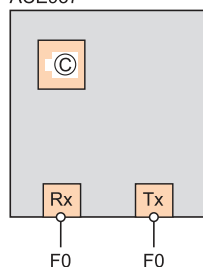
Ⓒ RJ45 socket to connect the interface to the base unit with a CCA612 cord.

- 1 Link 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).



(1) 70 mm (2.8 in) with CCA612 cord connected.

ACE937

**Connection**

- The sending and receiving fiber optic 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 Ⓒ on the base unit using a CCA612 cord (length = 3 m or 9.8 ft, white fittings).



ACE969TP-2 communication interface.



ACE969FO-2 communication interface.

ACE969TP-2 and ACE969FO-2

Function

The ACE969 multi-protocol communication interfaces are for Sepam series 60 and Sepam series 80.

They have two communication ports to connect a Sepam to two independent communication networks:

- The S-LAN (Supervisory Local Area Network) port is used to connect Sepam to a communication network dedicated to supervision, using one of the three following protocols:

- ☐ IEC 60870-5-103
- ☐ DNP3
- ☐ Modbus RTU.

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, which are identical except for the S-LAN port:

- ACE969TP-2 (Twisted Pair), for connection to an S-LAN network using a 2-wire RS 485 serial link
- ACE969FO-2 (Fiber Optic), for connection to an S-LAN network using a fiber-optic connection (star or ring).

The E-LAN port is always a 2-wire RS485 type port.

Characteristics

ACE969TP-2 and ACE969FO-2 module

Technical characteristics

Weight	0.285 kg (0.628 lb)	
Assembly	On symmetrical DIN rail	
Operating temperature	-25°C to +70°C (-13°F to +158°F)	
Environmental characteristics	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 RS 485 communication ports

Electrical interface

Standard	EIA 2-wire RS 485 differential
Distributed power supply	ACE969-2 not required (built-in)

Fiber optic communication port

Fiber optic interface

Fiber type	Graded-index multimode silica
Wavelength	820 nm (invisible 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
50/125	0.2	2.7	5.6	700 m (2300 ft)
62.5/125	0.275	3.2	9.4	1800 m (5900 ft)
100/140	0.3	4	14.9	2800 m (9200 ft)
200 (HCS)	0.37	6	19.2	2600 m (8500 ft)

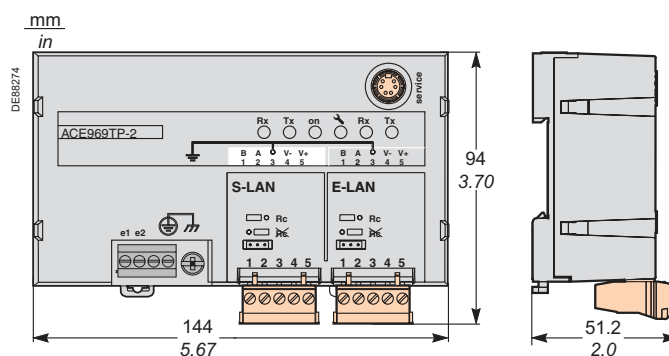
Maximum length calculated with:

- 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

$L_{max} = (9.4 - 3 - 0.6)/3.2 = 1.8 \text{ km (1.12 mi)}$

Dimensions



ACE969TP-2 and ACE969FO-2 network interfaces

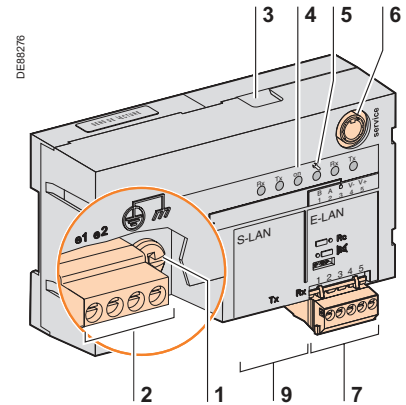
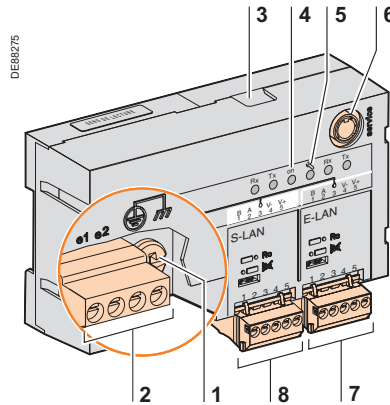
Description

ACE969-2 communication interfaces

ACE969TP-2

ACE969FO-2

- 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: ACE969-2 energized
- 5 Red LED: ACE969-2 interface status
 - LED off = ACE969-2 set up and communication operational
 - LED flashing = ACE969-2 not set up or setup incorrect
 - LED remains on = ACE969-2 has faulted
- 6 Service connector: reserved for software upgrades
- 7 E-LAN 2-wire RS485 communication port (ACE969TP-2 and ACE969FO-2)
- 8 S-LAN 2-wire RS485 communication port (ACE969TP-2)
- 9 S-LAN fiber-optic communication port (ACE969FO-2).

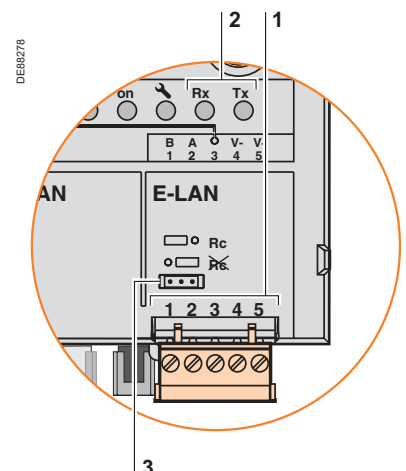
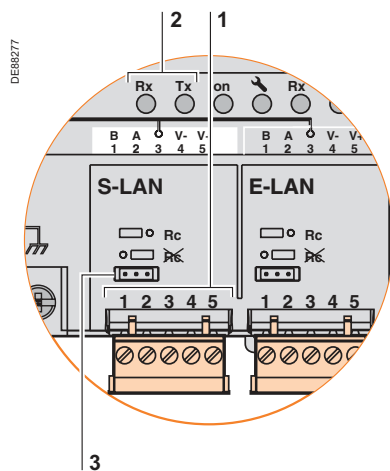


2-wire RS485 communication ports

S-LAN port (ACE969TP)

E-LAN port (ACE969TP or ACE969FO)

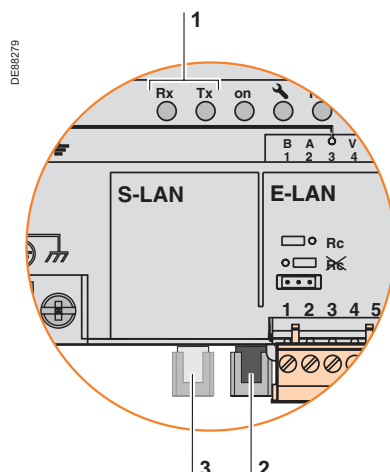
- 1 Draw-out terminal block, with two rows of connections to the RS485 2-wire network:
 - 2 black terminals: connection of RS485 twisted-pair (2 wires)
 - 2 green terminals: connection of twisted-pair for distributed power supply
- 2 Indication LEDs:
 - flashing Tx LED: Sepam sending
 - flashing Rx LED: Sepam receiving.
- 3 Jumper for RS485 network line-end impedance matching with load resistor ($R_c = 150 \Omega$), to be set to:
 - R_c , if the interface is not at the line end (default position)
 - R_c , if the interface is at the line end.



Fiber-optic communication port

S-LAN port (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).



ACE969TP-2 and ACE969FO-2 network interfaces

Connection

Power supply and Sepam

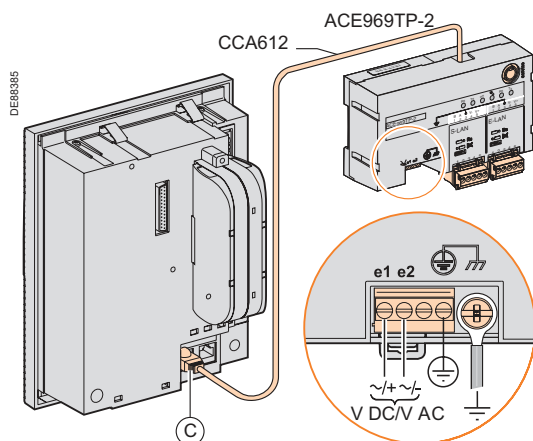
- The ACE969-2 interface connects to connector C on the Sepam base unit using a CCA612 cord (length = 3 m or 9.84 ft, white RJ45 fittings)
- The ACE969-2 interface must be supplied with 24 to 250 V DC or 110 to 240 V AC.

⚠ CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective earth and to the functional earth.
- Screw tight all terminals, even those not in use.

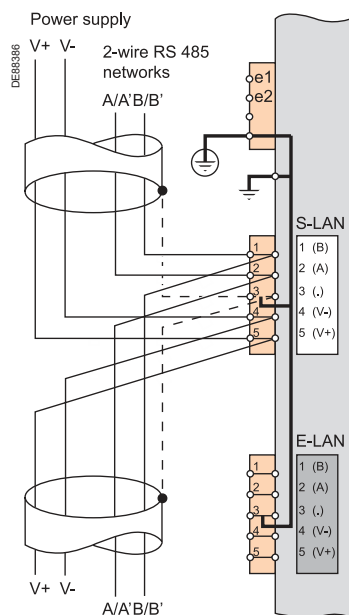
Failure to follow these instructions will result in death or serious injury.



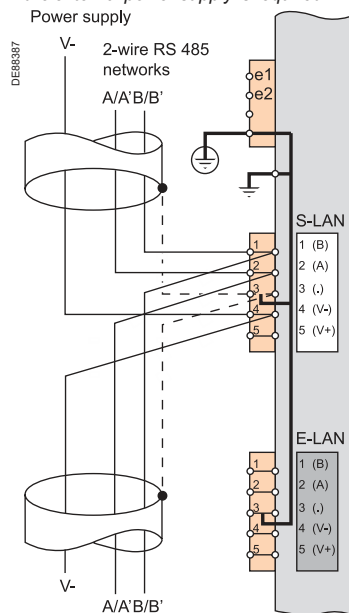
Terminals	Type	Wiring
e1-e2 - supply	Screw terminals	■ Wiring with no fittings: □ 1 wire with maximum cross-section 0.2 to 2.5 mm² (≥ AWG 24-12) - or 2 wires with maximum cross-section 0.2 to 1 mm² (≥ AWG 24-18) □ stripped length: 8 to 10 mm (0.31 to 0.39 in) ■ Wiring with fittings: □ recommended wiring with Schneider Electric fitting: - DZ5CE015D for 1 wire 1.5 mm² (AWG 16) - DZ5CE025D for 1 wire 2.5 mm² (AWG 12) - AZ5DE010D for 2 wires 1 mm² (AWG 18) □ tube length: 8.2 mm (0.32 in) □ stripped length: 8 mm (0.31 in).
Protective earth	Screw terminal	1 green/yellow wire, max. length 3 m (9.8 ft) and max. cross-section 2.5 mm ² (AWG 12)
Functional earth	4 mm (0.16 in) ring lug	Earthing braid, supplied for connection to cubicle grounding

ACE969TP-2 and ACE969FO-2 network interfaces

Connection



If ACE969TP and ACE969TP-2 are used together, the external power supply is required.

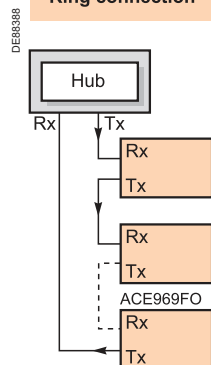


If ACE969TP-2 is used alone, the external power supply is not required, the V- connectors on the modules must be interconnected.

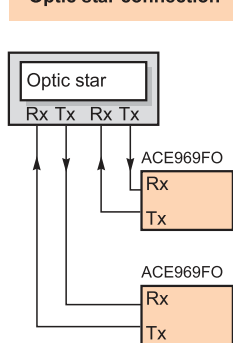
2-wire RS 485 communication ports (S-LAN or E-LAN)

- Connection of the RS 485 twisted pair (S-LAN or E-LAN) to terminals A and B.
- In case of ACE 969TP wired with ACE969TP-2:
 - connection of twisted pair for distributed power supply to terminals 5(V+) et 4(V-).
- In case of ACE969TP-2 only:
 - connexion only on the terminal 4(V-) (ground continuity)
 - no need of external power supply.
- The cable shields must be connected to the terminals marked 3(.) on the connection terminal blocks.
- Terminal marked 3(.) are linked by an internal connection to the earthing terminals of the ACETP-2 interface (protective an functional earthing): i.e the shielding of the RS 485 cables is earthed as well.
- On the ACE960TP-2 interface, the cable clamps for the S-LAN and E-LAN RS 485 networks are earthed by the terminal 3.

Ring connection



Optic star connection



Fiber optic communication port (S-LAN)

CAUTION

HAZARD OF BLINDING

Never look directly into the fiber optic.

Failure to follow this instruction can cause serious injury.

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 optic fibers must be equipped with male ST type connectors.

The fiber optics are screw-locked to Rx and Tx connectors.

ACE850TP and ACE850FO network interfaces



ACE850TP communication interface.



ACE850FO communication interface.

ACE850TP and ACE850FO

Function

ACE850 multi-protocol communication interfaces are for Sepam series 60 and Sepam series 80 units.

They have two Ethernet communication ports to connect a Sepam unit to a single Ethernet network depending on the topology (star or ring):

- For a star topology, only one communication port is used.
- For a ring topology, both Ethernet communication ports are used to provide redundancy. This redundancy conforms to the RSTP 802.1d 2004 standard.

Either port can be used for connection:

- To the S-LAN (Supervisory Local Area Network) port to connect a Sepam unit to an Ethernet communication network dedicated to supervision, using either of the following protocols:

- IEC 61850
- eModbus TCP/IP TRA 15.

- To the E-LAN (Engineering Local Area Network) port, reserved for remote parameter setting and operation of a Sepam unit using SFT2841 software.

There are two versions of the ACE850 interface, which are identical except for the type of port featured:

- ACE850TP (Twisted Pair), for connection to an Ethernet network (S-LAN or E-LAN) using a copper RJ45 10/100 Base TX Ethernet link.
- ACE850FO (Fiber Optic), for connection to an Ethernet network (S-LAN or E-LAN) using a 100Base FX fiber optic connection (star or ring).

Compatible Sepam units

The ACE850TP and ACE850FO multi-protocol interfaces are compatible with the following Sepam units:

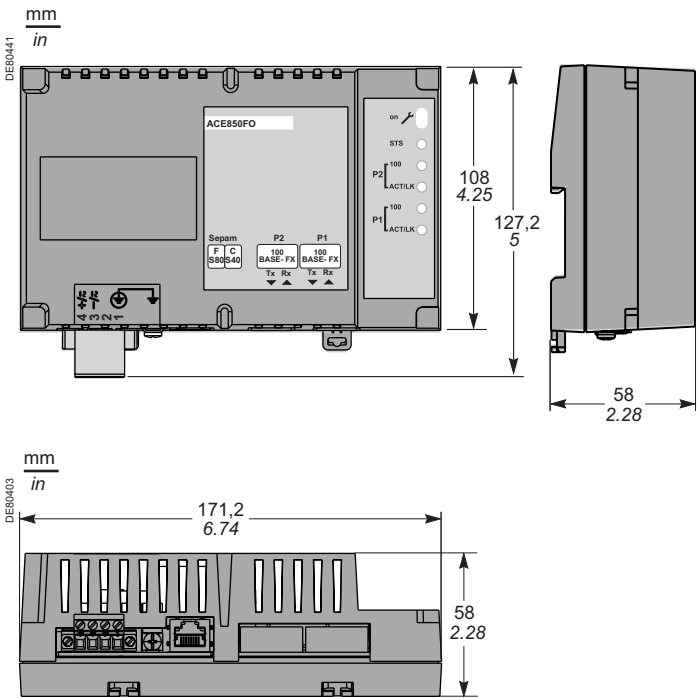
- Sepam series 60 version $\geq$ V7.00
- Sepam series 80 base version and application version $\geq$ V6.00 .

ACE850TP and ACE850FO network interfaces

Characteristics

ACE850TP and ACE850FO module					
Technical characteristics					
Weight		0,4 kg (0.88 lb)			
Assembly		On symmetrical DIN rail			
Operating temperature		-25°C to +70°C (-13°F to +158°F)			
Environmental characteristics		Same characteristics as Sepam base units			
Power supply					
Voltage		24 to 250 V CC	110 to 240 V CA		
Range		-20 % / +10 %	-20 % / +10 %		
Maximum consumption	ACE850TP	3,5 W in CC	1,5 VA in CA		
	ACE850FO	6,5 W in CC	2,5 VA in CA		
Inrush current		< 10 A 10 ms in CC	< 15 A 10 ms in CA		
Acceptable ripple content		12 %			
Acceptable momentary outages		100 ms			
Wired Ethernet communication ports (ACE850TP)					
Number of ports		2 x RJ45 ports			
Type of port		10/100 Base TX			
Protocols		HTTP, FTP, SNMP, SNTP, ARP, SFT, CEI61850, TCP/IP, RSTP 801.1d 2004			
Baud rate		10 or 100 Mbits/s			
Medium		CAT 5 STP or FTP or SFTP			
Maximum distance		100 m (328 ft)			
Fiber optic Ethernet communication ports (ACE850FO)					
Number of ports		2			
Type of port		100 Base FX			
Protocols		HTTP, FTP, SNMP, SNTP, ARP, SFT, CEI61850, TCP/IP, RSTP 801.1d 2004			
Baud rate		100 Mbits/s			
Fiber type		Multimode			
Wavelength		1300 nm			
Type of connector		SC			
Maximum length of fiber optic network					
Fiber optic diameter (µm)	Minimum optical power Tx (dBm)	Maximum optical power Tx (dBm)	Sensitivity RX (dBm)	Saturation RX (dBm)	Maximum distance
50/125	-22,5	-14	-33,9	-14	2 km (1.24 mi)
62,5/125	-19	-14	-33,9	-14	2 km (1.24 mi)

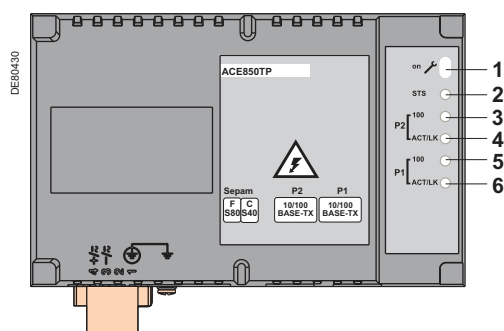
Dimensions



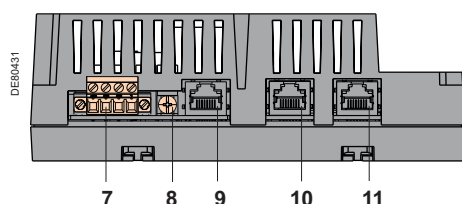
ACE850TP and ACE850FO network interfaces

Connection

ACE850TP communication interfaces



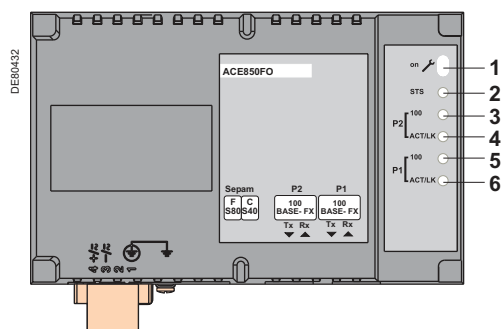
ACE850TP: Front view



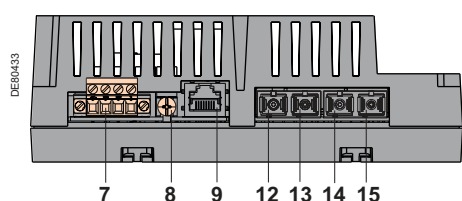
ACE850TP: View of underside

- 1 ACE850 communication interface status LED
 - LED off = ACE850 de-energized
 - Green LED permanently on = ACE850 energized and operational
 - Red LED flashing = ACE850 not configured and/or not connected to the base unit
 - Red LED permanently on = ACE850 not operational (initialization in progress or failed)
- 2 STS LED: communication status: green permanently on = OK
- 3 Ethernet Port 2 100 green LED: off = 10Mbps, permanently on = 100 Mbps
- 4 Ethernet Port 2 activity LED: flashing on transmission/reception
- 5 Ethernet Port 2 100 green LED: off = 10Mbps, permanently on = 100 Mbps
- 6 Ethernet Port 1 activity LED: flashing on transmission/reception
- 7 Power-supply terminal block
- 8 Grounding/earthing terminal using supplied braid
- 9 RJ45 socket to connect the interface to the Sepam base unit with a CCA614 cord :
 - Sepam series 80: port (F) (identified by a blue label on the Sepam unit)
- 10 RJ45 10/100 Base TX Ethernet communication port P2 (E-LAN or S-LAN)
- 11 RJ45 10/100 Base TX Ethernet communication port P1 (E-LAN or S-LAN)

ACE850FO communication interfaces



ACE850FO: Front view



ACE850FO: View of underside

- 1 ACE850 communication interface status LED
 - LED off = ACE850 de-energized
 - Green LED permanently on = ACE850 energized and operational
 - Red LED flashing = ACE850 not configured and/or not connected to the base unit
 - Red LED permanently on = ACE850 not operational (initialization in progress or failed)
- 2 STS LED: communication status: green permanently on = OK
- 3 Ethernet Port 2 100 green LED: permanently on = 100 Mbps
- 4 Ethernet Port 2 activity LED: flashing on transmission/reception
- 5 Ethernet Port 2 100 green LED: permanently on = 100 Mbps
- 6 Ethernet Port 1 activity LED: flashing on transmission/reception
- 7 Power-supply terminal block
- 8 Grounding/earthing terminal using supplied braid
- 9 RJ45 socket to connect the interface to the Sepam base unit with a CCA614 cord :
 - Sepam series 80: port (F) (identified by a blue label on the Sepam unit)
- 12 Tx fiber of 100 Base FX SC connector for Ethernet communication port P2 (E-LAN or S-LAN)
- 13 Rx fiber of 100 Base FX SC connector for Ethernet communication port P2 (E-LAN or S-LAN)
- 14 Tx fiber of 100 Base FX SC connector for Ethernet communication port P1 (E-LAN or S-LAN)
- 15 Rx fiber of 100 Base FX SC connector for Ethernet communication port P1 (E-LAN or S-LAN)

CAUTION

HAZARD OF BLINDING

Never look directly into the fiber optic.

Failure to follow this instruction can cause serious injury.

ACE850TP and ACE850FO

network interfaces

Connection

Connection to Sepam

- The ACE850 communication interface should only be connected to Sepam series 60 or Sepam series 80 base units using a CCA614 prefabricated cord (length = 3m or 9.8ft, blue RJ45 fittings).
- Sepam series 60 and series 80: Connect the CCA614 cord to the connector F on the Sepam base unit (blue label).

Connection to Sepam

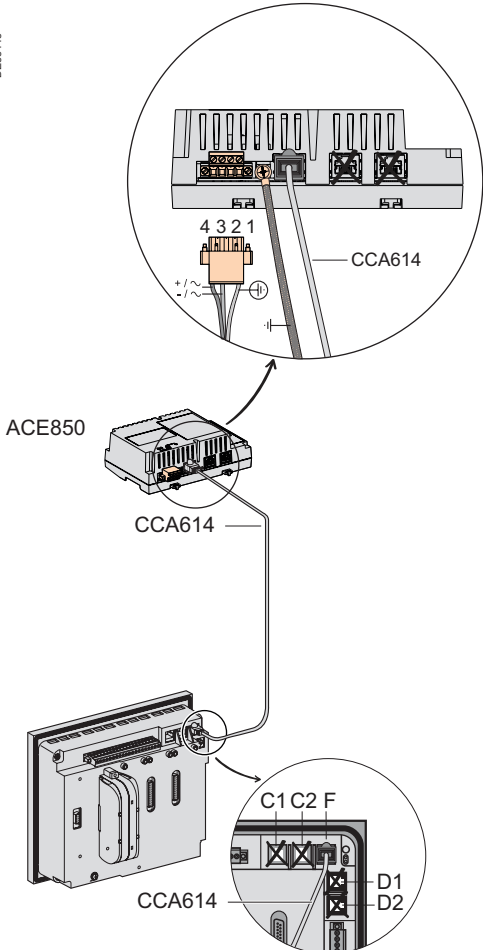
ACE850 interfaces must be powered by a 24 to 250 V DC or 110 to 240 V AC supply.

CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective ground and to the functional ground.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.



Connecting the ACE850 to a Sepam series 60 and series 80.

Terminals	Type	Wiring
3	- / ~	■ Wiring without fittings: □ 1 wire with maximum cross-section of 0.2 to 2.5 mm² (≥ AWG 20-12) or 2 wires with maximum cross-section of 0.5 to 1 mm² (≥ AWG 20-18) □ stripped length: 8 to 10 mm (0.31 to 0.39 in) ■ Wiring with fittings: □ recommended wiring with Schneider Electric fitting: - DZ5CE015D for 1 wire 1.5 mm² (AWG 16) - DZ5CE025D for 1 wire 2.5 mm² (AWG 12) - AZ5DE010D for 2 wires 1 mm² (AWG 18) □ tube length: 8.2 mm (0.32 in). □ stripped length: 8 mm (0.31 in).
4	+ / ~	
 Protective earth	Screw terminal	1 green/yellow wire, max. length 3 m (9.8 ft) and max. cross-section 2.5 mm ² (AWG 12)
 Functional earth	4 mm (0.16 in) ring lug	Earthing braid, supplied for connection to cubicle grounding

ACE909-2

RS 232 / RS 485 converter



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 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 supervisor communication settings.

Characteristics

⚠ CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

■ Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.

■ NEVER work alone.

■ Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.

■ Always use a properly rated voltage sensing device to confirm that all power is off.

■ Start by connecting the device to the protective earth and to the functional earth.

■ Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

Mechanical characteristics

Weight	0.280 kg (0.617 lb)
Assembly	On symmetrical or asymmetrical DIN rail

Electrical characteristics

Power supply	110 to 220 V AC $\pm$ 10%, 47 to 63 Hz
Galvanic isolation between ACE power supply and frame, and between ACE power supply and interface supply	2000 Vrms, 50 Hz, 1 min
Galvanic isolation between RS 232 and RS 485 interfaces	1000 Vrms, 50 Hz, 1 min
Protection by time-delayed fuse 5 mm x 20 mm (0.2 in x 0.79 in)	1 A rating

Communication and Sepam interface distributed supply

Data format	11 bits: 1 start, 8 data, 1 parity, 1 stop
Transmission delay	< 100 ns
Distributed power supply for Sepam interfaces	12 V DC or 24 V DC, 250 mA max
Maximum number of Sepam interfaces with distributed supply	12

Environmental characteristics

Operating temperature	-5°C to +55°C (+23°F to +131°F)
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Electromagnetic compatibility

	IEC standard	Value
Fast transient bursts, 5 ns	60255-22-4	4 kV with capacitive coupling in common mode 2 kV with direct coupling in common mode 1 kV with direct coupling in differential mode
1 MHz damped oscillating wave	60255-22-1	1 kV common mode 0.5 kV differential mode
1.2/50 μ s impulse waves	60255-5	3 kV common mode 1 kV differential mode

ACE909-2

RS 232 / RS 485 converter

Description and dimensions

- (A) Terminal block for RS 232 link limited to 10 m (33 ft).
 (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 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)				1
2 stop bits				0

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

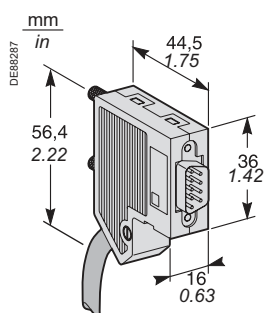
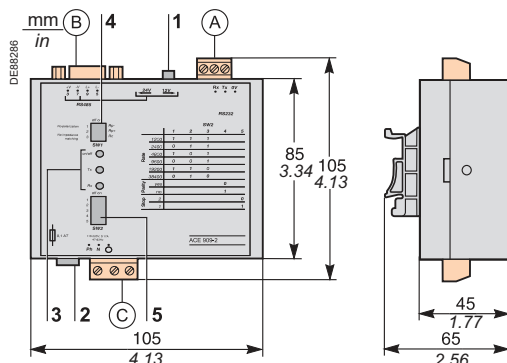
- To 2.5 mm² (AWG 12) screw type terminal block (A)
- Maximum length 10 m (33 ft)
- Rx/Tx: RS 232 receiving/sending by ACE909-2
- 0V: Rx/Tx common, do not earth.

2-wire RS 485 link with distributed power supply

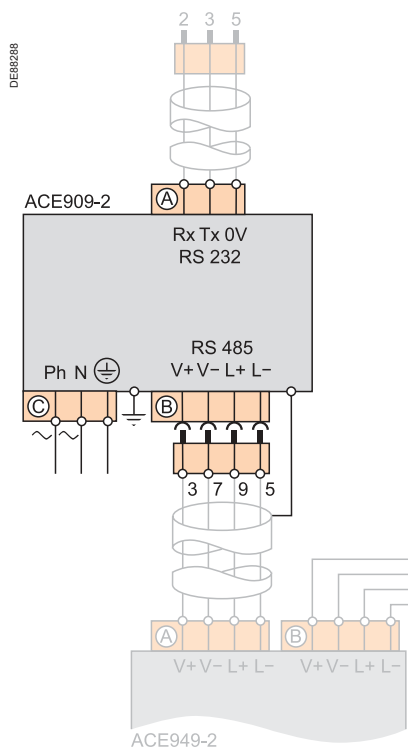
- To connector (B) female 9-pin sub-D
- 2-wire RS 485 signals: L+, L-
- Distributed power supply: V+ = 12 V DC or 24 V DC, V- = 0 V.

Power supply

- To 2.5 mm² (AWG 12) screw type terminal block (C)
- Reversible phase and neutral
- Earthed via terminal block and metal case (ring lug on back of case).



Male 9-pin sub-D connector supplied with the ACE909-2.



ACE919CA and ACE919CC RS 485 / RS 485 converters



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 ACE949-2, ACE959 or ACE969 interfaces.

There are 2 types of ACE919 converter:

- ACE919CC, DC-powered
- ACE919CA, AC-powered.

CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

■ Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.

■ NEVER work alone.

■ Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.

■ Always use a properly rated voltage sensing device to confirm that all power is off.

■ Start by connecting the device to the protective earth and to the functional earth.

■ Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

Characteristics

Mechanical characteristics

Weight	0.280 kg (0.617 lb)	
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 (0.2 in x 0.79 in)	1 A rating	1 A rating
Galvanic isolation between ACE power supply and frame, and between ACE power supply and interface supply		2000 Vrms, 50 Hz, 1 min

Communication and Sepam interface distributed supply

Data format	11 bits: 1 start, 8 data, 1 parity, 1 stop	
Transmission delay	< 100 ns	
Distributed power supply for Sepam interfaces	12 V DC or 24 V DC, 250 mA max	
Maximum number of Sepam interfaces with distributed supply	12	

Environmental characteristics

Operating temperature	-5°C to +55°C (+23°F to +131°F)	
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Electromagnetic compatibility

	IEC standard	Value
Fast transient bursts, 5 ns	60255-22-4	4 kV with capacitive coupling in common mode 2 kV with direct coupling in common mode 1 kV with direct coupling in differential mode
1 MHz damped oscillating wave	60255-22-1	1 kV common mode 0.5 kV differential mode
1.2/50 µs impulse waves	60255-5	3 kV common mode 1 kV differential mode

ACE919CA and ACE919CC

RS 485 / RS 485 converters

Description and dimensions

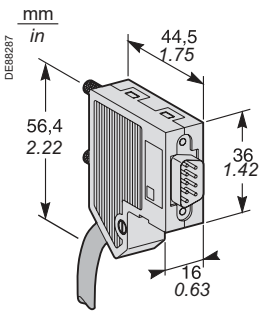
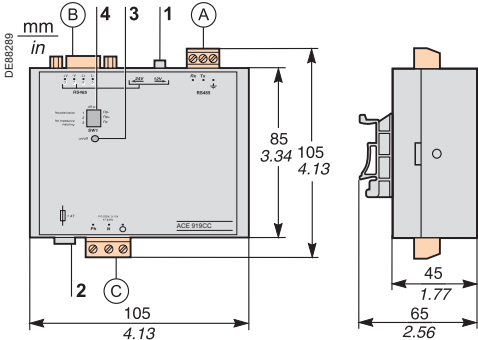
- (A) Terminal block for 2-wire RS 485 link without distributed power supply.
- (B) Female 9-pin sub-D connector to connect to the 2-wire RS 485 network, with distributed power supply.
1 screw-type male 9-pin sub-D connector is supplied with the converter.
- (C) Power supply terminal block.

- 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 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

Converter configuration when delivered

- 12 V DC distributed power supply
- 2-wire RS 485 network polarization and impedance matching resistors activated.



Male 9-pin sub-D connector supplied with the ACE919.

Connection

2-wire RS 485 link without distributed power supply

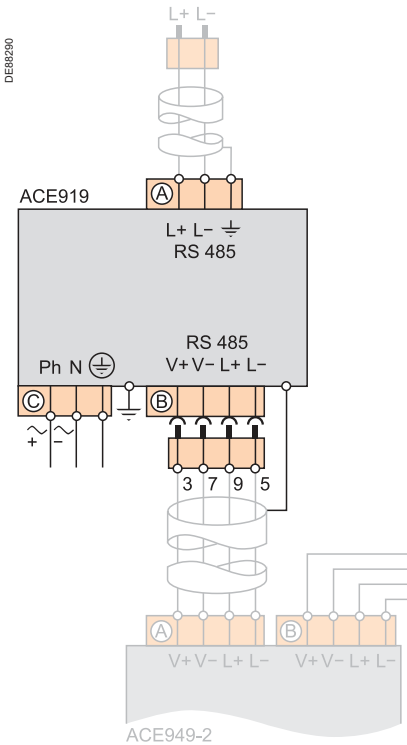
- To 2.5 mm² (AWG 12) screw type terminal block (A)
- L+, L-: 2-wire RS 485 signals
- ⚡ Shielding.

2-wire RS 485 link with distributed power supply

- To connector (B) female 9-pin sub-D
- 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 (AWG 12) screw type terminal block (C)
- Reversible phase and neutral (ACE919CA)
- Earthed via terminal block and metal case (ring lug on back of case).



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 ($50 \leq n \leq 1500$), 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) 0.05 InCT (IDMT)	**
Core balance CT + ACE990	**	0.10 InCT (DT) 0.05 InCT (IDMT)	** revamping * new
3 phase CT (I0 calculated by Sepam)	*	0.30 InCT (DT) ⁽¹⁾ 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.



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 60 and Sepam series 80
- or via the CCT640 connector and the additional voltage inputs for Sepam B83.

The table below presents the different connection possibilities for voltage transformers to Sepam.

	Sepam series 60	Sepam series 80	
Number of voltage inputs	3	4 main	4 additional ⁽¹⁾
Intermediate connector	-	-	CCT640
Sepam connector	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.



ARJA1.



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

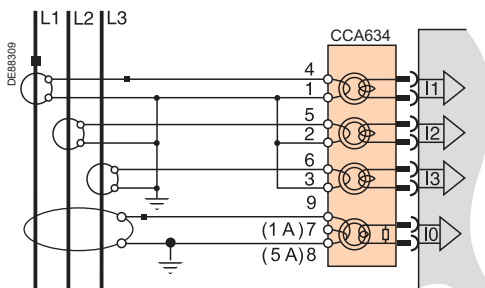
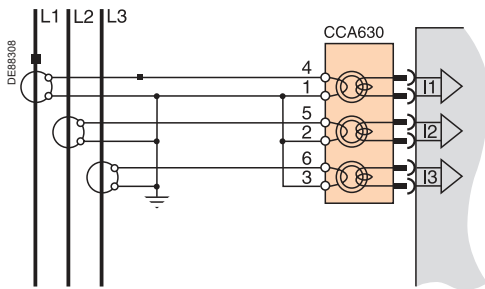
Current transformers are sized so as not to be saturated by the current values they are required to measure accurately (minimum $5 I_n$).

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_t
1 A	2.5 VA	5P 20	$< 3 \Omega$	$< 0.075 \Omega$
5 A	7.5 VA	5P 20	$< 0.2 \Omega$	$< 0.075 \Omega$



CCA630/CCA634 connector

Function

The current transformers (1 A or 5 A) are connected to the CCA630 or CCA634 connector on the rear panel of Sepam:

- The CCA630 connector is used to connect 3 phase current transformers to Sepam
- The CCA634 connector is used to connect 3 phase current transformers and a residual current transformer to Sepam.

The CCA630 and CCA634 connectors contain interposing ring CTs with through primaries, which ensure impedance matching and isolation between the 1 A or 5 A circuits and Sepam when measuring phase and residual currents.

The connectors can be disconnected with the power on since disconnection does not open the CT secondary circuit.

⚠ CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- To remove current inputs to the Sepam unit, unplug the CCA630 or CCA634 connector without disconnecting the wires from it. The CCA630 and CCA634 connectors ensure continuity of the current transformer secondary circuits.
- Before disconnecting the wires connected to the CCA630 or CCA634 connector, short-circuit the current transformer secondary circuits.

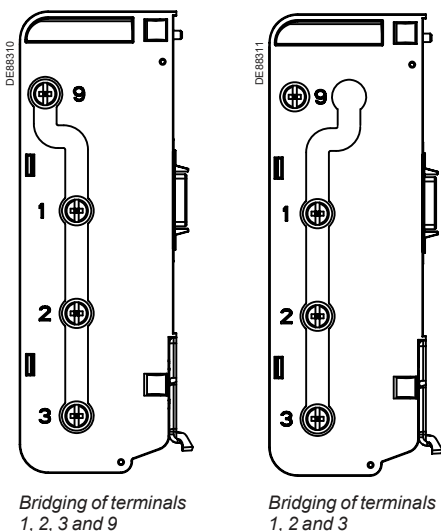
Failure to follow these instructions will result in death or serious injury.

PE80087



Connecting and assembling the CCA630 connector

1. Open the 2 side shields for access to the connection terminals. The shields can be removed, if necessary, to make wiring easier. If removed, they must be replaced after wiring.
2. If necessary, remove the bridging strap linking terminals 1, 2 and 3. This strap is supplied with the CCA630.
3. Connect the wires using 4 mm (0.16 in) ring lugs and check the tightness of the 6 screws that guarantee the continuity of the CT secondary circuits.
The connector accommodates wires with cross-sections of 1.5 to 6 mm² (AWG 16-10).
4. Close the side shields.
5. Plug the connector into the 9-pin inlet on the rear panel (item (B)).
6. Tighten the 2 CCA630 connector fastening screws on the rear panel of Sepam.



Connecting and assembling the CCA634 connector

1. Open the 2 side shields for access to the connection terminals. The shields can be removed, if necessary, to make wiring easier. If removed, they must be replaced after wiring.
2. According to the wiring required, remove or reverse the bridging strap. This is used to link either terminals 1, 2 and 3, or terminals 1, 2, 3 and 9 (see picture opposite).
3. Use terminal 7 (1 A) or 8 (5 A) to measure the residual current according to the CT secondary.
4. Connect the wires using 4 mm (0.16 in) ring lugs and check the tightness of the 6 screws that guarantee the continuity of the CT secondary circuits.
The connector accommodates wires with cross-sections of 1.5 to 6 mm² (AWG 16-10).
The wires only exit from the base.
5. Close the side shields.
6. Insert the connector pins into the slots on the base unit.
7. Flatten the connector against the unit to plug it into the 9-pin SUB-D connector (principle similar to that of the MES module).
8. Tighten the mounting screw.

CAUTION

HAZARD OF IMPROPER OPERATION

Sepam series 60 and series 80

■ Do not use a CCA634 on connector B1 and residual current input I0 on connector E (terminals 14 and 15) simultaneously.
Even if it is not connected to a sensor, a CCA634 on connector B1 will disturb input I0 on connector E.

■ Do not use a CCA634 on connector B2 and residual current input I'0 on connector E (terminals 17 and 18) simultaneously.
Even if it is not connected to a sensor, a CCA634 on connector B2 will disturb input I'0 on connector E.

Failure to follow this instruction can cause equipment damage.

PE88088



CLP1 LPCT sensor

Function

Low Power Current Transducer (LPCT) type sensors are voltage-output sensors, which are compliant with the IEC 60044-8 standard.

The Schneider Electric range of LPCTs includes the following sensors: CLP1, CLP2, CLP3, TLP130, TLP160 and TLP190.

CCA671 connector

Function

The 3 LPCT sensors are connected to the CCA671 connector on the rear panel of Sepam.

The connection of only one or two LPCT sensors is not allowed and causes Sepam to go into fail-safe position.

■ CCA671: radial plugs, for Sepam series 80.

Description

- 1 3 RJ45 plugs to connect the LPCT sensors.
- 2 3 blocks of microswitches to set the CCA671 to the rated phase current value.
- 3 Microswitch setting/selected rated current equivalency table (2 In values per position).
- 4 9-pin sub-D connector to connect test equipment (ACE917 for direct connector or via CCA613).

Rating of CCA671 connectors

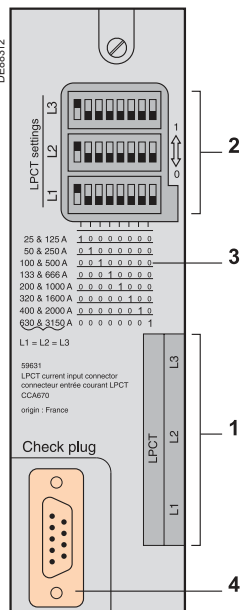
The CCA671 connector must be rated according to the rated primary current I_n measured by the LPCT sensors. I_n is the current value that corresponds to the rated secondary current of 22.5 mV. The possible settings for I_n are (in A): 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.

The selected I_n value should be:

- entered as a Sepam general setting
- configured by microswitch on the CCA671 connector.

Operating mode:

1. 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.
2. On the L1 block, set the microswitch for the selected rated current to "1" (2 I_n values per microswitch).
 - The table of equivalencies between the microswitch settings and the selected rated current I_n is printed on the connector
 - Leave the 7 other microswitches set to "0".
3. Set the other 2 blocks of switches L2 and L3 to the same position as the L1 block and close the shield.



CAUTION

HAZARD OF NON-OPERATION

- Set the microswitches for the CCA671 connector before commissioning the device.
- Check that only one microswitch is in position 1 for each block L1, L2, L3 and that no microswitch is in the center position.
- Check that the microswitch settings on all 3 blocks are identical.

Failure to follow these instructions can cause equipment damage.

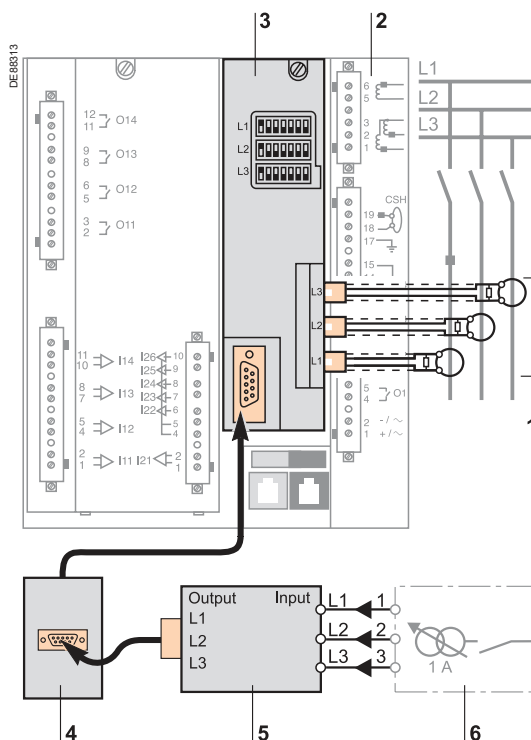
Accessory connection principle

⚠ CAUTION

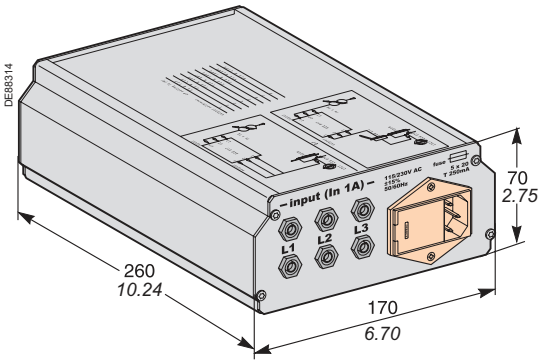
HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.

Failure to follow these instructions will result in death or serious injury.



- 1 LPCT sensor, equipped with a shielded cable fitted with a yellow RJ 45 plug which is plugged directly into the CCA671 connector.
- 2 Sepam protection unit.
- 3 CCA671 connector, LPCT voltage interface, with microswitch setting of rated current:
 - CCA671: radial plugs, for Sepam series 60 and series 80.
- 4 CCA613 remote test plug, flush-mounted on the front for Sepam series 60 and 80 of the cubicle and equipped with a 3-meter (9.84 ft) cord to be plugged into the test plug of the 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:

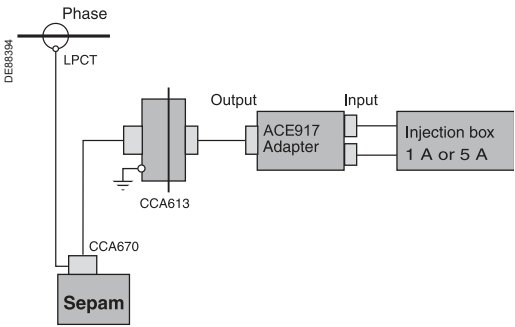
- The standard injection box
- The LPCT test plug:
 - integrated in the Sepam CCA671 interface connector
 - or transferred by means of the CCA613 accessory.

The following are supplied with the ACE917 injection adapter:

- Power supply cord
- 3-meter (9.84 ft) cord to connect the ACE917 to the LPCT test plug on CCA671 or CCA613.

Characteristics

Power supply	115/230 V AC
Protection by time-delayed fuse 5 mm x 20 mm (0.2 x 0.79 in)	0.25 A rating



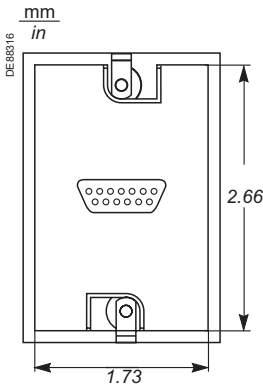
Accessory connection principle

CCA613 remote test plug

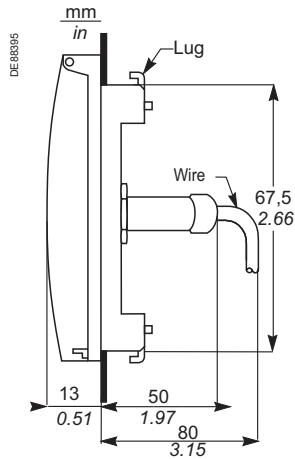
Function

The CCA613 test plug, flush-mounted on the front of the cubicle, is equipped with a 3-meter (9.84 ft) cord to transfer data from the test plug integrated in the CCA671 interface connector on the rear panel of Sepam.

Dimensions



Front view with cover lifted.



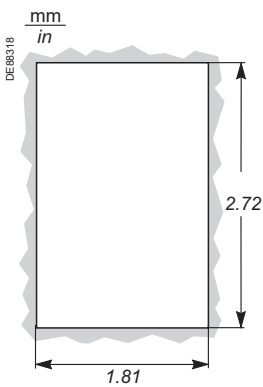
Right side view.

CAUTION

HAZARD OF CUTS

Trim the edges of the cut-out plates to remove any jagged edges.

Failure to follow this instruction can cause serious injury.



Cut-out.

CSH120 and CSH200

Core balance CTs



CSH120 and CSH200 core balance CTs.

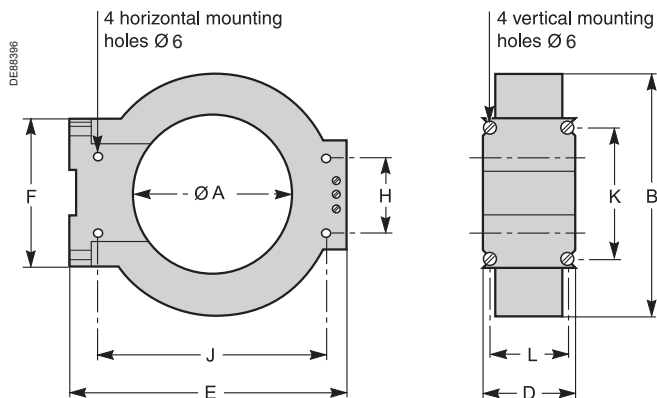
Function

The specifically designed CSH120 and CSH200 core balance CTs are for direct residual current measurement. The only difference between them is the diameter. Due to their low voltage insulation, they can only be used on cables.

Characteristics

	CSH120	CSH200
Inner diameter	120 mm (4.7 in)	200 mm (7.9 in)
Weight	0.6 kg (1.32 lb)	1.4 kg (3.09 lb)
Accuracy	±5% at 20°C (68°F) ±6% max. from -25°C to 70°C (-13°F to +158°F)	
Transformation ratio	1/470	
Maximum permissible current	20 kA - 1 s	
Operating temperature	-25°C to +70°C (-13°F to +158°F)	
Storage temperature	-40°C to +85°C (-40°F to +185°F)	

Dimensions



Dimensions	A	B	D	E	F	H	J	K	L
CSH120 (in)	120 (4.75)	164 (6.46)	44 (1.73)	190 (7.48)	80 (3.14)	40 (1.57)	166 (6.54)	65 (2.56)	35 (1.38)
CSH200 (in)	196 (7.72)	256 (10.1)	46 (1.81)	274 (10.8)	120 (4.72)	60 (2.36)	254 (10)	104 (4.09)	37 (1.46)

CSH120 and CSH200

Core balance CTs

CAUTION

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

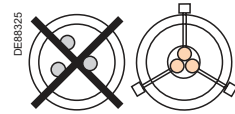
- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Only CSH120, CSH200 and CSH280 core balance CTs can be used for direct residual current measurement. Other residual current sensors require the use of an intermediate device, CSH30, ACE990 or CCA634.
- Install the core balance CTs on insulated cables.
- Cables with a rated voltage of more than 1000 V must also have an earthed shielding.

Failure to follow these instructions will result in death or serious injury.

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.



Assembly on MV cables.



Assembly on mounting plate.

CAUTION

HAZARD OF NON-OPERATION

Do not connect the secondary circuit of the CSH core balance CTs to earth. This connection is made in Sepam.

Failure to follow this instruction can cause equipment damages.

Connection

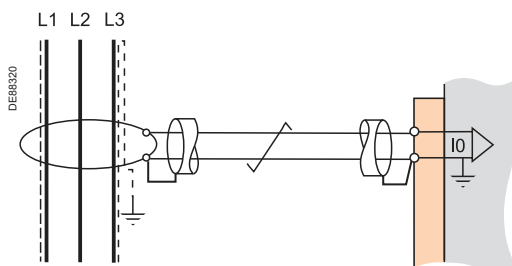
Connection for Sepam series 60 and 80

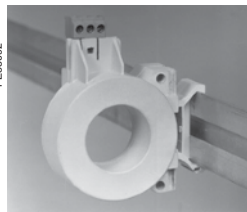
- To residual current I0 input, on connector (E), terminals 15 and 14 (shielding)
- To residual current I'0 input, on connector (E), terminals 18 and 17 (shielding). Only for Sepam series 80.

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 (30.5 mΩ/ft)
- Minimum dielectric strength: 1000 V (700 Vrms)
- Connect the cable shielding in the shortest manner possible to Sepam
- 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 exceed 4 Ω (i.e. 20 m maximum for 100 mΩ/m or 66 ft maximum for 30.5 mΩ/ft).





Vertical assembly of CSH30 interposing ring CT.



Horizontal assembly of CSH30 interposing ring CT.

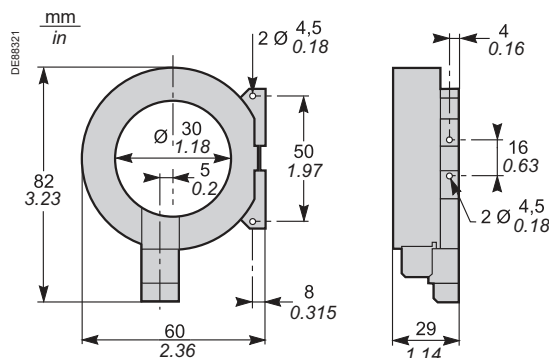
Function

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	0.12 kg (0.265 lb)
Assembly	On symmetrical DIN rail In vertical or horizontal position

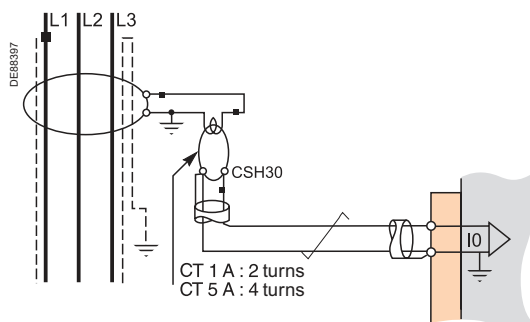
Dimensions



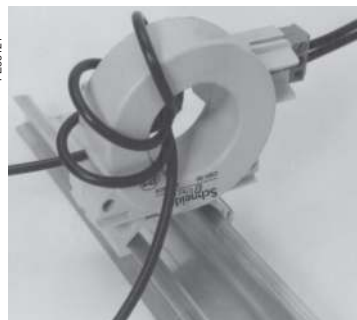
Connection

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

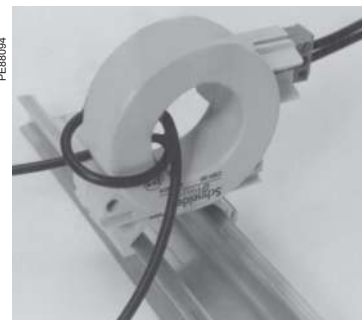


Connection to 5 A secondary circuit



1. Plug into the connector.
2. Insert the transformer secondary wire through the CSH30 interposing ring CT 4 times.

Connection to 1 A secondary circuit



1. Plug into the connector.
2. Insert the transformer secondary wire through the CSH30 interposing ring CT twice.

Connection for Sepam series 60 and 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). Only for Sepam series 80.

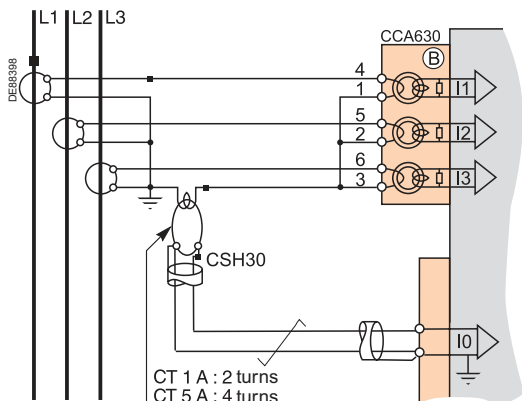
Recommended cable

- Sheathed cable, shielded by tinned copper braid
- Minimum cable cross-section 0.93 mm² (AWG 18) (max. 2.5 mm², AWG 12)
- Resistance per unit length < 100 mΩ/m (30.5 mΩ/ft)
- Minimum dielectric strength: 1000 V (700 Vrms)
- Maximum length: 2 m (6.6 ft).

It is essential for the CSH30 interposing ring CT to be installed near Sepam (Sepam - CSH30 link less than 2 m (6.6 ft) 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.



ACE990 Core balance CT interface



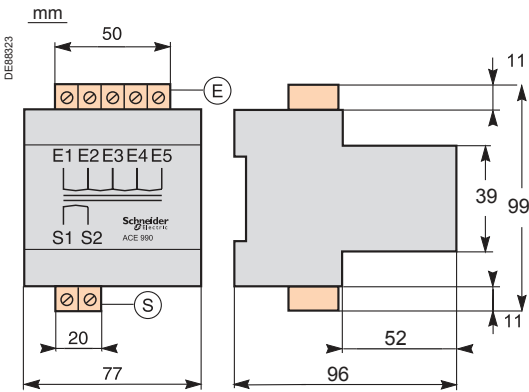
ACE990 core balance CT interface.

Function

The ACE990 is used to adapt measurements between an MV core balance CT with a ratio of 1/n ($50 \leq n \leq 1500$), and the Sepam residual current input.

Characteristics

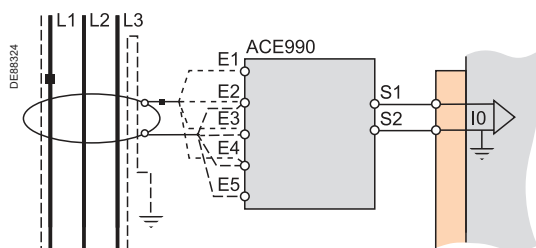
Weight	0.64 kg (1.41 lb)
Assembly	Mounted on symmetrical DIN rail
Amplitude accuracy	±1%
Phase accuracy	< 2°
Maximum permissible current	20 kA - 1 s (on the primary winding of an MV core balance CT with a ratio of 1/50 that does not saturate)
Operating temperature	-5°C to +55°C (+23°F to +131°F)
Storage temperature	-25°C to +70°C (-13°F to +158°F)



Description and dimensions

- (E) ACE990 input terminal block, for connection of the core balance CT.
- (S) ACE990 output terminal block, for connection of the Sepam residual current.

ACE990 Core balance CT interface



Connection

Connection of core balance CT

Only one core balance CT can 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 input terminals, it is necessary to know the following:

- Core balance CT ratio (1/n)
- Core balance CT power
- Close approximation of rated current I_{n0}
(I_{n0} is a general setting in Sepam and defines the earth fault protection setting range between 0.1 I_{n0} and 15 I_{n0}).

The table below can 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 I_{n0} setting, given by the following formula: **$I_{n0} = k \times \text{number of core balance CT turns}$** 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 terminal with the lowest index (Ex).

ACE990 Core balance CT interface

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 I_{n0} , i.e. 5 A.
2. Calculate the ratio:
approx. $I_{n0}/\text{number of turns} = 5/400 = 0.0125$.
3. Find the closest value of k in the table opposite to $k = 0.01136$.
4. Check the minimum power required for the core balance CT:
2 VA core balance CT > 0.1 VA V OK.
5. Connect the core balance CT secondary to ACE990 input terminals E2 and E4.
6. Set Sepam up with:
 $I_{n0} = 0.01136 \times 400 = 4.5 \text{ A}$.

This value of I_{n0} can be used to monitor current between 0.45 A and 67.5 A.

Wiring of MV core balance CT secondary circuit:

- S1 output to ACE990 E2 input terminal
- S2 output to ACE990 E4 input terminal.

Connection (cont.)

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

Connection for Sepam series 60 and 80

- To residual current I_0 input, on connector (E), terminals 15 and 14 (shielding)
- To residual current $I'0$ input, on connector (E), terminals 18 and 17 (shielding).
Only for Sepam series 80.

Recommended cables

- Cable between core balance CT and ACE990: less than 50 m (160 ft) long
- Sheathed cable, shielded by tinned copper braid between the ACE990 and Sepam, maximum length 2 m (6.6 ft)
- Cable cross-section between 0.93 mm² (AWG 18) and 2.5 mm² (AWG 12)
- Resistance per unit length less than 100 mΩ/m (30.5 mΩ/ft)
- Minimum dielectric strength: 100 Vrms.

Connect the connection cable shielding in the shortest manner possible (2 cm or 5.08 in 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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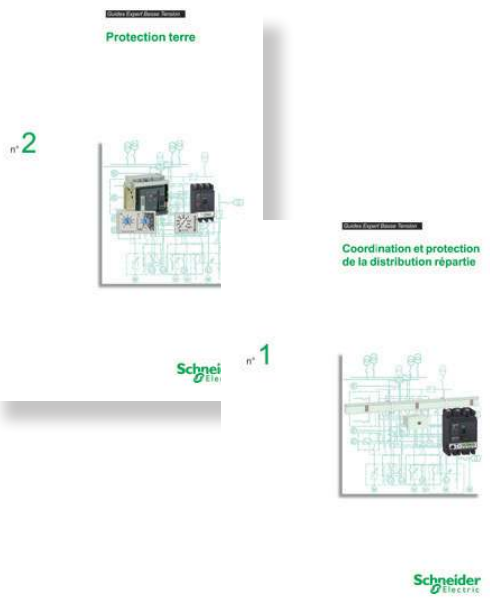
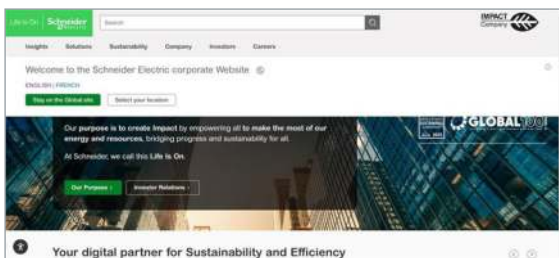
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The technical guide

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 - optimizes choice of protection and connection devices while also increasing markedly continuity of supply in the installations.



Order form

Sepam series 60
Sepam series 80

Range description	5
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Sepam series 60

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 60 base unit, cartridge, connectors and application

Base unit and UMI			Application Type	B1 sensor		
Base unit with mimic-based UMI	SEP666	59837 ☐	Substation S60	59787 ☐	CT ☐	CT ☐ LPCT ☐
Base unit with advanced UMI	SEP363	59836 ☐	S62	59789 ☐	CT ☐	CT ☐ LPCT ☐
With lead seal accessory ⁽¹⁾	AMT852	59639 ☐	Transformer T60	59790 ☐	CT ☐	CT ☐ LPCT ☐
Base unit without basic UMI	SEP060	59835 ☐	T62	59791 ☐	CT ☐	CT ☐ LPCT ☐
Remote advanced	DSM303	59608 ☐	Motor M61	59792 ☐	CT ☐	CT ☐ LPCT ☐
UMI module (compulsory with SEP060)			Generator G60	59793 ☐	CT ☐	CT ☐ LPCT ☐
Connection cord L = 0.6 m	CCA770	59660 ☐	G62	59794 ☐	CT ☐	CT ☐ LPCT ☐
L = 2 m	CCA772	59661 ☐	Capacitor C60	59795 ☐	CT ☐	CT ☐ LPCT ☐
L = 4 m	CCA774	59662 ☐			59630 ☐	59629 ☐ 59702 ☐
Mounting plate	AMT880	59706 ☐			CCA630 ☐	CCA634 ☐ CCA671 ☐

Note: 8 mounting clips included

Memory cartridge

Memory cartridge	MMS020	59707 ☐
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Working language

Sepam series 60	EN/FR	59846 ☐
	EN/ES	59847 ☐

Connectors

Type	Screw-type	CCA620	59668 ☐
	Ring-lug type	CCA622	59669 ☐

Note:
CCA630: 3 phase CT
CCA630: 3 phase CT + IO

(1) Can be used only with an advanced UMI

Modules, communication interfaces and core balance CTs

Core balance CTs			Modules		
Core balance CT, Ø 120 mm	CSH120	59635 ☐	Input / output modules		
Core balance CT, Ø 196 mm	CSH200	59636 ☐	14 inputs (24-250 V DC) + 6 outputs	MES120	59715 ☐
Core balance CT, Ø 291 mm	CSH300	59637 ☐	14 inputs (220-250 V DC) + 6 outputs	MES120G	59716 ☐
Interposing ring CT	CSH30	59634 ☐	14 inputs (110-125 V DC) + 6 outputs	MES120H	59722 ☐
Note: only one core balance CT can be added.			Note: the Sepam base unit comes with 4 outputs; 2 input/output modules can be added.		
Note: using core balance CTs is incompatible with the CCA634.			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 MCS025 can be used only with applications S, 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-2	59723 ☐	CCA612	59663 ☐	
Fiber optic interface	ACE969FO-2	59724 ☐	CCA612	59663 ☐	
TCP/IP interfaces (IEC 61850 and Modbus)					
TCP/IP firmware option		59754 ☐			
RJ45 interface	ACE850TP	59658 ☐			
Fiber optic interface	ACE850FO	59659 ☐			

Note: only one communication interface per Sepam application.

Note: a specific firmware is necessary to use the TCP/IP interfaces.

Note: the connection cord is included in ACE850 TP and FO interfaces.

Note: only one interface ACE850TP or ACE850FO per Sepam application.

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				Application Type		B1 sensor			B2 sensor				
Base unit with mimic-based UMI		SEP888	59705	Substation	S80	59729	CT	CT	LPCT				
Base unit with advanced UMI		SEP383	59704		S81	59730	CT	CT	LPCT				
With lead seal accessory ⁽¹⁾		AMT852	59639		S82	59731	CT	CT	LPCT				
Base unit without basic UMI		SEP080	59703	Transformer	S84	59732	CT	CT	LPCT				
Remote advanced		DSM303	59608		T81	59733	CT	CT	LPCT				
UMI module (compulsory with SEP080)					T82	59734	CT	CT	LPCT				
Connection cord L = 0.6 m		CCA770	59660	Motor	T87	59735	CT	CT		CT	CT		
L = 2 m		CCA772	59661		M81	59736	CT	CT	LPCT				
L = 4 m		CCA774	59662		M87	59737	CT	CT	LPCT	CT	CT	LPCT	
Mounting plate		AMT880	59706	Generator	M88	59738	CT	CT		CT	CT		
<i>Note: 8 mounting clips included</i>					G82	59739	CT	CT	LPCT				
Memory cartridge					G87	59741	CT	CT	LPCT	CT	CT	LPCT	
Memory cartridge		MMS020	59707	Busbar	G88	59742	CT	CT		CT	CT		
Extended memory cartridge		MMR020	59701		B80	59743	CT	CT	LPCT				
Logipam option		SFT080	59711		B83	59744	CT	CT		VT			
<i>Note: option required to use Logipam program.</i>				Capacitor	C86	59745	CT	CT	LPCT	CT	CT		
Working language						59630	59629	59702	59630	59629	59702	59632	
Sepam series 80		EN/FR	59709			CCA630	CCA634	CCA671	CCA630	CCA634	CCA671	CCT640	
		EN/ES	59710										
Connectors													
Type	Screw-type	CCA620	59668	<i>Note:</i>									
	Ring-lug type	CCA622	59669	CCA630: 3 phase CTCCA634: 3 phase CT + IO									

Note:
CCA630: 3 phase CTCCA634: 3 phase CT + IO

(1) Can be used only with an advanced UMI

Modules, communication interfaces and core balance CTs

Core balance CTs			Modules		
Core balance CT, Ø 120 mm	CSH120	59635	Input / output modules		
Core balance CT, Ø 196 mm	CSH200	59636	14 inputs (24-250 V DC) + 6 outputs	MES120	59715
Core balance CT, Ø 291 mm	CSH300	59637	14 inputs (220-250 V DC) + 6 outputs	MES120G	59716
Interposing ring CT	CSH30	59634	14 inputs (110-125 V DC) + 6 outputs	MES120H	59722
Note: the total number of core balance CTs cannot exceed 2.			Note: the Sepam base unit comes with 5 outputs; 3 input/output modules can be added.		
Warning: using core balance CTs is incompatible with the CCA634.			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.					
			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 MCS025 can be used only with applications S, B, G and T.					
			Communication interfaces		
			Modbus interfaces		
			Connection cord		
			2-wire RS 485 interface	ACE949-2	59642
			4-wire RS 485 interface	ACE959	59643
			Fiber optic interface	ACE937	59644
			Multi-protocol interfaces (Modbus, DNP3 or IEC 60870-5-103)		
			2-wire RS 485 interface	ACE969TP-2	59723
			Fiber optic interface	ACE969FO-2	59724
			TCP/IP interfaces (IEC 61850 and Modbus)		
			TCP/IP firmware option	59754	
			RJ45 interface	ACE850TP	59658
			Fiber optic interface	ACE850FO	59659
Note: the total number of communication interfaces cannot exceed 2.					
Note: a specific firmware is necessary to use the TCP/IP interfaces.					
Note: connection cords are included with the ACE850TP and ACE850FO interfaces.					
Note: only one interface ACE850TP or ACE850FO per Sepam application.					

Sepam accessories and spare parts

Check the boxes ☒ or indicate the required quantities in the appropriate spaces according to your choices.

Mounting accessories

MCS025:

Mounting plate	AMT840	59670	
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Sepam series 60 and 80 with advanced UMI

Lead seal accessory	AMT852	59639	
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Sepam series 60 and 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 cord RS232 connection	CCA783	59664	
PC cord USB connection	CCA784	59671	
Logipam SFT2885 programming software	CD SFT2885	59727	
IEC 61850 configuration software	CD SFT850	59726	

Input / output modules

Sepam series 60 and series 80

14 inputs + 6 outputs, 24-250 V DC	MES120	59715	
14 inputs + 6 outputs, 110-125 V DC	MES120H	59722	
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-2	59723	
Fiber optic multi-protocol interface (without CCA612)	ACE969FO-2	59724	
Connection cord, L = 3 m	CCA612	59663	
RJ45 TCP/IP interface (with CCA614)	ACE850TP	59658	
Fiber optic TCP/IP interface (with CCA614)	ACE850FO	59659	
Connection cord, L = 3 m, for TCP/IP interfaces	CCA614	59751	

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	

Core balance CTs

Core balance CT, Ø 120 mm	CSH120	59635	
Core balance CT, Ø 196 mm	CSH200	59636	
Core balance CT, Ø 291 mm	CSH300	59637	

Accessories for phase-current sensors (LPCT)

LPCT injection adapter	ACE917	59667	
Remote LPCT test plug	CCA613	59666	

Sepam accessories and spare parts

Check the boxes ☒ or indicate the required quantities in the appropriate spaces according to your choices.

Manuals

Sepam series 60

User's manual	SEPED310017	EN	☒	FR	☒	
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Sepam series 80

Metering, protection, control and monitoring user's manual	SEPED303001	EN	☒	FR	☒	
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Modbus communication user's manual	SEPED303002	EN	☒	FR	☒	
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Installation and operation manual	SEPED303003	EN	☒	FR	☒	
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Communication protocol

DNP3 protocol	SEPED305001	EN	☒	FR	☒	
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IEC 60870-5-103 protocol	SEPED305002	EN	☒	FR	☒	
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Note: the technical manuals must be ordered separately from the CDI centre in Evreux.

Spare connectors

Sepam

20-pin screw-type connector	CCA620	59668	
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20-pin ring lug connector	CCA622	59669	
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1 A / 5 A CT current connector	CCA630	59630	
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1 A / 5 A CT + IO current connector	CCA634	59629	
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LPCT radial current connector	CCA671	59702	
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VT voltage connector	CCT640	59632	
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MES modules

Connectors for 2 MES120	Kit 2640	59676	
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Spare Sepam series 60 and series 80 base units

Series 60 base unit with mimic-based UMI	SEP666	59837	
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Series 60 base unit with advanced UMI	SEP363	59836	
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Series 60 base unit without UMI	SEP060	59835	
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Series 80 base unit with mimic-based UMI	SEP888	59705	
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Series 80 base unit with advanced UMI	SEP383	59704	
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Series 80 base unit without UMI	SEP080	59703	
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12 spring clips	XBTZ3002	
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Note: the base units are supplied without connectors and without memory cartridges.

Sepam accessories and spare parts

Spare Sepam series 60 and series 80 memory cartridge

Memory cartridges	MMS020	59707	
Extended memory cartridges (Sepam 80 only)	MMR020	59701	

Note: memory cartridges cannot be sold without application. When ordering a base unit or a memory cartridge to be used with TCP/IP interfaces this option is mandatory.

Application series 60	Type		Working language			TCP/IP option	
			59846	59847		59754	
Substation	S60	59787	☐	☐	☐	☐	
	S62	59789	☐	☐	☐	☐	
Transformer	T60	59790	☐	☐	☐	☐	
	T62	59791	☐	☐	☐	☐	
Motor	M61	59792	☐	☐	☐	☐	
Generator	G60	59793	☐	☐	☐	☐	
	G62	59794	☐	☐	☐	☐	
Capacitor	C60	59795	☐	☐	☐	☐	
Application series 80	Type		Working language		Logipam	TCP/IP option	
			59709	59710		59711	59754
Substation	S80	59729	☐	☐	☐	☐	
	S81	59730	☐	☐	☐	☐	
	S82	59731	☐	☐	☐	☐	
	S84	59732	☐	☐	☐	☐	
Transformer	T81	59733	☐	☐	☐	☐	
	T82	59734	☐	☐	☐	☐	
	T87	59735	☐	☐	☐	☐	
Motor	M81	59736	☐	☐	☐	☐	
	M87	59737	☐	☐	☐	☐	
	M88	59738	☐	☐	☐	☐	
Generator	G82	59739	☐	☐	☐	☐	
	G87	59741	☐	☐	☐	☐	
	G88	59742	☐	☐	☐	☐	
Busbar	B80	59743	☐	☐	☐	☐	
	B83	59744	☐	☐	☐	☐	
Capacitor	C86	59745	☐	☐	☐	☐	

Note: customized reference for series 80 only: -

Check the boxes ☒ or indicate the required quantities in the appropriate spaces according to your choices.

Sepam series 60 and 80 UMI replacement kit

Kit advanced UMI series 60 and series 80	SDK383	59696	
Kit mimic-based UMI series 60 and series 80	SDK888	59697	
UMI tool kit	SDK000	59698	

Note: the UMI tool kit is required for installing the UMI kit.

Note: the same kit can be used with both Sepam series 60 and Sepam series 80.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



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