Sepam series 20 and Sepam series 40

Selection table
Sepam series 20

		Substation		Transformer		Motor	Busbar	
Protection	**ANSI code**	**S20**	**S24 (4)**	**T20**	**T24 (4)**	**M20**	**B21 (3)**	**B22**
Phase overcurrent	50/51	4	4	4	4	4		
Phase overcurrent cold load pick-up/blocking	CLPU 50/51		1		1			
Earth fault / Sensitive earth fault	50N/51N 50G/51G	4	4	4	4	4		
Earth fault cold load pick-up/blocking	CLPU 50/51N		1		1			
Breaker failure	50BF		1		1			
Negative sequence / unbalance	46	1	1	1	1	1		
Thermal overload	49RMS			2	2	2		
Phase undercurrent	37					1		
Excessive starting time, locked rotor	48/51LR/14					1		
Starts per hour	66					1		
Positive sequence undervoltage	27D/47						2	2
Remanent undervoltage	27R						1	1
Phase-to-phase undervoltage	27						2	2
Phase-to-neutral undervoltage	27S						1	1
Phase-to-phase overvoltage	59						2	2
Neutral voltage displacement	59N						2	2
Overfrequency	81H						1	1
Underfrequency	81L						2	2
Rate of change of frequency	81R							1
Recloser (4 cycles)	79	□	□					
Thermostat / Buchholz	26/63			□	□			
Temperature monitoring (8 RTDs)	38/49T			□	□	□		
Metering								
Phase current I1, I2, I3 RMS, residual current I0		■	■	■	■	■		
Demand current I1, I2, I3, peak demand current IM1, IM2, IM3		■	■	■	■	■		
Voltage U21, U32, U13, V1, V2, V3, residual voltage V0							■	■
Positive sequence voltage Vd / rotation direction							■	■
Frequency							■	■
Temperature				□	□	□		
Network and machine diagnosis								
Tripping current TripI1, TripI2, TripI3, TripI0		■	■	■	■	■		
Unbalance ratio / negative sequence current Ii		■	■	■	■	■		
Disturbance recording		■	■	■	■	■	■	■
Thermal capacity used				■	■	■		
Remaining operating time before overload tripping				■	■	■		
Waiting time after overload tripping				■	■	■		
Running hours counter / operating time				■	■	■		
Starting current and time						■		
Start inhibit time Number of starts before inhibition						■		
Cable arcing fault detection		■	■	■	■	■	■	■
Switchgear diagnosis								
Cumulative breaking current		■	■	■	■	■		
Trip circuit supervision		□	□	□	□	□	□	□
Number of operations, operating time, charging time		□	□	□	□	□		
Control and monitoring	**ANSI code**							
Circuit breaker / contactor control (1)	94/69	□	□	□	□	□	□	□
Latching / acknowledgement	86	■	■	■	■	■	■	■
Logic discrimination	68	□	□	□	□	□		
Switching of groups of settings		■ (2)	■ (2)	■ (2)	■ (2)	■ (2)		
Annunciation	30	■	■	■	■	■	■	■
Additional modules								
8 temperature sensor inputs - MET148-2 module				□	□	□		
1 low level analog output - MSA141 module		□	□	□	□	□	□	□
Logic inputs/outputs - MES114/MES114E/MES114F (10I/4O) module		□	□	□	□	□	□	□
Communication interface - ACE949-2, ACE959, ACE937, ACE969TP-2, ACE969FO-2, ECI850		□	□	□	□	□	□	□

■ *standard,* □ *according to parameter setting and MES114/MES114E/MES114F or MET148-2 input/output module options.*
(1) *For shunt trip unit or undervoltage trip unit.*
(2) *Exclusive choice between logic discrimination and switching from one 2-relay group of settings to another 2-relay group.*
(3) *Performs Sepam B20 functions.*
(4) *Applications S24 and T24 perform the functions of applications S23 and T23 respectively.*

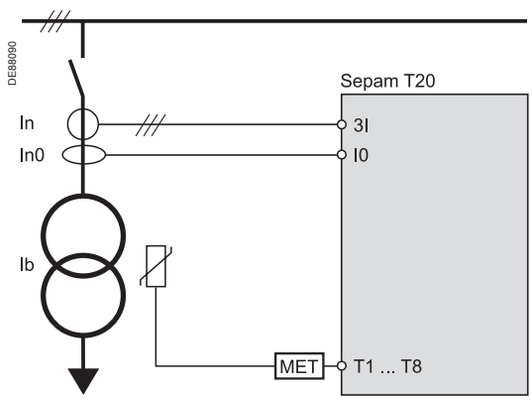
Selection table
Sepam series 40

		Substation										Transformer				Motor		Generator
Protection	**ANSI code**	**S40**	**S50**	**S41**	**S51**	**S42**	**S52**	**S43**	**S53**	**S44**	**S54**	**T40**	**T50**	**T42**	**T52**	**M40**	**M41**	**G40**
Phase overcurrent	50/51	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Phase overcurrent cold load pick-up / blocking	CLPU 50/51		4		4		4		4		4		4		4			
Voltage-restrained overcurrent	50V/51V																	1
Earth fault / Sensitive earth fault	50N/51N 50G/51G	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Earth fault cold load pick-up / blocking	CLPU 50/51N		4		4		4		4		4		4		4			
Breaker failure	50BF	1	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	2
Directional phase overcurrent	67					2	2							2	2			
Directional earth fault	67N/67NC			2	2	2	2	2	2					2	2		2	
Directional active overpower	32P			1	1	1	1	1	1								1	1
Directional reactive overpower	32Q/40																1	1
Thermal overload	49RMS											2	2	2	2	2	2	2
Phase undercurrent	37															1	1	
Excessive starting time, locked rotor	48/51LR/14															1	1	
Starts per hour	66															1	1	
Positive sequence undervoltage	27D															2	2	
Remanent undervoltage	27R															1	1	
Undervoltage (3)	27/27S	2	2	2	2	2	2			2	2	2	2	2	2	2	2	2
Overvoltage (3)	59	2	2	2	2	2	2			2	2	2	2	2	2	2	2	2
Neutral voltage displacement	59N	2	2	2	2	2	2					2	2	2	2		2	2
Negative sequence overvoltage	47	1	1	1	1	1	1			1	1	1	1	1	1		1	1
Overfrequency	81H	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
Recloser (4 cycles)	79	□	□	□	□	□	□	□	□	□	□							
Temperature monitoring (8 or 16 RTDs)	38/49T											□	□	□	□	□	□	□
Thermostat / Buchholz	26/63											□		□				
Broken conductor	46BC		1		1		1		1		1		1		1			
Metering																		
Phase current I1, I2, I3 RMS, residual current I0		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Demand current I1, I2, I3, peak demand current IM1, IM2, IM3		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Voltage U21, U32, U13, V1, V2, V3, residual voltage V0		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Positive sequence voltage Vd / rotation direction Negative sequence voltage Vi		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Frequency		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Active, reactive and apparent power P, Q, S Peak demand power PM, QM, power factor		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Calculated active and reactive energy (±W.h, ±var.h)		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Active and reactive energy by pulse counting (±W.h, ±.varh)		□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Temperature												□	□	□	□	□	□	□
Network and machine diagnosis																		
Tripping context		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Tripping current TripI1, TripI2, TripI3, TripI0		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Unbalance ratio / negative sequence current Ii		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Phase displacement Φ0, Φ1, Φ2, Φ3		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Disturbance recording		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Thermal capacity used												■	■	■	■	■	■	■
Remaining operating time before overload tripping												■	■	■	■	■	■	■
Waiting time after overload tripping												■	■	■	■	■	■	■
Running hours counter / operating time												■	■	■	■	■	■	■
Starting current and time																■	■	
Cable arcing fault detection		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Fault locator	21FL		■		■		■		■		■							
Start inhibit time, number of starts before inhibition																■	■	
Switchgear diagnosis																		
Cumulative breaking current		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Trip circuit supervision		□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Number of operations, operating time, charging time		□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
CT / VT supervision	60FL	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Control and monitoring	**ANSI code**																	
Circuit breaker / contactor control (1)	94/69	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Latching / acknowledgement	86	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Logic discrimination	68	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Switching of groups of settings		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Annunciation	30	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Logic equation editor		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Additional modules																		
8 temperature sensor inputs - MET148-2 module (2)												□	□	□	□	□	□	□
1 low level analog output - MSA141 module		□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Logic inputs/outputs - MES114/MES114E/MES114F (10I/4O) module		□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Communication interface - ACE949-2, ACE959, ACE937, ACE969TP-2, ACE969FO-2 , ACE850 TP, ACE850FO or ECI850		□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□

■ *standard,* □ *according to parameter setting and MES114/MES114E/MES114F or MET148-2 input/output module options.*
(1) *For shunt trip unit or undervoltage trip unit.*
(2) *2 modules possible.*
(3) *Exclusive choice, phase-to-neutral voltage or phase-to-phase voltage for each of the 2 relays.*

Sensor inputs

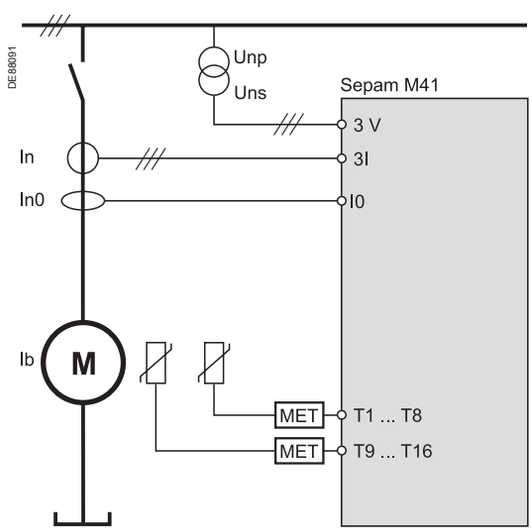
Each Sepam series 20 or Sepam series 40 has analog inputs that are connected to the measurement sensors required for the application.



Sepam T20 sensor inputs.

Sepam series 20 sensor inputs

	S20, S24	T20, T24, M20	B21, B22
Phase current inputs	3	3	0
Residual current input	1	1	0
Phase voltage inputs	0	0	3
Residual voltage input	0	0	1
Temperature inputs (on MET148-2 module)	0	8	0



Sepam M41 sensor inputs.

Sepam series 40 sensor inputs

	S40, S41, S42, S43, S44, S50, S51, S52, S53, S54		T40, T42, T50, T52, M40, M41, G40	
Phase current inputs	3		3	
Residual current input	1		1	
Phase voltage inputs	2	3	2	3
Residual voltage input	1	0	1	0
Temperature inputs (on MET148-2 module)	0		2 x 8	

General settings

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

General settings		Selection	Sepam series 20	Sepam series 40
In	Rated phase current (sensor primary current)	2 or 3 CT 1 A / 5 A	1 A to 6250 A	1 A to 6250 A
		3 LPCTs	25 A to 3150 A (1)	25 A to 3150 A (1)
Ib	Base current, according to rated power of equipment		0.4 to 1.3 In	0.2 to 1.3 In
In0	Rated residual current	Sum of 3 phase currents	See In rated phase current	See In rated phase current
		CSH120 or CSH200 core balance CT	2 A or 20 A rating	2 A, 5 A or 20 A rating
		1 A/5 A CT + CSH30 interposing ring CT	1 A to 6250 A	1 A to 6250 A (In0 = In)
		1 A/5 A CT + CSH30 interposing ring CT Sensitivity x10	-	1 A to 6250 A (In0 = In/10)
		Core balance CT + ACE990 (the core balance CT ratio 1/n must be such that 50 y n y 1500)	According to current monitored and use of ACE990	According to current monitored and use of ACE990
Unp	Rated primary phase-to-phase voltage (Vnp: rated primary phase-to-neutral voltage Vnp = Unp/$\sqrt{3}$)		220 V to 250 kV	220 V to 250 kV
Uns	Rated secondary phase-to-phase voltage	3 VTs: V1, V2, V3	90 V to 230 V in steps of 1 V	90 V to 230 V in steps of 1 V
		2 VTs: U21, U32	90 V to 120 V in steps of 1 V	90 V to 120 V in steps of 1 V
		1 VT: V1	90 V to 120 V in steps of 1 V	90 V to 120 V in steps of 1 V
Uns0	Secondary zero sequence voltage for primary zero sequence voltage Unp/$\sqrt{3}$		Uns/3 or Uns/$\sqrt{3}$	Uns/3 or Uns/$\sqrt{3}$
	Rated frequency		50 Hz or 60 Hz	50 Hz or 60 Hz
	Integration period (for demand current and peak demand current and power)		5, 10, 15, 30, 60 mn	5, 10, 15, 30, 60 mn
	Pulse-type accumulated energy meter	Increments active energy	-	0.1 kW.h to 5 MW.h
		Increments reactive energy	-	0.1 kvar.h to 5 Mvar.h

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

Metering and diagnosis
Description

Metering

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

Phase current

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

Residual current

Two residual current values are available depending on the type of Sepam and sensors connected to it:
- residual currents I0S, calculated by the vector sum of the 3 phase currents
- measured residual current I0.

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

Demand current and peak demand currents

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

Peak demand currents may be cleared.

Voltage and frequency

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

Power

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

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

Peak demand powers

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

Energy

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

Temperature

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

Metering and diagnosis
Description

Machine diagnosis assistance

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

Thermal capacity used

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

Remaining operating time before overload tripping

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

Waiting time after overload tripping

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

Running hours counter / operating time

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

Motor starting / overload current and time

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

The values are stored until the following start / overload.

Number of starts before inhibition/start inhibit time

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

Network diagnosis assistance

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

Tripping context

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

Tripping current

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

Negative sequence / unbalance

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

Phase displacement

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

Disturbance recording

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

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

Fault location

The network diagnosis function 21FL calculates the distance to a located fault in a medium voltage network. It is associated with the following protection functions:
- Single-phase fault - 50N/51N or 67N,
- Multi-phase fault - 50/51 or 67.

Only units with protection functions configured for circuit breaker tripping activate the Fault locator function.
The fault resistance is also calculated. The results of the calculation, as well as information on the type of fault located and the faulty phases are displayed and saved in the tripping context. The fault distance can be calculated in miles or kilometers. The 21FL function is designed to operate on an incoming feeder on a network with several feeders.

Data on the last five faults is saved.

Metering and diagnosis
Description

Sepam self-diagnosis

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

Internal failure

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

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

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

Detection of plugged connectors

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

Configuration checking

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

Switchgear diagnosis assistance

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

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

ANSI 60/60FL - CT/VT supervision

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

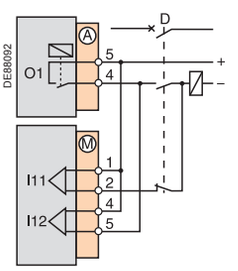
Monitoring includes:
- consistency checking of currents and voltages measured
- acquisition of phase or residual voltage transformer protection fuse blown contacts.

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

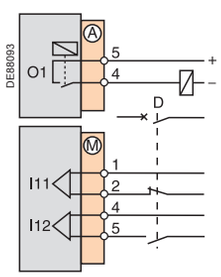
ANSI 74 - Trip circuit supervision

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

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



Connection for shunt trip coil monitoring.



Connection for undervoltage trip coil monitoring.

Cumulative breaking current

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

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

Number of operations

Cumulative number of opening operations performed by the breaking device.

Circuit breaker operating time and charging time

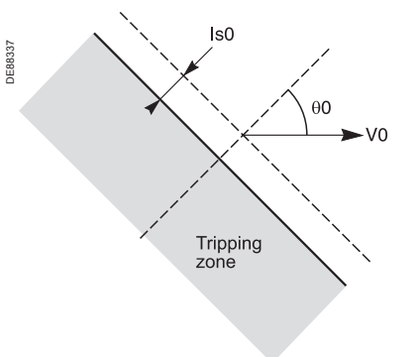
Used to assess the condition of the breaking device operating mechanism.

Metering and diagnosis
Characteristics

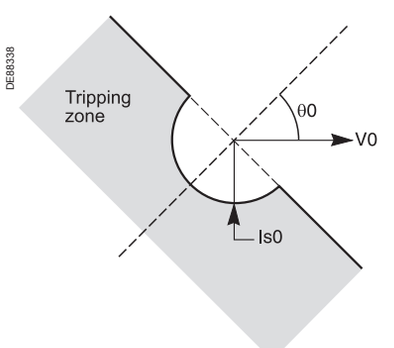
Functions		Measurement range	Accuracy (1) Sepam series 20	Accuracy (1) Sepam series 40	MSA141	Saving
Metering						
Phase current		0.1 to 40 In (3)	±1 %	±0.5 %	■	
Residual current	Calculated	0.1 to 40 In	±1 %	±1 %	■	
	Measured	0.1 to 20 In0	±1 %	±1 %	■	
Demand current		0.1 to 40 In	±1 %	±0.5 %		
Peak demand current		0.1 to 40 In	±1 %	±0.5 %		□
Phase-to-phase voltage		0.06 to 1.2 Unp	±1 %	±0.5 %	■	
Phase-to-neutral voltage		0.06 to 1.2 Vnp	±1 %	±0.5 %	■	
Residual voltage		0.04 to 3 Vnp	±1 %	±1 %		
Positive sequence voltage		0.05 to 1.2 Vnp	±5 %	±2 %		
Negative sequence voltage		0.05 to 1,2 Vnp	-	±2 %		
Frequency Sepam series 20		50 ±5 Hz or 60 ±5 Hz	±0.05 Hz	-	■	
Frequency Sepam series 40		25 to 65 Hz	-	±0.02 Hz	■	
Active power		0.015 Sn(2) to 999 MW	-	±1 %	■	
Reactive power		0.015 Sn(2) to 999 Mvar	-	±1 %	■	
Apparent power		0.015 Sn(2) to 999 MVA	-	±1 %	■	
Peak demand active power		0.015 Sn(2) to 999 MW	-	±1 %		□
Peak demand reactive power		0.015 Sn(2) to 999 Mvar	-	±1 %		□
Power factor		-1 to +1 (CAP/IND)	-	±1 %		
Calculated active energy		0 to 2.1.10^8 MW.h	-	±1 % ±1 digit		□
Calculated reactive energy		0 to 2.1.10^8 Mvar.h	-	±1 % ±1 digit		□
Temperature		-30 to +200 °C or -22 to +392 °F	±1 °C from +20 to +140 °C	±1 °C from +20 to +140 °C	■	
Network diagnosis assistance						
Tripping context						□
Phase tripping current		0.1 to 40 In	±5 %	±5 %		□
Earth fault tripping current		0.1 to 20 In0	±5 %	±5 %		□
Negative sequence / unbalance		10 to 500 % of Ib	±2 %	±2 %		
Phase displacement α0 (between V0 and I0)		0 to 359°	-	±2°		
Phase displacement φ1, φ2, φ3 (between V and I)		0 to 359°	-	±2°		
Disturbance recording		-	-	-		□ (4)
Machine operating assistance						
Thermal capacity used		0 to 800 % (100 % for I phase = Ib)	±1 %	±1 %	■	□
Remaining operating time before overload tripping		0 to 999 mn	±1 mn	±1 mn		
Waiting time after overload tripping		0 to 999 mn	±1 mn	±1 mn		
Running hours counter / operating time		0 to 65535 hours	±1 % or ±0.5 h	±1 % or ±0.5 h		□
Starting current		S20 : 0,5 Ib to 24 In S40 : 1,2 Ib to 24 In	±5 %	±5 %		□
Starting time		0 to 300 s	±300 ms	±300 ms		□
Number of starts before inhibition		0 to 60	1	1		
Start inhibit time		0 to 360 mn	±1 mn	±1 mn		
Cooling time constant		5 to 600 mn	-	±5 mn		
Switchgear diagnosis assistance						
Cumulative breaking current		0 to 65535 kA²	±10 %	±10 %		□
Number of operations		0 to 4.10^9	1	1		□
Operating time		20 to 100 ms	±1 ms	±1 ms		□
Charging time		1 to 20 s	±0.5 s	±0.5 s		□

■ *available on MSA141 analog output module, according to setup.*
□ *saved in the event of auxiliary supply outage.*
(1) *Under reference conditions (IEC 60255-6), typical accuracy at In or Unp, cos φ > 0.8.*
(2) *Sn: apparent power, = √3.Unp.In.*
(3) *Measurement up to 0.02 In for information purpose.*
(4) *Series 40 only.*

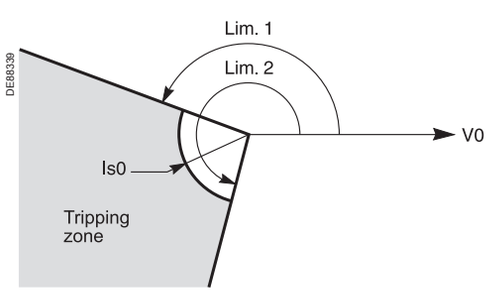
2



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



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



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

Directional current protection

ANSI 67 - Directional phase overcurrent

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

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

ANSI 67N/67NC - Directional earth fault

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

ANSI 67N/67NC type 1

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

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

ANSI 67N/67NC type 2

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

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

ANSI 67N/67NC type 3

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

Current protection functions

ANSI 50/51 - Phase overcurrent

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

Characteristics

■ 2 groups of settings
■ instantaneous or time-delayed tripping
■ definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
■ with or without timer hold. The protection incorporates a harmonic 2 restraint which can be used to set the protection Is set point close to the CT rated current In, including when a transformer closes. This restraint can be activated by parameter setting. The harmonic 2 restraint is valid as long as the current is less than half the minimum short-circuit current Isc of the network downstream of the protection.

With Sepam series 40, tripping can be confirmed or unconfirmed, according to parameter setting:
■ unconfirmed tripping: standard
■ tripping confirmed by negative sequence overvoltage protection (ANSI 47, unit 1), as backup for distant 2-phase short-circuits
■ tripping confirmed by undervoltage protection (ANSI 27, unit 1), as backup for phase-to-phase short-circuits in networks with low short-circuit power.

ANSI CLPU 50/51 - Phase overcurrent cold load pick-up/blocking (Cold Load Pick-Up I)

The Cold Load Pick-Up I or CLPU 50/51 function avoids nuisance tripping of the phase overcurrent protection (ANSI 50/51), during energization after a long outage.
Depending on the installation characteristics, these operations can actually generate transient inrush currents likely to exceed the protection set points.
These transient currents may be due to:
■ the power transformer magnetizing currents,
■ the motor starting currents,
■ the simultaneous resetting of all the loads in the installation (air conditioning, heating, etc.)

In principle, the protection settings should be defined so as to avoid tripping due to these transient currents. However, if these settings result in inadequate sensitivity levels or delays that are too long, the CLPU 50/51 function is used to increase or inhibit set points temporarily after energization.

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

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

Characteristics

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

ANSI CLPU 50N/51N- Earth fault cold load pick-up/blocking (Cold Load Pick-Up I0)

The Cold Load Pick-Up I0 or CLPU 50N/51N function avoids nuisance tripping of the earth fault protection (ANSI 50N/51N) during energization after a long outage.
Depending on the installation characteristics, such operations can actually generate transient inrush currents. If the residual current measurement is based on the sum of the 3 phase CTs, the aperiodic component of these transient currents can result in saturation of the phase CTs. This can lead to measurement of an incorrect residual current likely to exceed the protection set points.
These transient currents are essentially due to:
■ the power transformer magnetizing currents,
■ the motor starting currents.
In principle, the protection settings should be defined so as to avoid tripping due to these transient currents. However, if these settings result in inadequate sensitivity levels or delays that are too long, the CLPU 50N/51N function is used to increase or inhibit set points temporarily after energization.
If the residual current is measured by a correctly installed CT, there is less risk of measuring an incorrect residual current. In this case, there is no need to use the CLPU 50N/51N function.

ANSI 50BF - Breaker failure

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

ANSI 46 - Negative sequence / unbalance

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

Characteristics

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

ANSI 46BC - Broken conductor detection

Broken conductor detection protection indicates an open phase condition on the circuit in a medium voltage radial network.
This may be caused by one of the following:
■ broken conductor in contact with the ground at the source side
■ broken conductor in contact with the ground at the load side
■ open circuit (conductor not in contact with the ground) caused by:
□ broken conductor
□ blown fuse
□ circuit breaker pole failure.

2

Current protection functions (continued)

ANSI 49RMS - Thermal overload

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

Characteristics
■ 2 groups of settings
■ 1 adjustable alarm set point
■ 1 adjustable tripping set point
■ adjustable initial thermal capacity used setting, to adapt protection characteristics to fit manufacturer's thermal withstand curves
■ equipment heating and cooling time constants.
With Sepam series 40, the cooling time constant may be calculated automatically based on measurement of the equipment temperature by a sensor.

Recloser

ANSI 79

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

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

Directional power protection functions

ANSI 32P - Directional active overpower

Two-way protection based on calculated active power, for the following applications:
■ active overpower protection to detect overloads and allow load shedding
■ reverse active power protection:
□ against generators running like motors when the generators consume active power
□ against motors running like generators when the motors supply active power.

ANSI 32Q/40 - Directional reactive overpower

Two-way protection based on calculated reactive power to detect field loss on synchronous machines:
■ reactive overpower protection for motors which consume more reactive power with field loss
■ reverse reactive overpower protection for generators which consume reactive power with field loss.

Machine protection functions

ANSI 37 - Phase undercurrent

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

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

Protection of motors against overheating caused by:
■ excessive motor starting time due to overloads (e.g. conveyor) or insufficient supply voltage.
The reacceleration of a motor that is not shut down, indicated by a logic input, may be considered as starting.
■ locked rotor due to motor load (e.g. crusher):
□ in normal operation, after a normal start
□ directly upon starting, before the detection of excessive starting time, with detection of locked rotor by a zero speed detector connected to a logic input, or by the underspeed function.

ANSI 66 - Starts per hour

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

ANSI 50V/51V - Voltage-restrained overcurrent

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

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

ANSI 26/63 - Thermostat/Buchholz

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

ANSI 38/49T - Temperature monitoring

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

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

Voltage protection functions

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

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

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

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

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

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

Frequency protection functions

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

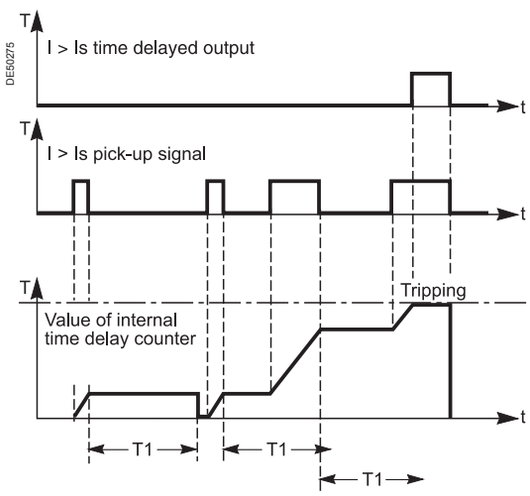
ANSI 81L - Underfrequency
Detection of abnormally low frequency compared to the rated frequency, to monitor power supply quality.
The protection may be used for overall tripping or load shedding.
Protection stability is ensured in the event of the loss of the main source and presence of remanent voltage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

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

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

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

Protection
Main characteristics



Detection of restriking faults with adjustable timer hold.

Current IDMT tripping curves

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

The curve equations are given page 105.

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

The time delays of current IDMT tripping curves (except for customized and RI curves) may be set as follows:
- time T, operating time at 10 x Is
- TMS factor, factor shown as T/b (see curve equation page 105).

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.

Summary table

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

Protection
Setting ranges

Functions	Settings		Time delays
ANSI 21FL - Fault locator			
Time to establish healthy state	1s to 99 mn		0,1 s to 300 s
Percentage of cable	0 to 30 %		
Distance unit Km or mile	Km or mile		
Direct line resistance	0,001 Ω/Km to 10 Ω/Km		
Direct line reactance	0,001 Ω/Km to 10 Ω/Km		
Direct cable resistance	0,001 Ω/Km to 10 Ω/Km		
Direct cable reactance	0,001 Ω/Km to 10 Ω/Km		
Zero sequence line resistance	0,001 Ω/Km to 10 Ω/Km		
Zero sequence line reactance	0,001 Ω/Km to 10 Ω/Km		
Zero sequence cable resistance	0,001 Ω/Km to 10 Ω/Km		
Zero sequence cable reactance	0,001 Ω/Km to 10 Ω/Km		
ANSI 27 - Phase-to-phase undervoltage			
	5 to 120 % of Unp		0.05 s to 300 s
ANSI 27D/47 - Positive sequence undervoltage			
	5 to 60 % of Unp		0.05 s to 300 s
ANSI 27R - Remanent undervoltage			
	5 to 120 % of Unp		0.05 s to 300 s
ANSI 27S - Phase-to-neutral undervoltage			
	5 to 120 % of Vnp		0.05 s to 300 s
ANSI 32P - Directional active overpower			
	1 to 120 % of Sn (2)		0.1 s to 300 s
ANSI 32Q/40 - Directional reactive overpower			
	5 to 120 % of Sn (2)		0.1 s to 300 s
ANSI 37 - Phase undercurrent			
	0.15 to 1 Ib		0.05 s to 300 s
ANSI 38/49T - Temperature monitoring (8 or 16 RTDs)			
Alarm and trip set points	0 to 180 °C (or 32 to 356 °F)		
ANSI 46 - Negative sequence / unbalance			
Definite time	0.1 to 5 Ib		0.1 s to 300 s
IDMT	0.1 to 0.5 Ib (Schneider Electric) 0.1 to 1 Ib (IEC, IEEE)		0.1 s to 1 s
Tripping curve	Schneider Electric		
	IEC: SIT/A, LTI/B, VIT/B, EIT/C (1)		
	IEEE: MI (D), VI (E), EI (F) (1)		
ANSI 46BC - Broken Conductor			
Ii/Id set point	10 to 100 %		0.15 s to 300 s
ANSI 47 - Negative sequence overvoltage			
	1 to 50 % of Unp		0.05 s to 300 s
ANSI 48/51LR/14 - Excessive starting time, locked rotor			
	0.5 Ib to 5 Ib	ST starting time	0.5 s to 300 s
		LT and LTS time delays	0.05 s to 300 s
ANSI 49RMS - Thermal overload		**Rate 1 and Rate 2**	
Accounting for negative sequence component		0 - 2,25 - 4,5 - 9	
Time constant	Heating	Sepam serie 20	T1: 1 to 120 mn
		Sepam serie 40	T1: 1 to 600 mn
	Cooling	Sepam serie 20	T2: 1 to 600 mn
		Sepam serie 40	T2: 5 to 600 mn
Alarm and tripping set points		50 to 300 % of rated thermal capacity	
Cold curve modification factor		0 to 100 %	
Switching of thermal settings conditions		By logic input	
		By Is set point adjustable from 0.25 to 8 Ib	
Maximum equipment temperature		60 to 200 °C (140 °F to 392 °F)	

(1) *Sepam series 40 only.*
(2) *Sn = √3.In.Unp.*

Protection
Setting ranges

Functions	Settings		Time delays
ANSI 50/51 - Phase overcurrent			
	Tripping time delay	Timer hold	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is set point	0.1 to 24 In	Definite time	Inst ; 0.05 s to 300 s
	0.1 to 2.4 In	IDMT	0.1 s to 12.5 s at 10 Is
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
Confirming (2)	None		
	By negative sequence overvoltage		
	By phase-to-phase undervoltage		
Second-harmonic set point	5 to 50 %		
CLPU 50/51 - Phase overcurrent cold load pick-up/blocking			
Time before activation Tcold			0,1 to 300 s
Pick-up threshold CLPUs	10 to 100 % of In		
Global action CLPU 50/51	Blocking or multiplication of the set point		
Action on unit x ANSI 50/51	OFF or ON		
Time delay T/x			100 ms to 999 mn
Multiplying factor M/x	100 to 999 % of Is		
ANSI 50BF - Breaker failure			
Presence of current	0.2 to 2 In		
Operating time	0.05 s to 300 s		
ANSI 50N/51N or 50G/51G - Earth fault / Sensitive earth fault			
	Tripping time delay	Timer hold	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	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	0.1 to 15 In0	Definite time	Inst ; 0.05 s to 300 s
	0.1 to 1 In0	IDMT	0.1 s to 12.5 s at 10 Is0
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
CLPU 50N/51N - Earth fault cold load pick-up/blocking			
Time before activation Tcold			0,1 to 300 s
Pick-up threshold CLPUs	10 to 100 % of In0		
Global action CLPU 50N/51N	Blocking or multiplication of the set point		
Action on unit x ANSI 50N/51N	OFF or ON		
Time delay T0/x			100 ms to 999 mn
Multiplying factor M0/x	100 to 999 % of Is0		
ANSI 50V/51V - Voltage-restrained overcurrent			
	Tripping time delay	Timer hold	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is set point	0.5 to 24 In	Definite time	Inst ; 0.05 s to 300 s
	0.5 to 2,4 In	IDMT	0.1 s to 12.5 s at 10 Is
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s

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

Protection
Setting ranges

Functions		Settings		Time delays
ANSI 59 - Overvoltage (L-L ou L-N)				
		50 to 150 % of Unp (or Vnp) if Uns < 208 V		0,05 s to 300 s
		50 to 135 % of Unp (or Vnp) if Uns ≥ 208 V		0,05 s to 300 s
ANSI 59N - Neutral voltage displacement				
		2 to 80 % of Unp		0.05 s to 300 s
ANSI 66 - Starts per hour				
Starts per period		1 to 60	Period	1 to 6 hr
Consecutive starts		1 to 60	Time between starts	0 to 90 mn
ANSI 67 - Directional phase overcurrent				
		Tripping time delay	Timer hold	
Tripping curve		Definite time	DT	
		SIT, LTI, VIT, EIT, UIT (1)	DT	
		RI	DT	
		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		0.1 to 24 In	Definite time	Inst ; 0.05 s to 300 s
		0.1 to 2,4 In	IDMT	0.1 s to 12.5 s at 10 Is
Timer hold		Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
		IDMT (IDMT ; reset time)		0.5 s to 20 s
Characteristic angle		30°, 45°, 60°		
ANSI 67N/67NC type 1 - Directional earth fault, according to I0 projection				
Characteristic angle		-45°, 0°, 15°, 30°, 45°, 60°, 90°		
Is0 set point		0.1 to 15 In0	Definite time	Inst ; 0.05 s to 300 s
Vs0 set point		2 to 80 % of Un		
Memory time		T0mem time	0 ; 0.05 s to 300 s	
		V0mem validity set point	0 ; 2 to 80 % of Unp	
ANSI 67N/67NC type 2 - Directional earth fault, according to I0 magnitude with half-plan tripping zone				
Characteristic angle		-45°, 0°, 15°, 30°, 45°, 60°, 90°		
		Tripping time delay	Timer hold	
Tripping curve		Definite time	DT	
		SIT, LTI, VIT, EIT, UIT (1)	DT	
		RI	DT	
		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		0.1 to 15 In0	Definite time	Inst ; 0.05 s to 300 s
		0.1 to 1 In0	IDMT	0.1 s to 12.5 s at 10 Is0
Vs0 set point		2 to 80 % of Unp		
Timer hold		Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
		IDMT (IDMT ; reset time)		0.5 s to 20 s
ANSI 67N/67NC type 3 - Directional earth fault, according to I0 magnitude with angular sector tripping zone				
Angle at start of tripping zone		0° to 359°		
Angle at end of tripping zone		0° to 359°		
Is0 set point	CSH core balance CT (2 A rating)	0.1 A to 30 A	Definite time	Inst ; 0.05 to 300 s
	1 A CT (sensitive, In0 = 0.1 CT In)	0.05 to 15 In0 (min. 0.1 A)		
	Core balance CT + ACE990 (range 1)	0.05 to 15 In0 (min. 0.1 A)		
Vs0 set point		Calculated V0 (sum of 3 voltages)	2 to 80 % of Unp	
		Measured V0 (external VT)	0.6 to 80 % of Unp	
ANSI 81H - Overfrequency				
Sepam series 20		50 to 53 Hz or 60 to 63 Hz		0.1 s to 300 s
Sepam series 40		50 to 55 Hz or 60 to 65 Hz		0.1 s to 300 s
ANSI 81L - Underfrequency				
Sepam series 20		45 to 50 Hz or 55 to 60 Hz		0.1 s to 300 s
Sepam series 40		40 to 50 Hz or 50 to 60 Hz		0.1 s to 300 s
ANSI 81R - Rate of change of frequency				
		0.1 to 10 Hz/s		Inst ; 0.15 s to 300 s

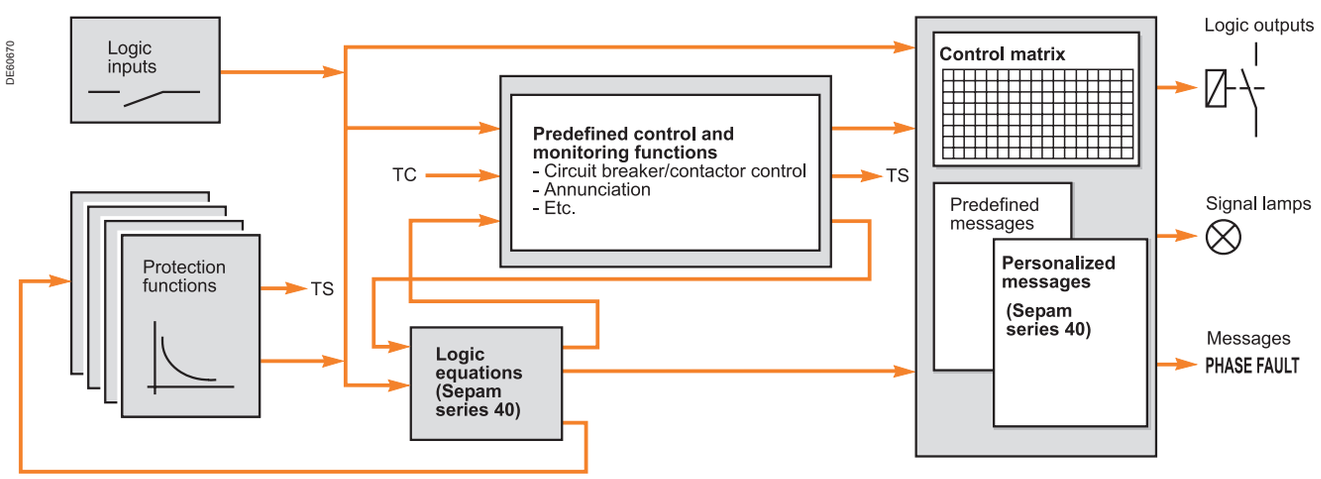
(1) *Tripping as of 1.2 Is.*

Control and monitoring
Description

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

Operating principle

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



Logic inputs and outputs

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

Control and monitoring
Description of predefined functions

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

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

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

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

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

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

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

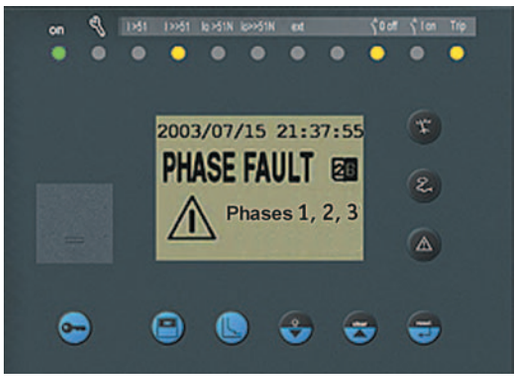
ANSI 68 - Logic discrimination
This function provides:
- perfect tripping discrimination with phase-to-phase and phase-to-earth short-circuits, on all types of network
- faster tripping of the breakers closest to the source (solving the drawback of conventional time discrimination).

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

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

Control and monitoring
Description of predefined functions

PE88028



Local indications on the Sepam front panel.

ANSI 30 - Local annunciation

LED indication on the Sepam front panel

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

Local annunciation on Sepam’s advanced UMI

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

Alarm processing

■ when an alarm appears, the related message replaces the current display and the related LED goes on.
The number and type of messages depend on the type of Sepam. The messages are linked to Sepam functions and may be viewed on the front-panel display and in the SFT2841 “Alarms” screen.

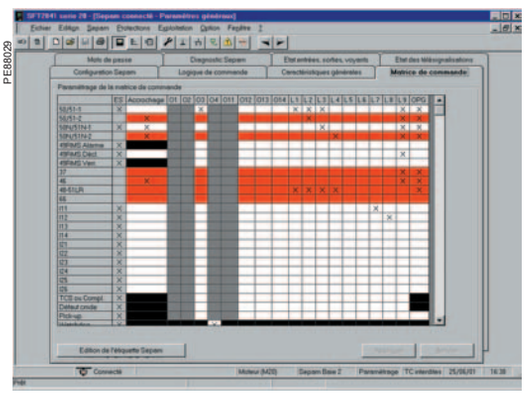
■ to clear the message from the display, press the clear key

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

■ the list of alarm messages remains accessible (key) and may be cleared by pressing the clear key.

Control and monitoring
Adaptation of predefined functions using the SFT2841 software

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


PE88029

SFT2841: control matrix.

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

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

Logic equation editor (Sepam series 40)
The logic equation editor included in the SFT2841 software can be used to:
- complete protection function processing:
  - additional interlocking
  - conditional inhibition/validation of functions
  - etc.
- adapt predefined control functions: particular circuit breaker or recloser control sequences, etc.

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

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

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

Personalized alarm and operating messages (Sepam series 40)
The alarm and operating messages may be personalized using the SFT2841 software tool.
The new messages are added to the list of existing messages and may be assigned via the control matrix for display:
- on the Sepam display
- in the SFT2841 “Alarms” and “Alarm History” screens.

Base unit
Presentation

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

PE88030

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

PE88031

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

PE88032

Customized Chinese advanced UMI.

User-Machine Interface

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

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

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

The characteristics of the remote advanced UMI module (DSM303) are presented on page 218 .

Advanced UMI

Comprehensive data for facility managers

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

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

Basic UMI

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

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

Working language

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

Please contact us regarding local language customization.

Setting and operating software

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

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

Base unit
Presentation

Selection guide

Base unit	With basic UMI	With integrated advanced UMI	With remote advanced UMI
	 PE88031	 PE88030	 PE88033
Functions			
Local indication			
Metering and diagnosis data		■	■
Alarms and operating messages		■	■
Sepam parameter setting		■	■
Protection setting		■	■
Version of Sepam and remote modules		■	■
Status of logic inputs		■	■
Local control			
Alarm acknowledgement	■	■	■
Sepam reset	■	■	■
Output testing		■	■
Characteristics			
Screen			
Size		128 x 64 pixels	128 x 64 pixels
Automatic contrast setting		■	■
Backlit screen		■	■
Keypad			
Number of keys	1	9	9
LEDs			
Sepam operating status	2 LEDs on front	2 LEDs on front	■ base unit: 2 LEDs on front ■ remote advanced UMI: 2 LEDs on front
Indication LEDs	9 LEDs on front	9 LEDs on front	9 LEDs on remote advanced UMI
Mounting			
	Flush mounted on front of cubicle	Flush mounted on front of cubicle	■ base unit with basic UMI, mounted at the back of the compartment using the AMT840 mounting plate ■ DSM303 remote advanced UMI module ,flush mounted on the front of the cubicle and connected to the base unit with the CCA77x prefabricated cord

Base unit
Presentation

Hardware characteristics

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

Backup capacity
Sepam series 40 allows the following data to be stored in the event of an auxiliary power outage for a minimum of 48 hours :
- time-tagged event tables
- disturbance recording data
- peak demands, tripping context, etc.
- date and time.

Four relay outputs
The 4 relay outputs O1 to O4 on the base unit must be connected to connector Ⓐ. Each output can be assigned to a predetermined function using the SFT2841 software.
O1, O2 and O3 are 3 control outputs with one NO contact. O1 and O2 are used by default for the switchgear control function:
- O1: switchgear tripping
- O2: switchgear closing inhibition.

O4 is an indication output with one NO contact and one NC contact.
It can be assigned to the watchdog function.

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

Phase current input connector
Current sensors connected to removable, screw-lockable connectors according to type of sensors used:
- CCA630 or CCA634 connector for 1 A or 5 A current transformers

or
- CCA670 connector for LPCT sensors.

The presence of these connectors is monitored.

Voltage input connector
Sepam B21 and B22
Voltage sensors connected to the removable, screw-lockable CCT640 connector.
The presence of the CCT640 connector is monitored.

Sepam series 40
Voltage sensors connected to the 6-pin connector Ⓔ.
A choice of 2 types of removable, screw-lockable 6-pin connectors:
- CCA626 screw-type connector

or
- CCA627 ring lug connector.

The presence of the Ⓔ connector is monitored.

Mounting accessories

AMT840 mounting plate
It is used to mount a Sepam with basic UMI inside the compartment with access to connectors on the rear panel.
Mounting used with remote advanced UMI module (DSM303).

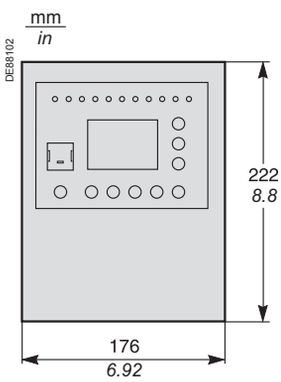
AMT852 lead sealing accessory
The AMT852 lead sealing accessory can be used to prevent unauthorized modification of the settings of Sepam series 20 and Sepam series 40 units with integrated advanced UMIs.
The accessory includes:
- a lead-sealable cover plate
- the screws required to secure the cover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

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

PE88034

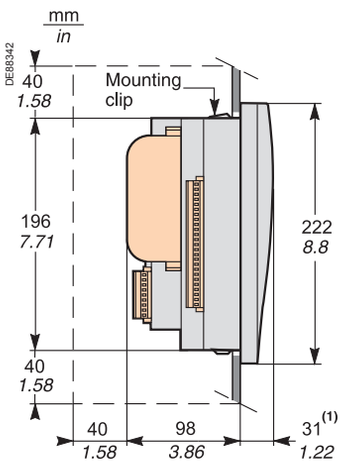
Sepam unit with integrated advanced UMI and lead sealing accessory AMT852.

Base unit
Dimensions



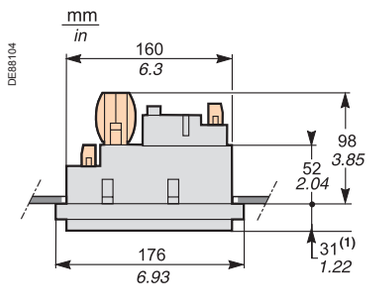
Front view of Sepam.

Dimensions



Sepam with advanced UMI and MES114, flush-mounted in front panel.

Clearance for Sepam assembly and wiring.



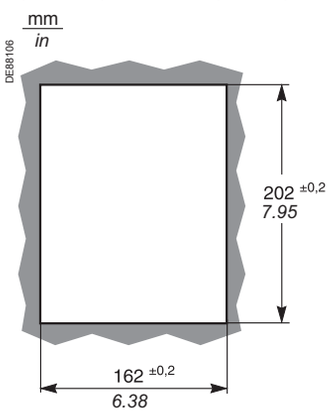
Sepam with advanced UMI and MES114, flush-mounted in front panel.

(1) *With basic UMI: 23 mm (0.91 in).*

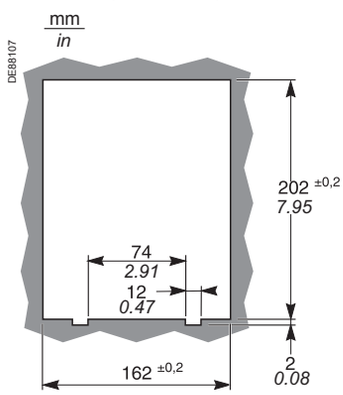
Cut-out

Cut-out accuracy must be complied with to ensure good withstand.

For mounting plate between 1.5 mm (0.059 in) and 3 mm (0.12 in) thick



For mounting plate 3.17 mm (0.125 inch) thick



⚠ CAUTION

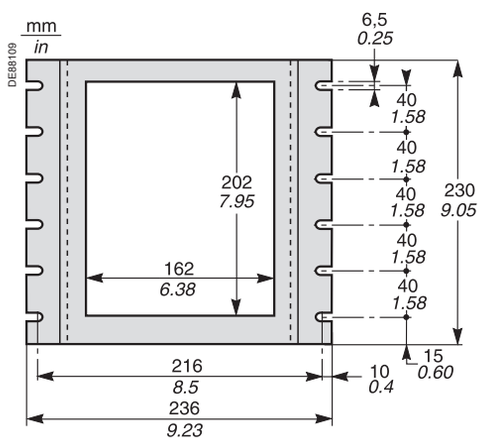
HAZARD OF CUTS

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

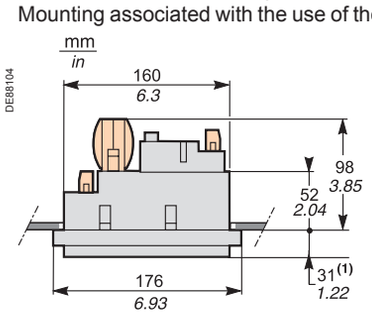
Failure to follow this instruction can cause serious injury.

Assembly with AMT840 mounting plate

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



AMT840 mounting plate.



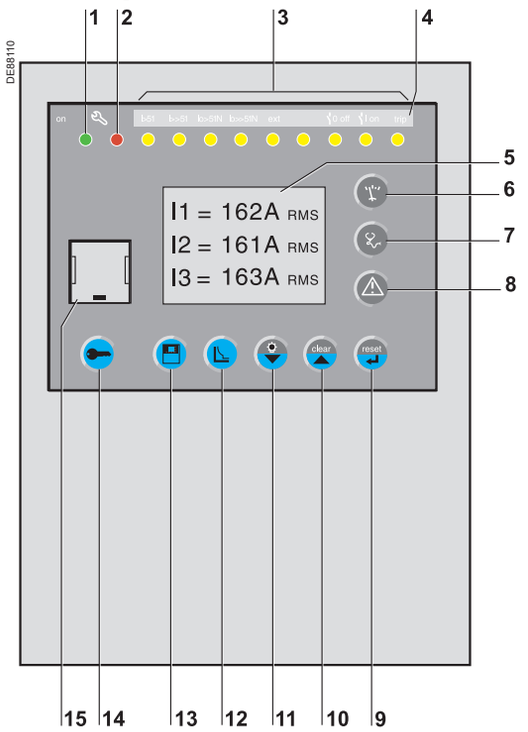
Sepam with basic UMI and MES114, mounted with AMT840 plate.
Mounting plate thickness: 2 mm (0.079 in).

Base unit
Description

Front panel with advanced UMI

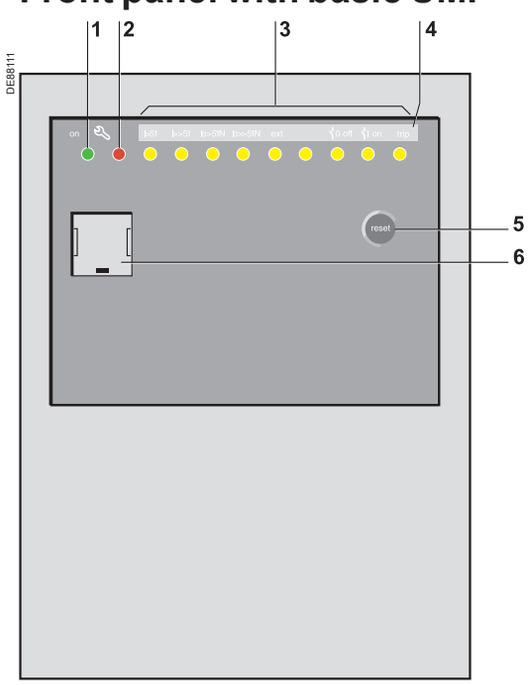
1 Green LED: Sepam on.
2 Red LED: Sepam unavailable.
3 9 yellow indication LEDs.
4 Label identifying the indication LEDs.
5 Graphical LCD screen.
6 Display of measurements.
7 Display of switchgear, network and machine diagnosis data.
8 Display of alarm messages.
9 Sepam reset (or confirm data entry).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

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



Front panel with basic UMI

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



Base unit
Description

Rear panel - Sepam series 20

1 Base unit.

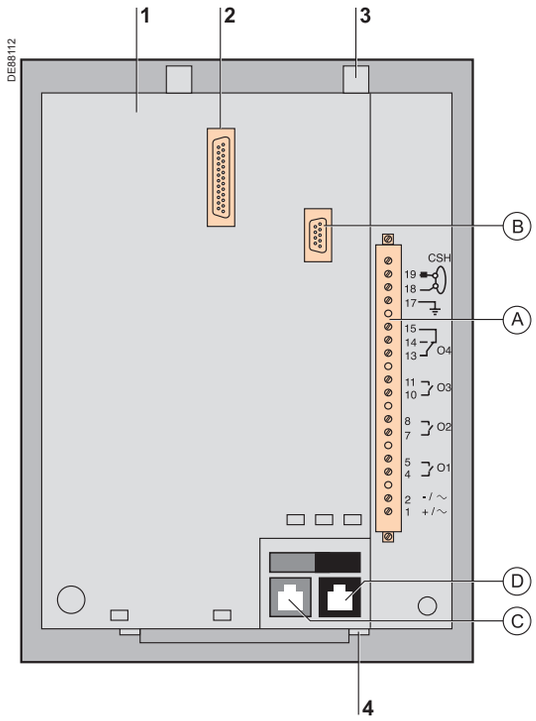
A 20-pin connector for:
- auxiliary power supply
- 4 relay outputs
- 1 residual current input (Sepam S20, S23, T20, T23, M20 only).

B
- Sepam S20, S23, T20, T23, M20: connector for 3 phase current I1, I2, I3 inputs and residual current
- Sepam B21 and B22: connector for 3 phase voltage V1, V2, V3 inputs and 1 residual voltage V0 input.

C Communication port.

D Remote module connection port.

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



Rear panel - Sepam series 40

1 Base unit.

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

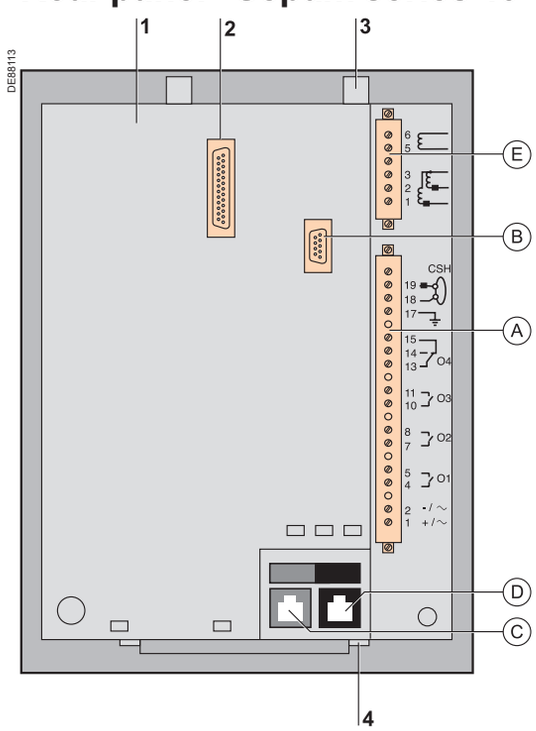
B Connector for 3 phase current I1, I2, I3 inputs and residual current

C Communication port.

D Remote module connection port .

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

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



Base unit
Technical characteristics

Weight

Sepam series 20	Minimum weight (base unit with basic UMI and without MES114)	1.2 kg (2.6 lb)
	Maximum weight (base unit with advanced UMI and MES114)	1.7 kg (3.7 lb)
Sepam series 40	Minimum weight (base unit with basic UMI and without MES114)	1.4 kg (3.1 lb)
	Maximum weight (base unit with advanced UMI and MES114)	1.9 kg (4.2 lb)

Analog inputs

Current transformer	Input impedance	< 0.02 Ω
1 A or 5 A CT (with CCA630 or CCA634)	Consumption	< 0.02 VA at 1 A
1 A to 6250 A ratings		< 0.5 VA at 5 A
	Rated thermal withstand	4 In
	1-second overload	100 In (≤ 500 A)
Voltage transformer	Input impedance	> 100 k Ω
220 V to 250 kV ratings	Input voltage	100 to 230/√3 V
	Rated thermal withstand	240 V
	1-second overload	480 V

Temperature sensor input (MET148-2 module)

Type of sensor	Pt 100	Ni 100 / 120
Isolation from earth	None	None
Current injected in sensor	4 mA	4 mA
Maximum distance between sensor and module	1 km (0.62 mi)	-

Logic inputs

		MES114	MES114E		MES114F	
Voltage		24 to 250 V DC	110 to 125 V DC	110 V AC	220 to 250 V DC	220 to 240 V AC
Range		19.2 to 275 V DC	88 to 150 V DC	88 to 132 V AC	176 to 275 V DC	176 to 264 V AC
Frequency		-	-	47 to 63 Hz	-	47 to 63 Hz
Typical consumption		3 mA	3 mA	3 mA	3 mA	3 mA
Typical switching threshold		14 V DC	82 V DC	58 V AC	154 V DC	120 V AC
Input limit voltage	At state 1	≥ 19 V DC	≥ 88 V DC	≥ 88 V AC	≥ 176 V DC	≥ 176 V AC
	At state 0	≤ 6 V DC	≤ 75 V DC	≤ 22 V AC	≤ 137 V DC	≤ 48 V AC
Isolation of inputs in relation to other isolated groups		Enhanced	Enhanced	Enhanced	Enhanced	Enhanced

Relays outputs

Control relay outputs (O1, O2, O3, O11 contacts) (2)

Voltage	DC	24 / 48 V DC	127 V DC	220 V DC	250 V DC	-
	AC (47.5 to 63 Hz)	-	-	-	-	100 to 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	-
	L/R load < 20 ms	6 / 2 A	0.5 A	0.2 A	-	-
	L/R load < 40 ms	4 / 1 A	0.2 A	0.1 A	-	-
	Resistive load	-	-	-	-	8 A
	p.f. load > 0.3	-	-	-	-	5 A
Making capacity		< 15 A for 200 ms				
Isolation of outputs in relation to other isolated groups		Enhanced				

Annunciation relay output (O4, O12, O13, O14 contacts)

Voltage	DC	24 / 48 V DC	127 V DC	220 V DC	250 V DC	-
	AC (47.5 to 63 Hz)	-	-	-	-	100 to 240 V AC
Continuous current		2 A	2 A	2 A	2 A	2 A
Breaking capacity	Resistive load	2 / 1 A	0.6 A	0.3 A	0.2 A	-
	L/R load < 20 ms	2 / 1 A	0.5 A	0.15 A	0.2 A (3)	-
	p.f. load > 0.3	-	-	-	-	1 A
Isolation of outputs in relation to other isolated groups		Enhanced				

Power supply

Voltage		24 / 250 V DC	110 / 240 V AC
Range		-20 % +10 %	-20 % +10 % (47.5 to 63 Hz)
Deactivated consumption (1)	Sepam series 20	< 4.5 W	< 9 VA
	Sepam series 40	< 6 W	< 6 VA
Maximum consumption (1)	Sepam series 20	< 8 W	< 15 VA
	Sepam series 40	< 11 W	< 25 VA
Inrush current	Sepam series 20, serie 40	< 10 A for 10 ms, < 28 A for 100 µs	< 15 A for first half-period
Acceptable momentary outages	Sepam series 20	10 ms	10 ms
	Sepam series 40	20 ms	20 ms

Analog output (MSA141 module)

Current	4 - 20 mA, 0 - 20 mA, 0 - 10 mA, 0 - 1 mA
Load impedance	< 600 Ω (wiring included)
Accuracy	0.50 % PE or 0,01 mA

(1) *According to configuration.*
(2) *Relay outputs comply with clause 6.7 of standard C37.90 (30 A, 200 ms, 2000 operations).*
(3) *Sepam series 20 only.*

Base unit
Environmental characteristics

Electromagnetic compatibility	Standard	Level / Class	Value
Emission tests			
Disturbing field emission	IEC 60255-25		
	EN 55022	A	
Conducted disturbance emission	IEC 60255-25		
	EN 55022	B	
Immunity tests – Radiated disturbances			
Immunity to radiated fields	IEC 60255-22-3		10 V/m ; 80 MHz - 1 GHz
	IEC 61000-4-3	III	10 V/m ; 80 MHz - 2 GHz
	ANSI C37.90.2 (2004)		20 V/m ; 80 MHz - 1 GHz
Electrostatic discharge	IEC 60255-22-2		8 kV air ; 6 kV contact
	ANSI C37.90.3		8 kV air ; 4 kV contact
Immunity to magnetic fields at network frequency	IEC 61000-4-8	IV	30 A/m (continuous) - 300 A/m (13 s)
Immunity tests – Conducted disturbances			
Immunity to conducted RF disturbances	IEC 60255-22-6		10 V
Immunity to conducted disturbances in common mode from 0 Hz to 150 kHz	IEC 61000-4-16	III	
Fast transient bursts	IEC 60255-22-4	A or B	4 kV ; 2.5 kHz / 2 kV ; 5 kHz
	IEC 61000-4-4	IV	4 kV ; 2.5 kHz
	ANSI C37.90.1		4 kV ; 2.5 kHz
1 MHz damped oscillating wave	IEC 60255-22-1	III	2.5 kV MC ; 1 kV MD
	ANSI C37.90.1		2.5 kV MC and MD
100 kHz damped oscillating wave	IEC 61000-4-12		2.5 kV MC ; 1 kV MD
Surges	IEC 61000-4-5	III	2 kV MC
Voltage interruptions	IEC 60255-11		Series 20: 100 %, 10 ms Series 40: 100 %, 20 ms

Mechanical robustness	Standard	Level / Class	Value
In operation			
Vibrations	IEC 60255-21-1	2	1 Gn ; 10 Hz - 150 Hz
	IEC 60068-2-6	Fc	3 Hz - 13.2 Hz ; a = ±1 mm (±0.039 In)
	IEC 60068-2-64	2M1	
Shocks	IEC 60255-21-2	2	10 Gn / 11 ms
Earthquakes	IEC 60255-21-3	2	2 Gn (horizontal axes)
			1 Gn (vertical axes)
De-energized			
Vibrations	IEC 60255-21-1	2	2 Gn ; 10 Hz - 150 Hz
Shocks	IEC 60255-21-2	2	30 Gn / 11 ms
Jolts	IEC 60255-21-2	2	20 Gn / 16 ms

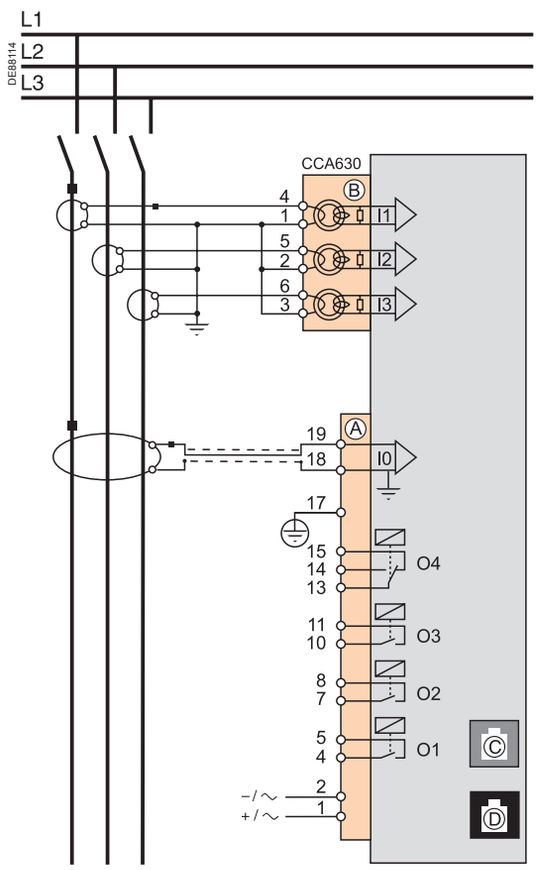
Climatic withstand	Standard	Level / Class	Value
In operation			
Exposure to cold	IEC 60068-2-1	Series 20: Ab Series 40: Ad	-25 °C (-13 °F)
Exposure to dry heat	IEC 60068-2-2	Series 20: Bb Series 40: Bd	+70 °C (+158 °F)
Continuous exposure to damp heat	IEC 60068-2-3	Ca	10 days ; 93 % RH ; 40 °C (104 °F)
Temperature variation with specified variation rate	IEC 60068-2-14	Nb	–25 °C to +70 °C (-13 °F to +158 °F) 5 °C/min (41 °F/min)
Salt mist	IEC 60068-2-52	Kb/2	
Influence of corrosion/gaz test 2	IEC 60068-2-60	C	21 Days, 75% RH, 25°C, 500.10-9 vol/vol H_2S; 1000.10-9 vol/vol SO^2
Influence of corrosion/gaz test 4	IEC 60068-2-60	Method 3	21 Days, 75% RH, 25°C, 10+/-5 H^2S; 200+/-20 SO^2 ; 200+/-20 NO^2, 10+/-5 Cl^2 (10-9 vol/vol)
	EIA 364-65A	IIIA	42 days, 75% RH, 30°C, 100+/-20 H^2S; 200+/-50 SO^2 ; 200+/-50 NO^2, 20+/-5 Cl^2 (10-9 vol/vol)
In storage (3)			
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 60068-2-3	Ca	56 days ; 93 % RH ; 40 °C (104 °F)

Safety	Standard	Level / Class	Value
Enclosure safety tests			
Front panel tightness	IEC 60529	IP52	Other panels closed, except for rear panel IP20
	NEMA	Type 12	
Fire withstand	IEC 60695-2-11		650 °C with glow wire (1562 °F)
Electrical safety tests			
1.2/50 µs impulse wave	IEC 60255-5		5 kV (1)
Power frequency dielectric withstand	IEC 60255-5		2 kV 1 mn (2)
Certification			
CE	Harmonized standard: EN 50263	■ European Electromagnetic Compatibility Directive (EMCD) 2004 / 108 / EC of 15 December 2004 ■ European Low Voltage Directive (LVD) 2006/95/CE of 12 December 2006	
UL - c UL us	UL508 - CSA C22.2 n° 14-95		File E212533
CSA	CSA C22.2 n° 14-95 / n° 94-M91 / n° 0.17-00		File 210625

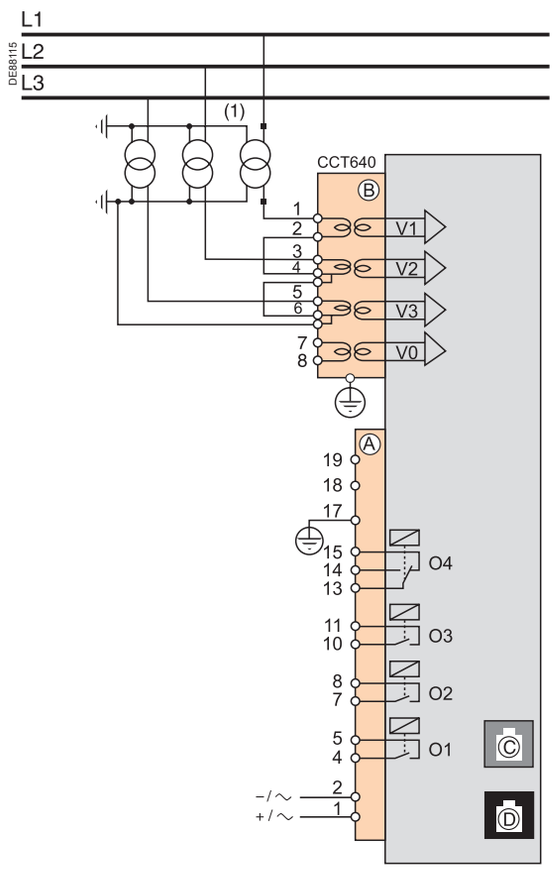
(1) *Except for communication: 3 kV in common mode and 1kV in differential mode*
(2) *Except for communication: 1 kVrms*
(3) *Sepam must be stored in its original packing.*

Base unit
Sepam series 20

Sepam S20, S23, T20, T23 and M20



Sepam B21 and B22



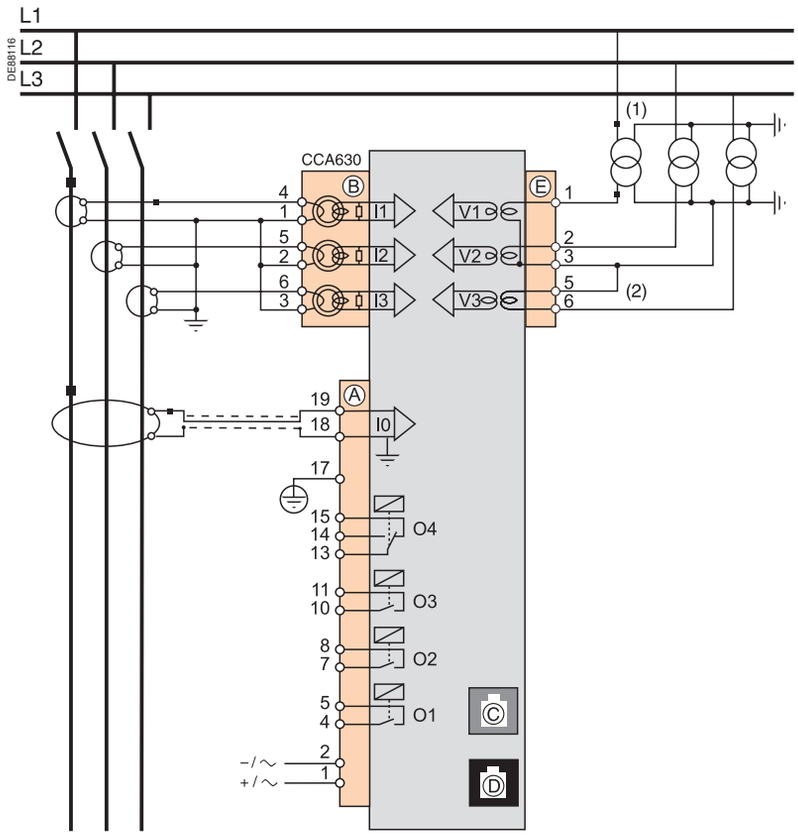
(1) This type of connection allows the calculation of residual voltage.

Connection

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

Connector	Type	Reference	Wiring
(A)	Screw type	CCA620	■ wiring with no fittings: □ 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 Telemecanique fittings: - DZ5CE015D for 1 x 1.5 mm² wire - DZ5CE025D for 1 x 2.5 mm² wire - AZ5DE010D for 2 x 1 mm² wires □ tube length: 8.2 mm □ stripped length: 8 mm
	6.35 mm ring lugs	CCA622	■ 6.35 mm ring or spade lugs (1/4 in) ■ 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: 0.7 to 1 Nm
(B) For Sepam S20, S23, T20, T23 and M20	4 mm ring lugs	CCA630, CCA634 for connection of 1 A or 5 A CTs	■ wire cross-section of 1.5 to 6 mm² (AWG 16-10) ■ tightening torque: 1.2 Nm (13.27 lb-in)
	RJ45 plug	CCA670, for connection of 3 LPCT sensors	Integrated with LPCT sensor
(B) For Sepam B21 and B22	Screw type	CCT640	Same as wiring for the CCA620
(C)	White RJ45 plug		CCA612
(D)	Black RJ45 plug		CCA770: L = 0.6 m (2 ft) CCA772: L = 2 m (6.6 ft) CCA774: L = 4 m (13 ft)

Base unit
Sepam series 40



(1) *This type of connection allows the calculation of residual voltage.*
(2) *Accessory for bridging terminals 3 and 5 supplied with CCA626 and CCA627 connector.*

Connection

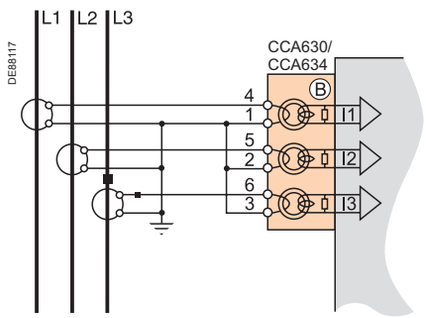
Dangerous voltages may be present on the terminal screws, whether the terminals are used or not. To avoid all danger of electrical shock, tighten all terminal screws so that they cannot be touched inadvertently.

Connector	Type	Reference	Wiring
(A)	Screw type	CCA620	■ wiring with no fittings: □ 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 Telemecanique fittings: - DZ5CE015D for 1 x 1.5 mm² wire - DZ5CE025D for 1 x 2.5 mm² wire - AZ5DE010D for 2 x 1 mm² wires □ tube length: 8.2 mm □ stripped length: 8 mm
	6.35 mm ring lugs	CCA622	■ 6.35 mm ring or spade lugs (1/4 in) ■ 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: 0.7 to 1 Nm
(B)	4 mm ring lugs	CCA630, CCA634, for connection of 1 A or 5 A CTs	■ wire cross-section of 1.5 to 6 mm² (AWG 16-10) ■ tightening torque: 1.2 Nm (13.27 lb-in)
	RJ45 plug	CCA670, for connection of 3 LPCT sensors	Integrated with LPCT sensor
(C)	White RJ45 plug		CCA612
(D)	Black RJ45 plug		CCA770: L = 0.6 m (2 ft) CCA772: L = 2 m (6.6 ft) CCA774: L = 4 m (13 ft)
(E)	Screw type	CCA626	Same as wiring for the CCA620
	6.35 mm ring lugs	CCA627	Same as wiring for the CCA622

Base unit

Other phase current input connection schemes

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



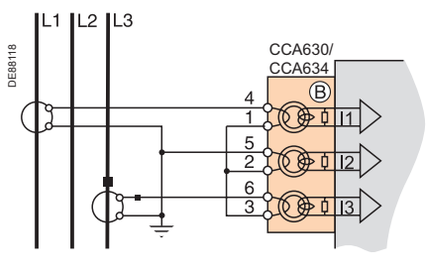
Description
Connection of 3 x 1 A or 5 A sensors to the CCA630 or CCA634 connector.

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



Description
Connection of 2 x 1 A or 5 A sensors to the CCA630 or CCA634 connector.

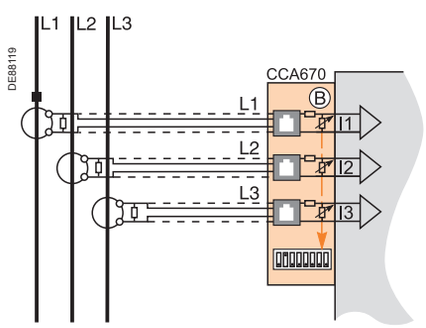
The measurement of phase currents 1 and 3 is sufficient to ensure all the phase current-based protection functions.
The phase current I2 is only assessed for metering functions, assuming that I0 = 0.

This arrangement does not allow the calculation of residual 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



Description
Connection of 3 Low Power Current Transducer (LPCT) type sensors to the CCA670 connector. The connection of only one or two LPCT sensors is not allowed and causes Sepam to go into fail-safe position.

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

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 2 twice:*

- *Software parameter setting using the advanced UMI or the SFT2841 software tool*
- *Hardware parameter setting using microswitches on the CCA670 connector*

Base unit
Other residual current input connection schemes

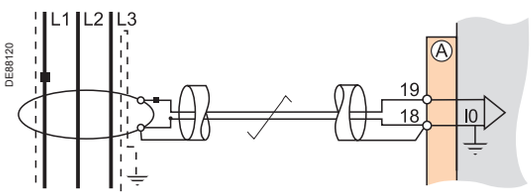
Variant 1: residual current calculation by sum of 3 phase currents

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

Parameters

Residual current	Rated residual current	Measuring range
Sum of 3 Is	In0 = In, CT primary current	0.1 to 40 In0

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

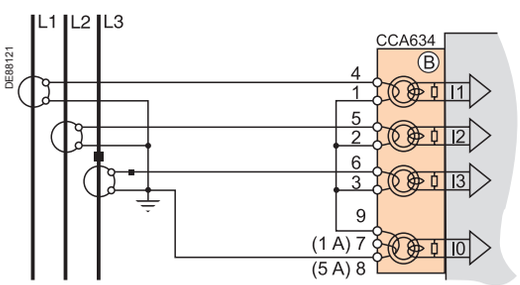


Description
Arrangement recommended for the protection of isolated or compensated neutral systems, in which very low fault currents need to be detected.

Parameters

Residual current	Rated residual current	Measuring range
2 A rating CSH	In0 = 2 A	0.2 to 40 A
5 A rating CSH (Sepam series 40)	In0 = 5 A	0.5 to 100 A
20 A rating CSH	In0 = 20 A	2 to 400 A

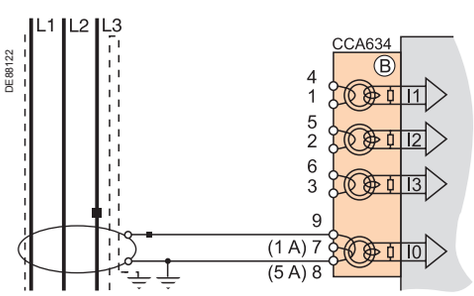
Variant 3: residual current measurement by 1 A or 5 A CTs and CCA634



Description
Residual current measurement by 1 A or 5 A CTs.
- Terminal 7: 1 A CT
- Terminal 8: 5 A CT

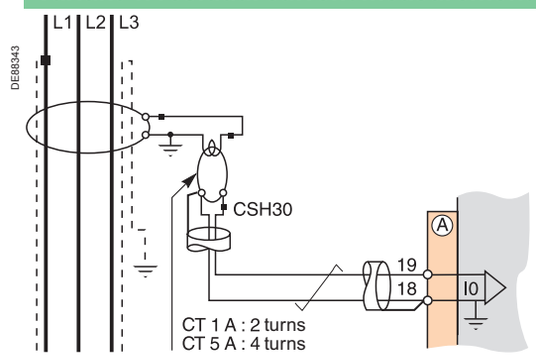
Parameters

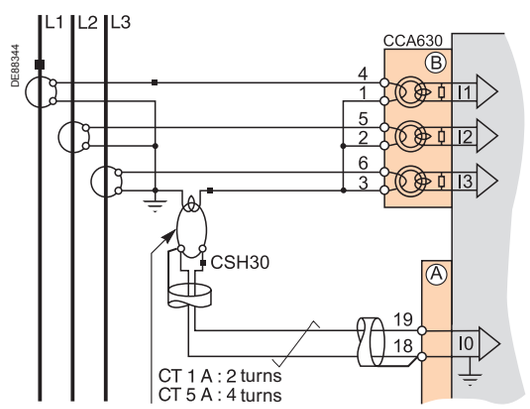
Residual current	Rated residual current	Measuring range
1 A CT	In0 = In, CT primary current	0.1 to 20 In0
1 A CT sensitive	In0 = In/10 (Sepam series 40)	0.1 to 20 In0
5 A CT	In0 = In, CT primary current	0.1 to 20 In0
5 A CT sensitive	In0 = In/10 (Sepam series 40)	0.1 to 20 In0



Base unit
Other residual current input connection schemes

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





Description

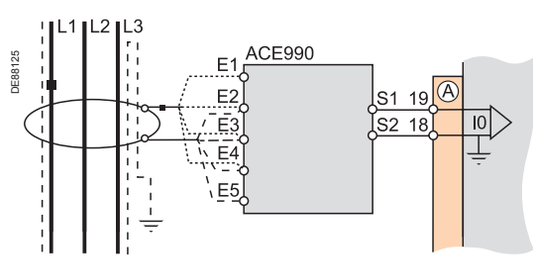
The CSH30 interposing ring CT is used to connect 1 A or 5 A CTs to Sepam to measure residual current:

- connection of CSH30 interposing ring CT to 1 A CT: make 2 turns through CSH primary
- connection of CSH30 interposing ring CT to 5 A CT: make 4 turns through CSH primary.
- for Sepam series 40, the sensitivity can be mulitplied by 10 using the "sensitive" setting with In0 = In/10.

Parameters

Residual current	Rated residual current	Measuring range
1 A CT	In0 = In, CT primary current	0.1 to 20 In0
1 A CT sensitive	In0 = In/10 (Sepam series 40)	0.1 to 20 In0
5 A CT	In0 = In, CT primary current	0.1 to 20 In0
5 A CT sensitive	In0 = In/10 (Sepam series 40)	0.1 to 20 In0

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 an MV core balance CT with a ratio of 1/n (50 < n < 1500) and the Sepam residual current input.
This arrangement allows the continued use of existing core balance CTs on the installation.

Parameters

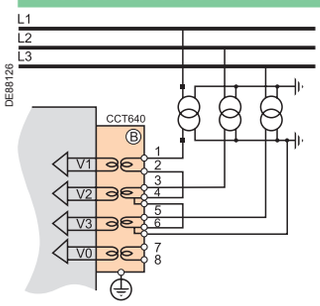
Residual current	Rated residual current	Measuring range
ACE990 - range 1 (0.00578 ≤ k ≤ 0.04)	In0 = Ik.n(1)	0.1 to 20 In0
ACE990 - range 2 (0.0578 ≤ k ≤ 0.26316)	In0 = Ik.n(1)	0.1 to 20 In0

(1) *n = number of core balance CT turns*
k = factor to be determined according to ACE990 wiring and setting range used by Sepam

Voltage inputs
Sepam series 20

The phase and residual voltage transformer secondary circuits are connected to the CCT640 connector (item Ⓑ) on Sepam series 20 type B units. The CCT640 connector contains 4 transformers which perform isolation and impedance matching of the VTs and Sepam input circuits.

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



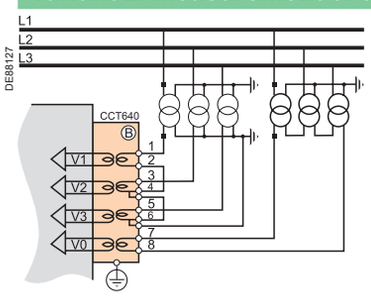
Parameters

Voltages measured by VTs	V1, V2, V3
Residual voltage	Sum of 3Vs

Functions available

Voltages measured	V1, V2, V3
Values calculated	U21, U32, U13, V0, Vd, f
Measurements available	All
Protection functions available (according to type of Sepam)	All

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



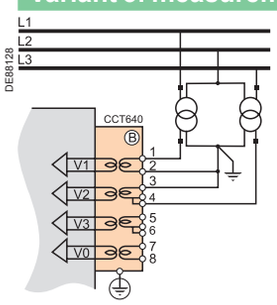
Parameters

Voltages measured by VTs	V1, V2, V3
Residual voltage	External VT

Functions available

Voltages measured	V1, V2, V3, V0
Values calculated	U21, U32, U13, Vd, f
Measurements available	All
Protection functions available (according to type of Sepam)	All

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



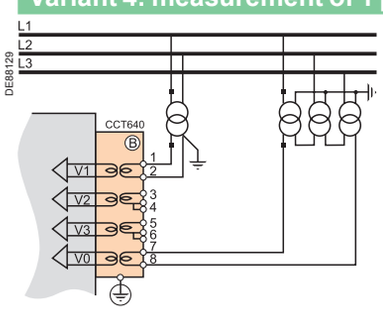
Parameters

Voltages measured by VTs	U21, U32
Residual voltage	None

Functions available

Voltages measured	V1, V2, V3
Values calculated	U13, Vd, f
Measurements available	U21, U32, U13, Vd, f
Protection functions available (according to type of Sepam)	All except 59N, 27S

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



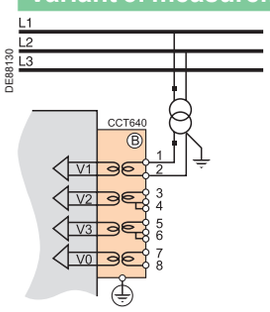
Parameters

Voltages measured by VTs	U21
Residual voltage	External VT

Functions available

Voltages measured	U21, V0
Values calculated	f
Measurements available	U21, V0, f
Protection functions available (according to type of Sepam)	All except 47, 27D, 27S

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



Parameters

Voltages measured by VTs	U21
Residual voltage	None

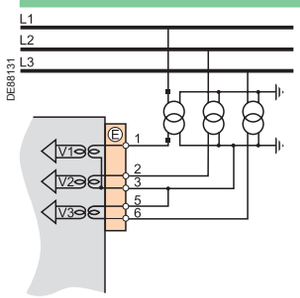
Functions available

Voltages measured	U21
Values calculated	f
Measurements available	U21, f
Protection functions available (according to type of Sepam)	All except 47, 27D, 59N, 27S

Voltage inputs
Sepam series 40

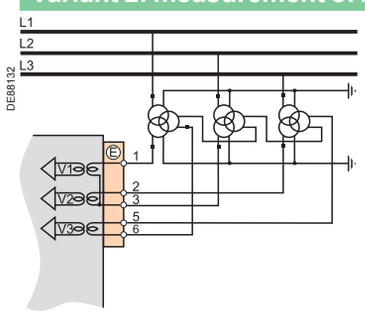
The phase and residual voltage transformer secondary circuits are connected directly to the connector marked (E).
The 3 impedance matching and isolation transformers are integrated in the Sepam series 40 base unit.

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



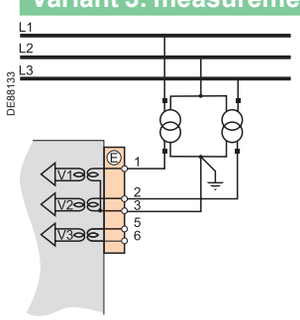
Phase voltage sensor parameter setting	3V
Residual voltage sensor parameter setting	3V sum
Voltages measured	V1, V2, V3
Values calculated	U21, U32, U13, V0, Vd, Vi, f
Measurements unavailable	None
Protection functions unavailable (according to type of Sepam)	None

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



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

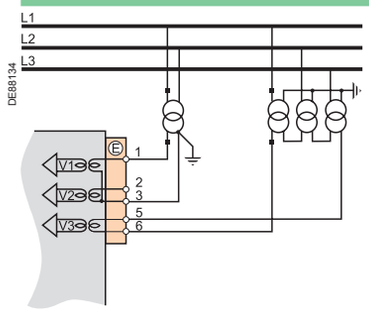
Variant 3: measurement of 2 phase-to-phase voltages



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

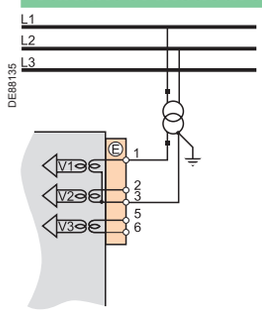
Voltage inputs
Sepam series 40

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



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

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



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