Protection
and control

Sepam range
Sepam 1000+
Installation
Use
Commissioning

Merlin Gerin
Modicon
Square D
Telemecanique

Schneider Electric

Contents

Caution

Storage

Sepam 1000+ may be stored in its original packaging in a closed sheltered location:
- ambient temperature comprised between -25°C to +70°C, -13°F to +160°F,
- humidity ⩽ 90%.

Periodic checking of the environment and packaging on a yearly basis is recommended.

Installation and commissioning

Once installed, Sepam 1000+ must be energized as soon as possible, especially in damp locations with more than 90% humidity.

Storage of Sepam unenergized and unpackaged for long periods may damage the unit.

We recommend that you follow the instructions given in this document for quick and correct installation of your Sepam 1000+:
- equipment identification,
- assembly,
- connection of current inputs, or connection of voltage inputs,
- connection of optional modules,
- connection of power supply and earth,
- checking prior to commissioning.

:

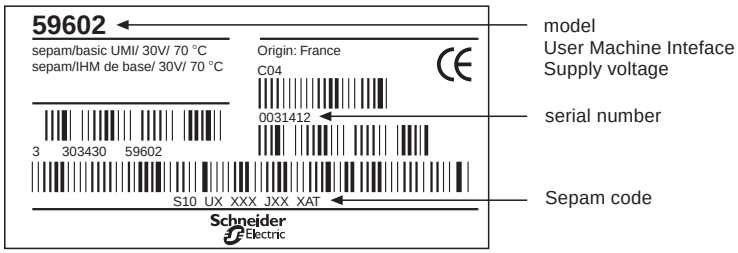
Identification

Each Sepam 1000+ comes in a single package which contains the base unit and connector.

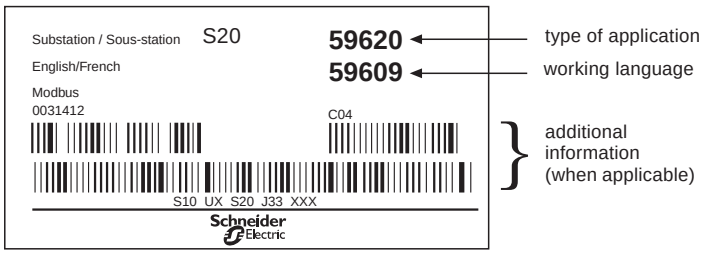
The other optional accessories such as modules, current or voltage input connectors and cords come in separate packages.

To identify a Sepam 1000+, check the label on the right side panel which describes the functional and hardware features of the product.

■ Hardware reference and designation

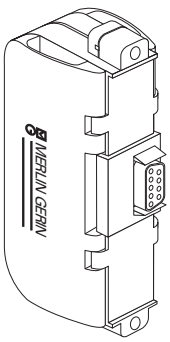


■ Software reference and designation

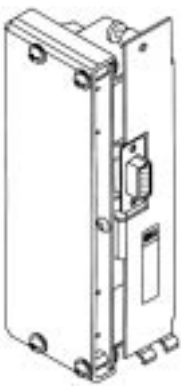


Each Sepam 1000+ base unit comes with the following connectors:

CCA 630* connector (S20, T20, M20)



CCT 640 connector (B21, B22)



The other connectors come mounted and screw-locked on the modules.

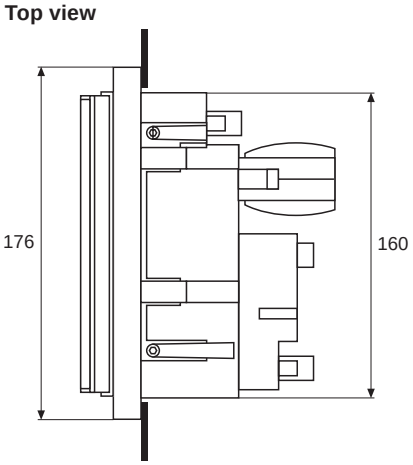
* or CCA 670 connector for LPCT sensors.

Sepam 1000+ base unit mounting

The Sepam is simply flush-mounted and clipped in the panel, without requiring any additional screw type fastening.

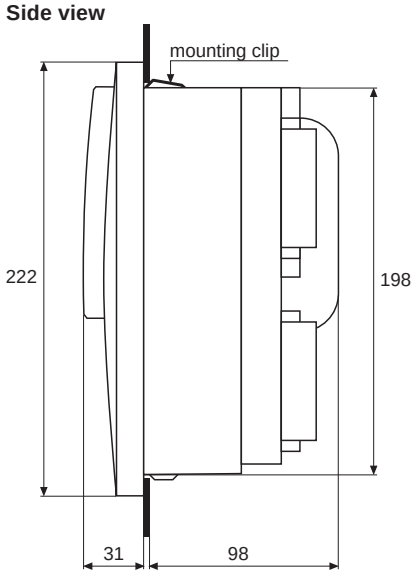
Flush-mounting in front panel

Top view

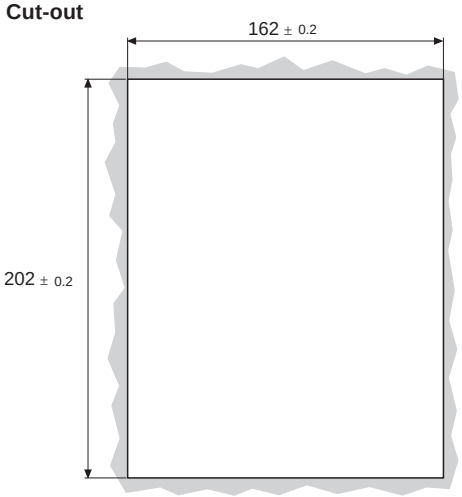


Assembly shown with advanced UMI and optional MES 114 module.
Weight = approx. 1.6 kg.

Side view



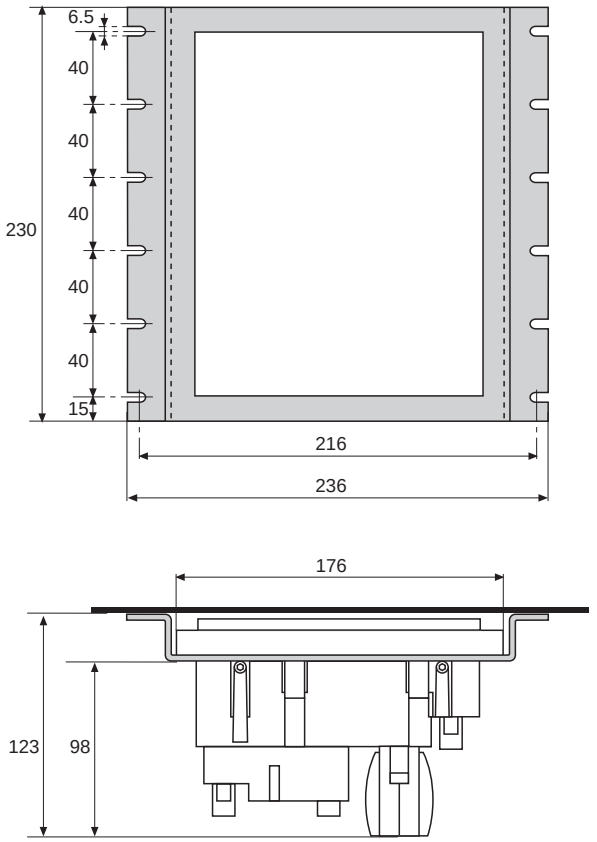
Cut-out



Support plate thickness < 3 mm.

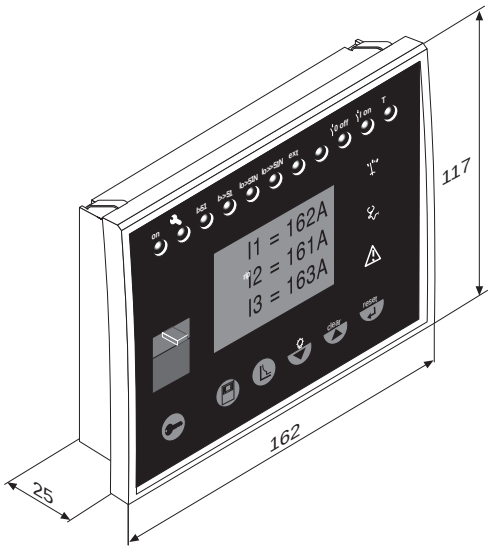
“Terminal block” assembly with AMT 840 plate
Used to mount the Sepam 1000+ at the back of the compartment with access to connectors on the rear panel.

Assembly associated with the use of the remote advanced UMI (DSM 303).



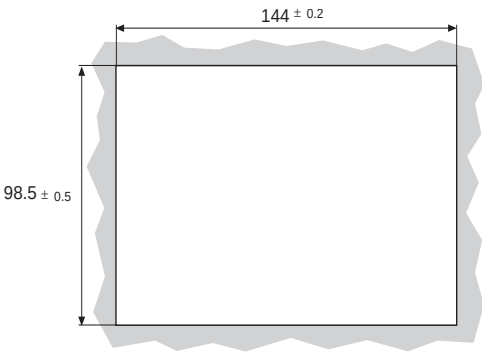
Assembly of the DSM 303 module in the front panel

The module is simply flush-mounted and clipped without requiring any additional screw type fastening.



Weight: approx. 0.3 kg
The depth with the connection cord is less than 30 mm.

Cut-out



Dimensions of the cut-out for flush-mounting
(support plate thickness < 3 mm).

Sepam 1000+ components

■ Base unit (1),

□ (A) base unit connector:

- power supply,
- output relay,
- input CSH 30, 120, 200 or ACE 990.

Screw type connector (CCA 620) represented, or ring lug connector (CCA 622).

□ (B) 1/5 A CT input current connector (CCA 630) or LPCT input current connector (CCA 670) or voltage input connector (CCT 640),

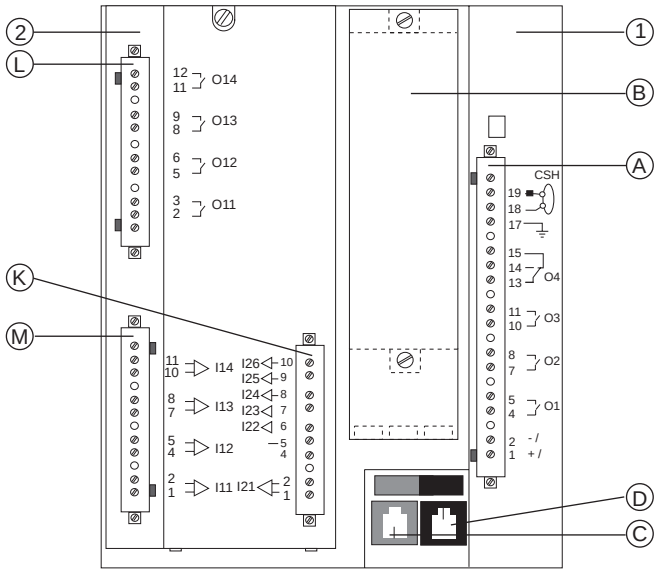
□ (C) communication module link connection (green),

□ (D) remote inter-module link connection (black),

■ (2) optional input/output modules (MES 108 or MES 114),

□ (L) (M) MES 108 or MES 114 module connectors,

□ (K) MES 114 module connector.



Connections

Base unit

The Sepam 1000+ connections are made to the removable connectors located on the rear of the device. All the connectors are screw-lockable.

CCA 670 and CCT 640 connectors installation on same principle as described for MES module.

Wiring of screw connectors:

■ without fitting:

□ maximum 1 wire cross-section of 0.2 to 2.5 mm² (≥ AWG 24-12) or 2 wires with maximum cross-section of 0.2 to 1 mm² (≥ AWG 24-16),

□ stripped length: 8 to 10 mm.

■ recommended wire fitting:

□ Telemecanique:
DZ5CE015D for 1 wire 1.5 mm²,
DZ5CE025D for 1 wire 2.5 mm²,
AZ5DE010D for 2 wires 1 mm²,

□ tube length: 8.2 mm,

□ stripped length: 8 mm.

Wiring of CCA 622 connector

■ ring lug 1/4" (6.35 mm).

Installation of the optional MES 108 or MES 114 module

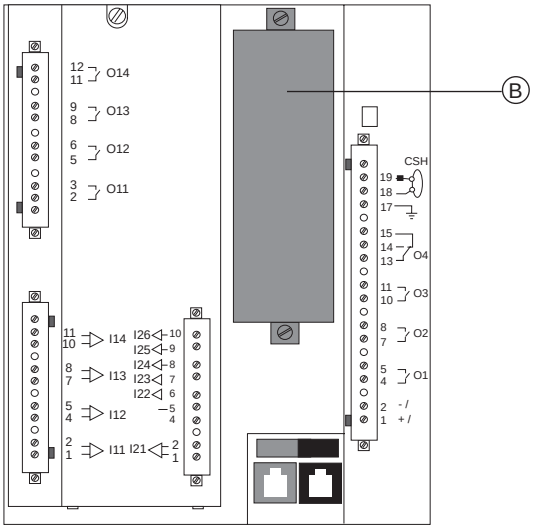
■ Insert the 2 pins on the MES module into the slots (1) on the base unit.

■ Push the module up against the unit to plug it into the connector (2).

■ Tighten the mounting screw (3).

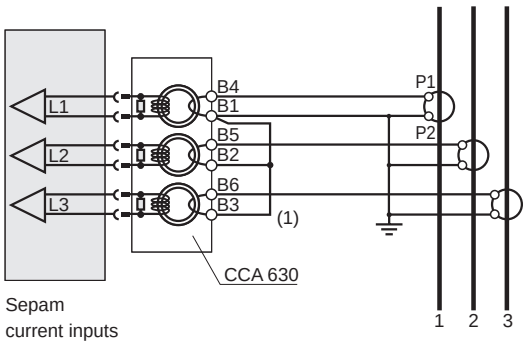
1 A or 5 A CT block and connection diagram

The current transformer (1 A or 5 A) secondary circuits are connected to the CCA 630 connector, item Ⓑ .



This connector contains 3 interposing ring CTs with through primaries, which ensure impedance matching and isolation between the 1 A or 5 A circuits and Sepam 1000+.

The connector may be disconnected with the power on since disconnection does not open the CT secondary circuits.



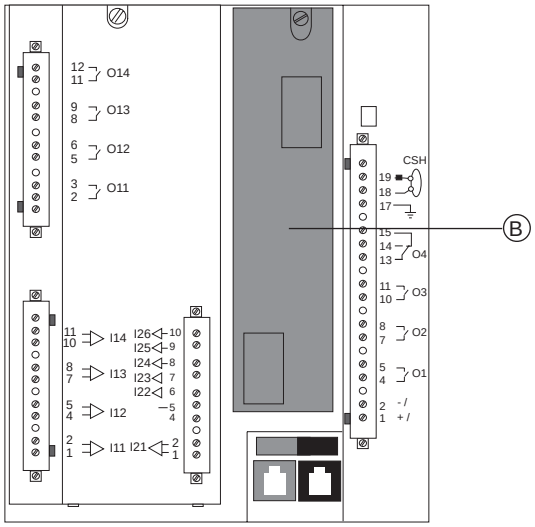
(1) bridging strap supplied with the CCA 630.

CCA 630 cabling

■ Open the 2 side shields for access to the connection terminals. The shields may be removed, if necessary, to facilitate wiring. If removed, replace them after wiring.
■ Remove the bridging strap, if necessary. The strap links terminals 1, 2 and 3.
■ Connect the wires using 4 mm ring lugs.
The connector accommodates wire with cross-sections of 1.5 to 6 mm^2 (AWG 16 to AWG 10).
■ Close the side shields.
■ Plug the connector into the 9-pin inlet on the rear of the device. Item Ⓑ .
■ Tighten the 2 CCA 630 connector fastening screws on the rear of Sepam 1000+.

LPCT sensor block and connection diagram

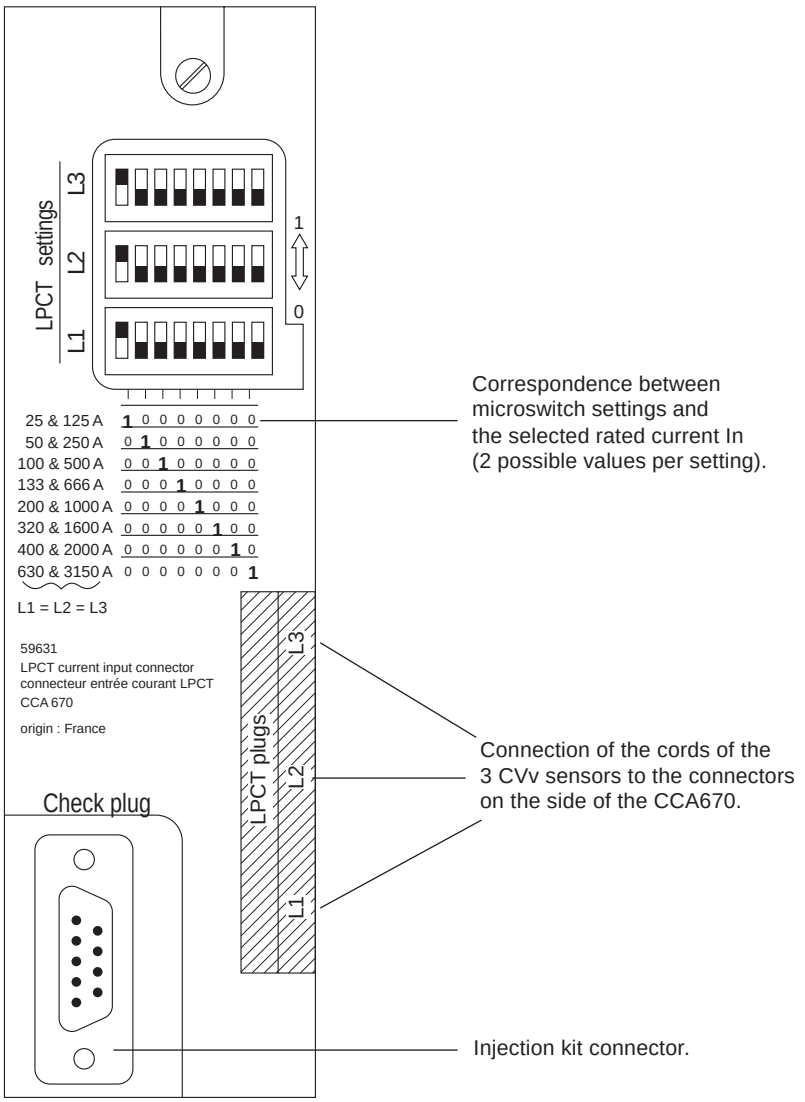
The LPCT current transformers (CVv 120 or CVv 200 sensors) are connected to the CCA 670 connector mounted on the rear panel of Sepam 1000+ item Ⓑ .



Setting up the connector

The CCA 670 connector should be calibrated when the Sepam 1000+ is commissioned according to the following instructions:

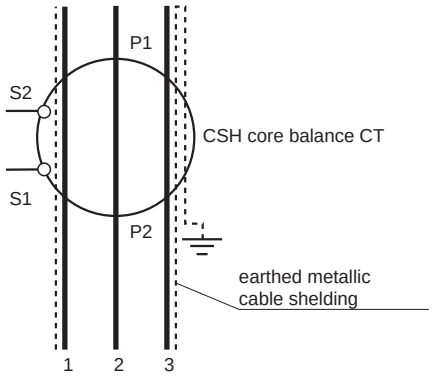
- use a screwdriver to remove the shield located in the “LPCT settings” zone; the shield protects 3 blocks of 8 microswitches marked L1, L2, L3,
- on the L1 block, set the microswitch for the selected rated current to “1”,
  - the rated current must be same as the one set up in Sepam (“General characteristics” menu via SFT 2841 software, “Current sensors” screen via advanced UMI),
  - leave the other 7 switches set to “0”,
- set the other 2 switch blocks L2 and L3 in the same position as the L1 block and close the shield again.



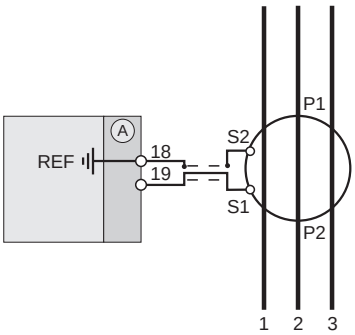
Use of CSH 120 and CSH 200 core balance CTs

The only difference between the CSH 120 and CSH 200 core balance CTs is their inner diameter (120 mm and 200 mm). Due to their low voltage isolation, they may only be used on cables.

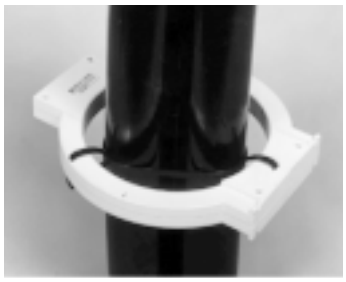
CSH 120 and CSH 200 connection diagram



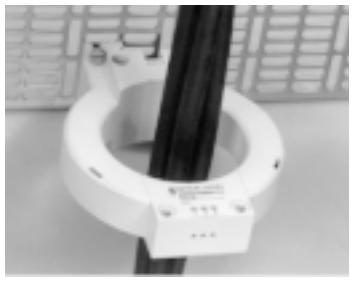
Cable shield earthing.



Assembly



Assembly on MV cables.

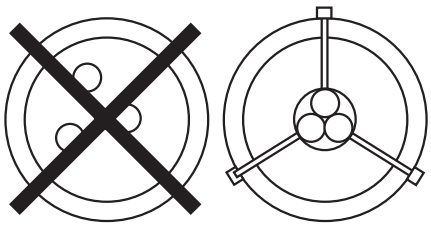


Assembly on mounting plate.

Group the MV cable (or cables) in the middle of the core balance CT.

Use non-conductive binding to hold the cable.

Remember to insert the 3 medium voltage cable shielding earthing cables through the core balance CT.



Cabling

The CSH 120 or CSH 200 core balance CT is connected to the Sepam 1000+ 20-pin connector (item Ⓐ).

Recommended cable:
- sheathed, shielded cable,
- min. cable cross-section 0.93 mm² (AWG 18),
- resistance per unit length < 100 mΩ/m,
- min. dielectric strength: 1000 V.

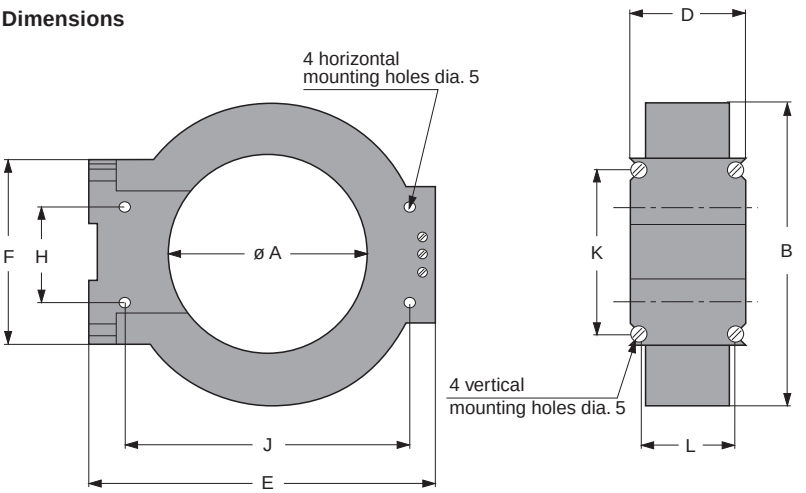
Connect the connector cable shielding in the shortest manner possible to terminal 18 on the Sepam 1000+.

Flatten the connection cable shielding against the metal frames of the cubicle.

The cable shielding is grounded in Sepam 1000+. Do not ground the cable by any other means.

The maximum resistance of the Sepam 1000+ connection wiring must not be more than 4 Ω.

Dimensions



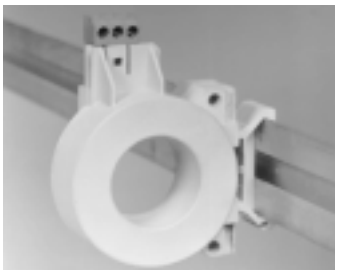
cotes (mm)									**weight**
CSH 120									0.6 kg
A	**B**	**D**	**E**	**F**	**H**	**J**	**K**	**L**	
120	164	44	190	76	40	166	62	35	
CSH 200									1.4 kg
200	256	46	274	120	60	257	104	37	

Use of CSH 30 interposing ring CT

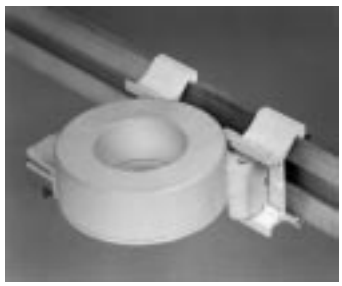
The CSH 30 interposing ring CT should be used when residual current is measured by a current transformer with a secondary circuit (1 A or 5 A). It acts as an interface between the current transformer and the Sepam 1000+ residual current input.

The CSH 30 interposing ring CT is mounted on a symmetrical DIN rail. It may also be mounted on a plate by means of the mounting holes in its base.

Assembly



Vertical mounting

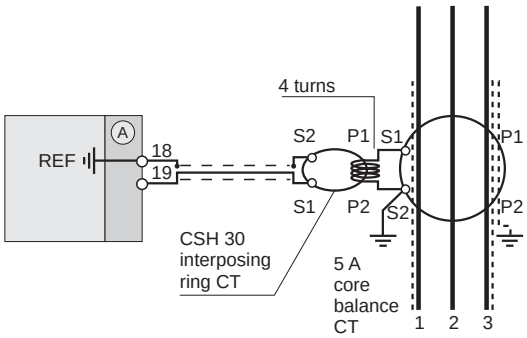


Horizonal mounting

Connection diagram

The CSH 30 is made to adapt to the type of 1 A or 5 A current transformer by the number of turns of the secondary wiring in the CSH 30 interposing ring CT:

- 5 A rating – 4 turns
- 1 A rating – 2 turns.



Example with 5 A CT.

Cabling

The secondary winding of the CSH 30 is connected to connector item Ⓐ .
Cable to be used:

- sheathed, shielded cable,
- min. cable cross-section 0.93 mm² (AWG 18) (maxi 2.5 mm²),
- resistance per unit length < 100 mΩ/m,
- min. dielectric strength: 1000 V.

It is essential for the CSH 30 interposing ring CT to be installed near Sepam 1000+ (Sepam CSH 30 link less than 2 m).

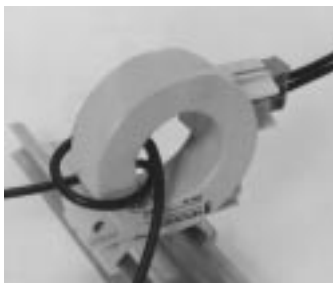
Flatten the cable against the metal frames of the cubicle.

The connection cable shielding is grounded in Sepam 1000+. Do not ground the cable by any other means.

Connection to 5 A secondary circuit

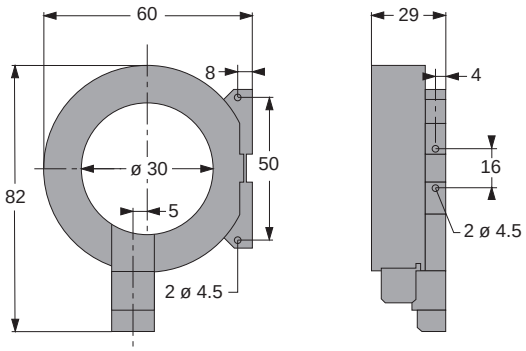
- Plug into the connector.
- Insert the transformer secondary wire through the CSH 30 interposing ring CT 4 times.

Connection to 1 A secondary circuit



- Plug into the connector.
- Insert the transformer secondary wire through the CSH 30 interposing ring CT twice.

Dimensions



weight: 0.12 kg

Use of ACE 990 interface

The ACE 990 is used to match the measurement of a MV core balance CT with ratio 1/n ($50 \le n \le 1500$), with that of the residual current input of Sepam 1000+.

So as not to downgrade measurement accuracy, the MV core balance CT must be able to supply sufficient power. The value is given in the chart opposite.

Connection

To wire the ACE 990 interface correctly, the following must be known:

- ratio of the core balance CT (1/n)
- core balance CT power,
- close approximation of Ino (1) rating.

The chart opposite may be used to determine the possible choices for the connection of the ACE 990 interface primary circuit to the Sepam 1000+ earth current input, as well as the Ino(1) setting.
The exact value of the rated Ino(1) to be set is given by the following formula:

Ino = k x number of core balance turns

where k is the factor defined in the chart opposite.

Example:

The core balance CT used has a ratio of 1/400 and power rating of 2 VA.
If the earth fault protection settings are between 0.5 A and 60 A, the rated Ino (1) used may be 5 A.

This value makes it possible to accurately measure from 0.5 A to 75 A.

- Calculate the following ratio:

$$\frac{\text{close approximation of Ino}}{\text{number of turns}}$$

i.e. 5/400 = 0.0125

- In the chart opposite, find the closest value of k.

A close value is k=0.01136.
It corresponds to core balance CTs that are supposed to deliver at least 0.1 VA of power.

- Calculate the value of Ino to be set:

Ino = 0.01136 x 400 = 4.5 A

This value of Ino may be used to monitor a current between 0.5 A and 67.5 A.

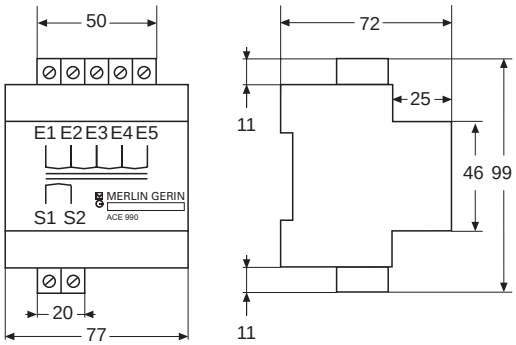
Characteristics

- Accuracy:
  - amplitude: ± 1 %,
  - phase: < 2°.
- Maximum permissible current: 20 kA, 1 s

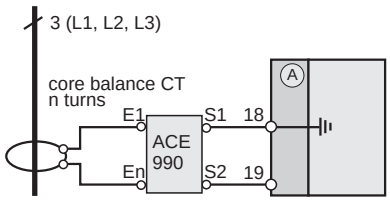
(on primary of MV core balance CT with ratio 1/50 which does not saturate).

- Operating temperature: - 5 °C to + 55 °C.
- Storage temperature: - 25 °C to + 70 °C.

(1): this is the current value for which the earth fault protection setting range extends to between 5% and 1500% of this value, at the most.
(2): rated residual current is set with 0.1 A resolution from advanced UMI and SFT 2841 ("General characteristics" menu)



Mounting on symmetrical DIN rail, weight 640 gr.



value of k	ACE 990 input	résidual current choice Sepam 1000+ (2)	Min power MV core balance CT
0.00578	E1 – E5	ACE 990 - range 1	0.1 VA
0.00676	E2 – E5	ACE 990 - range 1	0.1 VA
0.00885	E1 – E4	ACE 990 - range 1	0.1 VA
0.00909	E3 – E5	ACE 990 - range 1	0.1 VA
0.01136	**E2 – E4**	**ACE 990 -** range **1**	**0.1 VA**
0.01587	E1 – E3	ACE 990 - range 1	0.1 VA
0.01667	E4 – E5	ACE 990 - range1	0.1 VA
0.02000	E3 – E4	ACE 990 - range 1	0.1 VA
0.02632	E2 – E3	ACE 990 - range 1	0.1 VA
0.04000	E1 – E2	ACE 990 - range 1	0.2 VA
0.05780	E1 – E5	ACE 990 - range 2	2.5 VA
0.06757	E2 – E5	ACE 990 - range 2	2.5 VA
0.08850	E1 – E4	ACE 990 - range 2	3.0 VA
0.09091	E3 – E5	ACE 990 - range 2	3.0 VA
0.11364	E2 – E4	ACE 990 - range 2	3.0 VA
0.15873	E1 – E3	ACE 990 - range 2	4.5 VA
0.16667	E4 – E5	ACE 990 - range2	4.5 VA
0.20000	E3 – E4	ACE 990 - range 2	5.5 VA
0.26316	E2 – E3	ACE 990 - range 2	7.5 VA

Wiring

Only one core balance CT may be connected to the ACE 990 interface.

The secondary of the MV core balance CT is connected to 2 of the 5 inputs of the ACE 990 interface.

The cable coming from the core balance terminal marked S1 should be connected to the terminal with the lowest index (Ex).

Cables to be used:

- cable between core balance CT and ACE 990: length < 50 meters
- cable between ACE 990 and Sepam 1000+ shielded and encased (max. length = 2 meters),
- cable cross-section between 0.93 mm² (awg 18) and 2.5 mm² (awg 13),
- resistance per unit of length less than 100 mΩ / m,
- minimum dielectric strength: 100 V.

Connect the ACE 990 connection cable shielding in the shortest manner possible (max. 2 cm) to the pin 18 of connector Ⓐ.
Flatten the cable against the metallic frames of the cubicle.
The connection cable earthing is grounded in Sepam 1000+.
Do not ground the cable by any other means.

Connection of voltage inputs

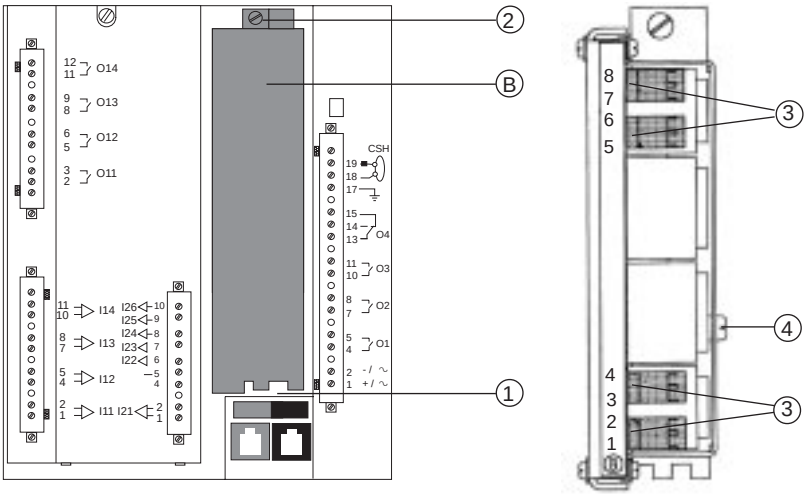
The phases and residual voltage transformers are connected to the CCT 640 Ⓑ of the Sepam B2X type.

Installation of CCT 640 connector

■ Position the 2 lugs located at the base of the connector CCT 640 in the holes ① on the base unit.
■ Press the connector to plug in the D-Sub 9 pins connector (same principle as MES module page 6).
■ Tighten the screw ②.

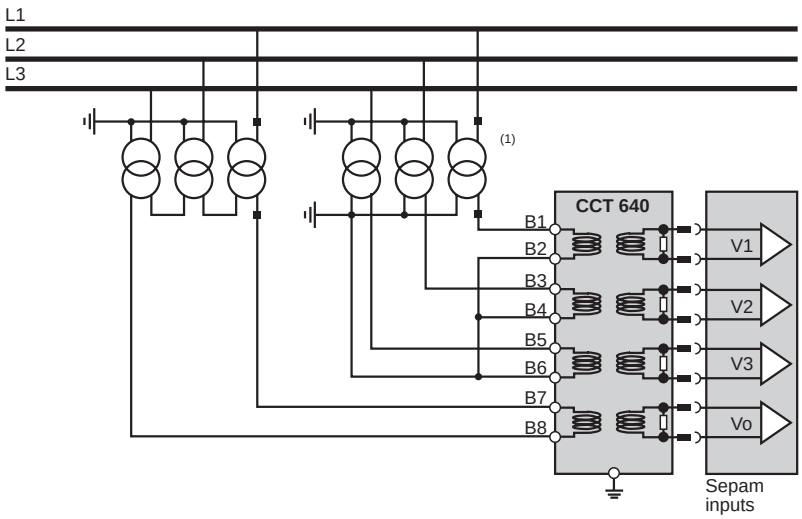
Connection

■ Connection are done on screw terminal at the back of the CCT 640 connector ③.
■ Refer to page 6 for cabling recommendation.
■ Earthing of CCT 640 (green/yellow cable and ring lug type connection) on screw ④.
(this connection insure electrical safety when the CCT640 is disconnected).



Principle

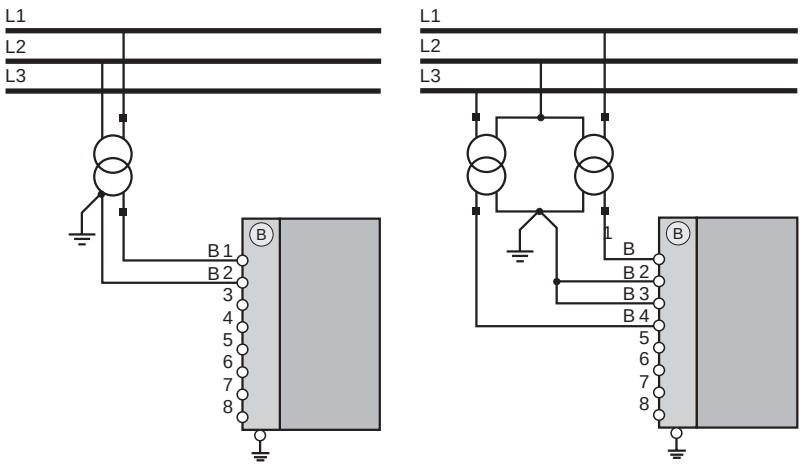
The connector includes 4 adaptation transformers.
Terminal B1 to B6 are dedicated for phases measurement (1).
Terminal B7 and B8 are dedicated to residual voltage measurement (schematic showed, not connected if residual voltage is computed by voltage summation).



Other connection schemes

Connection of 1 voltage transformer:
(does not allow use of positive sequence undervoltage or neutral voltage displacement protections or measurement of residual and positive sequence voltages).

Connection of 2 voltage transformers in V arrangement (does not allow use of neutral voltage displacement or measurement of residual voltage).

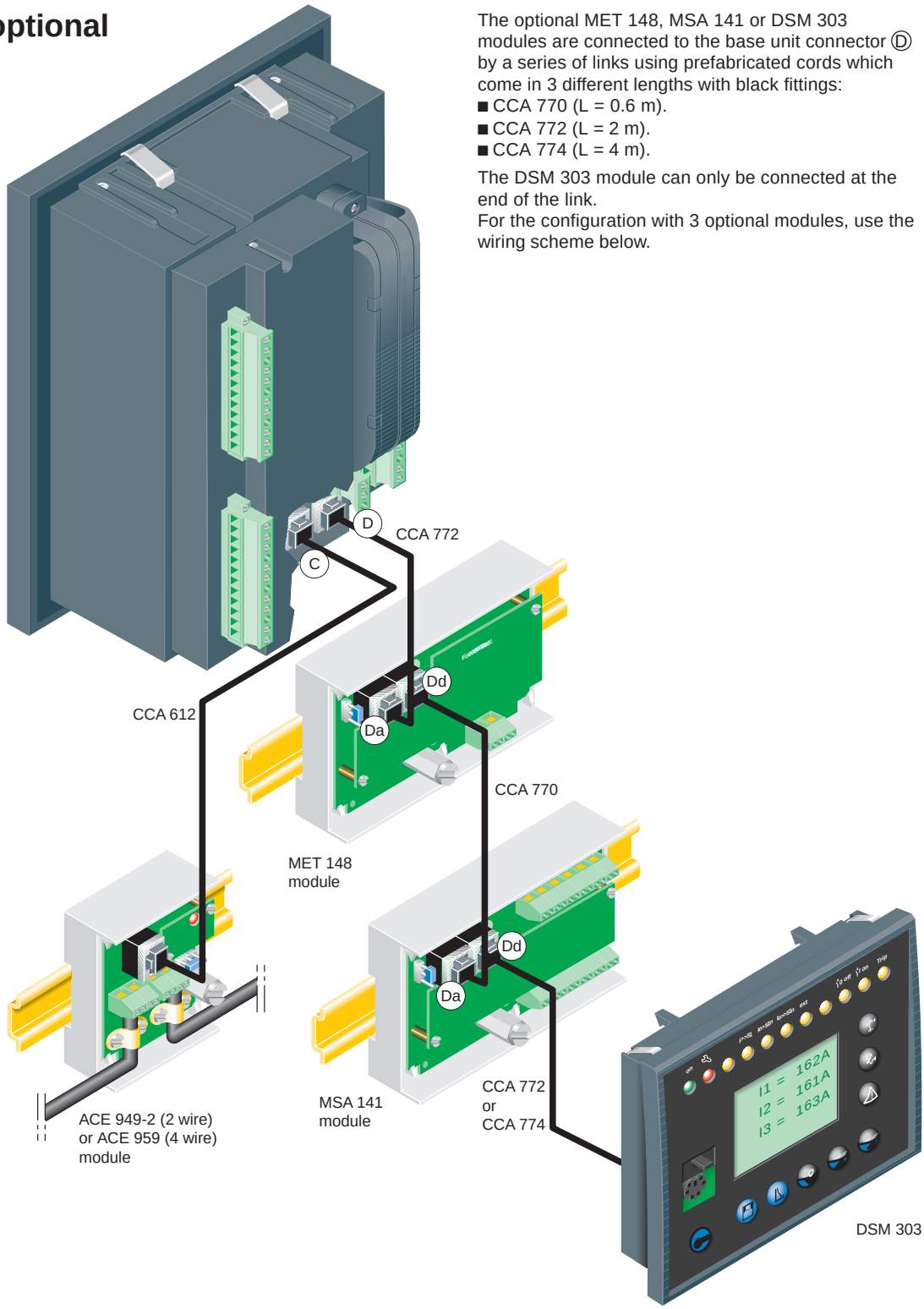


(1) 1, 2 or 3 VTs (case shown)

Connection of optional modules

The optional MET 148, MSA 141 or DSM 303 modules are connected to the base unit connector Ⓓ by a series of links using prefabricated cords which come in 3 different lengths with black fittings:
- CCA 770 (L = 0.6 m).
- CCA 772 (L = 2 m).
- CCA 774 (L = 4 m).

The DSM 303 module can only be connected at the end of the link.
For the configuration with 3 optional modules, use the wiring scheme below.



Communication interface module

These modules are used for simple, dependable commissioning of the RS485 link according to 2 connection topologies:

- 2-wire network with the ACE 949-2 module
- 4-wire network with the ACE 959 module

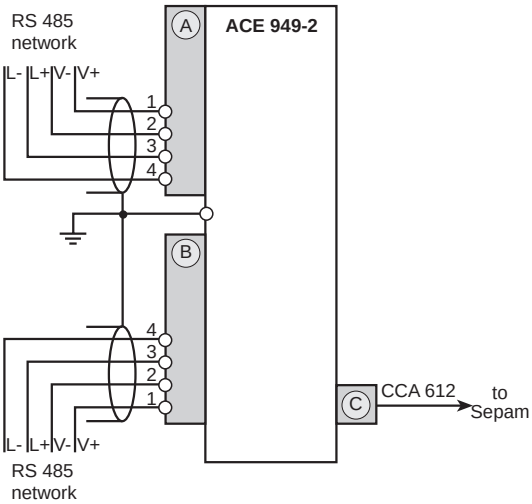
The RS 484 communication interfaces are supplied, via the network cable, by a single accessory that may be used to connect up to 25 units according to the chart below:

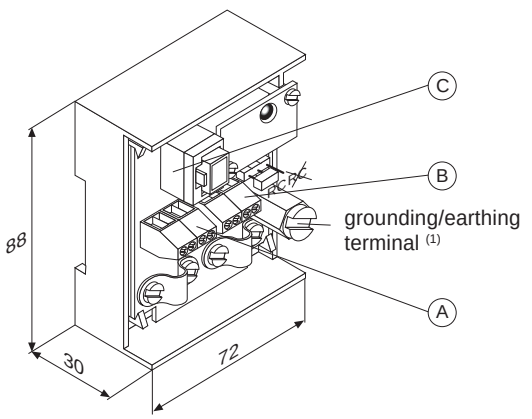
Maximum length of RS 485 network with distributed power supply (in m):	number of Sepam units connected			
	5	**10**	**20**	**25**
12 V distributed power supply	320	180	160	125
24 V distributed power	1000	750	450	375

- These values are obtained with a standard AWG24 2-pair cable with a resistance load per unit length of 78 1/2 / km.
- Tolerance with distributed power supply: ± 10%.
- Values multiplied by 3 with a maximum of 1300 m with a specific cable; reference FILECA F2644-1; Schneider-approved.

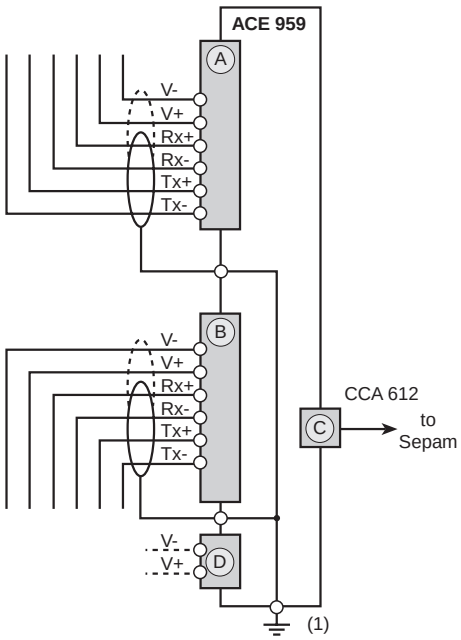
For information on the commissioning of the RS 485 network and the characteristics of the recommended cables, refer to “RS 485 Network Connection Guide“ PCRED399074EN.

■ ACE 949-2 interface for 2-wire RS 485 networks



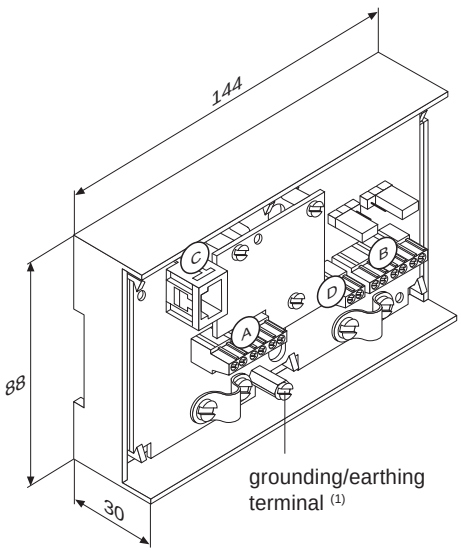


■ ACE 959 interface for 4-wire RS 485 network



Rx+, Rx- : Sepam receiving (eq IN+, IN-)

Tx+, Tx- : Sepam transmitting (eq OUT+, OUT-)



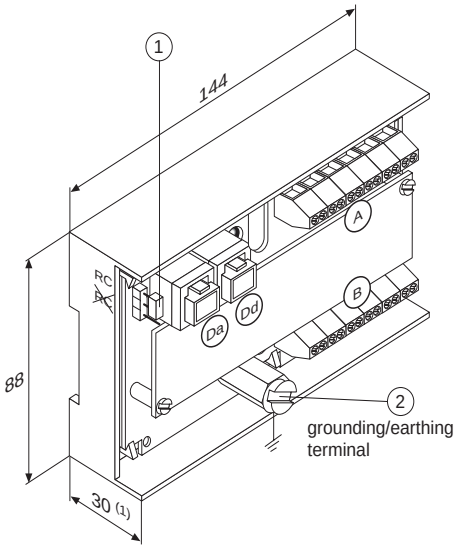
Connections

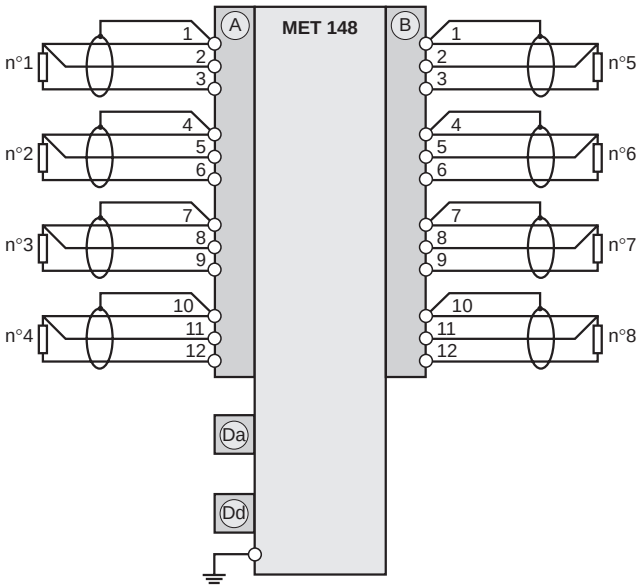
- The cable is connected to terminal blocks Ⓐ and Ⓑ situated on the module.
- The modules are fitted with clamps for the attachment and recovery of shielding at the network cable incoming and outgoing points.
- Each module is equipped with a 3-meter long CCA 612 prefabricated cable, with green fittings to be connected to the Ⓒ output Sepam 1000+.
- The ACE 959 accommodates a distributed power supply with separate wiring (not included in the shielded cable). Terminal block Ⓓ is used for the connection of the module that provides the distributed power supply.

(1) use a braid or cable fitted with a 4 mm ring lug.
Mounting of modules on symmetrical DIN rail.

Installation
Connection (cont'd)

MET 148 module





(1) dimension with cord = 70 mm
Mounted on symmetrical DIN rail.

Accuracy derating according to wiring

■ Connection in 3-wire mode: the error Dt is proportional to the length of the wire and inversely proportional to the wire cross-section:

$$\Delta t\ (°C) = 2 \times \frac{I\ (km)}{S\ (mm^2)}$$

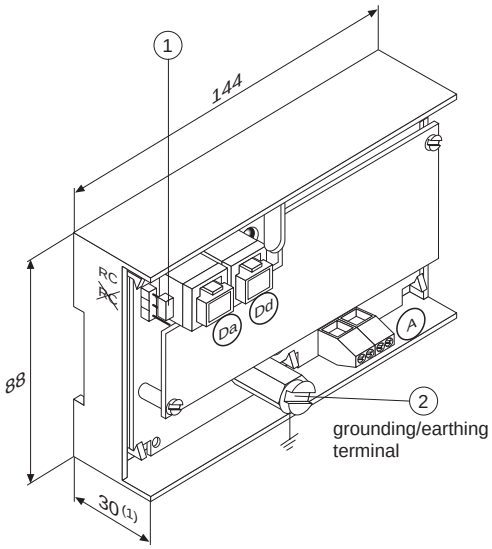
□ ±2.1°C/km for a cross-section of 0.93 mm²,
□ ±1°C/km for a cross-section of 1.92 mm².

Wiring

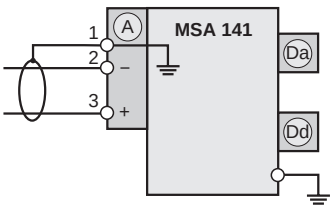
It is preferable to use shielded cables.
The use of unshielded cables may cause measurement errors, the size of which depends on the degree of electrical and magnetic disturbance in the cable surroundings.
Only connect the shielding at the MET 148 end and in the shortest manner possible to the corresponding terminals of the Ⓐ and Ⓑ connectors.
Do not connect the shielding at the temperature sensor end.
Recommended cross-sections according to distance:

■ up to 100 m > 1 mm², AWG 16,
■ up to 300 m ≥ 1.5 mm², AWG 14,
■ up to 1 km > 2.5 mm², AWG 12.

MSA 141 module



(1) dimension with cord = 70 mm
Mounted on symmetrical DIN rail.



Wiring

■ It is preferable to use shielded cables.
■ Connect the shielding at the MSA 141 end.
■ Rc < 600 Ω wiring included.

Setting

metering	unit	minimum value	maximum value
I1/I2/I3/Io current	dA	settings made (minimum value, max. value) using SFT 2841 software or advanced UMI are not checked with the corresponding parameter setting	
thermal capacity used	%		
frequency	0.01 Hz		
phase to phase voltages	V		
phase to neutral voltages V1/V2/V3	V	e.g. 0 to 3000 (dA) for range 1.5 In and rated In = 200 A	
RTD temperatures t1 to t8	°C		

Please note

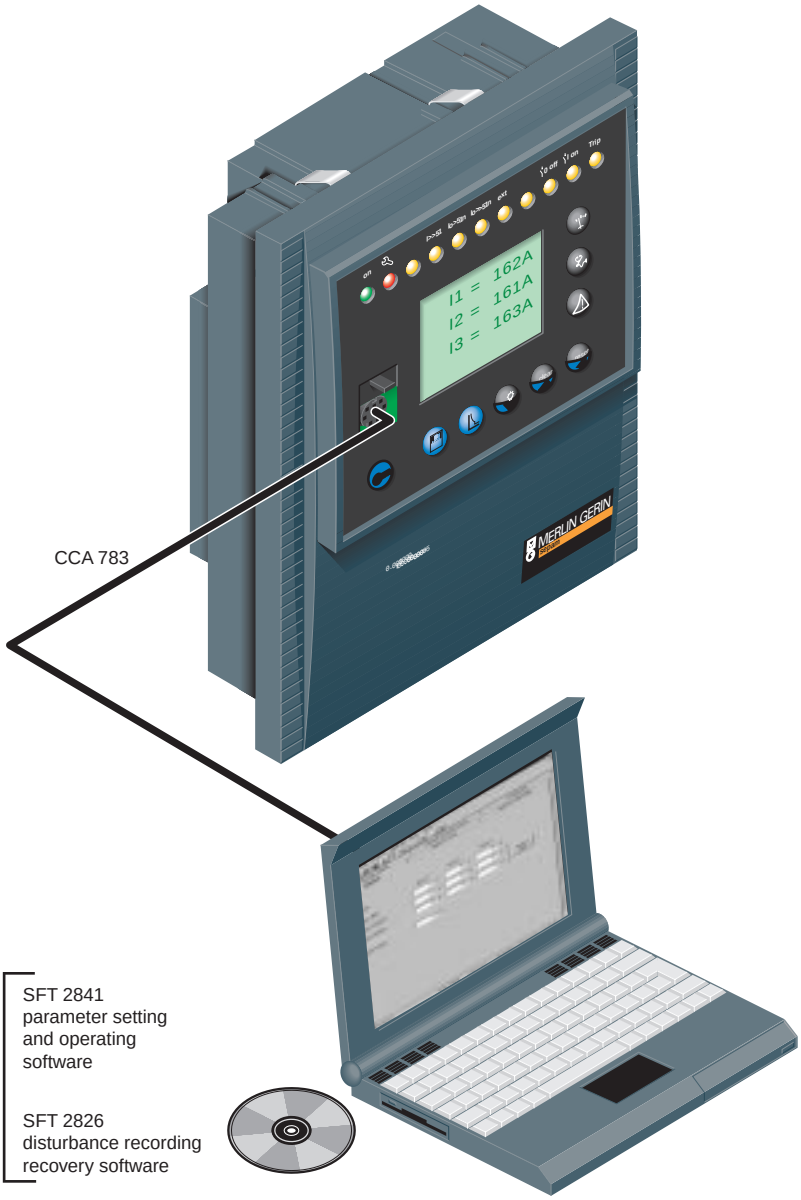
When modules are combined without DSM 303, jumper ① should be put in the RC (load resistance) position on the last module in the series (MET 148 or MSA 141). The modules are delivered in the ~~RC~~ position.

Item ② : use a braid or cable fitted with a 4 mm ring lug.

Use

Sepam 1000+ has two levels of UMI (User Machine Interface) suited to each operating requirement, completed by an expert UMI for PC (SFT 2841).

Sepam 1000
base unit with fixed advanced UMI



(1) the SFT 2841 kit includes:
- parameter setting and operating software,
- disturbance recording function recovery software,
- CCA 783 cord.

Use
“Expert UMI”

This UMI is available as a complement to the Standard or Advanced UMI on the screen of a PC equipped with the SFT 2841 software package and connected to the RS232 link on the front panel of the Sepam (operating in a Windows ≥ V95 or NT version).

All the data used for the same task is grouped together in the same screen to facilitate operation. Menus and icons are used to provide fast, direct access to the information.

Current operation
■ display of all metering and operating data,
■ display of alarm messages with the time format (date, hour, mn, s),
■ display of diagnostic data such as:
□ tripping current,
□ number of switchgear operations and cumulative breaking current,
■ display of all protection and parameter settings,
■ display of the logic status of inputs, outputs and signal lamps.

This UMI offers the solution suited to occasional local operation or for demanding personnel who require fast access to all the information.

Parameter and protection settings (1)
■ display and setting of all the parameters of each protection function on the same page,
■ program logic parameter setting, parameter setting of general installation and Sepam data,
■ input data may be prepared ahead of time and transferred into the corresponding Sepam units in a single operation (downloading function).

Main functions performed by SFT 2841:
■ changing of passwords,
■ entry of general parameters (ratings, integration period, ...),
■ entry of protection settings,
■ changing of program logic assignments,
■ enabling/disabling of functions,
■ saving of files.

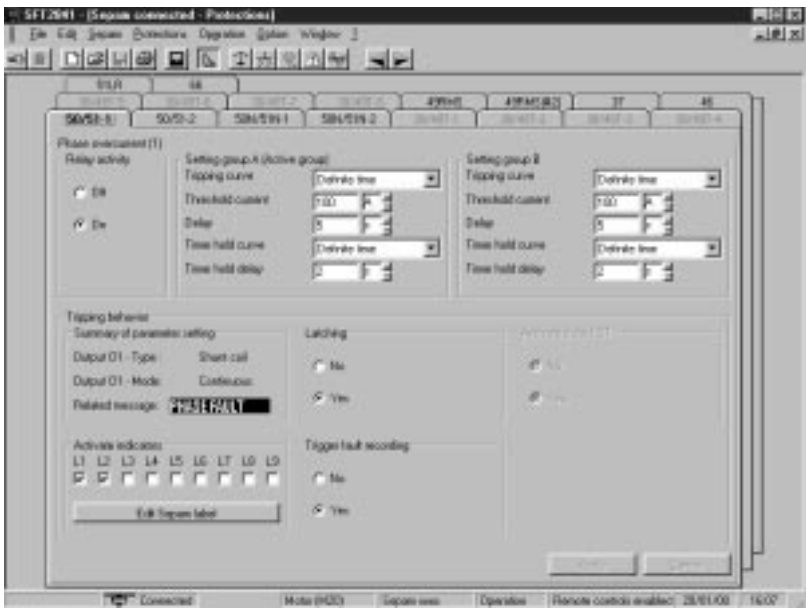
Saving
■ protection and parameter setting data may be saved (uploading function),
■ printing of reports is possible as well.

This UMI may also be used to recover disturbance recording files and provide graphic display using the SFT 2826 software package.

Operating assistance
Access from all the screens to a help function which contains all the technical data required for Sepam installation and use.

(1) modes available via 2 passwords (protection setting level, parameter setting level).

e.g. measurement display screen (Sepam S20).



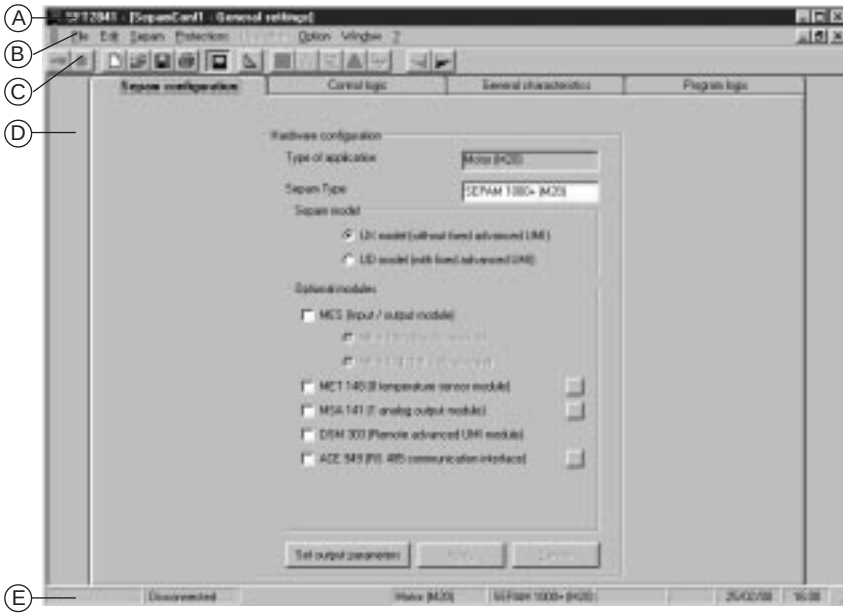
e.g. phase overcurrent protection setting screen.

General organization of the screen

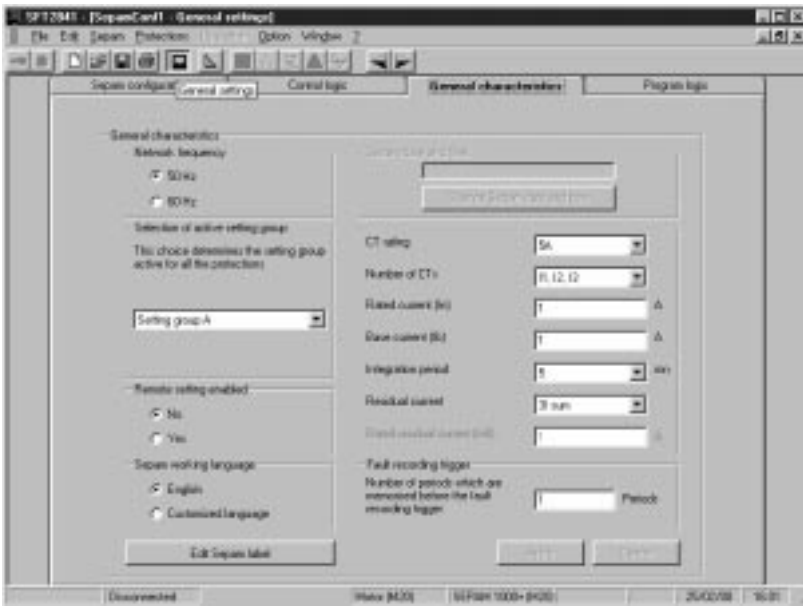
A Sepam document is displayed on the screen via a graphic interface that has the conventional Windows features.

All the SFT 2841 software screens are set up in the same way.

As follows:
■ Ⓐ : title bar, with:
□ name of the application (SFT 2841),
□ identification of the Sepam document displayed,
□ window manipulation handles.
■ Ⓑ : menu bar, to access all the SFT 2841 software functions (unavailable functions are dimmed),
■ Ⓒ : toolbar, a group of contextual icons for fast access to the main functions (also accessed via the menu bar),
■ Ⓓ : work zone available to the user, presented in the form of a tab boxes,
■ Ⓔ : status bar, with the following information relating to the active document:
□ alarm on,
□ identification of connection window,
□ SFT 2841 operating mode, connected or not connected,
□ type of Sepam,
□ Sepam editing identification,
□ identification level,
□ Sepam operating mode,
□ PC date and time.



Example: Sepam unit configuration screen.



Example: protection setting screen.

Use of SFT 2841 software in "not connected" to Sepam mode

Sepam parameter and protection setting
The parameter and protection setting of a Sepam using SFT 2841 consists of preparing the Sepam file containing all the characteristics that are specific to the application, a file that will then be downloaded into Sepam at the time of commissioning.

Operating mode:
■ create a Sepam file for the type of Sepam 1000+ to be parameterized. (The newly created file contains the Sepam 1000+ factory-set parameter and protection settings),
■ modify the "Sepam" page function sheet parameters and the "Protections" page function sheet protection settings.

A guided mode may be used to go through all the function sheets to be modified in the natural order.

The screens may be sequenced in guided mode by means of the "Previous screen" and "Next screen" functions in the "Options" menu, which are also available in the form of icones in the toolbar.

The function sheet / screens are sequenced in the following order:
1. "Sepam unit configuration",
2. "Control logic",
3. "General characteristics",
4. protection setting screens, according to the type of Sepam,
5. "Program logic".

Modification of function sheet contents:
■ the parameter and protection setting input fields are suited to the type of value:
□ choice buttons,
□ numerical value input fields,
□ dialogue box (Combo box).
■ the modifications made to a function sheet are to be "Applied" or "Canceled" before the user goes on to the following function sheet.
■ the consistency of the parameter and protection settings entered is checked:
□ a clear message specifies the inconsistent value in the function sheet opened,
□ values which become inconsistent following the modification of a parameter are replaced by "****" and must be corrected.

Use of SFT 2841 software in "connected" to Sepam mode

Precaution
When a portable PC is used, given the risks inherent to the accumulation of static electricity, the customary precaution consists of discharging in contact with an earthed metal frame before physically connecting the CCA 783 cord (supplied with the SFT 2841 kit).

Plugging into Sepam 1000+
■ plugging of the 9-pin connector (DSUB type) into one of the PC communication ports. Configuration of the PC communication port via the "Communication port" function in the "Options" menu.
■ plugging of the 6-pin connector into the connector (minidin type) situated behind the blanking plate on the front panel of the Sepam 1000+ or the DSM 303.

Connection to Sepam 1000+
2 possibilities for establishing the connection between SFT 2841 and Sepam 1000+ :
■ "Connection" function in the "Sepam" menu,
■ "Open" function in the "File" menu.

Once the connection with the Sepam 1000+ has been established, "Connected" appears in the status bar, and the Sepam 1000+ connection window may be accessed in the work zone.

User identification
The window intended for the entry of the 4-digit password is activated:
■ via the "Passwords" tab,
■ via the "Identification" function in the "Sepam" menu,
■ via the "Identification" icon.

The "return to Operating mode" function in the "Passwords" tab removes access rights to parameter and protection setting mode.

Downloading of parameters and protection settings
Parameter and protection files may only be downloaded into the connected Sepam in Parameter setting mode.

Once the connection has been established, the procedure for downloading a parameter and protection file is as follows:
■ activate the "Download Sepam" function in the "Sepam menu,
■ select the *.rpg file which is to contain the loaded data,
■ end operation message must be acquitted.

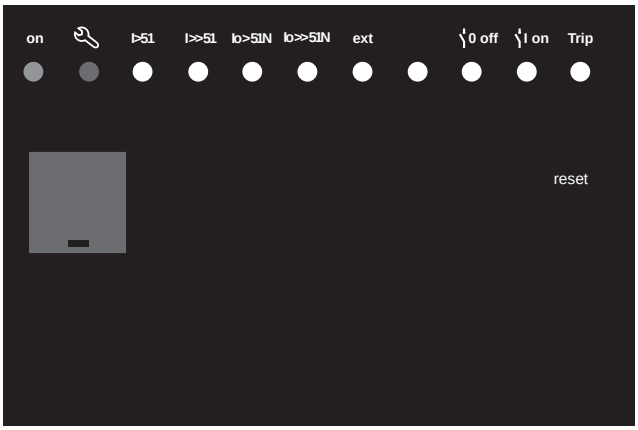
Return to factory settings
This operation is only possible in Parameter setting mode, via the "Sepam" menu. All of the Sepam general settings, protection settings and the command matrix go back to the default values.

Uploading parameters and protection settings
The connected Sepam parameter and protection setting file may only be uploaded in Operating mode.

Once the connection has been established, the procedure for unloading a parameter and protection setting file is as follows:
■ activate the "Upload Sepam" function in the "Sepam" menu,
■ select the *.rpg file which is to contain the uploaded data,
■ end operation message must be acquitted.

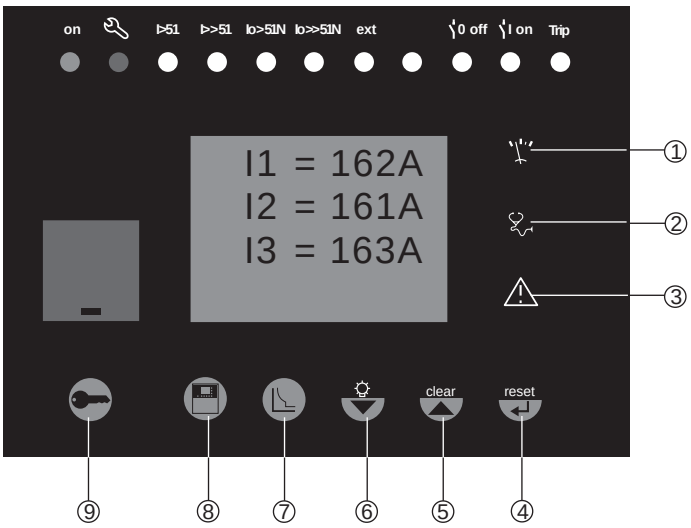
Local operation of Sepam
Connected to Sepam, SFT 2841 offers all the local operating functions available in the advanced UMI screen, completed by the following functions:
■ setting of Sepam internal clock, via the "Sepam general characteristics" tab,
■ implementation of the disturbance recording function, via the "Fault recording" menu "OPG": validation/inhibition of the function, recovery of Sepam files, start-up of SFT 2826,
■ consultation of the history of the last 64 Sepam alarms, with time-tagging,
■ access to Sepam diagnostic data, in the "Sepam" tab box, included in "Sepam diagnosis",
■ in Parameter setting mode, the switchgear diagnostic values may be modified: operation counter, cumulative breaking current to reset the values after a change of breaking device.

“Standard UMI”



This UMI includes:
■ 2 signal lamps indicating Sepam operating status:
□ green “**on**” indicator: device on,
□ red “**wrench**” indicator: device unavailable (initialization phase or detection of internal failure),
■ 9 parameterizable yellow signal lamps, fitted with a standard label (with SFT 2841, a customized label can be printed on a laser printer),
■ “**reset**” button for clearing faults and resetting,
■ 1 connection port for the RS232 link with the PC (CCA783 cord), the connector is protected by a sliding cover.

“Fixed or remote advanced UMI”



In addition to the standard UMI functions, this version provides:
■ **a “graphic” LCD display** for the display of measurements, parameter/protection settings and alarm and operating messages.

The number of lines, size of characters and symbols are in accordance with the screens and language versions.
■ **a 9-key keypad with 2 modes of use**:

White keys for current operation:
① display of measurements,
② display of “switchgear, network diagnosis” data,
③ display of alarm messages,
④ resetting,
⑤ acknowledgment and clearing of alarms.

Blue keys activated in parameter and protection setting mode:
⑦ access to protection settings,
⑧ access to Sepam parameter settings,
⑨ used to enter the 2 passwords required to change protection and parameter settings.

The “ ↵, ▲, ▼ ” keys (④,⑤,⑥) keys are used to navigate in the menus and to scroll and accept the values displayed.

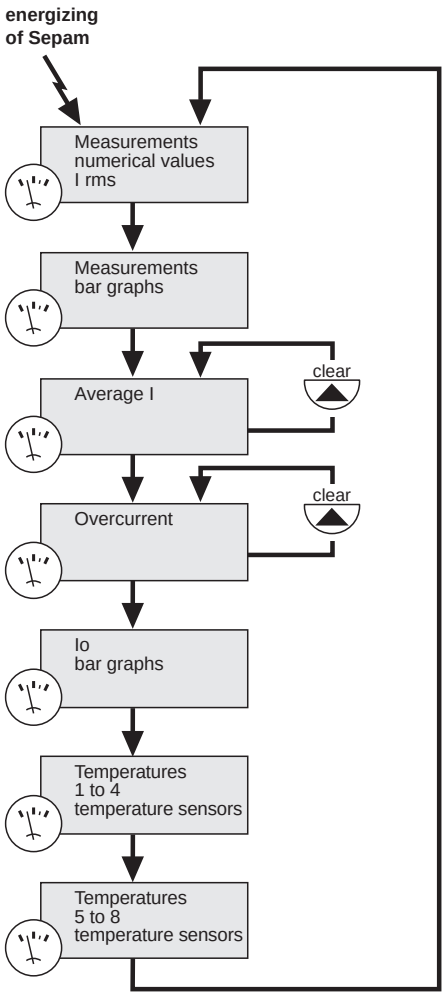
⑥ **“lamp test” keys**:
switching on sequence of all the signal lamps.

Access to measurements and parameters

The measurements and parameters may be accessed using the metering, diagnosis, status and protection keys. They are arranged in a series of screens as shown in the diagram opposite.

■ The data are split up by category in 4 loops, associated with the following 4 keys:
□ key : measurements,
□ key : switchgear diagnosis
and additional measurements:
□ key : general settings,
□ key : protection settings.
■ When the user presses a key, the system moves on to the next screen in the loop. When a screen includes more than 4 lines, the user moves about in the screen via the cursor keys (▲, ▼).

Example: measurement loop.

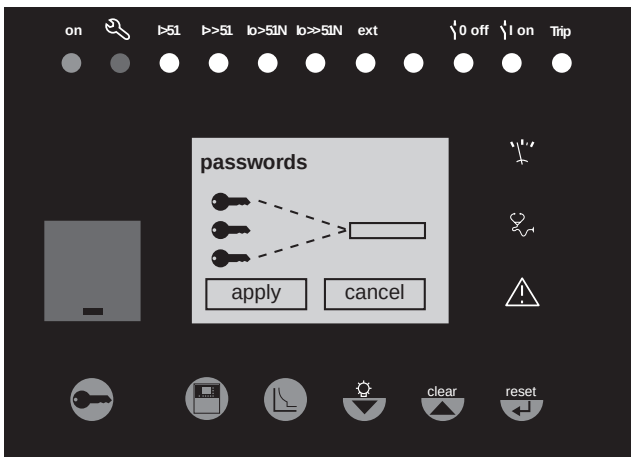


Protection and parameter setting modes

There are 3 levels of use:
■ operator level. Used to access all the screens in read mode and does not require any passwords.
■ protection setter level: requires the entry of the first password (key) allows protection setting (key).
■ parameter setter level: requires the entry of the second password (key) allows modification of the general settings as well (key).

Only general setter may modify the passwords.

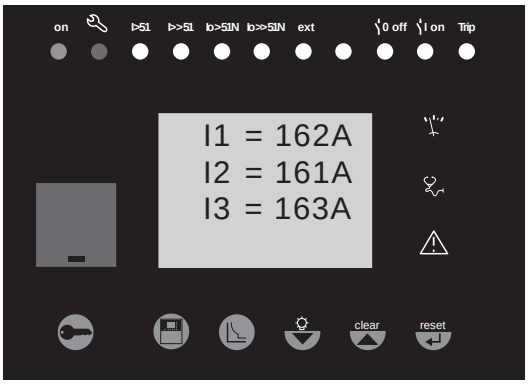
The passwords have 4 digits.



Use
Current operation (white keys)

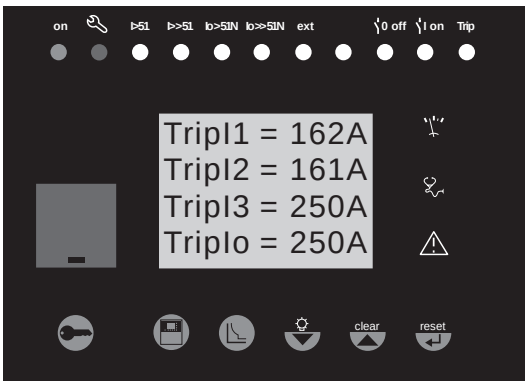
Key

The “metering” key is used to display the variables measured by Sepam.



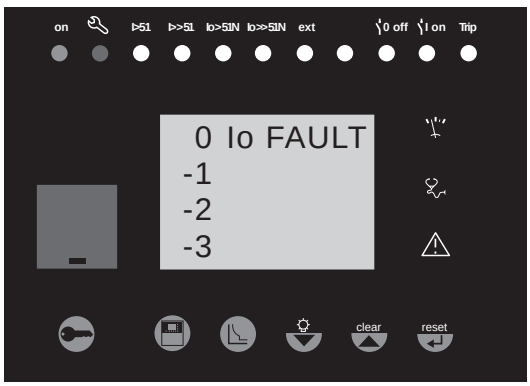
Key

The “diagnosis” key provides access to diagnostic data on the breaking device and additional measurements, to facilitate fault analysis.



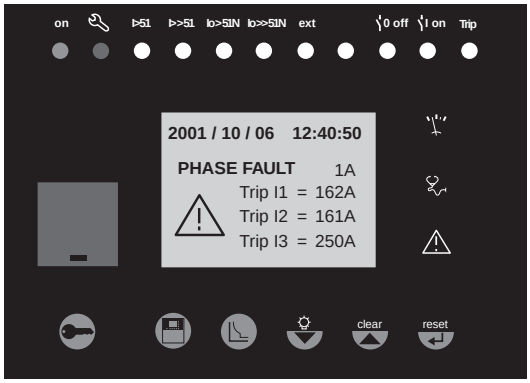
Key

The “alarms” key is used to consult the 16 most recent alarms that have not yet been acknowledged.



Key reset

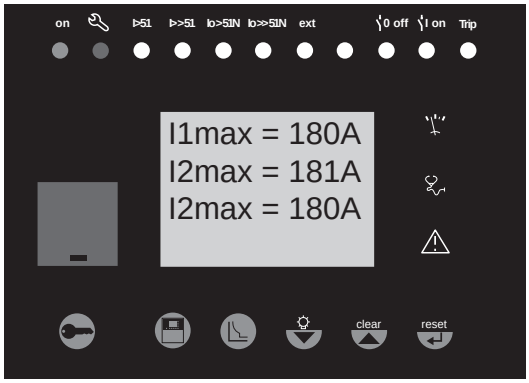
The "reset" key resets the Sepam
(signal lamps switch off and protection relays are recharged after the disappearance of faults).
The alarm messages are not erased.



Key clear

When an alarm is present in the Sepam display, the "clear" key is used to return to the screen that was present prior to the appearance of the alarm or to a less recent unacknowledged alarm. The Sepam is not reset.

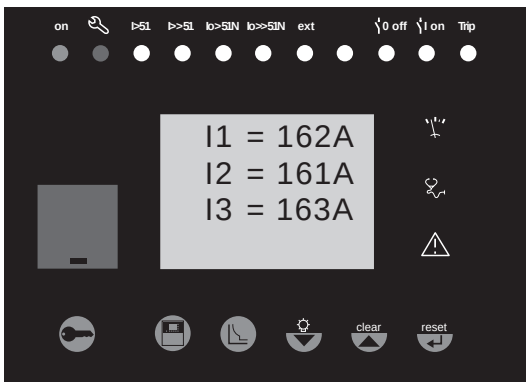
In the metering or diagnosis or alarm menus, the "clear" key may be used to reset the average currents, peak demand currents, running hours counter and alarm stack to zero when they are displayed.



Key

The "lamp test" key starts up a LED and display test sequence.

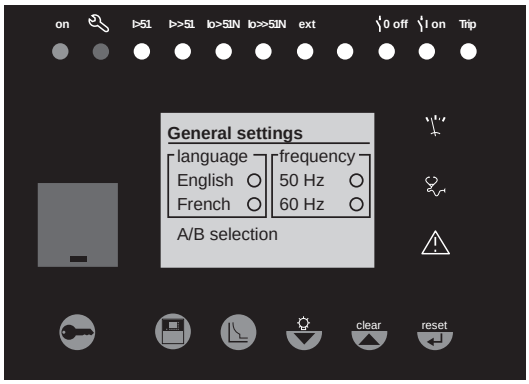
When an alarm is present, the "lamp test" key is disabled.



Use
Parameter and protection setting (blue keys)

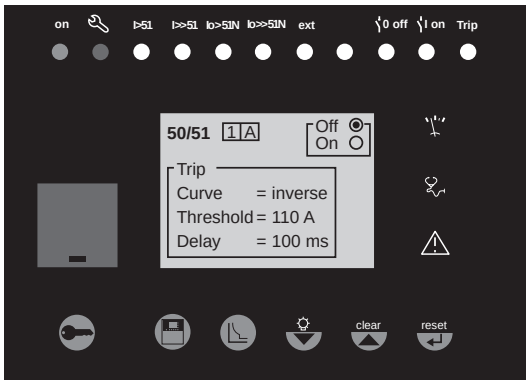
Key

The “status” key is used to display and enter the Sepam general settings. They define the characteristics of the protected equipment as wells and the different optional modules.



Key

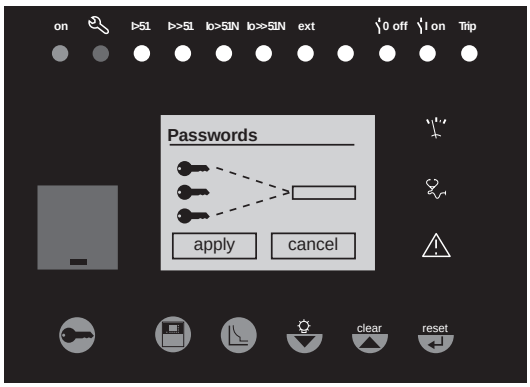
The “protection” key is used to display, set and enable or disable protections.



Key

The “wrench” key is used to enter the passwords for access to the different modes:
- protection setting,
- parameter setting.

and return to “operating” mode (with no passwords).

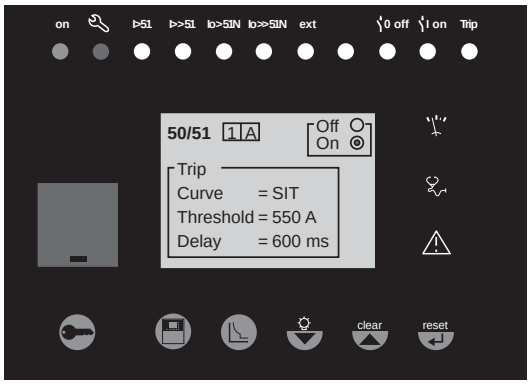


N.B. For parameter setting of signal lamps and output relays, it is necessary to use the SFT 2841 software, “program logic” menu.

Use
Parameter and protection setting (blue keys) (cont'd)

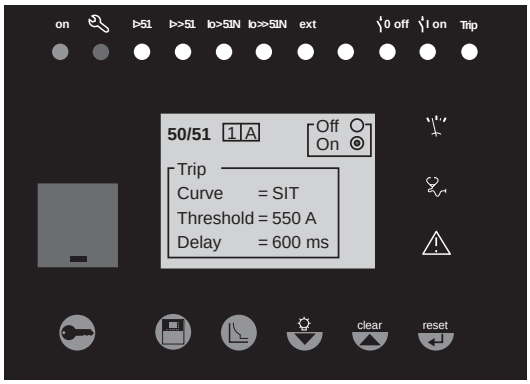
Key reset

The ↵ key is used to apply the protection settings, parameter settings and passwords.



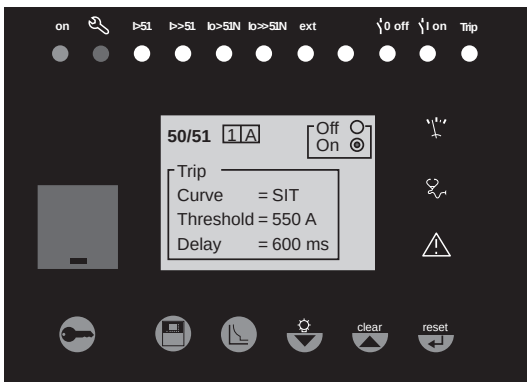
Key clear

When there are no alarms on the Sepam display and the user is in the status, protection or alarm menus, the ▲ , key is used to move the cursor up.



Key

When there are no alarms on the Sepam display and the user is in the status, protection or alarm menus, the ▼ key is used to move the cursor down.

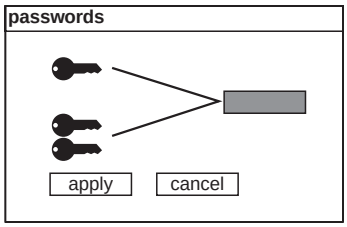


Use of passwords

Sepam 1000+ has two 4-digit passwords.
■ The first password, symbolized by a key, is used to modify protection settings.
■ The second password, symbolized by two keys, is used to modify protection settings and all the general settings.

The 2 factory passwords are: 0000

Entry of passwords
When the user presses the key, the following screen appears:

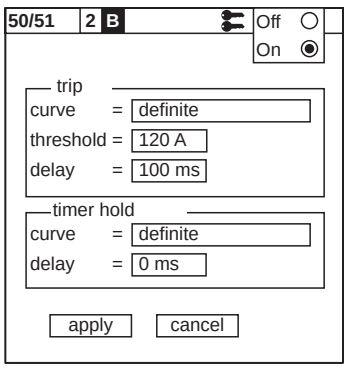


Press the key to position the cursor on the first digit 0 X X X

Scroll the digits using the cursor keys (▲ ▼) then confirm to go on to the next digit by pressing the key. Do not use characters other than the numbers 0 to 9 for each of the 4 digits. When the password for you qualification level is entered, press the key to position the cursor on the apply box. Press the key again to confirm.

When the Sepam is in protection setting mode, a key appears at the top of the display.

When the Sepam is in parameter setting mode, two keys appear at the top of the display.



Access to the protection setting or parameter setting modes is disabled:
■ by pressing the key,
■ automatically if no keys are activated for more than 5 minutes.

Modification of passwords

Only the parameter setting qualification level (2 keys) or the SFT 2841 allows modification of the passwords. Passwords are modified in the general settings screen, key.

Loss of passwords

If the factory passwords have been modified and the latest passwords entered have been irretrievably lost by the user. Please, contact your local after sales correspondent.

Entry of parameter or setting

Principle applicable to any screen of Sepam 1000+
(phase overcurrent protection example)
■ Enter password.
■ Acces to corresponding screen by pessing key.
■ Move cursor by pressing key to reach the desire box (example: curve).
■ Press key to confirm the selection, then select the type of curve by pressing ou key and confirm by pressing key.
■ Then press key to reach the followings boxes, up to the box apply.
■ Press the key to enter the setting.

Entry of numerical values

(e.g. current threshold value).
■ Position the cursor on the required box using the keys and confirm the choice by pressing the key .
■ The first digit to be set is selected; set the value using the keys (choice. 0……9).
■ Press the key to confirm the choice and go on to the next digit.
The values are entered with 3 significant digits and a period.
The unit (e.g. A or kA) is chosen using the last digit.
■ Press the to confirm the entry and the to access the next field.
■ All of the values entered will only be effective after the user confirms by selecting the apply box at the bottom of the screen and presses the key.

Points to be checked prior to commissioning

The following points should be checked before the Sepam 1000+ is energized.

Points to be checked

■ **Supply voltage**
Make sure that the cubicle auxiliary supply voltage matches the Sepam operating voltage. It is indicated on the label on the right side panel (see identification section).
Terminal 1: AC or positive polarity.
Terminal 2: AC or negative polarity.

■ **Earthing**
Check that the device is earthed correctly on terminal 17 of the 20-pin connector.

■ **Connectors**
Check that all the connectors are correctly plugged in and locked.

Energizing

When the auxiliary power supply is switched on, Sepam1000+ performs the following sequence which lasts for about 6 seconds:

■ green ON indicators and red indicators switch on,

■ red indicator switches off,

■ watchdog contact picks up.

The first screen displayed is the phase current or phase voltage metering screen depending on the application. Sepam is then in service.

Factory parameter setting:
■ general settings: factory setting,
■ protections: inhibited,
■ program logic: standard logic
(see charts on following pages).

Commissioning

All of the parameter and protection settings must be based on the network protection coordination study which is to be carried out prior to commissioning.

Enter the parameter and protection setting data.

Entry error messages
The modification of a parameter or protection setting may in some cases cause the automatic modification of another one or create a case of incompatible settings. When this is the case, a message appears on the display, asking the user to check the parameters concerned.

Advice
To avoid entry error messages, it is advisable to set the parameters in the following order:
■ general settings (key) before protections,
■ in the same screen, fill in all the values before pressing "apply".

Available functions according to Sepam 1000+ type

functions		type of Sepam substation	transformer	motor	busbar	
protections	**ANSI code**	**S20**	**T20**	**M20**	**B21(5)**	**B22**
phase overcurrent (1)	50/51	4	4	4		
earth fault (or neutral) (1)	50N/51N	4	4	4		
unbalance / negative sequence	46	1	1	1		
thermal overload	49 RMS		2	2		
phase undercurrent	37			1		
excessive starting time, locked rotor	48/51LR			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			□			
temperature monitoring (2)	38/49T		□	□		
metering						
phase current I1,I2,I3 RMS		■	■	■		
residual current Io		■	■	■		
average current I1, I2, I3		■	■	■		
peak demand phase current IM1,IM2,IM3		■	■	■		
line voltage U21, U32, U13					■	■
phase-to-neutral voltage V1, V2, V3					■	■
residual voltage Vo					■	■
positive sequence voltage / rotation direction					■	■
frequency					■	■
temperature measurement (2)			□	□		
network diagnosis						
tripping current I1,I2,I3, Io		■	■	■		
unbalance ratio / negative sequence current Ii		■	■	■		
running hours counter / operating time			■	■		
thermal capacity used			■	■		
remaining operating time before overload tripping			■	■		
waiting time after overload tripping			■			
starting current and time / overload				■		
start inhibit time delay, number of starts before inhibition				■		
disturbance recording		■	■	■	■	■
switchgear diagnosis						
cumulative breaking current^2		■	■	■		
trip circuit supervision		□	□	□	□	□
number of operations		□	□	□		
operating time		□	□	□		
operating time		□	□	□		
self-diagnosis						
watchdog		■	■	■	■	■
output relay test (3)		□	□	□	□	□
control and monitoring						
circuit breaker / contactor control (4)		□	□	□	□	□
logic discrimination		□	□	□		
4 addressable logic outputs		■	■	■	■	■
additional modules						
MET 148 module - 8 temperature sensor inputs			□	□		
MSA 141 module - 1 low level analog output		□	□	□	□	□
MES 108 module - (4I/4S) or MES 114 module - (10I/4O)		□	□	□	□	□
ACE 949-2 module - (2-wire) or ACE 959 (4-wire) RS485 interface		□	□	□	□	□

■ standard, □ according to parameter setting and MES 108 or MES 114 input/output module options.
(1) 4 relays with the exclusive possibility of logic discrimination or switching from one 2-relay group of settings to another 2-relay group.
(2) with MET 148 sensor option, 2 set points per sensor.
(3) with advanced UMI option only.
(4) for shunt trip unit or undervoltage release coil according to parameter setting.
(5) performs B20 type functions.

Sepam 1000+ displays the measurements required for operation

The values are displayed as primary values with the related units: A, V, Hz, °C, °F, …

Currents
- RMS measurement of the circuit's 3 phase currents.
- Residual current measurement.

Average currents and peak demand currents
Measurement of the average current on each of the 3 phases.
Measurement of the greatest average current on each of the 3 phases.
The peak demand currents give the current consumed at the time of peak loads.
The average current is calculated over a period that may be parameterized from 5 to 60 mn. The "clear" key is used to reset the peak demand currents to zero when they are on the display.

Tripping currents
Storage of the greatest average value of the 3 phase currents and earth current at the time Sepam gave the last tripping order, to provide the fault breaking current (fault analysis).
These values are stored until the next trip order is given.

Thermal capacity used
Measurement of the relative capacity used by the load. It is displayed as a percentage of the nominal thermal capacity.

Voltages
- Calculation or measurement of phase-to-neutral voltages V1, V2 and V3.
- Calculation or measurement of phase-to-phase voltages U21, U32 and U13.
- Calculation of positive sequence voltage Vd.
- Calculation of residual voltage Vo.

Frequency: measurement of frequency.

Temperature
Measurement of the temperature of each sensor.

Motor operation assistance function

Motor starting current and time / motor overload
Measures the maximum value of current absorbed by the motor during a starting sequence or at the time of an overload as well as the duration.

Number of starts before inhibition / start inhibit time delay
Indicates the remaining number of starts allowed by the starts per hour protection, then, if the number is zero, the waiting time before starting is allowed.

Remaining operating time before overload tripping
Indicates the time remaining before tripping by the thermal overload protection.

Waiting time after overload tripping
Indicates the time remaining before starting is allowed according to inhibition by the thermal protection.

Switchgear diagnosis assistance measurements

These measurements are to be compared with the data supplied by the switchgear manufacturer.

Cumulative breaking current
The displayed value may be used to evaluate the state of the circuit breaker poles.

Operating time, charging time
Measures the device operating time. These data may be used to evaluate the state of the pole and operating mechanism.

Number of operations
Cumulative number of breaker opening operations.

Running hours counter / operating time
Cumulative time during which the protected equipment (motor or transformer) is on load (I > 0.1 Ib).
The cumulative value is displayed in hours (0 to 65535 h) and saved every 4 hours.

Characteristics

general parameters (set in the general settings menu)			
frequency		50 Hz or 60 Hz	
phase current sensor		1 A or 5 A CT type rated current In (1)	nb. (I1,I2,I3) or (I1,I3) 1 A to 6250 A
		LPCT type rated current In (1)	number (I1, I2, I3) 25 A to 3150 A
residual current sensor		CSH 120/200 type rated current Ino	2 A or 20 A
		1 A or 5 A CT + CSH type rated current Ino (1)	or core balance CT 1 A to 6250 A
voltage sensor		rated primary voltage Unp (2)	220 V to 250 kV
		VT: 100, 110, 115, 120 V (Uns)	V1, V2, V3 U21, U32 U21
		TP : 200, 230 V	V1, V2, V3
metering functions		**ranges**	**accuracy** (7)
phase current residual current		0.1 to 1.5 In (1) 0.1 to 1.5 Ino (1)	typically ±1% (3) ±5%
peak demand current		0.1 to 1.5 In (1)	typically ±1%
tripping current	phase	0.1 to 40 In (1)	±5%
	earth	0.1 to 20 Ino (1)	±5%
thermal capacity used		0 to 800 % (4)	(3)
unbalance ratio (negative sequence current)		10 to 500 % Ib (5)	±2%
voltmeter voltages (ph-to-neutral or ph-to-ph)		0.05 to 1.2 Unp (2) or Vnp	typically ±1% (3)
voltmeter positive sequence voltage		0.05 to 1.2 Vnp (2)	±2%
voltmeter residual voltage		0.015 to 3 Vnp (2)	±1%
frequency meter		50 / 60 Hz ±5 Hz	±0.05 Hz (3)
temperature		-30°C to +200°C (6)	±1°C (3)
operating time		20 to 100 ms	typically ±1 ms
charging time		1 to 20 sec	±0.5 sec
running hours counter ±1% or ±0.5 h			0 to 65535 h
metering transducer		4-20; 0-20; 0-10 mA	±0.5%

(1) In, Ino: CT primary rated current
(2) Unp: rated primary phase-to-phase voltage; Vnp: primary phase-to-neutral voltage Vnp = (Unp/$\sqrt{3}$)
(3) measurements available in analog format according to parameter setting and MSA 141 module
(4) 100% is the thermal capacity used of the equipment being protected under its rated load: I = Ib
(5) Ib: base current of the equipment being protected
(6) displayed in °C or °F according to parameter setting, typical accuracy from + 20°C to +140°C
(7) in reference conditions (IEC 60255-4), typically at In or Un/Vn.

Phase overcurrent (ANSI 50/51)
Three-phase protection against overloads and phase-to-phase short-circuits.
The protection comprises four units:
■ IDMT or definite time,
■ instantaneous or time-delayed.

Sepam 1000+ offers a number of tripping curves:
■ definite time (DT),
■ IDMT.

The IDMT curves also include a reset time which is used for:
■ detection of restriking faults,
■ coordination with electromechanical relays.

Earth fault (ANSI 50/51N or 50/51G)
Connection and equipment earth fault protection.
Earth faults may be detected by:
■ three phase currents (3I sum),
■ a special core balance CT, CSH120 or CSH200, according to the required diameter; this method provides the highest sensitivity. Selection between two ratings (2 A and 20 A) provides a very wide setting range.
■ a current transformer (1 A or 5 A), combined with a CSH30 interposing ring CT.

The protection comprises four units:
■ IDMT or definite time,
■ instantaneous or time-delayed.

The characteristic curves are the same as those for the phase current overcurrent protection.

Each set point has a reset time setting (by an adjustable timer hold with definite time characteristic) that allows restriking faults to be detected.

Each set point has a 2 nd harmonic restraint in order to ensure stability during transformer energizing.

Negative sequence / unbalance (ANSI 46)
Protection against phase unbalance.
Sensitive protection against 2-phase faults on long feeders.
Protection of equipment against temperature build-up caused by an unbalanced supply or wrong phase rotation or the loss of a phase and protection against low levels of phase-to-phase overcurrent.

IDMT or definite time characteristics.

Thermal overload (ANSI 49)
Protection of equipment against thermal damage caused by overloads.

The thermal capacity used is calculated according to a mathematical model which takes into account:
■ RMS current values,
■ ambient temperature.

The function comprises:
■ an adjustable alarm set point,
■ an adjustable tripping set point,
□ transformer application.
The model takes into account the transformer heat rise and cooling time constants according to whether natural or forced ventilation is used (ONAN, ONAF) by logic input.
□ motor application.
The model takes into account:
- two time constants: the heat rise time constant, used when the motor is running, and the cooling time constant, used when the motor is stopped,
- effect of negative sequence current on rotor heating.

An additional setting may be used to adapt the protection to fit the motor thermal withstand given by the experimental hot and cold curves provided by the equipment manufacturer.

The thermal protection may be inhibited by a logic input when this is required by the process running conditions.

Phase undercurrent (ANSI 37)
Protection of pumps against the consequences of a loss of priming.
The protection detects time-delayed current drops that correspond to motor no-load operation, characteristic of the loss of pump priming.

Protections (cont'd)

Excessive starting time / locked rotor / (ANSI 48/51LR) (1)
Protection of motors that are liable to start with overloads or insufficient supply voltage and/or that drive loads that are liable to jam (e.g. crushers).
The **locked rotor** function is an overcurrent protection that is only confirmed after a time delay that corresponds to the normal starting time.

Starts per hour (ANSI 66) (1)
Protection against overheating caused by too frequent starts.
Checking of the number of:
- starts per hour (or adjustable time period),
- consecutive starts.

The protection inhibits motor energizing for a preset time period once the permissible limits have been reached.

Recloser (ANSI 79)
Automation device used to reclose the circuit breaker after tripping triggered by a transient fault on a line (the function includes 4 parameterizable reclosing cycles).

Thermostat, Buchholz (temperature, gas and pressure detector)
Protection of transformers against temperature rises and internal faults via logic inputs linked to devices integrated in the equipment.

Temperature monitoring (RTDs) (ANSI 38/49T)
Protection against abnormal overheating of motor windings and/or bearings equipped with RTDs.
The protection includes 2 independent set points that are adjustable for each RTD.

Positive sequence undervoltage (ANSI 27D), (ANSI 47)
Motor protection against malfunctioning due to insufficient or unbalanced supply voltage. Detection of phase rotation. In order for this protection to be used, voltage transformers must be connected to Sepam to measure U21 and U32.

Remanent undervoltage (ANSI 27R)
Monitoring of the clearing of voltage sustained by rotating machines after circuit opening. The protection is used to prevent transient electrical and mechanical phenomena that are caused by fast re-energizing of motors.
It monitors phase-to-phase voltage U21 or phase-to-neutral voltage V1.

Phase-to-phase undervoltage (ANSI 27)
Protection used either for automated functions (transfer, load shedding) or to protect motors against undervoltage. The protection monitors the drop in each of the phase-to-phase voltages being metered.

Phase-to-neutral undervoltage (ANSI 27S)
Protection used to detect phase-to-earth faults (in isolated neutral systems).

Overvoltage (ANSI 59)
Protection against abnormally high voltage or checking that there is sufficient voltage for power supply transfer (set point 1) and checking of phase-to-phase voltages U32 and U21 (set point 2).

Neutral voltage displacement (ANSI 59N)
Detection of insulation faults in ungrounded systems by measurement of neutral voltage displacement. The protection is generally used with transformer incomers or busbars.
The function includes 2 set points.

Overfrequency (ANSI 81H)
Protection against abnormally high frequency.

Underfrequency (ANSI 81L)
Detection of variances with respect to the rated frequency, in order to maintain a high quality power supply. The protection may be used for overall tripping or for load shedding.

Rate of change of frequency / ROCOF (ANSI 81R)
Protection used for fast disconnection of a source feeding a power network when a fault occurs or to check load shedding.

(1) possibility of motor re-acceleration to be taken into account by a logic input.

Setting ranges

general parameters (set in general settings menu)				
frequency	50 Hz or 60 Hz			
phase current sensor	1 A or 5 A CT type rated current In	number (I1, I2, I3) or (I1, I3) 1 A to 6250 A		
	LPCT type rated current In (3)	number (I1, I2, I3) 25 A to 3150 A		
residual current sensor	CSH 120/200 type rated current Ino	2 A or 20 A		
	1 A or 5 A CT + CSH type rated current Ino	or core balance CT (2) 1 A to 6250 A		
voltage sensor	rated primary voltage Unp	220 V to 250 kV		
	VT: 100, 110, 115, 120 V (Uns)	V1, V2, V3 U21, U32 U21		
	VT: 200, 230 V	V1, V2, V3		
functions	**settings**			**time delays**
phase overcurrent				
tripping curve		holding time		
	definite time	DT		
	SIT, LTI, VIT, EIT, UIT (1)	DT		
	RI	DT		
	CEI : SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT		
	IEEE : MI (D), VI (E), EI (F)	DT or IDMT		
	IAC : I, VI, EI	DT or IDMT		
Is set point	0.1 to 24 In	definite time		Inst; 0.05 s to 300 s
	0.1 to 2.4 In	IDMT		0.1 s to 12.5 s at 10 Is
holding time	definite time (timer hold)			Inst; 0.05 s to 300 s
	IDMT (reset time)			0.5 s to 300 s
earth fault				
tripping curve		holding time		
	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 15 Ino	definite time		Inst; 0.05 s to 300 s
	0.1 to 1 Ino	IDMT		0.1 s to 12.5 s at 10 Iso
holding time	definite time (timer hold)			Inst; 0.05 s to 300 s
	IDMT (reset time)			0.5 s to 300 s
negative sequence / unbalance				
definite time	0.1 to 5 Ib			0.1 s to 300 s
IDMT	0.1 to 0.5 Ib			0.1 s to 1 s
thermal overload			**operating rate 1**	**operating rate 2**
	negative sequence coefficient	0 -2.25-4.5-9		
	time constant	heat rise	T1: 5 to 120 mn	T1: 5 to 120 mn
		cooling	T2: 5 to 600 mn	T2: 5 to 600 mn
	alarm; tripping	50 to 300% of normal heat rise		
	cold curve modification coefficient	0 to 100%		
	operating rate change condition	by Is set point adjustable from 0.25 to 8 Ib (motor)		
		by logic input I26 (transformer)		
	maximum equipment temperature	60 to 200 °C		
phase undercurrent				
	0.15 to 1 Ib			0.05 s to 300 s
excessive starting time/ locked rotor				
	0.5 Ib to 5 Ib	ST start time LT, LTS time delay		0.5 s to 300 s 0.05 s to 300 s

Setting ranges (cont'd)

functions	settings		time delays
starts per hour			
	1 to 60 per hour	hour	1 to 6 h
	1 to 60 consecutive	time between starts	0 to 90 mn
temperature (RTDs)			
	0 to 180 °C (or 32 to 356°F)		
positive sequence undervoltage			
	30 to 100 % of Vnp (Unp/$\sqrt{3}$)		0.05 s to 300 s
remanent undervoltage			
	5 to 100 % of Unp		0.05 s to 300 s
phase-to-phase undervoltage			
	5 to 100 % of Unp		0.05 s to 300 s
phase-to-neutral undervoltage			
	5 to 100 % of Vnp		0.05 s to 300 s
phase-to-phase overvoltage			
	50 to 150 % of Unp		0.05 s to 300 s
neutral voltage displacement			
	2 to 80 % of Unp		0.05 s to 300 s
overfrequency			
	50 to 53 Hz or 60 to 63 Hz		0.1 s to 300 s
underfrequency			
set point 1 and set point 2	45 to 50 Hz or 55 to 60 Hz		0.1 s to 300 s
rate of change of frequency			
	0.1 to 10 Hz/s		Inst; 0.15 s to 300 s

Note: In current, Unp rated voltage and Ino current are general parameters that are set at the time of Sepam commissioning. They are given as the values on the metering transformer primary windings.
In is the current sensor rated current (CT rating) (adjustable from 1 to 6250 Amps),
Unp is the rated phase-to-phase voltage of the voltage sensor primary windings (adjustable from 220V to 250KV),
Ino is the core balance CT current rating,
Ib is the current which corresponds to the motor power rating, adjustable from 0.4 to 1.3 In.
The current, voltage and frequency values are set by direct entry of the values (resolution: 1 A, 1 V, 1 Hz, 1°C or F).
(1) tripping as of 1.2 Is.
(2) with ACE 990 interface for core balance CT with ratio n of 50 to 1500 turns.
(3) table of In values in Amps: 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.

Control and monitoring

Sepam 1000+ performs the basic control and monitoring functions necessary for the operation of the electrical network, thereby reducing the need for auxiliary relays.

The control and monitoring functions may be parameterized using the SFT 2841 software package, however each type of Sepam has parameter setting by default which allows easier commissioning in the most frequent cases of use.

Two control modes are available
■ Integrated circuit breaker control.
This logical function deals with all the circuit breaker making and breaking conditions based on position data, external control and recloser protection functions, etc…
■ Individual parameter setting of output relays.
Control of output relays according to an allocation matrix.

Breaking device control
Sepam is used to control breaking devices equipped with different types of closing and tripping coils:
■ circuit breakers with shunt trip or undervoltage trip units (parameter setting on front panel (1) or via SFT 2841),
■ latching contactors with shunt-trip units.

Output relay control (standard or fail-safe) may be set. By default, the program logic is adapted to control a circuit breaker with a shunt trip unit.
Open and close control via the communication link.

Latching / acknowledgment (ANSI 86)
Output relay latching may be parameterized. Latched tripping orders are stored and must be acknowledged in order for the device to be put back into service.

The user acknowledges via the keypad or remotely via a logic input or the communication link.

Inhibit closing (ANSI 69)
Sepam inhibits the closing of the circuit breaker or contactor according to the operation conditions.

Inhibit thermal protection
Thermal protection tripping may be inhibited via a logic input.

Re-acceleration
Allows a logic input to take into account the restarting of an unstopped motor.

Remote tripping
Circuit breakers or contactors may be remote-controlled via a logic input or via the communication link.

Inhibit remote control
A logic input inhibits the circuit breaker remote control mode via the communication link.

Switching of settings groups
Used to switch from on group of phase current and earth fault protection settings to another one.
The switch may be made by a logic input or via the communication link.

Logic discrimination (ANSI 68)
This function allows quick, selective tripping of the phase overcurrent and earth fault protection relays, whether definite time or IDMT, without requiring the use of time intervals between upstream and downstream protection devices.
The downstream relay transmits a blocking input signal if the protection devices' set points are exceeded.

The upstream relay receives the blocking input signal on the logic input, used for the inhibition function. A saving mechanism ensures the operation of the protection in the event of an inhibition link failure.

Annunciation (ANSI 30)
Sepam indicates the appearance of alarms by:
■ signal lamps on the front panel,
■ messages on the display.

The addressing of the signal lamps may be parameterized.

The sequence is as follows (advanced UMI):
■ when an event appears, the signal lamp goes on and the related message is displayed,
■ the user presses the "**clear**" key to erase the message,
■ after the fault disappears and the "**reset**" key is pressed, the signal lamp goes off and the protection is reset,
■ the list of alarm messages remains accessible (⚠ key) and may be cleared by pressing the "**clear**" key.

Remote annunciation
Used to remote information via the communication link.
Information such as circuit breaker position, SF6 fault alarm, etc.

Trip circuit supervision
Detects trip circuit faults (shunt trip units). Detects open/closed position discrepancy faults (undervoltage trip units).

Watchdog
Indicates Sepam unavailability.

Output relay testing
This function is used to activate each output relay.

(1) Sepam equipped with advanced UMI.

List of messages (1)

functions	**Anglais** (usine)	**Français**
phase overcurrent	PHASE FAULT	DEFAUT PHASE
earth fault	EARTH FAULT	DEFAUT TERRE
thermal overload	THERMAL ALARM THERMAL TRIP	ECHAUF^{T}. ALARME ECHAUF^{T}. DECL^{T}.
negative sequence / unbalance	UNBALANCE	DESEQUILIBRE
locked rotor / locked rotor on start	ROTOR BLOCKING ST^{RT} LOCKED ROT^{R}.	BLOCAGE ROTOR BLOC ROTOR DEM
excessive starting time	LONG START	DEMARRAGE LONG
starts per hour	START INHIBIT	DEMARRAGE INHIBE
phase undercurrent	UNDER CURRENT	COURANT <<
phase-to-phase overvoltage	OVERVOLTAGE	TENSION >>
phase-to-phase undervoltage	UNDERVOLTAGE	TENSION <<
positive sequence undervoltage	UNDERVOLTAGE	TENSION <<
phase-to-neutral undervoltage	UNDERVOLT. V1 UNDERVOLT. V2 UNDERVOLT. V3	TENSION << V1 TENSION << V2 TENSION << V3
neutral voltage displacement	Vo FAULT	DEFAUT Vo
overfrequency	OVER FREQ.	FREQUENCE >>
underfrequency	UNDER FREQ.	FREQUENCE <<
rate of change of frequency	ROCOF	DERIV. FREQ.
temperature monitoring (2)	OVER TEMP. ALM OVER TEMP. TRIP RTD'S FAULT	T° ALARME T°. DECL^{T}. DEFAUT SONDES
thermostat (3)	THERMOS^{T}. ALARM THERMOS^{T}. TRIP	THERM^{OT}. ALARME THERMOS^{T}. DECL^{T}.
Buchholz (3)	BUCHHOLZ ALARM BUCHH/GAS TRIP	BUCHH ALARME BUCHH/GAZ DECL^{T}.
pressure (3)	PRESSURE TRIP	PRESSION DECL^{T}.
trip circuit supervision	TRIP CIRCUIT	CIRCUIT DECL^{T}.
circuit breaker / contactor control	CONTROL FAULT	DEFAUT COM^{DE}.
recloser	PERMANENT FAULT	DEFAUT PERMAN^{T}.
recloser	CLEARED FAULT	DEFAUT ELIMINE

(1) Sepam equipped with advanced UMI or SFT 2841.
messages by default, the wording of the messages may be changed (please consult us).
(2) RTD'S FAULT message: refer to the maintenance chapter.
(3) according to parameter setting logic input I21 to I24 (T20 type).

Program logic

Each Sepam 1000+ has program logic by default according to type (S20, T20,…) as well as messages for the different signal lamps.

The functions are assigned according to the most frequent use of the unit. This parameter setting may be customized if required using the SFT 2841 software package.

Example: Sepam S20 equipped with optionnal module MES 114

		ES (2)	output								signal lamps									associated functions
functions			**O1**	**O2**	**O3**	**O4**	**O11**	**O12**	**O13**	**O14**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**	
phase protection (latching)	50/51-1	■	■	■				■			■								■	breaker
	50/51-2	■	■	■				■				■							■	control
earth fault protection	50N/51N-1	■	■	■					■				■						■	
	50N/51N-2	■	■	■					■					■					■	
unbalance protection	46	■	■	■															■	
recloser	79	■								■										
open position	I11	■															■			trip circuit supervision
closed position	I12	■																■		
blocking input receipt	I13	■																		logic discrimination
line switch open (1)	I14	■																		
tripping by external protection	I21	■													■					
	I22																			
	I23																			
	I24																			
inhibit remote control	I25	■																		remote control
SF6 pressure drop	I26	■		■																
blocking input transmission		■			■															logic discrimination
“pick-up” signal		■																		disturbance recording triggering
watchdog		■				■														

Output
O1 - tripping
O2 - inhibit closing
O3 - BI transmission
O4 - watchdog
O11 - close order
O12 - phase fault indication
O13 - earth fault indication
O14 – earth fault indication

Signal lamps
L1 - I > 51
L2 - I >> 51
L3 - Io > 51N
L4 - Io >> 51N
L5 - ext
L6 -
L7 - off
L8 - on
L9 - Trip

(1) or CB withdrawned position.
(2) in service.

Default parameter setting

The Sepam units are delivered with default parameter setting and protection setting according to the type of application. These “factory” settings are also used with the SFT 2841 software:
■ for the creation of new files in disconnected mode,
■ for a return to the “factory” settings in connected mode.

S20, T20 and M20 applications

Hardware configuration
■ Rn Identification: Sepam xxxx
■ Model: UX
■ MES module: absent
■ MET module: absent
■ MSA module: absent
■ DSM module: present
■ ACE module: absent

Output parameter setting
■ Outputs used: O1 to O4
■ Shunt coils: O1, O3
■ Undervoltage coils: O2, O4
■ Impulse mode: no (latched)

Program logic
■ Circuit breaker control: no
■ Logic discrimination: no
■ Use of logic inputs: not used

General characteristics
■ Network frequency: 50 Hz
■ Setting group: A
■ Enable remote setting: no
■ Working language: English
■ CT rating: 5 A
■ Number of CTs: 3 (I1, I2, I3)
■ Rated current In: 630 A
■ Base current Ib: 630 A
■ Integration period: 5 min
■ Residual current: 3I sum
■ Pre-trig for disturbance recording: 36 periods

Protections
■ All the protections are “off”.
■ The settings comprise values and choices that are informative and consistent with the general characteristics by default (in particular rated current In).
■ Tripping behavior
□ latching: yes,
□ activation of output O1: yes,
□ disturbance recording triggering: with.

Command matrix
■ S20 application:
□ activation of output O2 upon protection tripping,
□ activation of indicators according to front panel markings,
□ watchdog on output O4,
□ disturbance recording triggering upon signal pick-up.

■ Complements for T20 application:
□ activation of O1 without latching upon tripping of temperature monitoring 1 to 7,
□ activation of O1 and indicator L9 without latching upon thermal overload tripping.

■ Complements for M20 application:
□ activation of outputs O1 and O2 and indicator L9 upon tripping of functions 37 (phase U/C) and 51 LR (locked rotor),
□ activation of output O2 upon tripping of function 66 (starts per hour),
□ latching for function 51 LR.

B21[(1)], B22 applications

Hardware configuration
- Identification: Sepam xxxx
- Model: UX
- MES module: absent
- MET module: absent
- MSA module: absent
- DSM module: present
- ACE module: absent

Output parameter setting
- Outputs used: O1 to O4
- Shunt coils: O1 to O3
- Undervoltage coils: O4
- Impulse mode: no (latched)

Program logic
- Circuit breaker control: no
- Assignment of logic inputs: not useds

General characteristics
- Network frequency: 50 Hz
- Enable remote setting: no
- Working language: English
- Primary rated voltage (Unp): 20 kV
- Secondary rated voltage (Uns): 100 V
- Voltages measured by VTs: V1, V2, V3
- Residual voltage: 3V sum
- Pre-trig for disturbance recording: 36 periods

Protections
- All the protections are “off”
- The settings comprise values and choices that are informative and consistent with the general characteristics by default
- Latching: no
- Disturbance recording triggering: with

Command matrix
- Assignment of output relays and indicators according to chart:

functions		output				indicators								
B21	**B22**	**O1**	**O2**	**O3**	**O4**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**L8**	**L9**
27D-1	27D-1		■				■							
27D-2	27D-2	■					■							■
27R	27R			■				■						
27-1	27-1		■			■								
27-2	27-2	■				■								■
27S-1	27S-1	■				■								■
27S-2	27S-2	■				■								■
27S-3	27S-3	■				■								■
59-1	59-1		■						■					
59-2	59-2	■							■					■
59N-1	59N-1		■							■				
59N-2	59N-2	■								■				■
81H	81H	■									■			■
81L-1	81L-1		■									■		
81L-2	81L-2	■											■	■
	81R	■											■	■

- Disturbance recording triggering upon signal pick up.
- Watchdog on output O4.

Indicator marking
L1: U < 27
L2: U < 27D
L3: U < 27R
L4: U > 59
L5: U > 59N
L6: F > 81H
L7: F < 81L
L8: F << 81L
L9: Trip

(1) Type B21 performs the same functions as cancelled type B20.

Sepam 1000+ has a large number of self-tests that are carried out in the base unit and additional modules. The purpose of the self-tests is:
■ detect failures that may led to nuisance tripping or failure to trip when there is a fault,
■ put Sepam in the fail-safe position to avoid user errors,
■ notify the operator that a maintenance operation is required.

The “Sepam Diagnosis” screen, general settings menu of the SFT 2841 software package may be used for access to information on the state of the base unit and optional modules.

Shutdown in fail-safe position

The base unit goes into the fail-safe position in the following conditions:
■ detection of an internal failure by the self-tests,
■ missing sensor interface connector (CCA 630, CCA 670 or CCT 640 according to the type of application),
■ missing MES module when the module has been configured.

The fail-safe position is conveyed by:
■ ON indicator switched on,
■ indicator on the base unit steadily on,
■ “watchdog” relay 04 in fault position,
■ output relays deactivated,
■ all protections inhibited,
■ fault message on the display unit,

■ indicator on the DSM 303 module (remote advanced UMI option) flashing.

Downgraded operation

The base unit is in working order and indicates that one of the optional modules such as the DSM 303, MET 148 or MSA 141 is faulty or that a module is configured but not connected.

According to the model, this operating mode is conveyed by:

■ Sepam with integrated advanced UMI (UD base):
□ ON indicator switched on,
□ indicator on the base unit flashing, including when the display has broken down (off),
□ indicator on the faulty MET or MSA module steadily on.

The display shows a partial fault message and indicates the type of fault by a code:
□ code 1: inter-module link fault,
□ code 3: MET module unavailable,
□ code 4: MSA module unavailable.

■ Sepam with remote advanced UMI (UX + DSM 303 base):
□ ON indicator switched on,
□ indicator on the base unit flashing,
□ indicator on the faulty MET or MSA module steadily on,
□ display indicates the type of fault by a code (same as above).

Special case of faulty DSM 303:
□ ON indicator switched on,
□ indicator on the base unit flashing,
□ indicator on the DSM steadily on.

□ Display off.

This Sepam operating mode is also transmitted by the communication link.

RTD fault

Each temperature monitoring function, when activated, detects whether the RTD linked to the MET 148 module is short-circuited or cut.
When this is the case, the alarm message “RTD’S FAULT” is generated.
Since this alarm is common to the 8 functions, the identification of the faulty RTD or RTDs is obtained by consulting the values measured:

■ displayed measurement “****” if the RTD is short-circuited (T < - 35°C),
■ displayed measurement “-****” if the RTD is cut (or T > + 205°C).

Repair replacement

When the Sepam 1000+ or a module is considered to be faulty, have it replaced by a new product or module, since these components cannot be repaired.

Modbus communication

Presentation

Modbus communication enables Sepam 1000 + to be connected to a remote monitoring and control system equipped with a master Modbus communication channel and a physical link of the RS 485 type, or another interface equipped with an appropriate converter.

The Modbus protocol used by Sepam 1000+ is a compatible sub-group of the RTU Modbus (1) protocol (a Modbus master can communicate with several Sepam 1000+ units). Sepam 1000+ is always a slave station.

All the Sepam 1000+ units can be equipped with the ACE 949-2 (2-wire) or ACE 959 (4-wire) interface for connection to the communication network.

Refer to document PCRED399074EN «RS485 network connection guide» for network erection.

Data available

The data available depends on the type of Sepam.

Measurement readout
- phase and earth currents,
- peak demand phase currents,
- tripping currents,
- cumulative breaking current,
- phase-to-phase, phase-to-neutral and residual voltages,
- frequency,
- temperatures,
- thermal capacity used,
- number of starts and inhibit time,
- running hours counter,
- motor starting current and time,
- remaining operating time before overload tripping,
- waiting time after tripping,
- operating time and number of operations,
- circuit breaker loading time.

Program logic data readout
- A table of 64 preassigned remote indications (TS) (depending on the type of Sepam) is used the status of the program logic data.
- Reading the status of 10 digital inputs.

Remote control orders
Writing of 16 impulse type remote control orders (TC) in direct mode or in SBO (Select Before Operate) mode via 16 selection bits.

Other functions
- Sepam configuration and identification reading,
- time-tagging of events (synchronization by network or externally via logic input I21), tagging of events within a millisecond accuracy,
- remote reading of Sepam protection settings (remote reading),
- remote setting of protections (remote setting),
- remote control of analog output (2),
- transfer of disturbance recording data.

Supervision zone
This zone includes all the data used by the remote control and monitoring system and may be accessed in a single reading.

(1) Modbus is a Modicon patented trademark.
(2) with MSA 141 option.

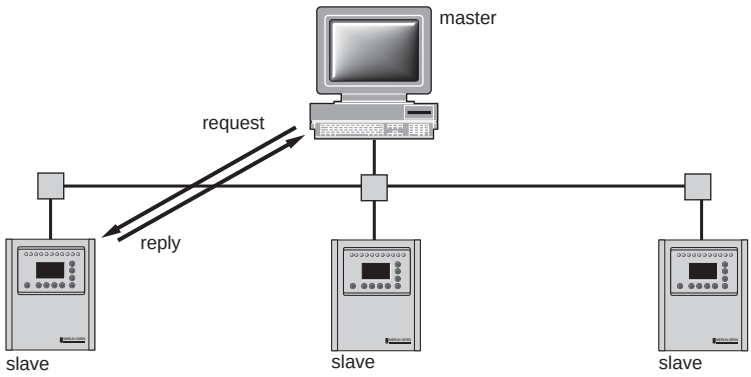
Modbus protocol

Characterization of exchanges
The Modbus protocol may be used to read or write one or more bits, one or more words, the contents of the event counters or the contents of the diagnosis counters.

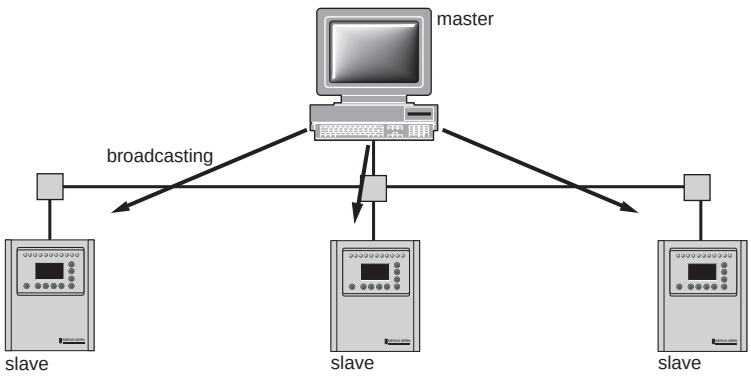
Modbus functions supported

Sepam 1000+'s Modbus protocol supports 11 functions:
- function 1: reading of n output or internal bits,
- function 2: reading of n input bits,
- function 3: reading of n output or internal words,
- function 4: reading of n input words,
- function 5: writing of 1 bit,
- function 6: writing of 1 word,
- function 7: high-speed reading of 8 bits,
- function 8: reading of diagnosis counters,
- function 11: reading of Modbus event counters,
- function 15: writing of n bits,
- function 16: writing of n words.

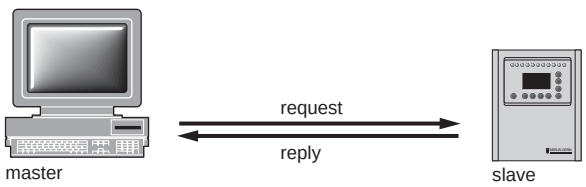
The following exception codes are supported:
- 1: unknown function code,
- 2: incorrect address,
- 3: incorrect data,
- 7: not acknowledged (remote reading and setting).



Exchanges are initiated by the master and include a request by the master and a reply by the slave (Sepam 1000+). Requests by the master are either addressed to a given Sepam 1000+ identified by its number in the first byte of the request frame, or addressed to all the Sepam 1000+s (broadcasting).



Broadcast commands are necessarily write commands. No replies are transmitted by the Sepam 1000+s.



It is not necessary to have a detailed knowledge of the protocol unless the master is a central computer which requires the corresponding programming. All Modbus exchanges include 2 messages: a request by the master and a reply by the Sepam 1000+.

All the frames that are exchanged have the same structure. Each message or frame contains 4 types of data:

slave number	function code	data zones	CRC 16 check zone

- slave number (1 byte): this indicates the receiving Sepam 1000+ (0 to FFh). If it is equal to zero, the request concerns all the slaves (broadcasting) and there is no reply message,
- function code (1 byte): this is used to select a command (read, write, bit, word) and to check that the reply is correct,
- data zones (n bytes): these zones contain the parameters relating to the function: bit address, word address, bit value, word value, number of bits, number of words,
- check zone (2 bytes): this zone is used to detect transmission errors.

Synchronization of exchanges
Any character that is received after a silence of more than 3 characters is considered as the beginning of a frame. A silence of at least 3 characters must be left on the line between two frames.

Example: at 9600 bauds, this time is equal to approximately 3 milliseconds.

Diagnosis counters

The following diagnosis counters are managed by Sepam 1000+:
■ **CPT1**, first word: number frames received OK, whether or not the slave is concerned,
■ **CPT2**, second word: number of frames received with a CRC error, or frames received with more than 255 bytes and not interpreted, or frames received with at least one character that has a parity error, “overrun, “framing”, “break” on the line. An incorrect rate causes incrementation of CPT2.
■ **CPT3**, third word: number of exception replies generated (even if not transmitted, as a result of a broadcast request),
■ **CPT4**, fourth word: number of frames specifically addressed to the station (excluding broadcasting),
■ **CPT5**, fifth word: number of broadcast frames received with no errors,
■ **CPT6**, sixth word: not significant,
■ **CPT7**, seventh word: number of “Sepam 1000+ not ready” replies generated,
■ **CPT8**, eighth word: number of frames received with at least one character that has a parity error, “overrun”, “framing”, “break” on the line,
■ **CPT9**, ninth word: number of correct requests received and correctly executed.

The counters are accessed using the special reading function (function 11 of Modbus protocol).

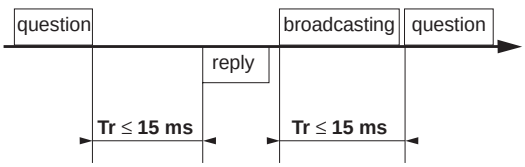
When the value of a counter is equal to FFFFh (65535), it automatically switches to 0000h (0).

The diagnosis counters are initialized to zero when the **auxiliary power is turned** off (or mains outage)
The CPT2 and CPT9 counters may be displayed on SFT2841 (“Sepam diagnosis“ screen).

Response time

The communication coupler **response time (Tr)** is less than 15 ms, including a 3-character silence (approximately 3 ms at 9600 bauds).

This time is given with the following parameters:
■ 9600 bauds,
■ format 8 bits, odd parity, 1 stop bit.



Characteristics

type of transmission	asynchronous serial			
protocol	Modbus slave			
rate	4800, 9600, 19200, 38400 bauds			
data format	1 start, 8 bits, no parity, 1 stop 1 start, 8 bits, even parity, 1 stop 1 start, 8 bits, odd parity, 1 stop			
electrical interface	2-wire differential, complies with EIA RS 485 standard			
type of connection	screw terminals and tightening clamps/ shielding continuity			
response time	less than 15 ms.			
maximum length of RS485 distributed power supply (in m):	number of Sepam connected: 5	10	20	25
12 V distributed power supply	320	180	160	125
24 V distributed power supply	1000	750	450	375

values obtained with a standard cable (2-pair AWG 24; resistance per unit length 78 Ω / km).
values multiplied by 3 with a maximum of 1300 m with specific cable, reference FILECA F2644-1; Schneider approved (refer to "RS485 - Modbus network connection accessories instruction manual", PCRED399074EN).

Setting the communication parameters

Before a Sepam 1000+ equipped with the Modbus communication system is put into service, 4 parameters need to be set.

selection	factory setting
transmission rate adjustable from 4800 to 38400 bauds	9600 bauds
slave n° assigned to the Sepam 1000+ adjustable from 1 to 255	n° 001
parity: even parity, odd parity, no parity	even parity
direct / confirmed remote control mode	direct

These 4 parameters are saved in the event of a power failure.

The Modbus slave number should be assigned before the Sepam 1000+ is connected to the communication network (the slave number is factory-set to 1 on all Sepam's).
Set the communication parameters before connecting the Sepam 1000+ to the communication network.
The communication parameters may be changed while the Sepam 1000+ is operating without disturbing operation. Sepam 1000+ ignores the first frame received after it is energized or after the communication parameters are changed via SFT 2841.

Green "line activity" indicator:
The green indicator on the ACE 949-2 or ACE 959 accessory is activated by variations of the electrical signal on the RS 485 network. When the master communicates with Sepam 1000+ (transmission or receiving), the green indicator flashes.

Testing the link

■ After cabling, check the indications given by the "line activity" green light.
■ Carry out read and write cycles using the test zone and the Modbus echo mode.
■ Use the SFT 2819 software to read and write the test zone.

The following Modbus frames, transmitted or received by a remote monitoring and control system are given for test purposes when the communication link is commissioned.

test zone	
read	
transmission	01 03 0C00 0002 (C75B) crc,
receipt	01 03 04 0000 0000 (FA33) crc.
write	
transmission	01 10 0C00 0001 02 1234 (6727) crc,
receipt	01 10 0C00 0001 (0299) crc.
read	
transmission	01 03 0C00 0001 (875A) crc,
receipt	01 03 02 1234 (B533) crc.
Modbus echo mode (see function 8 of Modbus protocol)	
transmission	01 08 0000 1234 (ED7C) crc,
receipt	01 08 0000 1234 (ED7C)crc

The CRC received by Sepam 1000+ is recalculated, which makes it possible to test the calculation of the CRC transmitted by the master:
■ the CRC received is correct, Sepam 1000+ replies,
■ the CRC received is not correct, Sepam 1000+ does not reply.

Malfunctions

■ It is advisable to connect the Sepam 1000+s one by one to the RS 485 network.
■ The display of the counters on SFT 2841 ("Sepam diagnosis" screen) makes it possible to check Modbus exchanges.
■ Check the Modbus slave number, the rate and the format using SFT 2841 or the Sepam UMI.
Make sure that the master is transmitting frames to the Sepam 1000+ concerned by checking the activity on the RS 232 - RS 485 converter, if there is one, and on the ACE 949-2 or ACE 959 module.
■ Check the cabling on each ACE 949 or ACE 959 module:
check the tightening of the screw-terminals on each module.
■ Check that the CCA 612 cable connecting the ACE 949-2 or ACE 959 module to the Sepam unit (item Ⓒ) is plugged in.
■ Check the polarization, which should only be at one point, and the impedance matching at the ends the RS 485 network.
■ Check that the cable being used is the recommended one.
■ Check that the ACE 909-2 or ACE 919 converter being used is connected and parameterized correctly.

Modbus communication
Data addresses and encoding

Presentation

Data which are similar from the monitoring and control application viewpoint are grouped together in adjacent address zones:

	hexadecimal starting address	ending address	Modbus functions enabled
synchronization zone	0002	0005	3, 16
identification zone	0006	000F	3
first events table			
exchange word	0040	0040	3, 6, 16
events (1 to 4)	0041	0060	3
second events table			
exchange word	0070	0070	3, 6, 16
events (1 to 4)	0071	0090	3
data			
states	0100	0105	3, 4 1, 2*
measurements	0106	0131	3, 4
remote control orders	01F0	01F0	3, 4, 6, 16 1, 2, 5, 15*
remote control confirmation	01F1	01F1	3, 4, 6, 16 1, 2, 5, 15*
test zone	0C00	0C0F	3, 4, 6, 16 1, 2, 5, 15
protection settings			
reading	2000	207C	3
reading request	2080	2080	3, 6, 16
remote settings	2100	217C	3, 16
disturbance recording			
choice of transfer function	2200	2203	3, 16
identification zone	2204	2228	3
fault rec. exchange word	2300	2300	3, 6, 16
fault rec. data	2301	237C	3
application			
configuration	FC00	FC02	3
application identification	FC10	FC22	3

N.B. Non-addressable zones may reply by an exception message or else supply non-significant data.

* these zones may be accessed in word mode or in bit mode.
The address of bit i ($0 \leqslant i \leqslant F$) of address word J is then (J x 16) + i.
e.g. 0C00 bit 0 = C000 0C00 bit 7 = C007

Synchronization zone

The synchronization zone is a table which contains the absolute date and time for the time-tagging function. Time messages should be written in a single block containing 4 words, using the function 16: write word. Messages can be read word by word or by groups of words using function 3.

synchronization zone	word address	access	Modbus function enabled
binary time (year)	0002	read/write	3, 16
binary time (months + days)	0003	read	3
binary time (hours + minutes)	0004	read	3
binary time (milliseconds)	0005	read	3

See "time-tagging of events" chapter for data format.

Identification zone

The identification zone contains system type information pertaining to the identification of the Sepam 1000+ equipment.

Some of the information in the identification zone is also found in the configuration zone at the address FC00h.

identification zone	word address	access	Modbus function enabled	format	value
manufacturer identification	0006	R	3		0100
equipment	0007	R	3		0
marking + equipment type	0008	R	3		id. FC01
communication version	0009	R	3		id.FC02
application version	000A/B	R	3	not managed	0
Sepam check-word	000C	R	3		idem 0100
synthesis zone	000D	R	3	not managed	0
command	000E	R/W	3/16	not managed	init. to 0
extension zone address	000F	R	3		FC00

First events zone

The events zone is a table which contains a maximum of 4 time-tagged events. Events should be read in a single block containing 33 words using function 3.

The exchange word can be written using functions 6 or 16, and read individually using function 3.

identification zone	word address	access	Modbus function enabled
exchange word	0040	read/write	3, 6, 16
event n°1	0041-0048	read	3
event n°2	0049-0050	read	3
event n°3	0051-0058	read	3
event n°4	0059-0060	read	3

See "time-tagging of events" chapter for data format.

Second events zone

The events zone is a table which contains a maximum of 4 time-tagged events. Events should be read in a single block containing 33 words using function 3.

The exchange word can be written using functions 6 or 16, and read individually using function 3.

identification zone	word address	access	Modbus function enabled
exchange word	0070	read/write	3, 6, 16
event n°1	0071-0078	read	3
event n°2	0079-0080	read	3
event n°3	0081-0088	read	3
event n°4	0089-0090	read	3

See "time-tagging of events" chapter for data format.

Status zone

The status zone is a table which contains the Sepam check-word, the pre-assigned remote annunciation bits (TS) and the logical inputs.

status	word address	bit address	access	function	format
Sepam check-word	100	1000	R	3/4 ou 1, 2, 7	X
TS1-TS16	101	1010	R	3/4 ou 1, 2	B
TS17-TS32	102	1020	R	3/4 ou 1, 2	B
TS33-TS48	103	1030	R	3/4 ou 1, 2	B
TS49-TS64	104	1040	R	3/4 ou 1, 2	B
logical inputs	105	1050	R	3/4 ou 1, 2	B

Measurement zone

The measurement zone contains the analog measurements.
Application **S20, M20, T20.**

measurements	Modbus address	access	function	format	unit
I1 phase current (gain x 1)	106	R	3/4	16 NS	0.1 A
I2 phase current (gain x 1)	107	R	3/4	16 NS	0.1 A
I3 phase current (gain x 1)	108	R	3/4	16 NS	0.1 A
Io residual current (gain x 1)	109	R	3/4	16 NS	0.1 A
Im1 average phase current (x1)	10A	R	3/4	16 NS	0.1 A
Im2 average phase current (x1)	10B	R	3/4	16 NS	0.1 A
Im3 average phase current (x1)	10C	R	3/4	16 NS	0.1 A
I1 phase current (gain x 10)	10D	R	3/4	16 NS	1 A
I2 phase current (gain x 10)	10E	R	3/4	16 NS	1 A
I3 phase current (gain x 10)	10F	R	3/4	16 NS	1 A
Io residual current (gain x 10)	110	R	3/4	16 NS	1 A
Im1 average phase current (x10)	111	R	3/4	16 NS	1 A
Im2 average phase current (x10)	112	R	3/4	16 NS	1 A
Im3 average phase current (x10)	113	R	3/4	16 NS	1 A
IM1 peak demand phase current	114	R	3/4	16 NS	1 A
IM2 peak demand phase current	115	R	3/4	16 NS	1 A
IM3 peak demand phase current	116	R	3/4	16 NS	1 A
reserved	117	R	3/4	–	–
Itrip1 tripping current	118	R	3/4	16 NS	10 A
Itrip2 tripping current	119	R	3/4	16 NS	10 A
Itrip3 tripping current	11A	R	3/4	16 NS	10 A
Itripo tripping current	11B	R	3/4	16 NS	1 A
cumulative breaking current	11C	R	3/4	16 NS	1 $(kA)^2$
number of operations	11D	R	3/4	16 NS	1
operating time	11E	R	3/4	16 NS	1 ms
charging time	11F	R	3/4	16 NS	1 sec
reserved	120	R	3/4	–	–
running hours counter	121	R	3/4	16 NS	1h
thermal capacity used	122	R	3/4	16 NS	%
operating time before overload tripping	123	R	3/4	16 NS	1 min
waiting time after overload tripping	124	R	3/4	16 NS	1 min
unbalance ratio	125	R	3/4	16 NS	% Ib
starting time / overload	126	R	3/4	16 NS	0.1 sec
starting current / overload	127	R	3/4	16 NS	1 A
start inhibit time delay	128	R	3/4	16 NS	1 min
number of starts allowed	129	R	3/4	16 NS	1
temperatures 1 to 8	12A/131	R	3/4	16 S	1 °C
reserved	*132/1EF*	*prohibited*			

N.B. Only those measurement that correspond to the Sepam function are significant, the others are set to the value 0.

Modbus communication
Data addresses and encoding (cont'd)

B20 application

measurements	Modbus address	access	function	format	unit
U21 phase to phase voltage (x1)	106	R	3/4	16 NS	1 V
U32 phase to phase voltage (x1)	107	R	3/4	16 NS	1 V
U13 phase to phase voltage (x1)	108	R	3/4	16 NS	1 V
V1 phase to neutral voltage (x1)	109	R	3/4	16 NS	1 V
V2 phase to neutral voltage (x1)	10A	R	3/4	16 NS	1 V
V3 phase to neutral voltage (x1)	10B	R	3/4	16 NS	1 V
Vo residual voltage (x1)	10C	R	3/4	16 NS	1 V
positive sequence voltage (x1)	10D	R	3/4	16 NS	1 V
frequency	10E	R	3/4	16 NS	0.01 Hz
U21 phase to phase voltage (x10)	10F	R	3/4	16 NS	10 V
U32 phase to phase voltage (x10)	110	R	3/4	16 NS	10 V
U13 phase to phase voltage (x10)	111	R	3/4	16 NS	10 V
V1 phase to neutral voltage (x10)	112	R	3/4	16 NS	10 V
V2 phase to neutral voltage (x10)	113	R	3/4	16 NS	10 V
V3 phase to neutral voltage (x10)	114	R	3/4	16 NS	10 V
Vo residual voltage (x10)	115	R	3/4	16 NS	10 V
positive sequence voltage (x10)	116	R	3/4	16 NS	10 V
reserved	*117/131*	*R*	*3/4*		*init. to 0*
reserved	*132/1EF*	*prohibited*			

Accuracy
The accuracy of the measurements depends on the order of the unit: it is equal to the value of the point divided by 2.

Examples :

I1	unit = 1 A	accuracy = 1/2 = 0.5 A
U21	unit = 10 V	accuracy= 10/2 = 5 V

Remote control zone

The remote control zone is a table which contains the pre-assigned remote control bits (TC). The zone may be read or written using the word functions or bit functions. See section on remote control orders.

remote control bits	word address	bit address	access	function	format
TC1-TC16	01F0	1F00	R/W	3/4/6/16 1/2/5/15	B
STC1-STC16	01F1	1F10	R/W	3/4/6/16 1/2/5/15	B
analog output control	01F2		L/E	3/4/6/16	16S

Protection setting zone

The protection setting zone is an exchange table which is used to read and set protections.

protection settings	word address	access	function
setting read buffer	2000/207C	R	3
setting read request	2080	R/W	3/6/16
remote setting request buffer	2100/217C	R/W	3/16

see section on protection settings.

Fault recorder zone

The fault recorder zone is an exchange table which is used to read records.

disturbance recording	word address		access	function
choice of transfer function	2200/2203	R/W	3/16	
identification zone	2204/2228	R	3	
fault rec. exchange word	2300	R/W	3/6/16	
fault rec. data	2301/237C	R	3	

see section on fault recorder

Test zone

The test zone is a 16-word zone that may be accessed via the communication link by all the functions, in both read and write modes, to facilitate communication testing at the time of commissioning or to test the link.

test zone	word address	bit address	access	Modbus function enabled	format	
test	0C00	C000-C00F	read/write	1, 2, 3, 4, 5, 6, 15, 16	none	init. to 0
	0C0F	C0F0-C0FF	read/write	1, 2, 3, 4, 5, 6, 15, 16	none	init. to 0

Configuration zone

The configuration zone contains information pertaining to the hardware and software configuration of the Sepam 1000+.

configuration zone	address word	access	format		
configuration					
Modbus address (slave no.)	FC00	R	3		
Sepam type (MSB) / hardware config. (LSB)	FC01	R	3		(1)
coupler type (MSB)/ version (LSB)	FC02	R	3		(2)
application identification					
type of application (S20, M20, etc.)	FC10/15	R	3	ASCII	12 characters
application version	FC16/18	R	3	ASCII	6 characters
application marking	FC19/22	R	3	ASCII	20 characters

(1) FC01 word: MSB = 10h (Sepam 1000+)
LSB = hardware configuration

bit	7	6	5	4	3	2	1	0
option	**UD/UX**	**reserved**	**reserved**	**DSM303**	**MSA141**	**MET148**	**MES114**	**MES108**
UX model	0	0	0	x	x	x	y	y
UD model	1	0	0	0	x	x	y	y

X = 1 if option included
Y = 1 if option included, exclusive options

(2) FC02 word: MSB = 01h (Modbus)
LSB = XY (communication version X, Y)

Data encoding

For all formats
If a measurement overruns the maximum permissible value for the related format, the value read for the measurement will be the maximum permissible value for the format.

Format 16 NS
All information is encoded in 16-bit words, in absolute value (unsigned), binary format. The zero bit (b0) is the least significant bit in the word.

Format 16 S signed measurements (temperatures, ...)
The information is encoded in a 16-bit word as a complement of 2:

Example:
- 0001 represents +1,
- FFFF represents –1.

Format B: Ix
Rank i bit in the word, with i between 0 and F.

examples		F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0
logical input	word address 0105							26	25	24	23	22	21	14	13	12	11
	bit address 105X																
TS 1 to 16	word address 0101	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	bit address 101x																
TS 49 to 64	word address 0104	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49
	bit address 104x																
TC 1 to 16	word address 01F0	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	bit address 1FOx																
STC 1 to 16	word address 01F1	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
	bit address 1F1x																

Format X: Sepam 1000+ check-word
This format applies only to the Sepam check-word that may be accessed at the word address 100h. This word contains various items of information relating to:
- Sepam 1000+ operating mode,
- time-tagging of events.

Each data item contained in the Sepam check-word may be accessed bit by bit, from address **1000** for the bit b0 to **100F** for the bit b15.

- Bit 15 : event present.
- Bit 14 : Sepam in "data loss" status.
- Bit 13 : Sepam not synchronous.
- Bit 12 : Sepam time not correct.
- Bit 11 : reserved.
- Bit 10 : Sepam in local ssetting mode.
- Bit 9 : major fault in Sepam.
- Bit 8 : partial fault in Sepam.
- Bit 7 : setting group A in service.
- Bit 6 : setting group B in service.
- Bit 3-0 : mapping number (1 to 16).

other bits reserved (undetermined values).

Status changes of bits 6, 7, 8, 10, 12, 13 and 14 of this word trigger the transmission of a time-tagged event.
Bits 3 to 0 encode a "mapping number" (from 1 to 15) which is used to identify the contents of the Modbus addresses, the assignment of which varies depending on the application.

Use of remote annunciation

Sepam provides the communication link with 64 remote annunciation bits (TS). The TS are pre-assigned to protection and control functions which depend on the Sepam model.
The TS can be read using the bit or word functions. Each TS transition is time-tagged and stored in the event stack (see section on time-tagging).

Address word 101: TS 1 to 16 (bit address 1010 to 101F)

TS	us	S20	T20	M20	B21	B22
1	protection 50/51 relay 1 group A	■	■	■		
2	protection 50/51 relay 2 group A	■	■	■		
3	protection 50/51 relay 1 group B	■	■	■		
4	protection 50/51 relay 2 group A	■	■	■		
5	protection 50N/51N relay 1 group A	■	■	■		
6	protection 50N/51N relay 2 group A	■	■	■		
7	protection 50N/51N relay 1 group B	■	■	■		
8	protection 50N/51N relay 2 group B	■	■	■		
9	protection 49 RMS alarm set point		■	■		
10	protection 49 RMS trip set point		■	■		
11	protection 37 (undercurrent)			■		
12	protection 46 (neg. seq/unbalance)	■	■	■		
13	protection 48/51LR (locked rotor)			■		
14	protection 48/51LR (rotor locking on start)			■		
15	protection 48/51LR (excessive starting time)			■		
16	protection 66 (starts per hour)			■		

Address word 102: TS 17 to 32 (bit address 1020 to 102F)

TS	use	S20	T20	M20	B21	B22
17	protection 27D (dir. undervoltage) relay 1			■	■	
18	protection 27D (dir. undervoltage) relay 2			■	■	
19	protection 27 (ph.-to-ph. undervoltage) relay 1				■	■
20	protection 27 (ph.-to-ph. undervoltage) relay 2				■	■
21	protection 27R (remanent U/V) relay 1				■	■
22	protection 59 (ph.-to-ph. overvoltage) relay 1				■	■
23	protection 59 (ph.-to-ph. overvoltage) relay 2				■	■
24	protection 59N (ph.-to-n. overvoltage) relay 1				■	■
25	protection 59N (ph.-to-n. overvoltage) relay 2				■	■
26	protection 81H (overfrequency)				■	■
27	protection 81L (underfrequency) relay 1				■	■
28	protection 81L (underfrequency) relay 2				■	■
29	protection 27S (undervoltage) phase 1				■	■
30	protection 27S (undervoltage) phase 2				■	■
31	protection 27S (undervoltage) phase 3				■	■
32	protection 81R (rate of change of frequency)					■

Address word 103: TS 33 to 48 (bit address 1030 to 103F)

TS	use	S20	T20	M20	B21	B22
33	reserved					
34	recloser in service	■				
35	recloser in progress	■				
36	recloser permanent trip	■				
37	recloser successful trip	■				
38	send blocking input	■	■	■		
39	remote setting inhibited	■	■	■	■	■
40	remote control inhibited	■	■	■	■	■
41	Sepam not reset after fault	■	■	■	■	■
42	remote control / position discrepancy	■	■	■	■	■
43	matching fault or Trip Circuit Supervision	■	■	■	■	■
44	disturbance recording memorized	■	■	■	■	■
45	control fault	■	■	■	■	■
46	disturbance recording inhibited	■	■	■	■	■
47	thermal protection inhibited		■	■		
48	RTD fault		■	■		

Address word 104: TS 49 to 64 (bit address 1040 to 104F)

TS	use	S20	T20	M20	B21	B22
49	protection 49T alarm set point sensor 1		■	■		
50	protection 49T tripping set point sensor 1		■	■		
51	protection 49T alarm set point sensor 2		■	■		
52	protection 49T tripping set point sensor 2		■	■		
53	protection 49T alarm set point sensor 3		■	■		
54	protection 49T tripping set point sensor 3		■	■		
55	protection 49T alarm set point sensor 4		■	■		
56	protection 49T tripping set point sensor 4		■	■		
57	protection 49T alarm set point sensor 5		■	■		
58	protection 49T tripping set point sensor 5		■	■		
59	protection 49T alarm set point sensor 6		■	■		
60	protection 49T tripping set point sensor 6		■	■		
61	protection 49T alarm set point sensor 7		■	■		
62	protection 49T tripping set point sensor 7		■	■		
63	protection 49T alarm set point sensor 8		■	■		
64	protection 49T tripping set point sensor 8		■	■		

Use of remote control orders

Remote control orders are pre-assigned to protection, control and metering functions.

Remote control orders may be carried out in two modes:
■ direct mode,
■ confirmed SBO (select before operate) mode.

All the remote control orders may be inhibited by a logical input, I25 on the MES114 module, except for the remote control tripping order TC1 which can still be activated at any time.
Logical input I25 may be set up according to 2 modes:
■ inhibited if the input is set to 1 (“POS“ prefix),
■ inhibited if the input is set to 0 (“NEG“ prefix).

The device tripping and closing and recloser enable and disable remote control orders are acknowledged if the “CB control“ function is validated and if the inputs necessary for the logic are present (MES108 module minimum).

Direct remote control order

The remote control order is executed when it is written in the remote control word. The program logic resets it to zero after the remote control order is acknowledged.

Confirmed SBO remote control order (select before operate)

In this mode, remote control orders involve two steps:
■ selection by the master of the order to be sent by writing of the bit in the STC word and checking of the selection by rereading of the word,
■ execution of the order to be sent by writing of the bit in the TC word.

The remote control order is executed if the bit in the STC word and the bit in the associated word are set; the program logic resets the bit STC and TC bits to zero after the remote control order is acknowledged.

Deselection of the STC bit takes place:
■ if the master deselects it by writing in the STC word,
■ if the master selects (write bit) a bit other than the one already selected,
■ if the master sets a bit in the TC word which does not match the selection. In this case, no remote control order is executed.

Analog output remote control

The analog output of the MSA 141 module may be set up for remote control via the MODBUS communication module (address word 1F2). The working range of the numerical value transmitted is defined by the parameter setting of the “min. value” and “max. value“ of the analog output.
This function is not affected by the remote control inhibition conditions.

Address word 1F0: TC 1 to 16 (address bit 1F00 to 1F0F)

CT	use	S20	T20	M20	B21	B22
1	tripping	■	■	■	■	■
2	closing	■	■	■	■	■
3	switching to setting group A	■	■	■		
4	switching to setting group B	■	■	■		
5	Sepam reset (reset)	■	■	■	■	■
6	peak demand current zero reset	■	■	■		
7	inhibit thermal protection		■	■		
8	inhibit disturbance recording triggering	■	■	■	■	■
9	confirm disturbance recording triggering	■	■	■	■	■
10	manual dist. rec. triggering	■	■	■	■	■
11	enable recloser	■				
12	disable recloser	■				
13	confirm thermal protection		■	■		
14	reserved					
15	reserved					
16	reserved					

Presentation

The communication system time-tags the data processed by Sepam 1000+. The time-tagging function assigns a date and precise time to status changes so that they can be accurately classified with over time. Time-tagged data are events that can be processed in the control room by the remote monitoring and control system using the communication protocol for data logging and chronological reports.

Sepam 1000+ time-tags the following data:
- logical inputs,
- remote annunciation bits,
- information pertaining to Sepam 1000+ equipment (see Sepam check-word),

Time-tagging is carried out systematically. Chronological sorting of the time-tagged events is performed by the remote monitoring and control system.

Time-tagging
Sepam 1000+ time-tagging uses absolute time (see section on date and time). When an event is detected, it is tagged with the absolute time given by Sepam 1000+'s internal clock.

All the Sepam 1000+ internal clocks must be synchronized so as to avoid drifts and all be the same to allow inter-Sepam 1000+ chronological sorting.

Sepam 1000+ has two mechanisms for managing its internal clock:
- **time-setting**:
for initializing or modifying the absolute time. A special Modbus message, called "time message", is used to time-set each Sepam 1000+,
- **synchronization**:
to avoid Sepam 1000+ internal clock drifts and ensure inter-Sepam 1000+ synchronization.

Internal clocks can be synchronized according to two principles:
- **internal synchronization**:
via the communication network without any additional cabling,
- **external synchronization**:
via a logical input with additional cabling.

At the time of commissioning, the user sets the synchronization mode parameter.

Initialization of the time-tagging function
Each time the communication system is initialized (energizing of Sepam 1000+), the events are generated in the following order:
- appearance of "data loss",
- appearance of "incorrect time",
- appearance of "not synchronous",
- disappearance of "data loss".

The function is initialized with the current values of the remote annunciation and logical input status without creating any events related to these data. After the initialization phase, event detection is activated. It can only be interrupted by saturation of the internal event storage queue or by the presence of a major fault in Sepam 1000+.

Date and time

An absolute date and time are generated internally by Sepam 1000+, comprising the following information: Year : Month : Day : Hour : minute : millisecond. The date and time format is standardized (ref.: IEC870-5-4).

Sepam 1000+'s internal clock is not saved; it needs to be time-set via the communication network each time the Sepam 1000+ is energized.

The time that is tagged on events is encoded in 8 bytes as follows:

b15	b14	b13	b12	b11	b10	b09	b08	b07	b06	b05	b04	b03	b02	b01	b00	word
0	0	0	0	0	0	0	0	0	Y	Y	Y	Y	Y	Y	Y	word 1
0	0	0	0	M	M	M	M	0	0	0	D	D	D	D	D	word 2
0	0	0	H	H	H	H	H	0	0	mn	mn	mn	mn	mn	mn	word 3
ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	word 4

Y - 1 byte for years: varies from 0 to 99 years.
The remote monitoring and control system must ensure that the year 00 is greater than 99.
M - 1 byte for months: varies from 1 to 12.
D - 1 byte for days: varies from 1 to 31.
H - 1 byte for hours: varies from 0 to 23.
mn - 1 byte for minutes: varies from 0 to 59.
ms - 2 bytes for milliseconds: varies from 0 to 59999.

This information is encoded in binary form. Sepam 1000+ is time-set via the "write word" function (function 16) at the address 0002 with a mandatory 4-word time message.
The bits set to "0" in the description above correspond to format fields which are not used and not generated by Sepam 1000+.
Since these bits can be transmitted to Sepam 1000+ with random values, Sepam 1000+ performs the necessary disabling.
Sepam 1000+ does not check the consistency or validity of the date and time received.

Synchronization clock

A synchronization clock is required for setting the date and time of Sepam 1000+.
Schneider Electric has tested the equipment sold by the following suppliers:
- Gorgy Timing, ref. RT 300, equipped with the M540 module.
- SCLE, ref. RH 1000+ -B.

Reading of events

Sepam 1000+ provides the master or masters with two event tables. The master reads the event table and acknowledges by writing the exchange word.
Sepam 1000+ updates its event table.

The events transmitted by Sepam 1000+ are not sorted chronologically.

Structure of the first event table:
- exchange word 0040h,
- event number 1
0041h ... 0048h,
- event number 2
0049h ... 0050h,
- event number 3
0051h ... 0058h,
- event number 4
0059h ... 0060h

Structure of the second event table:
- exchange word 0070h,
- event number 1
0071h ... 0078h,
- event number 2
0079h ... 0080h,
- event number 3
0081h ... 0088h,
- event number 4
0089h ... 0090h

The master necessarily reads a block of 33 words starting at the address 0040h/0070h, or one word at the address 0040h/0070h.

Exchange word
The exchange word is used to manage a special protocol to be sure not to lose events following a communication problem. The event table is numbered for this purpose.

The exchange word includes two fields:

- most significant byte = exchange number (8 bits): 0..255,

b15	b14	b13	b12	b11	b10	b09	b08

Exchange number: 0 .. 255

Description of the MS byte of the exchange word.

The exchange number contains a numbering byte which identifies the exchanges.

The exchange number is initialized to zero when Sepam 1000+ is energized. When it reaches its maximum value (FFh), it automatically returns to 0.

Sepam 1000+ numbers the exchanges and the master acknowledges the numbering.

- least significant byte = number of events (8 bits): 0..4.

b07	b06	b05	b04	b03	b02	b01	b00

Number of events: 0 .. 4

Description of LS byte of the exchange word.

Sepam 1000+ indicates the number of significant events in the event table in the least significant byte of the exchange word. Each non-significant event word is initialized to zero.

Event table acknowledgment
To inform Sepam 1000+ that the block read by the master has been correctly received, the master writes the number of the last exchange made in the “Exchange number” field, and resets the “Number of events” field of the exchange word to zero. After acknowledgment, the 4 events in the event table are initialized to zero and the old, acknowledged events are erased in Sepam 1000+.

Until the exchange word written by the master becomes “X,0” (with X = number of the previous exchange that the master wishes to acknowledge), the exchange word in the table remains at “X, number of previous events”.

Sepam 1000+ only increments the exchange number when new events are present (X+1, number of new events).

If the event table is empty, Sepam 1000+ performs no processing operations when the master reads the event table or the exchange word.

The data are encoded in binary form.

Description of event encoding

An event is encoded in 8 words with the following structure:

most significant byte	least significant byte	
word 1: type of event		
08	00	for remote annunciation, internal data logical inputs
word 2: event address		
		refer to bit addresses 1000 to 105F
word 3: reserved		
00	00	
word 4: falling edge: disappearance or rising edge: appearance		
00	00	falling edge
00	01	rising edge
word 5: year		
00	0 to 99 (year)	
word 6: month-day		
1 to 12 (month)	1 to 31 (day)	
word 7: hours-minutes		
0 to 23 (hours)	0 to 59 (minutes)	
word 8: milliseconds		
0 to 59999		

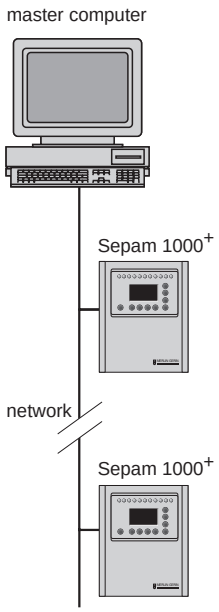
Synchronization

Sepam 1000+ accommodates two synchronization modes:

■ “internal via the network” synchronization mode by the broadcasting of a “time message” frame via the communication network. Slave number 0 is used for broadcasting,

■ “external” synchronization mode via a logical input.

The synchronization mode is selected at the time of commissioning via SFT 2841.



“Internal synchronization via the communication network” architecture.

Internal synchronization via the network mode

The “time message” frame is used both for time-setting and synchronization of Sepam 1000+. In this case, it must be transmitted regularly at brief intervals (between 10 and 60 seconds) in order to obtain synchronized time.

Sepam 1000+’s internal clock is reset each time a new time frame is received, and synchronization is maintained if the reset amplitude is less than 100 milliseconds.

With internal synchronization via the network, accuracy is linked to the master and its mastery of time frame transmission in the communication network.

Sepam 1000+ is synchronized without delay at the end of the receipt of the frame.

Time changes are made by the transmission to the Sepam 1000+ of a frame containing the new date and time.

Sepam 1000+ then switches into a transitional non-synchronous status.

When Sepam 1000+ is in synchronized status, if no “**time message**” is received for 200 seconds, the appearance of “not synchronous” event is triggered.

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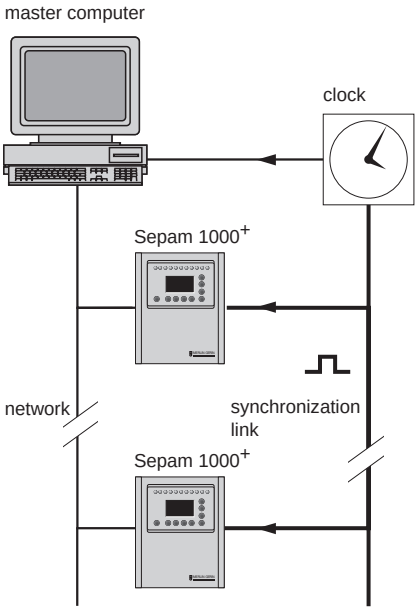
Modbus communication
Time-tagging of events (cont'd)



"External synchronization" via a logical input architecture.

External synchronization via a logical input mode
Sepam 1000+ can be synchronized externally using a logical input (I21) (require MES 114 module).
Synchronization is carried out on the rising edge of the logical input.
Sepam 1000+ can adapt to all synchronization "logical time pulse" periods from 10 to 60 s, by 10 s steps.

The shorter the synchronization period, the more accurate time-tagging of status changes will be.

The first time frame is used to initialize Sepam 1000+ with the absolute date and time; the following frames are used for the detection of any time changes.

The synchronization "logical time pulse" is used to reset Sepam 1000+'s internal clock. During the initialization phase, when Sepam 1000+ is in "non-synchronous" mode, resetting is allowed, within an amplitude of ± 4 s.

In the initialization phase, the resetting process (switching of Sepam 1000+ into "synchronous" mode) is based on a measurement of the difference between Sepam 1000+'s current time and the nearest ten second period. This measurement is taken at the time of the receipt of the time pulse following the initialization time frame. Resetting is allowed if the value of the difference is less than or equal to 4 seconds, in which case Sepam 1000+ switches to "synchronous" mode.

As of that time (the switching to "synchronous" mode), the resetting process is based on the measurement of a difference (between Sepam 1000+'s current time and the nearest ten second period at the time of the receipt of a "logical time pulse), which is adapted to match the "logical time pulse" period.

The "logical time pulse" period is determined automatically by Sepam 1000+ when it is energized based on first two pulses received: the "logical time pulse" must therefore be operational before Sepam 1000+ is energized.

The synchronization function only operates after Sepam 1000+ is time-set, i.e. after the disappearance of the "incorrect time" event.

Any time changes greater than ± 4 s in amplitude are made by transmitting a new time frame. The switch from summer time to winter time (and vice versa) is made in this way.

There is a temporary loss of synchronism when the time is changed.

The external synchronization mode requires additional equipment, a "synchronization clock", to generate a precise periodic synchronization time pulse.

If Sepam 1000+ is in correct time and synchronous status when the synchronization time pulse is generated, and if the difference in synchronism between the nearest ten second period and the receipt of the synchronization time pulse is greater than the synchronism error for 2 consecutive synchronization time pulses, it switches into non-synchronous status and generates the appearance of a "not synchronous" event.

Likewise, if Sepam 1000+ is in "correct time and synchronous" status, the failure to receive a synchronization time pulse for 200 seconds generates the appearance of a "not synchronous" event.

Sepam 1000+ in "data loss" (1) / "no data loss" (0) status
Sepam 1000+ has an internal storage queue with a 64-event capacity. Should the queue become saturated, i.e. 63 events already in the queue, the "**data loss**" event is generated by Sepam 1000+ in the 64th position, and event detection carries on.

The least recent events are lost to leave room for the most recent ones.

Reading of remote settings (remote reading)

Settings accessible for remote reading
Reading of the settings of all the protection functions may be accessed remotely.

Exchange principle
Remote reading of settings takes place in two steps:
■ first of all, the master indicates the code of the function for which it wishes to know the settings by means of a “request frame”. The request is acknowledged, in the Modbus sense of the term, to free the network,
■ the master then reads a reply zone to find the required information by means of a “reply frame”.

Each function has its own particular reply zone contents. The time needed between the request and reply is linked to Sepam 1000+'s low priority cycle time and may vary by several tens to several hundreds of ms.

Request frame
The request is made by the master using a “write word” (code 6 or 16) operation at the address 2080h of a 1-word frame consisting of the following:

2080h

B15	B14	B13	B12	B11	B10	B09	B08	B07	B06	B05	B04	B03	B02	B01	B00
function code								**relay number**							

The content of the address 2080h may be read using a Modbus “read word” (code 3).
The function code field may have the following values:
■ 01h to 99h (BCD encoding) for protection functions.

The relay number field is used as follows:
■ for protections, it indicates the relay involved, varying from 1 to N, N being the maximum number of relays available in the Sepam 1000+.
■ when only one relay is available, this number field is not controlled.

Exception replies
In addition to the usual cases, Sepam 1000+ can send Modbus type 07 exception replies (not acknowledged) if another remote reading request is being processed.

Reply frame
The reply sent back by the Sepam 1000+ fits into a zone containing a maximum of 125 words at the address 2000h, which is composed of the following:

2000h / 207C h

B15	B14	B13	B12	B11	B10	B09	B08	B07	B06	B05	B04	B03	B02	B01	B00
function code								relay number							
settings															
…….															
(special field for each function)															
…….															

This zone is read by a “read word” operation (code 3) at the address 2000h.
The length of the exchange may include:
■ the first word only (validity test),
■ the maximum size of the zone (125 words),
■ the usable size of the zone (determined by the function being addressed).

However, reading must always begin at the first word in the zone (any other address triggers an exception reply “incorrect address”).

The first word in the zone (function code and relay number) may have the following values:
xxyy: with
□ function code xx different from 00 at FFh,
□ relay number yy different from FFh.

The settings are available and validated. The word is a copy of the “request frame”. The zone contents remain valid until the next request is made.

The other words are not significant.

FFFFh: the “request frame” has been processed, but the results in the “reply frame” are not yet available. It is necessary to repeat “reply frame” reading. The other words are not significant.
xxFFh: with function code xx different from 00 and FFh. The function for which the remote reading request has been made is not valid. The function is not included in that particular Sepam 1000+, or remote reading of it is not authorized: refer to the list of functions which accommodate remote reading of settings.

Remote setting

Data that can be remotely set
Writing of the settings of all the protection functions may be accessed remotely.

Exchange principle
Remote setting is allowed for Sepam 1000+ units.

Remote setting is carried out for a given function, relay by relay. It takes place in two steps:
■ first of all, the master indicates the function code and relay number, followed by the values of all the settings in a "write request frame". The request is acknowledged to free the network,
■ the master then reads a reply zone to find the required information by means of a "reply frame", a reply zone designed for checking that the settings have been processed. Each function has its own particular reply zone contents. The contents are same as those of the reply frame.

The setting terminal has priority over the setting, which means that as long as the setting terminal is in parameter setting mode, the remote setting function is not operational.

To use remote setting, it is necessary to make all the settings for the function concerned, even if some of them have not changed.

Request frame
The request is made by the master using a "write n words" (code 16) operation at the address 2100h. The zone to be written contains a maximum of 125 words. It contains the values of all the settings. It consists of the following:

2100h

B15	B14	B13	B12	B11	B10	B09	B08	B07	B06	B05	B04	B03	B02	B01	B00
function code								relay number							
settings															
.....															
(special field for each function)															
.....															

The content of the address 2100h may be read using a "read n words" (code 3).

The function code field may have the following values:
■ 01h to 99h (BCD encoding) for the list of protection functions F01 to F99,

The relay number field is used as follows:
■ for protections, it indicates the relay involved, varying from 1 to N, N being the maximum number of relays available in the Sepam 1000+. It may never be equal to 0.

Exception replies
In addition to the usual cases, Sepam 1000+ can send type 07 exception replies (not acknowledged) if:
■ another remote reading or setting request is being processed,
■ the Sepam 1000+ is in parameter setting mode (local setting in progress),
■ the remote setting function is inhibited.

Reply frame
The reply sent back by the Sepam 1000+ is the same as the remote reading reply frame. It fits into a zone containing a maximum of 125 words at the address 1000+h, and is composed of the effective settings of the function following a semantic check:

2000h / 207C h

B15	B14	B13	B12	B11	B10	B09	B08	B07	B06	B05	B04	B03	B02	B01	B00
function code								relay number							
settings															
……															
(special field for each function)															
……															

This zone is read by a “read n words” operation (code 3) at the address 2000h.

The length of the exchange may include:
■ the first word only (validity test),
■ the maximum size of the reply zone (125 words),
■ the usable size of the reply zone (determined by the function being addressed).

However, reading must always begin at the first word in the address zone (any other address triggers an exception reply “incorrect address”).

The first word in the reply zone (function code and relay number) has the same values as those described for the remote reading reply frame:
■ **xxyy**: with
□ function code xx different from 00 at FFh,
□ relay number yy different from FFh.
The settings are available and validated. The word is a copy of the “request frame”. The zone contents remain valid until the next request is made.
■ **0000h**: no “request frame” has been formulated yet, as it is the case, in particular, when the Sepam 1000+ is switched on.
The other words are not significant.
■ **00FFh**:
□ Sepam 1000+ is in parameter setting mode (local setting in progress),
□ the remote setting function is inhibited.
■ **FFFFh**: the “request frame” has been processed, but the results in the “reply frame” are not yet available. It is necessary to repeat “reply frame” reading. The other words are not significant. This reply is also used when the Sepam 1000+ is in the process of setting locally (parameter setting mode).
■ **xxFFh**: with function code xx different from 00 and FFh. The function for which the remote reading request has been made is not valid. The function is not included in that particular Sepam 1000+, or access to the settings is impossible, both in read and write mode.

Description of settings

Data format
All the settings are transmitted in signed 32-bit whole number form (encoding, as a complement of 2).

Particular setting value:

7FFF FFFFh means that the setting is outside the validity range.

① The Enabled or Disabled setting is encoded as follows:
0 = Disabled, 1 = Enabled

② The tripping curve setting is encoded as follows:
0 = definite
1 = standard inverse time
2 = long time inverse
3 = very inverse time
4 = extremely inverse time
5 = ultra inverse time
6 = RI
7 = IEC SIT/A
8 = IEC LTI/B
9 = IEC VIT/
10 = IEC EIT/C
11 = IEEE Mod. inverse
12 = IEEE Very inverse
13 = IEEE extr. inverse
14 = IAC inverse
15 = IAC very inverse
16 = IAC ext. inverse

③ The setting of the holding time curve is encoded as follows:
0 = definite
1 = IDMT

④ The H2 restraint variable is encoded as follows:
0 = H2 restraint
1 = no H2 restraint

⑤ The tripping curve setting is:
0 = definite time
1 = IDMT

⑥ The negative sequence factor is:
0 = None (0)
1 = Low (2.25)
2 = Average (4.5)
3 = High (9)

⑦ Acknowledgment of the ambient temperature is encoded as follows:
0 = No
1 = Yes

⑧ Not used

⑨ The inhibition input setting is encoded as follows:
0 = No inhibition
1 = Inhibit recloser by logical input I26

⑩ Not used

⑪ The activation mode of each of the cycles is encoded as follows:

Correspondence between bit position and protection according to the chart below:

bit	activation by
0	inst O/C 1
1	time delayed O/C 1
2	inst O/C 2
3	time delayed O/C 2
4	inst E/F 1
5	time delayed E/F 1
6	inst E/F 2
7	time delayed E/F 2

The bit status is encoded as follows:

0 = No activation by the protection
1 = Activation by the protection

General characteristics settings (read only)
Function number: 3002

setting	data	format/unit
1	rated frequency	0 = 50 Hz, 1 = 60 Hz
2	remote setting enabled	1 = disabled
3	Sepam working language	0 = English, 1 = customized language
4	number of period before disturbance recording trigger	1
5	active setting group	0 = setting group A 1 = setting group B 2 = setting group A and B 3 = choice by input I13 4 = choice by remote control 5 = logic discrimination
6	setting mode	0 = TMS, 1 = 10I/Is
7	type of phase current sensor	0 = TC 5 A, 1 = TC 1 A 2 = LPCT
8	number of CTs	0 = 3 TC (I_1, I_2, I_3) 1 = 2 TC (I_1, I_3)
9	rated current	A
10	base current	A
11	residual current mode	0 = 3I sum 1 = 2A rated CSH 2 = 20A rated CSH 3 = 1A CT + CSH 4 = 5A CT + CSH 5 = ACE 990 range 1 6 = ACE 990 range 2
12	rated residual current Ino	A
13	integration period	0 = 5 mn 1 = 10 mn 2 = 15 mn 3 = 30 mn 4 = 60 mn
14	reserved	
15	rated primary voltage Unp	V
16	rated secondary voltage Uns	0 = 100 V 1 = 110 V 2 = 115 V 3 = 120 V 4 = 200 V 5 = 230 V
17	voltages mesured by VTs	0 = 3 V (V_1, V_2, V_3) 1 = 2 U (U21, U32) 2 = 1 U (U21)
18	residual voltage mode	0 = none 1 = 3V sum 2 = external VT – Uns/$\sqrt{3}$ 3 = external VT – Uns/3

Phase overcurrent protection settings
Function number: 01xx

Relay 1: xx = 01
Relay 2: xx = 02

setting	data	format/unit
1	reserved	
2	group A – tripping curve	②
3	group A – threshold current	0,1A
4	group A – tripping time delay	10 ms
5	group A – holding time curve	③
6	group A – holding time	10 ms
7	reserved	
8	reserved	
9	ON / OFF	①
10	group B – tripping curve	②
11	group B – threshold current	0,1A
12	group B – tripping time delay	10 ms
13	group B – holding time	③
14	group B – holding time	10 ms
15	reserved	
16	reserved	

Earth fault protection settings
Function number: 02xx

Relay 1: xx = 01
Relay 2: xx = 02

setting	data	format/unit
1	reserved	
2	group A – tripping curve	②
3	group A – threshold current	0.1A
4	group A – tripping time delay	10 ms
5	group A – holding time	③
6	group A – holding time	10 ms
7	group A – H2 restraint	④
8	reserved	
9	ON / OFF	①
10	group B – tripping curve	②
11	group B – threshold current	0.1A
12	group B – tripping time delay	10 ms
13	group B – temps de maintien	③
14	group B – temps de maintien	10 ms
15	group B – H2 restraint	④
16	reserved	

Negative sequence / unbalance protection settings
Function number: 0301

setting	data	format/unit
1	enabled or disabled	①
2	tripping curve	⑤
3	threshold current	% Ib
4	tripping time delay	10 ms

Thermal overload protection settings
Function number: 0401

setting	data	format/unit
1	enabled or disabled	①
2	negative sequence factor	⑥
3	current threshold for switching from group A/group B	% Ib
4	acknowledgment of ambient temperature	⑦
5	maximum equipment temperature	°C
6	reserved	
7	reserved	
8	group A – thermal capacity used alarm set point	%
9	group A – thermal capacity used trip set point	%
10	group A – heating time constant	minutes
11	group A – cooling time constant	minutes
12	group A – initial : thermal capacity used value	%
13	group B – enabled or disabled	①
14	group B – thermal capacity used alarm set point	%
15	group B – thermal capacity used trip set point	%
16	group B – heating time constant	minutes
17	group B – cooling time constant	minutes
18	group B – initial : thermal capacity used value	%

Phase undercurrent protection settings
Function number: 0501

setting	data	format/unit
1	enabled or disabled	①
2	threshold current	% Ib
3	tripping time delay	10 ms

Locked rotor, excessive starting time protection settings
Function number: 0601

setting	data	format/unit
1	enabled or disabled	①
2	threshold current	%
3	excessive starting time delayB (ST)	10 ms
4	locked rotor time delay (LT)	10 ms
5	locked rotor on start time delay (LTS)	10 ms

Starts per hour protection settings
Function number: 0701

setting	data	format/unit
1	enabled or disabled	①
2	period of time	hours
3	total number of starts	1
4	number of consecutive hot starts	1
5	number of consecutive starts	1
6	time delay between starts	minutes

Positive sequence undervoltage protection settings
Function number: 08xx

Relay 1: xx = 01
Relay 2: xx = 02

setting	data	format/unit
1	enabled or disabled	①
2	threshold voltage	% Unp
3	tripping time delay	10 ms
4 to 8	reserved	

Remanent undervoltage protection setting
Function number : 0901

setting	data	format/unit
1	enabled or disabled	①
2	threshold voltage	% Unp
3	tripping time delay	10 ms
4 to 8	reserved	

Phase-to-phase undervoltage protection settings
Function number: 10xx

Relay 1: xx = 01
Relay 2: xx = 02

setting	data	format/unit
1	enabled or disabled	①
2	threshold voltage	% Unp
3	tripping time delay	10 ms
4 to 8	reserved	

Phase-to-neutral undervoltage protection settings
Function number: 1801

setting	data	format/unit
1	enabled or disabled	①
2	threshold voltage	% Vnp
3	tripping time delay	10 ms
4 to 8	reserved	

Phase-to-phase overvoltage protection settings
Function number: 11xx

Relay 1: xx = 01
Relay 2: xx = 02

setting	data	format/unit
1	enabled or disabled	①
2	threshold voltage	% Unp
3	tripping time delay	10 ms
4 to 8	reserved	

Neutral voltage displacement protection settings
Function number: 12xx

Relay 1: xx = 01
Relay 2: xx = 02

setting	data	format/unit
1	enabled or disabled	(1)
2	threshold voltage	% Unp
3	tripping time delay	10 ms
4 to 8	reserved	

Overfrequency protection settings
Function number: 1301

setting	data	format/unit
1	enabled or disabled	(1)
2	threshold frequency	0.1 Hz
3	tripping time delay	10 ms

Underfrequency protection settings
Function number: 14xx

Relay 1: xx = 01
Relay 2: xx = 02

setting	data	format/unit
1	enabled or disabled	(1)
2	threshold voltage	0.1 Hz
3	tripping time delay	10 ms
4 to 8	reserved	

Rate of change of frequency protection settings
Function number: 1601

setting	data	format/unit
1	enabled or disabled	(1)
2	slip threshold	0.1 Hz/s
3	tripping time delay	10 ms
4 to 8	reserved	

Temperature monitoring protection settings
Function number: 15xx

Relay 1 : xx = 01
Relay 2 : xx = 02
Relay 3 : xx = 03
Relay 4 : xx = 04
Relay 5 : xx = 05
Relay-6 : xx = 06
Relay 7 : xx = 07
Relay 8 : xx = 08

setting	data	format/unit
1	enabled or disabled	(1)
2	alarm set point	°C
3	trip set point	°C
4 to 8	reserved	

Recloser function settings
Function number: 1701

setting	data	format/unit
1	recloser – enabled or disabled	(1)
2	recloser inhibition by input I26	(9)
3	number of cycles	1 to 4
4	recloser – disengaging time delay	10 ms
5	recloser – inhibition time delay	10 ms
6	reserved	
7	cycle 1 – activation mode	(11)
8	cycle 1 – isolation time delay	10 ms
9	reserved	
10	cycle 2 – activation mode	(11)
11	cycle 2 – isolation time delay	10 ms
12	reserved	
13	cycle 3 – activation mode	(11)
14	cycle 3 – isolation time delay	10 ms
15	reserved	
16	cycle 4 – activation mode	(11)
17	cycle 4 – isolation time delay	10 ms

Presentation

The disturbance recording function is used to record analog and logical signals during a time interval.

Sepam 1000+ can store two records.
Each record comprises two files:
- configuration file with suffix .CFG,
- data file with suffix .DAT.

The data of each record may be transferred via the link. It is possible to transfer 1 or 2 records to a remote monitoring and control system. The record may be transferred as many times as possible, until it is overwritten by a new record.

If a record is made by Sepam 1000+ while the oldest record is being transferred, the oldest record is altered.

If a command (e.g. a remote reading or remote setting request) is carried out during the transfer of a disturbance recording record, the record is not disturbed.

Time-setting

Each record may be dated.
Time-setting of the Sepam 1000+ is only carried out by the remote monitoring and control system. Time-setting is done in the same way as time-tagging (see section on synchronization).

Transferring records

The transfer request is made record by record, i.e. one configuration file and one data file per record.
The master sends the commands in order to:
- find out the characteristics of the records stored in an identification zone,
- read the contents of the different files,
- acknowledge each transfer,
- reread the identification zone to ensure that the record still appears in the list of records available.

Reading the identification zone

Given the volume of data to be transmitted, the master must ensure that there are data to be recovered and prepare the exchanges when necessary.

The identification zone, described below, is read by the reading of N words starting at the address 2204h:
- 2 reserve words forced to 0,
- size of record configuration files encoded in 1 word,
- size of record data files encoded in 1 word,
- number of records encoded in 1 word,
- date of the record (most recent) encoded in 4 words (see format below),
- date of the record (least recent) encoded in 4 words (see format below),
- 25 reserve words.

All of these data are consecutive.

Reading the contents of the different files

Request frame
The master makes the request by writing the date of the record to be transferred (code 16) in 4 words starting at the address 2200h.
It should be noted that requesting a new record amounts to stopping the transfers which are in progress. This is not the case for an identification zone transfer request.

2200h

B15	B14	B13	B12	B11	B10	B09	B08	B07	B06	B05	B04	B03	B02	B01	B00
O	O	O	O	O	O	O	O	Y	Y	Y	Y	Y	Y	Y	Y
O	O	O	O	M	M	M	M	O	O	O	D	D	D	D	D
O	O	O	H	H	H	H	H	O	O	mn	mn	mn	mn	mn	mn
ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms	ms

Y - 1 byte for years: varies from 0 to 99 years.

The master must ensure that the year 00 is greater than 99.

M - 1 byte for months: varies from 1 to 12.

D - 1 byte for days: varies from 1 to 31.

H - 1 byte for hours: varies from 0 to 23.

mn - 1 byte for minutes: varies from 0 to 59.

ms - 2 bytes for milliseconds: varies from 0 to 59999.

Reply frame
Reading of each portion of configuration and data file records by a reading frame (code 3) of 125 words starting at the address 2300h.

2300h

B15	B14	B13	B12	B11	B10	B09	B08	B07	B06	B05	B04	B03	B02	B01	B00
exchange number								number of usable bytes in the data zone							
.....															
data zone															
.....															

Reading should always begin with the first word in the address zone (any other address triggers an exception reply “incorrect address”). The configuration and data files are read in their entirety in the Sepam 1000+. They are transferred adjacently.

If the master requests more exchanges than necessary, the exchange number remains unchanged and the number of usable bytes is forced to 0. To guarantee the data transfers, it is necessary to allow a response time of about 500 ms between each reading operation at 2300h.

The first word transmitted is an exchange word. The exchange word comprises two fields:

■ the most significant byte contains the exchange number. It is incremented by 1 by the Sepam 1000+ each time a successful transfer takes place. When it reaches the value FF, it automatically goes back to zero,

■ the least significant byte contains the number of usable bytes in the data zone. It is initialized to zero after energizing and must be different from FFh.

The exchange word may also have the following values:

■ **xxyy**: the number of usable bytes in the data zone yy must be different from FFh,

■ **0000h**: no "read request frame" has been formulated yet, as it is the case, in particular, when the Sepam 1000+ is switched on. The other words are not significant,

■ **FFFFh**: the "request frame" has been processed, but the results in the reply zone are not yet available.

It is necessary to repeat "reply frame" reading. The other words are not significant. The words which follow the exchange word make up the data zone.
Since the configuration and data files are adjacent, a frame may contain the end of the configuration file and the beginning of the data file of a record.
It is up to the remote monitoring and control system software to reconstruct the files in accordance with the transmitted number of usable bytes and the size of the files indicated in the identification zone.

Acknowledging a transfer

To inform the Sepam 1000+ that a record block that it has just read has been received correctly, the master must write the number of the last exchange that it has carried out in the "exchange number" filed and set the "number of usable bytes in the data zone" of the exchange word to zero.

The Sepam 1000+ only increments the exchange number if new acquisition bursts are present.

Rereading the identification zone

To ensure that the record has not been modified, during its transfer by a new record, the master rereads the contents of the identification zone and ensures that the recovered record date is still present

Notes

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