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## General

Modbus communication allows Sepam to be connected to a supervisor or any other device with a master Modbus communication channel. Sepam is always a slave station.

Sepam is connected to a Modbus communication network via a communication interface.

There is a choice of two types of communication interface:

- communication interfaces to connect Sepam to a single network:
  - ACE949-2, for connection to a 2-wire RS 485 network
  - ACE959, for connection to a 4-wire RS 485 network
  - ACE937, for connection to a fiber-optic star network.
- communication interfaces to connect Sepam to two networks:
  - ACE969TP-2, for connection to:
    - one 2-wire RS 485 Modbus S-LAN supervision communication network
    - one 2-wire RS 485 E-LAN engineering communication network.
  - ACE969FO-2, for connection to:
    - one fiber-optic Modbus S-LAN supervision communication network
    - one 2-wire RS 485 E-LAN engineering communication network.

## Data available

The data available depend on the type of Sepam.

### Measurement readout

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

### Program logic data readout

- a table of 64 pre-assigned remote indications (TS) (depends on the type of Sepam) enables the readout of program logic data status
- readout of the status of 10 logic inputs.

### Remote control orders

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

### Other functions

- reading of Sepam configuration and identification
- time-tagging of events (synchronization via the network or externally via logic input I21), time-tagging within a millisecond
- remote reading of Sepam settings
- remote setting of protection units
- remote control of the analog output (with MSA141 option)
- transfer of disturbance recording data.

## 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

The Modbus protocol used by Sepam is a compatible sub-group of the RTU Modbus protocol.

The functions listed below are handled by Sepam:

- basic functions (data access):
  - 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.
- communication-management functions:
  - function 8: Modbus diagnosis
  - function 11: reading of Modbus event counter
  - function 43: sub-function 14: reading of identification.

The following exception codes are supported:

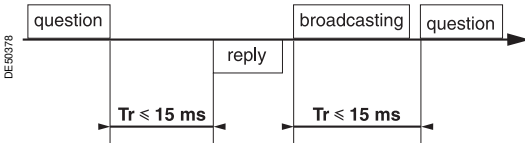
- 1: unknown function code
- 2: incorrect address
- 3: incorrect data
- 4: not ready (cannot process request)
- 7: not acknowledged (remote reading and setting).

## 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.

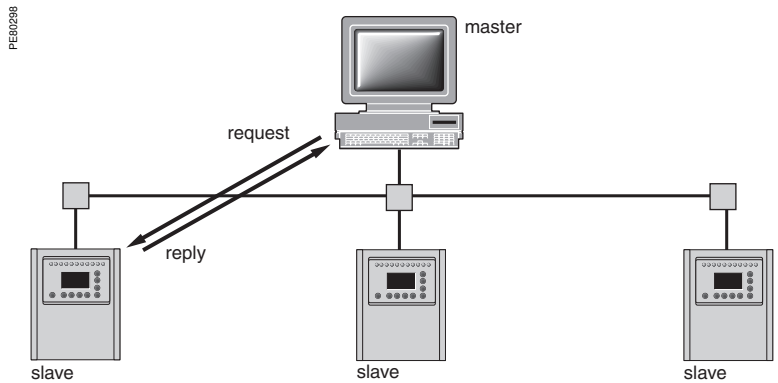


## Synchronization of exchanges

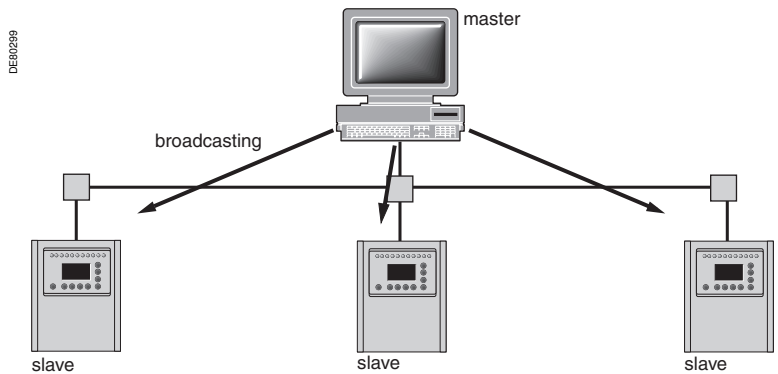
Any character that is received after a silence of more than 3 characters is considered as the beginning of a frame. A silence of at least 3 characters must be left on the line between two frames.

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

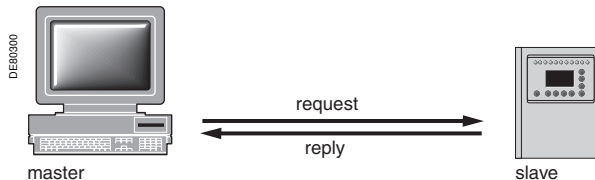
## Protocol principle



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



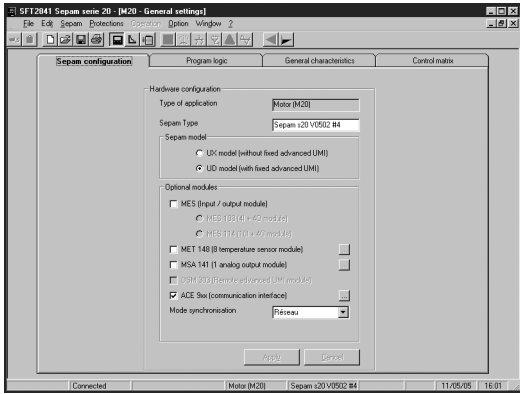
Broadcast commands are necessarily write commands. No replies are transmitted by the Sepam.



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. 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 (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.




SFT2841: Sepam Configuration screen.

### Access to configuration parameters

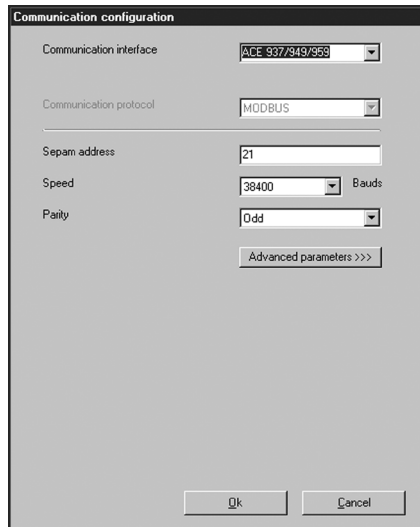
The Sepam communication interfaces are configured using SFT2841 software. The configuration parameters can be accessed from the Communication configuration window in SFT2841.

To access this window:

- open the **Sepam configuration** window in SFT2841
- check the box for ACE9xx (communication interface)
- click : the **Communication configuration** window appears
- select the type of interface used: ACE949/ACE959/ACE937, ACE969TP or ACE969FO
- select the Modbus communication protocol.

The configuration parameters will vary depending on the communication interface selected: ACE949/ACE959/ACE937, ACE969TP or ACE969FO. The table below specifies the parameters to be configured depending on the communication interface chosen.

Parameters to be configured	ACE949 ACE959 ACE937	ACE969TP	ACE969FO
Physical layer parameters	■	■	■
Fiber-optic parameters			■
Modbus advanced parameters	■	■	■
E-LAN parameters		■	■



SFT2841: communication configuration window for ACE949.

### Configuring the physical layer of the Modbus port

Asynchronous serial transmission is used with the following character format:

- 8 data bits
- 1 stop bit
- parity according to parameter setting.

The number of stop bits is always fixed at 1.

If a configuration with Parity has been selected, each character will contain 11 bits (1 start bit + 8 data bits + 1 parity bit + 1 stop bit)

If a No Parity configuration has been selected, each character will contain 10 bits (1 start bit + 8 data bits + 1 stop bit).

The configuration parameters for the physical layer of the Modbus port are:

- slave number (Sepam address)
- transmission speed
- parity check type.

Parameters	Authorized values	Default value
Sepam address	1 to 247	1
Speed	4800, 9600, 19200 or 38400 bauds	19200 bauds
Parity	None, Even or Odd	Even

### Configuring the ACE969FO-2 fiber-optic port

The configuration for the physical layer of the ACE969FO-2 fiber-optic port is completed with the following 2 parameters:

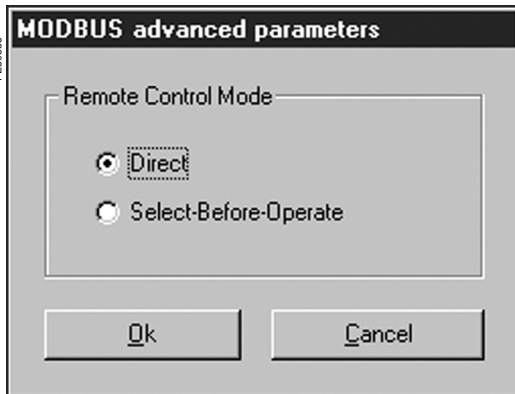
- link idle state: light-on or light-off
- echo mode: with or without.

Fiber-optic parameters	Authorized values	Default value
Link idle state	Light Off or Light On	Light Off
Echo mode	Yes (fiber-optic ring) or No (fiber-optic star)	No

**Note:** in echo mode, the Modbus master will receive the echo of its own request before the slave's reply. The Modbus master must be able to disregard this echo. Otherwise, it is impossible to create a Modbus fiber-optic ring.

PE5008

PE50664

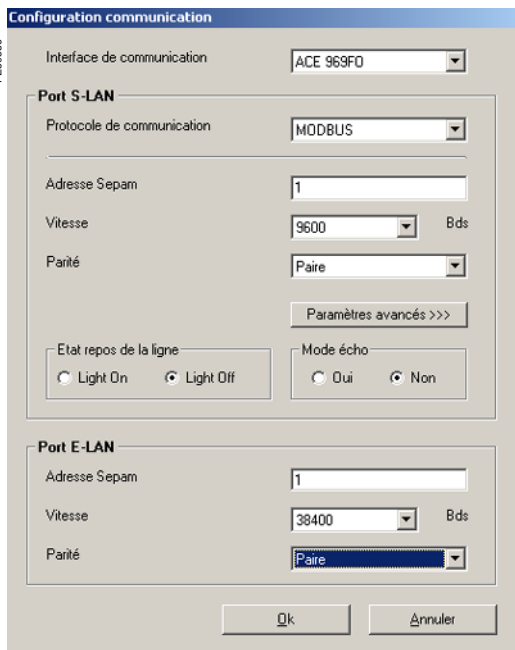


SFT2841: Modbus advanced parameters window.

### Configuring Modbus advanced parameters

The Sepam remote control mode is selected from the Advanced parameters window.

Advanced parameters	Authorized values	Default value
Remote control mode	Direct or SBO (Select Before Operate) mode	Direct



SFT2841: communication configuration window for ACE969FO.

### Configuring the physical layer of the ACE969-2 E-LAN port

The E-LAN port on the ACE969TP-2 and ACE969FO-2 communication interfaces is a 2-wire RS 485 port.

The configuration parameters for the physical layer of the E-LAN port are:

- Sepam address
- transmission speed
- parity check type.

The number of stop bits is always fixed at 1.

If a configuration with Parity has been selected, each character will contain 11 bits (1 start bit + 8 data bits + 1 parity bit + 1 stop bit)

If a No Parity configuration has been selected, each character will contain 10 bits (1 start bit + 8 data bits + 1 stop bit).

Parameters	Authorized values	Default value
Sepam address	1 to 247	1
Speed	4800, 9600, 19200 or 38400 bauds	38400 bauds
Parity	None, Even or Odd	Odd

### Configuration tips

- The Sepam address MUST be assigned before Sepam is connected to the communication network.
- You are also strongly advised to set the other physical layer configuration parameters before making the connection to the communication network.
- Modifying the configuration parameters during normal operation will not disturb Sepam but will reset the communication port.

## Installing the communication network

### Preliminary study

The communication network must first be the subject of a technical study to determine the following, according to the installation characteristics and constraints (geography, amount of information processed, etc.):

- the type of medium (electrical or fiber optic)
- the number of Sepam units per network
- the transmission speed
- the ACE interfaces configuration
- the Sepam parameter settings.

### Sepam user manual

The communication interfaces must be installed and connected in accordance with the instructions in the Installation chapter of this manual.

### Preliminary checks

The following preliminary checks must be made:

- check the CCA612 cord connection between the ACE interface and the Sepam base unit
- check the ACE Modbus communication port connection
- check the complete configuration of the ACE
- for the ACE969, check the auxiliary power supply connection.

### Checking the operation of the ACE interface

You can use the following to check that an ACE interface is operating correctly:

- the indicator LEDs on the front panel of the ACE
- the information provided by the SFT2841 software connected to Sepam:
  - on the Diagnosis screen
  - on the Communication configuration screens.

### Link activity LED for ACE949-2, ACE959 and ACE937

The link activity LED for ACE949-2, ACE959 and ACE937 interfaces flashes when Sepam transmission or reception is active.

### Indicator LEDs on the ACE969

- green "on" LED: ACE969 energized
- red "key" LED: ACE969 interface status
- LED off: ACE969 configured and communication operational
- LED flashing: ACE969 configuration error or ACE969 not configured
- LED on: ACE969 error
- link activity LED: S-LAN Tx flashing, Sepam transmission active
- link activity LED: S-LAN Rx flashing, Sepam reception active.

## Diagnosis using SFT2841 software

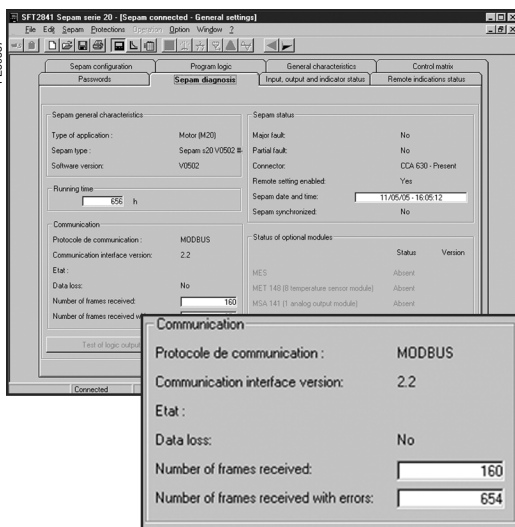
### Sepam diagnosis screen

When connected to Sepam, the SFT2841 software informs the operator of the general Sepam status and of the Sepam communication status in particular. All Sepam status information appears on the Sepam diagnosis screen.

### Sepam communication diagnosis

The operator is provided with the following information to assist with identifying and resolving communication problems:

- name of the protocol configured
- Modbus interface version number
- number of valid frames received (CPT9)
- number of invalid (mistaken) frames received (CPT2).



SFT2841: Sepam series 20 diagnosis screen.

### Link activity LED

The ACE interface link activity LEDs are activated by variations in the signal on the Modbus network. When the supervisor communicates with Sepam (during transmission or reception), these LEDs flash. After wiring, check the information given by the link activity LEDs when the supervisor operates.

**Note:** Flashing indicates that there is traffic passing to or from Sepam; it does not mean that the exchanges are valid.

### Functional test

If there is any doubt about correct operation of the link:

- run read/write cycles in the test zone
- use Modbus diagnosis function 8 (sub-code 0, echo mode).

The Modbus frames below, transmitted or received by a supervisor, are an example of a test performed when communication is set up.

Test zone	
<b>Read</b>	
Transmission	01 03 0C00 0002 C75B
Reception	01 03 04 0000 0000 FA33
<b>Write</b>	
Transmission	01 10 0C00 0001 02 1234 6727
Reception	01 10 0C00 0001 0299
<b>Read</b>	
Transmission	01 03 0C00 0001 875A
Reception	01 03 02 1234 B533
<b>Function 8 - Modbus diagnosis, echo mode</b>	
Transmission	01 08 0000 1234 ED7C
Reception	01 08 0000 1234 ED7C

Even in echo mode, Sepam recalculates and checks the CRC sent by the master:

- If the CRC received is valid, Sepam replies
- If the CRC received is invalid, Sepam does not reply.

### Modbus diagnosis counters

#### Counter definition

Sepam manages the Modbus diagnosis counters. These are:

- **CPT1:** Number of valid frames received, whether the slave is involved or not
- **CPT2:** Number of frames received with a CRC error or physical error (frames with more than 255 bytes, frames received with at least one parity, overrun, framing or line-break error)
- **CPT3:** Number of exception responses generated (even if not transmitted, due to receipt of a broadcast request)
- **CPT4:** Number of frames specifically addressed to the station (excluding broadcasting)
- **CPT5:** Number of valid broadcast frames received
- **CPT6:** Not significant
- **CPT7:** Not significant
- **CPT8:** Number of frames received with at least one character having a physical error (parity, overrun, framing or line break)
- **CPT9:** Number of valid requests received and correctly executed.

#### Counter reset

The counters are reset to 0:

- when they reach the maximum value FFFFh (65535)
- when they are reset by a Modbus command (function 8)
- when Sepam auxiliary power is lost
- when communication parameters are modified.

#### Using the counters

Modbus diagnosis counters help to detect and resolve communication problems. They can be accessed by the dedicated read functions (Modbus protocol functions 8 and 11).

#### CPT2 and CPT9 counters can be displayed on SFT2841

("Sepam Diagnosis" screen).

An incorrect speed (or parity) increments CPT2.

Non-reception is signaled by the lack of change on CPT9.

### Operating anomalies

It is advisable to connect the Sepam units to the Modbus network one by one. Make sure that the supervisor is sending frames to the relevant Sepam by checking the activity on the RS 232 - RS 485 converter or the fiber-optic converter if there is one, and on the ACE module.

#### RS 485 network

- check the wiring on each ACE module
- check the tightness of the screw terminals on each ACE module
- check the connection of the CCA612 cord linking the ACE module to the Sepam base unit
- check that polarization is only at one point and that impedance matching is at both ends of the RS 485 network
- check the auxiliary power supply connection to the ACE969TP-2
- check that the ACE909-2 or ACE919 converter used is connected, powered and set up correctly.

#### Fiber-optic network

- check the connections on the ACE module
- check the connection of the CCA612 cord linking the ACE module to the Sepam base unit
- check the auxiliary power supply connection to the ACE969FO-2
- check that the converter or fiber-optic star used is connected, powered and set up correctly
- for a fiber-optic ring, check that the Modbus master can handle the echo of its requests correctly.

#### In all cases

- check all the ACE configuration parameters on SFT2841
- check the CPT2 and CPT9 diagnostic counters on the SFT2841 ("Sepam Diagnosis" screen).

### 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
<b>First event table</b>			
Exchange word	0040	0040	3, 6, 16
Events (1 to 4)	0041	0060	3
<b>Second event table</b>			
Exchange word	0070	0070	3, 6, 16
Events (1 to 4)	0071	0090	3
<b>Data</b>			
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
<b>Protection settings</b>			
Reading	2000	207C	3
Reading request	2080	2080	3, 6, 16
Remote settings	2100	217C	3, 6
<b>Disturbance recording</b>			
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
<b>Application</b>			
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  $i$  ( $0 \leq i \leq F$ ) of address word  $J$  is then  $(J \times 16) + i$ .

e.g. 0C00 bit 0 = C000 0C00 bit 7 = C007.



### 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 a 16-bit word, 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	
Logic inputs								26	25	24	23	22	21	14	13	12	11
TS1 to TS16	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
TS49 to TS64	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	
TC1 to TC16	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
STC1 to STC16	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

#### Format X: Sepam 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 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 S-LAN communication monitoring active
- bit 10 Sepam in local setting 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 4 remote indication of tripping by protection function
- 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.

### 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 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 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		Idem FC01
Modbus version	0009	R	3		Idem 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 address	000F	R	3		FC00

This zone is provided to ensure compatibility with existing equipment. A more complete description is available starting at address FC00h in the configuration zone or using the identification read function.

### 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.

Events zone 1	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.

Events zone 2	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, pre-assigned remote annunciation bits (TS), and logic inputs.

Status	Word address	Bit address	Access	Modbus function enabled	Format
Sepam check-word	100	1000	R	3/4 or 1, 2, 7	X
TS1-TS16	101	1010	R	3/4 or 1, 2	B
TS17-TS32	102	1020	R	3/4 or 1, 2	B
TS33-TS48	103	1030	R	3/4 or 1, 2	B
TS49-TS64	104	1040	R	3/4 or 1, 2	B
Logic inputs	105	1050	R	3/4 or 1, 2	B

**Measurement zone**

(S20, S23, S24, T20, T23, T24 and M20 types)

Measurements	Word address	Access	Modbus function enabled	Format	Unit
I1 phase current (gain x 1)	106	R	3/4	16NS	0.1 A
I2 phase current (gain x 1)	107	R	3/4	16NS	0.1 A
I3 phase current (gain x 1)	108	R	3/4	16NS	0.1 A
I0 residual current (gain x 1)	109	R	3/4	16NS	0.1 A
Im1 average phase current (x 1)	10A	R	3/4	16NS	0.1 A
Im2 average phase current (x 1)	10B	R	3/4	16NS	0.1 A
Im3 average phase current (x 1)	10C	R	3/4	16NS	0.1 A
I1 phase current (gain x 10)	10D	R	3/4	16NS	1 A
I2 phase current (gain x 10)	10E	R	3/4	16NS	1 A
I3 phase current (gain x 10)	10F	R	3/4	16NS	1 A
I0 residual current (gain x 10)	110F	R	3/4	16NS	1 A
IM1 average phase current (x10)	111	R	3/4	16NS	1 A
IM2 average phase current (x10)	112	R	3/4	16NS	1 A
IM3 average phase current (x10)	113	R	3/4	16NS	1 A
IM1 peak demand phase current	114	R	3/4	16NS	1 A
IM2 peak demand phase current	115	R	3/4	16NS	1 A
IM3 peak demand phase current	116	R	3/4	16NS	1 A
Reserved	117	R	3/4	-	-
Itrip1 tripping current	118	R	3/4	16NS	10 A
Itrip2 tripping current	119	R	3/4	16NS	10 A
Itrip3 tripping current	11A	R	3/4	16NS	10 A
Itrip0 tripping current	11B	R	3/4	16NS	1 A
Cumulative breaking current	11C	R	3/4	16NS	1 (kA) <sup>2</sup>
Number of operations	11D	R	3/4	16NS	1
Operating time	11E	R	3/4	16NS	1 ms
Charging time	11F	R	3/4	16NS	1 sec
Reserved	120	R	3/4	-	-
Running hours counter	121	R	3/4	16NS	1 hr
Thermal capacity used	122	R	3/4	16NS	%
Operating time before overload tripping	123	R	3/4	16NS	1 min
Waiting time after overload tripping	124	R	3/4	16NS	1 min
Unbalance ratio	125	R	3/4	16NS	% lb
Starting time / overload	126	R	3/4	16NS	0.1 sec
Starting current overload	127	R	3/4	16NS	1 A
Start inhibit time delay	128	R	3/4	16NS	1 min
Number of starts allowed	129	R	3/4	16NS	1
Temperatures 1 to 8	12A/131	R	3/4	16S	1 °C
Reserved	132/1EF	Prohibited			

**Note:** Only the measurements related to the Sepam function are significant. The values of the others are zero.

## Measurement zone (B20, B21, B22 types)

Measurements	Word address	Access	Modbus function enabled	Format	Unit
U21 phase to phase voltage (x1)	106	R	3/4	16NS	1 V
U32 phase to phase voltage (x1)	107	R	3/4	16NS	1 V
U13 phase to phase voltage (x1)	108	R	3/4	16NS	1 V
V1 phase to neutral voltage (x1)	109	R	3/4	16NS	1 V
V2 phase to neutral voltage (x1)	10A	R	3/4	16NS	1 V
V3 phase to neutral voltage (x1)	10B	R	3/4	16NS	1 V
V0 residual voltage (x1)	10C	R	3/4	16NS	1 V
Positive sequence voltage (x1)	10D	R	3/4	16NS	1 V
Frequency	10E	R	3/4	16NS	0.01 Hz
U21 phase to phase voltage (x10)	10F	R	3/4	16NS	1 V
U32 phase to phase voltage (x10)	110	R	3/4	16NS	1 V
U13 phase to phase voltage (x10)	111	R	3/4	16NS	1 V
V1 phase to neutral voltage (x10)	112	R	3/4	16NS	1 V
V2 phase to neutral voltage (x10)	113	R	3/4	16NS	1 V
V3 phase to neutral voltage (x10)	114	R	3/4	16NS	1 V
V0 residual voltage (x10)	115	R	3/4	16NS	1 V
Positive sequence voltage (x10)	116	R	3/4	16NS	1 V
<i>Reserved</i>	<i>117/131</i>	<i>R</i>	<i>3/4</i>		<i>init. to 0</i>
<i>Reserved</i>	<i>132/1EF</i>	<i>Prohibited</i>			

## 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.

	Word address	Bit address	Access	Modbus function enabled	Format	Unit
<b>Remote controls</b>						
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	
Control of analog output	01F2		R/W	3/4/6/16	16S	
<i>Reserved</i>	<i>01F3</i>		<i>Prohibited</i>			
<b>S-LAN communication monitoring</b>						
Time delay	01F4		R/W	3/6/16	16NS	0.1 sec
<i>Reserved</i>	<i>01F5/0BFF</i>		<i>Prohibited</i>			

## Protection setting zone

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

Protection settings	Word address	Access	Modbus function enabled
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	Modbus function enabled
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.

Configuration zone	Word address	Access	Modbus function enabled	Format
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)
<b>application identification</b>				
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 )

LSB = hardware configuration

(2) FC02 word: MSB = 01h (Sepam )

LSB = XY (communication version X, Y)

Bit Option	7 UD/UX	6 reserved	5 MES114E/ MES114F	4 DSM303	3 MSA141	2 MET148-2 <sup>(3)</sup>	1 MES114	0 MES108
UX model	0	0	z	x	x	x	y	y
UX model	1	0	z	0	x	x	y	y

(3) or MET148.

x = 1 if option included

y = 1 if option included, exclusive options

z = 1 if Vac set up.

## 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 Time-tagging of events).

### Address word 0101: TS1 to TS16 (bit address 1010 to 101F)

TS	Use	S20	S24	T20	T24	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 B	■	■	■	■	■		
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 tripping set point			■	■	■		
11	Protection 37						■	
12	Protection 46	■	■	■	■	■		
13	Protection 48/51LR/14 (locked rotor)						■	
14	Protection 48/51LR/14 (locked rotor on start)						■	
15	Protection 48/51LR/14 (excessive starting time)						■	
16	Protection 66						■	

### Address word 0102: TS17 to TS32 (bit address 1020 to 102F)

TS	Use	S20	S24	T20	T24	M20	B21	B22
17	Protection 27D/47 relay 1						■	■
18	Protection 27D/47 relay 2						■	■
19	Protection 27 relay 1						■	■
20	Protection 27 relay 2						■	■
21	Protection 27R						■	■
22	Protection 59 relay 1						■	■
23	Protection 59 relay 2						■	■
24	Protection 59N relay 1						■	■
25	Protection 59N relay 2						■	■
26	Protection 81H						■	■
27	Protection 81L relay 1						■	■
28	Protection 81L relay 2						■	■
29	Protection 27S phase 1 <sup>(1)</sup>						■	■
30	Protection 27S phase 2 <sup>(1)</sup>						■	■
31	Protection 27S phase 3 <sup>(1)</sup>						■	■
32	Protection 81R							■

<sup>(1)</sup> Not available on the B20 application.

**Note:** Applications S24 and T24 perform the functions of applications S23 and T23 respectively and, in addition, the phase overcurrent and earth fault cold load pick-up functions.

**Address word 0103: TS33 to TS48 (bit address 1030 to 103F)**

TS	Use	S20	S24	T20	T24	M20	B21	B22
33	Protection 50BF		■		■			
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 0104: TS49 to TS64 (bit address 1040 to 104F)**

TS	Use	S20	S24	T20	T24	M20	B21	B22
49	Protection 38/49T alarm set point sensor 1			■	■	■		
50	Protection 38/49T tripping set point sensor 1			■	■	■		
51	Protection 38/49T alarm set point sensor 2			■	■	■		
52	Protection 38/49T tripping set point sensor 2			■	■	■		
53	Protection 38/49T alarm set point sensor 3			■	■	■		
54	Protection 38/49T tripping set point sensor 3			■	■	■		
55	Protection 38/49T alarm set point sensor 4			■	■	■		
56	Protection 38/49T tripping set point sensor 4			■	■	■		
57	Protection 38/49T alarm set point sensor 5			■	■	■		
58	Protection 38/49T tripping set point sensor 5			■	■	■		
59	Protection 38/49T alarm set point sensor 6			■	■	■		
60	Protection 38/49T tripping set point sensor 6			■	■	■		
61	Protection 38/49T alarm set point sensor 7			■	■	■		
62	Protection 38/49T tripping set point sensor 7			■	■	■		
63	Protection 38/49T alarm set point sensor 8			■	■	■		
64	Protection 38/49T tripping set point sensor 8			■	■	■		

**Address check-word 0100: bit 4 (bit address 1004)**

Use	S20	S24	T20	T24	M20	B21	B22
Bit 4 Tripping by protection function	■	■	■	■	■	■	■

**Note:** Applications S24 and T24 perform the functions of applications S23 and T23 respectively and, in addition, the phase overcurrent and earth fault cold load pick-up functions.

### 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 can be inhibited by logic input I25 on the MES114 module.

According to the parameter setting of logic input I25, the tripping remote control order TC1 can be activated at any time or can be inhibited.

Logic input I25 can 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 on the MES114 (or MES108) optional module.

#### 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 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.

### Address word 01F0: TC1 to TC16 (bit address 1F00 to 1F0F)

TC	Use	S20	S24	T20	T24	M20	B21	B22
1	Tripping	■	■	■	■	■	■	■
2	Closing	■	■	■	■	■	■	■
3	Switching to setting group A	■	■	■	■	■		
4	Switching to setting group B	■	■	■	■	■		
5	Sepam reset	■	■	■	■	■	■	■
6	Peak demand current zero reset	■	■	■	■	■		
7	Inhibit thermal protection			■	■	■		
8	Inhibit disturbance recording triggering (OPG <sup>(1)</sup> )	■	■	■	■	■	■	■
9	Confirm disturbance recording triggering (OPG <sup>(1)</sup> )	■	■	■	■	■	■	■
10	Manual disturbance recording triggering (OPG <sup>(1)</sup> )	■	■	■	■	■	■	■
11	Enable recloser	■	■					
12	Disable recloser	■	■					
13	Confirm thermal protection			■	■	■		
14	Reserved							
15	Activate S-LAN communication monitoring <sup>(2)</sup>	■	■	■	■	■	■	■
16	Inhibit S-LAN communication monitoring	■	■	■	■	■	■	■

<sup>(1)</sup> OPG : French acronym for disturbance recording.

<sup>(2)</sup> TC15 Remote control order follows the same TC1 inhibition mode.

**Note:** Applications S24 and T24 perform the functions of applications S23 and T23 respectively and, in addition, the phase overcurrent and earth fault cold load pick-up functions.

### Analog output remote control

The analog output of the MSA141 module may be set up for remote control via the Modbus communication module (word address 01F2). 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 remote control inhibition conditions.



## Presentation

The communication system time-tags the data processed by Sepam. 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 time-tags the following data:

- logic inputs
- remote annunciation bits
- information pertaining to Sepam 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 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's internal clock.

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

#### ■ synchronization:

to avoid Sepam internal clock drifts and ensure inter-Sepam synchronization.

Internal clocks can be synchronized according to two principles:

#### ■ internal synchronization:

via the communication network without any additional cabling,

#### ■ external synchronization:

via a logic 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), 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 logic 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.

## Date and time

### Presentation

An absolute date and time are managed internally by Sepam, consisting of the information Year: Month: Day: Hour: minute: millisecond.

The date and time format is standardized (ref: IEC 60870-5-4).

### Backup

The Sepam internal clock is backed up for 24 hours. After a power outage lasting longer than 24 hours, the time will need to be reset.

The duration of the Sepam date and time backup if the power supply fails depends on the ambient temperature and age of the Sepam.

Typical backup periods:

- |                         |                         |
|-------------------------|-------------------------|
| ■ at 25°                | ■ at 40°                |
| □ 24 hrs for 7 years    | □ 24 hrs for 3 years    |
| □ 18 hrs after 10 years | □ 16 hrs after 10 years |
| □ 14 hrs after 15 years | □ 10 hrs after 15 years |

### Setting the time

Sepam's internal clock can be set in one of 3 ways:

- by the supervisor, via the Modbus link
- by the SFT2841, "General characteristics" screen
- from the display unit of Sepam units equipped with the advanced UMI

The time associated with an event is encoded on 8 bytes as follows:

0	0	0	0	M	M	M	M	0	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	mn	word 3
ms	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 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.

Since these bits can be transmitted to Sepam with random values, Sepam performs the necessary disabling.

Sepam 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.

Schneider Electric has tested the following equipment:

Gorgy Timing, ref. RT 300, equipped with the M540 module.

## Reading of events

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

**The events sent by Sepam 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 is energized. When it reaches its maximum value (FFh), it automatically returns to 0. Sepam 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 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 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.

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

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

The data are encoded in binary form.

### Clearing an event queue

Writing a value "xxFFh" in the exchange word (any exchange number, event number = FFh) reinitializes the corresponding event queue (all stored events not yet transmitted are deleted).

### Sepam in data loss (1) / no data loss (0) status

Sepam has an internal storage queue with a capacity of 64 events. If the queue becomes saturated, a "data loss" event is inserted by Sepam when each event table is read.

The detection of events stops and the most recent events are lost.

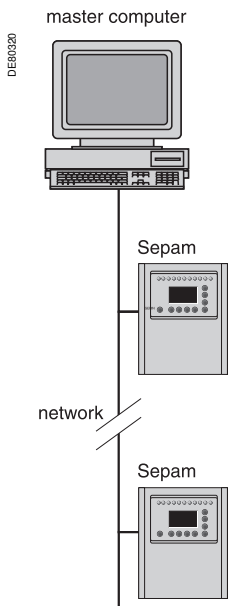
Data loss is managed independently for each of the two event tables. When the tables are read at different rates, data loss may occur at different times for each table or even, in some cases, appear only on the slowest channel.

**Note:** the "data loss" bit of the Sepam check word corresponds to the status of the first reading table (compatibility with earlier versions).

**Description of event encoding**

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

Most significant byte	Least significant byte	
<b>Word 1: type of event</b>		
08	00	For remote annunciation, internal data, logic inputs
<b>Word 2: event address</b>		
		Refer to bit addresses 1000 to 105F
<b>Word 3: reserved</b>		
00	00	
<b>Word 4: falling edge: disappearance or rising edge: appearance</b>		
00	00	Falling edge
00	01	Rising edge
<b>Word 5: year</b>		
00	0 to 99 (year)	
<b>Word 6: month-day</b>		
1 to 12 (month)	1 to 31 (day)	
<b>Word 7: hours-minutes</b>		
0 to 23 (hours)	0 to 59 (minutes)	
<b>Word 8: milliseconds</b>		
0 to 59999		



Architecture for "internal synchronization" via the communication network.

### Synchronization

Sepam 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 logic input.
- The synchronization mode is selected at the time of commissioning via SFT2841.

#### Internal synchronization via the network mode

The "time message" frame is used for both time-setting and synchronization of Sepam. In this case, it must be sent regularly at brief intervals (between 10 and 60 seconds) in order for synchronous time to be obtained.

Sepam's internal clock is reset each time a new time frame is received, and synchronization is maintained if the difference in synchronism is less than 100 milliseconds.

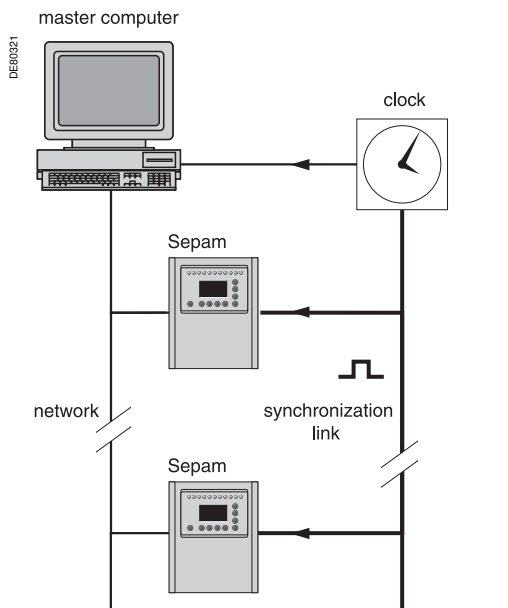
With internal synchronization via the network, accuracy is linked to the master and its mastery of time frame transmission in the communication network.

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

Time changes are made by sending a frame to Sepam with the new date and time.

Sepam then switches into a transitional non-synchronous status.

When Sepam is in synchronous status, if no "time message" is received for 200 seconds, the appearance of the "not synchronous" event is triggered.



Architecture for "external synchronization" via a logic input.

### Synchronization (cont'd)

#### External synchronization via a logic input mode

Sepam can be synchronized externally by means of a logic input (I21) (the MES114 module is required).

The synchronisation pulse is determined by the rising edge of the logic input. Sepam can adapt to all synchronization pulse periods from 10 to 60 s, by 10 s steps. The shorter the synchronization period, the more accurate time-tagging of status changes is.

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

The synchronization pulse is used to reset Sepam's internal clock. In the initialization phase, when Sepam is in "non-synchronous" mode, resetting is allowed, within an amplitude of  $\pm 4$  seconds.

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

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

**The synchronization pulse period is determined automatically by Sepam when it is energized, based on the first two pulses received: the synchronization pulse must therefore be operational before Sepam is energized.**

**The synchronization function only operates after Sepam has been time-set, i.e. after the disappearance of the "incorrect time" event.**

Any time changes greater than  $\pm 4$  seconds in amplitude are made by sending a new time frame. The switch from summer time to winter time (and vice versa) is made in this way as well.

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

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

## 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 the reply is linked to Sepam's low priority cycle time and may vary by several tens to several hundreds of milliseconds.

### Request frame

The request is made by the master using a "write word" (function 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" (function 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 protection, it indicates the relay involved, varying from 1 to N, N being the maximum number of relays available in the Sepam
- when only one relay is available, this number field is not controlled.

### Exception replies

In addition to the usual cases, Sepam 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, fits into a zone containing a maximum of 125 words at the address 2000h which is composed the following:

#### 2000h/207Ch

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 (function 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 mots)
- 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 and FFh
  - relay number yy different from FFh.

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

The other word 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 the particular Sepam, or remote reading of it is not authorized: refer to the list of functions which accommodate remote reading of settings.

**CAUTION**

**RISK OF UNINTENDED OPERATION**

- The device must only be configured and set by qualified personnel, using the results of the installation protection system study.
  - During commissioning of the installation and following any modification, check that the Sepam configuration and protection function settings are consistent with the results of this study.
- Failure to follow these instructions can result in equipment damage.**

**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 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 the 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.

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" (function 16) operation at the address 2100h. The zone to be written contains a maximum of 123 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" (function 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 protection, it indicates the relay involved, varying from 1 to N, N being the maximum number of relays available in the Sepam. It may never be equal to 0.

**Exception reply**

In addition to the usual cases, Sepam can send type 07 exception replies (not acknowledged) if:

- another remote reading or setting request is being processed
- the remote setting function is inhibited.

### Reply frame

The reply sent back by the Sepam is the same as the remote reading reply frame. It fits into a zone containing a maximum of 125 words at the address 2000h and is composed of the effective settings of the function following a semantic check:

#### 2000h-207Ch

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 (function 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.

■ **xyy**: with:

- function code xx different from 00 and 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 is switched on.

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, or access to 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

9 = IEC VIT/

2 = long time inverse

10 = IEC EIT/C

3 = very inverse time

11 = IEEE Mod. inverse

4 = extremely inverse time

12 = IEEE Very inverse

5 = ultra inverse time

13 = IEEE Extr. inverse

6 = RI

14 = IAC inverse

7 = IEC SIT/A

15 = IAC very inverse

8 = IEC LTI/B

16 = IAC extr. inverse

③ The setting of the timer hold curve is encoded as follows:

0 = definite time

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 logic 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 table 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.

⑫ The time delay unit for the CLPU functions is encoded as follows:

0 = millisecond

1 = second

2 = minute

**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	1
5	Active setting groupe	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 = 5 A CT 1 = 1 A CT 2 = LPTC
8	Number of CTs	0 = 3 TC (I1, I2, I3) 1 = 2 TC (I1, I3)
9	Rated current	A
10	Base current	A
11	Residual current mode	0 = 3I sum 1 = 2 A rated CSH 2 = 20 A rated CSH 3 = 1 A CT 4 = 5 A CT 5 = ACE990 Range 1 6 = ACE990 Range 2
12	Rated residual current I <sub>no</sub>	A
13	Integration period	0 = 5 mn 1 = 10 mn 2 = 15 mn 3 = 30 mn 4 = 60 mn
14	<i>Reserved</i>	
15	Rated primary voltage U <sub>np</sub>	V
16	Rated secondary voltage U <sub>ns</sub>	0 = 100 V 1 = 110 V 2 = 115 V 3 = 120 V 4 = 200 V 5 = 230 V 6 = Numerical value, see setting 19
17	Voltages mesured by VTs	0 = 3 V (V1, V2, V3) 1 = 2 U (U21, U32) 2 = 1 U (U21)
18	Residual voltage mode	0 = none 1 = 3 V sum 2 = external VT – U <sub>ns</sub> /√3 3 = external VT – U <sub>ns</sub> /3
19	Secondary rated voltage U <sub>ns</sub>	V

**Protection settings**

They are organized according to increasing ANSI codes.

**ANSI 27 - Phase-to-phase undervoltage**

Function number: 10xx

Relay 1: xx = 01

Relay 2: xx = 02

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Us set point	% Unp
3	Tripping time delay	10 ms
4 to 8	<i>Reserved</i>	

**ANSI 27D/47 - Positive sequence undervoltage**

Function number: 08xx

Relay 1: xx = 01

Relay 2: xx = 02

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Vsd set point	% Unp
3	Tripping time delay	10 ms
4 to 8	<i>Reserved</i>	

**ANSI 27R - Remanent undervoltage**

Function number: 0901

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Us set point	% Unp
3	Tripping time delay	10 ms
4 to 8	<i>Reserved</i>	

**ANSI 27S - Phase-to-neutral undervoltage**

Function number: 1801

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Vs set point	% Vnp
3	Tripping time delay	10 ms
4 to 8	<i>Reserved</i>	

**ANSI 37 - Phase undercurrent**

Function number: 0501

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Is set point	% Ib
3	Tripping time delay	10 ms

**ANSI 38/49T - Temperature monitoring**

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	<i>Reserved</i>	

**ANSI 46 - Negative sequence / unbalance**

Function number: 0301

Setting	Data	Format/Unit
1	Enable or disabled	①
2	Tripping curve	⑤
3	Is set point	% Ib
4	Tripping time delay	10 ms

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

Function number: 0601

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Is set point	% Ib
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

**ANSI 49RMS - Thermal overload**

Function number: 0401

Setting	Data	Format/Unit
1	Enable or disabled	①
2	Negative sequence factor	⑥
3	Is set point for switching from group A/group B	% Ib
4	Accounting for ambient temperature	⑦
5	Maximum equipment temperature	° C
6	<i>Reserved</i>	
7	<i>Reserved</i>	
8	Group A - heatrise alarm set point	%
9	Group A - Heat rise tripping set point	%
10	Group A - heating time constant	minutes
11	Group A - cooling time constant	minutes
12	Group A - initial heatrise value	%
13	Group B - enabled or disabled	①
14	Group B - heatrise alarm set point	%
15	Group B - heatrise tripping set point	%
16	Group B - heating time constant	minutes
17	Group B - cooling time constant	minutes
18	Group B - initial heatrise value	%

**ANSI 50/51 - Phase current**

Function number: 01xx

Relay 1: xx = 01

Relay 2: xx = 02

Setting	Data	Format/Unit
1	<i>Reserved</i>	
2	Group A - tripping curve	②
3	Group A - Is set point	0.1 A
4	Group A - tripping time delay	10 ms
5	Group A - timer hold curve	③
6	Group A - timer hold delay	10 ms
7	Group B - H2 restraint	④
8	Group B - Isc min	0,1 A
9	ON/OFF	①
10	Group B - tripping curve	②
11	Group B - Is set point	0.1 A
12	Group B - tripping time delay	10 ms
13	Group B - timer hold curve	③
14	Group B - timer hold delay	10 ms
15	Group B - H2 restraint	④
16	Group B - Isc min	0.1 A

**ANSI 50BF - Breaker failure**

Function number: 2101

Setting	Data	Format/Unit
1	ON or OFF	①
2	Is set point	0.1 A
3	Tripping time delay	10 ms
4	Use close position of circuit breaker	0 = No 1 = Yes

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

Function number: 02xx

Relay 1: xx = 01

Relay 2: xx = 02

Setting	Data	Format/Unit
1	<i>Reserved</i>	
2	Group A - tripping curve	②
3	Group A - Is0 set point	0.1 A
4	Group A - tripping time delay	10 ms
5	Group A - timer hold curve	③
6	Group A - timer hold delay	10 ms
7	Group A - H2 restraint	④
8	<i>Reserved</i>	
9	ON/OFF	①
10	Group B - tripping curve	②
11	Group B - Is0 set point	0.1 A
12	Group B - tripping time delay	10 ms
13	Group B - timer hold curve	③
14	Group B - timer hold delay	10 ms
15	Group B - H2 restraint	④
16	<i>Reserved</i>	

**ANSI 59 - Phase-to-phase overvoltage**

Function number: 11xx

Relay 1: xx = 01

Relay 2: xx = 02

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Us set point	% Unp
3	Tripping time delay	10 ms
4 to 8	<i>Reserved</i>	

**ANSI 59N - Neutral voltage displacement**

Function number: 12xx

Relay 1: xx = 01

Relay 2: xx = 02

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Vs0 set point	% Unp
3	Tripping time delay	10 ms
4 to 8	<i>Reserved</i>	

**ANSI 66 - Starts per hour**

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

**ANSI 79 - Recloser function**

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	<i>Reserved</i>	
7	Cycle 1 – activation mode	⑪
8	Cycle 1 – isolation time delay	10 ms
9	<i>Reserved</i>	
10	Cycle 2 – activation mode	⑪
11	Cycle 2 – isolation time delay	10 ms
12	<i>Reserved</i>	
13	Cycle 3 – activation mode	⑪
14	Cycle 3 – isolation time delay	10 ms
15	<i>Reserved</i>	
16	Cycle 4 – activation mode	⑪
17	Cycle 4 – isolation time delay	10 ms

**ANSI 81H - Overfrequency**

Function number: 1301

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Fs set point	0.1 Hz
3	Tripping time delay	10 ms
4 to 8	<i>Reserved</i>	

**ANSI 81L - Underfrequency**

Function number: 14xx

Relay 1: xx = 01

Relay 2: xx = 02

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	Fs set point	0.1 Hz
3	Tripping time delay	10 ms
4 to 8	<i>Reserved</i>	

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

Function number: 1601

Setting	Data	Format/Unit
1	Enabled or disabled	①
2	dFs/dt set point	0.1 Hz/s
3	Tripping time delay	10 ms
4 to 8	<i>Reserved</i>	

**CLPU 50/51 and CLPU 50N/51N function parameter settings**

Function number: 3006

Setting	Data	Format/Unit
1	Time before activation (Tcold)	10 ms
2	Pick-up threshold CPUs	% In
3	Global action CLPU 50/51 setting	0 = blocking 1 = multiplication
4	Global action CLPU 50N/51N setting	0 = blocking 1 = multiplication
5	Unit 1/Group A 50/51: pick-up time delay T	(1)
6	Unit 1/Group A 50/51: pick-up time delay T unit	(12)
7	Unit 1/Group A 50/51: multiplying factor M	% Is
8	Unit 1/Group A 50/51: ON or OFF	(1)
9	Unit 1/Group B 50/51: pick-up time delay T	(1)
10	Unit 1/Group B 50/51: pick-up time delay T unit	(12)
11	Unit 1/Group B 50/51: multiplying factor M	% Is
12	Unit 1/Group B 50/51: ON or OFF	(1)
13	Unit 2/Group A 50/51: pick-up time delay T	(1)
14	Unit 2/Group A 50/51: pick-up time delay T unit	(12)
15	Unit 2/Group A 50/51: multiplying factor M	% Is
16	Unit 2/Group A 50/51: ON or OFF	(1)
17	Unit 2/Group B 50/51: pick-up time delay T	(1)
18	Unit 2/Group B 50/51: pick-up time delay T unit	(12)
19	Unit 2/Group B 50/51: multiplying factor M	% Is
20	Unit 2/Group B 50/51: ON or OFF	(1)
21	Unit 1/Group A 50N/51N: pick-up time delay T0	(1)
22	Unit 1/Group A 50N/51N: pick-up time delay T0 unit	(12)
23	Unit 1/Group A 50N/51N: multiplying factor M0	% Is0
24	Unit 1/Group A 50N/51N: ON or OFF	(1)
25	Unit 1/Group B 50N/51N: pick-up time delay T0	(1)
26	Unit 1/Group B 50N/51N: pick-up time delay T0 unit	(12)
27	Unit 1/Group B 50N/51N: multiplying factor M0	% Is0
28	Unit 2/Group B 50N/51N: ON or OFF	(1)
29	Unit 2/Group A 50N/51N: pick-up time delay T0	(1)
30	Unit 2/Group A 50N/51N: pick-up time delay T0 unit	(12)
31	Unit 2/Group A 50N/51N: multiplying factor M0	% Is0
32	Unit 2/Group A 50N/51N: ON or OFF	(1)
33	Unit 2/Group B 50N/51N: pick-up time delay T0	(1)
34	Unit 2/Group B 50N/51N: pick-up time delay T0 unit	(12)
35	Unit 2/Group B 50N/51N: multiplying factor M0	% Is0
36	Unit 2/Group B 50N/51N: ON or OFF	(1)

(1) numerical value, see time delay T (or T0) unit setting.

**Presentation**

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

Sepam 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 Modbus 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 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 can be dated.

Time-setting of Sepam is described in the "Time-tagging of events" section.

**Transferring records**

The transfer requests are 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 words
- number of records encoded in 1 word
- date of record (most recent) encoded in 4 words (see format below)
- date of record (least recent) encoded in 4 words (see format below)
- 24 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 (function 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 later 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 (function 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 Sepam. 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 each time a successful transfer takes place. When it reaches the value FFh, 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:

- **xyyy**: 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 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 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" field and set the "number of usable bytes in the data zone" of the exchange word to zero.

The Sepam 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.

### Presentation

The "Read Device Identification" function is used to access in a standardized manner the information required to clearly identify a device.

The description is made up of a set of objects (ASCII character strings).

Sepam series 20 accepts the "read identification" function (conformity level 02).

For a complete description of the function, go to [www.modbus.org](http://www.modbus.org). The description below covers a subset of the function, adapted to Sepam series 20.

### Implementation

#### Request frame

The request frame is made of the following components.

Field	Size (bytes)	
Slave number	1	
43 (2Bh)	1	Generic access function code
14 (0Eh)	1	Read device identification
01 or 02	1	Type of read
00	1	Object number
CRC16	2	

The type of read is used to select a simplified (01) or a standard (02) description.

#### Reply frame

The reply frame is made of the following components.:

Field	Size (bytes)	
Slave number	1	
43 (2Bh)	1	Generic access function code
14 (0Eh)	1	Read device identification
01 or 02	1	Type of read
02	1	Conformity level
00	1	Continuation-frame flag (none for Sepam)
00	1	Reserved
n	1	Number of objects (according to read type)
Obj1	1	Number of first object
lg1	1	Length first object
txt1	lg1	ASCII string of first object
.....	...	
objn	1	Number $n^{\text{th}}$ object
lgn	1	Length $n^{\text{th}}$ object
txtn	lgn	ASCII string of $n^{\text{th}}$ object
CRC16	2	

#### Exception frame

If an error occurs during request processing, a special exception frame is sent.

Field	Size (bytes)	
Slave number	1	
171 (ABh)	1	Generic access exception (2Bh + 80h)
14 (0Eh)	1	Read device identification
01 or 03	1	Type of error
CRC16	2	

#### Sepam series 20 identification

The objects making up the Sepam series 20 identification are listed below.

Number	Type	Value
0	VendorName	"Merlin Gerin" or "Schneider Electric"
1	ProductCode	Application EAN13 code
2	MajorMinorRevision	Application version number (Vxxyy)
3	VendorURL	"www.schneider-electric.com"
4	ProductName	"Sepam series 20"
5	ModelName	Application name (e.g. "M20 Motor")
6	UserAppName	Sepam marking