

Sepam™ Series 80

Protective Relays

Modbus Communication Manual

Instruction Bulletin
63230-216-231-B1
Retain for future use.



Safety Instructions

Safety symbols and messages

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



ANSI symbol



IEC symbol

Risk of electric shock

The addition of either symbol to a “Danger” or “Warning” safety label on a device indicates that an electrical hazard exists, which will result in death or personal injury if the instructions are not followed.



Safety alert

This is the safety alert symbol. It is used to alert you to potential personal injury hazards and prompt you to consult the manual. Obey all safety instructions that follow this symbol in the manual to avoid possible injury or death.

Safety messages

DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury or property damage.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **could result in** death, serious injury or property damage.

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, minor or moderate injury or property damage.

Important notes

Restricted liability

Electrical equipment should be serviced and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this manual. This document is not intended as an instruction manual for untrained persons.

Device operation

The user is responsible for checking that the rated characteristics of the device are suitable for its application. The user is responsible for reading and following the device's operating and installation instructions before attempting to commission or maintain it. Failure to follow these instructions can affect device operation and constitute a hazard for people and property.

Protective grounding

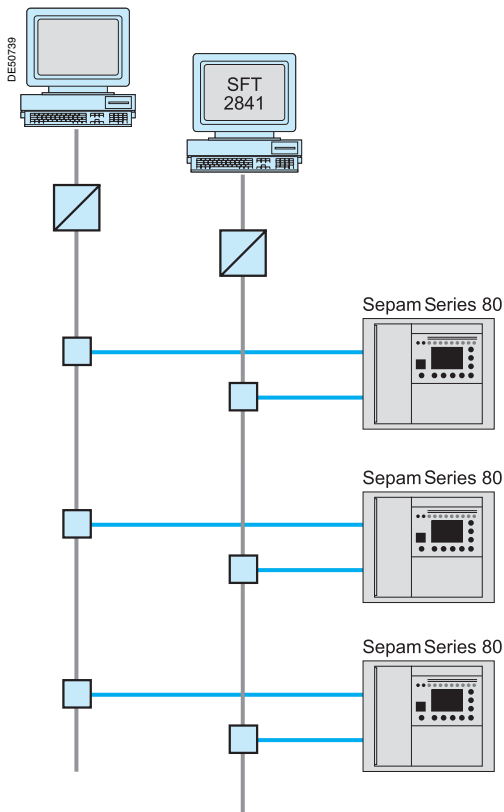
The user is responsible for compliance with all the existing international and national electrical codes concerning protective grounding of any device.

FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. This Class A digital apparatus complies with Canadian ICES-003.

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Sepam™ Series 80 - two ports for communication and remote operation by SFT2841

General

Modbus communication allows Sepam™ to connect to a supervisor or any other device with a master Modbus communication channel.

Sepam™ is always a slave station to Modbus.

Sepam™ Series 80 has two identical and independent communication ports, COM1 and COM2.

Sepam™ connects to a Modbus communication network through a communication interface.

There are two types of communication interface:

- communication interfaces connect Sepam™ to a single network:
 - ACE9492, for connection to a 2-wire RS485 network
 - ACE959, for connection to a 4-wire RS485 network
 - ACE937, for connection to a fiber-optic star network
- communication interfaces connect Sepam™ to two networks:
 - ACE969TP, for connection to:
 - one 2-wire RS485 Modbus S-LAN supervision communication network
 - one 2-wire RS485 E-LAN engineering communication network
 - ACE969FO, for connection to:
 - one fiber-optic Modbus S-LAN supervision communication network
 - one 2-wire RS485 E-LAN engineering communication network

Access Sepam™ Data

Available Data

Modbus communication provides access to many different functions, including:

- reading metering and diagnosis information
- reading status and remote indications
- transferring time-tagged events
- transferring disturbance-recording data
- viewing protection settings
- reading Sepam™ configuration and identification
- remotely controlling the analog output
- time-setting and synchronization

The actual list depends on the application, the type of Sepam™, and the enabled functions.

When enabled, Modbus communication also offers additional functions, such as:

- transmission of remote controls
- modification of protection settings

You can set up a password to protect these two functions.

Access Modes

Depending on the data, two access modes are used:

- **direct access** - you can access the data directly in a single read or write operation
- **indirect access** - access requires a number of read and write operations, using a protocol that is specific to the data accessed

Customized Table

With Sepam™ Series 80, you can set up a customized sub-group of data for quick reading of the most significant information on the user application for each Modbus port in your system.

Compatibility with Sepam™ 2000

Sepam™ Series 80 offers many additional functions while remaining compatible with Sepam™ 2000 addresses and formats for most information.

Protocol Operation

Modbus exchanges information between a master and one or more slave units that are identified by a number. It implements request-reply dialog, where requests are always initiated by the master. Modbus operates in ASCII and binary (RTU mode) formats.

Data is exchanged in the form of 16-bit words (also called registers) or simply bits. Each piece of information (bit or register) has a 16-bit address.

A detailed description of the protocol is provided in the appendix at the end of this manual. These descriptions are also at www.modbus.org.

Modbus Functions

The Modbus protocol that Sepam™ Series 80 uses is a compatible sub-group of the RTU Modbus protocol.

Sepam™ Series 80 handles the following functions:

- 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 7: high-speed reading of 8 bits
 - 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
- enhanced functions:
 - function 102: secure access

Sepam™ Series 80 supports these functions:

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

Multi-Master Operation

When Sepam™ units connect via a gateway to a multiple-access network (Ethernet, Modbus+, etc.), numerous masters can address the same unit by means of the same communication port.

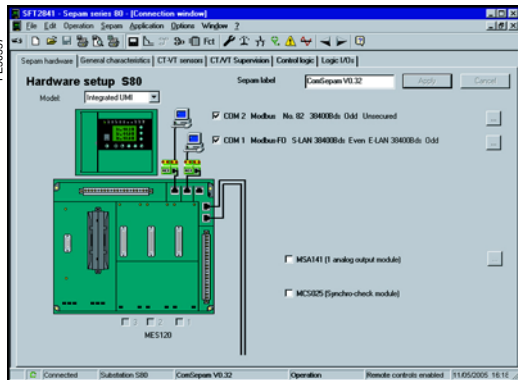
The serial line Modbus protocol cannot manage this type of architecture. The network designer is responsible for avoiding collisions.

- As a general rule, no particular precautions must be taken for direct-access data
- For indirect-access data, Sepam™ provides two exchange zones on each port, so that two simultaneous independent accesses by two different masters are possible

Performance

The typical response time between receiving the request and sending the reply is less than 10 milliseconds for 90% of exchanges. It may occasionally be longer, but generally the response time does not exceed 150 ms.

In indirect mode, the time needed between the request (or an acknowledgment) and the availability of the corresponding data depends on the Sepam™ low-priority step time and can vary from a few dozen to several hundred milliseconds.



SFT2841: Sepam™ configuration screen

Accessing Configuration Parameters

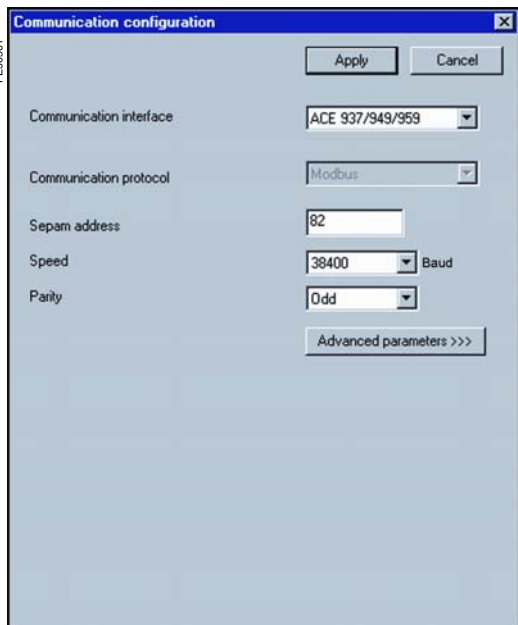
Use the SFT2841 software to configure the Sepam™ communication interfaces. You can access the configuration parameters from the Communication configuration window in the software.

To access this window:

- 1 Open the **Sepam™ configuration** window in SFT2841.
- 2 Check the COM1 or COM2 box as the communication port you want to configure
- 3 Click on the relevant button : The **Communication configuration** window appears.
- 4 Select the type of interface used: ACE949/ACE959/ACE937, ACE969TP or ACE969FO.
- 5 Select the Modbus communication protocol.

The configuration parameters will vary depending on the communication interface selected. The table below specifies the parameters to configure for the type of communication interface chosen.

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



SFT2841: communication configuration window for ACE949

Configuring the Physical Layer of the Modbus Port

Use the following character format with asynchronous serial transmission:

- 1 start bit
- 8 data bits
- 1 stop bit (always fixed at 1)
- parity according to parameter setting

If you select a configuration with parity, each character will contain 11 bits:
1 start bit + 8 data bits + 1 parity bit + 1 stop bit

If you select no parity configuration, 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 as follows:

- 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 baud	19200 baud
Parity	No parity, even, or odd	Even

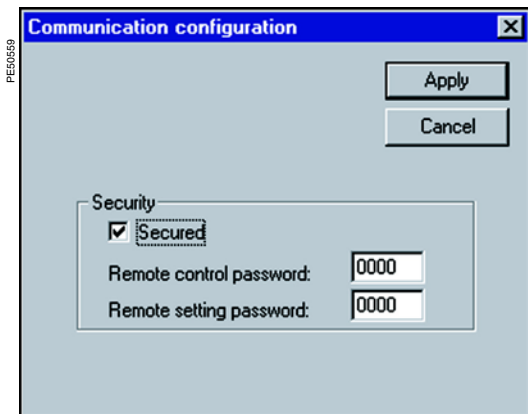
Configuring the ACE969FO Fiber-Optic Port

The configuration for the physical layer of the ACE969FO 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.



Modbus Advanced parameters window

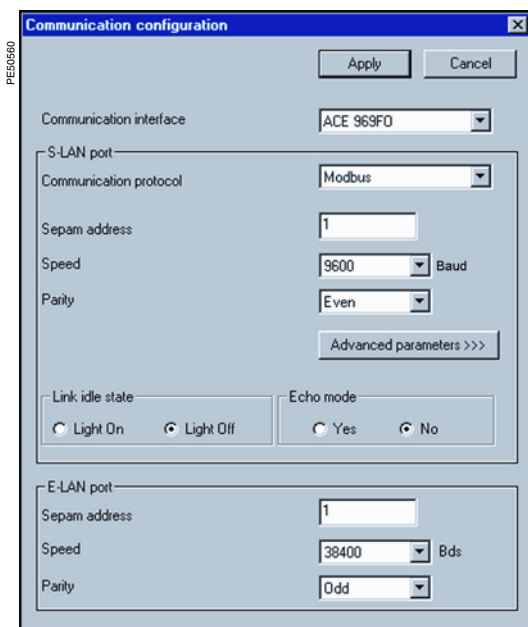
Configuring Modbus Advanced Parameters

You can password protect Sepam™ Series 80 remote controls and remote settings.

You can use advanced parameters to configure the security function by:

- activating the function
- entering the password for the remote controls
- entering the password for the remote settings

Advanced Parameters	Authorized Values	Default Value
Security function	On/Off	Off
Remote controls password	4-digit code	0000
Remote settings password	4-digit code	0000



Communication configuration window for ACE969FO

Configuring the Physical Layer of the ACE969 E-LAN Port

The E-LAN port on the ACE969TP and ACE969FO communication interfaces is a 2-wire RS485 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 you select configuration with parity, each character will contain 11 bits:

1 start bit + 8 data bits + 1 parity bit + 1 stop bit.

If you select no parity configuration, 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 baud	38400 baud
Parity	No parity, even, or odd	Odd

Configuration Tips

- 1 You MUST assign the Sepam™ address before connecting Sepam™ to the communication network.
- 2 It is equally important to set the other physical layer configuration parameters before making the connection to the communication network.
- 3 Modifying the configuration parameters during normal operation will not disturb Sepam™, but it will reset the communication port.

Installing the Communication Network

Preliminary Study

The physical characteristics of your facility (geography, amount of information possessed, etc.) are major factors in the technical study you must perform to determine the following options for your facility:

- 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™ Operating Instructions

Communication interfaces must be installed and connected in accordance with the Sepam™ Series 80 operating instructions, reference 63230-216-229.

Preliminary Checks

Make the following preliminary checks:

- 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 ACE Interface Operation

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 ACE9492, ACE959 and ACE937

The link activity LED for the ACE9492, ACE959, and ACE937 interfaces will flash when Sepam™ transmits or receives.

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

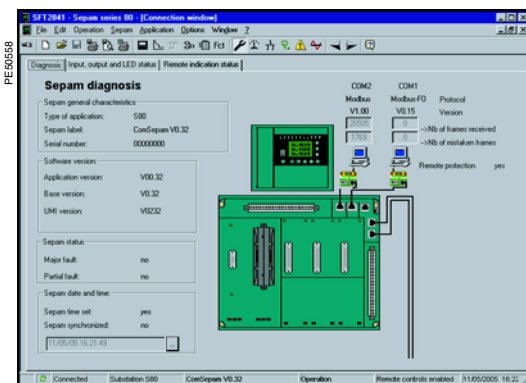
The SFT2841 software informs the operator of the general Sepam™ status and of the Sepam™ communication status in particular.

All Sepam™ status information appears on the Sepam™ diagnosis screen.

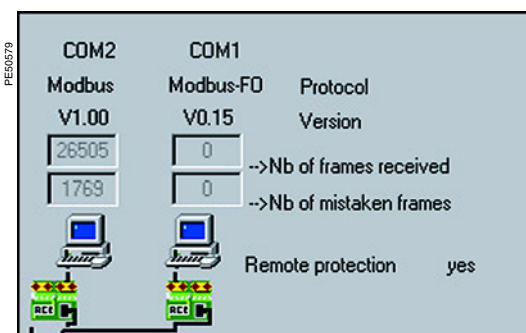
Sepam™ Communication Diagnosis

The operator receives 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 80 diagnosis screen



SFT2841: Communication diagnosis

Link Activity LED

The ACE interface link activity LEDs activate when there are 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 the exchanges are valid.

Functional Test

If correct link operation becomes questionable:

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

The Modbus frames below are an example of a test performed when communication is implemented. It does not matter if it is transmitted or received by a supervisor.

Test Zone			
Read	Transmission	01 03 0C00 0002 C75B	
	Reception	01 03 04 0000 0000 FA33	
Write	Transmission	01 10 0C00 0001 02 1234 6727	
	Reception	01 10 0C00 0001 0299	
Read	Transmission	01 03 0C00 0001 B75A	
	Reception	01 03 02 1234 B539	
Function 8 - Modbus Diagnosis, Echo Mode			
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 reset to "0" when:

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

Using the Counters

Modbus diagnosis counters help detect and resolve communications problems. Use Modbus protocol functions 8 and 11, the dedicated read functions, to access the counters.

You can display CPT2 and CPT9 counters 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

Connect the Sepam™ units to the Modbus network one by one. Check the activity on the RS232/RS485 converter or the fiber-optic converter (if there is one), and on the ACE module to ensure the supervisor sends frames to the relevant Sepam™.

RS485 Network

Check the following in the RS485 Network:

- the wiring on each ACE module
- the tightness of the screw terminals on each ACE module
- the CCA612 cord connection 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 RS485 network
- check the auxiliary power supply connection to the ACE969TP
- 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
- 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 SFT2841 ("Sepam™ Diagnosis" screen)

Presentation

Word Addresses

All Sepam™ information accessible via Modbus communication is organized in 16-bit words. Each word is identified by its address coded on 16 bits, from 0 to 65535 (FFFFh).

The essential information also has addresses coded from 0 to 9999 (270Fh) so that it is compatible with older equipment.

In the following pages of this document, all addresses are expressed in hexadecimal (xxxxh).

Data which are similar from the control-monitoring application and the coding viewpoint are grouped in adjacent address zones.

Bit Addresses

Some information is also available in bit form. The bit address is derived from the word address, where:

$$\text{bit address} = (\text{word address} \times 16) + \text{bit rank (0 to 15)}.$$

Example: word 0C00 bit 0 = C000, word 0C00 bit 14 = C00E.

Non-Defined Addresses

Use only the addresses defined in this document. If other addresses are used, Sepam™ may return an exception message or data that is not significant.

Direct-Access Data

These data are permanently identified by their Modbus address. They may be accessed by a single read or write operation, addressing either part or all the zone in question.

Indirect-Access Data

In this case, the Modbus addresses indicated make up an exchange zone occupied by different data, depending on the context. At least two operations are required for each exchange. The necessary protocol is indicated for each zone.



32-bit formats

For these data, the most-significant word is sent first.

Saturation

In all formats, if a datum overruns the maximum permissible value for the related format, the value read for the datum is the maximum permissible value for the format.

The maximum value can also indicate an abnormal calculation or value.

Data Coding

Except where mentioned in the text, Sepam™ data is coded in one of the formats below:

- 32S: 32-bit signed 2's complement value
- 32NS: 32-bit non-signed value
- 16S: 16-bit signed 2's complement value
- 16NS: 16-bit non-signed value
- 16O: 16-bit signed value, coded with a shift of 8000h
 - -32768 is coded 0
 - 0 is coded 8000h
 - 32767 is coded FFFFh)
- B: bit or set of bits
- IEC: time coding format using four words as per IEC 60870-5-4

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 1	reserved									year (0 to 99)						
Word 2	0	0	0	0	month (1 to 12)				0	0	0	day (1 to 31)				
Word 3	0	0	0	hour (0 to 23)					0	0	minute (0 to 59)					
Word 4	millisecond (0 to 59999)															

Bits set to 0 correspond to format fields not used by Sepam™. They are always read as 0 and are not taken into account during writing.

The reserved field is read as 0 and may receive different values during writing.

- ASCII: character string in ASCII code, the number of characters is indicated. When ASCII strings do not completely fill the field, zero bytes are added. The sequence of characters in Modbus words is the following:
 - character n in the LSB position
 - character n+1 in the MSB position
- MMmm: coding of a version number on 16 bits (major index in the MSB position, minor index in LSB position)

	Starting Address	Decimal	Ending Address	Access Mode	Access Type	Page
Time Management and Sepam™ (Compatible with Sepam™ 2000)						
Synchronization zone	0002		0005	direct	word	10
Identification zone	0006		000F	direct	word	15
Application Management						
Application zone	0180	354	01BF	direct	word	10
Metering and Diagnosis						
32-bit metering and diagnosis	0200	512	0291	direct	word	12
16-bit metering and diagnosis	0300		0335	direct	word	15
Directories						
Disturbance recordings	0400	1024	044F	direct	word	15
Tripping context	0480		0497	direct	word	15
Out-of-sync context	0500		0507	direct	word	15
Test						
Test zone	0C00	3072	0C0F	direct	word / bit	16
Status Conditions and Controls (Compatible with Sepam™ 2000)						
Logic inputs and logic equations	0C10		0C16	direct	word / bit	17
Logic outputs	0C20		0C2A	direct	word / bit	18
Analog-output control	0C30		0C30	direct	word	18
Logipam counters	0C40		0C57	direct	word	16
Remote-control orders	0C84		0C8B	direct	word / bit	19
Remote indications	0C8F		0C9E	direct	word / bit	21
Metering and Miscellaneous for Sepam™ 2000 Compatibility						
Disturb. rec. identification zone	D204		D210	direct	word	25
Measurements x 1	FA00	64000	FA2F	direct	word	26
Measurements x 10	FB00		FB24	direct	word	27
Compact zone	FB80		FB8F	direct	word	27
Configuration zone	FC00		FC03	direct	word	25
Event Table (First Table Compatible with Sepam™ 2000)						
First table	0040	64	0060	indirect	word	31
Second table	0070		0090	indirect	word	31
First Zone for Recording-Data Transfer						
Selection	2200	8704	2203	indirect	word	32
Read	2300		237C	indirect	word	33
Second Zone for Recording-Data Transfer (Compatible with Sepam™ 2000)						
Selection	D200	54760	D203	indirect	word	32
Read	D300		D37C	indirect	word	33
First Access Zone to Settings						
Read settings	2000	8192	207C	indirect	word	31
Read request	2080		2080	indirect	word	36
Remote setting	2100		217A	indirect	word	37
Second Access Zone to Settings (Compatible with Sepam™ 2000)						
Read settings	D000	3424	D07C	indirect	word	37
Read request	D080		D080	indirect	word	36
Remote setting	D100		D17A	indirect	word	37
Customized Table						
Data table	2600	9728	267C	direct	word	39
Configuration table	2680		26FC	direct	word	38

Note: FFFFh (65535) indicates max value, overflow, or invalid number.

Presentation

The following data are provided for each zone:

- each Modbus address for the zone
- the Modbus function codes available for reading
- the Modbus function codes available for writing
- data formats, values and units
- whether the data can be included in a customized table ("config")

The indicated addresses are always word addresses. For bit access, the bit address must be used (see the Access page).

Synchronization Zone

The **synchronization zone** is a data structure containing the absolute data and time used by Sepam™ to time-tag its various recordings (events, disturbance recording, etc.).

Synchronization Zone	Address	Read	Write	Format	Config.
Absolute time (year)	0002	3	16	IEC	-
Absolute time (month + day)	0003	3	16	IEC	-
Absolute time (hours + minutes)	0004	3	16	IEC	-
Absolute time (milliseconds)	0005	3	16	IEC	-



The zone should be written in a single block containing 4 words, using function 16 (write word).

Identification Zone

The **identification zone** contains system information pertaining to the identification of the Sepam™ equipment.

Synchronization Zone	Address	Read	Write	Value/ Format	Config.
Manufacturer identification	0006	3	-	0100	-
Equipment identification	0007	3	-	0	-
Marking + equipment type	0008	3	-	1200	-
Modbus version	0009	3	-	MMmm	-
Application technical level	000A	3	-	1 to n	-
version	000B	3	-	MMmm	-
Sepam™ check-word	000C	3	-	idem 0C8F	-
Summary zone	000D	3	-	0 (not mngd)	-
Command	000E	3	16	0 (not mngd)	-
Extension address	000F	3	-	180	-

This zone is provided to ensure compatibility with existing equipment. A more complete description is available starting at address 0180 in the application zone or using the identification read function.

Note: The formatting listed above is described on page 8.

Application Zone

The application zone contains information on the contents of Sepam™ Series 80. Some of the information is reserved.

Application Zone	Address	Read	Write	Format	Config.
Reserved	0180	3	-	-	-
Reserved	0181	3	-	-	-
Reserved	0182	3	-	-	-
Application abbreviation	0183/0185	3	-	ASCII 6c	-
Application name	0186/018F	3	-	ASCII 20c	-
Sepam™ marking	0190/0199	3	-	ASCII 20c	-
Application version	019A/019C	3	-	ASCII 6c	-
Local-language name	019D/01A6	3	-	ASCII 12c	-
Technical level	01A7	3	-	16NS	-
UV number	01A8	3	-	16NS	-
Reserved	01A9	3	-	-	-
Reserved	01AA	3	-	-	-
Reserved	01AB	3	-	-	-
Reserved	01AC	3	-	-	-
Reserved	01AD	3	-	-	-
Reserved	01AE	3	-	-	-
Local-language version	01AF	3	-	MMmm	-
English-language version	01B0	3	-	MMmm	-
Boot version	01B1	3	-	MMmm	-
Base version	01B2	3	-	MMmm	-
Communication version	01B3	3	-	MMmm	-
DSM-module version	01B4/01B6	3	-	ASCII 6c	-
MET1482 n° 1 module version	01B7/01B9	3	-	ASCII 6c	-
MET1482 n° 2 module version	01BA/01BC	3	-	ASCII 6c	-
MSA141 module version	01BD/01BF	3	-	ASCII 6c	-
Reserved	01C0/01C2	3	-	ASCII 6c	-
Mimic-based UMI version	01C3/01C5	3	-	ASCII 6c	-
MCS025 module version	01C6/01C8	3	-	ASCII 6c	-
ACE969 com1 module version	01C9/01CB	3	-	ASCII 6c	-
ACE969 com2 module version	01CC/01CE	3	-	ASCII 6c	-

Note: The formatting listed above is described on page 8.

32-Bit Metering and Diagnosis Zone

This zone contains all Sepam™ metering and diagnosis information coded on 32 bits. Zone size exceeds the capacity of a frame in that it requires at least two requests to read it in full. Depending on the application and the parameter settings, some information is not significant.

32-Bit Metering and Diagnosis Zone	Address	Read	Write	Format	Unit	Config.
Phase current Ia	0200/0201	3, 4	-	32NS	0.1 A	yes
Phase current Ib	0202/0203	3, 4	-	32NS	0.1 A	yes
Phase current Ic	0204/0205	3, 4	-	32NS	0.1 A	yes
Residual current Ir Σ	0206/0207	3, 4	-	32NS	0.1 A	yes
Residual current Ir	0208/0209	3, 4	-	32NS	0.1 A	yes
Demand current Ima	020A/020B	3, 4	-	32NS	0.1 A	yes
Demand current Imb	020C/020D	3, 4	-	32NS	0.1 A	yes
Demand current Imc	020E/020F	3, 4	-	32NS	0.1 A	yes
Peak demand current Ima	0210/0211	3, 4	-	32NS	0.1 A	yes
Peak demand current IMb	0212/0213	3, 4	-	32NS	0.1 A	yes
Peak demand current IMc	0214/0215	3, 4	-	32NS	0.1 A	yes
Phase-to-phase voltage Vab	0216/0217	3, 4	-	32NS	1 V	yes
Phase-to-phase voltage Vbc	0218/0219	3, 4	-	32NS	1 V	yes
Phase-to-phase voltage Vac	021A/021B	3, 4	-	32NS	1 V	yes
Phase-to-neutral voltage Van	021C/021D	3, 4	-	32NS	1 V	yes
Phase-to-neutral voltage Vbn	021E/021F	3, 4	-	32NS	1 V	yes
Phase-to-neutral voltage Vcn	0220/0221	3, 4	-	32NS	1 V	yes
Residual voltage Vr	0222/0223	3, 4	-	32NS	1 V	yes
Positive sequence voltage V1	0224/0225	3, 4	-	32NS	1 V	yes
Negative-sequence voltage V2	0226/0227	3, 4	-	32NS	1 V	yes
Frequency f	0228/0229	3, 4	-	32NS	0.01 Hz	yes
Active power P	022A/022B	3, 4	-	32S	0.1 kW	yes
Reactive power Q	022C/022D	3, 4	-	32S	0.1 kvar	yes
Apparent power S	022E/022F	3, 4	-	32S	0.1 kVA	yes
Power factor pf	0230/0331	3, 4	-	32S	0.01	yes
Peak demand active power PM	0232/0233	3, 4	-	32S	0.1 kW	yes
Peak demand reactive power QM	0234/0235	3, 4	-	32S	0.1 kvar	yes
Active power P phase a	0236/0237	3, 4	-	32S	0.1 kW	yes
Active power P phase b	0238/0239	3, 4	-	32S	0.1 kW	yes
Active power P phase c	023A/023B	3, 4	-	32S	0.1 kW	yes
Reactive power Q phase a	023C/023D	3, 4	-	32S	0.1 kvar	yes
Reactive power Q phase b	023E/023F	3, 4	-	32S	0.1 kvar	yes
Reactive power Q phase c	0240/0241	3, 4	-	32S	0.1 kvar	yes
Apparent power S phase a	0242/0243	3, 4	-	32S	0.1 kVA	yes
Apparent power S phase b	0244/0245	3, 4	-	32S	0.1 kVA	yes
Apparent power S phase c	0246/0247	3, 4	-	32S	0.1 kVA	yes
Positive active energy Ea+	0248/0249	3, 4	-	32NS	100 kWh	yes
Negative active energy Ea-	024A/024B	3, 4	-	32NS	100 kWh	yes
Positive reactive energy Er+	024C/024D	3, 4	-	32NS	100 kvarh	yes
Negative reactive energy Er-	024E/024F	3, 4	-	32NS	100 kvarh	yes
Ext. positive active energy Ea+	0250/0251	3, 4	-	32NS	100 kWh	yes
Ext. negative active energy Ea-	0252/0253	3, 4	-	32NS	100 kWh	yes
Ext. positive reactive energy Ea+	0254/0255	3, 4	-	32NS	100 kvarh	yes
Ext. negative reactive energy Ea-	0256/0257	3, 4	-	32NS	100 kvarh	yes
Neutral-point voltage V _{L,n} t	0258/0259	3, 4	-	32NS	1 V	yes
H3 neutral-point voltage VntH3	025A/025B	3, 4	-	32NS	1 V	yes
H3 residual voltage VrH3	025C/025D	3, 4	-	32NS	1 V	yes

Note: The formatting listed above is described on page 8.

32-Bit Metering and Diagnosis Zone (Cont.)

32-Bit Metering and Diagnosis Zone	Address	Read	Write	Format	Unit	Config.
Phase current I'a	025E/025F	3, 4	-	32NS	0.1 A	yes
Phase current I'b	0260/0261	3, 4	-	32NS	0.1 A	yes
Phase current I'c	0262/0263	3, 4	-	32NS	0.1 A	yes
Residual current I'r Σ	0264/0265	3, 4	-	32NS	0.1 A	yes
Residual current I'r	0266/0267	3, 4	-	32NS	0.1 A	yes
Number of operations	0268/0269	3, 4	-	32NS	1	yes
Tripping current phase a Tripl'a	026A/026B	3, 4	-	32NS	0.1 A	yes
Tripping current phase b Tripl'b	026C/026D	3, 4	-	32NS	0.1 A	yes
Tripping current phase c Tripl'c	026E/026F	3, 4	-	32NS	0.1 A	yes
Tripping current calculated I'r Tripl'n	0270/0271	3, 4	-	32NS	0.1 A	yes
Reserved	0272/0273	3, 4	-	-	-	yes
Reserved	0274/0275	3, 4	-	-	-	yes
Reserved	0276/0277	3, 4	-	-	-	yes
Reserved	0278/0279	3, 4	-	-	-	yes
Reserved	027A/027B	3, 4	-	-	-	yes
Number of operations	027C/027D	3, 4	-	32NS	1	yes
Differential current I'da	027E/027F	3, 4	-	32NS	0.1 A	yes
Differential current I'db	0280/0281	3, 4	-	32NS	0.1 A	yes
Differential current I'dc	0282/0283	3, 4	-	32NS	0.1 A	yes
Through current I'ta	0284/0285	3, 4	-	32NS	0.1 A	yes
Through current I'tb	0286/0287	3, 4	-	32NS	0.1 A	yes
Through current I'tc	0288/0289	3, 4	-	32NS	0.1 A	yes
Impedance Z1	028A/028B	3, 4	-	32NS	1 m Ω	yes
Impedance Zab	028C/028D	3, 4	-	32NS	1 m Ω	yes
Impedance Zbc	028E/028F	3, 4	-	32NS	1 m Ω	yes
Impedance Zac	0290/0291	3, 4	-	32NS	1 m Ω	yes
Phase-to-phase voltage V'ab	0292/0293	3, 4	-	32NS	1 V	yes
Phase-to-phase voltage V'bc	0294/0295	3, 4	-	32NS	1 V	yes
Phase-to-phase voltage V'ac	0296/0297	3, 4	-	32NS	1 V	yes
Phase-to-neutral voltage V'an	0298/0299	3, 4	-	32NS	1 V	yes
Phase-to-neutral voltage V'bn	029A/029B	3, 4	-	32NS	1 V	yes
Phase-to-neutral voltage V'cn	029C/029D	3, 4	-	32NS	1 V	yes
Residual voltage V'r	029E/029F	3, 4	-	32NS	1 V	yes
Positive sequence voltage V'1	02A0/02A1	3, 4	-	32NS	1 V	yes
Negative sequence voltage V'2	02A2/02A3	3, 4	-	32NS	1 V	yes
Frequency f'	02A4/02A5	3, 4	-	32NS	0.01 Hz	yes
Voltage difference dV _{LL} (sync-check)	02A6/02A7	3, 4	-	32NS	1 V	yes
Frequency difference df (sync-check)	02A8/02A9	3, 4	-	32NS	0.01 Hz	yes
Phase difference dPhi (sync-check)	02AA/02AB	3, 4	-	32NS	0.1°	yes
Capacitor capacitance C1 (or C21)	02AC/02AD	3, 4	-	32NS	0.1 μ F	yes
Capacitor capacitance C2 (or C32)	02AE/02AF	3, 4	-	32NS	0.1 μ F	yes
Capacitor capacitance C3 (or C13)	02B0/02B1	3, 4	-	32NS	0.1 μ F	yes
Reserved	02B2/02FF		-			

Note: The formatting listed above is described on page 8.

16-Bit Metering and Diagnosis Zone

This zone contains all Sepam™ metering and diagnosis information, coded on 16 bits. Depending on the application and the parameter settings, some information is not significant.

16-Bit Metering and Diagnosis Zone	Address	Read	Write	Format	Unit	Config.
Temperature 1 MET1482 n° 1	0300	3, 4	-	16S	1°C	yes
Temperature 2 MET1482 n° 1	0301	3, 4	-	16S	1°C	yes
Temperature 3 MET1482 n° 1	0302	3, 4	-	16S	1°C	yes
Temperature 4 MET1482 n° 1	0303	3, 4	-	16S	1°C	yes
Temperature 5 MET1482 n° 1	0304	3, 4	-	16S	1°C	yes
Temperature 6 MET1482 n° 1	0305	3, 4	-	16S	1°C	yes
Temperature 7 MET1482 n° 1	0306	3, 4	-	16S	1°C	yes
Temperature 8 MET1482 n° 1	0307	3, 4	-	16S	1°C	yes
Temperature 1 MET1482 n° 2	0308	3, 4	-	16S	1°C	yes
Temperature 2 MET1482 n° 2	0309	3, 4	-	16S	1°C	yes
Temperature 3 MET1482 n° 2	030A	3, 4	-	16S	1°C	yes
Temperature 4 MET1482 n° 2	030B	3, 4	-	16S	1°C	yes
Temperature 5 MET1482 n° 2	030C	3, 4	-	16S	1°C	yes
Temperature 6 MET1482 n° 2	030D	3, 4	-	16S	1°C	yes
Temperature 7 MET1482 n° 2	030E	3, 4	-	16S	1°C	yes
Temperature 8 MET1482 n° 2	030F	3, 4	-	16S	1°C	yes
Total harmonic distortion Vthd	0310	3, 4	-	16 NS	0.1 %	yes
Total harmonic distortion Ithd	0311	3, 4	-	16 NS	0.1 %	yes
Angle $\varphi_{r\Sigma}$	0312	3, 4	-	16 NS	1°	yes
Reserved	0313	3, 4	-	-	-	yes
Angle φ_r	0314	3, 4	-	16NS	1°	yes
Angle φ_r'	0315	3, 4	-	16NS	1°	yes
Angle φ_a	0316	3, 4	-	16NS	1°	yes
Angle φ_b	0317	3, 4	-	16NS	1°	yes
Angle φ_c	0318	3, 4	-	16NS	1°	yes
Negative sequence / unbalance	0319	3, 4	-	16NS	% Ib	yes
Negative sequence / unbalance '	031A	3, 4	-	16NS	% Ib'	yes
Machine rotation speed	031B	3, 4	-	16NS	rpm	yes
Thermal capacity used	031C	3, 4	-	16NS	%	yes
Running hours counter	031D	3, 4	-	16NS	1 hr	yes
Time before tripping	031E	3, 4	-	16NS	1 min	yes
Time before closing	031F	3, 4	-	16NS	1 min	yes
Starting time / overload	0320	3, 4	-	16NS	0.01 s	yes
Block start time	0321	3, 4	-	16NS	1 min	yes
Number of starts allowed	0322	3, 4	-	16NS	1	yes
Learnt cooling time constant T2 (49 RMS) thermal rate 1	0323	3, 4	-	16NS	1 min	yes
Learnt cooling time constant T2 (49 RMS) thermal rate 2	0324	3, 4	-	16NS	1 min	yes
Total cumulative breaking current	0325	3, 4	-	16NS	1(kA) ²	yes
Cumulative breaking current (0 < I < 2 I _N)	0326	3, 4	-	16NS	1(kA) ²	yes
Cum. breaking current (2 I _N < I < 5 I _N)	0327	3, 4	-	16NS	1(kA) ²	yes
Cum. breaking current (5 I _N < I < 10 I _N)	0328	3, 4	-	16NS	1(kA) ²	yes
Cum. breaking current (10 I _N < I < 40 I _N)	0329	3, 4	-	16NS	1(kA) ²	yes
Cumulative breaking current (I > 40 I _N)	032A	3, 4	-	16NS	1(kA) ²	yes
Initial value of cumulative breaking current	032B	3, 4	-	16NS	1(kA) ²	yes
Starting/overload current	032C	3, 4	-	16NS	1 A	yes
Operating time	032D	3, 4	-	16NS	1 ms	yes
Charging time	032E	3, 4	-	16NS	1 s	yes
Number of racking out operations	032F	3, 4	-	16NS	1	yes
Auxiliary voltage	0330	3, 4	-	16NS	0.1 V	yes
Number of trips on phase current	0331	3, 4	-	16NS	1	yes
Number of trips on ground-fault current	0332	3, 4	-	16NS	1	yes
Angle Ia / I'a	0333	3, 4	-	16NS	1°	yes
Angle Ib / I'b	0334	3, 4	-	16NS	1°	yes
Angle Ic / I'c	0335	3, 4	-	16NS	1°	yes
Operating time capacitor step 1	0336	3, 4	-	16NS	1 hr	yes
Operating time capacitor step 2	0337	3, 4	-	16NS	1 hr	yes
Operating time capacitor step 3	0338	3, 4	-	16NS	1 hr	yes
Operating time capacitor step 4	0339	3, 4	-	16NS	1 hr	yes

Note: The formatting listed above is described on page 8.

Directory Zones

These zones indicate the recordings available in Sepam™ Series 80 for the given data category. They have a similar structure.

Disturbance-Recording Directory

Disturbance-Recording Directory	Address	Read	Write	Format	Unit	Config.
Size of set-up files	0400	3	-	16NS	bytes	-
Size of data files	0401/0402	3	-	32NS	bytes	-
Number of records available	0403	3	-	16NS	1	-
Date of record 1 (most recent)	0404/0407	3	-	IEC	-	-
Date of record 2	0408/040B	3	-	IEC	-	-
...	...	...	...	...	...	...
Date of record 19 (oldest)	044C/044F	3	-	IEC	-	-

Tripping-Context Directory

Context Directory	Address	Read	Write	Format	Unit	Config.
Context size	0480	3	-	16NS	bytes	-
Not used	0481/0482	3	-	-	-	-
Number of records available	0483	3	-	16NS	1	-
Date of record 1 (most recent)	0484/0487	3	-	IEC	-	-
Date of record 2	0488/048B	3	-	IEC	-	-
...	...	...	...	...	...	...
Date of record 5 (oldest)	0494/0497	3	-	IEC	-	-

Out-of-Sync Context Directory

Context Directory	Address	Read	Write	Format	Unit	Config.
Context size	0500	3	-	16NS	bytes	-
Not used	0501/0502	3	-	-	-	-
Number of records available	0503	3	-	16NS	1	-
Date of record	0504	3	-	IEC	-	-

Note: The formatting listed above is described on page 8.

Test Zone

The **test zone** is a 16-word zone you can access through the communication link by all functions in both read and write modes. This helps facilitate communication testing when you commission or test the link.

These words are set to zero when Sepam™ starts.

Test Zone	Address	Bit Addresses	Read	Write	Config.
Test word 1	0C00	C000/C00F	1, 2, 3, 4	5, 6, 15, 16	-
Test word 2	0C01	C010/C01F	1, 2, 3, 4	5, 6, 15, 16	-
...	...	...	...	...	...
Test word 16	0C0F	C0F0/C0FF	1, 2, 3, 4	5, 6, 15, 16	-

Logipam Counter Zone

Counters used by the Logipam program.

Logipam Counter Zone	Address	Read	Write	Config.
C1	0C40	3, 4	-	yes
C2	0C41	3, 4	-	yes
C3	0C42	3, 4	-	yes
C4	0C43	3, 4	-	yes
C5	0C44	3, 4	-	yes
C6	0C45	3, 4	-	yes
C7	0C46	3, 4	-	yes
C8	0C47	3, 4	-	yes
C9	0C48	3, 4	-	yes
C10	0C49	3, 4	-	yes
C11	0C4A	3, 4	-	yes
C12	0C4B	3, 4	-	yes
C13	0C4C	3, 4	-	yes
C14	0C4D	3, 4	-	yes
C15	0C4E	3, 4	-	yes
C16	0C4F	3, 4	-	yes
C17	0C50	3, 4	-	yes
C18	0C51	3, 4	-	yes
C19	0C52	3, 4	-	yes
C20	0C53	3, 4	-	yes
C21	0C54	3, 4	-	yes
C22	0C55	3, 4	-	yes
C23	0C56	3, 4	-	yes
C24	0C57	3, 4	-	yes

Status-Condition and Control Zones

Logic Input / Logic Equation Zone

Input / Equation Zone	Address	Bit Addresses	Read	Write	Format	Config.
Logic inputs I101 to I114 (MES120 n° 1)	0C10	C100/C10F	1, 2, 3, 4	-	B	yes
Logic inputs I201 to I214 (MES120 n° 2)	0C11	C110/C11F	1, 2, 3, 4	-	B	yes
Logic inputs I301 to I314 (MES120 n° 3)	0C12	C120/C12F	1, 2, 3, 4	-	B	yes
Logic equation bits (1 st word)	0C13	C130/C13F	1, 2, 3, 4	-	B	yes
Logic equation bits (2 nd word)	0C14	C140/C14F	1, 2, 3, 4	-	B	yes
Logic equation bits (3 rd word)	0C15	C150/C15F	1, 2, 3, 4	-	B	yes
Logic equation bits (4 th word)	0C16	C160/C16F	1, 2, 3, 4	-	B	yes

Layout of logic inputs

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input	-	-	14	13	12	11	10	09	08	07	06	05	04	03	02	01

Logic Equation Bits

	1 st word 0C13	2 nd word 0C14	3 rd word 0C15	4 th word 0C16
Bit 00	V1	V17	V_TRIP_STP3	V_MIMIC_IN_9
Bit 01	V2	V18	V_TRIP_STP4	V_MIMIC_IN_10
Bit 02	V3	V19	V_CLOSE_STP1	V_MIMIC_IN_11
Bit 03	V4	V20	V_CLOSE_STP2	V_MIMIC_IN_12
Bit 04	V5	V_FLAGREC	V_CLOSE_STP3	V_MIMIC_IN_13
Bit 05	V6	V_TRIPCB	V_CLOSE_STP4	V_MIMIC_IN_14
Bit 06	V7	V_CLOSECB	V_TRANS_ON_FLT	V_MIMIC_IN_15
Bit 07	V8	V_BLOCKCLOSE	V_TRANS_STOP	V_MIMIC_IN_16
Bit 08	V9	V_RESET	V_MIMIC_IN_1	Reserved
Bit 09	V10	V_CLEAR	V_MIMIC_IN_2	Reserved
Bit 10	V11	V_BLOCKRESET_LOCAL	V_MIMIC_IN_3	Reserved
Bit 11	V12	V_SHUTDOWN	V_MIMIC_IN_4	Reserved
Bit 12	V13	V_DE-EXCITATION	V_MIMIC_IN_5	Reserved
Bit 13	V14	V_CLOSE_NOCTRL	V_MIMIC_IN_6	Reserved
Bit 14	V15	V_TRIP_STP1	V_MIMIC_IN_7	Reserved
Bit 15	V16	V_TRIP_STP2	V_MIMIC_IN_8	Reserved

Note: The formatting listed above is described on page 8.

Logic-Output Zone

This zone indicates the status of the logic outputs and the LEDs on the front panel.

Logic-Output Zone	Address	Bit Addresses	Read	Write	Format	Config.
Logic outputs O1 to O5 (base)	0C20	C200/C10F	1, 2, 3, 4	-	B	yes
Logic outputs O101 to O106 (MES120 n° 1)	0C21	C210/C21F	1, 2, 3, 4	-	B	yes
Logic outputs O201 to O206 (MES120 n° 2)	0C22	C220/C22F	1, 2, 3, 4	-	B	yes
Logic outputs O301 to O306 (MES120 n° 3)	0C23	C230/C23F	1, 2, 3, 4	-	B	yes
LED status	0C24	C240/C24F	1, 2, 3, 4	-	B	yes

Layout of logic outputs

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output	-	-	-	-	-	-	-	-	-	-	06	05	04	03	02	01

Layout of LEDs

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LED	-	-	-	-	-	-	L9	L8	L7	L6	L5	L4	L3	L2	L1	LD

LD: red "Sepam™ unavailable" LED.

**Remote control of the analog output**

You can set up the analog output of the MSA141 module for remote control via the Modbus communication link. The usable range of the numerical value transmitted is defined by the "min. value" and "max. value" settings of the analog output (SFT2841).

Analog-Output Control Zone

Analog-Output Zone	Address	Read	Write	Format	Config.
MSA141	0C30	3, 4	6, 16	16S/16NS ⁽¹⁾	-

(1) As per MSA141 parameter settings (option).

Note: The formatting listed above is described on page 8

Remote-Control Zone

Remote-Control Zone	Address	Bit Addresses	Read	Write	Format	Config.
TCM1 to TCM16	0C80	C800/C80F	1, 2, 3, 4	5, 6, 15, 16	B	-
TCM17 to TCM32	0C81	C810/C81F	1, 2, 3, 4	5, 6, 15, 16	B	-
STC1 to STC16	0C84	C840/C84F	1, 2, 3, 4	5, 6, 15, 16	B	-
STC17 to STC32	0C85	C850/C85F	1, 2, 3, 4	5, 6, 15, 16	B	-
STC33 to STC48	0C86	C860/C86F	1, 2, 3, 4	5, 6, 15, 16	B	-
STC49 to STC64	0C87	C870/C87F	1, 2, 3, 4	5, 6, 15, 16	B	-
* TC1 to TC16	0C88	C880/C88F	1, 2, 3, 4	5, 6, 15, 16	B	-
* TC17 to TC32	0C89	C890/C89F	1, 2, 3, 4	5, 6, 15, 16	B	-
* TC33 to TC48	0C8A	C8A0/C8AF	1, 2, 3, 4	5, 6, 15, 16	B	-
* TC49 to TC64	0C8B	C8B0/C8BF	1, 2, 3, 4	5, 6, 15, 16	B	-

Using Remote-Control Commands

You can transmit remote-control commands to Sepam™ by:

- 32 bits of maintained remote-control commands (TCM)
- 64 bits of pulse-type remote-control commands (TC)

You can execute pulse-type remote-control commands in either of the following modes:

- direct mode
- confirmed SBO (Select Before Operate) mode

Select these by the parameter settings.

Maintained Remote-Control Commands (TCM)

Maintained remote-control commands (TCM1 to TCM32) work like bistable multivibrators. They continuously maintain the value of the last state ordered. They are used only by the Logipam program, and will reset to zero if Sepam™ loses auxiliary power.

Pulse-Type Remote Control Commands (TC) in Direct Mode

The remote-control commands executes when it is written in the remote-control word. The program logic resets it to zero after the command is acknowledged.

Pulse-Type Remote Control Commands (TC) in Confirmed SBO Mode

Remote-control commands involve two steps:

- 1 selection by the master of the command to be sent by writing the bit in the STC word and checking of the selection by rereading the word
- 2 execution of the command to be sent by writing the bit in the TC word

The remote-control command is executed if the bit in the STC word and the bit in the associated TC word are set. The program logic resets the STC and TC bits to zero after the remote-control command 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 command is executed
- if the related command is not given within 30 seconds

Blocking Predefined Remote Control Commands

Predefined processing of remote-control commands may be inhibited, except for the tripping remote-control command TC1 which may be activated at any time:

- by choosing Local or Test control mode via the key-switch on Sepam™ relays with mimic-based UMIs
- by assigning a logic input to the "Inhibit remote control" function

The parameter setting of the logic input may be done in two modes:

- block if the input is set to 1
- block if the input is set to 0 (negative input)

In all cases, the remote-control commands remain available in Logipam which may be used to define a specific blocking logic.

Security

You can protect the remote-control zone against writing. See the section on security.

* **Note:** See the following for information about remote control assignment.

Remote-Control Zone (Cont'd)

Pulse-type remote-control commands not used by the Logipam program are pre-assigned to protection, control and metering functions.

The assignment of the remote-control commands is given in the tables below.

Depending on the applications and functions in operation, certain remote-control commands may not be applicable and will produce no effect.

The device tripping and closing and recloser enabling and disabling remote-control commands are acknowledged if the "Switchgear control" function is confirmed.

The corresponding value for Sepam™ 2000 is indicated. This value corresponds to the address, not the role (roles are not static in Sepam™ 2000).

When a remote-control command (TC) is used by the Logipam program, it is no longer assigned to a predefined function.

Word 0C88: TC1 to TC16		Sepam™ Series 80
Bit 00: TC1	Trip / open	KTC33
Bit 01: TC2	Closing	KTC34
Bit 02: TC3	Sepam™ reset	KTC35
Bit 03: TC4	Peak demand current reset	KTC36
Bit 04: TC5	Peak demand power reset	KTC37
Bit 05: TC6	Reserved	KTC38
Bit 06: TC7	Reserved	KTC39
Bit 07: TC8	Enable recloser	KTC40
Bit 08: TC9	Disable recloser	KTC41
Bit 09: TC10	Free	KTC42
Bit 10: TC11	Free	KTC43
Bit 11: TC12	Free	KTC44
Bit 12: TC13	Free	KTC45
Bit 13: TC14	Free	KTC46
Bit 14: TC15	Free	KTC47
Bit 15: TC16	Free	KTC48
Word 0C89: TC17 to TC32		Sepam™ Series 80
Bit 00: TC17	Reserved	KTC49
Bit 01: TC18	Block disturbance-recording triggering (OPG)	KTC50
Bit 02: TC19	Confirm disturbance-recording triggering (OPG)	KTC51
Bit 03: TC20	Manual disturbance-recording triggering (OPG)	KTC52
Bit 04: TC21	Free	KTC53
to		
Bit 12: TC29	Free	KTC61
Bit 13: TC30	Block thermal protection	KTC62
Bit 14: TC31	Confirm thermal protection	KTC63
Bit 15: TC32	Reset undercurrent protection	KTC64
Word 0C8A: TC33 to TC48		Sepam™ Series 80
Bit 00: TC33	Switching to setting group A	-
Bit 01: TC34	Switching to setting group B	-
Bit 02: TC35	Priority group shutdown	-
Bit 03: TC36	Cancel priority group shutdown	-
Bit 04: TC37	Enable sync-check	-
Bit 05: TC38	Disable sync-check	-
Bit 06: TC39	Enable voltage check	-
Bit 07: TC40	Disable voltage check	-
Bit 08: TC41	Open capacitor step 1	-
Bit 09: TC42	Open capacitor step 2	-
Bit 10: TC43	Open capacitor step 3	-
Bit 11: TC44	Open capacitor step 4	-
Bit 12: TC45	Close capacitor step 1	-
Bit 13: TC46	Close capacitor step 2	-
Bit 14: TC47	Close capacitor step 3	-
Bit 15: TC48	Close capacitor step 4	-
Word 0C8B: TC49 to TC64		Sepam™ Series 80
Bit 00: TC49	Free	-
to		
Bit 15: TC64	Free	-

Remote-Indications Zone

Remote-Indications Zone	Address	Bit Addresses	Read	Write	Format	Config.
Sepam™ check-word	0C8F	C8F0/C8FF	1, 2, 3, 4	-	B	yes
TS1-TS16	0C90	C900/C90F	1, 2, 3, 4	-	B	yes
TS17-TS32	0C91	C910/C91F	1, 2, 3, 4	-	B	yes
TS33-TS48	0C92	C920/C92F	1, 2, 3, 4	-	B	yes
TS49-TS64	0C93	C930/C93F	1, 2, 3, 4	-	B	yes
TS65-TS80	0C94	C940/C94F	1, 2, 3, 4	-	B	yes
TS81-TS96	0C95	C950/C95F	1, 2, 3, 4	-	B	yes
TS97-TS112	0C96	C960/C96F	1, 2, 3, 4	-	B	yes
TS113-TS128	0C97	C970/C97F	1, 2, 3, 4	-	B	yes
TS129-TS144	0C98	C980/C98F	1, 2, 3, 4	-	B	yes
TS145-TS160	0C99	C990/C99F	1, 2, 3, 4	-	B	yes
TS161-TS176	0C9A	C9A0/C9AF	1, 2, 3, 4	-	B	yes
TS177-TS192	0C9B	C9B0/C9BF	1, 2, 3, 4	-	B	yes
TS193-TS208	0C9C	C9C0/C9CF	1, 2, 3, 4	-	B	yes
TS209-TS224	0C9D	C9D0/C9DF	1, 2, 3, 4	-	B	yes
TS225-TS240	0C9E	C9E0/C9EF	1, 2, 3, 4	-	B	yes

The check word is comprised of a set of information on Sepam™ status. The "high-speed reading" function (7) accesses the most-significant byte in the check word (bits 15 to 8). Assignments are on the following pages.

Word 0C8F: Sepam™ Check-Word		Notes
Bit 0C8F0	Reserved	
Bit 01	Modbus Security function enabled	
Bit 02	Reserved	
Bit 03:	Sepam™ in "data loss" status in 2 nd event zone	(1) (2)
Bit 04:	Event in 2 nd event zone	(1)
Bit 05:	Setting group A in service	(2)
Bit 06:	Setting group B in service	(2)
Bit 07:	Sepam™ time not correct	(2)
Bit 08:	Sepam™ partial fault	(2)
Bit 09:	Sepam™ major fault	
Bit 10: 0C8FA	Sepam™ in parameter setting mode	(2)
Bit 11:	Remote setting blocked	
Bit 12:	Inductive network (1)/capacitive (0)	
Bit 13:	Sepam™ not synchronous	(2)
Bit 14:	Sepam™ in "data loss" status in 1 st event zone	(1) (2)
Bit 15: 0C8FF	Event in 1 st event zone	(1)

(1) This information is specific to each communication port.

(2) Status changes of bits 3, 5, 6, 7, 8, 10, 13, 14 trigger sending of a time-tagged event (see the section on time-tagged events).

Remote-indication bits (TS) are pre-assigned to protection, control and metering functions.

The tables below define each remote-indication bit. Depending on the applications and functions in operation, certain remote-indication bits may not be applicable. The corresponding bit address for Sepam™ 2000 is indicated. This bit corresponds to the address, not the assignment (which can change in Sepam™ 2000).

When Logipam uses a remote-indication bit address, the bit is no longer assigned to a predefined function. The Logipam program determines its functionality.

Word 0C90: TS1 to TS16		Sepam™ Series 80
Bit 00: TS1	Matching fault or Trip Circuit Supervision	KTS1
Bit 01: TS2	Control fault	KTS2
Bit 02: TS3	TC / position discrepancy	KTS3
Bit 03: TS4	External tripping 1	KTS4
Bit 04: TS5	Sepam™ not reset after fault	KTS5
Bit 05: TS6	External tripping 2	KTS6
Bit 06: TS7	External tripping 3	KTS7
Bit 07: TS8	Cos ϕ inductive	KTS8
Bit 08: TS9	Cos ϕ capacitive	KTS9
Bit 09: TS10	Closed position	KTS10
Bit 10: TS11	Device racked out	KTS11
Bit 11: TS12	SF6 alarm	KTS12
Bit 12: TS13	Grounding switch closed	KTS13
Bit 13: TS14	Remote-control enabled	KTS14
Bit 14: TS15	Overcurrent protection (summary)	KTS15
Bit 15: TS16	Free	KTS16

Word 0C91: TS17 to TS32		Sepam™ 2000
Bit 00: TS17	Free	KTS17
to		
Bit 14: TS31	Free	KTS31
Bit 15: TS32	Send blocking signal 1	KTS32
Word 0C92: TS33 to TS48		Sepam™ 2000
Bit 00: TS33	Free	KTS33
to		
Bit 15: TS48	Free	KTS48
Word 0C93: TS49 to TS64		Sepam™ 2000
Bit 00: TS49	Disturbance recording stored	KTS49
Bit 01: TS50	Disturbance recording blocked	KTS50
Bit 02: TS51	Remote setting blocked	KTS51
Bit 03: TS52	Free	KTS52
to		
Bit 15: TS64	Free	KTS64
Word 0C94: TS65 to TS80		
Bit 00: TS65	Protection 50/51 unit 1	
Bit 01: TS66	Protection 50/51 unit 2	
Bit 02: TS67	Protection 50/51 unit 3	
Bit 03: TS68	Protection 50/51 unit 4	
Bit 04: TS69	Protection 50/51 unit 5	
Bit 05: TS70	Protection 50/51 unit 6	
Bit 06: TS71	Protection 50/51 unit 7	
Bit 07: TS72	Protection 50/51 unit 8	
Bit 08: TS73	Protection 50N/51N unit 1	
Bit 09: TS74	Protection 50N/51N unit 2	
Bit 10: TS75	Protection 50N/51N unit 3	
Bit 11: TS76	Protection 50N/51N unit 4	
Bit 12: TS77	Protection 50N/51N unit 5	
Bit 13: TS78	Protection 50N/51N unit 6	
Bit 14: TS79	Protection 50N/51N unit 7	
Bit 15: TS80	Protection 50N/51N unit 8	
Word 0C95: TS81 to TS96		
Bit 00: TS81	Protection 27/27S unit 1	
Bit 01: TS82	Protection 27/27S unit 2	
Bit 02: TS83	Protection 27/27S unit 3	
Bit 03: TS84	Protection 27/27S unit 4	
Bit 04: TS85	Protection 27D unit 1	
Bit 05: TS86	Protection 27D unit 2	
Bit 06: TS87	Protection 27R unit 1	
Bit 07: TS88	Protection 27R unit 2	
Bit 08: TS89	Protection 59 unit 1	
Bit 09: TS90	Protection 59 unit 2	
Bit 10: TS91	Protection 59 unit 3	
Bit 11: TS92	Protection 59 unit 4	
Bit 12: TS93	Protection 59N unit 1	
Bit 13: TS94	Protection 59N unit 2	
Bit 14: TS95	Protection 51V unit 1	
Bit 15: TS96	Protection 51V unit 2	
Word 0C96: TS97 to TS112		
Bit 00: TS97	Protection 67 unit 1	
Bit 01: TS98	Protection 67 unit 2	
Bit 02: TS99	Protection 67N unit 1	
Bit 03: TS100	Protection 67N unit 2	
Bit 04: TS101	Protection 46 unit 1	
Bit 05: TS102	Protection 46 unit 2	
Bit 06: TS103	Protection 47 unit 1	
Bit 07: TS104	Protection 47 unit 2	
Bit 08: TS105	Protection 32P unit 1	
Bit 09: TS106	Protection 32P unit 2	
Bit 10: TS107	Protection 32Q	
Bit 11: TS108	Protection 37	
Bit 12: TS109	Protection 37P unit 1	
Bit 13: TS110	Protection 37P unit 2	
Bit 14: TS111	Protection 40	
Bit 15: TS112	Protection 50BF	

Word 0C97: TS113 to TS128

Bit 00: TS113	Protection 49RMS – alarm set point
Bit 01: TS114	Protection 49RMS – tripping set point
Bit 02: TS115	Protection 48/51LR (locked rotor)
Bit 03: TS116	Protection 48/51LR (locked rotor at start-up)
Bit 04: TS117	Protection 48/51LR (excessive starting time)
Bit 05: TS118	Protection 66
Bit 06: TS119	Protection 21B
Bit 07: TS120	Protection 50/27
Bit 08: TS121	Protection 64G2/27TN unit 1
Bit 09: TS122	Protection 64G2/27TN unit 2
Bit 10: TS123	Protection 78PS
Bit 11: TS124	Protection 67REF unit 1
Bit 12: TS125	Protection 67REF unit 2
Bit 13: TS126	Protection 87T2
Bit 14: TS127	Protection 87M/87G
Bit 15: TS128	Reserved

Word 0C98: TS129 to TS144

Bit 00: TS129	Protection 81H unit 1
Bit 01: TS130	Protection 81H unit 2
Bit 02: TS131	Protection 81L unit 1
Bit 03: TS132	Protection 81L unit 2
Bit 04: TS133	Protection 81L unit 3
Bit 05: TS134	Protection 81L unit 4
Bit 06: TS135	Protection 81R unit 1
Bit 07: TS136	Protection 81R unit 2
Bit 08: TS137	Protection 12 unit 1
Bit 09: TS138	Protection 12 unit 2
Bit 10: TS139	Protection 14 unit 1
Bit 11: TS140	Protection 14 unit 2
Bit 12: TS141	Protection 24 unit 1
Bit 13: TS142	Protection 24 unit 2
Bit 14: TS143	Reserved
Bit 15: TS144	Reserved

Word 0C99: TS145 to TS160

Bit 00: TS145	Protection 38/49T alarm sensor 1 MET148 n° 1
Bit 01: TS146	Protection 38/49T tripping sensor 1 MET148 n° 1
Bit 02: TS147	Protection 38/49T alarm sensor 2 MET148 n° 1
Bit 03: TS148	Protection 38/49T tripping sensor 2 MET148 n° 1
Bit 04: TS149	Protection 38/49T alarm sensor 3 MET148 n° 1
Bit 05: TS150	Protection 38/49T tripping sensor 3 MET148 n° 1
Bit 06: TS151	Protection 38/49T alarm sensor 4 MET148 n° 1
Bit 07: TS152	Protection 38/49T tripping sensor 4 MET148 n° 1
Bit 08: TS153	Protection 38/49T alarm sensor 5 MET148 n° 1
Bit 09: TS154	Protection 38/49T tripping sensor 5 MET148 n° 1
Bit 10: TS155	Protection 38/49T alarm sensor 6 MET148 n° 1
Bit 11: TS156	Protection 38/49T tripping sensor 6 MET148 n° 1
Bit 12: TS157	Protection 38/49T alarm sensor 7 MET148 n° 1
Bit 13: TS158	Protection 38/49T tripping sensor 7 MET148 n° 1
Bit 14: TS159	Protection 38/49T alarm sensor 8 MET148 n° 1
Bit 15: TS160	Protection 38/49T tripping sensor 8 MET148 n° 1

Word 0C9A: TS161 to TS176

Bit 00: TS161	Protection 38/49T alarm sensor 1 MET148 n° 2
Bit 01: TS162	Protection 38/49T tripping sensor 1 MET148 n° 2
Bit 02: TS163	Protection 38/49T alarm sensor 2 MET148 n° 2
Bit 03: TS164	Protection 38/49T tripping sensor 2 MET148 n° 2
Bit 04: TS165	Protection 38/49T alarm sensor 3 MET148 n° 2
Bit 05: TS166	Protection 38/49T tripping sensor 3 MET148 n° 2
Bit 06: TS167	Protection 38/49T alarm sensor 4 MET148 n° 2
Bit 07: TS168	Protection 38/49T tripping sensor 4 MET148 n° 2
Bit 08: TS169	Protection 38/49T alarm sensor 5 MET148 n° 2
Bit 09: TS170	Protection 38/49T tripping sensor 5 MET148 n° 2
Bit 10: TS171	Protection 38/49T alarm sensor 6 MET148 n° 2
Bit 11: TS172	Protection 38/49T tripping sensor 6 MET148 n° 2
Bit 12: TS173	Protection 38/49T alarm sensor 7 MET148 n° 2
Bit 13: TS174	Protection 38/49T tripping sensor 7 MET148 n° 2
Bit 14: TS175	Protection 38/49T alarm sensor 8 MET148 n° 2
Bit 15: TS176	Protection 38/49T tripping sensor 8 MET148 n° 2

Word 0C9B: TS177 to TS192

Bit 00: TS177	Protection 51C unit 1 (capacitor step 1)
Bit 01: TS178	Protection 51C unit 2 (capacitor step 1)
Bit 02: TS179	Protection 51C unit 3 (capacitor step 2)
Bit 03: TS180	Protection 51C unit 4 (capacitor step 2)
Bit 04: TS181	Protection 51C unit 5 (capacitor step 3)
Bit 05: TS182	Protection 51C unit 6 (capacitor step 3)
Bit 06: TS183	Protection 51C unit 7 (capacitor step 4)
Bit 07: TS184	Protection 51C unit 8 (capacitor step 4)
Bit 08: TS185	Thermistor alarm
Bit 09: TS186	Thermistor tripping
Bit 10: TS187	Buchholz alarm
Bit 11: TS188	Buchholz tripping
Bit 12: TS189	Thermostat alarm
Bit 13: TS190	Thermostat tripping
Bit 14: TS191	Pressure alarm
Bit 15: TS192	Pressure tripping

Word 0C9C: TS193 to TS208

Bit 00: TS193	MET1481 module sensor fault
Bit 01: TS194	MET1482 module sensor fault
Bit 02: TS195	Block thermal protection tripping
Bit 03: TS196	Main-phase reverse rotation
Bit 04: TS197	Additional-phase reverse rotation
Bit 05: TS198	Send blocking signal 2
Bit 06: TS199	Recloser: On
Bit 07: TS200	Recloser: ready
Bit 08: TS201	Recloser: final trip
Bit 09: TS202	Recloser: reclosing successful
Bit 10: TS203	Recloser: step 1 in progress
Bit 11: TS204	Recloser: step 2 in progress
Bit 12: TS205	Recloser: step 3 in progress
Bit 13: TS206	Recloser: step 4 in progress
Bit 14: TS207	Recloser: closing by recloser
Bit 15: TS208	Test mode

Word 0C9D: TS209 to TS224

Bit 00: TS209	Phase CT fault
Bit 01: TS210	Phase VT fault
Bit 02: TS211	Residual VT fault
Bit 03: TS212	Additional phase CT fault
Bit 04: TS213	Additional phase VT fault
Bit 05: TS214	Reserved
Bit 06: TS215	Load shedding
Bit 07: TS216	Restart
Bit 08: TS217	Min. V _{aux}
Bit 09: TS218	Max. V _{aux}
Bit 10: TS219	Battery low or absent
Bit 11: TS220	Request for sync-checked closing
Bit 12: TS221	dV synchronization failure
Bit 13: TS222	dPhi synchronization failure
Bit 14: TS223	dF synchronization failure
Bit 15: TS224	Synchronization stop

Word 0C9E: TS225 to TS240

Bit 00: TS225	Synchronization failure
Bit 01: TS226	Synchronization successful
Bit 02: TS227	Manual capacitor step control
Bit 03: TS228	Automatic capacitor step control
Bit 04: TS229	Capacitor step 1 matching fault
Bit 05: TS230	Capacitor step 2 matching fault
Bit 06: TS231	Capacitor step 3 matching fault
Bit 07: TS232	Capacitor step 4 matching fault
Bit 08: TS233	Reserved
Bit 09: TS234	Closing coil monitoring
Bit 10: TS235	Cumulative breaking current monitoring
Bit 11: TS236	Tie Breaker closing command
Bit 12: TS237	Tie Breaker synchronization failure
Bit 13: TS238	Tripping by automatic transfer (AT)
Bit 14: TS239	Reserved
Bit 15: TS240	Reserved



If data files are larger than 64 Kbytes, the number of records is forced to zero. Only the last two records are provided.

Sepam™ Series 80 Compatibility Zones

Disturbance Recording Identification Zone

This zone exists exclusively for address and format compatibility with Sepam™ 2000. Use the directory zone (address 400) when compatibility is not required.

Disturb. Rec. Identification Zone	Address	Read	Write	Format	Unit	Config.
Reserved	D204	3	-	-	-	-
Reserved	D205	3	-	-	-	-
Size of set-up files	D206	3	-	16NS	bytes	-
Size of data files	D207	3	-	16NS	bytes	-
Number of records available	D208	3	-	16NS	1	-
Date of record 1 (most recent)	D209/D20C	3	-	IEC		-
Date of record 2	D20D/D210	3	-	IEC		-

Configuration Zone

This zone exists exclusively for address and format compatibility with Sepam™ 2000. It is static and does not depend on the actual configuration of the Sepam™ Series 80 relay.

Configuration Zone	Address	Read	Write	Value	Config.
Not used	FC00	3	-	0	-
Sepam™ Series 80	FC01	3	-	1200 h	-
Not managed	FC02	3	-	0	-
Not managed	FC03	3	-	0	-

**Residual Current**

On Sepam™ 2000, measured and calculated residual currents are exclusive; they have the same Modbus address. On Sepam™ Series 80, the two values may both exist; the compatible address is used for the calculated value and the new address is used for the measured value.

Number of Starts / Inhibit Time

On Sepam™ 2000, these two values are exclusive and use the same Modbus address. They are differentiated by the sign. On Sepam™ Series 80, the two values may both exist; the compatible address is used for the number of starts and the new address is used for the block time.

Metering Zone x 1

Metering Zone x 1	Address	Read	Write	Format	Unit	Config.
Phase current Ia	FA00	3, 4	-	16NS	0.1 A	yes
Phase current Ib	FA01	3, 4	-	16NS	0.1 A	yes
Phase current Ic	FA02	3, 4	-	16NS	0.1 A	yes
Peak demand current IMA	FA03	3, 4	-	16NS	0.1 A	yes
Peak demand current IMb	FA04	3, 4	-	16NS	0.1 A	yes
Peak demand current IMc	FA05	3, 4	-	16NS	0.1 A	yes
Phase-to-phase voltage Vab	FA06	3, 4	-	16NS	1 V	yes
Phase-to-phase voltage Vbc	FA07	3, 4	-	16NS	1 V	yes
Phase-to-phase voltage Vac	FA08	3, 4	-	16NS	1 V	yes
Frequency f	FA09	3, 4	-	16NS	0.01 Hz	yes
Active power P	FA0A	3, 4	-	16O	1 kW	yes
Reactive power Q	FA0B	3, 4	-	16O	1 kvar	yes
Power factor cos φ	FA0C	3, 4	-	16O	0.01	yes
Peak demand active power PM	FA0D	3, 4	-	16NS	1 kW	yes
Peak demand reactive power QM	FA0E	3, 4	-	16NS	1 kvar	yes
Residual current IrΣ	FA0F	3, 4	-	16NS	0.1 A	yes
T1: temperature 1 MET n° 1	FA10	3, 4	-	16O	1°C	yes
T2: temperature 2 MET n° 1	FA11	3, 4	-	16O	1°C	yes
T3: temperature 3 MET n° 1	FA12	3, 4	-	16O	1°C	yes
T4: temperature 4 MET n° 1	FA13	3, 4	-	16O	1°C	yes
T5: temperature 5 MET n° 1	FA14	3, 4	-	16O	1°C	yes
T6: temperature 6 MET n° 1	FA15	3, 4	-	16O	1°C	yes
T7: temperature 7 MET n° 1	FA16	3, 4	-	16O	1°C	yes
T8: temperature 8 MET n° 1	FA17	3, 4	-	16O	1°C	yes
T9: temperature 1 MET n° 2	FA18	3, 4	-	16O	1°C	yes
T10: temperature 2 MET n° 2	FA19	3, 4	-	16O	1°C	yes
T11: temperature 3 MET n° 2	FA1A	3, 4	-	16O	1°C	yes
T12: temperature 4 MET n° 2	FA1B	3, 4	-	16O	1°C	yes
Thermal capacity used	FA1C	3, 4	-	16NS	0.1 %	yes
Number of starts	FA1D	3, 4	-	16NS	1	yes
Phase current I'a	FA1E	3, 4	-	16NS	0.1 A	yes
Phase current I'b	FA1F	3, 4	-	16NS	0.1 A	yes
Phase current I'c	FA20	3, 4	-	16NS	0.1 A	yes
Residual current I'rΣ	FA21	3, 4	-	16NS	0.1 A	yes
Phase-to-neutral voltage Van	FA22	3, 4	-	16NS	1 V	yes
Phase-to-neutral voltage Vbn	FA23	3, 4	-	16NS	1 V	yes
Phase-to-neutral voltage Vcn	FA24	3, 4	-	16NS	1 V	yes
Residual voltage Vr	FA25	3, 4	-	16NS	1 V	yes
Residual current Ir	FA26	3, 4	-	16NS	0.1 A	yes
Phase-to-phase voltage V'ab	FA27	3, 4	-	16NS	1 V	yes
Phase-to-phase voltage V'bc	FA28	3, 4	-	16NS	1 V	yes
Phase-to-phase voltage V'ac	FA29	3, 4	-	16NS	1 V	yes
Phase-to-neutral voltage V'an	FA2A	3, 4	-	16NS	1 V	yes
Phase-to-neutral voltage V'bn	FA2B	3, 4	-	16NS	1 V	yes
Phase-to-neutral voltage V'cn	FA2C	3, 4	-	16NS	1 V	yes
Residual voltage V'r	FA2D	3, 4	-	16NS	1 V	yes
Residual current I'r	FA2E	3, 4	-	16NS	0.1 A	yes
Block time	FA2F	3, 4	-	16NS	1 min.	yes

**Residual Current**

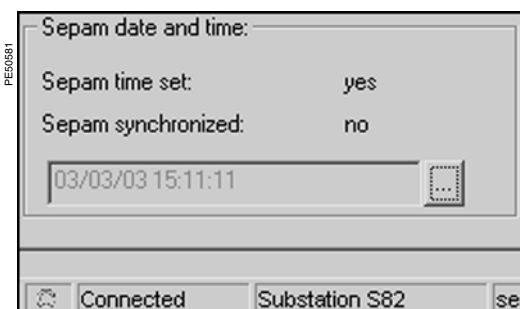
On Sepam™ 2000, measured and calculated residual currents are exclusive; they have the same Modbus address. On Sepam™ Series 80, the two values may both exist, the compatible address is used for the calculated value and the new address is used for the measured value.

Metering Zone x 10

Metering Zone x 10	Address	Read	Write	Format	Unit	Config.
Phase current Ia	FB00	3, 4	-	16NS	1 A	yes
Phase current Ib	FB01	3, 4	-	16NS	1 A	yes
Phase current Ic	FB02	3, 4	-	16NS	1 A	yes
Peak demand current IMA	FB03	3, 4	-	16NS	1 A	yes
Peak demand current IMb	FB04	3, 4	-	16NS	1 A	yes
Peak demand current IMc	FB05	3, 4	-	16NS	1 A	yes
Phase-to-phase voltage Vab	FB06	3, 4	-	16NS	10 V	yes
Phase-to-phase voltage Vbc	FB07	3, 4	-	16NS	10 V	yes
Phase-to-phase voltage Vac	FB08	3, 4	-	16NS	10 V	yes
Frequency f	FB09	3, 4	-	16NS	0.1 Hz	yes
Active power P	FB0A	3, 4	-	16O	10 kW	yes
Reactive power Q	FB0B	3, 4	-	16O	10 kvar	yes
Power factor cos φ	FB0C	3, 4	-	16O	0.01	yes
Peak demand active power PM	FB0D	3, 4	-	16NS	10 kW	yes
Peak demand reactive power QM	FB0E	3, 4	-	16NS	10 kvar	yes
Residual current IrΣ	FB0F	3, 4	-	16NS	1 A	yes
Last tripping current Itripa	FB10	3, 4	-	16NS	10 A	yes
Last tripping current Itripb	FB11	3, 4	-	16NS	10 A	yes
Last tripping current Itripc	FB12	3, 4	-	16NS	10 A	yes
Last tripping current Itripr	FB13	3, 4	-	16NS	1 A	yes
Phase current I'a	FB14	3, 4	-	16NS	1 A	yes
Phase current I'b	FB15	3, 4	-	16NS	1 A	yes
Phase current I'c	FB16	3, 4	-	16NS	1 A	yes
Phase-to-neutral voltage Van	FB17	3, 4	-	16NS	10 V	yes
Phase-to-neutral voltage Vbn	FB18	3, 4	-	16NS	10 V	yes
Phase-to-neutral voltage Vcn	FB19	3, 4	-	16NS	10 V	yes
Reserved	FB1A	3, 4	-	-	-	yes
Reserved	FB1B	3, 4	-	-	-	yes
Reserved	FB1C	3, 4	-	-	-	yes
Residual voltage Vr	FB1D	3, 4	-	16NS	10 V	yes
Residual current I'rΣ	FB1E	3, 4	-	16NS	1 A	yes
Reserved	FB1F	3, 4	-	-	-	yes
Reserved	FB20	3, 4	-	-	-	yes
Reserved	FB21	3, 4	-	-	-	yes
Reserved	FB22	3, 4	-	-	-	yes
Residual current Ir	FB23	3, 4	-	16NS	1 A	yes
Residual current I'r	FB24	3, 4	-	16NS	1 A	yes

Compact Zone

Compact Zone	Address	Read	Write	Format	Unit	Config.
Phase current Ia (x 1)	FB80	3, 4	-	16NS	0.1 A	-
Phase-to-phase voltage Vab (x 1)	FB81	3, 4	-	16NS	1 V	-
Active power P (x 1)	FB82	3, 4	-	16O	1 kW	-
Reactive power Q (x 1)	FB83	3, 4	-	16O	1 kvar	-
Sepam™ check-word (copy)	FB84	3, 4	-	B	-	-
TS1-TS16	FB85	3, 4	-	B	-	-
TS17-TS32	FB86	3, 4	-	B	-	-
TS33-TS48	FB87	3, 4	-	B	-	-
TS49-TS64	FB88	3, 4	-	B	-	-
Logic inputs I101 to I114	FB89	3, 4	-	B	-	-
Logic inputs I201 to I214	FB8A	3, 4	-	B	-	-
Logic inputs I301 to I314	FB8B	3, 4	-	B	-	-
Reserved	FB8C	3, 4	-	-	-	-
Logipam event counter C1	FB8D	3, 4	-	16NS	-	-
Logipam event counter C2	FB8E	3, 4	-	16NS	-	-
Reserved	FB8F	3, 4	-	-	-	-



SFT2841: date and time on the "Sepam™ diagnosis" screen

Presentation

Sepam™ Series 80 manages the date and time internally. If Sepam™ loses auxiliary power, the date and time function continues to operate, on the condition that a charged battery is installed.

The Sepam™ internal time function is used in particular to date alarms and other records.

Sepam™ time can be viewed:

- with SFT2841 ("Sepam™ diagnosis" screen)
- on the Sepam™ display
- by a Modbus read of the synchronization zone

Sepam™ also supplies the indication "Sepam™ time not correct" in the check-word if you need to reset the time when the battery is low or absent, for example. This information can also be viewed with SFT2841, on the "Sepam™ diagnosis" screen.

Time Setting

When you energize Sepam™, the time automatically sets by using the backed-up clock and functioning battery. When necessary, you can set the time on the Sepam™ Series 80 by using one of the following:

- SFT2841 ("Sepam™ diagnosis" screen)
- Sepam™ User Machine Interface
- Modbus communication (COM1 or COM2)

The Modbus time setting consists in writing the new value for the date and time in a single block in the synchronization zone (time frame).

Synchronization

You can ensure long-term time stability or coordinate a number of devices by synchronizing the Sepam™ relays. A number of synchronization sources are accepted:

- none (no synchronization inhibited)
- a pulse to logic input I103
- Modbus communication on COM1
- Modbus communication on COM2

Select a source on the "General characteristics" screen of the SFT 2841. Non-synchronous status is indicated in the check-word. You can also view this information on the "Sepam™ diagnosis" screen of the SFT2841 software.

Once Sepam™ is synchronized, the time sets only by sources compatible with the synchronization.

Time Setting	Synchronization Source			
	None	COM1	COM2	Network and Input I103
Local	■			
Via COM1		■		■
Via COM2			■	■

Modbus Communication Link Synchronization

The time frame is used for both time-setting and synchronizing Sepam™. It is sent regularly at brief intervals (between 10 and 60 seconds) to maintain synchronous time.

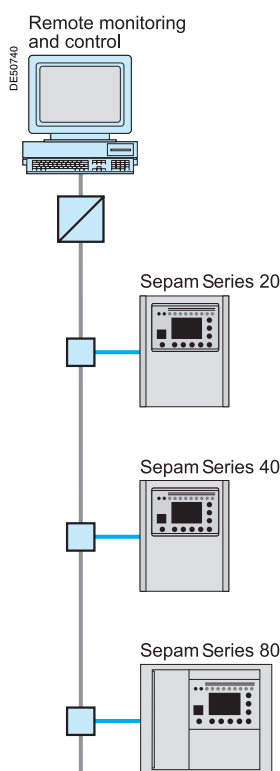
It is generally broadcast (slave number = 0).

The Sepam™ internal clock resets each time it receives a new time frame and maintains synchronization if the reset amplitude is less than 100 milliseconds.

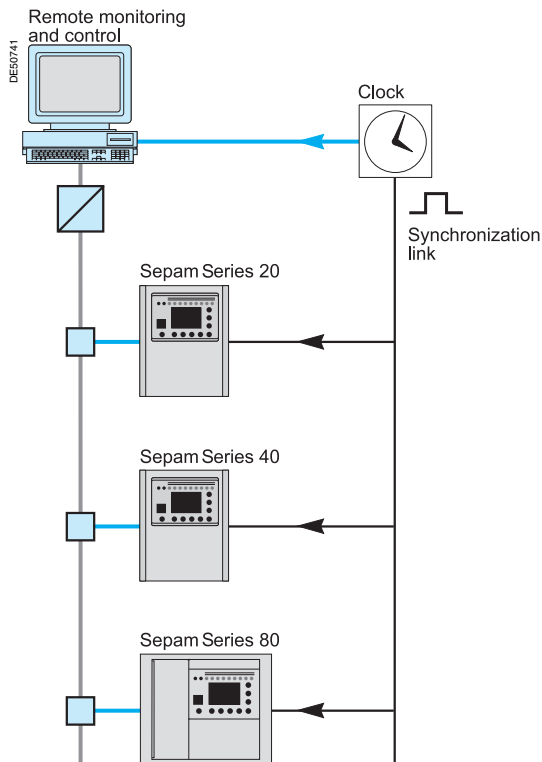
Because synchronization occurs via the Modbus network, accuracy depends on the master and its control over frame transmission time on the communication network. Sepam™ is synchronized without delay at the end of receiving the frame.

Time changes are made by sending a frame to Sepam™ with the new date and time. Sepam™. It then switches to a transitional non-synchronous status.

In synchronous status, non-reception of a time frame for over 200 seconds results in the loss of synchronization.



Synchronization of the Sepam™ clock by the communication network



External synchronization of the Sepam™ clock by sending a synchronization pulse to a logic input

Pulse Synchronization

Sepam™ can be synchronized externally by sending a periodic pulse (synchronization pulse) to logic input I103 (this requires a MES120 module). The pulse is used to reset the Sepam™ internal clock. The rising edge of the logic input initiates synchronization.

Sepam™ adapts to synchronization periods from 10 to 60 seconds in 10-second steps. The shorter the period, the more accurate the time setting.

When energized (or following a loss of synchronization), Sepam™ is in a "non-synchronous" mode. The resetting process (switching Sepam™ to "synchronous" mode) is based on measuring the difference between Sepam's current time and the nearest ten-second period. This measurement is taken when the pulse is received following time setting. Resetting is authorized if the difference is less than or equal to 4 seconds. In this case, Sepam™ shifts to "synchronous" mode.

After switching to "synchronous" mode, the resetting process is based on measuring the difference between Sepam™ current time and the nearest ten second period when the pulse is received, which is adapted to match the pulse period.

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

Synchronization operates only after Sepam™ has been time-set, that is. after the "incorrect time" end event.

Time changes greater than ± 4 seconds are made by sending a new time frame. The switching for Daylight Saving Time uses this procedure. Synchronization is temporarily lost when the time changes.

Synchronization is also lost if:

- the difference in synchronization between the closest 10-second period and pulse reception is greater than the synchronization error for two consecutive pulses
- the pulse is not received for a period longer than 200 seconds

Synchronization-Pulse Characteristics

Electrical Characteristics

The electrical characteristics are identical to those for MES120 module inputs.

Time Characteristics

Period: 10 to 60 seconds, in 10-second steps

State 1 minimum duration: 100 ms

State 0 minimum duration: 100 ms

Synchronization Clock

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

Schneider Electric has tested the following products:

Gorgy Timing, part no. RT3000, equipped with the M540 module

Presentation

The time-tagging function assigns a date and precise time to status changes (events) for accurate organization over time. Time-tagging is systematic and deals with:

- logic inputs
- remote indications
- certain information pertaining to Sepam™ equipment (see Sepam™ check-word)

Events can be used by a remote monitoring and control system for data logging and histories.

The remote monitoring and control system provides a chronological display of the time-tagged data.

Description

Time-Tagging

Event time-tagging uses the Sepam™ internal clock. When an event is detected, it is tagged with the current Sepam™ time.

Time-tagging accuracy depends essentially on how well the Sepam™ internal clock is synchronized (see the section on time setting and synchronization).

Temporarily Terminate Time-Tagging in Test Mode

You can use the test mode to temporarily stop transmitting all time-tagged events. Do this, for example, when you do not want equipment maintenance activity to interrupt normal remote operation. Turn the key switch on the mimic-based UMI to access this mode.

When Sepam™ enters Test mode, it:

- transmits remote-indication TS208 "Test mode" with a value of 1
- interrupts the transmission of all time-tagged events

When Sepam™ leaves Test mode, it transmits remote-indication TS208 "Test mode" with a value of 0.

Normal time-tagged events can be transmitted again. Status changes that take place in Test mode are permanently lost.

Event Queues

Sepam™ has four internal storage queues (two per communication port) with a capacity of 64 events. Each queue is independent of the others.

If one queue is full (63 events already recorded), a "**data loss**" event is generated in the 64th position and the queue no longer receives event data. The other queues are not affected and continue to receive any new detected events.

When a queue in "data loss" status is completely emptied, a "data loss" end event is generated and the queue then receives any detected events.

For each event queue of a Modbus port, the check-work contains certain information:

- presence of an event: indicates that there is at least one event that has not been read in the corresponding queue
- data loss: indicates that the queue is in "data loss" status (full)

Initialization

Each time Sepam™ is initialized (energized), events are generated in the following sequence:

- "data loss"
- "not synchronous"
- end of "data loss"

The "time not correct" event may also appear if there is no battery. The function is initialized with the current values of the remote indication and logic input status without creating any events related to those data. After the initialization phase, event detection is activated.



Reading must address either the exchange word or the entire table.

Reading Events

The system uses two Modbus tables to read the corresponding queues of events, in groups of four maximum, using a specific protocol to make sure no events are lost, even if communication problems occur.

Event Tables	Addr. Table 1	Addr. Table 2	Read	Write	Config.
Exchange word	0040	0070	3	6, 16	-
Event 1	0041/0048	0071/0078	3	-	-
Event 2	0049/0050	0079/0080	3	-	-
Event 3	0051/0058	0081/0088	3	-	-
Event 4	0059/0060	0089/0090	3	-	-

Exchange Word

The exchange word checks event reading. It consists of the elements below.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Exchange number 0...255								Event number 0...4							

The exchange number is initially set to zero when Sepam™ is energized. It is incremented for each transfer of a new set of events. When it reaches its maximum value (FFh), it automatically returns to zero.

Sepam™ numbers the exchanges and the master acknowledges this numbering. The event number indicates the number of significant events are truly present in the table. The remainder of the table is less significant.

Event Table Acknowledgment

After it correctly receives the set of events, the master must acknowledge the exchange by writing an exchange word with:

- "Exchange number" field: number of the last exchange carried out
- "Event number" field: set to zero

The acknowledged events are then cleared from the Sepam™ queue. If there are other events, they are made available in the table and the exchange number is incremented.

As long as an exchange is not acknowledged, the table remains as is and it is possible to read it again.

If acknowledgment is incorrect (incorrect value for the exchange word), it is not taken into account and the table remains as is.

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).

Description of Event Coding

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

Word	Information	Coding
1	Type of event	0800 h
2	Event address	Bit address (see inputs, TS, check-word)
3	Reserved	0
4	Event direction	0: falling edge 1: rising edge
5 to 8	Event time	IEC

Presentation

Sepam™ Series 80 records different types of data:

- disturbance recording
- tripping contexts
- out-of-sync context

The list of available records may be read in the corresponding directory zones. Two Modbus transfer zones per port recover records using a specific protocol ensuring correct transfer, even if communication problems occur.

Transfer

Transfers occur in the same manner for all types of records. Whatever the volume, data transfers in blocks that are compatible in size with Modbus frames. To make a transfer, the master:

- reads the directory zone to determine the list of available records
- selects the desired record
- waits until it is available and recovers the first block of data, using the exchange word to ensure correct synchronization
- acknowledges block transfer
- repeats reading and acknowledgment until all the blocks have been received
- reads the directory zone again to check that the record was not overwritten during transfer

A record can be transferred as many times as desired until a new record overwrites it. If Sepam™ makes a record while the oldest record is being transferred, the oldest record is overwritten.

Selecting a new record while a transfer is in progress interrupts the transfer.

Transfer Zones

Each transfer zone comprises a zone for record selection and a zone reading record data.

Selection Zone

Record transfer is initiated by writing the record identifier to the selection zone.

Selection	Addr. Zone 1	Addr. Zone 2	Read	Write	Config.
Word 1	2200	D200	3	16	-
Word 2	2201	D201	3	16	-
Word 3	2202	D202	3	16	-
Word 4	2203	D203	3	16	-

Record Identifier

The records to transfer are identified by their date as indicated in the directory zone, with an indicator in the most-significant byte of word 1:

- 0: disturbance recording
- 1: tripping contexts
- 2: out-of-sync context.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 1	Type of Record								Date of record (IEC)							
Word 2																
Word 3																
Word 4																



The zone should be written in a single block containing 4 words, using function 16 (write word).

The Sepam™ Series 80 capacity for simultaneous transfers is limited. Sepam™ sends a type 07 exception reply when it cannot handle a request. In this case, a new request must be made later.

Data Read Zone

Record data are made available in this zone.

Data Reading	Addr. Zone 1	Addr. Zone 2	Read	Write	Config.
Exchange word	2300	D300	3	6, 16	-
Data word 1	2301	D301	3	-	-
Data word 2	2302	D302	3	-	-
...	...	...	3	-	-
Data word 124	237C	D37C	3	-	-

Reading must always start at the beginning of the zone (exchange word). The data bytes not included in the significant information (see the section on the exchange word) do not contain significant values.

Exchange Word

The exchange word checks data reading. It consists of the elements below.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Exchange number 0...255								Number of usable bytes 0...248							

The exchange number initializes to zero when Sepam™ is energized. It is incremented for each transfer of a new block of data. When it reaches its maximum value (FFh), it automatically returns to zero.

Sepam™ numbers the exchanges and the master acknowledges the numbering. The number of bytes indicates the usable size of the data zone. It is initialized to zero after an energizing operation and varies between 0 and 248 (F8h).

The exchange word may also have the following values:

- **0000h**: no "read request" has yet been made. This is especially the case when Sepam™ is energized. The other data words are not significant.
- **FFFFh**: the "read request" has been processed, but the results are not yet available in the read zone. It is necessary to read again later.
- **xxFEh**: the transfer has been cancelled

Reading Acknowledgment

Following correct reception of the block of data, the master must acknowledge reading by writing an exchange word with:

- "Exchange number" field: number of the last exchange carried out
- "Number of bytes" field: set to zero

If transfer of the record is not finished, the exchange word is reset to FFFFh while the next block of data is prepared, otherwise the exchange word is not modified.

As long as a read has not been acknowledged, the zone remains as is and it is possible to read it again.

If acknowledgment is incorrect (incorrect value for the exchange word), it is not taken into account and the zone remains as is.

Note: it is not necessary to acknowledge tripping contexts which are contained in a single block.

Data Coding

Disturbance Recording

Each record has two files as defined by the COMTRADE standard:

- a configuration file (.CFG)
- a data file (.DAT) in binary mode

Because the configuration and data files transfer together, a block may contain the end of the configuration file and the beginning of the data file of a record. The remote monitoring and control system must reconstruct the files in accordance with the transmitted number of usable bytes and the size of the files indicated in the directory zone.

Tripping Contexts

Word	Information	Format	Unit
00	(exchange word)		
01 to 04	Context date	IEC	-
05/06	Tripping current phase a I _{tripa}	32NS	0.1 A
07/08	Tripping current phase b I _{tripb}	32NS	0.1 A
09/0A	Tripping current phase c I _{tripc}	32NS	0.1 A
0B/0C	Residual current I _{rΣ}	32NS	0.1 A
0D/0E	Residual current I _r	32NS	0.1 A
0F/10	Negative-sequence current I ₂	32NS	0.1 A
11/12	Phase-to-phase voltage V _{ab}	32NS	1 V
13/14	Phase-to-phase voltage V _{bc}	32NS	1 V
15/16	Phase-to-phase voltage V _{ac}	32NS	1 V
17/18	Phase-to-neutral voltage V _{an}	32NS	1 V
19/1A	Phase-to-neutral voltage V _{bn}	32NS	1 V
1B/1C	Phase-to-neutral voltage V _{cn}	32NS	1 V
1D/1E	Residual voltage V _r	32NS	1 V
1F/20	Positive sequence voltage V ₁	32NS	1 V
21/22	Negative-sequence voltage V ₂	32NS	1 V
23/24	Frequency f	32NS	0.01 Hz
25/26	Active power P	32S	1 kW
27/28	Reactive power Q	32S	1 kvar
29/2A	Apparent power S	32S	1 kVA
2B/2C	Additional tripping current I' _{tripa}	32NS	0.1 A
2D/2E	Additional tripping current I' _{tripb}	32NS	0.1 A
2F/30	Additional tripping current I' _{tripc}	32NS	0.1 A
31/32	Additional residual current I' _{rΣ}	32NS	0.1 A
33/34	Additional residual current I' _r	32NS	0.1 A
35/36	Additional negative-sequence current I' ₂	32NS	0.1 A
37/38	Phase-to-phase voltage V' _{ab}	32NS	1 V
39/3A	Phase-to-phase voltage V' _{bc}	32NS	1 V
3B/3C	Phase-to-phase voltage V' _{ac}	32NS	1 V
3D/3E	Phase-to-neutral voltage V' _{an}	32NS	1 V
3F/40	Phase-to-neutral voltage V' _{bn}	32NS	1 V
41/42	Phase-to-neutral voltage V' _{cn}	32NS	1 V
43/44	Residual voltage V' _r	32NS	1 V
45/46	Positive sequence voltage V' ₁	32NS	1 V
47/48	Negative sequence voltage V' ₂	32NS	1 V
49/4A	Frequency f'	32NS	0.01 Hz
4B/4C	Neutral-point voltage V _{Lr,t}	32NS	1 V
4D/4E	H3 neutral-point voltage V _{ntH3}	32NS	0.1 %
4F/50	H3 residual voltage V _{rH3}	32NS	0.1 %
51/52	Differential current I _{da}	32NS	0.1 A
53/54	Differential current I _{db}	32NS	0.1 A
55/56	Differential current I _{dc}	32NS	0.1 A
57/58	Through current I _{ta}	32NS	0.1 A
59/5A	Through current I _{tb}	32NS	0.1 A
5B/5C	Through current I _{tc}	32NS	0.1 A

Out-of-Sync Context

Word	Information	Format	Unit
00	(exchange word)		
01 to 04	Context date	IEC	-
05/06	Voltage difference dU	32NS	1 V
07	Frequency difference df	16NS	0.01 Hz
08	Phase difference dφ	16NS	0.1°

Presentation

You can access Sepam™ settings via Modbus communication to:

- read settings remotely (remote reading)
- modify settings remotely (remote setting), if authorized

Two Modbus zones per port offer access to the settings by using a specific protocol.

Accessible Functions

This remote reading of settings includes all protection and similar functions as well as the main Sepam™ general parameters.

The remote setting function deals exclusively with protection and similar functions.

Block Remote Setting

The user can block the remote-setting function by using a configuration parameter accessible via SFT2841. In the default set-up (factory settings), the remote-setting function is blocked.

Security

The user can protect the remote-setting zone against writing. See the section on security.



Inhibiting the remote setting also affects the SFT2841 connected to Modbus communication ports. When remote setting is inhibited, only the SFT2841 locally connected to Sepam™ can modify settings and parameters.

Operating Principles

Read Settings

For remote reading, the master:

- selects the function whose settings are requested (write in the request zone)
- waits until it is available and recovers the setting values
- uses the exchange word to ensure correct synchronization (read the setting read zone)

Remote Setting

For remote setting, the master:

- selects the function whose settings are to be modified remotely
- provides the list of new settings (write in the remote-setting zone)
- waits until processing is finished and recovers the accepted setting values
- uses the exchange word to ensure correct synchronization (read the setting read zone)
- checks that the settings have been accepted and processes any refusals

Note: The user must make all the settings for the function concerned, even if some have not changed.

Setting Access Zones

Each setting-access zone includes:

- a zone to select the function whose settings are requested
- a zone to read the settings of the selected function
- a zone to write the settings

Selection Zone for Setting Requests

A setting read is initiated by writing the function identifier to this zone.

Setting Request	Addr. Zone 1	Addr. Zone 2	Read	Write	Config.
Function identifier	2080	D080	3	6, 16	-

Function identification

Each function is identified by a function code and either a unit number (protection) or a subcode (other functions). A list of the function codes is provided in the appendices; no other values are valid.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Function code								Unit number or subcode							

Exception Replies

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

CAUTION

HAZARD OF IMPROPER 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 after 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 cause equipment damage

Setting Read Zone

Setting values are made available in this zone.

Read Settings	Addr. Zone 1	Addr. Zone 2	Read	Write	Config.
Function identifier	2000	D000	3	–	–
Setting 1	2001/2002	D101/D102	3	1–	–
Setting 2	2003/2004	D102/D003	3	–	–
...	...	...	3	–	–
Setting 62	207B/207C	D07B/D07C	3	–	–

Reading must always start at the beginning of the zone (exchange word). The length of the exchange may concern:

- the exchange word only (validity test)
- the maximum size of the zone (125 words)
- the usable size of the zone (determined by the function being addressed)

Exchange Word

The exchange word checks the reading of the settings. It can have the following values:

- **xxyy**: where
 - function code **xx** is not 00 or FFh
 - unit number or subcode **yy** is not FFh

The requested settings are available in the words below. The word is a copy of the request. The zone contents remain valid until the next request is made.

- **FFFFh**: the request has been processed, but the results are not yet available. It is necessary to read again later. The other words are not significant
- **xxFFh**: where the function code **xx** is not 00 or FFh. The read request for the settings of the designated function is not valid. The function (or the unit) does not exist for this Sepam™
- **0000h**: no "request frame" has yet been formulated. This is especially the case when Sepam™ is energized. The other words are not significant

Settings

All settings are 32 bits in length (two Modbus words). They are specific to each function and are described in the appendices.

Remote-Setting Zone

The new setting values are written in this zone.

Read Settings	Addr. Zone 1	Addr. Zone 2	Read	Write	Config.
Function identifier	2100	D100	3	16	-
Setting 1	2101/2102	D101/D102	3	16	-
Setting 2	2103/2004	D102/D003	3	16	-
...	...	...	3	16	-
Setting 61	2179/217A	D179/D17A	3	16	-

Writing must always start at the beginning of the zone.

Function Identifier

The function identifier is identical to the one used to read the settings.

Settings

All settings are 32 bits in length (two Modbus words). They are specific to each function and are described in the appendices.

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 blocked
- Sepam™ is set locally (SFT2841 or UMI)

Setting Acceptance Check

After processing the remote-setting zone, Sepam™ updates the read zone with the current function settings. In this case, the exchange word may also have another value:

- **FFFEh** meaning that the settings have been refused. Certain values are incorrect and are replaced by 7FFFFFFFh in the read zone

Presentation

The user can set up a customized table on each communication port of Sepam™ Series 80. The most frequently used information - and the bandwidth used on the network - will populate this table. This action will reduce the number of Modbus exchanges required by the master. Modbus uses a configuration table to set the parameters for the customized table.

Use

Configuration Table

Configuration Table	Address	Read	Write	Config.
Identifier	2680	3	16	-
Address datum 1	2681	3	16	-
Address datum 2	2682	3	16	-
...	...	3	16	-
Address datum 124	26FC	3	16	-

Writing the Configuration Table

Use this function to configure the data table. The first word in the configuration table is used as the configuration identifier. It is copied into the first word of the data table. The identifier can have any value except 0. Setting the value to 0 cancels the table configuration.

The identifier enables masters to generate a number of typical configurations and check which one is active. The identifier also determines whether another master has modified the active configuration. This requires concerted management between the masters.

Every other word in the table contains the Modbus address of the datum that should be set up in the corresponding spot in the data table (0, if the position is not used).

Only certain Modbus addresses are set up in these tables. The valid addresses are indicated in this document by "yes" in the "Config." column in the descriptions.

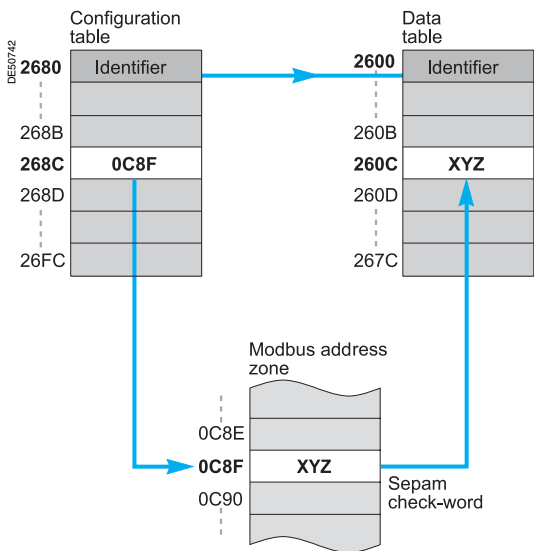
It is possible to write part or all of the table from any address. When 125 words are used (the maximum size of the data table), at least two writings are required to fill the configuration table because the maximum size of a Modbus write is 123 words.

Reading the Configuration Table

Use this function to read and check the configuration of the data table. Each address word can have one of the following values:

- 0000: position not used
- FFFFh: invalid address
- Address: address correctly configured

The user can read part or all of the zone from any address.



Example: by writing 0C8F to 268C, the result at 260C is a copy of the contents at address 0C8F (check-word)



Note:: Configuration takes place one Modbus word after another, in consecutive order. For a 32-bit value, it is necessary to provide the two successive addresses of the value. (This characteristic may be used to switch the order of words if there is a compatibility problem with the 32-bit format. It is also possible to use only the least-significant part of the 32-bit values if the range is sufficient for the given application.)

Data Table

Data Table	Address	Read	Write	Config.
Identifier	2600	3	-	-
Datum 1	2601	3	-	-
Datum 2	2602	3	-	-
...	...	3	-	-
Datum 124	267C	3	-	-

Reading the Data Table

Use this function to read the data set up at the corresponding position. The validity of the data is indicated in the configuration table. You can read all or part of the table from any address.

Exception Replies

Sepam™ sends a Modbus type 07 exception reply (not acknowledged) if the data table has not been set up. This may occur in the following cases:

- the table was never set up
- the table was set up, but one or more addresses are incorrect

The configuration table can be read again to identify the addresses in question:

- the configuration was cancelled (the identifier was set to 0)
- the configuration was lost (Sepam™ de-energized). In this case, it must be reloaded

Examples

In the example below, secure writing is using function 16 (write word) having a value of 9999h to Modbus address ABCDh on slave 3.

Request Frames

03	Slave
66	Security function code
00	Version
0000	Reserved
1234	Password
10	Write-word function code
ABCD	Address
0001	Number of words to be written
02	Number of bytes
9999	Value to be written
xxxx	CRC16

Normal Reply Frames

03	Slave
66	Security function code
00	Version
10	Write-word function code
0001	Number of words written
xxxx	CRC16

Exception Frames

Write-word function exception: it is not possible to write to the given address.

03	Slave
66	Security function code
00	Version
90	Write-word exception (10 + 80)
02	Incorrect address
xxxx	CRC16

Security exception: incorrect password

03	Slave
E6	Security exception (66 + 80)
80	Access refused
xxxx	CRC16

Presentation

With Sepam™ Series 80, the user can password protect remote controls and remote settings.

The security function is enabled using SFT2841 software. It covers both the remote controls and the remote settings by using different passwords for each:

- one for remote controls
- one for the remote settings, thus offering differentiated access

Implementation

The security function uses an extension of the Modbus protocol that encapsulates the standard remote-control and remote-setting frames in its own special frame.

Request Frames

The request frame is made of the following components.

Field	Size (bytes)	
Slave number	1	
102 (66h)	1	Security function code
00	1	Security version
0000	2	Reserved
xxxx	2	Password (BCD coding)
Standard function code	1	Encapsulated standard frame
Standard frame data	n	
...	n	
CRC16	2	

The standard function codes that can be used in the request are the codes accepted for writing to the corresponding addresses, like 6 and 16 for words and 5 and 15 for bits.

The security function does not affect reading.

The indicated password is created with SFT2841 for a given zone. It is a 16-bit binary coded decimal (BCD) code. For example, if the entered password is 1234, the value in the Modbus field is 1234h.

Reply Frames

The standard reply frame is also encapsulated with a reduced header.

Field	Size (bytes)	
Slave number	1	
102 (66h)	1	Security function code
00	1	Security version
Standard function code	1	Encapsulated standard reply
Standard reply	n	
...	n	
CRC16	2	

Exception Replies

Security-Function (Access Control) Exceptions

When Sepam's security function is enabled, request 102 must be used to access Sepam's protected data.

If a non-secure request is used, a standard exception **reply 02** (incorrect data addresses) is sent to indicate that the requested data cannot be accessed.

When **request 102** is used, a security-function **exception reply 80** is sent to indicate access refused for the following two cases:

- incorrect security level (the level asked for in the request is not 00)
- incorrect password

Standard-Function (Encapsulated) Exceptions

When access control is granted, the reply to request 102 can encapsulate a standard exception reply, as described for replies associated with Modbus standard function codes.

Presentation

The "Read Device Identification" function provides standardized access to the required information in order to clearly identify a device.

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

Sepam™ Series 80 accepts the "read identification" function (conformity level 02). For a complete description of the function, refer to www.modbus.org. The description below covers a subset of the function that is adapted to Sepam™ Series 80.

Implementation

Request Frame

The following components make up the request frame:

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 following components comprise the reply frame:

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 th object
lgn	1	Length n th object
txtn	lgn	ASCII string of n 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	1	Type of error
CRC16	2	

Sepam™ Series 80 Identification

The objects making up the Sepam™ Series 80 identification are listed below.

Number	Type	Value
0:	VendorName	"Merlin Gerin"
1:	ProductCode	Application EAN13 code
2:	MajorMinorRevision	Application version number (Vx.yy)
3:	VendorURL	"www.schneider-electric.com"
4:	ProductName	"Sepam™ Series 80"
5:	ModelName	Application name (e.g. "M87 Motor")
6:	UserAppName	Sepam™ marking

The simplified description includes only objects 0 to 2.

Introduction

This appendix describes the Modbus protocol and the functions required for Modbus communication with Sepam™ Series 80. It does not present the entire protocol.

This description is limited to the Modbus protocol using a serial link in binary mode (RTU mode).

Presentation

Exchanges

The Modbus protocol exchanges information by using a request-reply mechanism between master and a slave units.

An exchange is always initiated by the master. The only action on the part of a slave is to reply to requests received.

A number of slaves may be connected to a single master where the communication network permits. A request contains the address of the slave to identify the recipient. This number must be unique. Non-addressed slaves disregard the requests received.

Broadcasting

The master can also address all slaves using the conventional address "0". This type of exchange is called broadcasting.

Slaves do not respond to broadcast messages. Only those messages that do not require the transmission of data by the slaves can be broadcast.

Frames

All the frames exchanged have the same structure, made up of four fields.

Slave number	Function code	Data	Check (CRC16)
--------------	---------------	------	---------------

- slave number (1 byte): from 1 to 247 (0 for broadcasting)
- function code (1 byte): indicates the type of request (1 to 127)
- data (0 to n bytes): depends on the function code, see below
- check (2 bytes): CRC16 used to check frame integrity

The first two fields in the reply frame are identical to the request frame, if there is no error.

The maximum size of a frame is 256 bytes (255 for Sepam™ Series 80).

Synchronizing Exchanges

Any character that is received after a silence of more than 3.5 characters is considered the beginning of a frame. A minimum silence of 3.5 characters must always be observed between two frames.

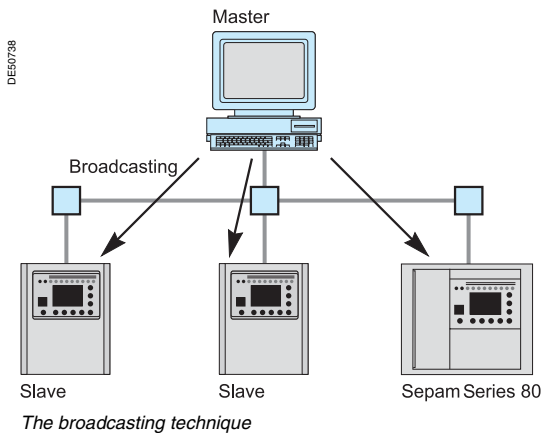
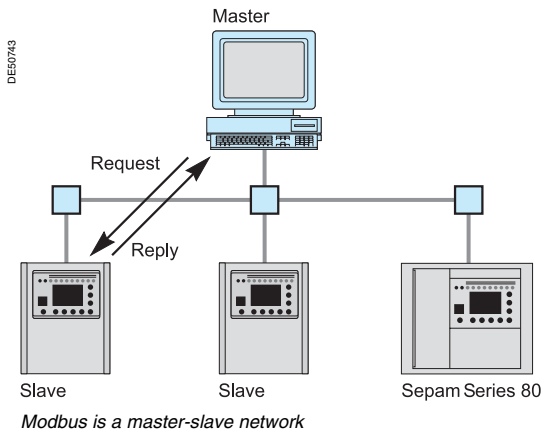
A slave disregards all frames:

- received with a physical error for one or more characters (format error, parity error, etc.)
- with an incorrect CRC16 result
- for which it is not the recipient

Data

Modbus uses two types of data, bits and 16-bit words (also called registers). Each element of data is identified by a 16-bit address.

The most-significant byte in 16-bit words is always sent first, for both data and addresses.



Modbus Functions

Function Types

The Modbus protocol offers a number of functions used to read and write data (bits or words). It also provides network-management and diagnosis functions.

In the descriptions below, **the slave number and the CRC16 are not shown** to facilitate reading, but they must be included in real frames.

Read N Bits Functions (1 and 2)

Request

1 or 2	Address of first bit to be read	Number of bits N to be read
1 byte	2 bytes	2 bytes

Reply

1 or 2	Number of bytes read	Data
1 byte	1 byte	(N + 7)/8 bytes

Function Code

- 1 - for internal or output bits
- 2 - for input bits

Data

The first bit sent is the least significant bit (LSB) in the first byte and the subsequent bits follow in that order. Any excess bits in the last byte are set to 0.

Read N Words Functions (3 and 4)

Request

3 or 4	Address of first word to be read	Number of words N to be read
1 byte	2 bytes	2 bytes

Reply

3 or 4	Number of bytes read	Data
1 byte	1 byte	2N bytes

Function Code

- 3 - for internal or output words
- 4 - for input words

Data

Words are sent in the order of increasing addresses.

Write Bit Function (5)

Request

5	Bit address	Bit value	0: bit set to 0 FFh: bit set to 1	0
1 byte	2 bytes	1 byte		1 byte

Reply

A reply is identical to the request.

Write Word Function (6)

Request

6	Word address	Word value
1 byte	2 bytes	2 bytes

Reply

It is identical to the request.

Write N Consecutive Bits Function (15)

Request

0Fh	Address of 1 st bit	Number of bits	Number of bytes	Data
1 byte	2 bytes	2 bytes	1 byte	(N + 7)/8 bytes

Data

Bits are coded similar to the Read bits function.

Reply

0Fh	Address of 1 st bit written	Number of bits written
1 byte	2 bytes	2 bytes

byte 1								byte 2							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1
1	1	0	0	0	0	0	0				2	1	1	1	1
B	A	9	8	7	6	5	4				0	F	E	D	C

Example: coding of the data field for reading 13 bits, starting at address 104h, with two reply bytes (the vertical numbers indicate the Modbus address of the bit in the corresponding position in the reply)

Write N Consecutive Words Function (16)**Request**

10h	Address of 1 st word	Number of words	Number of bytes	Data
1 byte	2 bytes	2 bytes	1 byte	2N bytes

Data

Words are sent in the order of increasing addresses.

Reply

10h	Address of 1 st word written	Number of words written
1 byte	2 bytes	2 bytes

High-Speed Reading of 8 Bits Function (7)**Request**

7
1 byte

Reply

7	Status byte
1 byte	1 byte

For Sepam™ Series 80, the status byte is the most-significant byte in the Sepam™ check-word (address 0C8Fh), namely, the bits C8F8h to C8FFh.

Diagnosis Function (8)**Request**

8	Subcode	Data
1 byte	2 bytes	2 bytes

Reply

8	Subcode	Data
1 byte	2 bytes	2 bytes

Function 8 Subcodes

Sub-code	Use	Request	Data
		Request	Reply
0000h	Echo mode	Any	Datum received
000Ah	Reset counters CPT1 to CPT9	0000	0000
000Bh	Read CPT1 (frames without errors)	0000	CPT1
000Ch	Read CPT2 (frames with errors)	0000	CPT2
000Dh	Read CPT3 (exception replies)	0000	CPT3
000Eh	Read CPT4 (frames sent to station)	0000	CPT4
000Fh	Read CPT5 (frames broadcast)	0000	CPT5
0010h	Read CPT6 (not managed by Sepam™)	0000	CPT6
0011h	Read CPT7 (not managed by Sepam™)	0000	CPT7
0012h	Read CPT8 (frames with physical errors)	0000	CPT8

Read Event Counters Function (11)

For Sepam™ Series 80, this is CPT9, the number of correct requests received and correctly executed.

Request

0Bh
1 byte

Reply

0Bh	0000	Counter CPT9
1 byte	2 bytes	2 bytes

Exception Replies

Each time a slave station receives an error-free frame that it cannot process, it sends an exception reply with the elements below.

Request function code + 80h	Type of exception
1 byte	1 byte

Exception Type	Meaning
01	Unknown function code
02	Incorrect address
03	Incorrect datum
04	Device not ready
07	Negative acknowledgment

Example: C Language Calculation

The function uses two parameters:

```

unsigned short CRC16(puchMsg, usDataLen)
unsigned char *puchMsg ;                               /* message to calculate CRC upon */
unsigned short usDataLen ;                             /* quantity of bytes in message */
{
    unsigned char uchCRChI = 0xFF ;                   /* high byte of CRC initialized */
    unsigned char uchCRCLo = 0xFF ;                   /* low byte of CRC initialized */
    unsigned uIndex ;                                  /* will index into CRC lookup table */
    while (usDataLen-- ) {                            /* pass through message buffer */
        uIndex = uchCRChI ^ *puchMsgg++ ;             /* calculate the CRC */
        uchCRChI = uchCRCLo ^ auchCRChI[uIndex] ;
        uchCRCLo = auchCRCLo[uIndex] ;
    }
    return (uchCRChI << 8 | uchCRCLo) ;
}

/* Table of CRC values for high-order byte */
static unsigned char auchCRChI[] = {
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40 } ;

/* Table of CRC values for low-order byte */
static char auchCRCLo[] = {
0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7, 0x05, 0xC5, 0xC4, 0x04,
0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E, 0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09, 0x08, 0xC8,
0xD8, 0x18, 0x19, 0xD9, 0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C, 0xDC,
0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3, 0x11, 0xD1, 0x10, 0xD0,
0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32, 0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0xF4, 0x34,
0x3C, 0xFC, 0xFD, 0x3D, 0xFF, 0x3F, 0xFE, 0xFA, 0x3A, 0xFB, 0x39, 0xF9, 0x38, 0xFB, 0x3B, 0x3E,
0x28, 0xE8, 0xE9, 0x29, 0xEB, 0x2B, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF, 0x2D, 0xED, 0xEC, 0x2C,
0xE4, 0x24, 0x25, 0xE5, 0x27, 0xE7, 0xE6, 0x26, 0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0,
0xA0, 0x60, 0x61, 0xA1, 0x63, 0xA3, 0xA2, 0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0xA4, 0xA4,
0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE, 0xAA, 0x6A, 0x6B, 0xAB, 0x69, 0xA9, 0xA8, 0x68,
0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0xBA, 0xBE, 0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C,
0xB4, 0x74, 0x75, 0xB5, 0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3, 0x73, 0xB1, 0x71, 0x70, 0xB0,
0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97, 0x55, 0x95, 0x54, 0x54,
0x9C, 0x5C, 0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E, 0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58, 0x98,
0x88, 0x48, 0x49, 0x89, 0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C,
0x44, 0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83, 0x41, 0x81, 0x40, 0x80 } ;

```

Setting Coding

Data Format

All the settings are transmitted in 32-bit signed 2's complement integer format.

Tripping and Timer Hold Curves Coding

The numbers correspond to the setting columns in the lists of settings.

① Tripping Curves

0 = definite time	
1 = inverse	9 = IEC very inverse / B
2 = long time inverse	10 = IEC extremely inverse / C
3 = very inverse	11 = IEEE moderately inverse
4 = extremely inverse	12 = IEEE very inverse
5 = ultra inverse	13 = IEEE extremely inverse
6 = RI	14 = IAC inverse
7 = IEC inverse / A	15 = IAC very inverse
8 = IEC long time inverse / B	16 = IAC extr. inverse
24 = Customized curve	
25 = EPATR-B	
26 = EPATR-C	

② Tripping Curves

0 = definite time	11 = IEEE moderately inverse
7 = IEC inverse / A	12 = IEEE very inverse
8 = IEC long time inverse / B	13 = IEEE extremely inverse
9 = IEC very inverse / B	17 = Specific Schneider curve
10 = IEC extremely inverse / C	20 = RI ²

③ Timer Hold Curves

0 = definite time
1 = IDMT

Common Protection Settings

All protection functions have the following settings at the head of the table.

Setting	Data	Format/Unit
1	Latching	0: no 1: yes
2	Program logic	see below
3	Activity	0: Off 1: On
4	Measurement origin	0: main 1: additional or special case, see below

Details on program-logic field

Bit	31	30		4	3	2	1	0
						DES	AGR	CDC

CDC = 1: the protection function takes part in circuit-breaker/contactors control
= 0: the protection function does not take part

AGR = 1: the protection function takes part in genset shutdown (generator application)
= 0: the protection function does not take part

DES = 1: the protection function takes part in de-excitation (generator application)
= 0: the protection function does not take part

When a common protection setting does not apply to a particular protection function, it is marked "reserved" in the table for the function.

Measurement Origin

Some special cases of coding for the measurement-origin field, for ANSI 50N/51 N, ANSI 67N/67NC and ANSI 59N protection functions, are indicated in the table below:

Value	50N/51N	67N/67NC	59N
0	I _r Σ	I _r Σ	V _r
1	I _r	I _r	V _{L_n} t
2	I' _r	I' _r	
3	I' _r Σ		

Protection Settings

They are organized according to **increasing ANSI codes**.

ANSI 12 - Overspeed

Function number: 72xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Set point	%
6	Tripping time delay	10 ms

ANSI 14 - Underspeed

Function number: 77xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Set point	%
6	Tripping time delay	10 ms

ANSI 21B - Underimpedance

Function number: 7401

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Zs set point	mΩ
6	Tripping time delay	10 ms

ANSI 24 - Overfluxing (V/Hz)

Function number: 75xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Machine tie breaker	0: delta 1: wye
6	Tripping curve	0 = definite 21 = Type A 22 = Type B 23 = Type C
7	Gs set point	0.01 pu
8	Tripping time delay	10 ms

ANSI 25 – Sync-Check

Function number: 1801

Setting	Data	Format/Unit
1	Reserved	
2	Reserved	
3	Activity	0: off 1: on
4	dVs set point	% $V_{Ln}p$ sync1 or % $V_{LL}p$ sync1
5	dFs set point	0.01 Hz
6	dPhis set point	°
7	Vs high set point	% $V_{Ln}p$ sync1 or % $V_{LL}p$ sync1
8	Vs low set point	% $V_{Ln}p$ sync1 or % $V_{LL}p$ sync1
9	Operating modes (no-voltage conditions for which tie breaker is allowed)	1: Dead1 AND Live2 2: Live1 AND Dead2 3: Dead1 XOR Dead2 4: Dead1 OR Dead2 5: Dead1 AND Dead2
10	Lead time	10 ms
11	Use of voltage check for tie breaker authorization	0: no 1: yes

ANSI 27 - Undervoltage

Function number: 32xx

Unit 1: xx = 01 to unit 4: xx = 04

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Tripping curve	0: definite 19: IDMT
6	Voltage mode	0: phase-to-neutral 1: phase-to-phase
7	V_{LLS} set point	% V_{LLP}
8	Tripping time delay	10 ms

ANSI 27D - Positive Sequence Undervoltage

Function number: 38xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Vds set point	% V_{LLP}
6	Tripping time delay	10 ms

ANSI 27R - Remanent Undervoltage

Function number: 35xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 4	Common settings	
5	V_{LLS} set point	% V_{LLP}
6	Tripping time delay	10 ms

ANSI 27TN/64G2 - Third Harmonic Undervoltage

Function number: 71xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Access	0: adaptive 1: fixed
6	Vs set point	0.1 % V_{LLtp}
7	Min. Ss set point	% Sb
8	Min. V_{Lrs} set point	% V_{LLP}
9	K set point	0.01
10	Tripping time delay	10 ms

ANSI 32P - Directional Active Overpower

Function number: 53xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Access	0: reverse power 1: overpower
6	Ps set point	100 W
7	Tripping time delay	10 ms

ANSI 32Q - Directional Reactive Overpower

Function number: 5401

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Access	0: reverse power 1: overpower
6	Qs set point	100 var
7	Tripping time delay	10 ms

ANSI 37 - Phase Undercurrent

Function number: 2201

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Is set point	% Ib
6	Tripping time delay	10 ms

ANSI 37P - Directional Active Underpower

Function number: 55xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Access	0: drawn 1: supplied
6	Ps set point	100 W
7	Tripping time delay	10 ms

ANSI 38/49T - Temperature Monitoring

Function number: 46xx

Unit 1: xx = 01 to unit 16: xx = 10h

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Ts1 alarm set point	°C
6	Ts2 alarm set point	°C

ANSI 40 - Field Loss (Underimpedance)

Function number: 7001

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Xa resistance	1 mΩ
6	Xb resistance	1 mΩ
7	Xc resistance	1 mΩ
8	Tripping time delay circle 1	10 ms
9	Tripping time delay circle Xd	10 ms

ANSI 46 - Negative Sequence/Current Unbalance

Function number: 45xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Tripping curve	②
6	Is set point	% Ib or % I'B
7	Tripping time delay	10 ms
8	K setting	1 to 100

ANSI 47 - Negative Sequence Overvoltage

Function number: 40xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 4	Common settings	
5	V2s set point	% V _{LLP}
6	Tripping time delay	10 ms

ANSI 48/51LR - Excessive Starting Time, Locked Rotor

Function number: 4401

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Is set point	% Ib
6	ST excessive starting time	10 ms
7	LT locked rotor time	10 ms
8	LTS locked on start time	10 ms

ANSI 49RMS - Thermal Overload

Function number: 4301

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Negative sequence factor (K)	0: none (0) 1: low (2.25) 2: medium (4.5) 3: high (9)
6	Is set point (shift group 1/group 2)	% Ib
7	Ambient temperature taken into account	0: no 1: yes
8	Maximum equipment temperature	°C
9	Additional settings taken into account (group 2)	0: no 1: yes
10	Learnt cooling time constant (T2 learnt) taken into account	0: no 1: yes
11	Group 1 - thermal alarm set point	%
12	Group 1 - thermal tripping set point	%
13	Group 1 - heating time constant	min.
14	Group 1 - cooling time constant	min.
15	Group 1 - initial heat rise	%
16	Group 2 - thermal alarm set point	%
17	Group 2 - thermal tripping set point	%
18	Group 2 - heating time constant	min.
19	Group 2 - cooling time constant	min.
20	Group 2 - initial heat rise	%
21	Group 2 - base current for group 2	0.1 A
22	49RMS cable - admissible current	0.1 A
	49RMS capacitor - tripping current	0.1 A
23	Associated time constant	min.
24	Current setting	0.1 A
25	Alarm current	0.1 A

Note: ■ thermal overload for machines: parameters 1 to 21

■ thermal overload for cables: parameters 1 to 4 and 22 to 23

■ thermal overload for capacitors: parameters 1 to 4 and 22 to 25

ANSI 50BF - Breaker Failure

Function number: 9801

Setting	Data	Format/Unit
1	Common settings	
2	Reserved	
3	Common settings	
4	Reserved	
5	Use of breaker closed input	0: no 1: yes
6	Is set point	0.1 A
7	Time	10 ms

ANSI 50/27 - Inadvertent Energization

Function number: 7301

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Is set point	0.1 A
6	Vs set point	% V _{LLP}
7	T1 time	10 ms
8	T2 time	10 ms
9	Use of breaker-position inputs	0: no 1: yes

ANSI 50/51 - Phase Overcurrent

Function number: 01xx

Unit 1: xx = 01 to unit 8: xx = 08

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Confirmation	0 = none 1 = neg. seq. overvoltage 2 = undervoltage
6	Group A - tripping curve	①
7	Group A - Is set point	0.1 A
8	Group A - tripping time delay	10 ms
9	Group A - timer hold curve	③
10	Group A - timer hold	10 ms
11	Group B - tripping curve	①
12	Group B - Is set point	0.1 A
13	Group B - tripping time delay	10 ms
14	Group B - timer hold curve	③
15	Group B - timer hold	10 ms

ANSI 50N/51N - Ground Fault

Function number: 06xx

Unit 1: xx = 01 to unit 8: xx = 08

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Group A - tripping curve	①
6	Group A - Isr set point	0.1 A
7	Group A - tripping time delay	10 ms
8	Group A - timer hold curve	③
9	Group A - timer hold	10 ms
10	Group A - H2 restraint	0: yes 1: no
11	Group B - tripping curve	①
12	Group B - Isr set point	0.1 A
13	Group B - tripping time delay	10 ms
14	Group B - timer hold curve	③
15	Group B - timer hold	10 ms
16	Group B - H2 restraint	0: yes 1: no

ANSI 50V/51V - Voltage-Restrained Phase Overcurrent

Function number: 19xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Tripping curve	①
6	Is set point	0.1 A
7	Tripping time delay	10 ms
8	Timer hold curve	③
9	Timer hold	10 ms

ANSI 51C – Capacitor Bank Unbalance

Function number: 03xx

Unit 1: xx = 01 to unit 8: xx = 08

Setting	Data	Format/Unit
1	Latching	0: no 1: yes
2	Switchgear control	0: no 1: yes
3	Activity	0: off 1: on
4	Reserved	
5	Is set point	0.01 A
6	Tripping time delay	10 ms

ANSI 59 - Overvoltage

Function number: 28xx

Unit 1: xx = 01 to unit 4: xx = 04

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Voltage mode	0: phase-to-neutral 1: phase-to-phase
6	Us set point	% V_{LLP}
7	Tripping time delay	10 ms

ANSI 59N - Neutral Voltage Displacement

Function number: 39xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Tripping curve	0: definite 18: IDMT
6	Vsr set point	% V_{LLP}
7	Tripping time delay	10 ms

ANSI 64REF - Restricted Ground Fault Differential

Function number: 64xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Isr set point	0.1 A

ANSI 66 - Starts per Hour

Function number: 4201

Setting	Data	Format/Unit
1	Common settings	
2	Reserved	
3	Common settings	
4	Reserved	
5	Period of time	Hours
6	Total number of starts	1
7	Number of consecutive hot starts	1
8	Number of consecutive cold starts	1
9	Time delay between stop and start	min.

ANSI 67 - Directional Phase Overcurrent

Function number: 52xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Group A - direction	0: line 1: bus
6	Group A - characteristic angle	3: 30° 4: 45° 5: 60°
7	Group A - tripping logic	0: 1/3 1: 2/3
8	Group A - tripping curve	①
9	Group A - Is set point	0.1 A
10	Group A - tripping time delay	10 ms
11	Group A - timer hold curve	③
12	Group A - timer hold	10 ms
13	Group B - direction	0: line 1: bus
14	Group B - characteristic angle	3: 30° 4: 45° 5: 60°
15	Group B - tripping logic	0: 1/3 1: 2/3
16	Group B - tripping curve	①
17	Group B - Is set point	0.1 A
18	Group B - tripping time delay	10 ms
19	Group B - timer hold curve	③
20	Group B - timer hold	10 ms

ANSI 67N/67NC - Directional Ground Fault

Function number: 50xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Access	0: projection (type 1) 1: directional (type 2) 2: directional with adjustable sector (type 3)
6	Group A - direction	0: line 1: bus
7	Group A - types 1 and 2: characteristic angle	0: -45° 1: 0° 2: 15° 3: 30° 4: 45° 5: 60° 6: 90°
	Group A - type 3: limiting angle 1	0° to 359°
8	Group A - type 1: sector	2: sector 76° 3: sector 83° 4: sector 86°
	Group A - type 3: limiting angle 2	0° to 359°
9	Group A - tripping curve	①
10	Group A - Isr set point	0.1 A
11	Group A - tripping time delay	10 ms
12	Group A - types 1 and 2: Vsr set point	% V _{LLP}
	Group A - type 3: Vs0 set point	0.1% V _{LLP}
13	Group A - timer hold curve	③
14	Group A - timer hold	10 ms
15	Group A - memory time	10 ms
16	Group A - memory voltage	% V _{LLP}
17	Group B - direction	0: line 1: bus
18	Group B - types 1 and 2: characteristic angle	Same as group A
	Group B - type 3: limiting angle 1	0° to 359°
19	Group B - type 1: sector	Same as group A
	Group B - type 3: limiting angle 2	0° to 359°
20	Group B - tripping curve	①
21	Group B - Isr set point	0.1 A
22	Group B - tripping time delay	10 ms
23	Group B - types 1 and 2: Vsr set point	% V _{LLP}
	Group B - type 3: Vsr set point	0.1% V _{LLP}
24	Group B - timer hold curve	③
25	Group B - timer hold	10 ms
26	Group B - memory time	10 ms
27	Group B - memory voltage	% V _{LLP}

ANSI 78PS - Pole Slip

Function number: 7601

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Access	0: equal-area criterion 1: power-swing criterion 2: both criteria
6	T area	10 ms
7	Max. number of power swings	1 to 30
8	Max. time between power swings	10 ms

ANSI 81H - Overfrequency

Function number: 57xx

Unit 1: xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Fs set point	0.1 Hz
6	Tripping time delay	10 ms
7	Reserved	
8	Vs set point	% V _{LLP}

ANSI 81L - Underfrequency

Function number: 56xx

Unit 1: xx = 01 to unit 4: xx = 04

Setting	Data	Format/Unit
1 to 4	Common settings	
5	Fs set point	0.1 Hz
6	Tripping time delay	10 ms
7	Restraint	0: no 1: yes
8	Vs set point	% V _{LLP}
9	Inhibition set point for frequency variation	Hz/s

ANSI 81R – Rate of Change of Frequency

Function number: 58xx

Unit: 1 xx = 01, unit 2: xx = 02

Setting	Data	Format/Unit
1	Latching	0: no 1: yes
2	Switchgear control	0: no 1: yes
3	Activity	0: off 1: on
4	Reserved	
5	dfs/dt set point	0.01 Hz/s
6	Tripping time delay	10 ms

ANSI 87M - Machine Differential

Function number: 6201

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Ids set point	1 A
6	Restraint on sensor loss	0: no 1: yes

ANSI 87T - Transformer Differential

Function number: 6001

Setting	Data	Format/Unit
1 to 3	Common settings	
4	Reserved	
5	Ids low set point	% IN1
6	Id/It slope	%
7	Restraint on CT loss	0: off 1: on
8	Test mode	0: off 1: on
9	Id/It2 slope	%
10	Id/It2 characteristic	0: off 1: on
11	Slope change point	0.1 A
12	Idmax high set point	0.1 A
13	Idmax high set point activity	0: off 1: on
14	Selection of restraint	0: conventional 1: self-adaptive
15	Second-harmonic set point	%
16	Second-harmonic restraint	0: off 1: on
17	Second-harmonic restraint type	0: phase-specific 1: global
18	Fifth-harmonic set point	%
19	Fifth-harmonic restraint	0: off 1: on
20	Fifth-harmonic restraint type	0: phase-specific 1: global
21	Isinr set point	%
22	Restraint on closing	0: off 1: on
23	Restraint on closing time delay	10 ms

Other Function Settings

ANSI 60CT Supervision (Voltage or Current Balance Relay)

Function number: 2601: CT supervision
2602: additional CT supervision

Setting	Data	Format/Unit
1	Reserved	
2	Reserved	
3	Common settings	
4	Reserved	
5	Action on 21G, 46, 40, 51N, 32P, 37P, 32Q, 78PS and 64REF functions	0: none 1: block
6	Tripping time delay	10 ms

ANSI 60VT Supervision (Voltage or Current Balance Relay)

Function number: 2701: VT supervision
2702: additional VT supervision

Setting	Data	Format/Unit
1	Reserved	
2	Reserved	
3	Common settings	
4	Reserved	
5	Use breaker-position or voltage-presence criterion	0: circuit breaker 1: voltage
6	Check loss of 3 V/2 V	0: no 1: yes
7	Test current	0: no 1: yes
8	Use V2, I2 criterion	0: no 1: yes
9	Action on 21G, 27/27S, 27D, 27TN, 32P, 32Q, 37P, 40, 47, 50/27, 51V, 59, 59N and 78PS functions	0: none 1: block
10	Action on 67 function	0: non directional 1: block
11	Action on 67N function	0: non directional 1: block
12	V2 tripping set point	%
13	I2 tripping set point	%
14	3 V/ 2 V _{LL} loss time	10 ms
15	V2, I2 criterion time	10 ms

ANSI 79 - Recloser

Function number: 1701

Setting	Data	Format/Unit
1	Reserved	
2	Reserved	
3	Common settings	
4	Reserved	
5	Number of shots	1 to 4
6	Reclaim time	10 ms
7	Safety time until ready	10 ms
8	Maximum additional dead time	0: no 1: yes
9	Maximum wait time	10 ms
10	Shot 1 activation mode	see below
11	Shot 2, 3, 4 activation mode	see below
12	Shot 1 dead time	10 ms
13	Shot 2 dead time	10 ms
14	Shot 3 dead time	10 ms
15	Shot 4 dead time	10 ms

Step Activation Mode

The activation mode of each shot is coded as follows:

Bit	Activation by (if Bit set to 1) / Non activation by (if bit set to 0)
0	Instantaneous protection 50/51 unit 1
1	Delayed protection 50/51 unit 1
2	Instantaneous protection 50/51 unit 2
3	Delayed protection 50/51 unit 2
4	Instantaneous protection 50/51 unit 3
5	Delayed protection 50/51 unit 3
6	Instantaneous protection 50/51 unit 4
7	Delayed protection 50/51 unit 4
8	Instantaneous protection 50N/51N unit 1
9	Delayed protection 50N/51N unit 1
10	Instantaneous protection 50N/51N unit 2
11	Delayed protection 50N/51N unit 2
12	Instantaneous protection 50N/51N unit 3
13	Delayed protection 50N/51N unit 3
14	Instantaneous protection 50N/51N unit 4
15	Delayed protection 50N/51N unit 4
16	Instantaneous protection 67N unit 1
17	Delayed protection 67N unit 1
18	Instantaneous protection 67N unit 2
19	Delayed protection 67N unit 2
20	Instantaneous protection 67 unit 1
21	Delayed protection 67 unit 1
22	Instantaneous protection 67 unit 2
23	Delayed protection 67 unit 2
24	Instantaneous V_DECL logic equation

General Parameters

These are "read only" settings.

Function number: D002

Setting	Data	Format/Unit
1	Working language	1: US English 2: other
2	Rated frequency	50, 60 (Hz)
3	Active group of settings	1: group A 2: group B 3: selection by logic input 4: selection by remote control
4	Demand-value integration period	5, 10, 15, 30, 60 minutes
5	Type of cubicle	1: main 2: feeder
6	Active-energy increment	100 to 5000000 (W)
7	Reactive-energy increment	100 to 5000000 (var)
8	Phase-rotation direction	1: direction 123 2: direction 132
9	Temperature unit	1: °C 2: °F
10	Remote-setting authorization	1: no 2: yes
11	Time synchronization mode	1: COM1 port 2: COM2 port 3: input I103 5: none
12	Remote-control mode	1: SBO mode 2: direct mode
13	Reserved	
14	Monitoring of auxiliary power	1: inactive 2: active
15	Rated auxiliary voltage	24 to 250 (V DC)
16	Aux. voltage alarm low set point	% rated Vaux, min. 20 V
17	Aux. voltage alarm high set point	% rated Vaux, max. 275 V
18	Logic inputs ignored on loss of Vaux	1: inactive 2: active
19	Base current I _B	0.2 to 1.3 In (A)
20	Rated current I _N	1 to 6250 A
21	Number of phase CTs	1: 2 CTs 2: 3 CTs
22	Phase CT rating	1: 1 A 2: 5 A 3: LPCT
23	Rated residual current I _{nr}	10 to 62500 (0.1 A)
24	Residual current measurement mode	1: CSH 2 A 3: CSH 20 A 4: 1 A CT 6: 5 A CT 8: ACE990 range 1 9: ACE990 range 2 11: not measured
25	Reserved	
26	Rated primary voltage V _{LLp}	220 to 250000 (V)
27	Rated secondary voltage V _{LLs}	90 to 230 (V)
28	VT wiring	1: 3 V, 2: 2 V, 3: 1 V, 4: 1 V
29	Residual voltage mode	1: none 2: Σ3V 3: VT V' _{LLs} /√3 4: VT V' _{LLs} /3
30	Neutral-point residual voltage measurement	1: none 2: present
31	Neutral-point rated voltage V _{LLp}	220 to 250000 (V)
32	Neutral-point rated voltage V _{LLs}	57 V to 133 V
33	Reserved	
34	Reserved	
35	Additional rated current I' _N	1 to 6250 A
36	Number of additional phase CTs	1: 2 CTs 2: 3 CTs 3: none
37	Additional phase CT rating	1: 1 A 2: 5 A 3: LPCT
38	Additional rated residual current I' _{nr}	10 to 62500 (0.1 A)
39	Additional residual current measurement mode	Idem 24
40	Rated primary voltage V' _{LLp}	220 to 250000 (V)
41	Rated secondary voltage V' _{LLs}	90 to 230 (V)
42	VT wiring, additional channels	1: 3 V, 2: 2 V, 3: 1 V, 4: 1 V
43	Residual voltage mode, additional channels	1: none 2: Σ3V 3: VT V' _{LLs} /√3 4: VT V' _{LLs} /3
44	Reserved	
45	Reserved	
46	Reserved	
47	Reserved	
48	Reserved	

Application-Specific Parameters

These are "read only" settings.

Function number: D003

Setting	Data	Format/Unit
1	Transformer presence	1: no 2: yes
2	Voltage winding 1 $V_{LL}N1$	220 to 250000 V
3	Voltage winding 2 $V_{LL}N2$	220 to 440000 V
4	Power S	100 to 999000 kVA
5	Vector shift	0 to 11
6	Rated motor speed	100 to 3600 rpm
7	Number of pulses per rotation	1 to 1800
8	Zero speed threshold	5 to 20%
9	Number of capacitor steps	1 to 4
10	Type of capacitor step connection	0: delta 1: wye
11	Weight of capacitor step 1	1
12	Weight of capacitor step 2	1, 2
13	Weight of capacitor step 3	1, 2, 3, 4
14	Weight of capacitor step 4	1, 2, 3, 4, 6, 8

Schneider Electric USA
295 Tech Park Drive, Suite 100
LaVergne, TN 37086
Tel : 1-888-SquareD (1-888-778-2733)
www.us.squared.com

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