Electrical network protection

Sepam series 20
Sepam series 40
Sepam series 80

IEC 60870-5-103 communication

User's manual
March

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a brand of Schneider Electric

Merlin Gerin

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.

Content

ACE969TP communication interface.

ACE969FO communication interface.

General

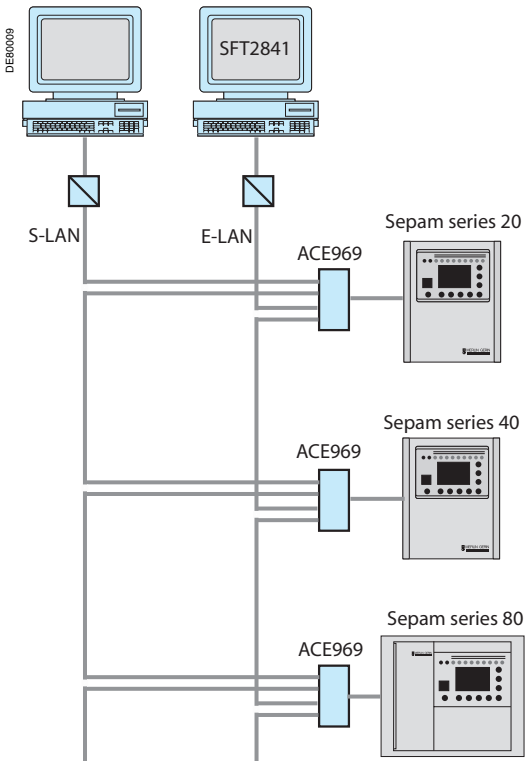
IEC 60870-5-103 communication enables Sepam series 20, Sepam series 40 and Sepam series 80 units to be connected to a supervisor or other device featuring an IEC 60870-5-103 communication channel.
Communication is based on the master/slave principle:
- Sepam is always a slave station.
- The master is the supervisor or another device.

IEC 60870-5-103 communication is available via the ACE969 communication interface.

ACE969 is a multiprotocol communication interface with two independent communication ports:
- The S-LAN (Supervisory-Local Area Network) port is used to connect Sepam to a communication network dedicated to supervision.
- The E-LAN (Engineering-Local Area Network) port is reserved for specific Sepam setup, operating and adjustment functions. This port is connected to the SFT2841 software tool.

The ACE969 interface is available in two versions, linked to the physical interface of the S-LAN supervision port:
- ACE969TP (Twisted Pair) for an S-LAN network, 2-wire RS 485 serial link
- ACE969FO (Fiber Optic) for a fiber-optic star or ring S-LAN

The E-LAN engineering port is always a 2-wire RS 485 type port.



Two independent networks:
S-LAN: IEC 60870-5-103 supervision
E-LAN: For SFT2841 operating functions.

Accessible data

IEC 60870-5-103 communication via the S-LAN port provides access to a great deal of information, in particular:
- Reading of metering information
- Reading of status conditions and time-tagged events
- Transfer of files including disturbance records and tripping contexts
- Time-setting and synchronization
- Transmission of remote controls

The actual list depends on the application, the type of Sepam, the enabled functions, and the ACE969 interface parameter settings.

Connecting the SFT2841 tool to the E-LAN port also provides access to all Sepam function parameters and operating data:
- Hardware configuration parameters
- Remote settings for protection functions
- Switching on/off of protection functions
- Retrieval of disturbance records
- Display of metering and diagnosis information
- Display of logic states
- Display of alarms

IEC 60870-5-103 protocol

Selected application functions of IEC 60870-5-5	User process
Selected application service data units of IEC 60870-5-3	Application layer
Selected application information elements of IEC 60870-5-4	(Layer 7)
Selected link transmission procedures of IEC 60870-5-2	Link layer
Selected transmission frame formats of IEC 60870-5-1	(Layer 2)
Fiber-optic system based on IEC 60874-2 or IEC 60874-10 and IEC 60794-1 and IEC 60794-2 or copper-wire-based system according to EIA RS-485	Physical layer (Layer 1)

IEC 60870-5-103 communication profile.

Presentation

The IEC 60870-5-103 protocol is a companion standard for the informative interface of protection equipment.
Standard IEC 60870-5-103 was prepared by IEC technical committee 57 (Power system control and associated communications).
It is a companion standard for the basic standards in series IEC 60870-5.

As a companion standard, it adds semantics to the definitions and functional profiles specified in the basic standards:
- Definition of the particular uses for information objects
- Definition of specialist information objects
- Definition of service procedures or additional parameters in respect of the basic standards

Standard IEC 60870-5-103 defines communication between protection equipment and devices of a control system (supervisor or RTU) in a substation.

Standard IEC 60870-5-103 can be obtained in full from the International Electrotechnical Commission: http://www.iec.ch.

IEC 60870-5-103 protocol

Protocol principle

General

Standard IEC 60870-5-103 defines a multipoint communication protocol via which information can be exchanged between a control system (supervisor or RTU) and one or more protection devices. The control system is the master and the protection devices are the slaves. Each slave is identified by a unique address between 1 and 254. Address 255 is reserved for broadcast frames.

Standard IEC 60870-5-103 defines two different methods for exchanging information:
- The first is based on the use of predefined data structures (ASDU - Application Service Data Units) and application procedures supporting the transmission of standardized information.
- The other uses generic services supporting the transmission of any type of information.

Sepam does not use generic services.

The protocol distinguishes between:
- The Monitoring direction for the transmission of ASDUs sent by a protection device (slave device) to the control system (master device).
- The Control direction for ASDUs sent by the control system to a protection device.

Monitoring direction

Communication is based on the cyclic transmission of link-layer polling requests by the master in order to invite the slave to send its data.
- Class 1 data polling is usually used for event transmission.
- Class 2 data polling is used for the cyclic transmission of metering information.

Control direction

The master can send:
- General commands (enable/disable functions: protection, recloser, etc.)
- A general interrogation request to obtain the current value of slave equipment status conditions and indications
- A transmission request for disturbance records
- Time synchronization commands
- Commands to reset the communication interface

Communication initialization

The slave communication interface only becomes operational once an initialization request sent by the master device has been received.
The absence of polling by the master is detected by the slave and this stops communication. To re-establish communication, the master device must send a reset request.

Information characteristics

All information exchanged between the control system and the protection equipment features:
- A function number
- An information number
- The ASDU number used to transmit the information
- The cause of the transmission

IEC 60870-5-103 protocol
Access to Sepam data

Sepam is a multifunctional digital relay, which supplies a great deal of information. Sepam data is categorized on the basis of function. Compliant with the data model defined in IEC 60870-5-103, all data is identified by a function number (FUN) and an information number (INF).

A detailed description of the Sepam data table, including function number and information number, appears in the Sepam data table section.

List of IEC 60870-5-103 standard functions

Sepam supports the subset of standard functions shown below.
Sepam uses the standard FUN and INF numbers for these functions.

FUN	Function name
255	System
160	Overcurrent protection

List of Sepam-specific functions

Sepam uses private FUN and INF numbers for these functions.

FUN	Function name
States and indications	
20	Sepam supervision
21	Switchgear and network
22	Logic equations
31	Logic inputs (MES no. 1)
32	Logic inputs (MES no. 2)
33	Logic inputs (MES no. 3)
41	Logipam group 1
42	Logipam group 2
43	Logipam group 3
Protections	
100	Overcurrent protections
101	Directional current protections
102	Voltage protections
103	Frequency protections
104	Motor/generator protections
105	Miscellaneous protections
106	Thermal protections
107	Power protections
108	Differential protections
109	Speed protection
Measurements	
10	Temperature measurements
11	Additional measurements 1
12	Additional measurements 2

List of standard ASDUs

Sepam supports the subset of standard ADSUs shown below.

ASDU	Function	Monitor direction	Control direction
1	Time-tagged message	■	
2	Time-tagged message with relative time	■	
5	Identification message	■	
6	Time synchronization	■	■
7	General interrogation		■
8	End of general interrogation	■	
9	Measurands II	■	
20	General command		■

List of private ASDUs

In addition to the functions and standard ASDU, Sepam supports a File transfer function, which uses private ASDUs.
This function can be used to retrieve:

- Tripping contexts (Sepam series 80 only)
- Disturbance records

Disturbance records are supplied in COMTRADE format.

ASDU	Function	Monitoring direction	Control direction
254	Transfer command		■
255	Transfer response	■	

The Sepam communication profile defines how the options of standard IEC 60870-5-103 are implemented by Sepam.
The presentation format and numbering used in this section are intentionally based on clause "8. Interoperability" of standard IEC 60870-5-103.

☑ *Indicates that Sepam supports the option from the standard.*
☐ *Indicates that Sepam does not support the option.*

8. Interoperability

Physical layer

8.1.1 Electrical interface

☑ EIA RS-485.
☑ Number of loads .....1..... for one protection device.

NOTE - EIA RS-485 standard defines unit loads so that 32 of them can be operated on one line. For detailed information refer to clause 3 of EIA RS-485 standard.

8.1.2 Optical interface

☑ Glass fiber.
☐ Plastic fiber.
☐ F-SMA type connector.
☑ BFOC/2.5 type connector.

8.1.3 Transmission speed

☑ 9,600 bps.
☑ 19,200 bps.

8. 8.2 Link layer

There are no choices for the link layer.

8.3 Application layer

8.3.1 Transmission mode for application data

Mode 1 (least significant byte first), as defined in 4.10 of IEC 60870-5-4, is used exclusively in this companion standard.

8.3.2 COMMON ADDRESS OF ASDU

☑ One COMMON ADDRESS OF ASDU (identical to station address)
☐ More than one COMMON ADDRESS OF ASDU

8.3.3 Selection of standard information numbers in monitoring direction

8.3.3.1 System functions in monitoring direction

	INF	Semantics
☑	<0>	End of general interrogation
☑	<0>	Time synchronization
☑	<2>	Reset FCB
☑	<3>	Reset CU
☑	<4>	Start/restart
☐	<5>	Power on

8.3.3.2 Status indications in monitoring direction

	INF	Semantics
☑	<16>	Auto-recloser active
☐	<17>	Teleprotection active
☐	<18>	Protection active
☑	<19>	LED reset
☑	<20>	Monitoring direction blocked
☐	<21>	Test mode
☐	<22>	Local parameter setting
☑	<23>	Characteristic 1
☑	<24>	Characteristic 2
☐	<25>	Characteristic 3
☐	<26>	Characteristic 4
☐	<27>	Auxiliary input 1
☐	<28>	Auxiliary input 2
☐	<29>	Auxiliary input 3
☐	<30>	Auxiliary input 4

8.3.3.3 Supervision indications in monitoring direction

	INF	Semantics
☑	<32>	Measurand supervision I
☑	<33>	Measurand supervision V
☑	<35>	Phase sequence supervision
☑	<36>	Trip circuit supervision
☐	<37>	I>> back-up operation
☐	<38>	VT fuse failure
☐	<39>	Teleprotection disturbed
☐	<46>	Group warning
☐	<47>	Group alarm

8.3.3.4 Earth fault indications in monitoring direction

	INF	Semantics
☐	<48>	Earth fault L1
☐	<49>	Earth fault L2
☐	<50>	Earth fault L3
☐	<51>	Earth fault forward, i.e. line
☐	<52>	Earth fault reverse, i.e. busbar

8.3.3.5 Fault indications in monitoring direction

	INF	Semantics
☐	<64>	Start/pick-up L1
☐	<65>	Start/pick-up L2
☐	<66>	Start/pick-up L3
☐	<67>	Start/pick-up N
☐	<68>	General trip
☐	<69>	Trip L1
☐	<70>	Trip L2
☐	<71>	Trip L3
☐	<72>	Trip I>> (back-up operation)
☐	<73>	Fault location X in ohms
☐	<74>	Fault forward/line
☐	<75>	Fault reverse/busbar
☐	<76>	Teleprotection signal transmitted
☐	<77>	Teleprotection signal received
☐	<78>	Zone 1
☐	<79>	Zone 2
☐	<80>	Zone 3
☐	<81>	Zone 4
☐	<82>	Zone 5
☐	<83>	Zone 6
☐	<84>	General start/pick-up
☑	<85>	Breaker failure
☐	<86>	Trip measuring system L1
☐	<87>	Trip measuring system L2
☐	<88>	Trip measuring system L3
☐	<89>	Trip measuring system E
☑	<90>	Trip I>
☑	<91>	Trip I>>
☑	<92>	Trip IN>
☑	<93>	Trip IN>>

8.3.3.6 Auto-reclosure indications in monitoring direction

	INF	Semantics
☑	<128>	CB 'on' by AR
☐	<129>	CB 'on' by delayed AR
☐	<130>	AR blocked

8.3.3.7 Measurands in monitoring direction

	INF	Semantics
☐	<144>	Measurand
☐	<145>	Measurands I, V
☐	<146>	Measurands I, V, P, Q
☐	<147>	Measurands IN, VEN
☑	<148>	Measurands IL1, 2, 3, VL1, 2, 3, P, Q, f

8.3.3.8 Generic functions in monitoring direction

	INF	Semantics
☐	<240>	Read headings of all defined groups
☐	<241>	Read values or attributes of all entries of one group
☐	<243>	Read directory of a single entry
☐	<244>	Read value or attribute of a single entry
☐	<245>	End of general interrogation of generic data
☐	<249>	Write entry with confirmation
☐	<250>	Write entry with execution
☐	<251>	Write entry aborted

8.3.4 Selection of standard information numbers in control direction

8.3.4.1 System functions in control direction

	INF	Semantics
☑	<0>	Initiation of general interrogation
☑	<0>	Time synchronization

8.3.4.2 General commands in control direction

	INF	Semantics
☑	<16>	Auto-recloser on/off
☐	<17>	Teleprotection on/off
☐	<18>	Protection on/off
☑	<19>	LED reset
☑	<23>	Activate characteristic 1
☑	<24>	Activate characteristic 2
☐	<25>	Activate characteristic 3
☐	<26>	Activate characteristic 4

8.3.4.3 Generic functions in control direction

	INF	Semantics
☐	<240>	Read headings of all defined groups
☐	<241>	Read values or attributes of all entries of one group
☐	<243>	Read directory of a single entry
☐	<244>	Read value or attribute of a single entry
☐	<245>	General interrogation of generic data
☐	<248>	Write entry
☐	<249>	Write entry with confirmation
☐	<250>	Write entry with execution
☐	<251>	Write entry aborted

8.3.5 Basic application functions

- ☐ Test mode
- ☑ Blocking of monitoring direction
- ☐ Disturbance data
- ☐ Generic services
- ☑ Private data

8.3.6 Miscellaneous

Measurands are transmitted with ASDU 3 as well as with ASDU 9. As defined in 7.2.6.8, the maximum MVAL can either be 1.2 or 2.4 times the rated value. No different rating shall be used in ASDU 3 and ASDU 9, i.e. for each measurand there is only one choice.

Measurand	Max. MVAL = rated value times		
	1.2	or	2.4
Current L1	☑		☐
Current L2	☑		☐
Current L3	☑		☐
Voltage L1-E	☑		☐
Voltage L2-E	☑		☐
Voltage L3-E	☑		☐
Active power P	☑		☐
Reactive power Q	☑		☐
Frequency f	☑		☐
Voltage L1 - L2	☑		☐

IEC 60870-5-103 protocol
Sepam data table

All Sepam data that can be exchanged with a supervisor via the IEC 60870-5-103 protocol is listed in two tables:
- *The monitoring direction data table, which lists all Sepam data to be transmitted to the supervisor.*
- *The control direction data table, which lists all supervisor data to be transmitted to Sepam.*

Description of the Sepam data table
The following information is provided for each data item:
- The ASDU (Application Service Data Unit) number
- The value of the FUN (Function) and INF (Information) identifiers
- The value of the COT (Cause Of Transmission) field
- A GI (General Interrogation) marker
- The Sepam data semantic
- The Sepam series for which the data is available

For Sepam series 20, Sepam B2X (dedicated to voltage applications) are distinct from Sepam S20, T20 and M20 (dedicated to current applications).
The effective availability of a Sepam data item also depends on the Sepam type and function parameter settings.

ASDU: Application Service Data Unit
The ASDU number identifies the standard data structure used by Sepam for data transmission.

FUN and INF: Function number and information number
Each Sepam data item is identified by:
- The number of the function to which the data belongs: FUN
- The information number of the basic data: INF

COT: Cause Of Transmission
The COT value shows the cause of transmission of the data.

Monitoring direction
In the monitoring direction, Sepam uses the following COT values:

COT	Label	
1	Spontaneous	Information produced spontaneously following a change of state (date-tagged event)
2	Cyclic	Information produced cyclically by Sepam (measurements)
3	Reset (FCB)	Response to command to reset the frame count bit (FCB)
4	Reset (CU)	Response to command to reset the communication unit (CU)
5	Start/restart	Response to command to initialize the communication interface
8	Time synchronization	Acknowledgment of time synchronization command
9	General interrogation	Information produced in response to a general interrogation command
10	End of general interrogation	Termination message of a general interrogation cycle
12	Remote operation	Change of state resulting from a supervisor command
20	Positive acknowledgement	Positive acknowledgment of command
21	Negative acknowledgement	Negative acknowledgment of command

Control direction
In the control direction, Sepam supports the following COT values:

COT	Label	
8	Time synchronization	Time synchronization command
9	General interrogation	Initialization of a general interrogation cycle
20	General command	Command from the supervisor such as open/close breaker, enable/disable a function, etc.

GI: General Interrogation
The GI marker indicates whether the data is produced in response to a general interrogation request. For this data, each change of state ("OFF" to "ON" and "ON" to "OFF") is also transmitted spontaneously.

IEC 60870-5-103 protocol
Sepam data table - Monitoring direction

ASDU	FUN	INF	COT	GI	IEC 60870-5-103 semantic	Sepam series 20		Sepam series 40	Sepam series 80
						B2X	Other		
	255	**System functions**							
8	255	0	10		End of general interrogation	■	■	■	■
6	255	0	8		Time synchronization	■	■	■	■
5	255	2	3		Reset frame count bit (FCB)	■	■	■	■
5	255	3	4		Reset communication unit (CU)	■	■	■	■
5	255	4	5		Start/restart	■	■	■	■

ASDU	FUN	INF	COT	GI	IEC 60870-5-103 semantic	Sepam semantic	Sepam series 20		Sepam series 40	Sepam series 80
							B2X	Other		
	160	**Maximum overcurrent protection (IEC 60870-5-103 standard function)**								
1	160	16	1, 9, 12, 20, 21	■	Auto-recloser active	Recloser on		■	■	■
1	160	19	1		LED reset	Sepam reset after fault	■	■	■	■
1	160	20	9, 11	■	Monitoring direction blocked	Monitoring direction blocked	■	■	■	■
1	160	23	1, 9, 12, 20, 21	■	Characteristic 1	Setting group A in service		■	■	■
1	160	24	1, 9, 12, 20, 21	■	Characteristic 2	Setting group B in service		■	■	■
1	160	32	1, 9	■	Measurand supervision I	Phase-CT fault			■	■
1	160	33	1, 9	■	Measurand supervision V	Phase-VT fault			■	■
1	160	35	1, 9	■	Phase sequence supervision	Main-phase reverse rotation			■	■
1	160	36	1, 9	■	Trip circuit supervision	Matching fault or Trip Circuit Supervision	■	■	■	■
2	160	85	1		Breaker failure	Protection 50BF		■	■	■
2	160	90	1		Trip I>	Protection 50/51 unit 1		■ (unit 1 group A)	■	■
2	160	91	1		Trip I>>	Protection 50/51 unit 2		■ (unit 2 group A)	■	■
2	160	92	1		Trip IN>	Protection 50N/51N unit 1		■ (unit 1 group A)	■	■
2	160	93	1		Trip IN>>	Protection 50N/51N unit 2		■ (unit 2 group A)	■	■
1	160	128	1		CB 'on' by Auto-recloser	Recloser: reclosing successful		■	■	■

IEC 60870-5-103 protocol
Sepam data table - Monitoring direction

ASDU	FUN	INF	COT	GI	Sepam semantic	Sepam series 20		Sepam series 40	Sepam series 80
						B2X	Other		
	20	**Sepam supervision**							
1	20	1	1, 9	■	Sepam partial fault	■	■	■	■
1	20	2	1, 9	■	Sepam major fault	■	■	■	■
1	20	3	1, 9	■	MET 148-1 module sensor fault		■	■	■
1	20	4	1, 9	■	MET 148-2 module sensor fault			■	■
1	20	5	1, 9	■	Control fault	■	■	■	■
1	20	6	1, 9	■	Residual VT fault			■	■
1	20	7	1, 9	■	Additional phase CT fault				■
1	20	8	1, 9	■	Additional phase VT fault				■
1	20	9	1, 9	■	Additional residual VT fault				■
1	20	10	1		Min. V_aux				■
1	20	11	1		Max. V_aux				■
1	20	12	1		Battery low or absent				■
1	20	13	1, 9	■	Test mode				■
	21	**Switchgear and network**							
1	21	1	1, 9, 12, 20, 21	■	Device closed				■
1	21	2	1, 9	■	Device racked out				■
1	21	3	1		SF6 alarm			■	■
1	21	4	1, 9	■	Earthing switch closed				■
1	21	5	1		Thermistor alarm			■	■
1	21	6	1		Thermistor tripping			■	■
1	21	7	1		Buchholz alarm			■	■
1	21	8	1		Buchholz tripping			■	■
1	21	9	1		Thermostat alarm			■	■
1	21	10	1		Thermostat tripping			■	■
1	21	11	1		Pressure alarm			■	■
1	21	12	1		Pressure tripping			■	■
1	21	13	1		External tripping 1			■	■
1	21	14	1		External tripping 2			■	■
1	21	15	1		External tripping 3			■	■
1	21	16	1		Load shedding				■
1	21	17	1		Restart				■
1	21	18	1, 9	■	Additional phase reverse rotation				■
1	21	19	1, 9	■	Recloser ready			■	■
1	21	20	1		Recloser: final trip		■	■	■
1	21	21	1		Send blocking signal 1		■	■	■
1	21	22	1		Send blocking signal 2			■	■
1	21	23	1, 9	■	Closing circuit supervision				■
1	21	24	1		Request for synchro-checked closing				■
1	21	25	1		Synchronization stop				■
1	21	26	1		Synchronization failure				■
1	21	27	1		Synchronization successful				■
1	21	28	1		dU synchronization failure				■
1	21	29	1		dPhi synchronization failure				■
1	21	30	1		dF synchronization failure				■
1	21	31	1		Manual capacitor step control				■
1	21	32	1		Automatic capacitor step control				■
1	21	33	1		Capacitor step 1 matching fault				■
1	21	34	1		Capacitor step 2 matching fault				■
1	21	35	1		Capacitor step 3 matching fault				■
1	21	36	1		Capacitor step 4 matching fault				■
1	21	37	1		Coupling closing order				■
1	21	38	1		Coupling synchronization failure				■
1	21	39	1		Tripping by automatic transfer (AT)				■
1	21	40	1		Cumulative breaking current monitoring				■
1	21	102	20, 21		Ack. of command Priority group shutdown				■
1	21	103	20, 21		Ack. of command Enable/Disable synchro-check				■
1	21	104	20, 21		Ack. of command Enable/Disable voltage check				■
1	21	111	20, 21		Ack. of command Close/Open capacitor step 1				■
1	21	112	20, 21		Ack. of command Close/Open capacitor step 2				■
1	21	113	20, 21		Ack. of command Close/Open capacitor step 3				■
1	21	114	20, 21		Ack. of command Close/Open capacitor step 4				■

IEC 60870-5-103 protocol
Sepam data table - Monitoring direction

ASDU	FUN	INF	COT	GI	Sepam semantic	Sepam series 20		Sepam series 40	Sepam series 80
						B2X	Other		
	22	**Logic equations**							
1	22	1	1, 9	■	V1			■	■
1	22	2	1, 9	■	V2			■	■
1	22	3	1, 9	■	V3			■	■
1	22	4	1, 9	■	V4			■	■
1	22	5	1, 9	■	V5			■	■
1	22	6	1, 9	■	V6			■	■
1	22	7	1, 9	■	V7			■	■
1	22	8	1, 9	■	V8			■	■
1	22	9	1, 9	■	V9			■	■
1	22	10	1, 9	■	V10			■	■
1	22	11	1, 9	■	V11				■
1	22	12	1, 9	■	V12				■
1	22	13	1, 9	■	V13				■
1	22	14	1, 9	■	V14				■
1	22	15	1, 9	■	V15				■
1	22	16	1, 9	■	V16				■
1	22	17	1, 9	■	V17				■
1	22	18	1, 9	■	V18				■
1	22	19	1, 9	■	V19				■
1	22	20	1, 9	■	V20				■
1	22	21	1, 9	■	V_FLAGREC			■	■
1	22	22	1, 9	■	V_TRIPCB			■	■
1	22	23	1, 9	■	V_CLOSECB			■	■
1	22	24	1, 9	■	V_INHIBCLOSE			■	■
1	22	25	1, 9	■	V_RESET				■
1	22	26	1, 9	■	V_CLEAR				■
1	22	27	1, 9	■	V_INHIBIT_RESET_LOCAL				■
1	22	28	1, 9	■	V_SHUTDOWN				■
1	22	29	1, 9	■	V_DE-EXCITATION				■
1	22	30	1, 9	■	V_CLOSE_NOCTRL				■
1	22	31	1, 9	■	V_TRIP_STP1				■
1	22	32	1, 9	■	V_TRIP_STP2				■
1	22	33	1, 9	■	V_TRIP_STP3				■
1	22	34	1, 9	■	V_TRIP_STP4				■
1	22	35	1, 9	■	V_CLOSE_STP1				■
1	22	36	1, 9	■	V_CLOSE_STP2				■
1	22	37	1, 9	■	V_CLOSE_STP3				■
1	22	38	1, 9	■	V_CLOSE_STP4				■
1	22	39	1, 9	■	V_TRANS_ON_FAULT				■
1	22	40	1, 9	■	V_TRANS_FAULT				■
1	22	41	1, 9	■	V_MIMIC_IN_1				■
1	22	42	1, 9	■	V_MIMIC_IN_2				■
1	22	43	1, 9	■	V_MIMIC_IN_3				■
1	22	44	1, 9	■	V_MIMIC_IN_4				■
1	22	45	1, 9	■	V_MIMIC_IN_5				■
1	22	46	1, 9	■	V_MIMIC_IN_6				■
1	22	47	1, 9	■	V_MIMIC_IN_7				■
1	22	48	1, 9	■	V_MIMIC_IN_8				■
1	22	49	1, 9	■	V_MIMIC_IN_9				■
1	22	50	1, 9	■	V_MIMIC_IN_10				■
1	22	51	1, 9	■	V_MIMIC_IN_11				■
1	22	52	1, 9	■	V_MIMIC_IN_12				■
1	22	53	1, 9	■	V_MIMIC_IN_13				■
1	22	54	1, 9	■	V_MIMIC_IN_14				■
1	22	55	1, 9	■	V_MIMIC_IN_15				■
1	22	56	1, 9	■	V_MIMIC_IN_16				■

IEC 60870-5-103 protocol
Sepam data table - Monitoring direction

ASDU	FUN	INF	COT	GI	Sepam semantic	Sepam series 20		Sepam series 40	Sepam series 80
						B2X	Other		
	31	**Logic inputs (MES no. 1)**							
1	31	1	1, 9	■	Logic input	I11	I11	I11	I101
1	31	2	1, 9	■	Logic input	I12	I12	I12	I102
1	31	3	1, 9	■	Logic input	I13	I13	I13	I103
1	31	4	1, 9	■	Logic input	I14	I14	I14	I104
1	31	5	1, 9	■	Logic input	I21	I21	I21	I105
1	31	6	1, 9	■	Logic input	I22	I22	I22	I106
1	31	7	1, 9	■	Logic input	I23	I23	I23	I107
1	31	8	1, 9	■	Logic input	I24	I24	I24	I108
1	31	9	1, 9	■	Logic input	I25	I25	I25	I109
1	31	10	1, 9	■	Logic input	I26	I26	I26	I110
1	31	11	1, 9	■	Logic input				I111
1	31	12	1, 9	■	Logic input				I112
1	31	13	1, 9	■	Logic input				I113
1	31	14	1, 9	■	Logic input				I114
	32	**Logic inputs (MES no. 2)**							
1	32	1 to 14	1, 9	■	Logic inputs I201 to I214				■
	33	**Logic inputs (MES no. 3)**							
1	3	1 to 14	1, 9	■	Logic inputs I301 to I314				■
	41	**Logipam group 1 (Sepam series 80 option)**							
1	41	16 to 31	1, 9	■	TS16 to TS31				■
1	41	106	20, 21		Ack. of command TC6				■
1	41	107	20, 21		Ack. of command TC7				■
1	41	110 to 117	20, 21		Ack. of command TC10 to Ack. of command TC17				■
	42	**Logipam group 2 (Sepam series 80 option)**							
1	42	33 to 48	1, 9	■	TS33 to TS48				■
1	42	121 to 129	20, 21		Ack. of command TC21 to Ack. of command TC29				■
	43	**Logipam group 3 (Sepam series 80 option)**							
1	43	52 to 64	1, 9	■	TS52 to TS64				■
1	43	149 to 164	20, 21		Ack. of command TC49 to Ack. of command TC64				■

IEC 60870-5-103 protocol
Sepam data table - Monitoring direction

ASDU	FUN	INF	COT	GI	Sepam semantic	Sepam series 20		Sepam series 40	Sepam series 80
						B2X	Other		
	100	**Overcurrent protections**							
2	100	1	1		Protection 50/51 unit 3		■ (unit 1 group B)	■	■
2	100	2	1		Protection 50/51 unit 4		■ (unit 2 group B)	■	■
2	100	3	1		Protection 50/51 unit 5				■
2	100	4	1		Protection 50/51 unit 6				■
2	100	5	1		Protection 50/51 unit 7				■
2	100	6	1		Protection 50/51 unit 8				■
2	100	7	1		Protection 50N/51N unit 3		■ (unit 1 group B)	■	■
2	100	8	1		Protection 50N/51N unit 4		■ (unit 2 group B)	■	■
2	100	9	1		Protection 50N/51N unit 5				■
2	100	10	1		Protection 50N/51N unit 6				■
2	100	11	1		Protection 50N/51N unit 7				■
2	100	12	1		Protection 50N/51N unit 8				■
2	100	13	1		Protection 51V unit 1			■	■
2	100	14	1		Protection 51V unit 2				■
	101	**Directional current protections**							
2	101	1	1		Protection 67 unit 1			■	■
2	101	2	1		Protection 67 unit 2			■	■
2	101	3	1		Protection 67N unit 1			■	■
2	101	4	1		Protection 67N unit 2			■	■
	102	**Voltage protections**							
2	102	1	1		Protection 27/27S unit 1	■		■	■
2	102	2	1		Protection 27/27S unit 2	■		■	■
2	102	3	1		Protection 27/27S unit 3				■
2	102	4	1		Protection 27/27S unit 4				■
2	102	5	1		Protection 27D unit 1	■		■	■
2	102	6	1		Protection 27D unit 2	■		■	■
2	102	7	1		Protection 27R unit 1	■		■	■
2	102	8	1		Protection 27R unit 2				■
2	102	11	1		Protection 59 unit 1	■		■	■
2	102	12	1		Protection 59 unit 2	■		■	■
2	102	13	1		Protection 59 unit 3				■
2	102	14	1		Protection 59 unit 4				■
2	102	21	1		Protection 59N unit 1	■		■	■
2	102	22	1		Protection 59N unit 2	■		■	■
2	102	31	1		Protection 27S phase 1	■			
2	102	32	1		Protection 27S phase 2	■			
2	102	33	1		Protection 27S phase 3	■			

IEC 60870-5-103 protocol
Sepam data table - Monitoring direction

ASDU	FUN	INF	COT	GI	Sepam semantic	Sepam series 20		Sepam series 40	Sepam series 80
						B2X	Other		
	103	**Frequency protections**							
2	103	1	1		Protection 81H unit 1	■		■	■
2	103	2	1		Protection 81H unit 2			■	■
2	103	11	1		Protection 81L unit 1	■		■	■
2	103	12	1		Protection 81L unit 2	■		■	■
2	103	13	1		Protection 81L unit 3			■	■
2	103	14	1		Protection 81L unit 4			■	■
2	103	21	1		Protection 81R unit 1	■			■
2	103	22	1		Protection 81R unit 2				■
	104	**Motor/generator protections**							
2	104	1	1		Protection 48/51LR (locked rotor)		■	■	■
2	104	2	1		Protection 48/51LR (locked rotor at start-up)		■	■	■
2	104	3	1		Protection 48/51LR (excessive starting time)		■	■	■
1	104	4	1, 9	■	Protection 66		■	■	■
2	104	5	1		Protection 21B				■
2	104	6	1		Protection 50/27				■
2	104	7	1		Protection 64G2/27TN unit 1				■
2	104	8	1		Protection 64G2/27TN unit 2				■
2	104	9	1		Protection 78PS				■
2	104	10	1		Protection 24 unit 1				■
2	104	11	1		Protection 24 unit 2				■
2	104	12	1		Protection 40				■
	105	**Miscellaneous protections**							
2	105	1	1		Protection 46 unit 1		■	■	■
2	105	2	1		Protection 46 unit 2			■	■
2	105	11	1		Protection 47 unit 1			■	■
2	105	12	1		Protection 47 unit 2				■
2	105	20	1		Protection 37		■	■	■
2	105	31	1		Protection 51C unit 1 (capacitor step 1)				■
2	105	32	1		Protection 51C unit 2 (capacitor step 1)				■
2	105	33	1		Protection 51C unit 3 (capacitor step 2)				■
2	105	34	1		Protection 51C unit 4 (capacitor step 2)				■
2	105	35	1		Protection 51C unit 5 (capacitor step 3)				■
2	105	36	1		Protection 51C unit 6 (capacitor step 3)				■
2	105	37	1		Protection 51C unit 7 (capacitor step 4)				■
2	105	38	1		Protection 51C unit 8 (capacitor step 4)				■
1	105	101	20, 21		Ack. of command Reset undercurrent protection			■	■

IEC 60870-5-103 protocol
Sepam data table - Monitoring direction

ASDU	FUN	INF	COT	GI	Sepam semantic	Sepam series 20		Sepam series 40	Sepam series 80
						B2X	Other		
	106	**Thermal protections**							
1	106	1	1		Protection 49 RMS alarm set point		■	■	■
1	106	2	1		Protection 49 RMS tripping set point		■	■	■
1	106	3	1, 9	■	Thermal protection tripping inhibited		■	■	■
1	106	11	1		Protection 38/49T tripping sensor 1 module 1		■	■	■
1	106	12	1		Protection 38/49T tripping sensor 2 module 1		■	■	■
1	106	13	1		Protection 38/49T tripping sensor 3 module 1		■	■	■
1	106	14	1		Protection 38/49T tripping sensor 4 module 1		■	■	■
1	106	15	1		Protection 38/49T tripping sensor 5 module 1		■	■	■
1	106	16	1		Protection 38/49T tripping sensor 6 module 1		■	■	■
1	106	17	1		Protection 38/49T tripping sensor 7 module 1		■	■	■
1	106	18	1		Protection 38/49T tripping sensor 8 module 1		■	■	■
1	106	21	1		Protection 38/49T tripping sensor 1 module 2			■	■
1	106	22	1		Protection 38/49T tripping sensor 2 module 2			■	■
1	106	23	1		Protection 38/49T tripping sensor 3 module 2			■	■
1	106	24	1		Protection 38/49T tripping sensor 4 module 2			■	■
1	106	25	1		Protection 38/49T tripping sensor 5 module 2			■	■
1	106	26	1		Protection 38/49T tripping sensor 6 module 2			■	■
1	106	27	1		Protection 38/49T tripping sensor 7 module 2			■	■
1	106	28	1		Protection 38/49T tripping sensor 8 module 2			■	■
1	106	31	1		Protection 38/49T alarm sensor 1 module 1		■	■	■
1	106	32	1		Protection 38/49T alarm sensor 2 module 1		■	■	■
1	106	33	1		Protection 38/49T alarm sensor 3 module 1		■	■	■
1	106	34	1		Protection 38/49T alarm sensor 4 module 1		■	■	■
1	106	35	1		Protection 38/49T alarm sensor 5 module 1		■	■	■
1	106	36	1		Protection 38/49T alarm sensor 6 module 1		■	■	■
1	106	37	1		Protection 38/49T alarm sensor 7 module 1		■	■	■
1	106	38	1		Protection 38/49T alarm sensor 8 module 1		■	■	■
1	106	41	1		Protection 38/49T alarm sensor 1 module 2			■	■
1	106	42	1		Protection 38/49T alarm sensor 2 module 2			■	■
1	106	43	1		Protection 38/49T alarm sensor 3 module 2			■	■
1	106	44	1		Protection 38/49T alarm sensor 4 module 2			■	■
1	106	45	1		Protection 38/49T alarm sensor 5 module 2			■	■
1	106	46	1		Protection 38/49T alarm sensor 6 module 2			■	■
1	106	47	1		Protection 38/49T alarm sensor 7 module 2			■	■
1	106	48	1		Protection 38/49T alarm sensor 8 module 2			■	■
	107	**Power protections**							
2	107	1	1		Protection 32P unit 1			■	■
2	107	2	1		Protection 32P unit 2				■
2	107	3	1		Protection 32Q			■	■
2	107	11	1		Protection 37P unit 1				■
2	107	12	1		Protection 37P unit 2				■
	108	**Differential protections**							
2	108	1	1		Protection 64REF unit 1				■
2	108	2	1		Protection 64REF unit 2				■
2	108	10	1		Protection 87T2				■
2	108	11	1		Protection 87M/87G				■
	109	**Speed protections**							
1	109	1	1		Protection 12 unit 1				■
1	109	2	1		Protection 12 unit 2				■
1	109	3	1		Protection 14 unit 1				■
1	109	4	1		Protection 14 unit 2				■

IEC 60870-5-103 protocol
Sepam data table - Monitoring direction

ASDU	FUN	INF	COT	GI	Sepam semantic	Sepam series 20		Sepam series 40	Sepam series 80
						B2X	Other		
	160	**Standard measurements**							
9	160	148	2		9 information elements MEA1 to MEA9				
					MEA1: Phase current I1		■	■	■
					MEA2: Phase current I2		■	■	■
					MEA3: Phase current I3		■	■	■
					MEA4: Phase-to-neutral voltage V1	■		■	■
					MEA5: Phase-to-neutral voltage V2	■		■	■
					MEA6: Phase-to-neutral voltage V3	■		■	■
					MEA7: Active power P			■	■
					MEA8: Reactive power Q			■	■
					MEA9: Frequency f	■		■	■
	10	**Temperature measurements**							
9	10	1	2		16 information elements: 16 temperatures MEA1 to MEA16, as a % of full scale (i.e. 200°C)				
					MEA1: Temperature sensor 1 module 1		■	■	■
					MEA2: Temperature sensor 2 module 1		■	■	■
					MEA3: Temperature sensor 3 module 1		■	■	■
					MEA4: Temperature sensor 4 module 1		■	■	■
					MEA5: Temperature sensor 5 module 1		■	■	■
					MEA6: Temperature sensor 6 module 1		■	■	■
					MEA7: Temperature sensor 7 module 1		■	■	■
					MEA8: Temperature sensor 8 module 1		■	■	■
					MEA9: Temperature sensor 1 module 2			■	■
					MEA10: Temperature sensor 2 module 2			■	■
					MEA11: Temperature sensor 3 module 2			■	■
					MEA12: Temperature sensor 4 module 2			■	■
					MEA13: Temperature sensor 5 module 2			■	■
					MEA14: Temperature sensor 6 module 2			■	■
					MEA15: Temperature sensor 7 module 2			■	■
					MEA16: Temperature sensor 8 module 2			■	■
	11	**Additional measurements 1**							
9	11	1	2		13 information elements MEA1 to MEA13				
					MEA1: Residual current I0Σ		■ (I0Σ or I0)	■	■
					MEA2: Residual current I0		■ (I0Σ or I0)	■	■
					MEA3: Negative sequence / unbalance T		■	■	■
					MEA4: Phase-to-phase voltage U21	■		■	■
					MEA5: Phase-to-phase voltage U32	■		■	■
					MEA6: Phase-to-phase voltage U13	■		■	■
					MEA7: Residual voltage V0	■		■	■
					MEA8: Positive sequence voltage Vd	■		■	■
					MEA9: Negative-sequence voltage Vi			■	■
					MEA10: Power factor Cos Phi			■	■
					MEA11: Neutral-point voltage Vnt				■
					MEA12: Total harmonic distortion Uthd				■
					MEA13: Total harmonic distortion Ithd				■
	12	**Additional measurements 2**							
9	12	1	2		16 information elements MEA1 to MEA16				
					MEA1: Phase current I'1				■
					MEA2: Phase current I'2				■
					MEA3: Phase current I'3				■
					MEA4: Residual current I'0Σ				■
					MEA5: Residual current I'0				■
					MEA6: Phase-to-phase voltage U'21				■
					MEA7: Phase-to-phase voltage U'32				■
					MEA8: Phase-to-phase voltage U'13				■
					MEA9: Phase-to-neutral voltage V'1				■
					MEA10: Phase-to-neutral voltage V'2				■
					MEA11: Phase-to-neutral voltage V'3				■
					MEA12: Residual voltage V'0				■
					MEA13: Positive sequence voltage V'd				■
					MEA14: Negative-sequence voltage V'i				■
					MEA15: Frequency f'				■
					MEA16: Negative sequence / unbalance T'				■

IEC 60870-5-103 protocol
Sepam data table - Control direction

ASDU	FUN	INF	COT	GI	Sepam semantic	Sepam series 20		Sepam series 40	Sepam series 80
						B2X	Other		
	255	**System functions**							
7	255	0	9		Initiation of general interrogation	■	■	■	■
6	255	0	8		Time synchronization	■	■	■	■
	160	**General commands**							
20	160	16	20		Enable recloser (ON)		■	■	■
20					Disable recloser (OFF)				
20	160	19	20		Sepam reset (ON)	■	■	■	■
20	160	23	20		Switching to setting group A (ON)		■	■	■
20	160	24	20		Switching to setting group B (ON)		■	■	■
	21	**Switchgear and network commands**							
20	21	1	20		Closing (ON)	■	■	■	■
					Trip/open (OFF)				
20	21	102	20		Priority group shutdown (ON)				■
					Cancel priority group shutdown (OFF)				
20	21	103	20		Enable synchro-check (ON)				■
					Disable synchro-check (OFF)				
20	21	104	20		Enable voltage check (ON)				■
					Disable voltage check (OFF)				
20	21	111	20		Close capacitor step 1 (ON)				■
					Open capacitor step 1 (OFF)				
20	21	112	20		Close capacitor step 2 (ON)				■
					Open capacitor step 2 (OFF)				
20	21	113	20		Close capacitor step 3 (ON)				■
					Open capacitor step 3 (OFF)				
20	21	114	20		Close capacitor step 4 (ON)				■
					Open capacitor step 4 (OFF)				
		Other commands							
20	105	101	20		Reset undercurrent protection (ON)			■	■
20	106	3	20		Inhibit thermal protection (ON)		■	■	■
					Confirm thermal protection (OFF)				
	41	**Logipam group 1 (Sepam series 80 option) TC available for the user**							
20	41	106	20		TC6				■
20	41	107	20		TC7				■
20	41	110 to 117	20		TC10 to TC17				■
	42	**Logipam group 2 (Sepam series 80 option) TC available for the user**							
20	42	121 to 129	20		TC21 to TC29				■
	43	**Logipam group 3 (Sepam series 80 option) TC available for the user**							
20	43	149 to 164	20		TC49 to TC64				■

Configuring the communication interfaces

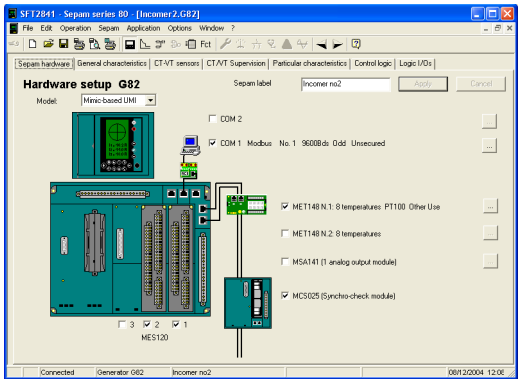
Presentation

The Sepam communication interfaces must be configured using SFT2841 software.

The IEC 60870-5-103 protocol is available with the ACE969TP or ACE969FO communication interfaces.
Several parameter categories have to be configured once the interface has been selected:

- The configuration parameters for the physical layer of the E-LAN port
- The configuration parameters for the physical layer of the S-LAN port
- The configuration parameters for functions specific to the IEC 60870-5-103 protocol (advanced S-LAN port parameters)

PE80012



SFT2841: Sepam series 80 hardware configuration.

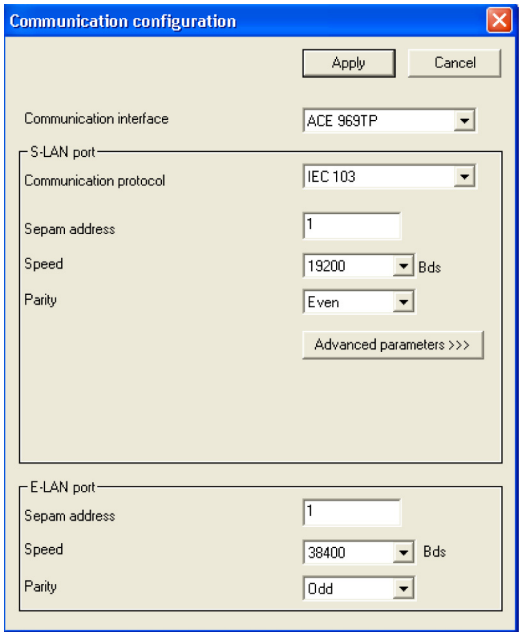
Access to configuration parameters

These parameters can be accessed from the **Communication configuration** window in the SFT2841 software.

To access this window:

- Display the **Sepam configuration** screen in SFT2841. This screen will vary according to the type of Sepam used (Sepam series 20, Sepam series 40 or Sepam series 80).
- Select the **Communication** option.
- Click … : the **Communication configuration** window appears.
- Select the type of interface used (ACE969TP or ACE969FO).
- Select the IEC103 communication protocol (S-LAN port).

PE80013



Configuration of the physical layer of the E-LAN port on an ACE969TP.

Configuration of the E-LAN port

Configuration of the physical layer

The E-LAN port on the ACE969TP and ACE969FO communication interfaces is a 2-wire RS 485 port.
The configuration parameters for the physical layer of the E-LAN port are:

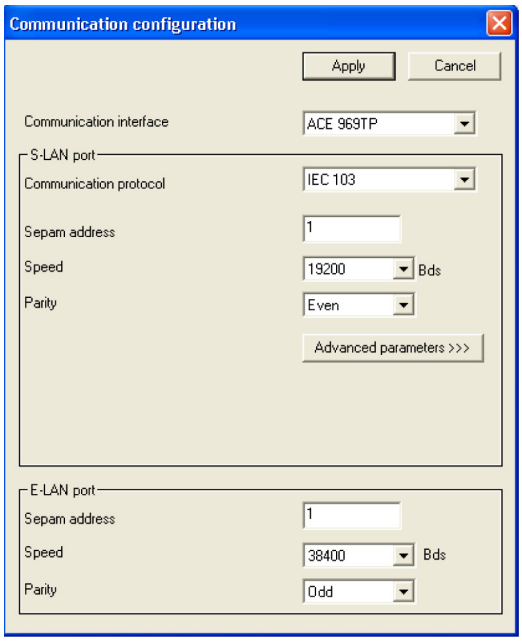
- Sepam address
- Transmission speed
- Parity check type

Parameters	Authorized values	Default value
Sepam address	1 to 247	1
Speed	4800, 9600, 19200 or 38400 bps	38400 bps
Parity	No parity, Even or Odd	Odd

Configuration tips

- The Sepam address MUST be assigned before Sepam is connected to the E-LAN communication network.
- You are also strongly advised to set the other physical layer configuration parameters before connecting to the communication network.
- Modifying the configuration parameters during normal operation will not disturb Sepam but will reset the E-LAN communication port. If SFT2841 is connected to Sepam via the E-LAN network, any communication between Sepam and SFT2841 will be interrupted.

Configuring the communication interfaces



Configuration of the physical layer of the S-LAN port on an ACE969TP.

Configuration of the S-LAN port: Physical layer

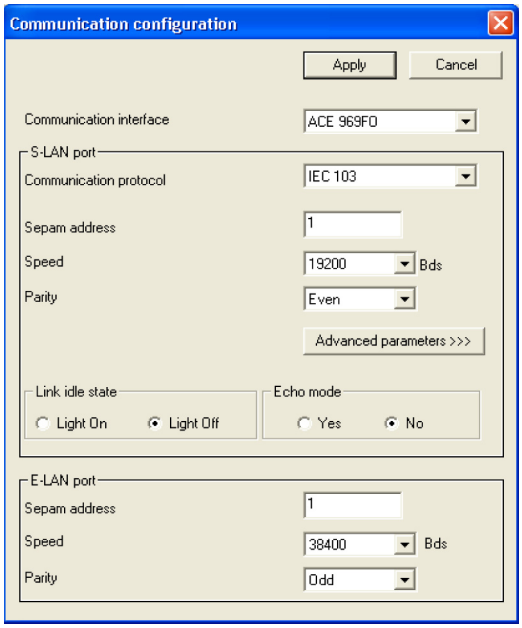
The configuration parameters will vary depending on the communication interface selected: ACE969TP or ACE969FO.

ACE969TP: 2-wire RS 485 S-LAN port

The configuration parameters for the physical layer of the S-LAN port on the ACE969TP are:

- Sepam address
- Transmission speed
- Parity check type

Parameters	Authorized values	Default value
Sepam address	0 to 254	1
Speed	4800, 9600, 19200 or 38400 bps	19200 bps
Parity	No parity, Even or Odd	Even



Configuration of the physical layer of the S-LAN port on an ACE969FO.

ACE969FO: Fiber-optic S-LAN port

The configuration parameters for the physical layer of the S-LAN port on the ACE969FO are:

- Sepam address
- Transmission speed
- Parity check type
- Link idle state: Light On or Light Off
- Echo mode: Yes or No

Echo mode must be activated when the Sepam is connected to an optical ring communication network.

Parameters	Authorized values	Default value
Sepam address	0 to 254	1
Speed	4800, 9600, 19200 or 38400 bps	19200 bps
Parity	No parity, Even or Odd	Even
Link idle state	Light Off or Light On	Light Off
Echo mode	Yes (optical ring) or No (optical star)	No

Configuration tips

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

Configuration of the S-LAN port: IEC 60870-5-103 protocol

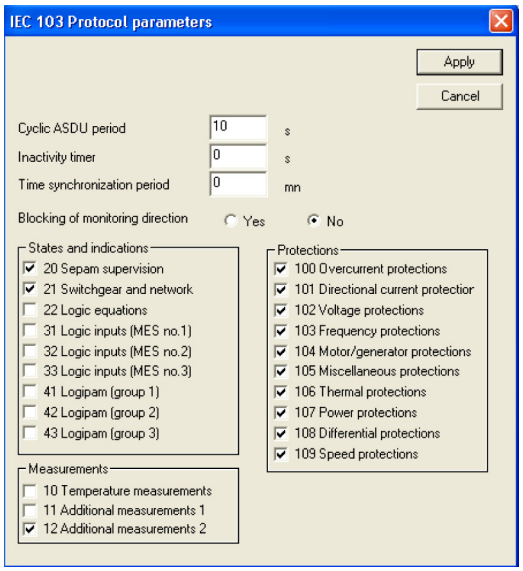
Configuration of the IEC 60870-5-103 protocol functions

The configuration of the IEC 60870-5-103 protocol functions is identical whether the ACE969TP interface or the ACE969FO interface is used.

Click the Advanced parameters button in the ACE969 configuration windows to open the **IEC 103 Protocol parameters** window, in which the following can be configured:

- The standard parameters as defined by standard IEC 60870-5-103
- The Sepam private data to be exchanged with the supervisor

PE80015



Configuration of the IEC 60870-5-103 protocol.

Configuration of the standard parameters

The standard IEC 60870-5-103 protocol parameters are as follows:

- Cyclic ASDU period
- Inactivity timer
- Time synchronization period
- Blocking of monitoring direction

Cyclic ASDU period

Period during which cyclic data, such as measurement information, is generated and updated by Sepam.
This parameter, which is expressed in seconds, must be set consistently with the interval at which this data is polled by the supervisor.

Inactivity timer

In normal operation, the supervisor sends polling requests to the Sepam units at regular intervals. Each Sepam monitors the activity of the supervisor by checking that polling requests are being received regularly.
If a Sepam fails to receive requests during a configurable period (the inactivity time delay), it will lock its communication port and cease to respond to requests sent subsequently by the supervisor.
To re-establish communication with a locked Sepam, the supervisor must initiate a reset.

Time synchronization period

Time synchronization is transmitted via ASDU 6.
If this ASDU has not been received at the end of time T (time synchronization period), Sepam will assume that its clock setting may be inaccurate and will assign the information "Invalid time" to time-tagged data.

Blocking of monitoring direction

Sepam can suspend the transmission of data in the monitoring direction, in accordance with the procedure specified by IEC 60870-5-103.

Parameters	Authorized values	Default value
Cyclic ASDU period	0 to 60 seconds	10 seconds
Inactivity timer	0 to 60000 seconds	0 (infinite)
Time synchronization period	0 to 60000 minutes	0
Blocking of monitoring direction	No or Yes	No

Configuring the communication interfaces

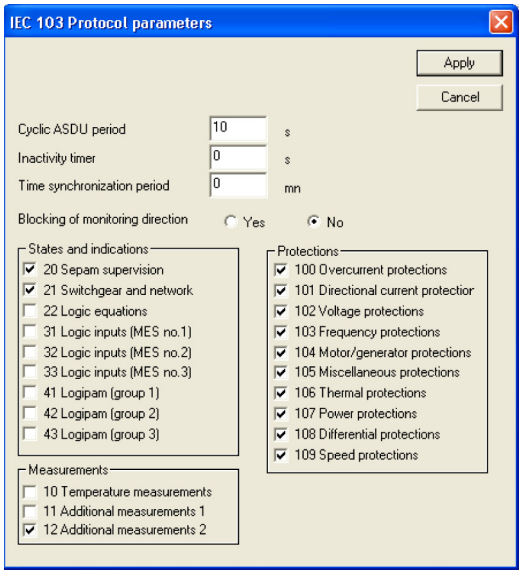
Selection of the data to be exchanged

Sepam private data is categorized in three subsets:
- States and indications
- Protections
- Measurements

In each subset, the data is organized into functional groups. A functional group is identified by a function number (FUN).

The data groups to be exchanged with the supervisor can be selected in the configuration window.
Only the data groups required for the application should be selected, in order to avoid overloading communication unnecessarily (in particular in the event of a general interrogation on the part of the supervisor).

PE80015



Configuration of the IEC 60870-5-103 protocol.

FUN	Function	Sepam series 20		Sepam series 40	Sepam series 80
		B2X	Other		
	States and indications				
20	Sepam supervision	■	■	■	■
21	Switchgear and network	NA	■	■	■
22	Logic equations	NA	NA	□	□
31	Logic inputs (MES no. 1)	□	□	□	□
32	Logic inputs (MES no. 2)	NA	NA	NA	□
33	Logic inputs (MES no. 3)	NA	NA	NA	□
41	Logipam (group 1)	NA	NA	NA	□
42	Logipam (group 2)	NA	NA	NA	□
43	Logipam (group 3)	NA	NA	NA	□
	Protections				
100	Overcurrent protections	NA	■	■	■
101	Directional current protections	NA	NA	■	■
102	Voltage protections	■	NA	■	■
103	Frequency protections	■	NA	■	■
104	Motor/generator protections	NA	■	■	■
105	Miscellaneous protections	NA	■	■	■
106	Thermal protections	NA	■	■	■
107	Power protections	NA	NA	■	■
108	Differential protections	NA	NA	NA	■
109	Speed protections	NA	NA	NA	■
	Measurements				
10	Temperature measurements	NA	□	□	□
11	Additional measurements 1	■	■	■	■
12	Additional measurements 2	NA	NA	NA	□

■ *Function available and selected by default*
□ *Function available and not selected by default*
NA (Not Applicable): Function not available for a Sepam series, not displayed in the IEC103 Protocol parameters window

Installation and operating instructions for Sepam

The communication interfaces must be installed and connected in accordance with the instructions in each Sepam user's and operation manual.

- Sepam series 20 user's manual, reference PCRED301005EN
- Sepam series 40 user's manual, reference PCRED301006EN
- Sepam series 80 operation manual, reference SEPED303003EN

Preliminary checks

The following preliminary checks must be made:

- Check the CCA612 cord connection between the ACE969 interface and the Sepam base unit.
- Check the auxiliary power supply connection to the ACE969.
- Check the connection between the S-LAN communication port and the ACE969.
- Check the complete configuration of the ACE969.

Checking the operation of the ACE969 interface

You can use the following to check that the ACE969 interface is operating correctly:

- The indicator LEDs on the front panel of the ACE969
- The information provided by the SFT2841 software connected to Sepam:
  - On the Diagnosis screen
  - On the Communication configuration screens

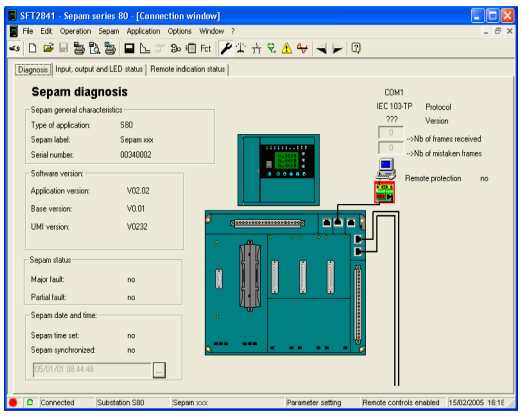
PE80001

ACE969TP communication interface.

Indication 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
- S-LAN Tx LED flashing: Sepam transmitting
- S-LAN Rx LED flashing: Sepam receiving

PE80016



SFT2841: Sepam series 80 diagnosis screen.

Diagnosis using SFT2841 software

Sepam diagnosis screen

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

Sepam communication diagnosis

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

- Name of the protocol configured
- IEC 60870-5-103 interface version number
- Number of frames received
- Number of mistaken frames received

These two counters are reset to zero if:

- The maximum value (65535) is reached
- The Sepam auxiliary power supply is lost
- The communication parameters are modified

Troubleshooting assistance

The following diagnosis information indicates whether Sepam and a supervisor are communicating correctly using the IEC 60870-5-103 protocol:

- ■ Indicator LEDs on the front panel of the ACE969:
  - □ Green "on" LED on
  - □ Red "key" LED off
  - □ S-LAN Rx and Tx LEDs flashing
- ■ Sepam diagnosis screen:
  - □ Name of the protocol configured: IEC 60870-5-103
  - □ IEC 60870-5-103 interface version number displayed
  - □ Number of frames received increasing at regular intervals
  - □ Number of mistaken frames received not increasing

Deviations from the above indicate that communication between Sepam and the supervisor has failed. The table below lists the possible causes of communication failures, along with the associated course of action to be taken in each case.

Symptoms		Possible cause	Action/Remedy
ACE969 LEDs	**SFT2841 diagnosis**		
"On" LED off	Protocol = ???? and/or Version = ????	No power supply to ACE969	Check the auxiliary power supply to the ACE969
"Key" LED on	Protocol = ???? and/or Version = ????	ACE969 failed	Replace the ACE969
"Key" LED flashing	Protocol = ???? and/or Version = ????	ACE969 not configured	Configure the ACE969 using SFT2841
		ACE969 is not connected to Sepam	Check the ACE969 connection to Sepam
		The ACE969 configuration is incorrect	Use SFT2841 to check the interface selected: ACE969TP or ACE969FO
S-LAN Rx LED flashing	Increase in mistaken frame counter value	The ACE969 physical layer configuration is incorrect	Use SFT2841 to check the following parameters: Transmission speed Parity
		The communication protocol selected is incorrect	Check the communication protocol selected
		The S-LAN network is not properly connected	Check the connection of the S-LAN network and the RS 485 remote power supply
S-LAN Rx LED flashing	The frame counter values are not increasing	The supervisor is not sending frames to Sepam	Use SFT2841 to check the Sepam address parameter and check that the supervisor is sending frames to Sepam
		The communication protocol selected is incorrect	Check the communication protocol selected
S-LAN Rx LED off		The supervisor is not sending frames on the network	Check that the supervisor is operating correctly
		The S-LAN network is not properly connected	Check the connection of the S-LAN network and the RS 485 remote power supply

Appendix 1: Sepam data coding

Presentation

The Monitoring and Control data managed by Sepam is coded in accordance with the structure of standard ASDUs as specified in standard IEC 60870-5-103.

ADSU	COT	Monitoring direction	Control direction	Description
1	1	■		Changes of state
1	9	■		States in response to general interrogation
2	1	■		Protection equipment tripping indication
5	4,5	■		Identification
9	2	■		Measurements
20	20		■	Commands

Status information coding: ASDU 1 and ASDU 2

Information on Sepam states and indications is coded using ASDU 1 and ASDU 2. It is obtained via requests to scan class 1 data.

ASDU 1

Bytes		*Description*
1	1	*ASDU number*
2	81h	*Structure qualifier*
3	1 or 9	*COT: 1 (spontaneous) or 9 (General Interrog. resp.)*
4		*ASDU common address: Sepam address*
5		*FUN: function number*
6		*INF: information number*
7		*DPI (Double Point Information): 1=OFF - 2=ON*
8	Time-tagged label	*Milliseconds (least significant byte)*
9		*Milliseconds (most significant byte)*
10		*Minutes + invalidity bit (most significant bit)*
11		*Minutes + Summer time bit (most significant bit)*
12		*Additional information: 0 if COT=1*
		General interrogation number if COT=9

ASDU 2

Bytes		*Description*
1	2	*ASDU number*
2	81h	*Structure qualifier*
3	1	*COT: 1 (spontaneous)*
4		*ASDU common address: Sepam address*
5		*FUN: function number*
6		*INF: information number*
7		*DPI (Double Point Information): 1=OFF - 2=ON*
8	0	*REL: Relative time elapsed between appearance of the fault and tripping (not managed by Sepam)*
9	0	
10	0	*FAN: Fault number (not managed by Sepam)*
11	0	
12	Time-tagged label	*Milliseconds (least significant byte)*
13		*Milliseconds (most significant byte)*
14		*Minutes + invalidity bit (most significant bit)*
15		*Minutes + Summer time bit (most significant bit)*
16		*Additional information: 0 if COT=1*
		General interrogation number if COT=9

Sepam identification: ASDU 5

ASDU 5 is generated by Sepam in response to initialization commands sent by the master:
- Reset CU (Communication Unit)
- Reset FCB (Frame Count Bit)

IEC 60870-5-103 communication is only operational after initialization by the master station. In response to this initialization request, Sepam generates two successive ASDU 5 type messages.

ASDU 5 in response to Reset CU

First ASDU 5 message:	COT = 4 (Reset CU) and INF = 3
Second ASDU 5 message:	COT = 5 (Start/restart) and INF = 4

ASDU 5 in response to Reset CU

First ASDU 5 message:	COT = 3 (Reset FCB) and INF = 2
Second ASDU 5 message:	COT = 5 (Start/restart) and INF = 4

Once communication has been established, if the master sends a new initialization request, only the first ASDU 5 message is generated.

ASDU 5

Bytes		*Description*
1	5	*ASDU number*
2	81h	*Structure qualifier*
3	COT	*COT: 3, 4 or 5*
4	@	*ASDU common address: Sepam address*
5	FUN	*FUN: function number*
6	INF	*INF: information number 2, 3 or 4*
7	2	*Compatibility level (level 2: Sepam does not support IEC 60870-5-103 generic services)*
8	"M"	*Manufacturer identification (8 ASCII characters) "MG SEPAM"*
9	"G"	
10	" "	
11	"S"	
12	"E"	
13	"P"	
14	"A"	
15	"M"	
16	"G"	*Application software identification (4 ASCII characters) For example, "G40 " for Sepam series 40 Generator application*
17	"4"	
18	"0"	
19	" "	

Measurement coding: ASDU 9

Sepam measurements are coded using ASDU 9.
They are obtained via requests to scan class 2 data.

The size of ASDU 9 depends on the number of measurements provided.
The number of measurements is shown in the Structure qualifier field.

ASDU 9

Bytes		*Description*
1	9	*ASDU number*
2	n	*Number of measurements coded in ASDU*
3	2	*COT: 2 (cyclical)*
4	@	*ASDU common address: Sepam address*
5	FUN	*FUN: function number*
6	INF	*INF: information number*
7	MES 1	*Measurement 1 (least significant byte)*
8		*Measurement 1 (most significant byte)*
..	...	
..	..	
..	MES n	*Measurement n (least significant byte)*
Zz		*Measurement n (most significant byte)*

Where Zz = 8 + 2 x (n - 1)

Each measurement is coded on 2 bytes.
The value provided is a value standardized by IEC 60870-5-103 which is coded as a 13-bit 2's complement value (bits 3 to 15). It is expressed in relation to a reference value.
Bit 0 is the overflow bit (OV: Overflow)
Bit 1 is the error bit (ERR)
Bit 2 is a reserved bit (RES); it is always 0

Most significant byte								*Least significant byte*							
15	*14*	*13*	*12*	*11*	*10*	*9*	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
Signed IEC standardized value on 13 bits													RES	ERR	OV

The actual value measured by Sepam is obtained from the IEC standardized value using the following formula:

$$\textbf{Measured value} = \textbf{Reference value} \times \frac{\textbf{Standardized value CEI} + 1}{2^{12}}$$

Sepam provides different types of measurements for which the reference values are:

Measurement types	Reference value	Dynamic
Currents	1.2 x Rated current	120%
Voltages	1.2 x Rated voltage	120%
Powers (P, Q)	1.2 x U x I x $\sqrt{3}$	120%
Frequencies	1.2 x Rated frequency	120%
Negative sequence/ unbalance, total harmonic distortion, etc.	1.2	120%
Cos Phi	1	100%
Temperature	200°C	100%

For example, if the rated current on Sepam is set to 630 A, the current value coded as 3251 represents a measured current equal to 600 A.
The value 3251 (0CB3h) is coded:

Most significant byte								*Least significant byte*							
Signed IEC standardized value on 13 bits													RES	ERR	OV
0	1	1	0	0	1	0	1	1	0	0	1	1	0	0	0
0	C				B			3					0	0	0

Command coding: ASDU 20

Commands are sent to Sepam (enable/disable functions, open/close, remote controls, etc.) via ASDU 20.

A command is always confirmed by Sepam through generation of an acknowledgement message by return using ASDU 1 (COT 20).
The General Command ASDU includes an identification number (Return Information Identifier, from 0 to 255), selected arbitrarily by the master. This number is copied as is by Sepam into the Command Acknowledgement ASDU so that a link can be established with the Command ASDU.
The value of the command is coded in the DCI (Double Command Information) byte; the authorized values are OFF (1) and ON (2).

ASDU 20

Bytes		*Description*
1	20	*ASDU number*
2	81h	*Structure qualifier*
3	20	*COT: 20 (general command)*
4	@	*ASDU common address: Sepam address*
5	FUN	*FUN: function number*
6	INF	*INF: information number*
7	DCI	*DCI (Double Command Information): 1=OFF - 2=ON*
8	RII	*RII: Return Information Identifier*

Appendix 2: File transfer
General

Presentation

Sepam records information, in the form of files, produced by the following functions:
- Disturbance records (for Sepam series 20, Sepam series 40 and Sepam series 80)
- Tripping contexts (for Sepam series 80 only)

These files can be retrieved using a file transfer procedure based on private ASDUs 254 and 255.

Types of file to be transferred

Definitions

The files that can be transferred from Sepam to the supervisor are:
- 1 DR (Disturbance Records) directory file, which contains the information required for transferring disturbance record files saved in Sepam
- 1 TR (Tripping Records) directory file, which contains the information required for transferring Tripping context files saved in Sepam
- Disturbance record files, which contain data saved in Sepam on events via the Disturbance recording function
- Tripping context files, which contain data saved by Sepam on tripping

File names

Each file is identified by a name coded in ASCII-character.

File	File name	Size of file name (in bytes)
DR directory	DR	2
Disturbance records	DR\yyyy-mm-dd-hh-mn-sssss	25
TR directory	TR	2
Tripping contexts	TR\yyyy-mm-dd-hh-mn-sssss	25

The name of Disturbance record and Tripping context files is encoded with the date the file is saved by Sepam:
- yyyy: year coded on 4 ASCII characters
- mm: month coded on 2 ASCII characters, from 01 to 12
- dd: day coded on 2 ASCII characters, from 01 to 31
- hh: hour coded on 2 ASCII characters, from 00 to 23
- mn: minutes coded on 2 ASCII characters, from 00 to 59
- sssss: milliseconds coded on 5 ASCII characters, from 00000 to 59999

Transfer principle

A Disturbance record file is transferred from Sepam to the supervisor in three stages:
1. The DR directory file is read by the supervisor
2. The contents of the DR file is interpreted by the supervisor, to identify the Disturbance record file to be transferred
3. The selected Disturbance record file is read

A Tripping context file is transferred from Sepam to the supervisor in the same way, using the TR directory file.

Reading a file

Procedure

The same procedure applies for reading all files (directory files and data files). This consists of an exchange of requests/responses between the supervisor and Sepam:

- The supervisor sends requests based on ASDU 254 (private ASDU).
- Responses from Sepam are retrieved by the supervisor via requests to scan class 1 data. Responses from Sepam are based on ASDU 255 (private ASDU).

A file is read in three stages:

1. The file to be transferred is opened via an Open request/response

2. Data is transferred from the file through a succession of Read Block requests/ responses

3. The file is closed via a Close request/response

Notes

- Only one file can be open at any one time: the directory must therefore be closed after reading, in order to be able to read one of the files in this directory.
- For an open file, only one transfer is permitted at any one time.
- A data block contains a maximum of 238 bytes. The number of Read Block requests necessary to transfer a file depends on its size.

ASDU requests and responses

ASDU	FUN	Control direction	Monitoring direction	Description
254	105	■		Open request
255	105		■	Open response
254	101	■		Read Block request
255	101		■	Read Block positive response
255	103		■	Read Block negative response
254	106	■		Close request
255	106		■	Close response

Checking and processing errors

Sepam performs a series of checks to ensure that a file is read correctly.
Any error that occurs whilst a file is being read causes the file to be closed automatically by Sepam.

Block number sequence check
Data blocks are numbered starting at 0. Blocks must be read in ascending order.
It is possible to reread the same block i several times, as long as no request has been made for the next block i+1 to be read.
A sequence error in the block number requested in a Read Block request generates a negative Read Block response (status = incorrect block number).

Data integrity check
A Disturbance record file or Tripping context file in Sepam can be overwritten at any time by a new record if a new event occurs. If a file is in the process of being read, then data obtained by the supervisor will be corrupt. Sepam signals this error in the Close response (status = corrupt file).

Inactivity check: aborting a read operation
Sepam manages an inactivity time delay when a file read operation has been initialized, and throughout the entire course of the read operation. If there is more than 60 seconds between two Read Block requests or between the last Read Block request and the Close request, Sepam automatically closes the file. A spontaneous Close response is generated by Sepam (status = file closed on detection of inactivity).

Execution reports

Responses from Sepam contain an execution report coded in the Status field of ASDU 255.
The values possible in the Status field are listed in the table below:

Status	Description
0	OK
3	Open error response: file does not exist
5	Open error response: file already open
6	Read Block negative response and Close error response: file identifier incorrect
16	Read Block negative response and Close error response: file not open
17	Spontaneous Close response: file closed on detection of inactivity
19	Close error response: file corrupted
20	Read Block negative response: block number incorrect

Presentation

ASDU 254 and 255 are used to perform the 3 steps necessary for reading a file:
- Open the file
- Read the data blocks
- Close the file

Coding of the request from the supervisor (ASDU 254) and coding of the response from Sepam (ASDU 255) is given for each step.

Opening a file

Open request

Field	*Size (bytes)*	*Description*
254	*1*	*ASDU number*
105	*1*	*FUN function number*
X	*1*	*Request number, selected arbitrarily by the supervisor*
n	*1*	*Length of the file name to be opened*
Byte 1 ... Byte n	*n*	*Name of the file to be opened*

Open response

Field	*Size (bytes)*	*Description*
255	*1*	*ASDU number*
105	*1*	*FUN function number*
X	*1*	*Number of the corresponding Open req.*
Status	*1*	*Execution report*
Least significant Most significant	*4*	*File identifier* *This identifier must be used in Read Block and Close requests*
Least significant Most significant	*4*	*File size in bytes* *(value on 32 bits)*

Reading a data block

Read Block request

Field	Size (bytes)	Description
254	1	ASDU number
101	1	FUN function number
	4	Open file identifier (provided by Sepam in the Open response)
	1	Block number to be read, from 0 to 127

Read Block positive response

Field	Size (bytes)	Description
255	1	ASDU number
101	1	FUN function number
	4	Open file identifier
	1	Block number read (+80h if last block)
n	1	Block size in bytes
Byte 1 ... Byte n	n	Block data

For the last block, the most significant bit in the Block number field is set to 1 by Sepam.

Read Block negative response

Field	Size (bytes)	Description
255	1	ASDU number
103	1	FUN function number
	4	Open file identifier
Status	1	Error report

Closing a file

Close request

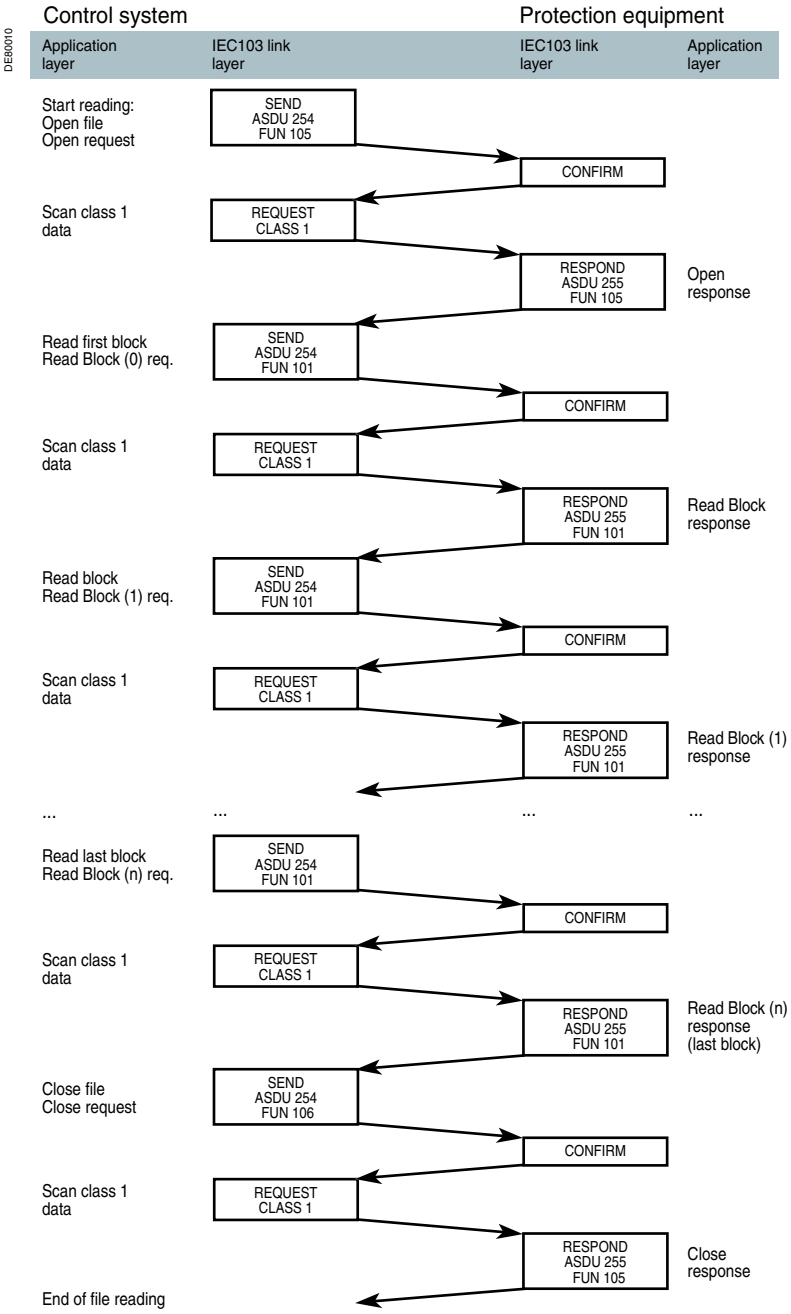
Field	Size (bytes)	Description
254	1	ASDU number
106	1	FUN function number
X	1	Request number, selected arbitrarily by the supervisor
	4	Open file identifier (provided by Sepam in the Open response)

Close response

Field	Size (bytes)	Description
255	1	ASDU number
106	1	FUN function number
X	1	Number of the corresponding Close req.
	4	Open file identifier (provided by Sepam in the Open response)
Status	1	Execution report

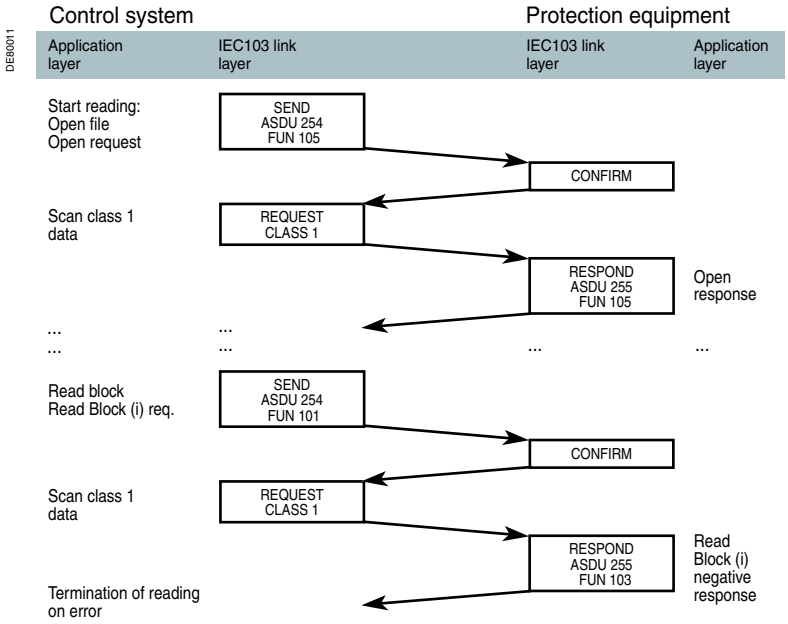
Appendix 2: File transfer
Frame sequences exchanged in order to read a file

Example 1: Complete read operation with no errors



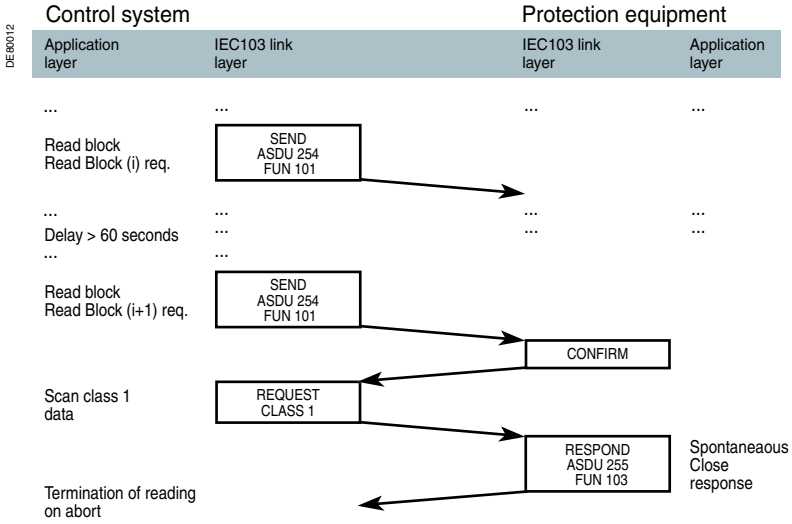
Appendix 2: File transfer
Frame sequences exchanged in order to read a file

Example 2: Read operation interrupted on error (Read Block negative response)



If an error occurs on a Read Block request, Sepam returns a negative Read Block response. The open file is automatically closed by Sepam.

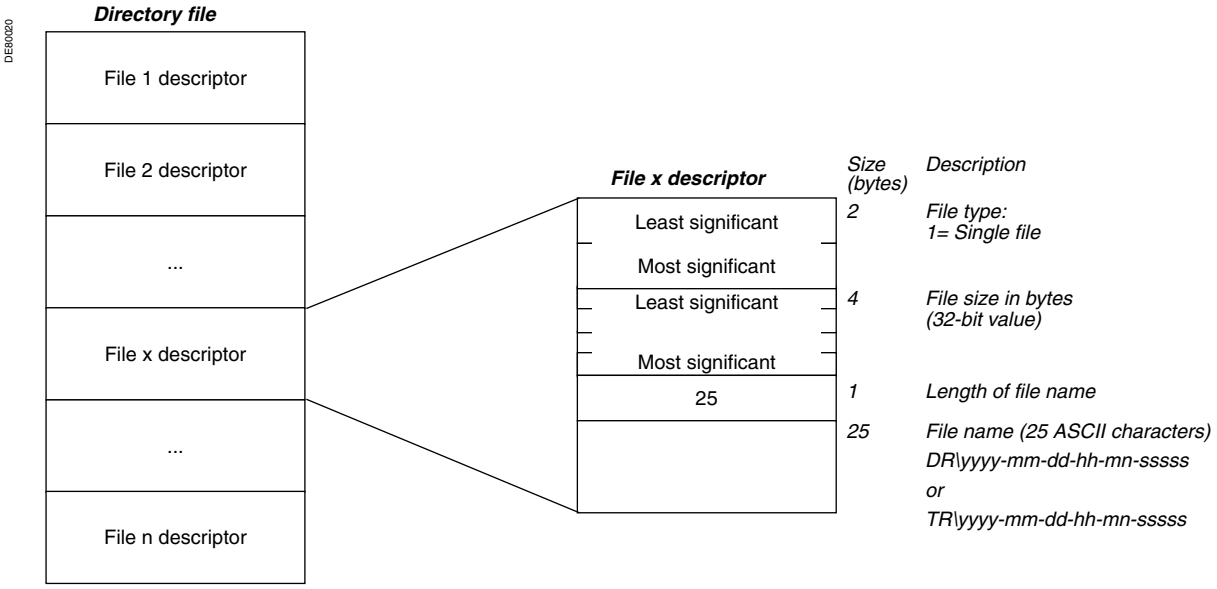
Example 3: Read operation interrupted on Sepam abort (spontaneous Close response)



If more than 60 seconds elapses between two Read Block requests or between the last Read Block request and the Close request, Sepam automatically closes the file. A spontaneous Close response is generated by Sepam (status = file closed on detection of inactivity).

DR or TR directory files

A directory file is a list of file descriptors.



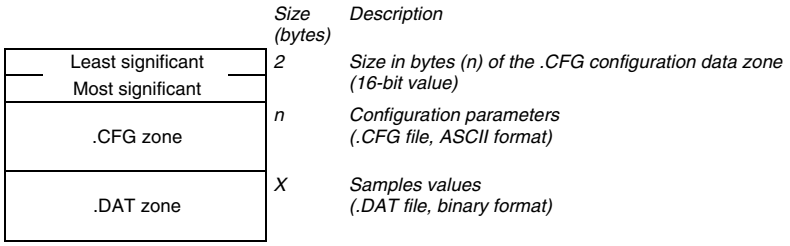
Disturbance record file DR\yyyy-mm-dd-hh-mn-sssss

Disturbance records produced by Sepam are coded in COMTRADE format. This format is also the one used in the IEC 60870-5-103 standard (only the file reading procedure is different from the one defined by IEC 60870-5-103).

A COMTRADE disturbance record consists of two standard files:
- A .CFG file, which includes the record configuration parameters (definition of analog and digital channels recorded, definition of sampling characteristics)
- A .DAT file, which includes the sampled values recorded for each channel

The disturbance record file **DR\yyyy-mm-dd-hh-mn-sssss** produced by Sepam is structured in such a way that it can reconstruct the .CFG and .DAT files.

Structure of file DR\yyyy-mm-dd-hh-mn-sssss



Tripping context files TR\yyyy-mm-dd-hh-mn-sssss

A Tripping context file contains a set of measurements recorded by Sepam when a protection function trips.
It consists of two parts:
- Date of the context, coded on 8 bytes
- List of measurements, with each measurement coded on 32 bits (4 bytes)

Structure of file TR\yyyy-mm-dd-hh-mn-sssss

	Size (bytes)	*Description*
Date	*8*	*Context date*
Measurement 1	*4*	*List of 44 measurements* *Each measurement is a 32-bit numeric value coded on 4 bytes, from the most significant to the least significant.*
... ...		...
Measurement 44	*4*	

The tripping context date is coded on 8 bytes

	7	*6*	*5*	*4*	*3*	*2*	*1*	*0*	
1	Reserved								*Reserved value, always 0*
2	Year								*Year from 0 to 99*
3	0	0	0	0	Month				*Month from 1 to 12*
4	0	0	0	Day					*Day from 1 to 31*
5	0	0	0	Hours					*Hours from 0 to 24*
6	0	0	Minutes						*Minutes from 0 to 59*
7	Milliseconds (most significant)								*Milliseconds from 0 to 59999*
8	Milliseconds (least significant)								

The tripping context comprises the 44 measurements listed in the table below.

No.	Information	Format	Unit
1	Tripping current phase 1 Itrip1	32NS	0.1 A
2	Tripping current phase 2 Itrip2	32NS	0.1 A
3	Tripping current phase 3 Itrip3	32NS	0.1 A
4	Residual current I0Σ	32NS	0.1 A
5	Residual current I0	32NS	0.1 A
6	Negative-sequence current Ii	32NS	0.1 A
7	Phase-to-phase voltage U21	32NS	1 V
8	Phase-to-phase voltage U32	32NS	1 V
9	Phase-to-phase voltage U13	32NS	1 V
10	Phase-to-neutral voltage V1	32NS	1 V
11	Phase-to-neutral voltage V2	32NS	1 V
12	Phase-to-neutral voltage V3	32NS	1 V
13	Residual voltage V0	32NS	1 V
14	Positive sequence voltage Vd	32NS	1 V
15	Negative-sequence voltage Vi	32NS	1 V
16	Frequency f	32NS	0.01 Hz
17	Active power P	32S	1 kW
18	Reactive power Q	32S	1 kvar
19	Apparent power S	32S	1 kVA
20	Additional tripping current I'trip1	32NS	0.1 A
21	Additional tripping current I'trip2	32NS	0.1 A
22	Additional tripping current I'trip3	32NS	0.1 A
23	Additional residual current I'0Σ	32NS	0.1 A
24	Additional residual current I'0	32NS	0.1 A
25	Additional negative-sequence current I'i	32NS	0.1 A
26	Phase-to-phase voltage U'21	32NS	1 V
27	Phase-to-phase voltage U'32	32NS	1 V
28	Phase-to-phase voltage U'13	32NS	1 V
29	Phase-to-neutral voltage V'1	32NS	1 V
30	Phase-to-neutral voltage V'2	32NS	1 V
31	Phase-to-neutral voltage V'3	32NS	1 V
32	Residual voltage V'0	32NS	1 V
33	Positive sequence voltage V'd	32NS	1 V
34	Negative-sequence voltage V'i	32NS	1 V
35	Frequency f'	32NS	0.01 Hz
36	Neutral-point voltage Vnt	32NS	1 V
37	H3 neutral-point voltage V3nt	32NS	0.1%
38	H3 residual voltage V3r	32NS	0.1%
39	Differential current Id1	32NS	0.1 A
40	Differential current Id2	32NS	0.1 A
41	Differential current Id3	32NS	0.1 A
42	Through current It1	32NS	0.1 A
43	Through current It2	32NS	0.1 A
44	Through current It3	32NS	0.1 A

The tripping context measurements are 32-bit numeric values coded on 4 bytes, from the most significant to the least significant.
The following formats are used:

- 32 NS: 32-bit non-signed value
- 32 S: 32-bit signed 2's complement value

Schneider Electric Industries SAS
89, boulevard Franklin Roosevelt
F - 92500 Rueil-Malmaison (France)
Tel: +33 (0)1 41 29 85 00

http://www.schneider-electric.com
http://www.merlin-gerin.com

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