Electrical network protection

Sepam

DNP3 communication

For Sepam series 20/40/60/80

User's manual

01/2013

Schneider Electric

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 indicates that an electrical hazard exists, which will result in 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. Obey all safety messages that follow this symbol to avoid possible injury or death.

Safety messages

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

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.

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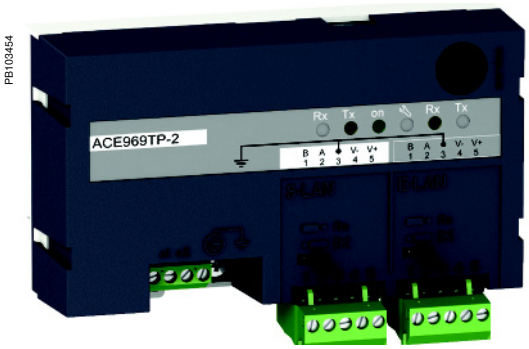
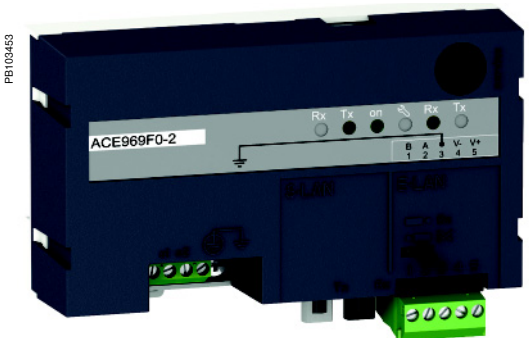


ACE969TP-2 communication interface.



ACE969FO-2 communication interface.

General

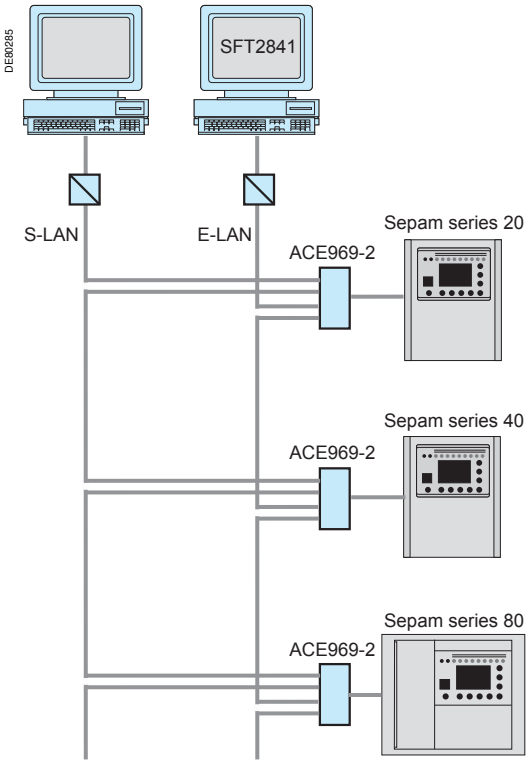
DNP3 communication enables Sepam units to be connected to a supervisor or other device featuring a DNP3 communication channel.
Communication is based on the master/slave principle:
- Sepam is always a slave station.
- The master is the supervisor or another device.

DNP3 communication is available via the ACE969-2 communication interface.

ACE969-2 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 ACE969-2 interface is available in two versions, linked to the physical interface of the S-LAN supervision port:
- ACE969TP-2 (Twisted Pair) for a 2-wire RS 485 serial link S-LAN
- ACE969FO-2 (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: DNP3 supervision
E-LAN: For SFT2841 operating functions.

Accessible data

DNP3 communication via the S-LAN port provides access to a great deal of information, in particular:

- Reading of status conditions, metering information and counters
- Reading of time-tagged events
- Transfer of files including disturbance records and, for Sepam series 60 and Sepam series 80, Tripping contexts, Out-of-sync context, Motor start reports, Motor start trends and Data logs
- Time-setting and synchronization
- Transmission of remote controls
- Control of analog outputs

The actual list depends on the application, the type of Sepam, the enabled functions, and the ACE969-2 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 and, for Sepam series 60 and Sepam series 80, Motor start reports, Motor start trends and Data logs
- Display of metering and diagnosis information
- Display of logic states
- Display of alarms

DNP3 protocol
Presentation

Definition

The DNP3 protocol specifies the coding of data and the rules for exchanging this data between a slave device and a master control and supervision device (supervisor or RTU).

DNP3 is an open (non-proprietary) protocol, which can be implemented by any communicating device (IED – Intelligent Electronic Device) without any restrictions.

History

Originally designed for electricity distribution companies, DNP3 is nowadays also used in other applications such as those found in water distribution companies, wastewater treatment companies and transport, as well as the oil and gas industries.

The DNP3 protocol was developed from the basic standards prepared by IEC technical committee 57 (Power system control and associated communications).

DNP3 was chosen by IEEE Task Force C.2 as the IEEE Recommendation for communication between RTUs and IEDs.

Initially developed by Harris Distributed Automation Products, the DNP3 specifications became public in 1993. They are now the property of the DNP3 User Group and under its control. The DNP3 User Group is a group of manufacturers and utilities from around the world. A Technical Committee is responsible for the maintenance and future development of the protocol.

Reference documents

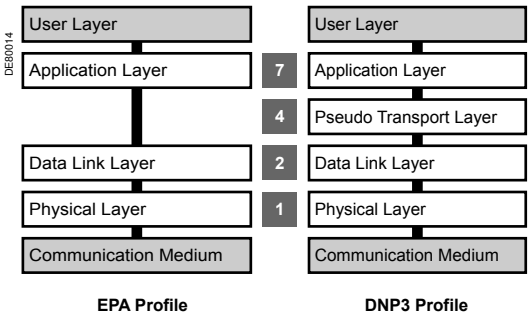
The DNP3 specifications are organized into four main parts, which make up the Basic 4 Document Set:
- Data Link Layer Protocol Description
- Transport Functions
- Application Layer Protocol Description
- Data Object Library

An additional set of specifications, DNP3 Subset Definitions, has been written by the DNP3 User Group to help equipment designers identify the protocol elements and options to use for each type of equipment concerned.

A series of Technical Bulletins is also available. These Technical Bulletins give setup details on particular points of the protocol.

The DNP3 documentation includes the definition of Certification Procedures. These procedures specify the tests to be performed on a communicating device in order to check and declare its compliance with the DNP3 protocol.

The complete DNP3 protocol documentation can be obtained from the DNP3 User Group (http://www.dnp.org/).



DNP3 communication profile.

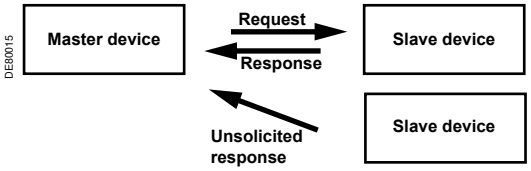
DNP3 and OSI model

DNP3 is a multipoint communication protocol via which information can be exchanged between a control system (supervisor or RTU) and one or more intelligent electronic devices (IED). The control system is the master and the IEDs are the slaves. Each device is identified by a unique address between 0 and 65519. Frames can be broadcast.

DNP3 is constructed on the EPA (Enhanced Performance Architecture) profile, which is a simplified version of the OSI (Open System Interconnection) model. EPA has only 3 layers:

- Physical
- Data Link
- Application

However, for transmission of large messages (2 kilobytes or more), data segmentation and reassembly functions have been added. All these functions constitute a Transport pseudo-layer.



Data transmission.

Transmission modes

The DNP3 data link layer manages communication in balanced mode, which means that both the master device and the slave device can initialize the transmission of messages.

In the conventional architecture of a supervision system, the master device is responsible for cyclical polling of the slave devices. In this case, transmission is always initialized by the master device, which sends a Request message to the slave device. The slave executes the requested action and sends back a Response message.

The slave device can, depending on its capacity and configuration, spontaneously send messages. Thus, without being solicited by the master, the slave can send messages to inform the master of the change of state of a binary data item, or the crossing of a metering or counter threshold. This information, sent spontaneously by the slave device, is called Unsolicited Responses.

The sending of Unsolicited Responses can be inhibited by the configuration of the slave and by a special command sent by the master.

To resolve conflicts of access to the communication medium, which may occur between the master and the slaves during spontaneous transmissions, the DNP3 protocol includes a collision management mechanism.

DNP3 functions and objects

DNP3 functions

DNP3 defines a large number of application and system functions.

Application functions

- Generic access to the data of the slave device (Read, Write)
- Transmission of commands, with or without preselection (Select, Operate, Direct Operate)
- Transmission of time-tagged events
- File transfer (Open, Read, Close, etc.)
- Counter management (Immediate Freeze, Freeze and Clear, etc.)
- Program management (Initialize, Start/stop Application, Save configuration)

System functions

- Time Synchronization
- Cold/Warm Restart
- Enable/Disable Spontaneous Message, etc.

The DNP3 functions are defined in the Application Layer Protocol Description part of the DNP3 specifications.

DNP3 objects

DNP3 defines a wide variety of objects to characterize the various types of data of a device:

- Binary type objects: Binary Input, Binary Input Change, Binary Output, Control Relay Output Block
- Analog type objects: Analog Input, Analog Input Change Event, Analog Output
- Counter type objects: Binary Counter, Frozen Counter

In each type of object, the data is identified by an Index, from index 0.
The data can be coded in various formats. The format is identified by a characteristic called the Variation.
For example:

- Object 2: Binary Input Change
  - Variation 1: Binary Input Change without Time
  - Variation 2: Binary Input Change with Time
- Object 30: Analog Input
  - Variation 1: 32-Bit Analog Input
  - Variation 2: 16-Bit Analog Input

All the types of object and their associated variations are defined in the Data Object Library part of the DNP3 specifications.

DNP3 subsets

Definition

Depending on its type, DNP3 equipment does not use all the functions, or all the types of object defined by the protocol. The DNP3 Subset Definitions part of the DNP3 specifications defines 3 function subsets:

- **DNP-L1:** This is the minimum subset. It applies to small devices such as a metering device or a simple protection relay.
- **DNP-L2:** This intermediate level is used to handle more sophisticated data. It concerns intelligent protection relays, other IED and small RTUs.
- **DNP-L3:**This is the highest level, generally used by complex equipment such as computers, data concentrators or large RTUs.

Interoperability

In order to determine the compatibility of DNP3 devices, all manufacturers of DNP3 devices MUST provide a set of documents describing the DNP3 options implemented in the device and the objects and functions handled by the device.

The following documents must be provided:

- **Device Profile:** This document identifies the DNP3 Application and Data Link layer options used by the device.
- **Implementation Table:** This table describes all the types of DNP3 object handled by the device, specifying the functions used to access them.
- **Point List:** This table provides the list of data handled by the device for each type of DNP3 object, indicating their access index, their default variation, and specifying whether the data is static or dynamic (generation of events).

DNP3 protocol
Access to Sepam data

Sepam uses the level 2 DNP3 functional subset (DNP-L2).
The data that can be accessed via the DNP3 interface depends on the type of Sepam.
They correspond to the DNP3 objects described opposite.

Remote indications: Binary Inputs

This category includes all the Sepam remote indications:
- Alarms from all the protection functions
- Alarms from the supervision functions: CT or VT fault, control fault
- Sepam status information (Sepam not reset, remote setting prohibited, remote-control orders prohibited)
- Status information specific to the Recloser and Disturbance recording functions
- Logic input states
- for Sepam series 60 and Sepam series 80: Status information specific to the Motor start report and Data log functions

Metering and diagnosis: Analog Inputs and Counters

Both categories of DNP3 objects are used by Sepam to encode information produced by the metering and diagnosis functions:
- Phase and earth currents, peak demand current
- Simple and residual phase-to-phase voltages, frequency
- Active and reactive power, peak demand power
- Energy meters
- Temperatures
- Switchgear diagnosis information: Cumulative breaking current, times and numbers of operations, circuit breaker reset time, etc.
- Machine operation help information: motor starting time, operating time before overload tripping, waiting time after tripping, etc.

Events

Types of event

Sepam generates three types of event:
- Events relating to binary information: Binary Input Change with Time
- Events relating to metering information: Analog Change Event
- Events relating to counters: Counter Change Event

Event groups

The information types that generate events are divided into several groups.
For binary information:
- Protection equipment tripping information
- Alarms from the supervision functions
- Internal and logic input states

For analog and counter information:
- Phase currents, residual currents
- Voltages
- Power
- Energy meters
- Temperatures

Event class

Each group can be characterized by allocation of a Class from 0 to 3, making it possible to define particular criteria for displaying events on the supervisor. Events can be obtained by reading the Sepam event stack, either globally or by class. By configuration, it is also possible to request Sepam to transmit events to the supervisor spontaneously.
Allocating class 0 to a group inhibits generation of events for all information items in this group.

Generating events

Events relating to binary information are generated on detection of a change in state associated with remote indications. These events are always time-tagged to the millisecond. The Sepam internal clock is synchronized via the DNP3 interface or via an external pulse on a logic input.
Events relating to metering information and counters are generated when crossing of a deadband is detected. The format (16 or 32 bits, with or without date) is selected by configuration.

Remote Controls: Binary Outputs/Control Relay Output Block

The remote controls are assigned to metering, protection or control functions by default and depend on the type of Sepam.
They are used in particular to:

- Control the opening and closing of the breaking device
- Reset Sepam and initialize the peak demands
- Select the active setting group by activating group A or B
- Activate or deactivate functions (recloser, thermal overload protection, disturbance recording).

The remote controls can be performed either in direct mode, or in confirmed SBO (Select Before Operate) mode.

Control of analog outputs: Analog Outputs/Analog Output Blocks

Sepam has an analog output module (MSA).
The analog output of the MSA module can be controlled in direct mode, or in confirmed SBO (Select Before Operate) mode.

File transfer: Sequential File Transfer

Sepam uses the Sequential File Transfer DNP3 object, and the associated transfer functions specified in Technical Bulletin 2000-001, to make the following files available to the supervisor:

- Disturbance records
- For Sepam series 60 and Sepam series 80:
  - Tripping contexts
  - out-of-sync context
  - Motor start reports
  - Motor start trends
  - Data logs.

Sepam identification: Octet String

Sepam uses the Octet String DNP3 object defined in Technical Bulletin 9701-004 to encode its identification in the form of an ASCII string.

Sepam communication profile (Sepam device profile)

Definition

The Sepam communication profile defines the options of the DNP3 protocol, connected with the Application and Data Link layers, used by Sepam. The presentation used here is that recommended by the DNP3 Device Profile Document in the DNP3 specifications.
☑ Indicates that the DNP3 option is used by Sepam
☐ Indicates that Sepam does not support the option

Sepam device profile

DNP3.00

DEVICE PROFILE DOCUMENT
This document must be accompanied by a table having the following headings:

Object Group	Request Function Codes	Response Function Codes
Object Variation	Request Qualifiers	Response Qualifiers
Object Name (optional)		

Vendor Name: Merlin Gerin or Schneider Electric

Device Name: Sepam series 20 / Sepam series 40 / Sepam series 60 / Sepam series 80

Highest DNP Level Supported:	Device Function:
For Requests Level 2 For Responses Level 2	☐ Master ☑ Slave

Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table):

Functions 20 and 21 are supported
Sequential File Transfer is supported

Maximum Data Link Frame Size (octets):	Maximum Application Fragent Size (octets):
Transmitted 292 Received 292	Transmitted 2048 Received 249

Maximum Data Link Re-tries:	Maximum Application Layer Re-tries:
☐ None ☐ Fixed at:..... ☑ Configurable, range 0 to 255 (def 2)	☑ None ☐ Configurable, range.....to.....

Requires Data Link Layer Confirmation:

☐ Never
☐ Always
☐ Sometimes

☑Configurable with SFT2841 software

Requires Application Layer Confirmation:

☐ Never
☐ Always
☑ When reporting Event Data
☑ When sending multi-fragment responses
☐ Sometimes

☐ Configurable

Timeouts while waiting for:

Data Link Confirm	☐ None	☐ Fixed at.....	☐ Variable	☑ Configurable
Complete Appl.Fragment	☑ None	☐ Fixed at.....	☐ Variable	☐ Configurable
Application Confirm	☐ None	☐ Fixed at.....	☐ Variable	☑ Configurable
Complete Appl.Response	☑ None	☐ Fixed at.....	☐ Variable	☐ Configurable

Configurable with SFT2841 software.

Sepam communication profile (Sepam device profile)

Sends/Executes Control Operations:

WRITE Binary Outputs	☑ Never	☐ Always	☐ Sometimes	☐ Configurable
SELECT/OPERATE	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
DIRECT/OPERATE	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
DIRECT/OPERATE - NO ACK	☐ Never	☑ Always	☐ Sometimes	☐ Configurable

Maximum number of CROB (object 12, variation 1) objects supported in a single message: 1
Maximum number of analog output (object 41, any variation) objects supported in a single message: 1
☐ Pattern Control Block and Pattern Mask (object 12, variations 2 and 3, respectively) supported.
☐ CROB (object 12) and analog output (object 41) permitted together in a single message.

Count > 1	☑ Never	☐ Always	☐ Sometimes	☐ Configurable
Pulse On	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
Pulse Off	☑ Never	☐ Always	☐ Sometimes	☐ Configurable
Latch On	☐ Never	☑ Always	☐ Sometimes	☐ Configurable
Latch Off	☑ Never	☐ Always	☐ Sometimes	☐ Configurable
Queue	☑ Never	☐ Always	☐ Sometime	☐ Configurable
Clear Queue	☑ Never	☐ Always	☐ Sometimes	☐ Configurable

ITEMS FOR SLAVE DEVICES ONLY:

Reports Binary Input Change Events when no specific variation requested:

☐ Never
☑ Only time-tagged
☐ Only non-time-tagged
☐ Configurable to send both, one or the other

Reports Time-tagged Binary Input Change Events when no specific variation requested:

☐ Never
☑ Binary Input Change With Time
☐ Binary Input Change With Relative Time
☐ Configurable

Sends Unsolicited Responses:

☐ Never
☑ Configurable with SFT2841 software
☐ Only certain objects
☐ Sometimes

☑ ENABLE/DISABLE UNSOLICITED Function codes supported

Sends Static Data in Unsolicited Responses:

☑ Never
☐ When Device Restarts
☐ When Status Flags Change

Default Counter Object/Variation:

☐ No Counters Reported
☐ Configurable
☑ Default Object 20
Default Variation 05
☐ Point-by-point list attached

Counters Roll Over at:

☐ No Counters Reported
☐ Configurable
☐ 16 Bits
☐ 32 Bits
☐ Other Value.....
☑ Point-by-point list attached

Send Multi-Fragment Responses: ☑ Yes ☐ No

Sepam implementation table

The presentation of the implementation table used here is that given in the DNP3 Subset Definitions document:
- *The function codes in bold correspond to the DNP3 functions required for level 2 devices.*
- *The function codes in italic correspond to the additional DNP3 functions provided by Sepam.*

Definition

The implementation table identifies the types of DNP3 objects handled by Sepam and the functions used to access them (Function Codes and Qualifier Codes).
Sepam uses the level 2 DNP3 functional subset (DNP-L2).
Sepam also manages additional DNP3 object types and functions.

Sepam implementation table

Object			Request		Response	
Object	**Variation**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
1	0	Binary Input - All Variations	**1**	**06,** *00, 01, 07, 08, 17, 28*		
1	1	Binary Input	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
1	2	Binary Input with Status	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
2	0	Binary Input Change - All Variations	**1**	**06, 07, 08**		
2	1	Binary Input Change without Time				
2	2	Binary Input Change with Time	**1**	**06, 07, 08**	**129, 130**	**17, 28**
2	3	Binary Input Change with Relative Time				
10	0	Binary Output - All Variations	**1**	**06,** *00, 01, 07, 08, 17, 28*		
10	1	Binary Output	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
10	2	Binary Output Status	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
12	0	Control Block - All Variations				
12	1	Control Relay Output Block	**3, 4, 5, 6**	**17, 28**	**129**	**Echo of request**
12	2	Pattern Control Block				
12	3	Pattern Mask				
20	0	Binary Counter - All Variations	**1**	**06,** *00, 01, 07, 08, 17, 28*		
20	1	32-Bit Binary Counter	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
20	2	16-Bit Binary Counter	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
20	3	32-Bit Delta Counter				
20	4	16-Bit Delta Counter				
20	5	32-Bit Binary Counter without Flag	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
20	6	16-Bit Binary Counter without Flag	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
20	7	32-Bit Delta Counter without Flag				
20	8	16-Bit Delta Counter without Flag				
21	Any	Frozen Counter				
22	0	Counter Change Event - All Variations	**1**	**06, 07, 08**		
22	1	32-Bit Counter Change Event without Time	**1**	**06, 07, 08**	**129, 130**	**17, 28**
22	2	16-Bit Counter Change Event without Time	**1**	**06, 07, 08**	**129, 130**	**17, 28**
22	3	32-Bit Delta Counter Change Event without Time				
22	4	16-Bit Delta Counter Change Event without Time				
22	5	32-Bit Counter Change Event with Time	*1*	*06, 07, 08*	*129, 130*	*17, 28*
22	6	16-Bit Counter Change Event with Time	*1*	*06, 07, 08*	*129, 130*	*17, 28*
22	7	32-Bit Delta Counter Change Event with Time				
22	8	16-Bit Delta Counter Change Event with Time				
23	Any	Frozen Counter Event				

Sepam implementation table

Object			Request		Response	
Object	**Variation**	**Description**	**Function Codes (dec)**	**Qualifier Codes (hex)**	**Function Codes (dec)**	**Qualifier Codes (hex)**
30	0	Analog Input - All Variations	**1**	**06,** *00, 01, 07, 08, 17, 28*		
30	1	32-Bit Analog Input	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
30	2	16-Bit Analog Input	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
30	3	32-Bit Analog Input without Flag	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
30	4	16-Bit Analog Input without Flag	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
31	Any	Frozen Analog Input				
32	0	Analog Change Event - All Variations	**1**	**06, 07, 08**		
32	1	32-Bit Analog Change Event without Time	**1**	**06, 07, 08**	**129, 130**	**17, 28**
32	2	16-Bit Analog Change Event without Time	**1**	**06, 07, 08**	**129, 130**	**17, 28**
32	3	32-Bit Analog Change Event with Time	*1*	*06, 07, 08*	*129, 130*	*17, 28*
32	4	16-Bit Analog Change Event with Time	*1*	*06, 07, 08*	*129, 130*	*17, 28*
33	Any	Frozen Analog Event				
40	0	Analog Output Status - All Variations	**1**	**06,** *00, 01, 07, 08, 17, 28*		
40	1	32-Bit Analog Output Status				
40	2	16-Bit Analog Output Status	*1*	*00, 01, 06, 07, 08, 17, 28*	**129**	**00, 01,** *17, 28*
41	0	Analog Output Block - All Variations				
41	1	32-Bit Analog Output Block				
41	2	16-Bit Analog Output Block	**3, 4, 5, 6**	**17, 28**	**129**	**Echo of request**
50	0	Time and Date - All Variations				
50	1	Time and Date	**2**, *1*	**07 where quantity=1**	*129*	*07 where quantity=1*
50	2	Time and Date with Interval				
51	0	Time and Date CTO - All Variations				
51	1	Time and Date CTO				
51	2	Unsynchronized Time and Date CTO				
52	0	Time Delay - All Variations				
52	1	Time Delay Coarse				
52	2	Time Delay Fine			**129**	**07 where quantity=1**
60	0					
60	1	Class 0 Data	**1**	**06**		
60	2	Class 1 Data	**1**	**06, 07, 08**		
60	3	Class 2 Data	**1**	**06, 07, 08**		
60	4	Class 3 Data	**1**	**06, 07, 08**		
70	1	File Identifier				
70	2	Authentication Object				
70	3	File Command Object	*25*	*5B*		
70	4	File Command Status Object	*26, 30*	*5B*	*129, 130*	*5B*
70	5	File Transport Object	*1*	*5B*	*129, 130*	*5B*
70	6	File Transport Status Object			*129, 130*	*5B*
70	7	File Descriptor Object				
80	1	Internal Indications	**2**	**00 index=7**		
81	1	Storage Object				
82	1	Device Profile				
83	1	Private Registration Object				
83	2	Private Registration Object Descriptor				
90	1	Application Identifier				
100	Any	Floating Point				
101	Any	Packed Binary-Coded Decimal				
110	0	Octet String	*1*	*06*	*129*	*00*
No Object		Cold Restart	**13**			
No Object		Warm Restart	*14*			
No Object		Delay Measurement	**23**			

Sepam Point List
Presentation

Point List: This table gives the list of all the Sepam data (data points) that can be accessed via the DNP3 interface.

The Sepam data that can be accessed via DNP3 is grouped together into DNP3 type objects:
- Binary Input
- Binary Output/Control Relay Output Block
- Counter
- Analog Input
- Analog Output/Analog Output Block
- Octet String
- Sequential File Transfer

The following is indicated for each type of object:
- The number of the static object and the number of any associated dynamic object used for generating events
- The variation used by default
- The DNP3 functions applicable to the object
- The list of Sepam data belonging to this type of object

The data is identified by an index (starting at 0). The Sepam series 20, Sepam series 40, Sepam series 60 and Sepam series 80 columns indicate for which Sepam family the data is available.
For Sepam 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.

Sepam Point List
Binary Input

Binary Input	
Static Object	
Object Number	1 = Binary Input
Default Variation	1 = Binary Input without Status
Request Function Codes supported	1 = Read
Change Event	
Object Number	2 = Binary Input Change
Default Variation	2 = Binary Input Change with Time
Request Function Codes supported	1 = Read
Class	Configurable from 0 to 3 According to one of 2 modes: predefined or customized

The class is assigned by data group as defined in the table below:

		Assignment mode		
Data group		**Predefined**	**Customized**	
Fault indications	Class_FI	1	0, 1, 2 or 3	default = 1
Alarms	Class_AL	2	0, 1, 2 or 3	default = 1
Status	Class_ST	3	0, 1, 2 or 3	default = 1

Index DNP3					Description	Class
Sepam series 20 B2X	Sepam series 20 Other	Sepam series 40	Sepam series 60	Sepam series 80		
					Sepam	
0	0	0	0	0	Sepam not reset after fault	Class_AL
1	1	1	1	1	Sepam partial fault	Class_AL
2	2	2	2	2	Sepam major fault	Class_FI
	3	3	3	3	Setting group A in service	Class_ST
	4	4	4	4	Setting group B in service	Class_ST
		5	5	5	Phase CT fault	Class_FI
		6	6	6	Phase VT fault	Class_FI
		7	7	7	Residual VT fault	Class_FI
			8	8	Additional phase CT fault	Class_FI
			9	9	Additional phase VT fault	Class_FI
			10	10	Additional residual VT fault	Class_FI
3	5	8	11	11	Remote setting inhibited	Class_ST
4	6	9			Remote-control inhibited	Class_ST
			12	12	Remote-control enabled	Class_ST
			13	13	Min.V_aux	Class_FI
			14	14	Max.V_aux	Class_FI
			15	15	Battery low or absent	Class_AL
					Breaking device	
5	7	10	16	16	Control fault	Class_FI
6	8	11	17	17	Matching fault or Trip Circuit Supervision	Class_FI
7	9	12	18	18	TC / position discrepancy	Class_AL
			19	19	Closed position	Class_ST
			20	20	Device racked out	Class_ST
		13	21	21	SF6 alarm	Class_AL
			22	22	Earthing switch closed	Class_ST
					Network	
		14	23	23	Main-phase reverse rotation	Class_AL
			24	24	Additional-phase reverse rotation	Class_AL
		15	25	25	Cos phi inductive	Class_ST
		16	26	26	Cos phi capacitive	Class_ST
			27	27	Load shedding	Class_AL
			28	28	Restart	Class_AL

Sepam Point List
Binary Input

DNP3 index					Description	Class
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80		
B2X	Other					
					Overcurrent protections	
	10	17	29	29	Protection 50/51 unit 1	Class_FI
	11	18	30	30	Protection 50/51 unit 2	Class_FI
	12	19	31	31	Protection 50/51 unit 3	Class_FI
	13	20	32	32	Protection 50/51 unit 4	Class_FI
				33	Protection 50/51 unit 5	Class_FI
				34	Protection 50/51 unit 6	Class_FI
				35	Protection 50/51 unit 7	Class_FI
				36	Protection 50/51 unit 8	Class_FI
	14	21	37	37	Protection 50N/51N unit 1	Class_FI
	15	22	38	38	Protection 50N/51N unit 2	Class_FI
	16	23	39	39	Protection 50N/51N unit 3	Class_FI
	17	24	40	40	Protection 50N/51N unit 4	Class_FI
				41	Protection 50N/51N unit 5	Class_FI
				42	Protection 50N/51N unit 6	Class_FI
				43	Protection 50N/51N unit 7	Class_FI
				44	Protection 50N/51N unit 8	Class_FI
		25	45	45	Protection 51V unit 1	Class_FI
				46	Protection 51V unit 2	Class_FI
					Directional current protections	
		26	47	47	Protection 67 unit 1	Class_FI
		27	48	48	Protection 67 unit 2	Class_FI
		28	49	49	Protection 67N unit 1	Class_FI
		29	50	50	Protection 67N unit 2	Class_FI
					Voltage protections	
8		30	51	51	Protection 27/27S unit 1	Class_FI
9		31	52	52	Protection 27/27S unit 2	Class_FI
				53	Protection 27/27S unit 3	Class_FI
				54	Protection 27/27S unit 4	Class_FI
10		32	55	55	Protection 27D unit 1	Class_FI
11		33	56	56	Protection 27D unit 2	Class_FI
12		34	57	57	Protection 27R unit 1	Class_FI
			58	58	Protection 27R unit 2	Class_FI
13		35	59	59	Protection 59 unit 1	Class_FI
14		36	60	60	Protection 59 unit 2	Class_FI
				61	Protection 59 unit 3	Class_FI
				62	Protection 59 unit 4	Class_FI
15		37	63	63	Protection 59N unit 1	Class_FI
16		38	64	64	Protection 59N unit 2	Class_FI
17					Protection 27S phase 1	Class_FI
18					Protection 27S phase 2	Class_FI
19					Protection 27S phase 3	Class_FI
					Frequency protections	
20		39	65	65	Protection 81H unit 1	Class_FI
		40	66	66	Protection 81H unit 2	Class_FI
21		41	67	67	Protection 81L unit 1	Class_FI
22		42	68	68	Protection 81L unit 2	Class_FI
		43	69	69	Protection 81L unit 3	Class_FI
		44	70	70	Protection 81L unit 4	Class_FI
23			71	71	Protection 81R unit 1	Class_FI
			72	72	Protection 81R unit 2	Class_FI
					Power protections	
		45	73	73	Protection 32P unit 1	Class_FI
			74	74	Protection 32P unit 2	Class_FI
		46	75	75	Protection 32Q	Class_FI
			76	76	Protection 37P unit 1	Class_FI
			77	77	Protection 37P unit 2	Class_FI

Sepam Point List
Binary Input

DNP3 index					Description	Class
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80		
B2X	Other					
					Motor/generator protections	
	18	47	78	78	Protection 48/51LR (locked rotor)	Class_FI
	19	48	79	79	Protection 48/51LR (locked rotor on startup)	Class_FI
	20	49	80	80	Protection 48/51LR (excessive starting time)	Class_FI
	21	50	81	81	Protection 66	Class_AL
				82	Protection 21G	Class_FI
				83	Protection 50/27	Class_FI
				84	Protection 64G2/27TN unit 1	Class_FI
				85	Protection 64G2/27TN unit 2	Class_FI
				86	Protection 78PS	Class_FI
				87	Protection 24 unit 1	Class_FI
				88	Protection 24 unit 2	Class_FI
			89	89	Protection 40	Class_FI
					Differential protections	
			90	90	Protection 64REF unit 1	Class_FI
			91	91	Protection 64REF unit 2	Class_FI
				92	Protection 87T2	Class_FI
				93	Protection 87M/87G	Class_FI
					Miscellaneous protections	
	22	51	94	94	Protection 46 unit 1	Class_FI
		52	95	95	Protection 46 unit 2	Class_FI
		53	96	96	Protection 47 unit 1	Class_FI
			97	97	Protection 47 unit 2	Class_FI
	23	54	98	98	Protection 37	Class_FI
	60	55	99	99	Protection 50BF	Class_FI
				100	Protection 51C unit 1 (capacitor step 1)	Class_FI
				101	Protection 51C unit 2 (capacitor step 1)	Class_FI
				102	Protection 51C unit 3 (capacitor step 2)	Class_FI
				103	Protection 51C unit 4 (capacitor step 2)	Class_FI
				104	Protection 51C unit 5 (capacitor step 3)	Class_FI
				105	Protection 51C unit 6 (capacitor step 3)	Class_FI
				106	Protection 51C unit 7 (capacitor step 4)	Class_FI
				107	Protection 51C unit 8 (capacitor step 4)	Class_FI
	24	56	108	108	Send blocking signal 1	Class_ST
		57	109	109	Send blocking signal 2	Class_ST
		58	110	110	External tripping 1	Class_FI
		59	111	111	External tripping 2	Class_FI
		60	112	112	External tripping 3	Class_FI
		61	113	113	Thermistor alarm	Class_AL
		62	114	114	Thermistor tripping	Class_FI
		63	115	115	Buchholz alarm	Class_AL
		64	116	116	Buchholz tripping	Class_FI
		65	117	117	Thermostat alarm	Class_AL
		66	118	118	Thermostat tripping	Class_FI
		67	119	119	Pressure alarm	Class_AL
		68	120	120	Pressure tripping	Class_FI
			121	121	Closing coil monitoring	Class_FI
			122	122	Request for synchro-checked closing	Class_ST
			123	123	Synchronization stop	Class_ST
			124	124	Synchronization failure	Class_ST
			125	125	Synchronization successful	Class_ST
				126	Manual capacitor step control	Class_ST
				127	Automatic capacitor step control	Class_ST
				128	Capacitor step 1 matching fault	Class_FI
				129	Capacitor step 2 matching fault	Class_FI
				130	Capacitor step 3 matching fault	Class_FI
				131	Capacitor step 4 matching fault	Class_FI
			132	132	Coupling closing order	Class_ST
			133	133	Coupling synchronization failure	Class_FI
				134	Tripping by automatic transfer (AT)	Class_AL
			135	135	Cumulative breaking current monitoring	Class_AL

Sepam Point List
Binary Input

DNP3 index					Description	Class
Sepam series 20 B2X	Sepam series 20 Other	Sepam series 40	Sepam series 60	Sepam series 80		
					Recloser	
	25	69	136	136	Recloser: on	Class_ST
		70	137	137	Recloser: ready	Class_ST
	26	71	138	138	Recloser: final trip	Class_AL
	27	72	139	139	Recloser: reclosing successful	Class_AL
	28	73			Recloser: in progress	Class_ST
			140	140	Recloser: cycle 1 in progress	Class_ST
			141	141	Recloser: cycle 2 in progress	Class_ST
			142	142	Recloser: cycle 3 in progress	Class_ST
			143	143	Recloser: cycle 4 in progress	Class_ST
			144	144	Recloser: closing by recloser	Class_ST
					Speed protections	
			145	145	Protection 12 unit 1	Class_FI
			146	146	Protection 12 unit 2	Class_FI
			147	147	Protection 14 unit 1	Class_FI
			148	148	Protection 14 unit 2	Class_FI
					Thermal protections	
	29	74	149	149	Protection 49 RMS alarm set point	Class_AL
	30	75	150	150	Protection 49 RMS tripping set point	Class_FI
	31	76	151	151	Thermal protection tripping inhibited	Class_ST
	32	77	152	152	MET 148-1 module sensor fault	Class_FI
		78	153	153	MET 148-2 module sensor fault	Class_FI
	33	79	154	154	Protection 38/49T tripping sensor 1 module 1	Class_FI
	34	80	155	155	Protection 38/49T tripping sensor 2 module 1	Class_FI
	35	81	156	156	Protection 38/49T tripping sensor 3 module 1	Class_FI
	36	82	157	157	Protection 38/49T tripping sensor 4 module 1	Class_FI
	37	83	158	158	Protection 38/49T tripping sensor 5 module 1	Class_FI
	38	84	159	159	Protection 38/49T tripping sensor 6 module 1	Class_FI
	39	85	160	160	Protection 38/49T tripping sensor 7 module 1	Class_FI
	40	86	161	161	Protection 38/49T tripping sensor 8 module 1	Class_FI
		87	162	162	Protection 38/49T tripping sensor 1 module 2	Class_FI
		88	163	163	Protection 38/49T tripping sensor 2 module 2	Class_FI
		89	164	164	Protection 38/49T tripping sensor 3 module 2	Class_FI
		90	165	165	Protection 38/49T tripping sensor 4 module 2	Class_FI
		91	166	166	Protection 38/49T tripping sensor 5 module 2	Class_FI
		92	167	167	Protection 38/49T tripping sensor 6 module 2	Class_FI
		93	168	168	Protection 38/49T tripping sensor 7 module 2	Class_FI
		94	169	169	Protection 38/49T tripping sensor 8 module 2	Class_FI
	41	95	170	170	Protection 38/49T alarm sensor 1 module 1	Class_AL
	42	96	171	171	Protection 38/49T alarm sensor 2 module 1	Class_AL
	43	97	172	172	Protection 38/49T alarm sensor 3 module 1	Class_AL
	44	98	173	173	Protection 38/49T alarm sensor 4 module 1	Class_AL
	45	99	174	174	Protection 38/49T alarm sensor 5 module 1	Class_AL
	46	100	175	175	Protection 38/49T alarm sensor 6 module 1	Class_AL
	47	101	176	176	Protection 38/49T alarm sensor 7 module 1	Class_AL
	48	102	177	177	Protection 38/49T alarm sensor 8 module 1	Class_AL
		103	178	178	Protection 38/49T alarm sensor 1 module 2	Class_AL
		104	179	179	Protection 38/49T alarm sensor 2 module 2	Class_AL
		105	180	180	Protection 38/49T alarm sensor 3 module 2	Class_AL
		106	181	181	Protection 38/49T alarm sensor 4 module 2	Class_AL
		107	182	182	Protection 38/49T alarm sensor 5 module 2	Class_AL
		108	183	183	Protection 38/49T alarm sensor 6 module 2	Class_AL
		109	184	184	Protection 38/49T alarm sensor 7 module 2	Class_AL
		110	185	185	Protection 38/49T alarm sensor 8 module 2	Class_AL

Sepam Point List
Binary Input

DNP3 index					Description	Class
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80		
B2X	Other					
					Logic inputs	
24 (I11)	49 (I11)	111 (I11)	186 (I101)	186 (I101)	Logic input	Class_ST
25 (I12)	50 (I12)	112 (I12)	187 (I102)	187 (I102)	Logic input	Class_ST
26 (I13)	51 (I13)	113 (I13)	188 (I103)	188 (I103)	Logic input	Class_ST
27 (I14)	52 (I14)	114 (I14)	189 (I104)	189 (I104)	Logic input	Class_ST
28 (I21)	53 (I21)	115 (I21)	190 (I105)	190 (I105)	Logic input	Class_ST
29 (I22)	54 (I22)	116 (I22)	191 (I106)	191 (I106)	Logic input	Class_ST
30 (I23)	55 (I23)	117 (I23)	192 (I107)	192 (I107)	Logic input	Class_ST
31 (I24)	56 (I24)	118 (I24)	193 (I108)	193 (I108)	Logic input	Class_ST
32 (I25)	57 (I25)	119 (I25)	194 (I109)	194 (I109)	Logic input	Class_ST
33 (I26)	58 (I26)	120 (I26)	195 (I110)	195 (I110)	Logic input	Class_ST
			196 (I111)	196 (I111)	Logic input	Class_ST
			197 (I112)	197 (I112)	Logic input	Class_ST
			198 (I113)	198 (I113)	Logic input	Class_ST
			199 (I114)	199 (I114)	Logic input	Class_ST
			200 to 213	200 to 213	Logic inputs I201 to I214	Class_ST
				214 to 227	Logic inputs I301 to I314	Class_ST
					Logic equations - part 1/2	
		121	228	228	V1	Class_ST
		122	229	229	V2	Class_ST
		123	230	230	V3	Class_ST
		124	231	231	V4	Class_ST
		125	232	232	V5	Class_ST
		126	233	233	V6	Class_ST
		127	234	234	V7	Class_ST
		128	235	235	V8	Class_ST
		129	236	236	V9	Class_ST
		130	237	237	V10	Class_ST
			238	238	V11	Class_ST
			239	239	V12	Class_ST
			240	240	V13	Class_ST
			241	241	V14	Class_ST
			242	242	V15	Class_ST
			243	243	V16	Class_ST
			244	244	V17	Class_ST
			245	245	V18	Class_ST
			246	246	V19	Class_ST
			247	247	V20	Class_ST
		131	248	248	V_FLAGREC	Class_ST
		132	249	249	V_TRIPCB	Class_ST
		133	250	250	V_CLOSECB	Class_ST
		134	251	251	V_INHIBCLOSE	Class_ST
			252	252	V_RESET	Class_ST
			253	253	V_CLEAR	Class_ST
			254	254	V_INHIBIT_RESET_LOCAL	Class_ST
			255	255	V_SHUTDOWN	Class_ST
			256	256	V_DE-EXCITATION	Class_ST
			257	257	V_CLOSE_NOCTRL	Class_ST
			258	258	V_TRIP_STP1	Class_ST
			259	259	V_TRIP_STP2	Class_ST
			260	260	V_TRIP_STP3	Class_ST
			261	261	V_TRIP_STP4	Class_ST
			262	262	V_CLOSE_STP1	Class_ST
			263	263	V_CLOSE_STP2	Class_ST
			264	264	V_CLOSE_STP3	Class_ST
			265	265	V_CLOSE_STP4	Class_ST
			266	266	V_TRANS_ON_FLT	Class_ST
			267	267	V_TRANS_STOP	Class_ST
			268 to 283	268 to 283	V_MIMIC_IN_1 to V_MIMIC_IN_16	Class_ST

Sepam Point List
Binary Input

DNP3 index					Description	Class
Sepam series 20 B2X	Sepam series 20 Other	Sepam series 40	Sepam series 60	Sepam series 80		
					Remote-indication bits (TS) available for Logipam	
				284 to 299	TS16 to TS31	Class_ST
				300 to 315	TS33 to TS48	Class_ST
				316 to 328	TS52 to TS64	Class_ST
					Additional information	
			329	329	dU synchronization failure	Class_AL
			330	330	dPhi synchronization failure	Class_AL
			331	331	dF synchronization failure	Class_AL
			332	332	Test mode	Class_ST
34	59	135	333	333	Disturbance recording inhibited	Class_ST
	60	55	99	99	Protection 50BF	Class_FI
35	61	136	334	334	General trip	Class_FI
			335	335	Ethernet communication fault	Class_AL
36	62	137			S-LAN communication monitoring active	Class_ST
		138			Protection 46BC	Class_FI
			336	336	New disturbance recording available	Class_ST
			337	337	Motor start report in progress	Class_ST
			338	338	Data log in progress	Class_ST
			339	339	New Data log available	Class_ST
			340	340	Discrepancy in the phase rotation direction selection command	Class_ST
					Logic equations - part 2/2	
			341	341	V_TRANS_V_EN	Class_ST
			342	342	V_MSR_START : MSR activation	Class_ST
			343	343	V_DLG_START: DLG activation	Class_ST

Sepam Point List
Binary Output
Control Relay Output Block

Binary Output	
Object Number	10 = Binary Output
Default Variation	2 = Binary Output Status
Request Function Codes supported	1 = Read ***Nota :*** *the point values are always read as 0*

Control Block	
Object Number	12 = Control Relay Output Block
Variation	1 = Control Relay Output Block
Request Function Codes supported	3 = Select 4 = Operate 5 = Direct Operate 6 = Direct Operate - No ACK

DNP3 index					Description
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80	
B2X	Other				
					Remote-control orders
0	0	0	0	0	Trip/open
1	1	1	1	1	Closing
2	2	2	2	2	Sepam reset
3	3	3	3	3	Inhibit disturbance-recording triggering
4	4	4	4	4	Confirm disturbance-recording triggering
5	5	5	5	5	Manual disturbance-recording triggering
	6	6	6	6	Enable recloser
	7	7	7	7	Disable recloser
	8	8	8	8	Switching to setting group A
	9	9	9	9	Switching to setting group B
	10	10	10	10	Inhibit thermal protection
	11	11	11	11	Confirm thermal protection
	12		12	12	Peak demand reset
		12			Peak demand current reset
		13	13	13	Reset protection 37
			14	14	Peak demand power reset
			15	15	Priority group shutdown
			16	16	Cancel priority group shutdown
			17	17	Enable synchro-check
			18	18	Disable synchro-check
			19	19	Enable voltage check
			20	20	Disable voltage check
				21	Open capacitor step 1
				22	Open capacitor step 2
				23	Open capacitor step 3
				24	Open capacitor step 4
				25	Close capacitor step 1
				26	Close capacitor step 2
				27	Close capacitor step 3
				28	Close capacitor step 4
					Remote-control orders (TC) available for Logipam
				29	TC6
				30	TC7
				31 to 38	TC10 to TC17
				39 to 47	TC21 to TC29
				48 to 63	TC49 to TC64

Sepam Point List
Control Relay Output Block

DNP3 index					Description
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80	
B2X	Other				
					Additional remote-control orders
6	13	14			S-LAN communication monitoring activation
7	14	15			S-LAN communication monitoring inhibition
		16			Inductive/capacitive phi indication inhibition
		17			Inductive/capacitive phi indication validation
			64	64	Motor start report start command
			65	65	Data log start command
			66	66	Data log stop command
			67	67	Phase rotation direction 123 monitoring command
			68	68	Phase rotation direction 132 monitoring command

Application to Sepam

All Binary Outputs accessed via the DNP3 interface are Single-Output type.
For Control Relay Output Blocks, Sepam accepts and processes the following control codes in the same way:

- 01: trip/close = NULL; Q = Cl = normal; Pulse On
- 03: trip/close = NULL; Q = Cl = normal; Latch On

Other codes are rejected by Sepam.
After executing the command, the Binary Output object is automatically reset to zero by Sepam. The current value of a Binary Output object is always read as zero.
In remote-control orders inhibited mode, Sepam rejects commands (Status code = local mode).

Sepam Point List
Counter

Counter	
Static Object	
Object Number	20 = Binary Counter
Default Variation	5 = 32 bits Counter without Flag
Request Function Codes supported	1 = Read
Change Event	
Object Number	22
Default Variation	1 = 32 bits Counter without time 2 = 16 bits Counter without flag 5 = 32 bits Counter with time 6 = 16 bits Counter with time (configurable)
Request Function Codes supported	1 = Read
Class	Configurable from 0 to 3 according to one of 2 modes: predefined or customized

The class is assigned by data group as defined in the table below:

		Assignment mode		
Data group		**Predefined**	**Customized**	
Energy	Class_E	0	0, 1, 2 or 3	default = 3

DNP3 index					Description	Format	Unit	Counter Change Event	
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80				Class	DeadBand
B2X	Other								
	0	0	0	0	Number of operations	32 bits	1	0	
		1	1	1	Positive active energy Ea+	32 bits	100 kWh	Class_E	DB_E
		2	2	2	Negative active energy Ea-	32 bits	100 kWh	Class_E	DB_E
		3	3	3	Positive reactive energy Er+	32 bits	100 kvarh	Class_E	DB_E
		4	4	4	Negative reactive energy Er-	32 bits	100 kvarh	Class_E	DB_E
		5	5	5	Ext. positive active energy Ea+	32 bits	100 kWh	Class_E	DB_E
		6	6	6	Ext. negative active energy Ea-	32 bits	100 kWh	Class_E	DB_E
		7	7	7	Ext. positive reactive energy Er+	32 bits	100 kvarh	Class_E	DB_E
		8	8	8	Ext. negative reactive energy Er-	32 bits	100 kvarh	Class_E	DB_E
			9	9	Number of trips on phase current	16 bits	1	0	
			10	10	Number of trips on earth-fault current	16 bits	1	0	
			11	11	Number of racking put operations	16 bits	1	0	
				12 to 35	Logipam counters C1 to C24	16 bits	1	0	

Sepam Point List
Analog Input

Analog Input	
Static Object	
Object Number	30 = Analog Input
Default Variation	3 = 32 bits Analog Input without Flag
Request Function Codes supported	1 = Read
Change Event	
Object Number	32
Default Variation	1 = 32 bits Analog Change Event without time 2 = 16 bits Analog Change Event without flag 5 = 32 bits Analog Change Event with time 6 = 16 bits Analog Change Event with time (configurable)
Request Function Codes supported	1 = Read
Class	Configurable from 0 to 3 according to one of 2 modes: predefined or customized

The class is assigned by data group as defined in the table below:

		Assignment mode		
Data group		**Predefined**	**Customized**	
Currents	Class_I	0	0, 1, 2 or 3	default = 2
Residual currents	Class_I0	0	0, 1, 2 or 3	default = 2
Voltages	Class_V	0	0, 1, 2 or 3	default = 2
Power	Class_P	0	0, 1, 2 or 3	default = 2
Frequency	Class_F	0	0, 1, 2 or 3	default = 2
Temperatures	Class_T	0	0, 1, 2 or 3	default = 2

DNP3 index					Description	Unit	Analog Input Change Event	
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80			Class	DeadBand
B2X	Other							
	0	0	0	0	Phase current I1	0.1A	Class_I	DB_I
	1	1	1	1	Phase current I2	0.1A	Class_I	DB_I
	2	2	2	2	Phase current I3	0.1A	Class_I	DB_I
0		3	3	3	Phase-to-neutral voltage V1	1V	Class_V	DB_V
1		4	4	4	Phase-to-neutral voltage V2	1V	Class_V	DB_V
2		5	5	5	Phase-to-neutral voltage V3	1V	Class_V	DB_V
		6	6	6	Active power P	0.1KW	Class_P	DB_P
		7	7	7	Reactive power Q	0.1kVar	Class_P	DB_P
3		8	8	8	Frequency f	0.01Hz	Class_F	DB_F
	3	9	9	9	Residual current I0 Σ	0.1A	Class_I0	DB_I0
		10	10	10	Residual current I0	0.1A	Class_I0	DB_I0
	4	11	11	11	Unbalance ratio T	1%	0	
4		12	12	12	Phase-to-phase voltage U21	1V	Class_V	DB_V
5		13	13	13	Phase-to-phase voltage U32	1V	Class_V	DB_V
6		14	14	14	Phase-to-phase voltage U13	1V	Class_V	DB_V
7		15	15	15	Residual voltage V0	1V	Class_V	DB_V
8		16	16	16	Positive-sequence voltage Vd	1V	Class_V	DB_V
		17	17	17	Negative-sequence voltage Vi	1V	Class_V	DB_V
		18	18	18	Power factor Cos Phi	0.01	Class_F	DB_F
			19	19	Neutral-point voltage Vnt	1V	Class_V	DB_V
			20	20	Total harmonic distortion Uthd	0.1%	0	
			21	21	Total harmonic distortion Ithd	0.1%	0	
	5	19	22	22	Demand current Im1	0.1A	Class_I	DB_I
	6	20	23	23	Demand current Im2	0.1A	Class_I	DB_I
	7	21	24	24	Demand current Im3	0.1A	Class_I	DB_I
	8	22	25	25	Peak demand current IM1	0.1A	Class_I	DB_I
	9	23	26	26	Peak demand current IM2	0.1A	Class_I	DB_I
	10	24	27	27	Peak demand current IM3	0.1A	Class_I	DB_I
		25	28	28	Apparent power S	0.1kVA	Class_P	DB_P
		26	29	29	Peak demand active power PM	0.1kW	Class_P	DB_P
		27	30	30	Peak demand reactive power QM	0.1kvar	Class_P	DB_P

Sepam Point List
Analog Input

Index DNP3					Description	Unit	Analog Input Change Event	
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80			Class	DeadBand
B2X	Other							
			31	31	Active power P phase 1	0.1kW	Class_P	DB_P
			32	32	Active power P phase 2	0.1kW	Class_P	DB_P
			33	33	Active power P phase 3	0.1kW	Class_P	DB_P
			34	34	Reactive power Q phase 1	0.1kvar	Class_P	DB_P
			35	35	Reactive power Q phase 2	0.1kvar	Class_P	DB_P
			36	36	Reactive power Q phase 3	0.1kvar	Class_P	DB_P
			37	37	Apparent power S phase 1	0.1kVA	Class_P	DB_P
			38	38	Apparent power S phase 2	0.1kVA	Class_P	DB_P
			39	39	Apparent power S phase 3	0.1kVA	Class_P	DB_P
	11	28	40	40	Temperature sensor 1 MET148 No. 1	1°C	Class_T	DB_T
	12	29	41	41	Temperature sensor 2 MET148 No. 1	1°C	Class_T	DB_T
	13	30	42	42	Temperature sensor 3 MET148 No. 1	1°C	Class_T	DB_T
	14	31	43	43	Temperature sensor 4 MET148 No. 1	1°C	Class_T	DB_T
	15	32	44	44	Temperature sensor 5 MET148 No. 1	1°C	Class_T	DB_T
	16	33	45	45	Temperature sensor 6 MET148 No. 1	1°C	Class_T	DB_T
	17	34	46	46	Temperature sensor 7 MET148 No. 1	1°C	Class_T	DB_T
	18	35	47	47	Temperature sensor 8 MET148 No. 1	1°C	Class_T	DB_T
		36	48	48	Temperature sensor 1 MET148 No. 2	1°C	Class_T	DB_T
		37	49	49	Temperature sensor 2 MET148 No. 2	1°C	Class_T	DB_T
		38	50	50	Temperature sensor 3 MET148 No. 2	1°C	Class_T	DB_T
		39	51	51	Temperature sensor 4 MET148 No. 2	1°C	Class_T	DB_T
		40	52	52	Temperature sensor 5 MET148 No. 2	1°C	Class_T	DB_T
		41	53	53	Temperature sensor 6 MET148 No. 2	1°C	Class_T	DB_T
		42	54	54	Temperature sensor 7 MET148 No. 2	1°C	Class_T	DB_T
		43	55	55	Temperature sensor 8 MET148 No. 2	1°C	Class_T	DB_T
		44	56	56	Angle Phi0 Σ	1°	0	
		45	57	57	Angle Phi0	1°	0	
			58	58	Angle Phi'0	1°	0	
		46	59	59	Angle Phi1	1°	0	
		47	60	60	Angle Phi2	1°	0	
		48	61	61	Angle Phi3	1°	0	
	19	49	62	62	Last tripping current phase Itrip1	1A : series 20 and series 40 0.1A : series 80	Class_I	0
	20	50	63	63	Last tripping current phase Itrip2	1A : series 20 and series 40 0.1A : series 80	Class_I	0
	21	51	64	64	Last tripping current phase Itrip3	1A : series 20 and series 40 0.1A : series 80	Class_I	0
	22	52	65	65	Last tripping current phase Itrip0	1A : series 20 and series 40 0.1A : series 80	Class_I0	0
	23	53	66	66	Thermal capacity used	%	0	
	24	54	67	67	Running hours counter	1 hr	0	
	25	55	68	68	Time before tripping	1 min	0	
	26	56	69	69	Time before closing	1 min	0	
	27	57	70	70	Starting time/overload	0.1s : series 20 and series 40 0.01s : series 80	0	
	28	58	71	71	Start inhibit time	1 min	0	
	29	59	72	72	Number of starts allowed	1	0	
	30	60	73	73	Total cumulative breaking current	1(kA)²	0	
		61	74	74	Cumulative breaking current (0<I<2In)	1(kA)²	0	
		62	75	75	Cumulative breaking current (2In<I<5In)	1(kA)²	0	
		63	76	76	Cumulative breaking current (5In<I<10In)	1(kA)²	0	
		64	77	77	Cumulative breaking current (10In<I<40In)	1(kA)²	0	
		65	78	78	Cumulative breaking current (I>40In)	1(kA)²	0	
		66	79	79	Initial value of cumulative breaking current	1(kA)²	0	
	31	67	80	80	Starting/overload current	1A	0	
	32	68	81	81	Operating time	1ms	0	
	33	69	82	82	Charging time	1ms: series 20 0.1s: series 40 1s: series 80	0	
		70	83	83	Learnt cooling time constant T2 (49 RMS) thermal rate 1	1 min	0	
		71	84	84	Learnt cooling time constant T2 (49 RMS) thermal rate 2	1 min	0	

Sepam Point List
Analog Input

DNP3 index					Description	Unit	Analog Input Change Event	
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80			Class	DeadBand
B2X	Other							
		72			Peak demand Ii/Id	1%	0	
		73			Faulty phase	bit 0: phase 1 bit 1: phase 2 bit 2: phase 3	0	
		74			Fault location	1m	0	
		75			Fault resistance	1mOhm	0	
			85	85	Machine rotation speed	rpm	0	
				86	Phase current I'1	0.1A	Class_I	DB_I
				87	Phase current I'2	0.1A	Class_I	DB_I
				88	Phase current I'3	0.1A	Class_I	DB_I
				89	Residual current I'0 Σ	0.1A	Class_I0	DB_I0
				90	Residual current I'0	0.1A	Class_I0	DB_I0
				91	Phase-to-phase voltage U'21	1V	Class_V	DB_V
				92	Phase-to-phase voltage U'32	1V	Class_V	DB_V
				93	Phase-to-phase voltage U'13	1V	Class_V	DB_V
				94	Phase-to-neutral voltage V'1	1V	Class_V	DB_V
				95	Phase-to-neutral voltage V'2	1V	Class_V	DB_V
				96	Phase-to-neutral voltage V'3	1V	Class_V	DB_V
				97	Residual voltage V'0	1V	Class_V	DB_V
				98	Positive sequence voltage V'd	1V	Class_V	DB_V
				99	Negative sequence voltage V'i	1V	Class_V	DB_V
				100	Frequency f'	0.01Hz	Class_F	DB_F
				101	Unbalance ratio T'	%	0	
				102	H3 neutral point voltage V3nt	1V	0	
				103	H3 residual voltage V3r	1V	0	
				104	Differential current Id1	0.1A	0	
				105	Differential current Id2	0.1A	0	
				106	Differential current Id3	0.1A	0	
				107	Through current It1	0.1A	0	
				108	Through current It2	0.1A	0	
				109	Through current It3	0.1A	0	
			110	110	Impedance Zd	1mΩ	0	
			111	111	Impedance Z21	1mΩ	0	
			112	112	Impedance Z32	1mΩ	0	
			113	113	Impedance Z13	1mΩ	0	
			114	114	Auxiliary voltage	0.1V	0	
				115	Angle I1/I'1	1°	0	
				116	Angle I2/I'2	1°	0	
				117	Angle I3/I'3	1°	0	
			118	118	dU (synchro-check)	1V	0	
			119	119	df (synchro-check)	0.01Hz	0	
			120	120	dPhi (synchro-check)	0.1°	0	
				121	Capacitor capacitance C1 or C21	0.1µF	0	
				122	Capacitor capacitance C2 or C32	0.1µF	0	
				123	Capacitor capacitance C3 or C13	0.1µF	0	
				124	Operating time capacitor step 1	1hr	0	
				125	Operating time capacitor step 2	1hr	0	
				126	Operating time capacitor step 3	1hr	0	
				127	Operating time capacitor step 4	1hr	0	

Sepam Point List
Analog Output Status
Analog Output Block

Analog Output Status	
Object Number	40 = Analog Output Status
Default Variation	2 = 16 bits Analog Output Status
Request Function Codes supported	1 = Read ***Note:*** *the returned values are meaningless*

Analog Output Block	
Object Number	41 = Analog Output Block
Variation	2 = 16 bits Analog Output Block
Request Function Codes supported	3 = Select 4 = Operate 5 = Direct Operate 6 = Direct Operate - No ACK

DNP3 index					Description
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80	
B2X	Other				
0	0	0	0	0	Remote control of the MSA141 analog output
1	1	1	-	-	S-LAN communication monitoring time delay

Application to Sepam

Each Analog Output Block control order must apply to only one channel at a time.
Reading of Analog Output Status is only supported for compatibility: returned values are meaningless.

Sepam Point List
Octet String
Sequential File Transfer

Octet String	
Static Object	
Object Number	110 = Octet String
Default Variation	xx = Size of Octet String
Request Function Codes supported	1 = Read
Change Event	
Object Number	None
Default Variation	None

DNP3 index					Description
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80	
B2X	Other				
0	0	0	0	0	Sepam identification

Sequential File Transfer	
Object Number	70 = Sequential File Transfer
Variation	3 = File Command Object 4 = File Command Status Object 5 = File Transport Object 6 = File Transport Status Object 7 = File Descriptor Object
Request Function Codes supported	1 = Read 25 = Open 26 = Close 30 = Abort

					Description
Sepam series 20		Sepam series 40	Sepam series 60	Sepam series 80	
B2X	Other				
■	■	■	■	■	Disturbance recording
			■	■	Tripping context
			■	■	Out-of-sync context
			■	■	Motor start reports
			■	■	Motor start trends
			■	■	Data logs

Configuring the communication interfaces

Presentation

The Sepam communication interfaces must be configured using SFT2841 software.

The DNP3 protocol is available with the ACE969TP-2 or ACE969FO-2 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 the functions specific to the DNP3 protocol (advanced S-LAN port parameters)

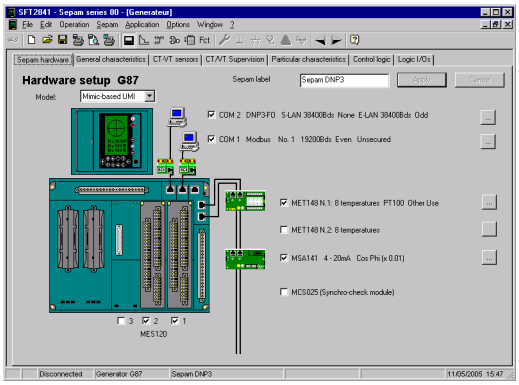
Access to configuration parameters

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

To access this window:

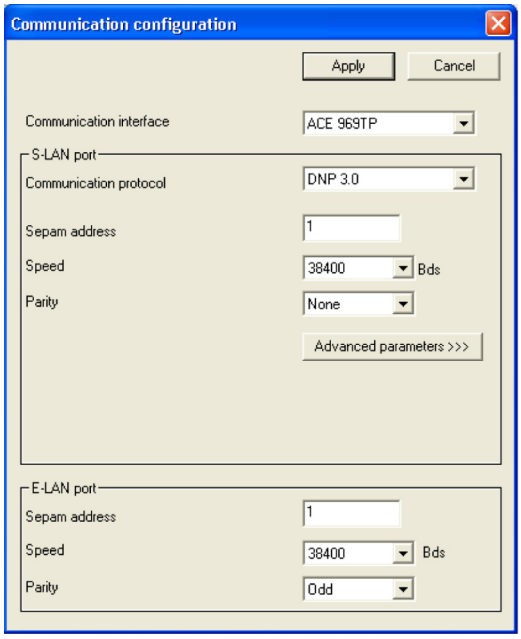
- Open the **Sepam configuration** window in SFT2841. This screen will vary according to the type of Sepam used.
- Select the **Communication** option.
- Click … : the **Communication configuration** window appears.
- Select the type of interface used (ACE969TP-2 or ACE969FO-2).
- Select the DNP3.0 communication protocol (S-LAN port).

PE80018



SFT2841: Sepam series 80 hardware configuration.

PE80019



Configuration of the physical layer of the E-LAN port on an ACE969TP-2.

Configuration of the E-LAN port

Configuration of the physical layer

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

- Sepam address
- Transmission speed
- Parity check type

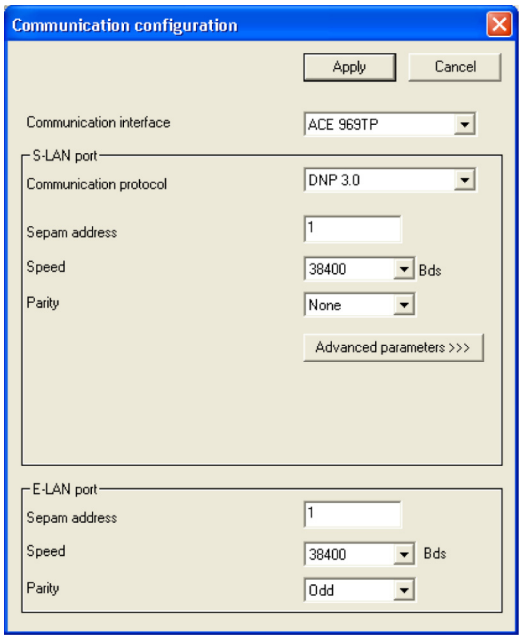
Parameters	Authorized values	Default value
Sepam address	1 to 247	1
Speed	4800, 9600, 19200 or 38400 bps	38400 bps
Parity	No parity, even or odd	Odd

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 making the connection 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, then 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

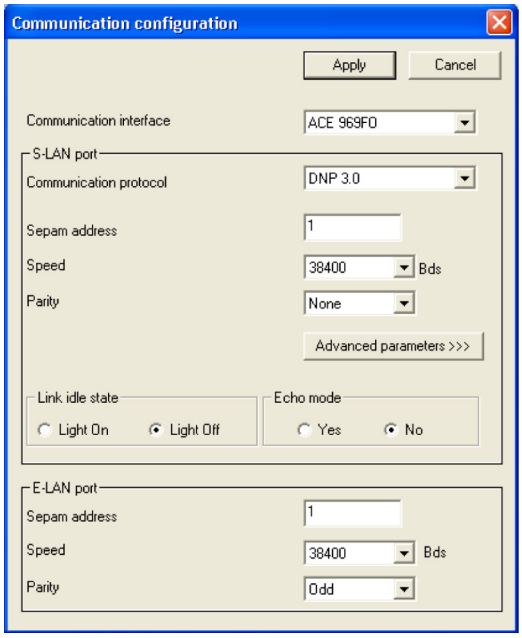
The configuration parameters will vary depending on the communication interface selected: ACE969TP or ACE969FO.

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 65519	1
Speed	4800, 9600, 19200 or 38400 bps	38400 bps
Parity	No parity, even or odd	No parity



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 a fiber-optic ring communication network.

Parameters	Authorized values	Default value
Sepam address	0 to 65519	1
Speed	4800, 9600, 19200 or 38400 bps	38400 bps
Parity	No parity, even or odd	No parity
Link idle state	Light Off or Light On	Light Off
Echo mode	Yes (fiber-optic ring) No (fiber-optic 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 making the connection to the communication network.
- Modifying the configuration parameters during normal operation will not disturb Sepam but will reset the S-LAN communication port.

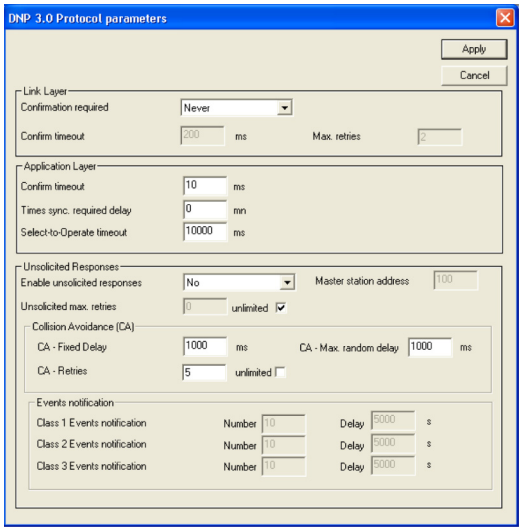
Configuration of the S-LAN port: DNP3 protocol

Configuration of the DNP3 protocol functions

The configuration of the DNP3 protocol functions is identical whether the ACE969TP-2 interface or the ACE969FO-2 communication interface is used.

Click the Advanced parameters button in the ACE969-2 configuration screens to open the **DNP3.0 Protocol parameters** window, in which the following can be configured:

- Data link layer
- Application layer
- Unsolicited responses
- Collision avoidance
- Events notification



Configuration of the DNP3 protocol.

Data Link layer parameters

In some cases where communication integrity is essential, it is possible to manage confirmations at Data Link layer level. In particular, when the transmission of unsolicited responses is authorized, Sepam may be asked to check its integrity. This option is configured using the following parameters:

- Confirmation required
- Confirm timeout
- Max. retries

Confirmation required

This parameter indicates to Sepam whether it must request a Data Link layer confirmation for the frames it sends to the master station:

- Never: Sepam never requests Data Link layer confirmation. The communication integrity check is only carried out at Application layer level.
- Always: Sepam requests a Data Link layer confirmation for all the frames it sends.
- Multiframe: in the case of an Application message that is broken up into several Data Link segments, Sepam requests a confirmation for each of the segments sent at Data Link layer level.

If a confirmation is requested by Sepam (Always, Multiframe), two additional parameters are defined.

Confirm timeout

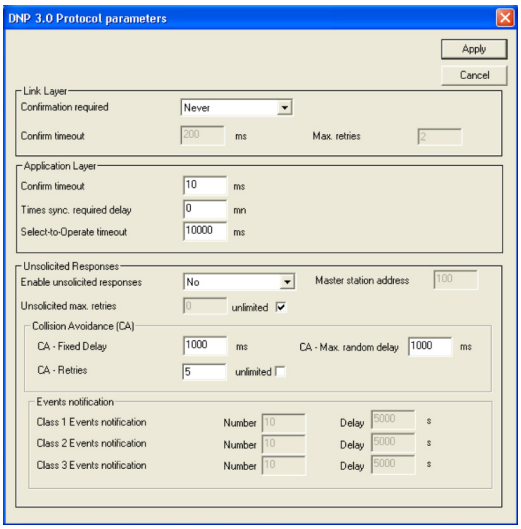
This parameter indicates the time at the end of which Sepam will resend the frame if it does not receive a confirmation.

Max. retries

This parameter sets the maximum number of retries authorized.

Parameters	Authorized values	Default value
Confirmation required	Never, always, multiframe	Never
Confirm timeout	50 to 60000 milliseconds	200 milliseconds
Max. retries	0 to 5	2

PE80021



Configuration of the DNP3 protocol.

Application layer parameters

Three parameters are defined for the Application layer:
- Confirm timeout
- Times sync. required delay
- Select-to-Operate timeout

Confirm timeout

This parameter applies to transmitting events (responses to a polling request from the master and unsolicited responses).
The events are stored by Sepam in an event stack.
When Sepam sends an Application message which includes events, it awaits confirmation from the master to establish that the message has been received correctly. If Sepam receives this confirmation before the end of the timeout, the transmitted events are deleted from the event stack. Otherwise, the events are kept by Sepam. They are then transmitted at the next polling request from the master.
If the Unsolicited Responses option is activated on Sepam, the message is automatically resent by Sepam (see Unsolicited responses).

An application message can comprise several events. If it is too large to be transmitted in a single Data Link frame, the message is broken up into a number of Data Link segments.
The Application layer confirm timeout must then be defined to be consistent with the value chosen at Data Link layer level.

If a Data Link timeout has been defined (T-Link), it is advisable to define the Application timeout (T-Application) in accordance with the following:
- Application Message Size < 249 bytes
  T-Application ⩾ (Max. retries + 1) x T-Link
- Application Message Size ⩾ 249 bytes
  T-Application ⩾ (Max. retries + 1) x T-Link x AppliMsgSize/249

Times sync. required delay

The time is synchronized by the master with transmission of a request to write the time. The transmission is performed periodically or at the request of a slave, which sets an internal Time Synchronization Required indicator. This indicator is present in all the messages transmitted by the slave.

Sepam monitors receipt of the time synchronization request.
The Times sync. required delay parameter defines the time at the end of which Sepam will set its internal Time Synchronization Required indicator if it does not receive a synchronization request.

If this parameter is set to zero, then the Time Synchronization Required indicator is not used and is always left at zero by Sepam. The synchronization request is then sent by the master without consulting Sepam.

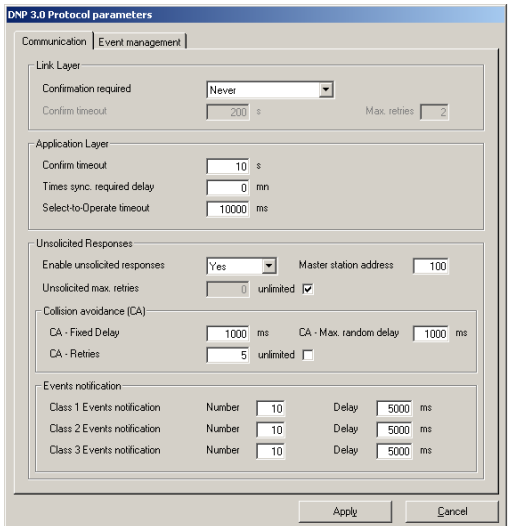
Select-to-Operate timeout

This parameter defines the maximum time authorized by Sepam between receipt of the request to select a command (Select) and the request to execute this command (Operate). At the end of this timeout, the execution command is rejected by Sepam and another selection is necessary.

Parameters	Authorized values	Default value
Confirm timeout	1 to 60000 seconds	10 seconds
Times sync. required delay	0 to 60000 minutes	0: function deactivated
Select-to-Operate timeout	100 to 60000 milliseconds	10000 milliseconds

Configuring the communication interfaces

PE80030



Configuration of the DNP3 protocol.

Unsolicited responses

Unsolicited responses correspond to events that Sepam can send spontaneously. The transmission of unsolicited responses can be enabled or disabled by configuration.
When transmission is authorized by Sepam configuration, the master can suspend or validate this authorization at any time using a special request.
When transmission is disabled by Sepam configuration, any request to enable/disable unsolicited messages received by Sepam is rejected by a message containing the Function Code Not Implemented error indication.

The configuration parameters of unsolicited responses are as follows:
- Enable unsolicited responses
- Unsolicited max. retries
- Master station address

Enable unsolicited responses
This parameter enables or disables the transmission of unsolicited responses by Sepam.

- If the value is No, transmission is disabled.

Events are stored in a stack and can only be obtained by reading the event stack, either globally or by class.

- If the value is Yes, transmission is enabled.

In accordance with the DNP3 specifications, this enabling is not sufficient and must be confirmed by the master. To do this, Sepam informs the master of its ability to send events spontaneously by sending an empty event. Spontaneous transmission will only be validated if Sepam receives an effective request for validation from the master.

- The Forced value enables acceptance of an interconnection with the master, in respect of which the old implementation does not fully comply with the DNP3 specifications. In this case, Sepam immediately sends the unsolicited responses without having to request the agreement of the master.

Unsolicited max. retries
The messages sent spontaneously by Sepam in order to transmit events must be acknowledged by an Application layer confirmation. The waiting time for the confirmation is that defined by the Confirm timeout parameter of the Application layer. If Sepam does not receive this confirmation, it tries to send the message again. The parameter Unsolicited max. retries defines the maximum number of retries authorized.

Once this number has been reached, the event transmission is suspended. Sepam then periodically tries to re-establish transmission to the master by sending a new message. The time taken for these attempts is at least 15 minutes. It is the same as the Confirm timeout parameter if the value of this parameter is greater than 15 minutes.

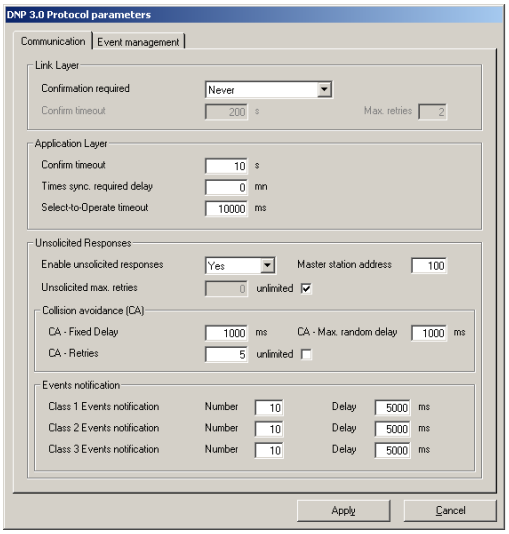
Note: *If there is a Sepam event stack overflow, the oldest events are lost.*

Master station address
This parameter gives the address of the station to which the events must be transmitted.

Parameters	Authorized values	Default value
Enable unsolicited responses	No, yes, forced	No
Unsolicited max. retries	0 to 1000, or unlimited	Unlimited
Master station address	0 to 65519	100

Configuring the communication interfaces

PE80030



Configuration of the DNP3 protocol.

Collision Avoidance - CA

The spontaneous transmission of events on a multipoint communication bus requires the collision management device described in DNP V3.00 Technical Bulletin 9804-007 to be set up. Sepam manages this device.

The device uses the following 3 parameters:
- CA-Fixed Delay
- CA-Max. random delay
- CA-Retries

Before sending, Sepam listens to see whether the communication bus is free.
If the bus is busy, Sepam waits until it is free, then waits for a time, called the Back-off time, before sending.

Backoff_time = CA-Fixed Delay + Random delay

The random delay is between 0 and the value of parameter CA-Max. random delay. If the bus is free after this waiting time, Sepam starts transmission. If the bus is busy, Sepam waits again, up to the number of times defined in CA-Retries (1 to 10 or unlimited).

Parameters	Authorized values	Default value
CA-Fixed Delay	0 to 60000 ms	1000 ms
CA-Max. random delay	0 to 60000 ms	1000 ms
CA-Retries	0 to 10, or unlimited	5

Events notification

Spontaneous events are grouped together by class (1, 2 or 3) and are transmitted in packets. The transmission of a packet is initiated by 2 factors:
- When the number of events constituting a packet (defined by the Number parameter) is reached
- When the maximum waiting time for a new event (defined by the Delay parameter) is reached

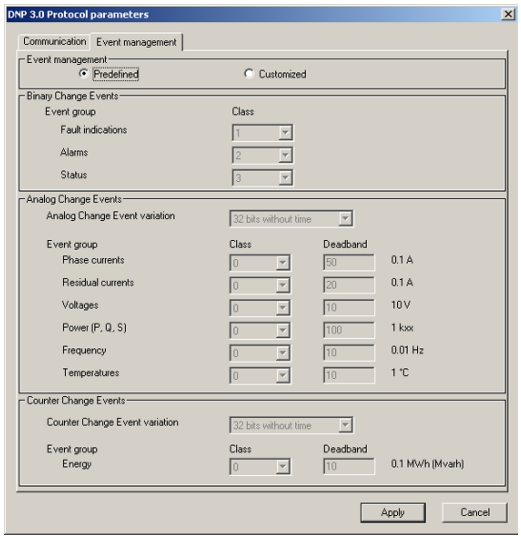
Parameters	Authorized values	Default value
Number	1 to 10	10
Delay	100 to 60000 ms	5000 ms

Event management

Introduction

There are two event management modes:
- Predefined management
- Customized management

PE80031



Predefined event management

Predefined management

Generating events

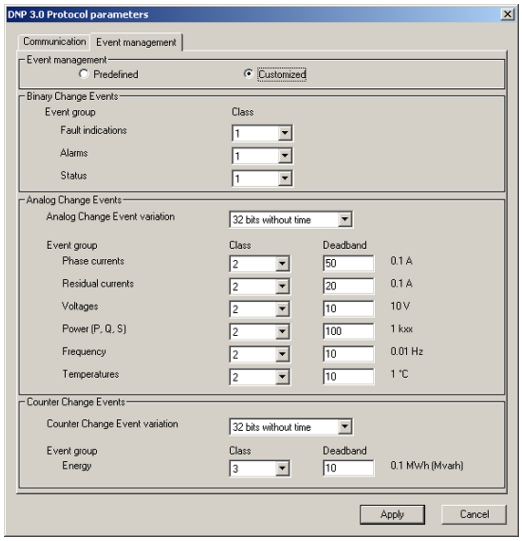
In this mode, only binary information (Binary Inputs) generates events.
An event is generated when a binary data item changes state.
Analog Input and Counter type information does not generate events. Their class is always 0.
The class associated with events cannot be modified. It is predefined in Sepam according to the nature of the information: Indication of fault, Alarm or Status with the following values:

Data group	Predefined class
Fault indications	1
Alarms	2
Status	3

Compatibility

The predefined management mode corresponds to operation of the ACE969-2 interface for versions of the software prior to V2.0. It is automatically selected by SFT2841 when an ACE969-2 configuration file version < V2.0 is opened, or when an on-line configuration is created with a Sepam unit equipped with an ACE969-2 interface < V2.0.
When this mode is selected, all the other configuration options are disabled and are grayed out.

PE80032



Customized event management

Customized management

In this mode, in addition to the binary information, Analog Input and Counter type information generates events.

Events relating to binary information

Binary data is split into 3 groups.
Unlike the previous mode, the default classes associated with the predefined groups can be changed freely by the user using the SFT2841 software. Allocating the value class 0 to a group results in inhibiting event generation for all data in this group.
The data groups and associated classes are as follows:

Data group	Authorized class	Default class
Fault indications	0 to 3	1
Alarms	0 to 3	1
Status	0 to 3	1

Events relating to Analog Input and Counter type information

Similarly to binary information, Analog Input and Counter type information belong to predefined groups associated with Classes.
In addition to the Class, Analog Input and Counter type information has two additional attributes:

- Variation
- Deadband

Variation

This attribute specifies the format in which events are generated by Sepam.
It is defined separately for all analog inputs and all counters.

Deadband

This attribute defines a range for monitoring changes of an analog or counter value. When the value strays outside this range, an event is generated. This attribute is defined at the level of each group of Analog Input and Counter type information.

The table below indicates the authorized and default values for the Class and Variation attributes:

Parameter	Authorized values	Default value
Class	0 to 3	2
Variation	32 bits without time 16 bits without time 32 bits with time 16 bits with time	32 bits without time
Deadband	0 to 65535; unit specific to each data group	According to the data group (see table below)

The table below indicates the default values and units of the Deadband parameter by data group:

Deadband parameter		
Data group	**Unit**	**Default value**
Phase currents	0.1 A	50 (5 A)
Residual currents	0.1 A	20 (2 A)
Voltages	10 V	10 (100 V)
Power (P, Q, S)	1 kxx	100 (100 kxx)
Frequency	0.01 Hz	10 (0.1 Hz)
Temperatures	1°C	10 (10°C)
Energy	0.1 MWh (Mvarh)	10 (1 MWh) (1 Mvarh)

Compatibility

The ACE969-2 interface version number is accessed via the Sepam Diagnosis screen when the SFT2841 tool is connected to Sepam.
The Customized event management option is not compatible with an ACE969-2 interface version earlier than V2.0.

If a configuration file incorporating this option has been loaded onto Sepam, the ACE969-2 interface will indicate a configuration error and the DNP3 interface will not be operational.
This error status can be diagnosed:

- on the front panel of the ACE969-2 interface (the red "key" LED flashes)
- on the Sepam Diagnosis screen of the SFT2841 tool connected to Sepam

It is then necessary to reconfigure the Sepam unit to replace the Customized option with the Predefined option compatible with all ACE969-2 versions.

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective earth and to the functional earth.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

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 60 user's manual, reference SEPED310017EN
- Sepam series 80 operation manual, reference SEPED303003EN

Preliminary checks

The following preliminary checks must be made:

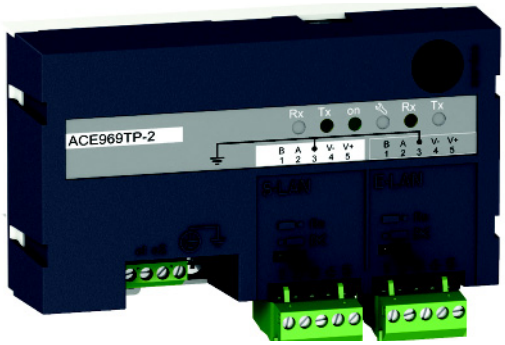
- Check the CCA612 cord connection between the ACE969-2 interface and the Sepam base unit.
- Check the auxiliary power supply connection to the ACE969-2.
- Check the S-LAN communication port connection on the ACE969-2.
- Check the complete configuration of the ACE969-2.

Checking the operation of the ACE969-2 interface

You can use the following to check that the ACE969-2 interface is operating correctly:

- The indicator LEDs on the front panel of the ACE969-2
- The information provided by the SFT2841 software connected to Sepam:
  - On the Diagnosis screen
  - On the Communication configuration screens

PB103454

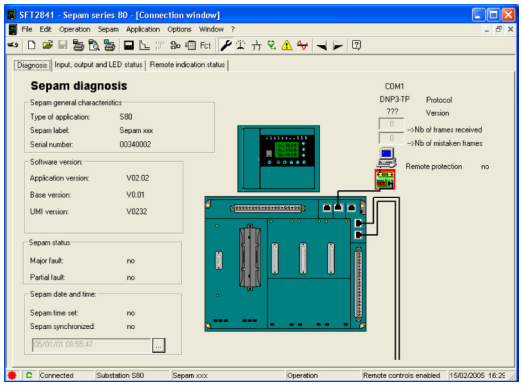


ACE969TP-2 communication interface.

Indicator LEDs on the ACE969-2

- Green "on" LED: ACE969-2 energized
- Red "key" LED: ACE969-2 interface status
  - LED off: ACE969-2 configured and communication operational
  - LED flashing: ACE969-2 configuration error or ACE969-2 not configured
  - LED on: ACE969-2 error
- S-LAN and E-LAN Tx / Rx LEDs:
  - S-LAN Tx LED flashing: Sepam transmitting
  - S-LAN Rx LED flashing: Sepam receiving
  - Tx and Rx off: RS 485 communication is idle
  - Tx or Rx LED is "on" while the RS 485 communication network is idle: the idle voltage state of the RS 485 network is incorrect

PE80023



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
- DNP3 interface version number
- Number of valid frames received
- Number of invalid (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 LEDs and the following information on the Sepam diagnosis screen indicate whether Sepam and a supervisor are communicating correctly using the DNP3 protocol:

- ■ Indicator LEDs on the front panel of the ACE969-2:
  - □ Green "on" LED on
  - □ Red "key" LED off
  - □ S-LAN Rx and Tx LEDs flashing
- ■ Sepam diagnosis screen:
  - □ Name of the protocol configured: DNP3
  - □ DNP3 interface version number displayed
  - □ Number of valid frames received increasing at regular intervals
  - □ Number of invalid 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 corrective action to be taken in each case.

Symptoms		Possible cause	Action/remedy
ACE969-2 LEDs	**SFT2841 diagnosis**		
"On" LED off	Protocol = ???? and/or Version = ????	No power supply to ACE969-2	Check the auxiliary power supply to the ACE969-2.
"Key" LED on	Protocol = ???? and/or Version = ????	ACE969-2 failed	Replace the ACE969-2.
"Key" LED flashing	Protocol = ???? and/or Version = ????	ACE969-2 not configured	Configure the ACE969-2 using SFT2841.
		ACE969-2 is not connected to Sepam	Check the ACE969-2 connection to Sepam.
		The ACE969-2 configuration is incorrect.	■ Use SFT2841 to check the interface selected: ACE969TP-2 or ACE969FO-2. ■ Check that the DNP3 event management mode is compatible with the ACE969-2 software version.
S-LAN Rx LED flashing	Increase in invalid frame counter value	The ACE969-2 physical layer configuration is incorrect.	Use SFT2841 to check the following parameters: ■ transmission speed ■ parity
		Incorrect choice of communication protocol	Check the communication protocol selected.
		The S-LAN network is incorrectly 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.
		Incorrect choice of communication protocol	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 incorrectly connected.	Check the connection of the S-LAN network and the RS 485 remote power supply.
Tx or Rx LED is "on" while the RS 485 communication network is idle.		The idle voltage state of the RS 485 network is incorrect.	■ Check that the pull-up and pull-down bias resistors are correctly installed on the RS 485 network. ■ Check that the 2 load resistors are correctly installed at each end of the RS 485 network.

Firmware modifications

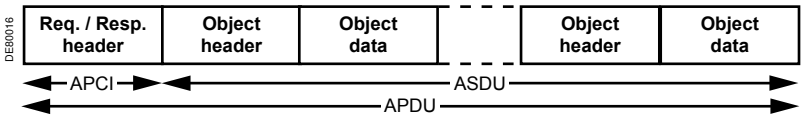
The table below describes the firmware version history of the ACE969.
The following information is provided for each firmware version:
- release date
- improvements,
- new features added.

Firmware version	Firmware version release date	Improvements	New features
V1.0	July 2005	First commercial version	
V2.8	2010		Addition of new information, in particular: 21FL and 46BC functions and SLAN communication monitoring.
V3.0	2013		Transfer of the new files: Motor start report, Motor start trend, Data log.
			Activation of new recordings by commands and associated status information.
			Transfer of the Out-of-sync context record.
		Updated communication protocol firmware components. The corrections below may have an impact on types of use not compliant with the protocol: ■ User managed events can use the wrong default variation when reporting events. ■ Adding a new event while waiting for the confirmation of an unsolicited response could incorrectly restart the delay timer. ■ If a Select with the same sequence number but different data was received, the new Select was not discarded. ■ The File Read Directory response did not limit the response data to the maximum block size specified in the Open request.	

Appendix 1: Structure of Application layer messages

Presentation

Application layer requests and responses exchanged between a supervisor and Sepam are encoded in data structures called ADPUs:
Application Protocol Data Units.



An APDU consists of the following fields:
■ APCI Request/Response header:
This field identifies the role of the message and conveys flow control information. This field is also called APCI: Application Protocol Control Information.
■ ASDU: Application Service Data Unit. This field contains Application layer user data.

Request and response headers

Request header

Field	*Size (bytes)*	*Description*
AC	*1*	AC: Application Control
FC	*1*	FC: Function Code

Response header

Field	*Size (bytes)*	*Description*
AC	*1*	AC: Application Control
FC	*1*	FC: Function Code
IIN - 1	*2*	IIN: Internal Indication
IIN - 2		

Application Control (AC) field

7	*6*	*5*	*4*	*3*	*2*	*1*	*0*
FIR	FIN	CON	SEQUENCE				

At Application layer level, DNP3 authorizes and manages the fragmentation of user data into several ASDUs.
The AC byte contains information that is needed to manage the fragmentation (for transmission) and re-assembly (for reception):
■ FIR: First Bit
□ FIR = 1: the first fragment of a new Application message
□ FIR = 0: any fragment
■ FIN: Final Bit
□ FIN = 1: the last fragment of a new Application
□ FIN = 0: there are still fragments to follow
■ CON: Confirmation request
The station receiving a message with this bit at 1 must return a confirmation message (Function code 0).
■ SEQUENCE: Sequence number
This number allows you to check that the fragments are sent and received in the correct order, without loss or duplication.
□ Numbers 0 to 15: Reserved for "Request" and "Response" messages.
After reaching 15, the counter restarts at 0.
□ Numbers 16 to 31: Reserved for "Unsolicited response" messages.
After reaching 31, the counter restarts at 16.

Appendix 1: Structure of Application layer messages

Function Code (FC) field

The FC byte contains the Application layer function code.
Sepam supports the function codes listed in the table below:

FC	Function	Description
Data transfer functions		
0	Confirm	Confirmation message
1	Read	Read requests; the response supplies the data requested (if available)
2	Write	Write request; the response gives the result of the operation
Control functions		
3	Select	Request to select an output; the response gives the state of the selected output
4	Operate	Request to activate a preselected output; the response gives the state of the activated output
5	Direct operate	Request to activate an output that has not been preselected; the response gives the state of the activated output
6	Direct operate No Ack	Request to activate an output that has not been preselected; no associated response
Application Control functions		
13	Cold Restart	Triggers the cold restart sequence; the response indicates the time when the station will become available again
14	Warm Restart	Triggers the warm restart sequence; the response indicates the time when the station will become available again
Configuration functions		
20	Enable Unsolicited Messages	Enables spontaneous reporting of information; the response gives the result of the operation
21	Disable Unsolicited Messages	Disables the spontaneous reporting of information; the response gives the result of the operation
Synchronization functions		
23	Delay Measurement	Used to determine the transmission time with a slave station; the value calculated is then used to correct the time of day when setting the time for the slave station
File management functions		
25	Open	Request to open a file
26	Close	Request to close a file
30	Abort	Request to abort the transfer of a file
Response function codes		
129	Response	Response message to a request
130	Unsolicited Response	Spontaneous message (not solicited by a request)

Appendix 1: Structure of Application layer messages

Internal Indication (IIN) field

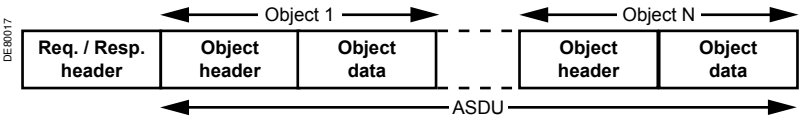
The 2 IIN (Internal Indication) bytes from the Response header provide indications about negative responses (in the case of an error or refusal on the slave's part).

IIN1	Description
Bit 0	Set to 1 to indicate the receipt of a broadcast frame; reset to 0 after the next response is sent
Bit 1	Class 1 data available; the master must poll the slave for this type of data
Bit 2	Class 2 data available; the master must poll the slave for this type of data
Bit 3	Class 3 data available; the master must poll the slave for this type of data
Bit 4	Synchronization request: the master must send a request to write the "Time and Date" object. Reset is possible if the master writes the bit to 0
Bit 5	Indicates that the slave outputs are in local mode (therefore not controllable by DNP3)
Bit 6	Faulty station
Bit 7	Indicates a station restart Reset if the master writes the bit to 0
IIN2	**Description**
Bit 0	Function code not available
Bit 1	Data unknown
Bit 2	Invalid value
Bit 3	Buffer overflow (event buffer or other application buffer)
Bit 4	Request already being processed
Bit 5	Current configuration error (reconfiguration is necessary)
Bit 6	Reserved; always at 0
Bit 7	Reserved; always at 0

Appendix 1: Structure of Application layer messages

Structure of an ADSU

An ADSU consists of a set of information objects, with each object having a header field and a data field.
A single ASDU can group several DNP3 objects of different types.



An ADSU consists of the following fields:
- Object header: This field identifies the type of DNP3 object.
- Object data: This field contains the user data associated with the object.

Object Header

Field	*Size (bytes)*	*Description*
Object Identifier	*2*	*Object identifier*
Qualifier	*1*	*Qualifier: Specifies the data addressing method*
Range	*0 to 8*	*This field is dependent on the value of the Qualifier field*

Object Identifier
The object identifier consist of 2 bytes:
- Byte 1: Object Group

This byte identifies the type of object to which the user data belongs.
For example, 30 = Analog Input.
- Byte 2: Variation

This byte identifies the object subtype.
For example, for the Analog Input object:
- Subtype 1 = 32 Analog Input bits
- Subtype 2 = 16 Analog Input bits

In a request, Variation 0 designates all objects of the group, regardless of their subtype. A master can therefore ask to read the analog inputs of a slave without knowing the subtype of 16 or 32 bits. The subtype is shown to him in the response.

Qualifier

7	*6*	*5*	*4*	*3*	*2*	*1*	*0*
0	Index size			Qualifier code			

The Qualifier byte consists of 2 data items:
- Qualifier Code, coded on 4 bits
- Index size, coded on 3 bits.

The combinations of the Qualifier Code and Index Size values specify the object addressing method.

Index size	Qualifier code	Object addressing
0	0	Addressing index range objects [start; end]. The start and end index values are coded on 8 bits in the Range field.
0	1	Addressing index range objects [start; end]. The start and end index values are coded on 16 bits in the Range field.
0	6	Addressing all objects of a given type. In this case, there is no Range field.
0	7	Addressing N index objects 0 to (N-1). The quantity N is coded on 8 bits in the Range field.
0	8	Addressing N index objects 0 to (N-1). The quantity N is coded on 16 bits in the Range field.
1	7	Addressing N objects, each of which is identified by its index coded on 8 bits. The quantity N is coded on 8 bits in the Range field.
2	8	Addressing N objects, each of which is identified by its index coded on 16 bits. The quantity N is coded on 16 bits in the Range field.
5	B	Special addressing, for variable sized objects. Used for the Sequential File Transfer object: The Range field gives the quantity of objects (= 1) on 8 bits and each object has a 16-bit prefix, which indicates its size in bytes.

Range
This field is dependent on the value of the Qualifier field (see above).

Appendix 1: Structure of Application layer messages

Object Data

To encode Sepam information, the following data objects are used:

- Binary Input
- Binary Output
- Counters
- Analog Input
- Analog Output

Binary Input object coding

Object number	Variation	Description
01	01	**Single-bit Binary Input**
01	02	**Binary Input with Status**
02	02	**Binary Input Change with Time**

Bytes

1	7	6	5	4	3	2	1	0
2	15	14	13	12	11	10	9	8
..	..	..	..	..	..	..	..	..
					n-1	n-2	n-3	n-4

Single-bit Binary Input

Series of bytes, where each bit represents an internal state or a discrete input. Each state or input has the value 0 or 1.
The figure here shows a series of n single-bit binary inputs.

Bytes

1	7	6	5	4	3	2	1	0

Binary Input with Status

7 indicator bits + 1 status value bit (0 or 1)

Bit 0: On-line	0 = on-line	1 = off-line
Bit 1: Restart	0 = normal	1 = restart
Bit 2: Communication lost	0 = normal	1 = lost
Bit 3: Remote forced data	0 = normal	1 = forced
Bit 4: Local forced data	0 = normal	1 = forced
Bit 5: Chatter filter	0 = normal	1 = filter on
Bit 6: Reserved	0	
Bit 7: State	0	1

Bytes

	7	*6*	*5*	*4*	*3*	*2*	*1*	*0*
1								
2	Time-tagged label							
3								
4								
5								
6								
7								
8								
9								

Binary Input Change with Time

Byte 1: 7 indicator bits + 1 status value bit (0 or 1)

Bit 0: On-line	0 = on-line	1 = off-line
Bit 1: Restart	0 = normal	1 = restart
Bit 2: Communication lost	0 = normal	1 = lost
Bit 3: Remote forced data	0 = normal	1 = forced
Bit 4: Local forced data	0 = normal	1 = forced
Bit 5: Chatter filter	0 = normal	1 = filter on
Bit 6: Reserved	0	
Bit 7: State	0	1

Time-tagged label (8 bytes)

48-bit unsigned integer
Number of milliseconds since 1st January 1970

Appendix 1: Structure of Application layer messages

Binary Output object coding

Object number	Variation	Description
10	01	**Single-bit Binary Output**
10	02	**Binary Output Status**
12	01	**Control Relay Output block**

Bytes

1	7	6	5	4	3	2	1	0
2	15	14	13	12	11	10	9	8
..	..	..	..	..	..	..	..	..
					n-1	n-2	n-3	n-4

Single-bit Binary Output

Series of bytes, where each bit represents an internal state or a discrete output. Each state or output has the value 0 or 1.
The figure here shows a series of n single-bit binary outputs.

Bytes

1	7	6	5	4	3	2	1	0

Binary Output Status

7 indicator bits + 1 status value bit (0 or 1)

bit 0: On-line	0 = on-line	1 = off-line
bit 1: Restart	0 = normal	1 = restart
bit 2: Communication lost	0 = normal	1 = lost
bit 3: Remote forced data	0 = normal	1 = forced
bit 4: Local forced data	0 = normal	1 = forced
bit 5: Reserved	0	
bit 6: Reserved	0	
bit 7: State	0	1

Bytes

	7	*6*	*5*	*4*	*3*	*2*	*1*	*0*
1	Trip/Close		CI	Q	Code			
2	Count							
3	On-Time							
6								
7	Off-Time							
10								
11	0	Status						

Control Relay Output block

Control code: 1 byte

Code:	0 = Null operation	
	1 = Pulse On	
	2 = Pulse Off	
	3 = Latch On	
	4 = Latch Off	
	5 to 15: undefined	
Q bit: Queue	0 = normal	1 = requeued
CI bit: Clear	0 = normal	1 = clear
Trip/Close	00 = NULL	
	01 = CLOSE	
	10 = TRIP	
Count: 1 byte	0 to 255 = Number of times the command is executed	
On-Time: 4 bytes	Millisecond counter on 32 bits	
Off-Time: 4 bytes	Millisecond counter on 32 bits	
Status: 1 byte	0 = Request accepted	
	1 = Req. refused on SBO timeout	
	2 = Req. refused: no SBO	
	3 = Req. refused: coding error	
	4 = Req. refused: command not supported	
	5 = Req. refused: output already set	
	6 = Req. refused: internal error	
	7 = Req. refused: local mode	

Application to Sepam

All Binary Outputs accessed via the DNP3 interface are Single-Output type.
For Control Relay Output Blocks, Sepam accepts and processes the following control codes in the same way:

- 01: trip/close = NULL; Q = CI = normal; Pulse On
- 03: trip/close = NULL; Q = CI = normal; Latch On

Other codes are rejected by Sepam.
After executing the command, the Binary Output object is automatically reset to zero by Sepam. The current value of a Binary Output object is always read as zero.

In remote-control orders inhibited mode, Sepam rejects commands (Status code = local mode).

Sepam only accepts the values Count = 0 and Count = 1.
If Count = 0, the request is accepted but the command is not executed.
If Count = 1, the request is accepted and the command is executed by Sepam.

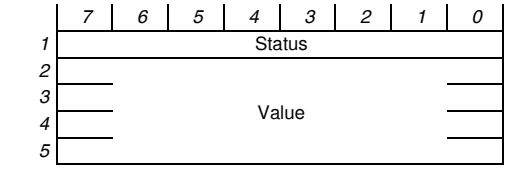
The On-Time and Off-Time fields are ignored by Sepam and can have any value.

Appendix 1: Structure of Application layer messages

Counter object coding

Object number	Variation	Description
20	01	**32-bit Binary counter**
20	05	**32-bit Binary counter without flag**

Bytes



32-bit Binary Counter

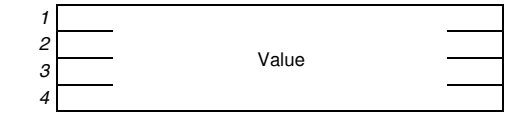
Status: 1 byte

Bit 0: On-line	0 = off-line	1 = on-line
Bit 1: Restart	0 = normal	1 = restart
Bit 2: Communication lost	0 = normal	1 = lost
Bit 3: Remote forced data	0 = normal	1 = forced
Bit 4: Local forced data	0 = normal	1 = forced
Bit 5: Roll-over	0 = normal	1 = roll-over
Bit 6: Reserved	0	
Bit 7: Reserved	0	

Value: 4 bytes

32-bit unsigned integer

Bytes



32-bit Binary counter without flag

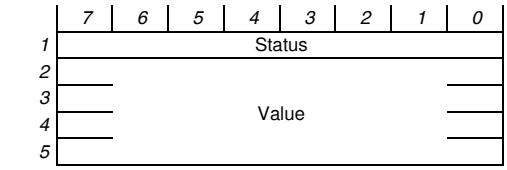
Value: 4 bytes

32-bit unsigned integer

Analog Input object coding

Object number	Variation	Description
30	01	**32-bit Analog Input**
30	03	**32-bit Analog Input without flag**

Bytes



32-bit Analog Input

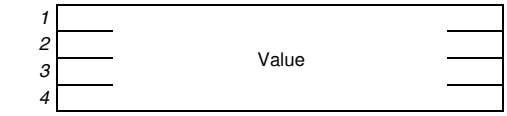
Status: 1 byte

Bit 0: On-line	0 = off-line	1 = on-line
Bit 1: Restart	0 = normal	1 = restart
Bit 2: Communication lost	0 = normal	1 = lost
Bit 3: Remote forced data	0 = normal	1 = forced
Bit 4: Local forced data	0 = normal	1 = forced
Bit 5: Over-range	0 = normal	1 = over-range
Bit 6: Reference check	0 = normal	1 = error
Bit 7: Reserved	0	

Value: 4 bytes

32-bit signed integer

Bytes



32-bit Analog Input without flag

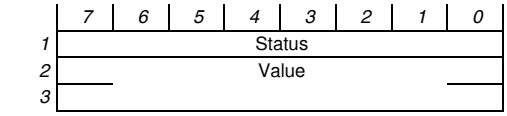
Value: 4 bytes

32-bit signed integer

Analog Output object coding

Object number	Variation	Description
40	02	**16-bit Analog Output Status**
41	02	**16-bit Analog Output block**

Bytes



16-bit Analog Output Status

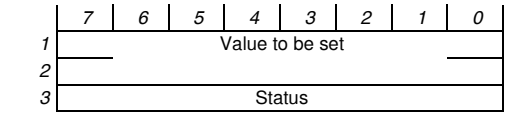
Status: 1 byte

Bit 0: On-line	0 = off-line	1 = on-line
Bit 1: Restart	0 = normal	1 = restart
Bit 2: Communication lost	0 = normal	1 = lost
Bit 3: Remote forced data	0 = normal	1 = forced
Bit 6: Reserved	0	
Bit 6: Reserved	0	
Bit 6: Reserved	0	
Bit 7: Reserved	0	

Value: 2 bytes

16-bit signed integer

Bytes



16-bit Analog Output Block

Value to be set: 2 bytes

16-bit signed integer

Status: 1 byte

1 = Req. refused on SBO timeout
2 = Req. refused: no SBO
3 = Req. refused: coding error
4 = Req. refused: command not supported
5 = Req. refused: output already set
6 = Req. refused: internal error

Appendix 2: File transfer
General

Presentation

Sepam saves the information from the functions in file format:
- Disturbance records
- For Sepam series 60 and Sepam series 80 only:
  - Tripping contexts
  - Out-of-sync context
  - Motor start report
  - Motor start trend
  - Data log.

These files can be retrieved using the transfer procedure specified in *DNP Technical Bulletin 2000-2001, Sequential File Transfer Objects*.

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
- 1 NS (Out-of-sync context) directory file, which contains the information required for transferring Out-of-Sync Context files saved in Sepam
- 1 MS (Motor start report) directory file, which contains the information required for transferring Motor Start files saved in Sepam
- 1 MT (Motor start trend) directory file, which contains the information required for transferring Motor Trend files saved in Sepam
- 1 DL (Data log) directory file, which contains the information required for transferring Data log 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
- The Out-of-sync context file, which contains data saved in Sepam when there is a lack of synchronization
- The Motor start report files, which contain data saved by Sepam on motor starting
- The Motor start trend files, which contain data saved in Sepam by the Motor start trend function
- The Data log files, which contain data saved in Sepam on tripping of this function

Appendix 2: File transfer
General

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	yyyy-mm-dd-hh-mn-sssss	22
TR directory	TR	2
Tripping contexts	yyyy-mm-dd-hh-mn-sssss	22
NS Out-of-sync context directory	NS	2
Out-of-sync context	yyyy-mm-dd-hh-mn-sssss	22
MS Motor start report directory	MS	2
Motor start report file	yyyy-mm-dd-hh-mn-sssss	22
MT Motor start trend directory	MT	2
Motor start trend file	yyyy-mm-dd-hh-mn-sssss	22
DL Data log directory	DL	2
Data log file	yyyy-mm-dd-hh-mn-sssss	22

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

The other files (Tripping context, Out-of-sync context, Motor start trend, Motor start trend, and Data log) are transferred in the same way, using the directory files TR, NS, MS, MT et DL, respectively.

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 requests from the supervisor are addressed on object 70.

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.
- The number of Read Block requests that are needed to transfer the file depends on the size of the file and the size of a block. The maximum size of a block is defined by the master in the Open request.

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, Tripping context, Out-of-sync context, Motor start report, Motor start trend or Data log 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 indicates this error in the Read response (status = file corrupted). Once the file is corrupted, it closes automatically. In this case, the Close request serves no purpose. However the response to the Close request will be: status = incorrect file identifier.

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).

Appendix 2: File transfer
General

File transfer functions

A file read operation uses the following DNP3 functions:

Function code	Function	Description
1	Read	Read a data block
25	Open	Open a file
26	Close	Close a file
30	Abort	Abort the file transfer
129	Response	Read, open or close response
130	Unsolicited response	Unsolicited read or close responses

Sequential File Transfer object

The file read operation uses object 70, with the following variations:

Object	Variation	Description	Request function	Response function
70	3	File Command Object	25	
70	4	File Command Status Object	26, 30	129
70	5	File Transport Object	1	129, 130
70	6	File Transport Status Object		129, 130
70	7	File Descriptor Object	-	-

Execution reports

The Sepam responses contain a coded execution report in the objects associated with the responses:

- File Command Status Object
- File Transport Status Object

The possible Status field values 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 or Close error response: Incorrect file identifier
16	Read or Close error response: File not open
17	Close error response: File closed on detection of inactivity
19	Read error response: Corrupt file
20	Read error response: Incorrect block number

Operations required to read a file

Operation	Function	Object Number - Variation	Description of the operation
Open	Fct 25	File Command Object 70-3	Open request Opening must be requested in "Read" mode The DNP3 master indicates: The ASCII name of the file to be opened The maximum size of the blocks to be used for the read operation For example, for a Disturbance record file recorded on 27 February 2012 at 13 h 36 min 28838 msec, the 25 bytes of the file name will be in the format 'DR\yyyy-mm-dd-hh-min-sssss' where 0x44 = 'D' 0x52 = 'R' 0x5C = '\' 0x32 = '2' 0x30 = '0' 0x31 = '1' 0x32 = '2', 0x2D = '-' 0x30 = '0' 0x32 = '2' 0x2D = '-' 0x32 = '2' 0x37 = '7' 0x2D = '-' 0x31 = '1' 0x33 = '3' 0x2D = '-' 0x33 = '3' 0x36 = '6' 0x2D = '-' 0x32 = '2' 0x39 = '9' 0x38 = '8' 0x33 = '3' 0x38 = '8'
Open response	Fct 129	File Command Status Object 70-4	Open response The object, sent back in response to Open, gives the following information: File Handle: identifier of the open file (32-bit) Status (OK, or no: file does not exist, already open, etc.) File Size Max Block Size (less than or equal to that requested in the Open request)
Read	Fct 1	File Transport Object 70-5	Block read response Reading is performed block by block The DNP3 master indicates: File handle Block no. (starting at 0)
Read response	Fct 129	File Transport Object 70-5	Block read response If the data is available immediately, Sepam sends back the "File Transport" object in response to the Read operation. Otherwise, Sepam sends back a NULL response and the object will be sent back later in response to a polling (or as an unsolicited response) as a class 3 event. The "File Transport" object gives: File handle The block number (that requested) with bit indicating if it is the last block The data (max. size = that agreed at the Open operation)
Read Error response	Fct 129	File Transport Status Object 70-6	If necessary, Sepam can indicate a read error: File Handle error, Block no. out of sequence, file closed on inactivity, etc.
Close request	Fct 26	File Command Status Object 70-4	After receiving the last block, the DNP3 master closes the file and supplies the Handle of the file to be closed.
Close response	Fct 129	File Command Status Object 70-4	The same "File Command Status" object is used for the Close response.

Special cases:

Operation	Function	Object	Description
Spontaneous close session	Fct 129	File Transport Status Object 70-6	In the event of inactivity, Sepam closes the read session (timeout expired).
Abort Request	Fct 30	File Command Status Object 70-4	The master can interrupt the file transfer by Abort.
Abort Response	Fct 129	File Command Status Object 70-4	The same "File Command Status" object is used for the Abort response.

Appendix 2: File transfer
Object coding
Sequential File Transfer

File Command Object

Object header	*Size (bytes)*
Object = 70	*1*
Variation = 3	*1*
Qualifier = 5Bh	*1*
Range = 1	*1*
Number of Octets in object	*2*

Object data	*Size (bytes)*	*Description*
File Name Offset	*2*	
File Name Size	*2*	
Time of creation	*6*	*Not used by Sepam; value 0*
Permissions	*2*	*Access in read mode (0124h)*
Authentication Key	*4*	*Not used by Sepam; value 0*
File Size	*4*	*Not used by Sepam; value 0*
Operational Mode	*2*	*Read mode = 1*
Maximum Block Size	*2*	*Maximum size of a data block*
Request ID	*2*	*Request number*
File Name	*n*	*File name*

File Command Status Object

Object header	*Size (bytes)*
Object = 70	*1*
Variation = 4	*1*
Qualifier = 5Bh	*1*
Range = 1	*1*
Number of Octets in object	*2*

Object data	*Size (bytes)*	*Description*
File Handle	*4*	*File identifier (32-bit numeric value)*
File Size	*4*	*Size of file in bytes (32-bit value)*
Maximum Block Size	*2*	*Maximum size of a data block*
Request ID	*2*	*Request number*
Status	*1*	*Execution report*

File Transport Object

Object header	*Size (bytes)*
Object = 70	*1*
Variation = 5	*1*
Qualifier = 5Bh	*1*
Range = 1	*1*
Number of Octets in object	*2*

Object data	*Size (bytes)*	*Description*
File Handle	*4*	*File identifier (32-bit numeric value)*
Block Number	*4*	*Block number* *The last block is characterized by the most significant bit at 1*
Block Data	*n*	*Data contained in the block*

Appendix 2: File transfer
Object coding
Sequential File Transfer

File Transport Status Object

Object header	*Size (bytes)*
Object = 70	*1*
Variation = 6	*1*
Qualifier = 5Bh	*1*
Range = 1	*1*
Number of Octets in object	*2*

Object data	*Size (bytes)*	*Description*
File Handle	*4*	*File identifier (32-bit numeric value)*
Block Number	*4*	*Block number* *The last block is characterized by the most significant bit at 1*
Status	*1*	*Execution report*

File Descriptor Object

Object header	*Size (bytes)*
Object = 70	*1*
Variation = 7	*1*
Qualifier = 5Bh	*1*
Range = 1	*1*
Number of Octets in object	*2*

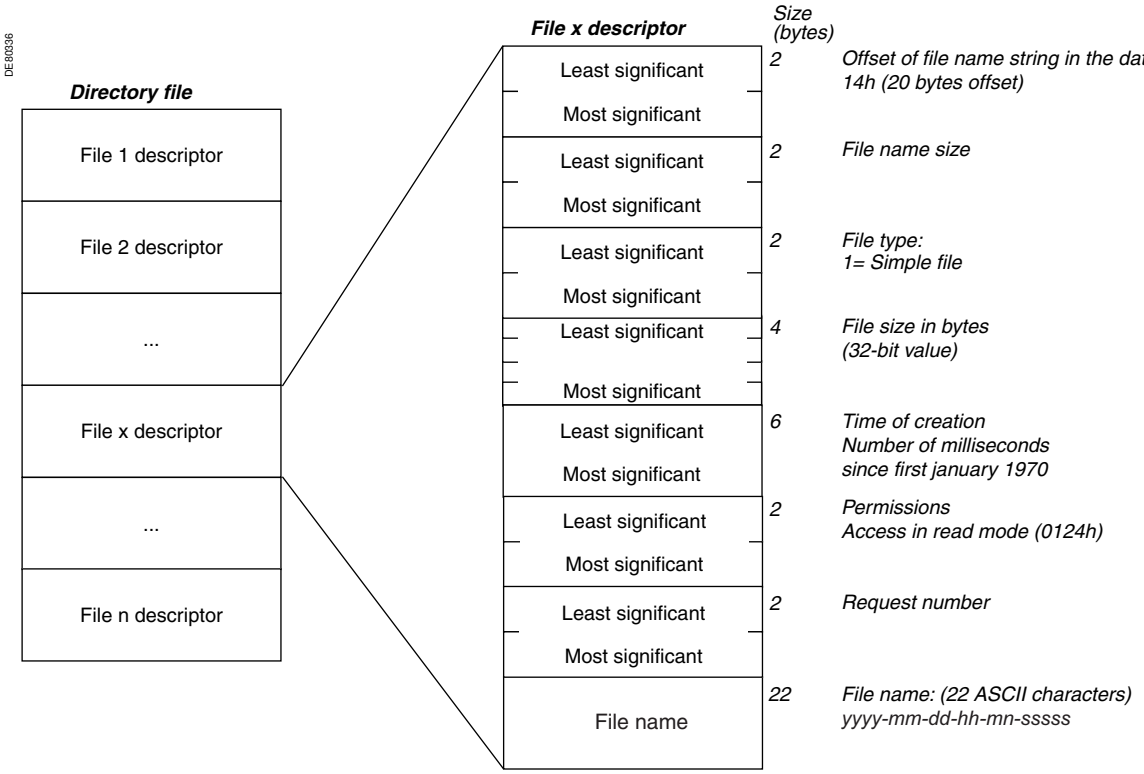
Object data	*Size (bytes)*	*Description*
File Name Offset	*2*	*Offset of file name string in the data object*
File Name Size	*2*	
File Type	*2*	*0 = directory file* *1 = simple file*
File Size	*4*	*Size of file in bytes (32-bit value)*
Time of creation	*6*	*Number of milliseconds since 1st January 1970*
Permissions	*2*	*Access in read mode (0124h)*
Request ID	*2*	*Request number*
File Name	*n*	*ASCII string (n characters)*

Example of DNP3 frames exchanged in order to read a file

Operation	Fct	Obj	Var	Sequence Application Layer Octets
Open	25	70	3	0xC0 25 70 03 0x5B.....(object data)
Open response	129	70	4	0xE0 129 IINs 70 04 0x5B.....(object data)
Confirm				0xC0 00
Read (Block 0)	1	70	5	0xC1 70 05 0x5B.....(object data)
Null Response				0xC1 129 IINs
N Poll				0xC3 01 Class poll
N+1 Poll				0xC3 01 Class poll
Poll response (File Data returned as event)	129	70	5	0xE3 129 70 05 0x5B.....(object data)
Confirm				0xC3 00
Read (Block 1)	1	70	5	0xC4 01 70 05 0x5B.....(object data)
Null Response				0xC1 129 IINs
N Poll				0xC5 01 Class poll
N+1 Poll				0xC6 01 Class poll
Poll response (File Data returned as event)	129	70	5	0xE3 129 70 05 0x5B.....(object data)
Confirm				0xC6 00
Read (Block 2, last Block)	1	70	5	0xC7 01 70 05 0x5B.....(object data)
Null Response				0xC7 129 IINs
N Poll				0xC8 01 Class poll
N+1 Poll				0xC9 01 Class poll
Poll response (File Data returned as event)	129	70	5	0xE9 129 70 05 0x5B.....(object data)
Confirm				0xC9 00
Close	26	70	4	0xCA 26 70 04 0x5B.....(object data)
Returns Status In Status Object	129	70	4	0xEA 129 IINs 70 04 0x5B.....(object data)
Confirm				0xCA 00

DR, TR, DL, MS, MT or NS directory files

A directory file is a list of file descriptors.
A file descriptor is coded in accordance with the DNP3 File Descriptor Object structure.



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

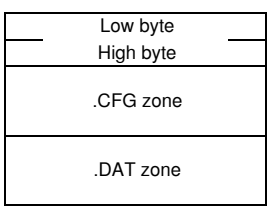
Disturbance records produced by Sepam are coded in COMTRADE format.

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 files are stored in Sepam in the directory DR. The name of each file gives the date and time of its production. It is coded yyyy-mm-dd-hh-mn-sssss

A disturbance record file produced by Sepam is structured in such a way that the COMTRADE .CFG and .DAT files can be easily obtained.

Structure of a Sepam disturbance record file



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

The tripping context files are stored in Sepam in the directory TR.
The name of each file gives the date and time of its production. It is coded: 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 a Sepam tripping context file

	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*	
Measurement 45	*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 45 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 I0 Σ	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
45	Phase rotation mode	32NS	0=123/1=132

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 unsigned value
- 32 S: 32-bit signed value

Data Log files DL\yyyy-mm-dd-hh-mn-sssss

Data Log records produced by Sepam are coded in COMTRADE format.

A COMTRADE Data Log 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 Data Log record files are stored in Sepam in the directory DL. The name of each file gives the date and time of its production. It is coded yyyy-mm-dd-hh-mn-sssss.

A Data Log record file produced by Sepam is structured in such a way that the COMTRADE .CFG and .DAT files can be easily obtained.

Structure of a Sepam Data Log record file

	Size (bytes)	*Description*
Low byte High byte	*2*	*Size in bytes (n) of the .CFG configuration data zone (16-bit value)*
.CFG zone	*n*	*Configuration parameters (.CFG file, ASCII format)*
.DAT zone	*X*	*Samples values (.DAT file, binary format)*

Motor Start file MS\yyyy-mm-dd-hh-mn-sssss

Motor start report files produced by Sepam are coded in COMTRADE format.

A COMTRADE Motor start report consists of 2 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 Motor start report files are stored in Sepam in the directory MS. The name of each file gives the date and time of its production. It is coded yyyy-mm-dd-hh-mn-sssss.

A Motor start report produced by Sepam is structured in such a way that the COMTRADE .CFG and .DAT files can be easily obtained.

Structure of a Sepam Motor Start file

	Size (bytes)	*Description*
Low byte High byte	*2*	*Size in bytes (n) of the .CFG configuration data zone (16-bit value)*
.CFG zone	*n*	*Configuration parameters (.CFG file, ASCII format)*
.DAT zone	*X*	*Samples values (.DAT file, binary format)*

Motor Trend file MT\yyyy-mm-dd-hh-mn-sssss

Motor Trend records produced by Sepam are coded in COMTRADE format.

A COMTRADE Motor Trend 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 Motor Trend record files are stored in Sepam in the directory MT. The name of each file gives the date and time of its production. It is coded yyyy-mm-dd-hh-mn-sssss.

A Motor Trend record file produced by Sepam is structured in such a way that the COMTRADE .CFG and .DAT files can be easily obtained.

Structure of a Sepam Motor Trend record file

	Size (bytes)	*Description*
Low byte High byte	*2*	*Size in bytes (n) of the .CFG configuration data zone (16-bit value)*
.CFG zone	*n*	*Configuration parameters (.CFG file, ASCII format)*
.DAT zone	*X*	*Samples values (.DAT file, binary format)*

Out-of-Sync Context files NS\yyyy-mm-dd-hh-mn-sssss

The Out-of-sync context file is stored in Sepam in the directory NS. The file name gives the date and time of its production. It is coded yyyy-mm-dd-hh-mn-sssss.

An Out-of-sync context file contains a set of measurements recorded by Sepam during a synchronisation attempt.
It consists of two parts:
- Date of the context, coded on 8 bytes
- List of measurements

Structure of a Sepam out-of-sync context file

	Size (bytes)	*Description*
Date	*8*	*Context date*
Measurement 1	*4*	*List of the 3 measurements*
Measurement 2	*2*	
Measurement 3	*2*	

The Out-of-sync context comprises the 3 measurements listed in the table below.

No.	Information	Format	Unit
1	Voltage difference - dU	32NS	0.1 % of Uns Sync1
2	Frequency difference - dF	16NS	0,001 Hz
3	Phase difference - dPhi	16NS	0,1°

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