Sepam - RS 485 network connection guide
12/2011
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.

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

<table>
<thead>
<tr>
<th><strong>DANGER</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER</strong> indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>WARNING</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WARNING</strong> indicates a potentially hazardous situation which, if not avoided, can result in death or serious injury.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CAUTION</strong></th>
</tr>
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<tbody>
<tr>
<td><strong>CAUTION</strong> indicates a potentially hazardous situation which, if not avoided, can result in minor or moderate injury.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th><strong>NOTICE</strong></th>
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<tbody>
<tr>
<td><strong>NOTICE</strong> is used to address practices not related to physical injury.</td>
</tr>
</tbody>
</table>

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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Introduction

Sepam protection units have an optional communication function. This manual is related to Sepam:
- series 10
- series 20
- series 40 (including the Sepam series 48, and the applications S5x and T5x)
- series 60
- series 80
- 2000

These Sepam units may be connected to any 2-wire or 4-wire RS 485 communication network and exchange all the information necessary for centralized control of the electrical installation via a supervisory system, using Modbus master/slave protocol.

To reduce cabling errors, the cause of most problems encountered in the implementation of communication networks, and limit those networks’ sensitivity to disturbances relating to the environment, a group of accessories is available to make it easier to connect Sepam units to an RS 485 network.

This manual presents:
- general characteristics of RS 485 networks
- accessories for connecting Sepam units to an RS 485 network
- how to associate them, illustrated by a few examples.

Sepam series 20, series 40, series 60, series 80 and Sepam 2000 communication architecture complies with the OSI (Open Systems Interconnect) model proposed by the International Standardization Organization (ISO).

The physical transmission of data signals complies with the EIA RS 485 standard (differential voltage transmission mode).

An RS 485 network may be cabled according to two different principles:
- 2-wire RS 485 network
- 4-wire RS 485 network.
**RS 485 network**

**Communication on the RS 485 bus**

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**Definition of data signals**

The EIA-485 standard (commonly known as RS 485) defines the electrical characteristics of a serial communication. This takes place on an electrical line, called the bus, which in practice consists of a twisted pair.

Data is transmitted by voltage changes in differential mode. The resulting voltage is usually around 5 V but this value can vary between 400 mV and 12 V depending on the startup conditions. The voltage delivered by a loaded driver must not be less than +/- 1.5 V.

The transmission driver injects 2 symmetrical signals onto the bus with a maximum amplitude of 6 V compared to the 0 V:

The resulting differential voltage is used to construct the binary signals 1 or 0. The transmitter line A will be negative with respect to line B for a binary 1, MARK or OFF state. The transmitter line A will be positive with respect to line B for a binary 0, SPACE or ON state.

**Nature of real-life signals**

In real-life conditions, the signals are distorted because the bus is not a perfect component. The choke and the lineic capacitance of the cable used slow down the edges and distort the dwell steps. In order to conserve the integrity of these signals it is essential to observe a few setup rules as described below.
**Choosing a topology**

Setting up RS 485 communication requires a bus-type topology. Loop or ring-type topologies are prohibited.

Loop or ring-type topology must be avoided as it does not allow bus impedance matching: the loop has no ends and the star causes as many reflections as it has branches. See "Bus matching", page 10.

**Choosing the type of connection**

Daisy-chain connection is the preferred type.
RS 485 network

Architectures

Example of architectures to be avoided

(A) The tap links should be less than 3 meters (the impact of reflection remains very low).

(B) The Y configuration is similar to a star.

(C) Clusters containing the master on the left and the 3 stations on the right constitute subnets that can cause as many reflections as slaves and prevent correct bus matching.

Architectures to be used in this configuration
**Structure of the bus**

### Physical medium

The bus consists of a cable containing between 1 and 3 pairs of shielded twisted conductors.

1 or 2 pairs are used to transmit data, depending on whether a 2-wire or 4-wire diagram is used. In the case of Sepam series 20, series 40, series 60 and series 80, a third pair may be needed to transport the power supply for the communication interfaces (distributed power supply).

In addition to carrying the differential signal, use of a shielded twisted pair can increase immunity to electromagnetic interference (EMC). Indeed, interlacing the strands can reduce to the absolute minimum the distance separating the 2 data wires, thus reducing the surface area able to pick up interference.

Similarly, the communication bus emissivity is reduced, which limits the electromagnetic interference affecting other equipment.

The pairs are shielded individually or all together by a copper braid. The shielding is connected at both ends but does not need to provide equipotential bonding. An earthing conductor with an appropriate cross-section must always connect the various devices if they are in different enclosures or buildings.

Particular care must be taken when connecting the shielding to make sure it is effective. For further information on the setup arrangements, see the shield examples page 15 and the Installation Assistance Guide for Sepam, reference SEPED309035EN.

### Cable specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overlap on twisted pair with tinned copper braid shielding</td>
<td>&gt; 65%</td>
</tr>
<tr>
<td>Resistance per unit length</td>
<td>&lt; 100 Ω/km</td>
</tr>
<tr>
<td>Cross-section</td>
<td>&gt; 0.22 mm² (24 AWG)</td>
</tr>
<tr>
<td>Characteristic impedance</td>
<td>120 Ω</td>
</tr>
<tr>
<td>Capacitance between conductors</td>
<td>&lt; 60 pF/m</td>
</tr>
<tr>
<td>Capacitance between conductors and shielding</td>
<td>&lt; 100 pF/m</td>
</tr>
<tr>
<td>Total cable length (unless restricted by the distributed power supply)</td>
<td>&lt; 1300 m</td>
</tr>
</tbody>
</table>

### Bus driver

The electronic circuit transmitting on the bus can, if needed, make available its reference voltage: the common.

In the Sepam range, only the series 10 offers this third signal, the others working purely as 2-wire or 4-wire.

#### Bus driver with common

![Bus driver diagram](image-url)
RS 485 network

Structure of the bus

Bus driver without common

Maximum number of stations on the bus

The maximum number of stations is limited by the addressing logic to 247 in Modbus and 254 in JBus. This logic limit cannot usually be achieved because electric parameters restrict the number of stations that can be physically connected to a much lower value.

Bus drivers are usually designed to supply 32 stations equipped with a receiver that imposes a so-called unitary load on the bus, which is the case for interfaces in the Sepam range. There are also receivers that impose a lesser load on the bus, allowing the number of stations to be increased.

For Sepam series 20/40/48/60/80 another limitation comes into play: the distributed power supply for the ACE949, ACE959 and ACE969 interfaces.

When the distributed power supply is supplied by an ACE909 or ACE919 converter the power it delivers limits the number of stations to 12.

When all the Sepam relays are connected via a bus cable whose specifications comply with the values stated in the above table, the voltage drop in the wires transmitting the distributed power supply is another limiting factor. In this case, you must choose between bus length and the maximum number of stations, see details in the table on page 18.

It is possible to get round this restriction by installing local distributed power supply points at judicious intervals around the architecture.
RS 485 network

Structure of the bus

Bus matching
Termination with resistors
High-speed data transmission on a bus is affected by the phenomenon of reflection at its ends. This phenomenon causes major signal distortion and must be countered. To do this, line impedance matching resistors are installed at both physical ends of the bus. For the RS 485 bus the value of these resistors is 120 to 150 Ω. The value of the resistors is in theory equal to the cable’s characteristic impedance. The value 150 Ω is recommended by Schneider Electric because it provides good matching and restricts the load imposed on the transmission drivers. These line-end resistors (called Rc) are usually found in communication setup accessories and can be turned on or off by microswitches. It is important to ensure that only 2 of these resistors are on on the entire bus.

The master is normally positioned at one end of the bus. In this case it should incorporate one of the 2 line-end resistors but this function is not necessarily allocated to the master.

If the master occupies a different physical position on the bus, matching should be implemented using the 2 slaves in the end positions.

Termination by RC network
A line terminator consisting of a resistor and a capacitor in series (VW3A8306 RC for example) can eliminate the DC load imposed on the drivers. **This type of termination should not be used when the common for the interfaces is not distributed.** For the Sepam range it should only be used with series 10 and only if the bus is solely linking Sepam series 10 relays. Moreover, Sepam series 10 Modbus communication works perfectly with purely resistive termination, which is the preferred type.
**Structure of the bus**

- **Polarization of the bus**
  The RS 485 standard defines a dead band of +/- 200 mV around the 0 V. In this zone some types of receivers are in an undefined state. To avoid getting into this state **the bus must be polarized**.
  To do this, 2 Rp resistors are installed, one between the +5 V and line B (L-) and one other between the 0 V and line A (L+) in order to pull these lines up to a defined voltage, should no transmitter be able to do it. Polarization results in a continuous flow of current across the line impedance matching resistors. **Line impedance matching and polarization resistors must be present simultaneously**.
  The bus should only be polarized in one location on the line to avoid random transmission. It is recommended that the master’s power supplies and polarization resistors be used.
  Rp resistors have a value of around 470 Ω (450 to 650 Ω). The Sepam 2000’s Modbus communication setup accessories and ACE909/919 converters can also be used to provide this polarization. However none of the Sepam series 10 to 80 interfaces can do so.

- **Please note:**
  Some equipment items do not comply with the RS 485 standard with respect to polarities as well as polarization and line impedance matching.
  When connecting equipments of several manufacturers, make sure to check these points.

- **Signal names**
  Active bus signals can have different names depending on where in the world they were manufactured and by whom.
Two-wire cabling of the communication network makes it possible to use a single shielded pair, which means simple cabling.
Each item of equipment connected to the network includes a transmitter and a receiver that are connected to the same cable.
Since communication is half duplex, alternating and two-way, messages are conveyed in both directions on the same line from the master to the slaves and vice versa.
Communication takes place alternately, with the transmitters taking turns on the line. The master can be any station.

**Connection of the stations**
The network comprises a single cable (a shielded, twisted pair). The various stations in the network are connected by linking both of the following:

- all the outputs marked + (TD+, RD+) to the network + wire (marked L+)
- all the outputs marked - (TD-, RD-) to the network - wire (marked L-).

**General architecture of a 2-wire RS 485 network**

**Line-end impedance matching**
Two 150 Ω resistors (Rc) are required (one at each end) to match line impedance. Each item of equipment, as well as each connector, connection box or Sepam interface, contains a 150 Ω resistor which can be used for this purpose.

**Polarization of the RS 485 network**
Polarization creates a continuous flow of current through the network, putting all the receivers in deactivated status until a transmitter is validated.
The network is polarized by connecting the (L+) line to the 0 V and the (L-) line to the 5 V via two 470 Ω polarization resistors (RP).
The network should only be polarized in one location on the line to avoid random transmission.
It is recommended that the master’s power supplies and resistors be used.
The ACE 909-2 and ACE 919 converters provide this polarization.
Some Schneider equipment offers also this possibility.

**Please note:**
Some equipment items do not comply with the RS 485 standard with respect to polarities as well as polarization and line impedance matching.
When connecting equipments of several manufacturers, make sure to check these points.
RS 485 network

4-wire RS 485 network

For 4-wire connection of the communication network, 2 shielded pairs are used. With 4-wire connection, the "master station" is defined and then the two communication lines, a master to slaves "transmission" line and a slaves to master "receiving" line.

Communication is alternating half duplex. Requests are sent from the master to the slaves on the transmission line. Replies are sent from the slaves to the master on the receiving line.

Connection of slave stations
The different network are stations are connection by linking:
- RD+ inputs to the L+ "transmission" line (A')
- RD- inputs to the L- "transmission" line (B')
- TD+ outputs to the L+ "receiving" line (A)
- TD- outputs to the L- "receiving" line (B).

Connection of the master station
The connection of the master station is the opposite of that of the slave stations:
- RD+ input to the L+ "receiving" line (A)
- RD- input to the L- "receiving" line (B)
- TD+ output to the L+ "transmission" line (A')
- TD- output to the L- "transmission" line (B').

General architecture of a 4-wire RS 485 network

Line-end impedance matching
Four 150 Ohm resistors (Rc) are mandatory (one at each end) for impedance matching of both the transmission and receiving lines.

Polarization of the RS 485 network
It is necessary to polarize both the transmission and receiving lines. Polarization of the transmission and receiving lines is not ensured by the Sepam interfaces.

\[ Rc = \text{load resistor (150 ohms)} \]
\[ Rp = \text{polarization resistor (470 ohms)} \]
RS 485 network

Coexistence of 2-wire and 4-wire equipment

When it is necessary for 2-wire and 4-wire equipment to coexist on the same bus, the bus must always be reduced to a 2-wire bus. This operation is performed by short-circuiting:
- Tx + with Rx + giving the signal D1
- Tx - with Rx - giving the signal D0

The diagram illustrates the coexistence of 2-wire/4-wire RS 485 equipment. The 4-wire network is converted to a 2-wire network by short-circuiting the appropriate points. The 2-wire network is obtained.

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2-wire network obtained.
Introduction
It is essential to connect shielded cables in order to protect high-frequency equipment. When the connection is made by a pigtail, i.e. a long wire, the protection is no longer effective at high frequencies.

Connecting the shielding through a partition
The most effective way to connect the shielding is connection using a metal cable gland through a partition, taking care to rough up the paintwork to ensure good electrical contact. It is possible to use a jumper that can ensure at least 180° contact.

Connection to screw terminal block
When connecting to a screw terminal block where it is impossible to use a jumper to connect the shielding, the length of the pigtail must be minimal.
Connecting the shielding with a connector

When using a connector to connect the shielding, the mechanism should provide 360° electrical continuity between the cable shielding and the equipment ground.
### Converter selection guides

| To supervisor | ACE909 | ACE909-2 | ACE919CA | ACE919CC | EGX200 | EGX400 | EGX100 | EGX300 | ECi850 / 
| Physical interface | 1 RS 232 port | 1 RS 232 port | 1 port 2-wire RS 485 | 1 port 2-wire RS 485 | 1 Ethernet port 10/100 base Tx | 1 Ethernet port 10/100 base Tx | 1 Ethernet port 10/100 base Tx | 1 Ethernet port 10/100 base Tx | G3200 |
| Modbus RTU | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| IEC 60870-5-103 | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| DNP3 | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| To Sepam | 12 Vdc | 12 or 24 Vdc | 12 or 24 Vdc | 12 or 24 Vdc | 12 or 24 Vdc | 12 or 24 Vdc | 12 or 24 Vdc | 12 or 24 Vdc | 12 or 24 Vdc |
| Physical interface | 1 port 2-wire RS 485 | 1 port 2-wire RS 485 | 1 port 2-wire RS 485 | 1 port 2-wire RS 485 | 1 port 2-wire RS 485 | 1 port 2-wire RS 485 | 1 port 2-wire RS 485 | 1 port 2-wire RS 485 | 1 port 2-wire RS 485 |
| Modbus RTU | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| IEC 60870-5-103 | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| DNP3 | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) | (1) |
| Max number of connected Sepam interfaces | 12 | 12 | 12 | 12 | 32 per port | 32 per port | 32 | 64 | 2 Sepam series 60/80 or 3 Sepam series 40/48 or 5 Sepam series 20 |

#### Power supply

<table>
<thead>
<tr>
<th></th>
<th>DC</th>
<th>AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>110 to 220 V</td>
<td>24 to 48 V</td>
</tr>
<tr>
<td>AC</td>
<td>24 V</td>
<td>24 V</td>
</tr>
</tbody>
</table>

(1) The supervisor protocol is the same as for Sepam.
(2) Limitation due to the power of the supply for the distributed power supply.

**Nota:** All these interfaces support the E-LAN protocol.

### Communication-interface selection guide

<table>
<thead>
<tr>
<th>Type of network</th>
<th>ACE949</th>
<th>ACE949-2</th>
<th>ACE959</th>
<th>ACE969TP</th>
<th>ACE969TP-2</th>
<th>ACE969FO</th>
<th>ACE969FO-2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protocol</strong></td>
<td>Modbus RTU</td>
<td>Modbus RTU</td>
<td>Modbus RTU</td>
<td>Modbus RTU</td>
<td>Modbus RTU</td>
<td>Modbus RTU</td>
<td>Modbus RTU</td>
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<td>(1)</td>
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<tr>
<td>DNP3</td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
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<tr>
<td>IEC 60870-5-103</td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
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<tr>
<td>DNP3</td>
<td>(1)</td>
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<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
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<td>(1)</td>
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<tr>
<td><strong>Physical interface</strong></td>
<td>RS 485</td>
<td>RS 485</td>
<td>RS 485</td>
<td>RS 485</td>
<td>RS 485</td>
<td>RS 485</td>
<td>RS 485</td>
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<td></td>
<td>2-wire</td>
<td>2-wire</td>
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<td></td>
<td>4-wire</td>
<td>4-wire</td>
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<tr>
<td><strong>Fiber optic</strong></td>
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</tr>
<tr>
<td><strong>Power supply</strong></td>
<td>DC</td>
<td>DC</td>
<td>DC</td>
<td>DC</td>
<td>DC</td>
<td>DC</td>
<td>DC</td>
</tr>
<tr>
<td>AC</td>
<td>Supplied by Sepam</td>
<td>Supplied by Sepam</td>
<td>Supplied by Sepam</td>
<td>Supplied by Sepam</td>
<td>Supplied by Sepam</td>
<td>Supplied by Sepam</td>
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</tr>
<tr>
<td></td>
<td>Supplied by Sepam</td>
<td>Supplied by Sepam</td>
<td>24 to 250 V</td>
<td>24 to 250 V</td>
<td>24 to 250 V</td>
<td>24 to 250 V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>110 to 240 V</td>
<td>110 to 240 V</td>
<td>110 to 240 V</td>
<td>110 to 240 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Distributed power supply</strong></td>
<td>12 Vdc only</td>
<td>12 or 24 Vdc</td>
<td>12 or 24 Vdc</td>
<td>12 or 24 Vdc</td>
<td>12 or 24 Vdc</td>
<td>12 or 24 Vdc</td>
<td>12 or 24 Vdc</td>
</tr>
<tr>
<td></td>
<td>(1) Only one connection possible, S-LAN or E-LAN.</td>
<td>(2) Not supported simultaneously (1 protocol per application).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
### General characteristics

#### Characteristics of Sepam communication interfaces

<table>
<thead>
<tr>
<th></th>
<th>Sepam series 10 A</th>
<th>Sepam series 20/40/48/60/80</th>
<th>Sepam 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of transmission</strong></td>
<td>Asynchronous serial</td>
<td>Asynchronous serial</td>
<td>Asynchronous serial</td>
</tr>
<tr>
<td><strong>Protocol</strong></td>
<td>Modbus / Jbus slave</td>
<td>Modbus / Jbus slave</td>
<td>Modbus / Jbus slave</td>
</tr>
<tr>
<td><strong>Rate</strong></td>
<td>4800, 9600, 19200, 38400 bauds</td>
<td>4800, 9600, 19200, 38400 bauds</td>
<td>300, 600, 1200, 2400, 4800, 9600, 12000, 38400 bauds</td>
</tr>
<tr>
<td><strong>Frame format</strong></td>
<td>11 bits (1 start, 8 bits, 1 parity, 1 stop)</td>
<td>11 bits (1 start, 8 bits, 1 parity, 1 stop)</td>
<td>11 bits (1 start, 8 bits, 1 parity, 1 stop)</td>
</tr>
<tr>
<td><strong>Parity bit setup</strong></td>
<td>No parity check</td>
<td>No parity check</td>
<td>No parity check</td>
</tr>
<tr>
<td></td>
<td>Even parity</td>
<td>Even parity</td>
<td>Even parity</td>
</tr>
<tr>
<td></td>
<td>Odd parity</td>
<td>Odd parity</td>
<td>Odd parity</td>
</tr>
<tr>
<td><strong>Maximum number of slaves on a Modbus RS 485 network</strong></td>
<td>31</td>
<td>25 (1)</td>
<td>32</td>
</tr>
<tr>
<td><strong>RS 485 electrical interface</strong></td>
<td>Embedded (connector C) 2-wire RS 485</td>
<td>ACE949-2, compliant with the EIA 2-wire differential RS 485 standard</td>
<td>Communication coupler board compliant with the EIA 2-wire or 4-wire differential RS 485 standard</td>
</tr>
<tr>
<td><strong>Communication interface supply</strong></td>
<td>Interface integrated in the product</td>
<td>External, by 12 Vdc or 24 Vdc auxiliary supply</td>
<td>By Sepam 2000</td>
</tr>
<tr>
<td><strong>Branch length</strong></td>
<td>3 m maximum</td>
<td>3 m maximum</td>
<td>3 m maximum</td>
</tr>
<tr>
<td><strong>Maximum length of RS 485 network with standard cable</strong></td>
<td>1300 m</td>
<td>With 12 Vdc bus-supplied interfaces (2): 320 m with 5 Sepam 180 m with 10 Sepam 160 m with 20 Sepam 125 m with 25 Sepam With interfaces with 24 Vdc bus-supplied interfaces (2): 1000 m with 5 Sepam 750 m with 10 Sepam 450 m with 20 Sepam 375 m with 25 Sepam</td>
<td>1300 m</td>
</tr>
</tbody>
</table>

(1) Limitation by voltage drop on the distributed power supply wires.
(2) Lengths multiplied by 3 with a high-performance FILEA cable with a maximum of 1300 m.
Communication interfaces

Sepam series 20/40/48/60/80

ACE949-2 and ACE959 multi-protocol interfaces

2 modules may be used for simple, dependable implementation of the Sepam communication option:
- **ACE949-2**: communication interface for 2-wire RS 485 network
- **ACE959**: communication interface for 4-wire RS 485 network.

The ACE949-2 and ACE959 remote modules are connected to the C connector of the Sepam base unit using the CCA612 prefabricated cable (L = 3 m). They are to be supplied by an external 12 Vdc or 24 Vdc ±10%, 500 mA supply. The 12 or 24 Vdc supply may be provided by the ACE909-2 or ACE919 converters.

*N.B.* The ACE949-2 interface replaces the ACE949 interface.

### ACE949-2: interface for 2-wire RS 485 network

![Diagram of ACE949-2](image)

- **Rx+**, Rx-: Sepam receiving (eq IN+, IN-)
- **Tx+**, Tx-: Sepam transmitting (eq OUT+, OUT-)

(1) Depth with CCA77x connection cord: 70 mm.
(2) Distributed power supply with separate cabling or included in the shielded cable (3 pairs).
(3) Terminal block for connection of the module providing the distributed power supply.

### ACE959: interface for 4-wire RS 485 network

![Diagram of ACE959](image)
Function
The ACE969 multi-protocol communication interfaces are for Sepam series 20, Sepam series 40, Sepam series 60 and Sepam series 80. They have two communication ports to connect a Sepam to two independent communication networks:
- The S-LAN (Supervisory Local Area Network) port is used to connect Sepam to a communication network dedicated to supervision, using one of the three following protocols:
  - IEC 60870-5-103
  - DNP3
  - Modbus RTU.
- The communication protocol is selected at the time of Sepam parameter setting.
- The E-LAN (Engineering Local Area Network) port, reserved for Sepam remote parameter setting and operation using the SFT2841 software.

There are two versions of the ACE969 interfaces, which are identical except for the S-LAN port:
- ACE969TP-2 (Twisted Pair), for connection to an S-LAN network using a 2-wire RS 485 serial link
- ACE969FO-2 (Fiber Optic), for connection to an S-LAN network using a fiber-optic connection (star or ring).

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

Compatible Sepam
The ACE969TP-2 and ACE969FO-2 multi-protocol interfaces are compatible with the following Sepam:
- Sepam series 20 version ≥ V0526
- Sepam series 40 version > V3.00 (not compatible with series 48)
- Sepam series 60 all versions
- Sepam series 80 base version and application version ≥ V3.00.

Characteristics
ACE969TP-2 and ACE969FO-2 module

Technical characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>ACE969TP-2</th>
<th>ACE969FO-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.285 kg (0.628 lb)</td>
<td></td>
</tr>
<tr>
<td>Assembly</td>
<td>On symmetrical DIN rail</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-25°C to +70°C (-13°F to +158°F)</td>
<td></td>
</tr>
<tr>
<td>Environmental characteristics</td>
<td>Same characteristics as Sepam base units</td>
<td></td>
</tr>
</tbody>
</table>

Power supply

<table>
<thead>
<tr>
<th>Parameter</th>
<th>ACE969TP-2</th>
<th>ACE969FO-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>24 to 250 Vdc</td>
<td>110 to 240 Vac</td>
</tr>
<tr>
<td>Range</td>
<td>-20% to +10%</td>
<td>-20% to +10%</td>
</tr>
<tr>
<td>Maximum consumption</td>
<td>2 W</td>
<td>3 VA</td>
</tr>
<tr>
<td>Inrush current</td>
<td>&lt; 10 A 100 μs</td>
<td></td>
</tr>
<tr>
<td>Acceptable ripple content</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>Acceptable momentary outages</td>
<td>20 ms</td>
<td></td>
</tr>
</tbody>
</table>

2-wire RS 485 communication ports

Electrical interface

| Standard                   | EIA 2-wire RS 485 differential |
| Distributed power supply   | ACE969-2 not required (built-in) |

Dimensions
Communication interfaces

Sepam series 20/40/60/80
ACE969TP-2
multi-protocol interfaces

ACE969-2 communication interfaces

ACE969TP-2

ACE969FO-2

1. Grounding/earthing terminal using supplied braid
2. Power-supply terminal block
3. RJ45 socket to connect the interface to the base unit with a CCA612 cord
4. Green LED: ACE969-2 energized
5. Red LED: ACE969-2 interface status
   - LED off = ACE969-2 set up and communication operational
   - LED flashing = ACE969-2 not set up or setup incorrect
   - LED remains on = ACE969-2 has faulted
6. Service connector: reserved for software upgrades
7. E-LAN 2-wire RS 485 communication port (ACE969TP-2 and ACE969FO-2)
8. S-LAN 2-wire RS 485 communication port (ACE969TP-2)
9. S-LAN fiber-optic communication port (ACE969FO-2).

2-wire RS 485 communication ports

S-LAN port (ACE969TP-2)

E-LAN port (ACE969TP-2 or ACE969FO-2)

1. Draw-out terminal block, with two rows of connections to the RS 485 2-wire network:
   - 2 black terminals: connection of RS 485 twisted-pair (2 wires)
   - 2 green terminals: connection of twisted pair for distributed power supply
2. Indication LEDs:
   - Flashing Tx LED: Sepam sending
   - Flashing Rx LED: Sepam receiving
3. Jumper for RS 485 network line-end impedance matching with load resistor (Rc = 150 Ω), to be set to:
   - \( R_x \), if the interface is not at the line end (default position)
   - Rc, if the interface is at the line end.
**Communication interfaces**

**Sepam series 20/40/60/80**

**ACE969TP-2**

**multi-protocol interfaces**

---

**Power supply and Sepam**

- The ACE969-2 interface connects to connector C on the Sepam base unit using a CCA612 cord (length = 3 m or 9.84 ft, white RJ45 fittings)
- The ACE969-2 interface must be supplied with 24 to 250 Vdc or 110 to 240 Vac.

---

**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.

---

**Terminals**

<table>
<thead>
<tr>
<th>Terminals</th>
<th>Type</th>
<th>Wiring</th>
</tr>
</thead>
</table>
| e1-e2 - supply | Screw terminals | Wiring with no fittings:  
- 1 wire with maximum cross-section 0.2 to 2.5 mm² (AWG 24-12)  
- 2 wires with maximum cross-section 0.2 to 1 mm² (AWG 24-18)  
- stripped length: 8 to 10 mm (0.31 to 0.39 in)  
Wiring with fittings:  
- recommended wiring with Schneider Electric fitting:  
  - DZ5CE015D for 1 wire 1.5 mm² (AWG 16)  
  - DZ5CE025D for 1 wire 2.5 mm² (AWG 12)  
  - AZ5DE010D for 2 wires 1 mm² (AWG 18)  
- tube length: 8.2 mm (0.32 in)  
- stripped length: 8 mm (0.31 in). |

---

**Protective earth**

| Screw terminal | 1 green/yellow wire, max. length 3 m (9.8 ft) and max. cross-section 2.5 mm² (AWG 12) |

---

**Functional earth**

| Ring lug | Earthing braid, supplied for connection to cubicle grounding |

---

[Image of wiring diagram]
2-wire RS 485 communication ports (S-LAN or E-LAN)

- Connection of the RS 485 twisted pair (S-LAN or E-LAN) to terminals A and B
- In case of ACE 969TP wired with ACE969TP-2:
  - connection of twisted pair for distributed power supply to terminals 5(V+) et 4(V-)
- In case of ACE969TP-2 only:
  - connection only on the terminal 4(V-) (ground continuity)
  - no need of external power supply
- The cable shields must be connected to the terminals marked 3(.) on the connection terminal blocks.
- Terminal marked 3(.) are linked by an internal connection to the earthing terminals of the ACETP-2 interface (protective and functional earthing): the shielding of the RS 485 cables is earthed as well.
- On the ACE960TP-2 interface, the cable clamps for the S-LAN and E-LAN RS 485 networks are earthed by the terminal 3.

If ACE969TP and ACE969TP-2 are used together, the external power supply is required.
Communication interfaces

Sepam series 20/40/48/60/80
Ethernet EGX200 gateway
Ethernet EGX400 server

Characteristics

<table>
<thead>
<tr>
<th>EGX200 and EGX400</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>700 g</td>
</tr>
<tr>
<td>Dimensions (H x W x P)</td>
<td>28 x 201 x 123 mm</td>
</tr>
<tr>
<td>Mounting</td>
<td>Symmetrical or asymmetrical DIN rail</td>
</tr>
<tr>
<td>Front or side position</td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>24 Vdc</td>
</tr>
<tr>
<td>100-240 Vac/24 Vdc adapter supplied</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>-30 °C to +80 °C</td>
</tr>
<tr>
<td>Humidity rating</td>
<td>5 % to 95 % relative humidity (without condensation) at +40 °C</td>
</tr>
</tbody>
</table>

Compliance with standards

Immunity in industrial environments
EN 61000-6-2
EN 61000-4-2/3/4/5/8/11
EN 55022/FCC class A
UL508
UL508 (complying with CSA C22.2 no. 14-M91)

Serial ports

Number of ports | 2 |
Types of ports | COM1: RS 485 (2-wire or 4-wire), COM2: RS 232 or RS 485 (2-wire or 4-wire), depending on settings |
Protocol | Modbus |
Baud rate | 38400 bauds |
Maximum number of directly connected devices | 32 per port, 64 in all |

Ethernet Port

<table>
<thead>
<tr>
<th>EGX200</th>
<th>EGX400</th>
</tr>
</thead>
</table>
Number of ports | 1 | 2 |
Types of ports | One 10/100baseTX port | One 10/100baseTX port, One 100baseFX port (multimode optic fiber) |
Protocol | Modbus/TCP | Modbus/TCP |
Baud rate | 10/100 MB | 10/100 MB |

Web server

Memory for custom HTML pages | None | 16 MB |

Installation

Side mounting on DIN rail

Front mounting on DIN rail

1. Power connector.
2. Ethernet indication LEDs.
3. 10/100BaseTX port for connection to Ethernet via an RJ45 connector.
4. 10/100BaseTX port for connection to Ethernet via an optic fiber (EGX400 only).
5. COM1: terminal block for RS 485 serial link.
6. COM1 indication LEDs.
7. COM2: terminal block for RS 485 serial link.
8. COM2 indication LEDs.
9. Mini-switches for setup of COM1 and COM2 ports.
10. COM2: subD-9 connector for connection to RS 232 serial link.
Communication interfaces

Sepam series 20/40/48/60/80
Ethernet EGX100 gateway
Ethernet EGX300 server

Characteristics

<table>
<thead>
<tr>
<th></th>
<th>EGX100</th>
<th>EGX300</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.17 kg (0.37 lb)</td>
<td></td>
</tr>
<tr>
<td>Dimensions (H x W x D)</td>
<td>91 x 72 x 68 mm</td>
<td></td>
</tr>
<tr>
<td>Mounting</td>
<td>DIN rail</td>
<td></td>
</tr>
<tr>
<td>Power-over-Ethernet (PoE)</td>
<td>Class 3</td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>24 Vdc if not using PoE</td>
<td></td>
</tr>
<tr>
<td>Operating temperature</td>
<td>–25 °C to +70 °C</td>
<td></td>
</tr>
<tr>
<td>Humidity rating</td>
<td>5 % to 95 % relative humidity (without condensation) at +55 °C</td>
<td></td>
</tr>
</tbody>
</table>

Regulatory/standards compliance for electromagnetic interference

| Emissions (radiated and conducted) | EN 55022/EN 55011/FCC Class A |
| Immunity for industrial environments | EN 61000-6-2 |
| Electrostatic discharge | EN 61000-4-2 |
| Radiated RF | EN 61000-4-3 |
| Electrical fast transients | EN 61000-4-4 |
| Surge | EN 61000-4-5 |
| Conducted RF | EN 61000-4-6 |
| Power frequency magnetic field | EN 61000-4-8 |

Regulatory/standards compliance for safety

| International (CB scheme) | IEC 60950 |
| USA | UL 508/UL 60950 |
| Canada | cUL (complies with CSA C22.2, n° 60950) |
| Europe | EN 60950 |
| Australia/New Zealand | AS/NZS25 60950, AS/NZS 60950 |

Serial ports

| Number of ports | 1 |
| Types of ports | RS 232 ou RS 485 (2-wire or 4-wire), depending on settings |
| Protocol | Modbus RTU/ASCII PowerLogic® (SY/MAX), JBus |
| Maximum baud rate | 38,400 ou 57,600 baud depending on settings |
| Maximum number of directly connected devices | 32 |

Ethernet port

| Number of ports | 1 |
| Types of ports | One 10/100 base TX (802.3af) port |
| Protocol | HTTP, Modbus TCP/IP, FTP, SNMP (MIB II), SNTP, SMTP |
| Baud rate | 10/100 MB |

Web server

| Memory for custom HTML pages | None |

Installation

DIN rail mounting (EGX100, EGX300)
Communication interfaces

Sepam series 20/40/60/80
ECI850 IEC 61850 Sepam server
G3200 IEC 61850 gateway

Function
The ECI850 can be used to connect Sepam series 20, Sepam series 40, Sepam series 60 and Sepam series 80 to an Ethernet network using the IEC 61850 protocol. The ECI850 creates the interface between the Ethernet/IEC 61850 network and a Sepam RS 485/Modbus network. A PRI surge arrester (ref. 16339) is supplied with the ECI850 to protect its power supply.

Compatible Sepam
The ECI850 servers are compatible with the following Sepam:
- Sepam series 20 version V0526
- Sepam series 40 version V3.00
- Sepam series 60 all versions
- Sepam series 80 base version and application version V3.00.

Characteristics

ECI850 module

Technical characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.17 kg (0.37 lb)</td>
</tr>
<tr>
<td>Assembly</td>
<td>On symmetrical DIN rail</td>
</tr>
</tbody>
</table>

Power supply

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>24 Vdc (± 10%) supplied by a class 2 power supply</td>
</tr>
<tr>
<td>Maximum consumption</td>
<td>4 W</td>
</tr>
<tr>
<td>Dielectric withstand</td>
<td>1.5 kV</td>
</tr>
</tbody>
</table>

Environmental characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>-25 °C to +70 °C (-13 °F to +158 °F)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 °C to +85 °C (-40 °F to +185 °F)</td>
</tr>
<tr>
<td>Humidity ratio</td>
<td>5 to 95% relative humidity (non condensing) at +55 °C (131 °F)</td>
</tr>
<tr>
<td>Degree of pollution</td>
<td>Class 2</td>
</tr>
<tr>
<td>Tightness</td>
<td>IP30</td>
</tr>
</tbody>
</table>

Electromagnetic compatibility

Emission tests

<table>
<thead>
<tr>
<th>Category</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emissions (radiated and conducted)</td>
<td>EN 55022/EN 55011/FCC Class A</td>
</tr>
</tbody>
</table>

Immunity tests - Radiated disturbances

<table>
<thead>
<tr>
<th>Category</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic discharge</td>
<td>EN 61000-4-2</td>
</tr>
<tr>
<td>Radiated radiofrequencies</td>
<td>EN 61000-4-3</td>
</tr>
<tr>
<td>Magnetic fields at the network frequency</td>
<td>EN 61000-4-8</td>
</tr>
</tbody>
</table>

Immunity tests - Conducted disturbances

<table>
<thead>
<tr>
<th>Category</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast transient bursts</td>
<td>EN 61000-4-4</td>
</tr>
<tr>
<td>Surges</td>
<td>EN 61000-4-5</td>
</tr>
<tr>
<td>Conducted radiofrequencies</td>
<td>EN 61000-4-6</td>
</tr>
</tbody>
</table>

Certification

Europe

<table>
<thead>
<tr>
<th>Category</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-wire/4-wire RS 485 communication port</td>
<td>2-wire or 4-wire differential RS 485 EIA</td>
</tr>
</tbody>
</table>

Electrical interface

<table>
<thead>
<tr>
<th>Category</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>2-wire or 4-wire differential RS 485 EIA</td>
</tr>
<tr>
<td>Max. number of Sepam units per ECI850</td>
<td>2 Sepam series 80 or 2 Sepam series 60 or 3 Sepam series 40 or 5 Sepam series 20</td>
</tr>
<tr>
<td>Maximum network length</td>
<td>1000 m (3300 ft)</td>
</tr>
</tbody>
</table>

Ethernet communication port

<table>
<thead>
<tr>
<th>Category</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of ports</td>
<td>1</td>
</tr>
<tr>
<td>Type of port</td>
<td>10/100 Base Tx</td>
</tr>
<tr>
<td>Protocols</td>
<td>HTTP, FTP, SNMP, SNTP, ARP, SFT, IEC 61850 TCP/IP</td>
</tr>
<tr>
<td>Transmission speed</td>
<td>10/100 Mbps</td>
</tr>
</tbody>
</table>
Communication interfaces

**Sepam series 20/40/60/80**
ECI850 IEC 61850 Sepam server
G3200 IEC 61850 gateway

---

**Characteristics (cont’d)**

<table>
<thead>
<tr>
<th>Electrical characteristics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal operating voltage</td>
<td>48 Vdc</td>
</tr>
<tr>
<td>Maximum discharge current</td>
<td>10 kA (8/20 μs wave)</td>
</tr>
<tr>
<td>Nominal discharge current</td>
<td>5 kA (8/20 μs wave)</td>
</tr>
<tr>
<td>Protection level</td>
<td>70 V</td>
</tr>
<tr>
<td>Response time</td>
<td>1 ns</td>
</tr>
</tbody>
</table>

**Connection**

- With cage terminals
- Cables with cross-section 2.5 to 4 mm² (AWG 12-10)

---

**Description**

1. LED: power-up/maintenance
2. Standard LEDs:
   - RS 485 LED: network link active
     - On: RS 485 mode
     - Off: RS 232 mode
   - Flashing green Tx LED: ECI850 transmission active
   - Flashing green Rx LED: ECI850 reception active
3. Ethernet LEDs:
   - LK green LED on: network link active
   - Flashing green Tx LED: ECI850 transmission active
   - Flashing green Rx LED: ECI850 reception active
   - 100 Mbps network speed
   - Off: 10 Mbps network speed
4. 10/100 Base Tx port for Ethernet connection by RJ45 connector
5. Connection of the 24 Vdc supply
6. Reset button
7. RS 485 connection
8. RS 485 parameter-setting selector switches
9. RS 232 connection

---

**Setting the RS 485 network parameters**

The network polarization and line impedance matching resistors and type of 2-wire/4-wire RS 485 network are selected by means of the RS 485 parameter-setting selector switches. These selector switches are configured by default for a 2-wire RS 485 network with network polarization and line impedance matching resistors.

<table>
<thead>
<tr>
<th>Network line impedance matching with resistor</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-wire RS 485</td>
<td>OFF</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-wire RS 485</td>
<td>ON</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Network polarization</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
</tr>
</thead>
<tbody>
<tr>
<td>at the 0 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>at the 5 V</td>
<td></td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Setting the Ethernet link parameters**

The TCSEAK0100 configuration kit can be used to connect a PC to the ECI850 to set the Ethernet link parameters.

<table>
<thead>
<tr>
<th>Selecting the RS 485 network</th>
<th>SW1</th>
<th>SW2</th>
<th>SW3</th>
<th>SW4</th>
<th>SW5</th>
<th>SW6</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-wire network</td>
<td>ON</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-wire network</td>
<td>OFF</td>
<td>OFF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PCRED399974EN - 12/2011
Communication interfaces
Sepam series 20/40/60/80
ECI850 IEC 61850 Sepam server
G3200 IEC 61850 gateway

Dimensions

Connection

- Connect the power supply and RS 485 twisted pair using cable with cross-section < 2.5 mm² (AWG 12)
- Connect the 24 Vdc power supply and the earth to inputs (1), (5) and (3) of the PRI surge arrester (ref. 16339) supplied with the ECI850
- Connect outputs (2), (8) and (6), (12) of the PRI surge arrester to the - and + terminals of the black screw terminal block
- Connect the RS 485 twisted pair (2-wire or 4-wire) to the (RX+ RX- or RX+ RX- TX+ TX-) terminals of the black screw terminal block
- Connect the RS 485 twisted pair shielding to the terminal of the black screw terminal block
- Connect the Ethernet cable to the green RJ45 connector

NOTICE

RISK OF DESTRUCTION OF THE ECI850
- Connect the PRI surge arrester in accordance with the wiring diagrams below.
- Check the quality of the earth connected to the surge arrester.
Failure to follow these instructions can result in equipment damage.
On Sepam 2000, the communication function is performed by an optional RS 485 communication coupler board, mounted on the CE40 supply board.

**Sepam 2000 communication interface**

Rear view of the CE40 board with communication coupler installed.

![Diagram of the communication coupler board for 2-wire or 4-wire RS 485 networks](image)

- **Diagram of the communication coupler board for 2-wire or 4-wire RS 485 networks**

  - Signal lamps:
    - Steady red: coupler fault or coupler initializing
    - Flashing green: communication active (transmission or receiving in progress)
  - Communication connector:
    - 9-pin Sub-D communication socket connector (Item B)

- **Diagram legend**:
  - **Rc** = load resistor
  - **Rp** = polarization resistor
Two connection boxes may be used to connect the Sepam 2000 communication interface to an RS 485 network:

- **CCA609 connection box:**
  - branching of a 2-wire or 4-wire RS 485 network
  - polarization of the RS 485 network by Sepam 2000

- **CCA629 connection box:**
  - branching of a 2-wire RS 485 network only
  - continuity of distributed power supply necessary for Sepam communication interfaces.

These two connection boxes are connected to the Sepam 2000 by a CCA602 prefabricated cable (L = 3 m). They facilitate the connection of new stations later on and make it possible to remove a station from the network without leaving any connectors “loose”.

**CCA609: 2-wire or 4-wire RS 485 connection box**

- validation of impedance matching on the end station only (strap 9-10)
- possibility of network polarization (in one location only) (straps 13-14 and 15-16) via a station
- earthing terminal
- 2-wire RS 485 network connection terminal block:
  - incoming: L+ to 1, L- to 2
  - outgoing: L+ to 3, L- to 4
- clamps for attachment and recovery of bus cable shielding (incoming/outgoing)

**CCA629: 2-wire RS 485 connection box**

- validation of impedance matching on the end station only (strap 1-2)
- earthing terminal
- 2-wire RS 485 network connection terminal block:
  - incoming: V+ to 1, V- to 2, L+ to 3, L- to 4
  - clamps for attachment and recovery of bus cable shielding (incoming/outgoing)

**Mechanical characteristics**

- mounting on symmetrical/asymmetrical DIN rail
- dimensions: 83 mm (L) x 85 mm (H) x 110 mm (D) with CCA602 connected
- weight: 120 g.
**Accessories**

**Sepam 2000**

**CCA619 connection box**

**CCA619: 2-wire RS 485 connector**

Each equipment item may be connected directly to a 2-wire RS 485 network via a CCA619 connector.

- dimensions: 23 mm (L) x 70 mm (H) x 50 mm (D)
- weight: 120 g.

**Connection of the CCA619 connector**

- Dimensions: 23 mm (L) x 70 mm (H) x 50 mm (D)
- Weight: 120 g.

**E61336DE10242**

**CCA619: 2-wire RS 485 connector**

Each equipment item may be connected directly to a 2-wire RS 485 network via a CCA619 connector.

- Dimensions: 23 mm (L) x 70 mm (H) x 50 mm (D)
- Weight: 120 g.

**CCA619 connection box**

**CCA619 is not at the end of the line:**

- 2-wire cable (standard)
- Line polarization
- 2 W
- POL

**CCA619 is at the end of the line:**

- 2 W
- POL

**CCA600: 9-pin plug**

The CCA600 connector may be used to make a cable of the appropriate length. A connector is supplied with the ACE909-2 and ACE919.

**CCA602: branching cable**

The CCA602 cable is used to create branches of the RS 485 network from the CCA609 or CCA629 connection box to each equipment item.

- It may also be used to connect the ACE909-2 converter (master / central computer link).
- This 3-meter cable comprises 9-pin sub-D connector with a metallic cover at either end.
RS 485 network cable

The RS 485 network cable needed to interconnect CCA connection boxes or ACE type interfaces should have the following characteristics:
- twisted pair with tinned copper braid shielding, coverage: > 65%
- resistance per unit length: < 100 Ω / km
- gauge: AWG 24
- characteristic impedance: 120 Ω
- capacitance between conductors: < 60 pF / m
- conductor and shielding: < 100 pF / m.

The total network cable length should not be greater than 1300 meters except limitation due to distributed power supply.

Examples of compatible standard cables:
- supplier: BELDEN
  - single-pair cable, reference 9841
  - 2-pair cable, reference 9842
- supplier: FILOTEX
  - 2-pair cable, reference FMA-2PS.

High-performance cables recommended for the connection of Sepam 1000*:
- cables with a pair dedicated to distributed power supply
  - resistance per unit length: < 34 Ω per km
  - AWG 20 gauge
- and 1 (or 2) pair(s) dedicated to the 2-wire or 4-wire RS 485 network
  - resistance per unit length: < 58 Ω / km
  - 1 supply pair (red-black)
  - AWG 22 gauge
- supplier: FILECA
  - 2-pair cable, reference F2644-1
    (1 red-black supply pair, 1 white-blue RS 485 pair)
    (cable distributed by Schneider Electric in 60 m strands, reference CCR301)
  - 3-pair cable, reference F3644-1
    (1 red-black supply pair, 2 white-blue and yellow-brown RS 485 pairs).

Wiring precautions

For the sake of both the safety of people and efficient combating against the effects of interference, the cabling of systems which comprise digital links must comply with a set of basic rules aimed at establishing an equipotential-bonded, meshed and earthed network.

Special care must be taken when making connections between buildings with earthing that is not interconnected.

For details and useful recommendations, please refer to the Schneider document DBTP 542 entitled “Modbus network guide”.

All the accessories make it possible to ensure the continuity of the cable shielding and regular grounding.

It is therefore necessary to ensure that:
- the 2 connectors at the ends of the CCA 602 branching cable are plugged in correctly and locked by the 2 screws specially provided
- the clamps are tightened onto the metallic shielding braid on each CCA609, CCA619, CCA629, ACE949-2, ACE959 connection box
- each CCA connection box is grounded (earthed) by a 2.5 mm2 diameter green-yellow wire or a short braid (< 10 cm) via the terminal specially provided
- the metal case of the ACE909-2, ACE919 converter is grounded (earthed) by a green-yellow mains power supply connector wire and an eye lug on the back of the case.
Accessories

ACE909-2 converters

Function
The ACE909-2 converter is used to connect a master/central computer equipped with a V24/RS 232 type serial port as a standard feature to stations connected to a 2-wire RS 485 network. Without requiring any flow control signals, after the parameters are set, the ACE909-2 converter performs conversion, network polarization and automatic dispatching of frames between the master and the stations by two-way simplex (half-duplex, single-pair) transmission.

The ACE909-2 converter also provides a 12 V DC or 24 V DC supply for the distributed power supply of the Sepam ACE949-2, ACE959 or ACE969-2 interfaces. The communication settings should be the same as the Sepam and supervisor communication settings.

Characteristics

<table>
<thead>
<tr>
<th><strong>Mechanical characteristics</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Weight</strong></td>
<td>0.280 kg (0.617 lb)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Electrical characteristics</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power supply</strong></td>
<td>110 to 220 Vac ± 10%, 47 to 63 Hz</td>
</tr>
<tr>
<td><strong>Galvanic isolation between ACE power supply and frame, and between ACE power supply and interface supply</strong></td>
<td>2000 Vrms, 50 Hz, 1 min</td>
</tr>
<tr>
<td><strong>Galvanic isolation between RS 232 and RS 485 interfaces</strong></td>
<td>1000 Vrms, 50 Hz, 1 min</td>
</tr>
<tr>
<td><strong>Protection by time-delayed fuse 5 mm x 20 mm (0.2 in x 0.79 in)</strong></td>
<td>1 A rating</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Communication and Sepam interface distributed supply</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data format</strong></td>
<td>11 bits: 1 start, 8 data, 1 parity, 1 stop</td>
</tr>
<tr>
<td><strong>Transmission delay</strong></td>
<td>&lt; 100 ns</td>
</tr>
<tr>
<td><strong>Distributed power supply for Sepam interfaces</strong></td>
<td>12 Vdc or 24 V CC, 250 mA max.</td>
</tr>
<tr>
<td><strong>Maximum number of Sepam interfaces with distributed supply</strong></td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Environmental characteristics</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating temperature</strong></td>
<td>-5°C to +55°C (+23°F to +131°F)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Electromagnetic compatibility</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IEC standard</strong></td>
<td>60255-22-4</td>
</tr>
<tr>
<td><strong>Value</strong></td>
<td>4 kV with capacitive coupling in common mode</td>
</tr>
<tr>
<td></td>
<td>2 kV with direct coupling in common mode</td>
</tr>
<tr>
<td></td>
<td>1 kV with direct coupling in differential mode</td>
</tr>
<tr>
<td><strong>Fast transient bursts, 5 ns</strong></td>
<td>60255-22-1</td>
</tr>
<tr>
<td><strong>1 MHz damped oscillating wave</strong></td>
<td>1 kV common mode</td>
</tr>
<tr>
<td><strong>1.2/50 μs impulse waves</strong></td>
<td>60255-5</td>
</tr>
<tr>
<td></td>
<td>0.5 kV differential mode</td>
</tr>
<tr>
<td></td>
<td>3 kV common mode</td>
</tr>
<tr>
<td></td>
<td>1 kV differential mode</td>
</tr>
</tbody>
</table>
**Accessories**

**ACE909-2 converters**

### Description and dimensions

- **A** Terminal block for RS 232 link limited to 10 m (33 ft).
- **B** Female 9-pin sub-D connector to connect to the 2-wire RS 485 network, with distributed power supply.
- **C** 1 screw-type male 9-pin sub-D connector is supplied with the converter.

#### Power-supply terminal block

1. Distributed power supply voltage selector switch, 12 Vdc or 24 V DC.
2. Protection fuse, unlocked by a 1/4 turn.
3. **LEDs:**
   - ON/OFF: on if ACE909-2 is energized
   - Tx: on if RS 232 sending by ACE909-2 is active
   - Rx: on if RS 232 receiving by ACE909-2 is active.
4. SW1, parameter setting of 2-wire RS 485 network polarization and line impedance matching resistors.

#### Function

<table>
<thead>
<tr>
<th>Rate (bauds)</th>
<th>SW2/1</th>
<th>SW2/2</th>
<th>SW2/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2400</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4800</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>9600</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>19200</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>38400</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

5. **SW2**, parameter setting of asynchronous data transmission rate and format (same parameters as for RS 232 link and 2-wire RS 485 network).

#### Converter configuration when delivered

- 12 Vdc distributed power supply
- 11-bit format, with parity check
- 2-wire RS 485 network polarization and impedance matching resistors activated.

### Connection

#### RS 232 link

- To 2.5 mm² (AWG 12) screw type terminal block **A**
- Maximum length 10 m (33 ft)
- Rx/Tx: RS 232 receiving/sending by ACE909-2
- OV: Rx/Tx common, do not earth.

#### 2-wire RS 485 link with distributed power supply

- To connector **B** female 9-pin sub-D
- 2-wire RS 485 signals: L+, L-
- Distributed power supply: V+ = 12 V DC or 24 V DC, V− = 0 V.

#### Power supply

- To 2.5 mm² (AWG 12) screw type terminal block **C**
- Reversible phase and neutral
- Earthed via terminal block and metal case (ring lug on back of case).
The ACE919 converters are used to connect a master/central computer equipped with an RS 485 type serial port as a standard feature to stations connected to a 2-wire RS 485 network. Without requiring any flow control signals, the ACE919 converters perform network polarization and impedance matching. The ACE919 converters also provide a 12 Vdc or 24 V DC supply for the distributed power supply of the Sepam ACE949-2, ACE959 or ACE969-2 interfaces. There are 2 types of ACE919 converter:
- ACE919CC, DC-powered
- ACE919CA, AC-powered.

**Characteristics**

**Mechanical characteristics**

- **Weight**: 0.280 kg (0.617 lb)
- **Assembly**: On symmetrical or asymmetrical DIN rail

**Electrical characteristics**

<table>
<thead>
<tr>
<th>Model</th>
<th>Power supply</th>
<th>Protection by time-delayed fuse 5 mm x 20 mm</th>
<th>Galvanic isolation between ACE power supply and frame, and between ACE power supply and interface supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACE919CA</td>
<td>110 to 220 Vac ±10%, 47 to 63 Hz</td>
<td>1 A rating</td>
<td>2000 Vrms, 50 Hz, 1 min</td>
</tr>
<tr>
<td>ACE919CC</td>
<td>24 to 48 Vdc ±20%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Communication and Sepam interface distributed supply**

- **Data format**: 11 bits: 1 start, 8 data, 1 parity, 1 stop
- **Transmission delay**: < 100 ns
- **Distributed power supply for Sepam interfaces**: 12 Vdc or 24 V CC, 250 mA max.
- **Maximum number of Sepam interfaces with distributed supply**: 12

**Environmental characteristics**

- **Operating temperature**: -5°C to +55°C (+23°F to +131°F)

**Electromagnetic compatibility**

<table>
<thead>
<tr>
<th>Value</th>
<th>IEC standard</th>
<th>4 kV with capacitive coupling in common mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2 kV with direct coupling in common mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 kV with direct coupling in differential mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value</th>
<th>IEC standard</th>
<th>1 kV common mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0.5 kV differential mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value</th>
<th>IEC standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2/50 μs impulse waves</td>
<td>60255-5</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**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.
ACE919 converters

Description and dimensions

A. Terminal block for 2-wire RS 485 link without distributed power supply.
B. Female 9-pin sub-D connector to connect to the 2-wire RS 485 network, with distributed power supply.
   1 screw-type male 9-pin sub-D connector is supplied with the converter.
C. Power supply terminal block.

1. Distributed power supply voltage selector switch, 12 V DC or 24 V DC.
2. Protection fuse, unlocked by a 1/4 turn.
3. ON/OFF LED: on if ACE919 is energized.
4. SW1, parameter setting of 2-wire RS 485 network polarization and line impedance matching resistors.

<table>
<thead>
<tr>
<th>Function</th>
<th>SW1/1</th>
<th>SW1/2</th>
<th>SW1/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polarization at 0 V via Rp -470 Ω</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polarization at 5 V via Rp +470 Ω</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-wire RS 485 network impedance matching by 150 Ω resistor</td>
<td>ON</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Converter configuration when delivered
- 12 Vdc distributed power supply
- 2-wire RS 485 network polarization and impedance matching resistors activated.

Connection

2-wire RS 485 link without distributed power supply
- To 2.5 mm² (AWG 12) screw type terminal block (A)
- L+, L-: 2-wire RS 485 signals
- Shielding.

2-wire RS 485 link with distributed power supply
- To connector (B) female 9-pin sub-D
- 2-wire RS 485 signals: L+, L-
- Distributed power supply: V+ = 12 V DC or 24 V DC, V- = 0 V.

Power supply
- To 2.5 mm² (AWG 12) screw type terminal block (C)
- Reversible phase and neutral (ACE919CA)
- Earthed via terminal block and metal case (ring lug on back of case).
Examples of connections

Connection of Sepam to an RS 485 network

Preamble
For reasons of clarity, the diagrams in this section do not show all the communication cable shielding connections. The communication interfaces must be earthed correctly to ensure correct communication network operation.

For more information on this subject, refer to the RS 485 Communication Accessories section in the Digital Protection Relays Installation Assistance Guide (reference SEPED309035).

ACE949, ACE959 and ACE969 interface power supply
The Modbus RS 485 communication interfaces for Sepam series 20/40/48/60/80 must be powered by an auxiliary supply known as a distributed power supply.

The supply voltage is 12 Vdc for the first generation ACE949 interface. ACE949-2, ACE959 and ACE969 second generation interfaces can be powered by a 12 or 24 Vdc supply.

The ACE969-2 interface does not require a distributed power supply.

Use of a 24 Vdc supply increases the permissible length of the communication bus.

The distributed power supply can be provided by ACE909 (12 Vdc only), ACE909-2 or ACE919 interfaces or by an auxiliary power source supplying a suitable voltage with a maximum ripple of 12%.

Power sizing is determined by the number of slaves present (or the number of intended slaves) and their consumption. Each of the interfaces mentioned above consume 16 mA on reception, a quasi-permanent state, and 40 mA on transmission. Theoretically a single slave transmits at a time t.

The voltage drop must be taken into account in the cable carrying the distribution power supply. For long distances, it is possible to use several local power supplies. In this case the negative poles are connected to provide electrical continuity but the positive pole is only distributed in the relevant zone.

See the last two connection examples below.

Configurations with RS 232 master
The RS 232 master must be followed by an RS 232 to RS 485 converter.

ACE909 2-wire RS 485 converter - first generation
The SW1 switch is used to set the communication parameters.

<table>
<thead>
<tr>
<th>Terminal no.</th>
<th>ON position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Line polarization active</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Line impedance matching active</td>
</tr>
</tbody>
</table>

Converter positioned at end of bus

Converter not positioned at end of bus

RS 232
ACE909
110 or 220 Vac power supply depending on the switch on the underside of the converter
Rp = line idle polarization resistor
Rc = load resistor

110 or 220 V ~

12 V 275

Schneider Electric
Examples of connections

Connection of Sepam to an RS 485 network

ACE909-2 2-wire RS 485 converter - second generation
The SW1 switch is used to set the communication parameters.

<table>
<thead>
<tr>
<th>Terminal no.</th>
<th>ON position</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Line polarization active</td>
</tr>
<tr>
<td>2</td>
<td>Line impedance matching active</td>
</tr>
</tbody>
</table>

Converter positioned at end of bus

Converter not positioned at end of bus

RS 232

Extensive 110 - 220 Vac power supply
Switch for selecting the distributed power supply voltage (12/24 Vdc)
Rc = load resistor
Rp = line idle polarization resistor

Configurations with RS 485 master
The 2-wire or 4-wire RS 485 master for the Sepam range is a third-party device. It must incorporate the polarization system and any load resistors required. If the device does not allow polarization, an ACE919 converter must be used to provide this function.

ACE919 converter
The SW1 switch is used to set the communication parameters.
Examples of connections  

Connection of Sepam to an RS 485 network

Ethernet/Modbus gateways
EGX100, EGX300 gateways, ECI850 server G3200 gateway
Communication parameter-setting switch:

<table>
<thead>
<tr>
<th>Terminal no.</th>
<th>Selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2-wire/4-wire line impedance</td>
</tr>
<tr>
<td>2</td>
<td>matching</td>
</tr>
<tr>
<td>3</td>
<td>Polarization at the 0 V</td>
</tr>
<tr>
<td>4</td>
<td>Polarization at the +5 V</td>
</tr>
<tr>
<td>5</td>
<td>2/4-wire mode</td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

- **2-wire mode**

![Diagram showing 2-wire mode connection]

- **4-wire mode**

![Diagram showing 4-wire mode connection]
Examples of connections

Connection of Sepam to an RS 485 network

**EGX200, EGX400 gateways**

**Communication parameter-setting switch**

<table>
<thead>
<tr>
<th>Switch n°</th>
<th>Port</th>
<th>Signal</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COM2</td>
<td>Tx</td>
<td>Termination</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Rx</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Rx-</td>
<td>Bias</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Rx+</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>COM1</td>
<td>Tx</td>
<td>Termination</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Rx</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Rx-</td>
<td>Bias</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Rx+</td>
<td></td>
</tr>
</tbody>
</table>

- **2-wire mode**

- **4-wire mode**
Examples of connections

Connection of Sepam to a 2-wire RS 485 network

Sepam series 20/40/60/80 with ACE949-2 and Sepam series 10 network in 2-wire mode

- Connection of Sepam to a 2-wire RS 485 network
- Sepam series 20/40/60/80 with ACE949-2 and Sepam series 10 network in 2-wire mode

\[ \text{Rc} = \text{load resistor} \]
\[ \text{Rp} = \text{polarization resistor} \]
\[ l = \text{maximum length according to number of Sepam relays and cable used} \]
\[ 12 \text{ or } 24 \text{ Vdc distribution power supply provided by ACE909/909-2 or ACE919} \]

Sepam series 10 network

- Sepam series 10 network
- \[ \text{Rc} = \text{load resistor} \]
- \[ \text{Rp} = \text{polarization resistor} \]
- \[ l = \text{maximum length according to number of Sepam relays and cable used} \]
Examples of connections  
Connection of Sepam to a 2-wire RS 485 network

RS 232 master with ACE909-2
Sepam 2000 raccordés par CCA629 et CCA602

RS 232
2 3 5
Rx/Tx/Ov
ACE909-2

Sepam 2000

CCA629
1 2

CCA602
1 2

(1) strap 1-2 : résistance d’adaptation de fin de ligne

Rc = load resistor  
Rp = polarization resistor

Sepam 2000 raccordés par CCA609 et CCA602

RS 232
2 3 5
Rx/Tx/Ov
ACE909-2

Sepam 2000

CCA629
1 2

CCA602
1 2

(1) CCA629 ou CCA609 à insérer pour une protection CEM de l’interface maître si besoin

(2) Strap 9-10 : résistance d’adaptation de fin de ligne

(3) Strap 5-6 et 7-8 : réseau RS 485 2 fils

Rc = load resistor  
Rp = polarization resistor

(1) CCA629 ou CCA609 à insérer pour une protection CEM de l’interface maître si besoin

Rc = load resistor  
Rp = polarization resistor

(1) CCA629 ou CCA609 à insérer pour une protection CEM de l’interface maître si besoin
Examples of connections

Connection of Sepam to a 2-wire RS 485 network

Sepam 2000 and Sepam series 20/40/60/80 network
Sepam 2000s connected via CCA629 to ensure continuity of the distributed power supply required by the ACE949-2 units

Rc = load resistor
Rp = polarization resistor
l = longueur maximum selon nombre de Sepam et câble utilisé
(1) Strap 1-2 : résistance d'adaptation de fin de ligne
(2) Sans télé-alimentation

---

Diagram showing connections and wiring details.
Examples of connections

2-wire RS 485 network extension with ACE919

\[ \text{RS 232} \]
\[ \text{Rx, Tx, Ox} \]
\[ \text{ACE909-2} \]
\[ \text{110 / 220} \sim \]
\[ \text{L-} \]
\[ \text{L+} \]
\[ \text{V+} \]
\[ \text{V-} \]
\[ \text{L+} \]
\[ \text{L-} \]
\[ \text{ACE919} \]
\[ \text{110 / 220} \sim \]
\[ \text{L-} \]
\[ \text{L+} \]
\[ \text{V+} \]
\[ \text{V-} \]
\[ \text{L+} \]
\[ \text{L-} \]
\[ \text{ACE919} \]
\[ \text{110 / 220} \sim \]
\[ \text{L-} \]
\[ \text{L+} \]
\[ \text{V+} \]
\[ \text{V-} \]
\[ \text{L+} \]
\[ \text{L-} \]
\[ \text{ACE919} \]

\[ \text{L-} \]
\[ \text{L+} \]
\[ \text{V+} \]
\[ \text{V-} \]
\[ \text{L+} \]
\[ \text{L-} \]
\[ \text{ACE919} \]
\[ \text{110 / 220} \sim \]
\[ \text{L-} \]
\[ \text{L+} \]
\[ \text{V+} \]
\[ \text{V-} \]
\[ \text{L+} \]
\[ \text{L-} \]
\[ \text{ACE919} \]

\[ \text{Rs} = \text{load resistor} \]
\[ \text{Rp} = \text{polarization resistor} \]
\[ \text{l} = \text{maximum length according to number of Sepam relays and cable used} \]
4-wire RS 485 master with Sepam 2000

Master station at end of line

(1) Line polarization, line impedance matching resistor (transmission and reception)
(2) Straps 9-10 and 11-12: line impedance matching resistor
(3) Removal of straps 5-6 and 7-8: 4-wire RS 485 network

4-wire RS 485 master with Sepam series 20/40/60/80 and Sepam 2000

Master station at end of line

Rc = load resistor
Rp = polarization resistor
(1) Line polarization, line impedance matching resistor (transmission and reception)
Setting of communication parameters
Before Modbus communication equipment is put into service, parameters need to be set.

<table>
<thead>
<tr>
<th>Selection</th>
<th>Where</th>
</tr>
</thead>
<tbody>
<tr>
<td>transmission rate</td>
<td>on converters</td>
</tr>
<tr>
<td>adjustable from 300 to 38 400 bauds</td>
<td>on equipment</td>
</tr>
<tr>
<td>slave n° assigned</td>
<td>on equipment</td>
</tr>
<tr>
<td>adjustable from 1 to 255</td>
<td></td>
</tr>
<tr>
<td>parity: no parity, even parity, odd parity</td>
<td>on converters, on equipment</td>
</tr>
<tr>
<td>line polarization</td>
<td>1 location only (master)</td>
</tr>
<tr>
<td>line impedance matching</td>
<td>at end of line, on converters, on equipment</td>
</tr>
</tbody>
</table>
Operating problems

It is advisable to connect the devices to the RS 485 network one by one. The green or yellow lamp indicates that there is traffic on the line. Make sure that the master sends frames to the equipment concerned and to the RS 232 - RS 485 / RS 485 - RS 485 converter, if there is.

Points to be checked

Check:
- the wiring to the CCA612 connectors, the CCA602 branching cables and the RS 485 network cable
- the wiring of the ACE converters
- the wiring to each CCA629, CCA609 and CCA619 connection box
- the wiring of the ACE949-2 or ACE959 interface
- the distributed voltage V+, V- (12 or 24Vdc)
- the polarization is in one location only
- the impedance matching is set up at the ends and only at the ends of the RS 485 network
- the cable used is the one advised
- the ACE converters used are correctly connected and parameterized
- the L+ or L- lines are not earthed
- the earthing of all the cable shielding
- the earthing of all the converters, interfaces and connection boxes.

Use an oscilloscope to check the forum of the signals:
- transmit voltage
  - level 0: $V_{AB}$ from +1.5 V to +6 V
  - level 1: $V_{AB}$ from -1.5 V to -6 V
  - In general, the level is 5 V
- reception voltage threshold
  - level 0: $V_{AB} > +0.2$ V
  - level 1: $V_{AB} < -0.2$ V.
Example of correct signals:

Zone A: transmission from the master, amplitude 5.4 V.
Zone B: transmission from the slave, amplitude 5 V.
Zone C: bus in the idle state: -0.2 V

The signals are symmetrical in relation to zero and the idle state is close to 0 V.

Example of incorrect signals:

Zone D: transmission from the master, amplitude 5 V.
Zone E: transmission from the slave, amplitude 2.8 V.
Zone F: bus in the idle state: -2 V.

In this case, the bus polarization is not adhered to. This is seen at the voltage’s strongly negative value when there is no communication. The slave’s response is not understood by the master since, although the amplitude is higher than 1.5 V, it is completely below the zero volt, preventing the master’s reception circuit from detecting signals 1 and 0.
### Connecting devices

#### Connection examples for Schneider Electric devices

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Marking</strong></td>
<td><strong>Pin N°</strong></td>
<td><strong>Color</strong></td>
<td><strong>Color</strong></td>
<td><strong>Color</strong></td>
<td><strong>SubD 9-F</strong></td>
<td><strong>Wago</strong></td>
<td><strong>SubD 9-F</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0V</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>0V</td>
<td>0V</td>
<td>0V</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Rp (0V)</td>
<td>Orange/White</td>
<td>24V</td>
<td>24V</td>
<td>Rp (0V)</td>
<td>24V</td>
<td>24V</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Rc</td>
<td>Red</td>
<td>Red</td>
<td>Red</td>
<td>Rc</td>
<td>Red</td>
<td>Red</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>B (Tp)</td>
<td>Blue</td>
<td>Blue</td>
<td>Blue</td>
<td>B' (Tp)</td>
<td>B' (Tp)</td>
<td>B' (Tp)</td>
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</tr>
<tr>
<td>5</td>
<td>B (Td)</td>
<td>White/Blue</td>
<td>Yellow</td>
<td>Yellow</td>
<td>B' (Td)</td>
<td>B' (Td)</td>
<td>B' (Td)</td>
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<tr>
<td>6</td>
<td>Rp (0V)</td>
<td>White/Orange</td>
<td>0V</td>
<td>0V</td>
<td>Rp (0V)</td>
<td>0V</td>
<td>0V</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Rc</td>
<td>Brown/White</td>
<td>24V</td>
<td>24V</td>
<td>Rc</td>
<td>24V</td>
<td>24V</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>A (Tp+)</td>
<td>White/Orange</td>
<td>White</td>
<td>White</td>
<td>A (Tp+)</td>
<td>White</td>
<td>White</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>A (Td+)</td>
<td>Black</td>
<td>Black</td>
<td>Black</td>
<td>A (Td+)</td>
<td>Black</td>
<td>Black</td>
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#### RS 485

<table>
<thead>
<tr>
<th>Marking</th>
<th>Sepam 20/40/60/80</th>
<th>Screw con.</th>
<th>Sepam 20/40/60/80</th>
<th>Screw con.</th>
<th>PM 300</th>
<th>Phoenix 5 pts</th>
<th>Phoenix 3 pts</th>
<th>PM 500</th>
<th>Phoenix 5 pts</th>
<th>Phoenix 3 pts</th>
<th>PM 700</th>
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<th>Screw con.</th>
<th>Phoenix 5 pts</th>
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</thead>
<tbody>
<tr>
<td><strong>B</strong></td>
<td>Rx+</td>
<td>B (Tp)</td>
<td>Rx+</td>
<td>B (Tp)</td>
<td>L-</td>
<td>Tx+</td>
<td>L+</td>
<td>Tx+</td>
<td>L+</td>
<td>Tx+</td>
<td>L-</td>
<td>Tx+</td>
<td>L+</td>
<td>Tx+</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>Rx-</td>
<td>A (Td)</td>
<td>Rx-</td>
<td>A (Td)</td>
<td>L-</td>
<td>Tx-</td>
<td>L+</td>
<td>Tx-</td>
<td>L+</td>
<td>Tx-</td>
<td>L-</td>
<td>Tx-</td>
<td>L+</td>
<td>Tx-</td>
</tr>
</tbody>
</table>

| **Case** | Shield | Braid | Shield | Braid | Shield | Braid | Shield | Braid | Shield | Braid | Shield | Braid | Shield | Braid |

#### RS 485

<table>
<thead>
<tr>
<th>Marking</th>
<th>Phoenix 5 pts</th>
<th>Screw con.</th>
<th>Phoenix 5 pts</th>
<th>Screw con.</th>
<th>Phoenix 5 pts</th>
<th>Screw con.</th>
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<th>Screw con.</th>
<th>Phoenix 5 pts</th>
<th>Screw con.</th>
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<th>Screw con.</th>
<th>Phoenix 5 pts</th>
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</thead>
<tbody>
<tr>
<td><strong>B</strong></td>
<td>Tx+ (pin 1)</td>
<td>Tx+ (pin 1/6)</td>
<td>Tx+ (pin 6)</td>
<td>Tx+</td>
<td>TxB</td>
<td>Tx+ (pin 2)</td>
<td>Tx+ (pin 2)</td>
<td>Tx+</td>
<td>Tx+</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>B</strong></td>
<td>Rx+ (pin 3)</td>
<td>Rx+ (pin 3/8)</td>
<td>Rx+ (pin 4)</td>
<td>Rx+</td>
<td>RxB</td>
<td>Rx+ (pin 4)</td>
<td>Rx+ (pin 4)</td>
<td>Rx+</td>
<td>Rx+</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>A</strong></td>
<td>Tx- (pin 2)</td>
<td>Tx- (pin 2/7)</td>
<td>Tx- (pin 1)</td>
<td>Tx-</td>
<td>TxA</td>
<td>Tx- (pin 1)</td>
<td>Tx- (pin 1)</td>
<td>Tx-</td>
<td>Tx-</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>A</strong></td>
<td>Rx- (pin 4)</td>
<td>Rx- (pin 4/9)</td>
<td>Rx- (pin 9)</td>
<td>Rx-</td>
<td>RxA</td>
<td>Rx- (pin 9)</td>
<td>Rx- (pin 9)</td>
<td>Rx-</td>
<td>Rx-</td>
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<td>Shield (pin 5)</td>
<td>Shield (pin 5/10)</td>
<td>Shield (pin 5)</td>
<td>Shield (pin 5)</td>
<td>Shield (pin 5)</td>
<td>Shield (pin 5)</td>
<td>Shield (pin 5)</td>
<td>Shield (pin 5)</td>
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#### RS 485

<table>
<thead>
<tr>
<th>Marking</th>
<th>Phoenix 4 pts</th>
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<th>Phoenix 4 pts</th>
<th>Screw con.</th>
<th>Phoenix 4 pts</th>
<th>Screw con.</th>
<th>Phoenix 4 pts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B</strong></td>
<td>Rp 5V (pin 8)</td>
<td>Rp 5V (pin 8)</td>
<td>Rp 5V (pin 8)</td>
<td>Rp 5V (pin 8)</td>
<td>Rp 5V (pin 8)</td>
<td>Rp 5V (pin 8)</td>
<td>Rp 5V (pin 8)</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>Rp (pin 11)</td>
<td>Rp (pin 11)</td>
<td>Rp (pin 11)</td>
<td>Rp (pin 11)</td>
<td>Rp (pin 11)</td>
<td>Rp (pin 11)</td>
<td>Rp (pin 11)</td>
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</table>

#### RS 485

<table>
<thead>
<tr>
<th>Marking</th>
<th>Phoenix 3 pts</th>
<th>Screw con.</th>
<th>Phoenix 3 pts</th>
<th>Screw con.</th>
<th>Phoenix 3 pts</th>
<th>Screw con.</th>
<th>Phoenix 3 pts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B</strong></td>
<td>Tx+ (pin 1)</td>
<td>A</td>
<td>Tx+ (pin 1)</td>
<td>A</td>
<td>Tx+ (pin 1)</td>
<td>A</td>
<td>Tx+ (pin 1)</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Rx+ (pin 3)</td>
<td>L+</td>
<td>B (Tp)</td>
<td>B (Tp)</td>
<td>L+</td>
<td>B (Tp)</td>
<td>B (Tp)</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td>L-</td>
<td>PH</td>
<td>L-</td>
<td>PH</td>
<td>L-</td>
<td>PH</td>
<td>L-</td>
</tr>
</tbody>
</table>

| **Case** | SH | SH | SH | SH | SH | SH | SH | SH |

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1. Do not use ION metering units with the EGX100 or EGX400 gateway, only with the EGX300 gateway.