# Sepam

Protection and control

Sepam - RS 485 network connection guide
12/2011

Schneider Electric
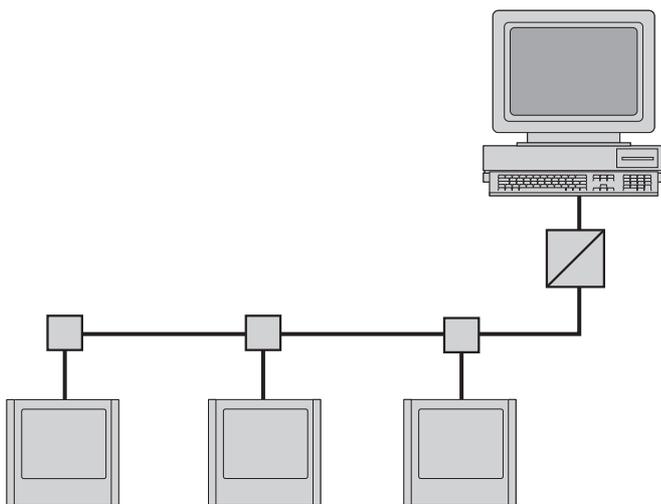
Safety instructions

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.

Risk of electric shock

ANSI symbol. *IEC symbol.*

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.

Contents

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.

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.
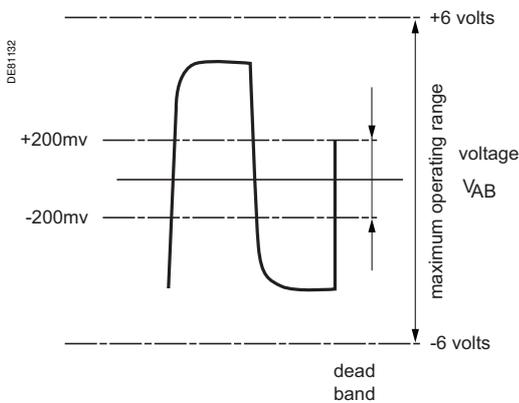
The transmission driver injects 2 symmetrical signals onto the bus with a maximum amplitude of 6 V compared to the 0 V:
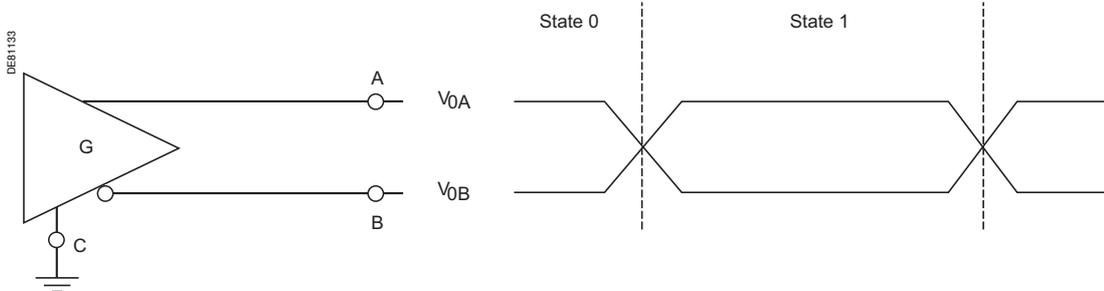
The resulting differential voltage is used to construct the binary signals 1 or 0.
The transmitter line A will be negative with respect to line B for a binary 1, MARK or OFF state.
The transmitter line A will be positive with respect to line B for a binary 0, SPACE or ON state.
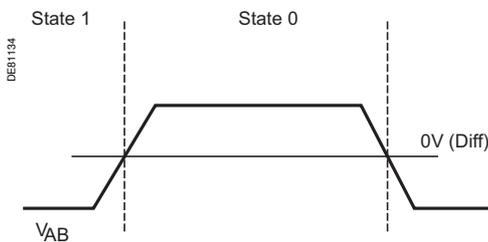
Nature of real-life signals

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.
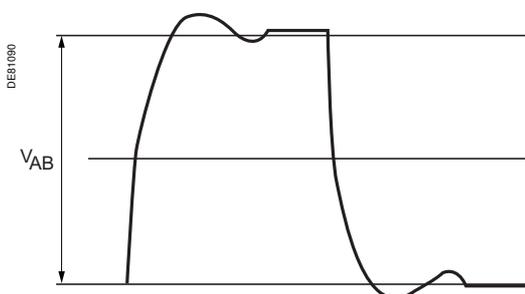
Choosing a topology

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

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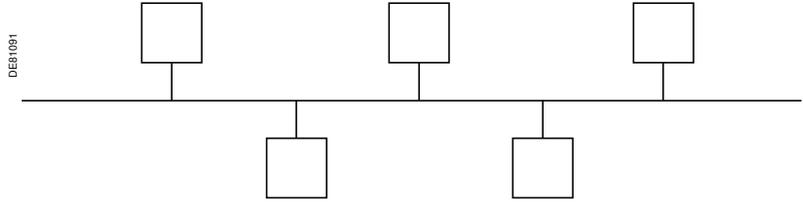
Loop or ring-type topology must be avoided as it does not allow bus impedance matching: the loop has no ends and the star causes as many reflections as it has branches. See"Bus matching", page 10.

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Stars

Rings
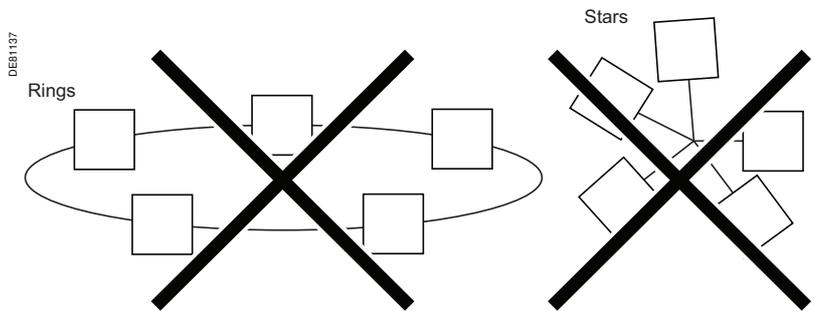
Choosing the type of connection

Daisy-chain connection is the preferred type.

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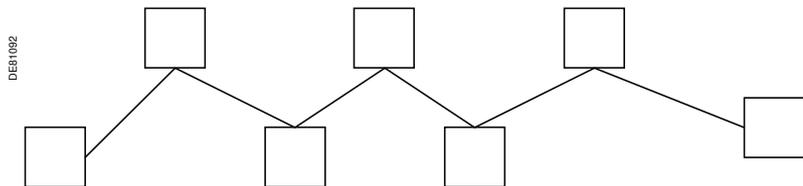
Example of architectures to be avoided
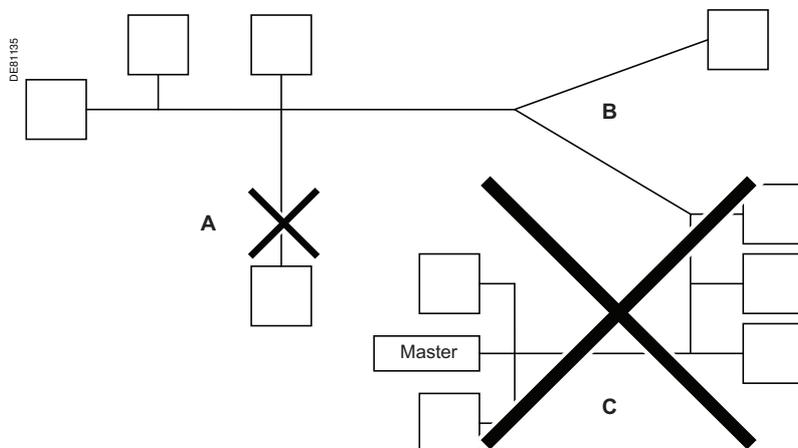
(A) The tap links should be less than 3 meters (the impact of reflection remains very low).
(B) The Y configuration is similar to a star.
(C) Clusters containing the master on the left and the 3 stations on the right constitute subnets that can cause as many reflections as slaves and prevent correct bus matching.

Architectures to be used in this configuration
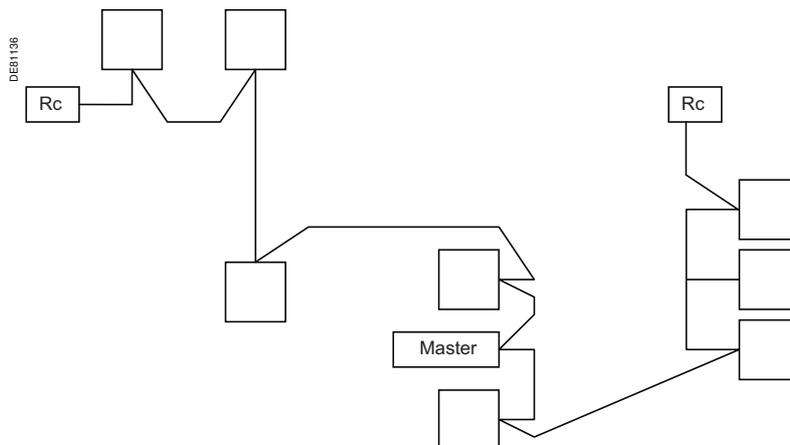
Physical medium

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	Value
Overlap on twisted pair with tinned copper braid shielding	> 65%
Resistance per unit length	< 100 Ω/km
Cross-section	> 0.22 mm^2 (24 AWG)
Characteristic impedance	120 Ω
Capacitance between conductors	< 60 pF/m
Capacitance between conductors and shielding	< 100 pF/m
Total cable length (unless restricted by the distributed power supply)	< 1300 m

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
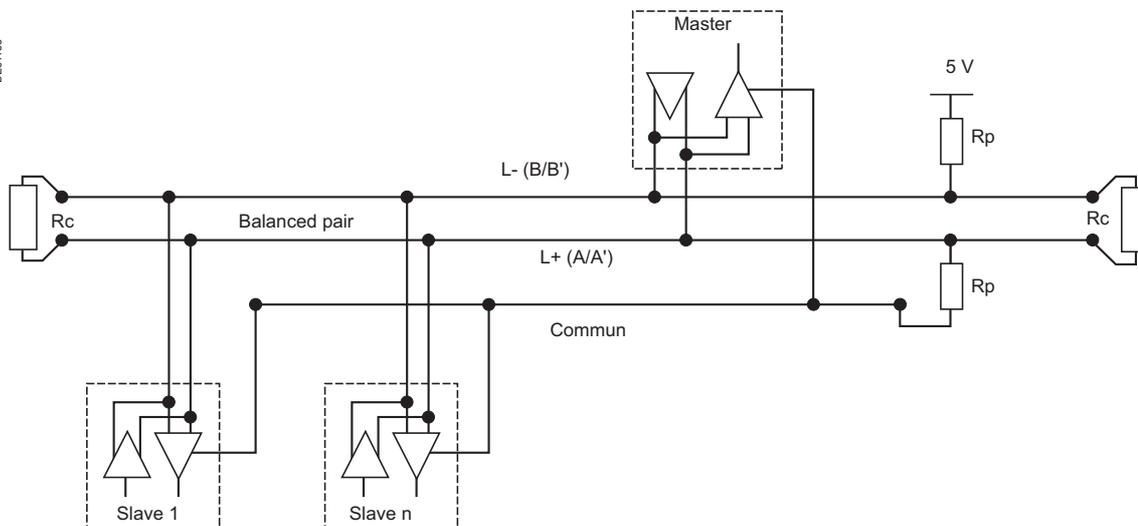
Bus driver without common
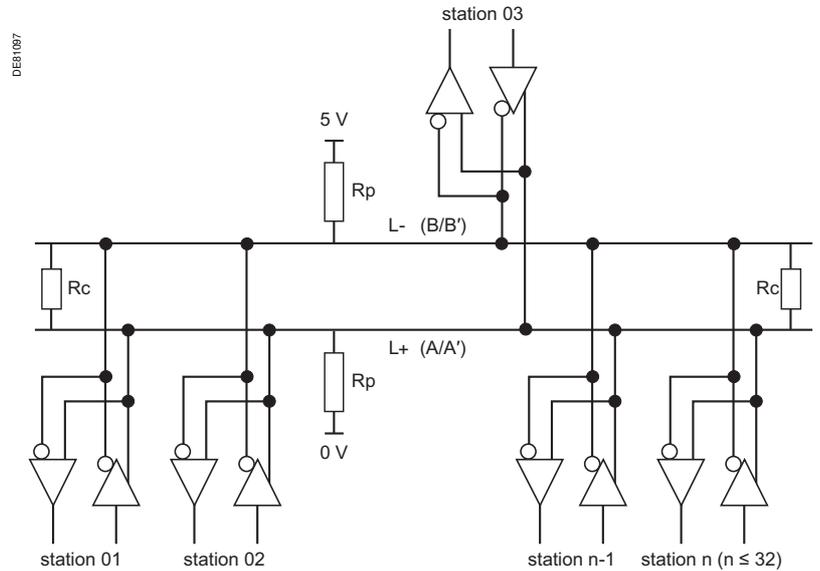
Maximum number of stations on the bus

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 be 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.

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 or off by microswitches.

It is important to ensure that only 2 of these resistors are on on the entire bus.
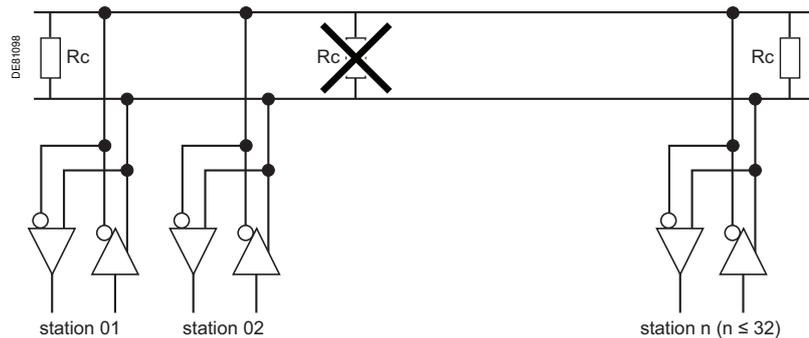
The master is normally positioned at one end of the bus. In this case it should incorporate one of the 2 line-end resistors but this function is not necessarily allocated to the master.
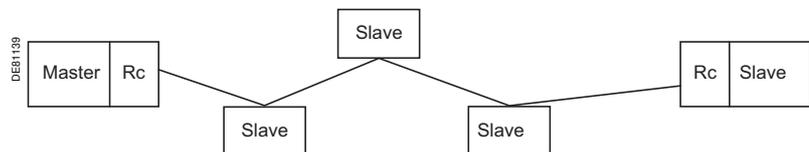
If the master occupies a different physical position on the bus, matching should be implemented using the 2 slaves in the end positions.
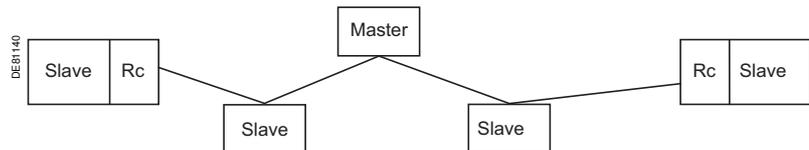
Termination by RC network

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
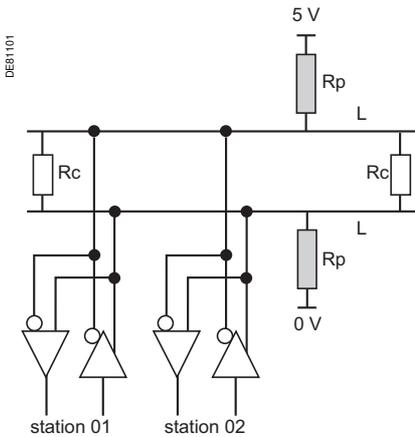
Polarization of the bus

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.
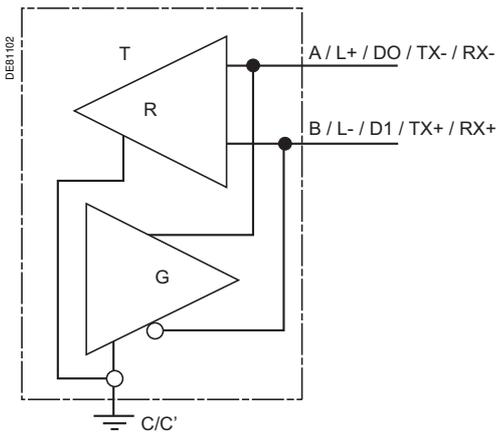
2-wire network.
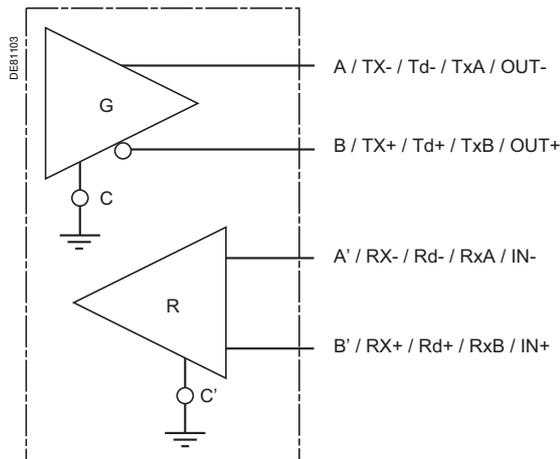
4-wire network.

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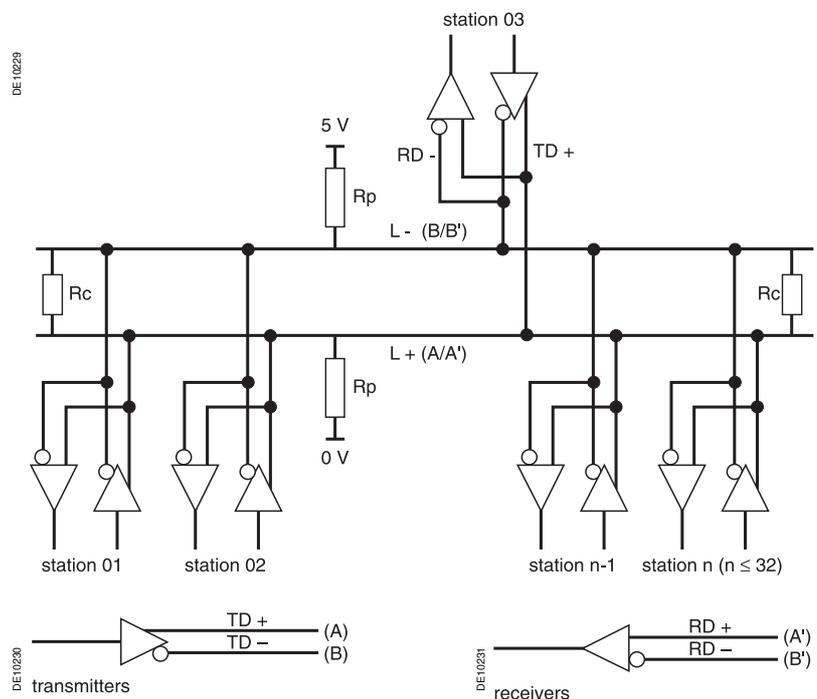
Line-end impedance matching
Two 150 Ω resistors (Rc) are required (one at each end) to match line impedance. Each item of equipment, as well as each connector, connection box or Sepam interface, contains a 150 Ω resistor which can be used for this purpose.

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.

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 salves 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
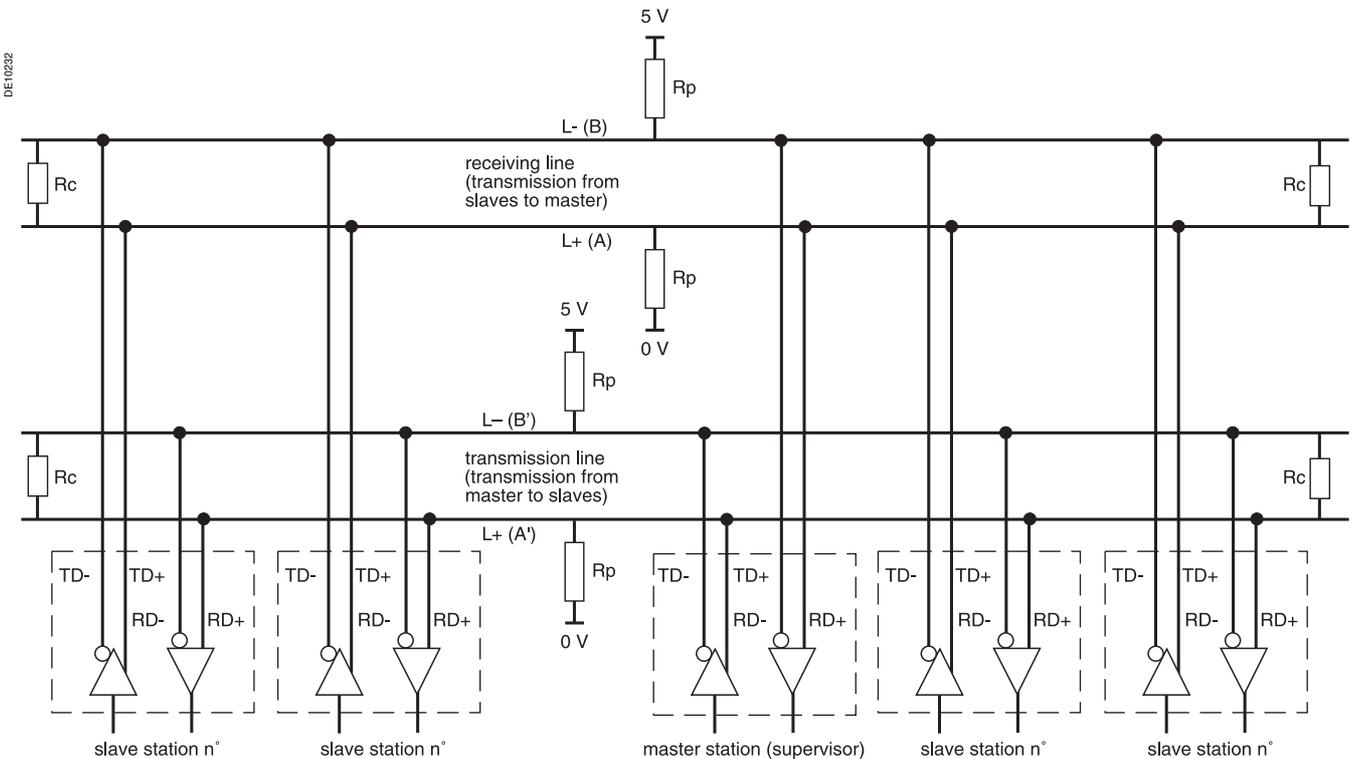
Rc = load resistor (150 ohms)

Rp = polarization resistor (470 ohms)

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.

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
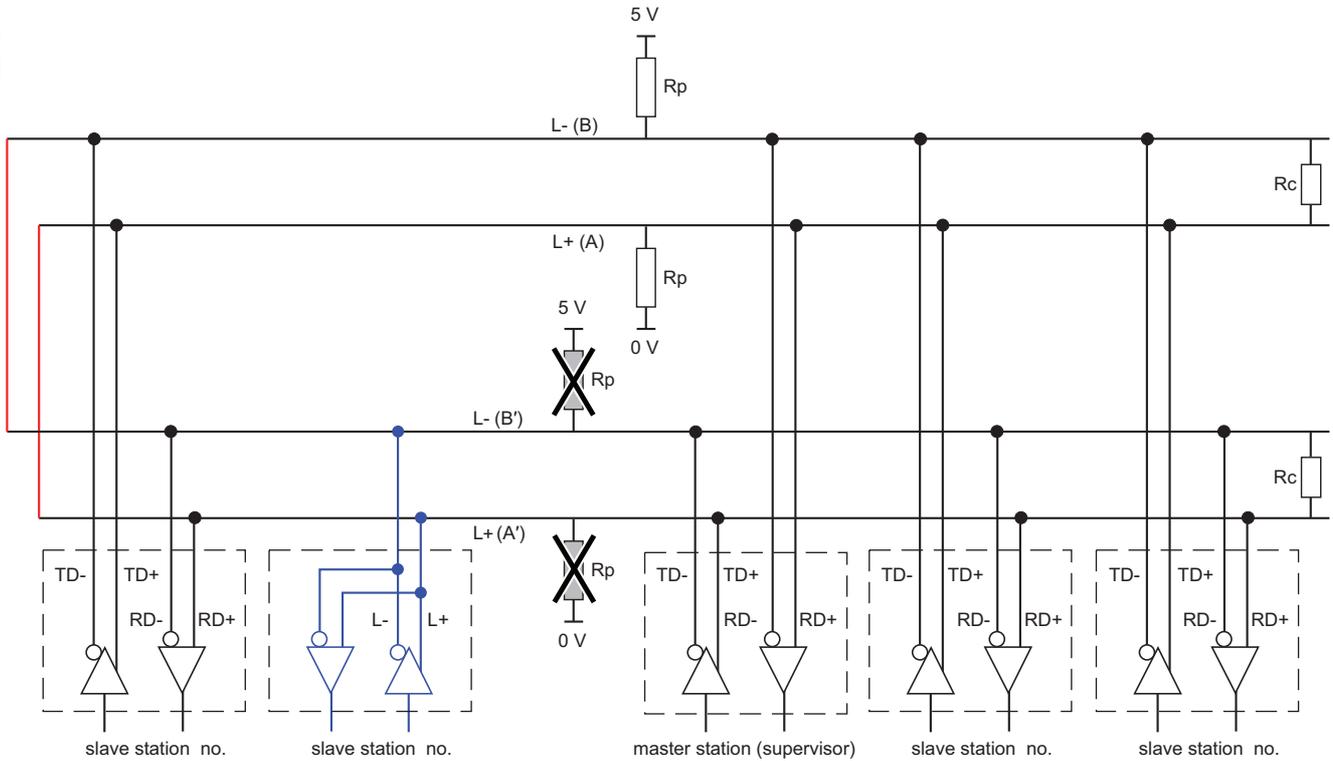
Coexistence of 2-wire/4-wire RS 485 equipment

2-wire network obtained.

Schneider Electric

Connecting the shielding
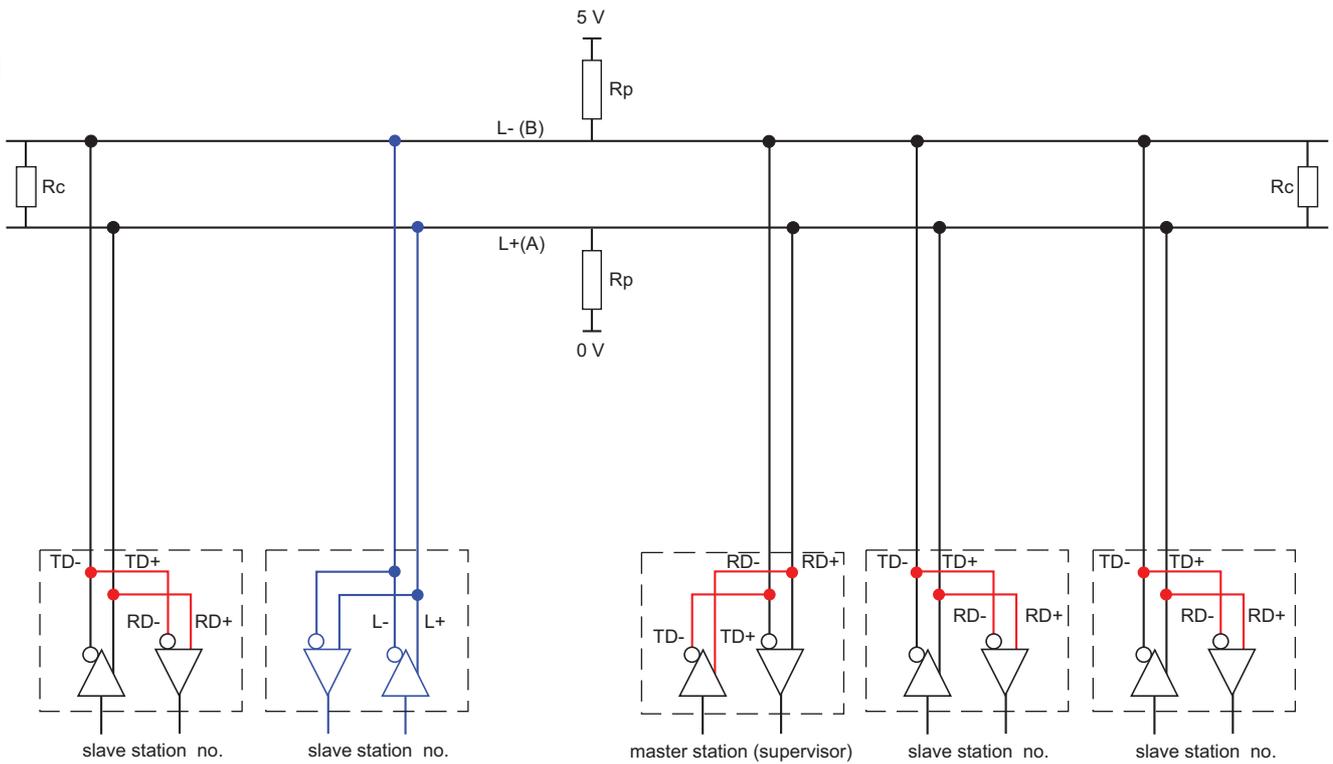
Introduction

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.

Wrong

Fairly good

Grounding bar

Good

Chassis at reference potential

Excellent
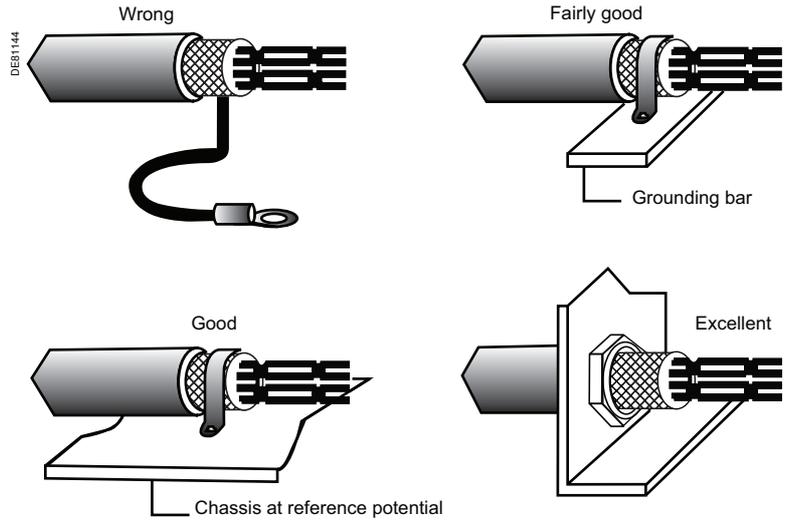
Connection to screw terminal block

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.

Grounding bar

NO

Acceptable if link very short

YES
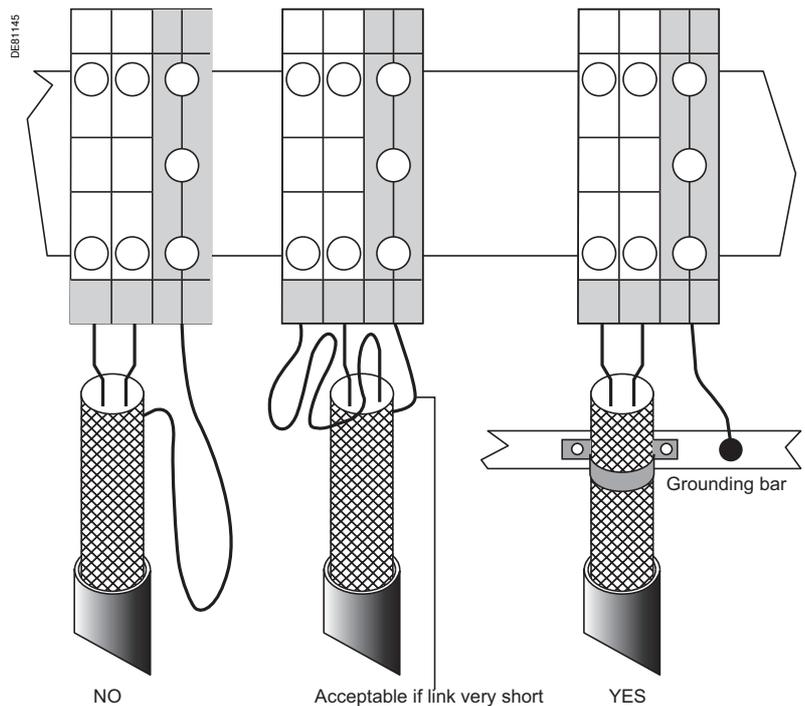
Connecting the shielding with a connector

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

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Connector with ground bosses

Contact between the shielding shrouds
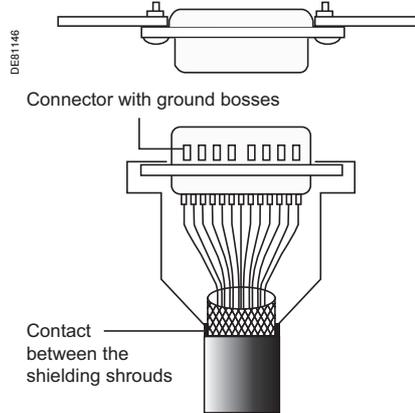
Converter selection guides

	ACE909	ACE909-2	ACE919CA	ACE919CC	EGX200	EGX400	EGX100	EGX300	ECI850 / G3200
To supervisor									
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 port 100 base Fx	1 Ethernet port 10/100 base Tx	1 Ethernet port 10/100 base Tx	1 Ethernet port 10/100 base Tx
Modbus RTU	■ (1)	■ (1)	■ (1)	■ (1)					
IEC 60870-5-103	■ (1)	■ (1)	■ (1)	■ (1)					
DNP3	■ (1)	■ (1)	■ (1)	■ (1)					
Modbus TCP/IP					■	■	■	■	
IEC 61850									■
To Sepam									
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 RS 485 2-wire or 4-wire	1 port RS 485 2-wire or 4-wire	1 port RS 485 2-wire or 4-wire	1 port RS 485 2-wire or 4-wire	1 port RS 485 2-wire or 4-wire
RS 485 distributed power supply	12 Vdc	12 or 24 Vdc	12 or 24 Vdc	12 or 24 Vdc					
Modbus RTU	■ (1)	■ (1)	■ (1)	■ (1)	■	■	■	■	■
IEC 60870-5-103	■ (1)	■ (1)	■ (1)	■ (1)					
DNP3	■ (1)	■ (1)	■ (1)	■ (1)					
Max number of connected Sepam interfaces	12 (2)	12 (2)	12 (2)	12 (2)	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									
DC					24 to 48 V	24 V	24 V	24 V	24 V	24 V
AC	110 to 220 V	110 to 220 V	110 to 220 V						

(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

	ACE949	ACE949-2	ACE959	ACE969TP		ACE969TP-2		ACE969FO		ACE969FO-2	
Type of network											
	S-LAN or E-LAN (1)	S-LAN or E-LAN (1)	S-LAN or E-LAN (1)	S-LAN	E-LAN	S-LAN	E-LAN	S-LAN	E-LAN	S-LAN	E-LAN
Protocol											
Modbus RTU	■	■	■	■ (2)	■	■ (2)	■	■ (2)	■	■ (2)	■
DNP3				■ (2)		■ (2)		■ (2)		■ (2)	
CEI 60870-5-103				■ (2)		■ (2)		■ (2)		■ (2)	
Modbus TCP/IP											
CEI 61850											
Physical interface											
RS 485 2-wire	■	■		■	■	■	■		■		■
4-wire			■								
Fiber optic								■		■	
Power supply											
DC	Supplied by Sepam	Supplied by Sepam	Supplied by Sepam	24 to 250 V		24 to 250 V		24 to 250 V		24 to 250 V	
AC				110 to 240 V		110 to 240 V		110 to 240 V		110 to 240 V	
Distributed power supply											
	12 Vdc only	12 or 24 Vdc	12 or 24 Vdc	12 or 24 Vdc		not required (embedded)	-	12 to 24 Vdc	-	not required (embedded)	

(1) Only one connection possible, S-LAN or E-LAN.
(2) Not supported simultaneously (1 protocol per application).

Characteristics of Sepam communication interfaces

	Sepam series 10 A	Sepam series 20/40/48/60/80	Sepam 2000
Type of transmission	Asynchronous serial	Asynchronous serial	Asynchronous serial
Protocol	Modbus / Jbus slave	Modbus / Jbus slave	Modbus / Jbus slave
Rate	4800, 9600, 19200, 38400 bauds	4800, 9600, 19200, 38400 bauds	300, 600, 1200, 2400, 4800, 9600, 19200, 38400 bauds
Frame format	11 bits (1 start, 8 bits, 1 parity, 1 stop)	11 bits (1 start, 8 bits, 1 parity, 1 stop)	11 bits (1 start, 8 bits, 1 parity, 1 stop)
Parity bit setup	No parity check Even parity Odd parity	No parity check Even parity Odd parity	No parity check Even parity Odd parity
Maximum number of slaves on a Modbus RS 485 network	31	25 [1]	32
RS 485 electrical interface	Embedded (connector C) 2-wire RS 485	ACE949-2, compliant with the EIA 2-wire differential RS 485 standard ACE959, compliant with the EIA 4-wire differential RS 485 standard	Communication coupler board compliant with the EIA 2-wire or 4-wire differential RS 485 standard
Communication interface supply	Interface integrated in the product	External, by 12 Vdc or 24 Vdc auxiliary supply	By Sepam 2000
Branch length	3 m maximum	3 m maximum	3 m maximum
Maximum length of RS 485 network with standard cable	1300 m	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	1300 m

(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.

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
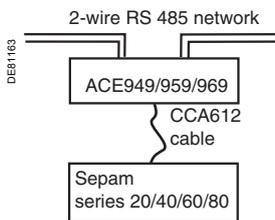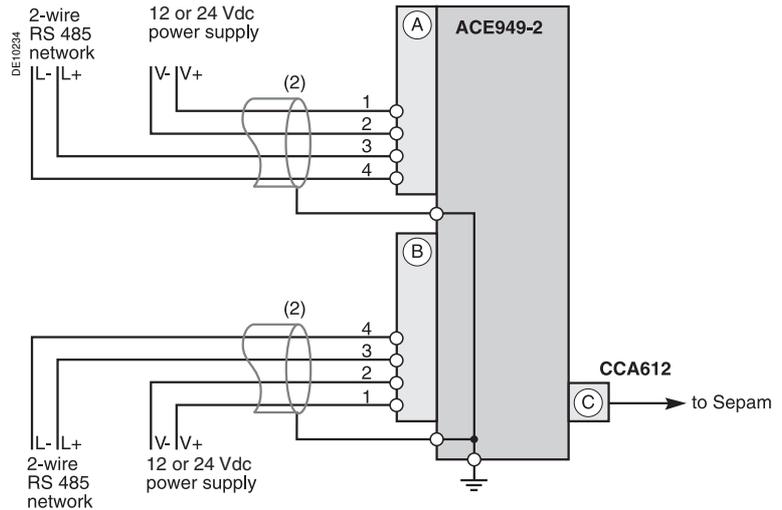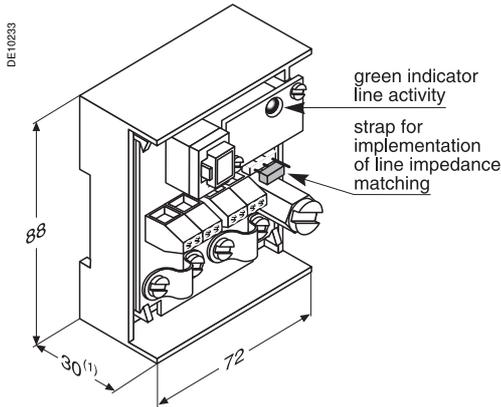
ACE959 : interface for 4-wire RS 485 network
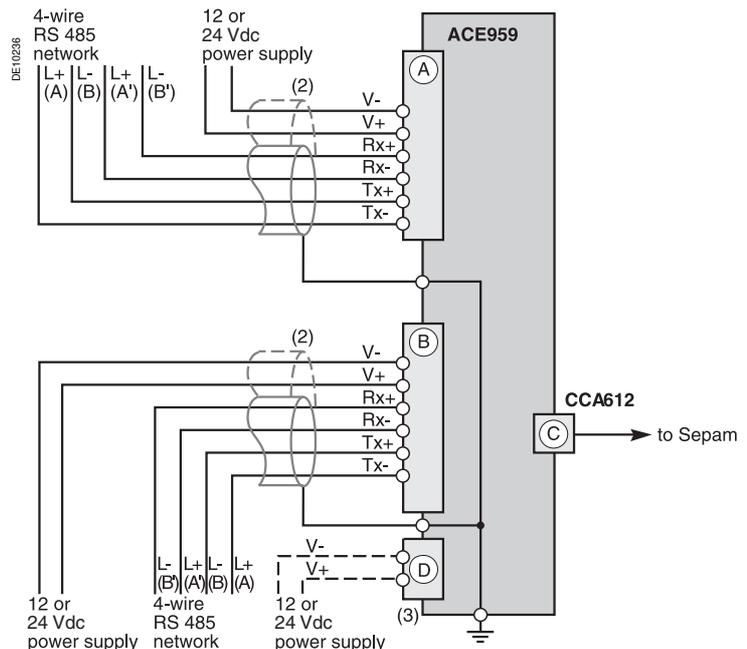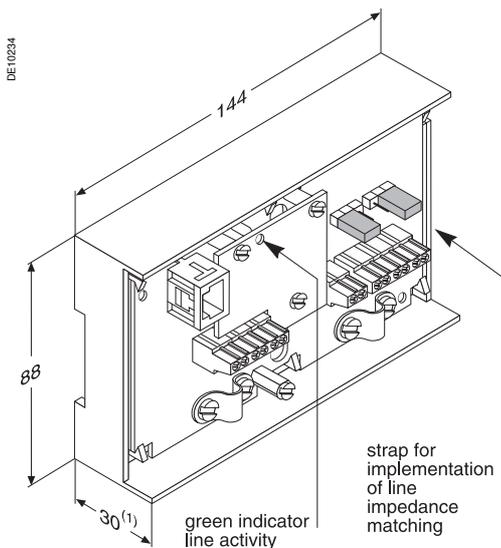
Rx+, Rx-: Sepam receiving (eq IN+, IN-)
Tx+, Tx-: Sepam transmitting (eq OUT+, OUT-)

(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.

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

ACE969TP-2 communication interface.

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		
Weight	0.285 kg (0.628 lb)	
Assembly	On symmetrical DIN rail	
Operating temperature	-25°C to +70°C (-13°F to +158°F)	
Environmental characteristics	Same characteristics as Sepam base units	
Power supply		
Voltage	24 to 250 Vdc	110 to 240 Vac
Range	-20%/+10%	-20%/+10%
Maximum consumption	2 W	3 VA
Inrush current	< 10 A 100 µs	
Acceptable ripple content	12%	
Acceptable momentary outages	20 ms	
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

Schneider
Electric

Sepam series 20/40/60/80
ACE969TP-2
multi-protocol interfaces
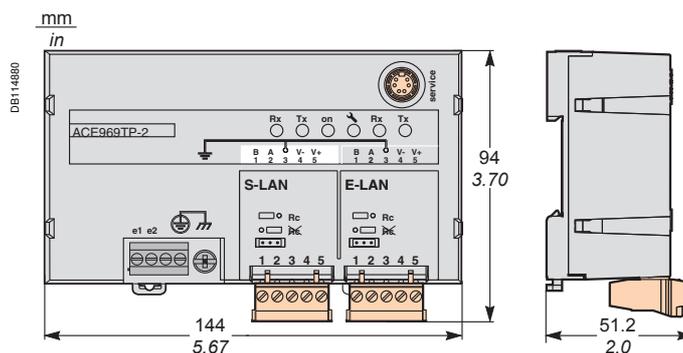
ACE969-2 communication interfaces

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).
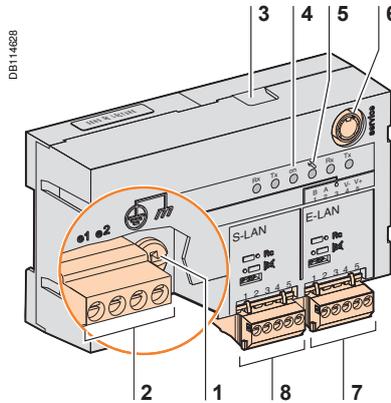
2-wire RS 485 communication ports

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:
   ■ ⊀c, if the interface is not at the line end (default position)
   ■ Rc, if the interface is at the line end.

Schneider Electric

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	Type	Wiring
e1-e2 - supply	Screw terminals	■ Wiring with no fittings: □ 1 wire with maximum cross-section 0.2 to 2.5 mm²(≥ AWG 24-12) or 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	4 mm (0.16 in) ring lug	Earthing braid, supplied for connection to cubicle grounding

Schneider Electric

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

If ACE969TP and ACE969TP-2 are used together, the external power supply is required.
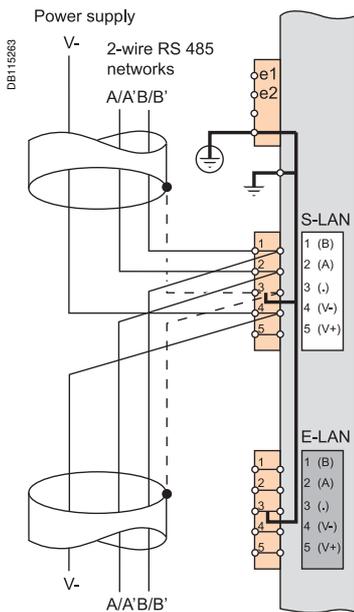
2-wire RS 485 communication ports (S-LAN or E-LAN)

■ 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 an functional earthing): Ie 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.

Sepam series 20/40/48/60/80
Ethernet EGX200 gateway
Ethernet EGX400 server
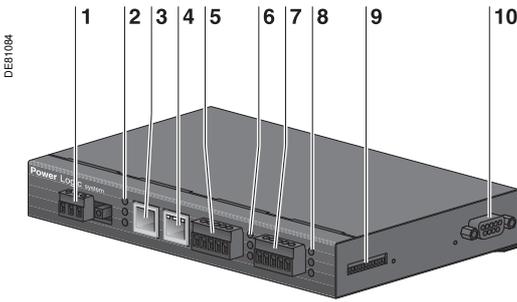
1 Power connector.
2 Ethernet indication LEDs.
3 10/100BaseTX port for connection to Ethernet via an RJ45 connector.
4 10/100BaseTX port for connection to Ethernet via an optic fiber (EGX400 only).
5 COM1: terminal block for RS 485 serial link.
6 COM1 indication LEDs.
7 COM2: terminal block for RS 485 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.

Characteristics

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

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 cUL (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	EGX200	EGX400
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

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

EGX100

PE88079

1 2 3 4

5 6 7 8
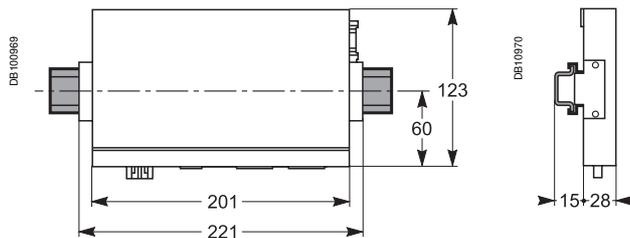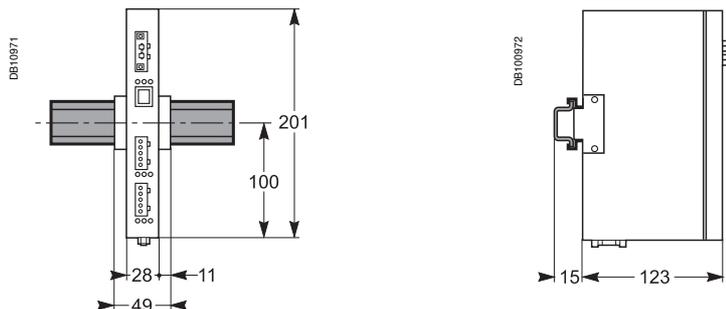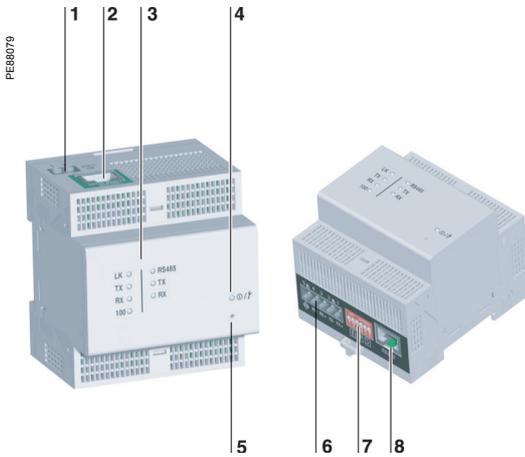
1 24 Vdc power connection.
2 10/100 Base TX (802.3af) port for connection to Ethernet via an RJ45 connector.
3 Ethernet and serial indication LEDs.
4 Power/Status LED.
5 Reset button.
6 RS485 connection.
7 Dip switches for biasing, termination, and 2-wire/4-wire jumpers.
8 RS232 connection.

EGX300

PE88079
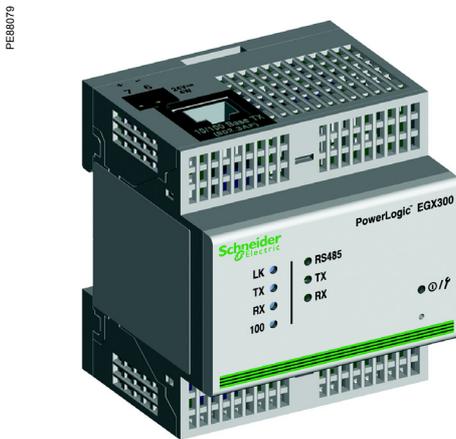
Characteristics

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

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	57,600
Maximum number of directly connected devices	32	64

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	512 Mo

Installation

DIN rail mounting (EGX100, EGX300)

DE80153

mm
in

35 1.38
57,9 2.28
80,8 3.18
90,7 3.57
72 2.83

65,8 2.59
45,2 1.78
49,5 1.95
68,3 2.69
2,5 0.10
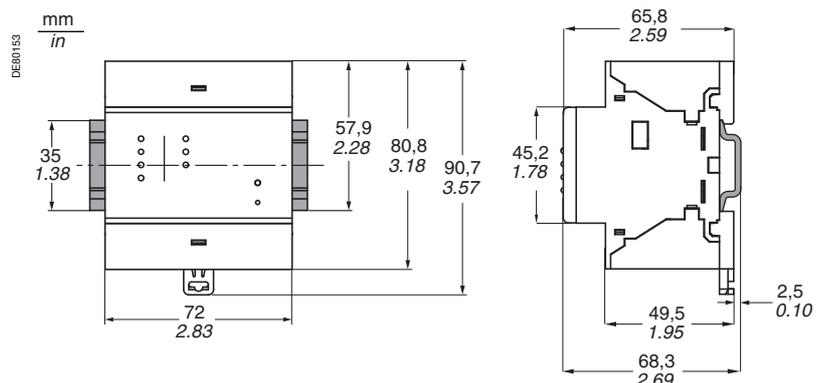
Sepam series 20/40/60/80
ECI850 IEC 61850 Sepam server
G3200 IEC 61850 gateway

ECI850 IEC 61850 Sepam server

PE80319
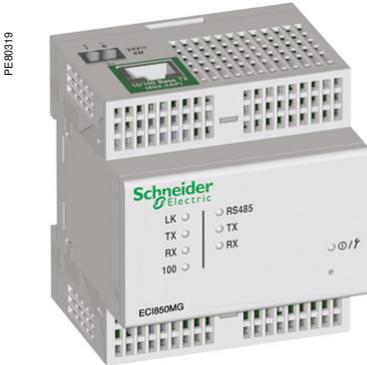
ECI850: IEC 61850 Sepam server.

G3200 IEC 61850 gateway

The G3200 gateway allows the IEC 61850 protocol to be used on products that do not support naturally it, such as Sepam 2000 and Masterpact (these products usually claim to have created a special CID file, not available in existing libraries). Connection to the RS485 bus is identical to that of the ECI850 in all respects.

Nota : *Marketing this product is restricted to certain Schneider Electric entities. Support for a product that is not yet listed in the catalog requires special development by Schneider Electric.*

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	
Weight	0.17 kg (0.37 lb)
Assembly	On symmetrical DIN rail
Power supply	
Voltage	24 Vdc (± 10%) supplied by a class 2 power supply
Maximum consumption	4 W
Dielectric withstand	1.5 kV
Environmental characteristics	
Operating temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Storage temperature	-40 °C to +85 °C (- 40 °F to +185 °F)
Humidity ratio	5 to 95% relative humidity (non condensing) at +55 °C (131 °F)
Degree of pollution	Class 2
Tightness	IP30
Electromagnetic compatibility	
Emission tests	
Emissions (radiated and conducted)	EN 55022/EN 55011/FCC Class A
Immunity tests - Radiated disturbances	
Electrostatic discharge	EN 61000-4-2
Radiated radiofrequencies	EN 61000-4-3
Magnetic fields at the network frequency	EN 61000-4-8
Immunity tests - Conducted disturbances	
Fast transient bursts	EN 61000-4-4
Surges	EN 61000-4-5
Conducted radiofrequencies	EN 61000-4-6
Safety	
International	IEC 60950
USA	UL 508/UL 60950
Canada	cUL (complies with CSA C22.2, no. 60950)
Australia/New Zealand	AS/NZS 60950
Certification	
Europe	CE
2-wire/4-wire RS 485 communication port	
Electrical interface	
Standard	2-wire or 4-wire differential RS 485 EIA
Max. number of Sepam units per ECI850	2 Sepam series 80 or 2 Sepam series 60 or 3 Sepam series 40 or 5 Sepam series 20
Maximum network length	1000 m (3300 ft)
Ethernet communication port	
Number of ports	1
Type of port	10/100 Base Tx
Protocols	HTTP, FTP, SNMP, SNTP, ARP, SFT, IEC 61850 TCP/IP
Transmission speed	10/100 Mbps

Characteristics (cont'd)

PRI surge arrester

Electrical characteristics	
Nominal operating voltage	48 Vdc
Maximum discharge current	10 kA (8/20 µs wave)
Nominal discharge current	5 kA (8/20 µs wave)
Protection level	70 V
Response time	1 ns
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 green LED:
  □ On: 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
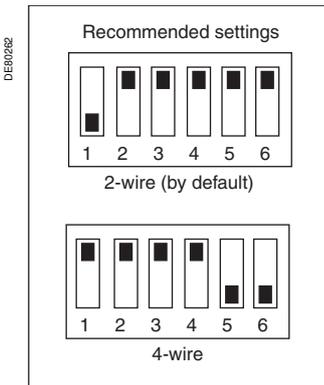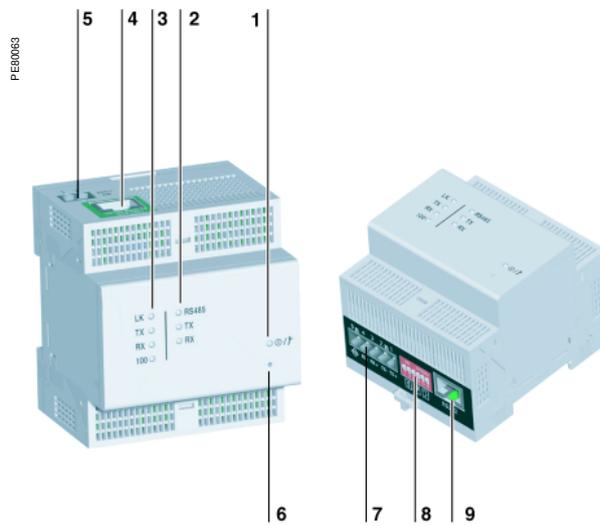
Setting the RS 485 network parameters.

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.

Network line impedance matching with resistor	SW1	SW2	SW3	SW4	SW5	SW6
2-wire RS 485	OFF	ON				
4-wire RS 485	ON	ON				

Network polarization	SW1	SW2	SW3	SW4	SW5	SW6
at the 0 V			ON			
at the 5 V				ON		

Selecting the RS 485 network	SW1	SW2	SW3	SW4	SW5	SW6
2-wire network					ON	ON
4-wire network					OFF	OFF

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.

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

Dimensions
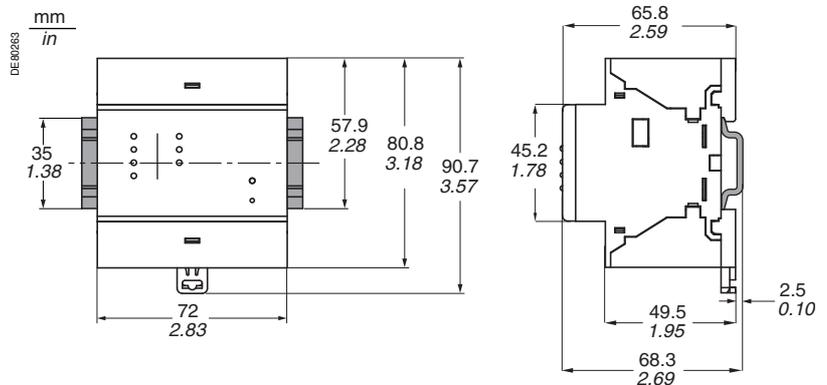
NOTICE

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.

Connection

■ Connect the power supply and RS 485 twisted pair using cable with cross-section ⩽ 2.5 mm^2 (⩾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 screen 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

2-wire RS 485 network

4-wire RS 485 network

Schneider Electric
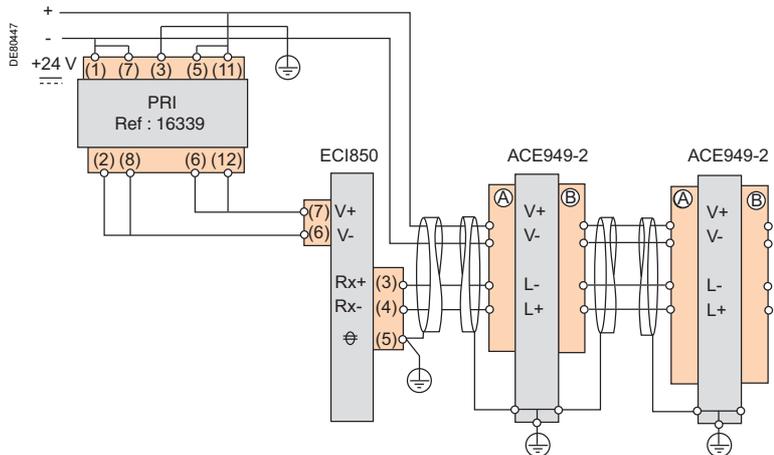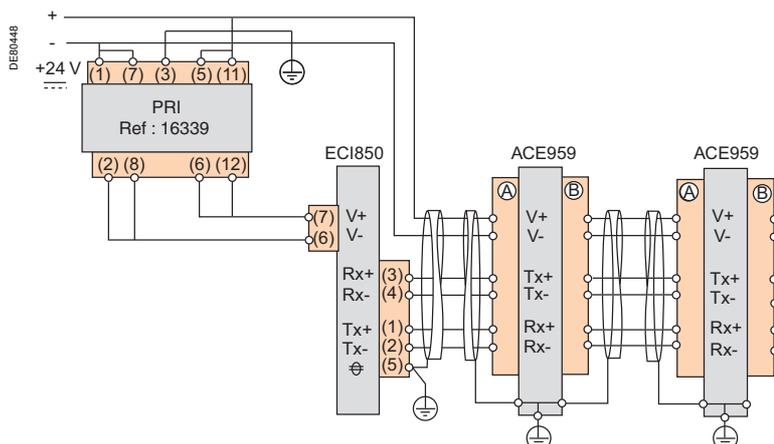
On Sepam 2000, the communication function is performed by an optional RS 485 communication coupler board, mounted on the CE40 supply board.

Sepam 2000 communication interface

Rear view of the CE40 board with communication coupler installed.

CE40

DE10237

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)

B

A

Sepam 2000 auxiliary
supply connector
(item A)
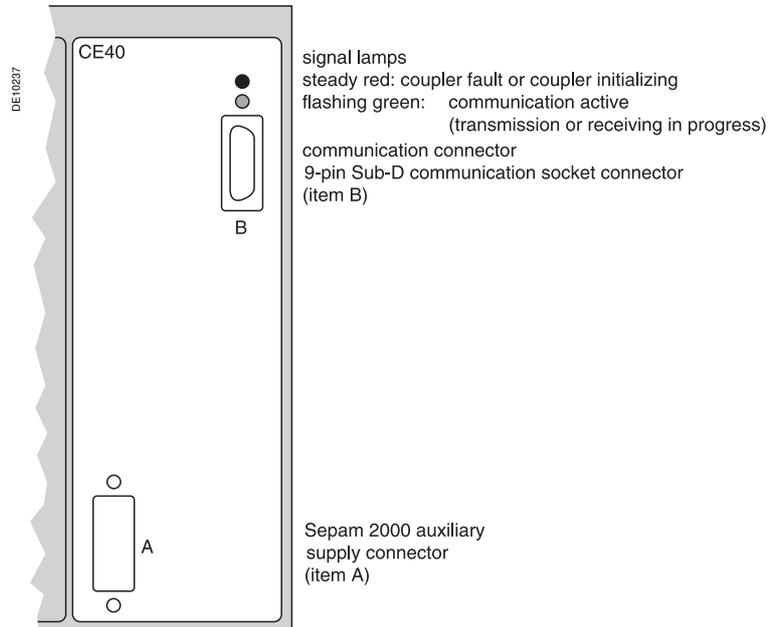
Diagram of the communication coupler board for 2-wire or 4-wire RS 485 networks

DE10238

0 V	Rp+
5 V	Rp-
	Rc
	RD+ (A')
	RD- (B')
	TD+ (A)
	TD- (B)

1
2 6
3 7
4 8
5 9

Rc = load resistor

Rp = polarization resistor

Accessories
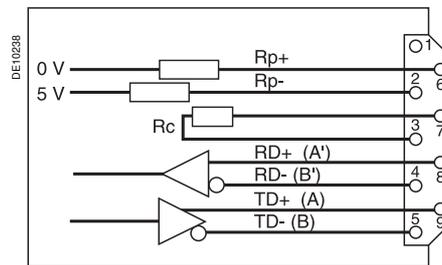
Sepam 2000
CCA609 connection box
CCA629 connection box

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

DE10239

connection via CCA602 connection cable

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

85

83

55

earthing terminal

2-wire RS 485 network connection terminal block:
incoming:
L+ to 1
L- to 2

outgoing:
L+ to 3
L- to 4

2-wire configuration (strap 5-6 and strap 7-8)

clamps for attachment and recovery of bus cable shielding (incoming/outgoing)

DE10240

2-wire RS 485 network

CCA609 or CCA629

CCA602 cable

Sepam 2000

CCA629: 2-wire RS 485 connection box

DE10241

connection via CCA602 connection cable

validation of impedance matching on the end station only (strap 1-2)

85

83

55

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.

Sepam 2000
CCA619 connection box

2-wire RS 485 network

DE10242

CCA619

Sepam 2000
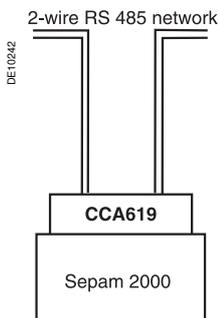
CCA619: 2-wire RS 485 connector

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

DE10243

L+ to +
L- to -

cable (2-wire) for chaining with another CCA619 connector

ground wire

23   46   70   50

DE10244
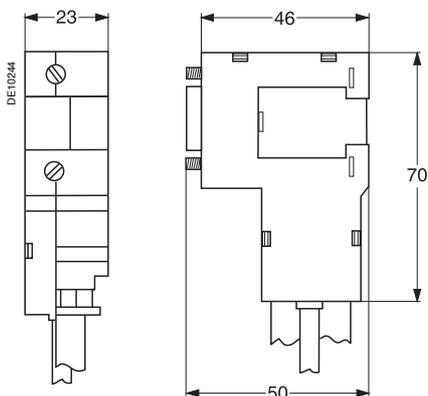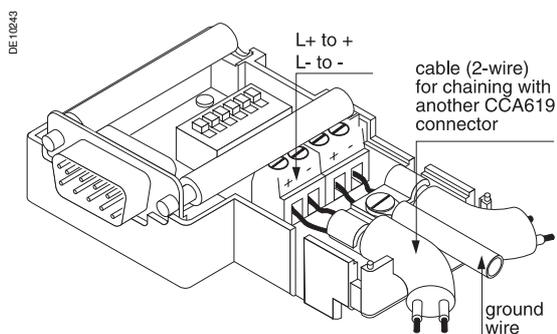
Setting of the configuration microswitches

CCA619 is not at the end of the line:

termination resistor connected

DE10245

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

not connected   no polarization
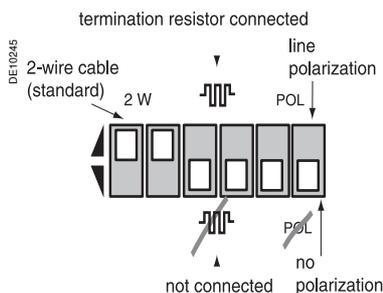
CCA619 is at the end of the line:

DE10246

2 W   POL
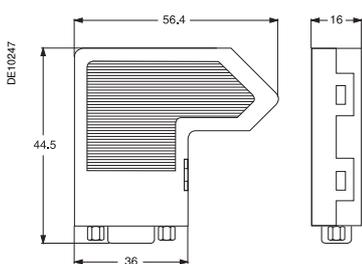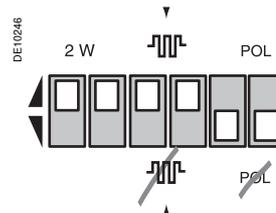
CCA600: 9-pin plug

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

DE10247

56.4   16   44.5   36
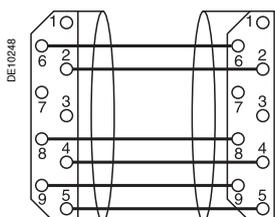
CCA602: branching cable

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.

DE10248

1   1
6   2   6   2
7   3   7   3
8   4   8   4
9   5   9   5

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.

ACE909-2 converters

ACE909-2 RS 232/RS 485 converter.

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.

⚠ ⚠ 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.

Characteristics

Mechanical characteristics

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

Electrical characteristics

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

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	IEC standard	Value
Fast transient bursts, 5 ns	60255-22-4	4 kV with capacitive coupling in common mode 2 kV with direct coupling in common mode 1 kV with direct coupling in differential mode
1 MHz damped oscillating wave	60255-22-1	1 kV common mode 0.5 kV differential mode
1.2/50 µs impulse waves	60255-5	3 kV common mode 1 kV differential mode

Male 9-pin sub-D connector supplied with the ACE909-2.

ACE909-2

Rx Tx 0V
RS 232

RS 485
V+ V− L+ L−

Ph N ⏚

3 7 9 5

ACE949-2

Description and dimensions

Ⓐ Terminal block for RS 232 link limited to 10 m (33 ft).

Ⓑ 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.

Ⓒ 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	SW1/1	SW1/2	SW1/3
Polarization at 0 V via Rp -470 Ω	ON		
Polarization at 5 V via Rp +470 Ω		ON	
2-wire RS 485 network impedance matching by 150 Ω resistor			ON

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

Rate (bauds)	SW2/1	SW2/2	SW2/3		
1200	1	1	1		
2400	0	1	1		
4800	1	0	1		
9600	0	0	1		
19200	1	1	0		
38400	0	1	0		
Format				**SW2/4**	**SW2/5**
With parity check				0	
Without parity check				1	
1 stop bit (compulsory for Sepam)					1
2 stop bits					0

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 Ⓐ
■ Maximum length 10 m (33 ft)
■ Rx/Tx: RS 232 receiving/sending by ACE909-2
■ 0V: Rx/Tx common, do not earth.

2-wire RS 485 link with distributed power supply
■ To connector Ⓑ 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 Ⓒ
■ Reversible phase and neutral
■ Earthed via terminal block and metal case (ring lug on back of case).

ACE919CC RS 485/RS 485 converter.

Function

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.

⚠ ⚠ 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.

Characteristics

Mechanical characteristics

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

Electrical characteristics	ACE919CA	ACE919CC
Power supply	110 to 220 Vac ±10%, 47 to 63 Hz	24 to 48 Vdc ±20%
Protection by time-delayed fuse 5 mm x 20 mm (0.2 in x 0.79 in)	1 A rating	1 A rating
Galvanic isolation between ACE power supply and frame, and between ACE power supply and interface supply		2000 Vrms, 50 Hz, 1 min

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	IEC standard	Value
Fast transient bursts, 5 ns	60255-22-4	4 kV with capacitive coupling in common mode 2 kV with direct coupling in common mode 1 kV with direct coupling in differential mode
1 MHz damped oscillating wave	60255-22-1	1 kV common mode 0.5 kV differential mode
1.2/50 µs impulse waves	60255-5	3 kV common mode 1 kV differential mode

Male 9-pin sub-D connector supplied with the ACE919.

Description and dimensions

Ⓐ Terminal block for 2-wire RS 485 link without distributed power supply.

Ⓑ 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.

Ⓒ 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.

Function	SW1/1	SW1/2	SW1/3
Polarization at 0 V via Rp -470 Ω	ON		
Polarization at 5 V via Rp +470 Ω		ON	
2-wire RS 485 network impedance matching by 150 Ω resistor			ON

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 Ⓐ
■ L+, L-: 2-wire RS 485 signals
■ ⏚ Shielding.

2-wire RS 485 link with distributed power supply
■ To connector Ⓑ 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 Ⓒ
■ Reversible phase and neutral (ACE919CA)
■ Earthed via terminal block and metal case (ring lug on back of case).

Connection of Sepam to an RS 485 network
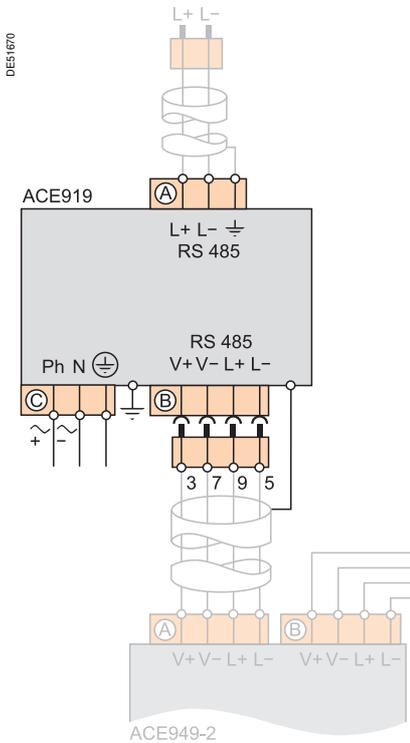
Preamble

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.

Terminal no.	ON position
1	Line polarization active
2	
3	Line impedance matching active

OFF ON
1 — Rp-
2 — Rp+
3 — Rc
SW1

Converter positioned at end of bus

OFF ON
1 — Rp-
2 — Rp+
3 — Rc
SW1
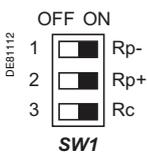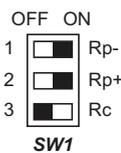
Converter not positioned at end of bus
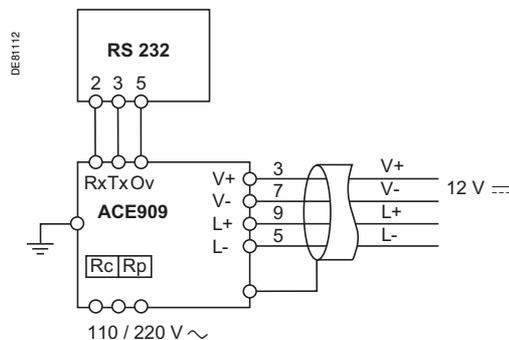
110 or 220 Vac power supply depending on the switch on the underside of the converter
Rc = load resistor
Rp = line idle polarization resistor

Connection of Sepam to an RS 485 network

OFF ON
1 Rp-
2 Rp+
3 Rc
SW1

Converter positioned at end of bus

OFF ON
1 Rp-
2 Rp+
3 Rc
SW1
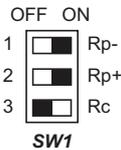
Converter not positioned at end of bus

ACE909-2 2-wire RS 485 converter - second generation

The SW1 switch is used to set the communication parameters.

| Terminal no.	ON position
1	Line polarization active
2	
3	Line impedance matching active

RS 232
2 3 5

Rx Tx 0v
ACE909-2
V+ 3 V+
V- 7 V- 12/24 V ⎓
L+ 9 L+
L- 5 L-

Rc Rp
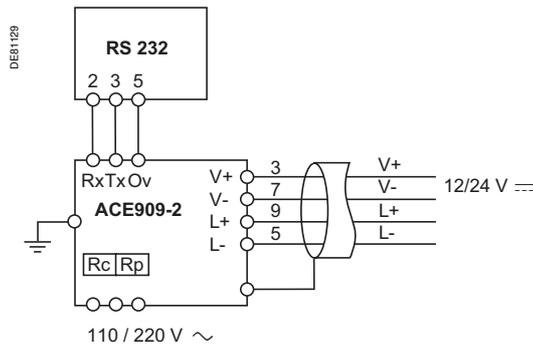
110 / 220 V ∼

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.
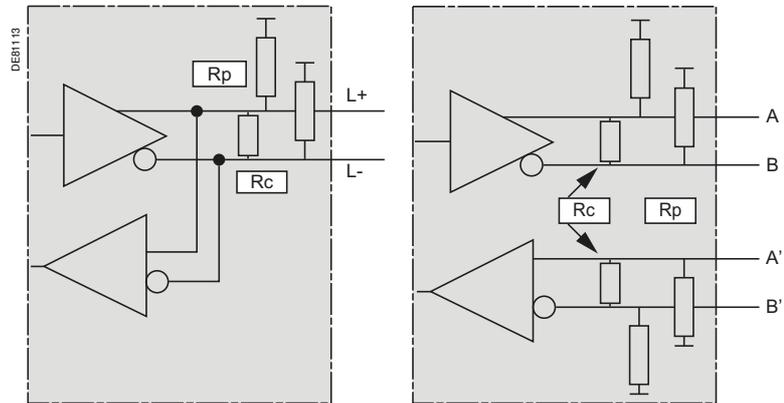
ACE919 converter

The SW1 switch is used to set the communication parameters.

L+
L-

ACE919
V+ 3 V+
V- 7 V-
L+ 9 L+
L- 5 L-

Rc Rp

24 - 48 V ⎓
110 / 220 V ∼

OFF ON
1 Rp-
2 Rp+
3 Rc
SW1

Converter positioned at end of bus

OFF ON
1 Rp-
2 Rp+
3 Rc
SW1

Converter not positioned at end of bus

Connection of Sepam to an RS 485 network
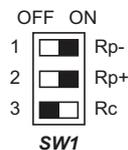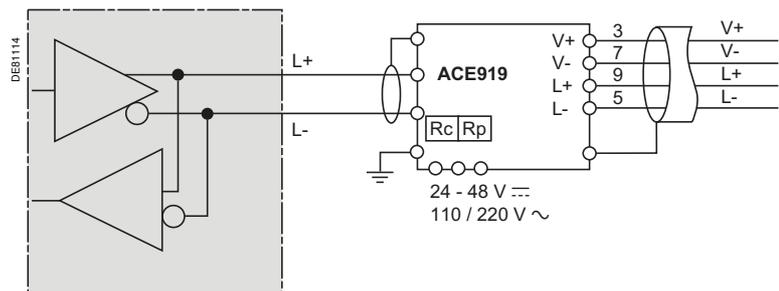
Ethernet/Modbus gateways

EGX100, EGX300 gateways, ECI850 server G3200 gateway

Communication parameter-setting switch:

Terminal no.	Selection
1	2-wire/4-wire line impedance matching
2	
3	Polarization at the 0 V
4	Polarization at the +5 V
5	2/4-wire mode
6	

■ 2-wire mode

=ON =OFF

Converter positioned at end of bus

=ON =OFF
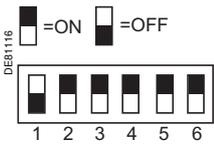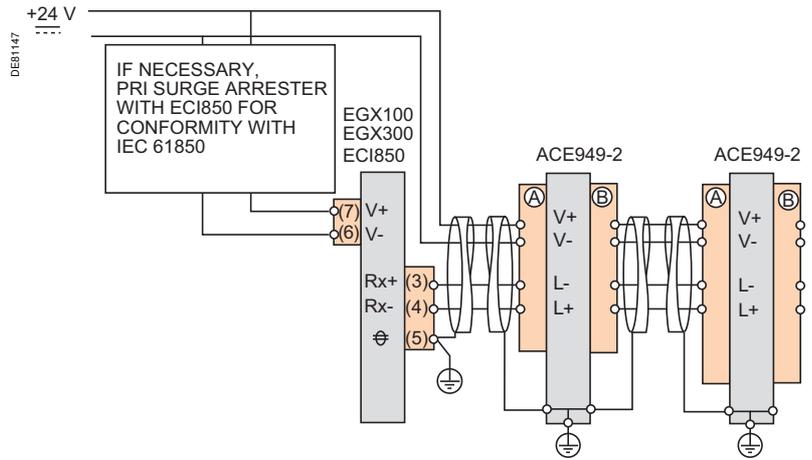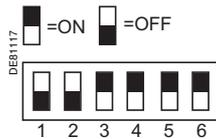
Converter not positioned at end of bus

■ 4-wire mode
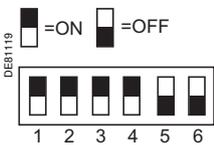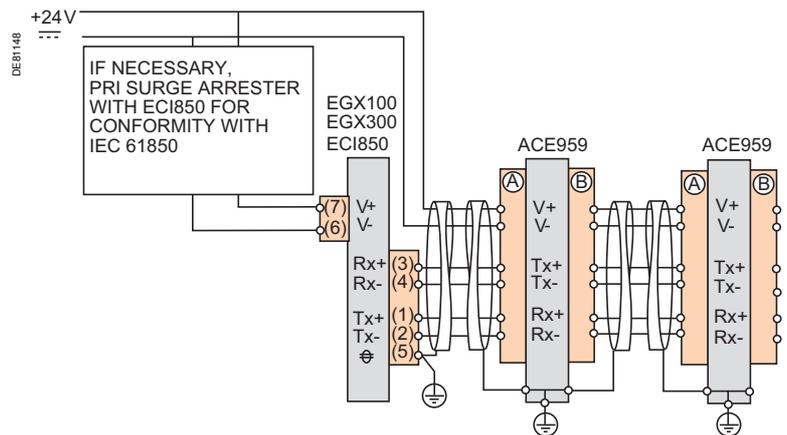
=ON =OFF

Converter positioned at end of bus

=ON =OFF

Converter not positioned at end of bus

Connection of Sepam to an RS 485 network
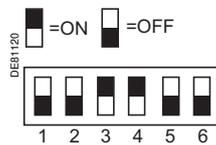
EGX200, EGX400 gateways

Communication parameter-setting switch

Switch n°	Port	Signal	Meaning
1	COM2	Tx	Termination
2		Rx	
3		Rx-	Bias
4		Rx+	
5	–	–	–
6	–	–	–
7	COM1	Tx	Termination
8		Rx	
9		Rx-	Bias
10		Rx+	

■ 2-wire mode
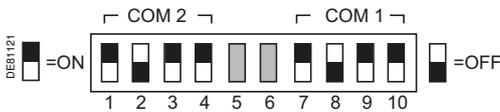
Gateway positioned at end of bus
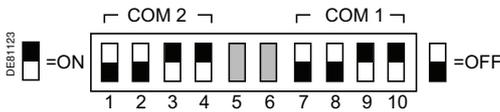
Gateway not positioned at end of bus
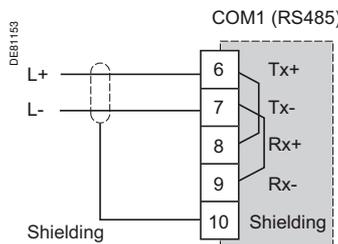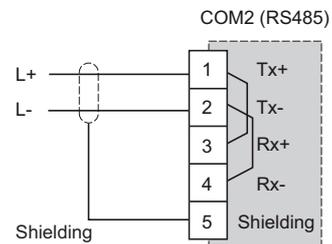
COM1 connector   *COM2 connector*

■ 4-wire mode
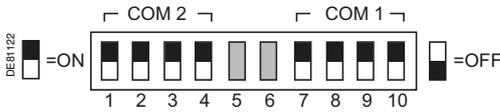
Gateway positioned at end of bus
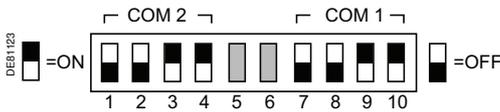
Gateway not positioned at end of bus
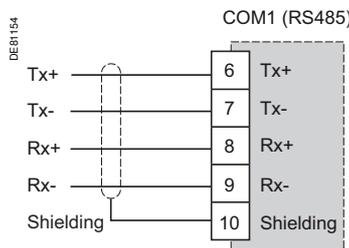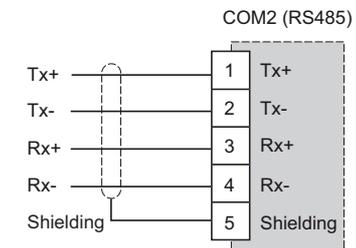
COM1 connector   *COM2 connector*

Sepam series 20/40/60/80 with ACE949-2 and Sepam series 10 network in 2-wire mode
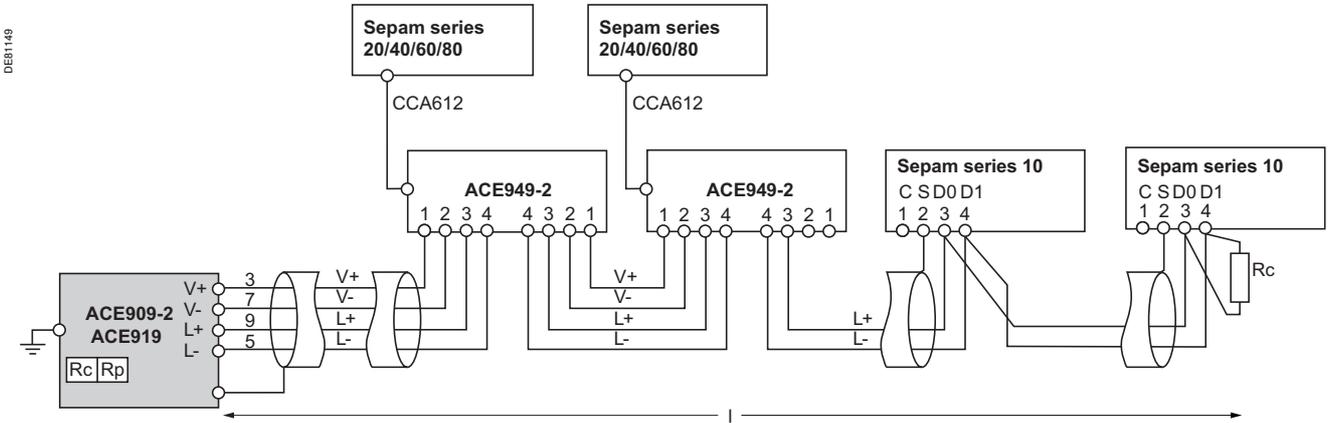
DE81149

Rc = load resistor

Rp = polarization resistor

l = maximum length according to number of Sepam relays and cable used

12 or 24 Vdc distribution power supply provided by ACE909/909-2 or ACE919

Sepam series 10 network
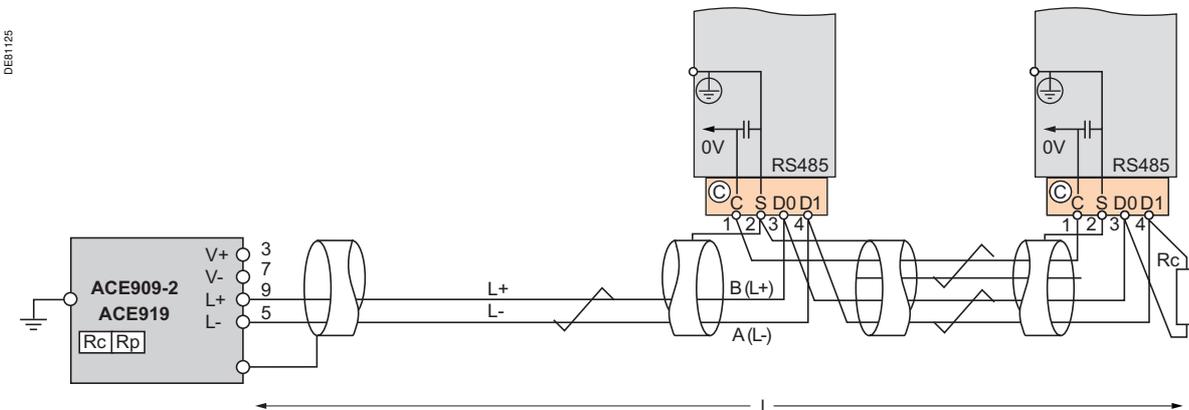
DE81125

Rc = load resistor

Rp = polarization resistor

l = maximum length according to number of Sepam relays and cable used

Connection of Sepam to a 2-wire RS 485 network

RS 232 master with ACE909-2

Sepam 2000 raccordés par CCA629 et CCA602
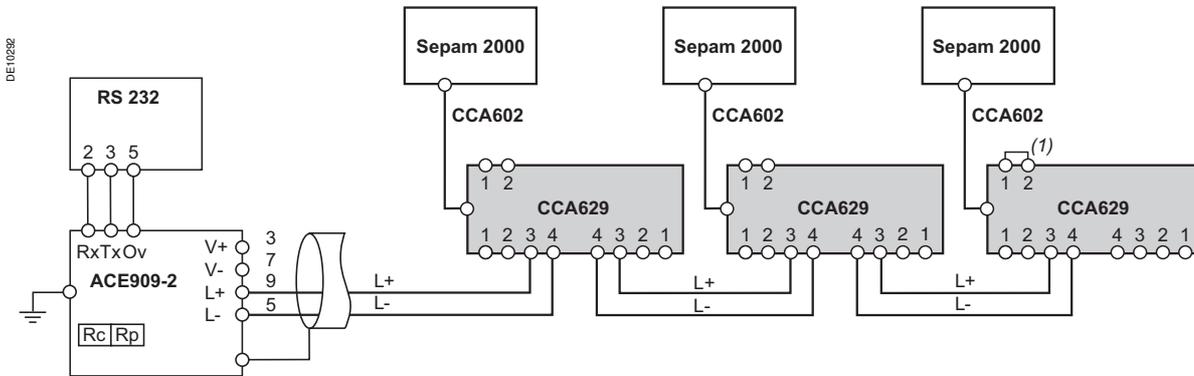
Rc = load resistor

Rp = polarization resistor

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

Sepam 2000 raccordés par CCA609 et CCA602
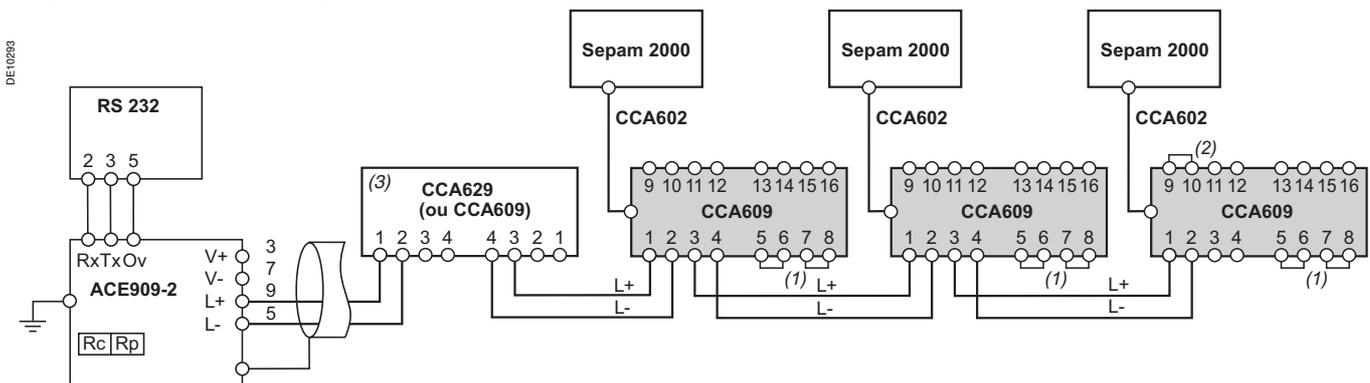
Rc = load resistor

Rp = polarization resistor

(1) *Straps 5-6 et 7-8 : réseau RS 485 2 fils*

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

(3) *CCA629 ou CCA609 à insérer pour une protection CEM de l'interface maître si besoin*
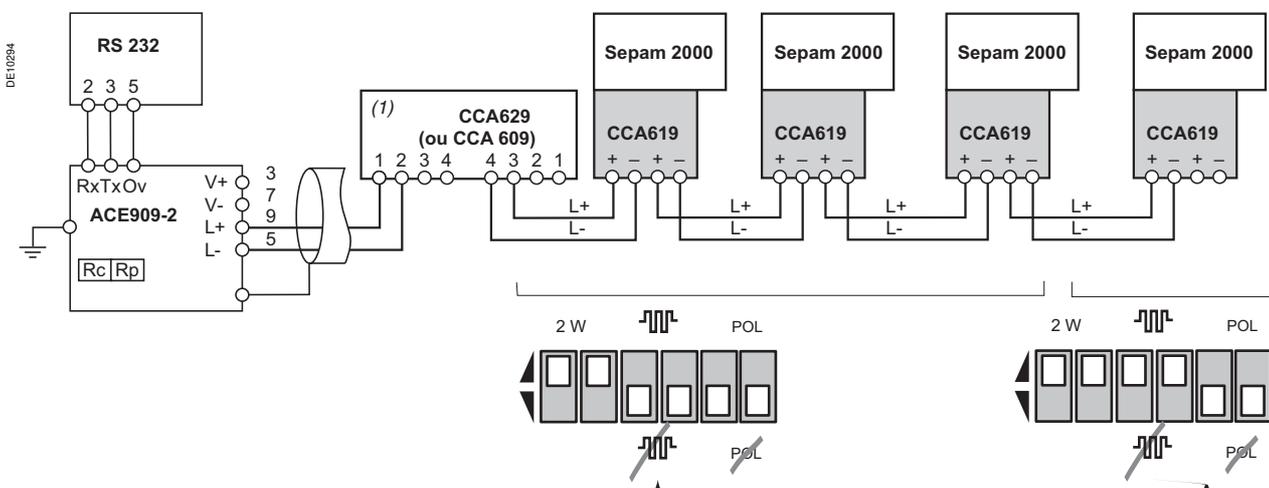
Rc = load resistor

Rp = polarization resistor

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

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

DE81150

Sepam series 20/40/60/80 — CCA612

Sepam 2000 — CCA602

Sepam series 20/40/60/80 — CCA612

Sepam 2000 — CCA602 (1)

ACE949-2 | 1 2 | CCA629 | ACE949-2 | 1 2 | CCA629

1 2 3 4   4 3 2 1   1 2 3 4   4 3 2 1   1 2 3 4   4 3 2 1   1 2 3 4   4 3 2 1

ACE909-2 / ACE919
V+ 3
V- 7
L+ 9
L- 5
Rc Rp

V+ / V- / L+ / L-

(2)

l
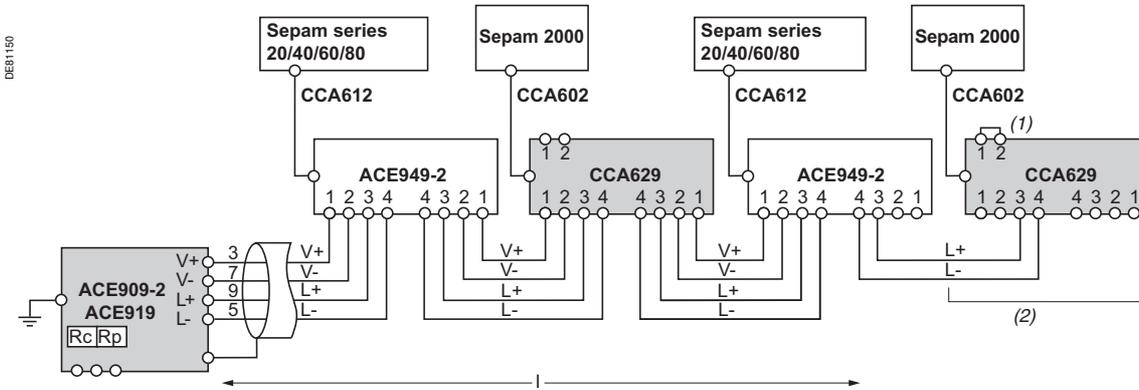
Rc = load resistor

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
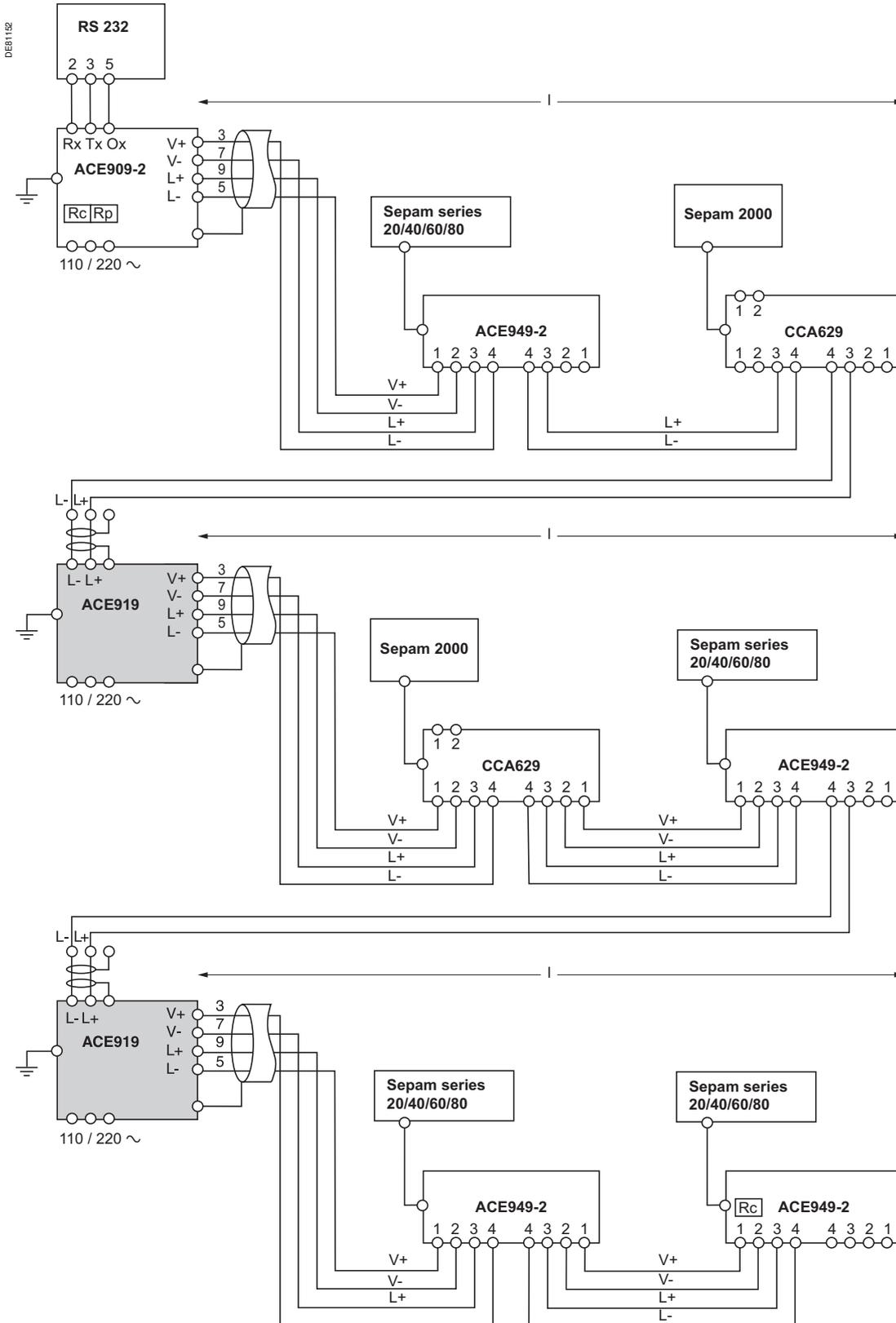
2-wire RS 485 network extension with ACE919

DE81152

```
                          RS 232
                          2  3  5
```

```
                    Rx Tx Ox    V+  3
                    ACE909-2    V-  7
                                L+  9
                                L-  5
                    Rc Rp
                  110 / 220 ∼
```

Sepam series 20/40/60/80

Sepam 2000

ACE949-2
1 2 3 4   4 3 2 1

CCA629
1 2
1 2 3 4   4 3 2 1

V+
V-
L+   L+
L-   L-

```
  L- L+
              L- L+    V+  3
              ACE919   V-  7
                       L+  9
                       L-  5
            110 / 220 ∼
```

Sepam 2000

Sepam series 20/40/60/80

CCA629
1 2
1 2 3 4   4 3 2 1

ACE949-2
1 2 3 4   4 3 2 1

V+   V+
V-   V-
L+   L+
L-   L-

```
  L- L+
              L- L+    V+  3
              ACE919   V-  7
                       L+  9
                       L-  5
            110 / 220 ∼
```

Sepam series 20/40/60/80

Sepam series 20/40/60/80

ACE949-2
1 2 3 4   4 3 2 1

Rc ACE949-2
1 2 3 4   4 3 2 1

V+   V+
V-   V-
L+   L+
                      L-

Rc = load resistor

Rp = polarization resistor

I = maximum length according to number of Sepam relays and cable used

Schneider Electric

Connection of Sepam to a 4-wire RS 485 network

4-wire RS 485 master with Sepam 2000

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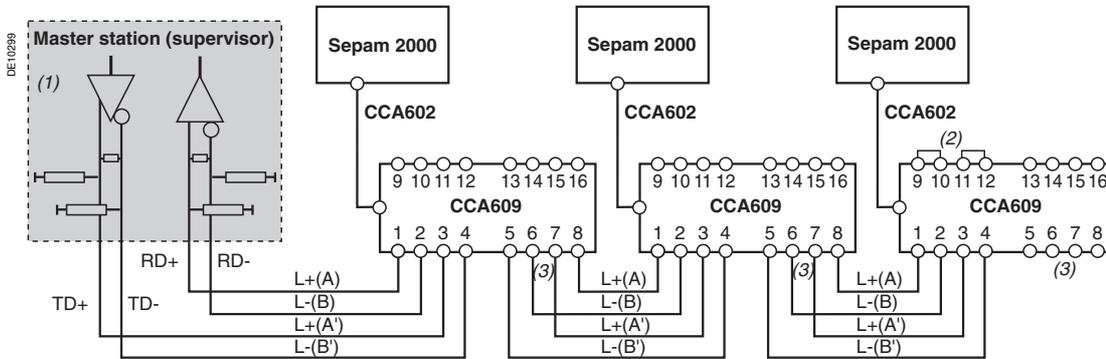
(1) *Line polarization, line impedance matching resistor (transmission and reception)*
(2) *Straps 9-10 and 11-12: line impedance matching resistor*
(3) *Removal of straps 5-6 and 7-8: 4-wire RS 485 network*

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

Master station at end of line
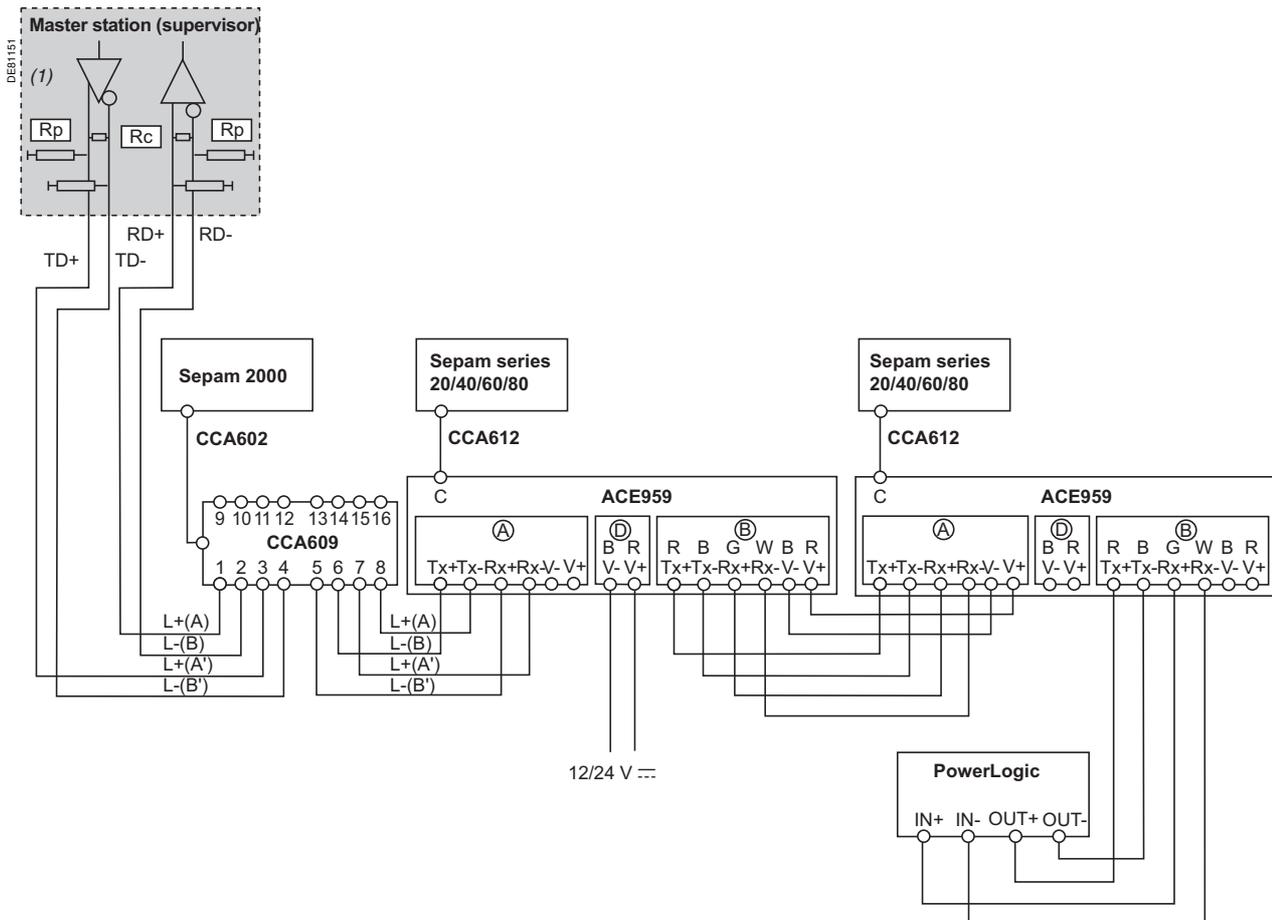
Rc = load resistor
Rp = polarization resistor
(1) *Line polarization, line impedance matching resistor (transmission and reception)*

Setting and testing

Setting of communication parameters

Before Modbus communicatioln equipment is put into service, parameters need to be set.

Selection	Where
transmission rate adjustable from 300 to 38 400 bauds	on converters on equipment
slave n° assigned adjustable from 1 to 255	on equipment
parity: no parity, even parity, odd parity	on converters on equipment
line polarization	1 location only (master)
line impedance matching	at end of line on converters on equipment

Schneider Electric

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 convecters
■ 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 Vto +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.

State 0
level 0

State 1
level 1

station 03

5 V

RD-   TD+

Rp

L- (B/B')

Rc   Rc

L+ (A/A')

Rp

0 V
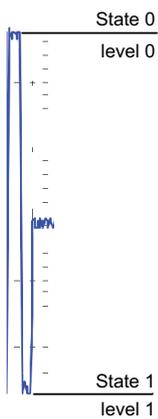
station 01   station 02   station n-1   station n (n ≤ 32)
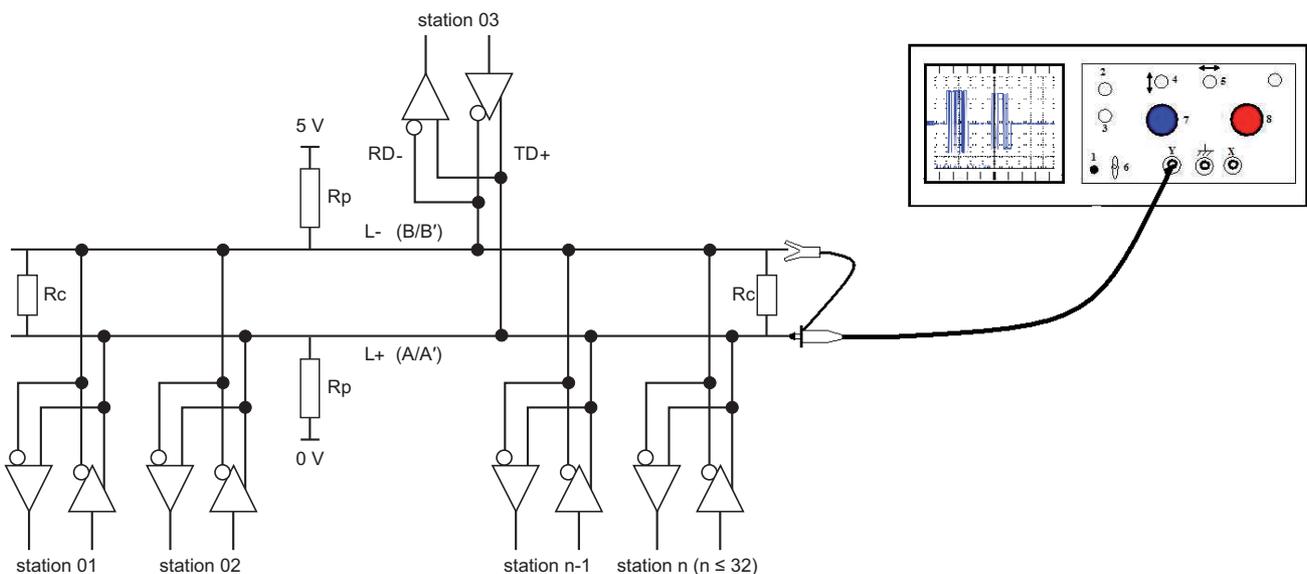
Example of correct signals:

DE81159

Example of incorrect signals:

DE81160
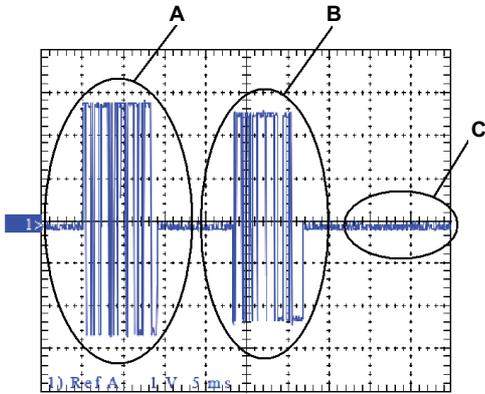
Zone A: transmission from the master, amplitude 5.4 V.
Zone B: transmission from the slave, amplitude 5 V.
Zone C: bus in the idle state: -0.2 V
The signals are symmetrical in relation to zero and the idle state is close to 0 V.
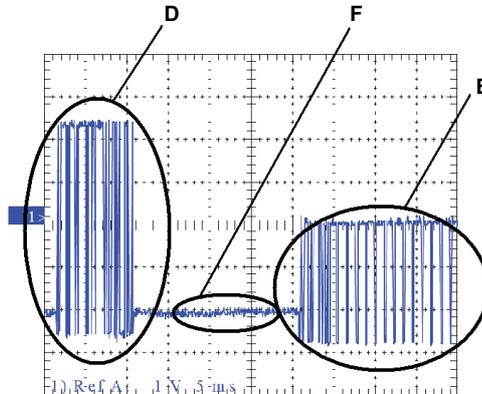
Zone D: transmission from the master, amplitude 5 V.
Zone E: transmission from the slave, amplitude 2.8 V.
Zone F: bus in the idle state: -2 V.
In this case, the bus polarization is not adhered to. This is seen at the voltage's strongly negative value when there is no communication. The slave's response 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.

Annexes **Connecting devices**

Connection examples for Schneider Electric devices

RS 485	SubD-9 standard	Schneider Electric standard	Belden 9842 cable (RS 485)	Belden 8723 cable	Belden 8104 cable (SCP CM 4030)	Digipact & Modbus systems	CJB 306 / CSD 309	Masterpact	DC150 / XLI / Sepam 2000
Marking	Pin N°	Marking	Color	Color	Color	Color	SubD 9-F	Wago	SubD 9-F
	1	0V				Black	0V	E2	0V
	2	Rp (5V)			Orange/White	Red	24V	E1	Rp (5V)
	3	Rc					N.C.		Rc.
B'	4	B' (Rd-)	Blue	Green	Green/White	Blue	B' (In+)	E6	B' (Rd-)
B	5	B (Td-)	White/Blue	Red	Green/White	Yellow	B (Out+)	E4	B (Td-)
	6	Rp (0V)			White/Orange	Black	0V	E2	Rp (0V)
	7	Rc			Brown/White	Red	24V	E1	Rc
A'	8	A' (Rd+)	White/Orange	White	White/Green	White	A' (In-)	E5	A' (Rd+)
A	9	A (Td+)	Orange	Black	White/Green	Brown	A (Out-)	E3	A (Td+)
	Case	Shield	Braid	Braid	Braid	Braid	Case		Case

RS 485	Sepam 20/40/60/80 ACE 949	Sepam 20/40/60/80 ACE 959	PM 300	PM 500	PM 600	PM 700	PM 800	CM 2000	CM 4000 Daisy chain
Marking	Screw con.	Screw con.	Phoenix 5 pts	Phoenix 3 pts	Phoenix 5 pts	Phoenix 3 pts	Phoenix 3 pts	Screw con.	Phoenix 5 pts
B'		Rx+	B' (Rd-)		In+ (pin 5)			In+ (pin 20)	Rx+ (pin 20)
B	L-	Tx+	B (Td-)	L+	Out+ (pin 3)	+	+	Out+ (pin 22)	Tx+ (pin 22)
			Rc						
A'		Rx-	A' (Rd+)		In- (pin 4)			In- (pin 21)	Rx- (pin 21)
A	L+	Tx-	A (Td+)	L-	Out- (pin 2)	-	-	Out- (pin 23)	Tx- (pin 23)
			Shield (pin 18)			Shield	Shield	Shield (pin 24)	Shield (pin 24)

RS 485	ECC Master COM3	EGX 100-300, ECI850, G3200 (com 1/ -) EGX 200-400 (com 2/1)	PS750 (COM3/4)	174 CEV 300 (Bridge Master)	IC 108 A (232/485 Master)	ACE 909 (232/485 Master)	ETIC MTI 133-2 (Modem Master)	RS 485 Master for CM4 demo-case, portable CM4 & EGW2	Daisy chain of CM4 demo-case & portable CM4
Marking	Phoenix 5 pts	Phoenix 5 pts	SubD-9-M	Screw con.	Screw con.	SubD 9-F	Phoenix 2 pts	SubD 9-F	SubD 9-F
B'	Tx+ (pin 1)	Tx+ (pin 1/6)	Tx+ (pin 6)	Tx+	TxB			Tx+ (pin 2)	Rx+ (pin 2)
B	Rx+ (pin 3)	Rx+ (pin 3/8)	Rx+ (pin 4)	Rx+	RxB	L- (B/B')	B (pin 7)	Rx+ (pin 4)	Tx+ (pin 4)
A'	Tx- (pin 2)	Tx- (pin 2/7)	Tx- (pin 1)	Tx-	TxA			Tx- (pin 1)	Rx- (pin 1)
A	Rx- (pin 4)	Rx- (pin 4/9)	Rx- (pin 9)	Rx-	RxA	L+ (A/A')	A (pin 8)	Rx- (pin 3)	Tx- (pin 3)
	Shield (pin 5)	Shield (pin 5/10)	Shield (pin 5)	GND				Shield (pin 9)	Shield (pin 9)

RS 485	232/485 AFI local adaptation	TSX SCY 11601	TSX Nano	LUFP7	PM9C	W330	ION [1]	Conzerv DM6200 PM1200	Vigilohm IM20
Marking	Phoenix 4 pts	SubD 25	Screw con.	RJ45	Screw con.	RJ45	Screw con.	Screw con.	Phoenix 4 pts
		Rp 5V (pin 9)							
		Rc (pin 11)							
B'	T+ (pin 1)		A						
B	R+ (pin 3)	L+ (pin 24)	B	B(+) (4)	B/B'	D1 (4)	+	7	D1
		Rp 0V (pin 21)							0V
		Rc (pin 23)							
A'	T- (pin 2)								
A	R- (pin 4)	L- (pin 6)		A(-) (5)	A/A'	D0 (5)	-	14	D0
							SH		SH (13)

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

As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.

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12-2011