SBWEB HW manual

rev. 0.1, 15/05/2013

SBWEB SYSTEM DESCRIPTION AND INSTALLATION MANUAL

This manual is an integral part of the SBWEB system. Please read it carefully, as it contains important information regarding safety.

- The SBWEB system must be used only for the usage it has been designed for. Every other kind of usage is potentially unsafe. The manufacturer is not responsible for improper usage.
- The manufacturer is not responsible for the consequences of using non-original spare parts.
- This manual is subject to change without notice.

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1 System description

The SBWEB system provides a decentralized installation concept for building automation. Bus-powered sensors and small decentralized I/O-modules are installed in the field at the actual sensor/actuator points, and linked together through the Dupline two-wire bus. This simplifies the wiring significantly compared to the traditional hardwired star connections to the DDC controllers. It also allows the individual DDC Controllers to connect to a larger number of field I/O points and over much longer distance. Furthermore, the system provides a high degree of flexibility for system enhancements and last-minute changes.

The SBWEB system is also able to manage Energy Meters linked via RS485, Modbus-RTU protocol.

All the data points from the Dupline bus and the energy meters are automatically converted to BACnet objects, thereby allowing seamless integration with DDC Controllers and BMS systems
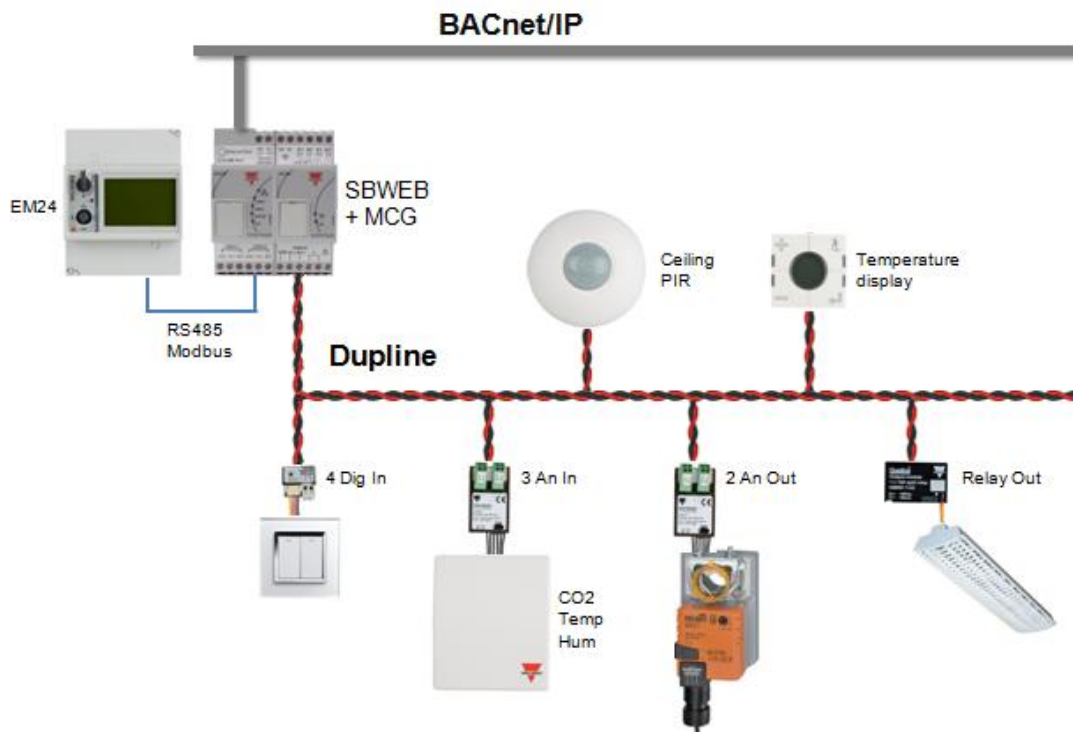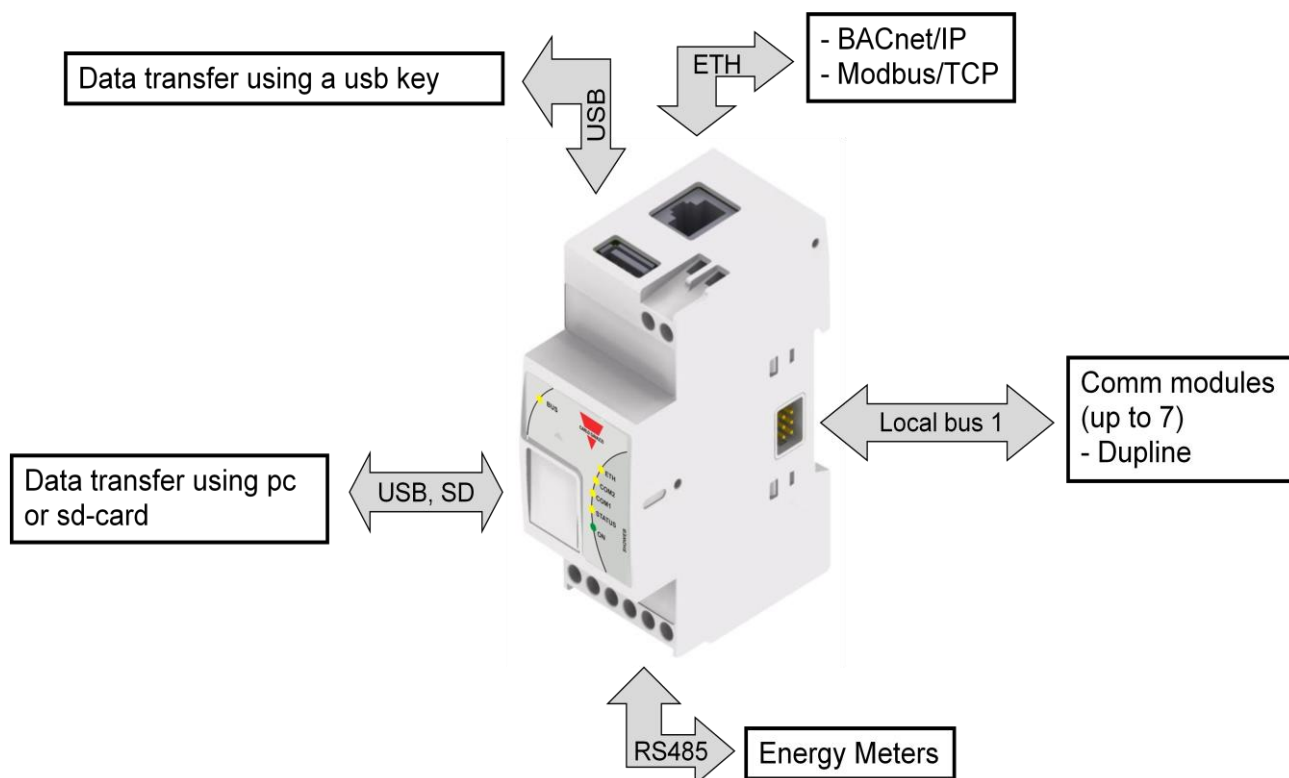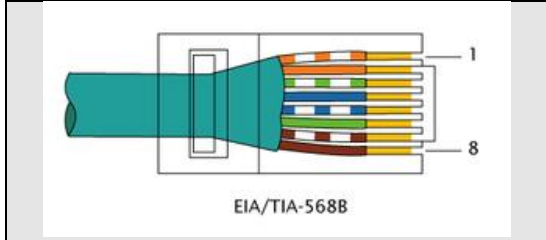
1.1 The master unit: SB2WEB24

The SB2WEB24 is the central CPU of the SBWEB system. It is a Linux based embedded PC that manages the collection of data points from the Dupline networks and Energy Meters, and subsequently makes them available as BACnet/IP objects.

The SB2WEB24 needs to be programmed by means of the PC-based configuration software SBWEB tool. During the configuration process the user selects the Dupline modules and energy meters to be used in the system, with the option to place them in a structured view of the building. For some modules, operational parameters need to be entered, e.g. scaling values for analog I/O-modules and PIR detection thresholds. The tool automatically creates BACnet objects for all the data points of the selected modules. BACnet instance numbers can be edited, and if desired, unused BACnet objects can be removed.

The configuration time can be reduced by using the option to scan the Dupline network(s) and automatically detect the connected modules in an installed system.

The following table provides a summary of the characteristics of the product:

Ports and connections	1 X 12 to 28Vdc power supply (**A1+** and **A2-**) 2 X RS-485 (COM1 and COM2) : 	COM1	Data – (A-)
	Data + (B+)
	GND
COM2	Data – (A-)
	Data + (B+)
	GND | 1 X RJ-45 connector for 10/100 Base-T Ethernet [Communication] EIA/TIA-568B Pin 1 TX+ / Pin 2 TX- / Pin 3 Rx+ / Pin 6 Rx- 1 X standard USB 1 X mini (internal use only) 1 X slot for micro SD or SDHC memory card
Absorption	5W Max.
Operating conditions	-25°C to 40°C
COM port termination	Both COM ports are internally terminated with a value of 150Ω and polarized with two 511Ω resistors (from "B+" to +5V and from "A-" to GND). As a consequence no other external connection is required from the SB2WEB24 side (see Appendix A for the other termination).

1.1.1 SB2WEB24 bus description

Local bus 1: This is placed in the connector on the right side and it is called the High Speed bus. This bus is used to connect the Dupline® generators to the SB2WEB24.

Local bus 2: Connector on the left side (not in use)

RS485 port 1: Not in use

RS485 port 2: This is a serial port with modbus master capability used to connect to Carlo Gavazzi energy meters.

USB port: This is placed on the top of the housing and it can be used to change the IP address and to upload/download the firmware, the configuration of the installation, the data logging.

SD-card: The SB2WEB24 can read data from/to a micro SD-card that has to be placed frontally behind the small door: it can be only used to change the IP address.

Ethernet port: Placed on the top of the housing and has to be used to connect to the SBWEB tool

1.2 Bus generators

The SB2WEB24 is the brain of the SBWEB system, but it cannot work alone (unless only EM's are connected via the built-in RS485 port). It needs the Dupline® bus generators to send commands to the slave modules and collect information from them. For this reason, the Dupline® bus generators can be considered as the pulsating heart that makes all the information flow. They are connected to the SB2WEB24 via the high speed bus that is present both on the local bus and on the terminals at the bottom of the bus generators. This means that the connection is very fast and easy in a cabinet, since the modules only have to be plugged together, without any wiring, and at the same time it is very straightforward if the bus generators have to be mounted in different cabinets. Up to 7 bus generators can be connected to one SB2WEB24.
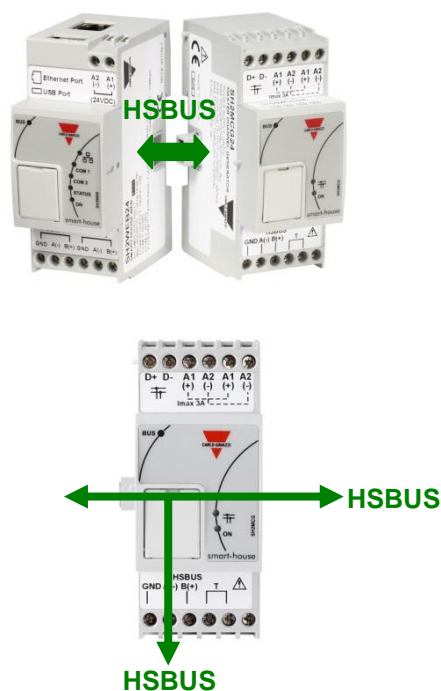
Example 1: The bus generators are all connected in the same Din-rail.
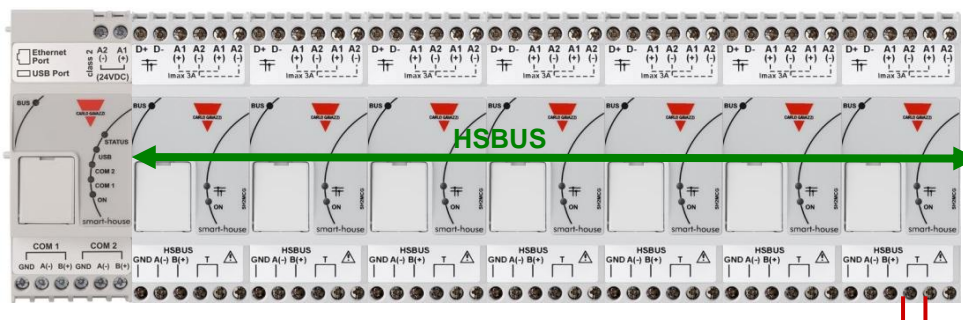
Example 2: The bus generators are mounted in different cabinets.
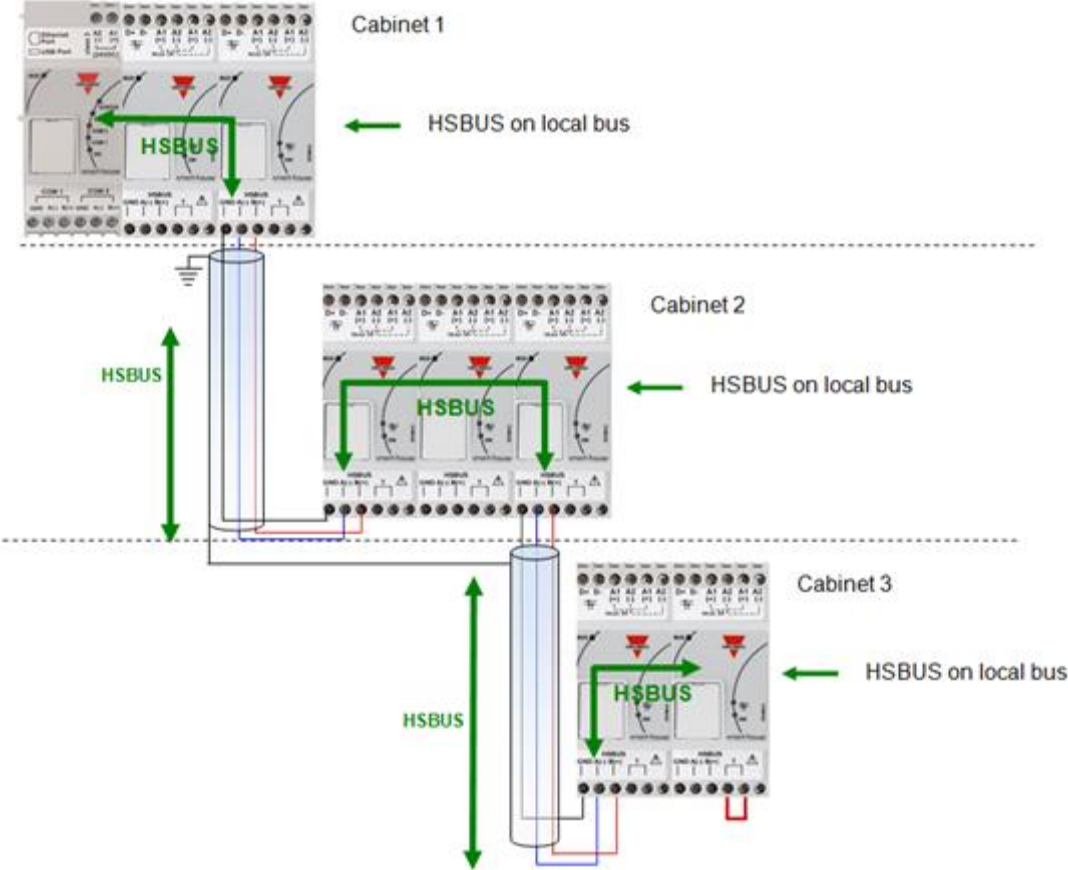
Example 3: The bus generators SH2MCG24 do not need to be put all together in a DIN rail, and they can be mixed with the Dupline® modules as is shown in the picture below.

Also in this case there is no need to wire the RS485 for the HS speed bus since the local bus connector of the Dupline® modules is transparent to it. The installer only has to terminate the HS speed bus in the last bus generator of the RS485 network.
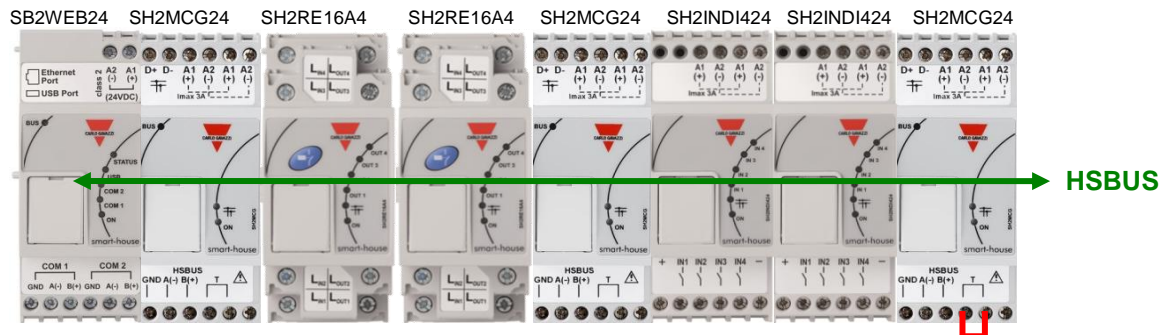
1.2.1 Wiring the high speed bus

The high speed bus is an RS485 bus, at 256Kbit.
The cable
The RS485 communication cable is a shielded, twisted pair cable. Many cable manufacturers supply cable meeting the RS485 standard. Other cabling, such as telephone cable, coaxial cable and multi-core wires should not be used as they could prove problematic and not provide satisfactory performance.Cables must be at least 0.5 mm.
Topology
The cable must be installed to pass close by each node. Stubs (cables joining the node to the cable),stars(multiple cable segments brought back to a single point) or loops must not be used.
Cable length
The maximum length of a single cable run is 600 metres.
Connection of the cable shield
The shield of the RS485 cable establishes a reference voltage for the RS485 signal conductors.
The "screen pig-tails" going into the terminals should be as short as possible. The shield should be continuous throughout the installation, the best way is to connect the shield to earth ground in only one point as nearest as possible to the SH2MCG (the best is on the terminal where the cable is connected). This connection is not to be shared with other devices which could add external noise or disturbance.
Termination
The network must be terminated at each end on the last bus generator of the network (see the T terminals in the picture above) while it has already been terminated on the SB2WEB24 side. This is to avoid reflections which would disrupt communication.
Cable Insulation
The communication cable must not be run in cable trays carrying power wiring nor in close proximity to power wiring. Current surges in power wiring due to high equipment starting currents or to faults can disrupt communication.

For more details please see appendix A.

1.2.2 The Dupline® bus

The Dupline® bus is a signal transmission system that reduces the need for wires, as compared to an ordinary installation. Using only 2 wires, the information can be transmitted from up to 3 km away. Several input and output modules are supplied from the same 2 wires. Both digital (on-off) and analogue (e.g. temperature, light level, wind speed and other) data is present on the bus at the same time and it is collected by the SH2MCG24 and then processed by the SB2WEB24.

The SH2MCG24 is the smart Dupline® bus generator that powers the Dupline® bus onto the local bus and onto the terminals at the top. All the Dupline® slave modules have to be connected to one SH2MCG24 to be part of the SBWEB system.
The SH2MCG24 is powered by 15 to 30Vdc.
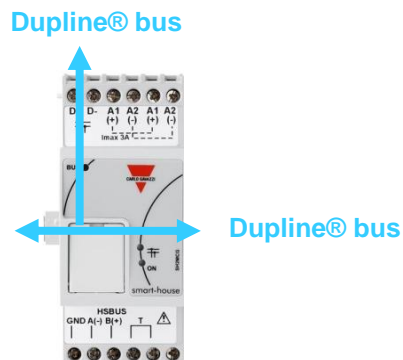
The Dupline® modules in the SBWEB system can be divided into two groups:
- Decentralized modules: these are all the modules such as light switches, PIR sensors, lux sensors, decentralized I/O modules, etc which are mounted into the wall boxes or on the wall
- Centralized cabinet modules: these are the ones housed in the 1-DIN or 2-DIN housing for din rail mounting

All our **decentralised** Dupline® devices are connected to each other with a single 2-wire cable. This cable carries the communication signal that comes from the bus generator SH2MCG24. These 2 wires carry a DC low-voltage pulsating signal, and therefore attention must be paid to keep the correct polarity of the connection.
***The Bus is overload and short-circuit protected, but anyway it is a good rule to avoid to invert the polarity.***
The modules cannot withstand voltages other than the Dupline® signal voltage (5.5V to 10V).

The so-called *decentralised* modules can be divided into the following groups:
- Light switches
- PIR sensors
- Temperature displays
- Water and smoke detectors
- Wind sensor
- Humidity sensor
- Light sensor
- Decentralised input/output module

The installation is not to be engineered around the Dupline® bus because it can be matched to the application. The routing of the cable may be in a line, star, ring or any combination.
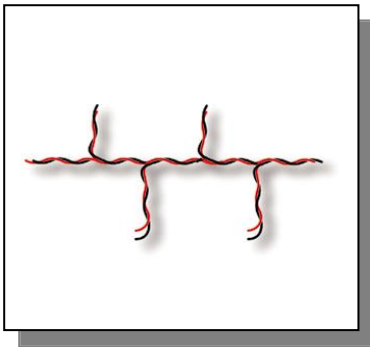
Straight-through: the best place for theSH2MCG24 would be in the middle of the line
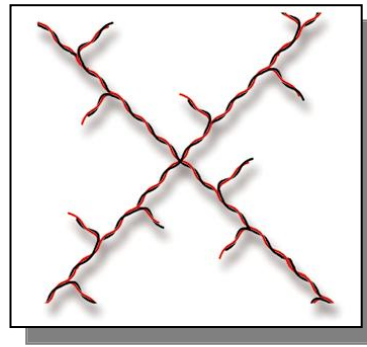
Star: the best place for the SH2MCG24 would be in the middle of the star
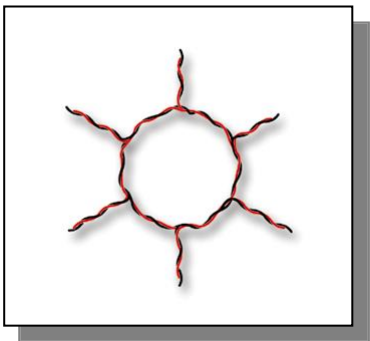
Ring: the best location for the SH2MCG24 is in the middle between the two farthest distant modules.
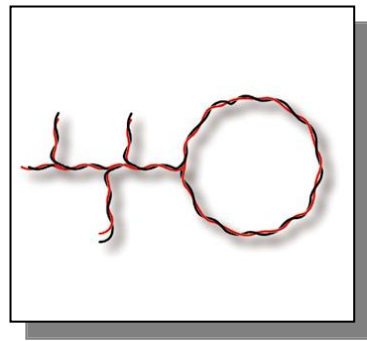
Combined: the best location for the SH2MCG24 is in the middle between the two farthest distant modules.

1.2.3 Cable and installation tips

1.2.3.1 New Installation Planning

When planning a new installation, a generic Bus cable can be used: it is better to use a twisted cable in order to prevent electrical noise from affecting one conductor more than the other and thereby creating an unbalanced Dupline® system.

The table below can be used to find the right cable: this can easily be carried out by considering the maximum distance between the SH2MCG24 and the farthest module in the installation and checking the table below.

The values shown in the table have been calculated considering a balanced distribution of the modules in the Dupline® bus.

Installations where most of the modules are placed at the end of the network may be critical and this is not recommended (the table is not valid in this case).

The values shown in the table are also suitable for installations where the majority of the modules are placed at the beginning of the network (close to the SH2MCG24); this type of connection represents the best configuration to guarantee the best performance of the system.

Table of cable sections:

Max current Consumption	Cable size		
	$0.75 \ mm^2$ (AWG 19), twisted	$1 \ mm^2$ (AWG 17), twisted	$1.5 \ mm^2$ (AWG 15), twisted
450 mA	50 m	70 m	100 m
350 mA	65 m	90 m	130 m
300 mA	75 m	100 m	150 m
250 mA	90 m	120 m	180 m
200 mA	115 m	150 m	230 m
150 mA	150 m	200 m	300 m
100 mA	225 m	300 m	450 m
50 mA	450 m	600 m	900 m

The user is recommended to select cables according to the length end consumption shown in the table above. It is also advisable to use polyethylene conductor insulation to have lower cable capacitance.

The total consumption of all the modules supplied by the Dupline® bus (e.g. light switch, PIR, lux sensors) and the cable resistance affect the voltage of the Dupline® bus.

The drop in the Bus voltage might cause the modules placed far from the SH2MCG24 to not work correctly.

1.2.3.2 Installation on Existing Cables

If the installation uses existing cables, it is important to verify the cross section of conductors according to the above cable section table.

Once the cable size is checked, it is important to ensure that there is no leakage between the two conductors and, also, no leakage from the conductors to ground or shield.

The best method of leakage testing before connecting any Dupline® modules is to use an insulation tester (min. 500 V) to verify a resistance higher than 100.000 kΩ.

1.2.3.3 Dupline Cable Routing

The Dupline® cable is a signal cable and it should, therefore, be routed as such. This means that it is better to keep it separate from power cables, high energy noise sources such as contactors, switched inductive loads etc. However, if there are no other alternative possibilities, the routing of Dupline ® cable may pass close to power cables.

Recommendations:
1) Do not connect any of the wires to other voltage potentials.
2) Do not connect any of the wires to protective earth (PE).
3) Do not use cable gauges larger than 1.5 mm^2 .

1.2.3.4 I/O-modules Cabling

During the installation of each module, the length of external cables (input/output) must be selected according to the datasheet reference.

These wires must be treated as signal wires and be kept away from contactors, relays, motors and other inductive noise sources. In extreme cases it is necessary to use shielded cable. But here the shield must also be properly grounded at one point only.

With the high flexibility of Dupline®, external input and output wires should, of course, be kept as short as possible by bringing the Dupline® bus to the points where signals are to be transmitted or received.

Note: For the dimmer module the cable between the cabinet module and the light should not exceed 25 metres.

Note: For input modules with contact inputs, the short circuit current (indicated on the individual datasheets) must be noted and adequate switching devices must be selected for trouble-free operation.

Note: if multi-conductor cable is used, where some of the conductors are spare, we highly recommend connecting all spare wires to ground (preferably close to the SH2MCG24). This to reduce the "antenna effect" of open-end wires.

1.2.4 How to define the number of Dupline® networks

The new SBWEB system is based on a new protocol over the Dupline® bus that is called *SmartDupline®.*
Smart Dupline® implements a master-slave protocol running over standard Dupline® networks.

The concept of SmartDupline® is based on the SIN: it is a Specific Identification Number that is unique for each Dupline® module produced and it is written into the module during the production process and cannot be modified.
The SIN code is printed on the product label by applying this format:

SIN: 255.255.255

It contains information about the type of the Dupline® module (light switches, pir, I/O modules, …), the firmware release and much more.

SmartDupline® enriches the previous protocol with these features:
1) By means of the Specific Identification Number the Master can program the network address ADD (1..250) in each device.
2) By means of the network address the Master can program the Dupline® standard channel addresses and all the other module parameters.
3) By means of the network address the Master can access all input and output module information.
4) In a single message frame it is possible to manage double word information.
5) A CRC control is implemented in request and reply frames. Should an error occur, the bus generator resends the request until it receives a correct frame.

Analogue data is transmitted via the SmartDupline® protocol without using digital I/O channels.
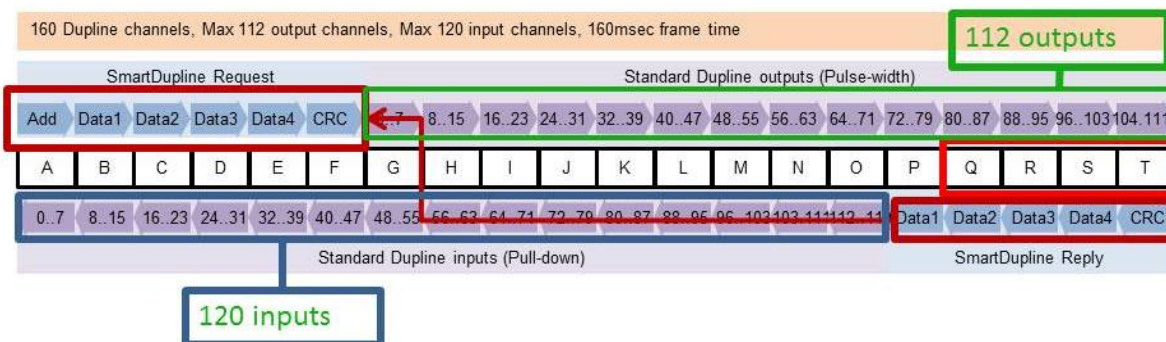
To calculate the number of SH2MCG24 required, the following points have to be taken into consideration:
1) Each SH2MCG24 can drive up to 250 Dupline® modules (as explained above, it can assign network addresses from 1 to 250).
2) Each SH2MCG24 can manage up to 112 output signals (e.g. output relays, leds, dimmer,…)
3) Each SH2MCG24 can manage up to 120 input signals (light switches, digital input,…)
4) Since most of the Dupline® slave modules are powered by the bus, the SH2MCG24 provides it with a maximum output current of 450mA (at temperature 30°C), the lower is the current the higher is the life time of all the system.

The installer will have to calculate the sum of the required modules and their consumption in terms of current and input/output signals: when one of the four limits mentioned above is surpassed, a new Dupline® network (i.e. a new SH2MCG24) has to be added.
We suggest designing the Dupline® networks in the best possible way by dividing them according to specific areas (for example floors) and not to use the bus at its maximum load in order to have space for further expansion and to prolong its life.

The consumption of input/output signals and current of every slave Dupline® module is given in the relevant datasheet.

Current consumption: in the datasheet/instruction manual this is always given in the *Dupline® Specifications* of each module.

Dupline® Specifications

Voltage	8.2 V
Maximum Dupline® voltage	10 V
Minimum Dupline® voltage	5.5 V
Maximum Dupline® current	2 mA

Dupline® channel consumption: in the datasheet/instruction manual this is always given in the *Mode of Operation section* under *Coding/Addressing*.

Mode of Operation

Coding/Addressing
If the light switch module is connected to the SH2WEB24 controller, no addressing is needed since the module is provided with a specific identification number (SIN): the user has only to insert the SIN in the SH tool when creating the system configuration.
Used channels: 4 input channels, 4 output channels.

1.2.5 Dupline® bus in the cabinet

Thanks to the local bus concept, the DIN-rail slave modules (dimmers, relays, rollerblind modules, etc…) can just be plugged into the SH2MCG24, without the need for any wiring. The decentralised modules, such as light switches, PIR sensors, temperature display, …are connected to the SH2MCG24 by the two wires coming from the terminals at the top.
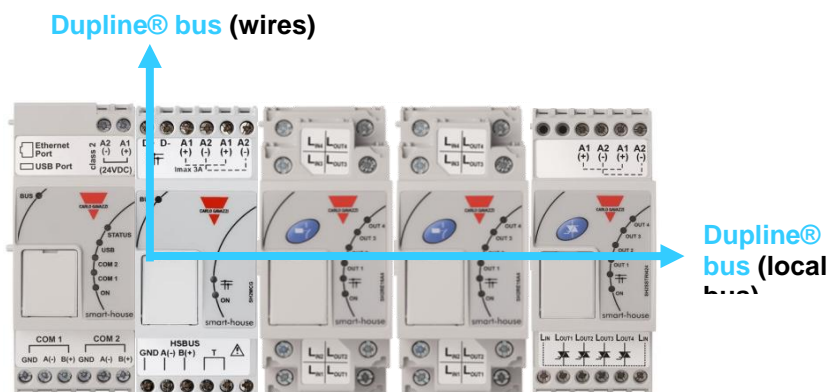

If more bus generators are connected in a DIN rail, they do not need to be plugged next to one other and they can also be mixed with the Dupline® I/O modules. The only rule that the installer has to take into account is that a Dupline® I/O module is connected to the Dupline® network generated by the last SH2MCG24 at its left. See picture below.
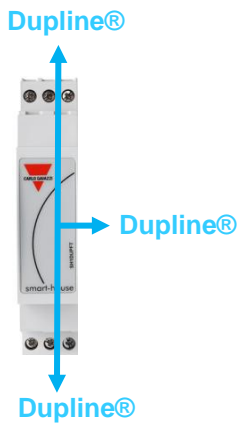
Example 1:
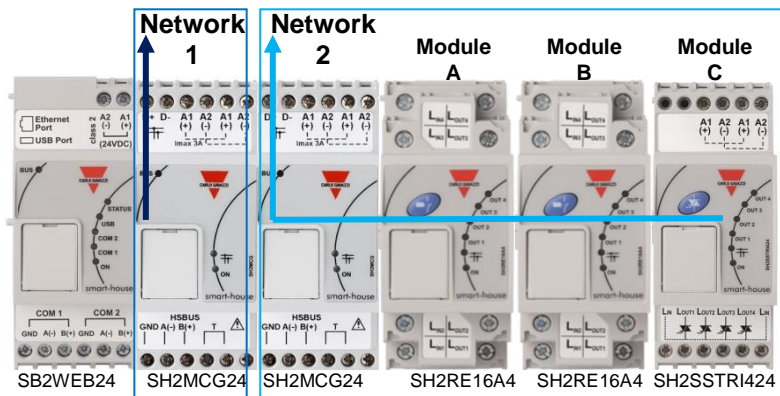
Modules **A**, **B**, and **C** are connected to the Dupline® network **2**.

Example 2:
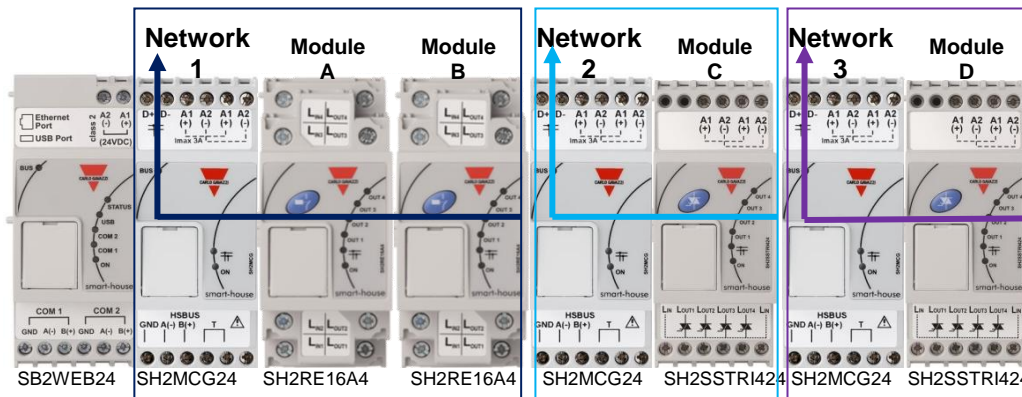
Modules **A** and **B** are connected to the Dupline® network **1**.
Module **C** is connected to the Dupline® network **2**.
Module **D** is connected to the Dupline® network **3**.

Since there are no Dupline® terminals on the top of the slave modules, to connect the Dupline® bus between different rails in a cabinet, the Dupline® transparent module SH1DUPFT has to be used.
The SH1DUPFT simplifies the wiring of a SBWEB installation: it has to be connected at the beginning of a rail row bringing the Dupline® bus from the top and bottom connectors to the internal bus and vice versa. Internally, the three connectors are short-circuited. This means that the buses connected to the top and bottom connectors must be in the same Dupline® network.
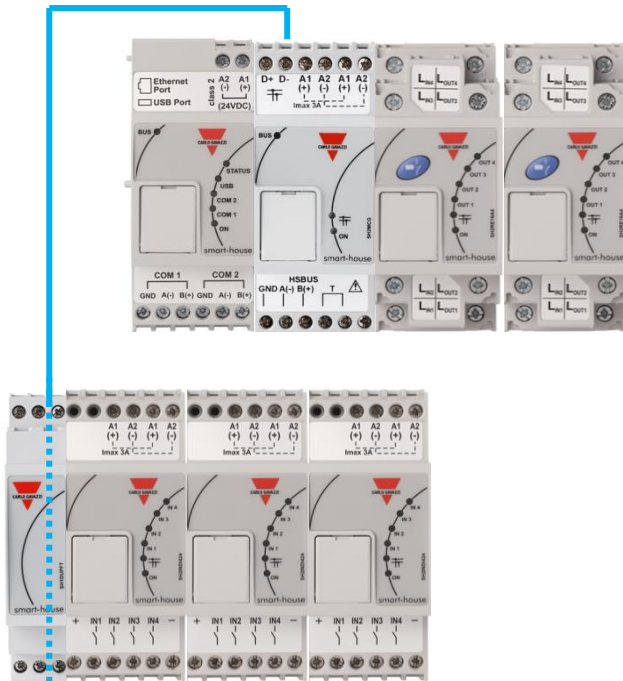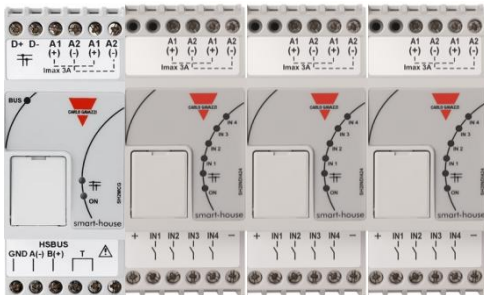
Example 3:
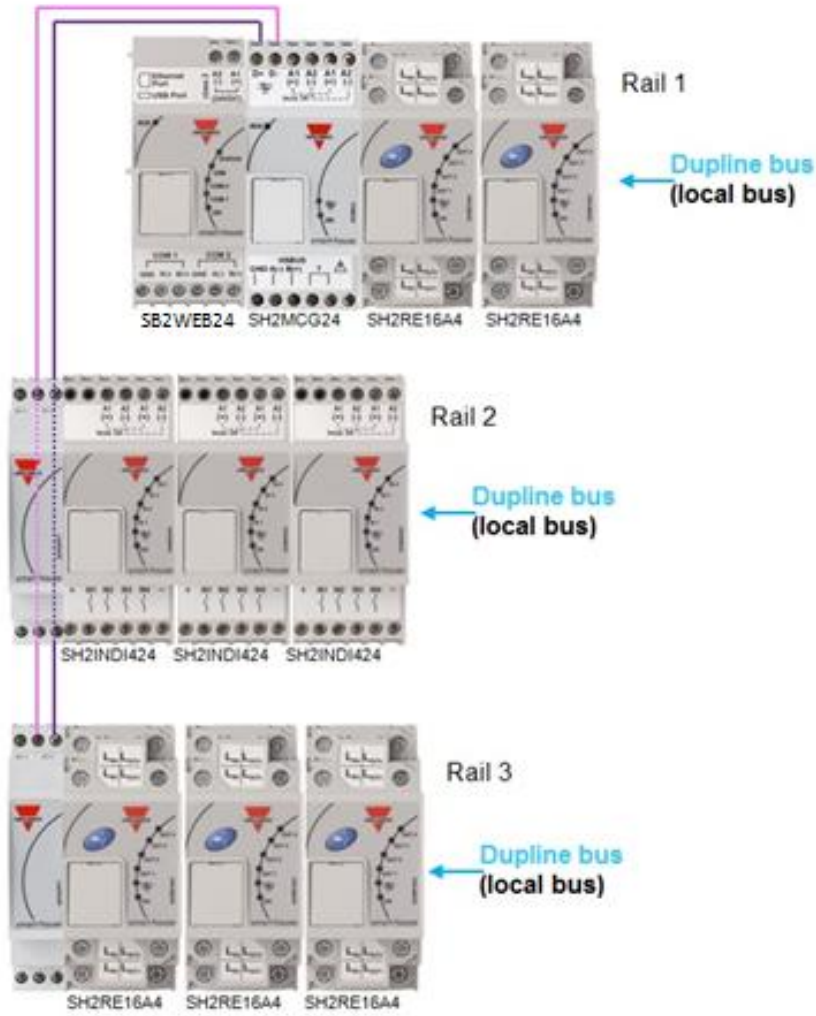
Recommendations:
Do not connect one SH1DUPFT to two Dupline® networks, otherwise the two buses will be shortcircuited: the situation below must be avoided.

This connection must be avoided otherwise two Dupline® networks will be short circuited. If this should happen, the system will not be damaged since the bus is protected, but it will not work properly.
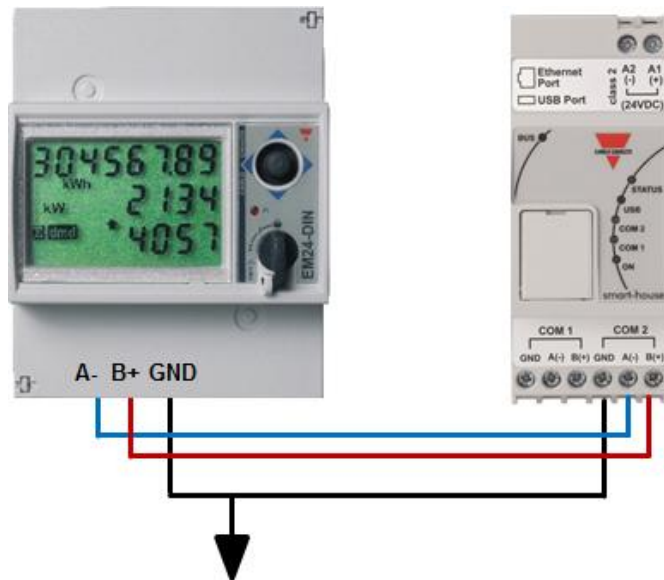
1.4 How to connect the energy meters

COM port 2 of the SB2WEB24 is an RS-485 port with modbus master capability and it is dedicated to Carlo Gavazzi energy meters.

Up to 32 energy meters can be connected to one SB2WEB24.

The values that will be available as BACnet objects are:

EM21	EM 33	EM 24	EM 26
VLN SYS	V L1-N	VLN SYS	VLN SYS
V L1-N	V L2-N	V L1-N	V L1-N
V L2-N	V L3-N	V L2-N	V L2-N
V L3-N	A L1	V L3-N	V L3-N
VLL SYS	A L2	VLL SYS	VLL SYS
V L1-L2	A L3	V L1-L2	V L1-L2
V L2-L3	kW SYS	V L2-L3	V L2-L3
V L3-L1	kWh AC	V L3-L1	V L3-L1
A L1		A L1	A L1
A L2		A L2	A L2
A L3		A L3	A L3
kW L1		kW L1	kW L1
kW L2		kW L2	kW L2
kW L3		kW L3	kW L3
kW SYS		kW SYS	kW SYS
kWh AC		kWh AC	kWh AC

An example of the connection between an energy meter and the SB2WEB24 is shown below:


Different types of energy meter can be mixed, and they can also have different baud rate (see the SBWEB tool software manual for more details about how to configure the SB2WEB24 to manage them).

N.B. The energy meters should be configured and connected to the load as described in the relevant instruction manuals. No configuration nor discovery can be carried out using the SBWEB tool software.

For more details about the wiring of the RS-485, please refer to appendix A.

1.5 Ethernet connection

The PC running the SBWEB tool connects to the SB2WEB24 via a TCP/IP connection. The SB2WEB24 has to be connected to the same LAN as the PC via the RJ45 connector on the top of the module. When connecting the network cable, the Ethernet port LEDS will light up.
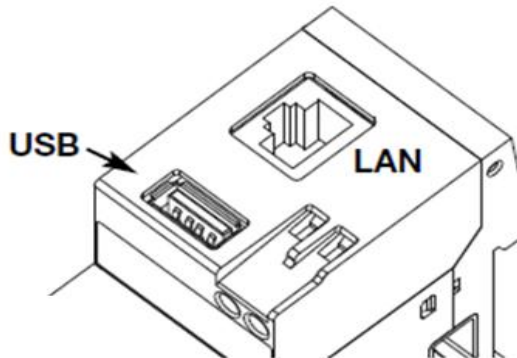

To configure the IP address, please refer to the SBWEB tool software manual..

1.6 Micro SD

The IP address can be changed by using a "Micro SD" or "SDHC" memory card correctly inserted into the relevant slot (see SBWEB tool software manual).
N.B: the maximum capacity of the Micro SD card is 16GB.

1. Open the flap located on the SB2WEB24 front panel. Identify the slot specifically designed for the insertion of the "Micro SD" memory card.
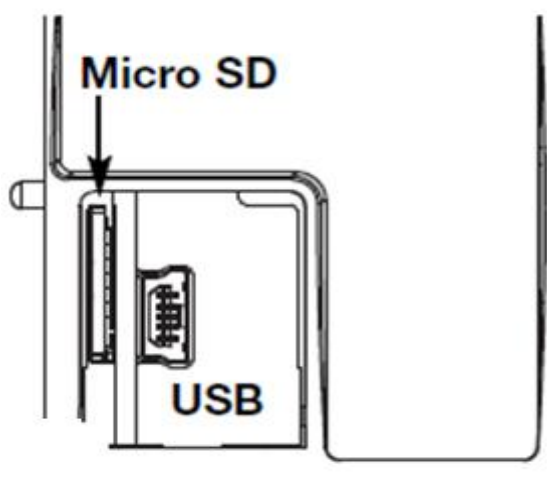
2. Insert the Micro SD card, making sure it is not write-protected and it is correctly formatted (FAT32).

3. Close the flap. <u>Warning</u>: if the flap is not properly closed SB2WEB24 will not enable any writing or reading operation (flap closing is verified by a micro switch located under the flap).

4. As soon as the flap is closed, SB2WEB24 will install the newly inserted memory card and update the IP address. <u>Warning</u>: opening the flap during the writing stage will stop the data transfer process and may potentially damage the Micro SD memory.

1.7 Pen drive installation

The IP address can be changed by using a Pen drive.
N.B: the maximum capacity of the Micro SD card is 16GB.

1. Identify the USB port specifically designed for the insertion of the "Pen Drive" memory.
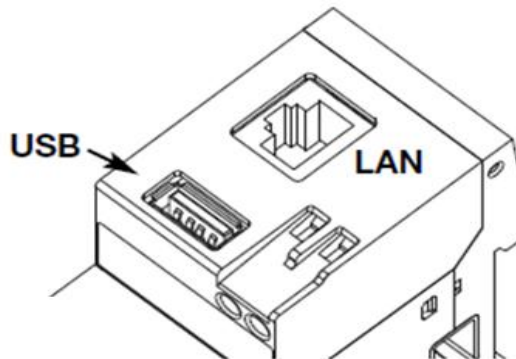
2. Insert the Pen-drive, making sure it is not write-protected and it is correctly formatted (FAT32).
3. As soon as you have inserted the Pen-drive, SB2WEB24 will install the newly inserted memory and update the IP address. While the installation and writing operations are under way, the front "USB" LED (blue) will blink. Warning: disconnecting the Pen-drive during the writing stage will stop the data transfer process.

1.8 Sizing of Carlo Gavazzi DC power supply

The SBWEB system is powered by to 24 Vdc nominal (15-30 Vdc)
Since most of the Decentral Dupline® slave modules are powered by the bus, the sizing of the power supply has to be based on the DIN-rail modules, and among these only the ones powered by 15 to 30 Vdc: the power dimmers and the relay output modules that switch 230 Ac load are powered by 230Vac.

In the table below, the list of devices is given, with the relevant power consumption that has to be considered in the sizing of the power supply.

Item number	Description	Operational power
SB2WEB24	Master unit	5.0 W
SH2MCG24	Bus generator	6.5 W
SH2RODC224	Roller blind module for DC motor	3.0 W
SH2ROAC224	Roller blind module for AC motor	3.0 W
SH2INDI424	Digital input module	0.4 W
SH2SSTRI424	Solid state relay output module	0.4W
SH2D10V424	1 to 10V dimmer	0.4 W
SH2UMMF124	Universal mobile modem	5.0 W

The suggested families are: SPDT24xx, SPM3241, SPM4241, SPM5 and SPM5B (battery charger). According to the power required, the right models has to be selected.

1.8.1 How to calculate the power needed

To calculate the required power, the sum of the consumption of all the Din-rail modules has to be calculated.
For example, if in an installation the following modules are present, the total consumption has to be calculated following the column *Consumption* in the table below :

Item number	Quantity	Consumption
SB2WEB24	1	1x 5.0 = 5.00 W
SH2MCG24	2	2x 6.5 = 13.0 W
SH2RODC224	0	
SH2ROAC224	4	4x 3.0 = 12.0 W
SH2INDI424	2	2x 0.4 = 0.80 W
SH2SSTRI424	0	
SH2D10V424	5	5x 0.4 = 2.00 W
SH2UMMF124	1	1x 5.0 = 5.00 W
	Total needed power	**37.80 W**

In this case a power supply delivering 40W is the right solution.

1.8.2 How to wire the power supply

The DIN-rail modules powered by to 24 Vdc nominal (15-30 Vdc) come with in/out connections to speed up wiring: there are two A1(+) terminals that are internally short circuited, and two A2(-) terminals that are also short circuited.

The best wiring should be carried out as shown below. The immunity to EMC can be improved connecting the minus of the DC power supplier of the system (-) to the earth ground.
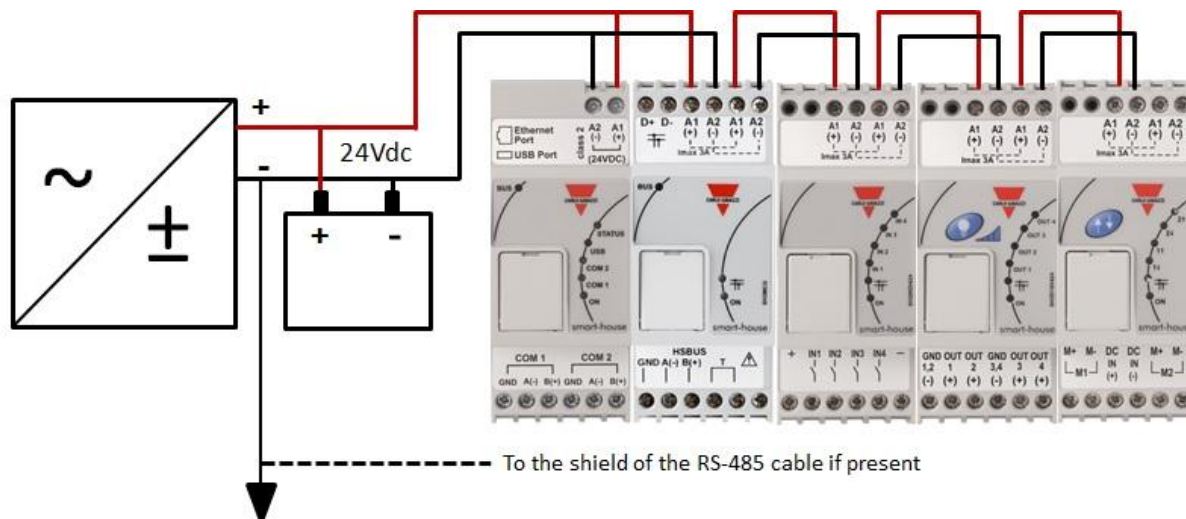
All the DIN-rail modules with the in/out terminals come with two short wires already screwed into the A1 and A2 terminals in order to speed up commissioning.

Recommendations:

1) Be careful to have a total current not greater than 3A on the power supply if using the in/out terminals, since the maximum current that the internal connections can withstand is 3A.
   If Dc motors are used to control roller blinds or windows, do not supply them from the same wires used in the in/out connections since the maximum current they can withstand is 3A (see below: in this case the sizing of the power supply must take into consideration also the consumption of the motor).

2) It is recommended that the system is supplied @24Vdc in order to reduce the current and thus the stress on the internal electronic components. This will result in a longer lifetime of the modules.
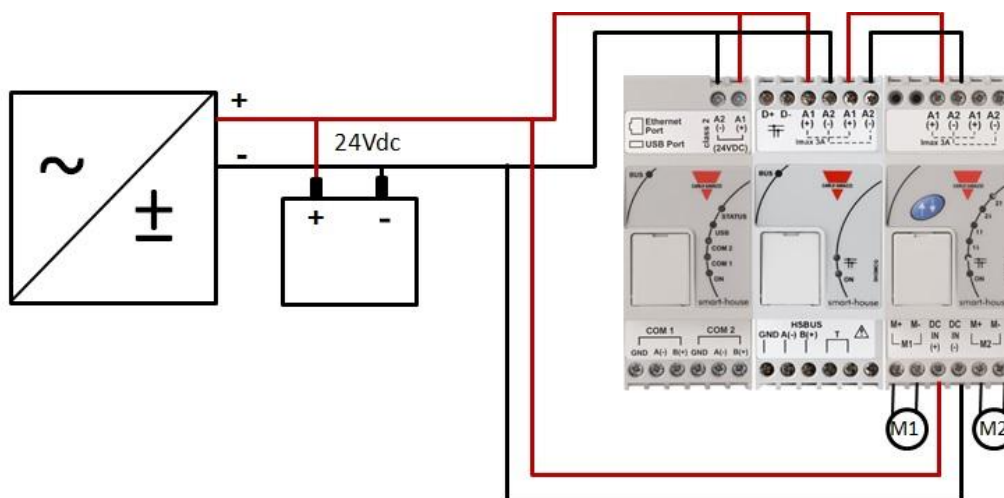
2 Installing the SBWEB system

When switching on the SB2WEB24, the following LEDs will light up on the front panel: green "ON" LED (indicating the device is powered), yellow "BUS" LED (indicating HSbus activity), yellow COM2 LED (indicating COM door activity), blue "USB" LED (indicating the presence of a USB device) and red Status LED (at the first start-up it will be ON, indicating that no configuration is present). When connecting the network cable, the Ethernet port LEDS will also light up.

When switching on the SH2MCG24, the following LEDs will light up on the front panel: green "ON" LED (indicating the device is powered), yellow "BUS" LED (indicating HSbus activity), yellow Dupline® LED (indicating Dupline® bus activity).

When switching ON the other DIN-rail I/O modules, the following LEDs will light up on the front panel: green "ON" LED (indicating the device is powered), yellow "ON" Dupline® LED (indicating Dupline® bus activity), red I/O LEDs (indicating the relevant input/output status).

The SB2WEB24 IP settings are factory-configured to start as DHCP. If no routers are present, please change the IP address as described in the SBWEB tool manual, by using the USB key.

To create a configuration, please follow the instructions in the SH tool manual.

3 Appendix "A" – RS485 network guidelines

3.1 MODBUS via Serial line (RS-485) guidelines

3.1.1 Introduction

The RS-485 is a half-duplex multidrop network: multiple transmitters and receivers may share the same line, but only one transmitter may be active at any given time. The TIA/EIA-485-A says nothing about the communication protocol to be used.

The MODBUS standard defines an application layer messaging protocol. The MODBUS Serial Line is a master-slave protocol which may use the RS-485 as its physical interface.

3.1.2 RS-485 cable

The suggested cable is the shielded twisted for three wire connections. Cables must be at least 0,5mm. The typical cable impedance should be between 100 ohm and 120 ohm.

3.1.3 RS-485 grounding

Communication through a RS-485 system is made by means of a balanced pair with a common so a three wire connection is needed. The shield must be connected directly to earth ground, preferably at one point only for the entire RS-485 Bus. Generally this point should be chosen on the master device or on its tap and not shared with other devices (inverters,…) which could add external noise or disturbance.

3.1.4 RS-485 shielding

A shielded cable is required to guarantee a high degree of immunity to EMC and lightning events. The improvement of EMC immunity can also be done connecting the minus of the DC power supplier of the system (-) to the earth ground.

3.1.5 RS-485 termination

A termination is needed at each end of the bus. Termination must not be placed anywhere else. Suggested terminations are as follows:

| Suggested terminations for MODBUS over RS485 serial line				
Description	**Type**	**Connection**	**Suggested termination**	**Notes**
3W RS-485	Only on the EM side	Between the two conductors of the balanced line (near each end of the bus)	R = 150 ohm/0.5W (resistor)	EM24, EM33

As for the SH2MCG24, EM21 and EM26 the relevant terminals have to be short circuited.

3.1.6 RS-485 wiring procedure

Suitable wire sleeves must be used for wiring. If any wire splice is to be used, this splice must be soldered, taking special care to cover the splice with a cable shield and to ensure proper continuity.
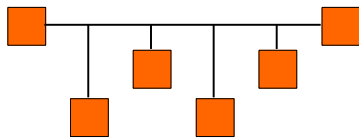
3.1.7 RS-485 topology

Due to signal reflection issues, topology is not free, but only certain configurations are allowed. The only configuration which guarantees sufficient reliability is the daisy-chain. The maximum length of a derivation is 1 metre.
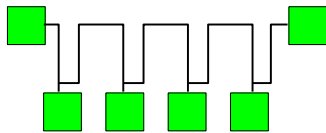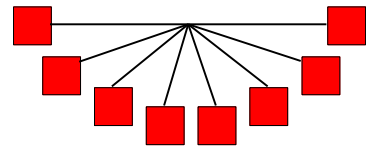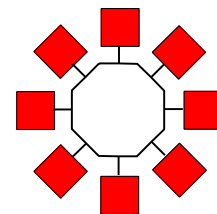
Daisy Chain (best)
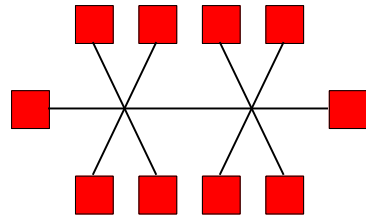
Backbone with stars or clusters (avoid)

Backbone stubs (workable)

Stars network (avoid)

Ring (avoid)

4 Appendix B - Safety recommendations

This section contains important safety related information. If these recommendations are not strictly followed, serious damage may occur to devices or machinery and serious injury or death may occur to people. Please read this manual carefully before beginning any installation, maintenance or operational activity.

Safety recommendations to be followed when installing, operating and maintaining the equipment.

SAFETY RECOMMENDATIONS		The manufacturer denies any kind of direct or indirect responsibility for consequences resulting from the non-observance of the safety recommendations and from misuse of the equipment.
	UNAUTHORIZED PEOPLE MUST NOT TOUCH	The product contains electrical components constantly under voltage. Only skilled personnel correctly trained to operate on circuits constantly under voltage are allowed to open the cover of the device.
	DO NOT USE WATER TO PUT OUT FIRE	Water jets or jets of other liquids must not come in contact with the electric panel
	INSTALL AVOIDING DIRECT EXPOSURE TO SUNLIGHT	Direct exposure to sunlight may cause overheating even if the ambient temperature is in the requested range. Do not install the device near to heat sources.
	DO NOT CONNECT VOLTAGES EXCEEDING RATED VALUES	Do not connect supply voltages exceeding rated values to avoid damage to the equipment and potential risk of injury or death to operators
	DO NOT SHORT CIRCUIT TERMINALS	Do not short circuit terminals (+) and (-) to avoid damage to the equipment and injury or death to operators

SAFETY RECOMMENDATIONS		The manufacturer denies any kind of direct or indirect responsibility for consequences resulting from the non-observance of the safety recommendations and from misuse of the equipment.
	ELECTRICAL COMPONENTS CONSTANTLY UNDER HIGH VOLTAGE	
	DANGER !!! RISK OF DAMAGE AND INJURY AS A RESULT OF INCORRECT WIRING	Carefully check wiring. Incorrect wiring of the device terminals can cause irreversible damage to the equipment and injury to operators. Use cable lugs for any wiring cables.
	DANGER !!! RISK OF DAMAGE AND INJURY AS A RESULT OF INCORRECT GROUNDING	Carefully check grounding. The user must provide a grounding system in compliance with the regulations in force according to the electrical installation in use.
	DANGER !!! FIRE HAZARD IN THE PRESENCE OF INFLAMMABLE FUMES	There is a fire or explosion hazard if the device is installed in the presence of inflammable fumes. The device must not be installed in places exposed to explosion or fire hazard
	ALWAYS TIGHTEN SCREWS CORRECTLY	Always correctly tighten the fastening screws of the wiring terminals