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# Sx2WEB HW manual

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rev. 0.5, 01/02/2016

## **SMART-HOUSE SYSTEM DESCRIPTION AND INSTALLATION MANUAL**

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

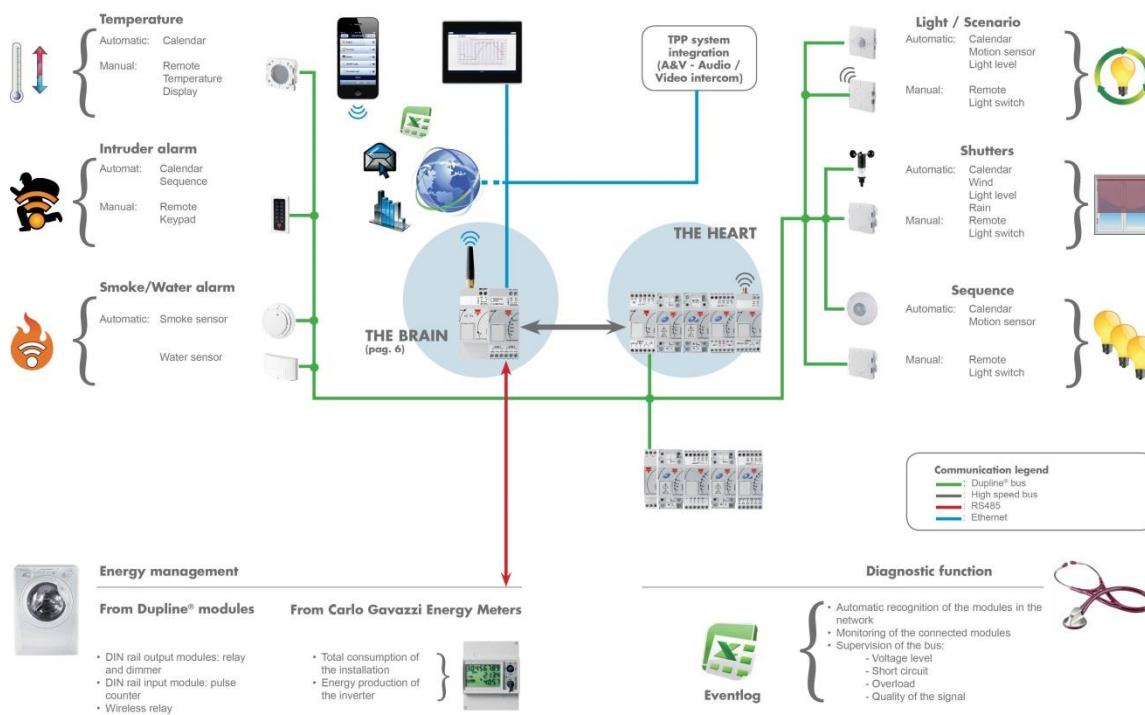
- The smart-house system must be used only for the usage it has been designed for. Every other kind of usage is potentially unsafe. The manufacturer is not responsible for improper usage.
- The manufacturer is not responsible for the consequences of using non-original spare parts.
- This manual is subject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

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## 1 System description

The smart-house system delivers complete solutions for home automation, including lighting scenarios to select the best ambience, shutter control to regulate perfect light and shade, temperature management to combine optimum comfort with optimum efficiency, intrusion, flooding and smoke monitoring to protect from any burglary or damage to the house and a scheduler to program all events and basic functions. All this means very special automation. The system also includes energy monitoring, logging power, water and gas consumption and the information present on the bus (temperatures, humidity, light level, ...). All this data is available in graph form, simply by using a smart device or a PC, thanks to the embedded webserver. Moreover, the system is an open platform designed for easy and fast integration with products from other companies, since we use protocols based on TCP/IP, for which we deliver complete documentation.

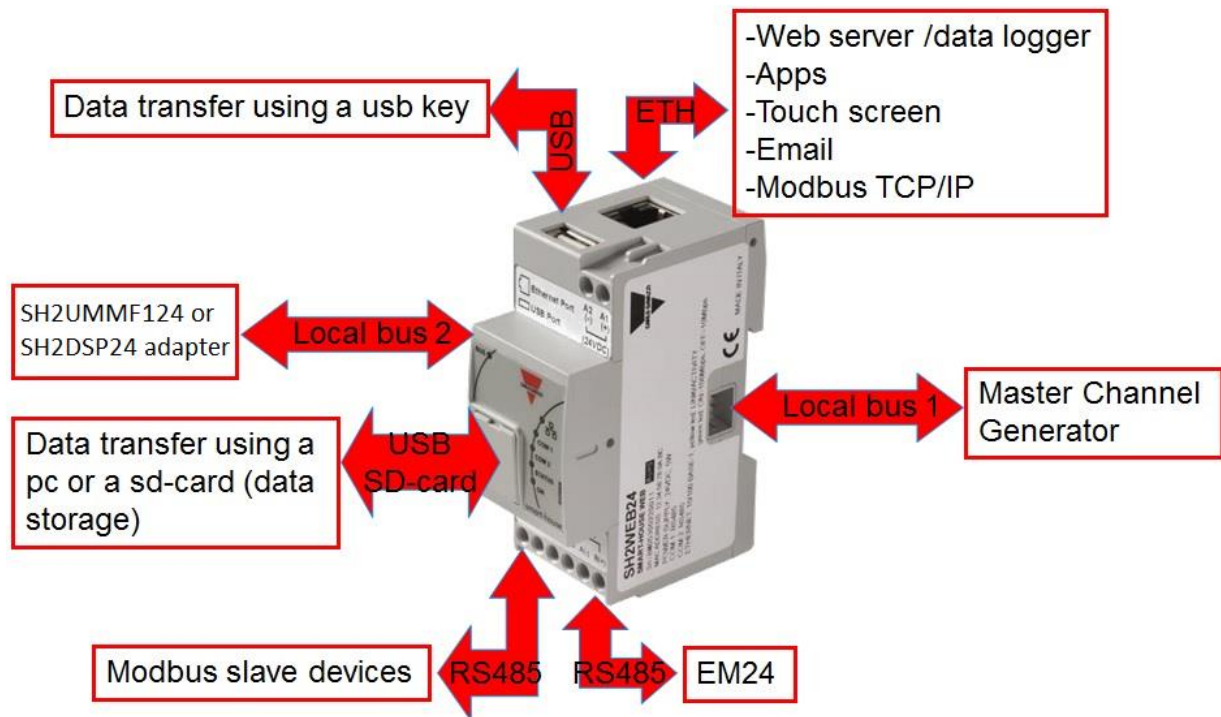


### 1.1 The master unit: Sx2WEB24 (SH2WEB24 or SB2WEB24)

The system is based on a central CPU, the Sx2WEB24, a Linux based embedded PC that manages all the smart functions. It is programmed by means of powerful software, the Sx tool. The Sx2WEB24 has the Ethernet communication capability to be remotely controlled and monitored by smart-devices/PCs; it is also a data logger that can record any value/event coming from the many buses it can connect to (Wireless and Dupline® buses, two RS485 ports, Ethernet). This master unit is also provided with an SD-card and USB port to upload/download data and system configurations.

The Sx2WEB24 is the brain of the system. It collects all the information from the buses it is connected to. All the field devices such as light switches, input/output modules, sensors and so on are connected to the Sx2WEB24 via the Dupline® bus. The Dupline® bus is not generated directly by the Sx2WEB24 but a bus generator is needed, the SH2MCG24.

Here below a diagram of the system is shown.



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

|   |   |      |             |             |     |      |             |             |     |   |           |           |           |           |
|---|---|------|-------------|-------------|-----|------|-------------|-------------|-----|---|-----------|-----------|-----------|-----------|
| Ports and connections                           | <p>1 X 15 to 30Vdc power supply (<b>A1+</b> and <b>A2-</b>)<br/>2 X RS-485 (COM1 and COM2) :</p> <table border="1" style="margin-left: 40px;"> <tr> <td rowspan="3" style="background-color: #e0e0e0;">COM1</td> <td>Data – (A-)</td> </tr> <tr> <td>Data + (B+)</td> </tr> <tr> <td>GND</td> </tr> <tr> <td rowspan="3" style="background-color: #e0e0e0;">COM2</td> <td>Data – (A-)</td> </tr> <tr> <td>Data + (B+)</td> </tr> <tr> <td>GND</td> </tr> </table> <p>1 X RJ-45 connector for 10/100 Base-T Ethernet [Communication]</p> <table border="1" style="margin-left: 40px;"> <tr> <td rowspan="4" style="text-align: center;"> <p style="text-align: center;">EIA/TIA-568B</p> </td> <td>Pin 1 TX+</td> </tr> <tr> <td>Pin 2 TX-</td> </tr> <tr> <td>Pin 3 Rx+</td> </tr> <tr> <td>Pin 6 Rx-</td> </tr> </table> <p>1 X standard USB<br/>1 X mini USB connection<br/>1 X slot for micro SD or SDHC memory card</p> | COM1 | Data – (A-) | Data + (B+) | GND | COM2 | Data – (A-) | Data + (B+) | GND | <p style="text-align: center;">EIA/TIA-568B</p> | Pin 1 TX+ | Pin 2 TX- | Pin 3 Rx+ | Pin 6 Rx- |
| COM1  | Data – (A-)   |      |             |             |     |      |             |             |     |   |           |           |           |           |
|   | Data + (B+)   |      |             |             |     |      |             |             |     |   |           |           |           |           |
|   | GND   |      |             |             |     |      |             |             |     |   |           |           |           |           |
| COM2  | Data – (A-)   |      |             |             |     |      |             |             |     |   |           |           |           |           |
|   | Data + (B+)   |      |             |             |     |      |             |             |     |   |           |           |           |           |
|   | GND   |      |             |             |     |      |             |             |     |   |           |           |           |           |
| <p style="text-align: center;">EIA/TIA-568B</p> | Pin 1 TX+   |      |             |             |     |      |             |             |     |   |           |           |           |           |
|   | Pin 2 TX-   |      |             |             |     |      |             |             |     |   |           |           |           |           |
|   | Pin 3 Rx+   |      |             |             |     |      |             |             |     |   |           |           |           |           |
|   | Pin 6 Rx-   |      |             |             |     |      |             |             |     |   |           |           |           |           |
| 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 Sx2WEB24 side (see Appendix A for the other termination).   |      |             |             |     |      |             |             |     |   |           |           |           |           |

### 1.1.1 Sx2WEB24 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 Sx2WEB24.

**Local bus 2:** This is placed in the connector on the left side and it is a USB bus used to connect to the universal mobile modem SH2UMMF14<sup>(\*)</sup> and to the usb dongle connection module SH2DSP24.

<sup>(\*)</sup> The SH2UMMF124 is no longer available.

**RS485 port 1:** This is a serial port used to connect to other third party serial devices.

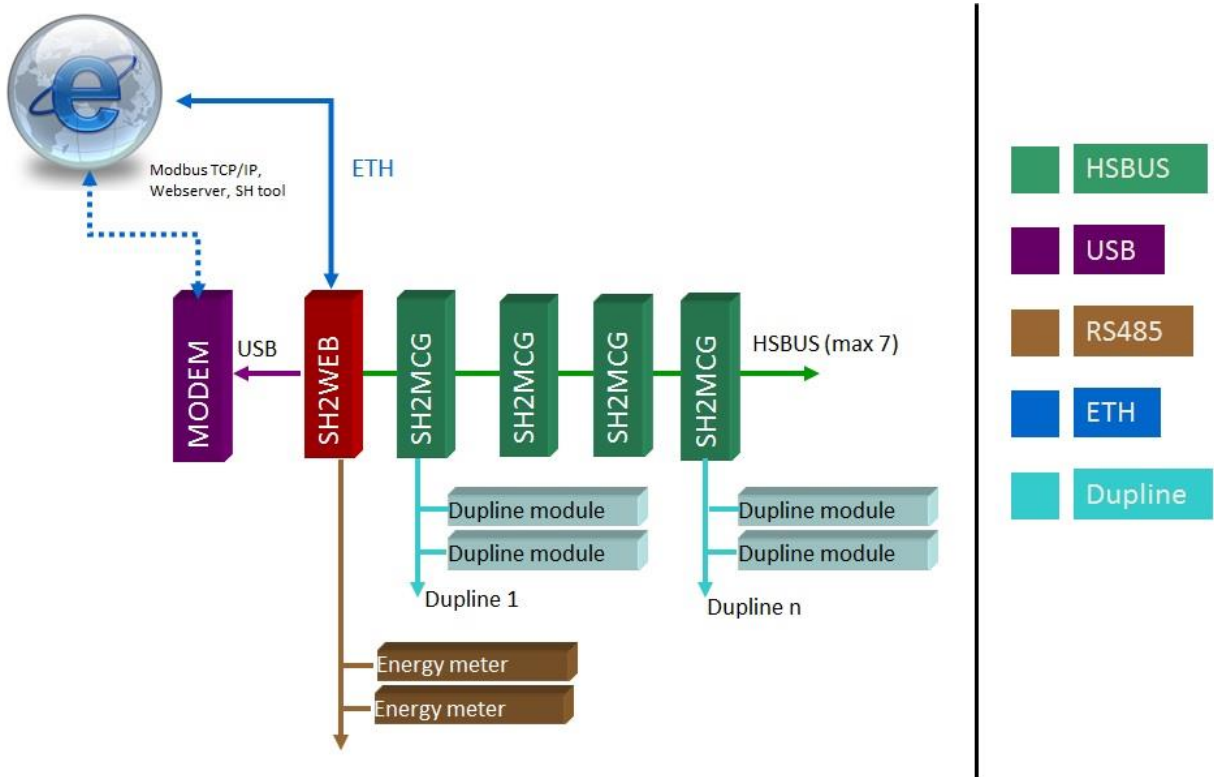
**RS485 port 2:** This is a serial port with modbus master capability used to connect to Carlo Gavazzi energy meters.

**USB port:** This is placed on the top of the housing and it can be used to change the IP address.

**SD-card:** It can be only used to change the IP address.

**Ethernet port:** This is placed on the top of the housing and has to be used to connect to the Sx tool.

The buses can be summarized as shown below.

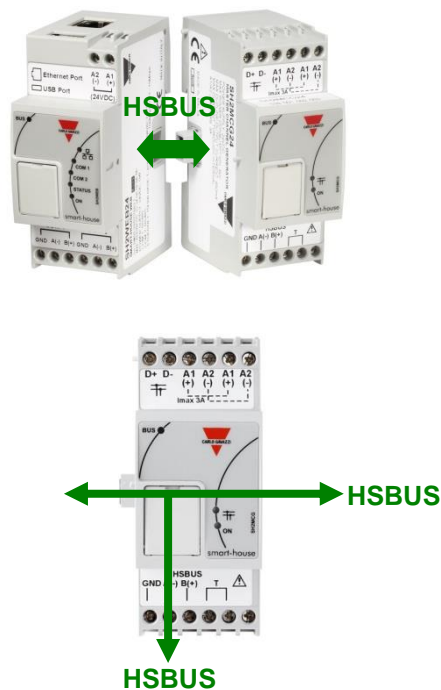


**N.B.:** All the connections described in the following paragraphs must be carried out without power supply.

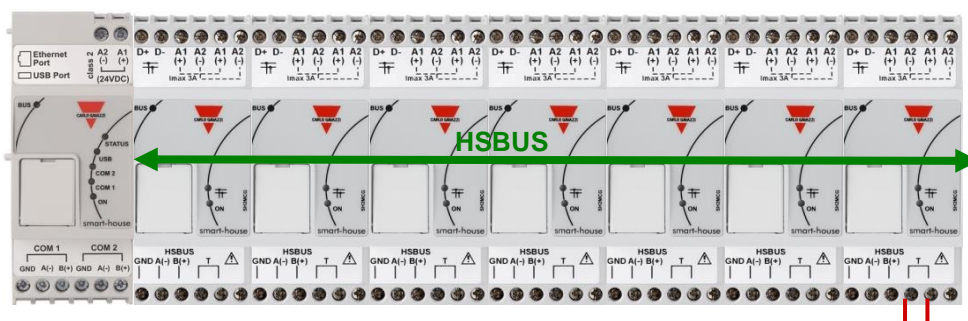
## 1.2 Bus generators

The Sx2WEB24 (i.e. SH2WEB24 or SB2WEB24) is the brain of the smart-house system but it cannot work alone and 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 Sx2WEB24 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 Sx2WEB24.

The bus generators can be a mix of the Smart Dupline® generators SH2MCG24, the wireless bus WiDup generators SH2WBU230N and the Dupline® generator SH2DUG24.

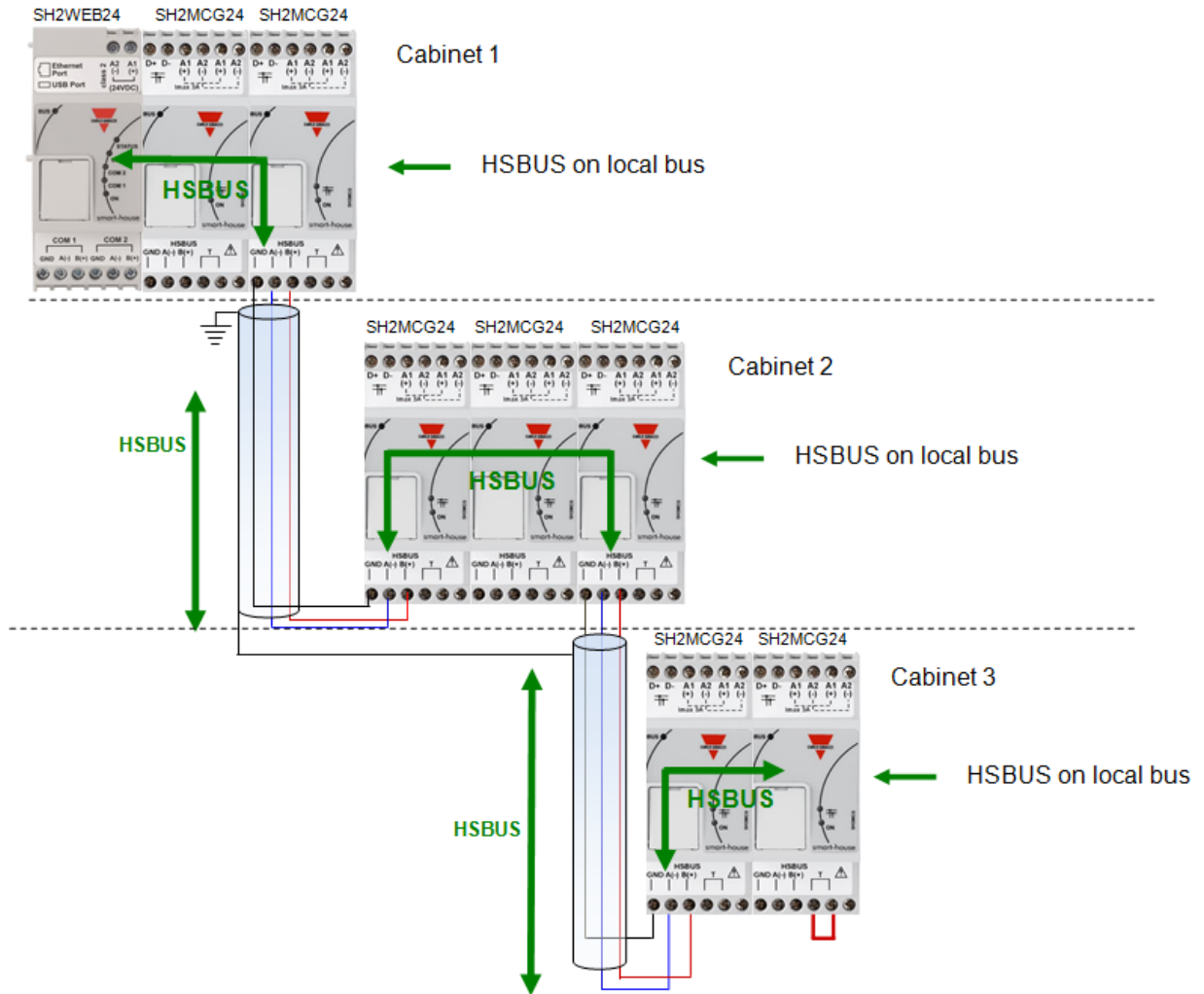


Example 1: The bus generators are all connected in the same Din-rail.

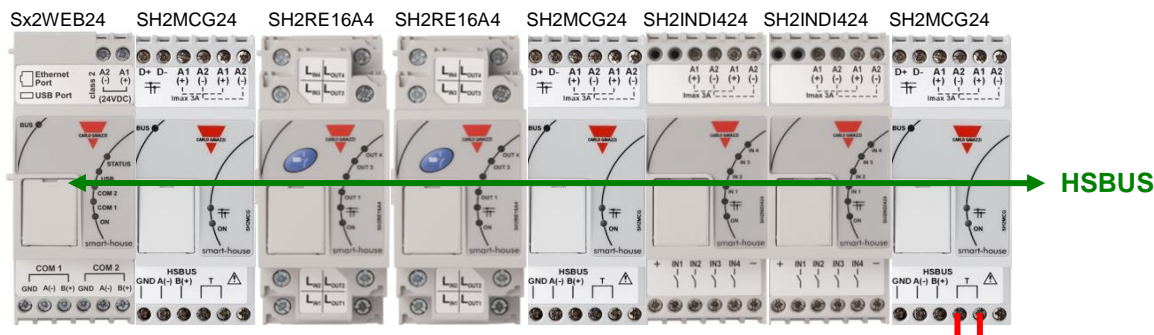




Example 2: The bus generators are mounted in different cabinets.



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 serial interface, at 256Kbit/s

#### **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 the cable 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 SH2MCG24 (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 the 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 Sx2WEB24 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.

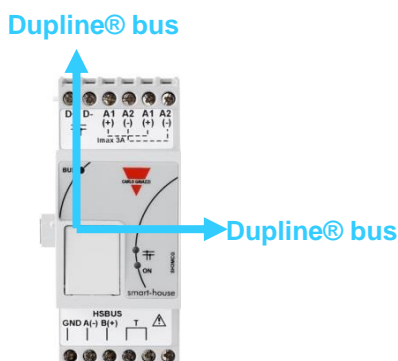
For more details please see appendix A.

### 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 2 km away. Many 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 Sx2WEB24.

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 smart-house system.

The SH2MCG24 is powered by 15 to 30Vdc.



The Dupline® modules in the smart-house 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.***

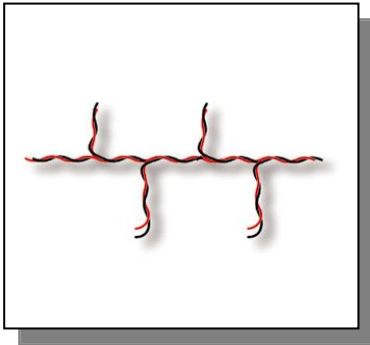
The modules cannot withstand voltages other than the Dupline® signal voltage (5.5V to 10V).



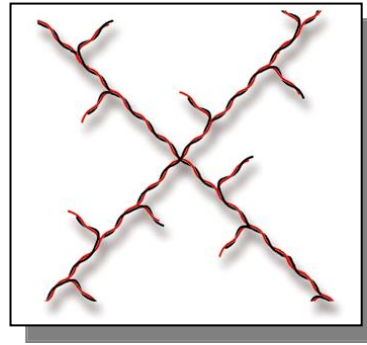
The so-called *decentralised* modules can be divided into the following groups:

- Light switches
- PIR sensors
- Temperature displays
- Water and smoke detectors
- Wind sensors
- Humidity sensors
- Light sensors
- Decentralised input/output modules

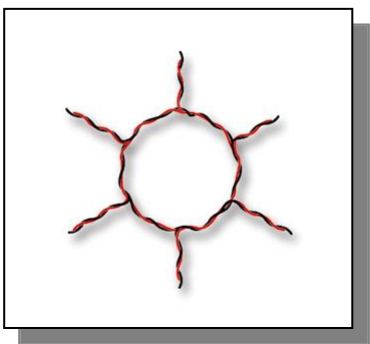
The installation is not to be engineered around the Dupline® bus because it can be matched to the application. The routing of the cable may be in a line, star, ring or any combination.



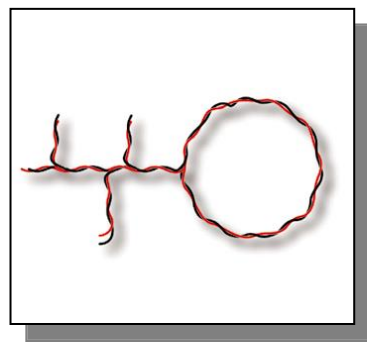
*Straight-through:* the best place for the SH2MCG24 would be in the middle of the line



*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.

In the case of very noisy installations (with noise sources such as contactors, inductive loads etc) we recommend the use of a shielded cable.

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 <sup>2</sup> (AWG 19), twisted | 1 mm <sup>2</sup> (AWG 17), twisted | 1.5 mm <sup>2</sup> (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 and 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 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. Should the power cables be very noisy, we suggest using shielded cables.

#### 1.2.3.4 Cable Splices and Connections

Cable splices are often the source of problems.

It is strongly recommended to splice only cables of the same characteristics (wire cross section, capacitance, etc). The splicing contact resistance must be as low as possible. Twisted wire splicing under a wire nut or terminal strip can deteriorate over a certain period of time. It is, therefore, advisable to use soldering splices. For shielded cable the shield must be continued, but it must not be grounded at the splicing points. Splices need to be water-tight to prevent the entry of water into the cable, which could result in increased capacitance.

**Note:** Bad splices and/or splices left uncovered, exposed to humid environments, could create critical problems difficult to route.

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.

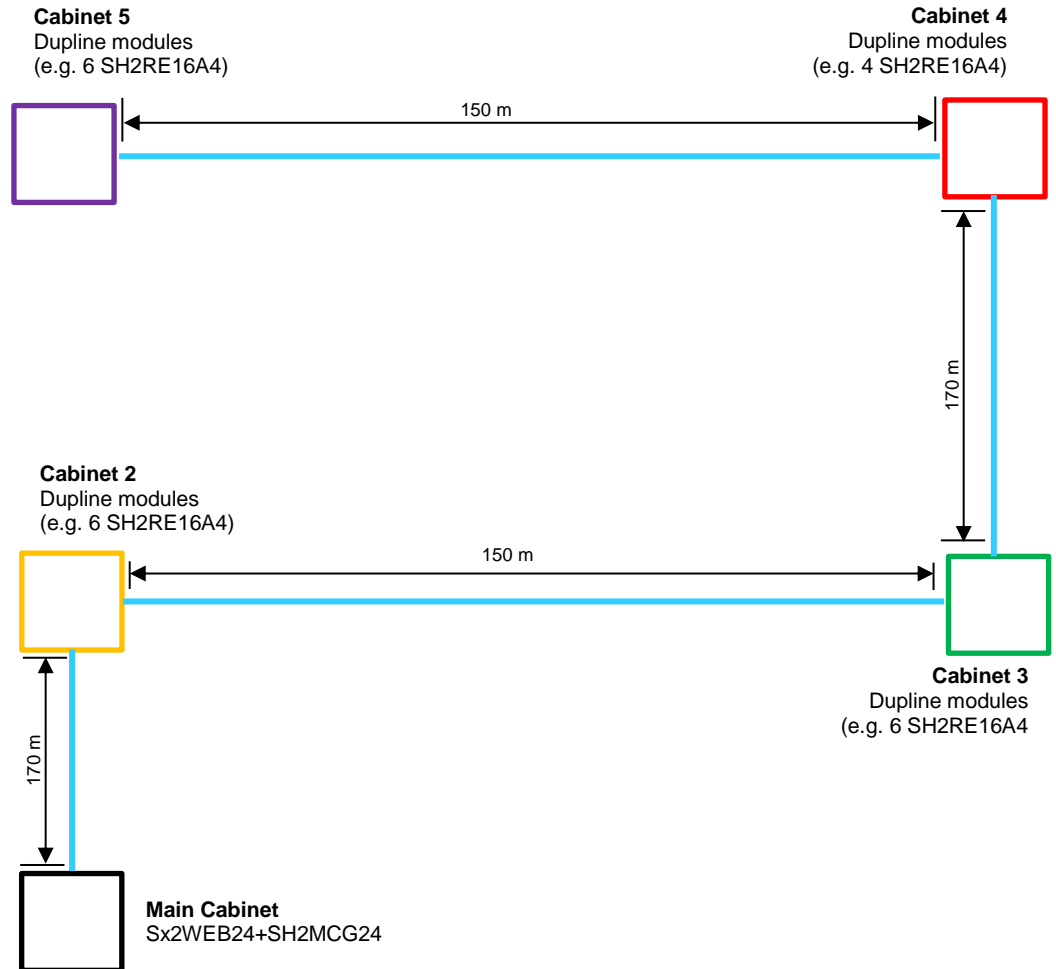
**Note:** if multi-conductor cable is used, where some of the conductors are spare, we highly recommend connecting all spare wires to ground (preferably close to the SH2MCG24). This to reduce the "antenna effect" of open-end wires.

#### 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 parallel any wires to increase the square of the cores.
- 4) Do not use cable gauges larger than 1.5 mm<sup>2</sup>.

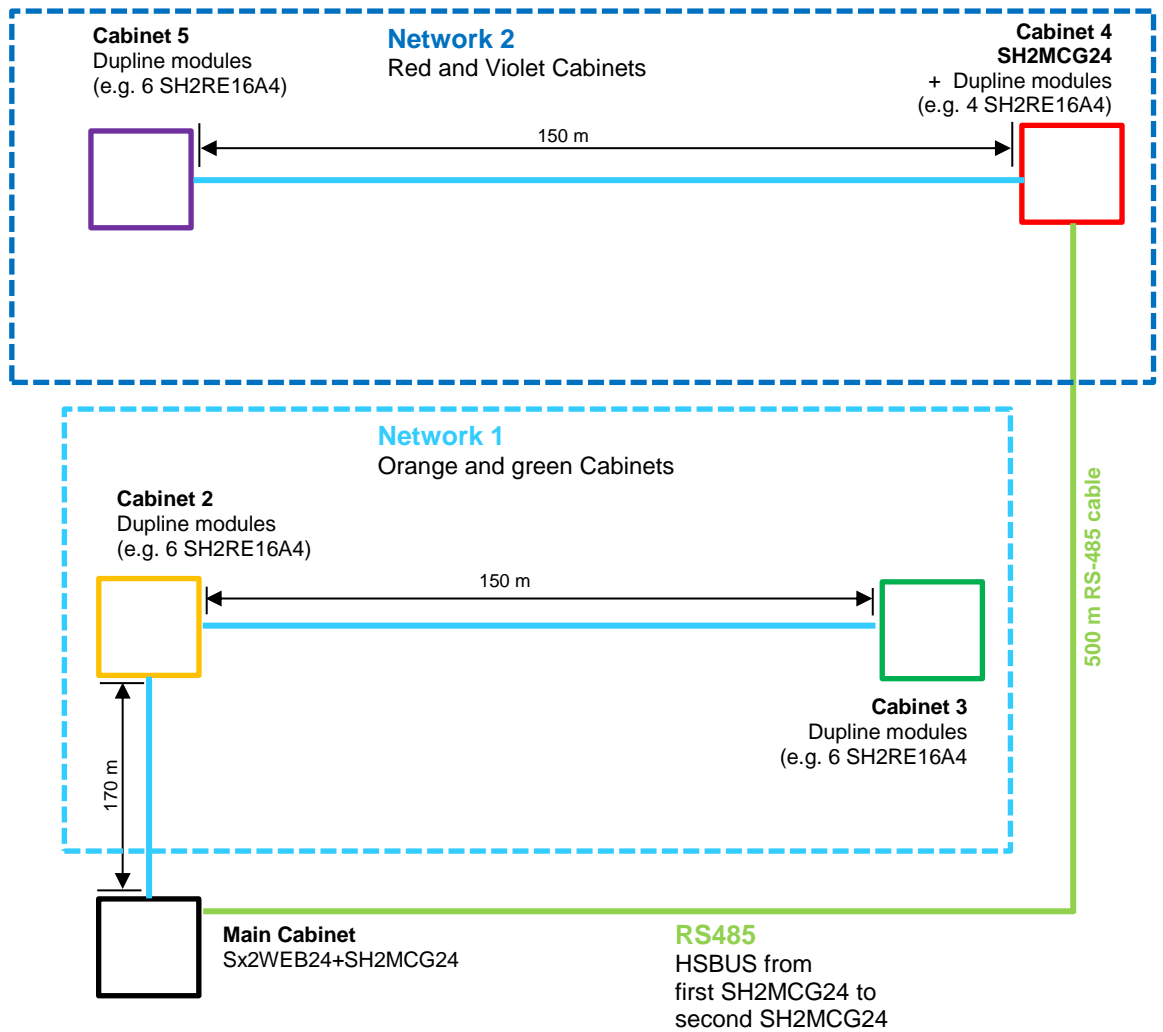
Connection examples:

**Wrong connection:**



This network design is not recommended because the cable resistance and the load from bus-powered modules result in an excess of voltage drop.

Right connection:





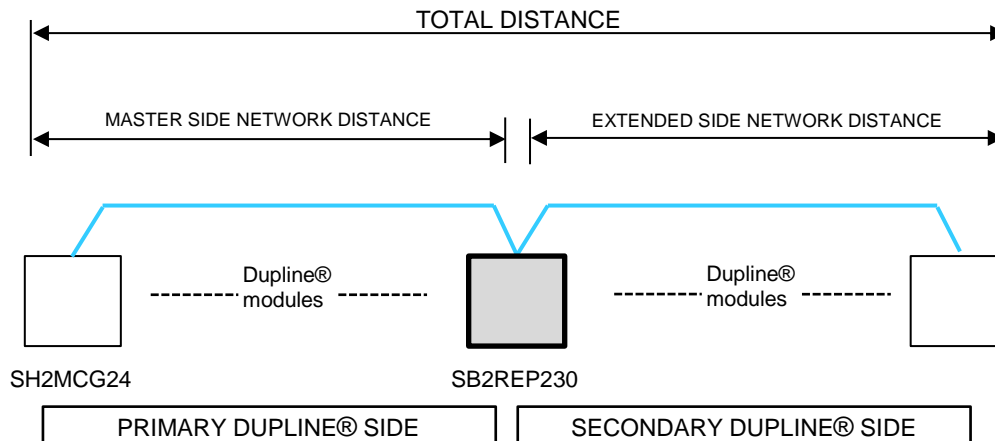
## 1.2.4 How to extend the Dupline® bus

### 1.2.4.1 Network design

Sometimes, in new or in existing installations, there is the need to extend the length of the Dupline® network beyond the typical Dupline® operative distance. At the same time, it could be necessary to place some modules at the end of the Dupline® network where a balanced distribution of the modules is not possible: the cable resistance and load from bus-powered modules result in an excess voltage drop and might cause the modules placed far from the Dupline® generator not to work properly.

The SB2REP230 module is a 115 to 230 VAC-powered Dupline® repeater and isolator and is the ideal solution to overcome the problems described above. It also allows the network design to be simplified and it can be connected to any point on the Dupline® bus.

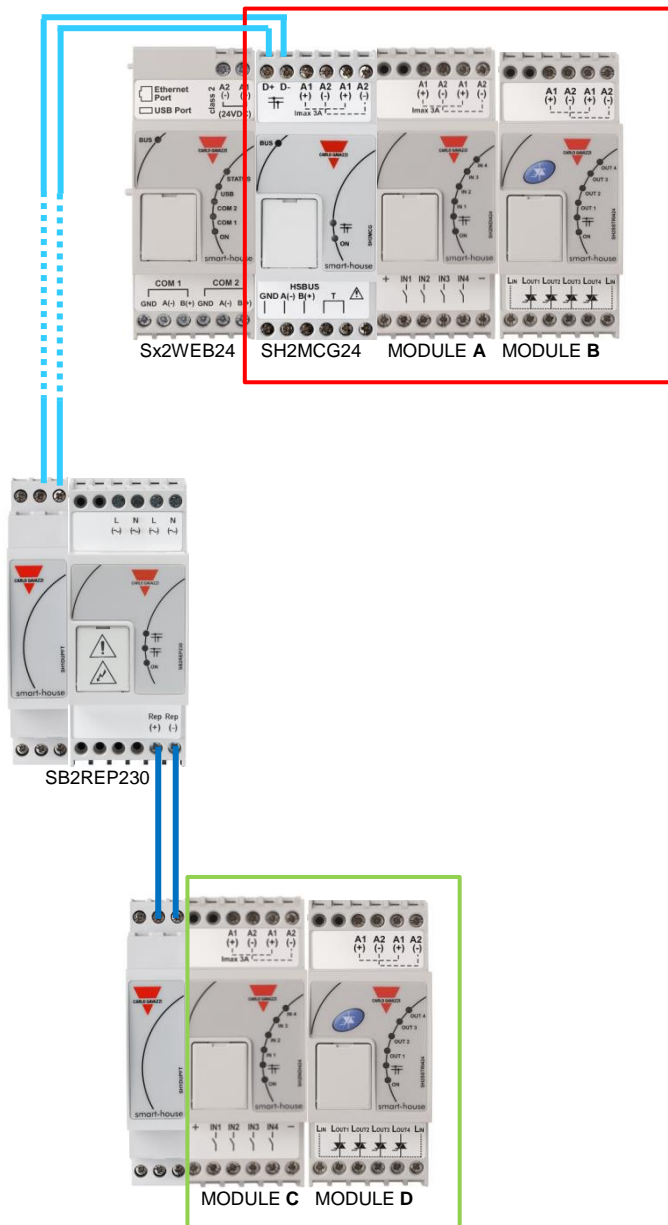
The picture below shows a simplified wiring diagram between the Dupline® repeater and the Dupline® generator:



## 1.2.4.2 Repeater wiring

The repeater regenerates the voltage level of the Dupline® signal from the bus generator and also provides an output drive capability of up to 300mA. Since most of the Dupline slave modules are bus-powered, the SB2REP230 provides the bus power supply to the modules connected to it.

Example 1:



**Note:** the local bus on both sides is connected to the primary side of the Dupline network, so the secondary side has always to be connected to the terminals REP+ and REP-

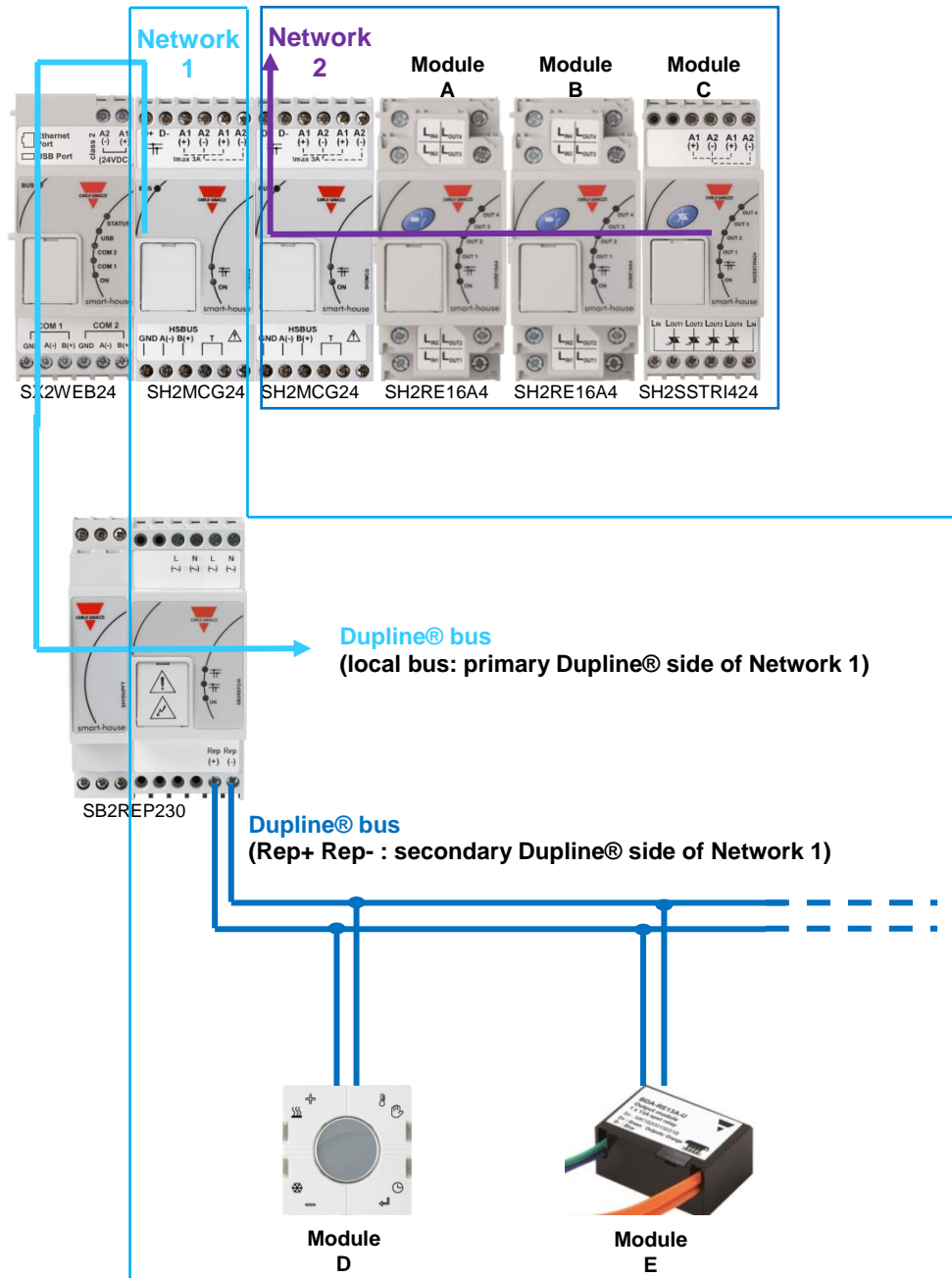
Dupline current for Modules **A** and **B** are provided by the Dupline® generator

Dupline current for Modules **C** and **D** are provided by the Dupline® repeater

How to install a Sx2WEB system

The Dupline® repeater does not create any new Dupline® network: all the Dupline® slave modules connected to the SB2REP230 are part of the same network generated by the SH2MCG24 which the repeater is connected to.

Example 2: The example below shows the network topology



Modules **D** and **E** are part of the **Dupline® network 1**

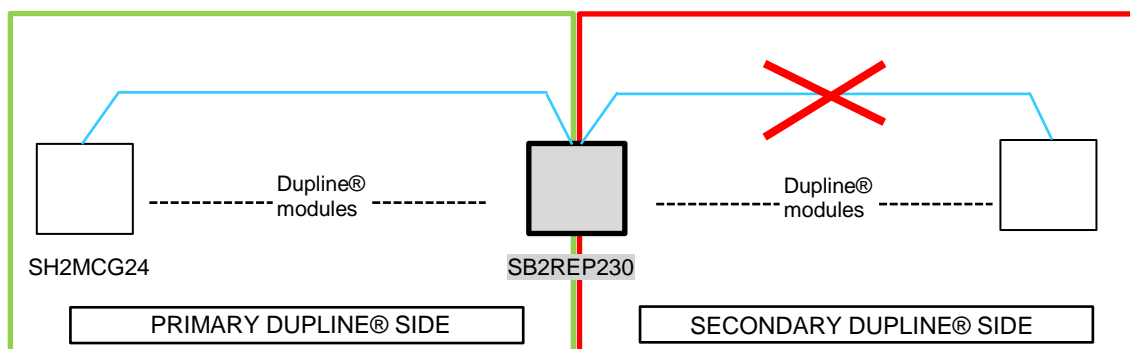
Modules **A**, **B** and **C** are part of the **Dupline® network 2**

### 1.2.4.3 Isolator feature

In addition, the isolator feature contributes to the separation of the sides of the bus for maximum safety. The primary and secondary Dupline® signals are isolated, which means the primary side, made up of the modules connected to the Dupline® generator, will continue to operate in the case of a short circuit on the secondary side, made up of the modules connected to the Dupline® repeater.

As shown in the example below, the modules connected to the Dupline generator (shown in the green box) will continue to operate in the case of a short circuit on the secondary side (shown in the red box)

Example 3:



As soon as the short circuit is removed, the secondary side will automatically become operational again.

**N.B.** In the case of a short circuit on the primary Dupline® side, the secondary Dupline® also goes down: until the short circuit is removed (see above), neither of the Dupline sides will operate.

### 1.2.4.4 Placing the SB2REP230 in a project

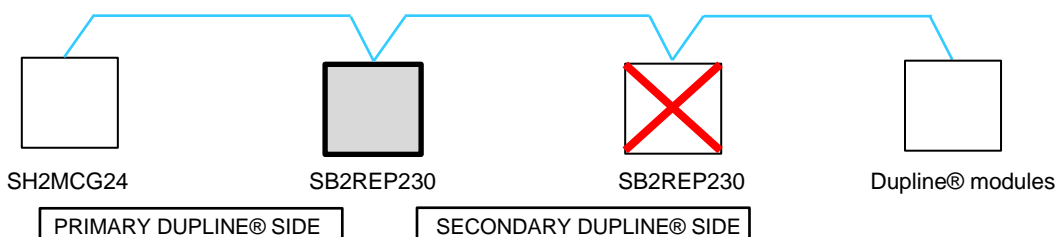
To wire a Dupline repeater into a network, the Dupline transparent module SH1DUPFT has to be used: the terminals on the top of the SH2MCG24 are connected to the Transparent module and the Dupline repeater just has to be plugged into the local bus connector. The Dupline® repeater is typically mounted in a different cabinet some distance from the SH2MCG24.

The secondary side has to be connected to the terminals REP+ and REP- (see pictures on pages 18 and 19).

The Dupline repeater is able to regenerate the bus voltage starting from a minimum value of 5.5V: care must be taken to connect it before the voltage drops to below this minimum voltage.

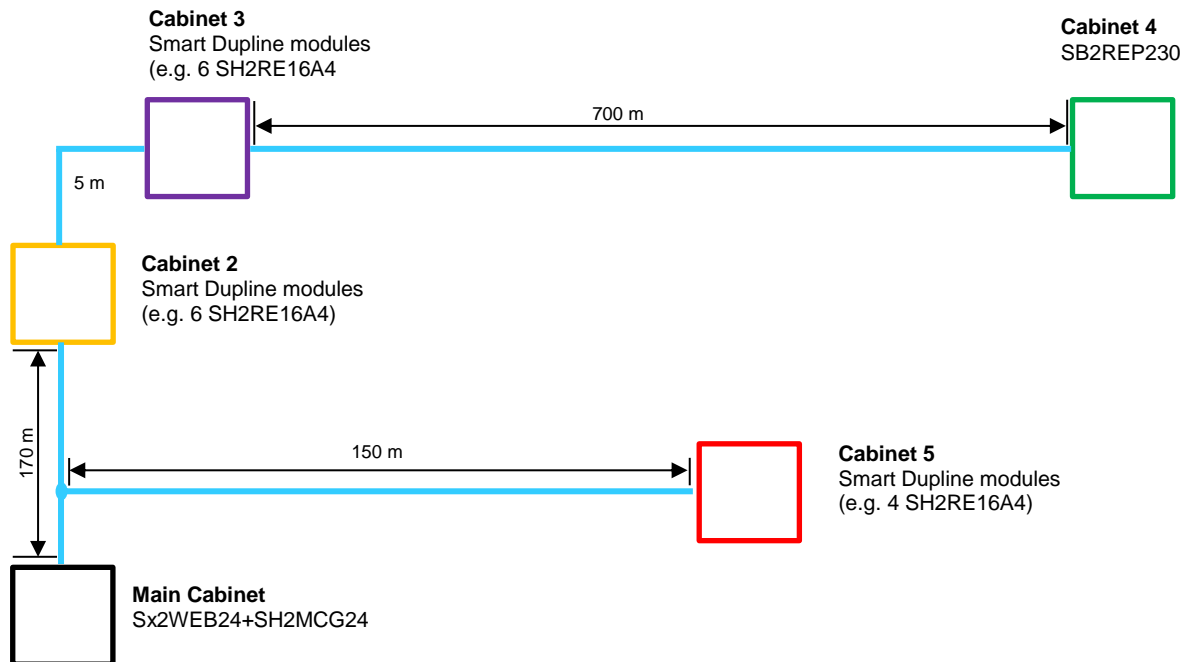
#### Recommendation:

*On each bus branch it is not possible to connect more than one repeater in series: the connection shown in the picture below must be avoided.*



**Example of correct wiring:**

The example below shows a correct network design, where the installer has placed the Dupline® DIN-rail modules in different cabinets and the distances have been calculated by considering the cable section and the voltage drop due to the bus-powered connected modules.



In the main cabinet, shown by the black square in the picture above, the installer has placed the Sx2WEB24 and the SH2MCG24.

The other cabinets are shown in colours:

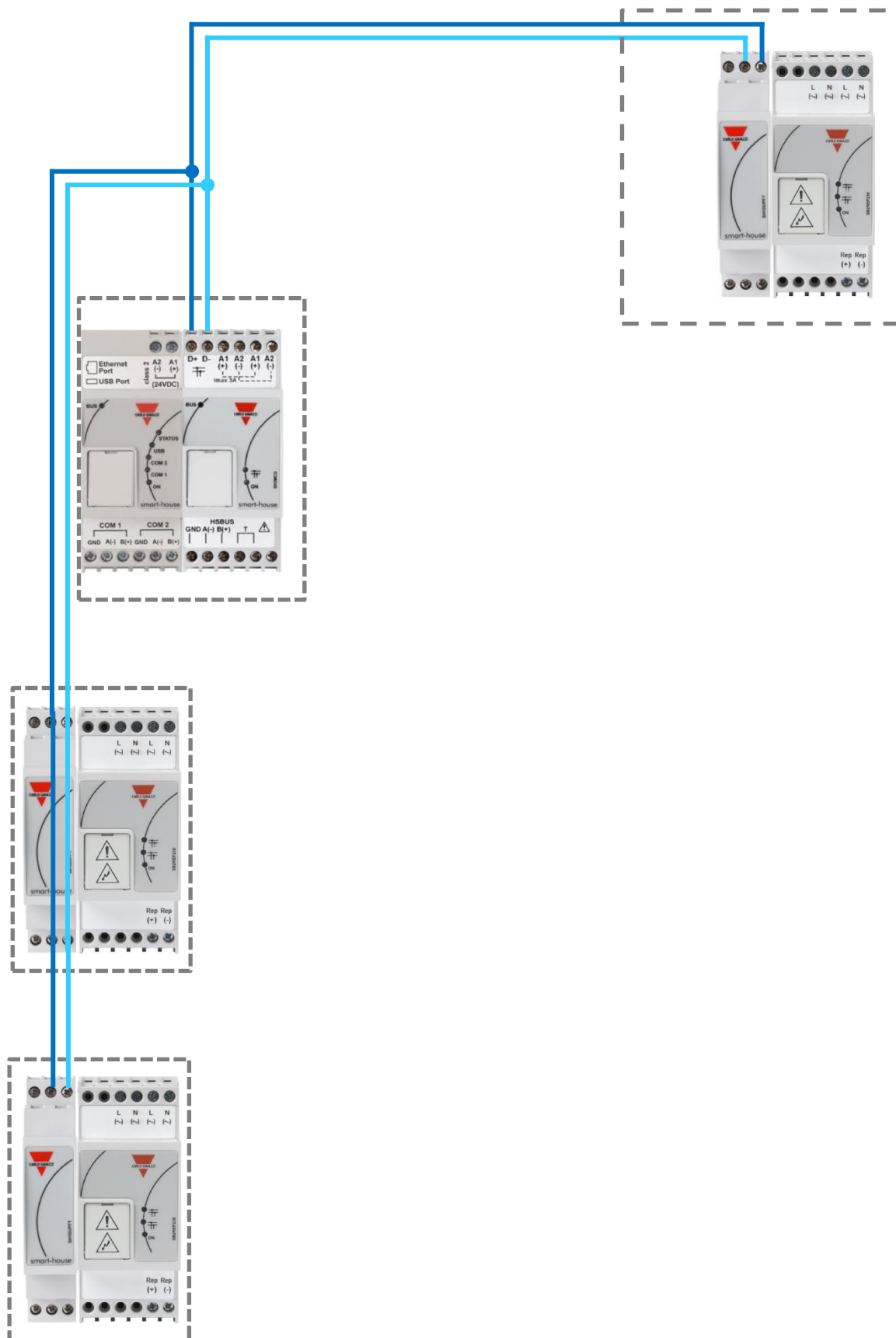
- the red one is 150 metres from the SH2MCG24: the repeater is not necessary because of the short distance and the small load connected
- the yellow cabinet is next to the violet one and they are 170 metres away from the Dupline generator. Here the installer has placed 6 Din-rail modules (SH2RE16A4), which do not generate too high a voltage drop since, in normal conditions, the consumption of the 4 relay modules supplied by the bus is 6mA ( even if this value increases when a relay is switched on/off)
- in the violet cabinet, the installer has placed another 6 SH2RE16A4 modules
- the green cabinet is 700 metres away from the violet cabinet and the repeater is placed here to boost the current and voltage, which otherwise are not sufficient to supply the other relay modules placed here.

**Example of Dupline Bus current calculation (see the voltage-drop file)**

To calculate the voltage drop at the end of the 700m, as shown in the green cabinet in the picture above, the installer has to use the [excel file](#), available in our Product Selection website, in the SB2WEB24 and SH2WEB24 pages.

The data used to calculate the voltage drop in the example above is:

- Cable section: 0.75 mm;
- Number of modules in the yellow and violet cabinets: 12
- Consumption of a SH2RE16A4: 6mA
- Total consumption of the network: about 72 mA
- Voltage measured at the end of the 700m: 5.5V



How to install a Sx2WEB system

### 1.2.5 How to define the number of Dupline® networks

The smart-house 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:

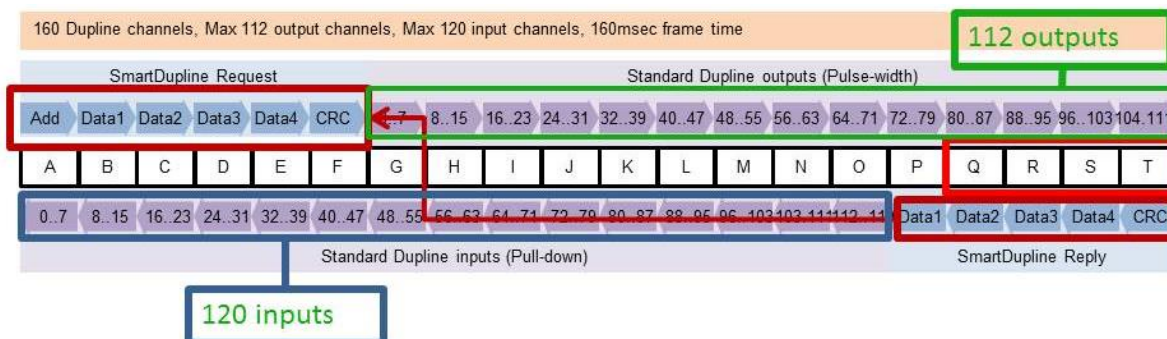
**SIN: 255.255.255**

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

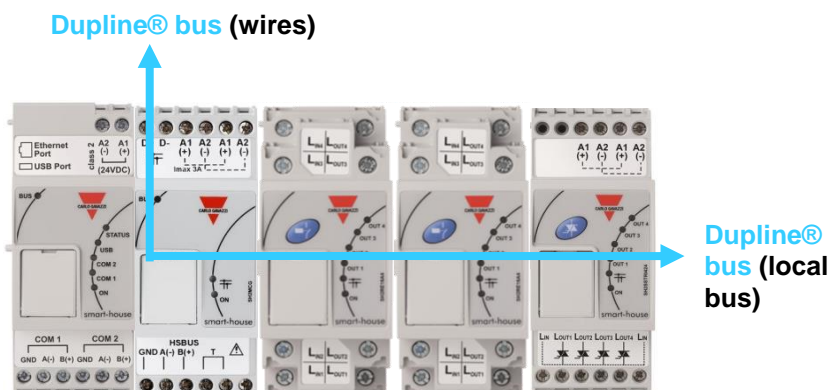
If the light switch module is connected to the SH2WEB24 controller, no addressing is needed since the module is provided with a specific identification number (SIN): the user has only to insert the SIN in the SH tool when creating the system configuration.

Used channels: 4 input channels, 4 output channels.



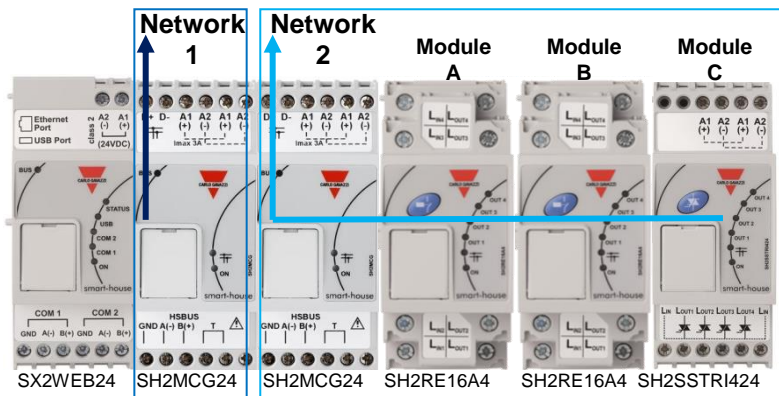
### 1.2.6 Dupline® bus in the cabinet

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.



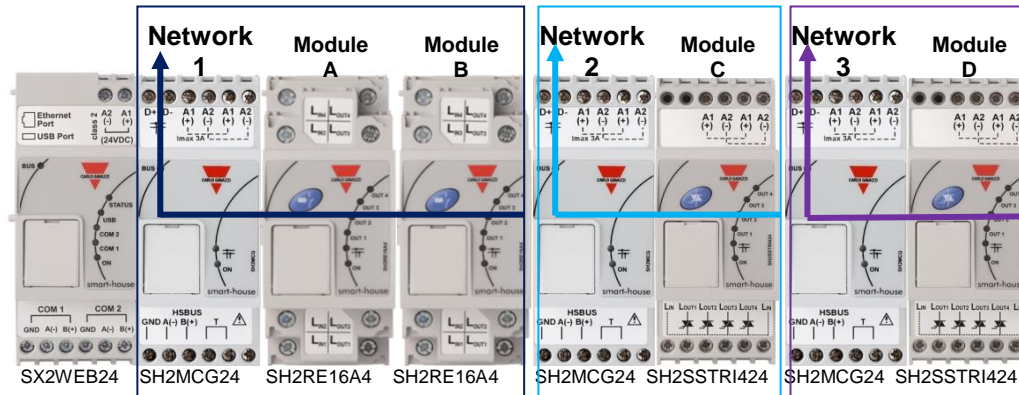
If more bus generators are connected in a DIN rail, they do not need to be plugged next to one other and they can also be mixed with the Dupline® I/O modules. The only rule that the installer has to take into account is that a Dupline® I/O module is connected to the Dupline® network generated by the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

Example 1:



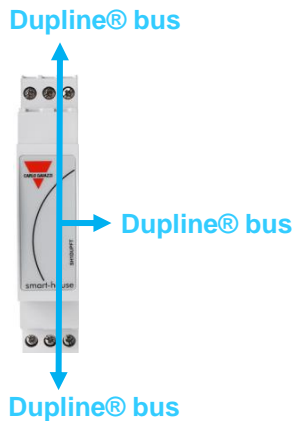
Modules A, B, and C are connected to the Dupline® network 2.

Example 2:

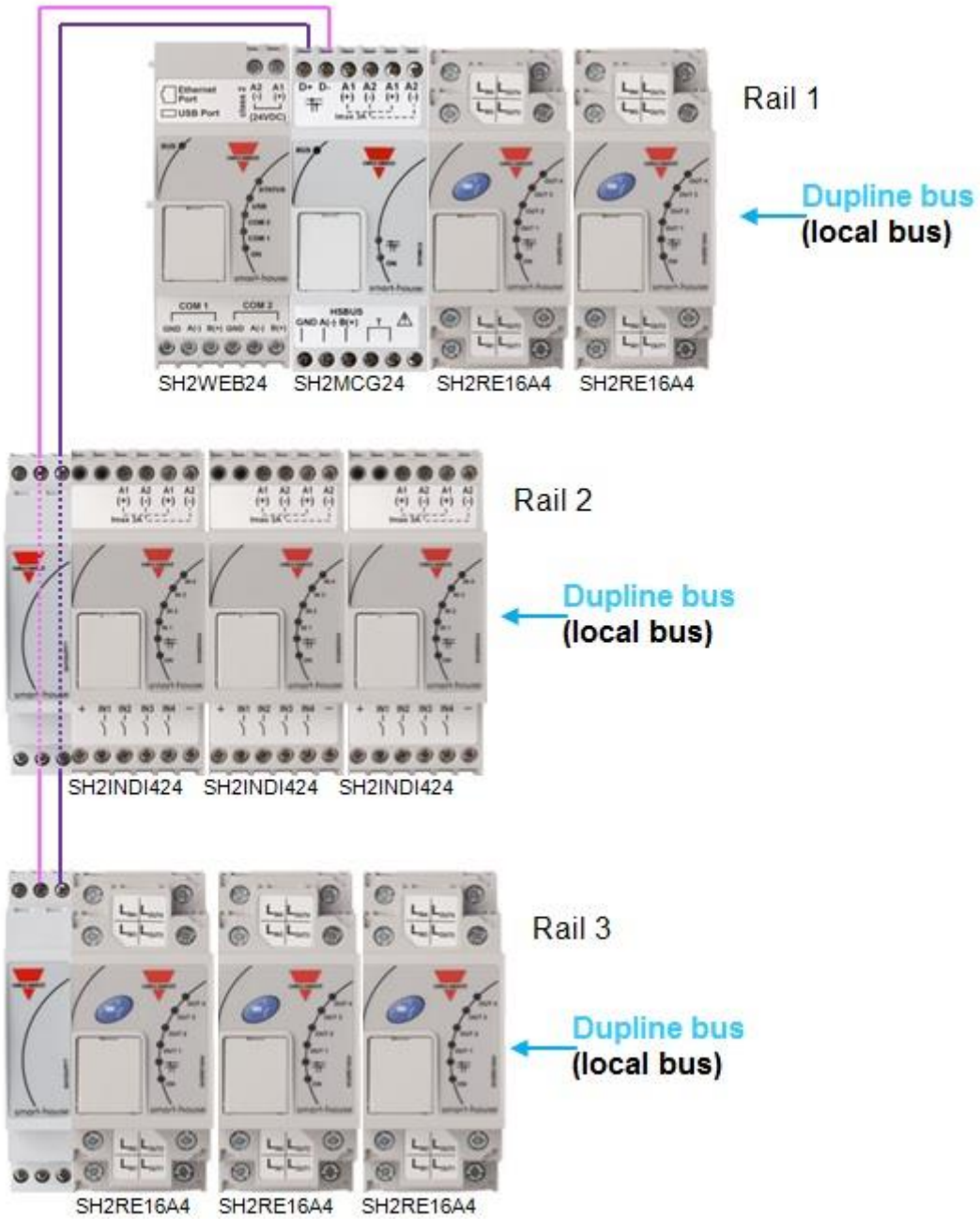


Modules **A** and **B** are connected to the Dupline® network **1**.  
 Module **C** is connected to the Dupline® network **2**.  
 Module **D** is connected to the Dupline® network **3**.

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 smart-house 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.

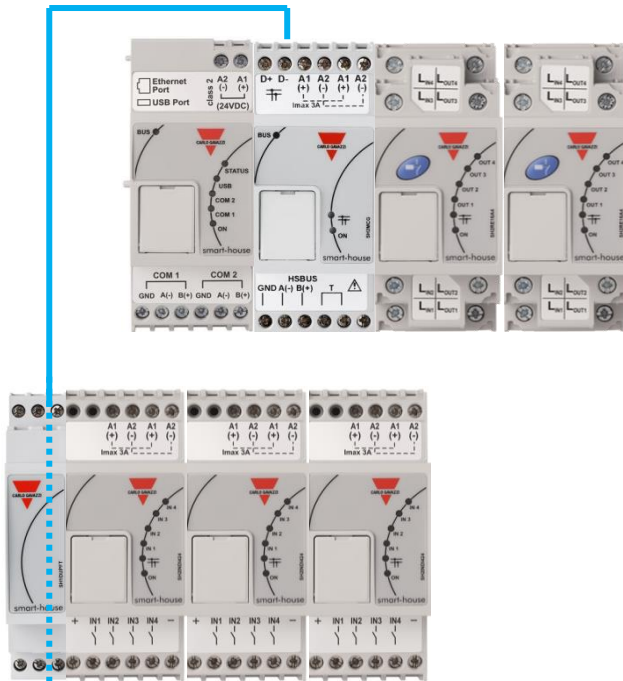


Example 3:

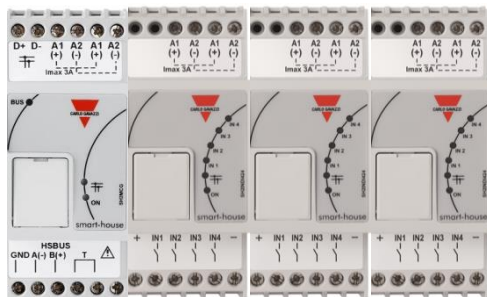


## Recommendations:

Do not connect one SH1DUPFT to two Dupline® networks, otherwise the two buses will be short-circuited: 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.



## 1.3 The wireless bus WiDup

Please see the manual *How to install the smart-house wireless system*.

## 1.4 How to connect the modem

The Universal Mobile Modem SH2UMMF124 or the USB Dongle Connection Module SH2DSP24 have to be connected to the Sx2WEB24 through the auxiliary bus on the left side of the Sx2WEB24. The modem can be used to send/receive messages or to access the Internet when the LAN connection is not available.

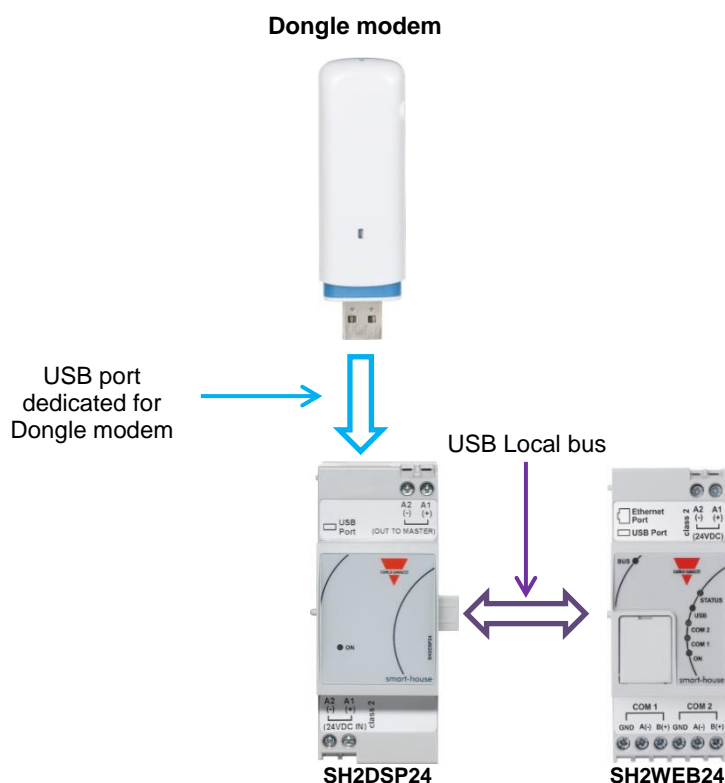
The modem is configured by means of the Sx tool software: the user has to define the type of modem used, the PPP parameters if necessary, the phone numbers from/to which it has to receive/send the messages, the type of connection required (Data connection always active, Data connection if LAN not available, Only LAN).

### 1.4.1 How to connect the USB Dongle Connection Module SH2DSP24

The SH2DSP24 is a Sx2WEB24 accessory module that provides a reliable and cost effective way to connect to the Internet by using mobile networks via a dongle modem.

The installer has to carry out the following procedure:

1. Connect the SH2DSP24 to the left of the Sx2WEB24 controller;
2. Insert the SIM into the dongle USB modem<sup>(\*)</sup> through the SIM slot. Make sure the **SIM is not protected by a PIN code** (should that be the case, disable the protection). Please refer to the user manual of the model/manufacturer;
3. Insert the USB modem into the USB port located on the top of the SH2DSP24 module;
4. Connect the 24VDC power supply;
5. Configure it by means of the Sx tool software.

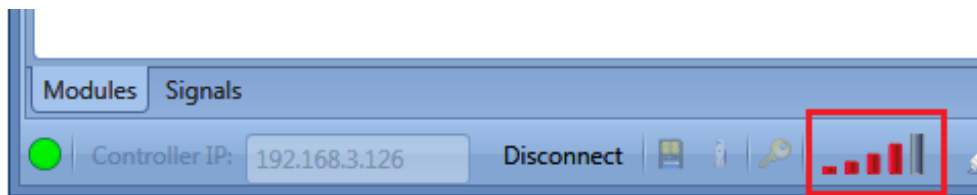


(\*) The table below shows the compatible USB modems:

| Manufacturer | Model   | Type     |
|--------------|---------|----------|
| HUAWEI       | MS2131  | 3G modem |
| D-LINK       | DWM 157 |          |

**Recommendation:**

Place the modem where there is good signal reception: this can be checked by connecting to the Sx tool: at the bottom of the user interface there are 5 bars that indicate the field strength, as shown in the picture below.



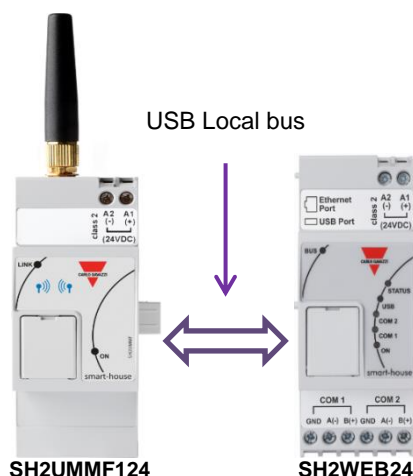
**N.B. Since the USB port used by the dongle modem is the same as the one used by the USB key in the Sx2WEB24, the USB key cannot be used if the modem is already connected.**

### 1.4.2 How to connect the Universal Mobile Modem SH2UMMF124

The Universal mobile modem SH2UMMF124 module is no longer available: it is mentioned here only to understand compatibility with the past.

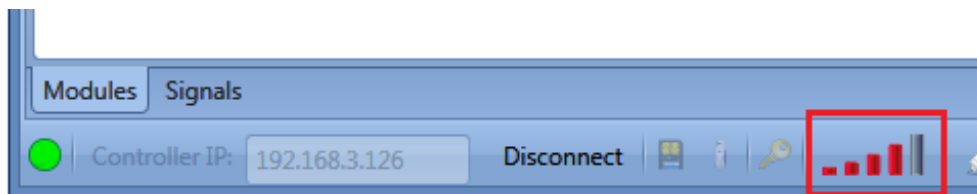
The installer has to perform the following steps to install the SH2UMMF124 modem:

1. Connect the SH2UMMF124 to the left of the Sx2WEB24 controller;
2. Insert the SIM into the SH2UMMF124 modem through the special slot. Make sure the **SIM is not protected by a PIN code** (should that be the case, disable the protection);
3. Connect the antenna;
4. Connect the 24VDC power supply;
5. Configure it by means of the Sx tool software.



#### Recommendation:

Place the modem where there is good signal reception: this can be checked by connecting to the Sx tool: at the bottom of the user interface there are 5 bars that indicate the field strength, as shown in the example in the picture below.



**N.B. Since the USB port used by the dongle modem is the same as the one used by the USB key in the Sx2WEB24, the USB key cannot be used if the modem is already connected.**

## 1.5 How to connect the energy meters

COM port 2 of the Sx2WEB24 is an RS-485 port with modbus master capability and it is dedicated to Carlo Gavazzi energy meters.

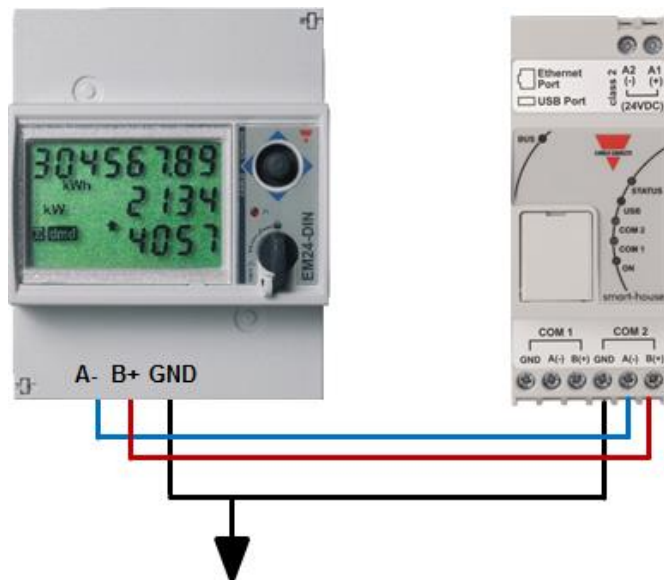
The Sx2WEB24 is a data logger that collects data from the following energy meters: EM21, EM23, EM24, EM26, EM33.

**Up to 64 energy meters can be connected to one Sx2WEB24.**

All the values available on the EM's modbus map are available on the Sx2WEB24.

The data is saved in an .XLSX or CSV file and can be downloaded by using the Sx tool or the webserver of the Sx2WEB24, accessing it with a PC.

An example of the connection between an energy meter and the Sx2WEB24 is shown below:



Different types of energy meter can be mixed, and they can also have different baud rate (see the Sx tool software manual for more details about how to configure the Sx2WEB24 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 Sx tool software.***

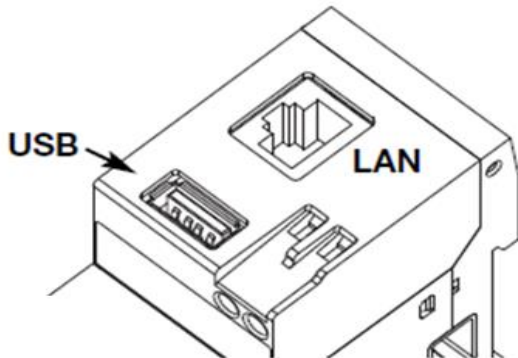
For more details about the wiring of the RS-485, please refer to appendix A.



## 1.6 Ethernet connection

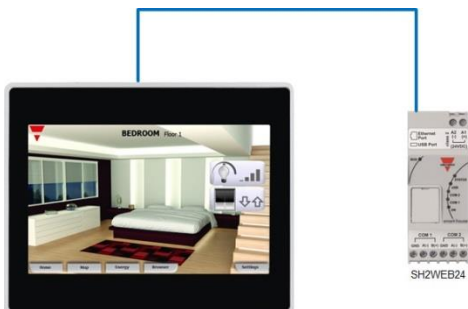
The Sx2WEB24 is configured by using the Sx tool, which has to be connected via the LAN port on the top of the Sx2WEB24.

When connecting the network cable, the Ethernet port LEDs will also light up.



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

The LAN connection can be used to connect the Sx2WEB24 to an Ethernet network when it has to be connected to other devices over TCP/IP such as the BTM-Tx-24 display.



The TCP/IP device can be connected directly to the Sx2WEB24 with a peer to peer connection by using fixed IP (see the Sx tool manual to configure a fixed IP).



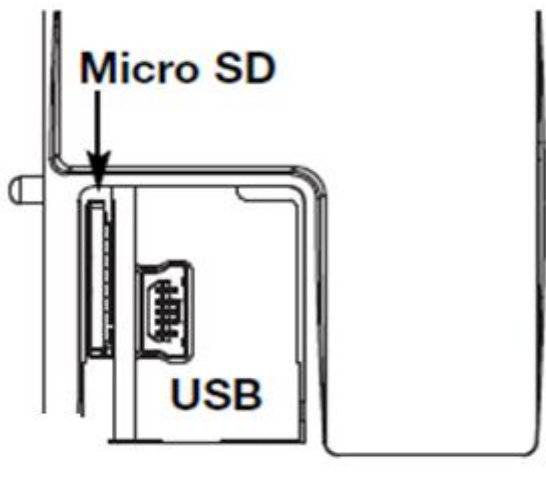
The TCP/IP devices can be connected to the Sx2WEB24 via a router by using both DHCP addressing or fixed IP with NAT forwarding if the Sx2WEB24 is to be visualised via the Internet.

## 1.7 Micro SD

The IP address can be changed by using a “Micro SD” or “SDHC” memory card correctly inserted into the relevant slot (see Sx tool software manual).

**N.B: the maximum capacity of the Micro SD card is 16GB.**

1. Open the flap located on the Sx2WEB24 front panel. Identify the slot specifically designed for the insertion of the “Micro SD” memory card.



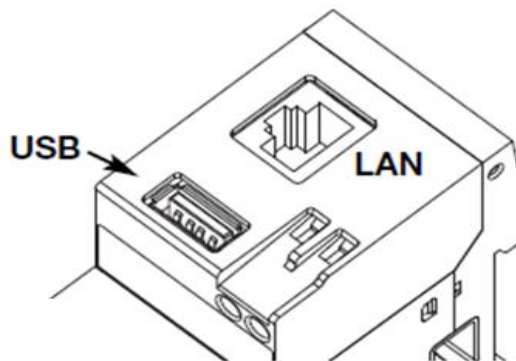
2. Insert the Micro SD card, making sure it is not write-protected and it is correctly formatted (FAT32).
3. Close the flap. Warning: if the flap is not properly closed Sx2WEB24 will not enable any writing or reading operation (flap closing is verified by a micro switch located under the flap).
4. As soon as the flap is closed, Sx2WEB24 will install the newly inserted memory card and update the IP address. Warning: opening the flap during the writing stage will stop the data transfer process and may potentially damage the Micro SD memory.

## 1.8 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, Sx2WEB24 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.

## 1.9 Sizing of Carlo Gavazzi DC power supply

The smart-house system is powered by 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 |
|-------------|----------------------------------|-------------------|
| Sx2WEB24    | 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.

### 1.9.1 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 :

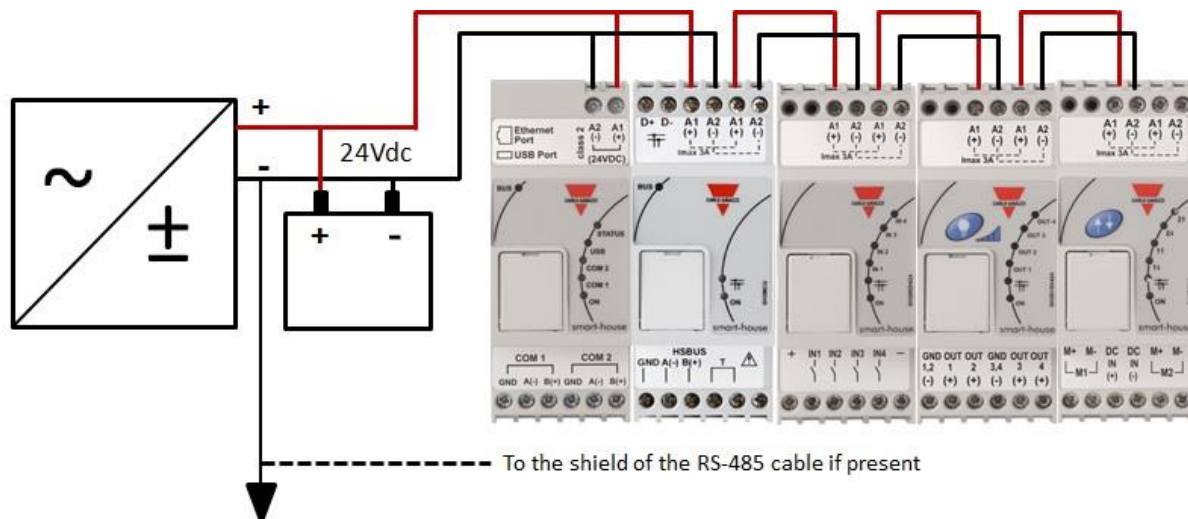
| Item number | Quantity           | Consumption     |
|-------------|--------------------|-----------------|
| Sx2WEB24    | 1                  | 1x 5.0 = 5.00 W |
| SH2MCG24    | 2                  | 2x 6.5 = 13.0 W |
| SH2RODC224  | 0                  |                 |
| SH2ROAC224  | 4                  | 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 | <b>37.80 W</b>  |

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

### 1.9.2 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.

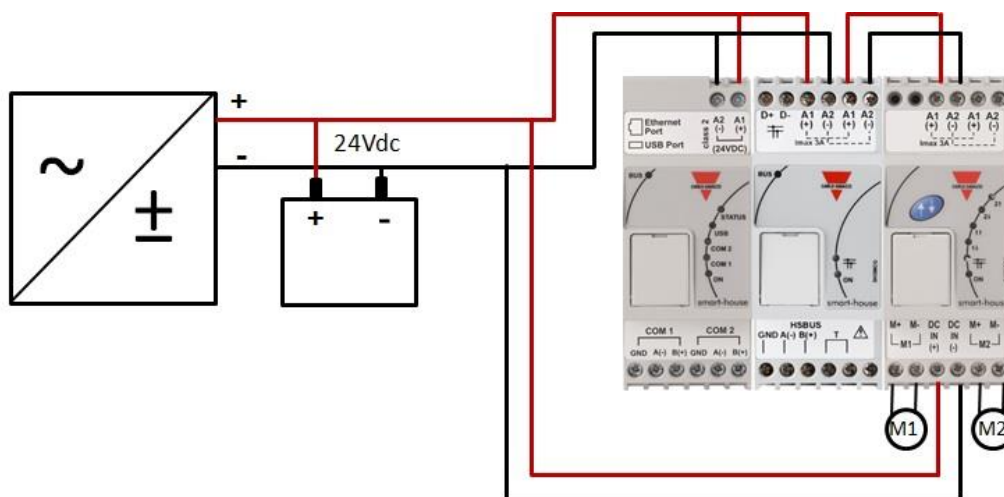
The best wiring should be carried out as shown below. The immunity to EMC can be improved connecting the minus of the DC power supplier of the system (-) to the earth ground.



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) Use a battery back-up system to avoid switching off the installation if a power down should occur.
- 2) 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).
- 3) 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 smart-house system

The installer has to perform the following steps to install a smart-house system:

1. Define the required smart-house functions and the relevant smart-house modules
2. Define the number of necessary bus generators, following the suggestion described in paragraph *How to define the number of Dupline® networks*
3. Size the 24 Vdc power supply as described in paragraph *Sizing of Carlo Gavazzi DC power supply*
4. Install the Dupline® bus, following the suggestion given in paragraph *The Dupline® bus*
5. Position and design the cabinet(s) correctly, following the suggestion given in the description of the Dupline® bus and the HSbus.
6. If the modem is part of the installation, it has to be placed to the left of the SX2WEB24
7. The DIN-rail module has to be placed as described in the Dupline® a HSbus paragraphs
8. Connect the loads and inputs/outputs as described in the relevant datasheets of the DIN-rail modules (ON/OFF light, dimmable light, blind motors, ...)
9. If present, connect the energy meters to the serial port COM 2 and configure them (modbus address, baud rate,...)
10. Connect the LAN if present via the Ethernet connector
11. Connect the power supply: 24Vdc and 230Vac

When switching on the Sx2WEB24, 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 or when it is connected to a PC via the Sx tool). 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 SH2UMMF124, the following LEDs will light up on the front panel:

- Green LED: ON (indicating the machine is powered)
- Blue LED: *fast blinking*: searching for the cover signal / not registered / switching off.  
*slow blinking*: service is registered and signal is available.  
*steadily on*: communication under way.

When switching on the SH2DSP24, the green LED will be lit up, indicating the module is powered. See the LED/LEDs on the dongle USB modem for any network information.

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).

After connecting and powering the Sx2WEB24, connect it to the Sx tool, following the instructions in the Sx tool manual.

The Sx2WEB24 IP settings are factory-configured to start as DHCP. If no routers are present, please change the IP address as described in the Sx tool manual, by using the USB key.

To create a configuration, please follow the instructions in the Sx 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<sup>2</sup>. 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 |

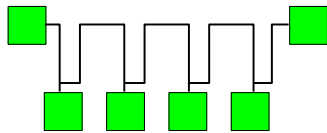
As for the SH2MCG24, EM21 and EM26 the relevant terminals have to be short circuited.

##### 3.1.6 RS-485 wiring procedure

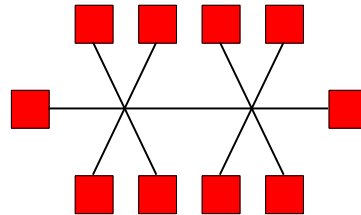
Suitable wire sleeves must be used for wiring. If any wire splice is to be used, this splice must be soldered, taking special care to cover the splice with a cable shield and to ensure proper continuity.

### 3.1.7 RS-485 topology

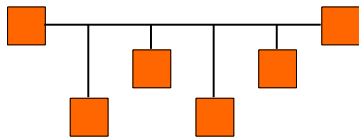
Due to signal reflection issues, topology is not free, but only certain configurations are allowed. The only configuration which guarantees sufficient reliability is the daisy-chain. The maximum length of a derivation is 1 metre.



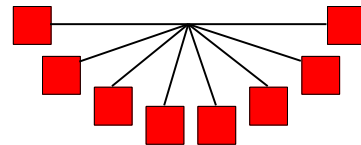
Daisy Chain (best)



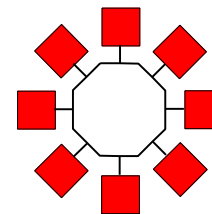
Backbone with stars or clusters (avoid)



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.

| <b>SAFETY RECOMMENDATIONS</b>   |   | 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.                   |
|---|---|--|
|    | <b>UNAUTHORIZED PEOPLE MUST NOT TOUCH</b>             | 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. |
|  | <b>DO NOT USE WATER TO PUT OUT FIRE</b>               | Water jets or jets of other liquids must not come in contact with the electric panel   |
|  | <b>INSTALL AVOIDING DIRECT EXPOSURE TO SUNLIGHT</b>   | 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.   |
|  | <b>DO NOT CONNECT VOLTAGES EXCEEDING RATED VALUES</b> | Do not connect supply voltages exceeding rated values to avoid damage to the equipment and potential risk of injury or death to operators  |
|  | <b>DO NOT SHORT CIRCUIT TERMINALS</b>                 | Do not short circuit terminals (+) and (-) to avoid damage to the equipment and injury or death to operators   |

| <b>SAFETY RECOMMENDATIONS</b>   |  | 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. |
|---|--|--|
|    | <b>ELECTRICAL COMPONENTS CONSTANTLY UNDER HIGH VOLTAGE</b>                     |  |
|    | <b>DANGER !!! RISK OF DAMAGE AND INJURY AS A RESULT OF INCORRECT WIRING</b>    | 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.           |
|   | <b>DANGER !!! RISK OF DAMAGE AND INJURY AS A RESULT OF INCORRECT GROUNDING</b> | Carefully check grounding. The user must provide a grounding system in compliance with the regulations in force according to the electrical installation in use.                         |
|  | <b>DANGER !!! FIRE HAZARD IN THE PRESENCE OF INFLAMMABLE FUMES</b>             | 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      |
|  | <b>ALWAYS TIGHTEN SCREWS CORRECTLY</b>   | Always correctly tighten the fastening screws of the wiring terminals  |