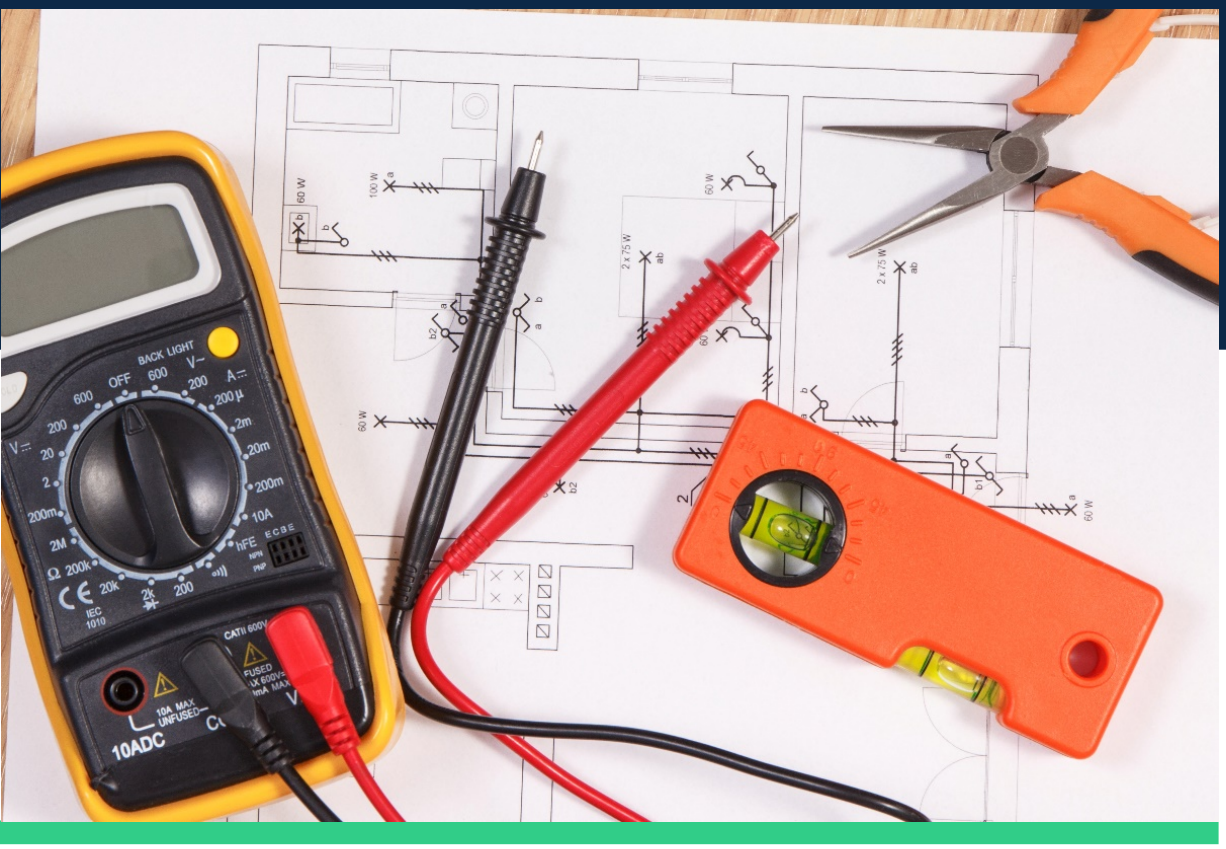
Electrical installation guide

v3.2



chameleon®

The smart home of the future

Contents

1. Preamble

This document was created for electricians and constructors for pre-cabling and installation of Chameleon smart home systems. Hereinafter, we shall present the key concepts and instruments of the Chameleon system, the central control box, which includes the rail mountable control units, followed by the cabling of the smart home network, and finally, the connection of the modules. Completing the checklist at the end of the document means that the system is ready to be programmed.

1.1. Chameleon devices

The Chameleon smart home solution is a wirelink system connected to sensors and actuators (and the internet) in households, and is capable of carrying out complex smart-home functions via the communication between these devices.

Chameleon devices belong to 3 main groups:

1. Central unit or controller

   The controller is the heart of the smart home system, which is absolutely vital. Here is where the mini computer is, which is responsible for carrying out more complex functions. Connecting the central unit to the internet allows the user to control the home remotely, using a mobile app.

   Furthermore, the controller (hardware version 1.2.0) includes:

   - Analogue and digital inputs
   - Relays
   - Wiegand ports

   which may be sufficient to carry out the functions in the smallest homes. In most cases however, the system needs to be extended.

1. 1 - Chameleon central unit (controller)

2. DIN Rail Extension Module

Extension units are standard 35-mm modules **mountable onto DIN rails**, which connect to the controller via **CAN buses**. Their objective is **extending the number of connection options**, which are limited on the controller.

2. 2 - Chameleon Extension module

Several types available:

Name	Function	Number of extended connections
LS Extension	LS bus extension	2
0-10V IN Extension	Analogue IN extension	4
0-10V OUT Extension	Analogue OUT extension	4
NONC Extension	Digital port extension	24
Relay 10 Extension	Relay port extension	10
Shutter 5 Extension	Shitter OUT extension	5
Dimmer 6 Extension	Dimmer controller extension	6

3. Wall or LS modules (behind switches)

Small, wall mountable (in mounting box, behind switches) modules, which are, in fact, actuators or control actuators. Usually, these make up the largest part of the smart home system.

They connect to the controller (or the aforementioned DIN rail LS extension) via so-called **LS** ("Low Speed") **buses**.
There are two types of external encasing: lower (19 mm) or higher (25 mm). The contacts are located on them separately: low-current spring contacts on one side, screw terminal strips on the other. On their bottom, there is a small red status indicator LED, which aids in troubleshooting.

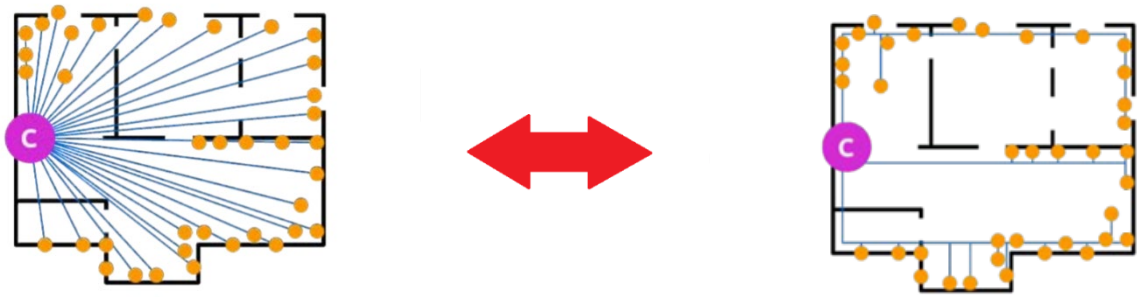
3. 3 – Chameleon wall (LS) module

There are several types of these, as well:

- Switch module
- 12-24V and 230V dimmer modules
- Shutter control modules
- 2 and 8-port digital IN (alternative switch) modules
- Thermostat interface (NGBS) module

Cabling of the smart home system

1.2. Topology



Point-to-point cabling *Cabling in wooden structures*

4. 4 - Comparison of point-to-point and wooden structure cabling used for LS modules

1.3. Distribution box assembly

It is recommended to install the power supply unit, the controller, the DIN rail modules into the traditional, masked home distributor developed for the circuit breakers.

We recommend taking the following into consideration when selecting the size:

- we recommend having a reserve of at least 20%,
- a space of a few modules is left at the end of each row, where an entire device cannot fit,
- room must be provided for the cabling as well

There is usually no space in the distribution box to separate high-current and low-current energy cables for each row, but when doing vertical cabling, it is recommended to route high-current cables on one side, and low-current cables on the other. For terminal strips, low and high-current strips must be separated and labelled.

5. *5 – Ready mountable low-current Chameleon distributor*

1.4. Bus cable

1.4.1. Type

6. *6 – 4-kV KNX bus cable*

As a rule, cables with different voltage levels (extra low and low voltage) cannot be routed in the same conduit, with the exception of 4-kV insulation strength cables, like bus cables.

For this reason, in the Chameleon system, **J-y(st)y 2x2x0,8** cables with a 4-kV insulation strength must be used. The most commonly known cables of this type are **green KNX/EIB cables**. This way, high and low-current cables do not require separate conduits.

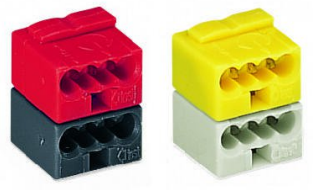
Bus cables, alarm cables must be labelled (e.g., with a thin sharpie), otherwise, troubleshooting will be very hard.

	Image	Type	Comment
✓		J-y(st)y 2x2x0,8 KNX/EIB	green, Insulation strength: 4 kV
✗		J-y(st)y	grey, Insulation strength: usually 1-2 kV (must not be routed in same conduit as high-current)
✗		0.22 alarm cable	not suitable
✗		Ethernet cable	limited suitability (for fewer modules, shorter distances and routed in separate conduit – not recommended!)

1 *1 – Suitable bus cables*

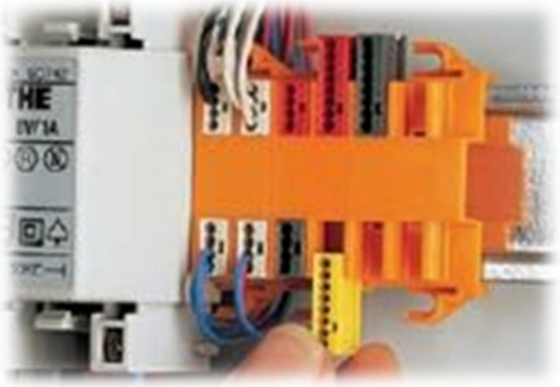
1.4.2. Connection

The four strands of the bus cable are recommended to be connected with the microWAGO (243 series) manufactured for KNX/EIB cables.



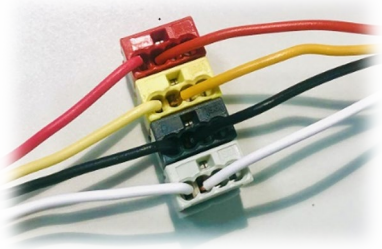
7. 7 – WAGO 243 series (micro)

Micro WAGO's can be connected to one another, with rail mountable supporting elements available for them, and they are also available in the colours of the bus cables.



SEQ ábra * ARABIC *Fig. 8 – DIN rail mountable WAGO support*

The use of appropriate colouring, as per the figure below, is recommended.



8. 9 - Connection of bus cable with microWAGO

If these are unavailable, then WAGO's made for simple, solid cables may also be used, but these are harder to work with, since their springs are strong and it's harder to insert cable strands into them.

9. *10 - WAGO 2273 series*

The uninsulated strand routed next to the bus cable's shielding is thinner, so this cannot be connected with a WAGO 243, but it *can* be connected with WAGO 221 with locking lever.

10. *11 - WAGO 221 series*

1.5. CAN bus

The CAN bus connects DIN extension modules with the Chameleon controller.

1.5.1. Topology

It is a strictly straight bus; there may be no branches, so DIN devices must be fastened. If, for some reason, the topology would nevertheless be a point-to-point one, then two bus cables must be routed to a device (e.g., distributor-collector) so that the physically straight bus topology can still be configured.

11. *12 - CAN bus, incorrect branch and solution with two cables*

The controller does not necessarily have to be at the end of the bus.

1.5.2. Limitations

The CAN bus can have a maximum length of up to 1 km, however, more devices require more input power, which may cause major supply voltages at large distances. If the supply voltage of the bus falls below 20V, the situation must be resolved, for example, via local supply.

1.5.3. Colour coding

Recommended colour coding: on the CAN connectors, in this order from left to right

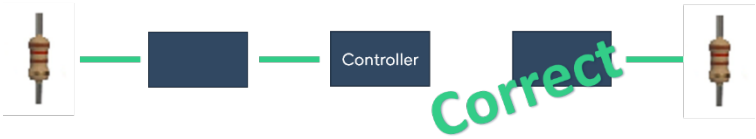
Colour	Role
Red	+24 V Supply Voltage
Black	GND
Yellow	CAN H data line +
White	CAN L data line –
uninsulated thin strand	shield

2 *2 – CAN bus colour coding*

1.5.4. Connection

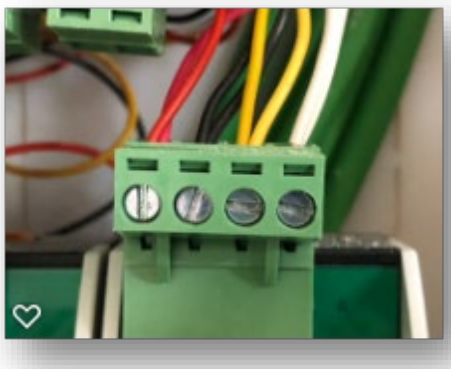
The 120-ohm termination resistor is required at both ends of the CAN bus. These are not integrated into the controller either, but we provide them as standard for each of our controllers. It is easiest to place the resistors in the CAN screw terminals of the modules at the two ends of the bus, between the yellow and the white wires, by wrapping the legs of the resistor around the 0.8 solid copper core, otherwise the connector will not fasten it properly.

(The resistors can only be omitted for very short distances; we recommend always using them in practice.)



12. *13 – CAN bus with termination resistors*

The simplest way to continue the bus cable's routing is using the strip terminals of the modules.



13. *14 - Typical CAN connection*

The shields must also be connected together and they must be connected precisely at a single point into the house's EPH network, preferably next to the controller or inside the main distribution panel.

14. *15 - Connection of CAN bus in practice*

1.6. LS bus

The LS bus connects the wall modules (placed in the mounting boxes) with the controller (or the LS extension module).

1.6.1. Topology

Unlike the electrical installation of traditional sensors, the cabling of the LS modules is not point-to-point, so the baffling jungle of cables around the central unit can be avoided.

LS module cabling is bus-based, meaning that **it allows for tree-like branching**. In certain modules, incoming and outgoing bus cables have separate configurations.

1.6.2. Limitations

- The maximum length of an LS bus is 100 m.
- **An LS bus can hold a maximum of 16 modules**. If more modules are required, an LS extension module must be installed in the system (connection: chapter 4.2.5). We recommend not using all of it for future extendibility, and connecting just 12 to 13 devices to a single bus.
- **The maximum current may be A1**! It can be used to power safety technology devices; however, it cannot be burdened too much! (Magnetic gate locks must not be connected to it!)

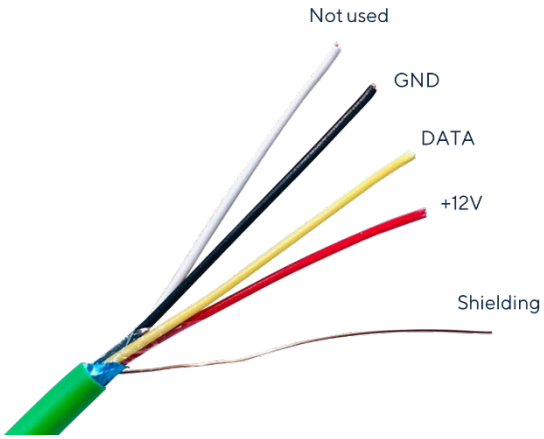
1.6.3. Colour coding

Colour coding of the 4 strands of the J-y(st)y 2x2x0,8 KNX/EIB cable for LS bus:

Colour	Role
Red	+12 V Supply Voltage
Yellow	Data line
Black	GND
White	Not in use (backup)*
uninsulated thin strand	shield

3 *3 – LS bus colour coding*

*: E.g., second LS bus, separate supply voltage (e.g., 15V supply voltage of NGBS power supplies), backup in case of failure, etc.



15. *– LS bus colour coding*

In case of bifurcations, splicing, **all four strands and shielding must be connected**, even if according to the current plans, the LS bus will only be using three strands.

1.6.4. Connection

As we've previously mentioned, the LS bus can also follow a tree structure, meaning that it can have junctions.

- In case of bifurcations, splicing, all four strands and shielding must be connected, even if according to the current plans, the LS bus will only be using three strands. (For what could the fourth strand be used? E.g., a second LS bus, separate supply voltage, backup in case of failure, etc.)
- For NGBS iCON thermostats, a separate power supply may be required, which can be resolved via the LS bus's unused, fourth strand, so this is another reason for which it is necessary to connect all four strands in all nodes.
- The shields must also be connected together and they must be connected precisely at a single point into the house's EPH network, preferably next to the controller/LS Tree extension or inside the main distribution panel.
- Distribution and further routing of the LS bus may be done in the following ways:
    - it is difficult to connect two cables/strands into a single connection point of an LS module, but it can be done with a little finesse,
    - Certain wall LS modules have two LS bus ports, so when connecting the modules to the bus, input and output LS bus cables do not need to be paired in a single connection point.
    - They can be divided into however many routes with WAGOs. In this way, only one bus cable needs to be connected into one module, which is the recommended solution, however, enough room must be provided for the WAGO's division, and there won't necessarily be enough room left behind an LS module (with the exception of alternative modules).

1.6.5. Cabling - tubing

It is worthwhile routing them to every switch and connector, as this way, you will have the option to add plus circuits to the system in the future, e.g., when changing the furniture arrangement, the connector's controller can be moved together with the floor lamp.

We recommend to include conduits one size larger in the plan, due to the additional space required for the bus cable.

Distribution of lighting and shutter circuits follows bus distribution, so the bus cable (from the controller or LS Extension), as well as the high-current power supply (from the high-current distributor) can be routed to a switch module within the same conduit.

Example of typical tubing, cabling topology: The common supply cables of several lighting circuits are started from the distribution board. For the first switch, the bus and high-current cables can be branched off towards the local LS module and circuit, or the next switch/LS module/circuit. As such, switches on a single bus cable, which are practically on the same distribution branch are connected in succession, and the local consumer(s) is/are supplied from the LS modules behind each switch.

1.6.6. Mounting boxes

Deeper mounting boxes (e.g., with a depth of 65 mm) must be used for the LS modules.

	Image	Manufacturer	Comment
✓		UNIVOLT	One of the best is the UNIVOLT box, which is a few mms deeper and it also has a larger diameter compared to ordinary mounting boxes. Furthermore it can not only be perforated at medium depth, but also at its lower points, as well as its bottom.
😐		Kaiser /Budvill	Smaller than UNIVOLT, and can only be perforated in the middle, but still usable
✗		Schneider	green in colour Narrows toward the rear (cables do not fit next to the LS module)
✗		Conventional	Non deepened

4 4 – recommended mounting boxes

Assuming a plaster thickness of 1.5 cm, the placement of two 65-mm deep boxes exactly facing each other on two sides of a size 10 partition wall is still possible, with accurate installation.

There aren't really any deepened, rectangular mounting boxes for thin, Italian, modular fixtures. In this case, the solution is to install 20 mms below the usual depth, and the framework must be fastened with longer screws. Another solution may be to install a 20-mm EPS below the box, which can be scraped out after knocking out the bottom of the box. TEM boxes are available instead of the Vimar boxes, which are 20-mm deeper. We recommend using the TEM boxes. However, 20-mm boosters are available for the Vimar boxes, with the option to place as many as two on top of one box. This latter solution is the best, but it is also more expensive.

There are deepened mounting boxes for drywall as well, but these cannot be connected in line.

There are also more shallow mounting boxes with so-called "pockets", mainly used in drywall, but they can also be used in solid walls:

16. *17 - mounting box with pocket for drywall*

We recommend connecting the conduits to the mounting boxes at the largest depth, at the back, so the following, preferred installation order can be configured:

- cables and connections at the back,
- LS module in the median plane, with a decal and a status indicator LED outward,
- connection assembly on the outside.

Placement of cable connections is not recommended inside the mounting boxes, since this way, not enough room is left for the LS modules. This is especially true for the socket control modules placed behind socket fixtures, as sockets go further inside the box than switches. How can cable connections behind LS modules be avoided?

- If ceiling lighting is cabled via MMFals, then the connection must not be made behind the switch, but above it, in a separate connection box near the ceiling. This also bears the advantage that in case of an accidental cable perforation when mounting shelves or pelmets, the damaged cable section will be easily replaceable.
- For MÜIII conduits, they must be routed from the superior column to the switches, sockets by only routing the fixtures' own cables to the box behind the fixtures.
- For Betonflex/Symalen conduits, there is no superior column. We recommend replacing this with a larger (100x100, 80x120, etc.) connection box installed near the floor. This way, it can be ensured that each fixture only receives their own cables, with no cable connection being necessary behind the modules.

If connection behind the fixtures cannot be avoided, a solution may be to add an additional 10 or 20-mm booster frame to the deepened boxes when installing them, as required.

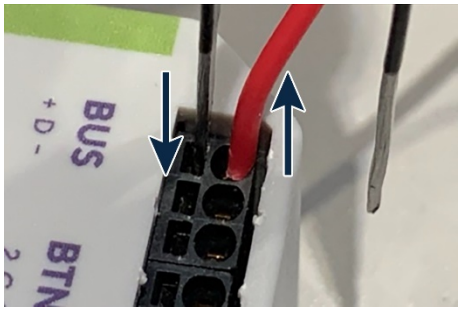
17. *18 – booster frames for mounting boxes*

KOPOS boxes (KO 110/L NA Kopos) with a footprint of 100x100 mm can also be used as connection boxes. This is the only solution in which a high and low-current installation, with a dividing wall, at two different voltage levels within the same box is possible.

18. *19 - mounting box with dividing wall*

1.6.7. Connection

A shorter 4-5 mm blanking length is required for connection on the low-current side. This is especially important when using devices without the option for additional bus connection, so 2 strands must be forced into each connection point of the LS bus (no supported, but permitted solution). The cables from the low-current connectors of the LS modules can be pulled out either via rotation or by using a thin tool (e.g., one end of a pair of tweezers) to go into the rectangular hole next to the cable.



19. *20 - Pulling out a cable from an LS module*

The easiest way to connect and LS module with a switch is by using the small pieces cut out from the bus cable's strands. All switches are button switches, simple or double switches, or shutter switches.

When connecting a thermometer chip, pay attention that it must be connected at different points, depending on the module's version. Faulty connection may damage the chip.

If twisted pair cables (MT, MKH, MTL, etc.) are connected into the LS modules, the work is made easier, however, they must be equipped with ferrules. The perforation on the housing of the LS modules only allows for the use of uninsulated, or at most, 1.5 mm^2 insulated ferrules. Maximum connectable cable diameter: 2.5 mm^2 (with uninsulated ferrule).

1.6.8. Placement

An LS module needs to be installed so the red status indicator LED (1-mm hole) on its bottom faces outward, which makes troubleshooting much easier. Order going outward from the inside: connection-module-switch fixture.

If the LS modules are not installed behind the fixtured, but into a connection box, it is still recommended that their cover be removable, so they can be accessible in case of troubleshooting or failure.

1.7. Comparison of the two buses

Although the same KNX/EIB J-y(st)y 2x2x0.8 cable is used for both buses, there are serious differences between the two, shown in the following summarising table:

	CAN bus	LS bus
Where is it used?	Between DIN rail extension devices	Between wall, LS devices
Topology	Straight, no branching allowed	Tree-structure
Does it require termination resistors?	Yes, 120Ω on both ends	No
How many strands are used	All four	Usually only three
Supply Voltage	24 VDC	12V DC
Maximum length	1 km	100 m
Maximum number of devices		16 per channel*
Maximum power		1A

5 *5 - Comparison of Chameleon buses (CAN, LS)*

*: Maximum recommended number of devices should not be used; a reserve must be provided for possible future extentions.

2. Implementation of features

In the following, we will present the implementation of smart home features using Chameleon devices.

2.1. Shutter control

2.1.1. Chameleon devices

Shutter control modules are units capable of capable of controlling window shade motors. Window shades may be shutters, blinds, curtains, arm awnings, etc. They work very similarly to Switch (or Relay) modules, with the difference that their software does not allow simultaneous up-down movement of the shutters (thus preventing damage to the motors and the shutters). Please use our traditional relay (LS switch) modules to operate garage doors!

Shutter control is possible with the following Chameleon devices:

- **LS Shutter** – shutter control wall module (connection: chapter 4.3.2)
  - For single shutter control.
  - When connecting, please pay attention that the LS module's **up and down directions are not interchangeable**, so bot the IN and the OUT sides must be connected exactly as shown on the connection figure, as this is the only way to insure correct control.
  - Please pay attention to the following when **placing** the LS module:

- **Do not put wallpaper over the box**, because the relays may get burned, and they may need to be replaced, repaired): place behind removable connection box / switch cabinet.
- The LS module is an indoor device! It cannot take condensation, so **do not place it in a shutter case!** They may be placed either behind the switch, or next to the shutter case, in a connection box located inside; and it's worth connecting the factory connection cable of the shutter motor directly into the LS module.

- **DIN Shutter 5 Extension** – shutter control extension module (connection: chapter 4.2.2)
  For controlling at most 5 shutters.

2.1.2. Motors

- Smart home systems can be used to control shutter motors, which have a separate phase input for upwards motion, and a separate one for downwards motion. We recommend choosing the simplest type.
- Shutters controlled by impulse dry contact relays are not suitable because the smart home system does not know which way the shutter is moved by the impulse.
- Remote-controlled shutters are also unsuitable.
- DC motor window shades with polarity reversal require the installation of an external relay

2.1.3. Switches

Most often, we use dual **pushbutton** (not stateful!) shutter switches marked with and upward and a downward arrow to control shutter.

20 *21 – Legrand dual pushbutton switch*

Versions with STOP buttons may also be used, but only impulse-operated, pushbutton types.

21. *22 – Legrand Valena Life shutter control switch with STOP button*

2.1.4. Cabling

Shutter and light switches are often placed next to each other, so it may seem worthwhile to supply them from the same supply branch, but configuring such mixed circuits is not practical, because the transient electrical start-up impulse of shutter motors is clearly visible in the lighting of a room, which could lead to bothersome flashing. This can be avoided if **shutters and lighting are supplied from separate branches**, starting from the distribution board.

We recommend connecting **a single shutter motor to one shutter control output**, so if one motor fails, this does not cause the failure of other motors. If required, several shutter motors can be connected in parallel, but only to a single relay output. Parallel connection of manual switches will lead to failure. We do not recommend connecting shutters with different heights (run times) in parallel.

Shutters are usually connected with 4-strand cables: two connected strands + zero + protective conductor, so for example, cabling can be done with 4x1 MT cables, as three strands will not be enough.

Shutters must be installed and final positions must be set in all cases prior to programming the smart home. Usually, shutter motors with electronic end positions must be programmed with their own test cables. This may be done reasonably before connecting the LS modules, so let the shutter installers do their job first!

During programming, the Shutter modules are in so-called "service" mode: we count running time; during programming, there are cases where the button needs to be pushed continuously to move the shutter downward.

2.1.5. Several motors on a single output

If you want to control two shutters on a single output, you will need at 2 at least 2NO relays (or 4 1NO relays), or 2 3NO relays (or 6 1NO relays) for three motors, and so on. The controller output moves the relay(s) pertaining to one direction, while the relay(s) operate(s) the motors. There won't be any problems, even in case of motor lock-up, if the relay contacts do not stick.

2.2. Lighting control

Simple connection of lighting can be done with Chameleon **LS Switch** (connection: chapter 4.3.1), or **DIN Relay 10 extension** (connection: chapter 4.2.1) modules, which contain 2 and 10 controllable relays respectively.

General information:

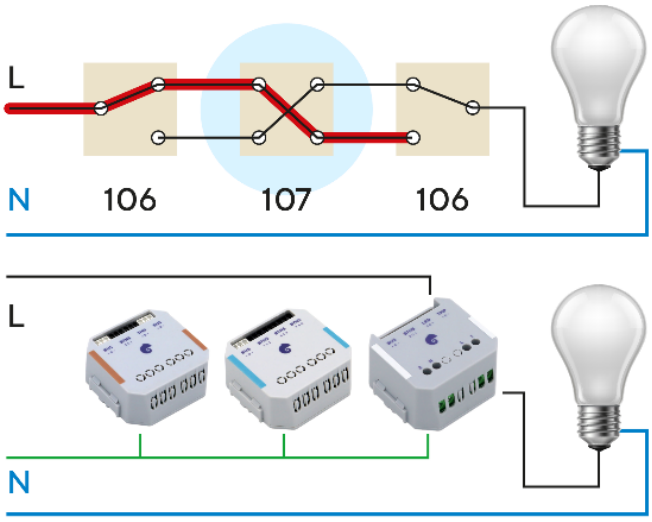
- If power supply is provided for the LS modules connected to the switches, they will carry out their function even without a controller (they can do switching and dimming). This operation is called **local control**.
- Instead of traditional, two-state (stateful) toggle switches (changeover switches, cross-connects), we use **always** use "bell switches" with **pushbuttons**. (Traditional switches can be configured by installing springs in them.)

2.2.1. Alternative switching

For alternative switching, a switch must be designated, behind which the **LS switch module** needs to be placed (connection: chapter 4.3.1), with the phase and connected lamp cables also being connected there. All switches are pushbuttons, and 106, 107, 106+6 switches are not required, nor are the so-called playwire, as it isn't being used, but it is in the way.

Alternative switching with dimming is also possible, in which case, an **LS dimmer module** is placed behind the designated switch (connection: chapter 4.3.5). In this case, the zero must also be shut down.

For other pushbuttons, we use **LS alternative modules** (connection: chapters 4.3.3 and 4.3.4). Since control is done entirely through software, LS alternative modules switching a single circuit do not need to be on one bus cable. Thanks to software control, LS alternative modules do not have a "local control" feature.

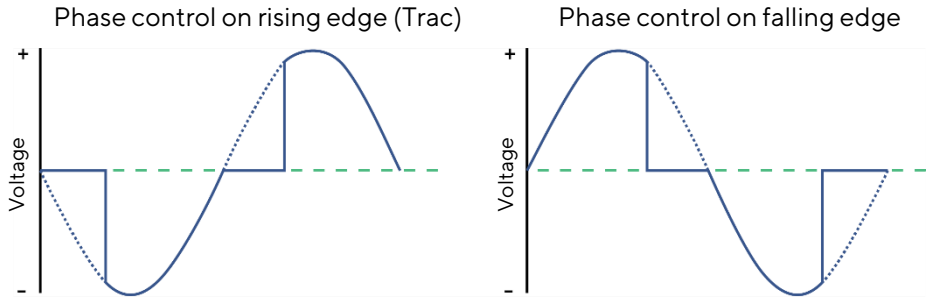


22. *23 - Alternative switching in conventional and Chameleon system*

2.3. Dimming

2.3.1. 230V AC

Alternating current (AC) dimming operates on the phase-cut principle. Traditional TRIAC dimmers (forward phase / trailing edge control) switch of at the zero crossing, while the MOSFET (reverse phase / leading edge control) solution, which we also use, turns on at the zero crossing.



23. *24 - AC dimming with phase splitting*

Since phase length represents control information for the electronics, unlike in traditional electrical installation, **the neutral conductor in addition to the phase must also be connected to the LS module**.

Switches

230V dimming is done via one pushbutton per channel, so since the modules are dual channel, dual pushbuttons are most often fitted.

Use of phase-controlled LED power supplies is not recommended, as the result is a solution that is noisier, controllable over a smaller range, (the supply demand of the electronics cannot be supplied at 8-18%) and less fail-safe. Use DC dimmers instead!

Testing

It is possible that a dimmer module be dimmed to such a low percentage, that the light source connected to it may not even turn on, so it will do nothing by simply clicking it off and on. For this reason, when testing, their operation must be tested by pressing the button twice, which sets them to the maximum 100% brightness, or the button must be held down, which must lead to changes in the brightness.

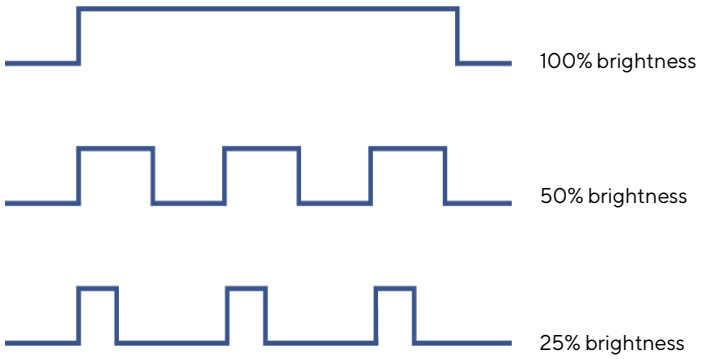
2.3.2.12-24V DC

LED strips should be dimmed not only for added functionality, but also from an electrical point of view, on the DC side.

When switching on the primary side, the buffer capacitors of the power supply take up a large amount of power for a short period of time, which may lead to the failure of the switch relay. While on the secondary side, the current is high due to the low voltage, which may even get to 6-8-10A, and moreover, it is DC, where arc quenching is a much more difficult task for the relay.

There are dimmable LED power supplies, which can be phase-controlled, via a 230VAC dimmer placed on the primer side. This has the same disadvantage as we've already mentioned at eh 230-VAC dimming: brightness cannot be fully decreased, and lower quality power supply units tend to buzz at low brightness.

The best solution is direct current (DC) dimming, based on Pulse Width Modulation (PWM): changing the fill factor of the square wave signal, at a sufficiently high (kHz) frequency, the light source does not vibrate, but operates according to the average power.



24. 25 - DC dimming with PWM

What LED strip should you choose?

The Chameleon system's RGBW LS module can operate in the 0 to 48V range, so both voltage popular in the trade flow (12V and 24V) can be used. The advantage of 12V is the wider selection, while the 24V's is lower voltage drops and cable cross-section demand due to lower amperage.

The LED strip's necessary power is determined by the type of use: mood lighting requires less power, while main lighting requires more. High power is also unnecessary night-time walking lights, footlights, contour lighting. Indirect lighting, however, requires the integration of additional power.

Out of RGBW LED strips, we support common-anode LED strips, similarly to other manufacturers. Most of the commercially available coloured LED strips are like this.

Switches

For RGBW dimming, a single coloured LED strip can be connected to one LS module, however, installing a dual pushbutton switch is still recommended, as one will control white lighting, and the other, coloured lighting.

Chameleon devices

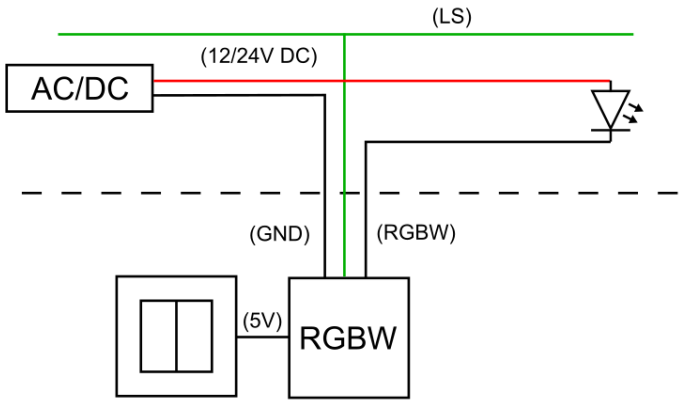
Chameleon's 4-channel **LS RGBW module** (connection: chapter 4.3.6) is suitable for the dimming of DC (usually LED) light sources. With this module, the Red-Blue-Green and white colour channels of LEDs can be set up separately, so you can mix and match to get the colour you prefer. The module operates at up to 48V, but the most common supply voltages are 12V or 24V. We recommend using 24V, as this way, the supply voltage is lower and results in lower losses in the cables.

Cabling

For 12 to 24V LED light sources, the supply voltages are high even despite the LEDs' low power, requiring larger cable cross-sections than usual, especially for longer distances. For longer LED strips, single or even dual power supply is usually not enough, and there intermediate supply may be required. Concrete plans can be made based on precise data, but a good rule of thumb is adding additional power supply units every 5 metres. The goal is to keep the 5 or 6x1.5 (RGBW channels + 1 or 2 GNDs) as short as possible.

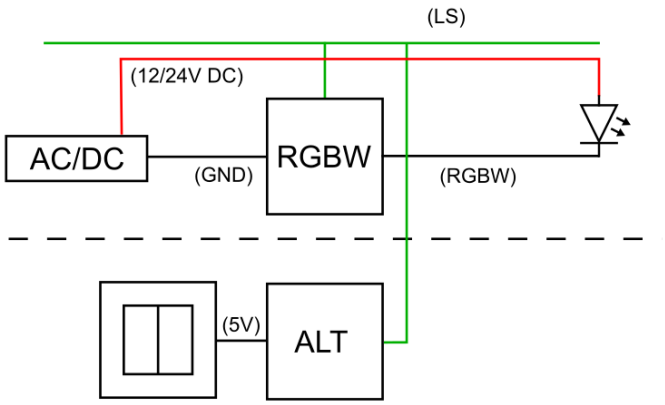
Here, there are 3 available cabling options:

1. Basic situation: DC voltage needs to be routed to the LS module placed behind the switch, then back to the consumer;
    - advantage: simplicity,
    - disadvantage: many cables, and DC cables require separate conduits (even if there is also 230V),

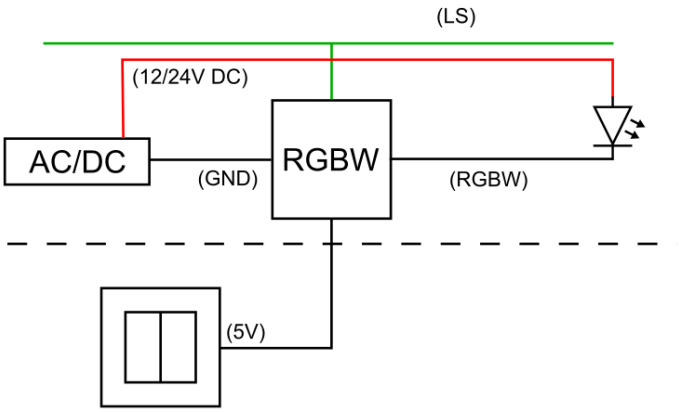


For bigger power and/or RGBW, in order to avoid thick/many cables, the **LS RGBW Dimmer module** is placed up high (in the suspended ceiling), between the power supply unit and the LED light source, and the LS bus is routed up there.

2. An LS Alternative module is then placed down behind the switch, which is programmed together with the Dimmer module in the controller.
    - advantage: best looking solution,
    - disadvantage: not the cheapest



3. The switch's cable is routed up to the input of the LS Dimmer module placed up high;
    - advantage: simple solution, especially if the distance between the switch and the light source is short,
    - disadvantage: There may be a disturbance between the switch and the module in the 5V switch input (there should be no problems within ~1.5 m)



Testing

In their basic factory condition, the dimmer modules can start from 0%. For this reason, when testing, their operation must be tested by pressing the button twice, which sets them to the maximum 100% brightness.

2.4. Heating control

2.4.1. Heat measuring via chip

This is the simplest and cheapest solution, but it also has disadvantages (e.g., it must be calibrated).

Type LMT87 analogue thermometer chips can be optionally connected to most LS modules (with the exception of the 8-port digital input (Alt8) one). The 5V power (VDD) necessary is produced by the module. Thermometer chips are made with two types of cases that are very similar, but **with different pinouts**, so please pay increased attention to this. Colour coding of cables soldered onto them by us for both pinout types:

- black: GND
- yellow or white: D, measured analogue signal, around 2.7VDC
- red: +5 V supply voltage

Placement of the thermometer chips is critical from the point of view of measurement precision. The chips must be placed by routing the three cables out through the fixture, and placing the sensor itself behind the frame, on its **bottom** part.

25. *26 - Temperature sensor routed behind the frame*

We recommend cutting out or making a hole on the bottom part of the frame, which allows air to flow in, allowing the sensor to actually measure the room temperature.

26. 27 – Frame cut out for air flow

If the fixtures are connected in line above one another, then the chip must be placed at the bottom of the lowermost fixture. The conduit connected to the box may be insulated, so the draught (e.g., from the pipeline routed under the underfloor heating) does not influence the measurements. Otherwise, what will be measured is the air flowing through the conduits, heated by the underfloor heating or even the modules, which can lead to faulty regulation.

Installing thermometer chips on external walls is not recommended, because despite the insulation, they show lower temperatures than the room does during winter, and higher during summer.

2.4.2. Heat and Relative Humidity (RH) measurement iCON thermostats

This solution has several advantages over the chips:

- local display on the wall,
- local intervention option on the wall,
- humidity measurement,
- does not require calibration,
- allows for more accurate reading than the analogue chip solution

In Chameleon smart home system, the modules connecting to NGBS iCON thermostats are LS thermostat interface modules (connection: chapter *4.3.7 Thermostat module*).

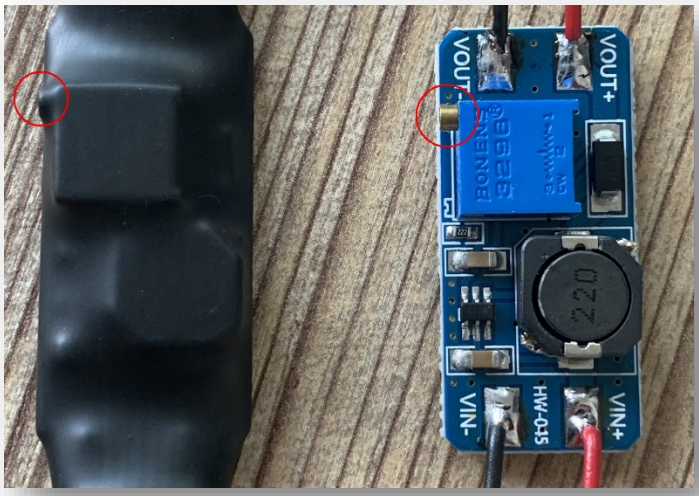
These thermostats can also be installed on standard mounting boxes, however, they cannot be connected in line, so room must be provided at the switches. Recommended mounting height: eye level, approx. 140 cm.

The power supply voltage of an iCON thermostat is 15V, which means it cannot be supplied directly from the 12V of the LS bus.

27. 28 - iCON thermostat display

There are two power supply options:

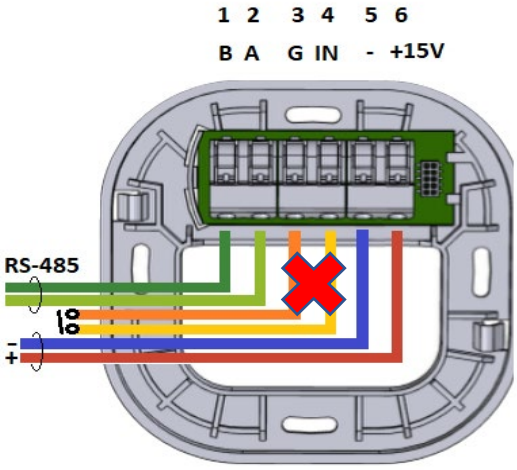
- from a 15V power supply unit via the LS bus's backup (white) line
- locally with a step-up converter



28. *29 - Connection of DC/DC step-up converter*

We visibly mark the IN and OUT of the converter during production, but if the label should fall off, then the above image will help to easily identify the connection points. The image's upper part shows the outputs, and its lower parts shows the inputs. Black is implicitly the 0 V, and the red is the +12 V output.

Connection is shows on the image below. We do not use connection points 3 and 4 of the thermostat.



29. *30 - Connection of NGBS iCON 200 thermostat*

2.4.3. Heating control integration with NGBS iCON2 system

If an NGBS iCON2 heating control is used in the home, it is enough to connect it to the same network as the Chameleon controller, and set it up on the configuration interface. In other cases, the following shall apply:

Valves are usually controlled via valve actuators, which can be installed in the following locations:

- on the angle valve of a radiator – objectionable from an aesthetic point of view, but they require point-to-point cabling, which can also be configured afterwards,

- onto distributor-collectors – there are two cabling options
    - the DIN rail **Relay extension module** (connection: chapter 4.2.1) can be placed near the distributor-collector – take into account the possibility of water seepage, ambient temperature and ventilation options (e.g., placing the relay module in the recessed reinforced box of the distributor-collector is not recommended).
    - the relay can be placed elsewhere (e.g., in the central distributor or next to a different distributor-collector), in which case a 7-8-10-12 x 1 mm^2 YSLY high-current signal cable must be routed between the valve actuators and the relay module. For the YSLY-Jz, common in the trade flow, the strand market with green-yellow can only be used as a protective conductor. One of the numbered strands – practically, the one with the highest number – can be used as zero. Both ends of this strand must be marked with blue electrical tape. So if there are 10 circuits with 10 thermoheads on a distributor-collector, responsible for heating or cooling 5 rooms (zones), then 5+2 strands will be required (5 connected phases, the zero and z-s-t are not used). Generally speaking, the required number of strands is n+2, where "n" is the number of zones (not of the circuits). You must not forget that it does not matter if the underfloor heating and ceiling cooling distributor-collector are next to (under) each other, the thermoheads of one room cannot be connected between the two distributor-collectors, because it must be possible to securely switch ceiling cooling on and off (floors are not cooled).

Thermoelectronic valve actuators are usually 230V ones, so they can be routed together with high-current cables, in a single conduit. for 24V versions, they cannot be routed in a conduit with high-current cables, but they can be routed together with low-current cables.

The relay outputs may only be programmed if a list is made regarding what heating circuits have been connected to which relay. Several heating circuits of a single room may be connected to a single relay output, with thermoheads being connected in parallel.

Mixer valve control: solved with iCON2 or typically, with a 0 to 10V analogue voltage signal.

The circulation pump is switched on and off by a relay. It is typically no controlled by any other means.

2.4.4. Installation of Siemens STA23HD thermoheads onto a distributor-collector

Installation

1. First, the black adaptor ring must be installed on the valve's thread,
2. followed by the thermohead (until it clicks, until the green strip goes into the notch on the lower grey ring), and then
3. the connector is plugged in. This must be done in parallel with the themohead's axis, not with the plastic cover. If you are not skilled enough, then the thin disc connector can easily get bent and it will not open the valve.

Reassembly

If such a head is removed and needs to be put back, then if not installed correctly, the upper part of the thermohead will be loose and untight, easy to wind up manually, and can only be closed halfway, but it will be possible to push it back all the way by hand, etc. In these cases, the valve will always be open and will not regulate. It can be easily reassembled by resetting the factory delivery status: use your thumb to push back the black button inside the thermohead strongly, then fasten in this position by turning the grey ring to reset it into its factory condition.

3. Integration

3.1. Small gate, pedestrian entrance

Intercoms are power via PoE (Power over Ethernet), so a single Cat5e or Cat6 Ethernet cable will be enough for them. The use of shielded cables, such as SFTP, is recommended. Cannot be routed in the same conduit as high-current cables!

Doorbird D101S devices can be mounted onto the wall, with the possibility of recessed/wall mounting larger Doorbirds and Akuvoxes. Connection behind the device is required for pre-wall mounting as well, which can be done in a 65-mm mounting box. Doorbird D101S devices cannot hide larger mounting boxes. In-wall mounted devices have their own boxes.

There are two connection options:

- standard PoE (preferred):
  - Doorbird:
    - only support ModeA PoE, so it cannot be supplied by all PoE devices (e.g., supply with TP-Link TL-PoE150S is possible),
    - connection is possible either via RJ45 or via its own connection cable, which needs to be connected via the Ethernet cable
  - Akuvox: simple RJ45 connection
- passive PoE
  - Doorbird: 15VDC (power supply provided)
  - Akuvox: 12VDC (power supply not provided)
  - usual colour coding:
    - blue+white and blue is the positive cable (!), this is connected to the red,
    - brown+brown and white is the GND, this is connected to the black,
  - there are passive PoE injectors which can also be used both outside and inside

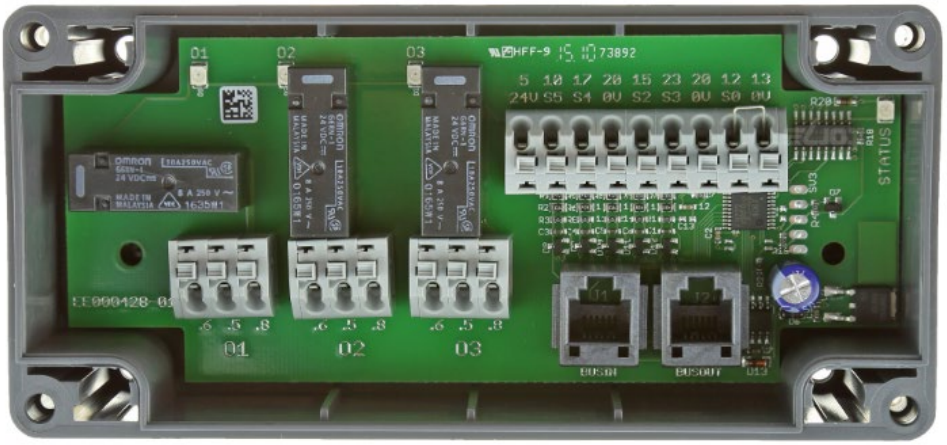
However, opening the gate lock must be handled separately. The opening voltage of buzz-in magnetic locks will also need to be provided, which will require a separate 2x1, or for longer distances, a 2x1.5 cable. **12V power supply must not be provided from the LS bus**, because the high power consumption of the magnetic lock may cause disturbances in the modules' power supply.

Conduits must be routed to the box behind the intercom, so that the opening voltage may be provided from the intercom's relay as well. If there is an EXIT (gate open) button, then that must also be routed under the intercom.

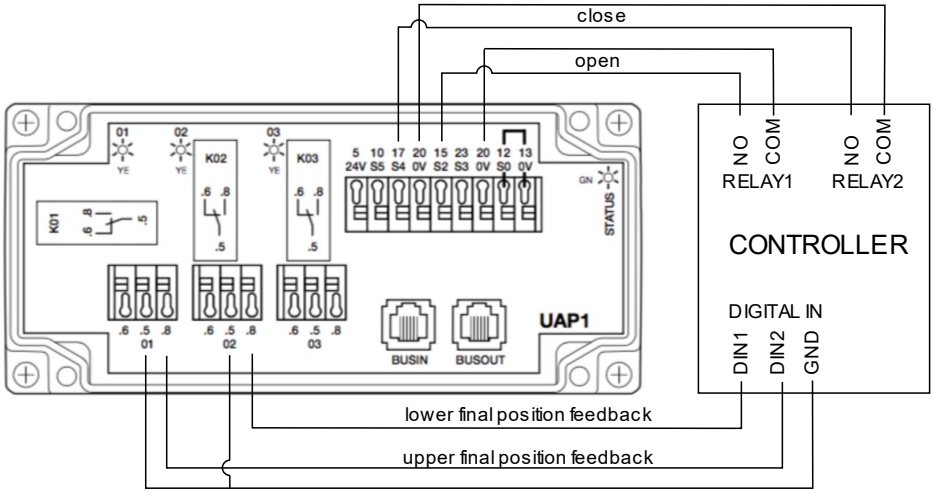
Opening detectors are not compulsory, but they can be integrated as additional features for controlling small gates, which can be signalled by the application on the interface, for example.

3.2. Large gates, vehicle entrances

The best solution is **using an integration module**, which is able to receive opening and closing orders, as well as transmit opening sensor condition on a single point. A suitable module is, for example, the Hörmann UAP1. In this case, the bus cabling of gate automation must be done separately, and you must connect to the integration module, which must be connected to the Chameleon system, with an 8-strand alarm cable.

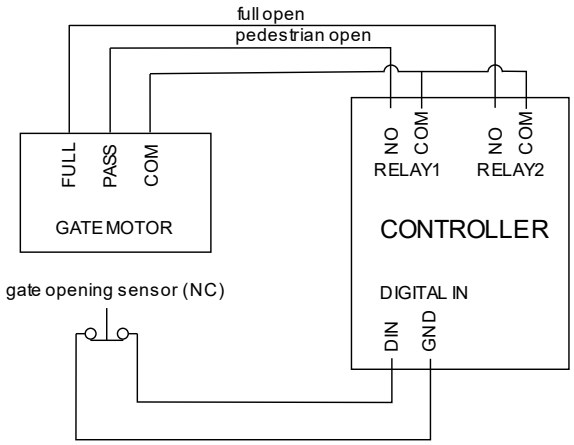


30. *31 - Hörmann UAP1 universal adapter panel*



31. *32 - Connection of Hörmann UAP1 into the Chameleon controller*

If the module is not available, then the opening order, as well as the opening sensor must be cabled separately, all the way to the gate, which requires a 6-strand alarm cable for each gate.



32. *33 - General connection of gate control to the controller*

In addition to control, the 230V supply voltage must also be routed to the fence, the gate, because the gate motors, as well as lighting will be powered from this supply.

3.3. Cabling of safety technology devices

These are low-current devices, cabled via 0.22 alarm cables, or Ethernet cables. Routing them in a single conduit with high-current cables is **prohibited**.

Cabling of devices:

Device	Cable requirement
opening sensor	2x0.22 or 4x0.22
motion sensor	4x0.22
siren	2x0.5 + 6x0.22
code keyboard, card and fingerprint reader	2x0.5 + 6x0.22
wind sensor	4x0.22
through-flow sensor	4x0.22
water leak sensor	4x0.22

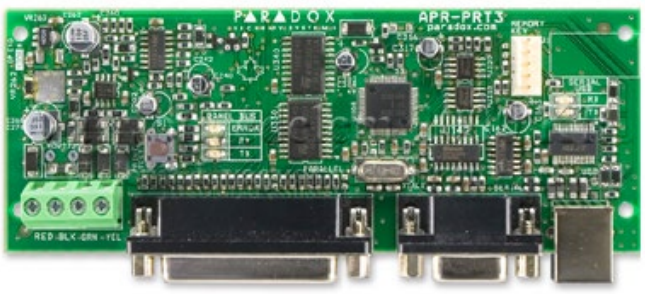
6 6 – Cabling requirements of safety technology devices

All cables must be labelled. Programming may only be carried out if a list is made regarding which sensor is connected to which digital input.

The contact of safety technology devices is usually closed (NC) in the baseline, so for example, motion sensors must be connected in line in a stairway, if you want to connect several to a single output.

3.3.1. Integration of alarm system

We recommend connecting safety technology devices to the alarm. Their signals are received from it via integration. Currently, we have experience with the Paradox Digiplex EVO product range, but in theory, we can communicate with any alarm sending-receiving ASCII characters via RS232. On the Paradox alarm side, an APR-PRT3 printer module is required, which can be connected to the controller's serial port via a D-SUB connector.



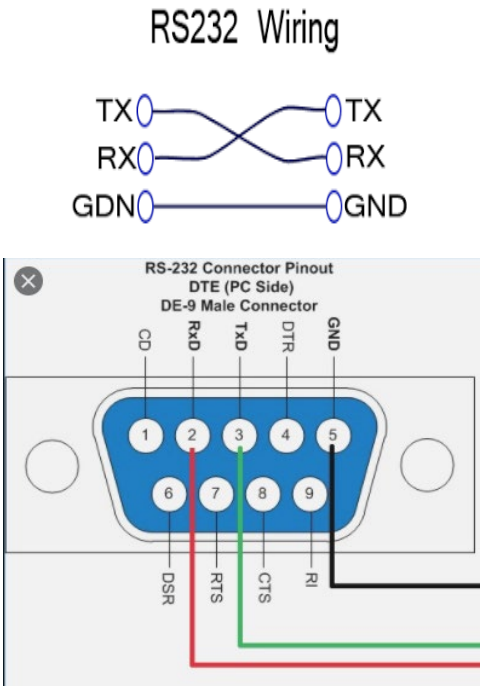
33. *34 - Paradox APR-PRT3 integration and printer module*

A 4x0.22 cable will be needed between the controller and the alarm port, which can be used to connect the RS-232's 3 cables (TX, RX, GND) to the controller from the DB9 connector. We recommend carrying out connection with a DB9 male - serial port converter.

34. *35 – DB9 (male) – screw terminal strip converters*

The connectors in the first two pictures need to have the nuts used for fastening removed, as these are already on the PRT3, so you wouldn't be able to plug them in. The third image shows a version that can be used without dismantling.

When connecting the DB9 connector, pay attention to connect one side's Tx to the other side's Rx, so the Tx and Rx need to be "cross" connected.



35. *36 – Connection of DB9 male connector*

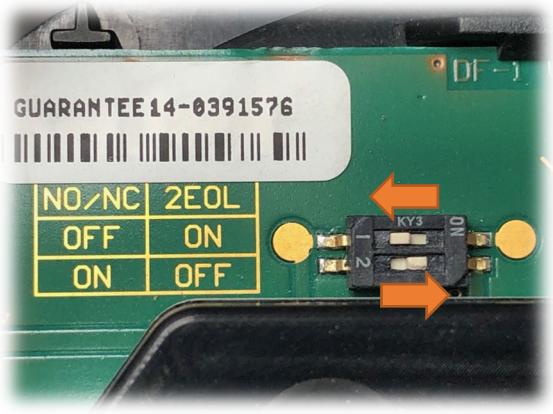
The DB9 connector's connection diagram is wrong in the PRT3 module's own documentation, as the descriptions of pins 2-3 are switched. That diagram must show Tx-Rx connection from the device's point of view.

3.3.2. Connection of Wiegand

Devices using the Wiegand protocol can be connected to the designated Wiegand ports of the controller (2 devices, connection: chapter 4.1), or the NO/NC digital input extension module (3 devices, connection: chapter 4.2.4). These devices typically use a power supply of 12V DC (usually red and black) and they communicate via D0/W0 (usually green) and D1/W1 (usually white) strands. Such devices often have a pushbutton, an audible or visible warning device, connected separately, which require additional strands, pairs of strands.

3.3.3. Satel TSD-1 combined optical smoke and thermal velocity sensor

Sensors that can save lives or protect you from major economic damages are recommended to be connected to a specialised system: the alarm. There is nothing to be lost, as these can be obtained via integration: for example, the water sensor's signal can be used to stop the water.



36. *37 - Appropriate setup of Satel TSD-1*

Appropriate setup of DIP switches:
1: OFF
2. ON
Connection:
1: GND
2: relay (to NC input)
3: relay (in our case, this is also a GND, but should be cabled separately)
4: +12V

3.3.4. Connection of Satel FD-1

Requires a supply voltage of 12 V (red-black) and returns contact (yellow-white).

We recommend carrying out jumper connection to NC.

3.3.5. Connection of under-bed motion sensors

Simple motion sensors can also be placed here, like Paradox DG 460 infrared sensors, as they are flat and easily mountable either to the underside of the bed, or on the floor.

The 12-V supply voltage can be supplied from the LS bus as well, with two options for connecting the motion signal:

a. the device is left in the default NC, in which case the two PIRs are connected in line,
b. the J2 jumper is removed, and the NO is used, in which case the correct connection type is parallel connection.

If the signal is connected to the input of an LS_SW, RGBW or a 230 dimmer, then choose option b, as these devices are (currently) incapable of NC. The only NC-compatible modules are the Alt8 and DI24/NONC.

37. *38 - Paradox DG 460*

3.4. Connection of 0-10V photometers, outdoor and engineering thermometers, pressure transducers etc.

The widely used 0-10V analogue sensors, transceivers can be connected to the analogue inputs of the 1.x controller or the DIN 0-10 IN module. These devices require 12VDC or 24VDC power supply, both of which can be provided from the controller. Output signal is usually GND-relative, so it is enough to connect its output to one of the AIN inputs.

3.5. Internet connection

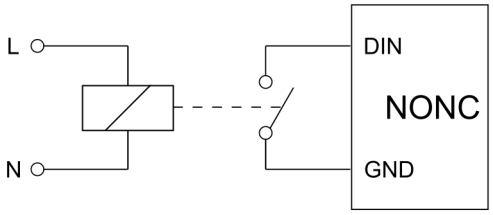
Connecting the Chameleon controller and the Loxone Miniserver (Go) (if available) to the local network requires two strands of Cat5e or Cat6 Ethernet cables to the switch or router serving as the LAN's central unit.

3.6. Connection of uninterruptible power supply (UPS)

Since the output of an uninterruptible power supply is a traditional socket, the connector plug can also be inserted rotated 180 degrees, thus switching the zero-phase. Therefore, **it is PROHIBITED to connect the plug connector cable to the zero rail of the small distributor**, because in case of an unlucky connection, the phase will be the one connected to this uninsulated metal part!

Only our own devices, as well as the LED power supplies can be connected to the uninterruptible power supply, if:

- It can support the maximum power, and
- there is a voltage monitor relay, which provides information for automatic light dimming in case of a power outage. This is a simple AC relay connected to any digital (contact) input.

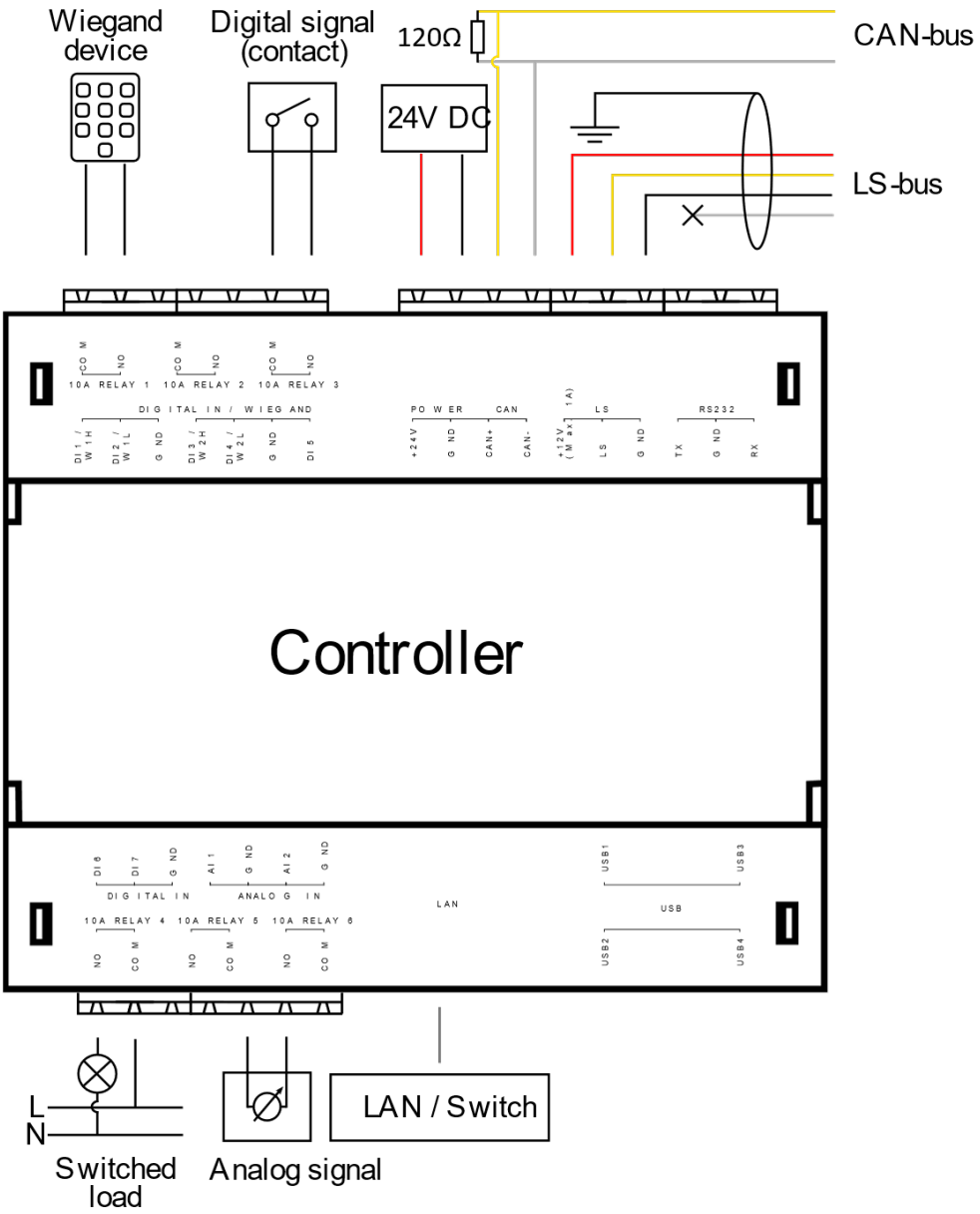


38. *39 - Connection of the voltage monitor relay to a general digital (contact) input*

4. Connection of Chameleon modules

4.1. Chameleon controller

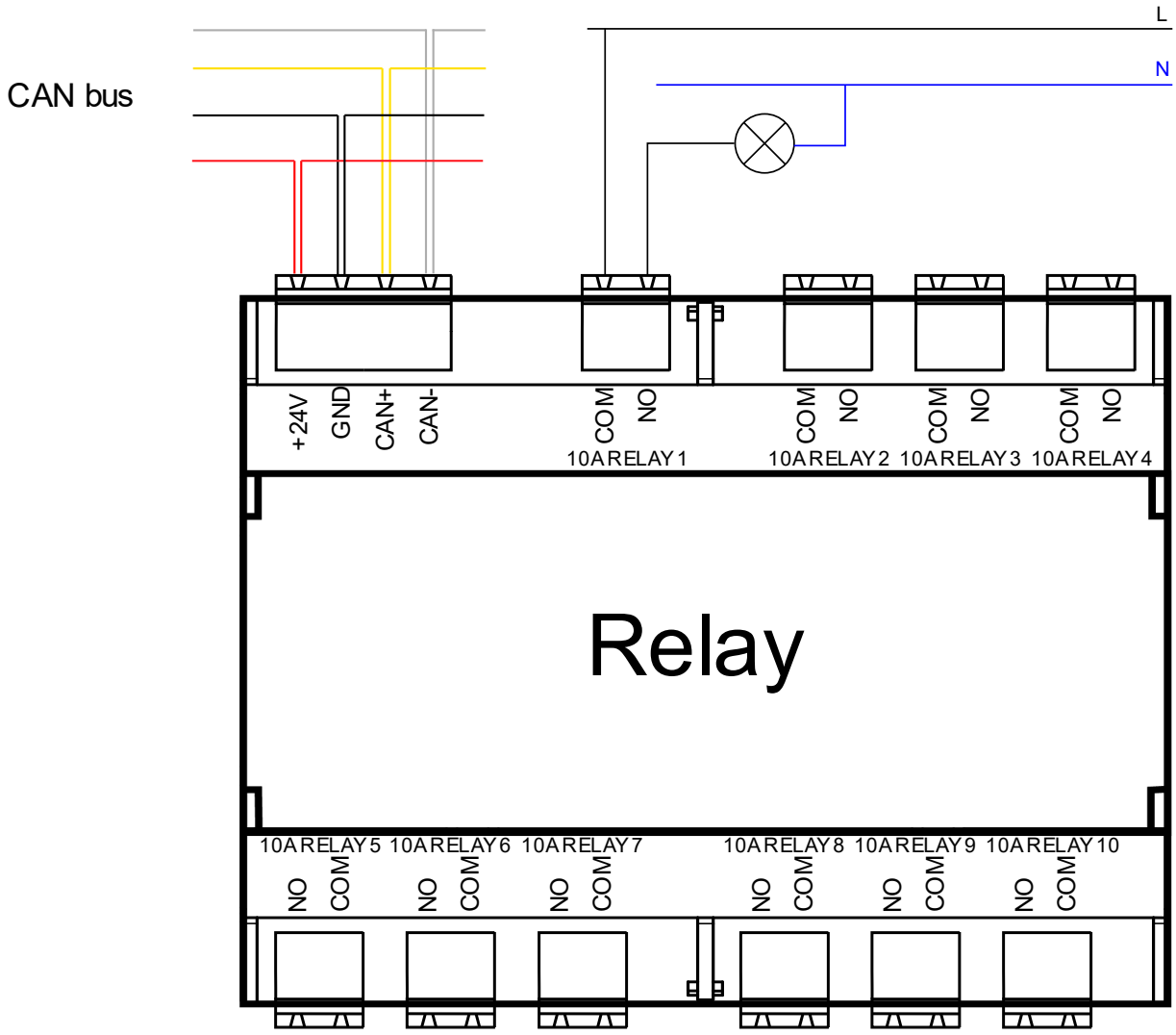
Item no.: CH002, Version: v1.2.0



4.2. Extension modules

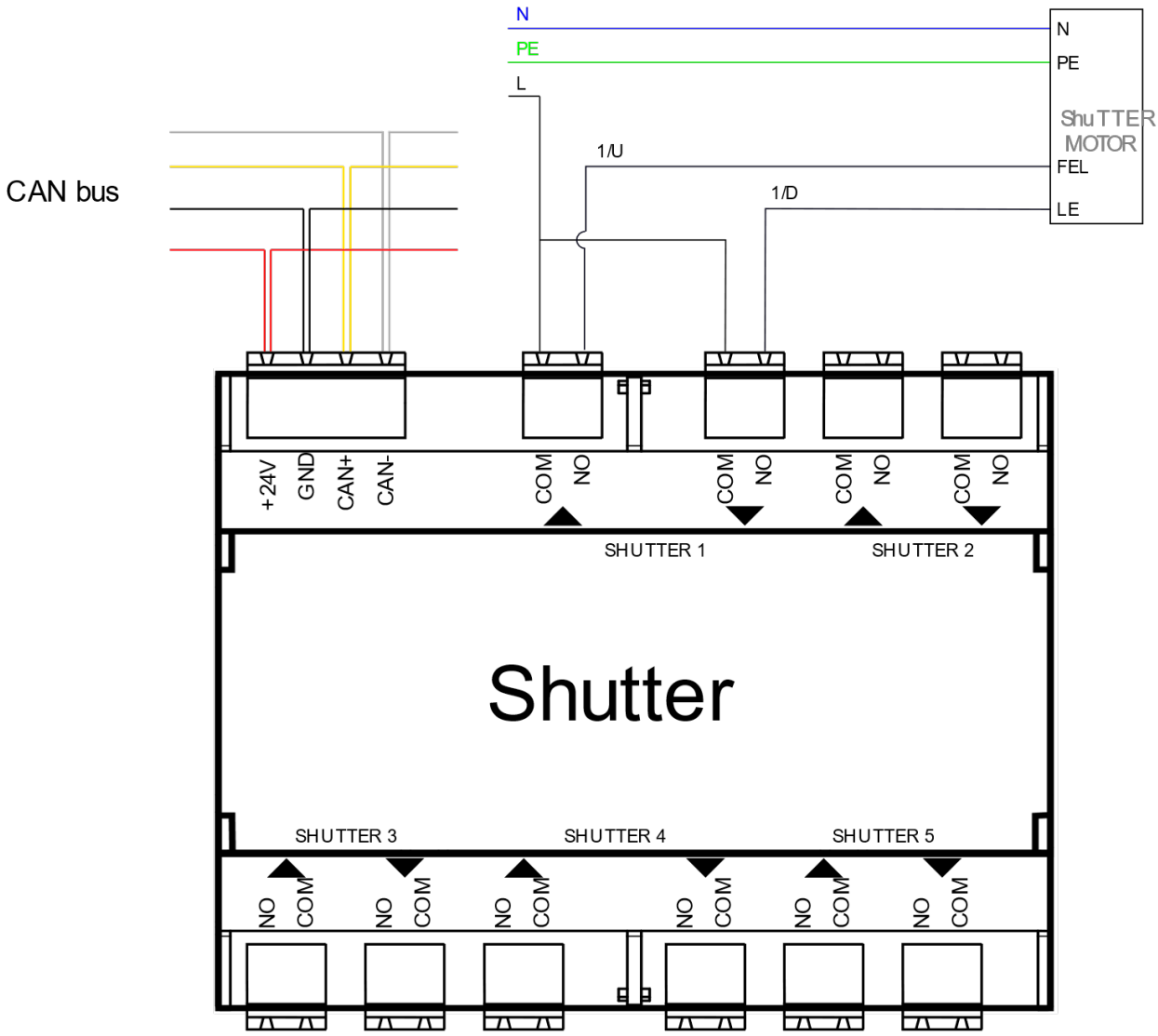
4.2.1. Relay 10 extension

Item no.: CH003, Version: v1.1.2



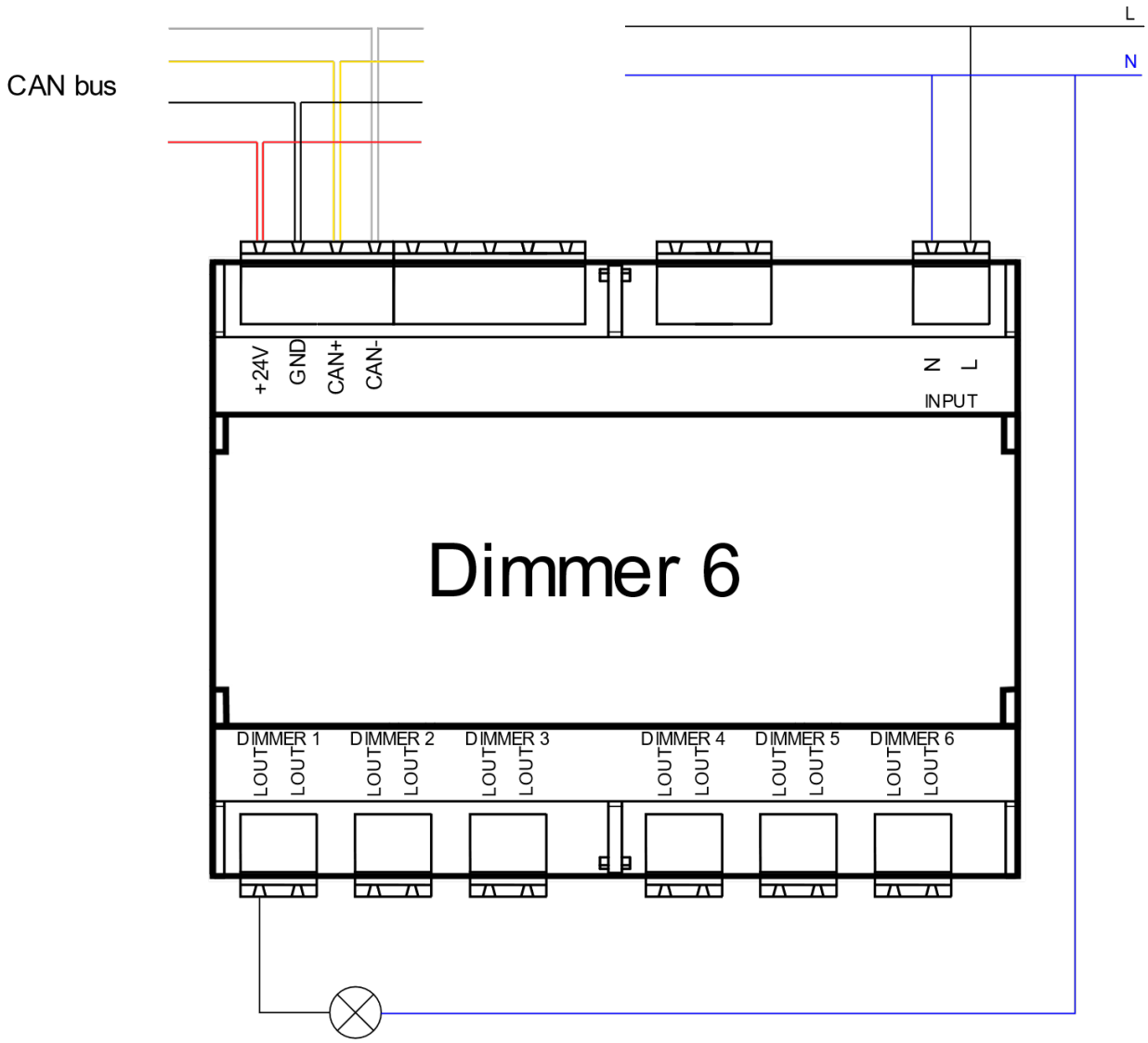
4.2.2. Shutter control 5 extension

Item no.: CH007, Version: v1.1.2



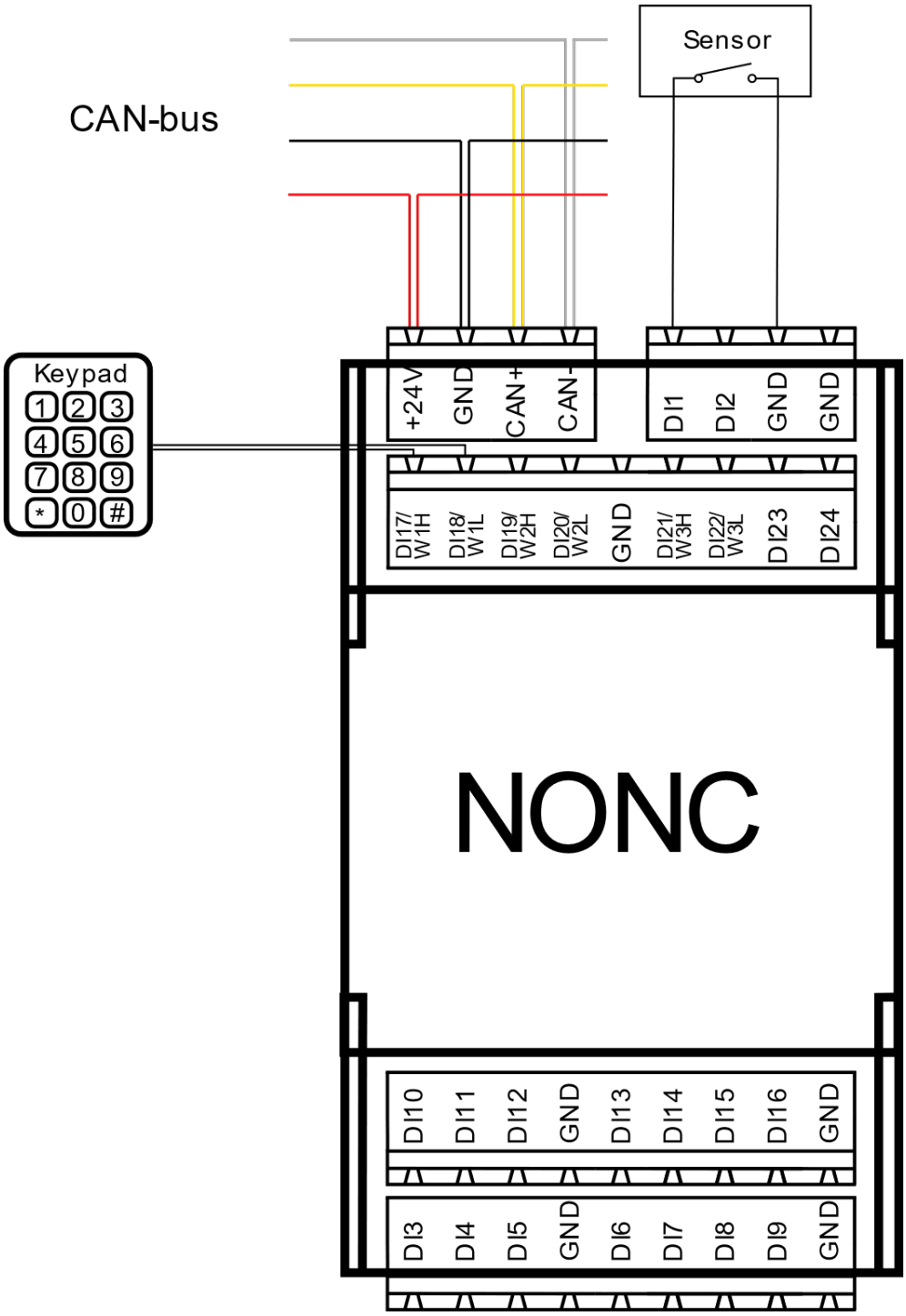
4.2.3. Dimmer control 6 extension

Item no.: CH008, Version: v1.0.1



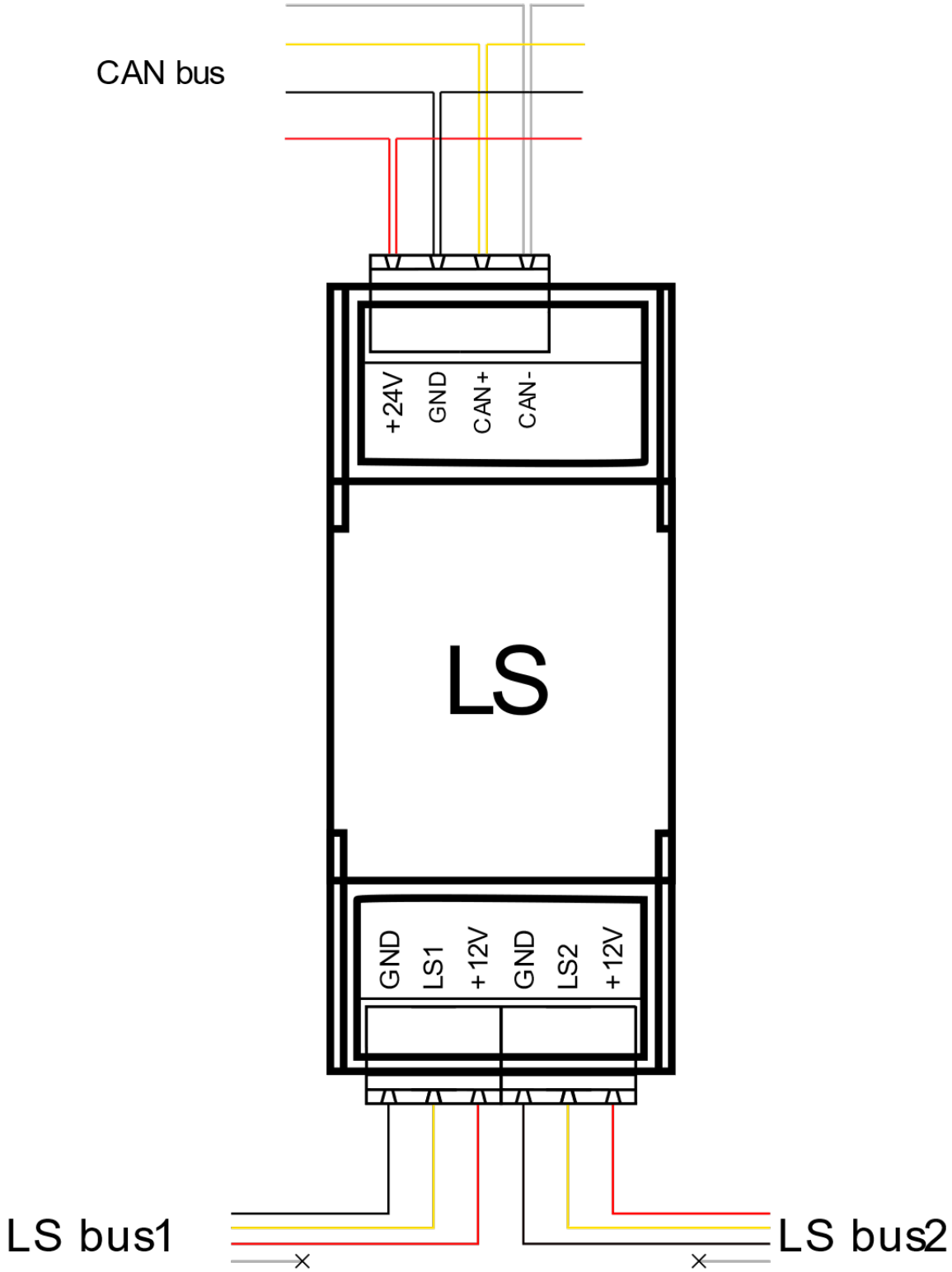
4.2.4. Digital IN 24 extension (NO/NC)

Item no.: CH004, Version: v1.1.1



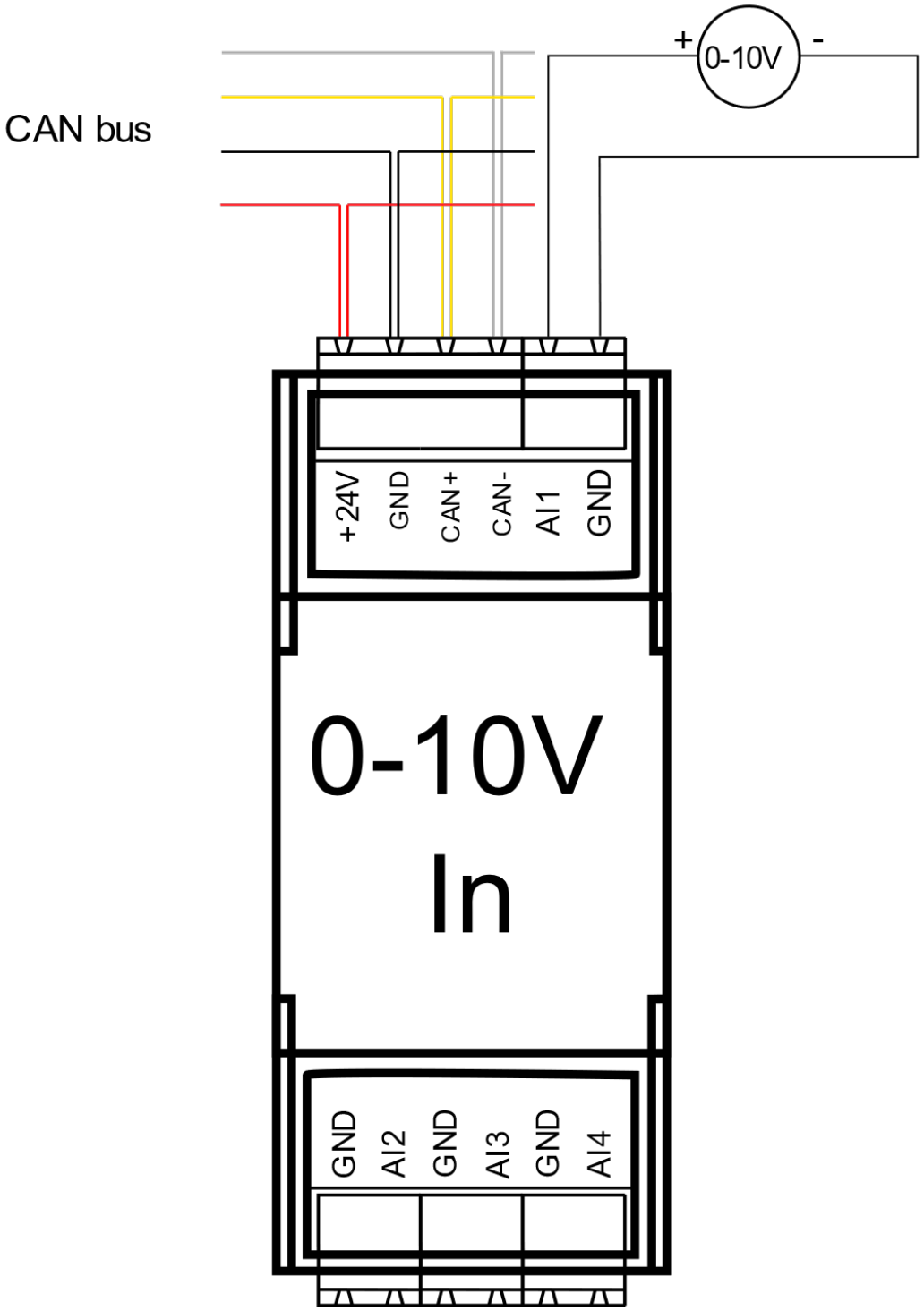
4.2.5.LS 2 extension

Item no.: CH005, Version: v1.2.1



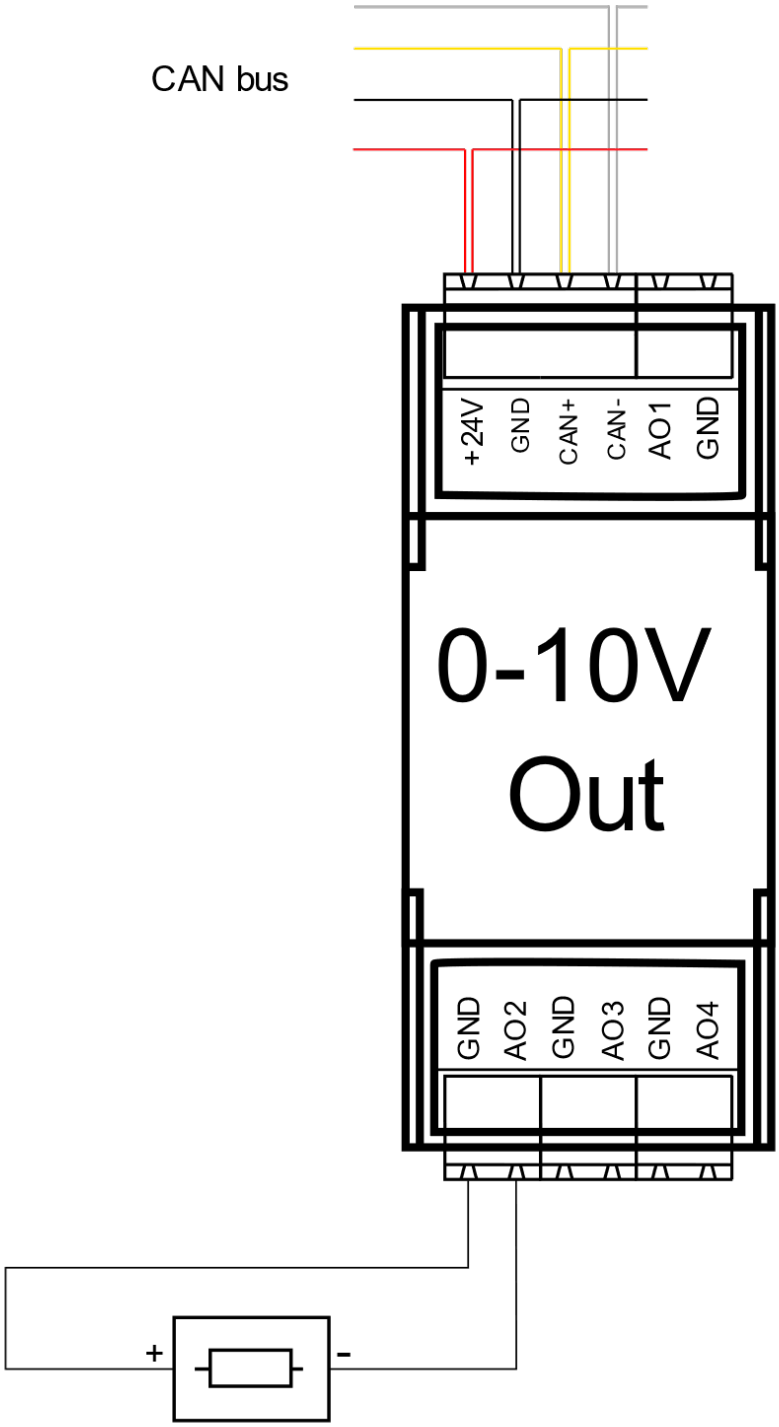
4.2.6. Analogue IN 4 extension

Item no.: CH006, Version: v1.2.0



4.2.7. Analogue OUT 4 extension

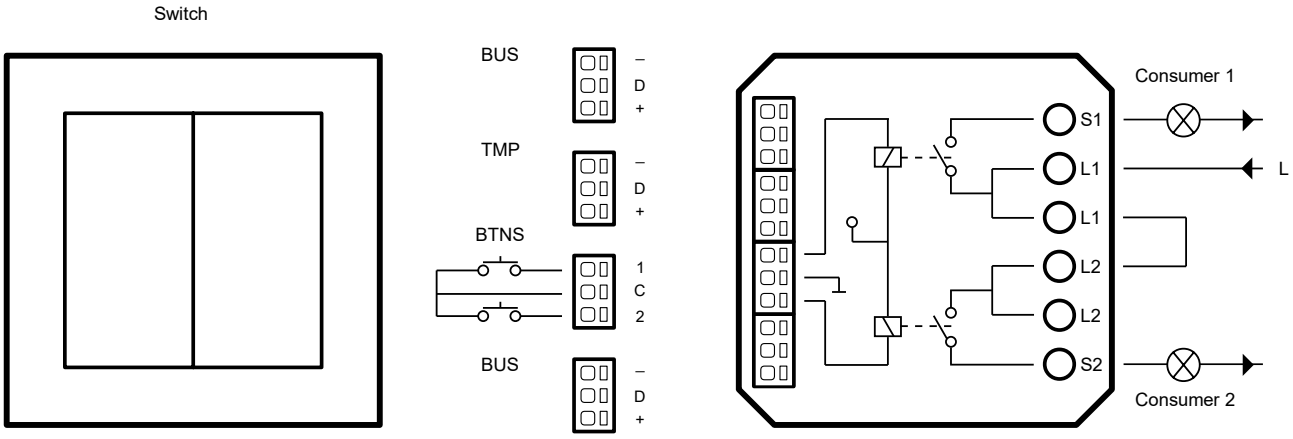
Item no.: CH009, Version: v1.2.0



4.3. LS wall modules

4.3.1. Switch module

Item no.: CH029, Version: v1.4.0

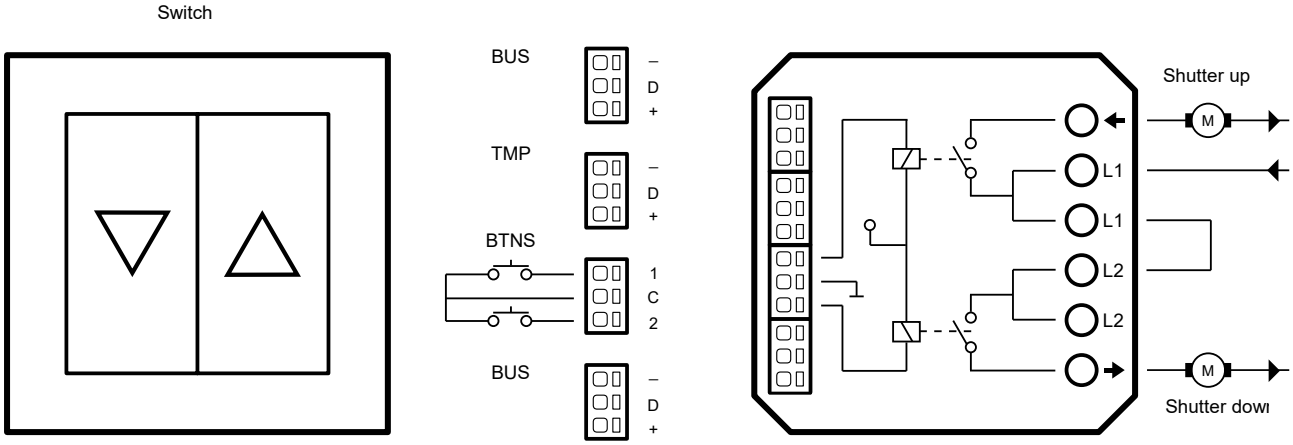


Connection between the two relays is not realised within the device, so the two relays can be used separately from each other, even on different voltage levels.

4.3.2. Shutter control module

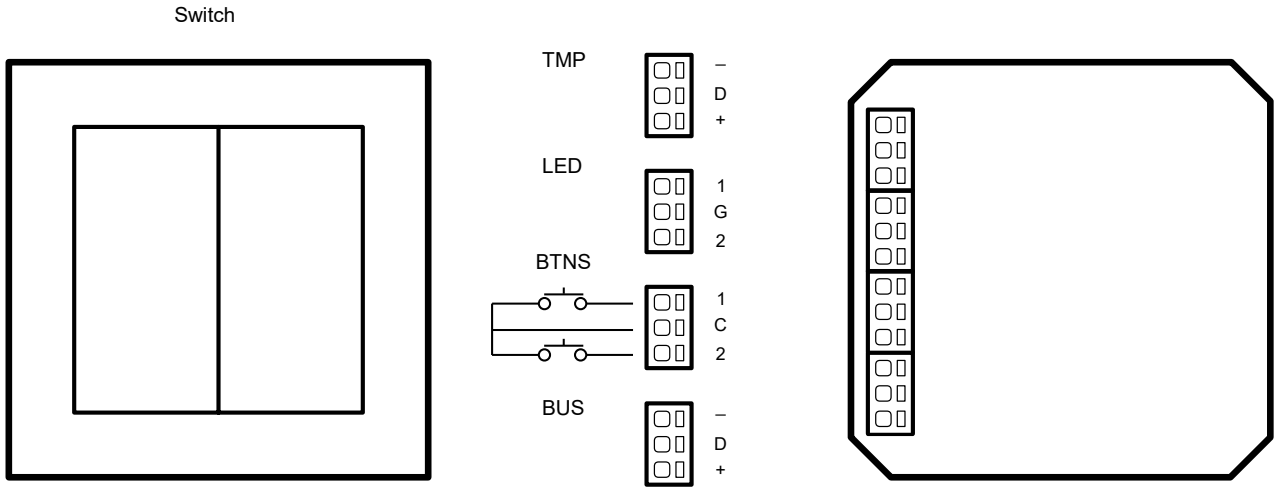
Item no.: CH030, Version: v1.4.0

Warning! Up and down direction are NOT interchangeable!



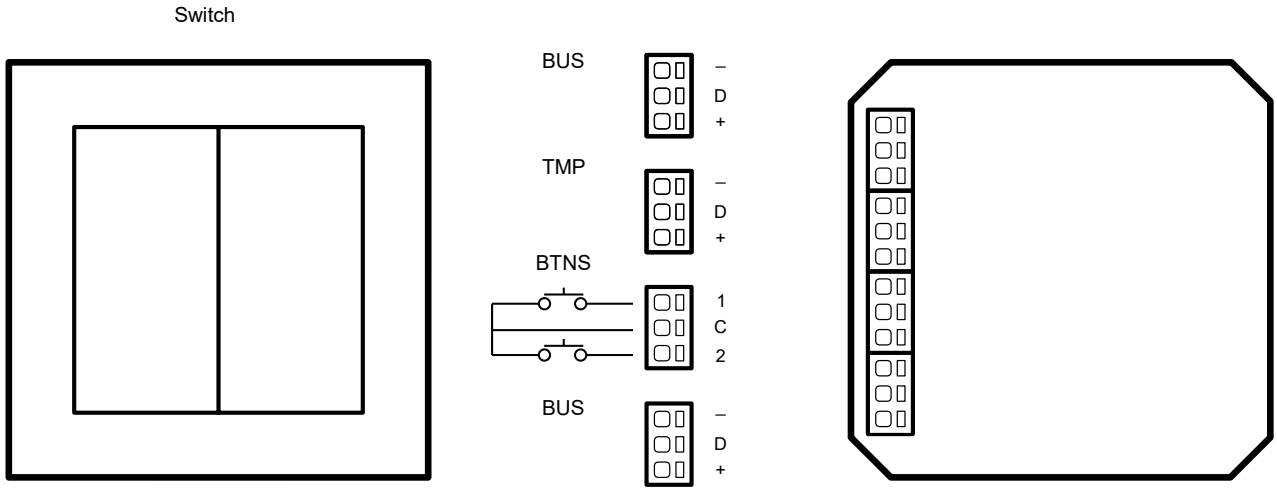
4.3.3.2-channel digital IN (ALTERNATIVE 2) module

Item no.: CH031, Version: v1.3.3



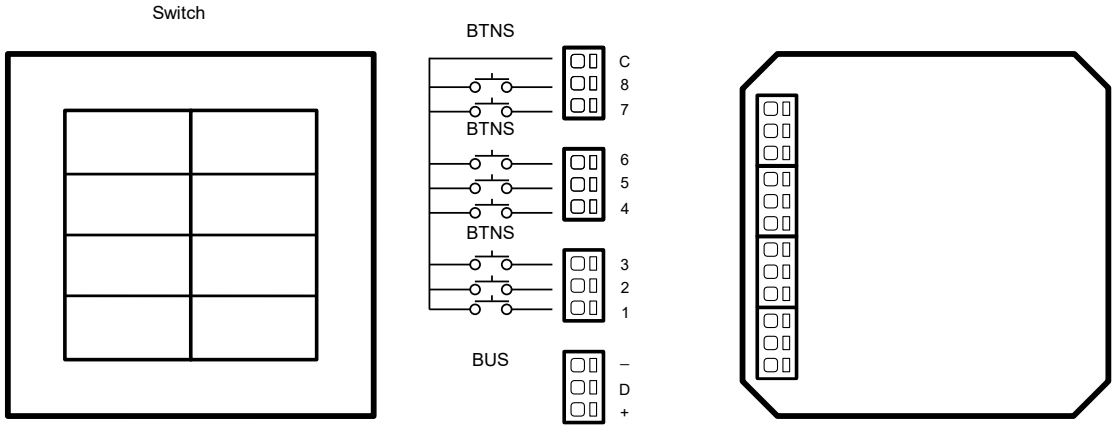
Item no.: CH031, Version: v1.4.0

Version 1.4.0 has 2 LS bus connectors, so additional connection of the bus is simple.



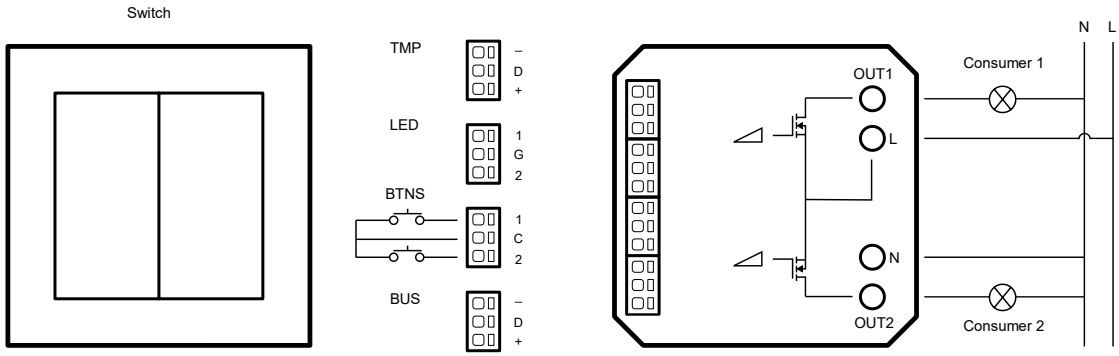
4.3.4.8-port digital IN (ALTERNATIVE 8) module

Item no.: CH037, Version: v1.0.1



4.3.5.2x230 Dimmer module

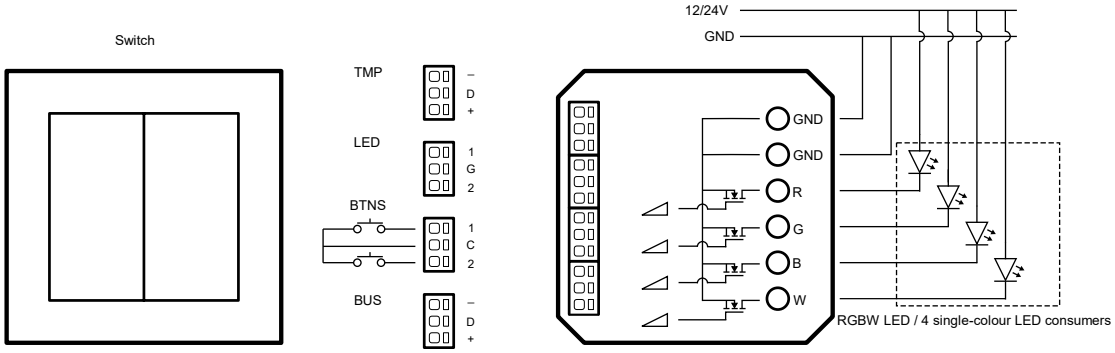
Item no.: CH038, Version: v1.0.2



Max. load: 100W/channel

4.3.6.RGBW dimmer module (12/24V)

Item no.: CH039, Version: v1.0.2

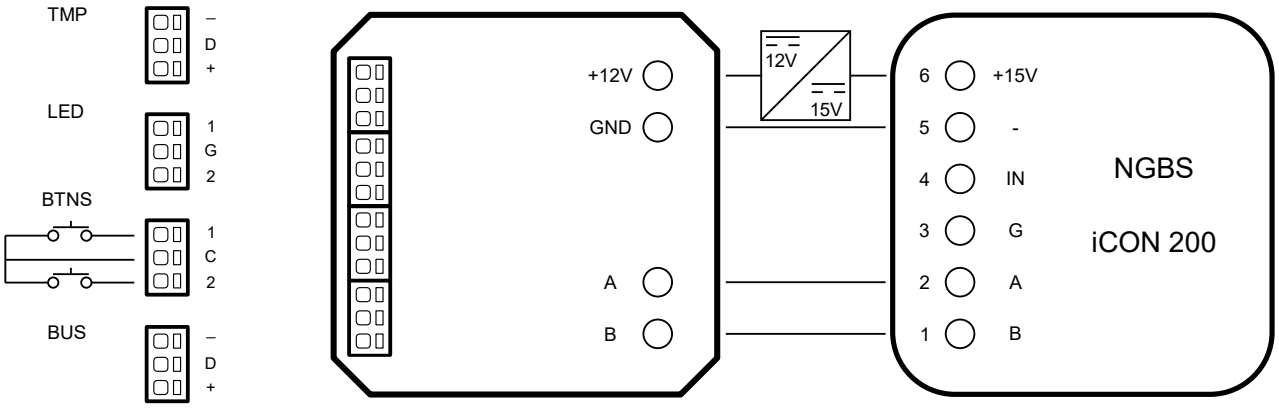


Maximum load: 10A/channel, max 20A total
Amplifiers can also be used here, the same as everywhere else, whether it's white or RGBW.
GND double connection is only necessary if the module's total load exceeds 16A.

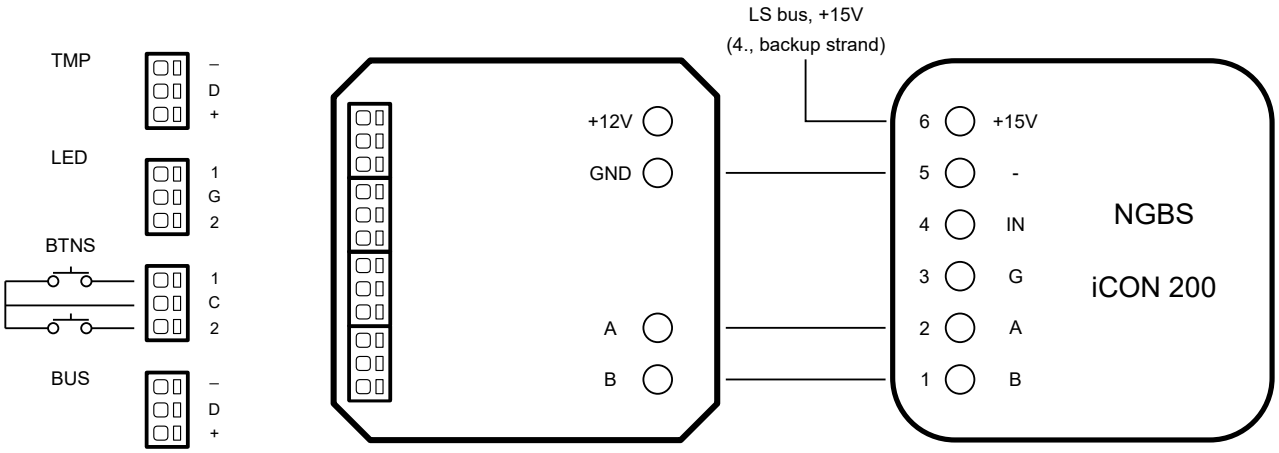
4.3.7. Thermostat module

Item no.: CH035, Version: v1.0.3

The 15V supply voltage required for thermostats can be supplied in two ways:



39. 40 - Use of a step-up converter



40. 41 - Routing 15V via LS bus

The pushbuttons can be used as digital inputs (alternative switch). This module is actually an Alt2, with a thermostat fitting.

You can find detailed information and data sheets on our currently marketed products on our website:
https://chameleon-smarthome.com/webshop

5. Notes

6. Checklist for handover for programming

With this checklist, the Client and their electrician acknowledge that they have carried out all installation works of the system, as per the contractual provisions, and the system is ready to be programmed.

Placing a check next to the following lines means that substantive testing of the given point has been carried out and the task is completed/the test was successful. Unsuccessful tests shall be marked with X, and points not applicable on the given system shall be marked with N/A.

	Inspection
	All DIN and LS devices are installed physically in position, and are connected
	All high-current connections have been carried out (lighting, shutter, heating appliances, etc.)
	All low-current connections have been carried out (Wiegand, opening and motion sensors, etc.)
	CAN bus connected, with 120-ohm terminations at both ends
	There is no short-circuit between any two strands of the CAN bus
	LS bus(es) are connected, with a maximum number of 16 devices per bus
	There is no short-circuit between any two strands of the LS bus
	Power supplied to devices
	CAN bus measures 24V
	LS bus measures 12V
	NGBS thermostats measure 15V
	The switch modules carry out switching when the switch is pressed
	Shutters, blinds move up and down when the switch is held down
	Lower and upper final positions of shutters and blinds are set up
	Dimmers increase and decrease brightness when the switch is held down
	NGBS thermostats' displays turn on if their buttons are pushed
	There are two local network termination points (UTP) for Chameleon and Loxone (if available)

Client name:	Electrician name:
Client signature:	Electrician signature:

Technical assistance:

+36 1 770 7730

M – F: 9:00 AM – 5:30 PM

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