CARLO GAVAZZI
Automation Components

CARLO GAVAZZI

Carpark 3
Parking guidance system

Design and installation manual

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Carlo Gavazzi Carpark 3

List of Abbreviations Used in This Manual

PGS – Parking Guiding System

MCMG – Carpark Master Generator

CC – Carpark Controller

CS – Carpark Server

DIM – Display Interface Module

PCB – Printed Circuit Board

SIN - Specific Identification Number

MZC – Master Zone Counter

DPO – Detection Point

Introduction:

The Dupline® 3 Parking Guidance system saves time and reduces stress for drivers.
Dynamic displays, strategically positioned throughout the facility, provide 'space available' counts and efficiently guide the driver to vacant spaces with clear and bright green arrows pointing the way.
If there are no vacant parking spaces in an area, the display will show a bright red cross to discourage the drivers from entering this area. Other displays can be made to show the total number of vacant spaces on a particular level or in the entire parking facility. Dynamic message displays can also be used in the facility to provide additional information to drivers. Some examples could be Caution, Construction Ahead, Buckle-Up or any other message that needs to be communicated to the drivers in the facility.

In the parking space
Space by space, we will focus on the 45-degree sensor for lane mounting. Installation of the vertical sensor is also explained, but basically, physical installation and precautions are the same for all types of sensors and LED indicators.
A 45-degree sensor with bright, built-in LEDs is placed in the lane outside each parking space. Eight different colours, freely programmable, can be selected to show either green for vacancy or red for occupied. If the space is for disabled parking, the colours become blue and red. The bright LED indicators provide a visual reference from a distance as drivers search for vacant parking spaces.
The Dupline® Parking sensors utilise a special ultrasonic frequency, much like the one used by bats to catch flying insects. A sophisticated microprocessor built into the sensor transmits a 40-KHz signal, which hits the ground. All the echoes it finds are used to decide the bay status. Once detection has been confirmed, the

indicator lights will switch from green or blue to red and the displays and software counts will be accurately updated as well.

The Software…

The Dupline® 3 Parking Guidance System is inherently robust, and it is a stand-alone system. This system requires no PC to run, it only needs a PC for system configuration. In addition, Carlo Gavazzi supplies carpark software, which enables monitoring of the real-time situation of each parking space or level in a facility. It also has an alarm component, which can provide logging and indication of a variety of conditions with operator-defined limits.

Some typical alarm functions include time limits for individual spaces, occupied levels and maximum occupied indications. Additionally, the software graphically displays tables and graphs showing the occupancy rates for the areas, the levels and the entire facility.

The software is also an excellent tool for data logging and historical trending and analysis. Data can be stored and utilised for multiple facilities, a single facility, a level, or even for an individual space.

The software allows authorised operators to book or reserve spaces. When an open space is booked, the associated indicator light in the parking space will turn red, and it will provide a connection to the software's overview where the corresponding virtual indicator light turns red. The software also provides a web server that enables access to the carpark system via tablets, smartphones etc.

Planning a Dupline® Parking Guidance System (PGS)

As with any good system, the majority of your time and effort should be spent in the 'planning'. An old proverb says: 'A good plan today is better than a perfect plan tomorrow.'

In this section system planning is divided into four distinct phases. These four phases should be completely understood and completed before moving on to the actual Installation.

Phase 1: Gather Tools and Information

This includes technical drawings/information/layout of the parking system acquired from the customer. The drawings used must always be the latest version to avoid any mistakes in the subsequent work.

The drawings should consist of lanes, cross-sections, parking spaces, both regular and for disabled, location of displays and cabinets, cabinet size, available power and location and the location of the equipment room where the software server will be installed.

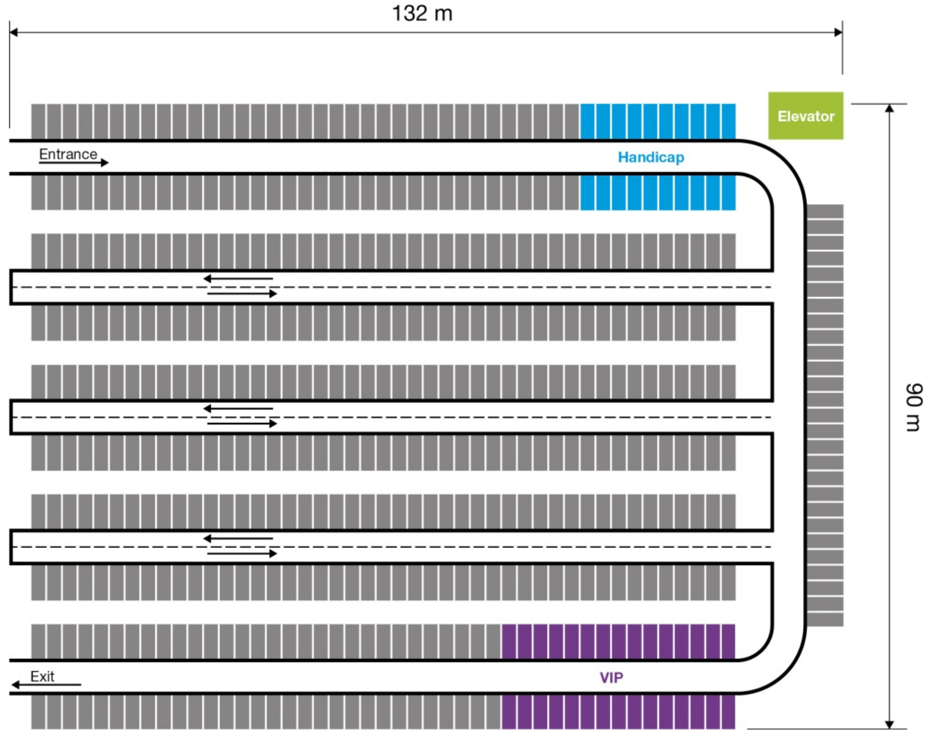
Traffic flow: Single direction or bi-directional.

A true-to-scale CAD drawing with information of the parking structure, including lane distances for determines the cabling and maximum number of sensors allowed per MCMG.

Parking space dimensions: length, width and the distance from the floor to the ceiling. The relationship between the floor and ceiling angle is also critical.

The dimensions from centre line to centre line of the spaces.

Any information on using existing or new cable trays to pull wires for the sensors



Phase 2: Display Placement, Lane Definition, Sensor Mounting

Define the number of displays based on the natural flow of cars in the parking facility, in cooperation with the customer. The best way to do this is by making a joint walk-through and drive-through.

Confirm any architectural considerations with the customer regarding signals, finding one's way and any other equipment to be installed in the parking facility.

Split the parking into segments and use the lanes as a natural part of these segments.

Define the type of displays. Should they simply display an 'arrow' and 'red-cross', or should they display space availability counts as well? It all depends on the natural flow and the customer's requests and needs.

Determine the necessary environmental ratings of the displays in relation to the intended use and installation. Also take into consideration the accidental intrusion of water from plumbing leaks and wind-blown rain or snow.

Decide if there should be one or more multi-level 'Tower' or 'Monument' displays installed at the entrance to the parking structure providing a snapshot of all available spaces on each level.

What should the displays show? Several available spaces in many lanes or just local available spaces from a single lane.

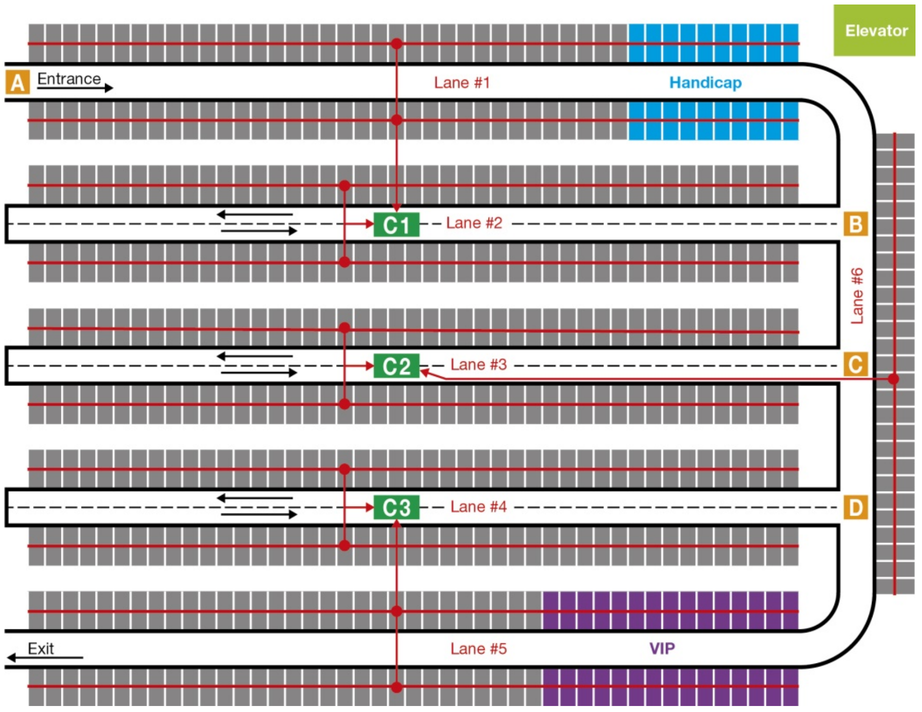
A maximum of 50 sensors and a maximum of 150 m wire in a line (branch). A maximum of 90 sensors per generator. General rules based on 1. 5 mm^2 cable.

Decide whether space-mounted vertical sensors, lane-mounted 45-degree sensors or sensors and separate LED indicators should be used.

Determine whether the sensor must be mounted directly to the ceiling or in a tray or lowered. Always try to select the most functional and aesthetic solution in relation to cost-effectiveness.

Decide which spaces should be used as disabled parking spaces. Normally, disabled parking spaces are placed close to escalators and elevators, and their numbers are determined in accordance with regulatory laws.

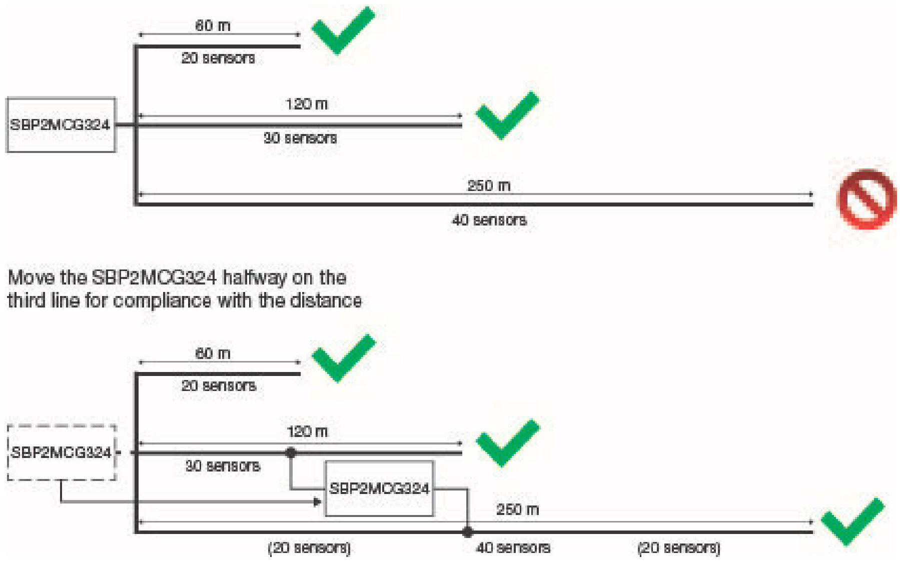
Determine the number and placement of the cabinets. Ideally, they should be placed so that the sensor loads are equal in all directions. They should be accessible only by ladder or cherry picker so as to be protected from tampering. The maximum rating of the enclosures should be NEMA 3R or IP54.



Phase 3: Design One Lane (…and Build from There)

As a rule-of-thumb, there is a maximum of 50 sensors and 150 m (490 feet) of wire in a line. The wire must be an unshielded 14-16 AWG type. There must be a maximum of 90 sensors per generator. If the line has less than 50 sensors and the wire length is longer than 150 m (490 feet), please refer to the voltage drop calculation described in detail in the 'calculation' section.

Power supply calculation (the number of sensors determine the size of the power supply). Because of the pulsating output from the MCMG, always use a double size power supply with power out on 28 VDC. When using a 28- VDC/2.5- Amp power supply, 50 sensors can be installed in a line. When using a 28 VDC / 5 Amp power supply, 90 sensors can be installed per generator.



The sensor/base must be mounted either on the ceiling or a rail. Daisy-chain all the sensor bases and display interface modules in the lane with the Dupline® 3-wire bus. Power the system and program the sensors and displays by means of the SBP2WEB24 programming tool.

Design of the placement of sensors, indicators, cable trays and cabinets.

If you use the 45-degree angled sensor SBPSUSL45, it is essential to mount it at a distance of between 2 and 2.5 m from the floor.

If you use the vertical sensor SBPSUSL, the maximum height must not exceed 4 m (13.2 feet). If so, it is important that the sensor is lowered by means of ceiling mounting brackets.

The sensor must be mounted with a vertical deviation of maximum +- 5°.

Using external LED indicator SBPILED, please make sure they are installed in the lane, so that they are visible for drivers at a satisfactory distance.

Use aesthetic cable rails, where sensors can be installed and cables can be pulled and mounted.

Place cabinets in a logical way with short distances to the lanes to avoid long cables. For example, place many small cabinets in the area or on the floor or place a big cabinet in the middle of the area or floor.

Phase 4: Dupline® Parking Guidance Software

Use an existing IP network or create a new TCP/IP network.

Determine the number of spaces to be monitored on each level and in total.

Require parking drawings in JPEG, PNG or PDF to be imported into the carpark software.

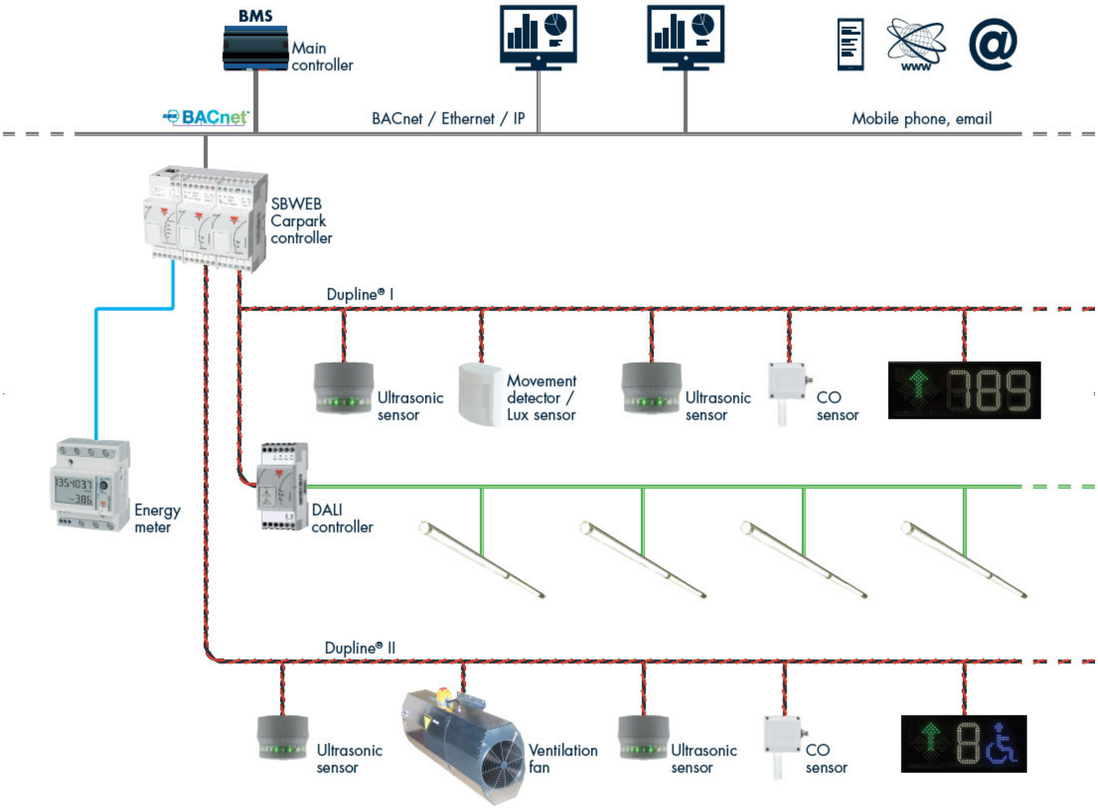
Seven pieces of SBP2MCG324s can be multi-dropped to a single SBP2WEB24 controller. To enlarge your carpark system, the carpark server SBPCPY24 can operate with 10 SBP2WEB24 modules. In installations bigger than 6300 sensors, a larger server can operate with several SBPCYP24s. That way, we can expand the installation many times.

All SBP2MCG324s have a unique ID number (SIN number). Information on available and occupied spaces from the parking area are transmitted via the SBP2MCG324 to the SBP2WEB24 controller and then to the software. In Carpark installations with less than 630 spaces (maximum 1 SBP2WEB24), the software is made in the SBP2WEB24. In installations larger than 630 spaces (up to 10 SBP2WEB24s), the software is made in the SBP2CPY24.

The carpark software can be programmed in advance and installed the very moment the physical installation is finished.

Secondary Considerations

Different kinds of building automation components like the CO sensor, light sensors or movement sensors could easily be built into a Parking Guidance System (PGS) system. By selecting the SBP2WEB24 controller, the customer will have various numbers of flexible solutions at a lower cost.



It is also important to consider the installation costs, especially the necessary man-hours, but also the costs of cables and wall boxes. We recommend the use of inexpensive standard 3-wire, unshielded 1.5 mm^2 (14-16AWG) cables for the Carlo Gavazzi Dupline® Parking Guidance System. In order to reduce man-hours for the installation, we have designed the sensor in such a way that it can be wired easily and quickly without the use of screwdrivers. The bases/sensors are programmed from the SBP2WEB24 configuration tool when they are mounted, wired and powered. The programming and calibration take just a few minutes to execute for a complete lane. Just make sure that no cars are occupying the Carpark spaces during calibration.

One-Floor System Example

The diagram below is a theoretical example of how to implement 477 sensors on a single floor. Additional floors would be configured, installed and brought online exactly the same way. Refer to section 'Example of a PGS for Multiple Floors'.

In the planning process, displays are positioned at the entrance and at each line.

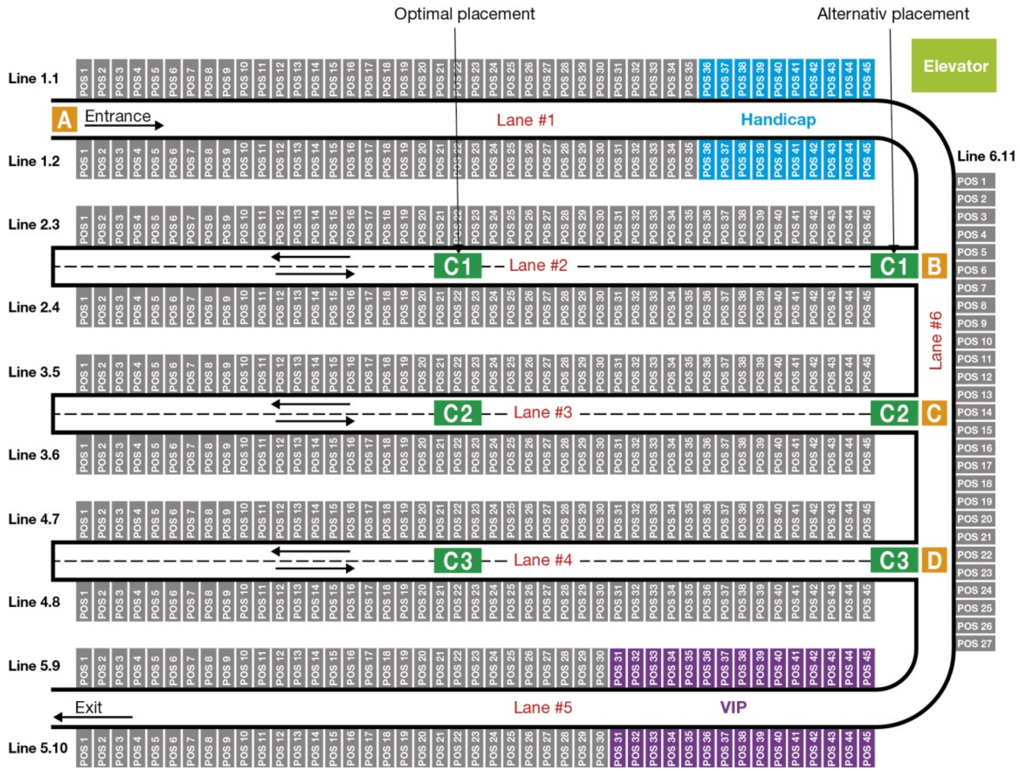
The entrance display (A) will show all available spaces on the entire floor. The first branch display (B) will show available spaces on that particular lane and the displays C and D will also show available spaces from their lanes.

Design of the lanes can be made in many ways. We will always suggest an easy structure with a good overview, which holds an extra margin for voltage drop, power consumption and any future installation.

In this example we have 6 lanes. Lanes 1, 2, 3, 4 and 5 each have two lines with 45 spaces per line, totalling 90 sensors per lane. Lane 6 has one line with 27 spaces.

The length has been calculated to 135 m (435 feet), so there is a margin for both voltage drop and power consumption calculations.

Placement of the cabinets is in close proximity to the B, C and D displays providing us with the shortest practical distance between the lanes.



Car Park Displays

The displays are all connected to the 3-wire Dupline® bus through the display-interface module that converts Dupline® to Modbus. The displays can be connected to any of the lanes and show the demanded available spaces. The programming of the displays takes place by using the SBP2WEB24 configuration tool. Each of the displays requires its own power supply.

Cabinets

The three cabinets C1, C2 and C3 should be mounted as shown in the scheme. If this is not possible, an alternative placement should be found. ***It is important that the distance between the cabinet and the last sensor on a line does not exceed a voltage drop of 3.5 V.***

- C1 should contain power supplies for lanes 1, 2
    - Power supplies for Displays A and B
    - Dupline® Master Generator SBP2MCG324 for lanes 1 and 2
    - The SBP2WEB24 controller and/or the main controller SBP2CPY24 (Use only the SBP2CPY24 if more than one Carpark controller (SBP2WEB24) is used)
- C2 should contain modules for lanes 3 and 6
- C3 should contain modules for lanes 4 and 5
- Additional floors would be managed in the same way

Addressing Parking Spaces and Displays

All the bases upon which the sensors are mounted have a unique SIN number. The SIN numbers on the bases do not need to be in consecutive order, but when each sensor is activated by the SBP2WEB24 configuration tool, it is important to activate the sensors in consecutive order. There are no limitations or restrictions in placing sensors for different purposes right after each other. So, the installer can have 'Normal', 'Disabled' or 'VIP' spaces placed among each other. It is the same sensor that is used. The difference is generated by the configuration tool.

Each display is connected to a display interface, which also has a SIN number. The display interface is connected to the same Dupline® bus as the Carpark sensors. The display can be placed anywhere on the Dupline® bus and on any MCMG in the system. The data to be showed on the display are available on any Dupline® bus in the entire Carpark system.

In our example we do not have a separate display to show available spaces for disabled people. However, it would be easy to add a separate display to the software, and we would recommend one display, one display interface and one power supply as hardware for this extra feature. If, for instance, 20 spaces are designated as spaces for disabled people, we will have to point out these spaces in the configuration software to make them visible on the display.

Example of a PGS for Multiple Floors

Planning a Parking Guidance System (PGS) with multiple floors implies the same considerations as planning one floor only. Determine displays, lanes, natural car flow in the Parking Guidance System and of course all the other phases in the process mentioned at the beginning of this installation manual.
Cable lengths of the 3-wire Dupline® bus to supply sensors, displays and Ethernet runs must be carefully considered.
After finishing the planning process, the installation can start. Pulling wires, install rails, mount sensors, displays and cabinets. Using the SBP2WEB24 configuration tool, the installer can program and test parts of

the installation before the entire installation is finished. When bases, sensors and MCMGs are connected and powered, they can be tested and programmed before the rest of the system is completed.

Example:

Ground level:
4 normal lanes (lanes) with 76 spaces each and including 4 spaces for disabled people on each of the 4 lanes. 16 disabled spaces in total.
Level one:
4 normal lanes (lanes) with 72 spaces each.
Level two:
4 normal lanes (lanes) with 72 spaces each. Including 4 spaces with disabled spaces on each of the 4 lanes. 16 disabled spaces in total.
There are 304 spaces on the ground floor, 288 spaces on level 1 and finally 288 spaces on level 2. A total of 880 spaces, including 32 spaces for disabled people.
All the lanes including the disabled spaces are connected with a 3-wire Dupline® bus to their selected SBP2MCG324 with a unique ID number.

Outside the PGS installation, three displays (Monument) show the number of available spaces on all three levels and two displays to show available disabled parking spaces on the ground floor and level 2 respectively.

The three displays that show available spaces on all the ‘normal’ lanes (lanes) are connected to any 3-wire Dupline® bus via a display interface module.

The two displays that show available spaces on all the disabled parking spaces are connected to any 3-wire Dupline® bus via a display interface module.

In this example we have 12 lanes, which means we need 12 SBP2MCG324s one for each lane. It is possible to manage with fewer SBP2MCG324s, but to keep the installation easy and logical, we use one SBP2MCG324 for each lane.

Having 12 SBP2MCG324s, we need two SBP2WEB24 controllers and one SBP2CPY24 as Carpark Server.

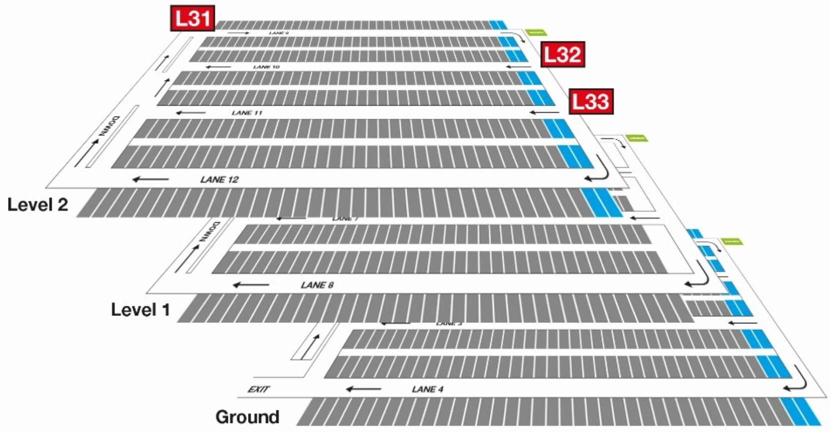
Each of the SBP2MCG324s has a unique SIN number and is connected to its local CC, the SBP2WEB24. Afterwards, the two SBP2WEB24s are connected to the CS (SBP2CPY24) to distribute the data to the SBP2WEB24 controllers.

The best installations have a well-thought-out layout as too many displays may become counterproductive due to information overload.

In level 2, we could have a display at the entrance that shows available spaces at this level only. Disabled parking spaces are not included.

A simple display, L31, which shows a green arrow or a red cross, is placed at the entrance to level 2.

At each lane, we place a simple display with an arrow/a red cross to show available spaces in that direction.



Installation of the PGS

Short Installation

In this section, the installer is given a tool to answer most questions that arise during the installation of cables. Now the planning has ended, and we move forward towards the installation process starting with:

SBPSUSL45 Carpark Lane Sensor (Used in Most Installations)

Sensors must be installed at a distance of maximum 2.0 m (6.56 feet) and maximum 2.5 m (8.2 feet) from the floor.

Use for instance cable trays to mount the sensors and Base A and the base holder SPB2BASEA to save labour costs.

If the base holder is mounted directly on the ceiling, use the base holder SBP2BASEB (for pipe installation).

Make sure that Base A (B) is mounted correctly, so when the sensor is mounted it is pointing towards to carpark space. For best performance it is recommended to mount the sensor in height of 2.5 m at the entrance of the parking space. Refer to section 'Placing the sensor'.

For aesthetic reasons, mount the sensors in a straight line and at the same height.

Mount the sensors directed at an angle of 45 degrees to the ground with a deviation of maximum +-5 degree vertically and maximum +- 2 degree horizontally.

When mounting the wires into the push wire connectors on the sensors, cut the insulation carefully to avoid damage to the conductor.

Cut only 1 cm (.394 or 25/64 inches) of the inner insulation on the conductor, when using a solid core cable pressed into the push wire connector. Same procedure with a stranded wire. Cut the cable and mount a ferrule on the wire ends. Press the wire ends into the push wire connector. Refer to section *'General Installation'* for a more specific description.

SBP2MCG324 Carpark Master Generator

The Dupline® Master Generator (MCMG) SBP2MCG324 is used in all lanes to supply carpark sensors, LED indicators and display interface modules.

Make sure that cable lengths or number of loads (sensors) are not exceeded when the modules are connected to the MCMG. This means a maximum of 50 sensors in a line and 150 m cable, or a maximum of 90 sensors in total.

Use a double-sized power supply because of the pulsating output on the MCMG.

SBP2WEB24 Carpark Controller

The SBP2WEB24 controller can control a maximum of seven MCMGs. It can be installed in a cabinet with the MCMG or separately. Maximum 630 sensors in installations with one SBP2WEB24.

SBP2CPY24 Carpark Server

Large installations with more than 630 spaces (or more than one SBP2WEB24 and up to 10 pieces maximum), require the SBP2CPY24. This module controls the Carpark software, in which the installer can perform bookings, schedules, alarms, trend curves etc.

Cabling

Use a 3-conductor 1.5 mm^2 (14-16AWG) unshielded single core wire for the sensors OR

use a 3-conductor 1.5 mm^2 (14-16AWG) unshielded stranded wire with ferrules for the sensors.

Use a 2-conductor 1.0 mm^2 (14AWG) unshielded cable for power to the display interface module.

Use a 2-conductor 1.0 mm^2 (14AWG) unshielded cable for RS485 to the display interface module.

Cabinets

Place the cabinets according to plan.

Use large cabinets to take account of future installations and to avoid heat dissipation.

Use a 1.5 mm^2 (14-16AWG) stranded wire with ferrules for internal wiring.

Programming

Carpark 3 must be programmed by the SBP2WEB24 configuration tool. This tool is used to locate the Carpark modules and to connect them to the correct Lane, Line and Position. The configuration software is a part of the SBP2WEB24.

Below, in section 'Configuration software', we show a programming example for a small lane with lines.

The Carpark 3 also includes Carpark software, from which the installer can perform the complete monitoring and controlling of the carpark system. In installations with only one SBP2WEB24 module (also less than 630 spaces), this software is available in the SBP2WEB24 module. However, in larger installations with two or more SBP2WEB24s (up to 10 units or 6300 spaces), the Carpark Server SBP2CPY24 will be needed.

This manual will not get around programming in details. Detailed programming, examples etc. can be found in the software manual for the SBP2WEB24 controller, which is also available at http://productselection.net/

Only a few programming examples and screenshots will be shown in this manual.

Below in section 'Carpark software', we show an example of a programming procedure. The procedure briefly describes the important elements and the steps to follow. It is important to follow the steps described or to use the software manual to achieve a good result.

The Dupline® Fieldbus

General Information on the Fieldbus

The bus system that links the carpark sensors and display interface together is the Dupline® fieldbus. This highly reliable, robust bus system has been proven in more than 150,000 installations worldwide in a wide range of building automation applications such as water distribution, mining, railways and parking systems.

Dupline® Bus Features and Benefits

The strength of the Dupline® system consists of a unique set of features which enables elegant, flexible and cost-effective solutions.
The Dupline® bus is a signal transmission system that reduces the need for wires, as compared to an ordinary installation. Using only 2-wires, information can be transmitted from a distance of up to 2 km. Many input and output modules are supplied from the same 2-wires. Both digital (On-Off) and analogue data (e.g. temperature, light level, wind speed) are present on the bus at the same time. The data are collected by the SH2MCG24 and then processed by the SB2WEB24.
The SH2MCG24 is the smart Dupline® bus generator that powers the Dupline® bus via the local bus and via the terminals of the modules. All Dupline® slave modules have to be connected to one SH2MCG24 to be part of the smart-building system.
The Dupline® modules in the smart-building system can be divided into two groups:

- Decentralised modules: all the modules such as light switches, PIR sensors, lux sensors, decentralised I/O modules that are mounted in the wall boxes or on the wall.
- Centralised cabinet modules: the modules that are mounted in 1-DIN or 2-DIN housings for Din rail mounting.

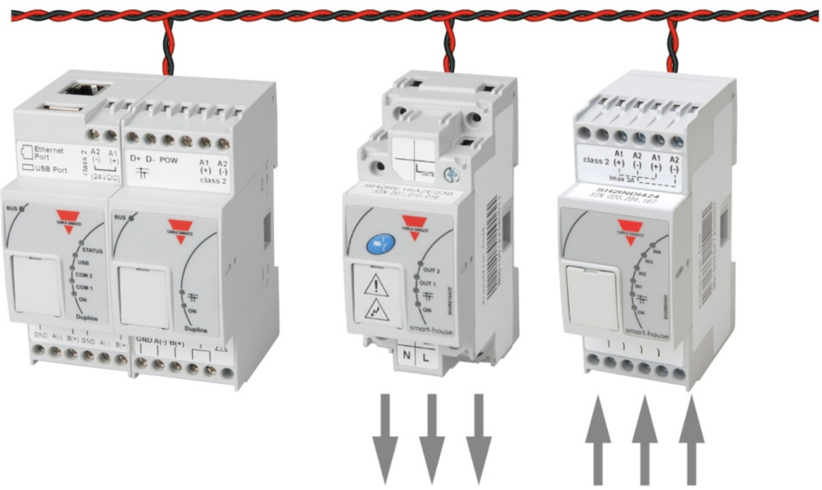
All the decentralised Dupline® devices are connected to each other with a single two-wire cable. This cable carries the communication signal that comes from the bus generator SH2MCG24. These two-wires carry a DC low-voltage pulsating signal, and therefore, attention must be paid to keep the correct polarity of the connection.
These unique Dupline® features provide considerable cost savings in many installations.

Dupline® Basic Elements

A Dupline® network consists of five basic elements: The controller, a master generator, input modules, output modules and a two-wire cable. The controller is the brain of the system and collects all information from its connected busses. The functions and the software are part of this module. The master generator controls the communication on the Dupline® bus. It sends out the Dupline® carrier signal and coordinates all transmissions between input and output modules.

Input modules connect to contacts, voltages and analogue signal sources etc. and transmit this information via the two-wire cable. In the parking system, the ultrasonic sensors can be regarded as input modules, because they use the Dupline® bus to send status information to the master generator.

Output modules connect to loads such as lights, roller blinds, motor contactors and valves. In the parking system, the master generator can be regarded as an output module controlling the display based on the information received from the sensors via the Dupline® bus.



Dupline® Bus and Smart Dupline® Bus

The smart-building system is based on a new protocol of the Dupline® bus. The protocol is called *Smart Dupline®.*
Smart Dupline® implements a master-slave protocol running on standard Dupline® networks.
The concept of Smart Dupline® is based on the SIN – a Specific Identification Number which is unique for each and every Dupline® module. The SIN is incorporated into the module during the production process and cannot be modified.
The SIN code is printed on the product label like this:

SIN: 255.255.255

The SIN contains information about the type of Dupline® module (light switches, pir, I/O modules), the firmware release and much more.
Smart-Dupline® enriches the previous Dupline® bus protocol with these features:
1) The master generator can program the network address ADD (1...250) in each device by means of the Specific Identification Number.
2) The master generator can program the Dupline® standard channel addresses and all the other module parameters by means of the Specific Identification Number.
3) The master generator can **access** all input and output module information by means of the Specific Identification Number.
4) It is possible to manage double word information in a single message frame
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 Smart Dupline® protocol without using digital I/O channels.

Dupline® Bus Including a 3'rd Wire

The parking guidance system uses an expanded version of Dupline® in which a 24-VDC power supply is included as a 3rd wire. The reason being that a power supply is needed for the Carpark sensors on the bus. The power supply must be synchronised with the Dupline® bus, and this is taken care of by the specific carpark master generator (MCMG) for the parking system.

One carpark master generator, which drives one lane of the basic 3-wire Dupline® fieldbus, can manage up to 120 inputs and 112 outputs. Because of the load and the voltage drop we recommend you not to install more than 50 Carpark sensors on a line and no more than 90 Carpark sensors in total on a generator (MCMG).

Dupline® Extra Features

The wide range of Dupline® products for building and industrial applications are fully compatible with the parking guidance system, which makes it possible to extend the functionality to include such things as control of lighting and ventilation based on the presence of persons, CO2 levels and time of the day. Yet another option is to record the energy consumption in power distribution panels throughout the building in a central place by means of energy meter directly connected to the bus. These are just a few examples among lots of combinations to accomplish the required solution.

System Description

In this chapter you will get an overview of the entire structure of the parking guidance system. There is a short description of the basic elements of the system, followed by a description of the structure of a system lane. Then it is described how the individual lanes can be linked together to create a large parking guidance system with thousands of potential spaces. Also, a definition is offered for the network structure required to link the system to a PC with the Parking Guidance software installed.

Basic Modules

Lane and vertical mounted sensors

Vertical sensor with a built-in LED indicator light, (8 colour, red, green, amber, yellow, light-blue, blue, purple and white) SBPSUSL

45-degree sensor with a built-in LED indicator light, (8 colour, red, green, amber, yellow, light-blue, blue, purple and white) SBPSUSL45

Vertical sensor

45 degree sensor

Each parking space must be equipped with one of these ultrasonic sensors, which detect whether or not a car is present. These sensors are designed to be used together with the Carpark software and they enable the Carpark operator to control the colour of each sensor. This is useful if the Carpark installation offers VIP spaces, family spaces etc. There are two versions of this sensor: a 45 degree angled sensor with a built-in 8-colour indication and one vertical with a built-in 8-colour indication. For best performance the 45-degree sensor is recommended to be mounted in height of 2.5 m at the entrance of the parking space.

This is the prevalent sensor type because of the installation costs and installation time.

The carpark sensor consists of two parts: the sensor itself and a base holder to be mounted on the ceiling, cable tray or installation box. The sensor has a small cable with a male RJ12 connector that must be plugged into the female RJ 12 connector in the base part. The sensor is detachable from the base, which makes replacement of the sensor easy. Once the sensor is locked to its holder, it is secured by a safety lock. The sensor is not delivered with the base. The base must be ordered separately.

LED Indicator

LED indicator with eight colours built in (red, green, amber, yellow, light-blue, blue, purple and white), Dupline® bus powered SBPILED

The LED indicator consists of three bright RGB diodes implemented in a housing of transparent polycarbonate. It uses the same base holder as the sensors. The LED indicator has a small cable with a male RJ12 connector that must be plugged into the female RJ12 connector on the base part. LED indicator is not delivered with a base module. The base must be ordered separately.

LED indicator

Base A and Base B

Base A, low base with SIN number SBPBASEA

Base B, tall base with SIN number SBPBASEB

Base A is a low base used for rail mounting. The cable is inserted from the top of the base and the knockouts are used for mounting in the rail.

Base B is a tall base used for mounting on the ceiling. The knockouts on the side of the base are for pipes with the 3-wire cables.

Both base types can be used together with all Carpark 3 sensors or LED indicators. The base has a 2*3-wire connection for d+, d- and POW. The base also has a female RJ12 connector, which must be connected to the sensor or LED indicator. Moreover, it has a PCB containing the unique SIN number for identification when connected to the Dupline® bus. The PCB on the base also stores the calibration data for the sensor. If replacement of the sensor is needed, it is not necessary to perform a new calibration

The base is not delivered with the carpark sensor or LED indicator, but must be ordered separately.

Base A

Base B

Carpark Master Generator (MCMG)

The purpose of the MCMG is to generate the 1-kHz Dupline® carrier signal that enables all the devices on the bus to communicate with each other. Furthermore, it synchronises the power supply for the sensors and LED indicators with the Dupline® bus signal in order to achieve a 3-wire bus with communication and power. Finally, it acts as a Smart- Dupline® interface in order to deliver the sensors' status data to the SBP2WEB24 controller. The MCMG does not have galvanic separation between input voltage and output voltage, so use a power supply with galvanic separation and a 28VDC on the output.

Each Carpark Master Generator SBP2MCG324 can operate with 90 carpark sensors in total, and a maximum of seven SBP2MCG324s can be connected together to one carpark controller, the SBP2WEB24. This equates to a maximum of 630 carpark sensors. This number can be expanded by using the carpark server SBP2CPY24. See section 'Carpark Server'.

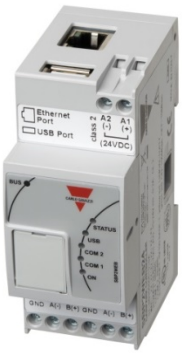
Carpark Controller

The carpark controller is based on a central CPU, the Sx2WEB24, which is a Linux-based embedded PC that manages all the smart functions. It is programmed by means of software, the SBP2WEB24 tool. The SBP2WEB24 has the Ethernet communication capability to be remotely controlled and monitored by smart-devices/PCs, and it is also a data logger, which can record any value/event coming from the many busses to which it can connect (Wireless and Dupline® busses, two RS485 ports, Ethernet). This master unit is also supplied with an SD-card and USB port to upload/download data and system configurations.

Each SBP2WEB24 can operate with up to seven SBP2MCG324s in a network.

The SBP2WEB24 is the brain of the system. It collects all pieces of information from the buses to which it is connected. All field devices such as light switches, input/output modules and carpark sensors are connected to the SBP2WEB24 via the SBP2MCG324 Dupline® master generator.

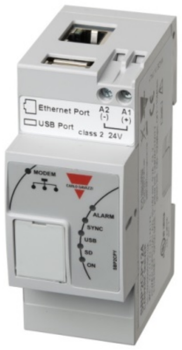
Furthermore, the SBP2WEB24 has a built-in web server and includes Carpark software to enable the operator to control and monitor the entire carpark installation. Booking, schedules, trend curves, alarms etc. are just a few of the parameters that are available.



Carpark Server

The SBP2CPY24 allows users to manage distributed installations. In each location one SBP2CPY24 unit is in charge of gathering data from the connected devices (Carpark sensor, light switches, PIR, etc.) and store them inside its local DB, allowing information from many plants to be centralised in a single database and Web-Server, without the need of a dedicated PC. Furthermore, the SBP2CPY24 has built-in Carpark software from where the installer can control and monitor the entire carpark installation. Booking, schedules, trend curves, alarms etc. are just a few parameters that are available.

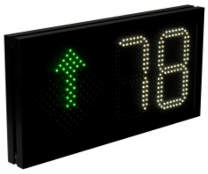
Monitoring and data management of up to 10 distributed installations of SBP2WEB24. Referring to section 'Carpark Master Generator' each SBP2WEB24 can handle 630 carpark sensors. By using the SBP2CPY24, we can expand the carpark installation by 10 SBP2WEB24. That is 6300 carpark sensors in total. This number can be even bigger using a different carpark server. If this is the question, please contact your nearest Carlo Gavazzi sales office for further information.

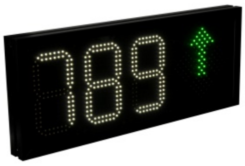


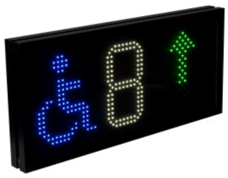
Carpark Displays

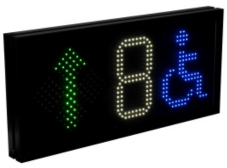
Arrow	SBPDISA
Arrow+Heat	SBPDISAT
Arrow Left+Disabled Right	SBPDISALH
Arrow Left+Disabled Right + Heat	SBPDISALHT
Arrow Right+Disabled Left	SBPDISARH
Arrow Right+Disabled Left + Heat	SBPDISARHT
Digit2	SBPDIS2
Digit2 + Heat	SBPDIS2T
Arrow Left+Digit2 Right	SBPDIS2AL
Arrow Left+Digit2 Right + Heat	SBPDIS2ALT
Arrow Right+Digit2 Left	SBPDIS2AR
Arrow Right+Digit2 Left + Heat	SBPDIS2ART
Digit3	SBPDIS3
Digit3 + Heat	SBPDIS3T
Arrow Right+Digit3 Left	SBPDIS3AR
Arrow Right+Digit3 Left + Heat	SBPDIS3ART
Arrow Left+Digit3 Right	SBPDIS3AL
Arrow Left+Digit3 Right + Heat	SBPDIS3ALT
Arrow Right+Disabled Left+Digit1	SBPDIS1ARH
Arrow Right+Disabled Left+Digit1+ Heat	SBPDIS1ARHT
Arrow Left+Disabled Right+Digit1	SBPDIS1ALH
Arrow Left+Disabled Right+Digit1+Heat	SBPDIS1ALHT
Digit4	SBPDIS4
Digit4 + Heat	SBPDIS4T
Text display	SBPDIS9
Text display + Heat	SBPDIS9T

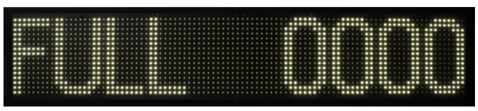










The displays are connected to the Dupline® bus via the display interface module SBP2DI48524. The displays operate with RS485 Modbus RTU protocol and shows available spaces using bright green arrows or/and bright white digits. The displays are programmable from the SBP2WEB24 configuration tool and can be programmed to show 'running or steady arrows' pointing 'up, 'down', 'left' or 'right'. The text display has the option to show a user-defined text of maximum 9 digits for either a 'full' or 'vacant' situation. In situations where low ambient temperatures are present (lower than -20 degree Celsius), we recommend using the version where the heat element is built in. This heat element will have a working display down to -40 degree Celsius.

The number of displays in an installation is free, until of course, the numbers of addresses in the SBP2WEB24 are used.

Carpark Display Interface Module

Dupline® to Modbus RTU converter SBP2DI48524

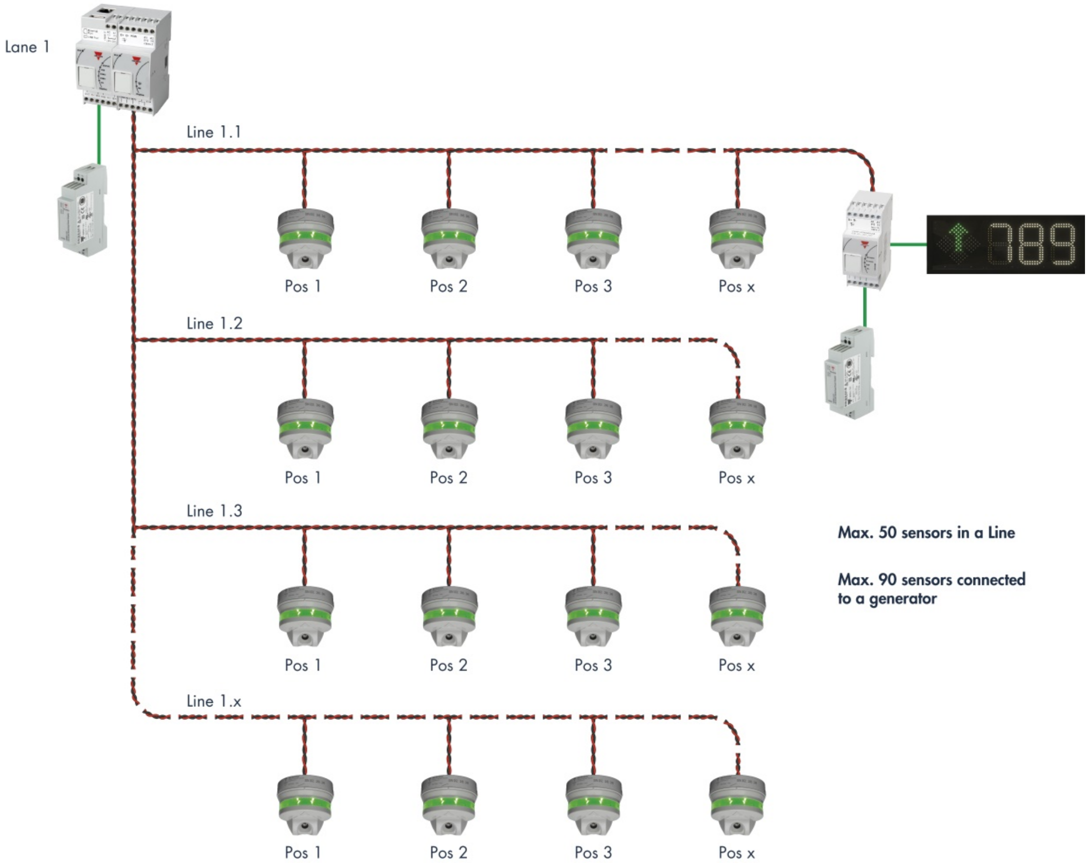
The carpark interface module is used to connect the Carpark displays directly to the Dupline® bus. Each module has a unique SIN number, which must be programmed by the SBP2WEB24 configuration tool. Each display must have its own interface module and can be mounted up to 300 m from the display because of the RS485 connection.

System Structure

At first sight, you may presume that it is a complex task to design a Dupline® parking guidance system for a parking facility with hundreds or thousands of parking spaces. But when you understand the basic structure of the system, you will realise that it is simply composed of a number of identically structured system lanes linked together to create a big system. This chapter begins with a definition of the structure of the basic system lane. Then we describe how the lanes can be linked together to create the overall system, including a network for central parking facilities monitoring software.

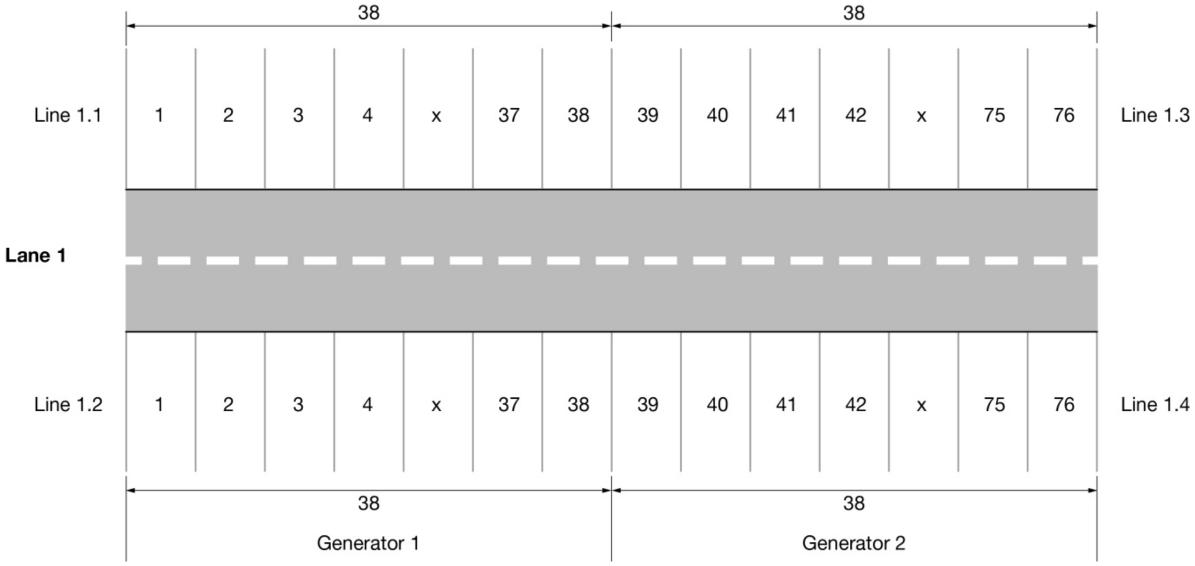
Definition of Lane, Line and Position

The definition of Lane, Line and Position takes begins by defining the maximum number of sensors connected to a generator. We can connect 90 Carpark sensors to a generator and maximum 50 sensors on a line.



With this information, we can define the number of sensors on a line and, when we have the physical layout of the carpark system, the number of generators for the lane.

In the drawing below, a single carpark lane is shown. A lane refers to the physical lane in the carpark building. The lane can be long or short with few or many cars. That depends completely on the structure in the building. If a lane has 76 spaces on each side, then we can decide to split up the lane in four equal parts with 38 sensors in each part, and thereby have 4 lines in one lane.



The generators must be placed in a way that reduces unnecessary wire length. Extra wire increases the voltage drop and thereby reduces the number of sensors in the installation. Please refer to the section on 'calculation'.

In this example the two generators are placed in the opposite ends of the lane and supply line 1.1-1.2 and 1.3-1.4, respectively. In total, each generator supplies 2*38=76 sensors.

In the above example, we have 38 sensors on each line, but we could have used the maximum number of sensors connected to a line and thereby have 50 sensors on line 1.1 and 40 sensors on line 1.2. This would total 90 sensors for the first generator. Twenty-six sensors on line 1.3 and 36 sensors on line 1.4. This comes out to 62 sensors for the second generator. This makes no difference to the system. However, due to good balance in the system, it makes sense to equal the load on all four lines as mentioned in the first example.

The Carpark Master Generator with DC Power Supply

SBP2MCG324 Carpark Master Generator generates the Dupline® carrier signal and 28VDC power supply synchronization needed to create the 3-wire bus linking all the sensors and display interfaces in the lane together. In a given lane you will always find one - but only one – carpark master generator. The MCMG can operate with maximum 50 sensors in a line and maximum 90 sensors in total.

Sensors

Each parking space belonging to a lane/line needs a sensor to detect the presence of a car. Each sensor must be connected to the 3-wire carpark bus, assigned by the SBP2WEB24 configuration tool, to be able to transmit the sensor status (occupied/not occupied/disabled/VIP/etc.). For best performance it is recommended to mount the 45-degree sensor in height of 2.5 m at the entrance of the parking space. The built in LEDs will clearly indicate to the drivers if the parking space is available or not. Other sensor/LED indicator solutions are available and are further described under 'General Installation – Selection of sensor type'.

Display and Display Interfaces

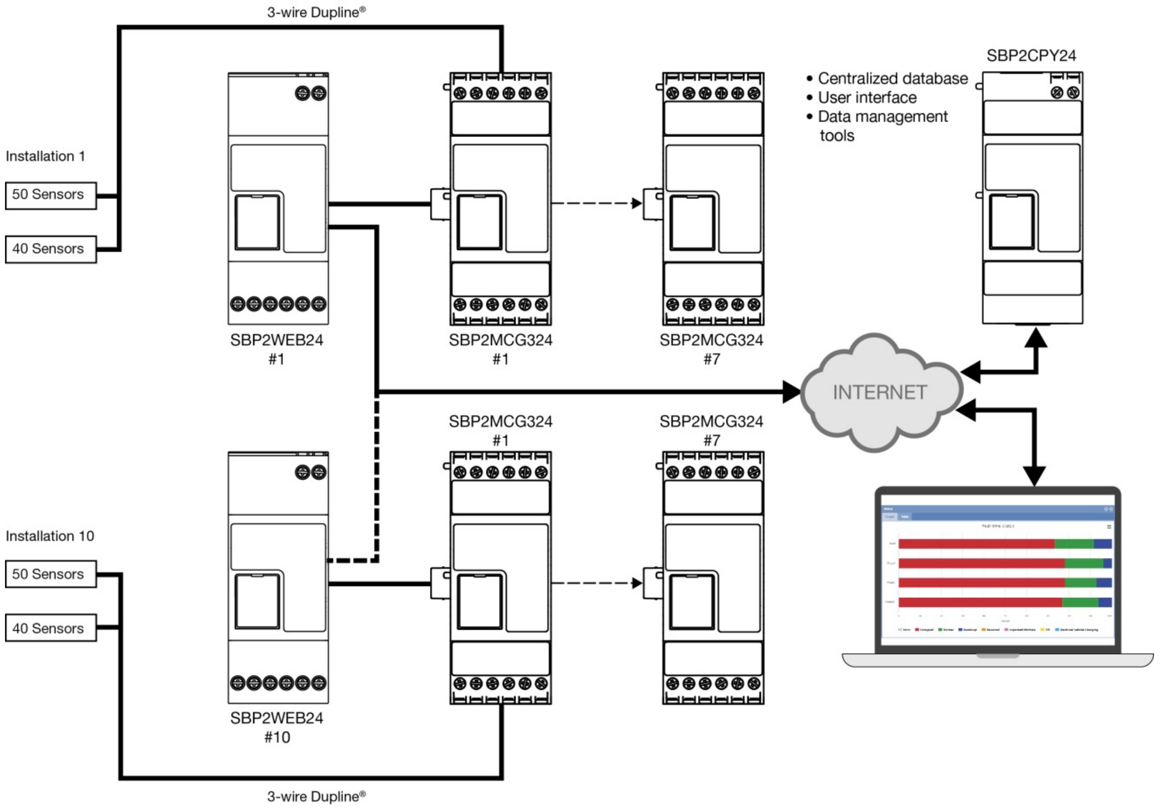
The display interface is a small compact module with two purposes. Converting Dupline® to Modbus and identifying the display by the SIN number. A display interface is needed for each display.

The display shows the number of available carpark spaces and or the direction. The display can be mounted anywhere on the Dupline® bus and be programmed to show the number of available spaces the installer decides. Totally, lane by lane, disabled, VIP or a combination of the different options together.

Combining Lanes to a Complete System

When the lanes are defined, we use the SBP2WEB24 controller and the SBP2CPY24 carpark server to combine and upscale the carpark system from 100 to 1000 or even 10.000 spaces.

Each SBP2WEB24 can operate with maximum seven SBP2MCG324. That is 7*90=630 spaces in total. By using the Carpark server SBP2CPY24, we can operate with ten SBP2WEB24, so we have 10*630=6300 spaces. If additional spaces are needed, please contact Carlo Gavazzi for further information.

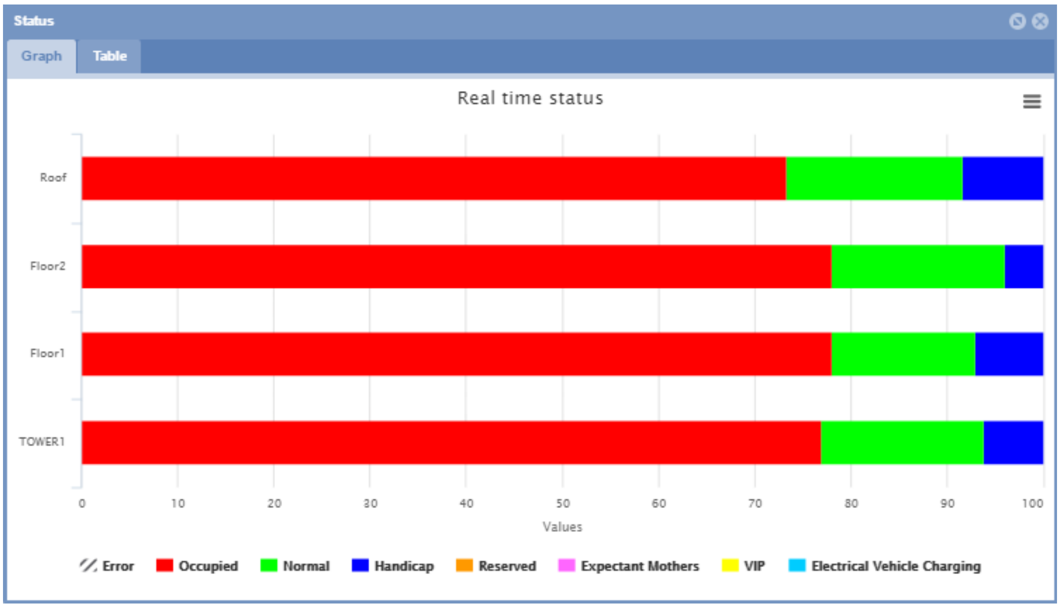


Software and Web server

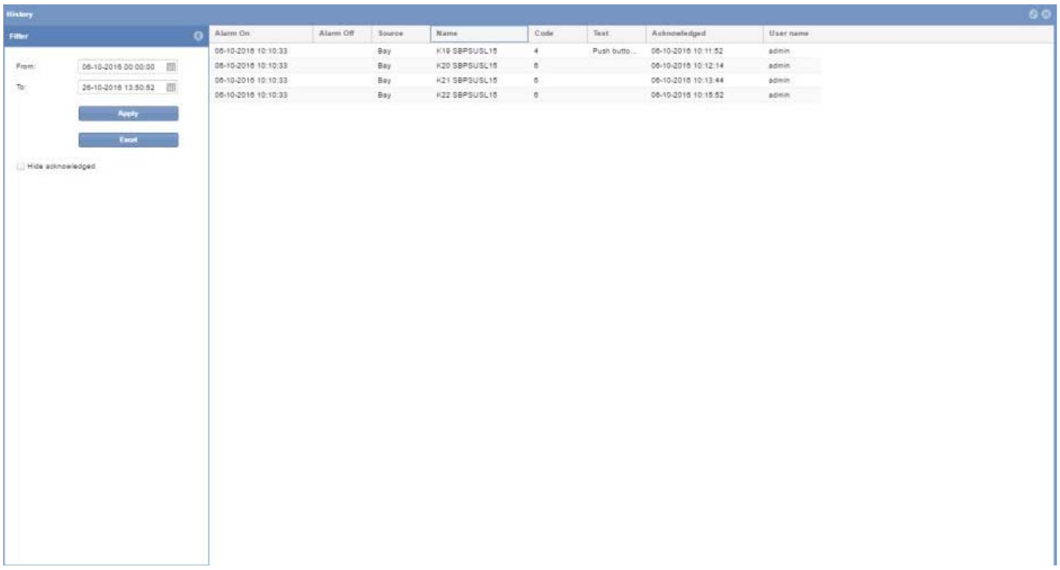
The last part is to program the system by using the SBP2WEB24 configuration tool. In systems with more than one SBP2WEB24, the installer must program each SBP2WEB24 independently. In smaller systems (below 630) the web server in the SBP2WEB24 can monitor and control all the sensors and other Dupline® products. In larger systems the web server in the SBP2CPY24 controls and monitors all the I/O s in the entire system.

The configuration tool also has the carpark software built in. The installer can design the carpark with drawings, see alarms, see historical data, vacancy space by space or in lanes, occupancy data and many other features.

Status view:



Alarm table:



Occupancy trend:

System Requirements

Operating Systems: Windows 7, Windows 8, Windows 10

Browser recommended: Google chrome

Standard Desktop PC or Laptop with Ethernet / WIFI

Hard Disk: Minimum1 GB of available space

Display: 1024 x 768 high colour, 32-bit (Minimum); 1600 x 1200 high colour, 32-bit

Suggested: 24” monitor, with a resolution capable of 1600 x 1200 pixels in high colour.

General Installation

Cable

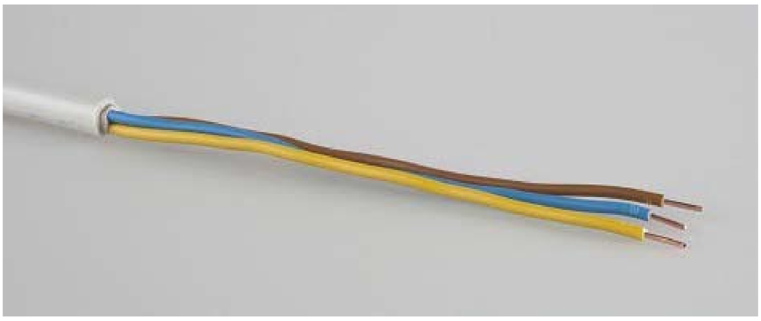
The 3-wire cable used in the Carpark system supplies both Dupline® signals and power to the sensors.

To avoid voltage drop at the far end of the cable or to avoid reflections in the cable, we require a cable that meets the following specifications:

3-conductor, 1.5 mm^2, (14-16AWG), non-shielded, single-core. If a multi-core cable is used, it is essential to mount a ferrule on each wire end, because the connections on the sensors are all ‘push connectors’.

3 * 1.5 mm^2 multi-core wire with ferrule

3 * 1.5 mm^2 (14-16AWG) single-core wire



Practical Cabling Techniques

The following issues must be taken into consideration when installing the Dupline® bus cable.

• Do not mount the Dupline® bus cable close to high voltage installations such as:

• Motors

• High voltage cable

• Inverters

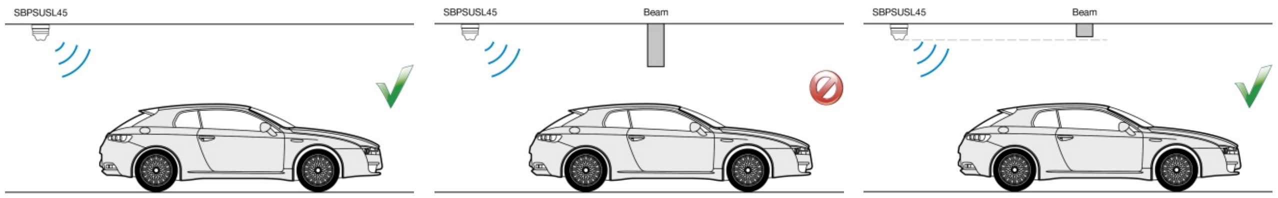
• Breakers

• Make sure that water cannot penetrate the Dupline® bus cable or junction boxes. Water can cause poor connections and random activations of the sensors

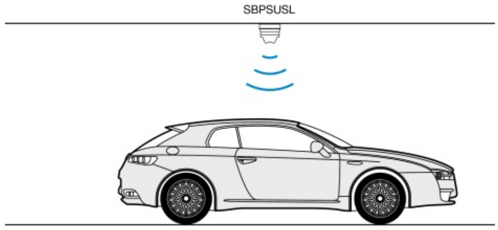
• If the cable is installed close to high voltage cables or equipment, use a shielded cable

Selection of Sensor Type

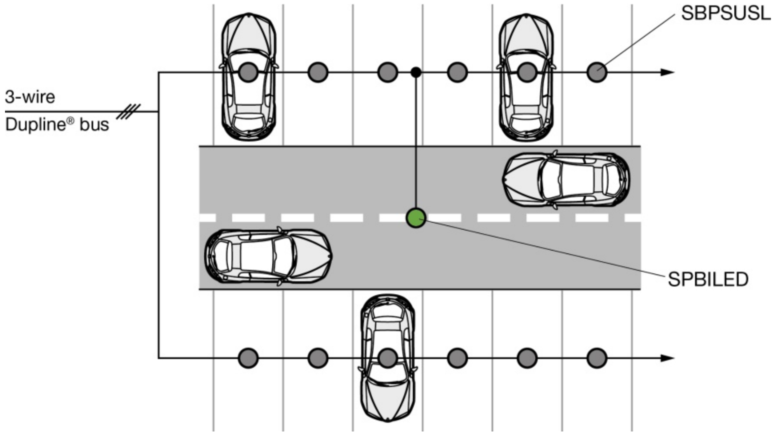
Depending of the installation, we must decide which sensor to use. In most installations we will use the 45 degree angled sensor. For best performance it is recommended to mount the 45-degree sensor in height of 2.5 m at the entrance of the parking space. If there are obstacles lower than the sensor, a calibration of the sensor can be difficult. If the calibration fails, it is possible to manually enter the distance (from sensor to floor) in the configuration software. This distance overwrites the calibration function, so it is not needed to make a calibration. If the LED in the sensor returns with green steady signal (no cars in the parking space), the sensor is ok. If the sensor is red or blinking red, check the distance once more or replace the sensor. Further description of the manual distance procedure is described in section 'Override free space (calibration)'



In installations where the sensor is to be mounted directly above the car, please use the vertical sensor SBPSUSL. The SBPSUSL has up to 8 different freely selectable colours.



The vertical solution with external LED indicator represents a cost reduction through the number of passive LED indicators. One LED indicator can be programmed as OR gate to monitor x-numbers of sensors, and if all the monitored sensors are occupied, the LED indicator will change colour to occupy. If one or several sensors are available, the LED indicator will show the colour for available space.



Placing the Sensor

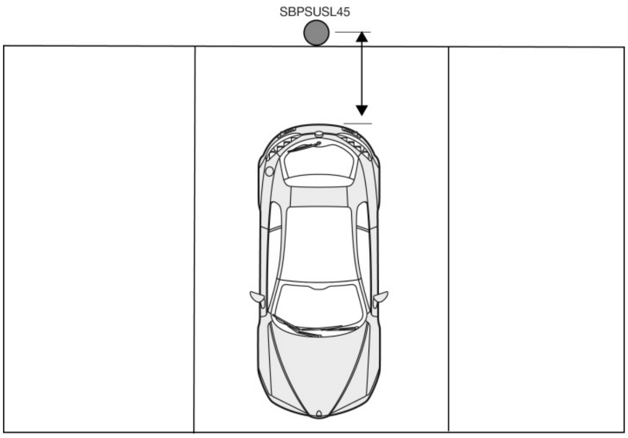
When installing sensors, it is important to investigate what kind of technique is the best in the specific installation.

In most installations, the lane-mounted sensor will be preferred because of the reduced cost of labour and material used. In some circumstances the vertical sensor is preferred, but that will be a decision made by the owner and the architect of the building.

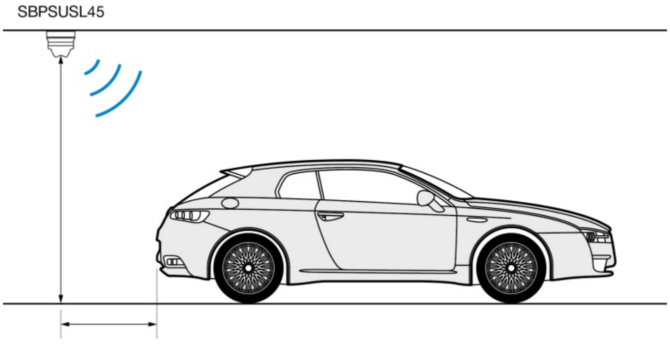
The 45-degree sensor must be mounted in the lane in front of the carpark space.

For best performance it is recommended to mount the 45-degree sensor in height of 2.5 m at the entrance of the parking space.

Sensor mounted in front of the parking space



Safe detection distance



The Safe detection distance is important to obtain a reliable detection of the car. If the installer does not obey this information, the sensors might not detect correctly.

*Table for combination between sensor height and distance to car

Mounting height of sensor in m	Safe detection distance in m
2,0	1,4
2,1	1,5
2,2	1,55
2,3	1,6
2,4	1,7
2,5	1,8

The aesthetic point of view must also be taken into consideration when mounting the sensor.

Make sure that the base is mounted so that the connectors in the base are pointing towards the carpark space. See the pictures below. See also under section 'Position of sensors'.

Place lane-mounted sensor correct outside the carpark space in an atheistic manner.

Place the base connectors so they are pointing towards the carpark space

The vertical carpark sensor must be mounted in the middle of the carpark space pointing directly down to the floor. The sensor must be mounted in an aesthetic manner maximum 4 m from the floor.

In both choices it is important to obey the rules of maximum +-5-degree vertical deviation and +-2-degree horizontal deviation for the lane mounted sensor. See section below: Positioning of sensor.

Please install the sensor according to the datasheet.

In the planning stage, decisions must be made as to where and how to mount the sensors. The decisions based on physical conditions will include:

• On the ceiling

• On a cable tray

• As a lowered sensor

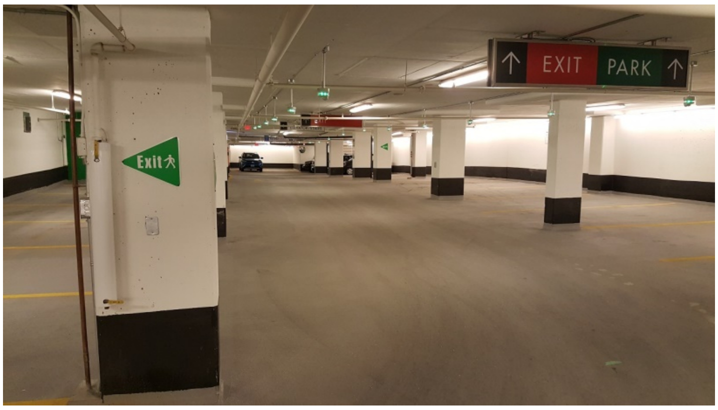
Each technique can be used, but installation time, price and aesthetic considerations must be taken into account.

In our experience, cable tray installation is a very quick installation. In addition, it is cheap (in Europe because of the labour) and it has a nice (aesthetic) appearance. In Asia experience has shown that customers prefer the lowered sensor installation.

Sensors mounted on a cable tray

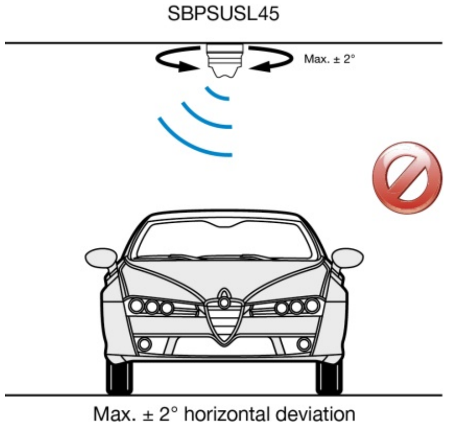
Sensors mounted on the ceiling

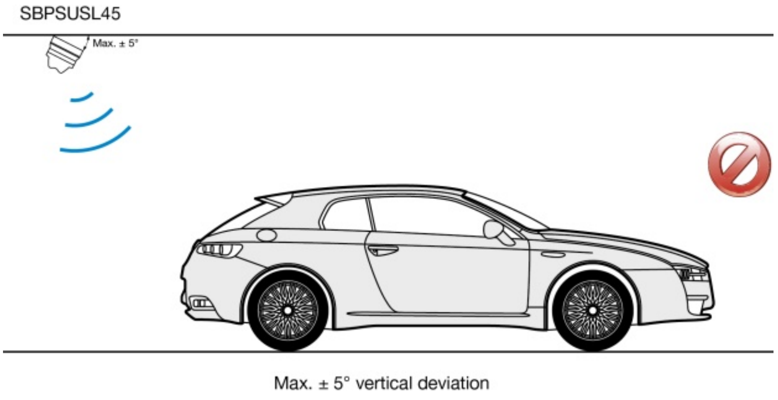
Lowered sensor installation



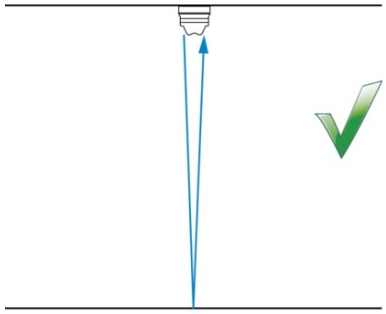
Positioning the Sensor

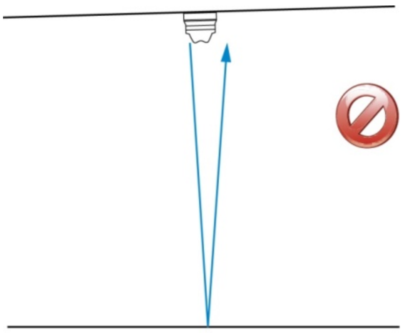
The lane mounted sensor must be installed pointing at a 45-degree angle towards a hard and straight surface. Rubble, sand and grass cannot be used as surface. If water and snow are covering the surface, the sensor cannot detect if a car is present or not. If a car is covered with snow, the sensor cannot detect the car. The sensor angle must be maximum +-5-degree vertical deviation and maximum +-2-degree horizontal deviation. Make sure that the base is mounted correctly so that the sensor is pointing towards the carpark space when mounted to the base.





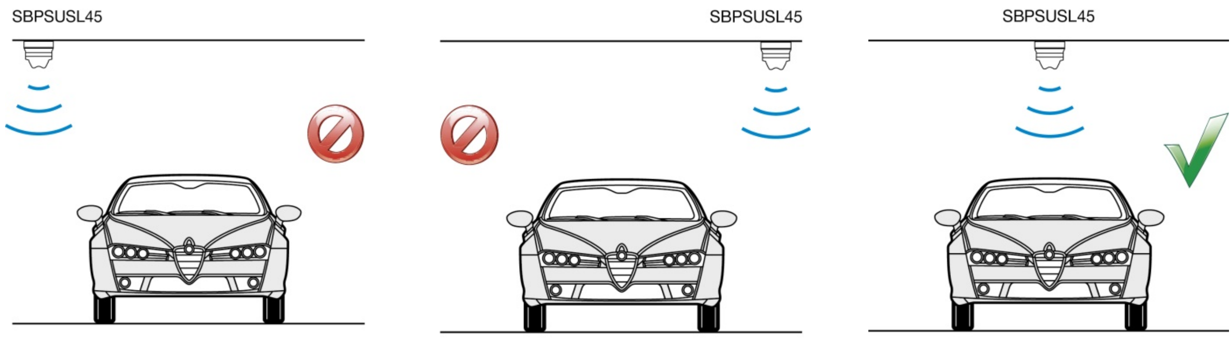
The vertical sensor must be installed pointing straight down to a hard and straight surface. The angle of the sensor must have maximum +-5-degree vertical deviation.



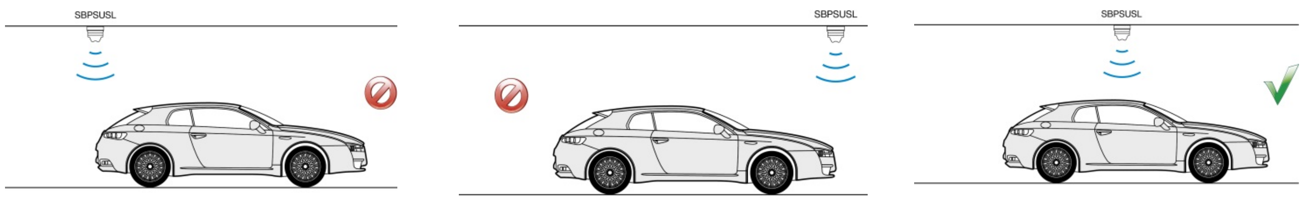


Both type of sensors, sends out a 40 kHz ultrasonic signal, and it is important that the receiver inside the sensor is able to detect the returning signal without problems. If the angle is difficult or the surface is of poor quality, the signal can be interrupted resulting in the sensor flashing red.

The lane mounted sensor must be mounted correctly in the middle, in front of the parking space in height of 2.5 m, to ensure a perfect and reliable signal.



The vertical sensor must be mounted correctly in the middle of the parking space to ensure a perfect and reliable signal.



Wiring the Base

The wires can be connected to the base connectors without the use of tools because the ‘push connector technique’ is used. Just press the stripped single-core/ferrule wire into the connector and it will be perfectly connected on the inside.

Mount the wire by pushing the wire into the connector

To release the wire from the push connector, press and then pull the wire.

Leave 20 cm or 8 inches of extra wire for making the connections to the base. This extra wire not only makes it easier to connect the sensors, but it also prevents stress to the connections due to extreme radii.

Mounting the Sensor in the Base Holder

Connect the sensor to the base with RJ12 connector

The sensor must be mounted into either base A or base B.

Step 1: Place the sensor with the vertical mark so it is pointing towards the tip of the triangle on the base.

Step 2: Twist the sensor clockwise until the vertical mark is positioned at the rear end of the triangle. The sensor is now fixed to the base.

Step 3: The sensor can be sealed to the base by inserting a screwdriver in the slot on the side of the sensor. Turn the screwdriver anti-clockwise for sealing

Step 1

Step 2:

Step 3

Releasing sensor from Base:

Step 1: Use a small screwdriver and put it in the vertical slot on the base

Step 2: Turn the screwdriver clockwise to detach the sensor from the base

Step 3: Twist the sensor anticlockwise.

Step 1

Step 2

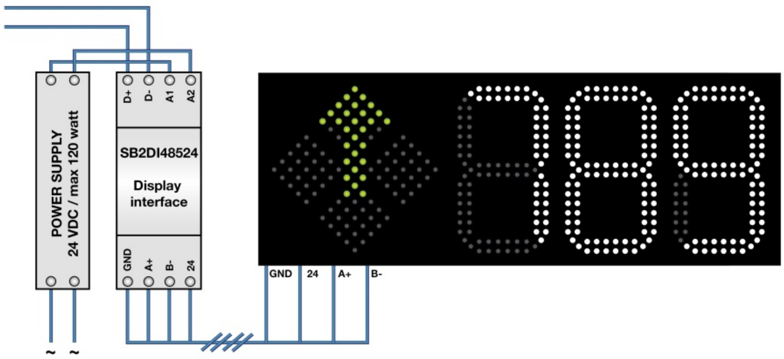
Step 3

Mounting the Display and Display Interface Module

Display Interface Module

The display interface SBP2DI48524 is a 2-din rail 'black box' that converts Dupline® to Modbus. It can be installed nearthe display or in the cabinet (maximum 300 m from display) with the other cabinet modules.

The interface module is 24 VDC supplied by an external supply. Do not power the interface module with the pulsating 28V from the Dupline® bus. The interface module must be mounted with D+, D- from any Dupline® lane in the Carpark system. The output is a RS485 and 24VDC output which must be connected to the yellow and green wire and brown and white wire on the display.



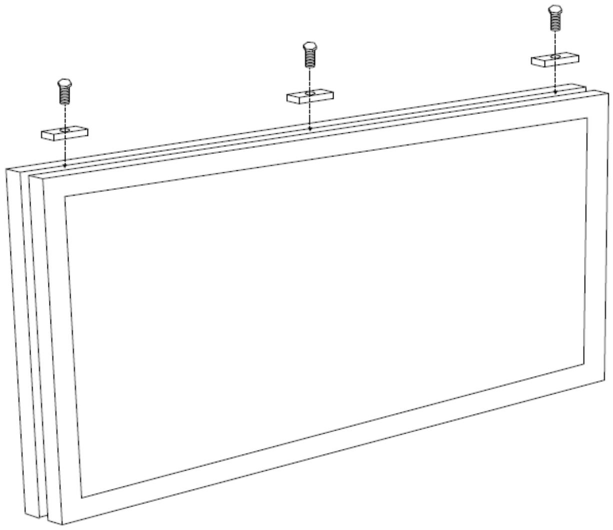
Display

The display has 4 wires that must be connected to 24VDC (Brown, White) and RS485 (Yellow +, Green -) respectively to the display interface module. See above.

There are a large variety of displays, and for example, the data regarding dimensions and power consumption can be found in the datasheets. The correct size of the power supply must be chosen accordingly to this information.

The display must be mounted with the supplied hammer nuts.

The display's aluminium frame has a slit where three 6 mm nuts for mounting are placed. By using the nuts, the installer can install the display in the ceiling or on the wall.



The display shall be mounted by using the included hammernuts.
Put the hammernuts in the slit and twist to secure.
Use e.g. a threaded rod or screw with 6 mm to secure the display to the wall or ceiling.
Note: Do not open the display under any circumstances. The display and sealing can be damaged. Also the waranty will be lost.

If the display is mounted in environments with temperatures lower than -20 C degrees, we recommend using the display variant SBPDISxxxT.

The ‘T’ indicates a built-in heating element that ensures an operational temperature if the temperature drops below -20°C.

Cabinet Installation

The cabinet(s) for all the DIN rail-mounted Parking Guidance System modules is (are) suggested to be placed in the middle of the system in order to have a uniform load. It is also an advantage (because only few cabinets are used) and the length of the cable to the sensors is reduced. This subject was discussed earlier in the planning process. See section ‘Phase three’. The cable length can be calculated as shown under the section ‘Calculation’.

Reducing the length of the cable to the sensors makes it possible to mount more sensors on the same Dupline® bus. (But maximum 50 sensors in a line and maximum 90 sensors to a MCMG).

If required, the cabinet(s) can be installed away from the system or simply at the end of the system. If the rules mentioned in section ‘Calculation’ are ignored, it is important to perform a load and voltage drop calculation. See the same section, ‘Calculation’.

Cabinet Modules

The cabinet modules are din-rail mounted. The modules we will use are listed below.

Basic modules:

Carpark master generator SBP2MCG324

Carpark controller	SBP2WEB24
Power supplies	any approved galvanically separated DC power supplies with 28VDC output
Optional modules:	
Carpark server	SBP2CPY24 (if the number of spaces exceeds 630 spaces or 2 or more SBP2WEB24 modules)
Carpark display interface	SBP2DI48524

Cabinet Structure

The selected cabinet must always be an approved cabinet according to the regulations of the building or country for that specific installation. Refer to planning process in section 1.

Use a cabinet with enough space for heat dissipation so that overheating caused by power supplies and power consumption is prevented.

Place the modules in lanes and use cable channels to maintain the aesthetics of the cabinet and to keep it in order. If more than one wire is connected in a terminal, make sure that the same square is used and/or use ferrules to ensure a good connection in the terminal.

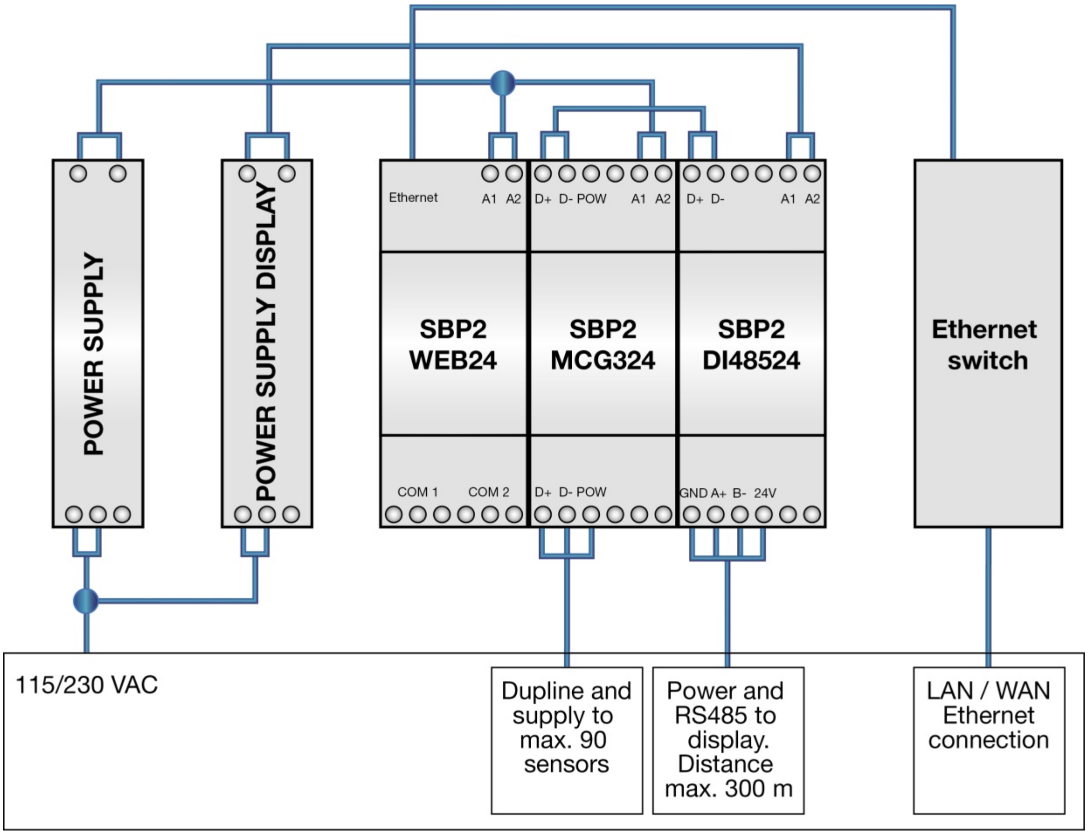
This example shows one SBP2WEB24 and two SBP2MCG324 with two power supplies. To the left we have a display interface module and one SBP2CPY24 that is powered from one power supply

Example of a simple wiring in a cabinet

In this example we have on the top row, three 2Amp power supplies for the SBP2CPY24 and the SBP2WEB24 on the top row and the SBP2WEB24 on row two respectively. Additionally we have five SBP2MCG324 with five 5amp power supplies on row two and three. Further on we have fuses, Ethernet switch and a cabinet power switch on row three and four.

The SBP2WEB24 on row one is for light control and HVAC equipment.

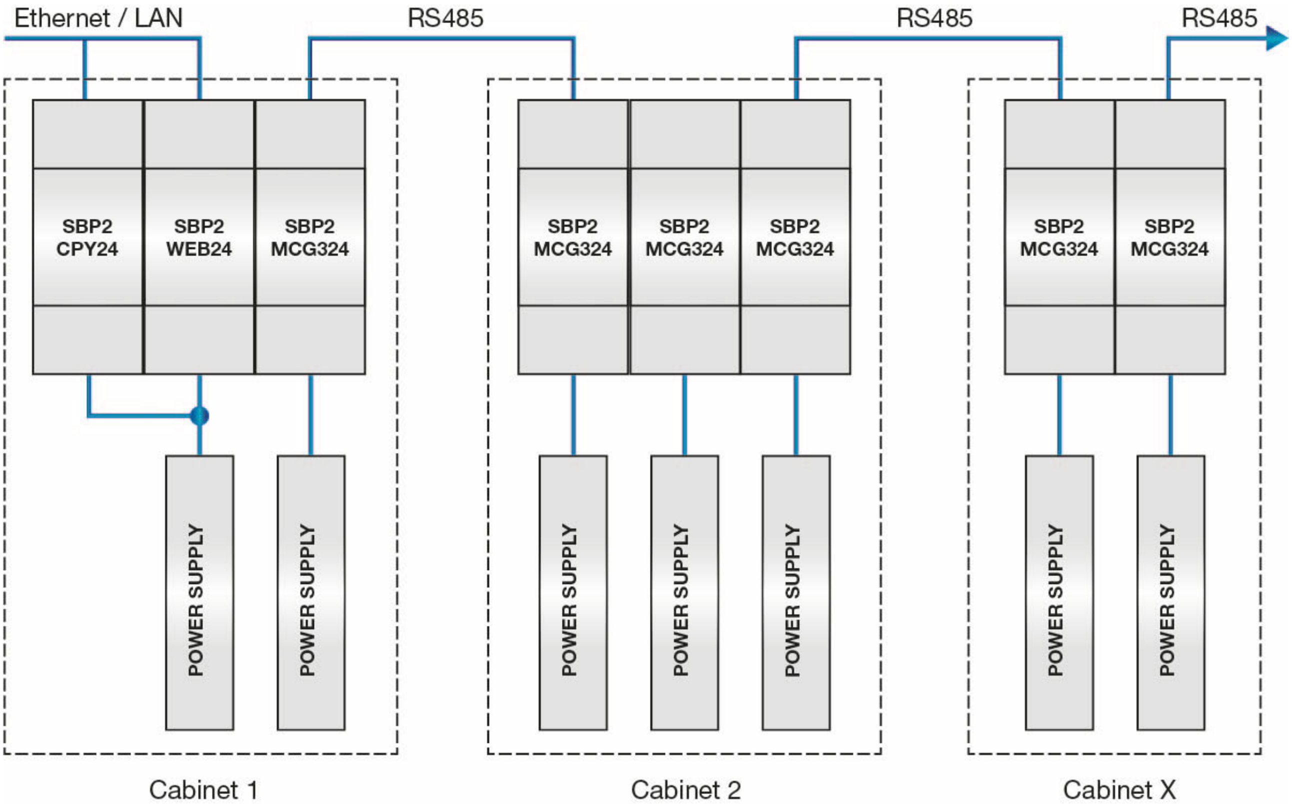
The drawing below shows an example of a lane including power supplies and display interface.



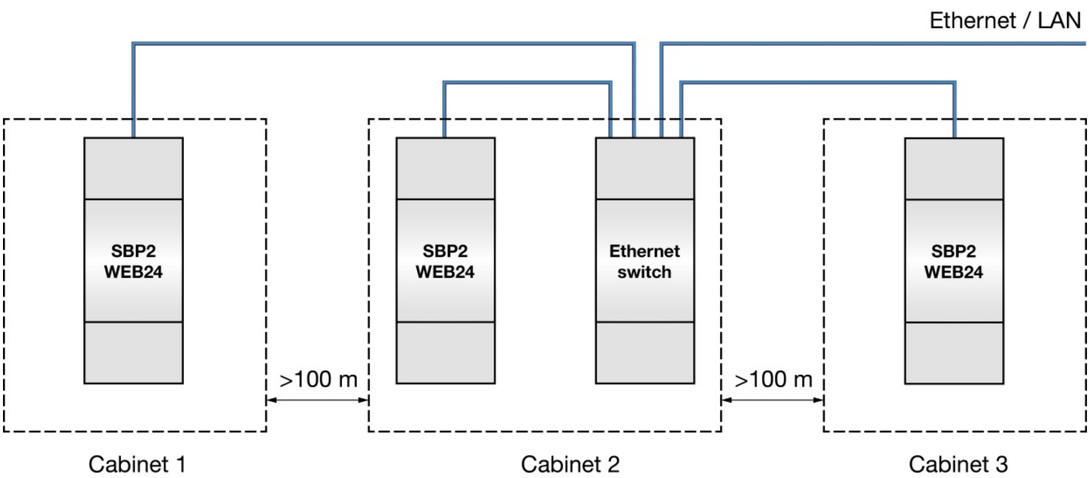
Interconnections of Cabinets

The MCG modules in the cabinets are connected to lanes containing sensors and displays. But to make the system complete, we must interconnect the cabinets with each other.

The interconnection is done by making a connection using the RS485 on the MCG from cabinet to cabinet. The RS485 connection between the SBP2MCG324 can achieve a length of maximum 600 m. When the connection is complete, all the data are available on any bus in the system.



Each of the SBP2WEB24 controllers has an Ethernet connection for the network. Keep in mind that the Ethernet cable must not exceed 100 m without repeating, so if distances are long, use an Ethernet switch to meet this requirement..



Software

This section will briefly discuss the configuration software and the carpark software. A more detailed information and guide can be found in the software installation manual. Both manuals are available on: http://productselection.net

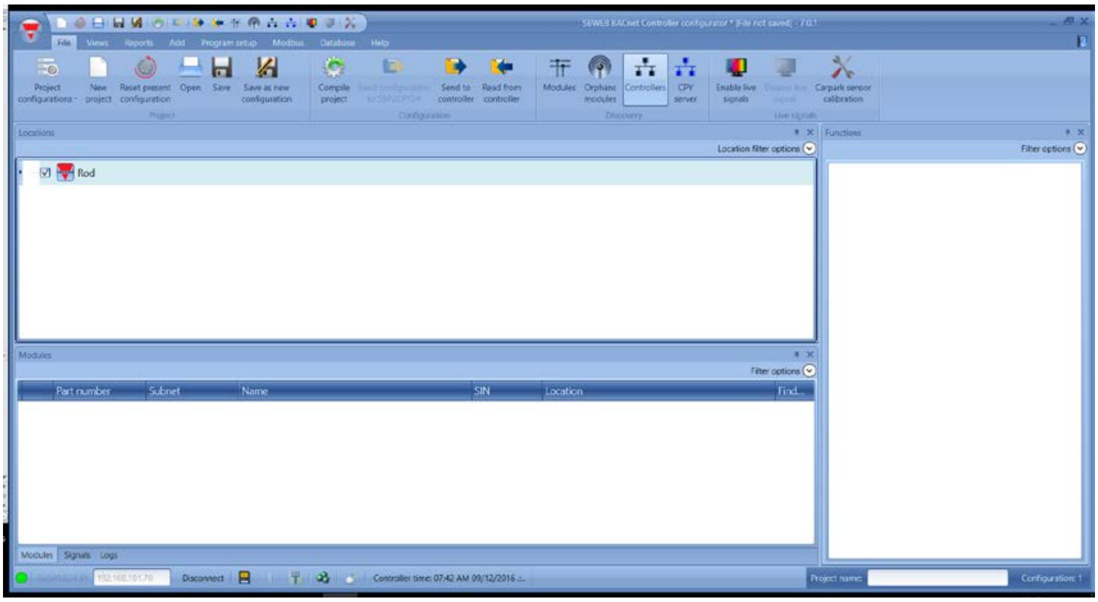
In the following, we will discuss the configuration of the carpark modules including assigning the sensors, LED indicators and display interfaces to the proper lanes and lines. Calibration will be discussed as well.

Configuration Software

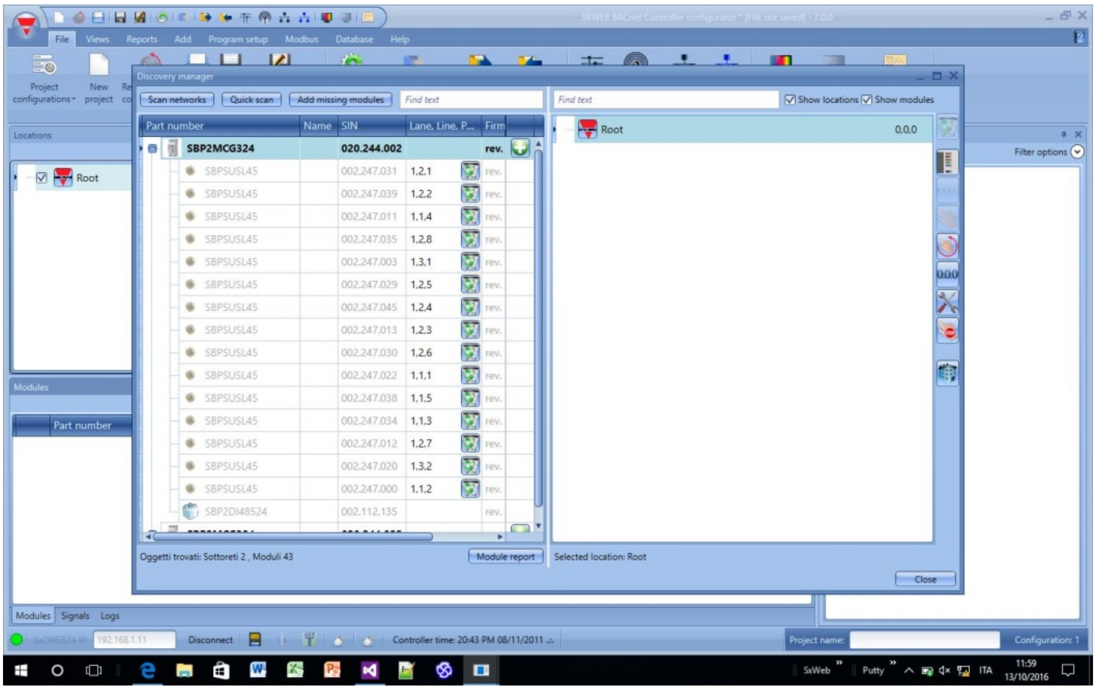
When all the modules are connected to the bus and the power is on, the next step is to start configuring the carpark modules to the respective lanes, lines and positions. The configuration software can be found here: http://productselection.net

Configuration and Assigning Carpark Sensors

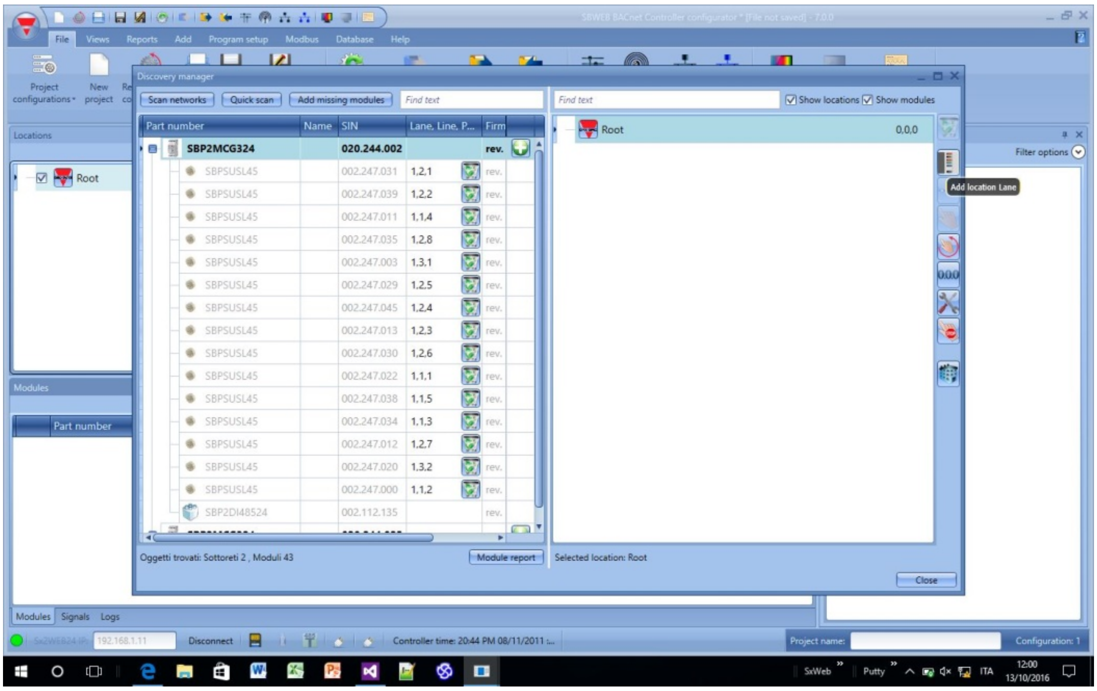
Step 1: Select the carpark controller for the specific lane(s) you want to work on



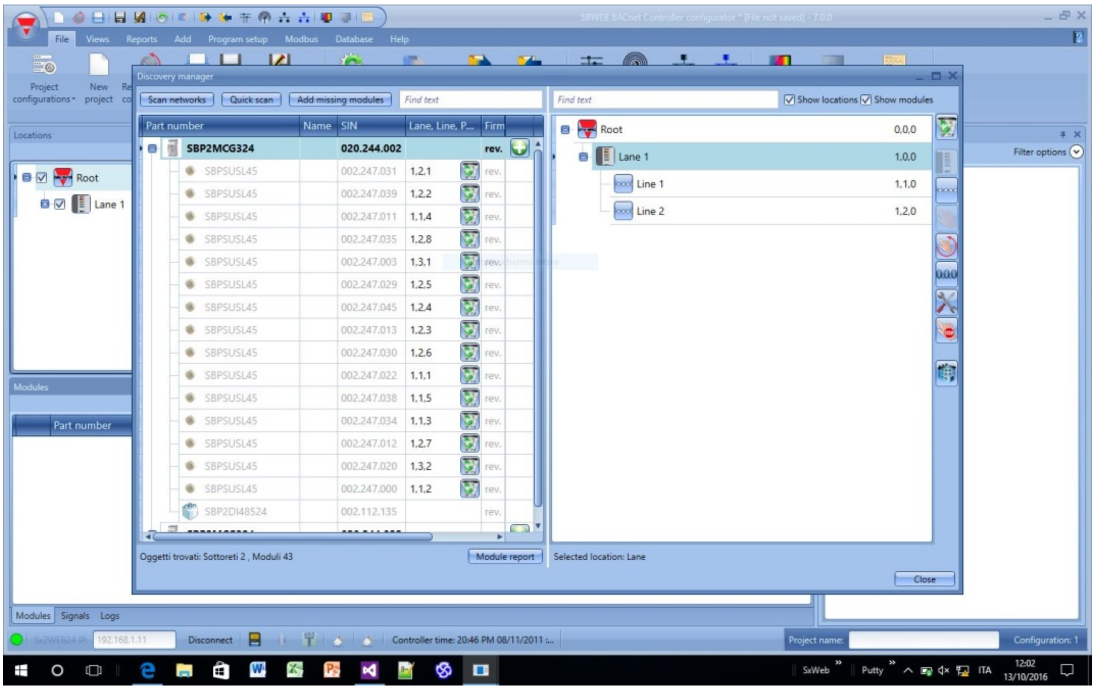
Step 2: When the modules are connected, select ‘Modules’ and ‘Quick Scan’. The quick scan can take minutes depending on the number of modules connected to the SBP2WEB24. (Maximum 630 carpark sensors)



Step 3: Define the lanes by pressing “Add Location Lane” on the toolbar to the right



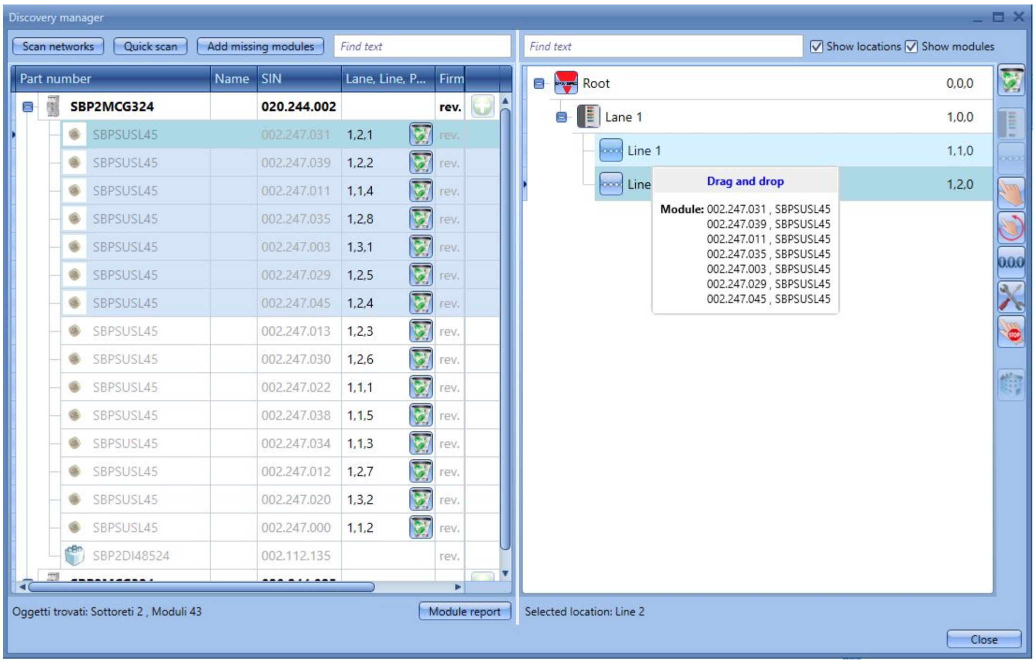
Step 4: Define the lines according to the physical layout by pressing “Add Location Line” on the toolbar to the right.



Now you have two options to assign the carpark sensors. Either drag and drop the sensors you want to assign to a specific line by using the SIN number, or assign the sensors manually by pressing the assign button on each sensor in consecutive order. Option 2 is the easiest and fastest way to assign the sensors and is recommended for all types of installations.

Option1:

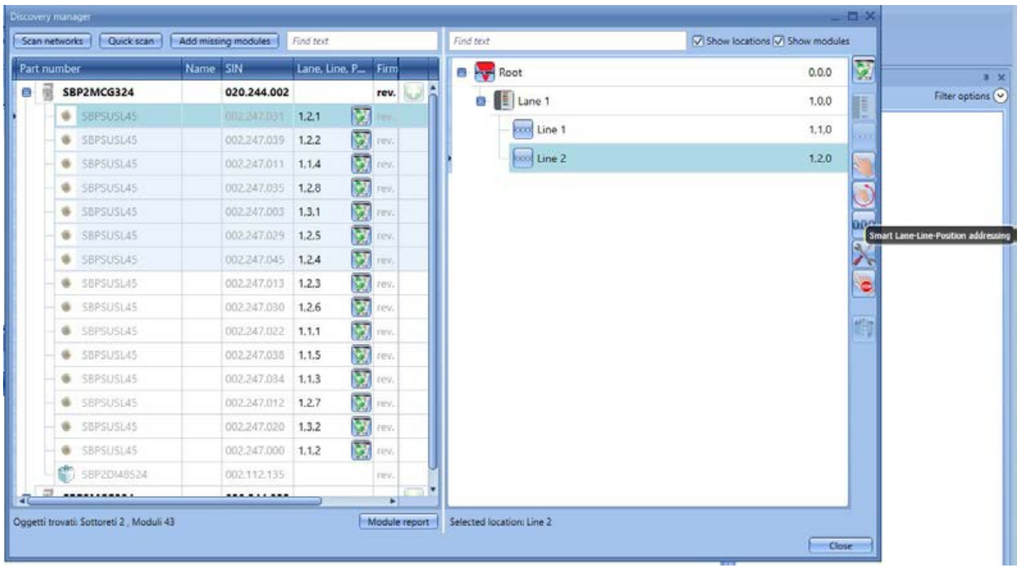
The picture below is an example of lining the sensors by drag and drop.



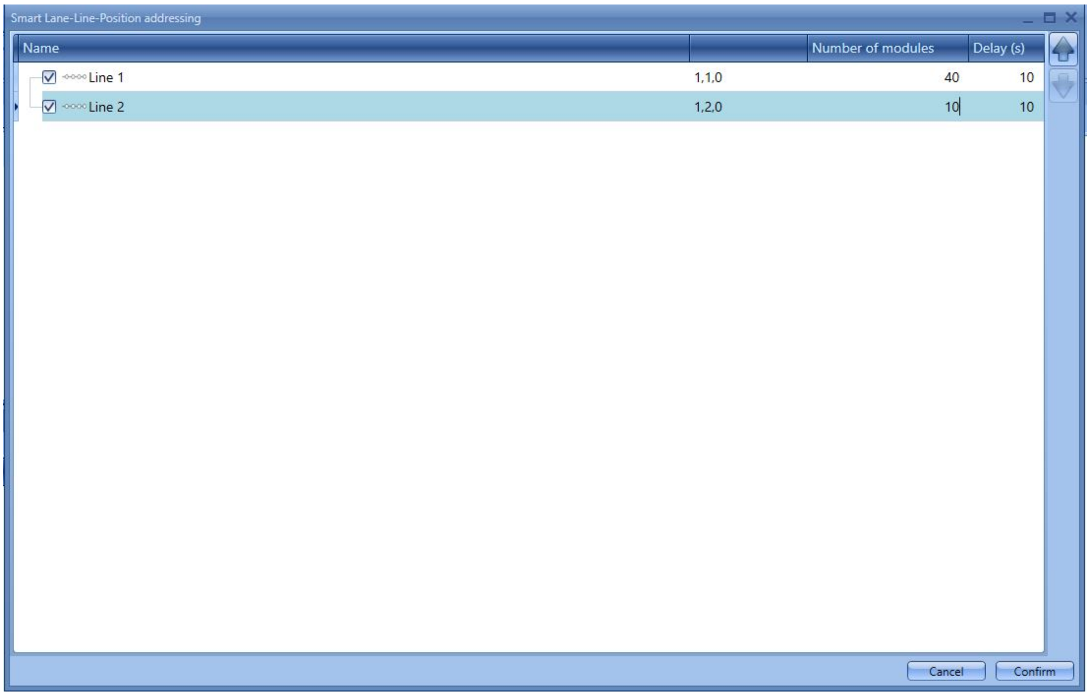
When the sensors have been dragged from the list on the left side to the specific line on the right side (see picture above), the installer must manually place the sensors in consecutive order by positioning them internally.

Option two:

Define the lines as the above picture shows and then select the ‘Smart Lane-Line Position Addressing’ mode in the toolbar on the right side.



This enables the manual sensor assign mode and opens the window below. Using this option, the installer just needs to select the "Number of modules" in each line and then manually assign each sensor by pressing the local button on the sensors in consecutive order. See the guide below.



Select the number of sensors which must be assigned for the lines and also select a time delay. Default is 10 sec.

Press 'Confirm' to accept and to start the assign sequence.

LED feedback from sensors: All sensors that are selected to be assigned will start blinking yellow

Go to line 1 and press the button on the first sensor. This sensor will get position 1 in line 1.

LED feedback from sensors: Sensor 1 will change from blinking yellow to blinking green. The other sensors continue to blink yellow. Continue pressing all the sensors in consecutive order in line 1.

Press the button on the last sensor in line 1

LED feedback from sensors: All the sensors from line 2 and forward will turn off in a preselected time delay (defined in assign mode. See above). This time delay is adjustable (default of 10 sec) and indicates that line 1 assignment has ended and you can start line 2. After the time delay has expired, the LEDs on the sensors from line 2 and forward start blinking yellow, and you can continue assigning the sensors to the correct positions until all sensors has been assigned.

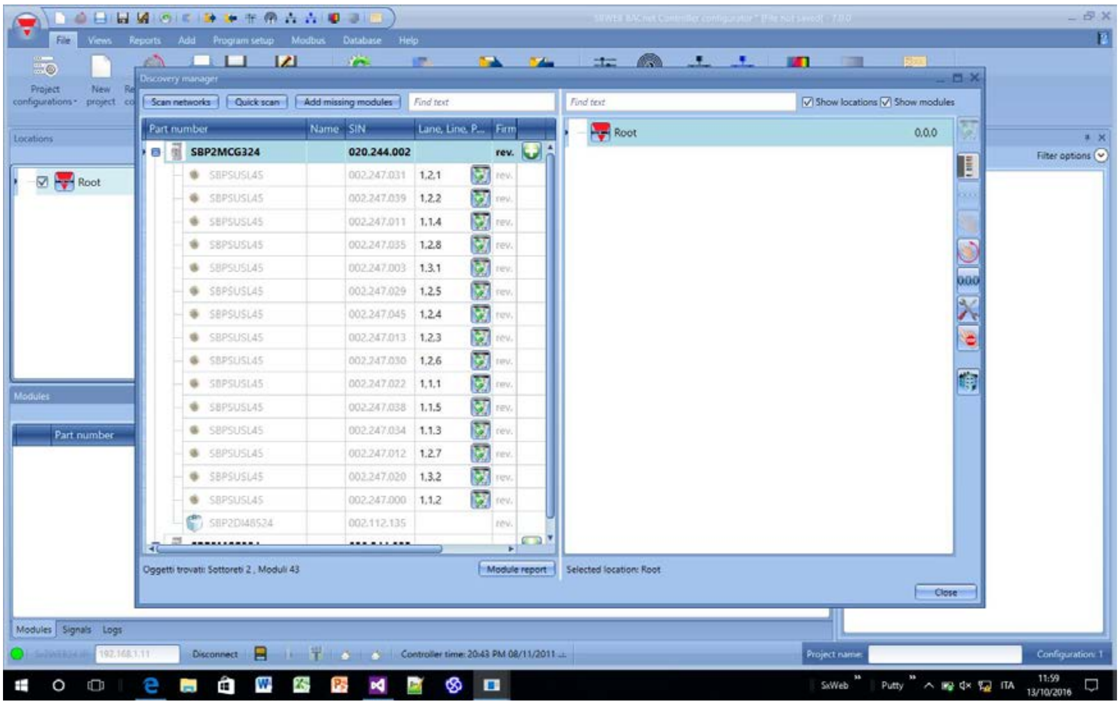
It is very important to assign the sensors in consecutive order, so the sensors are referring to the correct physical position on the line. If this rule is not observed, the sensors do not refer to the correct position and the assign sequence must be repeated until it is correct.

When the assignment has ended, remember to save and upload the configuration to the carpark controller.

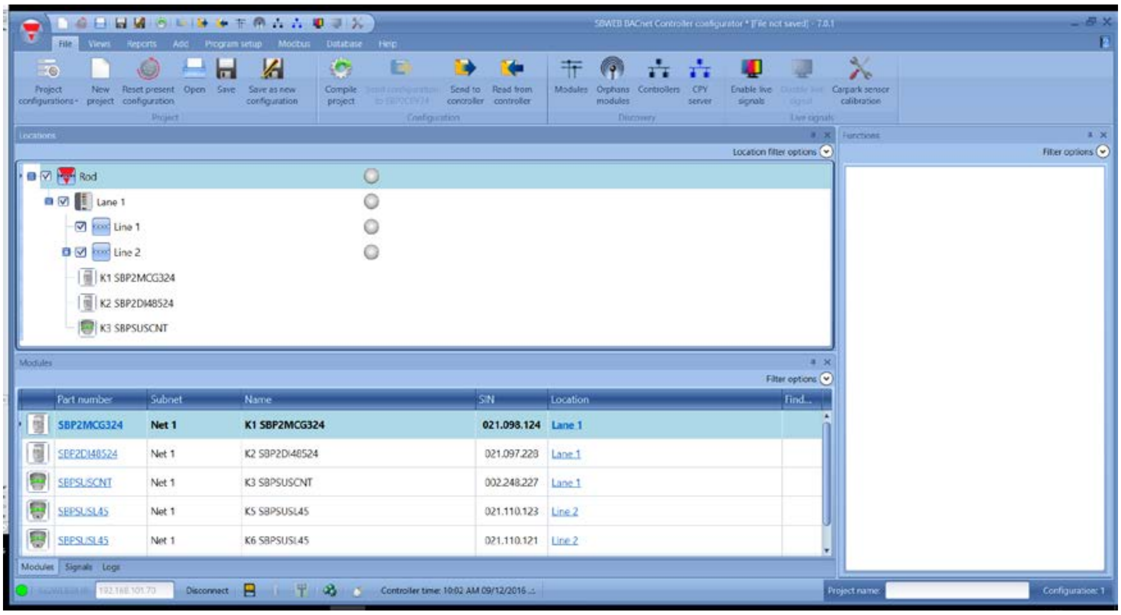
Assigning Display Interface Modules (DIM)

The DIM is not assigned in the same way as the sensor, but in configuration mode, the DIM must be assigned a unique name and a display type (2 digits, 3 digits etc.).

To find the correct DIM in the list, use the SIN number and compare this with the physical SIN number on the module.



Select the DIM in the list below by clicking on the icon

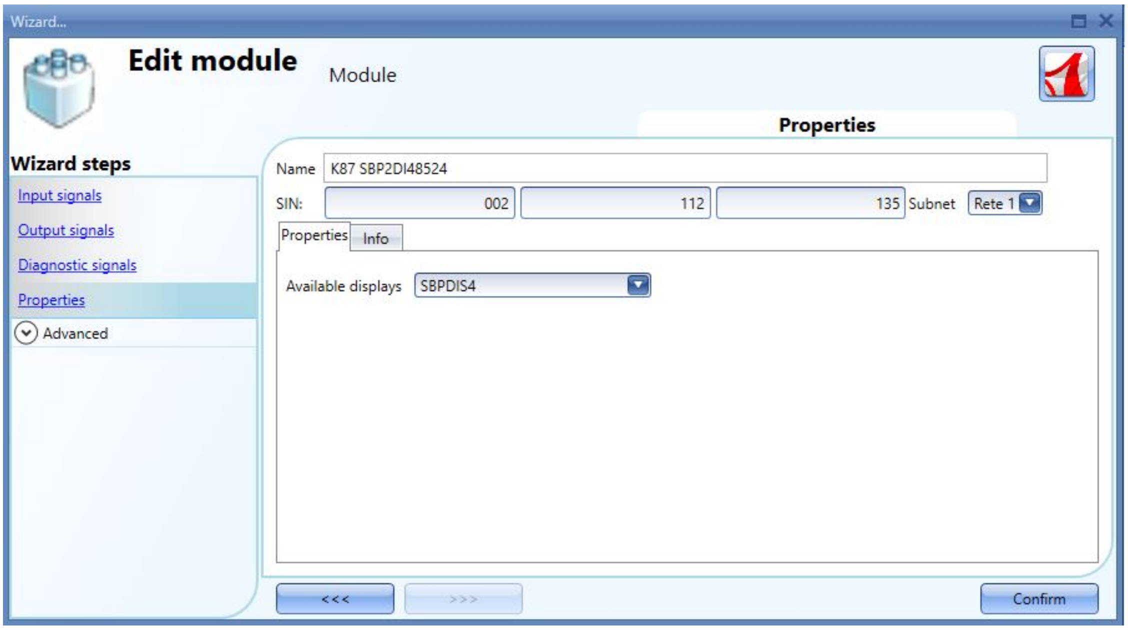


Select a proper name for the display. E.g. ‘Total floor 1’

Select under ‘Properties’ – ‘Available displays’. In this example, a 4-digit display is selected.

Repeat this procedure until all the DIMs are named and assigned to a display type.

Save the work and upload data to the controller.

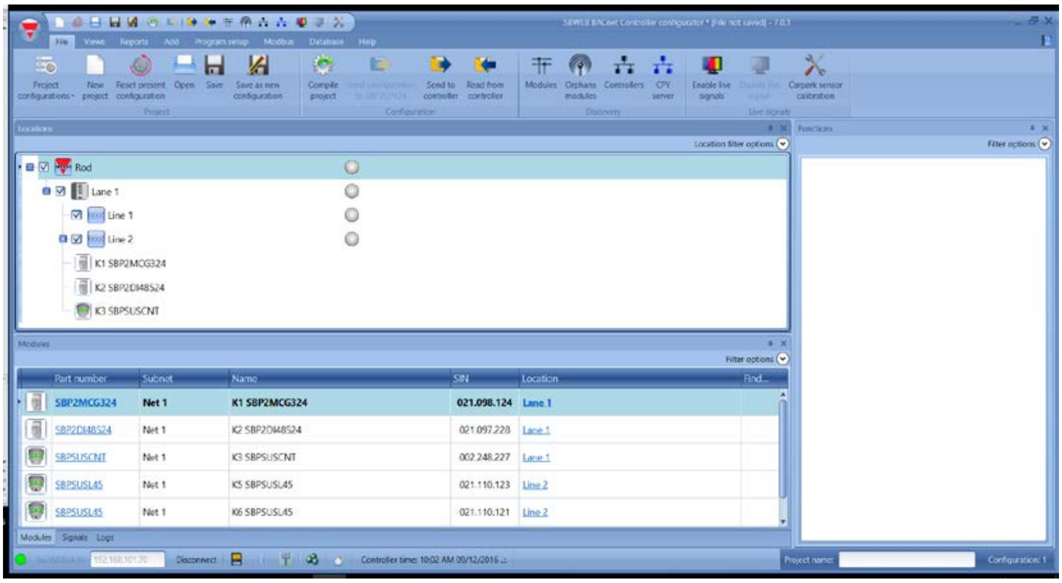


Calibration

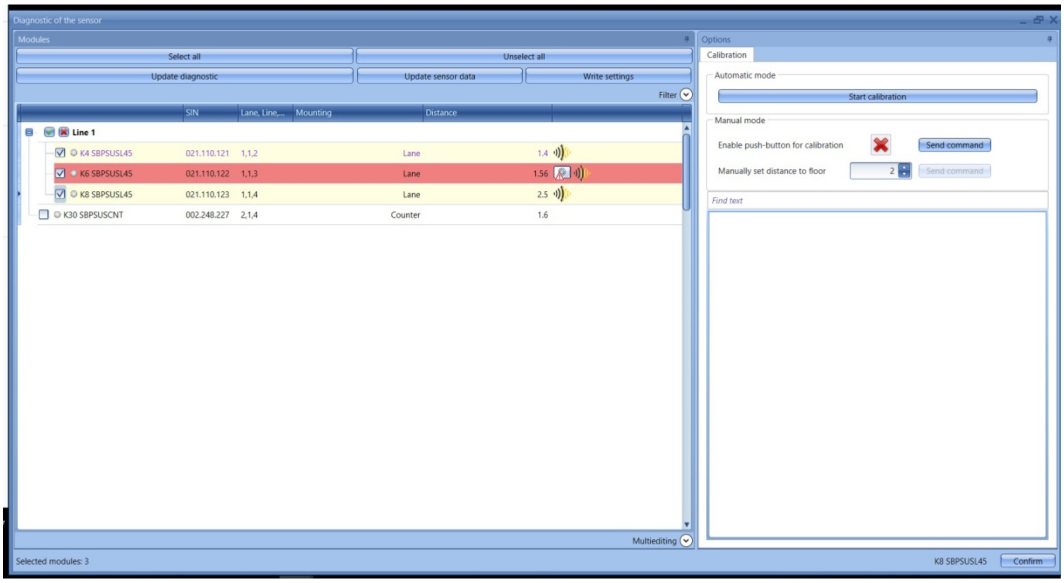
When the sensors, LED indicators and display interfaces have been assigned, the next step is to calibrate all the sensors. Please keep in mind that calibration can only take place when the carpark space is empty.

Automatic calibration

Select ‘Carpark sensor calibration’ from the upper toolbar.



In the left menu, you can select the number of sensors to calibrate (maximum 630 sensors), or you can select a group of sensors or one by one. You can identify the sensor by using the SIN number or the physical location, e.g. 2.7.18 (Lane 2, Line 7 and Position 18),

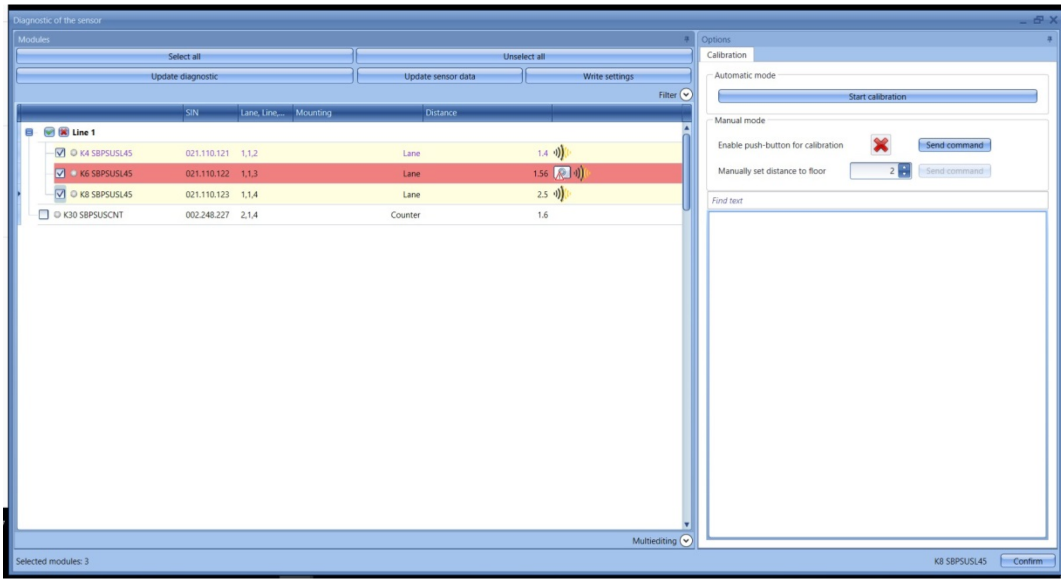


Press ‘Start Calibration’ in Automation mode

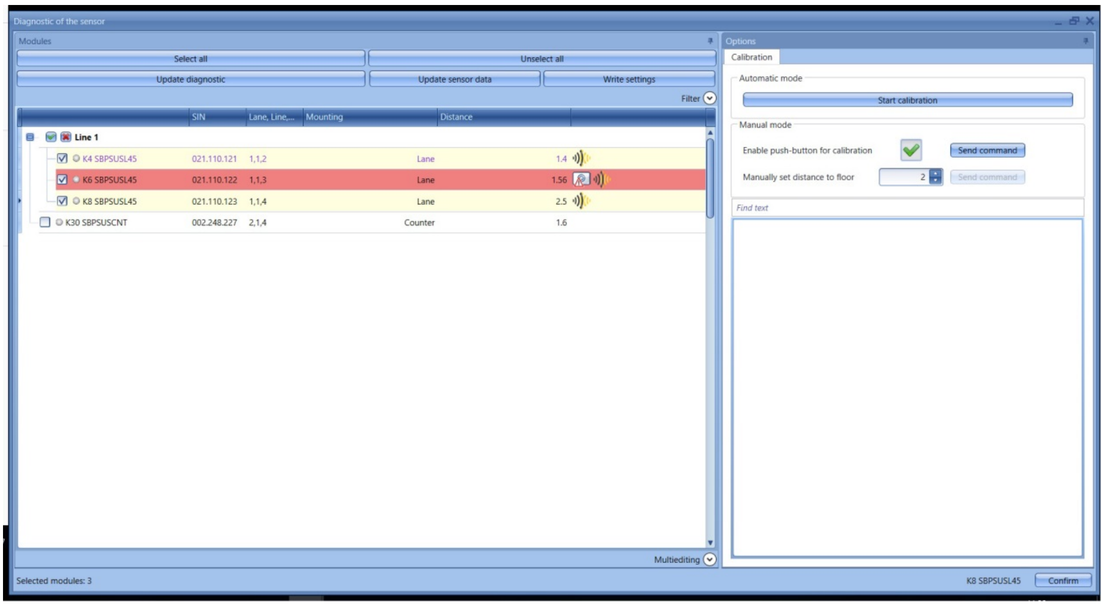
Feedback from the LEDs on the selected sensors: Yellow flashes for 3 sec. Then the colour changes to green for 3 seconds and turns steady green if the calibration ends successfully. If the colour flashes red and turns steady red, please try to calibrate once more. If still unsuccessful, the sensor is defective and must be replaced. Once the sensor has been replaced, perform calibration again.

Manual Calibration

The manual calibration is performed in situations where the installer only needs to calibrate one or a few sensors. This is often the case in situations where a single sensor has become defective for an unknown reason.



Press 'red cross' in the manual calibration menu. The cross changes to a green tick and allows you to 'Send a command' to specific sensor(s) for manual calibration.



The sensor(s) to be calibrated are found on the list in the window to the left.

Select a lane/line by ticking the appropriate box or open the lane to select one or several sensors. When the sensors are selected, go to the calibration menu on the right side and press the 'Send' command.

The local button on the sensor is now enabled for manual calibration.

Press the button on the sensor for calibration.

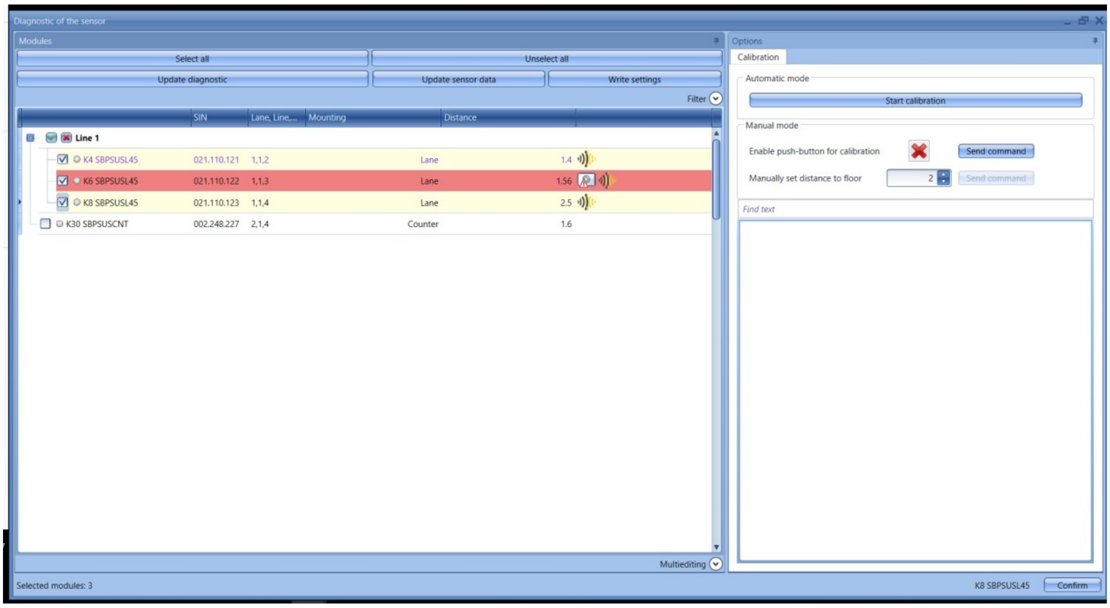
Feedback from the LEDs on the selected sensor: Yellow flashes for 15 sec. Then the colour changes to flashing green for 3 seconds and turns steady green if the calibration ends successfully. If the colour flashes red and turns steady red, please try to calibrate once more. If still unsuccessful, the sensor is defective and must be replaced. Once the sensor has been replaced, perform the calibration again.

When the calibration has ended deselect manual calibration mode by ticking the calibration menu.

Override mounting height (Calibration)

This function can be used to override the calibration for a single or several sensors. This function is used in those situations where the 45-degree sensor is not capable of performing a calibration because of the construction of the parking space. If obstacles are mounted lower than the 45-degree sensor, it can be difficult to calibrate the sensors. See section 'Selection of Sensor Type'.

The override function is completely legal and the sensor will perform correctly without calibration.



Steps to follow:

- Measure the distance from the floor (directly under the sensor) to the sensor.
- Select the sensor(s) in the left menu, whose height must be overridden manually
- Type in the height by scrolling the up/down key under 'Override mounting height"

- When the height is selected, press the ‘Send’ command

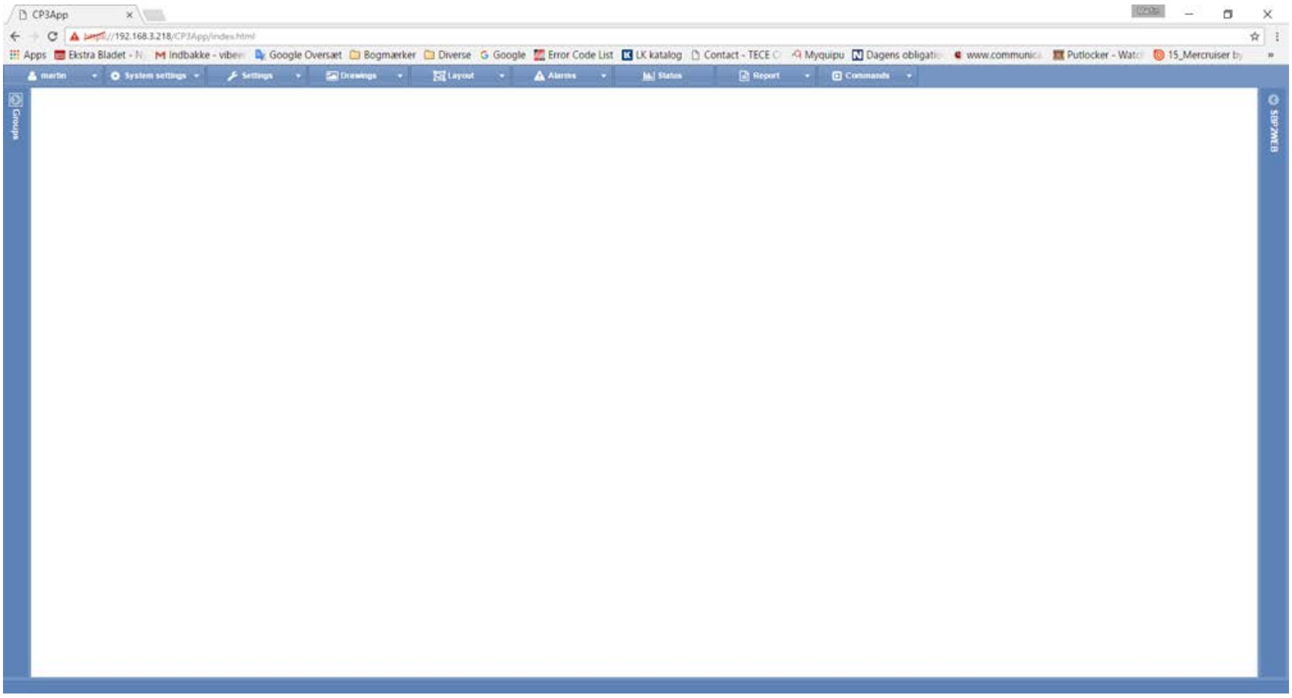
Feedback from the LEDs on the selected sensor: The sensor turns steady green (no cars present at the carpark space). If the LED on the sensor is still red or blinking red, check the distance once more and resend the command or replace the sensor.

Carpark Software

When the configuration is complete, we move to the carpark software part where we can import drawings, make alarms, analyse trend curves, book and unbook carpark spaces etc. In this manual we will only show a small part of all these functions while referring to the carpark software manual, which can be downloaded here: http://productselection.net

Basic Setup

The screenshot below shows a carpark software before it has been configured. It is important that the installer/programmer starts working with the carpark software in the right order to get the best result.
Always start from left to right on the toolbar.



- ‘User’. Settings for language settings, date/year, and so on.

This setup is a requirement for running the CPY with the correct date and time format (European/US)

- ‘System Settings’. For selecting LAN, Modem, Clock and Firmware.

This setup is a requirement for LAN or Modem settings together with the Clock. Clock is needed for real time stamp and for internal use of the clock. Always check for latest firmware release.

- ‘Settings’. For selecting general park settings, such as account, status/category setup.

The first three menus must be completed because the settings have an impact on the future database in the carpark software. The last two menus (Group Settings and Scheduler) can be filled out later. They are used for booking, sending data to emulated displays, etc.

- ‘Drawings’ adds drawings and designs carpark structures.

Optional. In the drawings menu, the installer can build up the entire structure of the carpark installation. Drawings can be imported and icons can show the status of each space, such as available, occupied, disabled, VIP etc. Physical displays with steady or moving arrows can be assigned and configured, and emulated displays can be configured to show a specific status, such as the number of occupied spaces or VIP spaces in one floor or the entire system.

- ‘Layout’. Option for personal screen view. E.g. Status page and alarm page as the preferred screen view.

This menu is optional but can be used to personalise each user’s screen layout. Show the menus as cascade or in layers. Decide which menus shall be in focus etc.

- ‘Alarm’. See historical alarms and acknowledge alarms. It is also possible to set different alarm set points for groups or individual carpark spaces.

Optional.Useful if, for example, you want to set the alarm if predefined parking times are exceeded.

- ‘Status’. A view of the entire system shown as bar graphs or as a table.

Optional, but provides the operator with useful information of the occupancy on each floor or the entire system

- ‘Reports’. For occupancy and space statistics.

Optional, but useful for historical investigations of space and area statistics, such as occupancy, available spaces and most used/unused spaces, either as a graph or as a table.

- ‘Commands’. For example, the sequence setup to control a gate when the carpark is occupied.

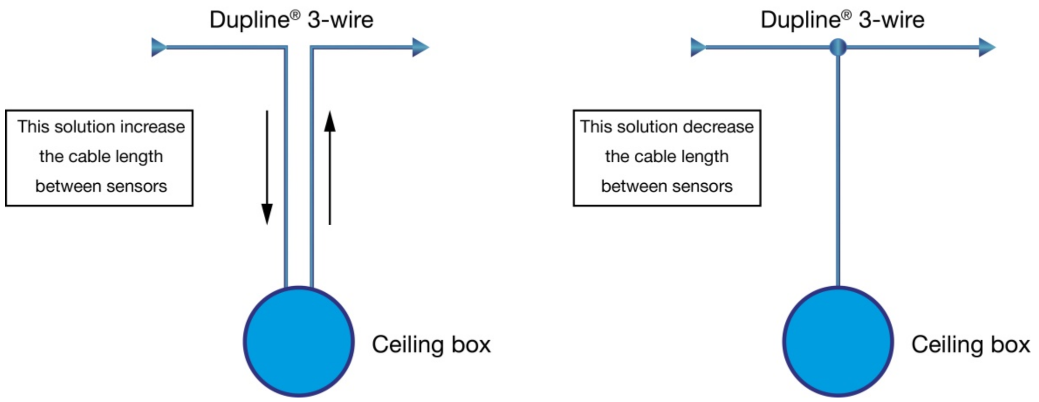
Optional but useful to control a gate when the floor/all is occupied, for example.

System Calculation

Before any installation, it is important to make sure that the system with cables, sensors, LED indicators etc. are correctly mounted according to load and voltage drop. We will discuss some basic rules to adhere to this so that the outcome will be the best-designed installation in all circumstances.

Rules of Thumb

- Maximum 90 carpark sensors connected to a MCMG
- Maximum 50 sensors in a Line
- Use always unshielded 3*1.5 mm^2 cables for the sensors and LED indicators
- Use maximum 3 m between each sensor / LED indicator. (If the sensor is lowered from rail or ceiling, it is recommended to make the connection in the ceiling box and only pull one 3-wire to the sensor/LED indicator, instead of pulling the cable down and then up again. See drawing below.
- Maximum 60 m cable from the cabinet to the first sensor in line when cable type3*1.5 mm^2 is used.



Note: It is recommended to make the connection in the ceiling box instead of pulling the wire from the ceiling to the sensor and back to ceiling again. This is to avoid a long cable distance.

Example:

If the lowered pipe from ceiling to the sensor is 0.5 m, the cable between the sensors will be increased by 2*0.5 = 1.0 m.

Using the table below, we can see the result by increasing from 2.5 to 3.5 m using 50 sensors in a line.

Changing distance between sensors is not a big problem as shown in the table. However, changing the number of sensors is more significant. If there is 3 m between each sensor, the table shows a change from 130 m to 81 m going from 40 to 50 sensors. That is 60% extra cable length.

Calculation

If you are searching for different installation methods, please follow the calculation examples below.

For maximum 90 sensors connected to a MCMG and maximum 50 sensors in a Line.

Resistance in 1.5 mm^2 wire: 13 ohm/km

Current consumption in sensor: 28 mA

Maximum current in a lane is 28 * 90 = 2.52 A

The SBP2MCG324 has a maximum output current of 2.6 Amp.

A 25 % duty cycle is worst case scenario. This is because no outputs are used on the Dupline® when only carpark sensors are used. This means we have 125 % current (pulsating) from the cabinet to the first sensor.

We accept a maximum voltage drop of 3.5V on the Dupline® bus, from the cabinet to the last sensor in the line. Because the D-wire is a ”common wire” for both Dupline® and the 28V supply, the calculation is as follows:

2'nd degree equation:

$0.5*S*X^2+X*L-7216=0$

X = Number of sensors

S = Length between the sensors

L = The distance from cabinet to first sensor in line

This formula can be used to calculate the above mentioned unknown factors in a carpark line. Please find the calculation spreadsheet named "cp3" on http://productselection.net/

Table for Cable Length, Cross Section and Number of Sensors in a Line

The table below can help decide upon cable length and number of sensors in a line from cabinet to sensor 1 and between the sensors.

An example could be:

50 sensors in a line using a 1.5mm^2 cable. Distances between sensors are 3.0 m.

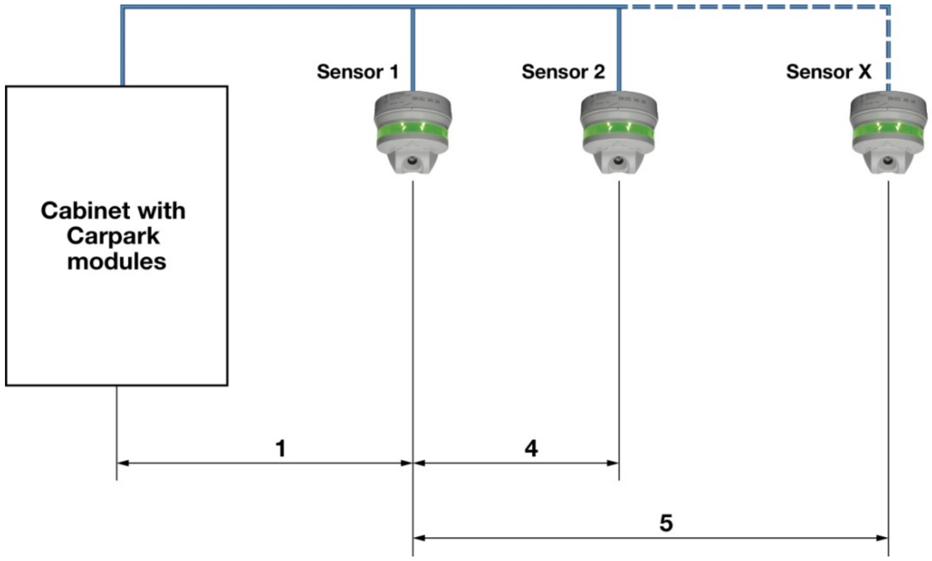
The result from the table is the following:

Maximum cable length from the cabinet to first sensor in line is 69 m

Maximum cable from sensor 1 to sensor 50 is 150 m

1	2		4			5
Cable C-1	40	50	2.5 m	3.0 m	3.5 m	Cable 1-X
130	X		X			100
120	X			X		120
110	X				X	140
81		X	X			125
69		X		X		150
56		X			X	175

1. Cable length in m between cabinet and sensor 1
2. Number of sensors on a line
3. Distance between sensors in m
4. Cable in m between sensor 1 and sensor X



Please contact your Carlo Gavazzi Sales office if you have any questions regarding the calculations, or if you need help with your calculations.

Carpark Master Zone Counter (MZC)

Introduction

The Master Zone Counter (MZC) is part of the Dupline® Carpark 3 system. The MZC is a counting system which is able to detect and count cars when they enter and exit zones in the Carpark facility and send the information to displays and the Dupline® Carpark software for display on a computer.

To make the MZC system fully compatible with the single-space detection system, the MZC transmits its count values by emulating a number of single space segments. This means that the values for the displays are broadcasted on the 3-wire Dupline® bus. Also, the values are displayable in the CPY, so that they can be used in the Carpark software equal to the data from the standard space by space system.

The MZC system is often used in a single-space system to keep track of the cars on the rooftop, where no ultrasonic single-space sensors can be installed. It can also be used to implement a complete parking guidance system at a lower cost than a single-space system.

Hardware

The MZC is using the same hardware as the standard Carpark guiding system:

SBP2MCG324 - Carpark master generator

SBP2WEB24 - Carpark controller

SBP2CPY24 - Carpark server

SBPSUSCNT - Carpark Count sensor

If a stand-alone counting system is required, the customer will need these modules.

If the customer already has a space-by-space system but want to add a count solution on a rooftop, it would suffice to add an SBP2MCG324 for the count part. The software for the MZC is already built into the SBP2WEB24 and the SBP2CPY24.

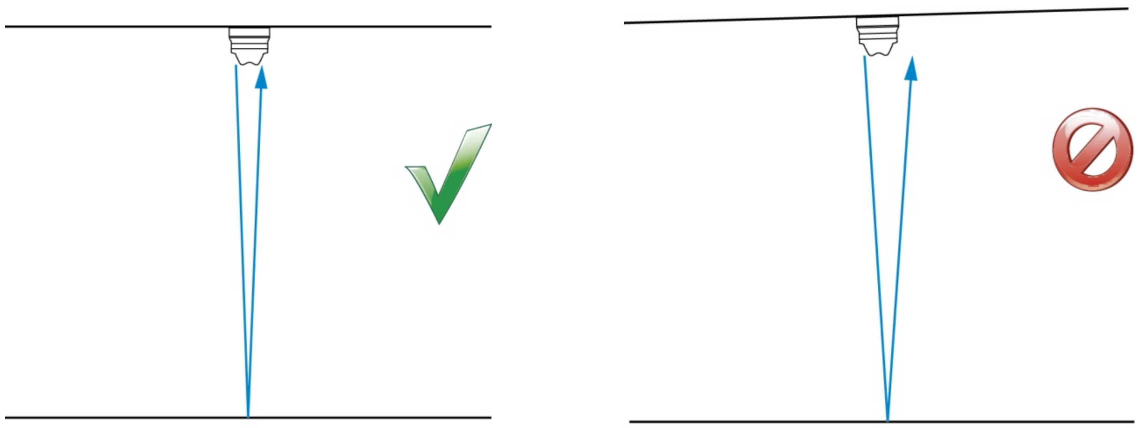
Sensor

The counting system needs a specially designed sensor for counting. The SBPSUSCNT is a vertical sensor with a rapid detection principle. This means it can count cars running up to 20 Km/h. The sensor is to be mounted in the driving lane at the height of maximum 4 m from the floor level pointing directly towards the floor. When a car passes beneath the sensor, the signal is transmitted to the Carpark system as an entry or an exit. The sensor uses the 3-wire Dupline® bus and must be installed in the same way as other Dupline® Carpark 3 sensors. Use the same installation rules as for the standard Carpark 3 sensors:

maximum 50 sensors in a line and maximum 90 sensors on an SBP2MCG324 Carpark master. Please refer to the section on ‘Calculation’.

SBPSUSCNT

The sensor must be mounted, so that it is pointing directly towards the floor with a deviation of maximum two degrees to avoid poor detection. The accuracy of the sensor mounting is proportional to the quality of the sensor detection.



Operating Principles of the Counting system

The counting system can work as a stand-alone counting system or in a mixed solution together with the Carpark single-space system. In any case, the counting system consists of a group of MZCs, and each of these MZCs has a certain number of entry and exit points for the cars. These are called detection points (DPOs) and this is where the sensors must be mounted to detect passing cars.

To make the counting system fully compatible with the single-space system, the MZC transmits its MZC count values by emulating a number of single-space segments, depending on the total number of spaces in the MZCs. These values are then available for the SBP2CPY24 where the data can be monitored in the Carpark software.

MZC

Typically, one MZC comprises a level of the parking facility, but it can also be a part of a level or even the entire carpark. An MZC has a certain amount of parking spaces available, and the function of the MZC system is to detect and count the cars entering and leaving the MZC and thus keep track of the number of available spaces.

The counting system transmits the availability number for each MZC and allows the MZC to be read by local or totalizing displays. This communication takes place in the SBP2CPY24 part, where the carpark software is located.

Detection Points (DPOs)

A detection point is a lane or driveway where cars enter or leave an MZC. A typical example of a DPO is a ramp between two floors, but it could also be the entry point from the street into the Carpark, or the exit point. In many cases one and the same DPO is involved in two MZCs. For example, a DPO which is an exit point for floor 2 can, at the same time, be an entry point for floor 3. The MZC system can handle maximum 40 DPOs. Each DPO consists of minimum one sensor ('One-sensor DPO'), but normally of two sensors ('Two-sensor DPO').

Each detection point needs sensors connected to the 3-wire Dupline® bus to detect passing cars. Dupline® ultrasonic sensors are usually used, but other sensor types, like standard photoelectric sensors or loop detectors, can be employed. Connection is made by coupling the sensor output to a Dupline® input module.

The MZC provides the option to use either one or two sensors in each DPO. We recommend two sensors with a distance of 2-3 m between them because this solution offers the possibility to detect the direction of the car and allows a more efficient filtering to avoid false detections. Please refer to the section 'Mounting the Sensors' for further information. Sometimes cars go in the wrong direction in a unidirectional lane, and in a two-sensor solution, the MZC is able to manage this problem so that the count will still be correct. In bidirectional lanes two sensors are mandatory.

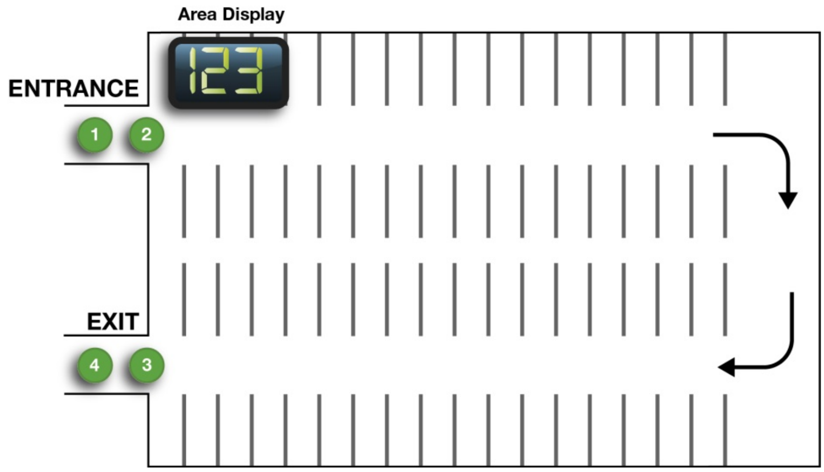
When configuring detection points, it is possible to define a timeout value. This timeout feature is only to be used in case of a long distance (more than 3 m) between sensor 1 and sensor 2. The timeout allows accurate car detection as long as the delay period is shorter than the timeout value from the moment where sensor 1 becomes inactive till the moment where sensor 2 becomes active. For a typical distance of 2-3 m between the sensors, 1 sec. is the recommended value. Too high a value increases the risk of detection faults.
Single-sensor DPOs are mainly implemented when it is impossible or difficult to use two sensors, for example in an outdoor installation with loop detectors.

Initialisation and adjustment

In the initial configuration, the installer has to define the number of spaces in each MZC. From that point, the MZC will increment or decrement the count values as the cars enter or leave the MZCs beneath the detection points. Since any counting system involves the risk of accumulating detection faults, it is important to have a manual counting adjustment facility that can be used from time to time whenever required. In the Dupline® Carpark counting system, this manual adjustment is performed via the built-in web server, which can be accessed from a smart-phone or a laptop. By using a standard browser, the number of available spaces from each MZC can be read and adjusted if needed. The web server is also used for the configuration of the MZC. For further information on this topic, please refer to the SBP2CPY24 software installation manual. This manual is available here: http://productselection.net/

Stand-alone system examples

A simple parking facility with one entrance and one exit



Minimum requirements for this simple stand-alone system are:

- 1 SBP2MCG324 Carpark master generator

- 1 SBP2WEB24 Carpark controller

- 1 power supply 28VDC

- 2 sensors to detect passing cars at the entrance

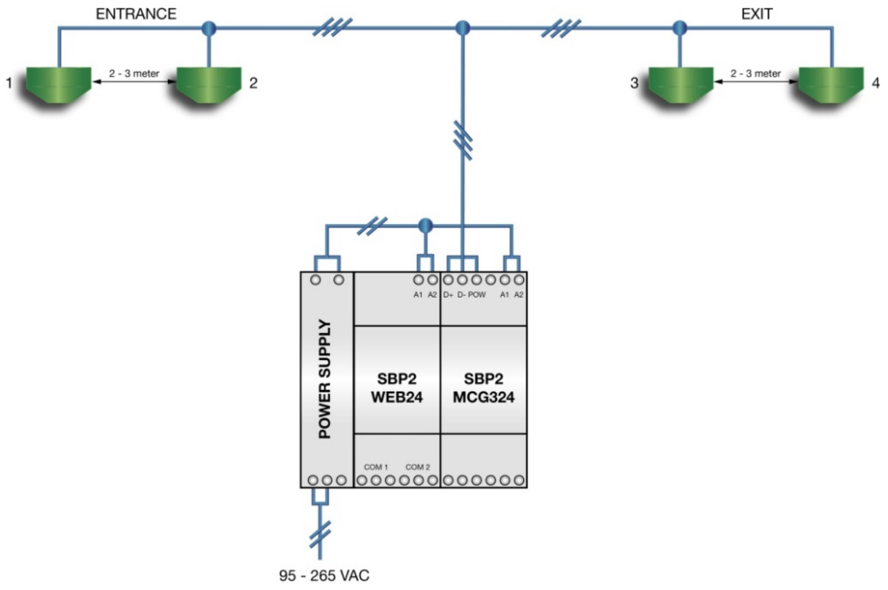
- 2 sensors to detect passing cars at the exit

- A PC to program the MZC

- Displays (optional but should always be a part of a counting system)

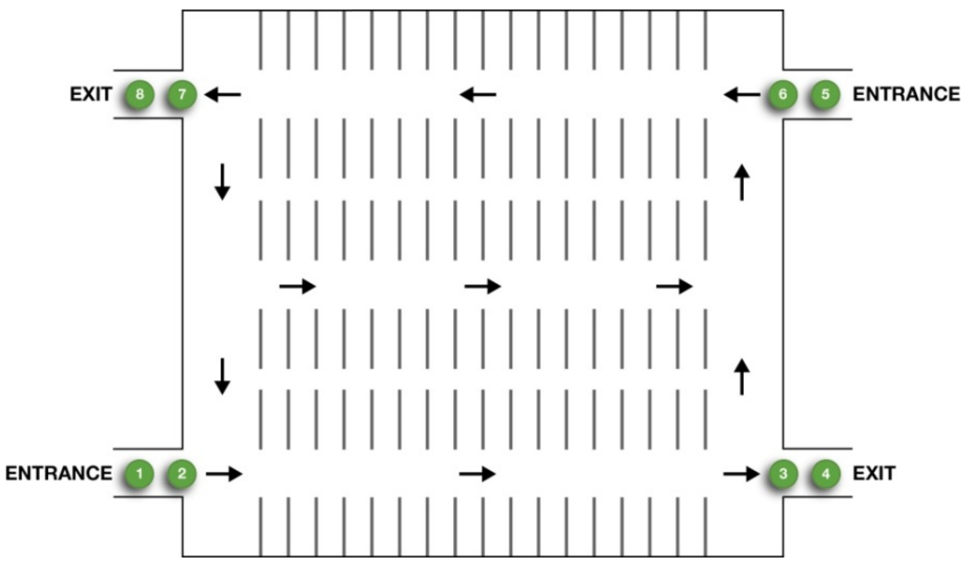
The power supplies used must have the correct ampere size. Each of the Carpark master modules (SBP2MCG324) can supply the third wire with 2.6 Amp, and the output of this module is pulsating. This means that the power supply must be at least double size (5.2 Amp). The power consumption depends on the number of sensors connected to the 3-wire Dupline® bus.

Note: The modules are short-circuit protected and will not be ruined by a short circuit. If a short circuit occurs, the yellow LED on the MCG module will be blinking. Make sure that the wiring is correct prior to connecting power to the system.

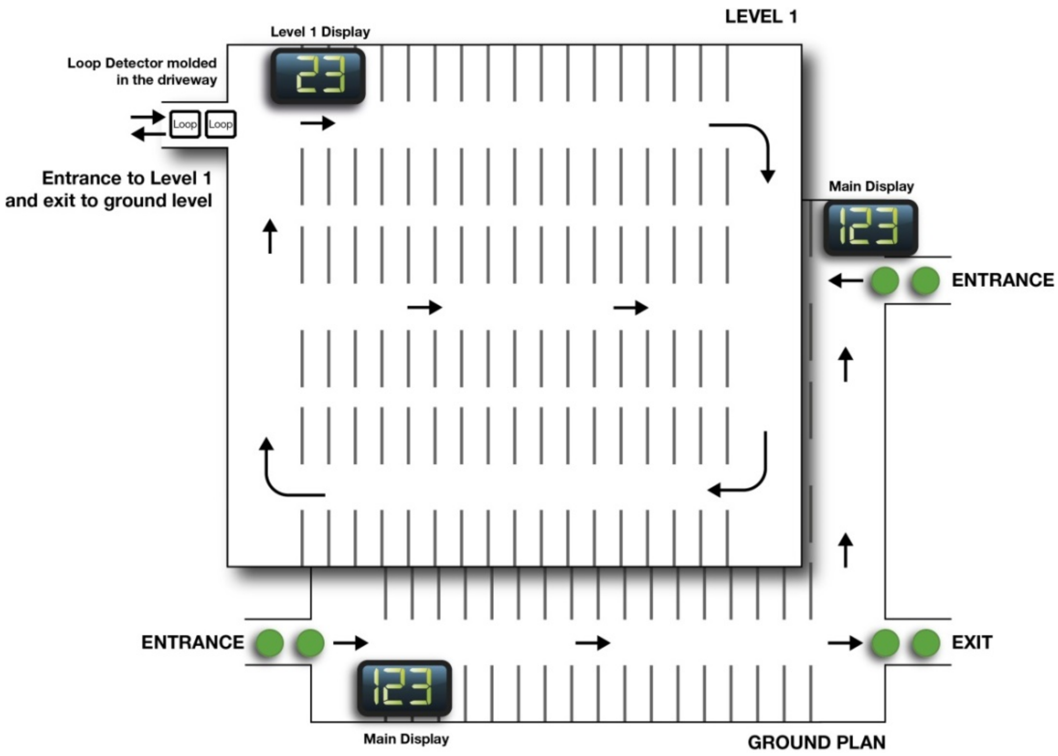


A simple stand-alone system (see the above example) can easily be transformed into a complex system with multiple entrances and exits (see the example below) by adding two additional detection points (DPOs), each with two sensors connected to the 3-wire Dupline® bus.

A simple parking facility with two entrances and two exits



Example of multiple floors



In this example, we have two MZCs: ground level and 1st floor level. They will be named MZC 1 and MZC 2 in the following.

MZC 1 has two entrances (DPOs) from ground level and one entrance (DPO) from MZC 2 (the transition from level 1 to ground level is also an entrance). This makes three entrances in total.

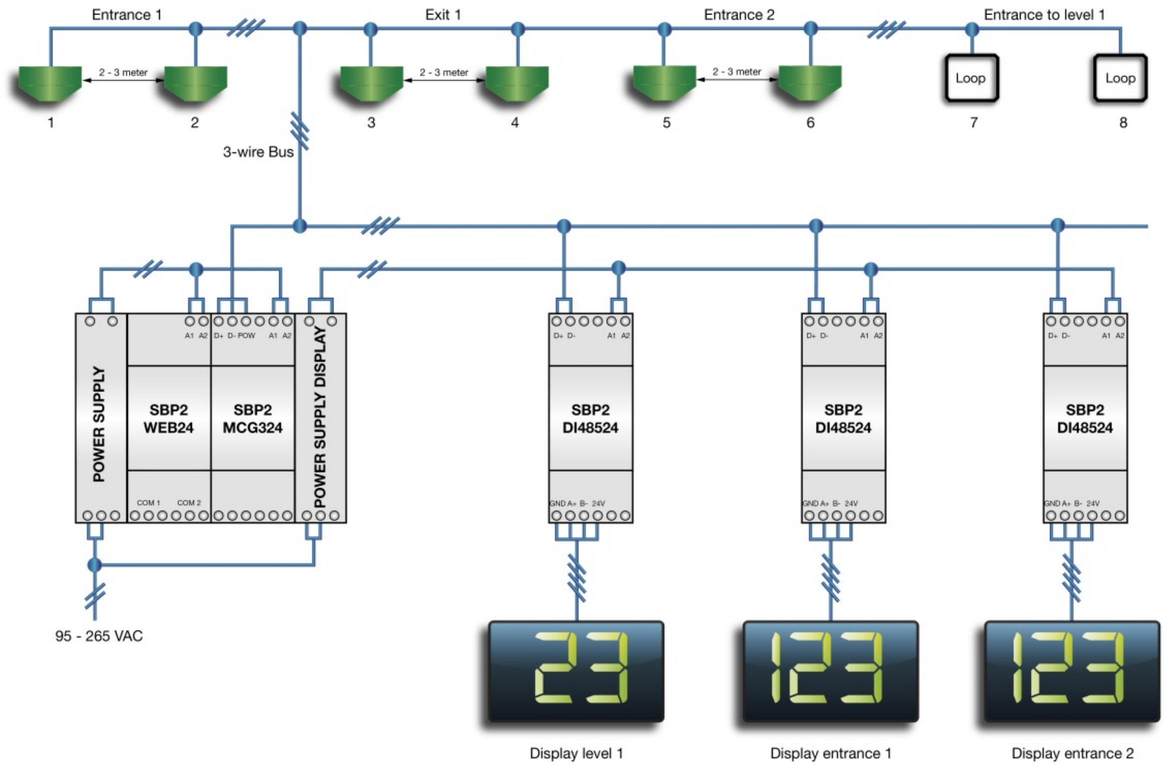
MZC 1 also has two exits (DPOs). One exit to Main Street and one exit to MZC 2.

MZC 2 has one entrance (DPO) from MZC 1 and one exit (DPO) to MZC 1.

Each DPO consists of two sensors connected to the 3-wire Dupline® bus.

In the diagram below, we have converted the 2-floor installation into modules. We need 6 ultrasonic sensors and 2 loop detectors for the entrances and exits. We use loop detectors, because the ultrasonic sensors cannot be used outside on a roof.

Connection diagram for the above 2-floor 4-DPO example



MZC counting system with a split between standard and reserved spaces

MZC counting systems in parking facilities have a recurring issue in not being able to detect the split between standard and reserved spaces, typically used for handicap or VIP spaces. So, even if the signs outside the car park are showing that spaces are available, the driver may find that there are no open spaces in the required category.

The MZC system offers the option to manage the split between standard and reserved spaces. The reserved spaces are implemented as a single space system where each space is equipped with a carpark sensor. The precise reserved space availability information achieved is linked to the MZC, which can calculate the available standard spaces from the total number of spaces. As a result, the displays outside the car park can show how many spaces in each category are available. As a further benefit, the system makes it easier for disabled people to find the handicap spaces because of the blue LED indicators. Reserved VIP spaces could be indicated by amber LEDs.

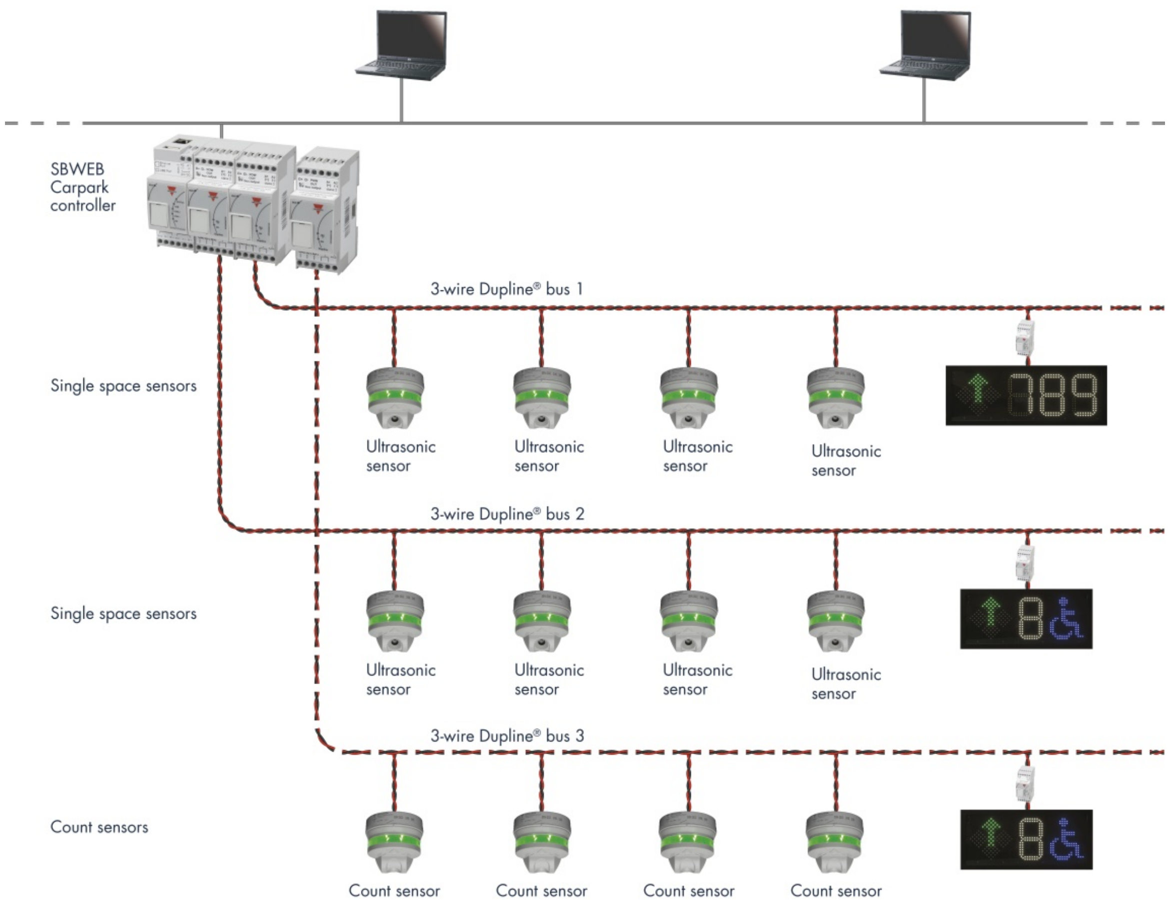
We recommend that the installer uses an independent SBP2MCG324 MCG for the counting system. This only as a precaution against failure on the 3-wire bus. If the systems are kept electrically separated, failure will affect only the afflicted circuit and not the entire system.

MZC combined with the Single-Space System

The MZC can easily be combined with the single-space detection system. Using the same configuration tool and the same carpark software (SBP2CPY24) as for the single-space system, installers can easily combine an MZC system and a single-space system.

The counting system uses a different sensor (SBPSUSCNT) intended for counting, and the single-space system uses either a lane-mounted sensor or a vertical sensor for detection of cars in a parking space. The additional modules used are equal for both systems. Assignment and calibration in the configuration tool are equal for all sensor types used in Carpark 3. The significant difference between single-space and MZC lies in the configuration part. The design in the SBP2CPY24 is more or less equal to the single-space system. Please refer to the 'Software Installation Manual'. The software installation manual is available here: http://productselection.net/

Single-space detection and counting system combined



Installation of the Counting System

Below we will describe installation of the counting system and especially the count sensor in details. Correct installation of the sensor will improve the accuracy of the entire counting system. Examples of further actions to improve accuracy, such as mechanical solutions, will follow.

The Count Sensor

The MZC is the heart of the counting system - but in order to make the counts, we need sensors. The ultrasonic sensor SBPSUSCNT is designed for this purpose. The sensor must be installed indoors or in such a way that the housing is not exposed to water.

Other sensor types, like for instance optical sensors or loop detectors, can be used. They just need to be connected to a Dupline® transmitter.

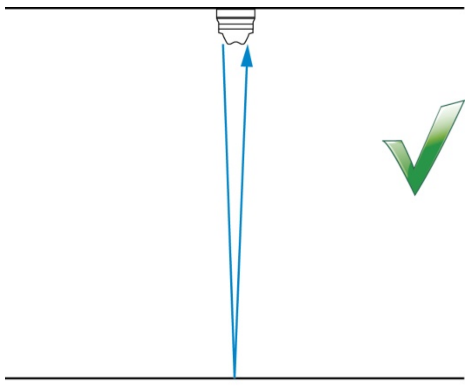
In this chapter we will describe the ultrasonic sensor.

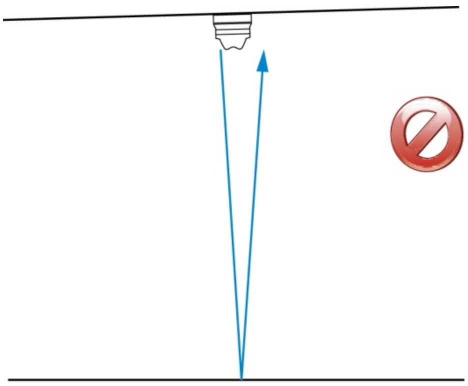
Sensor Hardware

Only the count sensor SBPSUSCNT can be used together with the MZC. Other ultrasonic sensors do not work with the MZC system. The base holders SBPBASEA and SBPBASEB can be used with the count sensor.

Sensor Installation (DPO)

The vertical sensor must be installed pointing directly to a hard and straight surface. It must be mounted on the ceiling over the driving lane no more than 4.0 m above the floor and pointing directly towards the floor. The angle of the sensor must have a vertical deviation of maximum +-2-degrees. Sensors must be installed at all entrances and exits to provide a correct counting.





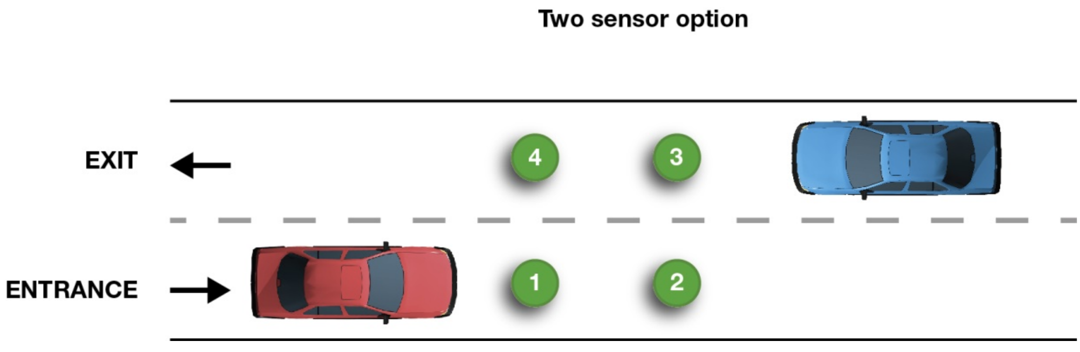
The sensor sends out a 40 kHz ultrasonic signal, and it is important that the receiver inside the sensor is able to detect the returning signal without problems. If the angle is awkward or the surface of poor quality, the signal might be interrupted resulting in the sensor's flashing red or even miscounting.

Various possibilities of installation of one and two sensors at exits and entrances will be described in the below sections.

Two-sensor DPO

The two-sensor option is probably the most common installation. This solution makes it possible to use the same lane as entrance and exit, even if the cars are going the wrong way. Installations often consist of independent entrances and exits as shown below.

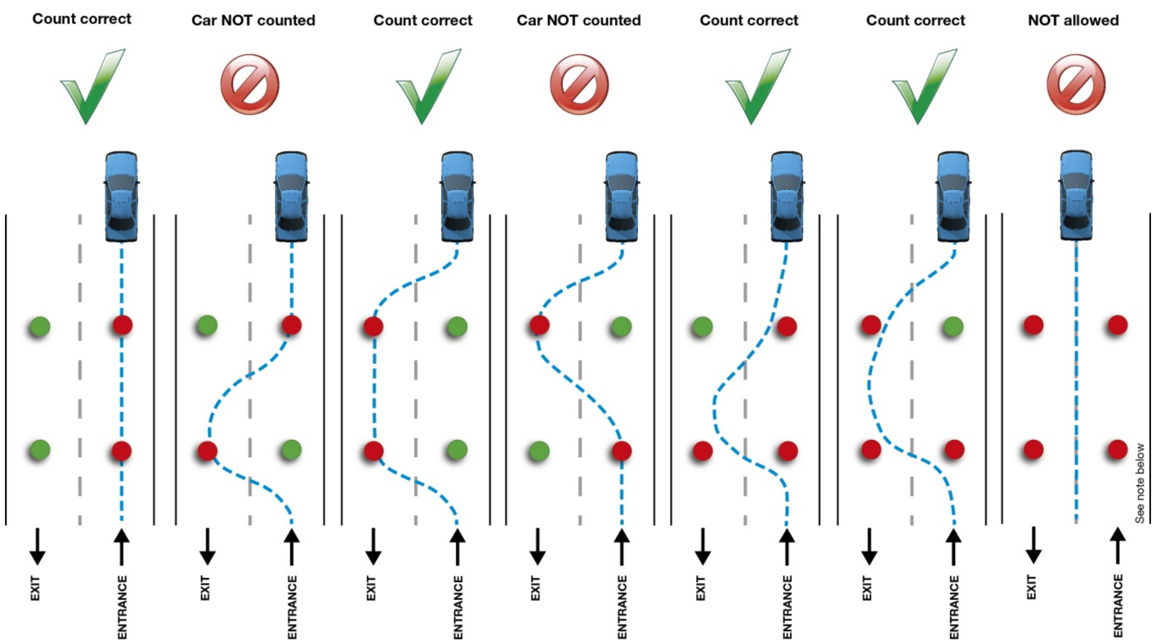
A two-sensor solution could look like this:



The entrance DPO consists of two sensors, sensor 1 and sensor 2. The DPO in the MZC is programmed so that sensor 1 is first and sensor 2 is second. In this way, the system is able to determine the direction of the car. If, for some reason, sensor 2 is activated before sensor 1, the MZC will accept this as an exit, if sensor 1 is activated shortly after sensor 2 has been activated.

The below schema describes the different rules of counting to which the MZC will be exposed in various circumstances. These examples illustrate only the possibilities for the entrance, but the same rules apply for the exit as well.

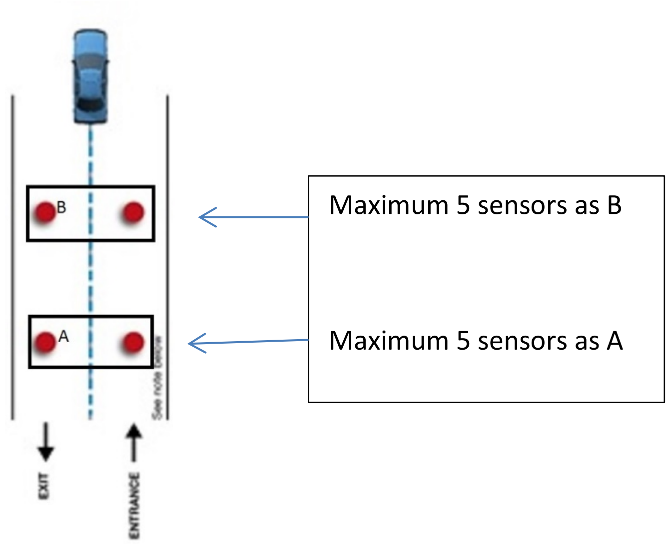
Schema of counting rules



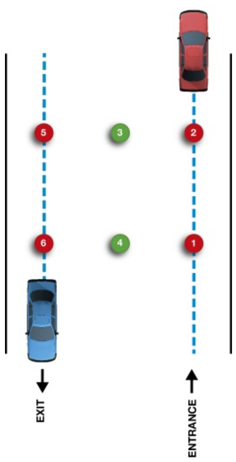
The rule to the right, where all four sensors are pairwise activated, is only allowed if the sensors are pairwise programmed in the configuration tool as entrance sensors and exit sensors respectively. If this is the case, the system will count the cars correctly. See example below.

In the below drawing we have an example where two sensors marked “A” are programmed as entrance sensors and the opposite sensors marked “B” are programmed as exit sensors.

It is possible to increase the number of sensors for group A and B to ten sensors in total. Five sensors for each group. Please refer to the software manual available here: http://productselection.net/



In the example below: if two cars are passing the sensors at the same time, the MZC will not count correctly, because, when activated, the MZC cannot determine if the car is going in or out. However, placing the DPO close to a cross section, corner or another place where the drivers will automatically slow down or be patient, this phenomenon will seldom appear.



Sensors 1, 4, 6 are programmed as input sensor and sensor 2, 3, 5 as output sensors.

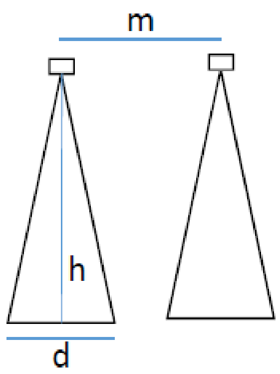
Mounting the Sensors

Knowing the distance between the sensors is very important. When mounting the sensors, the installer must be careful to install the sensors correctly.

The sensors can be mounted on either rail, in the ceiling or as lowered sensors on a conduit.

The sensor must be installed above the lane at the height of maximum 4 m and minimum 2 m. The angle of the sensor beam is 17 degrees. This is the case in the below calculation.

Example of two ultrasonic sensor beams



In a 2-sensor DPO, the following precautions must be taken into consideration:

- When sensors are installed at maximum height (h), the distance (m) can be calculated in this way: 2*h*tan17 = 2*4*tan(17 (+2))= 2,75 m

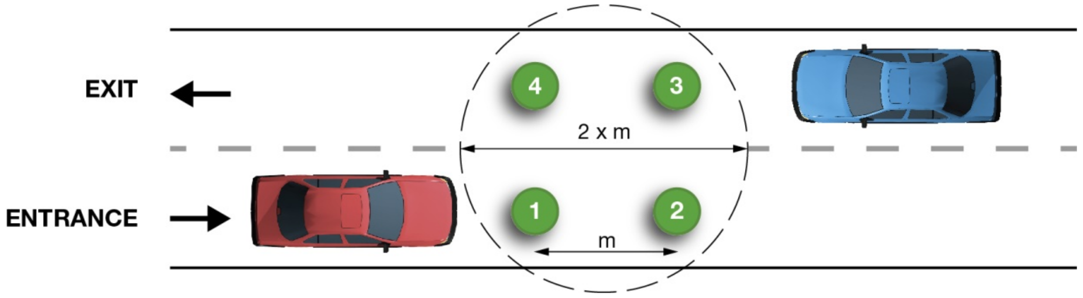
The (+2) is the maximum allowed deviation of the installation accuracy.

The equation above implies that the sensors must be installed no closer than 2, 75 m to each other to avoid crosstalk and false activations.

If we change the height to 3 m, the maximum distance (m) is 2, 07 m

We recommend installing the sensors no closer than 2 m and 3 m if the sensor is mounted at a height of 4 m.

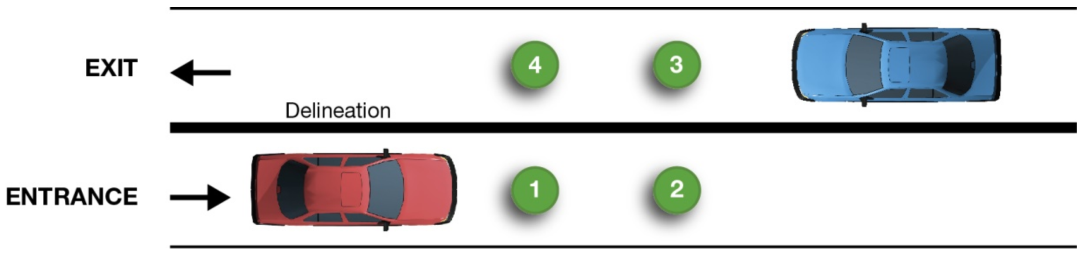
The sensors can also detect movement if doors, gates and other moving parts are in their range. The below drawing show a circle which indicate a perimeter not to install any movement parts closer than 2*m that can disturb the count sensors. (m) is the distance between the sensors and we recommend a perimeter from center of the circle on 2*m.



In some installations, a delineator to separate the lanes must be used to increase the performance of the counting system.

Example:

If a car is driving in the middle of the lane, the counting system is in risk of not counting correctly because the sensors may detect the car in a false way. To increase the counting accuracy, it can be an advantage to places a delineator between the two lanes to avoid cars driving in the middle of the lane.



Bumper-to-Bumper

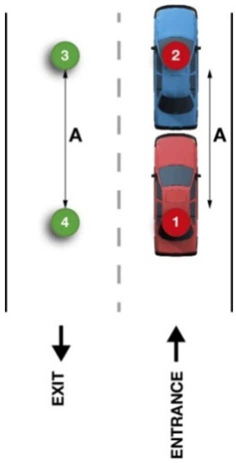
If cars are driving bumper-to-bumper, the sensors are not able to distinguish the cars from each other, and the counting becomes incorrect.

The mounting height of the count sensor influences how close the cars can drive before the sensor can no longer distinguish one from the other.

If the sensor is mounted at 4 m, the distance between the cars must be at least 1.40 m to make each car distinguishable to the sensor.

If the sensor is mounted at 3 m, the distance between the cars must be at least 1.00 m to make each car distinguishable to the sensor.

Cars driving bumper-to-bumper

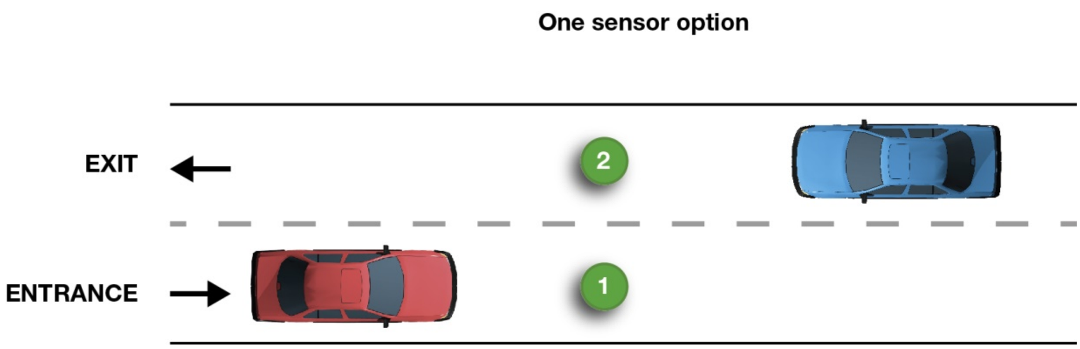


This problem can be minimised by using optical sensors which are fast and precise enough to detect the small gap between the cars. However, even if this option is used, detection can still be inaccurate, so therefore an access barrier or a speed bump between sensor 1 and sensor 2 might be the best solution to achieve optimum accuracy.

One-sensor DPO

A one-sensor solution at the entrance and exit can make a correct detection/counting.

A one-sensor solution could look like this:



This solution is only recommendable if the direction of the cars is entirely predictable, for instance if the entrances and exits are totally divided so that cars are not able to go in the wrong direction.

Programming the Sensor

The count sensor is programmed by means of the SBP2WEB24 configuration tool. This tool can be downloaded here: http://productselection.net/

The count sensor has some features that can be useful during the installation. Depending on the speed of the cars, the sensor can be programmed to count slower or faster by using the filters in the configuration tool.

Filter	Measure 1	Measure 2	Measure 4	Measure 6
Km/h	45	33.7	16.8	8.4
msec	80	160	240	320

The above table gives the installer some options to choose between four filters. Choosing the correct filter must be depends of the worst case speed. If cars are driving 10 Km/h, choose filter 4 and so on. Filter 1 must only be used in very special circumstances. This filter is so fast that false detections can be detected. This could be windy situations or similar. We will in those circumstances where a car goes more than 30Km/h always suggest speedbumps to slow down the speed. This will increase the accuracy of the counting system. We believe that filter 4 or filter 6 is the most common filters to use.

Appendix A:

Counting system accuracy

Determination of a counting system's accuracy in number/percent is quite challenging and needs further explanation. Suggestions for optimising the accuracy, based on experience gained from numerous carpark installations, will follow below.

The accuracy is not solely determined by the sensors and the MZC, but also by the physical environments and the general installation.

The sensor must be mounted on a solid surface protected against shocks. Any movement of the sensor may cause faulty activations resulting in miscounts. Therefore, the sensor should be mounted directly in the ceiling. However, if the ceiling is more than 4 m from the floor, it will be necessary to lower the sensor to the required level using conduits or rail mounting. Of course the mounting must be completely robust and shock-free.

In an ideal world, the system should be quite accurate and we have experienced an accuracy of 98 % on most floors (upper floors) in a Carpark building.

Example:

A multi-storey car park of five floors with 200 spaces on each floor.

If the system is 100% occupied, 1000 cars will be passing by the main entrance on floor 1. On floor 2 the number is 800 cars at the entrance and so on, and on floor 5 it is 200 cars. More cars through a DPO (entrance or exit point) will increase the risk of miscount. A miscount on one floor will affect the accuracy of available spaces for up to two floors.

If the main entrance DPO is faulty and does not detect cars driving in, only this floor's display shows a wrong number of available spaces.

If a car leaves floor 1 to go to floor 2 and the DPO on this floor is defective, the number of available spaces on floor 1 and 2 will be affected. The reason is that this DPO works as an exit DPO for floor 1 and entrance DPO for floor 2.

Delineation

If there is no delineation between the entrance and the exit lanes, experience shows that vehicles will always drive in the middle of the lane, which might cause activation of more than one DPO. If this happens, the system will count the same vehicle twice and the number of available spaces will be decreased or increased by two.

However, if there is only one DPO, it is possible to drive in the middle of the lane and still be counted correctly. Still, this solution has a downside. If two cars pass one another in the DPO area, the system will count only the first car that activates the sensor. The other car stays undetected. In this situation, it is not possible to tell if the system will increase or decrease the number of available spaces by one.

Car speed is yet another issue. The sensor's built-in filter can be used to correct this problem. If filter 1 is chosen, the sensor will detect cars driving up to 45 km/h. If filter 4 is chosen, cars that drive less than 8 km/h will be detected.

Speed bumps

For safety and correct counting, we recommend speed bumps together with the DPO.

We recommend always driving slow through the counting system to increase the accuracy. Filter 4 and filter 6 in the counting system represent a speed no more than 8-16 km/h and that is a prober speed. However, speed bumps will help prevent bumper-to-bumper driving, thereby highly increasing the accuracy, especially during rush hours.

Anarchist drivers

Driving across the DPO and diagonally activate the sensors, is another problem we have experienced in the Carpark systems. Such behaviour is no problem in systems with only one DPO. If, however, there is more than one DPO, the counting system will not accept this as a valid signal and the car will not be detected.

A counting system with many DPOs, no delineation and perhaps parked cars on the lanes beside the sensors will never be a reliable and accurate system. Resetting the system more often, perhaps every day, will be necessary. And, of course, resetting is possible with the MZC. A built-in scheduler can reset the system at a specific time selected by the system administrator. An appropriate time could be during the night-time when there are no or only few cars in the carpark system. Inaccuracies are unavoidable, but if the system is reset every 24 hours, the inaccuracy will not increase (if there are no parked cars when the system is reset). The automatic reset will always show maximum available spaces. Besides that, the counting system has a built-in offset. This function makes it possible to reset the system when cars are parked in the system. If the parking has 1000 spaces in total and there are 45 cars parked at the time when the installer performs a reset, it is possible to select 45 as an offset in the automatic reset function. This function is also described in the software installation manual.

Sensor mounting

The sensor must always be mounted to point directly towards an even and hard surface. The surface must not be sand, rubble or grass. For instance, concrete or asphalt can reflect an ultrasonic signal of acceptable quality back to the sensor. Make sure that water, snow or objects do not disturb the signal, since faulty activations may be a result.

The sensor must be mounted on a solid surface protected against shocks. Any movement of the sensor may cause faulty activations resulting in miscounts. Therefore, the sensor should be mounted directly in the ceiling. However, if the ceiling is more than 4 m from the floor, it will be necessary to lower the sensor to the required level using conduits or rail mounting. Of course the mounting must be completely robust and shock-free.

Troubleshooting

1. Wrong cabling of the sensors

Correct Connection	POW	D-	D+
Wrong connection A	POW	D+	D-
Wrong connection B	D+	POW	D-
Wrong connection C	D+	D-	POW
Wrong connection D	D-	D+	POW
Wrong connection E	D-	POW	D+

A) Badly connected sensors stay white and they do not work.
B) Badly connected sensors burn and are no longer workable.
C) Badly connected sensors are dim red, and they do not work.
D) Badly connected sensors are off and they do not work.
E) Badly connected sensors are off, the others have white light on for 5/6 seconds and then turn off, the MCG goes into protection mode (Dupline® signal LED flashing fast)

2. Some sensors are showing green LEDs, some white LEDs:
- check if there is a wrong connection of the first sensor on the line showing white LEDs (wrong connection A on table 1.1)
- check if cables are well inserted in the connector of the base, a missing D+ or D- can interrupt the Dupline® bus

3. Some sensors are steady green and not reacting:
- the sensors are not calibrated, please follow the Configuration Manual about how to calibrate a sensor
- the sensors are not addressed, please follow the Configuration Manual about how to address a sensor

4. Sensors are flashing yellow: the addressing procedure has not been finalised, please follow the Configuration Manual about how to address a sensor

5. Displays are not showing anything:
- check cable connection
- check if the display has been correctly set on both SBP2WEB24 and on the web server interface