AUTOPARK
CAR PARKING AUTOMATION

Standard
FUNCTIONAL SPECIFICATION

Palletless
CAR PARKING SYSTEM

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Functional specification

1 General specification
2 Car dimension
3 Layout
4 Design principles Autopark pallet less parking technology

5 Component specification
- Module Robot (Transporter and shuttle)
- Module Entrance gate (Turn plate and measurement equipment)
- Module Elevator
- Module Control (Hardware and software)

Functional specification

1 General

- Type — Indoor Automatic palletless System
- Parking capacity — 140-280 cars / tower
- Layer — 10 – 20 parking Layers
- Cars / layer — 2 x 7 = 14 cars per layer
- Cycle time — max. 3 min for single order
- Capacity — appr. 20-25 Cars/ gate / hour
- Quality — According German standard
- Availability — min according VDI 4466 ≤ 98%
- Design form — semi-round and square

Autopark concept :

- Full Redundancy
- Modular capacity
- Teleservice remote operation
- High availability

2 Car dimensions

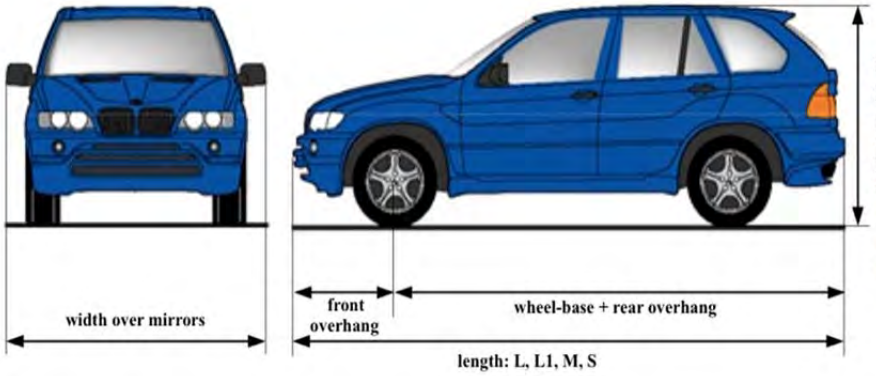


Fig. 1. Maximal dimensions

The dimensions are according the German standard

This covers Smart as smallest car and Mercedes S-class as biggest car plus common SUV's

Car dimension

- Length Max 5.300 mm
- Width Max 2.050 mm
- Height Max 1500–1850–2100mm
- Weight Max 2300 kg

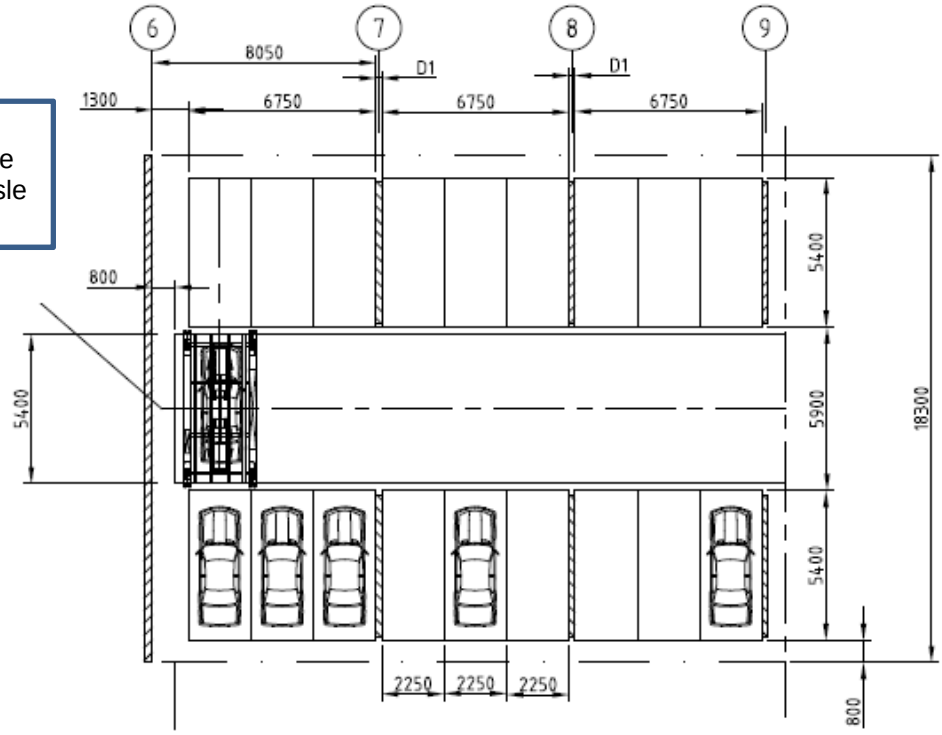
- Rear / front overhang max 1.100 mm
- Wheel base 1850 -3050 mm
- Wheel width clearance inside 1.200 mm
- Wheel width clearance outside 1.850 mm
- Minimum floor clearance ≥ 100 mm
- Tolerance weight
  front – rear min 40-60% / max 60-40%

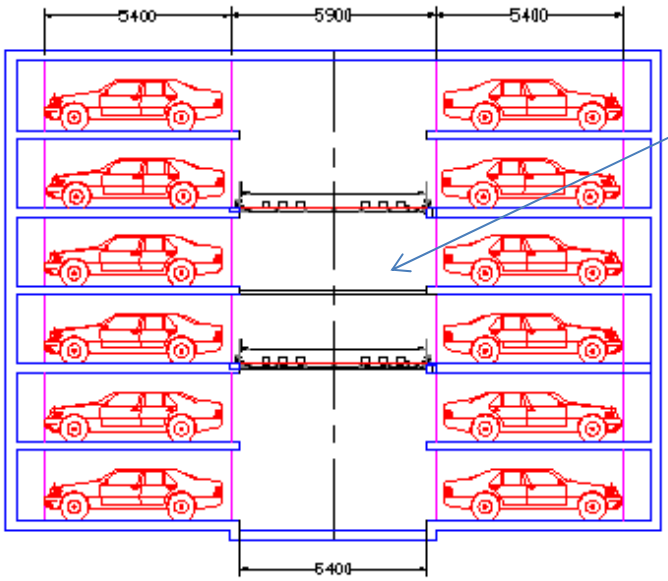
3 Layout

Example

Typical layout

Option for service bypass end of aisle





Option for service floor , fire compartment and/ or stability connection for steel construction

(See separate layout and datasheet information)

4 Design principles Autopark pallet less parking technology

The palletless parking system is designed based on the following principles

Modular elements
System is based on a modular system. Single modules could be configured to a project layout. Depending of the Layout, size and capacity requirement the following modular elements could be used.

A Robot (Shuttle and T-car
B Entrance gate (Measurement unit and turning table
C Vertical transport (Main elevator and/or redundancy elevator)
D Central Control (Logistic control)

Redundancy layout concept
To get a maximum performance all layout configurations should be based on a redundant concept. Meaning that the system stays operational, even when one component fails. This means, there always have to be a minimum of 2 modules in each project, which are connected in the layout to cover the complete project layout (no floorlevel limitations for shuttle and T-car). Next to that the Control system also has a backup function and simple hand operation in case of breakdown.

Layout and project size
Based on the redundancy concept as described, the minimum project size for a project will be 140 places to get an economic acceptable solution.

Entrance gate
Entrance gate is always integrated with Car measurement equipment in the floor and turning plate. In the entrance room there is no mechanical guidance for positioning the Car. In this way the entrance floor has a high quality of performance for the user. Entrance door is an option. Walls and ceiling are part of scope delivery client.

Robot concept
Shuttle height is designed for 100 mm free space under the car ; The vehicle can be handled directly at the wheels so no additional brackets are to be foreseen to create additional space . To reduce possible handling or positioning failures the floor flatness specification has to fullfill minimum requirement as specified. The shuttle is based on a Autonomic Principle; this means there is no Physical connection between T-car and Shuttle. The Shuttle is equipped with on board power system. Loading of this power system is done by load contacts which are positioned on the T-car . Loading will be done during horizontal transport of the T-car.

Logistic and software concept
The central project control is based in Siemens PLC and has communication to single units. Standard software protocol is used for all the modules. In this protocol status, errors and order information are transferred. Central project PLC controls the project safety to all single elements and also communicates with the logistic module. The logistic module gives single orders to the other modules, which execute these orders at de-central level. During order handling the status is reported to the logistic system. Project safety is controlled by central PLC .

Teleservice concept
The service concept for all modules is based on a teleservice concept. This means that the central control is connected to internet gateway. In this way remote control, remote diagnose and software uploading is possible . As consequence each project needs an Internet connection. To allow safe remote operation the system is equipped with IP-Camera system and a working light in the garage must be available for video service application (min 120 lux on every place) .
Norm and regulation
Basic design is made on European standard CE/MR based on EN 14010 for mechanical parking systems and German regulation VDI 4466

Design and production method

Product design of the modules elements are made in solid works 3D model. The standard production methods are based on Europe standard CNC laser cutting – Bending and CNC turning equipment. Material specification based on Europe standards.

Temperature and surrounding

The standard product design is made for indoor application with a temperature range from +5 °C till +30°C. for the electrical components. System should be protected to outside weather conditions as snow ,rain, frost etc . So in case the outside temperature will be extreme also the inside temperature will be out of the standard range of +5 °C- +30°C. Additional heating and / or cooling is optional in the module and are crucial for the hydraulic systems and the battery system in the shuttle . Also other electronical parts will need optional climate regulations, in case the temperature is out of specification from original suppliers. This modification is not foreseen in the actual design. Temperature and surrounding control needs to be foreseen by climatic equipment in parking tower as specified in scope of delivery.

Assumptions used for lifecycle and performance indicators

The calculation of the lifecycle and performance indicators is based on the assumption that each car will have one IN parking movement and one OUT parking movement per day. Based on the minimum number of modular elements in a project layout, the average transfer time OUT parking (= time from parking place to transfer room) for a single order is depending on the place in the system and size of the elevator height. Cycle time calculation will be made during detail engineering. In case of a higher use of the garage the lifecycle and performance level will be an equivalent of the design value.

Availability

The design availability of the module is based as described in the German regulation VDI 4466.
The overal availability of the automatic parking system module needs to be at least 98%. Calculating according to VDI 3581 and calculated on 24/7 use of a garage.

In case of a redundancy concept in the layout , Autopark has practical project experience . During a 5 year period the average availability was > 99% according VDI . (99,4% during total average time). Condition for these performances is a good maintenance – sparepart on site – well trained local service team - 24/7 teleservice connection to the project etc .

Software

Software for the modular components is delivered based on project license. Source code is NOT part of the delivery only a user license limited to a unique project application. Software is protected by license key based on project configuration. Software backup can be made for service purposes by the local service department.

5 COMPONENT SPECIFICATION

All specification based on Premium version

5.1 Robot-module

This is the combination of a Shuttle and a Transporter.

General Robot

- Project quantity min 2 robots
- Load capacity max 2.300 KG
- Operating temp. +5 to +35 C
- Communication Wireless
- Control Siemens

Shuttle

- Shuttle Speed max 60 m/min
- Dimension
  - -Length 3.500 mm
  - -Width 1.000 mm
  - -height >100 mm
- Positioning Encoder / laser
- Lift principe Wheel clamp

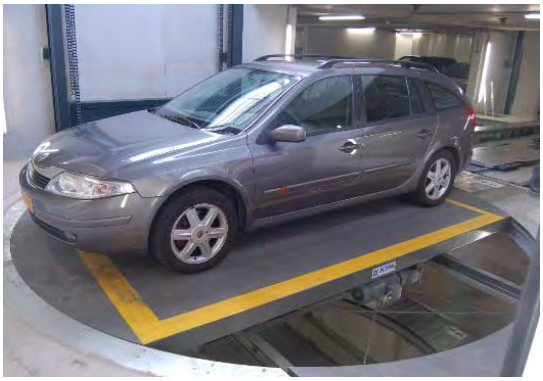
Transporter

- Transporter Speed max 90 m/min
- Dimension
  - Length 5800 mm
  - Width 2800 mm
  - Floor height 150 mm
- Drive engine 4 (** 2)
- Positioning Barcode – laser

5.2 MODULE Entrance gate (Turn plate and measurement system)

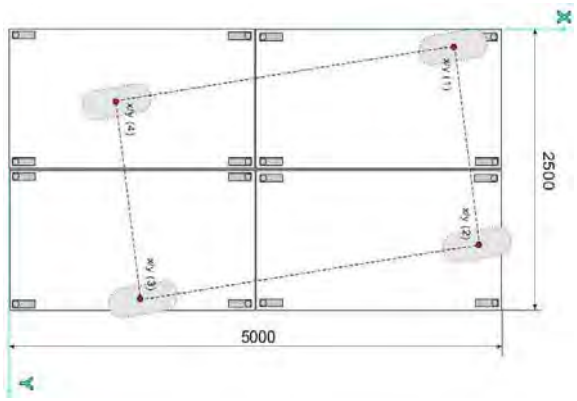
All specification based on Premium version

Turnplate



- Turn speed Max 1,5 RPM
- Motor power 1.5KW
- Load capacity 2300 KG
- Turn angle 270 °
- Project quantity min 2 entrance

Car Measurement system



- Width Inside essay
- Length inside essay
- Height 3 classes
- Weight < 2300 kg
- Wheelbase width and length
- Orientation Inside essay

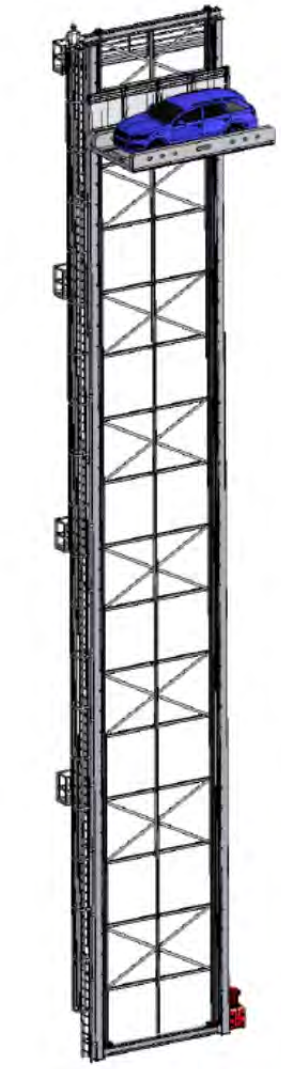
Entrance box type

Type 1 : Round type
In – out at same size
Turnplate turns car in right position forwards out

Type 2 : Rectangular
Drive through Principal

5.3 MODULE ELEVATOR

All specification based on Premium version



Function specification

- Platform dimension
  - length ca 5.800 mm
  - Width ca 2.900 mm
- Shaft dimension
  - length ca 6.500 mm
  - Width ca 4.000 mm
- Pit ca 1.500 mm
- Load capacity 5000 KG *
- Lift height max 45 m
- Floor stops Max 20 layers
- Motor engine Service friendly on basement level
- Driving Belt principle
- Motor power < to be defined>
- Speed min 2.0 m/s
- Positioning Laser distance
- Project quantity 2 elevators

* *Robot plus heavy car*

5.4 MODULE CONTROL (Hardware and software)

All specification based on Premium version

Human – Machine and safety Interface (HMI)

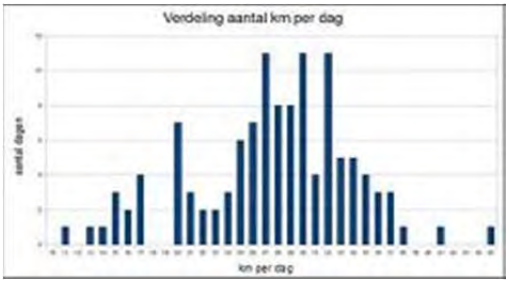
- HMI – interface in entrance gate
- Operator text ticker
- Door control
- Safety Push buttons

Central Logistic control

- Single Robot control
- Single Elevator control
- Single Entrance gate control
- Central Safety control
- External Access control

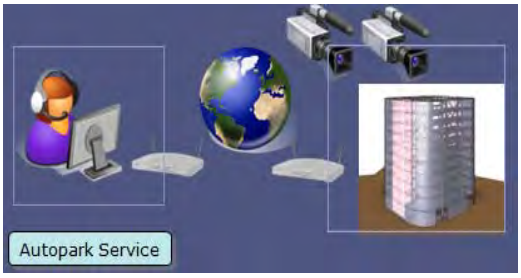
Statistic report

- Element status
- Order report
- Error report
- Manual operation



Teleservice functionality

- Remote diagnose
- Remote operation
- Remote video control



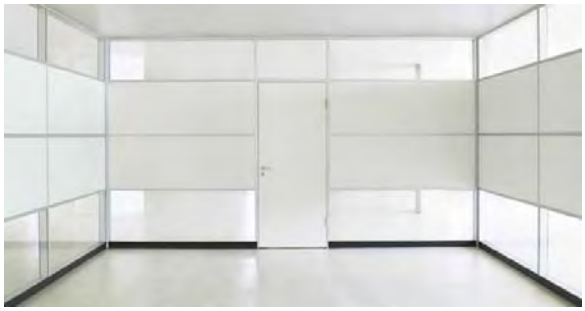
General

- Redundancy data backup
- UPC power backup central control
- Software based on max 3 optim. algorithm (to be defined)
- Interface to Access control (TCP-IP)

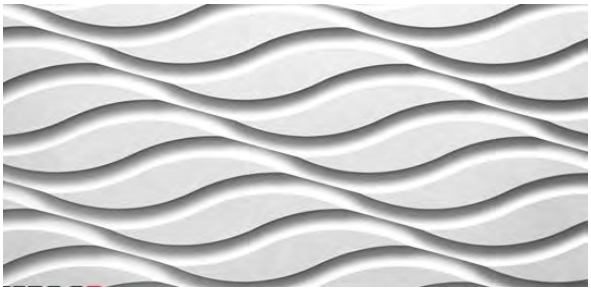
  (delivery third party – not scope Autopark)

OPTION ENTRY GATE CONSTRUCTION / DECORATION ELEMENTS

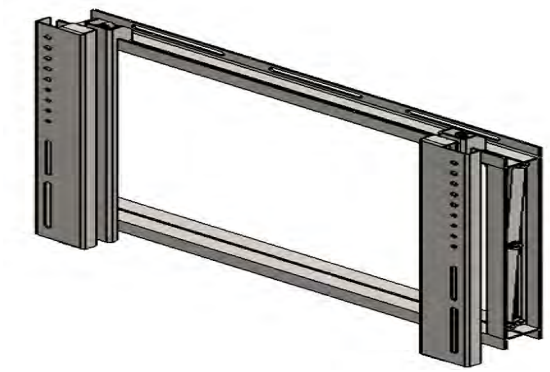
1 Construction wall elements



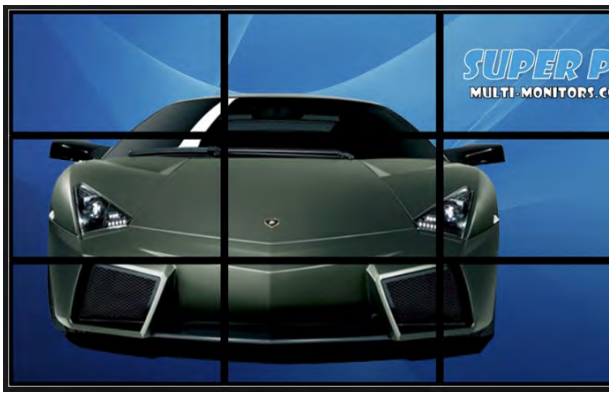
2 Wall decoration



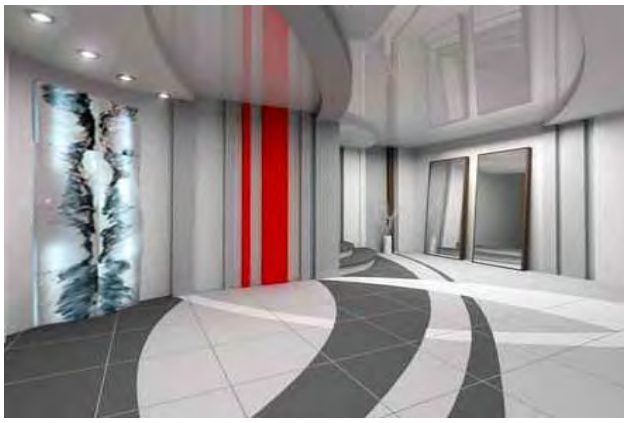
3 Wall integrated panel



4 Multi monitor marketing – or advertisement



5 LED or glas design



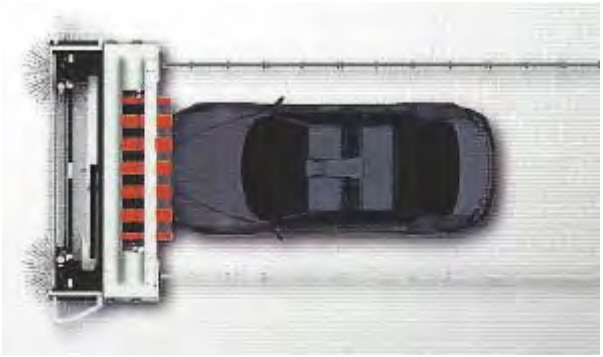
6 Wall imago design and payment terminal design

Autopark car wash option for automatic parking system

Dimension

- Wash car height max 2.300 mm
- Max machine width 4.100 mm
- Min floor height 3.100 mm
- Length of system 9 .000 mm

- Total machine weight 2000 kg
- Capacity appr 10 car –hr **



*** also other types available with higher capacity*