PCVUE EV CHARGE KIT - DESCRIPTION

PcVue EV Charge solution description

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1. Introduction

1.1 General

The PcVue EV Charge Kit is a set of functions dedicated to the intelligent supervision of a fleet of electric vehicle charging stations.
The "PcVue EV Charge Kit" is an easily deployable solution, in the form of a PcVue project that can be adapted and enhanced according to customer requirements.

The purpose of this document is to present the contents of the "PcVue EV Charge Kit" and specify its positioning:

- A general description :
  - understanding the solution
  - define its scope
- A need identification guide :
  - analysis, qualification of needs
  - estimate of resources
- A description of the features :
  - solution functions in detail
  - technical information

1.2 Glossary

List of acronyms used in this document :

EV Charge	Electric vehicle charging infrastructure
EVSE	Electrical Vehicle Supply Equipment (equivalent to EV Charge)
OCPP	Open Charge Point Protocol (dedicated to EV Charge)
JSON	JavaScript Object Notation
PICS	Protocol Implementation Conformance Statement
CSMS	Charging Station Management System
CPO	Charge Point Operator
CP	Charge Point (charger, terminal)
CN	Connector
VDV	Verband Deutscher Verkehrsunternehmen (German standard for the management of electric vehicle charging points)

2. General description

2.1 Context

The "PcVue EV Charge Kit" is designed for use in the supervision of Electric Vehicle Charging Facilities. It offers a solution based on OCPP communication, enabling vehicle charging control, infrastructure management and transaction archiving.

OCPP communication allows the kit to be as independent as possible of the type and brand of charging station.

2.2 Kit construction

The PcVue EV Charge Kit consists of 4 components:

- PcVue software, which provides
  - OCPP 1.6 JSON communication library
  - Its application design environment
- A model project containing :
  - A ready-to-use user interface, enabling interaction with the infrastructure
  - A configuration interface for setting parameters
  - A data archiving system
  - Alarm management
  - EV Charge application functions

- A dynamic link library supporting the Smart Charging function, i.e :
  - Automatic start of vehicle charging
  - Intelligent distribution of available energy
- An OCPP proxy function

A user manual is supplied with the kit.

2.3 Topology

The PcVue EV Charge Kit is based on a 4-level topological architecture:

- The project — Root node containing all sites
  Configuration management (libraries, archiving, schedules, etc.)
- The site — Contains chargers. Defines maximum energy consumption for Smart Charging applications.
- The charger — OCPP connection, connector operating mode
- The connector — Charging unit (socket), load parameter recipient

2.3.1 The site

The site corresponds to a charging station, such as a depot, a parking lot... This level is an application creation dedicated to applying Smart Charging and global rules to charging stations. In particular, the following parameters are defined here:

- The site's available energy limit
- The unity of energy
- Terminal activation schedules

A project can contain several sites.
A site contains charging stations (or chargers).

2.3.2 Charger

The charger (ChargePoint or terminal) corresponds to the communicating OCPP equipment. It contains connectors for charging vehicles. The functions associated with the charger are as follows:

- As an OCPP client, it manages the connection with the server to which it is associated (such as PcVue) and sends OCPP messages.
- Ensures that the energy allocated to the connectors is limited to their actual capacity (this is the site's physical equipment).
- Distribution of available energy in connectors, according to operating rules

Depending on its make and type, a charger contains one or more connectors designed to charge a vehicle.
A site may contain a heterogeneous set of loaders.

Note: although using the OCPP protocol, charger behavior may vary according to brand, type and firmware. As a result, the content and frequency of OCPP messages received by the server may differ for charging the same vehicle, depending on the type of charger.

2.3.3 Connector

The connector is the charging unit for the terminals. It is the source of the vehicle charging transaction. It is based on a set of specific parameters, including the charging profile used for intelligent management.
In the PcVue EV Charge Kit solution, the connector is the sole recipient of charge profiles sent by PcVue. The charge profile contains the energy limit - power or current - to be used to charge the vehicle.

2.4 Scope and limits

- **Brief description:**
  - The PcVue EV Charge Kit is a standard PcVue solution for controlling charging stations.
    - Ready-to-use solution: once configured, it offers an operational application implementing the basic EV Charge functions.
    - Adaptable solution: it can be used as a basic application to design a more complete or complex supervision system, based on the PcVue development environment.
  - PcVue EV Charge Kit uses OCPP 1.6 JSON protocol
    - User interfaces enable OCPP communication and manual control of terminals
    - It can be used with the OCPP proxy function, which makes certain OCPP functions available to another OCPP server (e.g. authorization management, payment operator).
  - It offers intelligent management of vehicle charging based on power (Watt) or current (Ampere).
  - It implements a native Web client
  - It can be hosted on a local PC or in the Cloud
  - It is compatible with the client-server architectures offered by
    NB: OCPP communication redundancy is not supported.

- **Who is the PcVue EV Charge designed for?**
  - To the site operator :
    - Installation of the ready-to-use solution through assistance (editor or integrator)
    - Help with getting to grips with the system (training, support)
  - A system in automation / industrial computing :
    - Tailor the ready-to-use solution to the operator's specific needs
    - Addition of new EV Charge functional bricks
    - Interaction of EV Charge management with other technical areas (e.g. photovoltaic panels, BMS, access control systems, etc.) in the same PcVue application

3. Need identification guide

Any deployment of the "PcVue EV Charge Kit" requires a prior study of operational requirements and the infrastructure concerned. This study quantifies the effort required to implement the solution.

The aim of this chapter is to draw up a list of points to be addressed, helping to qualify the application to be proposed.
This guide is based on 4 main points:

- Overall project feasibility
- Estimated load required to set up the kit
- A list of additional functions
- Services to be provided

3.1 Feasibility

The points below address the issues that will help determine the kit's feasibility.

- Installation infrastructure
  - Hosting: local, cloud
  - Overall volume: number of units
  - Validation of protocols used

- Equipment compatibility
  - Loader types: already tested/proven or not
  - Information returned by loaders (MeterValues)
  - Number of connectors: multi-connector management type
  - Energy type: power, current, AC/DC

3.2 Estimated set-up time

The time required to set up the kit depends on the size of the installation, the functions required and the customization of these functions.

- Function inventory
  - Number of sites (with independent Smart Charging management)
  - Number of connectors
  - Using Smart Charging
  - Using proxy mode

- Adjustment and customization
  - Main view
  - Alarm management, e-mail dispatch

- Desired adaptations

- In terminal management: multi-connectors, vehicle identification data, information sent by the MeterValues service, etc.
- In Smart Charging: load-holding settings, prioritization, etc.
- In archiving format: database storage

3.3 Additional functions

Additional functions require further study to define the effort required.

- Inventory of kit-related modifications
  - Language, user management
  - Additional views
  - Customized load authorization management
  - Documentation

- Other functions to be implemented
  - SCADA standard
  - Other field: integration of another project (e.g. BMS, industry...)

3.4 Services

The following points deal with additional issues relating to the service offering.

- Defining roles and involvement
  - Development Manager
  - Maintenance Manager
  - Warranty

- Reminder of the prerequisites that must be met before implementation
  - Operational network infrastructure
  - Provision of a PC running the operating system corresponding to the version of PcVue
  - Software requirements - other than PcVue - operational (e.g. for a database archiving system)

4. Functional description

4.1 Contents

PcVue EV Charge Kit solution from PcVue contains the following functions:

- OCPP 1.6 JSON communication :
  - Implementation assistance procedure
  - OCPP terminal test and maintenance
  - Proxy role

- A typical OCPP procedure sequence (adaptable and modifiable)
- A customizable native graphical interface
- site navigation
    - A customizable main view for each site
    - Web accessibility
- Smart Charging : Smart Charging
- Operating functions
    - Load activation schedule management
    - Terminal reservation tool (OCPP function)
    - History management
    - ...

The "PcVue EV Charge Kit" can be enhanced with other native PcVue functions, including (but not limited to) :

- OCPP protocol version 2.0.1
- Action sequencing tool
- Protocol VDV 261 *

*Contact us for availability

4.2 OCPP

4.2.1 Protocol

The PcVue EV Charge Kit is based on the OCPP version 1.6 JSON protocol.
PcVue implements all OCPP server functionalities (see PICS table below).

Some messages sent by the loader are awaiting replies after processing.
The PcVue EV Charge Kit project implements the necessary processing in the OCPP exchange sequencing function.

Features	PICS OCPP 1.6 JSON		PcVue's role	Treatment to be implemented
CORE	Authorize	✓	Server	✓
	BootNotification	✓	Server	
	ChangeAvailability	✓	Client	
	ChangeConfiguration	✓	Client	
	ClearCache	✓	Client	
	DataTransfer	✓	Server	
	GetConfiguration	✓	Client	
	Heartbeat	✓	Server	
	MeterValues	✓	Server	
	RemoteStartTransaction	✓	Client	
	RemoteStopTransaction	✓	Client	
	Reset	✓	Client	
	StartTransaction	✓	Server	✓
	StatusNotification	✓	Server	
	StopTransaction	✓	Server	✓
	UnlockConnector	✓	Client	
FIRMWARE MANAGEMENT	GetDiagnostics	✓	Client	
	DiagnosticsStatusNotification	✓	Server	
	FirmwareStatusNotification	✓	Server	
	UpdateFirmware	✓	Client	
LOCAL AUTH LIST MANAGEMENT	GetLocalListVersion	✓	Client	
	SendLocalList	✓	Client	
RESERVATION	CancelReservation	✓	Client	
	ReserveNow	✓	Client	
SMART CHARGING	ClearChargingProfile	✓	Client	
	GetCompositeSchedule	✓	Client	
	SetChargingProfile	✓	Client	
REMOTE TRIGGER	TriggerMessage	✓	Client	

Table1 : Simplified PICS OCPP 1.6

NB: As PcVue is an OCPP server, the establishment of connections is at the initiative of the loaders.

4.2.2 Test and maintenance tools

The application has 2 interfaces dedicated to OCPP exchange tests (to validate functions and messages) and maintenance (to send unit messages). These tools can be used with any type of OCPP client.

Description of main functions:

- Manual management of authorization response
- Retrieving and modifying charger settings
- Diagnostic functions, firmware update
- Reset
- Customize and send load profiles

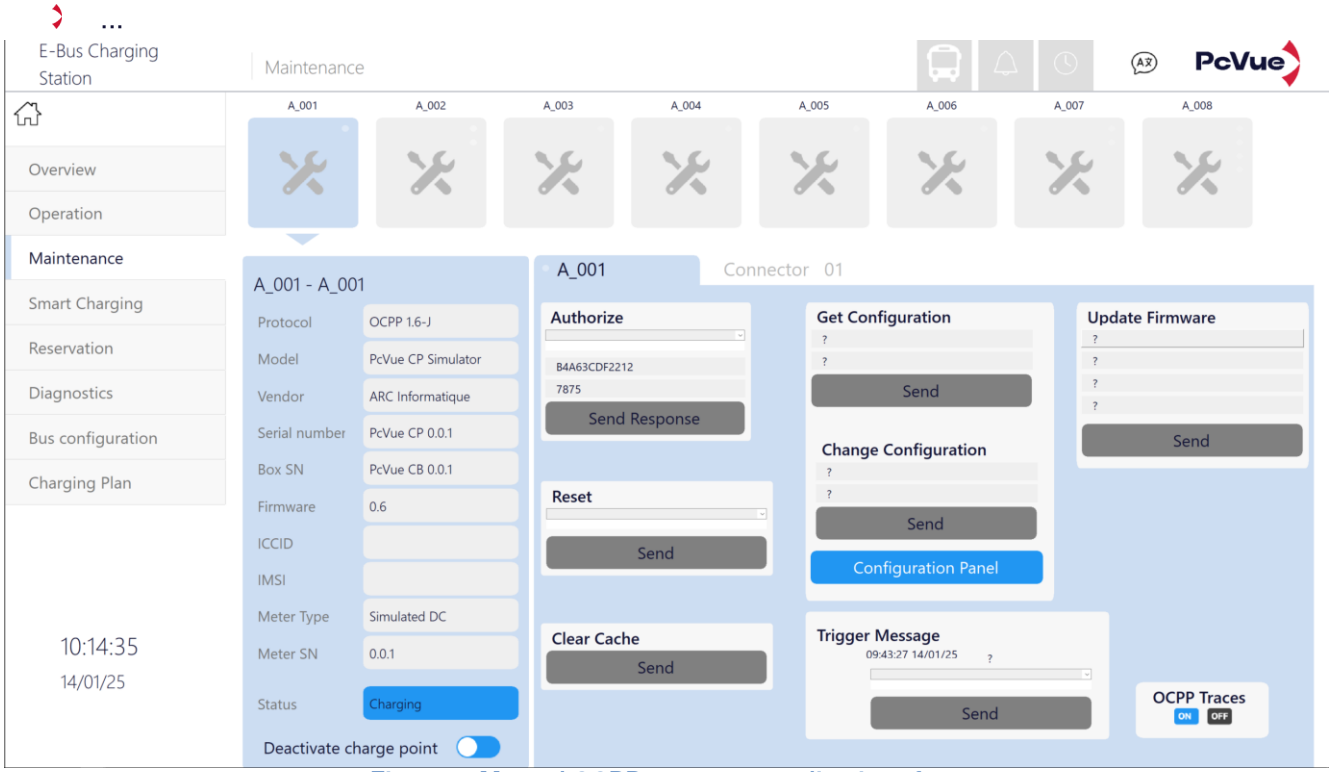


Figure1 : Manual OCPP message sending interface

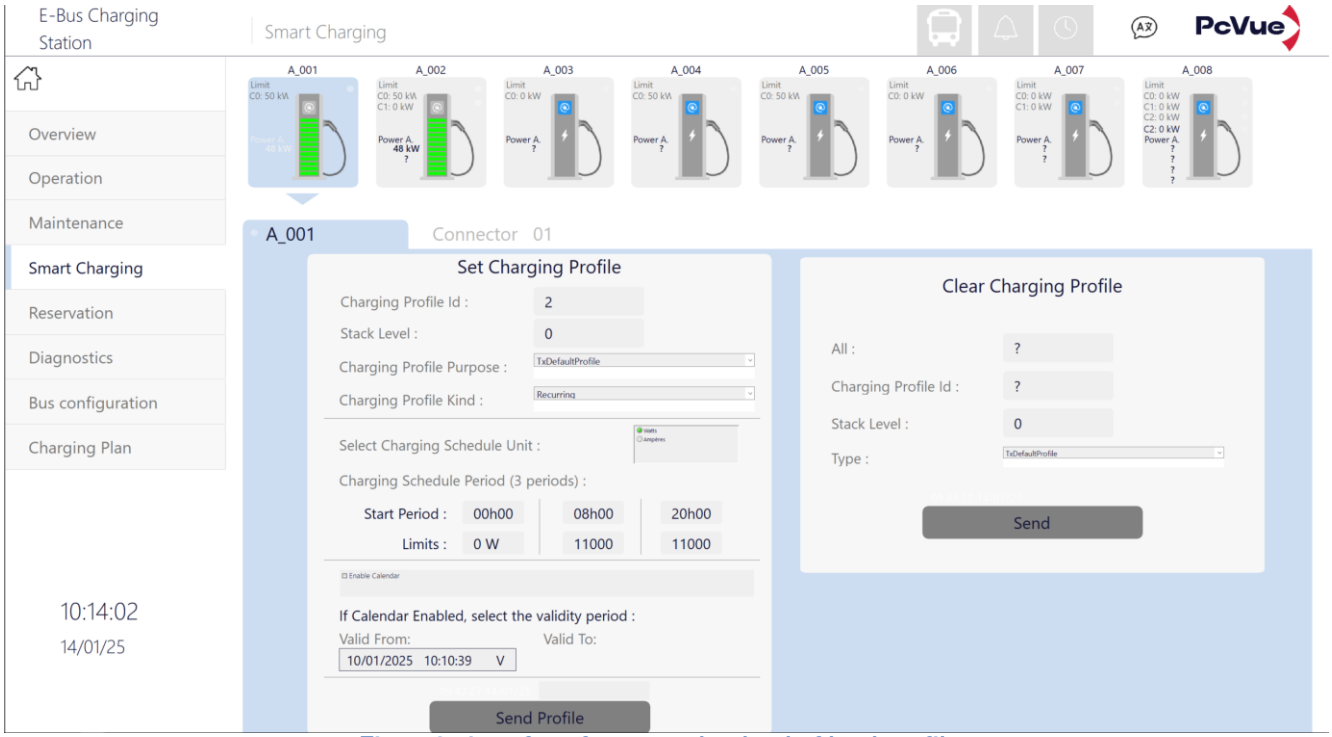


Figure2 : interface for manual upload of load profiles

4.2.3 Proxy

A loader can only connect to one CSMS (OCPP server). In practice, various stakeholders wish to retrieve data from the loader.

The proxy mechanism enables the third-party central system (CSMS or CPO) to receive OCPP messages from the loader as if it were directly connected to it.

As an OCPP proxy, PcVue can be used to relay OCPP messages.

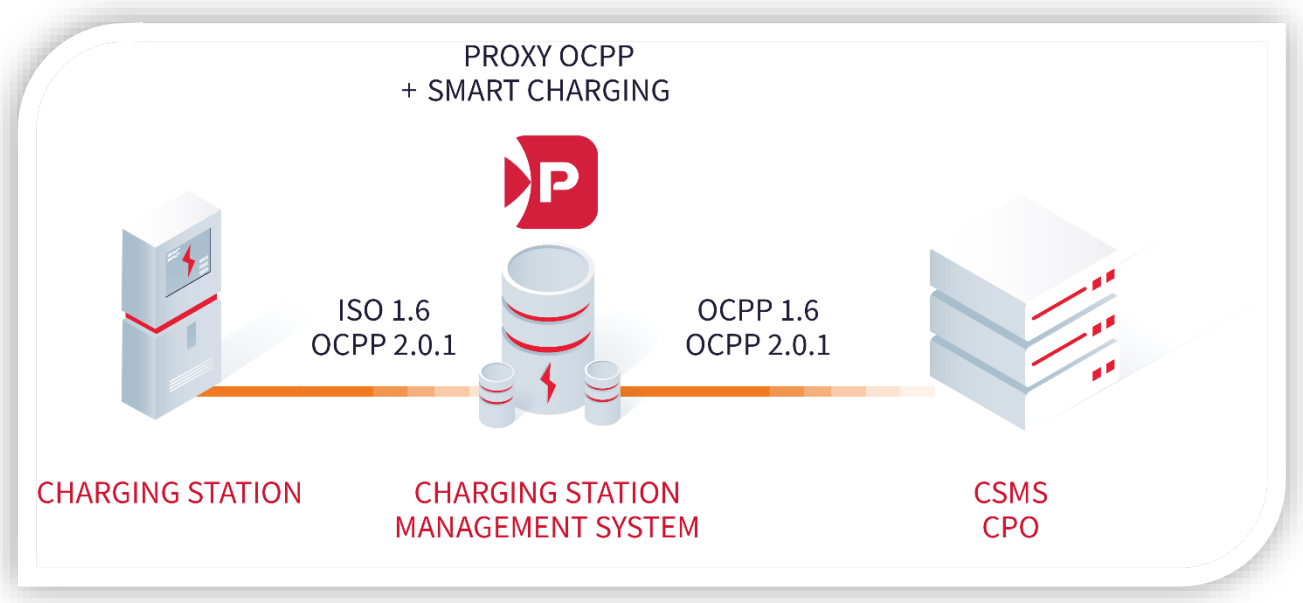


Figure3 : PcVue as an OCPP proxy

General information :

- All OCPP functions are supported by the proxy
- Only one CSMS can be connected to the proxy

Proxy in " PcVue EV Charge Kit "

A common use of the PcVue EV Charge is to have PcVue manage Smart Charging and third-party software manage authorization (rights, charging schedule, etc.) via the proxy.

4.3 Sequencing procedures

As PcVue is an OCPP server, taking into account messages sent by the charging stations requires meticulous internal organization. This sequencing of exchanges and procedures is at the heart of the solution. The main OCPP functions included in this sequencing are :

- Establishing the connection
- Authorize charging (Authorize)
- Load launch (StartTransaction)
- Load data retrieval (MeterValues)
- Load stop (StopTransaction)

The following illustration shows the sequence of procedures in the PcVue EV Charge Kit.

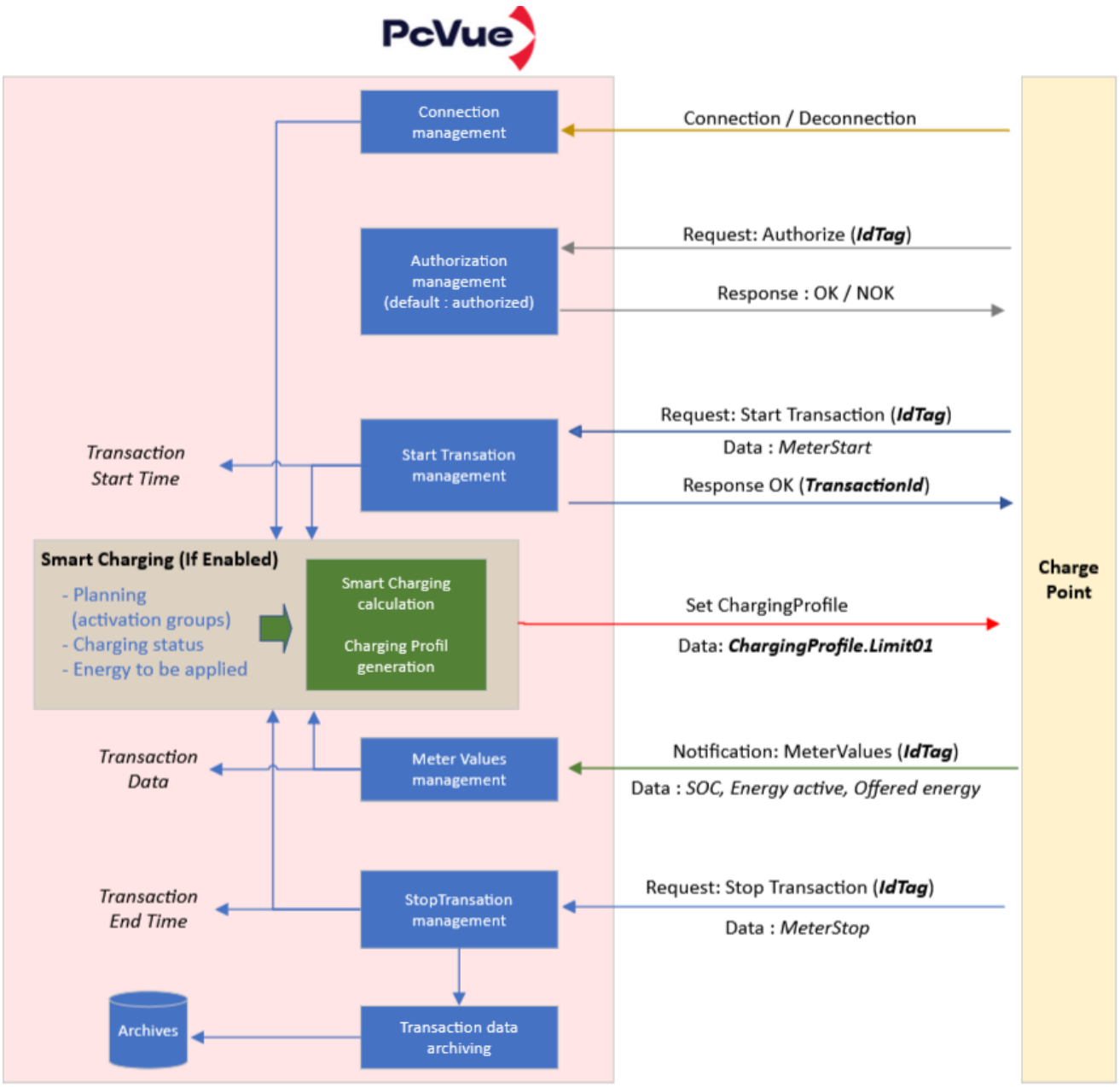


Figure4 : sequence of procedures

4.4 Graphic interface

4.4.1 Navigation

The "PcVue EV Charge Kit" project features navigation based on a side and top navigation bar. By default, the customizable view is the home view, although it is possible to create one or more intermediate views.

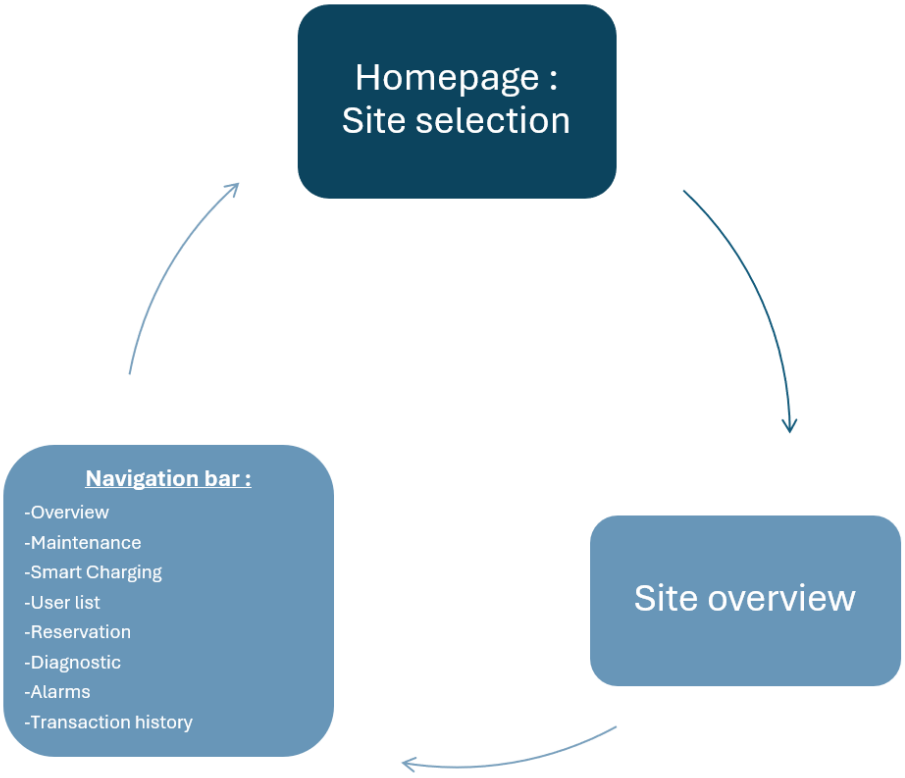


Figure5 : navigation principle

4.4.2 Generated views

Supervision views are generated when the project configuration is applied, according to the number of terminals declared.

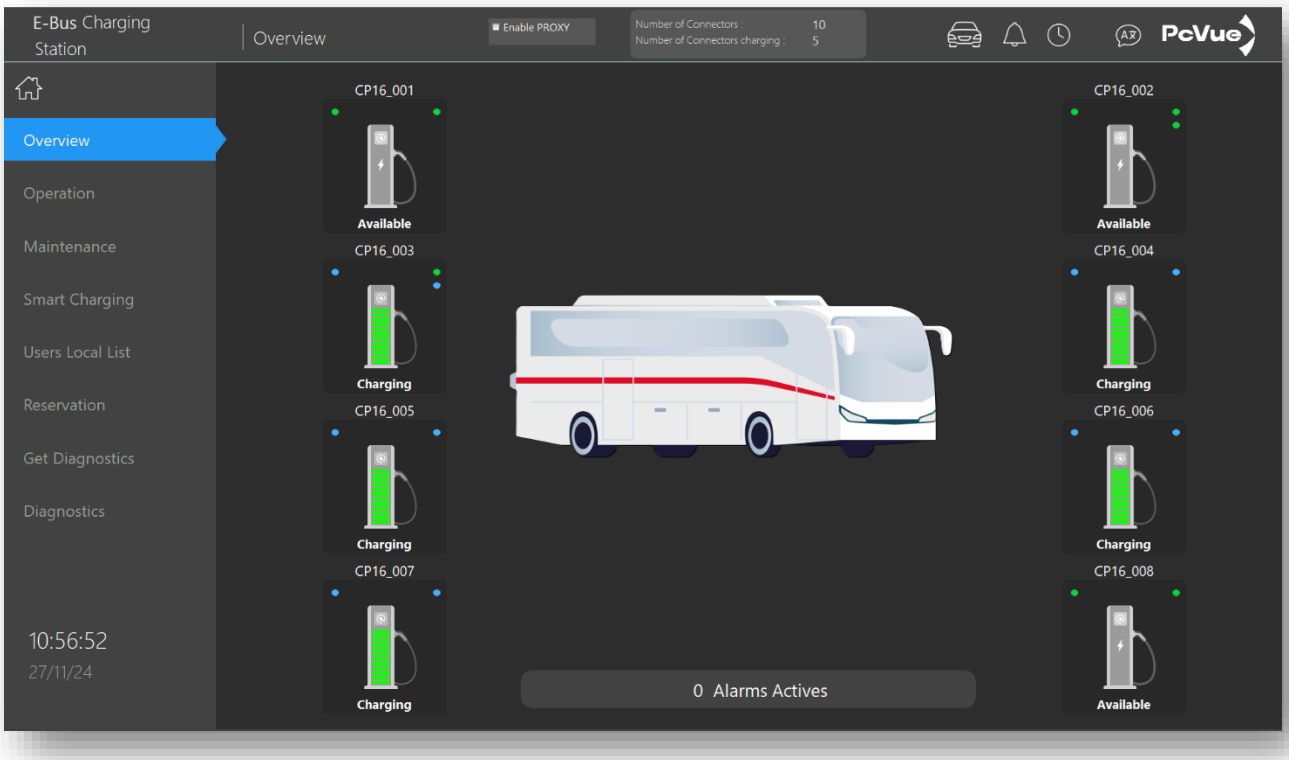


Figure6 : site overview

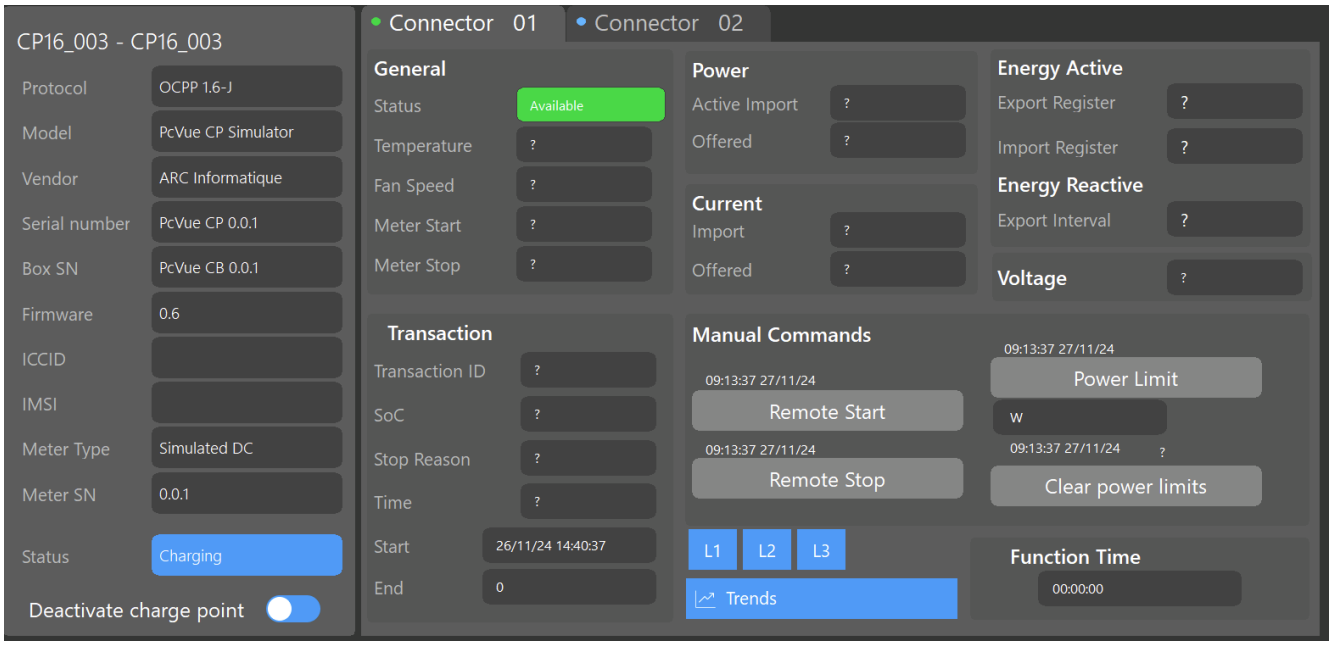


Figure7 : detailed view of a charging station

4.4.3 Customizable main view

With an appropriate license (Development or Full), you can use the Editor mode to create and insert graphical objects and animated symbols in synoptics.

The "PcVue EV Charge Kit" thus offers not only customization of the home page and other generated pages, but also the possibility of creating new views.

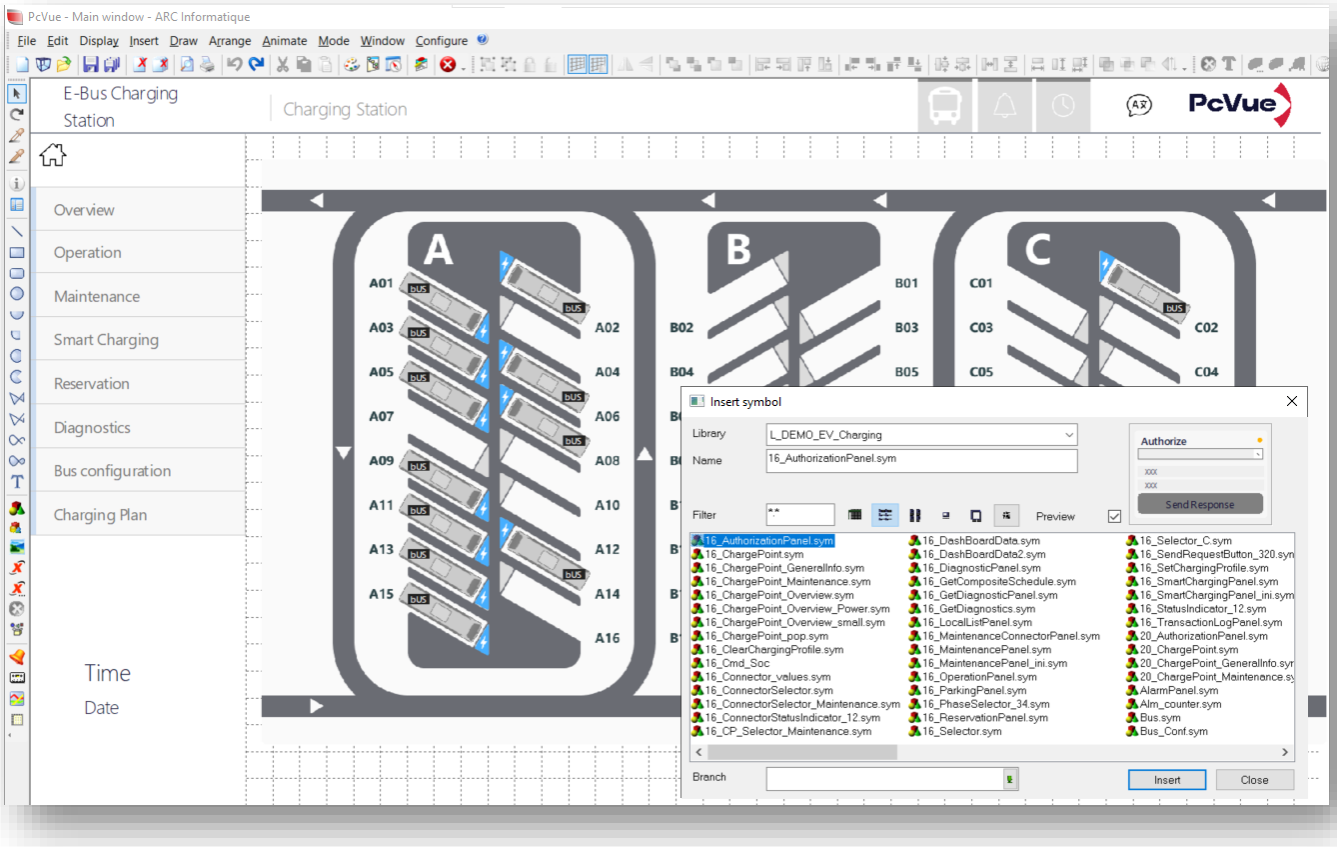
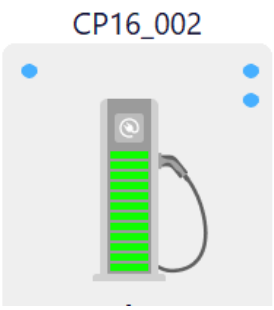


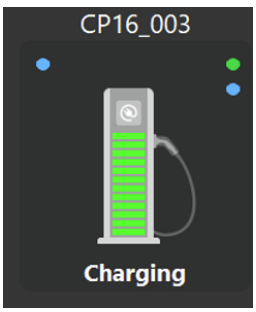
Figure8 : Editor mode mimic diagram

4.4.4 Symbols and representation

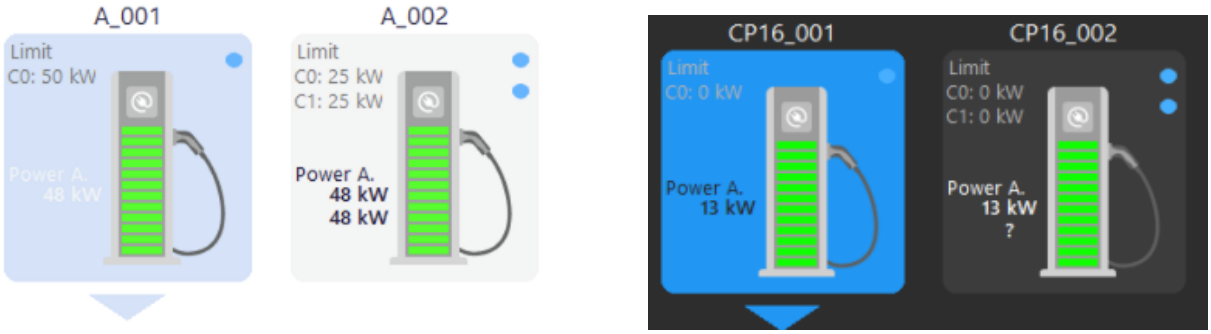
The symbol library provides animated objects describing the state of the chargers. The main objects used in the generated pages are shown below:

- Main charger symbol

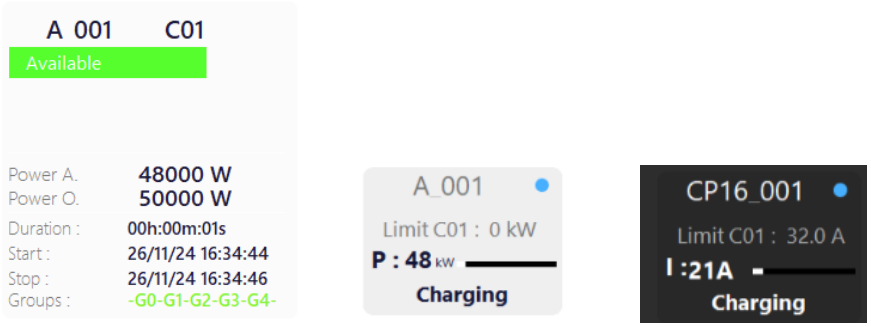




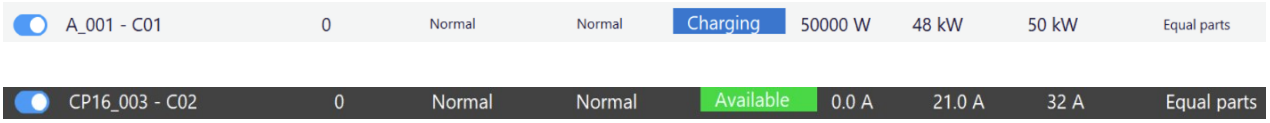
- Objects representing the Smart Charging function



- Objects with different levels of detail of a connector performing a charge



- Symbols used in lists



4.4.5 Web Client

The application features a native Web client, based on WebVue. This function doesn't require any special development, and displays the project's graphical interface in HTML5 format, which can be used from a web browser on any device: computer, tablet, smartphone...
WebVue is based on *EasyMobileTechnology*, which makes setup and deployment quick, easy and secure.

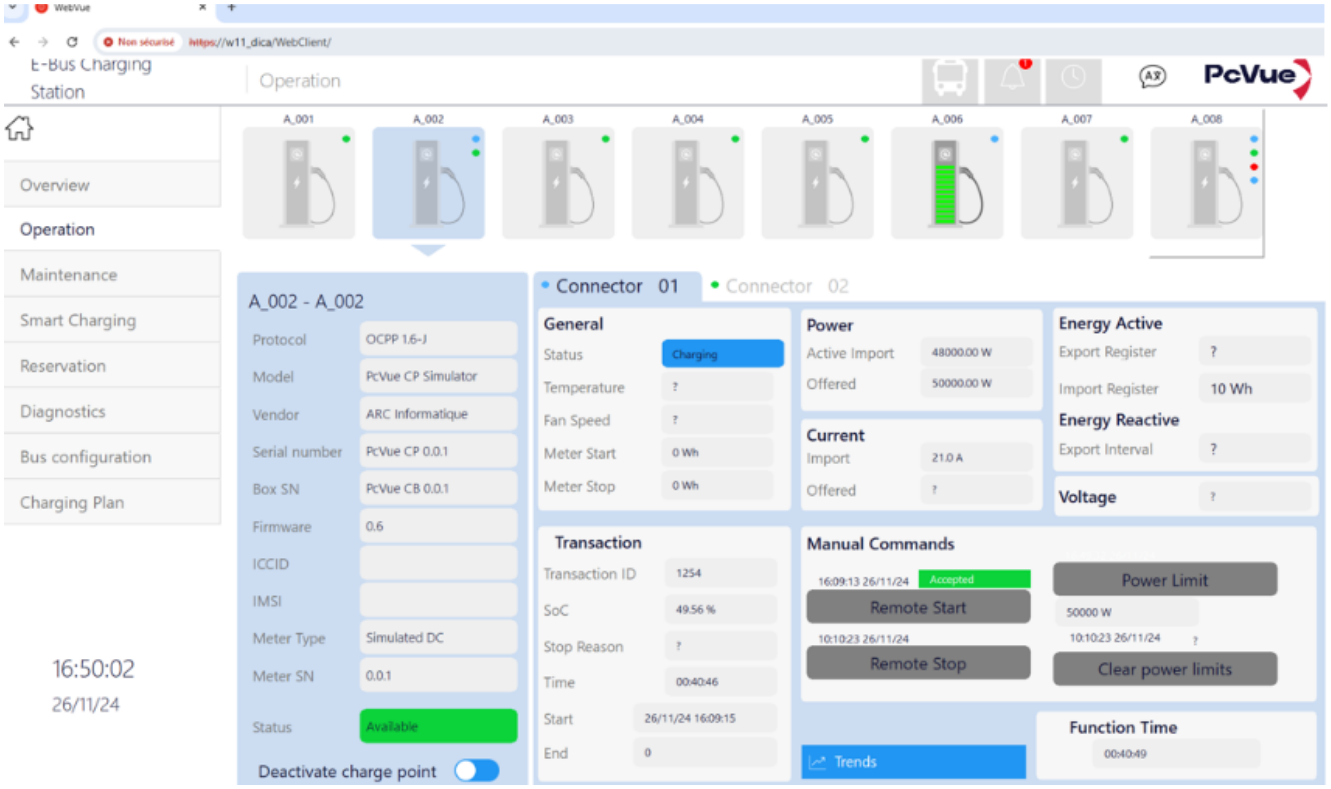


Figure9 : loader detail page from WebVue

4.5 Smart Charging

4.5.1 Role

Smart Charging is a PcVue application that automates the energy management of charging stations for electric vehicles. It is based on real-time data from the installation, and in particular from the charging stations.

In the "PcVue EV Charge Kit", the Smart Charging function performs the following functions:

- Terminal activation schedule management
- Intelligent distribution of the energy to be made available to the terminals according to
  - Energy available for the site
  - Energy required by the charging station
  - Transaction or terminal prioritization
  - Multi-connector loader management
- Automatic reloading

4.5.2 Allocation algorithm

The energy distribution algorithm is based on data from the 3 topological levels. The following diagram summarizes the input-output of the algorithm.

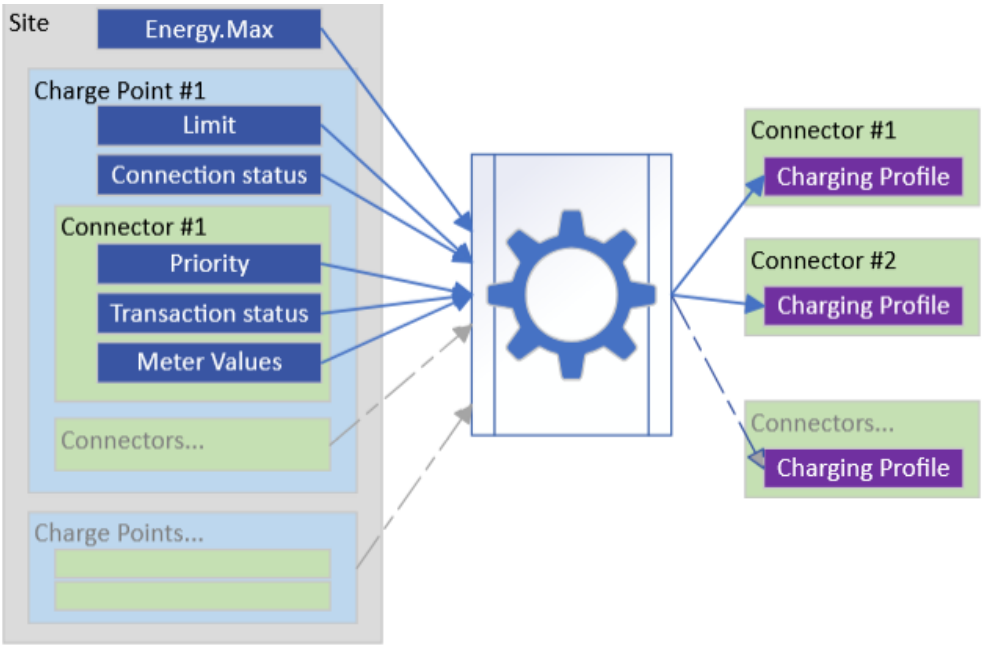


Figure10 : Input-output of the dispatching algorithm

Brief description:

- For starters :
  - **Site limit**: represents the energy limit not to be exceeded by all connectors under load.
  - **Connector status**: determines the number of active connectors, in order to share the available power fairly.
  - **Active and donated energy**: if donated energy is not fully consumed, allows energy to be redistributed
- Output:
  - Modification of the **energy limitation** (power or current) applied to the connectors, which forms the basis of a load profile.

4.5.3 Main parameters

The Smart Charging function offers parameters for customizing the load distribution method. These parameters are :

- **Priority**: giving priority to connectors
- **The operating mode:** to compensate for differences in loader behavior
- **Launch energy:** to avoid exceeding the maximum site energy during load launches
- **Dead band, hysteresis:** to avoid too frequent changes

4.6 Operating functions

4.6.1 Activation schedule management

The application provides an activation schedule for the connectors linked to the terminals. This function is based on 10 groups providing an activation schedule. The operator is free to assign individual connectors to the groups of his choice, in order to make the connectors accessible according to his strategy.

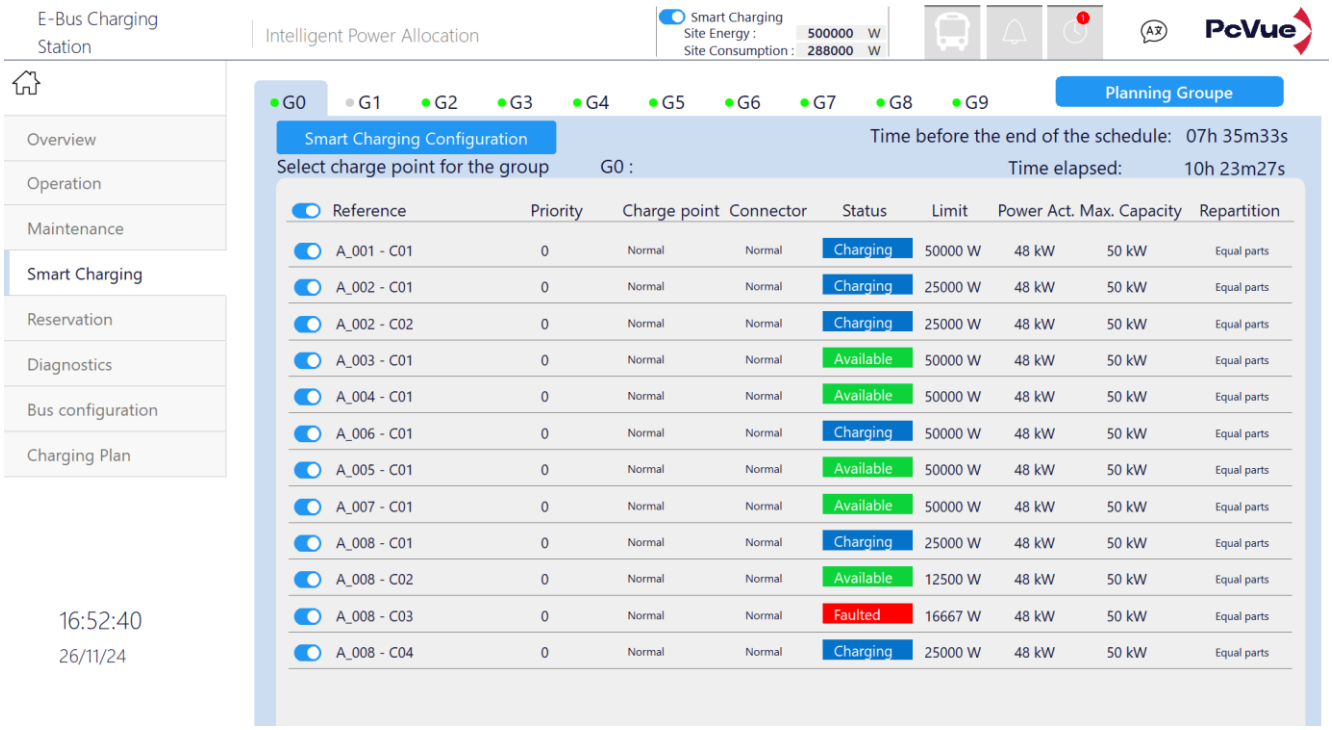


Figure11 : activation schedule

Notes :

- 10 groups per site can be configured
- A connector can belong to several groups
- Each group has its own schedule
- A schedule describing activation times

4.6.2 History

The "PcVue EV Charge Kit" project natively offers a system for archiving transaction data in a proprietary format. It is also possible to store the archives in a SQL Server database, so that the data can be used by a third-party tool (additional functionality).

Transaction history can be accessed from a synoptic view that offers

- a filtering system by date, terminal or vehicle (if information is available)
- an Excel export function

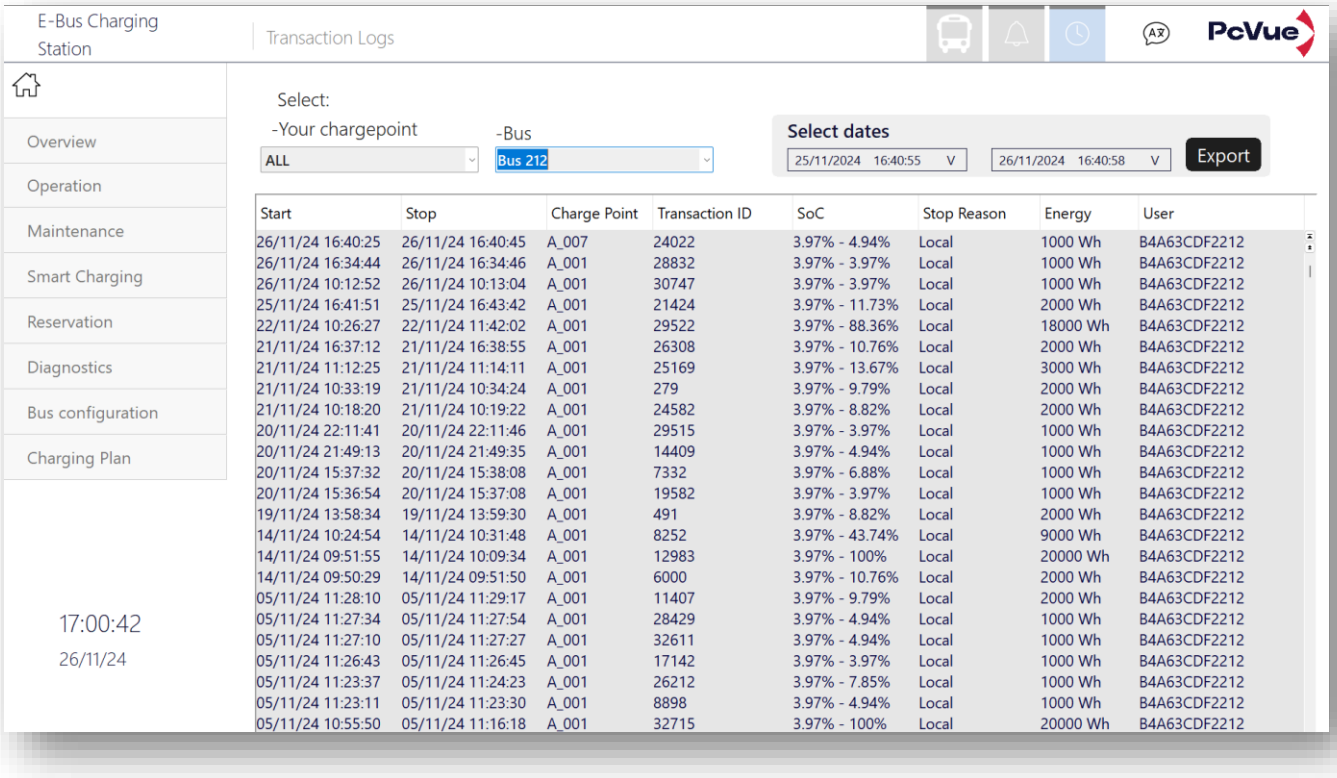


Figure12 : Transaction history

Analog loading data (power, current, state of charge (SoC), temperature, etc.) from the OCPP "MeterValues" service are also archived and made available for consultation in the form of curves. The presence of this data depends on its availability via the associated terminal.

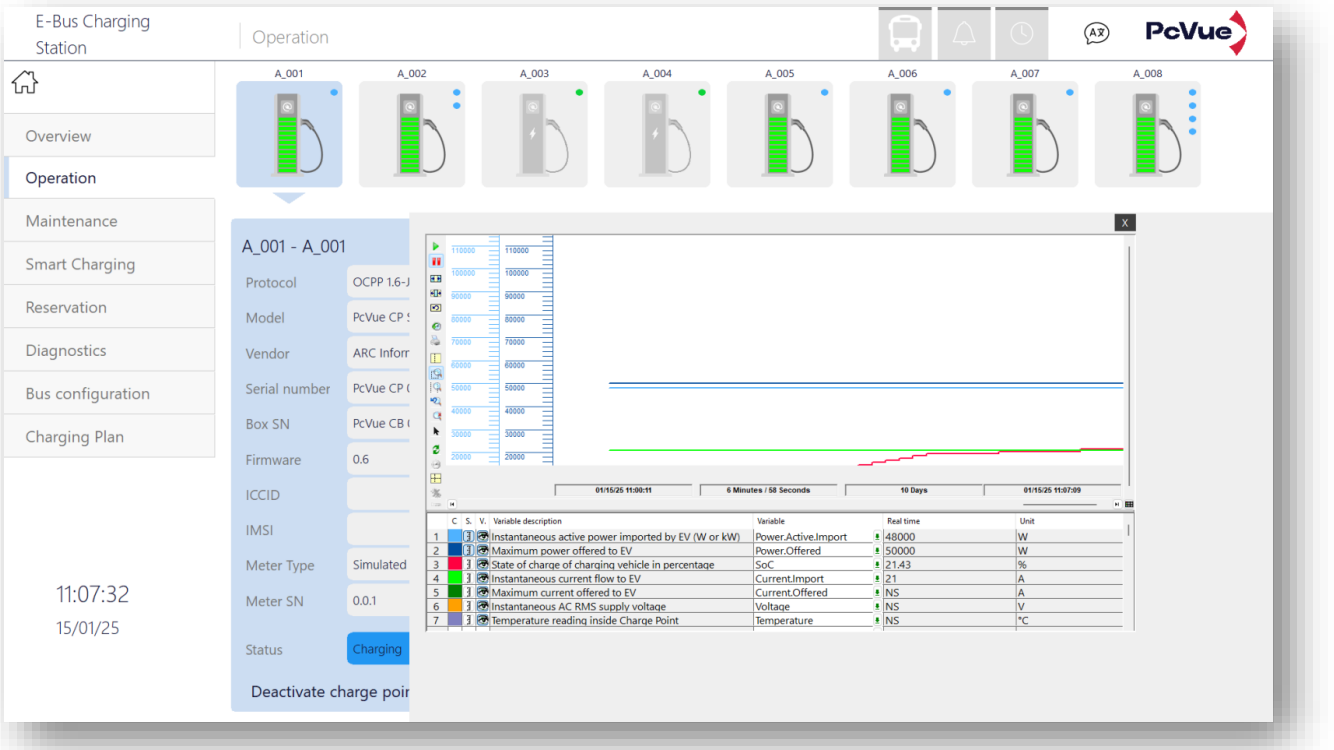


Figure13 : MeterValues history

4.6.3 Miscellaneous

In addition to the functions described above, the "PcVue EV Charge Kit" contains a number of native, standard supervisory functions that can be adapted as required.

These main functions are :

- User management: 3 levels (administrator, operator, guest)
- Alarm management :
  - alarms related to OCPP terminal availability
  - email on alarm
- Bilingualism

4.6.4 On Call management

PcVue offers built-in features for on call management, and can also connect to third party products for advanced on call management.

4.6.4.1 SMS et Emails

The broadcast of events notifications such as alarms, or real time data from the process is possible using SMS or Email directly sent from PcVue.

- Built-in device configuration
- Priority levels definition
- Possibility to define message templates including static or dynamic parameters as well as substitution characters associated with the context (value of a tag at the time of the message delivery)
- Automatic delivery of messages on alarm, event or any action

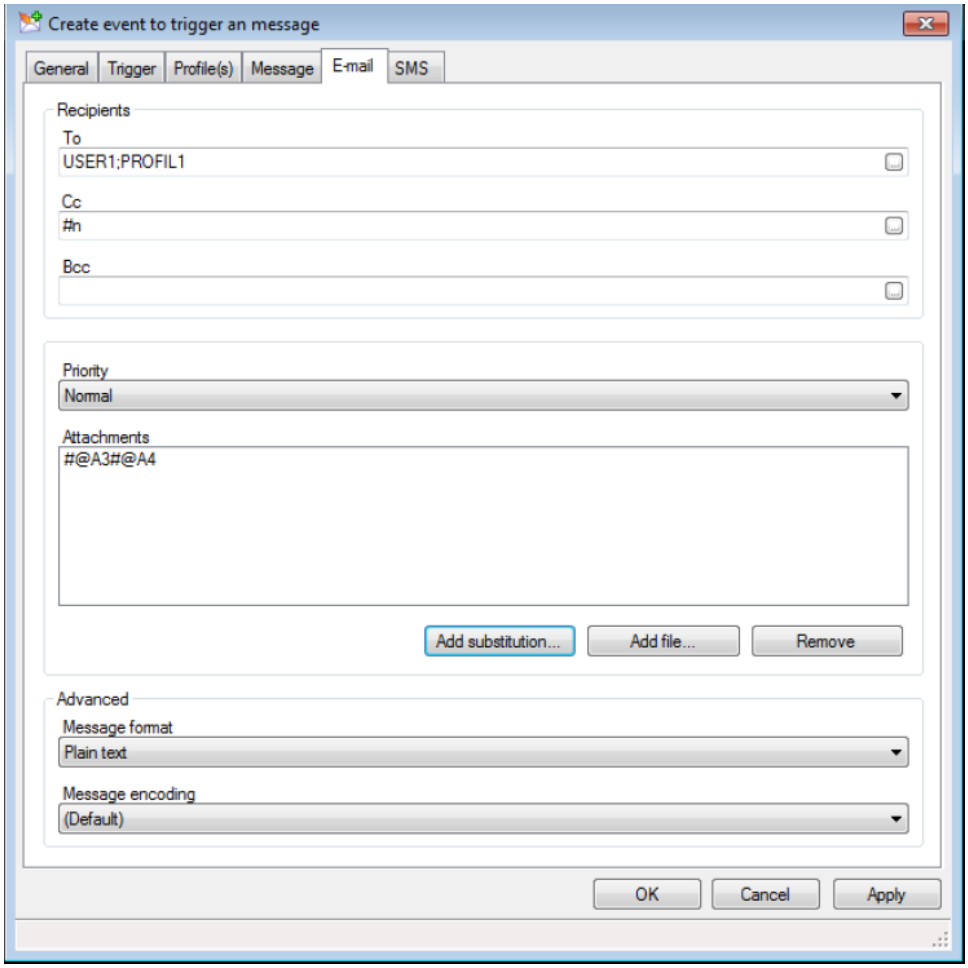


Figure 14 - Message profile

4.6.4.2 Advanced On Call Management

As a part of the **PcVue Solutions** suite, **Alert**™ easily connects with **PcVue** through a dedicated interface (Mediator) as well as with other industrial SCADA systems, using DDE or the OPC protocol.

Alert™ issues information through various media:

• Telephone (landline or mobile): operators are called by telephone, listen to alarms and acknowledge them through the integrated voice server.
• Short messages (SMS) to alert operators working offsite via mobile phone or pager.
• Dedicated paging systems to quickly alert maintenance operators working on site.
• Fax, teleprinter and email to receive written reports of the alarms detected and their contexts.
• Internet browser or WAP-enabled mobile phone.

The calls are also logged by **Alert**™, together with the operators' acknowledgements of them. Each acknowledgement of an alarm is automatically forwarded to **PcVue**.

4.6.5 Alarms

In PcVue an alarm is generated by a bit variable that has been configured with alarm behavior. This means that alarms have all the flexibility associated with a bit plus the characteristics required by an alarm. Changes in alarm value are time-stamped to millisecond resolution. The origin of the time-stamp can be PcVue itself or the source of the value (PLC, OPC etc.).
A real-time alarm list is provided by the Alarm Viewer. Alarms can also be used in the HMI's animations the same as any other variable to produce color changes, change text strings, exchange symbols etc. Individual alarms can be accepted by an operator with the corresponding user rights. Advanced group alarm acceptance strategies can be configured using SCADA Basic. In distributed applications alarms are broadcast to all nodes. Alarm acceptance (subject to user rights) can take place on any station.

4.6.5.1 Alarm levels

PcVue supports 30 alarm levels. Alarm display, acknowledgment and masking levels can be different. (For ease of configuration, by default, they are the same.) These levels are also defined in the user profiles. Depending on their profile settings the user may be able to display, acknowledge or mask an alarm with a given level.

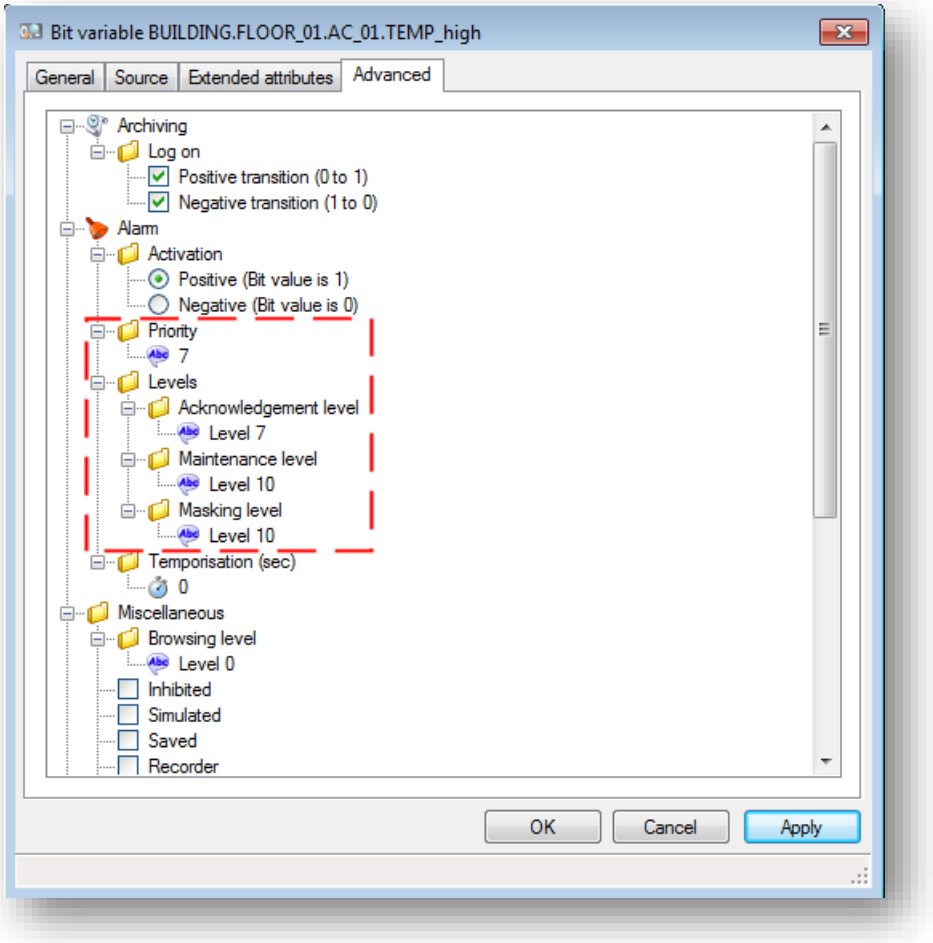


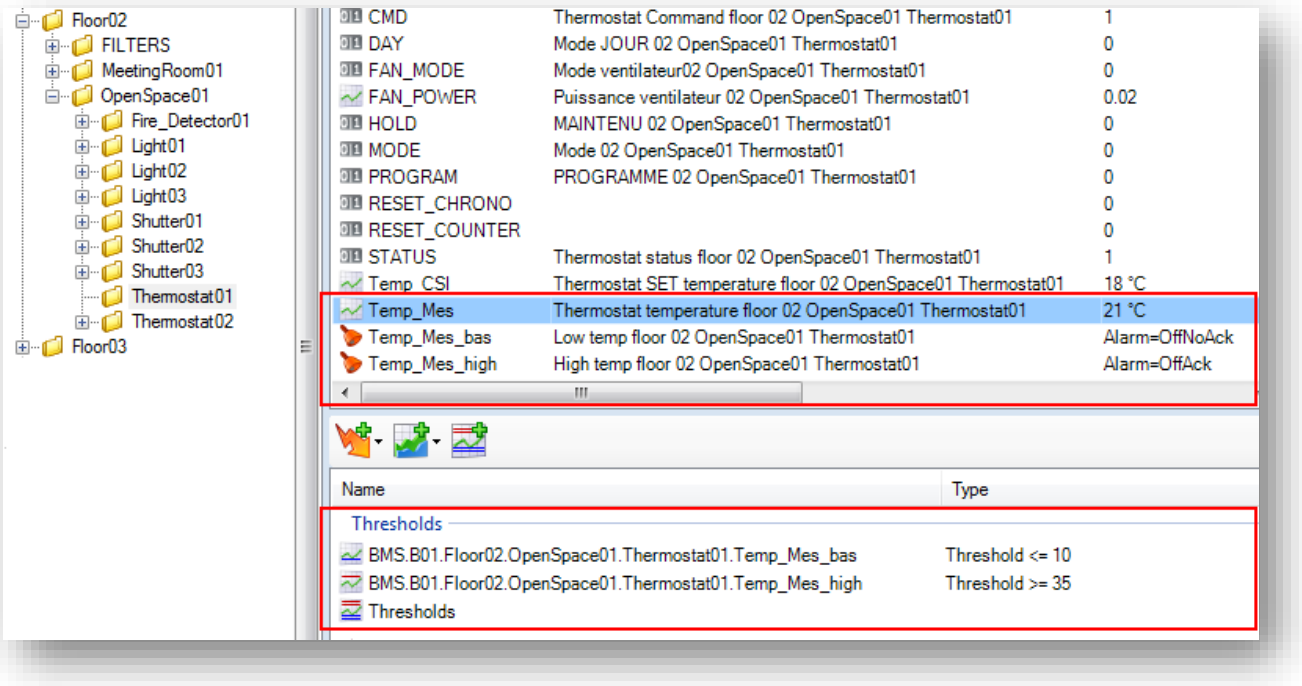
Figure 14 - Alarm levels settings

4.6.5.2 Temporization

A period in seconds between the source changing to the active state and the bit state following it (and hence the alarm activating). Should the source return to the inactive state before the temporization period is over the alarm will not activate. A value of 0 disables temporization and the alarm activates immediately the source changes to active

4.6.5.3 Thresholds

A threshold is one of the behaviors that can be attached to a register variable. A threshold sets and clears a bit depending on the rising or falling value of the register and a configurable hysteresis. Up to four thresholds can be specified per register and can be used to directly generate alarms.



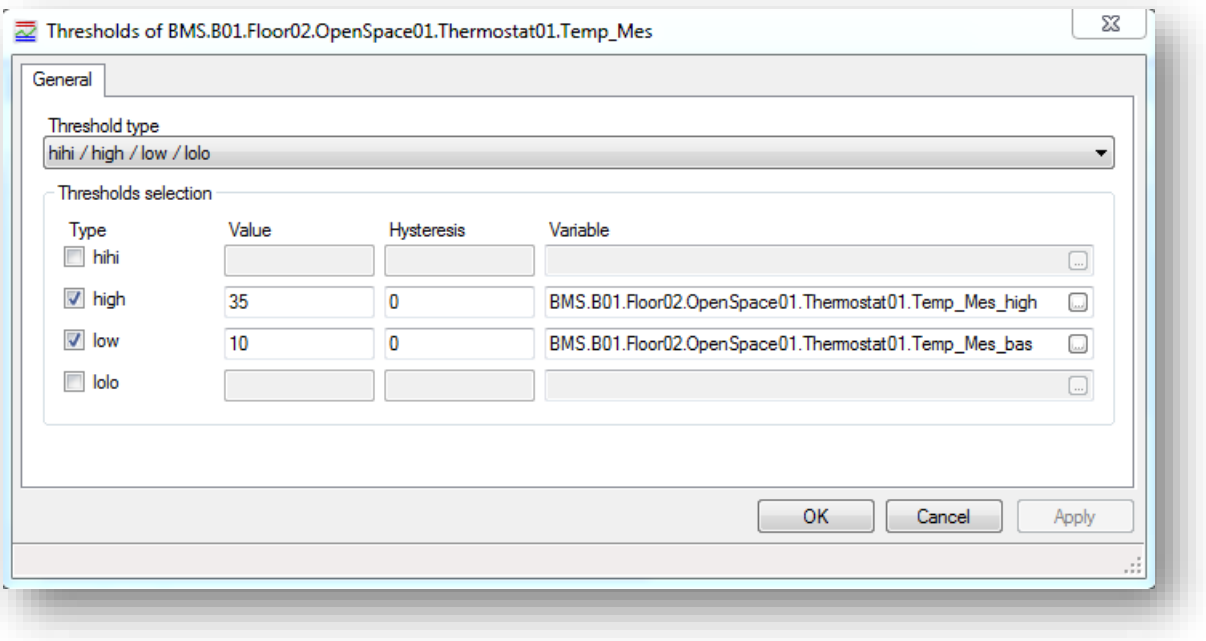


Figure 15 - Thresholds variables

4.6.5.4 Masking

To help prevent alarm cascades, an alarm can be masked by another alarm, a bit or an expression. Alarms can also be temporarily inhibited by the operator or taken out of service completely using maintenance mode.

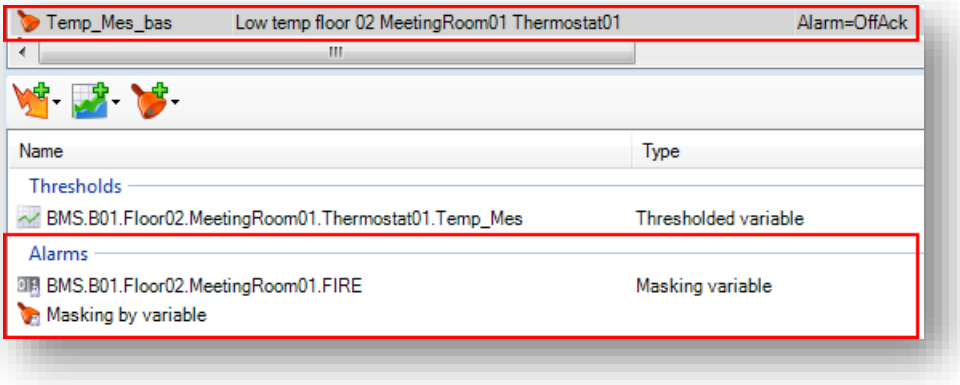


Figure 16 - Masking variable

4.6.5.5 Alarm counters

Alarm counters by level, status, Domain and Nature are easily configured using specially named register variables. These can be displayed in the HMI and trigger actions (such as sending an email or generating an audible alarm) in the same way as any other variable.
Advanced alarm counters using expressions and alarm properties can be configured using a technique called alarm synthesis

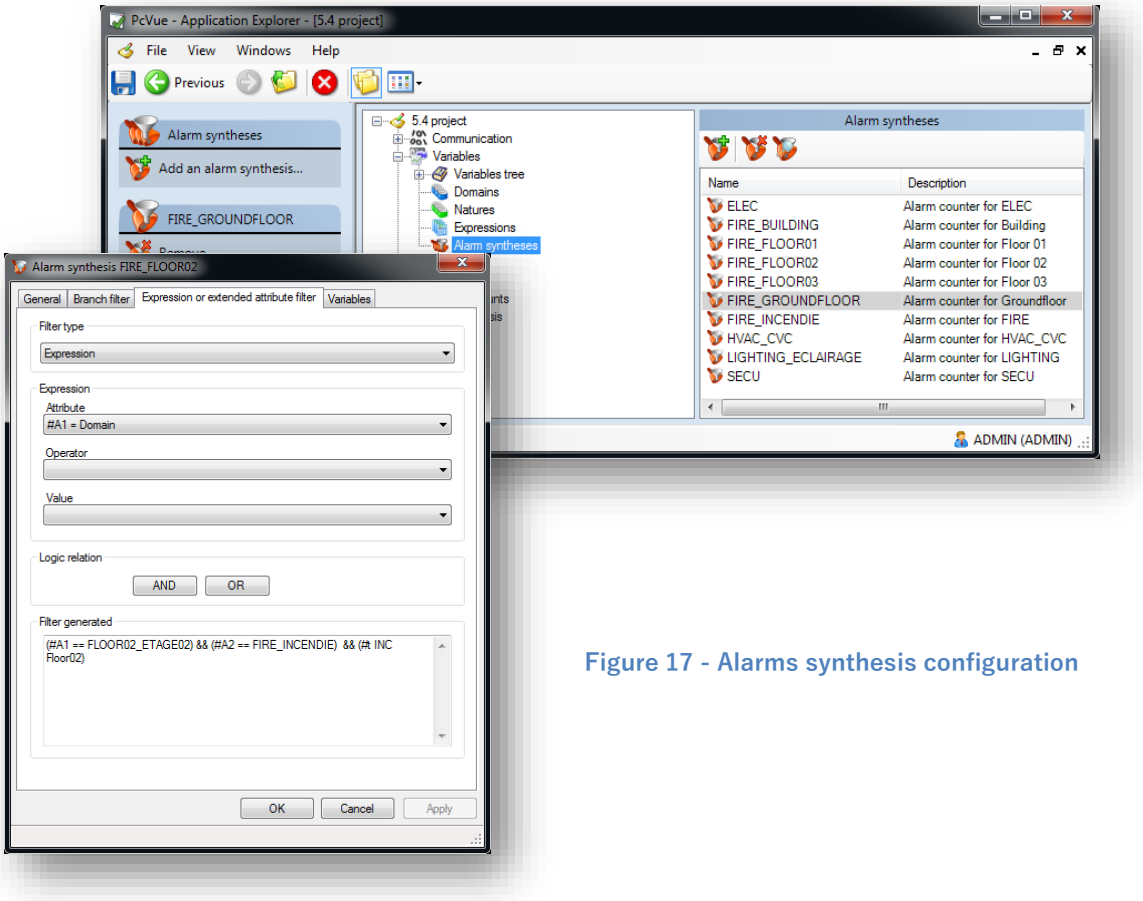


Figure 17 - Alarms synthesis configuration

PCVUE EV CHARGE KIT - DESCRIPTION

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