INSTALLATION

&

USER MANUAL

DYNAMIC LOAD MANAGEMENT

-PREMIUM-

CIRCONTROL
Mobility & eMobility

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1 PREFACE

This document provides information about the Dynamic Load Management - Premium. It is a system that balances the supply of electricity given to the electric vehicles depending on the building demand.

THE FOLLOWING SYMBOLS ARE USED FOR IMPORTANT SAFETY INFORMATION IN THIS DOCUMENT	
	ELECTRIC RISK! Take precautions to make the electrical connection inside the units. Units must be disconnected from any power source during commissioning.
	ATTENTION! Indicates that the damage to property can occur if appropiate precautions are not taken.
	TAKE NOTE! Indicates some kind of tip or advise.

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2 INSTALLATION GUIDELINES

2.1 IMPORTANT SAFETY INSTRUCTIONS

Read carefully all the instructions before starting to ensure properly installation and configuration.

The units must be installed safely and ensure adequate protection.

- Comply strictly with electrical safety regulations according to your country.
- Do not make repairs or manipulations with the units energised.
- Only trained and qualified personnel should have access to low-voltage electrical parts inside the devices.
- Check the installation annually by qualified technician.
- Dynamic Load Management is compatible neither with charging Mode 1 nor with Mode 4.
- Main supply can be either three-phase or single-phase.
- Charge points must be single-phase.
- Do not use Dynamic Load Management for another purpose which has been conceived and only with CIRCONTROL Charge points. Otherwise, CIRCONTROL will reject all responsibility and the warranty will be void.
- Remove from service any item that has a fault that could be dangerous for users (broken plugs, caps that don't close...).
- Use only CIRCONTROL supplied spare parts.

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2.2 ELECTRICAL WIRING CONSIDERATIONS

Before start with the wiring connection of the Charge points shall take in consideration this section.

2.2.1 Charge points – Input power supply

If the Charge points do not include elements of electrical protection, consider the following instructions:

The input power supply line must be hardwired from a distribution board to the charge point under electrical safety regulations according to your country regulations. Minimum safety required protections:

- RCD: Type A. $I_{\Delta N}$=0.03A.
- MCB: maximum value according to the maximum output current of the Charge points.

2.2.2 Power supply Line dimensioning

The dimensioning of the input power supply line must be checked by a qualified electrician.

The power supply must have a general switch and a unique differential, installed according to the standards of local or state security.

Check that the power supply line has enough capacity to power the unit; length, cable section, and the protection thereof (hose or cover) should be adequate for the unit.

Check using a multimeter that the supply voltage is stable within acceptable values.

2.2.3 Charge point – Maximum output current

If the power supply is lower than the maximum output current of the Charge points, an adjustment to a lower nominal current must be performed using the tool “Charge Point Setup”. Do not modify this value if the power supply is not restrictive.

Note that depending on the model of Charge point the maximum output current may vary.

Please refer to “*FAQ*” section in order to know how to change this value.

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3 SYSTEM DESCRIPTION

Load Management System monitors the power consumption of the building in real-time and all contracted power that is not being used is provided to the electric vehicles.

All the dedicated current for electric vehicle is equally distributed on each plug in order to not exceed the contracted power.

It is recommended to have at least 6A (Mode 3 minimum current permitted) per socket in the worst case when the consumption of the building is too high.

Load Management system can pause charging transactions when the current for each socket is less than 6A and resuming charging transactions when the current goes back to 6A or greater for each socket.

If the available power for the electric vehicles is very low, the longer it takes to the vehicle to charge up to 100%

3.1 PLUG WORK MODE

There are two groups of plug work mode:

a) Priority plugs
b) Standard plugs (no priority)

Priority plugs preferably charge before than standards. System gives the maximum current to the priority plugs allowing charging faster than standard plugs and the remaining current not used by priority vehicles is provided to the standard plugs (if available and according between the contracted power and the building consumption).

EXAMPLE

$\boldsymbol{Available\ current\ for\ EV}: \mathbf{40A}$

$\mathbf{1}\ \boldsymbol{priority\ plug\ charging\ at}: \mathbf{32A}$

$\boldsymbol{Remaining\ current\ for\ standard\ plugs}: \quad 40 - \mathbf{32} = \mathbf{8A}$

- Priority plugs only become in operation within an established time slot.
- Priority plugs are an optional feature. By default is disabled and can be enabled any time.

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The standard plugs start a charging transaction in the following cases:

- Remaining current not being used by priority vehicles. Explained in example above.
- No priority plugs are charging.
- Present time slot is not set as priority and all plugs are considered as standard.

3.2 GENERAL BEHAVIOR

In both groups (priority and/or standard plugs) the load management policy works as follows:

1. Available current is equally distributed on each occupied plug.
2. System pause one by one the existing charging transactions if the available current is not enough to keep charging all the plugs simultaneously.
3. Plugs remain paused until enough power is available back again. Display of the charge point shows:

4. System resumes all the paused charging transactions one by one as a queue and regulating the current on each plug without exceeding the contracted power.
5. System also resumes one paused charging transaction after one vehicle has the battery fully charged.
6. System pauses a charging transaction if the EV switches to State B after a short period of time, in addition it is queued and the current now is distributed to the other active charging transactions. *This is an optional parameter and can be changed if necessary.

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7. Each plug has one ID internally assigned. This IDs cannot be changed:

CHARGE POINT	PLUG	ID
01	A	1
	B	2
02	A	3
	B	4
03	A	5
	B	6
04	A	7
	B	8
05	A	9
	B	10
06	A	11
	B	12
07	A	13
	B	14
08	A	15
	B	16
09	A	17
	B	18
10	A	19
	B	20
11	A	21
	B	22
12	A	23
	B	24
13	A	25
	B	26
14	A	27
	B	28
15	A	29
	B	30

These IDs are only needed in following cases:

A. Insufficient power to keep charging all plugs simultaneously at 6A.
B. Enough power available to resume existing paused charging transactions.

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Case A

Existing started charging transactions are become paused until not exceed the maximum contracted power from the highest plug ID to the smallest plug ID.

EXAMPLE

Charging ID plugs: 1,2,3,4

Plug ID queue: 4 → 3 → 2

a. **Not enough power to have 4 plugs charging simultaneously. Plug ID=4 is the first one to pause.**
b. **Not enough power to have 3 plugs charging simultaneously. Building + EV real-time consumptions are exceeding the contracted power. ID=3 is the following to pause.**
c. **Exceeding contracted power. ID=2 is paused.**
d. **ID=1 remains charging. Building + EV real-time consumptions are less than contracted power.**

Case B

Existing paused charging transactions are resumed from the smallest plug ID to the highest plug ID.

EXAMPLE

Following above *Case A* example, charging ID plugs: 1

Plug ID queue: 2 → 3 → 4

a. **Building + EV real-time consumptions are less than contracted power. Plug ID=2 is the first one to resume.**
b. **2 plugs are now charging simultaneously. Building + EV real-time consumptions are less the contracted power. ID=3 is the following to resume.**
c. **3 plugs are now charging simultaneously. Resuming plug ID=4.**
d. **4 plugs now charging simultaneously. Building + EV consumptions don't exceed the contracted power.**

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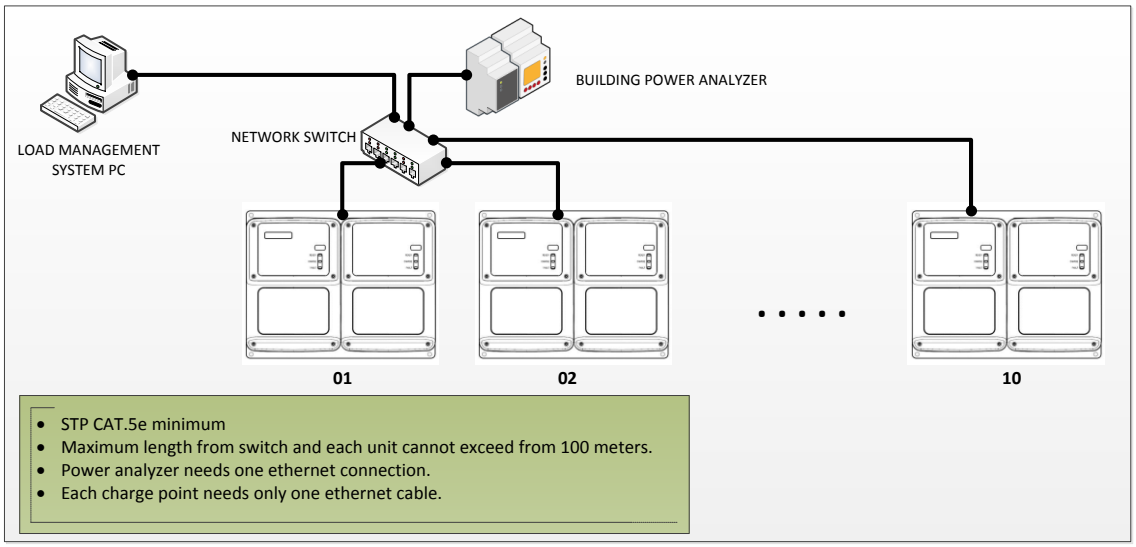
4 REQUISITES

4.1 ETHERNET COMMUNICATION

Charge points, building power analyser and the load management PC are together connected into a network switch (not provided):



Please consider the distance between each device (charge point, Building Meter or PC) and network switch. Maximum allowed length of the Ethernet cable is 100 meters.

It is highly recommended using at least FTP Ethernet cable. Cat 5e.

4.1.1 IP ADDRESSING

Load Management system only works under static IP addresses and each device connected to the network switch needs a static IP address:

- Charge points
- TCP2RS
- Load Management PC

Please refer to the section "*FAQ*" to consult how to assign IP addresses.

4.2 CHARGE POINTS

Load management system is compatible with following models:

- Dual outlet AC charge point model.
- Single outlet AC charge point model.

4.2.1 CONSIDERATIONS

- Dual and single AC charge points models must have Mode 3 charge mode (Type 1, Type 2 or Type 3 connectors).
- Mode 1 and Mode 2 charging modes are not compatible (CEE 7/4 sockets) under load management system.
- DC chargers are not compatible.

4.3 LOAD MANAGEMENT PC

4.3.1 REQUIREMENTS

Minimum requirements

- **CPU**: Dual Core
- **RAM**: 2Gb RAM
- **S.O.**: Windows XP or higher

4.3.2 LICENSE KEY

Hasp USB key must be plugged in and the LED ON in the server:

If the LED from the hasp is not lighting ON, Load Management system will be automatically OFF in the following one hour.

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4.4 POWER ANALYSER

Power analyser is an optional feature when the power line is not fully dedicated for electric vehicle because other electric devices are connected on the same supply.

The analyser allows to the Load Management System to prevent excess power consumption by electric vehicle considering the real-time consumption from the building.

Following devices are needed to read the power consumption of the building for the load management system:

TCP2RS+	CVM-MINI	MC3

- **TCP2RS+:** RS485 (Modbus RTU) to Ethernet (Modbus TCP) converter.
- **CVM-MINI:** Three-phase power analyser.
- **MC3**: Current transformer, needed to measure the consumption.

Only CVM-MINI power analyser is compatible with the Load Management System.

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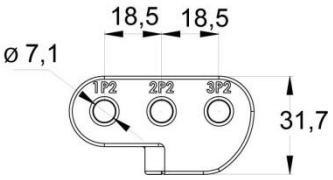
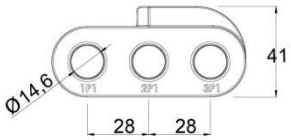
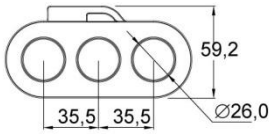
4.4.1 MC3 CONSIDERATIONS

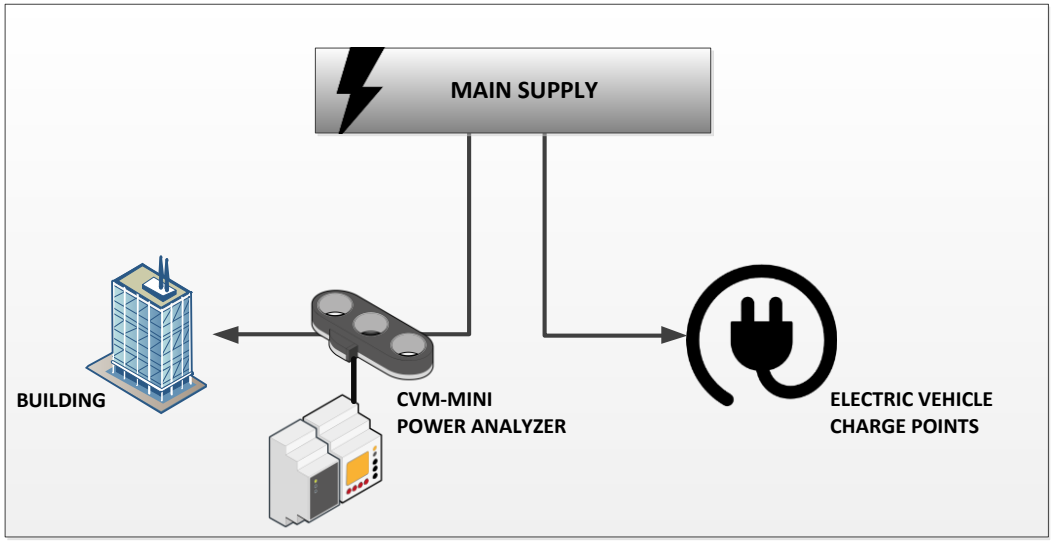
MC3 is the current transformer used with CVM-MINI. Different MC3 can be found for each wiring need:

MC3-63	MC3-125	MC3-250
		
Max. Current: **63A**	Max. Current: **125A**	Max. Current: **250A**

Wiring section of the building supply must be checked by a qualified electrician in order to select the correct MC3.

4.4.2 MC3 LOCATION

Building power supply line and Electric Vehicle supply line must be separated from the main distribution board.



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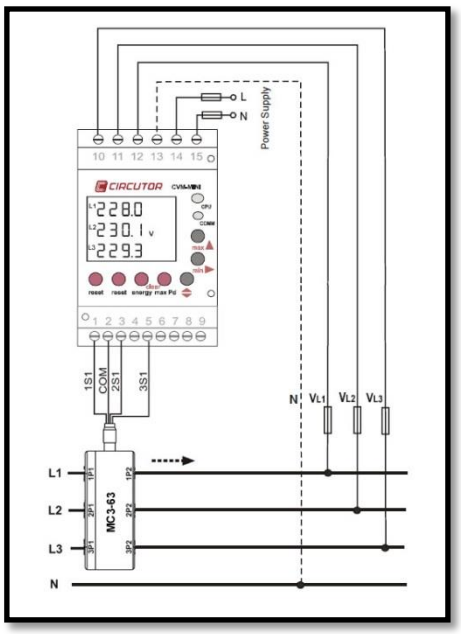
4.4.3 CVM-MINI CONNECTION



CVM-MINI	MC3 Connection
PIN 01	1S1
PIN 02	COM
PIN 03	2S1
PIN 04	*Nothing*
PIN 05	3S1
PIN 06 – 09	*Nothing*

CVM-MINI	Voltage connection
PIN 10	L1
PIN 11	L2
PIN 12	L3
PIN 13	N

CVM-MINI	Supply	
PIN 14	L	$230V_{AC}$
PIN 15	N	

Only trained and qualified personnel should manipulate the wiring.

4.4.4 MC3 LOAD DIRECTION

Before installing the current transformer, pay attention to the load direction from power supply and the correct order of the phases in order to ensure the correct reading of the power consumption.

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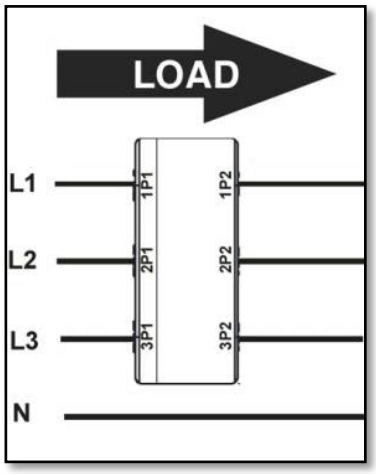
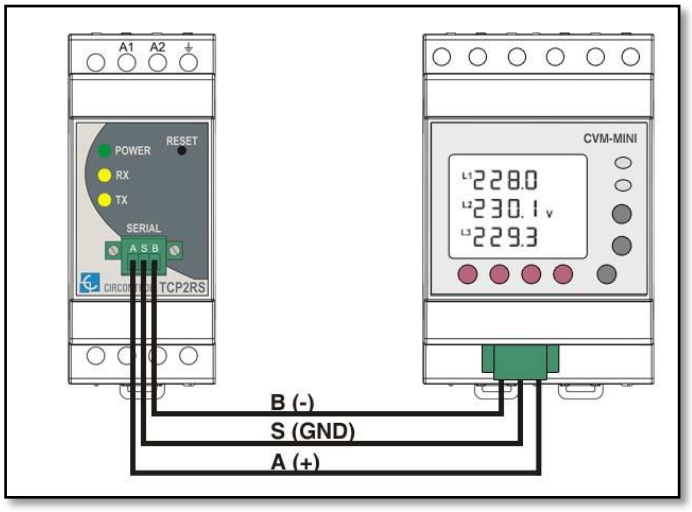


1P1= L1 Input power	**1P2**= L1 Output power
2P1= L2 Input power	**2P2**=L2 Output power
3P1= L3 Input power	**3P2**=L2 Output power

Improper installation of the current reader can cause a malfunction of the load management system.

4.4.5 RS-485 CONNECTION

TCP2RS and CVM-MINI must be connected between each other using a 2 wire twisted shielded communication cable (STP CAT.5e recommended).



Respect the polarity of the wiring connections otherwise load management system cannot communicate with CVM-MINI.

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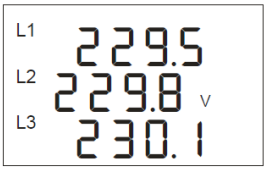
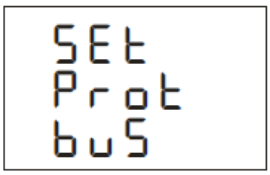
4.4.6 RS-485 SETTINGS

Load management system expects to find the CVM-MINI under following RS485 connection details:

- **Peripheral number**: 1
- **Baud rate**: 19200

Use the display and buttons of the device in order to establish the above configuration:

STEP	ACTION
1	Make sure to having powered the CVM-MINI in order to apply the new settings to the device. Voltage measurement from each phase is the default information displayed by the screen. Following picture shows an example: 
2	To setup communications, first press *Reset* key for a second and immediately press *Setup* key for a long time until following message is displayed on screen: 

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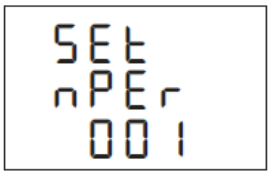
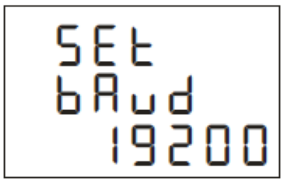
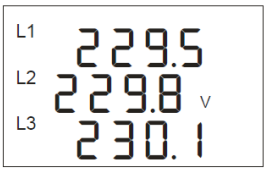
3	Press button two times until following message is displayed on screen:  This option allows to modifying the peripheral number of the energy meter.
4	To change the peripheral number, repeatedly press the key to increasing the value of the digit which is flashing at the time. When the required value is on the screen, move on the following digit by pressing to change the remaining values. Press key to confirm the value entered.
5	Next option on the setup menu is baud rate. Press until 19200Bps value is displayed as shown:  Press key to confirm the value entered.
6	Press 4 times key to return to the main screen: 
7	**<u>Process completed.</u>** No additional configuration is required to operate with CVM-MINI energy meters.

4.5 TCP2RS

TCP2RS is a gateway between RS-485 devices and Load Management System.

Before installing the device, please take note about the MAC code labelled in one side of the device. An IP address must be applied once the device is connected to the network.

SUPPLY	
A1: L **A2**: N ⏚: Ground	**230V AC**
RS-485	
A: Terminal (+) **S**: Ground **B:** Terminal (-)	

4.6 DISTRIBUTION BOARDS

Load management is ready to work only under 1 distribution board (three-phase connection) and a maximum of 15 charge points (30 sockets max.).

All the charge points must be connected in single-phase and distributed between L1, L2 or L3.

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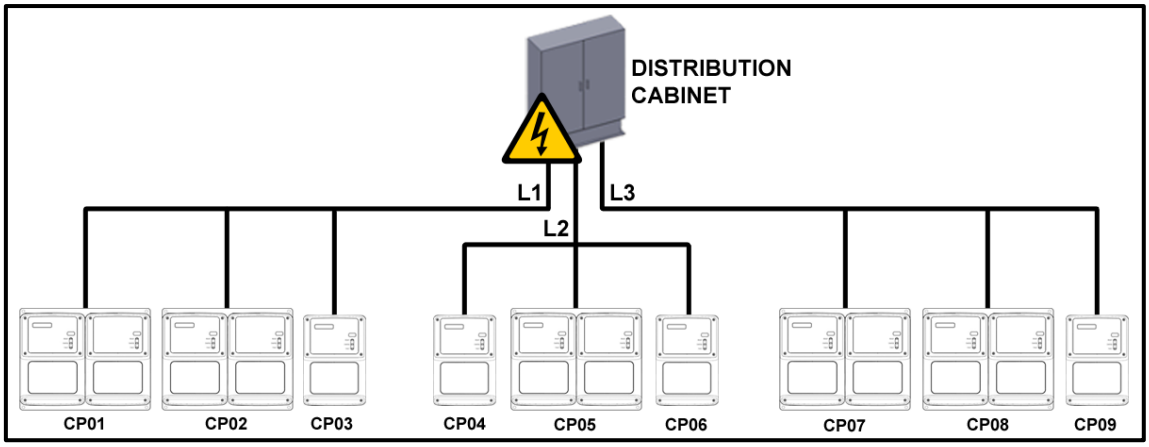
5 LOAD MANAGEMENT SYSTEM

All charge points are deactivated first time Load Management System is started and manual setting must be done in order to enable each one.

5.1 DISTRIBUTION BOARDS

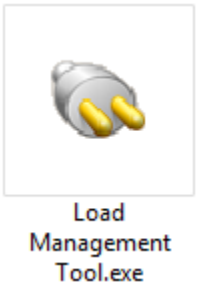
There is no specific electric order about how the software expects to have installed all the charge points, but it is required to set the electric connection of each Charge point the first time Load Management System is started.

Example of distribution:



Only trained and qualified personnel should manipulate the wiring.

Use *Load Management tool* software to define electric phase connection of the socket otherwise the system cannot operate with the charge point:



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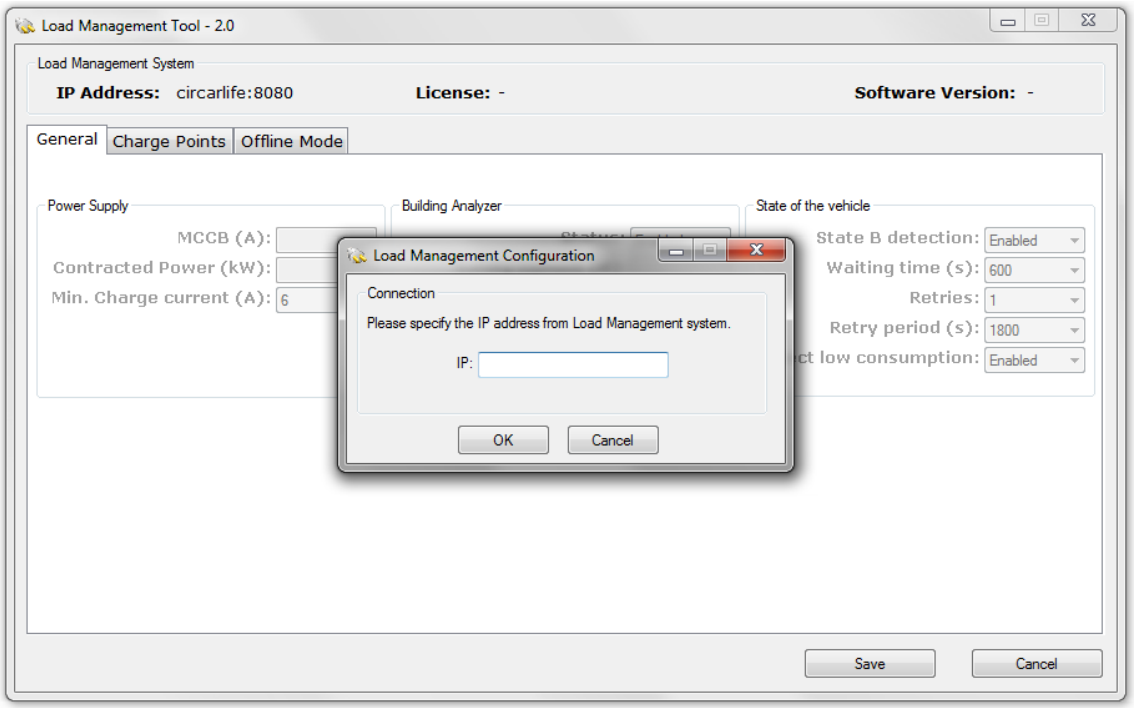
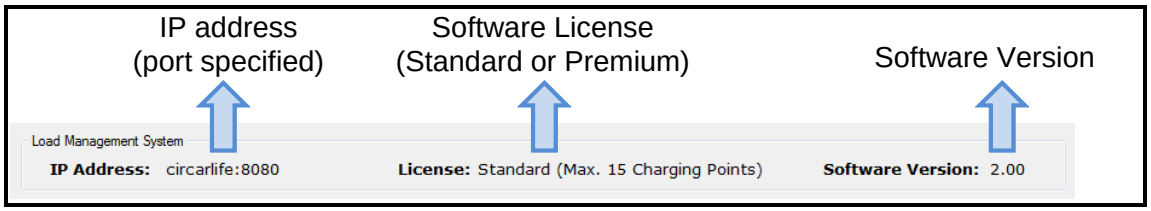
5.2 LOAD MANAGEMENT TOOL

By executing the application this window will appear:



The IP address of the Load Management System needs to be introduced, in order to retrieve its data and check the configuration.



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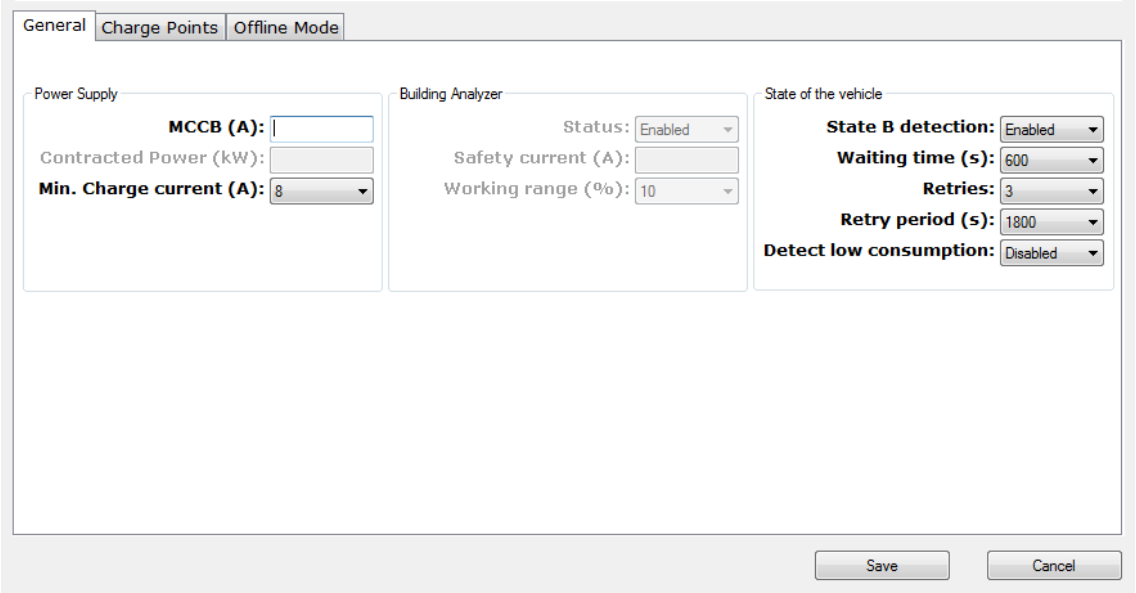
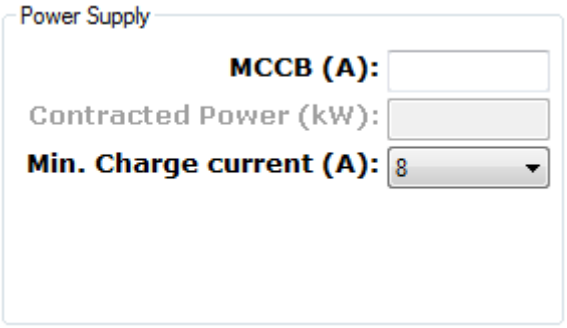
5.2.1 GENERAL



Power Supply



- Max MCCB current
- Contracted Power (only available for Dynamic Load Management Premium)
- Current that the Load Management System understands as the minimum charging current per socket (8 Amps by default).

It is highly recommended to apply a 15% margin when choosing the caliber of the MCCB, in order to prevent it from working at the limit.

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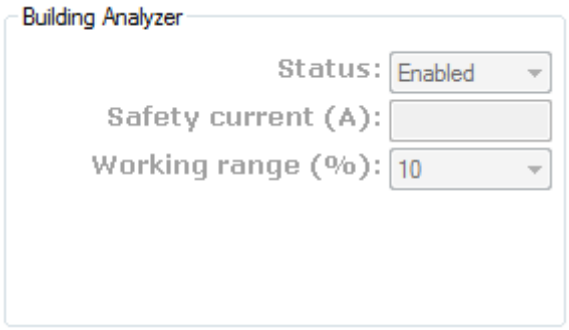
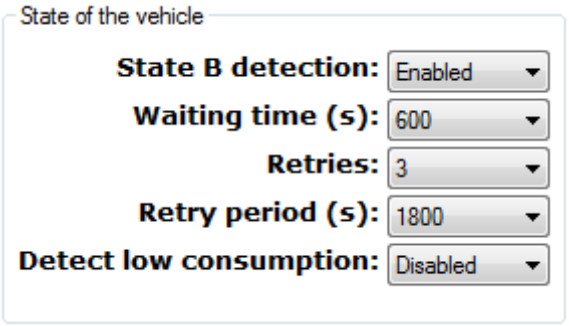
Building Analyser

Only available for Dynamic Load Management Premium.



- Status (Enabled/Disabled)
- Safety current
- Working range

State of the Vehicle



- State B detection status
- Waiting time
- Number of retries
- Period between retries
- Low consumption status

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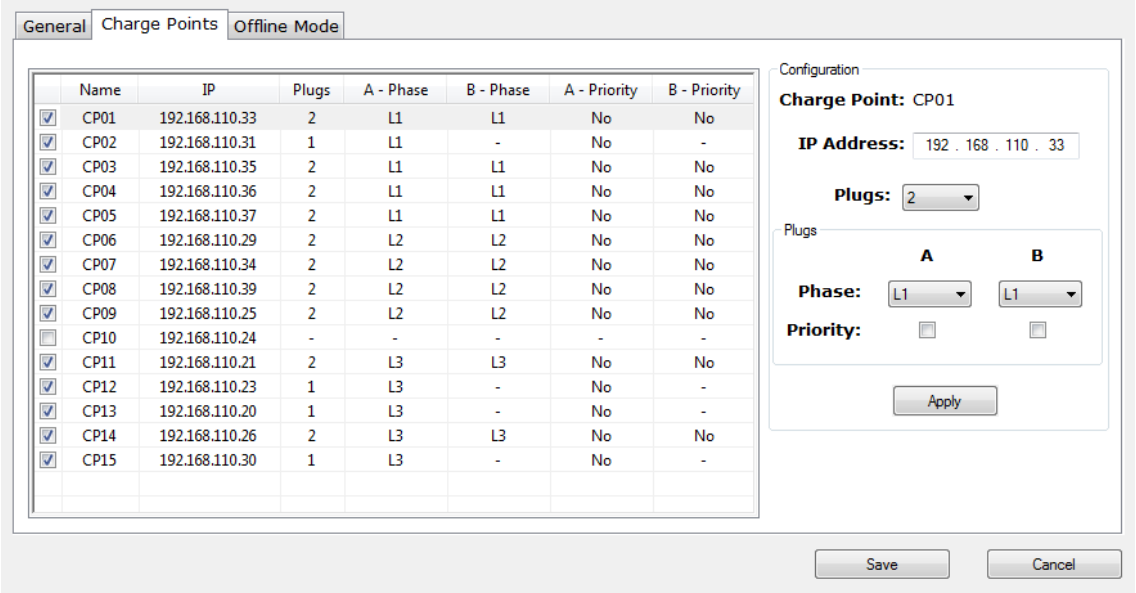
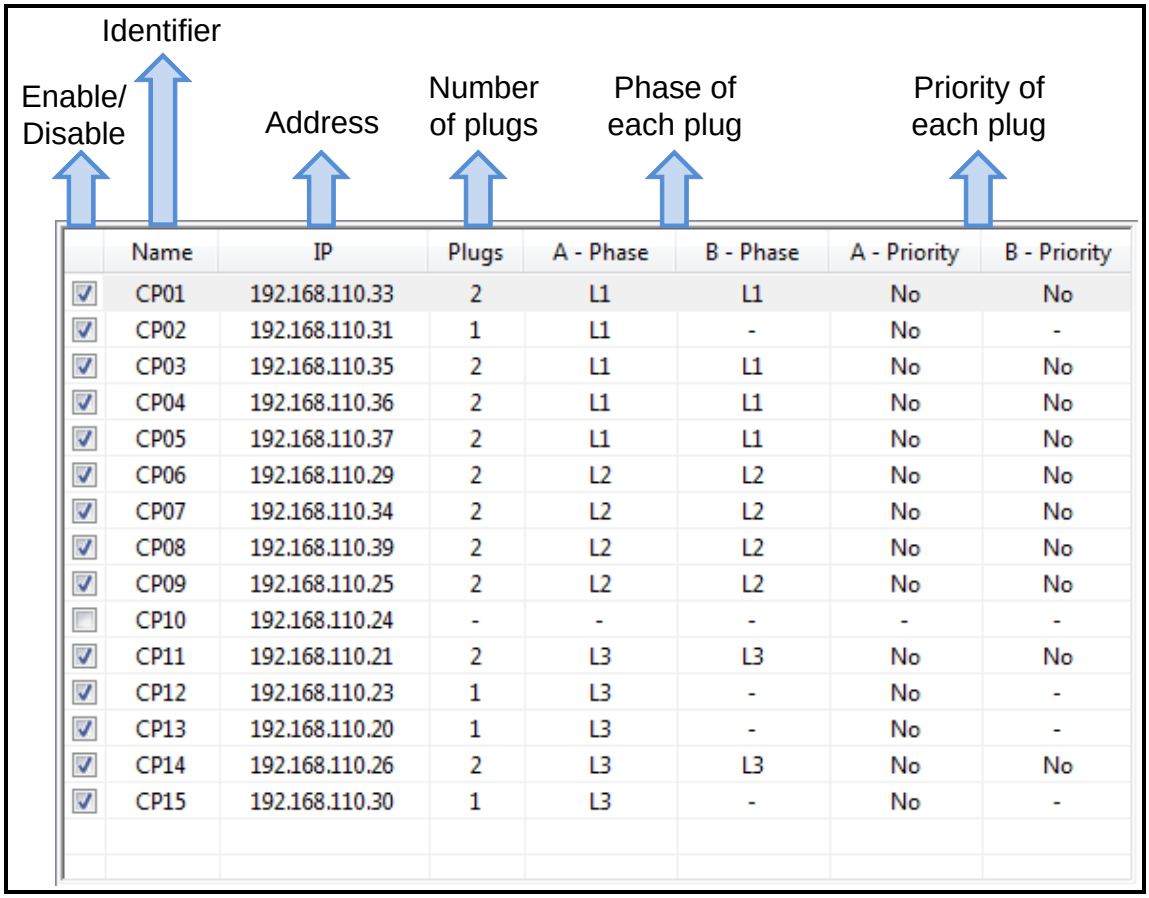
5.2.2 CHARGE POINTS



Table



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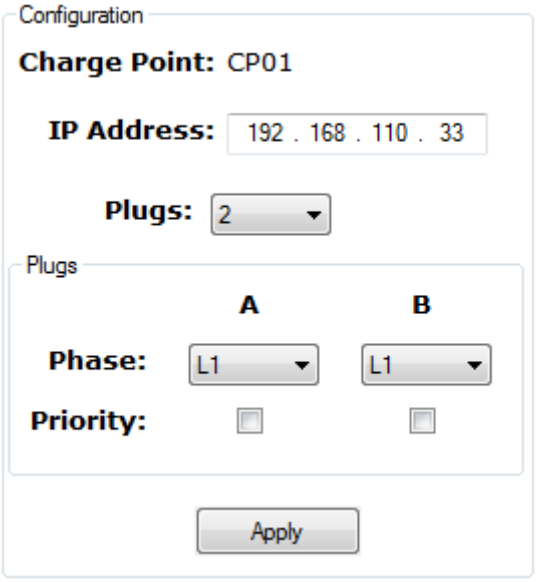
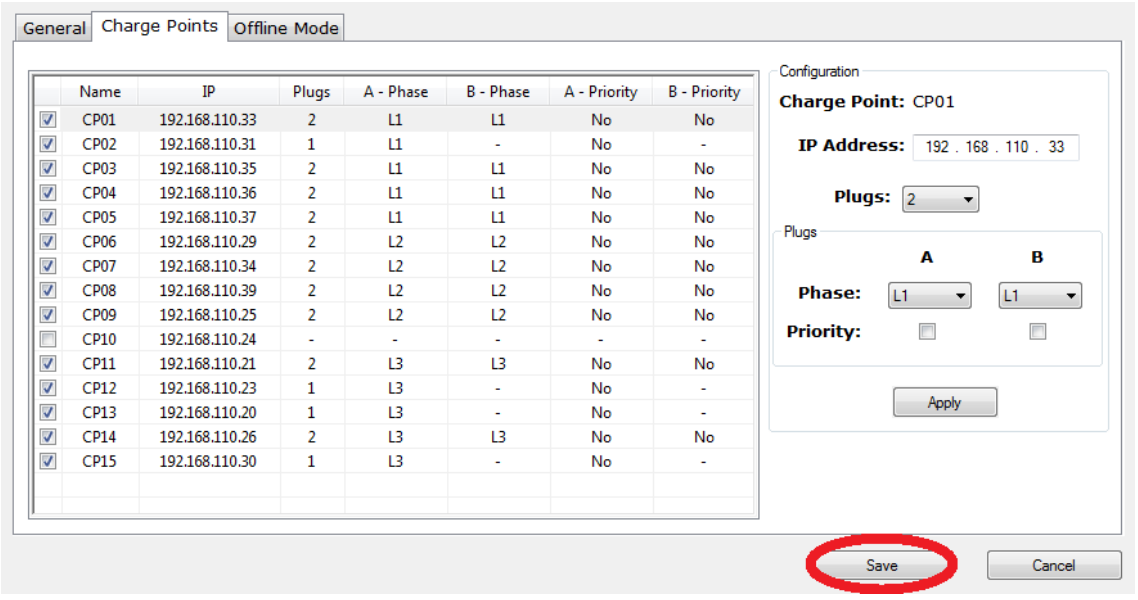
Configuration



- IP address of the Charge point.
- Number of plugs (1 or 2)
- Phase of each plug (L1, L2 or L3)
- Priority of each plug (Priority or No-Priority)

*By clicking “Apply”, the configuration is set in the table. Nevertheless, the changes don’t apply in the Load Management System until the “Save” button is clicked:



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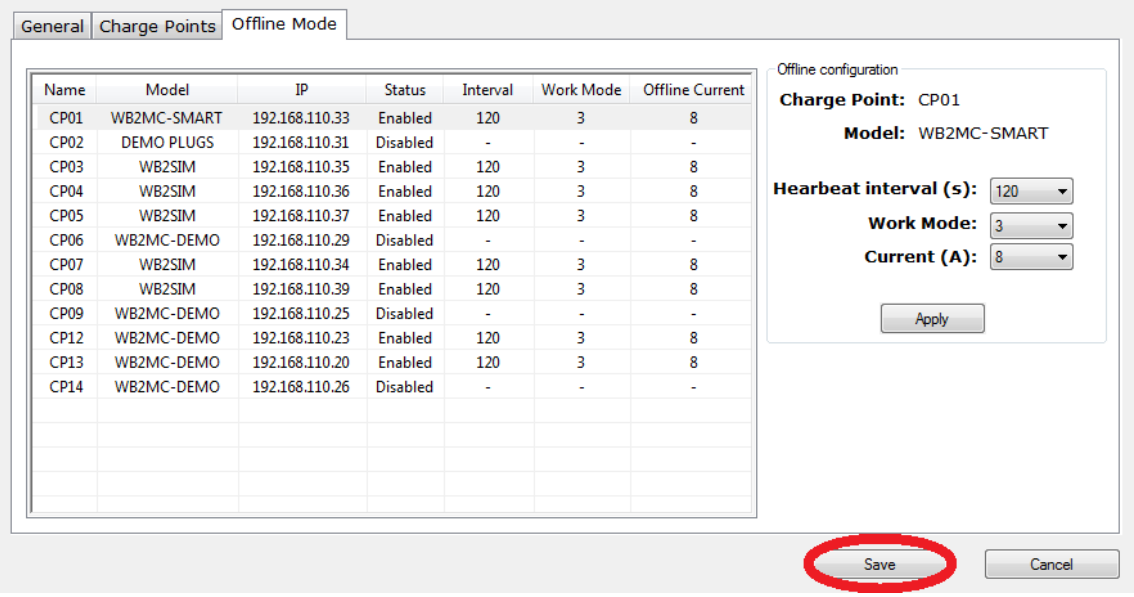
5.2.3 OFFLINE MODE

*By clicking “Apply”, the configuration is set in the table. Nevertheless, the changes don’t apply in the Load Management System until the “Save” button is clicked:



- Heartbeat interval
- Offline mode (0, 1, 2 or 3)
- Offline current

For further information about the Offline Mode, please refer to section “CHARGE POINTS – OFFLINE MODE”

---

6 CHARGE POINTS – OFFLINE MODE

Sometimes, the network connection can be lost due to an unexpected issue such as the PC is powered OFF or even the server is shutdown. In those cases, the Charge points cannot see the Master and they are the ones who make the decisions in order to keep supplying the electric vehicles, their behaviour can be configured in four different ways:

MODE	ACTIVE CHARGING TRANSACTIONS	NEW CHARGING TRANSACTIONS	COMMMENTS
0	Paused.	Paused.	-
1	Still active, without modifying the current.	Paused.	-
2	Still active, the maximum current is set to 8A* per socket.	Paused.	*The maximum current can be modified.
3	Still active, the maximum current is set to 8A* per socket.	Start charging at 8A* per socket.	

When the connection is re-established and the Charge points are able to see the Master, they are again under Master commands.

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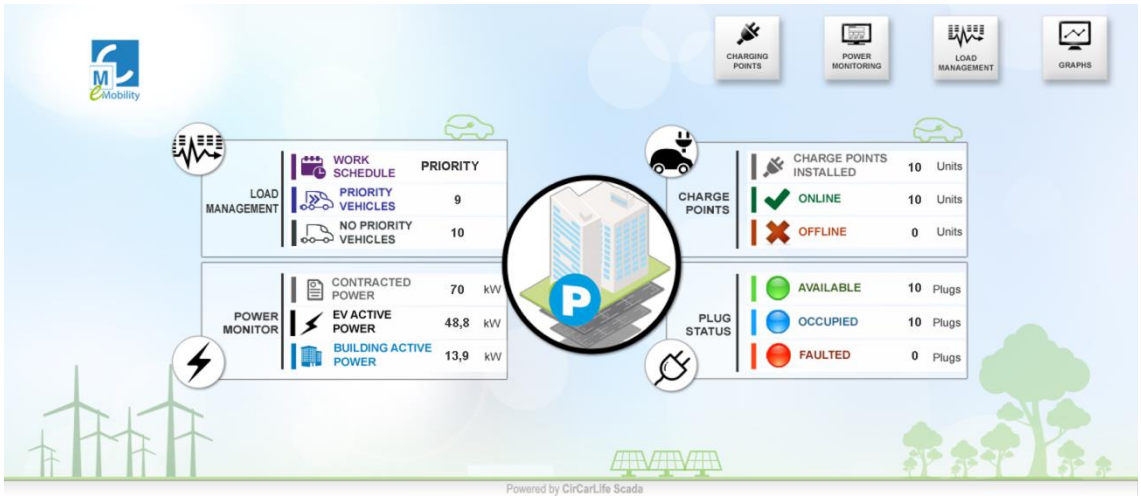
7 SCREENS

7.1 MAIN

Status information about Charge points and Load Management.



7.1.1 TOP MENU

- Set / Display the license plate in each plug
- Status of the plugs
- System counters
- System counters
- Priority schedule
- Consumption table per phases and priority

CHARGING POINTS | POWER MONITORING | LOAD MANAGEMENT | GRAPHS

- System counters
- Status of the plugs and the power consumption per phase
- Consumption of the building + EV
- Power consumption of the building , EV and the sum of both
- Historical graphs

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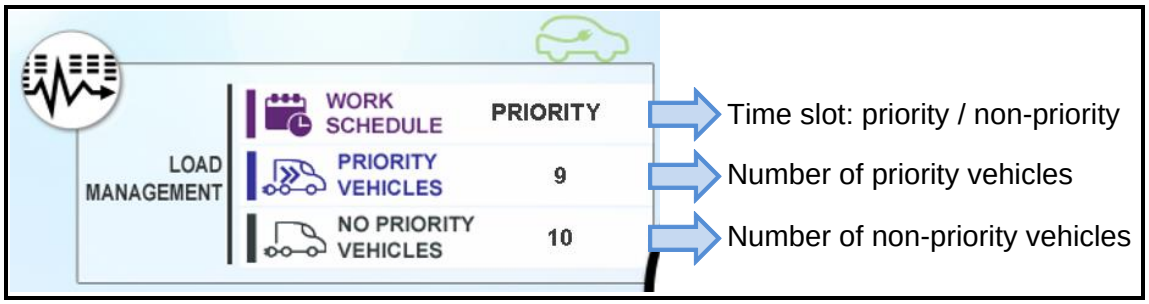
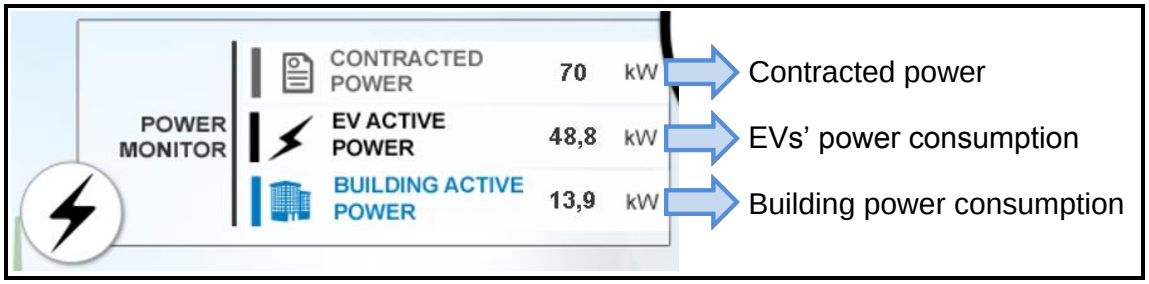
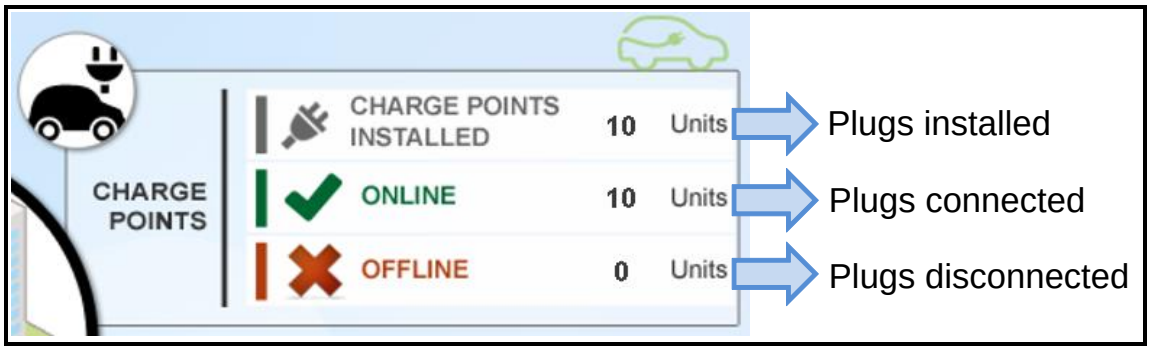
7.1.2 LOAD MANAGEMENT



7.1.3 POWER MONITORING



7.1.4 CHARGE POINTS



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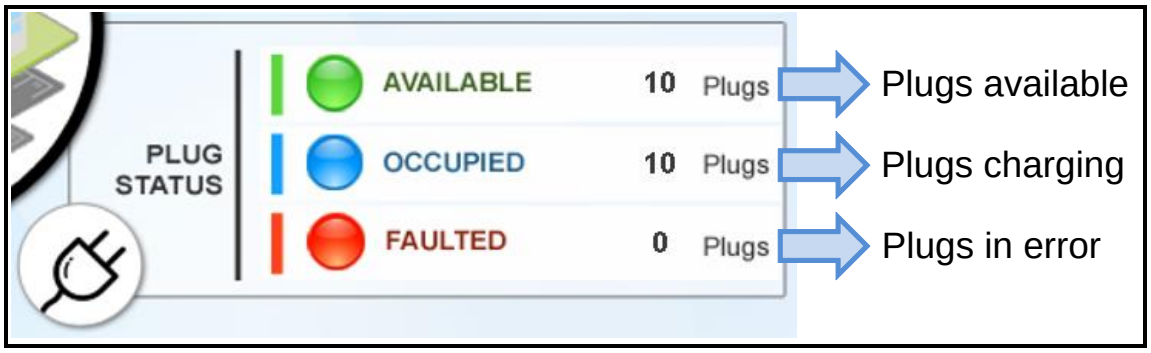
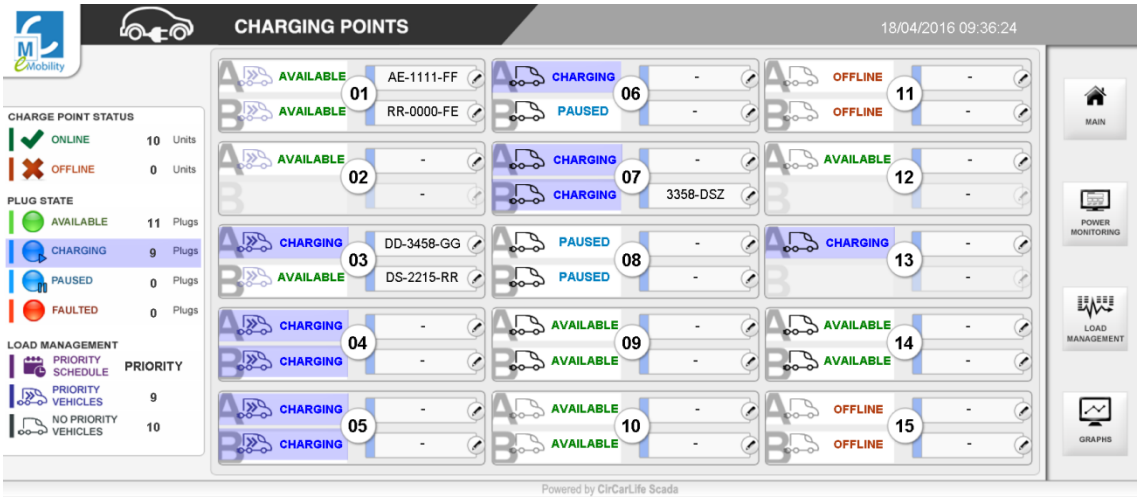
7.1.5 PLUG STATUS



7.2 CHARGE POINTS

Information about the Charge points and the Plugs.



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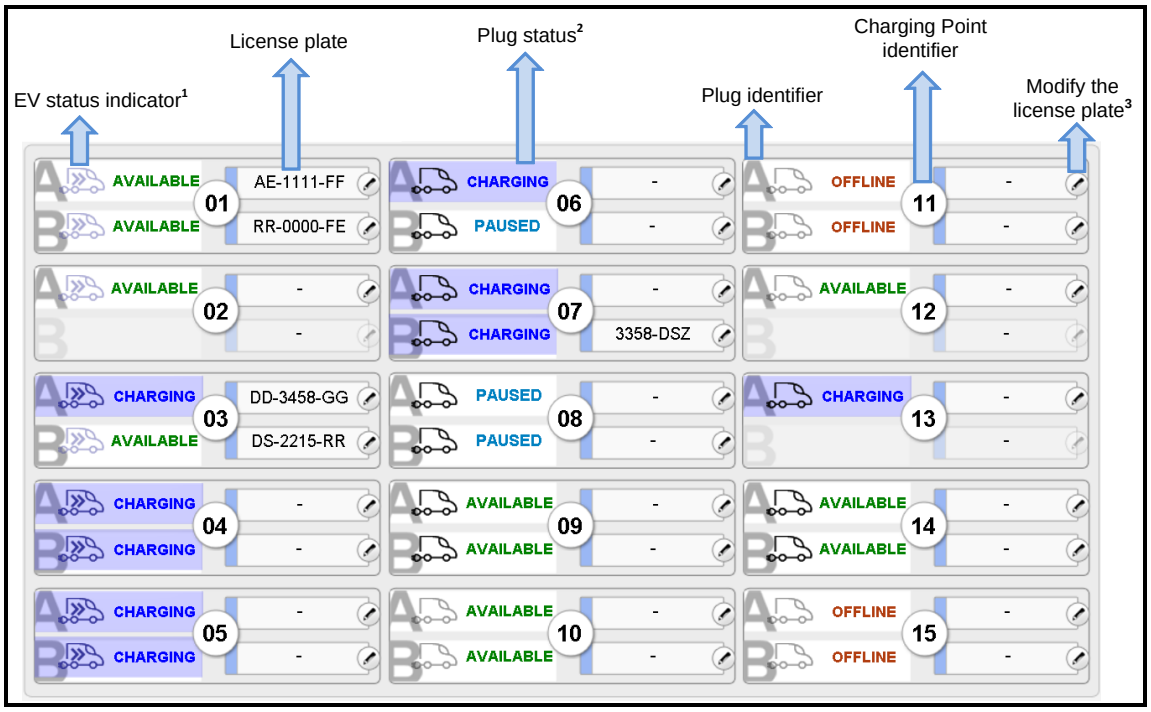
7.2.1 STATUS OF THE CHARGE POINTS



[1] (a) EV indicator based on the priority and if a car is plugged in or not.

[2] (b) Different plug status.

[3] (c) A licence plate or identifier can be assigned to a particular plug.

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(a) EV status indicators:

Non-priority / Not plugged in

Non-priority / Plugged in

Priority / Not plugged in

Priority / Plugged in

(b) Plug status:

STATUS	DEFINITION
AVAILABLE	The plug is available and ready.
CHARGING	The vehicle in this plug is charging.
PAUSED	The charging transaction is paused.
DISCONNECTED	Network connection failure between the Load Management System and the Charge point
FAULTED	The charge point has some kind of error, please contact technical assistance.
ERR. CFG	The parameters of the charge point configuration have to be modified. This will only happen while the commissioning is taking place.
DISABLED	The Charge point is disabled.

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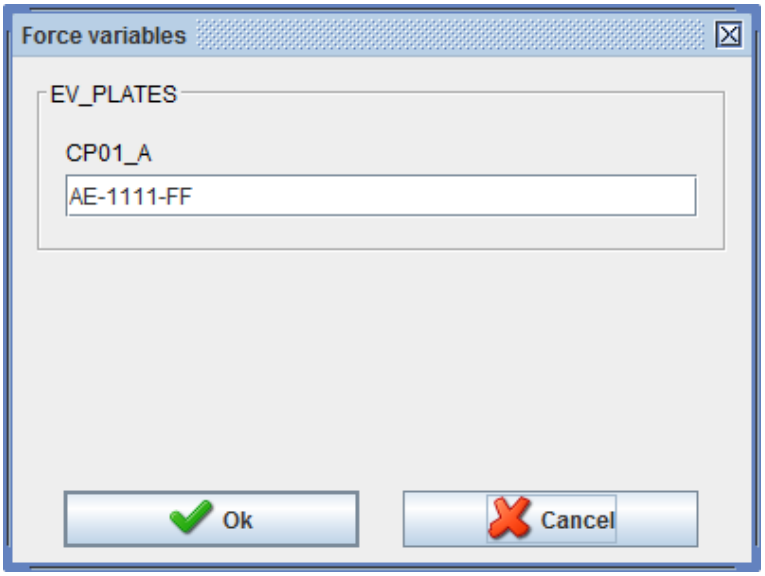
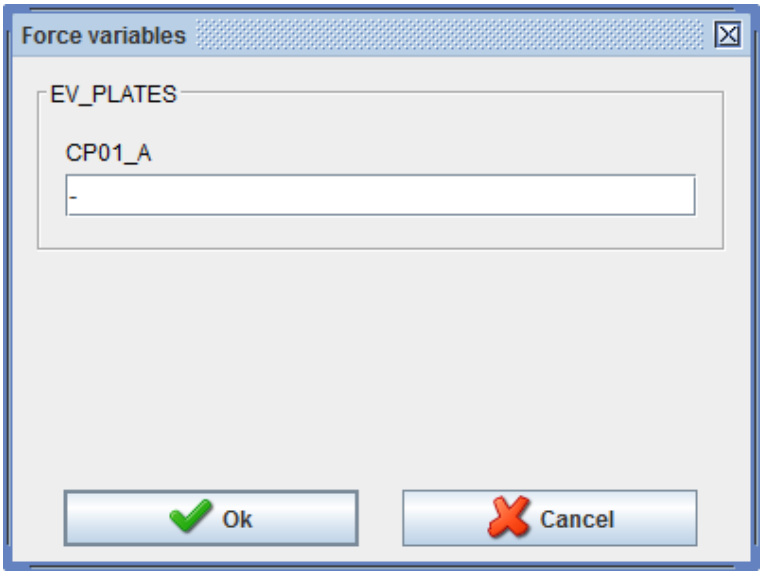
(c) To assign a license plate to a certain Plug, click on .

The next dialog will appear:



If no license plate is needed a '-' symbol must be placed, the field cannot be void. As shown below:



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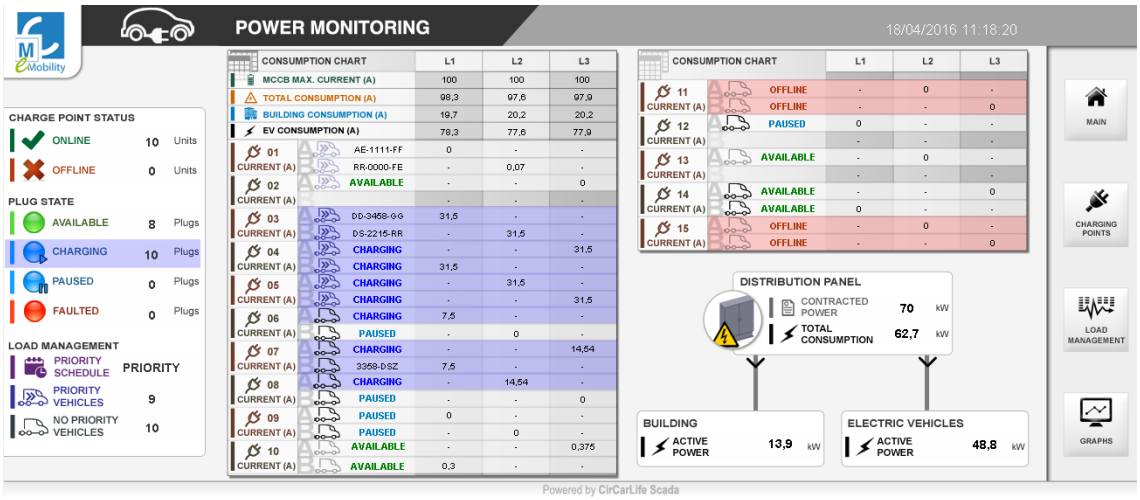
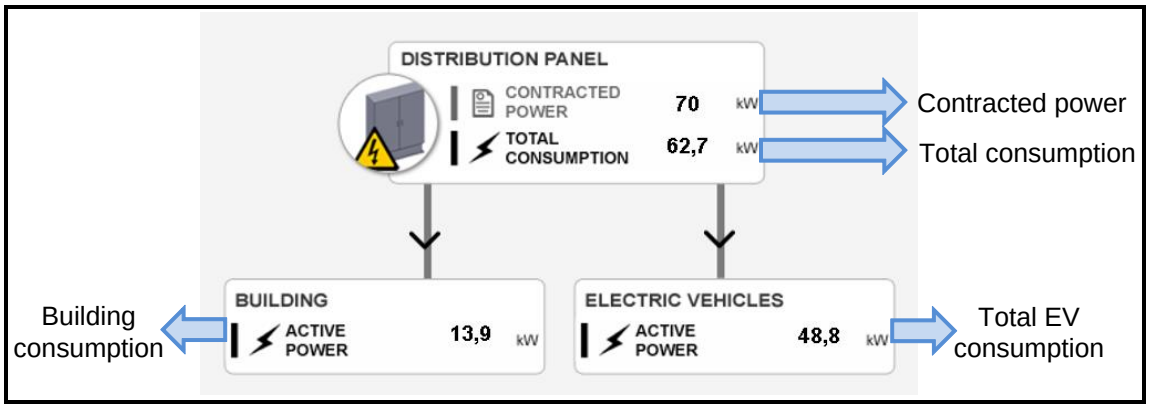
7.3 POWER MONITORING

- Status of the Charge points
- Distribution panel of different power consumption
- Current consumption table per phase



7.3.1 DISTRIBUTION PANEL

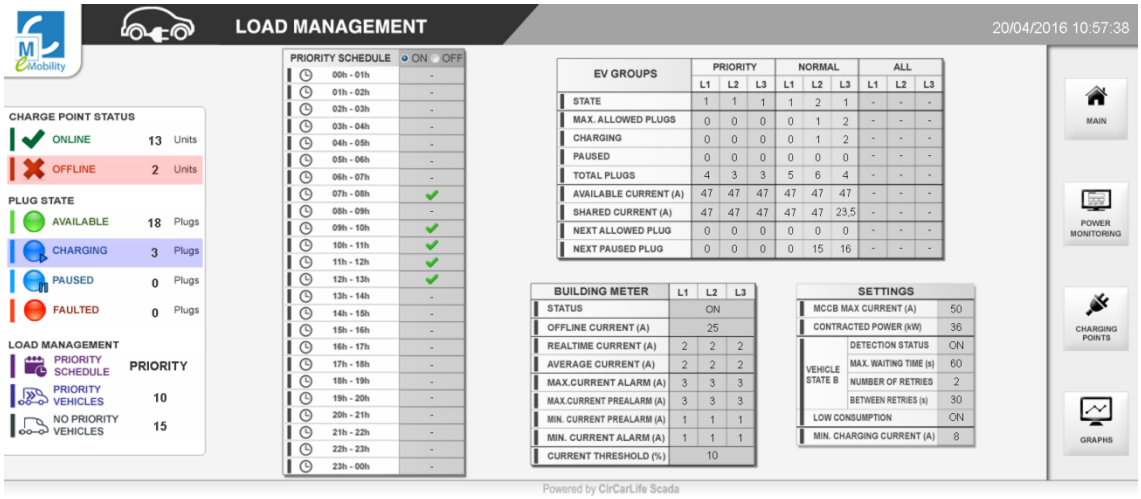


7.3.2 CONSUMPTION PER PHASE

CONSUMPTION CHART	L1	L2	L3	
MCCB MAX. CURRENT (A)	100	100	100	MCCB Max Current
TOTAL CONSUMPTION (A)	98,4	97,6	99	Total consumption
BUILDING CONSUMPTION (A)	20,2	20,6	20,6	Building consumption
EV CONSUMPTION (A)	78,4	77,6	78	Total EV consumption

7.4 LOAD MANAGEMENT

- Status of the Charge points
- Enable/Disable priority schedule
- Set priority time slots
- Table per phases
- Analyser
- Parameters



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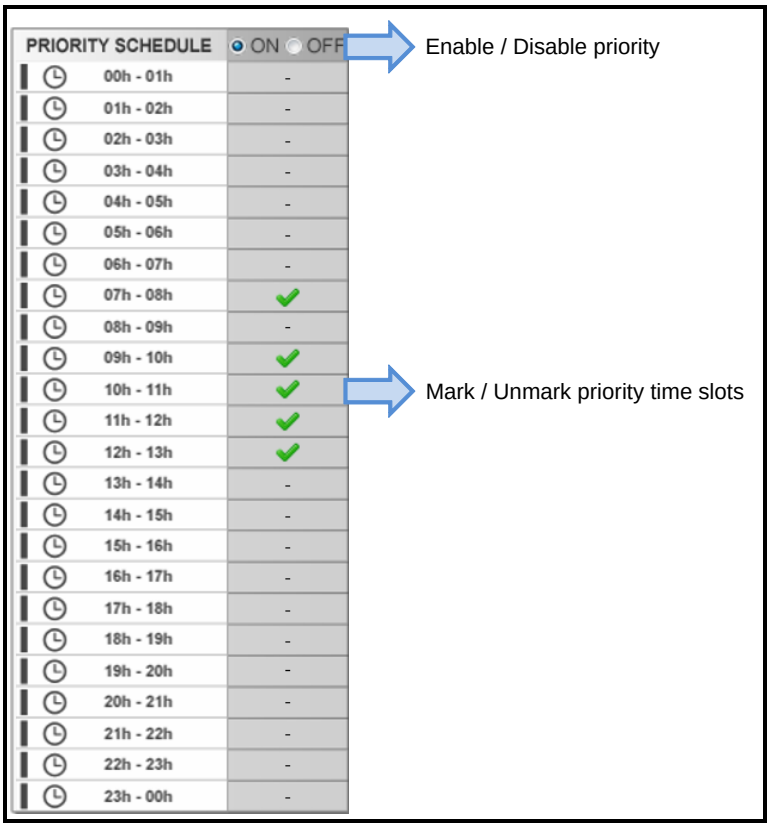
7.4.1 PRIORITY SCHEDULE



7.4.2 TABLE PER PHASES

When priority schedule is ON, the table shows differentially Priority and Non-priority:

	EV GROUPS	PRIORITY			NORMAL			ALL		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
Load Management state[1]	STATE	1	1	1	3	3	3	-	-	-
Number of plugs able to charge	MAX. ALLOWED PLUGS	2	2	2	2	1	1	-	-	-
Plugs charging	CHARGING	2	2	2	2	1	1	-	-	-
Plugs paused	PAUSED	0	0	0	2	2	1	-	-	-
Total installed plugs	TOTAL PLUGS	3	3	3	6	6	6	-	-	-
Current available	AVAILABLE CURRENT (A)	80	79	79	16	15	15	-	-	-
Current shared	SHARED CURRENT (A)	40	39,5	39,5	8	15	15	-	-	-
Next plug to resume	NEXT ALLOWED PLUG	0	0	0	17	15	16	-	-	-
Next plug to pause	NEXT PAUSED PLUG	8	9	10	14	12	13	-	-	-

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When priority schedule is OFF, the table shows all data in one column:

	EV GROUPS	PRIORITY			NORMAL			ALL		
		L1	L2	L3	L1	L2	L3	L1	L2	L3
Load Management state[1]	STATE	-	-	-	-	-	-	1	1	1
Number of plugs able to charge	MAX. ALLOWED PLUGS	-	-	-	-	-	-	6	5	4
Plugs charging	CHARGING	-	-	-	-	-	-	4	3	3
Plugs paused	PAUSED	-	-	-	-	-	-	2	2	1
Total installed plugs	TOTAL PLUGS	-	-	-	-	-	-	9	9	9
Current available	AVAILABLE CURRENT (A)	-	-	-	-	-	-	80	79	79
Current shared	SHARED CURRENT (A)	-	-	-	-	-	-	13,3	15,8	19,8
Next plug to resume	NEXT ALLOWED PLUG	-	-	-	-	-	-	17	15	16
Next plug to pause	NEXT PAUSED PLUG	-	-	-	-	-	-	14	12	13

[1] There are five Load Management states, these states are dynamic and change based on the active Charging Transactions and the available power:

STATE	DESCRIPTION	COMMENTS
1	Available power	All active Charging Transactions can charge simultaneously at least at the minimum current (8A by default).
2	Power decreasing	New Charging Transactions start progressively without exceeding the contracted power.
3	Limited power	New Charging Transactions are paused until there is enough power back again.
4	Power exceeded	Not all active Charging Transactions can charge simultaneously and one or more need to be paused in order to avoid an overload.
5	Unavailable power	Not enough power available and all Charging Transactions are paused.

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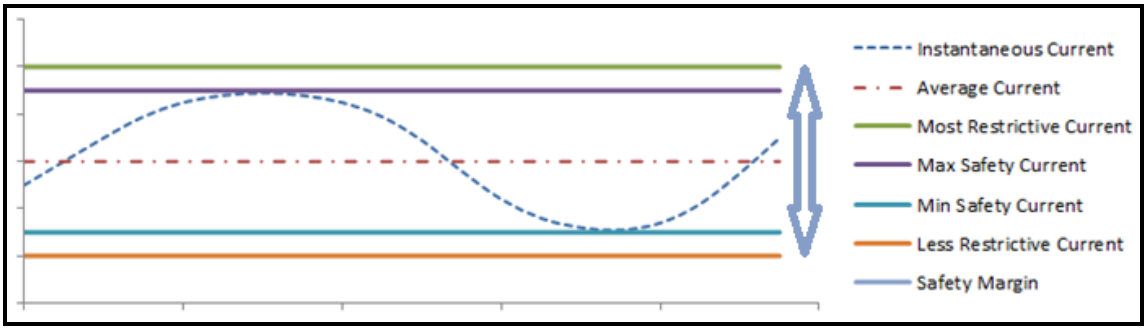
7.4.3 ANALYSER

BUILDING METER	L1	L2	L3	
STATUS	ON			State of the analyzer
OFFLINE CURRENT (A)	25			Default current when the analyzer is offline
REALTIME CURRENT (A)	2	2	2	Instantaneous current
AVERAGE CURRENT (A)	2	2	2	Average current
MAX.CURRENT ALARM (A)	3	3	3	Most restrictive current
MAX.CURRENT PREALARM (A)	3	3	3	Max safety current
MIN. CURRENT PREALARM (A)	1	1	1	Min safety current
MIN. CURRENT ALARM (A)	1	1	1	Less restrictive current
CURRENT THRESHOLD (%)	10			Safety margin



- Instantaneous current: current that is being used in real time.

- Average current: calculated mean of the actual current and is used to adjust the "Safety margin".

- Safety margin: customizable parameter used to protect the installation from overloads or unexpected current peaks.

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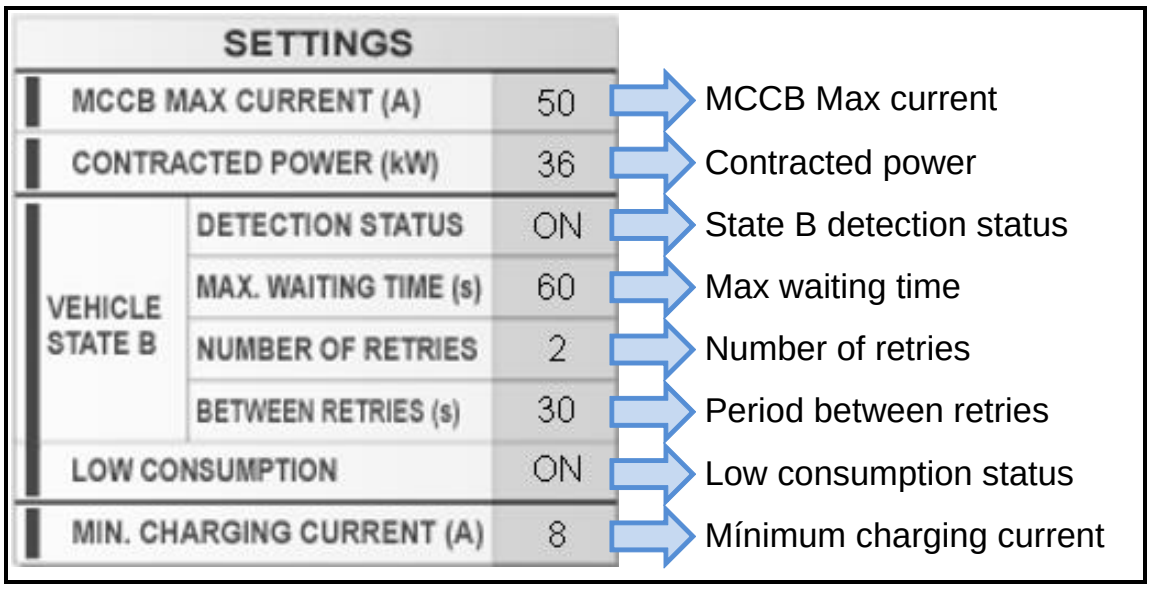
7.4.4 PARAMETERS



State B detection:

This is a customizable feature, meaning that can be enabled/disabled and its parameters can be adjusted at will.

Switching it ON allows us to keep supplying the electric vehicles even if the EVs switch from state C to B.

When this happens, the Load Management System is monitoring during a time interval named “Max waiting time” (customizable parameter) to discriminate whether the vehicle is in state B because:

a) It decides to rest and stops charging for a while or if someone opens the doors of the vehicle.
b) It is fully charged.

If the EV remains in state B, the Charging Transaction is queued in order to give its assigned current to the other active Charging Transactions.

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If the EV demands power while “Max waiting time” and there is enough power, the Charging Transaction is resumed. Nevertheless, if there is no power available the Charging Transaction is queued.

The Charging Transaction will be in queue for a certain period of time named “Period between retries” (customizable parameter). When this period ends, the cycle will start again and will be repeated as many times as the parameter “Number of retries” is set. Furthermore, when this limit is exceeded no more retries are made.

It may be turned OFF, if there is enough power to supply all the Charge points at least at the minimum current.

Low consumption status:

By switching it ON, the current from one EV will distribute to the others when its consumption is too low.

When an EV is charging below 6A (limit set by the IEC 61851-1 standard) the Charging Transaction will be queued.

This queue is the same as the mentioned in the previous section (State B detection) and the Charging Transaction follows the same procedure.

It may be turned OFF, if there is enough power to supply all the Charge points at least at the minimum current.

It is highly recommended to enable this two features when:

a) The contracted current is not enough to supply all the Plugs at once.

b) The Charge points and the building are sharing the same power supply.

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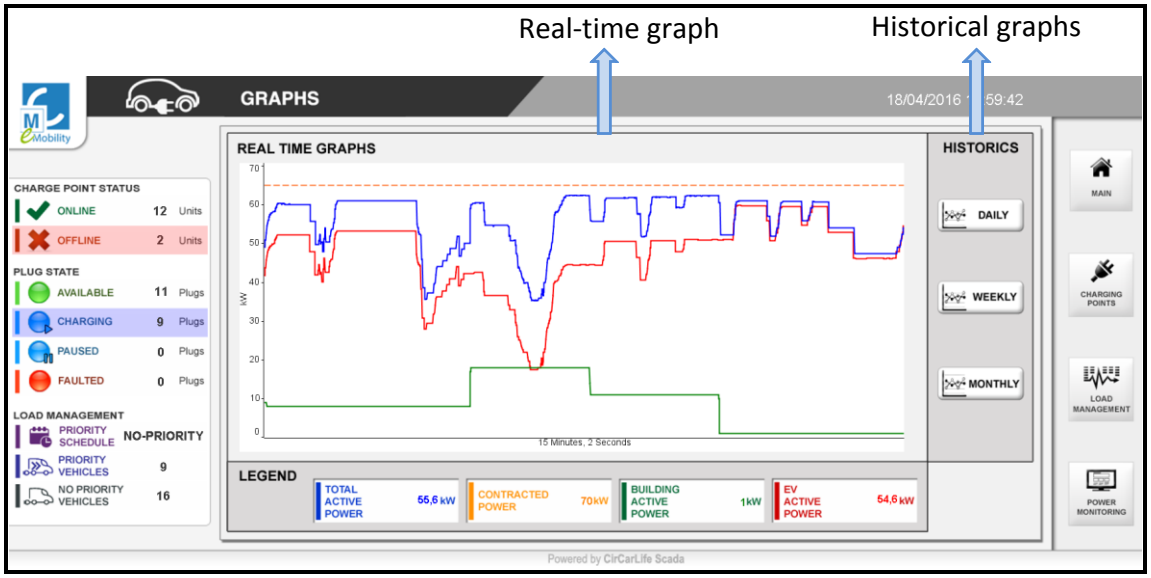
7.5 POWER GRAPHS

- Power consumption of the building, the EV and the sum of both in real time, compared to the contracted power.
- Historical graphs.

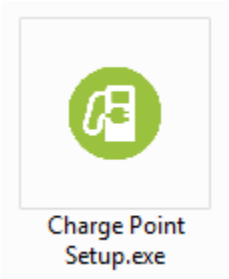


8 FAQ

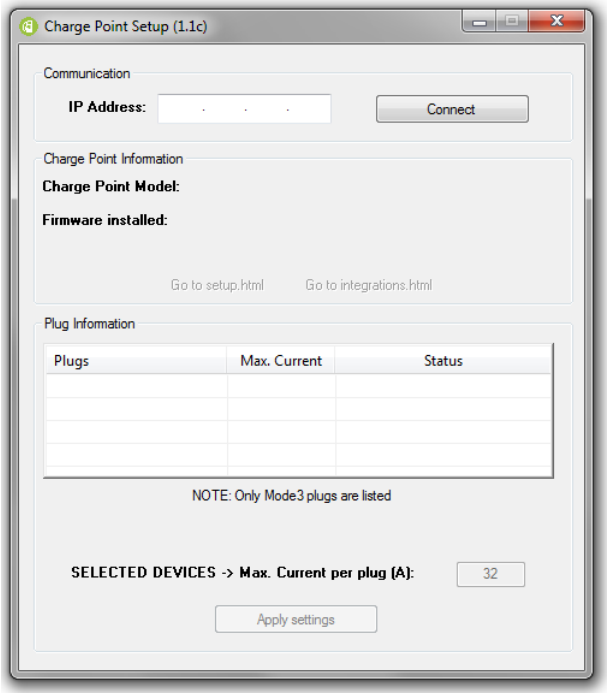
8.1 How to change the maximum output current?

If the maximum output current of a Charge point needs to be modified in order to not exceed the value of the power supply follow these steps:

1. Execute the tool “Charge Point Setup”.



2. By executing the application this window will appear:



Charge Point Setup can be downloaded from CIRCONTROL webpage: http://circontrol.com/downloads/

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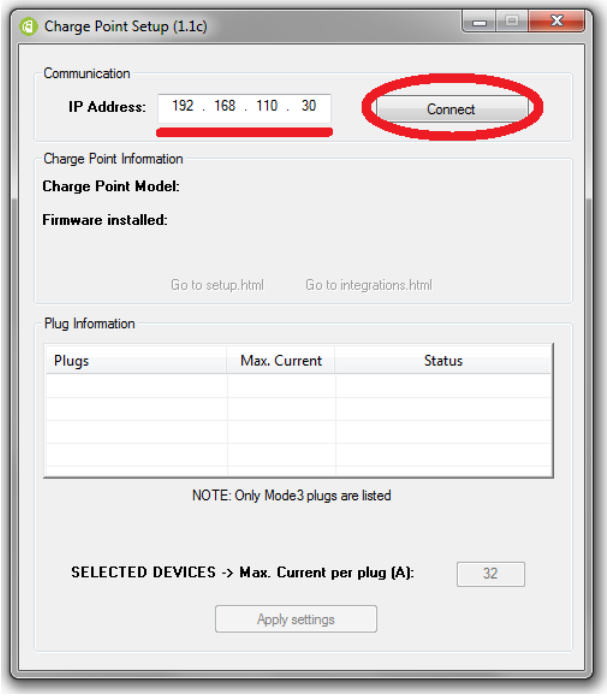
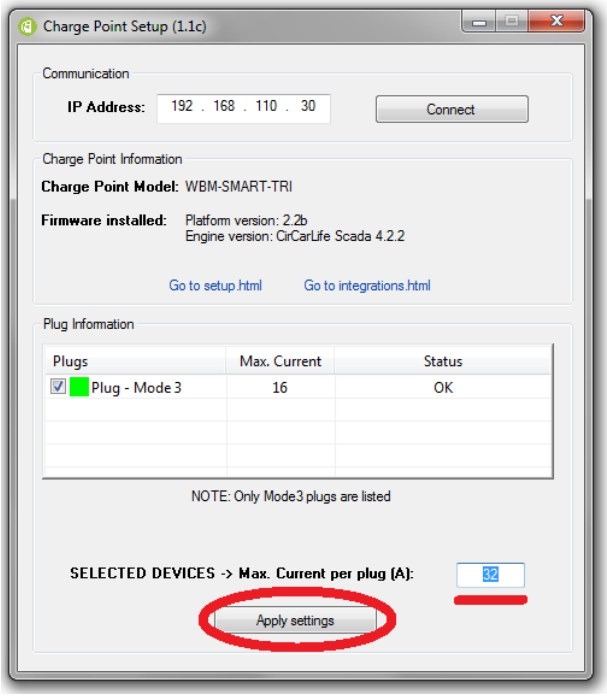
3. Enter the Charge point IP Adress and click Connect.



4. Modify the current and click Apply settings.



Depending on the model of Charge point the maximum output current may vary.

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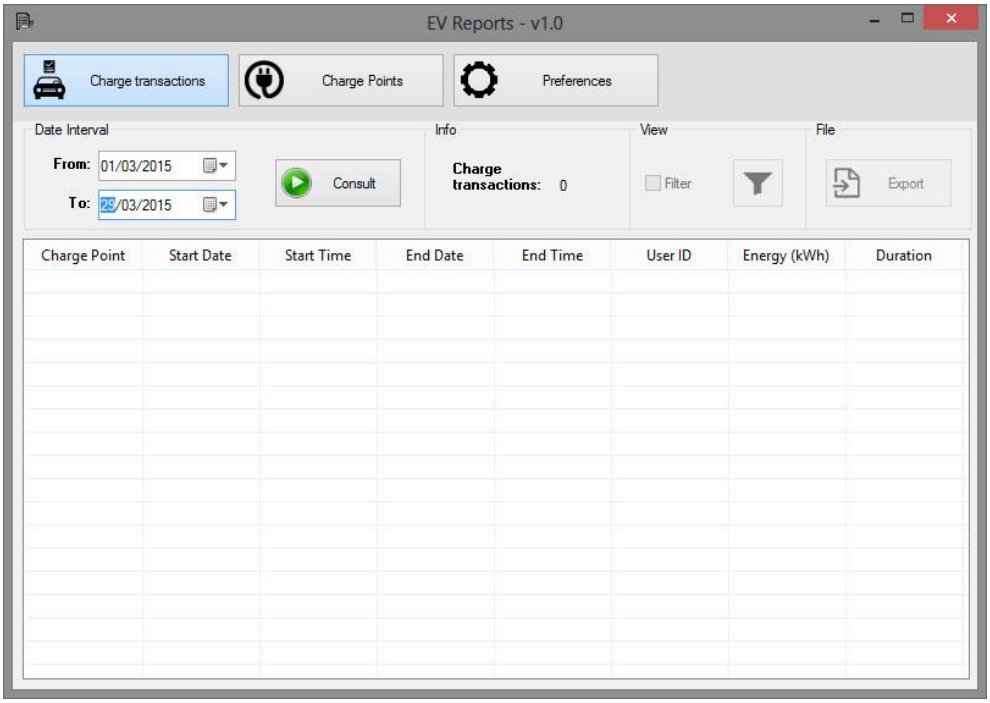
8.2 How to import reports?

The Load Management System does not support importing reports of the Charging Transactions. In order to do that a Tool named EV Reports is needed.

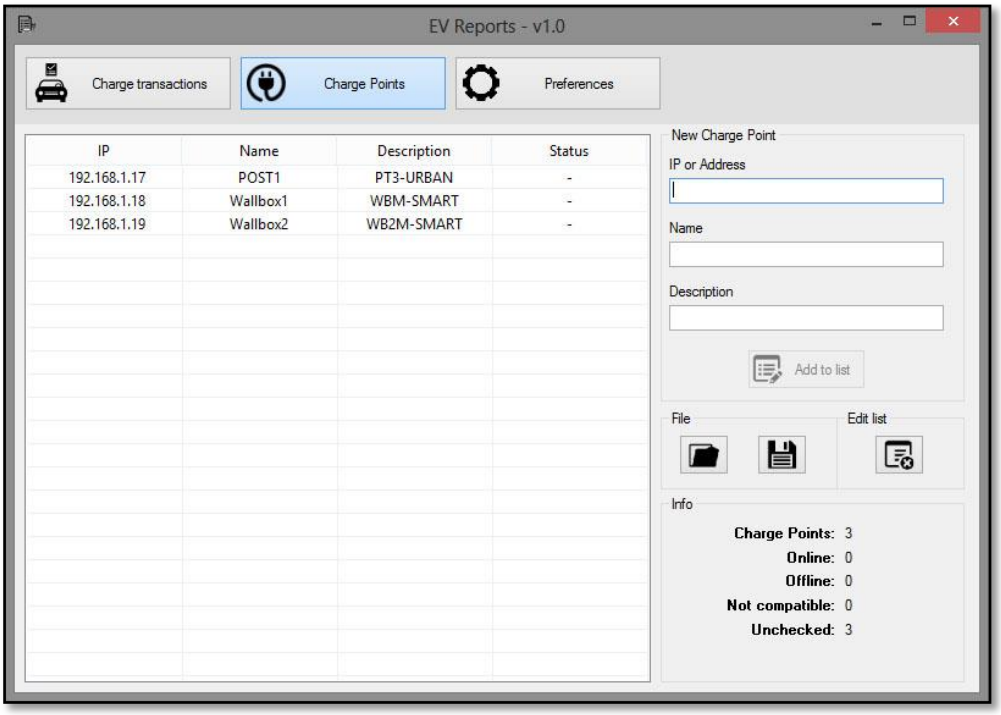
8.2.1 CHARGE TRANSACTIONS VIEW

List of Charging Transactions during the desired interval.



8.2.2 CHARGE POINTS VIEW

List of Charge points where information is extracted.

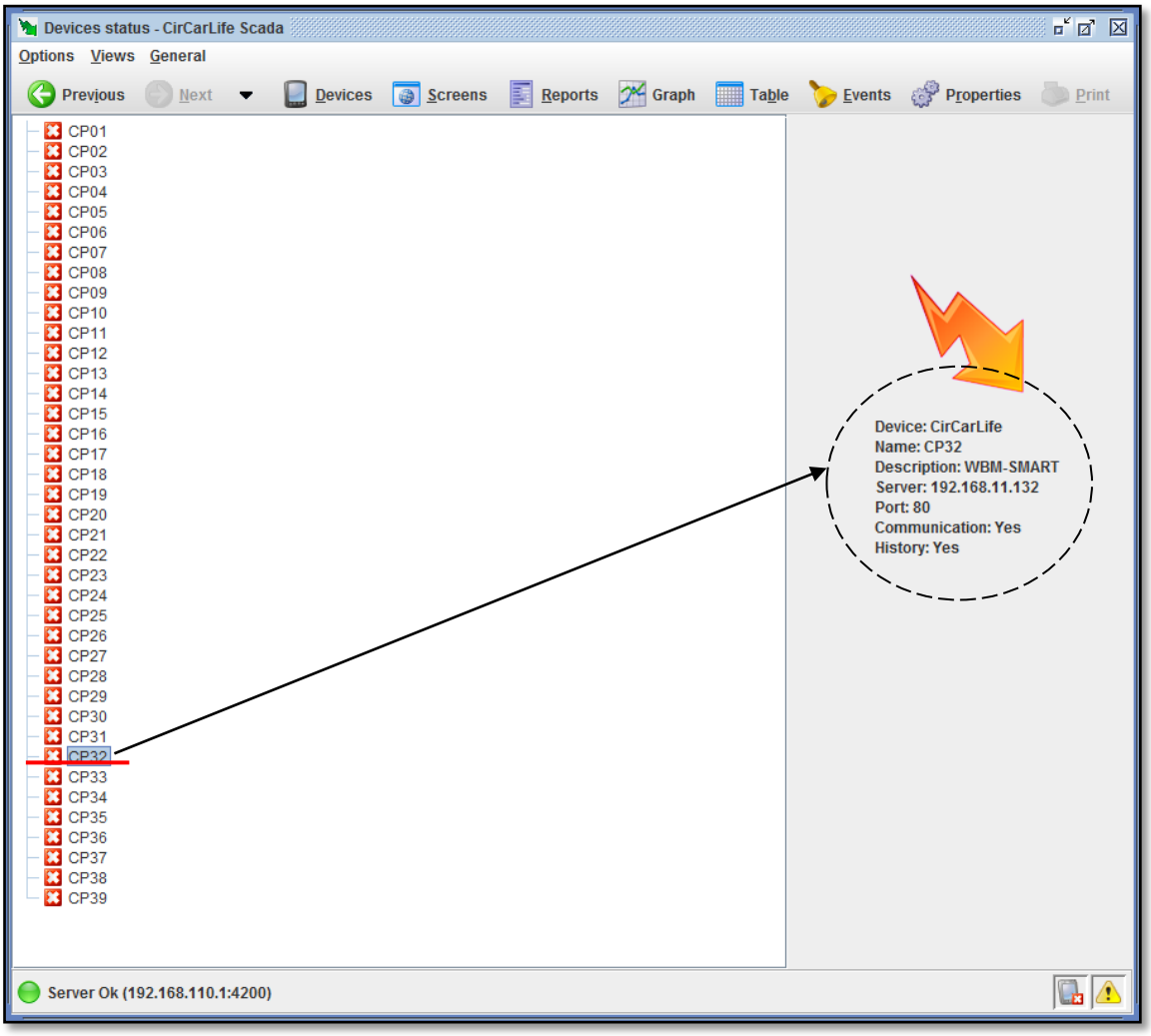


Note: Only one time is needed to add all the charge points. Every time EVR is started it will remember all the charge points listed last time.

EV Reports, as well as its manual, can be downloaded from CIRCONTROL webpage: http://circontrol.com/downloads/
For further information please consult it.

8.3 How to know which IP addresses do we have assigned?

1. Open the client and get connection to the Load Management System.
2. Go to Device Status.
3. Select the desired charge point. In the right pane there are the connection details.



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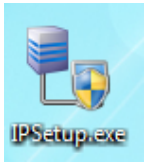
8.4 How to apply the IP address?

Take note about the MAC identifier of each Charge point and TCP2RS converter in order to apply IP address:

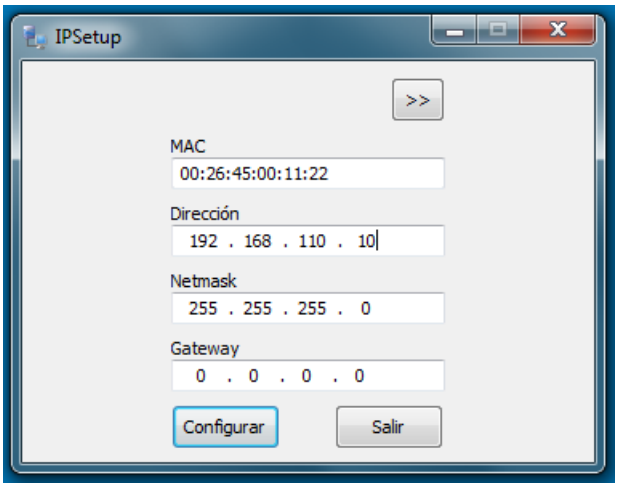
CHARGE POINT ID	MAC	IP
01	00:26:45:00:11:22	192.168.110.10
02	00:26:45:00:11:23	192.168.110.11
03	00:26:45:00:11:24	192.168.110.12

EXAMPLE

Use the IPSetup tool and the mac code from charge point (labelled in one side of the charge point) to apply IP addresses.



Example:



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