



New "mode 1&2-only" charging station added to OCPP certification

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OCA White Paper

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1. Introduction

The technology around charging station is still evolving. Usually most attention goes to the development of charging stations that deliver ever more power: fast chargers, ultra-fast chargers and megawatt chargers. At the same time, the need for low-cost charging stations for at home, office or parking lots is growing.

For this market a new type of charging station has recently been developed: the so-called "mode 1&2-only" charging station. In this white paper we explain what it is, and how it differs from a regular charging station. We will also explain how certifying such a device differs from certifying a regular charging station.

2. Mode 1&2-only charging station

The mode 1&2-only charging station was first introduced in 2021 in South Korea as a low-cost alternative that can be installed in high quantities in parking garages. In order to explain how it differs from a regular AC charger, we need first need to describe the meaning of *charging modes*.

Charging modes

A regular AC charger is also called a "mode 3" charger. These "modes" are defined in the IEC 61851 standard, and refer to the safety protocol between electric vehicle (EV) and charging station.

Mode 1

This mode refers to a standard household power outlet with a simple extension cord connecting to the vehicle. There are no safety measures. The maximum allowed current is 16 A. In many countries it is not allowed to charge EVs via mode 1. This type of charging is normally only used for e-bikes and e-scooters.

Mode 2

This mode adds a device to the power cord that implements safety measures: the in-cable control and protection device (IC-CPD). A power cord with an IC-CPD is usually delivered with every EV, and is commonly called "emergency charger" or "granny charger". The maximum allowed current is 32 A, but in practice the IC-CPD limits the current to 10-12 A. Mode 2 charging is a safe way to charge an EV from a household outlet, because the IC-CPD implements the "mode 3" protocol towards the EV. The cable between household outlet and IC-CPD is a regular extension cord; the cable towards the EV is a charging cable with a type 1, 2, or 3 connector (IEC 62196).

Mode 3

In case of mode 3 charging, the control and protection device is built-in into the charging outlet. The control unit detects when an EV is connected, and communicates with it via a PWM signal (pulse width modulation) on one of the signal pins of the charging connector. The PWM signal tells the EV how much power it is allowed to draw. This is not only a safety function, but also allows regulation of the power for smart charging. The cable towards EV is a charging cable with a type 1, 2, or 3 connector (IEC 62196). The cable can be a fixed part of the charging outlet, or it can be detachable.

Mode 4

This mode requires a high-level communication protocol that can exchange much more information than a PWM signal, for example by using TCP/IP or CANbus. It is used for high power charging (notably DC charging) or for vehicle-to-grid (i.e. discharging of EV).

Charging stations

Charging stations come in two flavours: a connected charging station or a dumb (i.e. not connected) charging station. The latter is basically nothing more than a charging outlet with mode 3 support. It is commonly used for residential charging. The connected charging station is used by charging station network operators. It is a charging outlet with mode 3 or 4 support and an additional communication controller that communicates with the charging station network operator, who controls the charging stations. The user has to be authorised before charging and is thus known to the operator, who can then invoice the user for the service.

Mode 1&2-only charging station

The new mode 1&2-only charging station is a charging station with a communication controller to communicate with a charging station network operator, but only equipped with a standard household outlet. Via this household outlet it is possible to charge an e-bike or e-scooter (mode 1 charging) or to charge an EV with an IC-CPD cable (mode 2 charging). Hence, the name mode 1&2-only charging station.

Users need to be authorised before charging via mode 1 or 2, just like a regular charging station, and will be invoiced when using it. However, when the outlet is used for other purposes, then no authorisation is needed. To achieve this, the mode 1&2-only charging station will only require authorisation when the amount of power that is drawn exceeds a configured limit, e.g. 1000 W. This allows a vacuum cleaner to be connected to it without authorisation, but an EV or e-scooter that is charging will require authorisation first.

The cost savings compared with a mode 3 charging station lie in the fact that the device is simpler, since the "mode 3 logic" is not needed (it is in the IC-CPD cable from the user), and installation is much cheaper. The mode 1&2-only charger is basically a household outlet, so no additional requirements are needed for the electrical installation. An existing household outlet can simply be replaced by a unit with a mode 1&2-only charger.

OCPP

OCPP is the de facto standard communication protocol for charging stations to communicate with the network operator. The mode 1&2-only charger is equipped with an OCPP 1.6 communication controller and an RFID reader, just like regular charging stations. To the network operator the mode 1&2-only charger will behave as a normal charging station, with a few limitations, which we will discuss in the next section.



3. Limitations of a mode 1&2-only charging station

A mode 1&2-only charging station behaves like any other OCPP-connected charging station. However, since it uses a standard household outlet instead of a type 1, 2 or 3 connector as normally used for EV charging, there are a few limitations.

Detecting EV connection

The mode 1&2-only charging station detects when a plug is inserted and will send a StatusNotification with status "Preparing" when that happens. A regular charging cable with a type 1, 2, or 3 connector has a signal wire that is used to detect whether both ends (charger and EV) are connected. This is not possible with the household connector. Instead, a mode 1&2-only charging station detects an EV by the fact that a current of more than a configured limit (e.g. 6 A) is drawn, after which it opens a relays to stop the power flow until the charging session is authorized.

Locking connector in place

A regular charging connector is locked in place when a transaction starts. This is both for safety reasons, and to avoid cable theft. Connector-locking is not possible with a household plug.

Controlling charging power

In the case of AC charging the charging unit of the EV determines how much power is drawn from the charging station. The charging station can limit the power that the EV draws via the mode 3 signal, which communicates the maximum allowed current. This maximum can be simply be the maximum capacity of the charging station, but it can also be a value that changes dynamically to support "smart charging", i.e. to regulate charging levels for load-balancing or to protect against grid overload. The IC-CPD in the charging cable communicates a fixed maximum current of around 10-12 A (depending on brand and local regulations) to the EV. No smart charging is possible, since there is no communication between IC-CPD and charging station.

4. OCPP certification

In 2022 the mode 1&2-only charging station was added to the OCPP 1.6 certification program. This has been added as a "charging station product subtype". The reasoning behind this is that the mode 1&2-only charging

station, as described in [Limitations of a mode 1&2-only charging station](#), has some limitations that affect part of the OCPP communication. To enable this type of device to become OCPP-certified, and at the same time clearly distinguish between devices that are limited or not, the certification allows for specific *product subtypes*.

For a mode 1&2-only charging station there are some specific rules applicable for certification, the main differences being:

1. It is not possible to certify the Smart Charging Certification profile. Since it is physically not possible to apply smart charging via mode 3, this feature profile is excluded from OCPP certification.
2. For test cases where an UnlockConnector message is sent to the mode 1&2-only charging station, it only has to respond that this is not supported.
3. A specific scenario must be supported for handling the case where a transaction is stopped by disconnecting on EV side. Mode 3 or 4 charging stations can choose how to handle this, but for a mode 1&2-only charging station it is enough that the transaction is stopped when the cable is disconnected at either side.

All other features of OCPP are treated and tested in the same way as a regular charging station.