Technical Update

1. Earthing

First up, earthing and earth rods, in particular. These are relevant when installing at a domestic premise with a "PME" earthing system. Here are the details...

Protective Multiple Earth (PME) Systems

Many new homes are wired using a Protective Multiple Earth (PME) system. In a PME system, the home's earth wiring all runs back to the main supply point where it connects to the Neutral conductor coming into the home. This allows the mains supply to share a conductor for both earth and neutral entering the house. The EV chargepoint is also connected to this same point, using the same earth.

PME systems ensure very low Neutral to Earth impedance in the home and allow the RCDs fitted in your consumer unit to reliably detect earth faults.

Risk in Case of Neutral Failure

However, PME systems have a rare but possible fault situation should the Neutral connection to a home somehow be disconnected upstream, e.g. a nearby digger cuts a cable and disconnects only the Neutral. With no Neutral all the appliances in the home would appear dead, but if there are any light bulbs or heaters turned on the Neutral will rise to the mains potential, as these devices are connected from Live to Neutral (but the Neutral is now not connected to anything). Now because the house earth is connected to Neutral, the house earth will also rise to towards mains potential. NB: any RCDs fitted will not protect for this failure.

Inside the home this is not as dangerous as it might seem, because if all conductors are at the same potential there is no potential difference between them to do harm. However, because the car is located outside the home and is connected to the earth inside the home there is the chance of a difference in voltage between the earth (chassis) of the car and the actual ground potential outside the home, which would then be apparent to a person stood on the ground and touching the metalwork of the car.

Upstream Neutral faults are rare but it's important to allow for them in case they do happen.

Protecting Against Neutral Failure

In order to protect against Neutral failures, the IET Wiring Regulations (BS7671) state that the earth impedance between the vehicle charging earth and the true ground (for chargers fitted outside the home) be under 200 ohms to minimise any voltage developed between the two and ensure correct operation of an RCD.

It can be possible to achieve this 200 ohms Earth impedance by sinking one or more dedicated earth rods for the chargepoint.

Earth Rods

An earth rod is a copper spike (usually 4ft long) that is driven into the ground and connected to the chargepoint's earth.

Whilst this system can work, it is often difficult to install, and even when fitted it is difficult to ensure a sufficiently low impedance connection to true earth (this depends on soil type, moisture and other variables).

In addition, other metallic objects in the same equipotential zone (existing outside taps, lighting, metal cladding etc) may use a PME earth. In this case installing an earth rod for the chargepoint can make this equipotential zone (essentially the area surrounding the parked car) more dangerous.

Exceptions and Alternatives to Earth Rods

According to the IET 18th Edition Wiring Regulations (BS 7671), the fitting of a dedicated earth rod to the EVSE is not required if one of three exceptions mentioned in regulation 722.411.4.1 is met. We recommend looking them up yourself, but for simplicity and mindful of copyright, we have paraphrased them below:
For homes with PME systems, if it is not possible to fit an effective earth rod and none of the three exceptions can be achieved, the remaining options are to not fit a charge point at all (which risks the customer charging using a 13A socket and Mode 2 box, which will have exactly the same Neutral failure risks), or to fit an isolation transformer.

Isolation transformers represent an additional expense, unnecessary additional electrical consumption, can be noisy, weigh upwards of 50kg and must be installed in a covered location, usually inside the house. None of which makes them an appealing option.

Noting the challenges above, Pod Point chose to set about creating a system that would meet exception (iii).

	Exception	Viable
(i)	This exception assumes a 3 phase domestic supply (very rare in the UK), and requires a maximum of 70V touch voltage. Given the calculations provided in the guide this would require at least 50A load per phase at all times, highly unlikely in a domestic environment.	✗
(ii)	This allows for a change to the earthing arrangements for the whole property; where an additional earth rod is sunk and connected back to the house's PME Earth, the charge point can then be connected to the PME. As well as potentially contravening DNO advice, this option does not take into account the risk of additional properties sharing the same PME Neutral. We, therefore, do not consider it advisable to do this, even if a low enough impedance reading is possible.	✗
(iii)	Allows fitment of a device that will isolate the supply if the touch voltage exceeds 70V for more than 5 seconds. While this is clearly the preferable exception, such a device has not been readily available to installers.	✓

Pod Point Neutral Failure Detection Circuit

Since 2017, Pod Point's chargers have included a circuit that detects a Neutral failure (or even partial failure) and immediately puts the charger into a fault mode. In addition, Pod Point chargers incorporate a safety disconnect for the Earth connection to the car in addition to the double Live and Neutral disconnects.

In the event of a partial or full Neutral fault, Pod Point chargers completely isolate the car to prevent current flow without relying on earth rods, transformers or difficult to ensure low ground impedance. The chargepoint enters a fault state that it will not leave until the chargepoint is powered down at source and repowered up. If the Neutral failure remains in effect, the chargepoint will return to fault state.

This system meets exception (iii), provides complete protection from Neutral faults, complete with necessary redundancy, and is a key part of our commitment to the safety and reliability of our products.

Reporting of Failures

The Pod Point can send diagnostic data on this and other safety related issues - e.g. disconnected earths, reverse polarity supplies, elevated neutral voltages, under/over voltages and charging cable faults - via its WiFi connection. In case of comms failure, the safety features are still fully operational.

Pod Point has detected several anomalous events on customers' supplies "in the wild" and instructed them to contact their DNO immediately. Though Neutral failures are rare, on two separate occasions we have detected anomalies have been consistent with upstream Neutral failure.

Recognition of the Pod Point System

Recognising that this system is a significant improvement on standard industry practice, Pod Point sought to ensure that it was understood by the NICEIC. After significant internal testing, we shared full details of the Neutral failure detection system directly with the NICEIC.

Pod Point chargers effectively provides equivalent safety measures to the "multipole isolation device" specified in BS7671, and the text in exception (iii) in the 18th Edition (BS7671:2018) includes the statement "Equivalent functionality [to the multipole isolation device] could be included within the charging equipment", allowing for the provision of such safety features within the chargepoint.

Hopefully that clarifies the earth rod matters, next up the changes regarding RCDs/RCBOs from the 18th Edition...

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2. RCD/RCBO Choice in Light of "18th Edition" Changes

Until 1st January 2019 it was deemed permissible to install a chargepoint protected by a Type A RCBO only, however from January 1st 2019 the new 18th Edition of the IET Wiring Regulations (BS 7671) have come into effect.

Risks from DC Leakage Fault

The IET have recognised that if there is more than 6mA DC leakage and an AC fault at the same time on a circuit protected by a Type A RCBO, there is a very slight chance that the DC leakage could “blind” the RCBO and it wouldn't trip on the AC fault.
The new guidance therefore calls for the installation of additional protections in the form of 6mA DC leakage detection.

Type B, or not Type B...

There are two options to meet the new guidance:

- Fit a Type B RCD and an MCB at source
- Fit a Type A RCBO and build 6mA DC leakage detection into the chargepoint (an RCBO is effectively an RCD and MCB integrated into one unit).

To ensure you can charge as safely as possible, and to streamline installation (using a single, compact RCBO), Pod Point have chosen to build a 6mA DC leakage detection circuit into our chargers.

In the event of a DC fault occurring, the Pod Point will trip to a fault state and safely prevent your car from charging. This fault state can be remotely diagnosed by Pod Point so we can ensure you get back up and running ASAP. Conversely, a Type B would merely trip and no information would be provided as to what had caused this.

We hope that has provided some clarity. We take safety very seriously at Pod Point, and strive to offer the safest chargepoints, while taking an innovative approach to make life as easy as possible for our customers.