Installation of charging stations for EVs with the podis® energy bus system.

Dimensioning of the branch circuits

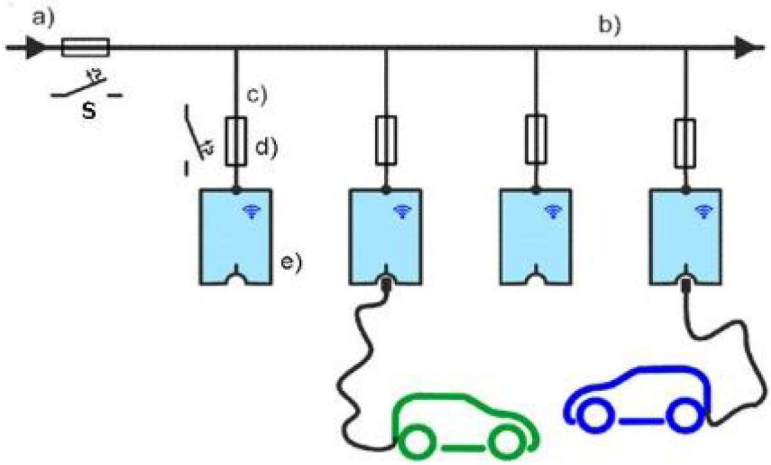
Arrangement of overcurrent and residual current devices

Initial situation/ Questions	How are charging stations for charging mode 3 connected to the podis® energy bus and how are the electrical safety requirements fulfilled? In particular, how are the vertical branch circuits between the supplying, horizontal podis® flat cable and the charging stations dimensioned and protected? Where are the overcurrent and residual current devices located and how are they rated?

Basics Standards	IEC 60364 (HD 60364) «Low-voltage electrical installations» Part 4-43:2023 «Protection for safety - Protection against overcurrent» clauses 433.2 and 434.2 and Part 5-53:2019 «Selection and erection of electrical equipment - Switchgear and controlgear» as well as Part 7-722:2018 «Supplies for electric vehicles» And additional national requirements for the connection of EV charging equipment if any.

Installation of charging stations	Typically, several charging stations are supplied via a common flat cable of the podis® power bus system 5 x 16 mm² (b), which is protected by an upstream overcurrent protection device (a) with a rated current (nominal current) of I_n 63 A.

	This cable usually runs horizontally, typically at the head of the parking spaces where the charging stations are located. Each charging station is supplied from the common supply line (podis® power bus) via vertical lines (c) by the podis® connection modules. The overcurrent devices d) and residual current devices for protecting the charging stations are located in the branching end circuits.

Fig. 1	**Schematic:** Common (horizontal) supply line (podis® energy bus b)) with overcurrent protection device a) and vertical branch lines c) with overcurrent protection devices d) and connected chargers with load management e) 

Overcurrent protection podis® flat cable	**podis® flat cable b); (horizontal supply line)** The common, usually horizontally installed supply line (b) is protected against overload and short circuit by the upstream overcurrent protection device (a).

Overcurrent protection **Vertical branch lines with reduced conductor cross-section**	**Branch circuits c) (vertical) to the charging stations** The circuits c) branch off from the podis® flat line b) are connected to the podis® adapter modules by screw terminals or plugged to the podis® adapter modules with an RST installation- connector. The branch circuits c) are protected by the downstream overcurrent protection devices d) in the event of an overload. According to IEC 60364-4-43; clause 433.2.2, these overcurrent protection devices may be placed along the run of the conductor, i.e.: - in the charging station themselves or - directly upstream of the charging station or - along the conductor run branch off from the podis® flat cable. Due to these overcurrent protection devices are not placed at the point where the conductor is reduced in cross-sectional area as required by clause 433.2.1, one of the following two requirements a) or b) must be fulfilled for short-circuit protection according to IEC 61364-4-43 clause 433.2.2. a) In accordance to IEC 61364-4-43 clause 434.2.2, the cable with reduced cross-section branch off from the podis® flat cable is protected by the overcurrent protection device a), which is installed on the feed side of the podis® flat cable, in the event of a short circuit. In the event of a short-circuit, the impedance of the fault loop must be limited so that the upstream overcurrent protective device a) switches off before the reduced-cross-section cable part c) exceeds the maximum permitted temperature ($k^2 \cdot s^2 \geq I^2 \cdot t$); see IEC 61364-4-43 clause 434.5.2. In this case, the permissible tripping time according to IEC 60364-4-41 clause 411.3.2 Table 41.1 shall not be exceeded. b) The length of the branching cable, which is not protected against short-circuit, does not exceed 3 m and is installed in a short-circuit and earth-fault protected manner– IEC 60364-4-43 clause 434.2.1.

	This condition may be obtained for example by reinforcing the protection of the wiring against external influences ensuring inherently short-circuit and earth fault proof installation. This requirement can be met with a metallic cable conduit according to IEC 61386. The use of a metallic cable conduit can worsen the heat dissipation in this part of the route, therefore the current carrying capacity shall be determined to be suitable for the part of the route with the most adverse conditions. See IEC 60364-5-52 clause 523.8. **Recommendation**: We recommend version 1) - short-circuit protection by the upstream overcurrent protection device a). Argumentation: For variant a), standard-compliant short-circuit protection is ensured even without short-circuit and earth-fault proof installation if the branch lines c) have a cross-section of at least 6 mm² and a selective main circuit breaker (SMCB) 63 A tripping characteristic E is used for the overcurrent protection device a). For safe tripping of the main circuit breaker (SMCB), the impedance of the fault loop must be taken into account.
Selectivity Overcurrent protection device	To ensure the selectivity of the overcurrent protection devices, the overcurrent protection devices connected in series must be matched to each other. Selectivity can be assumed if a suitable selective main circuit breaker (SMCB) is used at the beginning of the podis® flat cable and then circuit breakers (MCB) coordinated on the SMCB are used in the lines before the charging stations or in the charging stations. The specifications of the switchgear manufacturer must be observed.

Residual current device (RCDs)	Each charging connection point (charging station) must be protected by its own residual current device (RCD) with a rated residual current $I_n \leq 30$ mA according to IEC 60364-7-722. If the protection against DC residual currents > 6 mA required by the standard is already integrated in the charging station, type A residual current devices (RCDs) with $I_n \leq 30$ mA can be used. Otherwise, type B residual current devices (RCDs) must be used.

Selectivity Residual current device (RCDs)	If required for operation (availability of the system), selectivity between the residual current devices (RCDs) of the connection points and any existing residual current device (RCD) of the upstream circuit must be ensured in accordance with IEC 60364-7-722. The type of residual current devices used must be taken into account. A RCD type A must not be installed upstream of an RCD type B. A DC fault detection device (RDC-DD) integrated in the charging station is not affected by this, see IEC 60364-7-722. Alternatively, the use of a residual current protective device “EV” (RDCPD) is possible, which protects against AC residual currents and against smooth DC residual currents.

2024-02-28

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