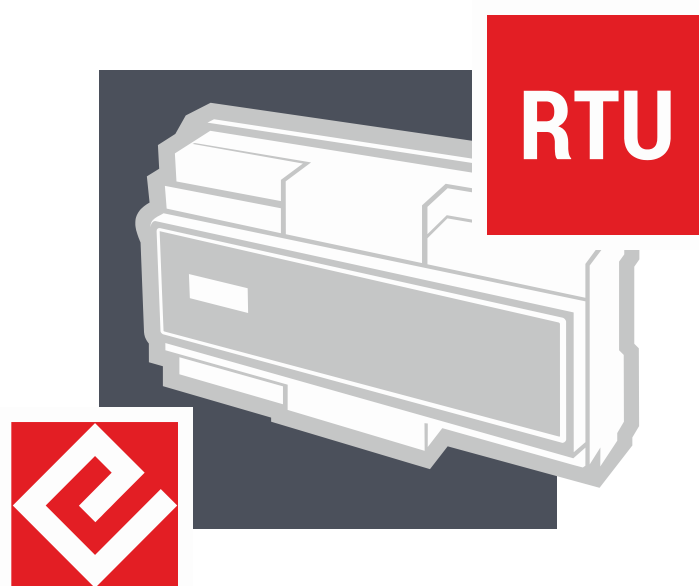




Requirements for the placement and installation of DMU units for the Vdip and PMU system



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Requirements for the placement and installation of DMU units for the Vdip and PMU system

Requirements for DTS suitable for DMU installation

DTS unsuitable for placement of a Vdip DMU

These DTS should be preferentially excluded from the list of suitable locations for DMU placement:

- a) DTS of large customers with significant impulsive loads (wastewater treatment plants, fuel stations, high-power machine tools and motors, etc.)
- b) DTS characterized by significant flicker (subject to impulsive loading with substantial power) and stations to which significant sources of interference are connected
- c) DTS with OLTC transformers (otherwise, online transmission of the current tap position setting must be ensured)
- d) DTS with no or poor GSM signal coverage – stations without GSM coverage, without the possibility of installing an external antenna, etc.
- e) Other DTS unsuitable for DMU installation according to DSO criteria

DTS suitable for placement of a Vdip DMU with backup power supply

- a) Good GSM signal coverage (possibility of installing an external antenna)
- b) Located at the end of long feeders (terminal DTS)
- c) Ideally lightly loaded DTS without significant impulsive loads

DTS unsuitable for placement of a DMU with PMU

- a) DTS of large customers with significant impulsive loads
- b) DTS with OLTC transformers (otherwise, online transmission of the tap position setting must be ensured)
- c) Impossibility of connecting current inputs
- d) DTS with no or poor GSM and GPS signal coverage (stations without a direct view of the sky, without the possibility of installing an external antenna, etc.)

Requirements for DMU placement within an MV feeder

Vdip system requirements

- a) Each section of the MV feeder that can be switched (especially by remote-controlled devices and sectionalizing switches) should contain at least one Vdip DMU unit.
- b) DMUs should preferably be installed at the ends of long radial feeders (DTS at the end of each radial section longer than approximately 4 km).
- c) DMUs with backup power supply should preferably be installed at the ends of very long radial feeders (locations with the highest short-circuit impedance).
- d) The number of DMUs should be selected with regard to the total feeder length and its topological complexity. The Vdip system can effectively localize only those faults that occur upstream of at least one DMU (from the feeder source perspective). For typical overhead or mixed networks, an average DMU penetration of ≥ 4 km of line per DMU can be used, i.e. for a



feeder with a total length of 100 km, 25 DMUs can be used, or even fewer in the case of a feeder with a high number of long radial sections.

- e) Higher penetration can be applied in areas with frequent fault occurrence, while lower penetration can be used near the beginning of a selected feeder and in topologically less complex areas.

PMU system requirements

- a) PMU installation should be selected primarily in the area of remote-controlled devices – one unit upstream and one downstream of the remote-controlled device. When using a PMU at a splitting point with PMU measurement (e.g. a recloser), it is sufficient to install the DMU PMU on the side where the remote-controlled device does not have PTN measurement.
- b) Each section of the MV feeder that can be switched should contain one PMU unit.
- c) Ideally, selected Vdip DMU units should be supplemented with GPS synchronization.

Requirements for DMU installation and DTS information

Required information for DTS selected for a Vdip DMU

- a) Identification of the current DTS transformation ratio (ideally including photo documentation of the nameplate and the current tap position).
- b) After DMU installation, verify the correct phase sequence.
- c) Verify communication between the DMU and the control center.

Required information for DTS selected for a PMU DMU

- a) Identification of the current DTS transformation ratio together with photo documentation of the DTS nameplate and the current tap position.
- b) Transformer parameters (short-circuit and no-load measurements).
- c) Record CT/PT ratios (configure them in the DMU).
- d) After DMU installation, verify the correct phase sequence.
- e) Verify communication between the DMU and the control center.
- f) Verify GPS signal reception and time synchronization.

Description of the procedure for automated selection of DTS suitable for Vdip DMU installation

- a) Exclude unsuitable DTS from the list.
- b) Mark prioritized DTS (taking DSO criteria into account; optional).
- c) For a normally operated network, perform DMU selection based on the impedance criterion:
 - a. Select the impedance-wise most distant DTS (with maximum short-circuit impedance Z_k) and store it in the list of suitable stations.
 - b. Remove from the list of suitable DTS those that are within the impedance reach of the station selected in step a) (the impedance distance is adjustable via a minimum distance parameter defining DMU penetration, e.g. 4 km).
 - c. Repeat steps a) and b) until no further suitable DTS are available.
 - d. Store the list of selected DTS (the inverted order will be used as the weight of the respective DTS, see step f).
- d) For a fully meshed network area (all splitting points are closed), apply procedure c):



- a. Select the impedance-wise most distant DTS (with maximum short-circuit impedance) and store it in the list of suitable stations.
 - b. Remove from the list of suitable DTS those that are within the impedance reach of the station selected in step a) (adjustable via the minimum distance parameter defining DMU penetration, e.g. 4 km).
 - c. Repeat steps a) and b) until no further suitable DTS are available.
 - d. Store the list of selected DTS (the inverted order will be used as the weight of the respective DTS, see step f).
- e) For alternatively operated networks or other possible feeder operating modes, perform DMU selection based on the impedance criterion (procedure according to c)).
- f) Selection of the final list of DTS for installation:
- a. Determine the intersection of DTS selected in steps c) to e). During this intersection, respect the sum of weights of each DTS (0 = not present in any list; if present, sum the weights from the individual lists).
Note: the weight is given by the inverse order in which the DTS was added to the list.
 - b. Sort the DTS according to their weight.
 - c. In each MV feeder section that can be switched, select the DTS with the highest weight for the final list.
 - d. Gradually remove DTS with the lowest weight until the maximum number of DTS for the Vdip system is reached (limited by the DSO). In case of equal DTS weights, prioritize the weight from the normal operating configuration.
Note: the number of DTS in the list can be adjusted by setting the impedance distance.
- g) Selection of DTS suitable for installation of DMUs with backup power supply:
- a. Define the maximum number of DTS.
 - b. Define DTS suitable for installation of battery-backed DMUs.
 - c. Add weights to this list according to procedure f) and select the maximum number of DTS with the highest weight.

