

SUCCESS CASE 26.2024

SMART Earthing Monitor System

OPTIMIZING PERIODIC
INSPECTIONS AND
MAINTENANCE LOGISTICS

THE CHALLENGE

The continuous earthing monitoring of electrical distribution network assets guarantees that the main security system of the installation is working under the necessary specifications but also allows for the identification of anomalous situations in which a grounded element generates current flows in the earthing system. The earthing system is the most relevant security system in any electrical infrastructure. All electrical assets are directly or indirectly connected to the earthing system in order to guarantee safety in case of loss of isolation, fault current, etc. As such, the earthing system reflects the state of health of the electrical installation.

THE SOLUTION

The SMART Earthing Monitor System was developed to continuously check earthing installations and grounded assets. As in the case of the LV Network Smart Balancer, the SMART Earthing Monitor System was fully designed and produced by the multidisciplinary team specialised in SMART Solutions of the Spanish company [Aplicaciones Tecnológicas S.A.](#)

By means of distributed SMART Earthing Monitoring sensors, it is possible to determine if the earthing system is in a proper working state or if there is any situation that requires corrective actions, for instance, if an increase in the earth resistance value due to materials degradation (e.g., corrosion) is detected. Besides that, it is also possible to detect loss of earth conductor continuity or situations in which security voltages could introduce risk, requiring additional verifications/actions to guarantee the safety of the asset.

On the other hand, the measurement of the current flows in the grounding system allows the identification of, for instance, leakage currents, fault currents, and harmonics. Criteria for preventive

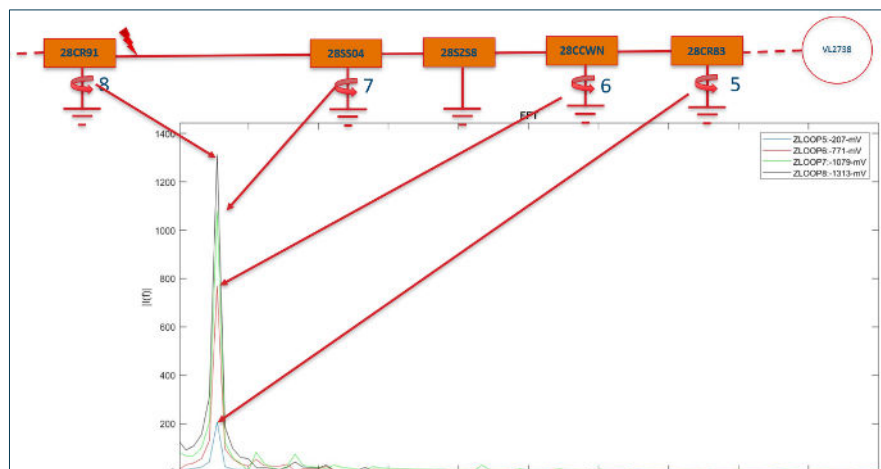


and predictive maintenance can then be established by cloud analysis of this information. In this case, to fulfil regulatory requirements by means of unattended measures, it is necessary to deal with unattended adjustments and calibration of the devices. To address this, the SMART Earthing Monitor System includes a novelty **self-calibrating system** that ensures the proper functioning of the devices validated by the metrology laboratory of LCOE, the electrotechnical reference laboratory in Spain. Moreover, the certification of step and touch voltages is based on the MSC¹ algorithm developed by LCOE. Through a conservative approach, this ensures that security voltages are compliant with regulations considering the distribution network topology and the level of interconnection among earthing assets. To complement the measurements and complete the periodic regulatory verification, a digitalised checklist was developed on app.

MAIN ACHIEVEMENTS

The main results after the **installation of more than 3.500 monitored assets** (e.g., on-pole and indoor secondary substations, and transited support towers) are as follows.

- The distributed devices were put in service by means of an app for Test & Commissioning which is used to verify the **proper functioning of the devices** and the **status of the monitored location**, offering specific **recommendations at locations where deviations were detected**.
- The app-based procedure allowed for the **harmonisation of practices and procedures** in different areas, attended by different staff and maintenance personnel.
- A **breakage detection function** based on flow current analysis was implemented in real on-service urban underground circuits (Alcalá de Henares) and allowed for the identification of a weak point in the medium voltage distribution network by monitoring predictive key performance indicators related to secondary, simultaneous or induced breakages in the network.



Example of current flows used for breakage detection.

¹ Acronym for Simplified Conservative Method in Spanish.

- A set of **configurable alerts** related to the earthing system of the monitored asset, the detection of current flows and the malfunctioning of the monitoring devices has been developed.
- A **catalogue of solutions and setups** related to different scenarios and secondary substation topologies has been developed.

Besides its sensing capabilities, the SMART Earthing Monitor System devices include expansion ports to add other sensors, increasing the capabilities of the system with the inclusion of existing or new sensors (e.g., digital cameras, presence control, etc). The additional sensors use the communications and analytics capabilities of the system, keeping the focus on the concept of legacy for actual and future upgrades.

KEY SUCCESS FACTORS

- Distributed earthing monitoring sensors.
- Big Data and Cloud computing.
- Self-calibration system.
- Use of the MSC Algorithm to ensure certification of step and touch voltages.
- Earth current flows analysis.