

Cathodic Protection of Steel in Concrete Using LXI Connectivity

The Challenge

Concrete, which is an integral part of many modern infrastructures, loses its durability when the reinforcing steel starts to corrode. Exposure to deicing salt, for example, would cause this and this results in a dramatically reduced structural life span.



Corrosion in steel is an electrochemical process in which small electrical potentials develop due to the differences in material composition and structure. When concrete structures are subject to corrosive substances, for example deicing salt, over prolonged periods of time, which is an issue with bridges and parking facilities in colder climates, the salt permeates the concrete, reduces its alkalinity, and prevents the concrete from protecting the steel resulting in corrosion. Typically the repair requires the removal and replacement of the affected concrete, which represents a significant cost.

The Solution

An alternative to this expensive solution is cathodic protection, which does not require the replacement of concrete. Cathodic protection applies an electrical field to the concrete with the steel reinforcement being used as the cathode. Current flows towards the steel reinforcement, effectively protecting the steel from corrosion. Cathodic protection systems can be monitored for efficiency with the use of voltage probes and sensors.

To build and deploy a cathodic protection system, the following components are required: a modular power system and a switch/measure unit. An alternative to the switch/measure unit is an individual digital multimeter, and LXI-based switch modules.

System Operation

After verifying that the system is working correctly, the power supplies are turned on and current is applied, which causes the concrete to polarize. The current is either programmed to a predefined level or increased steadily until the potential has shifted by a certain voltage difference.

Once polarization has taken place, the system is tested again. The power supplies are switched off in order to monitor the depolarization of the concrete. After switching off the supplies, the "switch-off potential" is measured. Then, the voltage shift is monitored over the course of several hours. If the desired conditions are not met, the strength of the electrical field is altered during the next cycle.

The measurement system needs to have the following characteristics:

- **High input impedance.** The measurements need to be taken while placing as little load as possible on the sensors.
- **Stable measurements.** Frequently relatively long cables are used, which can result in noise.
- **Synchronization capability.** Some measurements need to be taken right after switching off the power supplies so the power supply and multimeter need to be synchronized.



Remote Access

LXI components use Ethernet for connectivity and control and can connect directly to any standard Ethernet LAN. Ethernet combines high-data transfer rates, ease-of-use, flexibility with simultaneous communication and different protocols, and stability. It is ideal for bridging large distances in distributed test applications.

Each of the LXI instruments used is intelligent. In smaller applications this may eliminate the need for a local system controller. This is enabled by the distributed intelligence in the individual instruments. When appropriate, a central controller accesses the remote site, downloads gathered measurement data, and, when necessary, reconfigures the instruments. More complex installations may include a local system controller that monitors the network, analyzes measurement data, reconfigures the system as required, and generates alarms if operating parameters are out of predefined limits.

Ease-of-use

Typically LXI instruments feature built-in web servers so that users can monitor and control the system using Ethernet and any standard web browser. All major instrument functionalities are accessible through the web server, greatly simplifying software development, system commissioning, troubleshooting, and maintenance.

Cathodic protection, with its electronic measurement requirement, is an obvious fit for LXI technology. Commercial, low-cost Ethernet services can be used to gain access and immediate control over the installation. LXI instruments are self-contained, dependable units that lend themselves naturally to remote installations, in the lab or outside. They demonstrate predictable operation and are easy to set up, configure, and debug.

About LXI and the LXI Consortium

LXI is the LAN-based successor to GPIB. The LXI standard goes beyond GPIB to provide additional capabilities that reduce the time it takes to set up, configure and debug test systems by connecting directly to the standard ports on a PC. It also removes the inherent cable length limitations of GPIB. Also, LXI software and drivers simplify test system set-up. LXI also helps integrators leverage the time and effort already invested in system software and architecture.

The standard is managed by the LXI Consortium, a not-for-profit corporation comprised of leading test and measurement companies. The group's goals are to develop, support and promote the LXI standard. LXI's flexible packaging, high-speed I/O, and prolific use of LAN address a broad range of commercial, industrial, aerospace and military applications. Additional information about LXI-compliant products as well as licensing, specifications and consortium membership is available at www.lxistandard.org



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