SCS-100

Smart Charging Simulator

Product brochure

MAXEYE TECHNOLOGIES™

Introduction

Accelerating the Future of EV Charging Validation. The **SCS-100 Smart Charging Simulator** is MaxEye's next-generation intelligent charging simulation platform that recreates real-world EV charging scenarios with exceptional accuracy. Designed for OEMs, Tier-1 suppliers, charging infrastructure manufacturers, and test laboratories, it enables end-to-end validation of charging communication, interoperability, control strategies, and fault conditions across global AC and DC charging standards. With support for automated test execution, programmable charging scenarios, and seamless integration into HIL and Software-Defined Vehicle (SDV) validation environments, the SCS-100 empowers engineering teams to develop robust, standards-compliant charging systems faster while reducing testing cost, complexity, and dependence on physical charging infrastructure.

Key Features

- **Dual-Mode EV/EVSE Emulation** – Software-configurable architecture capable of operating as either an Electric Vehicle (EV) or Electric Vehicle Supply Equipment (EVSE), enabling comprehensive validation of charging controllers, OBCs, BMSs, CCUs, and charging stations.
- **Comprehensive Global Charging Protocol Support** – Real-time implementation of ISO 15118, DIN 70121, CHAdeMO, and GB/T communication protocols with native support for Plug & Charge cryptographic authentication and secure certificate handling.
- **Built-in Protocol Conformance Testing** – Integrated conformance test suites for ISO 15118, DIN 70121, CHAdeMO, and GB/T standards to simplify compliance verification, reduce certification effort, and accelerate product qualification.
- **Control Pilot Signal Simulation** – Precise generation and manipulation of Control Pilot voltage levels, PWM duty cycle, and resistance states to validate charging state transitions, hardware protection mechanisms, and IEC 61851 compliance.
- **Communication Timing & Sequence Validation** – Configurable delay, reordering, duplication, omission, and timeout of protocol messages to validate communication robustness, timeout handling, and recovery mechanisms under abnormal operating conditions.
- **Advanced Fault Injection Framework** – Inject corrupted, malformed, invalid, dropped, duplicated, or unexpected protocol messages to verify system resilience, error detection, diagnostic reporting, and functional safety behavior.
- **Comprehensive Protocol Logging & Analysis** – Dedicated Ethernet and USB interfaces capture complete protocol exchanges with high-resolution timestamps, enabling detailed packet-level analysis, debugging, and traceability.
- **Automation & HIL Integration** – Open APIs for seamless integration with HIL platforms, automated test frameworks, and CI/CD environments, enabling repeatable regression testing, interoperability validation, and pre-certification workflows.
- **Programmable Charging Scenarios** – Create and execute customizable charging sessions covering normal operation, boundary conditions, fault scenarios, and interoperability testing across multiple charging standards.

- **High-Speed Automated Test Execution** – Supports unattended execution of large-scale test campaigns, significantly reducing validation time while improving test repeatability and engineering productivity.
- **Scalable and Future-Ready Platform** – Modular software architecture designed to accommodate evolving charging standards, emerging EV technologies, and future protocol enhancements without major hardware changes.

Compatible standards:

Standard Classification	Standard	Core Charging Architecture
North American Standards	• SAE J1772 • SAE J3068-1 & J3068-2 • NACS (SAE J3400)	• AC Level 1 / Level 2 & DC Fast Charging • Three-Phase AC Charging for Heavy Duty • North American Charging Standard
European & International Standards	• IEC 61851-1 • ISO 15118-2, -3 & -20 • DIN SPEC 70121	• Basic AC / DC Control Pilot Signalling • Network Layer & High-Level Communication • 2nd Gen Smart Charging & Bidirectional V2G • Combined Charging System (CCS) DC Fast Charging
Chinese National Standards	• GB/T 18487.1 • GB/T 27930	• AC/DC Conductive Charging Control Systems • CAN-based DC Charging Communication Protocol
Japanese Standards	• CHAdeMO (V0.91, 1.X, 2.0) • CHAdeMO e-PTW 1.0	• Dedicated High-Power DC Charging Interface • Electric Powered Two-Wheeler Specification
Next-Generation High-Power	• MCS (Megawatt Charging System) • ChaoJi	• High-Current Charging for Heavy-Duty Vehicles • Ultra-High-Power Global Harmonized DC Interface

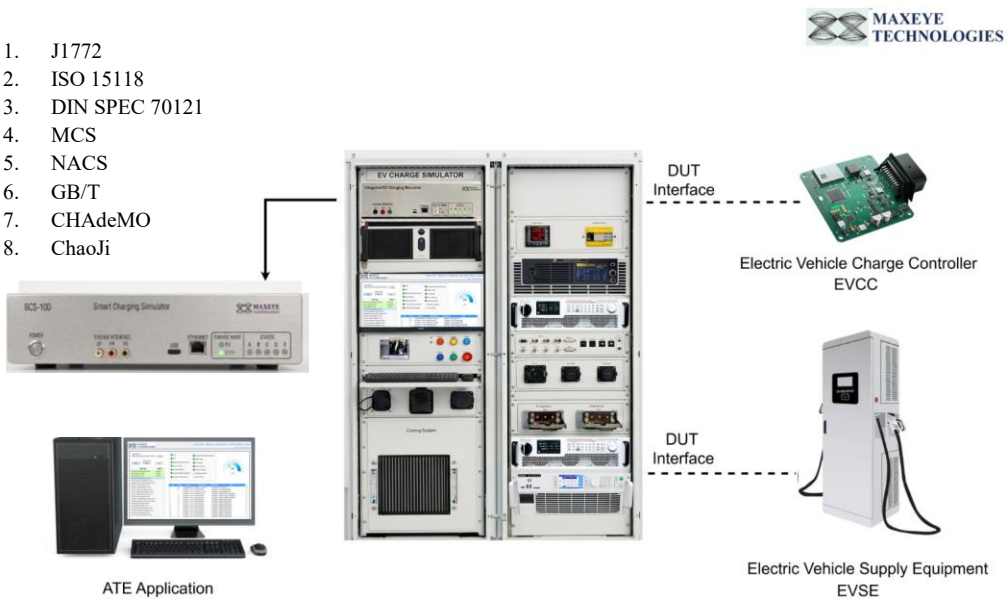
Advanced Physical-Layer & Protocol Fault Injection

The SCS-100 features a deterministic, high-speed fault injection engine designed to evaluate the physical and digital safety limits of the Device Under Test (DUT) in real time. During active DC charging, the system can dynamically drift or spike the Control Pilot (CP) duty cycle beyond its mandatory 5% PWM threshold to evaluate protection reactions, and programmatically disconnect the CP or PP/CC lines at any stage to replicate cable malfunctions, pin degradation, or latch failures. Additionally, it allows engineers to inject out-of-boundary or attenuated HomePlug Green PHY PLC signals to validate the limits of high-level EVCC/SECC communication, while simultaneously generating corrupt CAN and LIN fault frames to ensure secondary vehicle networks execute safe-state transitions during digital interface failures.

HIL Test System with SCS-100

Protocols:

1. J1772
2. ISO 15118
3. DIN SPEC 70121
4. MCS
5. NACS
6. GB/T
7. CHAdeMO
8. ChaoJi



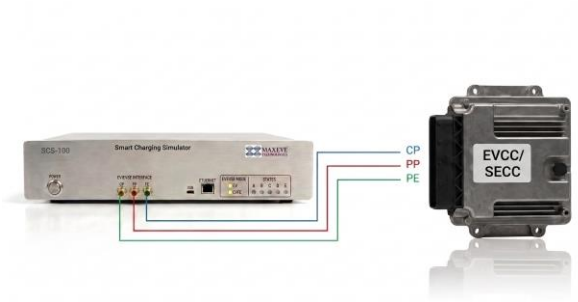
The connection layout establishes a closed-loop real-time interface by linking the central HIL test rack—driven by the SCS-100 simulator and a dedicated ATE control PC—directly to the target controller via dedicated Device Under Test (DUT) interfaces. When configured for vehicle-side testing, the simulator connects to an external EVCC to mimic a physical charging station, sending low-level Control Pilot PWM signals, Proximity Detection resistance lines, and high-level PLC or CAN/LIN protocol communication frames. Conversely, when configured for charger-side testing, the architecture routes these exact physical and digital lines to an external EVSE to safely emulate an oncoming electric vehicle.

This dual-role layout supports three critical engineering use cases: Interoperability Validation to sweep through global protocol stacks (such as ISO 15118, NACS, and GB/T) on a single test bench; Automated Regression Testing to run automated scripts via the ATE application to verify software stability over thousands of continuous cycles; and Safety-Critical Fault Injection to safely introduce signal anomalies—like duty cycle drifts, physical line disconnects, and corrupted network frames—to evaluate diagnostic and protective safety routines.

SCS-100 Use case scenarios

1.Signal Level protocol conformance testing

The SCS-100 connects directly to an EVCC or SECC ECU to validate software and logic conformance with global standards like ISO 15118, DIN 70121, and IEC 61851. By interfacing with the Control Pilot and Proximity Pilot lines, it simulates and measures ±12V PWM duty cycles, verifies PP resistance, and tests standard charging state transitions (States A to E) without requiring high-voltage hardware.



2.EVSE Simulator HIL

Simulating a real charger, the SCS-100 integrated with the ATE HIL system plugs into an EV to simulate charging protocol and deliver dynamic AC/DC power with sources. This validates the entire vehicle-side ecosystem—including the EVCC, BMS, OBC, and safety interlocks—simultaneously under real power conditions, grid constraints, and emergency shutdowns.

3.EV Simulator HIL

Simulating a real EV, the SCS-100 integrated with the ATE HIL cabinet plugs into a charger (EVSE) to simulate the EV charging protocol behaviors and sink dynamic AC/DC power using internal regenerative loads. This validates the charger's power electronics, safety systems, and control loops across diverse vehicle profiles (like 400V to 800V) while enabling the emulation of critical faults.

4.Man in the Middle

A non-intrusive Passive Man-in-the-Middle (MitM) Monitoring mode designed for real-time traffic analysis and physical-layer auditing between an active EV and EVSE link. Operating inline without disturbing standard handshake timings or line impedances, this feature captures, decodes, and logs all unencrypted high-level communication (such as HomePlug Green PHY EXI/XML messages across DIN SPEC 70121 or ISO 15118 without TLS) alongside CP PWM, PP analog states and power level parameters.

Charging Test System with SCS-100

Key Features

- **Dual-Role Emulation:** Seamlessly switches between behaving as an EV simulator and an EVSE simulator.
- **Integrated protocol conformance** test suites provided to validate compliance with ISO 15118, DIN 70121, CHAdeMO, and GB/T standards, reducing certification effort and accelerating product qualification.
- **Physical Signal Validation:** Directly interfaces with CP and PP lines to simulate and measure PWM duty cycles, PP resistance, and standard charging state transitions (States A to E)
- **Signal Fault Injection:** Safely introduces communication anomalies—such as Control Pilot duty-cycle drifts, physical line disconnects, and corrupted network frames—to test system resilience.
- **Multi-Vehicle Profile Testing:** Quickly switches between diverse virtual vehicle architectures to validate charger compatibility on a single test bench.
- **Dynamic Regenerative Loading:** Commands internal high-power regenerative loads to sink high-voltage AC or DC current, perfectly mimicking the real-time energy absorption of actual battery packs.
- **Programmable Charging Scenarios –** Create and execute customizable charging sessions covering normal operation, boundary conditions, fault scenarios, and interoperability testing across multiple charging standards.

The MaxEye SCS-100 Smart Charging Simulator is a versatile instrument used in EV/EVSE HIL test systems, designed to validate global charging standards—such as ISO 15118, DIN 70121, and IEC 61851—at both signal and high-power levels.

This dual-role system can operate as a signal-level emulator connected to an EVCC or SECC ECU to verify software logic, a power-level EVSE simulator that delivers dynamic AC/DC power to test a physical vehicle, or a power-level EV simulator that uses regenerative loads to safely test charging station power electronics.