

SL1040A-ST2 Scienlab Charging Discovery System – Portable Series

EV & EVSE Test



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Solution Overview

The Keysight SL1040A-ST2 Scienlab Charging Discovery System – Portable Series (Portable CDS) is a modular solution for conformance and interoperability testing of Electric Vehicle (EV) and EV Supply Equipment (EVSE) charging interfaces up to 400 A and 1,000 V DC. Thanks to its modular design, the CDS can be configured to meet customers' specific needs for testing and validating the charging interface of electric vehicles and charging infrastructures.

The Portable CDS supports all major global charging standards and communication protocols:

- CCS (Type 1, Type 2, NACS)
- GB/T
- CHAdeMO

A detailed list of supported charging versions is provided in the respective data sheets for [SL2000A](#) and [SL1300A](#).

Furthermore, the SL1040A-ST2 is recognized as certified [CharIN Conformance Test System \(CCTS\)](#) for Basic and Extended application profiles, supporting industry recognized conformance and interoperability processes required for CCS based EV and EVSE validation.

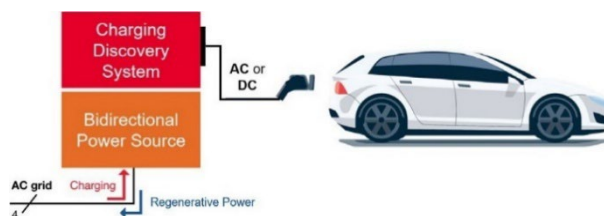
Additional CDS variants, such as EMC shielded, high-power, or megawatt-level solutions, are described in the corresponding data sheets available on our website for [charging test equipment and solutions](#).

Main Use Cases

EV Test

Use Case 1: EV Test

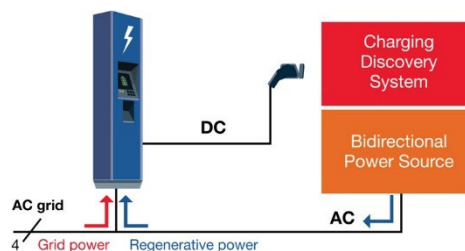
The CDS can be used as a configurable charging infrastructure (e.g., DC charging station or AC wallbox). The EV test is designed for testing up to 400 A DC and 100 A AC (as per supplier specifications). It can be used for functional testing of charging interfaces of any EV, as well as for safety, interoperability, conformance, and durability tests.



EVSE Test

Use Case 2: EVSE Test

In this use case, the CDS serves as a universal, configurable charging interface emulation of an EV. Designed to accommodate plug-ins for up to 400 A DC and 100 A AC. Again, this allows functional, safety, interoperability, conformance, and durability testing of any EVSE product.



Man-in-the-Middle Test

Use Case 3: Man-in-the-Middle Test

In this third use case, the CDS is connected between two real devices to capture all electrical signals and digital communication between an EVSE and EV. The user can identify and trace potential interoperability issues.

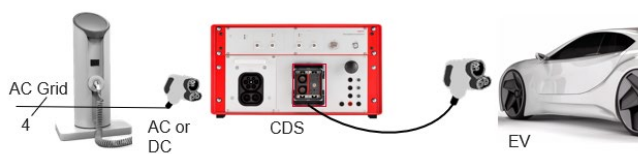


Configuration Examples

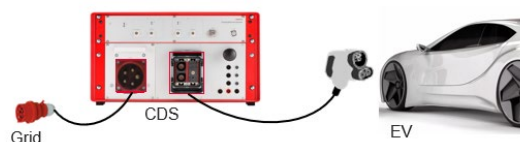
When ordering CDS hardware, it is essential to consider the specific use case and test scope. For certain applications, such as conformance testing of charging communication protocols, the CDS alone may suffice. The following table shows three examples of CDS configurations.

Example 1: Standalone CDS

In some cases, a standalone CDS configuration is adequate. It enables AC man-in-the-middle analysis, as well as AC charging tests of an EV when used in conjunction with the CEE plug-in adapter (see SL1040A-107).

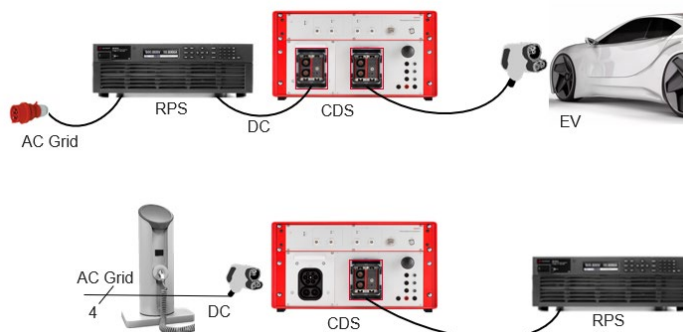


Adding emulation packages (SL201XA and SL202XA) enables DC man-in-the-middle analysis and testing of the V2G/CAN communication protocol.



Example 2: CDS and Low-Power DC Supply

Adding a DC power source or load, even with low power, enables most DC conformance and interoperability testing. Keysight RP7900 Regenerative Power System (RPS) offers a scalable solution (5 to 150 kW) that integrates seamlessly with CDS. It can be used as a source or load, thus allowing for EV and EVSE testing with a single setup.



Example 3: CDS and High-Power DC Supply

For high-power DC charging, the CDS can be attached to larger DC emulators with a capacity of 300 kW or more. EV and EVSE testing at full power range becomes possible.

Note: For high-power charging EV testing, a high-power CDS with liquid-cooled adapters may be required.



Note: For subsequent orders of Keysight RP79XX, note that any RPS module must be commissioned by a CDS service engineer before first use. Contact your local Keysight field engineer for all service options.

Modularity of the Solution

This chapter provides a detailed examination of the modularity of the CDS HP Series, focusing on components from the real-time computer to the high-voltage module. Figure 1 provides a generic overview of this modularity. This data sheet details the components highlighted in the red sections of the diagram. The components shown in dark gray, representing extended functionality and optional system expansions, are described in their respective data sheets.

For information on accessories such as power source adapters, EV inlets, and EV connectors, please refer to the dedicated [EV Charging and EVSE Plug-In Adapter](#) data sheet. Information about the operating software environments, including all associated emulation packages and conformance and interoperability test cases, is provided in the respective data sheets for [SL2000A](#) and [SL1300A](#).

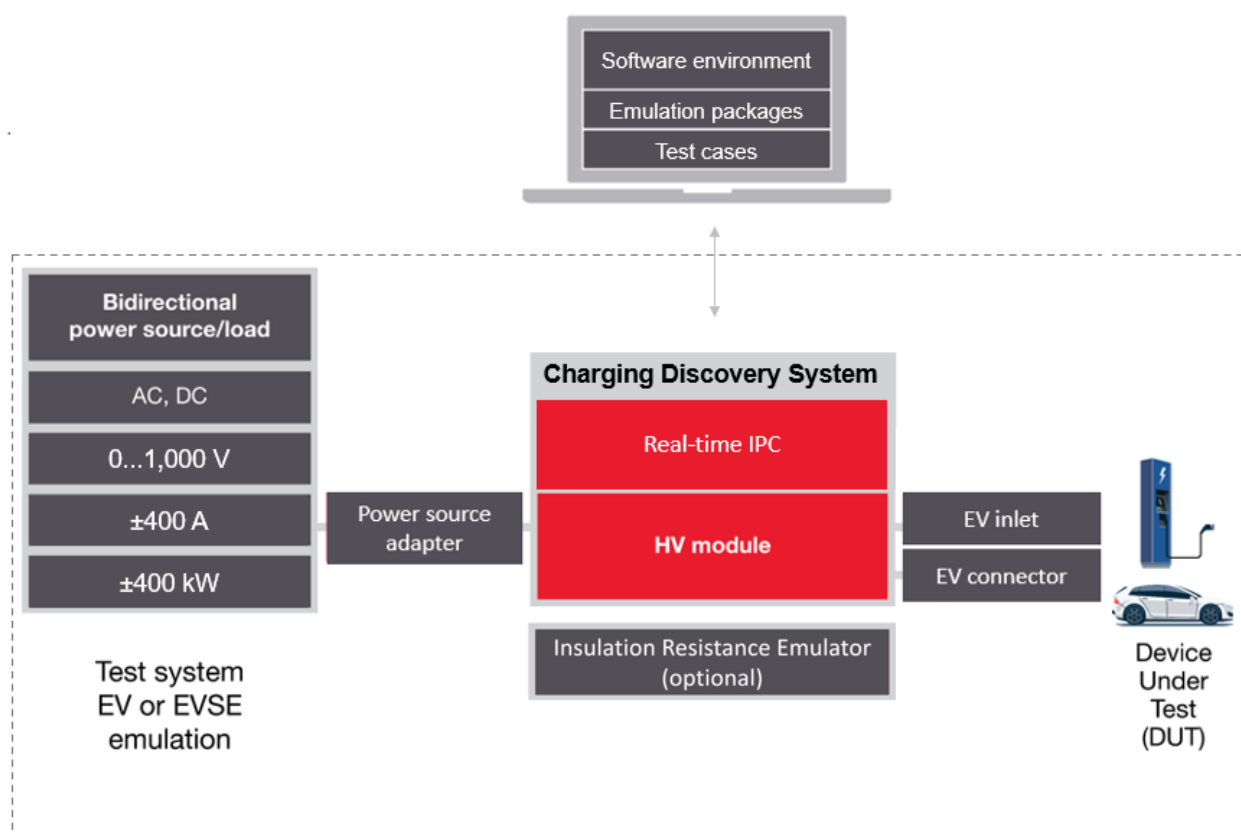


Figure 1. Modularity of the SL1040A-ST2 Scienlab Charging Discovery System – Portable Series

SL1040A-ST2 Scienlab Charging Discovery System – Portable Series

Figure 2 shows the front panel of the SL1040A-ST2 Portable CDS. This panel features several key components, including the real-time computer, the high-voltage module, and a cassette slot designed for EV adapters or EVSE inlets.



Figure 2. SL1040A-ST2 Portable CDS front panel

Real-time Computer in a 19" Plug-in Unit

The following figure illustrates the same front panel, with a spotlight highlighting the real-time computer in a 19" plug-in unit.



Figure 3. Real-time computer of the Portable CDS

General Functions

- Real-time computing control unit with high system performance and low dead times.
- Standard-compliant emulation of the EV or EVSE charging communication controller; programmable using documented interfaces.
- Built-in control of up to two charging sockets with locking actuator and temperature monitoring.
- Man-in-the-middle mode for analyzing the charging communication interface between EV and EVSE.

Keysight software drivers allow easy integration of Keysight power sources and sinks.

PWM Functionality

- Measurement of the PWM level on the EVSE and EV sides.
- Emulation of the EVSE signal generator with adjustable positive or negative amplitude, frequency, and duty cycle.
- Testing of the PWM signal with respect to level, edge steepness, frequency, and duty cycle.
- Variation of the Control Pilot's (CP) line impedance with switchable parallel resistors and capacitors.
- Emulation of the vehicle side with freely programmable CP resistance within the specified resistance decade according to IEC 61851-1.

Fault injection: control pilot line break and short circuit to Protective Earth (PE).

GB/T and CHAdeMO Signals

- CAN high and CAN low signals
- GB/T communication signals (CC1 and CC2, A+, A-)
- CHAdeMO communication signals

All signals are provided by two DSUB 15 mating plugs that are divided into EV and EVSE sides.

Proximity Pilot (PP)

- Measurement and interpretation of the resistance of the PP for coding the current rating of the charging cable.
- Emulation of the PP resistance (during EVSE emulation)
- Fault injection: Line break and short circuit to PE

System Architecture

The CDS comprises several internal electronic functional groups designed to meet EV and EVSE requirements. The following block diagram shows the system architecture:

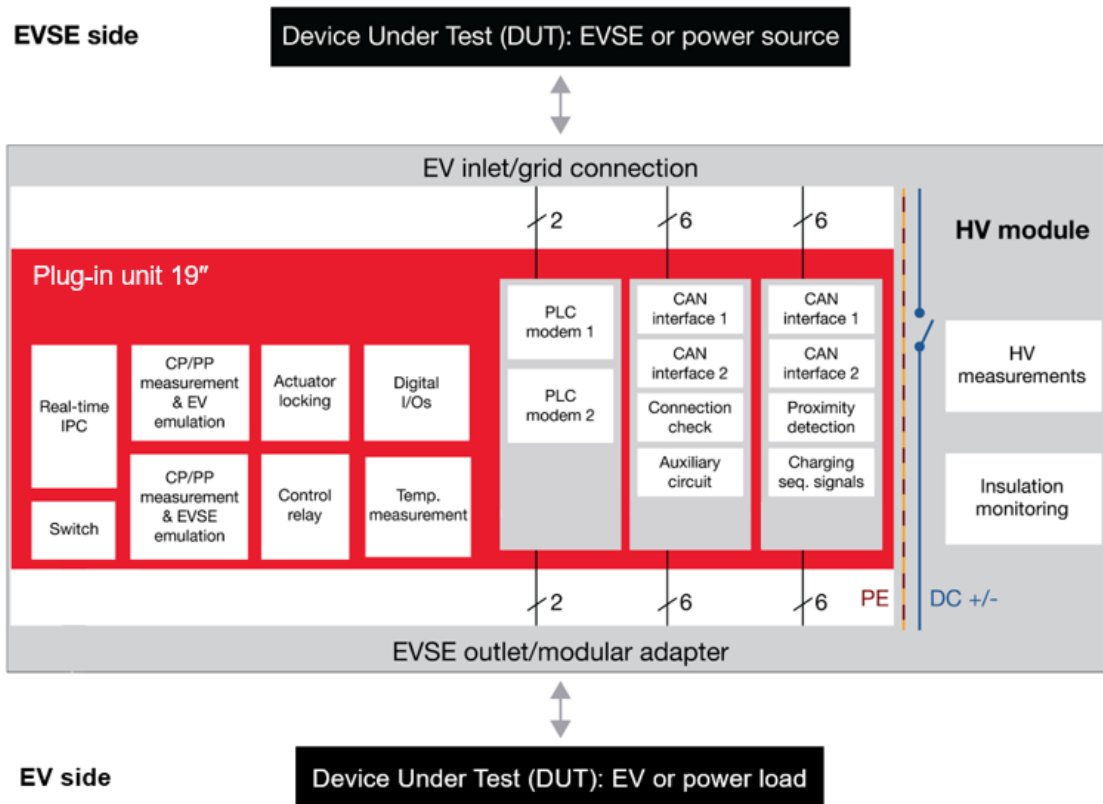


Figure 4. Block diagram of the CDS architecture

High-Voltage Module

The high-voltage (HV) module connects the control unit to the DUT, i.e., vehicle and/or charging infrastructure. Several variants are available to fulfill different worldwide standards. In addition to country and standard-dependent DUT contacting, the HV module is incorporated in a 19-inch housing, current transducers, safety components, and power contactors for AC and DC.



Figure 5. HV module of the Portable CDS

The figure below provides a detailed illustration of the components and interfaces of the HV module within the Portable CDS.

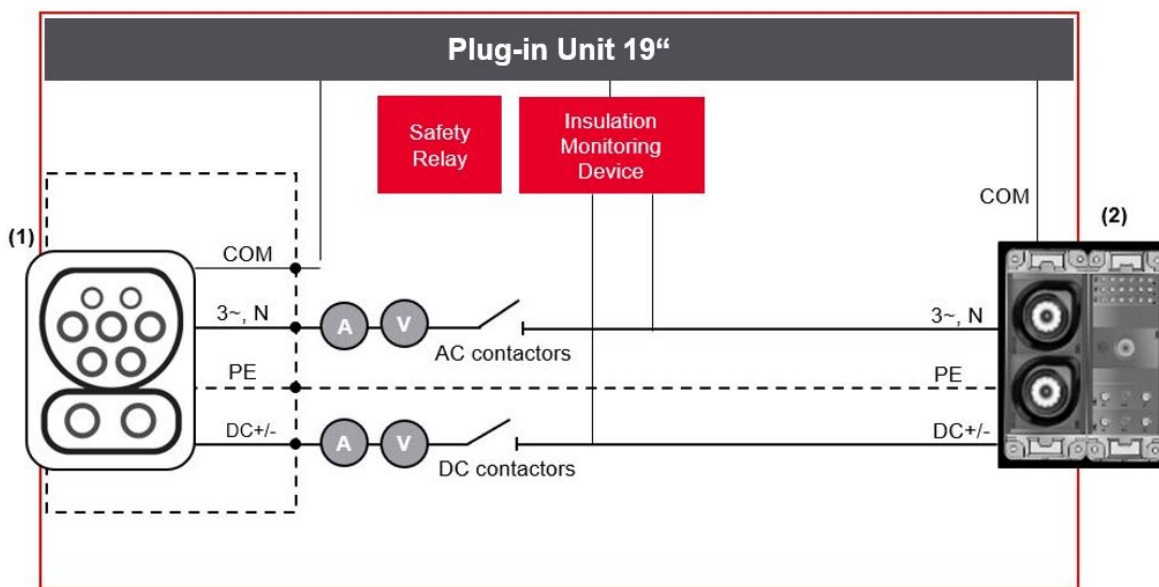


Figure 6. HV module within the Portable CDS

Interfaces

Operating buttons	fast stop (safety shutdown)
(1) Connection EVSE/external source	via EVSE inlet ¹
(2) Connection EV/external load	via EV charging adapter ¹
AC connection	0 to 400 V _{L-L} rms; 32 A rms (per phase)
DC connection	350 A DC (continuous); 400 A DC (approx. 90 min) ²
HV measuring	1,000 V DC

1. For more information, refer to the [EV Charging and EVSE Plug-In Adapter data sheet](#).

Note: The voltage and current carrying capacity rating may be limited by the attached EV adapter or EVSE inlet.

2. After the short-term use of 400 A DC, the system needs 30 minutes to cool down.

3. Support and remote interface licenses are optionally available.

Technical Data

System Data SL1040A-ST2

System Characteristics

Model number	SL1040A-ST2
Dimension (H x W x D)	300 ¹ x 520 x 600 mm
Weight	36 kg (without plug-in unit)
Heat dissipation (environment)	max. 500 W
Protection degree	IP40
Available storage space for log files/traces	max. 100 GB
Recommended recalibration period	12 months

Operating Conditions

Ambient temperature (operation)	5 to 40 °C
Ambient temperature (transport/storage)	-22 to +55 °C
Relative humidity	max. 80% (non-condensing) for temperatures up to 31 °C, decreasing linearly to 50% (non-condensing) at 40 °C
Sound Pressure (operator/bystander)	< 70 dB (A)
Altitude (AMSL)	2,000 m

Power Supply

Voltage supply	100 to 240 V AC (±10 %)
Input frequency	50 to 60 Hz (± 2%)

Interfaces

Electrical isolation	Consistently between power supply, electronics, measuring technology, and DUT PE
Measuring taps – Control pilot EV	BNC socket
Measuring taps – Control pilot EVSE	BNC socket

1. +30 mm with folded out feet.

Specifications

Unless otherwise noted, specifications are warranted over the ambient temperature range of 5 °C to 40 °C after a 30-minute warm-up period. Specifications apply at the output terminals. Accuracy specifications are warranted for a period of one year.

Electrical Specification		Value
AC ratings	Voltage	0 to 300 V _{L-N} rms
		0 to 500 V _{L-L} rms
	Current	32 A rms (per phase)
DC ratings	Voltage	±1,000 V
	Current	±350 A (continuous)
		±400 A (approx. 90 min followed by 30 min cooling)

Output Ratings	Measurement Range	Range	Accuracy
AC ratings	Measurement category CAT III 300 V		
	Voltage (L1-N, L2-N, L3-N)	0 to 300 V _{L-N} rms	±0.5 V offset ±0.25% of reading
	Current (L1, L2, L3, N)	0 to 35 A rms	±0.1 A offset ±0.5% of reading
DC ratings	Voltage (DC, DC-PE)	±1,000 V	±0.5 V offset ±0.1% of reading
			Typical: ±0.1 V offset ±0.05% of reading
	Current	±400 A	±0.5 A offset ±0.1% of reading
			Typical: ±0.125 A offset ±0.1% of reading
Residual current PE		±300 mA	±1 mA offset ±0.5% of reading

Communication Signals		Range	Accuracy
Control pilot parameter	EVSE		
	Voltage programming	±15 V	±0.02 V Typical: ± 0.004 V
	Frequency programming	900 to 1100 Hz	± 0.1 Hz
	Frequency measurement	900 to 1100 Hz	± 0.1 Hz
	Duty cycle programming	0 to 100%	± 0.05%
	Duty cycle measurement	0 to 100%	± 0.5%
	EV		
	Frequency measurement	900 to 1100 Hz	± 0.1 Hz
	Resistance decade	1 to 20000 Ω	± (0.1% of value + 0.75 Ω offset), 1 Ω resolution
	Duty cycle measurement	0 to 100%	± 0.5%
	EV/EVSE		
	Voltage measurement	± 15 V	±0.01 V Typical: ± 0.004 V
Proximity pilot parameter	EV/EVSE		
	Resistance measurement	50 to 3250 Ω	± 0.6% of range

Supplemental Characteristics

Supplemental characteristics are not warranted but are descriptions of performance determined either by design or by type testing. All supplemental characteristics are typical unless otherwise noted.

Communication Signals		Range	Accuracy
Control pilot parameter	EVSE		
	Rise time measurement	1 to 220 μ s	<1 μ s
	Fall time measurement	1 to 220 μ s	<1 μ s
	Capacitance programming	fixed: 300 pF	fix: $\pm 10\%$
		variable: 1,600; 1,800; 3,100 pF	variable: $\pm 3\%$
	Rise time measurement	1,000 $\Omega \pm 30 \Omega$	typ. $\pm 0.1\%$ max. $\pm 0.5\%$
	EV		
	Rise time measurement	1 to 220 μ s	< 1 μ s
	Fall time measurement	1 to 220 μ s	< 1 μ s
	Capacitance programming	1,500; 2,400; 3,900 pF	$\pm 5\%$ of value
	Voltage diode programming	0.55; 0.7; 0.85 V	$\pm 5\%$ of value
Proximity pilot parameter	EVSE		
	Resistance programming	0 to 1,218 Ω ; 1,400 to 2,618 Ω ; 4,000 to 5,218 Ω ; 8,500 to 9,718 Ω	$\pm 1.8\%$ of value; Resolution: The resistance can be set in the following steps: 0, 3, 5, 8 Ω . All values that are set to invalid values are set to the next smaller value
	EV		
	Resistance programming	2,160; 2,430; 2,700; 2,970; 3,240 Ω	$\pm 1\%$ of value

In addition to the technical data, the Portable CDS provides the following functions:

Control Pilot:

- Oscillator status programming (EVSE)
 - State measurement (EV/EVSE)
 - Open circuit programming (EV/EVSE)
- Short circuit programming (with < 1 Ω) (EV)

Proximity Pilot:

- Short circuit programming (EV/EVSE)
- Open circuit programming (EV/EVSE)

Keysight Hardware Options

SL1040A-IRE Scienlab Insulation Resistance Emulator

For testing the insulation monitoring function of a vehicle or charging station, a variable resistance is connected between DC+ and PE, and between DC- and PE, via the Charging Discovery System (CDS). The Scienlab Insulation Resistance Emulator (IRE) can be used to systematically emulate an insulation fault. The IRE may only be used in combination with the CDS and is shipped with an example test case for EVSE testing.

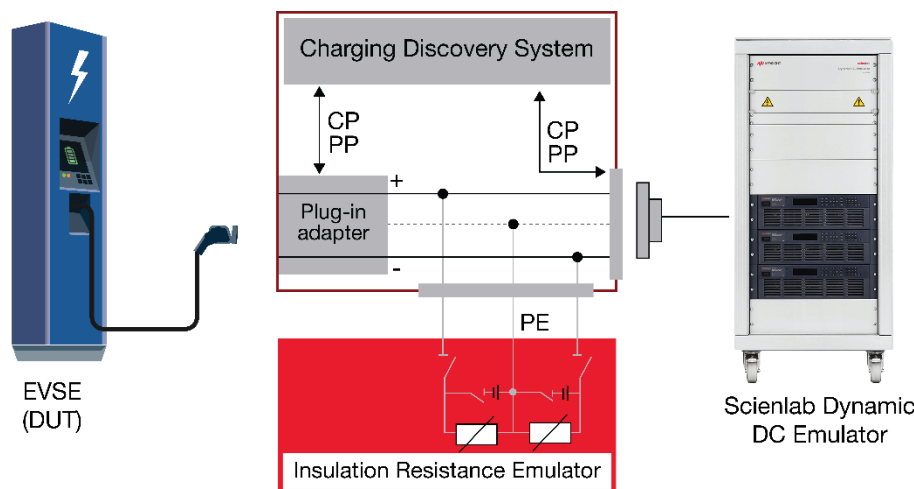


Figure 7. System topology including the SL1040A-IRE and SL1041B Scienlab Dynamic DC Emulator

System Characteristics

Dimension (H x W x D)	220 x 520 x 600 mm
Weight	approx. 25 kg
Protection class	IP40
Recommended recalibration period	12 months
Adjusting range per R-cascade	500 Ω to 2 M Ω
Step width per R-cascade	500 Ω
Max. adjustment deviation at 1 k Ω to 1 M Ω	1% of adjusted value + 60 Ω
Adjusting range per C-cascade	0 to 3.5 μ F
Step width per C-cascade	0.5 μ F
Max. adjustment deviation at 0.5 μ F to 3.5 μ F	5% of adjusted value
Rges_min (software limit for current limitation)	U_{bat} / I_{max}
Max. operating voltage	1,000 V DC
Self-protection	Minimum total resistance DC+ to DC- limited by software 32 mA fuse

SL1040A-TC1 Transport Case

Case to transport a CDS or an external passive HV load. A fitted plastic foam casing ensures safe transportation free from vibrations.

Transport Case Description

Dimension (H x W x D)	approx. 640 x 690 x 430 mm
Weight	approx. 7 kg
Material	Aluminum
Lock	2x quick release on one side
Included accessories	ABUS three-digit combination lock

The following photos show the transport case:



Figure 8. Exemplary photos of the transport case

Project Management and Commissioning Services

The following services are offered by Keysight to ensure a smooth laboratory delivery, installation, commissioning, and reduce ramp-up time for our customers. The exact definition of services depends on the facilities, customer expertise, and overall scope of the project. Please work with your Keysight sales representative to discuss your specific needs.

PS-XPM-100-SL Project Management Services

Keysight recommends project management services, which provide an experienced project manager dedicated to your project and serving as a direct communication interface between Keysight and your project management team.

The project manager takes over responsibility for:

- Defining and controlling the project schedule, critical path, and following project milestones
- Consulting with the customer to progress through relevant design, installation, safety, installation, commissioning, and acceptance planning phases.
- Communicating the project status regularly and ensuring any unscheduled project events or project deviations are communicated and promptly discussed with the customer project team
- Coordinating applicable delivery, installation, and commissioning on-site
- Providing complete and accurate project documentation to the customer

PS-XCOM-100-SL Project Commissioning Services

Project commissioning services for the test solution include an experienced test bench engineer to validate and complete the test bench setup, ensuring it is ready for the customer's initial usage. It includes validating specific hardware and software configurations per the project requirements and any specific consulting agreed upon between Keysight and the customer.

This service includes:

- Inspection of hardware/laboratory after installation
- Validation of software/network communication at test benches
- Validation of electrical installation, system connections to applicable associated workcell hardware, and a complete commissioning checklist
- Validation of the applicable safety and system interlocks matrix
- Support in commissioning the test system and instructions on how to use it
- Presence of an experienced test bench engineer during the first usage of the test bench

Startup Assistance

Startup assistance is flexible instruction designed to get your team up to speed quickly, by providing training with an introduction to your new solution from Keysight Technologies. The goal of this assistance is to familiarize you with the hardware and software tools within your solution so that you can adapt it to your own specific application and test cases. Training takes place at your site and focuses on instrument fundamentals and operations starter training. Detailed topics can include:

Basic Training - 1-Day Training on the Introduction to the Hardware

- Switching a system on, the order of the instruments
- Getting a system in ready mode (software & hardware)
- Resetting the system & safety matrix after an emergency off
- Connect cables to DUT
- Setting up a system in software and starting a test
- System care

Advanced Training - 1 or 2 Days of Advanced Use of the Software

- Programming examples and exercises
- Details on system warnings/errors and how to react to them

Premium - Custom # of Days

Custom content based on customer needs

Solution Service Description Summary

KeysightCare for solutions services goes beyond basic warranty, providing a priority-one connection between our resources and your teams. Every support tier includes access to the Keysight Support Portal and Knowledge Center, where you can find answers, manage service requests, and interact with Keysight experts familiar with the instruments and software you are using and the challenges you face. All the packages offer onsite options for large systems that cannot be moved.

- **Warranty Plus** – Reduce risk and avoid project delays with technical support coverage
- **Assured** – Increase supportability to match your application needs with a committed turnaround time.
- **Enhanced** – Keep your project schedules on track and receive priority support and even faster turnaround times for repairs and calibration to optimize your solution.

Support Agreement Description	KeysightCare Warranty Plus for Solutions *		KeysightCare Assured for Solutions		KeysightCare Enhanced for Solutions	
	Return to Keysight* R-55T-001-X ¹	Onsite R-55T-005-X ¹	Return to Keysight* R-55U-001-X ¹	Onsite R-55U-005-X ¹	Return to Keysight* R-55V-001-X ¹	Onsite R-55V-006-X ¹
Solution Technical Support (Hardware and Software²)						
Keysight Support Portal	24x7 access to Knowledge Center, calibration certificates, service requests, and other asset details.					
Remote Technical Support response times ³	≤ 2 business days	≤ 2 business days	≤ 4 business hours	≤ 4 business hours	≤ 2 business hours	≤ 2 business hours
Onsite Technical Support ⁴				•		•
Solution Hardware Support						
Repair service coverage	Return to Keysight	Onsite	Return to Keysight	Onsite	Return to Keysight	Onsite
Repair service turnaround or response time	No commitment	No commitment	≤ 10 business days turnaround time ⁷	≤ 12 business days response time ⁶	≤ 7 business days turnaround time ⁷	≤ 5 business days response time ⁶
Solution Calibration service ⁵					Up to Keysight Calibration + Uncertainty + GuardBand ing Return to Keysight	Up to Keysight Calibration + Uncertainty + GuardBand ing Onsite
Calibration service turnaround time					≤ 5 business days	Scheduled
Proactive firmware release notification			•	•	•	•

* Only offered for solutions where Assured and Enhanced support levels are not yet available.

1. When ordering, update with the relevant (Solution Product Number (SPN) based on the length of service required (e.g., -1, -2, -3, or -5 for 1 year, 2 years, 3 years, or 5 years).
2. KeysightCare Software Agreement required for software support.

3. Remote Technical Support response time is measured from the time you contact the KTAS team to have an initial meaningful response from the case owner.
4. Onsite technical support is provided at the discretion of Keysight
5. The recommended recalibration period is 12 months
6. Response time is measured from the date the service request is received to the date Keysight arrives at your site.
7. Turnaround time is an actual service-performing time and does not include shipping, customer processing, or trans-shipment time.

Please note: Not all services are available on all solutions. See the [Service Definition Tool](#) for services available for your Keysight solution.

Extend the Capabilities of Your Test Solution

Meet the Charging Discovery System Family of Solutions

Accelerate Your Charging Interface Testing and Validate Charging Behavior Across EV and EVSE

Keysight's Charging Discovery System Series (CDS) supports the latest adapters and protocols used with electric vehicles (EVs) and electric vehicle supply equipment (EVSE). As use cases, standards, and protocols evolve, our modular, upgradable portfolio will help you ensure conformance and interoperability today and tomorrow.



Figure 9. From left to right: SL1040A EMC CDS, SL1047A High-Power CDS, SL1040A Portable CDS, and SL2600A Megawatt CDS with EV and EVSE test

- Configure the CDS to meet your specific needs and replace multiple real EV/EVSEs with a single test solution.
- Address R&D and type-approval applications with automated functional, conformance, interoperability, safety, and quality testing.
- Automate and accelerate conformance testing with pre-programmed test cases.
- Gain a comprehensive view of current and voltage measurements, as well as charging communication.

Find out more about the SL1040A Scienlab CDS Series [here](#).

Find out more about the SL1047A Scienlab CDS – High-Power Series [here](#).

Find out more about the SL2600A Megawatt CDS [here](#).

Meet the SL2000A Charging Discover Software

Accelerate Your Charging Interface Testing Operations

The SL2000A software is essential for operating the CDS hardware with Keysight AC/DC emulators, offering functionalities such as visualizing measured values, recording test sequences, and generating comprehensive reports. Additionally, it is important to note that the Charging Discover Software is not licensed; instead, licenses are activated directly on the CDS hardware, ensuring seamless integration and operation.



Figure 10. SL2000A Charging Discover Software

Find out more about the SL2000A Charging Discover Software [here](#).

Meet the SL1300A Charging Discover Test Packages

Perform Conformance and Interoperability Testing with Test Suites

The SL1300A Charging Discover Test Packages include comprehensive test cases for all key charging conformance and interoperability standards. Each test package is developed according to the official specification and carefully verified with all CDS hardware configurations and every software release version. Hence, it is the quickest and simplest way to get valid test results out of the box.

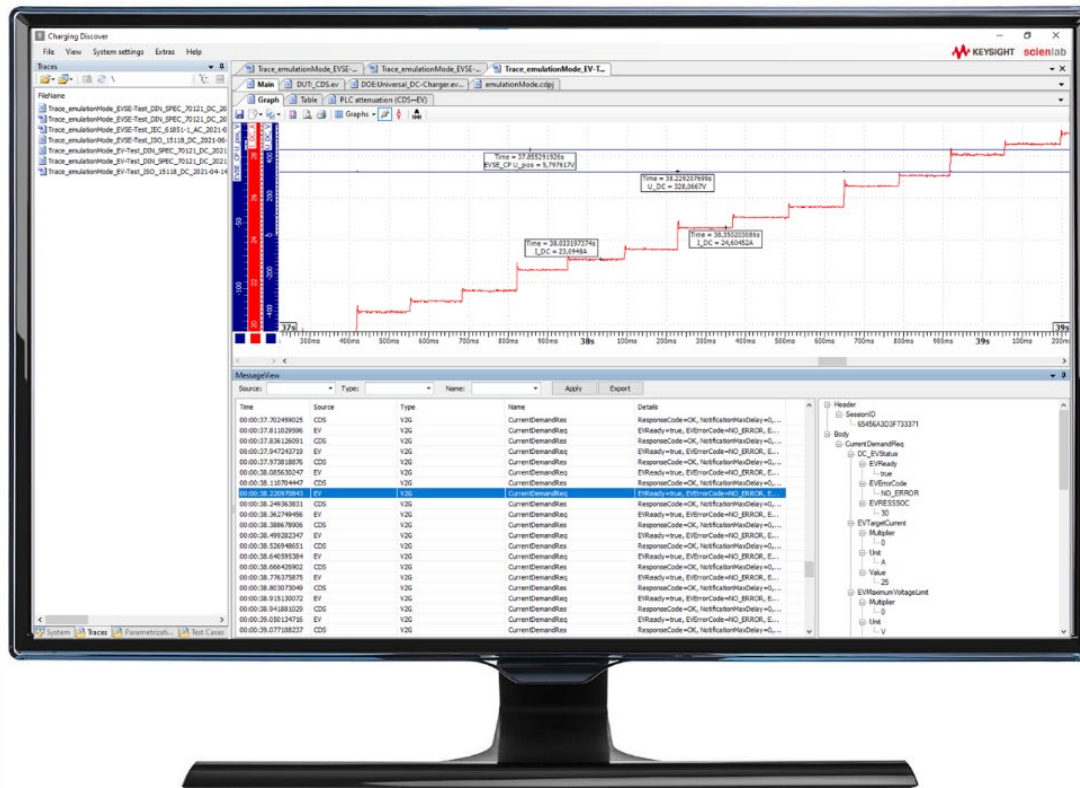


Figure 11. SL1300A Charging Discover Test Packages

Find out more about the SL1300A Charging Discover Test Packages [here](#).

Meet the RP7900 Series Regenerative Power System

The Keysight RP7900 Series regenerative power system is a family of bi-directional, regenerative DC power supplies featuring highly integrated safety features that protect both personnel and the device under test. The regenerative capability enables the energy normally consumed to be returned to the grid cleanly, saving costs associated with energy consumption and cooling.



Figure 12. RP7900 Series Regenerative Power System.

Find out more about the RP7900 Series [here](#).

Meet the SL1200A Series Scienlab Regenerative AC Emulator, 3-Phase

The SL1200A Series was designed to handle all your 3-phase AC test needs up to 1,200 VAC, from 30 to 810 kVA, without the need for a transformer. Two voltage ranges are available: 600 VAC and 1,200 VAC. The 600 VAC models are ideal for EV and EVSE charging test applications.

- Covers AC test needs; up to 1,200 VL-L; up to 130 A; up to 810 kVA.
- Achieve 1,200 VL-L at full specifications without extra equipment, such as a transformer.
- Save energy with a 100% regenerative (bidirectional) power solution with >85% efficiency.
- Get up and run immediately with easy SL2000A Charging Discover Software integration.



Figure 13. SL1200A Series Scienlab Regenerative AC Emulator

Find out more about the SL1200A Series [here](#).

Meet the SL1800A Scienlab Regenerative DC Emulator – High-Power Series

Keysight's SL1800A Scienlab Regenerative DC Emulator – High-Power Series enables you to emulate the large batteries in electric vehicles. The bidirectional power flow allows emulation of both power-sourcing applications, such as traction inverter test, as well as power-absorbing (sinking) applications, such as EV charging. Being regenerative, the power absorbed is delivered back to the grid, saving on energy and cooling costs. With bi-directionality, integrated DC voltage and current controllers, high dynamics, and its regenerative energy feedback capacity, the Scienlab Dynamic DC Emulator provides an all-in-one system for efficient and effective testing of the power electronic components in EV and EVSE.

- Fully integrated with SL1040A, SL1047A Scienlab Charging Discovery System and SL2600A Megawatt Charging Discovery System.
- Available for high voltage, high-power applications. Extendable to meet future, increased power needs.
- Energy-efficient source and sink mode (96%).



Figure 14. SL1800A Scienlab Regenerative DC Emulator - High-Power Series

Find out more about the SL1800A Series [here](#).

Keysight enables innovators to push the boundaries of engineering by quickly solving design, emulation, and test challenges to create the best product experiences. Start your innovation journey at www.keysight.com.



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