

Scienlab Charging Discovery System

EMC Series for EV Test

SL1040A-EMC



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Solution Overview

The Scienlab Charging Discovery System – EMC Series (EMC CDS) covers electromagnetic compatibility (EMC) applications. It is intended for use inside an anechoic chamber for immunity and emission tests (conducted or radiated) of electric vehicles (EV) and electric vehicle supply equipment (EVSE), during AC or DC charging.

Due to the special EMC shielded design and built-in low-noise components, the emission of the EMC CDS is reduced to a minimum level. This enables EMC testing under real charging conditions without unnecessary test environment interference. Furthermore, the EMC CDS is immune to external electromagnetic fields and can be placed close to the specimen during immunity tests.

- Reliable, interoperable emulation of the EVSE charging communication controller (SECC)
- Easy configuration of charging protocol and operating point through Windows control software
- Charging Discover or optionally via customer automation software (using the CDS remote interface)
- Real-time capable control PC with high system performance and low dead times
Note: IPC is placed typically outside of the EMC chamber
- Portable shielded “galvanized metal” case with grounding contact springs.

The EMC CDS is software compatible with the **SL1040A Scienlab Charging Discovery System – Portable Series**. However, Keysight designed it for reliable charging emulation, without extended fault injection required for conformance testing.

This data sheet describes the EMC-optimized Charging Discovery System (CDS) for EV testing. Power source adapters, EV inlets, and EV connectors can be found in the [EV Charging and EVSE Plug-In Adapter datasheet](#).

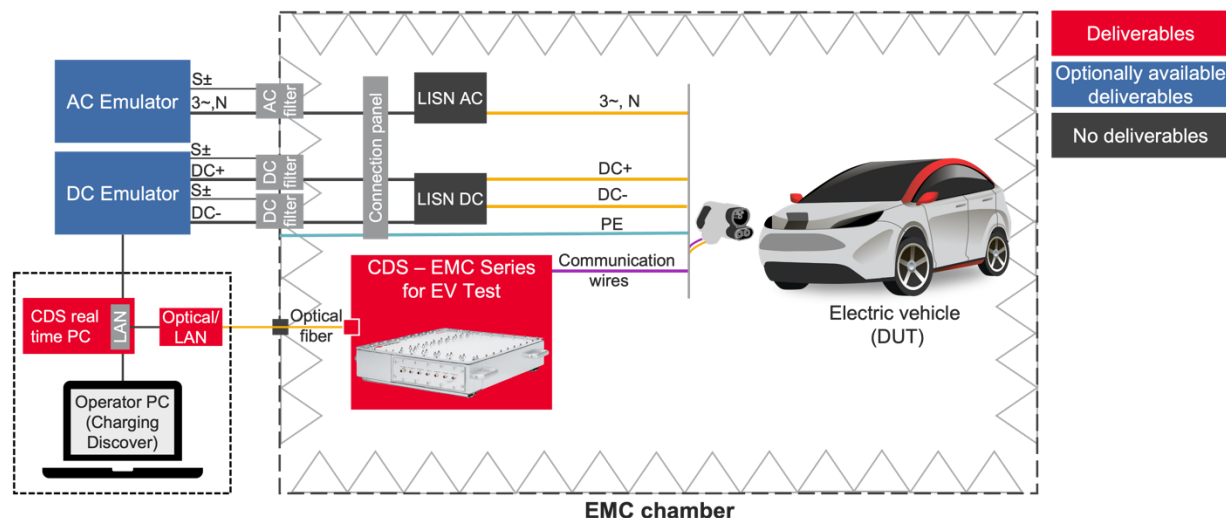


Figure 1. Exemplary architecture of a test environment for EV test

Note: This data sheet describes the essential product and its system options. If you need a full solution, contact your local Keysight Sales and Service office for a statement of work proposal including required periphery, installation, and other services.

Operation modes

Emulation mode

In emulation mode, the CDS reproduces the behavior of the charging processes as described in the standards. However, there are a few locations where the CDS is more tolerant than the standards. The electrical behavior is modeled with some simple charging models.

Tolerances

Common tolerances	Timeouts: The CDS warns about a timeout violation but proceeds with the charging process.
IEC 61851-1/SAE J1772/ GB/T 18487-2015	• Increased tolerance values for control pilot (CP) voltage • Increased tolerance values for proximity pilot (PP) / connection confirmation (CC) resistance • Violations of power/current level are ignored with respect to the pulse width modulation (PWM) duty cycles (only switch-off limits in device of emulation (DoE) profile and system limits are checked)
DIN SPEC 70121/ ISO 15118	• CP and PP/CC tolerances are the same as described above. • Signal Level Attenuation Characterization (SLAC) is not interrupted by CDS in case of invalid parameters, but warnings are displayed.
CHAdemo	Warns about ground errors but proceeds with charging process.
GB/T 27930-2011/2015	• Connection detection on CC1 and CC2 within the range of ± 1 V in reference to the nominal value. • Auxiliary voltage (A+/A-) will be accepted if measurement value is above 11 V.

No-HV mode

The No-HV mode is implicitly activated if no power source/sink is selected in Charging Discover on the emulation side. To make charging possible, some high-level protocol messages and set point parameters are filled with theoretically calculated measurement data.

SL1040A-EMC Charging Discovery System EMC Series for EV Test

Keysight designed the shielded CDS variant to be used for EMC compliance and homologation tests. This item is the main module which can be extended by optional communication modules (see SL1040A-301, SL1040A-302, SL1040A-303, SL1040A-305).

Figure 2 below shows a three-dimensional view of the shielded housing. During operation, the housing is permanently closed with a lid.

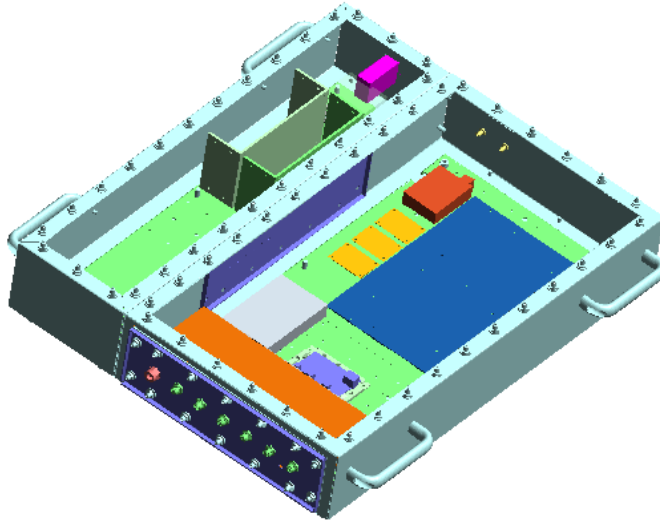


Figure 2. 3D drawing of the SL1040A-EMC

General functions

- Reliable, interoperable emulation of the EVSE charging communication controller (SECC); verified by thousands of successful charging sessions with almost all available EV brands and models
- Easy configuration of charging protocol and operating point through Windows control software Charging Discover (see also corresponding data sheet) or optionally via customer automation software (using the CDS remote interface)
- Integrated PWM emulation for the Control Pilot circuit of the EVSE signal generator with adjustable positive/negative amplitude, frequency, and duty cycle
- Integrated emulation of the Proximity Pilot circuit
- Real-time capable control PC with high system performance and low dead times. Note: IPC is placed typically outside of the EMC chamber (see section “Real-time PC”)
- Portable shielded “galvanized metal” case with grounding contact springs
- Isolated interface to Real-time PC via Optical Data Converter (see section “Optical Data Converter”)
- Direct support of Keysight power sources and sinks

Standards and directives

The EMC CDS supports the following charging communication standards:

The basic functions include:

- AC charging mode according to IEC 61851-1 (PWM)
- AC charging mode according to SAE J1772 (PWM)
- AC charging mode according to GB/T 18487 (PWM)
- AC charging process according to Bharat AC Slow (no charging communication)
- AC charging process according to IS 17017 (Part 1):2018 (PWM)

The following are available when ordering communication modules:

- DC fast charging mode according to DIN SPEC 70121 & ISO 15118 (PLC)
- AC charging mode according to ISO 15118 (PLC)
- DC fast charging mode according to GB/T 27930 (CAN)
- DC fast charging mode according to CHAdeMO (CAN)
- DC fast charging mode according to Bharat (DC):2017 (CAN)

EMC performance

- EMC optimized case for emission and immunity testing
- Immunity of CDS rated up to 200 V/m (30 Mhz to 1 Ghz)

Figures 3, 4, and 5 show sample EMC measurement results to illustrate the CDS emission performance.

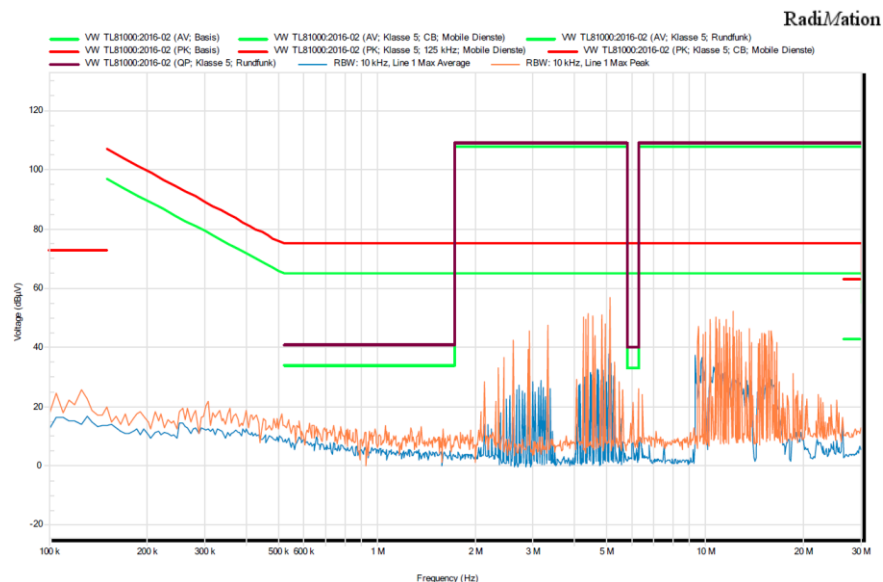


Figure 3. Results of conducted emission test between 100 kHz and 30 MHz, with active PLC modem

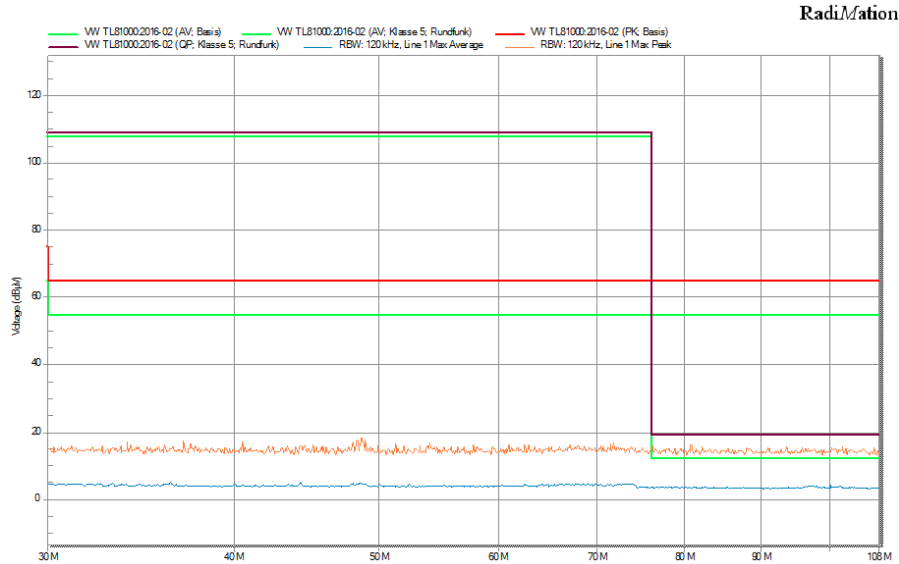


Figure 1. Results of conducted emission test between 30 and 108 MHz, with active PLC modem

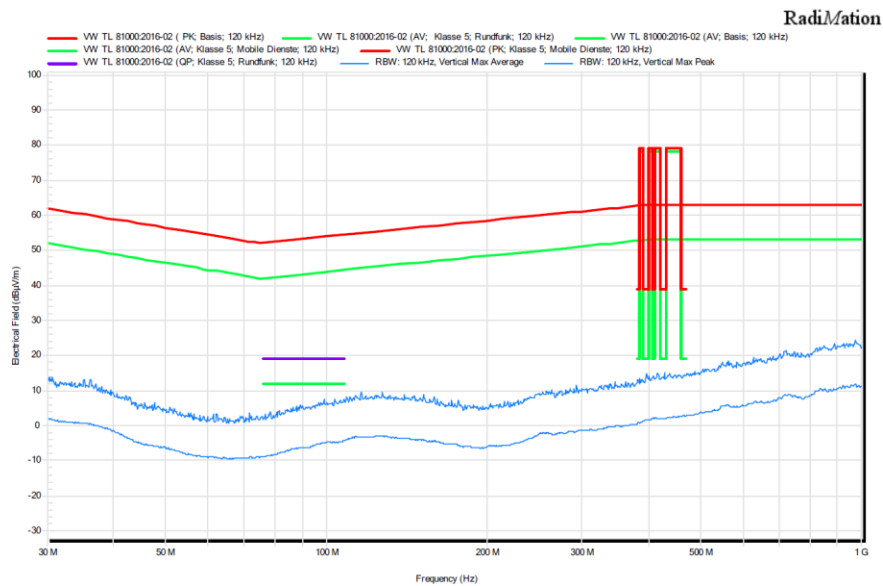


Figure 2. Results of radiated emission test between 30 MHz and 1 GHz, vertical polarization

Interfaces

Figure 6 shows the schematic layout of the EMC-optimized communication module and its interfaces.

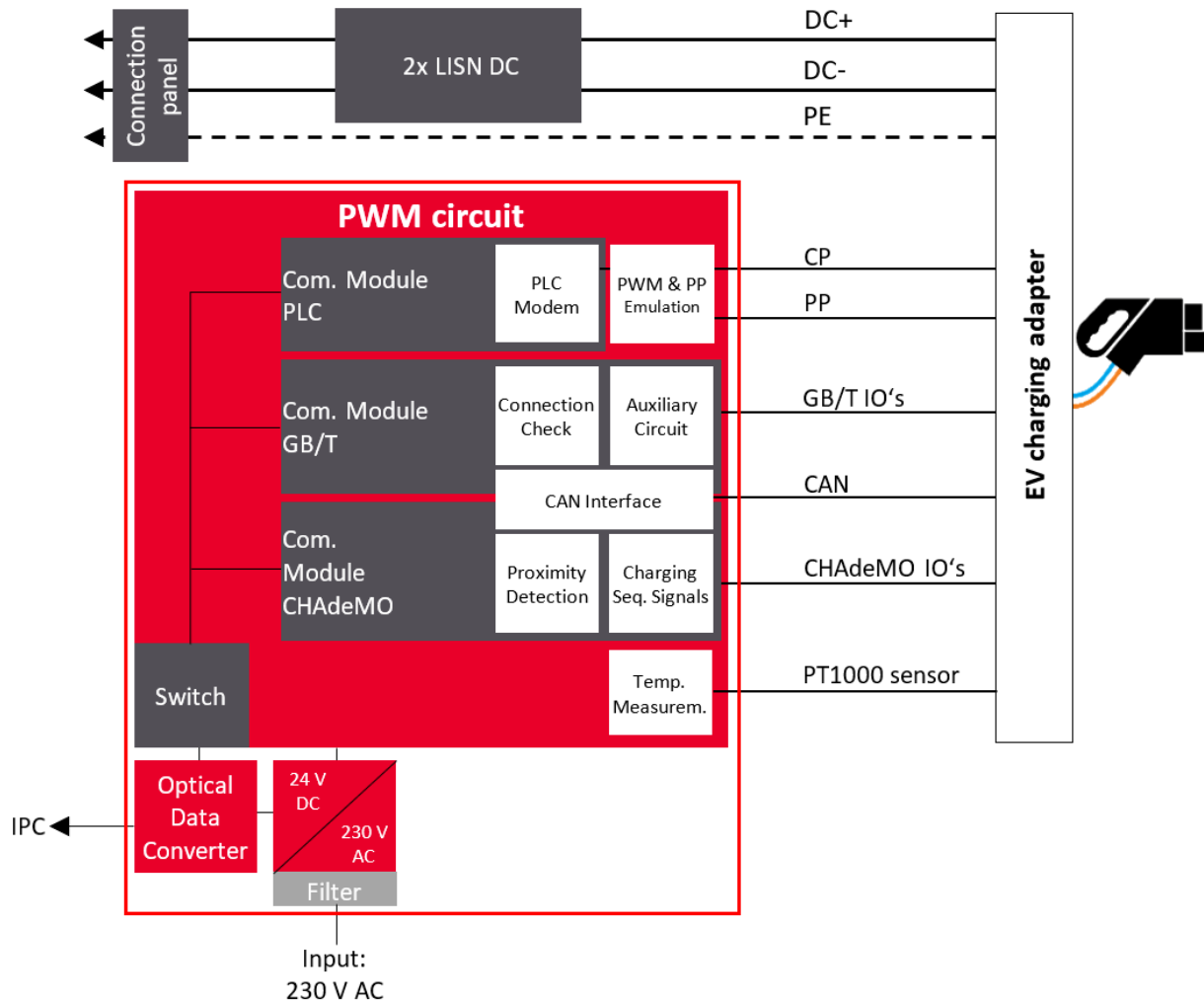


Figure 6. EMC optimized communication module (exemplary for DC charging)

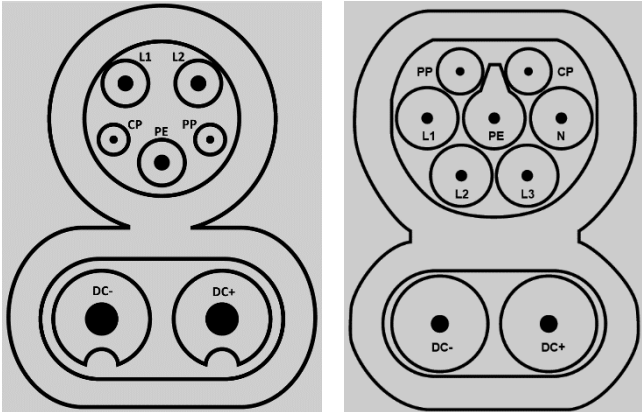
- A. Connection from power source to connection panel:
 - DC+ and DC- from “Dynamic DC Emulator” (located outside of the EMC chamber) through EMC. Often DC+ and DC- wires are installed underneath the EMC chamber. At the connection panel, the cables are connected with Line Impedance Stabilization Networks (LISN) via HV plugs.
- B. Connection from connection panel to LISN:
 - Unipolar DC+ and DC- connection between lab-specific connection panel and LISN terminals. Note: Cables and connectors are not included with this item.
- C. Connection from CDS/LISN to EV charging adapter:
 - DC+ and DC-: Standard DC cables from EV charging adapter
 - Communication (CP, PP, CAN): Via shielded bus system cables by Phoenix Contact
- D. Connection to electric vehicle:
 - Via EV charging adapter

Communication modules

SL1040A-301 Communication module PLC

Adding the SL1040-301 communication module PLC to the Charging Discovery System supports the following additional functions:

- EVSE emulation according to the standards DIN SPEC 70121 (2014) and ISO 15118 (EIM only)
- Recording of all V2G messages and display of the information contained therein in plain text
- Manipulation of V2G messages and active delaying of timings (fault insertion)
- Testing of the PLC communication for adherence to the PLC level, the standardized frequency bands, the carrier frequencies, and the signal quality/strength
- Testing of the EV charging interface for compliance with the standard

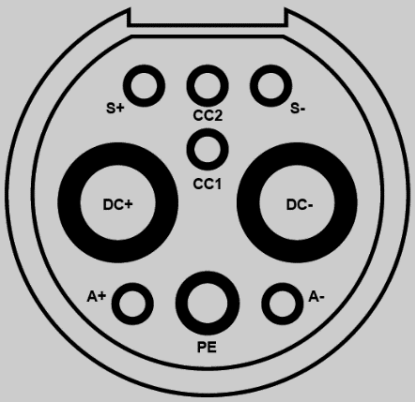
Pin	Designation	Function	Charging interface
CP	Control Pilot	PWM control line plus digital communication via PLC	
PP	Proximity Pilot	EV testing of the charging cable connection	

Note: This option does not include electromechanical contacting (connector/inlet). See the [EV Charging and EVSE Plug-In Adapter data sheet](#) for complete details.

SL1040A-302 Communication module GB/T

Adding the SL1040-302 communication module GB/T to the Charging Discovery System supports the following additional functions:

- EVSE emulation according to GB/T 27930-2011 and -2015 (DC)
- Recording of all EV CAN messages and display of the information contained therein in plain text

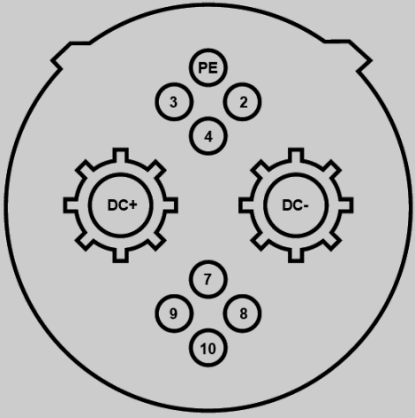
Pin	Designation	Function	Charging interface
S+	CAN-High	CAN Bus: High level communication	
S-	CAN-Low		
CC1	Connection confirmation 1	EV testing of the charging cable connection	
CC2	Connection confirmation 2	EVSE testing of the charging cable connection	
A+	Auxiliary Circuit +	EVSE voltage supply for EVCC	
A-	Auxiliary Circuit –	EVSE voltage supply for EVCC	

Note: This option does not include electromechanical contacting (connector/inlet). See the [EV Charging](#) and [EVSE Plug-In Adapter data sheet](#) for complete details.

SL1040A-303 Communication module CHAdeMO

Adding the SL1040-303 communication module CHAdeMO to the Charging Discovery System supports the following additional functions:

- EVSE emulation according to the CHAdeMO specification
- Recording of all EV CAN messages and display of the information contained therein in plain text
- Supported CHAdeMO protocols: 0.9; 0.9.1; 1.0.0; 1.0.1; 1.1; 1.2; 2.0

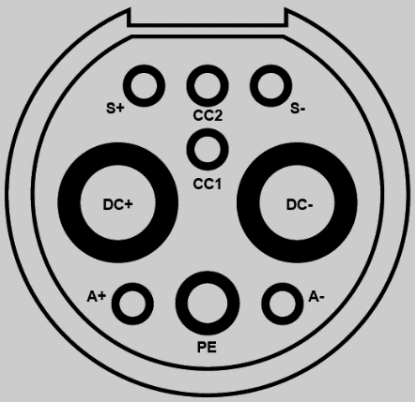
Pin	Designation	Function	Charging interface
8	CAN-High	CAN Bus: High level communication	
9	CAN-Low		
7	Connector proximity detection	EV testing of the charging cable connection	
4	Vehicle charge permission	EV opening for charging process	
2	Charging sequence signal 1	EVSE “start” charging	
10	Charging sequence signal 2	EVSE releasing the charging process	

Note: This option does not include electromechanical contacting (connector/inlet). See the [EV Charging and EVSE Plug-In Adapter data sheet](#) for complete details.

SL1040A-305 Communication module Bharat

Adding the SL1040-305 communication module Bharat to the Charging Discovery System supports the following additional functions:

- EVSE emulation according to Bharat (DC):2017, which is based on the standard GB/T 27930-2015
- Recording of all EV CAN messages and display of the information contained therein in plain text

Pin	Designation	Function	Charging interface
S+	CAN-High	CAN Bus: High level communication	
S-	CAN-Low		
CC1	Connection confirmation 1	EV testing of the charging cable connection	
CC2	Connection confirmation 2	EVSE testing of the charging cable connection	
A+	Auxiliary Circuit +	EVSE voltage supply for EVCC	
A-	Auxiliary Circuit –	EVSE voltage supply for EVCC	

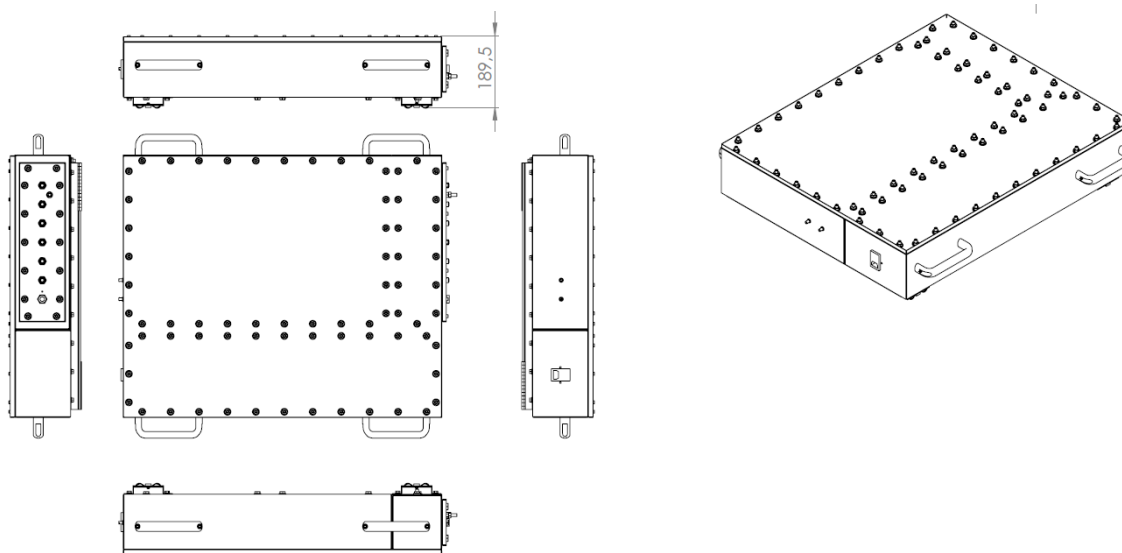
Note: This option does not include electromechanical contacting (connector/inlet). See the [EV Charging and EVSE Plug-In Adapter data sheet](#) for complete details.

Technical Data

System data

System characteristics

Dimension (H x W x D)	Approx. 190 x 880 x 800 mm
Weight	Approx. 45 kg
System heat radiation	Max. 200 W
Protection class	IP20
Recommended re-calibration period	12 months
Power supply	24 V DC via 230 V AC C13 socket
Charging communication ports	1. Communication Temperature 2. Communication Control Pilot / Proximity Pilot 3. Communication GB/T DC 4. Communication CAN 5. Communication CHAdeMO 6. Communication CHAdeMO lock 7. Auxiliary Power GB/T DC
Interface to operator PC	2x ST-ST gigabit duplex optical fiber cable 50/125 μ m



Operating conditions

Ambient temperature	5 to 40 °C
Relative Humidity	30 to 75% (non-condensing)
Maximum operating altitude	2,000 m ASL

Electrical data

Voltage supply	230 V AC ($\pm 10\%$), 50 Hz ($\pm 2\%$), 360 VA max.
Fuse protection	6.3 A
Interface to operating PC	1 Gbit/s via LWL, Ethernet, 2 x ST socket (appropriate for 50/125 μm and 62,5/125 μm multimode fiber optic cable)
Potential separation	Continuously between feed, electronics, measurement technology and DUT PE

Specifications

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

Communication signals		Range	Accuracy
Control Pilot Parameter	Voltage programming	0 to 15 V	± 0.02 V Typical: ± 0.004 V
	Positive voltage measurement	0 to 15 V	± 0.01 V Typical: ± 0.004 V
	Negative voltage measurement	-15 to 0 V	± 0.01 V Typical: ± 0.004 V

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	Frequency programming	900 to 1100 Hz	± 0.1 Hz
	Frequency measurement	900 to 1100 Hz	± 0.1 Hz
	Duty cycle programming	0 to 100%	$\pm 0.05\%$
	Duty cycle measurement	0 to 100%	$\pm 0.5\%$
	Rise time measurement	1 to 220 μs	< 1 μs
	Fall time measurement	1 to 220 μs	< 1 μs
	Capacitance programming	fixed: 300 pF; variable: 1600; 1800; 3100 pF	fix: $\pm 10\%$; variable: $\pm 3\%$
	Resistance programming	1000 $\Omega \pm 30$ Ω	$\pm 0.1\%$
	Frequency programming	900 to 1100 Hz	± 0.1 Hz
	Frequency measurement	900 to 1100 Hz	± 0.1 Hz

Real-time PC

The real-time PC is responsible for the test- and application execution and is normally placed in the control room near the EMC chamber. The technical specifications are shown in the table below:

Supermicro X10SBA	Value
Chassis	19-inch standard rack (½ U)
Processor	Intel J1900 / 4x 2,0 GHz
Memory	4 GB DDR3 RAM
Storage	128 GB SSD
Interface to operator PC	1,000 Mbit/s

Optical data converter

The optical data converter connects the EMC CDS with the real-time PC. It converts the light wave signals coming from the CDS into digital signals, which are then forwarded to the operator's PC via an Ethernet interface.

Specifications	Value
Power input	5 V DC power supply (230 V AC input) is included
Standard protocol	IEEE802.3 10Base-T standard IEEE802.3u 100Base-TX/FX standard IEEE802.3z 1000Base-TX/FX standard
Connector	1x UTP RJ-45 connector 1x SC/ST/SFP connector
Operation mode	Full duplex mode or half duplex mode
Transfer fiber	
Multi-mode	50/125, 62.5/125 or 100/140 µm
Single mode	8.3/125, 8.7/125, 9/125 or 10/125 µm

Note: Optical fiber cables are not in the scope of delivery. For the connection of the optical data converter with the CDS, a separate feedthrough is necessary (through the chamber wall). Feedthrough and work for installation are also not in the scope of delivery of this item.

Included in the scope of delivery

- Operating instructions
- CE declaration of conformity

Project Management and Commissioning Services

The following services are offered by Keysight to ensure smooth laboratory delivery, installation, and commissioning, and to 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 for each test bench project. By ordering the project management services, an experienced project manager is dedicated to your project and acts as a direct communication interface from Keysight to the customer's project management team.

The project manager takes over the responsibility to:

- Define and control project schedule, critical path and follow project milestones
- Consult with customers to progress through relevant design, installation, safety, installation, commissioning, and acceptance planning phases.
- Communicate project status regularly and ensure any unscheduled project events or project deviations are communicated and promptly discussed with the customer project team
- Coordinate applicable delivery, installation, and commissioning on site
- Provide complete and accurate project documentation to the customer

PS-XCOM-100-SL Project commissioning services

Project commissioning services for the test solution provide an experienced test bench engineer to validate and complete the test bench setup in readiness 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 work cell hardware, and complete commissioning checklist
- Validation of applicable safety and system interlocks matrix
- Verification of system performance without DUT connection
- Support in commissioning the test system and instructions on how to use it
- The presence of an experienced test bench engineer during the first usage of the test bench

PS-XENG-100-SL Engineering Services

Project engineering services provide specialized engineering services for factory planning and industrialization during project development and implementation. The customer's project team will have access to engineering expertise to aid in various tasks specific to their project including but not limited to:

- Facilities and lab layout
- Special power requirements
- Electrical design for system infrastructure
- Cabling to test benches
- Preparation and design of cable assemblies
- Necessary IT and LAN integration to manage test bench control

HS0002A-108 Preliminary Acceptance (Factory Acceptance Testing)

Factory Acceptance Test is an optional service and can be carried out for the first unit of each Keysight solution variant at Keysight premises. The Factory Acceptance Test includes:

- System assembly composed of Keysight Battery tester
- System review, inspection and check for connections and communication
- Testing the connections and overall systems

Keysight will notify when the equipment is ready for initial inspection and testing to identify any defects.

If any defects are identified in the equipment during the Factory Acceptance Testing, Keysight shall correct and report.

Factory Acceptance Test service will be performed on respective equipment. Typically does not include a full system performance check with other workcell equipment or customer DUT. This does not include the installation of cable penetrations between power electronics and test fixtures (done on-site during site build-up).

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 about introduction to the hardware

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

Advanced training - 1 or 2 days 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

KeysightCare for Solutions

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.

Service deliverables

Support Agreement Description	KeysightCare for Solutions Warranty Plus*		KeysightCare for Solutions Assured		KeysightCare for Solutions Enhanced	
	Return to Keysight** R-55T-001- X ¹	Onsite Upgrade R-55T-005- X ¹	Return to Keysight** R-55U-001-X ¹	Onsite Upgrade R-55U-005-X ¹	Return to Keysight** R-55V-001-X ¹	Onsite Upgrade 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 time 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 ⁸					Up to Keysight calibration + uncertainty + guard banding Return to Keysight	Up to Keysight calibration + uncertainty + guard banding Onsite
Calibration turnaround time					≤ 5 business days	Scheduled
Application of service notes	Safety and recalls	Safety and recalls	Recommended During service	Recommended During service	Recommended Proactive	Recommended Proactive
Preventative maintenance ⁵						•
Proactive firmware release notifications				•		•

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

** The Return to Keysight option is only available for the SL1040A-ST2 Portable Series.

- 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 or at the discretion of Keysight.
- 5 3rd party products are excluded for assured and enhanced packages.
- 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. It doesn't include shipping, customer processing or trans-shipment time.
- 8 Recommended re-calibration period is 12 months.

Extend the Capabilities of Your Test Solution

Meet the Scienlab Charging Discovery System Family of solutions

Accelerate your charging interface testing and validate charging behavior across EV and EVSE

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

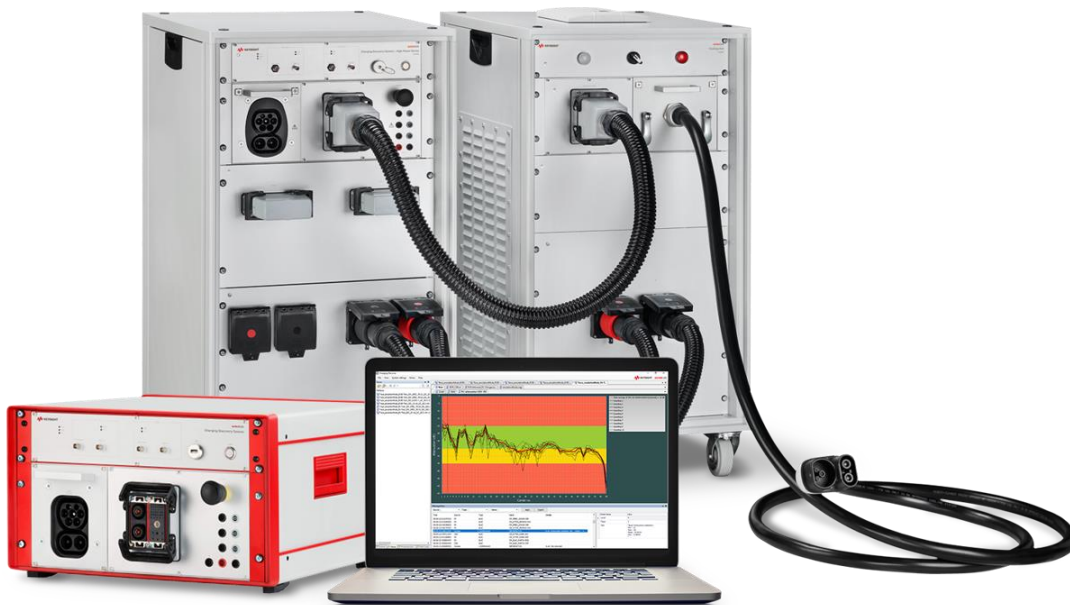


Figure 7. From left to right: SL1040A CDS – Portable Series, SL1047A CDS – High-Power Series, and SL1093A Charging Discover Software

- Configure the CDS to your specific needs and replace multiple real EV/EVSE with one 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.
- Get a holistic view of current and voltage measurements as well as charging communication.

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

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

Find out more about SL1093A Scienlab Charging Discover [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 with highly integrated safety features that protect both your people and your 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 7. 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 1200 VAC, from 30 to 630 kVA without the need for a transformer. Two voltage ranges are available: 600 VAC and 1200 VAC. The 600 VAC models are ideal for EV and EVSE charging test applications.

- Covers AC test needs; up to 1200 VL-L; up to 130 A; up to 630 kVA
- Achieve 1200 VL-L at full specifications without extra equipment, such as a transformer
- Save energy with 100% regenerative (bidirectional) power solution with >85% efficiency
- Get up and running immediately with an intuitive soft front panel (SFP)



Figure 6. 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 and SL1047A Scienlab 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 7. SL1800A Scienlab Regenerative DC Emulator - High-Power Series

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