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ELECTRIC VEHICLE SUPPLY EQUIPMENT TESTING

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WHAT IS EVSE (ELECTRIC VEHICLE SUPPLY EQUIPMENT) TESTING?

Electric vehicle (EV) technology is one of the fastest-developing technologies in the world, and how it is managed and regulated has a huge influence on how successful the industry and its infrastructure is. This is the main reason why EVSE testing is a key factor in the increasing success of EV motoring.

EVSE doesn’t just cover the charging stations it also includes inlet ports, outlet ports, connectors, cables and the communication protocol that enables the EV to communicate with the charging station and engage it in transferring energy from a utility source to the EV. All of this needs checking, inspecting and testing.

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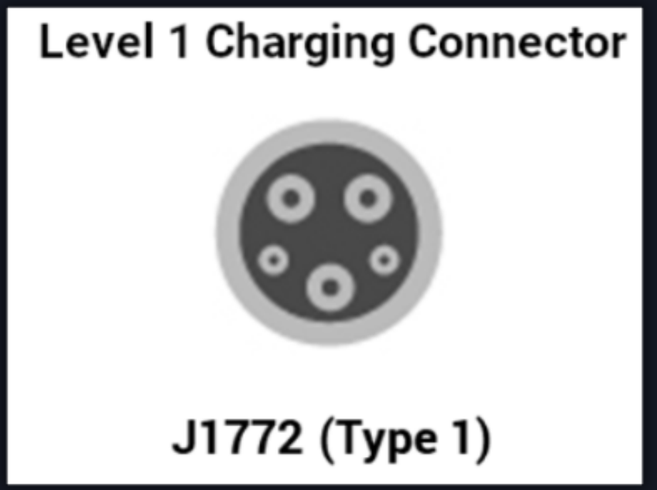
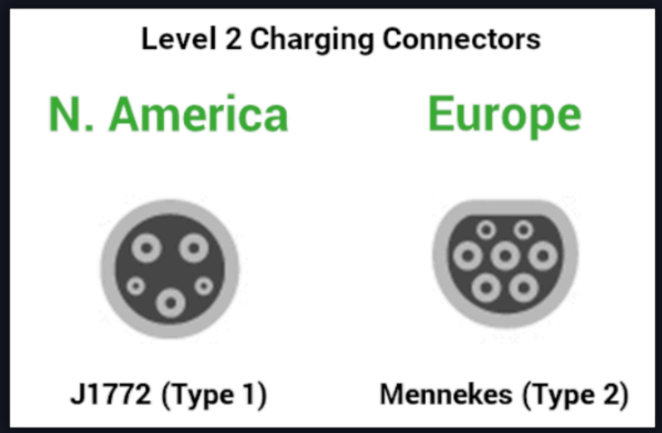
SOLUTION FOR DIFFERENT LEVEL OF EV CHARGING

LEVEL 1 EV CHARGING:- Level 1 Utilizes Standard 120 Volt AC Outlet
Power Output 1kW to 1.8kW

LEVEL 2 EV CHARGING:-Level 2 Utilizes Standard 120 Volt AC Outlet
Power Output 3kW to 22kW

LEVEL 3 EV CHARGING:-Level 3 Utilizes Standard Three Phase outlet
Level 3 Charger converts AC to DC
Power Output 30kW to 360kW





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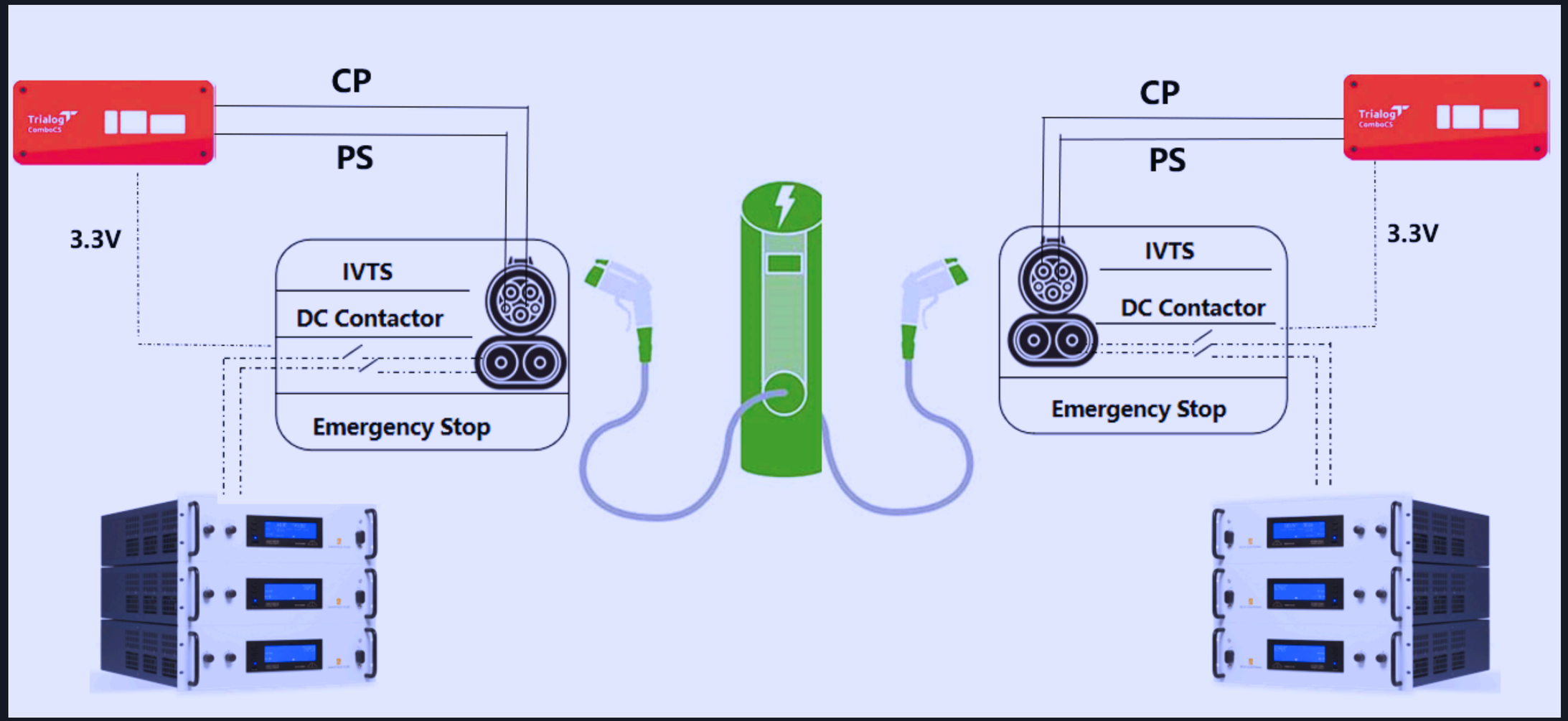
Combo CS4M Setup



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EV ComboCS(4M) -Supports

ISO 15118-3 / DIN 70121

- **SLAC**
- **SLAC Validation**

ISO 15118-2 / ISO 15118-20 / DIN 70121

- **SDP**
- **State machines: AC and DC and V2**
- **Payment options: EIM and PnC**

Optional functions:

- ***Service Details***
- ***Smart Charging***
- ***Metering Receipt***
- ***Welding Detection***
- ***Pause / Resume***

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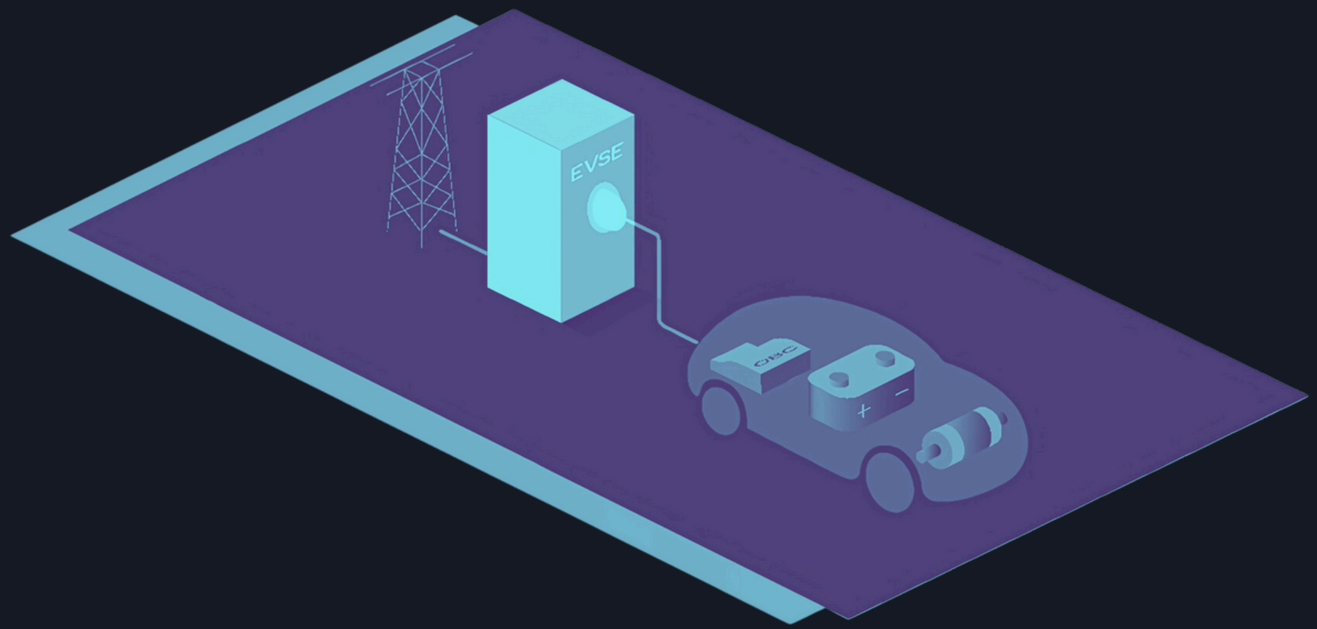
OFF-BOARD EV CHARGER

Test platforms

Electrical Vehicle Supply Equipments (EVSE), also called Off-board chargers, are the components interfacing the public grid to an electric vehicle. They are standardized in 4 different modes, described in the following page, depending on the power, safety functionality and communication capabilities.

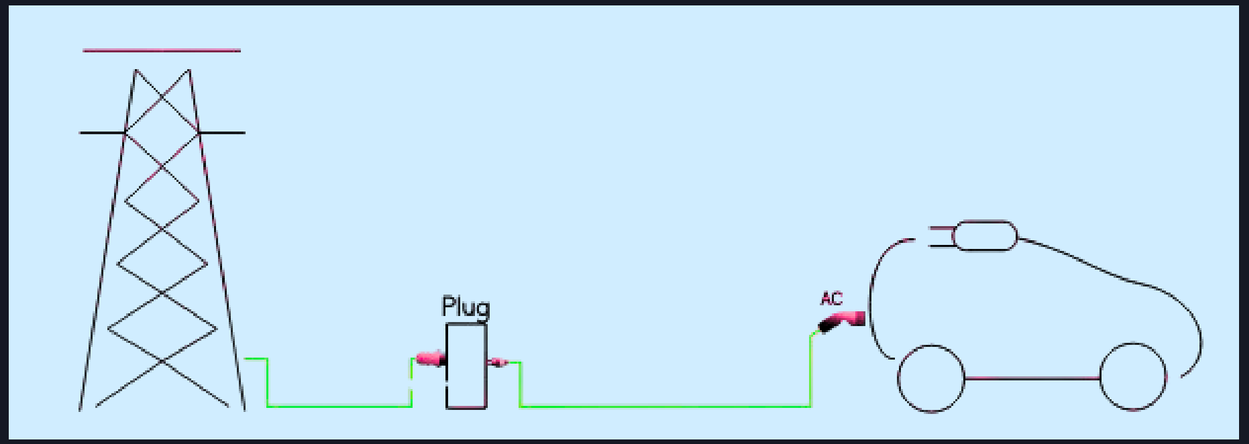


OFF-BOARD EV CHARGER

Test platforms

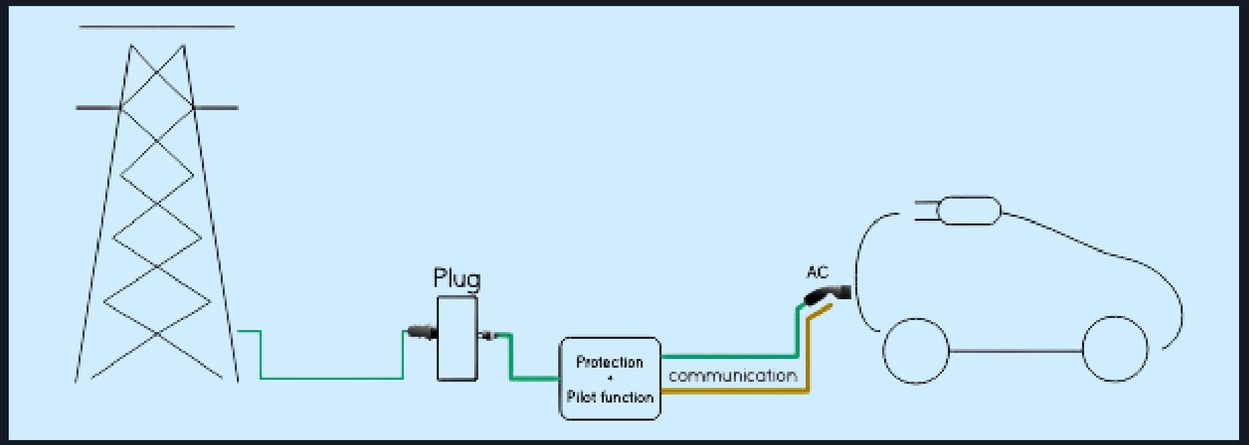
Mode 1

Slow AC charging Maximum current of 16 A Without communication Standard power connections



Mode 2

Slow AC charging Maximum current of 32 A Protection and Pilot function in the cable



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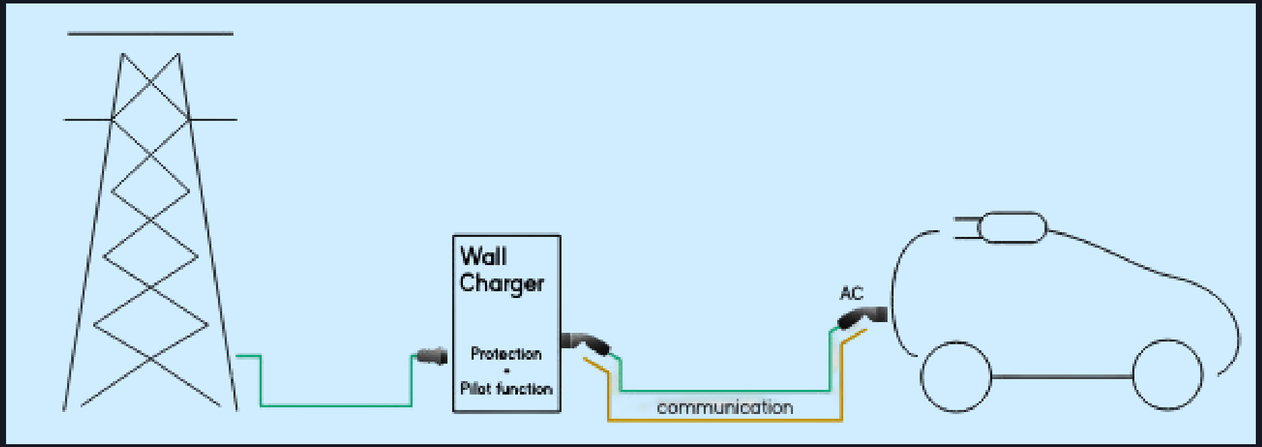
OFF-BOARD EV CHARGER

Test platforms

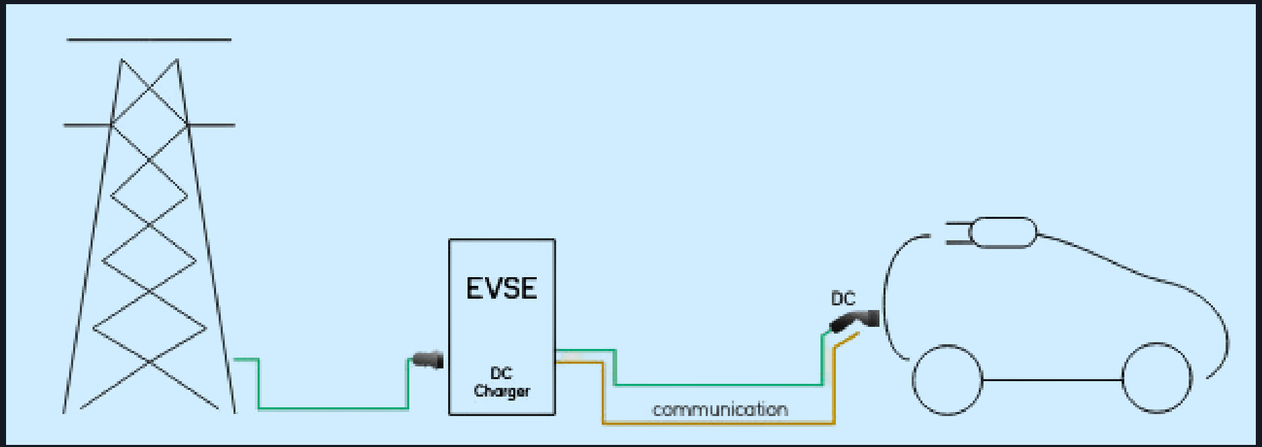
Mode 3

Slow or semi-quick AC charging
Maximum current of 63 A
Protection and Pilot function integrate into the wall charging



Mode 4

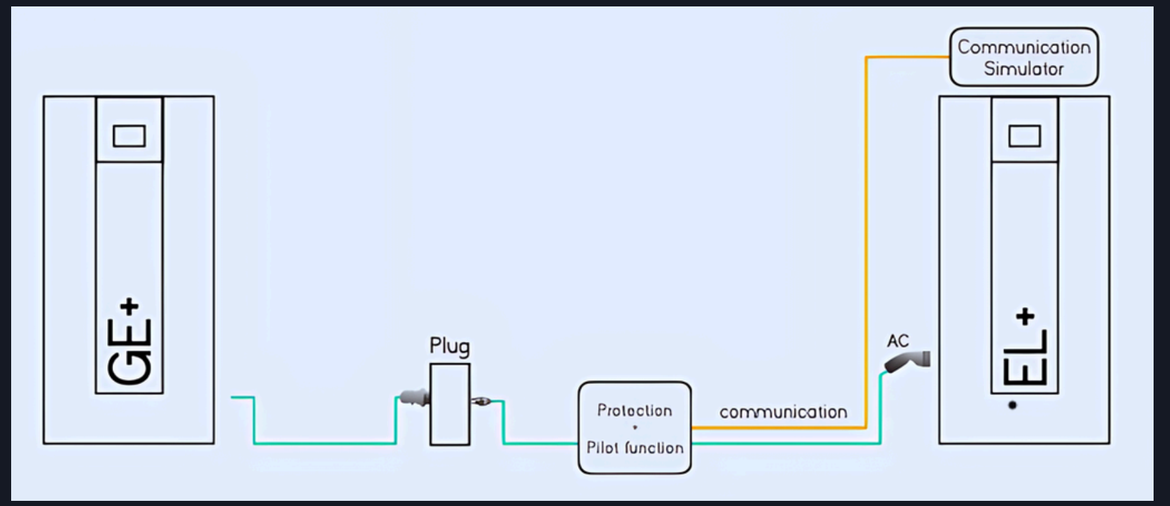
DC charging Maximum power of 38kW in low DC and 170kW in high DC Monitoring, Protection and Pilot function integrate into the charger



SOLUTIONS

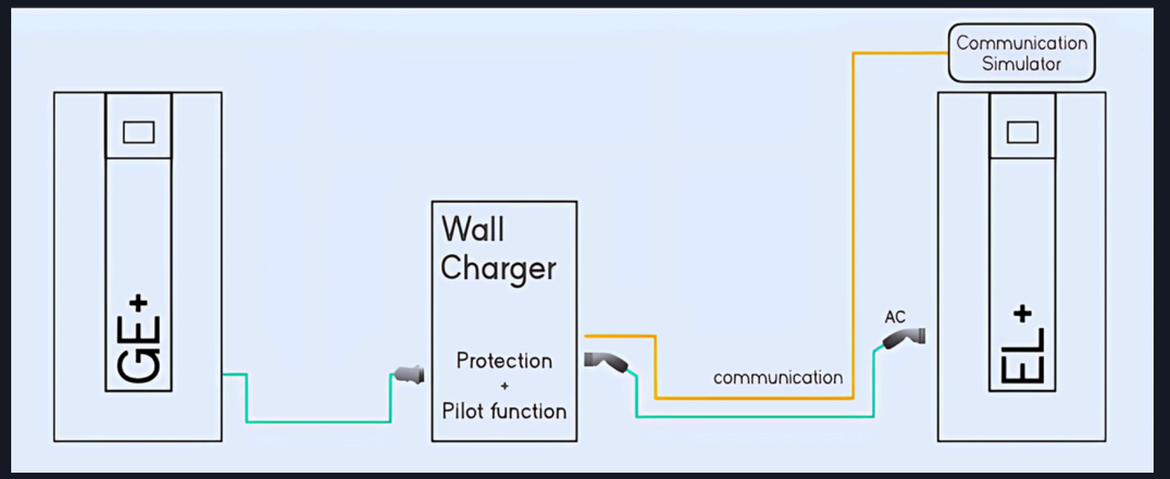
EVSE Mode 2
Test Plataform for Type 2 Charging Cables

SUITABLE PRODUCTS:
GE+ to emulate the grid
EL+ to simulate EV
GE&EL+ for non-simultaneous use
(suitable in all applications)



EVSE Mode 3
Test Plataform for Wall Chargers

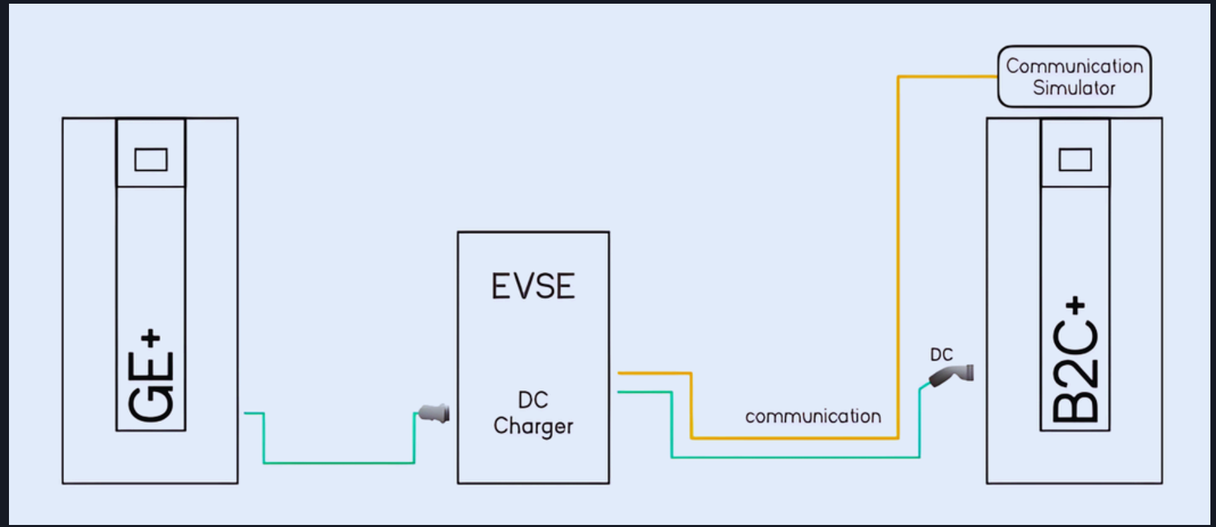
SUITABLE PRODUCTS
GE+ to emulate the grid
EL+ to simulate EV
GE&EL+ for non-simultaneous use
(suitable in all applications)



SOLUTIONS

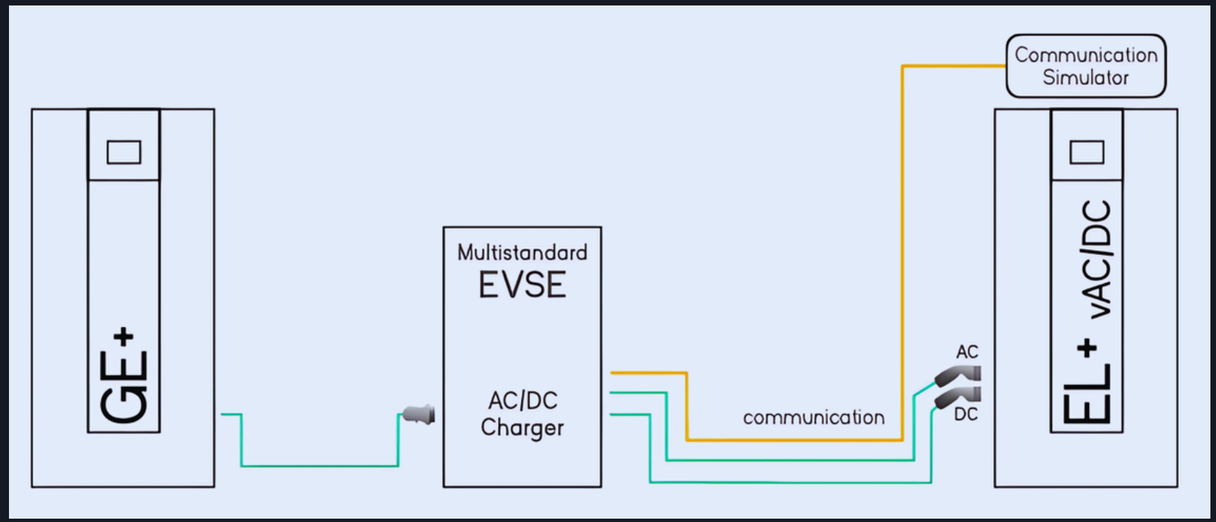
EVSE Mode 4
Test Plataform for DC Chargers

SUITABLE PRODUCTS
GE+ to emulate the grid
B2C+ to simulate EV
GE+ v AC/DC for non-simultaneous use (suitable in all applications)



Multistandard EVSE

SUITABLE PRODUCTS
GE+ to emulate the grid
EL+ vAC/DC to simulate EV
GE&EL+ for non-simultaneous use (suitable in all applications)

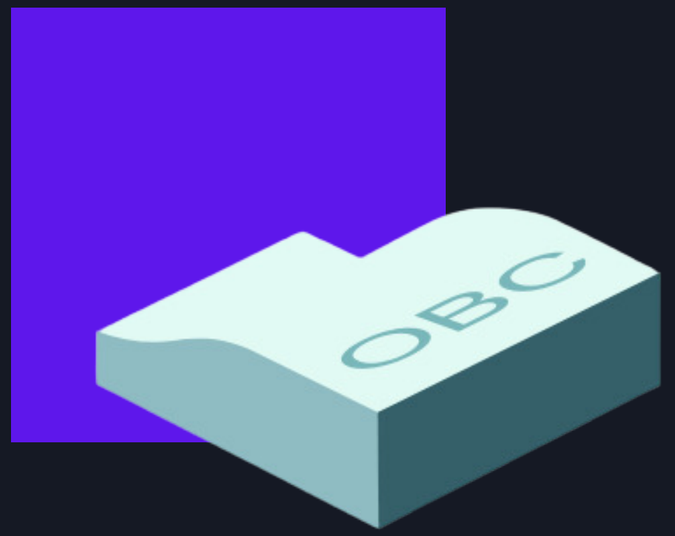


ON BOARD CHARGER

Test platforms

These AC to DC converters are used to charge the battery, in DC, directly from the public grid. They are embedded on the car, so they need to be light and in consequence, they are typically low power AC to DC converters. In some cases, however, the charger is part of the drive train converter allowing high power charging.

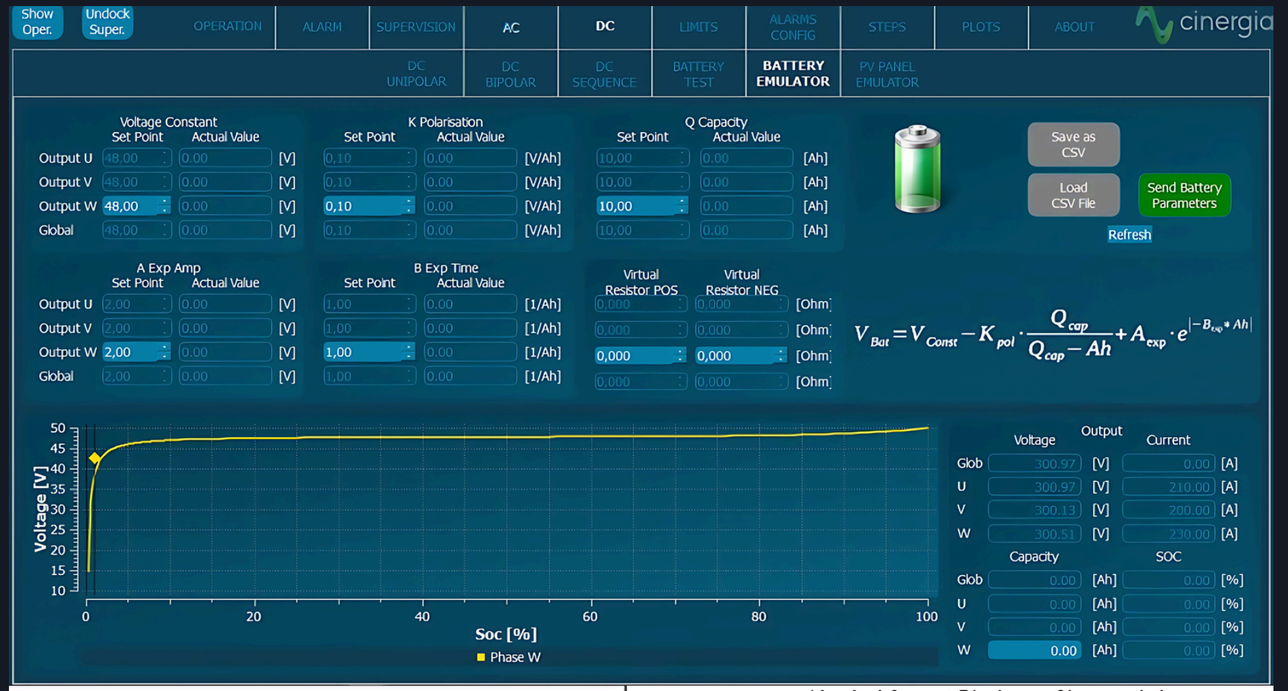
Our Grid Simulator (GE+) is perfect to test the AC side of the charger in stable and distorted conditions and perform functional and immunity assessment. The DC side will be tested using our DC Electronic Loads (B2C+) which include a software option to emulate the electrical behaviour of a battery.

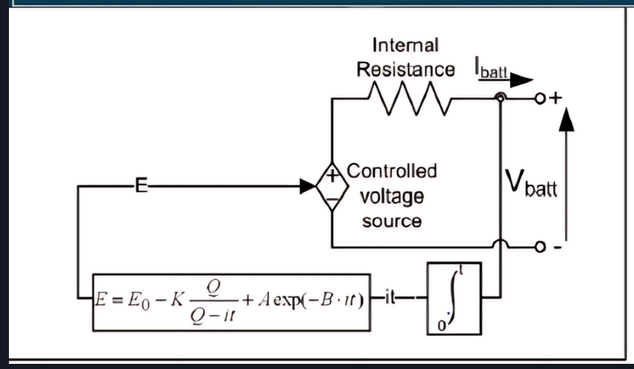


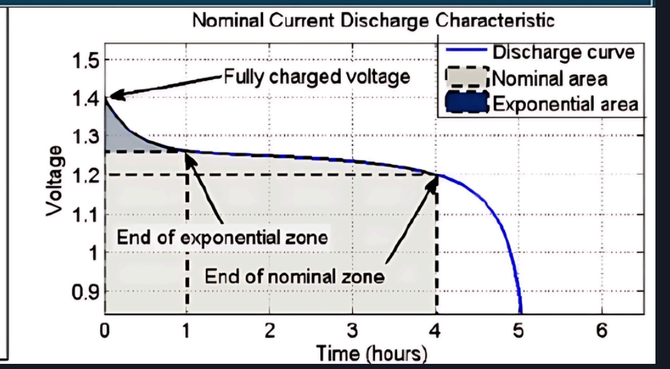
BATTERY EMULATION

The B2C+ integrates a mathematical model to emulate the voltage behaviour of a real battery pack. The output voltage will change as a function of the SOC and Current. By configuring the provided parameters, the voltage profile can be adjusted to match different technologies: LiIon, NiMH, NiCd, Pb, Flux, etc..

Our battery emulation software works with a model from O. Tremblay, L.-A. Dessaint, A.-I. Dekkiche, "A Generic Battery Model for the Dynamic Simulation of Hybrid Electric Vehicles" , 2007 IEEE® Vehicle Power and Propulsion Conference, September 9-13, 2007, Arlington/Texas, USA







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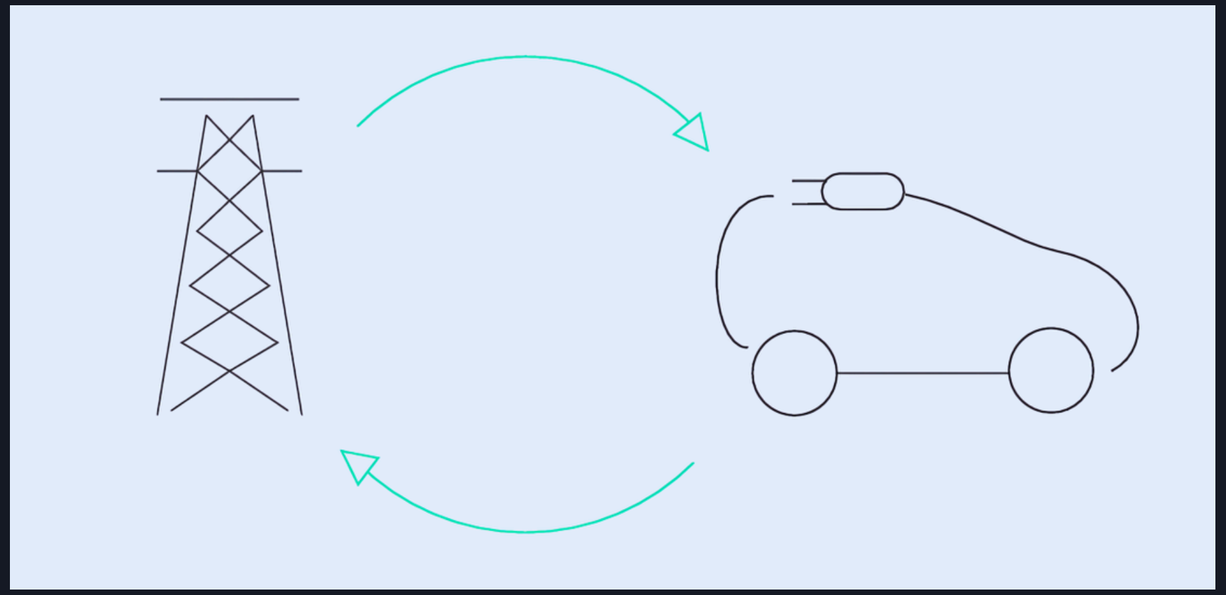
VEHICLE TO GRID (V2G) & VEHICLE TO HOME (V2H)

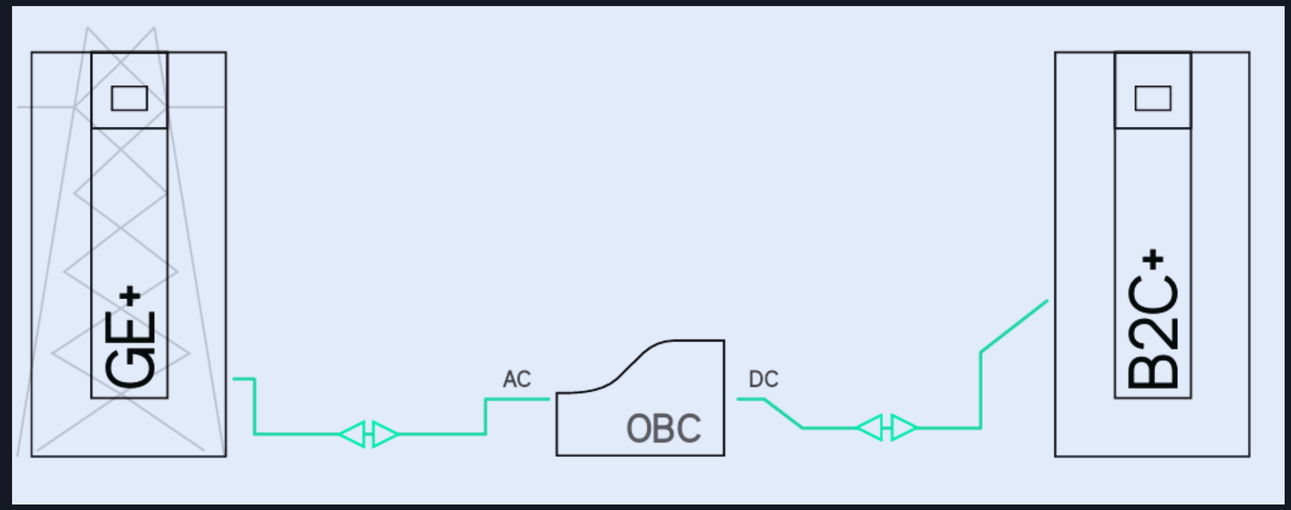
Test platforms

Vehicle to grid and Vehicle to home solutions are next generation systems envisioned to convert the electrical vehicle into an active agent of the electrical grid. These systems are able to reduce the power consumption (becoming a controllable load) or to supply energy from the EV battery into the grid to provide ancillary services in high-demand scenarios. New revolutionary developments go even further in using the EV battery as the energy resource of an islanded grid.



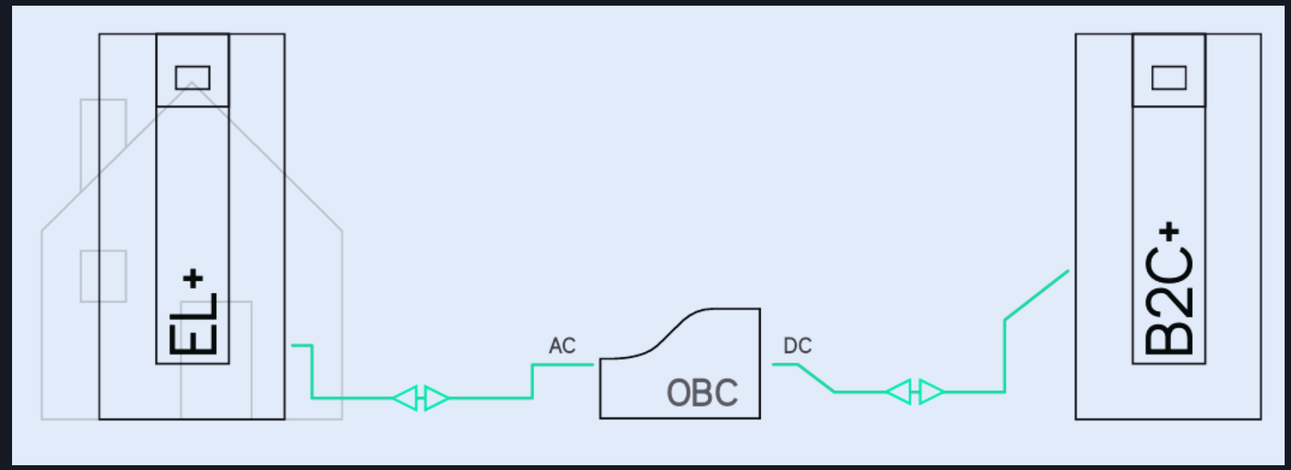
Test Platform for OBC in V2G system

SUITABLE PRODUCTS
GE+ to emulate grid
B2C+ to simulate Battery
GE+ vAC/DC for non-simultaneous use (suitable in all applications)

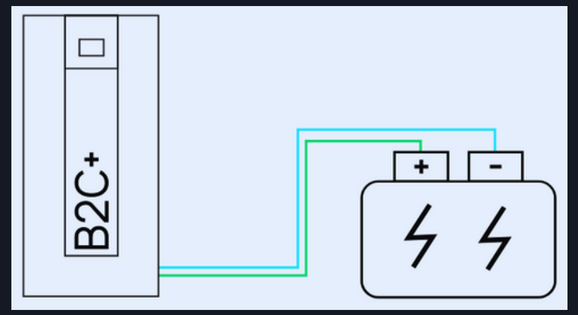


Test Platform for OBC in Vehicle to insulated grid

SUITABLE PRODUCTS
EL+ to emulate grid or loads
B2C+ to simulate Battery
EL+ vAC/DC for non-simultaneous use (suitable in all applications)



BATTERY PACK TESTING



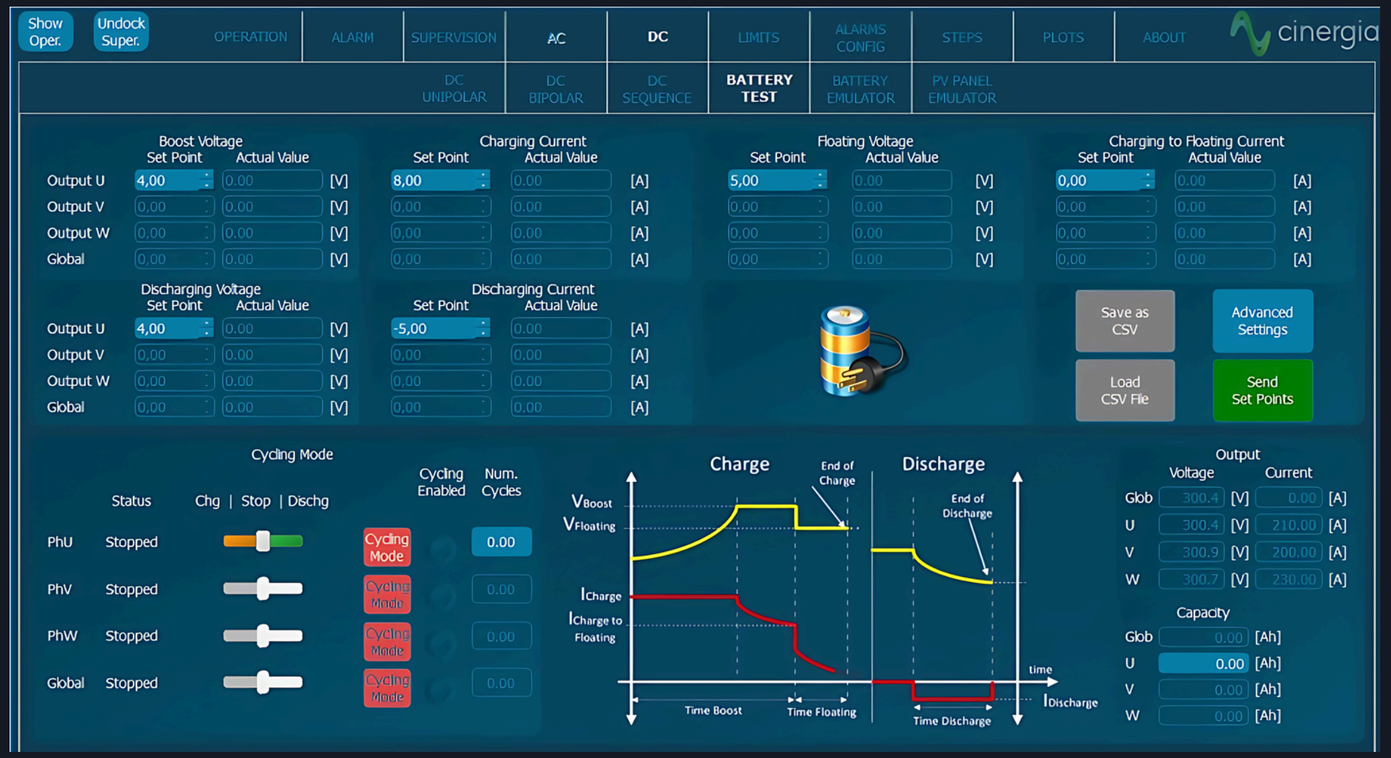
- Characteritzation
- Burn-in & Production Test
- Charger
- Discharge
- Cycling

Battery Pack Testing

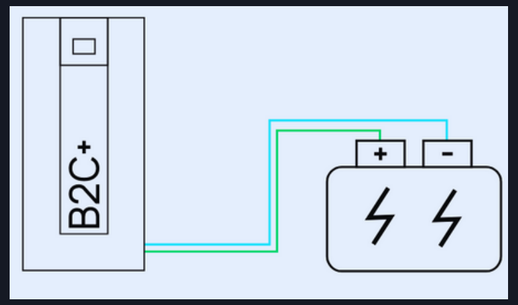
This functionality enables the user to precisely control the charge, discharge and cycling of a Battery. Basic parameters include the charge/discharge current, fast charge and floating voltages while Advanced parameters add Energy (Ah) and Time as transition conditions. Prof iles for each Battery technology can be saved and imported in .CSV files

Suitable Product

B2C+ with Battery Test & PHiL Operation Mode



EV DRIVE TRAIN EMULATION



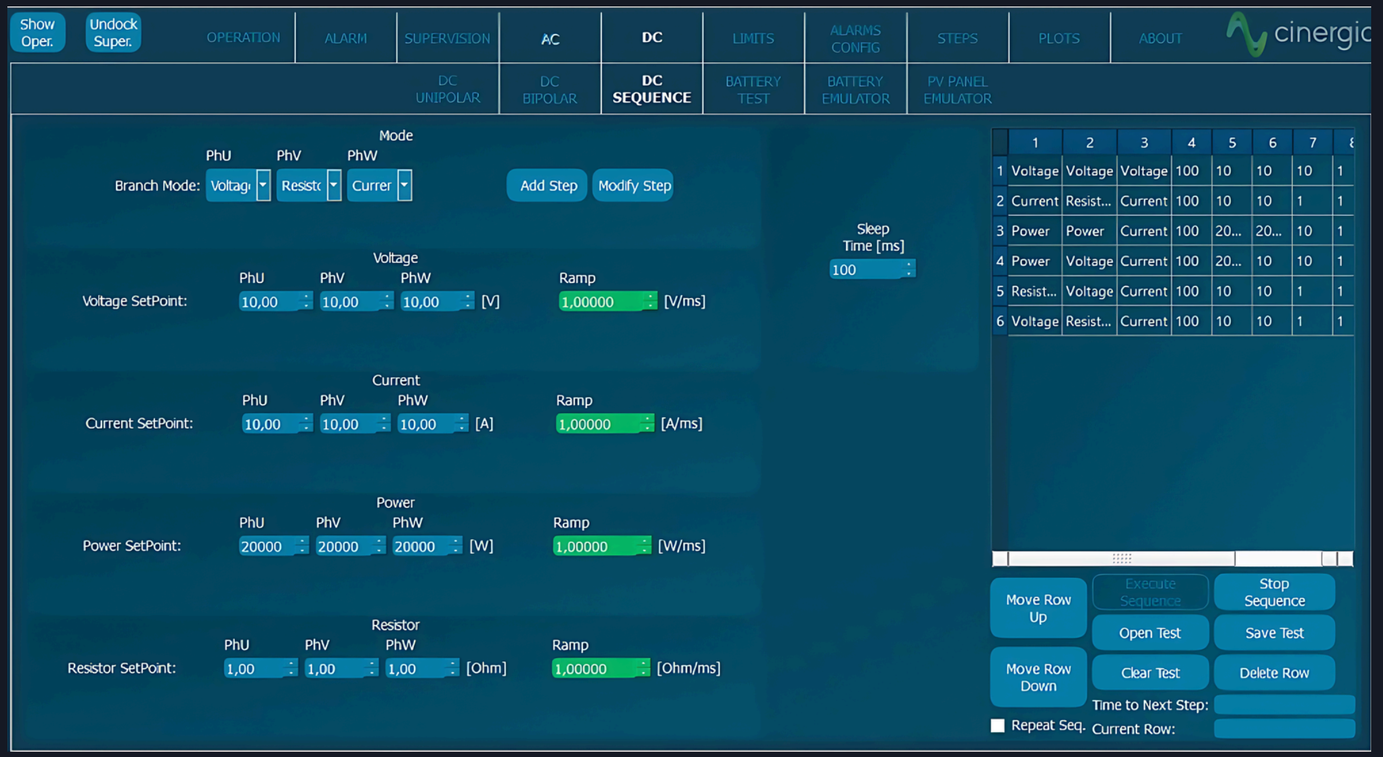
- Drivetrain emulation
- Driving profiles

Suitable Product

B2C+ with Battery Emulation Mode
B2C+ with PHiL Operation Mode & Power Operation Mode

Sequence

The User Interface Software integrates a Sequence Editor to create automatic test sequences, save them for future use and import them in .csv files. A smart datalogger can be activated to record automatically the resulting voltage and current measurements with a time resolution of 400 ms.



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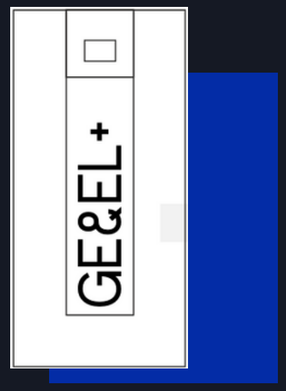
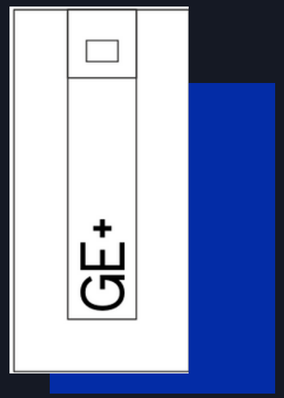
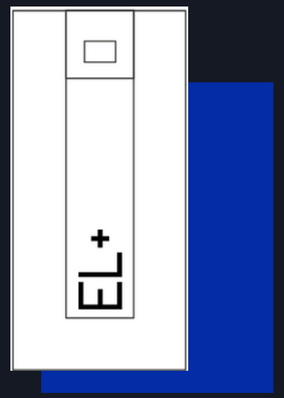
PRODUCTS



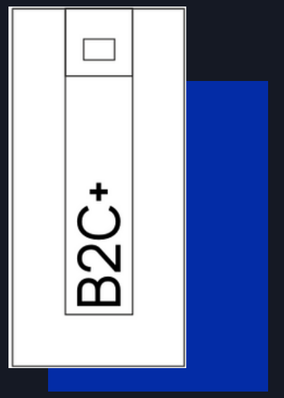
The GE&EL product family is the aggregation of Grid Simulators, Electronic Loads and Bidirectional DC Converters in one product



Grid Simulators are power electronic devices that emulate AC electrical grids in both normal and disturbed conditions.



The EL+ family is power electronic device designed to emulate AC and DC electrical loads.



CINERGIA's DC Programmable Power Supplies are designed to generate a controlled DC source or load.

MODELS	All-Terrain vAC/DC B2C+ All-in-one vAC	GE+ vAC/DC Full GE+ vAC	EL+ vAC/DC Full EL+ vAC	B2C+
AC POWER	7.5kW - 160kW	7.5kW - 160kW	7.5kW - 160kW	7.5kW - 160kW
DC POWER	7.5kW - 160kW	7.5kW - 160kW	7.5kW - 160kW	7.5kW - 160kW
AC CURRENT (PER PHASE)	11A - 232A	11A - 232A	11A - 232A	10V-750V/800V - 20V-750V/800V
DC CURRENT (PER PHASE/PARALLEL)*	±10A / ±30A - ±185A / ±555A	±10A / ±30A - ±185A / ±555A	±10A / ±30A - ±185A / ±555A	±10A / ±30A - ±185A / ±555A
KEY FEATURES	Bidirectional and Regenerative Clean grid current: THDi < 3% and PF > 0.98 Same power in AC & DC Parallelization of the units to increase the power. The most flexible unit in a single cabinet.	Bidirectional and Regenerative Clean grid current: THDi < 3% and PF > 0.98 Same power in AC & DC Parallelization of the units to increase the power.	Bidirectional and Regenerative Clean grid current: THDi < 3% and PF > 0.98 Same power in AC & DC Parallelization of the units to increase the power.	Bidirectional and Regenerative 2Q and 4Q conf iguration Clean grid current: THDi < 3% and PF > 0.98 Selialitzation of units to increase voltage up to 1500V Parallelization of units to increase the power.

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Scientific Mes-Technik Pvt. Ltd.,

B14, Industrial Estate, Pologround, Indore 452015, India

info@scientificindia.com

www.scientificindia.com

0731- 2422330-33

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LV 124 & LV 148

Automotive Test Standard for vehicle components and systems

Overview

The primary focus of LV124 is electrical load testing, which assesses the performance of components under various conditions to ensure they fulfil the severe requirements of automotive applications. LV148, on the other hand, goes into the field of EMC, investigating the vulnerability of electronic systems to electromagnetic interference (EMI) and developing mitigation strategies.

Delta Elektronika Programmable DC Power Supply are the Most Trustable Power Supplies to Test LV124 & LV148 Automotive Test Standards.

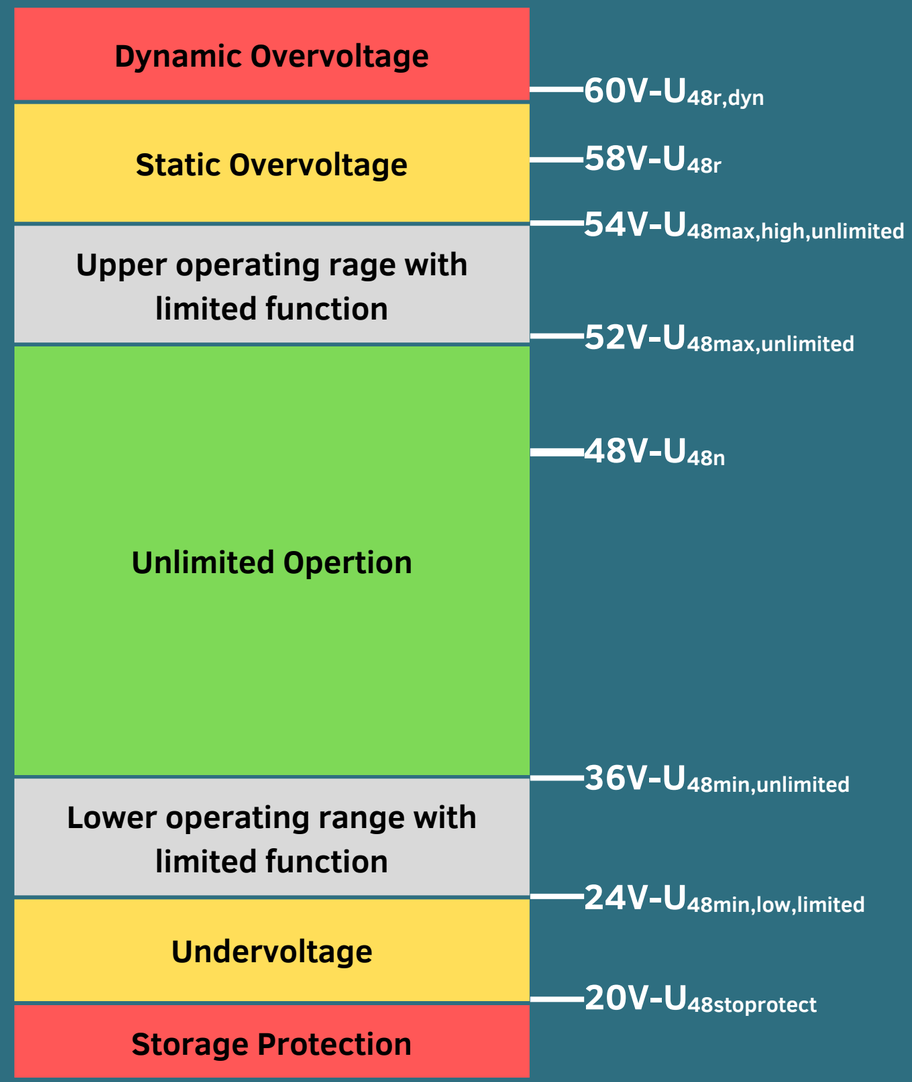
Delta Elektronika DC Power Supply with High efficiency, Auto ranging, High speed programming, flexible output,a standard web interface, and plug-and-play interfaces provide complete soluton to Test LV124 & LV148 Standards.

Operating Voltage Range LV 124

Code	Ubmin	Ubmax	Description
a	6V	16V	For functions that must retain their performance during starting of the engine
b	8V	16V	For functions that do not have to retain their performance during starting of the engine This encoding must only be used if the component cannot be classified in the encoding a, c or d.
c	9V	16V	For functions that must retain their performance when the engine is not running
d	9.8V	16V	For functions that must retain their performance when the engine is running

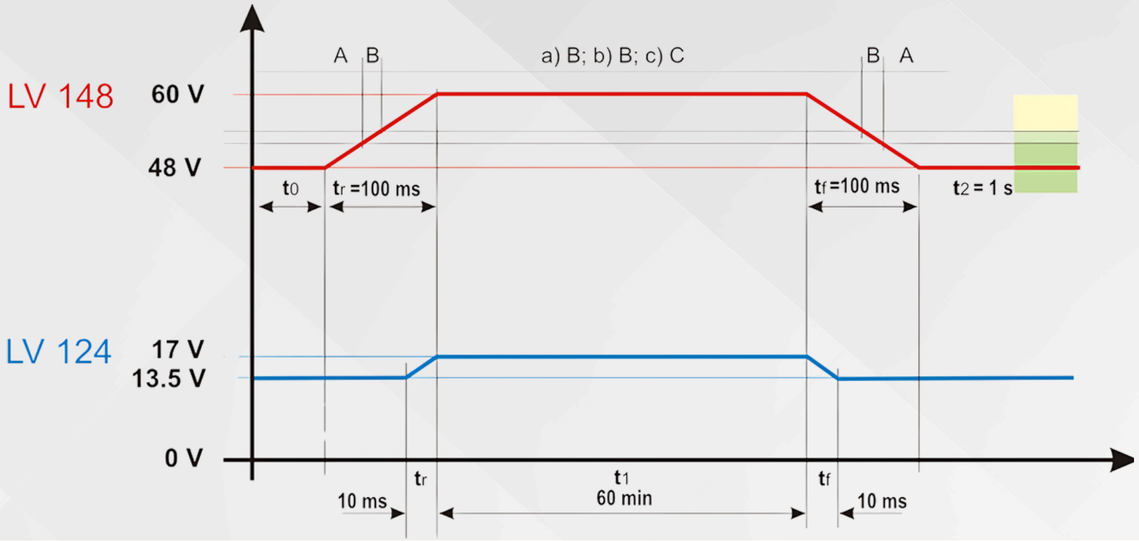
Operating Voltage Range LV 148

Shortcut	Terms LV 148	Value
U48r,dyn	Lower voltage limit of the dynamic overvoltage range	60V
U48r	Lower voltage limit of the 2 V tolerance to the dynamic overvoltage range	58V
U48max,high,limited	Max. voltage of the upper operating range with functional restriction	54V
U48max,unlimited	Max. voltage of the operating range without functional restriction	52V
U48n	BN48- nominal voltage	48V
U48min,unlimited	Min. voltage of the operating range without functional restriction	36V
U48min,low,limited	Min. voltage of the lower operating range with functional restriction	24V
U48stoprotect	Accumulator protected voltage	20V
U48pp	Peak – peak- voltage	
U48rms	Effektive value of a voltage	
U48max	Maximum voltage that may occur during a test	
U48min	Minimum voltage that may occur during a test	
U48test	BN48- test voltage	
U12test	BN12- test voltage	14V
U24test	BN24- test voltage	28V



Longterm Overvoltage Test

Purpose: The component's resistance to long-term overvoltage is tested. A generator control fault during driving operation is simulated.

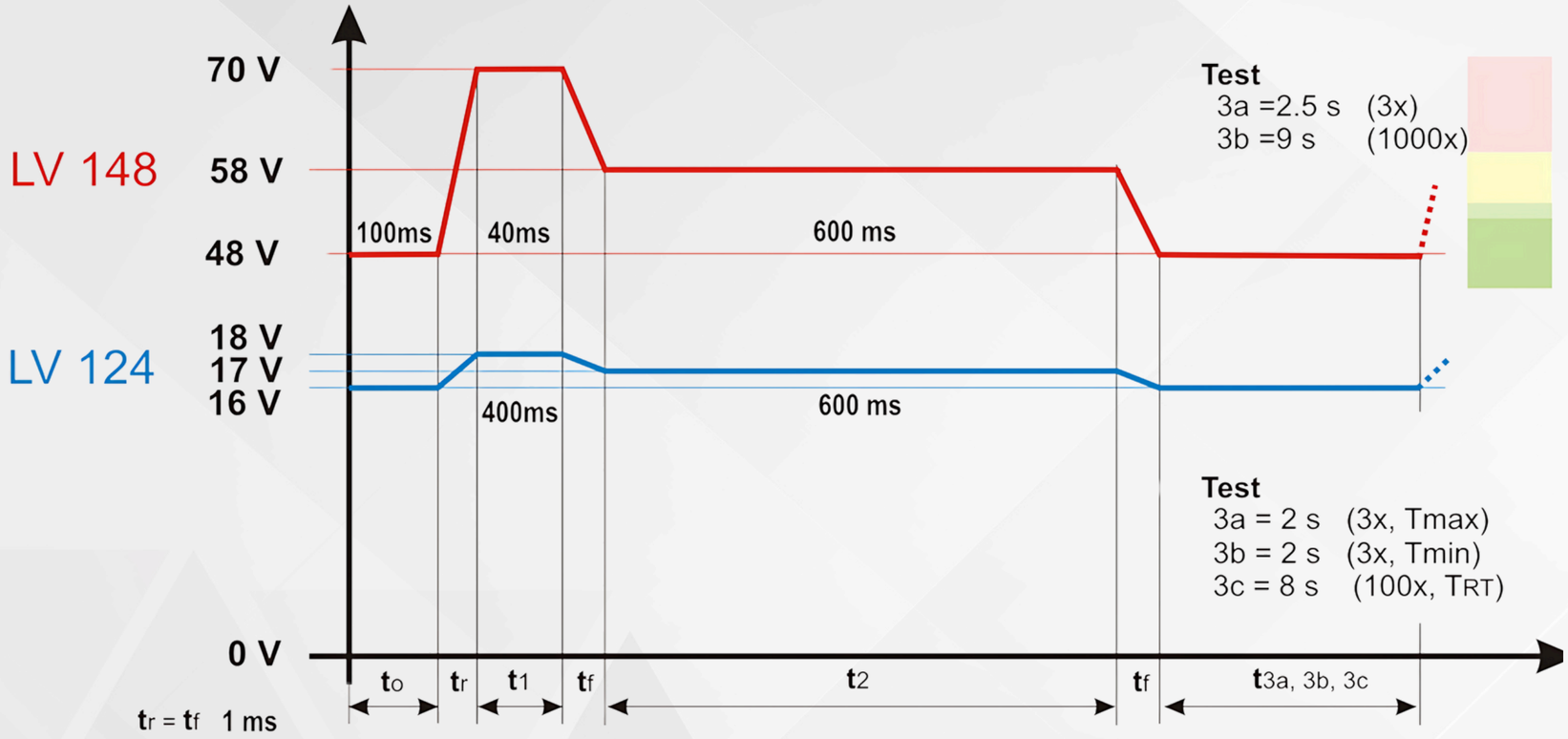


Requirements	Function Status
a) Components which convert el. Energy	B
b) Required function while driving	B
c) All other components	C

Parameter	LV 124	LV1 48
Operating mode DUT	Operating mode II.c	Operating mode II.a, II.b and II.c
Umax	17 V (+4 %, 0 %)	60,0 V ,U48r,dyn
Umin	13,5 V	48.0 V, U48n
tr	< 10 ms	0.1s
tf	< 10 ms	-
t1	60 min	60 min
Ttest	Tmax – 20K	Tmax - 20 °C
Number of cycles	1	1
Number of test samples at least	6	6

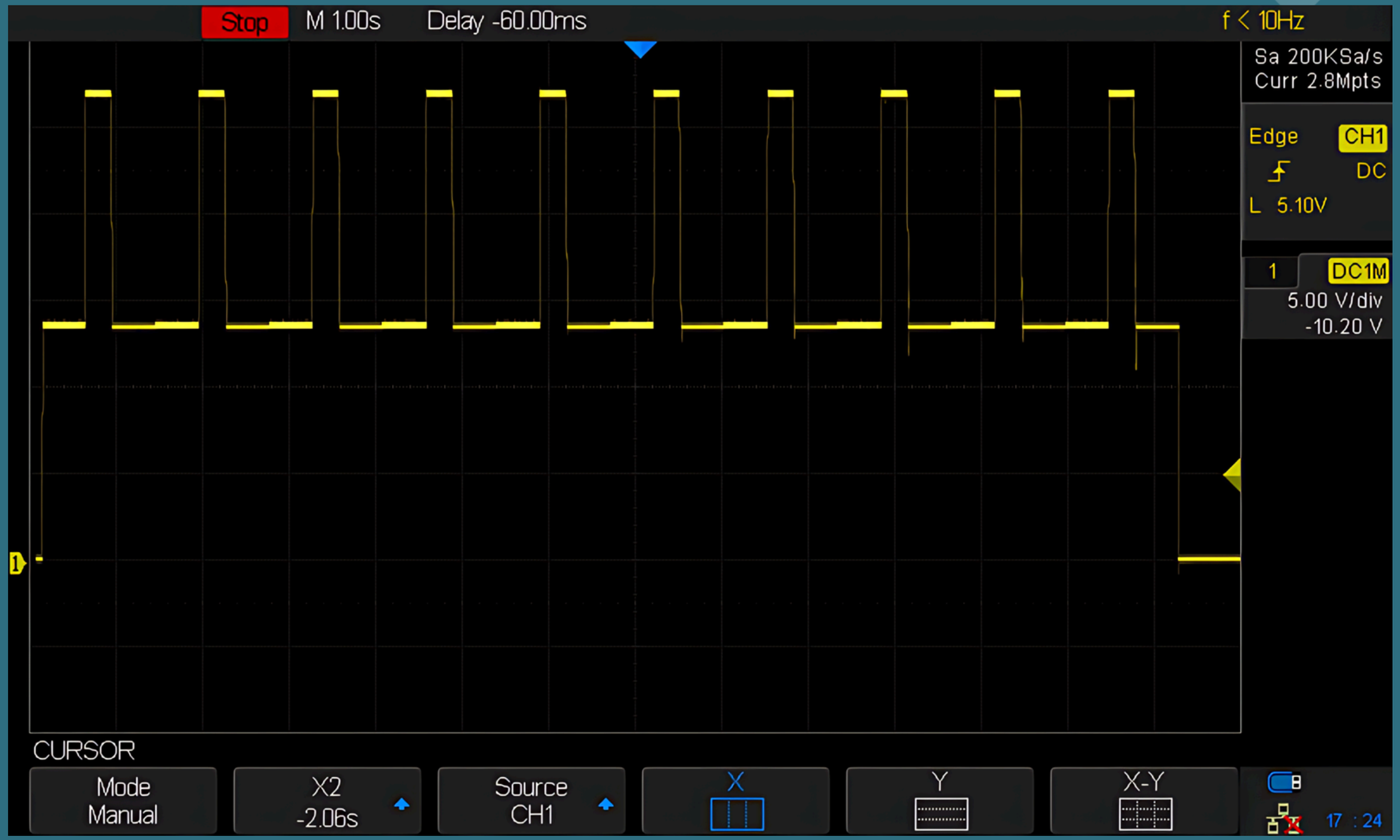
Transient Overvoltage

Purpose: Transient overvoltages may occur in the electric system due to the switching off of loads and due to short accelerator tip-ins. These overvoltages are simulated by means of this test.



	Functional Status
LV 124: 3 Test cases on different temperatures	A
LV 148: 2 tests, short test 3x, long duration test 1000x, Ri: 10 mΩ ≤ Ri ≤ 100 mΩ	A

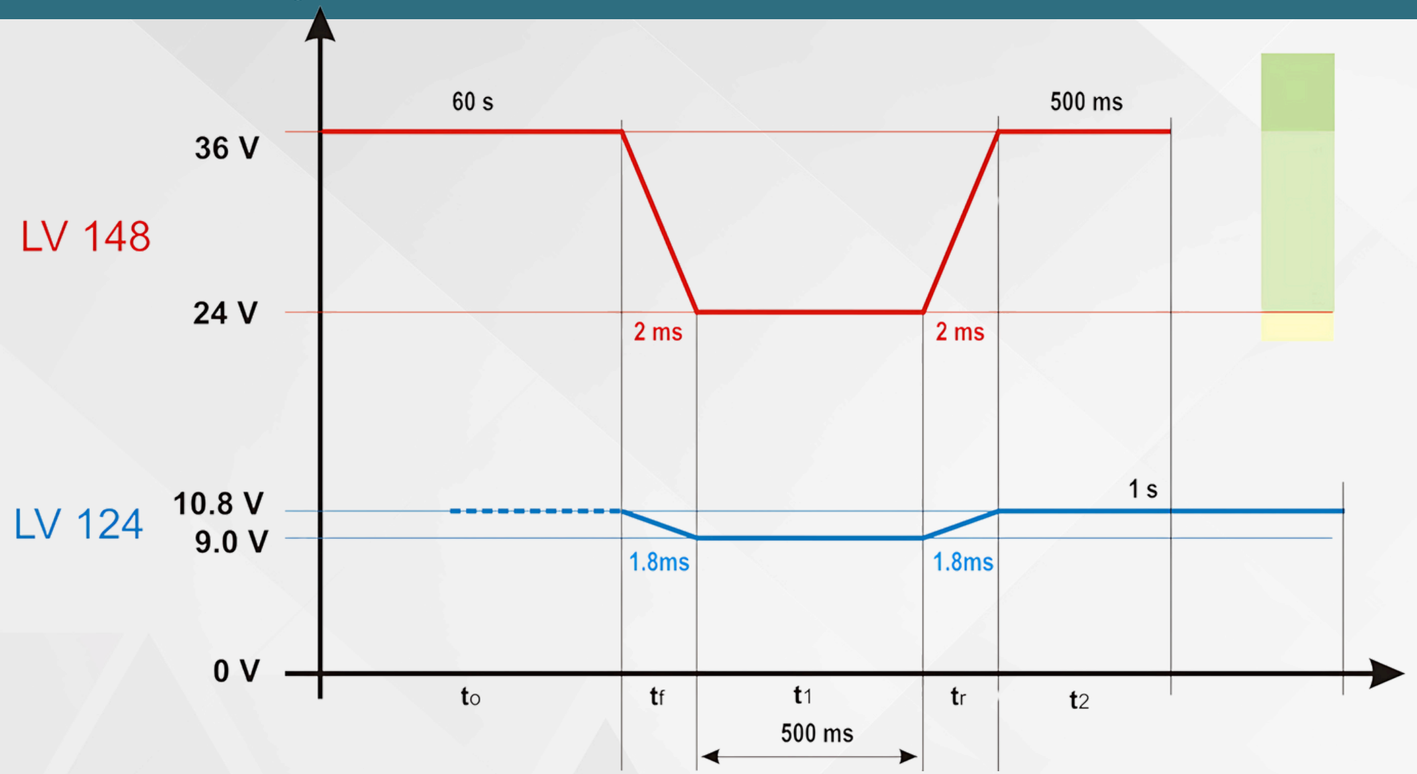
Transient Overvoltage



DSO Captured Waveform

Transient Undervoltage

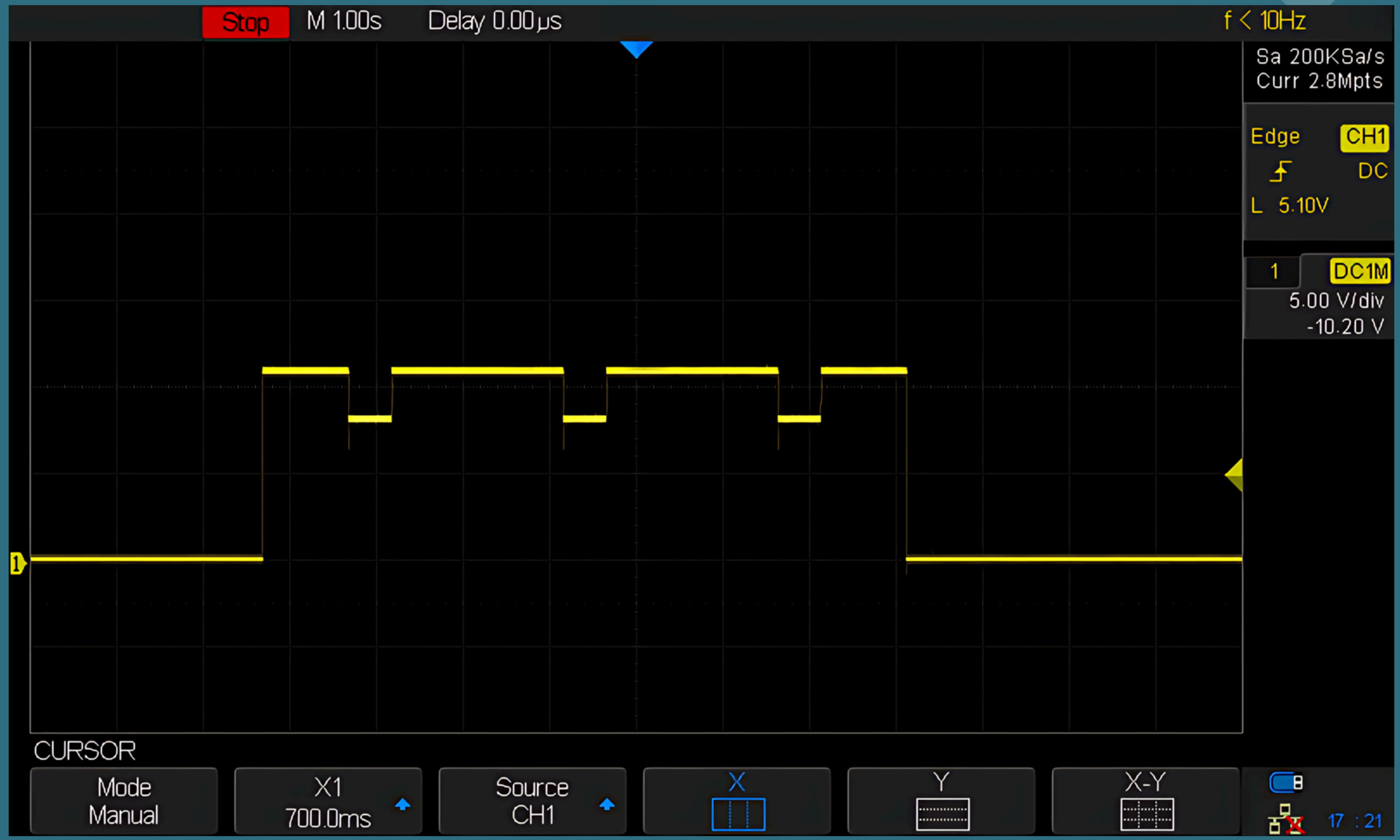
Purpose: Transient undervoltages in the electric system may occur due to switching on of loads. These undervoltages are simulated by means of this test.



10.8 V (+4 %, 0 %)
9.0 V (0 %, -4 %)

Requirements	**LV 124**	**LV 148**
Number of cycles:	ever 3 at Tmax and Tmin	1
Number of samples:	at least 6	6
Functional status:	**A**	**B**

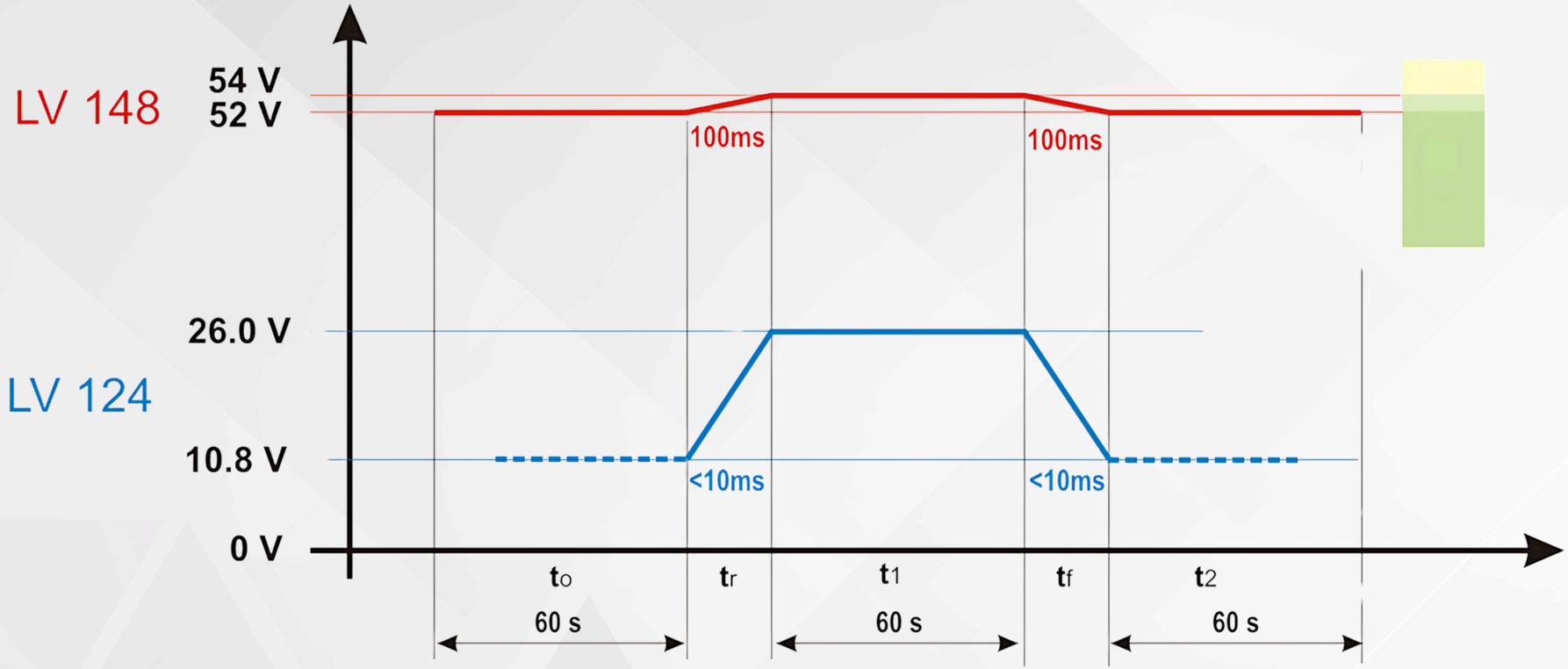
Transient Undervoltage



DSO Captured Waveform

Jumpstart

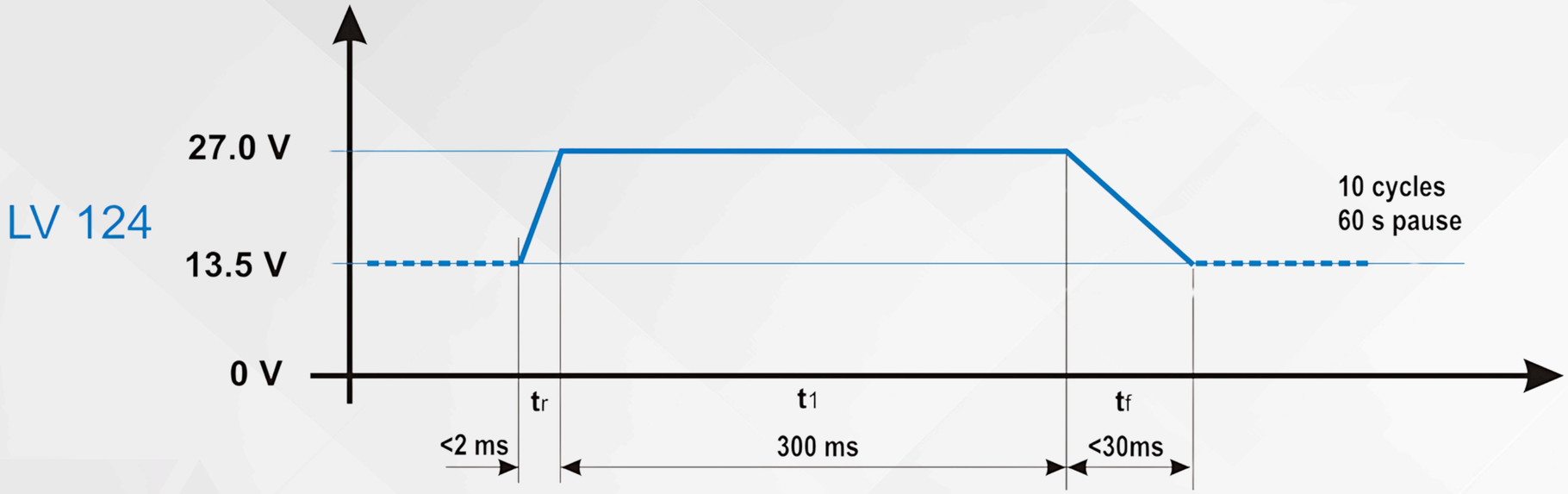
Purpose: Jump starting of the vehicle is simulated. The maximum test voltage results from commercial vehicle systems and their elevated electric system voltages. LV 148: Longer recuperation is simulated.



Requirements	LV 124	LV 148
Number of cycles:	1	1
Number of samples:	mind. 6	6
Functional status:	**C**	**A** (driving mode relevant) **B** (all others)

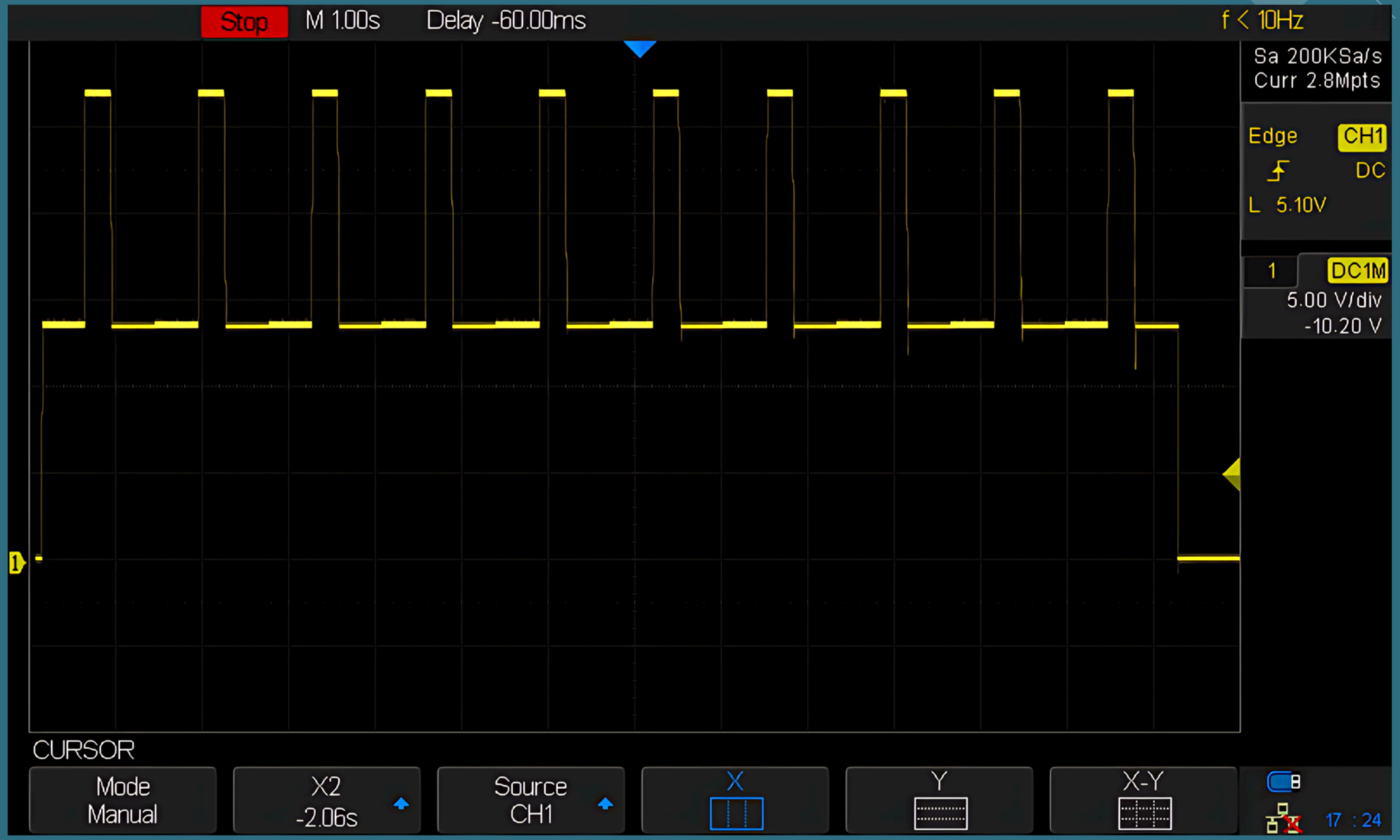
Load Dump

Purpose: Dumping of an electric load, in combination with a battery with reduced buffering ability, results in an energy-rich overvoltage pulse due to the generator characteristics. This pulse is simulated using this test.



Requirements	**LV 124**
Number of cycles:	10
Number of samples:	mind. 6
Functional status:	**A** (Saftey relevant components) **B** (all others)

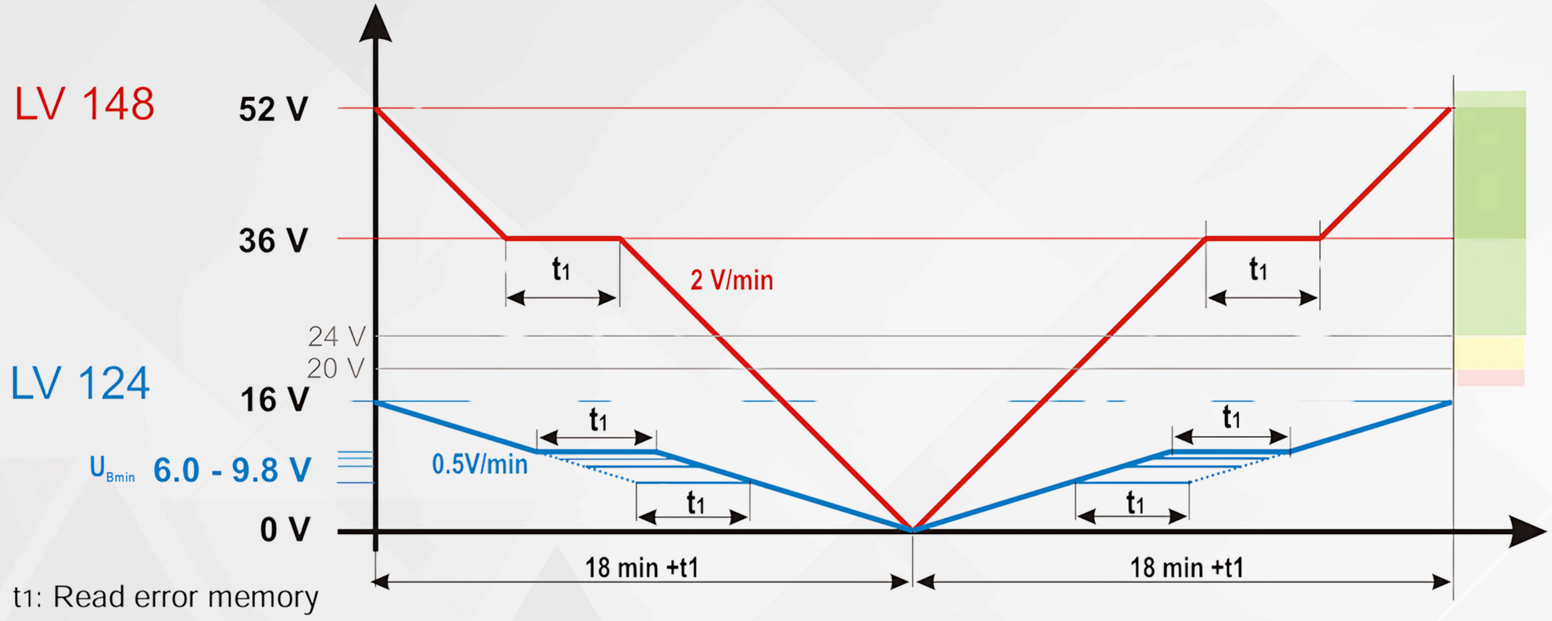
Load Dump



DSO Captured Waveform

Slow decrease and increase of the supply voltage

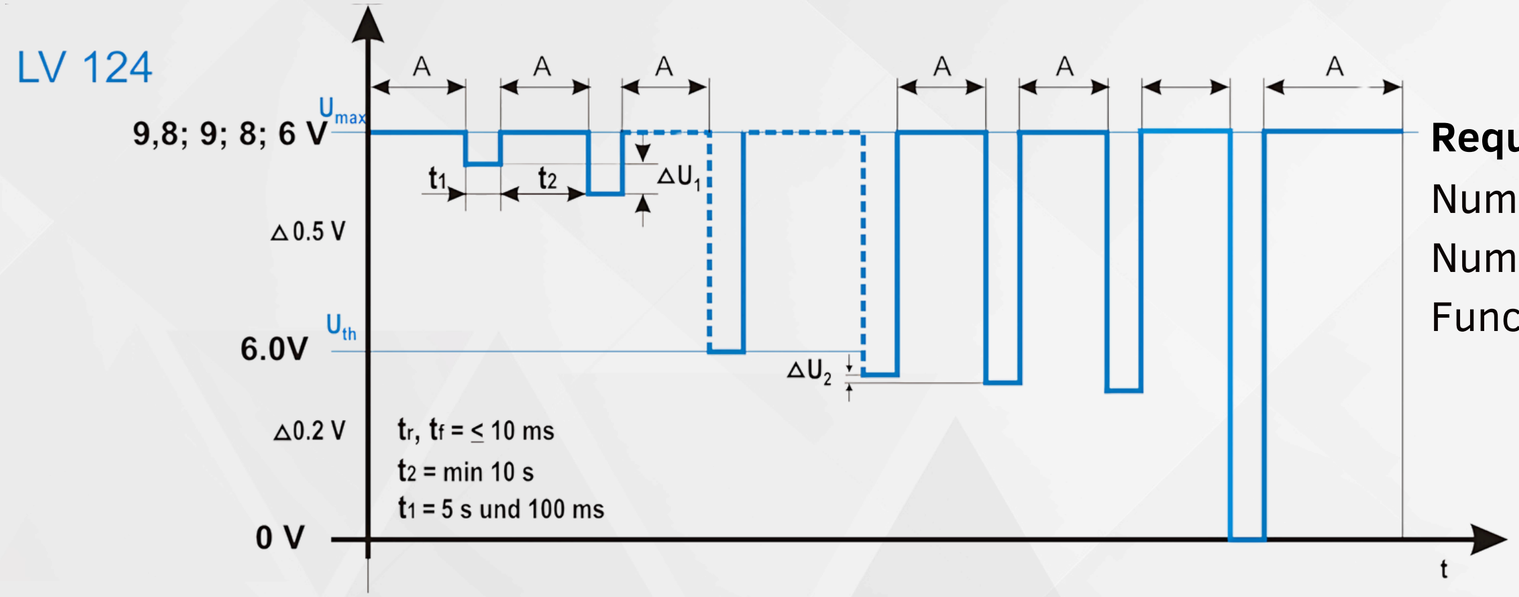
Purpose: The slow decrease and increase of the supply voltage is simulated as it occurs during the slow discharging and charging procedure of the vehicle battery.



Requirements	LV 124	LV 148
Number of cycles:	1	1
Number of samples:	min. 6	6
Functional status:	**A** (Inside the defined operating voltage) **C** (Outside the defined operating voltage)	(depends on voltage range)

Reset Behaviour

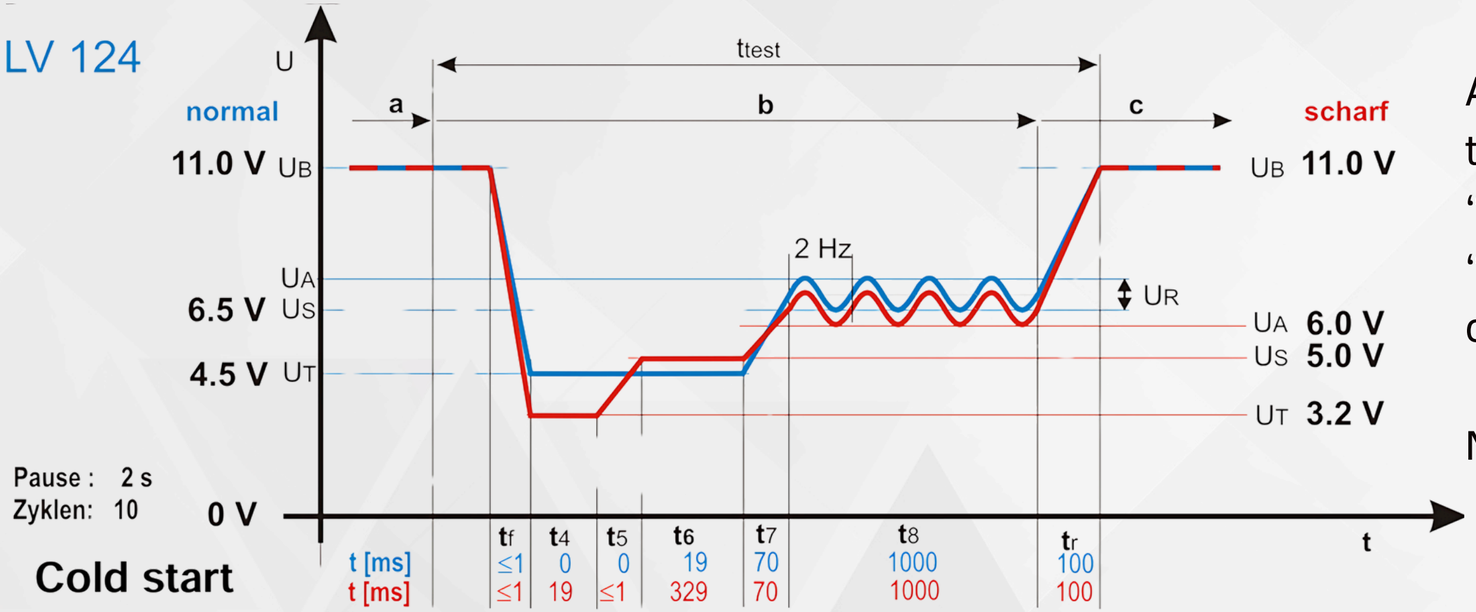
Purpose: Simulate and test a component's reset behaviour. Specify test boundary conditions (e.g., assembly, terminal, system) in detail. An arbitrary sequence of switching-on/off processes during operation must not result in undefined component behaviour. Voltage and time variances represent reset behaviour. Two test sequences are needed to replicate various switch-off times. A component has to go through both sequences.



Requirements	**LV 124**
Number of cycles:	1 per operating mode II.a / II.c
Number of samples:	min. 6
Functional status:	Detection when A exits for the first time.

Start Impulse

Purpose: When starting the engine, the battery voltage falls for a short period to a low value, and then again to rise slightly. The start process can happen under different vehicle start situations: To cover both cases at cold start and warm start two different test cases are required. A component has always to go through both test procedures.



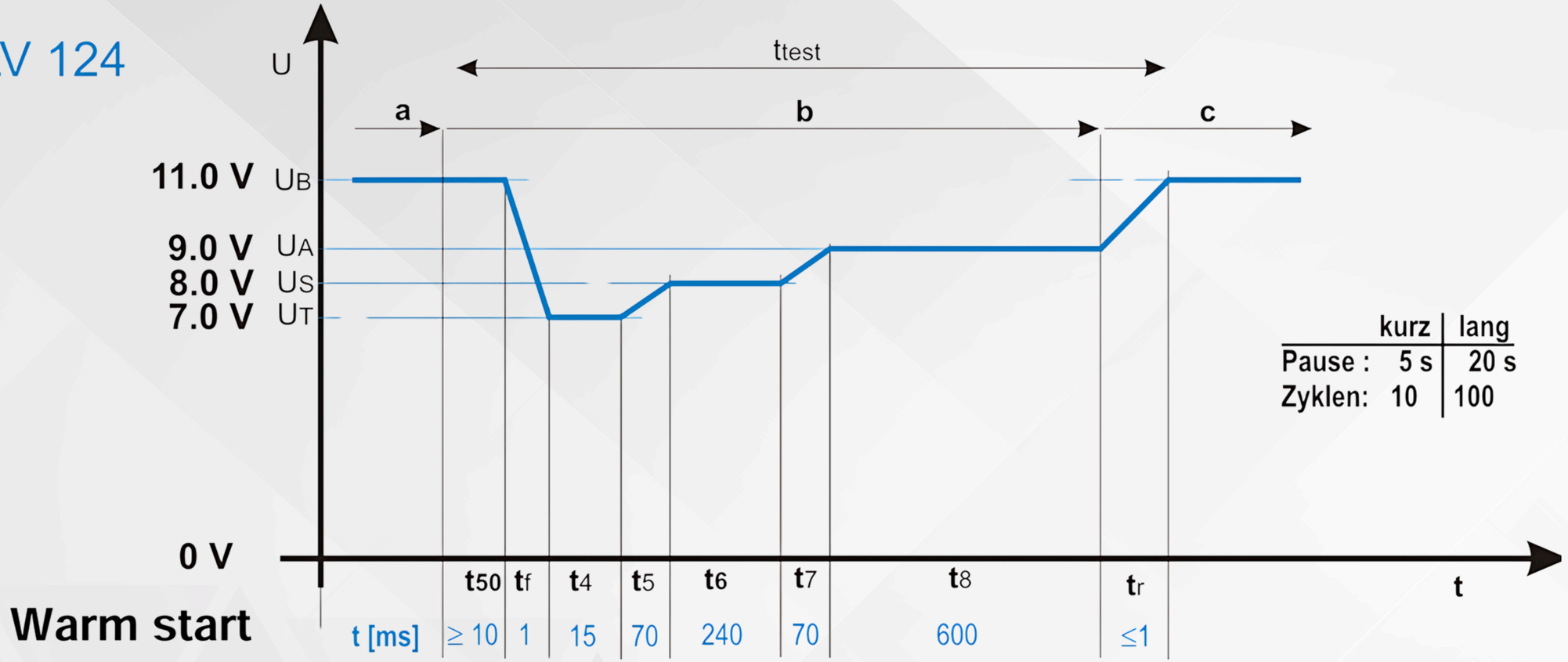
At test case 1 cold start (start the engine), there are test impulses for:
"**normal**" for normal cold start and "**severe**" with a lower battery voltage consider when starting the engine.

Number of samples: at least 6

Function Status	Test Case 1 normal, sharp	
Start relevant	**A**	**B**
Not start relevant	**C**	**C**

Start Impulse

LV 124



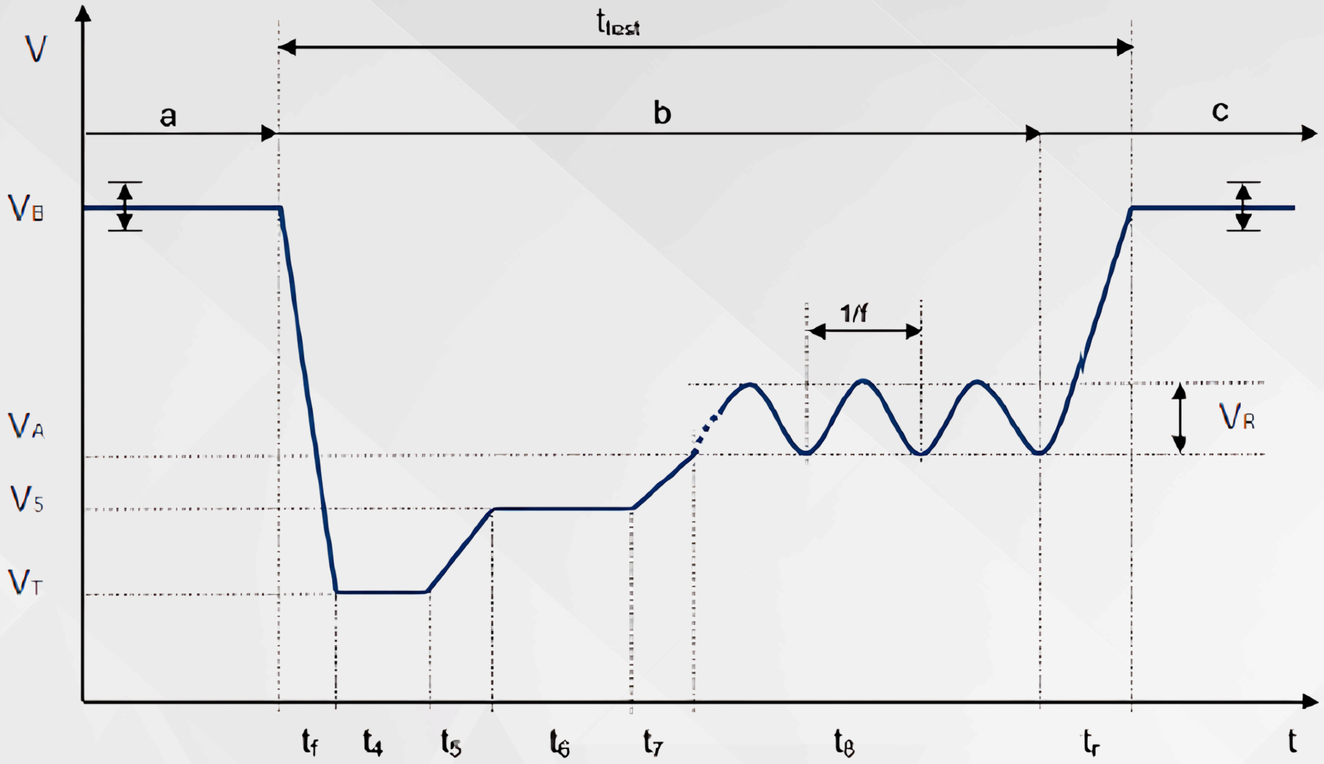
	kurz	lang
Pause :	5 s	20 s
Zyklen:	10	100

Warm start

At test case 2 warm start (automatic restart after a stop),
there are two cycles: **Short**: 5 seconds break 10x
Long: 20 seconds break 100 cycles
Number of samples: at least 6

Function Status	Test Case 1 short, long	
Start relevant	A	A
Not start relevant	A	A

Cold Start



Parameter	"Normal" test pulse	"Severe" test pulse
V_B	11,0 V	11,0 V
V_T	4,5 V (0%, -4%)	$3{,}2\ V^{+0{,}2\ V}$
V_S	4,5 V (0%, -4%)	5,0 V (0%, -4%)
V_A	6,5 V (0%, -4%)	6,0 V (0%, -4%)
V_R	2 V	2 V
t_f	≤1 ms	≤1 ms
t_4	0 ms	19 ms
t_5	0 ms	≤1 ms
t_6	19 ms	329 ms
t_7	50 ms	50 ms
t_8	10 s	10 s
t_r	100 ms	100 ms
f	2 Hz	2 Hz
Break between two cycles	2 s	2 s
Test cycles	10	10

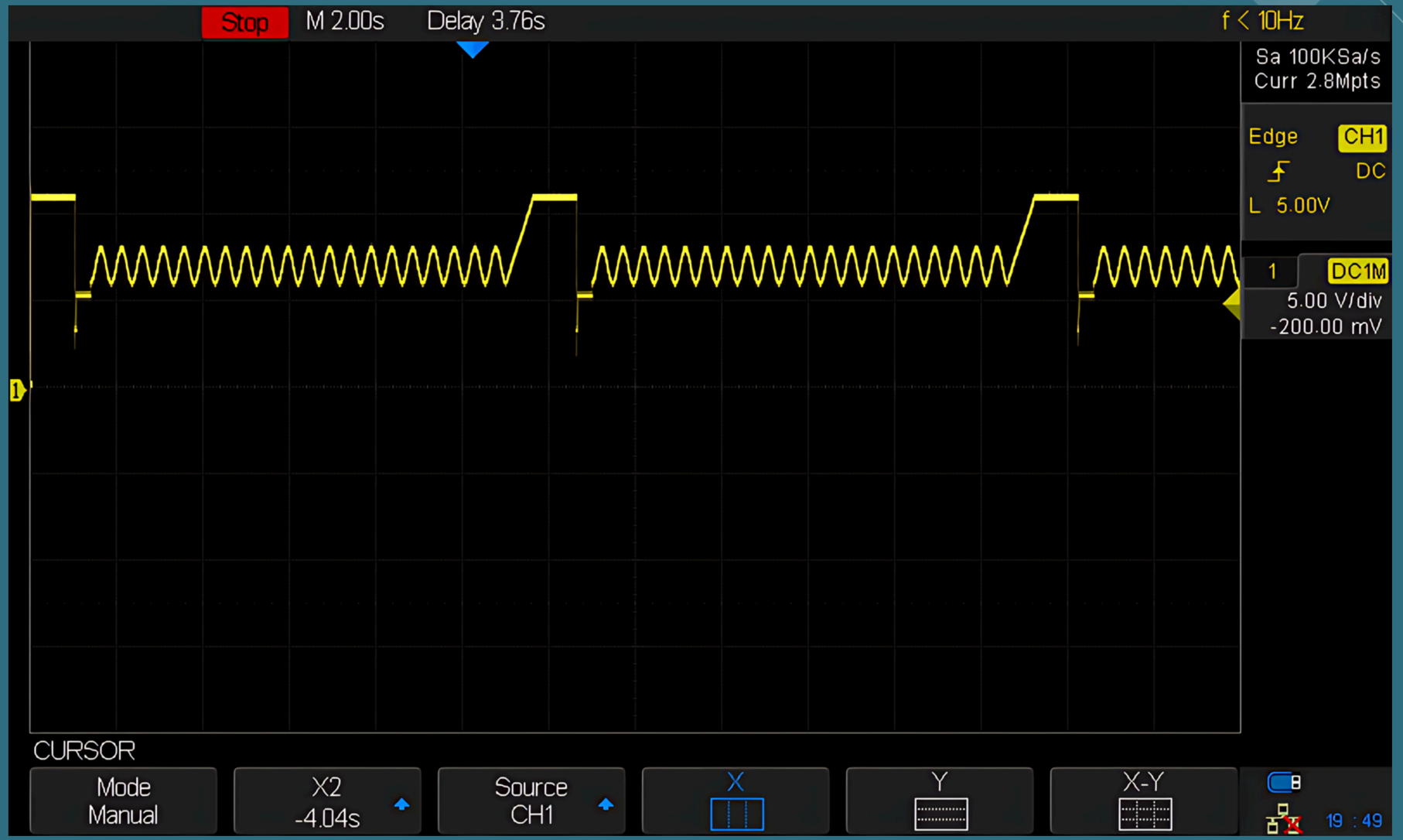
Components relevant for starting:

Test case 1 – Cold start: "Normal" test pulse: functional status A;"Severe" test pulse: functional status B

Components not relevant to starting:

Test case 1 – Cold start: "Normal" test pulse: functional status C;"Severe" test pulse: functional status C

Cold Start



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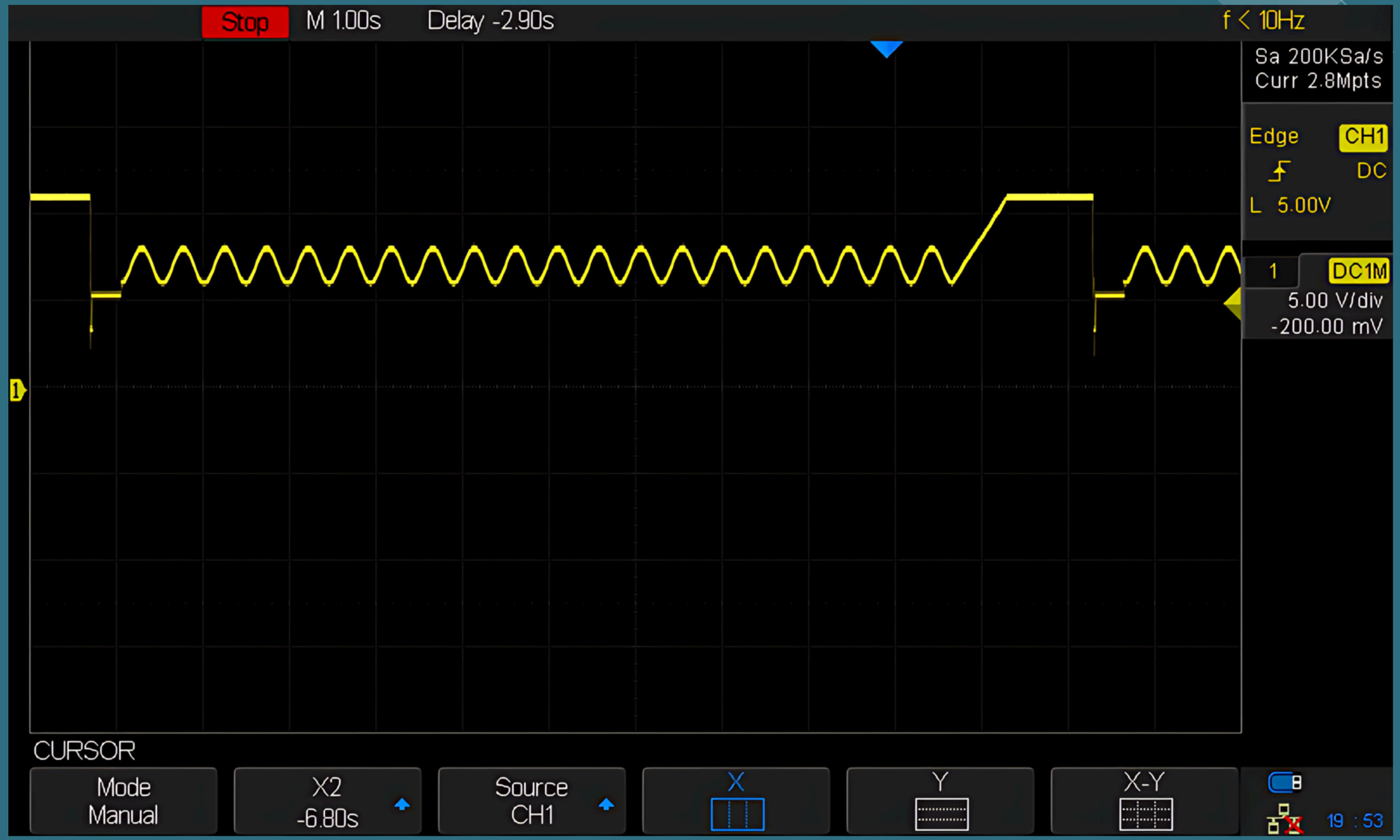
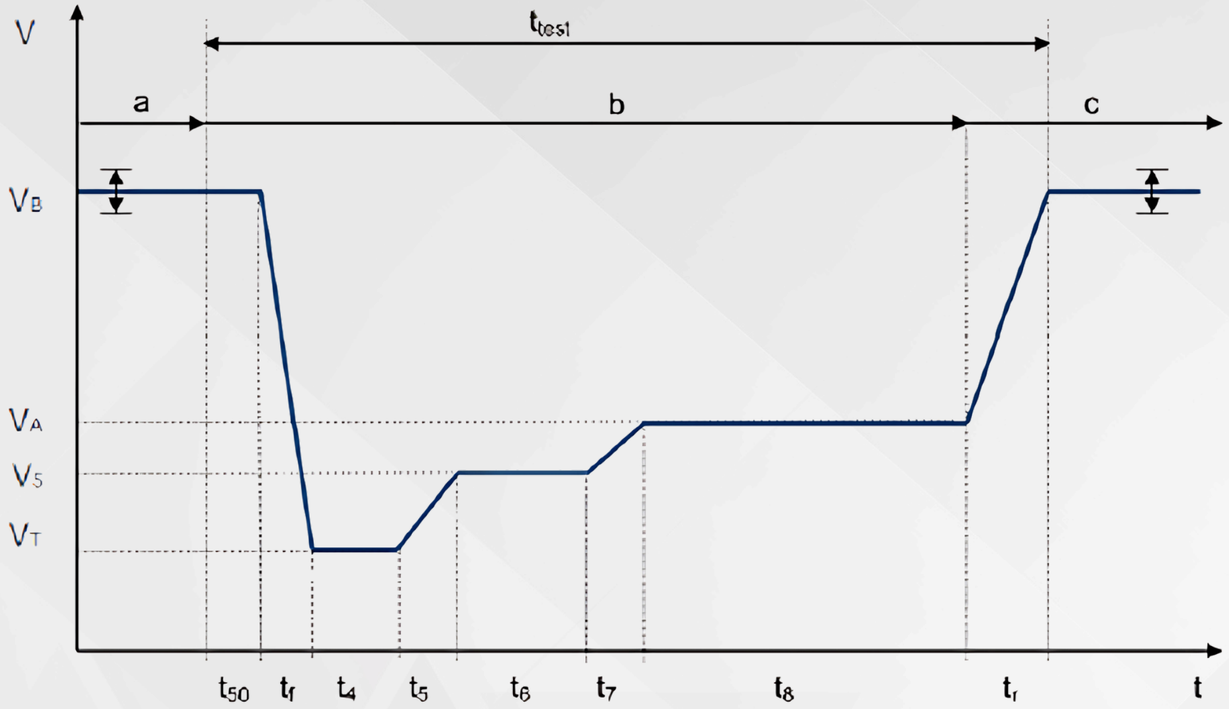
Cold Start



DSO Captured Waveform

Warm Start



Parameters	"Short" test sequence	"Long" test sequence
V_B	11,0 V	
V_T	7,0 V (0%, -4%)	
V_S	8,0 V (0%, -4%)	
V_A	9,0 V (0%, -4%)	
t_{50}	≥10 ms	
t_f	≤1 ms	
t_4	15 ms	
t_5	70 ms	
t_6	240 ms	
t_7	70 ms	
t_8	600 ms	
t_r	≤1 ms	
Break between two cycles	5 s	20 s
Test cycles	10	100

Components relevant for starting:

Test case 2 – Hot start: "Long" test sequence: functional status A;"Short" test sequence: functional status A

Components not relevant to starting:

Test case 2 – Hot start: "Long" test sequence: functional status A;"Short" test sequence: functional status A

Cold Cranking

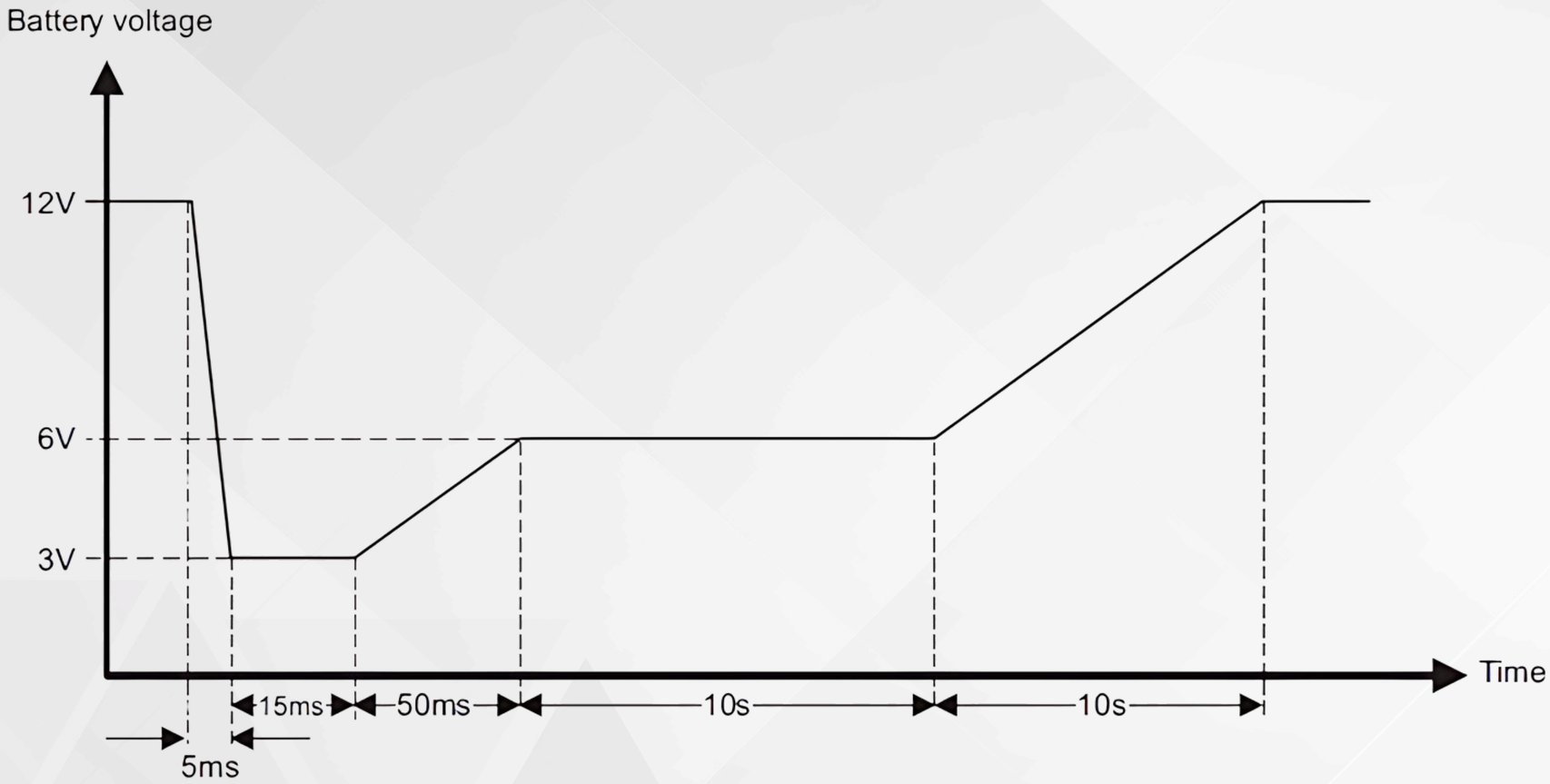


Figure 1. Typical Battery Voltage Profile Under a Cold-Cranking Condition

Cold Cranking

DSO Captured Waveform

scientiFic®

Scientific Mes-Technik Pvt. Ltd.,

B14, Industrial Estate, Pologround, Indore 452015, India

info@scientificindia.com

www.scientificindia.com

0731- 2422330-33