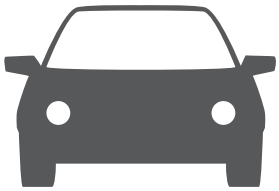
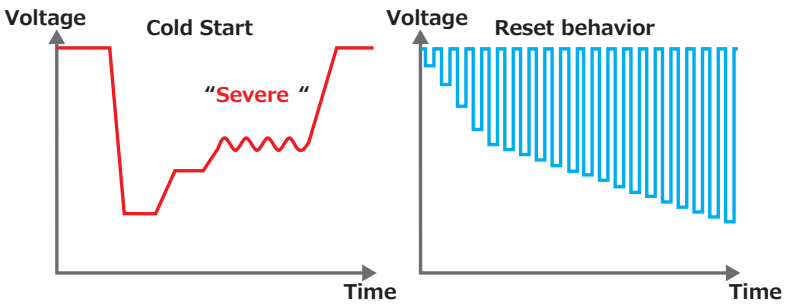
LV 124 & LV 148 Automotive Testing

ASR-2000 / ASR-3000 Series Programmable AC/DC Power Source

Utilize ASR-2000/3000 AC/DC power source for LV124 & LV148





LV 124 Electric and Electronic Components in Motor Vehicles up to 3.5t with a 12 V electric system - General Requirements Test Conditions and Tests

LV 148 Electric and Electronic Components for Vehicles with a 48V Electrical System Test Conditions and Tests

1.1.1 Tolerances

Standard tolerances		LV 124	LV 148
	Parameter	Tolerance	
f	Frequencies	± 1 %	± 1 %
T	Temperature	± 2°C	± 2°C
Frel	Humidity	± 5 %	± 5 %
t	Times	+ 5 %; 0 %	+ 5 %; 0 %
U	Voltages	± 2 %	± 0.5 %
I	Current	± 2 %	± 2 %

Standard values		LV 124	LV 148
Parameter		Tolerance	
TRT	Room temperature	23°C ± 5 °C	23°C ± 5 °C
Frel	Humidity	25 % to 75 % rel. humidity	25 % (+5 to 0 %) up to 75 % (-5 to 0 %) rel. humidity
Ttest	Test temperature	TRT room temperature	TRT room temperature
UB	Operating voltage (for test)	UB = 14 V	U48x
Ri	Source impedance	Ri ≦ 100 mΩ (E6) Ri < 30 mΩ / 100 mΩ (E15)	10 mΩ ≦ Ri ≦ 100 mΩ

1.1.2 Operating voltage range LV 124 / LV 148

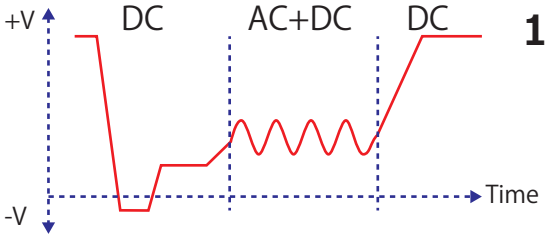
Code	Ubmin	Ubmax	Function / description LV 124
a	6 V	16 V	For functions that must retain their
			performance during starting of the engine
b	8 V	16 V	For functions that do not have to retain their
			performance during starting of the engine
			This encoding must only be used if the
			component cannot be classified in the
			encoding a, c or d.
c	9 V	16 V	For functions that must retain their
			performance when the engine is not
			running
d	9.8 V	16 V	For functions that must retain their
			performance when the engine is running

Shortcut	Terms LV 148	Values
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	58 V
U48max,high,limited	Max. voltage of the upper operating range with functional restriction	54 V
U48max,unlimited	Max. voltage of the operating range without functional restriction	52 V
U48n	BN48- nominal voltage	48 V
U48min,unlimited	Min. voltage of the operating range without functional restriction	24 V
U48min,low,limited	Min. voltage of the lower operating range with functional restriction	20 V
U48stoprotect	Accumulator protected voltage	
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	14 V
U24test	BN24- test voltage	28 V

LV 124 & LV 148 Automotive Testing

ASR-2000/2000R Series Programmable AC/DC Power Source

Need an AC+DC waveform power source?



500VA ASR-2050R
1000VA ASR-2100R

500VA ASR-2050
1000VA ASR-2100

Features

- Output Capacity: 500VA/500W ASR-2050(R), 1000VA/1000W ASR-2100(R)
- Output Rating: AC; 0 – 350 Vrms(@200V range), DC, AC+DC; 0 - ± 500 V(@200V range)
- Output mode: AC+DC-INT, AC-INT, DC-INT, AC+DC-EXT, AC-EXT, AC+DC-ADD, AC-ADD, AC+DC-SYNC, AC-SYNC
- Output Frequency: AC+DC mode; DC, 1Hz to 999.9 Hz, AC mode; 40Hz to 999.9Hz
- DC Output (100% of Rated Power): 0 - ± 500 V
- Measurement Items: Vrms, Vavg, Vpeak, Irms, IpkH, Iavg, Ipeak, P, S, Q, PF, CF, Voltage and Current Harmonic Analysis: THDv, THDi
- Remote Sensing
- Protection: OVP, OCP, OPP, OTP, AC Fail Detection and Fan Fail Alarm.
- Arbitrary Waveform Function: 16-bit, 4096 words, 16 ARB waveform memories
- Output On/Off Phase Angle control: 0.0° to 359.9° , variable (setting resolution 0.1°)
- Sequence Function: up to 999 steps, , up to 10 memories, Mode; DC-INT, AC-INT, and AC+DC-INT
- Simulation Function: 6 steps(Init, Normal1, Trans1, Abnormal, Trans2, Normal2, Init), up to 10 memories, Mode; AC+DC-INT
- Interface: USB Device and , LAN as standard, RS-232+GPIB as optional
- External Control I/O: Input; Sequence control (Start, Stop, Hold, branch 1/2,
  Output; Power source on/off, Output on/off , Software busy, Sequence sync output 0/1
- External Signal Input: SYNC mode; Synchronizing the output frequency with this external input signal
  EXT and ADD mode: Outputting the amplified external input signal with input signal.
- Built-in Output Relay Control

Model			ASR-2050 / ASR-2050R		ASR-2100 / ASR-2100R	
Output Rating for AC Mode						
Range			100 V	200 V	100 V	200 V
Voltage		Setting Range	0.0 V to 175.0 V,	0.0 V to 350.0 V	0.0 V to 175.0 V	0.0 V to 350.0 V
		Setting Resolution	0.1V			
		Accuracy*2	±(0.5 % of set + 0.6 V / 1.2 V)			
Output phase			Single phase, Two-wire			
Maximum current*3			5 A	2.5 A	10 A	5 A
Maximum peak current*4			20 A	10 A	40 A	20 A
Power capacity			500 VA		1000 VA	
Frequency	Setting range	AC Mode:	40.00 Hz to 999.9 Hz			
		AC+DC Mode:	1.00 Hz to 999.9 Hz			
	Setting resolution		0.01 Hz (1.00 to 99.99 Hz), 0.1 Hz (100.0 to 999.9 Hz)			
Output on phase			0.0° to 359.9° variable (setting resolution 0.1°)			
DC offset*6			Within ± 20 mV (TYP)			
Output Rating for DC Mode						
Range			100 V	200 V	100 V	200 V
Voltage		Setting Range	-250 V to +250 V	-500 V to +500 V	-250 V to +250 V	-500 V to +500 V
		Setting Resolution	0.1V			
		Accuracy*2	±(|0.5 % of set| + 0.6 V / 1.2 V)			
Maximum current*3			5 A	2.5 A	10 A	5 A
Maximum peak current*4			20 A	10 A	40 A	20 A
Power capacity			500 W		1000 W	

LV 124 & LV 148 Automotive Testing

ASR-3000 Series Programmable AC/DC Power Source

2000VA ASR-3200
3000VA ASR-3300
4000VA ASR-3400

Features

- Output Capacity: 2000VA/2000W ASR-3200, 3000VA/3000W ASR-3300
- Output Rating: AC 0 – 400 Vrms, DC 0 - ± 570 V @ 200V range
- Output mode: AC+DC-INT, AC-INT, DC-INT, AC+DC-EXT, AC-EXT, AC+DC-ADD, AC-ADD, AC+DC-SYNC, AC-SYNC
- Output Frequency: AC+DC mode; DC, 1Hz to 999.9 Hz, AC mode; 40Hz to 999.9Hz
- DC Output: (100% of Rated Power): 0 - ± 570 V
- Measurement Items: Vrms, Vavg, Vpeak, Irms, IpkH, Iavg, Ipeak, P, S, Q, PF, CF, Voltage and Current Harmonic Analysis(THDv, THDi)
- Remote Sensing
- Protection: OCP, OPP, OTP, AC Fail Detection and Fan Fail Alarm.
- Arbitrary Waveform Function: 16-bit, 4096 words, 16 ARB waveform memories
- Output On/Off Phase Angle control: 0.0° to 359.9° , variable (setting resolution 0.1°)
- Sequence Function: up to 999 steps, , up to 10 memories, Mode; DC-INT, AC-INT, and AC+DC-INT
- Simulation Function: 6 steps(Init, Normal1, Trans1, Abnormal, Trans2, Normal2, Init), up to 10 memories, Mode; AC+DC-INT
- Interface(std): USB, LAN, RS-232, GPIB
- External Control I/O: Input; Sequence control (Start, Stop, Hold, branch 1/2,
  Output; Power source on/off, Output on/off , Software busy, Sequence sync output 0/1
- External Signal Input: SYNC mode; Synchronizing the output frequency with this external input signal
  EXT and ADD mode: Outputting the amplified external input signal with input signal.
- Built-in Output Relay Control
- Built-in Web Server

Model			ASR-3200		ASR-3300		ASR-3400	
Output Rating for AC Mode								
Range			100 V	200 V	100 V	200 V	100 V	200 V
Voltage		Setting Range	0.0 V to 200.0 V	0.0 V to 400.0 V	0.0 V to 200.0 V	0.0 V to 400.0 V	0.0 V to 200.0 V	0.0 V to 400.0 V
		Setting Resolution	0.1V					
		Accuracy*2	±(0.5 % of set + 0.6 V / 1.2 V)					
Output phase			Single phase, Two-wire					
Maximum current*3			20A	10 A	30 A	15 A	40 A	20 A
Maximum peak current*4			120 A	60 A	180 A	90 A	240 A	120 A
Power capacity			2000 VA		3000 VA		4000 VA	
Frequency	Setting range	AC Mode:	40.00 Hz to 999.9 Hz					
		AC+DC Mode:	1.00 Hz to 999.9 Hz					
	Setting resolution		0.01 Hz (1.00 to 99.99 Hz), 0.1 Hz (100.0 to 999.9 Hz)					
Output on phase			0.0° to 359.9° variable (setting resolution 0.1°)					
DC offset*6			Within ± 20 mV (TYP)					
Output Rating for DC Mode								
Range			100 V	200 V	100 V	200 V	100 V	200 V
Voltage		Setting Range	-285V to +285 V	-570 V to +570 V	-285V to +285 V	-570 V to +570 V	-285V to +285 V	-570 V to +570 V
		Setting Resolution	0.1V					
		Accuracy*2	±(|0.5 % of set| + 0.6 V / 1.2 V)					
Maximum current*3			20 A	10 A	30 A	15 A	40 A	20 A
Maximum peak current*4			120 A	60 A	180 A	90 A	240 A	120 A
Power capacity			2000 W		3000 W		4000 W	

Sequence

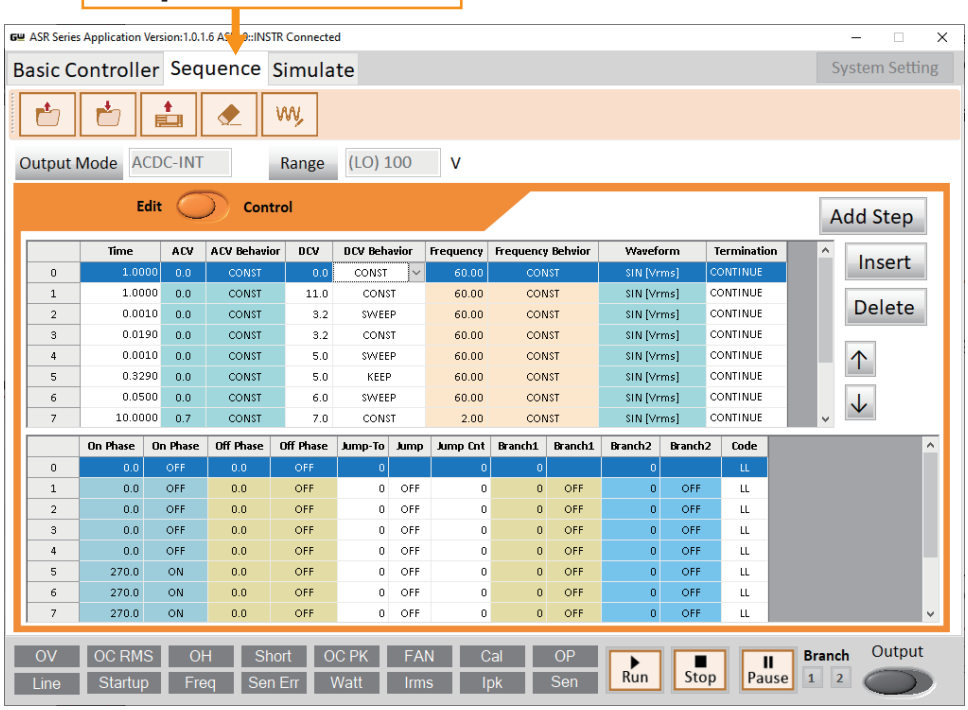
Create complex output waveforms.

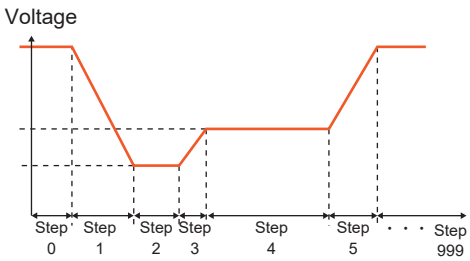
GW INSTEK
Simply Reliable Since 1975

The ASR series have a powerful sequence function that can create complex output waveforms.
The sequence feature works in DC-INT, AC-INT, and AC+DC-INT modes and includes DC, sine, square, triangle, and 16 arbitrary waveforms.
The sequence function consists of a total of 1000 steps (0 to 999 step).
Available parameters and waveforms depend on the selected output mode.
Each step can set the waveform, Voltage, and duration Time and select the behavior (constant/hold/sweep) for each step.
It also has a branch function to a specified step during sequence operation. All sequence data can save 10 internal sequence memories (SEQ0 to SEQ9) or external USB sticks.
Since the sequence function can control Start, Stop, Hold, and Branch from the External Control I/O, it can be used in combination with an external device.

PC Software of ASR

Sequence screen





[Output parameters]

- Time: 0.0001 ~ 999.9999s,resolution 0.0001s
- AC voltage*1: 0.0 - 350.0V (Range 200V) , 0.0 - 175.0V (Range 100V)
- DC voltage*1: 0.0 - ±500.0V (Range 200V), 0.0 - ±250.0V (Range 100V)
- Frequency: 1.00 - 999.9Hz (AC+DC-INT) , 40.00 - 999.9(AC-INT)
- Waveform: SIN / SQU / TRI / ARB1 to ARB16 (AC-DC-INT/AC-INT)
- On / OFF Phase: Free, Fixed (0.0 ~ 359.9º)
- Sync Code*2: Sequence sync output 0(L)/1(H) via External I/O connector

[Step operation types]

ACV/DCV Behaivior

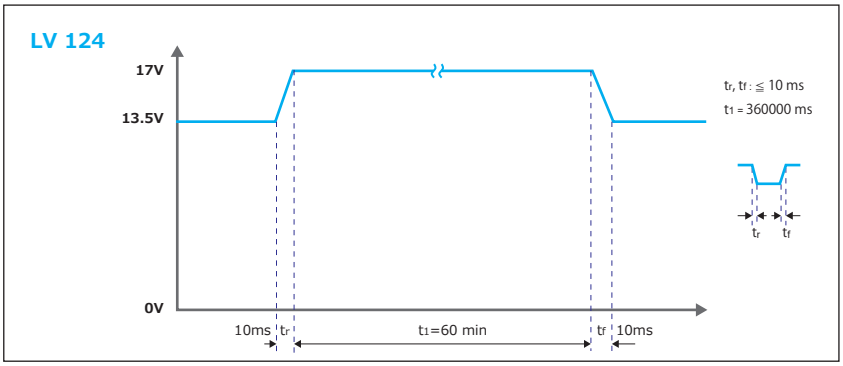
- CONST: the step immediately to setting values.
- KEEP : Keep the value of the previous step.
- SWEEP: Linearly increases or decreases the values from the end of the previous step to the end of the current step.

*: Maximum output voltage: ASR-2000; 500Vpp = DC+ACpp, ASR-3000; 570Vpp=DC+ACpp

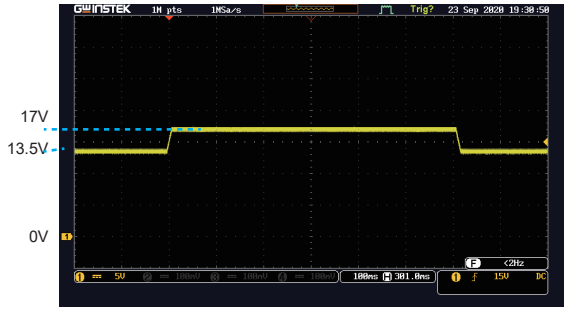
Number of sequences:	Retained for each operation mode (DC-INT, AC-INT and AC+DC-INT) and output voltage range (100 V/200 V).
Number of steps:	1 to 999 (per sequence) , Step 0 is assigned as a “Standby” step
Step time:	0.1 ms to 999.9999 s (resolution 0.1 ms or 0.0001 s)
Operations within step:	CT(Constant), KP(Keep), or SP(Linear Sweep)
Parameter:	DC voltage, AC voltage, frequency, waveform, phase (start, end), step synchronized output (2 bits)
Jump times:	1 to 999 or infinite
ON/OFF Phs	Sets the start and stop phase of the AC waveform for each step. (AC+DC-INT and AC-INT modes)

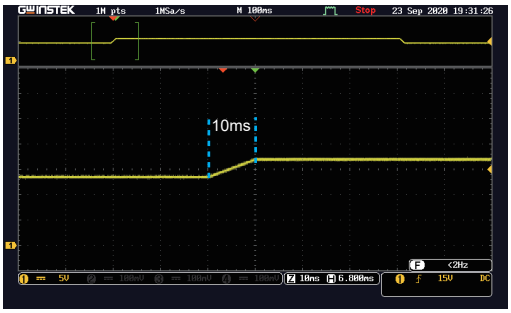
E-01 Long-term over voltages

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



Note: This waveform changed 600 min to 0.6 s.



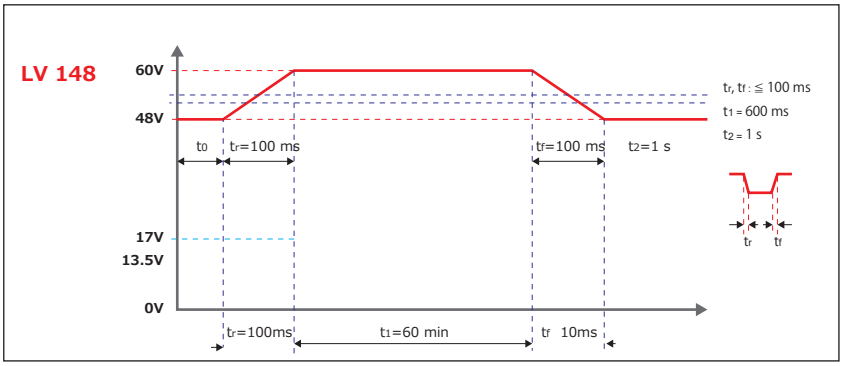


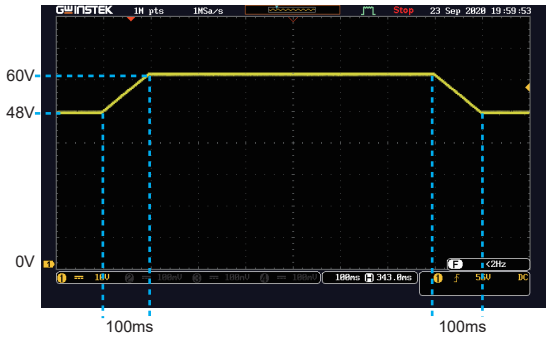
LV 124

Repeat

Mode: DC-INT

			tr	t1		tf	t2
Step No.	0	1	2	3	4	5	6
Time[ms]	0.0100	0.0100	0.0100	600.00	600.00	0.0100	0.6000
DCV [V]	13.5	13.5	17.0	17.0	17.0	13.5	13.5
DCV Behavior	CONST	CONST	SWEEP	KEEP	KEEP	SWEEP	END
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE
Jump-To	0	0	0	0	3	0	0
Jump		OFF	OFF	OFF	ON	OFF	ON
Jump Cnt	0	0	0	0	2	0	0
Branch 1	0	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL	LL





Note: This waveform changed 600 s to 6.0 s.

LV 148

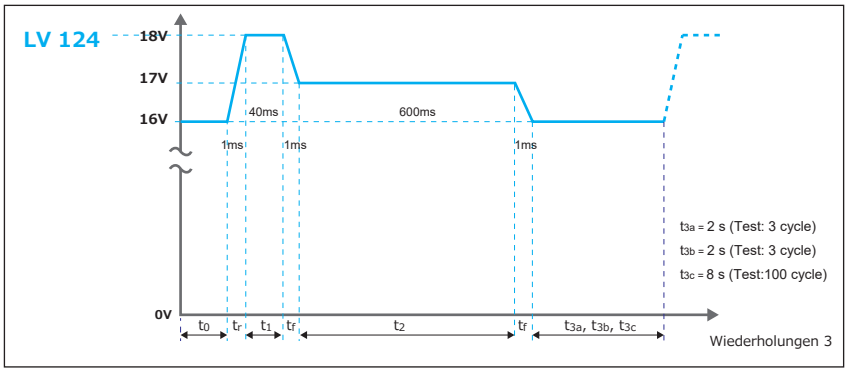
Repeat

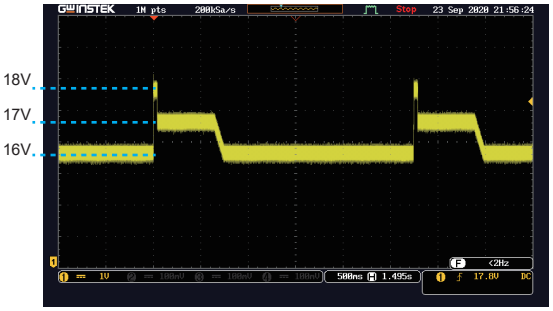
Mode: DC-INT

			tr	t1		tf	t2
Step No.	0	1	2	3	4	5	6
Time[ms]	0.0100	0.0100	0.1000	600.00	600.00	0.1000	1.0000
DCV [V]	48.0	48.0	60.0	60.0	60.0	48.0	48.0
DCV Behavior	CONST	CONST	SWEEP	KEEP	KEEP	SWEEP	END
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE
Jump-To	0	0	0	0	3	0	0
Jump		OFF	OFF	OFF	ON	OFF	ON
Jump Cnt	0	0	0	0	2	0	0
Branch 1	0	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL	LL

E02 Transiente overvoltages

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.





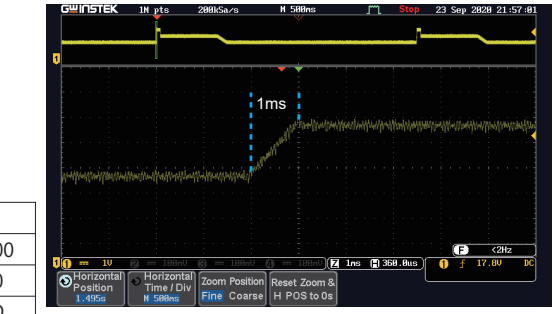
LV 124 : 3 Test cases on different temperatures; Functional status: A

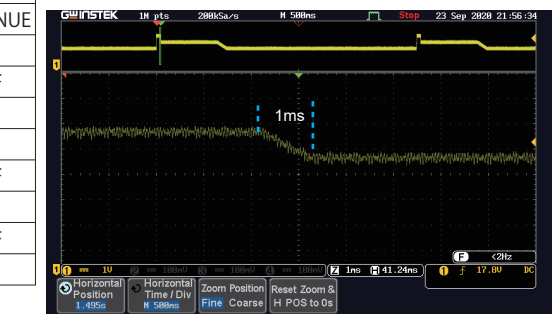
LV 124

Mode: DC-INT

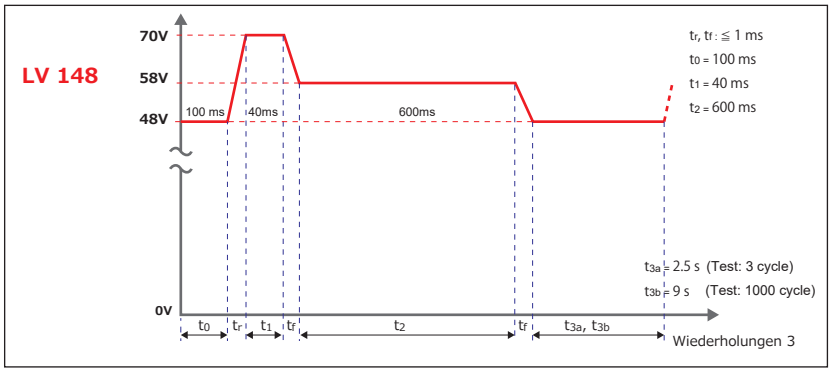
Repeat

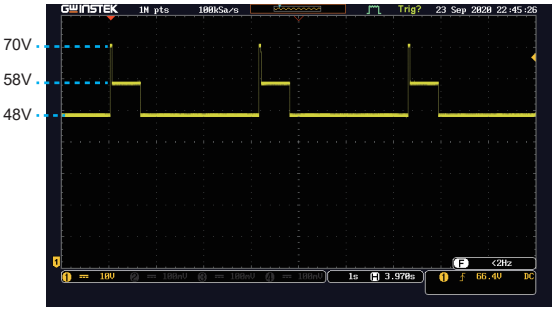
Step No.	0	1	2	3	4	5	6	7
Time[ms]	0.0100	0.0010	0.0400	0.0010	0.600	0.1000	0.6000	0.6000
DCV [V]	16.0	18.0	18.0	17.0	17.0	16.0	16.0	16.0
DCV Behavior	CONST	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP	END
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE
Jump-To	0	0	0	0	0	0	1	0
Jump		OFF	OFF	OFF	OFF	OFF	ON	OFF
Jump Cnt	0	0	0	0	0	0	3	0
Branch 1	0	0	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL	LL	LL





LV 148



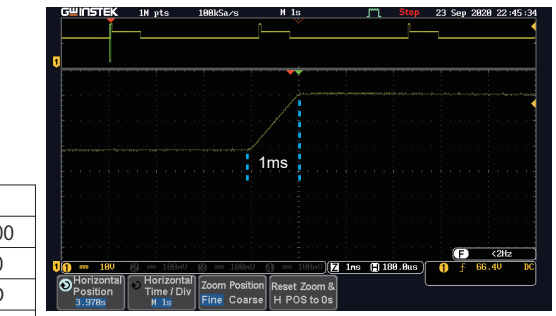


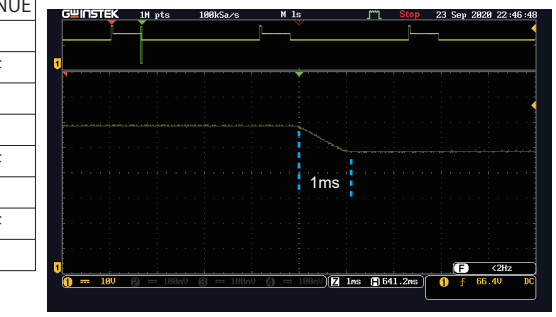
LV 148: 2 tests, short test 3x, long duration test 1000x, Ri: 10 mΩ ≤ Ri ≤ 100 mΩ
Functional status: A

Mode: DC-INT

Repeat

Step No.	0	1	2	3	4	5	6	7
Time[ms]	0.1000	0.0010	0.0400	0.0010	0.600	0.1000	2.5000	2.0000
DCV [V]	48.0	70.0	70.0	58.0	58.0	48.0	48.0	48.0
DCV Behavior	CONST	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP	END
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE
Jump-To	0	0	0	0	0	0	1	0
Jump		OFF	OFF	OFF	OFF	OFF	ON	OFF
Jump Cnt	0	0	0	0	0	0	3	0
Branch 1	0	0	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL	LL	LL

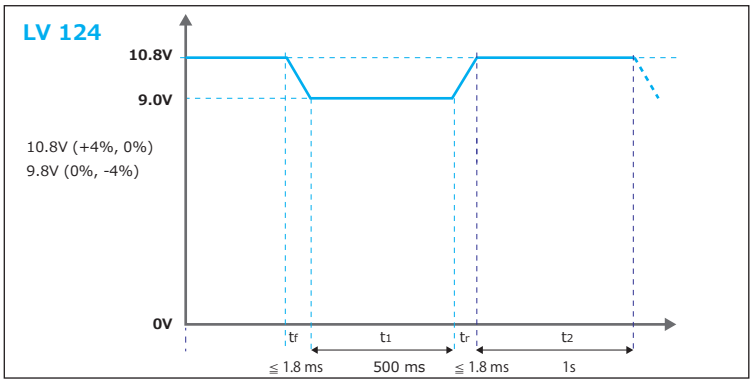


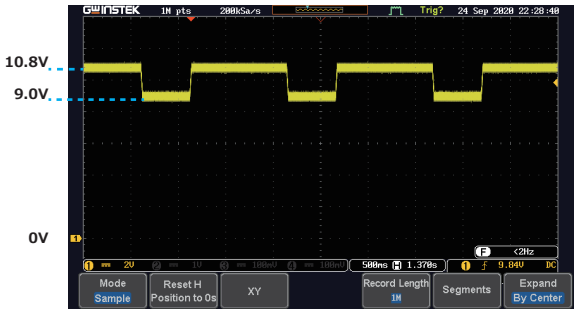


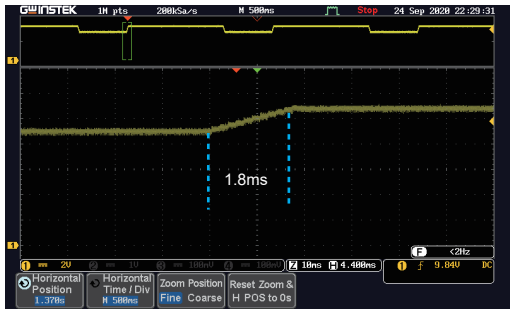
E-03, E48-03

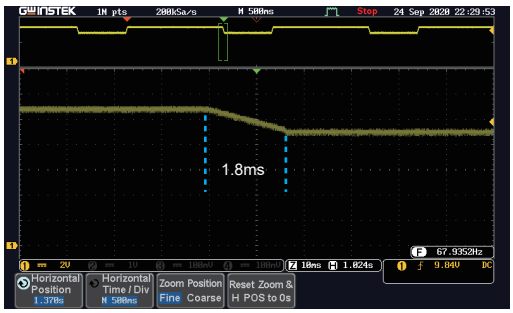
Transiente Undervoltages

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





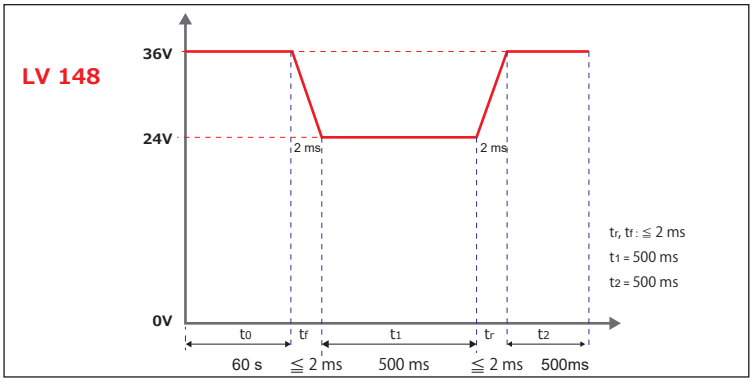


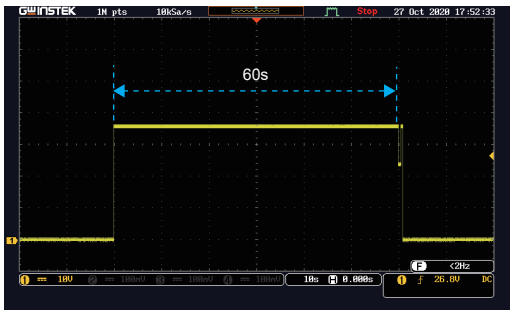


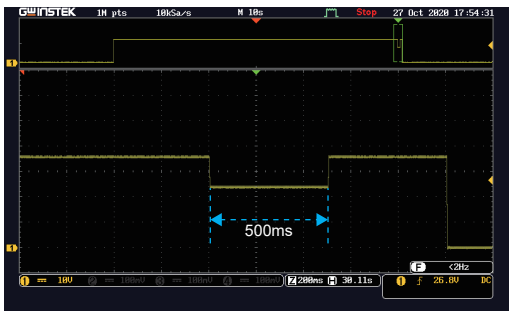
LV 124
Mode: DC-INT

Repeat

Step No.	0	1	2	3	4	5
Time[ms]	0.1000	0.0180	0.5000	0.0180	1.000	1.0000
DCV [V]	10.8	9.0	9.0	10.8	10.8	10.8
DCV Behavior	CONST	SWEEP	KEEP	SWEEP	KEEP	KEEP
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	END
Jump-To	0	0	0	0	1	0
Jump		OFF	OFF	OFF	ON	OFF
Jump Cnt	0	0	0	0	2	0
Branch 1	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL

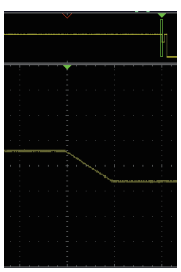


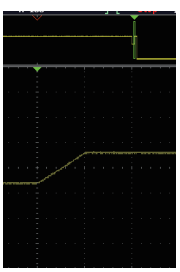




LV 148
Mode: DC-INT

Step No.	0	1	2	3	4	5
		t_0	t_f	t_1	t_r	t_2
Time[ms]	0.0100	60.000	0.0020	0.5000	0.0020	0.5000
DCV [V]	0.0	36.0	24.0	24.0	36.0	48.0
DCV Behavior	CONST	CONST	SWEEP	KEEP	SWEEP	SWEEP
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	END
Jump-To	0	0	0	0	0	0
Jump		OFF	OFF	OFF	OFF	OFF
Jump Cnt	0	0	0	0	0	0
Branch 1	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL

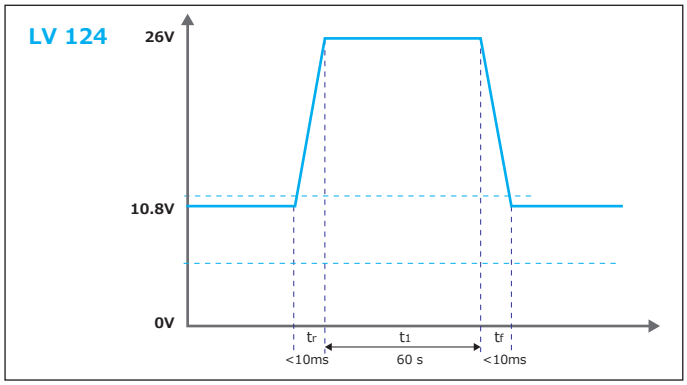


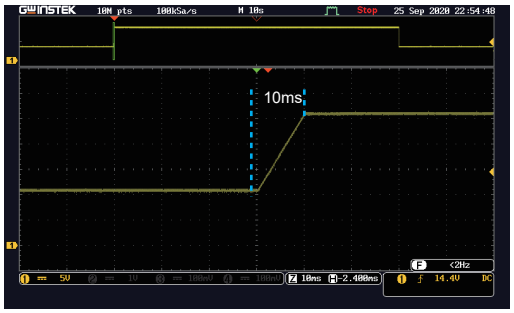


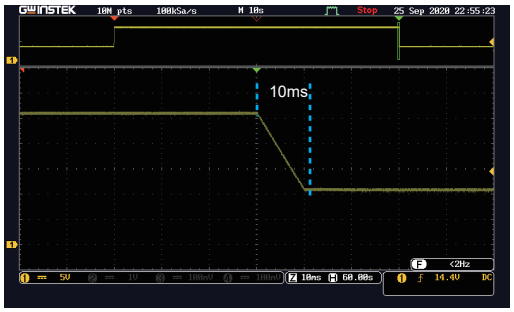
E-04, E

Jumpstart, resp. Recuperation

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.





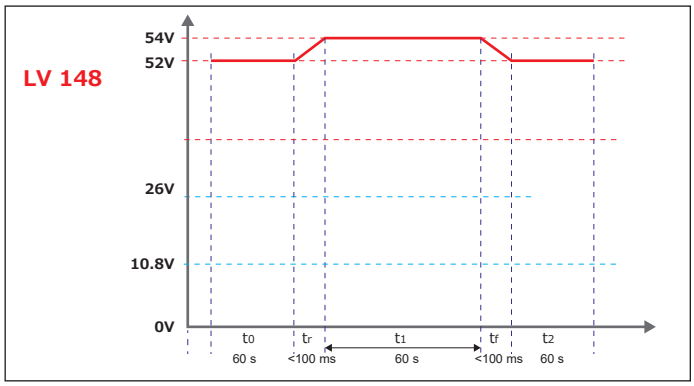


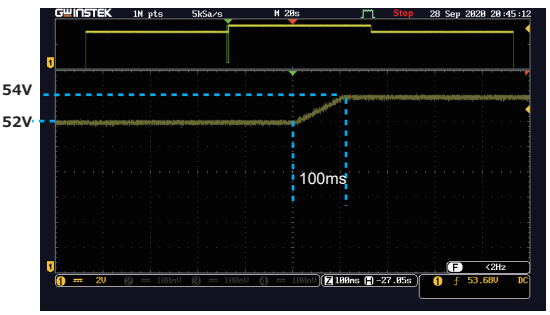
Number of cycles: 1

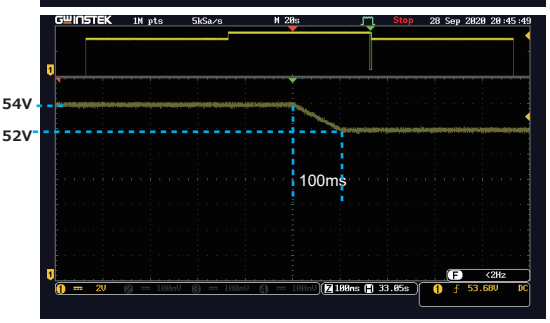
LV 124

Mode: DC-INT

Step No.	0	1	2	3	4	5	6
Time[ms]	0.0100	20.000	0.0100	60.00	0.0100	0.0100	0.6000
DCV [V]	0.0	10.8	26.0	26.0	10.8	13.5	13.5
DCV Behavior	CONST	CONST	SWEEP	KEEP	SWEEP	KEEP	END
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE
Jump-To	0	0	0	0	0	0	0
Jump		OFF	OFF	OFF	OFF	OFF	ON
Jump Cnt	0	0	0	0	0	0	0
Branch 1	0	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL	LL







Number of cycles: 1

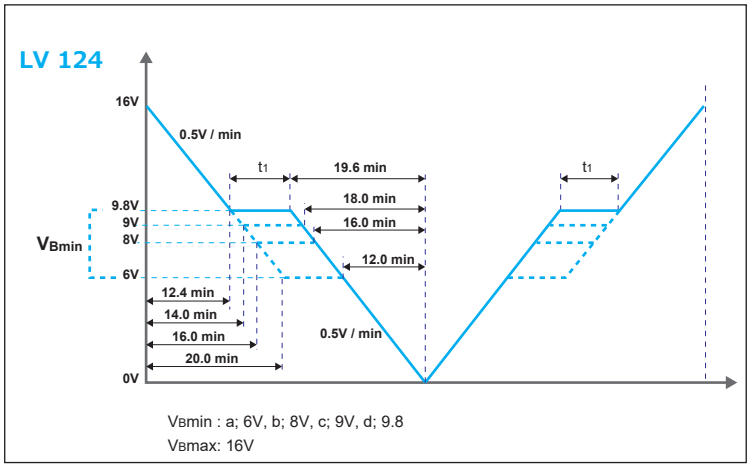
LV 148

Mode: DC-INT

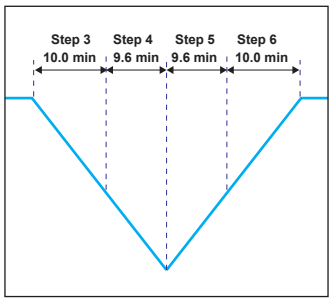
Step No.	0	1	2	3	4	5	6
Time[ms]	0.0100	60.000	0.1000	60.00	0.1000	60.0000	0.0100
DCV [V]	0.0	52.0	54.0	54.0	52.0	52.0	0.0
DCV Behavior	CONST	CONST	SWEEP	KEEP	SWEEP	KEEP	END
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE
Jump-To	0	0	0	0	0	0	0
Jump		OFF	OFF	OFF	OFF	OFF	ON
Jump Cnt	0	0	0	0	0	0	0
Branch 1	0	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL	LL

E-07 Slow decrease and increase of the supply voltage

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.



The maximum Step time for Sequence mode is 999.9999 seconds. If you want to set a time that exceeds the maximum step time, you can set it by combining steps.



Number of cycles: 1
t1/t2: Holding time at V1/V2 until event memory has been completely read out

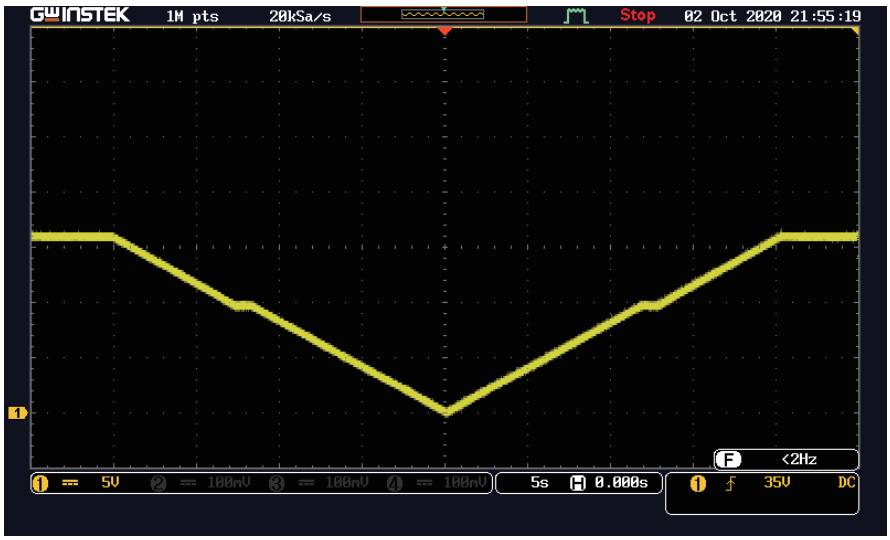
LV 124

Mode: DC-INT

VBmin=9.8V **19.6 min** **19.6 min**

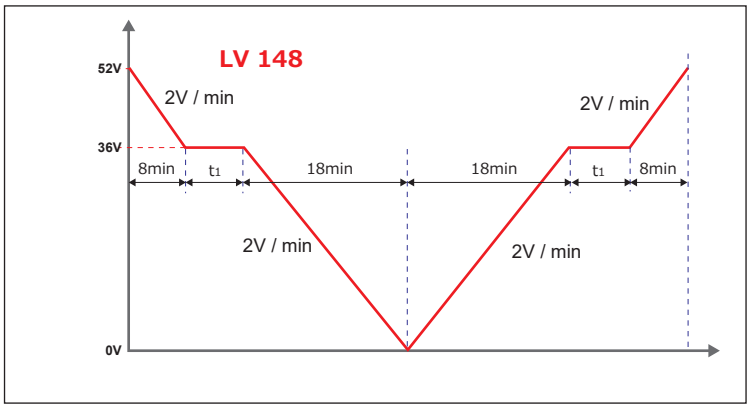
Step No.	0	1	2	3	4	5	6	7	8
Time[ms]	0.0100	744.0000	10.0000	600.0000	576.0000	576.0000	600.0000	10.0000	744.0000
DCV [V]	16.0	9.8	9.8	4.8	0	4.8	9.8	9.8	16.0
DCV Behavior	CONST	SWEEP	KEEP	SWEEP	SWEEP	SWEEP	SWEEP	KEEP	SWEEP
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	END
Jump-To	0	0	0	0	0	0	0	0	0
Jump		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Jump Cnt	0	0	0	0	0	0	0	0	0
Branch 1	0	0	0	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL	LL	LL	LL

In the figure below, the steps time changed so that the overall image is easy to understand.

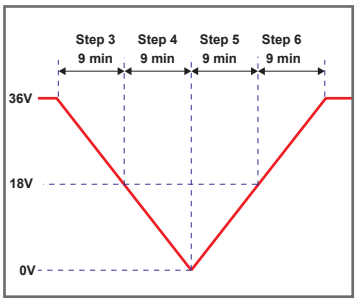


E48-06a Slow decrease and increase of the supply voltage

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.



The maximum Step time for Sequence mode is 999.9999 seconds. If you want to set a time that exceeds the maximum step time, you can set it by combining steps.

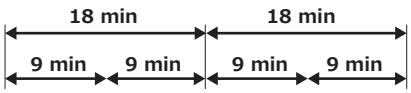


Number of cycles: 1
t1/t2: Holding time at V1/V2 until event memory has been completely read out

Number of cycles: 1
Functional status: depends on voltage range

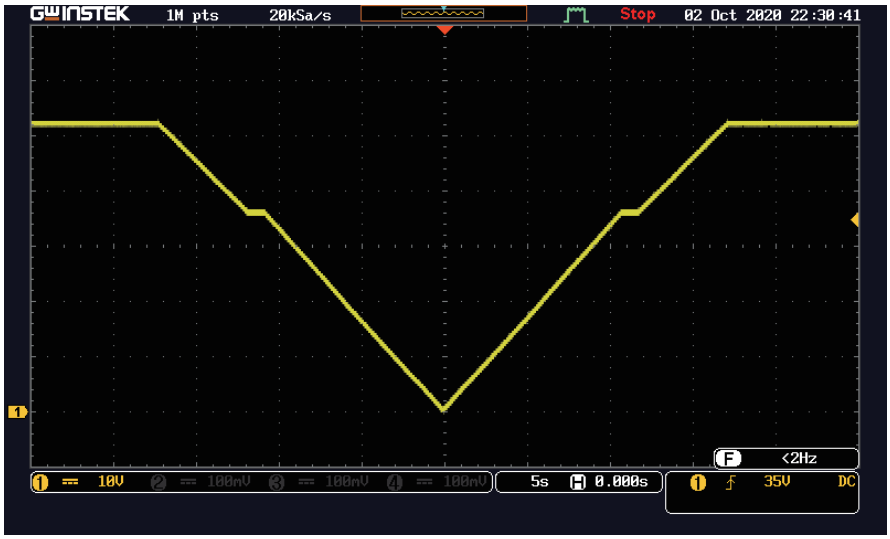
LV 148

Mode: DC-INT



Step No.	0	1	2	3	4	5	6	7	8
Time[ms]	0.0100	540.0000	10.0000	540.0000	540.0000	540.0000	540.0000	10.0000	540.0000
DCV [V]	52.0	36.0	36.0	18.0	0	18.0	36.0	36.0	52.0
DCV Behavior	CONST	SWEEP	KEEP	SWEEP	SWEEP	SWEEP	SWEEP	KEEP	SWEEP
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE
Jump-To	0	0	0	0	0	0	0	0	0
Jump		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Jump Cnt	0	0	0	0	0	0	0	0	0
Branch 1	0	0	0	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL	LL	LL	LL

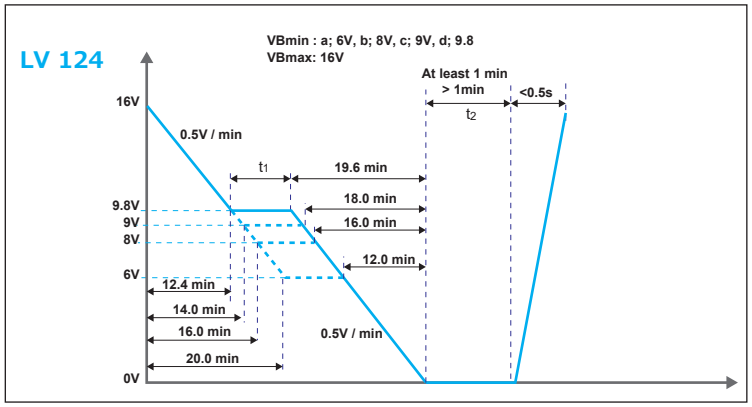
In the figure below, the steps time changed so that the overall image is easy to understand.



E-08, E48-07 Slow decrease, fast increase in the supply voltage

LV 124 This test simulates the slow decrease of the battery voltage to 0 V and the sudden reapplication of the battery voltage, e.g., by applying a jump start source.

LV 148 This test simulates the slow decrease of the vehicle system voltage to the energy storage protection voltage followed by shutdown to 0V and the sudden reconnect the system voltage by a charged or new energy storage battery.



Number of cycles: 1 per operating mode II.a / II.c
t1: Holding time at V1 until event memory has been completely read out
t2: At least 1 min; however, as long as internal capacity is completely discharged

LV 124

Mode: DC-INT V_{Bmin} = 9.8V

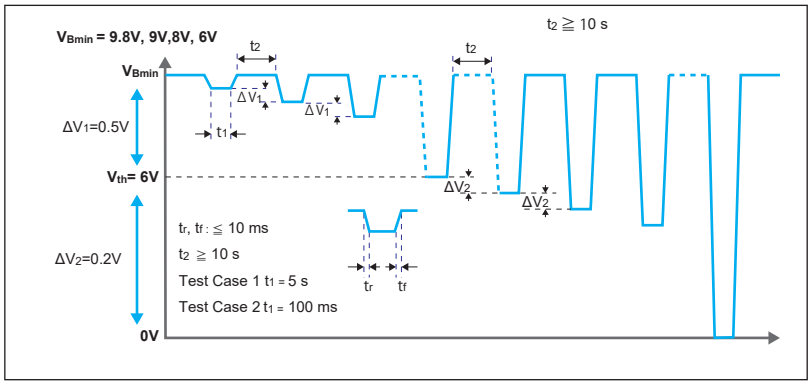
19.6 min

Step No.	0	1	2	3	4	5	6
Time[ms]	0.0100	744.0000	10.0000	600.0000	576.0000	60.0000	0.5000
DCV [V]	16.0	9.8	9.8	4.8	0	0.0	16.0
DCV Behavior	CONST	SWEEP	KEEP	SWEEP	SWEEP	KEEP	SWEEP
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	END
Jump-To	0	0	0	0	0	0	0
Jump		OFF	OFF	OFF	OFF	OFF	OFF
Jump Cnt	0	0	0	0	0	0	0
Branch 1	0	0	0	0	0	0	0
Branch 1		OFF	OFF	OFF	OFF	OFF	OFF
Branch 2	0	0	0	0	0	0	0
Branch 2		OFF	OFF	OFF	OFF	OFF	OFF
Code	LL	LL	LL	LL	LL	LL	LL

In the figure below, the steps time changed so that the overall image is easy to understand.

E-09, E48-08 Reset behavior

The reset behavior of a component in its environment is simulated and tested. Test boundary conditions (e.g., assembly, terminal, system) must be described in detail. During operation, an arbitrary sequence of repeated switching-on/off procedures occurs; this must not lead to an undefined behavior of the component. The reset behavior is represented by a voltage variance and a time variance. Two different test sequences are required to simulate different switch-off times. A component must always undergo both sequences.



Number of cycles: **1 per operating mode II.a / II.c**

Functional status: **Detection when A exits for the first time.**

Jump-To	0
Jump	OFF
Jump Cnt	0
Branch 1	0
Branch 1	OFF
Branch 2	0
Branch 2	OFF
Code	LL

LV 124

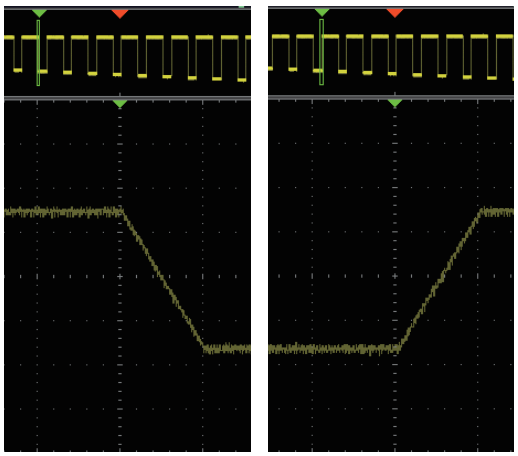
Mode: DC-INT **9.8V** ◄ **ΔV₁=0.5V** ► **6.0V**

Step No.	0	1	2	3	4	5	6	27	28	29	30
Time[ms]	10.0000	0.0100	5.0000	0.0100	10.0000	0.0100	5.0000	0.0100	10.0000	0.0100	5.0000
DCV [V]	9.8	9.3	9.3	9.8	9.8	8.8	8.8	9.8	9.8	6.0	6.0
DCV Behavior	CONST	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE

5.8V ◄ **ΔV₁=0.2V** ► **0.0V**

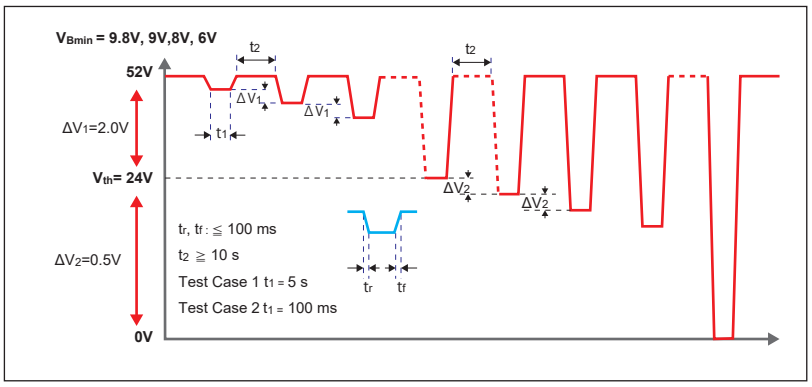
Step No.	31	32	33	34	35	36	37	149	150	151	152
Time[ms]	0.0100	10.0000	0.0100	5.0000	0.0100	10.0000	0.0100	0.0100	10.0000	0.0100	10.0000
DCV [V]	9.8	9.8	5.8	5.8	9.8	9.8	5.6	0.0	0.0	9.8	9.8
DCV Behavior	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP	SWEEP	SWEEP	KEEP	SWEEP	KEEP
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	END

In the figure below, the steps time changed so that the overall image is easy to understand.



E-09, E48-08 Reset behavior

The reset behavior of a component in its environment is simulated and tested. Test boundary conditions (e.g., assembly, terminal, system) must be described in detail. During operation, an arbitrary sequence of repeated switching-on/off procedures occurs; this must not lead to an undefined behavior of the component. The reset behavior is represented by a voltage variance and a time variance. Two different test sequences are required to simulate different switch-off times. A component must always undergo both sequences.



ump-To	0
Jump	OFF
Jump Cnt	0
Branch 1	0
Branch 1	OFF
Branch 2	0
Branch 2	OFF
Code	LL

Requirements **LV 148**

Number of cycles: **1 per operating mode II.c**

Functional status: **Detection when A exits for the first time.**

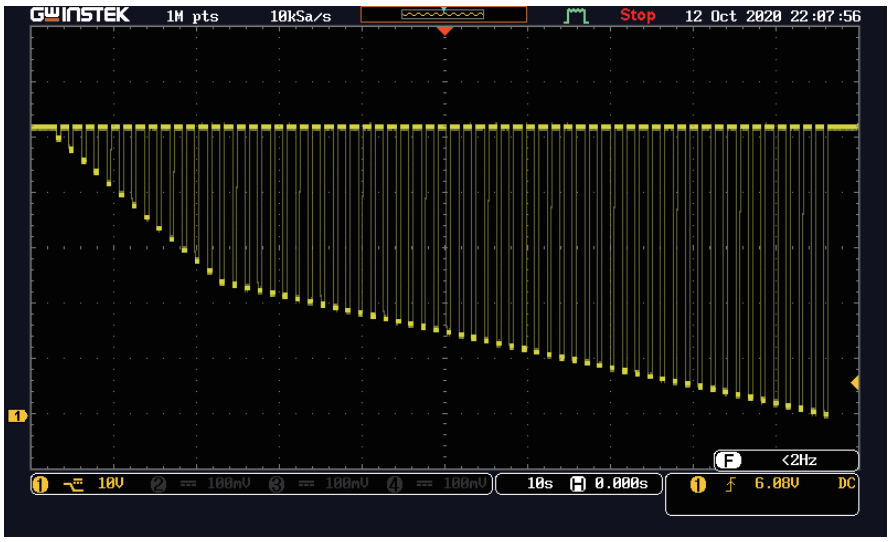
LV 148

Mode: DC-INT **52.0V** ← **ΔV1=2.0V** → **24.0V**

Step No.	0	1	2	3	4	5	6	51	52	53	54
Time[ms]	10.0000	0.1000	5.0000	0.1000	10.0000	0.1000	5.0000	0.0100	10.0000	0.1000	5.0000
DCV [V]	52.0	50.0	50.0	52.0	52.0	48.0	48.0	52.0	52.0	24.0	24.0
DCV Behavior	CONST	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE

23.5V ← **ΔV1=0.5V** → **0.0V**

Step No.	55	56	57	56	57	58	59	245	246	247	248
Time[ms]	0.1000	10.0000	0.1000	5.0000	0.1000	10.0000	0.1000	0.1000	10.0000	0.1000	10.0000
DCV [V]	52.0	52.0	23.5	23.5	52.0	52.0	23.0	0.0	0.0	52.0	52.0
DCV Behavior	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP	SWEEP	SWEEP	KEEP	SWEEP	KEEP
Termination	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	CONTINUE	END



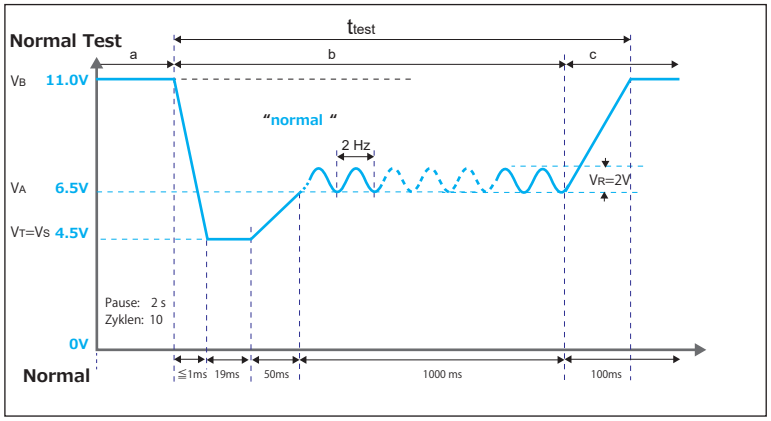
E-11 Start impulse

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.

Test case 1 : Cold start Normal

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

Example: Normal

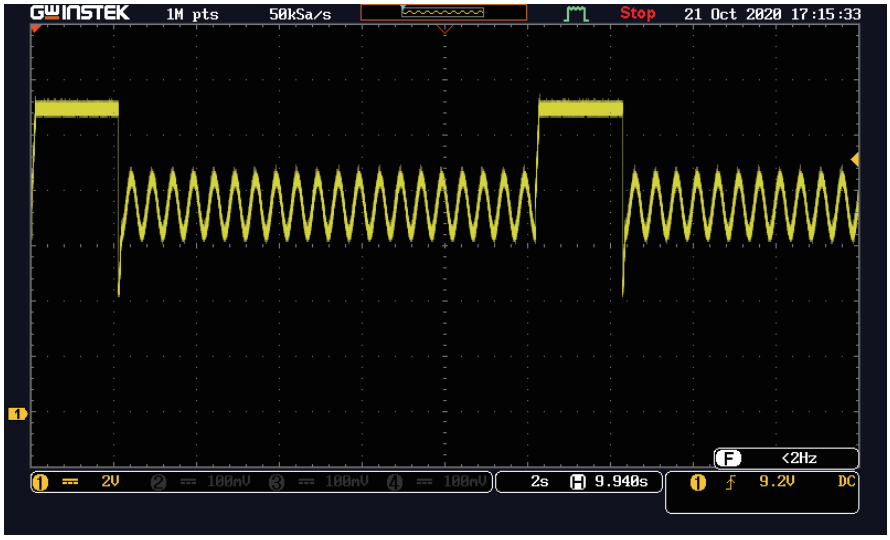


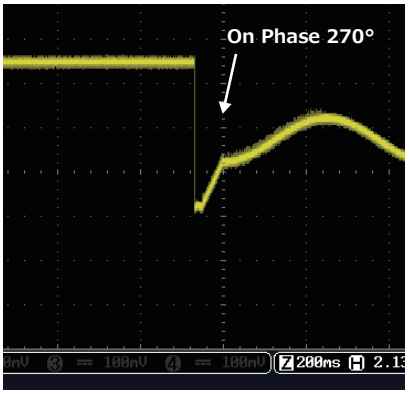
Note: The time axis scale is not the actual ratio.

Mode: AC/DC-INT

Step No.	0	1	2	3	4	5	6	7
Time[ms]	1.0000	1.0000	0.0010	0.0190	0.0500	10.0000	0.1000	1.0000
ACV [Vrms]	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0
ACV Behavior	CONST	CONST	CONST	CONST	CONST	CONST	CONST	CONST
DCV [V]	11.0	11.0	4.5	4.5	6.5	7.5	11.0	11.0
DCV Behavior	CONST	CONST	SWEEP	CONST	SWEEP	CONST	SWEEP	CONST
Frequency [Hz]	60.0	60.0	60.0	60.0	60.0	2.0	60.0	60.0
Frequency Behavior	CONT	CONT	CONT	CONT	CONT	CONT	CONT	CONT
Waveform	SIN	SIN	SIN	SIN	SIN	SIN	SIN	SIN
Termination	Continue	Continue	Continue	Continue	Continue	Continue	Continue	Continue
On Phase [Degree]	0.0	0.0	0.0	0.0	0.0	270.0	0.0	0.0
On Pase	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF

On Phas 270°



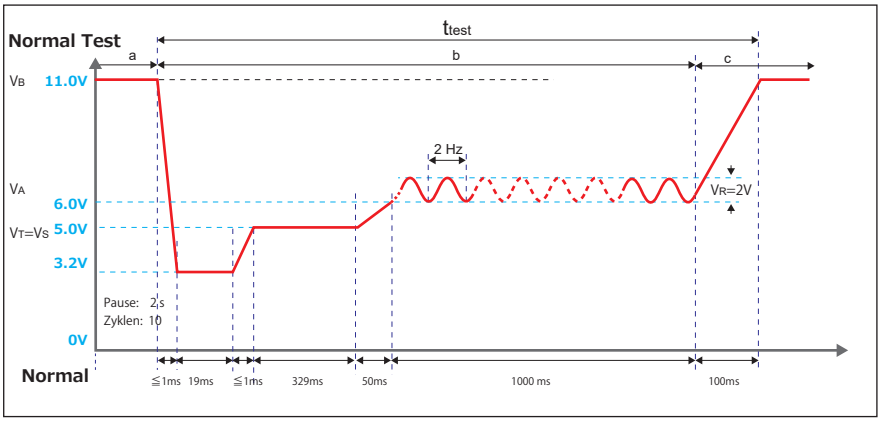


E-11 Start impulse

Test case1 : Cold start Severe

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

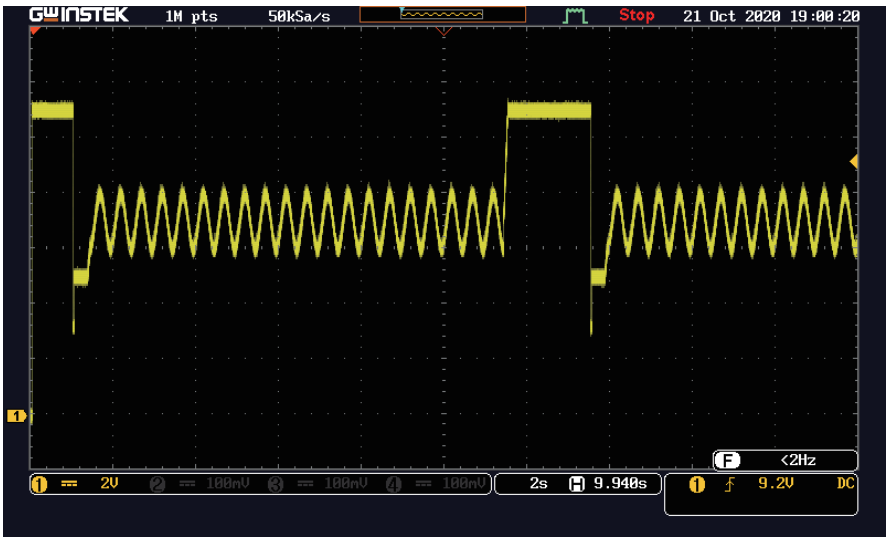
Example: Severe

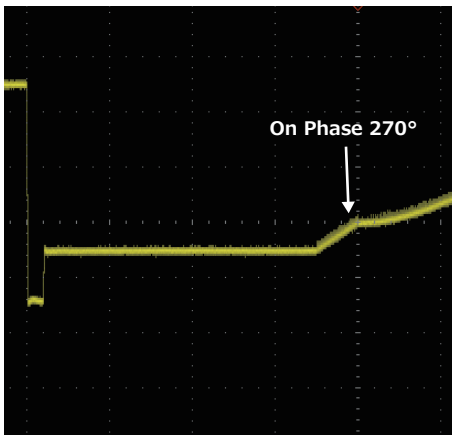


Note: The time axis scale is not the actual ratio.

Mode: AC/DC-INT

						On Phase 270°		
Step No.	0	1	2	3	4	5	6	7
Time[ms]	1.0000	1.0000	0.0010	0.0190	0.0500	10.0000	0.1000	1.0000
ACV [Vrms]	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0
ACV Behavior	CONST	CONST	CONST	CONST	CONST	CONST	CONST	CONST
DCV [V]	11.0	11.0	4.5	4.5	6.5	7.5	11.0	11.0
DCV Behavior	CONST	CONST	SWEEP	CONST	SWEEP	CONST	SWEEP	CONST
Frequency [Hz]	60.0	60.0	60.0	60.0	60.0	2.0	60.0	60.0
Frequency Behavior	CONT	CONT	CONT	CONT	CONT	CONT	CONT	CONT
Waveform	SIN	SIN	SIN	SIN	SIN	SIN	SIN	SIN
Termination	Continue	Continue	Continue	Continue	Continue	Continue	Continue	Continue
On Phase [Degree]	0.0	0.0	0.0	0.0	0.0	270.0	0.0	0.0
On Pase	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF

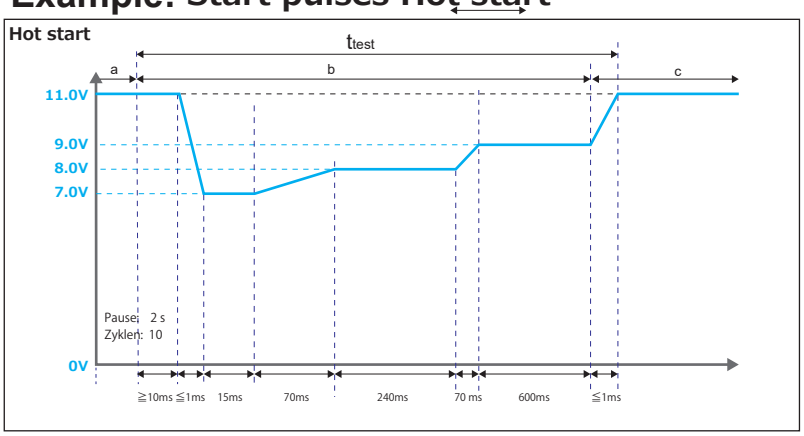




E-11 Start impulse

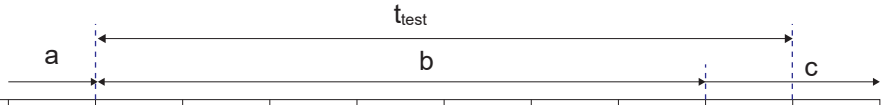
Test Case 2: Start pulses Hot start

Example: Start pulses Hot start

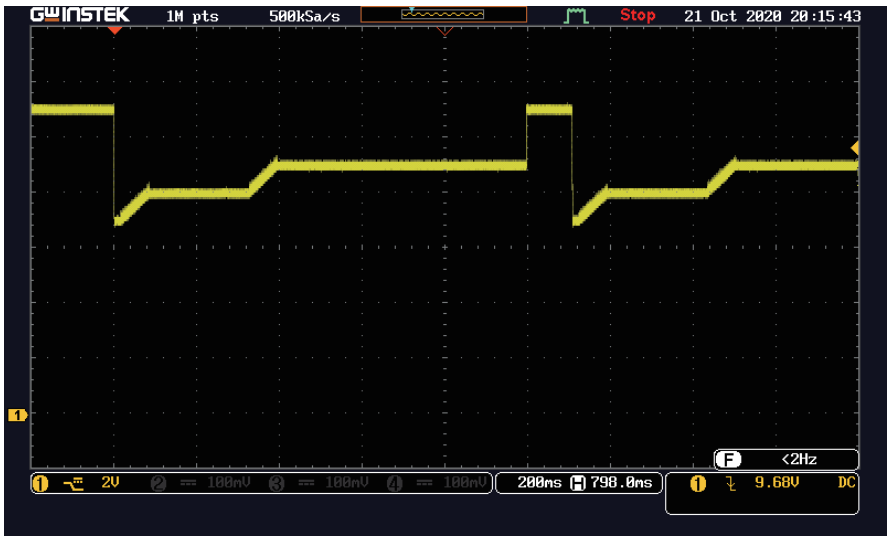


Note: The time axis scale is not the actual ratio.

Mode: DC-INT

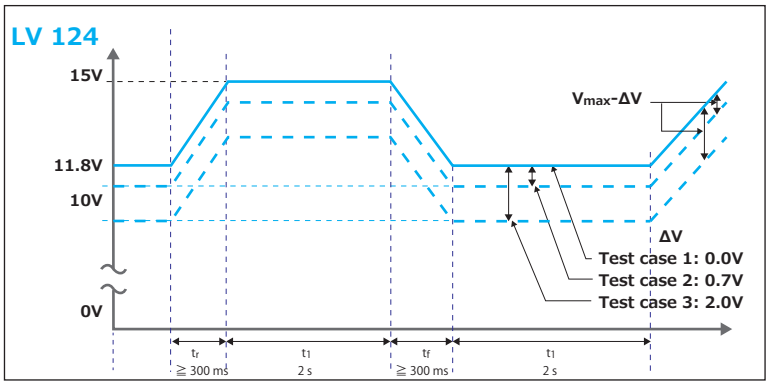


Step No.	0	1	2	3	4	5	6	7	8	9
Time[ms]	0.1000	0.0100	0.0010	0.0150	0.0700	0.2400	0.0700	0.6000	0.0010	0.1000
ACV [Vrms]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACV Behavior	CONST	CONST	CONST	CONST	CONST	CONST	CONST	CONST	CONST	CONST
DCV [V]	11.0	11.0	7.0	7.0	8.0	8.0	9.0	9.0	11.0	11.0
DCV Behavior	CONST	CONST	SWEEP	CONST	SWEEP	KEEP	SWEEP	KEEP	SWEEP	KEEP
Frequency [Hz]	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Frequency Behavior	CONT	CONT	CONT	CONT	CONT	CONT	CONT	CONT	CONT	CONT
Waveform	SIN	SIN	SIN	SIN	SIN	SIN	SIN	SIN	SIN	SIN
Termination	Continue	Continue	Continue	Continue	Continue	Continue	Continue	Continue	Continue	Continue
On Phase [Degree]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
On Pase	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF



E-12 Voltage curve with electric system control

The behavior of the electric system with voltage controls, e.g., with the use of intelligent generator controls or DC-DC converter controls, is simulated.

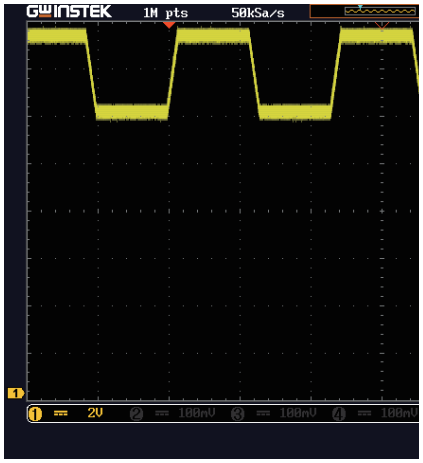


Operating mode of DUT	**Operating mode II.c**
Vmin	**(11,8 V - ΔV) (0 %, -4 %)**
Vmax	**(15 V - ΔV) (+4 %, 0 %)**
t1	**2 s**
tr	**≥300 ms**
tf	**≥300 ms**
Number of cycles	**10**
Number of samples	**at least 6**

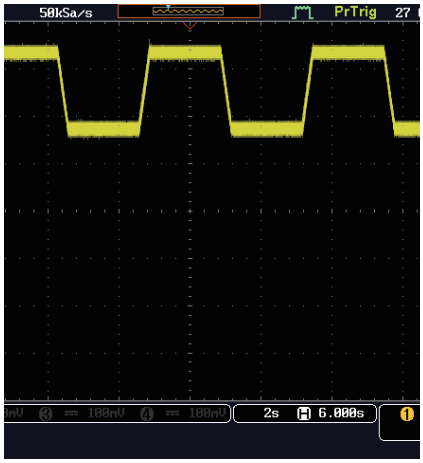
Repeat

Step No.	0	1	2	3	4	5	6
Time[ms]	1.0000	0.3000	0.3000	2.0000	0.3000	2.0000	0.1000
ACV [Vrms]	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACV Behavior	CONST	CONST	CONST	CONST	CONST	CONST	CONST
DCV [V]	11.8	11.8	15.0	15.0	11.8	11.8	11.0
DCV Behavior	CONST	KEEP	SWEEP	KEEP	SWEEP	KEEP	SWEEP
Frequency [Hz]	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Frequency Behavior	CONT	CONT	CONT	CONT	CONT	CONT	CONT
Waveform	SIN	SIN	SIN	SIN	SIN	SIN	SIN
Termination	Continue	Continue	Continue	Continue	Continue	Continue	END
Jump-To	0	0	0	0	0	2	0
Jump	OFF	OFF	OFF	OFF	OFF	ON	OFF
Jump Cnt	0	0	0	0	0	10	0

Test case 1: ΔV=0.0V



Test case 2: ΔV=0.7V



Test case 3: ΔV=2.0V