BATTERY CELL SURGE TESTER
MODEL 19311 SERIES

The Chroma 19311 Surge Tester Series is a powerful tool for testing the insulation quality of lead-acid battery cells before electrolyte injection. With its ability to apply high-voltage pulses, it enables accurate assessment of the insulation quality between the positive and negative plates, as well as the insulation quality of laser-cut trims on metal film resistors. The 19311 series has a maximum pulse output voltage of 6kV, four-wire voltage measurement, and a high-speed sampling rate of 200MHz, suitable for surge testing of battery cells as well as metal film resistors. Users can select either the single-channel tester (Model 19311) or the multi-channel scan tester (Model 19311-10) to meet their specific testing needs.

The 19311-10 model has 10 channels and can switch between multiple battery cells using a scan test method, with a single unit capable of testing up to 9 battery cells at a time. The 19311-10 can support up to 25 channels for testing up to 24 battery cells in a sequence by connecting with A190362 external scanning box. Quickly scanning and testing multiple battery cells at a time leads to significant savings on testing time and labor costs, making this instrument particularly suitable for use on production lines to increase throughput.

The main purpose of using high-voltage pulses to test the positive and negative plates of lead-acid battery cells before electrolyte injection is threefold: to detect the distance and quality of the insulation between the positive and negative plates in battery cell, to verify the presence of a separator and a short circuit between the positive and negative plates, so as to find out inferior or bad battery cells. The 19311 Series analyzes the insulation quality of battery cells using their internal inductance and high-voltage oscillation damping.

The primary objective of testing the resistance of metal film resistors with high-voltage pulses is to assess the insulation distance and quality of the laser trimming, as well as any short circuit risks, in order to identify inferior or defective products. The Chroma 19311 Series applies short and low-energy high-voltage pulses to the paralleled metal film resistors to detect any flaws in their internal insulation quality.

Therefore, by utilizing the impulse testing capabilities of the Chroma 19311 Series, the insulation quality of lead-acid battery cells, metal film resistors, and other components can be significantly improved, resulting in products that are highly reliable and suitable for long-term use.

RoHS2 Compliant · HANDLER · LAN · USB · RS-232 · CE

MODEL 19311 SERIES

KEY FEATURES

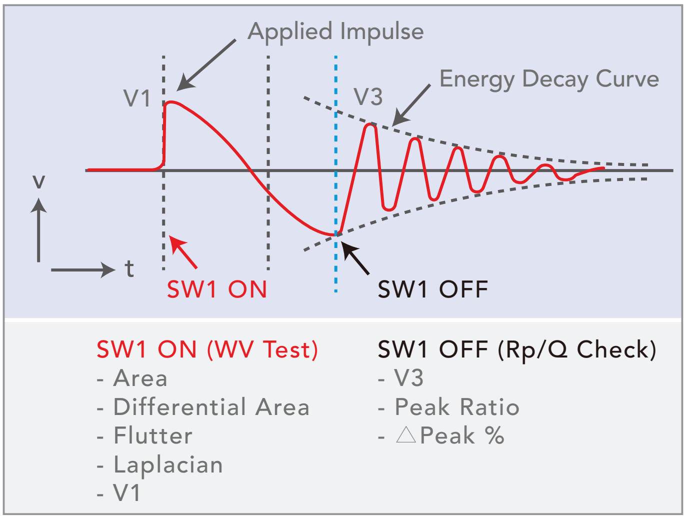
- Max. output voltage: 6kV
  (Depends on DUT's capacitance)
- Pulse interval: 30ms - 3000ms
- 8 types of judgements:
  - Area
  - Differential Area
  - Flutter
  - Laplacian
  - 1st Peak Voltage (V1)
  - 3rd Peak Voltage (V3)
  - Peak Ratio
  - △Peak%
- Contact Check
- Breakdown Voltage Mode (BDV Mode)
- Sampling rate: 200MHz
- Support up to 25 channels for scanning test (19311-10 with A190362 option)
- User interface:
  - English
  - Traditional Chinese
  - Simplified Chinese
- Support USB flash driver
  - Waveform, test conditions & Test results storage
  - Screen capture
  - Backup files
- Graphical color display
- Standard remote interface LAN, USB & RS232

Applications:

- Lead-acid batteries
- Metal film resistors (MELF, SMD/Chip)

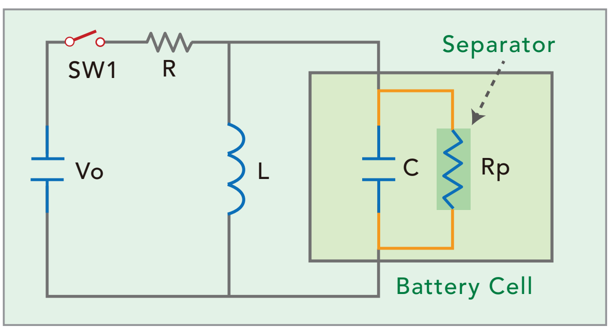
Advancing Excellence

SURGE TEST



Impulse test waveform diagram

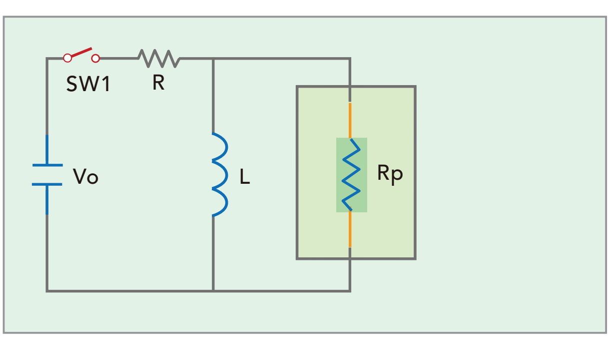
Surge testing is a method that applies a sufficiently high impulse voltage (up to 6kV) with a very short duration (<160uS) to the devices under test (DUTs), which include lead-acid battery cells and metal film resistors.



Vo : Internal Output Voltage	C : Equivalent Capacitance
R : Internal Resistor	Rp : Equivalent Parallel
L : Internal Inductor	Resistance (Separator)
SW1 : Switch	

Equivalent circuit for testing lead-acid battery cells

When the switch is opened and an impulse test is applied to the lead-acid battery cell, the internal resonant inductance of the 19311 Series causes the cell to resonate with the resonant inductance and capacitance inside the 19311 Series, producing a resonant waveform. The peak voltage of this resonant waveform can be used to detect any abnormal voltage withstand capability in the battery cell. When the switch is turned off, the lead-acid battery cell only resonates with the internal resonant inductance of the 19311 Series. The decay of the peak voltage of this resonant waveform represents the insulation quality of the battery cell. By analyzing the tested resonant waveform and comparing it with the golden sample, it is possible to determine whether the lead-acid battery cell is a good product. Impulse testing of lead-acid battery cells that have not yet been injected with electrolyte is mainly used to check for insulation defects or missing separator before electrolyte injection.



Vo : Internal Output Voltage	Rp : Metal film resistors
R : Internal Resistor	
L : Internal Inductor	
SW1 : Switch	

Equivalent circuit for testing metal film resistors

Identifying insulation defects at the laser trimming areas of metal film resistors using AC/DC voltage can be challenging. Insufficiently high test voltage or excessive test power make it difficult to detecting metal particles in the laser trimming. Therefore, impulse testing is necessary to ensure the insulation quality of metal film resistors at these laser trimming areas. When the switch is turned on and an impulse test is applied to the metal film resistor, the internal resonant inductance of the 19311 Series generates a self-resonance. The resulting resonant waveform can be analyzed or compared with the golden sample to assess the insulation of the metal film resistor. After the switch is turned off, the difference in the decay of the resonant waveform's peak voltage represents the difference in resistance value of the metal film resistor, as it is connected in parallel with the resonant inductance. The impulse test on the metal film resistor is primarily carried out to detect insulation issues in the laser trimming areas inside the capped metal film resistor, bringing out the true characteristics of products with poor quality. By examining potential problems such as poor insulation quality and insufficient insulation distance in the laser trimming areas of the metal film, this testing technique ensures that the resistance of the metal film resistor does not change over time due to inadequate insulation quality or insufficient insulation distance caused by laser cutting. This reduces the chance of workplace accidents and ensures the reliability of electrical products for long-term use.

Three Causes of Defects in Lead-Acid Battery Cells

Absence of the separator

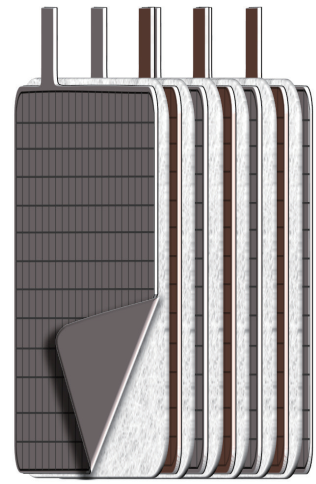
When there is no separator between the positive and negative plates, the positive and negative plates are prone to short circuiting.

Contamination by metal particles

When there are metal particles between the positive and negative plates, the insulation distance will be reduced, making the positive and negative plates susceptible to short circuiting.

Damage to the positive or negative plate

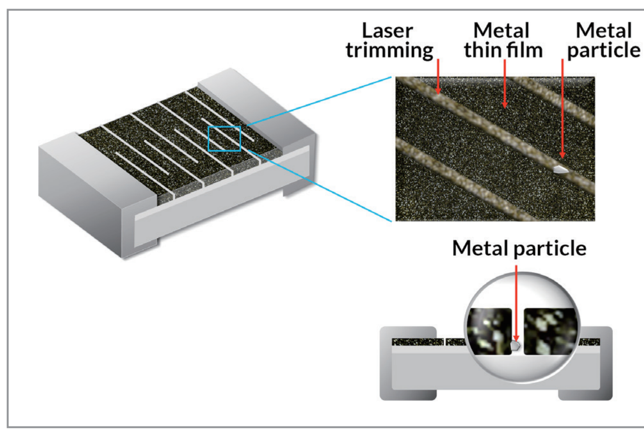
When the positive and negative plates are damaged, the insulation distance becomes shorter or the capacitance changes, making the positive and negative plates susceptible to short circuiting.



Four Causes of Defective Metal Film Resistors

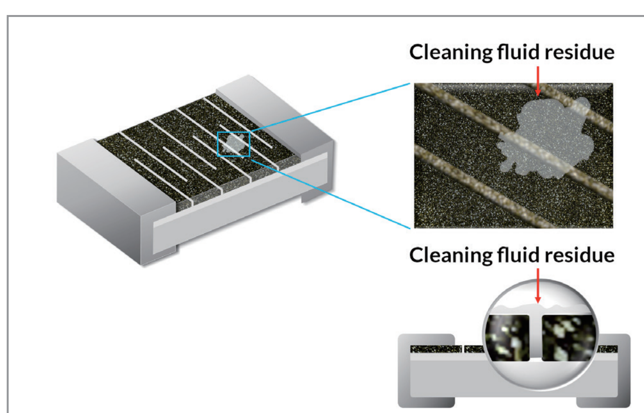
Metallic particles in the laser trimming

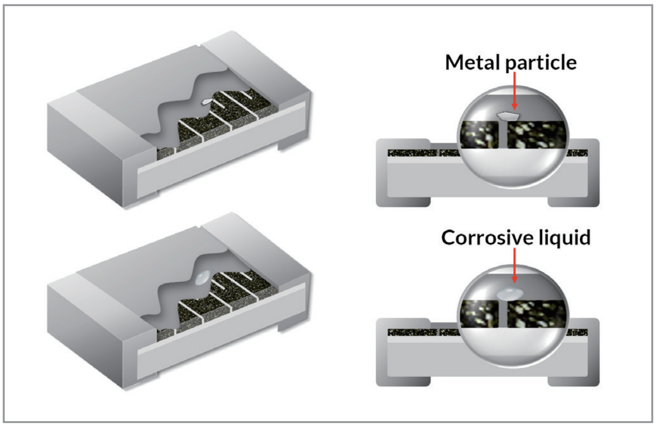
To create metal film resistors, a layer of metal film is first applied to a ceramic substrate, after which laser cutting is used to precisely adjust its resistance value. It is important that the laser-trimmed areas are well-insulated to prevent any potential short circuits in the metal film resistor. However, there may be a risk of short circuit due to the presence of metal impurity particles. Over time, this can lead to changes in the resistance value of the resistor.



Cleaning solution surface residue

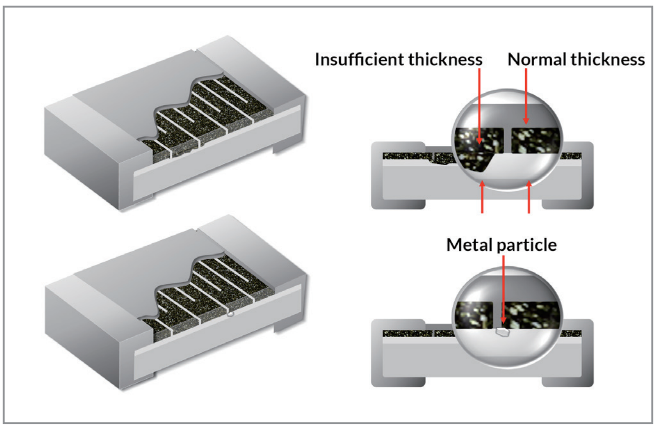
After the laser cutting process, a cleaning solution may be used to remove surface residue. Although there is a subsequent drying process, a small amount of cleaning solution may remain on the surface of the metal film. Over time, this residue can cause changes in the resistance value of the resistor due to electrochemical corrosion or erosion.





Inclusion of Metal or Corrosive Components in the Coating Material

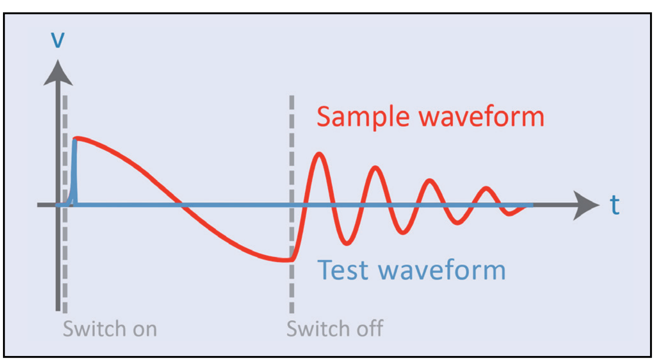
If the coating material used after laser cutting of the metal film resistor contains metal or corrosive components, there is a risk of short circuits or electrochemical corrosion, which can cause changes in the resistance value of the resistor.



Insufficient Insulation of the Ceramic Substrate

The ceramic substrate of the metal film resistor should have good insulation. If the thickness of the oxide layer/insulation layer is insufficient or if there are metal impurities remaining on the ceramic substrate, this can lead to poor insulation of the ceramic substrate of the metal film resistor. Over time, this can lead to changes in the resistance value of the resistor due to degradation caused by prolonged poor voltage withstand capability.

Eight Judgment Functions



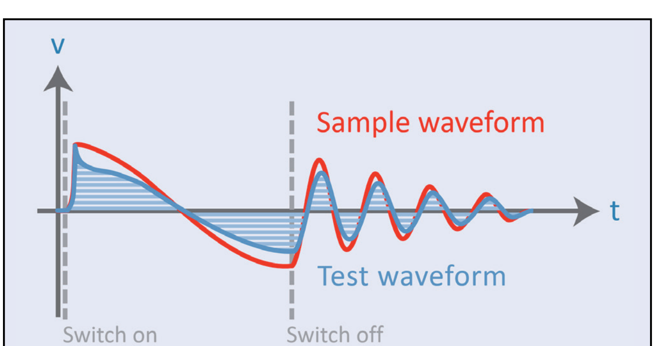
Short-circuited lead-acid battery cells / metal film resistors

Area(Recommended)

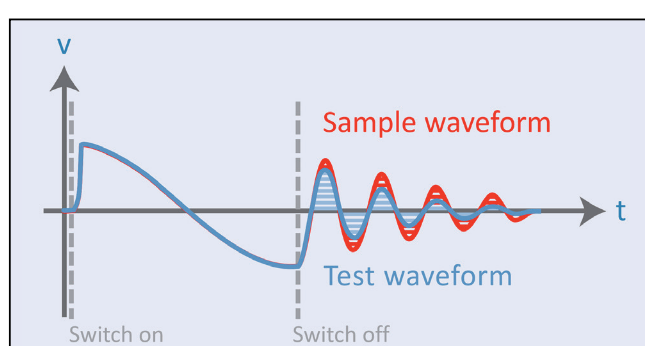
Area comparison is a method of comparing the total area of the test waveform with the total area of the sample waveform to show the degree of insulation. Under sufficient electric field strength/voltage, poor insulation can cause discharge, which leads to rapid decay of the waveform. Therefore, the total area of the test waveform will be smaller than that of the sample waveform.

Lead-acid battery cell: For detecting insulation defects between the positive and negative plates or the absence of the separator.

Metal film resistor: For detecting insulation defects in the laser trimming.



Lead-acid battery cell with moisture separator



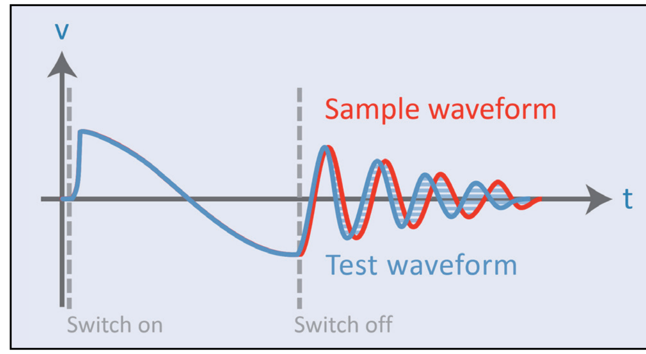
Metal film resistor with lowered resistance value

Differential Area

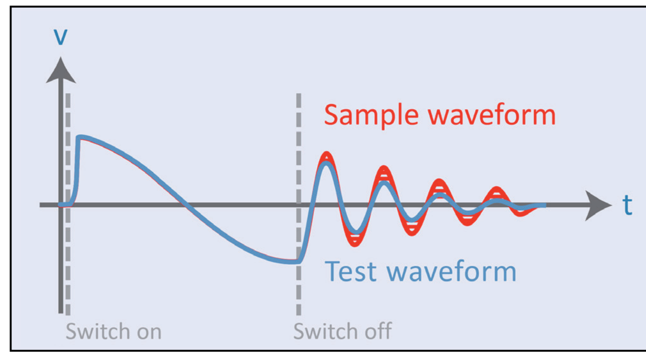
Differential Area comparison looks at the proportion of non-overlapping area between the test waveform and the sample waveform. When there are no big differences in the areas of the first resonance cycle, the size of this proportion represents the difference in capacitance or resistance value between the DUT and the sample. When the capacitance is larger, the resonant frequency of the waveform will be lower, and when the capacitance is smaller, the resonant frequency of the waveform will be higher.

Lead-acid battery cell: For inspecting the distance between the positive and negative plates and the number of plates.

Metal film resistor: For detecting changes in resistance value.



Lead-acid battery cells with different capacitance values

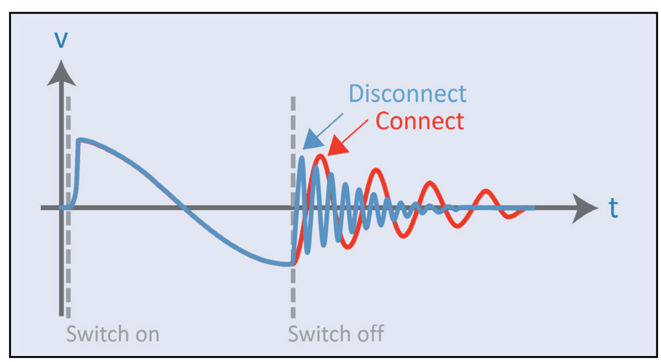


Metal film resistor with lowered resistance value

Flutter

Flutter detection calculates the overall magnitude of the waveform using a calculation method based on the first derivative. When there is no contact or connection to a capacitive device under test (DUT), the capacitance of the resonant circuit will be much smaller than when there is a DUT connected. This causes the resonant frequency of the waveform to become very high, resulting in a larger flutter detection result. Therefore, this characteristic can be used to do a contact check for the capacitive DUT.

Lead-acid battery cell: Verifies whether the impulse test is actually applied to the lead-acid battery cell.



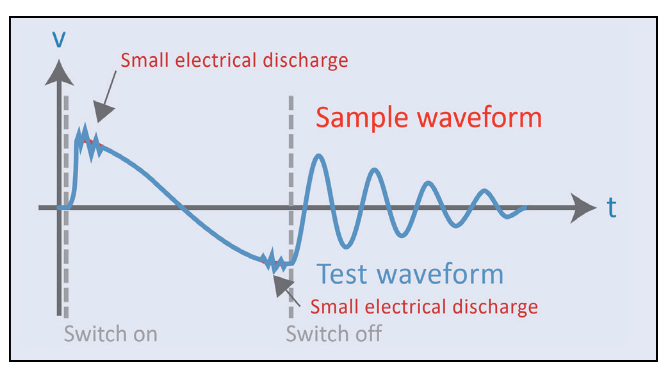
No contact with the lead-acid battery cell

Laplacian

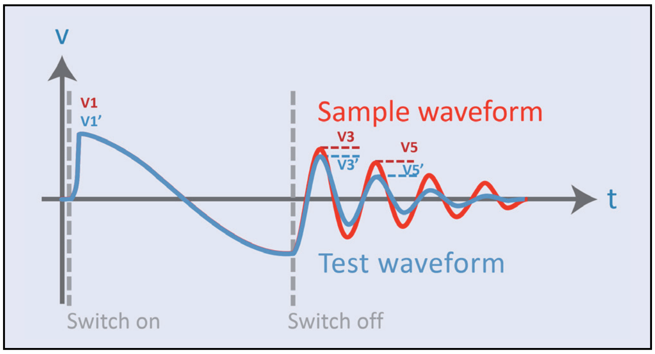
Laplacian detection uses a calculation method based on the second derivative to calculate changes in the slope of the resonant waveform. It helps to identify rapid slope changes, turning points, and flutter (jitter) on the resonant waveform due to a small discharge during the impulse test, in order to detect small discharges during the impulse test on the DUT.

Lead-acid battery cell: For identifying small discharges between the positive and negative plates

Metal film resistor: For identifying small discharges inside the metal film resistor.



Small discharge in the resonant waveform



The resonant waveform of Impulse test

First Peak Voltage (V1)

V1 is the first peak voltage in the resonant waveform. When the DUT has insufficient voltage withstand capability, discharge occurs at a certain level of electric field strength/voltage, causing the first peak voltage to be lower than the sample.
Lead-acid battery cell: A simple judgment of insulation defects between the positive and negative plates or the absence of separator
Metal film resistor: A simple judgment of insulation defects or short circuits at the laser trimming areas.

Third Peak Voltage (V3)

V3 is the third peak voltage in the resonant waveform. When the DUT has insufficient voltage withstand capability, discharge occurs at a certain level of electric field strength/voltage, and the release of energy causes the third voltage peak to be lower than that of the sample. When the insulation quality of the DUT is poor, the third peak voltage is lower due to faster and greater energy loss.
Lead-acid battery cell: Simple determination of the insulation quality between the positive and negative plate.
Metal film resistor: Simple determination of the insulation quality of the laser trimming areas.

Peak Ratio

Peak Ratio is the percentage calculated between the fifth peak voltage and the third peak voltage in the resonant waveform. When the equivalent parallel resistance (Rp) of the DUT is small or the insulation quality is poor, the fifth peak voltage becomes smaller due to greater and faster energy loss, resulting in a smaller Peak Ratio for DUTs with poorer insulation quality.
Lead-acid battery cell: The size of the Peak Ratio reflects the insulation quality between the positive and negative plates, making it a useful parameter for assessing the insulation quality of the battery cell.
Metal film resistor: The insulation quality of products with poorer insulation quality will cause changes in resistance due to discharge at the laser trimming areas. (Recommended resistance value: 30kΩ-300kΩ)

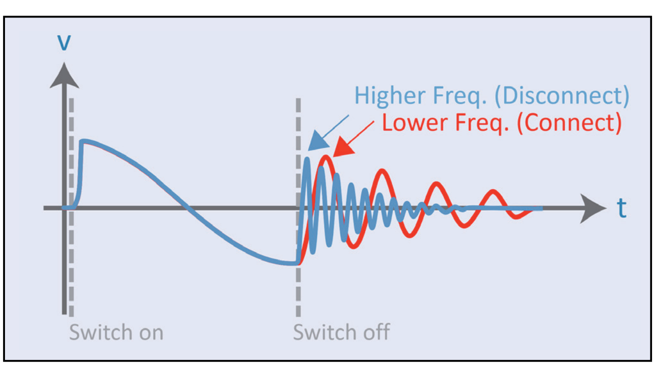
△Peak %

△Peak % is a parameter that compares the Peak Ratio of the test waveform with that of the sample waveform, and uses this comparison to identify products with insulation quality similar to that of the sample. When the insulation quality of the DUT is the same as that of the sample, or if the equivalent parallel resistance (Rp) of the DUT is the same as that of the sample, the Peak Ratio of the test waveform is the same as that of the sample waveform, resulting in a △Peak % of 0%. When the insulation quality of the DUT is lower than that of the sample, the Peak Ratio of the test waveform is smaller than that of the sample waveform, resulting in a negative △Peak %. This indicates that the insulation quality of the DUT is worse than that of the sample or the equivalent parallel resistance (Rp) of the DUT is smaller than that of the sample.
Lead-acid battery cell: △Peak % is used to assess whether the insulation quality between the positive and negative plates is similar to that of the sample.
Metal film resistor: △Peak % is used to assess whether the insulation quality at the laser trimming areas is similar to that of the sample. Products with poorer insulation quality will experience changes in resistance due to discharge. (Recommended resistance value: 30kΩ-300kΩ)

$$\text{Peak Ratio} = \frac{V_5}{V_3} \times 100\%$$

$$\Delta\ \text{Peak}\ \% = Peak\ Ratio_{Test} - Peak\ Ratio_{Sample}$$

Applications



Contact Check

The Contact Check function uses the difference in resonant frequency to detect whether there is a connection to the lead-acid battery cell. When there is poor contact or no connection to the lead-acid battery cell during testing, the capacitance will be smaller, resulting in a higher resonant frequency. This makes the difference in resonant frequency a useful characteristic for contact checking. Users can adjust the sensitivity of the Contact Check according to their needs by raising the percentage threshold to increase sensitivity or lowering it to reduce sensitivity.

Breakdown Voltage (BDV Mode)

19311 Series has the breakdown voltage mode for analysis, which can set the start voltage and the end voltage. While the test voltage increases from the start voltage to the end voltage, it checks whether or not the values of Area, Laplacian and Peak Ratio exceed the limits for finding the maximal withstand voltage of the battery cell. The research and development engineer can use the BDV mode to analyze and research the lead-acid battery cell, and establish the test voltage of the surge test for the production.

10/25 Channels Scanning Test

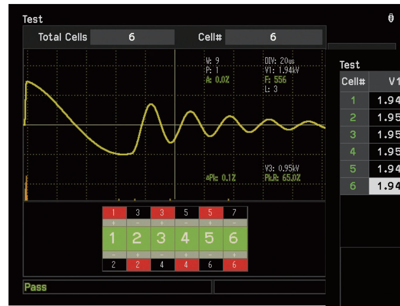
19311-10 has 10 channels in one single unit. It can test up to 9 cells (max.) in one test sequence. It also can expand the channels to 25 (max.) with a Scan Box (A190362), which can test up to 24 cells (max.) in one test sequence.

Screenshot

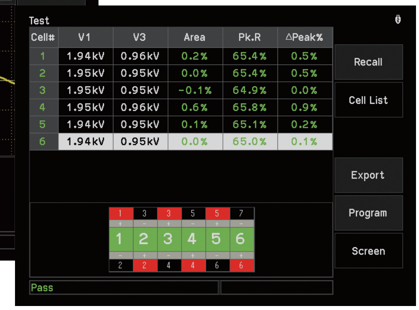
The operator can use the hot key to screenshot the screen display. The screenshot file will be stored into the USB flash drive that is plugged in.

Export

The operator can use the Export function to export the data of the current test result into the USB flash drive that is plugged in, and analyze the data of the current test result. The file storage format is in CSV (Comma Separated Values) format.



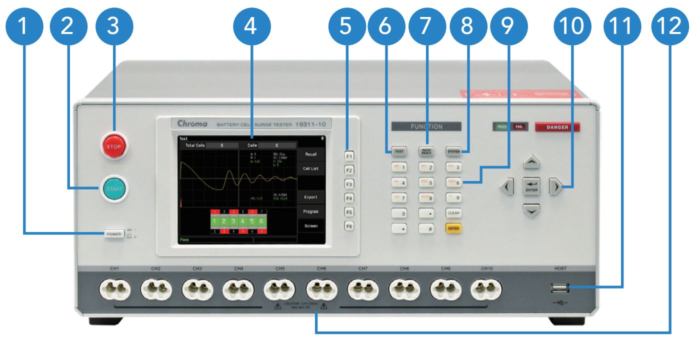
Test Results (Waveform display)

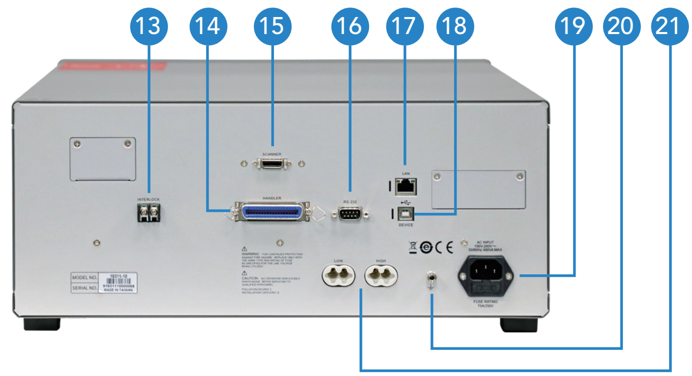


Test Results (Table display)

PANEL DESCRIPTION

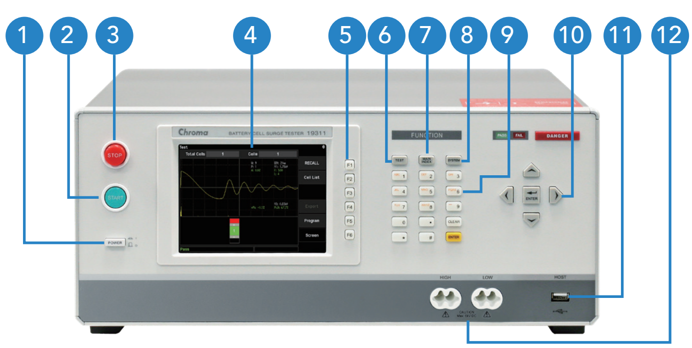
19311-10

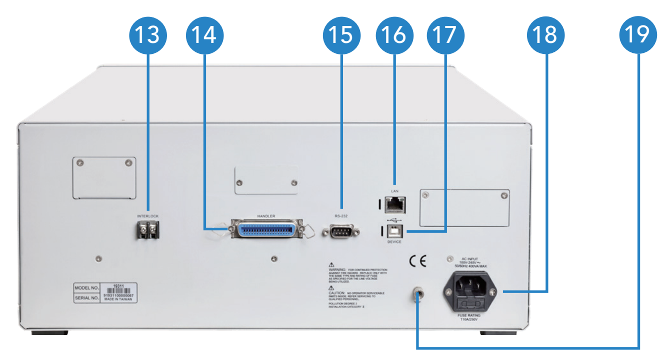




1. Power Switch
2. Start Button
3. Stop Button
4. LCD Color Display
5. Function Keys
6. Test Mode
7. Main index
8. System
9. Keypad
10. Direction Keypad
11. USB Flash Drive interface
12. Test Terminals/Channels
13. Safety interlock switch: Safety mechanism that interrupts output
14. HANDLER Interface: Automated Production Line
15. Scanner Control Interface: External Scanner A190362
16. RS-232 Interface: Remote Control
17. LAN Interface: Remote Control
18. USB Interface: Remote Control
19. Power input: used for AC power input
20. Grounding terminal: used for grounding
21. Scanner Channel Connection: External Scanner A190362

19311





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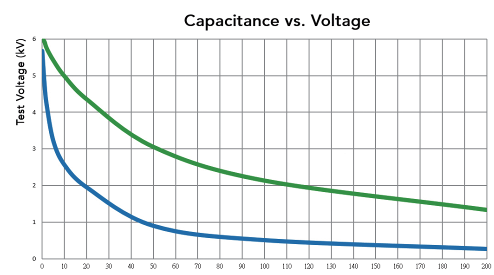
19. Grounding terminal: used for grounding

SPECIFICATIONS

Model	19311	19311-10
Output Voltage, Step	0.10 kV-6.00 kV, 0.01 kV *	
Test Voltage	≥ 3.00kV @ 100 Ω	≥ 3.00kV @ 50nF
Sampling Rate	200MHz	
Width Range	11 Range : 1-11 & Auto	
Pulse Number	1-32 & Continue	
Pulse Interval	30ms - 3000ms for ≤ 4kV 60ms - 3000ms for > 4kV 80mS - 3000ms for continue (Screen On) 30mS - 3000ms for continue (Screen Off)	
Channels	1	10
Screen Display Resolution	640 x 480 dots (VGA)	
Waveform Display Range	color display 512 x 256 dots	
Judgment	Area, Differential Area, Flutter, Laplacian, V1, V3, Peak Ratio, △Peak %	
Test Time	1 DUT/cell : ≤0.1s (Fastest)	6 cells : ≤1.2s (Fastest)
Electrical Hazard Protection Function		
Key Lock	Yes (password control)	
Interlock	Yes	
Indication	GO : Green LED ; NG : Red LED	
Alarm	GO : Short Beep ; NG : Long Beep	
Interfaces	Handler, RS-232, USB, LAN (Ethernet)	
General		
Operation Environment	Temperature : 0˚C - 40˚C ; Humidity: 15% to 90% ; R.H @ ≦ 40˚C	
Power Consumption	No load : <150VA Rated load : <400VA	
Power Requirements	100 - 240Vac, 50 / 60Hz	
Dimension (W x H x D)	177 x 428 x 500 mm / 6.97 x 16.85 x 19.69 inch	
Weight	26 kg / 57.32 lbs	

Note * : Chroma recommends to use the standard test cable (≤ 3 meters) for the surge test. Any test cable, which is longer than 3 meters or not the standard test cable from Chroma, may affect the test waveform and the test result.

All specifications are subject to change without notice. Please visit the official website for the latest specifications.



ORDERING INFORMATION

19311 : Battery Cell Surge Tester
19311-10 : Battery Cell Surge Tester (10 channels)
A190362 : 16-channel 4-wire HV External Scanning Box
A190364 : 4-wire test cable with bare wire (1.5m)
A190365 : 4-wire test cable with bare wire (3m)

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