HIOKI

INSTRUCTION MANUAL

# 3931

# HIGH VOLTAGE CONTACT CHECKER

HIOKI E. E. CORPORATION

# Contents

# Introduction

Thank you for purchasing the HIOKI “3931 HIGH VOLTAGE CONTACT CHECKER”. To obtain maximum performance from the product, please read this manual first, and keep it handy for future reference.

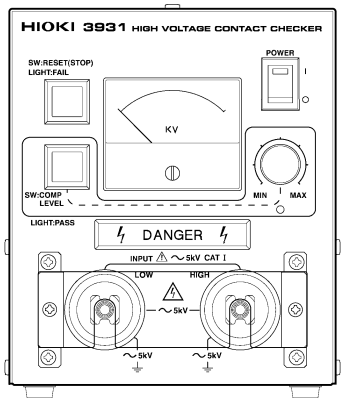
### Warranty

HOKI cannot be responsible for losses caused either directly or indirectly by the use of the 3931 with other equipment, or if ownership is transferred to a third party.

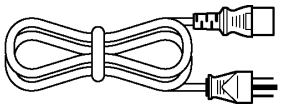
# Inspection

- When you receive the product, inspect it carefully to ensure that no damage occurred during shipping. In particular, check the accessories and connectors. If damage is evident, or if it fails to operate according to the specifications, contact your dealer or Hioki representative.
- Use the original packing materials when reshipping the product, if possible.

## Checking the contents of the package




3931 HIGH VOLTAGE CONTACT CHECKER (1)



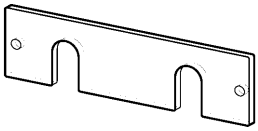
Power cord (1)

(red)

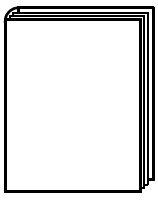
9615-01 H.V. TEST LEAD
(high voltage side, 1)

(black)

9615-03 H.V. TEST LEAD
(low voltage, 1)



Stopper plate (1)



Instruction manual (1)

# Safety Notes

**DANGER**

**This product is designed to conform to IEC 61010 Safety Standards, and has been thoroughly tested for safety prior to shipment. However, mishandling during use could result in injury or death, as well as damage to the product. Be certain that you understand the instructions and precautions in the manual before use. We disclaim any responsibility for accidents or injuries not resulting directly from product defects.**

This manual contains information and warnings essential for safe operation of the product and for maintaining it in safe operating condition. Before using the product, be sure to carefully read the following safety notes.

## Safety Symbols

| | |
|---|---|
| ⚠ | In the manual, the ⚠ symbol indicates particularly important information that the user should read before using the product. |
| ⚠ | The ⚠ symbol printed on the product indicates that the user should refer to a corresponding topic in the manual (marked with the ⚠ symbol) before using the relevant function. |
| ⚡ | Indicates that dangerous voltage may be present at this terminal. |
| ⏚ | Indicates a grounding terminal. |
| ⏚ | Indicates a protective conductor terminal. |
| ~ | Indicates AC (Alternating Current). |
| I | Indicates the ON side of the power switch. |
| O | Indicates the OFF side of the power switch. |

The following symbols in this manual indicate the relative importance of cautions and warnings.

| | |
|---|---|
| DANGER | Indicates that incorrect operation presents an extreme hazard that could result in serious injury or death to the user. |
| WARNING | Indicates that incorrect operation presents a significant hazard that could result in serious injury or death to the user. |
| CAUTION | Indicates that incorrect operation presents a possibility of injury to the user or damage to the product. |
| NOTE | Advisory items related to performance or correct operation of the product. |

## Other Symbols

| | |
|---|---|
| ⃠ | Indicates the prohibited action. |
| ❖ | Indicates the reference. |

## Accuracy

We define measurement tolerances in terms of f.s. (full scale) and dgt. (digit) values, with the following meanings:

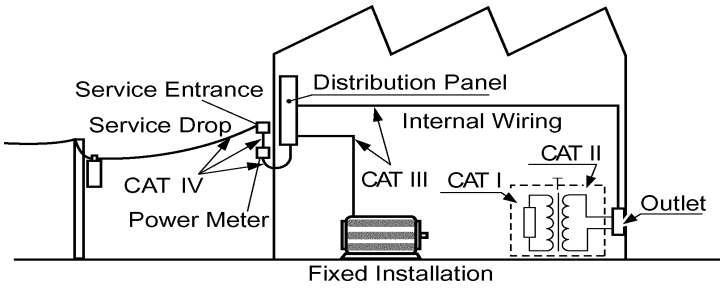
**f.s. (maximum display value or scale length)**
The maximum displayable value or the full length of the scale.
This is usually the maximum value of the currently selected range.

**dgt. (resolution)**
The smallest displayable unit on a digital measuring product, i.e., the input value that causes the digital display to show a "1".

## Overvoltage categories (CAT)

The input section conforms to CAT I (5000 V) safety requirements, and the power supply section conforms to CAT II (300 V) requirements.
To ensure safe operation of measurement products, IEC 60664 establishes safety standards for various electrical environments, categorized as CAT I to CAT IV, and called overvoltage categories. These are defined as follows.

| | |
|---|---|
| CAT I | Secondary electrical circuits connected to an AC electrical outlet through a transformer or similar device. |
| CAT II | Primary electrical circuits in equipment connected to an AC electrical outlet by a power cord (portable tools, household appliances, etc.) |
| CAT III | Primary electrical circuits of heavy equipment (fixed installations) connected directly to the distribution panel, and feeders from the distribution panel to outlets. |
| CAT IV | The circuit from the service drop to the service entrance, and to the power meter and primary overcurrent protection device (distribution panel). |




Higher-numbered categories correspond to electrical environments with greater momentary energy, so a measurement product designed for CAT III environments can endure greater momentary energy than one designed for CAT II. Using a measurement product in an environment designated with a higher-numbered category than that for which the product is rated could result in a severe accident, and must be carefully avoided.

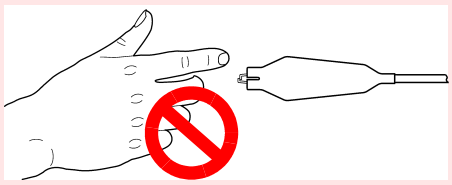
# Usage Notes

Follow these precautions to ensure safe operation and to obtain the full benefits of the various functions.

## To avoid electric shock

**DANGER**

- **Do not remove the product's case.**
  **The internal components of the product carry high voltages and may become very hot during operation.**
- **Do not touch the alligator clip while high voltage is being generated. The vinyl sheath on the alligator clip of the H.V. TEST LEADs (9615-01, 9615-03) does not have an insulation withstand voltage.**



**WARNING**

**Check the voltage.**

100 to 240 V AC

- **To ensure the safety of the operator first, connect the protective conductor terminal to a grounded conductor before making any other connections.**
- **To avoid electric shock and ensure safe operation, connect the power cord to a grounded (3-contact) outlet.**
- **Before turning the product on, make sure the source voltage matches that indicated on the product's power connector. Connection to an improper supply voltage may damage the product and present an electrical hazard.**

**CAUTION**

- Turn off the power to all devices before plugging or unplugging any of the external I/O terminals.
- Make sure the power is turned off before connecting or disconnecting the power cord.
- If the protective functions of the product are damaged, either remove it from service or mark it clearly so that others do not use it inadvertently.

# Setting up the 3931

**⚠WARNING**

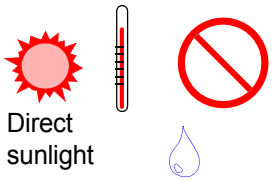
**Do not get wet.**

Corrosive or explosive gases

- **To avoid damage to the product, do not allow the product to get wet, and do not use it when your hands are wet.**
- **Do not use the product where it may be exposed to corrosive or combustible gases. The product may be damaged or cause an explosion.**

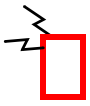
**⚠CAUTION**

**Avoid the following:**



Direct sunlight

High temperature
High humidity



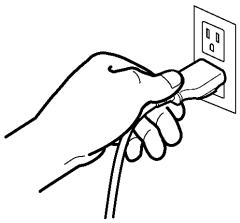
Electomagnetic radiation

Dust

- Do not store or use the product where it could be exposed to direct sunlight, high temperature or humidity, or condensation. Under such conditions, the product may be damaged and insulation may deteriorate so that it no longer meets specifications.
- Do not use the product near a device that generates a strong electromagnetic field or electrostatic charge, as these may cause erroneous measurements.
- To avoid damage to the product, protect it from vibration or shock during transport and handling, and be especially careful to avoid dropping.
- This product is not designed to be entirely water- or dust-proof. To avoid damage, do not use it in a wet or dusty environment.
- This product should be installed and operated indoors only, between 0 and 40°C and 35 to 80% RH.
- Do not install the instrument upside-down, or stand it on its side.

## Handling the cords

**⚠CAUTION**



- To avoid damaging the power cord, grasp the plug, not the cord, when unplugging the cord from the power outlet.
- To avoid damaging the H.V. TEST LEADs, do not bend or pull the test leads.
- Avoid stepping on or pinching the cable, which could damage the cable insulation.
- For safety reasons, when taking measurements, only use the H.V. TEST LEADs (9615-01, 9615-03) provided with the product.

## Preliminary checks

Before using the product the first time, verify that it operates normally to ensure that the no damage occurred during storage or shipping. If you find any damage, contact your dealer or Hioki representative.

**⚠WARNING**

**Before using the product, make sure that the insulation on the H.V TEST LEADs is undamaged and that no bare conductors are improperly exposed. Using the product under such conditions could result in electrocution. Replace the H.V TEST LEADs with the specified Hioki Model 9615-01, 9615-03.**

# Chapter 1 Overview

## 1.1 Product Overview

⚠CAUTION

The 3931 HIGH VOLTAGE CONTACT CHECKER is a contact checker used for the Hioki WITHSTANDING VOLTAGE HiTESTER with its LOW side grounded. Do not use the 3931 for any other purpose. The 3931 is not designed to serve as an isolation voltmeter.

### (1) Monitoring the measurement terminal voltage

Because it monitors the voltage of the measurement terminal, the 3931 can detect a broken wire or contact failure during a withstand voltage test. As a result, this checker does not require time only for a contact check and will improve the reliability of the test without increasing the tact time (minimum withstand voltage test time: 1 sec). The 3931 also detects a drop in test voltage arising from fluctuations in the supply voltage.

### (2) Direct connection with the Hioki WITHSTANDING VOLTAGE HiTESTER series

The 3931 is directly connectable to the Hioki WITHSTANDING VOLTAGE HiTESTER (3158, 3173, 3159, and 3153). These HiTESTERs require no setting, except that during use of the 3153, "Do not include the TEST blinking time in the $\overline{\text{TEST}}$-signal ON output" must be selected using the optional function.
If a broken wire or contact failure is detected, the error indication LED of the 3931 lights up, the buzzer sounds to indicate the occurrence of a failure, and the operation of the connected HiTESTER is stopped.
The 3931 is not designed for insulation resistance testing and cannot be used with the continuous test function or the program test function of the 3159 and 3153. In addition, the 3931 is designed exclusively for AC withstand voltage testing and cannot be used for DC withstand voltage testing.

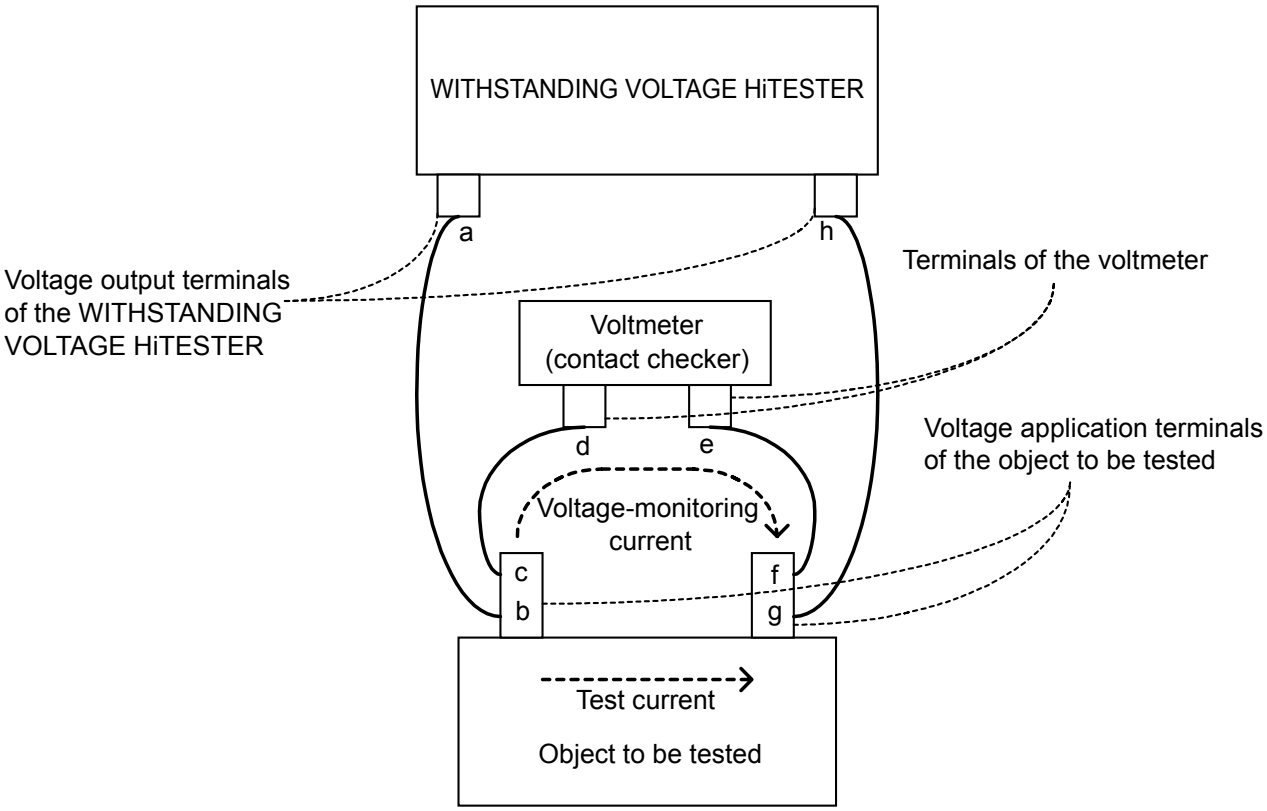
### (3) Analog voltmeter

The measurement terminal voltage is checked on the analog voltmeter (the generated voltage is checked on the voltmeter of the WITHSTANDING VOLTAGE HiTESTER). Switch over the meter to set the criterion voltage (threshold voltage).

### (4) Warning on the application of a dangerous voltage

During the contact check (voltage monitoring), the **DANGER** lamp remains ON to indicate the application of a dangerous voltage. If a dangerous voltage is input while the contact check is not being performed, the **DANGER** lamp will start blinking (50 V to 100 V).

# 1.2 Principle



The voltmeter (contact checker) shown in the diagram above is generally not used for a withstand voltage test, and the output voltage between a and h of the WITHSTANDING VOLTAGE HiTESTER is applied to voltage application terminals b and g of the object to be tested. The test current flows from a → b → g → h. The WITHSTANDING VOLTAGE HiTESTER monitors this current to determine whether the object to be tested has sufficient voltage withstand capability.
However, if no current flows, the tester considers the object to have sufficient voltage withstand capability. Thus, if no current flows because a wire is broken somewhere in the current path of a → b → g → h, the test is judged to have been passed.

To solve this problem, a voltmeter (contact checker) is connected to the voltage application terminals of the device to be tested, as in the WITHSTANDING VOLTAGE HiTESTER shown in the diagram. The voltmeter (contact checker) checks to determine whether the voltage output from the WITHSTANDING VOLTAGE HiTESTER is applied to the voltage application terminals.
Assume that a wire is broken somewhere between a and b or g and h, and that the correct voltage is not applied to the voltage application terminal. In the event of a contact failure, the correct voltage is not applied to the voltage application terminal.
The output voltage from the WITHSTANDING VOLTAGE HiTESTER (hereinafter referred to as the "threshold voltage") is compared with the voltage applied to the voltage application terminals. If the voltage applied to a voltage application terminal is less than the threshold voltage, a broken wire or contact failure has occurred. If a wire is broken in the wiring while a voltmeter (contact checker) c and d or e and f, a failure is also detected. A broken wire between c and d or e and f does not directly affect the test. This is detected as a failure of the testing equipment.

An electric current also flows to the voltmeter (contact checker). Such a current may affect the test. The threshold current during the withstand voltage test is normally approximately 0.1 mA to several tens of mA. If the current flowing to the voltmeter (contact checker) is no more than several tens of μA, it is considered to be low enough not to affect the withstand voltage test. Even if the current does affect the test, the current flowing to the voltmeter (contact checker) can always be estimated and added to the threshold current of the WITHSTANDING VOLTAGE HiTESTER.

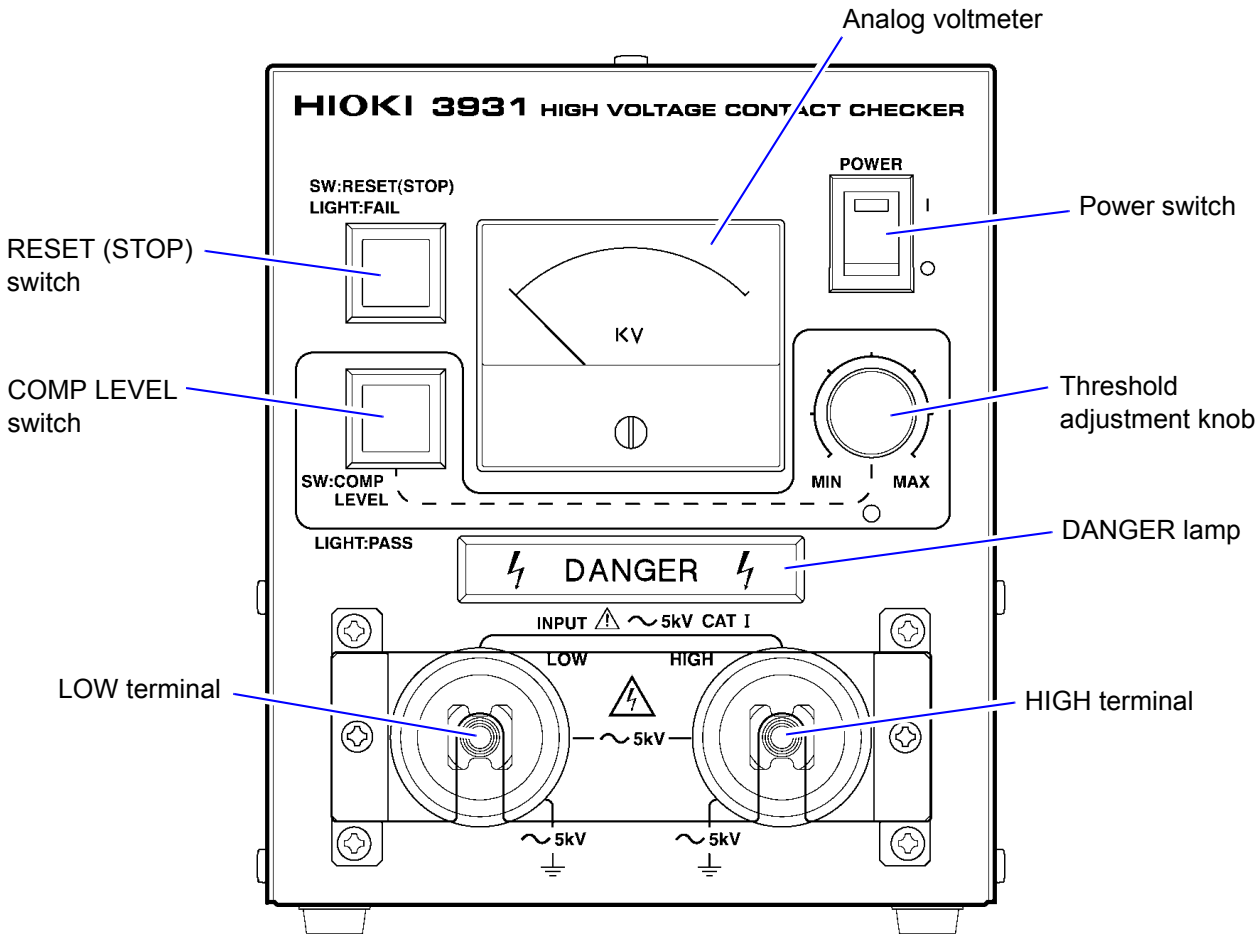
When the WITHSTANDING VOLTAGE HiTESTER is of the supply-voltage boosting type, the output of which is not stabilized, the output voltage varies with fluctuations in the commercial supply voltage. As a voltmeter (contact checker) monitors the voltage of the voltage application terminals of the device to be tested, it detects an abnormal voltage due to these voltage fluctuations, thereby further increasing the reliability of the test.
In addition, as the voltmeter also conducts a contact check during the withstand voltage test, it does not require time only for a contact check and therefore will improve the reliability of the test without increasing the tact time on the production line.

# 1.3 Parts Names

## 1.3.1 Front Panel

**⚠WARNING**

**To prevent electric shock, when the DANGER lamp is lit, never touch the input-voltage terminals (HIGH and LOW), the H.V. TEST LEADs, or the tested object.**

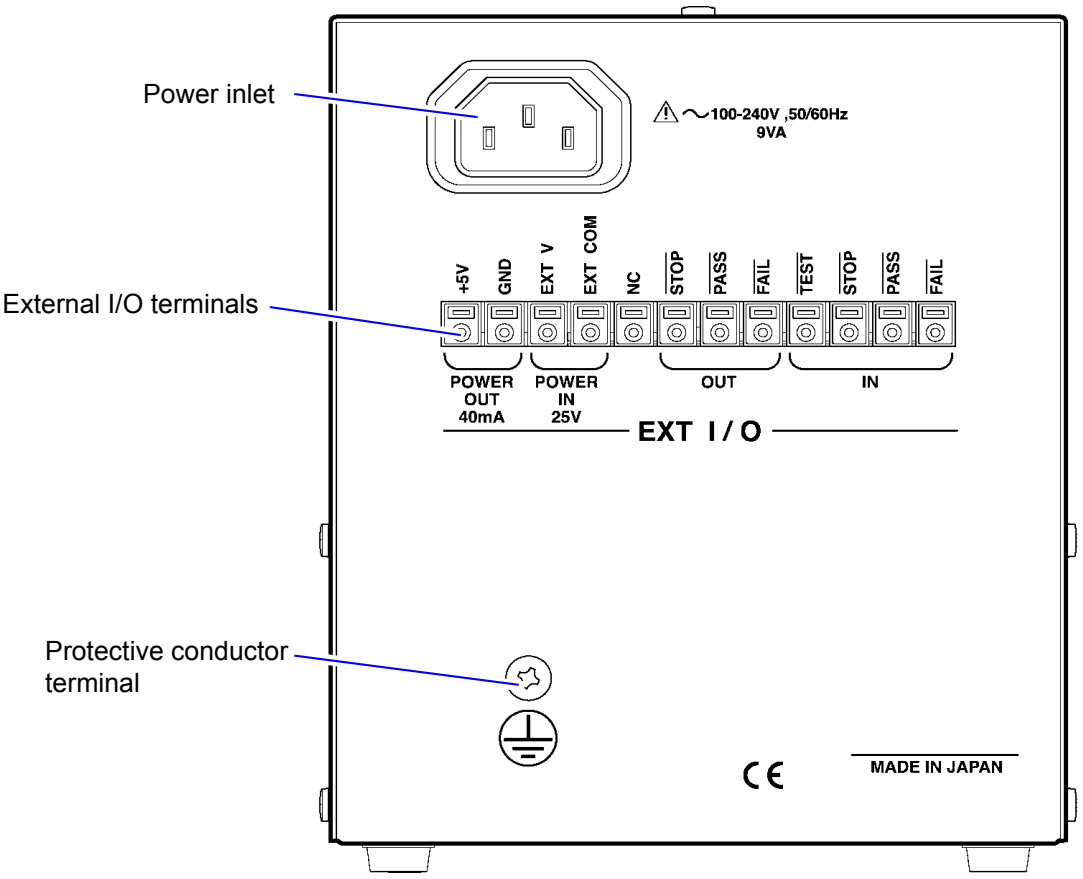


| | |
|---|---|
| RESET (STOP) switch | Releases the stop state of the connected WITHSTANDING VOLTAGE HiTESTER or the FAIL state after a failure is detected. |
| COMP LEVEL switch | Changes the meter indication.<br>OFF (normal) : Indicates the measurement terminal voltage.<br>ON (depressed) : Indicates the set threshold voltage.<br>When this switch is ON, a $\overline{\text{FAIL}}$ signal is not output to an external device. As the FAIL judgment is available, if a failure is detected, the $\overline{\text{FAIL}}$ signal is output to the external device after the switch is turned OFF. This switch lamp lights up in green if the test is being conducted properly. |
| LOW terminal | Low-voltage input terminal for measurement terminal voltage monitoring. Isolated from the housing. |
| HIGH terminal | High-voltage input terminal for measurement terminal voltage monitoring. |
| DANGER lamp | Lights up during a test.<br>Starts blinking to provide a warning if a dangerous voltage is input while the test is not being performed. |
| Threshold adjustment knob | Sets the voltage used as a criterion for failure.<br>The threshold voltage is normally set to the voltage output from the WITHSTANDING VOLTAGE HiTESTER. |
| Power switch | Powers the 3931 on or off.<br>The LED lights up when power is turned ON. |
| Analog voltmeter | Indicates output-voltage when testing withstand voltage. |

# 1.3.2 Rear Panel

**WARNING**

**To prevent electric shock, when the DANGER lamp is lit or blinking, never touch the input-voltage terminals (HIGH and LOW), the H.V. TEST LEADs, or the tested object.**




| | |
|---|---|
| Power inlet | Supplies power. Connect the supplied power cord to this inlet. |
| External I/O terminals | Used to connect the 3931 to a WITHSTANDING VOLTAGE HiTESTER and control the 3931. |
| Protective conductor terminal | Used to earth a protective ground wire.<br>Be sure to make grounding connections before starting a test. |

**NOTE**

In this manual, an input signal is expressed as "signal name_IN" and an output signal as "signal name_OUT."

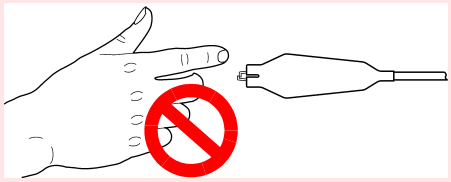
(Example) $\overline{\text{STOP}}$ output signal $\overline{\text{STOP\_OUT}}$

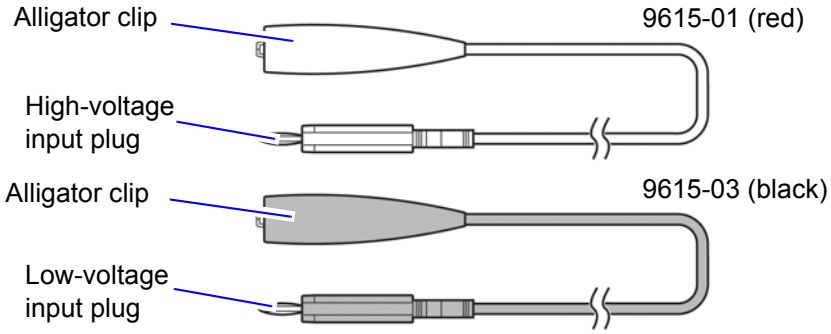
$\overline{\text{FAIL}}$ input signal $\overline{\text{FAIL\_IN}}$

# 1.3.3 H.V. TEST LEADs (9615-01, 9615-03)

**DANGER**

**To prevent electric shock, do not touch the alligator clip while high voltage is being generated. The vinyl sheath on the alligator clip of the H.V. TEST LEADs does not have an insulation withstand voltage.**

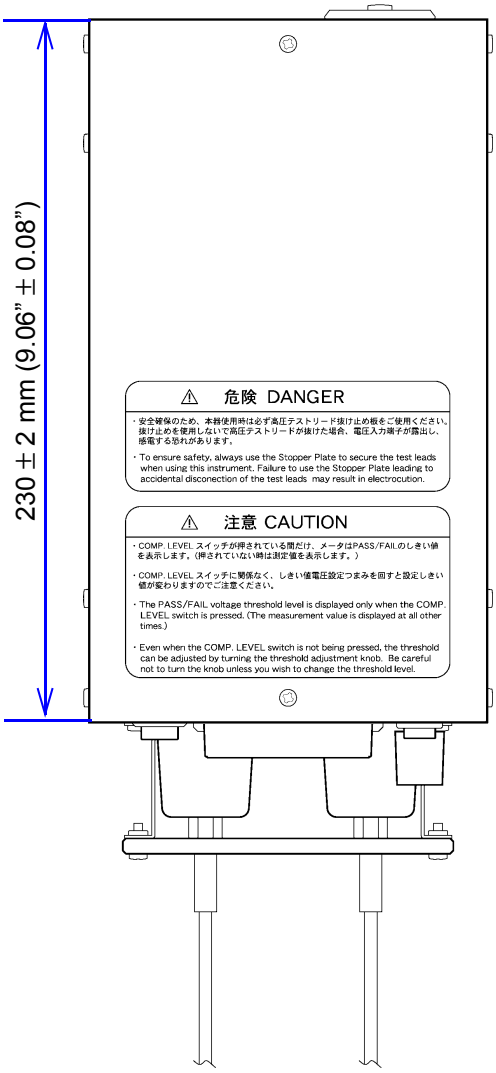


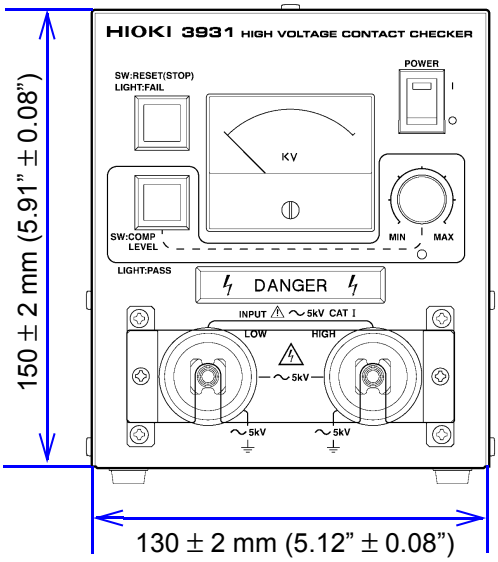



* The plugs for high voltage and low voltage are of the same size.

| | |
|---|---|
| Alligator clip | Attach to the test point on the device being measured. |
| High-voltage input plug (red) | Connect to the HIGH terminal on the unit. |
| Low-voltage input plug (black) | Connect to the LOW terminal on the unit. |

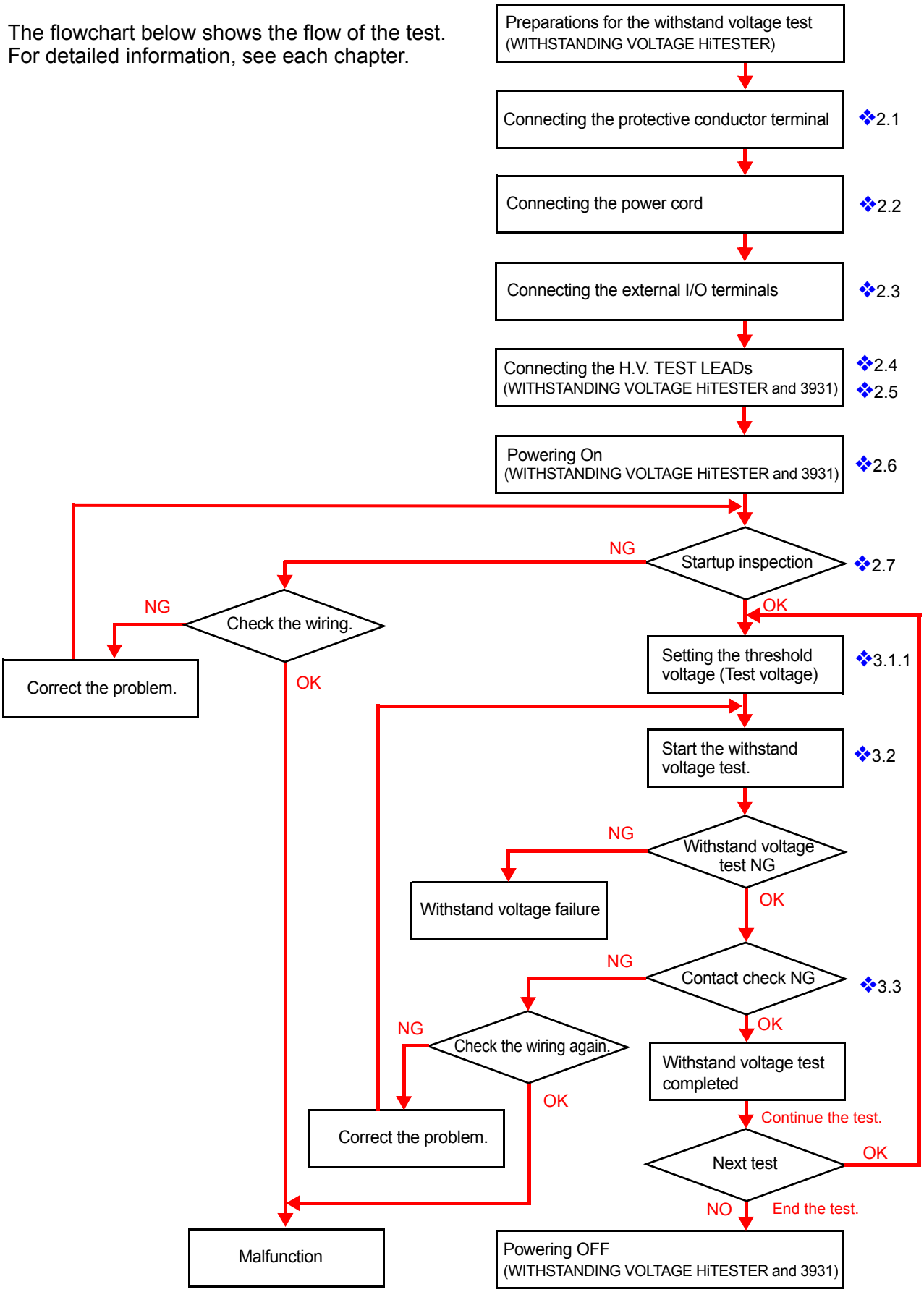
# 1.4 External Dimensions



# 1.5 Measurement Flowchart

The flowchart below shows the flow of the test.
For detailed information, see each chapter.



## *1.5 Measurement Flowchart*

# Testing Arrangements Chapter 2

## 2.1 Connecting the Protective Conductor Terminal

**⚠WARNING**

**Observe the following precautions to avoid electric shock.**

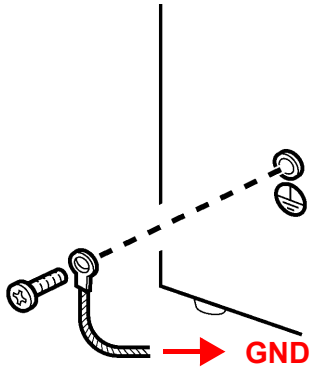
- **Connect the protective conductor terminal to a grounded conductor before making any other connections.**
- **Be sure to connect the protective conductor terminal to a grounded conductor.**

1. Using a Phillips-head screwdriver, remove the screw of the protective conductor terminal from the rear of the unit.

2. Connect an electric wire with a sufficient current capacity to the protective conductor terminal, and secure the wire using a Phillips-head screwdriver.

| | | |
|---|---|---|
| Specified cable | UL1015 AWG16 | Sumitomo Electric Industries, Ltd.'s or equivalent |
| Press-fit terminal | BT1.25_F4 | Fuji Terminal Industry Co., Ltd.'s or equivalent |

3. Ground the other end of the wire.

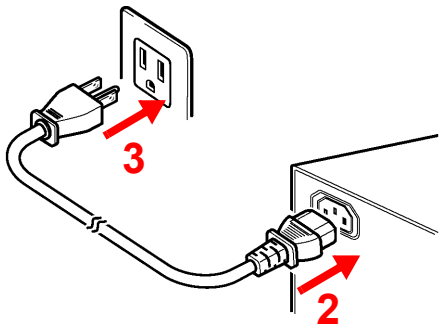


# 2.2 Connecting the Power Cord

**⚠WARNING**

- **Before turning the product on, make sure the source voltage matches that indicated on the product's power connector. Connection to an improper supply voltage may damage the product and present an electrical hazard.**
- **To avoid electric shock and ensure safe operation, connect the power cord to a grounded (3-contact) outlet.**

1. Be sure that the power switch is turned to OFF(◯).
2. Connect the power cord provided to the power inlet on the back of the unit.
3. Insert the plug into the grounded outlet.

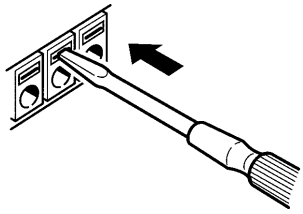


# 2.3 Connecting the External I/O Terminals

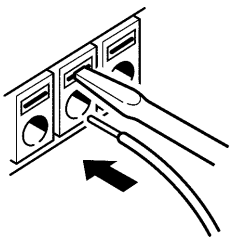
**⚠CAUTION**

Connect the external I/O terminals before turning on the power. If the external I/O terminals are installed or removed following startup, malfunction may result.

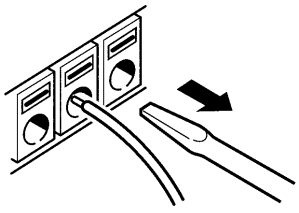
1. Press the top of the external I/O terminal with a flathead screwdriver.



2. While holding down the top of the terminal, insert a stripped (approximately 1 cm) signal wire into the terminal.



3. Draw out the screwdriver.



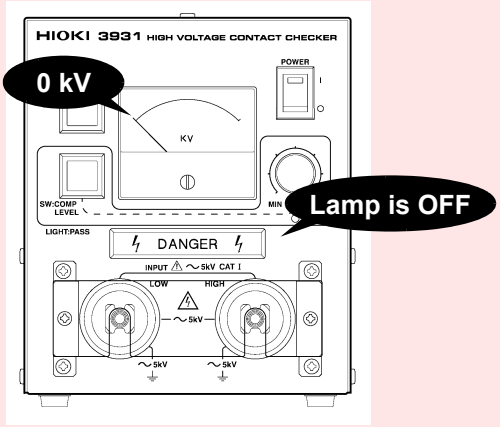
**NOTE**

- For the external I/O terminals specification, see 4.1, "External I/O Terminals" (page 43).
- The 3931 starts failure detection upon receipt of a signal from the connected WITHSTANDING VOLTAGE HiTESTER. Confirm that the external I/O terminals are properly connected to the WITHSTANDING VOLTAGE HiTESTER.

# 2.4 Connecting the H.V. TEST LEADs to the 3931

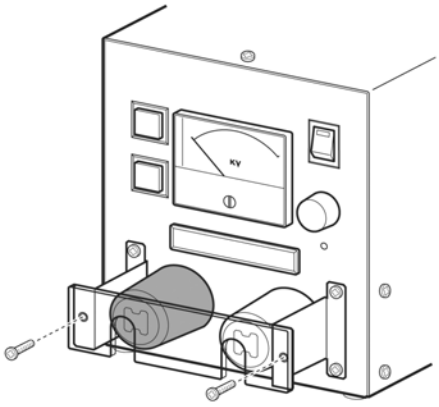
**⚠WARNING**

- **Before connecting the H.V. TEST LEADs, make sure that the insulation on the H.V. TEST LEADs is undamaged and that no bare conductors are improperly exposed. Using the product under such conditions could result in electrocution. Replace the H.V TEST LEADs with the specified Hioki Model 9615-01, 9615-03.**
- **To avoid electric shock, check the following to confirm that a high voltage is not applied to the measurement terminal before connecting the H.V. TEST LEADs to the 3931.**
  **(1) The analog voltmeter reads 0 kV.**
  **(2) The DANGER lamp is OFF.**

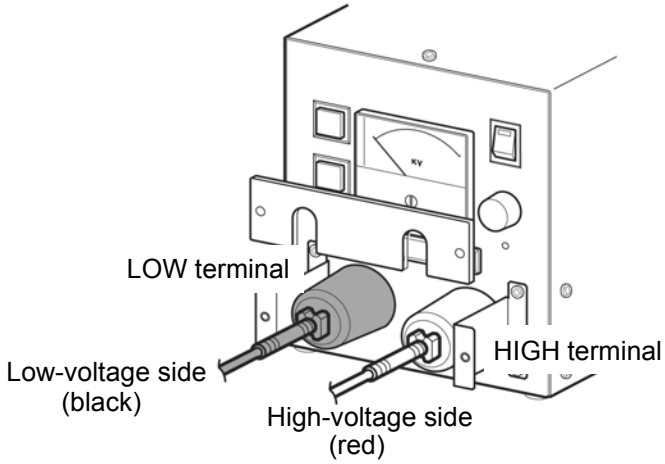



- **To ensure safety, be sure to use the stopper plate. If the H.V. TEST LEAD comes off and the stopper plate is not used, the voltage input terminal is exposed, which may result in electric shock.**
- **To avoid electrical accidents, confirm that the H.V. TEST LEAD is securely connected before starting the test. It is dangerous to output a voltage with the TEST LEAD not properly connected.**
- **Be careful to ensure that the polarity of the H.V. TEST LEAD is correct. The LOW side of the 3931 is isolated from the housing (protective earth potential). Although it withstands up to 5 kVrms, if the polarity is incorrect, electric shock may occur, which will also result in a measurement error.**

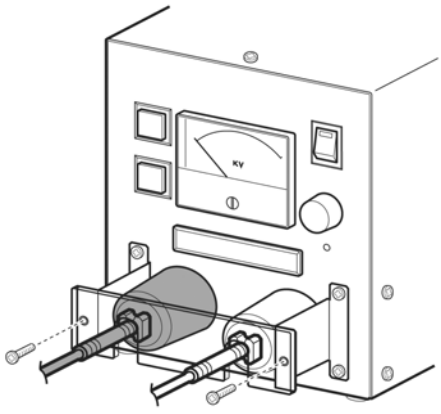
1. Remove the screws fastening the stopper plate.
2. Remove the stopper plate.



3. Connect the H.V. TEST LEADs. Be careful to ensure that the polarity is correct.




4. Attach the stopper plate.
5. Fasten the stopper plate with the screws.



# 2.5 Connecting the H.V. TEST LEADs to the Device to be Tested

**⚠WARNING**

**Observe the following precautions to avoid electric shock.**

- **Check the following to confirm that a high voltage is not applied to the voltage input terminals before connecting the H.V. TEST LEADs to the device.**
  **(1) The analog voltmeter of the WITHSTANDING VOLTAGE HiTESTER reads 0 kV.**
  **(2) DANGER lamp of the WITHSTANDING VOLTAGE HiTESTER is off.**
- **Make sure that no high voltage is being applied between the input-voltage terminals (HIGH and LOW), before touching the input-voltage terminals, the H.V. TEST LEADs, or tested object. Even following a test, there may be a residual voltage at the input-voltage terminals.**
- **Be careful to ensure that the polarity of the H.V. TEST LEAD is correct. Connect the HIGH side (high-tension side, red) of the H.V. TEST LEAD to the HIGH side (high-tension side, red) of the device to be tested to which the WITHSTANDING VOLTAGE HiTESTER is connected, and the LOW side (low-tension side, black) of the H.V. TEST LEAD to the LOW side (GND, black) of the device.**
  **The LOW side of the 3931 is isolated from the housing (protective earth potential). Although it withstands up to 5 kVrms, if the polarity is incorrect, electric shock may occur, which will also result in a measurement error.**

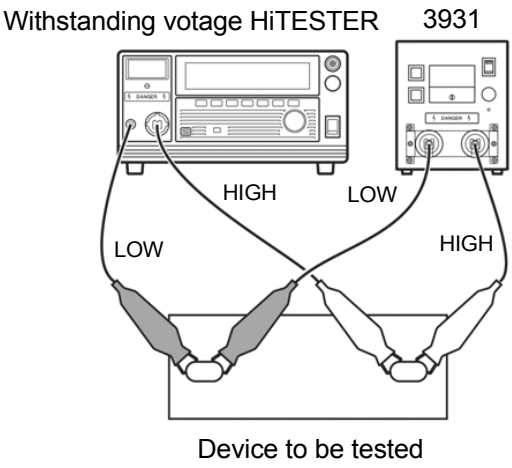
1. Confirm that the analog voltmeter of the WITHSTANDING VOLTAGE HiTESTER reads 0 kV and that the **DANGER** lamp is off.

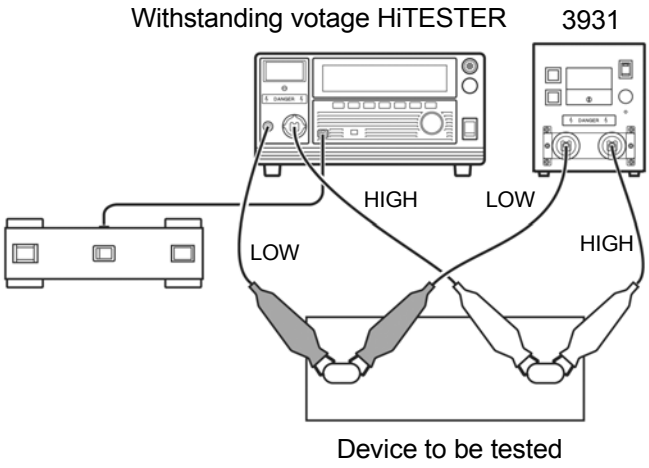
2. Connect the LOW side (black) of the H.V. TEST LEAD to the device to be tested.

3. Connect the HIGH side (red) of the H.V. TEST LEAD to the device to be tested.
❖Hioki WITHSTANDING VOLTAGE HiTESTER Instruction Manual

**NOTE**

Confirm that the H.V. TEST LEADs connected to the HiTESTER and the 3931 do not touch each other. If the leads touch each other, the 3931 cannot detect contact failure, although it can detect a broken wire. Confirm that the probes are securely connected and that they will not come off during the test.



# 2.6 Powering On and Off the 3931

**⚠WARNING**

**Before turning the product on, make sure the source voltage matches that indicated on the product's power connector. Connection to an improper supply voltage may damage the product and present an electrical hazard.**

**NOTE**

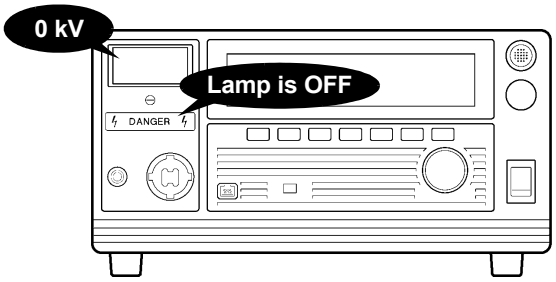
Allow 10 minutes warming up after powering on.

## Powering on the unit

Turn the power switch to ON( | ).

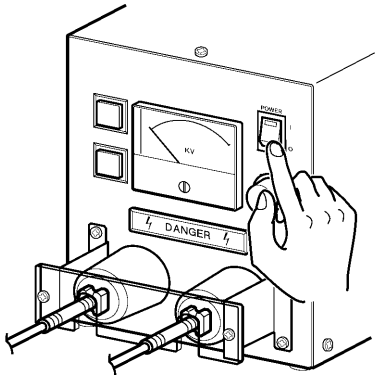
## Powering off the unit

1. Upon completion of the test, check the following.
   - The analog voltmeter of the WITHSTANDING VOLTAGE HiTESTER reads 0 kV.
   - **DANGER** lamp of the WITHSTANDING VOLTAGE HiTESTER is off.




3158 AC WITHSTANDING VOLTAGE HiTESTER

2. Turn the power switch to OFF(○).




If the analog voltmeter of the WITHSTANDING VOLTAGE HiTESTER does not read 0 kV or the **DANGER** lamp is on despite the fact that the test has been completed, the 3931 may malfunction. Turn off the power and contact your vender (our agent) or your nearest Hioki office.

# 2.7 Startup Inspection

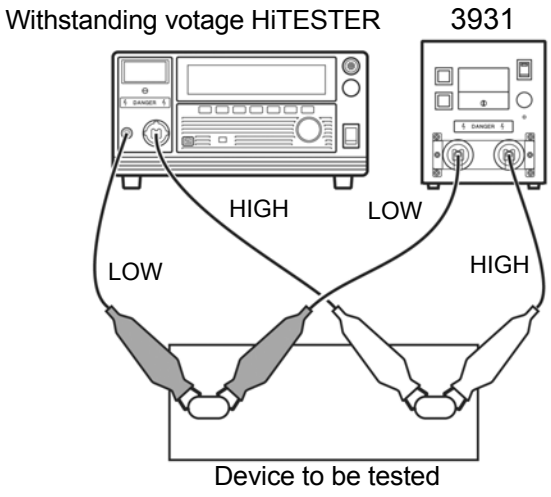
To ensure safe testing, check the following before starting operation:
For inspections of the WITHSTANDING VOLTAGE HiTESTER, see its operator's manual.

## 2.7.1 Cutoff Voltage

Check to confirm that the 3931 operates properly. After connecting the 3931 to the WITHSTANDING VOLTAGE HiTESTER, confirm that the 3931 enters the PASS state when the voltage exceeds the set threshold voltage and enters the FAIL state when the voltage is below the threshold. To create a FAIL state, set up the 3931 as shown in the example below.

**(Example)**
Threshold voltage: 2.5 kV
- Check for the PASS state
  HiTESTER output voltage: 2.7 kV
- Check for the FAIL state
  HiTESTER output voltage: 2.3 kV

1. Connect the 3931 to the WITHSTANDING VOLTAGE HiTESTER in order to conduct a test. Do not forget to connect the external I/O terminals.
❖2.3, "Connecting the External I/O Terminals" (page 19)

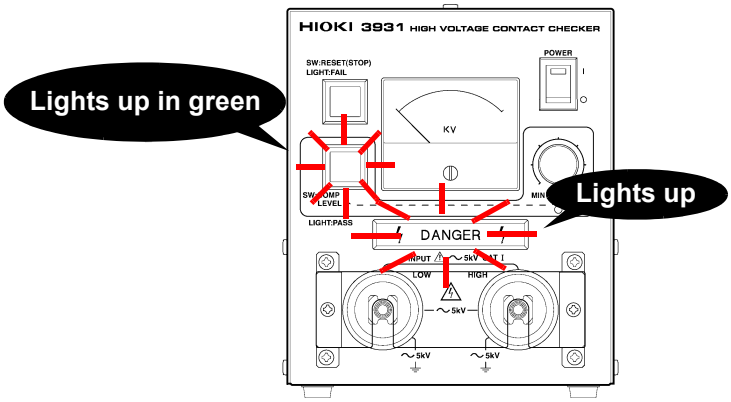



2. Set the threshold voltage to **2.5 kV**.
❖3.1.1, "Setting the Threshold Voltage" (page 31)

3. Set the output voltage of the WITHSTANDING VOLTAGE HiTESTER to **2.7 kV**.
The output voltage may be any voltage, provided that it exceeds the threshold voltage. (In the example above, it shall be greater than 2.5 kV.)
❖Hioki WITHSTANDING VOLTAGE HiTESTER Instruction Manual

4. Start up the WITHSTANDING VOLTAGE HiTESTER to input the voltage to the 3931. Turn off the test timer of the HiTESTER to make it easier to check that the 3931 operates normally before the test.

5. Confirm that the **COMP LEVEL** switch lights up in green and that the **DANGER** lamp lights up (steady). (This indicates that the withstand voltage test is being performed properly.)




6. Set the output voltage of the WITHSTANDING VOLTAGE HiTESTER to **2.3 kV**.
The output voltage may be any voltage, provided that it is lower than the threshold voltage. Normally, deduct 5% from the threshold voltage (deduct 50 V when the threshold is 1 kV or less).

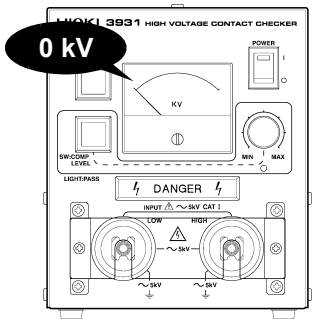
7. When the 3158, 3159, or 3173 is used, gradually turn the output voltage adjustment knob counterclockwise. Confirm that the 3931 enters the FAIL state and the WITHSTANDING VOLTAGE HiTESTER stops when the output voltage of the HiTESTER falls below 2.5 kV.

8. When the 3153 is used, stop the 3153, set the output voltage to 2.3 kV, and then restart the 3153.
❖3.3.2, "FAIL State" (page 40)
❖4.1.5, "Example of Connection to the WITHSTANDING VOLTAGE HiTESTER" (page 48)
"Connection to the 3153 (Using an automatic machine)"(page 52)

# 2.7.2 Analog Voltmeter

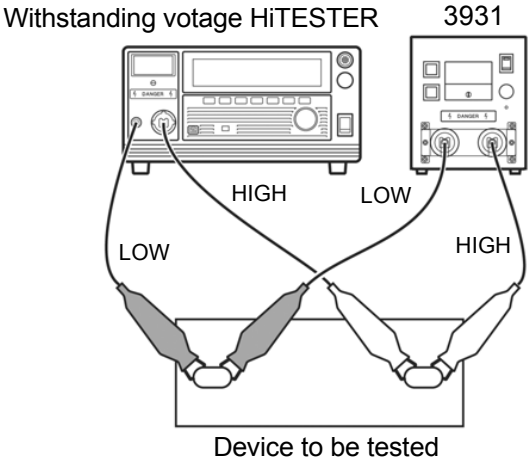
**(Example)**
Check to confirm that the margin of error of the analog voltmeter is within ± 5% f.s.
- HiTESTER output voltage: 2.5 kV
- Meter of the 3931: Shall read 2.25 kV to 2.75 kV

1. Before turning on the power, confirm that the analog voltmeter reads **0 kV**.




2. If the indicator does not point to zero, adjust the zero position using a flathead screwdriver.

3. Set the output voltage of the WITHSTANDING VOLTAGE HiTESTER to **2.5 kV** and start up the HiTESTER.
❖Hioki WITHSTANDING VOLTAGE HiTESTER Instruction Manual



4. Confirm that the meter of the 3931 reads the same voltage as the output voltage of the WITHSTANDING VOLTAGE HiTESTER.
In this example, the meter shall indicate a value between **2.25 V** and **2.75 V**.

**NOTE**

Do not twist together (twisted pair) the H.V. test leads connected to the 3931 and to the HiTESTER (HIGH with HIGH and LOW with LOW). If they are twisted together, due to influence of the capacity coupling, the meter may indicate a voltage even if no voltage is input to the 3931 (approximately 10% of the input) applied during the withstand voltage test. Never twist HIGH and LOW leads together into a pair.

# Chapter 3 Testing Method

This chapter explains in detail the procedure for using the 3931 HIGH VOLTAGE CONTACT CHECKER (test condition setting procedure and testing procedure).
Read Chapter 2, "Testing Arrangements" (page 17), and make the necessary preparations for testing.

# 3.1 Test Startup Flow

The flowchart below explains how a test is carried out.

**(Example)**
Check for broken wires and contact failures during the withstand voltage test using the 3931.
- HiTESTER output voltage : 2.5 kV (2.4 kV if the threshold voltage is set)
- Threshold voltage of the 3931: 2.5 kV

**Setting the test parameters**
❖3.1.1, "Setting the Threshold Voltage"
Set the test conditions. Set the threshold voltage to 2.5 kV.

↓

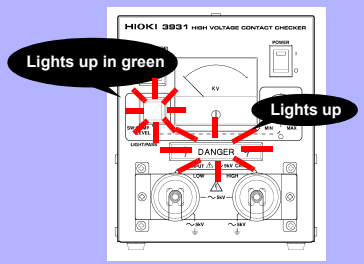
**Start the test.**
❖3.2, "Starting a Test"
1. Connect the WITHSTANDING VOLTAGE HiTESTER, the device to be tested, and the 3931.
2. Set the output voltage of the WITHSTANDING VOLTAGE HiTESTER to **2.5 kV**.
3. Press the external START switch of the WITHSTANDING VOLTAGE HiTESTER; the test will start.
4. When the 3931 starts voltage monitoring, the **DANGER** lamp of the 3931 will light up (and remain on).

* If a voltage of 50 V to 100 V is input while the 3931 is not yet in the START state, the **DANGER** lamp will go out.

↓

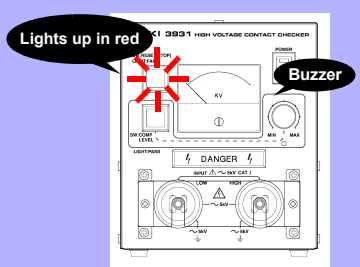
**PASS/FAIL judgment**
❖3.3, "PASS or FAIL Determination"

- PASS: The test is being conducted properly.




The **COMP LEVEL** switch will light up in green. This indicates that the voltages monitored in the set test time exceed the set threshold voltage. If the test is completed in this state, the withstand voltage test is judged as PASS or FAIL by the WITHSTANDING VOLTAGE HiTESTER.

- FAIL: A failure is detected.




The **RESET (STOP)** switch will light up in red and the buzzer will sound. The 3931 stops the WITHSTANDING VOLTAGE HiTESTER. Please note that the PASS judgment made by the WITHSTANDING VOLTAGE HiTESTER is meaningless if the 3931 has detected a failure.

# 3.1.1 Setting the Threshold Voltage

**⚠CAUTION**

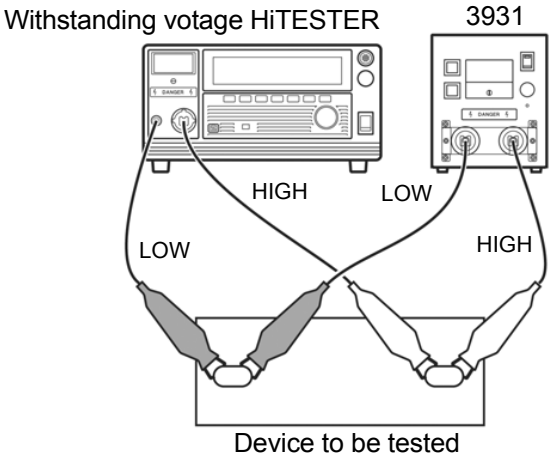
- When the WITHSTANDING VOLTAGE HiTESTER is of the supply voltage boosting type, the output of which is not stabilized, the 3931 detects an abnormal output voltage due to fluctuations in the supply voltage. If the 3931 is judged as FAIL even within the allowable voltage fluctuation range, use a stabilized power supply for the WITHSTANDING VOLTAGE HiTESTER or set the threshold voltage of the 3931 to a low value so as to allow for voltage fluctuations.
- To avoid errors, do not change the threshold voltage setting during testing.

## Setting the Threshold by Applying Voltage from the HiTESTER

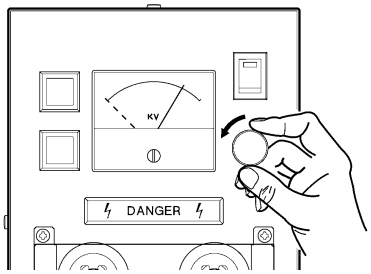
**⚠DANGER**

**To avoid electric shock, never touch the input-voltage terminals (HIGH and LOW), the H.V. TEST LEADs, or tested object.**
**This method prevents meter errors and internal errors and therefore enables more accurate setting than that made only by watching the meter. It is, however, more dangerous, as a high voltage is applied.**

1. Set the output voltage of the WITHSTANDING VOLTAGE HiTESTER to **2.5 kV**.
   ❖Hioki WITHSTANDING VOLTAGE HiTESTER Instruction Manual
2. Connect a non-defective device to be tested.
   ❖2.4, "Connecting the H.V. TEST LEADs to the 3931" (page 20)
   ❖2.5, "Connecting the H.V. TEST LEADs to the Device to be Tested" (page 22)

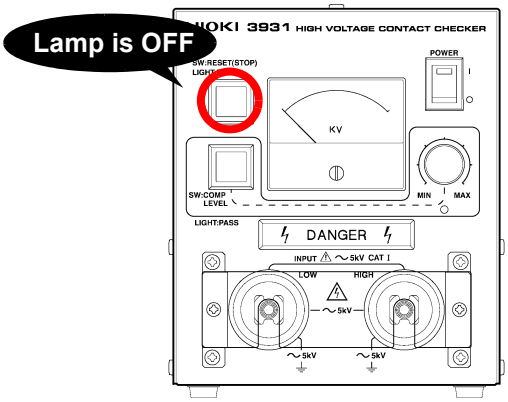


3. Fully rotate the threshold adjustment knob of the 3931 counterclockwise.



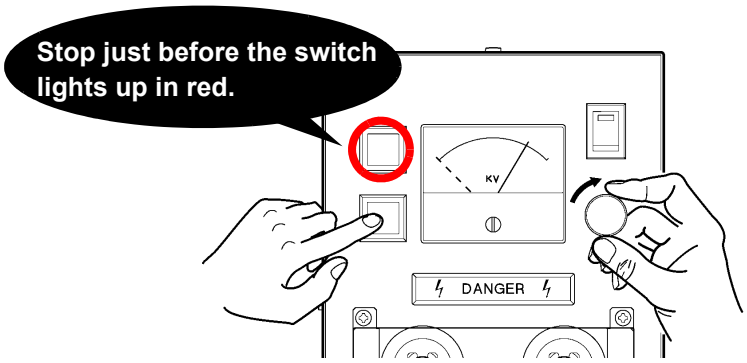

4. Start up the WITHSTANDING VOLTAGE HiTESTER and apply a test voltage.

5. Confirm that the **RESET (STOP)** switch lamp is off.




**Judged as FAIL**
This is merely an internal error and not a failure of the 3931. Start up the WITHSTANDING VOLTAGE HiTESTER while holding down **COMP LEVEL** switch and perform all steps through step 6. If a $\overline{\text{TEST}}$ signal is properly input from the WITHSTANDING VOLTAGE HiTESTER, the **DANGER** lamp of the 3931 will light up.

6. While holding down the **COMP LEVEL** switch, rotate the threshold adjustment knob clockwise.



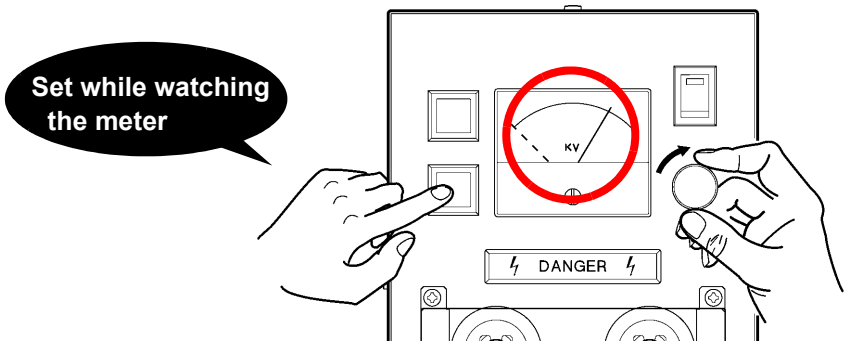

When the measurement terminal voltage falls below the threshold, the **RESET (STOP)** switch lights up in red. The optimum setting position is that in which the switch lamp is completely off (the closest position to that in which the lamp remains on, rather than blinking).
When the threshold voltage is set by this method, the output voltage of the WITHSTANDING VOLTAGE HiTESTER can be set to approximately -30 V. We recommend that the threshold voltage be set within this range.

**NOTE**

- While the **COMP LEVEL** switch is on, failure detection is continued internally but a $\overline{\text{FAIL}}$ signal is not output. If the **RESET (STOP)** switch lights up during setting of the threshold, the 3931 enters the FAIL state after setting is completed and the **COMP LEVEL** switch is turned off (not depressed). However, this does not indicate a failure of the 3931. Press the **RESET (STOP)** switch to cancel the FAIL state.
- If the output of the WITHSTANDING VOLTAGE HiTESTER is affected by fluctuations in the supply voltage, this effect can be minimized by setting the threshold to a low value. However, this reduces the sensitivity of the 3931. We recommend that a stabilized power supply be used for the WITHSTANDING VOLTAGE HiTESTER, rather than setting the threshold to too low of a value.
- If a wire is broken when a large current (10 mA or below) flows during a withstand voltage test, the discharge of sparks is increased. When the difference between the threshold voltage and the test voltage is large and spark discharge occurs, a FAIL judgment may not be made due to the influence of noise. In such a case, set the threshold closer to the output voltage of the WITHSTANDING VOLTAGE HiTESTER.

## Setting the Threshold Without Applying Voltage from the HiTESTER

While holding down the **COMP LEVEL** switch, rotate the threshold adjustment knob to set the threshold voltage to **2.5 kV**. Set the threshold voltage while watching the meter.

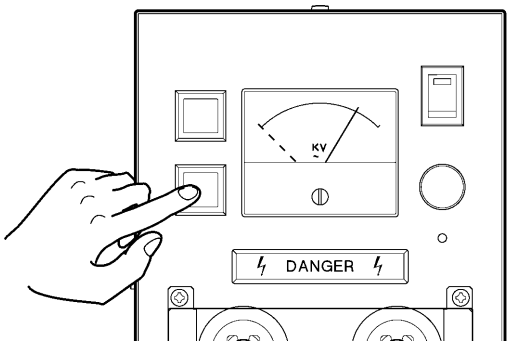



**NOTE**

- With this method, the threshold can be set without applying a high voltage to the 3931. However, the set threshold voltage may not be accurate due to an internal error. Adjust the setting as necessary.
- Ideally, the threshold voltage be the same as the voltage output by the WITHSTANDING VOLTAGE HiTESTER. In reality, we recommend that the output voltage be slightly less than the set threshold voltage.
- If the output of the WITHSTANDING VOLTAGE HiTESTER is affected by fluctuations in the supply voltage, this effect can be minimized by setting the threshold to a low level. However, this reduces the sensitivity of the 3931. We recommend that a stabilized power supply be used for the WITHSTANDING VOLTAGE HiTESTER, rather than setting the threshold to too low a level.

## How is the Set Threshold voltage Viewed?

Press the **COMP LEVEL** switch; this will allow the set voltage to be viewed.



# 3.2 Starting a Test

**⚠WARNING**

**Observe the following precautions to avoid electric shock.**

- **Confirm the following items, before a high voltage is applied:**
  **(1) The analog voltmeter of the WITHSTANDING VOLTAGE HiTESTER reads 0 kV.**
  **(2) DANGER lamp of the WITHSTANDING VOLTAGE HiTESTER is off.**
- **Never touch the HIGH terminal, the H.V. TEST LEADs, or the device to be tested when the threshold voltage of the 3931 is set while a high voltage is output from the WITHSTANDING VOLTAGE HiTESTER.**

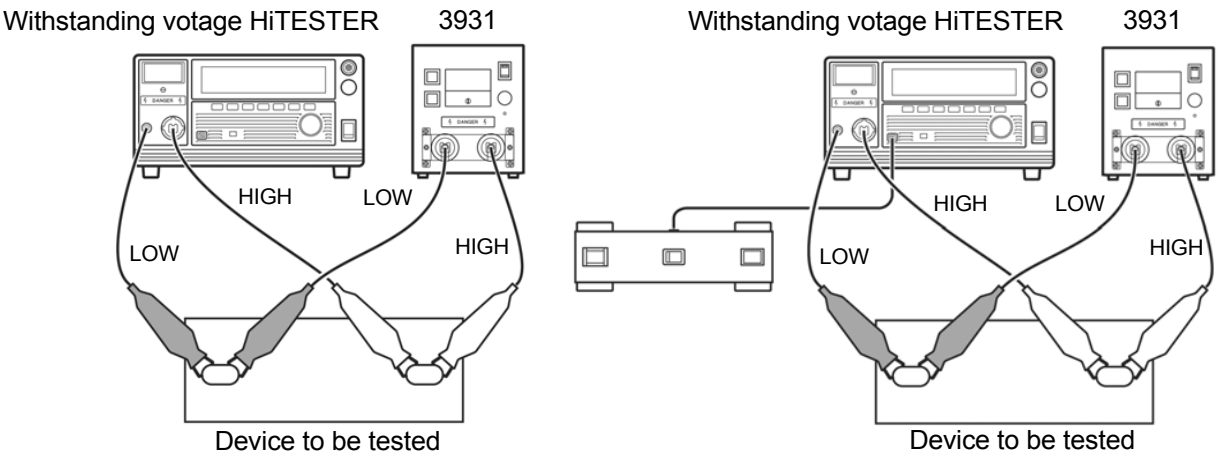
**⚠CAUTION**

To avoid errors, do not change the threshold voltage setting during testing.

**NOTE**

The 3931 starts failure detection upon receipt of a signal from the connected WITHSTANDING VOLTAGE HiTESTER. Once the setting has been made, it is not necessary to operate the 3931 to start the test. Start and stop the test on the WITHSTANDING VOLTAGE HiTESTER.

1. Connect the 3931 to the WITHSTANDING VOLTAGE HiTESTER.
Do not forget to connect the external I/O terminals.
❖Chapter 2, "Testing Arrangements" (page 17)




2. Set the threshold voltage to **2.5 kV**.
❖3.1.1, "Setting the Threshold Voltage" (page 31)

3. Set the output voltage of the WITHSTANDING VOLTAGE HiTESTER to **2.5 kV**.
❖Hioki WITHSTANDING VOLTAGE HiTESTER Instruction Manual

4. Start the withstand voltage test in accordance with the operating procedure of the WITHSTANDING VOLTAGE HiTESTER.
Upon receipt of a $\overline{\text{TEST}}$ signal from the WITHSTANDING VOLTAGE HiTESTER, the 3931 automatically starts failure detection.

5. Press the external **START** switch of the WITHSTANDING VOLTAGE HiTESTER; the withstand voltage test will start. When measurement has been started properly, the **DANGER** lamp will light up.

**NOTE**

As the external I/O of the WITHSTANDING VOLTAGE HiTESTER is used, the **START** key of the HiTESTER may be disabled. Start the test in accordance with the correct procedure.
❖Hioki WITHSTANDING VOLTAGE HiTESTER Instruction Manual

## How is the Test Interrupted?

Stop the WITHSTANDING VOLTAGE HiTESTER by pressing the **RESET (STOP)** switch of the 3931 or using the control method for the HiTESTER. When the **RESET (STOP)** switch of the 3931 is pressed, the 3931 transmits a $\overline{\text{STOP}}$ signal to the WITHSTANDING VOLTAGE HiTESTER and stops its voltage output. If no failure has been detected thus far, the 3931 judges that "no failure is detected."

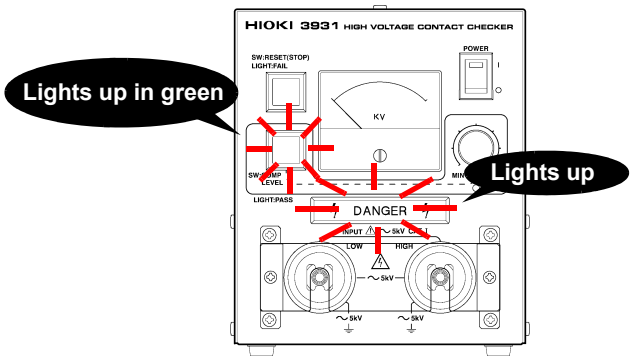
# 3.3 PASS or FAIL Determination

## 3.3.1 PASS State

**⚠WARNING**

- **Even when a test has been terminated, there may still be voltage in the input-voltage terminals. Confirm the following items, before touching the input-voltage terminals (HIGH and LOW), the H.V. TEST LEADs, or tested object.**
  **(1) The analog voltmeter of the WITHSTANDING VOLTAGE HiTESTER reads 0 kV.**
  **(2) DANGER lamp of the WITHSTANDING VOLTAGE HiTESTER is off.**
- **When a high voltage is applied to a cable and a wire in the cable is broken, spark discharge occurs and the withstand voltage test may be affected by noise. Take measures for noise protection.**

When the **COMP LEVEL** switch of the 3931 lights up in green, the PASS state is indicated, i.e., the test is being performed properly. Upon receipt of a $\overline{\text{TEST}}$ signal from the WITHSTANDING VOLTAGE HiTESTER, the 3931 starts the test. After the test has been started, when the voltage between the measurement terminals exceeds the set threshold voltage, the **COMP LEVEL** switch lights up in green.



NOTE

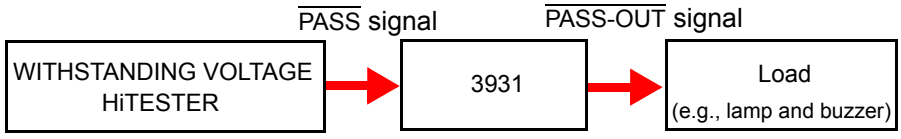
- If the 3931 detects a broken wire/contact failure or an abnormal test voltage, the PASS signal from the WITHSTANDING VOLTAGE HiTESTER is masked. Even if the WITHSTANDING VOLTAGE HiTESTER has made a PASS judgment, the 3931 does not output a PASS_OUT signal. When the 3931 outputs a PASS_OUT signal (L level), if the 3931 is properly connected to the WITHSTANDING VOLTAGE HiTESTER, the test has been completed properly.
- When a TEST signal is not input from the WITHSTANDING VOLTAGE HiTESTER, if the 3931 detects a voltage of 50 V to 100 V, the **DANGER** lamp starts blinking. While the **DANGER** lamp is blinking, the judgment of the 3931 is not sent to the WITHSTANDING VOLTAGE HiTESTER, and the test is not determined to have been completed.
- If a TEST signal is input from the WITHSTANDING VOLTAGE HiTESTER, the **DANGER** lamp remains steadily lit. When the **DANGER** lamp is on and the **COMP LEVEL** switch is lit up in green, the test is being performed properly. Under these conditions, if the WITHSTANDING VOLTAGE HiTESTER makes a PASS judgment, the test has been completed without any failure such as a broken wire, contact failure, or voltage fluctuation. The 3931 will not control the WITHSTANDING VOLTAGE HiTESTER. Take the necessary steps in accordance with a PASS judgment.
- A PASS signal from the WITHSTANDING VOLTAGE HiTESTER is output after the time set on the HiTESTER's timer has elapsed. When the timer is not used, a PASS signal is not output.

❖Hioki WITHSTANDING VOLTAGE HiTESTER Instruction Manual

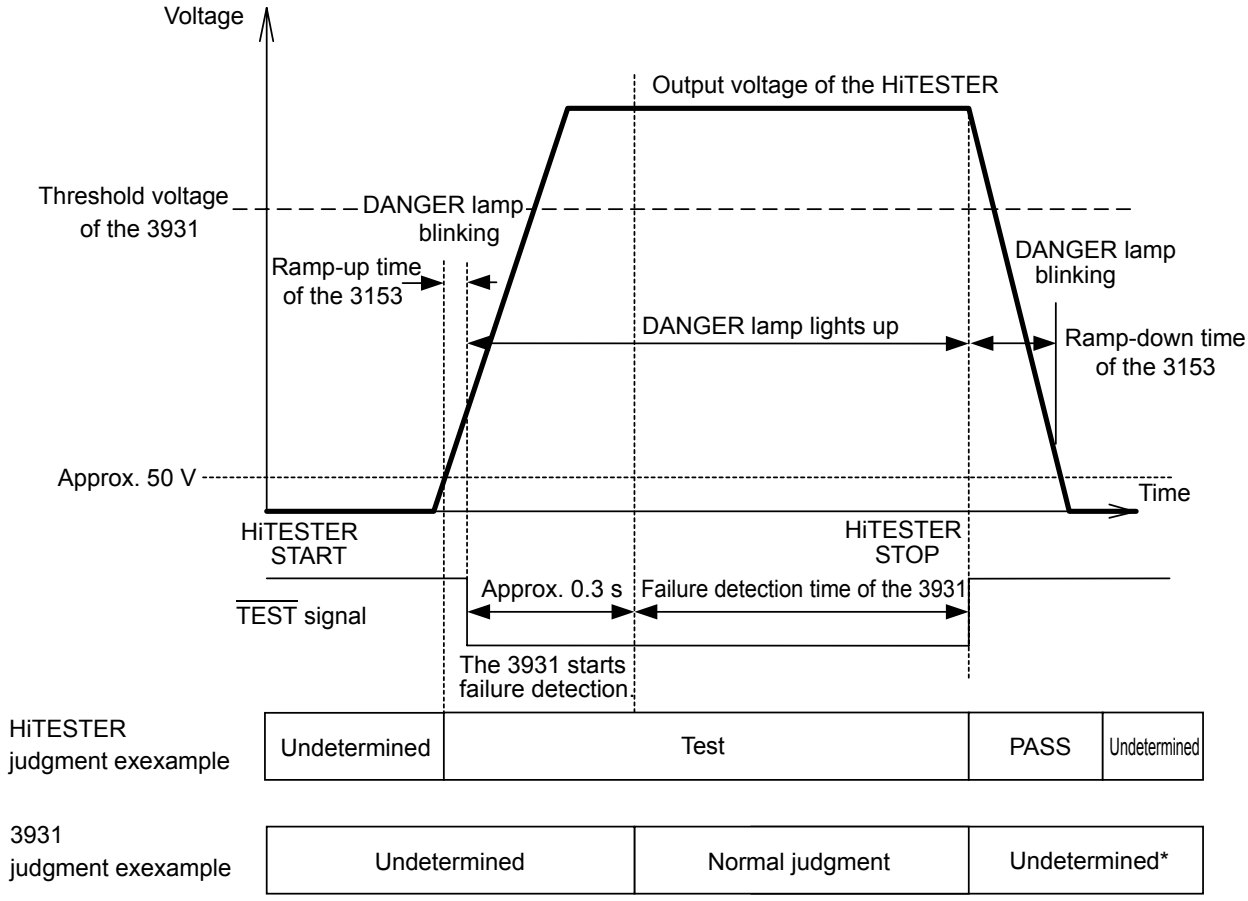
## Flow of Pass Determination

- The 3931 makes a PASS judgment and acts as shown below when the voltage between the measurement terminals exceeds the set threshold voltage.

1. Lights up the **COMP LEVEL** switch in green
2. Receives a $\overline{\text{PASS}}$ signal from the WITHSTANDING VOLTAGE HiTESTER
3. Outputs a $\overline{\text{PASS\_OUT}}$ signal




- The diagram below shows the operation in detail, from start to completion of the test. For details on PASS judgment, see the operator's manual of the WITHSTANDING VOLTAGE HiTESTER used.



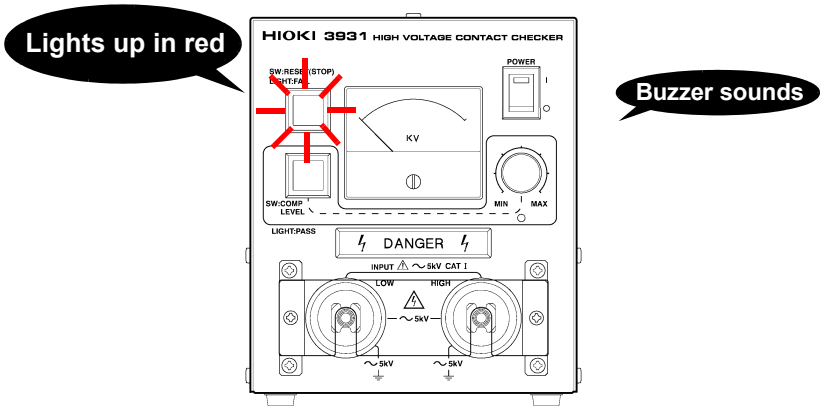

* The 3931 outputs a $\overline{\text{PASS}}$ signal from the HiTESTER ($\overline{\text{PASS IN}}$).

# 3.3.2 FAIL State

**WARNING**

- **Even when a test has been terminated, there may still be voltage in the input-voltage terminals. Confirm the following items, before touching the input-voltage terminals (HIGH and LOW), the H.V. TEST LEADs, or tested object.**
  **(1) The analog voltmeter of the WITHSTANDING VOLTAGE HiTESTER reads 0 kV.**
  **(2) DANGER lamp of the WITHSTANDING VOLTAGE HiTESTER is off.**
- **When a high voltage is applied to a cable and a wire in the cable is broken, spark discharge occurs and the withstand voltage test may be affected by noise. Take measures for noise protection.**

When the **RESET (STOP)** switch of the 3931 lights up in red, the FAIL state is indicated. If the monitored voltage falls below the set threshold voltage during the test, the 3931 immediately sends a $\overline{\text{STOP}}$ signal to the WITHSTANDING VOLTAGE HiTESTER in order to stop the output of the voltage.

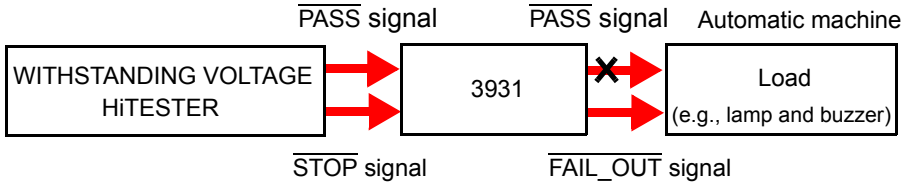



If the 3931 enters the FAIL state, press the **RESET (STOP)** switch to cancel the FAIL state (the state continues until the switch is pressed).

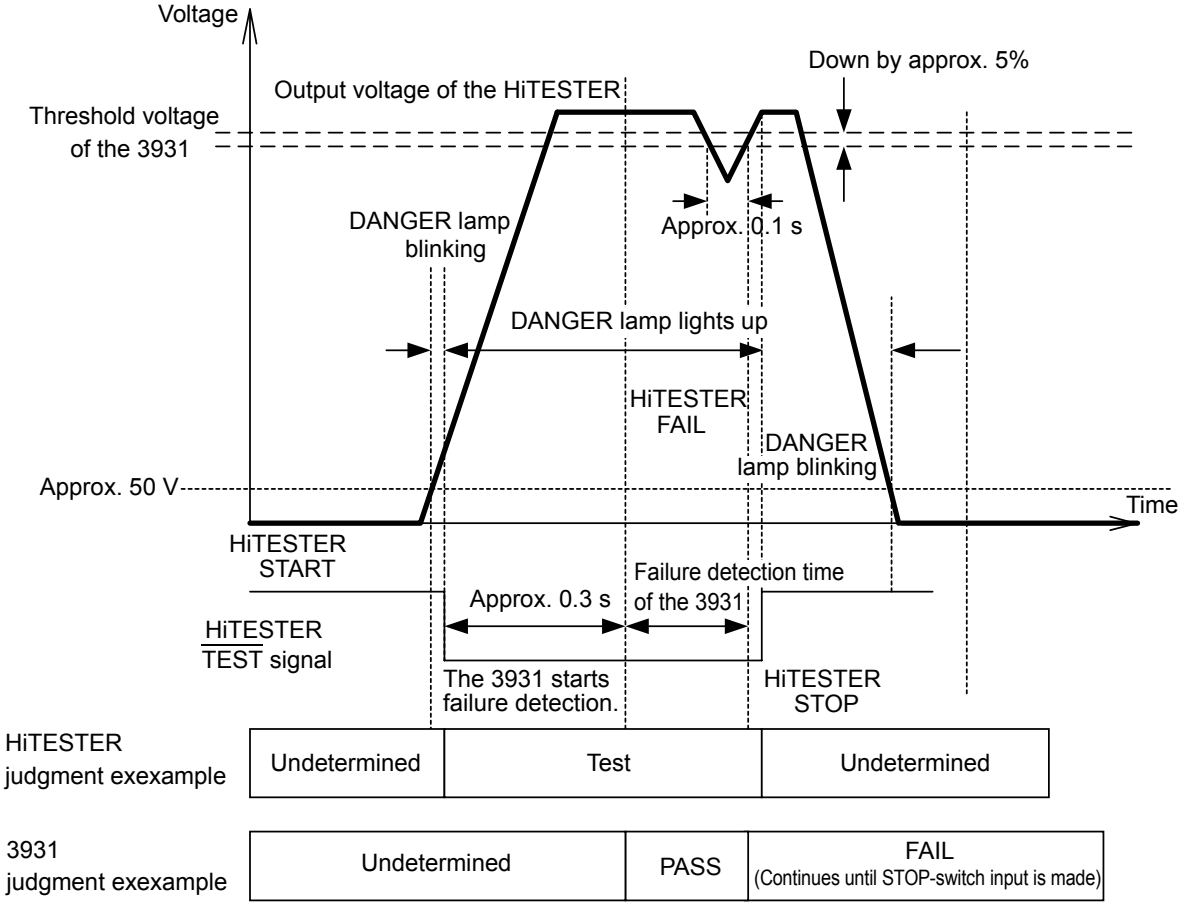
## Flow of Fail Determination

- If the voltage between the measurement terminals falls below the threshold voltage due to a broken wire, contact failure, or voltage fluctuation, the 3931 makes a FAIL judgment and acts as shown below.

1. Lights up the **RESET (STOP)** switch in red.
2. Masks (invalidates) the $\overline{\text{PASS}}$ signal from the WITHSTANDING VOLTAGE HiTESTER.
3. Sounds the buzzer.
4. Transmits a $\overline{\text{STOP}}$ signal to the connected WITHSTANDING VOLTAGE HiTESTER
5. Transmits a $\overline{\text{FAIL\_OUT}}$ signal.




- The diagram below shows the operation in detail



# External Interface Chapter 4

## 4.1 External I/O Terminals

The 3931 HIGH VOLTAGE CONTACT CHECKER automatically monitors the state of the test upon receipt of a signal from the WITHSTANDING VOLTAGE HiTESTER. If it is not properly connected to the WITHSTANDING VOLTAGE HiTESTER, the abnormal state detected by the 3931 will not be reflected in the test. Be sure to properly connect the external I/O signal lines to the WITHSTANDING VOLTAGE HiTESTER.
All signals are based on negative logic and become effective at the LOW level.

**NOTE**

In this manual, an input signal is expressed as "signal name_IN" and an output signal as "signal name_OUT."
(Example) $\overline{\text{STOP}}$ output signal $\overline{\text{STOP\_OUT}}$
$\overline{\text{FAIL}}$ input signal $\overline{\text{FAIL\_IN}}$

# 4.1.1 Signal Line

## Input Signal

| Input Signal from an Automatic Machine | |
|---|---|
| $\overline{\text{STOP\_IN}}$ | Connects $\overline{\text{STOP}}$-signal output from an automatic machine, such as a computer and sequencer, to the WITHSTANDING VOLTAGE HiTESTER. This signal and the $\overline{\text{STOP}}$ signal of the 3931 are combined by wired-OR logic and output as a $\overline{\text{STOP\_OUT}}$ signal. |

| Input Signal from the WITHSTANDING VOLTAGE HiTESTER | |
|---|---|
| $\overline{\text{TEST\_IN}}$ | Connects the $\overline{\text{TEST}}$ signal of the WITHSTANDING VOLTAGE HiTESTER. When this signal is input, the 3931 considers the withstand voltage test to have started and starts failure detection. |
| $\overline{\text{PASS\_IN}}$ | Connects the $\overline{\text{PASS}}$ signal of the WITHSTANDING VOLTAGE HiTESTER.<br>If the 3931 detects a failure, the 3931 invalidates the $\overline{\text{PASS}}$ signal from the WITHSTANDING VOLTAGE HiTESTER and outputs a $\overline{\text{PASS\_OUT}}$ signal. |
| $\overline{\text{FAIL\_IN}}$ | Connects the $\overline{\text{FAIL}}$ signal from the WITHSTANDING VOLTAGE HiTESTER. The $\overline{\text{FAIL}}$ signal from the WITHSTANDING VOLTAGE HiTESTER and the $\overline{\text{FAIL}}$ signal due to a failure detected by the 3931 are combined by wired-OR logic and output as a $\overline{\text{FAIL\_OUT}}$ signal. |

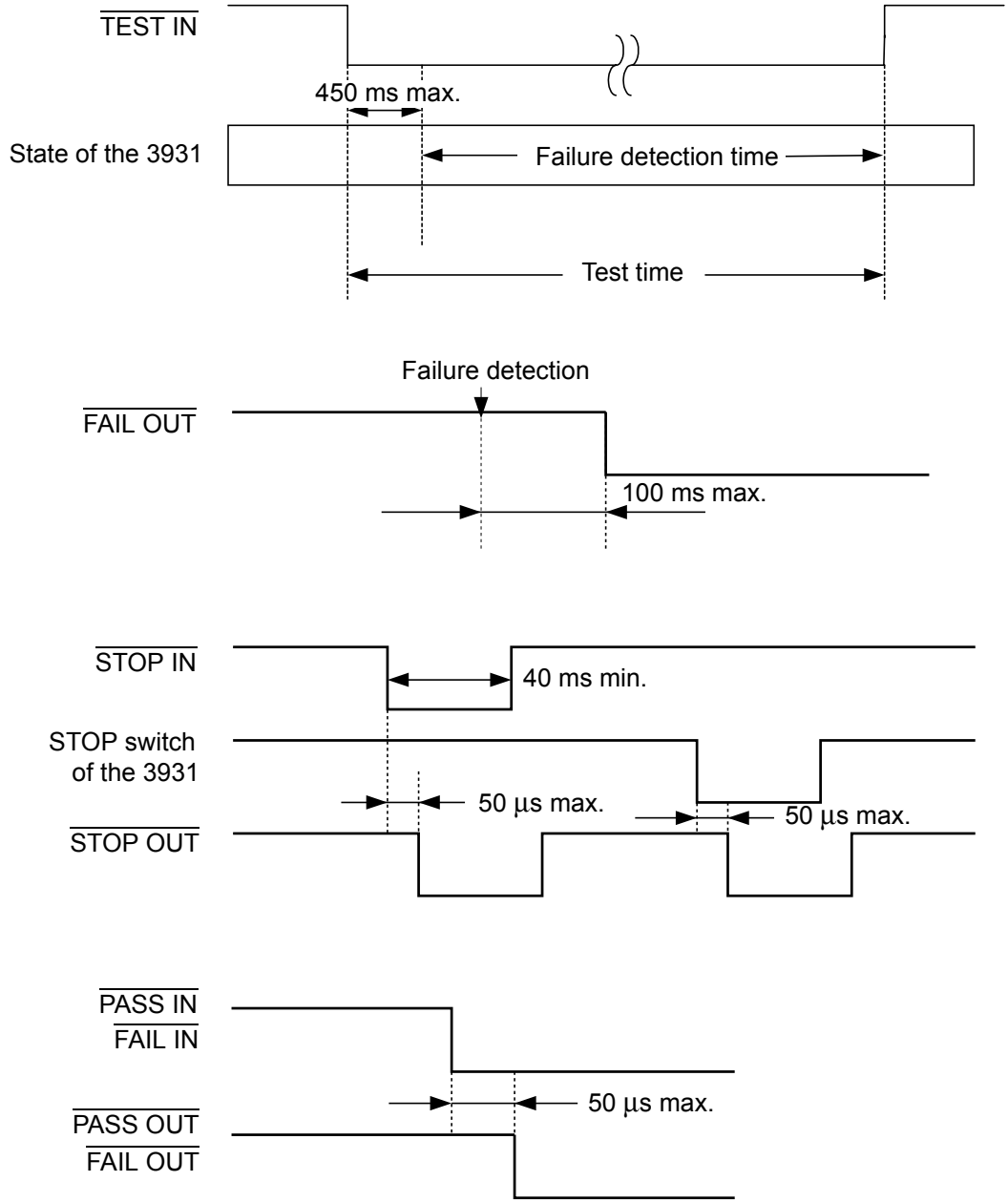
## Output Signal

| Output Signal to an Automatic Machine | |
|---|---|
| $\overline{\text{PASS\_OUT}}$ | If the 3931 detects a failure, the 3931 invalidates the $\overline{\text{PASS}}$ signal from the WITHSTANDING VOLTAGE HiTESTER and outputs this signal to the automatic machine. If the 3931 does not detect a failure, the 3931 outputs a $\overline{\text{PASS}}$ signal from the WITHSTANDING VOLTAGE HiTESTER. |
| $\overline{\text{FAIL\_OUT}}$ | If the 3931 detects a failure or the WITHSTANDING VOLTAGE HiTESTER enters the FAIL state, this signal is output. |

| Output Signal to the WITHSTANDING VOLTAGE HiTESTER | |
|---|---|
| $\overline{\text{STOP\_OUT}}$ | If a $\overline{\text{STOP}}$ signal is input from an automatic machine, if the **RESET (STOP)** switch of the 3931 is pressed, or if the 3931 detects a failure and enters FAIL state, the 3931 outputs a $\overline{\text{STOP}}$ signal to the WITHSTANDING VOLTAGE HiTESTER in order to stop the test. |

# 4.1.2 Timing Chart of External I/O Signals

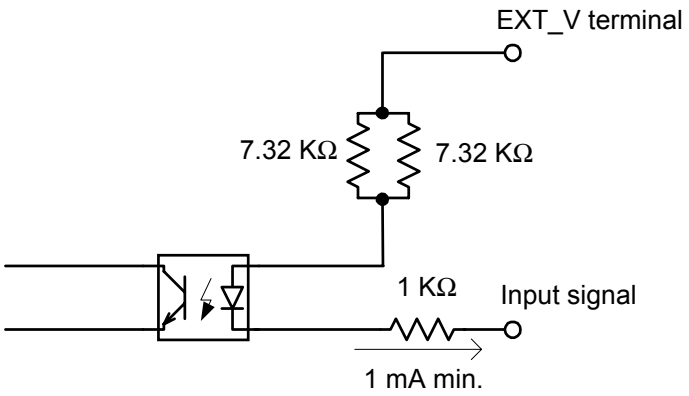
The diagram below shows the timing of external I/O signals and the start and stop of failure detection. For the timing relating to the withstand voltage test, see the operator's manual of the WITHSTANDING VOLTAGE HiTESTER.



# 4.1.3 Example of Input Signal Connection

This section provides details of signals input to the 3931.

| Input signals | Active low input<br>(Insulated with a photo coupler) |
|---|---|
| Applied voltage<br>Voltage between $V_{EXT\_V}$ and $V_{COM}$ | 5 V DC min.<br>25 V DC max. |
| HIGH level input voltage | $V_{EXT\_V}$-1.0 min. $V_{EXT\_V}$+1.0 max. |
| LOW level input voltage | $V_{EXT\_COM}$-0.5 V min. $V_{EXT\_V}$-4.0 max. |
| LOW level input current | 1 mA min. |
| Signal names | $\overline{\text{STOP\_IN}}$ : Stoppage of test<br>$\overline{\text{TEST\_IN}}$ : Failure detection time<br>$\overline{\text{PASS\_IN}}$ : Normal end of test<br>$\overline{\text{FAIL\_IN}}$ : Abnormal end of test<br>Each signal is connected to $V_{EXT\_V}$ at 3.66 kΩ. |



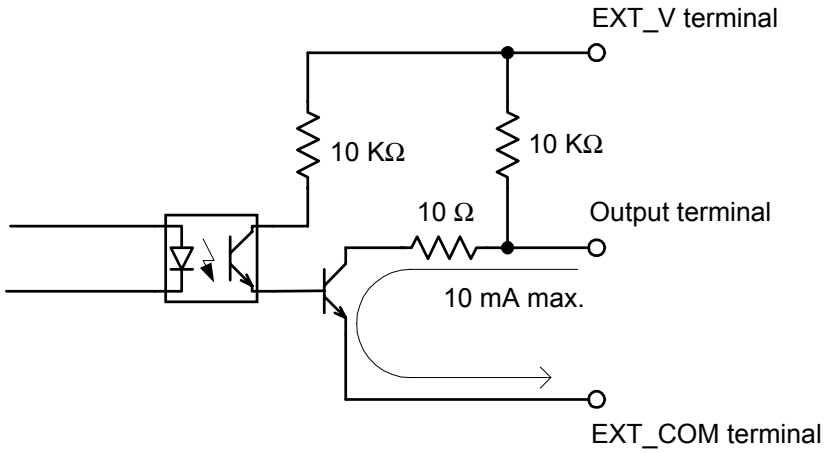

**NOTE**

- Design the connection to the input signals so as to prevent errors by using a relay, switch, or other circuit to prevent chattering.
- Design the connection so that a current of at least 1 mA flows when an input signal is active.

# 4.1.4 Example of Output Signal Connection

This section provides details of signals output to the 3931.

| Output signals | Active low input<br>(Insulated with a photo coupler) |
|---|---|
| Applied voltage<br>Voltage between $V_{EXT\_DCV}$ and $V_{COM}$ | 5 V DC min.<br>25 V DC max. |
| HIGH level input voltage | $V_{EXT\_V}$-0.5 min. $V_{EXT\_V}$ max. |
| LOW level input voltage | $V_{EXT\_COM}$-0.5 V min. $V_{EXT\_COM}$+0.5 V max. |
| LOW level input current | 10 mA min. (Sink current) |
| Signal names | $\overline{\text{STOP\_OUT}}$ : Stoppage of test<br>$\overline{\text{TEST\_OUT}}$ : Failure detection time<br>$\overline{\text{PASS\_OUT}}$ : Normal end of test<br>$\overline{\text{FAIL\_OUT}}$ : Abnormal end of test<br>Each signal is connected to $V_{EXT\_V}$ at 10 kΩ. |



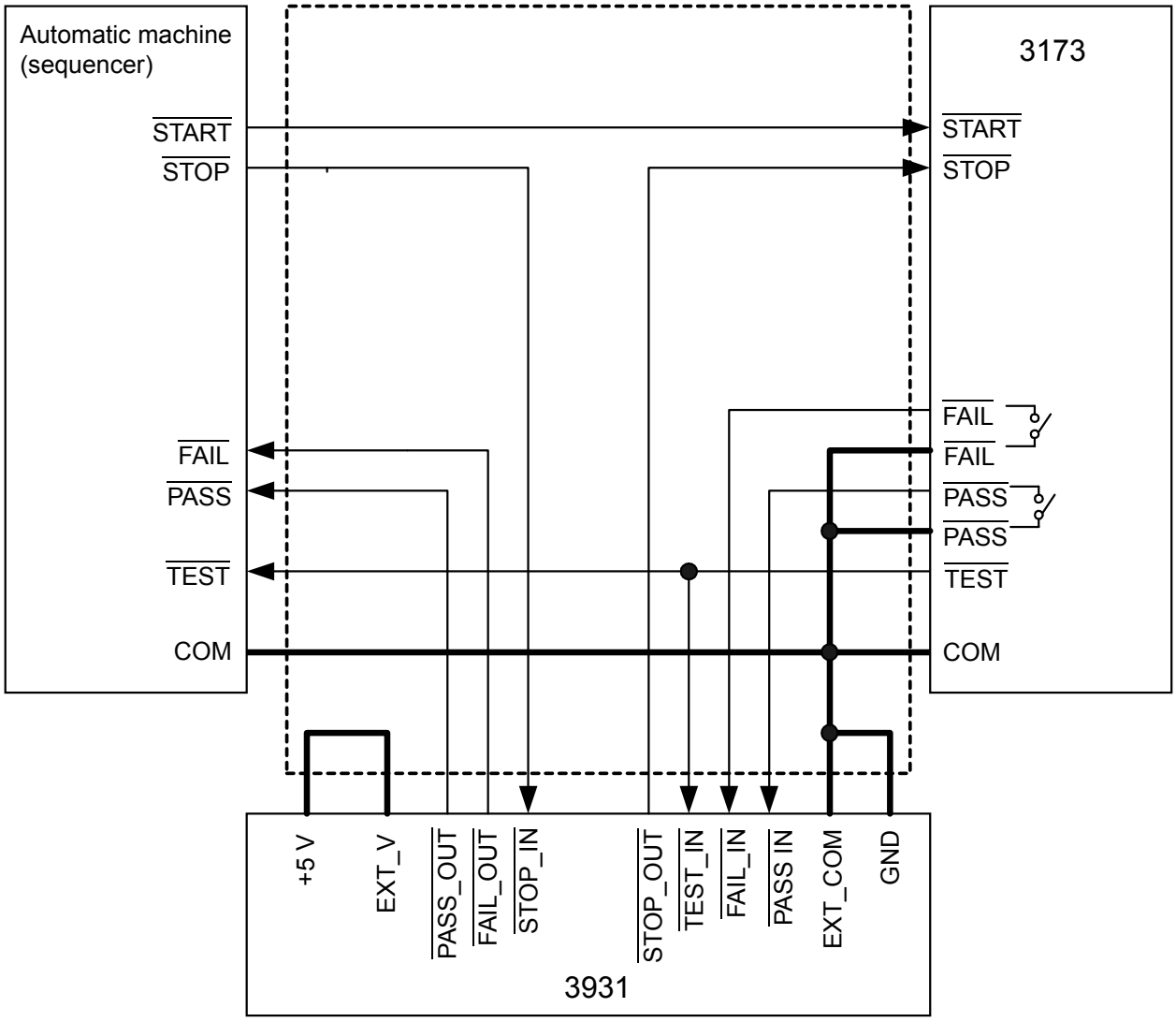

**NOTE**

- The maximum sinkable current is 10 mA per signal.
- When a relay or other inductive load is connected, connect the diode in parallel with the coil.

# 4.1.5 Example of Connection to the WITHSTANDING VOLTAGE HiTESTER

This section provides an example of connection to the Hioki WITHSTANDING VOLTAGE HiTESTER. The lines inside the broken line shall be connected by the user.

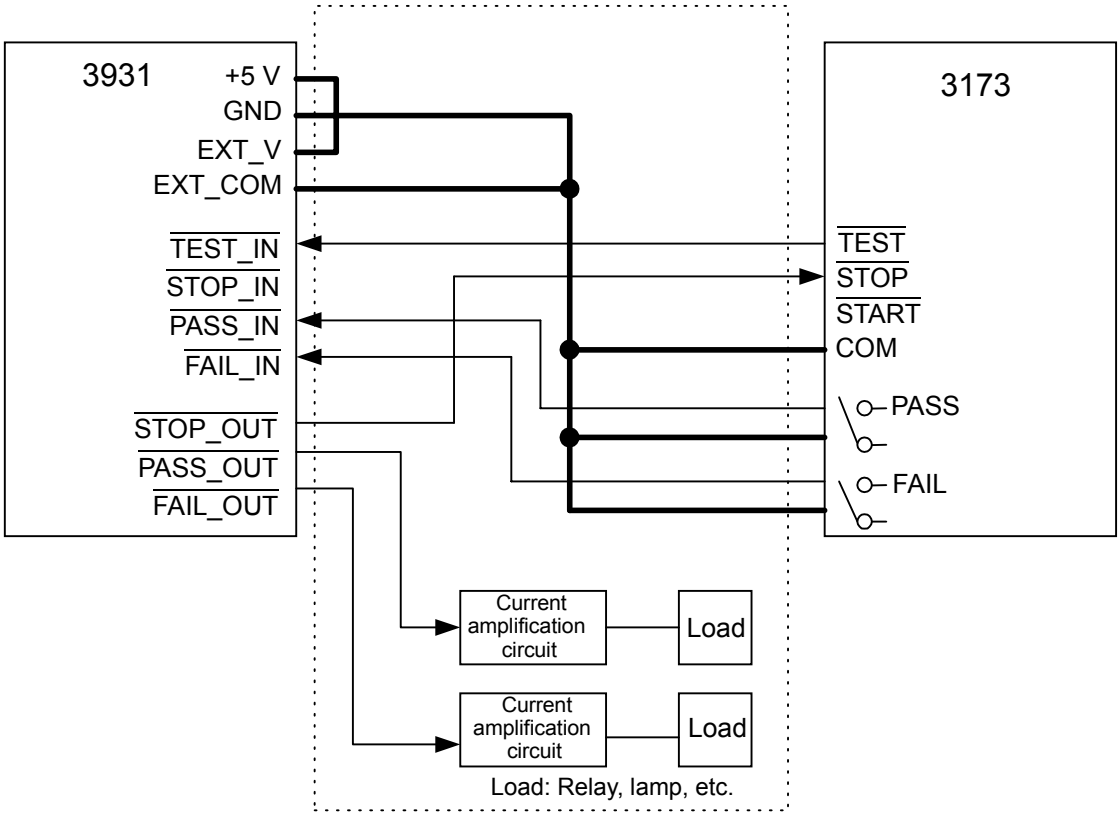
## Connection to the 3173 (Using an automatic machine)




* The arrow indicates the direction of signal transmission.

The diagram above assumes that the operation is controlled from all automatic machines.

## Connection to the 3173 (Not using an automatic machine)

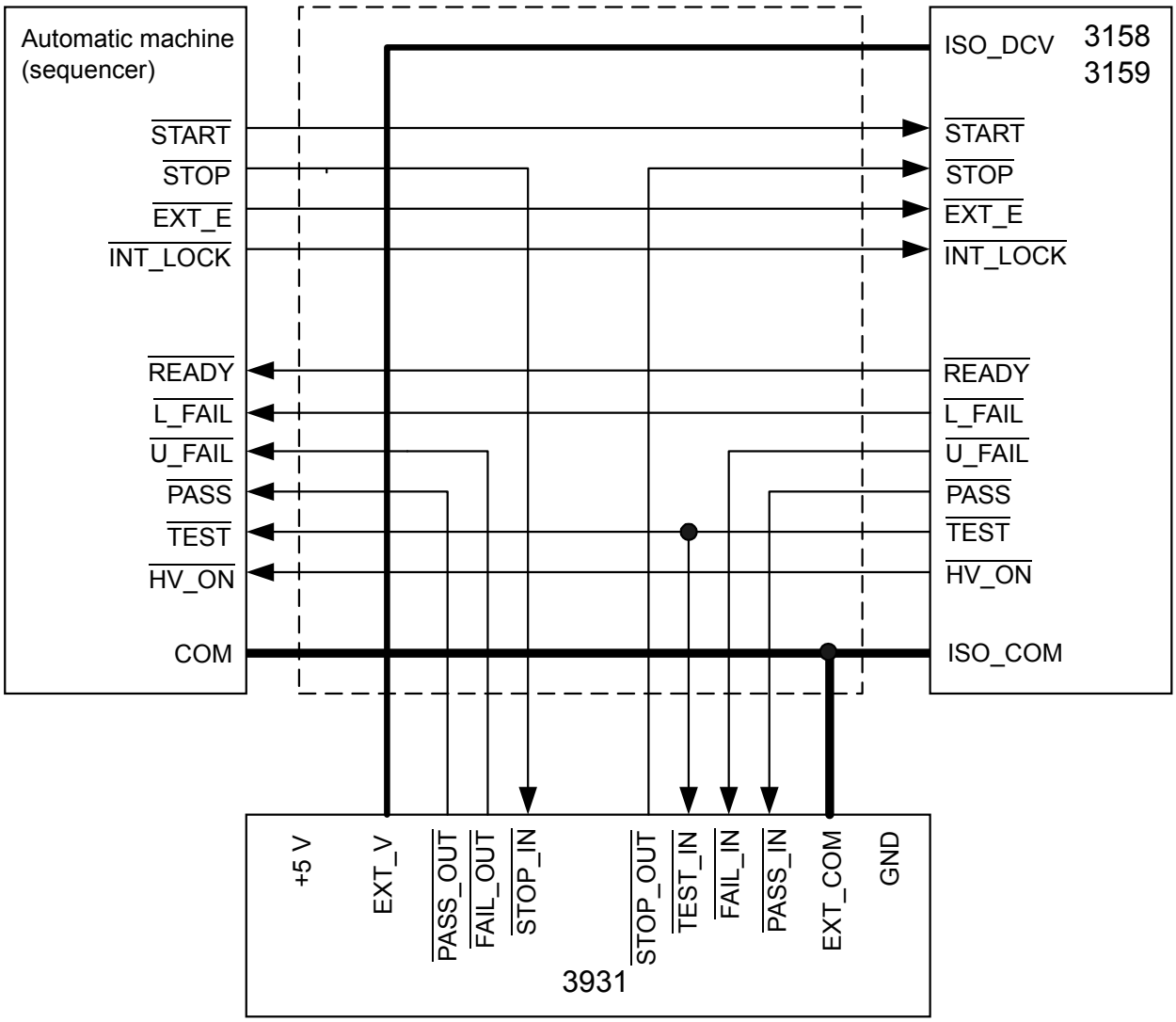



* The arrow indicates the direction of signal transmission.

**NOTE**

PASS_IN and PASS_OUT signals are not necessary if an external relay or lamp is not used.

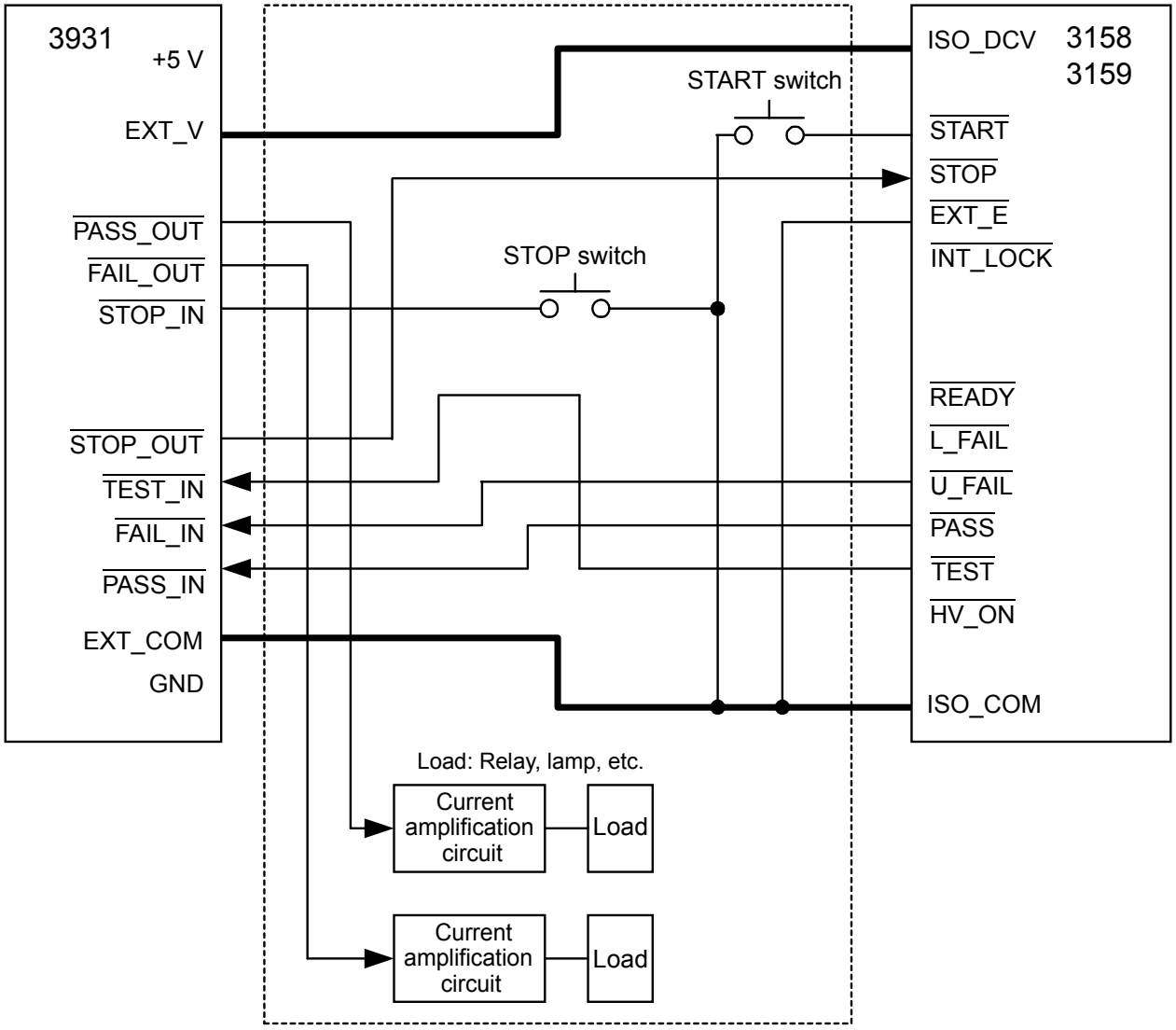
## Connection to the 3158 and 3159 (Using an automatic machine)




* The arrow indicates the direction of signal transmission.

The diagram above assumes that the operation is controlled from all automatic machines.

## Connection to the 3158 and 3159 (Not using an automatic machine)

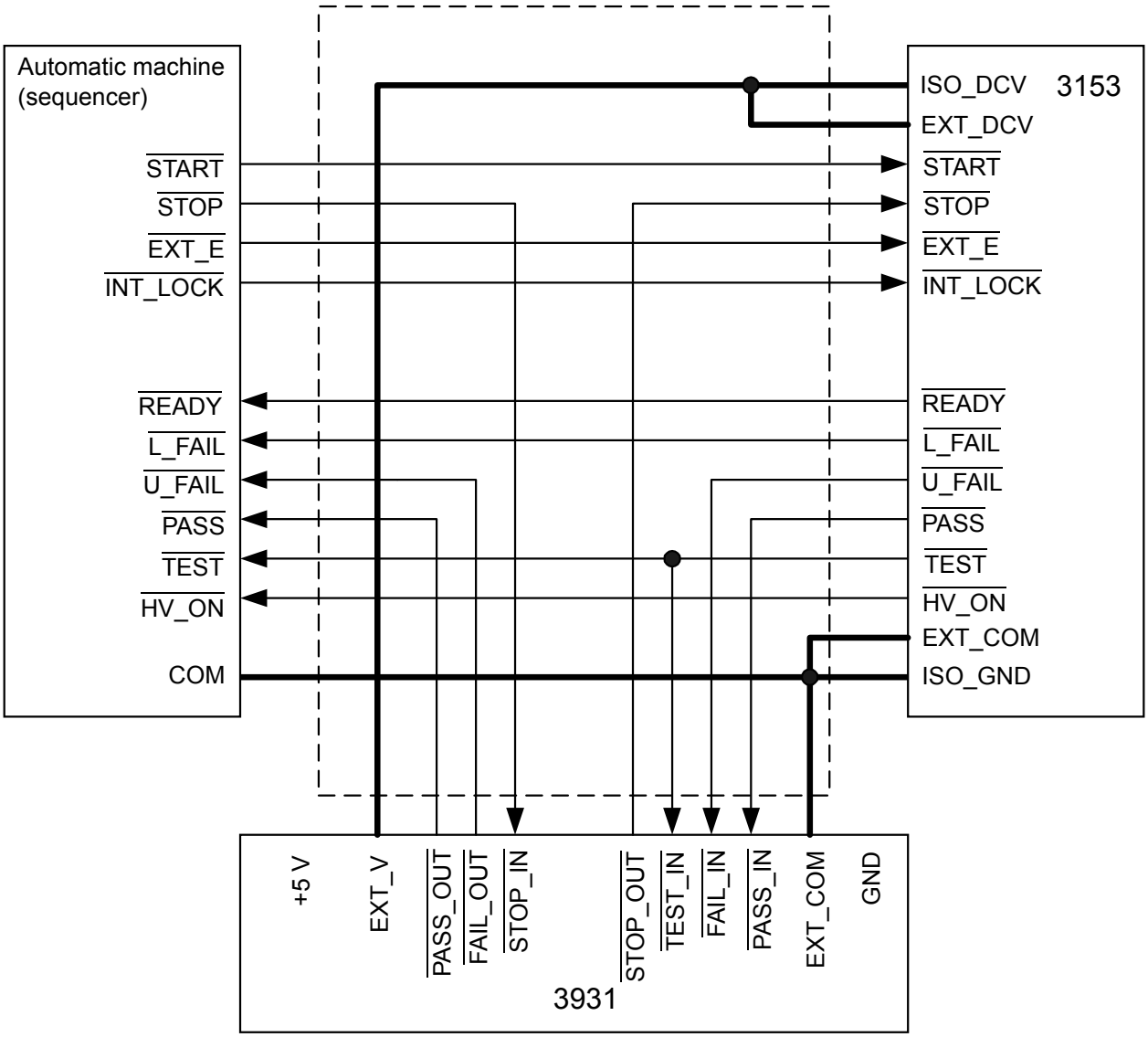



* The arrow indicates the direction of signal transmission.

**NOTE**

- The 3931 does not support insulation-resistance measurement of the 3159 and the 3153 and therefore cannot be used for the continuous test or program test.
- In the above connection, the START and STOP switches on the above diagram, and STOP switch of the 3158 or 3159 are valid. The START switch of the 3158 or 3159 is invalid.
- When a remote controller is used (9613, 9614), if the OPERATE switch is on, the START switch on the above diagram and the START switch of the 3158 or 3159 are invalid. The STOP switch on the above diagram and those of the remote controller and the 3931 are valid. If the OPERATE switch is off, any control from the remote controller is invalid.
- PASS_IN and PASS_OUT signals are not necessary if an external relay or lamp is not used.

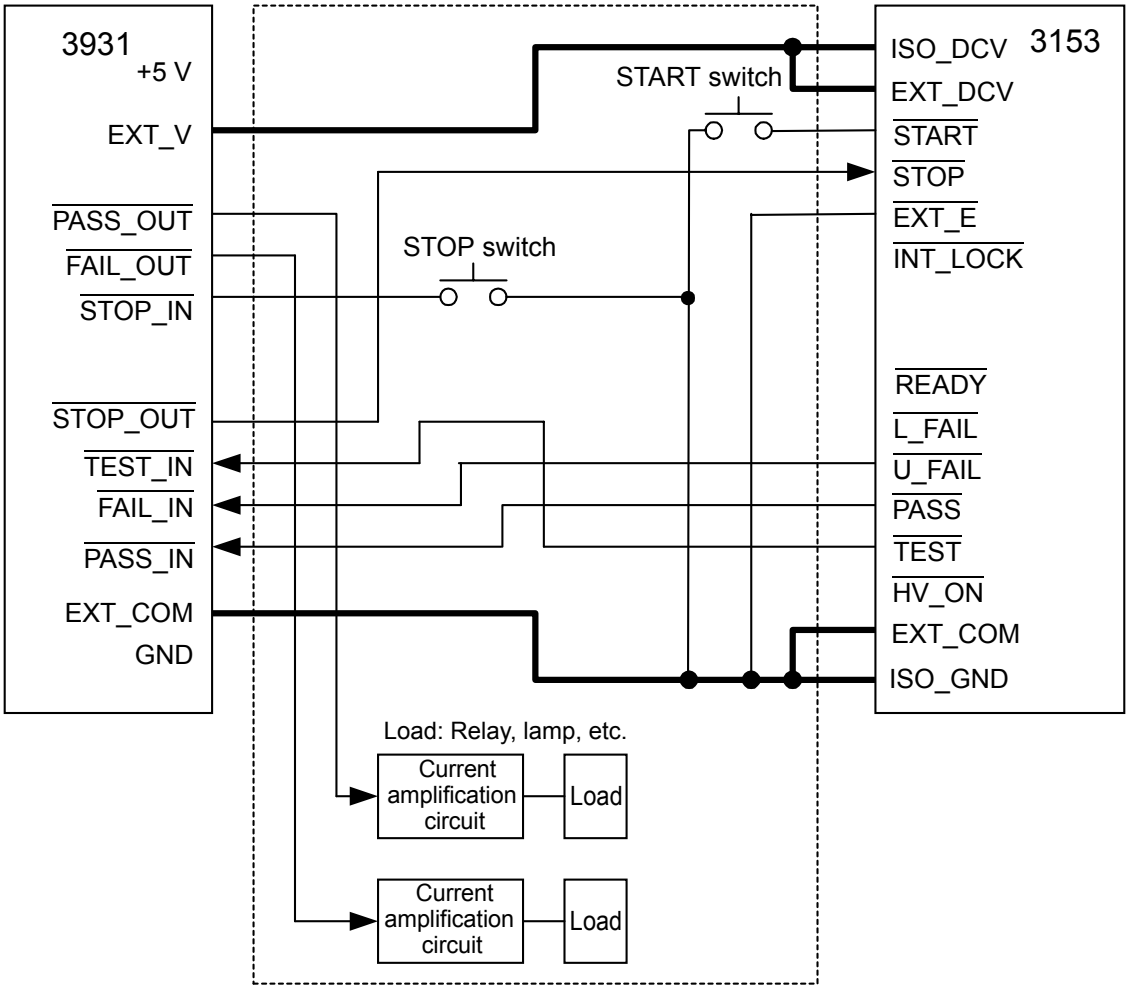
## Connection to the 3153 (Using an automatic machine)




* The arrow indicates the direction of signal transmission.

The diagram above assumes that the operation is controlled from all automatic machines.

## Connection to the 3153 (Not using an automatic machine)




* The arrow indicates the direction of signal transmission

**NOTE**

- The 3931 does not support insulation-resistance measurement of the 3159 and the 3153 and therefore cannot be used for the continuous test or program test.
- When the 3153 is used, the lamp-up/lamp-down function included in its output may affect the failure detection of the 3931. Using the optional function, set the $\overline{\text{TEST}}$ signal output so that the TEST blinking time is not included in the $\overline{\text{TEST}}$ signal ON time.
  ❖3153 WITHSTANDING VOLTAGE HiTESTER Instruction Manual
- In the above connection, the START and STOP switches on the above diagram, and STOP switch of the 3153 are valid. The START switch of the 3153 is invalid.
- When a remote controller is used (9613, 9614), if the OPERATE switch is on, the START switch on the above diagram and the START switch of the 3153 are invalid. The STOP switch on the above diagram and those of the remote controller and the 3931 are valid. If the OPERATE switch is off, any control from the remote controller is invalid.
- $\overline{\text{PASS\_IN}}$ and $\overline{\text{PASS\_OUT}}$ signals are not necessary if an external relay or lamp is not used.

# Specifications Chapter 5

## 5.1 Basic Specifications

### Input Unit for the Non-Insulation WITHSTANDING VOLTAGE HiTESTER

| | |
|---|---|
| Maximum input voltage | 5 kV AC, 50/60 Hz |
| Maximum rated voltage to the earth | 5 kV AC, 50/60 Hz |
| Measurable range | 200 V to 5 kV AC, 50/60 Hz |
| Waveform | Commercial-power waveform, sine wave |
| Threshold voltage adjustment method | Manual adjustment |
| Voltmeter | Analog voltmeter - average-value rectification rms type, 0 to 5 kV AC ±5% f.s. (after more than 10 minutes of warm-up time) |
| Principle of operation | Monitors the voltages of the measurement terminals during a withstand voltage test, and detects abnormal voltages due to contact failure or a broken wire (also makes a FAIL judgment when the output voltage of the HiTESTER drops due to fluctuations in the supply voltage) |
| Input impedance | High-tension input unit, 150 MΩ ± 10%<br>(HIGH side: 100 MΩ; LOW side: 50 MΩ)* |

* This indicates that a 100 MΩ resistor is inserted on the HIGH side, and a 50 MΩ resistor is inserted on the LOW side. It differs from the actual impedance, as a diode for rectification is inserted.

## Detection Unit for the Non-Insulation WITHSTANDING VOLTAGE HiTESTER

| | |
|---|---|
| Threshold voltage setting range | 200 V to 5 kV (rms), meter reading, LED indication or VR |
| PASS guarantee range | When the withstand voltage test has been completed with the monitored voltage exceeding the set threshold voltage |
| FAIL guarantee range | When the distortion rate is 5% or less, the monitored voltage is as follows:<br>5% or more of the set voltage when the set voltage is 1 kV to 5 kV<br>50 V or more when the set voltage is 200 V to 1 kV<br><br>When the monitored voltage remains smaller than the setting* for more than 100 ms (If the output voltage of the WITHSTANDING VOLTAGE HiTESTER remains larger than the setting and the current becomes larger than the threshold current (withstand voltage failure), the 3931 outputs a $\overline{\text{FAIL}}$ signal from the WITHSTANDING VOLTAGE HiTESTER and does not make its own FAIL judgment.) |
| Judgment method | Using an analog comparator |
| Judgment | Monitors abnormal voltage during a test. Outputs a $\overline{\text{PASS}}$ signal or $\overline{\text{FAIL}}$ signal, depending on whether a failure is detected.<br>PASS Does not make its own PASS judgment. Outputs a $\overline{\text{PASS}}$ signal from the WITHSTANDING VOLTAGE HiTESTER when a test is completed with the monitored voltage within the PASS guarantee range.<br>FAIL When the monitored voltage falls within the FAIL guarantee range, masks $\overline{\text{PASS}}$ signals from the WITHSTANDING VOLTAGE HiTESTER and transmits $\overline{\text{FAIL}}$ signals to the HiTESTER control master. Also outputs a $\overline{\text{STOP}}$ signal to the HiTESTER. |
| Judgment delay | Start monitoring Within 450 ms after the $\overline{\text{TEST}}$ signal becomes LOW<br>FAIL Output FAILWithin 100 ms after FAIL is detected |
| Action | Sounds a buzzer, lights up the LED, and outputs signals to EXT I/O terminal in accordance with the judgment result. |

* This value is not a value set by watching the meter, but by inputting a reference voltage so that a FAIL judgment will not be made.

# 5.1.1 Interface

## Rear Panel

| | |
|---|---|
| External output power supply | Non-isolated 5 V DC 40 mA, without stabilization, with current control |
| Between $V_{OUT}$ and $V_{COM}$ | 4.5 V DC or more when loaded with 40 mA |
| EXT_I/O input signal | Isolated using a photo coupler. Each signal is pulled up internally to $V_{EXT\_DCV}$ with 3.66 kΩ.<br>$\overline{\text{TEST\_IN}}$ $\overline{\text{STOP\_IN}}$<br>$\overline{\text{PASS\_IN}}$ $\overline{\text{FAIL\_IN}}$<br>Input level Determined by the external power supply (between $V_{EXT\_V}$ and $V_{EXT\_COM}$) to determine the input level<br>Voltage between $V_{EXT\_V}$ and $V_{EXT\_COM}$ 5 V min., 25 V max.<br>HIGH $V_{EXT\_V}$+1.0 V max., $V_{EXT\_V}$ - 1.0 V min.<br>LOW $V_{EXT\_V}$ - 4.0 V max., $V_{EXT\_COM}$ - 0.5 V min.<br>Minimum input current<br>1 mA (Source current at the LOW level) |
| EXT_I/O output signal | Isolated using a photo coupler. Each signal is pulled up internally to $V_{EXT\_V}$ with 10 kΩ.<br>$\overline{\text{STOP\_OUT}}$<br>$\overline{\text{PASS\_OUT}}$ $\overline{\text{FAIL\_OUT}}$<br>Output level Determined by the external power supply (between $V_{EXT\_V}$ and $V_{EXT\_COM}$) to determine the output level<br>Voltage between $V_{EXT\_V}$ and $V_{EXT\_COM}$ 5 V min., 25 V max.<br>HIGH $V_{EXT\_V}$ max., $V_{EXT\_V}$ - 0.5 V min.<br>LOW $V_{EXT\_COM}$+0.5 V max., $V_{EXT\_COM}$ - 0.5 V min.<br>Maximum output current<br>10 mA (Sink current at the LOW level) |

# 5.2 General Specifications

| | |
|---|---|
| Operating temperature and humidity | 0°C to 40°C (32°F to 104°F), 80% RH or less (non-condensating) |
| Storage temperature and humidity | -10°C to 50°C (14°F to 122°F), 90% RH or less (no condensation) |
| Temperature and humidity for guaranteed accuracy<br>Guaranteed accuracy period | 23°C ± 5°C (73°F ± 9°F), 80% RH or less (non-condensating)<br><br>For 1 year |
| Operating environment | Indoors, altitude up to 2000 m (6562-ft.) |
| Power supply | Rated voltage: 100 to 240 V AC (a change in voltage of ±10% taken into consideration), 50/60 Hz |
| Dielectric strength | • 8.2 kV AC, 1 mA for one minute<br>[voltage input terminals] - [instrument case]<br>• 1.35 kV AC, 10 mA for one minute<br>[power supply terminals] - [instrument case] |
| Maximum rated power | 9 VA |
| Dimensions | Approx. 130W X 150H X 230D mm (5.12”W X 5.91”H X 9.06”D)<br>(not including protrusions) |
| Mass | Approx. 1.9 kg (67.02 oz.) |
| Accessories | Power cord ..... 1<br>9615-01 H.V. TEST LEAD (high voltage side)..... 1<br>9615-03 H.V. TEST LEAD (low voltage side) ..... 1<br>Stopper plate ..... 1<br>Instruction Manual ..... 1 |
| Applicable Standards | EMC EN61326:1997+A1:1998+A2:2001 CLASS A<br>EN61000-3-2:2000<br>EN61000-3-3:1995+A1:2001<br>Safety EN61010-1:1993+A2:1995<br>Power supply : Pollution Degree 2, Overvoltage Category II<br>(anticipated transient overvoltage 2500 V)<br>EN61010-2-031:1994<br>Voltage input : Pollution Degree 2, Overvoltage Category I |

# 5.3 H.V. TEST LEADs (9615-01, 9615-03) Specifications

| | |
|---|---|
| Applicable Models | 9615-01: Hioki WITHSTANDING VOLTAGE HiTESTER<br>9615-03: 3931 HIGH VOLTAGE CONTACT CHECKER |
| Rated voltage | 5 kV AC or 5 kV DC |
| Rated current | 150 mA AC or 150 mA DC |
| Dielectric strength | 6.25 kV AC Sensitivity current 5 mA for one minute<br>Tested area (between cable conductor and cable sheath) |
| Operating temperature and humidity | 0°C to 40°C (32°F to 104°F), 80% RH or less (non-condensating) |
| Storage temperature and humidity | -10°C to 50°C (14°F to 122°F), 90% RH or less (no condensation) |
| Operating environment | Indoors, altitude up to 2000 m (6562-ft.) |
| Dimensions | Approx. 1.5 m |
| Mass | Approx. 50 g |
| Applicable Standards | EN61010-2-031:1994 Pollution Degree 2, Overvoltage Category I |

## 5.3 H.V. TEST LEADs (9615-01, 9615-03) Specifications

# Maintenance and Service Chapter 6

## 6.1 Cleaning and Storage

### Cleaning

To clean the product, wipe it gently with a soft cloth moistened with water or mild detergent. Never use solvents such as benzene, alcohol, acetone, ether, ketones, thinners or gasoline, as they can deform and discolor the case.

## 6.2 Repair and Servicing

⚠CAUTION

- Adjustments and repairs should be made only by technically qualified personnel.
- If damage is suspected, check the "Troubleshooting" section before contacting your dealer or Hioki representative.
- Pack the product carefully so that it will not be damaged during shipment, and include a detailed written description of the problem. Hioki cannot be responsible for damage that occurs during shipment.

- Spare and replacement parts for this product are guaranteed to be available only until 7 years after manufacture of this model is terminated.
- Use the original packing materials when reshipping the product, if possible.
- If the unit has been subject to moisture, or if oil and dust have accumulated in the unit interior, the danger of electrical shock or fires resulting from the deterioration of insulation increases greatly. If the unit is ever subject to excessive moisture, oil, or dust, cease use immediately, and return the unit to us for maintenance.

# Troubleshooting

If the product operates abnormally, check as described below.
If the product continues to operate abnormally after taking the specified corrective action, the product may be malfunctioning. Turn off the product's power switch immediately, then contact your dealer (Hioki agent) or the nearest Hioki sales office.

If any of the following should occur, stop using the unit, disconnect the power cord and the H.V. TEST LEADs and contact your dealer or Hioki representative.

- If you are certain that the unit is damaged.
- If the measurement is inoperative.
- If the unit was stored for a long period of time in high temperatures and humidity, or other undesirable conditions.
- If the unit was damaged in transit.

| Symptom | Check Item | Troubleshooting |
|---|---|---|
| • The **DANGER** lamp does not light up or blink even if the measured voltage is input.<br>• The meter is not operational. | Is the power cord disconnected? | Connect the power cord. |
| | Is the $\overline{\text{TEST}}$ signal line disconnected? | Check the external I/O terminal for the $\overline{\text{TEST}}$ signal. |
| • A FAIL judgment is not made even if the measured voltage falls below the threshold voltage. | Is the external I/O $\overline{\text{TEST}}$ signal line disconnected? | Connect $\overline{\text{TEST}}$ signal line correctly. |
| | Are the external I/O voltage level and current outside the specification? | Check the voltage level and load current. |
| • The **DANGER** lamp continues to blink after test has been started. | Has the $\overline{\text{STOP\_IN}}$ signal been input? | Make sure the $\overline{\text{STOP\_IN}}$ signal is not input during the test. |
| • The PASS or FAIL result is not output properly during inspections prior to daily operation. | Are the external I/O signal lines including the power supply disconnected? | Connect the signal lines correctly. |
| | Are the external I/O voltage level and current outside the specification? | Check the voltage level and load current. |
| | Is the threshold voltage correctly set? | Set the threshold voltage correctly. |
| | Is the supply voltage of the WITHSTANDING VOLTAGE HiTESTER fluctuating? | Use a stabilized power supply for the WITHSTANDING VOLTAGE HiTESTER, or set the threshold voltage lower to allow for fluctuations. |
| | Is there a problem with the H.V. TEST LEAD connected to the WITHSTANDING VOLTAGE HiTESTER or the 3931? | As the 3931 may be operating properly, inspect the H.V. TEST LEAD. |
| • The withstand voltage test result is NG (the WITHSTANDING VOLTAGE HiTESTER outputs an NG result) when the 3931 is connected. | | As the current flowing to the 3931 is very small (0.033 mA or less when 5 kV is input), it may still affect the withstand voltage test. Increase the threshold current of the WITHSTANDING VOLTAGE HiTESTER by 0.1 mA and repeat the test. |

HIOKI

# DECLARATION OF CONFORMITY

| | |
|---|---|
| Manufacturer's Name: | HIOKI E.E. CORPORATION |
| Manufacturer's Address: | 81 Koizumi, Ueda, Nagano 386-1192, Japan |
| Product Name: | HIGH VOLTAGE CONTACT CHECKER |
| Model Number: | 3931 |
| Accessory: | 9615-01 H.V. TEST LEAD<br>9615-03 H.V. TEST LEAD |

The above-mentioned products conform to the following product specifications:

| | |
|---|---|
| Safety: | EN61010-1:1993+A2:1995<br>EN61010-2-031:1994 |
| EMC: | EN61326:1997+A1:1998+A2:2001<br>Class A equipment<br>Minimum immunity test requirement<br>EN61000-3-2:2000<br>EN61000-3-3:1995+A1:2001 |

Supplementary Information:

The products herewith comply with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

HIOKI E.E. CORPORATION

26 August 2003

Yuji Hioki

President

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HIOKI 3931 HIGH VOLTAGE CONTACT CHECKER
Instruction Manual

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