JETGR0002-1-14.0 (2021)

## Preface

This General Test Method is a test method to be used in conjunction with the individual test method for the relevant grid-connected protective device for power supply systems, etc.

The individual test methods include items that supplement or modify the corresponding items in the General Test Method.

## I. Scope of application

This test method applies to the certification tests conducted by the Japan Electrical Safety & Environment Technology Laboratories (hereinafter referred to as "JET") on the following grid-connected protection devices, etc. for small distributed power supply systems that have been manufactured to comply with the "Interpretation of Technical Standards for Electrical Equipment", the "Guidelines for Technical Requirements for Grid Interconnection to Ensure Electric Power Quality (Agency for Natural Resources and Energy)", and the "Grid Interconnection Regulations" (JEAC9701), and that are intended to be interconnected to low-voltage distribution lines via a reverse converter.

### I.I Islanding operation prevention and FRT requirements for each electrical system

#### I.I.I About the designation

When a distinction needs to be made in the description, the designation shall be as follows.

- 【Standard active method】: For single-phase equipment, "JEM1498 Standard active islanding operation detection method for single-phase power conditioners for distributed generation", or for three-phase equipment, "JEM1505 Standard active islanding operation detection method for three-phase power conditioners for photovoltaic generation connected to low-voltage distribution lines" (both methods are frequency feedback with step injection).
- 【Multiple-unit FRT compatible type】: These systems have a "standard active system" and comply with FRT requirements (former name: "Multiple-connected system 1").
- 【FRT-compliant type】: With "conventional active method" and compliant with FRT requirements.
- 【200V-connected equipment】: Standard single-phase equipment; single-phase 2-wire 200V and single-phase 3-wire 100V/200V equipment that is interconnected to a single-phase 3-wire 100V/200V system. When comparing with the following [100V connected equipment], this name is used as necessary.
- 【100V connection equipment】: Equipment with a single-phase 2-wire 100V system that is connected to a single-phase 3-wire 100V/200V system.

### I.I.II Single-phase equipment (【200V connected equipment】/【100V connected equipment】)

Applicable to solar battery systems, gas engine systems, fuel cell systems, lithium-ion battery systems, combined systems of storage batteries and gas engine systems*, combined systems of storage batteries and fuel cells, combined systems of storage batteries and solar batteries, storage battery systems for electric vehicles (DC connection type), combined systems of storage batteries for electric vehicles (DC connection type) and solar batteries, and multi-input systems.

*Applications are currently not being accepted.

- 【The FRT requirements】 should be applied.
  It is desirable to adopt the "standard active method" whenever possible.
- 【100 V connection equipment】shall be applied to fuel cell systems and storage battery systems.

### I.I.III Three-phase equipment

- Applicable to solar battery systems, gas engine systems, fuel cell systems, lithium-ion battery systems, combined systems of storage batteries and solar batteries, systems of storage batteries (DC-connected) mounted on electric vehicles etc., combined systems of storage batteries (DC-connected) mounted on electric vehicles etc. and solar batteries, and multi-input systems.
- For the active islanding operation detection method, the "standard active method" may be adopted. The timing for making the "standard active method" mandatory will be considered in the future. Furthermore, if the "standard active method" is adopted, the "reactive power oscillation suppression function" shall also be adopted for three-phase equipment. In addition, when applying for equipment with a reactive power oscillation suppression function, it is desirable to consult with us in advance, as a certain period of time may be required for equipment installation, etc.
- FRT requirements shall be applied.

## I.II DC energy source dependent essential requirements

- If the DC energy source includes solar cells, the standard power factor shall be a constant power factor of 0.95. It may also have a set value that allows operation at any other power factor. However, power conditioners that have been certified with a power factor of 1.0 may be tested with a power factor of 1.0 if some of the tests are partially changed using a new test method for special reasons, such as "reactive power oscillation suppression function tests".
- If the DC energy source includes a gas engine, the gas engine part shall be certified by a third-party certification body.
- If the DC energy source includes a fuel cell, the part other than the grid-connected protection device shall be certified by a third-party certification body in accordance with the "Technical Standards and Inspection Methods for Small Fuel Cells for Stationary Use" established by the

Household Fuel Cell Certification System Study Committee of the Japan Electrical Manufacturers' Association.

- If the DC energy source includes a lithium-ion storage battery, the storage battery must have been certified by a third-party certification body. There are two types of power conditioners: the "storage battery separate type", which is separated from the storage battery, and the "storage battery integrated type", which is integrated with the storage battery.
- If the DC energy source includes storage batteries mounted on electric vehicles, etc., the power conditioner must have received a certification in accordance with the "V2H Charging and Discharging System Guidelines for Electric Vehicles, DC Version" (hereinafter referred to as the "V2H Guidelines (DC)") issued by the Electric Vehicle Power Supply System Association (EVPOSSA) and in accordance with the "V2H Certification Standards, DC Version" issued by the CHAdeMO Council.

### I.III Power Conditioner Connection Function for independent Circuits Applicable

The function of connecting a power conditioner to a independent circuit indicates the equipment that can be connected to a power conditioner for solar cells during independent operation.
(Hereinafter referred to as "Interconnection power conditioner during independent operation")
Applicable to storage battery systems, combined systems of storage batteries and solar cells, systems of storage batteries (DC-connected) mounted on electric vehicles, etc., combined systems of storage batteries (DC-connected) mounted on electric vehicles, etc. and solar cells, and multi-input systems.
For the contents of grid-connected protection devices, etc. with the function of connecting power conditioners to independent circuits, refer to the definition of terms.
Note that this does not apply to "100V connected equipment".

### I.IV Capacity ranges for each system and corresponding individual test methods

(a) In the case of photovoltaic systems：

- 【Multi-unit FRT-compatible】 and 【FRT-compatible】 equipment with an output of less than 20 kW in single-phase interconnection, and 【Multi-unit FRT-compatible】 and 【FRT-compatible】 equipment with an output of less than 50 kW in three-phase interconnection.
- For individual test methods, please refer to "Individual test methods for grid-connected protection devices for photovoltaic power generation systems supporting multiple units" for single-phase equipment and "Individual test methods for grid-connected protection devices for photovoltaic power generation systems" for three-phase equipment.

(b) In the case of gas engine systems：

- 【Multi-unit FRT-compatible】 and 【FRT-compatible】 equipment with a single-phase interconnection output of less than 10 kW, and 【Multi-unit FRT-compatible】 and 【FRT-

compatible】 equipment with a three-phase interconnection output of less than 10 kW.

- For the individual test method, please refer to "Individual Test Method of Grid Interconnection Protection Device for Gas Engine Cogeneration System".

(c) In the case of fuel cell systems：

- The fuel cell shall be a small PEFC or SOFC fuel cell for stationary use.
- Equipment with an output of less than 10 kW in a single-phase interconnection 【Multi-unit FRT-compatible】 or 【FRT-compatible】.

  however, for equipment with a 100 V connection, the output shall be 2 kVA or less.

  【Multi-unit FRT-compatible】 and 【FRT-compatible】 equipment with a three-phase interconnection output of less than 10 kW.
- For individual test methods, refer to "Individual test methods for grid-connected protection devices for stationary small fuel cell systems".

(d) In the case of a system using lithium-ion batteries：

- 【Multi-unit FRT-compatible】 and 【FRT-compatible】 with an output of 10 kW or less from a single-phase interconnection; however, for equipment with a 100 V connection, the output shall be 2 kVA or less.
- 【Multi-unit FRT-compatible】 and 【FRT-compatible】 equipment with an output of 10 kW or less from a three-phase interconnection: Forward/reverse conversion switching type (former name for some test methods: "charge/discharge switching type") and seamless type.
- For individual test methods, refer to "Individual Test Methods for Grid-connected Protective Equipment for Storage Battery Systems".

(e) In the case of a combined system of lithium-ion batteries and solar cells：

- 【Multi-unit FRT-compatible】 and 【FRT-compatible】 equipment with an output of 10 kW or less from a single-phase interconnected system 【Multi-unit FRT-compatible】 and 【FRT-compatible】 equipment with an output of 10 kW or less from a three-phase interconnected system.

  However, as the FRT requirements for multiple DC input systems with three-phase equipment have not yet been defined in the grid interconnection rules, the same judgment conditions as for photovoltaic power generation systems are tentatively applied.

  When defined in the grid interconnection rules, the definition will be followed.
- Forward/reverse conversion switching type and seamless type.
- For individual test methods, refer to "Individual Test Methods for Grid Interconnection Protection Devices, etc. for Multiple DC Input Systems (PV+BS)".

(f) For a combined system of lithium-ion battery and gas engine：

- For single-phase interconnected systems with an output of less than 10 kW, the following types of equipment are available: [Multiple-unit FRT compatible], [FRT compatible], and equipment

with forward/reverse conversion switching.

- For the individual test method, please refer to "Individual Test Method for Grid Interconnection Protection Devices for Multiple DC Input Systems (GE+BS)".

  Please note that this system is currently not being accepted.

(g) For combined systems of lithium-ion batteries and fuel cells：

- Single-phase interconnection with an output of less than 10 kW 【Multi-unit FRT-compatible】,【FRT-compatible】
- Forward/inverse conversion switching type.
- For the individual test method, refer to "Individual test method for grid-connected protective devices for multiple DC input systems (FC+BS)".

Please note that this system is currently not being accepted.

(h) In the case of storage battery systems for electric vehicles, etc. (DC connection type)

- Equipment with an output of less than 10kW from a single-phase interconnected system【Multi-unit FRT-compatible】 and 【FRT-compatible】
- Large number of 【Multi-unit FRT-compatible】 and 【FRT-compatible】 equipment with an output of less than 10 kW in a three-phase system
- Forward/reverse conversion switching type and seamless type.
- For individual test methods, refer to "Individual Test Methods for Grid Interconnection Protection Devices for Multiple DC Input Systems (PV+EV)".

(i) For combined systems of storage batteries (DC-connected) and solar cells mounted on electric vehicles, etc.：

- The following types of equipment shall be tested: 【Multi-unit FRT-compatible】 with single-phase interconnection output of less than 10 kW, 【FRT-compatible】 equipment with three-phase interconnection output of less than 10 kW, 【FRT-compatible】 equipment with forward/reverse conversion switching type and seamless type.
- For the individual test method, refer to "Individual Test Method for Grid Interconnection Protection Devices for Multiple DC Input Systems (PV+EV)".

(j) For multi-input systems with on-board storage batteries for electric vehicles (DC connection type), lithium-ion batteries and solar cells：

- The DC energy source that can be connected is either a solar cell, a lithium-ion battery, or a battery mounted on an electric vehicle. (Lithium-ion batteries and storage batteries mounted on electric vehicles are hereinafter collectively referred to as "storage batteries, etc.")
- Only one input is allowed for storage batteries mounted on electric vehicles, etc.
- The DC energy source shall include storage batteries, etc.
- Systems that include storage batteries for electric vehicles, etc. (DC-connected) are 【Multi-unit FRT-compatible】 and 【FRT-compatible】 equipment with a single-phase interconnection

output of less than 10 kW,【Multiple-unit FRT-compatible】and【FRT-compatible】equipment with a three-phase interconnection output of less than 10 kW.

- Systems that do not include storage batteries (DC-connected) for electric vehicles, etc., are【Multi-unit FRT-compatible】,【FRT-compatible】equipment with single-phase interconnection output of 10 kW or less, and【Multi-unit FRT-compatible】,【FRT-compatible】equipment with three-phase interconnection output of 10 kW or less.
- Forward/reverse conversion switching type and seamless type. The shape of the power conditioner shall be one of the following.
  1. Same enclosure
     All DC power converters and reverse converters etc.
  2. Partly separate enclosures
     some of the DC power converters are in separate enclosures from the reverse converter etc. and the DC bus connecting the separate DC power converters to the main body is connected by a cable.
  3. A separate enclosure
     all the DC power converters are in a separate enclosure from the reverse converter etc. and the respective DC busses are connected by cables.
- For the individual test method, refer to "Individual test method for grid-connected protective equipment etc. for multi-input systems".
- For grid-connected protective equipment, etc. equipped with a standard active method that has a rated output of more than 6 kW for all devices, the number of connected power conditioners in 3.2.8 Islanding Operation Prevention Test 2 may be conducted after consultation with the certification applicant.

| Systems | Interconnection | "Islanding operation and FRT requirements" | Output power | Active islanding operation detection method | FRT | Constant power factor control | Remote output control | PCS connection function to autonomous circuits | 100W connection | Required Certification |
|---|---|---|---|---|---|---|---|---|---|---|
| Photovoltaic systems | Single Phase | FRT with multiple units | Less than 20kW | JEM 1498 | Supported | Required | Yes/No | Not applicable | Not applicable | – |
| | | FRT compatible | | Conventional type | | | | | | |
| | Three Phase | FRT with multiple units | Less than 50kW | JEM 1505 | | | | | | |
| | | FRT compatible | | Conventional type | | | | | | |
| Gas engine systems | Single Phase | FRT with multiple units | Less than 10kW | JEM 1498 | | Not required | Not required | Not applicable | Not applicable | "Certification of the gas engine part by a third party certification body, etc." |
| | | FRT compatible | | Conventional type | | | | | | |
| | Three Phase | FRT with multiple units | Less than 10kW | JEM 1505 | | | | | | |
| | | FRT compatible | | Conventional type | | | | | | |
| | Single Phase | FRT with multiple units | Less than 10kW | JEM 1498 | | Not applicable | Not supported | Not applicable | Not Applicable | |
| Fuel cell system | Single Phase | FRT with multiple units | Less than 10kW | JEM 1498 | | Not required | Not required | Not applicable | Not Applicable | "Certification by a third party certification body in accordance with the "Technical Standards and Inspection Methods for Small Fuel Cells for Stationary Use" established by the Committee on Household Fuel Cell Certification Systems of the Japan Electrical Manufacturers' Association." |
| | | FRT compatible | | Conventional type | | | | | | |
| | Three Phase | FRT with multiple units | | JEM 1505 | | | | | Not applicable | |
| | | FRT compatible | | Conventional type | | | | | | |
| | Single Phase | FRT with multiple units | Less than 10kW | JEM 1498 | | Not applicable | Not supported | Not applicable | Not Applicable | |
| Lithium-ion battery system | Single Phase | FRT with multiple units | Less than 10kW | JEM 1498 | | Not required | Not required | Application *2 | Application | "The storage battery section has been certified by a third party certification body." |
| | | FRT compatible | | Conventional type | | | | | | |
| | Three Phase | FRT with multiple units | | JEM 1505 | | | | Not applicable | Not applicable | |
| | | FRT compatible | | Conventional type | | | | | | |
| | Single Phase | FRT with multiple units | Less than 10kW | JEM 1498 | | Required | Yes/No | Not applicable | Not applicable | |
| | | FRT compatible | | Conventional type | | | | | | |
| | Three Phase | FRT with multiple units | | JEM 1505 | | | | Not applicable | | |
| | | FRT compatible | | Conventional type | | | | | | |
| Storage batteries for electric vehicles (DC-connected) systems | Single Phase | FRT with multiple units | Less than 10kW | JEM 1498 | | Not required | Not required | Not applicable | Not applicable | Receipt of a certificate of acceptance in accordance with the "V2H Certification Criteria, Version C" issued by the CHAdeMO Council. |
| | | FRT compatible | | Conventional type | | | | | | |
| | Three Phase | FRT with multiple units | | JEM 1505 | | | | Not applicable | | |
| | | FRT compatible | | Conventional type | | | | | | |
| | Single Phase | FRT with multiple units | Less than 10kW | JEM 1498 | | Required | Yes/No | Not applicable | Not applicable | |
| | | FRT compatible | | Conventional type | | | | | | |
| | Three Phase | FRT with multiple units | | JEM 1505 | | | | Not applicable | | |
| | | FRT compatible | | Conventional type | | | | | | |
| Multi-input systems | Single Phase | FRT with multiple units | Less than 10kW (Less than 10kW) *3 | JEM 1498 | | Required *4 | Yes/No *4 | Not applicable | Not applicable | "Certification for storage batteries etc. is required depending on what is included in the DC energy source." |
| | | FRT compatible | | Conventional type | | | | | | |
| | Three Phase | FRT with multiple units | | JEM 1505 | | | | Not applicable | | |
| | | FRT compatible | | Conventional type | | | | | | |

*1) Currently not accepted.

*2) Not applicable to 100V connected equipment.

*3) Less than 10kW when the DC energy source includes storage batteries mounted on electric vehicles, etc.

*4) In the case of including solar cells as a DC energy source, "Yes/No": Not required if the power company at the installation site is limited.

## II. Certification tests

### II.I Scope of certification

(a) In the case of photovoltaic systems, the DC power input section is designed for connection to the solar cells, and the AC power output section is designed for interconnection to the low-voltage distribution line.

(b) In the case of gas engine systems, the electrical equipment, mainly the reverse converter, and the auxiliary equipment, etc., closely related to it electrically or functionally (excluding the gas engine part).

(c) In the case of fuel cell systems, the electrical equipment, mainly the reverse converter, and auxiliary equipment, etc., which are closely related to this equipment electrically or functionally (excluding the fuel cell part).

(d) In the case of a system using lithium-ion batteries, the electrical equipment mainly consisting of power conversion equipment and auxiliary equipment, etc. closely related to these electrically or functionally (limited to those related to grid-connected protection equipment).

(e) In the case of a combined system of lithium-ion batteries and solar cells, the electrical equipment mainly consisting of power conversion equipment and auxiliary equipment, etc. closely related to these electrically or functionally (limited to those related to grid-connected protection equipment).

(f) In the case of a combined system of a lithium-ion battery and a gas engine, the electrical equipment mainly consisting of a power conversion device and auxiliary equipment, etc. closely related to these electrically or functionally (limited to those related to the grid protection device).

(g) In the case of a combined system of a lithium-ion battery and a fuel cell, the electrical equipment mainly consisting of a power conversion device and auxiliary equipment, etc. closely related to these electrically or functionally (limited to those related to the grid protection device).

(h) For storage batteries mounted on electric vehicles, etc. (DC-connected type), electrical equipment mainly consisting of power conversion equipment and auxiliary equipment, etc. closely related to these electrically or functionally (limited to those related to grid-connected protection equipment).

(i) In the case of a combined system of on-board storage batteries (DC-connected) for electric vehicles, etc. and solar cells, the electric equipment mainly consisting of power conversion equipment and auxiliary equipment, etc. closely related to these electrically or functionally (limited to those related to grid-connected protection equipment).

(j) In the case of a multi-input system consisting of on-board storage batteries (DC-connected) for electric vehicles, etc., lithium-ion storage batteries, and solar cells, the electrical equipment mainly consisting of power conversion equipment and auxiliary equipment, etc. closely related to these electrically or functionally (limited to those related to grid-connected protection

equipment).

### II.II Scope of the tests

The tests are formal tests to be carried out on test articles of grid-connected protective equipment etc. and their components.

The scope of the test also includes parts other than the grid interconnection protection device etc. and auxiliary equipment electrically or mechanically related to it.

In the case of grid-connected protective devices for multi-input systems, the scope of the test includes all combinations of DC energy sources as defined in the scope of application.

### II.III Determination of conformity

All applicable tests specified in this test method and the individual test methods shall be carried out to determine conformity with the requirements.

However, JET may, at its discretion, omit the testing of items for which it has test data issued by a third-party certification body in connection with certification, etc., and items for which it is possible to determine conformity with the requirements by examining the equipment.

## III. Terms of Definition

The terms described in this general rule are, as a general rule, "system interconnection regulations" (JEAC9701) and "technical specifications of PCS with output control function" (The Federation of Electric Power Companies of Japan, The Federation of Electric Power Companies of Japan, The Japan Electrical Manufactures Association, Japan Photovoltaic Energy Association).

**Low voltage distribution line**

Low-voltage wiring that supplies power to an unspecified number of low-voltage customers.

Generally, there are single-phase two-wire system 100V, single-phase three-wire system 100V/200V and three-phase four-wire system: 100V/200V.

**Parallel**

To connect power generation equipment to a commercial power grid (hereinafter referred to as the "grid"). In addition, this general rule describes that the connection to the grid such as the power generation equipment is made in the AC circuit part and excludes the case where the DC connection is made through the rectifier.

**Disconnection**

Separate power generation equipment from the grid.

**Disconnection Point**

A place where power generation equipment can be disconnected from the grid by using a breaker or breaker.

**Interconnection**

The state from the time when power generation equipment is paralleled to the grid to the time when it is disconnected.

**Gate pulse signal**

A signal sent from the gate circuit in a device to the power semiconductor element of a reverse converter or DC power converter to realize power conversion operation by switching operation of the power semiconductor element.

**Gate block**

The gate pulse signal from the gate circuit shall be set to a zero value to cut the current conduction of the power semiconductor devices and stop the output power of the reverse conversion device, etc. or DC power conversion device.

However, if the gate block is also allowed for DC power conversion devices, it shall be stated separately in the test method.

**Without gate pulses**

A control action to stop the gate pulse signal of the gate circuit for a few milliseconds while continuing the output of AC current by reverse conversion operation in order to avoid operation stoppage due to overcurrent of the reverse conversion equipment, etc. or DC power conversion equipment.

**Standard active method**

Active Islanding operation method described in JEM1498 or JEM1505 (Japan Electrical Manufacturers' Association Standard). In the grid interconnection rules, it is described as "new type active method".

**Conventional active method**

Conventional active Islanding operation method described in the Grid Interconnection Rules.

**Multiple-unit FRT- compatible type (former name: "Multiple-unit FRT-compliant type 1")**

Standard active method is adopted and FRT requirements are applied.

**FRT-compatible type**

Conventional active method is used and FRT requirements are applied.

**Forward flow**

A state in which active power is flowing (power flow) from the grid side to the premises of the installer such as power generation equipment.

**Reverse flow**

A state in which active power is flowing (power flow) from the premises of the installer of power generation equipment to the grid side.

**Power conversion device**

A circuit with a power conversion function that converts AC power to DC power when charging storage batteries, etc. and vice versa when discharging.

**DC power converter**

A circuit that is one of the components of a power conditioner and converts DC power to DC power of different voltages.

**Inverse conversion device (inverter)**

A device that converts direct current power into alternating current power by utilizing the switching action of semiconductor devices for electric power.

There are two types depending on the method of conversion: self-excitation type, in which the conversion voltage is given by the components of the inverter, and separate excitation type, in which the voltage is given from outside the inverter.

**Reverse conversion device, etc. (The word "etc." is underlined in this test method for clarity.)**

Either a reverse conversion device or a power conversion device.

**DC energy source**

A DC power source that supplies DC power to the power conditioner.

Examples: "lithium-ion storage batteries", "solar cells", "fuel cells", "storage batteries on electric vehicles, etc. ", "DC power converter and storage battery in one unit," etc.

**Forward conversion**

Converting AC power to DC power by the conversion operation of the power converter.

**Reverse conversion**

Converting DC power to AC power by the conversion operation of the reverse converter.

**Grid interconnection protection device**

It is a general term for a system that realizes the interconnection protection function, which is composed of a protective relay (relay) necessary for grid interconnection or its equivalent function, an islanding detection function or a reverse charge detection function, and a disconnection breaker.

**Power Conditioner**

A device that integrates a reverse conversion device and a system interconnection protection device – Inverter.

**PCS**

Abbreviation for inverter (Power Conditioners).

**Islanding**

In the state where a part of the grid to which power generation equipment is interconnected is disconnected from the grid power source due to an accident, etc.

**Reverse charge**

It is a special condition of islanding operation, and there is no reverse power flow from the premises of the power generation equipment such as the equipment operator (when there is no load other than the premises of the installation of the power generation equipment in the system disconnected from the grid power supply), Only the voltage is applied from the power generation equipment to the point where it is disconnected from the system power supply.

**Voltage rise suppression function**

A function used as a countermeasure to regulate voltage by automatic voltage regulators. There are phase advancing/phase leading reactive power control function and output control function.

**Rated capacity**

The value of apparent power capacity indicated by the manufacturer as a rated value, expressed in VA or kVA.

**Rated output**

The value of active power output expressed in W or kW as the manufacturer's rated value.

**Rated current**

The value of current expressed in A as the manufacturer's rated value.

**Constant power factor control function**

A function in which the power conditioner performs phase advance operation at a constant power factor as a means of suppressing voltage increases in the distribution line due to reverse power flow. The power factor is the advancing power factor from the viewpoint of the power conditioner.

**Specified power factor**

The value of the operating power factor to be set in the test from among the power factor setting range for power conditioners equipped with a constant power factor control function.
Corresponds to θ1, θ2, and θ3 in Supplemental Fig. 1.
（Note: For power conditioners that do not include solar cells as a DC energy source, the specified power factor need not be applied.)

**Specified output**

In the case of a specified power factor, the value of the maximum output at the specified power factor, expressed in W or kW. Corresponds to the magnitudes of p1, p2, and p3 in Supplemental Fig. 1.

**Specified Apparent Power**

The value of apparent power when the power factor is the specified power factor and the output is the specified output, expressed in VA or kVA. Corresponds to the magnitudes of s1, s2, and s3 in Supplemental Fig. 1.

**Specified current**

The value of the current when the power factor is the specified power factor and the output is the specified output, expressed in A. Applies to the current values for s1, s2, and s3 in Supplemental Fig. 1.

**Maximum specified output**

The maximum specified output value within the power factor range, expressed in W or kW. Applies to the magnitude of p1 and p2 in Supplemental Fig. 1.

**Maximum specified apparent power**

The maximum value of apparent power among the specified apparent power in the power factor range.

**Maximum specified current**

The maximum value of current among the specified currents included in the power factor range.

**Independent operation**

A state in which power generation equipment, etc. is disconnected from the power system and power is supplied only to the load on the premises of the person who installed the power generation equipment.

**Auxiliary AC input**

An input that can be connected to an external AC power source that does not satisfy the grid connection requirements, such as the independent operation output of a photovoltaic power generation facility, etc., or the output of a portable generator, during independent operation.

**Auxiliary DC input**

Input that can be connected to an external DC power source that does not meet the grid connection requirements, such as the DC output of solar cells or storage batteries during independent operation.

**Forward conversion/reverse conversion switching type (former name in some test methods: "charge/discharge switching type")**

A method in which there is a fixed period of forward conversion/reverse conversion standby (charging/discharging standby) or suspension at the output end of the system when switching between forward conversion and reverse conversion during system interconnection.

**Connection**

The U-phase, V-phase, and W-phase terminals of the system etc. are collectively referred to as "connection port". System connection port, load connection port, etc.

**Connection port terminal**

The U-phase, V-phase, and W-phase terminals such as the system connection port and the load connection port are referred to as “connection port terminals”.

**Storage battery**

A storage battery is also called a secondary battery or a rechargeable battery and is a battery (a chemical battery) that can be used as a battery by storing electric power chemically by charging and can be repeatedly charged and discharged.

System interconnection protection device equipped with an inverter connection function to an independent circuit
The following shows an inverter equipped with some or all of the following components.

(1) The electric line from the grid to the load equipment passes through the inside of the inverter, and the connection port of the electric line from the system side inlet port breaker (hereinafter referred to as the "system connection port") to the load side distribution board. Connection port (hereinafter referred to as “load connection port”). Normally, power is supplied to the load connection port from the system connected to the system connection port, and it is switched so that power can be supplied to the load connection port from the system connected to the inside of the inverter during the independent operation.
The system connection port and the load connection port are connected without an electronic circuit such as a power converter.

**(2) A connection port for connecting the AC output of the grid interconnecting inverter during the independent operation (hereinafter " It has a "connection port for the inverter").**
**The load connection port and the Inverter connection port may be shared.**
**Moreover, the case where the self-sustained output of the inverse converter and the Inverter connection port are not electrically connected during the independent operation is excluded.**

Storage battery, etc. (In this test method, underlines are used to make it easier to see the presence or absence of "etc.")
Either or both of lithium-ion storage battery and storage battery for electric vehicle

**Charge**
Storing electric power in storage batteries. Depending on the type of storage battery, constant current charging, constant voltage charging, or a combination of these is performed.

**Discharge**
Output the electric power of the storage battery.

**Seamless type**

A method that can continuously change the switching between forward conversion (charge) and reverse conversion (discharge) at the output end of the system when the system is connected.

**Conversion standby (former name: "charging/discharging standby" in a part of test methods)**

A state in which the power conversion function of the power converter is stopped at the gate block without disconnecting by the switch.

**Storage battery integrated type (former name: "Integrated type")**

The inverter and the storage battery are composed in the same housing (integrated).

**Storage battery separation type (former name: "separation type")**

The inverter and the storage battery are composed of independent housings.

**Load following**

The output of the inverter should follow the fluctuation of the load in the home.

**Peak cut**

Supplying a certain amount or more of electricity to the domestic load from a system such as a storage battery in order to suppress the amount of electricity during the day.

**Dedicated load (excessive power recovery heater)**

A dedicated load equipped on equipment such as a heater that recovers excess power as heat when the power output exceeds the power supplied to the load on the premises of the installation such as power generation equipment.

**Storage battery for electric vehicles (DC connection type)**

A Inverter device that uses a lithium-ion storage battery installed in an electric vehicle as an input. The DC connection type is a system equipped with a connection system based on the "Charge/Discharge System Guideline for Electric Vehicles V2H DC Version" issued by the CHAdeMO Council.

**Class A**

Class A equipment is equipment that is suitable for use in all facilities except home facilities and low voltage power systems that feed buildings intended for residential use.

**Class B**

Class B equipment is equipment suitable for use in all facilities, including home facilities and low

voltage power systems that power buildings intended for residential use.

**Voltage rise suppression function**

A function used as a measure to adjust the voltage by an automatic voltage regulator.
It has a phase reactive power control function and an output control function.

**DC voltage converter**

A circuit that is one of the components of a Inverter and converts DC power into DC power of different voltage.

**Integrated Case**

All DC power converters and inverse converters are configured in the same housing.

**Partial Case**

Some DC power converters are composed of a case that is independent of the inverter, and a DC bus that connects the independent DC power converter and the main unit is connected by a cable.

**Separate housing**

A system in which all DC power converters are composed of a housing independent of the reverse converter, etc., and each DC bus is connected by a cable.

**DC energy source**

Supplying DC power to the Inverter.
Examples: "Lithium-ion storage battery", "solar cell", "fuel cell", "storage battery for electric vehicles", "integrated DC power converter and storage battery", etc.

**Multiple input system**

It is included in the multiple DC input system, and is composed of a power converter, a storage battery mounted on an electric vehicle (DC connection type) as a DC energy source, a lithium-ion storage battery, and a solar cell, and the combinations are as follows.

- A combination of multiple storage batteries (storage batteries for electric vehicles or lithium-ion storage batteries)
- A combination of storage batteries (storage batteries for electric vehicles or lithium-ion storage batteries) and solar cells

*The storage battery installed in electric vehicles, etc., has only one input.

**DC bus**

The location where the DC power converter and the inverter are connected is shown. However, the direct-current energy source may be directly connected to the inverse converter or the like.

**Frequency deviation**

For single-phase equipment, the amount of frequency change calculated by the calculation method defined in JEM1498.

For three-phase equipment, the amount of frequency change calculated by the calculation method defined in JEM1505.

**Frequency feedback gain**

Ratio of reactive power injection amount to frequency deviation (Example: 0.25p.u./0.5Hz)

**Active function Normal state**

A state in which reactive power injection is performed according to frequency deviation with the frequency feedback gain set as an initial setting (Note: reactive power injection of step injection due to sudden increase in fundamental wave voltage or sudden increase in harmonic voltage is allowed)

**Active function standby state**

The state where the frequency feedback gain is maintained at 0 and reactive power injection is not performed according to the frequency deviation (Note: reactive power injection is allowed only for step injection due to sudden increase in harmonic voltage)

**Flicker test standard machine (former name: "standard machine")**

The reference machine for the test used for the reactive power oscillation suppression confirmation test.

We selected from the models that represent the Inverters installed in the market.

The conditions are defined as follows.

(1) The maximum output is 3kW or more, JEM1498 is adopted, and the injection amount of the maximum reactive power is 0.25p.u. (1kVar).

(The maximum reactive power injection amount of the flicker test standard machine is 0.25p.u. (1kVar) is equivalent to the maximum reactive power injection amount of the 4kW inverter)

② The slope of the frequency feedback gain is 0.25 p.u. (1 kVar)/0.5 Hz.

**Maximum limit line impedance**

Appendix IX $Z_{LN}$ of the reactive power oscillation suppression confirmation test circuit. The maximum

value of line impedance that does not cause reactive power oscillation when the frequency feedback gain of one of the two flicker test reference machines is connected in parallel and phase jumping causes reactive power oscillation to occur

**Disturbance detection**

Function to detect the sign of reactive power oscillation during grid-connected operation of the inverter

**Power factor switching function by power flow**

The standard value of the power factor during reverse power flow and forward power flow during reverse conversion is different, and the power factor changes depending on the power flow.

**Broadly defined PCS**

An inverter consists of an output control device and a narrowly defined PCS. It has the function of receiving the control schedule from the power server and controlling the output of the narrowly defined PCS.

In addition, the inverter in a broad sense is described as a Power Conditioner (in broadly defined) in "Technical specifications of PCS with output control function".

**Narrowly defined PCS**

An inverter has a function of receiving an output control signal from the output control device and controlling active power to be sent to the power system according to the control signal.

In addition, the narrow sense inverter is described as a Power Conditioner (in narrowly defined) in "Technical specifications of PCS with output control function".

**Output control device**

A device that receives a control schedule from a power server and outputs a control signal to a narrow sense inverter. Control schedules are classified into fixed schedules and update schedules.

**Fixed schedule**

It is a schedule for registering control output in units of 13 months or months for power generation equipment, and control output for up to 400 days is set in 30-minute units.

**Update schedule**

It updates the fixed schedule according to the supply and demand situation and consists of the change time (30 minutes) and the control output value.

**Partial control**

Operation mode in which the control output can be specified in units of 1% with respect to the rated output and controlled with partial output

**Clip control**

In case the installed capacity increases due to the replacement of the narrow sense inverter as a relief measure for the power generation equipment installed before the establishment of the output control system, the installed capacity before the establishment of the system is a measure to exclude it from the target of output control. It is applied to power generation equipment less than 10kW.

**Contract capacity conversion**

The output control device has a function to set the solar cell panel capacity and Inverter capacity, converts the output control amount from the contracted capacity base to the inverter capacity, and gives a command to the narrow sense inverter.

**Echonet output control command**

Shows the generated power limit settings 1 and 2, the selling power limit settings, and the output control settings 1 and 2 defined as the properties of the residential photovoltaic power generation class rules described in the ECHONET Device Object Detailed Rules.

In case a new output control property is added to the residential photovoltaic power generation class regulation and the remote output control function of the electric power company is affected, the added property is also included.

## IV. Test method

- For power conditioners with constant power factor control, the following test method shall be used: Rated output shall be replaced with specified output, rated current shall be replaced with maximum specified current, apparent power shall be replaced with specified apparent power, and operating power factor shall be replaced with specified power factor.

  This does not apply to items that are listed separately from the rated output, such as specified output and specified apparent power.
- In power conditioners, it is desirable to have the ability to set all parameter/mask settings to factory default settings for testing purposes.
- It is desirable to have a setting function that allows the safety confirmation process at start-up, the time to block the input for a certain period of time after the return to power, and the time to wait for the voltage rise suppression operation to be shortened for testing purposes.
- In the case of grid-connected protection devices with the ability to connect the power conditioner

to a stand-alone circuit, all or part of the actual load may not be connected between the Test power conditioner and the AC power source as shown in the attached test circuit diagram cited in each test item, but the electrical connections will be equivalent, so the circuit connections shown in the attached diagram shall be used unless otherwise specified in each test item.

- In the case of a power conditioner that can be operated independently by connecting the power conditioner to a separate enclosure at the point of disconnection at the time of independence, the power conditioner itself shall have a grid protection function other than independence, and the disconnection point at the time of independence in the separate enclosure shall not interfere with that grid protection function.

  In the case of a power conditioner that can operate on its own without the connection of a separate enclosure for independent operation, the power conditioner shall satisfy the requirements of this test on its own.
- If ancillary equipment such as switching switches for independent circuits is included in the package, the switching switches must not interfere with the system protection function.
- If a specific function is masked for testing, the mask shall not affect the performance or functionality of any other function than the one being masked.

  If multiple function masks are to be used in a single setting, prior consultation shall be carried out to ensure that the combination can be tested.

  The details shall be clearly stated in the documentation.
- If the load-following function of the test power conditioner does not allow output to the AC power supply side, the function may be masked.

  The masking of the reverse power prevention control function shall be implemented after consultation with the applicant for certification.
- Equipment with an overvoltage relay (OVR) function, passive islanding operation prevention function, active islanding operation prevention function, frequency feedback function, step injection function, standby function for voltage rise suppression, reverse power prevention function, or load following function shall have a mask function for these functions. Equipment with conventional active islanding operation protection shall also be able to mask active operation.
- In order to carry out the test for the detection of islanding operation during forward conversion 1 on a seamless device, it is necessary to set up the step injection function and the frequency feedback function as auxiliary devices for the test, with the "operation stop due to active islanding operation detection" masked in the standard active islanding operation prevention function.
- Undervoltage relay (UVR) function, instantaneous unbalanced overvoltage relay function, Over Frequency Relay (OFR) function and Under Frequency Relay (UFR) function should also have a mask function for testing.
- Equipment with a power factor switching function using power flow shall have a function to fix

the power factor by setting.

- Equipment with a power factor switching function based on power flow shall start up with the reverse power flow state power factor.
- For items that have functions related to the following states, they shall have the ability to output electrical signals for the following states: dissolution relay state, gate block state, active standby state, step injection state, advance phase reactive power operation state, and power factor change in progress state due to power flow.

  (Refer to the remarks in 4.9 Power Factor Switching Test by Power Flow)

  The active standby state signal shall not be used together with the command signal used in the step injection function test. Other relays, such as independent relays and auxiliary input relays, should also be able to output relay signals.
- Output control state for voltage rise suppression, detection of voltage rise state, operation of voltage rise suppression function (advance reactive power control function and output control function)
- An external output signal port shall be provided for testing purposes to enable confirmation of the release and the holding of the operating standby time of the voltage rise suppression function. The signal of the advance reactive power control shall be flagged while the power factor is decreasing due to the advance reactive power control, and the signal of the output control shall be flagged when the output control is moving in the direction of suppressing the power, and the flag shall be lowered when the output control is moving in the direction of releasing the power.

  In addition, it may be used in conjunction with the command signal acknowledgement port used for step injection function tests, etc. (see Remark 2 of the voltage rise suppression function test for details).
- During the stand-alone operation detection test, it should also be possible to output "a signal indicating that the stop is due to an active method".

  An external output signal port capable of confirming the normal state of the active function and the standby state of the active function shall be provided for testing purposes in [Multiple-unit FRT compatible].

  This port shall not be used together with the command signal confirmation port used in the step injection function test.
- In the case of the 【FRT for multiple units】, in order to carry out the islanding operation detection test 1 in the active function standby state, it is desirable to start up in the active function standby state and to remain in that state for a certain period of time.

  For example, it is desirable to set the number of standby transitions to three or more times when "disturbance detection" as indicated in the JEM standard is detected, so that the active function standby state can be maintained for five minutes.

However, the system shall transition to the active function normal state in accordance with the standard.

If the above setting is not possible, it shall be possible to mask the function of switching from the active function standby state to the active function normal state by continuing undetected disturbance detection.

If neither of these methods is possible, the active standby state shall be maintained after consultation with the certification applicant.

- It shall have a forced active function normal setting function that maintains the active function normal state at all times.
- If there is more than one switch that could be the subject of the test, clarify which switch in the Test power conditioner is being referred to for the switch opening in the [Judgment Criteria] section of each test item. (Check with circuit diagrams, etc.)
- Unless otherwise stated, "switch" refers to the switch for disconnection during grid connection (hereinafter referred to as "switch for disconnection during grid operation"), and if the switch for disconnection during islanding operation (hereinafter referred to as "switch for disconnection during islanding operation") is different, it is described separately.
- The description of the test method is as follows


Select according to compliance.


If it is applicable, it will be implemented.

## 1 Structural test

[Judgment criteria]

【System does not include storage batteries, etc.】

A. Structural tests (excluding labeling items) shall be in accordance with the technical contents specified in the interpretation of the Ministerial Ordinance for Establishing Technical Standards for Electrical Appliances and Materials, Annex Table 8-1 "Common Items" (refer to the reference material "Structural Test Confirmation Items").

B. The display shall clearly indicate the following conditions, which can be checked without using tools.

- Operation, failure, stop, and independent operation (in case of having independent operation)
- If the system can be operated by an ordinary user, it shall indicate whether the switchgear (switchgear for operating main power on/off, etc.) is on or off.

The above indications are allowed to be displayed in multiple locations, as well as on remote control units and devices connected via a network. (When displaying on network equipment, etc., the user shall be able to check the display under the same conditions as when the user is using the equipment.

【System includes storage batteries etc.】

A. Structural tests (excluding labelling items) shall be carried out in accordance with

【Separate storage battery】: JIS C 4412-1 or JIS C 4412-2

【Integrated storage battery】: According to JIS C 4412-1.

In addition, the JIS standard selected for the following items shall be the same as the JIS standard selected for this test.

The same applies to all items to which JIS C 4412-1 or JIS C 4412-2 is applied.

In the case of a system using storage batteries mounted on electric vehicles, the following items shall be selected.

- The insulation distance shall be in accordance with JIS C 60664-1.
- The DC circuit on the charging/discharging connector side shall be insulated from the AC circuit and other DC energy sources.
- Only one charging/discharging connector shall be used.

B. The display shall clearly indicate the following conditions, which can be checked without using tools.

- Operation (or charge/discharge), standby for charge/discharge, stop, independent operation, failure (abnormality, etc.) Operation (or charge/discharge) and standby for charge/discharge can be substituted with "Operation".
- If an ordinary user can operate the switchgear (switchgear for operating main power

supply on/off, etc.), the display may be "on" or "off".

The above indications may be displayed in multiple locations, and may also be displayed by remote control units, networked devices, and the like. When displaying on networked equipment, etc., the user shall be able to check the display under the same conditions as when using the equipment.

【With the ability to connect the power conditioner to an independent circuit】

The following indications and conditions shall also be clear

(1) When the power line from the grid to the load device passes through the power conditioner

- The maximum allowable current or power value at the grid connection opening and the maximum allowable current or power value at the load connection opening.
- The point of connection to the terminal block etc. where the main line or its branch circuit is connected. (e.g., "grid side", "load side")

(2) If the power conditioner has a "power conditioner connection port" for connecting the AC output of a power conditioner for independent operation

- The type, maximum output, and electrical system of the power conditioner that can be connected during independent operation.
- If the power conditioner connection circuit is not equipped with an overcurrent circuit breaker required for branch circuits to grid-connected small-output power generation facilities as required by the internal rules, an indication to that effect shall be provided.

(3) The control of grid-connected protection devices, etc. equipped with power conditioner connection functions shall not be performed by signals from the coordinated power conditioner during independent operation.

(4) If the load connection port is not equipped with an overcurrent circuit breaker, this shall be indicated.

(5) If the "switch for disconnection during interconnection operation" and the "switch for disconnection during independent operation" are different, each switch shall be installed in the same housing and shall not be easily touched.

[Remarks]

1. When JIS standard is revised, the latest version of JIS standard shall be used in principle, but the handling of old JIS shall be decided in accordance with the operation of other organizations. The same shall apply to the parts of this test method described as JIS C 4412-1 or JIS C 4412-2.
2. For this test, IEC62109-1 test report with CB certificate issued by a certification body (NCB) under the CB scheme of IECEE is also acceptable.
   However, the following modifications shall be added and applied to accommodate the Japanese

power distribution system and grounding system.

(1) IEC62109-1 test is not tested as IT grounding equipment.

(2) During interconnection, the neutral wire shall be isolated from the earth and the energy storage system itself as well as from each phase of the power supply.

## 2 Insulation performance test

【System does not include storage batteries etc.】

Surge absorbers may be removed from the circuit in accordance with the interpretation of the Ministerial Ordinance for Establishing Technical Standards for Electrical Appliances and Materials, Appendix 8, Supplementary Table 3.

【System includes storage batteries etc.】

The common test conditions for this test shall be in accordance with JIS C 4412-1 or JIS C 4412-2.

In addition, follow [Remarks]1. of “1. structural test”.

[Remarks].

Also [Remarks] 2. of "1. Structural tests" shall be made applicable.

### 2.1 Insulation resistance test

【System does not include storage batteries etc.】

[Test Method]

A. The insulation resistance between the input/output terminals of the power conditioner and the non-charged metal part and the outer casing (if the outer casing is insulated, the metal foil adhered to the surface of the outer casing) shall be measured using an insulation resistance meter with an insulation resistance of 500 V (1,000 V in the case of the rated voltage of the test product exceeding 300 V but not exceeding 600 V) or an insulation resistance meter with equivalent performance, as specified in JIS C 1302:2002 "Insulation Resistance Meters". V) insulation resistance meter or an insulation resistance meter with equivalent performance. In addition to the closed circuit of the disconnection switchgear, if there is a dedicated load or auxiliary equipment, these circuits shall also be closed so that the test voltage can be applied.

B. If the insulation resistance value changes during the measurement, the value shall be the value after approximately one minute from the time the voltage is applied.

C. The details of the test conditions may be determined separately by consultation with the applicant for certification.

[Judgment criteria]

The insulation resistance shall be 1 MΩ or more.

【System include storage batteries etc.】

This test is based on JIS C 4412-1 or JIS C 4412-2 for both test method and judgment criteria.
In addition, follow [Remarks]1. of “1. structural test”.
[Remarks].
Also [Remarks] 2. of "1. Structural tests" shall be made applicable.

### 2.2 Commercial frequency withstand voltage test

【System does not include storage batteries etc.】

[Test Method]

A. An AC voltage of 1,500 V (1,000 V for those with a rated voltage of 150 V or less) shall be applied continuously for 1 minute between the input and output terminals of the power conditioner and the non-charging metal part and the outer casing (if the outer casing is insulated, metal foil adhered to the surface of the outer casing).
   In addition to the closed circuit of the disconnection switch, if there is a dedicated load or auxiliary equipment, these circuits shall also be closed so that the test voltage can be applied.

B. In the case of a part of an insulated transformer, such as a control circuit, which is charged by the voltage on the secondary side of the transformer, an alternating voltage of the value specified in Table 2.2-1 shall be applied continuously for 1 minute between the part charged by the voltage on the secondary side of the transformer and the uncharged metal part and the outer casing (or, if the outer casing is insulated, the metal foil adhered to the surface of the outer casing), and between the windings of the transformer. C.

C. For auxiliary equipment, an alternating voltage of the value specified in Table 2.2-1 shall be applied continuously for 1 minute between the charging part and the casing.

Table 2.2-1

| Voltage classification (V) | Test voltage (V) |
|---|---|
| Less than 30 | 500 |
| More than 30 and less than 150 | 1,000 |
| More than 150 and less than 300 | 1,500 |
| More than 300 and less than 600 | The voltage on the secondary side shall be E, 2E+1,000 |

D. The details of the test conditions may be determined separately in consultation with the applicant for certification.

[Judgement criteria]

Withstanding the specified AC voltage continuously for 1 minute without causing dielectric breakdown.

[Remarks].

①. Single-phase three-wire transformers shall be regarded as having a rated voltage of 200 V.

②. In testing the circuit of the secondary side of the transformer:

If one side of the secondary side is grounded, the test may be carried out with the grounding removed.

【System include storage batteries etc.】

This test is based on JIS C 4412-1 or JIS C 4412-2 for both test method and judgment criteria.

In addition, follow [Remarks]1. of “1. structural test”.

[Remarks].

Also [Remarks] 2. of "1. Structural tests" shall be made applicable.

### 2.3 Lightning impulse test

【System does not include storage batteries etc.】

[Test method]

A voltage with a wave head length of 1.2μS, a wave tail length of 50μS, and a wave height of 5.0kV is applied between the output terminal (main circuit lump) and the non-charging metal part (earth terminal) of the power conditioner, three times each with positive and negative polarity at a minimum interval of 1 minute.

[Judgment criteria]

1. No flashover between insulating voids or dielectric breakdown through the insulation.
2. After the test, the insulation resistance test in clause 2.1 shall be satisfied.

[Remarks]

In this test, if the Earth Leakage Breaker used as the main switchgear malfunctions, and the cause is the leakage current flowing through the surge absorber, noise prevention capacitor, etc., the test may be conducted by short-circuiting between the input and output terminals of the Earth Leakage Breaker.

【System include storage batteries etc.】

This test is based on JIS C 4412-1 or JIS C 4412-2 for both test method and judgment criteria.

In addition, follow [Remarks]1. of “1. structural test”.

[Remarks].

Also [Remarks] 2. of "1. Structural tests" shall be made applicable.

## 3 Protection function test

[In case the system includes the storage battery]
For the test with the storage battery, it is possible to use a DC power supply instead of the storage battery. In that case, use a DC power supply that can output the maximum DC specified value or more of the input such as the storage battery of the inverter.
The maximum DC current specified value refers to the maximum value of the DC current flowing into the storage battery port of the power conditioner specified by the certification applicant.
In this test method, the judgment criteria are described only in the test in which the overcurrent on the DC side is assumed to be high, but even in the test not described in the judgment criteria, it is not allowed to exceed this current specified value.

### 3.1 Simulated input test

The test in this section can be conducted under simulated operating conditions.
The method of driving in a simulated manner (simulated driving state) will be discussed with the certification applicant.

[Remarks]
The simulated input test is a test for confirming the operation of the protection function, which is difficult to perform in the actual operating state. For this reason, the inverter is put into a simulated operating state, the protection circuit is operated in the same manner as in the normal operating state, and an equivalent signal is given to the detection section to carry out the test.

#### 3.1.1 AC overcurrent test

[Test conditions]
The operating conditions of the power conditioner shall be simulated or normal operating conditions in consultation with the applicant for certification.

[Measurement method]

A. Apply an AC current of rated frequency to the sensing device (AC current transformer, etc.) at which the protective device does not operate, gradually increase the current to a level at which the protective device operates and measure the AC overcurrent detection level.
B. Increase the rated frequency AC current from zero to 110% of the rated value in a stepwise manner and measure the operating time of the protective device.

[Judgement criteria]

A. The AC overcurrent shall be detected, and the gate shall be blocked. The switch may be opened. However, this gate blocking and opening of switch refers to gate blocking and opening of switch of reverse converter etc. or DC power converter.
B. The protection level shall be within ±5% of the regulated value. The regulated value of the protection level shall be 150% or less of the rated current.
C. The operating time shall be within 0.5 seconds.

### 3.1.2 DC overvoltage and undervoltage tests

The following tests shall be carried out on the input terminals of all types of DC power converters with a DC bus or connection terminals to external wiring respectively.

[Test conditions]

The operating conditions of the power conditioner shall be simulated (Test Mode) or normal operating conditions as discussed with the applicant for certification.

[Measurement method]

A. Connect the DC power supply to the DC bus or the input terminal of the specified DC power converter.
B. The DC voltage is gradually increased from the voltage at which the protective device does not operate to the level at which the protective device operates, and the DC overvoltage detection level is measured.
C. Increase the DC voltage step by step from the rated voltage to 110% of the rated value and measure the operating time of the protective device.
D. Measure the DC undervoltage level by gradually lowering the DC voltage from 110% of the rated value to the level at which the protective device operates.
E. Allow the DC voltage to fall in steps from the rated voltage to 90% of the rated value and measure the operating time of the protective device.
F. The above measurements shall be carried out for all types of DC energy sources.

[Judgement criteria]

A. DC overvoltage and DC undervoltage shall be detected and the gate shall be blocked.
   The switch may be opened.
   Strictly speaking, this gate blocking and opening of switch refers to gate blocking and opening of switch of reverse converter etc. or DC power converter.

B. The protection level shall be within ±5% of the regulated value.

C. The operation time shall be within 0.5 seconds.

[Remarks]

For fuel cell power generation systems, the DC overvoltage test can be omitted, as overvoltage does not occur due to the principle of fuel cells. Also, for gas engine cogeneration systems, this test is not carried out because there is no DC voltage section.

### 3.1.3 DC component detection test

This test applies to power conditioners that do not have a transformer to prevent direct current from flowing out of the power conditioner into the grid.

**[Test condition]**

The operating state of the power conditioner shall be the simulated operating state or the normal operating state in consultation with the certification applicant.

**[Measuring method]**

A. Apply a DC current to the DC outflow detection circuit, gradually increase it to the level at which the protection device operates and measure the protection level.

B. Increase the DC current step by step to 110% of the specified protection level and measure the operating time of the protection device.

**[Judgment criteria]**

A) Detect DC current, open switch, and gate block.

B) The protection level shall be 1% or less of the rated output current.

C) The operating time must be within 0.5 seconds

## 3.2 Actual operation test

The test in this section shall be conducted under actual operating conditions.

Standard test conditions are shown below.

In each test item, only the part different from the standard test conditions should be described.

For inverters with constant power factor control, the rated output shall be read as the specified output and the rated current shall be read as the maximum specified current according to the following test method.

It should be noted that items such as specified output and specified apparent power are not limited to those described separately from the rated output.

The application of the single-phase two-wire 100V device test shall be in accordance with the application conditions of this test method.

[Standard Test Conditions for Inverse Transform Mode]

A. The test circuit is a circuit connection of Annex I, II, IV or V.
   In the case of the 100V connection mechanism, it is assumed that the circuit is connected to the attached drawing XII.
B. The AC power supply shall be operated at the rated voltage and frequency.
C. For inverters with conversion mode switching, set the inverter to the inverse conversion mode. For inverters with constant power factor control, set the power factor of the inverter to the specified power factor.
D. For the setting of the DC power supply, set the output of the inverter to be the rated output. When there are multiple types of DC energy sources, all the DC energy sources are operated.
E. The line impedance is short-circuited.
F. In principle, the settings of the protective relay of the protective device, etc., shall be the factory set values (as described in the application for certification) for the detection level and operating time, but may be changed according to the test only when the change is deemed appropriate. Furthermore, if the test cannot be conducted normally due to the protective device, the minimum protective function may be masked only when it is deemed appropriate to mask the protective function after consultation with the applicant for certification. (In the case of masking, the masked protective device shall be recorded.)
G. $SW_{LD}$ is turned on and the load is set so that the power conditioner has the output set in paragraph D. Furthermore, if a dedicated load, etc. is connected for the purpose of preventing reverse power, that load may be used. However, if it is difficult to reduce the dedicated load, etc., or if the output, etc. of the power conditioner is to be varied, this shall be done after consultation with the certification applicant. In the case of a power conditioner with a power factor switching function by power flow, the load and power source shall be set so that the power conditioner is in a reverse power flow state. The power factor switching by power flow may be masked and the test may be conducted with the power factor fixed.
H. When a DC power supply is used instead of a storage battery, etc., set the current limit value of the DC power supply to be equal to or greater than the specified maximum DC current value of the input of the storage battery, etc. of the inverter.
I. If a direct current power source is used instead of a storage battery, set the output voltage of the direct current power source to the input rated input voltage value of the storage battery of the inverter.

[When the system includes a storage battery, etc. and is in the forward conversion/conversion

standby mode]

Standard Test Conditions for Forward Conversion/Conversion Standby Mode

(Underlined points are different from the inverse transform mode.)

A. The test circuit shall be a circuit connection of Appendix I, II, IV or V.
   In the case of the 100V connection mechanism, the circuit is connected as shown in the attached drawing XII.

B. The AC power supply shall be operated at the rated voltage and frequency.

C. When measuring forward conversion mode, the power conditioner shall be set to forward conversion mode. When measuring the conversion standby mode, the power conditioner shall be set to the conversion standby mode after consultation with the certification applicant.

D. The DC power source settings shall be set in consultation with the certification applicant so that the charging power of storage batteries, etc. becomes the rated power when measuring in the forward conversion mode. When measuring the conversion standby mode, the power conditioner shall be set to the conversion standby mode upon consultation with the certification applicant.

E. The line impedance is short-circuited.

F. In principle, the settings of the protection relays and the like of the protection device are set to the detection level and the operation time at the time of factory shipment (as described in the certificate application form) but may be changed according to the test.
   In addition, if the protective device fails to successfully perform the test, the protective device may be masked after consultation with the certification applicant (if masked, the masked protective device shall be recorded).

G. $SW_{LD}$ is opened. In the case of an inverter having a power factor switching function by power flow, a test may be conducted by masking the power factor switching function by power flow and fixing the power factor.

H. When a DC power supply is used instead of a storage battery, etc., set the current limit value of the DC power supply to be equal to or greater than the specified maximum DC current value of the input of the storage battery, etc. of the inverter.

I. If a DC power source is used instead of a storage battery, set the output voltage of the direct current power source to the rated input voltage value of the input of the storage battery, etc. of the inverter.

### 3.2.1 AC overvoltage and undervoltage tests

【System includes storage batteries, etc.】

- In the case of a reverse/forward conversion switching type, the test shall be conducted in the reverse/forward conversion/standby conversion mode.

- In the case of a seamless system, the test shall be carried out in the reverse/forward conversion mode.

【Reverse conversion】

[Test conditions for inverse conversion].

The standard test conditions for the reverse conversion mode shown in Section 3.2 shall apply.

However, paragraphs D and F shall be changed to the following contents.

D. The DC power source setting shall be set to a level where the output harmonic current satisfies the criteria in 4.4 Output Harmonic Current Test and the output of the power conditioner is stable. The type of DC energy source is not specified.

F. The settings of the protective relay of the protective device shall be the set value of detection level and the operating time.

【System includes storage batteries, etc. and is in forward conversion/conversion standby mode】

[Test conditions for forward conversion/conversion standby mode]

The standard test conditions for Forward Conversion/Conversion Standby Mode shown in Section 3.2 shall apply.

However, paragraphs D and F shall be changed to the following content.

D. The DC power source setting shall be set to a level at which the charging power of storage batteries, etc. is stable when measuring in the forward conversion mode, after discussion with the certification applicant. When measuring conversion standby mode, the power conditioner shall be set to the conversion standby mode upon consultation with the certification applicant.

F. The settings of the protective relay of the protective device shall be the standard value of detection level and the operating time.

[Measurement method]

A. Gradually increase the AC voltage from 95% of the detection level of the overvoltage relay (OVR) and measure the voltage detection level at which the OVR detects the voltage abnormality and disconnects the power conditioner.

B. Stepwise increase the AC voltage from the rated voltage to 105% of the regulated value and measure the operating time until the OVR detects the voltage abnormality and disengages the power conditioner.

C. Gradually decrease the AC voltage from 105% of the detection level of the undervoltage relay (UVR) and measure the voltage detection level at which the UVR detects the voltage abnormality and disengages the power conditioner.

D. Allow the AC voltage to drop stepwise from the rated voltage to 95% of the regulated value and

measure the operating time until the UVR detects the voltage abnormality and disengages the power conditioner.

E. Carry out the above measurement for each phase.

F. Carry out the above measurements in all modes of operation that need to be carried out.

[Judgment criteria]

A. Abnormal voltage shall be detected, and the switchgear shall be opened, and gate blocked.

B. The protection level shall be within ±2% of the rated value.

C. The operating time shall be within ±0.1 second of the rated value.

D. Even if the system voltage is restored normally, the system shall not be re-parallel for the time specified in the specifications or for a set time (e.g., 150 seconds).
In addition, even if an operation signal is input by an operation switch, etc., the equipment shall not operate during the time when the re-parallel is prevented.

[Remarks].

In the case of an AC overvoltage test, if the voltage rise suppression function operates during the detection level measurement and the detection level cannot be measured accurately, the voltage rise suppression function may be masked during the detection level measurement.

### 3.2.2 Frequency rise and fall tests

【System includes storage batteries, etc.】

- In the case of a reverse/forward conversion switching type, this shall be carried out in reverse/forward conversion/standby mode respectively.
- In the case of a seamless system, this shall be carried out in the reverse/forward conversion mode respectively.

【Reverse conversion】

[Test conditions for reverse conversion]

The standard test conditions for the reverse conversion mode shown in Section 3.2 shall apply.

However, paragraphs D and F shall be changed to the following content.

D. The DC power source setting shall be set at a level where the output current harmonics are below the specified value and the output of the power conditioner is stable. The type of DC energy source is not specified.

**F.** The setting of the protective relay of the protective device shall be the set value of the detection level and the operating time.

【System contains storage batteries etc. and is in forward conversion/conversion standby mode】

[Test conditions for forward conversion/conversion standby mode]

The standard test conditions for Forward Conversion/Conversion Standby Mode shown in Section 3.2 shall apply.

However, paragraphs D and F shall be changed to the following content.

D. The DC power source setting shall be set to a level at which the charging power of storage batteries, etc. is stable when measuring in the forward conversion mode, after discussion with the certification applicant. When measuring conversion standby mode, the power conditioner shall be set to the conversion standby mode upon consultation with the certification applicant.

**F.** The settings of the protective relay of the protective device shall be the standard value of detection level and the operating time.

[Measurement method]

A. Gradually increase the frequency from -0.5 Hz, the detection level of the frequency rise relay (OFR) and measure the detection level at which the OFR detects the frequency rise and unties the power conditioner.

B. Increase the frequency step by step from the rated frequency to 105% of the rated value and measure the operating time until the OFR detects the frequency abnormality and disengages the power conditioner.

C. Gradually decrease the frequency from +0.5 Hz of the detection level of the frequency lowering relay (UFR) and measure the detection level at which the UFR detects the frequency abnormality and disengages the power conditioner.

D. Decrease the frequency step by step from the rated frequency to 95% of the rated value and measure the operating time until the UFR detects the frequency abnormality and disengages the power conditioner.

E. Carry out the above measurements in all modes of operation that need to be carried out.

[Judgment criteria]

A. Abnormal frequency shall be detected, and the switchgear shall be opened, and gate blocked.

B. The protection level shall be within ±0.1Hz of the rated value.

C. The operating time shall be within ±0.1 seconds of the rated value.

D. Even if the frequency recovers normally, the unit shall not be re-parallel for the time specified in the specifications or for a set time (e.g., 150 seconds). In addition, even if an operation signal is input by an operation switch, etc., the power conditioner shall not operate during the reparallel blocking time.

E. For FRT-compatible power conditioners, the regulated value shall include 47.5 Hz for 50 Hz and

57.0 Hz for 60 Hz.

【Remark】

If the islanding operation detection operates during the operation time test, the step width of the frequency change may be changed, or the islanding operation detection function may be masked.

### 3.2.3 Reverse power protection test

This test applies to inverters with reverse power protection.

In addition, the target of application of the Inverter connection function to the independent circuit complies with the applicable conditions of this test method.

A grid interconnection protection device equipped with an inverter connection function, etc. that has a Inverter connection port and is connected to the grid interconnection protection device connected to the Inverter connection port during islanding operation. In the case of including the following, in addition to any of the following 3.2.3.1, 3.2.3.2, and 3.2.3.3, perform the test of either 3.2.3.4 or 3.2.3.5 below according to the applicable specifications.

Note that,

(1) CT is installed by the contractor in the distribution board of the customer when the inverter is installed, and it should count as it is possible that the CT may be installed incorrectly (installation direction error, dropout, etc.). It should be noted that, if a test of incorrect mounting is performed, it is considered to be compliant if it shifts to a state such as start/stop, or power generation stop.

(2) A grid connection protection device equipped with a function to connect an inverter to an independent operation circuit, in which all CTs related to the reverse power relay (RPR) are installed inside the Inverter, the certification applicant. After discussing with, the CT mis-installation test can be omitted.

(3) If a dedicated load is connected for the purpose of preventing reverse power, that load can be used. However, if it is difficult to reduce the dedicated load, etc., or if the output of the Inverter, etc., is variable, it can be implemented after consultation with the certification applicant.

(4) If the output of the power conditioner changes with a decrease in load or dedicated load and the reverse power prevention function cannot be tested, the load-following function may be masked due to load fluctuations.

(5) If the load following function can be disabled independently of the reverse power prevention setting, set the reverse power prevention setting to valid and set the reverse power protection function to disabled to prevent the reverse power protection function.

(6) Devices with a reverse power protection function other than those in 3.2.3.1 are treated as devices with reverse power flow.

### 3.2.3.1 In case with reverse power relay (RPR)

This test applies to inverters with a reverse power relay (RPR).

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

However, the items D and G will be changed to the following contents.

D. The DC power source setting shall be set to an output level at which the power conditioner can reliably detect reverse power when it enters a no-load state, and at which the output harmonic current satisfies the criteria in 4.4 Output Harmonic Current Test and stable operation is possible. In the case of multiple types of DC energy sources, all DC energy sources shall be operated. In addition, the DC energy source that prevents reverse power shall be in a state where it is emitting power.

G. $SW_{LD}$ is turned on and the load is set to be forward current.
Furthermore, the statements after "Furthermore" in paragraph G do not apply.

[Measuring method]

A. Gradually reduce the load or the dedicated load, etc., and check the reverse power value that is disconnected when the Inverter output becomes larger than the load power.

B. The load or the dedicated load is lowered stepwise from 110% of the rated load to 90% of the set value, and the RPR detects reverse power and measures the operating time until the inverter is disconnected.

[Judgment criteria]

A. Regardless of the installation status of all the power flow status monitoring CTs installed at the power receiving point, the criteria below must be met. In addition, when the CT for power flow status monitoring is tested in the state of being incorrectly installed, it is compliant if it shifts to a state such as start/stop or power generation stop. In addition, if the CT is dropped or the wire cuts, the item B should be satisfied within 5 minutes. However, the description "detecting reverse power" does not apply.

B. Detect the reverse power, open the switch, and block the gate.

C. The reverse power protection level must be 5% or less of the inverter's rated output or maximum specified output.

D. The operation time should be within 0.5 seconds.

### 3.2.3.2 In case with function to stop the output of the DC energy source that prevents the

**reverse power when the reverse power detection function**

(Former name: In case with reverse power detection function other than reverse power relay (RPR))

This test applies to an inverter that includes both a DC energy source that prevents reverse power and a DC energy source that does not prevent reverse power, and that has this function.

[Test conditions]

The test conditions shown in Section 3.2.3.1 shall apply.

[Measuring method]

A. Check that the switch of the DC energy source that opens the DC power converter is open or the DC power converter is gate-blocked by reducing the load or the dedicated load etc. and preventing the reverse power when the Inverter output becomes larger than the load power.

B. Reverse load detection function detects the reverse power from 110% of the rated load to 90% of the output of the Inverter when only the direct current energy source that prevents the reverse power from the rated load operates. Then, measure the operation time until the switch of the DC energy source that prevents reverse power is opened or the DC power converter is gate blocked.

C. Using the above measurement as a DC energy source,
In the configuration described in the system registered for certification application,
In all configurations, including both a DC energy source that prevents reverse power and a DC energy source that does not prevent reverse power,
With the DC energy source operating that does not prevent reverse power,
Each type and combination of DC energy sources that prevent reverse power shall be tested separately. However, the output setting will be set after consultation with the certification applicant.

D. Execute A and B while the input of the DC energy source that does not prevent reverse power is stopped and only the DC energy source that prevents reverse power is operated.

[Judgment criteria]

(Underlined words are different from the criteria shown in 3.2.3.1)

A. Regardless of the installation status of all the power flow status monitoring CTs installed at the power receiving point, the criteria below must be met. In addition, when the CT for power flow status monitoring is tested in the state of being incorrectly installed, it is compliant if it shifts to a state such as start/stop, or power generation stop.
In addition, if CT is dropped or disconnected, the item “B” must be satisfied within 5 minutes.
However, the description "detecting reverse power" does not apply.
Furthermore, the DC energy source that prevents reverse power from switching to a charged state shall also be compliant.

B. Reverse power shall be detected and one of the following shall operate
   - The switchgear of the DC energy source preventing reverse power opens
   - The gate block or switchgear of the DC power converter of the DC energy source that prevents reverse power is open.
   - Gate block or switchgear of the reverse conversion device, etc., is open.

C. The level of reverse power protection shall be 5% or less of the output of the Inverter when only the DC energy source that prevents reverse power is operating at its rated value.

D. The operation time should be within 0.5 seconds.

E. Even if this function operates, it must operate according to the specifications except for the DC energy source that prevents reverse power.

**3.2.3.3 In case with function to prevent the reverse power flow from DC energy source that prevents the reverse power when the reversed power flow generated by the DC energy source that does not prevent the reverse power.**

This test includes both cases of a DC energy source that prevents reverse power and a DC energy source that does not prevent reverse power, applies to the inverter with the function to control the output power from the DC energy source that prevents the reverse power including the power flowing to the load.

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

However, the items D and G will be changed to the following contents.

D. For the DC power source setting, the output of the power conditioner is adjusted so that the output of the power conditioner is set to be the maximum possible for continuous operation.
   In the case of multiple DC energy sources, all DC energy sources shall be operated.
   In addition, the DC energy source that prevents reverse power shall be in a state where it is emitting power.

G. Turn on the $SW_{LD}$ and set the load to consume the output of the DC energy source that prevents reverse power.

[Measuring method]

The measurement method shown in 3.2.3.2 is applied. Reprinted below.

A. Check that the switch of the DC energy source that opens the DC power converter is open or the DC power converter is gate-blocked by reducing the load or the dedicated load etc. and preventing the reverse power when the Inverter output becomes larger than the load power.

B. Reverse load detection function detects the reverse power from 110% of the rated load to 90% of the output of the Inverter when only the direct current energy source that prevents the reverse

power from the rated load operates. Then, measure the operation time until the switch of the DC energy source that prevents reverse power is opened or the DC power converter is gate blocked.

C. Using the above measurement as a DC energy source,
In the configuration described in the system registered for certification application,
In all configurations, including both a DC energy source that prevents reverse power and a DC energy source that does not prevent reverse power,
With the DC energy source operating that does not prevent reverse power,
Each type and combination of DC energy sources that prevent reverse power shall be tested separately. However, the output setting will be set after consultation with the certification applicant.

D. Execute A and B while the input of the DC energy source that does not prevent reverse power is stopped and only the DC energy source that prevents reverse power is operated.

[Judgment criteria]

(Underlined words are different from the criteria shown in 3.2.3.1)

A. Regardless of the installation status of all the power flow status monitoring CTs installed at the power receiving point, the criteria below must be met. In addition, when the CT for power flow status monitoring is tested in the state of being incorrectly installed, it is compliant if it shifts to a state such as start/stop, or power generation stop.
In addition, if the CT is dropped or the wire cuts, the item “B” should be satisfied within 5 minutes. However, the description "detecting reverse power" does not apply.
Furthermore, the fact that the DC energy source that prevents reverse power from switching to the charging state shall also be conforming.

B. The load power and the output power (DC side) of the DC energy source that prevents reverse power shall be measured, and when "the output power of the DC energy source that prevents reverse power > the load power", one of the following shall operate.
- The switchgear of the DC energy source that prevents reverse power opens.
- The gate blocked by the DC power converter of the DC energy source that prevents reverse power.
- The gate block or switchgear of the reverse conversion device, etc., is open.

C. The reverse power protection level is “output power of DC energy source that prevents reverse power”- “load power” is 5% or less of the output of the Inverter when only the DC energy source that prevents reverse power operates at the rated power.

D. The operation time should be within 0.5 seconds.

E. Even if this function operates, it must operate according to the specifications except for the DC energy source that prevents reverse power.

**3.2.3.4 In case with function to stop the output power from DC energy source that prevents the reverse power when the reversed power flow generated by the Inverter that does not prevent the reverse power.**

This test is applied to a power conditioner that has this function in a grid interconnection protection device that has a function to connect a Inverter to an independent circuit. The DC energy source includes both a DC energy source that prevents reverse power and a DC energy source that does not prevent reverse power, and the contents of this test can be confirmed by the test in Section 3.2.3.2 from the CT connection position, etc. In this case, this test can be omitted.

[Test conditions]

The standard test conditions for reverse conversion mode shown in Section 3.2 is applied.

However, items A, D and G will be changed to the following contents.

A. In the test circuit, as shown in Fig. 1, an AC power source is connected to the system connection port, an inverter connection port is connected to the Inverter during islanding operation, and a load is connected to the load connection port. The Inverter to be connected during islanding operation and the driving power factor to be connected will be decided in consultation with the certification applicant.

D. The DC power source setting shall be set to an output level at which the power conditioner can reliably detect reverse power when it enters a no-load state, and at which the output harmonic current satisfies the criteria in 4.4 Output Harmonic Current Test and stable operation is possible. In the case of multiple DC energy sources, all DC energy sources shall be operated.
In addition, the DC energy source that prevents reverse power shall be in a state where it is producing power. The DC power source of the linked power conditioner during independent operation shall also be capable of stable operation at 5% or more of the rated output of the power conditioner to be certified.

G. $SW_{LD}$ and $SW_{LD2}$ shall be turned on, the DC energy source that prevents reverse power shall be set to output state, and the load shall be set to be forward current with the power conditioner also operating with stable output during independent operation. If necessary, the output value of the power conditioner may be determined in consultation with the certification applicant.

[Measuring method]

A. As shown in Figure 1, the test circuit connects the AC power supply to the grid connection port, the "power conditioner for independent operation" to the power conditioner connection port, and the load to the load connection port. The connected power conditioner for independent operation

and the operating power factor shall be decided upon consultation with the applicant for certification.

B. The load connected to the load connection port, or the dedicated load is stepped down from 110% of the rated load to 90% of the output of the Inverter when only the DC energy source that prevents reverse power is operated to reverse power. The detection function detects the reverse power and measures the operating time until the switch of the DC energy source that prevents the reverse power is opened, or the DC power converter is gate blocked.

C. In all configurations described in the system to be registered in the certification application, in all configurations that include both DC energy sources that prevent power and DC energy sources that do not prevent reverse power, and with the DC energy sources that do not prevent reverse power operating, the above tests shall be performed on all of the DC energy sources that prevent reverse power For each type, this shall be done for each type. However, the output setting will be set after consultation with the certification applicant.

[Judgment criteria]

(Underlined words are different from the criteria shown in 3.2.3.1)

A. Regardless of the installation status of all the power flow status monitoring CTs installed at the power receiving point, the criteria below must be met. In addition, when the CT for power flow status monitoring is tested in the state of being incorrectly installed, it is compliant if it shifts to a state such as start/stop or power generation stop. In addition, if the CT is dropped or the wire cuts, the item “B” should be satisfied within 5 minutes. However, the description "detecting reverse power" does not apply.

   Furthermore, the DC energy source that prevents reverse power from switching to a charged state shall also be compliant.

B. Reverse power shall be detected and one of the following shall operate

   - The switchgear of the DC energy source preventing reverse power opens
   - The gate block or switchgear of the DC power converter of the DC energy source that prevents reverse power is open.
   - Gate block or switchgear of the reverse conversion device, etc., is open.

C. The reverse power protection level shall be less than or equal to 5% of the output of the power conditioner when only the DC energy source preventing reverse power operates at rated operation.

D. The operation time should be within 0.5 seconds.

E. Even if this function operates, it must operate according to the specifications except for the DC energy source that prevents reverse power.

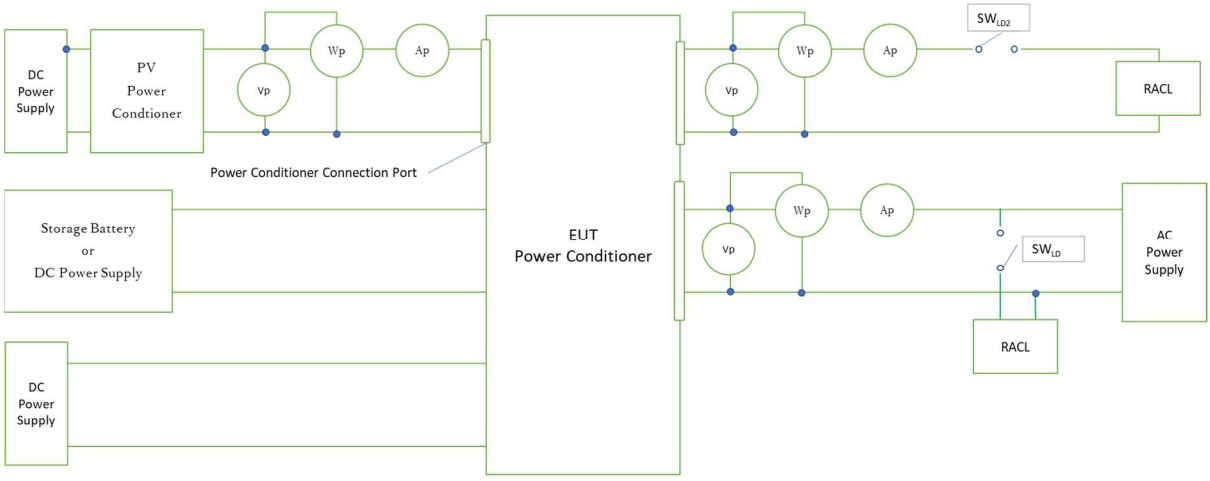



Figure 1 Measurement circuit when performing tests 3.2.3.4 and 3.2.3.5

**3.2.3.5 In case with function to prevent the reverse power flow from DC energy source that prevents the reverse power when the reversed power flow generated by the Inverter that does not prevent the reverse power.**

This test is applied to a grid interconnection protection device equipped with a Inverter connection function to an independent circuit.

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

However, items A, D and G will be changed to the following contents (where different from item 3.2.3.4 is underlined).

A. As shown in Figure 1, the test circuit connects the AC power supply to the grid connection port, the "power conditioner for independent operation" to the power conditioner connection port, and the load to the load connection port. The connected power conditioner for independent operation and the operating power factor shall be decided upon consultation with the applicant for certification.

D. For the DC power source setting, the output of the power conditioner is adjusted so that the output of the power conditioner is set to be the maximum possible for continuous operation. In the case of multiple DC energy sources, all DC energy sources shall be operated. In addition, the DC energy source that prevents reverse power should be in a state where it is emitting power. The DC power source of the linked power conditioner during independent operation shall also be capable of stable operation at 5% or more of the rated output of the power conditioner to be certified.

G. Turn on $SW_{LD}$ and $SW_{LD2}$, set the DC energy source that prevents reverse power to output state, set the load to consume the output of the DC energy source that prevents reverse power such as the reverse converter inside the power conditioner, and set the power conditioner to operate in the state where the output is stable during Independent operation, and the reverse power is flowing to the AC power supply side. If necessary, the output value of the power conditioner may be determined upon consultation with the certification applicant.

[Measuring method]

(Underlined words are different from the measurement method shown in 3.2.3.4)

A. Reverse load is prevented when the load connected to the load connection port or the dedicated load is gradually reduced, the reverse flow rate increases, and the output from the system connection port becomes larger than the output of the grid-connected Inverter during islanding operation. Check that the switch of the DC energy source is open, or the DC power converter is gate blocked.

B. The load connected to the load connection port, or the dedicated load is stepped down from 110% of the rated load to 90% of the output of the Inverter when only the DC energy source that prevents reverse power is operated to reverse power. The detection function detects the reverse power and measures the operating time until the switch of the DC energy source that prevents the reverse power is opened, or the DC power converter is gate blocked.

C. In the configuration described in the system that registers the above test for certification application,

   In all configurations, including both a DC energy source that prevents reverse power and a DC energy source that does not prevent reverse power,

   With the DC energy source operating that does not prevent reverse power,

   Each type and combination of DC energy sources that prevent reverse power shall be tested separately. However, the output setting will be set after consultation with the certification applicant.

[Judgment criteria]

(Underlined words are different from the criteria shown in 3.2.3.3)

A. Regardless of the installation status of all the power flow status monitoring CTs installed at the power receiving point, the criteria below must be met. In addition, when the CT for power flow status monitoring is tested in the state of being incorrectly installed, it is compliant if it shifts to a state such as start/stop, or power generation stop. In addition, if the CT is dropped or the wire breaks, the item “B” should be satisfied within 5 minutes. However, the description "detecting reverse power" does not apply.

Furthermore, the DC energy source that prevents reverse power from switching to a charged state shall also be compliant.

B. Measure the output (DC side) of the DC energy source that prevents load power and reverse power, and when either "output of the DC energy source that prevents reverse power > load power", operate either of the following:
However, for devices that are connected without reverse power flow, open the switch and gate block.
  - Switch of DC energy source to prevent reverse power is opened
  - Gate block is a DC power converter of DC energy source that prevents reverse power
  - Inverse conversion device opens gate block or switch

C. The reverse power protection level is “output power of DC energy source that prevents reverse power” - “load power” is 5% or less of the output of the Inverter when only the DC energy source that prevents reverse power operates at rated power.

D. The operation time should be within 0.5 seconds.

E. Even if this function operates, it must operate according to the specifications except for the DC energy source that prevents reverse power.

[Remarks]

1. The "output power" in this test indicates the output power of direct current flowing from the storage battery, etc. to the direct current power converter. Therefore, the power flowing between the storage battery, etc. and the power converter shall be measured.
2. Note that if a configuration with only a DC energy source that prevents reverse power exists in the equipment for multi-input systems, that configuration must comply with the test in 3.2.3.1 In case with reverse power relay (RPR).

### 3.2.5 Frequency Feedback Function Test

Applicable to "multi-unit Grid Connection FRT compatible type" ~~and "multi-unit Grid Connection type"~~.

Not applicable to "FRT compatible type" ~~and "Conventional type"~~.

This test is applied to all inverters connected in 3.2.8 Islanding prevention test 2.

In the seamless type, the inverter that operates the frequency feedback function during forward conversion is also tested during forward conversion.

Furthermore, in an inverter that has a power factor switching function based on the power flow, if the power factor error during forward power flow does not satisfy the criteria for reverse power flow in Section 4.3, even if the power factor during forward power flow is set, conduct this test.

In addition, if the power factor error during forward power flow satisfies the criteria for reverse power flow in Section 4.3, but the power factor during forward power flow is not within the specified power factor range during reverse power flow, specify This test is conducted by expanding the power factor range so that it includes the power factor during forward power flow.

[Test Objective].

Standard active systems are required to have no mutual interference between the same system, and it is to be confirmed that the injection timing of reactive power, which is an active signal, is performed as per the JEM standard.

[Test condition]

The standard test conditions for inverse conversion mode shown in Section 3.2 are applied.
However, the paragraphs D, F and G are changed as following

D. The DC power settings should be set so that all DC energy sources are operating and the power conditioner is at the output set in section 3.2.8.
F. The step injection function and the forced active function of the active method shall be set to normal settings, and the settings of the protective relay and other protective devices shall be factory defaults (as described in the application for certification).
G. Turn on $SW_{LD}$ and set the load so that the power conditioner will have the output set in section 3.2.8.

[Measuring method]

①. When confirming 1-step gain
The frequency of the AC power supply fluctuates ±0.01Hz in steps for one cycle. The phase for changing the frequency is 0°.
②. When confirming 2-stage gain
The frequency of one cycle at which the maximum reactive power set by simulation is injected is obtained in advance.
The frequency of the AC power supply is changed by the frequency obtained by simulation. The phase for changing the frequency is 0°.

[Judgment criteria]

①. When confirming 1-step gain
When the frequency is changed, the fluctuation of the reactive power exceeding the measurement error range should not be seen.

②. When confirming 2-step gain

A. Ability to inject reactive power for frequency feedback in addition to reactive power during normal operation.

B. The injection amount shall be 0.25 p.u. or less of the rated output or the maximum specified apparent power.

C. The reactive power to be injected is inductive when the frequency deviation is positive and capacitive when the frequency deviation is negative. Although the minimum value is not specified, the test in Section 3.2.7 must be met.

[Remarks]

In case the amount of reactive power injection is large, it may cause oscillation of reactive power, so it is desirable that the maximum injection amount and the injection ramp rate with respect to frequency be as small as possible without affecting the islanding operation detection. A slope of 0.25p.u./0.9Hz or less is recommended.

The latest standard information is available in the "Standard Specifications for PCS" (JEMA) on the "New Energy Systems" ➡ "Distributed Generation Systems" page of JEMA's website, so the information shall conform to the description.

### 3.2.6 Step Injection Function Test

Applicable to "multi-unit FRT compatible type" ~~and "multi-unit Grid Connection type"~~.

Not applicable to "FRT compatible type" ~~and "Conventional type"~~.

This test is applied to all inverters connected in 3.2.8 Islanding prevention test 2.

However, equipment that is recognized by JET to be identical to the EUT may be omitted.

In the seamless type, the inverter that operates the frequency feedback function during forward conversion is also tested during forward conversion.

Furthermore, in an inverter that has a power factor switching function based on the power flow, if the power factor error during forward power flow does not satisfy the criteria for reverse power flow in Section 4.3, even if the power factor during forward power flow is set, conduct this test.

[Test Objective.]

Same as frequency feedback test.

[Test condition]

Follow the test conditions indicated in section 3.2.5.

However, paragraph F shall be changed to the following content.

F. Only the frequency feedback function of the active method shall be masked, and the settings of the protective relay and other protective devices shall be as factory default (as described in the application for certification).

[Measuring method]

① When the harmonic voltage suddenly increases

A. With the AC power supply maintained at the rated frequency, the total harmonic voltage component of the 2nd to 7th order is rapidly increased by more than 2.0V.

In the test, the harmonic voltage component* is rapidly increased for each of the 2nd to 7th orders. However, for three-phase equipment, the 3rd and 6th orders are excluded.

In addition, any arbitrary 2nd to 7th harmonic voltage (the voltage of each harmonic voltage component is less than 2.0V) is combined and rapidly increased. At this time, the total harmonic voltage component * is set so as to increase by more than 2.0V.

* The applied voltage of the harmonic voltage component shall be based on the attached evaluation procedure manual.

$$H_{arm}[THD] = \sqrt{H_{arm}^2[2] + H_{arm}^2[4] + H_{arm}^2[5] + H_{arm}^2[6] + H_{arm}^2[7]}$$

B. Check the operation of the step injection function with a command signal.

C. Measure the output current and output voltage to calculate the amount of reactive power injection

② When the fundamental voltage suddenly increases

A. ~~In the case of [equipment with reactive power oscillation suppression function], enter the~~ Active function standby state. The active function standby state can be implemented after consultation with the certification applicant.

B. While keeping the AC power supply at the rated frequency, increase the fundamental wave voltage by an amount that exceeds 2.5 V * rapidly. *The applied voltage of the fundamental wave voltage shall be in accordance with the attached evaluation procedure.

C. Check the operation of the step injection function with a command signal.

D. Output current and output voltage are measured in order to calculate the amount of reactive power injection.

E. ~~In the case of [equipment with a reactive power oscillation suppression function],~~ set the active function to the normal state, and execute items B to D.

[Judgment criteria]

① When the harmonic voltage suddenly increases

A. Able to inject the reactive power (capacitive) for step injection in addition to reactive power during normal operation.

The injection amount must be less than the rated output or the maximum specified apparent power of 0.1p.u., and the injection must be executed within 3 cycles.

B. The minimum value of injection of reactive power and the minimum value of injection cycle are not specified but shall conform to the tests in Section 3.2.7.

The maximum value of injection of reactive power and the timing of injection shall be in accordance with the attached Evaluation Procedures.

② When the fundamental voltage suddenly increases

A. ~~In the case of [equipment with a reactive power oscillation suppression function],~~ Under the test conditions in the active function standby state, do not transition to the active function normal state and do not inject reactive power.

B. (Active function) Under normal test conditions, in addition to reactive power during normal operation, reactive power (capacitive) for step injection can be injected.

The injection amount must be less than the rated output or the maximum specified apparent power of 0.1p.u., and the injection must be executed within 3 cycles.

C. The minimum value of the reactive power injection and the minimum value of the injection cycle are not specified, but the test of 3.2.7 must be met.

The upper limit of the amount of reactive power injected and the timing of the injection shall be based on the attached evaluation procedure manual.

[Remarks]

1. Application example of arbitrary 2nd to 7th total harmonic voltage: Total harmonic voltage should be 2% (3rd: 1.2%, 5th: 1.2%, 7th: 1.2%)
2. [reactive power injection withing 3 cycles] when the harmonic voltage increases mean that the step injection function operates due to a sudden increase in the total harmonic voltage component of the 2nd to 7th order. (It is not allowed to use harmonic voltage of 8th order or higher)

### 3.2.7 Islanding protection test 1

[Test Objective.]

To verify that the passive and active methods satisfy the requirements of the Grid Interconnection Rules under various load conditions and operating conditions.

Apply the relevant items according to their respective scope of application.

[Common subject matter]

A. This test shall apply to power conditioners with Islanding operation prevention functions (passive and active methods) and shall be conducted using the following test methods that meet the operating conditions of the power conditioner.
   a. With reverse power flow
   b. Without reverse power flow

   In the case of products with small output (2.6 kW or less), since multiple units may be tested, the test may be conducted upon consultation with the applicant for certification regarding the battery configuration and other test methods.

B. Products without reverse power flow shall be tested for the function to prevent Islanding operation in consideration of the following conditions.

   However, it may be implemented upon consultation with the certification applicant.
   a. Load-following products may mask the load-following function. Masking of such functions may be implemented upon consultation with the certification applicant.
   b. Even if there is a dedicated load for the purpose of preventing reverse power flow, etc., the dedicated load shall not be used. However, if a dedicated load, etc. must be used, it may be implemented upon consultation with the certification applicant.

C. When the DC energy source includes storage batteries, etc. and is of the reverse/forward conversion switching type, the following operation checks shall be performed.
   a. The function to prevent Islanding operation shall operate in the reverse conversion mode.
   b. The protective function shall operate as specified in the forward conversion mode/standby conversion mode.

D. If the DC energy source includes a storage battery, etc., and if it is a seamless type, check the operation of the islanding prevention function in the reverse conversion mode and the forward conversion mode.

E. In the case of an inverter having a power factor switching function depending on the power flow, the power factor switching function depending on the power flow may be masked and the power factor may be fixed before the test.

F. In an inverter that has a power factor switching function depending on the power flow, if the power factor error during forward power flow does not satisfy the criteria for reverse power flow in Section 4.3, perform the test even if the power factor during forward power flow is set. If the power factor error during forward power flow satisfies the criteria for reverse power flow in Section 4.3, but the power factor during forward power flow is not within the specified power factor range during reverse power flow, specify This test is conducted by expanding the power factor range so that it includes the power factor during forward power flow.

G. In the case of [Multiple-unit FRT-compatible], put it in the active function standby state. It is

desirable that "disturbance detection 1" shown in the JEM standard is detected, the number of standby transitions is set to 3 or more, and the active function standby state can be maintained for 5 minutes. However, when the harmonic voltage rises above the specified value, it must transition to the active normal state according to the standard. If the above settings cannot be made, it is possible to mask the function of switching from the active function standby state to the active function normal state by continuing undetected disturbance detection. (If masked, record the masked operation function.)

H. If a protective device other than the islanding operation prevention function operates during the test, the test shall be performed even with that function masked. (If masked, record the masked operation function.)

The common load conditions are shown below.

[Common load conditions]

①. Resistive load

Turn on $SW_{LD}$ and set the R load so that the active power flow with the AC power supply meets the conditions in Table 3-2-7-2.

②. Balanced load (Rotating machine load)

A. Turn on the $SW_{LD}$, connect the rotating machine load with the moment of inertia of 0.014 $kg \cdot m^2$ or more of the number shown in Table 1, and operate the rotating machine with no load. In the case of [Multi-unit FRT compatible type] ~~and [Multiple unit interconnection compatible type],~~ the number of rotating machine loads is as shown in Table 3.2.7-1.

B. After setting the inverter to the operating power factor, turn on the $SW_{LD}$ and set the R, L and C loads so that the active power flow and reactive power flow with the AC power supply satisfy the conditions in Table 3-2-7-2.

③. Unbalanced load

After setting the inverter to the operating power factor, turn on the $SW_{LD}$ and set the R, L, and C loads so that the active power flow and reactive power flow with the AC power supply satisfy the conditions in Table 3-2-7-2.

**i. Reverse conversion mode measurement method**

[Test conditions for reverse conversion]

The standard test conditions for the inverse conversion mode shown in Section 3.2 shall apply.

However, paragraphs A and G shall be changed to the following contents.

A. The test circuit shall be the circuit connection shown in Appendix I, II, IV or V.

For single-phase devices with a 100V connection mechanism, use the circuit connection shown in Appendix XII. Also, equipment that generates harmonics (e.g., transformers, etc.; the power flowing through them must be stable) may be connected to the test circuit. In the case of three-phase equipment, one harmonic-generating device may be connected to each phase at the end of the system.

~~H. The protective relay settings of the protective device shall be the factory default values (as stated in the certification application form).~~

~~In addition, when the protective device other than the islanding prevention function operates during the test and [Equipment with reactive power oscillation suppression function], the active function standby state changes to the active function normal state due to the continuous undetected disturbance detection. When switching to, the operation function can be disabled. (If disabled, record the disabled operation function)~~

G. The load conditions are ① to ③ described in the [Common Load Conditions]

In addition, add paragraph J.

J. The number of power conditioners shown in Table 3.2.7-1 shall be connected.

If there are multiple patterns for the number of units to be connected, the number of units shall be determined upon consultation with the applicant for certification.

[Measuring method]

The test is carried out in all combinations of the following methods.

①. Passive method

A. Open the $SW_{CB}$ and measure the time to disconnection.

B. The above measurement is performed for the equilibrium load (rotator load).

②. Active method

Devices of [Multi-unit FRT compatible type] ~~and [Multiple unit interconnection type]~~ are not tested by this method.

A. Open the $SW_{CB}$ and measure the time to disconnection.

B. The above measurement is performed for each of the three [common load conditions].

③. Passive method + Active method

A. Open the $SW_{CB}$ and measure the time to disconnection.

B. Perform the above measurements for each of the three [common load conditions].

C. In addition, if the test is not performed only by the active method and the test is stopped by the passive method, then the passive method is masked under the load condition, and the time until the gate block and the switch are operated by the active method is measured.

[Judgment criteria]

[Multiple unit FRT compatible type]

Each inverter shall meet the following criteria, including the case of connecting two or more inverters.

①. Passive method

A. Islanding operation shall be detected and disconnected within 0.5 seconds.

In this case, due to the characteristics of the passive detection method, the existence of the non-detection zone (NDZ) is allowed, but the NDZ should be avoided as much as possible.

B. Even if the system voltage is restored, do not re-parallelized for the time specified in the specification or the settling time (e.g., 150 seconds).

②. Active method

A. The $SW_{CB}$ shall be opened and disconnected within 0.2 seconds.

The $SW_{CB}$ shall also be opened and disconnected within 0.2 seconds under conditions other than those shown in Table 3.2.7-2.

B. Even if the grid voltage is restored, the system shall not be re-parallelized for the time specified in the specifications or for a fixed period of time (e.g., 150 seconds).

③. Passive method + Active method

A. The $SW_{CB}$ shall be opened and disconnected within 0.2 seconds.

B. Even if the grid voltage is restored, the system shall not be re-parallelized for the time specified in the specifications or for a fixed period of time (e.g., 150 seconds).

[FRT compatible type],

①. Passive method

A. Disconnect within 0.5 sec. by the Islanding operation prevention function.

In this case, due to the characteristics of the passive detection method, the no detection zone (NDZ) is allowed, but the NDZ should be avoided as much as possible.

B. Even if the system voltage is restored, do not re-parallelized for the time specified in the specification or the settling time (e.g., 150 seconds).

②. Active method

A. Disconnection shall be performed between 0.5 seconds and 1 second by the Islanding operation prevention function.

B. Even if the system voltage is restored, do not re-parallelized for the time specified in the specifications or the settling time (e.g., 150 seconds).

③. Passive method + Active method

A. It shall be disconnected within 1 second by the Islanding operation prevention function.

However, if the active system detects and stops the machine, the time shall be between 0.5 seconds and 1 second.

B. Even if the system voltage is restored, do not re-parallelized for the time specified in the

specifications or the settling time (e.g., 150 seconds).

[In case of forward conversion/conversion standby mode including storage battery in the system]

**ii. Reverse conversion/forward conversion switching type forward conversion/conversion standby mode measurement method**

[Test conditions]

The standard test conditions for forward conversion/conversion standby mode shown in Section 3.2 is applied.

However, items A, ~~H~~ and G will be changed to the following contents.

A. The test circuit shall be the circuit connection shown in Appendix I, II, IV or V. In the case of a 100V connection mechanism, use the circuit connection shown in Appendix XII.
Also, equipment that generates harmonics (e.g., transformers, etc.; the flowing power must be stable) may be connected to the test circuit. In the case of three-phase equipment, one harmonic-generating device may be connected to each phase at the end of the system.

~~H. The protective relay settings of the protective device shall be the factory default values (as stated in the certification application form).~~
~~If the protective device other than the islanding prevention function operates during the test, the protective device can be disabled. (If disabled, record the disabled operation function)~~

G. The load conditions are no load and rated load.

[Measuring method]

①. Passive method

A. Open the $SW_{CB}$ and measure the time to disconnection.

B. Perform the above test with no load and rated load.

[Judgment criteria]

Each inverter shall meet the following criteria, including the case of connecting two or more inverters.

A. A power failure is detected, and the forward conversion/conversion standby mode stops according to specifications. In addition, it will not transit to the reverse conversion mode in a inverter that does not have a islanding operation function.

B. If the passive method is activated, the criterion (1) for the inverse conversion mode must be satisfied.

**iii. Seamless type of forward conversion mode measurement method**

**Test applies only to the seamless type.**

[Test conditions]

A. The test circuit shall be the circuit connection shown in Appendix VII or VIII.
If the single-phase device has a 100V connection mechanism, use the circuit connection shown in Appendix XII.
Also, equipment that generates harmonics (e.g., transformers, etc.; the flowing power must be stable) may be connected to the test circuit. In the case of three-phase equipment, one harmonic-generating device may be connected to each phase at the end of the system.

B. The AC power supply operates at the rated voltage and rated frequency.

C. The line impedance shall be short-circuited.

D. The settings of protective relays, etc. of the protective device shall be the factory default values (as stated in the certification application form).
In addition, when the protection device other than the islanding protection function operates during the test, or when the active function standby state is switched to the active function normal state due to the undetected disturbance detection, the operation function can be disabled. (If disabled, record the disabled operation function)

E. Set the input/output power of the inverter on the reverse conversion side and the inverter on the forward conversion side to the rated values.

F. Adjust the active power and reactive power at the interconnection point to (0, 0) by the R/L and C loads and the rotating machine load.

G. The frequency feedback function and the step injection function on the inverse conversion side are operated, but only the active detection is disabled.

[Measuring method]

①. Passive method
Open the $SW_{CB}$ and measure the time to disconnection.

②. Active method
Open the $SW_{CB}$ in the active function standby state then measure the time until it disconnects.

[Judgment criteria]

Each inverter shall meet the following criteria, including the case of connecting two or more inverters.

①. Passive method
Islanding operation shall be detected and disconnected within 0.5 seconds.
For power conditioners without independent operation function, the reverse conversion mode

shall not be shifted.

②. Active equation

A. $SW_{CB}$ shall be opened and the power conditioner on the forward conversion side shall be disconnected within 0.2 seconds by an active method.

B. Even if the system voltage is restored, do not re-parallel for the time specified in the specifications or the settling time (e.g., 150 seconds).

[Remarks]

1. Table 2 is the selected points for conducting the test, and the functional method is excellent in principle that there is no NDZ. Therefore, the above criteria should be satisfied even under the test conditions other than the points in Table 2.
2. Provide an external output signal port for testing in which the active function normal state and active function standby state can be confirmed in [equipment with reactive power oscillation suppression function]. Do not use it together with the command signal confirmation port specified in the step injection function test.
3. [Test conditions] The transformer required in paragraph “A” is intended to achieve the rapid increase in harmonic voltage required for the inverter to operate the islanding detection function when the $SW_{CB}$ is opened.
4. Definition of "Disconnection" shall be the point in time when both the gate block and the opening of the switchgear are established if this is realized by the opening of the gate block and the switchgear. All subsequent sections where no special description is given are the same.

Table 3.2.7.1

Number of connected PCS and rotating machine loads used during the test

| Rated output (kW) | Number of PCS | Number of rotating load |
|---|---|---|
| Less than 0.70～0.73 | 1～6 | 1 |
| Less than 0.73～0.89 | 1～5 | 1 |
| Less than 0.89～1.2 | 1～4 | 1 |
| Less than 1.2～1.6 | 1～3 | 1 |
| Less than 1.6～2.7 | 1～2 | 1 |
| Less than 2.7～6.0 | 1 | 1 |
| Less than 6.0～10.0 | 1 | 2 |
| Less than 10.0～14.0 | 1 | 3 |
| Less than 14.0～18.0 | 1 | 4 |
| Less than 18.0～22.0 | 1 | 5 |
| Less than 22.0～26.0 | 1 | 6 |
| Less than 26.0～30.0 | 1 | 7 |
| Less than 30.0～34.0 | 1 | 8 |
| Less than 34.0～38.0 | 1 | 9 |
| Less than 38.0～42.0 | 1 | 10 |
| Less than 42.0～46.0 | 1 | 11 |
| Less than 46.0～50.0 | 1 | 12 |

Note) You can select the number of connected inverters and the number of connected rotating machine loads that match the rated output of the inverter.

Table 3.2.7.2 Test conditions (active power, reactive power)

| | | | | |
|---|---|---|---|---|
| -10, 10 | -5, +10 | 0, +10 | +5, +10 | +10, +10 |
| -10, +5 | -5, +5 | 0, +5 | +5, +5 | +10, +5 |
| -10, 0 | -5, 0 | 0, 0 | +5, 0 | +10, 0 |
| -10, -5 | -5, -5 | 0, -5 | +5, -5 | +10, -5 |
| -10, -10 | -5, -10 | 0, -10 | +5, -10 | +10, -10 |

Note) It is the ratio (%) of active power and reactive power to the rated output or maximum specified output of the inverter.

### 3.2.8 Islanding protection test 2

This test is applicable to 【Multiple-unit FRT-compatible type】, and "3.2.8.1 Islanding operation prevention test in multiple-unit FRT-compatible type" and "3.2.8.2 Islanding operation prevention test in active function standby state" are to be performed.

This does not apply to [FRT-compatible type].

In the case of a power conditioner with a power factor switching function by power flow, the power factor switching function by power flow may be masked and the test may be performed with the power factor fixed.

### 3.2.8.1 Islanding protection test with multiple units connected

(Old name: Islanding operation prevention test under active function normal state)

[Test Objective.]

To confirm that the standard active method has the specified detection performance even if the number of power conditioners connected to the same distribution line increases, in accordance with the requirement that there be no mutual interference between the same method.

For the purpose of allowing connection of an unlimited number of units, it shall be confirmed that the detection time does not increase with an increase in the number of units connected.

For this reason, tests under the same detection conditions are required, so the state of the active function shall be fixed to the same state and the test shall be conducted.

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

However, item A, item D, item F and item G are changed to the following contents.

A. The test circuit shall be the circuit connection shown in Figure III attached.
   The even-numbered connected phases shall be reversed.
   Equipment that generates harmonics (e.g., transformers, etc.; the power flowing through them must be stable) may also be connected to the test circuit. The power flow should be stable) may be connected to the test circuit.
   In the case of three-phase equipment, one harmonic-generating device may be connected to each phase at the end of the system.
D. The DC power setting operates all DC energy sources.
   Set the power conditioner outputs to the values specified in Attachment " Explanation of the Islanding Operation Prevention Test 2 for Multiple Units Interconnected", respectively.
F. The settings of the protective relay and other protective devices shall be the factory default values (as described in the application for certification).
   Only the active method shall be applied to the Islanding operation prevention function. If any protective device other than the Islanding operation prevention function operates during the test, the operating protective device shall be masked (if masked, the masked operating protective device shall be recorded).
G. Turn on $SW_{LD}$ and set the following load conditions.

In addition, add terms J to K.

J. This test can connect up to 9 combinations of inverters.
   If the certification applicant wishes to test only the power conditioner part using a DC power

source with the specified characteristics, this may be done after consultation with the certification applicant.

K. The active state shall be set to "forced active normal state" or "active standby state".
However, the initial state of the active state shall not be changed during the test.

[Power Conditioner Settings]

When adjusting the output under the above test condition "D", it is assumed that all of the following conditions are satisfied.

A. The amount of reactive power injection shall be set so that the adjusted output is a percentage of the rated output.

B. The output current distortion ratio shall be measured at the adjusted output and shall be 5% or less for the total harmonic current distortion ratio and 3% or less for each harmonic current distortion ratio.

[Load condition, Balanced load (Rotating machine load)]

A. Set the load condition for the active and reactive power flow that had the longest Islanding operation duration in the Islanding operation prevention test 1.
However, for the load condition in which the step injection function operated in 3.2.7 Islanding operation prevention test 1, the longest load condition shall be set using the results of the retest after masking this function.

B. Adjust the total output value for each test unit to be a multiple of 4 kW. The number of rotating machine loads is the total output value divided by 4.

[Measuring method]

A. Adjust and connect the output of the inverter according to the [Attachment].

B. Open the $SW_{CB}$, measure the time to disconnect in each connected power conditioner in each number of connected units, and measure the longest disconnection time for all power conditioners.
Measure 15 times and obtain the average value.
This measurement shall be performed for each number of connected units.
The maximum number of test combinations with an increase in the number of connected power conditioners shall be 9.

C. Connect four inverters set according to the attached sheet to make sure that they do not interfere with the FRT mode.
Connect the connection phase of one of them in reverse.
In the case of three-phase equipment, connect one of them with the connection phase shifted by 120 °. However, if the inverter does not operate due to a connection phase error, etc., delay the

detection time of the active method of one inverter by 2/3 cycle or more.

D. Open the $SW_{CB}$, set the time and current waveform 15 times until the relay is opened and the gate is blocked.

[Judgment criteria]

A. The maximum value minus the minimum value of the average value group obtained for each number of connected units shall be within 20 ms.

B. As shown in the following formula, the difference between "the average value of 15 times of data measured with n+1 power conditioners connected" and "the average value of 15 times of data measured with n units connected" shall decrease or be the same in two or more cases.
However, the number of times is not required to be continuous.

$$\text{Average of 15 measurements with } n \text{ units connected."} \geqq \text{"Average of 15 measurements with } n+1 \text{ units connected.}$$

C. The maximum time to detect and disconnect Islanding operation in any of the connected power conditioners shall not exceed the judgment value in the Islanding operation prevention test 1.

D. In items C and D of "[Measurement method]", islanding operation is detected in any of the connected inverters. The maximum value of the switch opening, and gate blocking time shall not exceed the judgment value in the islanding operation prevention test 1 without entering the FRT mode.

[Remarks]

Items C and D of "[Measurement method]" are instantaneous when the output voltage drops due to the other inverters stopping before the connected inverters with different phases stop due to islanding operation detection. It has been confirmed that by recognizing it as a voltage drop (FRT) and continuing the operation, the condition for detecting islanding operation is not satisfied.

#### 3.2.8.2 Islanding protection test in active function standby state

This test is performed for [Multiple-unit FRT-compatible type].

Note that this test shall not be performed if the test in Section 3.2.8.1 is conducted in the "active standby state".

Furthermore, prior consultation is desirable for the reactive power oscillation suppression function of [three-phase equipment], as it may require a certain period of time for equipment installation, etc.

[Test Objective].

The standard active system has a mode called "active standby state" in which the active function is

suppressed to suppress reactive power oscillation.
In the active standby mode, the active function is suppressed and the detection time for Islanding operation may be prolonged, therefore, it shall be confirmed that the system will surely stop within the specified time even in the "active standby mode.

[Test conditions]

The standard test conditions for reverse conversion mode shown in Section 3.2 is applied.
However, item A, item D, item F and item G are changed to the following contents.

A. The test circuit shall be the circuit connection shown in Figure III attached.
   The phase of the even-numbered units shall be reversed.
   The number of power conditioners shall be the maximum number of units connected in one test.
   Equipment that generates harmonics (e.g., transformers, etc., but the power flowing through them shall be stable) may be connected to the test circuit.
   In the case of three-phase equipment, one harmonic-generating device may be connected to each phase at the end of the system.
D. Each DC power source should be set so that the output of the power conditioner is set to the value in the Attachment "Explanation of Islanding operation prevention test 2".
F. The settings of the protective relay and other protective devices shall be the factory default values (as described in the application for certification).
   Only the active method shall be applied to the Islanding operation prevention function. If any protective device other than the Islanding operation prevention function operates during the test, the operating protective device shall be masked (if masked, the masked operating protective device shall be recorded).
G. Turn on $SW_{LD}$ and set the load to consume the output of the power conditioner to be connected in section 3.2.8.

Furthermore, add the J term.

J. Set to "Active standby state".

[Measuring method]

A. Adjust and connect the output of the power conditioner according to the attached sheet.
B. Open the $SW_{CB}$ in the active function standby state and measure the time to disconnect 15 times at the maximum number of connected units in one test. The setting for the inverter to the active function standby state can be performed in consultation with the certification applicant.

[Judgment criteria]

$SW_{CB}$ shall be opened, and all connected power conditioners shall disconnect within 0.2 seconds.

[Remarks]

1. Must prepare an external output signal port for testing that can confirm the active function normal state and active function standby state. Do not common use with the command signal confirmation port used in the step injection function test.
2. The equipment generating the harmonics required in [TEST CONDITIONS] paragraph A shall be capable of achieving the surge in harmonic voltage required for the power conditioner to operate its Islanding operation prevention function when the $SW_{CB}$ is open.

### 3.2.9 Fixed-time injection blocking test after restoration of power

#### 3.2.9.1 Test to prevent power input for a certain period of time after power recovery 1

【System includes storage batteries, etc.】

- In the case of a reverse/forward conversion switching type, this shall be carried out in reverse/forward conversion/standby mode respectively.
- In the case of a seamless system, this shall be carried out in the reverse/forward conversion mode respectively.

【Reverse conversion mode】

[Test conditions]

The standard test conditions for the inverse conversion mode given in 3.2 shall apply. However, paragraphs D and F shall be changed to the following content.

D. The DC power source setting shall be set at a level where the output harmonic current satisfies the judgment criteria in "4.4 Output Harmonic Current Test" and the output of the power conditioner is stable. The type of DC energy source is not specified.

F. The settings of the protective relay, etc. of the protective device shall be the factory default values (as described in the application for certification), and the fixed values for the fixed time limit of inhibition of turning on the device shall be set to the respective fixed values.

[Measurement method]

A. $SW_{CB}$ is opened to generate a grid voltage interruption, which is maintained for 10 seconds.

B. Close the $SW_{CB}$ and restore the grid voltage.

C. If the power conditioner automatically parallels after the power is restored, measure the time between the restoration and the re-parallel.
If the power conditioner parallels by itself or by remote control, confirm that the

power conditioner does not reparallel within a certain period of time after the power is restored.

[Judgment criteria]

A. The power conditioner shall not re-parallel for the time specified or set in the specifications (e.g., 150 seconds) even if the grid voltage is restored after the power conditioner detects a power failure and un-parallels. If the set value is "manual", the system shall not be automatically re-parallelized except by manual operation.
B. Products that automatically switch to stand-alone operation when a power failure is detected shall not be paralleled for a certain period of time after the power is restored, even if the power is restored and the system is switched to interconnection operation.
C. Even if an operation signal is input by an operation switch, etc., the product shall not operate during the time when it is prevented from being re-paralleled.
D. In the case of a power conditioner with a power factor switching function due to power flow, the power conditioner shall operate at the specified power factor during reverse power flow for at least 10 minutes after startup, and no power factor switching shall occur.

【System includes storage batteries, etc. and is in forward conversion/conversion standby mode】

[Forward conversion/conversion standby mode]

[Test conditions]

The standard test conditions for forward conversion / conversion standby mode as described in section 3.2 apply.

However, paragraphs D and F shall be changed to the following content.

D. The DC power source setting shall be set in consultation with the certification applicant to a level at which the charging power of storage batteries, etc. is stable when measuring in the forward conversion mode. When measuring the standby conversion mode, the power conditioner shall be set to the standby conversion mode upon consultation with the certification applicant.
F. The settings of the protective relay, etc. of the protective device shall be the factory default values (as described in the application for certification), and the fixed time limit for the fixed-time input inhibition shall be set at the respective fixed values.

The [measuring method] and [judgment criteria] shall be in accordance with the reverse conversion mode.

### 3.2.9.2 Test to prevent power input for a certain period of time after power recovery 2

[Test Objective.]

In order to achieve a constant time interruption after power is restored, the time from power restoration to reconnection must be measured.

The control circuit that measures the time requires a power supply, and the power supply source varies depending on the product, such as DC or AC.

It must be confirmed that even in the event of a power interruption at each power supply source, it is possible to comply with the requirement to prevent power-on for a certain period of time after the power is restored.

The following tests shall be performed to verify the operation in the event of a system error or DC input error during the re-parallel blocking time in reverse conversion mode.

(1), (3), and (4) shall be performed for those using DC output power as the control power source, and (2), (3), and (4) shall be performed for those using commercial power as the control power source.

However, for models that use DC output power from a lithium-ion storage battery as the control power source, implement (2).

(1) DC input interruption test

(2) Re-interruption test

(3) Power failure test after DC input interruption

(4) DC input interruption test after re-interruption

[Common test conditions]

The standard test conditions for the reverse conversion mode as described in section 3.2 apply.

However, paragraphs D and F shall be amended as follows

D. The DC power source setting shall be set to a level where the output harmonic current satisfies the judgment criteria in "4.4 Output Harmonic Current Test" and the output of the power conditioner is stable.
   In the case of multiple types of DC energy sources, the DC energy sources shall be operated individually.

F. The settings of the protective relay, etc. of the protective device shall be the factory default values (as described in the application for certification), and the fixed time limit for the fixed-time input inhibition shall be set at the respective fixed values.

[Measurement method]

(1) DC input interruption test

A. Open the $SW_{CB}$ to cause a power interruption of the grid voltage and maintain it for 10 seconds.
B. Close the $SW_{CB}$ to restore the grid voltage.
C. During the power conditioner's re-parallel blocking time, shut down the DC input and maintain it so that the control power is completely turned off and operation is stopped.
D. Turn the DC input back on.
E. If the power conditioner automatically parallels itself after the power is restored, measure the time between the restoration of power and the re-paralleling of the power conditioner.
   If the power conditioner is paralleled by the main unit or remote-control unit, confirm that the power conditioner is not paralleled again within a certain period of time after the power is restored.

(2) Re-interruption test
A. Open the $SW_{CB}$ to cause a power interruption of the grid voltage and maintain it for 10 seconds.
B. Close the $SW_{CB}$ to restore the grid voltage.
C. During the power conditioner re-parallel blocking time, open the $SW_{CB}$, generate a power interruption of the grid voltage, and maintain it so that the control power is completely turned off and operation is stopped.
D. Close the $SW_{CB}$ and allow the grid voltage to be restored.
E. If the power conditioner automatically parallels the power after the power is restored, measure the time from the restoration of power according to paragraph (d) to the re-paralleling.
   If the power conditioner is paralleled by the main unit or remote-control unit, confirm that the power conditioner is not paralleled again within a certain period of time after the power is restored.

(3) Power failure test after interruption of DC input
A. Open the $SW_{CB}$ to cause a power interruption of the grid voltage and maintain it for 10 seconds.
B. Close the $SW_{CB}$ to restore grid voltage.
C. Shut down the DC input during the power conditioner's re-parallel blocking time.
D. Open the $SW_{CB}$ to cause a grid voltage interruption, completely cut off the control power supply, and stop operation.
E. Close the $SW_{CB}$ to restore grid voltage.
F. Turn on the DC input again.
G. After the power is restored, turn off the control power supply. If the power conditioner automatically parallels the grid after the power is restored, measure the time from the restoration of power according to paragraph D to the time when the power conditioner automatically parallels the grid again.
   If the power conditioner is paralleled by the main unit or by remote control, confirm that the power conditioner is not paralleled again within a certain period of time after the power is restored.

(4) DC input interruption test after re-power failure

A. Open the $SW_{CB}$ to cause a grid voltage interruption and maintain it for 10 seconds.

B. Close the $SW_{CB}$ to restore grid voltage.

C. Open the $SW_{CB}$ during the power conditioner's re-parallel blocking time.

D. Shut down the DC input, completely turn off the control power supply, and stop operation.

E. Close the $SW_{CB}$ and allow the grid voltage to be restored.

F. Turn the DC input back on.

G. If the power conditioner automatically parallels the grid after the power is restored, measure the time between the restoration of power according to paragraph (e) and the re-powering of the power conditioner.

If the power conditioner is paralleled by the main unit or by remote control, confirm that the power conditioner is not paralleled again within a certain period of time after the power is restored.

[Common judgment criteria]

The judgement criteria shown in Section 3.2.9.1 shall be satisfied.

The definition of "after power restoration" means the time after power restoration in the case of a re-power failure during power restoration.

3.2.9.1

[Judgment criteria]

A. The power conditioner shall not re-parallel for the time specified or set in the specifications (e.g., 150 seconds) even if the grid voltage is restored after the power conditioner detects a power failure and un-parallels. If the set value is "manual", the system shall not be automatically re-parallelized except by manual operation.

B. Products that automatically switch to stand-alone operation when a power failure is detected shall not be paralleled for a certain period of time after the power is restored, even if the power is restored and the system is switched to interconnection operation.

C. Even if an operation signal is input by an operation switch, etc., the product shall not operate during the time when it is prevented from being re-paralleled.

D. In the case of a power conditioner with a power factor switching function due to power flow, the power conditioner shall operate at the specified power factor during reverse power flow for at least 10 minutes after startup, and no power factor switching shall occur.

[Notes]

The DC input interruption in models using storage batteries mounted on electric vehicles, etc., shall be interrupted by the normal stop operation of the connection to the electric vehicle.

### 3.2.10 Instantaneous (unbalanced) overvoltage test

This test applies to power conditioners whose electrical system is single-phase 3-wire and single-phase 2-wire, and which have unbalanced overvoltage protection for connection to single-phase 3-wire distribution lines.

[Structure]

The terminal for connecting to the neutral wire (for overvoltage detection) shall be marked in an easily visible location nearby as being for the neutral wire.

[Test conditions]

The standard test conditions for the inverse conversion mode as given in section 3.2 apply.
Furthermore, clause J shall be added.

J. If it is necessary to mask the AC overvoltage detection, this may be done after consultation with the applicant for certification.

[Measurement method]

A. Gradually increase the AC voltage from 90% of the detection level of the instantaneous (unbalanced) overvoltage relay and measure the voltage detection level at which the instantaneous (unbalanced) overvoltage relay detects a voltage error and disconnects the power conditioner.
B. Stepwise increase of the AC voltage from the rated voltage to 110% of the regulated value and measurement of the operation time until the instantaneous (unbalanced) overvoltage relay detects a voltage abnormality and disconnects the power conditioner.

[Judgment criteria]

A. Abnormal voltage shall be detected and disconnected.
B. b. The operating protection level shall be within ±5% of the setpoint and shall not exceed 135V. When a gate block is included in the disconnection, the operating protection level of both the gate block and the switchgear switching shall satisfy this judgment.
C. The operating time shall be within 1 second.
D. Even if grid voltage is restored to normal, the device shall not re-parallelize for the time specified in the specifications or for a fixed period of time (e.g., 150 seconds). Even if an operation signal is input by an operation switch, etc., the device shall not be operated during the re-parallel

blocking time.

[Notes].

In the instantaneous (unbalanced) overvoltage test, if the voltage rise suppression function and the AC overvoltage relay operate during the detection level measurement and the detection level cannot be measured accurately, the voltage rise suppression function and the AC overvoltage relay may be masked during the detection level measurement.

### 3.2.11 Active function state transition verification test (state transition from the active function standby state to the active function normal state)

This test is conducted in the case of [Multiple-unit FRT compatible type].

In the case of three-phase equipment, a certain period may be required for equipment installation, etc., so prior consultation is recommended.

[Test Objective].

In the standard type active method, it shall be confirmed that the detection function of the active function standby state and the transition of the normal state to suppress the occurrence of voltage flicker is performed as per the JEM standard.

[Test conditions]

The standard test conditions for the reverse conversion mode shown in Section 3.2 shall apply.

[Method of measurement]

A. Activation of the active function standby state.
   The active function standby state may be implemented after consultation with the applicant for certification.
B. While maintaining the AC power supply at the rated frequency, apply (rapidly) 2.2 V of the 2nd to 7th total harmonic voltage components. The test shall be conducted by applying (rapidly increasing) 2.2 V of harmonic voltage components to each of the 2nd to 7th harmonics.
   In addition, arbitrary 2nd to 7th harmonic voltages (the voltage of each harmonic voltage component shall be less than 2.0V) shall be applied (rapidly) in combination. In this case, the total harmonic voltage component should be set to 2.2V.

$$H_{arm}[THD] = \sqrt{H_{arm}^2[2] + H_{arm}^2[3] + H_{arm}^2[4] + H_{arm}^2[5] + H_{arm}^2[6] + H_{arm}^2[7]}$$

C. The state transition of the active function shall be checked by external output signals.
D. The above test is carried out with an applied voltage of 1.8V (rapid increase).

[Judgment criteria]

A. In the case of measuring method B, the active function shall be shifted from the standby state to the active function normal state.
B. In the case of measuring method D, the active function shall not shift from the standby state to the active function normal state.

[Notes.]

Example of application of harmonic voltage: Superimposed so that the total harmonic voltage is 2% (3rd order: 1.2%, 5th order: 1.2%, 7th order: 1.2%).

### 3.2.12 Reactive power oscillation suppression verification test

This test is conducted in the case of [Multiple-unit FRT compatible type].

For three-phase equipment, a certain period may be required for equipment installation, etc., so prior consultation is recommended.

[Test conditions]

A. The test circuit shall be the circuit connection shown in Annex IX-1.
   However, in the case of equipment with a 100 V connection, the circuit shall be connected as shown in Appendix IX-2.
   The neutral line shall be connected to the terminal marked "neutral side". In the case of three-phase equipment, the circuit connection shown in Appendix IX-3 shall be used.
B. The AC power supply shall be operated at the rated voltage and frequency.
C. The output of the power conditioner of the flicker test reference unit (*1) shall be set at 3.0 kW, and the output of the test power conditioner (*2) shall be adjusted so that the total output of the Equipment Under Test (EUT) and the power conditioner of the flicker test reference unit is 6.0 kW.
   In the case of three-phase equipment, a single-phase 3.0 kW flicker test reference power conditioner shall be added to each phase to give a total of 9.0 kW, and the output of the test power conditioner shall be adjusted so that the total output of the EUT and the flicker test reference power conditioner is 18.0 kW.
   In addition, the frequency feedback function of the EUT and the power conditioner of the flicker test reference unit shall be enabled.
D. Open the $SW_{LN}$ and connect the maximum critical line impedance. (*3)
E. The settings of the protective relay, etc. of the protective device shall be the factory default values (as described in the application form for certification).

If a protective device such as an islanding operation prevention function operates during the test, the operating function may be masked.

F. Switch on the $SW_{LD}$ and set the load so that it consumes the output of the EUT and the power conditioner of the flicker test reference unit.
   In the case of power conditioners with a power factor switching function by power flow, the power factor switching function by power flow may be masked and the test may be conducted with the power factor fixed.

[Method of measurement]

A. Operate the flicker test reference unit power conditioner at an output power factor of 1.0.
B. Operate the power conditioner at the specified power factor and adjust the output of the test power conditioner so that the total output value reaches the specified output value.
   For products that experience reactive power oscillation before the total output value reaches the predetermined output value and enter the active function standby state, after consultation with the applicant for certification, make the active function normal by injecting harmonic voltage, etc. while the total output value is at the predetermined output value.
C. If the Test power conditioner does not enter the active function standby state without reactive power oscillation in clause “B”, the phase of the grid voltage shall be rapidly changed from 0° to 10°.
D. Confirm that the power conditioner switches from the active function normal state to the active function standby state by means of an external output signal (*4).

[Judgment criteria]

A. The Test power conditioner shall switch from the active function normal state to the active function standby state.
B. The EUT and flicker test reference power conditioner shall continue to suppress reactive power oscillation while continuing to operate for one minute.

[Notes]

1. The EUT shall not be stopped before it switches to the active function standby state during the test.
2. Handling of the Test power conditioner shall be as follows
   ①. The Test power conditioner shall be able to be set to inject reactive power at a rate adjusted by the power conditioner's function.
   ②. If the output of the Test power conditioner is small, two or more Test power conditioners shall be connected in parallel in the circuit connection shown in Appendix Figure IX.

However, in the case of 100 V connected equipment, the Test power conditioners shall be connected as follows

a. The total number of units shall be an even number.

b. The same number shall be connected to each phase.

c. The output power of each Test power conditioner shall be determined in consultation with the applicant for certification so that the output power is the same.

③. If the output power of the Test power conditioner is large and the Test power conditioner does not start up because of the line impedance for testing, the line impedance may be reduced in the circuit connection in Appendix Figure IX and two or more pairs of flicker test reference unit power conditioners may be connected in parallel.

3. Shown in Appendix Figure IX Reactive Power Oscillation Suppression Verification Test Circuit $Z_{LN}$.

For single-phase equipment, the maximum value of line impedance at which reactive power oscillation occurs when two flicker test reference units are connected in parallel and phase jumped, but no reactive power oscillation occurs when the frequency feedback gain of one of the two units is set to 0.

Or the maximum value of line impedance at which reactive power oscillation occurs when the EUT is made to phase jump in the normal state of the forced active function, but not in the standby state of the forced active function, with 1 single-phase flicker test reference unit connected in single-phase or 1 unit for each phase in 3-phase.

Example of maximum limit line impedance:

Single-phase: R phase (U phase) and T phase (W phase): (DC resistance min. 0.8Ω) + (inductance min. 0.8Ω)

Three-phase: Each phase: (DC resistance min. 0.5Ω) + (inductance min. 0.5Ω)

4. External output signal that can confirm active function normal state and active function standby state port shall be provided for testing purposes.

This port shall not be used together with the command signal confirmation port used for the step injection function test.

## 4 Steady-state characteristic tests

The tests in this section shall be conducted under actual operating conditions.

For power conditioners with constant power factor control, the following test method shall be used: Rated output shall be replaced with specified output, rated current with maximum specified current, apparent power with specified apparent power, and operating power factor with specified power factor.

Note that this does not apply to items that are listed separately from the rated output, such as

designated output and designated apparent power.
The "standard line impedance" used for the test shall be as follows:

If the EUT is a single-phase, two-wire system

a. For 100V equipment: (DC resistance 0.40 Ω±8%) + (inductance 0.37 mH±8%)
b. For 200V equipment: (DC resistance 0.38 Ω±8%) + (inductance 0.46 mH±8%)

If the EUT is a single-phase 3-wire system

a. phase R (U) and phase T (W): (DC resistance 0.19Ω±8%) + (inductance 0.23 mH±8%)
b. Phase N (O): (DC resistance: 0.21Ω±8%) + (inductance: 0.14 mH±8%)

If the EUT is a three-phase, three-wire system

a. Rated output 10 kW or less, each phase: (DC resistance 0.19 Ω ± 8%) + (Inductance 0.23 mH ± 8%)
b. Rated output over 10 kW and under 15 kW, each phase: (DC resistance 0.126 Ω ± 8%) + (Inductance 0.153 mH ± 8%)
c. Rated output over 15 kW and under 20 kW, each phase: (DC resistance 0.095 Ω ± 8%) + (Inductance 0.115 mH ± 8%)
d. Rated output over 20 kW and under 25 kW, each phase: (DC resistance 0.076 Ω ± 8%) + (Inductance 0.092 mH ± 8%)
e. Rated output over 25 kW and under 30 kW, each phase: (DC resistance 0.063 Ω ± 8%) + (Inductance 0.077 mH ± 8%)
f. Rated output over 30 kW and under 35 kW, each phase: (DC resistance 0.054 Ω ± 8%) + (Inductance 0.066 mH ± 8%)
g. Rated output over 35 kW and under 40 kW, each phase: (DC resistance 0.0475 Ω ± 8%) + (Inductance 0.057 mH ± 8%)
h. Rated output over 40 kW and under 45 kW, each phase: (DC resistance 0.042 Ω ± 8%) + (Inductance 0.051 mH ± 8%)
i. Rated output over 45 kW and under 50 kW, each phase: (DC resistance 0.038 Ω ± 8%) + (Inductance 0.046 mH ± 8%)

However, if the measurement can be carried out using the current impedance ((0.19 Ω ± 8% for DC resistance) + (0.23 mH ± 8% for inductance)), the above values do not apply.

### 4.1 AC voltage follow-up test

In the case of a power conditioner with a power factor switching function by power flow, if the error of the power factor at forward power flow does not satisfy the judgment criteria for reverse

power flow in Section 4.3, this test shall also be conducted with the power factor set at forward power flow.

If the error of the power factor at the forward power flow satisfies the criterion for the reverse power flow in clause 4.3, but the power factor at the forward power flow is not included in the specified power factor range for the reverse power flow, the test shall be conducted with the range extended so that the specified power factor range includes the power factor at the forward power flow.

[Test conditions]

The standard test conditions for inverse conversion mode given in section 3.2 apply.

The standard test conditions for the inverse conversion mode as described in section 3.2 shall be applied, except for the following changes in section E.

E. The $SW_{LN}$ shall be opened, and the line impedance shall be set to the "standard line impedance" as described in Section 4.

[Method of measurement]

A. Change the grid voltage within the range of +10% to -15% of the rated value and measure the AC output power, AC output current (harmonic components) and power factor at the upper and lower limits.
B. Harmonics shall be measured up to the 40th order.

[Judgment criteria]

A. The output of the power conditioner shall follow the voltage change of the grid and maintain the normal operating condition.
B. The output current distortion ratio shall be 5% or less for overall harmonic current distortion ratio and 3% or less for each harmonic current distortion ratio.

   The overall harmonic current distortion factor DF is calculated by the following formula

$$DF = \frac{\sqrt{\sum(i_{ACn})^2}}{i_{ACO}} \times 100(\%)$$

   $i_{ACn}$: effective value of the nth harmonic current component of the output current of the power conditioner (A)

   $i_{ACO}$: RMS value of AC rated current of the power conditioner (A)

   $n$: Harmonic order 2 to 40 orders.
C. The judgment criteria in section 4.3 shall be satisfied at the upper and lower limits of the grid voltage.

[Remarks.]

If the voltage rise suppression function operates when the system voltage is changed within the range of +10%, the voltage rise suppression function may be masked.

## 4.2 Frequency Tracking Test

In the case of a power conditioner with a power factor switching function based on power flow, if the error in the power factor during forward power flow does not satisfy the judgment criteria for reverse power flow in Section 4.3, this test shall also be conducted with the power factor set to the power factor during forward power flow.

If the error of the power factor at the forward power flow satisfies the criterion for the reverse power flow in clause 4.3, but the power factor at the forward power flow is not included in the specified power factor range for the reverse power flow, the test shall be conducted with the range extended so that the specified power factor range includes the power factor at the forward power flow.

[Test conditions]

Same test conditions as in section 4.1.

[Measurement method]

A. Change the frequency within ±1% of the rated value and measure the AC output power, AC output current (harmonic component), and power factor at the upper and lower limits.
B. Harmonics shall be measured up to the 40th order.

[judgement Criteria]

(Underline where the criteria differ from those given in section 4.1)

A. The output of the power conditioner shall follow the frequency change of the grid and maintain the normal operating condition.
B. The output current distortion ratio shall be 5% or less for overall harmonic current distortion ratio and 3% or less for each harmonic current distortion ratio. (See Section 4.1 for the calculation formula.)
C. The upper and lower limits of the system frequency shall satisfy the judgment criteria in Section 4.3.

## 4.3 Operation Power Factor Test

[Test conditions]

The same test conditions as in section 4.1 shall apply.

[Method of measurement]

A. If the power conditioner is a self-excitation type, set the output of the power conditioner to the output set in Section 3.2 and measure the AC output power to obtain the operating power factor. In the case of an operating power factor test for three-phase equipment, also measure 50% of the rated output power.

B. If the power conditioner is of the separate-excitation type, set the output of the power conditioner to the output set in Section 3.2, 50% and 12.5% of the rated output, and measure the AC output power to obtain the operating power factor.

C. In the case of a power conditioner with a power factor switching function by power flow, the power factor switching function by power flow shall be masked and the test shall be conducted with the power factor set to reverse power flow. In addition, the above test shall be conducted with the power factor set to the forward power flow state.

[Judgement Criteria]

【For power conditioners that include solar cells as the DC energy source】

When operated at the specified power factor, the reactive power value error shall be as follows or the power factor error shall be within ±0.005.

The apparent power and active power shall be measured values.

Furthermore, in the case of a power conditioner with a power factor switching function by power flow, if the criteria for determining the power factor at forward power flow follow the reactive power margin of error and power factor margin of error when operated at the specified power factor described above, the power factor value shall include a power factor value of 0.95 or more. If not, the operating power factor shall be 0.95 or higher.

The same errors allowed in the case of the specified power factor shall be allowed in the same manner.

①. When the power conditioner output changes according to the operating power factor

$$\left| \frac{\sqrt{\text{apparent power}^2 - \text{active power}^2}}{Maximum\ specified\ power\ output} - \frac{\text{apparent power} \times \sqrt{1 - Setting\ power\ factor^2}}{Maximum\ specified\ power\ output} \right| \leq 0.03$$

②. When the power conditioner has a specified output regardless of the operating power factor

$$\left| \frac{\sqrt{\text{apparent power}^2 - \text{active power}^2}}{Maximum\ specified\ power\ output} - \frac{\text{apparent power} \times \sqrt{1 - Setting\ power\ factor^2}}{Maximum\ specified\ power\ output} \right| \leq 0.05$$

For a power conditioner with a power factor switching function by power flow, if the operating

| |
|---|
| power factor at forward power flow is not within the reactive power margin of error and power factor error range when operated at the specified power factor and is 0.95 or more, the power factor error at forward power flow does not satisfy the judgment criteria in Section 4.3 in the power factor range at the specified power factor Judgment.<br><br>[Note].<br>In a complex type power conditioner where the active power output is constant up to a certain operating power factor regardless of the operating power factor, and above a certain operating power factor, the active power output varies according to the operating power factor, the judgment criteria (1) or (2) should be used according to the operating mode to which the operating power factor applies. |
| 【For power conditioners that do not include solar cells as a source of DC energy】<br>The operating power factor shall be 0.95 or higher. In addition, the allowable error when operating at the specified power factor shall be accepted as well. |

### 4.4 Output Harmonic Current Test

In the case of a power conditioner with a power factor switching function by power flow, if the error of the power factor during forward power flow does not satisfy the judgment criteria for reverse power flow in Section 4.3, this test shall also be conducted with the power factor set to the power factor during forward power flow.

If the error of the power factor at the forward power flow satisfies the criterion for the reverse power flow in clause 4.3, but the power factor at the forward power flow is not included in the specified power factor range for the reverse power flow, the test shall be conducted with the range extended so that the specified power factor range includes the power factor at the forward power flow.

[Test conditions]

Same test conditions as in section 4.1.

[Measurement method]

(Underline where the method differs from that given in clause 4.1)

A. If the power conditioner is a self-excited type, set the output of the power conditioner to the rated output (100%) and measure the AC output power to obtain the operating power factor. In the case of the operating power factor test of three-phase equipment, measurement at 50% shall also be carried out.

B. If the power conditioner is a separate-excitation type, set the output of the power conditioner

at 100%, 50% and 12.5% of the rated output, measure the AC output power and determine the output harmonic current.

C. Harmonics shall be measured up to the 40th order.

[Judgment criteria]

The output current distortion factor shall be 5% or less for overall harmonic current distortion factor and 3% or less for each order harmonic current distortion factor. (For the calculation formula, refer to Section 4.1)

### 4.5 Leakage current test

[Test conditions]

Since this test is a system characterization test, a DC power source cannot be used in place of a storage battery in the case of a system containing a storage battery.

The standard test conditions for the reverse conversion mode given in section 3.2 shall apply.

However, clause “A” shall be changed to the following content

A. The test circuit shall be the circuit connection shown in Annex I, II, IV or V.
   In the case of a 100V connection mechanism, the circuit connection shall be as shown in Appendix XII.
   In addition, an isolation transformer shall be connected between the power conditioner and the AC power supply.
   An isolation transformer may also be used for the power supply of the measuring instrument.
   In the case of 100 V-connected equipment, the measurement method "For interconnection to a single-phase 3-wire system" shall be applied.

[Measurement method]

[In the case of interconnection to a single-phase, two-wire system]

A. Connect a filter circuit containing a 1kΩ resistor between the grounded charging section of the AC side of the power conditioner and the exposed metal section of the device. In the case of equipment with a DC input terminal, connect a DC power supply in the same way as for the AC side. Furthermore, if the DC line is grounded outside the power conditioner, connect it to the grounded charging section of the AC side.

B. Measure the terminal voltage of the filter circuit as follows.
   If the DC line is grounded outside the power conditioner, connect the switching switch on the DC side to the grounded line (either E or F).
   If the DC line is not grounded outside the power conditioner, switch the switching switch

on the DC side to position D.

For the AC side, switch the switch to A or B and measure.

For the AC side, switch the switching switch to A or B and perform the measurement. Note that this applies to ports where cables may be connected.

The measurement shall be carried out by changing the settings of the equipment to obtain the maximum measurement value.

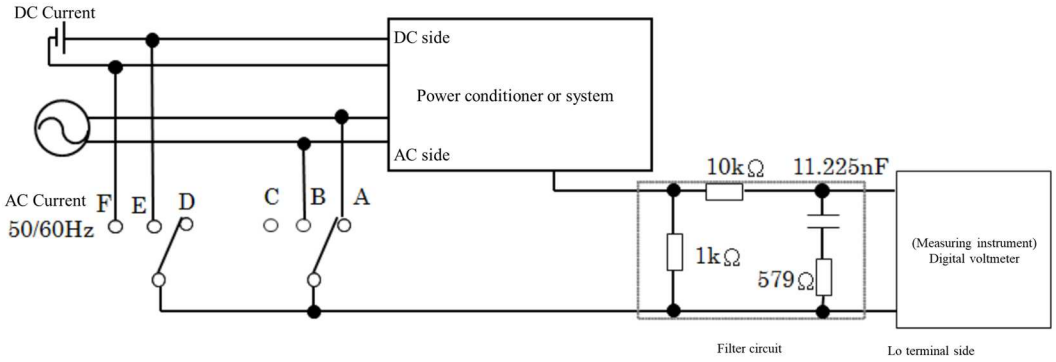



Fig. 1 Measurement circuit for single-phase two-wire interconnection

[In the case of interconnection to a single-phase 3-wire system]

A. Connect a filter circuit containing a 1kΩ resistor between the grounded charging section of the AC side of the power conditioner and the exposed metal part of the device and the earth. For equipment with a DC input terminal, connect a DC power supply in the same way as for the AC side. Furthermore, if the DC line is grounded outside the power conditioner, connect it to the grounded charging section of the AC side.

B. Measure the terminal voltage of the filter circuit as follows.

If the DC line is grounded outside the power conditioner, connect the switching switch on the DC side to the grounded line (either D or E).

If the DC line is not grounded outside the power conditioner, switch the switching switch on the DC side to position C.

For the AC side, switch the switch to position A for measurement.

In order to obtain the maximum measurement value, change the setting of the equipment and perform the measurement.

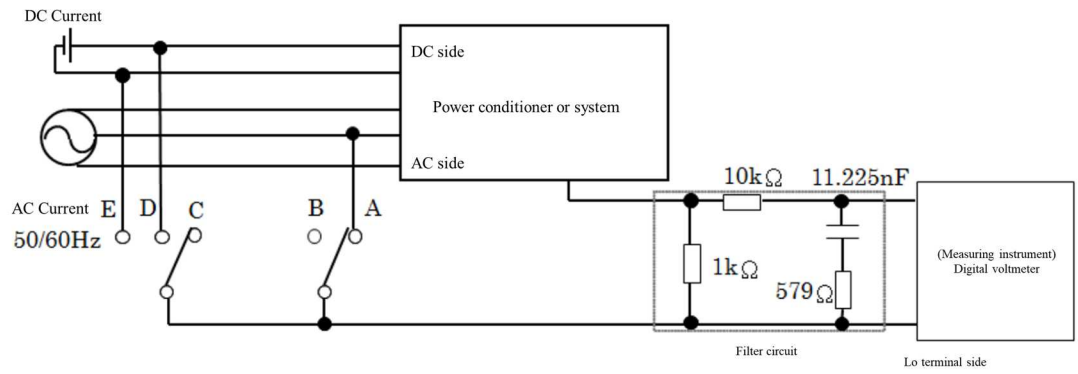



Fig. 2 Measurement circuit for single-phase three-wire interconnection

[In the case of interconnection to a three-phase, three-wire system]

A. A filter circuit containing a 1kΩ resistor shall be connected between the grounded charging section of the AC side of the power conditioner and the exposed metal part of the device. In the case of equipment with a DC input terminal, connect a DC power supply in the same way as for the AC side. Furthermore, if the DC line is grounded outside the power conditioner, connect it to the grounded charging section of the AC side.

B. Measure the terminal voltage of the filter circuit as follows.

If the DC line is grounded outside the power conditioner, connect the switching switch on the DC side to the grounded line (either F or G).

If the DC line is not grounded outside the power conditioner, switch the switching switch on the DC side to position E.

For the AC side, switch the switch to A, B or C and take the measurement. For the AC side, switch the switching switch to A, B or C. This applies to ports where cables may be connected.

In order to obtain the maximum measurement value, change the setting of the equipment and perform the measurement.

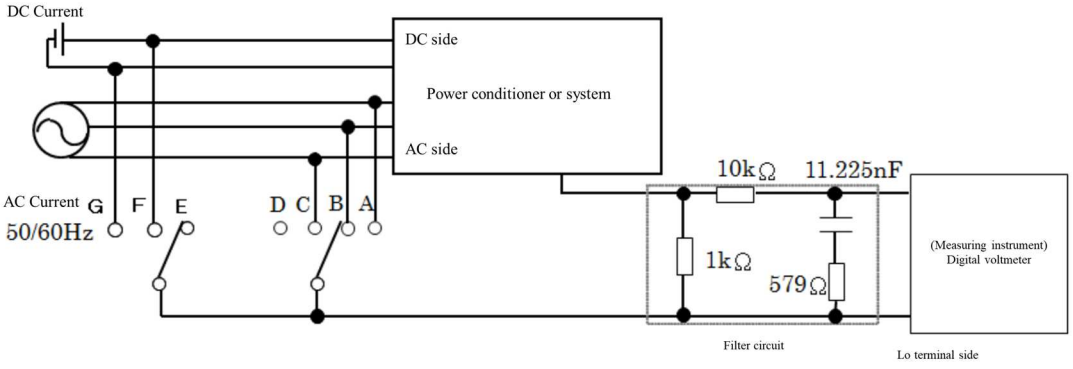



Fig. 3 Measurement circuit for interconnection to a three-phase, three-wire system

[Judgment criteria]

The terminal voltage of the filter circuit shall be 5V or less.

[Remarks]

The purpose of this test is to measure the leakage current that flows to the ground when the power conditioner is touched.

However, since the test is performed with the power supply floating, the current flowing between the supposedly grounded poles of the AC power supply and the power conditioner enclosure will be measured.

Furthermore, if the DC power supply is grounded, the test is also carried out by connecting the originally grounded pole of the DC to the grounded pole of the AC.

The above ports are defined as those that are exposed on the exterior of the power conditioner or inside the power conditioner where they can be touched by the test finger.

If the power conditioner contains a lithium-ion storage battery and is non-isolated, the system must include a storage unit and the use of a DC power supply is not allowed because the leakage current may increase on the storage battery side through the circuit.

If the power conditioner is an isolated type, the leakage current is interrupted by an isolation transformer, so the test can be carried out using a DC power supply.

### 4.6 Voltage rise suppression function test

This test applies to equipment with reverse power flow.

In the case of products with multiple suppression limit settings for the output control function, the standard value (factory default) shall be "0%".

[Common test conditions]

The standard test conditions for the inverse conversion mode shown in Section 3.2 apply.

However, items D, E, and G will be changed to the following contents.

D. In the DC power supply setting, only the DC energy source that does not prevent reverse power is operated, and the output of the power conditioner is set to be the rated output.

E. Open the $SW_{LN}$ and set the line impedance to the "standard line impedance*" described in Section 4.

***[Standard line impedance] - Excerpt from "4. steady state characteristic test"**

**4. steady state characteristic test**

The tests in this section shall be performed in actual operation.

Power conditioner that performs constant power factor control, read the rated output as the "specified output", the rated current as the "maximum specified current", the apparent power as the "specified apparent power", and the operating power factor as the "specified power factor" by the following test method.

In addition to the rated output, items such as designated output and designated apparent power are

not limited to this.

The "standard line impedance" used in the test is as follows.

Test equipment = single-phase two-wire system

a. For 100V equipment: (DC resistance 0.40 Ω ± 8%) + (Inductance 0.37 mH ± 8%)
b. For 200V equipment: (DC resistance 0.38 Ω ± 8%) + (Inductance 0.46 mH ± 8%)

Test equipment = single-phase three-wire system

a. R phase (U phase) and T phase (W phase): (DC resistance 0.19Ω ± 8%) + (Inductance 0.23 mH ± 8%)
b. N phase (O phase): (DC resistance 0.21Ω ± 8%) + (Inductance 0.14 mH ± 8%)

Test equipment = three-phase three-wire system

a. Rated output 10 kW or less, each phase: (DC resistance 0.19 Ω ± 8%) + (Inductance 0.23 mH ± 8%)
b. Rated output over 10 kW and under 15 kW, each phase: (DC resistance 0.126 Ω ± 8%) + (Inductance 0.153 mH ± 8%)
c. Rated output over 15 kW and under 20 kW, each phase: (DC resistance 0.095 Ω ± 8%) + (Inductance 0.115 mH ± 8%)
d. Rated output over 20 kW and under 25 kW, each phase: (DC resistance 0.076 Ω ± 8%) + (Inductance 0.092 mH ± 8%)
e. Rated output over 25 kW and under 30 kW, each phase: (DC resistance 0.063 Ω ± 8%) + (Inductance 0.077 mH ± 8%)
f. Rated output over 30 kW and under 35 kW, each phase: (DC resistance 0.054 Ω ± 8%) + (Inductance 0.066 mH ± 8%)
g. Rated output over 35 kW and under 40 kW, each phase: (DC resistance 0.0475 Ω ± 8%) + (Inductance 0.057 mH ± 8%)
h. Rated output over 40 kW and under 45 kW, each phase: (DC resistance 0.042 Ω ± 8%) + (Inductance 0.051 mH ± 8%)
i. Rated output over 45 kW and under 50 kW, each phase: (DC resistance 0.038 Ω ± 8%) + (Inductance 0.046 mH ± 8%)

However, if the current impedance ((DC resistance 0.19 Ω ± 8%) + (Inductance 0.23 mH ± 8%)) can be used for measurement, the above value does not apply.

In the case of 100V connection equipment, the line impedance applies to "single-phase three-

wire system".

G. Turn on the $SW_{LD}$, adjust the load in a timely manner so that it consumes less power than the rated output of the power conditioner, and set it so that the reverse power flow state can be maintained during the test.

In addition, add the J term.

J. When measuring the operating time, measure with the signal from the external output signal port.

### 4.6.1 Voltage rise suppression function test

(When no operation standby is performed)

Applies to products that can be set not to "standby for voltage rise suppression operation".

[Measuring method]

A. The voltage is gradually deviated by adjusting the AC power supply voltage, and the voltage at which the output control function and the advance-phase reactive power control function (if any) start operating, and the suppression effect (voltage) are confirmed. In the case of the advance-phase reactive power control function, the power factor shall be measured while the advance-phase reactive power control function is operating.

B. Furthermore, raise the voltage of the AC power supply and check the suppression limit value (0%) of the output control function (active power).

C. Gradually raise the voltage from the set value of -1.0% to + 1.0% by adjusting the AC power supply voltage and check the voltage at which the voltage rise suppression function operates.

D. By adjusting the AC power supply voltage, gradually lower the voltage from the voltage rise suppression operation state and check the voltage at which the output control function is released.

E. By adjusting the AC power supply voltage, the voltage is suddenly changed from the voltage rise suppression operating state to -5.0% of the set value, then check the operating time when the output control function is released.
~~(The test may be conducted by setting a short operation time period.)~~

F. The above measurement is carried out for each phase.
When measuring the time, use the signal from the external output signal port.

[Judgment criteria]

A. The output control function or the advance-phase reactive power control function shall maintain the output end voltage of the power conditioner at or below +0.5% of the regulated value. The lower limit of the power factor controlled by the advance phase reactive power control function shall be 0.85 or more.
However, the judgment shall be made after the voltage rise suppression function starts

operating and the voltage stabilizes.

B. The suppression limit value of the output control function (active power) is 0%.
At 0% output, a control error is recognized in which the output power fluctuation is 5% or less of the rated output or the maximum specified output.

C. The voltage at which the voltage rise suppression function operates shall be within ± 0.5% of the set value.

D. The voltage at which the output control function is released shall not have a hysteresis characteristic with the voltage at which the output control function starts operating.
However, due to control restrictions, it is permissible for the voltage at which the output control function is released to be higher than the starting voltage within the range indicated by item A.

E. The operation time for canceling the output control function shall be within 6 seconds.

### 4.6.2 Voltage rise suppression function test

(When having "operation standby function")

Applies to products that have a "voltage rise suppression operation standby function".

[Measuring method]

(The parts different from Section 4.6.1 are underlined.)

A. Gradually deviate the voltage by adjusting the AC power supply voltage and check the voltage at which the output control function and the advance-phase reactive power control function (if any) begins to operate (standby) and the suppression effect (voltage).
In the case of the advance-phase reactive power control function, the power factor shall be measured while the advance-phase reactive power control function is operating.

B. The suppression limit of the output control function (active power) shall be 0%.
In addition, a control error of 5% or less of the rated output or maximum specified output is allowed for output power fluctuation at 0% output.

C. By adjusting the AC power supply voltage, gradually increase the voltage from the set value of -1.0% to + 1.0% and check the voltage at which the voltage rise suppression function starts "operation standby".

D. 60 seconds after the voltage rise suppression function starts waiting for operation, suddenly change the voltage to -1.0% of the set value and check the operation time when the “operation standby” of the voltage rise suppression function is initialized.

E. By adjusting the AC power supply voltage, the voltage is gradually increased from the set value of -1.0%, then after starting the “operation standby” of the voltage rise suppression function, stop the voltage rise and check the operation time until the voltage rise suppression function operates.

F. Furthermore, increase the voltage of the AC power supply and check the time to reach the suppression limit value (0%) of the output control function (active power) after the voltage increase suppression function operates.

G. By adjusting the AC power supply voltage, gradually lower the voltage from the voltage rise suppression operation state and check the voltage at which the output control function is released.

H. By adjusting the AC power supply voltage, suddenly change the voltage from the voltage rise suppression operating state to -5.0% of the set value, then check the operating time when the output control function is released.
(The test may be conducted by setting a short operation time period.)
Furthermore, confirm that the operation standby time of the voltage rise suppression function is initialized at the external output signal port.

I. The above measurement is carried out for each phase.
When measuring the time, use the signal from the external output signal port.

[Judgment criteria]
(The parts different from Section 4.6.1 are underlined.)

A. The output control function or the advance-phase reactive power control function shall maintain the output end voltage of the power conditioner at or below +0.5% of the regulated value. The lower limit of the power factor controlled by the advance phase reactive power control function shall be 0.85 or more.
The voltage at which the output control function and the advance phase reactive power control function (if any) start operating (standby) shall be within ±0.5% of the settling value, respectively.
However, the judgment shall be made after the voltage rise suppression function starts operating and the voltage stabilizes.

B. The suppression limit value of the output control function (active power) is 0%.
At 0% output, a control error in which the output power fluctuation is 5% or less of the rated output or the maximum specified output is recognized.

C. The voltage at which the voltage rise suppression function starts "standby" must be within ± 0.5% of the set value.

D. The voltage rise suppression operation standby time must be initialized within 6 seconds.

E. The operation standby time of the voltage rise suppression function shall be 200 seconds (tolerance -0 / + 15 seconds).

F. It takes less than 100 seconds from the operation of the voltage rise suppression function to

the suppression limit value (0%).

G. The voltage at which the output control function is released shall not have a hysteresis characteristic with the voltage at which the output control function starts operating.
However, due to control restrictions, it is permissible for the voltage at which the output control function is released to be higher than the starting voltage within the range indicated by item A.

H. For output control function only:
The time for the output control function to be released must be within 6 seconds.
Furthermore, the voltage rise suppression operation standby time should be initialized when the output suppression state is resolved.
For phase-advancing reactive power control function and output control function:
The time for the output control function to be released must be within 6 seconds.
Furthermore, the voltage rise suppression operation standby time shall be initialized when the output suppression state is resolved, the phase advance reactive power control is released, and the power factor becomes the steady operation state.

[Remarks]

1. Concept of setting operation time limit
   - The standard value was set as the certification test method based on the idea that the operation time is set in cooperation with the voltage regulator of the distribution system according to the grid interconnection regulations.
   - The maximum operating time of the SVR (Step Voltage Regulator), which has the longest operating time among the voltage regulators of the distribution system, is set as the operating time of the voltage suppression function of the power conditioner.
   - Since the maximum operating time of the SVR is 200 seconds from the survey results of the Federation of Electric Power Companies of Japan, the operating time of the voltage rise suppression function of the power conditioner is set to 200 seconds.
2. Concept of setting the release time
   - It is the time from when the power conditioner detects that it has returned to the upper limit reference value of the distribution system voltage to when the release operation is started, and the following requirements are required for the release process.
   - One is to return to the steady operation state as soon as possible to reduce the power generation opportunity loss, and then to ensure that the output control function is released so that the operation and standby are not repeated.
   - As a method of achieving these requirements, the Japan Electric Industry Association investigated the product specifications and conducted a survey.
     The 6 seconds proposed as the release time limit for the output control function (active power control) was set as the standard value for the certification test method.

Regarding the cancellation of the phase-advancing reactive power control function, there is little effect on the loss of power generation opportunities, so no particular cancellation time limit is set.

3. Checking the operation of the voltage rise suppression function External output port setting
   - Operation of voltage rise suppression function (phase advance reactive power control function and output control function)
   - Provide an external output signal port for testing that can confirm the release and operation standby timed holding of the voltage rise suppression function.
     It may be used in combination with the command signal confirmation port used in the step injection function test or the like.
   - The release of the phase-advancing reactive power control function refers to the time when the power factor is in the steady operation state.
     In addition, the release of the output control function means that "when the voltage rise suppression function operates and the system voltage returns to the normal voltage, the power conditioner is in the direction of returning from the output suppression state to the rated output."
4. Explanation of "hysteresis" of judgment criteria
   - "Hysteresis characteristic is not recognized" in the judgment criteria means that the reference voltage for operation and release of the output control function is the same.

### 4.7 Temperature rise test

The test shall be carried out under conditions where the temperature rise is greatest for each part.
The conditions shall be determined in consultation with the applicant for certification.
However, for integrated storage batteries, the temperature rise of the storage unit shall be considered and conducted in the system.
Grid-connected protection devices with the function of connecting power conditioners to independent circuits shall be tested under the conditions where the temperature rise is the greatest.
The conditions shall be determined after consultation with the certification applicant.

[System does not include storage batteries, etc.]
[Test conditions]
The standard test conditions for the inverse conversion mode as given in section 3.2 shall apply.
However, clauses J to L shall be added.

J. If there are dedicated loads or auxiliary equipment, these shall be operated normally.
K. If the equipment is used in an enclosure, the test shall be carried out using the specified enclosure.
L. The reference ambient temperature shall be 30°C for indoor use, 40°C for outdoor use and

65°C for microinverters for AC modules in photovoltaic systems.

[Method of measurement]

A. Adjust the load so that the power conditioner output becomes the rated output and continue operation until the temperature rise of each part becomes saturated at the rated power factor. If a dedicated load is set, that load shall be used.

B. Operate the power conditioner until the temperature rise of each part becomes almost constant and measure the temperature of each part. If the temperature rises even after the power conditioner is stopped, continue to measure the temperature.

[Judgment criteria]

A. The temperature of each part shall be below the specified temperature. (The specified value shall be in accordance with Appendix 8, Supplementary Table 4 of the Interpretation of the Ministerial Ordinance Establishing Technical Standards for Electrical Appliances and Materials.)

B. After leaving the product unattended, it shall conform to the insulation resistance test in Section 2.1.

C. The product shall conform to the commercial frequency withstand voltage test in Section 2.2 after being left unattended.

[System includes storage batteries, etc.]

This test shall be conducted in accordance with JIS C 4412-1 or JIS C 4412-2 for both test method and judgment criteria. In addition, follow [Remarks] 1. of 1. Structural Tests.

However, for integrated storage batteries, the test shall be conducted on the system in consideration of the temperature rise of the storage unit.

The test shall also be carried out under the most severe conditions.

[Remarks]

[Remark] 2. of 1. Structural Tests may also be applied. However, the test shall be conducted under the conditions where the temperature rise of each part is greatest. If the tested operating conditions are insufficient, the test shall be conducted, and IEC62109-1 shall be applied for judgment criteria.

### 4.8 Soft start function test

[Test conditions].

The standard test conditions for inverse conversion mode as described in section 3.2 apply.

[Measurement method]

A. Restart the power conditioner after disconnection by an external switch (operation switch) of the

power conditioner.

B. Measure the AC output current when the power conditioner is restarted.

[Judgment criteria]

The maximum value of the AC output current shall be 150% or less of the rated current when the power conditioner is started, and the time for exceeding 105% shall be 0.5 seconds or less.

### 4.9 Power factor switching test by power flow

This test is applicable to power conditioners with power factor switching function by power flow.

[Test conditions]

The standard test conditions for reverse conversion mode as described in section 3.2 shall apply. However, if 5% of the rated output or maximum specified output is less than 150W, 95% of the specified output for reverse power flow (reverse power flow condition) and 105% of the specified output for forward power flow (forward power flow condition) shall be replaced with -150W (reverse power flow condition) and +150W (forward power flow condition), respectively.

[Method of measurement]

A. The load shall be increased in steps from 95% of the power conditioner's rated output at reverse power flow (reverse power flow condition) to 105% of the power conditioner's rated output at forward power flow (forward power flow condition) to achieve the forward power flow condition. Maintain the maximum time (but not less than 10 minutes) for detecting the changeover to the forward power flow power factor specified by the applicant for certification.

B. The load is changed to 95% of the specified output for reverse power flow (reverse power flow condition) and maintained for 220 seconds.

C. The load is changed again to 105% of the specified output for forward power flow (forward power flow condition) and maintained there.

D. Measure the time taken to switch to the forward power flow power factor after switching from the reverse power flow to the forward power flow power factor in paragraph C, using the external port to indicate that the power factor is being switched.

E. Measure the time of switching power factor and the change in reactive power during the switching period.

F. Measure the power factor after the switching to the power factor of the forward power flow state is completed.

G. Change the load to 95% of the specified output for reverse power flow (reverse power flow condition).

H. Measure the time between the switch from the forward power flow to the reverse power flow in section “G” and the completion of the switch to the reverse power flow power factor, using the external port to indicate that the power factor is being switched.

I. Measure the time of switching the power factor and the change in reactive power during the switching period.

J. Measure the power factor after the completion of switching to the power factor of the reverse power flow state.

[Judgment criteria]

A. The time measured in paragraph “D” of the measurement method shall be at least 10 minutes plus the maximum time required for power flow detection. The maximum time required for power flow detection shall be in accordance with the specifications provided by the applicant for certification, considering the frequency of communication.

B. The time required for switching the power factor as measured in paragraphs “E” and “I” of the measurement method shall be at least 80 seconds and no more than 100 seconds.

C. The change in reactive power during the power factor changeover as measured in paragraphs “E” and “I” of the measurement method shall be ramp-shape.

D. The power factor in the forward power flow condition shall be the forward power flow power factor specified by the applicant for certification.

E. The time measured in the measurement method shall be the minimum system time possible and shall not exceed 5 minutes. The minimum time possible for the system shall be confirmed in the specifications provided by the applicant for certification.

F. The power factor at the time of reverse power flow shall be the specified power factor.

G. The voltage rise suppression function shall take priority over this function. The priority shall be confirmed in the specifications provided by the applicant for certification.

[Remarks]

1. To confirm that the voltage rise suppression function is given priority, a comprehensive judgment shall be made based on information such as the following

- The switching to the forward power flow power factor shall not start during the voltage rise suppression (including the waiting time).
- The characteristics of the change in reactive power and active power when the voltage rise suppression function is activated while operating at the forward power flow power factor
- The characteristics of the change in reactive and active power when the voltage rise suppression starts during the switching from the power factor of the reverse power flow state to the power factor of the forward power flow state.

- Characteristics of change in reactive and active power when voltage rise suppression is initiated during the switchover from the power factor of the forward power flow state to the power factor of the reverse power flow state

2. When measuring the time at which the switching of the power factor of the power conditioner starts and ends, it shall be possible to confirm this by using a signal from an external output signal port that clearly shows the switching period. This may be used in conjunction with the command signal confirmation port used in step injection function tests, etc.
3. The time required for switching the power factor shall be less than or equal to the time from the operation of the voltage rise suppression function to the time when the suppression limit of the output control function (active power) is reached, and the change shall be sufficiently gradual so as not to affect the islanding operation prevention function, i.e., 80 to 100 seconds
4. The time required to complete the switch from forward power factor to reverse power factor after a reverse power condition is reached is 5 minutes, which is equivalent to the time required to detect a reverse power condition in a broadly defined power conditioner.
5. The time required for reverse power flow detection is 220 seconds, which is the time specified in Remark 4. minus the minimum time required for switching power factor specified in Remark 3.
6. The waiting time until the switchover to the forward power flow power factor is started after detecting the forward power flow is equal to the double of the waiting time of 200 seconds + the operating time of the voltage rise suppression function of 100 seconds, which ensures that the operation of the voltage rise suppression function is completed even if the function is activated immediately before the switchover to the forward power flow.

## 5. Excessive response characteristic test

The tests in this section shall be carried out under actual operating conditions.

### 5.1 Input power and load transient tests

In this test method, the sudden change of input power test and the sudden change of load test shall be applied, as necessary.

#### 5.1.1 Input power rapid change test

For configurations containing solar cells as DC energy source, the following tests shall be carried out

[Test conditions]

The standard test conditions for the inverse conversion mode as described in section 3.2 shall be applied, except that section “G” shall be changed to the following

G. Switch on the $SW_{LD}$ and set the load so that it consumes 50% of the rated output of the power

conditioner.

[Method of measurement]

A. Change the DC input for the solar cells of the power conditioner, change the AC output of the power conditioner rapidly from 50% to about 75% and maintain it for 10 seconds, then change the DC input of the power conditioner, change the AC output of the power conditioner rapidly to 50% and measure the AC output current.
B. Change the DC input of the power conditioner for the solar cells, change the AC output of the power conditioner rapidly from 50% to about 25% and maintain it for 10 seconds, then change the DC input of the power conditioner, change the AC output of the power conditioner rapidly to 50% and measure the AC output current.
C. Observe the stability of the AC output current, and if oscillations occur in the AC output current, measure the duration of the oscillations.

[Judgment criteria]

A. The power conditioner shall smoothly follow the sudden change in DC input power and stably output AC output power equivalent to the DC input power after the sudden change.
B. The AC output current of the power conditioner after the sudden change shall be 150% or less of the rated current, and the time for exceeding 105% shall be 0.5 seconds or less.
C. The power conditioner shall not behave in an unintended manner when the DC input power suddenly changes.

### 5.1.2 Load transient test

For the load-following type, the following tests are to be carried out.

[Test conditions]

The standard test conditions for the reverse conversion mode given in section 3.2 shall be applied, except that section “G” shall be changed to the following

G. Switch on the $SW_{LD}$ and set the load so that it consumes the output of the operating state combined in paragraph “D”.

[Method of measurement]

A. Operate the power conditioner so that its output is 50% of the rated output.
   If there is a dedicated load installed in the system to prevent reverse power flow, etc., the output of the power conditioner shall be set to be consumable.
B. Measure the AC output current by rapidly changing the load connected to the output of the power

conditioner from 50% to about 75% and then rapidly changing the load to 50% after the output of the power conditioner has stabilized.

C. Measure the AC output current by rapidly changing the load connected to the output of the power conditioner from 50% to about 25% and then rapidly changing the load to 50% after the output of the power conditioner has stabilized.

D. Operate the power conditioner so that its output becomes the rated output.
If there is a dedicated load installed in the system to prevent reverse power flow, etc., set the output of the power conditioner so that it can be consumed.

E. Measure the AC output current by rapidly changing the load connected to the output of the power conditioner from 100% to about 0% and then rapidly changing the load to 100% after the output of the power conditioner has stabilized.

[Judgment criteria]

A. The power conditioner shall follow sudden changes in load smoothly and output AC output power equivalent to the load after the sudden change in load in a stable manner. In addition, those without reverse power flow shall not reverse power flow.

B. The maximum value of the AC output current of the power conditioner after the sudden change shall be 150% or less of the rated current, and the time for exceeding 105% shall be 0.5 seconds or less.

C. The power conditioner shall not operate unintentionally when the load suddenly changes.

For the peak cut type, the following tests shall be conducted.

[Test conditions]

The test conditions indicated for the load-following type shall apply.

[Measurement method]

A. The maximum peak cut-off shall be set at 0% or the lowest value and the load-following type test shall be carried out.

B. Set the maximum peak cutoff amount to 50% of the rated output of the power conditioner.

C. Measure the AC output current by rapidly changing the load connected to the output of the power conditioner from 100% to 0%.

D. Measure the AC output current by rapidly changing the load connected to the output of the power conditioner from 0% to about 100%.

[Judgment criteria]

A. The power conditioner shall smoothly follow sudden changes in load and stably output AC power according to the specifications. In addition, those without reverse power flow shall not reverse power flow.
B. The maximum value of the AC output current of the power conditioner after a sudden change shall be 150% or less of the rated current, and the time for exceeding 105% shall be 0.5 seconds or less.
C. The power conditioner shall not operate in an unintended manner when the load changes suddenly.

### 5.2 Grid voltage transient test

[Test conditions]

The standard test conditions for reverse conversion mode as described in section 3.2 apply.

[Measurement method]

A. Operate the system voltage at the rated voltage of each phase of the power conditioner.
B. Suddenly change the system voltage to 105% of the rated value of each phase of the power conditioner and maintain it for 10 seconds, then suddenly change the system voltage to the rated value of each phase and measure the AC output current.
C. Operate the system voltage at the rated voltage of each phase of the power conditioner.
D. Suddenly change the system voltage to 95% of the rated value of each phase of the power conditioner and maintain it for 10 seconds, then suddenly change the system voltage to the rated value of each phase and measure the AC output current.

[Judgment criteria]

A. The power conditioner shall smoothly follow sudden changes in the system voltage and stably output AC output power equivalent to the system voltage after the sudden change.
B. The maximum value of the AC output current of the power conditioner after the sudden change shall be 150% or less of the rated current, and the time during which the current exceeds 105% shall be 0.5 seconds or less.

### 5.3 Grid voltage phase change test

#### 5.3.1 Grid voltage phase shift (phase difference 10°)

As all equipment is FRT compliant, this test, which only applies to non-FRT compliant equipment, will not be conducted.

For previous test methods, see "[Appendix] Test methods not currently implemented".

### 5.3.2 Abrupt change in system voltage phase (phase difference 120°)

[Test conditions]

The standard test conditions for the reverse conversion mode given in section 3.2 apply, except that section F is changed to the following

F. The settings of the protective relay of the protective device, etc. shall be the factory default values (as described in the application for certification) and the function to prevent islanding operation (passive and active methods) shall be masked.

[Method of measurement]

A. The output voltage phase of the power conditioner is set to the reference (0°) and operated.
B. Measure the AC output current by rapidly changing the phase of the system voltage from 0° to +120°.
C. Check the operating condition of the power conditioner and whether there is any damage in each part.
D. If the power conditioner has broken down, it shall be restarted automatically or manually.
E. The output voltage phase of the power conditioner shall be set to the standard (0°) for operation.
F. Measure the AC output current by rapidly changing the phase of the system voltage from 0° to -120°.
G. Perform paragraphs C and D.

[Judgement criteria]

A. The power conditioner continues to operate or is safely disconnect, and there is no damage to any part of the power conditioner.
B. The power conditioner can resume operation automatically or manually in the event of disconnection.

### 5.4 Grid voltage unbalance rapid change test

This test is applicable to power conditioners with single-phase 3-wire and 3-phase 3-wire electrical systems.

[Test conditions]

The standard test conditions for reverse conversion mode as described in section 3.2 apply.

[Measurement method]

| |
|---|
| [Single-phase three-wire system] |
| A. After operating the system voltage at the rated voltage of each phase of the power conditioner, |

perform the following conditions simultaneously and measure the AC output current.

- After the system voltage is suddenly changed to 105% from the single phase (U-N) rated value of the power conditioner and maintained for 10 seconds, the system voltage is suddenly changed to the rated value of each phase.
- A sudden change in the system voltage from the single phase (V-N) rating of the power conditioner to 95%, maintained for 10 seconds, and then a sudden change in the system voltage to the rated value of each phase.

B. After the system voltage is operated at the rated voltage of each phase of the power conditioner, the following conditions are carried out simultaneously and the AC output current is measured.

- The system voltage is suddenly changed to 95% from the single phase (U-N) rated value of the power conditioner and maintained for 10 seconds, and then the system voltage is suddenly changed to the rated value of each phase.
- The system voltage is suddenly changed to 105% of the single phase (V-N) rating of the power conditioner and maintained for 10 seconds, then the system voltage is suddenly changed to the rated value of each phase.

[Three-phase, three-wire system]

A. After operating the system voltage at the rated voltage of each phase of the power conditioner, perform the following conditions simultaneously and measure the AC output current.

- After the system voltage is suddenly changed to 105% of the power conditioner's single-phase (U-V) rated value and maintained for 10 seconds, the system voltage is suddenly changed to the rated value of each phase.
- The system voltage is suddenly changed to 95% of the rated value of one phase (V-W) of the power conditioner and maintained for 10 seconds, then the system voltage is suddenly changed to the rated value of each phase.

B. After the system voltage is operated at the rated voltage of each phase of the power conditioner, the following conditions are carried out simultaneously and the AC output current is measured.

- The system voltage is suddenly changed to 95% from the single phase (U-V) rated value of the power conditioner and maintained for 10 seconds, and then the system voltage is suddenly changed to the rated value of each phase.
- A sudden change in the system voltage to 105% of the single phase (V-W) rating of the power conditioner, maintained for 10 seconds, and then a sudden change in the system voltage to the rated value of each phase.

C. After the system voltage is operated at the rated voltage of each phase of the power conditioner, the following conditions are carried out simultaneously and the AC output current is measured.

- The system voltage is suddenly changed to 105% of the power conditioner's single-phase (V-W) rated value and maintained for 10 seconds, and then the system voltage is suddenly

changed to each phase's rated value.

- A sudden change in the system voltage from the single phase (W-U) rating of the power conditioner to 95%, maintained for 10 seconds, and then a sudden change in the system voltage to the rated value of each phase.

D. After the system voltage is operated at the rated voltage of each phase of the power conditioner, the following conditions are carried out simultaneously and the AC output current is measured.

- After operating the system voltage at the rated voltage of each phase of the power conditioner, perform the following conditions simultaneously and measure the AC output current.
- The system voltage is suddenly changed to 105% of the rated value of one phase (W-U) of the power conditioner and maintained for 10 seconds, then the system voltage is suddenly changed to the rated value of each phase.

E. After operating the system voltage at the rated voltage of each phase of the power conditioner, the following conditions shall be carried out simultaneously and the AC output current shall be measured.

- After the system voltage is suddenly changed to 105% from the single phase (W-U) rated value of the power conditioner and maintained for 10 seconds, the system voltage is suddenly changed to the rated value of each phase.
- A sudden change in the system voltage to 95% of the single phase (U-V) rating of the power conditioner, maintained for 10 seconds, and then a sudden change in the system voltage to the rated value of each phase.

F. After the system voltage is operated at the rated voltage of each phase of the power conditioner, the following conditions are carried out simultaneously and the AC output current is measured.

- The system voltage is suddenly changed to 95% from the single phase (W-U) rated value of the power conditioner and maintained for 10 seconds, and then the system voltage is suddenly changed to the rated value of each phase.
- The system voltage is suddenly changed to 105% of the single phase (U-V) rating of the power conditioner and maintained for 10 seconds, then the system voltage is suddenly changed to the rated value of each phase.

[Judgment criteria]

A. The power conditioner shall smoothly follow the sudden change in unbalanced line voltage and stably output AC output power equivalent to the unbalanced line voltage after the sudden change.

B. The maximum value of the AC output current of the power conditioner after the sudden change shall be 150% or less of the rated current, and the time during which the current exceeds 105% shall be 0.5 seconds or less.

## 6. External accident test

The tests in this section shall be carried out under actual operating conditions.

### 6.1 AC short circuit test

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.
However, item B is changed to the following

B. The AC power supply operates at the rated voltage and rated frequency. Also, it is set to detect the short-circuit current and open it within 0.1 seconds after the accident.

In addition, the J and K terms are added.

J. Set the short-circuit resistance $R_{SC}$ to a value equivalent to a load equivalent to 10 times or more the rated current of the inverter.

K. Leashed clothes around the inverter (Density is 25.4 mm, 72±4 warp, 69±4 weft, with plain weave that does not use the 30th warp and the 36th weft. Wrap (cotton cloth).

[Measuring method]

A. Close the switch $SW_{SC}$ to generate an AC short-circuit condition and measure the AC current and disconnection time on the output side of the inverter.
When using a DC power supply, the DC input current is also measured.

B. Check the condition of the bare skin.

C. Check the operating condition of the inverter and the presence or absence of damage to each part.

[Judgment criteria]

A. The outer shell should not be damaged, or the loose wrapping cloth should not burn.

B. The inverter should be safely disconnected and there is no damage to any part.

C. The AC output current during a short circuit should exceed 1/2 of the rated current for less than 1/2 cycle.

D. When using a DC power supply instead of a storage battery, etc., or when using a storage battery mounted on an electric vehicle, etc., the peak current of the DC input current shall be less than or equal to the maximum DC current specified value.

### 6.2 Instantaneous voltage drop test

As all equipment is FRT-compliant, this test, which applies only to non-FRT-compliant equipment,

will not be conducted.

For previous test methods, see "[Appendix] Test methods not currently performed".

### 6.3 Instantaneous voltage drop test (FRT test)

~~Applies to [Multi-unit FRT compatible type] and [FRT compatible type]. Not applicable to [Conventional type] and [Multiple-unit type].~~

In a system interconnection protection device equipped with a inverter connection function to an independent circuit, between the reverse conversion device and the system connection port, between the inverter connection port and the system connection port, and between the load connection port and the system connection port. It is assumed that all the switches are not opened in the instantaneous voltage drop test (FRT test). (Check the specifications of the switch etc.)

Furthermore, in a inverter that has a power factor switching function based on the power flow, if the power factor error during forward power flow does not satisfy the criteria for reverse power flow in Section 4.3, even if the power factor during forward power flow is set, Conduct this test.

If the power factor error during forward power flow satisfies the criteria for reverse power flow in Section 4.3, but the power factor during forward power flow is not within the specified power factor range during reverse power flow, specify This test is conducted by expanding the power factor range so that it includes the power factor during forward power flow.

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

However, the E item is changed to the following contents.

E. The line impedance shall be short-circuited. However, when the voltage rise suppression function operates, the voltage rise suppression function is masked.

The setting of the undervoltage relay (UVR) may be changed to a set value that does not interfere with the FRT test.

[Measuring method]

[For single-phase inverter]

A. Steady-state voltage is 100V, which is 107V, 101V, or 95V.
   There are three types of phase input angles for instantaneous voltage drop: 0°, 45°, and 90°.
   The output settings will be set in consultation with the certification applicant.

B. Generate an instantaneous voltage drop (remaining voltage is 20% or more of rated voltage, less than UVR operating voltage) for 1.0 second on the AC power supply side.

However, if the direct current energy source includes a fuel cell or gas engine, the duration of the instantaneous voltage drop shall be 0.3 seconds.

Furthermore, regardless of the steady-state voltage, the minimum residual voltage is 20V in all cases. If a DC power supply is used instead of the storage battery, the DC input current is also measured.

C. Generate an instantaneous power failure (remaining voltage is 0% or more and less than 20% of the rated voltage) for 1.0 second on the AC power supply side. However, if the direct current energy source includes a fuel cell or gas engine, the duration of the instantaneous voltage drop shall be 0.3 seconds.

D. In the voltage drop test, the gate block signal and current waveform are measured.

E. A single type of DC energy source is operated, and the above-mentioned test is carried out for all types of DC energy sources and their combinations at all of the combinations of the power supply voltage and the phase input angle. If the rated output cannot be obtained with a single type of DC energy source, it can be implemented after consultation with the applicant for certification.

F. In the case of a power conditioner that has a power factor switching function depending on the power flow and the time from the start of switching from the forward power factor to the reverse power factor is less than 1 second, 110% of the rated output of the inverter Set the load to consume and perform the above test.

[For three-phase inverter]

A. Steady-state voltage is 200V system with 222V, 202V, and 182V. There are three types of phase input angles for instantaneous voltage drop: 0°, 45°, and 90°.

The following tests are performed on all the above combinations.

B. An instantaneous voltage drops of 0.3 seconds (remaining voltage is 20% or more of the rated voltage and less than the UVR operating voltage) is generated on the AC power supply side. However, regardless of the steady-state voltage, the minimum residual voltage is 40V in all cases.

C. Generates an instantaneous power failure for 0.3 seconds (the remaining voltage is 0% or more and less than 20% of the rated voltage) on the AC power supply side.

D. In the above voltage drop test, the gate block signal and current are measured as light.

E. A single type of DC energy source is operated, and the above-mentioned test is carried out for all types of DC energy sources and their respective combinations at all of the combinations of the power supply voltage and the phase input angle. If the rated output cannot be obtained with a single type of DC energy source, it can be implemented after consultation with the applicant for certification.

| |
|---|
| F. In the case of a inverter that has a power factor switching function depending on the power flow and the time from the start of switching from the forward power factor to the reverse power factor is less than 1 second, 110% of the rated output of the inverter Set the load to consume and perform the above test. |

[Judgement Criteria]

(1) Instantaneous voltage drops

(Less than UVR operation voltage when remaining voltage is 20% or more)

A. For an instantaneous voltage drop of 20% residual voltage, operate in parallel (current continues) without blocking the gate. *1

B. The time for active power output to return to 80% after voltage restoration and before instantaneous voltage drop occurs within 0.1 seconds. However, in the case of single-phase and three-phase DC energy source is only the storage battery, or in the case of a combined system of single-phase storage battery, etc. and solar cells, if the recovery operation is performed by suppressing the load following power, up to 80% The recovery time may be within 0.4 seconds. Excludes combined systems of three-phase storage batteries and solar cells. Further, when the direct current energy source includes a fuel cell and a gas engine, the recovery time up to 80% may be within 1 second.

C. The maximum value of the AC output current of the inverter when the system voltage is restored shall be 150% or less of the rated current, and the time for which it exceeds 105% shall be 0.5 seconds or less. In addition, operate in parallel (current continues) without gate blocking. *1

D. When using a DC power supply instead of a storage battery, etc., the peak current of the DC input current must be below the maximum DC current specified value.

(2) Instantaneous power failure

(When the remaining voltage is 0% or more and less than 20%)

A. Continue parallel operation or gate block for an instantaneous voltage drop of 0% residual voltage.

B. The time during which the active power output returns to 80% after the voltage is restored and before the momentary voltage drop occurs is within 1.0 second. However, when using only solar cells as the DC energy source, the recovery time to 80% shall be within 0.2 seconds.

C. The maximum value of the AC output current of the inverter when the system voltage is restored shall be 150% or less of the rated current, and the time for which it exceeds 105% shall be 0.5 seconds or less. In addition, operate in parallel (current continues) without gate blocking. *1

D. For products that automatically switch to independent operation, do not shift to independent operation while the instantaneous voltage of residual voltage is 0%.

E. When using a DC power supply instead of a storage battery, etc., the peak current of the DC input current must be below the maximum DC current specified value.

[Voltage drops with phase change]

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 apply.

However, E and G will be changed to the following

E. The line impedance shall be short-circuited. However, when the voltage rise suppression function operates, the voltage rise suppression function is masked.

G. The protection relays of the protection device shall be set to the factory default values (as stated in the certification application form). In addition, in the case of a product that monitors the frequency change as a condition for returning from the active function standby state (which can be implemented after consultation with the certification applicant) to the active function normal state, it is also performed in the active function standby state. Furthermore, the setting of the undervoltage relay (UVR) may be changed to a set value that does not interfere with the FRT test.

[Measurement Method]

[For single-phase equipment]

A. There are three steady-state voltages of 107V, 101V, and 95V in the 100V system. Furthermore, in the case of a product that monitors the frequency change under the condition of returning from the active function standby state to the active function normal state, the frequency is changed to 101V in the active function standby state. The phase input angle of the instantaneous voltage drop is set to 0 °, 45 °, and 90 °. The output settings will be set in consultation with the certification applicant.

B. Causes an instantaneous voltage drop that lasts for 1.0 second or less on the AC power supply side. (Three-phase high-voltage Y connection side two-phase short-circuited state, residual voltage 20% or more, less than UVR operating voltage, phase change (advance / delay) on the delta connection side)。

When the high-voltage side two-phase short-circuit residual voltage is 20%, the low-voltage side residual voltage becomes 52% of the rated voltage and a phase change (advance / delay) of 41 °.

However, if the DC energy source includes a fuel cell or gas engine, the duration of the instantaneous voltage drop shall be 0.3 seconds or less.

Furthermore, the minimum residual voltage is 52V in all cases regardless of the steady state voltage. When a DC power supply is used instead of a storage battery, the DC input

current is also measured.

C. In the above voltage drop test, the gate block signal and the current waveform are measured.

D. A single type of DC energy source is operated, and the above test is performed for all types of each DC energy source and each combination for all combinations of the power supply voltage and the phase input angle. If the rated output cannot be obtained with a single type of DC energy source, it can be implemented in consultation with the certification applicant.

E. In the case of a inverter that has a power factor switching function based on power flow and the time from the start of switching from the forward power factor to the reverse power factor is 1 second or less.

Set the load so that it consumes 110% of the rated output of the inverter and perform the above test.

[For three-phase equipment]

A. There are three steady-state voltages of 222V, 202V, and 182V for the 200V system.

A. There are three steady-state voltages of 222V, 202V, and 182V for the 200V system. Furthermore, in the case of a product that monitors the frequency change under the condition of returning from the active function standby state to the active function normal state, it is implemented at 202V in the active function standby state.

The phase input angle of the instantaneous voltage drop is set to 0 °, 45 °, and 90 °. The following tests are performed for all of the above combinations.

B. In a three-phase high-voltage Y-connection side two-phase short-circuit state that lasts for 0.3 seconds or less on the AC power supply side, an instantaneous voltage drop of 20% or more and less than the UVR operating voltage occurs. In addition, each of the three phases is used as a reference phase. Tables 6.3-1 and 6.3-2 show examples of voltage and phase when the residual voltage is 20%.

C. In the voltage drop test, the gate block signal and the current waveform are measured.

D. A single type of DC energy source is operated, and the above test is performed for all types of each DC energy source and each combination for all combinations of the power supply voltage and the phase input angle. If the rated output cannot be obtained with a single type of DC energy source, it can be implemented in consultation with the certification applicant.

E. In the case of a inverter that has a power factor switching function based on power flow and the time from the start of switching from the forward power factor to the reverse power factor is 1 second or less. Set the load so that it consumes 110% of the rated output of the inverter and perform the above test.

Table 6.3-1 Test conditions on the Y connection side

(Calculation example when the two-phase short-circuit residual voltage is 20%)

| Steady state voltage | L1<br>Upper: Minimum low Voltage(V)<br>Lower: Phase (°) | L2<br>Upper: Minimum low Voltage(V)<br>Lower: Phase (°) | L3<br>Upper: Minimum low Voltage(V)<br>Lower: Phase (°) |
|---|---|---|---|
| 202V | 176.08<br>23.48 | 40.00<br>0.00 | 176.08<br>23.48 |
| 222V | 193.30<br>24.06 | 40.00<br>0.00 | 193.30<br>24.06 |
| 182V | 158.88<br>22.77 | 40.00<br>0.00 | 158.88<br>22.77 |

Table 6.3-2 Test conditions on the Δ connection side

(Calculation example when the residual voltage of the two-phase short circuit is 20%)

| Steady state voltage | L1<br>Upper: Minimum low Voltage(V)<br>Lower: Phase (°) | L2<br>Upper: Minimum low Voltage(V)<br>Lower: Phase (°) | L3<br>Upper: Minimum low Voltage(V)<br>Lower: Phase (°) |
|---|---|---|---|
| 202V | 106.78<br>41.07 | 202.00<br>0.00 | 106.78<br>41.07 |
| 222V | 116.28<br>42.67 | 222.00<br>0.00 | 116.28<br>42.67 |
| 182V | 97.37<br>39.16 | 182.00<br>0.00 | 97.37<br>39.16 |

[Judgment criteria]

A. Parallel operation (current continuation) without gate blocking for instantaneous voltage drop. *

B. The time for active power output to return to 80% after voltage restoration and before instantaneous voltage drop occurs within 0.1 seconds. However, when the recovery operation is performed by suppressing the load following power, the recovery time up to 80% may be 0.4 seconds or less. Excludes combined systems of three-phase storage batteries and solar cells, and photovoltaic power generation system. Further, when the direct current energy source includes a fuel cell and a gas engine, the recovery time up to 80% may be within 1 second.

C. The maximum value of the AC output current of the inverter when the system voltage is restored

shall be 150% or less of the rated current, and the time for which it exceeds 105% shall be 0.5 seconds or less. In addition, operate in parallel (current continues) without gate blocking.

D. When using a DC power supply instead of a storage battery, etc., the peak current of the DC input current shall be less than the maximum DC current specified value.

[Remarks]

1. *[1]It is allowed to remove the gate pulse when the system voltage drops and returns.
2. In the case of three-phase equipment, Table 6.3-1 and Table 6.3-2 are the calculated values of voltage drop and phase change (rounded to three decimal places) assuming a two-phase short-circuit accident of 202V, 222V and 182V to 40V.
   Depending on the accuracy of the power supply, it may not be possible to test with the values in the table. In this case, the test can be carried out within a settable range.
3. The amount of phase change in the case of a voltage drop accompanied by a phase change reflects the phase change on the delta connection side due to the two-phase short-circuit state on the three-phase high-voltage Y connection side. Therefore, the phase at the time of recovery returns to the original state after the three-phase high-voltage Y connection side two-phase short-circuit state is restored, and therefore returns to the phase when the phase before the voltage drop continues.

### 6.4 Frequency fluctuation test (FRT test)

~~Applies to [Multi unit FRT compatible type] and [FRT compatible type]. Not applicable to [Conventional type] and [Multiple unit type].~~

In grid-connected protective devices, etc. equipped with the function of connecting power conditioners to independent circuits, all switchgear between the reverse converter and the grid connection port, between the power conditioner connection port and the grid connection port, and between the load connection port and the grid connection port shall not be opened in the frequency fluctuation test (FRT test). (Check the specifications of the switchgear, etc.)

Furthermore, for power conditioners with a power factor switching function by power flow, if the error in the power factor at forward power flow does not satisfy the criteria for reverse power flow in Section 4.3, this test shall also be conducted with the power factor set to the power factor at forward power flow. If the error in the power factor at forward power flow satisfies the criteria for reverse power flow in Section 4.3, but the power factor at forward power flow is not included in the specified power factor range for reverse power flow, this test shall be performed by expanding the range so that the specified power factor range includes the power factor at forward power flow.

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.
The UFR settling value may be changed to allow this test to be performed successfully.

[Measuring method]

A. Check the operation of the inverter by giving a stepwise fluctuation of + 0.8Hz or less (in the case of 50Hz), + 1.0Hz or less (in the case of 60Hz), and a maximum of 3 cycles continuation to the AC power supply.
B. Give fluctuations in the range of ± 2Hz / s of the ramp state and check the operation of the inverter.
   - The upper limit of frequency is 51.5Hz or less for 50Hz and 61.8Hz or less for 60Hz.
   - The lower limit of the frequency is 47.5Hz or more for 50Hz and 57.0Hz or more for 60Hz.
C. Measure the gate block signal and current waveform.

[Judgment criteria]

A. Parallel operation (continuation of current) without gate block during frequency fluctuation.
B. Parallel operation (continuation of current) without gate block even after frequency fluctuation.

### 6.5 Load shedding test

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.
However, the item G will be changed to the following contents.

G. Turn on the $SW_{LD}$ and set the load to consume the rated output of the inverter.
   Furthermore, if a dedicated load is connected for the purpose of preventing reverse power, that load can be used. However, if it is difficult to reduce the dedicated load, etc., or if the output of the inverter, etc. is to be varied, it shall be carried out after consultation with the certification applicant.

However, the load is connected to the system side of the open switch $SW_{CB}$.

[Measuring method]

A. Open the switch $SW_{CB}$ and confirm that the inverter is disconnected.
B. Measure the operating time of the inverter switch and gate block.
C. Measure the voltage and AC current after opening.

[Judgment criteria]

A. Open the switch and block the gate.
B. The opening time of the switch and the operation time of the block shall be within 0.5 seconds.
C. The maximum value of the voltage after opening is 150% or less of the rated voltage, and the

time over 105% is 0.5 seconds or less.

## 7. Environmental compatibility test

Products with a rated output of 20kW or less are classified as Class B. If the rated output exceeds 20 kW and less than 50 kW, Class A is also permitted. However, for Class A, the fact that there may be potential difficulties in assuring compatibility of the electromagnetic environment in other environments due to conducted and radiated disturbances in user-friendly material must be included.

### 7.1 Emission test

#### 7.1.1 Conducted Disturbance Test

The load connection port terminal and power conditioner connection port terminal of grid-connected protective devices, etc. equipped with a function to connect a power conditioner to independent circuits are also subject to measurement, and the measurement method and judgment criteria shall be based on the criteria for the independent load terminal.

For products with separate disconnection points for independent operation, the power conditioner and disconnection points of the separate enclosure shall be considered as a single unit, the disconnection points of the power conditioner and separate enclosure shall be connected with the shortest cable, and the AC connection terminal to the grid and the independent load terminal at the disconnection points of the separate enclosure shall be the object of measurement. The connection point between the power conditioner and the disconnection point of the separate enclosure shall not be subject to measurement.

[For systems that include storage batteries, etc.]

- Conduct in reverse/forward conversion mode, respectively.

[Reverse conversion mode]

[Test Conditions]

This test is a system characterization test; therefore, for a system including storage batteries, a DC power source is not allowed to be used in place of the storage batteries.

The standard test conditions for reverse conversion mode shown in Section 3.2 shall apply.

However, items (A) and (D) shall be changed to the following content:

A. Test circuit shall be the circuit connections shown in Appendix I, II, IV, or V.
   In the case of a 100 V connection mechanism, the circuit connection shall be that of Appendix Figure XI.
   However, products with DC terminals shall insert a DC-AN as specified in CISPR11 (Version 6.2) and terminate with a 50 Ω resistor.
   The arrangement for measurement shall be as shown in the attached Figure VI.

D. The DC power source setting should be set so that the power conditioner output is at its maximum output.
In the case of multiple DC energy sources, the DC energy source shall be operated under the operating conditions that maximize the disturbance.

In addition, add item J.

J. For the DC terminal conducted disturbance, all DC power conversion devices shall be subject to measurement in externally connected configurations.
The DC power source may be a storage battery capable of supplying the rated input.

[The system includes storage batteries, etc., and is in the forward conversion mode].
The standard test conditions for forward conversion/standby conversion mode shown in Section 3.2 shall apply.
However, items (A) and (D) shall be changed to the following.

A. Test circuit shall be the circuit connections shown in Appendix I, II, IV, or V.
In the case of a 100 V connection mechanism, the circuit connection shall be that of Appendix Figure XI. However, products with DC terminals shall insert a DC-AN as specified in CISPR11 (Version 6.2) and terminate with a 50 Ω resistor.
The arrangement for measurement shall be as shown in the attached Figure VI.

D. The DC power source setting shall be set in consultation with the certification applicant so that the charging power of the storage battery or other device is rated for the measurement in the forward conversion mode. In the case of multiple types of DC energy sources, the DC energy sources shall be operated under the operating conditions that maximize the disturbance. The DC energy source may be a storage battery capable of supplying the rated input.

In addition, add a (J) term.

J. For the DC terminal conducted disturbance, all DC power conversion devices shall be subject to measurement in the externally connected configuration.

[Measuring Methods].

A. Conducted disturbance shall be measured at the AC and DC terminals of the power conditioner (but only in the case of those with external DC terminals).

B. Measure the conducted disturbance at the AC and DC terminals of the power conditioner. For products that can supply power to loads for independent operation even when not in independent operation, the terminals for independent loads in interconnected operation shall also be subject to measurement. Conducted disturbance shall be measured using a high-impedance probe. For applications after July 2022, this test shall be conducted for products that have wiring for power

supply always connected to the independent load terminal.

C. In the case where the system includes storage batteries, etc., the above test shall be conducted under the test conditions of [The system includes storage batteries, etc., and is in the forward conversion mode].

[Judgment Criteria]

・Conducted disturbance at the AC terminals shall be less than or equal to the following values

**Table 7.1.1-1 Tolerances for conducted disturbance**

| Frequency range (MHz) | Conducted disturbance dB (μV) Quasi-peak value | |
|---|---|---|
| | Class A | Class B |
| More than 0.15 and less than 0.5 | 100 | 66～56 |
| More than 0.5 and less than 5 | 86 | 56 |
| More than 5 and less than 30 | 90～73 | 60 |

・Conducted disturbance at the DC terminals shall be less than or equal to the following values

**Table 7.1.1-2 Tolerances for conducted disturbance**

| Frequency range (MHz) | Conducted disturbance dB (μV) Quasi-peak value |
|---|---|
| | Class A |
| More than 0.15 and less than 5 | 116～106 |
| More than 5 and less than 30 | 106～89 |

| Frequency range (MHz) | Conducted disturbance dB (μV) Quasi-peak value |
|---|---|
| | Class B |
| More than 0.15 and less than 0.5 | 84～74 |
| More than 0.5 and less than 30 | 74 |

However, the measurement frequency shall be in accordance with the table below.

**7.1.1-3 Measurement frequency range**

| DC cable length (L) | Measuring frequency |
|---|---|
| L＜3m | No measurement required |
| 3m≦L＜30m | According to Table 7.1.1-2 with f(MHz) = 60/L as the lower frequency limit |
| L≧30m | According to Table 7.1.1-2 |

L: Maximum length of cable connected to the DC terminals as specified by the product or manufacturer. If no maximum length is specified, the test shall be performed with a minimum length of 30 m.

・Conducted disturbance at the independent load terminals shall be less than or equal to the following values

**Table 7.1.1-4 Tolerances for conducted disturbance**

| Frequency range (MHz) | Conducted disturbance dB(μV)<br>Quasi-peak value |
|---|---|
| More than 0.15 and less than 0.5 | 80 |
| More than 0.5 and less than 30 | 74 |

Note

1) In Tables 7.1.1-1 to 7.1.1-4, the lower allowable value is applied at the boundary of frequencies.

2) In Tables 7.1.1-1 through 7.1.1-4, when "~" is included in the tolerance, the value for each frequency shall decrease linearly with the logarithm of the frequency.

[Remarks]

For products with a rated output of 20 kW or less that do not include storage batteries in the system, or for systems that include storage batteries in the system and use JIS C 4412-1 or JIS C 4412-2 as standards for structural requirements, the test methods described in the following may be applied. However, the expiration date shall be February 22, 2026.

The above treatment shall also apply to products that have been applied for renewal.

[Test Conditions]

This test is a system characterization test; therefore, for a system including storage batteries, a DC power source is not allowed to be used in place of the storage batteries.

The standard test conditions for reverse conversion mode shown in Section 3.2 shall apply.

However, items (A) and (D) shall be changed to the following content:

A. Test circuit shall be the circuit connections shown in Appendix I, II, IV, or V. In the case of a 100 V connection mechanism, the circuit connection shall be that of Appendix Figure XI. However, for products with external DC input, a CDN specified in JIS C 61000-4-6 shall be inserted between the power conditioner and the DC power supply and terminated with a 50Ω resistor. If inserting a CDN would prevent normal operation, the CDN need not be inserted. The arrangement at the time of measurement shall be as shown in Appendix Figure VI.

D. The DC power source setting should be set so that the power conditioner output is at its maximum output.
In the case of multiple DC energy sources, the DC energy source shall be operated under the operating conditions that maximize the disturbance.
In addition, add item J.

J. For the DC terminal conducted disturbance, all DC power conversion devices shall be subject

to measurement in externally connected configurations.

The DC power source may be a storage battery capable of supplying the rated input.

[System includes storage batteries, etc., and is in forward conversion mode]

The standard test conditions for forward conversion/standby conversion mode shown in Section 3.2 shall apply.

However, items (A) and (D) shall be changed to the following

A. Test circuit shall be the circuit connections shown in Appendix I, II, IV, or V. In the case of a 100 V connection mechanism, the circuit connection shall be that of Appendix Figure XI. However, for products with external DC input, a CDN specified in JIS C 61000-4-6 shall be inserted between the power conditioner and the DC power supply and terminated with a 50Ω resistor. If inserting a CDN would prevent normal operation, the CDN need not be inserted.

   The arrangement at the time of measurement shall be as shown in Appendix Figure VI. Further, the DC power source can be a storage battery capable of supplying the rated input.

D. The DC power source setting shall be set in consultation with the certification applicant so that the charging power of the storage battery or other device is rated for the measurement in the forward conversion mode. When measuring the conversion standby mode, the power conditioner shall be set in consultation with the certification applicant to be in the conversion standby mode.

   In the case of multiple DC energy sources, the system shall operate under the operating conditions that maximize the DC energy source disturbance.

   In addition, add a (J) term.

J. For the DC terminal conducted disturbance, all DC power conversion devices shall be subject to measurement in the externally connected configuration.

[Measurement method].

A. Measure the noise terminal voltage at the AC output terminal of the power conditioner.

B. At the DC input terminal of the power conditioner (but only in the case of those with an external DC input), measure the noise terminal voltage using a high-impedance probe.

C. For products that can supply power to loads for independent operation even when not in independent operation, the terminals for independent loads in interconnected operation shall also be subject to measurement. Conducted disturbance shall be measured using a high-impedance probe.

D. In the case where the system includes storage batteries, etc., the above test shall be conducted under the test conditions of [The system includes storage batteries, etc., and is in the forward

conversion mode].

[Judgment criteria]

The noise terminal voltage of the AC output terminal shall be less than or equal to the following values.

**Table 7.1.1-5 Tolerance of terminal voltage**

| Frequency range (MHz) | Noise terminal voltage dB(μV) Quasi-peak value |
|---|---|
| More than 0.15 and less than 0.5 | 66～56 |
| More than 0.5 and less than 5 | 56 |
| More than 5 and less than 30 | 60 |

- The noise terminal voltage of the DC output terminal and the independent load terminal shall be less than or equal to the following values

**Table 7.1.1-6 Tolerance of terminal voltage**

| Frequency range (MHz) | Noise terminal voltage dB(μV) Quasi-peak value |
|---|---|
| More than 0.15 and less than 0.5 | 80 |
| More than 0.5 and less than 5 | 74 |
| More than 5 and less than 30 | 74 |

Note

1) When "~" is included in the allowable values in Tables 7.1.1-5 through 7.1.1-6, the value for each frequency decreases linearly with the logarithm of the frequency.

### 7.1.2 Radiated emission test

[In case the system includes storage battery]

-Perform in each of the reverse conversion/forward conversion mode.

[Test conditions]

Since this test is a system characteristic evaluation test, a DC power supply cannot be used in place of the storage battery in the case of a system including a storage battery.

The standard test conditions for the inverse conversion mode shown in Section 3.2 apply.

However, items A and D will be changed to the following contents.

A. The test circuit shall be the circuit connection shown in Attached Figures I, II, IV or V. In the case of 100V connection mechanism, the circuit connection shown in Attached Figure XII is used.
Refer to CISPR 11 (version 6.2) for the test layout.
Use CMAD for power lines and cables that go out of the test site.
An example of arrangement at the time of measurement is shown in Attached Figure VI.
The DC power supply can be a storage battery capable of supplying the rated input.

D. The DC power supply setting is set so that the output of the inverter becomes the rated output.
When having a plurality of types of DC energy sources, the operation is performed in the operating condition where the DC energy source interfering wave is maximized.

[System includes storage batteries, etc., and is in forward conversion mode]
The standard test conditions for the forward conversion / conversion standby mode shown in Section 3.2 apply.

A. However, items a and d will be changed to the following contents.
The test circuit shall be the circuit connection shown in Attached Figures I, II, IV or V. In the case of 100V connection mechanism, the circuit connection shown in Attached Figure XII is used.
Refer to CISPR 11 (version 6.2) for the test layout. Use CMAD for power lines and cables that go out of the test site.
An example of arrangement at the time of measurement is shown in Attached Figure VI.
The DC power supply can be a storage battery capable of supplying the rated input.

D. The DC power supply setting is set in consultation with the certification applicant so that the charging power of the storage battery or the like is rated when measuring the forward conversion mode.
In addition, when measuring the conversion standby mode, the inverter is set to be in the conversion standby mode in consultation with the certification applicant.
When having a plurality of types of DC energy sources, the operation is performed in the operating condition where the DC energy source interfering wave is maximized.

[Measuring method]

A. The electric field strength is measured with an antenna installed at a distance of 10 m from the edge of the test volume.
However, for small devices defined in CISPR 11 (6.2th edition), the measurement distance can be set to 3 m.
For details, refer to CISPR 11 (6.2th edition).

B. In the case of [when the system includes a storage battery, etc.], the above test is performed under

the test conditions of [when the system includes a storage battery, etc. and is in the forward conversion mode].

[Judgment criteria]

・The radiated emission shall be below the following values.

Table 7.1.2-1 Tolerance for radiated disturbance

| Frequency range (MHz) | Radiated disturbance dB(μV/m) Quasi-peak value | | | |
|---|---|---|---|---|
| | class A | | class B | |
| | 10m method | 3m method | 10m method | 3m method |
| Over 30 but less than 230 | 50 | 60 | 30 | 40 |
| Over 230 but less than 1,000 | 50 | 60 | 37 | 47 |

[Remarks]

~~This test applies to products submitted after February 22, 2021.~~

This test is not mandatory for systems that do not include storage batteries, etc. in the system, or for systems that include storage batteries, etc. and use JIS C 4412-1 or JIS C 4412-2 as standards for structural requirements, etc. However, for products certified without this test, the expiration date shall be February 22, 2026.

The above treatment shall also apply to products that have applied for renewal.

### 7.2 Conduction fault test

In case the system includes storage batteries, etc.

・ Conducted in reverse/forward conversion mode, respectively.

[Test conditions]

The standard test conditions for the inverse conversion mode given in Section 3.2 shall apply, except that Sections D and E shall be changed to the following

D. The DC power setting shall be such that the output of the power conditioner is the rated output. In the case of multiple types of DC energy sources, the DC energy sources shall be operated under the operating conditions that maximize the disturbance. The output (effective power) of the power conditioner shall be set at 100%, 50% and 12.5% of the rated output, respectively. If the output cannot be varied as described above, the maximum and minimum of the output range shall be used.

E. Open the $SW_{LN}$ and set the line impedance to the "standard line impedance" as described in section 4.

In addition, section J shall be added.

J. When implemented in a system, auxiliary equipment other than power conditioners shall be operated normally.

[System includes storage batteries, etc., and is in forward conversion mode]

The standard test conditions for forward conversion/conversion standby mode as described in Section 3.2 shall be applied, with the exception that Sections D and E shall be changed to the following

D. The DC power supply setting shall be set in consultation with the applicant for certification so that the charging power of the storage batteries, etc. is rated when measuring in the forward conversion mode.

When measuring in the conversion standby mode, the power conditioner shall be set in consultation with the applicant for certification so that it is in the conversion standby mode.

In the case of multiple types of DC energy sources, the DC energy sources shall be operated in the operating conditions where the disturbance is maximum.

The charging power of the storage batteries, etc. shall be set in consultation with the applicant for certification to 100%, 50% and 12.5% of the rating specified by the applicant for certification, respectively.

If the output cannot be varied as described above, the maximum and minimum of the output range shall be used.

E. The $SW_{LN}$ shall be opened, and the line impedance shall be set to the "standard line impedance" as described in clause 4.

In addition, section J shall be added.

J. When implemented in a system, auxiliary equipment other than power conditioners shall be operated normally.

[Measurement method].

Operate the power conditioner so that its output (active power) becomes the output set in Section 3.2, 50% and 12.5% of the rated output (minimum of the output range), and measure the AC output voltage (harmonic component) of the power conditioner at that time.

[Judgment criteria]

Harmonic components in the 5kHz to 10kHz band shall be 89dB (μV) or less.

## 8. Electrical environment test

The tests in this section shall be carried out under actual operating conditions.

### 8.1 Grid voltage distortion tolerance test

In the case of a power conditioner with a power factor switching function by power flow, if the error of the power factor during forward power flow does not satisfy the judgment criterion for reverse power flow in Section 4.3, this test shall also be conducted with the power factor set to the power factor during forward power flow.

If the error of the power factor at the forward power flow satisfies the criterion for the reverse power flow in clause 4.3, but the power factor at the forward power flow is not included in the specified power factor range for the reverse power flow, the test shall be conducted with the range extended so that the specified power factor range includes the power factor at the forward power flow.

[Test conditions]

The standard test conditions for the inverse conversion mode given in section 3.2 apply.

However, clauses B, D and E shall be changed to the following

B. The AC power supply shall be operated at rated voltage and frequency, and voltage distortion shall be superimposed so that the total harmonic distortion factor of the voltage is 5% (e.g., 3rd order: 2.9%, 5th order: 2.9%, 7th order: 2.9%; for three-phase equipment, 4th order, etc., shall be used instead of 3rd order).

D. The DC power setting should be such that the output of the power conditioner is the rated output. If more than one type of DC energy source is used, all DC energy sources shall be operated. Set the output (active power) of the power conditioner to be 50% of the output and rated output set in Section 3.2.

E. The $SW_{LN}$ shall be opened, and the line impedance shall be set to the "standard line impedance" as described in Section 4.

In addition, section J shall be added.

J. When implemented in a system, auxiliary equipment other than the power conditioner shall be operated normally.

[Measurement method]

Measure the AC output power and power factor of the output section of the power conditioner with a 5% voltage distortion superimposed on the grid voltage.

At the same time, measure the AC output current (harmonic component) as a reference value.

[Judgment criteria]

The judgment criteria shown in Section 4.3 shall be applied.

Furthermore, stable operation shall be possible at each output.

The "Judgment criteria" in section 4.3 are restated.

【For power conditioners that include solar cells as the DC energy source】

When operated at the specified power factor, the reactive power value error shall be as follows or the power factor error shall be within ±0.005.

The apparent power and active power shall be measured values.

Furthermore, in the case of a power conditioner with a power factor switching function by power flow, if the criteria for determining the power factor at forward power flow follow the reactive power margin of error and power factor margin of error when operated at the specified power factor described above, the power factor value shall include a power factor value of 0.95 or more. If not, the operating power factor shall be 0.95 or higher.

The same errors allowed in the case of the specified power factor shall be allowed in the same manner.

③. When the power conditioner output changes according to the operating power factor

$$\left| \frac{\sqrt{\text{apparent power}^2 - \text{active power}^2}}{Maximum\ specified\ power\ output} - \frac{\text{apparent power} \times \sqrt{1 - Setting\ power\ factor^2}}{Maximum\ specified\ power\ output} \right| \leq 0.03$$

④. When the power conditioner has a specified output regardless of the operating power factor

$$\left| \frac{\sqrt{\text{apparent power}^2 - \text{active power}^2}}{Maximum\ specified\ power\ output} - \frac{\text{apparent power} \times \sqrt{1 - Setting\ power\ factor^2}}{Maximum\ specified\ power\ output} \right| \leq 0.05$$

For a power conditioner with a power factor switching function by power flow, if the operating power factor at forward power flow is not within the reactive power margin of error and power factor error range when operated at the specified power factor and is 0.95 or more, the power factor error at forward power flow does not satisfy the judgment criteria in Section 4.3 in the power factor range at the specified power factor Judgment.

[Note].

In a complex type power conditioner where the active power output is constant up to a certain operating power factor regardless of the operating power factor, and above a certain operating power factor, the active power output varies according to the operating power factor, the judgment criteria (1) or (2) should be used according to the operating mode to which the operating power factor applies.

【For power conditioners that do not include solar cells as a source of DC energy】

The operating power factor shall be 0.95 or higher. In addition, the allowable error when operating at the specified power factor shall be accepted as well.

### 8.2 Grid voltage unbalance test

This test is applicable to equipment whose electrical system is single-phase 3-wire and 3-phase 3-wire. In addition, for power conditioners with a power factor switching function by power flow, if the error in the power factor during forward power flow does not satisfy the judgment criteria for reverse power flow in Section 4.3, this test shall also be conducted with the power factor set to the power factor during forward power flow.

If the error of the power factor at the forward power flow satisfies the criterion for the reverse power flow in clause 4.3, but the power factor at the forward power flow is not included in the specified power factor range for the reverse power flow, the test shall be conducted with the range extended so that the specified power factor range includes the power factor at the forward power flow.

[Test conditions]

The standard test conditions for the reverse conversion mode as described in section 3.2 shall apply, except that section E shall be changed as follows:

E. The $SW_{LN}$ shall be opened, and the line impedance shall be set to the "standard line impedance" as described in Section 4.

[Measurement Method]

[In the case of a single-phase three-wire system]

A. After the system voltage is operated at the rated voltage value of each phase of the power conditioner, the following conditions are performed simultaneously, and the AC output power, AC output current (harmonic components) and power factor are measured for each phase.

- Change the system voltage from the single phase (U-N) rated value of the power conditioner to 107V.
- Change the system voltage from the single phase (V-N) rating of the power conditioner to 95V.

B. After operating the system voltage at the rated voltage value of each phase of the power conditioner, the following conditions shall be performed simultaneously, and the AC output power, AC output current (harmonic components), and power factor shall be measured for each phase.

- Change the system voltage from the single phase (U-N) rated value of the power conditioner to 95V.
- Change the system voltage from the single phase (V-N) rating of the power conditioner to 107V.

C. Harmonics are measured up to the 40th order.

[In the case of a three-phase, three-wire system]

A. After the system voltage is operated at the rated voltage value of each phase of the power

conditioner, the following conditions are performed simultaneously, and the AC output power, AC output current (harmonic components) and power factor are measured for each phase.

- Change the system voltage from the single phase (U-V) rated value of the power conditioner to 222V.
- Change the system voltage from the single phase (V-W) rating of the power conditioner to 182V.

B. After operating the system voltage at the rated voltage value of each phase of the power conditioner, the following conditions shall be performed simultaneously, and the AC output power, AC output current (harmonic components) and power factor shall be measured for each phase.

- Change the system voltage from the single phase (U-V) rated value of the power conditioner to 182V.
- Change the system voltage from the single phase (V-W) rating of the power conditioner to 222V.

C. After operating the system voltage at the rated voltage value of each phase of the power conditioner, the following conditions shall be carried out simultaneously, and the AC output power, AC output current (harmonic components) and power factor shall be measured for each phase.

- Change the system voltage from the single-phase (V-W) rated value of the power conditioner to 222V.
- Change the system voltage from the single phase (W-U) rating of the power conditioner to 182V.

D. After operating the system voltage at the rated voltage value of each phase of the power conditioner, the following conditions shall be performed simultaneously, and the AC output power, AC output current (harmonic components) and power factor shall be measured for each phase.

- Change the system voltage from the single phase (V-W) rated value of the power conditioner to 182V.
- Change the system voltage from the single phase (W-U) rating of the power conditioner to 222V.

E. After operating the system voltage at the rated voltage value of each phase of the power conditioner, simultaneously perform the following conditions and measure the AC output power, AC output current (harmonic components) and power factor for each phase.

- Change the system voltage from the single phase (W-U) rated value of the power conditioner to 222V.
- Change the system voltage from the single phase (U-V) rating of the power conditioner to

182V.

F. After operating the system voltage at the rated voltage value of each phase of the power conditioner, measure the AC output power, AC output current (harmonic components), and power factor for each phase by performing the following conditions simultaneously.

- Change the system voltage from the single phase (W-U) rated value of the power conditioner to 182V.
- The system voltage is varied from the single phase (U-V) rating of the power conditioner to 222V.

G. Harmonics are measured up to the 40th order.

[Judgement criteria]

A. The criteria set out in paragraph 4.1 B shall apply.

Section 4.1 B is restated.

The output current distortion factor shall be 5% or less for overall harmonic current distortion factor and 3% or less for each order harmonic current distortion factor.

The overall harmonic current distortion factor DF shall be determined by the following formula

$$DF = \frac{\sqrt{\sum(i_{ACn})^2}}{i_{ACO}} \times 100(\%)$$

$i_{ACn}$: effective value of the nth harmonic current component of the output current of the power conditioner (A)

$i_{ACO}$: RMS value of AC rated current of the power conditioner (A)

$n$: Harmonic order 2 to 40 orders.

B. The machine must be capable of stable operation.

[In the case of single-phase equipment]

In addition to the above criteria, the following criteria shall also apply.

C. The criteria given in clause 4.3 shall apply.

Note that the criteria in 4.3 are reiterated in the criteria in 8.1.

### 8.3 Surge immunity test

[In case the system includes storage battery.]

-Perform in each of the reverse conversion/forward conversion mode.

[Test conditions]

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

~~[In case the system includes storage battery]~~

~~The standard test conditions for forward conversion/conversion standby mode shown in Section 3.2 is applied.~~

~~However, the item D is changed to the following contents.~~

~~D. Set the DC power supply in consultation with the certification applicant so that all DC energy sources are operated and the charging power for storage battery at its rated power. In addition, when measuring in the conversion standby mode, set the inverter to be in the conversion standby mode in consultation with the certification applicant.~~

[Measuring method]

A. Apply the following 1kV voltage surges between the AC terminals: 3 times each positive and negative polarity at phase 0°, 3 times positive polarity at 90°, and 3 times negative polarity at phase 270°. Tests at levels lower than the specified level are not required.
   - Voltage waveform 1.2/50 μs
   - Current waveform 8/20 μs

B. Apply the following 2kV voltage surges between the AC terminal and ground: 3 times each positive and negative polarity at phase 0°, 3 times positive polarity at 90°, and 3 times negative polarity at phase 270°.
   Tests at levels lower than the specified level are not required.
   - Voltage waveform 1.2/50 μs
   - Current waveform 8/20 μs

The application conditions are in accordance with JIS C 61000-4-5:2018 "Electromagnetic Compatibility-Part 4-5: Test and measurement technology-Surge immunity test".

.

[Judgment criteria]

JIS C 61000-6-1:2019 Performance criteria B specified in "Electromagnetic Compatibility-Part 6-1: Common Standards-Immunity in residential, commercial, and light industrial environments".

If the operation is stopped, restart it automatically. However, stoppage due to detection of system voltage abnormality and/or system frequency abnormality is not judged as a malfunction.

### 8.4 Noise tolerance test

8.7 Not applicable since it is the same test as the electrical fast transient/burst immunity (EFT/B) test.

### 8.5 Electrostatic discharge immunity test

~~[In case the system includes storage battery]~~

~~- Perform in each of the reverse conversion/forward conversion mode.~~

[Test conditions]

Since this test is a system characteristic evaluation test, in the case of a system including a storage battery, a DC power supply cannot be used in place of the storage battery.

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

~~[In case the system includes storage battery]~~

~~The standard test conditions for forward conversion/conversion standby mode shown in Section 3.2 is applied.~~

~~However, the item D is changed to the following contents.~~

~~D. Set the DC power supply in consultation with the certification applicant so that all DC energy sources are operated and the charging power for storage battery at its rated power. In addition, when measuring in the conversion standby mode, set the inverter to be in the conversion standby mode in consultation with the certification applicant.~~

[Measuring method]

A. Immunity according to JIS C 61000-4-2:2012 "Electromagnetic Compatibility-Part 4: Test and measurement technology-Section 2: Electrostatic discharge immunity test" is applied. The test level is 4kV for contact discharge and 8kV for air discharge.

~~B. In [the system includes a storage battery], the above test is performed under the test conditions of [the system includes a storage battery, and in the forward conversion mode].~~

[Judgment criteria]

JIS C 61000-6-1: Performance criteria B specified in 2019.

### 8.6 Radiated radio frequency electromagnetic field immunity test

~~[In case the system includes storage battery]~~

~~- Perform in each of the reverse conversion/forward conversion mode.~~

[Test conditions]

Since this test is a system characteristic evaluation test, in the case of a system including a storage battery, a DC power supply cannot be used in place of the storage battery.

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

~~[In case the system includes storage battery]~~

~~The standard test conditions for forward conversion/conversion standby mode shown in Section 3.2 is~~

~~applied.~~

~~However, the item D is changed to the following contents.~~

~~D. Set the DC power supply in consultation with the certification applicant so that all DC energy sources are operated and the charging power for storage battery at its rated power. In addition, when measuring in the conversion standby mode, set the inverter to be in the conversion standby mode in consultation with the certification applicant.~~

[Measuring method]

A. JIS C 61000-4-3:2012 “Electromagnetic Compatibility-Part 4-3: Test and measurement technology-Radio frequency radio frequency electromagnetic field immunity test” shall be followed. The test level is 80HzM-1000MHz, electric field strength 3V/m, AM modulation (1kHz) 80%.

~~B. In [the system includes a storage battery], the above test is performed under the test conditions of [the system includes a storage battery, and in the forward conversion mode].~~

[Judgment criteria]

JIS C 61000-6-1: Performance criteria A specified in 2019.

### 8.7 Electrical fast transient/burst immunity (EFT/B) test

~~[In case the system includes storage battery]~~

~~- Implement in each of reverse conversion/forward conversion mode~~

[Test condition]

Since this test is a system characteristic evaluation test, in the case of a system including a storage battery, a DC power supply cannot be used in place of the storage battery.

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

~~[In case the system includes storage battery]~~

~~The standard test conditions for forward conversion/conversion standby mode shown in Section 3.2 is applied.~~

~~However, the D item is changed to the following contents.~~

~~D. Set the DC power supply in consultation with the certification applicant so that all DC energy sources are operated and the charging power for storage batteries, etc. is rated. When measuring in conversion standby mode, set the inverter to be in conversion standby mode after consultation with the certification applicant.~~

[Measuring method]

A. The application conditions conform to JIS C 61000-4-4:2015 "Electromagnetic Compatibility-Part 4-4: Test and measurement technology-Electrical fast transient/burst immunity test". The test level and repetition rate are shown in Table 8-7-1. Application to the DC input terminal and the signal/control port uses a capacitive coupling clamp.

Table 8.7-1 EFT/B test levels

| AC output terminal and protective ground | | DC input terminal and signal/control port<br>Applies only to ports where manufacturer's specifications may connect cables longer than 3m. | |
|---|---|---|---|
| Voltage Peak(kV) | Repetition rate（kHz） | Voltage Peak(kV) | Repetition rate（kHz） |
| 1.0 | 5.0 | 0.5 | 5.0 |

[Judgment criteria]

JIS C 61000-6-1: Performance criteria B specified in 2019.

## 8.8 Immunity test for conducted disturbances induced by radio frequency electromagnetic fields

~~[In case the system includes storage battery]~~

~~・Implement in each of reverse conversion/forward conversion mode~~

[Test condition]

Since this test is a system characteristic evaluation test, in the case of a system including a storage battery, a DC power supply cannot be used in place of the storage battery.

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

~~[In case the system includes storage battery]~~

~~The standard test conditions for forward conversion/conversion standby mode shown in Section 3.2 is applied.~~

~~However, the D item is changed to the following contents.~~

~~D. Set the DC power supply in consultation with the certification applicant so that all DC energy sources are operated and the charging power for storage batteries, etc. is rated. When measuring in conversion standby mode, set the inverter to be in conversion standby mode after consultation with the certification applicant.~~

[Measuring method]

A. The application conditions are in accordance with JIS C 61000-4-6: 2017 "Electromagnetic Compatibility-Part 4-6: Test and measurement technology-Immunity against conduction interference induced by radio frequency electromagnetic fields".
The test level is; AC output terminal, DC input terminal (applicable only to ports to which cables larger than 3 m may be connected according to the manufacturer's specifications), Signal / control port (applicable only to ports to which cables over 3m may be connected according to the manufacturer's specifications), For all of these, the frequency is 0.15MHz to 80MHz, the voltage level (e.m.f.) is 3V, and the AM modulation (1kHz) is 80%.

~~B. In [the system includes a storage battery], the above test is performed under the test conditions of [the system includes a storage battery, and in the forward conversion mode].~~

[Judgment criteria]

JIS C 61000-6-1: Performance criteria A specified in 2019.

### 8.9 Power frequency magnetic field immunity test

In a system that includes a storage battery, this applies to [storage battery integrated type]. Not applicable to [Battery separation type].

~~[In case the system includes storage battery]~~

~~・Implement in each of reverse conversion/forward conversion mode~~

[Test condition]

Since this test is a system characteristic evaluation test, in the case of a system including a storage battery, a DC power supply cannot be used in place of the storage battery.

The standard test conditions for inverse conversion mode shown in Section 3.2 is applied.

~~[In case the system includes storage battery]~~

~~The standard test conditions for forward conversion/conversion standby mode shown in Section 3.2 is applied.~~

~~However, the D item is changed to the following contents.~~

~~D. Set the DC power supply in consultation with the certification applicant so that all DC energy sources are operated and the charging power for storage batteries, etc. is rated. When measuring in conversion standby mode, set the inverter to be in conversion standby mode after consultation with the certification applicant.~~

[Measuring method]

A. The application conditions are in accordance with JIS 61000-4-8: 2016 "Electromagnetic Compatibility-Part 4: Test and measurement technology-Section 8: Power frequency magnetic field immunity test". The test level shall be 3 A / m.

B. ~~[In case the system includes a storage battery], the above test is performed under the test conditions of [the system includes a storage battery, and in the forward conversion mode]~~.

[Judgment criteria]

JIS C 61000-6-1: Performance criteria A specified in 2019.

[Remarks]

Regarding the storage battery integrated type, if it is clear that the system itself including the PCS is the source of noise, consider not applying it as in the case of the storage battery separated type (PCS alone).

## 9. Ambient resistance test

### 9.1 Humidity test

This test is applicable to items intended for indoor use.

[Method of measurement]

Leave the product in an atmosphere with an ambient temperature of 40°C and a relative humidity of 90-95% RH for 48 hours.

[Judgement criteria]

A. Conform to the insulation resistance test in clause 2.1 after standing.

B. After the test in A, the product shall conform to the commercial frequency withstand voltage test in Section 2.2.

### 9.2 Temperature and humidity cycle test

This test applies to those intended for outdoor use.

[Measuring method]

24-hour cycle including low temperature sub-cycle shown in Section 6.3.1 of JIS C 60068-2-38 (JIS C 0028-1988) “Environmental test method (electrical/electronic) temperature/humidity combination (cycle) test method” (Appended figure) Repeat 2a) for 5 cycles.

In the case of micro inverters for AC modules, the maximum temperature of JIS C 60068-2-38 (JIS C 0028-1988) Appendix 2a shall be 85°C.

[Judgment criteria]

A. After the cycle is completed, comply with the insulation resistance test in Section 2.1. If the measured insulation resistance is 0.3 MΩ or more, although it is not compatible with this, the insulation resistance test can be performed after leaving it at 25°C ± 2°C and 65% ± 5% for 24 hours.

B. After the test in A, the product shall comply with the commercial frequency withstand voltage test in Section 2.2.

### 9.3 Water injection test

This test is applicable to systems intended for outdoor use.

| |
|---|
| [System does not contain storage batteries etc.]<br>[Measuring method].<br>Water is poured uniformly at a rate of 3 mm per minute from an inclined direction of approximately 45° for 1 hour under rainfall conditions.<br><br>[Judgment criteria]<br>A. Water level Conform to the insulation resistance test in clause 2.1 while pouring water.<br>B. After the test in “A”, the system shall conform to the commercial frequency withstand voltage test in Section 2.2 while being flooded with water. |
| [System includes storage batteries, etc.]<br>This test shall be conducted in accordance with JIS C 4412-1 or JIS C 4412-2 for both test method and judgment criteria.<br>In accordance with [Remarks]1. of 1. Structural tests. |

### 10. Durability test

| |
|---|
| ~~[In the case that a test other than JIS C 4412-2 is selected for the structural test]~~<br>For relays, switch, etc. with mechanical action, the following tests are to be carried out. However, if the following performance is guaranteed by a known standard, it may be omitted.<br><br>[Measurement method]<br>A. Those that perform protective action by detecting abnormal conditions in the system or inside the power conditioner: Apply a voltage 1.1 times the operating voltage of the component and perform an open-close test 1,000 times with a load equivalent to the control load circuit applied.<br>B. Power conditioners that perform a control action to maintain a certain parameter at a certain level during operation: Apply a voltage 1.1 times the operating voltage of the component and |

perform an open/close test 10,000 times with a load equivalent to the control load circuit applied.

C. Operate more than once a day: Apply a voltage of 1.1 times the operating voltage of the component and perform the open/close test 10,000 times with a load equivalent to that of the control load circuit.

[Judgment criteria]

A. If the voltage is less than 1.1 times the operating voltage after the opening/closing test. After the opening/closing test, the insulation resistance test in Section 2.1 shall be satisfied.

B. After the opening/closing test, the product shall conform to the commercial frequency withstand voltage test in Section 2.2.

C. After the opening/closing test, conduct the "4.7 Temperature Rise Test", and the temperature of each part shall conform to the temperature rise test in Appendix 4, Supplementary Table 3 of the Interpretation of the Ministerial Ordinance Specifying Technical Standards for Electrical Appliances and Materials.

~~[When JIS C 4412-2 is selected for the structural test]~~

~~This test is based on JIS C 4412-2 for both test method and judgment criteria.~~

~~In addition, follow [Remarks]1. of 1. structural test.~~

## 11. Component failure test

[When the system does not include storage batteries, etc.]

[Measurement method]

Open-circuit or short-circuit the components used in the electronic circuit.

[Judgment criteria]

There shall be no risk of ignition.

The details shall be determined in consultation with the applicant for certification.

[In case the system includes storage batteries, etc.]

This test shall be conducted in accordance with JIS C 4412-1 or JIS C 4412-2 for both test method and judgment criteria.

In addition, follow [Remarks]1. of 1. structural test.

## 12. Independent operation test

### 12.1 Independent operation transition test

This test is applied to an inverter having an independent operation function. If islanding operation is possible by connecting the inverter and the disconnecting point of the independent housing, the test

shall be performed integrally with the disconnecting point of the independent case of the other housing.

[Structure]

[Common subject matter]

A. Independent operation shall be performed according to one of the following methods to prevent reverse charging to the grid and asynchronous switching.
If the switchgear for disconnection during interconnection operation and the switchgear for disconnection during independent operation are different, the circuit diagram and sequence of operation shall be checked.

a) In the independent operation, the disconnection from the grid shall be two mechanical relays, or one mechanical relay and one manual relay. (Check by operation sequence etc.)

b) In case there is only one mechanical relay for disconnection from the system during independent operation, and the disconnection point during independent operation is a separate housing from the inverter, it needs the following functions.
The following conditions are also applied to equipment that does not have a function to prevent the disconnection switch from transition to independent operation due to overcurrent detection and that supplies system power to the load via the disconnection point. In addition, we will consider applying the above standards after the next revision of the test method scheduled for June 2020.

- The system must have a lock function that reliably detects a power failure on the system side and cannot re-parallelize. (Check by the operation sequence etc.)
- If the switch for disconnection is not opened due to welding of contacts (disconnection from the system only by the gate block), it must have a function to prevent the transition to the independent operation.
- If the system has a function automatic transition to grid interconnection operation when the grid is recovered during independent operation, disconnect the inverter, and start operation after a certain period of time.

| |
|---|
| [In case without a function to connect the inverter to the independent circuit]<br>B. The independent operation output shall be supplied from the dedicated output terminal or the dedicated outlet and shall be labeled accordingly. This item does not apply if the disconnection location during independent operation is a case separate from the inverter.<br>C. When the auxiliary equipment such as a transition switch is included in the package and is supplied from the dedicated output terminal, the independent operation output power is not connected to the grid. |
| [In case with a function to connect the inverter to the independent circuit] |

B. Even if the switch installed in the main route where the power from the grid flows to the load equipment during the grid interconnection operation, even if it is welded, do not reverse charge or asynchronously reconnection the grid during independent operation. (Checked by the operation sequence etc.)

C. If the system recovers power during independent operation, supply power from the system to the load connection port after stopping the reverse converter, etc. by the gate block. In addition, the interconnection operation should start after a certain period of time. In the case of a inverter that includes a solar cell as a DC energy source, the operating power factor must also operate as described in the specifications and reach the specified power factor.

D. If there is a dedicated output terminal or a dedicated outlet for independent operation output, indicate that fact.

[Test conditions]

[In case without a function to connect the inverter to the independent circuit]

The standard test conditions for forward conversion/conversion standby mode shown in Section 3.2 is applied.

In addition, the J term is added.

J. Independent output is no load.

[In case the inverter has a function to connect to the independent circuit]

A. For the test circuit, connect the AC power supply to the system connection port of the inverter, and connect the load to the load connection port, the dedicated output terminal, or the dedicated outlet.

B. The AC power supply operates at the rated voltage and rated frequency.

C. The line impedance shall be short-circuited.

D. The protective relay settings of the protective device shall be the factory default values (as stated in the certification application form).

E. Set the load to be the maximum output of the reverse converter inside the power conditioner, etc. However, if the rated output for independent operation is smaller than the maximum output for grid-connected operation, the load shall be set so that the rated output for independent operation is the rated output for grid-connected operation.

[Measuring method]

A. During the interconnection operation, the $SW_{CB}$ is opened to simulate a power failure and switch to a state of independent operation.

B. During independent operation, $SW_{CB}$ is closed, and the power is restored to switch to the state of interconnection operation.

If the power conditioner automatically performs interconnection operation after power recovery, measure the time from power recovery to interconnection operation.
Also, when performing interconnection operation using the main unit, remote controller, etc., check the time until the interconnection operation starts after the power is restored.

C. If it has a power conditioner connection function to an independent circuit, the voltage at the power conditioner connection port is measured during the period from power recovery to interconnection operation.
In the case of a power conditioner with a load connection port, the voltage of the load connection port is measured during the period from power recovery to interconnection operation.

D. In order to confirm the operation when there is a system abnormality during the period from the power recovery in the above item B to the interconnection operation, make measurements according to 3.2.9.2 [Measurement method] of the input prevention test 2 for a certain period of time after the power recovery.

E. If b) of A ([Structure] [Common items] section) is applicable, perform the test of item A above with the contacts of the disconnection switch welded (short-circuited).

Details such as the measurement method will be decided in consultation with the certification applicant.

[Judgment criteria]

A. When switching from interconnected operation to independent operation, the system shall be safely switched to independent operation after disconnection.

B. When switching from independent operation to interconnected operation, the gate block shall cause the reverse converter and other equipment to stop and the independent operation output to cease.
After the power is restored, the system shall safely switch to interconnection operation after the time specified in the specifications or after a predetermined period of time has elapsed.
In the case of an inverter that includes a solar cell as a DC energy source, the operating power factor must also operate in the sequence and reach the specified power factor.

C. Satisfy the [Judgment criteria] of 3.2.9.2 the grid recovery test2 - constant time reconnecting prevention.

D. If structure B. b) is applied, the contact of the disconnect switch must be welded (short-circuited), and the transition from interconnected operation to independent operation must be prevented. The method of simulating welding will be decided in consultation with the applicant for certification.

E. When the inverter connection function to the independent operation circuit is provided, the

voltage application stop time for the inverter connection port and the load connection port must be 3 seconds or more after the independent operation of the inverter is stopped.

In addition, if the inverter can be operated independently by connecting the disconnection point of the separate housing when it is independent, and another inverter can be connected to the independent circuit, the time from when the independent operation output is stopped until the line is closed in another housing must be 3 seconds or more.

The application of this test will be considered after the next revision of the test method scheduled for January 2021.

[Remarks]

When connecting the independent operation output to a distribution board, etc. and using the existing indoor wiring, etc., not the independent operation performance of the inverter, but the power distribution of the house or building where the inverter is installed needs the authentication.

Although up until here, the test method for the grid interconnection protection device for small distributed power generation systems is out of the scope, it is generally counted as a case of using the existing indoor wiring for the independent operation output for the grid interconnection protection device for small distributed power generation systems. Therefore, the manual transition switch included in the package with the inverter from the factory would be certified as one product with the inverter, it can be simplified when it needs to prove the grid interconnection onsite.

### 12.2 Independent operation automatic transition test

This test is applied to a power conditioner that has an independent operation function that satisfies the 12.1 independent operation transition test, and also has an independent operation automatic switching function.

The details of the measurement method will be decided after consultation with the applicant for certification.

[Structure]

For devices that have the function of automatic transition between the grid interconnected operation state and the independent mode operation state, the transition time of independent operation (between the simultaneous voltage drop and the simultaneous power failure) must be within the transition time shown in the specification.

[Test conditions]

Follow the test conditions given in Section 1.2.1.

[Measuring method]

A. After the $SW_{CB}$ is opened in the grid interconnected operation state, the disconnection switch is opened, and the time from when the $SW_{CB}$ is opened until the independent operation output is measured.
B. In the independent operation state, set the power consumption of the independent load to be the no-load and the rated output of the independent operation output and measure the independent output voltage and frequency.

[Judgment criteria]

A. The transition time from $SW_{CB}$ opened to the independent mode operation is the not less than the time specified in the specifications.
B. In case of the independent operation state in single-phase 100V system, the voltage range is 101±6V. In case of single-phase 2-wire 200V system and 3-phase 200V system, consider as supplying 100V system power by single-phase 3-wire, the voltage range is 202±12V.
C. The frequency in the independent operation state must be equal to the frequency in the interconnected operation state.

[Remarks]

In the case of automatic switching, it may be assumed that the connection state of the load is not confirmed, so the voltage and frequency standards are applied.

### 12.3 Auxiliary input test

This test has the independent operation function that satisfies the 12.1 independent operation switching test, and is applied to the inverters ① to ③ below.

The auxiliary AC input and the auxiliary DC input are collectively referred to as the auxiliary input. The details of the measurement method will be decided after consultation with the certification applicant.

①. An auxiliary AC input terminal (a terminal to which power is supplied from another emergency AC power supply, etc.) to which an auxiliary AC input power supply is connected between the AC side of the power converter and the disconnection relay. (Hereinafter, referred to as "auxiliary AC input" in this section.)
②. Those that have an auxiliary DC input terminal (a terminal to which power is supplied from another emergency DC power supply, etc.) to which the auxiliary DC input power supply is connected on the DC side of the power converter. (Hereinafter referred to as "auxiliary DC input" in this section.)

③. It has an auxiliary AC input terminal, and the auxiliary AC input power source is connected to the DC side of the power converter through the AC/DC converter inside the inverter. The test items are the same as those of the auxiliary input terminal of ②.

[Construction]

When inputting power from the auxiliary AC input, use an auxiliary AC input relay that shuts off the current in the electrical path between the auxiliary AC input and the AC side of the power converter, and when input power from the auxiliary DC input.

Provide an auxiliary DC input relay for interrupting current in the electric path between the auxiliary DC input and the DC side of the power converter.

The auxiliary AC input relay and the auxiliary DC input relay are collectively referred to as an auxiliary input relay.

It must have the following functions to prevent connection of the auxiliary input to the system.

A. The electric system of the power supply input to the auxiliary AC input should be the same as the electric system of the independent operation output. (Check with the circuit diagram, instruction manual, specifications, etc.) However, single-phase two-wire and single-phase three-wire are considered to be the same.
B. When the disconnecting relay is closed, it shall have a lock mechanism that does not close the auxiliary input relay. (Check by the operation sequence etc.)
C. When the auxiliary relay switch is closed, it must have a lock mechanism that prevents the disconnection relay from being closed. (Check by the operation sequence etc.)
D. Those with auxiliary DC input shall have a reverse power protection mechanism that prevents reverse DC from the auxiliary DC input.

The following tests apply to those that have an auxiliary AC input, and that provide independent operation output with power supplied from the auxiliary AC input.

E. Due to the influence of the output voltage of the auxiliary AC power supply, the independent operation output voltage should not deviate from the range of 12.2 independent operation automatic transition test judgment criteria B.

The following items apply to those having a function of performing reverse conversion in the power conversion device in the state of input from the auxiliary AC power supply.

F. The gate is blocked when the auxiliary AC input relay is closed.
G. In case the input from the auxiliary AC power supply stops or deviates from the input range, the auxiliary AC input relay should open, or gate blocked within 1 second.

H. When releasing the gate block without the auxiliary AC input, open the auxiliary AC relay.

[Test conditions]

A. The test circuit shall be the circuit connection shown in Appendix I, II, IV or V. In the case of a 100V connection mechanism, use the circuit connection shown in Appendix XII.
B. Connect a resistance load that consumes the rated power for the independent operation output to the independent operation output.
C. The auxiliary input is connected to a power supply that can supply the rated voltage and power specified in the specifications. The power supply generates the voltage specified in the specifications.
D. The AC power supply operates at the rated voltage and rated frequency.
E. Set the output when the inverter is connected to the grid to the rated output.
F. The line impedance shall be short-circuited.
G. The protective relay settings of the protective device shall be the factory default values (as stated in the certification application form).
H. Turn on the $SW_{LD}$ and set the load to consume the rated power when the inverter is connected to the grid.

[Measuring method]

A. For products with specifications that allow interconnected operation with the power supply connected to the auxiliary input operating, the operation is switched to independent operation while the power supply connected to the auxiliary input is operating at the voltage specified in the specifications, and the operation is switched to a state in which power is supplied from the auxiliary input.

   For products with specifications that do not allow interconnected operation with the power supply connected to the auxiliary input in operation, the operation is switched to independent operation from the state in which the power supply connected to the auxiliary input is in operation at the voltage specified in the specifications, and the operation is switched to the state in which power is supplied from the auxiliary input.
B. 12.1 Structure of the independent operation transition test for the device with the configuration of A item b), the operation sequence operation of item A above is performed by simulating the welding (short circuit) state of the disconnecting switch contacts.
C. When the power supply connected to the auxiliary input is operated at the voltage specified in the specifications and the power from the auxiliary input is maintained for 10 seconds or more during independent operation, transition to the gird interconnection state.
D. If the auxiliary input relay is not at two mechanical disconnection relay points, the auxiliary input

relay is closed during independent operation, and the contact sequence of the auxiliary input relay is welded (short circuit) by performing the operation sequence operation in the above section C. Simulate the state.

E. For those with an auxiliary DC input, perform the operation in item A with the auxiliary DC input short-circuited.
Note that in this case, the DC power supply under the test condition C is disconnected.

The following test is applied to the one that has an auxiliary AC input and produces an independent output when power is supplied from the auxiliary AC input.

F. While operating the power supply connected to the auxiliary AC input at the voltage specified in the specifications, shift to independent operation. Gradually reduce to a voltage lower than the minimum input voltage specified by the certification applicant and measure the independent operation output voltage.

G. While operating the power supply connected to the auxiliary AC input at the voltage specified in the specifications, shift to independent operation. Gradually increase to a voltage lower than the maximum input voltage specified by the certification applicant and measure the independent operation output voltage.

The following test is applied to a power conversion device having an auxiliary AC input and having a function of performing an inverse conversion operation with the auxiliary AC power supply being input.

H. Transition to independent operation with the power supply connected to the auxiliary AC input stopped. After that, the power supply connected to the auxiliary AC input is operated.

I. While operating the power supply connected to the auxiliary AC input at the voltage specified in the specifications, transition to independent operation. After that, the power supply connected to the auxiliary AC input is stopped for 1 second or longer.

The following tests apply to those with an auxiliary AC input and the auxiliary AC input relay not opening when the auxiliary AC power supply is stopped.

J. After the end of the test in item I, transition to grid interconnection operation.

[Judgment criteria]

A. In case transition from the auxiliary input to the state where power is supplied, the auxiliary input relay shall be closed after the disconnection relay opened and gate blocked.

B. 12.1 Structure of independent operation relay test A. For the device of b), the auxiliary input relay shall not be closed.

C. After the auxiliary input relay is closed, the disconnection relay is closed and transition to the grid interconnection operation. However, in the case of the specifications that cannot be interconnected while the power supply connected to the auxiliary input is operating, stop the operation (open the disconnection relay and gate blocked).
D. The disconnection relay must not be reconnected.
E. The operation of the reverse power flow protection function has been confirmed from the auxiliary DC input section, and there is no damage to any part.
F. Independent operation output voltage 12.2 Independent operation automatic transition test Judgment criteria B. Do not deviate from the range of. If it deviates, the independent operation output should stop within 1 second.
G. Independent operation output voltage 12.2 Independent operation automatic transition test Judgment criteria B. Do not deviate from the range of. If it deviates, the independent operation output should stop within 1 second.
H. The auxiliary AC input switch shall be closed when the gate blocked.
I. Open the auxiliary AC input switch within 1 second after stopping the auxiliary AC power supply. Or gate blocked.
J. The auxiliary AC input switch must be opened before the gate blocked.

[Remarks]
Items A to J in [Judgment criteria] correspond to items A to J in [Measurement method] above.

### 12.4 Independent operation disconnection signal disruption test

It is applied when independent operation is possible by connecting the inverter and the disconnection point of another case when it is independent operation.

[Structure]
When connecting between the inverter such as signal lines other than the main circuit and the independent operation disconnection circuit, the structure shall be such that, incorrect wiring does not occur.

[Test conditions]
Follow the test conditions given in Section 12.1.

[Measuring method]
A. In case a signal line other than the main circuit connects between the inverter and the independent operation disconnection circuit, while the connection wiring is not connected, transition from

grid interconnection operation to independent operation state.

B. In case a signal line other than the main circuit connects between the inverter and the independent operation disconnection circuit, while the independent operation disconnection circuit is not available, transition from grid interconnection operation to independent operation state.

[Judgment criteria]

In any case, do not transition to independent operation.

**15. Remote output control confirmation test (specification confirmation of narrowly defined power conditioner)**

This test shall be in accordance with Section 1 of the Remote Output Control Function Test Method.

**16. Remote output control confirmation test (Specification confirmation of broadly defined power conditioner)**

This test shall be in accordance with Section 2 of the Remote Output Control Function Test Method.

**Supplementary provisions**

This test method shall apply to products applied for after the effective date of the test method cover date (the specific effective date will be posted on the "Notices" page of the website).

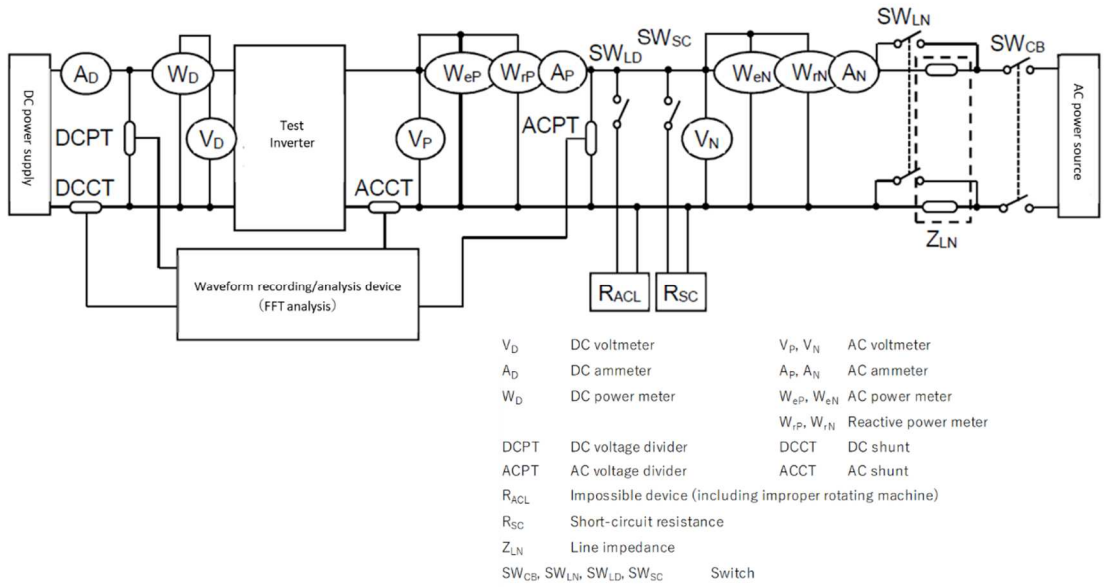
However, if there is an applicable date in the Supplementary Provision of each individual test method, that date shall take precedence.

**APPENDIX**

**Figure I　Test circuit when testing with a DC power supply**

Example for a solar system

*Note: Including the case of using a DC power supply instead of a storage battery in a storage battery system




| | | | |
|---|---|---|---|
| $V_D$ | DC voltmeter | $V_P$, $V_N$ | AC voltmeter |
| $A_D$ | DC ammeter | $A_P$, $A_N$ | AC ammeter |
| $W_D$ | DC power meter | $W_{eP}$, $W_{eN}$ | AC power meter |
| | | $W_{rP}$, $W_{rN}$ | Reactive power meter |
| DCPT | DC voltage divider | DCCT | DC shunt |
| ACPT | AC voltage divider | ACCT | AC shunt |
| $R_{ACL}$ | Impossible device (including improper rotating machine) | | |
| $R_{SC}$ | Short-circuit resistance | | |
| $Z_{LN}$ | Line impedance | | |
| $SW_{CB}$, $SW_{LN}$, $SW_{LD}$, $SW_{SC}$ | Switch | | |

**FigureII　Test circuit for system test**

(Case example for gas engine cogeneration system, fuel cell system, storage battery system, and storage battery mounted on electric vehicles <DC connection type> system)

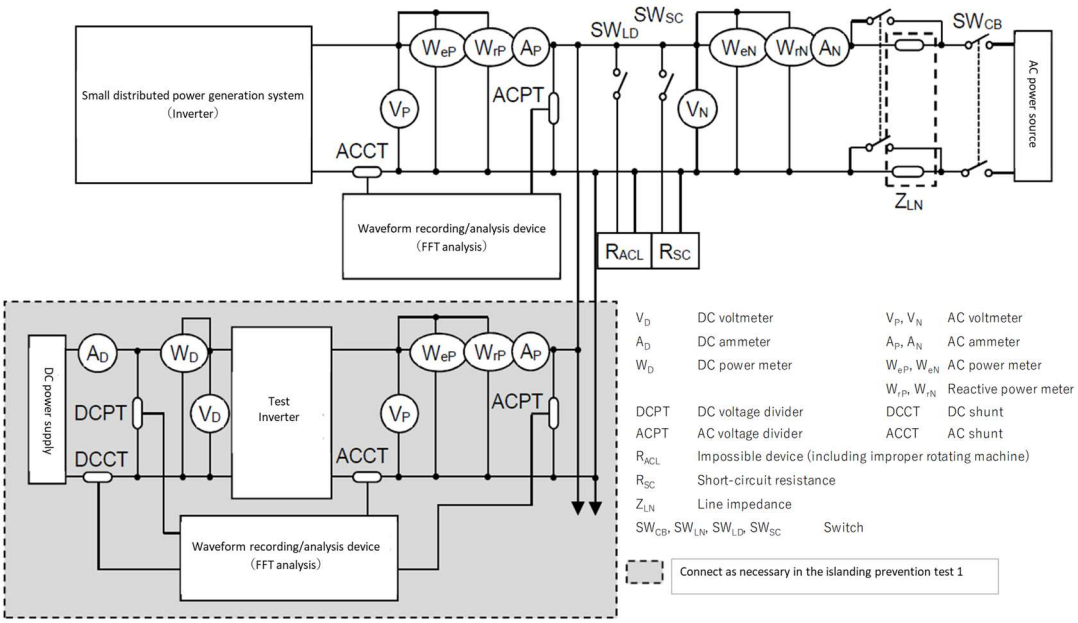
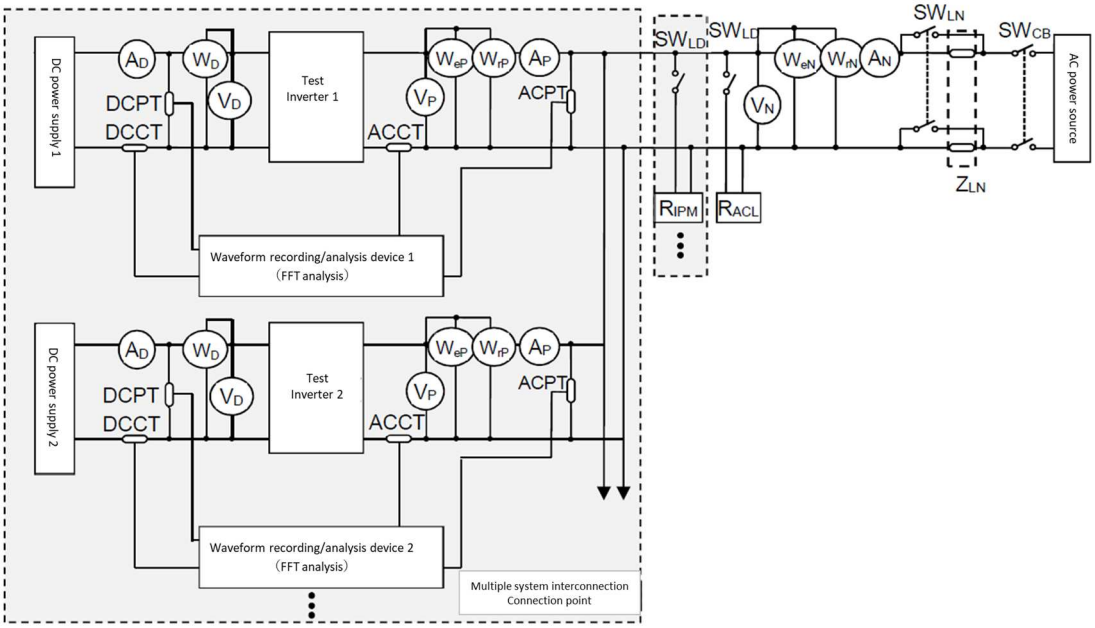


**Figure III　Test circuit when testing with multiple units connected**

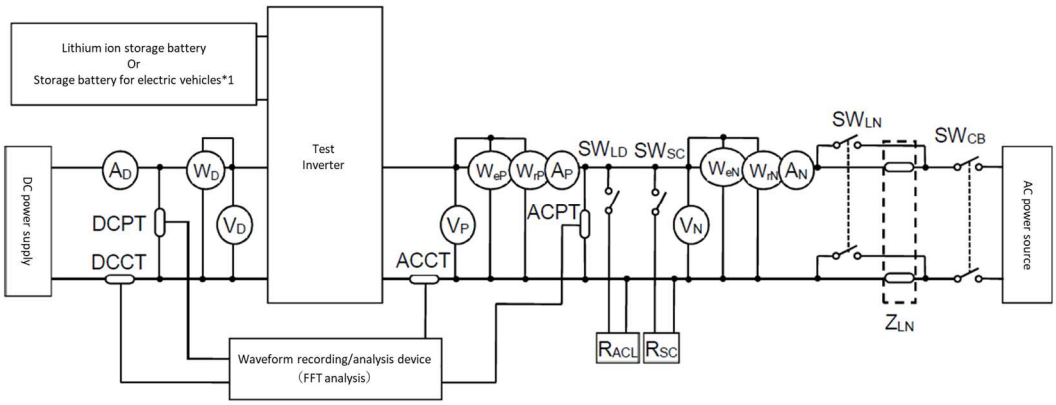
(Example of a photovoltaic power generation system compatible with multiple units)




| | | | | | |
|---|---|---|---|---|---|
| $V_D$ | DC voltmeter | $V_P$ | AC voltmeter | $V_N$ | AC voltmeter |
| $A_D$ | DC ammeter | $A_P$ | AC ammeter | $A_N$ | DC voltmeter |
| $W_D$ | DC power meter | $W_{eP}$ | AC power meter | $W_{eN}$ | AC power meter |
| $W_{rP}$ | Reactive power meter | $W_{rN}$ | Reactive power meter | | |
| DCPT | DC voltage divider | DCCT | DC shunt | | |
| ACPT | AC voltage divider | ACCT | AC shunt | | |
| $R_{ACL}$ | Impossible device (including improper rotating machine) | | | | |
| $R_{SC}$ | Load device | $R_{IPM}$ | Rotating machine load | | |
| $Z_{LN}$ | Line impedance | | | | |

$SW_{CB}$, $SW_{LN}$, $SW_{LD}$, $SW_{S(}$Switch

**Figure IV　Test circuit for testing multiple DC input systems and multi-input systems (Examples of photovoltaic power generation and lithium-ion storage batteries or photovoltaic power generation and storage batteries installed in electric vehicles, etc.)**

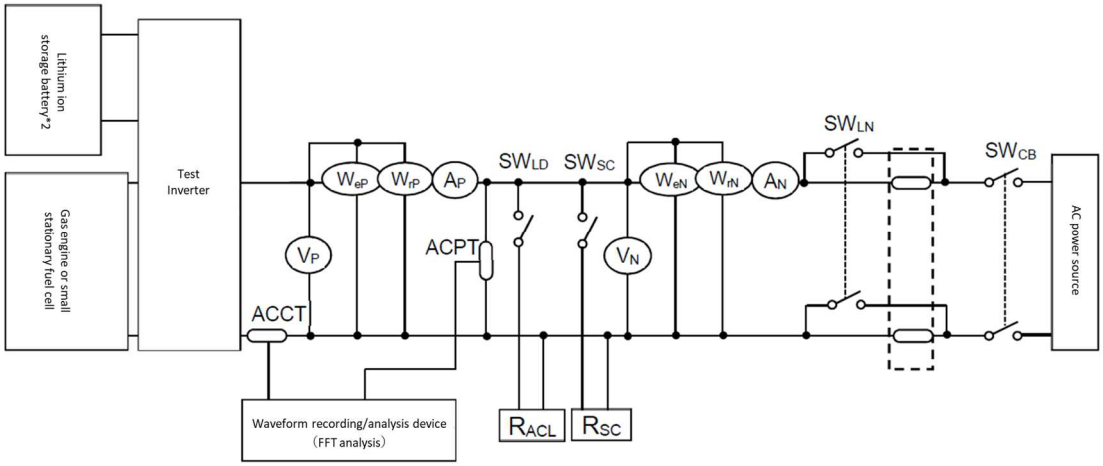



| | | | | | |
|---|---|---|---|---|---|
| $V_D$ | DC voltmeter | $V_P$ | AC voltmeter | $V_N$ | AC voltmeter |
| $A_D$ | DC ammeter | $A_P$ | AC ammeter | $A_N$ | DC voltmeter |
| $W_D$ | DC power meter | $W_{eP}$ | AC power meter | $W_{eN}$ | AC power meter |
| $W_{rP}$ | Reactive power meter | $W_{rN}$ | Reactive power meter | | |
| DCPT | DC voltage divider | DCCT | DC shunt | | |
| ACPT | AC voltage divider | ACCT | AC shunt | | |
| $R_{ACL}$ | Impossible device (including improper rotating machine) | | | | |
| $R_{SC}$ | Load device | $R_{IPM}$ | Rotating machine load | | |
| $Z_{LN}$ | Line impedance | | | | |

$SW_{CB}$, $SW_{LN}$, $SW_{LD}$, $SW_{S(}$Switch

**Figure V　Test circuit for testing multiple DC input systems**

(Cases of gas engine and lithium-ion storage battery or fuel cell and lithium-ion storage battery)



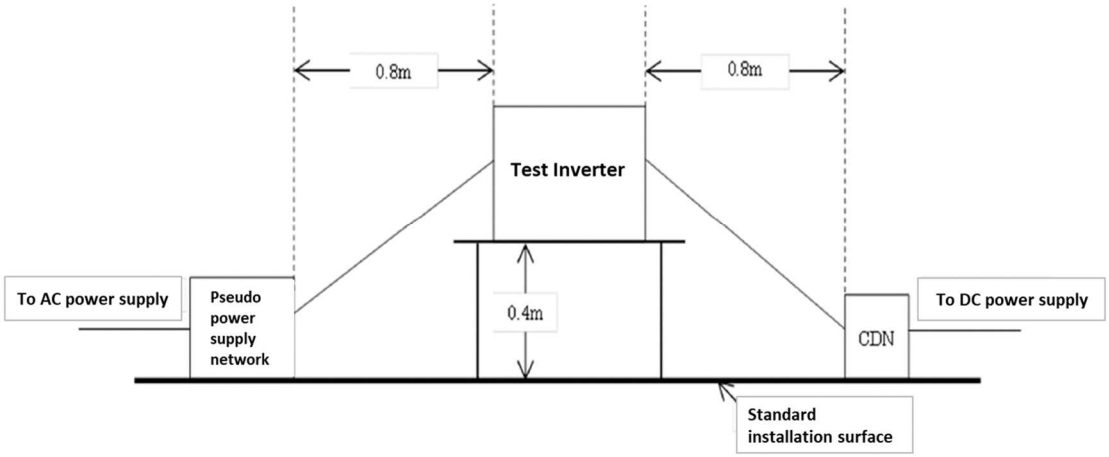

*2　The lithium-ion battery can be replaced with a DC power supply.

However, when using a DC power supply, measure the voltage and current.

Items that require system testing cannot be replaced by a DC power supply.

| | | | | | |
|---|---|---|---|---|---|
| $V_D$ | DC voltmeter | $V_P$ | AC voltmeter | $V_N$ | AC voltmeter |
| $A_D$ | DC ammeter | $A_P$ | AC ammeter | $A_N$ | DC voltmeter |
| $W_D$ | DC power meter | $W_{eP}$ | AC power meter | $W_{eN}$ | AC power meter |
| $W_{rP}$ | Reactive power meter | $W_{rN}$ | Reactive power meter | | |
| DCPT | DC voltage divider | DCCT | DC shunt | | |
| ACPT | AC voltage divider | ACCT | AC shunt | | |
| $R_{ACL}$ | Impossible device (including improper rotating machine) | | | | |
| $R_{SC}$ | Load device | $R_{IPM}$ | Rotating machine load | | |
| $Z_{LN}$ | Line impedance | | | | |
| $SW_{CB}$, $SW_{LN}$, $SW_{LD}$, $SW_{S(}$ | Switch | | | | |

**Figure VI－1　Location of test inverters for radio disturbance test (old standard)**




NB: The Test Inverter must be at least 0.8m from any metal other than the reference ground plate.

**Figure VI－2 Location of test inverters for radio disturbance test (old standard)**

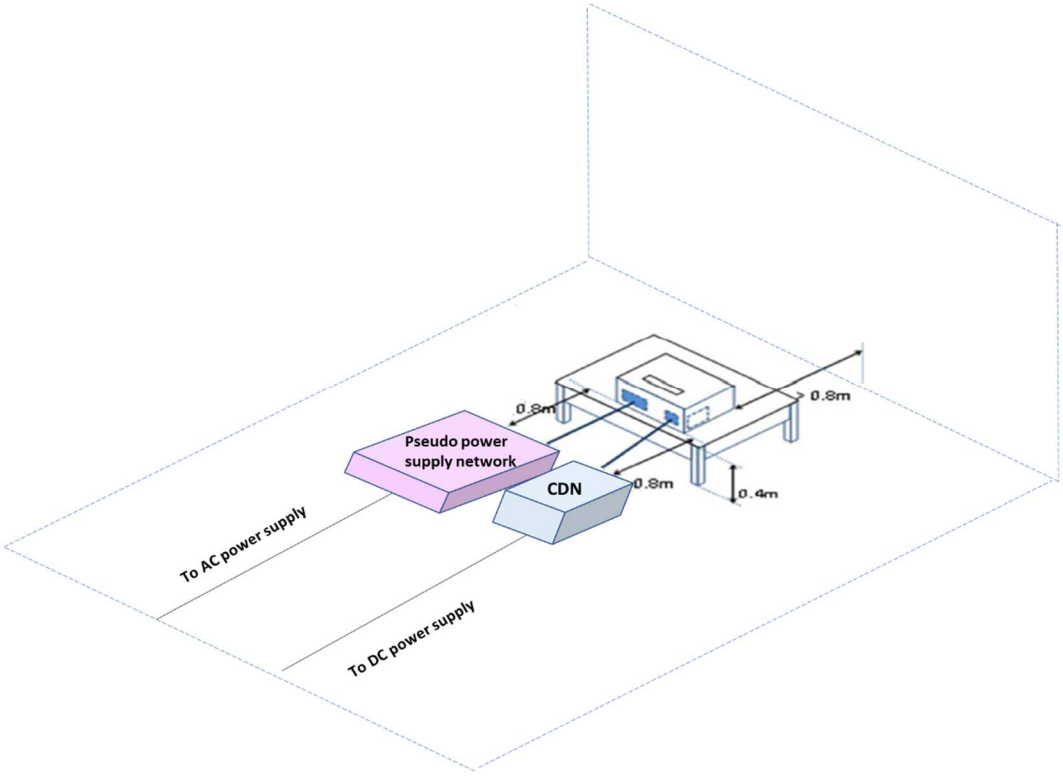
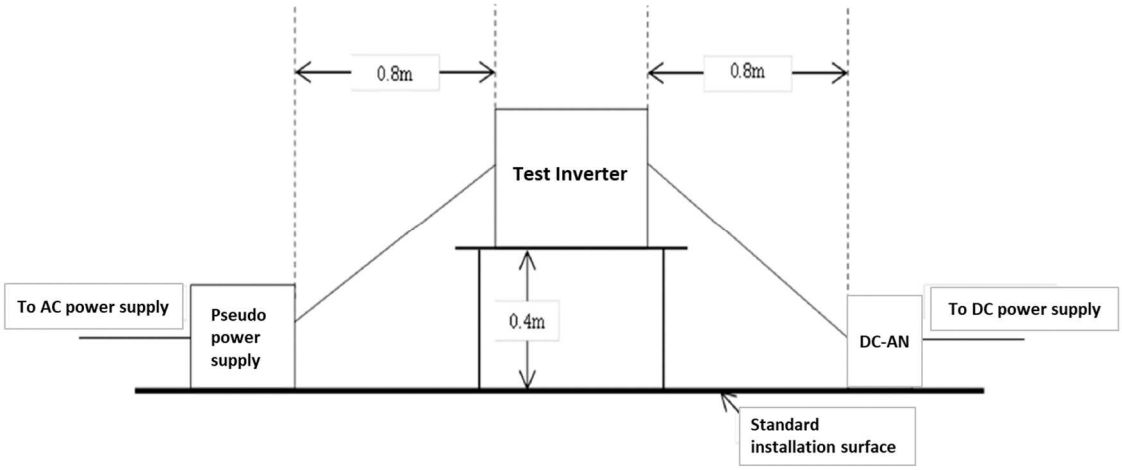


**Figure VI－3 Location of test inverters for radio disturbance test**




NB: The Test Inverter must be at least 0.8m from any metal other than the reference ground plate.

**Figure VI－4 Location of test inverters for radio disturbance test**

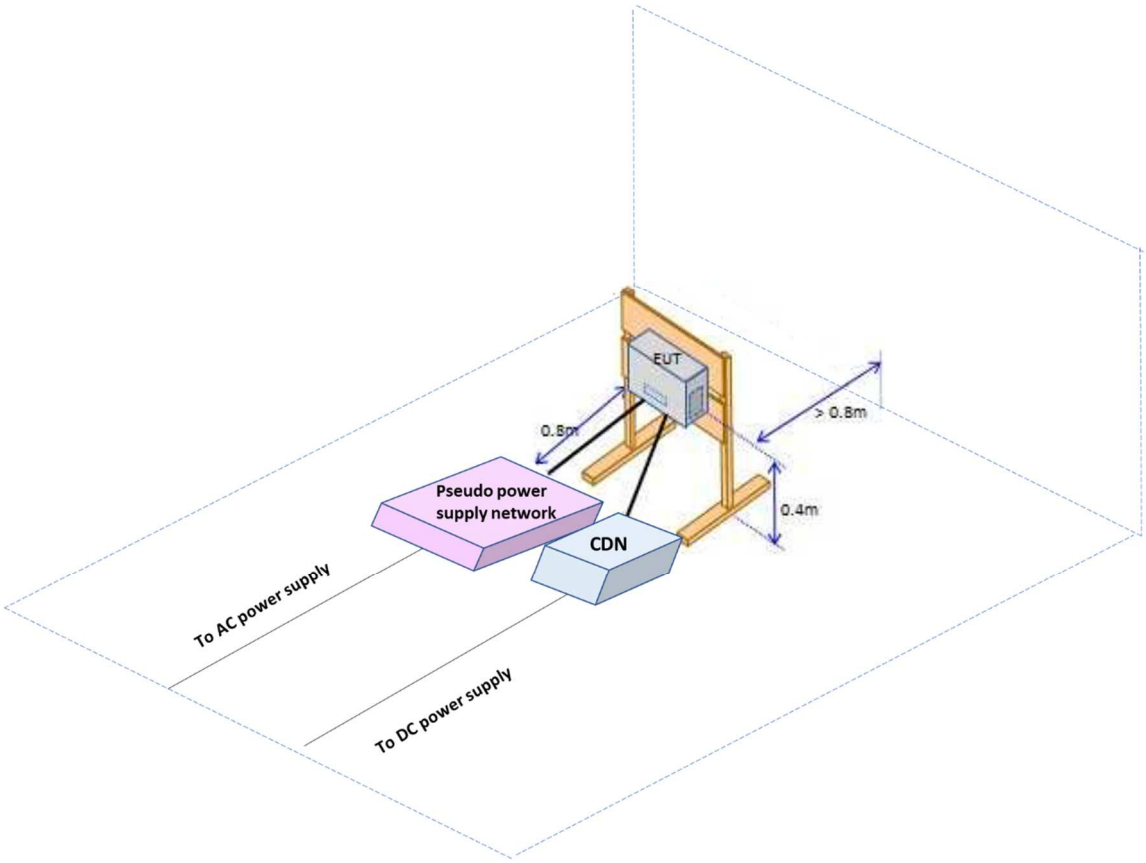


**Figure VI－5 Arrangement of test inverter for radiated emission test**

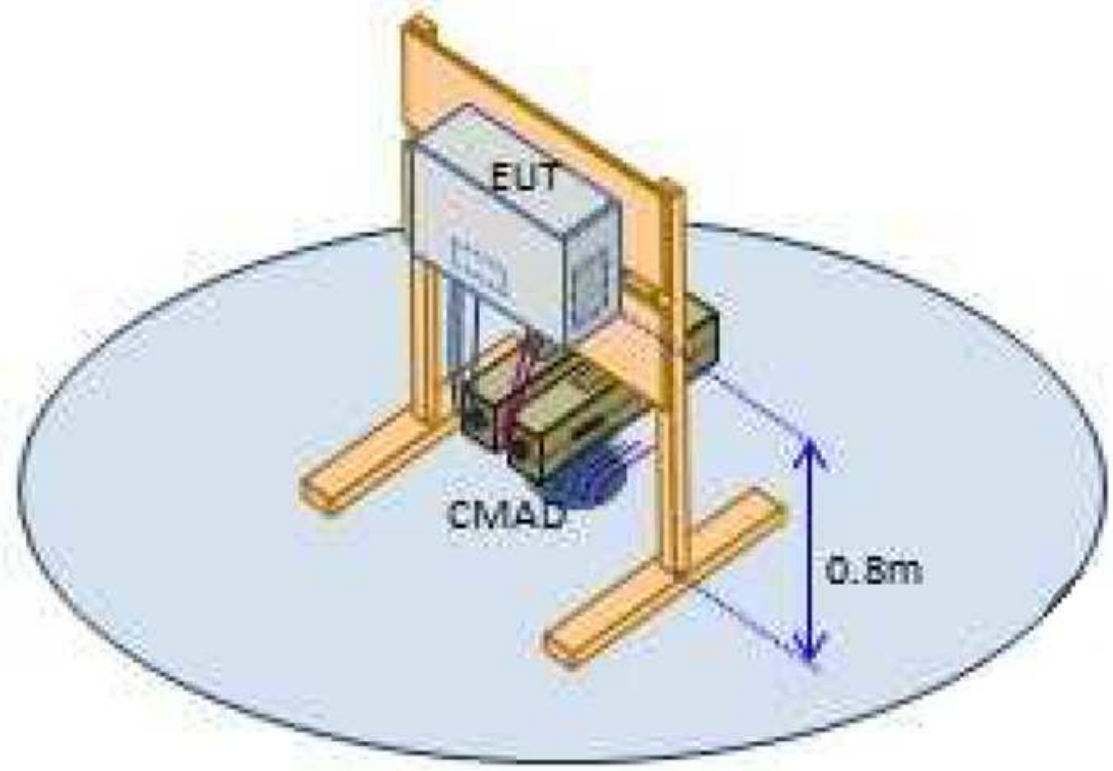
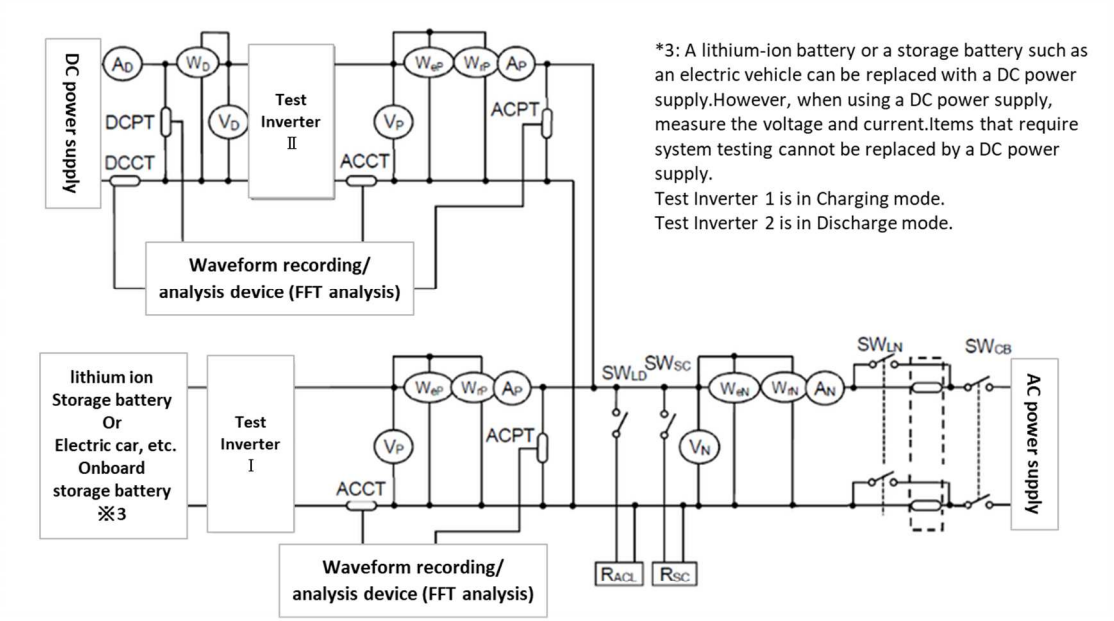


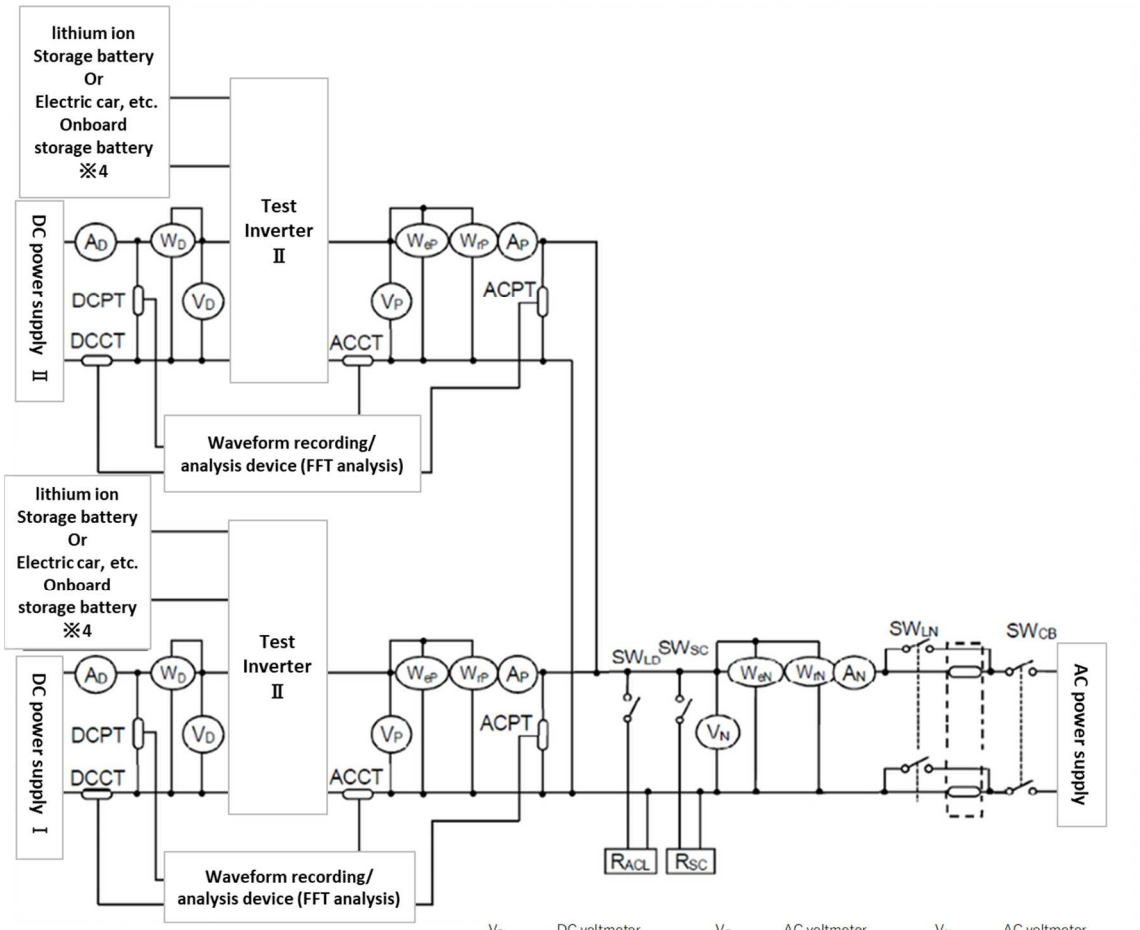
**Figure VII Circuit diagram of islanding prevention test 1 in charge mode for seamless storage battery system and seamless battery-equipped storage battery (DC connection type) system**




| | | | | | |
|---|---|---|---|---|---|
| $V_D$ | DC voltmeter | $V_P$ | AC voltmeter | $V_N$ | AC voltmeter |
| $A_D$ | DC ammeter | $A_P$ | AC ammeter | $A_N$ | DC voltmeter |
| $W_D$ | DC power meter | $W_{eP}$ | AC power meter | $W_{eN}$ | AC power meter |
| $W_{rP}$ | Reactive power meter | $W_{rN}$ | Reactive power meter | | |
| DCPT | DC voltage divider | DCCT | DC shunt | | |
| ACPT | AC voltage divider | ACCT | AC shunt | | |
| $R_{ACL}$ | Impossible device (including improper rotating machine) | | | | |
| $R_{SC}$ | Load device | $R_{IPM}$ | Rotating machine load | | |
| $Z_{LN}$ | Line impedance | | | | |

$SW_{CB}$, $SW_{LN}$, $SW_{LD}$, $SW_S$ Switch

**Figure VIII Circuit diagram of islanding prevention test 1 in forward conversion mode for seamless type multiple DC input system and seamless type multiple input system**




*4: A lithium-ion battery or a storage battery such as an electric vehicle can be replaced with a DC power supply.However, when using a DC power supply, measure the voltage and current.Items that require system testing cannot be replaced by a DC power supply.
Test Inverter 1 is in forward conversion mode.
Test Inverter 2 is in reverse conversion mode.

| | | | | | |
|---|---|---|---|---|---|
| $V_D$ | DC voltmeter | $V_P$ | AC voltmeter | $V_N$ | AC voltmeter |
| $A_D$ | DC ammeter | $A_P$ | AC ammeter | $A_N$ | DC voltmeter |
| $W_D$ | DC power meter | $W_{eP}$ | AC power meter | $W_{eN}$ | AC power meter |
| $W_{iP}$ | Reactive power meter | $W_{iN}$ | Reactive power meter | | |
| DCPT | DC voltage divider | DCCT | DC shunt | | |
| ACPT | AC voltage divider | ACCT | AC shunt | | |
| $R_{ACL}$ | Impossible device (including improper rotating machine) | | | | |
| $R_{SC}$ | Load device | $R_{IPM}$ | Rotating machine load | | |
| $Z_{LN}$ | Line impedance | | | | |

$SW_{CB}$, $SW_{LN}$, $SW_{LD}$, $SW_S$, Switch

**Figure IX-1 Reactive power oscillation suppression confirmation test circuit (for 200V connected devices)**

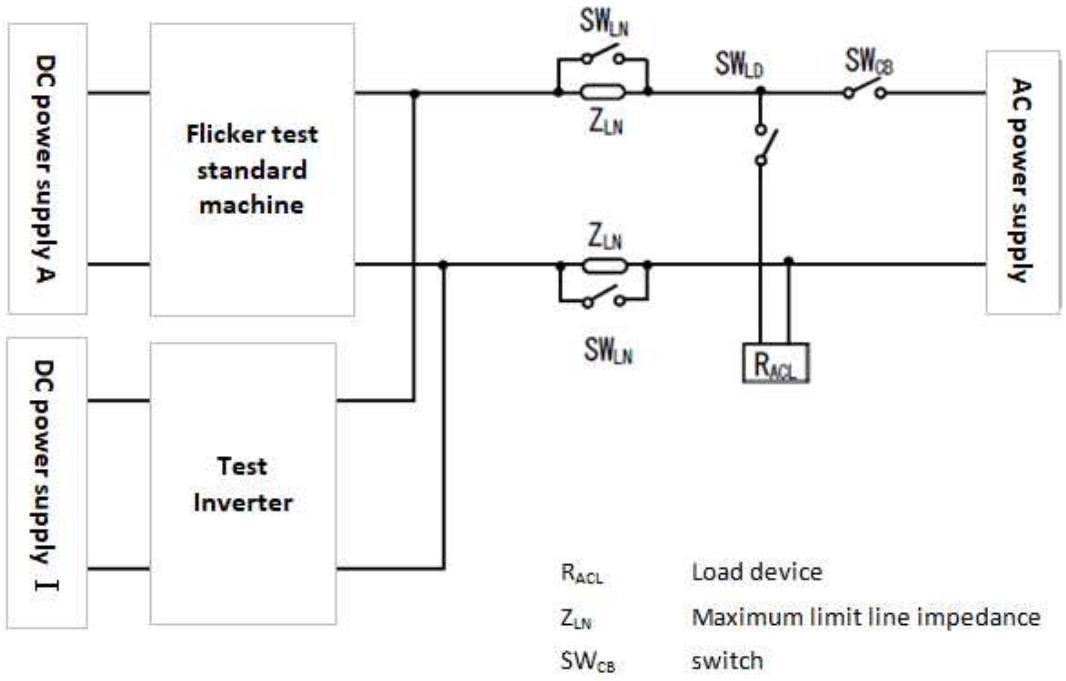



**Figure IX-2 Reactive power oscillation suppression confirmation test circuit (for 100V connected devices)**

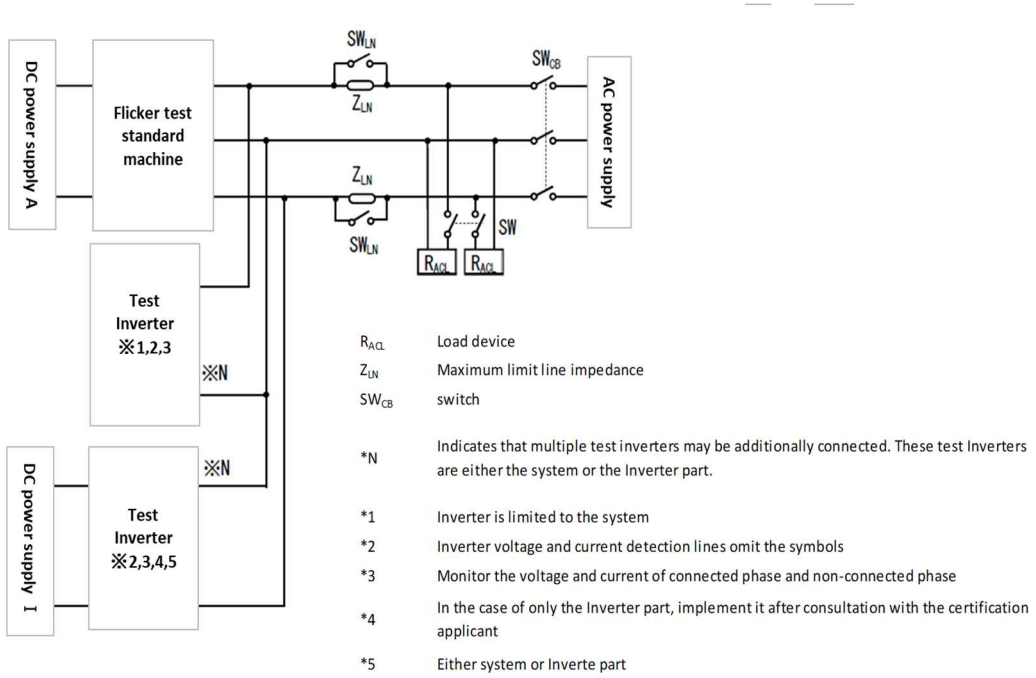


**Figure IX-3 Reactive power oscillation suppression confirmation test circuit (for three-phase connected devices)**

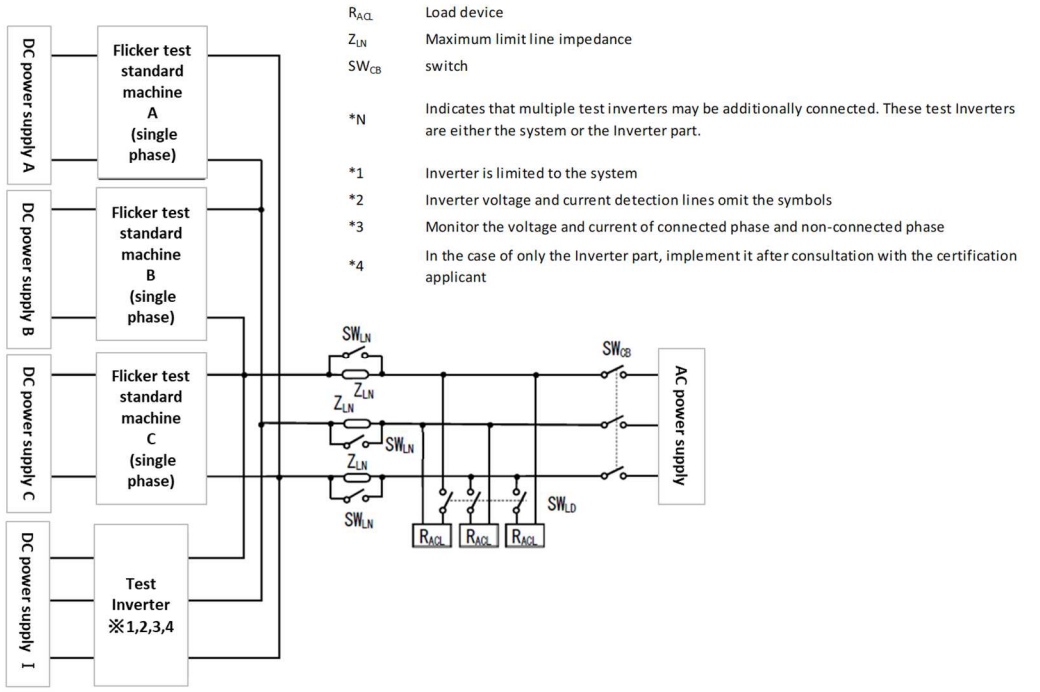



**Figure X Schematic of V2H guideline (DC) protocol test**

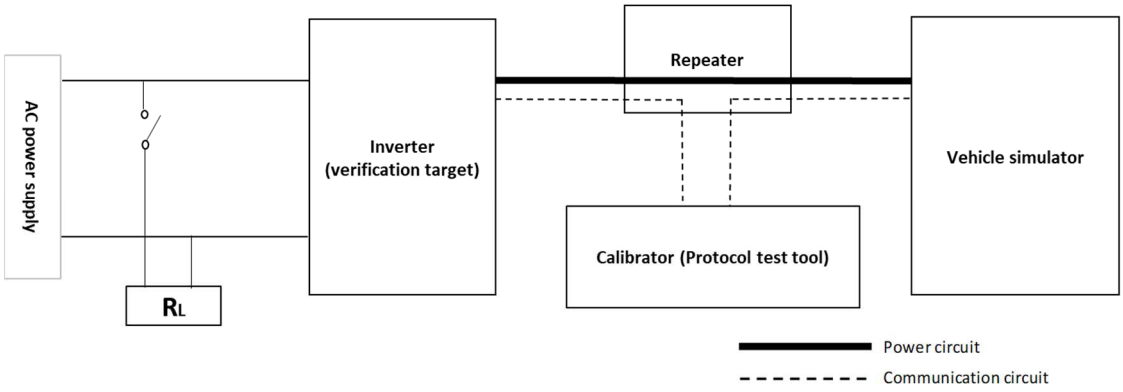


**Figure XI Inverter test circuit with remote output control function (for multiple DC inputs)**

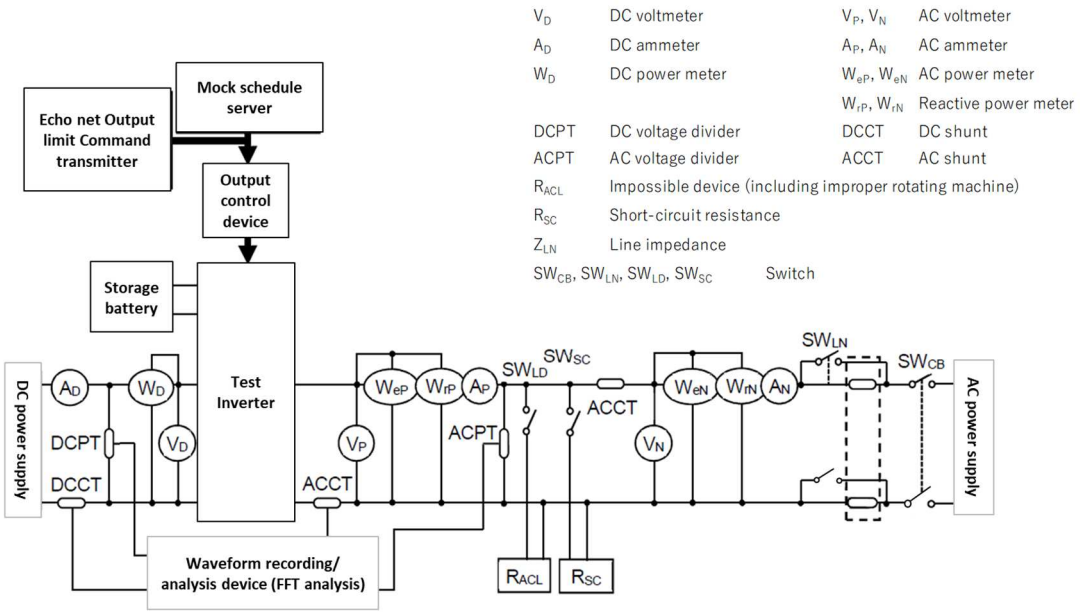
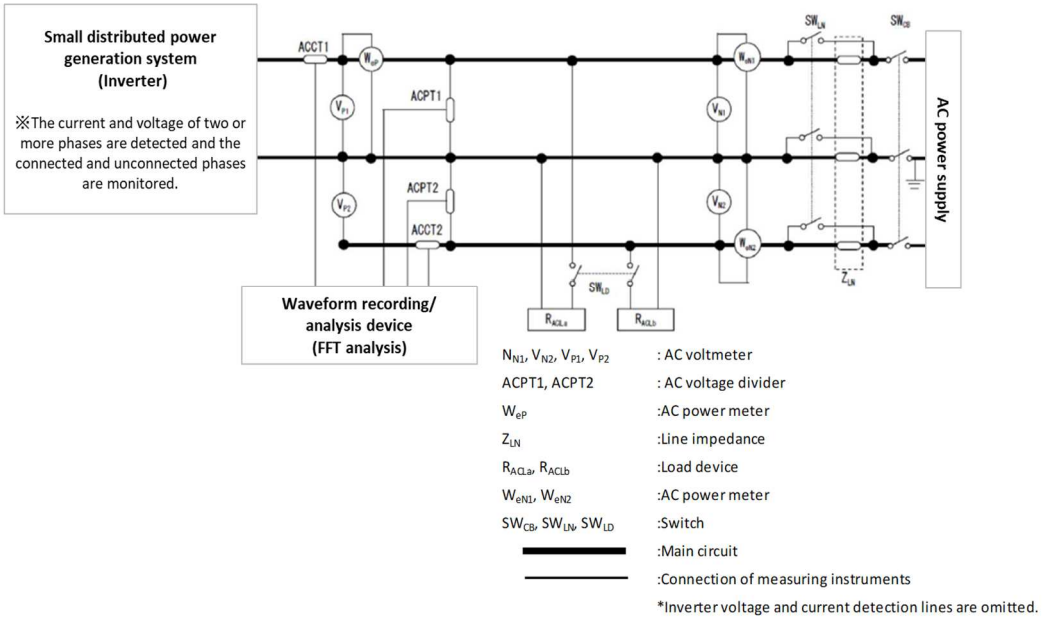
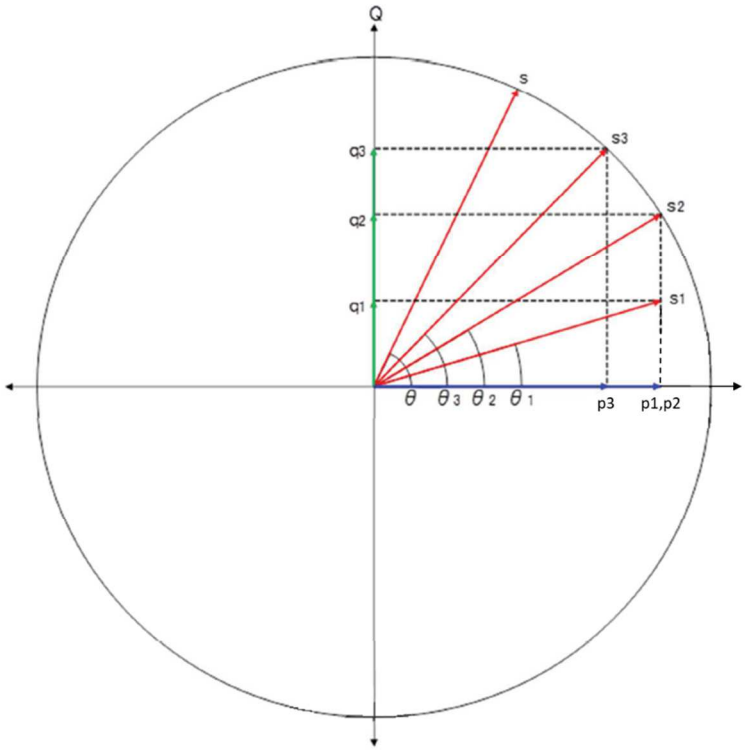



**Figure XII Circuit for testing with a power storage system for single-phase, two-wire, 100V connected equipment**





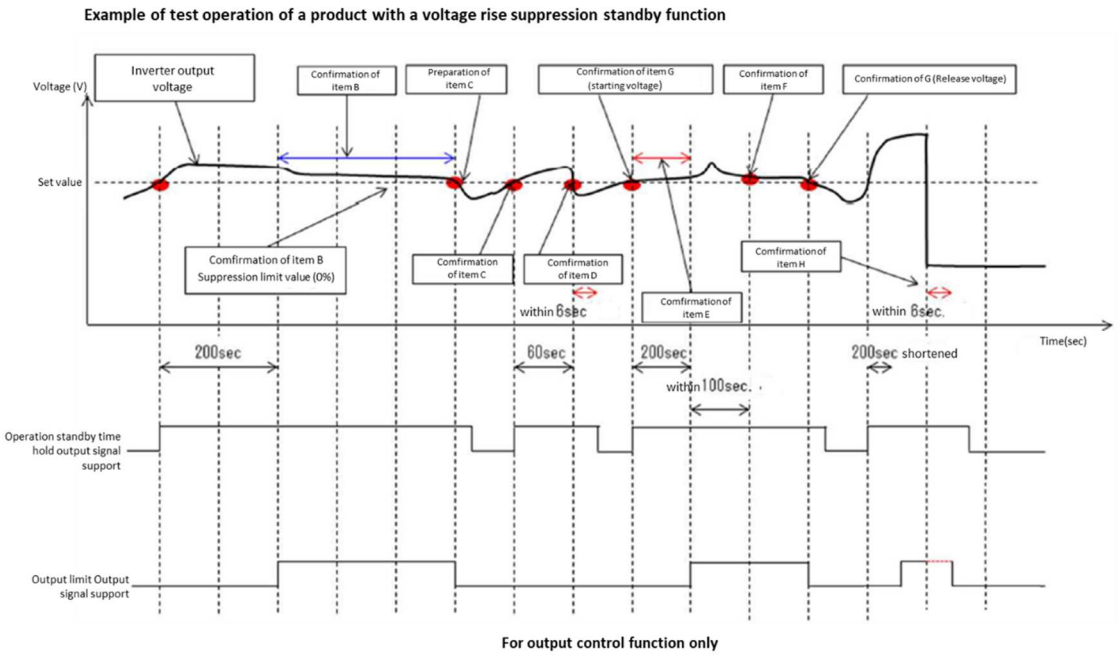

**Supplementary Figure 1 Example for relationship among each term in the Terms of Definition**

s : Maximum Specific Apparent Power

s1, s2, s3 : Specific Apparent Power

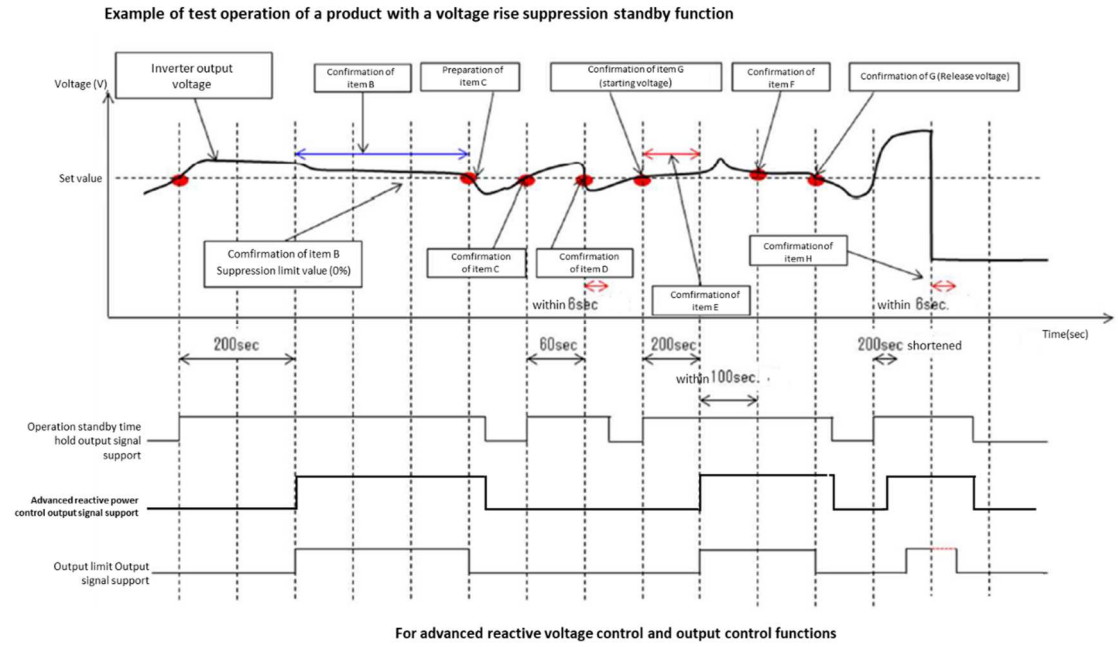
p1, p2, p3 : Specific Output

θ1, θ2, θ3: Specific Power Factor (Expressed in the Phase Angle)

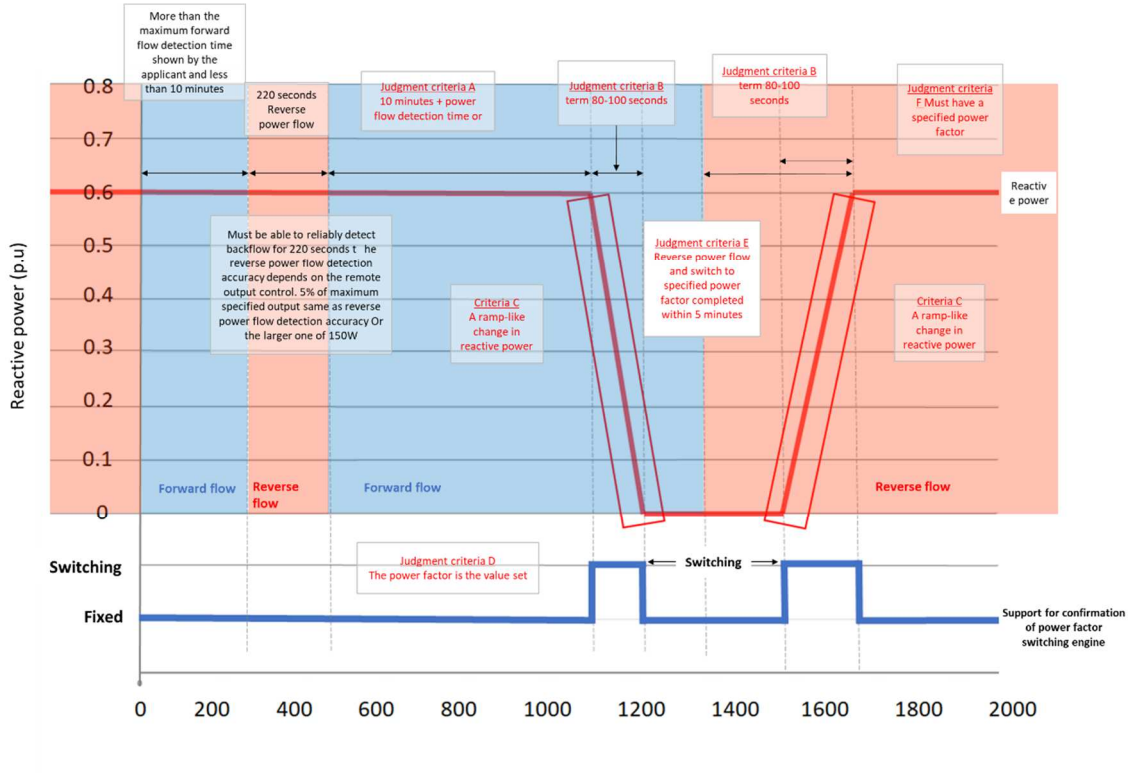



**For only output control function**

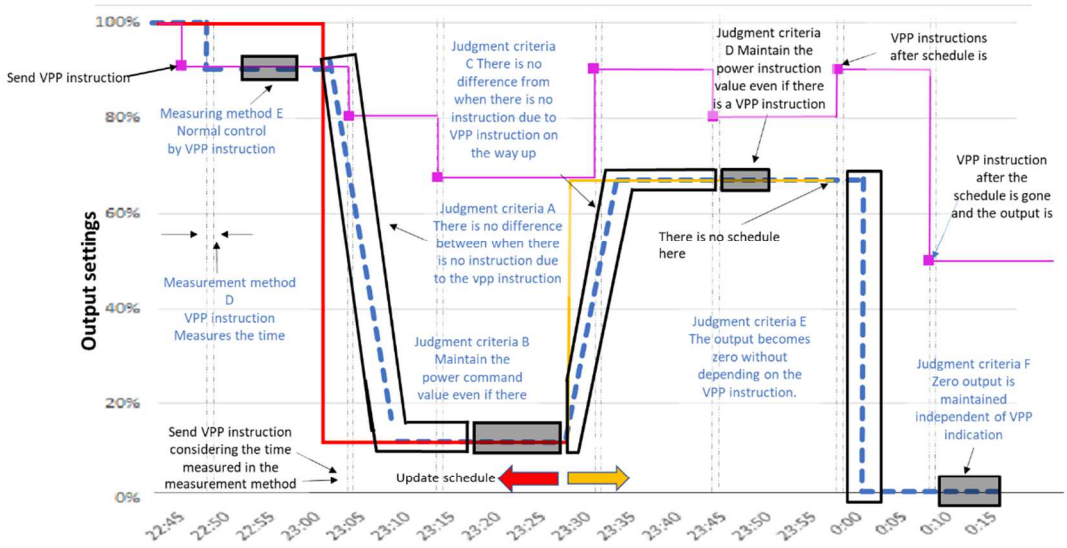
**Supplementary Figure 2 Example of testing operation for Voltage Rise Suppression Function (Output Control)**




**Supplementary Figure 3 Example of testing operation for Voltage Rise Suppression Function (Leading Phase Reactive Power Control and Output Control)**




**Supplementary Figure 4 Example of Testing Operation for Power Factor Switching Function depending on Power Flow**



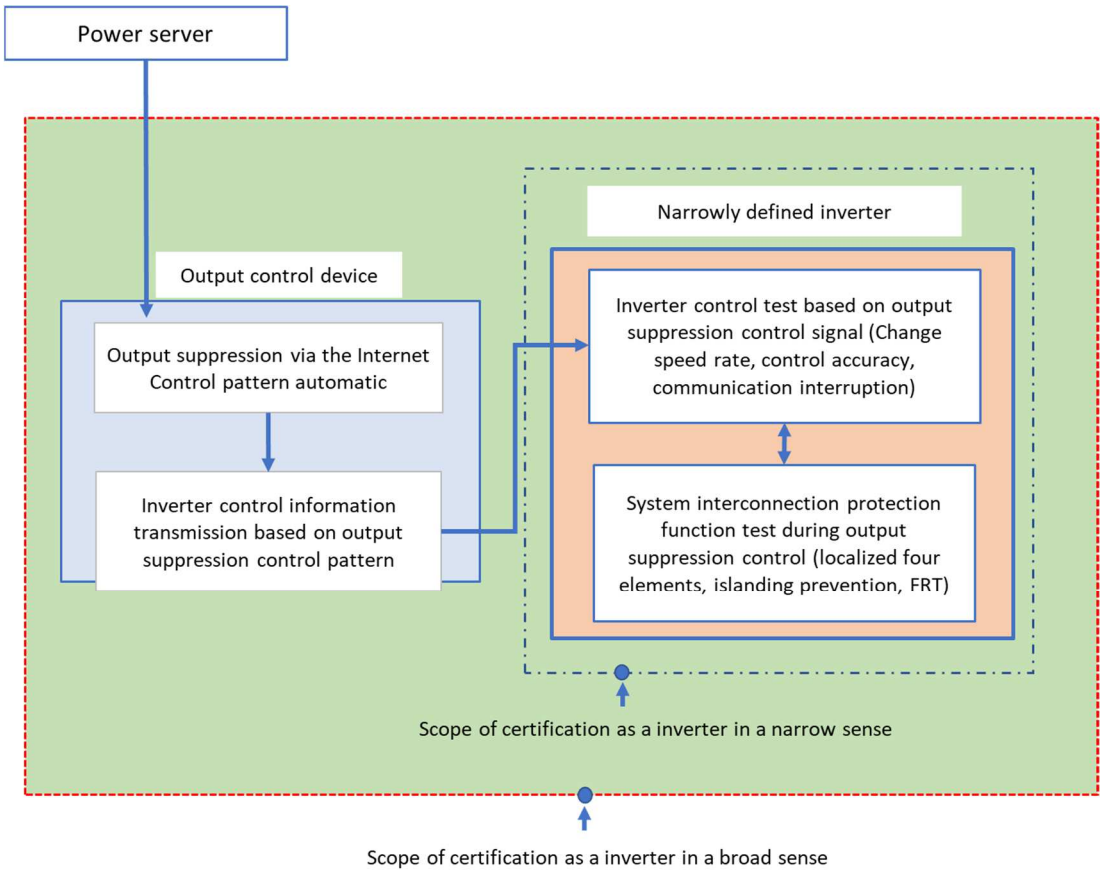

**Test operation example of priority confirmation test for Echonet output control command**

**Supplementary Figure 5 Example of Testing Operation for Econet output control command – priority confirming test**

**[Attached Sheet] Remote Output Control Confirmation Test - Explanation**

**[Scope of Certification]**

Scope of Certification for Narrow sense and Broad sense inverter is defined as the figure below.




Scope of remote output control certification test

Figure 1 Scope of Certification for inverter

[Output Accuracy Consideration]

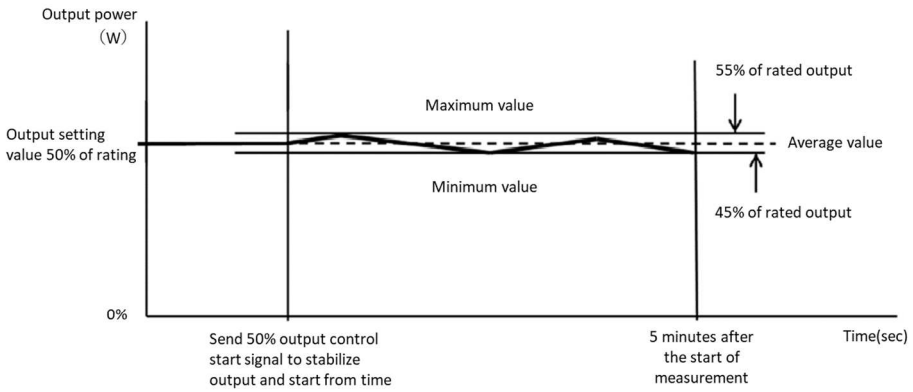
Set the power meter as the setting below, get the data in the csv file and plot the graph.

At Measurement period (1,500 points), the tolerance must be withing ±5% of maximum specific output.

Data update rate: 200 ms

Average process: off

Filter process: off




**Output scheme conceptual diagram**

Figure 2 Concept of Output accuracy

[Output Control Consideration]

Set the power meter as the setting below, get the data in the csv file and plot the graph.

At Measurement period (e.g., Control time 5 minutes: 1,500 points) as shown in the figure below.

Data update rate: 200 ms

Average process: off

Filter process: off

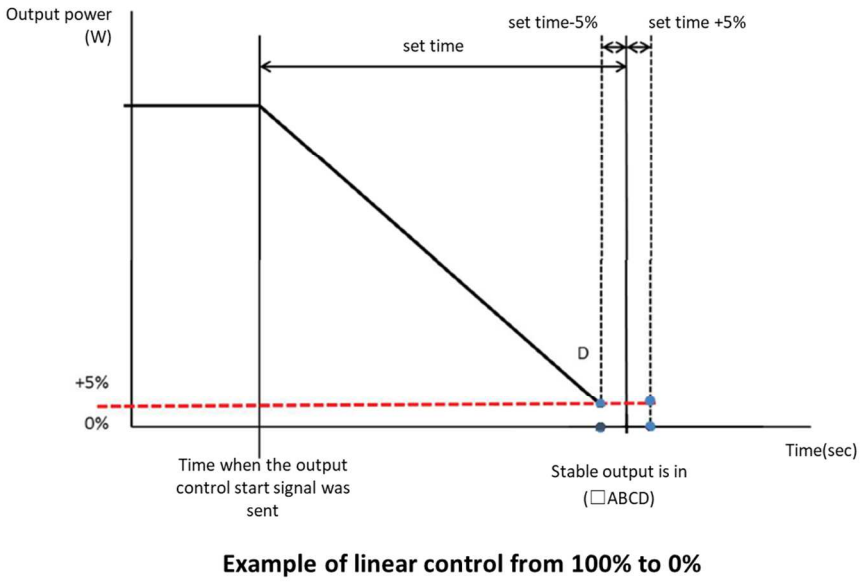



Figure 3 Example for the linear control 100% to 0%

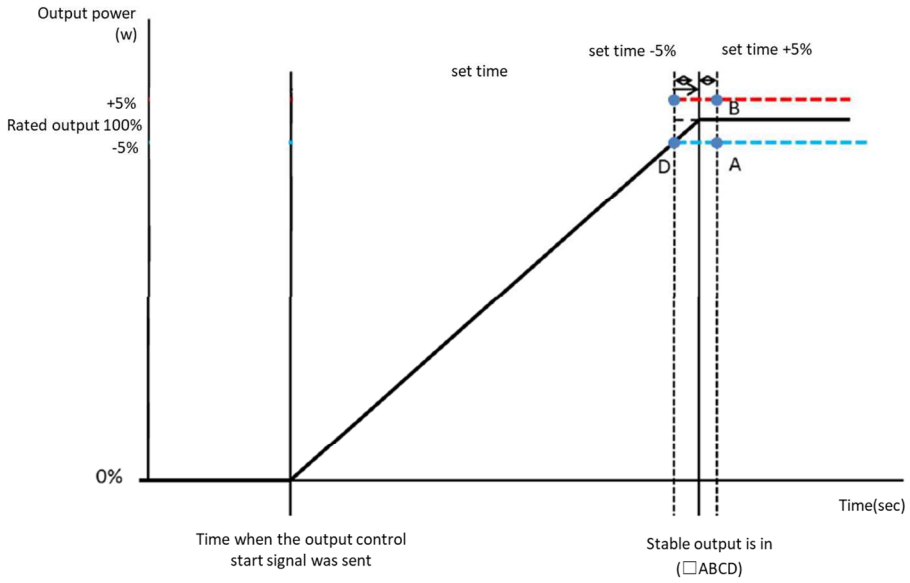



Figure 4 Example for the linear control 0% to 100%

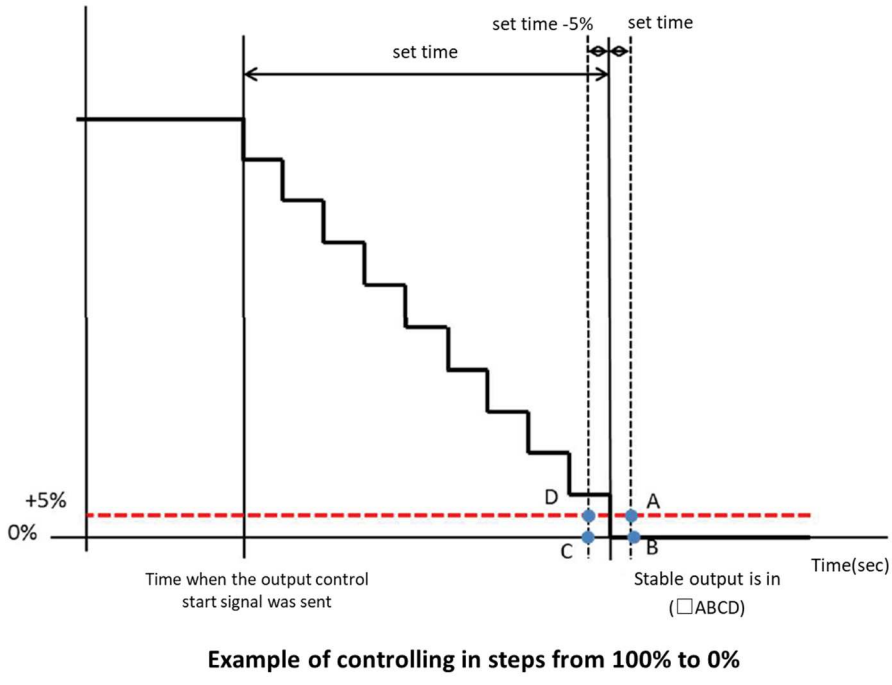



Figure 5 Example for the step control 100% to 0%

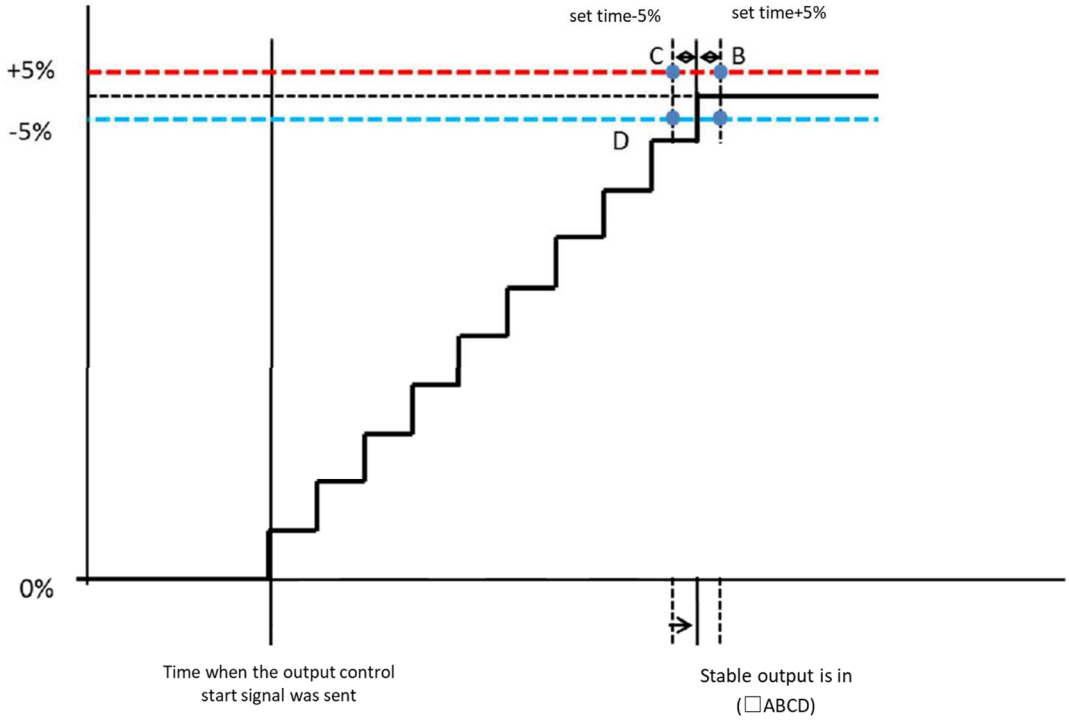



Figure 6 Example for the step control 0% to 100%

[Narrow sense inverter requirement specification]

| | |
|---|---|
| Output Control Setting Range | 0~100%, 1%step |
| Output Accuracy | Within ±5% of Rated Output |
| Control time to Control command | 100% -> 0%: within ±5 minutes |
| | 0% -> 100%: within ±5 minutes |
| | In case able to set the control time in the broad sense |
| | set it at 1 minute unit within ±5% |
| Communication disconnection | Within 5 minutes |
| Detection time | |
| Display for Communication disconnection | Depend on the maker spec. |
| Detection time | |

## Inverter with Output Control Function Certified Test Consideration

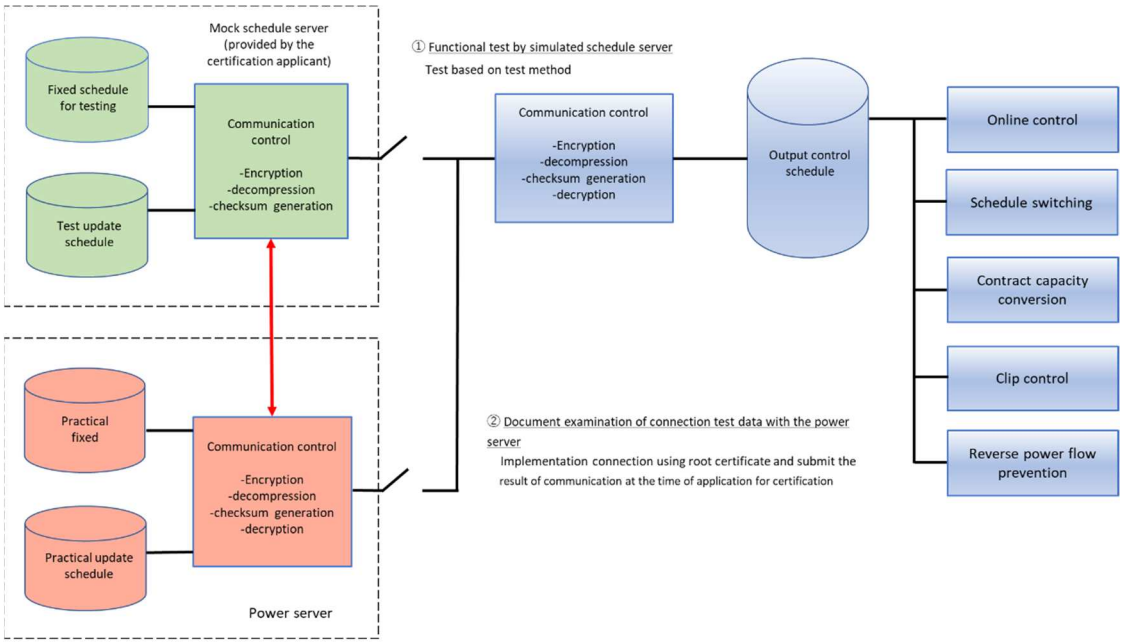



Figure 7 Certified Test consideration for Broad sense inverter

**Attachment: Evaluation procedure for frequency feedback function confirmation test and step injection function test**

**1. Evaluation procedure of frequency feedback function test**

(1) As described in test method 3.2.5, Change the frequency and measure the PCS voltage and current.
(2) Mask the active method (set it so that the frequency feedback function does not operate) and measure the voltage/current of PCS when the same frequency as in (1) is changed.
(3) Calculate the frequency from the voltage measured in (1) and calculate the period deviation.
(4) Calculate the amount of reactive current injection from the results measured in (1) and (2) and confirm that it does not exceed 0.25 p.u. (taking judgment error into consideration).
(5) Calculate the difference between the reactive current injection amount in (1) and the reactive current injection amount in (2). Thereby, the reactive current injection amount excluding the control response is obtained.
(6) Compare the reactive current injection amount obtained in (5) with the period deviation obtained in (3) to evaluate the reactive current injection timing.

**2. Evaluation procedure of step injection function test**

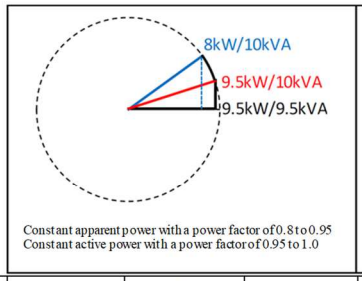
**(1)** Test method as described in Section 3.2.6, rapidly increase the harmonic voltage/fundamental voltage, and perform a test to see if the step injection function operates. When the step injection function operates, the reactive power is calculated from the voltage/current of PCS.
**(2)** If the step injection function does not work, perform a test to see if the step injection function works. When the step injection function operates, the reactive power is calculated from the voltage/current of PCS.
**(3)** If the step injection function does not work in (1), increase the harmonic voltage rapidly within the range of 2.0V + 10% and confirm that the step injection function does not work. Also, make sure that the step injection function does not work by rapidly increasing the fundamental voltage in the range of 2.5V-10%.
**(4)** In the case of a Power conditioner that includes a solar cell as a DC energy source, confirm from the reactive power calculation results that the reactive power does not exceed the maximum specified apparent power of 0.10 p.u. (considering the judgment error). In the case of an Power conditioner that does not include a solar cell as a DC energy source, confirm from the calculation result of the reactive power that the reactive power does not exceed the rated output of 0.10 p.u. (decision error is considered).
**(5)** In the case of a Power conditioner that includes a solar cell as a DC energy source, the reactive power injection starts when the reactive power exceeds the maximum specified apparent power

of 0.01 p.u. from the reactive power calculation results. In the case of a Power conditioner that does not include a solar cell as a DC energy source, the reactive power injection starts when the reactive power exceeds the rated output of 0.01 p.u. from the reactive power calculation results. In either case, confirm that the reactive power after 3 cycles (50Hz:60ms, 60Hz:50ms) has decreased from that time.

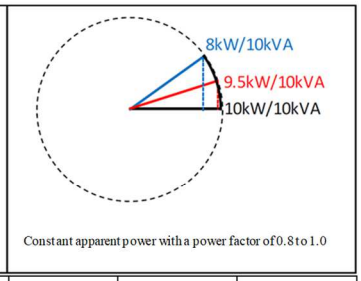
[Reference] Regarding the injection amount of frequency feedback and step injection, the standard of the maximum injection amount required in each test is "maximum apparent power".
However, at the stage of equipment design, the injection amount of reactive power (ratio to active power) when the power factor is changed is different depending on whether the maximum injection amount is designed based on "maximum apparent power" or based on "active power".
It should be noted that the islanding operation detection performance is affected by the injection amount of the reactive power with respect to the active power.

**Calculation example**

| | | |
|---|---|---|
| Maximum apparent power | 10kVA | |
| Maximum frequency feedback injection | 2.5kVA | 0.25 p.u. |
| Maximum step injection volume | 1kVA | 0.1 p.u. |



Constant apparent power with a power factor of 0.8 to 0.95
Constant active power with a power factor of 0.95 to 1.0



Constant apparent power with a power factor of 0.8 to 1.0

| Power factor | 0.8 | 0.95 | 1 | 0.8 | 0.95 | 1 |
|---|---|---|---|---|---|---|
| Maximum apparent power | | 10kVA | | | 10kVA | |
| Apparent power | 10kVA | 10kVA | 9.5kVA | 10kVA | 10kVA | 10kVA |
| Maximum active power | | 9.5kW | | | 10kW | |
| Active power | 8kW | 9.5kW | 9.5kW | 8kW | 9.5kW | 10kW |
| | | | | | | |
| **Frequency feedback injection volume** | | | | | | |
| Based on maximum apparent power | | 2.5kVA | | | 2.5kVA | |
| Based on apparent power | 2.5kVA | 2.5kVA | 2.375kVA | 2.5kVA | 2.5kVA | 2.5kVA |
| Based on maximum active power | | 2.375kVA | | | 2.5kVA | |
| Based on active power | 2kVA | 2.375kVA | 2.375kVA | 2kVA | 2.375kVA | 2.5kVA |
| | | | | | | |
| **Injection amount ratio to active power** | | | | | | |
| Based on maximum apparent power | 0.313 p.u. | 0.263 p.u. | 0.263 p.u. | 0.313 p.u. | 0.263 p.u. | 0.250 p.u. |
| Based on apparent power | 0.313 p.u. | 0.263 p.u. | 0.250 p.u. | 0.313 p.u. | 0.263 p.u. | 0.250 p.u. |
| Based on maximum active power | 0.297 p.u. | 0.250 p.u. | 0.250 p.u. | 0.313 p.u. | 0.263 p.u. | 0.250 p.u. |
| Based on active power | 0.250 p.u. | 0.250 p.u. | 0.250 p.u. | 0.250 p.u. | 0.250 p.u. | 0.250 p.u. |

Area where the amount of reactive power injection (ratio to active power) is lower than the standard power factor

The same idea for step injection

**[Attachment] Explanation for Islanding protection test 1excluding Rated output 4.0kW**

In the following text, "rated output" and "rated" shall be read as "specified output" in the case of power conditioners that include solar cells as the DC energy source. The test method for preventing Islanding operation of multiple-unit interconnected systems is based on a power conditioner with a rated output of 4.0 kW. When conducting the Islanding operation prevention test1, one rotating machine load is connected to a power conditioner with a rated output of 4.0 kW. Therefore, in conducting the Islanding operation prevention test1 for a power conditioner with a rated output of other than 4.0 kW, the number of units connected to the power conditioner and rotating machine load shall be determined based on the following considerations so that the test can be conducted without being affected by the rotating machine load as much as possible.

[Preparation for the test machine]

- The test unit shall consist of the PCS (only for solar PV) or power generation system to be certified (hereinafter referred to as the "master unit") and the same PCS or power generation system used for the master unit (hereinafter referred to as the "slave unit").
- The combination of master and slave machines for the test shall be as follows. However, if it is difficult to use the following combination, it shall be conducted upon consultation with the applicant for certification.

Combination 1
Master machine: Operated by the system (for solar power, operated by a simulated DC power supply)
Slave machine: Operated by simulated DC power supply (PCS only)

Combination 2
Master machine: Operated by the system (for solar power, operated by simulated DC power supply)
Slave machine: Operated by the system (operated by the DC simulated power supply in the case of solar power)

[Number of Test machine and connecting rotating machine load]

[Calculate the number of test machine]

- In case Rated 4kW or more, perform at the rated output, so the test machine is one.
- If the rating is less than 4kW, the number of units to be tested is calculated by the following method using the value obtained by rounding down the rated output so that the number of effective digits is two digits.

$N = \lfloor 4/\alpha \rfloor$ Formula (1)

$|\alpha \times N - 4|$ Formula (2)

$|\alpha \times (N+1) - 4|$ Formula (3)

α: Power conditioner rated output (kW) ⌊ ⌋: rounded down to the decimal point

M: number of connecting rotating machine load | |: absolute value

If Formula (2) ≤ Formula (3), then N units are connected, and if Formula (2) > Formula (3), then up to N+1 units can be connected.

Calculation example 1

In case PCS rated output 1.2kW

$N = \lfloor 4/1.2 \rfloor = 3$ Formula (1`)

$|1.2 \times 3 - 4| = |3.6 - 4| = 0.4$ Formula (2`)

$|1.2 \times (3+1) - 4||4.8 - 4| = 0.8$ Formula (3`)

Since Formula (2') ≤ Formula (3'), N is obtained. In other words, up to 3 units can be connected.

Calculation example 2

In case PCS rated output 1.19kW

$N = \lfloor 4/1.1 \rfloor = 3$ Formula (1")

$|1.1 \times 3 - 4| = |3.3 - 4| = 0.7$ Formula (2")

$|1.1 \times (3+1) - 4| = |4.4 - 4| = 0.4$ Formula (3")

Since Formula (2") > Formula (3"), N+1 is obtained. In other words,

up to 4 PCSs can be connected.

[Calculate the number of rotating machine load]

- In case PCS Rated 4kW or less, the number of connecting rotating machine load is 1.
- In case PCS more than rated 4kW, use the following method to calculate the number

$M = \lfloor \alpha/4 \rfloor$ Formula (4)

$|\alpha - 4 \times M|$ Formula (5)

$|\alpha - 4 \times (M+1)|$ Formula (6)

α: Power conditioner rated output (kW) ⌊ ⌋:Number Truncation

M: number of connecting rotating machine load | |: absolute value

If Formula (5) < Formula (6), the number of units is M. If Formula (5) ≥ Formula (6), the number of units is M+1.

Calculation example 3

$M = \lfloor 7/4 \rfloor = 1$ Formula (4`)

$|7 - 4 \times 1| = 3$ Formula (5`)

$|7 - 4 \times (1 + 1)| = 1$ Formula (6`)

Since Formula (5') > Formula (6'), M+1 units.

In other words, the rotating machine load is connected to 2 units.

Table 1 Example of the number of inverter and connecting rotating machine load

| Rated Output (kW) | Number of PCS | Number of Roatating Load |
|---|---|---|
| 0.70 - less than 0.73 | 1 - 6 | 1 |
| 0.73 - less than 0.89 | 1 - 5 | 1 |
| 0.89 - less than 1.2 | 1 - 4 | 1 |
| 1.2 - less than 1.6 | 1 - 3 | 1 |
| 1.6 - less than 2.7 | 1 - 2 | 1 |
| 2.7 - less than 6.0 | 1 | 1 |
| 6.0 - less than 10.0 | 1 | 2 |
| 10.0 - less than 14.0 | 1 | 3 |
| 14.0 - less than 18.0 | 1 | 4 |
| 18.0 - less than 22.0 | 1 | 5 |
| 22.0- less than 26.0 | 1 | 6 |
| 26.0 - less than 30.0 | 1 | 7 |
| 30.0 - less than 34.0 | 1 | 8 |
| 34.0 - less than 38.0 | 1 | 9 |
| 38.0 - less than 42.0 | 1 | 10 |
| 42.0 - less than 46.0 | 1 | 11 |
| 46.0 - less than 50.0 | 1 | 12 |

**[Attachment] Explanation for Multiple unit grid interconnection islanding protection test 2**

In the following text, "rated output" and "rated" shall be read as "specified output" in the case of power conditioners that include solar cells as the DC energy source.
For the Multiple Units Islanding Operation Prevention Test 2, it is necessary to compare the Islanding operation detection time under equal test conditions in order to confirm that the detection time of Islanding operation by the active method Islanding operation prevention function is not delayed with an increase in the number of units interconnected.
In this test, the rotating machine load is connected at a ratio of one rotating machine load for every 4 kW total output of the power conditioner. If the rated output of the power conditioner is other than 4 kW, the output of the power conditioner must be adjusted to eliminate the effect of the rotating machine load.
However, since a large number of units are required to make the total rated output a multiple of 4 kW using power conditioners with smaller rated outputs, plus the fact that the test units performing the other test items will not be equipped with the ability to adjust output, the output of the test units in this test and the number of units connected for the determination of output shall be The number of units to be connected for the output and determination of the test body in this test shall be determined based on the following considerations.

[Preparation for the test machine]

- The test unit shall be a PCS without modification for output adjustment (reactive power injection adjustment) subject to certification (hereinafter referred to as the "master unit") and a PCS with modifications for output adjustment (reactive power injection adjustment) necessary to adjust to the total output listed in Item Table 1 (hereinafter referred to as "Slave Machine") shall be prepared.
- The combination of master and slave machines for the test shall be as follows. However, if it is difficult to use the following combination, it shall be conducted upon consultation with the applicant for certification.

  Combination 1

  Master machine: operate the system (Test machine used in single test)

  Slave machine: operate with the DC simulator power supply (only inverter)

  Combination 2

  Master machine: operate the inverter with the DC simulator power supply separating from system

  Slave machine: operate with the DC simulator power supply (only inverter)

[Total output of test machine]

- Adjust in the multiplication of total output for each 4kW in each number in tests.
- Must meet the formular (4xm) kW below

  m x 4(kW) ≦Inverter rated output (kW) x Number of test machine N < (m+1) x 4 (kW)

  m: number of rotating machine load
- Table 1 shows the number of test machine of total output in each rated output for certification achievement
- As the description figure, the examples for rated output 1.2kW and 5.5kW are attached.

Table 1 number of test machine in total output

| | | Inverter Rated output (kW) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.7 | 0.8 | 1.0 | 1.2 | 1.5 | 2.0 | 2.7 | 3.0 | 3.2 | 3.3 | 3.5 | 4.0 | 4.5 | 4.8 | 5.0 | 5.5 | 5.8 | 10.0 |
| Number of test machine (N) | 2 | | | | | | 4 | 4 | 4 | | | | 8 | 8 | 8 | 8 | 8 | 8 | 20 |
| | 3 | | | | | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 12 | 12 | 12 | 12 | 16 | 16 | 28 |
| | 4 | | | 4 | 4 | 4 | 8 | 8 | 12 | 12 | 12 | 12 | 16 | 16 | 16 | 20 | 20 | 20 | 40 |
| | 5 | | | 4 | 4 | 4 | 8 | 12 | 12 | 16 | 16 | 16 | 20 | 20 | 24 | 24 | 24 | 28 | 48 |
| | 6 | 4 | 4 | 4 | 4 | 8 | 12 | 16 | 16 | 16 | 16 | 20 | 24 | 24 | 28 | 28 | 32 | 32 | 60 |
| | 7 | 4 | 4 | 4 | 4 | 8 | 12 | 16 | 20 | 20 | 20 | 24 | 28 | 28 | 32 | 32 | 36 | 40 | 68 |
| | 8 | 4 | 4 | 8 | 8 | 12 | 16 | 20 | 24 | 24 | 24 | 28 | 32 | 36 | 36 | 40 | 44 | 44 | 80 |
| | 9 | 4 | 4 | 8 | 8 | 12 | 16 | 24 | 24 | 28 | 28 | 28 | 36 | 40 | 40 | 44 | 48 | 52 | 88 |
| | 10 | 4 | 4 | 8 | 12 | 12 | 20 | 24 | 28 | 32 | 32 | 32 | 40 | 44 | 48 | 48 | 52 | 56 | 100 |
| | 11 | 4 | 8 | 8 | 12 | 16 | | | | 32 | 36 | 36 | | | | | | | |
| | 12 | 8 | 8 | 12 | 12 | | | | | | | | | | | | | | |
| | 13 | 8 | 8 | | | | | | | | | | | | | | | | |
| | 14 | 8 | 8 | | | | | | | | | | | | | | | | |

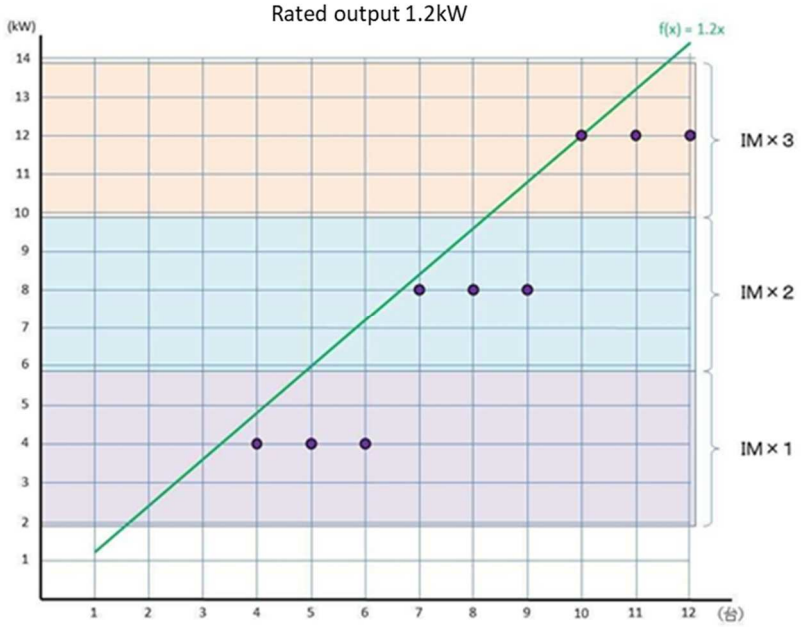
[Output adjustment for test machine]

- The output of the PCS shall be adjusted by connecting the master and slave units so that the total output is as shown in Table 1.
- The PCS to be used to meet the total output shown in Table 1 shall have an output current distortion factor of 5% or less for the total harmonic current distortion factor and 3% or less for each harmonic current distortion factor after output is adjusted.

[Combination of number of test machine]

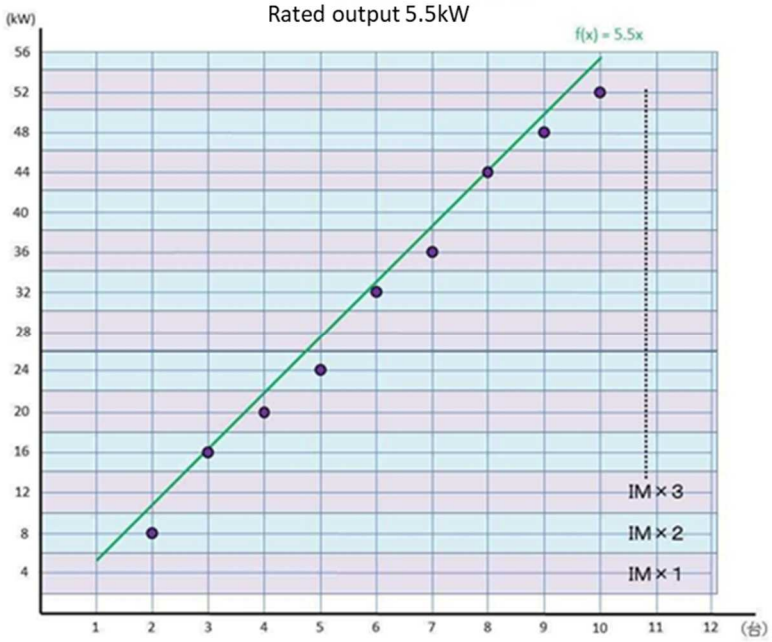
- When a PCS whose output has been adjusted to meet the output total in Table 1 cannot satisfy the output current distortion factor, the test of the number of connected units at that time shall not be included in the number of times.
- Attachments 1 through 17 show examples of combinations of the number of units tested at rated output.

Rated output 1.2kW




Number of PCS connected

Rated output 5.5kW




Number of PCS connected

**Attachment 1 In case rated output 0.7 kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 6 | 4.20 | 1/4kW | 0.7 x 5 + 0.5 x 1 |
| 2 | 7 | 4.90 | 1/4kW | 0.7 x 4 + 0.4 x 3 |
| 3 | 8 | 5.60 | 1/4kW | 0.7 x 2 + 0.5 x 2 + 0.4 x 4 |
| 4 | 9 | 6.30 | 1/4kW | 0.7 x 1 + 0.5 x 1 + 0.4 x 7 |
| 5 | 10 | 7.00 | 1/4kW | 0.7 x 1 + 0.4 x 6 + 0.3 x 3 |
| 6 | 11 | 7.70 | 1/4kW | 0.7 x 1 + 0.4 x 3 + 0.3 x 7 |
| 7 | 12 | 8.40 | 2/8kW | 0.7 x 10 + 0.5 x 2 |
| 8 | 13 | 9.10 | 2/8kW | 0.7 x 8 + 0.5 x 4 + 0.4 x 1 |
| 9 | 14 | 9.80 | 2/8kW | 0.7 x 8 + 0.4 x 6 |

**Attachment 2 In case rated output 0.75 kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 6 | 4.50 | 1/4kW | 0.75 x 4 + 0.5 x 2 |
| 2 | 7 | 5.25 | 1/4kW | 0.75 x 3 + 0.55 x 1 + 0.4 x 3 |
| 3 | 8 | 6.00 | 1/4kW | 0.75 x 2 + 0.5 x 1 + 0.4 x 5 |
| 4 | 9 | 6.75 | 1/4kW | 0.75 x 1 + 0.45 x 1 + 0.4 x 7 |
| 5 | 10 | 7.50 | 1/4kW | 0.75 x 1 + 0.45 x 1 + 0.4 x 4 + 0.3 x 4 |
| 6 | 11 | 8.25 | 2/8kW | 0.75 x 10 + 0.5 x1 |
| 7 | 12 | 9.00 | 2/8kW | 0.75 x 9 + 0.55 x 1 + 0.35 x 2 |
| | | | | 0.75 x 9 + 0.45 x 2 + 0.35 x 1 |
| 8 | 13 | 9.75 | 2/8kW | 0.75 x 8 + 0.4 x 5 |
| 9 | 14 | 10.50 | 2/8kW | 0.75 x 8 + 0.4 x 2 + 0.3 x 4 |

**Attachment 3 In case rated output 1.0kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 4 | 4.00 | 1/4kW | 1.0 x 4 |
| 2 | 5 | 5.00 | 1/4kW | 1.0 x 3 + 0.5 x 2 |
| 3 | 6 | 6.00 | 1/4kW | 1.0 x 2 + 0.5 x 4 |
| 4 | 7 | 7.00 | 1/4kW | 1.0 x 2 + 0.5 x 5 |
| 5 | 8 | 8.00 | 2/8kW | 1.0 x 8 |
| 6 | 9 | 9.00 | 2/8kW | 1.0 x 7 + 0.5 x 2 |
| 7 | 10 | 10.00 | 2/8kW | 1.0 x 6 + 0.5 x 4 |
| 8 | 11 | 11.00 | 2/8kW | 1.0 x 6 + 0.4 x 5 |
| 9 | 12 | 12.00 | 3/12kW | 1.0 x 12 |

**Attachment 4 In case rated output 1.2 kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 4 | 4.80 | 1/4kW | 1.2 x 2 + 0.8 x 2 |
| 2 | 5 | 6.00 | 1/4kW | 1.2 x 1 + 0.8 x 2 + 0.6 x 2 |
| 3 | 6 | 7.20 | 1/4kW | 1.2 x 1 + 0.6 x 3 + 0.5 x 2 |
| 4 | 7 | 8.40 | 2/8kW | 1.2 x 6 + 0.8 x 1 |
| 5 | 8 | 9.60 | 2/8kW | 1.2 x 5 + 0.8 x 1 + 0.6 x 2 |
| 6 | 9 | 10.80 | 2/8kW | 1.2 x 4 + 0.8 x 1 + 0.6 x 4 |
| 7 | 10 | 12.00 | 3/12kW | 1.2 x 10 |
| 8 | 11 | 13.20 | 3/12kW | 1.2 x 9 + 0.6 x 2 |
| 9 | 12 | 14.40 | 3/12kW | 1.2 x 8 + 0.6 x 4 |

**Attachment 5 In case rated output 1.5kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 3 | 4.50 | 1/4kW | 1.5 x 2 + 1.0 x 1 |
| 2 | 4 | 6.00 | 1/4kW | 1.5 x 1 + 1.0 x 1 +0.75 x 2 |
| 3 | 5 | 7.50 | 1/4kW | 1.2 x 1 + 0.6 x 3 + 0.5 x 2 |
| | | | | 1.5 x 1 + 0.75 x 2 + 0.5 x 2 |
| 4 | 6 | 9.00 | 2/8kW | 1.5 x 4 + 1.0 x 2 |
| 5 | 7 | 10.50 | 2/8kW | 1.5 x 2 + 1.0 x 5 |
| 6 | 8 | 12.00 | 3/12kW | 1.5 x 8 |
| 7 | 9 | 13.50 | 3/12kW | 1.5 x 6 + 1.0 x 3 |
| 8 | 10 | 15.00 | 3/12kW | 1.5 x 4 + 1.0 x 6 |
| 9 | 11 | 16.50 | 4/16kW | 1.5 x 10 + 1.0 x 1 |

**Attachment 6 In case rated output 2.0kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 2 | 4.00 | 1/4kW | 2.0 x 2 |
| 2 | 3 | 6.00 | 1/4kW | 2.0 x 1 + 1.0 x 2 |
| 3 | 4 | 8.00 | 2/8kW | 2.0 x 4 |
| 4 | 5 | 10.00 | 2/8kW | 2.0 x 3 + 1.0 x 2 |
| 5 | 6 | 12.00 | 3/12kW | 2.0 x 6 |
| 6 | 7 | 14.00 | 3/12kW | 2.0 x 5 + 1.0 x2 |
| 7 | 8 | 16.00 | 4/16kW | 2.0 x 8 |
| 8 | 9 | 18.00 | 4/16kW | 2.0 x 7 + 1.0 x 2 |
| 9 | 10 | 20.00 | 5/20kW | 2.0 x 10 |

**Attachment 7 In case rated output 2.7kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 2 | 5.40 | 1/4kW | 2.7 x 1 + 1.3 x 1 |
| 2 | 3 | 8.10 | 2/8kW | 2.7 x 2 + 2.6 x 1 |
| 3 | 4 | 10.80 | 2/8kW | 2.7 x 2 + 1.3 x 2 |
| 4 | 5 | 13.50 | 3/12kW | 2.7 x 3 + 2.6 x 1 +1.2 x 1 |
| 5 | 6 | 16.20 | 4/16kW | 2.7 x 4 + 2.6 x 2 |
| 6 | 7 | 18.90 | 4/16kW | 2.7 x 4 + 2.6 x 1 + 1.3 x 2 |
| 7 | 8 | 21.60 | 5/20kW | 2.7 x 5 + 2.6 x 2 + 1.3 x 1 |
| 8 | 9 | 24.30 | 6/24kW | 2.7 x 8 + 2.4 x 1 |
| 9 | 10 | 27.00 | 6/24kW | 2.7 x 6 + 2.6 x 2 + 1.3 x 2 |

**Attachment 8 In case rated output 3.0kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 2 | 6.00 | 1/4kW | 3.0 x 1 + 1.0 x 1 |
| 2 | 3 | 9.00 | 2/8kW | 3.0 x 2 + 2.0 x 1 |
| 3 | 4 | 12.00 | 3/12kW | 3.0 x 4 |
| 4 | 5 | 15.00 | 3/12kW | 3.0 x 3 + 1.5 x 2 |
| 5 | 6 | 18.00 | 4/16kW | 3.0 x 5 + 1.0 x 1 |
| 6 | 7 | 21.00 | 5/20kW | 3.0 x 6 + 2.0 x 1 |
| 7 | 8 | 24.00 | 6/24kW | 3.0 x 8 |
| 8 | 9 | 27.00 | 6/24kW | 3.0 x 7 + 1.5 x 2 |
| 9 | 10 | 30.00 | 7/28kW | 3.0 x 9 + 1.0 x 1 |

**Attachment 9 In case rated output 3.2kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 3 | 9.60 | 2/8kW | 3.2 x 2 + 1.6 x 1 |
| 2 | 4 | 12.80 | 3/12kW | 3.2 x 3 + 2.4 x 1 |
| 3 | 5 | 16.00 | 4/16kW | 3.2 x 5 |
| 4 | 6 | 19.20 | 4/16kW | 3.2 x 4 + 1.6 x 2 |
| 5 | 7 | 22.40 | 5/20kW | 3.2 x 5 + 2.0 x 2 |
| 6 | 8 | 25.60 | 6/24kW | 3.2 x 7 + 1.6 x 1 |
| 7 | 9 | 28.80 | 7/28kW | 3.2 x 8 + 2.4 x 1 |
| 8 | 10 | 32.00 | 8/32kW | 3.2 x 10 |
| 9 | 11 | 35.20 | 8/32kW | 3.2 x 9 + 1.6 x 2 |

**Attachment 10 In case rated power 3.3kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 3 | 9.90 | 2/8kW | 3.3 x 2 + 1.4 x 1 |
| | | | | 3.3 x 1 + 2.6 x 1 + 2.1 x 1 |
| 2 | 4 | 13.20 | 3/12kW | 3.3 x 3 + 2.1 x 1 |
| 3 | 5 | 16.50 | 4/16kW | 3.3 x 4 + 2.8 x 1 |
| 4 | 6 | 19.80 | 4/16kW | 3.3 x 4 + 1.4 x 2 |
| | | | | 3.3 x 2 + 2.6 x 2 + 2.1 x 2 |
| 5 | 7 | 23.10 | 5/20kW | 3.3 x 5 + 2.1 x 1 + 1.4 x 1 |
| | | | | 3.3 x 4 + 2.6 x 1 + 2.1 x 2 |
| 6 | 8 | 26.40 | 6/24kW | 3.3 x 6 + 2.1 x 2 |
| 7 | 9 | 29.70 | 7/28kW | 3.3 x 7 + 2.8 x 1 + 2.1 x 1 |
| 8 | 10 | 33.00 | 8/32kW | 3.3 x 8 + 2.8 x 2 |
| 9 | 11 | 36.30 | 9/36kW | 3.3 x 10 + 3.0 x 1 |

**Attachment 11 In case rated power 3.5kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 3 | 10.50 | 2/8kW | 3.5 x 1 + 2.5 x 1 + 2.0 x 1 |
| 2 | 4 | 14.00 | 3/12kW | 3.5 x 2 + 2.5 x 2 |
| 3 | 5 | 17.50 | 4/16kW | 3.5 x 4 + 2.0 x 1 |
| 4 | 6 | 21.00 | 5/20kW | 3.5 x 5 + 2.5 x 1 |
| 5 | 7 | 24.50 | 6/24kW | 3.5 x 6 + 3.0 x 1 |
| 6 | 8 | 28.00 | 7/28kW | 3.5 x 8 |
| 7 | 9 | 31.50 | 7/28kW | 3.5 x 5 + 3.0 x 1 +2.5 x 3 |
| 8 | 10 | 35.00 | 8/32kW | 3.5 x 8 + 2.0 x 2 |
| 9 | 11 | 38.50 | 9/36kW | 3.5 x 9 + 2.5 x 1 + 2.0 x 1 |

**Attachment 12 In case rated power 4.5kW**

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 2 | 9.00 | 2/8kW | 4.5 x 1 + 3.5 x 1 |
| 2 | 3 | 13.50 | 3/12kW | 4.5 x 1 + 3.5 x 1 + 4.0 x 1 |
| | | | | 4.5 x 2 + 3.0 x 1 |
| 3 | 4 | 18.00 | 4/16kW | 4.5 x 1 + 3.5 x 1 + 4.0 x 2 |
| | | | | 4.5 x 3 + 2.5 x 1 |
| 4 | 5 | 22.50 | 5/20kW | 4.5 x 1 + 3.5 x 1 + 4.0 x 3 |
| | | | | 4.5 x 4 + 2.0 x 1 |
| 5 | 6 | 27.00 | 6/24kW | 4.5 x 1 +3.5 x 1 + 4.0 x 4 |
| | | | | 4.5 x 4 + 3.0 x 2 |
| 6 | 7 | 31.50 | 7/28kW | 4.5 x 1 + 3.5 x 1 + 4.0 x 5 |
| | | | | 4.5 x 4 + 4.0 x 1 + 3.0 x 2 |
| 7 | 8 | 36.00 | 9/36kW | 4.5 x 8 |
| 8 | 9 | 40.50 | 10/40kW | 4.5 x 8 + 4.0 x 1 |
| 9 | 10 | 45.00 | 11/44kW | 4.5 x 8 + 4.0 x 2 |
| | | | | 4.5 x 9 + 3.5 x 1 |

## Attachment 13 In case rated power 4.8kW

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 2 | 9.60 | 2/8kW | 4.8 x 1 + 3.2 x 1 |
| 2 | 3 | 14.40 | 3/12kW | 4.8 x 2 + 2.4 x 1 |
| | | | | 4.8 x 1 + 3.2 x 1 + 4.0 x 1 |
| 3 | 4 | 19.20 | 4/16kW | 4.8 x 2 + 3.2 x 1 |
| | | | | 4.8 x 1 + 3.2 x 1 + 4.0 x 2 |
| 4 | 5 | 24.00 | 6/24kW | 4.8 x 5 |
| 5 | 6 | 28.80 | 7/28kW | 4.8 x 5 + 4.0 x 1 |
| 6 | 7 | 33.60 | 8/32kW | 4.8 x 5 + 4.0 x 2 |
| 7 | 8 | 38.40 | 9/36kW | 4.8 x 6 + 4.0 x 1 +3.2 x 1 |
| 8 | 9 | 43.20 | 10/40kW | 4.8 x 7 + 3.2 x 2 |
| 9 | 10 | 48.00 | 12/48kW | 4.8 x 10 |

## Attachment 14 In case rated power 5.0kW

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 2 | 10.00 | 2/8kW | 5.0 x 1 + 3.0 x 1 |
| 2 | 3 | 15.00 | 3/12kW | 5.0 x 2 + 2.0 x 1 |
| | | | | 5.0 x 1 + 3.0 x 1 +4.0 x 1 |
| 3 | 4 | 20.00 | 5/20kW | 5.0 x 4 |
| 4 | 5 | 25.00 | 6/24kW | 5.0 x 4 + 4.0 x 1 |
| 5 | 6 | 30.00 | 7/28kW | 5.0 x 5 + 3.0 x 1 |
| | | | | 5.0 x 5 + 4.0 x 2 |
| 6 | 7 | 35.00 | 8/32kW | 5.0 x 6 +2.0 x 1 |
| | | | | 5.0 x 4 +4.0 x 3 |
| 7 | 8 | 40.00 | 10/40kW | 5.0 x 8 |
| 8 | 9 | 45.00 | 11/44kW | 5.0 x 8 + 4.0 x 1 |
| 9 | 10 | 50.00 | 12/48kW | 5.0 x 9 + 3.0 x 1 |
| | | | | 5.0 x 8 + 4.0 x 2 |

## Attachment 15 In case rated power 5.5kW

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 2 | 11.00 | 2/8kW | 5.5 x 1 + 2.5 x 1 |
| 2 | 3 | 16.50 | 4/16kW | 5.5 x 2 + 5.0 x 1 |
| 3 | 4 | 22.00 | 5/20kW | 5.5 x 2 + 5.0 x 1 + 4.0 x 1 |
| 4 | 5 | 27.50 | 6/24kW | 5.5 x 2 + 5.0 x 1 + 4.0 x 2 |
| 5 | 6 | 33.00 | 8/32kW | 5.5 x 4 + 5.0 x 2 |
| 6 | 7 | 38.50 | 9/36kW | 5.5 x 4 + 5.0 x 2 +4.0 x 1 |
| 7 | 8 | 44.00 | 11/44kW | 5.5 x 8 |
| 8 | 9 | 49.50 | 12/48kW | 5.5 x 8 + 4.0 x 1 |
| 9 | 10 | 55.00 | 13/52kW | 5.5 x 8 + 4.0 x 2 |

## Attachment 16 In case rate output 5.8kW

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 2 | 11.60 | 2/8kW | 5.8 x 1 + 2.2 x 1 |
| 2 | 3 | 17.40 | 4/16kW | 5.8 x 1 + 5.1 x 2 |
| | | | | 5.8 x 2 + 4.4 x 1 |
| 3 | 4 | 23.20 | 5/20kW | 5.8 x 2 + 4.4 x 1 + 4.0 x 1 |
| 4 | 5 | 29.00 | 7/28kW | 5.8 x 4 + 4.8 x 1 |
| 5 | 6 | 34.80 | 8/32kW | 5.8 x 4 + 4.8 x 1 + 4.0 x 1 |
| | | | | 5.8 x 4 + 4.4 x 2 |
| 6 | 7 | 40.60 | 10/40kW | 5.8 x 4 + 5.6 x 3 |
| | | | | 5.8 x 5 + 5.5 x 2 |
| | | | | 5.8 x 6 + 5.2 x 1 |
| 7 | 8 | 46.40 | 11/44kW | 5.8 x 6 + 5.2 x 1 + 4.0 x 1 |
| | | | | 5.8 x 6 + 4.6 x 2 |
| 8 | 9 | 52.20 | 13/52kW | 5.8 x 8 + 5.6 x 1 |
| 9 | 10 | 58.00 | 14/56kW | 5.8 x 8 + 5.6 x 1 + 4.0 x 1 |
| | | | | 5.8 x 8 + 4.8 x 2 |

## Attachment 17 In case rated output 10.0kW

| Number of test repeated | Number of test inverter | Rated x Number | Number of rotating machine load /Output | Example for test output in each inverter |
|---|---|---|---|---|
| 1 | 2 | 20.00 | 5/20kW | 10.0 x 2 |
| 2 | 3 | 30.00 | 7/28kW | 10.0 x 2 + 8.0 x 1 |
| 3 | 4 | 40.00 | 10/40kW | 10.0 x 4 |
| 4 | 5 | 50.00 | 12/48kW | 10.0 x 4 + 8.0 x 1 |
| 5 | 6 | 60.00 | 15/60kW | 10.0 x 6 |
| 6 | 7 | 70.00 | 18/68kW | 10.0 x 6 + 8.0 x 1 |
| 7 | 8 | 80.00 | 20/80kW | 10.0 x 8 |
| 8 | 9 | 90.00 | 22/88kW | 10.0 x 8 + 8.0 x 1 |
| 9 | 10 | 100.00 | 25/100kW | 10.0 x 10 |

**(Reference data) Items to be confirmed by structural tests Appendix Table 8-1 Common items**

| | |
|---|---|
| **(1) Material** | |
| A | Materials of instrument body |
| B | Temperature limits for insulating materials |
| C | Prohibition of flammable materials such as celluloid |
| D | Insulators used in the arc section |
| E | Rust-proofing |
| F | Conductive materials |
| G | Outlines of external objects for outdoor use |
| H | Materials for terminal screws for power supply wires |
| I | Materials for terminal screws for grounding |
| J | Prohibited to use PCB (polychlorinated biphenyl) |
| K | Materials for parts in contact with drinking water, food, etc. |
| **(2) Structure** | |
| A | Assembly and normal operating conditions |
| ~~B~~ | ~~Remote control mechanism (remote control)~~ |
| C | Tip-over test |
| D | Construction materials (must be able to be firmly attached) |
| E | Arc generator (with arc-resistant insulation) |
| F | Charging section exposure<br>(The part where the voltage to ground and line voltage is 30 VAC or less or 45 VDC or less, exposed charging part 1 mA or less. (Excluding heating elements that generate heat, 150V or less, etc.) |
| G | Insulation distance |
| H | Insulation thickness |
| I | Loose connections (mechanical connections, aluminum creep, etc.) |
| J | Internal wiring of instrument body |
| K | Through-holes for power supply wires, etc. |
| L | Pulling of power supply wires (including wires connecting between appliances) |
| M | Short-circuit and overcurrent protection for wires connecting appliances |
| N | Guy wires (conductive parts must not be in danger of touching metal parts) |
| O | Structure and waterproofing to keep water away from the charging section |
| P | Moisture-proofing treatment (impregnation or application of insulating moisture-proofing impregnant, etc.) |

| | |
|---|---|
| Q | Restraint testing of electric motors and electromagnetic vibrators<br>Others (e.g., temperature control device short-circuit due to continuous energization) |
| R | Grounding obligation |
| S | Grounding mechanism |
| T | Rotational disturbance of electric motors |
| U | Protection of moving parts (indication) |
| V | Mounting and dismounting of a part of the instrument (certainty of mounting and dismounting) |
| W | Protection of interior lights, etc. |
| X | Switch indication |
| Y | Charging part in contact with liquid in a container |
| Z | Attachment of electric wires |
| AA | Heating element |
| BB | Mounting part of fuse |
| CC | Residual charge in capacitor (45 V or less) |
| DD | Indication of fuse |
| EE | Strength of outer wall |
| FF | Drop test of controller |

**[Attachment] Testing Methods Not Currently Conducted**

Items for which testing is no longer performed due to mandatory FRTs, etc., at the time of the 2021 test method revision are listed below for reference.

The test methods as of the September 2020 version of JETGR0002-1-12.0 (2020) are listed below for reference.

**5.3.1 Grid voltage phase shift (phase difference 10°)**

Applicable to [Conventional type] and [Multiple-unit interconnection type

Not applicable to [FRT-compatible type] and [FRT-compatible type].

[Test conditions]

The standard test conditions for the inverse conversion mode shown in Section 3.2 shall apply. However, paragraph F shall be changed to the following content.

F. The settings of the protective relay, etc. of the protective device shall be the factory default values (as described in the application for certification), and the function to prevent Islanding operation (passive and active methods) shall be masked.

[Measuring Methods].

A. Measure the output voltage phase of the power conditioner. The output voltage phase of the power conditioner is set as the reference (0°) and operated.
B. Change the phase of the grid voltage abruptly from 0° to +10°. The phase of the grid voltage shall be suddenly changed from 0° to +10°, maintained for 10 seconds, and then suddenly changed back to 0° and the AC output current shall be measured.
C. Measure the AC output current. The output voltage phase of the power conditioner shall be set to the reference (0°).
D. Measure the AC output current. The phase of the grid voltage shall be abruptly changed from 0° to -10°, maintained for 10 seconds, and then abruptly changed back to 0° and the AC output current shall be measured.

[Judgment Criteria].

A. Power Conditioner The power conditioner shall smoothly follow a sudden change in grid voltage phase and stably output AC output power equivalent to the phase of the grid voltage after the sudden change.
B. The power conditioner shall be able to output AC output power stably. The maximum AC output current of the power conditioner after a sudden change shall be 150% or less of the rated current, and the time exceeding 105% shall be 0.5 seconds or less.

**6.2 Instantaneous Voltage Drop Test**

Applicable to [Conventional type] and [Multiple-unit interconnection type].

Not applicable to [Multiple-unit FRT-compatible type] and [FRT-compatible type].

[Test Conditions]

The standard test conditions for the inverse conversion mode shown in Section 3.2 shall apply.

[Measuring Methods].

A. Measure the power conditioner output. b. Measure the power conditioner output. Operate the power conditioner at its rated output.
B. Cause a 0.3-second instantaneous power failure (residual voltage is 0% of rated voltage) on the AC power supply side. If a DC power supply is used, the DC input current shall also be measured.
C. Phase angle of instantaneous power failure C. The phase-in angles of the instantaneous power failure shall be 0°, 45°, and 90°, and tests shall be conducted at each phase-in angle. For three-phase equipment, phase R (phase U) or phase R-S (phase U-V) shall be the reference phase.
D. Power Conditioners Operate the power conditioner at rated output.
E. The power conditioner shall be operated at its rated output. (e) A 0.3 second instantaneous voltage drop (residual voltage is 70% of the rated voltage) shall be generated on the AC power supply side. If a DC power supply is used, the DC input current shall also be measured.
F. Phase of instantaneous voltage drop f. The instantaneous voltage drop shall be tested with phase-in angles of 0°, 45°, and 90°, and each phase-in angle shall be tested. For three-phase equipment, phase R (phase U) or phase R-S (phase U-V) shall be the reference phase.

[Judgment Criteria].

A. The system shall continue to operate stably against instantaneous power outage and voltage drop. Stable operation against instantaneous power failure and voltage drop.
B. When the gate is blocked, operation shall resume in approximately 10 seconds after the power is restored. If the gate is blocked, operation shall resume in approximately 10 seconds after power is restored.
C. When the gate is blocked, operation shall resume in approximately 10 seconds after power is restored. If the gate block and switchgear operate, operation shall resume approximately 10 seconds after power is restored.
D. When the system voltage is restored When grid voltage is restored, the AC output current shall be 150% or less of the rated current, and the time exceeding 105% shall be 0.5 seconds or less.
E. The system shall be operated in the same manner as a storage battery or similar device. When using a DC power source instead of storage batteries, etc., or when using storage batteries

mounted on electric vehicles, etc., the peak current of the DC input current shall be less than the maximum DC current specified value.

**Explanation of the translation of the update to JETGR0002-1-14.0 (2021)**

- Points of change from JETGR0002-1-13.0 to JETGR0002-1-14.0 are noted in **red**.
- Apart from the above-mentioned points of change, the original translation has been re-translated in consideration of readability for those parts of the text that were difficult to understand or contained errors, as well as for those parts where there are minor changes in the content, but the meaning remains generally unchanged.
  To distinguish them from the changes (in red), they are indicated in **blue**.

For Example, in the following cases, the changes are in **red**, and the modifications are in **blue**:

[Test Objective].
Standard active systems are required to have no mutual interference between the same system, and it is to be confirmed that the injection timing of reactive power, which is an active signal, is performed as per the JEM standard.

[Test condition]
The standard test conditions for inverse conversion mode shown in Section 3.2 are applied.
However, the paragraphs D, F and G are changed as following

E. The DC power settings should be set so that all DC energy sources are operating and the power conditioner is at the output set in section 3.2.8.
H. The step injection function and the forced active function of the active method shall be set to normal settings, and the settings of the protective relay and other protective devices shall be factory defaults (as described in the application for certification).
I. Turn on $SW_{LD}$ and set the load so that the power conditioner will have the output set in section 3.2.8.