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**Test procedure of islanding detection
measures for utility-interconnected
photovoltaic inverters**

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard submitted by the Japan Electrical Manufacturers' Association with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

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Test procedure of islanding detection measures for utility-interconnected photovoltaic inverters

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of IEC 62116 published in 2008 with some modifications of the technical contents.

The portions given sidelines or dotted underlines are the matters in which the contents of the corresponding International Standard have been modified. A list of modifications with the explanations is given in Annex JB. Annex JA is the matters not stated in the corresponding International Standard.

1 Scope

This Standard specifies the test procedure of islanding detection measures for utility-interconnected photovoltaic inverters (hereafter referred to as "power conditioners") relevant to the following items.

- a) a.c. rated output 10 W or over to and excl. 100 W
 - 1) d.c. input voltage 30 V or over up to and incl. 750 V
 - 2) a.c. output voltage 30 V or over up to and incl. 600 V
- b) a.c. rated output 100 W or over to and excl. 20 kW
 - 1) d.c. input voltage 750 V or under
 - 2) a.c. output voltage 600 V or under
- c) Operation format utility-interconnected operation to distribution line

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 62116 : 2008 *Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according to ISO/IEC Guide 21-1.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS C 8905 General rules for stand-alone photovoltaic power generating system

JIS C 8960 Glossary of terms for photovoltaic power generation

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS C 8905** and **JIS C 8960**, and the following apply.

3.1

(This term and definition in the corresponding International Standard is deleted as it is explained in **JIS** referred.)

3.1 A multi-input type power conditioner

power conditioner having plural d.c. input circuits

3.2 EUT (Equipment Under Testing)

equipment having the inverter function and islanding detection measures on which performances are tested

3.2A parallel

connection of photovoltaic inverter into the system

3.2B parallel-off

disconnection of photovoltaic inverter from the system

3.2C interconnection

state from the parallel to parallel-off the system of photovoltaic inverter

3.3

(This term and definition in the corresponding International Standard is deleted as it is explained in **JIS** referred.)

3.4

(This term and definition in the corresponding International Standard is deleted because it is not specified in this Standard.)

3.5

(This term and definition in the corresponding International Standard is deleted as it is explained in **JIS** referred.)

3.6

(This term and definition in the corresponding International Standard is deleted because it is not specified in this Standard.)

3.6A passive type system

system for the detection of islanding by detecting the change in frequency, etc. generated when the operation of a photovoltaic inverter moves to islanding

3.6B active type system

system for the detection of islanding by detecting the change in frequency, etc. generated when the operation of a photovoltaic inverter moves to islanding by making the

power conditioner give fluctuation to the active power output or the reactive power output of a photovoltaic inverter all the time

3.7 quality factor (Q_f)

factor indicating the sharpness of the resonance curve of a parallel resonance circuit used for an islanding preventing function test, which is defined by the following formula

NOTE : “Parallel” here refers to the parts connection in parallel in an electric circuit, which differs from “parallel” in 3.2A in definition.

$$Q_f = R \sqrt{\frac{C}{L}}$$

where, Q_f : quality factor

R : resistive load (Ω)

C : capacitive load (F, including shunt capacitors)

L : inductive load (H)

According to the active power, capacitance of inductive load and capacitance of capacitive load of the system, Q_f may be determined as follows.

$$Q_f = \left(\frac{1}{P} \right) \sqrt{P_{qL} \cdot P_{qC}}$$

where, P : active power (W)

P_{qL} : capacitance of inductive load (Var)

P_{qC} : capacitance of capacitive load (Var)

3.8 run-on time

period from the start of islanding to the parallel-off of the power conditioner

3.9 stopping signal

signal that turns off a main circuit power switching element (for detection of interconnected protection, detection of other abnormalities, operation switch, etc.) for the driver of a main circuit power switching element (IGBT, etc.)

3.10

(This term and definition in the corresponding International Standard is deleted because it is not specified in this Standard.)

4 Test circuit

For the test circuit, figure 1 shall be used for the single-input type, and figure 1A for the multi-input type.

Figure 1 and figure 1A show a standard test circuit for a.c. output of the single-phase two-wire system, and these are also applied to the single-phase three-wire system and the three-phase system. The case where other test circuits are applied shall be upon the agreement between the parties concerned with delivery.

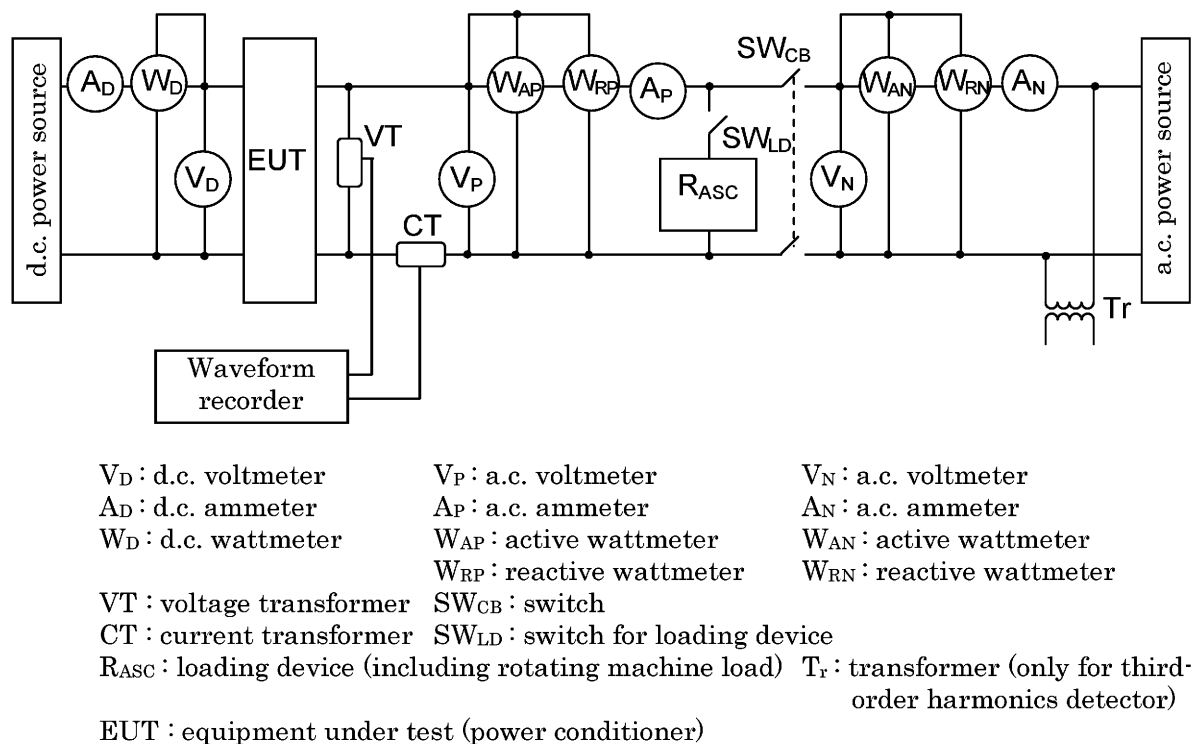
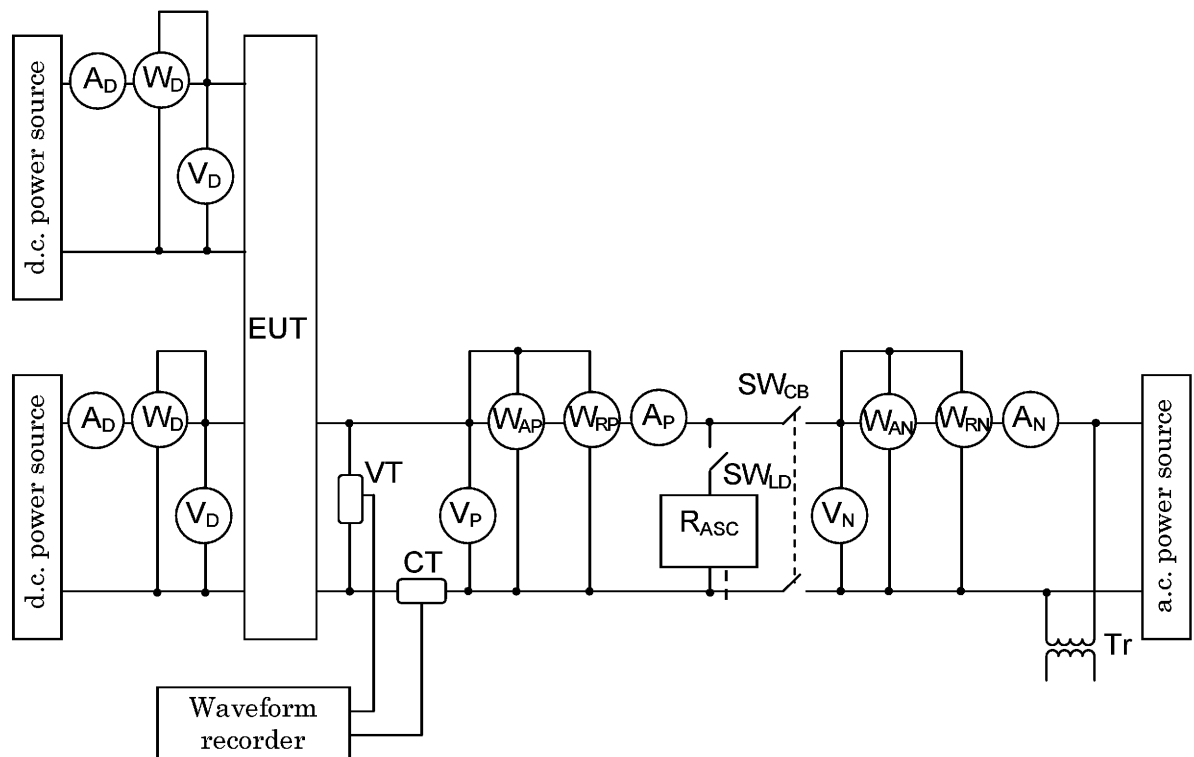


Figure 1 Test circuit of power conditioner (single-input)



See figure 1 for the explanation of instruments.

Figure 1A Test circuit of power conditioner (multi-input)

4A Measuring items

The measuring items required for the test of islanding detection measures shall be as given in table 1.

Table 1 Measuring items

Parameter	Symbol	Unit
EUT d.c. input ^{a), b)}	d.c. voltage	V_1
	d.c. current	A_1
	d.c. power	W_1
	Solar irradiance ^{c)}	G
EUT a.c. output	a.c. voltage ^{b), d), e)}	V_2
	a.c. current ^{b), d), e)}	A_2
	Active power ^{b)}	W_e
	Reactive power ^{b)}	W_r
	Voltage waveform ^{d), e), f), g)}	—
	Current waveform ^{d), e), f), g)}	—
	Relay signal ^{d)}	—
	Run-on time	t_R
	Stopping signal ^{h)}	SS
System side a.c. power source ^{b)}	System side a.c. voltage ^{b), d), e)}	V_3
	System side a.c. current ^{b), d), e)}	A_3
	System side active power	W_e
	System side reactive power	W_r
Notes ^{a)} It shall be measured when recording is required. ^{b)} Measurement shall be performed from before SW _{CB} opening. ^{c)} The pyranometer of silicon-type having high-speed performance but not thermopile type, which is used on the test performed using a photovoltaic array, shall be used. ^{d)} For measurement of voltage and current, the transducer of the same sampling rate shall be used. ^{e)} For the waveform measurement of voltage and current, each phase shall be measured <u>except the single-phase two-wire system</u> . ^{f)} The measurement of waveform data shall be performed until the output of EUT disappears from before the islanding test. The accuracy and resolution of time measurement shall be 1 ms or under. ^{g)} When recording the waveform, it shall be started from just before opening signal of SW _{CB} . ^{h)} It shall be applied when the signal from EUT is recordable.		

5 Test apparatus

5.1 Measuring instruments

For the measuring instruments used for the test, either an analogue instrument or a digital instrument, or both instruments shall be used. The accuracy of the measuring instruments shall be not lower than Class 0.5 except a waveform recorder. The accuracy of the waveform recorder shall be not lower than Class 1. If necessary, other measuring instruments (oscilloscope, etc.) are used together as appropriate.

5.2 d.c. power source

5.2.0A Type of d.c. power source

For the d.c. power source, a photovoltaic array simulator or a photovoltaic array shall be used.

When the power source above cannot be prepared, a constant voltage d.c. power source device may be used.

5.2.1 Photovoltaic array simulator

The photovoltaic array simulator shall be as follows.

- a) The photovoltaic array simulator is to simulate the predetermined photovoltaic array output characteristics, to adjust the output so that the current-voltage characteristics of photovoltaic array corresponding to arbitrary solar irradiance and arbitrary element temperature are shown, and to obtain the output power corresponding to the over input power of the power conditioner.
- b) When a photovoltaic array simulator is used as the d.c. power source, the following requirements shall be satisfied.
 - 1) **Parameter** The construction of photovoltaic array shall be capable of simulating the parameters (short-circuit current, open-circuit voltage, fill factor, etc.) of photovoltaic array recommended in order that EUT functions as part of the photovoltaic inverter.
 - 2) **Response performance** The response speed of a photovoltaic array simulator shall be not more than 1×10^{-3} s.

NOTE : The response performance is described because it affects the occurrence of d.c. ripples, etc. in the maximum power point tracking of EUT and the current-voltage characteristics of a photovoltaic cell.

- 3) **Stability of photovoltaic array characteristics** The output of photovoltaic array characteristics shall be continuously stable within 2 % except the change due to EUT while islanding continues.

(Table 2 in the corresponding International Standard is deleted because it is specified in the text of this Standard.)

5.2.2 Constant voltage d.c. power source device

The constant voltage d.c. power source device shall be as follows.

- a) The constant voltage d.c. power source device shall be such that the output power equivalent to the over input power of EUT is obtainable and the output voltage is changeable in the specified range.
- b) The constant voltage d.c. power source device shall be such that the output is adjustable to show the current-voltage characteristics of a photovoltaic array in combination with the series resistance.

(Table 2 in the corresponding International Standard is deleted because it is specified in the text of this Standard.)