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TECHNICAL SPECIFICATION

colour inside

Photovoltaic direct-driven appliance controllers –
Part 2: Operation modes and graphic display

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IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Part 2: Operation modes and graphic display

FOREWORD

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IEC TS 63349-2 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
82/1948/DTS	82/1984/RVDTS 82/1984A/RVDTS

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Specification is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 63349 series, published under the general title *Photovoltaic direct-driven appliance controllers*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

The distributed solar energy industry has been developing rapidly in recent years. Utilizing photovoltaic (PV) installation to drive appliances directly is more and more popular among solar energy applications, which will boost energy efficiency, simplify control system, reduce dependence on electrical grid and expand solar energy application. Photovoltaic direct-driven appliances (PVDDA) are an emerging type of PV installation. The PVDDA controller is an essential component of the PVDDA that lacks standardization. When PVDDA is operating, users might want to have a graphic display to monitor the real-time status and energy generating/consuming situation, which is what this document focuses on.

PHOTOVOLTAIC DIRECT-DRIVEN APPLIANCE CONTROLLERS –

Part 2: Operation modes and graphic display

1 Scope

This part of IEC 63349 defines operation modes of photovoltaic direct-driven appliance (PVDDA) controllers and describes one example of a graphic display. The graphic display is an interface to PVDDA users, which uses easily understood graphics to show a real-time operation mode, such as what equipment is installed, controlled and monitored in the system, which equipment is generating power and how much it generates, and which equipment is consuming power and how much it consumes. This helps with user's interest, knowledge, planning on renewable energy usage.

IEC 63349 is a series of standards for PVDDA controllers which can be used in various appliances including air conditioners, water pumps, refrigerators, etc. These standards only cover the requirements of PVDDA controllers.

Requirements for appliances are covered by their specific standards, for example, standards developed by IEC TC 59 on performance of household and similar electrical appliances, or by IEC TC 61 on safety of household and similar electrical appliances.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC TS 61836, *Solar photovoltaic energy systems – Terms, definitions and symbols*

IEC 61850-7-420, *Communication networks and systems for power utility automation – Part 7-420: Basic communication structure – Distributed energy resources and distribution automation logical nodes*

IEC 63349-1, *Photovoltaic direct-driven appliance controllers – Part 1: General requirements*[1]

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TS 61836, IEC 63349-1 as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

[1] To be published.

3.1
PV direct-driven appliance (PVDDA) controller
controller used for converting and regulating power conditions and flows among PV array, grid, energy storage, etc., and appliances (such as air-conditioner, refrigerator)

3.2
equipment configuration
combination of one or more equipment installed in a given PVDDA system

3.3
operation mode
real-time working status of a given PVDDA system with various energy flows “from” and “to” different equipment

3.4
power from
one or more equipment supplying power under specific operation mode, such as PV array or battery under discharging condition

3.5
power to
one or more equipment consuming power under specific operation mode, such as appliance, or battery under charging condition

4 Equipment configuration and operation modes

4.1 Equipment configuration

Equipment configuration indicates what type of equipment is installed in the PVDDA system. PV array and appliance within the scope of this document are two pieces of essential equipment. The system may also include one or more of these: electrical grid, energy storage, and other equipment. Table 1 shows the notations of the equipment and their orders on operation mode description.

Table 1 – Equipment notation

No.	Notation	Equipment
1	P	Photovoltaic array
2	A	Appliance
3	G	electrical Grid
4	S	energy Storage
5	V	electrical Vehicle
6	W	Wind turbine
7	F	Fuel cell
8	H	Hydraulic turbine
9	E1	other Equipment 1
10	E2	other Equipment 2
	…	

4.2 Power flow direction

From power flow direction point of view, installed equipment can be unidirectional or bi-directional:

- P is unidirectional equipment, only for power generation, or “power from”. In some special cases, such as PV array running a PID recovering mode, that is to supply reverse DC current to PV array, PV array becomes a power consumption equipment, or “power to’. However, these special cases are beyond the scope of this document, and will not be discussed hereinafter.
- A is unidirectional equipment, only for power consumption, or “power to”.
- G and S are bi-directional equipment. As a power source or “power from”, they provide power to other equipment. They can also consume power or “power to”, such as supplying electricity to the grid, or charging the battery.
- V, W, F, H, and others, depending on the nature of the equipment, could be unidirectional or bi-directional. The Wind turbine is unidirectional equipment. The Fuel cell may be bi-directional if it can run reversely to generate and store hydrogen. Hydraulic generator may also be bi-directional if it can pump water reversely to a higher level reservoir for energy storage.

4.3 Operation modes

The purpose of defining operation modes is to facilitate information and command communication between the controller and different equipment. The general communication network is defined and described in IEC 61850-7-420. Specific application of this communication network to PVDDA system may be developed in a later edition.

An Operation mode is described by 3 blocks. The first block is equipment configuration, followed by a double slash (//), then the second block is for “power from”, followed by an arrow (→), and the third block for “power to”.

Equipment configuration//Power from→Power to

In each block, equipment notations should be in the order presented in Table 1, and if any of these equipment is not presented in a block, just omit it.

For example:

PAGS//PG→A

where:

PAGS The First block is equipment configuration: installed equipment includes PV array, appliance, electrical grid, and energy storage;

PG The Second block is power from: power is from PV array and electrical grid. S is not in this block, because the energy storage is not providing power;

A The third block is power to: power is consumed by appliance. S and G are not present in this block, because the energy storage and the grid are not consuming power in this case.

4.4 Operation mode under different equipment configurations

Four common equipment configurations are PA, PAG, PAS, and PAGS. Under each of these configurations, there could be one or more operation modes.

Equipment configuration PA: equipment includes PV array and appliances. There is only one operation mode under this equipment configuration, and it is shown in Table 2.