



TECHNICAL SPECIFICATION

**Household and similar electrical appliances – Specifying smart capabilities, of
appliances and devices – General aspects**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 97.030

ISBN 978-2-8322-4933-8

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	8
2 Normative references	9
3 Terms, definitions and abbreviated terms	9
3.1 Terms and definitions.....	9
3.2 Abbreviated terms.....	15
4 Reference framework	15
4.1 Logical architecture.....	15
4.2 Capabilities of the CEM and the DEM	17
5 Smart operating modes.....	18
5.1 Classification of smart operating modes	18
5.2 Smart operating modes for specific devices	19
5.2.1 General	19
5.2.2 Safety.....	20
5.2.3 Always available functions	20
5.2.4 Initiation and termination of smart operation	20
5.2.5 Interaction with the CEM.....	21
5.2.6 Smart devices in user operation.....	21
5.3 Operation in "constrain or reduce load" mode	21
5.3.1 General	21
5.3.2 Fixed reference value	22
5.3.3 Floating reference value	22
5.3.4 Exclusion of specified functions	22
5.3.5 Multiple criteria	22
5.3.6 Preset constraint levels	22
5.3.7 Variable constraint levels.....	22
5.3.8 Expressing constraints in power or energy terms	23
5.4 Operation in "start or increase load" mode	23
5.4.1 General	23
5.4.2 Suitable devices	23
5.4.3 Protections and safety measures	24
5.4.4 Devices already under load	24
5.4.5 Risk of energy waste	24
5.5 Operation in "defer cycle" mode.....	24
5.5.1 Smart deferment and user deferment.....	24
5.5.2 Information required for this mode	25
5.6 Operation in "start or increase supply" mode.....	25
5.6.1 General	25
5.6.2 Suitable products and devices	25
5.6.3 Protections and safety measures	25
5.6.4 SSESs already supplying energy	26
5.7 Operation in "no supply" mode	26
5.8 Overrides	26
5.9 Device information transmission	27
5.10 Status Indicators.....	27

6	Testing smart operating modes	27
6.1	General principles	27
6.2	Setup for tests	28
6.3	Determining compliance with standards for smart performance	29
6.4	Determining the impact of smart operation on device performance	29
7	Information to be provided by manufacturers	30
7.1	General	30
7.2	Information that could to be provided	30
7.2.1	Technical information in device-performance standards	30
7.2.2	Information for device users	31
7.2.3	Information for appliance installers	31
Annex A (informative)	Device performance standards for typical devices	32
Annex B (informative)	Example of response rules for smart operating modes	33
Bibliography		35
Figure 1	– Logical Architecture	16
Figure 2	– Possible CEM, DEM and device configurations	16
Table 1	– Capabilities of customer (energy) manager and device (energy) manager	18
Table 2	– Smart operating modes	19
Table A.1	– Devices within scope of IEC TC59 and its sub-committees	32
Table B.1	–Combinations of smart operating modes, timing and duration	33

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SPECIFYING SMART CAPABILITIES, OF APPLIANCES AND DEVICES– GENERAL ASPECTS

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical specification when

- the required support cannot be obtained for the publication of an International Standard, despite repeated efforts, or
- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 62950, which is a technical specification, has been prepared by Working Group 15: Connection of household appliances to smart grids and appliances interaction, of IEC technical committee 59: Performance of household and similar electrical appliances.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
59/666/DTS	59/673/RVDTS

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

Technologies related to "smart grids" have been emerging for some time, for a range of reasons, including the need to reduce greenhouse gas emissions, utilise renewable energy resources and increase the overall resilience and efficiency of the electricity supply system as a whole. The electricity usage of the residential sector, especially household appliances, is a significant contributor to total energy consumption and peak demand. At the same time, consumers expect that innovations in the field of information technology will enhance user experiences in the context of "smart" home systems and "smart" appliances.

IEC TC 59 has considered the needs of the appliance market from a technology point of view and has identified products that will benefit from the potential for state-of-the-art technologies to add smart capabilities to household appliances, different architectures that may give rise to smart capabilities at a system-wide level, and the available protocols to control smart capabilities in household appliances and other devices.

This Technical Specification is intended to develop:

- a common architecture to apply to different use cases and to a wide range of appliance and product types, both inside and outside the scope of IEC TC59 (in this document where the term 'device' is used, it covers both appliances and products outside the scope of TC59); and
- the principles of defining and measuring smart operating modes and performance within the context of the common architecture.

The use cases considered in this document relate to the consumption (and possible discharge to the grid) of electrical energy, but future revisions of this document may not be limited to these aspects.

Appliances that are capable of exchanging information with each other, with the electricity grid and with other agents, and capable of altering their behaviour because of those interactions, are sometimes called "smart appliances". While it is not the task of this Technical Specification to define what constitutes a "smart appliance" in all circumstances, it is however possible to describe and test specific capabilities and modes of operation. Therefore, in this document, the term "smart" is used in conjunction with other terms (as in "smart appliance") in a limited sense, to describe an appliance or other product with the specific capabilities described.

A major driver for building-in such capabilities is to increase the overall resilience and economic efficiency of the electricity supply system as a whole, and its ability to accommodate more variable and distributed sources of generation (especially renewables).¹

There are several possible approaches to describing smart capabilities and smart operation:

- 1) in relation to an absolute indicator (e.g. if an appliance can pass a series of tests it may be described as "smart") – this is analogous to meeting a minimum energy performance standard;
- 2) on a comparative scale (e.g. one appliance may be "smarter" than another) – this is more difficult to demonstrate because it may require essentially subjective judgements of the relative importance of different criteria and different smart operating modes;
- 3) in terms of the trade-offs between smart capabilities and other performance criteria (e.g. an increase in energy consumption or reduction in wash performance that may occur as a result of smart operation).

¹ It is expected that consumers will receive a share of the economic benefits created by smart appliances, but it is not the role of standards to anticipate or limit the business arrangements that might transfer such benefit to the consumer (e.g. tariff structures or cash incentive payments).

These approaches are beyond the scope of this document.

The goal of this document is to support the development of a global market for appliances with smart capabilities by:

- defining the terms associated with smart capabilities and smart operation so that appliances and devices might be described in their specific performance standards as having 'smart capabilities in accordance with IEC standard NNNNN';
- clarifying the points where information is exchanged between smart appliances and devices and the electricity grid;
- defining the smart operating modes of appliances and devices in response to specific conditions;
- describing the general conditions for testing the smart operating modes of appliances and devices; and
- supporting sub-committees within TC59, and other technical committees and standardisation bodies, to include in their product specific performance standards descriptions of relevant smart capabilities and procedures for testing them and for measuring how other aspects of appliance performance might be affected by smart operation.

This document is also intended to assist manufacturers of home energy management systems, customer energy managers and similar products, and energy utilities and other remote agents wishing to encourage user response to variable energy prices or supply situations or wishing to offer direct load control services.

Some products may be capable of responses that are rapid enough to offer frequency and voltage management services to the grid. This is not the main scope of the smart operating modes described in this document, but manufacturers are free to offer such capabilities.

As smart operation usually depends on the integration of the appliance into a larger system, issues of inter-connection and inter-operability are likely to arise. Therefore, the overall 'architecture' of the system (as defined in this document and by other standards) will need to be considered. Any departures from standard architecture should be avoided.

Since the products covered by this document are likely to be widely traded, the inclusion of smart capabilities and operating modes in specific appliance and device performance standards should be flexible with regard to the presence of other equipment (e.g. "smart metering") or specific communication pathways and protocols, as these may not be present at all locations where the product will ultimately be purchased and installed.

It is recognised that the definition and standardisation of smart capabilities is at an early stage of development, and other approaches will emerge. Standardisation bodies and technical committees are urged to document the reasons for adopting alternative or modified approaches, so that they may be taken into account in future revisions of this document.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SPECIFYING SMART CAPABILITIES, OF APPLIANCES AND DEVICES – GENERAL ASPECTS

1 Scope

This Technical Specification (TS) sets out a reference framework for defining and testing smart capabilities and smart operating modes of appliances, small scale energy supplies (SSESs) and other devices (ODs) (collectively termed 'smart devices' if they have the defined capabilities). This document does not set minimum requirements for appliances, SSESs or ODs.

This document focuses on electricity consumption but the principles and general architecture can be applied to other types of energy and other services. This document focuses on appliances, SSESs and ODs, but the principles and general architecture can also be applied to other products that are capable of being equipped with a device (energy) manager (DEM).

This document:

- 1) defines terms that describe the smart capabilities and smart operating modes of appliances, SSESs and ODs;
- 2) describes the way in which such products respond to certain standard instructions and conditions that are likely to arise in the operation of smart grids;
- 3) describes various approaches to measuring how the products respond in particular smart operating modes.

Although many examples are given in relation to particular product types, this document is not intended to fully describe these matters for any particular product type. This document is intended for use by IEC and other standardisation bodies who wish to address smart capabilities and smart operating modes in the performance standards for the products for which they are responsible.

The smart device architecture and configurations described in this document, as illustrated in Figure 1 and Figure 2, are intended to guide but not necessarily limit the architecture for each specific product.

This document is relevant to testing interactions between the customer energy manager (CEM) and the device energy manager (DEM) in configurations 1 and 2, insofar as they are relevant to determining the smart operation of a device. It does not cover the interactions between the DEM and a separate DEM-ready device (in configurations 2 and 3). For the time being, these interactions may be the subject of separate standards.

This document does not cover configuration 4, in which the CEM-DEM interaction cannot be externally manipulated or observed in testing. In configuration 4, only the response of the product as a whole to grid information or remote agent instructions can be tested. This is beyond the scope of this document for the time being.

NOTE: Communications methods and protocols are not within the scope of this document, but their consideration can be useful when applying this document in the development of specific product performance standards. The methods of communication are expected to be either left open, or limited to one or more existing methods and protocols, and be capable of supporting the configurations in Figure 1 and Figure 2, and the capabilities and smart operating modes in Table 1 and Table 2.

2 Normative references

There are no normative references in this document.