

Australian/New Zealand Standard™

**Demand response capabilities and
supporting technologies for electrical
products**

**Part 3.1: Interaction of demand
response enabling devices and
electrical products—Operational
instructions and connections for air
conditioners**



AS/NZS 4755.3.1:2014

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee EL-054, Remote Demand Management of Electrical Products. It was approved on behalf of the Council of Standards Australia on 6 November 2014 and on behalf of the Council of Standards New Zealand on 31 October 2014. This Standard was published on 20 November 2014.

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Copper Development Centre Australia
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Department of Industry (Commonwealth)
Electricity Engineers Association, New Zealand
Electricity Networks Association New Zealand
Energy Networks Association
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ChargePoint
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Australian/New Zealand Standard™

Demand response capabilities and supporting technologies for electrical products

Part 3.1: Interaction of demand response enabling devices and electrical products—Operational instructions and connections for air conditioners

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee EL-054, Remote Demand Management of Electrical Products, to supersede AS/NZS 4755.3.1:2012.

This Standard forms part of a series that is intended to define the nomenclature, architecture and operational instructions for systems that can be used to remotely control electrical products, and to define the demand response capabilities of products. AS 4755—2007, *Framework for demand response capabilities and supporting technologies for electrical products*, will have its title and designation changed to become AS/NZS 4755.1. When complete, the series will comprise the following:

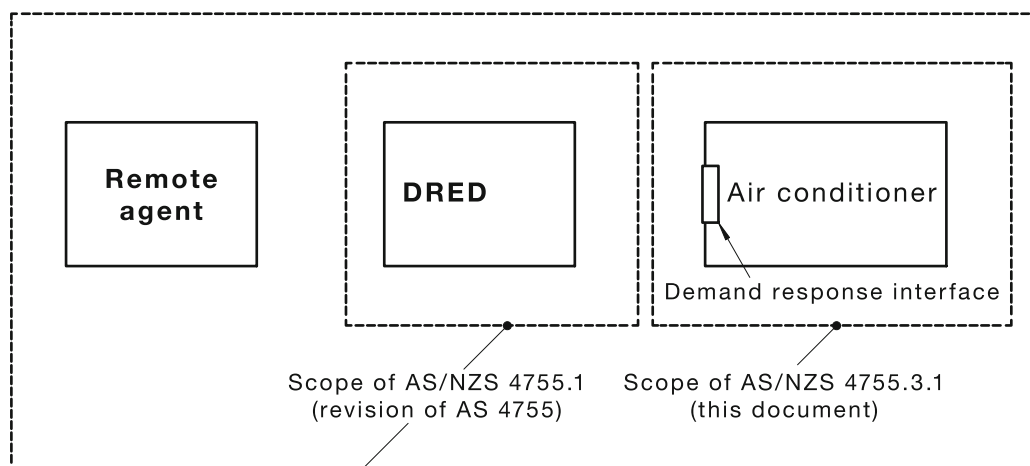
AS/NZS

- 4755 Demand response capabilities and supporting technologies for electrical products
- 4755.1 Part 1: Framework for demand response capabilities and requirements for demand response enabling devices (DREDs)
- 4755.3.1 Part 3.1: Interaction of demand response enabling devices and electrical products—Operational instructions and connections for air conditioners (this Standard)
- 4755.3.2 Part 3.2: Interaction of demand response enabling devices and electrical products—Operational instructions and connections for devices controlling swimming pool pump-units
- 4755.3.3 Part 3.3: Interaction of demand response enabling devices and electrical products—Operational instructions and connections for electric storage and electric-boosted storage water heaters
- 4755.3.4 Part 3.4: Interaction of demand response enabling devices and electrical products—Operational instructions and connections for grid-connected charge/discharge controllers for electric vehicles (EVSEs)

Detailed standards covering demand response operational instructions and interfaces with demand response enabling devices (DREDs) for other electrical products may also be prepared as needs are identified.

The diagram below depicts the structure of this Standard, AS/NZS 4755.3.1. This Standard covers the interaction of air conditioners with DREDs.

This Standard does not cover all aspects of construction and performance, which may be subject to other standards.



It is recommended that this Standard be read in conjunction with AS/NZS 4755.1.

The AS/NZS 4755 series creates a framework that will allow off-the-shelf equipment, communications technologies and electrical products to be integrated and adapted so that demand management solutions may be developed and deployed in a timely and economical fashion.

Although the series has been developed to support situations where demand response is initiated or managed by a remote agent, with the consent of the owner or user of the electrical product, there is no technical barrier that prevents the owner or user managing the operation of compliant electrical products through their own home area network, via the demand response interface.

This Standard pertains to a particular electrical product, the air conditioner. The Standard specifies, for air conditioners—

- (a) a standard demand response interface;
- (b) a standard set of operational instructions;
- (c) the required responses to the operational instructions;
- (d) the markings to be applied to products complying with the standard; and
- (e) the methods of testing to verify compliance.

This Standard is intended to support demand response programs that optimize the operation of the electricity supply system and allow the efficient planning and use of capital equipment, while minimizing the risks to the comfort and amenity of air conditioner users.

The costs and benefits of making this Standard mandatory are the subject of consideration by Australian and New Zealand Governments. If compliance were mandated, it would also be mandatory to register product details with the regulators of the national energy labelling and minimum energy performance standards program. Information about the status of this Standard and registration procedures (if required) is available at the Australian Government Energy Rating website (www.energyrating.gov.au).

The principal differences between this and the previous edition are as follows:

- (i) The reference power level for demand response has been changed from an absolute value (i.e. the energy used while operating at rated capacity in a controlled test environment) to a relative value (i.e. the energy used during normal operation at the same temperature and humidity conditions, either in a controlled environment or in the field).
- (ii) A test to ensure that response in DRM 2 differs from response in DRM 3 has been added.
- (iii) The prohibition on over-capacity operation (Clause 2.7 in the previous edition) has been removed.
- (iv) The required response in the event that the DRED transmits more than one OI at a time has been added (in a new Clause 2.7). This Clause will take effect from the date of publication of this Standard. However, Australian regulatory authorities have indicated that, in the event that compliance with this Standard becomes mandatory, they intend to accept products that would otherwise comply with this Standard (i.e. other than with Clause 2.7) as compliant for up to 3 years from publication of this revision. Users of this Standard should check the Australian Government Energy Rating website (www.energyrating.gov.au) regarding its status for regulatory purposes.

- (v) A new Clause 3.7, *Optional low voltage power supply*, has been added. This does not require the provision of such a power supply but specifies requirements for cases where it is provided.
- (vi) Section 5, *Testing and verifying demand response capability*, has been clarified. The clarifications include the specification of the most severe conditions under which compliance is required to be tested, and the addition of an alternative method of demonstrating compliance.
- (vii) Definitions and terminology have been updated to make this Standard consistent with the other parts of the AS/NZS 4755 series.

For the status of products that have been registered under the previous versions of this Standard, users should check the Australian Government Energy Rating website (www.energyrating.gov.au).

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	7
1.2 REFERENCED DOCUMENTS.....	7
1.3 DEFINITIONS.....	8
SECTION 2 OPERATIONAL INSTRUCTIONS AND DEMAND RESPONSE MODES	
2.1 GENERAL PRINCIPLES	11
2.2 DEMAND RESPONSE MODES	11
2.3 OVERRIDE CAPABILITY	14
2.4 RESPONSE TIMES.....	14
2.5 OPERATION OF AUXILIARY EQUIPMENT.....	14
2.6 HEATING AND COOLING MODES	14
2.7 MULTIPLE OPERATIONAL INSTRUCTIONS	15
SECTION 3 INTERFACES	
3.1 GENERAL.....	16
3.2 PHYSICAL INTERFACES	16
3.3 TERMINAL BLOCK.....	16
3.4 RJ45 SOCKET.....	17
3.5 CIRCUIT TO DRED	18
3.6 OPTIONAL 230 V A.C. POWER SUPPLY	19
3.7 OPTIONAL EXTRA-LOW VOLTAGE D.C. POWER SUPPLY.....	19
3.8 LOCATION AND ACCESS.....	19
SECTION 4 LABELLING AND MARKING OF DEMAND RESPONSE CAPABILITY	
4.1 GENERAL.....	20
4.2 REGISTRATION	20
4.3 POINT OF SALE LABELLING.....	20
4.4 MARKING	20
4.5 DOCUMENTATION.....	21
SECTION 5 TESTING AND VERIFYING DEMAND RESPONSE CAPABILITY	
5.1 GENERAL.....	22
5.2 GENERAL TEST PROVISIONS.....	22
5.3 SET-UP FOR TESTING (ALL TESTS)	23
5.4 TESTING RESPONSES TO OPERATING INSTRUCTIONS.....	23
5.5 NON-COMPLIANCE.....	24
5.6 INITIAL TESTING TO DETERMINE REDUCTION RATIOS FOR COMPLIANCE METHOD B (CAPACITY REDUCTION)	24
5.7 SCREENING TEST FOR BASIC DEMAND RESPONSE CAPABILITY (OPTIONAL).....	27
5.8 VERIFICATION OF CLAIMED COMPLIANCE WITH DRM 1	28
5.9 VERIFICATION OF CLAIMED COMPLIANCE WITH DRM 2	29
5.10 VERIFICATION OF CLAIMED COMPLIANCE WITH DRM 3	32
5.11 TEST REPORT.....	35

APPENDICES

A REGISTRATION INFORMATION FOR AIR CONDITIONERS COMPLYING
 WITH AS/NZS 4755.3.1 36

B VERIFICATION OF CLAIMED DEMAND RESPONSE CAPABILITY FOR AIR
 CONDITIONERS 38

C SEQUENCE OF TESTS FOR DETERMINING AND VERIFYING DEMAND
 RESPONSE CAPABILITY FOR AIR CONDITIONERS 43

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Australian/New Zealand Standard**Demand response capabilities and supporting technologies for electrical products****Part 3.1: Interaction of demand response enabling devices and electrical products—Operational instructions and connections for air conditioners**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard—

- (a) applies to air conditioners that do not contain a DRED, and have a demand response interface intended to connect with a DRED;
- (b) specifies a set of operational instructions that will meet the requirements of remote agents wishing to control the energy consumption of air conditioners;
- (c) specifies the responses required to the operational instructions;
- (d) specifies two alternative methods of connecting the demand response interface to the DRED; and
- (e) provides methods of testing to verify compliance.

Air conditioners covered by this Standard include, but are not restricted to, single-phase and three-phase air conditioners of the vapour compression type that fall within the scope of the AS/NZS 3823 series.

NOTE: If compliance with this Standard is made mandatory by the relevant Australian and New Zealand regulatory authorities, then any exclusion of product types, limitations on cooling output or other criteria for limiting regulatory scope will be stated in the regulations.

1.2 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

4755* Framework for demand response capabilities and supporting technologies for electrical products

AS/NZS

3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

3823 Performance of electrical appliances—Air conditioners and heat pumps (series)

3823.2 Part 2: Energy labelling and minimum energy performance standard (MEPS) requirements

4755 Demand response capabilities and supporting technologies for electrical products (series)

4755.1* Part 1: Framework for demand response capabilities and requirements for demand response enabling devices (DREDs)

* The definitions currently in AS 4755—2007 will be included in the forthcoming AS/NZS 4755.1.

AS/NZS

60335 Household and similar electrical appliances—Safety
60335.1 Part 1: General requirements

ISO

5151 Non-ducted air conditioners and heat pumps—Testing and rating for performance

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 4755 and those below apply.

1.3.1 Air conditioner

A heating and/or cooling device of the vapour compression type, designed primarily to provide conditioned air to an enclosed space, room or zone.

1.3.2 Asserted

The condition of a mechanical switch when the switch is closed, or the condition of an electronic switch when the load current of the switch is turned on.

1.3.3 Authorized person

A person, other than the user, who is authorized by the remote agent, the manufacturer of the electrical product, or both, to access, install or adjust parts or functions of the electrical product not accessible to the user.

1.3.4 Automatic override

A return to normal operation during a demand response event that is not initiated by the user or by the remote agent.

NOTE: This feature is intended to address the possibility of malfunction in the DRED.

1.3.5 Circumvention device

Any control, control device, software, component or part that alters the operating characteristics during any test procedure, resulting in measurements that are unrepresentative of how that product would perform under comparable conditions in normal operation.

1.3.6 Demand response (DR)

The automated alteration of an electrical product's normal mode of operation in response to an initiating signal originating from or defined by a remote agent.

1.3.7 Demand response capability

The ability of an electrical product to provide demand response, when connected to a DRED.

NOTES:

- 1 The capability may reside in the electrical product itself, or in the combination of the product and a separate DRED. If the demand response capability requires any additional external device, other than a DRED, details of the device(s) need to be specified in the manufacturer's or supplier's documentation.
- 2 An air conditioner that is *demand response capable* in accordance with AS/NZS 3823.2 has demand response capability as defined in this Standard. An air conditioner that is *potentially demand response capable* as defined in AS/NZS 3823.2 does not have demand response capability as defined in this Standard.

1.3.8 Demand response enabling device (DRED)

A device that provides the functionalities and capabilities to achieve demand response.

1.3.9 Demand response event

The period between the initiation and termination of an operational instruction.

1.3.10 Demand response interface

The physical connections and associated functions that enable an electrical product to receive operational instructions from a DRED.

1.3.11 Demand response mode (DRM)

A mode of operation within specified conditions, constraints or parameters during a demand response event (see Table 1).

1.3.12 Electrical product

A system or device designed to be connected to the grid and to provide, or control the provision of, an energy service, such as cooling, heating, motive power or energy storage. Includes all components required for normal operation and that are generally supplied or installed with the product, such as thermostats or user-operated remote controls.

NOTE: Examples of electrical products include air conditioners, water heaters, swimming pool pump-unit controllers, charge/discharge controllers for electric vehicles [also called Electric vehicle supply equipment (EVSE)] and grid-connected inverter energy systems.

1.3.13 Extra-low voltage

Voltage supplied from a source within the electrical product that does not exceed 50 V between conductors, and between conductors and earth, when the electrical product is supplied at rated voltage.

1.3.14 Maintenance or safety mode

A mode of operation, distinct from normal operation, that is intended to ensure the reliability or safety of the electrical product.

NOTE: Examples include, but are not limited to, oil recovery modes, compressor run down modes, and defrost recovery modes.

1.3.15 Manual override

The capability for the user to initiate a return to normal operation during a demand response event.

1.3.16 Normal operation

Operation under user control, including operation via user-set timers, thermostat settings and other operating parameters.

NOTE: Normal operation includes off-modes, standby modes and other modes that may be set by the user directly or by pre-programming.

1.3.17 Operational instruction (OI)

A signal instructing an electrical product to enter a specific demand response mode (see Table 1).

1.3.18 Rated capacity

The nominal rated capacity claimed by the manufacturer of an air conditioner model determined as follows, as applicable:

- (a) *Rated total cooling capacity* As claimed by the manufacturer in accordance with the AS/NZS 3823 series for temperature condition T1. (Units: W or kW.)
- (b) *Rated heating capacity* As claimed by the manufacturer in accordance with the AS/NZS 3823 series for temperature condition H1. (Units: W or kW.)

1.3.19 Rated power

Effective electrical power input of the air conditioner as claimed by the manufacturer in accordance with the AS/NZS 3823 series during the determination of rated total cooling capacity and rated heating capacity, as applicable. (Units: W or kW.)

1.3.20 Reduction ratio

The ratio of the compressor run time, speed or loading, while the air conditioner is operating in DRM 2 or DRM 3, to the compressor run time, speed or loading while the air conditioner is in normal operation, calculated in accordance with Clause 5.6.

1.3.21 Remote agent

A person, organization or entity, other than the user, who initiates demand response.

NOTES:

- 1 Examples include the electricity distributor, electricity retailer, electricity system manager and demand response aggregator.
- 2 The remote agent will generally have a contractual relationship with the user in which the user gives prior consent for the remote agent to initiate demand response under agreed conditions.

1.3.22 Response time

The time interval from the receipt of an OI until the initiation of the appropriate DRM.

1.3.23 RJ45 socket

The common name for the 8P8C modular connector that is generally used to terminate communications cables.

1.3.24 Safety extra-low voltage (SELV)

Voltage not exceeding 42 V between conductors and between conductors and earth, with the no-load voltage not exceeding 50 V.

When safety extra-low voltage is obtained from the supply mains, it is to be through a safety isolating transformer or a converter with separate windings, the insulation of which complies with double insulation or reinforced insulation requirements.

NOTE: There are differences between the definitions of and requirements for SELV provided in AS/NZS 3000 (where SELV refers to separated extra-low voltage) and AS/NZS 60335.1 (where SELV refers to safety extra-low voltage).

1.3.25 Shall

Indicates that a statement is mandatory.

1.3.26 Should

Indicates a recommendation.

1.3.27 Switch

A device for making and breaking the connection in an electrical circuit.

NOTE: A switch may be electromechanical or solid-state.

1.3.28 User

A person or entity that normally controls the operation of an electrical product.

1.3.29 User settings

The thermostat settings, fan speeds, on and off times, operating modes (heating or cooling) and other settings that are under the control of the user.

SECTION 2 OPERATIONAL INSTRUCTIONS AND DEMAND RESPONSE MODES

2.1 GENERAL PRINCIPLES

The air conditioner shall be capable of operating normally with or without a DRED connected to the interface.

An air conditioner shall be capable of meeting all the requirements of this Standard when one and only one DRED is connected. If an air conditioner has more than one interface complying with Section 3, then the connection of a DRED to any interface shall render all other interfaces inoperative as long as the DRED remains connected to that interface.

NOTE: This refers to air conditioners which may be configured so that there is more than one interface where a DRED may be connected, e.g. an indoor unit as well as an outdoor unit.

The air conditioner should comply with the operational instructions in a way that minimizes inconvenience and discomfort to the user and in a way that avoids drawing the user's attention to changes in operation at the beginning, during or end of a demand response event.

NOTE: Subject to the principles above, the air conditioner may indicate to users that it is in a demand response mode, by means of indicator lights or the display of text or graphic symbols (on fixed indoor or outdoor components or portable remote control units), or by other means, so that a user who notices a change in normal operation can verify that this is due to demand response rather than a malfunction.

2.2 DEMAND RESPONSE MODES

2.2.1 Mandatory and optional demand response modes

Air conditioner demand response modes are indicated in Table 1.

An air conditioner complying with this Standard shall be capable of at least demand response mode 1 (DRM 1).

An air conditioner that is capable of both DRM 2 and DRM 3 may have a fixed capability or a selectable capability. A fixed capability means that both DRM 2 and DRM 3 are permanently and separately available for connection to the DRED. A selectable capability means that either DRM 2 or DRM 3 may be selected by an authorized person, and one of these, but only one, is available for connection to the DRED at any given time.

NOTE: Selection may take place prior to installation, at the time of installation or later. A selectable capability may be designed to be selected once only or re-selectable, e.g. by resetting a dipswitch on a circuit board.

An air conditioner that is on at the start of a demand response event or switched on during a demand response event (either directly by the user or via a timer setting) shall enter the relevant demand response mode (if capable of that mode) within the response time specified in Clause 2.4, and shall remain in that mode for the remainder of the demand response event (i.e. the user cannot override the demand response event solely by switching the air conditioner off then on again), except if the conditions specified in Clause 2.7 are present.

An air conditioner that is not in operation during a demand response event, or ceases operation during a demand response event (either by a direct user command or via a timer setting), shall remain off until switched on by the user or in response to a timer setting (i.e. the end of the demand response event shall not be interpreted as a signal to commence operation).

NOTE: If any user settings other than 'on' and 'off' are affected by a demand response event, the air conditioner should revert to normal operation once the demand response event terminates. This is intended to preserve user preference settings and programming.

If an air conditioner initiates operation in a maintenance or safety mode during a demand response event, it may enter that mode and complete that operation. If the demand response event is still current when the operation is complete, the air conditioner shall enter the required demand response mode within the response time period specified in Clause 2.4.

TABLE 1
AIR CONDITIONER DEMAND RESPONSE MODES

Operational instruction (OI)	Demand response mode (DRM)	Description of operation in this mode	Mandatory for compliance with this Standard (AS/NZS 4755.3.1)
OI 1	DRM 1	Compressor off	Yes
OI 2	DRM 2	The air conditioner continues to cool or heat during the demand response event, but the total electrical energy (kWh) consumed by the air conditioner in a half hour period is not more than 50% of the total electrical energy that would be consumed in a half hour period during normal operation under the same temperature and humidity conditions, and the same user settings.	No
OI 3	DRM 3	The air conditioner continues to cool or heat during the demand response event, but the total electrical energy (kWh) consumed by the air conditioner in a half hour period is not more than 75% of the total electrical energy that would be consumed in a half hour period during normal operation under the same temperature and humidity conditions, and the same user settings.	No

An air conditioner shall have no demand response modes other than those in Table 1.

NOTE: Electrical products covered by other parts of the AS/NZS 4755 series may have additional demand response modes beyond those in Table 1.

An air conditioner shall only respond to the OIs corresponding to the DRMs of which it is capable. It shall not change its mode of operation in response to other OIs; if it is in normal operation at the time it shall remain in normal operation, and if it is in a demand response mode it shall remain in that mode.

NOTE: This applies to OIs transmitted one at a time. See Clause 2.7 regarding multiple OIs.

2.2.2 DRM 2 and DRM 3 operation

To satisfy DRM 2, the air conditioner shall operate in accordance with Equation 1.

To satisfy DRM 3, the air conditioner shall operate in accordance with Equation 2.

$$E_{(2)} \leq R \times 0.50 \quad \dots (1)$$

$$E_{(3)} \leq R \times 0.75 \quad \dots (2)$$

where

$E_{(2)}$ = total electrical energy (kWh) used by the air conditioner for all purposes (including compressors, controls and fans) over a 30 min period while operating in DRM 2

$E_{(3)}$ = total electrical energy (kWh) used by the air conditioner for all purposes (including compressors, controls and fans) over a 30 min period while operating in DRM 3

R = total electrical energy (kWh) used by the air conditioner for all purposes (including compressors, controls and fans) over a 30 min period while in normal operation

For verification of compliance with DRM 2 and DRM 3, a tolerance of +10% is permitted for $E_{(2)}$ and $E_{(3)}$.

R , $E_{(2)}$ and $E_{(3)}$ shall all be measured while the air conditioner is operating under the same temperature and humidity conditions and in the same operating mode (i.e. cooling or heating).

If an air conditioner is capable of both DRM 2 and DRM 3, then Equation 3 shall also be satisfied:

$$E_{(3)} - E_{(2)} \geq R \times 0.15 \quad \dots (3)$$

Air conditioners that are capable of cooling and of DRM 2 or DRM 3, or both, shall be capable of demonstrating compliance with DRM 2 or DRM 3, or both, as applicable, at Conditions T1 and T3 in ISO 5151 (Compliance Method A in Section 5 of this Standard). Alternatively, compliance may be demonstrated using Compliance Method B in Section 5.

Air conditioners that are capable of heating and of DRM 2 or DRM 3, or both, shall be capable of demonstrating compliance with DRM 2 or DRM 3, or both, as applicable, at Condition H1 in ISO 5151 (Compliance Method A in Section 5 of this Standard). Alternatively, compliance may be demonstrated using Compliance Method B in Section 5.

Example:

An air conditioner is capable of DRM 2 and DRM 3 as well as DRM 1. Under normal operation in cooling mode at Condition T1, it uses 1.52 kWh over a 30 min period. After receiving OI 2 it uses 0.80 kWh over a 30 min period. After receiving OI 3 it uses 1.1 kWh over a 30 min period.

$$R = 1.52$$

$$E_{(2)} = 0.80$$

To satisfy Equation 1, $E_{(2)} \leq 0.76$. As there is a tolerance of +10%, the energy use in DRM 2 can be up to $0.76 \times 1.1 = 0.84$ kWh. As $E_{(2)} = 0.80$, the air conditioner satisfies Equation 1 and complies with DRM 2.

$$E_{(3)} = 1.10$$

To satisfy Equation 2, $E_{(3)} \leq 1.14$. As $E_{(3)} = 1.10$, the air conditioner satisfies Equation 2 and complies with DRM 3 (without needing to invoke the tolerance).

$$E_{(3)} - E_{(2)} = 1.10 - 0.80 = 0.30$$

$$R \times 0.15 = 1.52 \times 0.15 = 0.23$$

Therefore $E_{(3)} - E_{(2)} \geq R \times 0.15$, so the air conditioner satisfies Equation 3.

NOTE: It is possible, indeed likely, that in practice the duration of demand response events will not be exact multiples of 30 min. However, if responding to OI 2 or OI 3, an air conditioner's control logic will need to anticipate the duration of the event so that it can manage operations to meet Equation 1 or Equation 2. For the purposes of this Standard, the anticipated duration should be 30 min. If the duration of the event extends beyond 30 min, the air conditioner should anticipate that the duration will be a further 30 min and so on. Verification of compliance will be carried out over one or more complete 30 min periods.

The conditions of DRM 2 and DRM 3 shall be met irrespective of changes in user settings during a demand response event (e.g. switching on 'turbo' or 'boost' modes).