

AHRI Standard 1380 (I-P)

2019 Standard for

**Demand Response through
Variable Capacity HVAC
Systems in Residential and
Small Commercial
Applications**



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IMPORTANT

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AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any tests conducted under its standards/guidelines will be non-hazardous or free from risk.

Note:

This is a new standard.

Foreword

Since AHRI Standard 1380 is a performance standard, it does not address aspects pertaining to network security and data privacy. However, such aspects may be addressed by pertinent safety standards of products covered in the scope of AHRI Standard 1380.

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DEMAND RESPONSE THROUGH VARIABLE CAPACITY HVAC SYSTEMS IN RESIDENTIAL AND SMALL COMMERCIAL APPLICATIONS

Section 1. Purpose

- 1.1 Purpose.** The purpose of this standard is to establish for Demand Response (DR) through variable capacity HVAC systems in residential and small commercial applications definitions; test requirements, operating and physical requirements, minimum data requirements for published ratings, marking and nameplate data and conformance conditions.
- 1.1.1 Intent.** This standard is intended for the guidance of HVAC systems and electric utility industries, including manufacturers, designers, installers, contractors, users and demand side management program managers. By providing standardized requirements for DR-ready HVAC systems, DR program managers can be assured the equipment is enabled to communicate in standardized messages on OpenADR 2.0 standardized DR communication protocols.
- 1.1.2 Review and Amendment.** This standard is subject to review and amendment as technology advances in both HVAC equipment and DR communication protocols.
- 1.1.3 DR strategies.** DR strategies may include but are not limited to concepts such as direct load control and price response programs.
- 1.2 Requirements.** This standard establishes requirements for variable capacity HVAC systems 65,000 Btu/hr and less that are capable of supporting DR strategies to benefit the electric grid in a predictable manner and to facilitate end users to participate in DR, price response or similar incentive programs offered by electric utilities or related entities. The requirements described in this standard include the following:
- 1.2.1** Specifications for standardized communication pathways and protocols to be utilized by DR-ready HVAC Systems to communicate with electric utilities or related entities operating DR programs.
 - 1.2.2** Specifications for communication connections to DR-ready HVAC Systems.
 - 1.2.3** Specifications for standardized communication signals between electric utilities or related entities and DR-ready HVAC Systems.
 - 1.2.4** Specifications for DR actions to be taken by DR-ready HVAC Systems in response to signals from electric utilities or related entities, considering instructions pre-configured in the system during enrollment process or otherwise by the building occupant.
 - 1.2.5** Specifications for transmittal to and from DR-ready HVAC Systems to facilitate enrollment in DR programs.

Section 2. Scope

- 2.1 Scope.** This Standard applies to communication, infrastructure and system functionality as they relate to the implementation of energy management strategies for variable capacity DR-ready HVAC systems installed in residential and small commercial applications with capacities of 65,000 Btu/hr or less as defined in Section 3.
- 2.1.1** Standardized communication required to enable participation in DR programs of electric utilities and related entities.
 - 2.1.2** Infrastructure or the minimum acceptable pathways, including the physical layer, to enable direct communication between HVAC systems and electric utilities and related entities throughout the U.S. and

Canada.

- 2.1.3** HVAC system functionality including the control modes and how the system responds to signals to modulate or restore normal operation.

2.2 *Exclusions.* This standard does not apply to any AC or HP equipment with capacity greater than or equal to 65,000 Btu/h at Rated Load Conditions.

Section 3. Definitions

All terms in this document will follow the standard industry definitions in the *ASHRAE Terminology* website, <https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology> unless otherwise defined in this section.

3.1 *Cloud Server.* A logical server that is built, hosted and delivered through a cloud computing platform over the Internet. Cloud Servers possess and exhibit similar capabilities and functionality to a typical server but are accessed remotely from a cloud service provider.

3.2 *Continuously-variable Capacity Equipment.* Equipment capable of varying its cooling and heating output continuously over a wide range. Typically, such equipment utilizes inverters (variable frequency drives) to raise and lower the speed and output of compressors, fans and blowers.

3.3 *Demand Response (DR).* An umbrella term used to describe a range of methods through which systems respond to grid conditions or signals. These methods include various peak-shedding, such as direct load control, price-response methods, and curtailment of load. This definition is applicable for both noun and adjective usage of DR.

3.4 *Demand Response-ready (DR-ready) HVAC System.* A system manufactured ready to operate on standardized communication protocols designed for DR use, and configured to respond in defined ways to defined signals, including any field modifications (e.g. use of an accessory) authorized by a manufacturer's installation instructions.

3.5 *Demand Side Management (DSM).* A process used for the modification of consumer demand for energy through various methods such as financial incentives, direct load control, behavior change through education, etc. The goal of DSM is usually to encourage the consumer to use less energy during peak hours, or to move the time of energy use to off-peak times.

3.6 *Discretely-variable Capacity Equipment.* Equipment having the capability of varying its cooling and heating output capacity in two or more discrete steps. Typically, such system utilizes compressors with mechanical unloading capability, or utilizes two or more compressors operating in parallel. Such systems may also utilize various techniques to vary the output of fans and blowers.

3.7 *Peak Load Pricing Event.* An event in which the electric utility or related entity experiences severe peak loads and raises utility rates substantially to signal the need to reduce power (kW) use.

3.8 *Rated Load Conditions.* Ambient conditions defined by AHRI Standard 210/240 for the purpose of measuring cooling and heating output and energy efficiency of AC or HP equipment. For the purpose of this Standard, the primary rating conditions for cooling operations is the 95°F cooling outdoor ambient rating point, A_{Full} ; for heat pump heating operation, is the 47°F heating outdoor ambient rating point as defined in AHRI Standard 210/240, at $H1_{Full}$ conditions for two-stage equipment as defined by AHRI Standard 210/240 and $H1_{Nom}$ for all other equipment.

3.9 *Rated Load Power.* The power (kW) consumed by AC or HP equipment at Rated Load Conditions defined by AHRI Standard 210/240. For the purpose of this Standard, the primary rating conditions for cooling operations is the 95°F cooling outdoor ambient rating point A_{Full} ; for heat pump heating operation, is the 47°F heating outdoor ambient rating point as defined in AHRI Standard 210/240, at $H1_{Full}$ conditions for two-stage equipment as defined by AHRI Standard 210/240 and $H1_{Nom}$ for all other equipment.

3.10 *Run Normal.* No DR event is in effect and the AC or HP equipment is running under local control.

3.11 *"Shall" or "Should".* "Shall" or "should" shall be interpreted as follows:

3.11.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.11.2 *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.12 *Test Tool.* A custom software application designed to connect to either CTA-2045-A or OpenADR 2.0 communication interfaces, which generates appropriate messages to assess the fulfillment of the requirements specified in Section 6 by the DR-ready HVAC system.

Section 4. Abbreviations and Symbols

4.1 Abbreviations used in this Standard:

4.1.1	AC	Air Conditioner
4.1.2	ACK	A communication response: acknowledged
4.1.3	CTA	Consumer Technologies Association
4.1.4	DHCP	Dynamic Host Configuration Protocol
4.1.5	DR	Demand Response
4.1.6	DSM	Demand Side Management
4.1.7	HP	Heat Pump
4.1.8	HVAC	Heating, Ventilation and Air Conditioning
4.1.9	kW	Kilowatt
4.1.10	NAK	A communication response: not acknowledged
4.1.11	VEN	Virtual end node, refers to the HVAC system in OpenADR
4.1.12	VTN	Virtual top node, refers the utility or other headend in OpenADR
4.1.13	W	Watt

Section 5. Test Requirements

5.1 *Test Requirements.* Configuration requirements, communication requirements, and equipment performance requirements shall be verified by tests conducted in accordance with the test method described in Appendix C and utilizing the communication protocols in Section 6.

5.1.1 *HVAC System.* HVAC system shall be tested using all components as recommended by the manufacturer.

Section 6. Operating and Physical Requirements

6.1 *Summary of Operating and Physical Requirements.* DR-ready HVAC System shall meet the communication and equipment performance requirements as itemized below for either CTA-2045-A or OpenADR 2.0 or both communication protocols. Compliance with all requirements shall be verified by tests in accordance with Appendix C.

6.1.1 *CTA-2045-A Communication Interface.*

6.1.1.1 Table 1 outlines the communication and discovery functions and equipment responses to CTA-2045-A signals.

6.1.1.2 Table 2 outlines the management functions and equipment responses to CTA-2045-A signals.

6.1.1.3 The physical and electrical aspects of this interface are set forth in Section 6.2.2.

Table 1. Communication and Discovery with CTA-2045-A

Function	CTA-2045-A Message	CTA-2045-A Reference	Usage and Purpose
Verifying Connectivity	Outside Comm Connection Status Message	Table 8-2	Outside Comm Connection Status Message is a CTA-2045-A mandatory message. This recurring signal, sent from the communication module to the HVAC system, with HVAC acknowledgment, allows: 1. the HVAC system to know that the attached communication module is successfully connected to a remote headend 2. the communication module to know that the HVAC system is present and connected
System Capabilities	Info Request – sent from the communication module to the HVAC system, with response	Section 9.1.1 Section 9.1.1.1 (request) and Section 9.1.1.2 (response)	Info request sent from the communication module enables the system type to be discovered. System responses shall include all mandatory CTA-2045-A fields noted by “M” in CTA-2045-A Section 9.1.1.2 plus: 1. Vendor ID (uniquely assigned to each manufacturer by the USNAP Alliance) 2. Device type = 0x0004 for heat pumps Device type = 0x0007 for AC only 3. Model number (to support device characterization) 4. Capability bitmap = For Continuously-variable Capacity Equipment set Bit 4 and for Discretely-variable Capacity Equipment set Bit 5
Maximum Indoor Temperature Offset	Get/Set Temperature Offset Setting the temperature offset and reading the present temperature offset	Section 9.1.5 Section 9.1.5.3 and 9.1.5.4 for setting the temperature offset Section 9.1.5.1 and 9.1.5.2 for reading the present temperature offset	A non-zero temperature offset “Set” by this message shall be used as the “Maximum Indoor Temperature Offset” for HVAC system during a load control or price event unless locally modified by the consumer. This offset number is a decrease in set point when in heating mode and an increase when in cooling mode. There are no limits associated with the default value. Manufacturers may provide consumers with means to alter the default value. The present “Maximum Indoor Temperature Offset” value shall always be returned in response to a “Get” message.
Operational State Query and Response	Operational State Query and Response Messages	Table 8-2	Operational state query and response enables remote systems to monitor the present state of the HVAC system and to verify that curtailment events are acted upon and in effect.