Status: Approved

Version: 1.2

SunSpec DER Information Model Specification

SunSpec Specification

Abstract

This document describes the SunSpec Distributed Energy Resource (DER) information models that provide support for the Institute of Electrical and Electronics Engineers (IEEE) 1547-2018 functionality using SunSpec information modeling.

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Revision History

Version	Date	Comments
1.0	4-20-2021	Initial release
1.1	3-14-2022	Formatting, copy editing, and front matter update.
1.2	6-24-2024	Adding missing information, fixing typos Adding Modbus Enable section

About the SunSpec Alliance

The SunSpec Alliance is a trade alliance of developers, manufacturers, operators, and service providers together pursuing open information standards for the distributed energy industry. SunSpec standards address most operational aspects of PV, storage, and other distributed energy power plants on the smart grid, including residential, commercial, and utility-scale systems, thus reducing cost, promoting innovation, and accelerating industry growth.

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SunSpec Alliance specifications are initiated by SunSpec members to establish an industry standard for mutual benefit. Any SunSpec member can propose a technical work item. Given sufficient interest and time to participate, and barring significant objections, a workgroup is formed and its charter is approved by the board of directors. The workgroup meets regularly to advance the agenda of the team.

The output of the workgroup is generally in the form of a SunSpec Interoperability Specification. These documents are considered to be normative, meaning that there is a matter of conformance required to support interoperability. The revision and associated process of managing these documents is tightly controlled. Other documents are informative, or make some recommendations with regard to best practices, but are not a matter of conformance. Informative documents can be revised more freely and more frequently to improve the quality and quantity of information provided.

SunSpec Interoperability Specifications follow a lifecycle pattern of: DRAFT, TEST, APPROVED, and SUPERSEDED.

For more information or to download a SunSpec Alliance specification, go to https://sunspec.org/about-sunspec-specifications/.

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1 Introduction

The SunSpec Distributed Energy Resource (DER) Information Model Specification defines SunSpec Device Information Models for DERs. A primary goal of this specification is to define a standard way for DERs and interfacing systems to exchange information. DERs and controlling entities that implement the models described in this specification can reliably perform DER management by implementing one or more of the following models, which comprise the complete set of DER related functions:

- DER AC Measurement
- DER Capacity
- DER Enter Service
- DER AC Controls
- DER Volt-Var
- DER Volt-Watt
- DER Trip LV
- DER Trip HV
- DER Trip LF
- DER Trip HF
- DER Frequency Droop
- DER Watt-Var
- DER Storage Capacity
- DER DC Measurement

This specification is intended to be used in conjunction with the SunSpec Device Information Model Specification and is compliant with the information modeling requirements specified in that standard.

This specification supports reading and writing Information Model points implemented in a DER. This document describes the full SunSpec DER Information Model Specification. Developers can choose how much or how little to implement.

DER information models aim to achieve the following:

- Adhere to the SunSpec Device Information Model specification.
- Support all DER interoperability functionality specified in IEEE 1547-2018.
- Define consistent implementation guidelines for all DERs that make it easy for developers to implement interoperable DER solutions.

1.1 Document Organization

Chapter 2 lists the standards documents that are normative references for this document.

Chapter 3 provides an introduction to DER management functions and the application of the DER Information Models.

Chapter 4 provides a detailed specification for each of the standardized SunSpec DER Information Models, specifying points, point groups, and their valid attributes and values.

1.2 Terminology

Definition element	Definition elements are associated with a Device Information Model and describe the model data structure and usage. A definition element can have a value or provide a container for other elements. The Device Information Model defines the following elements: • model • point • point group • symbol • comment Definition elements have attributes that qualify or describe the element.
Device	A device is an entity that exchanges data across communications interfaces. A device has a data set, modeled by Device Information Models, that describes physical and state information about the device. The device data set is the set of logically-related data points specific to the device type. The collections of Device Information Models that describe the data set correspond to the full set of device data points supported by the device.
Device Information Model	The Device Information Model is used to structure device data for exchange across communications interfaces. The model provides a mechanism for specifying the data set supported by a device, which consists of a set of standardized definition elements.
Device Information Model definition	A Device Information Model definition specifies the data points that make up the particular Device Information Model and the usage information associated with each data point. There is one definition for each Device Information Model. Device Information Model definitions represent collections of device data points. The canonical form of Device Information Model definitions are specified using JSON encoding.
Device Information Model instance	A Device Information Model instance is created from a Device Information Model definition. The instance includes data point values specified for each of the defined data points. There can be any number of instances of a Device Information Model.
May trip	A set of conditions where a DER is allowed to trip but is not required to trip.

Model	A Device Information Model *model* element defines a logical grouping of *points*. Each *model* has a unique model ID.
Momentary cessation	Suspension of injection of active power based on current conditions. It implies the ability to resume injection immediately on a change of conditions.
MUST, MUST NOT, REQUIRED, SHALL, SHALL NOT, SHOULD, SHOULD NOT, RECOMMENDED, MAY, and OPTIONAL	The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this specification, are to be interpreted as described in IETF RFC 2119.
Must trip	A set of conditions where a DER must trip.
Point	A Device Information Model *point* element defines a device data point and has a value.
Point group	A Device Information Model *group* element contains a group of *points* and/or other *point groups*.
Point group, top-level	The top-level point group is the first element of a Device Information Model and contains all other elements.
Reversion timer	A timer that limits the duration of a control, which implies a behavior to revert to on the termination of the control based on timer expiration.
Symbol	A Device Information Model *symbol* element defines a name-value pair. It is used to represent a constant value associated with the enumerated value or bit position of a *point*.
Trip	Cessation of injection of power by the DER. Implies a set of conditions must be met to resume injection of power.

2 Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

IEEE 1547-2018, Standard for Interconnection and Interoperability of Distributed Energy Resources With Associated Electric Power Systems Interfaces, Apr. 2018, <https://ieeexplore.ieee.org/document/8332112>.

SunSpec X99999; SunSpec Device Information Model Specification, version 0.1, May 2019.

3 Overview

This section presents the following general DER topics that apply to multiple information models:

- Curve management as applied to control functions that use linear curves to indicate the behavior associated with the function. Some information models have curve instances as data points.
- Reversion timers, which are used to limit the time a function operates with a specific set of settings.
- A trip/momentary cessation curve encoding for representing behavior during frequency and voltage disturbances.

3.1 Curve Management

Some control functions use piece-wise linear curves to indicate the behavior associated with the function. All functions that utilize curves have a set of curve management points, which can be updated to modify basic curve management functionality:

Symbol	Description	Access
Ena	Determines if the function is enabled or disabled.	read/write
AdptCrvReq	Select a new curve setting.	read/write
AdptCrvRslt	Result of the AdptCrvReq operation.	read-only
NPt	Number of possible curve points in each curve instance.	read-only
NCrv	Number of curve instances.	read-only
ActPt	Number of active points in the curve	read/write

Table 1: Curve Management Points

3.1.1 Curve Layout

A control function information model that uses a curve contains a configurable number of curves that have a configurable number of points:

- number of curves (NCrv)
- number of points in each curve (NPt)

Device Information Model curve instances occupy sequential locations in the information model. Each curve instance is represented by a sequential set of points that together define the behavior associated with the curve function. Each point is represented by one or more values, and the NPt point specifies the number of possible points in each curve instance. The ActPt point specifies the number of points that are currently active in the curve.

A Device Information Model that uses curves SHALL contain at least two curve instances. The first curve instance is a read-only curve instance that contains the current curve settings. Subsequent curve instances hold curve settings that can be used to update the current curve settings.

3.1.2 Curve Update

The enable point (Ena) determines if the function is enabled or disabled. If the enable point is set to zero (0) the function is disabled, and the setting associated with the function SHALL NOT be effective. If the enable point is set to one (1), the function SHALL be enabled, and the settings are active based on other points in the information model.

New curve settings SHALL be selected by writing one of the curve indexes to the adopt curve request point (AdptCrvReq). The index value SHALL be greater than one (1), which is the index of the active curve. This operation SHALL cause the settings located at the specified curve index to be copied to the active curve settings. The result of the operation SHALL update the adopt curve result point (AdptCrvRslt) with one of the following values:

- IN_PROGRESS
- COMPLETED
- FAILED

If the result is COMPLETED, reading the curve settings at curve index one (1) SHALL reflect the updated settings.

If a set of active curve settings update is in progress, the current curve settings SHALL remain active until the updated curve settings are accepted and made operational. If the update fails, the current settings SHALL remain effective without interruption.

3.2 Reversion Timers

A reversion timer SHALL be used to limit the time a function operates with a specific set of settings. If a reversion timer is enabled for a function and the timer expires without an update, the function SHALL revert to an alternate set of settings. If a setting is updated while the reversion timer is active or the function is re-enabled, the reversion timer SHALL be reinitialized with the reversion timeout value, and the timer is restarted.

The following data points SHALL manage reversion timer functionality:

- reversion timeout value (RvrtTms)
- reversion time remaining (RvrtRem)
- alternate, function-dependent revision settings

The following figure shows reversion timer states and state transition events:

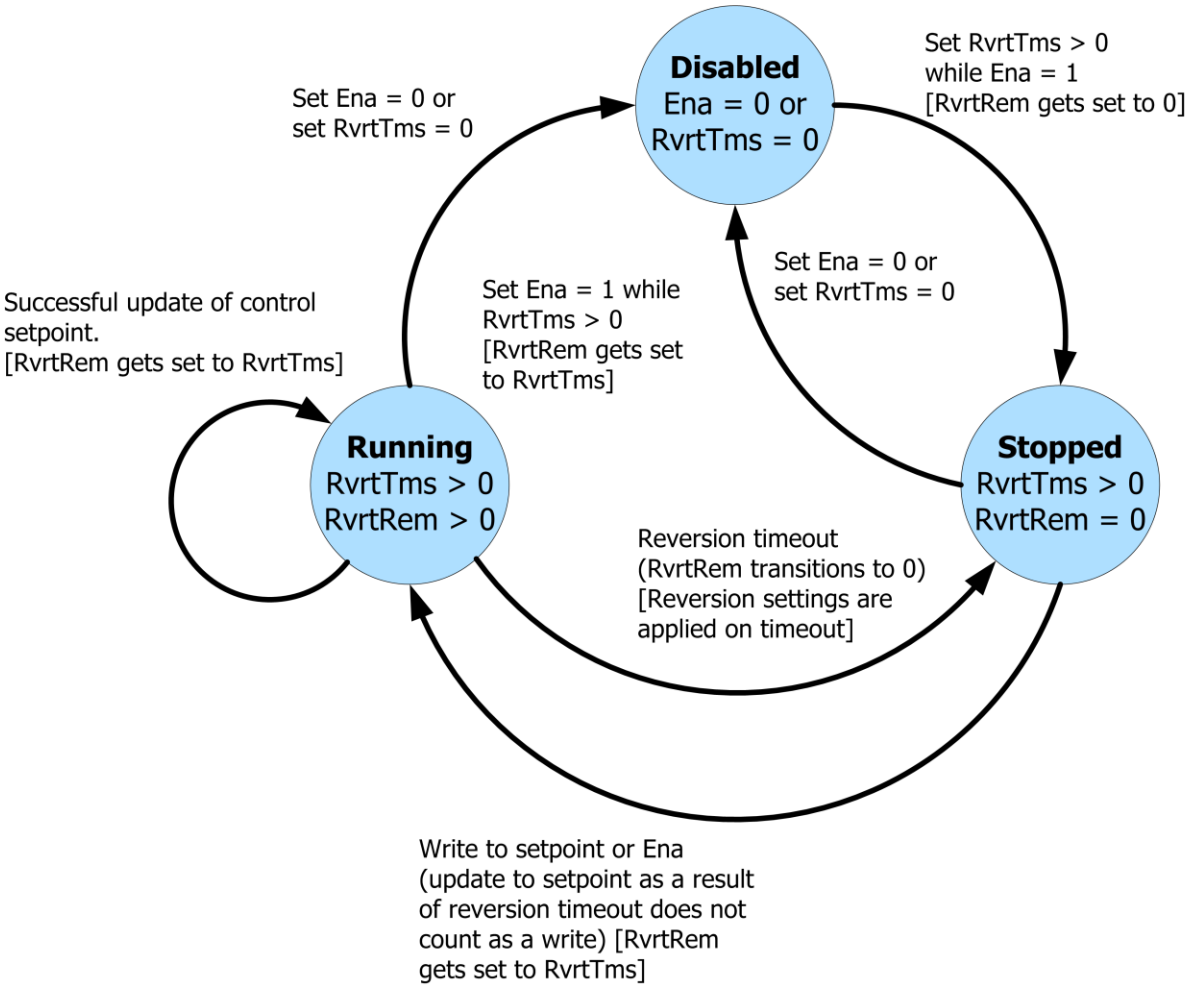

Figure 1: Reversion Timer States

A reversion timer SHALL be in one of the following states:

- Disabled
- Stopped
- Running

If a reversion timer is in the Disabled state, the reversion timer SHALL not affect the current function settings. In this state, the function SHALL be either not enabled or the reversion timeout value SHALL be set to zero (0).

If a reversion timer is in the Stopped state, the reversion timer SHALL not affect the current function settings. If a function setting is changed or the function re-enabled, the reversion timer SHALL be reinitialized with the reversion timeout value, and the timer SHALL be restarted.

If the reversion timer is in the Running state, the reversion time remaining SHALL indicate the time interval remaining until the reversion timer expires. When the revision timer expires, the specified alternate set of function settings SHALL be applied to the function and the reversion timer transitions to the Stopped state.

3.3 Modbus Enable

Since most of grid support functions in SunSpec Modbus have an enable field, the function or setting comes into effect only when this field is ENABLED. This is an enum field with the following values:

1. 0 (DISABLED)
2. 1 (ENABLED)

When the enable field is set to 0, any changes made to the setting will not take effect. For example, if the 704. WMaxLimPct is set to 90% but 704. WMaxLimPctEna = 0, the WMaxLimPCt register will have the value of 90% but the DER will not limit the active power to 90% of its nameplate rating. When the WMaxLimPctEna is set to 1, this update will take effect, and the DER will limit the active power to 90%.

If an enable is set to 1, any changes to the corresponding settings will be applied to the DER. Rewriting the enable is not required for the changes to be applied.

3.4 Trip/Momentary Cessation Settings

This section presents general information about the trip and momentary cessation settings for frequency and voltage disturbances.

3.4.1 Terminology Clarification

Historically, in communications information models, the term “ride-through” has been used as the general term referring to settings associated with voltage and frequency disturbance. However, IEEE 1547-2018 indicates that “ride-through” is a capability and that the term “ride-through” should not be used for settings. The preferred term that has been proposed generally is “disturbance response settings”. It is recommended that the term “ride-through” SHOULD NOT be used to describe the settings.

3.4.2 Trip/Momentary Cessation Region Representation

It is desirable to use a flexible mechanism to represent voltage and frequency trip regions and to handle as many use cases as possible. For example, the curves in some standards[1] require diagonal segments that cannot be represented using rectangular regions.

The trip and momentary cessation curves can be represented as piece-wise linear curves that define the regions associated with voltage and frequency trip, and momentary cessation behavior.

[1] European Network Code Requirements for Generators (RfG), “ENTSO-E Network Code for Requirements for Grid Connection Applicable to all Generators,” 2016.

Most threshold requirements can be represented by providing a method that defines the following three regions.

Region	DER Behavior	Precedence Hierarchy
trip	When the *trip* region is entered, the DER SHALL trip.	1 (highest)
may trip	When the *may trip* region is entered, the DER may either continue in its current operational mode or trip.	3
momentary cessation	When the *momentary cessation* region is entered, the DER SHALL cease to energize but SHALL NOT trip.	2

Table 2: Voltage and Frequency Trip Regions

Each region boundary is defined by a piece-wise linear curve such that when crossing the *may trip* curve, the DER is in the *may trip* region.

When crossing a curve of higher precedence, the DER SHALL assume the behavior of the higher precedence.

The difference between the *trip* and *momentary cessation* is the process of resuming operation after that region has been entered. The general distinction is that resumption from *momentary cessation* may be done fully and immediately on leaving the region, while resumption from *trip* may require additional considerations such as a delay and ramping operation. The exact resumption process may vary based on grid code and additional parameters. Because of the limits of some DERs, galvanic isolation may or may not be provided on a *trip*.

The following figure shows an example of the IEEE 1547-2018 trip/momentary cessation curves for voltage, and Table 4 shows curve points for the voltage example reference.

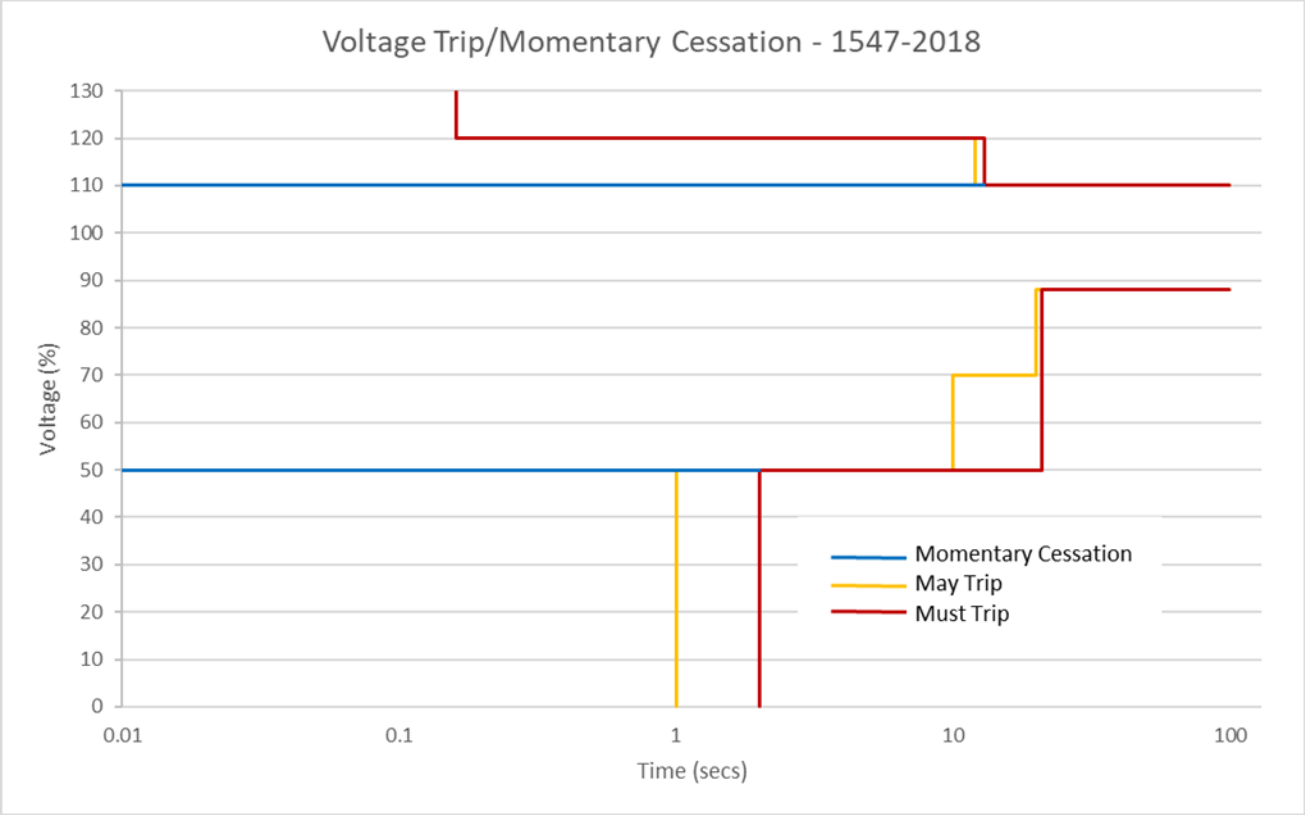

Figure 2: Voltage Trip/Momentary Cessation

Curve	Points
LV Trip	(0, 2), (.5, 2), (.5, 21), (.88, 21), (.88, 22)
LV Momentary Cessation	(.5, 0), (.5, 2)
LV May Trip	(0, 1), (.5, 1), (.5, 10), (.7, 10), (.7, 20), (.88, 20), (.88, 22)
HV Trip	(1.3,.16), (1.2, .16), (1.2, 13), (1.1, 13), (1.1, 14)
HV Momentary Cessation	(1.1, 0), (1.1, 14)
HV May Trip	(1.3,.16), (1.2, .16), (1.2, 12), (1.1, 12), (1.1, 14)

Table 3: Voltage Trip/Momentary Cessation Points

3.4.3 Configuration

A DER is typically configured with only the trip and momentary cessation curves, provided the behavior complies with the interconnection certification standard. The *may trip* curve can be useful if the DER makes use of the optional regions. The *may trip* curve represents the minimum ride-through requirements.

Currently, frequency disturbance response standards do not include momentary cessation regions so only the *trip* curve SHALL be required. An optional *may trip* curve MAY be configured.

Curves are assumed to extend infinitely vertically from the first point on the curve (positive voltage direction for HV and negative voltage direction for LV), and horizontally (positive time) from the last point on the curve.

It is recognized that DERs might have significant limitations on the shape of the curves it can support. Many DERs might only be able to support curves with vertical and horizontal curve segments within very specific ranges.

3.5 Mandatory/Optional Points

The designation of points in a model as mandatory is based on the core functionality of the model. If a model would be become non-functional without the point being implemented, it is defined as mandatory. This designation is not meant to represent requirements for any other standard or jurisdiction. Refer to the specific standards or jurisdictional guides for implementation requirements.

4 DER Information Models

This section describes each of the SunSpec DER Information Models:

- DER AC Measurement
- DER Capacity
- DER Enter Service
- DER AC Controls
- DER Volt-Var
- DER Volt-Watt
- DER Trip LV
- DER Trip HV
- DER Trip LF
- DER Trip HF
- DER Frequency Droop
- DER Watt-Var
- DER Storage Capacity
- DER DC Measurement

These models provide a standardized way to implement communication protocols of DERs for common DER management functions. Each model specification includes a point summary for the model followed by a detailed description of each point. Points that are part of a point group are indicated in the descriptions.

The summary tables list the following attributes for each point of the model:

Point or Point Group name	The Point or Point Group name field is the acronym associated with the point. A Point Group has a name and a type and includes the points below it, as indicated by indentation.
Point label	The Point label field
Point data type	The Point data type field specifies the data type of the point.
Point access capability	The Point access capability field specifies whether the point is read-only (`R`) or read-write (`RW`).
Point implementation requirement	The Point implementation requirement field specifies whether the point is mandatory (`M`), or optional (`O`).
Point value mutability	The Point value mutability field specifies if the value is static (`S`) or not.

The detailed point description of each point in a model includes:

- Point or point group name, which is the same as the name in the point summary table.
- Detailed description of the point or point group, including enumerated values for the point.

4.1 DER AC Measurement (701)

The DER AC Measurement information model contains the measurement data associated with the DER along with current status and alarm information. Neither the status nor the alarm information points are latched. They both reflect the current state of the DER and change when that status or alarm state changes.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERMeasureAC	DER AC Measurement	group			
ID	DER AC Measure Model ID	uint16		M	S
L	DER AC Measure Model Length	uint16		M	S
ACType	AC Wiring Type	enum16		M	
St	Operating State	enum16			
InvSt	Inverter State	enum16			
ConnSt	Grid Connection State	enum16			
Alrm	Alarm Bitfield	bitfield32			
DERMode	DER Operational Characteristics	bitfield32			
W	Active Power	int16			
VA	Apparent Power	int16			
Var	Reactive Power	int16			
PF	Power Factor	uint16			
A	Total AC Current	int16			
LLV	Voltage LL	uint16			
LNV	Voltage LN	uint16			
Hz	Frequency	uint32			
TotWhInj	Total Energy Injected	unit64			
TotWhAbs	Total Energy Absorbed	unit64			
TotVarhInj	Total Reactive Energy Injected	unit64			
TotVarhAbs	Total Reactive Energy Absorbed	unit64			
TmpAmb	Ambient Temperature	int16			
TmpCab	Cabinet Temperature	int16			
TmpSnk	Heat Sink Temperature	int16			
TmpTrns	Transformer Temperature	int16			
TmpSw	IGBT/MOSFET Temperature	int16			
TmpOt	Other Temperature	int16			
WL1	Watts L1	int16			
VAL1	VA L1	int16			
VarL1	Var L1	int16			
PFL1	PF L1	uint16			
AL1	Amps L1	int16			

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
VL1L2	Phase Voltage L1- L2	uint16			
VL1	Phase Voltage L1-N	uint16			
TotWhInjL1	Total Watt-Hours Inj L1	uint64			
TotWhAbsL1	Total Watt-Hours Abs L1	uint64			
TotVarhInjL1	Total Var-Hours Inj L1	uint64			
TotVarhAbsL1	Total Var-Hours Abs L1	uint64			
WL2	Watts L2	int16			
VAL2	VA L2	int16			
VarL2	VAR L2	int16			
PFL2	PF L2	uint16			
AL2	Amps L2	int16			
VL2L3	Phase Voltage L2- L3	uint16			
VL2	Phase Voltage L2-N	uint16			
TotWhInjL2	Total Watt-Hours Inj L2	uint64			
TotWhAbsL2	Total Watt-Hours Abs L2	uint64			
TotVarhInjL2	Total Var-Hours Inj L2	uint64			
TotVarhAbsL2	Total Var-Hours Abs L2	uint64			
WL3	Watts L3	int16			
VAL3	VA L3	int16			
VarL3	Var L3	int16			
PFL3	PF L3	uint16			
AL3	Amps L3	int16			
VL3L1	Phase Voltage L3- L1	uint16			
VL3	Phase Voltage L3-N	uint16			
TotWhInjL3	Total Watt-Hours Inj L3	uint64			
TotWhAbsL3	Total Watt-Hours Abs L3	uint64			
TotVarhInjL3	Total Var-Hours Inj L3	uint64			
TotVarhAbsL3	Total Var-Hours Abs L3	uint64			
ThrotPct	Throttling in Pct	uint16			
ThrotSrc	Throttle Source Information	bitfield32			
A_SF	Current Scale Factor	sunssf			S
V_SF	Voltage Scale Factor	sunssf			S
Hz_SF	Frequency Scale Factor	sunssf			S
W_SF	Active Power Scale Factor	sunssf			S
PF_SF	Power Factor Scale Factor	sunssf			S
VA_SF	Apparent Power Scale Factor	sunssf			S
Var_SF	Reactive Power Scale Factor	sunssf			S

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
TotWh_SF	Active Energy Scale Factor	sunssf			S
TotVarh_SF	Reactive Energy Scale Factor	sunssf			S
Tmp_SF	Temperature Scale Factor	sunssf			S
MnAlrmInfo	Manufacturer Alarm Info	string			

Table 4: DER AC Measurement Points

DERMeasureAC Points

DERMeasureAC — DER AC measurement model.

ID — DER AC measurement model ID.

L — DER AC measurement model length.

ACType — AC wiring type:
- SINGLE_PHASE (0) = Single Phase
- SPLIT_PHASE (1) = Split Phase
- THREE_PHASE (2) = Three Phase

St — Operating state of the DER:
- OFF (0) = Off
- ON (1) = On

InvSt — Inverter state:
- OFF (0) = Off
- SLEEPING (1) = Sleeping
- STARTING (2) = Starting
- RUNNING (3) = Running
- THROTTLED (4) = Active Power Throttled
- SHUTTING_DOWN (5) = Shutting Down
- FAULT (6) = Fault
- STANDBY (7) = Standby

ConnSt — Grid connection state:
- DISCONNECTED (0) = Disconnected
- CONNECTED (1) = Connected

Alrm	Active alarms for the DER: GROUND_FAULT(0) = Ground Fault DC_OVER_VOLT (1) = DC Over Voltage AC_DISCONNECT (2) = AC Disconnect Open DC_DISCONNECT (3) = DC Disconnect Open GRID_DISCONNECT (4) = Grid Disconnect CABINET_OPEN (5) = Cabinet Open MANUAL_SHUTDOWN (6) = Manual Shutdown OVER_TEMP (7) = Over Temperature OVER_FREQUENCY (8) = Frequency Above Limit UNDER_FREQUENCY (9) = Frequency Under Limit AC_OVER_VOLT (10) = AC Voltage Above Limit AC_UNDER_VOLT (11) = AC Voltage Under Limit BLOWN_STRING_FUSE (12) = Blown String Fuse on Input UNDER_TEMP (13) = Under Temperature MEMORY_LOSS (14) = Generic Memory or Communication Error (Internal) HW_TEST_FAILURE (15) = Hardware Test Failure MANUFACTURER_ALRM (16) = Manufacturer Alarm
DERMode	DER operational characteristics: GRID_FOLLOWING (0) = Grid Following GRID_FORMING (1) = Grid Forming PV_CLIPPED (2) = PV Output Clipped
W	Scale Factor: W_SF Units: W Total active power.
VA	Scale Factor: VA_SF Units: VA Total apparent power.
VAR	Scale Factor: Var_SF Units: Var Total reactive power.
PF	Scale Factor: PF_SF Power factor.

A	Scale Factor: A_SF Units: A Total AC current.
LLV	Scale Factor: V_SF Units: V Line to line AC voltage as an average of active phases.
LNV	Scale Factor: V_SF Units: V Line to neutral AC voltage as an average of active phases.
Hz	Scale Factor: Hz_SF Units: Hz AC frequency.
TotWhInj	Scale Factor: TotWh_SF Units: Wh Total active energy injected (Quadrants 1 & 4).
TotWhAbs	Scale Factor: TotWh_SF Units: Wh Total active energy absorbed (Quadrants 2 & 3).
TotVarhInj	Scale Factor: TotVarh_SF Units: Varh Total reactive energy injected (Quadrants 1 & 2).
TotVarhAbs	Scale Factor: TotVarh_SF Units: Varh Total reactive energy absorbed (Quadrants 3 & 4).
TmpAmb	Scale Factor: Tmp_SF Units: C Ambient temperature.

TmpCab	Scale Factor: Tmp_SF Units: C Cabinet temperature.
TmpSnk	Scale Factor: Tmp_SF Units: C Heat sink temperature.
TmpTrns	Scale Factor: Tmp_SF Units: C Transformer temperature.
TmpSw	Scale Factor: Tmp_SF Units: C IGBT/MOSFET temperature.
TmpOt	Scale Factor: Tmp_SF Units: C Other temperature.
WL1	Scale Factor: W_SF Units: W Active power L1.
VAL1	Scale Factor: VA_SF Units: VA Apparent power L1.
VarL1	Scale Factor: Var_SF Units: Var Reactive power L1.
PFL1	Scale Factor: PF_SF Power factor phase L1.

AL1	Scale Factor: A_SF Units: A Current phase L1.
VL1L2	Scale Factor: V_SF Units: V Phase voltage L1-L2.
VL1	Scale Factor: V_SF Units: V Phase voltage L1-N.
TotWhInjL1	Scale Factor: TotWh_SF Units: Wh Total active energy injected L1.
TotWhAbsL1	Scale Factor: TotWh_SF Units: Wh Total active energy absorbed L1.
TotVarhInjL1	Scale Factor: TotVarh_SF Units: Varh Total reactive energy injected L1.
TotVarhAbsL1	Scale Factor: TotVarh_SF Units: Varh Total reactive energy absorbed L1.
WL2	Scale Factor: W_SF Units: W Active power L2.
VAL2	Scale Factor: VA_SF Units: VA Apparent power L2.

VarL2	Scale Factor: Var_SF Units: Var Reactive power L2.
PFL2	Scale Factor: PF_SF Power factor L2.
AL2	Scale Factor: A_SF Units: A Current L2.
VL2L3	Scale Factor: V_SF Units: V Phase voltage L2-L3.
VL2	Scale Factor: V_SF Units: V Phase voltage L2-N.
TotWhInjL2	Scale Factor: TotWh_SF Units: Wh Total active energy injected L2.
TotWhAbsL2	Scale Factor: TotWh_SF Units: Wh Total active energy absorbed L2.
TotVarhInjL2	Scale Factor: TotVarh_SF Units: Varh Total reactive energy injected L2.
TotVarhAbsL2	Scale Factor: TotVarh_SF Units: Varh Total reactive energy absorbed L2.

WL3	Scale Factor: W_SF Units: W Active power L3.
VAL3	Scale Factor: VA_SF Units: VA Apparent power L3.
VarL3	Scale Factor: Var_SF Units: Var Reactive power L3.
PFL3	Scale Factor: PF_SF Power factor L3.
AL3	Scale Factor: A_SF Units: A Current L3.
VL3L1	Scale Factor: V_SF Units: V Phase voltage L3-L1.
VL3N	Scale Factor: V_SF Units: V Phase voltage L3-N.
TotWhInjL3	Scale Factor: TotWh_SF Units: Wh Total active energy injected L3.
TotWhAbsL3	Scale Factor: TotWh_SF Units: Wh Total active energy absorbed L3.

TotVarhInjL3	Scale Factor: TotVarh_SF Units: Varh Total reactive energy injected L3.
TotVarhAbsL3	Scale Factor: TotVarh_SF Units: Varh Total reactive energy absorbed L3.
ThrotPct	Throttling in Pct of maximum active power. Units: Pct
ThrotSrc	Active throttling source: MAX_W (0) = Maximum Active Power Limit FIXED_W (1) = Fixed Active Power FIXED_VAR (2) = Fixed Reactive Power FIXED_PF (3) = Fixed Power Factor VOLT_VAR (4) = Volt-Var Function FREQ_WATT (5) = Freq-Watt Function DYN_REACT_CURR (6) = Dynamic Reactive Current LVRT (7) = Low Voltage Ride-through HVRT (8) = High Voltage Ride-through WATT_VAR (9) = Watt-Var Function VOLT_WATT (10) = Volt-Watt Function SCHEDULED (11) = Scheduled LFRT (12) = Low Frequency Ride-through HFRT (13) = High Frequency Ride-through DERATED (14) = Derated
A_SF	Current scale factor.
V_SF	Voltage scale factor.
Hz_SF	Frequency scale factor.
W_SF	Active power scale factor.
PF_SF	Power factor scale factor.
VA_SF	Apparent power scale factor.
VAR_SF	Reactive power scale factor.

TotWh_SF	Active energy scale factor.
TotVarh_SF	Reactive energy scale factor.
Tmp_SF	Temperature scale factor.
ManAlrmInfo	Manufacturer alarm information. Valid if MANUFACTURER_ALRM indication is active.

4.2 DER Capacity (702)

The DER Capacity information model contains ratings for the DER that are read-only and settings for the DER that can be used to override some ratings.

The settings that are made available in an installation SHOULD default to the rating value. If a setting is adjusted from the default value, the setting value SHALL be used in place of the associated rating for any functions that use that rating to determine functional behavior.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERCapacity	DER Capacity	group			
ID	DER Capacity Model ID	uint16		M	S
L	DER Capacity Model Length	uint16		M	S
WMaxRtg	Active Power Max Rating	uint16			S
WOvrExtRtg	Active Power (Over-Excited) Rating	uint16			S
WOvrExtRtgPF	Specified Over-Excited PF	uint16			S
WUndExtRtg	Active Power (Under-Excited) Rating	uint16			S
WUndExtRtgPF	Specified Under-Excited PF	uint16			S
VAMaxRtg	Apparent Power Max Rating	uint16			S
VarMaxInjRtg	Reactive Power Injected Rating	uint16			S
VarMaxAbsRtg	Reactive Power Absorbed Rating	uint16			S
WChaRteMaxRtg	Charge Rate Max Rating	uint16			S
WDisChaRteMaxRtg	Discharge Rate Max Rating	uint16			S
VAChaRteMaxRtg	Charge Rate Max VA Rating	uint16			S
VADisChaRteMaxRtg	Discharge Rate Max VA Rating	uint16			S
VNomRtg	AC Voltage Nominal Rating	uint16			S
VMaxRtg	AC Voltage Max Rating	uint16			S
VMinRtg	AC Voltage Min Rating	uint16			S
AMaxRtg	AC Current Max Rating	uint16			S
PFOvrExtRtg	PF Over-Excited Rating	uint16			S
PFUndExtRtg	PF Under-Excited Rating	uint16			S
ReactSusceptRtg	Reactive Susceptance	uint16			S
NorOpCatRtg	Normal Operating Category	enum16			S
AbnOpCatRtg	Abnormal Operating Category	enum16			S
CtrlModes	Supported Control Modes	bitfield32			S
IntIslandCatRtg	Intentional Island Categories	Bitfield16			S
WMax	Active Power Max Setting	uint16	RW		
WMaxOvrExt	Active Power (Over-Excited) Setting	uint16	RW		
WOvrExtPF	Specified Over-Excited PF	uint16	RW		

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
WMaxUndExt	Active Power (Under-Excited) Setting	uint16	RW		
WUndExtPF	Specified Under-Excited PF	uint16	RW		
VAMax	Apparent Power Max Setting	uint16	RW		
VarMaxInj	Reactive Power Injected Setting	uint16	RW		
VarMaxAbs	Reactive Power Absorbed Setting	uint16	RW		
WChaRteMax	Charge Rate Max Setting	uint16	RW		
WDisChaRteMax	Discharge Rate Max Setting	uint16	RW		
VAChaRteMax	Charge Rate Max VA Setting	uint16	RW		
VADisChaRteMax	Discharge Rate Max VA Setting	uint16	RW		
VNom	Nominal AC Voltage Setting	uint16	RW		
VMax	AC Voltage Max Setting	uint16	RW		
VMin	AC Voltage Min Setting	uint16	RW		
AMax	AC Current Max Setting	uint16	RW		
PFOvrExt	PF Over-Excited Setting	uint16	RW		
PFUndExt	PF Under-Excited Setting	uint16	RW		
IntIslandCat	Intentional Island Categories	bitfield16	RW		
W_SF	Active Power Scale Factor	sunssf			S
PF_SF	Power Factor Scale Factor	sunssf			S
VA_SF	Apparent Power Scale Factor	sunssf			S
Var_SF	Reactive Power Scale Factor	sunssf			S
V_SF	Voltage Scale Factor	sunssf			S
A_SF	Current Scale Factor	sunssf			S
S_SF	Susceptance Scale Factor	sunssf			S

Table 5: DER Capacity Points

DERCapacity Points

DERCapacity	DER capacity model.
ID	DER capacity model ID.
L	DER capacity model length.

WMaxRtg	Scale Factor: W_SF Units: W Maximum active power rating at unity power factor in watts.
WOvrExtRtg	Scale Factor: W_SF Units: W Active power rating at specified over-excited power factor in watts.
WOvrExtRtgPF	Scale Factor: PF_SF Specified over-excited power factor.
WUndExtRtg	Scale Factor: W_SF Units: W Active power rating at specified under-excited power factor in watts.
WUndExtRtgPF	Scale Factor: PF_SF Specified under-excited power factor.
VAMaxRtg	Scale Factor: VA_SF Units: VA Maximum apparent power rating in volt-amperes.
VarMaxInjRtg	Scale Factor: Var_SF Units: Var Maximum injected reactive power rating in vars.
VarMaxAbsRtg	Scale Factor: Var_SF Units: Var Maximum absorbed reactive power rating in vars.
WChaRteMaxRtg	Scale Factor: W_SF Units: W Maximum active power charge rate in watts.

WDisChaRteMaxRtg	Scale Factor: W_SF Units: W Maximum active power discharge rate in watts.
VAChaRteMaxRtg	Scale Factor: VA_SF Units: VA Maximum apparent power charge rate in volt-amperes.
VADisChaRteMaxRtg	Scale Factor: VA_SF Units: VA Maximum apparent power discharge rate in volt-amperes.
VNomRtg	Scale Factor: V_SF Units: V AC voltage nominal rating.
VMaxRtg	Scale Factor: V_SF Units: V AC voltage maximum rating.
VMinRtg	Scale Factor: V_SF Units: V AC voltage minimum rating.
AMaxRtg	Scale Factor: A_SF Units: A AC current maximum rating in amps.
PFOvrExtRtg	Scale Factor: PF_SF Power factor over-excited rating.
PFUndExtRtg	Scale Factor: PF_SF Power factor under-excited rating.

ReactSusceptRtg	Scale Factor: S_SF Units: S Reactive susceptance that remains connected to the Area EPS in the cease to energize and trip state.
NorOpCatRtg	Normal operating performance category as specified in IEEE 1547-2018: CAT_A (0) = Category A CAT_B (1) = Category B
AbnOpCatRtg	Abnormal operating performance category as specified in IEEE 1547-2018: CAT_1 (0) = Category I CAT_2 (1) = Category II CAT_3 (2) = Category III
CtrlModes	Supported control mode functions: MAX_W (0) = Limit Maximum Active Power FIXED_W (1) = Fixed Active Power FIXED_VAR (2) = Fixed Reactive Power FIXED_PF (3) = Fixed Power Factor VOLT_VAR (4) = Volt-Var Function FREQ_WATT (5) = Freq-Watt Function DYN_REACT_CURR (6) = Dynamic Reactive Current Function LV_TRIP (7) = Low-Voltage Trip HV_TRIP (8) = High-Voltage Trip WATT_VAR (9) = Watt-Var Function VOLT_WATT (10) = Volt-Watt Function SCHEDULED (11) = Scheduling LF_TRIP (12) = Low-Frequency Trip HF_TRIP (13) = High-Frequency Trip
IntIslandCatRtg	Intentional island categories: UNCATEGORIZED (0) = Uncategorized INT_ISL_CAPABLE (1) = Intentional Island-Capable BLACK_START_CAPABLE (2) = Black Start-Capable ISOCH_CAPABLE (3) = Isochronous-Capable
WMax	Scale Factor: W_SF Units: W Maximum active power setting used to adjust maximum active power rating.

WMaxOvrExt	Scale Factor: W_SF Units: W Active power setting at specified over-excited power factor in watts.
WOvrExtPF	Scale Factor: PF_SF Specified over-excited power factor.
WMaxUndExt	Scale Factor: W_SF Units: W Active power setting at specified under-excited power factor in watts.
WUndExtPF	Scale Factor: PF_SF Specified under-excited power factor.
VAMax	Scale Factor: VA_SF Units: VA Maximum apparent power setting used to adjust maximum apparent power rating.
VarMaxInj	Scale Factor: Var_SF Units: Var Maximum injected reactive power setting used to adjust maximum injected reactive power rating.
VarMaxAbs	Scale Factor: Var_SF Units: Var Maximum absorbed reactive power setting used to adjust maximum absorbed reactive power rating.
WChaRteMax	Scale Factor: W_SF Units: W Maximum active power charge rate setting used to adjust maximum active power charge rate rating.

WDisChaRteMax	Scale Factor: W_SF Units: W Maximum active power discharge rate setting used to adjust maximum active power discharge rate rating.
VAChaRteMax	Scale Factor: VA_SF Units: VA Maximum apparent power charge rate setting used to adjust maximum apparent power charge rate rating.
VADisChaRteMax	Scale Factor: VA_SF Units: VA Maximum apparent power discharge rate setting used to adjust maximum apparent power discharge rate rating.
VNom	Scale Factor: V_SF Units: V Nominal AC voltage setting.
VMax	Scale Factor: V_SF Units: V AC voltage maximum setting used to adjust AC voltage maximum rating.
VMin	Scale Factor: V_SF Units: V AC voltage minimum setting used to adjust AC voltage minimum rating.
AMax	Scale Factor: A_SF Units: A Maximum AC current setting used to adjust maximum AC current rating.
PFOvrExt	Scale Factor: PF_SF Power factor over-excited setting.

PFUndExt	Scale Factor: PF_SF Power factor under-excited setting.
IntIslandCat	Intentional island categories.
W_SF	Active power scale factor.
PF_SF	Power factor scale factor.
VA_SF	Apparent power scale factor.
Var_SF	Reactive power scale factor.
V_SF	Voltage scale factor.
A_SF	Current scale factor.
S_SF	Susceptance scale factor.

4.3 DER Enter Service (703)

The DER Enter Service information model contains the Permit Enter Service point which determines if a DER is permitted to energize on the grid as well as points that contain the conditions that must be present to allow the DER to reenergize after tripping. If the Permit Enter Service is set to disabled while energized, the DER SHALL cease to energize and trip.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DEREnterService	Enter Service	group			
ID	Enter Service ID	uint16		M	S
L	Enter Service Length	uint16		M	S
ES	Permit Enter Service	enum16	RW		
ESVHi	Enter Service Voltage High	uint16	RW		
ESVLo	Enter Service Voltage Low	uint16	RW		
ESHzHi	Enter Service Frequency High	uint32	RW		
ESHzLo	Enter Service Frequency Low	uint32	RW		
ESDlyTms	Enter Service Delay Time	uint32	RW		
ESRndTms	Enter Service Random Delay	uint32	RW		
ESRmpTms	Enter Service Ramp Time	uint32	RW		
ESDlyRemTms	Enter Service Delay Remaining	uint32			
V_SF	Voltage Scale Factor	sunssf			S
Hz_SF	Frequency Scale Factor	sunssf			S

Table 6: DER Enter Service Points

DEREnterService Points

DEREnterService — Enter service.

ID — Enter service model ID.

L — Enter service model length.

ES — Permit enter service:
DISABLED (0) = Cease to energize and trip, remain de-energized
ENABLED (1) = Permitted to energize

ESVHi	Scale Factor: V_SF Units: Pct Enter service voltage high threshold as a percent of normal voltage.
ESVLo	Scale Factor: V_SF Units: Pct Enter service voltage low threshold as a percent of normal voltage.
ESHzHi	Scale Factor: Hz_SF Units: Hz Enter service frequency high threshold
ESHzLo	Scale Factor: Hz_SF Units: Hz Enter service frequency low threshold.
ESDlyTms	Units: Secs Enter service delay time in seconds.
ESRndTms	Units: Secs Enter service random delay in seconds.
ESRmpTms	Units: Secs Enter service ramp time in seconds.
ESDlyRemTms	Units: Secs Enter service delay remaining time in seconds.
V_SF	Voltage scale factor.
Hz_SF	Frequency scale factor.

4.4 DER AC Controls (704)

The DER AC Controls information model provides a group of immediate controls that include power factor when injecting power, power factor when absorbing power, limit active power, set active power, and set reactive power. Each control also provides reversion timer functionality that, if implemented, SHALL conform to the reversion timer behavior specified in 3.2 Reversion Timers

Synchronization groups are used for all power factor value pairs as they consist of a power factor and excitation value. The power factor and excitation values SHALL be processed atomically when read and written.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERCtlAC	DER AC Controls	group			
ID	Model ID	uint16		M	S
L	Model Length	uint16		M	S
PFWInjEna	Power Factor (W Inj) Enable	enum16	RW		
PFWInjEnaRvrt	Power Factor (W Inj) Reversion Enable Setting	enum16	RW		
PFWInjRvrtTms	PF Reversion Time (W Inj)	uint32	RW		
PFWInjRvrtRem	PF Reversion Time Rem (W Inj)	uint32			
PFWAbsEna	Power Factor (W Abs) Enable	enum16	RW		
PFWAbsEnaRvrt	PF (W Abs) Reversion Enable Setting	enum16	RW		
PFWAbsRvrtTms	PF Reversion Time (W Abs)	uint32	RW		
PFWAbsRvrtRem	PF Reversion Time Rem (W Abs)	uint32			
WMaxLimPctEna	Limit Max Active Power Pct Enable	enum16	RW		
WMaxLimPct	Limit Max Power Pct Setpoint	uint16	RW		
WMaxLimPctRvrt	Reversion Limit Max Power Pct	uint16	RW		
WMaxLimPctEnaRvrt	Reversion Limit Max Power Pct Enable	enum16	RW		
WMaxLimPctRvrtTms	Limit Max Power Pct Reversion Time	uint32	RW		
WMaxLimPctRvrtRem	Limit Max Power Pct Rev Time Rem	uint32			
WSetEna	Set Active Power Enable	enum16	RW		
WSetMod	Set Active Power Mode	enum16	RW		
WSet	Active Power Setpoint (W)	int32	RW		

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
WSetRvrt	Reversion Active Power (W)	int32	RW		
WSetPct	Active Power Setpoint (Pct)	int16	RW		
WSetPctRvrt	Reversion Active Power (Pct)	int16	RW		
WSetEnaRvrt	Reversion Active Power Enable	enum16	RW		
WSetRvrtTms	Active Power Reversion Time	uint32	RW		
WSetRvrtRem	Active Power Rev Time Rem	uint32			
VarSetEna	Set Reactive Power Enable	enum16	RW		
VarSetMod	Set Reactive Power Mode	enum16	RW		
VarSetPri	Set Reactive Power Priority	enum16	RW		
VarSet	Reactive Power Setpoint (Vars)	int32	RW		
VarSetRvrt	Reversion Reactive Power (Vars)	int32	RW		
VarSetPct	Reactive Power Setpoint (Pct)	int16	RW		
VarSetPctRvrt	Reversion Reactive Power (Pct)	int16	RW		
VarSetEnaRvrt	Reversion Reactive Power Enable	enum16	RW		
VarSetRvrtTms	Reactive Power Reversion Time	uint32	RW		
VarSetRvrtRem	Reactive Power Rev Time Rem	uint32			
WRmp	Normal Ramp Rate	uint16	RW		
WRmpRef	Normal Ramp Rate Reference	enum16	RW		
VarRmp	Reactive Power Ramp Rate	uint16	RW		
AntiIslEna	Anti-Islanding Enable	enum16	RW		
PF_SF	Power Factor Scale Factor	sunssf			S
WMaxLimPct_SF	Limit Max Power Scale Factor	sunssf			S
WSet_SF	Active Power Scale Factor	sunssf			S
WSetPct_SF	Active Power Pct Scale Factor	sunssf			S
VarSet_SF	Reactive Power Scale Factor	sunssf			S

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
VarSetPct_SF	Reactive Power Pct Scale Factor	sunssf			S
DERCtlAC.PFWInj	Power Factor (W Inj)	sync			
PF	Power Factor (W Inj)	uint16	RW		
Ext	Power Factor Excitation (W Inj)	enum16	RW		
DERCtlAC.PFWInjRvrt	Reversion Power Factor (W Inj)	sync			
PF	Reversion Power Factor (W Inj)	uint16	RW		
Ext	Reversion PF Excitation (W Inj)	enum16	RW		
DERCtlAC.PFWAbs	Power Factor (W Abs)	sync			
PF	Power Factor (W Abs)	uint16	RW		
Ext	Power Factor Excitation (W Abs)	enum16	RW		
DERCtlAC.PFWAbsRvrt	Reversion Power Factor (W Abs)	sync			
PF	Reversion Power Factor (W Abs)	uint16	RW		
Ext	Reversion PF Excitation (W Abs)	enum16	RW		

Table 7: DER AC Controls Points

DERCtlAC Points

DERCtlAC — DER AC controls model.

ID — DER AC controls model ID.

L — DER AC controls model length.

PFWInjEna — Power factor enable when injecting active power:
DISABLED (0) = Disabled
ENABLED (1) = Enabled

PFWInjEnaRvrt — Power factor reversion timer enable when injecting active power:
DISABLED (0) = Disabled
ENABLED (1) = Enabled

PFWInjRvrtTms	Units: Secs Power factor reversion timer when injecting active power.
PFWInjRvrtRem	Units: Secs Power factor reversion time remaining when injecting active power.
PFWAbsEna	Power factor enable when absorbing active power: DISABLED (0) = Disabled ENABLED (1) = Enabled
PFWAbsEnaRvrt	Power factor reversion timer enable when absorbing active power: DISABLED (0) = Disabled ENABLED (1) = Enabled
PFWAbsRvrtTms	Units: Secs Power factor reversion timer when absorbing active power.
PFWAbsRvrtRem	Units: Secs Power factor reversion time remaining when absorbing active power.
WMaxLimPctEna	Limit maximum active power percent enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
WMaxLimPct	Scale Factor: WMaxLimPct_SF Units: Pct Limit maximum active power value.
WMaxLimPctRvrt	Scale Factor: WMaxLimPct_SF Units: Pct Reversion limit maximum active power percent value.
WMaxLimPctEnaRvrt	Reversion limit maximum active power percent value enable: DISABLED (0) = Disabled ENABLED (1) = Enabled

WMaxLimPctRvrtTms	Units: Secs Limit maximum active power percent reversion time.
WMaxLimPctRvrtRem	Units: Secs Limit maximum active power percent reversion time remaining.
WSetEna	Set active power enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
WSetMod	Set active power mode: W_MAX_PCT (0) = Active Power as Max Percent WATTS (1) = Active Power as Watts
WSet	Scale Factor: WSet_SF Units: W Active power setting value in watts.
WSetRvrt	Scale Factor: WSet_SF Units: W Reversion active power setting value in watts.
WSetPct	Scale Factor: WSetPct_SF Units: Pct Active power setting value as a percent.
WSetPctRvrt	Scale Factor: WSetPct_SF Units: Pct Reversion active power setting value as percent.
WSetEnaRvrt	Reversion active power function enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
WSetRvrtTms	Units: Secs Set active power reversion time.

WSetRvrtRem	Units: Secs Set active power reversion time remaining.
VarSetEna	Set reactive power enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
VarSetMod	Set reactive power mode: W_MAX_PCT (0) = Reactive Power as Watt Max Pct VAR_MAX_PCT (1) = Reactive Power as Var Max Pct VAR_AVAIL_PCT (2) = Reactive Power as Var Avail Pct VA_MAX_PCT (3) = Reactive Power as VA Max Pct VARS (4) = Reactive Power as Vars
VarSetPri	Reactive power priority: ACTIVE (0) = Active Power Priority REACTIVE (1) = Reactive Power Priority VENDOR (2) = Vendor Power Priority
VarSet	Scale Factor: VarSet_SF Units: Var Reactive power setting value in vars.
VarSetRvrt	Scale Factor: VarSet_SF Units: Var Reversion reactive power setting value in vars.
VarSetPct	Scale Factor: VarSetPct_SF Units: Pct Reactive power setting value as a percent.
VarSetPctRvrt	Scale Factor: VarSetPct_SF Units: Pct Reversion reactive power setting value as a percent.
VarSetPctEnaRvrt	Reversion reactive power function enable: DISABLED (0) = Disabled ENABLED (1) = Enabled

VarSetRvrtTms	Units: Secs Set reactive power reversion time.
VarSetRvrtRem	Units: Secs Set reactive power reversion time remaining.
WRmp	Units: %Max/Sec Ramp rate for increases in active power during normal generation.
WRmpRef	Ramp rate reference unit for increases in active power or current during normal generation: A_MAX (0) = Max Current Ramp W_MAX (1) = Max Active Power Ramp
VarRmp	Units: %Max/Sec Ramp rate based on max reactive power per second.
AntiIslEna	Anti-islanding enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
PF_SF	Power factor scale factor.
WMaxLimPct_SF	Limit maximum power percent scale factor.
WSet_SF	Active power scale factor.
WSetPct_SF	Active power pct scale factor.
VarSet_SF	Reactive power scale factor.
VarSetPct_SF	Reactive power pct scale factor.
DERCtlAC.PFWInj	Power factor setpoint when injecting active power.
PF	Scale Factor: PF_SF Power factor setpoint when injecting active power.

Ext	Power factor excitation setpoint when injecting active power: OVER_EXCITED (0) = Over-excited UNDER_EXCITED (1) = Under-excited
DERCtlAC.PFWInjRvrt	Reversion power factor setpoint when injecting active power.
PF	Scale Factor: PF_SF Reversion power factor setpoint when injecting active power.
Ext	Reversion power factor excitation setpoint when injecting active power: OVER_EXCITED (0) = Over-Excited UNDER_EXCITED (1) = Under-Excited
DERCtlAC.PFWAbs	Power factor setpoint when absorbing active power.
PF	Scale Factor: PF_SF Power factor setpoint when absorbing active power.
Ext	Power factor excitation setpoint when absorbing active power: OVER_EXCITED (0) = Over-Excited UNDER_EXCITED (1) = Under-Excited
DERCtlAC.PFWAbsRvrt	Reversion power factor setpoint when absorbing active power.
PF	Scale Factor: PF_SF Reversion power factor setpoint when absorbing active power.
Ext	Reversion power factor excitation setpoint when absorbing active power: OVER_EXCITED (0) = Over-Excited UNDER_EXCITED (1) = Under-Excited

4.5 DER Volt-Var (705)

The DER Volt-Var information model supports the setting of volt-var controls as piece-wise linear curves. The model allows multiple curves to be supported. The implementation SHALL provide the curve support behavior specified in 3.1, Curve Management.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERVoltVar	DER Volt-Var	group			
ID	Model ID	uint16		M	S
L	Model Length	uint16		M	S
Ena	Module Enable	enum16	RW	M	
AdptCrvReq	Adopt Curve Request	uint16	RW	M	
AdptCrvRslt	Adopt Curve Result	enum16		M	
NPt	Number of Points	uint16		M	S
NCrv	Stored Curve Count	uint16		M	S
RvrtTms	Reversion Timeout	uint32	RW		
RvrtRem	Reversion Time Remaining	uint32			
RvrtCrv	Reversion Curve	uint16	RW		
V_SF	Voltage Scale Factor	sunssf		M	S
DeptRef_SF	Var Scale Factor	sunssf		M	S
RspTms_SF	Open-Loop Scale Factor	sunssf		M	S
DERVoltVar.Crv	Stored Curves	group			
ActPt	Active Points	uint16	RW	M	
DeptRef	Dependent Reference	enum16	RW	M	
Pri	Power Priority	enum16	RW		
VRef	Vref Adjustment	uint16	RW		
VRefAuto	Current Autonomous Vref	uint16			
VRefAutoEna	Autonomous Vref Enable	enum16	RW		
VRefAutoTms	Auto Vref Time Constant	uint16	RW		
RspTms	Open Loop Response Time	uint32	RW		
ReadOnly	Curve Access	enum16		M	S
DERVoltVar.Crv.Pt	Stored Curve Points	group			
V	Voltage Point	uint16	RW		
Var	Reactive Power Point	int16	RW		

Table 8: DER Volt-Var Points

DERVoltVar Points

DERVoltVar	DER Volt-Var model.
ID	DER Volt-Var model ID.
L	DER Volt-Var model length.
Ena	Volt-Var control enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
AdptCrvReq	Index of curve points to adopt. First curve index is 1.
AdptCrvRslt	Result of last set active curve operation: IN_PROGRESS (0) = Update In Progress COMPLETED (1) = Update Complete FAILED (2) = Update Failed
NPt	Number of curve points supported.
NCrv	Number of stored curves supported.
RvrtTms	Units: Secs Reversion time in seconds. No reversion time = 0.
RvrtRem	Reversion time remaining in seconds.
RvrtCrv	Default curve after reversion timeout.
V_SF	Scale factor for curve voltage points.
DeptRef_SF	Scale factor for curve var points.
RspTms_SF	Open loop response time scale factor.
DERVoltVar.Crv	Stored Curves
ActPt	Number of active points.

DeptRef	Curve dependent reference: W_MAX_PCT (0) = Percent Max Watts VAR_MAX_PCT (1) = Percent Max Vars VAR_AVAL_PCT (2) = Percent Available Vars VA_MAX_PCT (3) = Percent Max Apparent Power
Pri	Power priority: ACTIVE (0) = Active power priority REACTIVE (1) = Reactive power priority VENDOR (2) = Vendor power priority
VRef	Scale Factor: V_SF Units: VNomPct Vref adjustment as a percentage of nominal voltage.
VRefAuto	Scale Factor: V_SF Units: VNomPct Autonomous Vref value as a percentage of nominal voltage.
VRefAutoEna	Enable autonomous Vref: DISABLED (0) = Disabled ENABLED (1) = Enabled
VRefAutoTms	Units: Secs Autonomous Vref time constant.
RspTms	Scale Factor: RspTms_SF Units: Secs Open loop response time.
ReadOnly	Curve read-write access: RW (0) = Read-Write Access R (1) = Read-Only Access
DERVoltVar.Crv.Pt	Stored Curve Points

V	Scale Factor: V_SF Units: VNomPct Curve voltage point as percentage.
Var	Scale Factor: DeptRef_SF Units: DeptRef Curve reactive power point as set in DeptRef point.

4.6 DER Volt-Watt (706)

The DER Volt-Watt information model supports the setting of volt-watt controls as piece-wise linear curves. The model allows multiple curves to be supported. The implementation SHALL provide the curve support behavior specified in 3.1, Curve Management.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERVoltWatt	DER Volt-Watt	group			
ID	Model ID	uint16		M	S
L	Model Length	uint16		M	S
Ena	Module Enable	enum16	RW	M	
AdptCrvReq	Adopt Curve Request	uint16	RW	M	
AdptCrvRslt	Adopt Curve Result	enum16		M	
NPt	Number of Points	uint16		M	S
NCrv	Stored Curve Count	uint16		M	S
RvrtTms	Reversion Timeout	uint32	RW		
RvrtRem	Reversion Time Remaining	uint32			
RvrtCrv	Reversion Curve	uint16	RW		
V_SF	Voltage Scale Factor	sunssf		M	S
DeptRef_SF	Watt Scale Factor	sunssf		M	S
RspTms_SF	Open-Loop Scale Factor	sunssf		M	S
DERVoltWatt.Crv	Stored Curves	group			
ActPt	Active Points	uint16	RW	M	
DeptRef	Dependent Reference	enum16	RW	M	
RspTms	Open Loop Response Time	uint32	RW		
ReadOnly	Curve Access	enum16		M	S
DERVoltWatt.Crv.Pt	Stored Curve Points	group			
V	Voltage Point	uint16	RW		
W	Dependent Reference	int16	RW		

Table 9: DER Volt-Watt Points

DERVoltWatt Points

DERVoltWatt	DER Volt-Watt model.
ID	DER Volt-Watt model ID.
L	DER Volt-Watt model length.
Ena	Volt-Watt control enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
AdptCrvReq	Index of curve points to adopt. The first curve index is 1.
AdptCrvRslt	Result of last adopt curve operation: IN_PROGRESS (0) = Update in Progress COMPLETED (1) = Update Complete FAILED (2) = Update Failed
NPt	Number of curve points supported.
NCrv	Number of stored curves supported.
RvrtTms	Units: Secs Reversion time in seconds. 0 = No reversion time.
RvrtRem	Units: Secs Reversion time remaining in seconds.
RvrtCrv	Default curve after reversion timeout.
V_SF	Scale factor for curve voltage points.
DeptRef_SF	Scale factor for curve watt points.
RspTms_SF	Open loop response time scale factor.
DERVoltWatt.Crv	Stored Curves
ActPt	Number of active points.

DeptRef	Curve dependent reference: W_MAX_PCT (0) = Percent of maximum active power W_AVAL_PCT (1) = Percent of available active power
RspTms	Scale Factor: RspTms_SF Units: Secs Open loop response time.
ReadOnly	Curve read-write access: RW (0) = Read-Write Access R (1) = Read-Only Access
DERVoltWatt.Crv.Pt	Stored Curve Points
V	Scale Factor: V_SF Units: VNomPct Curve voltage point as percentage.
W	Scale Factor: DeptRef_SF Units: DeptRef Active power in percent of rated active power.

4.7 DER Trip Low Voltage (707)

The DER Trip Low Voltage information model provides the trip and momentary cessation settings for low voltage conditions. The implementation SHALL provide the trip/momentary cessation support behavior specified in 3.1, Curve Management.

The information model organizes the curves as sets of three curves with each set containing a curve for must trip, may trip, and momentary cessation. Multiple curve sets can be supported in the model.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERTripLV	DER Trip LV	group			
ID	DER Trip LV Model ID	uint16		M	S
L	DER Trip LV Model Length	uint16		M	S
Ena	DER Trip LV Module Enable	enum16	RW	M	
AdptCrvReq	Adopt Curve Request	uint16	RW	M	
AdptCrvRslt	Adopt Curve Result	enum16		M	
NPt	Number of Points	uint16		M	S
NCrvSet	Stored Curve Set Count	uint16		M	S
V_SF	Voltage Scale Factor	sunssf		M	S
Tms_SF	Time Point Scale Factor	sunssf		M	S
DERTripLV.Crv	Stored Curves	group			
ReadOnly	Curve Access	enum16		M	S
DERTripLV.Crv.MustTrip	Must Trip Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripLV.Crv.MustTrip.Pt	Must Trip Curve Points	group			
V	Voltage Point	uint16	RW		
Tms	Time Point	uint32	RW		
DERTripLV.Crv.MayTrip	May Trip Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripLV.Crv.MayTrip.Pt	May Trip Curve Points	group			
V	Voltage Point	uint16	RW		
Tms	Time Point	uint32	RW		
DERTripLV.Crv.MomCess	Momentary Cessation Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripLV.Crv.MomCess.Pt	Momentary Cessation Curve Points	group			
V	Voltage Point	uint16	RW		
Tms	Time Point	uint32	RW		

Table 10: DER Trip LV Points

DERTripLV Points

DERTripLV	DER low voltage trip model.
ID	DER low voltage trip model ID.
L	DER low voltage trip model length.
Ena	DER low voltage trip control enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
AdptCrvReq	Index of curve points to adopt. The first curve index is 1.
AdptCrvRslt	Result of last adopt curve operation: IN_PROGRESS (0) = Update in Progress COMPLETED (1) = Update Complete FAILED (2) = Update Failed
NPt	Number of curve points supported.
NCrvSet	Number of stored curve sets supported.
V_SF	Scale factor for curve voltage points.
Tms_SF	Scale factor for curve time points.
DERTripLV.Crv	Stored curve sets.
ReadOnly	Curve read-write access: RW (0) = Read-Write Access R (1) = Read-Only Access
DERTripLV.Crv.MustTrip	Stored must trip curve.
ActPt	Number of active points in must trip curve.
DERTripLV.Crv.MustTrip.Pt	Must trip curve points.

V	Scale Factor: V_SF Units: VNomPct Curve voltage point as percentage of VRef.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.
DERTripLV.Crv.MayTrip	Stored may trip curve.
ActPt	Number of active points in the may trip curve.
DERTripLV.Crv.MayTrip.Pt	May trip curve points.
V	Scale Factor: V_SF Units: VNomPct Curve voltage point as percentage of VRef.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.
DERTripLV.Crv.MomCess	Stored momentary cessation curve.
ActPt	Number of active points in the momentary cessation curve.
DERTripLV.Crv.MomCess.Pt	Momentary cessation curve points.
V	Scale Factor: V_SF Units: VNomPct Curve voltage point as percentage of VRef.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.

4.8 DER Trip High Voltage (708)

The DER Trip High Voltage information model provides the trip and momentary cessation settings for high voltage conditions. The implementation SHALL provide the trip/momentary cessation support behavior specified in 3.4, Trip/Momentary Cessation Settings.

The information model organizes the curves as sets of three curves with each set containing a curve for must trip, may trip, and momentary cessation. Multiple curve sets can be supported in the model.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERTripHV	DER Trip HV	group			
ID	DER Trip HV Model ID	uint16		M	S
L	DER Trip HV Model Length	uint16		M	S
Ena	DER Trip HV Module Enable	enum16	RW	M	
AdptCrvReq	Adopt Curve Request	uint16	RW	M	
AdptCrvRslt	Adopt Curve Result	enum16		M	
NPt	Number of Points	uint16		M	S
NCrvSet	Stored Curve Set Count	uint16		M	S
V_SF	Voltage Scale Factor	sunssf		M	S
Tms_SF	Time Point Scale Factor	sunssf		M	S
DERTripHV.Crv	Stored Curves	group			
ReadOnly	Curve Access	enum16		M	S
DERTripHV.Crv.MustTrip	Must Trip Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripHV.Crv.MustTrip.Pt	Must Trip Curve Points	group			
V	Voltage Point	uint16	RW		
Tms	Time Point	uint32	RW		
DERTripHV.Crv.MayTrip	May Trip Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripHV.Crv.MayTrip.Pt	May Trip Curve Points	group			
V	Voltage Point	uint16	RW		
Tms	Time Point	uint32	RW		
DERTripHV.Crv.MomCess	Momentary Cessation Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripHV.Crv.MomCess.Pt	Momentary Cessation Curve Points	group			
V	Voltage Point	uint16	RW		
Tms	Time Point	uint32	RW		

Table 11: DER Trip HV Points

DERTripHV Points

DERTripHV	DER high voltage trip model.
ID	DER high voltage trip model ID.
L	DER high voltage trip model length.
Ena	DER high voltage trip control enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
AdptCrvReq	Index of curve points to adopt. The first curve index is 1.
AdptCrvRslt	Result of last adopt curve operation: IN_PROGRESS (0) = Update in Progress COMPLETED (1) = Update Complete FAILED (2) = Update Failed
NPt	Number of curve points supported.
NCrvSet	Number of stored curve sets supported.
V_SF	Scale factor for curve voltage points.
Tms_SF	Scale factor for curve time points.
DERTripHV.Crv	Stored curve sets.
ReadOnly	Curve read-write access: RW (0) = Read-Write Access R (1) = Read-Only Access
DERTripHV.Crv.MustTrip	Stored must trip curve.
ActPt	Number of active points in must trip curve.
DERTripHV.Crv.MustTrip.Pt	Must trip curve points.

V	Scale Factor: V_SF Units: VNomPct Curve voltage point as percentage.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.
DERTripHV.Crv.MayTrip	Stored may trip curve.
ActPt	Number of active points in the may trip curve.
DERTripHV.Crv.MayTrip.Pt	May trip curve points.
V	Scale Factor: V_SF Units: VNomPct Curve voltage point as percentage.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.
DERTripHV.Crv.MomCess	Stored momentary cessation curve.
ActPt	Number of active points in the momentary cessation curve.
DERTripHV.Crv.MomCess.Pt	Momentary cessation curve points
V	Scale Factor: V_SF Units: VNomPct Curve voltage point as percentage.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.

4.9 DER Trip Low Frequency (709)

The DER Trip Low Frequency information model provides the trip and momentary cessation settings for low frequency conditions. The implementation SHALL provide the trip/momentary cessation support behavior specified in 3.4, Trip/Momentary Cessation Settings.

The information model organizes the curves as sets of three curves with each set containing a curve for must trip, may trip, and momentary cessation. Multiple curve sets can be supported in the model.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERTripLF	DER Trip LF	group			
ID	DER Trip LF Model ID	uint16		M	S
L	DER Trip LF Model Length	uint16		M	S
Ena	DER Trip LF Module Enable	enum16	RW	M	
AdptCrvReq	Adopt Curve Request	uint16	RW	M	
AdptCrvRslt	Adopt Curve Result	enum16		M	
NPt	Number of Points	uint16		M	S
NCrvSet	Stored Curve Set Count	uint16		M	S
Hz_SF	Frequency Scale Factor	sunssf		M	S
Tms_SF	Time Point Scale Factor	sunssf		M	S
DERTripLF.Crv	Stored Curves	group			
ReadOnly	Curve Access	enum16		M	S
DERTripLF.Crv.MustTrip	Must Trip Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripLF.Crv.MustTrip.Pt	Must Trip Curve Points	group			
Hz	Frequency Point	uint32	RW		
Tms	Time Point	uint32	RW		
DERTripLF.Crv.MayTrip	May Trip Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripLF.Crv.MayTrip.Pt	May Trip Curve Points	group			
Hz	Frequency Point	uint32	RW		
Tms	Time Point	uint32	RW		
DERTripLF.Crv.MomCess	Momentary Cessation Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripLF.Crv.MomCess.Pt	Momentary Cessation Curve Points	group			
Hz	Frequency Point	uint32	RW		
Tms	Time Point	uint32	RW		

Table 12: DER Trip LF Points

DERTripLF Points

DERTripLF	DER low frequency trip model.
ID	DER low frequency trip model ID.
L	DER low frequency trip model length.
Ena	DER low frequency trip control enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
AdptCrvReq	Index of curve points to adopt. The first curve index is 1.
AdptCrvRslt	Result of last adopt curve operation: IN_PROGRESS (0) = Update In Progress COMPLETED (1) = Update Complete FAILED (2) = Update Failed
NPt	Number of curve points supported.
NCrvSet	Number of stored curve sets supported.
Hz_SF	Scale factor for curve frequency points.
Tms_SF	Scale factor for curve time points.
DERTripLF.Crv	Stored curve sets.
ReadOnly	Curve read-write access: RW (0) = Read-Write Access R (1) = Read-Only Access
DERTripLF.Crv.MustTrip	Stored must trip curve.
ActPt	Number of active points in must trip curve.
DERTripLF.Crv.MustTrip.Pt	Must trip curve points.

Hz	Scale Factor: Hz_SF Units: Hz Curve frequency point.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.
DERTripLF.Crv.MayTrip	Stored may trip curve.
ActPt	Number of active points in the may trip curve.
DERTripLF.Crv.MayTrip.Pt	May trip curve points.
Hz	Scale Factor: Hz_SF Units: Hz Curve frequency point.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.
DERTripLF.Crv.MomCess	Stored momentary cessation curve.
ActPt	Number of active points in the momentary cessation curve.
DERTripLF.Crv.MomCess.Pt	Momentary cessation curve points.
Hz	Scale Factor: Hz_SF Units: Hz Curve frequency point.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.

4.10 DER Trip High Frequency (710)

The DER Trip High Frequency information model provides the trip and momentary cessation settings for high frequency conditions. The implementation SHALL provide the trip/momentary cessation support behavior specified in section 3.4, Trip/Momentary Cessation Settings.

The information model organizes the curves as sets of three curves with each set containing a curve for must trip, may trip, and momentary cessation. Multiple curve sets can be supported in the model.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERTripHF	DER Trip HF	group			
ID	DER Trip HF Model ID	uint16		M	S
L	DER Trip HF Model Length	uint16		M	S
Ena	DER Trip HF Module Enable	enum16	RW	M	
AdptCrvReq	Adopt Curve Request	uint16	RW	M	
AdptCrvRslt	Adopt Curve Result	enum16		M	
NPt	Number of Points	uint16		M	S
NCrvSet	Stored Curve Set Count	uint16		M	S
Hz_SF	Frequency Scale Factor	sunssf		M	S
Tms_SF	Time Point Scale Factor	sunssf		M	S
DERTripHF.Crv	Stored Curves	group			
ReadOnly	Curve Access	enum16		M	S
DERTripHF.Crv.MustTrip	Must Trip Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripHF.Crv.MustTrip.Pt	Must Trip Curve Points	group			
Hz	Frequency Point	uint32	RW		
Tms	Time Point	uint32	RW		
DERTripHF.Crv.MayTrip	May Trip Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripHF.Crv.MayTrip.Pt	May Trip Curve Points	group			
Hz	Frequency Point	uint32	RW		
Tms	Time Point	uint32	RW		
DERTripHF.Crv.MomCess	Momentary Cessation Curve	group			
ActPt	Number of Active Points	uint16	RW		
DERTripHF.Crv.MomCess.Pt	Momentary Cessation Curve Points	group			
Hz	Frequency Point	uint32	RW		
Tms	Time Point	uint32	RW		

Table 13: DER Trip HF Points

DERTripHF Points

DERTripHF	DER high frequency trip model.
ID	DER high frequency trip model ID.
L	DER high frequency trip model length.
Ena	DER high frequency trip control enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
AdptCrvReq	Index of curve points to adopt. The first curve index is 1.
AdptCrvRslt	Result of last adopt curve operation: IN_PROGRESS (0) = Update In Progress COMPLETED (1) = Update Complete FAILED (2) = Update Failed
NPt	Number of curve points supported.
NCrvSet	Number of stored curve sets supported.
Hz_SF	Scale factor for curve frequency points.
Tms_SF	Scale factor for curve time points.
DERTripHF.Crv	Stored curve sets.
ReadOnly	Curve read-write access: RW (0) = Read-Write Access R (1) = Read-Only Access
DERTripHF.Crv.MustTrip	Stored must trip curve.
ActPt	Number of active points in must trip curve.
DERTripHF.Crv.MustTrip.Pt	Must trip curve points.

Hz	Scale Factor: Hz_SF Units: Hz Curve frequency point.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.
DERTripHF.Crv.MayTrip	Stored may trip curve.
ActPt	Number of active points in may trip curve.
DERTripHF.Crv.MayTrip.Pt	May trip curve points.
Hz	Scale Factor: Hz_SF Units: Hz Curve frequency point.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.
DERTripHF.Crv.MomCess	Stored momentary cessation curve.
ActPt	Number of active points in the momentary cessation curve.
DERTripHF.Crv.MomCess.Pt	Momentary cessation curve points.
Hz	Scale Factor: Hz_SF Units: Hz Curve frequency point.
Tms	Scale Factor: Tms_SF Units: Secs Curve time point in seconds.

4.11 DER Frequency Droop (711)

The DER Frequency Droop information model supports frequency-watt settings as specified in IEEE 1547-2018. The terminology used in this information model corresponds directly to the IEEE 1547-2018 standard.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERFreqDroop	DER Frequency Droop	group			
ID	DER Frequency Droop ID	uint16		M	S
L	DER Frequency Droop Model Length	uint16		M	S
Ena	DER Frequency Droop Module Enable	enum16	RW	M	
AdptCtlReq	Adopt Control Request	uint16	RW	M	
AdptCtlRslt	Adopt Control Result	enum16		M	
NCtl	Stored Control Count	uint16		M	S
RvrtTms	Reversion Timeout	uint32	RW		
RvrtRem	Reversion Time Left	uint32			
RvrtCtl	Reversion Control	uint16	RW		
Db_SF	Deadband Scale Factor	sunssf		M	S
K_SF	Frequency Change Scale Factor	sunssf		M	S
RspTms_SF	Open-Loop Scale Factor	sunssf		M	S
DERFreqDroop.Ctl	Stored Curves	group			
DbOf	Over-Frequency Deadband	uint32	RW	M	
DbUf	Under-Frequency Deadband	uint32	RW	M	
KOf	Over- Frequency Change Ratio	uint16	RW	M	
KUf	Under Frequency Change Ratio	uint16	RW	M	
RspTms	Open-Loop Response Time	uint32	RW	M	
PMin	Minimum Active Power	int16	RW		
ReadOnly	Control Access	enum16		M	S

Table 14: DER Frequency Droop Points

DERFreqDroop Points

DERFreqDroop — DER Frequency Droop model.

ID — DER Frequency Droop model ID.

L — DER Frequency Droop model length.

Ena	DER Frequency-Watt (Frequency-Droop) control enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
AdptCtlReq	Set active control: The first control index is 1.
AdptCtlRslt	Result of last set active control operation: IN_PROGRESS (0) = Update In Progress COMPLETED (1) = Update Complete FAILED (2) = Update Failed
NCtl	Number of stored controls supported.
RvrtTms	Units: Secs Reversion time in seconds. 0 = No reversion time.
RvrtRem	Units: Secs Reversion time remaining in seconds.
RvrtCtl	Default control after reversion timeout.
Db_SF	Deadband scale factor.
K_SF	Frequency change scale factor.
RspTms_SF	Open loop response time scale factor.
DERFreqDroop.Ctl	Stored curve sets.
DbOf	Scale Factor: Db_SF Units: Hz The deadband value for over-frequency conditions in Hz.
DbUf	Scale Factor: Db_SF Units: Hz The deadband value for under-frequency conditions in Hz.

KOf	Scale Factor: K_SF Frequency droop per-unit frequency change for over-frequency conditions corresponding to 1 per-unit power output change.
KUf	Scale Factor: K_SF Frequency droop per-unit frequency change for under-frequency conditions corresponding to 1 per-unit power output change.
RspTms	Scale Factor: RspTms_SF Units: Secs The open-loop response time in seconds.
PMin	Units: Pct Minimum active power.
ReadOnly	Control read-write access: RW (0) = Read-Write Access R (1) = Read-Only Access

4.12 DER Watt-Var (712)

The DER Watt-Var information model supports the setting of watt-var controls as piece-wise linear curves. The model allows multiple curves to be supported. The implementation SHALL provide the curve support behavior specified in 3.1, Curve Management.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERWattVar	DER Watt-Var	group			
ID	DER Watt-Var Model ID	uint16		M	S
L	DER Watt-Var Model Length	uint16		M	S
Ena	DER Watt-Var Module Enable	enum16	RW	M	
AdptCrvReq	Set Active Curve Request	uint16	RW	M	S
AdptCrvRslt	Set Active Curve Result	enum16		M	S
NPt	Number of Points	uint16		M	S
NCrv	Stored Curve Count	uint16		M	S
RvrtTms	Reversion Timeout	uint32	RW		
RvrtRem	Reversion Time Left	uint32			
RvrtCrv	Reversion Curve	uint16	RW		
W_SF	Active Power Scale Factor	sunssf		M	S
DeptRef_SF	Var Scale Factor	sunssf		M	S
DERWattVar.Crv	Stored Curves	group			
ActPt	Active Points	uint16	RW	M	
DeptRef	Dependent Reference	enum16	RW	M	
Pri	Power Priority	enum16	RW		
ReadOnly	Curve Access	enum16		M	S
DERWattVar.Crv.Pt	Stored Curve Points	group			
W	Active Power Point	int16	RW		
Var	Reactive Power Point	int16	RW		

Table 15: DER Watt-Var Points

DERWattVar Points

DERWattVar — DER Watt-Var model.

ID — DER Watt-Var model ID.

L — DER Watt-Var model length.

Ena	DER Watt-Var control enable: DISABLED (0) = Disabled ENABLED (1) = Enabled
AdptCrvReq	Set active curve. The first curve index is 1.
AdptCrvRslt	Result of last set active curve operation: IN_PROGRESS (0) = Update In Progress COMPLETED (1) = Update Complete FAILED (2) = Update Failed
NPt	Number of curve points supported.
NCrv	Number of stored curves supported.
RvrtTms	Units: Secs Reversion time in seconds. No reversion time = 0.
RvrtRem	Units: Secs Reversion time remaining in seconds
RvrtCrv	Default curve after reversion timeout.
V_SF	Scale factor for curve voltage points.
DeptRef_SF	Scale factor for curve var points.
DERWattVar.Crv	Stored curve sets.
ActPt	Number of active points.
DeptRef	Curve dependent reference: W_MAX_PCT (0) = Percent Max Watts VAR_MAX_PCT (1) = Percent Max Vars VAR_AVAL_PCT (2) = Percent Available Vars VA_MAX_PCT (3) = Percent Max Apparent Power
Pri	Power priority: ACTIVE (0) = Active power priority REACTIVE (1) = Reactive power priority

ReadOnly	Curve read-write access: RW (0) = Read-Write Access R (1) = Read-Only Access
DERWattVar.Crv.Pt	Stored curve points.
W	Scale Factor: W_SF Units: WMaxPct Curve active power point as percentage.
Var	Scale Factor: DeptRef_SF Units: VarPct Curve reactive power point as set in DeptRef point.

4.13 DER Storage Capacity (713)

The DER Storage Capacity information model supports high-level storage capacity settings and status information.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERStorageCapacity	DER Storage Capacity	group			
ID	DER Storage Capacity ID	uint16		M	S
L	DER Storage Capacity Length	uint16		M	S
WHRtg	Energy Rating	uint16			
WHAvail	Energy Available	uint16			
SoC	State of Charge	uint16			
SoH	State of Health	uint16			
Sta	Storage Status	enum16			
WH_SF	Energy Scale Factor	sunssf			S
Pct_SF	Percent Scale Factor	sunssf			S

Table 16: DER Storage Capacity Points

DERStorageCapacity Points

DERStorageCapacity — DER Storage Capacity model.

ID — DER Storage Capacity model ID.

L — DER Storage Capacity model length.

WHRtg — Scale Factor: WH_SF
Units: WH

Energy rating of the DER storage.

WHAvail — Scale Factor: WH_SF
Units: WH

Energy available of the DER storage (WHAvail = WHRtg * SoC * SoH).

SoC	Scale Factor: Pct_SF Units: Pct State of charge of the DER storage.
SoH	Scale Factor: Pct_SF Units: Pct State of health of the DER storage.
Sta	Storage status: OK (0) = No Error WARNING (1) = Warning ERROR (2) = Error
WH_SF	Energy scale factor.
Pct_SF	Percent scale factor.

4.14 DER DC Measurement (714)

The DER DC Measurement information model contains the DC measurement data associated with the DER along with current status and alarm information. Neither the status nor the alarm information points are latched. They both reflect the current state of the DER and change when that status or alarm state changes.

The information model supports multiple DC ports.

Group/Point Name	Label	Data Type	RW Access (RW)	Mandatory (M)	Static (S)
DERMeasureDC	DER DC Measurement	group			
ID	DER DC Measure Model ID	uint16		M	S
L	DER DC Measure Model Length	uint16		M	S
PrtAlrms	Port Alarms	bitfield32			
NPrt	Number of Ports	uint16			S
DCA	DC Current	int16			
DCW	DC Power	int16			
DCWhInj	DC Energy Injected	uint64			
DCWhAbs	DC Energy Absorbed	uint64			
DCA_SF	DC Current Scale Factor	sunssf			S
DCV_SF	DC Voltage Scale Factor	sunssf			S
DCW_SF	DC Power Scale Factor	sunssf			S
DCWH_SF	DC Energy Scale Factor	sunssf			S
Tmp_SF	Temperature Scale Factor	sunssf			S
DERMeasureDC.Prt		group			
PrtTyp	Port Type	enum16			
ID	Port ID	uint16			
IDStr	Port ID String	string			
DCA	DC Current	int16			
DCV	DC Voltage	uint16			
DCW	DC Power	int16			
DCWhInj	DC Energy Injected	uint64			
DCWhAbs	DC Energy Absorbed	uint64			
Tmp	DC Port Temperature	int16			
DCSta	DC Port Status	enum16			
DCAlrm	DC Port Alarm	bitfield32			

Table 17: DER AC Measurement Points

DERMeasureDC

DERMeasureDC	DER DC measurement model.
ID	DER DC measurement model ID.
L	DER DC measurement model length.
PrtAlrms	Bitfield of ports with active alarms: Active alarm bit value = 1. No alarm bit value = 0. Bit 0 is first port.
NPrt	Number of DC ports.
DCA	Scale Factor: DCA_SF Units: A Total DC current for all ports.
DCW	Scale Factor: DCW_SF Units: W Total DC power for all ports.
DCWhInj	Scale Factor: DCWH_SF Units: Wh Total cumulative DC energy injected for all ports.
DCWhAbs	Scale Factor: DCWH_SF Units: Wh Total cumulative DC energy absorbed for all ports.
DCA_SF	DC current scale factor.
DCV_SF	DC voltage scale factor.
DCW_SF	DC power scale factor.
DCWH_SF	DC energy scale factor.

Tmp_SF	Temperature scale factor.
DERMeasureDC.Prt	Port group.
PrtTyp	Port type: PV (0) = Photovoltaic ESS (1) = Energy Storage System EV (2) = Electric Vehicle INJ (3) = Generic Injecting ABS (4) = Generic Absorbing BIDIR (5) = Generic Bidirectional DC_DC (6) = DC to DC
ID	Port ID.
IDStr	Port ID string.
DCA	Scale Factor: DCA_SF Units: A DC current for the port.
DCV	Scale Factor: DCV_SF Units: V DC voltage for the port.
DCW	Scale Factor: DCW_SF Units: W DC power for the port.
DCWhInj	Scale Factor: DCWH_SF Units: Wh Total cumulative DC energy injected for the port.
DCWhAbs	Scale Factor: DCWH_SF Units: Wh Total cumulative DC energy absorbed for the port.

Tmp	Scale Factor: Tmp_SF Units: C DC port temperature.
DCSta	DC port status: OFF (0) = Off ON (1) = On WARNING (2) = Warning ERROR (3) = Error
DCAlrm	DC port alarm: GROUND_FAULT (0) = Ground Fault INPUT_OVER_VOLTAGE (1) = Input Over Voltage DC_DISCONNECT (3) = DC Disconnect CABINET_OPEN (5) = Cabinet Open MANUAL_SHUTDOWN (6) = Manual Shutdown OVER_TEMP (7) = Over Temperature BLOWN_FUSE (12) = Blown Fuse UNDER_TEMP (13) = Under Temperature MEMORY_LOSS (14) = Memory Loss ARC_DETECTION (15) = Arc Detection RESERVED (19) = Reserved TEST_FAILED (20) = Test Failed INPUT_UNDER_VOLTAGE (21) = Under Voltage INPUT_OVER_CURRENT (22) = Over Current