Common File Format for DER Settings Exchange and Storage

Version 2.0

2022 TECHNICAL UPDATE

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3002025445
Technical Update, September 2022

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Acknowledgments

The Electric Power Research Institute (EPRI) prepared this report.

Principal Investigator
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This report describes research sponsored by EPRI.

EPRI would like to acknowledge the following organizations whose participation and materials contributed to this report:

Sunspec Alliance	Interstate Renewable Energy Council (IREC)
Fimer USA	OutBack Power Technologies
Enphase Energy	SMA America
National Renewable Energy Laboratory (NREL)	Fronius International
SunPower	ANB Systems
UL	Clean Power Research
US Department of Energy (DOE)	Dominion Energy
Duke Energy	Southern Company
Ameren	Hawaiian Electric
San Diego Gas & Electric	The United Illuminating Company
CenterPoint Energy	Entergy
Commonwealth Edison	Sempra Energy
Salt River Project	Arizona Public Service
Orange and Rockland Utilities	Consolidated Edison
FirstEnergy	Exelon
Baltimore Gas and Electric	Pepco Holdings
DTE	Fortis Alberta
LG&E and KU Energy	

This publication is a corporate document that should be cited in the literature in the following manner:

Common File Format for DER Settings Exchange and Storage: Version 2.0. EPRI, Palo Alto, CA: 2022. 3002025445.

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Section 1: Introduction

This document defines a common file format to support the exchange and storage of DER settings information. The Institute of Electrical and Electronics Engineers (IEEE) identifies a range of adjustable DER functions, as well as a set of readable nameplate and monitoring information, in the standard IEEE 1547-2018. Each adjustable function can be configured by one or more parameters. Collectively, these parameters determine how the DER behaves.

For new interconnections, utilities may specify how each function is to be configured. Because several parties are involved in the deployment process, it is useful to have a common file format such as this that can be exchanged between parties and interpreted consistently by both human and machine/software systems. To the extent possible, this common file definition utilizes the parameter attributes from the IEEE 1547.1-2020 standard, including the unique parameter labels, their data types, units, and possible value options. This standard dictates how these parameters and their values are expressed and formatted in a common file format so that anyone can interpret its contents without ambiguity. A common file format may also allow the development of software and parsers that can automatically read the contents of such a file. IEEE 1547-2018 specifies approximately 100 parameters for DER devices. This file format provides a practical way to verify the configuration of the standard parameters in DER inverters, as well as share the information with others.

1.1 Development Process

This file format was developed through an open working group facilitated by EPRI. The group was coordinated with stakeholders that participated in the recent IEEE 1547 revision process. It was open to any interested party and included academia, consultants, utilities, DER manufacturers, and national laboratories. The resulting file format described herein is free and open to the public. Going forward, EPRI aims to see the ongoing care and maintenance of this common format, ideally by contributing it to an appropriate standards-development organization such as the IEEE.

Section 2: Primary Uses

Possible use cases of a common DER configuration file include but are not limited to the following:

- How utilities provide required default settings (utility-required profile, URP) to the marketplace (*e.g.*, a file format that could be posted on a utility website or stored on a public website).
- How utilities provide developers with site-specific settings resulting from detailed interconnection studies.
- How DER developers receive, map, and apply specified settings into DER.
- How DER developers provide required proof of applied settings for new plants as part of the interconnection process.
- How utilities internally store and apply their system-wide records of DER settings for planning and operational purposes.
- How DER application management software and companies exchange required settings with both utilities and developers during the DER deployment process.

In this document, 'context' refers to the way in which a DER settings file is intended to be used. As defined in the following sections, the allowed content of a file may differ depending on its context. Two specific file contexts are defined in detail: 'Specified Settings' in Section 4 and 'Applied Settings' in Section 5. Detailed definitions for additional file contexts may be added in future revisions.

Section 3: DER Settings File Specification

3.1 File Format

A Comma separated variables (CSV) file format shall be used.

3.2 Character Encoding

The CSV file shall have UTF-8 character encoding. No other character encoding is permitted. See Appendix D for guidance about CSV file formats and encodings.

3.3 File Name

File names shall be of the format: *.csv

The (*) file name shall:

- be 255 characters or less
- include only printable ASCII characters
- not include the following special characters: '\', '/', ':', '*', '?', '"', '<', '>', '|', ' '

3.4 Columns in a File

3.4.1 Columns and Headings

A file shall contain two columns:

- Parameter labels (column 1) and
- Parameter values (column 2).

The first row of the file shall contain the following column headings in all caps:

- PARAMETER
- VALUE

3.4.2 Parameter Labels

Following the column headings, each row in a file shall contain a parameter label and the associated value of that parameter. The standard labels are presented in Table A-1. These are based on the naming convention initially developed in the

standard IEEE 1547.1-2020 and explained herein. Parameter labels are not case-sensitive; however, it is recommended to use uppercase characters to improve readability. In a common file, the context (see Section 3.6) of the settings shall be included as a suffix to each parameter except the metadata items.

3.4.3 Parameter Values

The values reflect the configuration and behavior of a DER. The units of the parameter values are specified in the IEEE 1547.1-2020 standard. The units from the standard shall be followed. Table 4-1 and Table 5-1 list the standard units for all the parameters.

3.5 Rows in a File

The number of rows in a file is variable. There shall be no blank rows before the last row in a file.

All the standard parameters from the IEEE 1547.1-2020 may be listed; each row represents one parameter of a DER, containing the parameter label and its value. It is permissible to exclude some parameters from the file, depending on the availability of certain functions in a DER device. If a function is available in the DER(s) targeted by a given file, regardless of whether the function is enabled or disabled, all the parameters related to this function may be populated.

Some parameters may not be allowed to be included in a file based on the usage context. For example, some nameplate parameters may not be allowed in certain contexts. This is, however, use-case-specific.

A parameter, including its suffix, shall not be repeated in a file.

The value for a parameter may be left blank. Any row without a value is equivalent to not having the row in the file. Technically, if there is nothing between the comma after the label and the newline character at the end of the row, that row can be ignored.

3.6 File Context Suffixes

As defined in the context-specific Sections below, most parameter labels include a required suffix corresponding to the context of the file usage. A suffix is typically a use-case-specific multiple-letter code appended to the parameter label with a dash (-) between the label and the suffix.

Suffixes are defined for the following contexts:

- Specified Settings: Settings containing information that is required or intended to be applied in one or more DER. Parameters in these settings shall have a suffix of '-SS' added to the root labels. See Section 4 for details with examples on how to indicate the context of the specified setting using a suffix.

- Applied Settings: Settings containing information that has been read from a DER, representing how it is presently configured. Most of the parameters in these settings shall have a suffix of '-AS' added to the root labels. See Section 5 for details with examples on how to indicate the context of the applied setting using a suffix.

Additional contexts may be defined in future revisions of this document.

3.7 Formats of Datatypes

Following the IEEE 1547.1-2020, the common file format shall support the following data types for the parameter values:

- Number
- Select-list
- Multi-list
- Text

Table 4-1 and Table 5-1 specify the datatype that shall be used for each parameter.

3.7.1 Number

A CSV file saves everything as text characters. No formatting is supported or stored in a CSV file. For parameter values that are of type 'number':

- All numbers shall be plain numbers:
  - Commas are not allowed in the numbers.
  - Scientific/exponential formats of numbers are not allowed. For example, '12,100', '12.1x10^3', or '1.21E4' are not allowed. Instead, '12100', without quotes, shall be used.
- Decimal numbers are allowed and as many digits before or after the decimal point as required, are allowed. See Appendix E if using MS Excel to create a CSV file to be aware of possible data loss.
- IEEE 1547-2018 defines the scale and resolution that shall be supported by DER. If number values used in a settings file exceed the capabilities of a DER to accept and store, then (a) it may not be accepted when written to a DER or (b) may be rounded or truncated when settings are read back for comparison.

3.7.2 Select-list

The datatype 'Select-list' is used for parameters for which there is a specific list of allowed values and only one can be selected as the value for the parameter. See Table 4-1 and Table 5-1 for the complete lists of possible values of parameters that have the datatype of 'Select-list'.

For example, the parameter CONST_PF_EXCITATION can have either INJ or ABS as its value. The values are pre-specified keywords.

Another example is the parameter ES_PERMIT_SERVICE, which can have either ENABLED or DISABLED as its value.

3.7.3 Multi-list

'Multi-list' also refers to parameters for which there is a specific list, but can have multiple items as values. The values shall be separated by dashes and with no spaces around.

For example, the parameter NP_SUPPORTED_MODES can have multiple values from the following list:

- CONST_PF
- CONST_Q_
- QV
- QP
- PV
- PF

If, for example, a device supported the 1st, 5th, and 6th of these items, then the value would be specified as CONST_PF-PV-PF in the common file.

See Table 4-1 and Table 5-1 for the complete lists of possible values for parameters that have the datatype of 'Multi-list'. The ordering of the items within the value list is arbitrary. For example, switching between CONST_PF-QV-PF and QV-PF-CONST_PF shall be allowed. The value shall be treated as a set without duplicates, and, if required, must be searched to check whether a particular item exists in the set.

3.7.4 Text/String

Table 4-1 and Table 5-1 identify the parameters that are of the data type 'text/string'. The value for such a parameter shall not exceed 512 UTF-8 encoded characters. For example, the parameter NP_SERIAL_NUM can have a value of '123ser456789' without the quotes. If a simple word processor such as notepad is used to provide a 'text' value that contains a comma, then the value must be specified within double-quotes. Otherwise, the CSV file format will interpret each comma-separated part as a different column.

3.8 The Order of Rows

Parameters may appear in any order in the file. In other words, the rows, except the column header row can be placed in any order. This allows for future extensibility in adding new standard parameters to the file. Any software that

parses the files needs to search through the whole file to find any particular item. However, it is recommended to keep the related parameters together to improve readability. For example, all the parameters for a certain function may be kept in subsequent rows.

3.9 Metadata

In this document, metadata refers to descriptive data that may be included in a file that cannot be read from or written to the DER. From the perspective of this common file specification, all Metadata items, except MT_FILE_INFO_TYPE, are optional. However, utilities and other users may require certain metadata items. When used, standard metadata parameter labels shall be used. Refer to Table 4-2 and Table 5-2 for the list of standard metadata labels. Each metadata is a separate row in the file. The order of the rows does not matter.

Metadata may be used to describe the applicability of the file, its origins, etc. For example:

- File context
- The DER device ID
- The utility name
- Location
- Applicable normal performance category
- Applicable date
- Power source, etc.

Note that the standard metadata labels in Table 4-2 and Table 5-2 are use-case-specific and only used in certain contexts. Some of the metadata items can be used in applied settings files, while other items are only allowed in specified settings files. At the time of this publication, these labels are not yet included in IEEE 1547.1-2020 but may be added in a future revision of the standard. See Section 4 and Section 5 for information on specified and applied settings files.

The metadata item MT_FILE_INFO_TYPE is required and provides a direct indication of the intended context of a file. This metadata is of type 'Select-list' and its typical value is either 'AS' or 'SS', without the quotes, depending on the context. If the value is 'AS', all the parameters in the file, except the metadata items, shall have the '-AS' suffix. Likewise, if the value is 'SS', all the parameters in the file, except the metadata items, shall have the '-SS' suffix.

3.10 COMMENT Rows

Additional rows may be added with the parameter label 'COMMENT' and parameter values that are strings of up to 512 characters. Multiple COMMENT rows are allowed in a file.

Section 4: File Context: Specified Settings

The specified settings file is a common use of a common file format. These files contain information that is required or intended to be applied in one or more DER. From a utility perspective, these are outbound files that are published to other interested stakeholders such as DER developers, other utilities, researchers, etc.

All the parameter labels shall include the suffix '-SS' without the quotes, as indicated in Table 4-1. '-SS' refers to 'specified settings.'

Table 4-1
IEEE 1547.1-2020 Standard parameter labels used in specified settings files

	Parameter Label	Units	Data Type	Allowed Values
1.	NP_P_MAX-SS	W	Number	
2.	NP_P_MAX_OVER_PF-SS	W	Number	
3.	NP_OVER_PF-SS		Number	
4.	NP_P_MAX_UNDER_PF-SS	W	Number	
5.	NP_UNDER_PF-SS		Number	
6.	NP_VA_MAX-SS	VA	Number	
7.	NP_Q_MAX_INJ-SS	VAr	Number	
8.	NP_Q_MAX_ABS-SS	VAr	Number	
9.	NP_P_MAX_CHARGE-SS	W	Number	
10.	NP_APPARENT_POWER_CHARGE_MAX-SS	VA	Number	
11.	NP_AC_V_NOM-SS	Vac	Number	
12.	AP_LIMIT_ENABLE-SS		Select-list	▪ ENABLED ▪ DISABLED
13.	AP_LIMIT-SS	P p.u.	Number	
14.	ES_PERMIT_SERVICE-SS		Select-list	▪ ENABLED ▪ DISABLED
15.	ES_V_LOW-SS	V p.u.	Number	
16.	ES_V_HIGH-SS	V p.u.	Number	
17.	ES_F_LOW-SS	Hz	Number	
18.	ES_F_HIGH-SS	Hz	Number	
19.	ES_RANDOMIZED_DELAY-SS	s	Number	
20.	ES_DELAY-SS	s	Number	
21.	ES_RAMP_RATE-SS	s	Number	
22.	CONST_PF_MODE_ENABLE-SS[1]		Select-list	▪ ENABLED ▪ DISABLED
23.	CONST_PF_EXCITATION-SS		Select-list	▪ INJ ▪ ABS
24.	CONST_PF-SS		Number	
25.	CONST_Q_MODE_ENABLE-SS[1]		Select-list	▪ ENABLED ▪ DISABLED
26.	CONST_Q-SS	VAr p.u.	Number	

[1] Only one of the four parameters, CONST_PF_MODE_ENABLE, CONST_Q_MODE_ENABLE, QV_MODE_ENABLE, and QP_MODE_ENABLE, may have the value ENABLED at one time.

Table 4-1 (continued)
IEEE 1547.1-2020 Standard parameter labels used in specified settings files

	Parameter Label	Units	Data Type	Allowed Values
27.	QV_MODE_ENABLE-SS[1]		Select-list	▪ ENABLED ▪ DISABLED
28.	QV_VREF-SS	V p.u.	Number	
29.	QV_VREF_AUTO_MODE-SS		Select-list	▪ ENABLED ▪ DISABLED
30.	QV_VREF_TIME-SS	s	Number	
31.	QV_CURVE_V2-SS	V p.u.	Number	
32.	QV_CURVE_Q2-SS	VAr p.u.	Number	
33.	QV_CURVE_V3-SS	V p.u.	Number	
34.	QV_CURVE_Q3-SS	VAr p.u.	Number	
35.	QV_CURVE_V1-SS	V p.u.	Number	
36.	QV_CURVE_Q1-SS	VAr p.u.	Number	
37.	QV_CURVE_V4-SS	V p.u.	Number	
38.	QV_CURVE_Q4-SS	VAr p.u.	Number	
39.	QV_OLRT-SS	s	Number	
40.	QP_MODE_ENABLE-SS[1]		Select-list	▪ ENABLED ▪ DISABLED
41.	QP_CURVE_P3_GEN-SS	P p.u.	Number	
42.	QP_CURVE_P2_GEN-SS	P p.u.	Number	
43.	QP_CURVE_P1_GEN-SS	P p.u.	Number	
44.	QP_CURVE_P1_LOAD-SS	P p.u.	Number	
45.	QP_CURVE_P2_LOAD-SS	P p.u.	Number	
46.	QP_CURVE_P3_LOAD-SS	P p.u.	Number	
47.	QP_CURVE_Q3_GEN-SS	VAr p.u.	Number	
48.	QP_CURVE_Q2_GEN-SS	VAr p.u.	Number	
49.	QP_CURVE_Q1_GEN-SS	VAr p.u.	Number	
50.	QP_CURVE_Q1_LOAD-SS	VAr p.u.	Number	
51.	QP_CURVE_Q2_LOAD-SS	VAr p.u.	Number	
52.	QP_CURVE_Q3_LOAD-SS	VAr p.u.	Number	
53.	PV_MODE_ENABLE-SS		Select-list	▪ ENABLED ▪ DISABLED
54.	PV_CURVE_V1-SS	V p.u.	Number	
55.	PV_CURVE_P1-SS	P p.u.	Number	
56.	PV_CURVE_V2-SS	V p.u.	Number	
57.	PV_CURVE_P2-SS	P p.u.	Number	

Table 4-1 (continued)
IEEE 1547.1-2020 Standard parameter labels used in specified settings files

	Parameter Label	Units	Data Type	Allowed Values
58.	PV_OLRT-SS	s	Number	
59.	OV2_TRIP_V-SS	V p.u.	Number	
60.	OV2_TRIP_T-SS	s	Number	
61.	OV1_TRIP_V-SS	V p.u.	Number	
62.	OV1_TRIP_T-SS	s	Number	
63.	UV1_TRIP_V-SS	V p.u.	Number	
64.	UV1_TRIP_T-SS	s	Number	
65.	UV2_TRIP_V-SS	V p.u.	Number	
66.	UV2_TRIP_T-SS	s	Number	
67.	OF2_TRIP_F-SS	Hz	Number	
68.	OF2_TRIP_T-SS	s	Number	
69.	OF1_TRIP_F-SS	Hz	Number	
70.	OF1_TRIP_T-SS	s	Number	
71.	UF1_TRIP_F-SS	Hz	Number	
72.	UF1_TRIP_T-SS	s	Number	
73.	UF2_TRIP_F-SS	Hz	Number	
74.	UF2_TRIP_T-SS	s	Number	
75.	PF_DBOF-SS	Hz	Number	
76.	PF_DBUF-SS	Hz	Number	
77.	PF_KOF-SS		Number	
78.	PF_KUF-SS		Number	
79.	PF_OLRT-SS	s	Number	
80.	MC_HVRT_V1-SS	V p.u.	Number	
81.	MC_LVRT_V1-SS	V p.u.	Number	

4.1 Nameplate Parameters

Only the updatable/adjustable nameplate parameters are allowed in a specified settings file. All the allowed nameplate parameters shall include the suffix '-SS'. Refer to Table 4-1 for a complete list of allowed nameplate parameters for this context.

4.2 Metadata

The value of MT_FILE_INFO_TYPE in a specified settings file shall be 'SS'. The inclusion of this metadata item is mandatory.

Table 4-2 presents the standard metadata labels that can be included in a specified settings file. The metadata items that end with '-APP', are derived from nameplate parameters and present the applicability of the specified settings file. For example, a utility may set the value of MT_NP_NORMAL_OP_CAT-APP to CAT_A, to indicate that this file is applicable to only 'category A' DERs.

Table 4-2
Standard metadata for specified settings files

	Metadata Label	Data Type	Allowed Values[2]	Unit	Description
1.	MT_FILE_INFO_TYPE	Select-list	▪ SS		Context of the data in the file
2.	MT_UTILITY_NAME	Text			Utility name
3.	MT_COUNTRY	Text			Country
4.	MT_STATE	Text			State
5.	MT_APPLICABILITY_DATE	Date			Date of applicability (mm/dd/yyyy format)
6.	MT_DER_SITE_NAME	Text			Site name
7.	MT_DER_OWNER_NAME	Text			DER owner
8.	MT_POWER_CONVERSION_DEV	Select-list	▪ SYNCHRONOUS_GENERATOR ▪ INVERTER ▪ INDUCTION_GENERATOR ▪ DOUBLY_FED_GENERATOR ▪ BATTERY_STORAGE ▪ OTHER		Power conversion device type(s) for which this settings file is applicable
9.	MT_NP_NORMAL_OP_CAT-APP	Multi-list	▪ CAT_A ▪ CAT_B		Applicable normal performance category
10.	MT_NP_ABNORMAL_OP_CAT-APP	Multi-list	▪ CAT_I ▪ CAT_II ▪ CAT_III		Applicable abnormal performance category
11.	MT_NP_P_MAX-MIN-APP	Number		W	Applicable DER size: Active power rating (W) – Min
12.	MT_NP_P_MAX-MAX-APP	Number		W	Applicable DER size: Active power rating (W) – Max

[2] Other allowed values may exist but this document focuses on AS and SS.

Table 4-2 (continued)
Standard metadata for specified settings files

	Metadata Label	Data Type	Allowed Values[3]	Unit	Description
13.	MT_NP_AC_V_ NOM-APP	Text (Each item needs to be a valid number)		V	String with dash-separated numbers that represent applicable nominal voltages for this settings file
14.	MT_SERVICE_TYPE	Multi-list	▪ PRIMARY_FEEDER ▪ SECONDARY_FEEDER ▪ SECONDARY_GRID_NETWORK ▪ SECONDARY_SPOT_NETWORK		Service type(s) for which this settings file is applicable
15.	MT_PRIMARY_POWER_SOURCE	Multi-list	▪ SOLAR ▪ BIOGAS ▪ FOSSIL_FUEL ▪ HYDRO		Primary power source(s) for which this settings file is applicable
16.	MT_APPLICATION_PURPOSE	Multi-list	▪ COMBINED_HEAT_AND_POWER ▪ MERCHANT_POWER_GENERATION ▪ BACKUP_GENERATION_FOR_CRITICAL_FACILITIES ▪ RETAIL_CUSTOMER_SELF_SUPPLY		Application purpose(s) for which this settings file is applicable
17.	MT_PRIMARY_MOVER	Multi-list	▪ RECIPROCATING_EN ▪ TURBINE ▪ FUEL_CELL ▪ PHOTOVOLTAIC_PANELS ▪ NONE[4]		Primary mover type(s) for which this settings file is applicable
18.	MT_VARIABLE_GENERATION_TYPE	Multi-list	▪ VARIABLE ▪ NON_VARIABLE		Variable generation type

[3] Other allowed values may exist but this document focuses on AS and SS.

[4] *E.g.*, battery only ESS.

Section 5: File Context: Applied Settings

The applied settings file is another common use of a common file format. These files contain information that has been read from a DER, representing how it is presently configured. From a utility perspective, these are inbound files that are sent by DER developers to utility personnel.

All the parameter labels in an applied settings file shall include '-AS', without the quotes, as the suffix, as indicated in Table 5-1. '-AS' refers to 'applied settings.'

Table 5-1
IEEE 1547.1-2020 Standard parameter labels used in applied settings files

	Parameter Label	Units	Data Type	Allowed Values
1.	NP_P_MAX-AS, NP_P_MAX	W	Number	
2.	NP_P_MAX_OVER_PF-AS, NP_P_MAX_OVER_PF	W	Number	
3.	NP_OVER_PF-AS, NP_OVER_PF		Number	
4.	NP_P_MAX_UNDER_PF-AS, NP_P_MAX_UNDER_PF	W	Number	
5.	NP_UNDER_PF-AS, NP_UNDER_PF		Number	
6.	NP_VA_MAX-AS, NP_VA_MAX	VA	Number	
7.	NP_NORMAL_OP_CAT-AS, NP_NORMAL_OP_CAT		Select-list	▪ CAT_A ▪ CAT_B
8.	NP_ABNORMAL_OP_CAT-AS, NP_ABNORMAL_OP_CAT		Select-list	▪ CAT_I ▪ CAT_II ▪ CAT_III
9.	NP_Q_MAX_INJ-AS, NP_Q_MAX_INJ	VAr	Number	
10.	NP_Q_MAX_ABS-AS, NP_Q_MAX_ABS	VAr	Number	
11.	NP_P_MAX_CHARGE-AS, NP_P_MAX_CHARGE	W	Number	
12.	NP_APPARENT_POWER_CHARGE_MAX-AS, NP_APPARENT_POWER_CHARGE_MAX	VA	Number	
13.	NP_AC_V_NOM-AS, NP_AC_V_NOM	Vac	Number	
14.	NP_AC_V_MAX-AS, NP_AC_V_MAX	Vac	Number	
15.	NP_AC_V_MIN-AS, NP_AC_V_MIN	Vac	Number	
16.	NP_SUPPORTED_MODES-AS, NP_SUPPORTED_MODES		Multi-list	▪ CONST_PF ▪ CONST_Q ▪ QV ▪ QP ▪ PV ▪ PF
17.	NP_REACTIVE_SUSCEPTANCE-AS, NP_REACTIVE_SUSCEPTANCE	Siemens	Number	
18.	NP_MANUFACTURER-AS, NP_MANUFACTURER		Text	
19.	NP_MODEL-AS, NP_MODEL		Text	
20.	NP_SERIAL_NUM-AS, NP_SERIAL_NUM		Text	
21.	NP_FW_VER-AS, NP_FW_VER		Text	

Table 5-1 (continued)
IEEE 1547.1-2020 Standard parameter labels used in applied settings files

	Parameter Label	Units	Data Type	Allowed Values
22.	AP_LIMIT_ENABLE-AS		Select-list	▪ ENABLED ▪ DISABLED
23.	AP_LIMIT-AS	P p.u.	Number	
24.	ES_PERMIT_SERVICE-AS		Select-list	▪ ENABLED ▪ DISABLED
25.	ES_V_LOW-AS	V p.u.	Number	
26.	ES_V_HIGH-AS	V p.u.	Number	
27.	ES_F_LOW-AS	Hz	Number	
28.	ES_F_HIGH-AS	Hz	Number	
29.	ES_RANDOMIZED_DELAY-AS	s	Number	
30.	ES_DELAY-AS	s	Number	
31.	ES_RAMP_RATE-AS	s	Number	
32.	CONST_PF_MODE_ENABLE-AS[1]		Select-list	▪ ENABLED ▪ DISABLED
33.	CONST_PF_EXCITATION-AS		Select-list	▪ INJ ▪ ABS
34.	CONST_PF-AS		Number	
35.	CONST_Q_MODE_ENABLE-AS[1]		Select-list	▪ ENABLED ▪ DISABLED
36.	CONST_Q-AS	VAr p.u.	Number	
37.	QV_MODE_ENABLE-AS[1]		Select-list	▪ ENABLED ▪ DISABLED
38.	QV_VREF-AS	V p.u.	Number	
39.	QV_VREF_AUTO_MODE-AS		Select-list	▪ ENABLED ▪ DISABLED
40.	QV_VREF_TIME-AS	s	Number	
41.	QV_CURVE_V2-AS	V p.u.	Number	
42.	QV_CURVE_Q2-AS	VAr p.u.	Number	
43.	QV_CURVE_V3-AS	V p.u.	Number	
44.	QV_CURVE_Q3-AS	VAr p.u.	Number	
45.	QV_CURVE_V1-AS	V p.u.	Number	
46.	QV_CURVE_Q1-AS	VAr p.u.	Number	
47.	QV_CURVE_V4-AS	V p.u.	Number	
48.	QV_CURVE_Q4-AS	VAr p.u.	Number	

Table 5-1 (continued)
IEEE 1547.1-2020 Standard parameter labels used in applied settings files

	Parameter Label	Units	Data Type	Allowed Values
49.	QV_OLRT-AS	s	Number	
50.	QP_MODE_ENABLE-AS[1]		Select-list	▪ ENABLED ▪ DISABLED
51.	QP_CURVE_P3_GEN-AS	P p.u.	Number	
52.	QP_CURVE_P2_GEN-AS	P p.u.	Number	
53.	QP_CURVE_P1_GEN-AS	P p.u.	Number	
54.	QP_CURVE_P1_LOAD-AS	P p.u.	Number	
55.	QP_CURVE_P2_LOAD-AS	P p.u.	Number	
56.	QP_CURVE_P3_LOAD-AS	P p.u.	Number	
57.	QP_CURVE_Q3_GEN-AS	VAr p.u.	Number	
58.	QP_CURVE_Q2_GEN-AS	VAr p.u.	Number	
59.	QP_CURVE_Q1_GEN-AS	VAr p.u.	Number	
60.	QP_CURVE_Q1_LOAD-AS	VAr p.u.	Number	
61.	QP_CURVE_Q2_LOAD-AS	VAr p.u.	Number	
62.	QP_CURVE_Q3_LOAD-AS	VAr p.u.	Number	
63.	PV_MODE_ENABLE-AS		Select-list	▪ ENABLED ▪ DISABLED
64.	PV_CURVE_V1-AS	V p.u.	Number	
65.	PV_CURVE_P1-AS	P p.u.	Number	
66.	PV_CURVE_V2-AS	V p.u.	Number	
67.	PV_CURVE_P2 -AS	P p.u.	Number	
68.	PV_OLRT-AS	s	Number	
69.	OV2_TRIP_V-AS	V p.u.	Number	
70.	OV2_TRIP_T-AS	s	Number	
71.	OV1_TRIP_V-AS	V p.u.	Number	
72.	OV1_TRIP_T-AS	s	Number	
73.	UV1_TRIP_V-AS	V p.u.	Number	
74.	UV1_TRIP_T-AS	s	Number	
75.	UV2_TRIP_V-AS	V p.u.	Number	
76.	UV2_TRIP_T-AS	s	Number	
77.	OF2_TRIP_F-AS	Hz	Number	
78.	OF2_TRIP_T-AS	s	Number	
79.	OF1_TRIP_F-AS	Hz	Number	
80.	OF1_TRIP_T-AS	s	Number	

Table 5-1 (continued)
IEEE 1547.1-2020 Standard parameter labels used in applied settings files

	Parameter Label	Units	Data Type	Allowed Values
81.	UF1_TRIP_F-AS	Hz	Number	
82.	UF1_TRIP_T-AS	s	Number	
83.	UF2_TRIP_F-AS	Hz	Number	
84.	UF2_TRIP_T-AS	s	Number	
85.	PF_DBOF-AS	Hz	Number	
86.	PF_DBUF-AS	Hz	Number	
87.	PF_KOF-AS		Number	
88.	PF_KUF-AS		Number	
89.	PF_OLRT-AS	s	Number	
90.	MC_HVRT_V1-AS	V p.u.	Number	
91.	MC_LVRT_V1-AS	V p.u.	Number	

5.1 Nameplate Parameters

All the 21 standard nameplate parameters can appear in an applied settings file with the suffix '-AS'. All the nameplate parameters included in an applied settings file are required to have the '-AS' suffix. The nameplate parameters without the '-AS' suffixes are optional and if included, shall indicate the original/built-in values. However, their corresponding nameplate parameters with the '-AS' suffix must be present in the same file. For example, if NP_P_MAX without the suffix is present in a file, NP_P_MAX-AS must be present in the same file. On the other hand, if NP_P_MAX-AS is present, NP_P_MAX is optional. Refer to Table 5-1 for a complete list of allowed parameters for the applied setting context.

5.2 Metadata

The value of MT_FILE_INFO_TYPE in an applied settings file shall be 'AS'. The inclusion of this metadata item is mandatory. Table 5-2 presents the standard metadata labels that can be included in an applied settings file.

Table 5-2
Standard metadata for applied settings files

	Metadata Label	Data Type	Allowed Values[2]	Description
1.	MT_FILE_INFO_TYPE	Select-list	▪ AS	Context of the data in the file
2.	MT_DER_ID	Text		DER unique ID/name
3.	MT_DER_SITE_NAME	Text		Site name
4.	MT_DER_OWNER_NAME	Text		DER owner
5.	MT_DEVELOPER_NAME	Text		Developer
6.	MT_DER_ADDRESS	Text		Physical Address
7.	MT_VALIDATION_DATE	Date		Settings configuration validation date (mm/dd/yyyy format)
8.	MT_VALIDATION_TIME	Text		Settings configuration validation time (hh:mm:ss 24-hour format local time)
9.	MT_ASSOCIATED_SUBSTATION	Text		Associated substation
10.	MT_ASSOCIATED_FEEDER	Text		Associated feeder/circuit
11.	MT_INTERCONNECTION_ID	Text		Interconnection ID

Section 6: Special Parameters

In addition to the standard parameters, there are a few parameters that are deemed as non-mandatory but they are included in the IEEE 1547-2018. Again, some parameters are frequently used by certain stakeholders but they are not included in the IEEE 1547-2018 standard. All such parameters may be included in a common file format; however, they will not be treated as standard parameters that are comprehensible to others. All these parameters, if included in a common file, must be followed by a dash (-) and the use-case-specific context, as described in Section 3.6.

6.1 Non-Mandatory Parameters

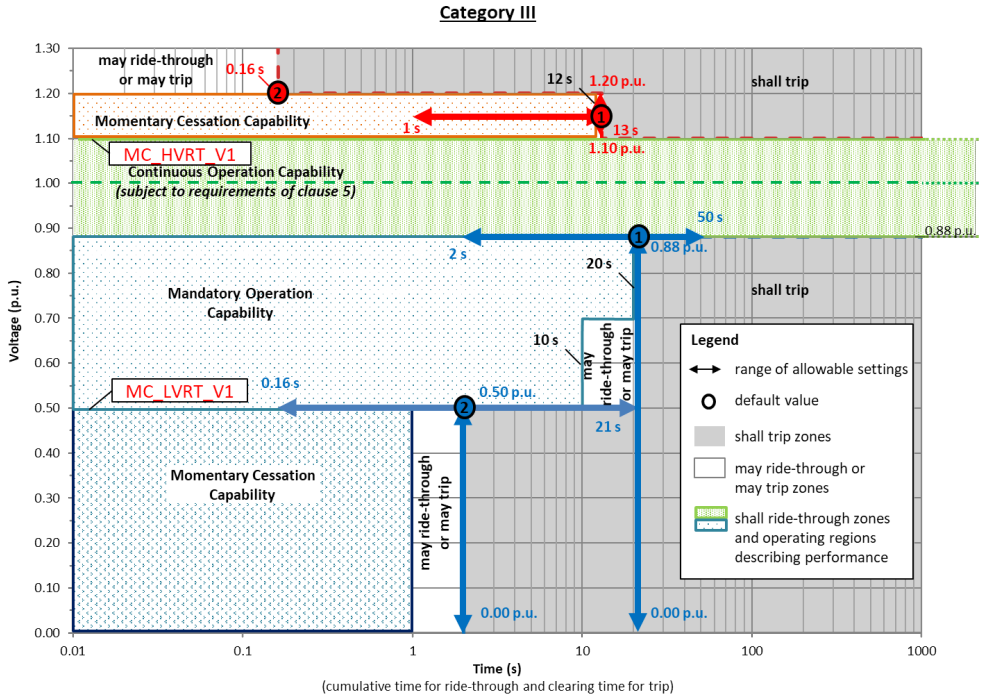

Figure 6-1
Momentary cessation parameters indicated in the DER response to abnormal voltages diagram

The momentary cessation parameters in Table 6-1 are not mandatory according to IEEE 1547-2018 but can be included in a settings file if required. Figure 6-1 shows which lines in a 'DER response to abnormal voltage' diagram these parameters refer to.

Table 6-1
Sample non-mandatory parameter labels

Parameter Label	Description
MC_HVRT_V1	High-voltage momentary cessation threshold voltage (V) in p.u.
MC_LVRT_V1	Low-voltage momentary cessation threshold voltage (V) in p.u.

6.2 Frequently Used Non-Standard Parameters

There are a few parameters that are frequently used by the industry. These may be included in a common file. However, other parties shall be allowed to ignore these parameters, as these are not standard according to IEEE 1547-2018. If included, the recipient of such a file should be communicated accordingly. Table 6-2 lists a few of these non-standard parameter labels.

Table 6-2
Sample non-standard parameter labels

Parameter Label	Description
OV3_TRIP_V	High voltage must trip curve point OV3 voltage setting. Per unit value based on NP_AC_V_NOM (voltage base)
OV3_TRIP_T	High voltage must trip curve point OV3 duration setting
UV3_TRIP_V	Low voltage must trip curve point UV3 voltage setting. Per unit value based on NP_AC_V_NOM (voltage base)
UV3_TRIP_T	Low voltage must trip curve point UV3 duration setting
OF3_TRIP_V	High frequency must trip curve point OF3 voltage setting. Frequency values shall be reported to 3 decimal places
OF3_TRIP_T	High frequency must trip curve point OF3 duration setting
UF3_TRIP_V	Low frequency must trip curve point UF2 voltage setting. Frequency values shall be reported to 3 decimal places
UF3_TRIP_T	Low frequency must trip curve point UF2 duration setting
UI_MODE_ENABLE	Unintentional islanding mode *enabled or disabled*

6.3 Special Non-Standard Parameters

There are a few non-standard parameters that may be required to model a DER. Table 6-3 presents the labels and descriptions used for them.

Table 6-3
Non-standard parameters used in DER modeling

Parameter Label	Description
NP_P_MIN_PU	DER minimum active power output in p.u. due to its prime mover constraint
NP_PHASE	Indication whether a modeled DER is *single* or *three*-phase
NP_PRIO_OUTSIDE_MIN_Q_REQ	Indication of DER output priority for *active* or *reactive* power, outside of the minimum reactive power capability requirements defined in IEEE 1547-2018

6.4 User-Defined Parameters

Files can have additional rows with custom parameters along with their context suffixes if required. These, however, shall not be treated as standard parameters and may be ignored by any software parser that does not recognize them. User-defined parameter labels shall not exceed 64 characters. Corresponding values shall not exceed 512 characters. Files may include as many custom parameters as desired. User-defined parameter labels shall not be duplicated on more than one row.

Appendix A: Standard Parameter Root Label and Description

Table A-1 contains the root parameter labels for all the IEEE 1547-2018 standard parameters and their descriptions. Please note that these labels must be followed by a suffix code that identifies the context of the use-case when used in a common file.

Table A-1
Standard parameter labels defined in IEEE 1547.1-2020

	Parameter Label	Description
1.	NP_P_MAX	Active power rating in watts at unity power factor
2.	NP_P_MAX_OVER_PF	Active power rating in watts at specified over-excited power factor
3.	NP_OVER_PF	Over-excited power factor (VArs injected)
4.	NP_P_MAX_UNDER_PF	Active power rating in watts at specified under-excited power factor
5.	NP_UNDER_PF	Under-excited power factor (VArs absorbed)
6.	NP_VA_MAX	Maximum apparent power rating in volt-amperes
7.	NP_NORMAL_OP_CAT	Normal operating performance category
8.	NP_ABNORMAL_OP_CAT	Abnormal operating performance category
9.	NP_Q_MAX_INJ	Maximum injected reactive power rating in volt-amperes reactive
10.	NP_Q_MAX_ABS	Maximum absorbed reactive power rating in volt-amperes reactive
11.	NP_P_MAX_CHARGE	Maximum active power charge rating in watts
12.	NP_APPARENT_POWER_ CHARGE_MAX	Maximum apparent power charge rating in volt-amperes. May differ from the apparent power maximum rating
13.	NP_AC_V_NOM	Base nominal AC voltage rating in RMS V_{ac}
14.	NP_AC_V_MAX	Maximum output RMS AC voltage (V_H) in the continuous operating region
15.	NP_AC_V_MIN	Minimum output RMS AC voltage (V_L) in the continuous operating region
16.	NP_SUPPORTED_MODES	Indication of support for each control mode function separated by dashes
17.	NP_REACTIVE_SUSCEPTANCE	Reactive susceptance that remains connected to the Area EPS in the cease to energize and trip state
18.	NP_MANUFACTURER	Manufacturer
19.	NP_MODEL	Model
20.	NP_SERIAL_NUM	Serial number
21.	NP_FW_VER	Firmware version
22.	AP_LIMIT_ ENABLE	Limit active power function enable
23.	AP_LIMIT	Active power limit setting. Per unit value based on NP_P_MAX or NP_P_MAX_CHARGE. Negative values indicate active power absorption
24.	ES_PERMIT_SERVICE	Permit service function enable. This function is activated by request from the Area EPS Operator
25.	ES_V_LOW	Enter service voltage - low - setting. Per unit value based on NP_AC_V_NOM (voltage base)
26.	ES_V_HIGH	Enter service voltage - high - setting. Per unit value based on NP_AC_V_NOM (voltage base)
27.	ES_F_LOW	Frequency in Hz, and shall be reported to 3 decimal places

Table A-1 (continued)
Standard parameter labels defined in IEEE 1547.1-2020

	Parameter Label	Description
28.	ES_F_HIGH	Frequency in Hz, and shall be reported to 3 decimal places.
29.	ES_DELAY	Minimum intentional enter service delay
30.	ES_RANDOMIZED_DELAY	Enter service randomized delay (optional feature in IEEE Std 1547-2018)
31.	ES_RAMP_RATE	Enter service soft-start duration in seconds. Time from zero to 100% of NP_P_MAX.
32.	CONST_PF_MODE_ENABLE	Constant power factor mode enable
33.	CONST_PF_EXCITATION	Under or over excited
34.	CONST_PF	Constant power factor setting, no sign should be used
35.	CONST_Q_MODE_ENABLE	Constant reactive power mode select
36.	CONST_Q	Injecting reactive power setting. Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
37.	QV_MODE_ENABLE	Voltage-Reactive power mode enable.
38.	QV_VREF	Per unit value based on NP_AC_V_NOM (voltage base)
39.	QV_VREF_AUTO_MODE	Autonomous V_{ref} adjustment enable.
40.	QV_VREF_TIME	V_{ref} adjustment time constant in seconds as specified by the area EPS operator
41.	QV_CURVE_V2	Volt-VAr point V2 setting. Per unit value based on NP_AC_V_NOM.
42.	QV_CURVE_Q2	VArs at V2 setting. Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
43.	QV_CURVE_V3	Volt-VAr point V3 setting. Per unit value based on NP_AC_V_NOM.
44.	QV_CURVE_Q3	VArs at V3 setting. Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
45.	QV_CURVE_V1	Volt-VAr point V1 setting. Per unit value based on NP_AC_V_NOM.
46.	QV_CURVE_Q1	VArs at V1 setting. Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
47.	QV_CURVE_V4	Volt-VAr point V4 setting. Per unit value based on NP_AC_V_NOM.
48.	QV_CURVE_Q4	VArs at V4 setting. Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
49.	QV_OLRT	Volt-VAr open-loop response time
50.	QP_MODE_ENABLE	Active power-Reactive power mode enable

Table A-1 (continued)
Standard parameter labels defined in IEEE 1547.1-2020

	Parameter Label	Description
51.	QP_CURVE_P3_GEN	Watt-VAr point P3 setting (generating active power). Per unit value based on NP_P_MAX.
52.	QP_CURVE_P2_GEN	Watt-VAr point P2 setting (generating active power). Per unit value based on NP_P_MAX.
53.	QP_CURVE_P1_GEN	Watt-VAr point P1 setting (generating active power). Per unit value based on NP_P_MAX.
54.	QP_CURVE_P1_LOAD	Watt-VAr point P1 setting (absorbing active power). Per unit value based on NP_P_MAX_CHARGE.
55.	QP_CURVE_P2_LOAD	Watt-VAr point P2 setting (absorbing active power). Per unit value based on NP_P_MAX_CHARGE.
56.	QP_CURVE_P3_LOAD	Watt-VAr point P3 setting (absorbing active power). Per unit value based on NP_P_MAX_CHARGE.
57.	QP_CURVE_Q3_GEN	VArs at point P3 setting (generating active power). Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
58.	QP_CURVE_Q2_GEN	VArs at point P2 setting (generating active power). Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
59.	QP_CURVE_Q1_GEN	VArs at point P1 setting (generating active power). Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
60.	QP_CURVE_Q1_LOAD	VArs at point P1 setting (absorbing active power). Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
61.	QP_CURVE_Q2_LOAD	VArs at point P2 setting (absorbing active power). Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
62.	QP_CURVE_Q3_LOAD	VArs at point P3 setting (absorbing active power). Per unit value based on NP_VA_MAX. Negative signs shall be used to indicate absorbing VAr.
63.	PV_MODE_ENABLE	Voltage-Active power mode enable
64.	PV_CURVE_V1	Volt-Watt point V1 setting. Per unit value based on NP_AC_V_NOM.
65.	PV_CURVE_P1	Watts at point V1 setting. Per unit value based on NP_P_MAX.
66.	PV_CURVE_V2	Volt-Watt point V2 setting. Per unit value based on NP_AC_V_NOM.
67.	PV_CURVE_P2	Watts at point V2 setting. Per unit value based on NP_P_MAX or NP_P_MAX_CHARGE. Negative values indicate active power absorption.

Table A-1 (continued)
Standard parameter labels defined in IEEE 1547.1-2020

	Parameter Label	Description
68.	PV_OLRT	Volt-Watt - Open loop response time
69.	OV2_TRIP_V	OV2 must trip over-voltage setting. Per unit value based on NP_AC_V_NOM.
70.	OV2_TRIP_T	OV2 must trip duration setting
71.	OV1_TRIP_V	OV1 must trip over-voltage setting. Per unit value based on NP_AC_V_NOM.
72.	OV1_TRIP_T	OV1 must trip duration setting
73.	UV1_TRIP_V	UV1 must trip under-voltage setting. Per unit value based on NP_AC_V_NOM.
74.	UV1_TRIP_T	UV1 must trip duration setting
75.	UV2_TRIP_V	UV2 must trip under-voltage setting. Per unit value based on NP_AC_V_NOM.
76.	UV2_TRIP_T	UV2 must trip duration setting
77.	OF2_TRIP_F	OF2 must trip over-frequency magnitude setting. Frequency values shall be reported to 3 decimal places.
78.	OF2_TRIP_T	OF2 must trip duration setting
79.	OF1_TRIP_F	OF1 must trip over-frequency magnitude setting. Frequency values shall be reported to 3 decimal places.
80.	OF1_TRIP_T	OF1 must trip duration setting
81.	UF1_TRIP_F	UF1 must trip under-frequency magnitude setting. Frequency values shall be reported to 3 decimal places.
82.	UF1_TRIP_T	UF1 must trip duration setting
83.	UF2_TRIP_F	UF2 must trip under-frequency magnitude setting. Frequency values shall be reported to 3 decimal places.
84.	UF2_TRIP_T	UF2 must trip duration setting
85.	PF_DBOF	Over frequency deadband offset from nominal frequency in Hz. Frequency values shall be reported to 3 decimal places.
86.	PF_DBUF	Under frequency deadband offset from nominal frequency in Hz. Frequency values shall be reported to 3 decimal places.
87.	PF_KOF	Over frequency per unit frequency change corresponding to a 1 per unit power change (frequency droop).
88.	PF_KUF	Under frequency per unit frequency change corresponding to a 1 per unit power change (frequency droop).
89.	PF_OLRT	Frequency-Active power open-loop response time

Appendix B: Common Mistakes to Avoid

Throughout the document, the rules to correctly create a DER settings file are available. Some of them are frequently used and are listed below to avoid confusion and mistakes while creating a settings file.

- All the nameplate parameters should have non-negative values. The negative sign to indicate 'absorption' is used with the p.u. values of the configured parameters.
- If a function is 'ENABLED', all the parameters in that function must be provided. If a function is 'DISABLED', the parameters for that function may or may not be provided.
- All the p.u. values of active power settings are based on NP_P_MAX if positive and based on NP_P_MAX_CHARGE if negative. The reactive power settings are based on NP_VA_MAX.
- The VAr functions are mutually exclusive. So, in the standard file format, only one of CONST_PF_MODE_ENABLE, CONST_Q_MODE_ENABLE, QV_MODE_ENABLE, and QP_MODE_ENABLE can be 'ENABLED' at a time.
- ES_RANDOMIZED_DELAY and ES_RAMP_RATE are mutually exclusive and cannot appear in a DER simultaneously. However, in an SS file, it is allowed to have non-zero values for both, because a utility may not be aware which one will be used by the developer to program a DER. On the other hand, in an AS file, one of these parameters must be 0 if ES_PERMIT_SERVICE is 'ENABLED'. Both these parameters cannot be 0 simultaneously.
- The value of the following parameters must be non-negative: CONST_PF, ES_DELAY, ES_RAMP_RATE, ES_RANDOMIZED_DELAY, QV_VREF_TIME, QV_OLRT, QP_OLRT, PV_OLRT, PF_OLRT, OV2_TRIP_T, OV1_TRIP_T, UV1_TRIP_T, UV2_TRIP_T, OF2_TRIP_T, OF1_TRIP_T, UF1_TRIP_T, UF2_TRIP_T, PF_DBOF, PF_DBUF, PF_KOF, PF_KUF.
- The following parameters must be whole numbers: ES_DELAY, ES_RAMP_RATE, ES_RANDOMIZED_DELAY. This is because the data type is constrained by some of the standard communication protocols.
- The frequency-droop parameters are always required: PF_DBOF, PF_DBUF, PF_KOF, PF_KUF, and PF_OLRT.

However, this is not a complete list of validations. The values of each parameter should follow its recommended range specified by the IEEE 1547-2018 standard but it is allowed to be out of range in some special cases.

Appendix C: File Context: Results Reporting Settings

Some regions and stakeholders may choose to apply the common file format described in this document in results reporting for the IEEE standard conformance test procedures for equipment interconnecting DER with electric power systems. The details of this use may be developed in a future revision of this document and will be treated as a different context. A suitable suffix should be used to include the context with the parameter labels. See the following for details: https://standards.ieee.org/standard/1547_1-2020.html

Appendix D: CSV File Encoding

While creating a common file in CSV format, a user needs to be careful about different encoding types. For example, the 'save as' operation in Microsoft (MS) Excel, results in four different options for saving as a CSV. Figure D-1 shows a screenshot of the 'save as' dialog with the CSV options highlighted.

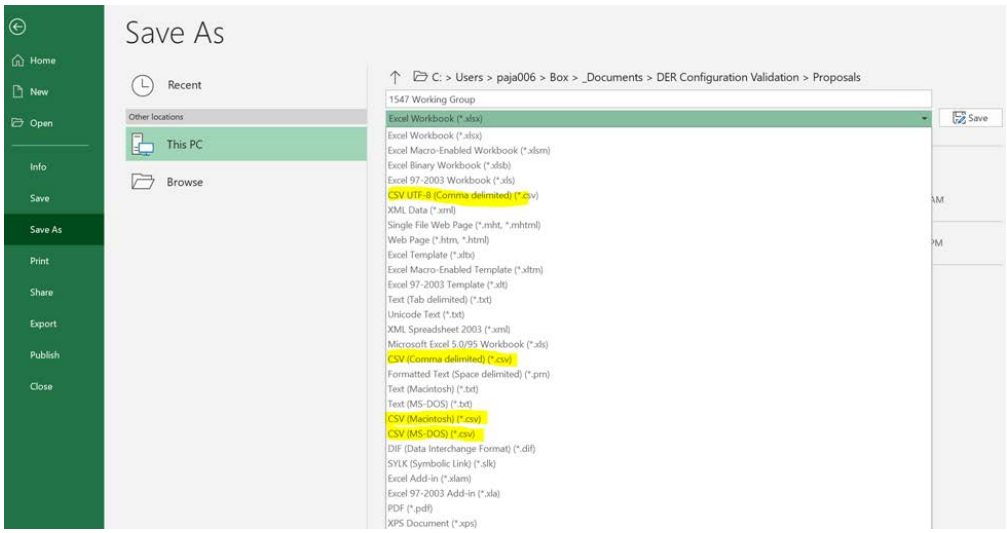

Figure D-1
Four CSV File Options in MS Excel

There is a subtle difference in how the contents are stored as binary information in a file system. When a simple Excel file is saved with the same content and saved it with all the options, as shown in Figure D-2. Figure D-2 shows the four CSV files within the file explorer, as well as the file contents viewed in MS Excel and Notepad applications.

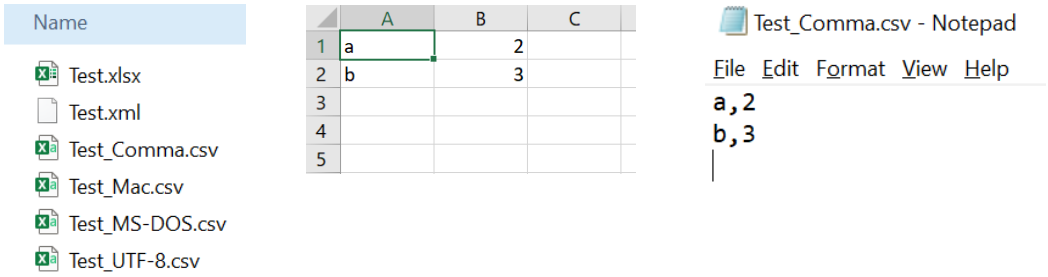

Figure D-2
Different CSV files with same content within file explorer

Table D-1 shows the different encoding systems used by the four different options presented in the 'Save as' dialog. As seen from the table, all the options save the file with UTF-8 encoding. However, the option 'CSV UTF-8 comma delimited (*.csv)' saves it with a Byte Order Marker (BOM) and 'CSV (Macintosh) (*.csv)' uses only Carriage Return (CR) to represent the new lines in the file.

Table D-1
File encodings for the four different options in the 'Save as' dialog of MS Excel

'Save as' formats	File types
CSV UTF-8 comma delimited (*.csv)	Windows (CR LF) UTF-8-BOM
CSV comma delimited (*.csv)	Windows (CR LF) UTF-8
CSV (Macintosh) (*.csv)	Windows (CR) UTF-8
CSV (MS-DOS) (*.csv)	Windows (CR LF) UTF-8

An online tool was used to investigate the binary file contents of the four CSV files. As illustrated in Figure D-3, there are differences in bits (binary data) between the files.

'CSV UTF-8 comma delimited (*.csv)' uses some extra bytes for several special characters known as Byte Order Markers (BOM) at the beginning of the file. The option 'CSV (Macintosh) (*.csv)' does not use the 'Linefeed (LF)' character along with 'Carriage Return (CR)' to indicate a new line. The other two options are identical and use two characters 'CR' and 'LF' to represent a new line.

So, which CSV format should we use while creating a common file using MS Excel? It is probably going to be okay to use any. This is because the libraries that programmers (software developers) use these days can usually handle the differences in the file encoding of these options. But it is recommended and safest to use 'CSV (Comma delimited) (*.csv)' uniformly.

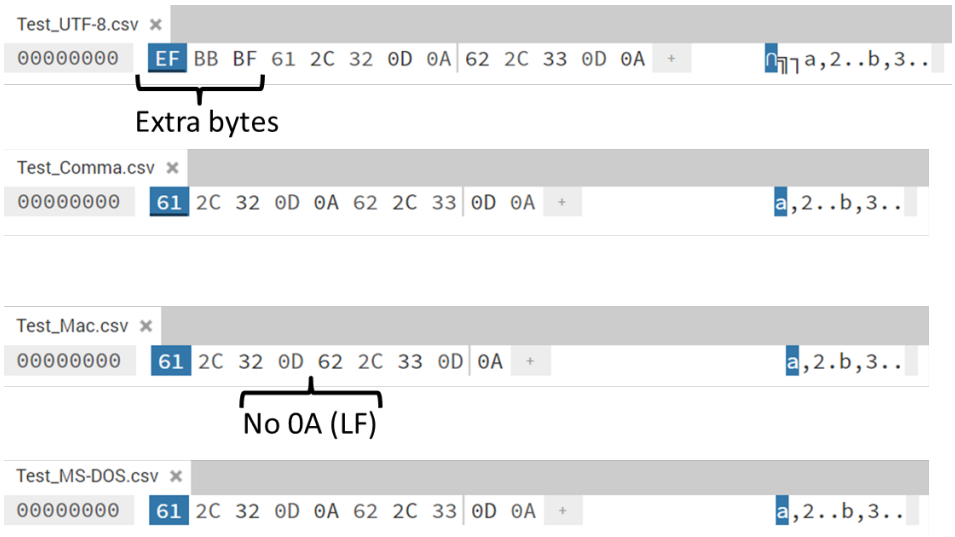

Figure D-3
Binary contents of the four CSV files as bytes of characters

Appendix E: Data Loss in CSV

When a CSV file is saved from MS Excel, there is a possibility of data loss, as explained in Figure E-1. For example, the number '123.45678912345' was typed into the first cell of the Excel document. When saved as a CSV, it was truncated to 123.4567891. In fact, MS Excel only saves the first 11 characters of a cell, if its format within Excel was 'General'. See Figure E-2 for reference. If you are using Excel to generate your CSV file and you require to have more than 11 characters for a number, then make sure to select the 'Number' format for your cell within Excel and then save as a CSV.

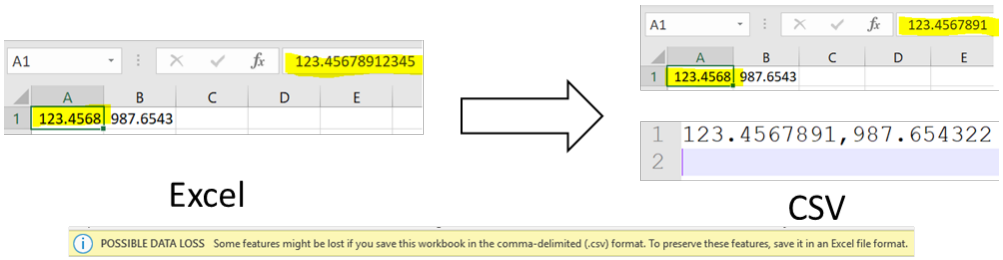

Figure E-1
Possible data loss when a CSV is saved from MS Excel

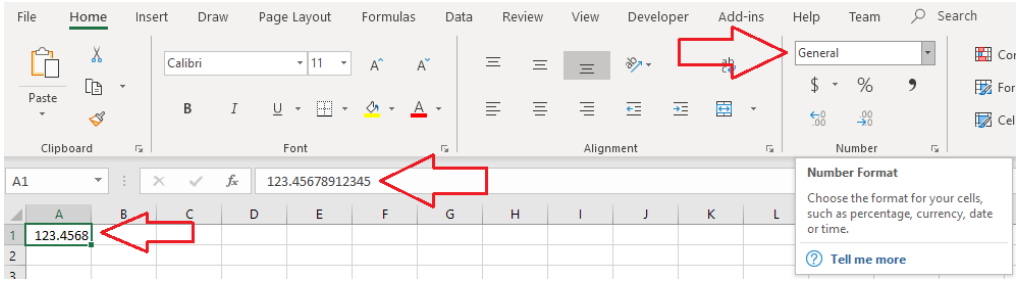

Figure E-2
Cell formatted as 'General' in MS Excel

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