Technical Bulletin
IEEE 1547-2018 and UL 1741-SB
April 2023

What is IEEE 1547-2018?

IEEE 1547 refers to "Standard 1547" as developed by the *Institute of Electrical and Electronics Engineers (IEEE)* to safely and functionally integrate distributed energy resources (DERs) into the electric distribution grid. The Energy Policy Act of 2005 established IEEE 1547 as the domestic interconnection standard for DERs.

At a high level, IEEE 1547 can be thought of as the baseline requirements to interconnect a DER with the public utility. The test procedures used to prove compliance with these requirements are outlined in IEEE 1547.1-2020.

The IEEE 1547 standard is continually updated to keep pace with rapidly innovating markets and technologies. The first iteration (IEEE 1547-2003) required DERs to disconnect when the grid was unstable. However, as DER adoption and functionality increased, advanced inverters and batteries became viewed as grid resources that could improve stability while also providing other useful grid services. Accordingly, revisions to the IEEE 1547 standard have been published every few years.

The most recent revision, published in 2018, incorporated "smart inverter" grid support features and interoperability testing to enable remote DER control by utilities.

Examples of inverter-specific functions under the IEEE 1547-2018 standard include:

- **Voltage regulation:** Maintaining voltage level(s) within a specific range(s) through reactive power injection or absorption
- **Frequency response:** Modulating power output as a function of frequency
- **Active and reactive power support:** Maintaining a steady power factor by sourcing or sinking reactive power
- **Local interoperability capability:** Insuring system-wide protection and control via sophisticated programmable functions and communications that will work even during a network failure
- **Ride-through capability:** Withstanding abnormal grid conditions such as voltage or frequency disturbances

Not all states have announced their plans for adopting the IEEE 1547-2018 Standard, but many of the biggest markets for solar PV (e.g., California, Texas, New York) either already have established dates or intend to by the end of 2023. The Interstate Renewable Energy Council (IREC) has published a 1547-2018 Adoption Tracker, which can be found here.

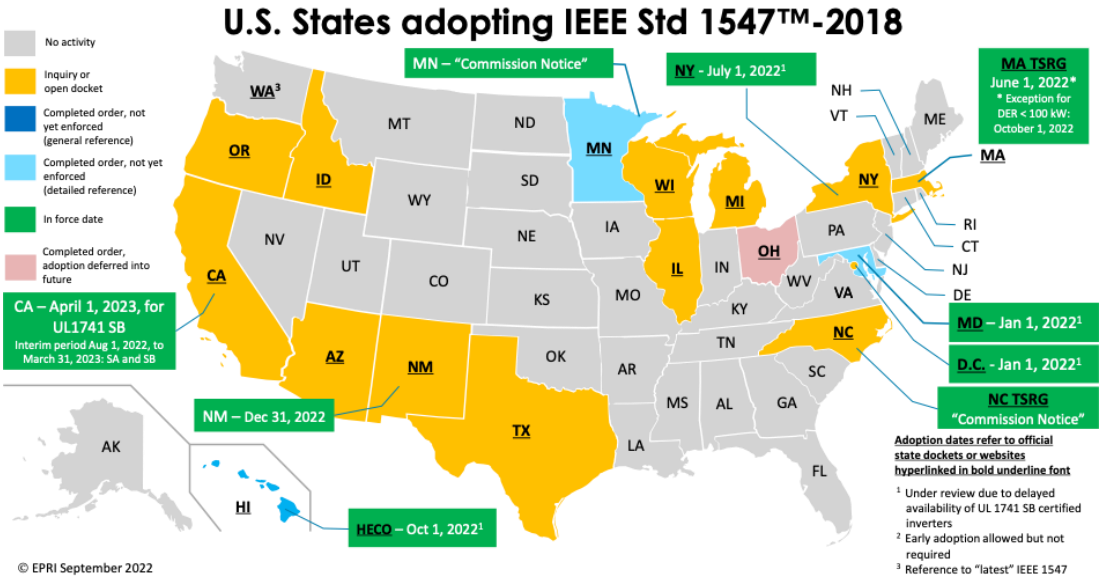

Figure 1: Map of IEEE 1547-2018 adoption by state. Source: IEEE

Grid Independent System Operators (ISOs) may also choose to adopt the IEEE 1547-2018 Standard. ISOs in the Midwest and Northeast have already introduced guidelines or have plans to do so soon. Check with your local ISO or utility for the latest updates on their adoption plans.

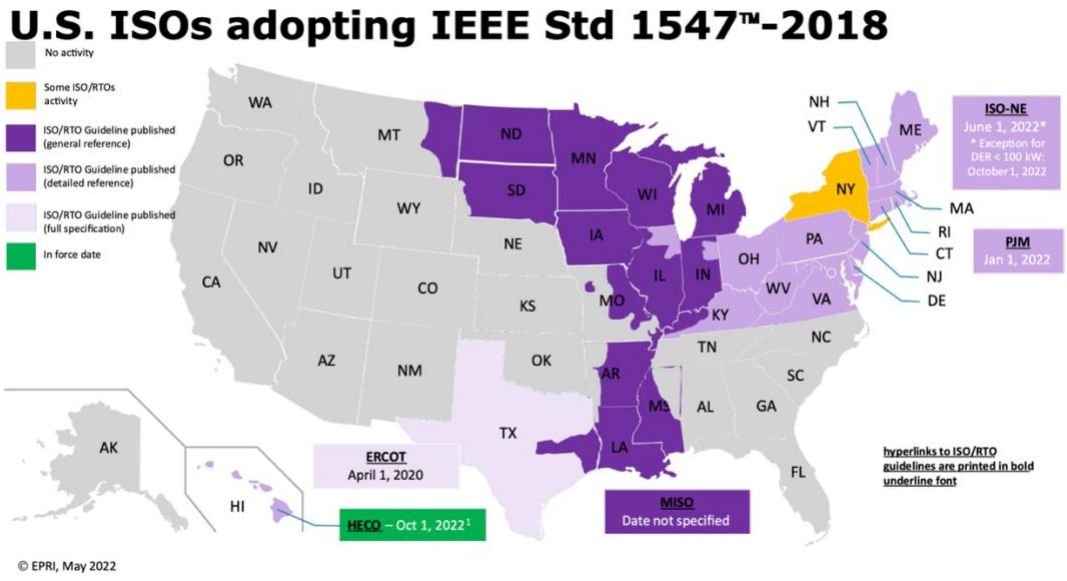

Figure 2: Map of IEEE 1547-2018 adoption by ISO. Source: IEEE

What is UL 1741-SB?

Underwriters Laboratories (UL) is an accredited standards developer, tester, and certifier in the U.S. and Canada, and acts as an independent third party to verify product or system compliance with IEEE or other industry standards.

UL 1741 is the official industry standard for certification of inverter safety. The tests that an "advanced inverter" must pass to receive UL 1741 certification were designed to meet or exceed the interconnection requirements set by the IEEE 1547-2018 standard and include additional tests for fire and electrical safety.

Since 2017, two major Supplements have been added to the UL 1741 standard: Supplement A (SA) and Supplement B (SB).

UL 1741-SA was published in conjunction with California Rule 21 Phase 1 requirements. These safety tests certify the "smart inverter" grid support functionality needed to modernize the grid through widespread DER integration. The testing requirements for UL 1741-SA are as follows:

- Anti-islanding
- Low/high-voltage ride-through (L/HVRT)
- Low/high-frequency ride-through (L/HFRT)
- Specified power factor (SPF)
- Volt/VAR mode
- Volt/watt mode
- Frequency/watt mode
- Ramp rate

UL 1741-SB introduced an interoperability conformance test in accordance with IEEE 1547.1-2020. Conformance can be achieved through either DNP3, IEEE 2030.5, or SunSpec Modbus communications protocols, which are used to store or send information and to control adjustable inverter functions. The testing requirements for UL 1741-SB are more stringent and include the following *in addition to the requirements defined above for UL 1741-SA certification*:

- Watt/VAR mode
- Voltage magnitude and time trip
- Frequency magnitude and time trip
- EMI
- Surge
- Rate of change of frequency (ROCOF)
- Dynamic voltage support
- Enter service
- Synchronization
- Open phase
- Harmonics
- DC injection
- Ground fault overvoltage (GFOV)
- Load rejection overvoltage (LROV)
- Prioritization of DER responses
- Fault current
- Persistence of DER parameter setting

New grid support functions as defined by Supplements A and B are optional for now but will soon be required in states such as California and Hawaii, with more states expected to follow.

Which CPS inverters are IEEE 1547-2018 and UL 1741-SB compliant?

CPS is proud to be among the first inverter manufacturers to receive UL 1741-SB certification for our 1,000 Vdc and 1,500 Vdc three-phase string inverter models. The following products, with firmware versions in parenthesis, are UL 1741-SB certified and compliant with the inverter-specific standards set by IEEE 1547-2018:

- CPS SCA25KTL-DO/US-208 (firmware version 4.0 or later)
- CPS SCA25KTL-DO-R/US-480 (firmware version 5.0 or later)
- CPS SCA36KTL-DO-US-480-V2 (all firmware versions)
- CPS SCA50KTL-DO/US-480 (firmware version 17.0 or later)
- CPS SCA60KTL-DO/US-480 (firmware version 17.0 or later)
- CPS SCH100KTL-DO/US-480 (firmware version 12.0 or later)
- CPS SCH100/125KTL-DO/US-600 (firmware version 12.0 or later)
- CPS SCH275KTL-DO/US-800 (all firmware versions)*

**CPS is awaiting additional test data to support Ground Fault Overvoltage requirements for the SCH275KTL inverter as described by UL1741-SB conformance tests. All other interoperability tests have been passed for all other CPS inverter models.*

Additional technical resources can be found here. For questions on CPS products or applications related to this bulletin, please contact Anton Patton at anton.patton@chintpower.com