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# SunSpec Rapid Shutdown Technology: Time-Tested and Proven



## **Abstract**

This document describes the development and the history of the *SunSpec Communication Signal For Rapid Shutdown* standard. It is intended to acquaint the reader with the process that the SunSpec Alliance uses to develop SunSpec Standards generally, and to provide insight about the technology choices that were made in the case of SunSpec Rapid Shutdown specification.

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## **About The SunSpec Alliance**

The SunSpec Alliance is a trade alliance of developers, manufacturers, and service providers, together pursuing information standards for the distributed energy industry. SunSpec standards address most operational aspects of PV 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. More than 120 organizations are members of the SunSpec Alliance, including global leaders from Asia, Europe, and North America. Membership is open to corporations, non-profits, and individuals. For more information about the SunSpec Alliance, or to download SunSpec specifications free of charge, please visit [www.sunspec.org](http://www.sunspec.org).

## **Contact Information**

SunSpec Alliance

4040 Moorpark Avenue, Suite 110

San Jose, CA 95117

[info@sunspec.org](mailto:info@sunspec.org)

## SunSpec Rapid Shutdown Technology: Time-Tested and Proven

Families and businesses across the U.S. are adopting solar PV and energy storage, recognizing that it is a more resilient energy solution that is better for the environment than fossil-fuel alternatives and delivers better bottom-line results. Thanks to improvements in technology and scale economics, the popularity of solar energy among consumers, businesses and large corporations continues to increase year-over-year. According to the Solar Energy Industries Association<sup>1</sup>, the industry has seen an average annual growth rate of 49% in the last 10 years.

To sustain this trend, industry-wide standardization is essential for solar. Particularly in the area of consumer- and first-responder safety, where the National Electrical Code (NEC) 2017 has specific requirements pertaining to de-energizing solar PV modules and arrays in the face of potential fire- or safety threats, standardized solutions that are easily understood are critical. NEC 2017 regulations are currently in effect in 36 U.S. states representing more than 80% of the U.S. rooftop solar market. In the next few years, nearly all states in the union will have adopted this standard or its successor (which are inclusive of NEC 2017 requirements).

Anticipating this trend, in 2015, 30 members of the SunSpec Alliance formed the SunSpec Communication Signal for Rapid Shutdown working group. After dozens of meetings with a wide array of manufacturers and stakeholders, and after 36 drafts of the functional specification and 10 drafts of the test specification, the SunSpec Communication Signal for Rapid Shutdown standard was published in 2017.

Shortly thereafter, the SunSpec Authorized Testing Laboratory network<sup>2</sup>, comprising 10 global laboratories that specialize in safety- and communication protocol testing, was established to provide validation and SunSpec product certification services. To date, more than 100 SunSpec Certified product lines<sup>3</sup> have been delivered to market through this network, including 12 product lines representing more than 50 discrete products that have been certified to the SunSpec Communication Signal for Rapid Shutdown.

Since its inception in 2009, the SunSpec Alliance has succeeded as a *de facto* standards developer by specifying solutions that are based on technologies that have been broadly adopted and are well understood in the marketplace. Like all SunSpec standards, the SunSpec Communication Signal for Rapid Shutdown standard fits this definition and is based on technology that has existed in the public domain for decades.

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<sup>1</sup> *Solar Industry Research Data*, available at <https://www.seia.org/solar-industry-research-data>.

<sup>2</sup> SunSpec Alliance Authorized Test Laboratory web page, available at <https://sunspec.org/sunspec-certified-authorized-test-laboratories/>

<sup>3</sup> SunSpec Certifications Registry web page, available at <https://certifications.sunspec.org/#/product-search>

To better understand SunSpec Communication Signal for Rapid Shutdown standard, it is important to understand the 12 key technologies the standard is built on, which are as follows:

- Permission to operate signal
- Shutdown signal
- Standby signal/standby power
- Powerline communications
- Watchdog timer
- Initiator
- Optional data
- Transmitter placement
- Spectrum choice/collisions
- Frequency shift keying
- Spread spectrum
- Barker codes

The SunSpec rapid shutdown working group selected these technologies using two criteria: 1) the technologies must have been discovered or perfected decades ago, and were therefore commonly, and freely, available in the market; and 2) the technologies are sufficient to perform the required function in a simple, repeatable, and reliable manner. SunSpec’s search and review of prior art<sup>4</sup> confirmed that the technologies specified in the SunSpec Communication Signal for Rapid Shutdown standard meet these criteria, thus allowing the industry to embrace the technologies and continue to build upon them. You can read these specifications yourself by downloading them, free of charge, from <https://sunspec.org>.

## Solar Technology And The Issue Of Patents

The push toward standardization is not without obstacles. Worldwide, companies are working hard to protect their intellectual property since it requires substantial investment in research and development. Solar manufacturers own patents on many of the technologies used in solar solutions that benefit the industry overall. As the article *Who Owns Our Carbon Future* states, “Use of patents and other forms of IP protection (such as design rights or trade secrets) is one way in which companies increase their ability to recoup their R&D investments<sup>5</sup>.”

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<sup>4</sup> *SunSpec Communication Signal for Rapid Shutdown Intellectual Property Prior Art Study*. The SunSpec Alliance. November 1, 2020, available at <https://sunspec.org/wp-content/uploads/2021/02/SunSpec-Rapid-Shutdown-Prior-Art-Synopsis-2021.pdf>

<sup>5</sup> *Who Owns Our Low Carbon Future? Intellectual Property and Energy Technologies*. Lee, Bernice; Iliev, Ilian and Preston, Felix. Chatham House, September 2009, available at <http://tinyurl.com/3jalr6t5>

Applied properly, patents can accelerate solar innovation as companies develop new technology to outpace their competitors and deliver value to customers. Conversely, when applied improperly—as in the case of patents that are not original but are rather based on non-original, well-established, and well-known methods—technology diffusion can slow to a snail's pace. Under these conditions, innovation can cease, thus hindering or even stifling expansion of a burgeoning solar market.

With the urgent need for clean energy worldwide, the solar industry needs to overcome these obstacles. One possible path is an open standard that accommodates patented technologies licensed under Reasonable and Non-Discriminatory (RAND) terms. With standards like these, the standard developer (for example, SunSpec Alliance) forms an agreement with the owner of a patent that allows their intellectual property to be used in standard and that also allows adopters of the standard, including direct competitors of the patent holder, to pay the same price as any other competitor in the market. RAND terms are a key part of the SunSpec membership agreement and a key aspect of most open standards development efforts.

Globally, according to a recent article in the *Journal of Research Policy*<sup>6</sup>, there is a move to reform the patent process and make it more selective. The article states the phenomenon of weak patents is increasingly recognized and investigated:

“Recent evidence suggests that highly significant shares of granted patents do not meet the patentability criteria of novelty and non-obviousness. For instance, Henkel and Zischka (2019) estimate that approximately 75% of granted German patents would be partially or fully invalidated if challenged in court.”

Those who own the patent process are looking more closely at prior art, which is the knowledge that existed prior to a patent filing, when they evaluate applications.<sup>7</sup>

Knowing the SunSpec Alliance has researched prior art associated with the technologies in its standard to establish their obviousness,<sup>8</sup> solar professionals can rest assured that rapid shutdown solutions are trustworthy.

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<sup>6</sup> *The impact of including standards-related documentation in patent prior art: Evidence from an EPO policy change.* Bekkers, Rudi; Martinelli, Arianna and Tamagni, Federico. *Research Policy*, September 2020, available at <https://www.sciencedirect.com/science/article/pii/S004873332030086X?via%3Dihub>

<sup>7</sup> *WIPO Intellectual Property Handbook.* World Intellectual Property Organization, 2004, available at <https://www.wipo.int/publications/en/details.jsp?id=275&plang=EN>

<sup>8</sup> *When is an Invention Obvious?* available at <https://www.ipwatchdog.com/2014/02/01/when-is-an-invention-obvious/id=47709/>

## A Clear Path For Rapid Shutdown Certification

SunSpec believes standardization is essential to the future of the solar industry. As chairman Tom Tansy wrote recently in PV Magazine, an industry based on time-tested standards operates more predictably and efficiently, benefitting all stakeholders. And as rapid shutdown compliance becomes more prevalent, component manufacturers will see a boost in business as more customers look for solutions that can work across systems. Standardization also drives down product and installation cost and encourages innovation throughout the market.<sup>9</sup>

Those companies that have adopted the SunSpec Communication Signal for Rapid Shutdown standard and have had their products SunSpec Certified are seeing many of the benefits of standardization in their businesses and are witnessing the positive impact it has on the U.S. solar market overall. Other jurisdictions, including mainland China, are also adopting SunSpec Certified Rapid Shutdown solutions, thus increasing the positive consumer- and first-responder impacts of the technology in markets around the world.

The increasing participation in SunSpec's rapid shutdown program has boosted the organization's importance and driven SunSpec to pursue accreditation through the ANSI National Accreditation Board, an organization that accredits organizations that certify products, processes and services. With ANSI accreditation, the solar industry will have even more reason to choose SunSpec-certified solutions available in the marketplace.

To meet the national mandate for rapid shutdown technology, SunSpec is introducing solar professionals to the benefits of SunSpec Rapid Shutdown by offering university- and NABCEP-accredited educational programs through extension programs at the University of California San Diego and at North Carolina State University. And as of January 2021, the SunSpec Communication Signal for Rapid Shutdown working group has re-convened to expand application of the technology in multi-module environments. The future is bright and we encourage you to join the SunSpec Alliance ecosystem of open standard solar and energy storage technology solutions providers.

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<sup>9</sup> *Standardization: The sign of a maturing solar industry*, available at <https://pv-magazine-usa.com/2020/09/30/standardization-the-sign-of-a-maturing-solar-industry>