Verifying MESA Device Specification Compliance

Using SunSpec Modbus Certification with the MESA Profile

Verifying ESS Device Compliance with the SunSpec Modbus Communication Standard Using the MESA Profile

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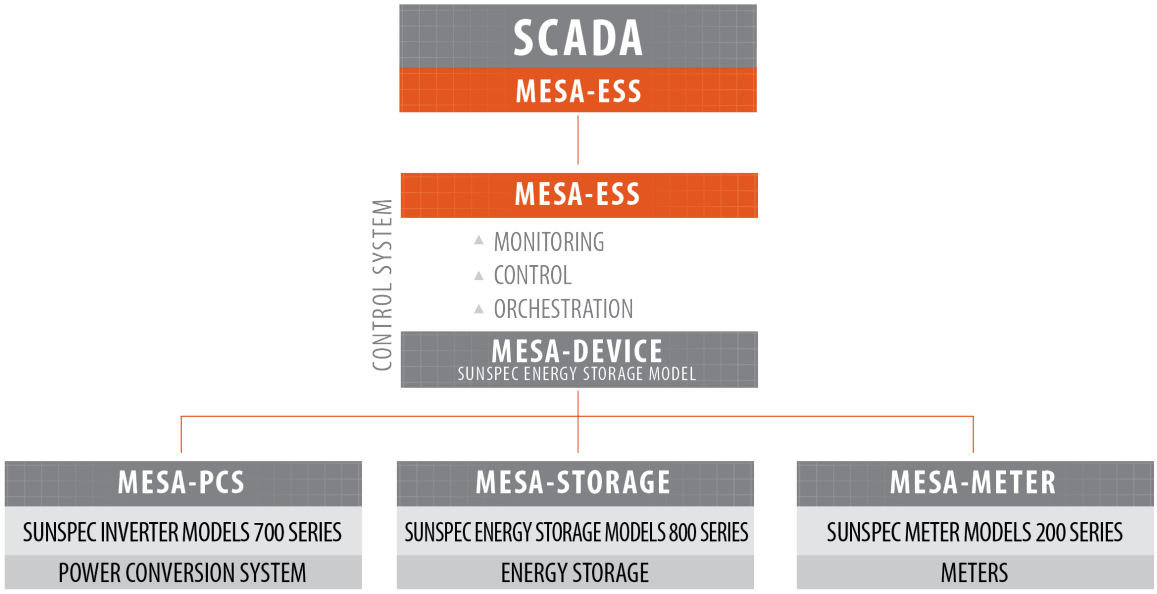
Introduction

This technical memo identifies tools that can be used to verify compliance with MESA-Device specification by using the SunSpec Modbus communications standard. The approach outlined below leverages the SunSpec Alliance's existing SunSpec Modbus certification[1] process.

MESA Specifications Background

MESA Standards Alliance (MESA)[2] has developed and manages two specifications: MESA-ESS and MESA-Device/SunSpec Energy Storage Model. MESA-ESS addresses communication between a utility's control system and energy storage systems (ESS). MESA-Device specifies standardized communications between components within the ESS.



MESA-Device Specifications/SunSpec Energy Storage Model addresses how energy storage components within an ESS communicate with each other and other operational components. MESA-Device specifications are built on the Modbus protocol.

[1] https://sunspec.org/certification/
[2] http://mesastandards.org/

SunSpec Modbus Certification Background

The SunSpec Certified program provides distributed energy resource (DER) interoperability, data communications, and cybersecurity functionality standards. The SunSpec Modbus interface, which SunSpec has been certifying under an earlier SunSpec certification program, will soon be added to the SunSpec Certified program.

SunSpec Modbus is an open standard that enables interoperability amongst DER system components. SunSpec Modbus is referenced in IEEE 1547-2018 Standard for DER Interconnection as one of the communication protocols that meets the interoperability requirements of the widely used IEEE 1547 Standard. The SunSpec Alliance currently manages SunSpec Modbus testing directly and is in the process of transferring testing responsibilities to SunSpec Authorized Test Laboratories (SunSpec ATLs).

SunSpec ATLs have the capability to provide interoperability, data communications, and cybersecurity testing services. SunSpec ATLs provide testing services for the SunSpec Certified program, with the SunSpec team responsible for validating results and issuing certification marks. SunSpec ATLs include CERE, CSA Group, Intertek, Kyrio, PCTest Engineer Laboratory, SGS, TUV Rheinland, and UL.[3]

The SunSpec certification process has the flexibility to accommodate specific considerations. For example, defining specific points for test within a range of acceptable settings, or changing designation of normally Optional Information model items in the baseline SunSpec standard to Mandatory. One term for defining a specific Certification evaluation/implementation basis can be called a "Profile." Below, a proposed MESA Profile is outlined for use in context of SunSpec certification of a MESA Device.

For more information on the SunSpec certification program, please visit https://sunspec.org/certification/.

[3] For more information on SunSpec ATLs, visit https://sunspec.org/sunspec-certified-authorized-test-laboratories/.

MESA Profile for SunSpec Modbus Certification

The three bolded items below are the requirements for creating a MESA-Device Profile for SunSpec Certification.

1) **The MESA Profile Information for SunSpec certification of MESA battery devices shall include the battery base model (802) and the relevant additional technology-appropriate information models from the 800 series.**

The MESA-Device Profile recommends renaming the 803–805 models to make them more generally applicable and technology neutral:

- 803: Battery Bank Model
- 804: Battery String Model
- 805: Battery Module Model

These models can be generally applied to batteries of different chemistries (e.g., Lithium, Zinc, Lead, etc.) that are organized hierarchically into banks, strings, modules, and cells. The battery chemistry is specified using Battery Type (Typ) in base model 802. Optional points in models 803–805 may remain unimplemented when not relevant for a specific technology.

In the future, additional models may be adopted to capture technologies that do not perfectly map into the general 803–805 battery models. An example is model 807, which is currently proposed for flow battery strings. Even in cases where technology-specific models may be required, the MESA-Device Profile recommends implementing the relevant models from 803–805 whenever possible to ensure maximum compatibility for MESA battery devices.

2) **The MESA Profile Information for SunSpec certification of MESA inverter devices shall include Information model 714.**

The Mandatory/Optional designations for the base 714 MESA PCS Model are shown below.

Label	Value	R/W	Mandatory (M/O)	Description
MESA-PCS	714	R	M	MESA-PCS model id.
	8	R	M	MESA-PCS model length.
Control Mode		R	M	Inverter control mode. Enumeration.
PCS Heartbeat		RW	O	Value is incremented every second with periodic resets to zero.

Controller Heartbeat	RW	O	Value is incremented every second with periodic resets to zero.
Alarm Reset	RW	O	Used to reset any latched alarms. 1 = Reset.
Set Operation	RW	M	Commands to PCS. Enumerated value.
Charge Current Limit	RW	O	Instantaneous maximum DC charge current.
Discharge Current Limit	RW	O	Instantaneous maximum DC discharge current.
Charge Voltage Limit	RW	O	Instantaneous maximum DC charge voltage.
Discharge Voltage Limit	RW	O	Instantaneous minimum DC discharge voltage.

3) The MESA Profile for SunSpec Certification of MESA Devices shall use the SunSpec standards information model's Mandatory/Optional designations.

The Mandatory/Optional designations for the battery base model (802) are shown below.

Label	Value	R/W	Mandatory (M/O)	Description
Battery Base Model	802	R	M	
	62	R	M	Model Length
Nameplate Charge Capacity		R	M	Nameplate charge capacity in amp-hours.
Nameplate Energy Capacity		R	M	Nameplate energy capacity in DC watt-hours.
Nameplate Max Charge Rate		R	M	Maximum rate of energy transfer into the storage device in DC watts.
Nameplate Max Discharge Rate		R	M	Maximum rate of energy transfer out of the storage device in DC watts.
Self Discharge Rate		R	O	Self discharge rate. Percentage of capacity (WHRtg) discharged per day.
Nameplate Max SoC		R	O	Manufacturer maximum state of charge, expressed as a percentage.
Nameplate Min SoC		R	O	Manufacturer minimum state of charge, expressed as a percentage.
Max Reserve Percent		RW	O	Setpoint for maximum reserve for storage as a percentage of the nominal maximum storage.
Min Reserve Percent		RW	O	Setpoint for maximum reserve for storage as a percentage of the nominal maximum storage.
State of Charge		R	M	State of charge, expressed as a percentage.

Depth of Discharge	R	O	Depth of discharge, expressed as a percentage.
State of Health	R	O	Percentage of battery life remaining.
Cycle Count	R	O	Number of cycles executed in the battery.
Charge Status	R	O	Charge status of storage device. Enumeration.
Control Mode	R	M	Battery control mode. Enumeration.
Battery Heartbeat	R	O	Value is incremented every second with periodic resets to zero.
Controller Heartbeat	RW	O	Value is incremented every second with periodic resets to zero.
Alarm Reset	RW	M	Used to reset any latched alarms. 1 = Reset.
Battery Type	R	M	Type of battery. Enumeration.
State of the Battery Bank	R	M	State of the battery bank. Enumeration.
Vendor Battery Bank State	R	O	Vendor specific battery bank state. Enumeration.
Warranty Date	R	O	Date the device warranty expires.
Battery Event 1 Bitfield	R	M	Alarms and warnings. Bit flags.
Battery Event 2 Bitfield	R	M	Alarms and warnings. Bit flags.
Vendor Event Bitfield 1	R	M	Vendor defined events.
Vendor Event Bitfield 2	R	M	Vendor defined events.
External Battery Voltage	R	M	DC Bus Voltage.
Max Battery Voltage	R	O	Instantaneous maximum battery voltage.
Min Battery Voltage	R	O	Instantaneous minimum battery voltage.
Max Cell Voltage	R	O	Maximum voltage for all cells in the bank.
Max Cell Voltage String	R	O	String containing the cell with maximum voltage.
Max Cell Voltage Module	R	O	Module containing the cell with maximum voltage.
Min Cell Voltage	R	O	Minimum voltage for all cells in the bank.
Min Cell Voltage String	R	O	String containing the cell with minimum voltage.

Min Cell Voltage Module	R	O	Module containing the cell with minimum voltage.
Average Cell Voltage	R	O	Average cell voltage for all cells in the bank.
Total DC Current	R	M	Total DC current flowing to/from the battery bank.
Max Charge Current	R	O	Instantaneous maximum DC charge current.
Max Discharge Current	R	O	Instantaneous maximum DC discharge current.
Total Power	R	M	Total power flowing to/from the battery bank.
Inverter State Request	R	O	Request from battery to start or stop the inverter. Enumeration.
Battery Power Request	R	O	AC Power requested by battery.
Set Operation	RW	M	Instruct the battery bank to perform an operation such as connecting. Enumeration.
Set Inverter State	RW	M	Set the current state of the inverter.
n/a	R	M	Scale factor for charge capacity.
n/a	R	M	Scale factor for energy capacity.
n/a	R	M	Scale factor for maximum charge and discharge rate.
n/a	R	O	Scale factor for self discharge rate.
n/a	R	M	Scale factor for state of charge values.
n/a	R	O	Scale factor for depth of discharge.
n/a	R	O	Scale factor for state of health.
n/a	R	M	Scale factor for DC bus voltage.
n/a	R	M	Scale factor for cell voltage.
n/a	R	M	Scale factor for DC current.

For More Information

Comments and questions are welcome. Please send your feedback to the MESA Testing & Certification Work Group Co-Chair, Jaime Kolln, at, Jaime.Kolln@pnnl.gov.

Appendix A: Team

MESA Standards Alliance Testing & Certification Work Group

The MESA Testing & Certification Work Group (T&C WG) is a MESA-member volunteer team that is facilitating development of processes and tools to support certification of MESA standards. Members and advisors of the T&C WG that contributed to this technical memo are listed below.

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