SunSpec Alliance Interoperability Specification

Multiple MPPT Inverter Extension Model

By: By. SunSpec Alliance Inverter Control Working Group

John Blair, John Nunneley, Bill Randle, Bob Fox, Lynn Linse

Version 1.2

This SunSpec Alliance Interoperability Specification extends the existing three inverter models (101, 102, and 103) to support inverters with more than one DC input connected to individual MPPT modules. The existing inverter models contain datapoints corresponding to only a single DC input and thus cannot actually be used to represent the DC values on an inverter with more than one MPPT module.

Change History

D-1: Initial Draft

D-2: Corrected typos and other errors.

Re-arranged datapoints to move the PAD register to the end of the fixed length section.

Allow DC_W to be implemented in the associated 101, 102 or 103 inverter model, emphasize that DC_A and DC_V must not be aggregated.

Set ID to 160 based on discussion.

Added 10: Reserved status value to avoid collision with the same status in the 501 and 502 models.

D-3: Added new requested datapoints: Tms, TmsPer and IDStr. Set all datapoints to optional with the exception of N. Added usage information for new datapoints in the Usage Requirements section.

D-4: Changed ID field type to new instanceid type.

D-5: Corrected mistakes in Tms and TmsPer types.

D-6: Move TmsPer out of repeated section. Add detail about what TmsPer (the measurement period) means. Removed the instanceid as a new type defined ID as a uint16 again.

D-7: Updated Title Page; Updated Copyright; Updated Abstract; Added “Protocol Mapping” section; Added “Support” section; Added “Certification” section

Introduction

This SunSpec Alliance Interoperability Specification extends the existing three inverter models (101, 102 and 103) to support inverters with more than one DC input connected to individual MPPT modules. The existing inverter models contain datapoints corresponding to only a single DC input and thus cannot actually be used to represent the DC values on an inverter with more than one MPPT module.

Protocol Mapping

The device specifications outlined in this document support Modbus and XML protocol.

Design Choices

Rather than revise the existing inverter models the decision was made to extend the existing model with additional information stored in a new model. This should simplify implementation and adoption.

A fixed length block explicitly describes the number of modules, scale factors, and a global event bitmask. The global event bitmask is specified to be the logical OR of all individual MPPT modules.

ID 160 was chosen with the intention of using the range 160 - 169 for modular inverter extension models.

Voltage and current values are uint16 for consistency with the existing DC current and voltage data types in the 101, 102 and 103 inverter models. After some discussion it was determined that negative values only made sense in the context of a charge controller, in which case an additional imported energy accumulator would be required.

No temperature scale factor is provided, as this was seen as superfluous. A fixed scale factor of 0 (whole degrees) is specified.

A “pad” register is provided to keep all 32 bit values aligned to even number offsets.

The MPPT DC input values correspond to the existing DC input values in the current inverter model, with the following exceptions:

- DC energy accumulators are provided
- Per module temperature values are provided
- Per module fault and status values are provided

Status and Event values are designed to correspond in meaning to values specified in the existing Inverter Models (101, 102 and 103) as well as the Solar Module Models (501 and 502).

Even though the information in the Multiple MPPT Inverter Extension Model is similar to the data in the Solar Module Models it was deemed valuable to create a new model as it more closely corresponds to the design of an inverter, explicitly identifies the MPPT modules by id and reduces the total number of datapoints.

The N field must describe the number of modules actually present, regardless of the number of repeated instances.

The requirements of the ID and N points have been designed to allow a logger to optimize reads for a device with a large number of unused MPPT modules. ID may be marked unimplemented (0xFFFF) if a module is not present. N must describe the number of modules actually present in the system. This allows for several read optimizations:

1. The logger may ignore all values present in an MPPT instance if the ID point is marked unimplemented. Since the accumulators may not be marked unimplemented this means loggers will avoid storing a large number of meaningless zeros.

2. The logger may stop reading the model after the specified number of modules is discovered.

An effort will be started to add these semantics to the SMDX model definition so loggers can take advantage of them without special cases. In the mean time a a logger may take advantage of these optimizations by implementing them specifically for this model.

Usage Requirements

This model must always be used with one of the existing 101, 102 or 103 inverter models. It cannot appear on a device without a corresponding inverter model.

The model should appear immediately after the inverter model it corresponds to.

The ID field may be marked not-implemented (0xFFFF). If this is the case a logger may, as an optimization, choose to ignore all values in the associated instance. A device must set all values in the associated instance to not-implemented if the ID field is set to not-implemented.

The associated inverter model **must** set DCA, DCA_SF, DCV and DCV_SF to not implemented. Avoid the temptation to "aggregate" these values since any such aggregation is meaningless unless the voltage is identical on all DC inputs.

An implementation may choose to combine the power from multiple MPPT modules and report a single combined power value.

The Tms datapoint allows for the synchronization of time data across multiple MPPT modules. The Smart Panel moduels (501 and 502) have the same datapoint with the same meaning.

The TmsPer represents a new concept in SunSpec models. TmsPer describes the number of seconds the MPPT datapoints are averaged over. This value applies to all the measured values with the exception of DCWH, since the average of an accumulator over time does not have meaning.

Implementations may set TmsPer to 0 to indicate that all measured values are instantaneous and synchronized. If the measured values are instantaneous but with no assurance of synchronization then TmsPer must be set to "not implemented" (0xFFFFFFFF). The TmsPer value is a 32 bit integer, which is obviously overkill. This was selected to avoid the need to add a PAD register to the repeating block.

No assumptions may be made about the sample frequency or other properties of the interval. Vendors are encouraged to document these properties in their implementation notes.

When the TmsPer time is implemented and non-zero, meaning the measured values represent averages, the Tms point must describe the end, or latest time of the time period. That is, if the period is a 15 second interval from 00:00:00 to 00:00:15, the Tms value must be 00:00:15.

The IDStr is a free-form string which can be used to describe the module. There is no requirement on the contents of this string.

N, the number of modules, must refer to the actual number of modules, not the number of instances in the repeating block.

Please note that only the N datapoint, the number of modules, is mandatory. This is deliberate, with the goal of providing maximum flexibility to implementations.

Modbus Register Map

Fixed Length Section

start offset	end offset	size	R/W	id	type	units	SF	description	M/O
0	0	1	R	ID	uint16			well known value (160)	M
1	1	1	R	L	uint16			8 + N * 22	M
2	2	1	R	N	uint16			Number of Modules that are present and implemented	M
3	3	1	R	DCA_SF	sunssf	A		DC Input Current Scale Factor	O
4	4	1	R	DCV_SF	sunssf	V		DC Voltage Scale Factor	O
5	5	1	R	DCW_SF	sunssf	W		DC Power Scale Factor	O
6	6	1	R	DCWH_SF	sunssf	WH		DC Energy Scale Factor	O
7	7	1	R	TmsPer	uint16			Measurement Period	
8	9	2	R	Evt	bitfield32			Global DC MPPT Events (logical OR of all modules)	O

Repeating Section (One per MPPT Module)

start offset	end offset	size	R/W	id	type	units	SF	description	M/O
10	10	1	R	ID	uint16			Input ID; "not implemented" indicates the entire instance can be ignored	O
11	18	8	R	IDStr	string			ID String	O
19	19	1	R	DCA	uint16	A	DCA_SF	DC current	O
20	20	1	R	DCV	uint16	V	DCV_SF	DC voltage	O
21	21	1	R	DCW	int16	W	DCW_SF	DC power	O
22	23	2	R	DCWH	acc32	WH	DCWH_SF		O
24	25	2	R	Tms	uint32	Secs		Timestamp (seconds since 2000-01-01-00:00:00)	O

start offset	end offset	size	R/W	id	type	units	SF	description	M/O
26	26	1	R	Tmp	int16	C	0	Module Temperature (fixed scale factor)	O
27	27	1	R	DCSt	sunssf	WG		DC Energy Scale Factor	O
28	29	2	R	DCEvt	bitfield32			DC MPPT events	O

Module Status Values

ID	Value	Label	Description
OFF	1	Off	Module is not operating
SLEEPING	2	Sleeping	Module is sleeping / auto-shutdown
STARTING	3	Starting	Module is starting up
MPPT	4	MPPT	Module is tracking maximum power point
THROTTLED	5	Throttled	Module is operating at reduced power
SHUTTING_DOWN	6	Shutting Down	Module is in the process of shutting down
FAULT	7	Fault	One or more faults exist
STANDBY	8	Standby	Device is in standby mode
TEST	9	Test	Device is in self test mode
RESERVED	10		

Module Event Bitfield

ID	Value (bit)	Label	Description
GROUND_FAULT	0	Ground Fault	A ground fault has occurred
INPUT_OVER_VOLTAGE	1	Input Over Voltage	DC input is over rated voltage
RESERVED	2		
DC_DISCONNECT	3	DC Disconnect	DC input has been disconnected
RESERVED	4		
CABINET_OPEN	5	Cabinet Open	The module housing is open
MANUAL_SHUTDOWN	6	Manual Shutdown	Module is in manual shutdown

ID	Value (bit)	Label	Description
OVER_TEMP	7	Over Temperature	Module is shut down due to over temperature condition
RESERVED	8		
RESERVED	9		
RESERVED	10		
RESERVED	11		
BLOWN_FUSE	12	Blown Fuse	DC Input fuse is blown
UNDER_TEMP	13	Under Temperature	Module is under temperature
MEMORY_LOSS	14	Memory Loss	Module firmware failure
ARC_DETECTION	15	Arc Detection	Arc signal detected on DC input
RESERVED	16		
RESERVED	17		
RESERVED	18		
RESERVED	19		
TEST_FAILED	20	Test Failed	Self test failed
INPUT_UNDER_VOLTAGE	21	Under Voltage	DC input under voltage
INPUT_OVER_CURRENT	22	Over Current	DC input over current

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- Product listing in SunSpec Certified catalog
- Inclusion in the bidding process for system builders specifying SunSpec compatibility

Support

The Alliance provides ongoing support for members and non-members utilizing SunSpec Alliance specifications. If you have any questions, concerns, or thoughts, please visit http://www.sunspec.org or email us at info@sunspec.org.