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## Document Change Record

Rev.	Date	Pages affected	Change Description
1	2011-12-20		Initial release
2	2012-04-17		Updated 2.2, RPS_Q_Ref to 1 word instead of 2. Updated info. about grid code required or not
3	2013-03-25		Updated Table 3. SunSpec events mapped to Eltek events and Table 4. Warnings and Alarms
4	2013-11-18		Updated Table 5 with new cos phi limits valid from GUI rev 1.50

## 1 Purpose

This document describes the Theia HE-t solar inverter RS485 Modbus protocol. The protocol is based on the SunSpec Alliance Modbus protocol. The latest version of the specs may be downloaded at <http://www.sunspec.org/specifications/>.

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## 2 Communication specification

### 2.1 SunSpec

The supported SunSpec messages are listed in the table below, and are based on Common Elements v1.4 and Inverter Models v1.1. The supported column states if the message is supported or not. If not, the default value as described in Common Elements v1.4 is returned.

Start	End	R/W	Name	Supported	Comment
1	2	R	C_SunSpec_ID	Yes	
3	3	R	C_SunSpec_DID	Yes	
4	4	R	C_SunSpec_Length	Yes	
5	20	R	C_Manufacturer	Yes	«Eltek»
21	36	R	C_Model	Yes	
37	44	R	C_Options	No	
45	52	R	C_Version	Yes	
53	68	R	C_SerialNumber	Yes	12 char, the rest is empty

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69	69	R/W	C_DeviceAddress	Yes	[1 – 247]
70	70	R	C_SunSpec_DID_IM	Yes	
71	71	R	C_SunSpec_Length_IM	Yes	
72	72	R	I_AC_Current	Yes	mA
73	73	R	I_AC_CurrentA	Yes	Is same as I_AC_Current in single phase system
74	74	R	I_AC_CurrentB	Yes	Is same as I_AC_Current in single phase system
75	75	R	I_AC_CurrentC	Yes	Is same as I_AC_Current in single phase system
76	76	R	I_AC_Current_SF	Yes	-3 to get value in A
77	77	R	I_AC_VoltageAB	Yes	Is same as I_AC_VoltageAN in delta system
78	78	R	I_AC_VoltageBC	Yes	Is same as I_AC_VoltageAN in delta system
79	79	R	I_AC_VoltageCA	Yes	Is same as I_AC_VoltageAN in delta system
80	80	R	I_AC_VoltageAN	Yes	dV
81	81	R	I_AC_VoltageBN	Yes	Is same as I_AC_VoltageAN
82	82	R	I_AC_VoltageCN	Yes	Is same as I_AC_VoltageAN
83	83	R	I_AC_Voltage_SF	Yes	-1 to get value in V
84	84	R	I_AC_Power	Yes	W
85	85	R	I_AC_Power_SF	Yes	0
86	86	R	I_AC_Frequency	Yes	cHz
87	87	R	I_AC_Frequency_SF	Yes	-2 to get value in Hz
88	88	R	I_AC_VA	Yes	VA
89	89	R	I_AC_VA_SF	Yes	0
90	90	R	I_AC_VAR	Yes	VAr
91	91	R	I_AC_VAR_SF	Yes	0
92	92	R	I_AC_PF	Yes	
93	93	R	I_AC_PF_SF	Yes	-3
94	95	R	I_AC_Energy_WH	Yes	Wh
96	96	R	I_AC_Energy_WH_SF	Yes	0
97	97	R	I_DC_Current	Yes	mA
98	98	R	I_DC_Current_SF	Yes	-3 to get value in A
99	99	R	I_DC_Voltage	Yes	dV
100	100	R	I_DC_Voltage_SF	Yes	-1 to get value in V
101	101	R	I_DC_Power	Yes	W
102	102	R	I_DC_Power_SF	Yes	0
103	103	R	I_Temp_Cab	Yes	cC
104	104	R	I_Temp_Sink	No	
105	105	R	I_Temp_Trans	No	
106	106	R	I_Temp_Other	No	
107	107	R	I_Temp_SF	Yes	-2 to get value in C
108	108	R	I_Status	Yes	
109	109	R	I_Status_Vendor	Yes	Same as I_Status -1. See Table 2
110	111	R	I_Event_1	Yes	See Table 3(both warnings and alarms)
112	113	R	I_Event_2	Yes	Return 0x00000000
114	115	R	I_Event_1_Vendor	Yes	Alarms. See Table 4
116	117	R	I_Event_2_Vendor	Yes	Warnings. See Table 4
118	119	R	I_Event_3_Vendor	Yes	Returns 0x00000000
120	121	R	I_Event_4_Vendor	Yes	Returns 0x00000000

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I_Status	I_Status_Vendor	Status name	Description
1	0	OFF	Night time, control processor off.
2	1	Sleeping	Sleeping (auto-shutdown)
3	2	Startup	Initialization, Checking input and grid starting conditions
4	3	Running	Normal operation, tracking power (MPPT)
5	4	Derating	Output power derated due to high internal temperature or power reference (throttled)
6	5	Shutting down	Shutting down
7	6	Shutdown	Failure or altering operational conditions
8	7	Service mode	Manual override/standby

Table 2. Status

SunSpec Event	SunSpec Bitfield	Description	Eltek alarm word bitfield	Eltek Description
I_EVENT_GROUND_FAULT	0x00000001	Ground fault	0x00000100	E9 Low PV isolation resistance
I_EVENT_DC_OVER_VOLT	0x00000002	DC over voltage	0x00000040	E7 High voltage on input side
I_EVENT_AC_DISCONNECT	0x00000004	AC disconnect open		N/A
I_EVENT_DC_DISCONNECT	0x00000008	DC disconnect open		N/A
I_EVENT_GRID_DISCONNECT	0x00000010	Grid shutdown	0x00000010	E5 Grid fault
I_EVENT_CABINET_OPEN	0x00000020	Cabinet open		N/A
I_EVENT_MANUAL_SHUTDOWN	0x00000040	Manual shutdown		N/A
I_EVENT_OVER_TEMP	0x00000080	Over temperature	0x00000800	E12 High inverter temperature
I_EVENT_OVER_FREQUENCY	0x00000100	Frequency above limit	0x00800000	E24 High frequency on output side
I_EVENT_UNDER_FREQUENCY	0x00000200	Frequency under limit	0x01000000	E25 Low frequency on output side
I_EVENT_AC_OVER_VOLT	0x00000400	AC Voltage above limit	0x00200000	E22 High AC voltage
I_EVENT_AC_UNDER_VOLT	0x00000800	AC Voltage under limit	0x00400000	E23 Low AC voltage
I_EVENT_BLOWN_STRING_FUSE	0x00001000	Blown String fuse on input	0x00010000	E17 Fuse fault
I_EVENT_UNDER_TEMP	0x00002000	Under temperature	0x00001000	E13 Low inverter temperature
I_EVENT_MEMORY_LOSS	0x00004000	Generic Memory or Communication error (internal)	0x00080000	E20 Microprocessor fault
I_EVENT_HW_TEST_FAILURE	0x00008000	Hardware test failure		N/A

Table 3. SunSpec events mapped to Eltek events

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Code/ bitfield	Alarm	Descr.	Alarm/ Warn
0	Panel Fault	Panel Fault	NA
1	Illegal Grid Setting	Illegal grid setting	W
2	Uninitialized Grid Setting	Uninitialized grid setting	W
3	Self Test Failure	Self test failure	W
4	Grid fault	Grid fault	W/A
5	GUI fault	GUI fault	W/A
6	High DC voltage	High DC voltage	A
7	Low DC voltage	Low DC voltage	A
8	Low PV isolation resistance	Low PV isolation resistance	A
9	Inverter DC side failure	Inverter DC side failure	W/A
10	Inverter AC side failure	Inverter AC side failure	W/A
11	High inverter temperature	High inverter temperature	W/A
12	Low inverter temperature	Low inverter temperature	W
13	Current/Power limitation	Current/Power limitation	W
14	Comm. failure	Comm. failure	A
15	Fan failure	Fan failure	W/A
16	Fuse fault	Fuse fault	A
17	Active power limitation	Active power limitation	W
18	Reactive power compensation	Reactive power compensation	W
19	Microprocessor fault	Microprocessor fault	W/A
20	Earth current trip [Future use]	Earth current trip [Future use]	W
21	Grid: High AC voltage	Grid: High AC voltage	W
22	Grid: Low AC voltage	Grid: Low AC voltage	W
23	Grid: High AC frequency	Grid: High AC frequency	W
24	Grid: Low AC frequency	Grid: Low AC frequency	W
25	Grid: High output DC current	Grid: High output DC current	W
26	Output power imbalance	Output power imbalance	NA
27	Grid fault, still running	Grid fault, still running	NA
28	VDR fault DC side	VDR fault DC side	W
29	[Future use]		NA
30	Ext Fan Failure	Ext Fan Failure [Future use]	W
31	DNO Remote trip	DNO Remote trip	W

Table 4. Warnings and Alarms

## 2.2 Grid settings

For reading and setting grid relates settings, see Table 5 below.

Start	End	Size	R/W	Name	Supported	Comment
122	122	1	R	C_SunSpec_DID_Eltek	Yes	64101. Uniquely identifies this as the SunSpec Vendor extension block "Eltek Inverter Extension" block.
123	123	1	R	C_SunSpec_Length_Eltek	Yes	Length of model block
124	124	1	R	Country_code	Yes	The grid code used in the unit, [0 – 254]
125	125	1	R	Feeding_phase	Yes	Feeding phase of the unit

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126	126	1	R	APD_method	Yes/No*	Active Power Derating method used
127	127	1	R/W	APD_PowerRef	Yes/No*	Active Power Derating Power reference in % of nominal power [0 – 100]
128	128	1	R	RPS_method	Yes/No*	Reactive Power Supply method
129	129	1	R/W	RPS_Q_Ref	Yes/No*	RPS reactive power reference [-100, +100]. Not currently supported.
130	130	1	R/W	RPS_CosPhi_Ref	Yes/No*	RPS Cos Phi reference. 100 is unity, corresponding to 1.00. Lagging: -90 corresponds to -0.90. Leading: 90 corresponds to +0.90.

Table 5. Grid settings items

\* Note that APD\_method, APD\_PowerRef, RPS\_method, RPS\_Q\_Ref and RPS\_CosPhi\_Ref are only supported when these settings are required by the grid code standards.

### 3 Related documentation

“SunSpec Alliance Specification - Common Elements v1.4.pdf” – The common elements.

“SunSpec Alliance Specification - Inverter Models v1.1.pdf” – The inverter model elements.