Declaration of Conformity
for SkyBox True Hybrid Energy System

Purpose

The intent of this document is to specify that the OutBack Power model listed below conforms to the following standards for grid-interactive inverter/chargers intended for use in the United States and Canada.

Scope

OutBack Power models covered by this Declaration of Conformity include the following.

- SkyBox SBX5048-120/240

⚠	**IMPORTANT:** This Declaration of Conformity covers only the model listed above. This Declaration does not cover any other models.

Listings

This product carries a listing report by UL and is listed to the following standards:

- UL 1741 — Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resource, 2nd Edition, dated 1/28/2010 (R2016) with supplement SA
- CSA C22.2 — General Use Power Supplies, No. 107.1-01 Ed. 3 (R2006)

Certifications

This product has been certified by UL to meet the following standards:

- UL1778 — Uninterruptible Power Systems, Annex FFF (normative): Backfeed Protection Test, 5th Edition, dated 6/13/2014
- Hawaiian Electric Companies (HECO) Rule 14H SRD
- California Rule 21 SRD
- IEEE 1547-2003 — Standard for Interconnecting Distributed Resources with Electric Power Systems
- IEEE 1547.1-2005 — Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

This product has been certified by PC Test (a SunSpec Authorized Test Lab) to meet the following standards:

- SunSpec IEEE 2030.5 CSIP — Certified for California Rule 21 Phase 2 and Phase 3 Functions 1 and 8
- IEEE 2030.5-2018 — Secure communications protocols with utility companies

Directives

This product meets the following directive:

- RoHS: Directive 2011/65/EU — "The restriction of the use of certain substances in electrical and electronic equipment"

Compliance

This product complies with the standards shown below and on the following pages:

Inverters intended for grid-interactive use in the United States and Canada must comply with the established standards of UL 1741, IEEE 1547, and IEEE 1547.1. These standards provide regulation for acceptable output voltage ranges, output frequency, total harmonic distortion (THD), and anti-islanding performance when the inverter is exporting power to a utility source. SkyBox products are tested using the procedures listed in IEEE 1547.1 to the standards listed in both UL 1741 and IEEE 1547. The following specifications have been validated through compliance testing and refer to exporting power to a simulated utility source of less than 1% voltage total harmonic distortion (THD).

- The output of the inverter exceeds the minimum power factor of 0.85 with a typical power factor of 0.96 or better.

- Individual harmonics do not exceed the limits specified in Table 3 of IEEE 1547 Section 4.3.3. The THD of the root mean square (RMS) current is less than 5%.

- The inverter ceases to export power to the simulated utility source under islanding conditions specified in IEEE 1547 Section 4.4.1.

- The inverter also ceases to export power to the simulated utility source after the output voltage or frequency of the simulated utility source are adjusted to each of the conditions specified in IEEE 1547 Section 4.2.3 Table 1 and Section 4.2.4 Table 2 within the times specified in those tables. SkyBox products are tested to comply with the table below.

Interconnection Response Times to Abnormal Voltages or Frequencies

FIXED Trip Limits per IEEE 1547 Utility interconnection voltage trip limits and trip times:	Magnitude (Volts)		Maximum Time (sec)
	L1 – L2	L1 – N	
Overvoltage/Fast	288	144	0.16
Overvoltage/Slow	264	132	1
Undervoltage/Slow	211.2	105.6	2
Undervoltage/Fast	120	60	0.16
Utility interconnection frequency trip limits and trip times:	Magnitude (Hertz)		Maximum Time (sec)
Low	59.3		0.16
High	60.5		0.16

NOTE: Default shipped settings. Values were verified within these limits during production line testing.

Manufacturer's Stated Accuracy

OutBack Power states the following accuracies according to the requirements of UL1741 SA.

Description	Item
Manufacturer's stated AC voltage accuracy (Vac)	2.4 V_{L-L}
Manufacturer's stated DC voltage accuracy - PV (Vdc)	6
Manufacturer's stated DC voltage accuracy - Battery (Vdc)	0.48
Manufacturer's stated AC current accuracy (Aac)	0.42
Manufacturer's stated frequency measurement accuracy (Hz)	0.02
Manufacturer's stated output power accuracy (%W)	3%
Manufacturer's stated reactive power accuracy (%)	10%
Manufacturer's stated power factor accuracy	0.03
Manufacturer's stated time accuracy (sec)	0.033

DC Ratings — PV Input	Specification
Maximum input voltage (Vdc)	600
Range of input operating voltage (Vdc)	200 to 600
DC Input Start Range (Vdc)	250
Maximum Input (operating) current (A)	20
Maximum input short circuit current (I_{sc})	32
Maximum short circuit fault current (A ac or dc)	705 A peak 128 µs
Circuit combiner on input?	Combined in BOS by PV switch
Max. Branch Circuit overcurrent protection (A dc)	Provided by others

DC Ratings — Battery Input	Specification
Maximum input voltage (Vdc)	60
Range of input operating voltage (Vdc)	42 to 60
DC Input Start Range (Vdc) (recommended)	44
Maximum Input (operating) current (A)	140
Maximum short circuit fault current (A ac or dc)	798 Adc 188 µs
Circuit combiner on input?	No
Max. Branch Circuit overcurrent protection (Adc)	175 A maximum, 10 kAIC minimum

AC Ratings — Output	Specification
Output – Grid configuration(s) allowed for product connection.	L1 - N - L2
Nominal (line to line/Line-Neutral) output voltage (Vac)	240 V_{LL} / 120 V_{LN}
AC Input Voltage Range L-N (Adjustable)	105.6 to 132 V_{LN}
Normal input / output frequency (Hz)	60
Maximum continuous output current (A)	24
Maximum continuous output power @ 25 °C (kW)	5.0
Maximum continuous output power @ 45 °C (kW)	5.0
Maximum continuous output power @ >45 °C (W)	1200[1]
Max. output (kW)	5.0
Output Power Factor leading or lagging	Default > 0.95
Maximum short circuit fault current (A ac or dc)	227 A_{RMS} / 511 A_{peak} for 0.198 ms
Max. Branch Circuit overcurrent protection (A)	60

Other Ratings	Specification
Max. output fault current (A) / duration (ms)	(Battery) 798 Adc 188 µs
Max. input fault current (A) / duration (ms)	(PV) 705 A peak 128 µs
Max. utility backfeed current to PV array (A)	420 A for 7.45 ms
Line Synchronization Characteristics / In-rush current	Method 2, 1.7 A maximum
Enclosure Ratings	Type 3R
Shipping temperature range	–30 to 80
Operating Temperature range	–20 to 60

INTERCONNECTION INTEGRITY TEST CATEGORIES:	Specification
C62.42.2 Ring Wave Surge Category	B
C62.42.2 Combination Wave Surge Category	B
C37.90.1 RF Immunity - compliance	Yes (Determined by test)
C37.90.2 Communication circuit - compliance	Yes (Determined by test)

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[1] In the extended operating range of elevated ambient temperatures (greater than 45°C), the SkyBox System may thermally derate. This may appear as oscillations in the output power as the unit heats and cools. In the mode of exporting photovoltaic power to the grid within a normal operating range (max power voltage of 250 Vdc to 550 Vdc) the power is reduced from the normal rating to an average power of 1200 watts.

Grid Support Function Parameters

OutBack Power used the following parameters during the testing of the grid support functions according to UL1741 SA.

ADJUSTABLE Trip Limits **Utility interconnection voltage trip limits and trip times:**	Magnitude (V)		Time (sec)	
	Min	Max	Min	Max
Overvoltage/Fast – HV2	252	288	0.12	50
Overvoltage/Slow – HV1	252	288	0.12	50
Undervoltage/Slow – LV1	120	228	0.12	50
Undervoltage/Fast – LV2	120	228	0.12	50
Undervoltage – LV3	108	168	0.12	50
Utility interconnection frequency trip limits and trip times:	Magnitude (V)		Time (sec)	
	Min	Max	Min	Max
Overfrequency – HF2	60.1	66	0.12	1000
Overfrequency – HF1	60.1	66	0.12	1000
Overfrequency – LF1	50	59.9	0.12	1000
Overfrequency – LF2	50	59.9	0.12	1000

NOTE: values entered in the UI will be adjusted to not be overlapping

SA9 L/HVRT Low and High Voltage Ride-Through	Value
Voltage ride-through set points are set by the Grid Interconnection Profile selection and are not adjustable through the UI (default values shown)	HV2 = 120%, HV1 = 110% LV1=88%, LV2=70%, LV3=50%
Available Time Values (HV1)	Off, 0.92 to 49 seconds (mandatory), 10 to 49 seconds (momentary)
Available Time Values (LV1)	Off, 1 to 49 seconds (mandatory)
Available Time Values (LV2)	Off, 10 to 49 seconds (mandatory)
Available Time Values (LV3)	Off, 1 second (momentary)

NOTE: Voltage ride-through settings outside the ranges above are not covered by the UL certification

SA10 L/HVRT Low and High Frequency Ride-Through	Value
Magnitude setpoint adjustability	See frequency adjustable trip limit above
Adjustable time range (seconds)	20 to 999

NOTE: Frequency ride-through settings outside the ranges above are not covered by the UL certification

SA11 RR – Normal Ramp Rate	Value
Output Current Rating (A) [I_{rated}]	20.83
Minimum normal ramp-up rate (%I_{rated} /sec) [$RR_{norm\_up\_min}$]	0.1%
Maximum normal ramp-up rate (%I_{rated} /sec) [$RR_{norm\_up\_max}$]	100%
Minimum output current (A) [I_{low}]	0
Ramp Rate Accuracy (%I_{rated} /sec) [MSA_{RR}]	Not Needed
Dwell Time (s) [t_d] – Time between tests to allow for stability	5

SA11 SS – Soft-Start Ramp Rate	Value
Output Current Rating (A) [I_{rated}]	20.83
Minimum normal ramp-up rate (%I_{rated} /sec) [RR_{ss_min}]	0.1%
Maximum normal ramp-up rate (%I_{rated} /sec) [RR_{ss_max}]	100%
Minimum output current (A) [I_{low}]	0
Ramp Rate Accuracy (%I_{rated} /sec) [MSA_{RR}]	Not Needed
Dwell Time (s) [t_d] – Time between tests to allow for stability	5 (Max and Avg), 20 (Min)

SA12 SPF – Specified Power Factor	Value
Apparent Power Rating (VA) [S_{rated}] – To Grid	5000
Output power Rating (W) [P_{rated}] – To Grid	5000
DC input voltage range with function enabled (V)	200 to 600
Nominal AC voltage (V) [V_{nom}]	240
AC voltage range with function enabled (V)	105.6 to 132 V_{LN}
AC voltage measurement accuracy (V) [MSA_{Vac}]	2.4 V_{LL} (1% rated)
DC voltage measurement accuracy (V) [MSA_{Vdc}]	6 V (1% of rated)
Active Power range of function (e.g. 20% - 100%) [P_{low}, P_{rated}]	20% to 100%
Power Factor Accuracy [MSA_{PF}]	3%
Power Factor Settling Time (s)	5
Minimum Inductive (Underexcited Power Factor [$PF_{min,ind}$]	−0.8
Minimum Capacitive (Overexcited) Power Factor [$PF_{min,cap}$]	0.8

SA13 Volt/VAr Mode (Q(V))	Value
Apparent Power Rating (VA) [S_{rated}] – To Grid	5000
Output power Rating (W) [P_{rated}] – To Grid	5000
EUT input voltage range with function enabled (V)	200 to 600
Nominal AC EPS voltage (V) [V_{nom}]	120 / 240
AC EPS voltage range with function enabled (V) [V_{min}, V_{max}]	184.8 (77%) to 283.2 (118%)
Reactive power accuracy (% or VAr)	10%
Maximum Ramp Rate (VAr/s)	200 VAr/sec
Maximum Rated Reactive Power Production (Capacitiive, Overexcited) (VAr) [$Q_{max,over\ cap}$]	53% of VA rating
Maximum Rated Reactive Power Absorption (Inductive, Underexcited) (VAr) [$Q_{max,over\ ind}$]	53% of VA rating
Maximum Slope (VAr/V) [K_{VARmax}]	552.1
Deadband Range (V) [$Deadband_{min}$, $Deadband_{max}$]	4.8, 30 V_{LL}
Setting Time (s)	10
Q_1 = the maximum reactive power production setting	2650 (both ind/cap)
Q_2 = the reactive power setting at the lower voltage deadband limit	2650 (both ind/cap)
Q_3 = the reactive power setting at the upper voltage deadband limit	2650 (both ind/cap)
Q_4 = The maximum reactive power absorption setting	2650 (both ind/cap)
V_1 = the voltage at Q_1 (% of nominal)	77 to 103
V_2 = the voltage at Q_2 (% of nominal)	92 to 105
V_3 = the voltage at Q_3 (% of nominal)	95 to 108
V_4 = the voltage at Q_4 (% of nominal)	97 to 118

SA14 Frequency-Watt (FW)	Value
Output Power Rating (W) – P_{rated}	5000
AC frequency range with function enabled (Hz) – [f_{min}, f_{max}]	55, 65
Manufacturer's stated AC frequency measurement accuracy (Hz or %Hz) – MSA_{Hz}	0.02 Hz
Manufacturer's stated P(f) accuracy (W or %W) – $MSA_{P(f)}$	200 W 4.0%
Settling Time (s) – t_s	6.0
Adjustment range of the start of frequency droop (Hz) – [f_{start_min}, f_{start_max}]	60.02, 61.00
Maximum slope of frequency droop (%P_{rated}/Hz) – $K_{Power-Freq\_Max}$	100
Minimum slope of frequency droop (%P_{rated}/Hz) - $K_{Power-Freq\_Min}$	10
Slope of the active power response to changes in frequency - K_{Power_Freq}	700 Watts/sec

SkyBox

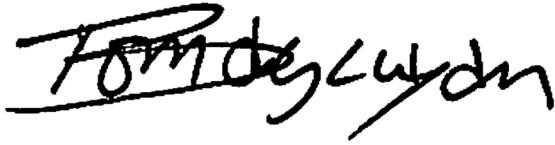| SA15 Volt-Watt (VW)	Value
Output Power Rating (W) – P_{rated}	5000
AC voltage range with function enabled (V) – [V_{min}, V_{max}]	211.2, 264
Nominal AC voltage (V) – V_{nom}	120 / 240
AC voltage accuracy (V or %V) – MSA_V	2.4 (1% rated)
Output Power accuracy (W or %W) – MSA_{watts}	150 (3%)
Accuracy of time – MSA_t	2 cycles
Settling Time (s) – t_s	5
Adjustment range of the start of active power reduction (V) – [V_{start_min},V_{start_max}]	103% to 109%
Adjustment range of the stop of the curtailment function (V) – [V_{stop_min},V_{stop_max}]	104% to 110%
Maximum slope of active power reduction (%P_{rated}/V) – $K_{Power-Volt\_Max}$	100%
Minimum slope of active power reduction (%P_{rated}/V) - $K_{Power-Volt\_Min}$	14.3%
Range of adjustment of a delay before return to normal operation (s) – [t_{return_min},t_{return_max}]	NA
Adjustment range of the rate of return to normal operation (%P_{rated}/Sec) – [$K_{Power\_Rate\_Min}$, $K_{Power\_Rate\_Max}$]	NA
Use of hysteresis in the Volt-Watt function	No
Slope of the active power response to changes in voltage - K_{Power_Volt}	NA
Active power rate of return to normal operation - K_{Power_Rate}	NA

Voltage Default Settings		SA	SA LS&T	HECO 1	HECO 2
Overvoltage – HV2	Value	120	120	120	120
	Trip Time	0.16	0.16	0.16	0.16
	Ride-through Time	N/A	N/A	N/A	N/A
	Ride-through Mode	N/A	N/A	N/A	N/A
Overvoltage – HV1	Value	110	110	110	110
	Trip Time	13	1	1	1
	Ride-through Time	12	N/A	0.92	0.92
	Ride-through Mode	Momentary	N/A	Mandatory	Mandatory
Undervoltage – LV1	Value	88	88	88	88
	Trip Time	21	2	21	21
	Ride-through Time	20	N/A	20	20
	Ride-through Mode	Mandatory	N/A	Mandatory	Mandatory
Undervoltage – LV2	Value	70	70	70	70
	Trip Time	11	0.16	11	11
	Ride-through Time	10	N/A	10	10
	Ride-through Mode	Mandatory	N/A	Mandatory	Mandatory
Undervoltage – LV3	Value	50	N/A	50	50
	Trip Time	1.5	N/A	2	2
	Ride-through Time	1	N/A	N/A	N/A
	Ride-through Mode	Momentary	N/A	N/A	N/A
Values are in percent of nominal voltage Times are in seconds SA LS&T = SA Load Shed and Transfer per CPUC's decision D14-12-035 HECO 1 = O'ahu, Maui and Hawai'i settings HECO 2 = Lana'i and Moloka'i settings					

Frequency Default Settings		SA	SA LS&T	HECO 1	HECO 2
Overfrequency – HF2	Value	62.0	N/A	64.0	65.0
	Trip Time	0.16	N/A	0.16	0.16
	Ride-through Time	N/A	N/A	N/A	N/A
	Ride-through Mode	N/A	N/A	N/A	N/A
Overfrequency – HF1	Value	60.5	60.5	63.0	63.0
	Trip Time	300	0.16	21	21
	Ride-through Time	299	N/A	20	20
	Ride-through Mode	Mandatory	N/A	Mandatory	Mandatory
Underfrequency – LF1	Value	58.5	58.5	57.0	57.0
	Trip Time	300	0.16	21	21
	Ride-through Time	299	N/A	20	20
	Ride-through Mode	Mandatory	N/A	Mandatory	Mandatory
Underfrequency – LF2	Value	57.0	N/A	56	50
	Trip Time	0.16	N/A	0.16	0.16
	Ride-through Time	N/A	N/A	N/A	N/A
	Ride-through Mode	N/A	N/A	N/A	N/A
	Values are actual frequency Times are in seconds SA LS&T = SA Load Shed and Transfer per CPUC's decision D14-12-035 HECO 1 = O'ahu, Maui and Hawai'i settings HECO 2 = Lana'i and Moloka'i settings				

I hereby certify that the equipment named above has been designed to comply with the relevant sections of the above referenced specifications. The unit complies with all applicable requirements.

[signature]

Bo Magluyan
Product Manager
OutBack Power
Date: November 17, 2020

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Date and Revision

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OutBack
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