



Test Report

MASTER CONTRACT: 235284
REPORT: 70116642
PROJECT: 70116642

Edition 1: March 22, 2017; Project 70116642– Shanghai
Issued by Kyle Song;

Signature: *Kyle Song.*

Contents: Test Report - Pages 1 to 6

PRODUCTS

Transformerless Grid Support Utility Interactive Inverter, Models SUN2000-33KTL-US, SUN2000-36KTL-US and SUN2000-40KTL-US, permanently connected, system ratings as follows:

Model	SUN2000-33KTL-US	SUN2000-36KTL-US	SUN2000-40KTL-US
INPUT RATINGS:			
Maximum input voltage	1000 Vdc	1000 Vdc	1000 Vdc
Range of input operating voltage	200-1000 Vdc	200-1000 Vdc	200-1000 Vdc
Range of MPPT input operating voltage	460-850 Vdc	490-850 Vdc	530-850 Vdc
Number of MPPT	4	4	4
Maximum input string	8 (2 per MPPT)	8 (2 per MPPT)	8 (2 per MPPT)
Maximum input current (dc)	88 A (22 A per MPPT)	88 A (22 A per MPPT)	88 A (22 A per MPPT)
Maximum input short circuit current(dc)	120 A (30 A per MPPT)	120 A (30 A per MPPT)	120 A (30 A per MPPT)
Maximum input source backfeed current to input source	0 A	0 A	0 A
OUTPUT RATINGS:			
Output power factor rating	> 0.99 (adj. ±0.8)	> 0.99 (adj. ±0.8)	> 0.99 (adj. ±0.8)
Operating voltage range (ac) (L-L)	422 – 528 Vac	422 – 528 Vac	422 – 528 Vac
Number of Phases	3Ø	3Ø	3Ø

This report shall not be reproduced, except in full, without the approval of CSA Group.

1st Floor, Building 4, Qilai Industrial City, 889 Yishan Road, Shanghai, 200233 China
Telephone: (86)21.33688282 Fax: (86)21.33681122 www.csagroup.org

Model	SUN2000-33KTL-US	SUN2000-36KTL-US	SUN2000-40KTL-US
Operating frequency range or single frequency	59.3-60.5Hz	59.3-60.5Hz	59.3-60.5Hz
Nominal output voltage (ac)	480 Vac	480 Vac	480 Vac
Normal output frequency	60 Hz	60 Hz	60 Hz
Maximum continuous output current (ac)	40.1 A	43.4 A	48.2 A
Maximum continuous output power	33300 W	36000 W	40000 W
Maximum output fault current (ac) and duration	-190.4Apk, 79.672ms 58.23Arms@1 cycle 51.11Arms@3 cycles	-190.4Apk, 79.672ms 58.23Arms@1 cycle 51.11Arms@3 cycles	-190.4Apk, 79.672ms 58.23Arms@1 cycle 51.11Arms@3 cycles
Maximum output overcurrent protection (ac)	160 A	160 A	160 A
Utility interconnection voltage and frequency trip limits and trip times	See note 1	See note 1	See note 1
Trip limit and trip time accuracy	Voltage:	±1% V (L-L)	±1% V (L-L)
	Frequency:	±0.01 Hz	±0.01 Hz
	Time:	1%, but not less than 120ms	1%, but not less than 120ms
Normal operation temperature range	-25°C to 60°C	-25°C to 60°C	-25°C to 60°C
Output power temperature derating and maximum full power operating ambient	See note 2	See note 2	See note 2
Enclosure Rating Type	Type 4X	Type 4X	Type 4X

Notes:

1. Utility Interconnection Voltage and Frequency Trip Limits and Trip Times:

- a) Voltage and frequency limits for utility interaction according to Table 1 and Table 2 per IEEE 1547-2003 (R2008)

Condition	Simulated utility source		Maximum time (sec) at 60 Hz before cessation of current to the simulated utility
	Voltage (V)	Frequency (Hz)	
A	< 50% V	Rated (60 Hz)	0.16
B	50% V ≤ V < 88% V (adjustable)	Rated (60 Hz)	0.16 to 2 (adjustable)
C	110% V < V < 120% V (adjustable)	Rated (60 Hz)	0.16 to 1 (adjustable)
D	120% V ≤ V	Rated (60 Hz)	0.16
E	Rated	f > 60.5	0.16
F	Rated	57 < f < 59.8	0.16 to 300 (adjustable)
G	Rated	f < 57	0.16

- b) Voltage and frequency limits for utility interaction according to Table 1 and Table 2 per IEEE 1547a-2014

Condition		Simulated utility source		Clearing time (s)	Clearing time: adjustable up to and including (s)
		Voltage (V)	Frequency (Hz)		
A	LV3	< 45% V	Rated (60 Hz)	0.16	0.16
B	LV2	45% V ≤ V < 60% V	Rated (60 Hz)	1	11
C	LV1	60% V ≤ V < 88% V	Rated (60 Hz)	2	21
D	HV1	110% V < V < 120% V	Rated (60 Hz)	1	13
E	HV2	120% V ≤ V	Rated (60 Hz)	0.16	0.16
F	UF1	Rated	f < 57.0 (56 – 60 adjustable)	0.16	10
G	UF2	Rated	f < 59.5 (56 – 60 adjustable)	2	300
H	OF1	Rated	f > 60.5 (60 – 64 adjustable)	2	300
I	OF2	Rated	f > 62 (60 – 64 adjustable)	0.16	10

2. Operating power envelope as a function of ambient temperature:

Model	MPPT Input	-25°C	50°C	55°C	60°C
SUN2000-33KTL-US	460Vdc	33kW	33kW	33kW	28kW
	850Vdc	33kW	33kW	33kW	32kW
SUN2000-36KTL-US	490Vdc	36kW	36kW	36kW	29kW
	850Vdc	36kW	36kW	36kW	32kW
SUN2000-40KTL-US	530Vdc	40kW	40kW	40kW	32kW
	850Vdc	40kW	40kW	40kW	32kW

3. All models meet the surge requirements of IEEE C62.41.2-2002, Location Category B (6kV). Tests were performed using ring wave and combination waveforms, both polarities, for common mode and differential mode coupling, 20 pulses each test. After surge testing the units were operational with control functionally verified by frequency and voltage disconnect tests.

4. This product's software for isolation monitor interrupter and ARC fault detection have been evaluated to the requirements of UL Standard No. 1998 under Class 1 per CSA report 70097865. This evaluation has been carried out on a specified version of the electronic controller hardware and software described as below:

Model	PCB board type	Microprocessor	Software Version and date	Software project or edition number
SUN2000-33KTL-US, SUN2000-36KTL-US, SUN2000-40KTL-US	Control Board	TMS320F28066PZT	SUN2000 V200 R002C20	Ed.2
		TMS320F28335ZJZS	SUN2000 V200 R002C20	Ed.2
	AFCI Board	TMS320F28032PAGT	SUN2000 V200 R002C20	Ed.2

5. Models SUN2000-33KTL-US, SUN2000-36KTL-US and SUN2000-40KTL-US are provided with PV DC ARC-Fault Circuit Protection for series arcing faults.
6. Models SUN2000-33KTL-US, SUN2000-36KTL-US and SUN2000-40KTL-US have been evaluated to meet the California Rule 21 grid support function according to UL 1741 Supplement SA.

APPLICABLE REQUIREMENTS

CSA C22.2 No. 107.1-01 - General Use Power Supplies

*UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources (Second Edition, Revision September 7, 2016)

CSA TIL M-07 - Interim Certification Requirements for Photovoltaic (PV) DC Arc-Fault Protection (Issue Number 1, March 11, 2013)

UL 1699B - Outline of Investigation for Photovoltaic (PV) DC Arc-Fault Circuit Protection (Issue Number 2, January 14, 2013)

*Note: Conformity to UL 1741 (Second Edition, Revision September 7, 2016) includes compliance with applicable requirements of IEEE 1547-2003 (R2008), IEEE 1547a-2014, IEEE 1547.1-2005(R2011), IEEE 1547.1a-2015, California Electric Rule 21 and Supplement SA.

TEST HISTORY

Project 70116642

Transformerless Grid Support Utility Interactive Inverters SUN2000-33KTL-US, SUN2000-36KTL-US and SUN2000-40KTL-US were tested at Huawei Technologies Co., Ltd. The tests were witnessed by a CSA representative from the Shanghai office. The following tests were performed under the requirements of UL 1741-2nd Edition Revision September 7, 2016, with acceptable results:

General Overview of Standard Evaluations Requirements and Test Results		
Standards	Applicable Requirement/Topic	Comment
UL1741 SA 8	Anti-islanding Protection	Performed on SUN2000-40KTL-US with acceptable results.
UL1741 SA 9	Low and High Voltage Ride-Through	Performed on SUN2000-33KTL-US and SUN2000-40KTL-US with acceptable results.
UL1741 SA 10	Low and High Frequency Ride-Through	Performed on SUN2000-33KTL-US and SUN2000-40KTL-US with acceptable results.
UL1741 SA 11	Normal Ramp Rate	Performed on SUN2000-40KTL-US with acceptable results.
UL1741 SA 11	Soft-Start Ramp Rate	Performed on SUN2000-33KTL-US and SUN2000-40KTL-US with acceptable results.
UL1741 SA 12	Specified Power Factor	Performed on SUN2000-33KTL-US and SUN2000-40KTL-US with acceptable results.
UL1741 SA 13	Volt/Var Mode	Performed on SUN2000-33KTL-US and SUN2000-40KTL-US with acceptable results.
UL1741 SA 14	Frequency-Watt (FW) – Optional	Performed on SUN2000-33KTL-US and SUN2000-40KTL-US with acceptable results.
UL1741 SA 15	Volt-Watt (VW) – Optional	Performed on SUN2000-40KTL-US with acceptable results.

Equipment List:

#	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Due Date
A	AC SOURCE	Ametek	RS90	1515A00638	2017/5/6
B	PV Source	Chroma	62150H-1000S	62150EF00927	2017/5/6
C	PV Source	Chroma	62150H-1000S	62150EF00973	2017/5/6
D	PV Source	Chroma	62150H-1000S	62150EF01013	2017/5/6
E	PV Source	Chroma	62150H-1000S	62150EF01014	2017/5/6

#	Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Due Date
F	Power Meter	YOKOGAWA	WT1800	91LC25126	2017/10/29
G	Oscilloscope	Tektronix	DP07054	C010424	2018/1/30
H	Voltage Probe	Tektronix	P5205A	SN:C011108	2018/1/30
I	Voltage Probe	Tektronix	P5205A	SN:C011118	2018/1/30
J	Voltage Probe	Tektronix	P5205A	SN:C011125	2018/1/30
K	Current Transducer	HIOKI	CT6865	120118228	2017/5/13
L	Current Transducer	HIOKI	CT6865	120118226	2017/5/13
M	Current Transducer	HIOKI	CT6865	120118225	2018/1/30
N	Smart Logger	HUAWEI	SmartLogger	2102310QHU10 D3000005	N/A

---End of Report---