



<b>TEST REPORT</b>	
<b>Standard CEI 0-21:2019</b>	
<b>TUV SUD Test Report for Reference technical rules for the connection of active and passive users to the LV electrical Utilities</b>	
Report No.:	70.409.20.012.08-00
Date of issue:	2020-07-14
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Client:	Ningbo Sunways Technologies Co., Ltd.
Client number:	104339
Address:	No. 1, Second Road, Green Industrial Zone, Chongshou Town, 315334 Cixi, Ningbo, Zhejiang, PEOPLE'S REPUBLIC OF CHINA
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Standard:	This TUV SUD test report form is based on the following requirements: CEI 0-21:2019
TRF number and revision:	CEI 0-21 Rev.00
TRF originated by:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch, Mr. Yang Pengdong
Copyright blank test report:	This test report is based on the content of the standard (see above). The test report considered selected clauses of the a.m. standard(s) and experience gained with product testing. It was prepared by TUV SUD Product Service.  TUV SUD Group takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context.
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Scheme:	<input type="checkbox"/> TUV Mark <input type="checkbox"/> without certification <input checked="" type="checkbox"/> Type D certificate, it's a released document for grid compliance <input type="checkbox"/> GS Mark <input type="checkbox"/> NRTL Mark <input type="checkbox"/> EU-Directive
Non-standard test method:	<input type="checkbox"/> No <input type="checkbox"/> Yes, see details under Summary of testing
National deviations:	N/A
Compiled by:	Jianyong Li Min Zeng (Printed Name and Signature)
Approved by:	Kai Zhao (Printed Name and Signature)



Test sample:	Engineering sample
Type of test object:	GRID-CONNECTED PV INVERTER
Trademark:	<b><i>sunways</i></b>
Model and/or type reference:	STS-3KTL, STS-3.6KTL, STS-4.2KTL, STS-4.6KTL, STS-5KTL, STS-6KTL
Rating(s):	See rating labels on page 7 to 8
Manufacturer:	Ningbo Sunways Technologies Co., Ltd.
Manufacturer number:	104339
Address:	No. 1, Second Road, Green Industrial Zone, Chongshou Town, 315334 Cixi, Ningbo, Zhejiang, PEOPLE'S REPUBLIC OF CHINA
Sub-contractors/ tests (clause):	N/A
Name:	N/A
Order description:	<input checked="" type="checkbox"/> Complete test according to TRF
	<input type="checkbox"/> Partial test according to manufacturer's specifications
	<input type="checkbox"/> Preliminary test
	<input type="checkbox"/> Spot check
	<input type="checkbox"/> Others:
Date of order:	2020-07-02
Date of receipt of test item:	2020-07-02
Date(s) of performance of test:	2020-07-02 to 2020-07-14
Test item particulars:	All the tests results confirmed to the requirements of the standard.
<b>Purpose of the product:</b>	<p>The devices are transformer-less Inverters which converts direct current optimized by photovoltaic DC conditioner to alternating current, and they are intended to be connected in parallel with the mains to supply common load.</p> <p>They are intended for professional incorporation into PV system, and they are assessed on a component test basis.</p>
<b>Model difference:</b>	<p>STS-6KTL: basic model.</p> <p>STS-3KTL, STS-3.6KTL, STS-4.2KTL, STS-4.6KTL, STS-5KTL, STS-6KTL are the same family design products, other models are technical similar as basic model, except for rated output power, max output power and current, please see table below in <b>Characteristic data</b>.</p>
<b>Characteristic data</b> (not shown on the marking plate):	
<b>Ratings for inverter:</b>	
<b>Input</b>	



Model Parameter	STS-3KTL	STS-3.6KTL	STS-4.2KTL	STS-4.6KTL	STS-5KTL	STS-6KTL
Max. Input Voltage	600 Vd.c.					
MPPT Voltage Range	100-550 Vd.c.					
Max. Input Current	12.5/12.5 Ad.c.					
Isc PV	15/15 Ad.c.					

**Output**

Model Parameter	STS-3KTL	STS-3.6KTL	STS-4.2KTL	STS-4.6KTL	STS-5KTL	STS-6KTL
Output Rated Power	3000 W	3600 W	4200 W	4600 W	5000 W	6000 W
Output Max. Apparent Power	3300 VA	3960 VA	4600 VA	4600 VA	5500 VA	6600 VA
Output Rated Voltage	230 Va.c.					
Output Rated Frequency	50					
Output Rated Current	13 Aa.c.	15.7 Aa.c.	18.3 Aa.c.	20 Aa.c.	21.7 Aa.c.	26.1 Aa.c.
Output Max. Current	15 Aa.c.	18 Aa.c.	21 Aa.c.	21 Aa.c.	25 Aa.c.	28.7 Aa.c.
Power factor(adj.)	0.8 leading ... 0.8 lagging					

**Appendix Tables:**
**Annex A: Features and tests for the Interface Protection system (SPI)**

A.4.3.1, A.4.3.2 and A.4.7	Test procedure for maximum/minimum frequency (STS-6KTL)							P
<b>Cold: -25°C ± 2°C (16 h) according to EN 60068-2-1; performance A (powered)</b>								
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (low, "0") ; operation in wide frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	93.0	91.0	96.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	5			$0 \leq \Delta t \leq 21$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	83.0	87.0	87.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	4			$0 \leq \Delta t \leq 21$
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	93.0	93.0	93.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	0			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	95.0	90.0	92.0	$77 \leq t \leq 123$
Max. Error among the repetition	0			$\leq 0.02$ Hz	5			$0 \leq \Delta t \leq 21$



of tests								
Definitive operation mode: In presence of communication network; external signal (low, value "0") ; local command (high, "1") ; operation in wide frequencies windows; trip time is 1 s for 81>S2 and 4 s for 81<S2								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.50	47.50	47.50	$47.48 \leq f \leq 47.52$	4023.3	4049.0	4046.0	$3860 \leq t \leq 4140$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	25.7			$0 \leq \Delta t \leq 60$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	996.4	996.6	1020.0	$950 \leq t \leq 1050$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	23.6			$0 \leq \Delta t \leq 30$
Definitive operation mode: in case of telecommunication network temporary unavailable or in case of external command sent by DSO; external signal (high, value "1") ; local command (lhigh, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	94.0	105.0	91.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	14			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	95.0	109.0	109.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	14			$0 \leq \Delta t \leq 21$
Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required: <ul style="list-style-type: none"> <li>• <math>\leq 2</math> % for the voltages</li> <li>• <math>\pm 20</math> mHz for the frequency thresholds</li> </ul>								



- $\leq 1 \% \pm 20 \text{ ms}$  for the trip times

<b>A.4.3.1, A.4.3.2</b>	<b>Test procedure for maximum/minimum frequency (STS-6KTL)</b>							<b>P</b>
<b>Dry hot: +55°C ± 2°C (16 h) according to EN 60068-2-2; performance A (powered)</b>								
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (low, "0") ; operation in wide frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	85.0	94.00	86.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02 \text{ Hz}$	9			$0 \leq \Delta t \leq 21$
(2): 81>S2	51.50	51.50	51.5	$51.48 \leq f \leq 51.52$	93.0	96.0	95.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02 \text{ Hz}$	3			$0 \leq \Delta t \leq 21$
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	94.0	95.0	95.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02 \text{ Hz}$	1			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	90.0	95.0	89.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02 \text{ Hz}$	6			$0 \leq \Delta t \leq 21$
Definitive operation mode: In presence of communication network; external signal (low, value "0") ; local command (low, "1") ;								

operation in wide frequencies windows; trip time is 1 s for 81>S2 and 4 s for 81<S2								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	3974.0	3994.0	3934.0	$3860 \leq t \leq 4140$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	60			$0 \leq \Delta t \leq 60$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	990.1	1000.0	980.1	$950 \leq t \leq 1050$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	19.9			$0 \leq \Delta t \leq 30$
Definitive operation mode: in case of telecommunication network temporary unavailable or in case of external command sent by DSO; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	100.0	94.0	106.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	12			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	94.0	95.0	86.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	9			$0 \leq \Delta t \leq 21$
Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required: <ul style="list-style-type: none"> <li>• <math>\leq 2</math> % for the voltages</li> <li>• <math>\pm 20</math> mHz for the frequency thresholds</li> <li>• <math>\leq 1</math> % <math>\pm 20</math> ms for the trip times</li> </ul>								

<b>A.4.3.1, A.4.3.2</b>	<b>Test procedure for maximum/minimum frequency (STS-6KTL)</b>	<b>P</b>
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Damp heat: 40°C ± 2°C, 93% ± 3% RH (4 days) according to EN 60068-2-78; performance A (powered)								
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (low, "0") ; operation in wide frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	91.0	95.0	92.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	4			$0 \leq \Delta t \leq 21$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	94.0	93.0	94.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	1			$0 \leq \Delta t \leq 21$
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	97.0	94.0	91.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	6			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	90.0	91.0	95.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	5			$0 \leq \Delta t \leq 21$
Definitive operation mode: In presence of communication network; external signal (low, value "0") ; local command (high, "1") ; operation in wide frequencies windows; trip time is 1 s for 81>S2 and 4 s for 81<S2								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required



								[ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	3984.0	3964.0	3974.0	$3860 \leq t \leq 4140$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	20			$0 \leq \Delta t \leq 60$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	992.1	992.1	980.1	$950 \leq t \leq 1050$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	12			$0 \leq \Delta t \leq 30$
Definitive operation mode: in case of telecommunication network temporary unavailable or in case of external command sent by DSO; external signal (high, value "1") ; local command (high "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	117.0	107.0	109.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	10			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	111.0	100.0	106.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	11			$0 \leq \Delta t \leq 21$
Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required: <ul style="list-style-type: none"> <li>• <math>\leq 2</math> % for the voltages</li> <li>• <math>\pm 20</math> mHz for the frequency thresholds</li> <li>• <math>\leq 1</math> % <math>\pm 20</math> ms for the trip times</li> </ul>								

<b>A.4.3.1, A.4.3.2</b>	<b>Test procedure for maximum/minimum frequency (STS-6KTL)</b>	P
<b>Temperature change: -10°C /55°C <math>\pm</math> 2°C (3h + 3h) according to EN 60068-2-14; performance A (powered)</b>		



Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (low, "0") ; operation in wide frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	92.0	90.0	93.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	3			$0 \leq \Delta t \leq 21$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	90.0	95.0	95.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	5			$0 \leq \Delta t \leq 21$
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	92.0	94.0	92.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	2			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	94.0	90.0	90.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	4			$0 \leq \Delta t \leq 21$
Definitive operation mode: In presence of communication network; external signal (low, value "0") ; local command (high, "1") ; operation in wide frequencies windows; trip time is 1 s for 81>S2 and 4 s for 81<S2								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq$	3974.0	3994.0	3974.0	$3860 \leq t \leq$



				47.52				4140
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	20			$0 \leq \Delta t \leq 60$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	982.1	990.1	992.1	$950 \leq t \leq 1050$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	10			$0 \leq \Delta t \leq 30$
<p>Definitive operation mode: in case of telecommunication network temporary unavailable or in case of external command sent by DSO;  external signal (high, value "1") ; local command (high, "1") ;  operation in narrow frequencies windows; trip time is 100 ms</p>								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	102.0	109.0	110.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	8			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	107.0	101.0	95.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	12			$0 \leq \Delta t \leq 21$
<p>Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required:</p> <ul style="list-style-type: none"> <li>• <math>\leq 2</math> % for the voltages</li> <li>• <math>\pm 20</math> mHz for the frequency thresholds</li> <li>• <math>\leq 1</math> % <math>\pm 20</math> ms for the trip times</li> </ul>								

<b>A.4.3.1, A.4.3.2</b>	<b>Test procedure for maximum/minimum frequency (STS-6KTL)</b>	<b>P</b>
<p><b>After all environmental tests of below (not powered):</b>  <b>Cold: -25°C ± 2°C (16 h) according to EN 60068-2-1; performance B</b>  <b>Dry hot: +70°C ± 2°C (16 h) according to EN 60068-2-2; performance B</b></p>		



Damp heat: 40°C ± 2°C. 93% ± 3% RH (4 days) according to EN 60068-2-78; performance B								
Temperature change: -25°C /70°C ± 2°C (3h + 3h) according to EN 60068-2-14; performance B								
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (low, "0") ; operation in wide frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	90	93	87	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	6			$0 \leq \Delta t \leq 21$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	91	94	92	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	3			$0 \leq \Delta t \leq 21$
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	96	95	95	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	1			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	96	95	93	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	3			$0 \leq \Delta t \leq 21$
Definitive operation mode: In presence of communication network; external signal (low, value "0") ; local command (low, "1") ; operation in wide frequencies windows; trip time is 1 s for 81>S2 and 4 s for 81<S2								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required

								[ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	4029	4019	4019	$3860 \leq t \leq 4140$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	10			$0 \leq \Delta t \leq 60$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	990	1006	994	$950 \leq t \leq 1050$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	16.3			$0 \leq \Delta t \leq 30$
Definitive operation mode: in case of telecommunication network temporary unavailable or in case of external command sent by DSO; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	105	119	117	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	14			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	95	104	108	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	13			$0 \leq \Delta t \leq 21$
Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required: <ul style="list-style-type: none"> <li>• <math>\leq 2</math> % for the voltages</li> <li>• <math>\pm 20</math> mHz for the frequency thresholds</li> <li>• <math>\leq 1</math> % <math>\pm 20</math> ms for the trip times</li> </ul> Performance criterion B: The equipment must continue to function as expected after the test, the test performance after all climatic compatibility tests								

<b>A.4.3.1, A.4.3.2 and</b>	<b>Test procedure for maximum/minimum frequency (STS-6KTL)</b>	P
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A.4.7								
Tested at: <b>Ambient temperature:</b> 20 °C ± 2 °C; <b>Atmospheric Pressure:</b> 96 kPa ± 10 kPa <b>Relative humidity:</b> between 35% and 75%								
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (low, "0") ; operation in wide frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	91.0	95.0	92.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	4			$0 \leq \Delta t \leq 21$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	94.0	93.0	94.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	1			$0 \leq \Delta t \leq 21$
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	97.0	94.0	91.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	6			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	90.0	91.0	95.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	5			$0 \leq \Delta t \leq 21$
Definitive operation mode: In presence of communication network;								

external signal (low, value "0") ; local command (high, "1") ; operation in wide frequencies windows; trip time is 1 s for 81>S2 and 4 s for 81<S2								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S2	47.48	47.48	47.48	$47.48 \leq f \leq 47.52$	3944.0	3954.0	3964.0	$3860 \leq t \leq 4140$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	20			$0 \leq \Delta t \leq 60$
(2): 81>S2	51.50	51.50	51.50	$51.48 \leq f \leq 51.52$	976.1	970.1	984.1	$950 \leq t \leq 1050$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	14			$0 \leq \Delta t \leq 30$
Definitive operation mode: in case of telecommunication network temporary unavailable or in case of external command sent by DSO; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms								
Frequency	Tripping threshold				Tripping time			
	Detected [Hz]			Required [Hz]	Detected [ms]			Required [ms]
(1): 81<S1	49.79	49.79	49.79	$49.78 \leq f \leq 49.82$	95.0	89.0	88.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	7			$0 \leq \Delta t \leq 21$
(2): 81>S1	50.21	50.21	50.21	$50.18 \leq f \leq 50.22$	96.0	105.0	95.0	$77 \leq t \leq 123$
Max. Error among the repetition of tests	0			$\leq 0.02$ Hz	10			$0 \leq \Delta t \leq 21$
Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required: <ul style="list-style-type: none"> <li>• <math>\leq 2</math> % for the voltages</li> <li>• <math>\pm 20</math> mHz for the frequency thresholds</li> <li>• <math>\leq 1</math> % <math>\pm 20</math> ms for the trip times</li> </ul> Maximum/minimum frequency test did after ambient temperature test of equipment not fed and equipment								



fed.

<b>A.4.3.1, A.4.3.2 and A.4.7</b>	<b>Test procedure for maximum/minimum voltage (STS-6KTL)</b>	P
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**Cold: -10°C ± 2°C (16 h) according to EN 60068-2-1; performance A (powered)**

Voltage	Tripping threshold				Tripping time			
	Detected [V]			Required [V]	Detected [ms]			Required [ms]
Min (27.S1)	195.4	195.2	195.5	$193.2 \leq U \leq 197.8$	1492.0	1488.0	1492.0	$1435 \leq t \leq 1565$
Max. Error among the repetition of tests	0.3			$\leq 4.6$	4			$0 \leq \Delta t \leq 35$
Min (27.S2)	33.3	33.6	33.5	$32.2 \leq U \leq 36.8$	189.0	185.0	189.0	$174 \leq t \leq 226$
Max. Error among the repetition of tests	0.3			$\leq 4.6$	4			$0 \leq \Delta t \leq 22$
Max (59.S2)	263.2	263.5	263.5	$262.2 \leq U \leq 266.8$	191.0	193.0	190.0	$174 \leq t \leq 226$
Max. Error among the repetition of tests	0.3			$\leq 4.6$	9			$0 \leq \Delta t \leq 22$
59.S1	Test condition 1: 600s@Un to 112%Un				494.1s	494.1s	496.1s	$t \leq 603s$
59.S1	Test condition 2: 600s@Un to 600s@108%Un				No trip	No trip	No trip	N/A
59.S1	Test condition 3: 600s@106%Un to 114%Un				300.1s	300.1s	298.1s	$225s \leq t \leq 375s$

Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required:

- $\leq 2 \%$  for the voltages
- $\pm 20$  mHz for the frequency thresholds
- $\leq 1 \% \pm 20$  ms for the trip times





<b>A.4.3.1, A.4.3.2 and A.4.7</b>	<b>Test procedure for maximum/minimum voltage (STS-6KTL)</b>							<b>P</b>
<b>Dry hot: +60°C ± 2°C (16 h) according to EN 60068-2-2; performance A (powered)</b>								
Voltage	Tripping threshold				Tripping time			
	Detected [V]			Required [V]	Detected [ms]			Required [ms]
Min (27.S1)	195.1	195.1	195.5	$193.2 \leq U \leq 197.8$	1492.0	1492.0	1492.0	$1435 \leq t \leq 1565$
Max. Error among the repetition of tests	0.4			$\leq 4.6$	0			$0 \leq \Delta t \leq 35$
Min (27.S2)	33.7	33.3	33.5	$32.2 \leq U \leq 36.8$	189	189	189	$174 \leq t \leq 226$
Max. Error among the repetition of tests	0.4			$\leq 4.6$	0			$0 \leq \Delta t \leq 22$
Max (59.S2)	263.5	263.1	263.5	$262.2 \leq U \leq 266.8$	191.0	188.0	190.0	$174 \leq t \leq 226$
Max. Error among the repetition of tests	0.4			$\leq 4.6$	3			$0 \leq \Delta t \leq 22$
59.S1	Test condition 1: 600s@Un to 112%Un				495s	491s	497s	$t \leq 603s$
59.S1	Test condition 2: 600s@Un to 600s@108%Un				No trip	No trip	No trip	N/A
59.S1	Test condition 3: 600s@106%Un to 114%Un				358.2s	304.6s	361.6s	$225s \leq t \leq 375s$
Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check. variation of the error during the repetition of tests required:								
<ul style="list-style-type: none"> <li>• <math>\leq 2\%</math> for the voltages</li> <li>• <math>\pm 20</math> mHz for the frequency thresholds</li> <li>• <math>\leq 1\% \pm 20</math> ms for the trip times</li> </ul>								

<b>A.4.3.1, A.4.3.2 and A.4.7</b>	<b>Test procedure for maximum/minimum voltage (STS-6KTL)</b>							<b>P</b>
<b>Damp heat: 40°C ± 2°C. 93% ± 3% RH (4 days) according to EN 60068-2-78; performance A (powered)</b>								
Voltage	Tripping threshold				Tripping time			
	Detected [V]			Required [V]	Detected [ms]			Required [ms]



Min (27.S1)	195.4	195.1	195.5	$193.2 \leq U \leq 197.8$	1478.0	1494.0	1486.0	$1435 \leq t \leq 1565$
Max. Error among the repetition of tests	0.4			$\leq 4.6$	16			$0 \leq \Delta t \leq 35$
Min (27.S2)	33.2	33.6	33.5	$32.2 \leq U \leq 36.8$	198.0	200.0	197.0	$174 \leq t \leq 226$
Max. Error among the repetition of tests	0.4			$\leq 4.6$	3			$0 \leq \Delta t \leq 22$
Max (59.S2)	263.2	263.5	263.5	$262.2 \leq U \leq 266.8$	192.6	187.6	190.6	$174 \leq t \leq 226$
Max. Error among the repetition of tests	0.3			$\leq 4.6$	5			$0 \leq \Delta t \leq 22$
59.S1	Test condition 1: 600s@Un to 112%Un				496s	496s	497s	$t \leq 603s$
59.S1	Test condition 2: 600s@Un to 600s@108%Un				No trip	No trip	No trip	N/A
59.S1	Test condition 3: 600s@106%Un to 114%Un				372.6s	299.6s	287.6s	$225s \leq t \leq 375s$

Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required:

- $\leq 2\%$  for the voltages
- $\pm 20$  mHz for the frequency thresholds
- $\leq 1\% \pm 20$  ms for the trip times

<b>A.4.3.1, A.4.3.2 and A.4.7</b>	<b>Test procedure for maximum/minimum voltage (STS-6KTL)</b>	P
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**Temperature change: -25°C /60°C  $\pm$  2°C (3h + 3h) according to EN 60068-2-14; performance A (powered)**

Voltage	Tripping threshold				Tripping time			
	Detected [V]			Required [V]	Detected [ms]			Required [ms]
Min (27.S1)	195.1	195.1	194.5	$193.2 \leq U \leq 197.8$	1486.0	1494.0	1494.0	$1435 \leq t \leq 1565$
Max. Error among the repetition of tests	0.6			$\leq 4.6$	8			$0 \leq \Delta t \leq 35$
Min (27.S2)	33.9	33.6	33.5	$32.2 \leq U \leq 36.8$	201.0	187.0	200.0	$174 \leq t \leq 226$



Max. Error among the repetition of tests	0.4			$\leq 4.6$	14			$0 \leq \Delta t \leq 22$
Max (59.S2)	263.0	263.5	263.5	$262.2 \leq U \leq 266.8$	186.6	199.6	182.6	$174 \leq t \leq 226$
Max. Error among the repetition of tests	0.5			$\leq 4.6$	17			$0 \leq \Delta t \leq 22$
59.S1	Test condition 1: 600s@Un to 112%Un				496.0s	502.0s	497.0s	$t \leq 603s$
59.S1	Test condition 2: 600s@Un to 600s@108%Un				No trip	No trip	No trip	N/A
59.S1	Test condition 3: 600s@106%Un to 114%Un				299.0s	365.0s	300.0s	$225s \leq t \leq 375s$
<p>Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required:</p> <ul style="list-style-type: none"> <li>• <math>\leq 2\%</math> for the voltages</li> <li>• <math>\pm 20</math> mHz for the frequency thresholds</li> <li>• <math>\leq 1\% \pm 20</math> ms for the trip times</li> </ul>								

<b>A.4.3.1, A.4.3.2 and A.4.7</b>	<b>Test procedure for maximum/minimum voltage (STS-6KTL)</b>							P
<p><b>After all environmental tests of below (not powered):</b>  <b>Cold: <math>-25^{\circ}\text{C} \pm 2^{\circ}\text{C}</math> (16 h) according to EN 60068-2-1; performance B</b>  <b>Dry hot: <math>+70^{\circ}\text{C} \pm 2^{\circ}\text{C}</math> (16 h) according to EN 60068-2-2; performance B</b>  <b>Damp heat: <math>40^{\circ}\text{C} \pm 2^{\circ}\text{C}</math>. 93% <math>\pm</math> 3% RH (4 days) according to EN 60068-2-78; performance B</b>  <b>Temperature change: <math>-25^{\circ}\text{C} / 70^{\circ}\text{C} \pm 2^{\circ}\text{C}</math> (3h + 3h) according to EN 60068-2-14; performance B</b></p>								
Voltage	Tripping threshold				Tripping time			
	Detected [V]			Required [V]	Detected [ms]			Required [ms]
Min (27.S1)	195.0	195.1	195.5	$193.2 \leq U \leq 197.8$	1490.0	1478.0	1486.0	$1435 \leq t \leq 1565$
Max. Error among the repetition of tests	0.5			$\leq 4.6$	12			$0 \leq \Delta t \leq 35$
Min (27.S2)	33.9	33.3	33.5	$32.2 \leq U \leq 36.8$	197.0	199.8	190.2	$174 \leq t \leq 226$
Max. Error among the repetition	0.6			$\leq 4.6$	9.6			$0 \leq \Delta t \leq 22$



of tests								
Max (59.S2)	263.1	263.5	263.5	$262.2 \leq U \leq 266.8$	208.2	223.2	224.2	$174 \leq t \leq 226$
Max. Error among the repetition of tests	0.4			$\leq 4.6$	16			$0 \leq \Delta t \leq 22$
59.S1	Test condition 1: 600s@Un to 112%Un				498.0s	495.0s	498.0s	$t \leq 603s$
59.S1	Test condition 2: 600s@Un to 600s@108%Un				No trip	No trip	No trip	N/A
59.S1	Test condition 3: 600s@106%Un to 114%Un				300.0s	290.0s	286.0s	$225s \leq t \leq 375s$

Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check variation of the error during the repetition of tests required:

- $\leq 2\%$  for the voltages
- $\pm 20$  mHz for the frequency thresholds
- $\leq 1\% \pm 20$  ms for the trip times

Performance criterion B: The equipment must continue to function as expected after the test, the test performance after all climatic compatibility tests

<b>A.4.3.1, A.4.3.2 and A.4.7</b>	<b>Test procedure for maximum/minimum voltage (STS-6KTL)</b>	P
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Tested at:

**Ambient temperature:**  $20\text{ °C} \pm 2\text{ °C}$ ;

**Atmospheric Pressure:**  $96\text{ kPa} \pm 10\text{ kPa}$

**Relative humidity:** between 35% and 75%

Voltage	Tripping threshold				Tripping time			
	Detected [V]			Required [V]	Detected [ms]			Required [ms]
Min (27.S1)	195.4	195.1	195.5	$193.2 \leq U \leq 197.8$	1505.0	1487.0	1485.0	$1435 \leq t \leq 1565$
Max. Error among the repetition of tests	0.4			$\leq 4.6\text{ V}$	20			$0 \leq \Delta t \leq 35$
Min (27.S2)*	33.2	33.6	33.5	$32.2 \leq U \leq 36.8$	189.4	194.4	198.4	$174 \leq t \leq 226$
Max. Error among	0.4			$\leq 4.6\text{ V}$	9			$0 \leq \Delta t \leq 22$



the repetition of tests								
Max (59.S2)	263.5	263.1	263.5	$262.2 \leq U \leq 266.8$	185.5	190.6	196.6	$174 \leq t \leq 226$
Max. Error among the repetition of tests	0.4			$\leq 4.6 V$	11.1			$0 \leq \Delta t \leq 22$
59.S1	Test condition 1: 600s@Un to 112%Un				262.9s	459.9s	459.9s	$t \leq 603s$
59.S1	Test condition 2: 600s@Un to 600s@108%Un				No trip	No trip	No trip	N/A
59.S1	Test condition 3: 600s@106%Un to 114%Un				261.0s	256.6s	257.0s	$225s \leq t \leq 375s$

Supplementary information: integrated SPI into inverter, falling ratio and falling time are not required to check  
 \*: Mandatory threshold only for static generators with installed total power exceeding 11.08 KW.

variation of the error during the repetition of tests required:

- $\leq 2 \%$  for the voltages
- $\pm 20$  mHz for the frequency thresholds
- $\leq 1 \% \pm 20$  ms for the trip times

Maximum/minimum voltage test did after ambient temperature test of equipment not fed and equipment fed.

<b>A.4.3.3.1 Insensitivity to harmonics of the frequency relay (STS-6KTL)</b>						<b>P</b>
Tested at:						
<b>Ambient temperature: 20 °C ± 2 °C;</b>						
<b>Atmospheric Pressure: 96 kPa ± 10 kPa</b>						
<b>Relative humidity: between 35% and 75%</b>						
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (low, "0") ; operation in wide frequencies windows; trip time is 100 ms						
Threshold id.	Type of value	Test nr.	Required value	Measured value	Required value	P/F
81<.S2	Disconnection [Hz]	1	47.50	47.49	47.5±0.02	P
		2		47.49	47.5±0.02	P
		3		47.49	47.5±0.02	P
At: 230Vrms		1	100	88.0	77≤t≤123	P
		2		89.0	77≤t≤123	P
		3		97.0	77≤t≤123	P

Threshold id.	Type of value	Test nr.	Required value	Measured value	Required value	P/F
81>.S2  At: 230Vrms	Disconnection [Hz]	1	51.5	51.51	51.5±0.02	P
		2		51.51	51.5±0.02	P
		3		51.51	51.5±0.02	P
		1	100	92.0	77≤t≤123	P
		2		85.0	77≤t≤123	P
		3		86.0	77≤t≤123	P
Standalone operation mode: In absence of communication network; external signal (high, value "1") ; local command (high, "1") ; operation in narrow frequencies windows; trip time is 100 ms						
Threshold id.	Type of value	Test nr.	Required value	Measured value	Required value	P/F
81<.S1  At: 230Vrms	Disconnection [Hz]	1	49.8	49.80	49.8±0.02	P
		2		49.80	49.8±0.02	P
		3		49.80	49.8±0.02	P
	Disconnection [ms]	1	100	87.0	77≤t≤123	P
		2		88.0	77≤t≤123	P
		3		86.0	77≤t≤123	P
Threshold id.	Type of value	Test nr.	Required value	Measured value	Required value	P/F
81>.S1  At: 230Vrms	Disconnection [Hz]	1	50.20	50.21	50.2±0.02	P
		2		50.21	50.2±0.02	P
		3		50.21	50.2±0.02	P
	Disconnection [ms]	1	100	89.0	77≤t≤123	P
		2		84.0	77≤t≤123	P
		3		87.0	77≤t≤123	P
Definitive operation mode: In presence of communication network; external signal (low, value "0") ; local command (low, "1") ; operation in wide frequencies windows; trip time is 1 s for 81>S2 and 4 s for 81<S2						
Threshold id.	Type of value	Test nr.	Required value	Measured value	Required value	P/F
81<.S2	Disconnection [Hz]	1	47.50	47.48	47.5±0.02	P
		2		47.48	47.5±0.02	P
		3		47.48	47.5±0.02	P

At: 230Vrms		1	4000	3998.0	3860 ≤ t ≤ 4140	P
		2		3995.0	3860 ≤ t ≤ 4140	P
		3		4000.0	3860 ≤ t ≤ 4140	P
Threshold id.	Type of value	Test nr.	Required value	Measured value	Required value	P/F
81>.S2	Disconnection [Hz]	1	51.5	51.52	51.5±0.02	P
		2		51.52	51.5±0.02	P
		3		51.52	51.5±0.02	P
At: 230Vrms	Disconnection [ms]	1	1000	985.0	950≤t≤1050	P
		2		990.0	950≤t≤1050	P
		3		995.0	950≤t≤1050	P

Definitive operation mode: in case of telecommunication network temporary unavailable or in case of external command sent by DSO;  
external signal (high, value "1") ; local command (low, "1") ;  
operation in narrow frequencies windows; trip time is 100 ms

Threshold id.	Type of value	Test nr.	Required value	Measured value	Required value	P/F
81<.S1	Disconnection [Hz]	1	49.8	49.80	49.8±0.02	P
		2		49.80	49.8±0.02	P
		3		49.80	49.8±0.02	P
At: 230Vrms	Disconnection [ms]	1	100	87.0	77≤t≤123	P
		2		88.0	77≤t≤123	P
		3		86.0	77≤t≤123	P
Threshold id.	Type of value	Test nr.	Required value	Measured value	Required value	P/F
81>.S1	Disconnection [Hz]	1	50.20	50.21	50.2±0.02	P
		2		50.21	50.2±0.02	P
		3		50.21	50.2±0.02	P
At: 230Vrms	Disconnection [ms]	1	100	89.0	77≤t≤123	P
		2		84.0	77≤t≤123	P
		3		87.0	77≤t≤123	P

**Additional information:**

variation of the error during the repetition of tests required:

- ≤ 2 % for the voltages
- ± 20 mHz for the frequency thresholds
- ≤ 1 % ± 20 ms for the trip times