



TEST REPORT

PPP 58051A:2012 Rev. 00

TÜV SÜD Test Report for RECOMMENDATIONS FOR THE CONNECTION OF GENERATING PLANT TO THE DISTRIBUTION SYSTEMS OF LICENSED DISTRIBUTION NETWORK OPERATORS

Report reference No .....	64.290.13.01829.01
Date of issue .....	31 July 2013
Project handler.....	Richard Li
Testing Laboratory Name .....	Jiangsu TÜV Product Service Ltd. Guangzhou Branch
Testing laboratory .....	Jiangsu TÜV Product Service Ltd. Guangzhou Branch
Address .....	5F, Communication Building, 163 Pingyun Rd, Huangpu Ave. West, Guangzhou 510656, P. R. China
Testing location .....	as above
Client .....	GUANGZHOU SANJING ELECTRIC CO., LTD
Client number .....	77831
Address.....	No.17, Xiangshan Road, 510663 Guangzhou Science City, Guangdong, PEOPLE'S REPUBLIC OF CHINA
Standard .....	This TÜV SÜD test report form is based on the following requirements: PPP 58051A:2012 Rev. 00  <b>ENA Engineering Recommendation, G59 Issue 2 Amendment 1:2011</b>
TRF originated by .....	Jiangsu TÜV SÜD Product Service Co. Ltd., Mr. Frank Zhu
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 TÜV SUD Product Service GmbH.  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.
Test procedure .....	<input type="checkbox"/> GS, <input type="checkbox"/> TÜV Mark, <input type="checkbox"/> EU-Directive, <input type="checkbox"/> without certification <input checked="" type="checkbox"/> Type verification of conformity
Non-standard test method .....	N/A
National deviations.....	N/A
Number of pages(report) .....	18 Pages
Number of pages (Attachments) .....	12 Pages(Photo documentation)
Compiled by: Richard Li (+ signature) <i>Richard Li</i>	Approved by: Billy Qiu (+ signature) <i>Billy Qiu</i>





Test sample.....	PV Grid-connected inverter	
Type of test object .....	Photovoltaic	
Trademark .....		
Model and/or type reference .....	Suntrio-TL6K, Suntrio-TL8K, Suntrio-TL10K, Suntrio-TL12K, Suntrio-TL15K, Suntrio-TL17K, Suntrio-TL20K	
Rating(s) .....	See page 7	
Manufacturer.....	GUANGZHOU SANJING ELECTRIC CO., LTD	
Manufacturer number.....	77831	
Address.....	No.17, Xiangshan Road, 510663 Guangzhou Science City, Guangdong, 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"/>	
Date of order.....	1 July 2013	
Date of receipt of test item .....	2 July 2013	
Date(s) of performance of test .....	2 July 2013 – 31 July 2013	
Test item particulars:		
Clause	Requirement	
A13.1	Power Quality. Harmonics Emissions	
A13.1	Power Quality. Voltage fluctuations	
A13.1	Power Quality. DC injection	
A13.1	Power Quality. Power factor	
A13.1	Protection. Voltage tests	
A13.1	Protection. Frequency tests	
A13.1	Protection. Loss of mains test	
A13.1	Protection. Re-connection times	
A13.1	Fault level contribution	
Attachments:		
This test report shall be also used in conjunction with 12 pages of photo document.		
General remarks:		
"(see remark #)" refers to a remark appended to the report.		
"(see appended table)" refers to a table appended to the report.		
Throughout this report a comma is used as the decimal separator.		
The test results presented in this report relate only to the object tested.		
This report shall not be reproduced except in full without the written approval of the testing laboratory.		



**Summary of testing:**

- / deviation(s) found
- / no deviation(s) found

**Copy of marking plate:**

**SAJ** Solar Inverter Guangzhou Sanjing Electric Co., Ltd.  
Tel: (+86)20-66608619 Fax: (+86)20-66608589  
Web: www.saj-solar.com E-mail: service@sajelec.com

### Suntrio-TL6K

PV input ratings	
Max. DC Voltage	1000 d.c.V
DC Nominal Voltage	640 d.c.V
Vdc MPPT(full load)	320-800 d.c.V
Isc PV <sup>a</sup> (maximum absolu)	12/12 d.c.A
Pdc Max.	6.3 kW
Max. Number of Parallel Strings(PV1/PV2)	2/2
AC output ratings	
Voltage (nominal)	3/N/PE 230/400 a.c.V
Current (nominal)	8.7 a.c.A
Current(Maximum continuous)	9.7 a.c.A
Frequency (nominal)	50 Hz
Power (nominal continuous)	6 kW
Power (maximum continuous)	6 kW
Power Factor	0.9i...1...0.9c
Operating Temperature Range	-20°C~+60°C
IP Protection	IP65
Protection Class	I

S/N

P/C

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### Suntrio-TL8K

PV input ratings	
Max. DC Voltage	1000 d.c.V
DC Nominal Voltage	640 d.c.V
Vdc MPPT(full load)	340-800 d.c.V
Isc PV <sup>a</sup> (maximum absolu)	12/12 d.c.A
Pdc Max.	8.2 kW
Max. Number of Parallel Strings(PV1/PV2)	2/2
AC output ratings	
Voltage (nominal)	3/N/PE 230/400 a.c.V
Current (nominal)	11.6 a.c.A
Current(Maximum continuous)	12.9 a.c.A
Frequency (nominal)	50 Hz
Power (nominal continuous)	8 kW
Power (maximum continuous)	8 kW
Power Factor	0.9i...1...0.9c
Operating Temperature Range	-20°C~+60°C
IP Protection	IP65
Protection Class	I

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**Suntrio-TL10K**

PV input ratings	
Max. DC Voltage	1000 d.c.V
DC Nominal Voltage	640 d.c.V
Vdc MPPT(full load)	430-800 d.c.V
Isc PV <sup>a</sup> (maximum absolu)	12/12 d.c.A
Pdc Max.	10.4 kW
Max. Number of Parallel Strings(PV1/PV2)	2/2
AC output ratings	
Voltage (nominal)	3/N/PE 230/400 a.c.V
Current (nominal)	14.5 a.c.A
Current(Maximum continuous)	16.2 a.c.A
Frequency (nominal)	50 Hz
Power (nominal continuous)	10 kW
Power (maximum continuous)	10 kW
Power Factor	0.9i...1...0.9c
Operating Temperature Range	-20°C~+60°C
IP Protection	IP65
Protection Class	I



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**Suntrio-TL12K**

PV input ratings	
Max. DC Voltage	1000 d.c.V
DC Nominal Voltage	640 d.c.V
Vdc MPPT(full load)	380-800 d.c.V
Isc PV <sup>a</sup> (maximum absolu)	18/18 d.c.A
Pdc Max.	12.5 kW
Max. Number of Parallel Strings(PV1/PV2)	2/2
AC output ratings	
Voltage (nominal)	3/N/PE 230/400 a.c.V
Current (nominal)	17.4 a.c.A
Current(Maximum continuous)	19.4 a.c.A
Frequency (nominal)	50 Hz
Power (nominal continuous)	12 kW
Power (maximum continuous)	12 kW
Power Factor	0.9i...1...0.9c
Operating Temperature Range	-20°C~+60°C
IP Protection	IP65
Protection Class	I



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### Suntrio-TL20K


	PV input ratings	
	Max. DC Voltage	1000 d.c.V
	DC Nominal Voltage	640 d.c.V
	Vdc MPPT(full load)	468-800 d.c.V
	Isc PV <sup>a</sup> (maximum absolu)	22/22 d.c.A
	Pdc Max.	20.6 kW
	Max. Number of Parallel Strings(PV1/PV2)	3/3
	AC output ratings	
	Voltage (nominal)	3/N/PE 230/400 a.c.V
	Current (nominal)	29 a.c.A
Current(Maximum continuous)	29 a.c.A	
Frequency (nominal)	50 Hz	
Power (nominal continuous)	20 kW	
Power (maximum continuous)	20 kW	
Power Factor	0.9l...1...0.9c	
Operating Temperature Range	-20°C~+60°C	
IP Protection	IP65	
Protection Class	I	

















S/N

P/C

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**Picture of the product:**  
 Refer to Photo documentation.

**Characteristic data:**

Model	Sun trio-TL6K	Sun trio-TL8K	Sun trio-TL10K
Vmax. PV	1000 Vd.c.	1000 Vd.c.	1000 Vd.c.
Isc PV	2x12 Ad.c.	2x12 Ad.c.	2x12 Ad.c.
Max. continuous a.c. output current	9,7 Aa.c.	12,9 Aa.c.	16,2 Aa.c.
Max. continuous output power	6 kW	8 kW	10 kW
Frequency	50 Hz	50 Hz	50 Hz
Nominal AC voltage	3/N/PE, 230/400 V	3/N/PE, 230/400 V	3/N/PE, 230/400 V
Power factor range(Cos phi, adjustable)	0,9 <sub>under-excited</sub> to 0,9 <sub>over-excited</sub>	0,9 <sub>under-excited</sub> to 0,9 <sub>over-excited</sub>	0,9 <sub>under-excited</sub> to 0,9 <sub>over-excited</sub>
Protective Class	I	I	I
Ingress protection	IP65	IP65	IP65

Model	Sun trio-TL12K	Sun trio-TL15K	Sun trio-TL17K	Sun trio-TL20K
Vmax. PV	1000 Vd.c.	1000 Vd.c.	1000 Vd.c.	1000 Vd.c.
Isc PV	2x18 Ad.c.	2x22 Ad.c.	2x22 Ad.c.	2x22 Ad.c.
Max. continuous a.c. output current	19,4 Aa.c.	24,0 Aa.c.	27,0 Aa.c.	29,0 Aa.c.
Max. continuous output power	12 kW	15 kW	17 kW	20 kW
Frequency	50 Hz	50 Hz	50 Hz	50 Hz
Nominal AC voltage	3/N/PE, 230/400 V	3/N/PE, 230/400 V	3/N/PE, 230/400 V	3/N/PE, 230/400 V
Power factor range(Cos phi, adjustable)	0,9 <sub>under-excited</sub> to 0,9 <sub>over-excited</sub>	0,9 <sub>under-excited</sub> to 0,9 <sub>over-excited</sub>	0,9 <sub>under-excited</sub> to 0,9 <sub>over-excited</sub>	0,9 <sub>under-excited</sub> to 0,9 <sub>over-excited</sub>
Protective Class	I	I	I	I
Ingress protection	IP65	IP65	IP65	IP65



<b>Test item particulars</b> .....	
Equipment mobility .....	<input type="checkbox"/> movable <input type="checkbox"/> hand-held <input type="checkbox"/> stationary <input checked="" type="checkbox"/> fixed <input type="checkbox"/> transportable <input type="checkbox"/> for building-in
Connection to the mains.....	<input type="checkbox"/> pluggable equipment <input type="checkbox"/> direct plug-in <input checked="" type="checkbox"/> permanent connection <input type="checkbox"/> for building-in
Environmental category.....	<input checked="" type="checkbox"/> outdoor <input type="checkbox"/> indoor unconditional <input type="checkbox"/> indoor conditional
Over voltage category Mains .....	<input type="checkbox"/> OVC I <input type="checkbox"/> OVC II <input checked="" type="checkbox"/> OVC III <input type="checkbox"/> OVC IV
Over voltage category PV.....	<input type="checkbox"/> OVC I <input checked="" type="checkbox"/> OVC II <input type="checkbox"/> OVC III <input type="checkbox"/> OVC IV
Mains supply tolerance (%).....	-90 / +110 %
Tested for power systems .....	TN and TT system
IT testing, phase-phase voltage (V).....	N/A
Class of equipment.....	<input checked="" type="checkbox"/> Class I <input type="checkbox"/> Class II <input type="checkbox"/> Class III <input type="checkbox"/> Not classified
Mass of equipment (kg).....	35 kg (for Suntrio-TL6K, Suntrio-TL8K, Suntrio-TL10K), 45 kg (for Suntrio-TL12K), 50 kg (Suntrio-TL15K, Suntrio-TL17K, Suntrio-TL20K)
Pollution degree .....	3 (External), 2 (Internal)
IP protection class .....	IP65
<b>General product information:</b>	
<p>(1) The units are non-isolated PV grid-interactive inverters, for outdoor use;</p> <p>(2) The inverter is intended to be mounted on the concrete wall with screws and expansion tube;</p> <p>(3) There are two independent MPP trackers. Each tracker have two independent strings for Suntrio-TL12K model and each tracker have three independent strings for Suntrio-TL15K, Suntrio-TL17K and Suntrio-TL20K models;</p> <p>(4) If the model Suntrio-TL6K or Suntrio-TL8K or Suntrio-TL10K is selected a generating unit, 2 or more of the units shall be parallel connected to one PCC to set up a small generating plant with each phase over than 16A.</p> <p>(5) For grid code of G59/2-1, the inverter is designed to be operated with a fixed Cos phi=1 settings inside.</p> <p>(6) Firmware version of the control: V1.04 (Master), V1.03 (Slave)</p>	
<b>Model differences:</b>	
<p>(1) The three models(Suntrio-TL6K, Suntrio-TL8K, Suntrio-TL10K) have same enclosure construction, same input and output connections, same PCB layout, same electronic control circuit and have similar software designed, with difference is the software settings of output power for different models.</p> <p>(2) The four models(Suntrio-TL12K, Suntrio-TL15K, Suntrio-TL17K, Suntrio-TL20K) have same enclosure construction, same output connections, same PCB layout, same electronic control circuit and have similar software designed, with difference is the software settings of output power for different models and have different amount strings of each MPPT trackers for Suntrio-TL12K, have different amount of external cooling fans for Suntrio-TL12K.</p> <p>(3) The Suntrio-TL6K, Suntrio-TL8K, Suntrio-TL10K series and Suntrio-TL12K, Suntrio-TL15K, Suntrio-TL17K, Suntrio-TL20K series have same enclosure dimensions, similar PCB layout, similar electronic control circuit and similar software designed, with mainly difference are the HS dimensions, parameters of power semiconductor and inductors.</p>	
Possible test case verdicts:	
- test case does not apply to the test object.....	N/A / not included in the order
- test object does meet the requirement .....	P / (pass)
- test object does not meet the requirement .....	F. / (fail)
Possible suffixes to the verdicts:	
- suffix for detailed information for the client.....	- C / (comment)
- suffix for important information for factory inspection...:	- M / (manufacturing)





ER G59/2-1			
Clause	Requirement – Test	Result – Remark	Verdict
6	Connection application		P
6.1	General		P
6.2	Application for connection	The listed models are type tested to G59/2-1 in this report.	P
6.3	System analysis for connection design	The models listed in this report are intended to connected to LV level.	P
7	Connection arrangements		P
7.1	Operating modes	Long-term parallel operation mode is considered	P
7.2	Long-term parallel operation		P
7.3	Infrequent short-term parallel operation		P
7.4	Switched alternative-only operation		N/A
7.4.1	General		N/A
7.4.2	Changeover operated at HV		N/A
7.4.3	Changeover operated at LV		N/A
8	Earthing	See below	P
8.1	General		P
8.2	HV generating plant		N/A
8.3	LV generating plant	The PV grid-interactive inverter is designed to connect a TN system LV grid with permanently connected earthing	P
9	Generating plant connection design and operation	See below	P
9.1	General criteria		P
9.2	Generating plant connection design	The plant grid connection shall consider the inverter AC output rating with detail in page 5	P
9.3	Generating plant performance and control requirements	The inverter has automatic control system inside. The automatic control system can disconnect the inverter from the grid in case of fault conditions: Over/under voltage Over/under frequency Islanding (loss of main)	P
9.4	Fault contributions and switchgear considerations	The fault contribution during grid fault is tested. See appended table	P
9.5	Voltage limits and control	The inverter passively follows the grid voltage and can be normally operated at nominal voltage +/- 10%.	P



ER G59/2-1			
Clause	Requirement – Test	Result – Remark	Verdict
9.6	Power quality	Single phase design for the inverter. The power quality of the inverter is listed as appended table, it comply with BS EN 61000-3-12	P
9.7	System stability		P
9.8	Island mode	Anti islanding operation	P
10	Protection		P
10.1	General	Two stage approach	P
10.2	Protection requirements	Automatic disconnect device is provided in the inverter to protect the inverter and the grid	P
10.3	Loss of Mains (LoM)		P
10.4	Neutral voltage displacement protection	Small scale inverter	P
10.5	Protection settings	See appended table	P
10.6	Typical protection application diagrams	LV generator for parallel operation only	P
11	Installation, operation and control interface	To be considered during installation	N/A
11.1	General		N/A
11.2	Isolation and safety labeling		N/A
11.3	Site responsibility schedule		N/A
11.4	Operational and safety aspects		N/A
11.5	Synchronizing and operational control		N/A
12	Testing and commissioning		P
12.1	ER G83/1-1 compliant generating unit		N/A
12.2	Non ER G83/1-1 compliant or >16A per phase but <50kW 3 Phase (or 17kW 1 phase) Generating unit	The inverter is type tested according to section 10.5.	P
12.3	Generating units larger than 50kW 3 phase (or 17kW 1 phase)		N/A
12.4	Changes in the installation		P
13	Appendices		P
13.1	Generating plant type verification test sheet	See appended table	P
13.2	Generating plant installation and commissioning test (1) Type approved generating plant (>16A per phase but < 50kW 3phase or 17kW 1 phase)		N/A
13.3	Generating plant installation and commissioning test (2) Non type approved generating plant and generating plant >50kW 3 phase or 17kW 1 phase		N/A
13.4	Generating plant decommissioning confirmation		N/A
13.5	Additional information relating to system stability studies		P
13.6	Loss of Mains (LoM) protection analysis		P



ER G59/2-1			
Clause	Requirement – Test	Result – Remark	Verdict
13.7	Type certification and type testing		P
13.8	Main statutory and other obligations		N/A



POWER QUALITY Harmonic current emissions										
Minimal Short Circuit Ratio $R_{scc}$ : 33										
Value of Short Circuit Power $S_{sc}$ corresponding to $R_{scc}$ :			Suntrio-TL6K		0,199 MVA					
			Suntrio-TL10K		0,331 MVA					
			Suntrio-TL12K		0,398 MVA					
			Suntrio-TL20K		0,663 MVA					
Equipment Phases: Three Phase										
Description			Harmonic Current % = $100I_n/I_1$					Harmonic Current Distortion Factors (%)		
Harmonic:			3 <sup>rd</sup>	5 <sup>th</sup>	7 <sup>th</sup>	9 <sup>th</sup>	11 <sup>th</sup>	13 <sup>th</sup>	THD	PWHD
Limit:			21.6	10.7	7.2	3.8	3.1	2.0	23	23
Actual Value:	Suntrio-TL6K	L1	0,251	0,974	0,691	0,023	0,303	0,352	1,305	3,330
		L2	0,191	1,259	0,695	0,393	0,316	0,333	1,572	3,042
		L3	0,067	0,825	0,361	1,269	0,134	0,195	1,576	2,442
	Suntrio-TL10K	L1	0,017	1,464	1,031	0,055	0,552	0,420	2,118	2,236
		L2	0,166	1,521	0,955	0,066	0,518	0,471	2,168	2,289
		L3	0,096	1,424	1,084	0,044	0,521	0,460	2,189	2,212
	Suntrio-TL12K	L1	0,016	1,326	0,787	0,035	0,467	0,355	1,860	2,608
		L2	0,190	1,243	0,889	0,045	0,463	0,394	1,956	2,568
		L3	0,093	1,249	0,875	0,015	0,445	0,387	1,873	2,781
	Suntrio-TL20K	L1	0,891	1,184	0,827	0,264	0,261	0,198	2,218	3,798
		L2	0,740	0,841	0,389	0,117	0,313	0,176	1,948	3,887
		L3	1,102	1,040	0,847	0,245	0,171	0,231	2,391	3,804
Notes:										
Detailed requirements are specified in BS EN 61000-3-12.										
Where BS EN 61000-3-12 requires assessment of separate loads (i.e. for equipment with more than one rating or for hybrid equipment) then the values for each separate load shall be provided.										

Voltage fluctuations and Flicker										
Equipment meets BSEN 61000-3-3: Yes										
			Starting			Stopping			Running	
			$d_{max}$	$d_c$	$d_{(t)}$	$d_{max}$	$d_c$	$d_{(t)}$	$P_{st}$	$P_{It}$ 2 hours
Limits set under BS EN 61000-3-3			4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65
Measured Values	Suntrio-TL10K	L1	0,82	0,67	0	1,05	0,67	0	0,242	0,180
		L2	0,78	0,64	0	1,03	0,64	0	0,322	0,232
		L3	0,78	0,64	0	1,05	0,72	0	0,250	0,182
	Suntrio-TL20K	L1	0,88	0,72	0	1,36	0,76	0	0,293	0,192
		L2	0,91	0,70	0	1,35	0,73	0	0,324	0,252
		L3	0,89	0,69	0	1,32	0,74	0	0,298	0,194



Suntrio-TL6K									
Power quality. DC injection.									
Test power level	10%			55%			100%		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Recorded Value (A)	0,0195	0,0113	0,0211	0,0090	0,0024	0,0023	0,0062	0,0011	0,0100
As % of Rated AC current	0,219%	0,127%	0,237%	0,101%	0,027%	0,026%	0,070%	0,012%	0,112%
Limit	0,25%			0,25%			0,25%		

Suntrio-TL10K									
Power quality. DC injection.									
Test power level	10%			55%			100%		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Recorded Value (A)	0,0098	0,0187	0,0047	0,0019	0,0011	0,0107	0,0098	0,0187	0,0047
As % of Rated AC current	0,068%	0,129%	0,032%	0,013%	0,008%	0,074%	0,068%	0,129%	0,032%
Limit	0,25%			0,25%			0,25%		

Suntrio-TL12K									
Power quality. DC injection.									
Test power level	10%			55%			100%		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Recorded Value (A)	0,0095	0,0014	0,0070	0,0045	0,0151	0,0078	0,0209	0,0005	0,0183
As % of Rated AC current	0,068%	0,008%	0,040%	0,026%	0,087%	0,045%	0,120%	0,003%	0,105%
Limit	0,25%			0,25%			0,25%		

Suntrio-TL20K									
Power quality. DC injection.									
Test power level	10%			55%			100%		
	L1	L2	L3	L1	L2	L3	L1	L2	L3
Recorded Value (A)	0,0035	0,0027	0,0082	0,0135	0,0014	0,0109	0,0102	0,0023	0,0018
As % of Rated AC current	0,012%	0,009%	0,028%	0,047%	0,005%	0,038%	0,035%	0,008%	0,006%
Limit	0,25%			0,25%			0,25%		



Suntrio-TL6K										
Power Quality. Power factor.										
	216,2 V			230 V			253 V			Measured at three voltage levels and at full output. Voltage to be maintained within + or – 1.5% of the stated level during the test.
	L1	L2	L3	L1	L2	L3	L1	L2	L3	
Measured value	0,988	0,988	0,989	0,989	0,988	0,986	0,985	0,988	0,986	
Limit	>0,95			>0,95			>0,95			

Suntrio-TL12K										
Power Quality. Power factor.										
	216,2 V			230 V			253 V			Measured at three voltage levels and at full output. Voltage to be maintained within + or – 1.5% of the stated level during the test.
	L1	L2	L3	L1	L2	L3	L1	L2	L3	
Measured value	0,996	0,996	0,996	0,998	0,997	0,998	0,996	0,996	0,997	
Limit	>0,95			>0,95			>0,95			



Suntrio-TL6K						
Protection. Frequency tests.						
Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47,5 Hz	20 s	47,48	20,09 s	47,7 Hz 25 s	No trip
U/F stage 2	47 Hz	0,5 s	46,98	563 ms	47,2 Hz 19,98 s	No trip
					46,8 Hz 0,48 s	No trip
O/F stage 1	51,5 Hz	90 s	51,50	90,03 s	51,3 Hz 95 s	No trip
O/F stage 2	52 Hz	0,5 s	52,00	532 ms	51,8 Hz 89,98 s	No trip
					52,2 Hz 0,48 s	No trip
<p>Note for frequency tests the Frequency required to trip is the setting <math>\pm 0.1</math>Hz the time delay can be measured at a larger deviation than the minimum required to operate the projection. The "No-trip tests" need to be carried out at the setting <math>\pm 0.2</math>Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p> <p>The test method are refer to ENA Engineering Recommendation G59, Issue 3 2013(draft version)</p>						

Suntrio-TL20K						
Protection. Frequency tests.						
Function	Setting		Trip test		"No trip tests"	
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47,5 Hz	20 s	47,52	20,09 s	47,7 Hz 25 s	No trip
U/F stage 2	47 Hz	0,5 s	47,02	557 ms	47,2 Hz 19,98 s	No trip
					46,8 Hz 0,48 s	No trip
O/F stage 1	51,5 Hz	90 s	51,50	90,02 s	51,3 Hz 95 s	No trip
O/F stage 2	52 Hz	0,5 s	52,00	523 ms	51,8 Hz 89,98 s	No trip
					52,2 Hz 0,48 s	No trip
<p>Note for frequency tests the Frequency required to trip is the setting <math>\pm 0.1</math>Hz the time delay can be measured at a larger deviation than the minimum required to operate the projection. The "No-trip tests" need to be carried out at the setting <math>\pm 0.2</math>Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p> <p>The test method are refer to ENA Engineering Recommendation G59, Issue 3 2013(draft version)</p>						



Suntrio-TL6K							
Protection. Voltage tests.							
Function		Setting		Trip test		"No trip tests" All phases at same voltage	
		Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V stage 1	L1 -- N	200,1 V	2,5 s	201,2	2,527 s	204,1 V 3,5 s	No trip
	L2 -- N	200,1 V	2,5 s	201,2	2,529 s		
	L3 -- N	200,1 V	2,5 s	201,2	2,539 s		
U/V stage 2	L1 -- N	184 V	0,5 s	185,0	518 ms	188 V 2,48 s	No trip
	L2 -- N	184 V	0,5 s	185,0	521 ms		
	L3 -- N	184 V	0,5 s	184,8	532 ms		
						180 V 0,48 s	No trip
O/V stage 1	L1 -- N	262,2 V	1,0 s	264,1	1,042 s	258,2 V 2,0 s	No trip
	L2 -- N	262,2 V	1,0 s	264,0	1,050 s		
	L3 -- N	262,2 V	1,0 s	263,9	1,040 s		
O/V stage 2	L1 -- N	273,7 V	0,5 s	274,8	528 ms	269,7 V 0,98 s	No trip
	L2 -- N	273,7 V	0,5 s	274,8	538 ms		
	L3 -- N	273,7 V	0,5 s	274,6	532 ms		
						277,7 V 0,48 s	No trip

Note for voltage tests the voltage required to trip is the setting plus or minus 3.45 V the time delay can be measured at a larger deviation than the minimum required to operate the projection. The No-trip tests need to be carried out at the setting  $\pm 4V$  and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

The test method are refer to ENA Engineering Recommendation G59, Issue 3 2013(draft version)





Suntrio-TL20K							
Protection. Voltage tests.							
Function		Setting		Trip test		"No trip tests" All phases at same voltage	
		Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V stage 1	L1 -- N	200,1 V	2,5 s	199,2	2,556 s	204,1 V 3,5 s	No trip
	L2 -- N	200,1 V	2,5 s	199,1	2,561 s		
	L3 -- N	200,1 V	2,5 s	199,2	2,546 s		
U/V stage 2	L1 -- N	184 V	0,5 s	183,4	533,4 ms	188 V 2,48 s	No trip
	L2 -- N	184 V	0,5 s	183,4	542,4 ms		
	L3 -- N	184 V	0,5 s	183,3	538,4 ms		
						180 V 0,48 s	No trip
O/V stage 1	L1 -- N	262,2 V	1,0 s	261,6	1,028 s	258,2 V 2,0 s	No trip
	L2 -- N	262,2 V	1,0 s	261,5	1,034 s		
	L3 -- N	262,2 V	1,0 s	261,8	1,032 s		
O/V stage 2	L1 -- N	273,7 V	0,5 s	273,2	516 ms	269,7 V 0,98 s	No trip
	L2 -- N	273,7 V	0,5 s	273,1	517 ms		
	L3 -- N	273,7 V	0,5 s	273,3	519 ms		
						277,7 V 0,48 s	No trip
<p>Note for voltage tests the voltage required to trip is the setting plus or minus 3.45 V the time delay can be measured at a larger deviation than the minimum required to operate the projection. The No-trip tests need to be carried out at the setting <math>\pm 4V</math> and for the relevant times as shown in the table above to ensure that the protection will not trip in error.</p> <p>The test method are refer to ENA Engineering Recommendation G59, Issue 3 2013(draft version)</p>							



<b>Protection. Loss of Mains test.</b>							
Note: inverter tested according to BS EN 62116.							
Test Power and imbalance		33% -5% Q Test 22	66% -5% Q Test 12	100% -5% P Test 5	33% +5% Q Test 31	66% +5% Q Test 21	100% +5% P Test 10
Trip time. Limit is 0,5 s	Suntrio-TL10K	0,213 s	0,180 s	0,112 s	0,282 s	0,213 s	0,313 s
	Suntrio-TL20K	0,183 s	0,172 s	0,112 s	0,194 s	0,312 s	0,313 s

<b>Suntrio-TL20K</b>					
<b>Protection. Re-connection timer.</b>					
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
180 s	195,2 s / 196,2 s / 196,2 s / 196,2 s	At 266,2 V	At 196,1 V	At 47,4 Hz	At 51,6 Hz
Confirmation that the SSEG does not re-connect.		No connection	No connection	No connection	No connection

<b>Suntrio-TL20K</b>					
<b>Fault level contribution.</b>					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	$i_p$	--	20 ms	$30 V_{r.m.s}$	1,2 A
Initial Value of aperiodic current	A	--	100 ms	$30 V_{r.m.s}$	0
Initial symmetrical short-circuit current*	$I''_k$	--	250 ms	$30 V_{r.m.s}$	0
Decaying (aperiodic) component of short circuit current*	$i_{DC}$	--	500 ms	$30 V_{r.m.s}$	0
Reactance/Resistance Ratio of source*	X / R	--	Time to trip	0,050	In seconds

..... End of test report.....