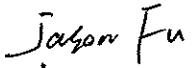
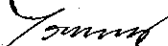



TEST REPORT VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012 Power generation systems connected to the low-voltage distribution network	
Report Reference No.	140327081GZU-001
Date of issue	19 May 2014
Total number of pages	62 Pages
Testing Laboratory	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Address	Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD, Guangzhou, China
Testing location/ address	Same as above
Tested by (name + signature)	Jason Fu 
Approved by (+ signature)	Tommy Zhong 
Applicant's name	Shenzhen SOFARSOLAR Co., Ltd.
Address	3A-1, Huake Building, East Technology Park, Qiaoxiang Road, Nanshan District, Shenzhen, China
Test specification:	
Standard	VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012
Test procedure	Type test
Non-standard test method	N/A
Test Report Form No.	VDE-AR-N 4105b
Test Report Form(s) Originator	Intertek Taiwan
Master TRF	Dated 2013-10
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Test item description	Grid-connected PV inverter
Trade Mark	
Manufacturer	Same as Applicant
Model/Type reference	Sofar 20000TL-Sx, Sofar 17000TL-Sx, Sofar 15000TL-Sx, Sofar 10000TL-Sx (x=0-6)
Ratings	Maximum d.c. input voltage: 1000 V Input voltage rang: 250-960 V Max. input current: 2×24 A (for Sofar 20000TL-Sx); 2×21 A (for Sofar 17000TL-Sx, Sofar 15000TL-Sx); 2×15 A (for Sofar 10000TL-Sx) Max. PV Isc: 2×30 A (for Sofar 20000TL-Sx); 2×27 A (for Sofar 17000TL-Sx, Sofar 15000TL-Sx); 2×20 A (for Sofar 10000TL-Sx) Nominal output voltage: 3/N/PE230V/400V Max. output current: 3×29 A (for Sofar 20000TL-Sx); 3×25 A (for Sofar 17000TL-Sx); 3×22 A (for Sofar 15000TL-Sx); 3×15 A (for Sofar 10000TL-Sx) Nominal frequency: 50 Hz

Max. output power: 20000 W (for Sofar 20000TL-Sx); 17000 W (for Sofar 17000TL-Sx); 15000 W (for Sofar 15000TL-Sx); 10000 W (for Sofar 10000TL-Sx)

Ingress protection: IP65

Operating temperature range: -25~60°C

Summary of testing:																					
<p>Tests performed (name of test and test clause):</p> <table border="1"> <thead> <tr> <th>VDE4105 (VDE0124)</th> <th>Test Description</th> </tr> </thead> <tbody> <tr> <td>5.4.3 (5.1.3)</td> <td>Flicker</td> </tr> <tr> <td>5.4.4 (5.1.4)</td> <td>Harmonics and inter-harmonics</td> </tr> <tr> <td>5.7.3.3 (5.3.4)</td> <td>Active power feed-in at overfrequency</td> </tr> <tr> <td>5.7.3.4 (5.3.5)</td> <td>Active power feed-in at underfrequency</td> </tr> <tr> <td>6.5.1 (5.4.5.1 & 5.4.5.2)</td> <td>Protective arrangements for the Interface switch</td> </tr> <tr> <td>6.5.2 (5.4.5.3 & 5.4.5.5)</td> <td>Protective functions</td> </tr> <tr> <td>6.5.3 (5.4.6.1 & 5.4.6.2)</td> <td>Islanding detection</td> </tr> <tr> <td>8.3.1 (5.4.7.1 & 5.4.7.2)</td> <td>Connection conditions and synchronisation</td> </tr> <tr> <td>8.3.4</td> <td>Connection of power generation units with inverters</td> </tr> </tbody> </table>	VDE4105 (VDE0124)	Test Description	5.4.3 (5.1.3)	Flicker	5.4.4 (5.1.4)	Harmonics and inter-harmonics	5.7.3.3 (5.3.4)	Active power feed-in at overfrequency	5.7.3.4 (5.3.5)	Active power feed-in at underfrequency	6.5.1 (5.4.5.1 & 5.4.5.2)	Protective arrangements for the Interface switch	6.5.2 (5.4.5.3 & 5.4.5.5)	Protective functions	6.5.3 (5.4.6.1 & 5.4.6.2)	Islanding detection	8.3.1 (5.4.7.1 & 5.4.7.2)	Connection conditions and synchronisation	8.3.4	Connection of power generation units with inverters	<p>Testing location:</p> <p>Intertek Testing Services Shenzhen Ltd. Guangzhou Branch</p> <p>Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD, Guangzhou, China</p>
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Copy of representative marking plate (representative):

SOFAR SOLAR	
Solar Inverter	Sofar 10000TL-S3
Max. DC Input Voltage	1000V
Operating MPPT voltage range	250-960V
Max. Input Current	2*15A
Max. PV Isc	2*20A
Nominal Grid Voltage	3/N/PE,230/400V
Max. Output Current	3*15A
Nominal Grid Frequency	50Hz
Max. Output Power	10000W
Power factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25~+60°C
Protective Class	Class I
Manufacturer: shenzhen SOFARSOLAR Co.,Ltd	
Made in China	
VDE-AR-N4105, RD1699, VDE0126-1-1, G83/2, UTE C15-712-1, C10/11, EN50438	

SOFAR SOLAR	
Solar Inverter	Sofar 15000TL-S3
Max. DC Input Voltage	1000V
Operating MPPT voltage range	250-960V
Max. Input Current	2*21A
Max. PV Isc	2*27A
Nominal Grid Voltage	3/N/PE,230/400V
Max. Output Current	3*22A
Nominal Grid Frequency	50Hz
Max. Output Power	15000W
Power factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25~+60°C
Protective Class	Class I
Manufacturer: shenzhen SOFARSOLAR Co.,Ltd	
Made in China	
VDE-AR-N4105, RD1699, VDE0126-1-1, G59/3, UTE C15-712-1, C10/11, IEC62116, IEC61727	

SOFAR SOLAR	
Solar Inverter	Sofar 17000TL-S3
Max. DC Input Voltage	1000V
Operating MPPT voltage range	250-960V
Max. Input Current	2*21A
Max. PV Isc	2*27A
Nominal Grid Voltage	3/N/PE,230/400V
Max. Output Current	3*25A
Nominal Grid Frequency	50Hz
Max. Output Power	17000W
Power factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25~+60°C
Protective Class	Class I
Manufacturer: shenzhen SOFARSOLAR Co.,Ltd	
Made in China	
VDE-AR-N4105, RD1699, VDE0126-1-1, G59/3, UTE C15-712-1, C10/11, IEC62116, IEC61727	

SOFAR SOLAR	
Solar Inverter	Sofar 20000TL-S3
Max. DC Input Voltage	1000V
Operating MPPT voltage range	250-960V
Max. Input Current	2*24A
Max. PV Isc	2*30A
Nominal Grid Voltage	3/N/PE,230/400V
Max. Output Current	3*29A
Nominal Grid Frequency	50Hz
Max. Output Power	20000W
Power factor	>0.99(adjustable+/-0.8)
Ingress Protection	IP65
Operating Temperature Range	-25~+60°C
Protective Class	Class I
Manufacturer: shenzhen SOFARSOLAR Co.,Ltd	
Made in China	
VDE-AR-N4105, RD1699, VDE0126-1-1, G59/3, UTE C15-712-1, C10/11, IEC62116, IEC61727	



Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the front surface of enclosure and visible after installation.

Test item particulars	
Temperature range	-25°C ~ +60 °C
AC Overvoltage category	<input type="checkbox"/> OVC I <input type="checkbox"/> OVC II <input checked="" type="checkbox"/> OVC III <input type="checkbox"/> OVC IV
DC Overvoltage category	<input type="checkbox"/> OVC I <input checked="" type="checkbox"/> OVC II <input type="checkbox"/> OVC III <input type="checkbox"/> OVC IV
IP protection class	IP65
Possible test case verdicts:	
- test case does not apply to the test object	N/A (Not applicable)
- test object does meet the requirement.....	P (Pass)
- test object does not meet the requirement.....	F (Fail)
Testing	
Date of receipt of test item	27 Mar 2014
Date (s) of performance of tests	27 Mar 2014 – 09 May 2014
General remarks:	
<p>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 Issuing testing laboratory. "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report.</p> <p>When determining for test conclusion, measurement uncertainty of tests has been considered. This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program. The test report only allows to be revised only within the report defined retention period unless standard or regulation was withdrawn or invalid.</p> <p>Throughout this report a point is used as the decimal separator.</p>	
General product information:	
<ol style="list-style-type: none"> Product covered by this report is non-isolated grid-connected PV inverter for connection with low voltage grid in terms of VDE-AR-N 4105. The PGU is tested with RS485 to verify the function of controlled active power. The PGU contain integrated NS protection function. For use in power generation system large than 30KVA, additional central NS protection shall be provided. The inverters intended to operate at ambient temperature -25°C - +60°C and 250-960 Vdc input, which will be specified in the user manual, The inverters will output full power when operated at 45°C. If operated at higher than 45°C temperature, the output power derating. The firmware version used for testing is V1.00 <p>For all models, if the DC input voltage is higher than 850 Vdc the output power will be derating. For model Sofar 20000TL-Sx, if the DC input voltage is lower than 430 Vdc, the output power will be derating. For model Sofar 17000TL-Sx, if the DC input voltage is lower than 420 Vdc, the output power will be derating. For model Sofar 15000TL-Sx, if the DC input voltage is lower than 370 Vdc, the output power will be derating.</p>	

For model Sofar 10000TL-Sx, if the DC input voltage is lower than 350 Vdc, the output power will be derating.

For all models, if the AC output voltage is lower than 230 Vac the output current will be limited to not higher than rated output current.

Model difference:

All the models have identical mechanical and electrical construction except some components and some parameter of the software architecture in order to control the max output power. And refer to the following table for detail.

Model	DC Cable Gland	PV connector	DC inside connector	Fuse PCB+ String detection board	DC surge arrester	DC switch	AC switch	AC surge arrester
Sofar 20000TL-S0 Sofar 17000TL-S0 Sofar 15000TL-S0 Sofar 10000TL-S0	√		√					
Sofar 20000TL-S1 Sofar 17000TL-S1 Sofar 15000TL-S1 Sofar 10000TL-S1	√		√			√		
Sofar 20000TL-S2 Sofar 17000TL-S2 Sofar 15000TL-S2 Sofar 10000TL-S2		√	√			√		
Sofar 20000TL-S3 Sofar 17000TL-S3 Sofar 15000TL-S3 Sofar 10000TL-S3		√		√		√		
Sofar 20000TL-S4 Sofar 17000TL-S4 Sofar 15000TL-S4 Sofar 10000TL-S4		√		√	√	√		
Sofar 20000TL-S5 Sofar 17000TL-S5 Sofar 15000TL-S5 Sofar 10000TL-S5		√		√	√	√		√
Sofar 20000TL-S6 Sofar 17000TL-S6 Sofar 15000TL-S6 Sofar 10000TL-S6		√		√	√	√	√	√

√ denote incorporating this component

Model Sofar 17000TL-Sx similar to Sofar 20000TL-Sx except amount of the DC-link capacitors, different of input and output sampling resistors and different inductance of Boost, invert inductor.

Model Sofar 15000TL-Sx similar to Sofar 17000TL-Sx except amount of the DC-link capacitors, different inductance of Boost, invert inductor and less PV input circuits (including PV terminal, fuse and sampling circuits of fuse).

Model Sofar 10000TL-Sx similiae to Sofar 15000TL-Sx except amount of the DC-link capacitors and boost diode, different of input and output sampling resistors and different inductance of Boost, invert inductor.

Model Sofar 20000TL-Sx and Sofar 17000TL-Sx have two external fans.

Model Sofar 17000TL-Sx has one external fan and model Sofar 10000TL-Sx has not.

For clause 5.4.3 , 5.4.4 and 5.7.5, model Sofar 10000TL-S6 and Sofar 20000TL-S6 are used as representative for testing

For other clause, only model Sofar 20000TL-S6 for testing.

Factory information:

Factory: Dongguan dingqiang Machinery & Electric Co., Ltd.

Address: No. 8, Fulong road, Qingxi town, Dongguan city, Guangdong, China

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
4	General framework conditions		N/A
4.1	Provisions and regulations		N/A
4.2	Application procedure and connection relevant document		N/A
4.3	Initial start-up of the power generation system		N/A
5	Network connection		P
5.1	<p>Principles for determination of the network connection point</p> <p>Power generation systems shall be connected at a suitable point in the network, the network operator determines the suitable network connection point that ensures safe network operation, also when taking account of the power generation system, and at which the power applied for can be drawn and transmitted. The decisive aspect for evaluation of the network connection is always the behaviour of the power generation system at the network connection point or at the PCC. This is to ensure that the power generation system is operated without interfering reactions and without affecting the supply of other customers. Annex E shows examples for connection evaluations of power generation systems.</p> <p>Power generation systems which are installed on different plots with their own respective network connections shall, as a rule, not be connected to the network operator's network together in the same network connection point. Power generation systems installed on a building with several network connections may be connected to the network operator's network together at the same network connection point.</p> <p>All separate supply points shall be permanently marked by the supply point owner with the following label "Sectioning point" power generation system/ supply network".</p>		N/A
5.2	<p>Rating of the network equipment</p> <p>Power generation systems may cause higher loading of lines, transformers and other network equipment. Therefore, the network operator examines the loading capacity of the network equipment with regard to the connected power generation systems in accordance with the relevant rating regulations.</p> <p>For calculation purposes the maximum apparent power of the sum of all power generation systems S_{Amax} and usually the load factor $m=1$ shall be used. The only exceptions are buried cables for the connection of photovoltaic systems for which a load factor $m= 0.7$ shall be used.</p>		N/A

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
5.3	<p>Permissible voltage change</p> <p>For undisturbed operation of the network, the amount of the voltage change caused by all power generation systems with a network connection point in a low-voltage network shall at none of the PCCs in this network may a value of 3 % as compared with the voltage without power generation systems.</p> <p>If stipulated by the network operator and if necessary, taking into account the possibilities of the static voltage stability it may be permitted in individual justified cases to deviate from this value of 3%. When calculating the voltage change, the displacement factor shall be taken into account which is provided by the network operator for the maximum apparent connection power of the power generation system S_{Amax}. For determination of the voltage change for meshed low-voltage networks an high spatially distributed feed-in powers, it is recommended to use complex load-flow calculations.</p>		N/A
5.4	System reactions		P
5.4.1	<p>General</p> <p>The electrical installations of the customer system shall be planned, constructed and operated so that reactions to the network operator's network and to the systems of other customers are permanently reduced to a permissible minimum. Should interfering reactions on the network operator's network occur nonetheless, the customer shall apply measured to his system that is to be coordinated with the network operator. The network operator is entitled to disconnect the power generation system concerned from the network until the deficiencies are corrected. The connection owner provides the network operator with values from the device documents of the manufacturer which are necessary in order to evaluate system reactions (see Annex F.3).</p>		N/A
5.4.2	<p>Rapid voltage changes</p> <p>Voltage chances at the PCC attributable to the simultaneous connection and disconnection of power generation units do not give rise to inadmissible network reactions if the maximum voltage change does not exceed a value of 3% (related to U_n) at the PCC.</p> <p>For a value of 3% the frequency shall not exceed once every 10 min.</p> <p>Depending on the network short-circuit power S_{kV} at the PCC of maximum apparent connection power S_{Emax} of the activated power generation unit and on th ratio of starting current I_a to rated current I_{rE}, the voltage change can be estimated.</p>		N/A

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
5.4.3	<p>Flicker</p> <p>The measured variable and the evaluation criterion for flicker caused by power generation systems is the long-term flicker strength P_{lt}.</p> <p>For power generation systems with rated currents of up to 75 A, reactions are deemed to be limited sufficiently, if the power generation units comply with the limit values given in DIN EN 61000-3-3 (VDE 0838-3) or DIN EN 61000-3-11 (VDE 0838-11), respectively.</p> <p>Together, all power generation systems in the low-voltage network shall not exceed the following flicker strength at the most unfavourable PCC:</p> <p>Long-term flicker strength: $P_{lt} = 0.5$.</p> <p>This value also applies to power generation systems with rated currents above 75A.</p>	<p>Model: Sofar 10000TL-S6</p> <p>The measured $P_{lt} = 0.192$</p> <p>Model: Sofar 20000TL-S6</p> <p>The measured $P_{lt} = 0.196$</p>	P
5.4.4	<p>Harmonics and inter-harmonics</p> <p>The currents of harmonics and inter-harmonics generated by power generation systems shall be included in the conformity check.</p> <p>For power generation systems reactions are deemed to be limited sufficiently, if the power generation units comply with the following limit values:</p> <ul style="list-style-type: none"> - for rated currents of up to and including 16 A per conductor: the limit values of class A (Table 1) specified in DIN EN 61000-3-2 (VDE0838-2); - for rated currents above 16 A and up to and including 75 A per conductor: the limit values of Table 2 and Table 3 specified in DIN EN 61000-3-12 (VDE 0838-12). <p>If in the standard mentioned, limit values are explicitly stated for power generation units then these limit values shall apply.</p>	See "F.3 Requirements for the test report for power generation units" for details.	P
5.4.5	<p>Voltage unbalance</p> <p>If several single-phase power generation systems are connected to the same network connection point, then uniform distribution of the power supplied to the three line conductors shall be aimed for, where a maximum power difference of 4.6kVA shall not exceed.</p>		P
5.4.6	<p>Commutation notches</p> <p>The relative depth of commutation notches d_{kom} through line-commutated inverters shall not exceed the value of $d_{kom} = 5\%$</p>		N/A

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
5.4.7	<p>Audio-frequency centralised ripple-control</p> <p>Audio-frequency centralised ripple-control are usually operated at frequencies between approx. 100 Hz and 1500 Hz. Information about the locally applied ripple-control frequency can be obtained from the network operator. Broadcasting levels of audio-frequency impulses are normally about 1 % U_n to 4 % U_n.</p> <p>Apart from the limitation of the level reduction, it is not allowed to generate inadmissible interference voltages. The following rules shall apply in particular:</p> <ul style="list-style-type: none"> - The interference voltage caused by a power generation system whose frequency corresponds to the locally applied ripple-control frequency or is very close to it (+/- 5 Hz), shall not exceed the value of 0.1 % U_n. - The interference voltage caused by a power generation system whose frequency lies at the ambient frequencies of +/- 100 Hz to the locally applied ripple-control frequency or in its immediate proximity, shall not exceed a value of 0.3 % U_n. 	Considered for final PGU	N/A
5.4.8	<p>Carrier frequency usage of the customer network</p> <p>If the system operator runs a system with carrier frequency usage of this network, then shall be ensured by means of suitable devices that interfering influences on other customer systems as well as on the systems of the network operator are avoided.</p> <p>Shared usage of the network operator's network by the customer is permitted solely with the network operator's consent for the carrier frequent transmission of signals.</p>	Considered for final PGU	N/A
5.4.9	<p>Precautionary measures against voltage drops and voltage interruptions</p> <p>If power generation systems are sensitive to short-time voltage drops or interruptions of supply, then the customer shall take suitable measures to safeguard the system and to ensure operation operational safety.</p>		P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
5.5	<p>Connection criteria</p> <p>For the technical execution of connections of the power generation system or the customer system with a power generation system, the technical connections of the network operator shall be considered. If the generated power is fully supplied to the network operator's network, then the connection line of the power generation system shall be firmly connected to the meter panel within the customer system and the meter panel shall then be executed in accordance with the applicable Technical connection condition.</p> <p>Power generation systems may also be single-phase connected to the network, if the sum of all single-phase connected power generation units per network connection does not exceed the following: $S_{E_{max}} \leq 4.6kVA$ per line conductor. It is possible to connect in single phase, distributed to the three line conductors, at maximum $3 \times 4.6kVA = S_{E_{max}} \leq 13.8kVA$. The limits given above are exceeded at the network connection point, any extension shall be three-phase connected to the three-phase system. This requirement may also be satisfied by communicatively coupling single-phase connected power generation units of the same primary energy carrier.</p> <p>The communicative coupling between power generation units ensures the power generation system's balanced supply to the individual line conductors of the three-phase network in accordance with three-phase inverter systems.</p> <p>For all that, the maximum permissible imbalance of 4.6kVA at a single network connection point for the sum of all power generation systems applies here as well.</p>		P
5.6	Three-phase network		P
5.6.1	<p>General</p> <p>For the purposes of maintaining the symmetric characteristics of the three-phase network, three-phase power generation systems shall have the characteristics described in the following.</p>		P
5.6.2	<p>Three-phase synchronous generators</p> <p>Synchronous generators generate an electromotive force (EMF) or synchronous generated voltage (open-circuit voltage), respectively, satisfying the conditions for ideal balance.</p>		P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
5.6.3	<p>Three-phase inverter systems</p> <p>For three-phase power generation systems with network feed-in over inverters, the power shall be fed three-phase balanced into the three line conductors. The inverter circuit shall preferably be set up as a three-phase current unit.</p> <p>A circuit of single –phase inverters is deemed to be technically equivalent, if these inverters feed three-phase balanced into the three line conductors by means of a suitable communicative coupling.</p> <p>In the medium term, three-phase inverter systems shall provide all the three-phase related functions of the three-phase synchronous generators.</p>	Considered for final PGU	N/A
5.7	Behaviour of the power generation system at the network		P
5.7.1	<p>General</p> <p>Automatic disconnection from the network is not permitted for frequency deviations within the range of 47.5 Hz to 51.5 Hz. The mode of action is described in detail in 5.7.3.3 and 5.7.3.4. Implementation of the frequency dependent active load control is carried out in the open-loop control of the power generation units.</p>		P
5.7.2	<p>Maximum permissible short-circuit current</p> <p>Due to operation of power generation system, the short-circuit current of the low-voltage network is increased by the short-circuit current of the power generation system. Therefore, information about the short-circuit current of the power generation system to be expected at the network connection point has shall be provided in accordance with 4.2. For determination of the short-circuit current contributed by the power generation system the following roughly estimated values can be assumed :</p> <ul style="list-style-type: none"> - For synchronous generators: 8 times the rated current; - For asynchronous generators: 6 times the rated current; - For generators with inverters: 1 time the rated current. 		N/A

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
5.7.3	Active power output		P
5.7.3.1	Basics		P
5.7.3.2	<p>Generation management/network security management</p> <p>Power generation systems with a system power of more than 100 kW shall be able to reduce their active power in steps of not more than 10 % of the maximum active power P_{Amax}. For every operational state and from each and every operation point, it shall be possible for this power to be reduced to a set point provided by the network operator. This set point is generally provided at the network connection point gradually or continually and it corresponds to a percentage related to the maximum active power P_{Amax}.</p> <p>Variable power generation systems shall carry out the power output reduction to the respective set point immediately, however, at maximum within a minute. It shall be technically possible for these power generation systems to reduce the power to the set point 10% without automatic disconnection from the network, and only at a value o less than 10% of the maximum active power P_{Amax} is they permitted to disconnect the network.</p> <p>All other power generation systems shall carry out the power output reduction to the respective set point within a maximum period of five minutes. If the set point is not reached within five minutes, then the power generation system shall be disconnected.</p>	<p>The PGU is able to reduce active output power via RS485 interface. The final PGS installation shall be equipped with a interface device between the dry contact of network operator.</p> <p>Although the power of PGU is less than 100KW. However, it can fulfil the requirement of EEG</p> <p>The communication port of PGU is RS 232. it should be adapted with external dry contact signals for final PGS installation</p>	P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
5.7.3.3	<p>Active power feed-in at overfrequency</p> <p>At frequencies between 50.2 Hz and 51.5 Hz, all adjustable power generation systems shall reduce or increase the active power P_M generated instantaneously with a gradient of 40 % of P_M per Hz. It follows that the power generation unit will continuously move up and down the frequency characteristic curve in the frequency range of 50.2 Hz to 51.5 Hz with regard to its active power feed-in. the increment of the frequency measurement shall be ≤ 10 mHz.</p> <p>If the mains frequency drops again to a value below 50.2 Hz and if the possible generation power is greater at that instant than the active power P_M, then the increase of the active power supplied to the network operator's network shall not exceed a gradient of 10 % of the maximum active power P_{Amax} per minute.</p> <p>At mains frequencies > 51.5 Hz, the power generation system shall disconnect from the network immediately.</p> <p>There are no restrictions for frequencies of $47.5 \text{ Hz} \leq f_{mains} \leq 50.2 \text{ Hz}$.</p> <p>Disconnection from the network is required for $f_{mains} \leq 47.5 \text{ Hz}$ and $f_{mains} \geq 51.5 \text{ Hz}$.</p>	(see appended table)	P
5.7.3.4	<p>Active power feed-in at underfrequency</p> <p>For frequencies between 47.5 Hz and 50.0 Hz, automatic disconnection from the network as a result of a frequency deviation is not permitted.</p>	Unit normally operate.	P
5.7.4	<p>Principles for network support</p> <p>Power generation systems shall be able to contribute to the static voltage stability in the network operator's network. Static voltage stability is understood to be the voltage stability in the low-voltage network at which the slow voltage changes are maintained within compatible limits in the distribution network.</p>		P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
5.7.5	<p>Reactive power</p> <p>Irrespective of the number of feed-in phases, power generation systems shall allow for operation under normal stationary operating conditions in the voltage tolerance band $U_n \pm 10\%$ and in their permissible operation points starting with an active power of more than 20 % of the rated active power with the following displacement factors $\cos\varphi$:</p> <ul style="list-style-type: none"> - power generation system $S_{E_{max}} \leq 3.68 \text{ kVA}$: $\cos\varphi = 0.95$ under-excited to 0.95 over-excited. - power generation system $3.68 \text{ kVA} < S_{E_{max}} \leq 13.8 \text{ kVA}$: characteristic curve provided by the network operator within $\cos\varphi = 0.95$ under-excited to 0.95 over-excited - power generation system $S_{E_{max}} > 13.8 \text{ kVA}$: characteristic curve provided by the network operator within $\cos\varphi = 0.90$ under-excited to 0.90 over-excited. 	<p>PGU $S_{E_{max}} > 13.8 \text{ kVA}$: characteristic curve provided by the network operator within $\cos\varphi = 0.90$ under-excited to 0.90 over-excited.</p> <p>(see appended table)</p>	P
6	<p>Construction of the power generation system/network and system protection (NS protection)</p>		P
6.1	<p>General requirements</p> <p>The network and system protection (NS protection) is a type-tested protective device with a conformity certificate in which all protective functions specified in 6.5 are installed. The NS protection acts on the interfaces switch in accordance with 6.4. The NS protection shall be realized as central NS protection at the central meter panel. For power generation systems of $\leq 30\text{kVA}$ it is also permitted to have an NS protection installed in the power generation unit(s). depending on the sum of the maximum apparent powers of all power generation systems connected to the same network connection point, $S_{A_{max}}$. The following conditions apply for the NS protection:</p> <ul style="list-style-type: none"> - $S_{A_{max}} > 30\text{kVA}$: Central NS protection at the central meter panel. - $S_{A_{max}} \leq 30\text{kVA}$: Central NS protection at the central meter panel or decentralized in a sub-distribution or integrated NS protection <p>The loss of the auxiliary voltage of the central NS protection or the control of the integrated NS protection shall lead to an instantaneous tripping of the interface switch. Tripping of a relay of the integrated protection disconnection periods is kept. The protective functions shall be maintained even in the event of a malfunction in the system control.</p> <p>Single-fault tolerance shall be ensured for both central and integrated NS protection.</p>	<p>Integrated NS protection</p> <p>For final PGU>30KVA, additional central NS protection shall be provided at the central meter panel</p>	P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
6.2	<p>Central NS protection</p> <p>The central NS protection shall be accommodated as independent apparatus in a suitable circuit distributor in accordance with TAB 2007, Clause 8, Paragraph 1, and not in the upper connection compartment specified in TAB 2007, 7.2, Paragraph 9 and connected to the central meter panel.</p>		N/A
6.3	<p>Integrated NS protection</p> <p>The NS protection can be integrated in the programmable system control of the power generation units. If so, then both the test button and the sealing may be omitted, however, password protection is required, if the protective function U > is adjustable.</p>		P
6.4	<p>Interface switch</p>		P
6.4.1	<p>General</p> <p>For the connection of the power generation system to the network operator's low-voltage network or to the remaining customer system, it is necessary to use an interface switch. It consists of two electric switching devices connected in series and shall thus be constructed redundantly. The interface switch is controlled by the NS protection and activates automatically if at least one protective function responds.</p> <p>The breaking devices of the interface switch shall be designed to be short-circuit proof and shall be releasable without delay and with due regard to the protective devices required by clause 6.5. The breaking capacity of the two breaking devices of the interface switch shall be dimensioned at least in accordance with the responding range of the upstream safety fuse or the maximum short-circuit current contribution of the power generation system.</p> <p>Switches with at least breaking capacity shall be use for both breaking devices of the interface switch. In addition to that, all-pole disconnection shall be ensured.</p>	<p>Integrated power relay in the PGU. Each live conductor is constructed with two relays comply with A.6 requirement.</p>	P
6.4.2	<p>Central interface switch</p> <p>The two break devices of the central interface switch shall be executed as galvanic break devices.</p> <p>The two break devices of the interface switch shall be installed directly at the central meter panel in the circuit distributor of the power generation system.</p>		N/A

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
6.4.3	<p>Integrated interface switch</p> <p>Construction of the interface switch shall be carried out taking into consideration the single-fault tolerance.</p> <p>An interface switch ensures a single-fault tolerant all-phase galvanic breaking.</p> <p>For power generation systems with inverters, the interface switch shall be provided on the inverter's network side. A short circuit in the inverter shall not impair the switching function of the interface switch.</p>	Two series relays	P
6.5	Protective devices for the interface switch		P
	Comments:		
6.5.1	<p>General</p> <p>The purpose of the NS protection is to disconnect the power generation system from the net in the event of inadmissible voltage and frequency values. This is intended to prevent an unintentional feed-in of the power generation system into a power-supply unit separated from the remaining distribution network as well as the feed-in of faults within this network.</p> <p>The system operator shall himself take precautions to prevent damages to his systems and installations as might be caused by switching actions, voltage fluctuations and automatic reclosings in the network connected upstream or other process in the network of the network operator.</p> <p>The following functions of the decoupling protection shall be implemented:</p> <ul style="list-style-type: none"> - Voltage drop protection $U <$; - Rise-in-voltage protection $U >$; - Rise-in-voltage protection $U >>$; - Frequency decrease protection $f <$; - Frequency increase protection $f >$; - Islanding detection. <p>The setting values of the protective functions and the last five dated failure reports shall be readable at the NS protection. Interruptions of supply with durations of 3 s or longer shall not lead to loss of any of the failure reports. Read-out shall be possible at the central NS protection irrespective of the operational state of the power generation system and without any additional aids. For integrated NS protection read-out may be carried out using a data interface.</p>		P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
6.5.2	<p>Protective functions</p> <p>The protective functions of the NS protection shall be designed so that the disconnection time (the sum of the proper times of NS protection and interface switch plus a delay for the protection relay, which may or may not be adjustable) does not exceed 200 ms.</p>	PGU compliance with this function and not exceed 200 ms	P
6.5.3	<p>Islanding detection</p> <p>The islanding detection is implemented in the central NS protection or in the integrated NS protection of the power generation unit. If an islanding detection system acting on the integrated interface switch is integrated in all power generation units of a power generation system, then it is permitted to omit the islanding detection in the central NS protection regardless of the system power.</p> <p>Detection of an isolated network and disconnection of the power generation system by means of the interface switch shall be completed within 5 seconds.</p>	PGU compliance with this function and does not exceed 5s	P
7	Metering for billing purposes		N/A
	<p>Installation and operation of the measuring devices shall be agreed in due time between the system operator and the network or metering point operator, respectively.</p> <p>According to the German Calibration Act, only certified and calibrated meters and transformers shall be used in the course of business.</p>		N/A
8	Operation of the system		P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
8.1	<p>General</p> <p>The operation of electrical installations included all technical and organisational activities required to ensure the functional efficiency and safety of the systems. These activities include all operating measures as well as electrical and non-electrical operations as described in the applicable rules and regulations.</p> <p>For connection of the power generator systems, the conditions given in 8.3 shall be satisfied. During operation, the conditions of clause 5, which the decisions regarding the connection of the power generation system were based on, shall only be changed with the consent of the network operator.</p> <p>The system operator shall ensure that the equipment - required for parallel operation with the low-voltage network is always in proper technical condition. It is required to have an electrically skilled person check the switches and protective devices for proper functioning at regular intervals. This requirement is deemed to be satisfied for normal operating and environmental conditions if the test intervals mentioned in BGV A3 or TRBS 1201 are adhered to. Te repeat tests shall include at least the following:</p> <ul style="list-style-type: none"> - Check of the environmental conditions and elimination of deficiencies, if required; - Tripping control of the interface switch. <p>Power reduction or disconnection required due to network conditions: upon request of the network operator, the system operator is obliged to switch off the power generation system or to disconnect it from the network if this is required for conduction work that are necessary for operational purposes in the network operator's network.</p> <p>Access: upon co-ordination with the system operator, the network operator shall be granted access to all components of the power generation system, interfaces switch, facilities of the power generation/ network security management, and the power generation units.</p> <p>Exchange of information: the network operator will inform the system operator about substantial modifications in his network which will have an impact on the current parallel operation.</p> <p>Coupling of network connection points: different network connection points on the network of the network operator shall not be operated in galvanic connection through systems of one or more system operators.</p> <p>Behaviour in the event of disturbances: the reconnection</p>		P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
	conditions given in 8.3 shall be satisfied.		
8.2	<p>Particular characteristics of the management of the network operator's network</p> <ul style="list-style-type: none"> - Earthing and short-circuiting for works on the network: After isolation, a prerequisite for the safety of works on the network is to prevent any voltage sources from reconnecting unintentionally. - Operation of the network stand-by systems: For certain works on the network, the network operator has to disconnect sub-networks from the remaining network. In order to ensure continuous supply to the customers during this time, the network operator may use network stand-by systems. Normally, the network operator will inform the customers concerned about the use and operation of network stand-by systems. 	Consider in power system only	N/A
8.3	Connection conditions and synchronisation		P
8.3.1	<p>General</p> <p>A power generation system shall be connected to the network operator's network only if a suitable device determines that both the mains voltage and the mains frequency are within the tolerance range of 85 % Un to 110 % Un or 47.5 Hz to 50.05 Hz, respectively, for a period of at least 60 seconds.</p> <p>If decoupling protection devices are tripped because of a short interruption, then the power generation system is permitted to already reconnect as soon as the mains voltage and mains frequency have uninterruptedly remained within the tolerance ranges given above for a period of 5 seconds. Short time interruptions are characterised by the NS protection settings of the mains frequency and/ or network voltage being exceeded or undershot for a maximum period of 3 seconds.</p> <p>The power generation system being reconnected to the network operator's network at the tripping of the decoupling protection device, the active power of controllable power generation systems supplied to the network operator's network shall not exceed the gradient of 10 % of the active power per minute.</p>	(See appended table)	P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
8.3.2	<p>Connection of synchronous generators</p> <p>A synchronisation device shall be provided in a suitable place for synchronous generators coupled directly to the network.</p>		N/A
8.3.3	<p>Connection of asynchronous generator</p> <p>For asynchronous generators started by a prime mover and connected at a rotational speed between 95 % and 105 % of the synchronous rotational speed, $k_{i_{max}}$ is expected to be = 4.</p>		N/A
8.3.4	<p>Connection of power generation units with inverters</p> <p>Power generation units with inverters shall only be connected with $k_{i_{max}} \leq 1.2$.</p>	The $k_{i_{max}}$ is 0.383	P
8.4	<p>Reactive power compensation</p> <p>Equipment for reactive power compensation shall either: be connected or disconnected together with the consumption devices or power generation systems; or operated via control equipment.</p>	See clause 5.7.5	P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
9	Verification of the electrical properties		P
9.1	<p>General</p> <p>The certificates of conformity issued for the power generation units and the NS protection shall confirm their conformity with requirements of this VDE application guide at least with regard to the properties described in 9.2 to 9.4.</p>		P
9.2	Verification of the feed-in power		P
9.2.1	<p>Verification of the feed-in power</p> <p>For power generation units, it is sufficient to indicate the maximum active power feed-in.</p>		P
9.2.2	<p>Verification of the reactive power values</p> <p>Indication of the maximum reactive powers for inductive and maximum capacitive reactive power extraction as a function of the feed-in active power is required. For this at least the conditions give in 5.7.5 shall be satisfied.</p> <p>For power generations units with a generator directly coupled to the network which, due its very operational principle, cannot control the reactive power and, therefore, uses non-controllable, fixed capacities $\cos\phi$ shall be reached within 60 seconds. The maximum deviation at $\cos\phi$ nominal voltage shall be 0.02.</p>		P
9.2.3	<p>Verification of the reactive power transition function</p> <p>In order to check the standard characteristic curve $\cos\phi$ (P) given in 5.7.5, the change of the active power mode of operation is to be checked in correspondence to the magnitude of the active power feed-in.</p>		P
9.3	<p>Verification of the network reactions</p> <p>In order to verify the permissible network reactions specified in 5.4, it is required to submit evidence provided by the manufacturer for the radiated interference produced by the power generation unit.</p>		P
9.4	<p>Verification of the features of the network and system protection</p> <p>Compliance with the conditions required by Clause 6 for NS protection for the protection against inadmissible voltage and frequency increase/decrease shall be verified based on measurements.</p>		P

VDE-AR-N 4105:2011 in conjunction with E DIN V VDE V 0124-100:2012			
Clause	Requirement - Test	Result - Remark	Verdict
	Annex A: Explanations (informative)		--
	Annex B: Connection examples (informative)		--
	Annex C: Examples of meter panel configurations (informative)		--
	Annex D: Islanding detection (normative)		P
D.1	Islanding detection by means of the oscillation circuit test		P
D.2	Islanding detection by three-phase voltage monitoring		N/A
	Annex E: Examples for the connection evaluation of power generation systems (informative)		--
	Annex F: Forms (mandatory)		P
F.1	Initial start-up protocol – Power generation systems, low voltage		N/A
F.2	Data sheet for power generation systems		P
F.3	Requirements for the test report for power generation units		P
F.4	Requirements for the test report for the NS protection		N/A
	Annex G: Forms (optional) (informative)		N/A
G.1	Application		N/A
G.2	Certificate of conformity for power generation units		N/A
G.3	Certificate of conformity of the network and system protection		N/A

Appendix 1- Test Result

5.7.3.2		Table: Generation management/network security management (the signal of the reference value must be reduced from 100%, 90% ...10% P _n)					P
String	1	U _{DC} = Un	750 Vdc	U _{ac} = Un	230Vac	P = (W)	20000 W
P (W)				P (W)			
100%				20100W			
90%				18100W			
80%				16000W			
70%				14000W			
60%				12000W			
50%				10000W			
40%				8002W			
30%				5990W			
20%				3990W			
10%				1970W			
Supplementary information:							

5.7.3.3		Table: Active poewr output feed-in at overfrequency				P	
Model No.:		Sofar 20000TL-S6				--	
		> 80% P _{Emax}					
		40%P _M (W)		8033.6		10%P _{Emax} (W)	2008.4
	f (Hz)	Measured output Power (W)	Measured $\Sigma P = P_{measured} - P_M$ (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)		
	50Hz ± 0.01Hz	50.00	20084	--	--	--	
	50.25Hz ± 0.05Hz	50.25	19769	315	19682.3	86.7	
	50.70Hz ± 0.10Hz	50.70	16131	3953	15665.5	465.5	
	51.15Hz ± 0.05Hz	50.15	12494	7590	12452.1	41.9	
	50.70Hz ± 0.10Hz	50.70	16098	3986	15665.5	432.5	
	50.25Hz ± 0.05Hz	50.25	18757	1327	19682.3	925.3	
	50Hz ± 0.01Hz	50.00	20010	--	--	--	
		40% ~ 60% of P _{Emax}					
		40%P _M (W)		4019.6		10%P _{Emax} (W)	2008.4
	f (Hz)	Measured output Power (W)	Measured $\Sigma P = P_{measured} - P_M$ (W)	Calculated from standard characteristic curve P (W)	Tolerance between measured P and calculated P (W)		
	50Hz ± 0.01Hz	50.00	10049	--	--	--	
	50.25Hz ± 0.05Hz	50.25	9935	114	9848.1	86.9	
	50.70Hz ± 0.10Hz	50.70	8065	1984	8039.2	25.8	
	51.15Hz ± 0.05Hz	50.15	6250	3799	6230.4	19.6	
	50.70Hz ± 0.10Hz	50.70	8054	1995	8039.2	14.8	
	50.25Hz ± 0.05Hz	50.25	9752	297	9848.1	96.1	
	50Hz ± 0.01Hz	50.00	20078	--	--	--	
Supplementary information:							

Appendix 1- Test Result

Amplitude increase or decrease of 40%Pm/Hz, the tolerance is less than or equal to 10%P

	> 80% P _{E_{max}} · Disconnection from the network?	Trip time (ms)	40% ~ 60% of PE _{max} Disconnection from the network?	Trip time (ms)	Remark
51.65Hz ± 0.05Hz	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	144	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	178	--
	Start up?		Start up?		Gradient (W/min)
50.1Hz ± 0.01Hz	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		--
50Hz ± 0.01Hz	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		1836

5.7.5 Measurement of the Range of Power and of the Reactive Power				
DC input:	AC output: 1.0Un			Rated Active Power
750 Vdc	230 Vac; 50 Hz			20 kW
Measurement Item	cosφ	Apparent Power (kVA)	Active Power (kW)	Reactive Power (kVar)
a)	0.9998	20.10	20.09	-0.400
b)	0.7938	19.793	15.712	-12.037
c)	0.8064	20.412	16.459	12.072
d)	0.7941	7.515	5.971	-4.562
e)	0.8044	7.443	5.989	4.395
DC input:	AC output: 1.09Un			Rated Active Power
750 Vdc	250.7 Vac; 50 Hz			20 kW
Measurement Item	cosφ	Apparent Power (kVA)	Active Power (kW)	Reactive Power (kVar)
a)	0.9997	20.07	20.07	-0.450
b)	0.7934	19.773	15.689	-12.035
c)	0.8067	20.378	16.438	12.044
d)	0.7935	7.539	5.985	-4585
e)	0.8043	7.463	6.005	4.432
S _{E_{max}} (kVA)	20.10			
P _{E_{max}} (kW)	20.09			
Remark: negative denotes leading, positive denotes lagging.				

5.7.5 Testing for the cos φ adjustment accuracy									
91% Un					109% Un				
Step	S(kVA)	P(kW)	Q(kVAR)	cosφ	Step	S(kVA)	P(kW)	Q(kVAR)	cosφ
a)	--	--	--	--	a)	--	--	--	--
S _{max}	--	--	--	--	S _{max}	--	--	--	--
b)	6.162	5.857	1.912	0.9506	b)	4.288	4.081	1.134	0.9519
S _{max}	9.508	9.047	2.926	0.9515	S _{max}	10.08	9.590	3.115	0.9511
c)	6.173	5.848	-1.975	0.9474	c)	4.310	4.073	-1.412	0.9448
S _{max}	9.383	8.887	-3.009	0.9407	S _{max}	9.959	9.429	-3.206	0.9468
d)	12.882	11.654	5.490	0.9046	d)	8.924	8.057	3.838	0.9028
S _{max}	18.548	16.767	7.932	0.9040	S _{max}	20.31	18.35	8.698	0.9037
e)	12.980	11.632	-5.759	0.8962	e)	8.927	7.988	-3.586	0.8948
S _{max}	18.132	16.263	-8.038	0.8964	S _{max}	19.92	17.81	-8.92	0.8942

Appendix 1- Test Result

Remark: negative denotes leading, positive denotes lagging.
 Condition b, c testing for model Sofar 10000TL-S6.
 Condition d, e testing for model Sofar 20000TL-S6.

5.7.5		Testing of a displacement factor/active power characteristic curve $\cos\phi(P)$								
Model		Sofar 20000TL-S6								
Step		20% $P_{E_{max}}$	30% $P_{E_{max}}$	40% $P_{E_{max}}$	50% $P_{E_{max}}$	60% $P_{E_{max}}$	70% $P_{E_{max}}$	80% $P_{E_{max}}$	90% $P_{E_{max}}$	100% $P_{E_{max}}$
a)	P(kW)	4.0045	6.0037	7.9964	10.063	12.001	13.993	15.997	17.996	18.183
	Cos ϕ (actual)	0.9963	0.9983	0.9989	0.9979	0.9744	0.9539	0.9319	0.9114	0.9089
	Cos ϕ (limit)	1	1	1	1	0.98	0.96	0.94	0.92	0.90
b)	P(kW)	4048	--	--	10.045	--	--	--	17.972	--
	Cos ϕ (actual)	0.9965	--	--	0.9981	--	--	--	0.9113	--
	Cos ϕ (limit)	1.00	--	--	1.00	--	--	--	0.92	--
	Settling time (actual)	0.9	--	--	1.3s	--	--	--	1.2s	--
	Settling time (limit)	10s	--	--	10s	--	--	--	10s	--

5.7.5		Testing of a displacement factor/active power characteristic curve $\cos\phi(P)$								
Model		Sofar 10000TL-S6								
Step		20% $P_{E_{max}}$	30% $P_{E_{max}}$	40% $P_{E_{max}}$	50% $P_{E_{max}}$	60% $P_{E_{max}}$	70% $P_{E_{max}}$	80% $P_{E_{max}}$	90% $P_{E_{max}}$	100% $P_{E_{max}}$
a)	P(kW)	2.037	3.008	4.009	4.992	6.012	7.007	8.002	9.019	9.499
	Cos ϕ (actual)	0.9996	0.9983	0.9990	0.9993	0.9879	0.9781	0.9668	0.9570	0.9523
	Cos ϕ (limit)	1	1	1	1	0.99	0.98	0.97	0.96	0.95
b)	P(kW)	2.035	--	--	4.893	--	--	--	9.175	--
	Cos ϕ (actual)	0.9963	--	--	0.9993	--	--	--	0.9738	--
	Cos ϕ (limit)	1.00	--	--	1.00	--	--	--	0.96	--
	Settling time (actual)	0.9s	--	--	1.3	--	--	--	1.2s	--
	Settling time (limit)	10S	--	--	10S	--	--	--	10S	--

6.1 (6.5.1)	TABLE: General requirements	P
Design of functional safety:		
Two series relays used in the line and neutral conductor , and it having 2 separate relay control circuits, each controlling one line relay and one neutral relay, in any single fault scenario involving one control circuit or one relay, the other control circuit can detect the fault and alarm.		
Supplementary information:		
Two series relays would be automatically checked before the inverter starts operation		

Appendix 1- Test Result

String	1	$U_{DC} = U_n$	850Vdc	$U_{ac} = U_n$	230Vac	P = (W)	20K
Component No.		Fault		Observation			
CB18		S/C		Display " ID20" and can not start up			
One output relay		S/C		Display " ID55" and can not connect to the grid			
CEA4 (for DC Current transducer)		S/C		The unit operated normally at beginning. LCD displayed error input current, after about 3 min. And the unit shut down and disconnected from the grid. Error message:"permanent".			
CC1		S/C		The unit shut down and disconnected from the grid immediately. Error message:"ID11". No damaged and no hazards.			
QA1 Pin D-S		S/C		The unit operated normally. No damaged and no hazards.			
CA37		S/C		The unit operated normally. No damaged and no hazards.			
DA18 pin 1-2		S/C		The unit shut down and disconnected from the grid immediately. Error message:"permanent". No damaged and no hazards.			
DA19 Pin 1-2		S/C		Output breaker opened. The unit shut down and disconnected from the grid immediately. Component DA19, QA19, QA20, DA20 damaged. LCD no display. No hazards.			
QA29 Pin C-G		S/C		Output breaker opened. The unit shut down and disconnected from the grid immediately. Component QA29, QA28 damaged. LCD no display and no hazards.			
QA19 Pin C-E		S/C		The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.			
CA129		S/C		The unit shut down and disconnected from the grid immediately. Components QD1, QD2, QD3, DA19, DA20, QA19, QA20, DA24, DA25, QA28, QA29 damaged. LCD no display. No hazards.			
CD1		S/C		The unit shut down and disconnected from the grid immediately. Output breaker opened. Components QD2, QD3, QD1 damaged. Error message:"ID66, ID27, ID26, ID02, ID70". No hazards			
CB25		S/C		The unit operated normally. No damage and no hazard.			
CB44 (for AC current transducer)		S/C		The unit shut down and disconnected from the grid immediately. No damaged and no hazards.			
DA11		S/C		The unit shut down and disconnected from the grid immediately. DC fan stopped. LCD no display. No damaged and no hazards.			
DA13		S/C		The unit shut down and disconnected from the grid immediately. DC fan stop. LCD no display. No damaged and no hazards.			
DA8		S/C		The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.			

Appendix 1- Test Result

DA6	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards
QA5 D-G	S/C	The unit shut down and disconnected from the grid immediately. Components QA5, RA146, RA145, RA152, RA153, RA154,QA12, DA6 damaged. LCD no display. No hazards
QA5 D-S	S/C	The unit shut down and disconnected from the grid immediately. Components QA5, RA146, RA145, RA152, RA153, RA154, UA12, CA85, DA6, RA124, QD1, QD2, QD3 damaged. LCD no display. No hazards.
UA14 Pin1-2	S/C	DC fan speeded up. After about 3 min, the unit shut down and disconnected from the grid immediately. Components DA15, RA47, QA6, CA110, CA114, UA12, QA9 damaged. LCD no display. No hazards.
UA14 pin 3-4	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.
TA1 Pin4-8	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.
TA1 Pin Pin 9-11	S/C	The unit shut down and disconnected from the grid immediately. LCD no display. No damaged and no hazards.
TA1 Pin14-16	S/C	The unit shut down and disconnected from the grid immediately. No damaged and no hazards.
<p>Supplementary information:</p> <p>SC: Short-circuited; OC: Open-circuited; O/L: Overloaded.</p> <p>During the test:</p> <p>Fire do not propagates beyond the EUT; Equipment do not emitt molten metal; Enclosures do not deform to cause non-compliance with the standard. Pass the dielectric test.</p>		

6.5.2 Rated Voltage (Un)	Protective functions (Results of Voltage monitoring)					
	230V		Rated Frequency		50 Hz	
	1	2	3	4	5	6
Phase R	(V)	(ms)	(V)	(ms)	(V)	(ms)
118% Un	272.4	108.0	271.8	114.0	272.2	116.0
77% Un	176.8	123.8	177.1	115.0	176.8	134.0
Phase S	(V)	(ms)	(V)	(ms)	(V)	(ms)
118% Un	272.4	125.0	271.8	110.0	116.0	116.0
77% Un	176.8	129.0	177.1	121.0	176.8	130.0
Phase T	(V)	(ms)	(V)	(ms)	(V)	(ms)
118% Un	272.4	117.0	271.8	110.0	116.0	121.0
77% Un	176.8	107.5	177.1	121.0	176.8	123.0
Phase R,S,T	(V)	(ms)	(V)	(ms)	(V)	(ms)
118% Un	272.4	99.0	271.8	117.0	116.0	122.0
77% Un	176.8	116	177.1	108.0	176.8	131.0

Appendix 1- Test Result

6.5.2	Protective functions (Results of the Protection of the Increase in Voltage as 10-min moving average)		
	Output Voltage (V)	Switch	
		On/Off state Finally	Time until Switch off (s)
100% Un	231.11	<input checked="" type="checkbox"/> On <input type="checkbox"/> Off	Work normally
112% Un	258.06	<input type="checkbox"/> On <input checked="" type="checkbox"/> Off	475s
100% Un	230.0	<input checked="" type="checkbox"/> On <input type="checkbox"/> Off	Work normally
108% Un	248.8	<input checked="" type="checkbox"/> On <input type="checkbox"/> Off	Work normally
106% Un	243.9	<input checked="" type="checkbox"/> On <input type="checkbox"/> Off	Work normally
114% Un	262.8	<input type="checkbox"/> On <input checked="" type="checkbox"/> Off	263s

6.5.2	Protective functions (Results of Frequency)					
	1		2		3	
	f (Hz)	Trip time (ms)	f (Hz)	Trip time (ms)	f (Hz)	Trip time (ms)
Frequency decrease	47.45	105.0	47.45	85.0	47.45	100.0
Frequency increase	51.55	112.0	51.55	106.0	51.55	114.0

Appendix 1- Test Result

6.5.3		TABLE: Islanding detection				P
Q =		2.1		Klurfactor =		1.1
L =		36.09 mH		C =		2529.8 uF
P = 1.0 P _N = (W)	20000W	P = 0.5 P _N = (W)	10000W	P = 0.25 P _N = (W)	5000W	
L =41.04KVar	Cut-off time (ms)	L =20.52KVar	Cut-off time	L =10.26KVar	Cut-off time	
95%	289	95%	1080	95%	224	
96%	375	96%	1150	96%	240	
97%	413	97%	1170	97%	198	
98%	318	98%	1120	98%	218	
99%	412	99%	1150	99%	262	
100%	412	100%	386	100%	836	
101%	380	101%	362	101%	828	
102%	370	102%	338	102%	775	
103%	368	103%	1130	103%	804	
104%	412	104%	980	104%	780	
105%	374	105%	90	105%	764	
Supplementary information:						

8.3.1 (5.5.1 & 5.5.2)	Connection conditions		
DC input:	AC output:		Rated Output Power
750Vdc	230Vac;	50Hz	20kW
Measure Item	Reconnection?		Reconnection Time (>60s)
f _{ist} = 47,45Hz	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Can not reconnection
f _{ist} ≥ 47,55Hz	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	74.4s
f _{ist} = 50,1Hz	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Can not reconnection
f _{ist} ≤ 50,0Hz	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	74.0s
U _{ist} < 85% U _n	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Can not reconnection
U _{ist} ≥ 85% U _n	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	73.9s
U _{ist} > 110% U _n	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Can not reconnection
U _{ist} ≤ 110% U _n	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	74.4s

8.3.1 (5.5.1 & 5.5.2)	Short-time Interruption								
	1			2			3		
	U _n (V)	Repeated Time (s)	Gradient (W/min)	U _n (V)	Repeated Time (s)	Gradient (W/min)	U _n (V)	Repeated Time (s)	Gradient (W/min)
After 2s of 77% U _n	230	76.5	1825	230	76.0	1810	230	76.0	1804
After 4s of 77% U _n	230	79.0	1892	230	76.0	1828	230	78.0	1836

Appendix 1- Test Result

F.3 Requirements for the test report for power generation units

Extract from test report for unit certificate: 140327081GZU-001											
Determination of electrical properties											
Installation Type:	Grid-connected PV Inverter (Sofar 20000TL-S6)										
Manufacturer:	Shenzhen SOFARSOLAR Co., Ltd.										
Rated Voltage:	3/N/PE230V/400V										
Reactive power reference											
Active power $P/P_n(\%)$	10	20	30	40	50	60	70	80	90	100	
Max. possible $\cos \varphi$ <small>underexcited</small>	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Max. possible $\cos \varphi$ <small>overexcited</small>	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Compliance of required displacement factor $\cos \varphi$											
Default in system control	0.90 over	0.92 over	0.94 over	0.96 over	0.98 over	1.00	0.98 under	0.96 under	0.94 under	0.92 under	0.90 under
Measured value at PGU terminals	0.9046	0.9118	0.9428	0.9511	0.9755	0.9984	0.9744	0.9540	0.9315	0.9119	0.9043
Reactive power transfer function – Standard-$\cos \varphi$-(P)-characteristic											
Active power $P/P_n(\%)$	10	20	30	40	50	60	70	80	90	100	
$\cos \varphi$	0.9961	0.9963	0.9983	0.9989	0.9979	0.9744	0.9539	0.9319	0.9114	0.9089	
Conform to Standard- $\cos \varphi$ -(P)-characteristic											
Switching actions											
Making operation without default (of primary energy carrier)	k_i						--				
Worst case at switch over of generator sections	k_i						--				
Making operation at reference conditions (of primary energy carrier)	k_i						--				
Breaking operation at nominal power	k_i						--				
Worst-case value of all switching operations	$k_{i\max}$						0.383				
Flicker											
Angle of network impedance ψ_k :							32°				
Long-term flicker strength Plt:							0.196				

Appendix 1- Test Result

5.4.4		Harmonics and inter-harmonics (Harmonics according to DIN EN 61000-3-2)										
Model No.		Sofar 10000TL-S6										
Load current: <u>100</u> %												
Harm. order h		1	2	3	4	5	6	7	8	9	10	
Current (A)		14.4299	0.0051	0.0679	0.0201	0.1814	0.0020	0.1293	0.0055	0.0056	0.0015	
		14.4676	0.0078	0.0369	0.0165	0.1611	0.0018	0.1096	0.0040	0.0056	0.0031	
		14.4927	0.0129	0.0305	0.0183	0.1648	0.0023	0.1291	0.0036	0.0072	0.0026	
Limit (A)		--	1.08	2.30	0.43	1.14	0.30	0.77	0.23	0.40	0.184	
Harm. order h		11	12	13	14	15	16	17	18	19	20	
Current (A)		0.0466	0.0025	0.0360	0.0026	0.0085	0.0014	0.0175	0.0017	0.0127	0.0015	
		0.0423	0.0015	0.0288	0.0029	0.0019	0.0011	0.0208	0.0015	0.0123	0.0011	
		0.0423	0.0014	0.0394	0.0040	0.0046	0.0013	0.0171	0.0010	0.0182	0.0026	
Limit (A)		0.33000	0.15333	0.21000	0.13143	0.15000	0.11500	0.13235	0.10222	0.11842	0.09200	
Harm. order h		21	22	23	24	25	26	27	28	29	30	
Current (A)		0.0042	0.0018	0.0062	0.0006	0.0042	0.0024	0.0060	0.0016	0.0015	0.0006	
		0.0023	0.0011	0.0093	0.0012	0.0062	0.0010	0.0018	0.0002	0.0038	0.0023	
		0.0052	0.0026	0.0077	0.0008	0.0086	0.0026	0.0034	0.0015	0.0051	0.0016	
Limit (A)		0.10714	0.08364	0.09783	0.07667	0.09000	0.07077	0.08333	0.06571	0.07759	0.06133	
Harm. order h		31	32	33	34	35	36	37	38	39	40	
Current (A)		0.0017	0.0017	0.0036	0.0009	0.0025	0.0008	0.0044	0.0003	0.0049	0.0010	
		0.0030	0.0015	0.0015	0.0011	0.0016	0.0009	0.0052	0.0005	0.0028	0.0033	
		0.0039	0.0026	0.0042	0.0017	0.0024	0.0009	0.0007	0.0007	0.0025	0.0023	
Limit (A)		0.07258	0.05750	0.06818	0.05412	0.06429	0.05111	0.06081	0.04842	0.05769	0.04600	
THD (%)		1.792					PWHD(%)	--				
		1.549										
		1.678										
Limit (%)		5.0					Limit (%)	--				

5.4.4		Harmonics and inter-harmonics (Harmonics according to DIN EN 61000-3-12)									
Model No.		Sofar 20000TL-S6									
Load current: <u>100</u> %											
Harm. order h		1	2	3	4	5	6	7	8	9	10
Current(A)		28.8655	0.0362	0.0245	0.0238	0.1508	0.0013	0.1786	0.0114	0.0034	0.0072
		28.8378	0.0289	0.0442	0.0201	0.1597	0.0057	0.1590	0.0130	0.0070	0.0062
		28.8689	0.0328	0.0188	0.0258	0.1403	0.0052	0.1701	0.0139	0.0127	0.0070
Limit (A)		--	1.08	2.30	0.43	1.14	0.30	0.77	0.23	0.40	0.184
Harm. order h		11	12	13	14	15	16	17	18	19	20
Current (A)		0.0562	0.0019	0.0503	0.0028	0.0062	0.0013	0.0411	0.0006	0.0357	0.0039
		0.0558	0.0009	0.0402	0.0024	0.0076	0.0032	0.0413	0.0027	0.0304	0.0031
		0.0584	0.0017	0.0465	0.0047	0.0116	0.0019	0.0452	0.0024	0.0379	0.0033



Appendix 1- Test Result

Limit (A)	0.33000	0.15333	0.21000	0.13143	0.15000	0.11500	0.13235	0.10222	0.11842	0.09200
Harm. order h	21	22	23	24	25	26	27	28	29	30
Current(A)	0.0025	0.0022	0.0306	0.0024	0.0363	0.0021	0.0010	0.0005	0.0266	0.0015
	0.0079	0.0020	0.0316	0.0023	0.0301	0.0010	0.0062	0.0009	0.0264	0.0021
	0.0077	0.0004	0.0371	0.0010	0.0346	0.0017	0.0069	0.0010	0.0330	0.0031
Limit (A)	0.10714	0.08364	0.09783	0.07667	0.09000	0.07077	0.08333	0.06571	0.07759	0.06133
Harm. order h	31	32	33	34	35	36	37	38	39	40
Current(A)	0.0280	0.0021	0.0024	0.0013	0.0220	0.0011	0.0183	0.0007	0.0014	0.0007
	0.0240	0.0029	0.0092	0.0005	0.0193	0.0009	0.0152	0.0004	0.0060	0.0001
	0.0278	0.0017	0.0065	0.0010	0.0259	0.0021	0.0205	0.0002	0.0046	0.0005
Limit (A)	0.07258	0.05750	0.06818	0.05412	0.06429	0.05111	0.06081	0.04842	0.05769	0.04600
THD (%)	1.157				PWHD(%)		--			
	1.118									
	1.166									
Limit (%)	5.0				Limit (%)		--			

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 10000TL-S6 (Phase R)										
Power P/Pn[%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.00692	0.01748	0.01028	0.00663	0.00485	0.00413	0.00364	0.00323	0.00290	0.00268	0.00295
3	0.00469	0.00790	0.00438	0.00295	0.00258	0.00243	0.00230	0.00228	0.00224	0.00222	0.00242
4	0.00407	0.02099	0.01026	0.00685	0.00520	0.00398	0.00334	0.00287	0.00249	0.00220	0.00173
5	0.00324	0.07560	0.01568	0.01560	0.01592	0.01600	0.01519	0.01490	0.01504	0.01486	0.01448
6	0.00274	0.00229	0.00115	0.00072	0.00051	0.00040	0.00037	0.00033	0.00032	0.00030	0.00025
7	0.00318	0.05760	0.01191	0.00453	0.00724	0.00897	0.01004	0.01012	0.01008	0.01011	0.01022
8	0.00242	0.00770	0.00422	0.00287	0.00209	0.00146	0.00102	0.00079	0.00058	0.00047	0.00033
9	0.00416	0.00834	0.00429	0.00261	0.00175	0.00132	0.00109	0.00095	0.00084	0.00082	0.00071
10	0.00219	0.00613	0.00120	0.00128	0.00106	0.00101	0.00081	0.00066	0.00056	0.00047	0.00034
11	0.00251	0.04645	0.02158	0.01040	0.00399	0.00152	0.00152	0.00207	0.00253	0.00272	0.00293
12	0.00193	0.00175	0.00082	0.00056	0.00032	0.00030	0.00026	0.00024	0.00025	0.00020	0.00020
13	0.00239	0.04072	0.01937	0.00965	0.00438	0.00228	0.00172	0.00158	0.00163	0.00172	0.00172
14	0.00194	0.00704	0.00139	0.00078	0.00064	0.00085	0.00072	0.00060	0.00054	0.00047	0.00039
15	0.00189	0.00434	0.00301	0.00228	0.00166	0.00118	0.00090	0.00073	0.00065	0.00067	0.00066
16	0.00185	0.00686	0.00138	0.00056	0.00032	0.00047	0.00055	0.00051	0.00039	0.00035	0.00033
17	0.00185	0.02010	0.01894	0.00896	0.00389	0.00226	0.00203	0.00184	0.00180	0.00175	0.00167
18	0.00188	0.00164	0.00053	0.00032	0.00024	0.00022	0.00019	0.00016	0.00016	0.00014	0.00013
19	0.00187	0.01368	0.01516	0.00777	0.00422	0.00246	0.00153	0.00109	0.00105	0.00116	0.00131
20	0.00174	0.00207	0.00235	0.00155	0.00047	0.00047	0.00062	0.00058	0.00052	0.00039	0.00031
21	0.00203	0.00297	0.00155	0.00073	0.00060	0.00041	0.00038	0.00034	0.00030	0.00028	0.00020
22	0.00198	0.00213	0.00125	0.00086	0.00050	0.00026	0.00021	0.00023	0.00017	0.00019	0.00020
23	0.00222	0.01186	0.01066	0.00538	0.00322	0.00232	0.00161	0.00115	0.00101	0.00102	0.00104
24	0.00187	0.00129	0.00050	0.00034	0.00027	0.00021	0.00019	0.00016	0.00014	0.00012	0.00012
25	0.00181	0.01609	0.00873	0.00392	0.00239	0.00194	0.00147	0.00109	0.00094	0.00093	0.00096
26	0.00164	0.00142	0.00068	0.00102	0.00076	0.00029	0.00017	0.00028	0.00034	0.00029	0.00023
27	0.00182	0.00121	0.00110	0.00055	0.00034	0.00033	0.00026	0.00021	0.00019	0.00022	0.00020
28	0.00171	0.00185	0.00047	0.00078	0.00060	0.00036	0.00015	0.00019	0.00019	0.00015	0.00015
29	0.00173	0.01392	0.00668	0.00218	0.00141	0.00141	0.00121	0.00105	0.00103	0.00099	0.00099
30	0.00164	0.00127	0.00050	0.00028	0.00021	0.00019	0.00013	0.00013	0.00012	0.00011	0.00008
31	0.00176	0.01060	0.00700	0.00166	0.00088	0.00105	0.00105	0.00094	0.00083	0.00077	0.00071
32	0.00168	0.00121	0.00041	0.00051	0.00066	0.00049	0.00020	0.00014	0.00021	0.00023	0.00019
33	0.00185	0.00123	0.00128	0.00058	0.00033	0.00036	0.00022	0.00017	0.00016	0.00017	0.00015
34	0.00185	0.00144	0.00057	0.00032	0.00034	0.00031	0.00020	0.00018	0.00014	0.00011	0.00014
35	0.00184	0.00417	0.00774	0.00195	0.00045	0.00058	0.00077	0.00085	0.00087	0.00081	0.00073
36	0.00169	0.00115	0.00040	0.00023	0.00019	0.00016	0.00014	0.00012	0.00011	0.00010	0.00008
37	0.00193	0.00445	0.00778	0.00253	0.00038	0.00026	0.00050	0.00069	0.00080	0.00080	0.00079
38	0.00196	0.00185	0.00084	0.00038	0.00026	0.00025	0.00023	0.00016	0.00012	0.00011	0.00012
39	0.00183	0.00141	0.00070	0.00067	0.00047	0.00027	0.00026	0.00023	0.00021	0.00021	0.00018
40	0.00184	0.00237	0.00087	0.00035	0.00021	0.00034	0.00031	0.00019	0.00010	0.00010	0.00010

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 10000TL-S6 (Phase R)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (Hz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.00866	0.00560	0.00294	0.00476	0.00237	0.00260	0.00200	0.00226	0.00200	0.00232	0.00139
125	0.00657	0.00399	0.00217	0.00204	0.00157	0.00131	0.00118	0.00107	0.00094	0.00090	0.00080
175	0.00535	0.00790	0.00391	0.00144	0.00105	0.00091	0.00080	0.00074	0.00064	0.00063	0.00057
225	0.00461	0.00301	0.00161	0.00273	0.00209	0.00172	0.00147	0.00127	0.00110	0.00102	0.00089
275	0.00409	0.00307	0.00149	0.00113	0.00081	0.00069	0.00059	0.00052	0.00043	0.00046	0.00038
325	0.00364	0.00292	0.00141	0.00100	0.00079	0.00066	0.00057	0.00050	0.00043	0.00044	0.00039
375	0.00370	0.00919	0.00469	0.00097	0.00077	0.00060	0.00052	0.00041	0.00037	0.00034	0.00032
425	0.00338	0.00224	0.00106	0.00324	0.00242	0.00192	0.00164	0.00139	0.00125	0.00112	0.00101
475	0.00326	0.00989	0.00494	0.00085	0.00060	0.00045	0.00037	0.00035	0.00031	0.00028	0.00027
525	0.00300	0.00203	0.00102	0.00332	0.00252	0.00207	0.00177	0.00152	0.00134	0.00122	0.00110
575	0.00303	0.00182	0.00103	0.00065	0.00056	0.00048	0.00040	0.00035	0.00031	0.00027	0.00025
625	0.00283	0.00213	0.00094	0.00069	0.00051	0.00042	0.00036	0.00031	0.00025	0.00025	0.00022
675	0.00278	0.00810	0.00404	0.00064	0.00046	0.00040	0.00036	0.00028	0.00026	0.00024	0.00021
725	0.00284	0.00183	0.00083	0.00265	0.00201	0.00162	0.00139	0.00118	0.00102	0.00093	0.00083
775	0.00277	0.00414	0.00198	0.00053	0.00043	0.00033	0.00027	0.00025	0.00021	0.00020	0.00018
825	0.00275	0.00143	0.00086	0.00137	0.00102	0.00076	0.00064	0.00053	0.00048	0.00043	0.00037
875	0.00262	0.00148	0.00080	0.00053	0.00037	0.00030	0.00027	0.00024	0.00022	0.00019	0.00018
925	0.00276	0.00141	0.00081	0.00057	0.00039	0.00032	0.00025	0.00021	0.00017	0.00017	0.00015
975	0.00277	0.00135	0.00072	0.00049	0.00032	0.00028	0.00024	0.00021	0.00020	0.00018	0.00017
1025	0.00271	0.00140	0.00072	0.00050	0.00035	0.00030	0.00026	0.00020	0.00019	0.00018	0.00017
1075	0.00261	0.00135	0.00075	0.00048	0.00034	0.00027	0.00023	0.00019	0.00017	0.00016	0.00015
1125	0.00264	0.00141	0.00080	0.00050	0.00039	0.00031	0.00024	0.00019	0.00019	0.00018	0.00015
1175	0.00271	0.00135	0.00073	0.00048	0.00034	0.00026	0.00024	0.00020	0.00018	0.00016	0.00015
1225	0.00270	0.00133	0.00072	0.00044	0.00032	0.00027	0.00023	0.00020	0.00017	0.00016	0.00013
1275	0.00254	0.00123	0.00069	0.00044	0.00035	0.00024	0.00021	0.00020	0.00017	0.00017	0.00015
1325	0.00276	0.00126	0.00066	0.00042	0.00031	0.00023	0.00020	0.00017	0.00016	0.00015	0.00014
1375	0.00259	0.00128	0.00066	0.00042	0.00032	0.00024	0.00020	0.00018	0.00016	0.00015	0.00012
1425	0.00275	0.00122	0.00064	0.00041	0.00030	0.00022	0.00020	0.00018	0.00015	0.00014	0.00012
1475	0.00265	0.00119	0.00069	0.00043	0.00029	0.00024	0.00020	0.00017	0.00015	0.00015	0.00014
1525	0.00325	0.00132	0.00064	0.00039	0.00028	0.00022	0.00019	0.00017	0.00015	0.00013	0.00012
1575	0.00257	0.00122	0.00057	0.00044	0.00031	0.00024	0.00020	0.00018	0.00015	0.00015	0.00013
1625	0.00771	0.00330	0.00163	0.00040	0.00030	0.00024	0.00019	0.00016	0.00015	0.00014	0.00012
1675	0.00293	0.00122	0.00065	0.00111	0.00082	0.00064	0.00055	0.00046	0.00039	0.00034	0.00030
1725	0.00382	0.00146	0.00077	0.00039	0.00029	0.00022	0.00019	0.00018	0.00015	0.00013	0.00012
1775	0.00326	0.00143	0.00070	0.00050	0.00036	0.00030	0.00025	0.00020	0.00018	0.00016	0.00015
1825	0.00806	0.00262	0.00131	0.00044	0.00029	0.00024	0.00021	0.00018	0.00016	0.00016	0.00013
1875	0.00297	0.00106	0.00056	0.00092	0.00066	0.00052	0.00044	0.00036	0.00031	0.00028	0.00024
1925	0.00336	0.00133	0.00070	0.00039	0.00027	0.00022	0.00018	0.00015	0.00013	0.00013	0.00014
1975	0.00253	0.00112	0.00058	0.00044	0.00032	0.00027	0.00022	0.00018	0.00017	0.00014	0.00013

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 10000TL-S6 (Phase R)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (kHz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.00162	0.00091	0.00039	0.00027	0.00017	0.00016	0.00012	0.00011	0.00011	0.00010	0.00008
2.3	0.00177	0.00145	0.00044	0.00056	0.00021	0.00027	0.00020	0.00011	0.00009	0.00010	0.00008
2.5	0.00246	0.00149	0.00055	0.00071	0.00041	0.00036	0.00021	0.00013	0.00017	0.00017	0.00011
2.7	0.00197	0.00109	0.00038	0.00023	0.00023	0.00015	0.00015	0.00011	0.00010	0.00011	0.00009
2.9	0.00208	0.00142	0.00039	0.00043	0.00024	0.00020	0.00012	0.00016	0.00020	0.00022	0.00022
3.1	0.00509	0.00456	0.00212	0.00153	0.00098	0.00089	0.00071	0.00060	0.00057	0.00050	0.00036
3.3	0.00277	0.00112	0.00045	0.00031	0.00019	0.00022	0.00011	0.00012	0.00009	0.00008	0.00007
3.5	0.00201	0.00172	0.00076	0.00086	0.00041	0.00027	0.00025	0.00015	0.00011	0.00009	0.00007
3.7	0.00195	0.00115	0.00059	0.00037	0.00033	0.00028	0.00013	0.00011	0.00010	0.00010	0.00009
3.9	0.00236	0.00176	0.00072	0.00051	0.00030	0.00027	0.00019	0.00014	0.00010	0.00008	0.00008
4.1	0.00225	0.00106	0.00052	0.00023	0.00025	0.00017	0.00013	0.00014	0.00010	0.00009	0.00009
4.3	0.00201	0.00085	0.00045	0.00029	0.00024	0.00015	0.00013	0.00012	0.00010	0.00010	0.00013
4.5	0.00215	0.00128	0.00059	0.00037	0.00022	0.00021	0.00016	0.00011	0.00010	0.00009	0.00007
4.7	0.00202	0.00082	0.00050	0.00035	0.00020	0.00017	0.00015	0.00011	0.00010	0.00009	0.00009
4.9	0.00194	0.00094	0.00044	0.00037	0.00024	0.00021	0.00016	0.00012	0.00010	0.00009	0.00008
5.1	0.00200	0.00142	0.00069	0.00037	0.00025	0.00023	0.00019	0.00015	0.00010	0.00010	0.00008
5.3	0.00197	0.00125	0.00056	0.00035	0.00019	0.00018	0.00014	0.00011	0.00010	0.00010	0.00008
5.5	0.00238	0.00111	0.00052	0.00041	0.00027	0.00019	0.00019	0.00014	0.00011	0.00015	0.00009
5.7	0.00189	0.00094	0.00055	0.00032	0.00022	0.00017	0.00013	0.00011	0.00009	0.00008	0.00007
5.9	0.00203	0.00110	0.00046	0.00031	0.00023	0.00019	0.00013	0.00011	0.00009	0.00008	0.00008
6.1	0.00192	0.00115	0.00044	0.00035	0.00024	0.00018	0.00014	0.00011	0.00009	0.00010	0.00007
6.3	0.00225	0.00087	0.00039	0.00024	0.00017	0.00014	0.00012	0.00011	0.00009	0.00008	0.00008
6.5	0.00276	0.00184	0.00082	0.00051	0.00038	0.00024	0.00021	0.00019	0.00017	0.00013	0.00009
6.7	0.00203	0.00087	0.00038	0.00026	0.00023	0.00014	0.00014	0.00015	0.00012	0.00008	0.00007
6.9	0.00160	0.00075	0.00041	0.00027	0.00018	0.00015	0.00011	0.00010	0.00010	0.00008	0.00007
7.1	0.00167	0.00089	0.00042	0.00024	0.00020	0.00015	0.00013	0.00009	0.00007	0.00007	0.00006
7.3	0.00151	0.00081	0.00029	0.00019	0.00016	0.00012	0.00010	0.00010	0.00008	0.00006	0.00006
7.5	0.00153	0.00064	0.00033	0.00020	0.00016	0.00012	0.00011	0.00009	0.00007	0.00007	0.00006
7.7	0.00159	0.00086	0.00038	0.00025	0.00015	0.00013	0.00011	0.00009	0.00007	0.00007	0.00006
7.9	0.00163	0.00091	0.00034	0.00019	0.00014	0.00012	0.00009	0.00011	0.00008	0.00007	0.00006
8.1	0.00153	0.00067	0.00030	0.00022	0.00013	0.00012	0.00010	0.00007	0.00007	0.00007	0.00006
8.3	0.00159	0.00063	0.00029	0.00019	0.00015	0.00012	0.00010	0.00008	0.00007	0.00006	0.00005
8.5	0.00151	0.00061	0.00027	0.00019	0.00017	0.00013	0.00011	0.00010	0.00007	0.00006	0.00005
8.7	0.00159	0.00069	0.00029	0.00019	0.00013	0.00011	0.00008	0.00008	0.00007	0.00006	0.00005
8.9	0.00144	0.00060	0.00028	0.00018	0.00013	0.00010	0.00008	0.00008	0.00007	0.00006	0.00005

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 10000TL-S6 (Phase S)										
Power P/Pn[%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.00973	0.01983	0.01130	0.00754	0.00582	0.00489	0.00427	0.00375	0.00337	0.00308	0.00310
3	0.00712	0.01381	0.00917	0.00565	0.00419	0.00327	0.00256	0.00200	0.00162	0.00148	0.00167
4	0.00534	0.02170	0.01059	0.00703	0.00507	0.00380	0.00323	0.00275	0.00242	0.00215	0.00172
5	0.00425	0.07444	0.01524	0.01563	0.01613	0.01626	0.01565	0.01524	0.01518	0.01487	0.01448
6	0.00398	0.00246	0.00100	0.00064	0.00043	0.00038	0.00036	0.00034	0.00033	0.00027	0.00019
7	0.00375	0.05874	0.01207	0.00346	0.00543	0.00744	0.00887	0.00920	0.00940	0.00955	0.00971
8	0.00343	0.00713	0.00421	0.00288	0.00230	0.00150	0.00106	0.00078	0.00057	0.00046	0.00022
9	0.00383	0.01294	0.00551	0.00349	0.00247	0.00197	0.00170	0.00146	0.00137	0.00131	0.00130
10	0.00316	0.00523	0.00118	0.00129	0.00126	0.00114	0.00093	0.00074	0.00061	0.00054	0.00034
11	0.00331	0.05440	0.02027	0.00935	0.00427	0.00250	0.00201	0.00196	0.00219	0.00244	0.00273
12	0.00295	0.00217	0.00071	0.00042	0.00034	0.00025	0.00024	0.00021	0.00024	0.00019	0.00014
13	0.00328	0.04156	0.01948	0.00931	0.00463	0.00283	0.00213	0.00174	0.00158	0.00159	0.00150
14	0.00260	0.00886	0.00116	0.00071	0.00074	0.00092	0.00081	0.00063	0.00054	0.00046	0.00041
15	0.00285	0.00341	0.00336	0.00272	0.00181	0.00140	0.00109	0.00082	0.00075	0.00074	0.00076
16	0.00284	0.00652	0.00129	0.00056	0.00038	0.00060	0.00062	0.00059	0.00048	0.00040	0.00033
17	0.00285	0.01915	0.02038	0.00914	0.00372	0.00227	0.00212	0.00198	0.00187	0.00185	0.00181
18	0.00266	0.00222	0.00058	0.00040	0.00026	0.00023	0.00023	0.00018	0.00017	0.00014	0.00013
19	0.00258	0.01101	0.01628	0.00795	0.00400	0.00247	0.00171	0.00131	0.00124	0.00131	0.00133
20	0.00323	0.00268	0.00218	0.00143	0.00048	0.00042	0.00062	0.00057	0.00053	0.00042	0.00027
21	0.00299	0.00368	0.00223	0.00111	0.00074	0.00051	0.00043	0.00040	0.00035	0.00032	0.00026
22	0.00319	0.00212	0.00128	0.00089	0.00051	0.00025	0.00024	0.00029	0.00023	0.00021	0.00024
23	0.00291	0.01365	0.01118	0.00597	0.00327	0.00216	0.00148	0.00114	0.00101	0.00104	0.00102
24	0.00249	0.00171	0.00060	0.00035	0.00027	0.00023	0.00018	0.00014	0.00013	0.00011	0.00010
25	0.00265	0.01642	0.00908	0.00436	0.00228	0.00180	0.00149	0.00124	0.00106	0.00102	0.00102
26	0.00259	0.00217	0.00084	0.00108	0.00076	0.00025	0.00018	0.00025	0.00030	0.00027	0.00022
27	0.00249	0.00113	0.00100	0.00072	0.00058	0.00043	0.00040	0.00033	0.00027	0.00025	0.00022
28	0.00259	0.00130	0.00045	0.00082	0.00081	0.00040	0.00015	0.00025	0.00025	0.00020	0.00015
29	0.00269	0.01464	0.00663	0.00227	0.00145	0.00138	0.00120	0.00099	0.00092	0.00088	0.00088
30	0.00258	0.00174	0.00044	0.00026	0.00021	0.00016	0.00014	0.00012	0.00012	0.00012	0.00009
31	0.00257	0.00956	0.00739	0.00193	0.00092	0.00099	0.00101	0.00094	0.00088	0.00084	0.00081
32	0.00306	0.00104	0.00048	0.00043	0.00064	0.00050	0.00024	0.00015	0.00019	0.00022	0.00019
33	0.00269	0.00144	0.00173	0.00090	0.00058	0.00052	0.00041	0.00026	0.00017	0.00016	0.00014
34	0.00335	0.00184	0.00057	0.00035	0.00042	0.00037	0.00023	0.00019	0.00017	0.00015	0.00014
35	0.00272	0.00335	0.00803	0.00208	0.00039	0.00053	0.00076	0.00079	0.00078	0.00072	0.00066
36	0.00264	0.00143	0.00044	0.00024	0.00021	0.00017	0.00013	0.00012	0.00011	0.00010	0.00009
37	0.00273	0.00515	0.00762	0.00286	0.00051	0.00025	0.00041	0.00064	0.00079	0.00080	0.00078
38	0.00270	0.00213	0.00098	0.00047	0.00036	0.00032	0.00020	0.00018	0.00016	0.00015	0.00014
39	0.00269	0.00258	0.00161	0.00114	0.00071	0.00055	0.00035	0.00029	0.00035	0.00038	0.00034
40	0.00268	0.00226	0.00066	0.00038	0.00023	0.00041	0.00035	0.00019	0.00010	0.00010	0.00011

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 10000TL-S6 (Phase S)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (Hz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.01933	0.00559	0.00466	0.00493	0.00212	0.00237	0.00156	0.00202	0.00190	0.00218	0.00114
125	0.01254	0.00436	0.00228	0.00196	0.00123	0.00103	0.00079	0.00081	0.00074	0.00074	0.00051
175	0.00940	0.00314	0.00167	0.00135	0.00082	0.00069	0.00051	0.00049	0.00046	0.00050	0.00031
225	0.00773	0.00822	0.00419	0.00291	0.00214	0.00171	0.00148	0.00127	0.00113	0.00104	0.00090
275	0.00642	0.00235	0.00117	0.00095	0.00067	0.00046	0.00041	0.00043	0.00036	0.00036	0.00029
325	0.00586	0.00222	0.00117	0.00089	0.00058	0.00046	0.00039	0.00034	0.00033	0.00032	0.00026
375	0.00535	0.00199	0.00098	0.00083	0.00053	0.00043	0.00036	0.00032	0.00029	0.00027	0.00022
425	0.00498	0.00671	0.00343	0.00232	0.00173	0.00142	0.00115	0.00098	0.00085	0.00078	0.00072
475	0.00486	0.00182	0.00105	0.00078	0.00050	0.00046	0.00035	0.00030	0.00028	0.00024	0.00024
525	0.00476	0.00963	0.00492	0.00334	0.00252	0.00206	0.00176	0.00150	0.00133	0.00121	0.00106
575	0.00469	0.00176	0.00093	0.00067	0.00049	0.00036	0.00030	0.00027	0.00023	0.00023	0.00018
625	0.00422	0.00197	0.00100	0.00075	0.00059	0.00044	0.00035	0.00032	0.00025	0.00024	0.00021
675	0.00421	0.00180	0.00106	0.00064	0.00040	0.00034	0.00029	0.00024	0.00023	0.00022	0.00018
725	0.00415	0.00636	0.00319	0.00217	0.00162	0.00129	0.00107	0.00092	0.00081	0.00075	0.00065
775	0.00407	0.00148	0.00080	0.00054	0.00038	0.00030	0.00024	0.00021	0.00021	0.00019	0.00016
825	0.00406	0.00346	0.00179	0.00115	0.00084	0.00067	0.00054	0.00046	0.00041	0.00037	0.00034
875	0.00415	0.00149	0.00078	0.00057	0.00038	0.00030	0.00025	0.00021	0.00020	0.00018	0.00017
925	0.00410	0.00151	0.00080	0.00058	0.00036	0.00031	0.00024	0.00020	0.00018	0.00017	0.00015
975	0.00394	0.00153	0.00079	0.00050	0.00033	0.00027	0.00022	0.00020	0.00017	0.00017	0.00016
1025	0.00391	0.00143	0.00075	0.00053	0.00033	0.00027	0.00022	0.00019	0.00018	0.00016	0.00015
1075	0.00420	0.00141	0.00071	0.00054	0.00035	0.00029	0.00023	0.00018	0.00016	0.00017	0.00015
1125	0.00634	0.00181	0.00095	0.00068	0.00045	0.00035	0.00029	0.00025	0.00024	0.00022	0.00019
1175	0.00403	0.00139	0.00076	0.00046	0.00032	0.00027	0.00025	0.00019	0.00017	0.00017	0.00014
1225	0.00373	0.00134	0.00071	0.00048	0.00032	0.00027	0.00022	0.00017	0.00017	0.00016	0.00013
1275	0.00383	0.00118	0.00071	0.00044	0.00031	0.00025	0.00019	0.00018	0.00015	0.00016	0.00014
1325	0.00398	0.00117	0.00067	0.00042	0.00030	0.00023	0.00020	0.00017	0.00015	0.00014	0.00013
1375	0.00378	0.00124	0.00068	0.00044	0.00030	0.00024	0.00021	0.00016	0.00015	0.00014	0.00013
1425	0.00383	0.00126	0.00066	0.00041	0.00031	0.00025	0.00019	0.00015	0.00014	0.00014	0.00012
1475	0.00391	0.00116	0.00064	0.00042	0.00029	0.00023	0.00020	0.00016	0.00016	0.00014	0.00013
1525	0.00383	0.00120	0.00067	0.00040	0.00030	0.00023	0.00019	0.00016	0.00014	0.00013	0.00013
1575	0.00465	0.00138	0.00076	0.00048	0.00035	0.00029	0.00023	0.00020	0.00018	0.00016	0.00014
1625	0.00402	0.00118	0.00062	0.00040	0.00030	0.00023	0.00019	0.00016	0.00014	0.00012	0.00012
1675	0.01114	0.00304	0.00157	0.00102	0.00075	0.00059	0.00051	0.00043	0.00037	0.00032	0.00028
1725	0.00426	0.00117	0.00061	0.00045	0.00030	0.00024	0.00021	0.00017	0.00015	0.00014	0.00012
1775	0.00388	0.00119	0.00063	0.00041	0.00028	0.00023	0.00018	0.00015	0.00015	0.00014	0.00012
1825	0.00447	0.00126	0.00065	0.00043	0.00029	0.00024	0.00020	0.00017	0.00016	0.00014	0.00013
1875	0.01099	0.00330	0.00166	0.00114	0.00083	0.00065	0.00055	0.00046	0.00040	0.00035	0.00031
1925	0.00405	0.00115	0.00062	0.00041	0.00028	0.00023	0.00019	0.00017	0.00014	0.00013	0.00011
1975	0.00462	0.00131	0.00069	0.00043	0.00032	0.00026	0.00022	0.00018	0.00016	0.00014	0.00012

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 10000TL-S6 (Phase S)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (kHz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.00257	0.00140	0.00046	0.00029	0.00019	0.00016	0.00013	0.00011	0.00008	0.00009	0.00008
2.3	0.00310	0.00170	0.00042	0.00066	0.00023	0.00025	0.00013	0.00016	0.00017	0.00014	0.00008
2.5	0.00342	0.00144	0.00077	0.00088	0.00055	0.00044	0.00033	0.00019	0.00017	0.00017	0.00010
2.7	0.00350	0.00152	0.00041	0.00047	0.00042	0.00023	0.00023	0.00013	0.00011	0.00013	0.00012
2.9	0.00388	0.00262	0.00084	0.00076	0.00068	0.00035	0.00034	0.00019	0.00011	0.00015	0.00017
3.1	0.00926	0.00530	0.00250	0.00198	0.00140	0.00108	0.00095	0.00078	0.00073	0.00065	0.00044
3.3	0.00365	0.00106	0.00046	0.00030	0.00020	0.00018	0.00014	0.00011	0.00010	0.00009	0.00008
3.5	0.00356	0.00168	0.00103	0.00101	0.00042	0.00035	0.00035	0.00020	0.00019	0.00017	0.00010
3.7	0.00363	0.00235	0.00109	0.00069	0.00024	0.00031	0.00030	0.00013	0.00012	0.00011	0.00010
3.9	0.00342	0.00158	0.00079	0.00052	0.00026	0.00027	0.00019	0.00012	0.00010	0.00009	0.00010
4.1	0.00319	0.00152	0.00043	0.00029	0.00023	0.00017	0.00013	0.00014	0.00010	0.00010	0.00014
4.3	0.00312	0.00131	0.00049	0.00043	0.00032	0.00019	0.00014	0.00012	0.00010	0.00012	0.00012
4.5	0.00365	0.00113	0.00055	0.00035	0.00023	0.00021	0.00017	0.00011	0.00010	0.00009	0.00009
4.7	0.00334	0.00111	0.00073	0.00031	0.00030	0.00022	0.00018	0.00012	0.00010	0.00010	0.00011
4.9	0.00337	0.00141	0.00054	0.00041	0.00029	0.00027	0.00018	0.00013	0.00010	0.00009	0.00009
5.1	0.00366	0.00120	0.00054	0.00030	0.00022	0.00019	0.00015	0.00014	0.00010	0.00011	0.00011
5.3	0.00316	0.00089	0.00054	0.00041	0.00023	0.00026	0.00021	0.00015	0.00011	0.00014	0.00009
5.5	0.00303	0.00135	0.00055	0.00053	0.00030	0.00020	0.00021	0.00012	0.00009	0.00010	0.00009
5.7	0.00267	0.00075	0.00036	0.00027	0.00020	0.00016	0.00014	0.00010	0.00009	0.00009	0.00007
5.9	0.00324	0.00082	0.00037	0.00025	0.00029	0.00016	0.00013	0.00015	0.00013	0.00010	0.00008
6.1	0.00247	0.00140	0.00058	0.00033	0.00022	0.00018	0.00014	0.00011	0.00012	0.00011	0.00008
6.3	0.00235	0.00067	0.00035	0.00022	0.00018	0.00013	0.00011	0.00010	0.00008	0.00008	0.00007
6.5	0.00274	0.00131	0.00057	0.00042	0.00028	0.00019	0.00015	0.00014	0.00014	0.00013	0.00008
6.7	0.00248	0.00105	0.00044	0.00028	0.00020	0.00016	0.00011	0.00010	0.00009	0.00009	0.00007
6.9	0.00237	0.00063	0.00034	0.00022	0.00017	0.00012	0.00011	0.00009	0.00008	0.00007	0.00006
7.1	0.00217	0.00064	0.00031	0.00020	0.00016	0.00012	0.00012	0.00012	0.00009	0.00007	0.00006
7.3	0.00220	0.00073	0.00039	0.00023	0.00015	0.00014	0.00010	0.00009	0.00008	0.00007	0.00006
7.5	0.00226	0.00072	0.00028	0.00021	0.00016	0.00012	0.00010	0.00011	0.00009	0.00006	0.00006
7.7	0.00216	0.00063	0.00028	0.00019	0.00017	0.00011	0.00010	0.00011	0.00008	0.00007	0.00006
7.9	0.00213	0.00055	0.00031	0.00018	0.00013	0.00011	0.00009	0.00008	0.00007	0.00007	0.00006
8.1	0.00210	0.00056	0.00030	0.00021	0.00017	0.00012	0.00011	0.00010	0.00008	0.00007	0.00006
8.3	0.00227	0.00061	0.00032	0.00020	0.00015	0.00013	0.00010	0.00008	0.00007	0.00007	0.00005
8.5	0.00215	0.00053	0.00032	0.00019	0.00014	0.00012	0.00009	0.00008	0.00007	0.00007	0.00005
8.7	0.00215	0.00054	0.00035	0.00023	0.00017	0.00014	0.00012	0.00009	0.00007	0.00007	0.00005
8.9	0.00205	0.00060	0.00028	0.00021	0.00013	0.00012	0.00009	0.00007	0.00006	0.00006	0.00005

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 10000TL-S6 (Phase T)										
Power P/Pn[%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.00892	0.01843	0.01113	0.01254	0.00599	0.00508	0.00437	0.00389	0.00345	0.00322	0.00322
3	0.00799	0.00665	0.00273	0.00365	0.00173	0.00164	0.00185	0.00191	0.00210	0.00178	0.00140
4	0.00502	0.01990	0.00990	0.01106	0.00500	0.00383	0.00326	0.00281	0.00248	0.00217	0.00161
5	0.01596	0.06370	0.01260	0.02338	0.01472	0.01495	0.01418	0.01361	0.01345	0.01307	0.01284
6	0.00390	0.00192	0.00087	0.00107	0.00041	0.00034	0.00029	0.00029	0.00025	0.00023	0.00017
7	0.00344	0.05293	0.01045	0.00516	0.00609	0.00770	0.00881	0.00912	0.00922	0.00933	0.00948
8	0.00302	0.00661	0.00373	0.00454	0.00200	0.00138	0.00095	0.00071	0.00052	0.00039	0.00030
9	0.00330	0.00459	0.00204	0.00261	0.00118	0.00101	0.00093	0.00075	0.00075	0.00074	0.00074
10	0.00265	0.00520	0.00137	0.00232	0.00124	0.00112	0.00091	0.00069	0.00063	0.00053	0.00037
11	0.00281	0.04676	0.01859	0.01681	0.00491	0.00223	0.00118	0.00132	0.00193	0.00230	0.00271
12	0.00247	0.00164	0.00062	0.00078	0.00030	0.00025	0.00020	0.00018	0.00017	0.00016	0.00013
13	0.00255	0.03584	0.01967	0.01543	0.00423	0.00260	0.00230	0.00203	0.00189	0.00182	0.00172
14	0.00258	0.00763	0.00117	0.00110	0.00055	0.00076	0.00066	0.00053	0.00047	0.00041	0.00033
15	0.00233	0.00363	0.00139	0.00143	0.00054	0.00047	0.00034	0.00027	0.00025	0.00024	0.00024
16	0.00243	0.00550	0.00163	0.00116	0.00039	0.00060	0.00061	0.00056	0.00046	0.00038	0.00031
17	0.00232	0.01993	0.01795	0.01338	0.00351	0.00227	0.00202	0.00184	0.00174	0.00175	0.00173
18	0.00238	0.00154	0.00049	0.00060	0.00023	0.00020	0.00018	0.00016	0.00013	0.00011	0.00010
19	0.00450	0.01319	0.01477	0.01335	0.00423	0.00244	0.00159	0.00125	0.00127	0.00140	0.00145
20	0.00311	0.00184	0.00211	0.00240	0.00047	0.00035	0.00052	0.00052	0.00048	0.00036	0.00028
21	0.00497	0.00192	0.00125	0.00114	0.00063	0.00045	0.00038	0.00034	0.00030	0.00029	0.00026
22	0.00340	0.00143	0.00138	0.00167	0.00054	0.00023	0.00022	0.00029	0.00023	0.00023	0.00023
23	0.00425	0.01169	0.01044	0.00841	0.00271	0.00200	0.00147	0.00114	0.00100	0.00102	0.00104
24	0.00242	0.00136	0.00059	0.00059	0.00026	0.00021	0.00019	0.00018	0.00015	0.00011	0.00011
25	0.00224	0.01357	0.00754	0.00663	0.00246	0.00196	0.00148	0.00115	0.00106	0.00103	0.00103
26	0.00223	0.00203	0.00070	0.00145	0.00060	0.00027	0.00016	0.00020	0.00025	0.00026	0.00022
27	0.00206	0.00141	0.00073	0.00134	0.00048	0.00029	0.00017	0.00014	0.00014	0.00017	0.00017
28	0.00228	0.00138	0.00046	0.00135	0.00079	0.00040	0.00016	0.00024	0.00024	0.00020	0.00020
29	0.00200	0.01338	0.00649	0.00357	0.00128	0.00123	0.00103	0.00091	0.00090	0.00093	0.00095
30	0.00226	0.00114	0.00037	0.00047	0.00020	0.00016	0.00013	0.00013	0.00011	0.00010	0.00007
31	0.00221	0.00891	0.00629	0.00267	0.00090	0.00115	0.00107	0.00095	0.00084	0.00080	0.00076
32	0.00233	0.00135	0.00041	0.00068	0.00046	0.00045	0.00022	0.00013	0.00016	0.00019	0.00016
33	0.00245	0.00138	0.00110	0.00079	0.00031	0.00032	0.00027	0.00024	0.00025	0.00024	0.00020
34	0.00249	0.00125	0.00059	0.00056	0.00035	0.00035	0.00023	0.00017	0.00015	0.00014	0.00014
35	0.00219	0.00350	0.00778	0.00340	0.00040	0.00043	0.00067	0.00072	0.00076	0.00071	0.00061
36	0.00224	0.00118	0.00044	0.00052	0.00019	0.00016	0.00012	0.00011	0.00010	0.00009	0.00007
37	0.00229	0.00405	0.00696	0.00422	0.00040	0.00035	0.00048	0.00070	0.00081	0.00079	0.00076
38	0.00218	0.00156	0.00093	0.00088	0.00032	0.00024	0.00014	0.00019	0.00015	0.00011	0.00011
39	0.00228	0.00079	0.00098	0.00142	0.00041	0.00036	0.00024	0.00019	0.00020	0.00023	0.00027
40	0.00220	0.00230	0.00080	0.00070	0.00029	0.00046	0.00043	0.00021	0.00011	0.00012	0.00014

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 10000TL-S6 (Phase T)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (Hz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.01785	0.00613	0.00449	0.00788	0.00201	0.00261	0.00171	0.00212	0.00178	0.00204	0.00113
125	0.01201	0.00481	0.00271	0.00361	0.00139	0.00130	0.00108	0.00101	0.00079	0.00076	0.00065
175	0.00884	0.00283	0.00164	0.00220	0.00088	0.00084	0.00068	0.00064	0.00055	0.00054	0.00045
225	0.00755	0.00411	0.00220	0.00281	0.00120	0.00114	0.00108	0.00096	0.00085	0.00077	0.00068
275	0.00736	0.00238	0.00132	0.00178	0.00073	0.00063	0.00052	0.00047	0.00038	0.00040	0.00030
325	0.00539	0.00227	0.00120	0.00151	0.00060	0.00058	0.00045	0.00045	0.00033	0.00035	0.00030
375	0.00505	0.00228	0.00133	0.00174	0.00059	0.00054	0.00043	0.00039	0.00032	0.00031	0.00027
425	0.00457	0.00995	0.00512	0.00605	0.00271	0.00210	0.00180	0.00153	0.00135	0.00122	0.00108
475	0.00451	0.00201	0.00098	0.00127	0.00053	0.00043	0.00037	0.00030	0.00027	0.00026	0.00023
525	0.00410	0.00341	0.00185	0.00231	0.00100	0.00080	0.00066	0.00060	0.00053	0.00046	0.00041
575	0.00386	0.00168	0.00092	0.00101	0.00049	0.00038	0.00034	0.00031	0.00027	0.00025	0.00021
625	0.00387	0.00169	0.00094	0.00104	0.00042	0.00036	0.00030	0.00030	0.00023	0.00022	0.00020
675	0.00393	0.00180	0.00078	0.00099	0.00043	0.00036	0.00031	0.00025	0.00022	0.00020	0.00016
725	0.00380	0.00794	0.00398	0.00461	0.00209	0.00167	0.00142	0.00122	0.00106	0.00096	0.00086
775	0.00376	0.00164	0.00073	0.00087	0.00038	0.00035	0.00025	0.00023	0.00020	0.00019	0.00017
825	0.00360	0.00199	0.00098	0.00113	0.00048	0.00038	0.00033	0.00029	0.00024	0.00024	0.00020
875	0.00334	0.00143	0.00079	0.00089	0.00033	0.00029	0.00024	0.00021	0.00018	0.00018	0.00016
925	0.00392	0.00136	0.00079	0.00096	0.00037	0.00030	0.00024	0.00020	0.00018	0.00018	0.00015
975	0.00382	0.00138	0.00079	0.00081	0.00033	0.00029	0.00024	0.00022	0.00018	0.00017	0.00014
1025	0.00397	0.00120	0.00070	0.00092	0.00039	0.00032	0.00025	0.00020	0.00021	0.00019	0.00017
1075	0.00373	0.00140	0.00069	0.00086	0.00035	0.00030	0.00023	0.00019	0.00019	0.00017	0.00015
1125	0.00359	0.00118	0.00074	0.00090	0.00042	0.00033	0.00024	0.00019	0.00021	0.00020	0.00019
1175	0.00349	0.00122	0.00064	0.00082	0.00035	0.00028	0.00022	0.00019	0.00018	0.00017	0.00014
1225	0.00358	0.00110	0.00065	0.00085	0.00037	0.00031	0.00020	0.00018	0.00018	0.00017	0.00015
1275	0.00335	0.00109	0.00064	0.00070	0.00030	0.00025	0.00021	0.00018	0.00016	0.00014	0.00013
1325	0.00334	0.00112	0.00062	0.00071	0.00032	0.00024	0.00020	0.00017	0.00015	0.00015	0.00013
1375	0.00352	0.00114	0.00064	0.00071	0.00028	0.00023	0.00020	0.00017	0.00015	0.00014	0.00012
1425	0.00332	0.00115	0.00062	0.00069	0.00029	0.00024	0.00020	0.00017	0.00015	0.00014	0.00012
1475	0.00344	0.00108	0.00061	0.00068	0.00027	0.00024	0.00019	0.00016	0.00014	0.00014	0.00011
1525	0.00344	0.00110	0.00058	0.00061	0.00029	0.00022	0.00018	0.00016	0.00014	0.00013	0.00012
1575	0.00402	0.00121	0.00068	0.00073	0.00030	0.00025	0.00020	0.00017	0.00016	0.00014	0.00012
1625	0.00326	0.00107	0.00058	0.00063	0.00027	0.00023	0.00019	0.00016	0.00014	0.00013	0.00012
1675	0.00896	0.00229	0.00119	0.00133	0.00058	0.00047	0.00039	0.00032	0.00029	0.00025	0.00022
1725	0.00383	0.00118	0.00065	0.00070	0.00029	0.00023	0.00019	0.00017	0.00015	0.00014	0.00012
1775	0.00336	0.00100	0.00059	0.00063	0.00027	0.00023	0.00020	0.00015	0.00013	0.00013	0.00012
1825	0.00376	0.00109	0.00060	0.00061	0.00028	0.00022	0.00019	0.00016	0.00014	0.00013	0.00011
1875	0.00920	0.00261	0.00131	0.00154	0.00065	0.00053	0.00043	0.00036	0.00031	0.00028	0.00025
1925	0.00319	0.00103	0.00054	0.00063	0.00027	0.00023	0.00018	0.00015	0.00014	0.00013	0.00012
1975	0.00372	0.00109	0.00060	0.00068	0.00028	0.00023	0.00019	0.00016	0.00014	0.00013	0.00012

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 10000TL-S6 (Phase T)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (kHz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.00220	0.00094	0.00037	0.00042	0.00018	0.00017	0.00015	0.00012	0.00010	0.00009	0.00007
2.3	0.00296	0.00183	0.00038	0.00106	0.00021	0.00031	0.00019	0.00013	0.00015	0.00015	0.00011
2.5	0.00277	0.00124	0.00056	0.00136	0.00040	0.00037	0.00023	0.00012	0.00014	0.00011	0.00008
2.7	0.00229	0.00083	0.00038	0.00058	0.00018	0.00017	0.00012	0.00015	0.00015	0.00015	0.00011
2.9	0.00267	0.00097	0.00102	0.00049	0.00028	0.00025	0.00021	0.00023	0.00021	0.00022	0.00019
3.1	0.00919	0.00693	0.00337	0.00426	0.00177	0.00145	0.00119	0.00096	0.00083	0.00072	0.00047
3.3	0.00534	0.00251	0.00134	0.00140	0.00057	0.00052	0.00039	0.00035	0.00029	0.00022	0.00012
3.5	0.00290	0.00204	0.00118	0.00187	0.00055	0.00042	0.00042	0.00025	0.00021	0.00016	0.00009
3.7	0.00269	0.00268	0.00136	0.00085	0.00042	0.00046	0.00027	0.00014	0.00010	0.00008	0.00009
3.9	0.00233	0.00136	0.00052	0.00058	0.00023	0.00022	0.00015	0.00011	0.00011	0.00009	0.00009
4.1	0.00247	0.00174	0.00048	0.00047	0.00030	0.00021	0.00014	0.00017	0.00012	0.00011	0.00014
4.3	0.00248	0.00137	0.00063	0.00082	0.00032	0.00020	0.00014	0.00014	0.00012	0.00009	0.00011
4.5	0.00249	0.00102	0.00042	0.00045	0.00022	0.00016	0.00013	0.00012	0.00012	0.00008	0.00009
4.7	0.00260	0.00088	0.00053	0.00060	0.00036	0.00024	0.00022	0.00012	0.00011	0.00009	0.00008
4.9	0.00299	0.00139	0.00057	0.00052	0.00029	0.00021	0.00017	0.00013	0.00010	0.00009	0.00009
5.1	0.00294	0.00111	0.00059	0.00060	0.00025	0.00018	0.00017	0.00015	0.00012	0.00009	0.00009
5.3	0.00292	0.00144	0.00085	0.00093	0.00034	0.00031	0.00025	0.00019	0.00011	0.00016	0.00009
5.5	0.00301	0.00104	0.00060	0.00112	0.00038	0.00028	0.00025	0.00017	0.00011	0.00014	0.00008
5.7	0.00263	0.00092	0.00062	0.00064	0.00025	0.00023	0.00016	0.00013	0.00009	0.00009	0.00008
5.9	0.00273	0.00069	0.00041	0.00047	0.00023	0.00016	0.00013	0.00013	0.00013	0.00010	0.00008
6.1	0.00292	0.00085	0.00042	0.00041	0.00019	0.00014	0.00012	0.00012	0.00013	0.00009	0.00010
6.3	0.00300	0.00129	0.00058	0.00054	0.00022	0.00018	0.00015	0.00010	0.00011	0.00009	0.00008
6.5	0.00337	0.00139	0.00069	0.00078	0.00030	0.00019	0.00016	0.00015	0.00019	0.00011	0.00009
6.7	0.00245	0.00115	0.00053	0.00066	0.00027	0.00021	0.00013	0.00020	0.00014	0.00009	0.00007
6.9	0.00285	0.00066	0.00045	0.00043	0.00029	0.00025	0.00025	0.00013	0.00023	0.00021	0.00019
7.1	0.00230	0.00075	0.00034	0.00035	0.00014	0.00011	0.00011	0.00012	0.00009	0.00007	0.00006
7.3	0.00195	0.00067	0.00039	0.00035	0.00016	0.00013	0.00010	0.00013	0.00009	0.00007	0.00006
7.5	0.00202	0.00053	0.00037	0.00034	0.00016	0.00012	0.00011	0.00010	0.00008	0.00007	0.00006
7.7	0.00195	0.00081	0.00043	0.00040	0.00018	0.00013	0.00011	0.00014	0.00009	0.00007	0.00006
7.9	0.00205	0.00068	0.00032	0.00033	0.00014	0.00012	0.00009	0.00021	0.00007	0.00006	0.00006
8.1	0.00181	0.00053	0.00028	0.00031	0.00015	0.00011	0.00009	0.00014	0.00008	0.00007	0.00005
8.3	0.00186	0.00053	0.00027	0.00031	0.00020	0.00012	0.00013	0.00012	0.00007	0.00006	0.00005
8.5	0.00193	0.00066	0.00029	0.00032	0.00013	0.00011	0.00008	0.00016	0.00007	0.00006	0.00006
8.7	0.00184	0.00057	0.00024	0.00028	0.00014	0.00010	0.00008	0.00014	0.00007	0.00007	0.00005
8.9	0.00177	0.00056	0.00035	0.00042	0.00018	0.00014	0.00012	0.00019	0.00007	0.00006	0.00005

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 20000TL-S6 (Phase R)										
Power P/Pn[%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.00953	0.00626	0.00366	0.00965	0.00205	0.00176	0.00163	0.00141	0.00146	0.00163	0.00141
3	0.00881	0.01992	0.01199	0.00212	0.00806	0.00789	0.00754	0.00733	0.00764	0.00725	0.00610
4	0.00586	0.00584	0.00336	0.01827	0.00171	0.00142	0.00127	0.00115	0.00104	0.00086	0.00077
5	0.00621	0.02882	0.01641	0.00059	0.01749	0.01763	0.01579	0.01649	0.01270	0.01419	0.01237
6	0.00409	0.00132	0.00080	0.00739	0.00050	0.00044	0.00040	0.00034	0.00036	0.00032	0.00019
7	0.00564	0.03818	0.00437	0.00127	0.00958	0.00852	0.00890	0.00659	0.00915	0.00713	0.00810
8	0.00359	0.00203	0.00191	0.00093	0.00079	0.00046	0.00032	0.00027	0.00034	0.00027	0.00032
9	0.00345	0.00392	0.00142	0.00063	0.00064	0.00065	0.00070	0.00074	0.00085	0.00077	0.00080
10	0.00313	0.00133	0.00075	0.00145	0.00050	0.00037	0.00031	0.00027	0.00023	0.00023	0.00033
11	0.00330	0.05686	0.01161	0.00029	0.00266	0.00401	0.00427	0.00425	0.00412	0.00399	0.00347
12	0.00286	0.00104	0.00049	0.00375	0.00023	0.00021	0.00018	0.00017	0.00015	0.00016	0.00021
13	0.00305	0.05702	0.01289	0.00062	0.00054	0.00143	0.00173	0.00179	0.00175	0.00163	0.00171
14	0.00296	0.00309	0.00058	0.00160	0.00062	0.00045	0.00032	0.00022	0.00019	0.00017	0.00010
15	0.00284	0.00625	0.00257	0.00027	0.00146	0.00117	0.00096	0.00090	0.00082	0.00082	0.00082
16	0.00270	0.00191	0.00048	0.00357	0.00024	0.00022	0.00020	0.00017	0.00014	0.00015	0.00020
17	0.00296	0.04167	0.01121	0.00024	0.00034	0.00172	0.00233	0.00246	0.00246	0.00239	0.00216
18	0.00268	0.00114	0.00037	0.00404	0.00018	0.00013	0.00011	0.00020	0.00011	0.00011	0.00019
19	0.00285	0.02230	0.00835	0.00045	0.00172	0.00059	0.00061	0.00078	0.00092	0.00100	0.00105
20	0.00270	0.00258	0.00120	0.00086	0.00054	0.00052	0.00041	0.00029	0.00020	0.00014	0.00014
21	0.00260	0.00287	0.00102	0.00024	0.00061	0.00046	0.00046	0.00049	0.00054	0.00058	0.00048
22	0.00269	0.00098	0.00059	0.00334	0.00015	0.00013	0.00012	0.00012	0.00012	0.00011	0.00007
23	0.00271	0.01544	0.00445	0.00026	0.00182	0.00039	0.00098	0.00138	0.00156	0.00157	0.00150
24	0.00264	0.00104	0.00048	0.00238	0.00020	0.00017	0.00014	0.00011	0.00010	0.00009	0.00008
25	0.00273	0.01430	0.00394	0.00035	0.00170	0.00083	0.00031	0.00024	0.00045	0.00057	0.00059
26	0.00257	0.00161	0.00046	0.00037	0.00015	0.00015	0.00026	0.00018	0.00016	0.00014	0.00011
27	0.00241	0.00168	0.00052	0.00036	0.00025	0.00031	0.00033	0.00035	0.00040	0.00045	0.00045
28	0.00250	0.00102	0.00047	0.00120	0.00024	0.00021	0.00017	0.00013	0.00010	0.00009	0.00010
29	0.00265	0.01760	0.00417	0.00017	0.00137	0.00066	0.00025	0.00070	0.00095	0.00105	0.00102
30	0.00260	0.00065	0.00028	0.00180	0.00012	0.00011	0.00009	0.00009	0.00007	0.00007	0.00006
31	0.00249	0.01363	0.00418	0.00027	0.00119	0.00088	0.00047	0.00018	0.00023	0.00034	0.00043
32	0.00247	0.00120	0.00046	0.00050	0.00016	0.00013	0.00016	0.00019	0.00017	0.00014	0.00014
33	0.00268	0.00201	0.00063	0.00017	0.00026	0.00037	0.00033	0.00033	0.00034	0.00036	0.00042
34	0.00273	0.00101	0.00036	0.00146	0.00012	0.00010	0.00009	0.00008	0.00007	0.00008	0.00007
35	0.00285	0.01036	0.00387	0.00030	0.00082	0.00074	0.00025	0.00031	0.00059	0.00073	0.00079
36	0.00278	0.00056	0.00030	0.00170	0.00017	0.00013	0.00011	0.00010	0.00006	0.00009	0.00007
37	0.00296	0.00630	0.00270	0.00015	0.00102	0.00077	0.00056	0.00029	0.00021	0.00026	0.00024
38	0.00281	0.00065	0.00044	0.00029	0.00012	0.00010	0.00009	0.00008	0.00009	0.00009	0.00008
39	0.00258	0.00179	0.00076	0.00015	0.00026	0.00022	0.00030	0.00029	0.00028	0.00030	0.00032
40	0.00277	0.00083	0.00025	0.00965	0.00012	0.00009	0.00010	0.00010	0.00010	0.00007	0.00006

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 20000TL-S6 (Phase R)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (Hz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.01956	0.00468	0.00323	0.00279	0.00258	0.00227	0.00254	0.00415	0.00468	0.00457	0.00126
125	0.01267	0.00395	0.00217	0.00146	0.00129	0.00103	0.00100	0.00100	0.00096	0.00095	0.00058
175	0.00974	0.00276	0.00158	0.00116	0.00091	0.00077	0.00073	0.00076	0.00070	0.00075	0.00045
225	0.00785	0.00885	0.00453	0.00302	0.00233	0.00182	0.00155	0.00137	0.00127	0.00113	0.00041
275	0.00661	0.00185	0.00126	0.00085	0.00063	0.00051	0.00050	0.00048	0.00047	0.00048	0.00030
325	0.00605	0.00173	0.00105	0.00072	0.00060	0.00048	0.00046	0.00043	0.00043	0.00044	0.00029
375	0.00575	0.00150	0.00105	0.00065	0.00048	0.00039	0.00040	0.00037	0.00042	0.00036	0.00023
425	0.00505	0.00579	0.00297	0.00201	0.00149	0.00119	0.00102	0.00090	0.00085	0.00075	0.00023
475	0.00497	0.00161	0.00082	0.00061	0.00041	0.00031	0.00031	0.00030	0.00033	0.00032	0.00019
525	0.00481	0.01051	0.00530	0.00352	0.00269	0.00215	0.00183	0.00157	0.00139	0.00126	0.00019
575	0.00456	0.00162	0.00089	0.00059	0.00046	0.00035	0.00032	0.00027	0.00028	0.00026	0.00017
625	0.00444	0.00155	0.00079	0.00048	0.00040	0.00032	0.00028	0.00027	0.00025	0.00026	0.00015
675	0.00470	0.00127	0.00067	0.00049	0.00038	0.00027	0.00024	0.00023	0.00025	0.00023	0.00016
725	0.00430	0.00555	0.00274	0.00182	0.00137	0.00111	0.00094	0.00081	0.00071	0.00066	0.00015
775	0.00424	0.00104	0.00062	0.00040	0.00028	0.00024	0.00023	0.00021	0.00020	0.00021	0.00013
825	0.00421	0.00381	0.00181	0.00121	0.00086	0.00067	0.00056	0.00050	0.00044	0.00040	0.00014
875	0.00400	0.00115	0.00054	0.00050	0.00038	0.00030	0.00028	0.00031	0.00024	0.00021	0.00012
925	0.00403	0.00106	0.00061	0.00038	0.00026	0.00021	0.00019	0.00027	0.00018	0.00017	0.00012
975	0.00393	0.00114	0.00048	0.00032	0.00024	0.00020	0.00019	0.00019	0.00017	0.00017	0.00012
1025	0.00424	0.00110	0.00048	0.00031	0.00024	0.00019	0.00017	0.00016	0.00016	0.00016	0.00011
1075	0.00400	0.00090	0.00049	0.00031	0.00022	0.00017	0.00016	0.00014	0.00015	0.00015	0.00010
1125	0.00439	0.00092	0.00048	0.00032	0.00023	0.00017	0.00014	0.00015	0.00014	0.00014	0.00009
1175	0.00397	0.00089	0.00049	0.00030	0.00020	0.00019	0.00018	0.00016	0.00016	0.00014	0.00010
1225	0.00432	0.00089	0.00049	0.00030	0.00021	0.00017	0.00016	0.00014	0.00013	0.00012	0.00009
1275	0.00408	0.00100	0.00049	0.00030	0.00024	0.00019	0.00030	0.00016	0.00015	0.00014	0.00011
1325	0.00398	0.00083	0.00042	0.00027	0.00019	0.00016	0.00018	0.00015	0.00013	0.00012	0.00012
1375	0.00419	0.00084	0.00044	0.00026	0.00020	0.00017	0.00014	0.00013	0.00013	0.00012	0.00011
1425	0.00402	0.00084	0.00042	0.00027	0.00020	0.00016	0.00014	0.00013	0.00012	0.00011	0.00008
1475	0.00417	0.00085	0.00040	0.00025	0.00018	0.00015	0.00014	0.00015	0.00014	0.00012	0.00009
1525	0.00390	0.00092	0.00041	0.00026	0.00018	0.00015	0.00013	0.00013	0.00012	0.00011	0.00007
1575	0.00476	0.00144	0.00044	0.00026	0.00019	0.00016	0.00013	0.00013	0.00013	0.00012	0.00008
1625	0.00385	0.00083	0.00041	0.00024	0.00018	0.00026	0.00013	0.00012	0.00012	0.00011	0.00008
1675	0.01222	0.00173	0.00107	0.00054	0.00041	0.00032	0.00025	0.00022	0.00020	0.00018	0.00007
1725	0.00421	0.00087	0.00039	0.00026	0.00020	0.00015	0.00013	0.00012	0.00011	0.00015	0.00006
1775	0.00565	0.00091	0.00044	0.00043	0.00032	0.00013	0.00012	0.00012	0.00012	0.00017	0.00008
1825	0.00440	0.00080	0.00041	0.00029	0.00018	0.00015	0.00012	0.00012	0.00012	0.00013	0.00008
1875	0.01238	0.00155	0.00080	0.00047	0.00036	0.00028	0.00024	0.00021	0.00019	0.00017	0.00008
1925	0.00439	0.00079	0.00038	0.00022	0.00016	0.00013	0.00012	0.00011	0.00010	0.00010	0.00007
1975	0.00486	0.00077	0.00040	0.00024	0.00018	0.00014	0.00013	0.00011	0.00011	0.00010	0.00006

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 20000TL-S6 (Phase R)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (kHz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.00252	0.00059	0.00021	0.00014	0.00011	0.00008	0.00007	0.00006	0.00006	0.00006	0.00006
2.3	0.00311	0.00089	0.00040	0.00020	0.00015	0.00013	0.00008	0.00006	0.00005	0.00005	0.00006
2.5	0.00506	0.00078	0.00045	0.00022	0.00013	0.00010	0.00011	0.00011	0.00009	0.00007	0.00006
2.7	0.00279	0.00050	0.00020	0.00013	0.00010	0.00007	0.00007	0.00007	0.00006	0.00005	0.00005
2.9	0.00278	0.00056	0.00023	0.00014	0.00012	0.00009	0.00008	0.00007	0.00008	0.00009	0.00006
3.1	0.00981	0.00229	0.00095	0.00077	0.00058	0.00043	0.00035	0.00027	0.00022	0.00020	0.00018
3.3	0.00488	0.00075	0.00035	0.00026	0.00018	0.00012	0.00009	0.00006	0.00006	0.00005	0.00004
3.5	0.00430	0.00082	0.00038	0.00022	0.00016	0.00013	0.00009	0.00007	0.00005	0.00005	0.00003
3.7	0.00337	0.00048	0.00033	0.00016	0.00012	0.00010	0.00009	0.00007	0.00006	0.00006	0.00005
3.9	0.00353	0.00071	0.00035	0.00021	0.00014	0.00011	0.00009	0.00008	0.00006	0.00005	0.00003
4.1	0.00306	0.00053	0.00029	0.00019	0.00012	0.00009	0.00007	0.00006	0.00006	0.00005	0.00004
4.3	0.00307	0.00043	0.00026	0.00015	0.00010	0.00008	0.00006	0.00006	0.00005	0.00005	0.00002
4.5	0.00296	0.00061	0.00027	0.00019	0.00013	0.00009	0.00007	0.00006	0.00006	0.00005	0.00003
4.7	0.00322	0.00051	0.00021	0.00016	0.00010	0.00008	0.00007	0.00006	0.00006	0.00004	0.00002
4.9	0.00298	0.00060	0.00029	0.00024	0.00013	0.00009	0.00008	0.00006	0.00006	0.00005	0.00002
5.1	0.00333	0.00053	0.00025	0.00016	0.00012	0.00009	0.00007	0.00006	0.00005	0.00004	0.00002
5.3	0.00320	0.00045	0.00021	0.00016	0.00010	0.00011	0.00007	0.00005	0.00005	0.00004	0.00002
5.5	0.00294	0.00057	0.00027	0.00019	0.00013	0.00010	0.00008	0.00007	0.00005	0.00004	0.00002
5.7	0.00295	0.00049	0.00022	0.00014	0.00011	0.00008	0.00007	0.00006	0.00005	0.00004	0.00002
5.9	0.00278	0.00044	0.00026	0.00016	0.00012	0.00010	0.00008	0.00006	0.00005	0.00005	0.00002
6.1	0.00271	0.00048	0.00025	0.00016	0.00013	0.00009	0.00008	0.00007	0.00005	0.00004	0.00003
6.3	0.00324	0.00047	0.00021	0.00015	0.00012	0.00008	0.00008	0.00006	0.00005	0.00004	0.00002
6.5	0.00291	0.00049	0.00027	0.00019	0.00015	0.00012	0.00009	0.00007	0.00006	0.00004	0.00004
6.7	0.00293	0.00037	0.00020	0.00011	0.00009	0.00007	0.00007	0.00006	0.00005	0.00005	0.00003
6.9	0.00246	0.00040	0.00020	0.00012	0.00010	0.00007	0.00006	0.00006	0.00005	0.00004	0.00003
7.1	0.00303	0.00035	0.00018	0.00012	0.00010	0.00007	0.00006	0.00005	0.00004	0.00004	0.00003
7.3	0.00246	0.00041	0.00021	0.00014	0.00010	0.00007	0.00006	0.00005	0.00004	0.00003	0.00002
7.5	0.00296	0.00040	0.00019	0.00014	0.00010	0.00007	0.00007	0.00006	0.00005	0.00003	0.00002
7.7	0.00278	0.00036	0.00026	0.00016	0.00011	0.00009	0.00007	0.00005	0.00004	0.00004	0.00002
7.9	0.00283	0.00049	0.00020	0.00012	0.00009	0.00008	0.00007	0.00005	0.00004	0.00003	0.00002
8.1	0.00239	0.00038	0.00018	0.00013	0.00009	0.00008	0.00006	0.00005	0.00004	0.00003	0.00002
8.3	0.00222	0.00041	0.00018	0.00012	0.00008	0.00006	0.00006	0.00004	0.00004	0.00003	0.00002
8.5	0.00221	0.00035	0.00016	0.00011	0.00008	0.00007	0.00006	0.00004	0.00004	0.00003	0.00002
8.7	0.00230	0.00035	0.00017	0.00011	0.00009	0.00006	0.00005	0.00005	0.00004	0.00003	0.00002
8.9	0.00233	0.00035	0.00017	0.00010	0.00008	0.00006	0.00005	0.00005	0.00004	0.00004	0.00002

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 20000TL-S6 (Phase S)										
Power P/Pn[%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.00978	0.00672	0.00395	0.00264	0.00213	0.00186	0.00170	0.00150	0.00162	0.00171	0.00126
3	0.00803	0.02457	0.01432	0.00221	0.00206	0.00709	0.00639	0.00607	0.00623	0.00656	0.00574
4	0.00545	0.00725	0.00417	0.00180	0.00142	0.00137	0.00115	0.00102	0.00091	0.00075	0.00071
5	0.00511	0.02704	0.01839	0.01538	0.01411	0.01608	0.01361	0.01337	0.00978	0.01000	0.00738
6	0.00389	0.00183	0.00106	0.00087	0.00053	0.00025	0.00027	0.00029	0.00037	0.00038	0.00027
7	0.00443	0.03515	0.00273	0.00922	0.01096	0.00727	0.00805	0.00594	0.00869	0.00682	0.00787
8	0.00335	0.00212	0.00136	0.00112	0.00063	0.00033	0.00029	0.00022	0.00028	0.00023	0.00026
9	0.00312	0.00678	0.00240	0.00156	0.00086	0.00119	0.00157	0.00175	0.00175	0.00186	0.00192
10	0.00308	0.00158	0.00054	0.00088	0.00068	0.00039	0.00033	0.00029	0.00029	0.00020	0.00017
11	0.00307	0.05028	0.00921	0.00265	0.00125	0.00246	0.00267	0.00272	0.00280	0.00283	0.00265
12	0.00286	0.00114	0.00043	0.00044	0.00037	0.00020	0.00017	0.00016	0.00016	0.00021	0.00015
13	0.00295	0.05336	0.01036	0.00154	0.00175	0.00206	0.00243	0.00251	0.00248	0.00230	0.00211
14	0.00278	0.00250	0.00057	0.00060	0.00058	0.00030	0.00025	0.00020	0.00018	0.00016	0.00009
15	0.00251	0.00737	0.00192	0.00058	0.00099	0.00031	0.00062	0.00087	0.00102	0.00108	0.00113
16	0.00252	0.00316	0.00059	0.00044	0.00052	0.00031	0.00021	0.00019	0.00017	0.00017	0.00016
17	0.00274	0.03860	0.00910	0.00319	0.00034	0.00128	0.00188	0.00213	0.00225	0.00223	0.00209
18	0.00253	0.00097	0.00041	0.00020	0.00023	0.00016	0.00013	0.00021	0.00012	0.00012	0.00014
19	0.00292	0.02757	0.00740	0.00374	0.00092	0.00086	0.00152	0.00183	0.00199	0.00200	0.00188
20	0.00249	0.00203	0.00074	0.00031	0.00044	0.00033	0.00028	0.00022	0.00017	0.00010	0.00014
21	0.00266	0.00321	0.00207	0.00059	0.00061	0.00094	0.00113	0.00117	0.00114	0.00111	0.00100
22	0.00324	0.00163	0.00083	0.00025	0.00016	0.00016	0.00014	0.00012	0.00012	0.00013	0.00015
23	0.00257	0.01355	0.00357	0.00304	0.00156	0.00036	0.00063	0.00109	0.00133	0.00143	0.00149
24	0.00318	0.00087	0.00037	0.00026	0.00024	0.00017	0.00013	0.00011	0.00010	0.00009	0.00006
25	0.00280	0.01507	0.00282	0.00265	0.00146	0.00034	0.00070	0.00110	0.00129	0.00140	0.00134
26	0.00253	0.00116	0.00040	0.00028	0.00015	0.00011	0.00016	0.00013	0.00011	0.00011	0.00010
27	0.00240	0.00228	0.00097	0.00084	0.00037	0.00025	0.00056	0.00072	0.00078	0.00081	0.00079
28	0.00245	0.00134	0.00038	0.00036	0.00019	0.00017	0.00018	0.00015	0.00012	0.00010	0.00008
29	0.00248	0.01488	0.00371	0.00148	0.00125	0.00061	0.00021	0.00056	0.00088	0.00105	0.00108
30	0.00229	0.00091	0.00034	0.00026	0.00015	0.00010	0.00012	0.00009	0.00009	0.00008	0.00004
31	0.00265	0.01602	0.00366	0.00138	0.00127	0.00054	0.00033	0.00072	0.00097	0.00109	0.00109
32	0.00243	0.00120	0.00033	0.00025	0.00017	0.00011	0.00009	0.00010	0.00010	0.00011	0.00007
33	0.00251	0.00128	0.00122	0.00074	0.00041	0.00049	0.00056	0.00067	0.00070	0.00069	0.00068
34	0.00291	0.00147	0.00035	0.00017	0.00012	0.00011	0.00008	0.00008	0.00008	0.00007	0.00004
35	0.00238	0.00951	0.00282	0.00159	0.00110	0.00061	0.00026	0.00024	0.00052	0.00070	0.00074
36	0.00232	0.00074	0.00036	0.00039	0.00016	0.00010	0.00008	0.00009	0.00007	0.00012	0.00003
37	0.00277	0.00624	0.00292	0.00137	0.00079	0.00051	0.00028	0.00047	0.00068	0.00080	0.00076
38	0.00255	0.00082	0.00041	0.00016	0.00011	0.00010	0.00008	0.00008	0.00008	0.00007	0.00005
39	0.00237	0.00127	0.00148	0.00044	0.00039	0.00020	0.00021	0.00027	0.00036	0.00041	0.00043
40	0.00252	0.00061	0.00047	0.00023	0.00020	0.00012	0.00010	0.00011	0.00012	0.00008	0.00010

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 20000TL-S6 (Phase S)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (Hz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.02013	0.00334	0.00238	0.00242	0.00231	0.00196	0.00220	0.00395	0.00440	0.00436	0.00097
125	0.01271	0.00362	0.00189	0.00158	0.00123	0.00088	0.00078	0.00103	0.00086	0.00087	0.00033
175	0.00969	0.00214	0.00114	0.00085	0.00073	0.00053	0.00053	0.00072	0.00074	0.00075	0.00022
225	0.00757	0.00792	0.00413	0.00174	0.00139	0.00168	0.00145	0.00132	0.00128	0.00112	0.00020
275	0.00659	0.00149	0.00082	0.00069	0.00054	0.00037	0.00035	0.00047	0.00052	0.00049	0.00018
325	0.00589	0.00156	0.00082	0.00062	0.00047	0.00035	0.00032	0.00039	0.00040	0.00041	0.00017
375	0.00518	0.00119	0.00074	0.00056	0.00044	0.00034	0.00029	0.00035	0.00035	0.00036	0.00015
425	0.00495	0.00674	0.00339	0.00300	0.00228	0.00135	0.00114	0.00100	0.00092	0.00078	0.00013
475	0.00459	0.00164	0.00068	0.00045	0.00036	0.00029	0.00028	0.00032	0.00038	0.00033	0.00013
525	0.00468	0.00859	0.00436	0.00157	0.00119	0.00178	0.00152	0.00134	0.00119	0.00109	0.00013
575	0.00439	0.00150	0.00075	0.00049	0.00040	0.00028	0.00027	0.00029	0.00029	0.00026	0.00011
625	0.00425	0.00160	0.00080	0.00043	0.00037	0.00028	0.00026	0.00029	0.00028	0.00028	0.00010
675	0.00433	0.00126	0.00059	0.00044	0.00031	0.00028	0.00024	0.00028	0.00026	0.00025	0.00012
725	0.00399	0.00529	0.00257	0.00239	0.00181	0.00106	0.00091	0.00081	0.00072	0.00066	0.00010
775	0.00400	0.00122	0.00056	0.00037	0.00028	0.00021	0.00019	0.00021	0.00022	0.00021	0.00010
825	0.00396	0.00296	0.00134	0.00063	0.00049	0.00052	0.00043	0.00040	0.00037	0.00034	0.00012
875	0.00396	0.00107	0.00050	0.00036	0.00028	0.00021	0.00019	0.00027	0.00019	0.00018	0.00009
925	0.00395	0.00114	0.00057	0.00035	0.00025	0.00021	0.00018	0.00027	0.00020	0.00019	0.00009
975	0.00385	0.00088	0.00047	0.00028	0.00022	0.00019	0.00017	0.00021	0.00019	0.00017	0.00010
1025	0.00381	0.00092	0.00047	0.00027	0.00023	0.00018	0.00017	0.00018	0.00019	0.00017	0.00009
1075	0.00391	0.00090	0.00048	0.00026	0.00021	0.00017	0.00016	0.00017	0.00016	0.00015	0.00009
1125	0.00613	0.00111	0.00059	0.00030	0.00020	0.00020	0.00018	0.00019	0.00017	0.00016	0.00009
1175	0.00400	0.00091	0.00044	0.00029	0.00020	0.00017	0.00016	0.00017	0.00015	0.00014	0.00008
1225	0.00400	0.00087	0.00045	0.00030	0.00020	0.00017	0.00016	0.00015	0.00014	0.00014	0.00008
1275	0.00376	0.00091	0.00046	0.00027	0.00020	0.00018	0.00030	0.00016	0.00015	0.00014	0.00011
1325	0.00352	0.00085	0.00040	0.00029	0.00020	0.00016	0.00017	0.00016	0.00015	0.00013	0.00018
1375	0.00383	0.00080	0.00043	0.00025	0.00020	0.00017	0.00015	0.00015	0.00014	0.00012	0.00014
1425	0.00365	0.00080	0.00041	0.00023	0.00019	0.00015	0.00013	0.00014	0.00013	0.00012	0.00008
1475	0.00387	0.00093	0.00039	0.00023	0.00018	0.00016	0.00014	0.00015	0.00014	0.00013	0.00007
1525	0.00367	0.00094	0.00039	0.00023	0.00018	0.00015	0.00013	0.00014	0.00012	0.00012	0.00007
1575	0.00486	0.00131	0.00044	0.00024	0.00018	0.00017	0.00014	0.00014	0.00014	0.00012	0.00007
1625	0.00394	0.00078	0.00040	0.00023	0.00016	0.00025	0.00013	0.00012	0.00013	0.00011	0.00006
1675	0.01142	0.00159	0.00100	0.00044	0.00033	0.00031	0.00025	0.00022	0.00019	0.00018	0.00006
1725	0.00381	0.00079	0.00041	0.00024	0.00022	0.00014	0.00013	0.00011	0.00011	0.00015	0.00006
1775	0.00378	0.00067	0.00037	0.00071	0.00049	0.00013	0.00012	0.00013	0.00011	0.00019	0.00007
1825	0.00404	0.00074	0.00038	0.00036	0.00018	0.00014	0.00012	0.00012	0.00011	0.00017	0.00007
1875	0.01135	0.00169	0.00084	0.00043	0.00032	0.00031	0.00026	0.00023	0.00020	0.00018	0.00006
1925	0.00383	0.00072	0.00035	0.00022	0.00016	0.00014	0.00012	0.00012	0.00010	0.00009	0.00005
1975	0.00428	0.00072	0.00039	0.00023	0.00017	0.00014	0.00012	0.00012	0.00011	0.00010	0.00005

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 20000TL-S6 (Phase S)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (kHz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.00228	0.00058	0.00031	0.00012	0.00010	0.00008	0.00008	0.00007	0.00006	0.00007	0.00005
2.3	0.00280	0.00080	0.00037	0.00012	0.00010	0.00010	0.00009	0.00008	0.00006	0.00006	0.00005
2.5	0.00449	0.00076	0.00066	0.00021	0.00018	0.00015	0.00010	0.00010	0.00008	0.00006	0.00003
2.7	0.00347	0.00050	0.00038	0.00013	0.00012	0.00010	0.00007	0.00008	0.00009	0.00006	0.00004
2.9	0.00515	0.00060	0.00045	0.00014	0.00011	0.00010	0.00008	0.00008	0.00006	0.00007	0.00004
3.1	0.00965	0.00204	0.00098	0.00095	0.00073	0.00042	0.00035	0.00030	0.00023	0.00017	0.00014
3.3	0.00299	0.00073	0.00030	0.00046	0.00031	0.00012	0.00013	0.00010	0.00009	0.00008	0.00008
3.5	0.00474	0.00106	0.00054	0.00041	0.00032	0.00026	0.00019	0.00013	0.00008	0.00006	0.00005
3.7	0.00736	0.00155	0.00048	0.00038	0.00024	0.00022	0.00015	0.00009	0.00007	0.00005	0.00004
3.9	0.00816	0.00127	0.00055	0.00025	0.00017	0.00022	0.00015	0.00008	0.00009	0.00007	0.00005
4.1	0.00280	0.00055	0.00025	0.00016	0.00011	0.00010	0.00008	0.00006	0.00007	0.00006	0.00004
4.3	0.00289	0.00068	0.00030	0.00017	0.00011	0.00009	0.00006	0.00006	0.00007	0.00004	0.00003
4.5	0.00315	0.00070	0.00040	0.00015	0.00010	0.00010	0.00008	0.00007	0.00007	0.00005	0.00002
4.7	0.00340	0.00071	0.00038	0.00019	0.00013	0.00011	0.00008	0.00005	0.00006	0.00005	0.00002
4.9	0.00321	0.00079	0.00033	0.00015	0.00011	0.00011	0.00009	0.00007	0.00007	0.00005	0.00003
5.1	0.00287	0.00062	0.00029	0.00017	0.00011	0.00009	0.00007	0.00006	0.00006	0.00004	0.00003
5.3	0.00297	0.00056	0.00028	0.00018	0.00013	0.00015	0.00007	0.00006	0.00006	0.00005	0.00003
5.5	0.00245	0.00047	0.00033	0.00015	0.00014	0.00009	0.00008	0.00006	0.00005	0.00004	0.00002
5.7	0.00297	0.00051	0.00023	0.00015	0.00010	0.00008	0.00006	0.00007	0.00005	0.00004	0.00002
5.9	0.00298	0.00036	0.00020	0.00014	0.00009	0.00010	0.00008	0.00005	0.00005	0.00004	0.00003
6.1	0.00292	0.00059	0.00026	0.00011	0.00009	0.00010	0.00008	0.00007	0.00005	0.00004	0.00003
6.3	0.00301	0.00041	0.00019	0.00016	0.00012	0.00008	0.00007	0.00006	0.00005	0.00004	0.00002
6.5	0.00231	0.00040	0.00025	0.00012	0.00010	0.00009	0.00006	0.00006	0.00005	0.00005	0.00004
6.7	0.00231	0.00042	0.00026	0.00011	0.00009	0.00007	0.00006	0.00007	0.00004	0.00004	0.00002
6.9	0.00220	0.00038	0.00022	0.00028	0.00024	0.00008	0.00005	0.00006	0.00004	0.00004	0.00002
7.1	0.00268	0.00044	0.00021	0.00011	0.00008	0.00007	0.00006	0.00006	0.00004	0.00004	0.00002
7.3	0.00237	0.00039	0.00020	0.00010	0.00009	0.00008	0.00005	0.00005	0.00004	0.00004	0.00003
7.5	0.00238	0.00041	0.00016	0.00011	0.00008	0.00006	0.00007	0.00006	0.00004	0.00004	0.00002
7.7	0.00198	0.00031	0.00018	0.00011	0.00009	0.00007	0.00006	0.00005	0.00004	0.00003	0.00002
7.9	0.00208	0.00032	0.00019	0.00011	0.00009	0.00006	0.00005	0.00005	0.00004	0.00004	0.00002
8.1	0.00226	0.00036	0.00016	0.00009	0.00007	0.00008	0.00007	0.00004	0.00004	0.00003	0.00002
8.3	0.00229	0.00033	0.00018	0.00009	0.00008	0.00006	0.00005	0.00005	0.00004	0.00003	0.00002
8.5	0.00226	0.00030	0.00019	0.00013	0.00008	0.00006	0.00005	0.00005	0.00004	0.00003	0.00002
8.7	0.00201	0.00028	0.00016	0.00010	0.00007	0.00007	0.00005	0.00005	0.00004	0.00003	0.00002
8.9	0.00206	0.00031	0.00017	0.00010	0.00007	0.00006	0.00005	0.00005	0.00003	0.00003	0.00002

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 20000TL-S6 (Phase T)										
Power P/Pn[%]	0	10	20	30	40	50	60	70	80	90	100
Harmonic number	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2	0.00651	0.00578	0.00365	0.00281	0.00230	0.00184	0.00167	0.00156	0.00167	0.00162	0.00123
3	0.00575	0.00469	0.00261	0.01091	0.00828	0.00220	0.00208	0.00198	0.00194	0.00137	0.00262
4	0.00698	0.00549	0.00310	0.00240	0.00173	0.00126	0.00117	0.00119	0.00095	0.00082	0.00078
5	0.00329	0.01728	0.01467	0.01832	0.01643	0.01372	0.01126	0.01162	0.00791	0.00937	0.00897
6	0.00274	0.00204	0.00144	0.00070	0.00045	0.00032	0.00033	0.00032	0.00042	0.00037	0.00012
7	0.00286	0.03466	0.00393	0.00613	0.00842	0.00931	0.00987	0.00772	0.01029	0.00846	0.00927
8	0.00227	0.00239	0.00185	0.00083	0.00051	0.00036	0.00027	0.00026	0.00042	0.00030	0.00022
9	0.00210	0.00481	0.00261	0.00123	0.00091	0.00055	0.00071	0.00090	0.00086	0.00108	0.00114
10	0.00192	0.00109	0.00083	0.00054	0.00051	0.00045	0.00034	0.00029	0.00025	0.00026	0.00033
11	0.00187	0.05187	0.01178	0.00239	0.00179	0.00249	0.00274	0.00280	0.00274	0.00273	0.00246
12	0.00174	0.00132	0.00042	0.00037	0.00031	0.00023	0.00019	0.00017	0.00023	0.00018	0.00012
13	0.00183	0.05521	0.01086	0.00323	0.00156	0.00290	0.00314	0.00308	0.00294	0.00267	0.00255
14	0.00172	0.00204	0.00052	0.00045	0.00037	0.00042	0.00029	0.00024	0.00020	0.00020	0.00008
15	0.00166	0.00295	0.00124	0.00147	0.00100	0.00120	0.00124	0.00113	0.00102	0.00088	0.00079
16	0.00156	0.00281	0.00050	0.00034	0.00043	0.00039	0.00026	0.00018	0.00017	0.00018	0.00019
17	0.00160	0.03804	0.01004	0.00257	0.00040	0.00099	0.00124	0.00127	0.00130	0.00124	0.00120
18	0.00156	0.00120	0.00040	0.00022	0.00022	0.00020	0.00013	0.00034	0.00014	0.00012	0.00013
19	0.00190	0.02690	0.00902	0.00306	0.00099	0.00132	0.00189	0.00211	0.00217	0.00213	0.00214
20	0.00154	0.00211	0.00085	0.00038	0.00038	0.00042	0.00031	0.00023	0.00017	0.00014	0.00007
21	0.00158	0.00325	0.00148	0.00124	0.00066	0.00071	0.00068	0.00064	0.00056	0.00049	0.00048
22	0.00156	0.00143	0.00072	0.00029	0.00016	0.00019	0.00017	0.00013	0.00015	0.00014	0.00014
23	0.00161	0.01338	0.00425	0.00238	0.00144	0.00047	0.00045	0.00065	0.00079	0.00083	0.00085
24	0.00161	0.00120	0.00050	0.00025	0.00019	0.00022	0.00016	0.00012	0.00012	0.00010	0.00008
25	0.00173	0.01303	0.00406	0.00167	0.00131	0.00053	0.00087	0.00118	0.00133	0.00138	0.00135
26	0.00156	0.00072	0.00029	0.00018	0.00015	0.00013	0.00031	0.00014	0.00014	0.00011	0.00010
27	0.00148	0.00177	0.00079	0.00073	0.00032	0.00034	0.00059	0.00067	0.00065	0.00058	0.00050
28	0.00164	0.00134	0.00043	0.00035	0.00021	0.00021	0.00020	0.00018	0.00014	0.00011	0.00008
29	0.00142	0.01425	0.00429	0.00119	0.00102	0.00054	0.00019	0.00032	0.00050	0.00057	0.00061
30	0.00151	0.00094	0.00033	0.00024	0.00015	0.00012	0.00013	0.00009	0.00009	0.00008	0.00006
31	0.00179	0.01338	0.00435	0.00099	0.00090	0.00068	0.00044	0.00071	0.00089	0.00099	0.00100
32	0.00148	0.00059	0.00032	0.00016	0.00015	0.00016	0.00016	0.00015	0.00014	0.00010	0.00010
33	0.00165	0.00210	0.00145	0.00084	0.00069	0.00043	0.00038	0.00041	0.00041	0.00035	0.00026
34	0.00175	0.00098	0.00030	0.00020	0.00012	0.00011	0.00009	0.00010	0.00010	0.00010	0.00009
35	0.00148	0.00894	0.00368	0.00150	0.00081	0.00066	0.00030	0.00015	0.00031	0.00044	0.00047
36	0.00157	0.00082	0.00044	0.00024	0.00014	0.00008	0.00010	0.00008	0.00007	0.00008	0.00005
37	0.00154	0.00598	0.00328	0.00129	0.00057	0.00067	0.00031	0.00034	0.00051	0.00063	0.00068
38	0.00156	0.00054	0.00024	0.00017	0.00014	0.00009	0.00008	0.00007	0.00006	0.00007	0.00005
39	0.00153	0.00081	0.00072	0.00041	0.00020	0.00027	0.00030	0.00038	0.00042	0.00040	0.00037
40	0.00139	0.00051	0.00039	0.00022	0.00017	0.00013	0.00013	0.00015	0.00014	0.00010	0.00010

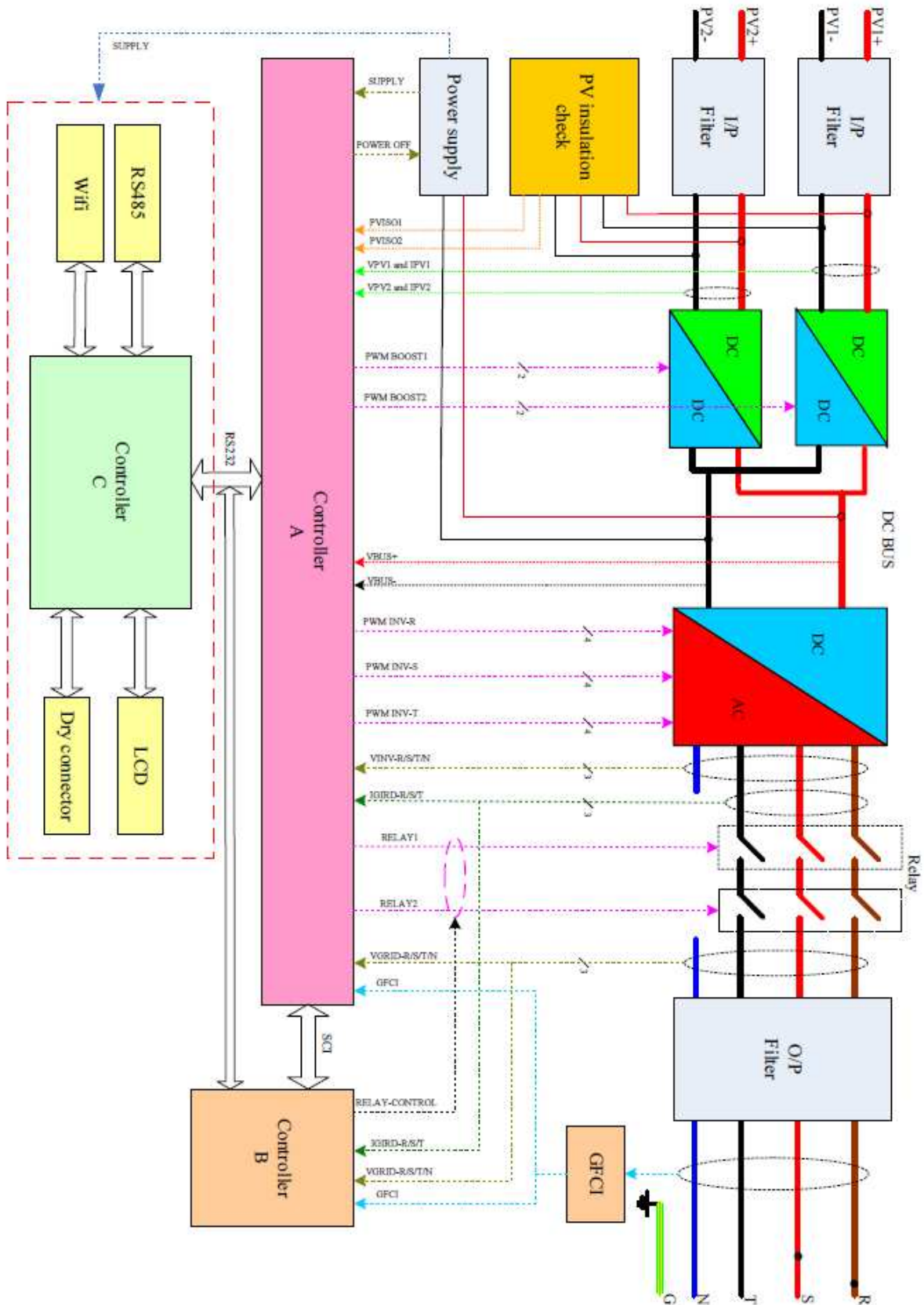
5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 20000TL-S6 (Phase T)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (Hz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
75	0.01360	0.00380	0.00239	0.00248	0.00243	0.00194	0.00205	0.00359	0.00433	0.00404	0.00101
125	0.00847	0.00394	0.00209	0.00136	0.00118	0.00099	0.00087	0.00094	0.00100	0.00087	0.00041
175	0.00684	0.00212	0.00116	0.00082	0.00072	0.00064	0.00055	0.00068	0.00083	0.00062	0.00033
225	0.00967	0.00499	0.00258	0.00274	0.00212	0.00111	0.00091	0.00093	0.00099	0.00085	0.00030
275	0.00444	0.00122	0.00086	0.00059	0.00046	0.00044	0.00045	0.00061	0.00064	0.00059	0.00022
325	0.00393	0.00124	0.00080	0.00053	0.00043	0.00040	0.00038	0.00038	0.00048	0.00041	0.00020
375	0.00356	0.00153	0.00085	0.00051	0.00042	0.00035	0.00033	0.00037	0.00053	0.00039	0.00018
425	0.00346	0.00882	0.00453	0.00223	0.00167	0.00180	0.00152	0.00135	0.00131	0.00109	0.00016
475	0.00323	0.00129	0.00065	0.00047	0.00035	0.00029	0.00029	0.00035	0.00043	0.00034	0.00014
525	0.00300	0.00445	0.00231	0.00296	0.00225	0.00097	0.00084	0.00076	0.00074	0.00066	0.00012
575	0.00281	0.00152	0.00070	0.00048	0.00038	0.00030	0.00029	0.00030	0.00033	0.00029	0.00016
625	0.00278	0.00141	0.00061	0.00050	0.00038	0.00030	0.00026	0.00027	0.00028	0.00028	0.00014
675	0.00267	0.00106	0.00055	0.00039	0.00030	0.00025	0.00021	0.00025	0.00028	0.00021	0.00012
725	0.00270	0.00706	0.00358	0.00174	0.00137	0.00144	0.00121	0.00105	0.00097	0.00086	0.00011
775	0.00248	0.00115	0.00057	0.00037	0.00031	0.00022	0.00020	0.00022	0.00025	0.00023	0.00011
825	0.00255	0.00195	0.00095	0.00086	0.00066	0.00038	0.00032	0.00033	0.00029	0.00028	0.00012
875	0.00256	0.00106	0.00048	0.00035	0.00026	0.00023	0.00021	0.00039	0.00022	0.00020	0.00012
925	0.00249	0.00118	0.00057	0.00036	0.00026	0.00021	0.00018	0.00041	0.00020	0.00019	0.00011
975	0.00238	0.00094	0.00045	0.00028	0.00022	0.00019	0.00017	0.00021	0.00019	0.00015	0.00009
1025	0.00389	0.00090	0.00045	0.00027	0.00022	0.00017	0.00016	0.00018	0.00019	0.00016	0.00009
1075	0.00339	0.00087	0.00047	0.00028	0.00022	0.00016	0.00015	0.00017	0.00018	0.00015	0.00009
1125	0.00308	0.00091	0.00046	0.00034	0.00025	0.00015	0.00014	0.00016	0.00015	0.00014	0.00008
1175	0.00324	0.00083	0.00047	0.00028	0.00022	0.00019	0.00016	0.00015	0.00016	0.00013	0.00009
1225	0.00363	0.00080	0.00048	0.00028	0.00021	0.00017	0.00017	0.00015	0.00014	0.00014	0.00009
1275	0.00247	0.00093	0.00046	0.00029	0.00022	0.00019	0.00050	0.00015	0.00015	0.00013	0.00009
1325	0.00230	0.00079	0.00041	0.00027	0.00018	0.00016	0.00021	0.00016	0.00015	0.00012	0.00012
1375	0.00236	0.00083	0.00040	0.00026	0.00019	0.00018	0.00014	0.00014	0.00014	0.00012	0.00010
1425	0.00239	0.00077	0.00036	0.00025	0.00018	0.00015	0.00013	0.00016	0.00012	0.00011	0.00007
1475	0.00247	0.00079	0.00038	0.00023	0.00018	0.00014	0.00013	0.00013	0.00012	0.00011	0.00008
1525	0.00240	0.00095	0.00039	0.00023	0.00018	0.00014	0.00011	0.00014	0.00014	0.00011	0.00007
1575	0.00279	0.00214	0.00040	0.00026	0.00020	0.00017	0.00013	0.00013	0.00013	0.00013	0.00007
1625	0.00239	0.00082	0.00042	0.00022	0.00017	0.00042	0.00012	0.00012	0.00014	0.00011	0.00007
1675	0.00662	0.00136	0.00139	0.00051	0.00038	0.00032	0.00021	0.00019	0.00017	0.00016	0.00007
1725	0.00251	0.00077	0.00042	0.00024	0.00020	0.00014	0.00012	0.00011	0.00013	0.00022	0.00006
1775	0.00237	0.00073	0.00036	0.00041	0.00028	0.00013	0.00011	0.00011	0.00011	0.00022	0.00007
1825	0.00243	0.00077	0.00037	0.00028	0.00018	0.00013	0.00011	0.00011	0.00011	0.00013	0.00006
1875	0.00625	0.00128	0.00068	0.00053	0.00040	0.00025	0.00020	0.00018	0.00017	0.00015	0.00007
1925	0.00229	0.00064	0.00034	0.00022	0.00016	0.00012	0.00011	0.00010	0.00010	0.00010	0.00007
1975	0.00272	0.00068	0.00036	0.00023	0.00018	0.00012	0.00011	0.00010	0.00011	0.00010	0.00006

5.4.4 Harmonics and inter-harmonics											
Model No.	Sofar 20000TL-S6 (Phase T)										
Active power P/P_n (%)	0	10	20	30	40	50	60	70	80	90	100
Frequency (kHz)	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]	I [%]
2.1	0.00148	0.00069	0.00027	0.00014	0.00012	0.00008	0.00007	0.00006	0.00006	0.00005	0.00005
2.3	0.00152	0.00093	0.00024	0.00021	0.00015	0.00008	0.00008	0.00007	0.00007	0.00006	0.00005
2.5	0.00248	0.00082	0.00042	0.00035	0.00021	0.00012	0.00010	0.00007	0.00005	0.00005	0.00006
2.7	0.00208	0.00057	0.00022	0.00019	0.00013	0.00008	0.00007	0.00006	0.00007	0.00007	0.00007
2.9	0.00169	0.00045	0.00030	0.00021	0.00014	0.00011	0.00009	0.00008	0.00009	0.00010	0.00007
3.1	0.00803	0.00280	0.00127	0.00066	0.00051	0.00055	0.00043	0.00035	0.00029	0.00021	0.00016
3.3	0.00480	0.00132	0.00062	0.00024	0.00016	0.00020	0.00018	0.00014	0.00012	0.00009	0.00008
3.5	0.00245	0.00103	0.00053	0.00040	0.00032	0.00024	0.00019	0.00014	0.00009	0.00007	0.00006
3.7	0.00456	0.00121	0.00071	0.00038	0.00026	0.00020	0.00012	0.00008	0.00005	0.00005	0.00004
3.9	0.00259	0.00065	0.00049	0.00030	0.00027	0.00014	0.00010	0.00007	0.00005	0.00006	0.00005
4.1	0.00161	0.00041	0.00024	0.00018	0.00012	0.00008	0.00006	0.00006	0.00005	0.00005	0.00003
4.3	0.00176	0.00057	0.00022	0.00017	0.00011	0.00007	0.00007	0.00007	0.00005	0.00004	0.00002
4.5	0.00210	0.00055	0.00029	0.00018	0.00012	0.00008	0.00007	0.00006	0.00005	0.00004	0.00002
4.7	0.00170	0.00046	0.00033	0.00021	0.00013	0.00010	0.00008	0.00006	0.00007	0.00005	0.00002
4.9	0.00193	0.00043	0.00023	0.00021	0.00013	0.00008	0.00008	0.00007	0.00006	0.00005	0.00003
5.1	0.00182	0.00050	0.00020	0.00019	0.00012	0.00008	0.00008	0.00007	0.00005	0.00005	0.00002
5.3	0.00171	0.00063	0.00027	0.00017	0.00013	0.00011	0.00007	0.00007	0.00005	0.00005	0.00003
5.5	0.00181	0.00046	0.00027	0.00020	0.00014	0.00010	0.00009	0.00008	0.00006	0.00005	0.00002
5.7	0.00181	0.00041	0.00020	0.00019	0.00009	0.00008	0.00007	0.00006	0.00005	0.00004	0.00002
5.9	0.00155	0.00037	0.00019	0.00019	0.00011	0.00008	0.00007	0.00006	0.00005	0.00004	0.00003
6.1	0.00182	0.00044	0.00019	0.00015	0.00014	0.00008	0.00007	0.00005	0.00005	0.00004	0.00002
6.3	0.00157	0.00044	0.00024	0.00013	0.00009	0.00008	0.00007	0.00005	0.00005	0.00005	0.00002
6.5	0.00184	0.00043	0.00017	0.00014	0.00011	0.00008	0.00007	0.00006	0.00006	0.00005	0.00005
6.7	0.00151	0.00034	0.00020	0.00013	0.00011	0.00007	0.00007	0.00007	0.00006	0.00005	0.00003
6.9	0.00442	0.00085	0.00047	0.00012	0.00009	0.00016	0.00007	0.00005	0.00005	0.00004	0.00009
7.1	0.00135	0.00036	0.00017	0.00013	0.00008	0.00006	0.00006	0.00006	0.00005	0.00004	0.00002
7.3	0.00138	0.00030	0.00016	0.00010	0.00009	0.00006	0.00005	0.00005	0.00004	0.00003	0.00002
7.5	0.00158	0.00030	0.00018	0.00013	0.00009	0.00006	0.00005	0.00005	0.00005	0.00004	0.00003
7.7	0.00154	0.00033	0.00016	0.00010	0.00009	0.00007	0.00007	0.00006	0.00005	0.00003	0.00002
7.9	0.00136	0.00034	0.00019	0.00011	0.00008	0.00007	0.00005	0.00005	0.00005	0.00003	0.00002
8.1	0.00133	0.00028	0.00015	0.00012	0.00010	0.00006	0.00005	0.00004	0.00004	0.00003	0.00002
8.3	0.00124	0.00031	0.00014	0.00011	0.00008	0.00006	0.00006	0.00004	0.00004	0.00003	0.00002
8.5	0.00118	0.00033	0.00020	0.00012	0.00008	0.00007	0.00005	0.00005	0.00004	0.00003	0.00002
8.7	0.00120	0.00030	0.00014	0.00011	0.00008	0.00005	0.00005	0.00005	0.00004	0.00003	0.00002
8.9	0.00125	0.00027	0.00016	0.00014	0.00007	0.00006	0.00005	0.00004	0.00004	0.00003	0.00002

F.4 Requirements for the test report for the NS protection

Extract from test report for unit certificate: 140327081GZU-001							
Determination of electrical properties							
<input checked="" type="checkbox"/> NS protection as integrated NS protection							
Type of NS protection: Integration				Other manufacturer's data			
Software/ firmware version: V1.00				Assigned to PGU type:			
Manufacturer: Shenzhen SOFARSOLAR Co., Ltd.				Integrated interface switch			
Measuring period:							
Protection function	Setting value	Tripping value (Vac)			Break time (ms)		
		1 st	2 nd	3 rd	1 st	2 nd	3 rd
Voltage drop protection $U <$	0.77 U_n	176.8	177.1	176.8	123.8	115.0	134.0
Voltage drop protection $U <$	0.8 U_n	--	--	--	--	--	--
Rise-in-voltage protection $U >$	1.1 U_n	--	--	--	475s*		
Rise-in-voltage protection $U >>$	1.15 U_n	--	--	--	--	--	--
Rise-in-voltage protection $U >>$	1.18 U_n	272.4	271.8	272.2	108.0	114.0	116.0
Frequency decrease protection $f <$	47.5 Hz	47.45	47.45	47.45	105.0	85.0	100.0
Frequency increase protection $f >$	51.5 Hz	51.55	51.55	51.55	112.0	106.0	114.0
Proper time of interface switch		20ms					
<p>The break time (sum of tripping time NS protection plus proper time of interface switch) shall not exceed 200ms. The verification of the full functional chain "NS protection – Interface switch" has yield to intended disconnection. * Results of the protection of the Increase in voltage as 10-min moving average</p>							

Appendix 2: System topology



Appendix 4: Test equipment list



Overall view of the unit



Bottom view of the unit

Appendix 4: Test equipment list

PV connector (Sofar 20000TL-Sx and Sofar 17000TL-Sx has 3x2 pairs)
(Sofar 15000TL-Sx and Sofar 10000TL-Sx has 2x2 pairs)



Terminals view of the unit (for models "-S2" to "-S6")



Terminals view of the unit (without AC switch)

Appendix 4: Test equipment list



Terminals view of the unit for model Sofar 10000TL-Sx



Terminals view of the unit (for models "-S0" to "-S1")

Appendix 4: Test equipment list

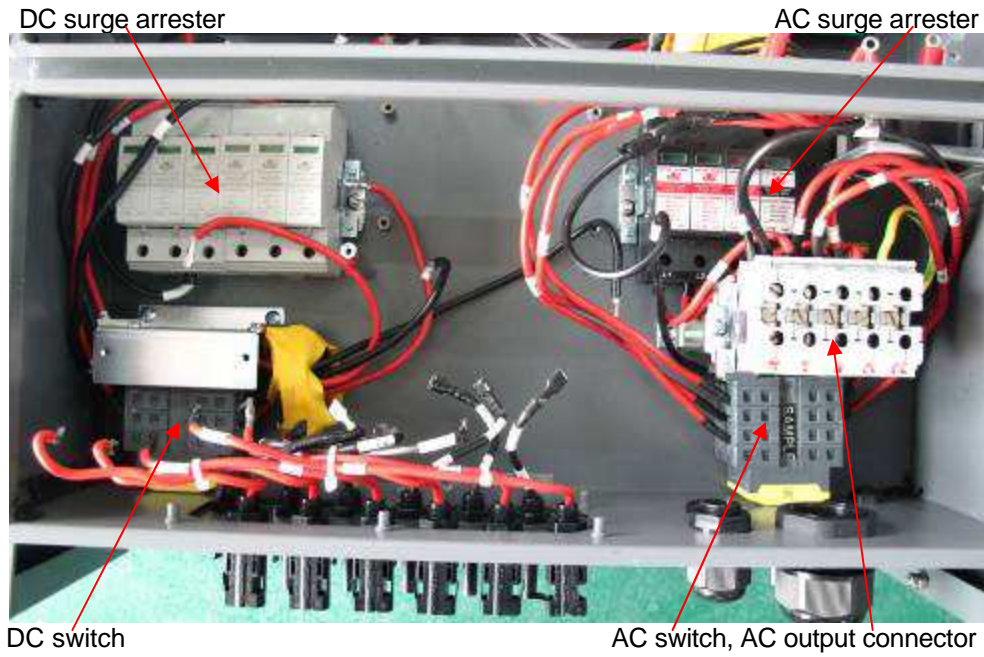


Internal view of the unit



Internal view of the unit

Appendix 4: Test equipment list



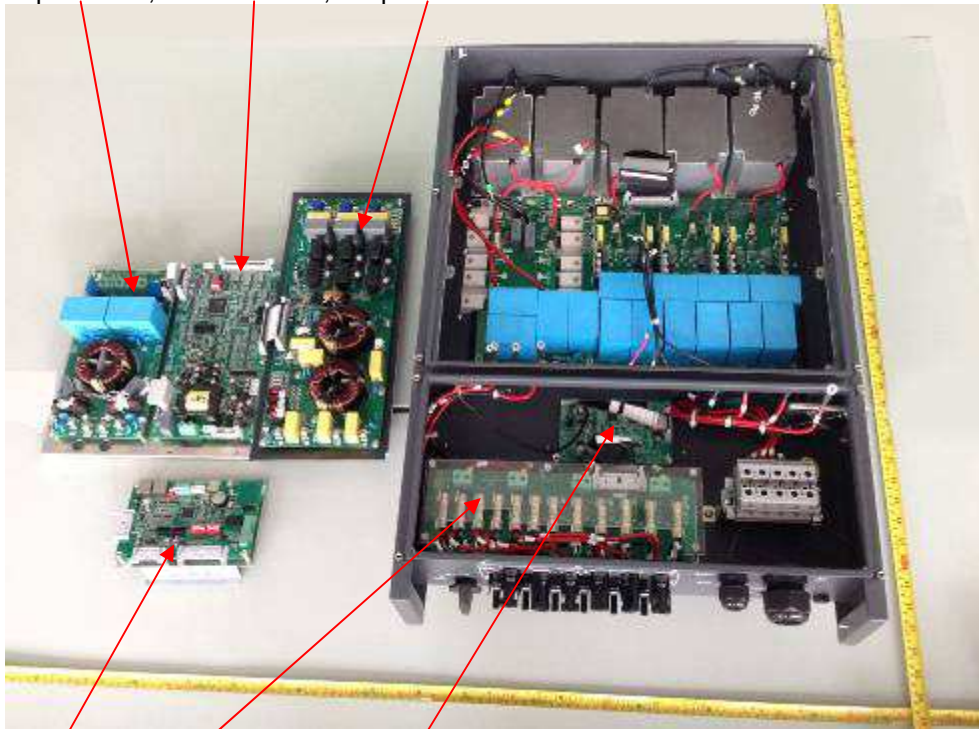
Internal view of the unit



Internal view of the unit

Appendix 4: Test equipment list

Input board, Control board, Output board



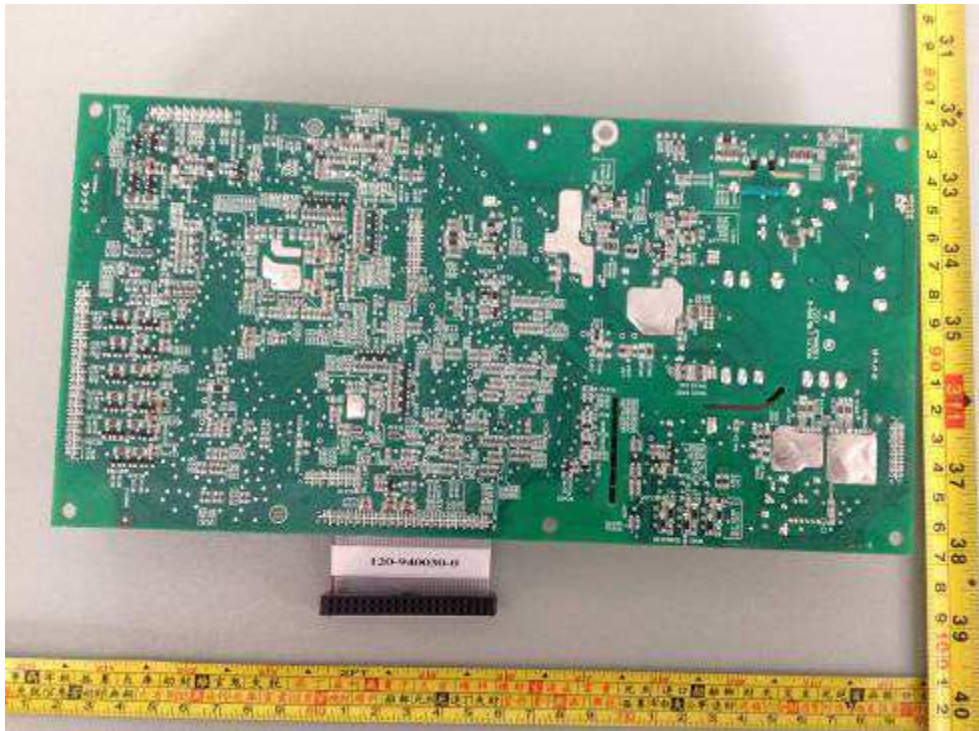
COM board, Fuse board, String detection board

Internal view of the unit



Front view of the control board

Appendix 4: Test equipment list



Bottom view of the control board

Appendix 4: Test equipment list

<u>Equipment Description:</u>				
<u>Number:</u>	<u>Equipment No.</u>	<u>Name</u>	<u>Brand</u>	<u>Model</u>
01	SA200-01	Power analyzer	YOKOWAWA	WT3000
02	SA200-04	DC Power	--	DCST-800-120
03	SA200-05	AC Power	--	ACST-L-33075
04	SA050-11	Oscillograph	Tektronix	TDS3052
05	SA002-17	Withstand voltage tester	KIKVSUI	T0S5052
06	SA023-08	Earthing resistor tester	OS	CS9950L
07	SA016-13	Programmable temperature and humidity test chamber	--	WGD/SJ-40408
08	SA200-02	RLC Load	--	ACLT-4830H