



**BUREAU
VERITAS**

Certificate of compliance

Applicant: SMA Solar Technology AG
Sonnenallee 1
34266 Niestetal
Germany

Product: Grid-tied photovoltaic (PV) inverter

Model: STP60-10
SHP75-10

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with Engineering Recommendation G59/3 for photovoltaic systems with a three-phase parallel coupling via an inverter in the public mains supply. The automatic disconnection device is an integral part of the aforementioned inverter. This serves as a replacement for the disconnection device with isolating function that can access the distribution network provider at any time.

Applied rules and standards:

Engineering Recommendation G59/3:2013, G59/3-1:2014, G59/3-2:2015, G59/3-3:2018

Recommendation for the Connection of Generating Plant to the Distribution Systems of licensed Distribution Network Operators.

DIN V VDE V 0126-1-1:2006-02 (Functional safety)

Automatic disconnection device between a generator and the public low-voltage grid

The STP60-10 and SHP75-10 are rated >16A per phase and $\geq 50\text{kW}$ (3 phase). The default values for "Small Power Stations" on the low-voltage grid were verified.

At the time of issue of this certificate the safety concept of an aforementioned representative product corresponds to the valid safety specifications for the specified use in accordance with regulations.

Report number: 14TH0075-G59/3_0
Certificate number: U18-0297
Date of issue: 2018-05-29

Certification body



Holger Schaffer

Certification body of Bureau Veritas Consumer Products Services Germany GmbH
Accredited according to DIN EN ISO/IEC 17065



Deutsche
Akkreditierungsstelle
D-ZE-12024-01-00

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G59/3.		
Manufacturer / applicant:	SMA Solar Technology AG Sonnenallee 1 34266 Niestetal Germany	
Generating Unit technology	Grid-tied photovoltaic inverter	
Rated values	STP60-10	SHP75-10
Maximum rated capacity	60kW	75kW
Rated voltage	230 / 400 V	230 / 400 V
Firmware version	1.32; 1.40; 1.45; 1.50; 1.60, 1.70, 1.80; 1.90 or above	
Measurement period:	2014-09-15 to 2014-09-19 2018-03-09 to 2018-05-14	
Description of the structure of the power generation unit (Figure 1):		
<p>The power generation unit is equipped with a PV and line-side EMC filter. The power generation unit has no galvanic isolation between DC input and AC output. Output switch-off is performed with single-fault tolerance based on two series-connected relays in line and neutral. This enables a safe disconnection of the power generation unit from the network in case of error.</p>		
<p>The above stated Generating Units are tested according the requirements in the Engineering Recommendation G59/3. Any modification that affects the stated tests must be named by the manufacturer/supplier of the product to ensure that the product meets all requirements of the Engineering Recommendation G59/3.</p>		

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Protection. Voltage tests. SHP75-10. 230 / 400V						
Phase L1 to L2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	346,6V	2,5s	346,0V	2,533s	353,5V / 3,5s	No trip
U/V stage 2	318,7V	0,5s	318,6V	0,535s	325,6V / 2,48s	No trip
					311,8V / 0,48s	No trip
O/V stage 1	454,1V	1,0s	454,5V	1,033s	447,2V / 2,0s	No trip
O/V stage 2	474,1V	0,5s	473,9V	0,532s	467,1V / 0,98s	No trip
					481V / 0,48s	No trip

Phase L2 to L3						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	346,6V	2,5s	346,1V	2,530s	353,5V / 3,5s	No trip
U/V stage 2	318,7V	0,5s	318,9V	0,536s	325,6V / 2,48s	No trip
					311,8V / 0,48s	No trip
O/V stage 1	454,1V	1,0s	454,2V	1,054s	447,2V / 2,0s	No trip
O/V stage 2	474,1V	0,5s	473,8V	0,554s	467,1V / 0,98s	No trip
					481V / 0,48s	No trip

Phase L3 to L1						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	346,6V	2,5s	346,2V	2,513s	353,5V / 3,5s	No trip
U/V stage 2	318,7V	0,5s	318,4V	0,515s	325,6V / 2,48s	No trip
					311,8V / 0,48s	No trip
O/V stage 1	454,1V	1,0s	454,0V	1,013s	447,2V / 2,0s	No trip
O/V stage 2	474,1V	0,5s	474,2V	0,514s	467,1V / 0,98s	No trip
					481V / 0,48s	No trip

Note. For Voltage tests the Voltage required to trip is the setting $\pm 3,45V$. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting $\pm 4V$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Protection. Voltage tests. SHP75-10. 240 / 416V						
Phase L1 to L2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	361,7V	2,5s	361,4V	2,545s	368,6V / 3,5s	No trip
U/V stage 2	332,6V	0,5s	332,4V	0,546s	339,5V / 2,48s	No trip
					325,6V / 0,48s	No trip
O/V stage 1	473,9V	1,0s	473,9V	1,047s	467V / 2,0s	No trip
O/V stage 2	494,7V	0,5s	494,8V	0,551s	487,7V / 0,98s	No trip
					500,9V / 0,48s	No trip

Phase L2 to L3						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	361,7V	2,5s	361,4V	2,526s	368,6V / 3,5s	No trip
U/V stage 2	332,6V	0,5s	332,3V	0,547s	339,5V / 2,48s	No trip
					325,6V / 0,48s	No trip
O/V stage 1	473,9V	1,0s	473,9V	1,047s	467V / 2,0s	No trip
O/V stage 2	494,7V	0,5s	494,8V	0,546s	487,7V / 0,98s	No trip
					500,9V / 0,48s	No trip

Phase L3 to L1						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	361,7V	2,5s	361,4V	2,546s	368,6V / 3,5s	No trip
U/V stage 2	332,6V	0,5s	332,4V	0,533s	339,5V / 2,48s	No trip
					325,6V / 0,48s	No trip
O/V stage 1	473,9V	1,0s	473,9V	1,056s	467V / 2,0s	No trip
O/V stage 2	494,7V	0,5s	494,8V	0,537s	487,7V / 0,98s	No trip
					500,9V / 0,48s	No trip

Note. For Voltage tests the Voltage required to trip is the setting $\pm 3,45V$. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting $\pm 4V$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Protection. Voltage tests. STP60-10. 230 / 400V						
Phase L1 to L2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	346,6V	2,5s	347,3V	2,510s	353,5V / 3,5s	No trip
U/V stage 2	318,7V	0,5s	319,2V	0,550s	325,6V / 2,48s	No trip
					311,8V / 0,48s	No trip
O/V stage 1	454,1V	1,0s	456,6V	1,040s	447,2V / 2,0s	No trip
O/V stage 2	474,1V	0,5s	477,4V	0,550s	467,1V / 0,98s	No trip
					481V / 0,48s	No trip

Phase L2 to L3						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	346,6V	2,5s	347,4V	2,560s	353,5V / 3,5s	No trip
U/V stage 2	318,7V	0,5s	319,6V	0,550s	325,6V / 2,48s	No trip
					311,8V / 0,48s	No trip
O/V stage 1	454,1V	1,0s	457,1V	1,050s	447,2V / 2,0s	No trip
O/V stage 2	474,1V	0,5s	477,5V	0,550s	467,1V / 0,98s	No trip
					481V / 0,48s	No trip

Phase L3 to L1						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	346,6V	2,5s	347,1V	2,540s	353,5V / 3,5s	No trip
U/V stage 2	318,7V	0,5s	319,7V	0,550s	325,6V / 2,48s	No trip
					311,8V / 0,48s	No trip
O/V stage 1	454,1V	1,0s	456,4V	1,050s	447,2V / 2,0s	No trip
O/V stage 2	474,1V	0,5s	477,4V	0,560s	467,1V / 0,98s	No trip
					481V / 0,48s	No trip

Note. For Voltage tests the Voltage required to trip is the setting $\pm 3,45V$. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting $\pm 4V$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Protection. Voltage tests. STP60-10. 240 / 416V						
Phase L1 to L2						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	361,7V	2,5s	361,1V	2,620s	368,6V / 3,5s	No trip
U/V stage 2	332,6V	0,5s	333,4V	0,550s	339,5V / 2,48s	No trip
					325,6V / 0,48s	No trip
O/V stage 1	473,9V	1,0s	475,8V	1,050s	467V / 2,0s	No trip
O/V stage 2	494,7V	0,5s	496,6V	0,550s	487,7V / 0,98s	No trip
					500,9V / 0,48s	No trip

Phase L2 to L3						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	361,7V	2,5s	363,4V	2,620s	368,6V / 3,5s	No trip
U/V stage 2	332,6V	0,5s	333,6V	0,550s	339,5V / 2,48s	No trip
					325,6V / 0,48s	No trip
O/V stage 1	473,9V	1,0s	475,8V	1,060s	467V / 2,0s	No trip
O/V stage 2	494,7V	0,5s	496,6V	0,540s	487,7V / 0,98s	No trip
					500,9V / 0,48s	No trip

Phase L3 to L1						
Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage	Time delay	Voltage / time	Confirm no trip
U/V stage 1	361,7V	2,5s	361,3V	2,630s	368,6V / 3,5s	No trip
U/V stage 2	332,6V	0,5s	333,4V	0,560s	339,5V / 2,48s	No trip
					325,6V / 0,48s	No trip
O/V stage 1	473,9V	1,0s	475,6V	1,060s	467V / 2,0s	No trip
O/V stage 2	494,7V	0,5s	496,4V	0,540s	487,7V / 0,98s	No trip
					500,9V / 0,48s	No trip

Note. For Voltage tests the Voltage required to trip is the setting $\pm 3,45V$. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting $\pm 4V$ and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

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Protection. Frequency tests. SHP75-10						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,50Hz	20,04s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	47,00Hz	0,544s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,50Hz	90,00s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,00Hz	0,542s	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting $\pm 0,1$ Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No-trip tests" need to be carried out at the setting $\pm 0,2$ Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Frequency tests. STP60-10						
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency	Time delay	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20s	47,49Hz	20,03s	47,7Hz / 25s	No trip
U/F stage 2	47Hz	0,5s	47,00Hz	0,55s	47,2Hz / 19,98s	No trip
					46,8Hz / 0,48s	No trip
O/F stage 1	51,5Hz	90s	51,50Hz	90,00s	51,3Hz / 95s	No trip
O/F stage 2	52Hz	0,5s	52,00Hz	0,54	51,8Hz / 89,98s	No trip
					52,2Hz / 0,48s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting $\pm 0,1$ Hz. In order to measure the time delay a larger deviation than the minimum required to operate the projection can be used. The "No-trip tests" need to be carried out at the setting $\pm 0,2$ Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Loss of Mains.						
BS EN 62116						
Balancing load on islanded network	33% of -5% Q Test 22	66% of -5% Q Test 12	100% of -5% P Test 5	33% of +5% Q Test 31	66% of +5% Q Test 21	100% of +5% P Test 10
Trip time. Ph1 fuse removed	416ms	396ms	496ms	426ms	416ms	644ms
Trip time. Ph2 fuse removed	416ms	396ms	496ms	426ms	416ms	644ms
Trip time. Ph3 fuse removed	416ms	396ms	496ms	426ms	416ms	644ms

Note for technologies which have a substantial shut down time this can be added to the 0,5 seconds in establishing that the trip occurred in less than 0,5s. Maximum shut down time could therefore be up to 1,0 seconds for these technologies.

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

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Protection. Re-connection timer. SHP75-10				
Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.5.7.1.				
Voltage				
Time delay setting		Measured delay		
20s		21,1s		
Frequency				
Time delay setting		Measured delay		
20s		21,1s		
230 / 400V				
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection
240 / 416V				
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 277,7V	At 204,6V	At 47,4Hz	At 51,6Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection
Protection. Re-connection timer. STP60-10				
Test should prove that the reconnection sequence starts in no less than 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 10.5.7.1.				
Voltage				
Time delay setting		Measured delay		
20s		21,2s		
Frequency				
Time delay setting		Measured delay		
20s		27,1s		
230 / 400V				
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 196,1V	At 47,4Hz	At 51,6Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection
240 / 416V				
	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 277,7V	At 204,6V	At 47,4Hz	At 51,6Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

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Protection. Frequency change, Stability test.				
	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49,5Hz	+50 degrees		No trip
Negative Vector Shift	50,5Hz	- 50 degrees		No trip
Positive Frequency drift	49,0Hz	+0,95Hz/sec	51,0Hz	No trip
Negative Frequency drift	51,0Hz	-0,95Hz/sec	49,0Hz	No trip



Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Power Quality. Harmonics. SHP75-10						
Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 12,44kW		100% of rated output 24,82kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,490	0,454	0,515	0,477	8%	8%
3rd	0,285	0,265	0,359	0,333	21,6%	N/A
4th	0,146	0,135	0,236	0,219	4%	4%
5th	0,120	0,111	0,218	0,202	10,7%	10,7%
6th	0,095	0,088	0,169	0,157	2,67%	2,67%
7th	0,106	0,099	0,208	0,193	7,2%	7,2%
8th	0,084	0,078	0,132	0,123	2%	2%
9th	0,132	0,123	0,227	0,210	3,8%	N/A
10th	0,034	0,032	0,067	0,062	1,6%	1,6%
11th	0,154	0,142	0,093	0,086	3,1%	3,1%
12th	0,032	0,029	0,069	0,064	1,33%	1,33%
13th	0,167	0,155	0,127	0,118	2%	2%
14th	0,023	0,021	0,035	0,032	N/A	N/A
15th	0,018	0,017	0,037	0,034	N/A	N/A
16th	0,030	0,027	0,051	0,047	N/A	N/A
17th	0,167	0,154	0,166	0,154	N/A	N/A
18th	0,015	0,014	0,026	0,024	N/A	N/A
19th	0,106	0,098	0,111	0,103	N/A	N/A
20th	0,014	0,013	0,023	0,022	N/A	N/A
21th	0,012	0,011	0,021	0,020	N/A	N/A
22th	0,010	0,010	0,019	0,017	N/A	N/A
23th	0,055	0,051	0,090	0,083	N/A	N/A
24th	0,012	0,011	0,022	0,021	N/A	N/A
25th	0,050	0,046	0,076	0,071	N/A	N/A
26th	0,008	0,008	0,015	0,014	N/A	N/A
27th	0,009	0,008	0,017	0,016	N/A	N/A
28th	0,011	0,011	0,019	0,017	N/A	N/A
29th	0,039	0,036	0,060	0,056	N/A	N/A
30th	0,011	0,010	0,018	0,017	N/A	N/A
31th	0,036	0,033	0,047	0,044	N/A	N/A
32th	0,016	0,015	0,023	0,022	N/A	N/A
33th	0,019	0,018	0,035	0,032	N/A	N/A
34th	0,019	0,018	0,034	0,032	N/A	N/A
35th	0,029	0,027	0,040	0,037	N/A	N/A
36th	0,009	0,009	0,020	0,018	N/A	N/A
37th	0,038	0,035	0,059	0,055	N/A	N/A
38th	0,041	0,038	0,061	0,056	N/A	N/A
39th	0,033	0,030	0,054	0,050	N/A	N/A
40th	0,038	0,035	0,062	0,058	N/A	N/A
THD ₄₀	1,33%		0,81%		23%	13%
PWHD	0,004%		0,001%		23%	22%



Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Power Quality. Harmonics.						
Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 12,45kW		100% of rated output 24,84kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,532	0,493	0,671	0,622	8%	8%
3rd	0,228	0,211	0,225	0,208	21,6%	N/A
4th	0,157	0,146	0,169	0,157	4%	4%
5th	0,061	0,057	0,092	0,085	10,7%	10,7%
6th	0,060	0,055	0,129	0,120	2,67%	2,67%
7th	0,061	0,056	0,111	0,103	7,2%	7,2%
8th	0,049	0,046	0,071	0,066	2%	2%
9th	0,107	0,099	0,165	0,153	3,8%	N/A
10th	0,055	0,051	0,105	0,097	1,6%	1,6%
11th	0,159	0,147	0,151	0,140	3,1%	3,1%
12th	0,041	0,038	0,094	0,087	1,33%	1,33%
13th	0,177	0,164	0,155	0,143	2%	2%
14th	0,032	0,030	0,048	0,044	N/A	N/A
15th	0,024	0,022	0,038	0,035	N/A	N/A
16th	0,024	0,022	0,031	0,029	N/A	N/A
17th	0,177	0,164	0,174	0,161	N/A	N/A
18th	0,017	0,015	0,028	0,026	N/A	N/A
19th	0,119	0,110	0,120	0,111	N/A	N/A
20th	0,015	0,014	0,019	0,018	N/A	N/A
21th	0,011	0,010	0,017	0,016	N/A	N/A
22th	0,014	0,013	0,024	0,022	N/A	N/A
23th	0,054	0,050	0,090	0,084	N/A	N/A
24th	0,015	0,014	0,027	0,025	N/A	N/A
25th	0,050	0,047	0,077	0,071	N/A	N/A
26th	0,014	0,013	0,022	0,020	N/A	N/A
27th	0,012	0,011	0,020	0,018	N/A	N/A
28th	0,010	0,009	0,014	0,013	N/A	N/A
29th	0,040	0,037	0,060	0,055	N/A	N/A
30th	0,009	0,008	0,015	0,014	N/A	N/A
31th	0,037	0,034	0,051	0,047	N/A	N/A
32th	0,016	0,015	0,028	0,026	N/A	N/A
33th	0,028	0,026	0,048	0,045	N/A	N/A
34th	0,031	0,028	0,061	0,057	N/A	N/A
35th	0,040	0,037	0,060	0,056	N/A	N/A
36th	0,040	0,037	0,060	0,055	N/A	N/A
37th	0,030	0,027	0,044	0,041	N/A	N/A
38th	0,019	0,017	0,022	0,021	N/A	N/A
39th	0,018	0,017	0,030	0,027	N/A	N/A
40th	0,020	0,018	0,033	0,030	N/A	N/A
THD ₄₀	1,32%		0,81%		23%	13%
PWHD	0,005%		0,001%		23%	22%

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Power Quality. Harmonics.						
Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 12,45kW		100% of rated output 24,84kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,259	0,240	0,357	0,330	8%	8%
3rd	0,211	0,195	0,244	0,226	21,6%	N/A
4th	0,160	0,148	0,237	0,220	4%	4%
5th	0,089	0,083	0,163	0,151	10,7%	10,7%
6th	0,067	0,062	0,111	0,103	2,67%	2,67%
7th	0,069	0,064	0,109	0,101	7,2%	7,2%
8th	0,064	0,059	0,131	0,122	2%	2%
9th	0,065	0,060	0,161	0,150	3,8%	N/A
10th	0,046	0,042	0,102	0,094	1,6%	1,6%
11th	0,155	0,144	0,125	0,116	3,1%	3,1%
12th	0,040	0,037	0,063	0,058	1,33%	1,33%
13th	0,171	0,159	0,137	0,127	2%	2%
14th	0,024	0,022	0,037	0,035	N/A	N/A
15th	0,019	0,018	0,038	0,035	N/A	N/A
16th	0,023	0,021	0,037	0,034	N/A	N/A
17th	0,176	0,163	0,178	0,165	N/A	N/A
18th	0,019	0,018	0,034	0,032	N/A	N/A
19th	0,106	0,098	0,115	0,106	N/A	N/A
20th	0,012	0,011	0,019	0,017	N/A	N/A
21th	0,011	0,010	0,018	0,016	N/A	N/A
22th	0,013	0,012	0,021	0,020	N/A	N/A
23th	0,057	0,053	0,091	0,085	N/A	N/A
24th	0,013	0,012	0,021	0,019	N/A	N/A
25th	0,049	0,046	0,073	0,068	N/A	N/A
26th	0,013	0,012	0,021	0,020	N/A	N/A
27th	0,011	0,010	0,019	0,018	N/A	N/A
28th	0,010	0,009	0,015	0,014	N/A	N/A
29th	0,039	0,036	0,057	0,053	N/A	N/A
30th	0,010	0,009	0,015	0,014	N/A	N/A
31th	0,034	0,032	0,050	0,047	N/A	N/A
32th	0,012	0,011	0,022	0,020	N/A	N/A
33th	0,026	0,024	0,037	0,034	N/A	N/A
34th	0,027	0,025	0,045	0,042	N/A	N/A
35th	0,039	0,036	0,064	0,060	N/A	N/A
36th	0,037	0,034	0,063	0,058	N/A	N/A
37th	0,032	0,030	0,060	0,056	N/A	N/A
38th	0,024	0,022	0,043	0,040	N/A	N/A
39th	0,018	0,017	0,028	0,026	N/A	N/A
40th	0,021	0,020	0,033	0,031	N/A	N/A
THD ₄₀	0,98%		0,64%		23%	13%
PWHD	0,005%		0,001%		23%	22%



BUREAU
VERITAS

Annex to the G59/3 certificate of compliance No. U18-0297

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Power Quality. Harmonics. STP60-10						
Phase 1						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 10,04kW		100% of rated output 19,90kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,171	0,199	0,242	0,281	8%	8%
3rd	0,193	0,223	0,084	0,097	21,6%	N/A
4th	0,070	0,081	0,053	0,062	4%	4%
5th	0,155	0,180	0,049	0,057	10,7%	10,7%
6th	0,040	0,047	0,033	0,039	2,67%	2,67%
7th	0,049	0,057	0,052	0,060	7,2%	7,2%
8th	0,030	0,035	0,025	0,028	2%	2%
9th	0,053	0,061	0,031	0,036	3,8%	N/A
10th	0,028	0,033	0,025	0,029	1,6%	1,6%
11th	0,098	0,113	0,159	0,185	3,1%	3,1%
12th	0,024	0,027	0,019	0,022	1,33%	1,33%
13th	0,101	0,118	0,166	0,192	2%	2%
14th	0,014	0,016	0,014	0,017	N/A	N/A
15th	0,013	0,016	0,012	0,014	N/A	N/A
16th	0,013	0,015	0,013	0,015	N/A	N/A
17th	0,127	0,147	0,155	0,179	N/A	N/A
18th	0,008	0,009	0,009	0,011	N/A	N/A
19th	0,097	0,112	0,113	0,131	N/A	N/A
20th	0,007	0,008	0,009	0,011	N/A	N/A
21th	0,009	0,011	0,010	0,012	N/A	N/A
22th	0,006	0,007	0,008	0,009	N/A	N/A
23th	0,074	0,086	0,062	0,072	N/A	N/A
24th	0,008	0,010	0,010	0,011	N/A	N/A
25th	0,073	0,084	0,064	0,074	N/A	N/A
26th	0,008	0,009	0,009	0,010	N/A	N/A
27th	0,033	0,039	0,033	0,039	N/A	N/A
28th	0,006	0,007	0,007	0,008	N/A	N/A
29th	0,041	0,048	0,037	0,043	N/A	N/A
30th	0,006	0,007	0,006	0,007	N/A	N/A
31th	0,034	0,040	0,032	0,037	N/A	N/A
32th	0,007	0,008	0,006	0,007	N/A	N/A
33th	0,008	0,009	0,006	0,007	N/A	N/A
34th	0,006	0,007	0,005	0,006	N/A	N/A
35th	0,019	0,022	0,014	0,017	N/A	N/A
36th	0,016	0,019	0,012	0,014	N/A	N/A
37th	0,015	0,018	0,011	0,013	N/A	N/A
38th	0,013	0,015	0,010	0,011	N/A	N/A
39th	0,007	0,008	0,005	0,006	N/A	N/A
40th	0,008	0,009	0,005	0,006	N/A	N/A
THD ₄₀	0,47%		0,98%		23%	13%
PWHD	0,0012%		0,0062%		23%	22%

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Power Quality. Harmonics.						
Phase 2						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 10,03kW		100% of rated output 19,93kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,234	0,271	0,238	0,276	8%	8%
3rd	0,073	0,084	0,129	0,149	21,6%	N/A
4th	0,058	0,068	0,071	0,082	4%	4%
5th	0,034	0,040	0,074	0,086	10,7%	10,7%
6th	0,031	0,036	0,035	0,041	2,67%	2,67%
7th	0,045	0,052	0,029	0,033	7,2%	7,2%
8th	0,022	0,025	0,025	0,029	2%	2%
9th	0,022	0,026	0,059	0,068	3,8%	N/A
10th	0,025	0,029	0,030	0,034	1,6%	1,6%
11th	0,153	0,177	0,100	0,115	3,1%	3,1%
12th	0,022	0,025	0,024	0,028	1,33%	1,33%
13th	0,164	0,189	0,096	0,111	2%	2%
14th	0,017	0,019	0,016	0,019	N/A	N/A
15th	0,012	0,013	0,016	0,018	N/A	N/A
16th	0,012	0,014	0,012	0,014	N/A	N/A
17th	0,154	0,178	0,128	0,148	N/A	N/A
18th	0,011	0,013	0,009	0,011	N/A	N/A
19th	0,117	0,135	0,095	0,110	N/A	N/A
20th	0,009	0,010	0,007	0,008	N/A	N/A
21th	0,009	0,011	0,009	0,010	N/A	N/A
22th	0,009	0,010	0,007	0,008	N/A	N/A
23th	0,058	0,067	0,073	0,085	N/A	N/A
24th	0,010	0,012	0,010	0,011	N/A	N/A
25th	0,064	0,074	0,071	0,082	N/A	N/A
26th	0,009	0,011	0,008	0,009	N/A	N/A
27th	0,033	0,039	0,032	0,037	N/A	N/A
28th	0,006	0,007	0,006	0,007	N/A	N/A
29th	0,035	0,040	0,040	0,046	N/A	N/A
30th	0,006	0,006	0,006	0,007	N/A	N/A
31th	0,032	0,037	0,033	0,039	N/A	N/A
32th	0,007	0,008	0,007	0,009	N/A	N/A
33th	0,007	0,008	0,008	0,009	N/A	N/A
34th	0,007	0,008	0,009	0,010	N/A	N/A
35th	0,013	0,016	0,019	0,022	N/A	N/A
36th	0,013	0,015	0,017	0,020	N/A	N/A
37th	0,012	0,014	0,014	0,017	N/A	N/A
38th	0,009	0,011	0,012	0,014	N/A	N/A
39th	0,004	0,004	0,006	0,007	N/A	N/A
40th	0,003	0,004	0,004	0,004	N/A	N/A
THD ₄₀	0,45%		0,95%		23%	13%
PWHD	0,0012%		0,006%		23%	22%

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Power Quality. Harmonics.						
Phase 3						
Generating Unit tested to BS EN 61000-3-12						
Generating Unit rating per phase (rpp)						
	At 45-55% of rated output 10,06kW		100% of rated output 19,95kW			
Harmonic	Measured Value (MV) in Amps	Measured Value (MV) in %	Measured Value (MV) in Amps	Measured Value (MV) in %	Limit in BS EN61000-3-12 in %	
					1 phase	3 phase
2nd	0,171	0,197	0,108	0,125	8%	8%
3rd	0,068	0,079	0,096	0,111	21,6%	N/A
4th	0,055	0,064	0,071	0,082	4%	4%
5th	0,038	0,044	0,129	0,149	10,7%	10,7%
6th	0,031	0,035	0,033	0,039	2,67%	2,67%
7th	0,042	0,049	0,036	0,041	7,2%	7,2%
8th	0,022	0,025	0,027	0,031	2%	2%
9th	0,026	0,030	0,042	0,049	3,8%	N/A
10th	0,024	0,028	0,029	0,034	1,6%	1,6%
11th	0,153	0,177	0,094	0,108	3,1%	3,1%
12th	0,021	0,024	0,024	0,027	1,33%	1,33%
13th	0,164	0,190	0,099	0,115	2%	2%
14th	0,015	0,017	0,015	0,018	N/A	N/A
15th	0,011	0,013	0,014	0,016	N/A	N/A
16th	0,012	0,014	0,013	0,015	N/A	N/A
17th	0,159	0,184	0,133	0,153	N/A	N/A
18th	0,011	0,012	0,009	0,011	N/A	N/A
19th	0,115	0,132	0,095	0,109	N/A	N/A
20th	0,008	0,009	0,008	0,009	N/A	N/A
21th	0,010	0,011	0,010	0,012	N/A	N/A
22th	0,009	0,010	0,007	0,008	N/A	N/A
23th	0,062	0,072	0,078	0,090	N/A	N/A
24th	0,010	0,011	0,009	0,010	N/A	N/A
25th	0,061	0,071	0,071	0,082	N/A	N/A
26th	0,008	0,010	0,009	0,011	N/A	N/A
27th	0,033	0,038	0,034	0,039	N/A	N/A
28th	0,006	0,007	0,006	0,007	N/A	N/A
29th	0,038	0,044	0,043	0,050	N/A	N/A
30th	0,006	0,007	0,006	0,007	N/A	N/A
31th	0,031	0,035	0,033	0,038	N/A	N/A
32th	0,006	0,007	0,007	0,008	N/A	N/A
33th	0,006	0,007	0,007	0,008	N/A	N/A
34th	0,007	0,008	0,007	0,008	N/A	N/A
35th	0,016	0,018	0,020	0,023	N/A	N/A
36th	0,013	0,015	0,017	0,019	N/A	N/A
37th	0,011	0,013	0,016	0,018	N/A	N/A
38th	0,010	0,011	0,012	0,014	N/A	N/A
39th	0,003	0,004	0,004	0,004	N/A	N/A
40th	0,003	0,004	0,005	0,006	N/A	N/A
THD ₄₀	0,39%		0,87%		23%	13%
PWHD	0,0012%		0,006%		23%	22%

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Power Quality. Power factor. SHP75-10. 230 / 400V				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	
Power Quality. Power factor. SHP75-10. 240 / 416V				
	225,6V	240V	264V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	
Power Quality. Power factor. STP60-10. 230 / 400V				
	216,2V	230V	253V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	1,000	1,000	1,000	
Limit	>0,95	>0,95	>0,95	
Power Quality. Power factor. STP60-10. 240 / 416V				
	225,6V	240V	264V	Measured at three voltage levels and at full output. Voltage to be maintained within $\pm 1.5\%$ of the stated level during the test.
Measured value	0,999	1,000	1,000	
Limit	>0,95	>0,95	>0,95	

Power Quality. Voltage fluctuation and Flicker.								
	Starting			Stopping			Running	
	dmax	dc	d(t)	dmax	dc	d(t)	Pst	Plt 2 hours
Normalised to required maximum impedance	3,3%	3,3%	0%	3,3%	3,3%	0%	0,086	0,086
Limits set under BS EN 61000-3-11	4%	3,3%	3,3% 500ms	4%	3,3%	3,3% 500ms	1,0	0,65
Test impedance	R	0,24* 0,4^	Ω	XI	0,15* 0,25	Ω		
Standard impedance	R	0,24* 0,4^	Ω	XI	0,15* 0,25^	Ω		

Appendix E Type Verification Test Report

Extract from test report according to the Engineering Recommendation G59/3

Nr. 14TH0075-G59/3_0

Power Quality. DC injection.			
Phase L1			
Test level power	10%	55%	100%
Recorded value	7,46mA	12,10mA	14,40mA
As % of rated AC current	0,01%	0,01%	0,01%
Limit	0,25%	0,25%	0,25%
Phase L2			
Test level power	10%	55%	100%
Recorded value	31,27mA	33,96mA	37,68mA
As % of rated AC current	0,03%	0,03%	0,03%
Limit	0,25%	0,25%	0,25%
Phase L3			
Test level power	10%	55%	100%
Recorded value	32,10mA	14,96mA	16,97mA
As % of rated AC current	0,03%	0,01%	0,02%
Limit	0,25%	0,25%	0,25%

Fault level Contribution.					
For a directly coupled SSEG			For a Inverter SSEG		
Parameter	Symbol	Value	Time after fault	Volts	Amps
Peak Short Circuit current	I_p	N/A	20ms	50,8	38,7
Initial Value of aperiodic current	A	N/A	100ms	50,6	36,3
Initial symmetrical short-circuit current*	I_k	N/A	250ms	50,3	57,3
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	50,3	64,6
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	0,526	In seconds

For rotating machines and linear piston machines the test should produce a 0s – 2s plot of the short circuit current as seen at the Generating Unit terminals.

* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot.

Self Monitoring – Solid state switching.	N/A
It has been verified that in the event of the solid state switching device failing to disconnect the Generating Unit, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0,5 seconds.	
Note. Unit do not provide solid state switching relays. In case the semiconductor bridge is switched off, then the voltage on the output drops to 0. In this case the relays on the output will also open.	