Certificate of compliance

Applicant:

Bender GmbH & Co. KG
Londorfer Str. 65
35305 Grünberg
Germany

Product: **Automatic disconnection device between a generator and the public grid**

Model: **VMD460-NA**

Use in accordance with regulations:

Automatic disconnection device with three-phase mains surveillance in accordance with Engineering Recommendation G98/1 for systems with a three-phase parallel coupling 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 G98/1-4:2019
Requirements for the connection of Fully Type Tested Micro-generators (up to and including 16 A per phase) in parallel with public Low Voltage Distribution Networks

DIN V VDE V 0126-1-1:2006-02 (4.1 Functional safety)
Automatic disconnection device between a generator and the public low-voltage grid

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:	**13TH0057-G98/1_0**	**Certification program:**	**NSOP-0032-DEU-ZE-V01**
Certificate number:	**U19-0449**	**Date of issue:**	**2019-08-02**

Certification body

Holger Schaffer

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

A partial representation of the certificate requires the written approval of Bureau Veritas Consumer Products Services Germany GmbH

Appendix C Type Test Verification Report	
Extract from test report according to the Engineering Recommendation G98/1	**Nr. 13TH0057-G98/1_0**

Type Approval and declaration of compliance with the requirements of Engineering Recommendation G98/1.			
PGM Technology	Automatic disconnection device between a generator and the public grid		
Manufacturer	Bender GmbH & Co. KG		
Address	Londorfer Str. 65, 35305 Grünberg, Germany		
Tel	+49 6401 807-0	**Fax**	+49 6401 807-259
Email	info@bender.de	**Website**	https://www.bender.de
Rated values	VMD460-NA		
Rated voltage	Un (L-N) 0 – 300 V Un (L-L) 0 – 520 V 45 HZ – 65 Hz		
Firmware version	D0398 V1.30 D0403 V2.40		
Measurement period:	2019-06-11 to 2019-07-10		

Description of the structure of the power generation unit:

The VMD460-NA is an external interface protection device and connects the inverter with the grid. The device serves as disconnection facility for illegitimate frequency and voltage limits. The output can be switched off by two relays in series. This assures that the opening of the output circuit will also operate in case of one error.

The above stated Generating Units are tested according the requirements in the Engineering Recommendation G98/1. 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 G98/1.

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 13TH0057-G98/1_0**

Protection. Voltage tests.

Phase 1 to N

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V	184	2,5	185,0	2,608	188V / 5s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	262,1	1,091	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	274,1	0,591	269,7V 0,95s	No trip
					277,7V 0,45s	No trip

Protection. Voltage tests.

Phase 2 to N

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V	184	2,5	185,4	2,592	188V / 5s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	262,3	1,090	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	274,3	0,597	269,7V 0,95s	No trip
					277,7V 0,45s	No trip

Appendix C Type Test Verification Report

Extract from test report according to the Engineering Recommendation G98/1 **Nr. 13TH0057-G98/1_0**

Protection. Voltage tests.

Phase 3 to N

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V	184	2,5	186,0	2,585	188V / 5s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2	1,0	262,4	1,094	258,2V 5,0s	No trip
O/V stage 2	273,7	0,5	275,3	0,593	269,7V 0,95s	No trip
					277,7V 0,45s	No trip

Note. For Voltage tests the Voltage required to trip is the setting ±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 ±4V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

Protection. Voltage tests.

Phase 1 to Phase 2

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V	318,7	2,5	319,6	2,604	325,6V / 5,0s	No trip
					311,8V / 2,45s	No trip
O/V stage 1	454,1	1,0	454,0	1,089	447,2V / 5,0s	No trip
O/V stage 2	474,0	0,5	474,6	0,581	467,1V / 0,95s	No trip
					481,0V / 0,45s	No trip

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Extract from test report according to the Engineering Recommendation G98/1 **Nr. 13TH0057-G98/1_0**

Protection. Voltage tests.

Phase 2 to Phase 3

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V	318,7	2,5	319,7	2,555	325,6V / 5,0s	No trip
					311,8V / 2,45s	No trip
O/V stage 1	454,1	1,0	454,1	1,081	447,2V / 5,0s	No trip
O/V stage 2	474,0	0,5	474,6	0,586	467,1V / 0,95s	No trip
					481,0V / 0,45s	No trip

Protection. Voltage tests.

Phase 3 to 1

Function	Setting		Trip test		No trip test	
	Voltage [V]	Time delay [s]	Voltage [V]	Time delay [s]	Voltage / time	Confirm no trip
U/V	318,7	2,5	320,0	2,589	325,6V / 5,0s	No trip
					311,8V / 2,45s	No trip
O/V stage 1	454,1	1,0	455,2	1,084	447,2V / 5,0s	No trip
O/V stage 2	474,0	0,5	475,6	0,588	467,1V / 0,95s	No trip
					481,0V / 0,45s	No trip

Note. For Voltage tests the Voltage required to trip is the setting ±5,98 V. 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 ±6,9 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

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Protection. Frequency tests.

Function	Setting		Trip test		No trip test	
	Frequency [Hz]	Time delay [s]	Frequency [Hz]	Time delay [s]	Frequency / time	Confirm no trip
U/F stage 1	47,5	20	47,49	20,1	47,7Hz / 30s	No trip
U/F stage 2	47	0,5	46,99	0,627	47,2Hz / 19,5s	No trip
					46,8Hz / 0,45s	No trip
O/F stage 2	52	0,5	52,01	0,676	51,8Hz / 120s	No trip
					52,2Hz / 0,45s	No trip

Note. For Frequency Trip tests the Frequency required to trip is the setting ±0,1Hz. 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 ±0,2Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

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Extract from test report according to the Engineering Recommendation G98/1 **Nr. 13TH0057-G98/1_0**

Protection. Re-connection timer.	
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 2.	
Over Voltage	
Time delay setting	**Measured delay**
20s	20,0s
Under Voltage	
Time delay setting	**Measured delay**
20s	20,0s
Over Frequency	
Time delay setting	**Measured delay**
20s	20,0s
Under Frequency	
Time delay setting	**Measured delay**
20s	20,1s

	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.			
	At 266,2V	At 180,0V	At 47,4Hz	At 52,1Hz
Confirmation that the Generating Unit does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Protection. Frequency change, Stability test.				
	Start Frequency [Hz]	**Change**	**Test time**	**Confirm no trip**
Positive Vector Shift	49,5	+50 degrees		No trip
Negative Vector Shift	50,5	-50 degrees		No trip
	Ramp range	**Test frequency ramp**	**Test duration**	**Confirm no trip**
Positive Frequency drift	49,0 to 51,0	+0,95Hz/sec	2,1s	No trip
Negative Frequency drift	51,0 to 49,0	-0,95Hz/sec	2,1s	No trip

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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 (Functional safety of the internal automatic disconnection device according to VDE 0126-100).	

Logic Interface (input port) Required by paragraph 11.1.3	**P**
Confirm that an input port is provided and can be used to shut down the module.	Yes