TEST REPORT

Engineering recommendation G99/1

Requirements for the connection of generation equipment in parallel with public distribution networks

Report reference number ..... :	**PVUK2102WDG0105-1**
Date of issue ..... ……..:	2021-03-30
Total number of pages ..... ……..:	66
Testing laboratory name ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
Address ..... :	No. 96, Guantai Road (Houjie Section), Houjie Town, Dongguan City, Guangdong Province, 523942, People's Republic of China
Accreditation ..... :	ilac-MRA A2LA ACCREDITED Certificate # 2951.01
Applicant's name ..... :	**Shenzhen SOFARSOLAR Co., Ltd.**
Address ..... :	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China
Test specification	
Standard ..... :	G99/1-6:2020
	For Type A inverter connected Power Generating Modules
Test Report Form No. ..... :	G99/1 VER.2
TRF Originator ..... :	Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Master TRF ..... :	Dated 2020-03-07
Test item description ..... :	**AC-Coupled Storage Inverter**
Trademark ..... :	SOFAR SOLAR
Model / Type ..... :	ME 5KTL-3PH, ME 6KTL-3PH, ME 8KTL-3PH, ME 10KTL-3PH, ME 15KTL-3PH, ME 20KTL-3PH

Ratings .....:	**ME 5KTL-3PH**	**ME 6KTL-3PH**	**ME 8KTL-3PH**
Battery type .....:	Li-ion & Lead-acid		
Full load battery voltage range [V]....:	200-800	240-800	320-800
Battery voltage range[V].....:	180-800		
Battery current [A] .....:	Max. 25,0A		
Output AC voltage [V].....:	3/N/PE, 230/400,50Hz		
Output AC current [A].....:	8	10	13
Output power [VA].....:	Max. 5500	Max. 6600	Max. 8800
Ratings .....:	**ME 10KTL-3PH**	**ME 15KTL-3PH**	**ME 20KTL-3PH**
Battery type .....:	Li-ion & Lead-acid		
Full load battery voltage range [V]....:	200-800	300-800	400-800
Battery voltage range[V].....:	180-800		
Battery current [A] .....:	Max. 25,0 x 2		
Output AC voltage [V].....:	3/N/PE, 230/400,50Hz		
Output AC current [A].....:	16	24	32
Output power [VA].....:	Max. 11000	Max. 16500	Max. 22000

The inverters listed above may be installed with the following batteries:			
Manufacturer .....:	PYLONTECH	Weco	General Lithium
Battery Model.....:	H48050	ESS-5K3-HV-LV	AMASS(GTX3000)
Capacity of each battery module (kWh).....:	2,4	5,3	2,.5
Number(s) of battery modules recommended by the manufacturer .:	4-28	4-26	4-20
Note: The batteries are not integrated into the inverter and must be installed according to the local regulations.			

Testing Location ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
Address ..... :	No. 96, Guantai Road (Houjie Section), Houjie Town, Dongguan City, Guangdong Province, 523942, People's Republic of China
Tested by (name and signature) ..... :	Lukes Lin 
Approved by (name and signature) ..... :	James Huang 
Manufacturer's name ..... :	**Shenzhen SOFARSOLAR Co., Ltd.**
Manufacturer address ..... :	401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen, China
Factory's name ..... :	**Dongguan SOFAR SOLAR Co.,Ltd.**
Factory address ..... :	1F - 6F, Building E, No. 1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City, Guangdong, China.

Document History			
Date	**Internal reference**	**Modification / Change / Status**	**Revision**
2021-03-30	Lukes Lin	Initial report was written.	0
Supplementary information:			

Test items particulars	
Equipment mobility..... :	Permanent connection
Operating condition..... :	Continuous
Class of equipment..... :	Class I
Protection against ingress of water.. :	IP65 according to EN 60529
Mass of equipment [kg]..... :	Approx. 34(ME 20KTL-3PH, ME 15KTL-3PH, ME 10KTL-3PH) Approx. 30(ME 8KTL-3PH, ME 6KTL-3PH, ME 5KTL-3PH
Test case verdicts	
Test case does not apply to the test object..... :	N/A
Test item does meet the requirement..... :	P(ass)
Test item does not meet the requirement..... :	F(ail)
Testing	
Date of receipt of test item..... :	2021-02-20
Date(s) of performance of test..... :	2021-02-20 to 2021-03-30

General remarks:

The test result presented in this report relate only to the object(s) tested. The report shall state compliance of the tested objects with the requirements of G99/1. This report must not be reproduced in part or in full without the written approval of the issuing testing laboratory.

”(see Annex #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

Throughout this report a comma is used as the decimal separator.

This Test Report consists of the following documents:

1. Test Results
2. Annex No. 1 – Pictures of the unit
3. Annex No. 2 – Test equipment list

Copy of marking plate

SOFAR SOLAR

AC-Coupled Storage Inverter

Model No:	ME 5KTL-3PH
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25A
Battery Max. Discharging Current	25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	8A
Max. Power Output to Grid	5500VA
Max. Current from Grid	15A
Max. Power from Grid	10000VA
Back-up Max. Output Current	8A
Back-up Max. Output Power	5500VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60℃
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III,DC II

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China

VDE0126-1-1,VDE-AR-N4105
G98,G99,EN50549,AS4777,UTE C15-712-1

SOFAR SOLAR

AC-Coupled Storage Inverter

Model No:	ME 6KTL-3PH
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25A
Battery Max. Discharging Current	25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	10A
Max. Power Output to Grid	6600VA
Max. Current from Grid	17A
Max. Power from Grid	12000VA
Back-up Max. Output Current	10A
Back-up Max. Output Power	6600VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60℃
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III,DC II

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China

VDE0126-1-1,VDE-AR-N4105
G98,G99,EN50549,AS4777,UTE C15-712-1

Copy of marking plate

SOFAR SOLAR

AC-Coupled Storage Inverter

Model No:	ME 8KTL-3PH
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25A
Battery Max. Discharging Current	25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	13A
Max. Power Output to Grid	8800VA
Max. Current from Grid	24A
Max. Power from Grid	16000VA
Back-up Max. Output Current	13A
Back-up Max. Output Power	8800VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60℃
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III,DC II

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China

VDE0126-1-1,VDE-AR-N4105
G98,G99,EN50549,AS4777,UTE C15-712-1

SOFAR SOLAR

AC-Coupled Storage Inverter

Model No:	ME 10KTL-3PH
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25/25A
Battery Max. Discharging Current	25/25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	16A
Max. Power Output to Grid	11000VA
Max. Current from Grid	29A
Max. Power from Grid	20000VA
Back-up Max. Output Current	16A
Back-up Max. Output Power	11000VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60℃
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III,DC II

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China

VDE0126-1-1,VDE-AR-N4105
G98,G99,EN50549,AS4777,UTE C15-712-1

Copy of marking plate

SOFAR SOLAR

AC-Coupled Storage Inverter

Model No:	ME 15KTL-3PH
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25/25A
Battery Max. Discharging Current	25/25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	24A
Max. Power Output to Grid	16500VA
Max. Current from Grid	44A
Max. Power from Grid	30000VA
Back-up Max. Output Current	24A
Back-up Max. Output Power	16500VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60℃
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III,DC II

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China

VDE0126-1-1,VDE-AR-N4105
G98,G99,EN50549,AS4777,UTE C15-712-1

SOFAR SOLAR

AC-Coupled Storage Inverter

Model No:	ME 20KTL-3PH
Battery Type	Li-Ion
Battery Voltage Range	180~800V
Battery Max. Charging Current	25/25A
Battery Max. Discharging Current	25/25A
Nominal Grid/Back-up Voltage	3/N/PE, 380/400V
Nominal Grid/Back-up Frequency	50/60Hz
Max. Current Output to Grid	32A
Max. Power Output to Grid	22000VA
Max. Current from Grid	58A
Max. Power from Grid	40000VA
Back-up Max. Output Current	32A
Back-up Max. Output Power	22000VA
Power Factor	1(adjustable+/-0.8)
Operating Temperature Range	-30~+60℃
Ingress Protection	IP65
Protective Class	ClassI
Inverter Topology	Non-isolated
Overvoltage Category	AC III,DC II

Manufacturer : Shenzhen SOFARSOLAR Co.,Ltd.
Address : 401, Building 4, AnTongDa Industrial Park,
District 68, XingDong Community,XinAn Street,
BaoAn District, Shenzhen, China

VDE0126-1-1,VDE-AR-N4105
G98,G99,EN50549,AS4777,UTE C15-712-1

General product information:

The inverter converts DC voltage, generated by batteries, into AC voltage. Battey can also be charged from the AC grid.

The inverter is a single-phase type and only one machine is allowed on each line conductor.

The input and output are protected by varistors to Earth. The unit is providing EMC filtering at the batteries input and output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundantly by the high power switching bridge and two relays. This assures that the opening of the output circuit will also operate in case of a single error.

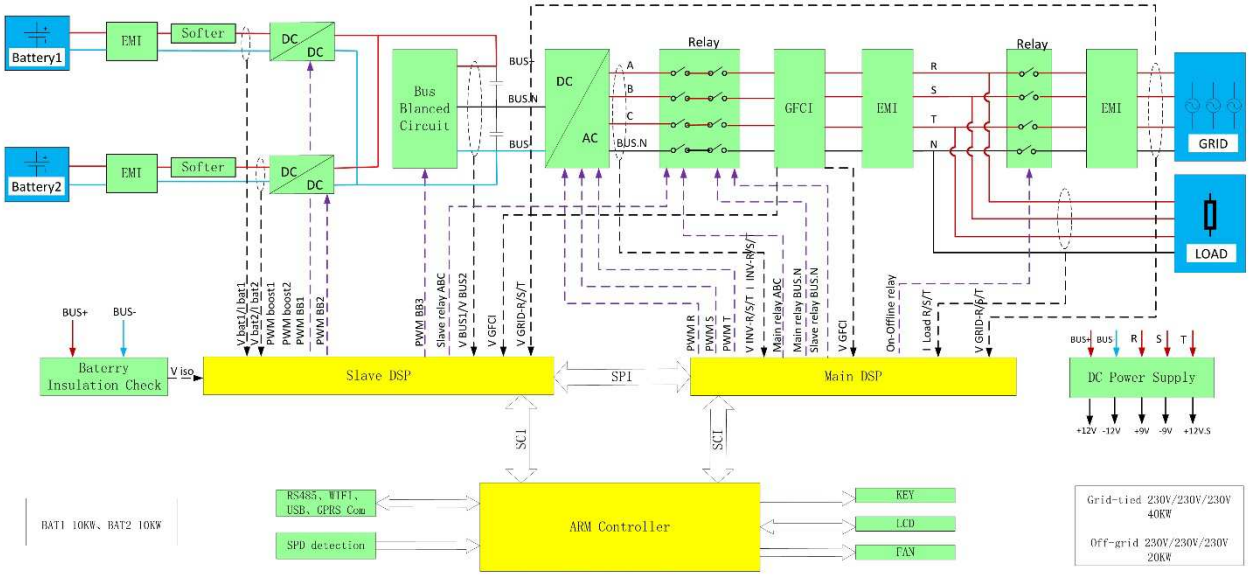


Figure 1 – Block diagram

The internal control is redundant built. It consists of Microcontroller Main DSP (U37) and slave DSP (U39).

The Main DSP (U37) control the relays by switching signals; measures the battery voltage, battery current, Bus voltage, grid voltage, frequency, AC current with injected DC and the array insulation resistance to ground. In addition it tests the current sensors and the RCMU circuit before each start up.

The slave DSP (U39) is measures the grid voltage, grid frequency and residual current, also can switch off the relays independently, and communicate with Main DSP (U37) each other.

The current is measured by a current sensor. The AC current signal and the injected DC current signal are sent to the Main DSP(U37). The Main DSP(U37) tests and calibrates before each start up all current sensors. The unit provides two relays in series in all output conductors. When single fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the battery and the mains. All the relays are tested before each start up.

The models ME 5KTL-3PH, ME 6KTL-3PH, ME 8KTL-3PH, ME 10KTL-3PH, ME 15KTL-3PH and ME 20KTL-3PH are completely identical and output power derated by software, except for the following table.

	ME 5KTL-3PH	ME 6KTL-3PH	ME 8KTL-3PH	ME 10KTL-3PH	ME 15KTL-3PH	ME 20KTL-3PH
INV inductor	2,0 mH		1,12 mH		0,876 mH	
Fan	Without			With		

Differences of the models

The models ME 5KTL-3PH, ME 6KTL-3PH, ME 8KTL-3PH, ME 10KTL-3PH, ME 15KTL-3PH and ME 20KTL-3PH are completely identical except for the INV inductor, the output power derated by software.

The product was tested on:

Hardware version: V002
Software version: V000001

Engineering recommendation G99-1			
Clause	**Requirement – Test**	**Result – Remark**	**Verdict**
A.7	**Requirements for Type Testing Power Generating Modules**		
A.7.1	**Power Park Module Requirements**		
A.7.1.1	**Certification & Type Testing Generating Unit Requirements**		
A.7.1.2	Type Verification Functional Testing of the Interface Protection		**P**
A.7.1.2.1	Disconnection times		**P**
A.7.1.2.2	Over / Under Voltage	see Table A.7.1.2.2	**P**
A.7.1.2.3	Over / Under Frequency	see Table A.7.1.2.3	**P**
A.7.1.2.4	Loss of Mains Protection	see Table A.7.1.2.4	**P**
A.7.1.2.5	Re-connection	see Table A.7.1.2.5	**P**
A.7.1.2.6	Frequency Drift and Step Change Stability test	see Table A.7.1.2.6	**P**
A.7.1.3	Limited Frequency Sensitive Mode – Over (LFSM-O)	see Table A.7.1.3	**P**
A.7.1.4.1	Harmonics	see Table A.7.1.4.1	**P**
A.7.1.4.2	Power Factor	see Table A.7.1.4.1	**P**
A.7.1.4.3	Voltage Flicker	see Table A.7.1.4.3	**P**
A.7.1.4.4	DC Injection	see Table A.7.1.4.4	**P**
A.7.1.5	Short Circuit Current Contribution	see Table A.7.1.5	**P**
A.7.1.6	Self-Monitoring - Solid State Disconnection		**N/A**
A.7.2.3	Power Output with Falling Frequency	see Table A.7.2.3	**P**

G99-1 Type A Test Results:

A.7.1.2 Type Verification Functional Testing of the Interface Protection Functional safety - fault condition tests according DIN V VDE V 0126-1-1								P
	ambient temperature [°C] :			24°C				
	model/type of power supply :			DC: N8957APV AC: RS180-3PI / RS90-3PI				
	manufacturer of power supply :			DC: Keysight AC: Ametek				
	rated markings of power supply :			DC: 0-1500V, 15KW AC: 0-650V, 270KW				
component No.	fault	test condition		test time	fuse No.	fault condition		result
		AC	DC			AC	DC	
Relay defect RL1 pin4-pin3	Short before start up	230V 0,05A	850V 0,10A	10min.	--	230V 0,05A	850V 0,10A	Indicate Relay fault,error code“ID41”(RelayFail). Do not connect to AC mainsn. No damage,no hazards.
Relay defect RL2 pin4-pin3	Short before start up	230V 0,05A	850V 0,10A	10min.	--	230V 0,05A	850V 0,10A	Indicate Relay fault,error code“ID41”(RelayFail). Do not connect to AC mainsn. No damage,no hazards.
Relay defect RL3 pin4-pin3	Short before start up	230V 0,05A	850V 0,10A	10min.	--	230V 0,05A	850V 0,10A	Indicate Relay fault,error code“ID41”(RelayFail). Do not connect to AC mainsn. No damage,no hazards.
Relay defect RL4 pin4-pin3	Short before start up	230V 0,05A	850V 0,10A	10min.	--	230V 0,05A	850V 0,10A	Indicate Relay fault,error code“ID41”(RelayFail). Do not connect to AC mainsn. No damage,no hazards.
Relay defect RL5 pin4-pin3	Short before start up	230V 0,05A	850V 0,10A	10min.	--	230V 0,05A	850V 0,10A	Indicate Relay fault,error code“ID41”(RelayFail). Do not connect to AC mainsn. No damage,no hazards.
Relay defect RL6 pin4-pin3	Short before start up	230V 0,05A	850V 0,10A	10min.	--	230V 0,05A	850V 0,10A	Indicate Relay fault,error code“ID41”(RelayFail). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R137	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid. error code“ID02”(GridUVP). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R 140	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid. error code“ID01”(GridOVP). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R157	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid. error code“ID02”(GridUVP). Do not connect to AC mainsn. No damage,no hazards.

Grid voltage monitoring R 159	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid. error code“ID01”(GridOVP). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R152	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid. error code“ID02”(GridUVP). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R 155	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid. error code“ID01”(GridOVP). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R147	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid. error code“ID02”(GridUVP). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R 149	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid. error code“ID01”(GridOVP). Do not connect to AC mainsn. No damage,no hazards.
Current sensor defect C10	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate DCI fault,error code“ID18”(HwADFaultDCI). Do not connect to AC mainsn. No damage,no hazards.
Current sensor defect C 51	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate DCI fault,error code“ID18”(HwADFaultDCI). Do not connect to AC mainsn. No damage,no hazards.
Current sensor defect C102	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate DCI fault,error code“ID18”(HwADFaultDCI). Do not connect to AC mainsn. No damage,no hazards.
Current sensor defect R 57	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate Grid current fault,error code“ID17”(HwADFaultIGrid). Do not connect to AC mainsn. No damage,no hazards.
Current sensor defect R 166	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate DCI fault,error code“ID18”(HwADFaultDCI). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R109	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 16,0A	850V 25,0A/ 25,0A	No fault. no damage.Offline – DCV is wrong.
Grid voltage monitoring R109	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 16,0A	850V 25,0A/ 25,0A	No fault.no damage. Offline – DCV is wrong.

Grid voltage monitoring R203	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate Grid voltage fault,error code ”ID19”(HwADFaultVGrid(DC)), ”ID20”(HwADFaultVGrid(AC)). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R240	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate Grid voltage fault,error code ”ID19”(HwADFaultVGrid(DC)), ”ID20”(HwADFaultVGrid(AC)). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring C541	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate Grid voltage fault,error code”ID20”(HwADFaultVGrid(AC)). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring C539	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate Grid voltage fault,error code”ID20”(HwADFaultVGrid(AC)). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring C540	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate Grid voltage fault,error code”ID20”(HwADFaultVGrid(AC)). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R904	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate Grid voltage fault,error code”ID19”(HwADFaultVGrid(DC)). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R905	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate Grid voltage fault,error code“ID19”(HwADFaultVGrid(DC)). Do not connect to AC mainsn. No damage,no hazards.
Grid voltage monitoring R906	Open	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate Grid voltage fault,error code”ID19”(HwADFaultVGrid(DC)). Do not connect to AC mainsn. No damage,no hazards.
DSP communication defect R481	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate SCI fault,error code”ID154”(SciCommLose(AC)). Do not connect to AC mainsn. Q26 damage,no hazards.

DSP communication defect R484	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Indicate SCI fault,error code"ID153"(SciCommLose(DC)). Do not connect to AC mainsn. Q25 damage,no hazards.
Loss of control C287	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid,no error code. Do not connect to AC mainsn. No damage.No hazards.
Loss of control C277	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid,error code"ID33,ID34,ID153,ID154"(SpiCommLose DC/AC, SciCommLose DC/AC). Do not connect to AC mainsn. No damage.No hazards.
Loss of control C548	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid,error code"ID33,ID34,ID153,ID154"(SpiCommLose DC/AC, SciCommLose DC/AC). Do not connect to AC mainsn. No damage.No hazards.
Loss of control C679	Short	230V 16,0A	850V 25,0A / 25,0A	10min.	--	230V 0,05A	850V 0,10A	Output a.c. relays operated, disconnected with grid,error code"ID33,ID34,ID153,ID154"(SpiCommLose DC/AC, SciCommLose DC/AC). Do not connect to AC mainsn. No damage.No hazards.
The errors in the control circuit simulate that the safety is even ensured during single fault. The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.								

Operating Range		**P**
Setting values	Over-voltage [V]:	253,0
	Under-voltage [V]:	195,5
	Over-frequency [Hz]:	52,00
	Under-frequency [Hz]:	47,00

- Test 1: U = 195,5 V; f = 47,0 Hz; P = 1,00 Sn; cosφ = 1; at least 20 s
- Test 2: U = 195,5 V; f = 47,5 Hz; P = 1,00 Sn; cosφ = 1; at least 90 mins
- Test 3: U = 253,0 V; f = 51,5 Hz; P = 1,00 Sn; cosφ = 1; at least 90 mins
- Test 4: U = 253,0 V; f = 52,0 Hz; P = 1,00 Sn; cosφ = 1; at least 15 mins
- Test 5: U = 230,0 V; f = 50,0 to 50,5 Hz;RoCoF=1Hz/s; P = 1,00 Sn; cosφ = 1

Test sequence	Voltage [V]	Frequency [Hz]	Output power [W]	Cos φ [1]
Test 1	195,64	47,00	18662	0,9968
Test 2	195,97	47,50	18728	0,9978
Test 3	253,70	51,50	20061	0,9979
Test 4	253,69	52,00	20032	0,9974
Test5	230,78	50,50	20061	0,9994

Note:

During the tests the interface protection was disabled.

Operation at reduced power is allowed during test 1 and test 2, equal to the maximum power that can be supplied on reaching the maximum output current limit (P ≥ 0,85 Sn).

During the sequence of test 3 and test 4, automatic adjustment to reduce power in the case of over-frequency was disabled.

The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

A.7.1.2.2 Over / Under Voltage

Table 10.1 Settingd for long term parallel Operation

P

Test: L1 to N

Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage (V)	Time delay (s)	Voltage / time	Confirm no trip
U/V	184,0V (0,8 pu)	2,5s	183,5	2,520	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2V (1,14 pu)	1,0s	263,2	1,018	258,2V / 5,0s	No trip
O/V stage 2	273,7V (1,19 pu)	0,5s	274,6	0,534	269,7V / 0,95s	No trip
					277,7V / 0,45s	No trip

Test: L2 to N

Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage (V)	Time delay (s)	Voltage / time	Confirm no trip
U/V	184,0V (0,8 pu)	2,5s	183,5	2,520	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2V (1,14 pu)	1,0s	263,3	1,006	258,2V / 5,0s	No trip
O/V stage 2	273,7V (1,19 pu)	0,5s	274,5	0,522	269,7V / 0,95s	No trip
					277,7V / 0,45s	No trip

Test: L3 to N

Function	Setting		Trip test		No trip test	
	Voltage	Time delay	Voltage (V)	Time delay (s)	Voltage / time	Confirm no trip
U/V	184,0V (0,8 pu)	2,5s	183,4	2,530	188V / 5,0s	No trip
					180V / 2,45s	No trip
O/V stage 1	262,2V (1,14 pu)	1,0s	263,2	1,040	258,2V / 5,0s	No trip
O/V stage 2	273,7V (1,19 pu)	0,5s	274,5	0,518	269,7V / 0,95s	No trip
					277,7V / 0,45s	No trip

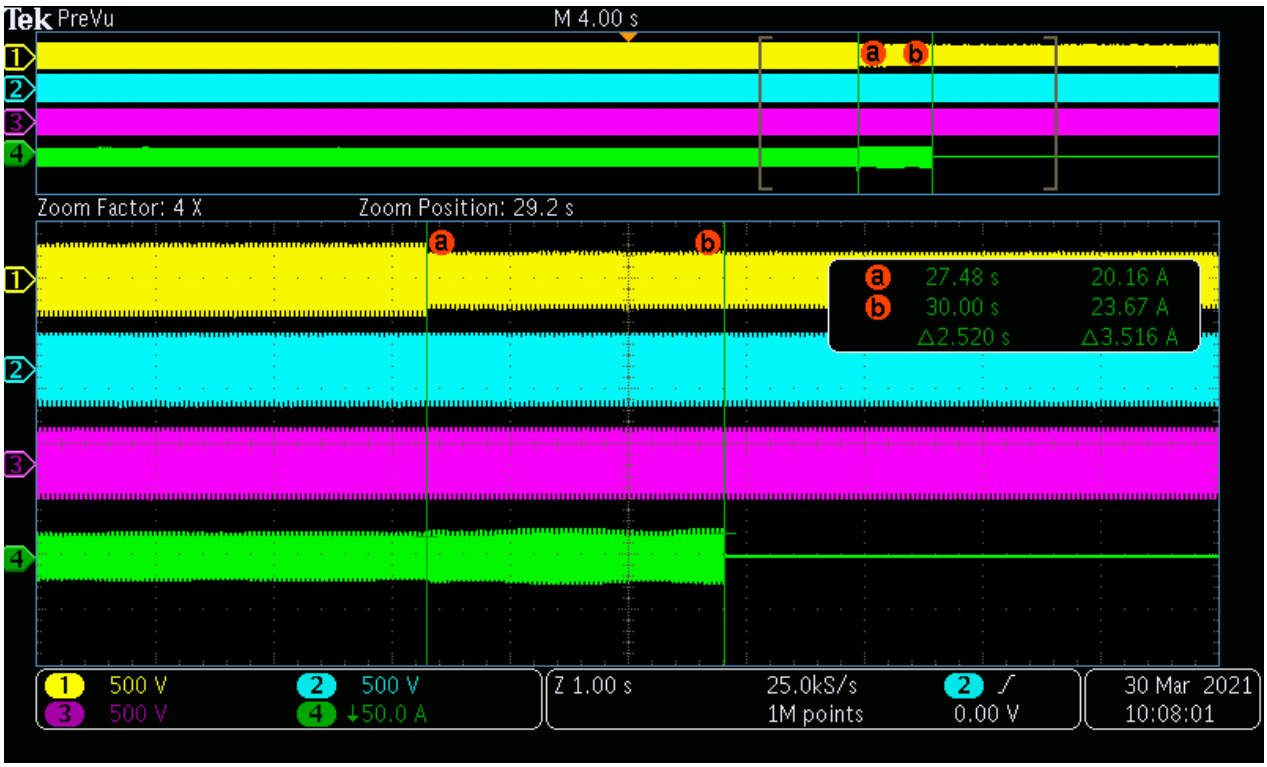
Note:

The total disconnection time for voltage and frequency protection, including the operating time of the disconnection device, shall be the time delay setting with a tolerance of, -0s + 0.5 s.

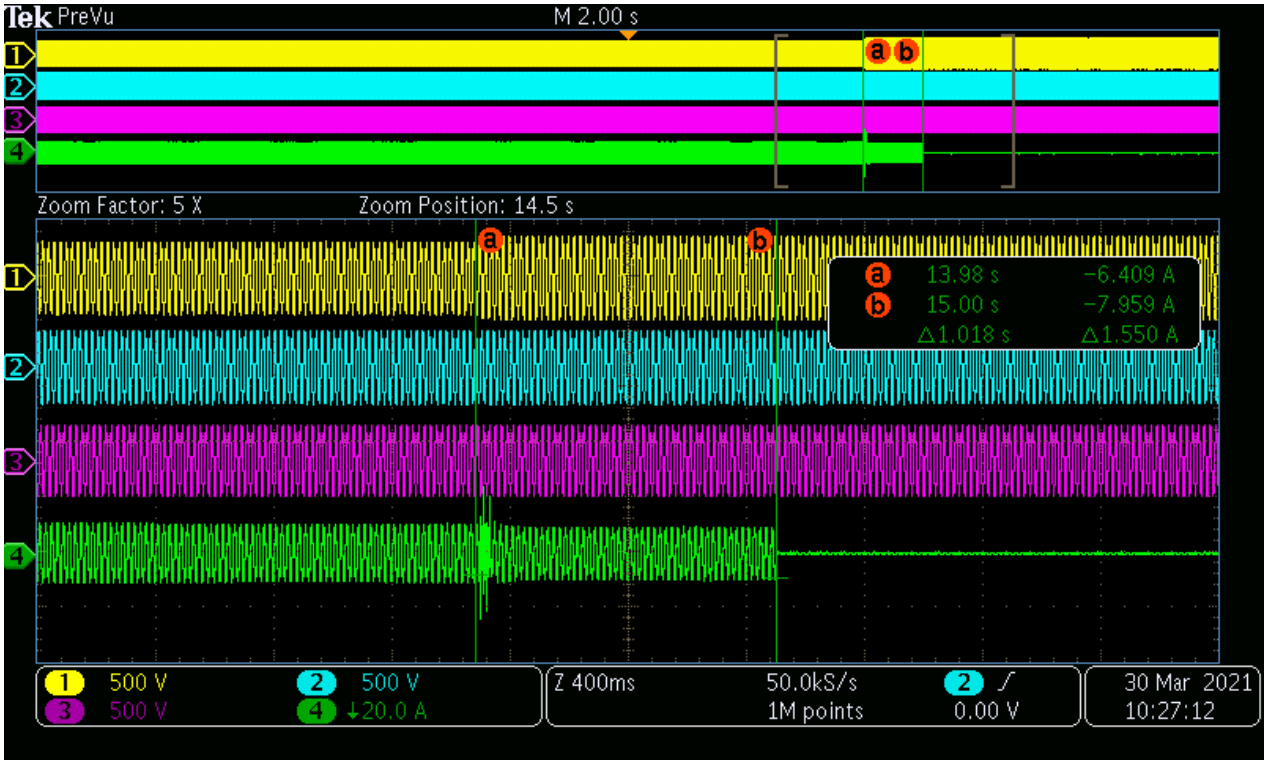
The Voltage required to trip is the setting ±3.45 V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4 V and for the relevant times as shown in the table above to ensure that the protection will not trip in error.

The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

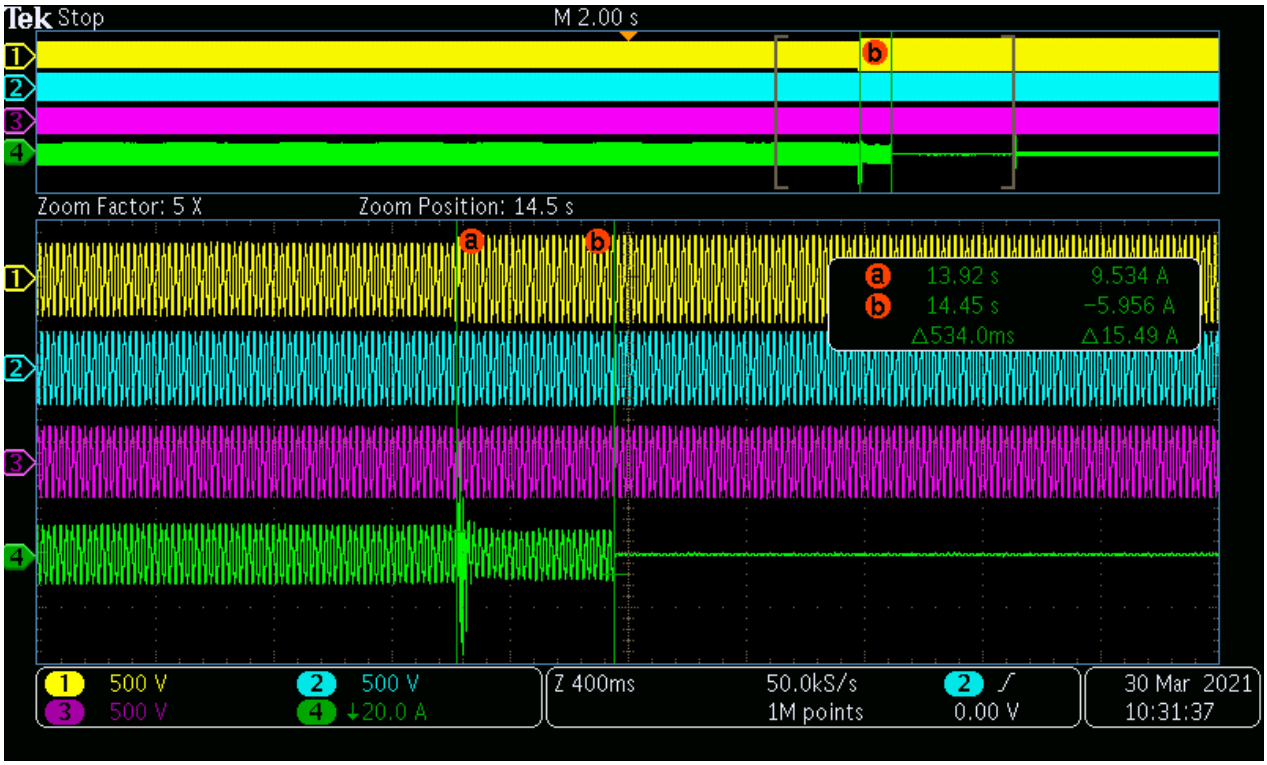
Under voltage disconnection (L1 to N)



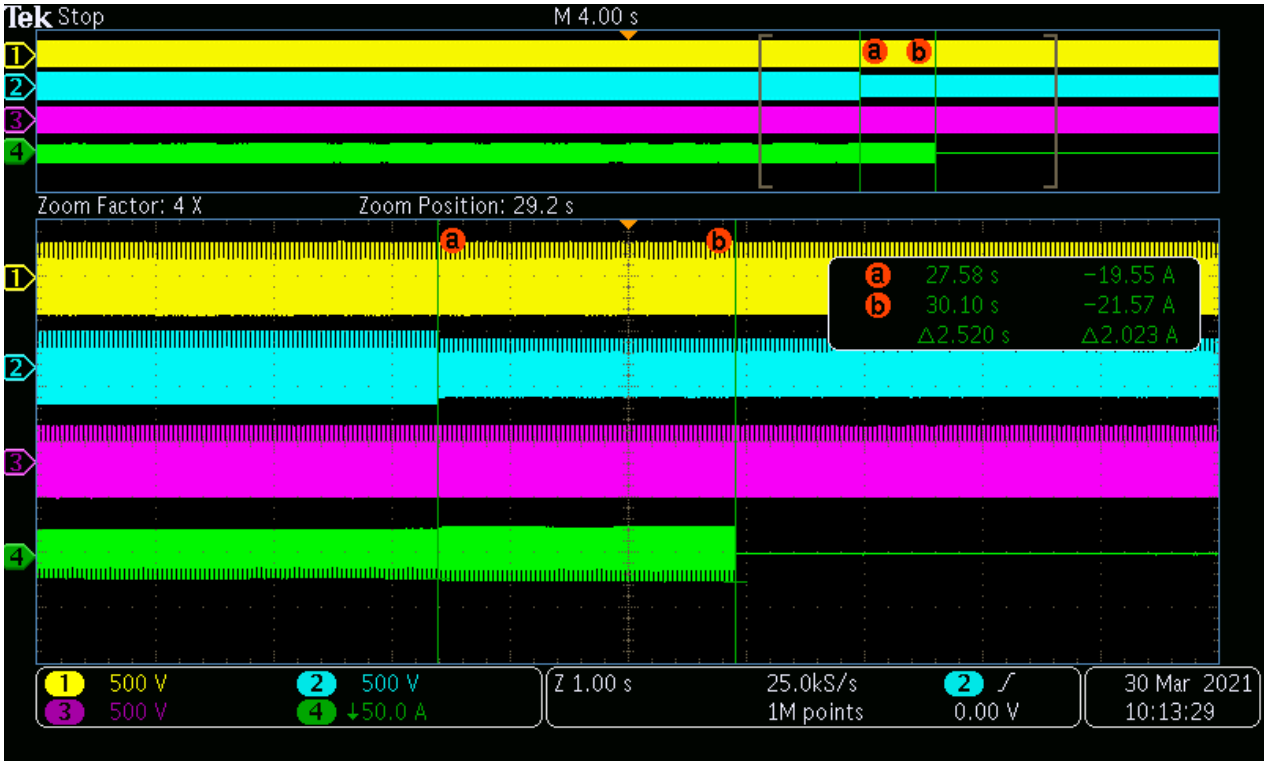
Over voltage disconnection of the stage 1 (L1 to N)



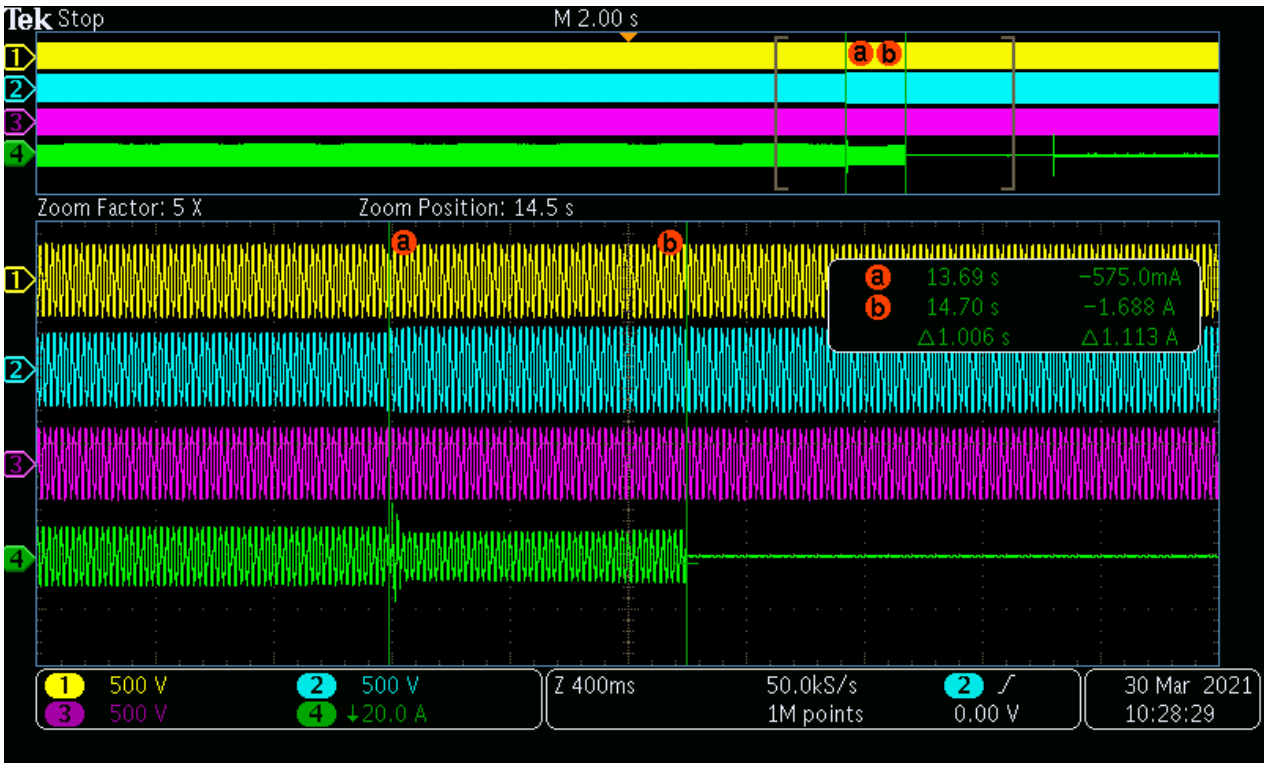
Over voltage disconnection of the stage 2 (L1 to N)



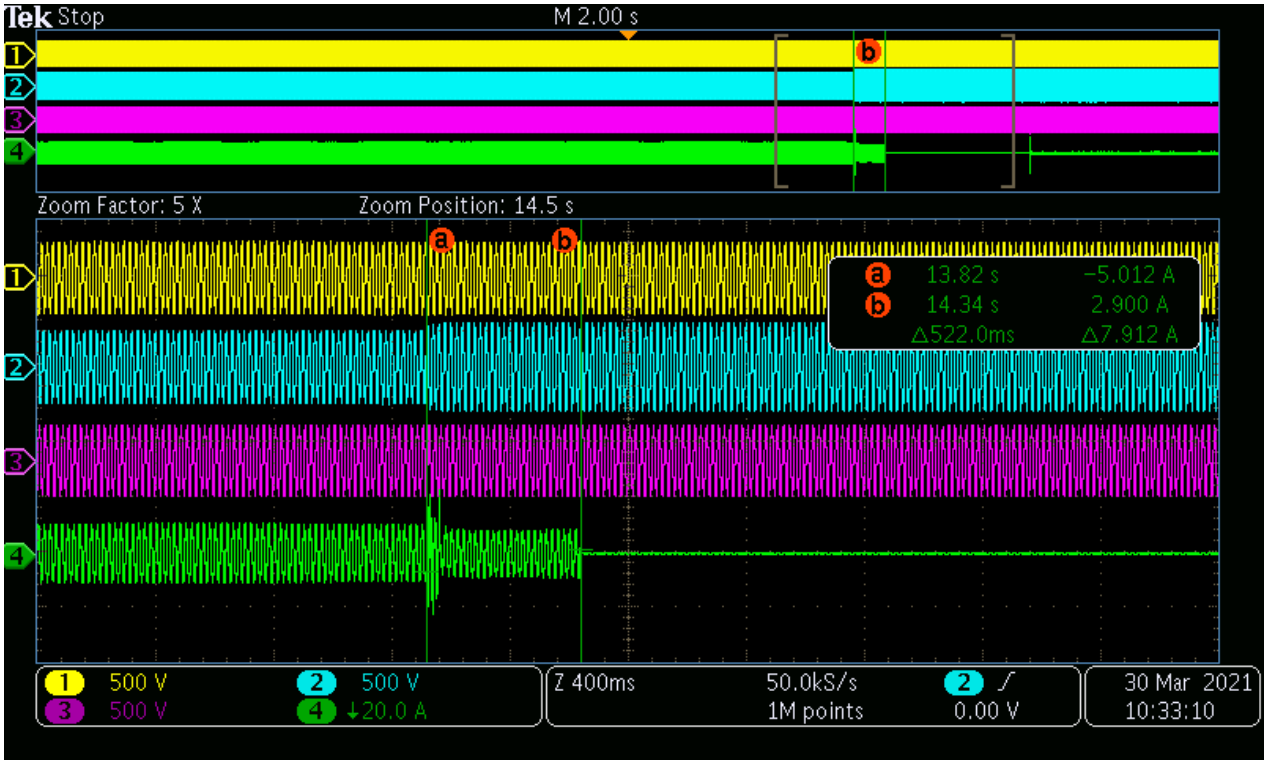
Under voltage disconnection (L2 to N)



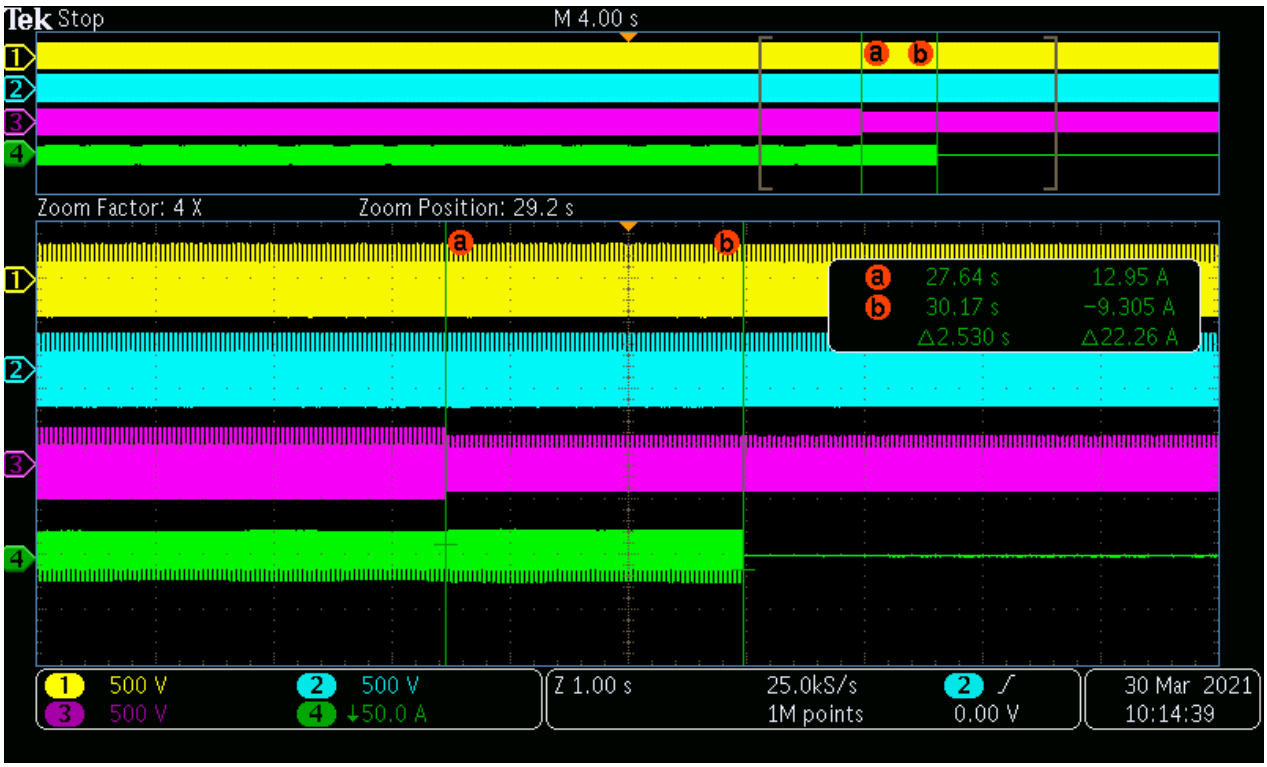
Over voltage disconnection of the stage 1 (L2 to N)



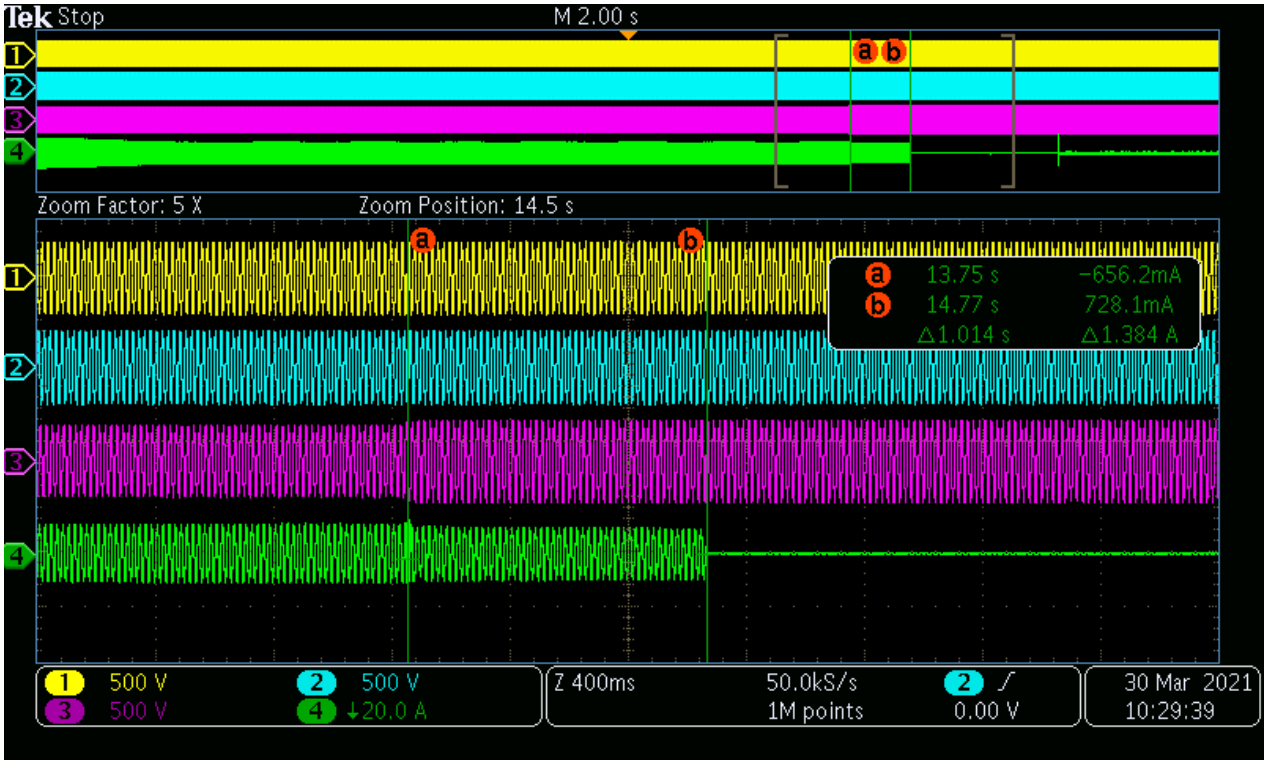
Over voltage disconnection of the stage 2 (L2 to N)



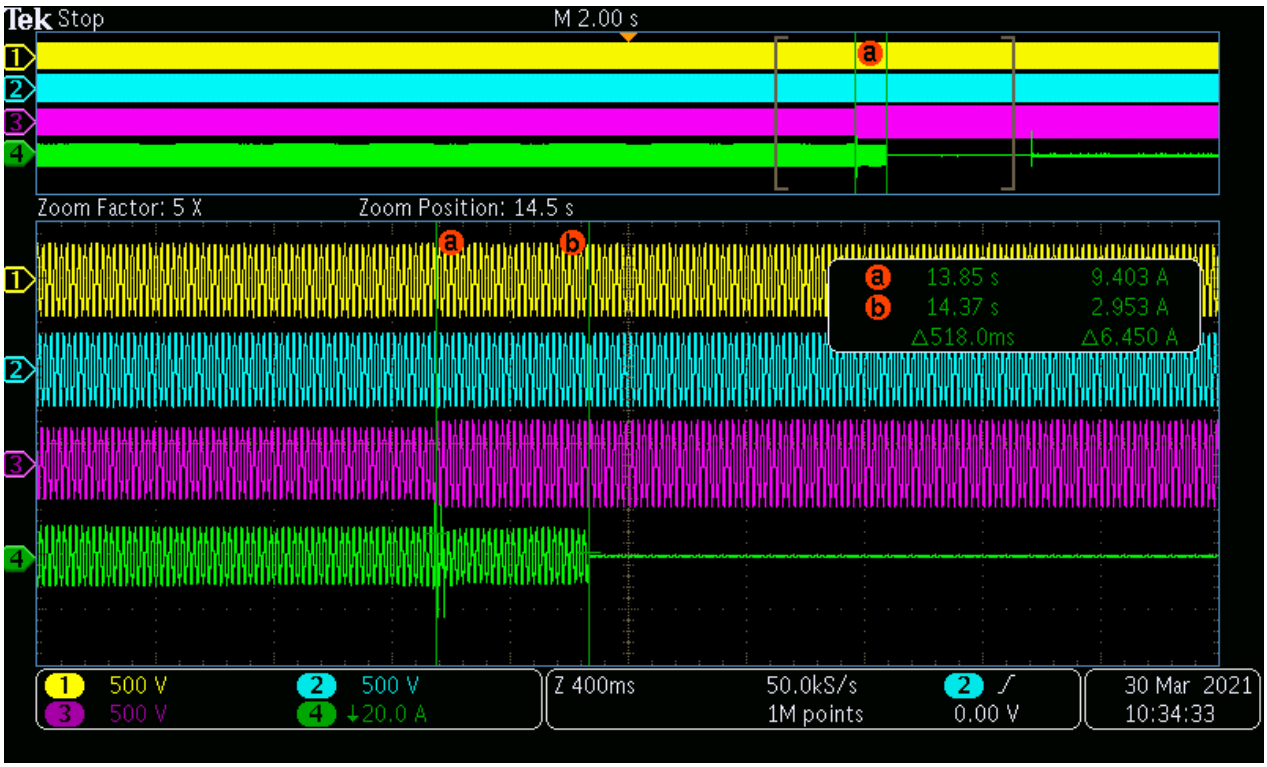
Under voltage disconnection (L3 to N)



Over voltage disconnection of the stage 1 (L3 to N)



Over voltage disconnection of the stage 2 (L3 to N)



A.7.1.2.3 Over / Under Frequency	P

Test:

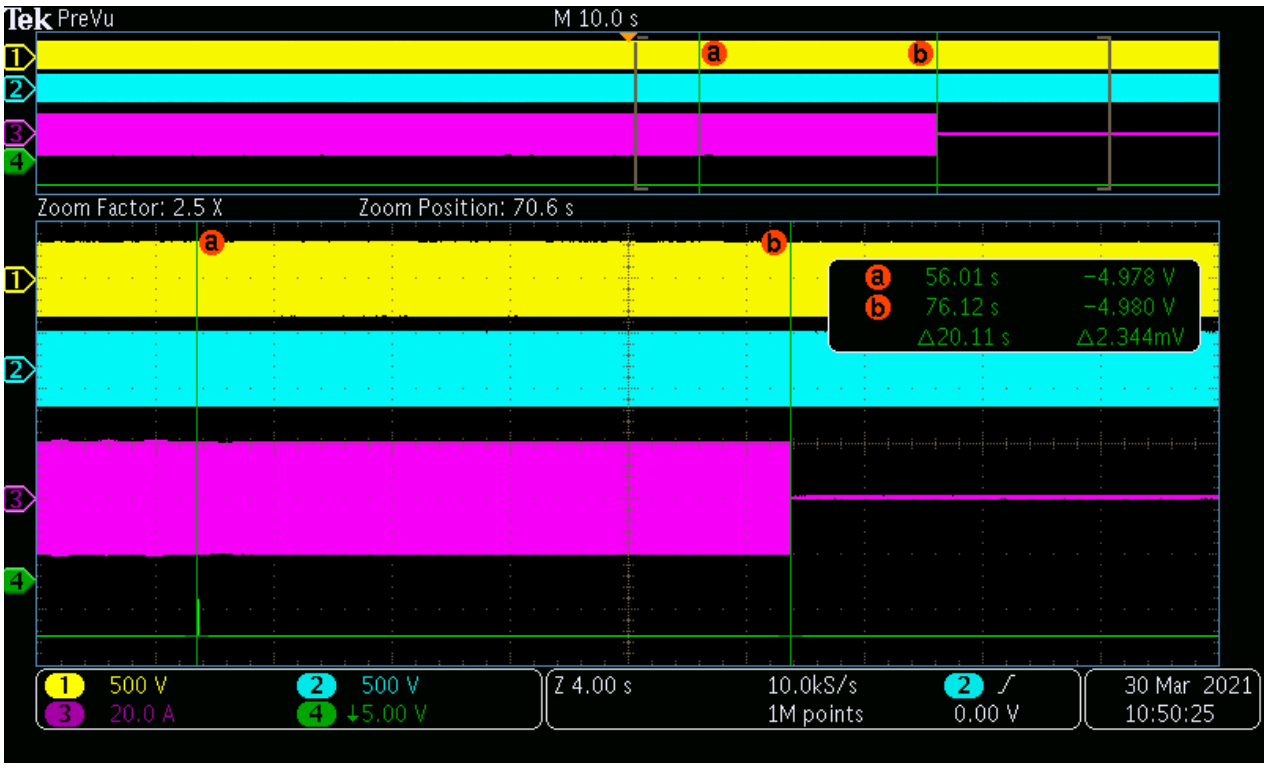
Function	Setting		Trip test		No trip test	
	Frequency	Time delay	Frequency (Hz)	Time delay (s)	Frequency / time	Confirm no trip
U/F stage 1	47,5Hz	20,0s	47,47	20,110	47,7Hz / 30s	No trip
U/F stage 2	47,0Hz	0,5s	46,97	0,528	47,2Hz / 19,5s	No trip
					46,8 Hz / 0,45s	No trip
O/F	52,0Hz	0,5s	52,03	0,536	51,8Hz / 120s	No trip
					52,2 Hz / 0,45s	No trip

Note:

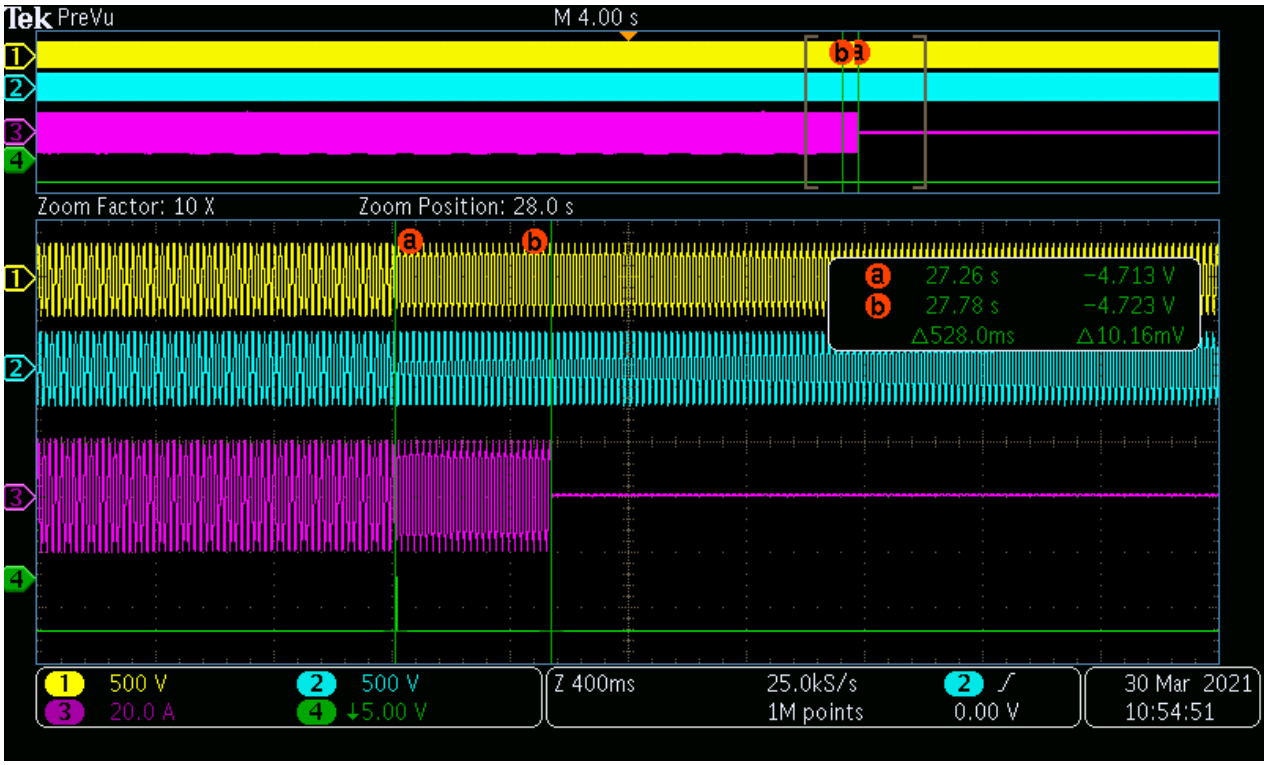
The total disconnection time for voltage and frequency protection, including the operating time of the disconnection device, shall be the time delay setting with a tolerance of, -0s + 0.5 s.

For frequency trip tests the frequency required to trip is the setting ± 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 ± 0.2 Hz and for the relevant times as shown in the table above to ensure that the protection will not trip in error.
The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

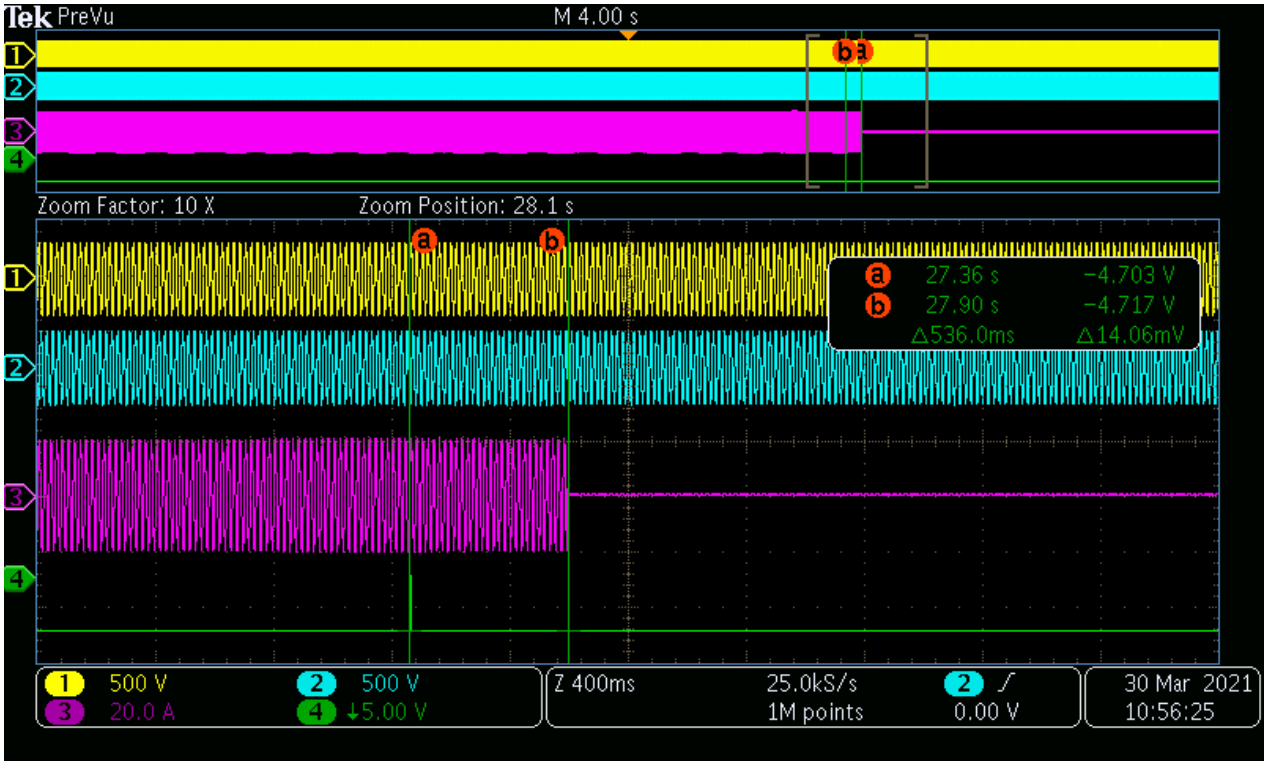
Under frequency disconnection of the stage 1



Under frequency disconnection of the stage 2



Over frequency disconnection



A.7.1.2.4 Loss of mains protection according BS EN 62116 The requirement is specified in section 10.2, test procedure in Annex A.2.2.4 Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)	**P**

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	0,5s

No	P_{EUT} 1) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} 2) (% of nominal)	Q_{AC} 3) (% of nominal)	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks4)
1	100	100	0	0	6,660	525	1,002	490	Test A at BL
8	100	100	-5	-5	6,660	525	1,028	442	Test A at IB
9	100	100	-5	0	6,660	525	1,054	478	Test A at IB
10	100	100	-5	+5	6,660	525	1,080	424	Test A at IB
13	100	100	0	-5	6,660	525	0,976	432	Test A at IB
14	100	100	0	+5	6,660	525	1,026	450	Test A at IB
17	100	100	+5	-5	6,660	525	0,930	420	Test A at IB
18	100	100	+5	0	6,660	525	0,954	474	Test A at IB
19	100	100	+5	+5	6,660	525	0,977	394	Test A at IB

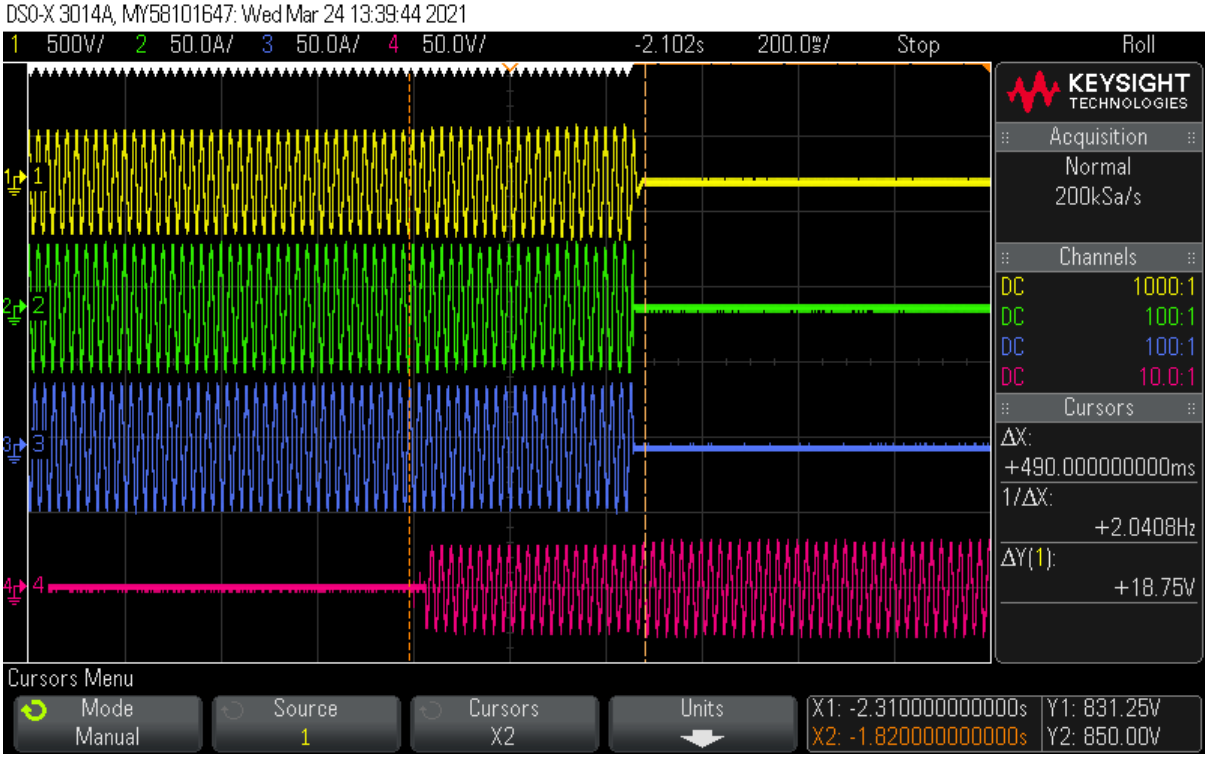
Parameter at 0%	L= 25,27 mH	R= 7,95 Ω	C= 400,94 µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20 ms

Note:
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.
RLC is adjusted to min. +/-1% of the inverter rated output power
[1] P_{EUT}: EUT output power
[2] P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[3] Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[4] BL: Balance condition, IB: Imbalance condition.
Condition A:
EUT output power PEUT = Maximum [5]
EUT input voltage [6] = >90% of rated input voltage range
[5] Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,9 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 100% nominal power



A.7.1.2.4 Loss of mains protection according BS EN 62116

P

The requirement is specified in section 10.2, test procedure in Annex A.2.2.4
Load imbalance (real, reactive load) for test condition A (EUT output = 50 % – 66 %)

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	0,5s

No	P_{EUT} [1] (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} [2] (% of nominal)	Q_{AC} [3] (% of nominal)	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks[4]
11	66	66	0	-5	4,400	410	0,977	430	Test B at IB
10	66	66	0	-4	4,400	410	0,982	470	Test B at IB
9	66	66	0	-3	4,400	410	0,987	440	Test B at IB
8	66	66	0	-2	4,400	410	0,992	436	Test B at IB
7	66	66	0	-1	4,400	410	0,997	458	Test B at IB
1	66	66	0	0	4,400	410	1,002	484	Test B at BL
2	66	66	0	1	4,400	410	1,007	474	Test B at IB
3	66	66	0	2	4,400	410	1,012	446	Test B at IB
4	66	66	0	3	4,400	410	1,017	426	Test B at IB
5	66	66	0	4	4,400	410	1,022	460	Test B at IB
6	66	66	0	5	4,400	410	1,027	428	Test B at IB

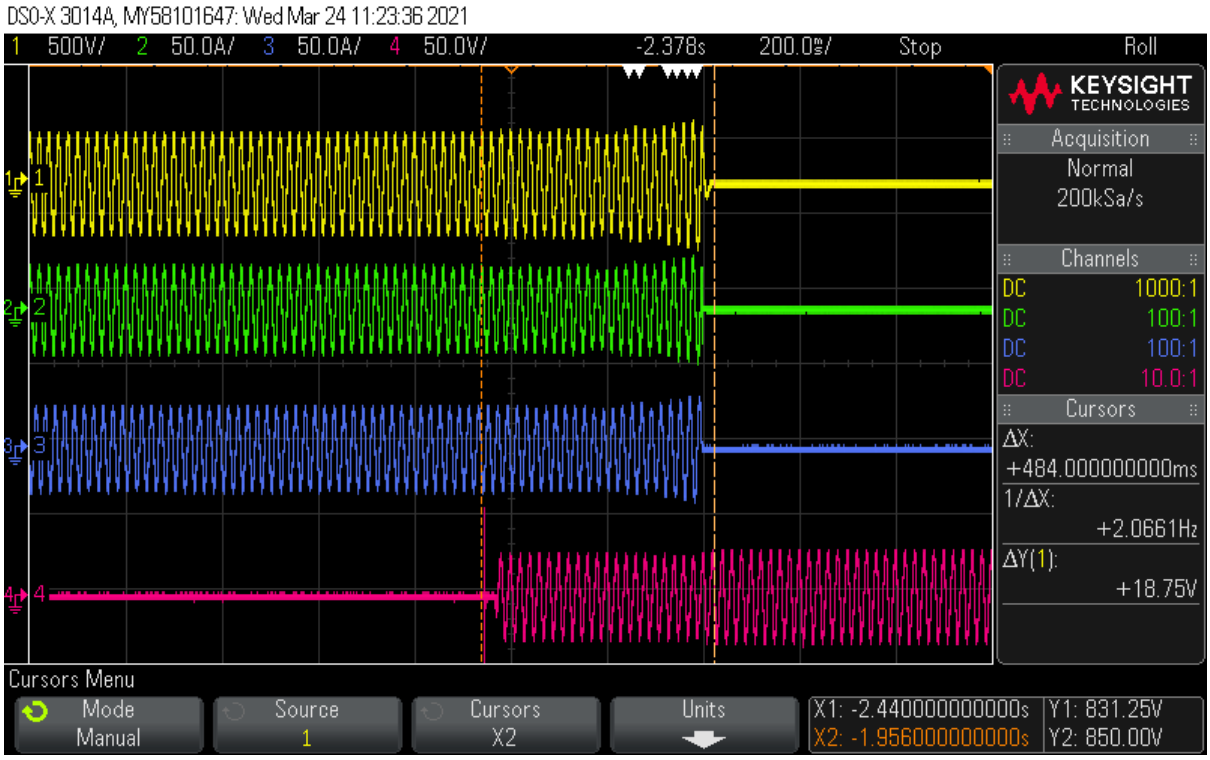
Parameter at 0%	L= 38,28 mH	R= 12,02 Ω	C= 264,68µF

Indicate additional shut down time included in above results. (Disconnection device operation time)	20 ms

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
[1] P_{EUT}: EUT output power
[2] P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[3] Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
[4] BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 50 % – 66 % of maximum
EUT input voltage [5] = 50 % of rated input voltage range, ±10 %
[5] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,5 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

Disconnection at P_{AC} 0% and Q_{AC} 0% reactive load and 66% nominal power



A.7.1.2.4 Loss of mains protection according BS EN 62116

The requirement is specified in section 10.2, test procedure in Annex A.2.2.4
Load imbalance (real, reactive load) for test condition A (EUT output = 25 % – 33 %)

P

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	0,5s

No	P_{EUT} 1) (% of EUT rating)	Reactive load (% of Q_L in 6.1.d) 1)	P_{AC} 2) (% of nominal)	Q_{AC} 3) (% of nominal)	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks4)
11	33	33	0	-5	2,200	272	0,977	308	Test B at IB
10	33	33	0	-4	2,200	272	0,982	362	Test B at IB
9	33	33	0	-3	2,200	272	0,987	306	Test B at IB
8	33	33	0	-2	2,200	272	0,992	348	Test B at IB
7	33	33	0	-1	2,200	272	0,997	316	Test B at IB
1	33	33	0	0	2,200	272	1,002	476	Test B at BL
2	33	33	0	1	2,200	272	1,007	426	Test B at IB
3	33	33	0	2	2,200	272	1,012	322	Test B at IB
4	33	33	0	3	2,200	272	1,017	400	Test B at IB
5	33	33	0	4	2,200	272	1,022	452	Test B at IB
6	33	33	0	5	2,200	272	1,027	298	Test B at IB

Parameter at 0%	L= 76,56 mH	R= 24,10 Ω	C= 132,34 µF

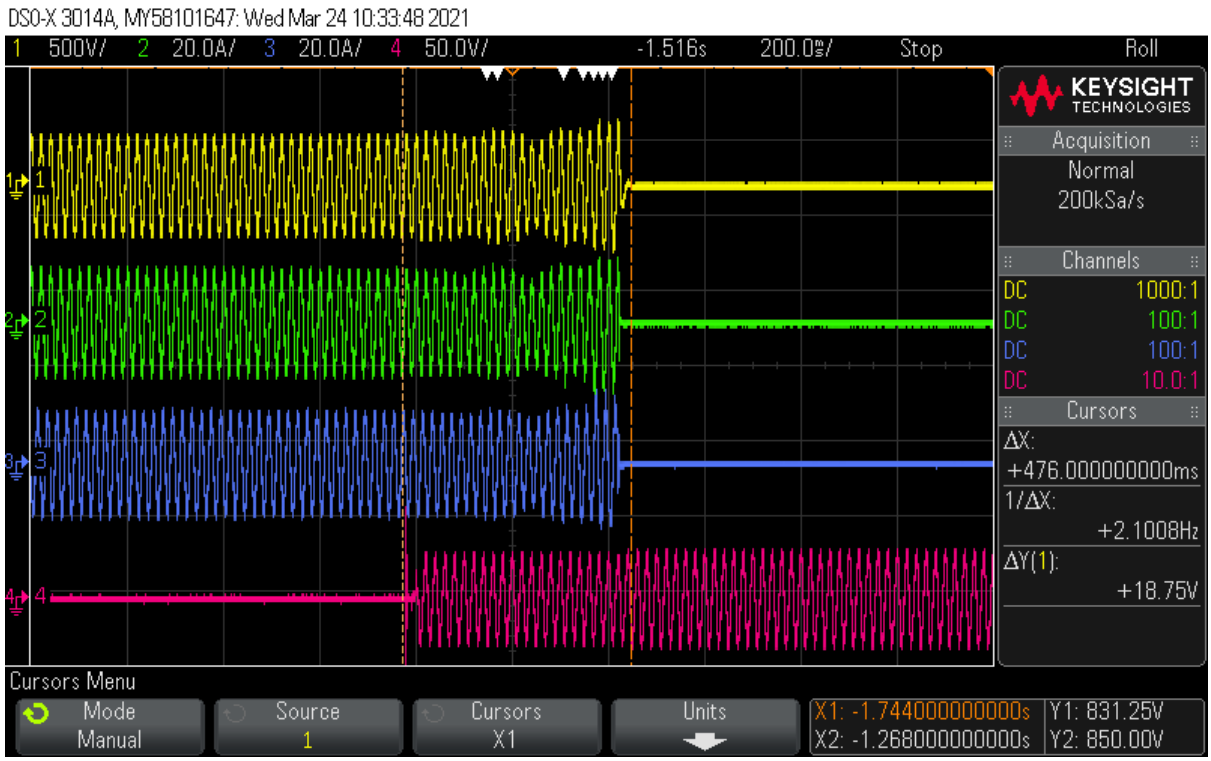
Indicate additional shut down time included in above results. (Disconnection device operation time)	20 ms

Note:
RLC is adjusted to min. +/-1% of the inverter rated output power
1) P_{EUT}: EUT output power
2) P_{AC}: Real power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
3) Q_{AC}: Reactive power flow at S1 in Figure 1. Positive means power from EUT to utility. Nominal is the 0 % test condition value.
4) BL: Balance condition, IB: Imbalance condition.
Condition C:
EUT output power PEUT = 25 % – 33 % 5) of maximum
EUT input voltage 6) = <10 % of rated input voltage range
5) Or minimum allowable EUT output level if greater than 33 %.
6) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,1 × (Y – X). Y shall not exceed 0,8 × EUT maximum system voltage (i.e., maximum allowable array open circuit voltage). In any case, the EUT should not be operated outside of its allowable input voltage range.

The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by

software.

Disconnection at P_{AC} 0% and Q_{AC} 0 reactive load and 33% nominal power



A.7.1.2.5 Reconnection	P

Test:

Test should prove that the reconnection sequence starts after a minimum delay of 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 1.

Under Voltage	
Time delay setting	Measured delay
20s	74s
Over Voltage	
Time delay setting	Measured delay
20s	73s
Under Frequency	
Time delay setting	Measured delay
20s	73s
Over Frequency	
Time delay setting	Measured delay
20s	74

	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 SSEG does not re-connect.	No reconnection	No reconnection	No reconnection	No reconnection

Note:
The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

A.7.1.2.6 Frequency Drift and Step Change Stability test				P
Test:				
	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49,0Hz	+50 degrees		No trip
Negative Vector Shift	50,0Hz	-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

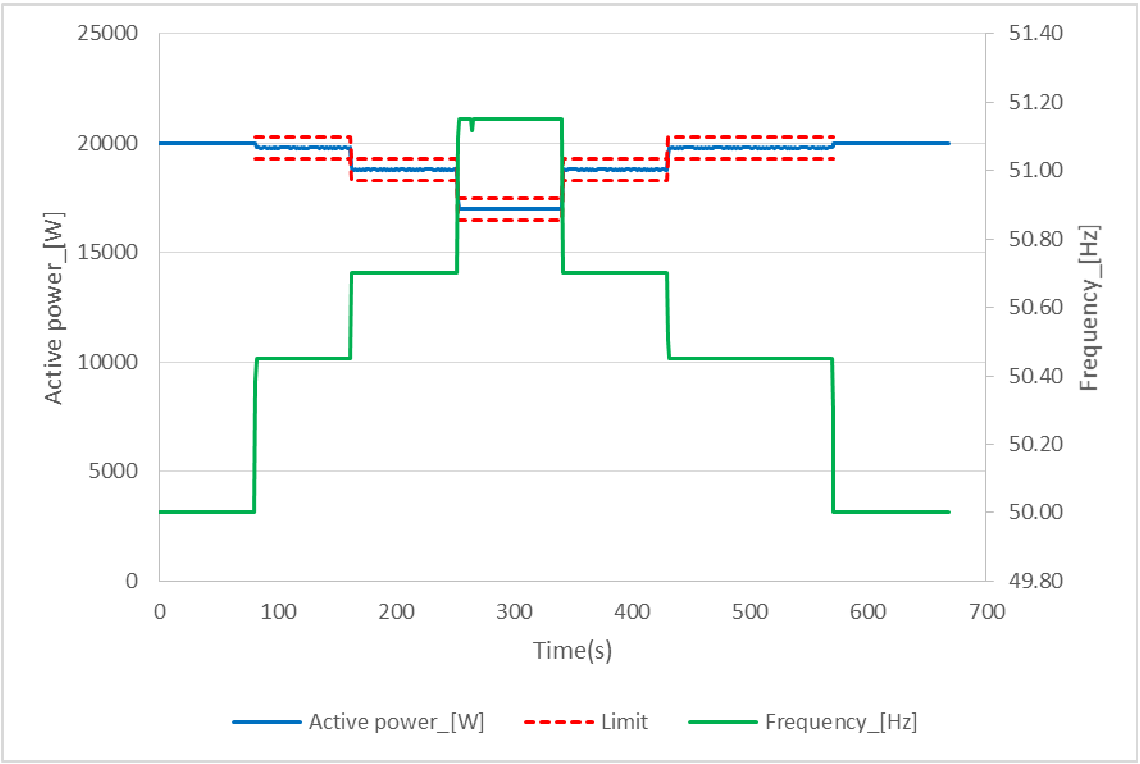
Note:
Manufacturers considering new designs should allow for the RoCoF where stability is required to be increased to, up to 2Hz per second, as proposed in the new European network codes, which are expected to come into force over the period 2014/2015. Under these conditions RoCoF will cease to be an effective loss of mains protection and is unlikely to be permitted in future revisions of this document.

For the step change test the SSEG should be operated with a measureable output at the start frequency and then a vector shift should be applied by extending or reducing the time of a single cycle with subsequent cycles returning to the start frequency. The start frequency should then be maintained for a period of at least 10 seconds to complete the test. The SSEG should not trip during this test.

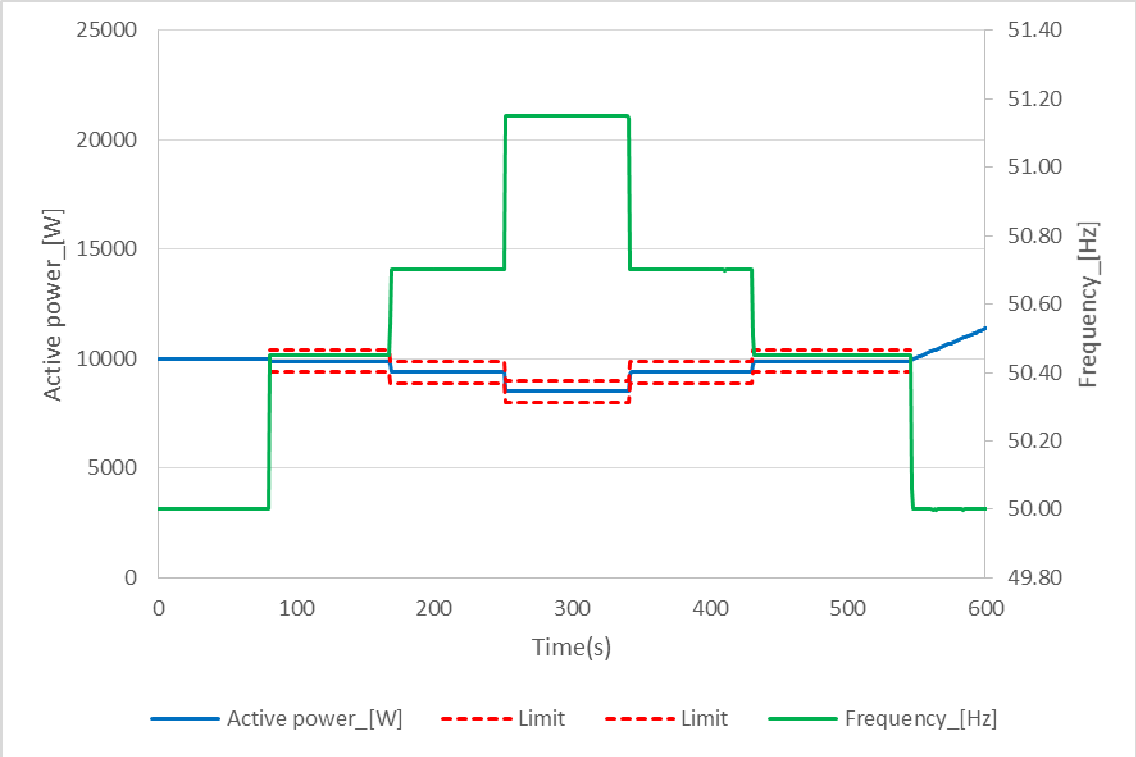
For frequency drift tests the SSEG should be operated with a measureable output at the start frequency and then the frequency changed in a ramp function at 0,95Hz per second to the end frequency. On reaching the end frequency it should be maintained for a period of at least10 seconds. The SSEG should not trip during this test.

The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

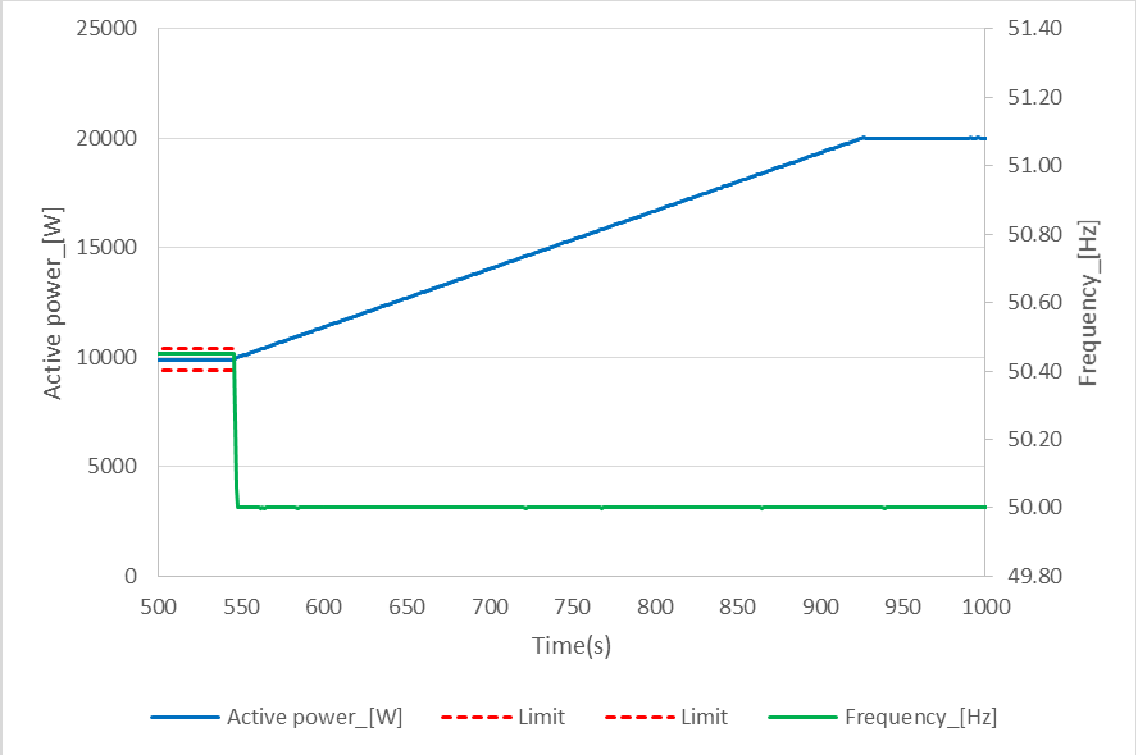
A.7.1.3 Power response to over-frequency							P
Test:							
1-min mean value [Hz]:	a) 50,00	b) 50,45	c) 50,70	d) 51,15	e) 50,70	f) 50,45	g) 50,00
1. Measurement a) to g): Active power output > 80% P_n							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P_M [W]:	N/A	19804	18804	17003	18804	19804	N/A
P_{E60} [W]:	20004	19790	18796	17004	18796	19790	19999
$\Delta P_{E60}/P_M$ [%]:	N/A	0,07	0,04	0,00	0,04	0,07	N/A
2. Measurement a) to g): Active power output 40% and 60% after freezing > 80% P_n							
Frequency [Hz]:	50,00	50,45	50,70	51,15	50,70	50,45	50,00
P_M [W]:	N/A	9895	9395	8496	9395	9895	N/A
P_{E60} [W]:	9995	9894	9401	8514	9401	9893	20017
$\Delta P_{E60}/P_M$ [%]:	N/A	0,01	0,03	0,09	0,03	0,01	N/A
Limit $\Delta P/P_{1min}$:	2,5 % of P_M						
Graph of Measurement 1.: Active power output > 80% P_n							



Graph of Measurement 2.:Active power output 40% and 60% after freezing > 80% P_n



Graph of power gradient:



Test:

The test is conducted for two powers. First, the test must start at a power > 80% P_n ("Measurement 1"), and in a second test, for a power between 40% to 60% P_n ("Measurement 2"). In the second test, after freezing of the P_M, the available active power output must be increased to a value > 80% P_n, and after the network frequency of 50,4 Hz is fallen below, the rise of the active power gradient must be recorded.

Point g) must be held until the micro-generator is again feeding in with the active power output available.

Assessment criterion:

For f = 50,4 Hz, the value of the P_M active power currently being generated is "frozen".

a) For adjustable micro-generators when:

1) the active power reduces between measuring points b) and f) given above with the set gradient P_M per Hz for a increasing frequency (or rises for a frequency decreasing again).

2) the maximum active power gradient occurring in point is less than the configured maximum active power per minute

3) the reaction value of the setpoint determined by the gradient characteristic curve does not differ from P_n by more than ± 10%.

4) the settling time is equal or below 2 s with an intentional delay set to zero

b) For partly adjustable micro-generators

1) when they behave as in a) within their adjustment range, and

2) when, outside the adjustable range, the power fed in on leaving the adjustment range remains constant until shutdown. Shutdown must be no later than at 51,5 Hz.

The droop values should between 8,52% and 12,82%.

Note:

The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

A.7.1.4.1 Harmonic Current Emissions							P
Generating Unit tested to BS EN 61000-3-12							
Test result: ME 20KTL-3PH							
Generating Unit rating per phase (rpp)							Harmonic %
	At 100%% of rated output						
	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in [%]
1th	28,890	28,611	29,035	--	--	--	--
2th	0,126	0,126	0,122	0,438	0,439	0,421	1
3th	0,332	0,332	0,334	1,149	1,159	1,149	4
4th	0,009	0,007	0,008	0,030	0,026	0,027	1
5th	0,108	0,109	0,117	0,373	0,379	0,403	4
6th	0,015	0,015	0,016	0,052	0,053	0,054	1
7th	0,080	0,081	0,080	0,276	0,282	0,277	4
8th	0,007	0,005	0,006	0,023	0,019	0,021	1
9th	0,060	0,060	0,060	0,207	0,209	0,206	4
10th	0,006	0,005	0,004	0,019	0,019	0,015	0,5
11th	0,038	0,035	0,044	0,132	0,123	0,150	2
12th	0,006	0,005	0,005	0,019	0,016	0,016	0,5
13th	0,026	0,027	0,025	0,091	0,095	0,086	2
14th	0,005	0,004	0,003	0,017	0,013	0,011	0,5
15th	0,021	0,020	0,021	0,071	0,070	0,072	2
16th	0,005	0,004	0,003	0,017	0,014	0,010	0,5
17th	0,012	0,008	0,011	0,041	0,029	0,039	1,5
18th	0,005	0,003	0,002	0,017	0,012	0,008	0,5
19th	0,009	0,007	0,006	0,031	0,026	0,022	1,5
20th	0,005	0,003	0,003	0,017	0,010	0,009	0,5
21th	0,011	0,007	0,006	0,037	0,025	0,022	1,5
22th	0,005	0,003	0,003	0,017	0,012	0,009	0,5
23th	0,008	0,004	0,003	0,026	0,014	0,011	0,6
24th	0,005	0,003	0,002	0,018	0,011	0,008	0,5
25th	0,008	0,003	0,004	0,027	0,012	0,013	0,6
26th	0,005	0,003	0,003	0,017	0,010	0,009	0,5
27th	0,006	0,004	0,004	0,020	0,013	0,014	0,6
28th	0,005	0,003	0,003	0,016	0,012	0,009	0,5
29th	0,010	0,006	0,004	0,034	0,022	0,013	0,6
30th	0,005	0,003	0,002	0,018	0,012	0,008	0,5
31th	0,009	0,005	0,006	0,033	0,016	0,020	0,6
32th	0,005	0,003	0,003	0,016	0,010	0,010	0,5
33th	0,004	0,004	0,005	0,015	0,015	0,016	0,6
34th	0,005	0,003	0,003	0,016	0,012	0,009	--
35th	0,009	0,006	0,004	0,031	0,023	0,015	--
36th	0,005	0,004	0,003	0,018	0,013	0,009	--
37th	0,009	0,006	0,007	0,032	0,020	0,023	--
38th	0,004	0,003	0,004	0,015	0,010	0,013	--
39th	0,004	0,004	0,004	0,014	0,015	0,013	--
40th	0,004	0,003	0,003	0,014	0,011	0,009	--
41th	0,008	0,006	0,004	0,026	0,020	0,015	--
42th	0,006	0,005	0,005	0,021	0,018	0,016	--
43th	0,009	0,006	0,006	0,030	0,021	0,020	--
44th	0,005	0,003	0,003	0,016	0,011	0,012	--
45th	0,004	0,004	0,003	0,013	0,015	0,012	--
46th	0,010	0,009	0,009	0,035	0,030	0,033	--
47th	0,007	0,007	0,006	0,026	0,025	0,021	--

A.7.1.4.1 Harmonic Current Emissions							P
Generating Unit tested to BS EN 61000-3-12							
48th	0,007	0,006	0,006	0,024	0,022	0,021	--
49th	0,008	0,007	0,007	0,029	0,024	0,025	--
50th	0,010	0,009	0,010	0,035	0,032	0,034	--
THD_[%]	--	--	--	1,352	1,359	1,353	23
PWHD_[%}	--	--	--	0,880	0,695	0.675	23

A.7.1.4.1 Harmonic Current Emissions							P
Generating Unit tested to BS EN 61000-3-12							
Test result: ME 20KTL-3PH							
Generating Unit rating per phase (rpp)							Harmonic %
	At 50%% of rated output						
	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in [%]
1th	14,540	14,357	14,533	--	--	--	--
2th	0,065	0,065	0,064	0,450	0,456	0,438	1
3th	0,171	0,171	0,172	1,176	1,191	1,184	4
4th	0,004	0,004	0,004	0,031	0,028	0,028	1
5th	0,058	0,058	0,063	0,402	0,405	0,432	4
6th	0,008	0,008	0,008	0,056	0,057	0,057	1
7th	0,042	0,043	0,043	0,287	0,300	0,294	4
8th	0,003	0,003	0,003	0,022	0,018	0,019	1
9th	0,032	0,033	0,033	0,222	0,227	0,226	4
10th	0,003	0,003	0,002	0,019	0,019	0,015	0,5
11th	0,020	0,019	0,022	0,140	0,132	0,154	2
12th	0,003	0,002	0,002	0,019	0,017	0,016	0,5
13th	0,014	0,014	0,013	0,096	0,098	0,093	2
14th	0,002	0,002	0,002	0,016	0,014	0,011	0,5
15th	0,011	0,011	0,012	0,074	0,078	0,079	2
16th	0,002	0,002	0,002	0,015	0,015	0,011	0,5
17th	0,007	0,005	0,006	0,045	0,036	0,041	1,5
18th	0,002	0,002	0,001	0,015	0,012	0,008	0,5
19th	0,005	0,004	0,004	0,032	0,027	0,027	1,5
20th	0,002	0,002	0,001	0,016	0,011	0,008	0,5
21th	0,005	0,004	0,004	0,032	0,029	0,025	1,5
22th	0,002	0,002	0,001	0,015	0,012	0,009	0,5
23th	0,004	0,002	0,002	0,026	0,017	0,011	0,6
24th	0,002	0,002	0,001	0,016	0,011	0,007	0,5
25th	0,004	0,002	0,002	0,026	0,013	0,013	0,6
26th	0,002	0,001	0,001	0,016	0,010	0,009	0,5
27th	0,002	0,002	0,002	0,015	0,014	0,016	0,6
28th	0,002	0,002	0,002	0,014	0,012	0,011	0,5
29th	0,004	0,003	0,002	0,029	0,024	0,015	0,6
30th	0,002	0,002	0,001	0,016	0,012	0,009	0,5
31th	0,004	0,003	0,003	0,030	0,018	0,019	0,6
32th	0,002	0,001	0,001	0,015	0,010	0,009	0,5
33th	0,002	0,002	0,003	0,014	0,016	0,018	0,6
34th	0,002	0,002	0,001	0,014	0,012	0,010	--
35th	0,004	0,003	0,002	0,027	0,023	0,017	--
36th	0,002	0,002	0,001	0,016	0,012	0,009	--
37th	0,004	0,003	0,003	0,028	0,021	0,020	--
38th	0,002	0,002	0,002	0,014	0,011	0,011	--
39th	0,002	0,002	0,002	0,012	0,015	0,015	--
40th	0,002	0,002	0,001	0,013	0,011	0,010	--
41th	0,003	0,003	0,002	0,022	0,020	0,015	--
42th	0,003	0,003	0,003	0,020	0,018	0,017	--
43th	0,004	0,003	0,003	0,026	0,022	0,018	--
44th	0,002	0,002	0,002	0,015	0,012	0,011	--
45th	0,002	0,002	0,002	0,013	0,017	0,012	--
46th	0,005	0,005	0,005	0,037	0,033	0,035	--
47th	0,003	0,003	0,003	0,021	0,023	0,020	--

A.7.1.4.1 Harmonic Current Emissions							P
Generating Unit tested to BS EN 61000-3-12							
48th	0,003	0,003	0,003	0,023	0,022	0,024	--
49th	0,004	0,003	0,003	0,026	0,024	0,023	--
50th	0,006	0,005	0,005	0,038	0,034	0,036	--
THD_[%]	--	--	--	1,392	1,408	1,405	23
PWHD_[%}	--	--	--	0,134	0,118	0,114	23

Note:
The tests should be based on the limits of the EN 61000-3-12 for more than 16A.

A.7.1.4.1 Harmonic Current Emissions							P
Generating Unit tested to BS EN 61000-3-12							
Test result: ME 15KTL-3PH							
Generating Unit rating per phase (rpp)							Harmonic %
	At 100%% of rated output						
	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in [%]
1th	21,862	21,606	21,870	--	--	--	--
2th	0,094	0,095	0,092	0,432	0,438	0,419	1
3th	0,253	0,253	0,255	1,158	1,172	1,165	4
4th	0,006	0,006	0,006	0,029	0,027	0,028	1
5th	0,085	0,085	0,091	0,388	0,391	0,418	4
6th	0,011	0,011	0,011	0,051	0,051	0,052	1
7th	0,061	0,063	0,062	0,277	0,291	0,285	4
8th	0,005	0,004	0,004	0,022	0,018	0,019	1
9th	0,047	0,047	0,047	0,215	0,218	0,216	4
10th	0,004	0,004	0,004	0,019	0,020	0,016	0,5
11th	0,030	0,027	0,033	0,136	0,127	0,151	2
12th	0,004	0,004	0,004	0,019	0,018	0,019	0,5
13th	0,020	0,021	0,020	0,092	0,097	0,089	2
14th	0,004	0,003	0,003	0,016	0,014	0,013	0,5
15th	0,016	0,016	0,017	0,072	0,074	0,075	2
16th	0,004	0,003	0,002	0,016	0,014	0,011	0,5
17th	0,009	0,007	0,009	0,042	0,033	0,040	1,5
18th	0,003	0,003	0,002	0,015	0,012	0,008	0,5
19th	0,007	0,006	0,005	0,031	0,026	0,024	1,5
20th	0,004	0,002	0,002	0,016	0,011	0,008	0,5
21th	0,007	0,006	0,005	0,034	0,027	0,023	1,5
22th	0,003	0,003	0,002	0,015	0,012	0,009	0,5
23th	0,005	0,003	0,002	0,025	0,016	0,010	0,6
24th	0,004	0,002	0,002	0,016	0,011	0,007	0,5
25th	0,006	0,003	0,003	0,026	0,012	0,012	0,6
26th	0,003	0,002	0,002	0,016	0,010	0,009	0,5
27th	0,004	0,003	0,003	0,016	0,013	0,015	0,6
28th	0,003	0,003	0,002	0,014	0,013	0,010	0,5
29th	0,007	0,005	0,003	0,030	0,023	0,013	0,6
30th	0,004	0,003	0,002	0,016	0,012	0,008	0,5
31th	0,007	0,004	0,004	0,031	0,018	0,018	0,6
32th	0,003	0,002	0,002	0,016	0,009	0,010	0,5
33th	0,003	0,003	0,004	0,013	0,015	0,017	0,6
34th	0,003	0,003	0,002	0,014	0,013	0,009	--
35th	0,006	0,005	0,003	0,028	0,023	0,016	--
36th	0,004	0,003	0,002	0,017	0,012	0,009	--
37th	0,006	0,005	0,005	0,030	0,021	0,022	--
38th	0,003	0,002	0,003	0,014	0,010	0,012	--
39th	0,003	0,003	0,003	0,013	0,014	0,015	--
40th	0,003	0,002	0,002	0,013	0,011	0,009	--
41th	0,005	0,004	0,003	0,023	0,019	0,015	--
42th	0,004	0,004	0,003	0,020	0,018	0,015	--
43th	0,006	0,005	0,004	0,028	0,021	0,017	--
44th	0,003	0,002	0,002	0,016	0,012	0,011	--
45th	0,003	0,003	0,003	0,013	0,015	0,012	--
46th	0,008	0,007	0,007	0,036	0,032	0,034	--
47th	0,005	0,005	0,005	0,023	0,024	0,021	--

A.7.1.4.1 Harmonic Current Emissions							P
Generating Unit tested to BS EN 61000-3-12							
48th	0,005	0,005	0,004	0,024	0,022	0,020	--
49th	0,006	0,005	0,005	0,028	0,023	0,022	--
50th	0,008	0,007	0,008	0,036	0,033	0,034	--
THD_[%]	--	--	--	1,363	1,379	1,374	23
PWHD_[%}	--	--	--	0,134	0,113	0,109	23

A.7.1.4.1 Harmonic Current Emissions							P
Generating Unit tested to BS EN 61000-3-12							
Test result: ME 15KTL-3PH							
Generating Unit rating per phase (rpp)							Harmonic %
	At 50%% of rated output						
	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in [%]
1th	10,923	10,792	10,934	--	--	--	--
2th	0,046	0,046	0,044	0,419	0,425	0,406	1
3th	0,131	0,131	0,132	1,202	1,216	1,209	4
4th	0,003	0,003	0,003	0,030	0,028	0,029	1
5th	0,046	0,046	0,049	0,417	0,424	0,451	4
6th	0,006	0,006	0,006	0,055	0,056	0,057	1
7th	0,033	0,034	0,034	0,302	0,311	0,307	4
8th	0,002	0,002	0,002	0,021	0,019	0,020	1
9th	0,026	0,026	0,026	0,234	0,239	0,238	4
10th	0,002	0,002	0,002	0,019	0,019	0,016	0,5
11th	0,016	0,015	0,017	0,144	0,138	0,158	2
12th	0,002	0,002	0,002	0,019	0,017	0,016	0,5
13th	0,011	0,011	0,010	0,104	0,102	0,096	2
14th	0,002	0,001	0,001	0,015	0,013	0,010	0,5
15th	0,009	0,009	0,009	0,079	0,083	0,085	2
16th	0,002	0,001	0,001	0,015	0,014	0,011	0,5
17th	0,005	0,004	0,005	0,049	0,039	0,044	1,5
18th	0,002	0,001	0,001	0,015	0,011	0,008	0,5
19th	0,004	0,003	0,003	0,035	0,029	0,030	1,5
20th	0,002	0,001	0,001	0,015	0,010	0,008	0,5
21th	0,004	0,003	0,003	0,033	0,029	0,026	1,5
22th	0,001	0,001	0,001	0,014	0,011	0,009	0,5
23th	0,003	0,002	0,001	0,028	0,017	0,013	0,6
24th	0,002	0,001	0,001	0,015	0,010	0,007	0,5
25th	0,003	0,001	0,002	0,025	0,012	0,014	0,6
26th	0,002	0,001	0,001	0,014	0,010	0,008	0,5
27th	0,002	0,001	0,002	0,015	0,014	0,016	0,6
28th	0,001	0,001	0,001	0,012	0,012	0,009	0,5
29th	0,003	0,002	0,002	0,030	0,022	0,016	0,6
30th	0,002	0,001	0,001	0,014	0,011	0,009	0,5
31th	0,003	0,002	0,002	0,028	0,019	0,021	0,6
32th	0,001	0,001	0,001	0,013	0,010	0,009	0,5
33th	0,002	0,002	0,002	0,014	0,015	0,017	0,6
34th	0,001	0,001	0,001	0,013	0,011	0,009	--
35th	0,003	0,002	0,002	0,026	0,021	0,017	--
36th	0,002	0,001	0,001	0,015	0,011	0,010	--
37th	0,003	0,002	0,002	0,026	0,021	0,022	--
38th	0,001	0,001	0,001	0,012	0,011	0,011	--
39th	0,001	0,002	0,002	0,012	0,016	0,016	--
40th	0,001	0,001	0,001	0,012	0,010	0,009	--
41th	0,002	0,002	0,002	0,021	0,019	0,015	--
42th	0,002	0,002	0,002	0,020	0,018	0,018	--
43th	0,003	0,002	0,002	0,023	0,022	0,017	--
44th	0,002	0,001	0,001	0,014	0,012	0,011	--
45th	0,001	0,002	0,002	0,013	0,017	0,015	--
46th	0,004	0,004	0,004	0,038	0,035	0,036	--
47th	0,002	0,002	0,002	0,021	0,022	0,021	--

A.7.1.4.1 Harmonic Current Emissions							P
Generating Unit tested to BS EN 61000-3-12							
48th	0,003	0,002	0,003	0,024	0,023	0,023	--
49th	0,003	0,003	0,002	0,025	0,025	0,021	--
50th	0,004	0,004	0,004	0,039	0,036	0,037	--
THD_[%]	--	--	--	1,415	1,431	1,428	23
PWHD_[%}	--	--	--	0,137	0,121	0,121	23

A.7.1.4.1 Harmonic Current Emissions							P
Generating Unit tested to BS EN 61000-3-12							
Test result: ME 5KTL-3PH							
Generating Unit rating per phase (rpp)							Harmonic %
	At 100%% of rated output						
	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in [%]
1th	7,341	7,245	7,340	--	--	--	--
2th	0,030	0,032	0,032	0,412	0,435	0,430	1
3th	0,095	0,094	0,094	1,290	1,297	1,278	4
4th	0,002	0,002	0,002	0,030	0,030	0,031	1
5th	0,037	0,035	0,035	0,511	0,484	0,479	4
6th	0,004	0,004	0,004	0,054	0,055	0,054	1
7th	0,026	0,026	0,026	0,355	0,356	0,349	4
8th	0,002	0,002	0,002	0,023	0,025	0,027	1
9th	0,020	0,019	0,019	0,267	0,266	0,261	4
10th	0,001	0,002	0,002	0,020	0,025	0,022	0,5
11th	0,013	0,011	0,012	0,175	0,153	0,166	2
12th	0,001	0,002	0,002	0,019	0,022	0,021	0,5
13th	0,008	0,009	0,009	0,111	0,120	0,119	2
14th	0,001	0,001	0,001	0,014	0,019	0,018	0,5
15th	0,007	0,006	0,006	0,097	0,089	0,087	2
16th	0,001	0,001	0,001	0,013	0,019	0,016	0,5
17th	0,004	0,003	0,005	0,056	0,048	0,064	1,5
18th	0,001	0,001	0,001	0,011	0,017	0,016	0,5
19th	0,003	0,003	0,003	0,035	0,037	0,045	1,5
20th	0,001	0,001	0,001	0,012	0,015	0,016	0,5
21th	0,002	0,002	0,002	0,027	0,027	0,032	1,5
22th	0,001	0,001	0,001	0,011	0,018	0,014	0,5
23th	0,001	0,001	0,002	0,016	0,021	0,033	0,6
24th	0,001	0,001	0,001	0,009	0,015	0,016	0,5
25th	0,001	0,001	0,002	0,019	0,019	0,025	0,6
26th	0,001	0,001	0,001	0,014	0,014	0,017	0,5
27th	0,002	0,002	0,001	0,021	0,021	0,019	0,6
28th	0,001	0,001	0,001	0,012	0,018	0,014	0,5
29th	0,001	0,002	0,002	0,017	0,024	0,029	0,6
30th	0,001	0,001	0,001	0,011	0,015	0,017	0,5
31th	0,002	0,002	0,002	0,024	0,025	0,026	0,6
32th	0,001	0,001	0,001	0,014	0,014	0,015	0,5
33th	0,002	0,002	0,001	0,022	0,023	0,017	0,6
34th	0,001	0,001	0,001	0,012	0,017	0,015	--
35th	0,002	0,002	0,002	0,024	0,025	0,024	--
36th	0,001	0,001	0,001	0,011	0,013	0,017	--
37th	0,002	0,002	0,002	0,025	0,028	0,021	--
38th	0,001	0,001	0,001	0,015	0,015	0,014	--
39th	0,002	0,002	0,001	0,021	0,023	0,014	--
40th	0,001	0,001	0,001	0,011	0,016	0,013	--
THD_[%]	--	--	--	1,536	1,539	1,520	23
PWHD_[%}	--	--	--	3,760	3,992	3,987	23

A.7.1.4.1 Harmonic Current Emissions	P

Generating Unit tested to BS EN 61000-3-12

Test result: ME 5KTL-3PH

Generating Unit rating per phase (rpp)							Harmonic %
	At 50%% of rated output						
	Measured Value (MV) in Amps			Measured Value (MV) in %			Limit in BS EN61000-3-12 in [%]
1th	3,653	3,604	3,651	--	--	--	--
2th	0,017	0,017	0,016	0,461	0,460	0,448	1
3th	0,049	0,049	0,050	1,345	1,366	1,357	4
4th	0,001	0,001	0,001	0,035	0,034	0,033	1
5th	0,019	0,019	0,021	0,533	0,528	0,562	4
6th	0,002	0,003	0,003	0,068	0,070	0,071	1
7th	0,014	0,014	0,014	0,395	0,396	0,391	4
8th	0,001	0,001	0,001	0,030	0,031	0,027	1
9th	0,009	0,009	0,009	0,250	0,258	0,256	4
10th	0,001	0,001	0,001	0,031	0,032	0,028	0,5
11th	0,007	0,006	0,007	0,188	0,169	0,192	2
12th	0,001	0,001	0,001	0,023	0,026	0,023	0,5
13th	0,005	0,005	0,005	0,138	0,136	0,124	2
14th	0,001	0,001	0,001	0,027	0,027	0,021	0,5
15th	0,003	0,003	0,003	0,073	0,078	0,082	2
16th	0,001	0,001	0,001	0,025	0,029	0,018	0,5
17th	0,003	0,002	0,002	0,073	0,056	0,068	1,5
18th	0,001	0,001	0,001	0,021	0,022	0,016	0,5
19th	0,002	0,002	0,001	0,049	0,049	0,039	1,5
20th	0,001	0,001	0,001	0,027	0,021	0,019	0,5
21th	0,001	0,001	0,001	0,024	0,030	0,027	1,5
22th	0,001	0,001	0,001	0,021	0,028	0,014	0,5
23th	0,001	0,001	0,001	0,033	0,029	0,029	0,6
24th	0,001	0,001	0,000	0,025	0,021	0,013	0,5
25th	0,001	0,001	0,001	0,019	0,032	0,028	0,6
26th	0,001	0,001	0,001	0,026	0,019	0,020	0,5
27th	0,001	0,001	0,001	0,018	0,033	0,033	0,6
28th	0,001	0,001	0,001	0,020	0,028	0,014	0,5
29th	0,001	0,001	0,001	0,024	0,029	0,029	0,6
30th	0,001	0,001	0,001	0,024	0,020	0,014	0,5
31th	0,001	0,001	0,001	0,018	0,040	0,032	0,6
32th	0,001	0,001	0,001	0,023	0,016	0,020	0,5
33th	0,001	0,001	0,001	0,018	0,037	0,033	0,6
34th	0,001	0,001	0,001	0,022	0,026	0,015	--
35th	0,001	0,001	0,002	0,022	0,032	0,044	--
36th	0,001	0,001	0,001	0,024	0,018	0,015	--
37th	0,001	0,002	0,001	0,018	0,046	0,038	--
38th	0,001	0,001	0,001	0,023	0,018	0,020	--
39th	0,001	0,001	0,001	0,019	0,038	0,037	--
40th	0,001	0,001	0,000	0,020	0,025	0,012	--
THD_[%]	--	--	--	1,617	1,633	1,632	23
PWHD_[%}	--	--	--	4,275	4,696	4,409	23

Note:

The tests should be based on the limits of the EN 61000-3-12 for more than 16A.

The tests had been performed on the ME 20KTL-3PH, ME 15KTL-3PHand ME 5KTL-3PH are valid for the ME 6KTL-3PH, ME 8KTL-3PH and ME 10KTL-3PH since it is same as in hardware and just power derated by software.

A.7.1.4.2 Power factor				P
Test:				
ME 5KTL-3PH				
Output power	216,2 V	230 V	253,20 V	
20%	0,9981i	0,9969i	0,9952i	Measured at three voltage levels and at full output. Voltage to be maintained within ±1.5% of the stated level during the test.
50%	0,9994i	0,9995i	0,9994i	
75%	0,9996i	0,9996i	0,9995i	
100%	0,9996i	0,9996i	0,9996i	
Limit	>0,95	>0,95	>0,95	
ME 10KTL-3PH				
Output power	216,2 V	230 V	253,20 V	
20%	0,9981i	0,9969i	0,9952i	Measured at three voltage levels and at full output. Voltage to be maintained within ±1.5% of the stated level during the test.
50%	0,9994i	0,9995i	0,9994i	
75%	0,9996i	0,9996i	0,9995i	
100%	0,9996i	0,9996i	0,9996i	
Limit	>0,95	>0,95	>0,95	
ME 15KTL-3PH				
Output power	216,2 V	230 V	253,20 V	
20%	0,9992	0,9990	0,9985	Measured at three voltage levels and at full output. Voltage to be maintained within ±1.5% of the stated level during the test.
50%	0,9996	0,9996	0,9996	
75%	0,9997	0,9996	0,9996	
100%	0,9997	0,9996	0,9996	
Limit	>0,95	>0,95	>0,95	
ME 20KTL-3PH				
Output power	216,2 V	230 V	253,20 V	
20%	0,9993	0,9992	0,9989	Measured at three voltage levels and at full output. Voltage to be maintained within ±1.5% of the stated level during the test.
50%	0,9996	0,9996	0,9996	
75%	0,9997	0,9997	0,9997	
100%	0,9997	0,9997	0,9997	
Limit	>0,95	>0,95	>0,95	

Note:
The power factor capability of the SSEG shall conform to EN 50438. When operating at Registered Capacity the SSEGshall operate at apower factor within the range 0.95 lagging to 0.95 leading relative to the voltage waveform unless otherwise agreed with the DNO eg for power factor improvement.

The test set up shall be such that the Inverter supplies full load to the DNO's Distribution System via the

power factor (pf) meter and the variac as shown below in figure A5. The Inverter pf should be within the limits given in 5.6, for three test voltages 230 V –6%, 230V and 230 V +10%.
The tests had been performed on the ME 20KTL-3PH, ME 15KTL-3PH, ME 10KTL-3PH and ME 5KTL-3PH are valid for the ME 6KTL-3PH, ME 8KTL-3PH since it is same as in hardware and just power derated by software.

A.7.1.4.3 Voltage Flicker — P

	Starting			Stopping			Running	
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_{st}	P_{lt} 2 hours
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 value	See below							

inverter >16A
ME 15KTL-3PH

Limit	dc% = 3,3	P_{st}=1,0	P_{lt}=0,65
Test value	See below		

L1 phase

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.002	Pass	2.054	Pass	0.0	Pass	0.171	Pass		
2	0.001	Pass	2.057	Pass	0.0	Pass	0.119	Pass		
3	0.001	Pass	2.047	Pass	0.0	Pass	0.167	Pass		
4	0.001	Pass	3.048	Pass	0.0	Pass	0.136	Pass		
5	0.001	Pass	2.049	Pass	0.0	Pass	0.157	Pass		
6	0.002	Pass	2.063	Pass	0.0	Pass	0.158	Pass		
7	0.001	Pass	2.052	Pass	0.0	Pass	0.153	Pass		
8	0.002	Pass	2.054	Pass	0.0	Pass	0.169	Pass		
9	0.002	Pass	2.051	Pass	0.0	Pass	0.135	Pass		
10	0.002	Pass	3.047	Pass	0.0	Pass	0.177	Pass		
11	0.001	Pass	2.058	Pass	0.0	Pass	0.122	Pass		
12	0.001	Pass	2.052	Pass	0.0	Pass	0.164	Pass		
Result		Pass		Pass		Pass		Pass	0.153	Pass

L2 Phase

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.001	Pass	2.051	Pass	0.0	Pass	0.131	Pass		
2	0.001	Pass	3.028	Pass	0.0	Pass	0.169	Pass		
3	0.002	Pass	2.052	Pass	0.0	Pass	0.153	Pass		
4	0.001	Pass	1.034	Pass	0.0	Pass	0.167	Pass		
5	0.002	Pass	3.035	Pass	0.0	Pass	0.164	Pass		
6	0.001	Pass	2.045	Pass	0.0	Pass	0.156	Pass		
7	0.001	Pass	2.043	Pass	0.0	Pass	0.177	Pass		
8	0.002	Pass	2.053	Pass	0.0	Pass	0.132	Pass		
9	0.001	Pass	3.021	Pass	0.0	Pass	0.176	Pass		
10	0.001	Pass	2.052	Pass	0.0	Pass	0.160	Pass		
11	0.001	Pass	3.036	Pass	0.0	Pass	0.168	Pass		
12	0.002	Pass	2.044	Pass	0.0	Pass	0.160	Pass		
Result		Pass		Pass		Pass		Pass	0.163	Pass

L3 phase

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.034	Pass	2.102	Pass	0.0	Pass	0.782	Pass		
2	0.041	Pass	2.111	Pass	0.0	Pass	0.265	Pass		
3	0.031	Pass	2.119	Pass	0.0	Pass	0.263	Pass		
4	0.027	Pass	3.089	Pass	0.0	Pass	0.265	Pass		
5	0.035	Pass	2.084	Pass	0.0	Pass	0.264	Pass		
6	0.037	Pass	2.130	Pass	0.0	Pass	0.264	Pass		
7	0.034	Pass	2.104	Pass	0.0	Pass	0.265	Pass		
8	0.036	Pass	2.104	Pass	0.0	Pass	0.264	Pass		
9	0.037	Pass	2.080	Pass	0.0	Pass	0.265	Pass		
10	0.044	Pass	2.101	Pass	0.0	Pass	0.263	Pass		
11	0.039	Pass	2.109	Pass	0.0	Pass	0.263	Pass		
12	0.039	Pass	2.074	Pass	0.0	Pass	0.266	Pass		
Result		Pass		Pass		Pass		Pass	0.264	Pass

Test impedance	R	0,24	Ω	Xl	0,15	Ω
Standard impedance	R	0,24* 0,4^	Ω	Xl	0,15* 0,25^	Ω
Maximum Impedance	R	0,24	Ω	Xl	0,1	Ω

inverter >16A ME 20KTL-3PH			
Limit	dc% = 3,3	P_{st}=1,0	P_{lt}=0,65
Test value	See below		

L1 phase

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.110	Pass	0.187	Pass	0.0	Pass	0.075	Pass		
2	0.110	Pass	0.185	Pass	0.0	Pass	0.076	Pass		
3	0.107	Pass	0.180	Pass	0.0	Pass	0.078	Pass		
4	0.108	Pass	0.170	Pass	0.0	Pass	0.078	Pass		
5	0.101	Pass	0.165	Pass	0.0	Pass	0.070	Pass		
6	0.104	Pass	0.166	Pass	0.0	Pass	0.064	Pass		
7	0.104	Pass	0.162	Pass	0.0	Pass	0.065	Pass		
8	0.101	Pass	0.203	Pass	0.0	Pass	0.059	Pass		
9	0.127	Pass	0.186	Pass	0.0	Pass	0.059	Pass		
10	0.115	Pass	0.168	Pass	0.0	Pass	0.058	Pass		
11	0.115	Pass	0.182	Pass	0.0	Pass	0.060	Pass		
12	0.107	Pass	0.168	Pass	0.0	Pass	0.065	Pass		
Result		Pass		Pass		Pass		Pass	0.068	Pass

L2 Phase

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.027	Pass	0.140	Pass	0.0	Pass	0.154	Pass		
2	0.022	Pass	0.132	Pass	0.0	Pass	0.154	Pass		
3	0.029	Pass	0.146	Pass	0.0	Pass	0.153	Pass		
4	0.029	Pass	0.132	Pass	0.0	Pass	0.153	Pass		
5	0.008	Pass	0.129	Pass	0.0	Pass	0.150	Pass		
6	0.029	Pass	0.130	Pass	0.0	Pass	0.145	Pass		
7	0.027	Pass	0.136	Pass	0.0	Pass	0.147	Pass		
8	0.032	Pass	0.130	Pass	0.0	Pass	0.143	Pass		
9	0.030	Pass	0.137	Pass	0.0	Pass	0.143	Pass		
10	0.014	Pass	0.134	Pass	0.0	Pass	0.141	Pass		
11	0.013	Pass	0.128	Pass	0.0	Pass	0.143	Pass		
12	0.025	Pass	0.133	Pass	0.0	Pass	0.148	Pass		
Result		Pass		Pass		Pass		Pass	0.148	Pass

L3 phase

	dc[%]		dmax[%]		d(t)[ms]		Pst		Plt	
Limit	3.30		4.00		500 3.30%		1.00		0.65 N:12	
No. 1	0.000	Pass	0.000	Pass	0.0	Pass	0.064	Pass		
2	0.018	Pass	0.105	Pass	0.0	Pass	0.065	Pass		
3	0.000	Pass	0.000	Pass	0.0	Pass	0.066	Pass		
4	0.028	Pass	0.103	Pass	0.0	Pass	0.067	Pass		
5	0.000	Pass	0.000	Pass	0.0	Pass	0.061	Pass		
6	0.012	Pass	0.101	Pass	0.0	Pass	0.054	Pass		
7	0.009	Pass	0.104	Pass	0.0	Pass	0.057	Pass		
8	0.014	Pass	0.101	Pass	0.0	Pass	0.052	Pass		
9	0.000	Pass	0.000	Pass	0.0	Pass	0.051	Pass		
10	0.000	Pass	0.000	Pass	0.0	Pass	0.050	Pass		
11	0.020	Pass	0.105	Pass	0.0	Pass	0.052	Pass		
12	0.000	Pass	0.000	Pass	0.0	Pass	0.058	Pass		
Result		Pass		Pass		Pass		Pass	0.059	Pass

Test impedance	R	0,24	Ω	Xl	0,15	Ω
Standard impedance	R	0,24* 0,4^	Ω	Xl	0,15* 0,25^	Ω
Maximum Impedance	R	0,24	Ω	Xl	0,1	Ω

Note:
*The stationary deviance of dc% is more relevant than the dynamic deviance of d_{max} at starting and stopping.

Mains Impedance according EN61000-3-11: **R_{max} = 0,24Ω; jX_{max}= 0,15Ω @50Hz (|Z_{max}| = 0,283/0,4717Ω)**
for single phase inverter use also R_n = 0,16Ω; jX_n= 0,1Ω

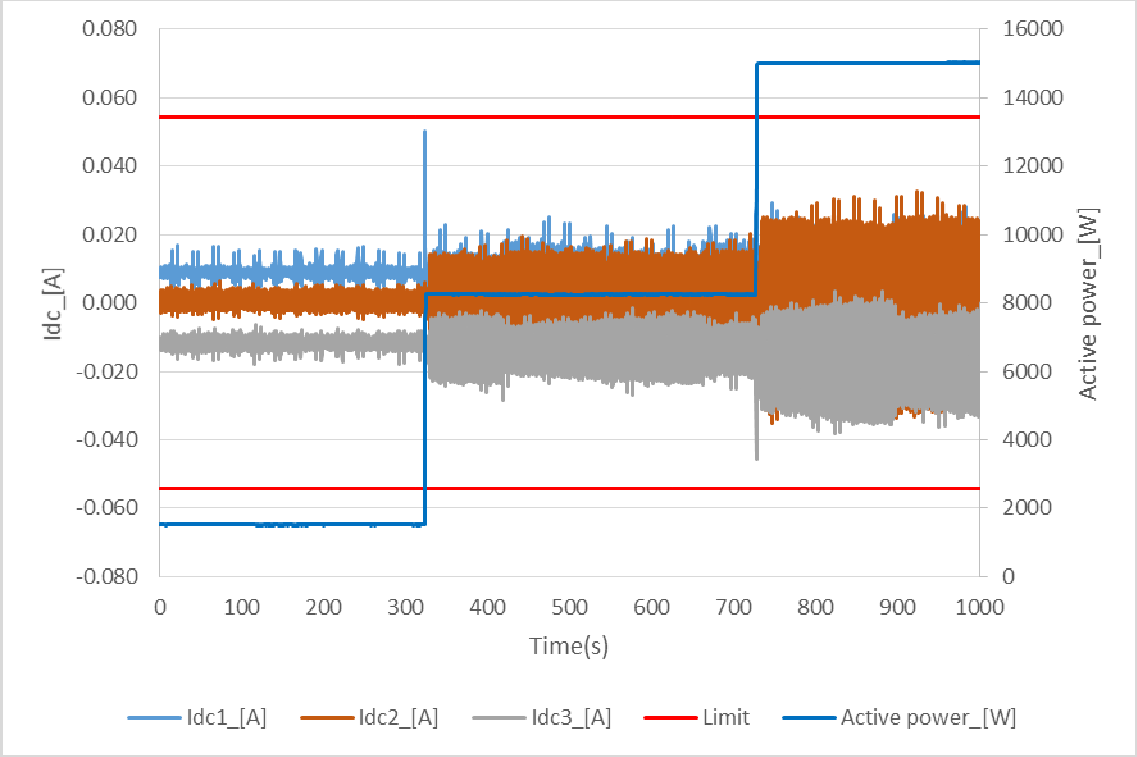
Calculation of the maximum permissible grid impedance at the point of common coupling based on d_c:
$Z_{max} = Z_{ref} * 3,3\% / d_c(P_n)$

The tests should be based on the limits of the EN 61000-3-11 for more than 16A.
The tests had been performed on the ME 20KTL-3PH, ME 15KTL-3PHare valid for the ME 6KTL-3PH, ME 8KTL-3PH, ME 10KTL-3PH and ME 5KTL-3PH since it is same as in hardware and just power derated by software.

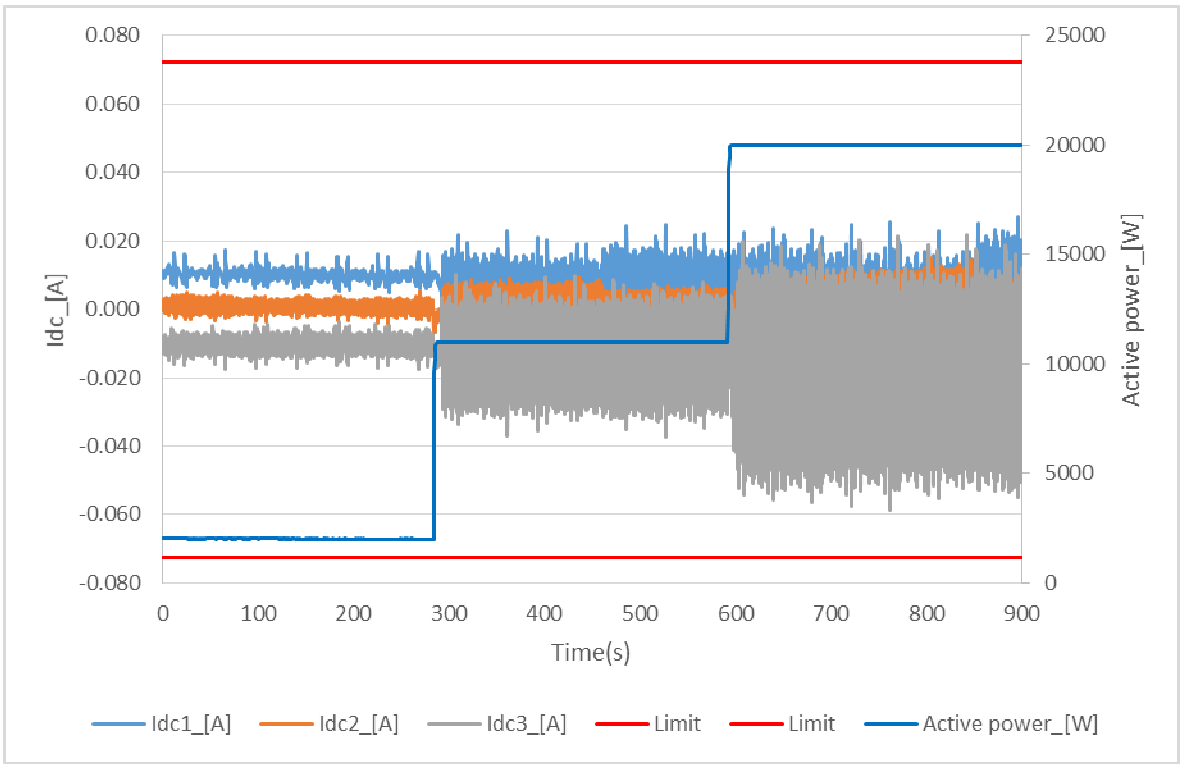
A.7.1.4.4 DC injection			P
ME 15KTL-3PH			
Test level power	10%	55%	100%
Abs, Max, DC (mA)	17	23	30
As % of rated AC current	0,08	0,10	0,14
Abs, Ave, DC (mA)	9	8	9
As % of rated AC current	0,04	0,04	0,04
Limit	0,25%	0,25%	0,25%
Abs, Max, DC (mA)	6	20	35
As % of rated AC current	0,03	0,09	0,16
Abs, Ave, DC (mA)	2	9	17
As % of rated AC current	0,01	0,04	0,08
Limit	0,25%	0,25%	0,25%
Abs, Max, DC (mA)	18	27	38
As % of rated AC current	0,08	0,12	0,18
Abs, Ave, DC (mA)	12	14	17
As % of rated AC current	0,05	0,06	0,08

ME 20KTL-3PH			
Test level power	10%	55%	100%
Abs, Max, DC (mA)	17	25	26
As % of rated AC current	0,06	0,09	0,09
Abs, Ave, DC (mA)	10	8	8
As % of rated AC current	0,04	0,03	0,03
Limit	0,25%	0,25%	0,25%
Abs, Max, DC (mA)	5	15	29
As % of rated AC current	0,02	0,05	0,10
Abs, Ave, DC (mA)	2	6	13
As % of rated AC current	0,01	0,02	0,04
Limit	0,25%	0,25%	0,25%
Abs, Max, DC (mA)	18	37	59
As % of rated AC current	0,06	0,13	0,20
Abs, Ave, DC (mA)	10	14	24
As % of rated AC current	0,04	0,05	0,08
Limit	0,25%	0,25%	0,25%

Graph: ME 15KTL-3PH



Graph: ME 20KTL-3PH

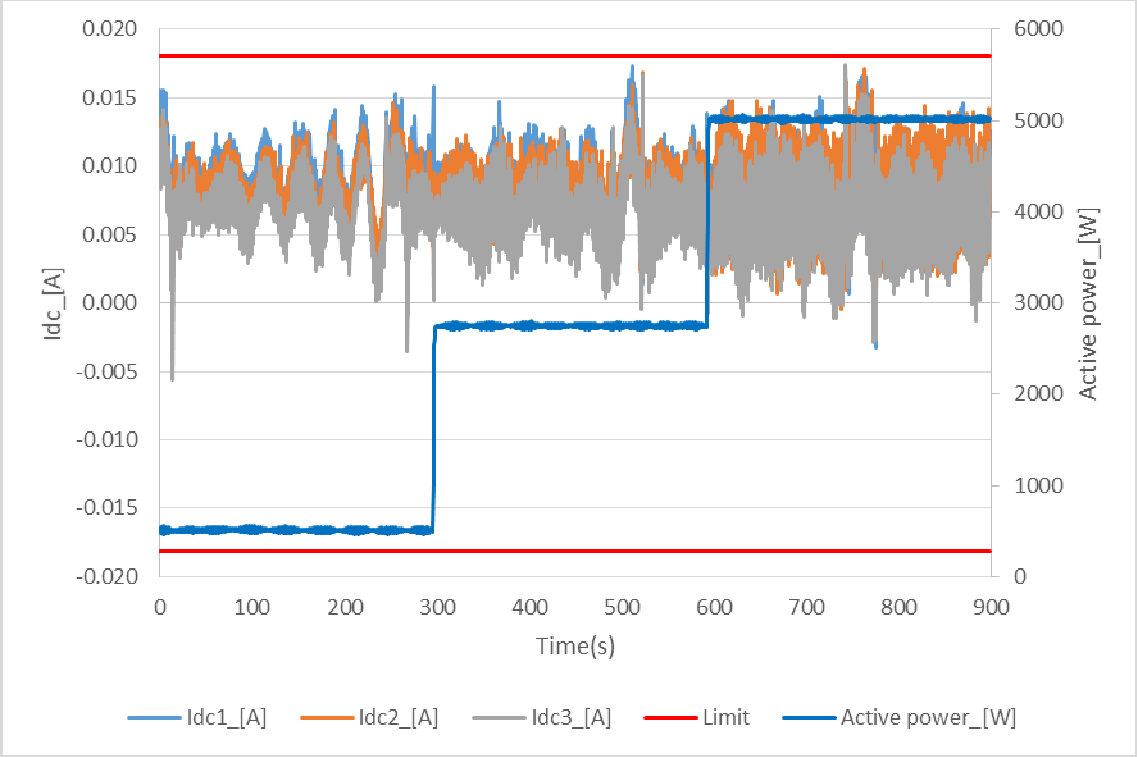


ME 5KTL-3PH			
Test level power	10%	55%	100%
Abs, Max, DC (mA)	16	17	17
As % of rated AC current	0,21	0,24	0,23
Abs, Ave, DC (mA)	10	10	9
As % of rated AC current	0,14	0,13	0,13
Limit	0,25%	0,25%	0,25%
Abs, Max, DC (mA)	15	17	17
As % of rated AC current	0,20	0,23	0,24
Abs, Ave, DC (mA)	9	8	8
As % of rated AC current	0,12	0,11	0,11
Limit	0,25%	0,25%	0,25%
Abs, Max, DC (mA)	14	17	17
As % of rated AC current	0,20	0,23	0,24
Abs, Ave, DC (mA)	7	7	7
As % of rated AC current	0,10	0,09	0,09
Limit	0,25%	0,25%	0,25%

Note:
The level of DC injection from the Inverter-connected PV generator in to the DNO's Distribution System shall not exceed the levels specified in 5.5 when measured during operation at three levels, 10%, 55% and 100% of rating with a tolerance of plus or minus 5%.

The tests had been performed on the ME 20KTL-3PH, ME 15KTL-3PHand ME 5KTL-3PH are valid for the ME 6KTL-3PH, ME 8KTL-3PH and ME 10KTL-3PH since it is same as in hardware and just power derated by software.

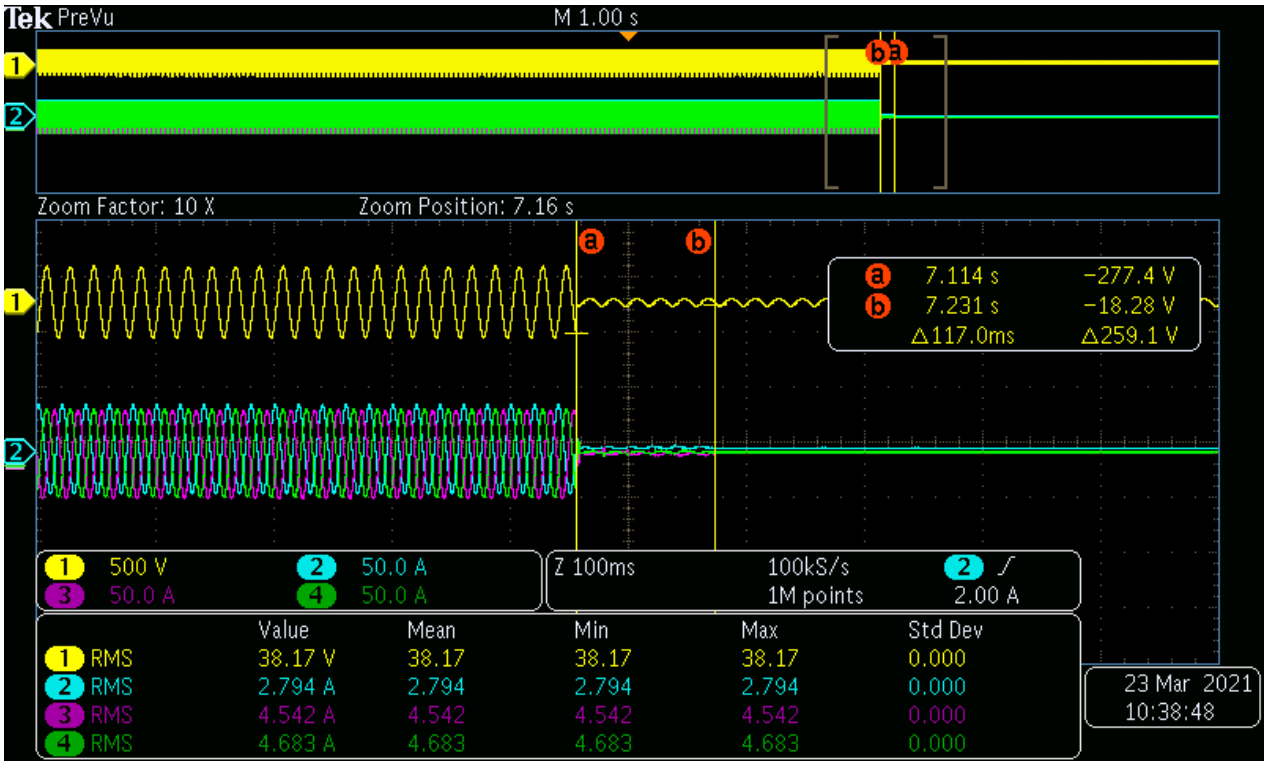
Graph: ME 5KTL-3PH



A.7.1.5 Short Circuit Current Contribution for Inverters					P
L1 to N					
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	36,37	5,238
Initial Value of aperiodic current	A	N/A	100ms	33,25	3,376
Initial symmetrical short-circuit current*	I_k	N/A	250ms	31,34	2,755
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	112ms	In seconds
L2 to N					
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	79,10	13,68
Initial Value of aperiodic current	A	N/A	100ms	45,26	6,263
Initial symmetrical short-circuit current*	I_k	N/A	250ms	42,60	4,829
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	117ms	In seconds
L3 to N					
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	56,93	11,16
Initial Value of aperiodic current	A	N/A	100ms	39,05	5,057
Initial symmetrical short-circuit current*	I_k	N/A	250ms	38,17	4,683
Decaying (aperiodic) component of short circuit current*	i_{DC}	N/A	500ms	N/A	N/A
Reactance/Resistance Ratio of source*	X/R	N/A	Time to trip	117ms	In seconds

Note:
The values of voltage and current should be recorded for a period of up to 1 second when the changeover switch should be returned to the normal position. The voltage and current at relevant times shall be recorded in the type test report (Appendix 4) including the time taken for the Inverter to trip.

The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

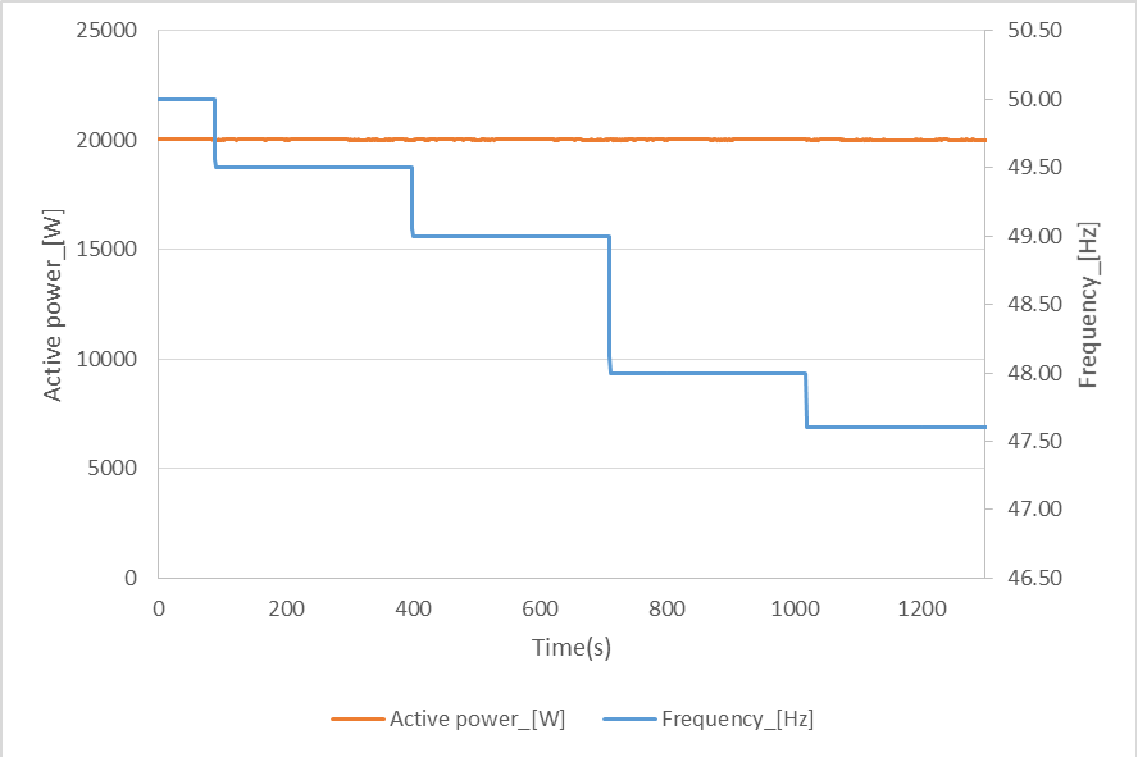

Tek PreVu
M 1.00 s
Zoom Factor: 10 X
Zoom Position: 7.16 s
a 7.114 s -277.4 V
b 7.231 s -18.28 V
Δ117.0ms Δ259.1 V
1 500 V
2 50.0 A
3 50.0 A
4 50.0 A
Z 100ms
100kS/s
1M points
2 2.00 A
Value Mean Min Max Std Dev
1 RMS 38.17 V 38.17 38.17 38.17 0.000
2 RMS 2.794 A 2.794 2.794 2.794 0.000
3 RMS 4.542 A 4.542 4.542 4.542 0.000
4 RMS 4.683 A 4.683 4.683 4.683 0.000
23 Mar 2021
10:38:48

A.7.1.6 Self Monitoring – Solid state Disconnection.	**N/A**
It has been verified that in the event of the solid state switching device failing to disconnect the SSEG, 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 0126-1-1).	

Wiring fuctional tests: If required by para 15.2.1.	**N/A**
Confirm that the relevant test schedule is attached (test to be undertaken at time of commissioning)	N/A

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

A.7.2.3 Power Output with Falling Frequency	P



Criteria:

The frequency should then be set to 49,5 Hz for 5 minutes. The output should remain at 100% of Registered Capacity.
The frequency should then be set to 49,0 Hz and once the output has stabilised, held at this frequency for 5 minutes. The Active Power output must not be below 99% of Registered Capacity.
The frequency should then be set to 48,0 Hz and once the output has stabilised, held at this frequency for 5 minutes. The Active Power output must not be below 97% of Registered Capacity.
The frequency should then be set to 47,6 Hz and once the output has stabilised, held at this frequency for 5 minutes. The Active Power output must not be below 96.2% of Registered Capacity.
The frequency should then be set to 47,1 Hz and held at this frequency for 20 s. The Active Power output must not be below 95.0% of Registered Capacity and the Synchronous Power Generating Module must not trip in less than the 20s of the test.

The tests had been performed on the ME 20KTL-3PH is valid for the ME 15KTL-3PH, ME 10KTL-3PH, ME 8KTL-3PH, ME 6KTL-3PH and ME 5KTL-3PH since it is similar in hardware and just power derated by software.

Annex No. 1

Pictures of the unit

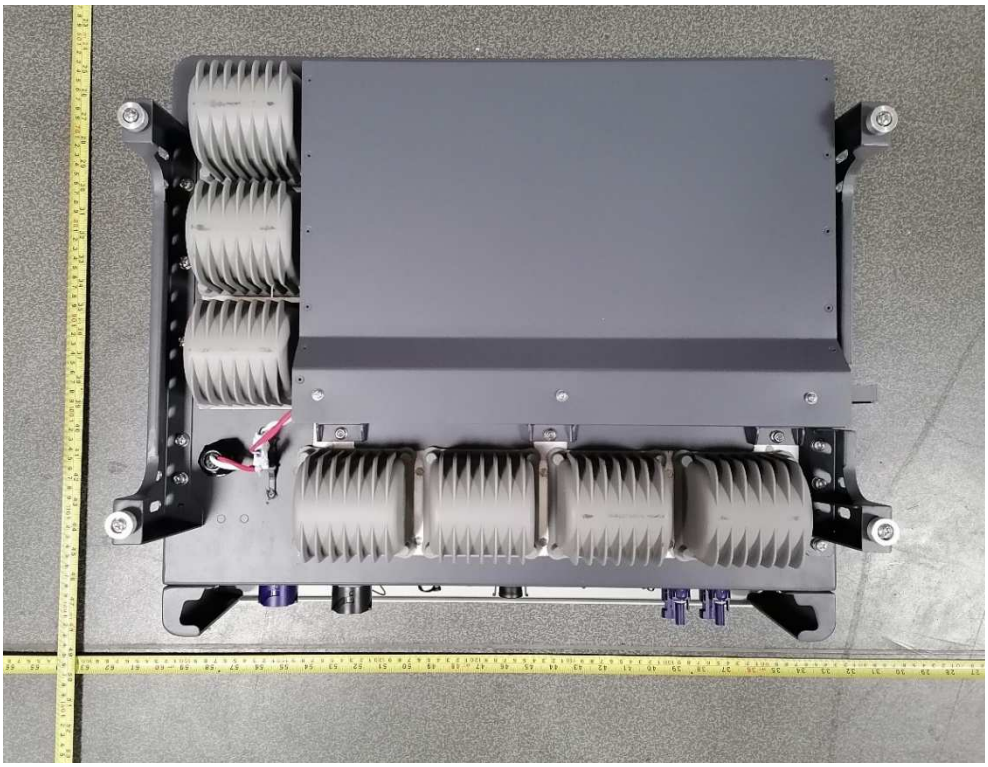
The full pictures refer to PHOTO DOCUMENT
Project No.: 2102WDG0105-2
Date: 2021-03-29

Enclosure front view ME 5KTL-3PH to ME 20KTL-3PH


Enclosure side view-1 ME 5KTL-3PH to ME 20KTL-3PH

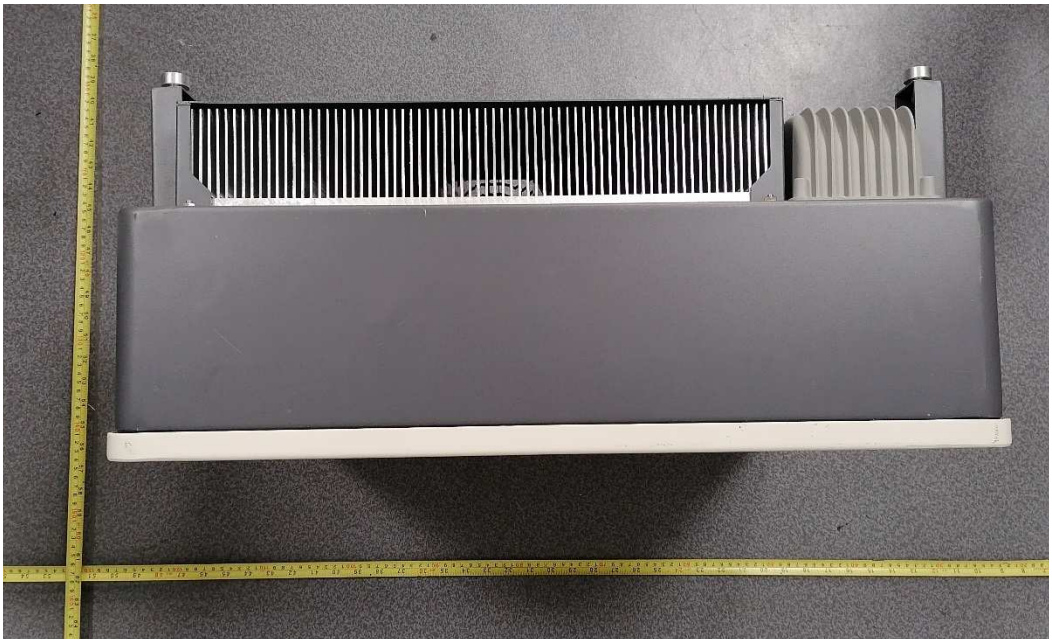

Enclosure side view-2
ME 5KTL-3PH to ME 20KTL-3PH

Enclosure rear view
ME 10KTL-3PH to ME 20KTL-3PH



Enclosure rear view
ME 5KTL-3PH to ME 8KTL-3PH

Enclosure top view
ME 5KTL-3PH to ME 20KTL-3PH



Enclosure teminal view
ME 10KTL-3PH to ME 20KTL-3PH

Enclosure teminal view
ME 5KTL-3PH to ME 8KTL-3PH

Annex No. 2

Test Equipment list

Testing Location: Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch

Date(s) of performance test: 2021-02-20 to 2021-03-30

Equipment	Internal No,	Manufacturer	Type	Serial No.	Next Calibration date
AC Source	A7040019DG	Chroma	61512	61512000439	Monitored by Power Analyzer
	A7040020DG	Chroma	61512	61512000438	
DC Simulation Power Supply	A7040016DG	Chroma	62150H-1000S	62150EF00490	
	A7040017DG	Chroma	620028	620028EF00120	
RLC Load	A7150027DG	Qunling	ACLT-3803H	93VOO2869	
Eight Channel Digital Phosphor Oscilloscope	A4089017DG	YOKOGAWA	DL850	91N726247	Sep. 23, 2021
Power Analyzer	A4080002DG	YOKOGAWA	WT3000	91M210852	Jun. 16, 2021
Oscilloscope probe	A4089008DG	Tektronix	TPP1000	C008230	Aug. 10, 2021
	A4089010DG	Tektronix	TPP1000	C008228	Aug. 10, 2021
	A4089011DG	Tektronix	TPP1000	C008229	Aug. 10, 2021
Current transducer	A1060007DG	YOKOGAWA	CT200	1130700012	Sep. 02, 2021
	A1060008DG	YOKOGAWA	CT200	1130700017	Sep. 02, 2021
	A1060012DG	YOKOGAWA	CT200	1130700018	Sep. 02, 2021
Power Analyser	//	ZLG	PA5000H	C8202909082002110001	Mar. 04, 2022
Oscilloscope	//	Agilent	DS05014A	MY50070288	Jan. 04, 2022
	//	KEYSIGHT	DSOX3014T	MY59243036	Jan. 04, 2022
	//	Tektronix	MD03024	C055210	Jan. 04, 2022
Oscilloscope current probe	//	CYBERTEK	CP1000A	C181000922	Jan. 04, 2022
	//	FLUKE	IL000S	304134485	Jan. 04, 2022
	//	CYBERTEK	CP1000A	C181000929	Jan. 04, 2022
	//	CYBERTEK	CP1000A	C191000141	Jan. 04, 2022
Oscilloscope probe	//	SANHUA	SI-9110	152655	Jan. 04, 2022
	//	SANHUA	SI-9110	111134	Jan. 04, 2022
	//	SANHUA	SI-9110	111539	Jan. 04, 2022