TEST REPORT

IEC 62116

Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters

Report reference number ..... :	**PV2102WDG0105-5**
Date of issue ..... :.....	2021-03-30
Total number of pages ..... :.....	30
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
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..... :	IEC 62116:2014
Test Report Form No. ..... :	IEC/EN 62116 VER.2
TRF Originator ..... :	Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Master TRF ..... :	Dated 2020-03-11
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. 30kg for ME 5KTL-3PH, ME 6KTL-3PH, ME 8KTL-3PH Approx. 34kg for ME 10KTL-3PH, ME 15KTL-3PH, ME 20KTL-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 2021-03-26

General remarks:

The test result presented in this report relate only to the object(s) tested.
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.

According to the client's requirement, test mothed refer to the standard IEC 62116:2014.

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

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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.
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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,
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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,
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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,
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G98,G99,EN50549,AS4777,UTE C15-712-1

General product information:

The inverter converts DC voltage, generated by batteries, into AC voltage. Battery can also be charged from the AC grid.
The units are three-phases inverter.
Rate of change of frequency (RoCoF) detection was used for LOM protection.

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.

Description of the power circuit (Figure 1):

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.

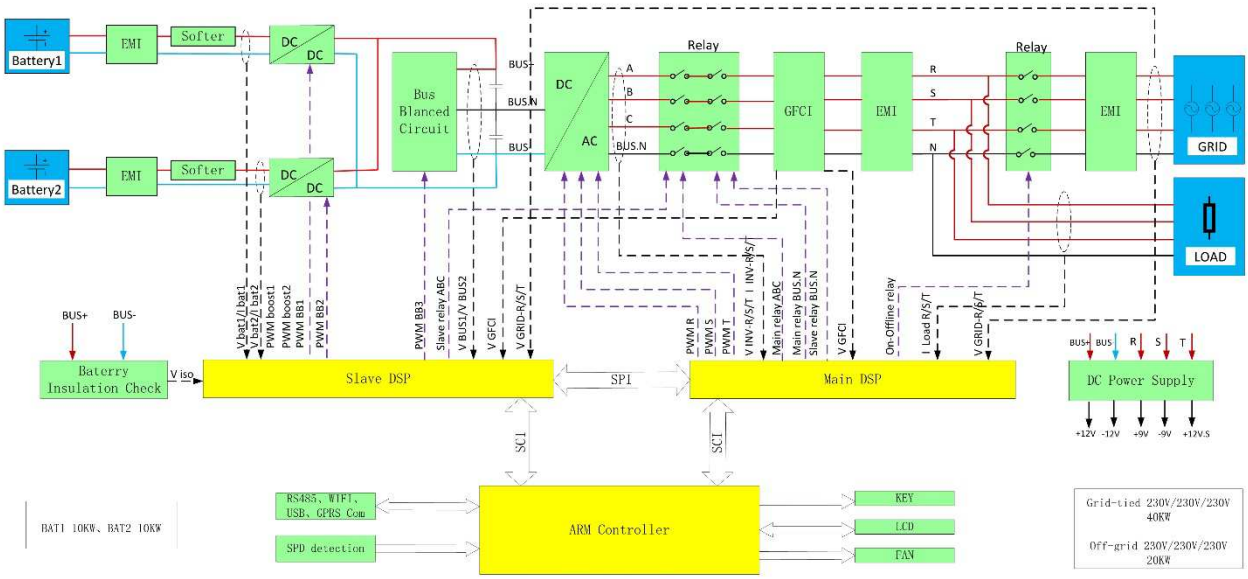

Figure 1 – Block diagram

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 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		

The product was tested on:

Hardware version: V002
Software version: V000001

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Clause	Requirement + Test	Result - Remark	Verdict

4	**Testing circuit**		**P**
	The testing circuit shown in Figure 1 is employed.	Considered.	P
	Similar circuits are used for three-phase output.		P
	Parameters to be measured are shown in Table 1 and Figure 1. Parameters to be recorded in the test report are discussed in Clause 7.	Considered.	P
5	**Testing equipment**		P
5.1	**Measuring instruments**		P
	The waveform measurement/capture device is able to record the waveform from the beginning of the islanding test until the EUT ceases to energize the island.		P
	For multi-phase EUT, all phases are monitored.	Three phases ara monitored.	P
	A waveform monitor designed to detect and calculate the run-on time may be used.	Oscilloscope is used.	P
	For multi-phase EUT, the test and measurement equipment is recorded each phase current and each phase-to-neutral or phase-to-phase voltage, as appropriate, to determine fundamental frequency active and reactive power flow over the duration of the test.	Considered.	P
	A sampling rate of 10 kHz or higher is recommended. The minimum measurement accuracy is 1 % or less of rated EUT nominal output voltage and 1 % or less of rated EUT output current	Considered.	P
	Current, active power, and reactive power measurements through switch S1 used to determine the circuit balance conditions report the fundamental (50 Hz or 60 Hz) component.	Considered.	P
5.2	**DC power source**		P
5.2.1	**General**		**P**
	A PV array or PV array simulator (preferred) may be used. If the EUT can operate in utility-interconnected mode from a storage battery, a DC power source may be used in lieu of a battery as long as the DC power source is not the limiting device as far as the maximum EUT input current is concerned.	Li-ion Battery used.	N/A
	The DC power source provides voltage and current necessary to meet the testing requirements described in Clause 6.	Li-ion Battery used.	P
5.2.2	**PV array simulator**	Li-ion Battery used.	**N/A**
	The tests are conducted at the input voltage defined in Table 2 below, and the current is limited to 1,5 times the rated photovoltaic input current, except when specified otherwise by the test requirements.		N/A
	A PV array simulator is recommended, however, any type of power source may be used if it does not influence the test results.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict

5.2.3	**Current and voltage limited DC power supply with series resistance**	Li-ion Battery used.	**P**
	A DC power source used as the EUT input source is capable of EUT maximum input power (so as to achieve EUT maximum output power) at minimum and maximum EUT input operating voltage.		P
	The power source provides adjustable current and voltage limit, set to provide the desired short circuit current and open circuit voltage when combined with the series and shunt resistance described below.		P
	A series resistance (and, optionally, a shunt resistance) is selected to provide a fill factor within the range: Output power: Sufficient to provide maximum EUT output power and other levels specified by test conditions of table 5. Response speed: The response time of a simulator to a step in output voltage, due to a 5% load change, results in a settling of the output current to within 10% of its final value in less than 1ms. Stability: Excluding the variations caused by the EUT MPPT, simulator output power remains stable within 2 % of specified power level over the duration of the test: from the point where load balance is achieved until the island condition is cleared or the allowable run-on time is exceeded. Power factor: 0.25 to 0.8		N/A
5.2.4	**PV array**	Li-ion Battery used.	**N/A**
	A PV array used as the EUT input source is capable of EUT maximum input power at minimum and maximum EUT input operating voltage.		N/A
	Testing is limited to times when the irradiance varies by no more than 2 % over the duration of the test as measured by a silicon-type pyranometer or reference device. It may be necessary to adjust the array configuration to achieve the input voltage and power levels prescribed in 6.1.		N/A
5.3	**AC power source**		**P**
	The utility grid or other AC power source may be used as long as it meets the conditions specified in Table 4. **Table 4 – AC power source requirements** Items / Conditions: Voltage: Nominal ±2,0 % Voltage THD: < 2,5 % Frequency: Nominal ±0,1 Hz Phase angle distance [1]: 120 ° ± 1,5 ° [1] Three-phase case only	Considered.	P
5.4	**AC loads**		**P**

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Clause	Requirement + Test	Result - Remark	Verdict
	On the AC side of the EUT, variable resistance, capacitance, and inductance are connected in parallel as loads between the EUT and the AC power source. Other sources of load, such as electronic loads, may be used if it can be shown that the source does not cause results that are different than would be obtained with passive resistors, inductors, and capacitors.	Considered.	P
	All AC loads are rated for and adjustable to all test conditions. The equations for Qf are based upon an ideal parallel RLC circuit. For this reason, non-inductive resistors, low loss (high Qf) inductors, and capacitors with low effective series resistance and effective series inductance are utilized in the test circuit. Iron core inductors, if used, are not exceed a current THD of 2 % when operated at nominal voltage. Load components are conservatively rated for the voltage and power levels expected. Resistor power ratings are chosen so as to minimize thermally-induced drift in esistance values during the course of the test.	Considered.	P
	Active and reactive power is calculated (using the measurements provided in Table 1) in each of the R, L and C legs of the load so that these parasitic parameters (and parasitics introduced by variacs or autotransformers) are properly accounted for when calculating Qf.	Considered.	P
6	**Test for single or multi-phase inverter**		**P**
6.1	**Test procedure**	(see appended table)	**P**
	The test uses an RLC load, resonant at the EUT nominal frequency (50 Hz or 60 Hz) and matched to the EUT output power.		P
	For multi-phase EUT, the load is balanced across all phases and the switch S1 as in Figure 1 opens all phases	The switch could open all phases.	P
	This test is performed with the EUT conditions as in Table 5, where power and voltage values are given as a percent of EUT full output rating.		P
	a)..Determine EUT test output power		P
	b) .Adjusting the DC input source		P
	c) .Turn off the EUT and open S1		P
	d) .Adjust the RLC circuit to have Qf = 1.0 ±0.05		P
	e)..Connect the RLC load configured in step d) to the EUT by closing S2		P
	f)...Open the utility-disconnect switch S1 to initiate the test, Run-on time is recorded.		P
	g)..For test condition A, adjust the real load and only one of the reactive load components to each of the load imbalance conditions shown in the shaded portion of table 6. If any of the recorded run-on times are longer than the one recorded for the rated balance condition, then the non-shaded parameter combinations also require testing.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	h) For test condition B and C, adjust the only one reactive load components by approximately 1,0% per test, within a total range of 95% to 105% of the operating point. If run-on times are still increasing at the 95% or 105% points, additional 1% increments have to be taken until run-on times begin decreasing.		P
6.2	**Pass/fail criteria**		**P**
	An EUT is considered to comply with the requirements for islanding protection when each case of recorded run-on time is less than 2 s or meets the requirements of local codes.		P
7	**Documentation**		**P**
	At a minimum, the following information is recorded and maintained in the test report.		P
	a) Specifications of EUT. Table 8 provides an example of the type of information that is provided.		P
	b) Measurement results. Table 9 provides an example of the type of information that is provided. Actual measured values is to be recorded.		P
	c) Block diagram of test circuit.		P
	d) Specifications of the test and measurement equipment. Table 10 provides an example of the type of information that is provided.		P
	e) Any test configuration or procedure details such as methods of achieving specified load and EUT output conditions.		P
	f) Any additional information required by the testing laboratory's accreditation.		P
	g) Specify the evaluation criterion from clause 6.2 that was utilized to determine if the product passed or failed the test.		P
Annex A	Islanding as it applies to PV systems(Informative)		--
A.1	General		--
A.2	Impact of distortion on islanding		--
Annex B	Test for independent islanding detection device (relay)(Informative)		--
B.1	Introduction		--
B.2	Testing circuit		--
B.3	Testing equipment		--
B.4	Testing procedure		--
B.5	Documentation		--

IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict

Test overview:

IEC 62116:2014		
Clause	**Test**	**Result**
	Type test:	
6.1	Islanding protection according table 6 - Load imbalance (real, reactive load) for test condition A (EUT ouput = 100%)	**P**
6.1	Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %)	**P**
6.1	Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %)	**P**

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Clause	Requirement + Test	Result - Remark	Verdict

6.1 Islanding protection

Test circuit and parameters

Parameter	Symbol	Units
EUT DC Input		
DC voltage	V_{DC}	V
DC Current	I_{DC}	A
DC Power	P_{DC}	W
EUT AC ouput		
AC voltage	V_{EUT}	V
AC current	I_{EUT}	A
Real power	P_{EUT}	W
Reactive power	Q_{EUT}	VAr
Test Load		
Resistive load current	I_R	A
Inductive load current	I_L	A
Capacitive load current	I_C	A
AC (utility) power source		
Utility real power	P_{AC}	W
Utility reactive power	Q_{AC}	VAr
Utility current	I_{AC}	A

Block diagram test circuit IEC 62116:2008

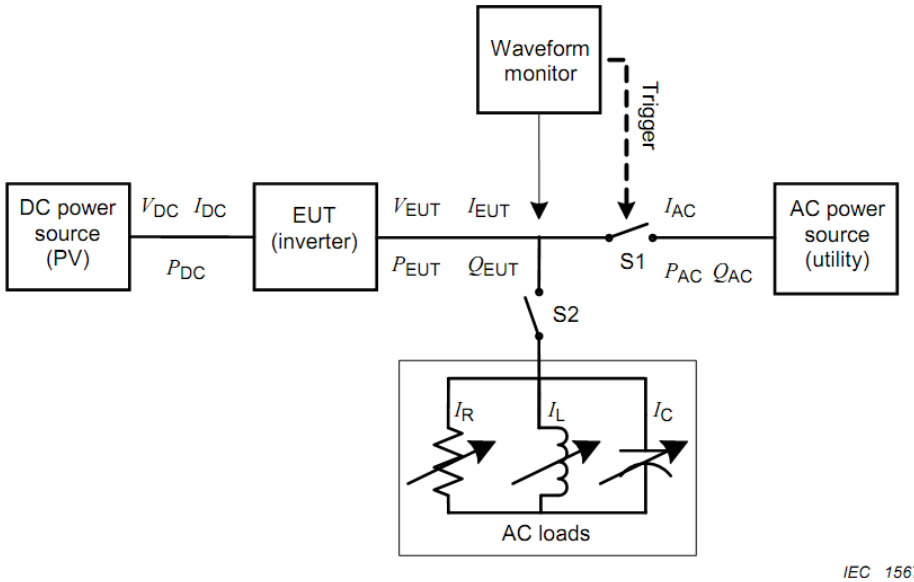


Figure 1 – Test circuit for islanding detection function in a power conditioner (inverter)

IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict

6.1 Islanding protection according table 6 - Load imbalance (real, reactive load) for test condition A (EUT output = 100%)	**P**

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

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]	I_{AC} 4) [A]	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	100	100	0	0	0,168	6,660	525	1,002	490	BL
8	100	100	-5	-5	1,619	6,660	525	1,028	442	IB
9	100	100	-5	0	1,657	6,660	525	1,054	478	IB
10	100	100	-5	+5	1,619	6,660	525	1,080	424	IB
13	100	100	0	-5	0,175	6,660	525	0,976	432	IB
14	100	100	0	+5	0,175	6,660	525	1,026	450	IB
17	100	100	+5	-5	1,605	6,660	525	0,930	420	IB
18	100	100	+5	0	1,570	6,660	525	0,954	474	IB
19	100	100	+5	+5	1,605	6,660	525	0,977	394	IB

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

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) Fundamental of I_{AC} when RLC is adjusted
5) BL: Balance condition, IB: Imbalance condition.

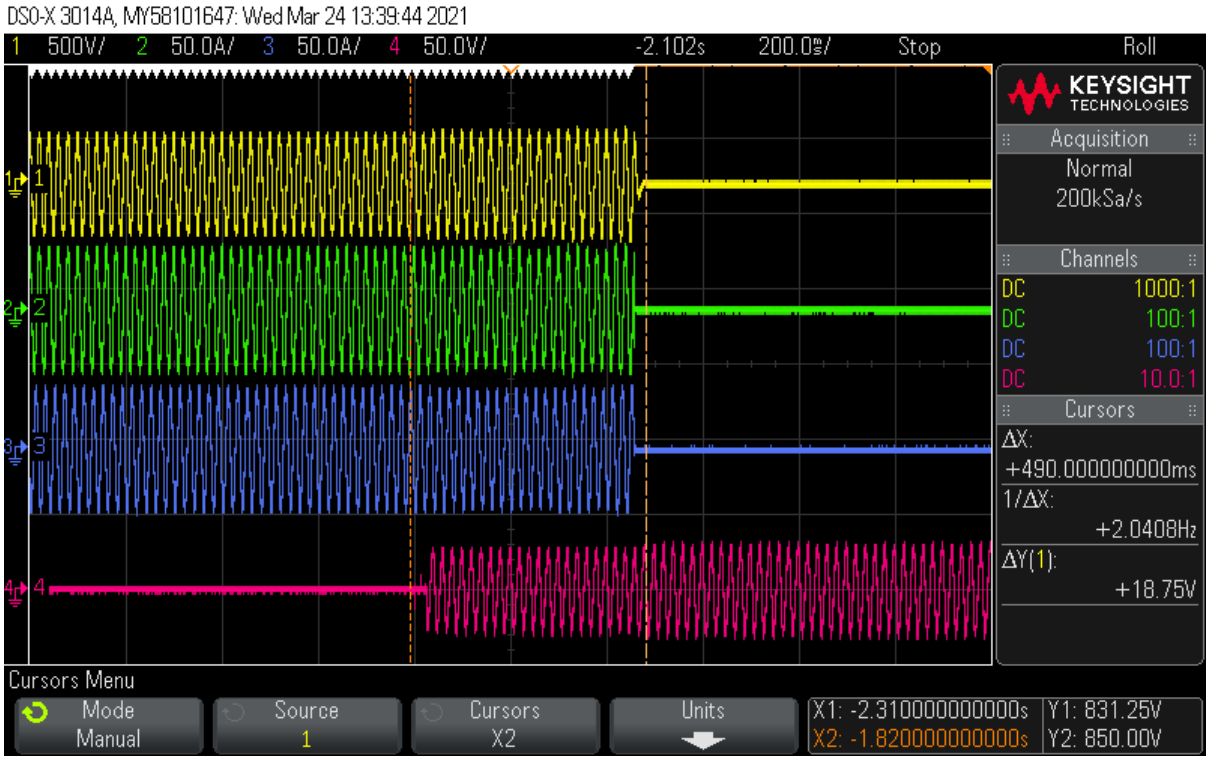
Condition A:
EUT output power PEUT = Maximum 6)
EUT input voltage 6) = >75% of rated input voltage range

6) Maximum EUT output power condition should be achieved using the maximum allowable input power. Actual output power may exceed nominal rated output.
7) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 90 % of range =X + 0,75 × (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.

IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict

The tests had been performed on the ME 20KTL-3PH is valid for the ME 5KTL-3PH, ME 6KTL-3PH, ME 8KTL-3PH, ME 10KTL-3PH and ME 15KTL-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



IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict

6.1 Islanding protection according Table 7 – Load imbalance (reactive load) for test condition B (EUT output = 50 % – 66 %) — **P**

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

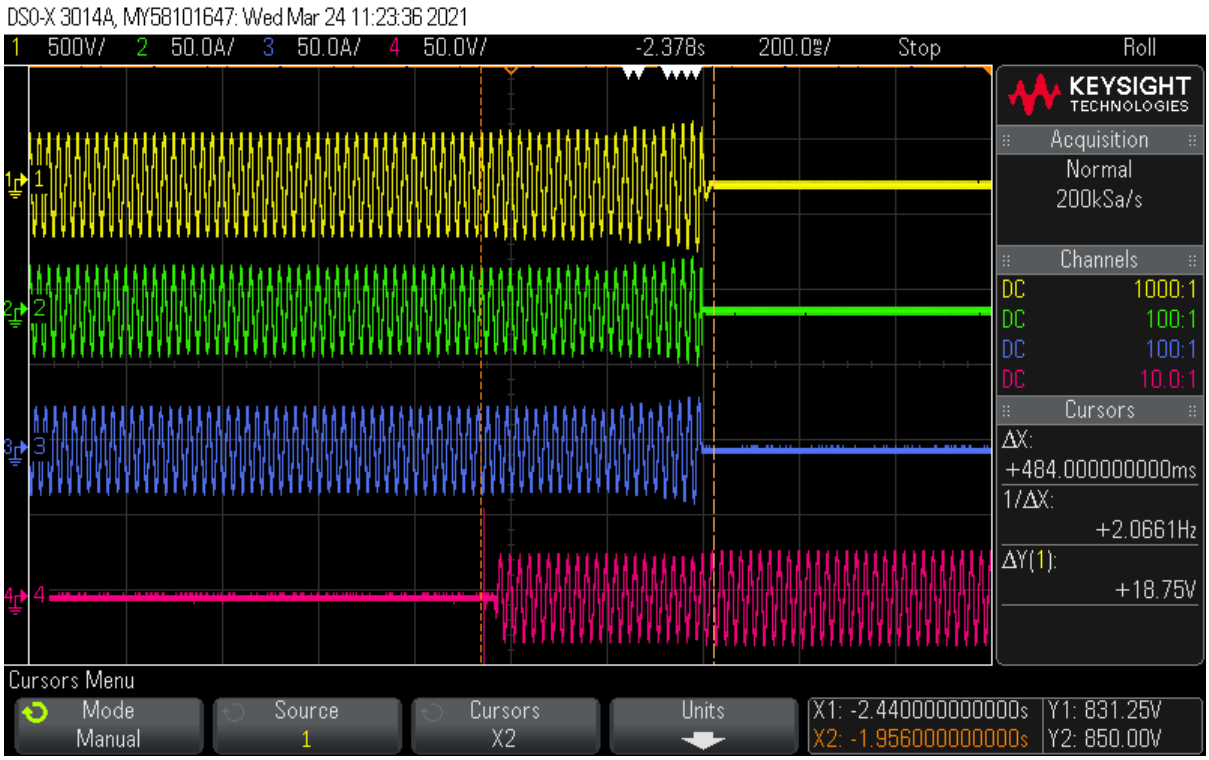
No	P_{EUT} [1] [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) 1]	P_{AC} [2] [% of nominal]	Q_{AC} [3] [% of nominal]	I_{AC} [4] [A]	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks [5]
1	66	66	0	-5	0,156	4,400	410	0,977	430	IB
2	66	66	0	-4	0,164	4,400	410	0,982	470	IB
3	66	66	0	-3	0,171	4,400	410	0,987	440	IB
4	66	66	0	-2	0,176	4,400	410	0,992	436	IB
5	66	66	0	-1	0,179	4,400	410	0,997	458	IB
6	66	66	0	0	0,136	4,400	410	1,002	484	BL
7	66	66	0	1	0,179	4,400	410	1,007	474	IB
8	66	66	0	2	0,176	4,400	410	1,012	446	IB
9	66	66	0	3	0,171	4,400	410	1,017	426	IB
10	66	66	0	4	0,164	4,400	410	1,022	460	IB
11	66	66	0	5	0,156	4,400	410	1,027	428	IB

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

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] Fundamental of I_{AC} when RLC is adjusted
[5] BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power P_{EUT} = 50 % – 66 % of maximum
EUT input voltage [6] = 50 % of rated input voltage range, ±10 %
[6] Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 50 % 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 5KTL-3PH, ME 6KTL-3PH, ME 8KTL-3PH, ME 10KTL-3PH and ME 15KTL-3PH since it is similar in hardware and just power derated by software.

IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict

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



IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict

6.1 Islanding protection according Table 7 – Load imbalance (reactive load) for test condition C (EUT output = 25 % – 33 %) — **P**

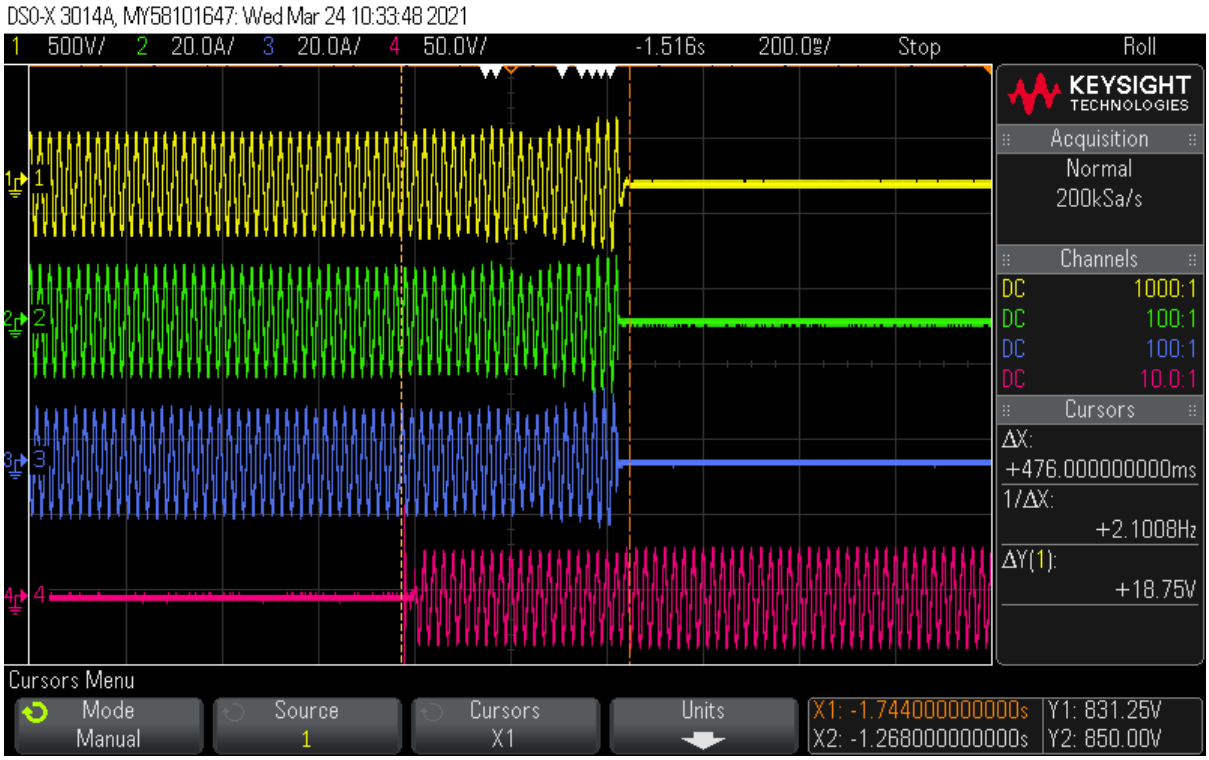
Test conditions			Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1							
Disconnection limit			2s							
No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6.1.d) 1]	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [kW per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	33	33	0	-5	0,136	2,200	272	0,977	308	IB
2	33	33	0	-4	0,140	2,200	272	0,982	362	IB
3	33	33	0	-3	0,143	2,200	272	0,987	306	IB
4	33	33	0	-2	0,146	2,200	272	0,992	348	IB
5	33	33	0	-1	0,147	2,200	272	0,997	316	IB
6	33	33	0	0	0,126	2,200	272	1,002	476	BL
7	33	33	0	1	0,147	2,200	272	1,007	426	IB
8	33	33	0	2	0,146	2,200	272	1,012	322	IB
9	33	33	0	3	0,143	2,200	272	1,017	400	IB
10	33	33	0	4	0,140	2,200	272	1,022	452	IB
11	33	33	0	5	0,136	2,200	272	1,027	298	IB

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

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) Fundamental of I_{AC} when RLC is adjusted
5) BL: Balance condition, IB: Imbalance condition.
Condition B:
EUT output power PEUT = 25 % – 33 % 6) of maximum
EUT input voltage 7) = <20 % of rated input voltage range
6) Or minimum allowable EUT output level if greater than 33 %.
7) Based on EUT rated input operating range. For example, If range is between X volts and Y volts, 10 % of range =X + 0,2 × (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 5KTL-3PH, ME 6KTL-3PH, ME 8KTL-3PH, ME 10KTL-3PH and ME 15KTL-3PH since it is similar in hardware and just power derated by software.

IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict

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

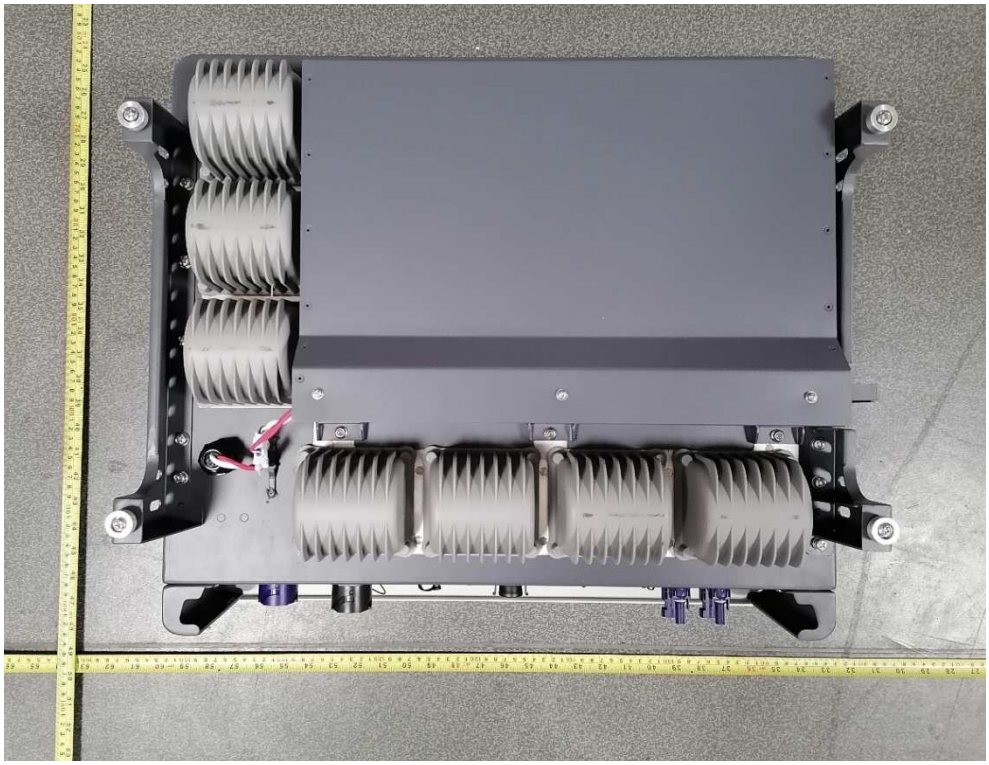


Enclosure front view ME 5KTL-3PH to ME 20KTL-3PH


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

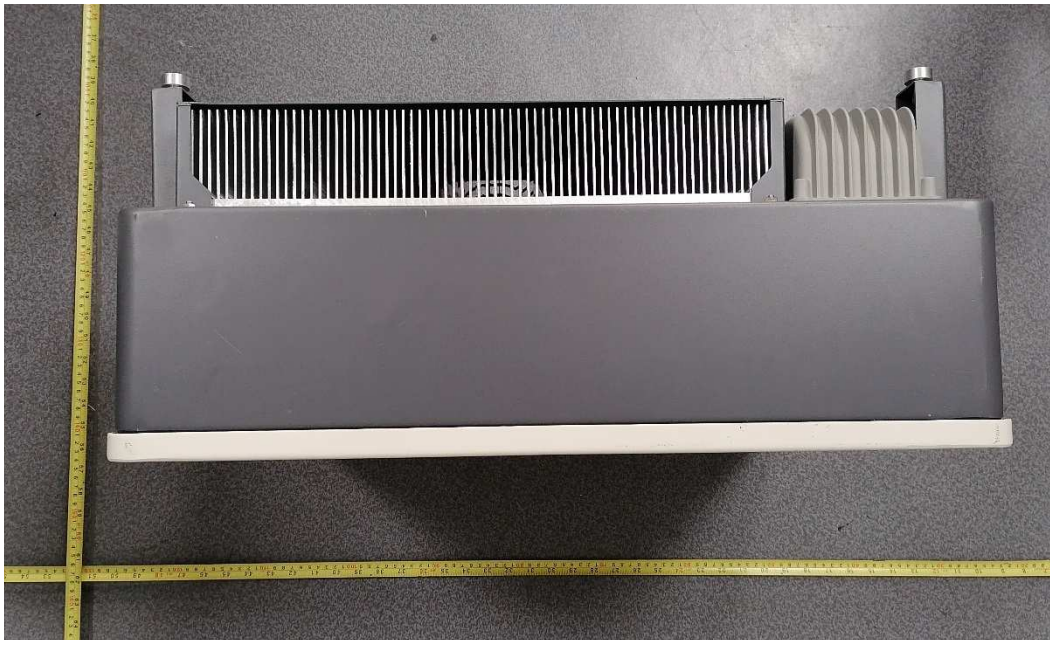

Enclosure side view-2
ME 5KTL-3PH to ME 20KTL-3PH

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. 1

Pictures of the unit

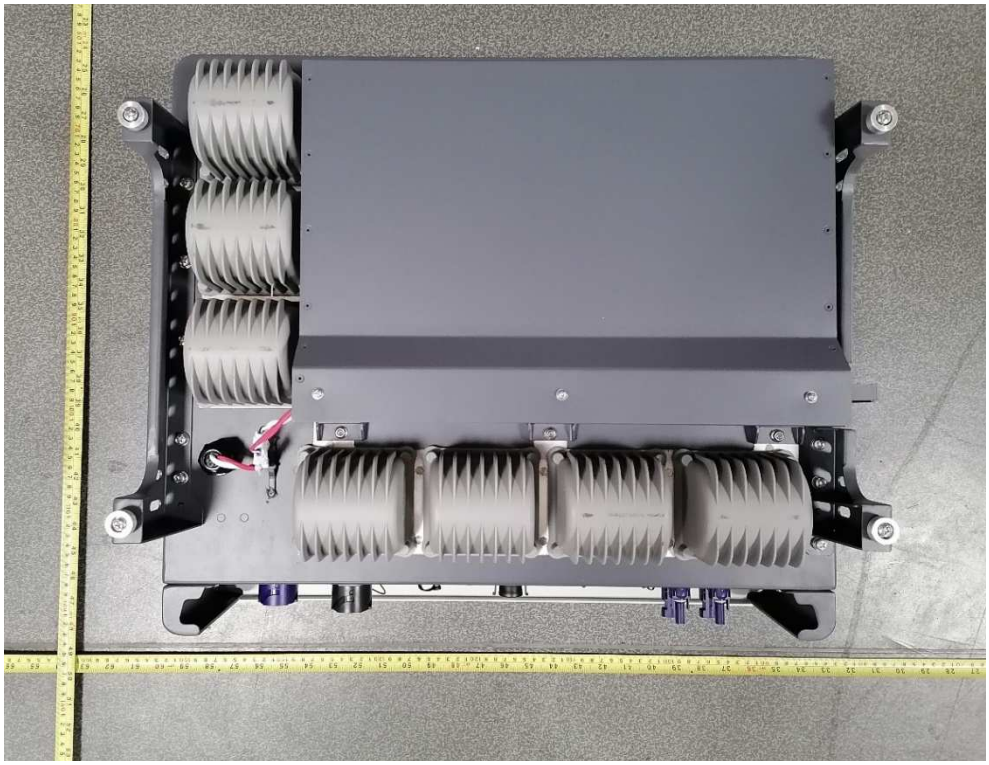
The full pictures refer to PHOTO DOCUMENT
Project No.: 2102WDG0105-2
Date: 2021-03-29

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

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

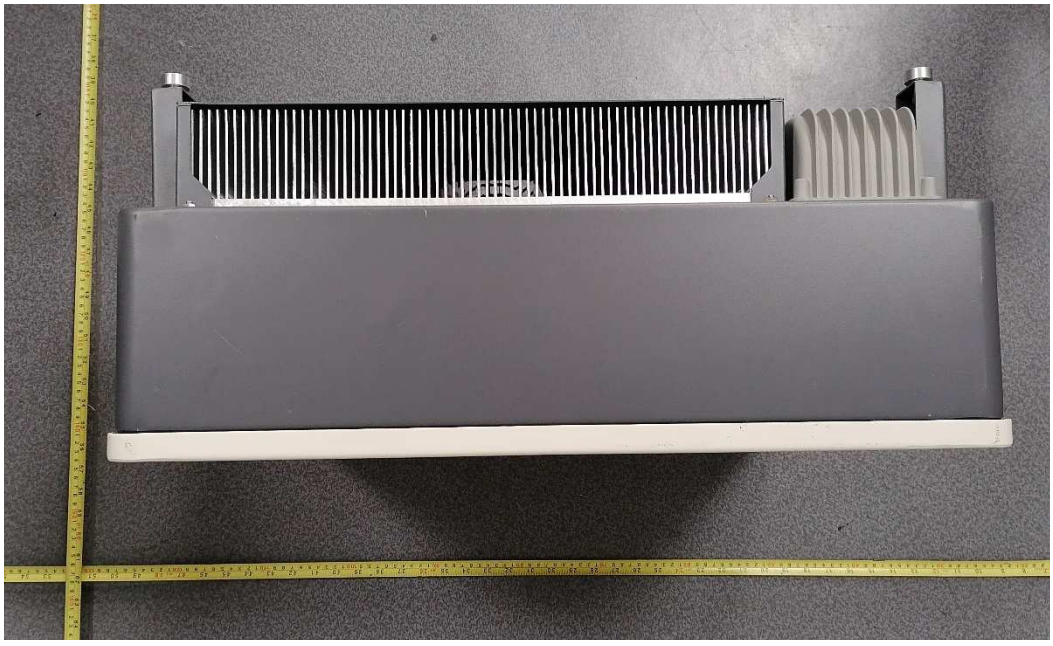
Enclosure side view-2
ME 5KTL-3PH to ME 20KTL-3PH

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

Test location: Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Dates of performance test: 2021-02-20 to 2021-03-26

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
Oscilloscope	//	KEYSIGHT	DSOX3014T	MY59243036	Jan. 04, 2022