TEST REPORT

UNE206007-1/ UNE 206006

Requisitos de conexion a la red eléctrica
Parte 1: Inversores para conexion a la red de distribución
Ensayos de detección de funcionamiento en isla de múltiples inversores fotovoltaicos conectados a red en paralelo

Report reference number ..... :	**PVSP200917N016-3**
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Testing laboratory name ..... :	**Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch**
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Accrediation ..... :	ilac-MRA 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..... :	UNE 206007-1:2013 UNE 206006:2011
Test Report Form No. ..... :	UNE 206007-1 VER.0
TRF Originator ..... :	Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Master TRF ..... :	Dated 2020-03-11
Test item description..... :	**Hybrid inverter**
Trademark..... :	SOFAR SOLAR
Model / Type ..... :	HYD 3000-EP, HYD 3680-EP, HYD 4000-EP, HYD 4600-EP, HYD 5000-EP, HYD 5500-EP, HYD 6000-EP

Ratings .....:	**HYD 3000-EP**	**HYD 3680-EP**	**HYD 4000-EP**
Full load MPP DC voltage range [V] :	160-520V	180-520V	200-520V
Input DC voltage range[V].....:	90-600V		
Input DC current [A].....:	Max. 13A/13A		
Output AC voltage [V].....:	L/N/PE, 230Vac, 50Hz		
Output AC current [A].....:	15,0	16,0	20,0
Output power [W] .....:	3000	3680	4000
Max. output power [VA].....:	3300	3680	4400
Output DC voltage range [V].....: [Battery charge]……:	42-58V		
Input/Output DC current [A].....: [Battery charge/discharge] ……:	Max. 75A	Max. 80A	Max. 85A
Charge and discharge power[W].....:	Max. 3750	Max. 4000	Max. 4250
Output AC voltage [V].....:	L/N/PE, 230Vac, 50Hz		
Max. Input/Output AC current [A].....: [Battery charge/discharge mode] …:	13,6	16,0	18,2
Max. Input/Output AC power [VA].....: [Battery charge/discharge mode] …:	3000	3680	4000
Ratings .....:	**HYD 4600-EP**	**HYD 5000-EP**	**HYD 5500-EP**
Full load MPP DC voltage range [V] :	230-520V	250-520V	250-520V
Input DC voltage range[V].....:	90-600V		
Input DC current [A].....:	Max. 13A/13A		
Output AC voltage [V].....:	L/N/PE, 230Vac, 50Hz		
Output AC current [A].....:	20,9	21,7	25,0
Output power [W] .....:	4600	5000	5000
Max. output power [VA].....:	4600	5000	5500
Output DC voltage range [V].....: [Battery charge]……:	42-58V		
Input/Output DC current [A].....: [Battery charge/discharge] ……:	Max. 100A		
Charge and discharge power[W].....:	Max. 5000		
Output AC voltage [V].....:	L/N/PE, 230Vac, 50Hz		
Max. Input/Output AC current [A].....: [Battery charge/discharge mode] …:	20,9	22,7	22,7
Max. Input/Output AC power [VA].....: [Battery charge/discharge mode] …:	4600	5000	5000

Ratings .....:	**HYD 6000-EP**
Full load MPP DC voltage range [V] :	300-520V
Input DC voltage range[V].....:	90-600V
Input DC current [A].....:	Max. 13A/13A
Output AC voltage [V].....:	L/N/PE, 230Vac, 50Hz
Output AC current [A].....:	27,3
Output power [W] .....:	6000
Max. output power [VA].....:	6000
Output DC voltage range [V].....: [Battery charge]……:	42-58V
Input/Output DC current [A].....: [Battery charge/discharge] ……:	Max. 100A
Charge and discharge power[W].....:	Max. 5000
Output AC voltage [V].....:	L/N/PE, 230Vac, 50Hz
Max. Input/Output AC current [A].....: [Battery charge/discharge mode] …:	22,7
Max. Input/Output AC power [VA]....: [Battery charge/discharge mode] …:	5000

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**
2021-03-02	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. 21.5kg

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 ..... :	2020-09-17
Date(s) of performance of test ..... :	2020-09-17 to 2021-02-26

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 UNE 206007-1 (Requisitos de conexion a la red eléctrica Parte 1: Inversores para conexion a la red de distribución) and UNE 206006 (Ensayos de detección de funcionamiento en isla de múltiples inversores fotovoltaicos conectados a red en paralelo),

The test result presented in this report relate only to the object(s) tested,
This report shall not be reproduced in part or in full without the written approval of the issuing testing laboratory,

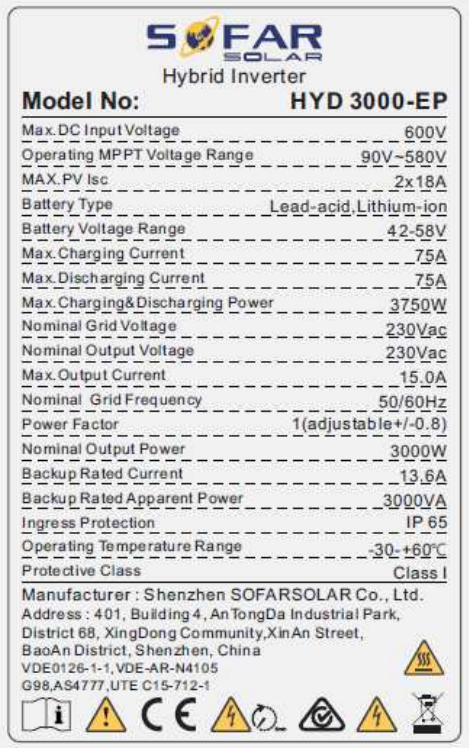
"(see Annex #)" refers to additional information appended to the report,
"(see appended table)" refers to a table appended to the report,

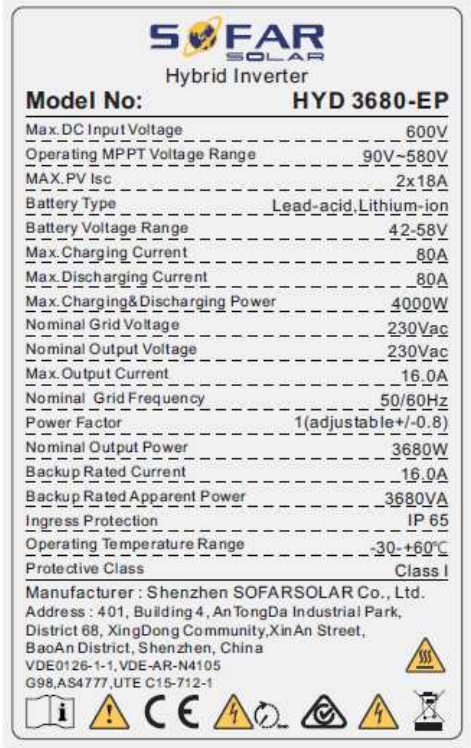
Throughout this report a comma is used as the decimal separator,

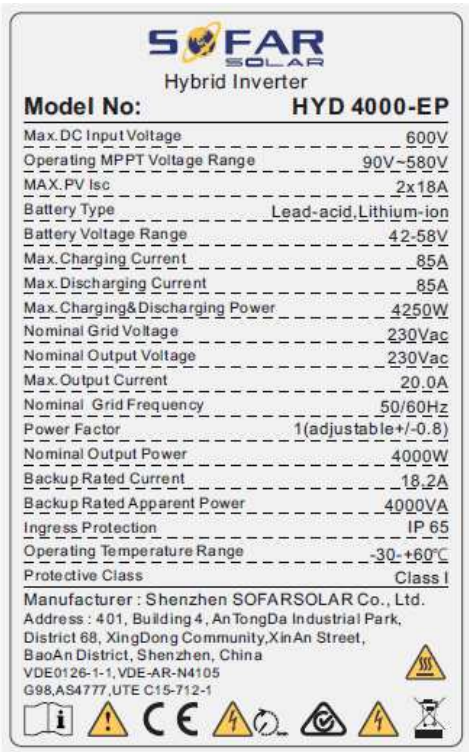
This Test Report consists of the following documents:

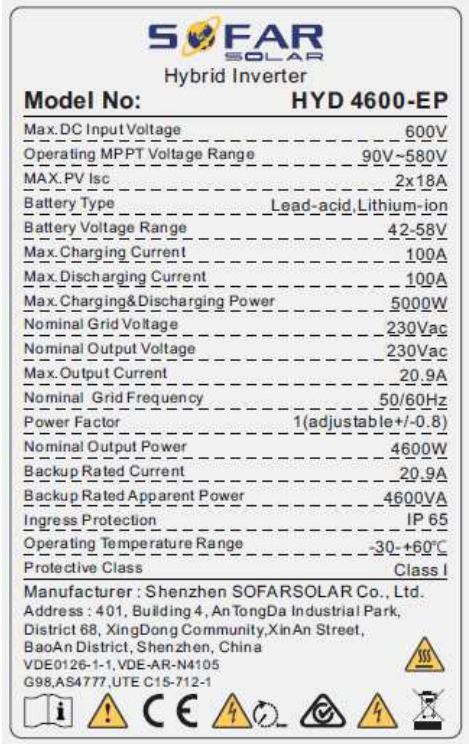
1. Test Results
2. Annex No. 1 – Pictures of the unit
3. Annex No. 2 –Test equipment list

Copy of marking plate









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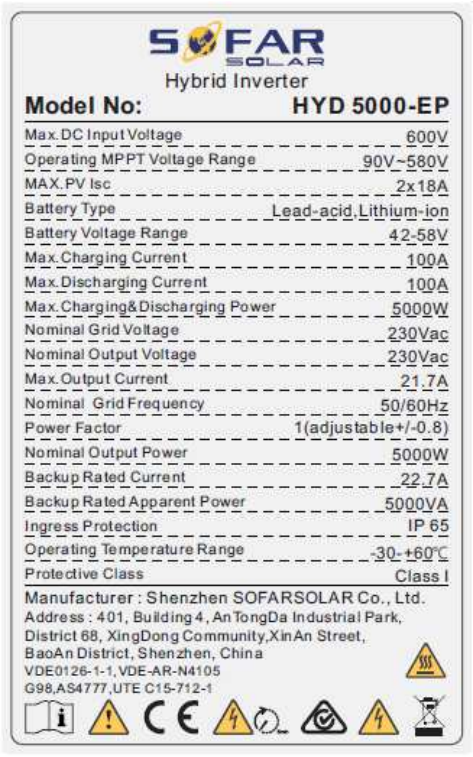
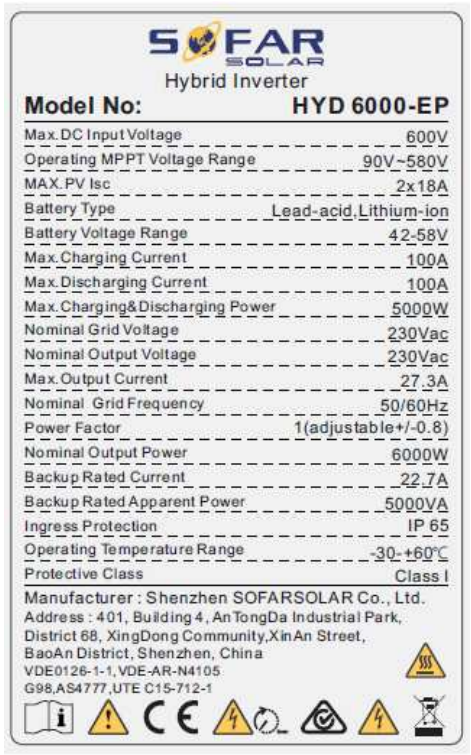




General product information:

The inverter converts DC voltage, generated by photovoltaic modules, into AC voltage.
The units are single-phases hybrid-inverter.
Rate of change of frequency (RoCoF) detection was used for LOM protection.

Description of the power circuit (Figure 1):

The charging current to batteries from PV array and grid, battery management unit is integrated in External Energy storage.

The Solar converter is a single-phase type, only one machine is allowed on each line conductor and power capacity is allowed to less than 11,08kW while is parallel to power generation system
The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit will also operate in case of one error.

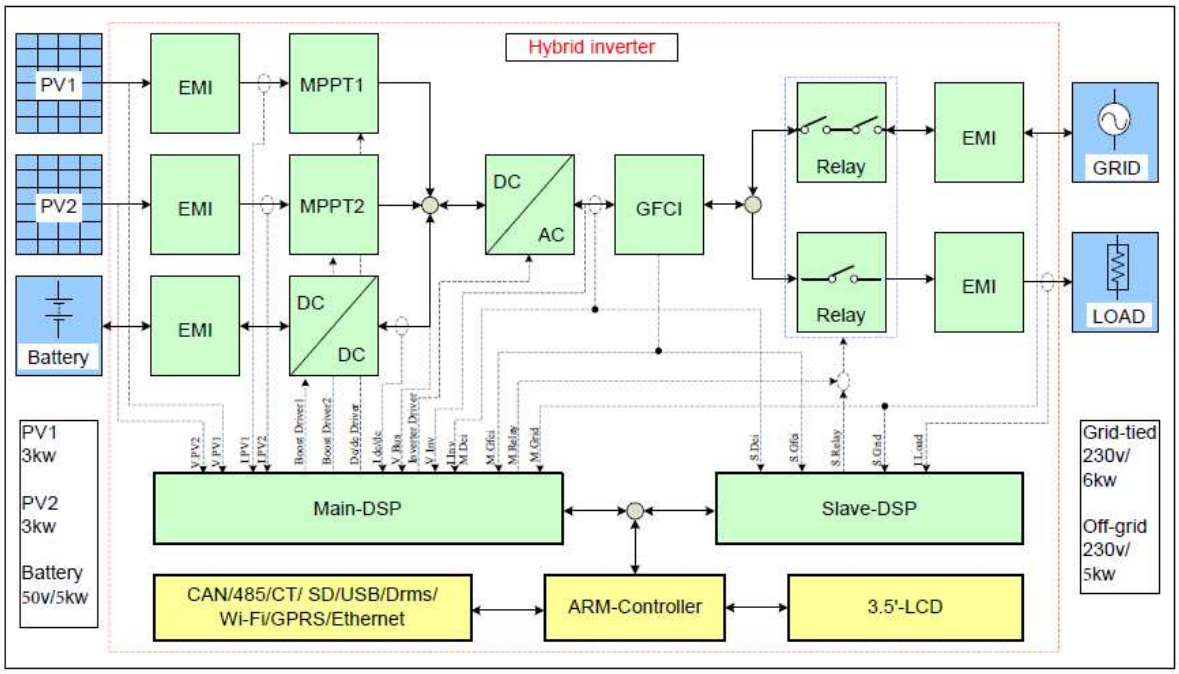


Figure 1 – Block diagram

The internal control is redundant built. It consists of Main DSP(U4) and slave DSP(U43).

The Main DSP(U4) can control the relays, measures voltage, and frequency, AC current with injected DC, insulation resistance and residual current, In addition it tests the array insulation resistance and the RCMU circuit before each start up.

The slave DSP(U43) is using for controlling the relays, measuring the voltage， frequency, inject a dc AC current, the residual current, and communicating with the master DSP(U4). And if the communicating with the master DSP, the slave DSP will disconnect the relays.

The unit provides two relays in series on Line and Neutral conductors. When single-fault applied to one relay, alarm an error code in display panel, another redundant relay provides basic insulation maintained between the PV array and the mains. All the relays are tested before start up. Both controllers Main DSP(U4), Slave DSP(U43) can open the relays.

Differences of the models:

The models HYD 3000-EP, HYD 3680-EP, HYD 4000-EP, HYD 4600-EP, HYD 5000-EP, HYD 5500-EP and HYD 6000-EP are completely identical and output power derated by software, except for the following table.

	HYD 3000-EP	HYD 3680-EP	HYD 4000-EP	HYD 4600-EP	HYD 5000-EP	HYD 5500-EP	HYD 6000-EP
R332, R334, R336	(NC, 0Ω, NC)			(0Ω, NC, 0Ω)			
Bus capacitance	6pcs			8pcs			
INV inductor	1,035mH			0,75mH			
R123, R132	(499Ω, 499Ω)			(1.5kΩ, 1.5kΩ)			

The product was tested on:

Hardware version: V001

Software version: V02000

Test report

UNE 206007-1:2013			
Clause/§	**Requirement:**	**Remark:**	**Verdict**
5. Technical Requirements			
5.1 Direct Current Injection into the Grid			
1	The inverter shall guarantee that any direct current injected into the grid does not exceed 0,5% of rated current,		**P**
5.2 Behavior in the Event of an Insulation Fault			
1	The inverter shall measure the impedance of the PV array to ground, In transformerless inverters, this protection shall only be active before the inverter is connected to the grid, The measurement circuit shall detect an insulation resistance between the live parts of the PV array (positive and negative) and ground below the value of resistance R as defined in EN 62109-2, If the insulation resistance is below this value, the inverter shall: 1. In invertors with low or high frequency transformers, indicate an insulation fault (the inverter may connect or remain connected to the grid), 2. In transformerless inverters, indicate an insulation fault and not connect to the grid,		**P**
5.3 Detection of Fault Currents in the PV Array			
1	Inverters with low frequency transformers and inverters with high frequency transformers are not subject to this requirement, In transformerless inverters, a ground fault current detection unit is required between the grid and the PV array,	5,3,1 Maximum Current Test This shall be conducted according to the specifications of EN 62109-2, chapter 4,8,3,5,1, a) 5,3,2 Instantaneous Variations of Current Test This shall be conducted according to the specifications of EN 62109-2, chapter 4,8,3,5,1, b)	**P**
5.4 Voltage and frequency Disconnection **5.5 Automatic Reconnection**			
1	An automatic connection switch for automatic disconnection-connection of the facility in the event of a network voltage or frequency anomaly, together with a locking relay, Eventually, the function of this switch may be performed by the switch or switches of the generator equipment, Eventually, the functions of the automatic connection switch and general cut-off switch may be performed by the same device,	The unit provides an integrated automatic disconnection device which opens in case of loss of voltage and frequency. See appended table.	**P**

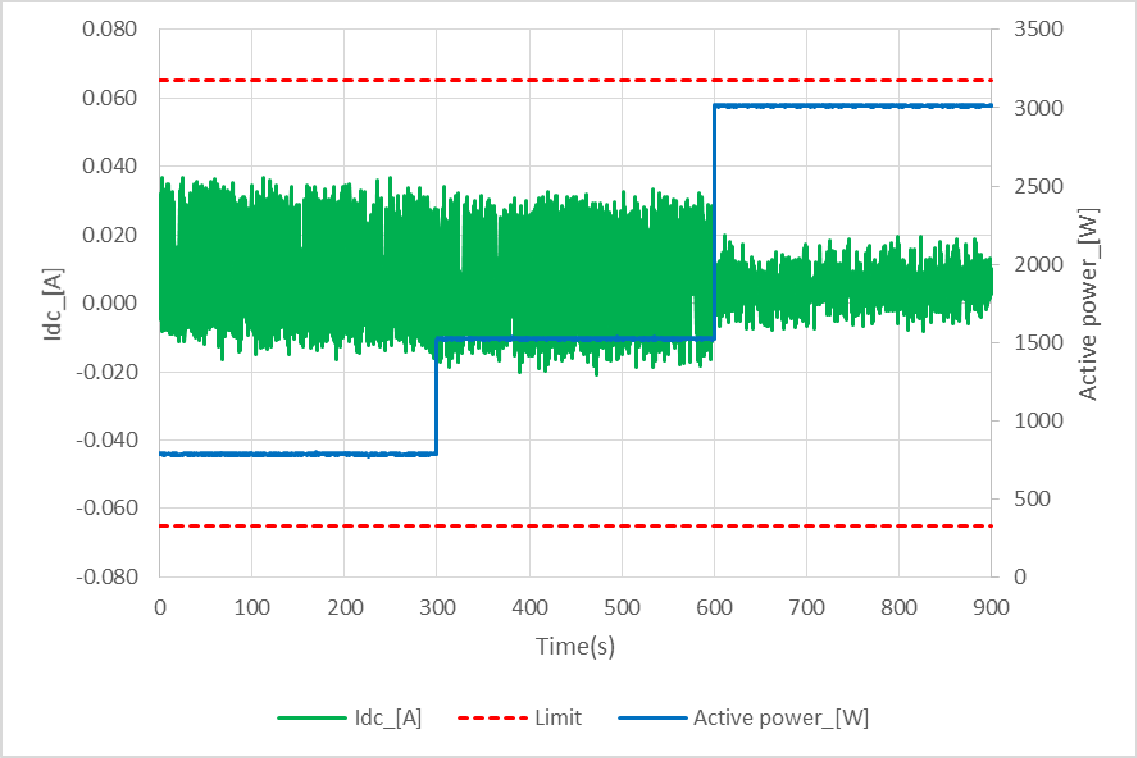
UNE 206007-1:2013			
Clause/§	**Requirement:**	**Remark:**	**Verdict**
2	Maximum and minimum frequency connection protections and maximum and minimum voltage between phases as indicated in table 1 (RD 1699/2011), where the low voltage proposal is generalised for all other levels, In insular and extra-peninsular electrical systems, the above values shall be the ones indicated in the respective operating procedures, The voltage for measuring these values shall be taken from the network side of the general automatic switch for high voltage facilities or the main switches of the generators in low voltage networks, In the event of activating the maximum frequency protection, reconnection shall only be made when the frequency reaches a value that is less than or equal to 50 Hz,	With modification according to RD413:2014 for RD1699 Upper frequency: 51,0 Hz Lower frequency: 48,0 Hz Upper voltage (stage 2): Un +15% Upper voltage (stage 1): Un +10% Lower voltage: Un -15% Automatic reconnection after at least 180s according to IEC 61727:2001 once the grid conditions are within the limits of clause d) See appended tables. Parameters are adjustable only for the installer and protected via password.	**P**
3	In addition, for voltages greater than 1 kV and up to 36 kV inclusive, the disconnection criteria for maximum homopolar voltage shall be added,	The inverter is designed for connection to the low voltage grid,	**P**
4	These protections may act on the general switch or on the switch or switches of the equipment or generators,	The unit provides an integrated automatic disconnection device which opens in case of an error.	**P**
5	The protections shall be sealed by the supply company, after the necessary checks on the switching system and on the integration of the protection functions into the generator equipment,	The values can be changed by authorised staff and are protected by password	**P**
6	In the event that the generator or inverter equipment have the above-described protections, these shall comply with current legislation, and in particular, the Low voltage electro technical regulations, approved by Royal Decree 842/2002 of 2 August 2002, the Regulations governing technical conditions and safety assurance in electric power stations, substations and transformation stations, approved by Royal Decree 3275/1982 of 12 November 1982 and the Regulations governing technical conditions and safety assurance in high voltage electrical lines, approved by Royal Decree 223/2008 of 15 February 2008, for facilities operating parallel to the supply network, In this case, there is no need for the protections to be duplicated,	Considered.	**P**

UNE 206007-1:2013			
Clause/§	**Requirement:**	**Remark:**	**Verdict**
5.6 Island Operation Detection			
1	Inverters connected to the low voltage grid shall comply with the specifications of AENOR Report UNE 206006 IN, Inverters within installations with anti-island systems at the grid termination point are permitted to not incorporate island operation detection systems, The inverter's anti-island systems shall not prevent compliance with standards in force applicable to the power generation plant,		**P**
5.7 Overvoltage generation			
1	The inverter shall not generate overvoltages at its alternating current connection, complying with the limits set in tables 2 or 3 as applicable,	Table 2 and 3 are stated in UNE206007-1.	**P**
5.8 Grid quality			
1	Emission (EN 61000-6-3) and Immunity (EN 61000-6-2) requirements have to be conform according to the respective actual and valid standards, Harmonics have to be conform according to EN 61000-3-2 (-3-12 for >16A/phase), The voltage fluctuations due to connection/disconnection to the public grid of less than 5%, This is covered by Flicker according to EN 61000-3-3 (-3-11 for >16A/phase)	The inverter is tested according to the EMC requirements. For detailed information please see the EMC test report.	**P**
5.9 Out of Syncronism			
1	The PV inverter must be able to withstand an out-of-sync reactivation, to prepare against the possibility of a network reactivation in less time than it takes for the anti-islanding system to actuate or for the system to be disconnected, The simulator must be capable of producing a 90º and 180° phase shift in its output voltage,		**P**

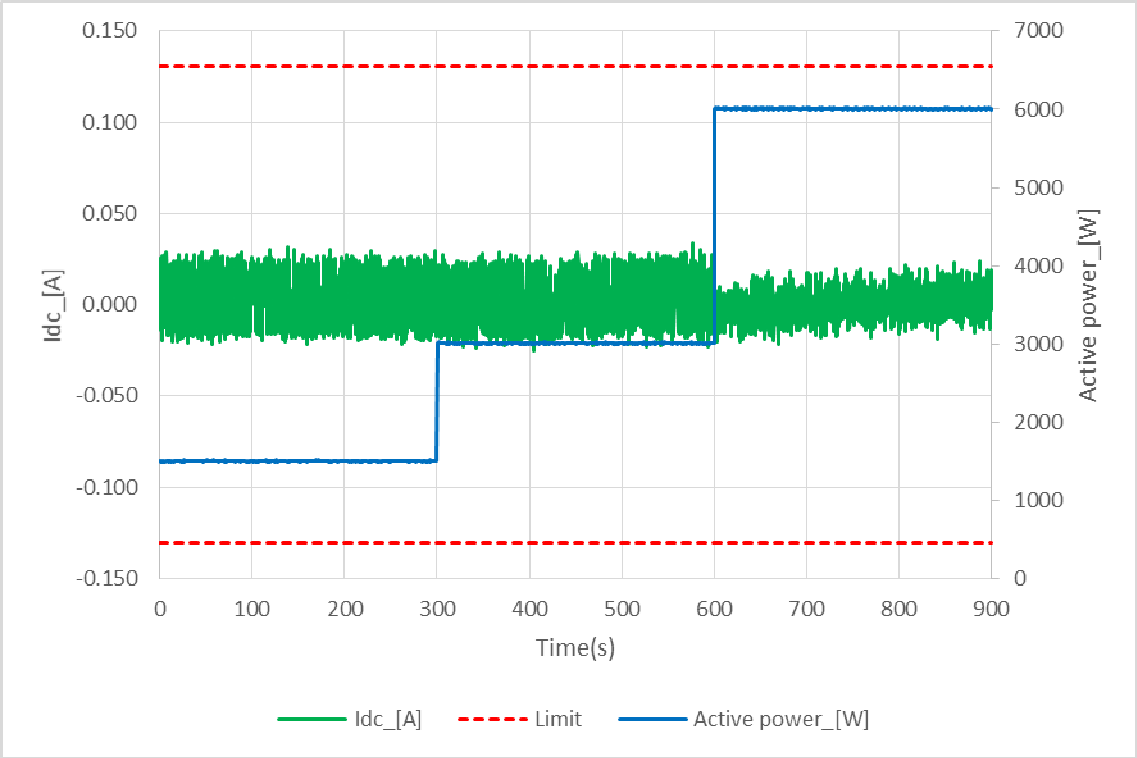
UNE 206007-1:2013		
Article	**Test**	**Result**
5. Technical Requirements		
5.1	**Direct Current Injection into the Grid**	**P**
5.2	**Behaviour in the Event of an Insulation Fault**	**P**
5.3	**Detection of Fault Currents in the PV Array**	**P**
	5.3.1 Maximum Current Test	**P**
	5.3.2 Instantaneous Variations of Current Test	**P**
5.4	**Voltage and Frequency Disconnection**	**P**
5.5	**Automatic Reconnection**	**P**
5.6	**Island Operation Detection**	**P**
5.7	**Overvoltage Generation**	**P**
5.8	**Grid Quality**	**P**
5.9	**Out of Syncronism**	**P**

Test Results

5.1 Direct current injection into grid			P
Test result: HYD 3000-EP			
Power Level	25%	50%	100%
Watt	785	1524	3014
Vrms	230,12	230,25	230,50
Arms	3,475	6,651	13,092
PF	0,982	0,995	0,999
Cosφ	0,982	0,995	0,999
Abs, Max, DC (mA)	37	34	20
Abs, Max, DC (%)	0,282	0,263	0,152
Abs, Ave, DC (mA)	14	12	6
Abs, Ave, DC (%)	0,104	0,094	0,044



Test result: HYD 6000-EP			
Power Level	25%	50%	100%
Watt	1503	3009	6006
Vrms	230,30	230,56	231,01
Arms	6,560	13,067	26,012
PF	0,995	0,999	0,999
Cosφ	0,995	0,999	0,999
Abs, Max, DC (mA)	32	34	24
Abs, Max, DC (%)	0,121	0,130	0,091
Abs, Ave, DC (mA)	11	11	6
Abs, Ave, DC (%)	0,041	0,041	0,024



Note:
The inverter shall guarantee that any direct current injected into the grid does not exceed 0,5% of rated current,
Before testing, the internal temperature of the inverter has reached a steady state (less than 2ºC temperature change in 15 minutes),

The tests had been performed on the HYD 6000-EP and HYD 3000-EPis valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP , HYD 4000-EP and HYD 3680-EP, since it is identical in hardware and software construction except output power derated by software.

5.2 Behaviour in the Event of an Insulation Fault	**P**

DC Voltage below minimum operating voltage (V)	DC Voltage for inverter begin operation (V)	Resistance between ground and PV input terminal (KΩ)	Required Insulation resistance R = ($V_{MAX\ PV}$ / 30mA) (KΩ)	Result
DC+				
100	120	150	20	PV inverter cannot start up, Error message: (IsoFault);
100	120	150	20	
100	120	150	20	
100	120	150	20	
100	120	150	20	
DC-				
100	120	150	20	PV inverter cannot start up, Error message: (IsoFault);
100	120	150	20	
100	120	150	20	
100	120	150	20	
100	120	150	20	

Note:

The test procedure is defined in IEC 62109-2, For isolated inverters, shall indicate a fault in accordance with 13,9 (operation is allowed); the fault indication shall be maintained until the array insulation resistance has recovered to a value higher than the limit above

For non-isolated inverters, or inverters with isolation not complying with the leakage current limits in the minimum inverter isolation requirements in Table 30, shall indicate a fault in accordance with 13,9, and shall not connect to the mains; the inverter may continue to make the measurement, may stop indicating a fault and may connect to the mains if the array insulation resistance has recovered to a value higher than the limit above,

It is not required to test all PV input terminals if analysis of the design indicates that one or more terminals can be expected to have the same result, for example where multiple PV string inputs are in parallel,

Supplementary information:

The tests had been performed on the HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

The test results refer to the original test report 201015063GZU-002 issued by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch dated on 2020-11-23.

5.3 Detection of Fault Currents in the PV Array	**P**
5.3.1 Maximum Current Test	**P**

Fault Current (mA)		Disconnection time (ms)	
Measured Fault Current	Limit 300mA for output power ≤ 30 kVA 10mA per kVA for output power > 30 kVA	Measured Disconnection time	Limit
+ PV to N:			
Un			
145	300	246	300
155	300	254	300
156	300	244	300
154	300	242	300
155	300	256	300
- PV to N:			
Un			
145	300	234	300
149	300	260	300
150	300	230	300
149	300	232	300
147	300	244	300

Note:
The tests are based on IEC 62109-2, chapter 4,8,3,5,1, a),
– maximum 300mA for inverters with continuous output power rating ≤30 kVA;
– maximum 10mA per kVA of rated continuous output power for inverters with continuous output power rating > 30 kVA,
This test shall be repeated 5 times, and for all 5 tests the time to disconnect shall not exceed 0,3s,
The test is repeated for each PV input terminal, It is not required to test all PV input terminals if analysis of the design indicates that one or more terminals can be expected to have the same result, for example where multiple PV string inputs are in parallel,

Supplementary information:

The tests had been performed on the HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

The test results refer to the original test report 201015063GZU-002 issued by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch dated on 2020-11-23.

5.3.2 Instantaneous Variations of Current Test		P
+PV to N		
Limit (mA)	Disconnection time (ms) Un	Limit (ms)
30	214	300
30	230	300
30	224	300
30	208	300
30	228	300
60	118	150
60	128	150
60	105	150
60	121	150
60	133	150
150	32	40
150	26	40
150	36	40
150	36	40
150	31	40
-PV to N		
Limit (mA)	Disconnection time (ms) Un	Limit (ms)
30	206	300
30	226	300
30	234	300
30	218	300
30	212	300
60	110	150
60	123	150
60	131	150
60	125	150
60	129	150
150	27	40
150	22	40
150	29	40
150	34	40
150	24	40

Note:
The tests are based on IEC 62109-2, chapter 4,8,3,5,1, b).
The capacitive current is risen until disconnection.
Test condition: I_c + 30/60/150mA <= I_{cmax}, R_1 is set that 30/60/150mA Flow and switch S is closed.

Supplementary information:

The tests had been performed on the HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

The test results refer to the original test report 201015063GZU-002 issued by Intertek Testing Services Shenzhen Ltd. Guangzhou Branch dated on 2020-11-23.

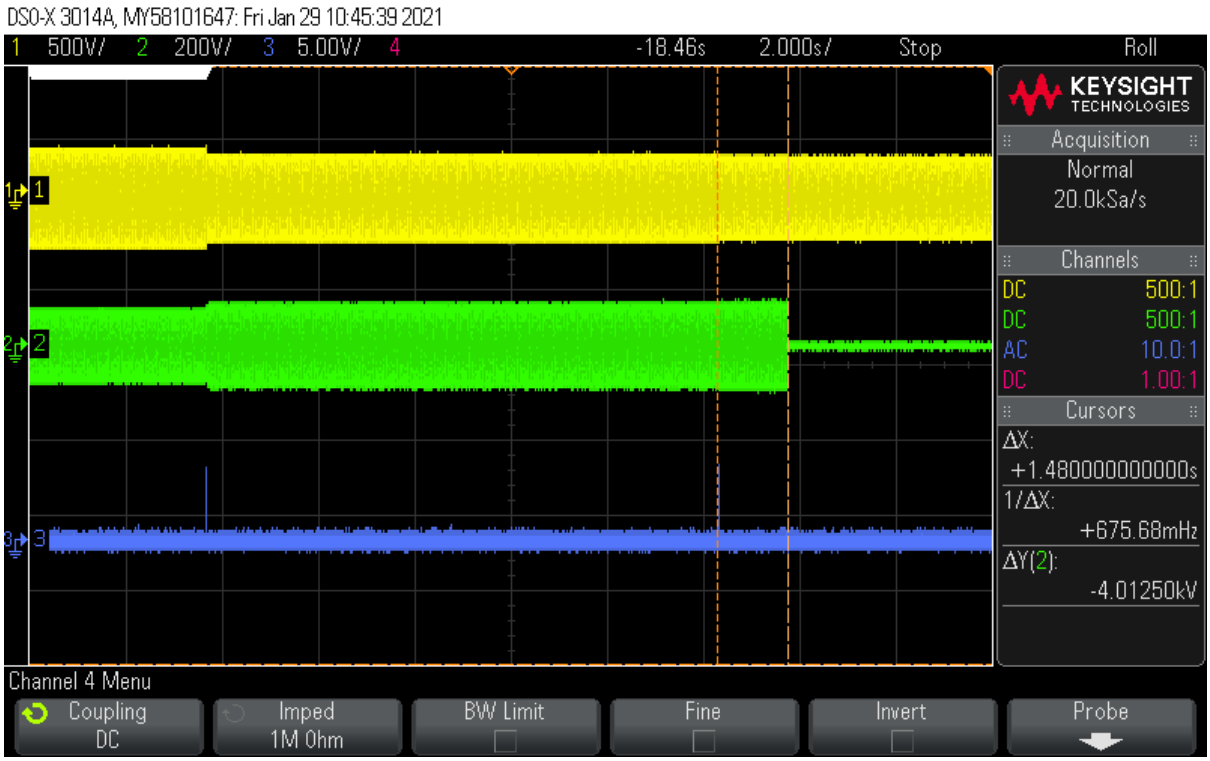
5.4 Voltage and Frequency Disconnection									**P**
Voltage Monitoring									
Test conditions:	**								
	under voltage				**over voltage (stage 1)**				
Parameter	Voltage	Time [ms]			Voltage	Time [ms]			
Limit	195V	**<= 1500 ms***			253V	**<= 1500 ms**			
Trip value	194,0				254,8				
Disconnection time	**210V to 190V**	1460	1480	1480	**240V to 255V**	1480	1460	1480	
	230V to 190V	1430	1420	1440	**230V to 255V**	1450	1440	1430	
Reconnection time:	**>=180 s**	184 s			**>=180 s**	185 s			
	--				**over voltage (stage 2)**				
Parameter	--				Voltage	Time (ms)			
Limit					264,5V	**<= 200 ms**			
Trip value	**--**				264,2				
Disconnection time	--				**245V to 265V**	168	184	170	
	--				**230V to 265V**	184	194	180	
Reconnection time:	--				**>=180 s**	185 s			
	--								

Note:
The test is based on the limits of RD1699:2011/RD413:2014.
The maximum and minimum voltage connection protection must be set to Un +10% (stage 1), Un +15% (stage 2) and Un -15%, The accuracy for the voltage measurement must be in a range of +/-2,3V (1% $U_{nom,}$).

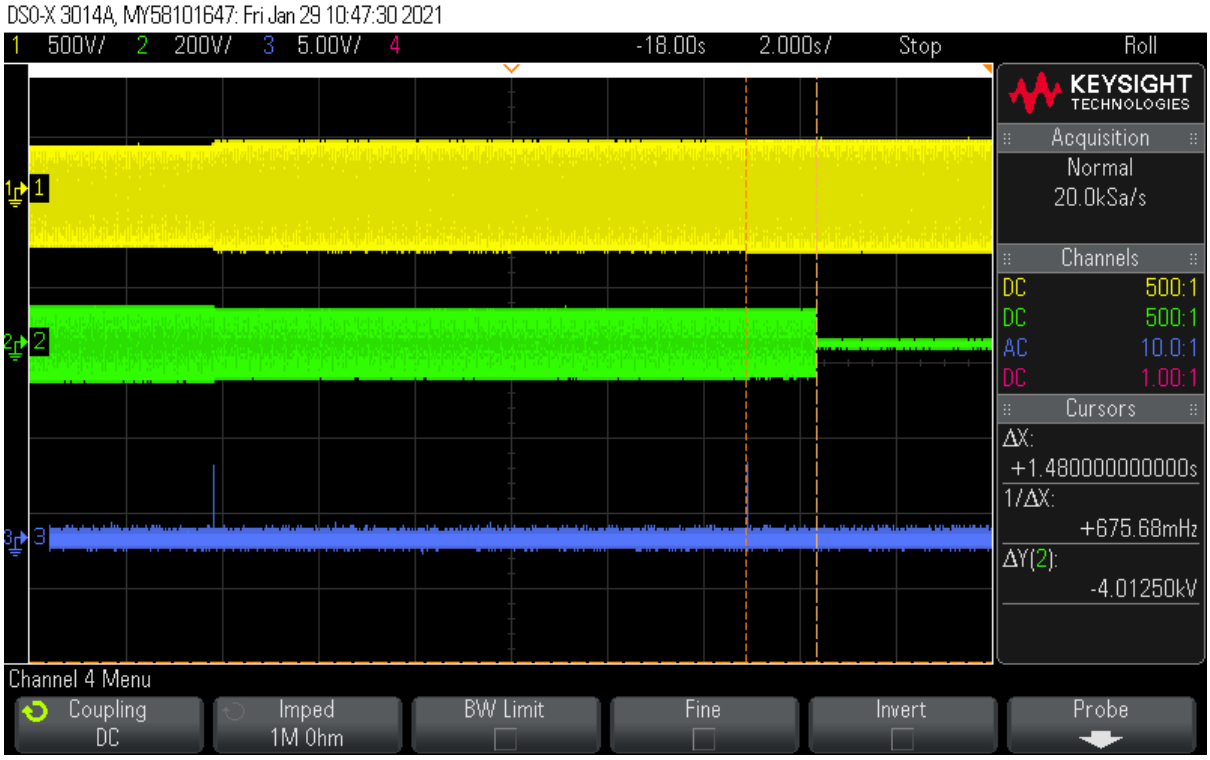
* In case of facilities required to meet performance requirements against voltage sags, The time performance should be equal to 1,5 s.

The tests had been performed on the HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

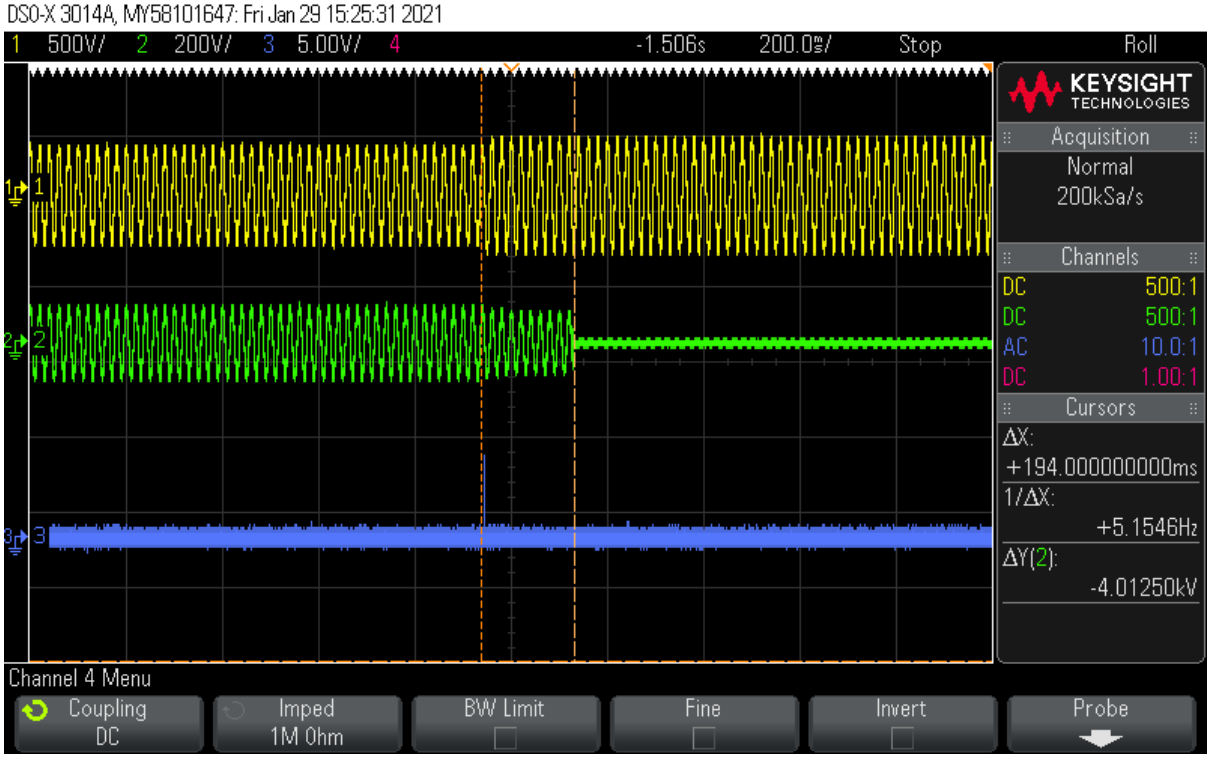
under voltage:



over voltage (stage 1):



over voltage (stage 2):

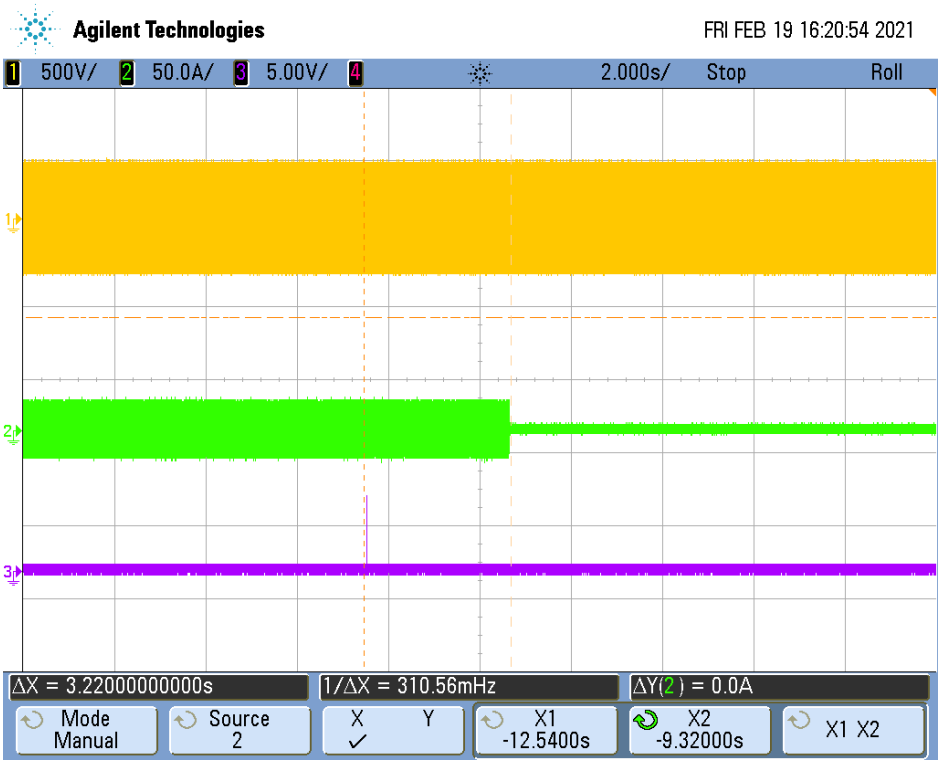


Frequency monitoring									**P**
	under frequency				**over frequency**				
Parameter	Frequency [Hz]	Time [s]			Frequency [Hz]	Time [s]			
Output Voltage		**~85%U_N**	**U_N**	**~110%U_N**		**~85%U_N**	**U_N**	**~110%U_N**	
Limit	**48,0 Hz**	**at least 3 s**			**51,0 Hz**	**<= 500 ms**			
Trip value		48,00	48,00	48,00		51,02	51,02	51,02	
Disconnection time (s)	48,1Hz to 47,9Hz	3,140	3,160	3,220	50,9Hz to 51,1Hz	0,432	0,406	0,422	
		3,160	3,190	3,200		0,432	0,412	0,424	
Reconnection time:	**>=180 s**	185 s			**>=180 s**	185 s			

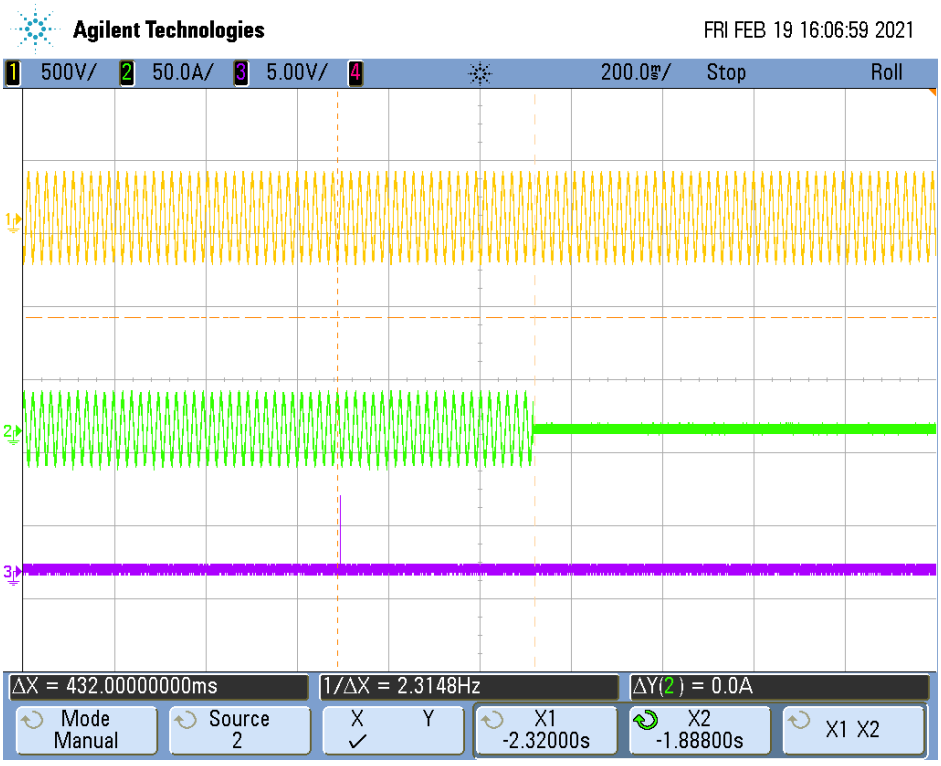
Note:
The test is based on the limits of RD661:2007/RD413:2014.

The tests had been performed on the HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

under frequency:



over frequency:



5.5 Automatic Reconnection			**P**
Setting values reconnection	Setting $T_{reconnection}$ ≥ 180s:	180 s	
	Setting $f_{reconnection}$ ≤ 50,00Hz:	50 Hz	
Connecting conditions for frequencies:			
a)	50,00 Hz		inverter running
	f_{ist}	**Reset time:**	**Limit:**
	Switch to b) for ≥ Setting $T_{reconnection}$:		
b)	≥ 50,50 Hz	No connection	inverter has to disconnect, no resetting allowed
	Switch to c) for ≥ Setting $T_{reconnection}$:		
c)	50,05 Hz	No connection	no resetting allowed
	Switch to d) for ≥ Setting $T_{reconnection}$:		
d)	≤ 50,00 Hz	185	resetting allowed after ≥ Setting $T_{reconnection}$

Test:
The test is based on the limits of RD413,
see points a) to d) for the test process,
The measurement was carried out with a programmable AC source,
e,g, connecting conditions for frequencies:
a) AC source was programmed in such a way that the AC output is set to 230 V / 50 Hz
b) AC source is set for ≥ Setting $T_{reconnection}$ to 230 V / 50,5 Hz, switching on again is not permitted
c) AC source is set to 230 V / 50,05 Hz for ≥ Setting $T_{reconnection}$, reconnection is not permitted
d) AC source is set back to 230 V / 50,0 Hz, reconnection is allowed after ≥ Setting $T_{reconnection}$,

Note:
In the event of activating the maximum frequency protection, reconnection shall only be made when the frequency reaches a value that is less than or equal to 50 Hz, The accuracy for the frequency measurement must be in a range of +/-0,05 Hz (0,1% $f_{nom.}$),

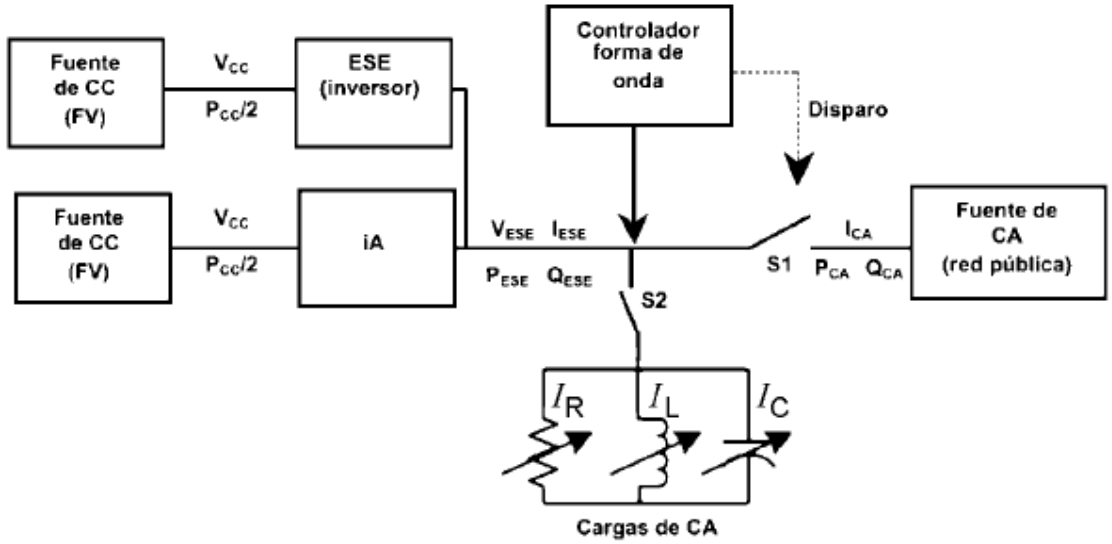
The tests had been performed on the HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

5.6 Island Operation Detection	P

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 UNE 206006:2011



Note:
Test 1: Both inverters are feeding in parallel with Anti-Islanding detection activated.
Test 2: Both inverters are feeding in parallel with Anti-Islanding detection deactivated of the second inverter.

Each inverter is generating 50% of the required test-bin.

The testing is based on EN 62116.

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

TEST 1

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	2s (IEC 62116)

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} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	100	100	0	0	0,18	6004	457	0,999	458	BL
2	100	100	-5	-5	1,06	6004	457	1,025	406	IB
3	100	100	-5	0	1,10	6004	457	1,051	446	IB
4	100	100	-5	+5	1,07	6004	457	1,077	404	IB
5	100	100	0	-5	0,61	6004	457	0,973	390	IB
6	100	100	0	+5	0,60	6004	457	1,023	412	IB
7	100	100	+5	-5	1,92	6004	457	0,927	378	IB
8	100	100	+5	0	1,89	6004	457	0,951	386	IB
9	100	100	+5	+5	1,91	6004	457	0,975	374	IB

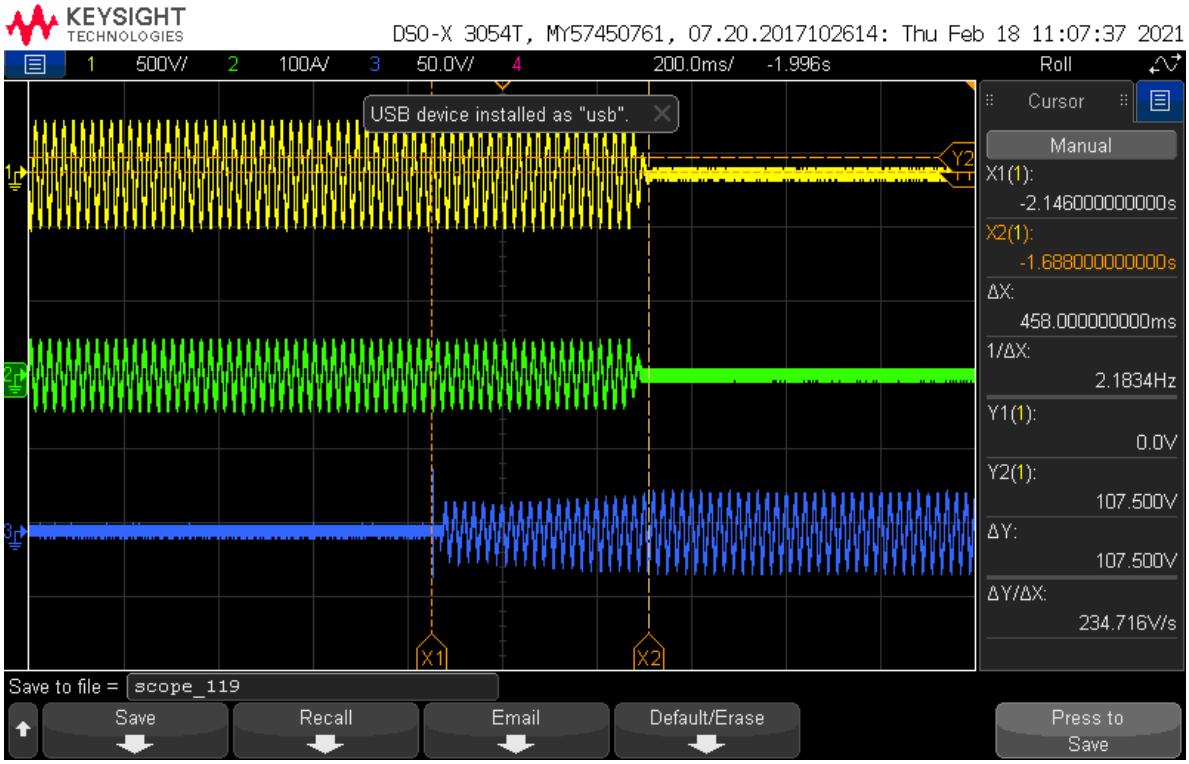
Parameter at 0% per phase	L= 27,91 mH	R= 8,76 Ω	C= 363,08 µF

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.

The tests had been performed on the HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

Disconnection at No. 1



5.6 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 (IEC 62116)

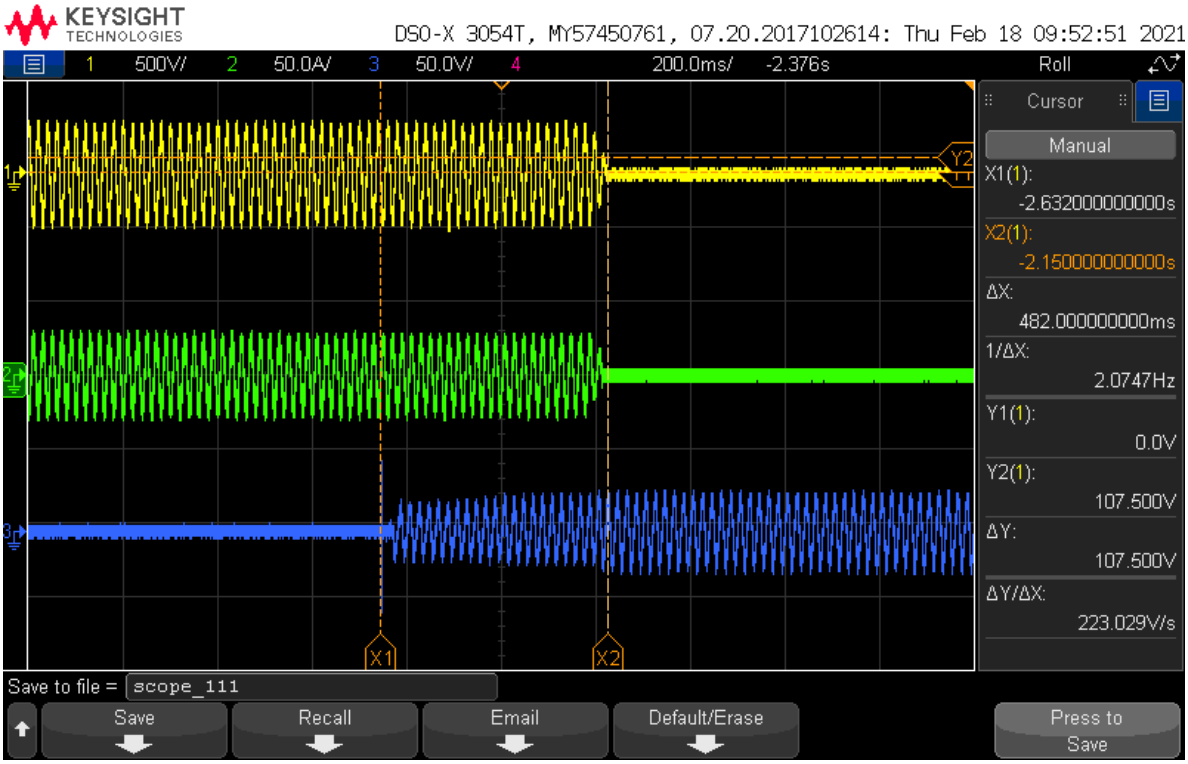
No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6,1,d) 1]	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	66	66	0	-5	0,26	3995	365	0,974	426	IB
2	66	66	0	-4	0,25	3995	365	0,979	438	IB
3	66	66	0	-3	0,25	3995	365	0,984	434	IB
4	66	66	0	-2	0,24	3995	365	0,989	464	IB
5	66	66	0	-1	0,24	3995	365	0,994	440	IB
6	66	66	0	0	0,18	3995	365	0,999	482	BL
7	66	66	0	1	0,23	3995	365	1,004	406	IB
8	66	66	0	2	0,23	3995	365	1,009	404	IB
9	66	66	0	3	0,24	3995	365	1,014	422	IB
10	66	66	0	4	0,24	3995	365	1,019	410	IB
11	66	66	0	5	0,25	3995	365	1,024	384	IB

Parameter at 0% per phase	L= 42,19 mH	R= 13,24 Ω	C= 240,15 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 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 HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

Disconnection at No. 6



5.6 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 (IEC 62116)

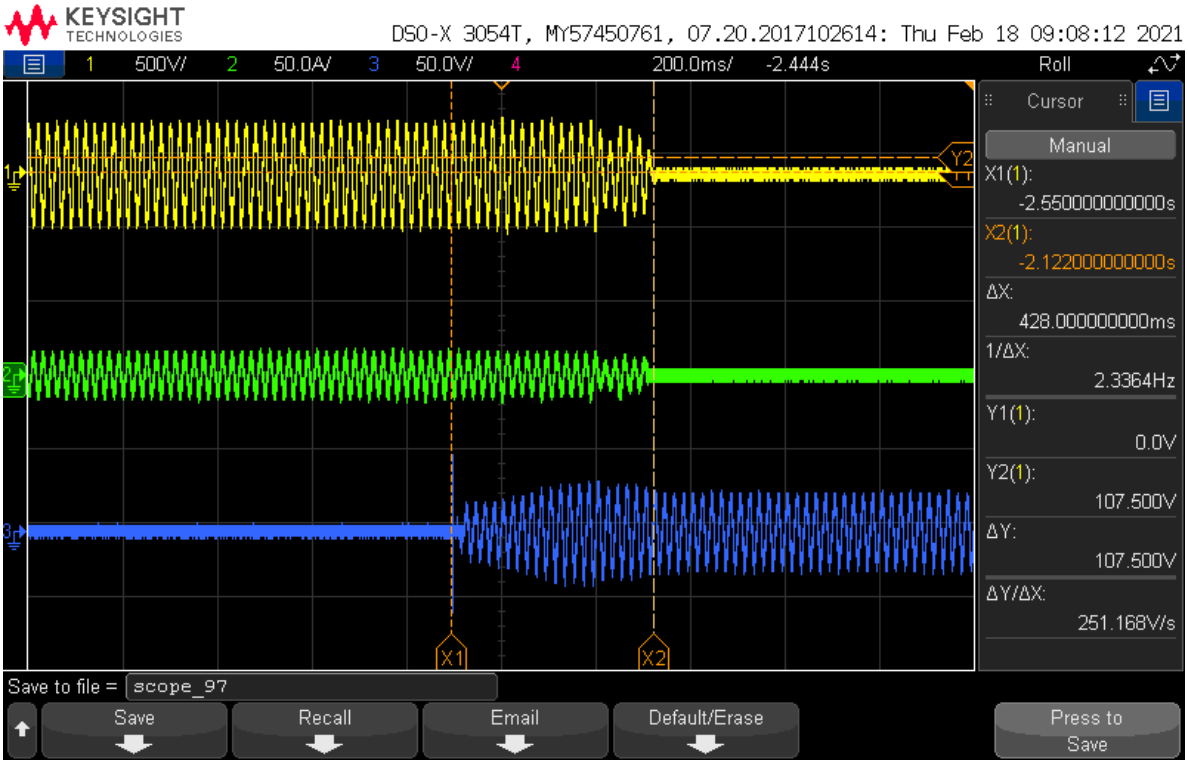
No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6,1,d) 1]	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	33	33	0	-5	0,27	2000	273	0,976	334	IB
2	33	33	0	-4	0,27	2000	273	0,981	370	IB
3	33	33	0	-3	0,27	2000	273	0,986	344	IB
4	33	33	0	-2	0,26	2000	273	0,991	396	IB
5	33	33	0	-1	0,26	2000	273	0,996	326	IB
6	33	33	0	0	0,19	2000	273	1,001	**428**	BL
7	33	33	0	1	0,27	2000	273	1,006	398	IB
8	33	33	0	2	0,27	2000	273	1,011	404	IB
9	33	33	0	3	0,27	2000	273	1,016	398	IB
10	33	33	0	4	0,28	2000	273	1,021	376	IB
11	33	33	0	5	0,28	2000	273	1,026	366	IB

Parameter at 0% per phase	L= 83,69 mH	R= 26,32 Ω	C= 121,07 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 HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

Disconnection at No. 6



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

TEST 2

Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality = 1
Disconnection limit	2s (IEC 62116)

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} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	100	100	0	0	0,12	5950	457	0,994	1940	BL
2	100	100	-5	-5	1,41	5950	457	1,020	1790	IB
3	100	100	-5	0	1,40	5950	457	1,046	1770	IB
4	100	100	-5	+5	1,33	5950	457	1,072	1850	IB
5	100	100	0	-5	0,13	5950	457	0,969	1900	IB
6	100	100	0	+5	0,20	5950	457	1,019	1860	IB
7	100	100	+5	-5	1,42	5950	457	0,923	1850	IB
8	100	100	+5	0	1,42	5950	457	0,947	1890	IB
9	100	100	+5	+5	1,49	5950	457	0,970	1800	IB

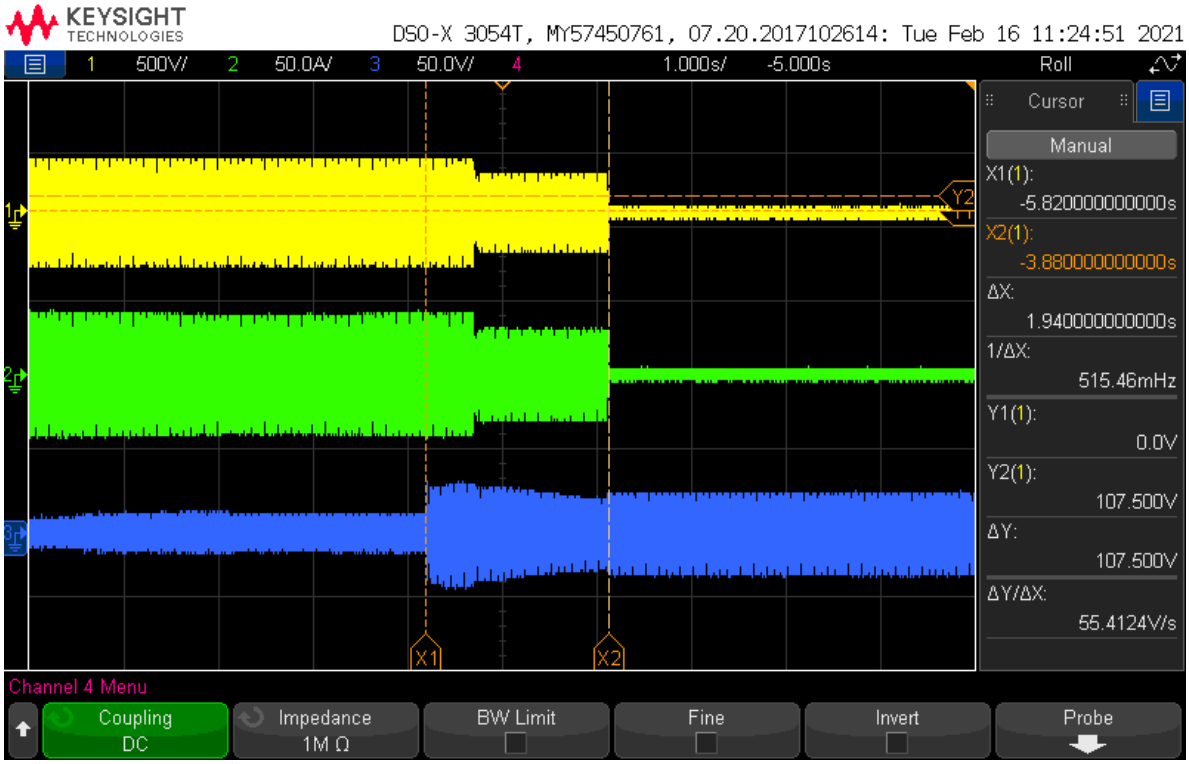
Parameter at 0% per phase	L= 28,47 mH	R= 8,89 Ω	C= 355,88 µF

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

The tests had been performed on the HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

Disconnection at No. 1



5.6 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 (IEC 62116)

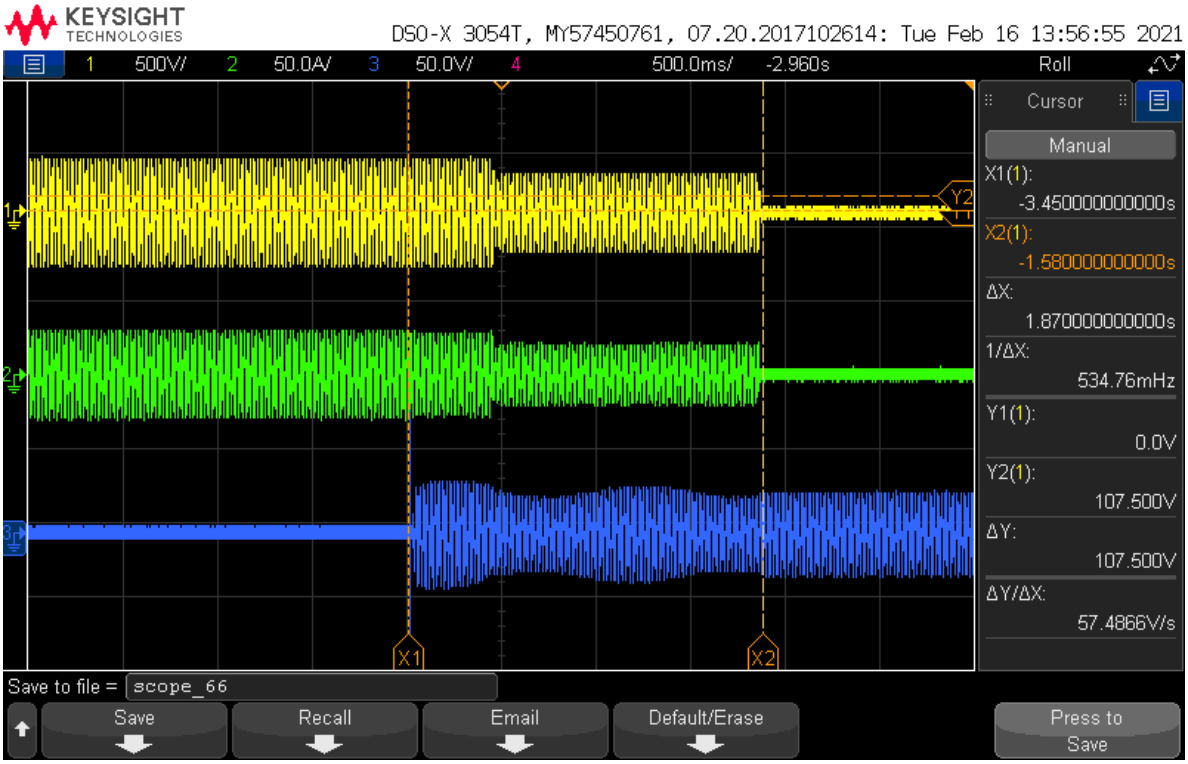
No	P_{EUT} 1) [% of EUT rating]	Reactive load [% of Q_L in 6,1,d) 1]	P_{AC} 2) [% of nominal]	Q_{AC} 3) [% of nominal]	I_{AC} 4) [A]	P_{EUT} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	66	66	0	-5	0,21	3983	365	0,973	1810	IB
2	66	66	0	-4	0,20	3983	365	0,978	1840	IB
3	66	66	0	-3	0,20	3983	365	0,983	1820	IB
4	66	66	0	-2	0,20	3983	365	0,989	1800	IB
5	66	66	0	-1	0,20	3983	365	0,994	1830	IB
6	66	66	0	0	0,20	3983	365	0,999	1870	BL
7	66	66	0	1	0,21	3983	365	1,004	1840	IB
8	66	66	0	2	0,22	3983	365	1,008	1830	IB
9	66	66	0	3	0,23	3983	365	1,013	1840	IB
10	66	66	0	4	0,24	3983	365	1,018	1850	IB
11	66	66	0	5	0,25	3983	365	1,023	1810	IB

Parameter at 0% per phase	L= 42,32 mH	R= 13,28 Ω	C= 239,43 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 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 HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

Disconnection at No. 6



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

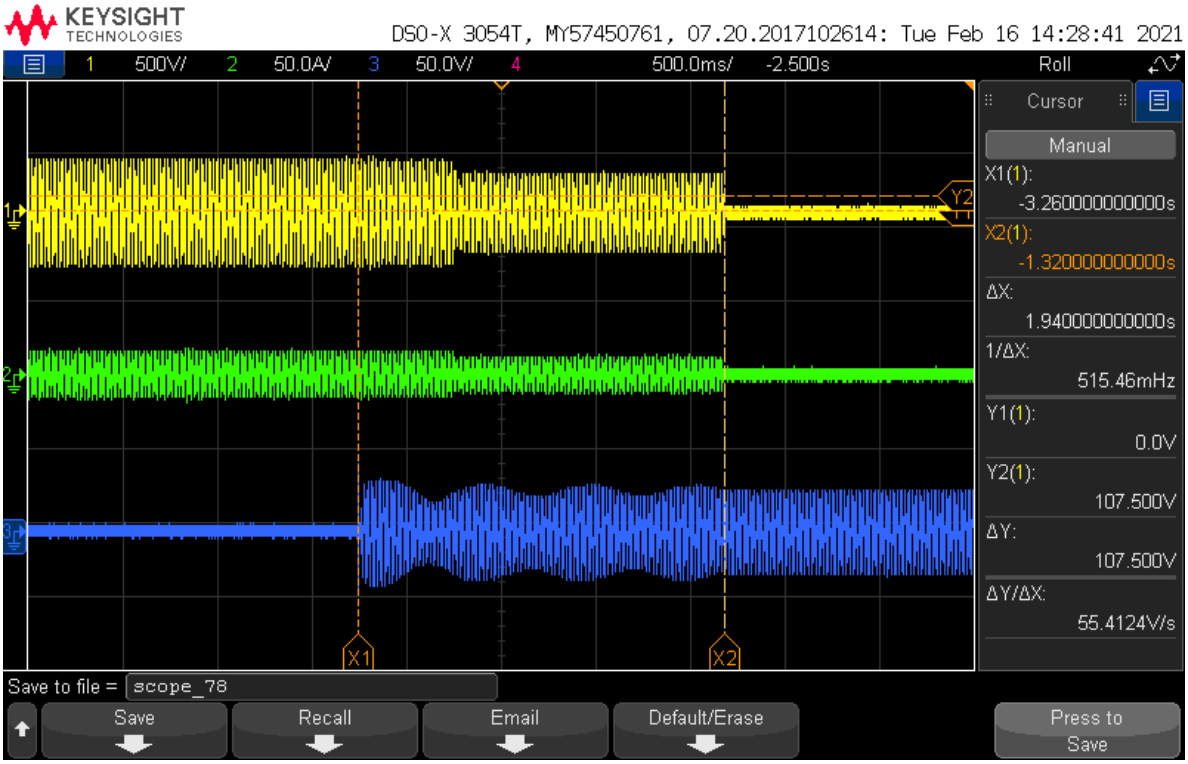
Test conditions	Frequency: 50+/-0,1Hz U_N=230+/-3Vac Distortion factor of chokes < 2% Quality =1
Disconnection limit	2s (IEC 62116)

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} [W per phase]	V_{DC} [V]	Q_f [1]	Run on Time [ms]	Remarks 5)
1	33	33	0	-5	0,16	1993	273	0,975	1870	IB
2	33	33	0	-4	0,16	1993	273	0,980	1910	IB
3	33	33	0	-3	0,16	1993	273	0,985	1900	IB
4	33	33	0	-2	0,16	1993	273	0,990	1920	IB
5	33	33	0	-1	0,16	1993	273	0,995	1880	IB
6	33	33	0	0	0,16	1993	273	1,000	1940	BL
7	33	33	0	1	0,17	1993	273	1,005	1810	IB
8	33	33	0	2	0,18	1993	273	1,010	1820	IB
9	33	33	0	3	0,18	1993	273	1,015	1880	IB
10	33	33	0	4	0,19	1993	273	1,020	1840	IB
11	33	33	0	5	0,20	1993	273	1,025	1820	IB

Parameter at 0% per phase	L= 84,49 mH	R= 26,54 Ω	C= 119,92 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 HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

Disconnection at No. 6



5.7 Overvoltage Generation **Phase- neutral**				**P**
L1 phase to neutral	50+/-5% Output Power (VA)		100+/-5% Output Power (VA)	
	Duration (s)	Line to neutral (V)	Duration(s)	Line to neutral (V)
Limit	0,0002	910	0,0002	910
Test value	0,0002	206	0,0002	6
Limit	0,0006	710	0,0006	710
Test value	0,0006	227	0,0006	143
Limit	0,002	580	0,002	580
Test value	0,002	359	0,002	385
Limit	0,006	470	0,006	470
Test value	0,006	374	0,006	401
Limit	0,02	420	0,02	420
Test value	0,02	320	0,02	186
Limit	0,06	390	0,06	390
Test value	0,06	257	0,06	152
Limit	0,2	390	0,2	390
Test value	0,2	126	0,2	75
Limit	0,6	390	0,6	390
Test value	0,6	6	0,6	7

Note:

The tests are based on the procedure of AS/NZS 4777,2.

The inverter shall not generate overvoltages at its alternating current connection, complying with the limits set in tables 2 or 3 of UNE206007-1 as applicable.

The test shall be performed for a power greater than 50% of rated power, Repeat the test three times.

The tests had been performed on the HYD 6000-EP is valid for the HYD 5500-EP, HYD 5000-EP, HYD 4600-EP, HYD 4000-EP, HYD 3680-EP and HYD 3000-EP, since it is identical in hardware and software construction except output power derated by software.

5.8 Grid quality				P
Harmonics: HYD 3000-EP				**P**
Normal ambient (EN 61000-3-2) Output power (33±5)%				
Watts(W)		**1002**		
Vrms(V)		**230,23**		
Arms(A)		**4,385**		
Frequency(Hz)		**50,00**		
THD* (33% output power)		**4,12%**		
Harmonics	**Current Magnitude (A)**	**% of Nominal current**	**Phase**	**Harmonic Current Limits (A)**
1st	4,370	-	Single Phase	N/A
2nd	0,006	0,144	Single Phase	1,080
3rd	0,152	3,468	Single Phase	2,300
4th	0,003	0,065	Single Phase	0,430
5th	0,073	1,674	Single Phase	1,140
6th	0,002	0,052	Single Phase	0,300
7th	0,042	0,959	Single Phase	0,770
8th	0,002	0,042	Single Phase	0,230
9th	0,026	0,601	Single Phase	0,400
10th	0,002	0,036	Single Phase	0,184
11th	0,016	0,372	Single Phase	0,330
12th	0,001	0,033	Single Phase	0,153
13th	0,014	0,328	Single Phase	0,210
14th	0,001	0,029	Single Phase	0,131
15th	0,012	0,282	Single Phase	0,150
16th	0,001	0,026	Single Phase	0,115
17th	0,012	0,264	Single Phase	0,132
18th	0,001	0,024	Single Phase	0,102
19th	0,011	0,252	Single Phase	0,118
20th	0,001	0,021	Single Phase	0,092
21th	0,011	0,252	Single Phase	0,107
22th	0,001	0,024	Single Phase	0,084
23th	0,010	0,236	Single Phase	0,098
24th	0,001	0,020	Single Phase	0,077
25th	0,010	0,231	Single Phase	0,090
26th	0,001	0,024	Single Phase	0,071
27th	0,009	0,210	Single Phase	0,083
28th	0,001	0,019	Single Phase	0,066
29th	0,008	0,191	Single Phase	0,078
30th	0,001	0,027	Single Phase	0,061
31th	0,008	0,173	Single Phase	0,073
32th	0,001	0,023	Single Phase	0,058
33th	0,007	0,153	Single Phase	0,680
34th	0,001	0,024	Single Phase	0,054
35th	0,006	0,134	Single Phase	0,064
36th	0,001	0,022	Single Phase	0,051
37th	0,006	0,126	Single Phase	0,061
38th	0,001	0,028	Single Phase	0,048
39th	0,005	0,115	Single Phase	0,058
40th	0,001	0,023	Single Phase	0,046

Normal ambient (EN 61000-3-2) Output power (66±5)%				
Watts(W)		**2002**		
Vrms(V)		**230,34**		
Arms(A)		**8,704**		
Frequency(Hz)		**50,00**		
THD* (66% output power)		**2,09**		
Harmonics	**Current Magnitude (A)**	**% of Nominal current**	**Phase**	**Harmonic Current Limits (A)**
1st	8,696	-	Single Phase	N/A
2nd	0,012	0,134	Single Phase	1,080
3rd	0,153	1,756	Single Phase	2,300
4th	0,005	0,058	Single Phase	0,430
5th	0,077	0,883	Single Phase	1,140
6th	0,004	0,042	Single Phase	0,300
7th	0,042	0,480	Single Phase	0,770
8th	0,003	0,032	Single Phase	0,230
9th	0,026	0,295	Single Phase	0,400
10th	0,002	0,026	Single Phase	0,184
11th	0,018	0,207	Single Phase	0,330
12th	0,002	0,021	Single Phase	0,153
13th	0,015	0,168	Single Phase	0,210
14th	0,002	0,018	Single Phase	0,131
15th	0,012	0,136	Single Phase	0,150
16th	0,001	0,016	Single Phase	0,115
17th	0,012	0,134	Single Phase	0,132
18th	0,001	0,014	Single Phase	0,102
19th	0,010	0,118	Single Phase	0,118
20th	0,001	0,013	Single Phase	0,092
21th	0,009	0,108	Single Phase	0,107
22th	0,001	0,012	Single Phase	0,084
23th	0,008	0,092	Single Phase	0,098
24th	0,001	0,011	Single Phase	0,077
25th	0,007	0,083	Single Phase	0,090
26th	0,001	0,011	Single Phase	0,071
27th	0,006	0,074	Single Phase	0,083
28th	0,001	0,010	Single Phase	0,066
29th	0,005	0,058	Single Phase	0,078
30th	0,001	0,014	Single Phase	0,061
31th	0,005	0,056	Single Phase	0,073
32th	0,001	0,010	Single Phase	0,058
33th	0,004	0,050	Single Phase	0,680
34th	0,001	0,010	Single Phase	0,054
35th	0,004	0,045	Single Phase	0,064
36th	0,001	0,011	Single Phase	0,051
37th	0,004	0,042	Single Phase	0,061
38th	0,001	0,013	Single Phase	0,048
39th	0,003	0,038	Single Phase	0,058
40th	0,001	0,013	Single Phase	0,046

Normal ambient (EN 61000-3-2) Output power (100±5)%				
Watts(W)		**3022**		
Vrms(V)		**230,47**		
Arms(A)		**13,121**		
Frequency(Hz)		**50,00**		
THD* (100% output power)		**1,61**		
Harmonics	**Current Magnitude (A)**	**% of Nominal current**	**Phase**	**Harmonic Current Limits (A)**
1st	13,114	-	Single Phase	N/A
2nd	0,017	0,133	Single Phase	1,080
3rd	0,172	1,314	Single Phase	2,300
4th	0,008	0,058	Single Phase	0,430
5th	0,094	0,714	Single Phase	1,140
6th	0,005	0,039	Single Phase	0,300
7th	0,058	0,439	Single Phase	0,770
8th	0,004	0,029	Single Phase	0,230
9th	0,037	0,281	Single Phase	0,400
10th	0,003	0,023	Single Phase	0,184
11th	0,022	0,168	Single Phase	0,330
12th	0,002	0,019	Single Phase	0,153
13th	0,015	0,113	Single Phase	0,210
14th	0,002	0,015	Single Phase	0,131
15th	0,011	0,082	Single Phase	0,150
16th	0,002	0,012	Single Phase	0,115
17th	0,010	0,074	Single Phase	0,132
18th	0,001	0,011	Single Phase	0,102
19th	0,007	0,053	Single Phase	0,118
20th	0,001	0,010	Single Phase	0,092
21th	0,006	0,045	Single Phase	0,107
22th	0,001	0,010	Single Phase	0,084
23th	0,004	0,032	Single Phase	0,098
24th	0,001	0,008	Single Phase	0,077
25th	0,003	0,026	Single Phase	0,090
26th	0,001	0,008	Single Phase	0,071
27th	0,003	0,023	Single Phase	0,083
28th	0,001	0,008	Single Phase	0,066
29th	0,003	0,020	Single Phase	0,078
30th	0,001	0,009	Single Phase	0,061
31th	0,003	0,021	Single Phase	0,073
32th	0,001	0,007	Single Phase	0,058
33th	0,003	0,021	Single Phase	0,680
34th	0,001	0,009	Single Phase	0,054
35th	0,002	0,018	Single Phase	0,064
36th	0,001	0,008	Single Phase	0,051
37th	0,002	0,018	Single Phase	0,061
38th	0,002	0,012	Single Phase	0,048
39th	0,002	0,017	Single Phase	0,058
40th	0,001	0,009	Single Phase	0,046
Note: The tests should be based on the limits of the EN61000-3-2 for less than 16A and on EN 61000-3-12 for more than 16A,				

5.8 Grid quality				P
Harmonics: HYD 6000-EP				**P**
Normal ambient (EN 61000-3-12) Output power (33±5)%				
Watts(kW)		**2,055**		
Vrms(V)		**230,38**		
Arms(A)		**8,943**		
Frequency(Hz)		**50,00**		
THD* (33% output power)		**2,093**		
Harmonics	**Current Magnitude (A)**	**% of Nominal current**	**Phase**	**Harmonic Current Limits (%)**
1st	8,933	--	Single Phase	N/A
2nd	0,011	0,122	Single Phase	8
3rd	0,160	1,789	Single Phase	21,6
4th	0,005	0,055	Single Phase	4
5th	0,077	0,866	Single Phase	10,7
6th	0,004	0,039	Single Phase	2,67
7th	0,041	0,460	Single Phase	7,2
8th	0,003	0,033	Single Phase	2
9th	0,023	0,261	Single Phase	3,8
10th	0,002	0,024	Single Phase	1,6
11th	0,015	0,167	Single Phase	3,1
12th	0,002	0,021	Single Phase	1,33
13th	0,009	0,106	Single Phase	2
14th	0,001	0,017	Single Phase	N/A
15th	0,008	0,087	Single Phase	N/A
16th	0,001	0,014	Single Phase	N/A
17th	0,008	0,090	Single Phase	N/A
18th	0,001	0,012	Single Phase	N/A
19th	0,008	0,090	Single Phase	N/A
20th	0,001	0,011	Single Phase	N/A
21th	0,008	0,093	Single Phase	N/A
22th	0,001	0,010	Single Phase	N/A
23th	0,008	0,089	Single Phase	N/A
24th	0,001	0,010	Single Phase	N/A
25th	0,008	0,087	Single Phase	N/A
26th	0,001	0,009	Single Phase	N/A
27th	0,008	0,093	Single Phase	N/A
28th	0,001	0,009	Single Phase	N/A
29th	0,007	0,080	Single Phase	N/A
30th	0,001	0,010	Single Phase	N/A
31th	0,007	0,081	Single Phase	N/A
32th	0,001	0,009	Single Phase	N/A
33th	0,007	0,079	Single Phase	N/A
34th	0,001	0,008	Single Phase	N/A
35th	0,006	0,071	Single Phase	N/A
36th	0,001	0,010	Single Phase	N/A
37th	0,006	0,064	Single Phase	N/A
38th	0,001	0,010	Single Phase	N/A
39th	0,006	0,066	Single Phase	N/A
40th	0,001	0,009	Single Phase	N/A

Normal ambient (EN 61000-3-12) Output power (66±5)%				
Watts(kW)		**4,091**		
Vrms(V)		**230,76**		
Arms(A)		**17,743**		
Frequency(Hz)		**50,00**		
THD* (66% output power)		**1,114**		
Harmonics	**Current Magnitude (A)**	**% of Nominal current**	**Phase**	**Harmonic Current Limits (%)**
1st	17,735	-	Single Phase	N/A
2nd	0,021	0,121	Single Phase	8
3rd	0,168	0,950	Single Phase	21,6
4th	0,010	0,055	Single Phase	4
5th	0,076	0,426	Single Phase	10,7
6th	0,007	0,040	Single Phase	2,67
7th	0,039	0,221	Single Phase	7,2
8th	0,006	0,031	Single Phase	2
9th	0,020	0,115	Single Phase	3,8
10th	0,005	0,026	Single Phase	1,6
11th	0,011	0,065	Single Phase	3,1
12th	0,004	0,020	Single Phase	1,33
13th	0,010	0,058	Single Phase	2
14th	0,003	0,016	Single Phase	N/A
15th	0,011	0,061	Single Phase	N/A
16th	0,002	0,012	Single Phase	N/A
17th	0,012	0,070	Single Phase	N/A
18th	0,002	0,009	Single Phase	N/A
19th	0,014	0,076	Single Phase	N/A
20th	0,002	0,009	Single Phase	N/A
21th	0,014	0,078	Single Phase	N/A
22th	0,001	0,008	Single Phase	N/A
23th	0,014	0,077	Single Phase	N/A
24th	0,001	0,008	Single Phase	N/A
25th	0,014	0,077	Single Phase	N/A
26th	0,001	0,006	Single Phase	N/A
27th	0,014	0,077	Single Phase	N/A
28th	0,001	0,007	Single Phase	N/A
29th	0,013	0,071	Single Phase	N/A
30th	0,001	0,007	Single Phase	N/A
31th	0,013	0,072	Single Phase	N/A
32th	0,001	0,006	Single Phase	N/A
33th	0,012	0,067	Single Phase	N/A
34th	0,001	0,006	Single Phase	N/A
35th	0,011	0,064	Single Phase	N/A
36th	0,002	0,009	Single Phase	N/A
37th	0,011	0,060	Single Phase	N/A
38th	0,001	0,006	Single Phase	N/A
39th	0,011	0,062	Single Phase	N/A
40th	0,001	0,005	Single Phase	N/A

Normal ambient (EN 61000-3-12) Output power (100±5)%				
Watts(kW)		**6,010**		
Vrms(V)		**230,12**		
Arms(A)		**26,022**		
Frequency(Hz)		**50,00**		
THD* (100% output power)		**0,811**		
Harmonics	**Current Magnitude (A)**	**% of Nominal current**	**Phase**	**Harmonic Current Limits (%)**
1st	26,010	-	Single Phase	N/A
2nd	0,031	0,121	Single Phase	8
3rd	0,181	0,697	Single Phase	21,6
4th	0,014	0,053	Single Phase	4
5th	0,071	0,272	Single Phase	10,7
6th	0,010	0,039	Single Phase	2,67
7th	0,034	0,129	Single Phase	7,2
8th	0,008	0,029	Single Phase	2
9th	0,018	0,071	Single Phase	3,8
10th	0,006	0,022	Single Phase	1,6
11th	0,016	0,060	Single Phase	3,1
12th	0,005	0,018	Single Phase	1,33
13th	0,018	0,070	Single Phase	2
14th	0,004	0,014	Single Phase	N/A
15th	0,019	0,073	Single Phase	N/A
16th	0,003	0,011	Single Phase	N/A
17th	0,020	0,078	Single Phase	N/A
18th	0,002	0,009	Single Phase	N/A
19th	0,019	0,074	Single Phase	N/A
20th	0,002	0,008	Single Phase	N/A
21th	0,019	0,072	Single Phase	N/A
22th	0,002	0,007	Single Phase	N/A
23th	0,018	0,070	Single Phase	N/A
24th	0,002	0,009	Single Phase	N/A
25th	0,016	0,061	Single Phase	N/A
26th	0,002	0,007	Single Phase	N/A
27th	0,015	0,060	Single Phase	N/A
28th	0,002	0,007	Single Phase	N/A
29th	0,015	0,056	Single Phase	N/A
30th	0,002	0,007	Single Phase	N/A
31th	0,013	0,050	Single Phase	N/A
32th	0,001	0,006	Single Phase	N/A
33th	0,012	0,048	Single Phase	N/A
34th	0,001	0,005	Single Phase	N/A
35th	0,011	0,044	Single Phase	N/A
36th	0,001	0,005	Single Phase	N/A
37th	0,010	0,038	Single Phase	N/A
38th	0,001	0,005	Single Phase	N/A
39th	0,010	0,038	Single Phase	N/A
40th	0,001	0,004	Single Phase	N/A

Note:
The tests should be based on the limits of the EN61000-3-2 for less than 16A and on EN 61000-3-12 for more than 16A.
The tests had been performed on the HYD 6000-EP and HYD 3000-EP are valid for the HYD 3680-EP, HYD 4000-EP and HYD 5000-EP since it is similar in hardware and just power derated by software.

5.8 Grid quality				**P**
Flicker				**P**
HYD 3000-EP				
Normal ambient				
Output power:	Flicker limits according to:	Result:		
		Plt	Pst	dc%
33%	EN 61000-3-3	0,151	0,153	0,064
66%	EN 61000-3-3	0,151	0,153	0,064
100%*	EN 61000-3-3	0,175	0,176	0,041
HYD 6000-EP				
Normal ambient				
Output power:	Flicker limits according to:	Result:		
		Plt	Pst	dc%
33%	EN 61000-3-11	0,121	0,124	0,068
66%	EN 61000-3-11	0,183	0,186	0,031
100%*	EN 61000-3-11	0,166	0,168	0,053

Note:

*The stationary deviance of dc% is bigger 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}| =0,625Ω)**

Bei Einphasigen Invertern Zmax sowie Rn und jxn angeben **R_n = 0,1Ω; jX_n=0,1Ω**

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

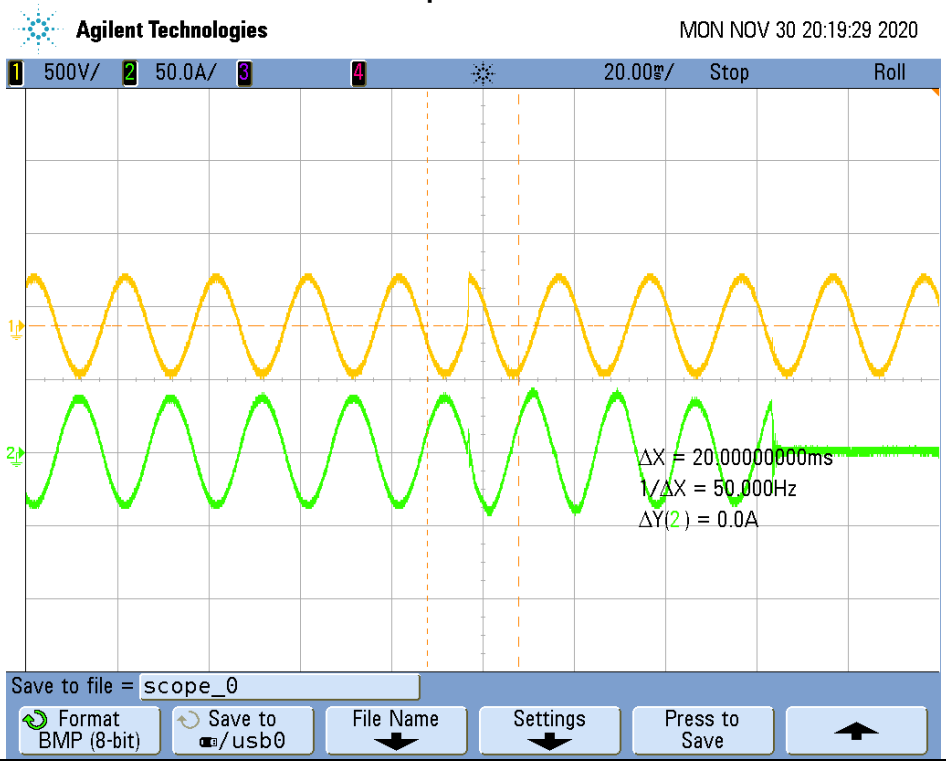
The tests should be based on the limits of the EN61000-3-3 for less than 16A and on EN 61000-3-11 for more than 16A.

The tests had been performed on the HYD 6000-EP and HYD 3000-EP are valid for the HYD 3680-EP, HYD 4000-EP and HYD 5000-EP since it is similar in hardware and just power derated by software.

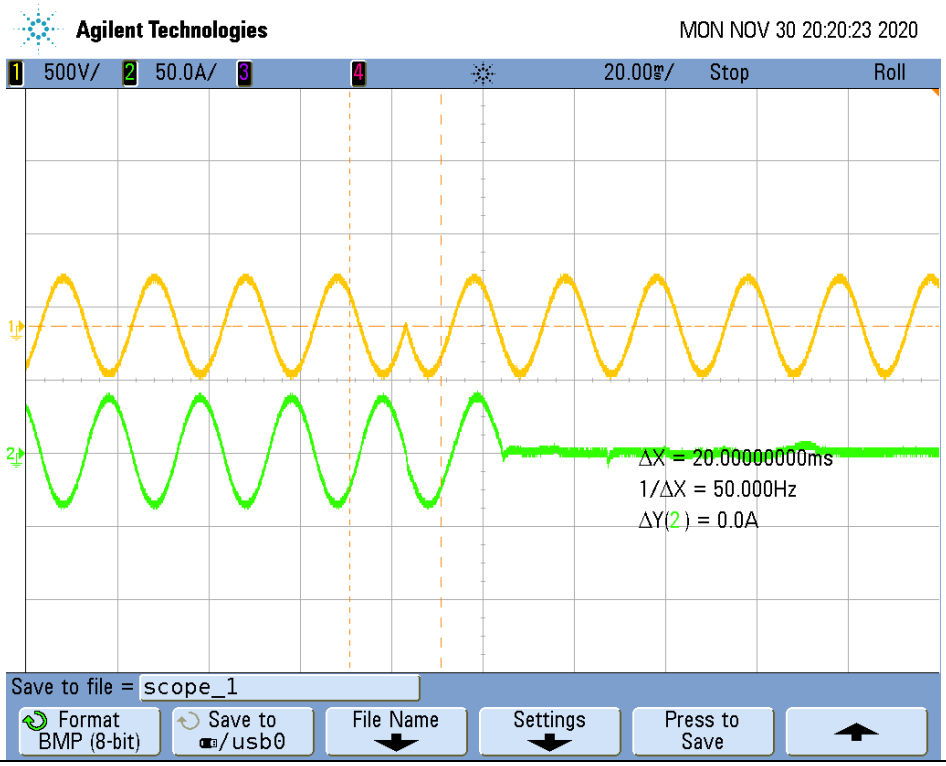
5.9 Out of Synchronism	P

Test results

90° phase shift



180° phase shift



Note:

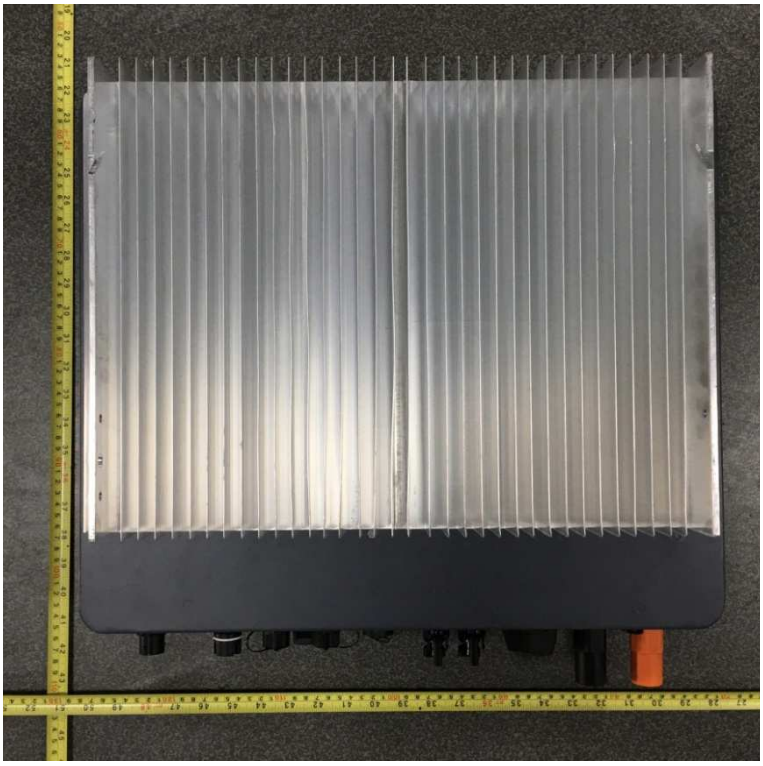
The simulator must be capable of producing a 90º and 180° phase shift in its output voltage.
The inverter must be operating at nominal power and unity power factor for at least 5 minutes.
Once the inverter is in steady state operation, following the above step, a transient is induced to produce a 180° phase shift in the simulator voltage Vr, The process is repeated for a 90º phase shift.
The test report shall state the phase shift to a tolerance of 1° and the inverter current for the period from 20 ms before to 200 ms after the phase shift was induced.
The tests had been performed on the GW5048D-ES are valid for the GW3648D-ES since it is same as in hardware and just power derated by software.

Annex 1

Pictures of the unit

The full pictures refer to PHOTO DOCUMENT
Project No.: 200917N016
Date: 2021-01-12

Enclosure front view

Enclosure rear view


Enclosure bottom view

Enclosure side view

Annex No. 2

Test Equipment list

Test Local: Bureau Veritas Shenzhen Co., Ltd. Dongguan Branch
Dates of performer test: 2020-09-17 to 2021-02-26

Equipment	Internal No.	Manufacturer	Type	Serial No.	Next Calibration date
Power Analyser	A4080002DG	YOKOGAWA	WT3000	91M210852	Jun. 16, 2021
AC Source	A7040019DG	Chroma	61512	61512000439	Monitored by Power Analyser
	A7040020DG	Chroma	61512	61512000438	
DC Simulation Power Supply	A7040015DG	Chroma	62150H-1000S	62150EF00488	
	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. 24, 2020
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	C820290908200 2110001	Mar. 02, 2021
Oscilloscope	//	Agilent	DS05014A	MY50070266	Jan. 05, 2022
Oscilloscope current probe	//	FLUKE	i1000S	29503223	Jan. 05, 2022
	//	FLUKE	iL000S	30413448	Jan. 05, 2022
	//	CYBERTEK	CP1000A	C181000929	Jan. 05, 2022
	//	CYBERTEK	CP1000A	C181000922	Jan. 05, 2022
	//	CYBERTEK	CP1000A	C191000141	Jan. 05, 2022
Oscilloscope voltage probe	//	SANHUA	SI-9110	152655	Jan. 05, 2022
	//	SANHUA	SI-9110	111134	Jan. 05, 2022
	//	SANHUA	SI-9110	111539	Jan. 05, 2022
	//	SIGLENT	DPB5150A	D15A150052	Jan. 05, 2022
	//	SIGLENT	DPB5150A	D15A200317	Jan. 05, 2022
	//	SIGLENT	DPB5150A	D15A200314	Jan. 05, 2022
	//	SIGLENT	DPB5150A	D15A150047	Jan. 05, 2022