TEST REPORT

Engineering Recommendation G83 Issue 2 Amendment 1 July 2018 Recommendations For The Connection Of Type Tested Small-Scale Embedded Generators (Up To 16A Per Phase) In Parallel With Low-Voltage Distribution Systems

Report reference No ..... :	180903078GZU-002
Tested by (printed name and signature) ..... :	Jason Fu Senior Project Engineer
Approved by (printed name and signature) ..... :	Tommy Zhong Assistant Technical Manager
Date of issue ..... :	10 Sep 2018
	25 pages
Testing Laboratory Name ..... :	Intertek Testing Services Shenzhen Ltd. Guangzhou Branch
Address ..... :	Block E, No.7-2 Guang Dong Software Science Park, Caipin Road, Guangzhou Science City, GETDD, Guangzhou, China
Testing location ..... :	Same as above
Address ..... :	Same as above
Applicant's Name ..... :	Shenzhen SOFAR SOLAR Co., Ltd.
Address ..... :	5/F, Building 4, Antongda Industrial Park, No.1 Liuxian Avenue. Xin'an Street , Bao'an District, Shenzhen, P.R, China
Test specification	
Standard..... :	G83 Issue 2 Amendment 1 : July 2018
Test procedure ..... :	Type approval
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	G83/2a
TRF originator . ..... :	Intertek
Master TRF ..... :	dated 2013-07
Test item description ..... :	Hybrid Inverter
Trademark ..... :	SOFAR SOLAR
Manufacturer ..... :	Same as applicant
Factory ..... :	Same as applicant
Model and/or type reference ..... :	HYD 3000-ES, HYD 3600-ES
Rating(s)..... :	Model: HYD 3000-ES Max. DC Input Voltage: 600Vdc Operating MPPT Voltage Range: 90Vdc – 580Vdc Max. PV Isc: 2 X 15A Battery Type: Lead-acid, Lithium-ion Battery Voltage Range: 42-58V

	Max. Charging Current: 65A Max. Discharging Current: 70A Max. Charging & Discharging Power: 3000VA Nominal Grid voltage: 230Vac Nominal Output Voltage (backup): 230Vac Max. output current: 13.7A Nominal Grid Frequency: 50Hz Power Factor: 1 (adjustable +/-0.8) Nominal output power: 3000VA Backup Rated current: 13.2A Backup Rated Apparent Power: 3000VA Ingress Protection: IP 65 Protective Class: I Operating temperature range: -25 — +60℃ Model: HYD 3600-ES Max. DC Input Voltage: 600Vdc Operating MPPT Voltage Range: 90Vdc – 580Vdc Max. PV Isc: 2 X 15A Battery Type: Lead-acid, Lithium-ion Battery Voltage Range: 42-58V Max. Charging Current: 65A Max. Discharging Current: 70A Max. Charging & Discharging Power: 3000VA Nominal Grid voltage: 230Vac Nominal Output Voltage (backup): 230Vac Max. output current: 16A Nominal Grid Frequency: 50Hz Power Factor: 1 (adjustable +/-0.8) Nominal output power: 3680VA Backup Rated current: 13.2A Backup Rated Apparent Power: 3000VA Ingress Protection: IP 65 Protective Class: I Operating temperature range: -25 — +60℃
Summary of testing: The sample(s) tested complied with the type test requirement of G83 Issue 2 Amendment 1 : July 2018	

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 .....:	03 Sep 2018
Date(s) of performance of test .....:	03 Sep 2018 – 07 Sep 2018

General remarks

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

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

When determining the test conclusion, the Measurement Uncertainty of test has been considered.

General product information:

The unit is a single-phase hybrid inverter, it can converts the high PV voltage and Grid voltage to low DC for charge battery, also converts PV voltage and battery voltage to AC output .

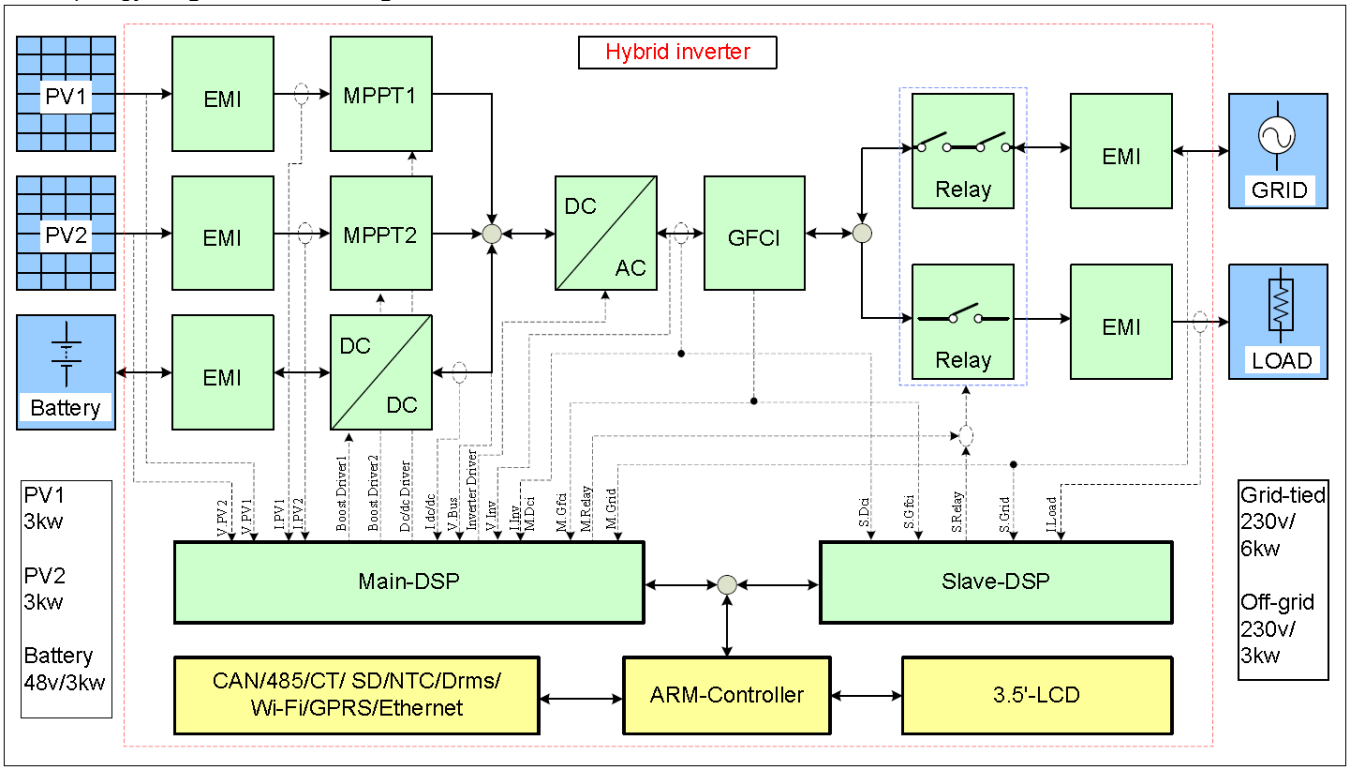
The unit is providing EMC filtering at the PV and battery side. It does provide galvanic separation from PV side to Grid. The battery circuit does provide high frequency isolation to PV side and AC mains.

The unit has two controllers. the master DSP controller monitor the charge or discharge statue; measure the PV voltage and current, battery voltage, bus voltage, buck voltage and current, AC voltage, current, GFCI and frequency.

The slave DSP controller monitor AC voltage , current ,frequency , GFCI and communicate with the master controller

The master DSP and slave DSP are used together to control relay open or close, if the single fault on one DSP, the other one DSP can be capable to open the relay, so that still providing safety means

The topology diagram as following:



Model differences:

Model HYD 3000-ES is identical with model HYD 3600-ES

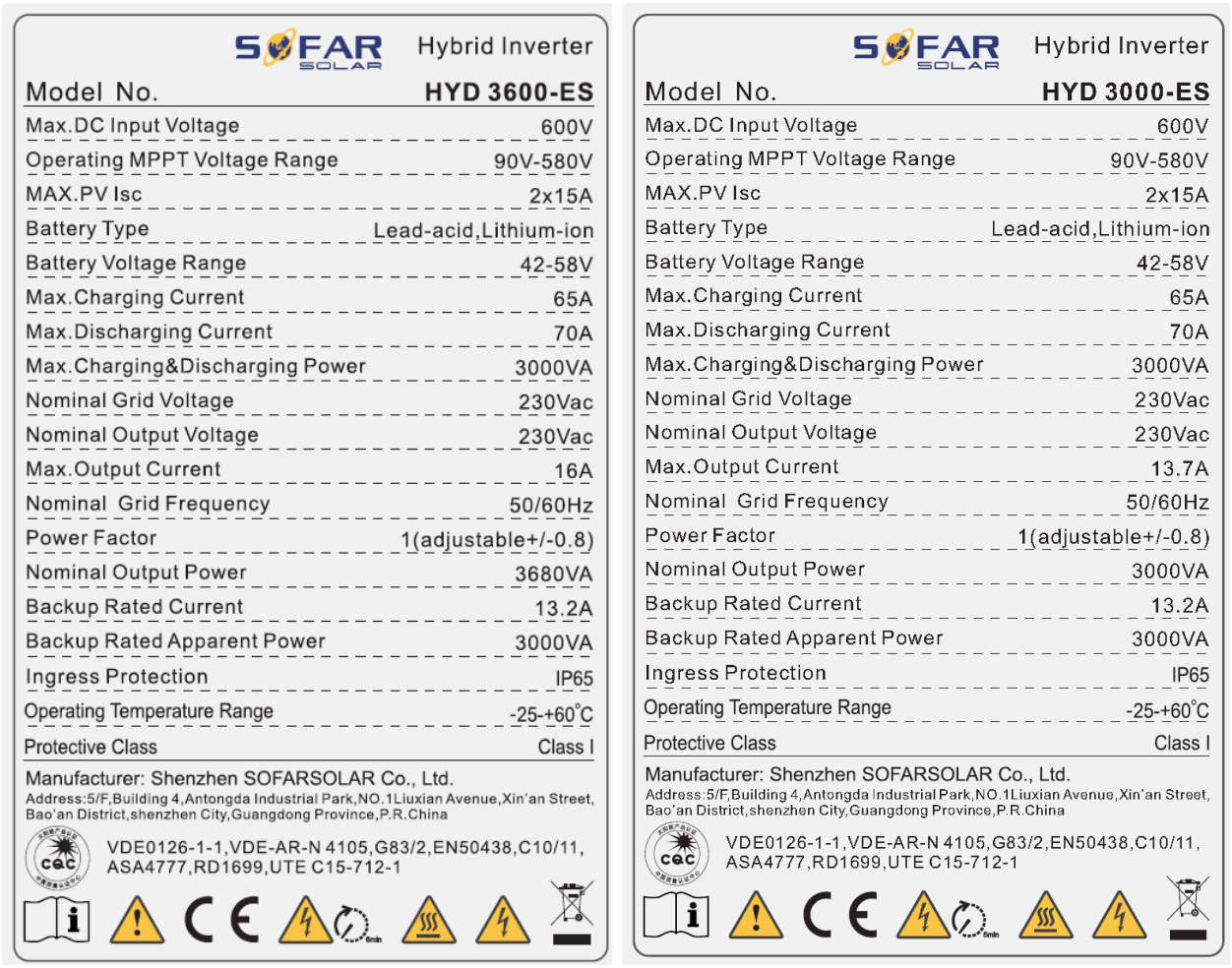
The product was tested on:

The Software version: V1.00

The Hardware version: V1.00

Other than special notes, typical model HYD 3600-ES used as representative for testing in this report.

Copy of marking plate:



SOFAR SOLAR Hybrid Inverter

Model No.	HYD 3600-ES
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90V-580V
MAX.PV Isc	2x15A
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58V
Max.Charging Current	65A
Max.Discharging Current	70A
Max.Charging&Discharging Power	3000VA
Nominal Grid Voltage	230Vac
Nominal Output Voltage	230Vac
Max.Output Current	16A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	3680VA
Backup Rated Current	13.2A
Backup Rated Apparent Power	3000VA
Ingress Protection	IP65
Operating Temperature Range	-25-+60°C
Protective Class	Class I

Manufacturer: Shenzhen SOFARSOLAR Co., Ltd.
Address:5/F,Building 4,Antongda Industrial Park,NO.1Liuxian Avenue,Xin'an Street, Bao'an District,shenzhen City,Guangdong Province,P.R.China

VDE0126-1-1,VDE-AR-N 4105,G83/2,EN50438,C10/11, ASA4777,RD1699,UTE C15-712-1

SOFAR SOLAR Hybrid Inverter

Model No.	HYD 3000-ES
Max.DC Input Voltage	600V
Operating MPPT Voltage Range	90V-580V
MAX.PV Isc	2x15A
Battery Type	Lead-acid,Lithium-ion
Battery Voltage Range	42-58V
Max.Charging Current	65A
Max.Discharging Current	70A
Max.Charging&Discharging Power	3000VA
Nominal Grid Voltage	230Vac
Nominal Output Voltage	230Vac
Max.Output Current	13.7A
Nominal Grid Frequency	50/60Hz
Power Factor	1(adjustable+/-0.8)
Nominal Output Power	3000VA
Backup Rated Current	13.2A
Backup Rated Apparent Power	3000VA
Ingress Protection	IP65
Operating Temperature Range	-25-+60°C
Protective Class	Class I

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VDE0126-1-1,VDE-AR-N 4105,G83/2,EN50438,C10/11, ASA4777,RD1699,UTE C15-712-1

Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation.

Engineering recommendation G83/2			
Clause	Requirement – Test	Result – Remark	Verdict
5	Connection, Protection & Testing Requirements		P
5.1	Connection Procedure		N/A
5.2	Installation Wiring and Isolation		N/A
5.3	Interface Protection	Integrated into SSEG	P
5.3.1	Interface Protection Settings and Test Requirements	See table 5.3.1	P
	Interface Protection shall be installed which disconnects the SSEG system from the DNO's Distribution System when any parameter is outside of the settings shown in Table 1.		P
	The total disconnection time for voltage and frequency protection including the operating time of the disconnection device shall be the trip delay setting with a tolerance of, -0 s + 0.5s.		P
	All settings shall be applied as shown in the above table, so that they can be inspected if required by the DNO to confirm that the settings are correct.		P
	Only devices that have protection settings set and locked during manufacture can be considered as Type Tested		P
	The Manufacturer needs to establish a secure way of displaying the settings in one of the following ways.	The way (b) applied	P
	a) A display on a screen which can be read; b) A display on a PC which can communicate with the device and confirm that it is the correct device by means of a serial number permanently fixed to the device and visible on the PC screen at the same time as the settings; c) Display of all settings including nominal voltage and current outputs, alongside the serial number of the device, permanently fixed to the device.		P
	The Manufacturer must ensure that the Interface Protection is capable of measuring voltage to an accuracy of ± 1.5% of the nominal value (± 3.45V) and of measuring frequency to ± 0.2% of the nominal value (± 0.1Hz) across its operating range of voltage, frequency and temperature.	See table 5.3.1	P
	In response to a protection operation the SSEG system shall be automatically disconnected from the DNO's Distribution System, this disconnection must be achieved preferably by the separation of mechanical contacts or alternatively by the operation of a suitably rated solid state switching device.	Two series relay	P
5.3.2	Loss of Mains Protection	See table 5.3.2	P
5.3.3	Frequency Drift and Step Change Stability Test	See table 5.3.3	P

Engineering recommendation G83/2			
Clause	Requirement – Test	Result – Remark	Verdict
5.3.4	Automatic Reconnection	See table 5.3.4	P
	the voltage and frequency on the DNO's Distribution System have remained within the limits of Table 1 for a minimum of 20 seconds		P
5.4	Quality of Supply		P
	the SSEG shall comply with the requirements of the EMC Directive and in particular the product family emission standards listed in Table 2.		P
5.4.1	Testing for Harmonic emissions	See table 5.4.1	P
5.4.2	Testing for flicker	See table 5.4.2	P
5.5	DC Injection	See table 5.5 and 5.6	P
	The upper limit for DC injection is 0.25% of AC current rating per phase		P
	Where necessary the DC emission requirements can also be satisfied by installing an isolating transformer between the Inverter and the connection to the DNO's Distribution System.		N/A
5.6	Power Factor	See table 5.5 and 5.6	P
	A power factor within the range 0.95 lagging to 0.95 leading	A Fixed power factor at range 0.95 lagging to 0.95 leading	P
5.7	Short Circuit Current Contribution	See table 5.7.2	--
5.7.1	Directly Coupled Generation	PV inverter	N/A
5.7.2	Inverter Connected Generation		P
5.8	Voltage Unbalance	Single phase	N/A
5.9	Certification Requirements		P
6	Operation and Safety	CE marking	P
6.1	Operational Requirements		N/A
6.2	Labelling		N/A
6.3	Maintenance & Routine Testing	This information including in the installation and user instructions	P
	Periodic testing of the SSEG is recommended at intervals prescribed by the Manufacturer. This information shall be included in the installation and User Instructions.		P
6.4	Earthing		N/A
7	Commissioning/Decommissioning and Acceptance Testing		N/A
Appendix 1	Connection Procedure Flow Chart		N/A
Appendix 2	Application for Connection		N/A
Appendix 3	SSEG Installation Commissioning Confirmation		N/A

Engineering recommendation G83/2			
Clause	Requirement – Test	Result – Remark	Verdict
Appendix 4	Type Verification Test Report		N/A
Appendix 5	SSEG Decommissioning Confirmation		N/A
Appendix 6	Relaxation of Commissioning Notification Timescales for SSEG: HSE Certificate of Exemption (August 2008)		N/A
Annex A1	Common Inverter Requirements.		P
A1.1	Certification & Type Testing SSEG Requirements		P
A1.2	CE Marking and Certification	A label with CE marking	P
A1.3	Type Verification Functional Testing of the Interface Protection		P
A1.3.1	Disconnection times		P
A1.3.2	Over / Under Voltage		P
A1.3.3	Over / Under Frequency		P
A1.3.4	Loss of Mains Protection		P
A1.3.5	Re-connection		P
A1.3.6	Frequency Drift and Step Change Stability test.		P
A1.4	POWER QUALITY		P
A1.4.1	Harmonics		P
A1.4.2	Power Factor		P
A1.4.3	Voltage Flicker		P
A1.4.4	DC Injection		P
A1.4.5	Overcurrent Protection		N/A
A1.4.6	Short Circuit Current Contribution		P
A1.4.7	Self-Monitoring - Solid State Disconnection		N/A
A1.4.8	Electromagnetic Compatibility (EMC)		P
Annex B1	Common Directly Coupled Connected SSEG Requirements		N/A
Annex C1	Separate Specific SSEG Technology Requirements		N/A
	C1.2 Photovoltaic		N/A
	C1.6 Energy Storage Device	Energy Storage Devices can be connected to DNO's Distribution System using inverters	P

Appendix 1: Testing table

Table 5.3.1 Protection. Frequency tests The requirement is specified in section 5.3.1, test procedure in Annex A						P
Function	Setting		Trip test			
	Frequency	Time delay	Frequency	Time delay	Frequency /time	Confirm no trip
U/F stage 1	47.5Hz	20s	47.49 Hz	20.25s	47.7Hz 25s	No trip
U/F stage 2	47Hz	0.5s	46.99Hz	0.602s	47.2Hz 19.98s	No trip
					46.8Hz 0.48s	No trip
O/F stage 1	51.5Hz	90s	51.5 Hz	90.40s	51.3Hz 95s	No trip
O/F stage 2	52Hz	0.5s	52.0 Hz	0.698s	51.8Hz 89.98s	No trip
					52.2Hz 0.48s	No trip
Operation of the under/over frequency protection will be demonstrated for an increase or decrease of frequency within ± 0.5% of the trip settings, e.g. for an Over Frequency setting of 50.5 Hz the permissible operating range is 50.5 ± 0.2525 Hz. The test frequency should be applied in steps of ± 0.5% of setting for a duration that is longer than the trip time delay, for example 1 second in the case of a delay setting of 0.5 second. The tests performed on model HYD 3600-ES, that are representable with HYD 3000-ES						

Appendix 1: Testing table

Table 5.3.1 (Continue) Protection. Voltage tests The requirement is specified in section 5.3.1, test procedure in Annex A or B 1.3.2						P
Function	Setting		Trip test		No trip tests	
	Voltage	Time delay	Voltage	Time delay	Voltage /time	Confirm no trip
U/V stage 1	200.1V	2.5s	199.0V	2.515s	204.1V 3.5s	No trip
U/V stage 2	184V	0.5s	183.0V	0.528s	188V 3.5s	No trip
					180V 0.48s	No trip
O/V stage 1	262.2V	1.0s	263.0V	1.011s	258.2V 2.0s	No trip
O/V stage 2	273.7V	0.5s	274.0V	0.516s	269.7V 0.98s	No trip
					277.7V 0.48s	No trip
Note for Voltage tests the Voltage required to trip is the setting ±3.45V. The time delay can be measured at a larger deviation than the minimum required to operate the protection. The No trip tests need to be carried out at the setting ±4V and for the relevant times as shown in the table above to ensure that the protection will not trip in error. The tests performed on model HYD 3600-ES, that are representable with HYD 3000-ES						

Appendix 1: Testing table

Table 5.3.2 Protestion.Loss of Mains (LoM) detection **The requirement is specified in section 5.3.2, test procedure in Annex A** **as an alternative, inverters can be tested to BS EN 62116.** **Model: HYD 3600-ES**									**P**
No.	PEUT[1)] (% of EUT rating)	Reactive load (% of QL in 6.1.d)1)	PAC[2)] (% of nominal)	QAC[3)] (% of nominal)	Run on time (ms)	PEUT (KW)	Actual Qf	VDC	Remarks[4)]
1	100	100	0	0	280.0	3.540	1.00	550	Test A at BL
2	66	66	0	0	420.0	2.345	0.99	340	Test B at BL
3	33	33	0	0	265.2	1.208	1.01	130	Test C at BL
4	100	100	-5	-5	218.4	3.540	0.97	550	Test A at IB
5	100	100	-5	0	256.2	3.540	0.95	550	Test A at IB
6	100	100	-5	5	197.0	3.540	0.93	550	Test A at IB
7	100	100	0	-5	270.4	3.540	1.02	550	Test A at IB
8	100	100	0	5	202.8	3.540	0.97	550	Test A at IB
9	100	100	5	-5	238.8	3.540	1.08	550	Test A at IB
10	100	100	5	0	213.0	3.540	1.05	550	Test A at IB
11	100	100	5	5	247.8	3.540	1.03	550	Test A at IB
12	66	66	0	-5	203.7	2.345	1.03	340	Test B at IB
13	66	66	0	-4	290.4	2.345	1.02	340	Test B at IB
14	66	66	0	-3	279.9	2.345	1.01	340	Test B at IB
15	66	66	0	-2	287.1	2.345	1.01	340	Test B at IB
16	66	66	0	-1	206.4	2.345	1.01	340	Test B at IB
17	66	66	0	1	300.6	2.345	0.99	340	Test B at IB
18	66	66	0	2	243.6	2.345	0.98	340	Test B at IB
19	66	66	0	3	282.4	2.345	0.98	340	Test B at IB
20	66	66	0	4	256.6	2.345	0.98	340	Test B at IB
21	66	66	0	5	220.5	2.345	0.97	340	Test B at IB
22	33	33	0	-5	181.6	1.208	1.02	130	Test C at IB
23	33	33	0	-4	253.4	1.208	1.02	130	Test C at IB
24	33	33	0	-3	279.2	1.208	1.01	130	Test C at IB
25	33	33	0	-2	185.0	1.208	1.00	130	Test C at IB
26	33	33	0	-1	258.3	1.208	1.00	130	Test C at IB
27	33	33	0	1	225.0	1.208	1.00	130	Test C at IB
28	33	33	0	2	256.9	1.208	0.99	130	Test C at IB
29	33	33	0	3	242.9	1.208	0.99	130	Test C at IB
30	33	33	0	4	242.2	1.208	0.99	130	Test C at IB
31	33	33	0	5	239.4	1.208	0.99	130	Test C at IB

Appendix 1: Testing table

Table 5.3.3 Protection. Frequency change, Stability test The requirement is specified in section 5.3.3, test procedure in Annex A or B 1.3.6				P
	Start Frequency	Change	End Frequency	Confirm no trip
Positive Vector Shift	49.5Hz	+50degrees		No trip
Negative Vector Shift	50.5Hz	- 50 degrees		No trip
	Ramp range	Test frequency ramp	Test Duration	Confirm no trip
Positive Frequency drift	49.0Hz to 51.0Hz	+0.95Hz/sec	2.1s	No trip
Negative Frequency drift	51.0Hz to 49.0Hz	-0.95Hz/sec	2.1s	No trip

Table 5.3.4 Protection. Re-connection timer. The requirement is specified in section 5.3.4, test procedure in Annex A or B 1.3.5						P
Test should prove that the reconnection sequence starts after a minimum delay of 20 seconds for restoration of voltage and frequency to within the stage 1 settings of table 1.						
Time delay setting	Measured delay	Checks on no reconnection when voltage or frequency is brought to just outside stage 1 limits of table 1.				
20s	25.0s	At 266.2V	At 196.1V	At 47.4Hz	At 51.6Hz	
Confirmation that the SSEG does not re-connect.		Not reconnection	Not reconnection	Not reconnection	Not reconnection	

Table 5.4.1 Harmonics Model: HYD 3600-ES						P
SSEG rating per phase (rpp)			3.680kW		NV=MV*3.68/rpp	
Harmonic	At 45-55% of rated output		100% of rated output			
	Measured Value (MV)	Normalised Value (NV)	Measured Value (MV)	Normalised Value (NV)	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.0045	0.0045	0.0019	0.0019	1.080	
3	0.1550	0.1550	0.1821	0.1821	2.300	
4	0.0010	0.0010	0.0061	0.0061	0.430	
5	0.0596	0.0596	0.0518	0.0518	1.140	
6	0.0005	0.0005	0.0136	0.0136	0.300	

Appendix 1: Testing table

7	0.0350	0.0350	0.0409	0.0409	0.770	
8	0.0007	0.0007	0.0078	0.0078	0.230	
9	0.0179	0.0179	0.0122	0.0122	0.400	
10	0.0012	0.0012	0.0038	0.0038	0.184	
11	0.0069	0.0069	0.0064	0.0064	0.330	
12	0.0001	0.0001	0.0107	0.0107	0.153	
13	0.0027	0.0027	0.0072	0.0072	0.210	
14	0.0009	0.0009	0.0058	0.0058	0.131	
15	0.0004	0.0004	0.0090	0.0090	0.150	
16	0.0004	0.0004	0.0028	0.0028	0.115	
17	0.0030	0.0030	0.0138	0.0138	0.132	
18	0.0004	0.0004	0.0065	0.0065	0.102	
19	0.0052	0.0052	0.0072	0.0072	0.118	
20	0.0002	0.0002	0.0026	0.0026	0.092	
21	0.0060	0.0060	0.0138	0.0138	0.107	0.160
22	0.0007	0.0007	0.0030	0.0030	0.084	
23	0.0071	0.0071	0.0139	0.0139	0.098	0.147
24	0.0011	0.0011	0.0063	0.0063	0.077	
25	0.0083	0.0083	0.0101	0.0101	0.090	0.135

Appendix 1: Testing table

26	0.0011	0.0011	0.0032	0.0032	0.071	
27	0.0073	0.0073	0.0146	0.0146	0.083	0.124
28	0.0012	0.0012	0.0026	0.0026	0.066	
29	0.0075	0.0075	0.0127	0.0127	0.078	0.117
30	0.0008	0.0008	0.0060	0.0060	0.061	
31	0.0073	0.0073	0.0127	0.0127	0.073	0.109
32	0.0003	0.0003	0.0020	0.0020	0.058	
33	0.0080	0.0080	0.0126	0.0126	0.068	0.102
34	0.0017	0.0017	0.0089	0.0089	0.054	
35	0.0082	0.0082	0.0109	0.0109	0.064	0.096
36	0.0009	0.0009	0.0140	0.0140	0.051	
37	0.0074	0.0074	0.0118	0.0118	0.061	0.091
38	0.0002	0.0002	0.0139	0.0139	0.048	
39	0.0078	0.0078	0.0124	0.0124	0.058	0.087
40	0.0036	0.0036	0.0443	0.0443	0.046	

Model: HYD 3000-ES						P
SSEG rating per phase (rpp)			3.000kW		NV=MV*3.68/rpp	
Harmonic	At 45-55% of rated output		100% of rated output			
	Measured Value (MV)	Normalised Value (NV)	Measured Value (MV)	Normalised Value (NV)	Limit in BS EN 61000-3-2 in Amps	Higher limit for odd harmonics 21 and above
2	0.0087	0.0107	0.0026	0.0032	1.080	

Appendix 1: Testing table

3	0.1455	0.1785	0.1697	0.2082	2.300	
4	0.0009	0.0011	0.0037	0.0045	0.430	
5	0.0621	0.0762	0.0629	0.0772	1.140	
6	0.0010	0.0012	0.0027	0.0033	0.300	
7	0.0320	0.0393	0.0290	0.0356	0.770	
8	0.0008	0.0010	0.0023	0.0028	0.230	
9	0.0174	0.0213	0.0150	0.0184	0.400	
10	0.0015	0.0018	0.0018	0.0022	0.184	
11	0.0080	0.0098	0.0058	0.0071	0.330	
12	0.0013	0.0016	0.0024	0.0029	0.153	
13	0.0030	0.0037	0.0017	0.0021	0.210	
14	0.0011	0.0013	0.0008	0.0010	0.131	
15	0.0010	0.0012	0.0042	0.0052	0.150	
16	0.0008	0.0010	0.0006	0.0007	0.115	
17	0.0027	0.0033	0.0049	0.0060	0.132	
18	0.0003	0.0004	0.0004	0.0005	0.102	
19	0.0049	0.0060	0.0082	0.0101	0.118	
20	0.0003	0.0004	0.0011	0.0013	0.092	
21	0.0054	0.0066	0.0089	0.0109	0.107	0.160

Appendix 1: Testing table

22	0.0013	0.0016	0.0023	0.0028	0.084	
23	0.0058	0.0071	0.0097	0.0119	0.098	0.147
24	0.0004	0.0005	0.0007	0.0009	0.077	
25	0.0063	0.0077	0.0100	0.0123	0.090	0.135
26	0.0003	0.0004	0.0010	0.0012	0.071	
27	0.0074	0.0091	0.0094	0.0115	0.083	0.124
28	0.0006	0.0007	0.0015	0.0018	0.066	
29	0.0069	0.0085	0.0100	0.0123	0.078	0.117
30	0.0009	0.0011	0.0028	0.0034	0.061	
31	0.0072	0.0088	0.0101	0.0124	0.073	0.109
32	0.0009	0.0011	0.0007	0.0009	0.058	
33	0.0076	0.0093	0.0098	0.0120	0.068	0.102
34	0.0026	0.0032	0.0043	0.0053	0.054	
35	0.0073	0.0090	0.0100	0.0123	0.064	0.096
36	0.0005	0.0006	0.0055	0.0067	0.051	
37	0.0072	0.0088	0.0094	0.0115	0.061	0.091
38	0.0007	0.0009	0.0036	0.0044	0.048	
39	0.0074	0.0091	0.0100	0.0123	0.058	0.087
40	0.0047	0.0058	0.0245	0.0301	0.046	
Note: the higher limits for odd harmonics 21 and above are only allowable under certain conditions, if these higher limits are utilised please state the exemption used as detailed in part 6.2.3.4 of BS EN						

Appendix 1: Testing table

61000-3-2 in the box below.

Power Quality. Voltage fluctuations and Flicker. The requirement is specified in section 5.4.2, test procedure in Annex A or B 1.4.3								
	Starting			Stopping			Running	
	d_{max}	d_c	$d_{(t)}$	d_{max}	d_c	$d_{(t)}$	P_{st}	P_{lt} 2 hours
Measured Values(%)	1.00	0.55	0.00	1.00	0.55	0.00	0.23	0.23
Normalised to standard impedance and 3.68kW for multiple units(%)	100%	100%	100%	100%	100%	100%	100%	100%
Limits set under BS EN 61000-3-2	4%	3.3%	3.3% 500ms	4%	3.3%	3.3% 500ms	1.0	0.65

Appendix 1: Testing table

Table 5.5 and 5.6 Model: HYD 3600-ES						P
G83/2 Limit	**DC injection**			**Power factor**		
	0.25%, tested at three power levels			0.95 lag– 0.95 lead at three voltage levels, Measured at three voltage levels and at full output. Voltage to be maintained within ±1.5% of the stated level during the test.		
Test level	10%	55%	100%	216.2V	230V	253V
Test value	0.0018	0.0033	0.0029	0.9985	0.9983	0.9977
Model: HYD 3000-ES						P
G83/2 Limit	**DC injection**			**Power factor**		
	0.25%, tested at three power levels			0.95 lag– 0.95 lead at three voltage levels, Measured at three voltage levels and at full output. Voltage to be maintained within ±1.5% of the stated level during the test.		
Test level	10%	55%	100%	216.2V	230V	253V
Test value	0.0016	0.0009	0.0011	0.9980	0.9977	0.9968

Appendix 1: Testing table

Table 5.7 Fault level contribution. The requirement is specified in section 5.7, test procedure in Annex A or B 1.4.6		
For an Inverter SSEG.		
Time after fault	Volts	Amps
20ms	157.6V	40.22A
100ms	--	--
250ms	--	--
500ms	--	--
Time to trip	81.6ms	

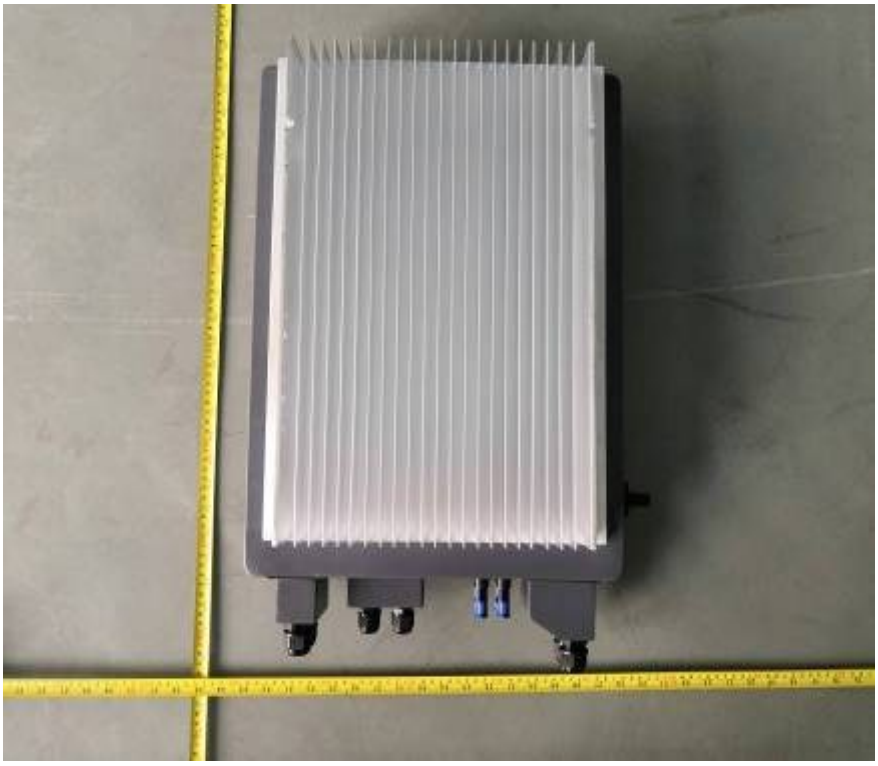
SELF MONITORING – SOLID STATE SWITCHING	
Test	**N/A**
It has been verified that in the event of the solid state switching device failing to disconnect the SSEG, the voltage on the output side of the switching device is reduced to a value below 50 volt within 0.5 sec.	**No** **(mechanical relays used)**

Appendix 2: Photos

Overview

Overview

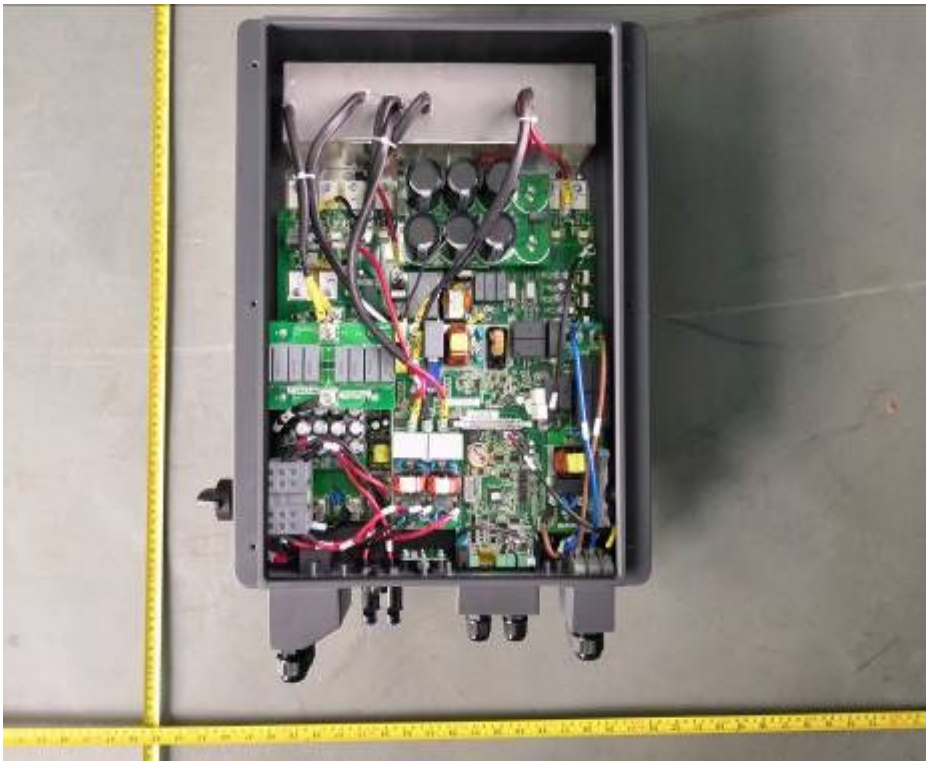
Appendix 2: Photos



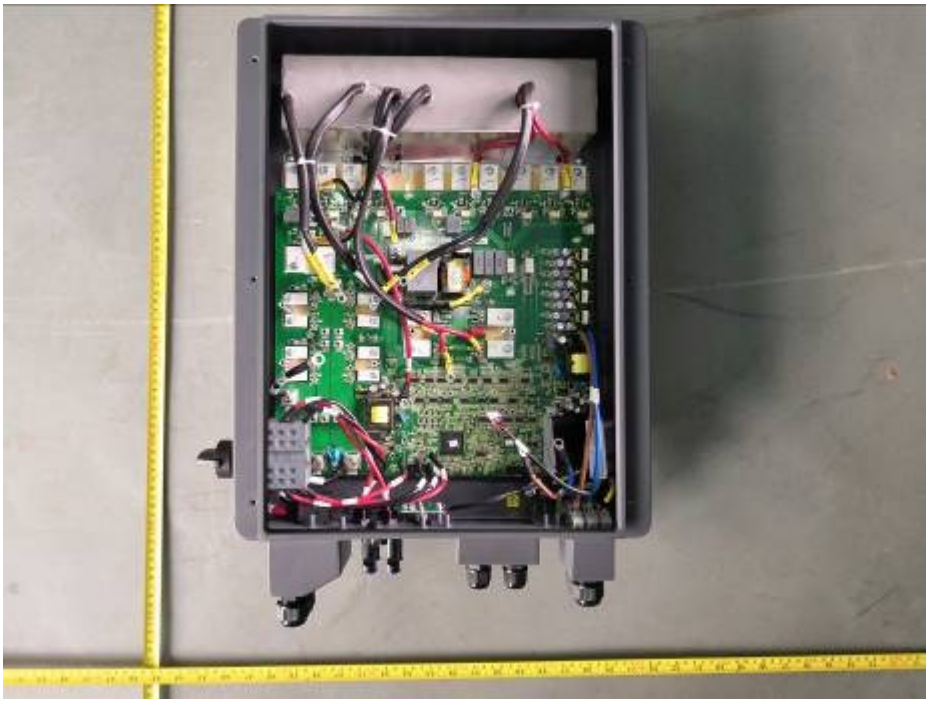
Bottom view

Connection terminal view

Appendix 2: Photos



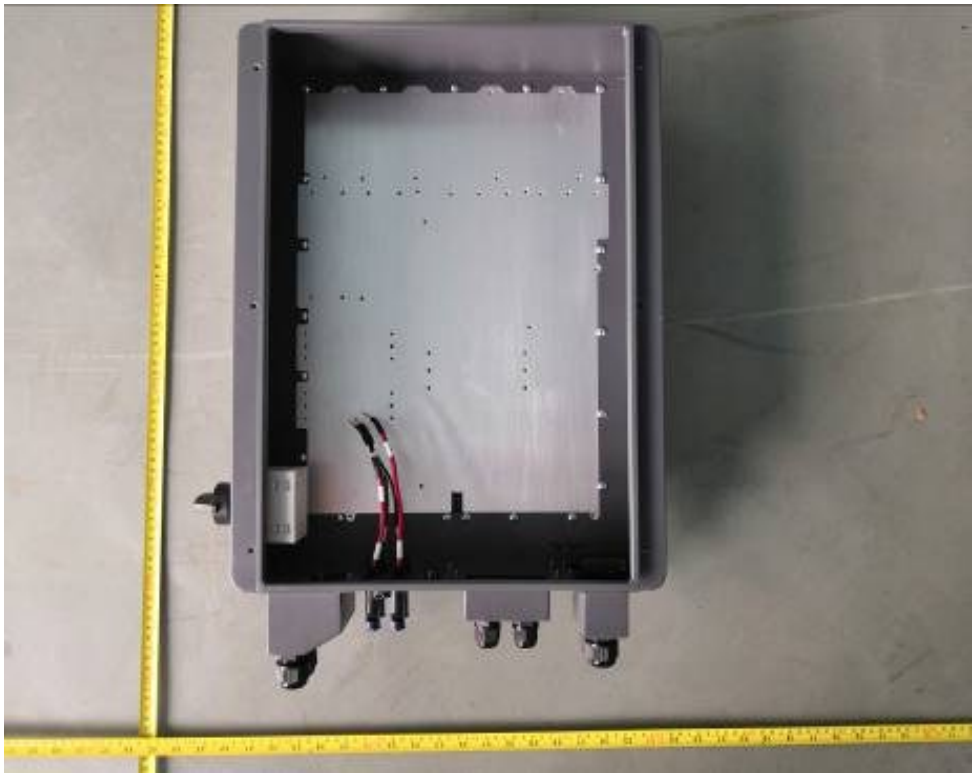
Internal view



Internal view

Appendix 2: Photos

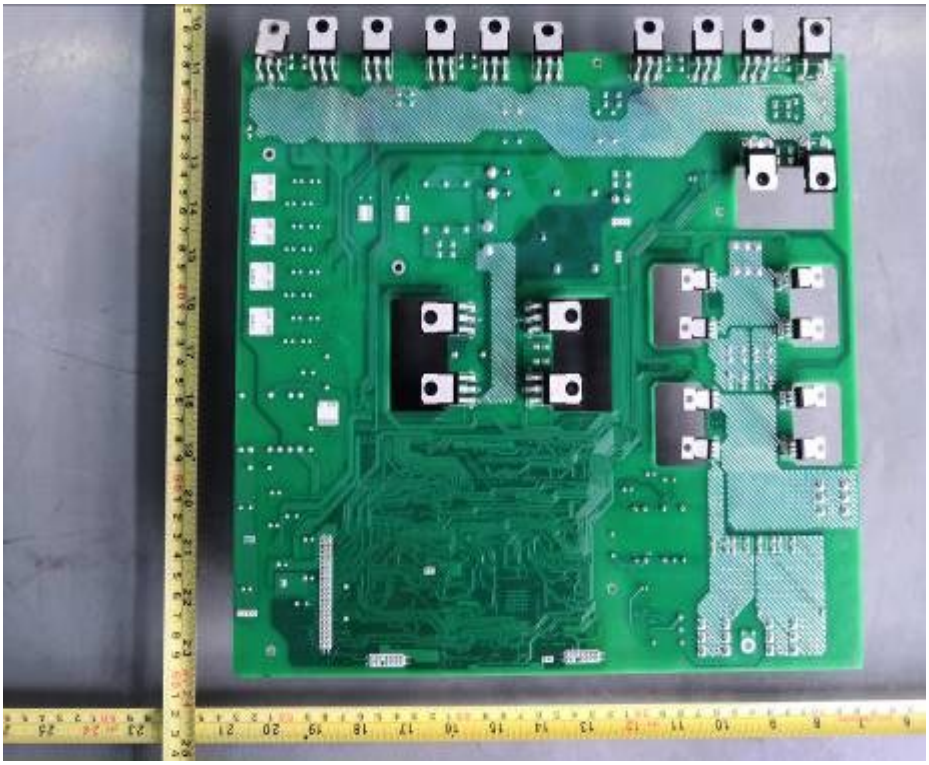
Earthing view



Internal view

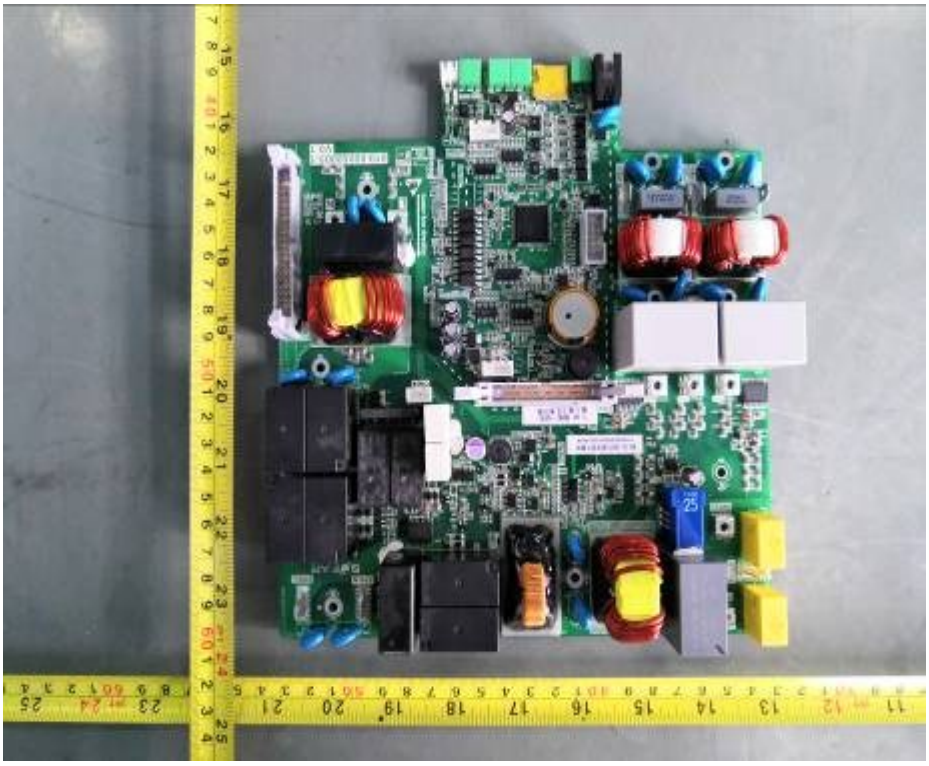
Appendix 2: Photos

Power board view (Components side)

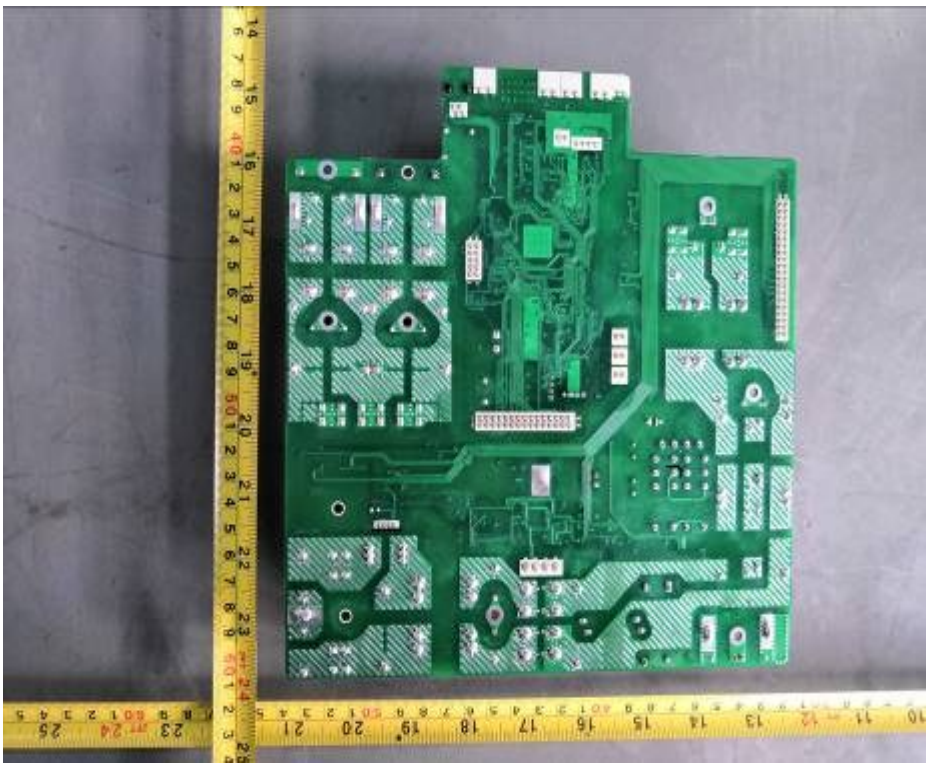


Power board view (Soldered side)

Appendix 2: Photos



Input/output and connection board view (Components side)



Input/output and connection board view (Soldered side)

(End of Report)