

Prüfbericht-Nr.: <i>Test report no.:</i>	CN21F3AS 002	Auftrags-Nr.: <i>Order no.:</i>	244453306	Seite 1 von 9 Page 1 of 9
Kunden-Referenz-Nr.: <i>Client reference no.:</i>	2044868	Auftragsdatum: <i>Order date:</i>	2022-09-30	
Auftraggeber: <i>Client:</i>	Hanwha Solutions Corporation 86 Cheonggyecheon-ro, Jung-gu, Seoul, 04541, Republic of Korea			
Prüfgegenstand: <i>Test item:</i>	Hybrid Inverter			
Bezeichnung / Typ-Nr.: <i>Identification / Type no.:</i>	Q.VOLT H4.6S, Q.VOLT H5S, Q.VOLT A4.6S, Q.VOLT A5S			
Auftrags-Inhalt: <i>Order content:</i>	AK certificate			
Prüfgrundlage: <i>Test specification:</i>	G99/1-8/09.21 Type A Requirements for the connection of generation equipment in parallel with public distribution networks on or after 27 April 2019			
Wareneingangsdatum: <i>Date of sample receipt:</i>	2022-09-30			
Prüfmuster-Nr.: <i>Test sample no.:</i>	A003357821-001			
Prüfzeitraum: <i>Testing period:</i>	2022-09-30 – 2022-10-06			
Ort der Prüfung: <i>Place of testing:</i>	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüflaboratorium: <i>Testing laboratory:</i>	TÜV Rheinland (Shanghai) Co., Ltd.			
Prüfergebnis*: <i>Test result*:</i>	Pass			
geprüft von: <i>tested by:</i>			genehmigt von: <i>authorized by:</i>	
Datum: <i>Date:</i>	2022-10-07		Ausstellungsdatum: <i>Issue date:</i>	2022-10-07
Stellung / Position:	Project Engineer		Stellung / Position:	Reviewer
Sonstiges / Other:	This report is based on the report CN21F3AS 001 to update the standard from G99/1-6 to G99/1-8. And this product is only tested according to Type A of G99/1-8/09.21 on this test report. The compliance of cyber security refer to the manufacturer 's declaration for detail.			
Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i>	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* Legende: P(ass) = entspricht o.g. Prüfgrundlage(n) F(ail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet * Legend: P(ass) = passed a.m. test specification(s) F(ail) = failed a.m. test specification(s) N/A = not applicable N/T = not tested				
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the above mentioned test sample as. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.</i>				

V05

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Liste der verwendeten Prüfmittel
List of used test equipment

Equip.	Description	Model	Manufacturer
9017073	Power Analyser(DEWETRON)	DEWE2-PA7	Austria, DEWETRON
9017074	Current Sensor(For WT3000)	IT 200-S	LEM
9017075	Current Sensor(For WT3000)	IT 200-S	LEM
9017076	Current Sensor(For WT3000)	IT 200-S	LEM
9017077	Current Sensor(For WT3000)	IT 200-S	LEM
9017078	Programmable AC Source(61860)	61860	Chroma ATE INC.
9017080	Oscilloscope	MDO3024	Tektronix
G1819265	ScopeCoder	DL850	JAPAN, Yokogawa
G1819266	Power Analyser(WT3000)	WT3000	JAPAN, Yokogawa
G1819268	Anti-islanding test detection devices	ACLT-4830H	QUNLING Energy Resources
G1819277	PV array simulator	62150H-1000S	Chroma Co.
G1819278	PV array simulator	62150H-1000S	Chroma Co.
G1819279	PV array simulator	62150H-1000S	Chroma Co.
G1819280	PV array simulator	62150H-1000S	Chroma Co.

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Produktbeschreibung Product description

Copy of marking plate:

ENGINEERED, DESIGNED AND QUALITY TESTED BY Q CELLS IN KOREA

PRODUCT NAME: Q.VOLT H4.6S

Q CELLS

MADE IN KOREA

DC (Photovoltaic Module Input)	Max. Voltage	[V]	600
	Rated Input Voltage	[V]	550
AC (Input)	MPPT Range	[V]	90 - 550
	Max. PV Current Per String ImpP / Isc	[A]	15 / 20
AC (Output)	AC Nominal Voltage / Frequency	[V] [Hz]	230 50, 60
	Max. / Rated Current	[A]	41 33 (Bypass)
AC (Output)	AC Nominal Power	[kW]	5 (4.6 for DE)
	Max. / Rated Apparent Power	[kVA]	5 (4.6 for DE)
AC (Output)	AC Nominal Voltage / Frequency	[V] [Hz]	230 50, 60
	Max. / Rated Current	[A]	25 / 21.7 (25 / 20 for DE)
LOAD (Output)	Power Factor		0.95 lagging to 0.95 leading
	AC Nominal Active Power Pn / Max	[kW]	5 (4.6 for DE)
DC (Battery)	AC Nominal Voltage / Frequency	[V] [Hz]	230 50, 60
	Max. / Rated Current	[A]	25 / 21.7 (25 / 20 for DE)
DC (Battery)	Rated Input Voltage	[Vdc]	202.8
	Max. DC Current	[A]	20
Operating Temperature		[°C]	-20 - 60
Battery Type		Rechargeable Li-Ion	
Inverter topology		Non-isolated	
Ingress Protection		IP65	
Over Voltage Category		OVC II (DC) / OVC III (AC)	
Protective Class		I	
DRM 0 [X]		DRM 1 [X]	
DRM 2 [X]		DRM 3 [X]	
DRM 4 [X]		DRM 5 [X]	
DRM 6 [X]		DRM 7 [X]	
DRM 8 [X]			

VDE-AR-N 4105:2018, CE, IEC 62109-1, IEC 62109-2, IEC 62619, IEC 62477-1
EN 61000-6-2, EN 61000-6-3, IEC 60068-2-52, EN 60730-1 ANNEX.H, IEC 60529

Warning
Warning dust supply

**Do not work on this equipment until it is isolated
from both mains and on-site generation supplies**

Isolate on site Generating Unit at _____
Isolate mains supply at _____

Mfg Date & No. _____

QR Code
to Manual

Hanwha Q CELLS GmbH
Sonnenallee 17-21 Bitterfeld-Wolfen OT Thalheim, 06766 Germany
WEB www.q-cells.eu

Description for LED Indicator

● Error	● Off Grid Operation	● Offline Mode	● Firmware Upgrade
● Setting Status	● All Operation Paused	● Online Mode	

ENGINEERED, DESIGNED AND QUALITY TESTED BY Q CELLS IN KOREA

PRODUCT NAME: Q.VOLT H5S

Q CELLS

MADE IN KOREA

DC (Photovoltaic Module Input)	Max. Voltage	[V]	600
	Rated Input Voltage	[V]	550
AC (Input)	MPPT Range	[V]	90 - 550
	Max. PV Current Per String ImpP / Isc	[A]	15 / 20
AC (Output)	AC Nominal Voltage / Frequency	[V] [Hz]	230 50, 60
	Max. Current	[A]	41
AC (Output)	AC Nominal Power	[kW]	5.0
	Max. / Rated Apparent Power	[kVA]	5.0
AC (Output)	AC Nominal Voltage / Frequency	[V] [Hz]	230 50, 60
	Max. Current	[A]	25
LOAD (Output)	Power Factor		0.8 lagging to 0.8 leading
	AC Nominal Active Power Pn / Max	[kW]	5.0
DC (Battery)	AC Nominal Voltage / Frequency	[V] [Hz]	230 50, 60
	Max. / Rated Current	[A]	25
DC (Battery)	Rated Input Voltage	[Vdc]	202.8
	Max. DC Current	[A]	20
Operating Temperature		[°C]	-20 - 60
Battery Type		Rechargeable Li-Ion	
Inverter topology		Non-isolated	
Ingress Protection		IP65	
Over Voltage Category		OVC II (DC) / OVC III (AC)	
Protective Class		I	
DRM 0 [X]		DRM 1 [X]	
DRM 2 [X]		DRM 3 [X]	
DRM 4 [X]		DRM 5 [X]	
DRM 6 [X]		DRM 7 [X]	
DRM 8 [X]			

AS/NZS 4777.2:2020, CE, IEC 62109-1, IEC 62109-2, IEC 62619, IEC 62477-1
EN 61000-6-3, AS62040-1, IEC 60068.2-52, EN 60730-1 ANNEX.H, IEC 60529

Warning
Warning dust supply

**Do not work on this equipment until it is isolated
from both mains and on-site generation supplies**

Isolate on site Generating Unit at _____
Isolate mains supply at _____

Mfg Date & No. _____

QR Code
to Manual

Hanwha Q CELLS Australia Pty Ltd
Suite 1, Level 1, 15 Blue Street, North Sydney, NSW 2060 Australia
TEL 1 800 Q CELLS or 02 9016 3033
WEB www.q-cells.com/au

Description for LED Indicator

● Error	● Off Grid Operation	● Offline Mode	● Firmware Upgrade
● Setting Status	● All Operation Paused	● Online Mode	

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Produktbeschreibung
Product description

ENGINEERED, DESIGNED AND QUALITY TESTED BY Q CELLS IN KOREA

PRODUCT NAME: Q.VOLT A4.6S

Q CELLS

MADE IN KOREA

	AC Nominal Voltage / Frequency	[V]	230 50, 60
	Max. / Rated Current	[A]	41 33 (Bypass)
	AC Nominal Power	[kW]	5 (4.6 for DE)
	Max. / Rated Apparent Power	[kVA]	5 (4.6 for DE)
	AC Nominal Voltage / Frequency	[V]	230 50, 60
	Max. / Rated Current	[A]	25 / 21.7 (25 / 20 for DE)
	Power Factor		0.95 lagging to 0.95 leading
	AC Nominal Active Power Pn / Max	[kW]	5 (4.6 for DE)
	AC Nominal Voltage / Frequency	[V]	230 50, 60
	Max. / Rated Current	[A]	25 / 21.7 (25 / 20 for DE)
	Rated Input Voltage	[Vdc]	202.8
	Max. DC Current	[A]	20
Operating Temperature [°C] -20 - 60			
Battery Type Rechargeable Li-Ion			
Inverter topology Non-isolated			
Ingress Protection IP65			
Over Voltage Category OVC III			
Protective Class I			

VDE-AR-N 4105:2018, CE, IEC 62109-1, IEC 62109-2, IEC 62619, IEC 62477-1
EN 61000-6-2, EN 61000-6-3, IEC 60068-2-52, EN 60730-1 ANNEX.H, IEC 60529

 **Warning dual supply**  **Do not work on this equipment until it is isolated from both mains and on-site generation supplies**

Isolate on site Generating Unit at _____
Isolate mains supply at _____

Mfg Date & No. _____

QR Code to Manual 

Hanwha Q CELLS GmbH
Sonnenallee 17-21 Bitterfeld-Wolfen OT Thelheim, 06766 Germany
WEB www.q-cells.eu

Description for LED Indicator

 Error	 Off Grid Operation	 Offline Mode	 Firmware Upgrade
 Setting Status	 All Operation Paused	 Online Mode	

ENGINEERED, DESIGNED AND QUALITY TESTED BY Q CELLS IN KOREA

PRODUCT NAME: Q.VOLT A5S

Q CELLS

MADE IN KOREA

	AC Nominal Voltage / Frequency	[V]	230 50, 60
	Max. Current	[A]	41
	AC Nominal Power	[kW]	5.0
	Max. / Rated Apparent Power	[kVA]	5.0
	AC Nominal Voltage / Frequency	[V]	230 50, 60
	Max. Current	[A]	25
	Power Factor		0.8 lagging to 0.8 leading
	AC Nominal Active Power Pn / Max	[kW]	5.0
	AC Nominal Voltage / Frequency	[V]	230 50, 60
	Max. Current	[A]	25
	Rated Input Voltage	[Vdc]	202.8
	Max. DC Current	[A]	20
Operating Temperature [°C] -20 - 60			
Battery Type Rechargeable Li-Ion			
Inverter topology Non-isolated			
Ingress Protection IP65			
Over Voltage Category OVC III			
Protective Class I			

DRM 0 [X] DRM 1 [X] DRM 2 [X] DRM 3 [X] DRM 4 [X]
DRM 5 [X] DRM 6 [X] DRM 7 [X] DRM 8 [X]

AS/NZS 4777.2:2020, CE, IEC 62109-1, IEC 62109-2, IEC 62619, IEC 62477-1
EN 61000-6-3, AS62040-1, IEC 60068.2-52, EN 60730-1 ANNEX.H, IEC 60529

 **Warning dual supply**  **Do not work on this equipment until it is isolated from both mains and on-site generation supplies**

Isolate on site Generating Unit at _____
Isolate mains supply at _____

Mfg Date & No. _____

QR Code to Manual 

Hanwha Q CELLS Australia Pty Ltd
Suite 1, Level 1, 15 Blue Street, North Sydney, NSW 2060 Australia
TEL 1 800 Q CELLS or 02 9016 3033
WEB www.q-cells.com/au

Description for LED Indicator

 Error	 Off Grid Operation	 Offline Mode	 Firmware Upgrade
 Setting Status	 All Operation Paused	 Online Mode	

Produktbeschreibung Product description

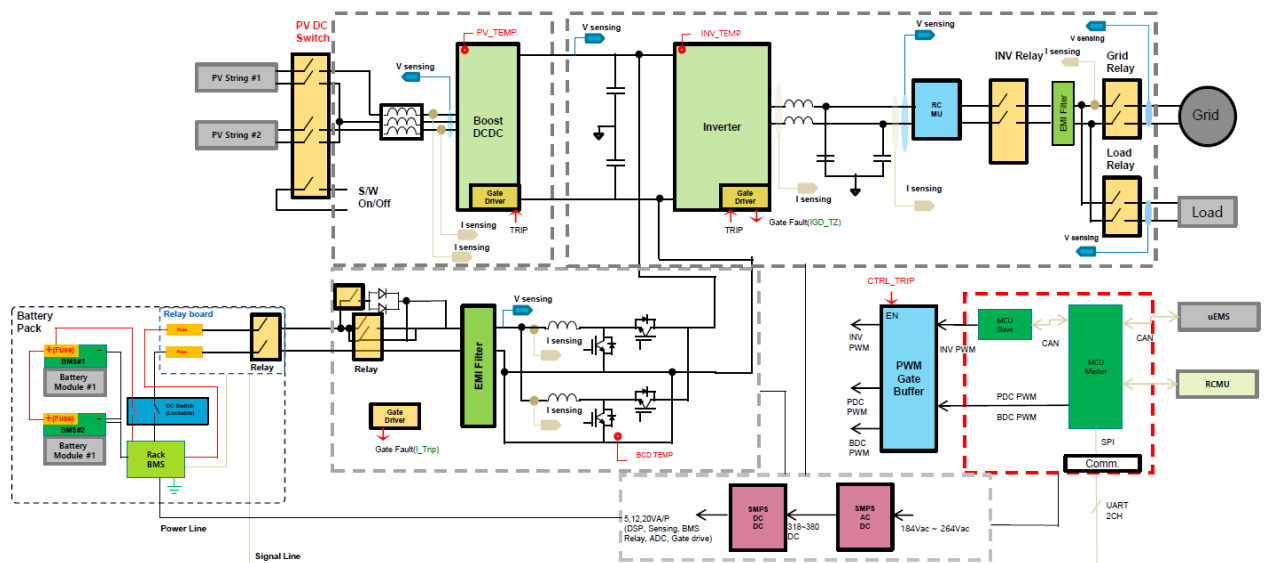
Brief description:

The PCE under test (EUT) is a multiple mode inverter of 5kW which utilizes the advanced power electronics conversion components such as MOSFET, IGBT, IPM to convert the variable DC power generated from the photovoltaic (PV) arrays as well as batteries (BAT) to the stable utility AC power which can be fed into the commercial electrical grid. The product is able to work stand-alone while the grid is not present.

The interface protection device is redundantly comprised by two groups of INV relay and grid relay.

While off-grid mode is disabled, both INV and grid relays would be deactivated to disconnect the grid.

While off-grid mode is enabled, grid relay shall be deactivated to disconnect the grid. Meanwhile, the status of grid relay would be monitored by monitoring circuit in case relay failure. When grid relay failed to trip, INV relay would act to cut off the system.



Block Diagram

Interface relays disconnect the equipment from utility in case any one of following grid faults occurred:

1. PV array insulation resistance fault
2. Residual current fault
3. Over & under grid voltage
4. Over & under grid frequency
5. Islanding operation
6. Over DC injection current

Model Difference:

All models are technical equivalent on hard and software. The rated power is reduced by limit of software. Q.VOLT A4.6S and Q.VOLT A5S remove the PV input strings.

The product was tested on:
Software version: V 1.0

Unless otherwise specified, all tests were performed on Q.VOLT H5S to represent other family models. All tests were performed under 230V, 50Hz grid condition.

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Produktbeschreibung
Product description

Model List:

MODELS LIST		Q.VOLT A4.6S	Q.VOLT H4.6S
PV INPUT	$V_{MAX\ PV}$ [Vdc]	N/A	600
	$I_{SC\ PV}$ [A]	N/A	2*20
	MPP Voltage Range V_{MPP} [Vdc]	N/A	90-550
	Max. Input Current I_{MAX} [A]	N/A	2*15
BAT INPUT	Rated input voltage [V]	202.8	202.8
	Max. change/dischang current [A]	16.9/20	16.9/20
	Battery Type	Li-ion	Li-ion
AC OUTPUT	Rated Output Voltage per phase U_n [Vac]	230	
	Rated Output Frequency F_n [Hz]	50/60	
	Rated Apparent Power S_n [kVA]	5.0	
	Max. Active Power P_{Emax} [kW]	5.0	
	Max. Apparent power S_{Emax} [kVA]	5.0	
	Max. Output Current I_{max} [A]	25.0	
	Power Factor Range $\cos\phi$ [λ]	0.95 lagging to 0.95 leading	
	Operation Temperature (°C)	-20 - +60	
	Overvoltage Category	OVC II(DC) / OVC III(AC)	
	Protection Degree	IP65	
	Protective class	Class I	
	Inverter topology	Non-isolated	
	Firmware version	V 1.0	

MODELS LIST		Q.VOLT A5S	Q.VOLT H5S
PV INPUT	$V_{MAX\ PV}$ [Vdc]	N/A	600
	$I_{SC\ PV}$ [A]	N/A	2*20
	MPP Voltage Range V_{MPP} [Vdc]	N/A	90-550
	Max. Input Current I_{MAX} [A]	N/A	2*15
BAT INPUT	Rated input voltage [V]	202.8	202.8
	Max. change/dischang current [A]	16.9/20	16.9/20
	Battery Type	Li-ion	Li-ion
AC OUTPUT	Rated Output Voltage per phase U_n [Vac]	230	
	Rated Output Frequency F_n [Hz]	50/60	
	Rated Apparent Power S_n [kVA]	5.0	
	Max. Active Power P_{Emax} [kW]	5.0	

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Produktbeschreibung
Product description

Max. Apparent power S_{Emax} [kVA]	5.0
Max. Output Current I_{max} [A]	25.0
Power Factor Range $\cos\phi$ [λ]	0.8 lagging to 0.8 leading
Operation Temperature ($^{\circ}\text{C}$)	-20 - +60
Overvoltage Category	OVC II(DC) / OVC III(AC)
Protection Degree	IP65
Protective class	Class I
Inverter topology	Non-isolated
Firmware version	V 1.0

ROTECTION SETTINGS	Voltage threshold value [V]	$U_{MIN}: 0.8U_n$, $U_{MAX \text{ stage 1}}: 1.14U_n$, $U_{MAX \text{ stage 2}}: 1.19U_n$
	Voltage trip time [ms]	$U_{MIN}: 2500-2600$ $U_{MAX \text{ stage 1}}: 1000-1100$ $U_{MAX \text{ stage 2}}: 500-600$
	Frequency threshold value [Hz]	$F_{MIN \text{ stage 1}}: 47.5$, $F_{MIN \text{ stage 2}}: 47.0$, $F_{MAX}: 52.0$
	Frequency trip time [ms]	$F_{MIN \text{ stage 1}}: 20000-20100$, $F_{MIN \text{ stage 2}}: 500-600$ $F_{MAX}: 500-600$
	Active anti-islanding trip time [ms]	≤ 500
	Reconnection Voltage [V]	$U_{MIN}: >0.8U_n$, $U_{MAX}: <1.14U_n$
	Reconnection Frequency [Hz]	$F_{MIN}: >47.5$ $F_{MAX}: 52.0$
	Reconnection Time [s]	≥ 60

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Absatz	Anforderungen - Prüfungen	Messergebnisse - Bemerkungen	Bewertung
Clause	Requirements - Tests	Measuring results - Remarks	Evaluation

10	Protection	Considered, see appended test table for detail.	P
11	Type A Power Generating Module Technical Requirements	Considered, see appended test table for detail.	P
12	Type B Power Generating Module Technical Requirements	Considered, see appended test table for detail.	N/A
13	Type C and type D Power Generating Module Technical Requirements	Considered, see appended test table for detail.	N/A

ANLAGE zum Prüfbericht-Nr.: CN21F3AS 002
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ZUSATZ-DOKUMENTATION
ADDITIONAL DOCUMENTATION

See attachment for test data.

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Project Engineer:	Theo Tang	Reviewer:	Jingge Pan
Signature:	<i>Theo Tang</i>	Signature:	<i>Jingge Pan</i>

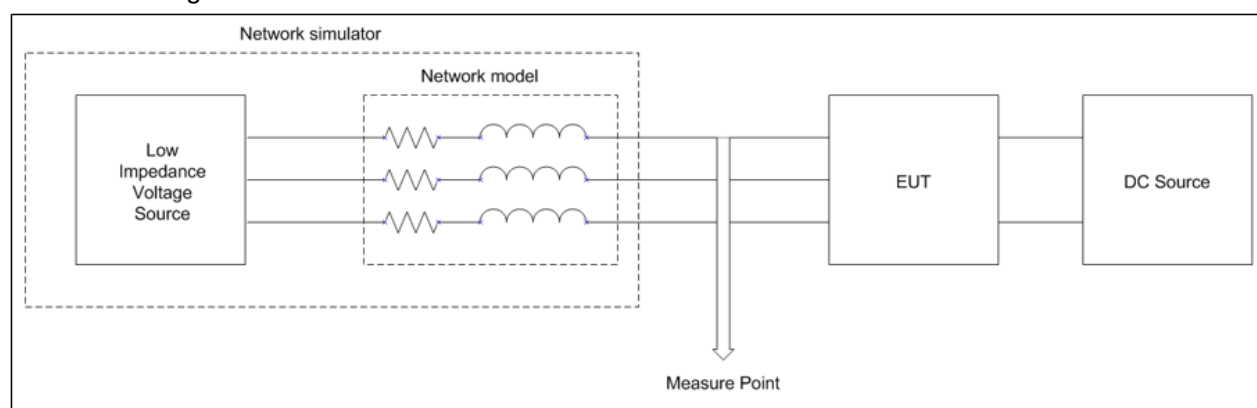
Testing Location:	
Name:	TÜV Rheinland (Shanghai) Co., Ltd.
Address:	B1-13/F No.177, Lane 777, West Guangzhong Road, Jingan District, Shanghai 200072, P.R. China

Test Sample No.:	A003357821-001
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Test Condition:	Temperature: 25°C Relative humidity: 70%
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Test Date:	2022.09.30 – 2022.10.06
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Test bench diagram:



A network model (grid impedance simulator) only connected in test bench in flicker and harmonic test, in the other tests the network model is bypassed.

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Absatz	G99:2020	Messergebnisse - Bemerkungen	Bewertung	
Clause	Anforderungen - Prüfungen / Requirements - Tests	Measuring results - Remarks	Evaluation	

Clause	Test items	Remark
1	Normal operating range (Operation range)	Pass
2.1	Harmonics current (THDi)	For PGU ≤ 75A, per IEC 61000-3-12
2.2	Harmonics current (linter & lhigher)	N/A, Extra test than A2-3 report form, particular for PGU > 75A
3.1	Voltage fluctuations (Flicker)	For PGU ≤ 75A, per IEC 61000-3-11
3.2	Voltage fluctuations (Flicker)	N/A, Extra test than A2-3 report form, particular for PGU > 75A
4	DC Injection (Idc)	Pass
5	Power factor	Pass
6	Protection-Frequency tests (OF/UF)	Pass
7	Protection-Frequency tests (OV/UV)	Pass
8.1	Protection-Loss of mains test (Anti-islanding)	Pass
8.2	Vector shift stability test	Pass
8.3	RoCoF stability test (RoCoF)	Pass
9.1	Limited Frequency Sensitive Mode-Over frequency test (LFSM-O)	Pass
9.2	Limited Frequency Sensitive Mode-Under frequency test (LFSM-U)	N/A, Extra test than A2-3 report form, particular for type C and type D plant
9.3	Frequency Sensitive Mode (FSM-O)	N/A, Extra test than A2-3 report form, particular for type C and type D plant
9.4	Frequency Sensitive Mode (FSM-U)	N/A, Extra test than A2-3 report form, particular for type C and type D plant
10	Protection-Reconnection timer (Reconnection)	Pass
11	Fault level contribution	Pass
12	Self-Monitoring solid state switching	N/A, only for solid state switching
13	Wiring functional tests	N/A, none on-site test.
14	Logic interface (input port)	Pass
15	P&Q range	N/A, Extra test than A2-3 report form, particular for type B, type C and type D plant
16	Fault Voltage-Ride Through (FVRT)	N/A, Extra test than A2-3 report form, particular for type B, type C and type D plant

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1				TABLE: Normal operating range (Operation range)	
Test Conditions				Measurements	Limitation
U/Un	f [Hz]	cosφ	t [s]		
85%	47.0	1.00	20	No disconnect	No disconnect
85%	47.5	1.00	5400	No disconnect	No disconnect
110%	51.5	1.00	5400	No disconnect	No disconnect
100%	50.0	1.00	5400	No disconnect	No disconnect
110%	52.0	1.00	900	No disconnect	No disconnect
frequency change rate 1Hz/s				No disconnect	No disconnect
Note(s): * Function of interface protection and activating active power response to over/under frequency and voltage shall be disable.					

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2.1	TABLE: Harmonics current (THDi)				P
P/Pn[%]	50		100		Limit
Order No.	Measurement				
	[A]	Ih/In [%]	[A]	Ih/In [%]	Ih/In [%]
1	10.9880	50.545	21.7464	100.033	--
2	0.0013	0.006	0.0011	0.005	8
3	0.4550	2.093	0.7245	3.333	21.6
4	0.0026	0.012	0.0066	0.030	4
5	0.1171	0.539	0.1444	0.664	10.7
6	0.0042	0.019	0.0059	0.027	2.67
7	0.0851	0.391	0.1177	0.541	7.2
8	0.0038	0.017	0.0021	0.010	2
9	0.0608	0.280	0.1062	0.489	3.8
10	0.0015	0.007	0.0032	0.015	1.6
11	0.0407	0.187	0.0844	0.388	3.1
12	0.0034	0.016	0.0023	0.011	1.33
13	0.0313	0.144	0.0707	0.325	2
THDi	2.235%		3.558%		13
PWHD	0.954%		2.686%		22
Note(s): If the inverter is three-phase inverter, then the worst value of the three phases has been choosed. Since the nominal current of product In>75A, the following extra flicker table 2.2 has been also impelmented per BS EN 61000-4-7, as the requirement of EREC G5.					

3.1	TABLE: Voltage fluctuations (Flicker)						P	
	Starting			Stooping			Running	
	dmax[%]	dc[%]	d(t)[ms]	dmax[%]	dc[%]	d(t)[ms]	P _{st}	P _{lt}
Measured value	0.51	0.019	0.0	0.49	0.018	0.0	0.03	0.03
Z _{ref} Normalised value	0.51	0.019	0.0	0.49	0.018	0.0	0.03	0.03
Z _{max} Normalised value	--	--	--	--	--	--	--	--
Limitation	4.0	3.3	500	4.0	3.3	500	1.0	0.65
Test impedance Z _{test}	R	0.24	Ω	XI	0.15	Ω		
Z _{ref} Normalised value	R	0.24	Ω	XI	0.15	Ω		
Z _{max} Normalised value	R	--	Ω	XI	--	Ω		

Note(s): The worst value of the three phases has been choosed.

Since the nominal current of product I_n>75A, the following extra flicker table 3.2 has been also impelmented per BS EN 61400-21, as the requirement of EREC P28, clause 8.8.

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4	TABLE: DC Injection (Idc)			P
Test power level(P/Pn)	10%	55%	100%	
Recorded DC value in Amps	0.0017	0.0032	0.0201	
as % of rated AC current	0.008%	0.015%	0.092%	
Limit	0.25%	0.25%	0.25%	
Note(s):				

5	TABLE: Power Factor							P
Test Conditions			Measurements					Limit
P/Pn	cosφ	U/Un	P [W]	Q [Var]	cosφ	U [V]	I [A]	cosφ
100%	1.00	0.94	4996.8	190.3	0.999	216.2	23.13	>0.95
100%	1.00	1.0	5004.5	195.3	0.999	230.1	21.76	>0.95
100%	1.00	1.1	4920.6	203.5	0.999	253.0	19.46	>0.95
Note(s):								

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6	TABLE: Protection-Frequency tests (OF/UF)		P
Condition	Setting [Hz]	Measurement	Limitation
		Trip value [Hz]	
F>>	52.0	52.02	± 0.1% of f_n
F<	47.5	47.48	
F<<	47	46.98	
Condition	Setting [ms]	Measurement	Limitation
		Trip time	
F>>	500	550	500-600
F<	20000	20060	20000-20100
F<<	500	560	500-600
Condition		Measurement	limitation
F [Hz]	t [s]		
47.7	30	No trip	No trip
47.2	19.5	No trip	No trip
46.8	0.45	No trip	No trip
51.8	120	No trip	No trip
52.2	0.45	No trip	No trip
Note(s):			

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7	TABLE: Protection-Voltage tests (OV/UV)					P
Condition	Setting [U/Un]	Measurement				Limitation
		Trip value [V]				
		L1	L2	L3	L123	
U>>	1.19 (1.13*)	273.2	--	--	--	± 1% of U _n
U>	1.14 (1.10*)	261.9	--	--	--	
U<<	0.80	183.6	--	--	--	
Condition	Setting [ms]	Measurement				Limitation
		Trip time				
		L1	L2	L3	L123	
U>>	500	520	--	--	--	500-600
U>	1000	1040	--	--	--	1000-1100
U<<	2500	2560	--	--	--	2500-2600
Condition		Measurement				limitation
U/Un	t [s]					
0.82	5	No trip				No trip
0.78	2.45	No trip				No trip
1.12	5	No trip				No trip
1.17	0.95	No trip				No trip
1.20	0.45	No trip				No trip
Note(s):*: settings for product connect with a non-standard transformer						

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8.1	TABLE: Protection-Loss of mains test					P
Power 100%						
Input :435Vdc						
Conditions	P _w [kW]	Q _L [kVar]	Q _C [kVar]	Q _f	Trip time [ms]	Limitation [ms]
P _R : -10% Q _C : +10%	L1: 4.48	L1: 4.98	L1: 5.49	1.17	313.4	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
P _R : -10% Q _C : +5%	L1: 4.48	L1: 4.98	L1: 5.24	1.14	327.7	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
P _R : -10% Q _C : 0%	L1: 4.48	L1: 4.98	L1: 4.99	1.11	441.9	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
P _R : -10% Q _C : -5%	L1: 4.48	L1: 4.98	L1: 4.74	1.08	289.9	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
P _R : -10% Q _C : -10%	L1: 4.48	L1: 4.98	L1: 4.49	1.06	221.4	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
P _R : -5% Q _C : +10%	L1: 4.73	L1: 4.98	L1: 5.49	1.11	242.8	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
P _R : -5% Q _C : -10%	L1: 4.73	L1: 4.98	L1: 4.49	1.00	295.8	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
P _R : 0% Q _C : +10%	L1: 4.98	L1: 4.98	L1: 5.49	1.05	291.5	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
P _R : -5% Q _C : +5%	L1: 4.73	L1: 4.98	L1: 5.24	1.08	275.0	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		

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PR: -5% QC: 0%	L1: 4.73	L1: 4.98	L1: 4.99	1.05	464.3	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: -5% QC: -5%	L1: 4.73	L1: 4.98	L1: 4.74	1.03	233.1	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: +5%	L1: 4.98	L1: 4.98	L1: 5.24	1.03	286.9	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: 0%	L1: 4.98	L1: 4.98	L1: 4.99	1.00	468.9	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: -5%	L1: 4.98	L1: 4.98	L1: 4.74	0.98	265.2	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: +5% QC: +5%	L1: 5.23	L1: 4.98	L1: 5.24	0.98	356.2	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: +5% QC: 0%	L1: 5.23	L1: 4.98	L1: 4.99	0.95	444.7	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: +5% QC: -5%	L1: 5.23	L1: 4.98	L1: 4.74	0.93	252.4	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: -10%	L1: 4.98	L1: 4.98	L1: 4.49	0.95	244.3	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: +5% QC: +10%	L1: 5.23	L1: 4.98	L1: 5.49	1.00	275.4	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: +5%	L1: 5.23	L1: 4.98	L1: 4.49	0.90	282.8	

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Qc: -10%	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Pr: +10% Qc: +10%	L1: 5.48	L1: 4.98	L1: 5.49	0.95	270.7	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Pr: +10% Qc: +5%	L1: 5.48	L1: 4.98	L1: 5.24	0.93	305.5	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Pr: +10% Qc: 0%	L1: 5.48	L1: 4.98	L1: 4.99	0.91	396.4	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Pr: 10% Qc: -5%	L1: 5.48	L1: 4.98	L1: 4.74	0.89	210.0	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Pr: +10% Qc: -10%	L1: 5.48	L1: 4.98	L1: 4.49	0.86	213.1	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Power 66%						
Input :320Vdc						
Conditions	P _w [kW]	Q _L [kVA]	Q _c [kVA]	Q _f	Trip time [ms]	Limitation [ms]
Pr: 0% Qc: -5%	L1: 3.32	L1: 3.31	L1: 3.16	0.97	313.9	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Pr: 0% Qc: -4%	L1: 3.32	L1: 3.31	L1: 3.20	0.98	351.4	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Pr: 0% Qc: -3%	L1: 3.32	L1: 3.31	L1: 3.23	0.98	363.2	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Pr: 0% Qc: -2%	L1: 3.32	L1: 3.31	L1: 3.26	0.99	275.8	
	L2: --	L2: --	L2: --	--		500

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	L3: --	L3: --	L3: --	--		
PR: 0% QC: -1%	L1: 3.32	L1: 3.31	L1: 3.30	0.99	411.2	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: 0%	L1: 3.32	L1: 3.31	L1: 3.33	1.00	458.7	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: +1%	L1: 3.32	L1: 3.31	L1: 3.36	1.00	372.3	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: +2%	L1: 3.32	L1: 3.31	L1: 3.40	1.01	407.6	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: +3%	L1: 3.32	L1: 3.31	L1: 3.43	1.01	366.1	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: +4%	L1: 3.32	L1: 3.31	L1: 3.46	1.02	353.7	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: +5%	L1: 3.32	L1: 3.31	L1: 3.50	1.02	335.7	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
Power 33%						
Input : 182Vdc						
Conditions	P _w [kW]	Q _L [kVA]	Q _c [kVA]	Q _f	Trip time [ms]	Limitation [ms]
PR: 0% QC: -5%	L1: 1.63	L1: 1.63	L1: 1.56	0.98	251.7	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0%	L1: 1.63	L1: 1.63	L1: 1.57	0.98	279.2	

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QC: -4%	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: -3%	L1: 1.63	L1: 1.63	L1: 1.59	0.99	312.9	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: -2%	L1: 1.63	L1: 1.63	L1: 1.61	0.99	360.1	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: -1%	L1: 1.63	L1: 1.63	L1: 1.62	1.00	355.0	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: 0%	L1: 1.63	L1: 1.63	L1: 1.64	1.00	385.4	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: +1%	L1: 1.63	L1: 1.63	L1: 1.66	1.01	344.2	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: +2%	L1: 1.63	L1: 1.63	L1: 1.67	1.01	317.7	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% QC: +3%	L1: 1.63	L1: 1.63	L1: 1.69	1.02	330.6	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0%	L1: 1.63	L1: 1.63	L1: 1.71	1.02	356.9	

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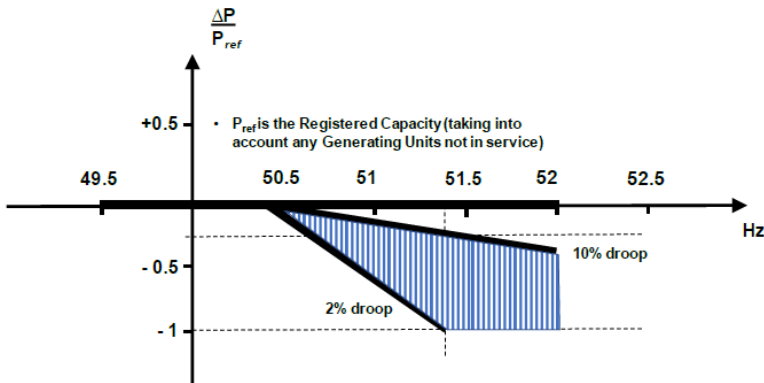
Qc: +4%	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		
PR: 0% Qc: +5%	L1: 1.63	L1: 1.63	L1: 1.72	1.03	334.5	
	L2: --	L2: --	L2: --	--		500
	L3: --	L3: --	L3: --	--		

8.2	TABLE: Vector shift stability test				P
Test Condition		Start Frequency	Change	Measurement	Limit
Positive Vector Shift		49.5Hz	+50degree	No trip	No trip
Negative Vector Shift		50.5Hz	-50degree	No trip	No trip

8.3	TABLE: RoCoF stability test				P
Ramp range		Test frequency ramp:	Test Duration	Measurement	Limit
49Hz->51Hz		+ 0.95 Hz/s	2.1 s	No trip	No trip
51Hz->49Hz		- 0.95 Hz/s	2.1 s	No trip	No trip

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9.1	TABLE: Limitest frequency sensitive mode-over frequency (LFSM-O)							P		
Test No. 1										
Test Conditions		Measurements				Target value	Δ	Limitation		
f [Hz]	P/Pn	f [Hz]	T _{rise} [s]	T _{settling} [s]	T _v [s]	P/Pn	Δ P/Pn	Δ P/Pn	T _{rise} [s]	T _v [s]
a) 50	100.5%	50.00	--	--	--	100%	0.5%	≤± 10%	≤10	≤2
b) 50.45	98.7%	50.45	1.0	1.0	0.0	99%	-0.3%			
c) 50.7	93.7%	50.70	1.0	1.0	0.0	94%	-0.3%			
d) 51.15	84.8%	51.15	1.0	1.0	0.0	83%	1.8%			
e) 50.7	93.9%	50.70	1.0	1.0	0.0	94%	-0.1%			
f) 50.45	98.9%	50.45	1.0	1.0	0.0	99%	-0.1%			
g) 50	100.6%	50.00	1.0	1.0	0.0	100%	0.6%			
Test No. 2										
Test Conditions		Measurements				Target value	Δ	Limitation		
f [Hz]	P/Pn	f [Hz]	T _{rise} [s]	T _{settling} [s]	T _v [s]	P/Pn	Δ P/Pn	Δ P/Pn	T _{rise} [s]	T _v [s]
a) 50	50.1%	50.00	--	--	--	50%	0.1%	≤± 10%	≤10	≤2
b) 50.45	49.5%	50.45	1.0	1.0	0.0	49%	0.5%			
c) 50.7	44.4%	50.70	1.0	1.0	0.0	44%	0.4%			
d) 51.15	35.3%	51.15	1.0	1.0	0.0	33%	2.3%			
e) 50.7	44.6%	50.70	1.0	1.0	0.0	44%	0.6%			
f) 50.45	49.6%	50.45	1.0	1.0	0.0	49%	0.6%			
g) 50	50.2%	49.99	1.0	1.0	0.0	50%	0.2%			
Note(s):										
P(f) curve setting for test: f1: 50.4Hz; fstop: 50.4Hz (Deactivated); Droop: 10%										
 • P_{ref} is the Registered Capacity (taking into account any Generating Units not in service)										

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10	TABLE: Protection-Reconnection timer (Reconnection)				P
Condition	Measurement		Limitation		
	Delay time [s]	Power Gradient [per mimute]	Delay time [s]	Power Gradient	
Reconnection:					
1.12Un	60.7	--	60	--	
0.82Un	60.7	--			
47.6Hz	60.7	--			
51.9Hz	60.7	--			
1.16Un	No reconnection	--	No reconnection	--	
0.78Un	No reconnection	--			
47.4Hz	No reconnection	--			
52.1Hz	No reconnection	--			
Note(s):					

11	TABLE: Fault level contribution		P
Test Condition	Measurement		
	U [V]	I [A]	
20ms after fault	14.208	0.2080	
100ms after fault	9.2917	0.1625	
250ms after fault	9.2500	0.1583	
500ms after fault	9.2083	0.1500	
Trip time [ms]	2.1		

12	TABLE: Self-Monitoring solid state switching	N/A
It has been verified that in the event of the solid state switching device failing to disconnect the Power Park Module, the voltage on the output side of the switching device is reduced to a value below 50 volts within 0.5 s.		N/A

13	TABLE: Wiring functional tests	N/A
Confirm that the relevant test schedule is attached (tests to be undertaken at time of commissioning)		N/A

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14	TABLE: Logic interface (input port).	P																				
Confirm that an input port is provided and can be used to shut down the module.																						
DRM Specification																						
The inverter supports the DRM (Demand Response Mode) function as specified in AS/NZS 4777.2.																						
<table><tr><th>Mode</th><th>Description</th></tr><tr><td>DRM 0</td><td>The inverter is in the state of "Key-stop."</td></tr><tr><td>DRM 1</td><td>The import power from the grid is 0.</td></tr><tr><td>DRM 2</td><td>The import power from the grid is no more than 50 % of the rated power.</td></tr><tr><td>DRM 3</td><td>The import power from the grid is no more than 75 % of the rated power.</td></tr><tr><td>DRM 4</td><td>The import power from the grid is no more than 100 % of the rated power, but subject to the constraints from other active DRMs.</td></tr><tr><td>DRM 5</td><td>The export power from the grid is 0.</td></tr><tr><td>DRM 6</td><td>The export power from the grid is no more than 50 % of the rated power.</td></tr><tr><td>DRM 7</td><td>The export power from the grid is no more than 75 % of the rated power.</td></tr><tr><td>DRM 8</td><td>The export power from the grid is no more than 100 % of the rated power, but subject to the constraints from other active DRMs.</td></tr></table>			Mode	Description	DRM 0	The inverter is in the state of "Key-stop."	DRM 1	The import power from the grid is 0.	DRM 2	The import power from the grid is no more than 50 % of the rated power.	DRM 3	The import power from the grid is no more than 75 % of the rated power.	DRM 4	The import power from the grid is no more than 100 % of the rated power, but subject to the constraints from other active DRMs.	DRM 5	The export power from the grid is 0.	DRM 6	The export power from the grid is no more than 50 % of the rated power.	DRM 7	The export power from the grid is no more than 75 % of the rated power.	DRM 8	The export power from the grid is no more than 100 % of the rated power, but subject to the constraints from other active DRMs.
Mode	Description																					
DRM 0	The inverter is in the state of "Key-stop."																					
DRM 1	The import power from the grid is 0.																					
DRM 2	The import power from the grid is no more than 50 % of the rated power.																					
DRM 3	The import power from the grid is no more than 75 % of the rated power.																					
DRM 4	The import power from the grid is no more than 100 % of the rated power, but subject to the constraints from other active DRMs.																					
DRM 5	The export power from the grid is 0.																					
DRM 6	The export power from the grid is no more than 50 % of the rated power.																					
DRM 7	The export power from the grid is no more than 75 % of the rated power.																					
DRM 8	The export power from the grid is no more than 100 % of the rated power, but subject to the constraints from other active DRMs.																					
Corresponding relationship between cables and pins (568B) is as follows:																						
	T568B	Corresponding DRM																				
	Pin 1: White-orange	DRM 1/5																				
	Pin 2: Orange	DRM 2/6																				
	Pin 3: White-green	DRM 3/7																				
	Pin 4: Blue	DRM 4/8																				
	Pin 5: White-blue	RefGen																				
	Pin 6: Green	Com. DRM 0																				
	Pin 7: White-brown	-																				
	Pin 8: Brown	-																				

-TEST REPORT END

PHOTO DOCUMENTATION

CN21F3AS 002

for

Hybrid Grid-Connected PV Inverter

Q.VOLT H4.6S, Q.VOLT H5S, Q.VOLT A4.6S, Q.VOLT
A5S

Hanwha Solutions Corporation



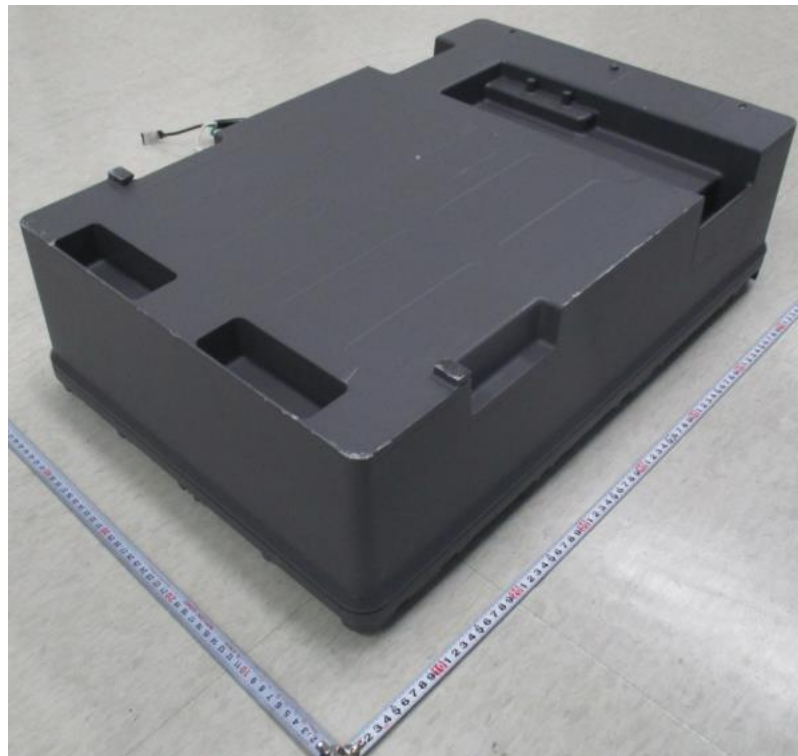
This documentation consists of 3 pages (excluding this cover page)

Report Number: CN21F3AS 002

Model: Q.VOLT H4.6S, Q.VOLT H5S, Q.VOLT A4.6S, Q.VOLT A5S



Overall view



Back view1

Report Number: CN21F3AS 002

Model: Q.VOLT H4.6S, Q.VOLT H5S, Q.VOLT A4.6S, Q.VOLT A5S



Back view2



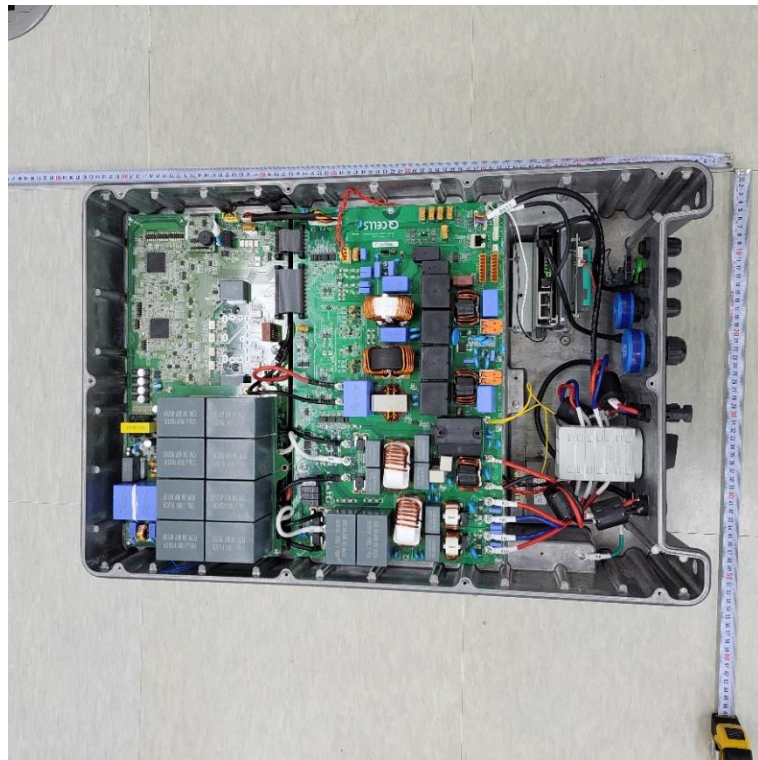
Bottom view

Report Number: CN21F3AS 002

Model: Q.VOLT H4.6S, Q.VOLT H5S, Q.VOLT A4.6S, Q.VOLT A5S



Side view



Internal view