TEST REPORT
IEC 61727
Photovoltaic (PV) systems – Characteristics of the utility interface

Report Number. ..... :	6052106.51B
Date of issue..... :	2019-08-16
Total number of pages ..... :	43
Name of Testing Laboratory preparing the Report ..... :	DEKRA Testing and Certification (Suzhou) Co., Ltd.
Applicant's name..... :	EAST Group Co., Ltd.
Address..... :	No.6 Northern Industry Road, Songshan Lake Sci. & Tech. Industrial Park, Dongguan City, Guangdong Province, China
Test specification:	
Standard ..... :	IEC 61727:2004
Test procedure ..... :	Type test
Non-standard test method ..... :	N/A
Test Report Form No. ..... :	IEC61727B
Test Report Form(s) Originator.... :	TÜV SÜD Product Service GmbH
Master TRF..... :	Dated 2017-11-03

This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.

General disclaimer:

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 CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.
The measurement result is considered in conformance with the requirement if it is within the prescribed limit, It is not necessary to account the uncertainty associated with the measurement result.
The information provided by the customer in this report may affect the validity of the results, the test lab is not responsible for it.
This report is only for reference and is not used for legal proof function in China market.

Test item description..... :	Grid-connected PV Inverter
Trade Mark..... :	EAST
Manufacturer..... :	EAST Group Co., Ltd. No.6 Northern Industry Road, Songshan Lake Sci. & Tech. Industrial Park, Dongguan City, Guangdong Province, China
Model/Type reference..... :	EA5KTSI, EA6KTSI, EA8KTSI, EA10KTSI, EA13KTSI, EA16KTSI
Ratings..... :	EA5KTSI: PV input: Max. 1000 Vdc, MPPT voltage range: 120-950 Vdc, max 11A /11 A, Isc PV: 12 A/12 A Output: 230/400 Vac, 3/N/PE, 50 Hz, 5000 VA, max 7.3 A EA6KTSI: PV input: Max. 1000 Vdc, MPPT voltage range: 120-950 Vdc, max 11 A/11 A, Isc PV: 12 A/12 A Output: 230/400 Vac, 3/N/PE, 50 Hz, 6000 VA, max 8.7 A EA8KTSI: PV input: Max. 1000 Vdc, MPPT voltage range: 120-950 Vdc, max 11 A/11 A, Isc PV: 12 A/12 A Output: 230/400 Vac, 3/N/PE, 50 Hz, 8000 VA, max 11.6 A EA10KTSI: PV input: Max. 1000 Vdc, MPPT voltage range: 200-950 Vdc, max 11 A, Isc PV: 12 A/12 A Output: 230/400 Vac, 3/N/PE, 50 Hz, 10000 VA, max 14.5 A EA13KTSI: PV input: Max. 1000 Vdc, MPPT voltage range: 200-950 Vdc, max 22 A/11 A, Isc PV: 24 A/12 A Output: 230/400 Vac, 3/N/PE, 50 Hz, 13000 VA, max 18.9 A EA16KTSI: PV input: Max. 1000 Vdc, MPPT voltage range: 200-950 Vdc, max 22 A/11 A, Isc PV: 24 A/12 A Output: 230/400 Vac, 3/N/PE, 50 Hz, 16000 VA, max 23.2 A

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):

☒	**Testing Laboratory:**	DEKRA Testing and Certification (Suzhou) Co., Ltd.	
	Testing location/ address.....:	No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China.	
	Tested by (name, function, signature).....:	Hua Yu	
	Approved by (name, function, signature)...:	Jason Guo	
☐	~~**Testing procedure: CTF Stage 1:**~~		
	~~**Testing location/ address.....:**~~		
	~~**Tested by (name, function, signature).....:**~~		

~~Approved by (name, function, signature)…:~~		
☐ ~~Testing procedure: CTF Stage 2:~~		
~~Testing location/ address……:~~		
~~Tested by (name + signature) ……:~~		
~~Witnessed by (name, function, signature)..:~~		
~~Approved by (name, function, signature)…:~~		
☐ ~~Testing procedure: CTF Stage 3:~~		
☐ ~~Testing procedure: CTF Stage 4:~~		
~~Testing location/ address……:~~		
~~Tested by (name, function, signature)……:~~		
~~Witnessed by (name, function, signature)..:~~		
~~Approved by (name, function, signature)…:~~		
~~Supervised by (name, function, signature) :~~		

List of Attachments (including a total number of pages in each attachment):

This test report contains 5 parts listed as below:

- 6052106.51A covering IEC 61683 and pictures (37 pages)
- 6052106.51B covering IEC 61727 (35 pages)
- 6052106.51C covering IEC 62116 (23 pages)
- 6052106.51D covering IEC 60068-2-x ("x" including 1, 2, 14, 30) (7 pages)
- 6052106.51E covering IEC 60529 (5 pages)

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
Full applicable clauses test according standards: IEC 61727: 2004 (Second Edition)	DEKRA Testing and Certification (Suzhou) Co., Ltd. No.99, Hongye Road, Suzhou Industrial Park, Suzhou, Jiangsu, P.R. China.

Summary of compliance with National Differences (List of countries addressed):

☒ **The product fulfils the requirements of IEC 61727: 2004 (Second Edition).**

Copy of marking plate:

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.

EAST

PV Inverter	
Model	EA5KTSI
Max.Input Voltage	1000Vd.c.
MPPT Voltage Range	120~950Vd.c.
Max.Input Current	11A/11A
Isc PV	12A/12A
Rated Output Voltage	3/N/PE~230V/400Va.c.
Rated Output Frequency	50/60Hz
Max.Output Current	7.3A
Rated Output Power	5000W
Max. Apparent Power	5000VA
Power Factor Range	0.8 cap.~0.8 ind.
Enclosure	IP65
Overvoltage Category	III(AC), II (DC)
Ambient Temperature	-25℃~60℃

EA5KTSI 201903290001 Protection Class I

5min

EAST

PV Inverter	
Model	EA6KTSI
Max.Input Voltage	1000Vd.c.
MPPT Voltage Range	120~950Vd.c.
Max.Input Current	11A/11A
Isc PV	12A/12A
Rated Output Voltage	3/N/PE~230V/400Va.c.
Rated Output Frequency	50/60Hz
Max.Output Current	8.7A
Rated Output Power	6000W
Max. Apparent Power	6000VA
Power Factor Range	0.8 cap.~0.8 ind.
Enclosure	IP65
Overvoltage Category	III(AC), II (DC)
Ambient Temperature	-25℃~60℃

EA6KTSI 201903290001 Protection Class I

5min

EAST

PV Inverter	
Model	EA8KTSI
Max.Input Voltage	1000Vd.c.
MPPT Voltage Range	120~950Vd.c.
Max.Input Current	11A/11A
Isc PV	12A/12A
Rated Output Voltage	3/N/PE~230V/400Va.c.
Rated Output Frequency	50/60Hz
Max.Output Current	11.6A
Rated Output Power	8000W
Max. Apparent Power	8000VA
Power Factor Range	0.8 cap.~0.8 ind.
Enclosure	IP65
Overvoltage Category	III(AC), II (DC)
Ambient Temperature	-25℃~60℃

EA8KTSI 201903290001 Protection Class I

5min

EAST

PV Inverter	
Model	EA10KTSI
Max.Input Voltage	1000Vd.c.
MPPT Voltage Range	200~950Vd.c.
Max.Input Current	11A/11A
Isc PV	12A/12A
Rated Output Voltage	3/N/PE~230V/400Va.c.
Rated Output Frequency	50/60Hz
Max.Output Current	14.5A
Rated Output Power	10000W
Max. Apparent Power	10000VA
Power Factor Range	0.8 cap.~0.8 ind.
Enclosure	IP65
Overvoltage Category	III(AC), II (DC)
Ambient Temperature	-25℃~60℃

EA10KTSI 201903290001 Protection Class I

5min

EAST

PV Inverter	
Model	EA13KTSI
Max.Input Voltage	1000Vd.c.
MPPT Voltage Range	200~950Vd.c.
Max.Input Current	22A/11A
Isc PV	24A/12A
Rated Output Voltage	3/N/PE~230V/400Va.c.
Rated Output Frequency	50/60Hz
Max.Output Current	18.9A
Rated Output Power	13000W
Max. Apparent Power	13000VA
Power Factor Range	0.8 cap.~0.8 ind.
Enclosure	IP65
Overvoltage Category	III(AC), II (DC)
Ambient Temperature	-25℃~60℃

EA13KTSI 201903290001 Protection Class I

5min

EAST

PV Inverter	
Model	EA16KTSI
Max.Input Voltage	1000Vd.c.
MPPT Voltage Range	200~950Vd.c.
Max.Input Current	22A/11A
Isc PV	24A/12A
Rated Output Voltage	3/N/PE~230V/400Va.c.
Rated Output Frequency	50/60Hz
Max.Output Current	23.2A
Rated Output Power	16000W
Max. Apparent Power	16000VA
Power Factor Range	0.8 cap.~0.8 ind.
Enclosure	IP65
Overvoltage Category	III(AC), II (DC)
Ambient Temperature	-25℃~60℃

EA16KTSI 201903290001 Protection Class I

5min

DRM label:

DRM0	X	DRM1		DRM2	
DRM3		DRM4		DRM5	X
DRM6	X	DRM7	X	DRM8	X

Test item particulars .....:	
Classification of installation and use.....:	Fixed
Supply Connection .....:	pluggable equipment
.....:	
Possible test case verdicts:	
- test case does not apply to the test object..... :	N/A
- test object does meet the requirement..... :	P (Pass)
- test object does not meet the requirement..... :	F (Fail)
Testing ..... :	
Date of receipt of test item..... :	2019-04-10 (samples provided by applicant)
Date (s) of performance of tests ..... :	2019-04-12 to 2019-08-14

General remarks:

"(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 ☐ comma / ☒ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided.....:	☐ **Yes** ☒ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies)..... :	EAST Group Co., Ltd. No.6 Northern Industry Road, Songshan Lake Sci. & Tech. Industrial Park, Dongguan City, Guangdong Province, China

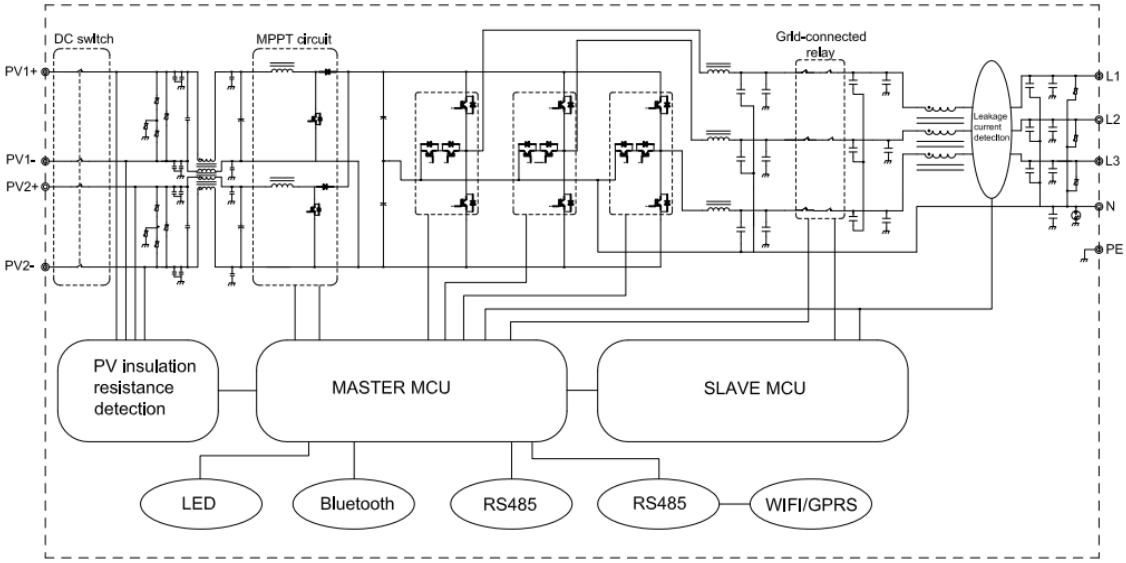
General product information:

The products are grid-connected photovoltaic inverter converts DC voltage into AC voltage, the unit is providing EMC filtering at the input and output towards mains.

The output was switched off redundant by the high power switching bridge and relay in series. This designation assures that the disconnection of the output circuit from the grid will also operate in case of one error.

The internal control is redundant built. It consists of two Microcontrollers (master DSP U1, slave DSP U22). The master DSP can control the relays; detect the PV voltage, PV current and BUS voltage, measures grid voltage, frequency, AC current with injected DC, insulation resistance to ground and residual current. The slave CPU (U22) were also detected grid voltage, injected DC current and residual current. Both microcontrollers communicate with each other. Any abnormal of those electrical parameter will trigger the disconnection of the inverter from the grid.

Block Diagram



Model difference:

1) The model EA5KTSI is identical with EA6KTSI; EA8KTSI is identical with EA10KTSI; EA13KTSI is identical with EA16KTSI in hardware and just power derating according to setting variations parameter in software.
2) The models EA5KTSI, EA6KTSI, EA8KTSI, EA10KTSI and EA13KTSI are identical with EA16KTSI in topological schematic circuit diagram of hardware except for the bus capacitors number (EA5KTSI and EA6KTSI with 2 bus capacitors, EA8KTSI and EA10KTSI with 4 bus capacitors, EA13KTSI and EA16KTSI with 6 bus capacitors); boost current sensor rating; inductive reactance of INV inductors and Boost inductors; Boost diode rating; Internal fan (Only model EA13KTSI and EA16KTSI designed with internal fan); the type designation and the input/output electrical rating.

The product was tested on:

Hardware version: 00C

Software version: HornetV008

Unless otherwise specified, all the tests were performed on model EA16KTSI and also applicable for all other models stated in this report. According to the user manual and testing, the product was evaluated for maximum ambient temperature of 60°C and will derating the output power above 45°C.

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict
4	**UTILITY COMPATIBILITY**		**P**
	The quality of power provided by the PV system for the on-site AC loads and for power delivered to the utility is governed by practices and standards on voltage, flicker, frequency, harmonics and power factor.		P
	Deviation from these standards represents out-of-bounds conditions and may require the PV system to sense the deviation and properly disconnect from the utility system.		P
4.1	**Voltage, current and frequency**		**P**
	The PV system AC voltage, current and frequency are compatible with the utility system.		P
4.2	**Normal voltage operating range**		**P**
	Utility-interconnected PV systems do not normally regulate voltage, they inject current into the utility. Therefore, the voltage operating range for PV inverters is selected as a protection function that responds to abnormal utility conditions, not as a voltage regulation function.	See appended table	P
4.3	**Flicker**		**P**
	The operation of the PV system is not cause voltage flicker in excess of limits stated in the relevant sections of IEC 61000-3-3 for systems less than 16 A or IEC 61000-3-5 for systems with current of 16 A and above.		P
4.4	**DC injection**		**P**
	The PV system is not inject DC current greater than 1 % of the rated inverter output current, into the utility AC interface under any operating condition.	See appended table	P
4.5	**Normal frequency operating range**		**P**
	The PV system operates in synchronism with the utility system, and within the frequency trip limits defined in 5.2.2.	See appended table	P
4.6	**Harmonics and waveform distortion**		**P**
	Total harmonic current distortion is less than 5 % at rated inverter output. Each individual harmonic is limited to the percentages listed in Table 1.		P
	Even harmonics in these ranges is less than 25 % of the lower odd harmonic limits listed.		P

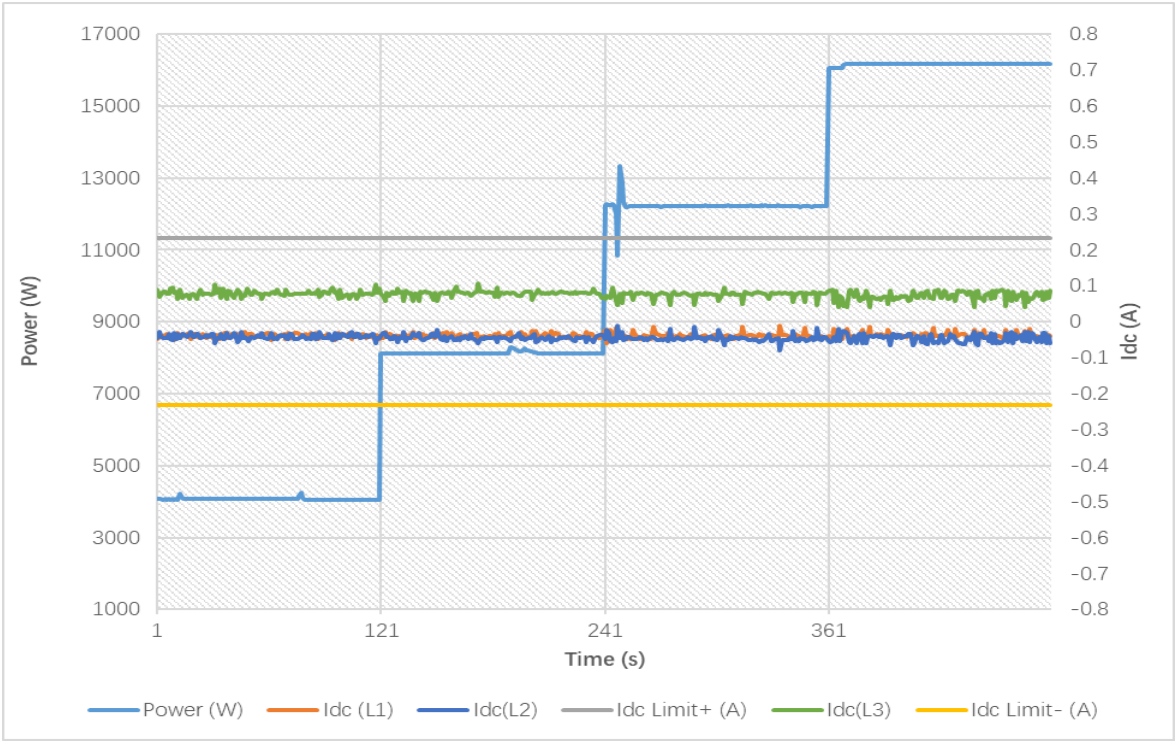
IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict
	Table 1 – Current distortion limits **Odd harmonics** / **Distortion limit** 3rd through 9th — Less than 4,0 % 11th through 15th — Less than 2,0 % 17th through 21st — Less than 1,5 % 23rd through 33rd — Less than 0,6 % **Even harmonics** / **Distortion limit** 2nd through 8th — Less than 1,0 % 10th through 32nd — Less than 0,5 %	See appended table	P
4.7	The PV system has a lagging power factor greater than 0,9 when the output is greater than 50 % of the rated inverter output power.		P
5	**PERSONNEL SAFETY AND EQUIPMENT PROTECTION**		**P**
	This Clause provides information and considerations for the safe and proper operation of the utility-connected PV systems.		P
5.1	**Loss of utility voltage**		**P**
	To prevent islanding, a utility connected PV system ceases to energize the utility system from a de-energized distribution line irrespective of connected loads or other generators within specified time limits.		P
	A utility distribution line can become de-energized for several reasons. For example, a substation breaker opening due to fault conditions or the distribution line switched out during maintenance.		P
5.2	**Over/under voltage and frequency**		**P**
	The abnormal utility conditions of concern are voltage and frequency excursions above or below the values stated in this Clause, and the complete disconnection of the utility, presenting the potential for a distributed resource island.		P
5.2.1	**Over/under voltage**		**P**
	When the interface voltage deviates outside the conditions specified in Table 2, the photovoltaic system ceases to energize the utility distribution system. This applies to any phase of a multiphase system.		P
	Table 2 – Response to abnormal voltages **Voltage (at point of utility connection)** / **Maximum trip time*** V < 0,5 × Vnominal — 0,1 s 50 % ≤ V < 85 % — 2,0 s 85 % ≤ V ≤ 110 % — Continuous operation 110 % < V < 135 % — 2,0 s 135 % ≤ V — 0,05 s * Trip time refers to the time between the abnormal condition occurring and the inverter ceasing to energize the utility line. The PV system control circuits shall actually remain connected to the utility to allow sensing of utility electrical conditions for use by the "reconnect" feature.		P
5.2.2	**Over/under frequency**		**P**

IEC 61727			
Clause	Requirement + Test	Result - Remark	Verdict
	When the utility frequency deviates outside the specified conditions the photovoltaic system ceases to energize the utility line. The unit does not have to cease to energize if the frequency returns to the normal utility continuous operation condition within the specified trip time.		P
	When the utility frequency is outside the range of ±1 Hz, the system ceases to energize the utility line within 0,2 s. The purpose of the allowed range and time delay is to allow continued operation for short-term disturbances and to avoid excessive nuisance tripping in weak-utility system conditions.	See appended table	P
5.3	**Islanding protection**		**P**
	The PV system must cease to energize the utility line within 2 s of loss of utility.	See appended table	P
5.4	**Response to utility recovery**		**P**
	Following an out-of-range utility condition that has caused the photovoltaic system to cease energizing, the photovoltaic system is not energize the utility line for 20 s to 5 min after the utility service voltage and frequency have recovered to within the specified ranges.	See appended table	P
5.5	**Earthing**		**P**
	The utility interface equipment is earthed/grounded in accordance with IEC 60364-7-712.		P
5.6	**Short circuit protection**		**P**
	The photovoltaic system has short-circuit protection in accordance with IEC 60364-7-712.		P
5.7	**Isolation and switching**		**P**
	A method of isolation and switching is provided in accordance with IEC 60364-7-712.		P

4.3	TABLE: Flicker		P
Model	EA16KTSI		
L1 phase			
Parameter			
Limit	dc%=3.3%	**Pst = 1.0**	**Plt = 0.65**
Test value	0.107	0.037	0.021
L2 phase			
Parameter			
Limit	dc%=3.3%	**Pst = 1.0**	**Plt = 0.65**
Test value	0.086	0.022	0.019
L3 phase			
Parameter			
Limit	dc%=3.3%	**Pst = 1.0**	**Plt = 0.65**
Test value	0.070	0.033	0.020
Supplementary information: The tests were performed on model EA16KTSI also applicable for all other models stated in this report.			

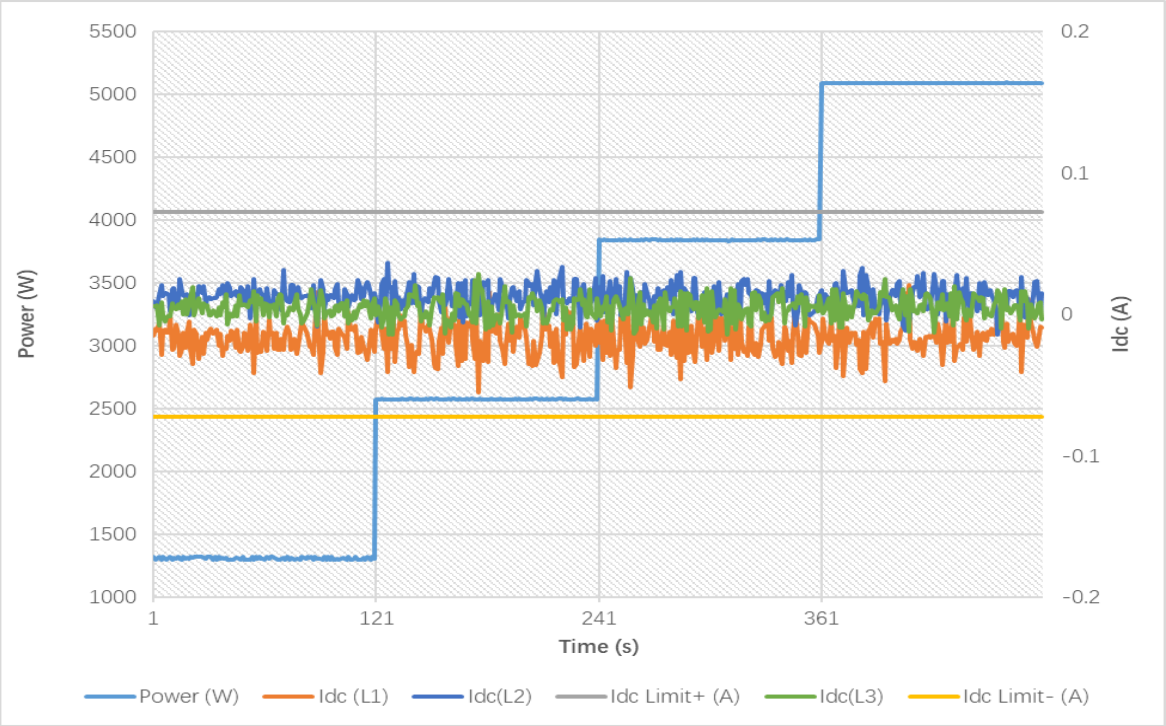
4.4	TABLE: Direct current injection					P
Model	EA16KTSI					
Rated output current (A)	**Ratio of rated output power (VA)**	**Measured DC output current**			**Isolated transformer ? (Yes/No)**	**Limit (mA)**
		L1 (mA)	**L2 (mA)**	**L3 (mA)**		
23.2	25%	52	58	103	No	232
23.2	50%	51	62	106	No	232
23.2	75%	58	80	103	No	232
23.2	100%	58	69	94	No	232

Diagram of permanent DC current Injection: 25%/50%/75%/100%Pn



Model	EA5KTSI					
Rated output current (A)	Ratio of rated output power (VA)	Measured DC output current			Isolated transformer ? (Yes/No)	Limit (mA)
		L1 (mA)	L2 (mA)	L3 (mA)		
7.3	25%	41	31	19	No	73
7.3	50%	54	37	28	No	73
7.3	75%	51	33	27	No	73
7.3	100%	47	33	25	No	73

Diagram of permanent DC current Injection: 25%/50%/75%/100%Pn



Supplementary information:
The PV system shall not inject DC current greater than 1 % of the rated inverter output current, into the utility AC interface under any operating condition.
The tests were performed on models EA16KTSI and EA5KTSI also applicable for all other models stated in this report.

4.6	TABLE: Harmonics and waveform distortion				P
Model		EA16KTSI		L1 phase	
Watts			5390.9		
VA			5407.2		
Vrms			231.1		
Arms			23.5		
PF			0.997		
Frequency (Hz)			50.0		
THD (%)			1.91		
Harmonic	**% of fundamental**	**Limits (% of fundamental)**	**Harmonic**	**% of fundamental**	**Limits (% of fundamental)**
02	0.37	1	03	0.27	4
04	0.17	1	05	0.69	4
06	0.03	1	07	0.89	4
08	0.51	1	09	0.28	4
10	0.11	0.5	11	0.51	2
12	0.08	0.5	13	0.48	2
14	0.08	0.5	15	0.12	2
16	0.07	0.5	17	0.30	1.5
18	0.09	0.5	19	0.41	1.5
20	0.09	0.5	21	0.56	1.5
22	0.12	0.5	23	0.38	0.6
24	0.07	0.5	25	0.33	0.6
26	0.09	0.5	27	0.24	0.6
28	0.09	0.5	29	0.24	0.6
30	0.06	0.5	31	0.23	0.6
32	0.08	0.5	33	0.20	0.6

4.6	TABLE: Harmonics and waveform distortion				P
Model		EA16KTSI		L2 phase	
Watts			5316.7		
VA			5332.7		
Vrms			231.2		
Arms			23.1		
PF			0.997		
Frequency (Hz)			50.0		
THD (%)			2.04		
Harmonic	**% of fundamental**	**Limits (% of fundamental)**	**Harmonic**	**% of fundamental**	**Limits (% of fundamental)**
02	0.62	1	03	0.54	4
04	0.30	1	05	0.66	4
06	0.10	1	07	0.76	4
08	0.09	1	09	0.22	4
10	0.12	0.5	11	0.58	2
12	0.05	0.5	13	0.31	2
14	0.13	0.5	15	0.09	2
16	0.10	0.5	17	0.38	1.5
18	0.10	0.5	19	0.57	1.5
20	0.23	0.5	21	0.63	1.5
22	0.15	0.5	23	0.48	0.6
24	0.12	0.5	25	0.19	0.6
26	0.14	0.5	27	0.20	0.6
28	0.11	0.5	29	0.27	0.6
30	0.09	0.5	31	0.19	0.6
32	0.08	0.5	33	0.09	0.6

4.6	TABLE: Harmonics and waveform distortion				P
Model		EA16KTSI		L3 phase	
Watts			5385.1		
VA			5406.7		
Vrms			231.1		
Arms			23.5		
PF			0.996		
Frequency (Hz)			50.0		
THD (%)			2.12		
Harmonic	**% of fundamental**	**Limits (% of fundamental)**	**Harmonic**	**% of fundamental**	**Limits (% of fundamental)**
02	0.34	1	03	0.76	4
04	0.12	1	05	0.65	4
06	0.09	1	07	0.98	4
08	0.05	1	09	0.46	4
10	0.06	0.5	11	0.53	2
12	0.08	0.5	13	0.43	2
14	0.10	0.5	15	0.14	2
16	0.06	0.5	17	0.36	1.5
18	0.06	0.5	19	0.46	1.5
20	0.16	0.5	21	0.49	1.5
22	0.13	0.5	23	0.50	0.6
24	0.10	0.5	25	0.28	0.6
26	0.10	0.5	27	0.23	0.6
28	0.09	0.5	29	0.17	0.6
30	0.09	0.5	31	0.21	0.6
32	0.06	0.5	33	0.23	0.6

4.6	TABLE: Harmonics and waveform distortion				P
Model		EA5KTSI		L1 phase	
Watts			1714.5		
VA			1721.2		
Vrms			231.1		
Arms			7.4		
PF			0.996		
Frequency (Hz)			50.0		
THD (%)			1.88		
Harmonic	**% of fundamental**	**Limits (% of fundamental)**	**Harmonic**	**% of fundamental**	**Limits (% of fundamental)**
02	0.28	1	03	0.16	4
04	0.35	1	05	0.82	4
06	0.12	1	07	0.47	4
08	0.12	1	09	0.08	4
10	0.05	0.5	11	0.34	2
12	0.05	0.5	13	0.48	2
14	0.05	0.5	15	0.08	2
16	0.08	0.5	17	0.25	1.5
18	0.10	0.5	19	0.20	1.5
20	0.07	0.5	21	0.22	1.5
22	0.08	0.5	23	0.47	0.6
24	0.10	0.5	25	0.51	0.6
26	0.08	0.5	27	0.11	0.6
28	0.08	0.5	29	0.47	0.6
30	0.16	0.5	31	0.48	0.6
32	0.07	0.5	33	0.15	0.6

4.6	TABLE: Harmonics and waveform distortion				P
Model		EA5KTSI		L2 phase	
Watts			1702.2		
VA			1710.7		
Vrms			229.8		
Arms			7.4		
PF			0.995		
Frequency (Hz)			50.0		
THD (%)			1.83		
Harmonic	**% of fundamental**	**Limits (% of fundamental)**	**Harmonic**	**% of fundamental**	**Limits (% of fundamental)**
02	0.29	1	03	0.32	4
04	0.32	1	05	0.86	4
06	0.05	1	07	0.41	4
08	0.09	1	09	0.16	4
10	0.10	0.5	11	0.37	2
12	0.18	0.5	13	0.53	2
14	0.04	0.5	15	0.06	2
16	0.08	0.5	17	0.24	1.5
18	0.09	0.5	19	0.18	1.5
20	0.08	0.5	21	0.17	1.5
22	0.09	0.5	23	0.46	0.6
24	0.10	0.5	25	0.47	0.6
26	0.06	0.5	27	0.08	0.6
28	0.09	0.5	29	0.48	0.6
30	0.14	0.5	31	0.42	0.6
32	0.05	0.5	33	0.21	0.6

4.6	TABLE: Harmonics and waveform distortion				P
Model		EA5KTSI		L3 phase	
Watts			1699.3		
VA			1706.1		
Vrms			230.0		
Arms			7.4		
PF			0.996		
Frequency (Hz)			50.0		
THD (%)			1.79		
Harmonic	**% of fundamental**	**Limits (% of fundamental)**	**Harmonic**	**% of fundamental**	**Limits (% of fundamental)**
02	0.18	1	03	0.18	4
04	0.05	1	05	0.87	4
06	0.11	1	07	0.30	4
08	0.05	1	09	0.11	4
10	0.08	0.5	11	0.31	2
12	0.17	0.5	13	0.53	2
14	0.05	0.5	15	0.07	2
16	0.06	0.5	17	0.18	1.5
18	0.06	0.5	19	0.23	1.5
20	0.05	0.5	21	0.25	1.5
22	0.06	0.5	23	0.50	0.6
24	0.12	0.5	25	0.53	0.6
26	0.08	0.5	27	0.09	0.6
28	0.06	0.5	29	0.44	0.6
30	0.18	0.5	31	0.47	0.6
32	0.10	0.5	33	0.18	0.6

Supplementary information:
The tests were performed on model EA16KTSI and EA5KTSI also applicable for all other models stated in this report.

4.7	TABLE: Power factor				P
Biggest model of the series:	**EA16KTSI**				
IEC61727 Limit:	> 0,9 when the output is greater than 50 % P_n				
Power level	25%	50%	75%	100%	
Input voltage (Vdc)	743	728	705	651	
Output voltage (Vac)	230.4	230.6	230.9	231.1	
Output power (VA)	4586	8838	12580	16300	
Power factor	0.921	0.969	0.984	0.998	
Supplementary information: The PV system shall have a lagging power factor greater than 0,9 when the output is greater than 50 % of the rated inverter output power.					

4.7	TABLE: Power factor				P
Smallest model of the series:	**EA5KTSI**				
IEC61727 Limit:	> 0,9 when the output is greater than 50 % P_n				
Power level	25%	50%	75%	100%	
Input voltage (Vdc)	689.9	674.8	654.4	620.7	
Output voltage (Vac)	229.6	229.7	229.9	230.1	
Output power (VA)	1318.5	2582.8	3841.2	5097.2	
Power factor	0.994	0.998	0.999	1.000	
Supplementary information: The PV system shall have a lagging power factor greater than 0,9 when the output is greater than 50 % of the rated inverter output power. The tests were performed on model EA16KTSI and EA5KTSI also applicable for all other models stated in this report.					

5.2.1	**TABLE: Over / under voltage test**					**P**
Model	**EA16KTSI, L1 phase**					
Output power	Under Voltage			Over Voltage		
First level						
Limit [V]	195.5			253.0		
Measured trip voltage [V]	195.3	195.0	195.1	253.3	253.4	253.2
Disconnection time [s]	1.212	1.174	1.196	1.132	1.334	1.178
Limit [s]	<= 2.0			<= 2.0		
Reconnection time [s]	78.86			63.66		
Limit [s]	20 < t < 300			20 < t < 300		
Second level						
Limit [V]	115.0			310.5		
Measured trip voltage [V]	114.6	114.4	114.2	310.9	311	310.8
Disconnection time [s]	0.096	0.10	0.09	0.026	0.02	0.024
Limit [s]	<= 0.1			<= 0.05		
Reconnection time [s]	75.78			75.78		
Limit [s]	20 < t < 300			20 < t < 300		

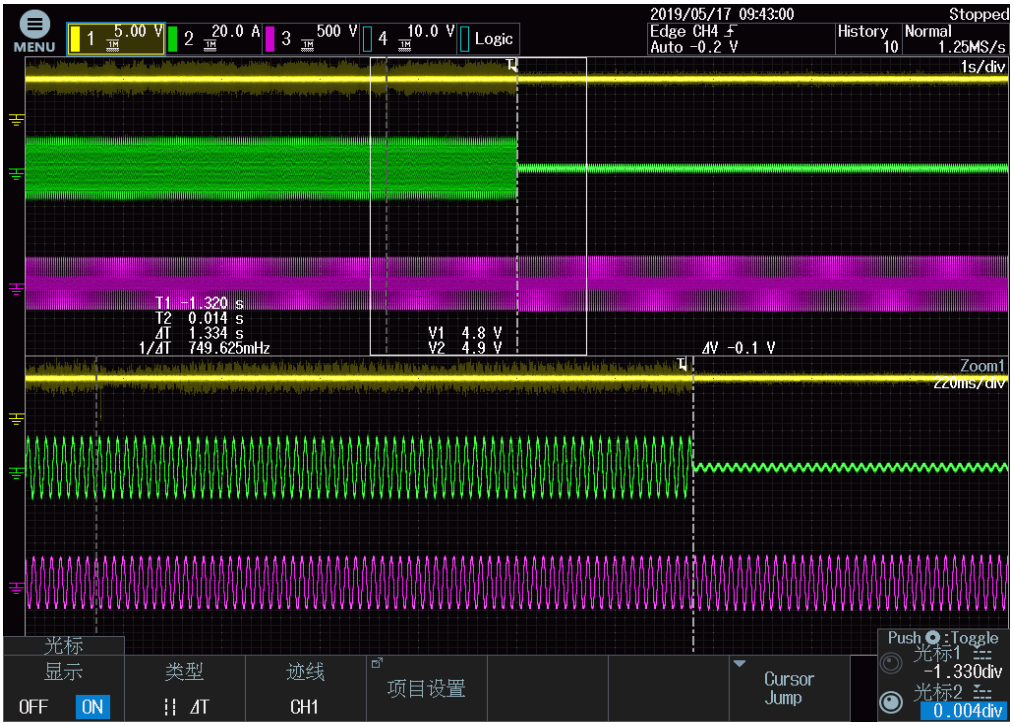
Supplementary information:

Trip time refers to the time between the abnormal condition occurring and the inverter ceasing to energize the utility line. The PV system control circuits shall actually remain connected to the utility to allow sensing of utility electrical conditions for use by the “reconnect” feature.

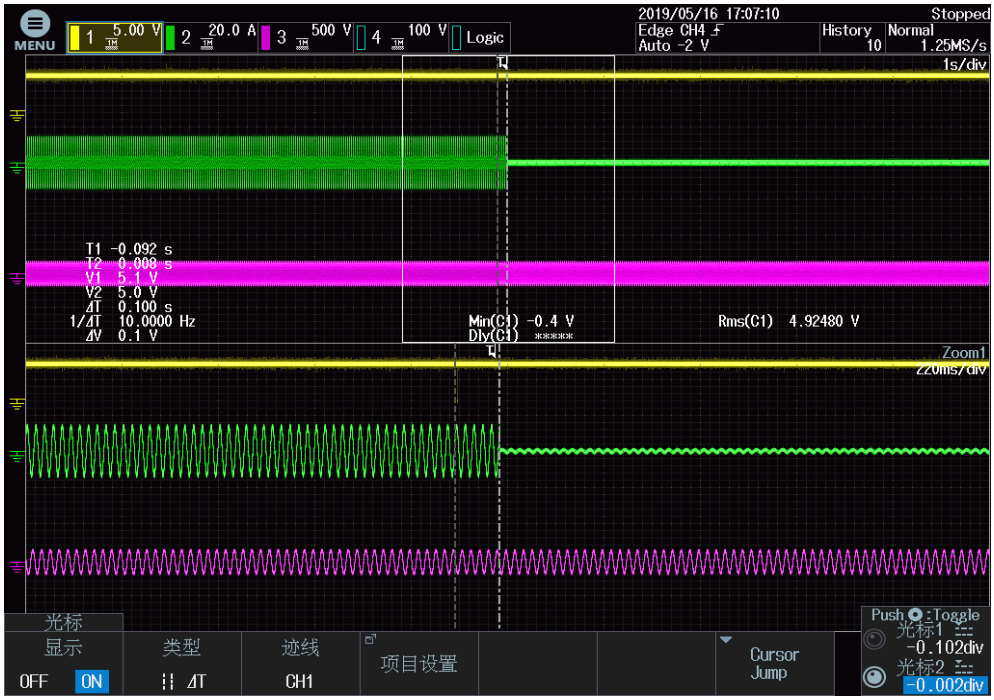
The tests were performed on model EA16KTSI also applicable for all other models stated in this report.

Disconnection Time - Under Voltage First Level

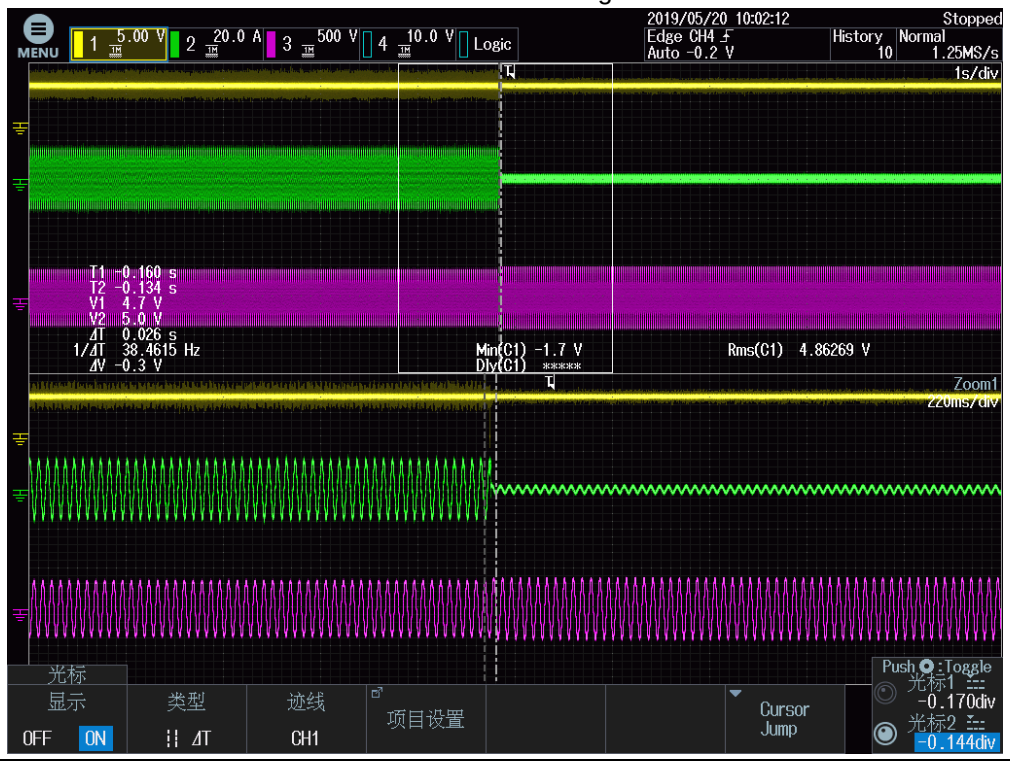
Disconnection Time - Over Voltage First Level



Disconnection Time - Under Voltage Second Level



Disconnection Time - Over Voltage Second Level



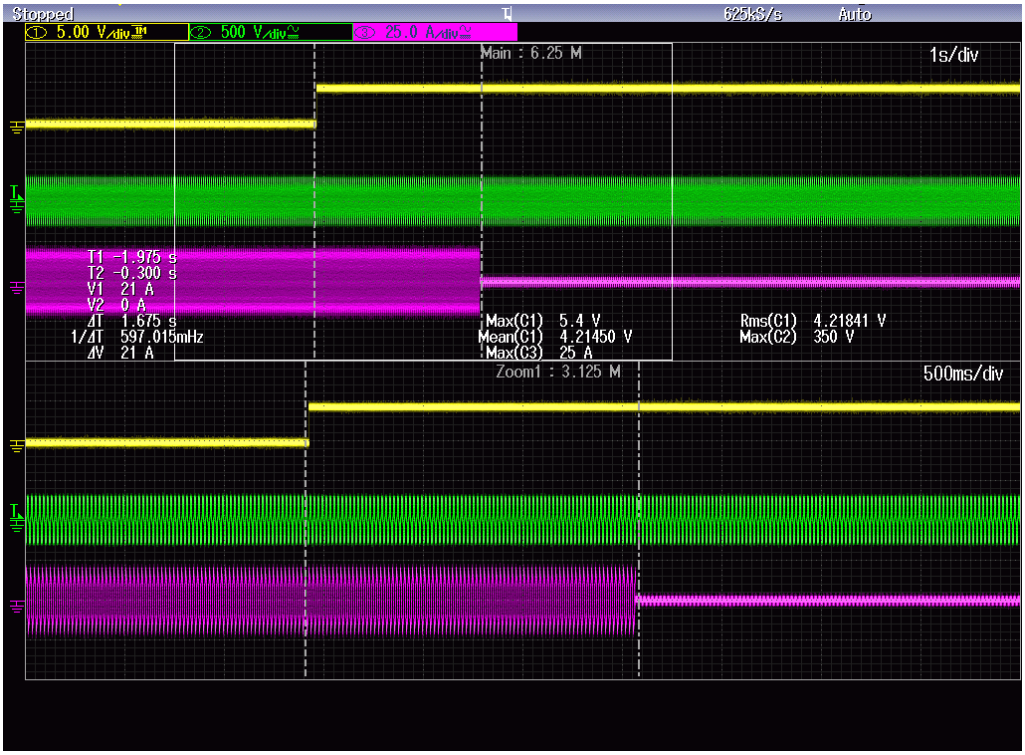
5.2.1	**TABLE: Over / under voltage test**						**P**
Model	**EA16KTSI, L2 phase**						
Output power	Under Voltage			Over Voltage			
First level							
Limit [V]	195.5			253.0			
Measured trip voltage [V]	195.2	195.5	195.1	253.0	253.1	253.3	
Disconnection time [s]	1.670	1.660	1.675	1.790	1.710	1.695	
Limit [s]	<= 2.0			<= 2.0			
Reconnection time [s]	78.36			77.56			
Limit [s]	20 < t < 300			20 < t < 300			
Second level							
Limit [V]	115.0			310.5			
Measured trip voltage [V]	115.2	115.0	114.8	310.3	310.5	310.2	
Disconnection time [s]	0.096	0.076	0.089	0.043	0.042	0.044	
Limit [s]	<= 0.1			<= 0.05			
Reconnection time [s]	75.58			76.08			
Limit [s]	20 < t < 300			20 < t < 300			

Supplementary information:

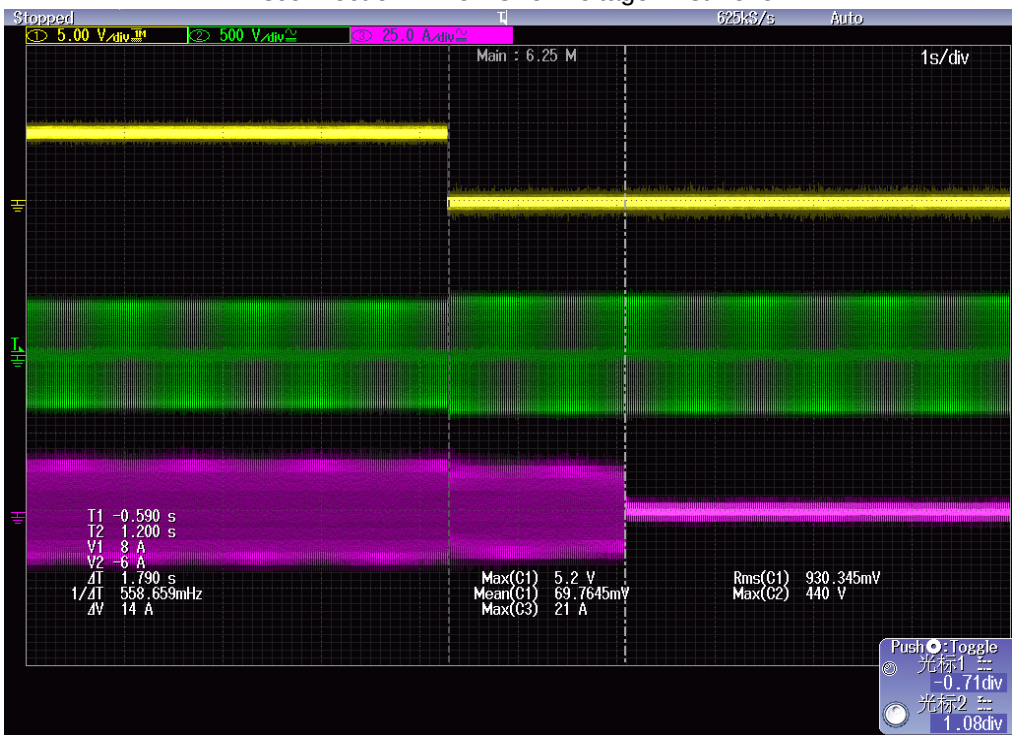
Trip time refers to the time between the abnormal condition occurring and the inverter ceasing to energize the utility line. The PV system control circuits shall actually remain connected to the utility to allow sensing of utility electrical conditions for use by the “reconnect” feature.

The tests were performed on model EA16KTSI also applicable for all other models stated in this report.

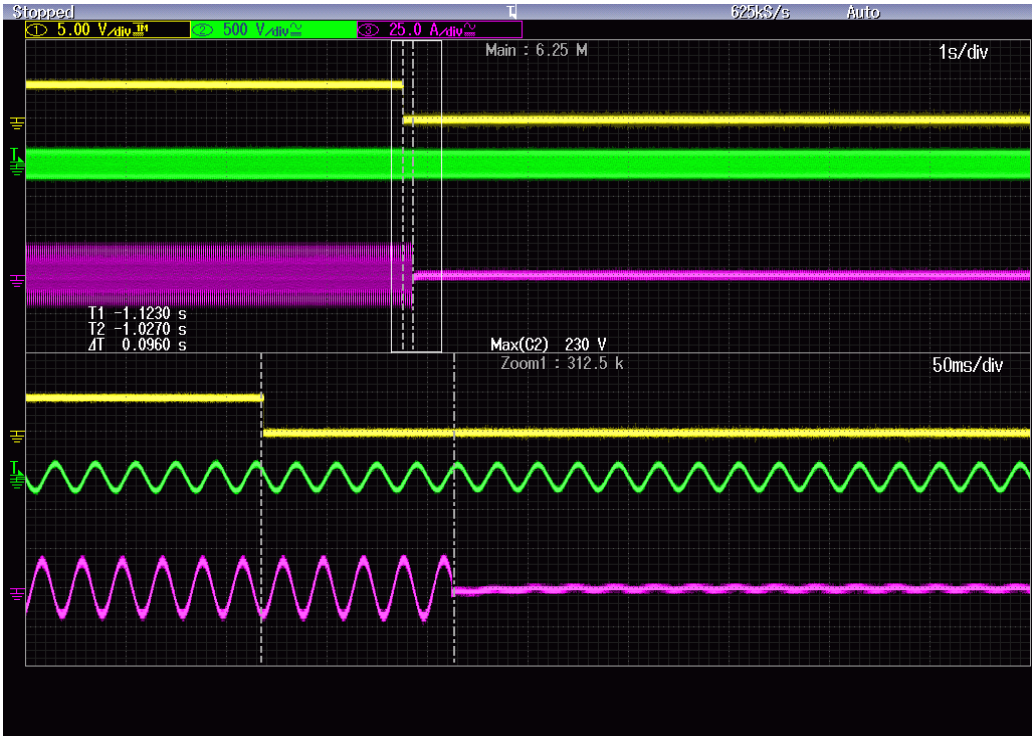
Disconnection Time - Under Voltage First Level



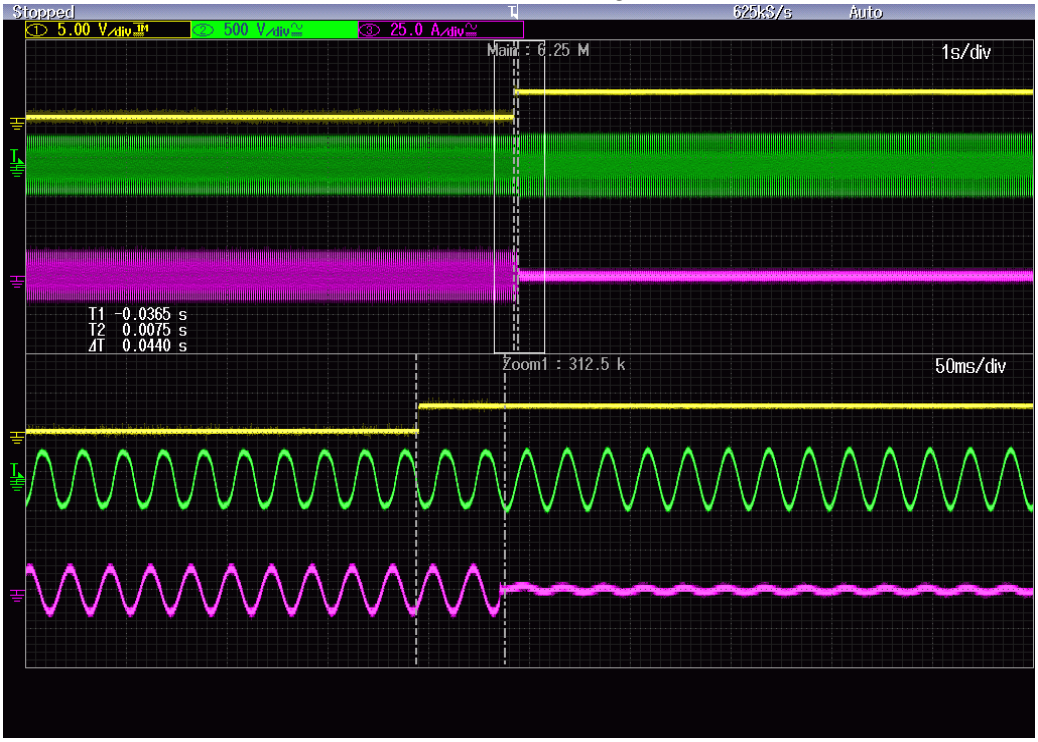
Disconnection Time - Over Voltage First Level



Disconnection Time - Under Voltage Second Level



Disconnection Time - Over Voltage Second Level



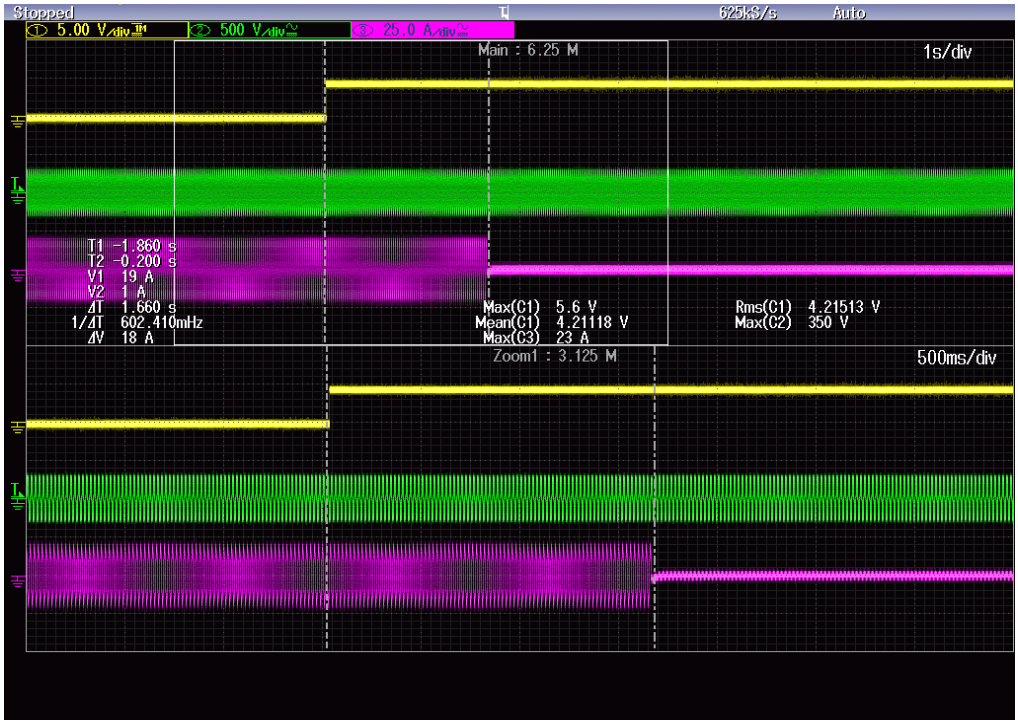
5.2.1	**TABLE: Over / under voltage test**						**P**
Model	**EA16KTSI, L3 phase**						
Output power	Under Voltage			Over Voltage			
First level							
Limit [V]	195.5			253.0			
Measured trip voltage [V]	195.6	195.4	195.2	253.3	253.4	253.3	
Disconnection time [s]	1.660	1.655	1.650	1.700	1.675	1.700	
Limit [s]	<= 2.0			<= 2.0			
Reconnection time [s]	78.36			78.86			
Limit [s]	20 < t < 300			20 < t < 300			
Second level							
Limit [V]	115.0			310.5			
Measured trip voltage [V]	115.0	114.6	114.5	310.8	310.5	310.7	
Disconnection time [s]	0.079	0.076	0.076	0.042	0.044	0.042	
Limit [s]	<= 0.1			<= 0.05			
Reconnection time [s]	75.38			75.78			
Limit [s]	20 < t < 300			20 < t < 300			

Supplementary information:

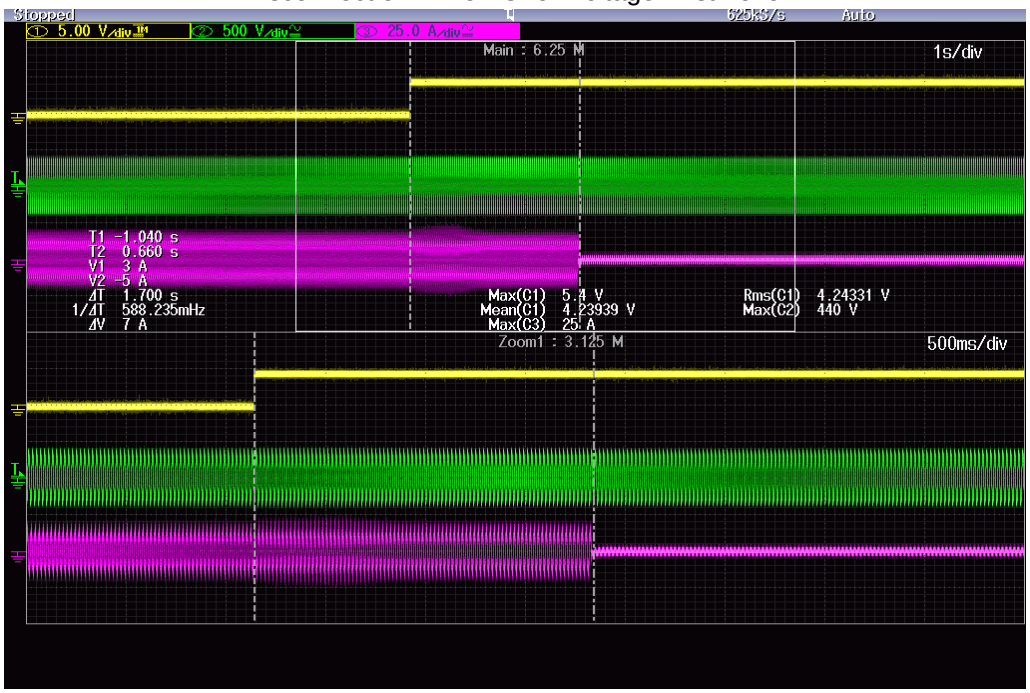
Trip time refers to the time between the abnormal condition occurring and the inverter ceasing to energize the utility line. The PV system control circuits shall actually remain connected to the utility to allow sensing of utility electrical conditions for use by the “reconnect” feature.

The tests were performed on model EA16KTSI also applicable for all other models stated in this report.

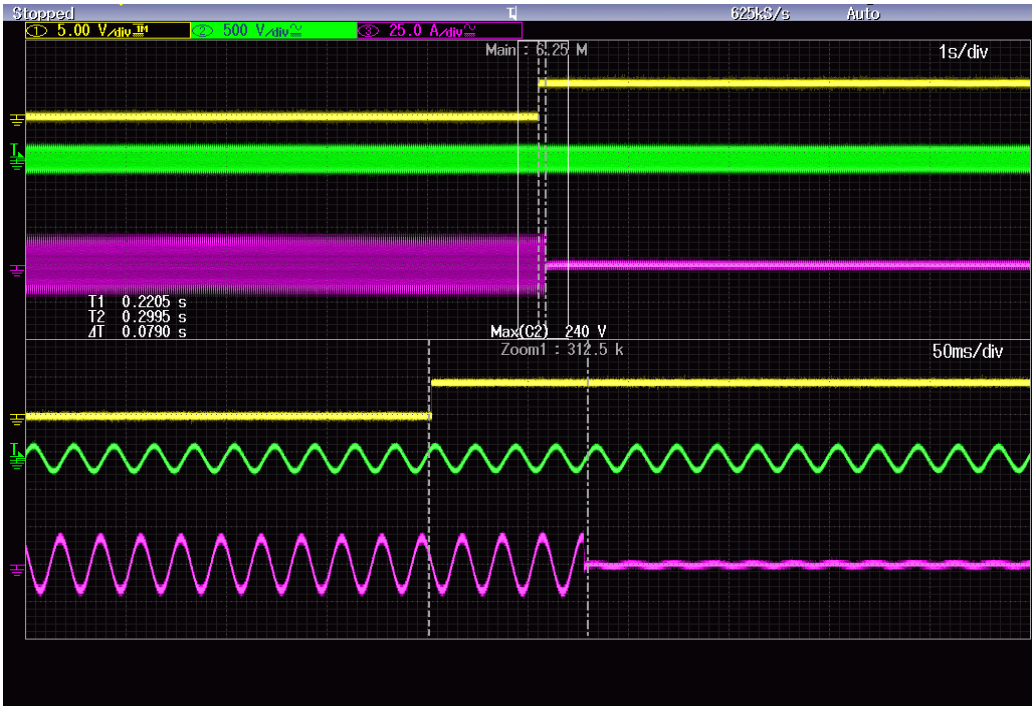
Disconnection Time - Under Voltage First Level



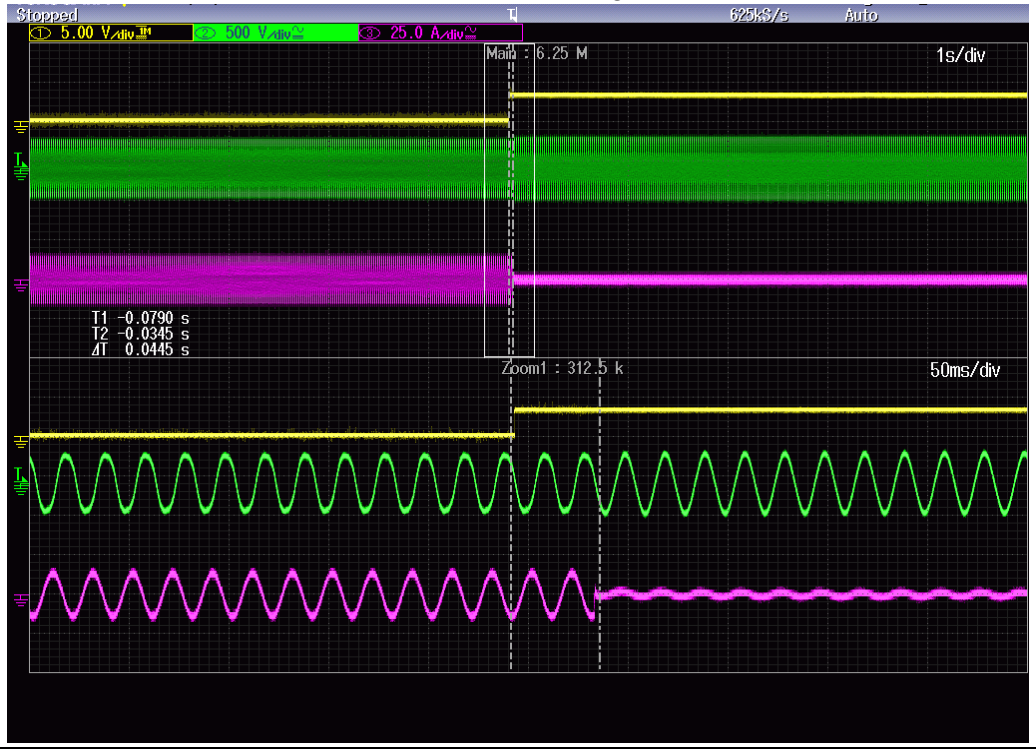
Disconnection Time - Over Voltage First Level



Disconnection Time - Under Voltage Second Level



Disconnection Time - Over Voltage Second Level



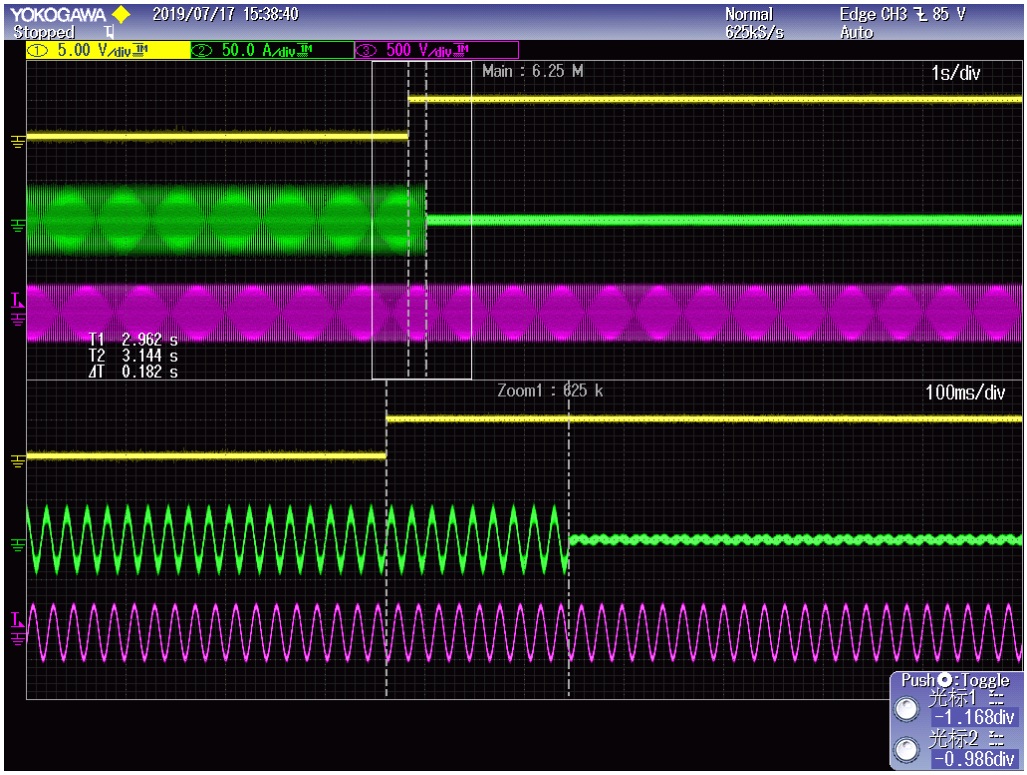
5.2.2	TABLE: Over / under frequency test					P
Output power	Under Frequency			Over Frequency		
Limit [Hz]	49.0			51.0		
Measured trip frequency [Hz]	48.97	48.96	48.97	51.04	51.03	51.03
Disconnection time [s]	0.182	0.155	0.177	0.133	0.168	0.142
Limit [s]	<= 0.2			<= 0.2		
Reconnection time [s]	76.08			75.78		
Limit [s]	20 < t < 300			20 < t < 300		

Supplementary information:

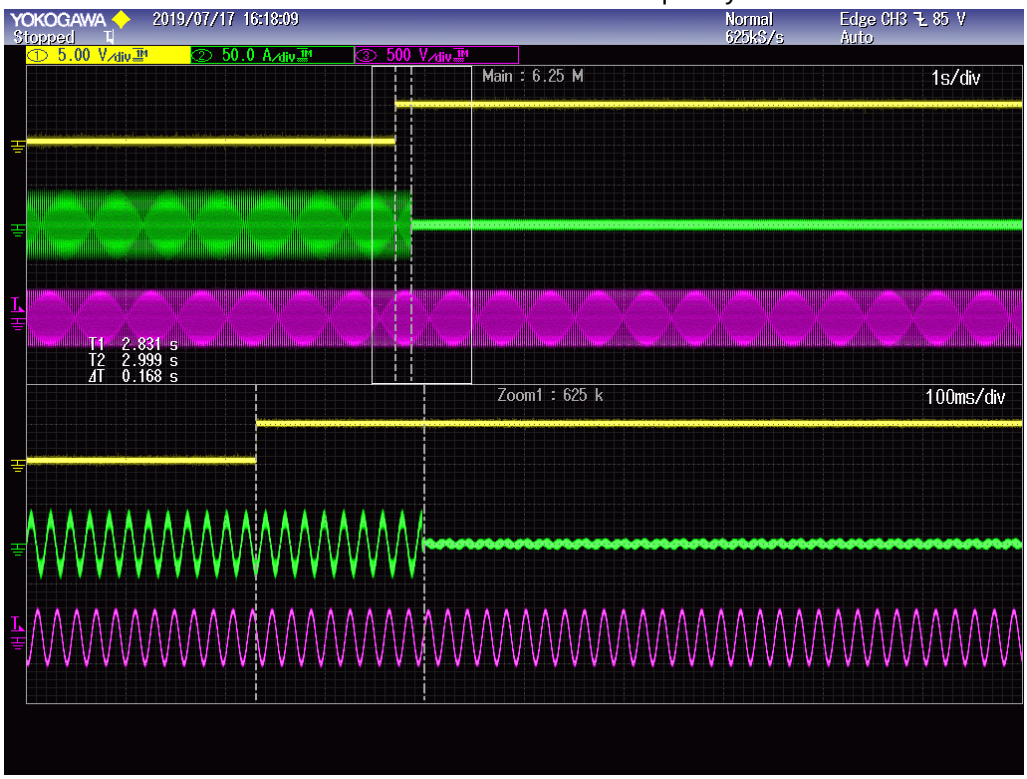
When the utility frequency is outside the range of ±1 Hz, the system shall cease to energize the utility line within 0.2 s. The purpose of the allowed range and time delay is to allow continued operation for short-term disturbances and to avoid excessive nuisance tripping in weak-utility system conditions.

The tests were performed on model EA16KTSI also applicable for all other models stated in this report.

Disconnection Time - Under Frequency



Disconnection Time - Over Frequency

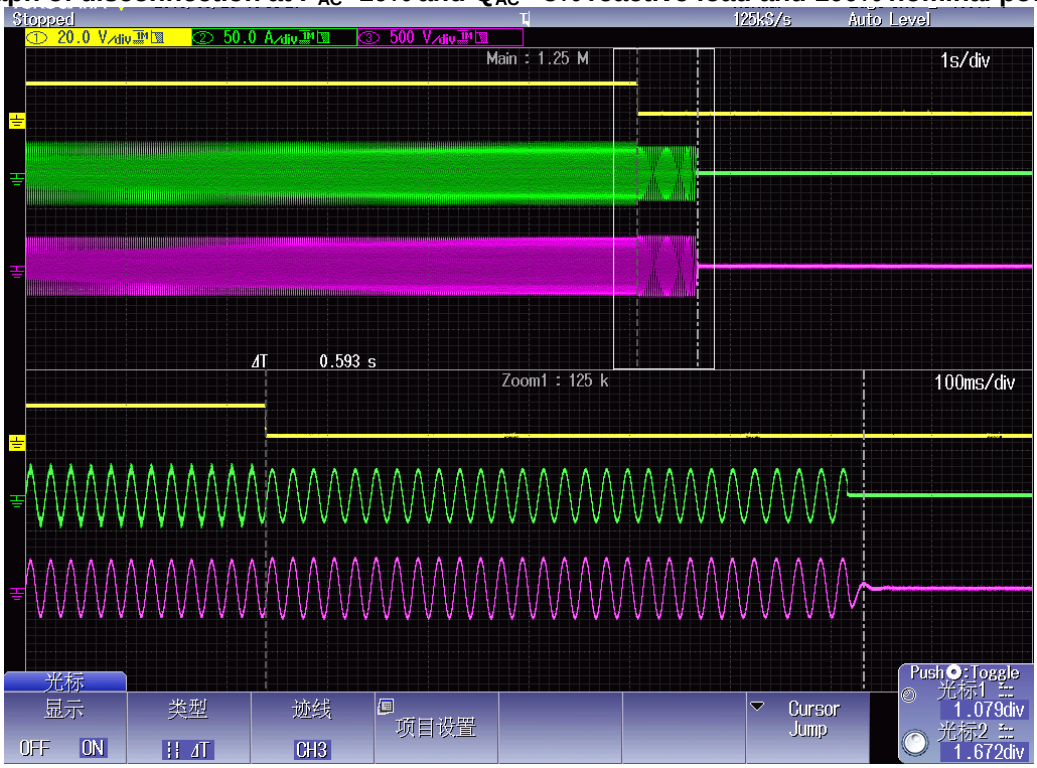


5.3	TABLE: Islanding protection - tested condition and run-on time – L1 phase								P
No.	P_{EUT} (% of EUT rating)	Reactive load (% of normial)	P_{AC}	Q_{AC}	Run-on time (ms)	P_{EUT} (W)	Actual Q_f (kVar)	V_{DC}	Remark
Test condition A									
1	100	100	0	0	263	5305	1.01	818	Test A at BL
2	100	100	0	- 5	224	5317	0.97	818	Test A at IB
3	100	100	0	+ 5	285	5250	1.04	817	Test A at IB
4	100	100	- 5	- 5	133	5216	1.04	817	Test A at IB
5	100	100	- 5	0	210	5305	1.08	818	Test A at IB
6	100	100	- 5	+ 5	239	5351	1.11	817	Test A at IB
7	100	100	+ 5	- 5	124	5335	0.93	817	Test A at IB
8	100	100	+ 5	0	494	5323	0.97	817	Test A at IB
9	100	100	+ 5	+ 5	253	5342	0.99	818	Test A at IB
10	100	100	- 5	- 10	110	5337	1.00	817	Test A at IB
11	100	100	- 5	+ 10	170	5326	1.14	817	Test A at IB
12	100	100	0	- 10	126	5310	0.94	817	Test A at IB
13	100	100	0	+ 10	176	5321	1.07	818	Test A at IB
14	100	100	+ 5	- 10	105	5330	0.90	817	Test A at IB
15	100	100	+ 5	+ 10	138	5319	1.02	818	Test A at IB
16	100	100	- 10	- 10	129	5318	1.06	818	Test A at IB
17	100	100	- 10	- 5	137	5343	1.10	818	Test A at IB
18	100	100	- 10	0	442	5337	1.14	818	Test A at IB
19	100	100	- 10	+ 5	593	5339	1.16	817	Test A at IB
20	100	100	- 10	+10	209	5350	1.20	817	Test A at IB
21	100	100	+ 10	- 10	134	5344	0.85	817	Test A at IB
22	100	100	+ 10	- 5	175	5364	0.88	817	Test A at IB
23	100	100	+ 10	0	214	5322	0.93	818	Test A at IB
24	100	100	+ 10	+ 5	370	5355	0.94	818	Test A at IB

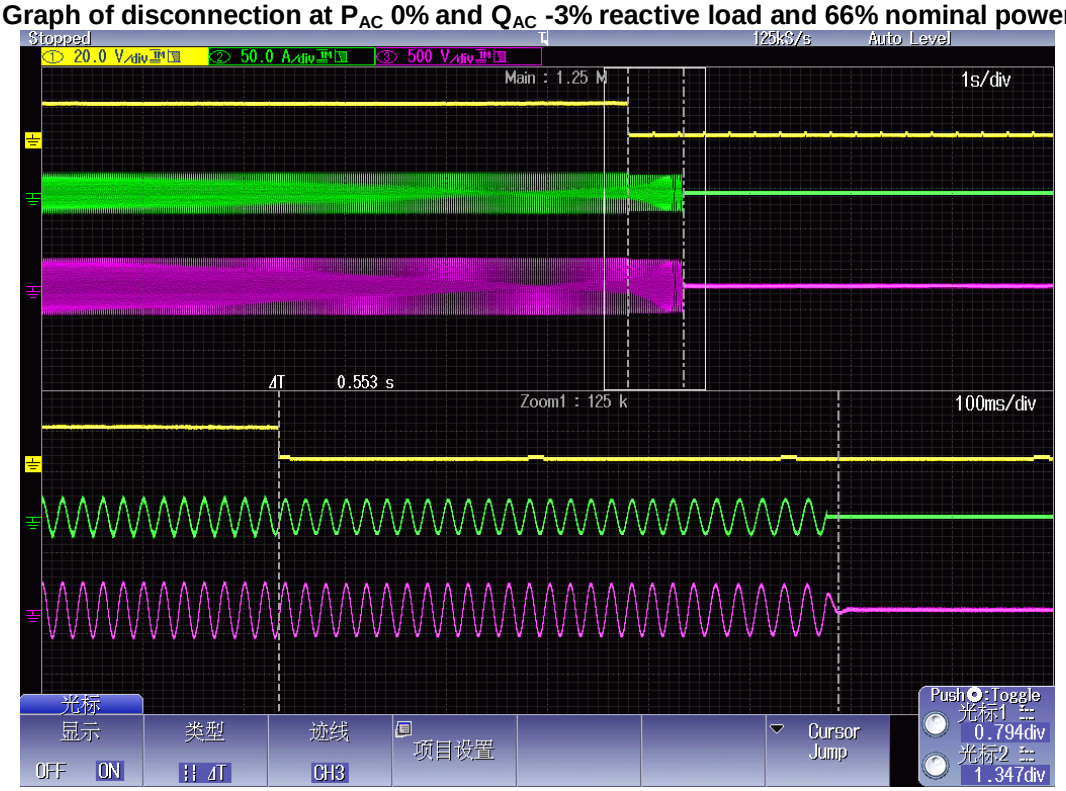
25	100	100	+ 10	+ 10	177	5341	0.98	818	Test A at IB
Test condition B									
1	66	66	0	- 5	382	3441	0.95	673	Test B at IB
2	66	66	0	- 4	341	3451	0.96	674	Test B at IB
3	66	66	0	- 3	553	3455	0.96	673	Test B at IB
4	66	66	0	- 2	247	3464	0.98	673	Test B at IB
5	66	66	0	- 1	353	3468	0.99	673	Test B at IB
6	66	66	0	0	549	3470	1.00	673	Test B at BL
7	66	66	0	+ 1	312	3477	1.00	673	Test B at IB
8	66	66	0	+ 2	233	3465	1.00	673	Test B at IB
9	66	66	0	+ 3	473	3448	1.00	673	Test B at IB
10	66	66	0	+ 4	214	3473	1.01	674	Test B at IB
11	66	66	0	+ 5	174	3455	1,02	674	Test B at IB
Test condition C									
1	33	33	0	- 5	420	1791	0.98	447	Test C at IB
2	33	33	0	- 4	602	1789	0.96	448	Test C at IB
3	33	33	0	- 3	382	1796	0.97	448	Test C at IB
4	33	33	0	- 2	443	1787	0.97	448	Test C at IB
5	33	33	0	- 1	503	1794	0.98	448	Test C at IB
6	33	33	0	0	220	1791	1.00	448	Test C at BL
7	33	33	0	+ 1	203	1792	1.02	449	Test C at IB
8	33	33	0	+ 2	239	1795	1.02	448	Test C at IB
9	33	33	0	+ 3	322	1793	1.03	448	Test C at IB
10	33	33	0	+ 4	187	1794	1.04	448	Test C at IB
11	33	33	0	+ 5	162	1794	1.07	448	Test C at IB

Remark:
For test condition A:
If any of the recorded run-on times are longer than the one recorded for the rated balance condition, then the non-shaded parameter combinations also require testing.
For test condition B and C:
If run-on times are still increasing at the 95 % or 105 % points, additional 1 % increments is taken until run-on times begin decreasing.
The tests were performed on model EA16KTSI also applicable for all other models stated in this report.

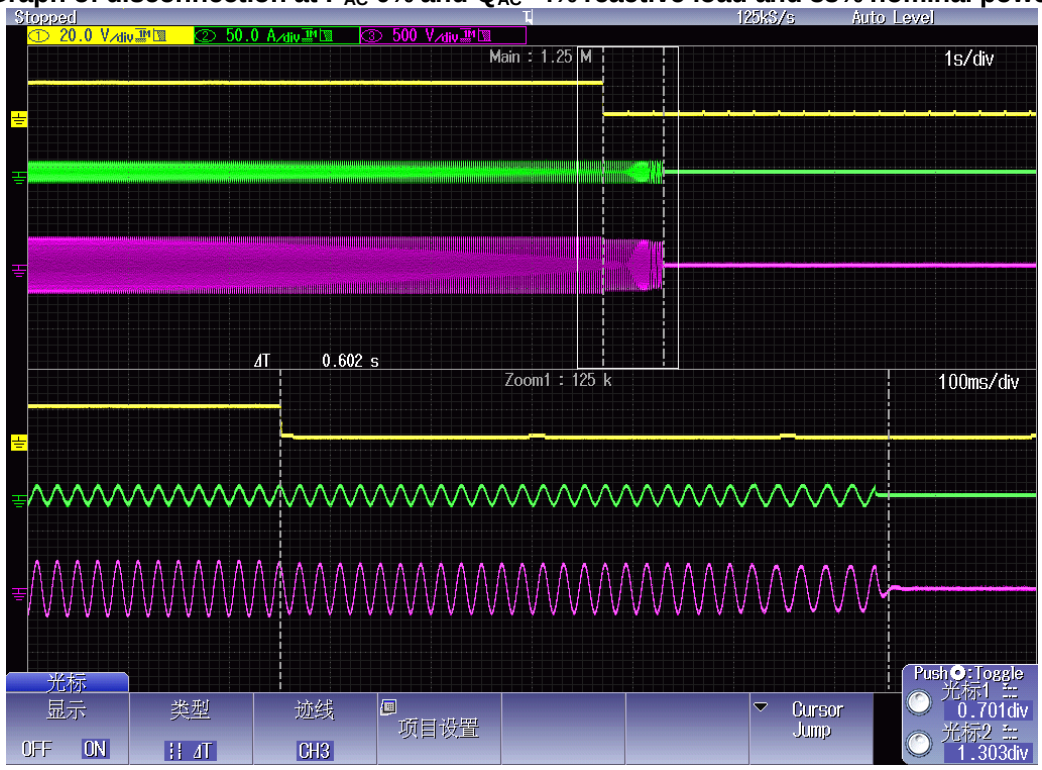
Graph of disconnection at P_{AC} -10% and Q_{AC} +5% reactive load and 100% nominal power



Graph of disconnection at P_{AC} 0% and Q_{AC} -3% reactive load and 66% nominal power



Graph of disconnection at P_{AC} 0% and Q_{AC} -4% reactive load and 33% nominal power

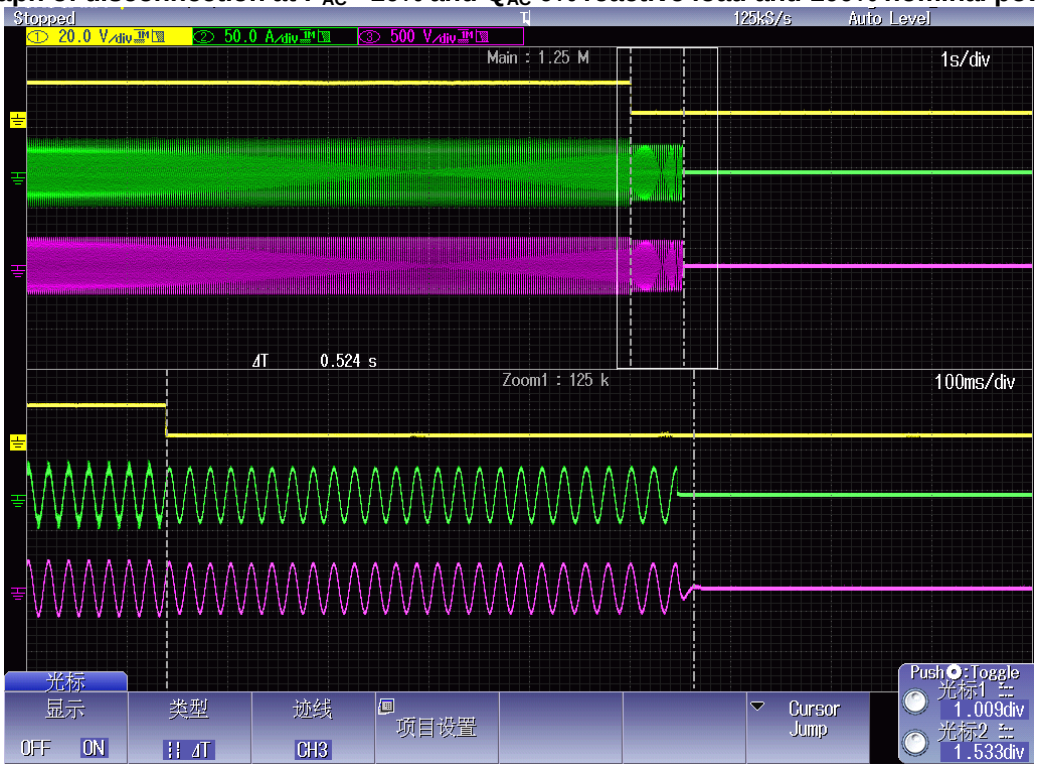


5.3	TABLE: Islanding protection - tested condition and run-on time – L2 phase								P
No.	P_{EUT} (% of EUT rating)	Reactive load (% of normial)	P_{AC}	Q_{AC}	Run-on time (ms)	P_{EUT} (W)	Actual Q_f (kVar)	V_{DC}	Remark
Test condition A									
1	100	100	0	0	219	5326	1.01	818	Test A at BL
2	100	100	0	- 5	312	5303	0.99	817	Test A at IB
3	100	100	0	+ 5	155	5266	1.04	818	Test A at IB
4	100	100	- 5	- 5	233	5284	1.05	818	Test A at IB
5	100	100	- 5	0	369	5288	1.08	818	Test A at IB
6	100	100	- 5	+ 5	206	5270	1.10	818	Test A at IB
7	100	100	+ 5	- 5	183	5276	0.95	818	Test A at IB
8	100	100	+ 5	0	444	5268	0.97	817	Test A at IB
9	100	100	+ 5	+ 5	393	5294	1.00	818	Test A at IB
10	100	100	- 5	- 10	143	5289	1.03	818	Test A at IB
11	100	100	- 5	+ 10	161	5281	1.13	817	Test A at IB
12	100	100	0	- 10	140	5285	0.97	818	Test A at IB
13	100	100	0	+ 10	148	5291	1.08	818	Test A at IB
14	100	100	+ 5	- 10	152	5277	0.93	817	Test A at IB
15	100	100	+ 5	+ 10	156	5277	1.02	818	Test A at IB
16	100	100	- 10	- 10	160	5279	1.08	818	Test A at IB
17	100	100	- 10	- 5	280	5279	1.11	818	Test A at IB
18	100	100	- 10	0	380	5254	1.12	818	Test A at IB
19	100	100	- 10	+ 5	470	5260	1.16	818	Test A at IB
20	100	100	- 10	+10	201	5267	1.20	817	Test A at IB
21	100	100	+ 10	- 10	137	5238	0.89	818	Test A at IB
22	100	100	+ 10	- 5	218	5257	0.91	818	Test A at IB
23	100	100	+ 10	0	524	5240	0.93	818	Test A at IB
24	100	100	+ 10	+ 5	264	5255	0.95	817	Test A at IB

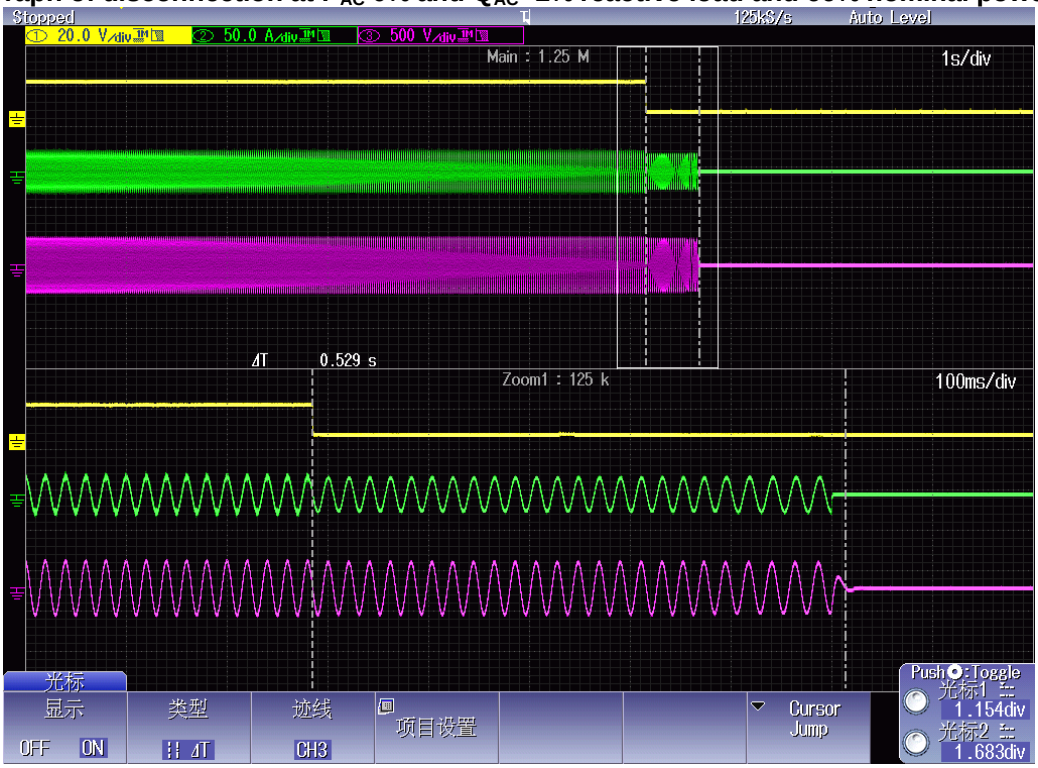
25	100	100	+ 10	+ 10	177	5257	0.98	817	Test A at IB
Test condition B									
1	66	66	0	- 5	358	3529	0.98	673	Test B at IB
2	66	66	0	- 4	365	3549	0.98	674	Test B at IB
3	66	66	0	- 3	242	3546	0.99	673	Test B at IB
4	66	66	0	- 2	529	3537	0.99	673	Test B at IB
5	66	66	0	- 1	363	3555	1.00	673	Test B at IB
6	66	66	0	0	467	3543	1.00	674	Test B at BL
7	66	66	0	+ 1	293	3534	1.01	673	Test B at IB
8	66	66	0	+ 2	273	3549	1.01	673	Test B at IB
9	66	66	0	+ 3	224	3537	1.01	673	Test B at IB
10	66	66	0	+ 4	278	3553	1.02	673	Test B at IB
11	66	66	0	+ 5	272	3553	1.02	673	Test B at IB
Test condition C									
1	33	33	0	- 5	509	1770	0.98	448	Test C at IB
2	33	33	0	- 4	425	1772	0.98	449	Test C at IB
3	33	33	0	- 3	546	1773	0.99	448	Test C at IB
4	33	33	0	- 2	409	1776	1.00	448	Test C at IB
5	33	33	0	- 1	396	1775	1.00	449	Test C at IB
6	33	33	0	0	374	1773	1.00	448	Test C at BL
7	33	33	0	+ 1	364	1777	1.01	448	Test C at IB
8	33	33	0	+ 2	292	1776	1.02	448	Test C at IB
9	33	33	0	+ 3	258	1776	1.02	449	Test C at IB
10	33	33	0	+ 4	258	1779	1.02	448	Test C at IB
11	33	33	0	+ 5	164	1777	1.03	448	Test C at IB

Remark:
For test condition A:
If any of the recorded run-on times are longer than the one recorded for the rated balance condition, then the non-shaded parameter combinations also require testing.
For test condition B and C:
If run-on times are still increasing at the 95 % or 105 % points, additional 1 % increments is taken until run-on times begin decreasing.
The tests were performed on model EA16KTSI also applicable for all other models stated in this report.

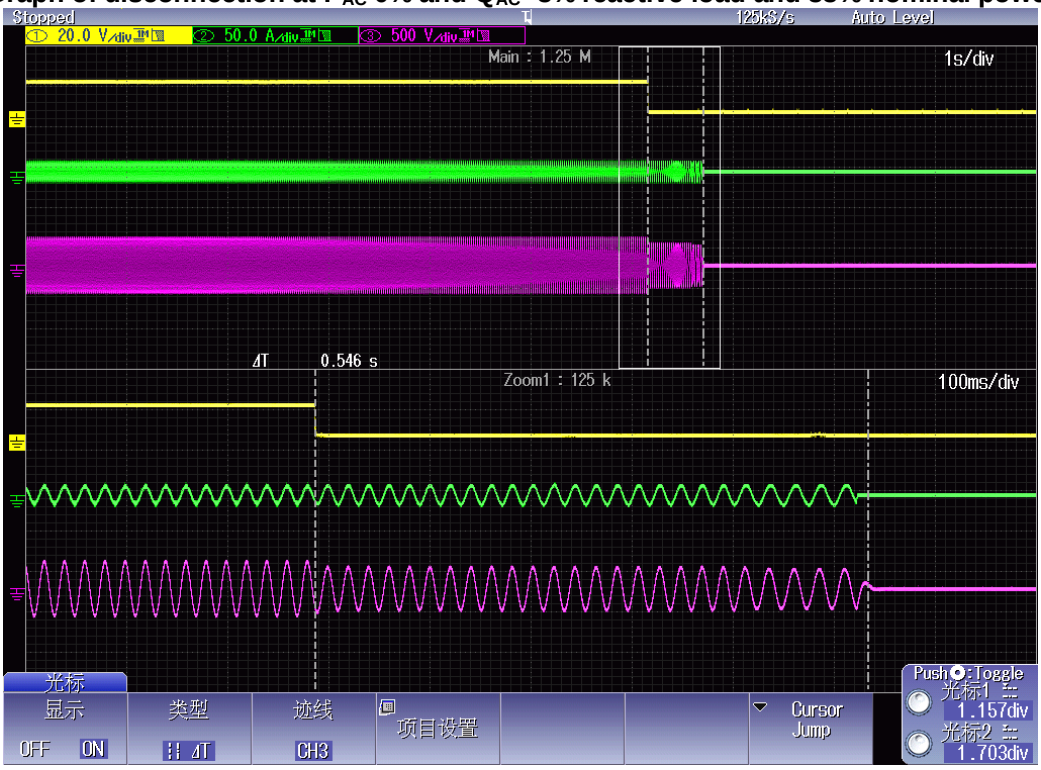
Graph of disconnection at P_{AC} +10% and Q_{AC} 0% reactive load and 100% nominal power



Graph of disconnection at P_{AC} 0% and Q_{AC} -2% reactive load and 66% nominal power



Graph of disconnection at P_{AC} 0% and Q_{AC} -3% reactive load and 33% nominal power

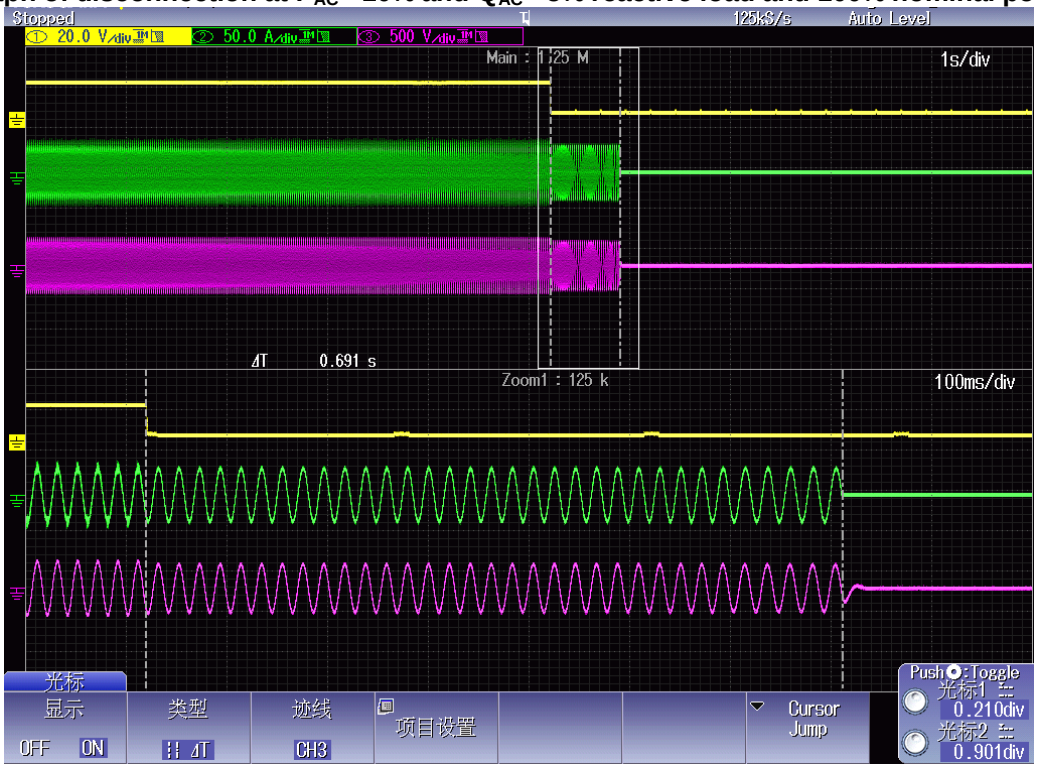


5.3	TABLE: Islanding protection - tested condition and run-on time – L3 phase								P
No.	P_{EUT} (% of EUT rating)	Reactive load (% of normial)	P_{AC}	Q_{AC}	Run-on time (ms)	P_{EUT} (W)	Actual Q_f (kVar)	V_{DC}	Remark
Test condition A									
1	100	100	0	0	213	5248	1.00	818	Test A at BL
2	100	100	0	- 5	172	5218	0.95	818	Test A at IB
3	100	100	0	+ 5	502	5231	1.01	818	Test A at IB
4	100	100	- 5	- 5	170	5244	1.01	817	Test A at IB
5	100	100	- 5	0	415	5249	1.05	818	Test A at IB
6	100	100	- 5	+ 5	241	5254	1.06	818	Test A at IB
7	100	100	+ 5	- 5	159	5264	0.91	818	Test A at IB
8	100	100	+ 5	0	454	5243	0.94	818	Test A at IB
9	100	100	+ 5	+ 5	217	5234	0.95	817	Test A at IB
10	100	100	- 5	- 10	132	5237	0.99	817	Test A at IB
11	100	100	- 5	+ 10	198	5248	1.09	818	Test A at IB
12	100	100	0	- 10	143	5223	0.94	817	Test A at IB
13	100	100	0	+ 10	189	5246	1.03	817	Test A at IB
14	100	100	+ 5	- 10	149	5228	0.90	817	Test A at IB
15	100	100	+ 5	+ 10	160	5244	0.99	817	Test A at IB
16	100	100	- 10	- 10	149	5239	1.04	818	Test A at IB
17	100	100	- 10	- 5	160	5234	1.05	817	Test A at IB
18	100	100	- 10	0	376	5230	1.11	817	Test A at IB
19	100	100	- 10	+ 5	573	5207	1,11	817	Test A at IB
20	100	100	- 10	+10	218	5243	1.15	817	Test A at IB
21	100	100	+ 10	- 10	137	5234	0.86	817	Test A at IB
22	100	100	+ 10	- 5	145	5225	0.87	817	Test A at IB
23	100	100	+ 10	0	496	5255	0.90	818	Test A at IB
24	100	100	+ 10	+ 5	691	5239	0.91	817	Test A at IB

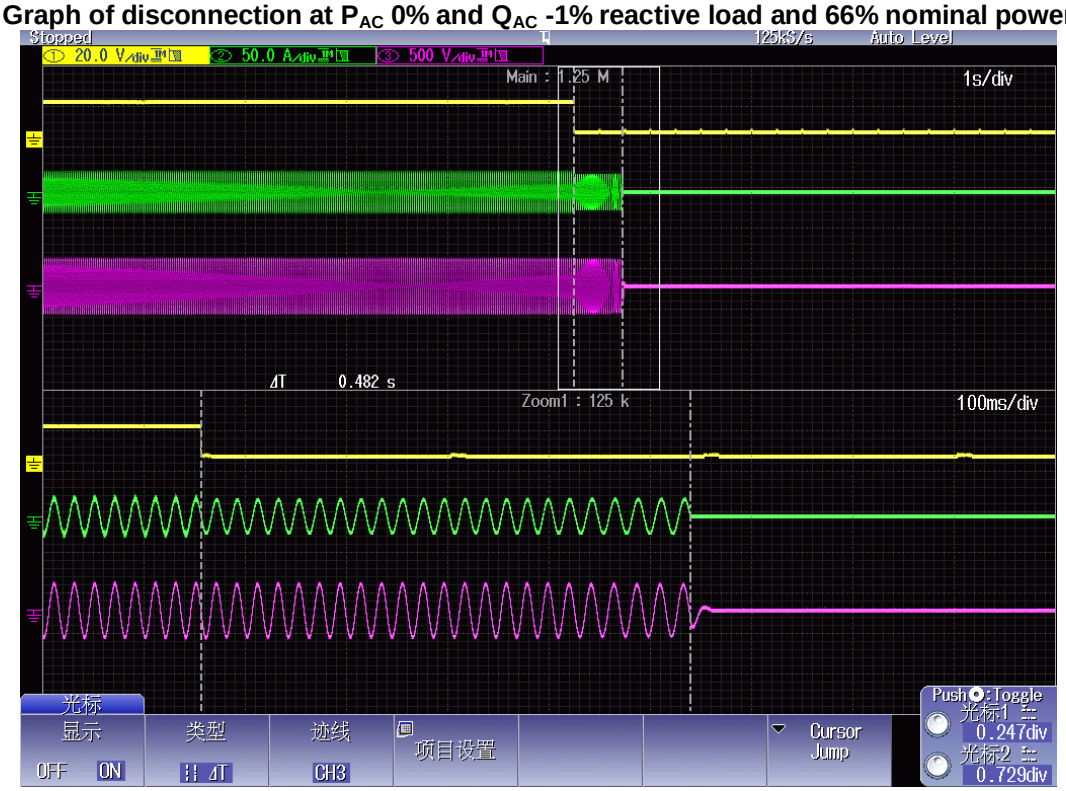
25	100	100	+ 10	+ 10	151	5245	0.95	817	Test A at IB
Test condition B									
1	66	66	0	- 5	303	3515	0.95	673	Test B at IB
2	66	66	0	- 4	327	3526	0.95	673	Test B at IB
3	66	66	0	- 3	347	3532	0.96	673	Test B at IB
4	66	66	0	- 2	216	3519	0.97	674	Test B at IB
5	66	66	0	- 1	482	3549	0.98	673	Test B at IB
6	66	66	0	0	165	3523	1.01	673	Test B at BL
7	66	66	0	+ 1	220	3546	1.01	673	Test B at IB
8	66	66	0	+ 2	324	3531	1.01	673	Test B at IB
9	66	66	0	+ 3	311	3540	1.01	673	Test B at IB
10	66	66	0	+ 4	169	3543	1.01	673	Test B at IB
11	66	66	0	+ 5	180	3545	1.02	673	Test B at IB
Test condition C									
1	33	33	0	- 5	170	1756	0.99	448	Test C at IB
2	33	33	0	- 4	217	1767	0.99	448	Test C at IB
3	33	33	0	- 3	230	1768	0.99	448	Test C at IB
4	33	33	0	- 2	498	1771	0.99	448	Test C at IB
5	33	33	0	- 1	490	1749	0.99	448	Test C at IB
6	33	33	0	0	394	1771	1.01	448	Test C at BL
7	33	33	0	+ 1	307	1765	1.02	448	Test C at IB
8	33	33	0	+ 2	188	1776	1,03	448	Test C at IB
9	33	33	0	+ 3	253	1770	1.04	448	Test C at IB
10	33	33	0	+ 4	157	1758	1.07	448	Test C at IB
11	33	33	0	+ 5	165	1770	1.08	448	Test C at IB

Remark:
For test condition A:
If any of the recorded run-on times are longer than the one recorded for the rated balance condition, then the non-shaded parameter combinations also require testing.
For test condition B and C:
If run-on times are still increasing at the 95 % or 105 % points, additional 1 % increments is taken until run-on times begin decreasing.
The tests were performed on model EA16KTSI also applicable for all other models stated in this report.

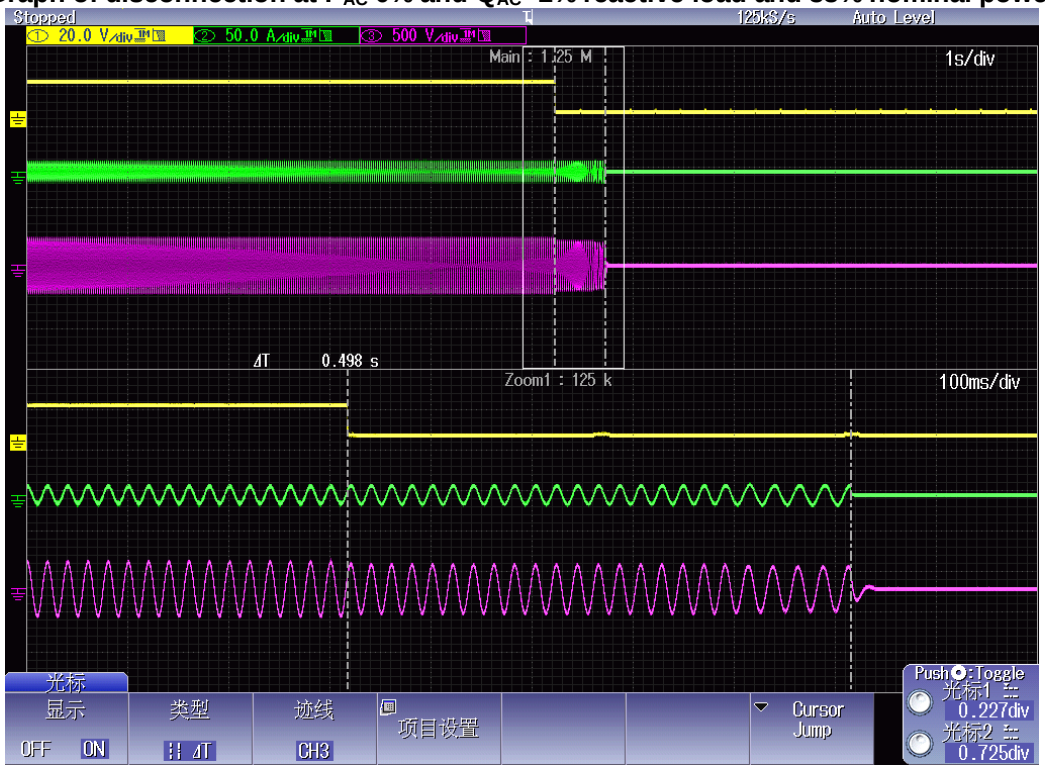
Graph of disconnection at P_{AC} +10% and Q_{AC} +5% reactive load and 100% nominal power



Graph of disconnection at P_{AC} 0% and Q_{AC} -1% reactive load and 66% nominal power



Graph of disconnection at P_{AC} 0% and Q_{AC} -2% reactive load and 33% nominal power



--- End of test report---