

SEMI F47
Voltage Sag Immunity Test Report
for
Power Supply QS10.121



Other devices covered by this report:

QS10.121-ww	Standard units
ww: blank	Standard Units
C1	Version with conformal coated pc-boards
A1	Version with conformal coated pc-boards and ATEX/IECEx approval

SEMI F47 Test Report

Document Number	QS10.121 Semi F47 Rev2 TR1
Approval Order Number	LAB 20-805
Standards	SEMI F47-0706 (July 2006) SPECIFICATION FOR SEMICONDUCTOR PROCESSING EQUIPMENT - Voltage Sag Immunity Compliance Tests IEC 61000-4-11 2004 +A1:2017 Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase
Applicant	PULS GmbH Elektrastraße 6 81925 Munich, Germany
Test Laboratory	PULS Vario GmbH Kranichberggasse 6 1120 Vienna, Austria
Test Engineer	Thomas Ramel
Test Date	25.06.2020 - 03.08.2020
Description of Test Device	Built-in power supplies for DIN-Rail mounting
Devices under Evaluation	QS10.121 Input: AC 100-240V, Output: DC 12-15V, 15A
S/N of Devices	QS10.121: S/N: 19958868 A
Application Details	Input voltage: 1-Phase AC 120V, 208V Input frequency: 50 or 60Hz Output load: 180W

PASS/FAIL Criteria:

In accordance with paragraph 7.8.2 a) of SEMI F47-0706
The output voltage is not allowed to deviated more than 5% of the initial value
DC OK contact is not allowed to trigger during and after the test

Test Result:

PASS

The test device passed all essential SEMI F47-0706 tests according to the defined application details without any limitations and is qualified to bear the following approval mark:



Since DC power supplies, as covered in this test report, are only components of a semiconductor processing equipment, the tests of the SEMI F47 standard were conducted with selected rated characteristics of the DC power supply.

The system integrator of the final semiconductor processing equipment needs to judge if the results of this test report are compatible with the SEMI F47 requirements of his system or if test data under other operating conditions are additionally required.

The system integrator also needs to judge if the results of the inrush current peaks are compatible with the selected external fuses for input protection.

The system integrator also needs to be aware about aging effects. It is expected that the ride through time can be reduced by 15% at end of the specified lifetime expectancy.

A SEMI F47 certificate is not intended for this type of component, however the product fulfils the general requirements and can be marked with the following symbol.

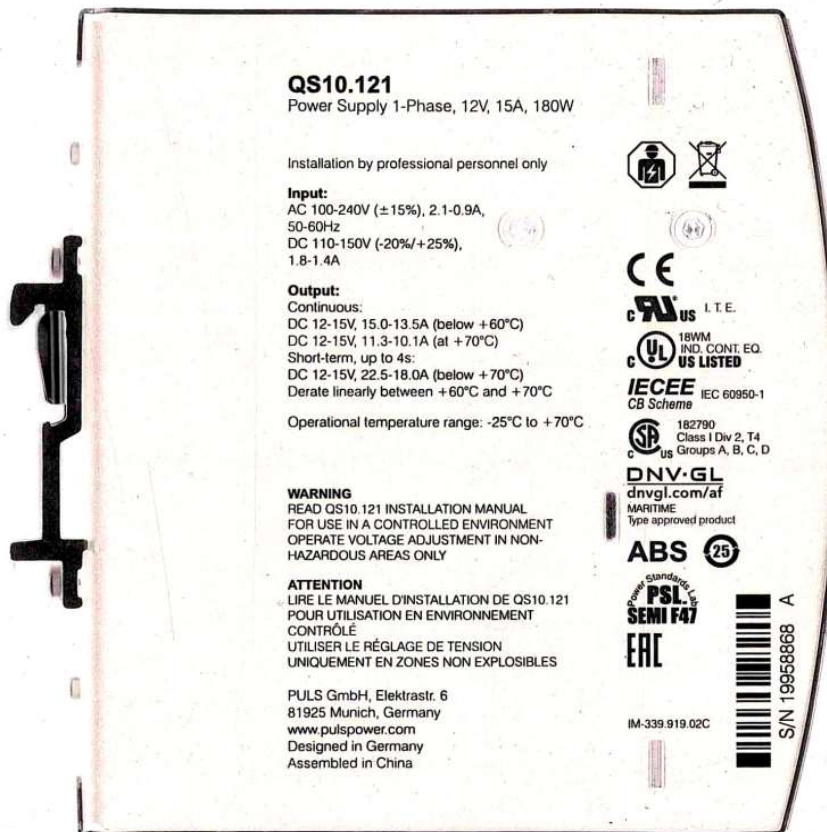
Approved

Harald Etlinger
Sr. Qualification Eng.
PULS Vario GmbH, Vienna

Date of Approval

03.08.2020

Copy of marking plate:



List of Test Equipment

Type	Model	Inventory number
Test generator	Kikusui PCR3000WE2	10381
el. Load	el. Load Chroma 63201	10046
Oscilloscope	LeCroy WS454	10130
Oscilloscope	LeCroy WS424	10127
Differential Probe	Lecroy	10246
Current Probe	LeCroy CP30	10378

The test equipment complies with the requirements of IEC 61000-4-11.

The peak current capability of the test generator was evaluated according Annex A of IEC 61000-4-11 and is able to deliver minimum 32.7A.

Test Specification for SEMI F47 compliance

Voltage Sag Immunity according to the following table:

Sag depth#1	Duration	Duration at 50 Hz	Duration at 60 Hz
50%	200ms	10 cycles	12 cycles
70%	500ms	25 cycles	30 cycles
80%	1000ms	50 cycles	60 cycles

#1 Sag depth is expressed in percent of remaining nominal voltage. For example, during a 70% voltage sag on a 200 volt nominal system, the voltage is reduced during the sag to 140 volts and not 60 volts.

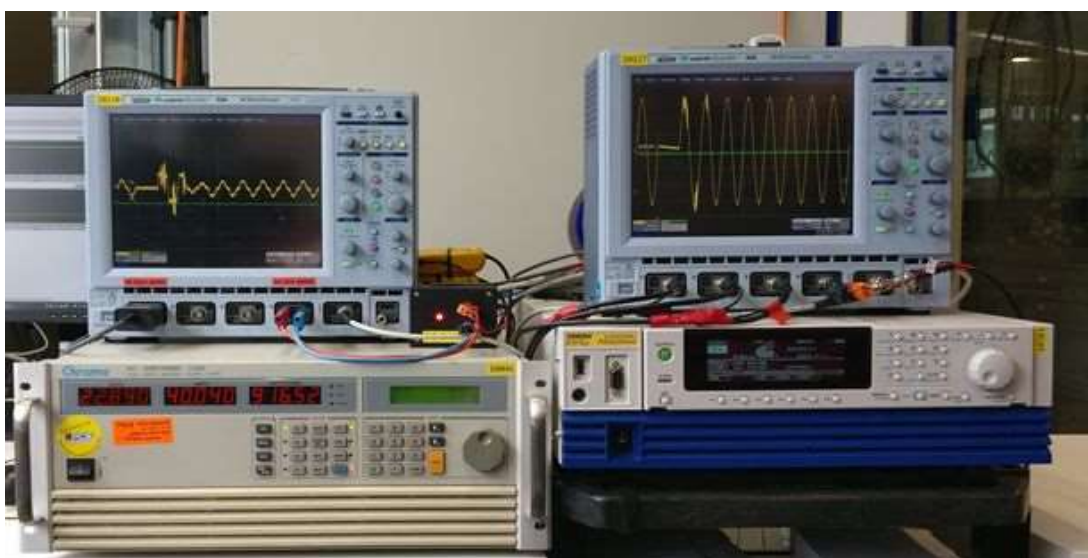
Test Setup

The unit under test in normal operating condition mounted in climate chamber.

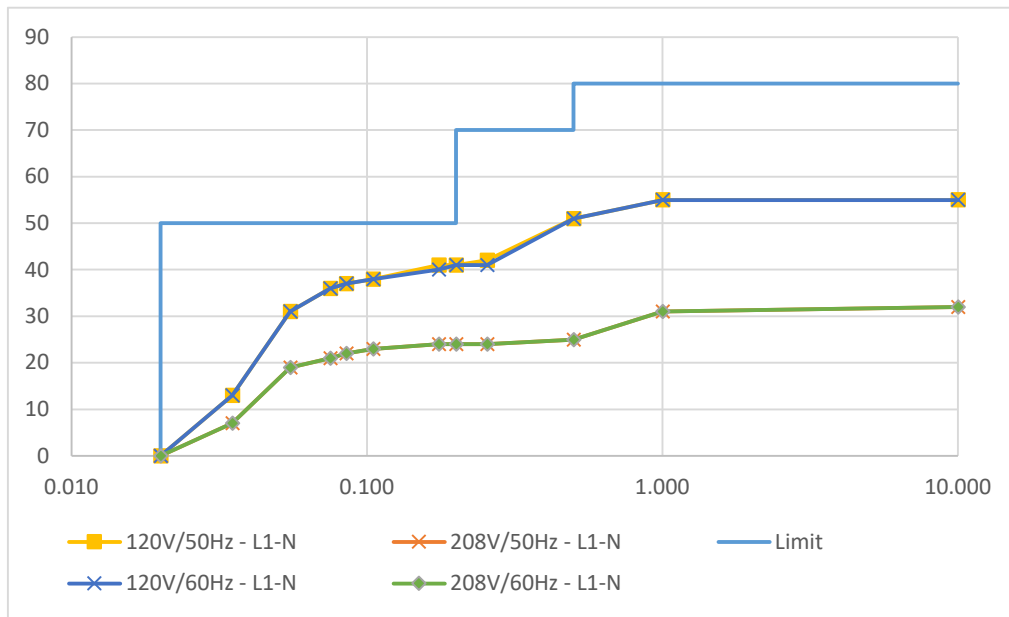
The input is connected to an AC Source. The input voltage is measured with a 100:1 differential probe and the input current is measured with current probes. These probes are connected to oscilloscopes.

The output is connected to an active load. The output voltage is connected directly to the oscilloscope. "DC-OK" signal is also measured with an oscilloscope.

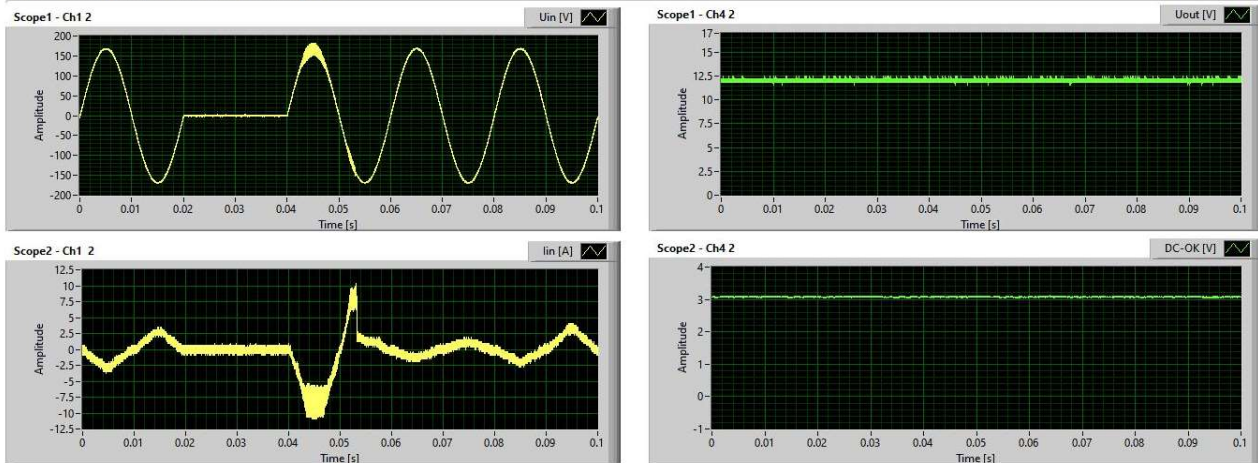
Input and output voltages are measured with oscilloscope #1 and input currents with oscilloscope #2.



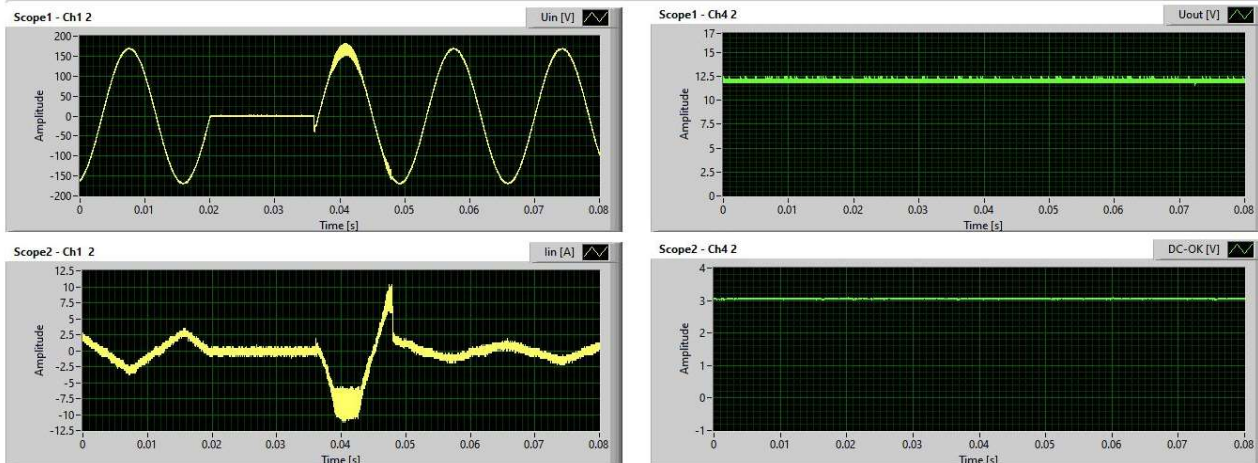
Voltage Sag Results



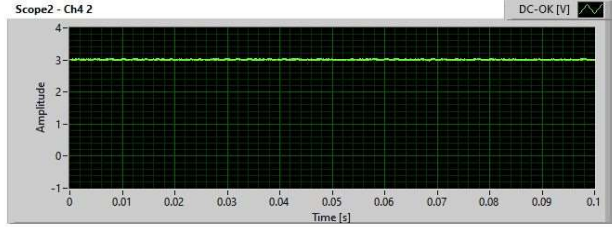
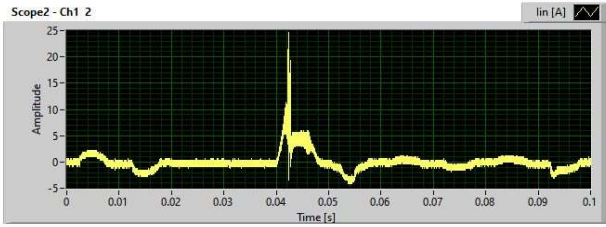
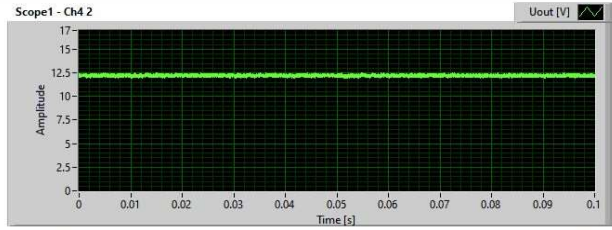
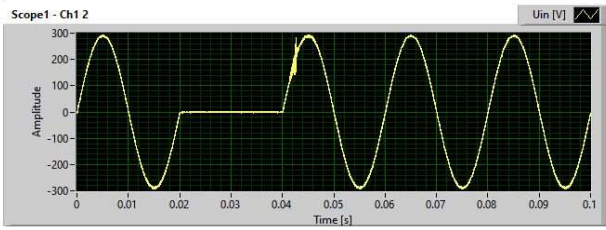
25°C Norm 120V 50Hz 0.020s 0% L1-N 0°



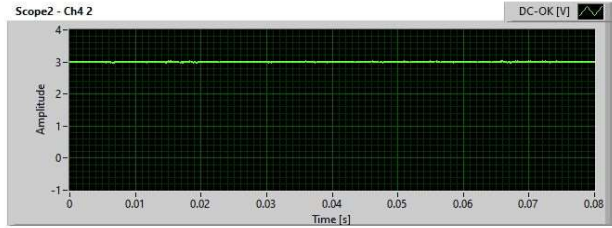
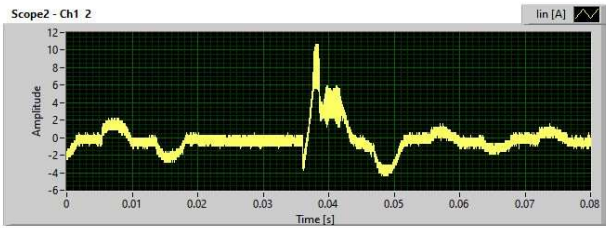
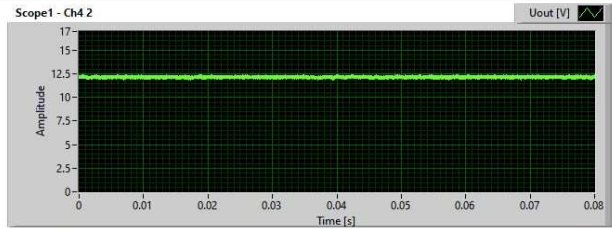
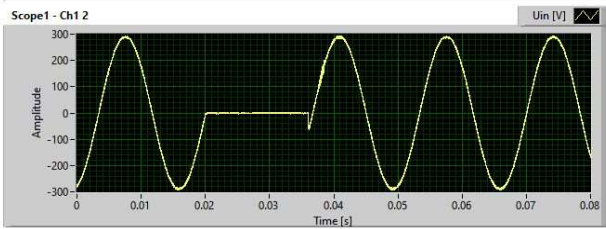
25°C Norm 120V 60Hz 0.016s 0% L1-N 0°



25°C Norm 208V 50Hz 0.020s 0% L1-N 0°



25°C Norm 208V 60Hz 0.016s 0% L1-N 0°



Conducted Tests at 120V 50Hz

Input Voltage 120Vac
 Input Frequency 50Hz
 Output Voltage 12V
 Output Current 15A
 Ambient Temperature 25°C

Sag duration [s]	Voltage remaining [%]	Pos. peak current [A]	Neg. peak current [A]
0.020	0	10.3	-10.9
0.200	50	9.1	-10.3
0.500	70	5.6	-6.2
1	80	5	-5.3
10	80	5	-4.7

Informational measurements

Sag duration [s]	Voltage remaining [%]	Sag duration [s]	Voltage remaining [%]
0.020	0	0.175	41
0.035	13	0.200	41
0.055	31	0.255	42
0.075	36	0.500	51
0.085	37	1	55
0.105	38	10	55

Conducted Tests at 120V 60Hz

Input Voltage 120Vac
 Input Frequency 60Hz
 Output Voltage 12V
 Output Current 15A
 Ambient Temperature 25°C

Sag duration [s]	Voltage remaining [%]	Pos. peak current [A]	Neg. peak current [A]
0.016	0	10.3	-11.2
0.200	50	9.1	-10.6
0.500	70	6.2	-5.9
1	80	5.3	-5.3
10	80	5.3	-4.7

Informational measurements

Sag duration [s]	Voltage remaining [%]	Sag duration [s]	Voltage remaining [%]
0.016	0	0.175	40
0.035	13	0.200	41
0.055	31	0.255	41
0.075	36	0.500	51
0.085	37	1	55
0.105	38	10	55

Conducted Tests at 208V 50Hz

Input Voltage 208Vac
 Input Frequency 50Hz
 Output Voltage 12V
 Output Current 15A
 Ambient Temperature 25°C

Sag duration [s]	Voltage remaining [%]	Pos. peak current [A]	Neg. peak current [A]
0.020	0	24.7	-4.1
0.200	50	8.7	-9.4
0.500	70	6.6	-4.4
1	80	3.4	-3.7
10	80	3.4	-3.4

Informational measurements

Sag duration [s]	Voltage remaining [%]	Sag duration [s]	Voltage remaining [%]
0.020	0	0.175	24
0.035	7	0.200	24
0.055	19	0.255	24
0.075	21	0.500	25
0.085	22	1	31
0.105	23	10	32

Conducted Tests at 208V 60Hz

Input Voltage 208Vac
 Input Frequency 60Hz
 Output Voltage 12V
 Output Current 15A
 Ambient Temperature 25°C

Sag duration [s]	Voltage remaining [%]	Pos. peak current [A]	Neg. peak current [A]
0.016	0	10.6	-4.4
0.200	50	8.7	-8.7
0.500	70	6.2	-5
1	80	3.7	-3.4
10	80	3.1	-3.4

Informational measurements

Sag duration [s]	Voltage remaining [%]	Sag duration [s]	Voltage remaining [%]
0.016	0	0.175	24
0.035	7	0.200	24
0.055	19	0.255	24
0.075	21	0.500	25
0.085	22	1	31
0.105	23	10	32

Inrush current measurements according 61000-4-11 at 208V 50Hz

Input Voltage	208Vac
Input Frequency	50Hz
Output Voltage	12V
Output Current	15A
Ambient Temperature	25°C

Peak input current measurements on unit under test:

First two measurements turn off input power for EUT for 5 minutes and then

Measure peak input current when AC turned on at 90°: 4.1A

Measure peak input current when AC turned on at 270°: 3.7A

Next two measurements turn on the input power for EUT for at least 1 minute then turn off input power for 5s and on again.

Measure peak input current when AC turned on at 90°: 3.7A

Measure peak input current when AC turned on at 270°: 3.7A

Inrush current measurements according 61000-4-11 at 208V 60Hz

Input Voltage	208Vac
Input Frequency	60Hz
Output Voltage	12V
Output Current	15A
Ambient Temperature	25°C

Peak input current measurements on unit under test:

First two measurements turn off input power for EUT for 5 minutes and then

Measure peak input current when AC turned on at 90°: 3.7A

Measure peak input current when AC turned on at 270°: 3.7A

on again.

Measure peak input current when AC turned on at 90°: 3.7A

Measure peak input current when AC turned on at 270°: 3.7A

Operating conditions and their influence in test results:**a) Ambient temperature:**

Control measurements show that the ambient temperature has only a minor influence in the ride-through time test results.

Depending on the used topology to reduce the input inrush current, the ambient temperature can have a major influence in the arising peak current after the sag test. Therefore, tests were performed at ambient temperatures of 25°C and +60°C.

It is assumed that semiconductor processing equipment is never used at lower temperatures than +25°C. Although the power supply itself is specified down to -25°C, a test at such low temperatures is not performed.

b) Mains frequency 50Hz vs. 60Hz:

Control measurements show that 50Hz testing is more critical than 60Hz testing.

Therefore, unless otherwise noted, all tests were performed with a mains frequency of 50Hz.

c) Output voltage 24V vs. 28V:

The ride-through time depend on the stored energy in the input capacitors and the amount of output power. The output voltage is not essential as long as the output power is constant.

The adjusted output voltage has no influence in input currents peaks after input voltage sags.

Therefore, unless otherwise noted, all tests were performed with an output voltage of 24Vdc.

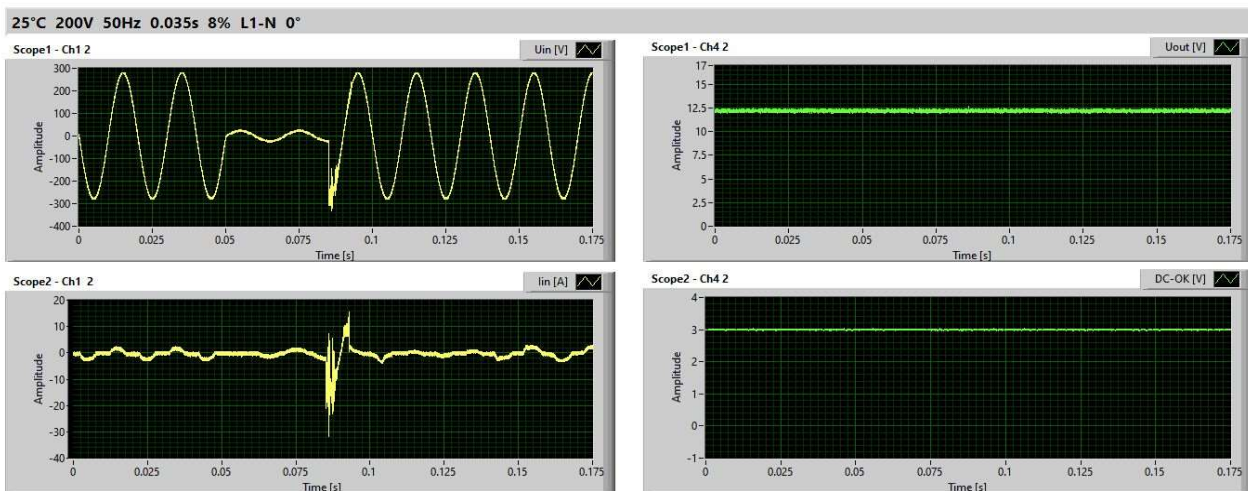
APPENDIX

Informational measurements at 200V

Input Voltage 200Vac
 Input Frequency 50Hz
 Output Voltage 12V
 Output Current 15A
 Ambient Temperature 25°C

Informational measurements

Sag duration [s]	Voltage remaining [%]	Positive peak current [A]	Negative peak current [A]
0.020	0	23.7	-4.7
0.035	8	15.6	-31.9
0.055	20	11.2	-30.9
0.075	22	15	-29.1
0.085	23	21.6	-10
0.105	24	25.9	-9.7
0.175	25	9.1	-27.8
0.200	25	23.1	-8.1
0.255	25	9.7	-22.8
0.500	26	21.9	-7.8
1	32	18.7	-9.7
10	33	15.6	-9.7



Informational measurements at 230V

Input Voltage 230Vac
 Input Frequency 50Hz
 Output Voltage 12V
 Output Current 15A
 Ambient Temperature 25°C

Informational measurements

Sag duration [s]	Voltage remaining [%]	Positive peak current [A]	Negative peak current [A]
0.020	0	24.1	-3.4
0.035	6	10	-23.7
0.055	17	9.4	-25
0.075	19	9.1	-25.3
0.085	20	29.1	-9.4
0.105	21	27.5	-8.1
0.175	22	7.2	-25.6
0.200	22	24.7	-8.1
0.255	22	7.2	-29.1
0.500	22	21.6	-8.1
1	28	15	-10
10	29	8.4	-8.7

