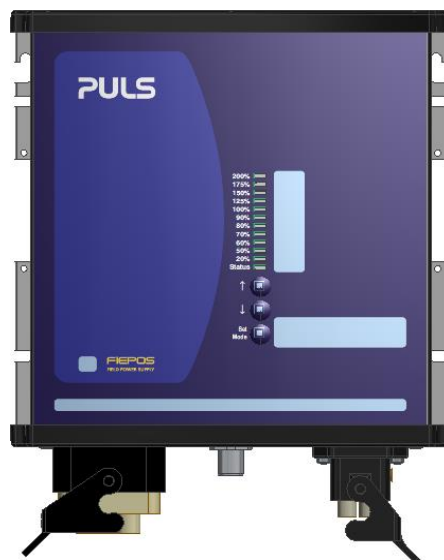


# SEMI F47

## Voltage Sag Immunity Test Report

### for

## Power Supply FPT500.24b-aaa- bbb



**Other devices covered by this report:**

**FPT500.aab-ccc-ddd Three-phase input, 500W output**

- |             |         |   |
|-------------|---------|---|
| <b>b:</b>   | 1       | Standard version, adjustable output voltage                       |
|             | 2       | Standard version, output voltage not adjustable                   |
|             | 5       | Version with multiple outputs individually current limited        |
|             | 6       | Version with multiple NEC CLASS 2 limited power source outputs    |
|             | 7       | Version with regular and NEC CLASS 2 limited power source outputs |
| <b>ccc:</b> | 001-999 | Defines the connection terminal module                            |
| <b>ddd:</b> | 001-999 | Defines product variant (consecutive number)                      |

## SEMI F47 Test Report

<b>Document Number</b>	FPT500.241 Semi F47 Rev1 TR1
<b>Approval Order Number</b>	
<b>Standards</b>	<b>SEMI F47-0706</b> (July 2006) SPECIFICATION FOR SEMICONDUCTOR PROCESSING EQUIPMENT - Voltage Sag Immunity Compliance Tests  <b>IEC 61000-4-11</b> 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
<b>Applicant</b>	PULS GmbH Elektrastraße 6 81925 Munich, Germany
<b>Test Laboratory</b>	PULS Vario GmbH Kranichberggasse 6 1120 Vienna, Austria
<b>Test Engineer</b>	David Baumhackl
<b>Test Date</b>	17.09.2020
<b>Description of Test Device</b>	Built-in power supplies for DIN-Rail mounting
<b>Devices under Evaluation</b>	FPT500.241-002-101 Input: 3AC 380-480V, Output: DC 24-28V, 500W
<b>S/N of Devices</b>	FPT500.241-002-101 : S/N: 20 711 683
<b>Application Details</b>	Input Voltage: 3-Phase AC 400V Input Frequency: 50 or 60Hz Output Load: 500W

**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****18.09.2020**

Copy of marking plate:

**FPT500.241-002-101**  
Power Supply 3-Phase, 24V, 500W

Installation by professional personnel only

**WARNING**  
READ FPT500.241-002-101 INSTALLATION MANUAL

**ATTENTION**  
LIRE LE MANUEL D'INSTALLATION DE FPT500.241-002-101

**Input:**  
3AC 380-480V, 1.1-0.9A, 50-60Hz

**Output**  
Continuous:  
DC 24-28V, 600W (below +45°C)  
DC 24-28V, 500W (at +55°C)  
DC 24-28V, 350W (at +70°C)  
Up to 5s:  
DC 24-28V, 1000W (below +55°C)  
DC 24-28V, 700W (at +70°C)  
Derate linearly between +45°C and +70°C  
Operational temperature range: -25°C to +70°C

PULS GmbH, Elektrastr. 6, 81925 Munich, Germany  
www.pulspower.com  
Designed in Germany, Assembled in the Czech Republic

IM-451.921.00A

S/N 20 711 683

List of Test Equipment

Type	Model	Inventory number
AC Source	Kikusui PCR3000WE2	10372
Scope	LeCroy WS454	10130
Scope	LeCroy WS424	10179
Current Probe	LeCroy CP150	10266
Current Probe	LeCroy CP031	10267
Current Probe	LeCroy CP30	10379
Differential Probe	LeCroy AP031	10262
Differential Probe	Testec Elektronik GmbH SI 9001	10244
Differential Probe	Testec Elektronik GmbH SI 9001	10336
el. Load	Chroma 63201 - 2.6kW	10053

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.

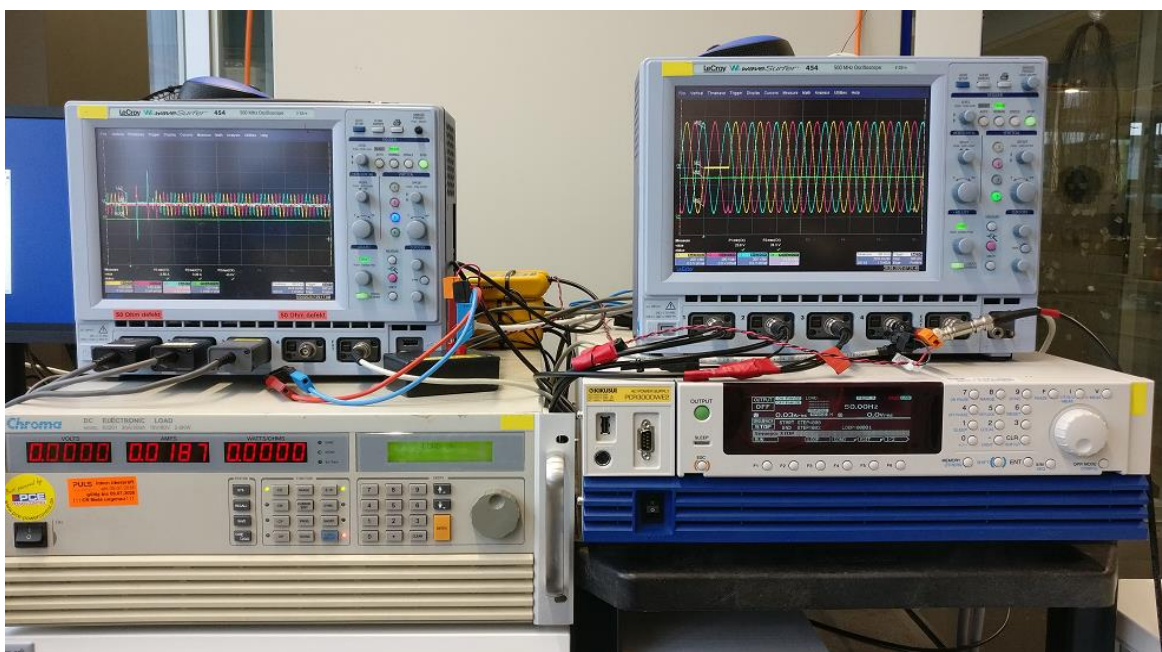
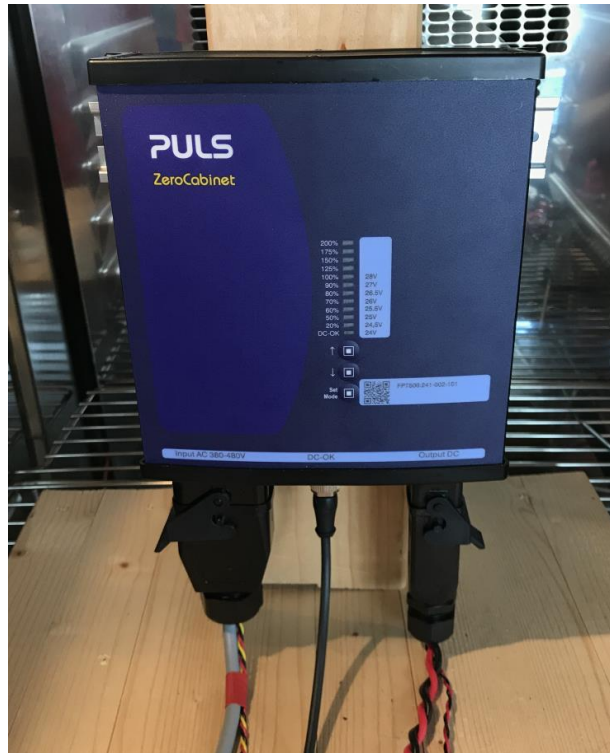
## Test Setup

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

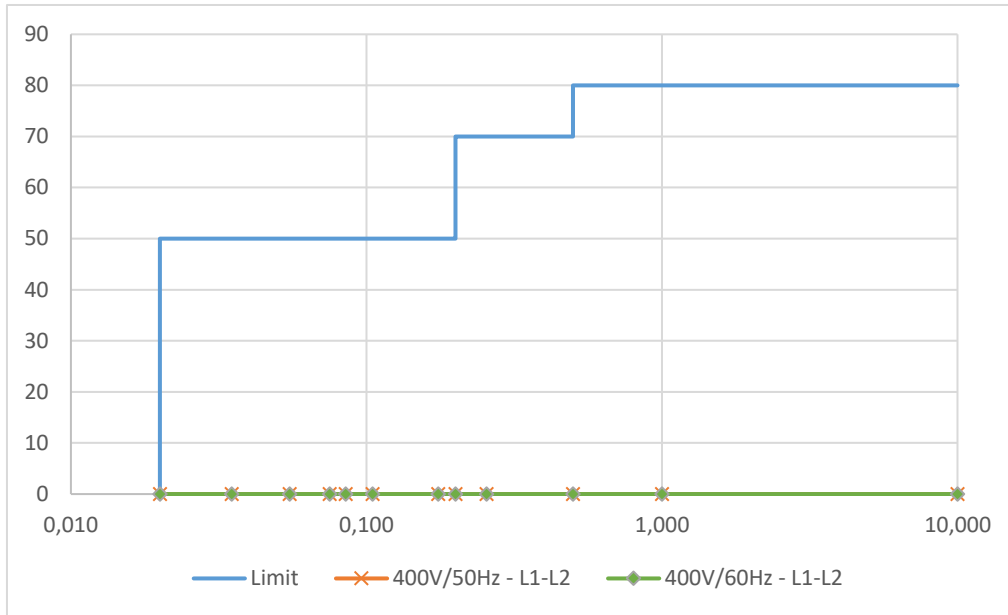
The input is connected to an AC Source. The input voltage is measured with a 100:1 differential probe and the input current is measured with current probes. These probes are connected to oscilloscopes.

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.

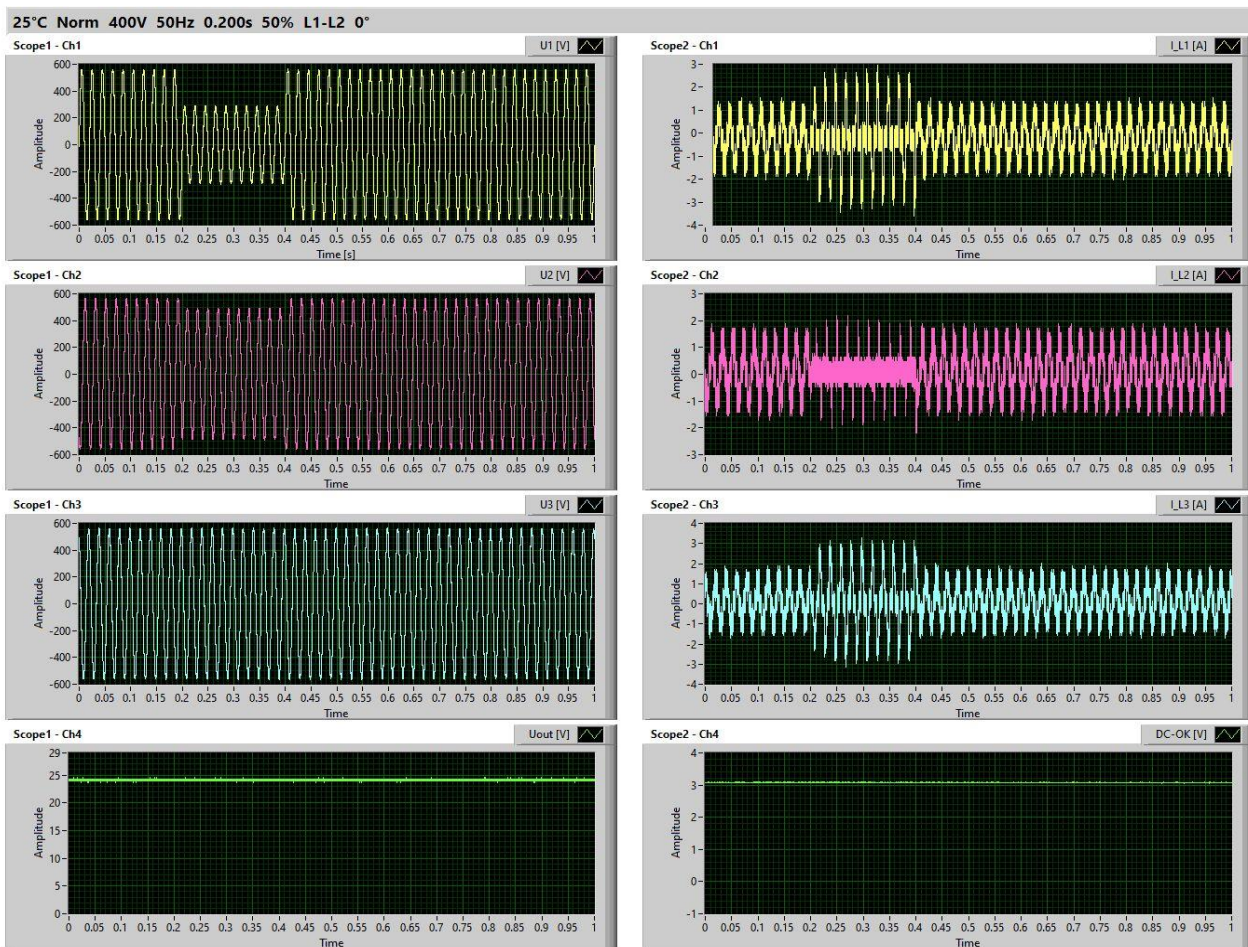


### Voltage Sag Results

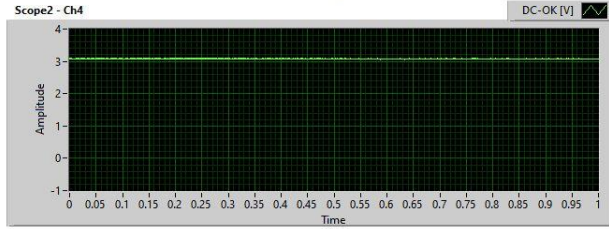
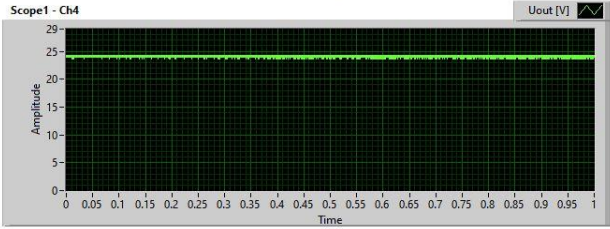
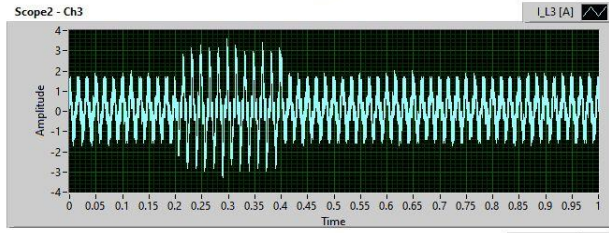
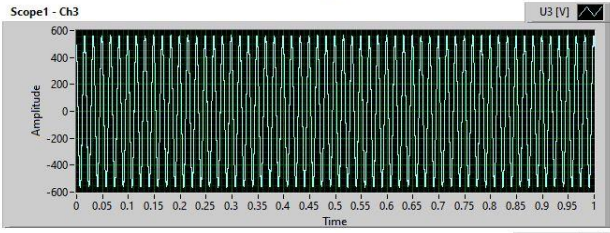
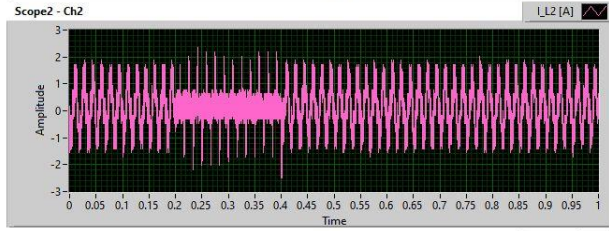
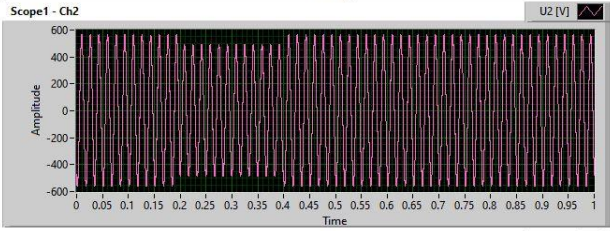
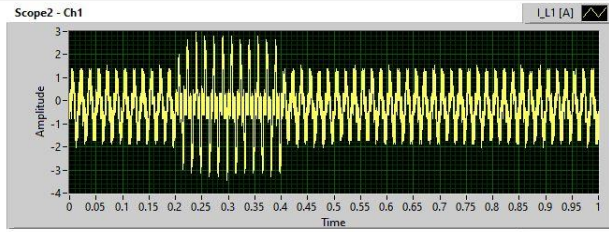
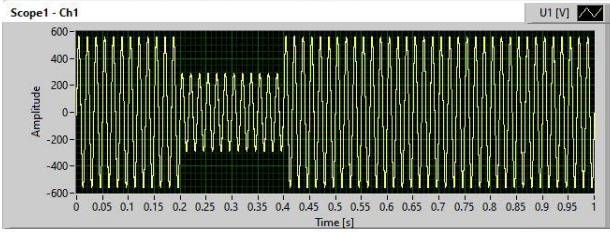


For all Sag times the voltage can be reduced to 0V without any influence on the output

### Input Voltages and Currents



25°C Norm 400V 60Hz 0.200s 50% L1-L2 0°



### Conducted Tests at 400V 50Hz

Input Voltage	400Vac	Output Voltage	24V
Input Frequency	50Hz	Output Current	20.83A
Sag	L1-L2	Ambient Temperature	25°C

Sag duration [s]	Voltage remaining [%]	L1		L2		L3	
		max	min	max	min	max	min
0,020	0	2,2	-2	2,2	-2,8	3,1	-2,7
0,200	50	3	-3,6	2,2	-2,2	3,3	-3,1
0,500	70	2,7	-3,1	2,2	-2,2	3	-2,8
1	80	2,2	-2,8	1,9	-1,9	2,7	-2,5
10	80	2,3	-2,8	2	-1,9	2,7	-2,5

### Informational measurements

Sag duration [s]	Voltage remaining [%]	Sag duration [s]	Voltage remaining [%]
0,020	0	0,175	0
0,035	0	0,200	0
0,055	0	0,255	0
0,075	0	0,500	0
0,085	0	1	0
0,105	0	10	0

### Conducted Tests at 400V 60Hz

Input Voltage	400Vac	Output Voltage	24V
Input Frequency	60Hz	Output Current	20.83A
Sag	L1-L2	Ambient Temperature	25°C

Sag duration [s]	Voltage remaining [%]	L1		L2		L3	
		max	min	max	min	max	min
0,016	0	2,2	-2,2	2	-2,7	3,1	-2,3
0,200	50	3	-3,4	2,3	-2,5	3,6	-3,3
0,500	70	2,5	-3,1	2	-2,2	3,1	-2,8
1	80	2,2	-2,7	2,2	-1,9	2,7	-2,7
10	80	2,2	-2,8	2	-1,7	2,8	-2,3

### Informational measurements

Sag duration [s]	Voltage remaining [%]	Sag duration [s]	Voltage remaining [%]
0,016	0	0,175	0
0,035	0	0,200	0
0,055	0	0,255	0
0,075	0	0,500	0
0,085	0	1	0
0,105	0	10	0



### Inrush current measurements according 61000-4-11 at 400V 50Hz

Input Voltage	400Vac
Input Frequency	50Hz
Output Voltage	24V
Output Current	20.83A
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°: 14.8A

Measure peak input current when AC turned on at 270°: 15.6A

on again.

Measure peak input current when AC turned on at 90°: 10.3A

Measure peak input current when AC turned on at 270°: 16.3A

### Inrush current measurements according 61000-4-11 at 400V 60Hz

Input Voltage	400Vac
Input Frequency	60Hz
Output Voltage	24V
Output Current	20.83A
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°: 14.7A

Measure peak input current when AC turned on at 270°: 16.6A

on again.

Measure peak input current when AC turned on at 90°: 10.8A

Measure peak input current when AC turned on at 270°: 17.2A

### **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

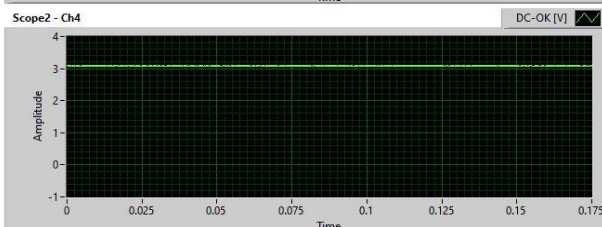
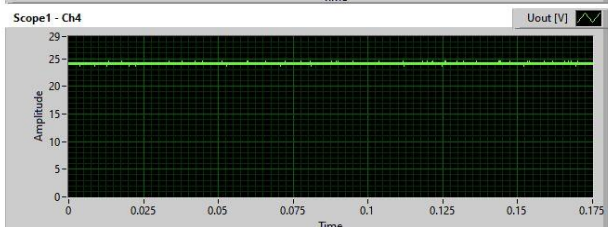
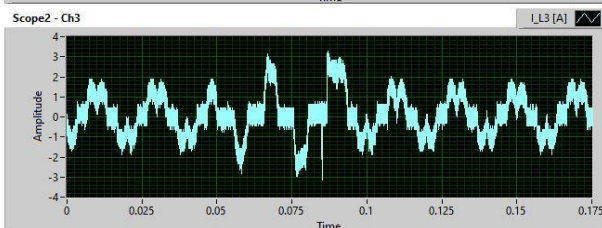
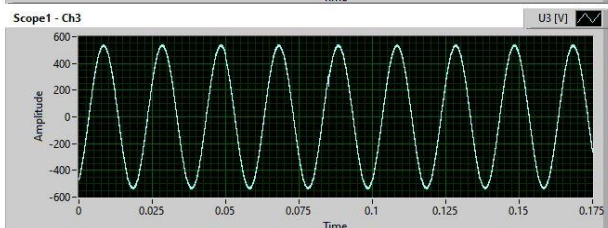
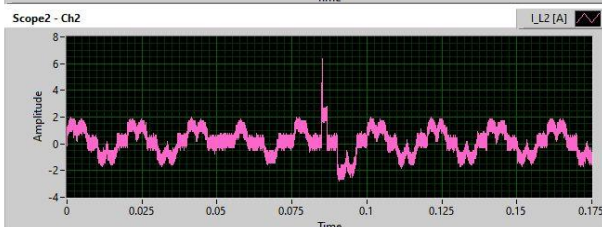
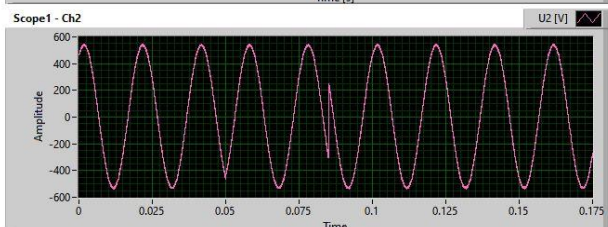
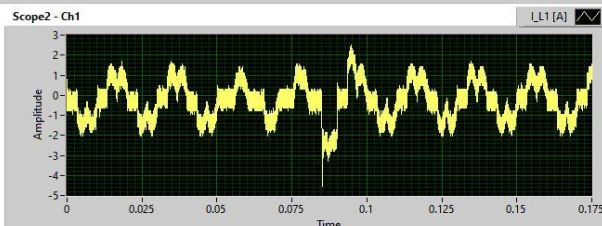
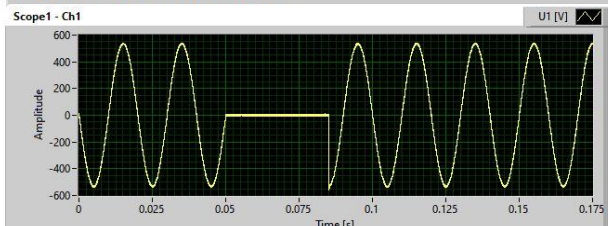
### Informational measurements at 380V

Input Voltage	380Vac	Output Voltage	24V
Input Frequency	50Hz	Output Current	20.83A
Sag	L1-L2	Ambient Temperature	25°C

### Informational measurements

Sag duration [s]	Voltage remaining [%]	L1		L2		L3	
		max	min	max	min	max	min
0,020	0	2,3	-2,5	2,2	-2,8	3,1	-2,7
0,035	0	2,5	-4,5	6,4	-2,8	3,3	-3,1
0,055	0	2,8	-4,5	6,3	-3,0	3,4	-3,6
0,075	0	3,0	-4,4	6,4	-3,1	3,6	-3,6
0,085	0	4,1	-3,1	3,4	-5,9	3,8	-3,6
0,105	0	3,6	-3,3	3,6	-6,1	3,8	-3,4
0,175	0	2,8	-4,4	6,3	-3,3	3,9	-3,6
0,200	0	3,1	-2,3	2,2	-3,3	4,1	-3,4
0,255	0	2,8	-4,2	6,1	-3,1	3,8	-3,9
0,500	0	2,7	-2,3	2,2	-3,3	4,1	-3,6
1	0	2,8	-2,3	2,3	-3,4	3,9	-3,4
10	0	2,5	-2,3	2,3	-3,0	3,9	-3,6

25°C 380V 50Hz 0.035s 0% L1-L2 0°



### Informational measurements at 480V

Input Voltage	480Vac	Output Voltage	24V
Input Frequency	50Hz	Output Current	20.83A
Sag	L1-L2	Ambient Temperature	25°C

### Informational measurements

Sag duration [s]	Voltage remaining [%]	L1		L2		L3	
		max	min	max	min	max	min
0,020	0	1,4	-1,9	2,0	-2,3	2,8	-2,5
0,035	0	1,4	-8,0	8,1	-1,6	3,1	-4,4
0,055	0	1,6	-7,7	7,8	-1,7	3,0	-4,2
0,075	0	1,6	-7,5	7,7	-1,7	2,8	-4,1
0,085	0	7,3	-2,0	1,9	-7,7	4,5	-2,7
0,105	0	7,0	-1,9	1,9	-7,5	4,7	-2,8
0,175	0	1,4	-7,5	7,7	-1,6	2,8	-4,2
0,200	0	1,6	-1,9	1,9	-1,6	2,8	-2,7
0,255	0	1,4	-7,3	7,5	-1,6	3,1	-3,9
0,500	0	1,6	-1,9	1,9	-1,7	2,8	-2,7
1	0	1,4	-2,0	1,7	-1,7	2,8	-2,7
10	0	1,4	-1,9	1,9	-1,7	2,8	-2,7

