SEMI F47
Voltage Sag Immunity Test Report
for
Power Supply CT10.241

Other devices covered by this report:

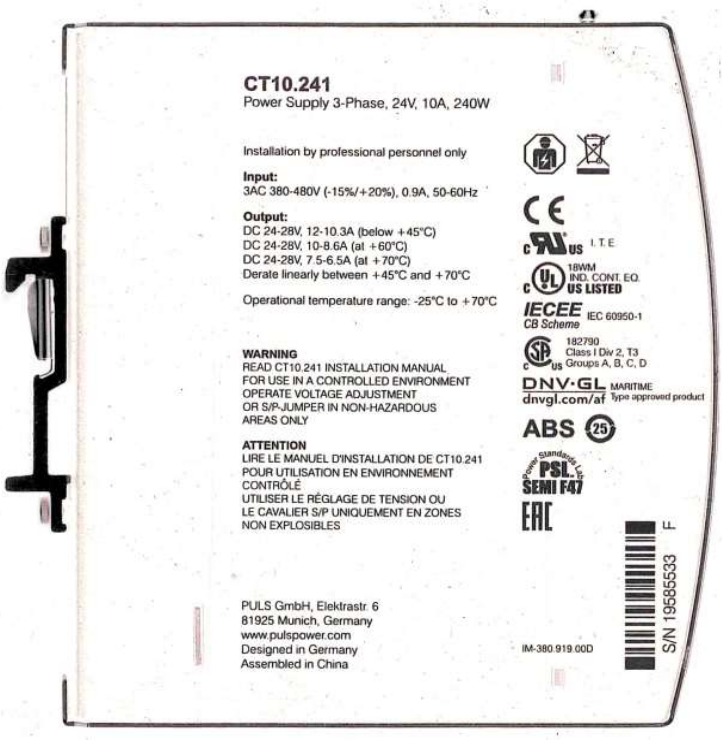
QT20.241-ww		Standard units
ww:	blank	Standard unit
	C1	Version with conformal coated pc-boards

SEMI F47 Test Report

Document Number	CT10.241 Semi F47 Rev2 TR1
Approval Order Number	LAB20-771
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	25.05.2020
Description of Test Device:	Built-in power supplies for DIN-Rail mounting
Devices under Evaluation:	CT10.241 Input: 3AC 380-480V, DC 24-28V, 10A
S/N of Devices:	CT10.241: S/N: 19585533 F
Application Details:	Input Voltage: 3-Phase AC 400V Input Frequency: 50 or 60Hz Output Load: 240W

PASS/FAIL Criterions:	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	**29.06.2020**

Copy of marking plate:



List of Test Equipment

Type	Model	Inventory number
AC Source	Kikusui PCR3000WE2	10381
el. Load	Chroma 63201 - 2.6kW	10046
Oscilloscope	LeCroy WS454	10127
Oscilloscope	LeCroy WS454	10130
Current Probe	LeCroy CP031	10267
Current Probe	LeCroy CP031	10378
Current Probe	LeCroy CP150	10290
Differential Probe	Testec Elektronik GmbH SI 9001	10246
Differential Probe	Testec Elektronik GmbH SI 9001	10245
Differential Probe	Testec Elektronik GmbH SI 9001	10244

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

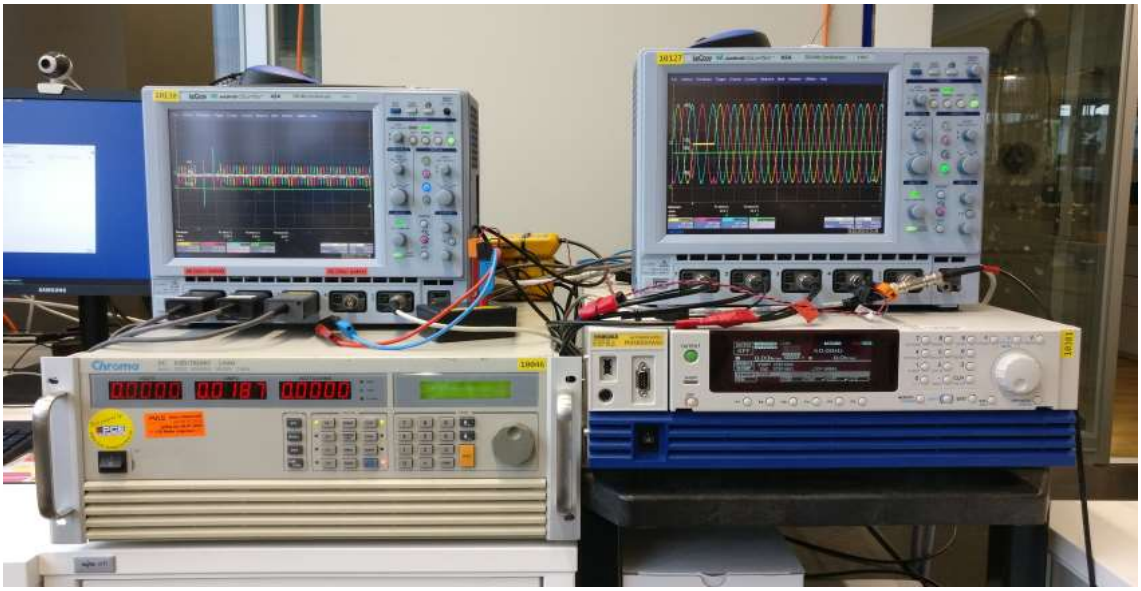
#1 Sag depth is expressed in percent of remaining nominal voltage. For example, during a 70% voltage sag on a 200 volt nominal system, the voltage is reduced during the sag to 140 volts and not 60 volts.

Test Setup

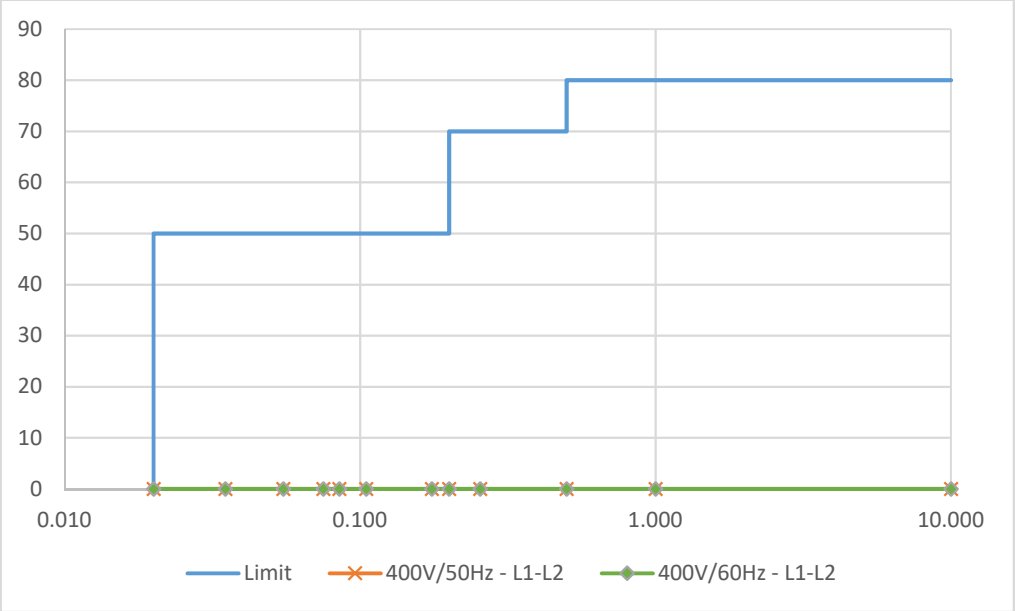
The unit under test in normal operating condition mounted in climate chamber.
The input is connected to an AC Source. The input voltage is measured with a 100:1 differential probe and the input current is measured with current probes. These probes are connected to oscilloscopes.

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.

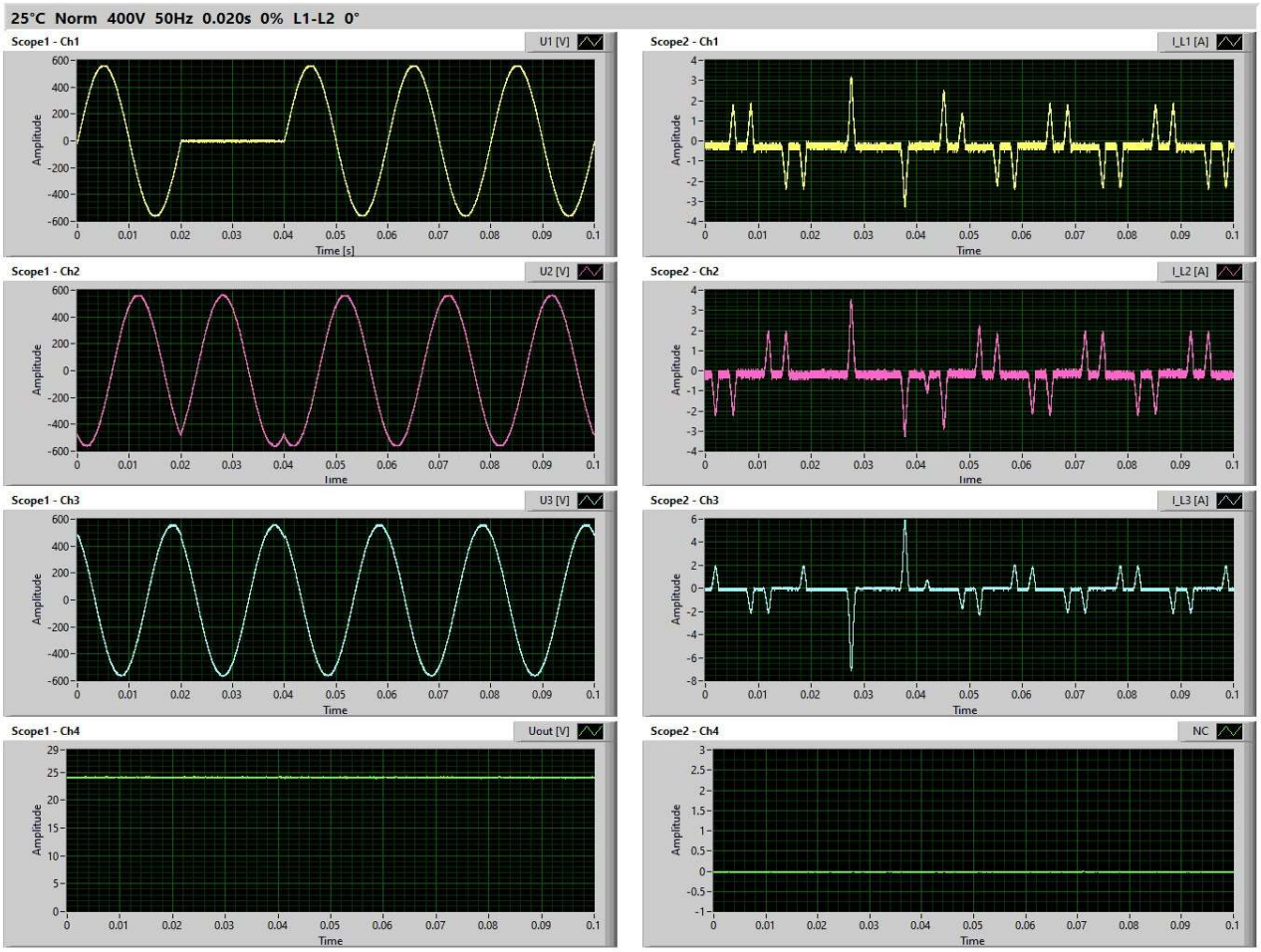


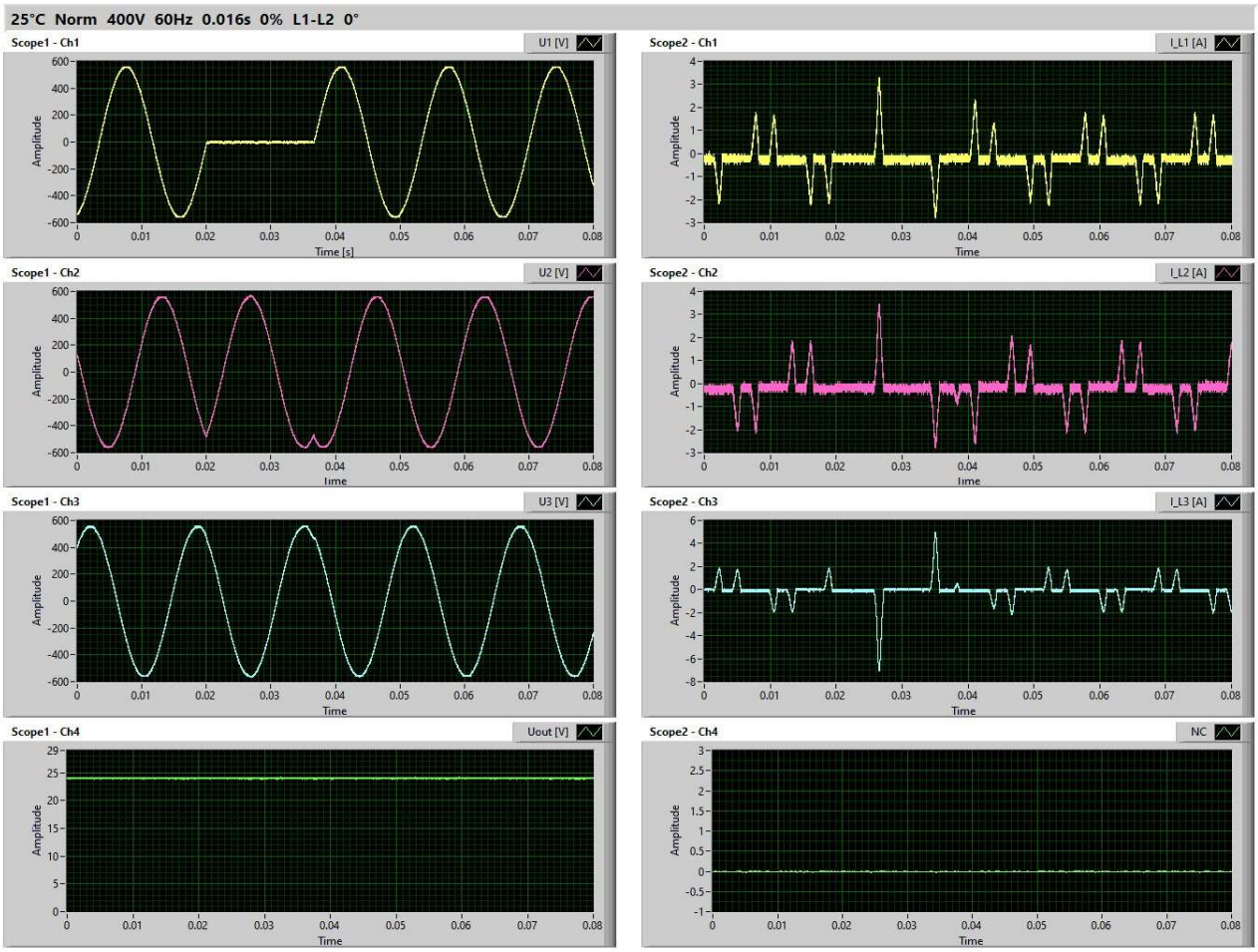
Voltage Sag Results



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 0.016s 0% L1-L2 0°
Scope1 - Ch1
U1 [V]
Scope2 - Ch1
I_L1 [A]
Scope1 - Ch2
U2 [V]
Scope2 - Ch2
I_L2 [A]
Scope1 - Ch3
U3 [V]
Scope2 - Ch3
I_L3 [A]
Scope1 - Ch4
Uout [V]
Scope2 - Ch4
NC
Amplitude
Time
Time [s]

Conducted Tests at 400V 50Hz

Input Voltage	400Vac	Output Voltage	24V
Input Frequency	50Hz	Output Current	10A
Sag	L1-L2	Ambient Temperature	25°C

Sag duration [s]	Voltage remaining [%]	L1		L2		L3	
		max	min	max	min	max	min
0.020	0	3.2	-3.3	3.6	-3.3	5.9	-7.1
0.200	50	6.3	-5.9	2.2	-2.9	5.7	-6.8
0.500	70	6.4	-5.9	2.2	-2.9	5.7	-6.8
1	80	6.3	-5.9	2.2	-2.7	5.7	-6.8
10	80	6.2	-5.9	2.1	-2.3	5.6	-6.7

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	10A
Sag	L1-L2	Ambient Temperature	25°C

Sag duration [s]	Voltage remaining [%]	L1		L2		L3	
		max	min	max	min	max	min
0.016	0	3.3	-2.8	3.5	-2.8	5	-7
0.200	50	6.2	-5.4	2.1	-2.6	5.3	-6.7
0.500	70	6.2	-5.4	2	-2.6	5.2	-6.7
1	80	6.2	-5.4	2	-2.6	5.2	-6.7
10	80	5.9	-5.4	1.9	-2.3	5.2	-6.5

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	10A
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°: 6.8A
Measure peak input current when AC turned on at 270°: 6.8A
on again.
Measure peak input current when AC turned on at 90°: 7A

Measure peak input current when AC turned on at 270°: 6.9A

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

Input Voltage	400Vac
Input Frequency	60Hz
Output Voltage	24V
Output Current	10A
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°: 7.1A
Measure peak input current when AC turned on at 270°: 6.9A
on again.
Measure peak input current when AC turned on at 90°: 7.1A
Measure peak input current when AC turned on at 270°: 6.9A

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.

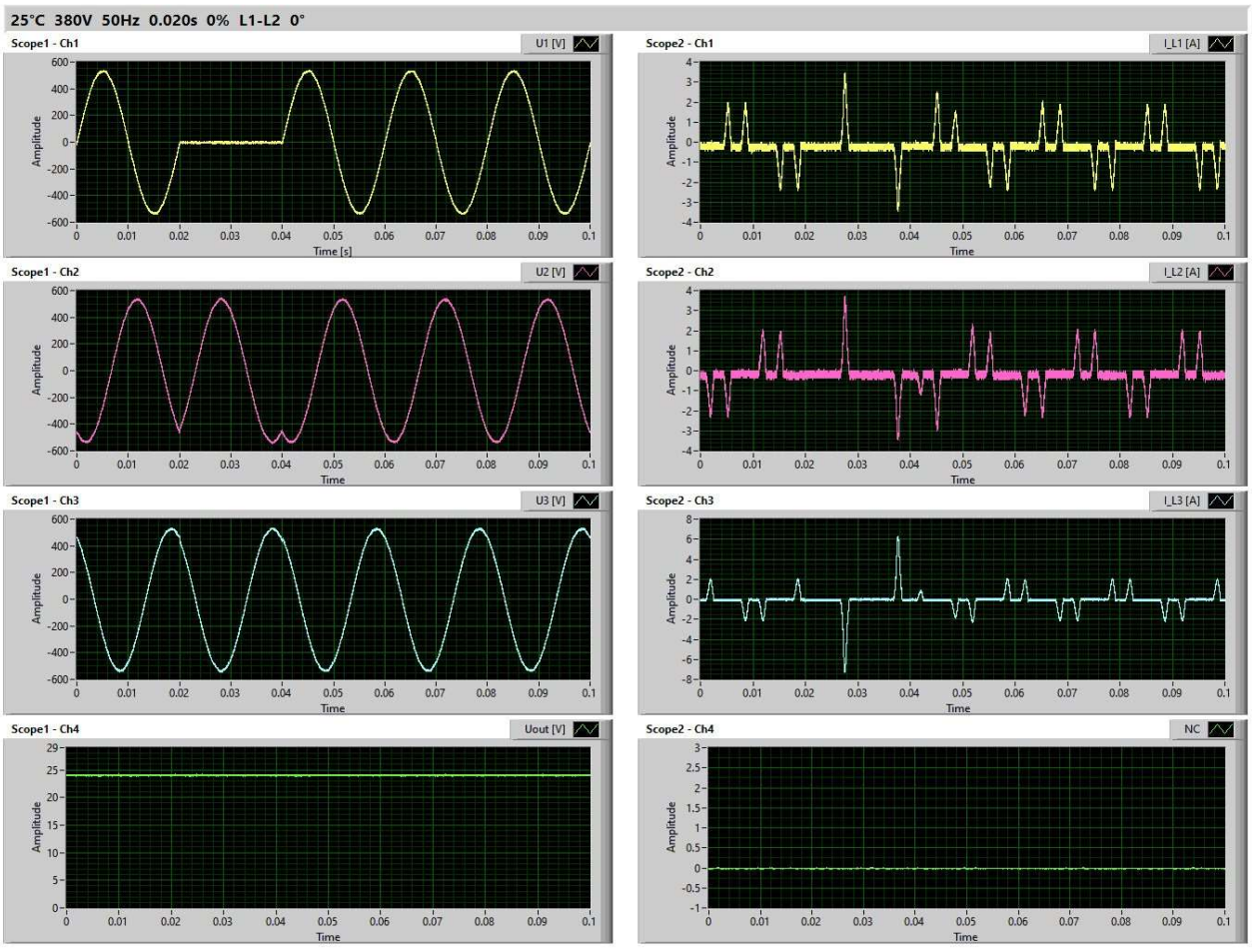
APPENDIX

Informational measurements at 380V

Input Voltage	380Vac	Output Voltage	24V
Input Frequency	50Hz	Output Current	10A
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	3.5	-3.5	3.8	-3.5	6.3	-7.3
0.035	0	3.5	-3.5	3.7	-3.5	6.3	-7.3
0.055	0	3.4	-3.4	3.7	-3.5	6.3	-7.3
0.075	0	3.4	-3.5	3.8	-3.5	6.3	-7.3
0.085	0	3.4	-3.5	3.7	-3.5	6.3	-7.3
0.105	0	3.4	-3.5	3.7	-3.6	6.3	-7.3
0.175	0	3.3	-3.5	3.6	-3.5	6.3	-7.3
0.200	0	3.4	-3.5	3.5	-3.5	6.3	-7.3
0.255	0	3.4	-3.5	3.6	-3.5	6.3	-7.2
0.500	0	3.4	-3.4	3.6	-3.5	6.3	-7.2
1	0	3.3	-3.5	3.7	-3.5	6.3	-7.2
10	0	3.3	-3.5	3.6	-3.6	6.1	-7.2



Informational measurements at 480V

Input Voltage	480Vac	Output Voltage	24V
Input Frequency	50Hz	Output Current	10A
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	0.000	3.100	-2.800	3.300	-2.700	4.900	-6.600
0.035	0.000	3.000	-2.800	3.200	-2.900	5.200	-6.600
0.055	0.000	3.000	-2.800	3.200	-2.900	5.200	-6.600
0.075	0.000	3.000	-2.900	3.300	-2.900	5.200	-6.600
0.085	0.000	3.000	-2.800	3.300	-2.900	5.200	-6.600
0.105	0.000	2.900	-2.900	3.200	-2.900	5.200	-6.600
0.175	0.000	2.900	-2.900	3.200	-2.900	5.200	-6.600
0.200	0.000	2.900	-2.900	3.200	-3.000	5.200	-6.600
0.255	0.000	2.900	-2.800	3.200	-2.800	5.200	-6.600
0.500	0.000	2.900	-2.900	3.200	-2.900	5.100	-6.500
1.000	0.000	2.900	-2.900	3.100	-2.900	5.200	-6.500
10.000	0.000	2.300	-2.700	2.600	-2.800	4.900	-5.600