Test Report issued under the responsibility of:

TEST REPORT
IEC 62116
Test procedure of islanding prevention measures for utility-interconnected photovoltaic inverters

Report Number. .....:	GZES191002576302
Date of issue .....:	07/11/2019
Total number of pages.....	12
Name of Testing Laboratory preparing the Report.....:	SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch
Applicant's name.....:	EVOLVE ENERGY GROUP CO., LIMITED
Address .....:	RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK
Test specification:	
Standard .....:	IEC/EN 62116: 2014 (Second Edition)
Test procedure .....:	Characteristic Examination
Non-standard test method .....:	N/A
Test Report Form No. .....:	IEC62116B
Test Report Form(s) Originator ....:	TÜV SÜD Product Service GmbH
Master TRF.....:	Dated 2014-10

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.

Test item description..:	Solar Grid-tied Inverter
Trade Mark.....:	EVVO
Manufacturer .....:	EVOLVE ENERGY GROUP CO., LIMITED
Address.....:	RM 702, 7/F FU FAI COMM CTR 27 HILLIER ST SHEUNG WAN, HK
Model/Type reference .:	EVVO 3200TL-AV, EVVO 3000TL-AV, EVVO 2700TL-AV, EVVO 2200TL-AV, EVVO 1600TL-AV, EVVO 1100TL-AV
Ratings.....:	See model list in Page 6. **Test Serial Number:** SA3ES027K4P020 **Test Firmware version:** V100

Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☐	~~**CB Testing Laboratory:**~~		
~~**Testing location/ address.....:**~~			
☐	~~**Associated CB Testing Laboratory:**~~		
☒	**Testing procedure: TMP/CTF Stage 1:**	Shenzhen SOFAR SOLAR Co., Ltd.	
Testing location/ address.....:		401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China	
Tested by (name, function		go zhang oject Engineer)	Hugo Zhang
Approved by (name, funct		ger Hu echnical Reviewer)	
☐	~~**Testing procedure: WMT/CTF Stage 2:**~~		
☐	~~**Testing procedure: SMT/CTF Stage 3 or 4:**~~		

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

50 Hz		
Attachment #	Description	Pages
Attachment I	Pictures of the EUT and Electrical Schemes	12 pages
Attachment II	Graphics of the Test Results	3 pages
Attachment III	Graphics of the Islanding Behavior Detection	22 pages
Attachment IV	Testing Information	6 pages

Summary of testing:

Tests performed (name of test and test clause):

All clauses except:

- Sub-clause d) of the Table 5 of the point 6.1. Voltage and frequency trips shall be adjusted according to National Standards and/or local codes.

From the result of inspection and tests performed on the submitted sample we conclude that it complies with the requirements of the Standard.

Remarks: All the test results are from the report below:

- IEC/EN 62116: 2014 (Second Edition)

Test Report No: 2219 / 0185 -B-E1 which issued by SGS Tecnos, S.A. (Electrical Testing Laboratory) on 26/07/2019

Testing location:

Shenzhen SOFAR SOLAR Co., Ltd.

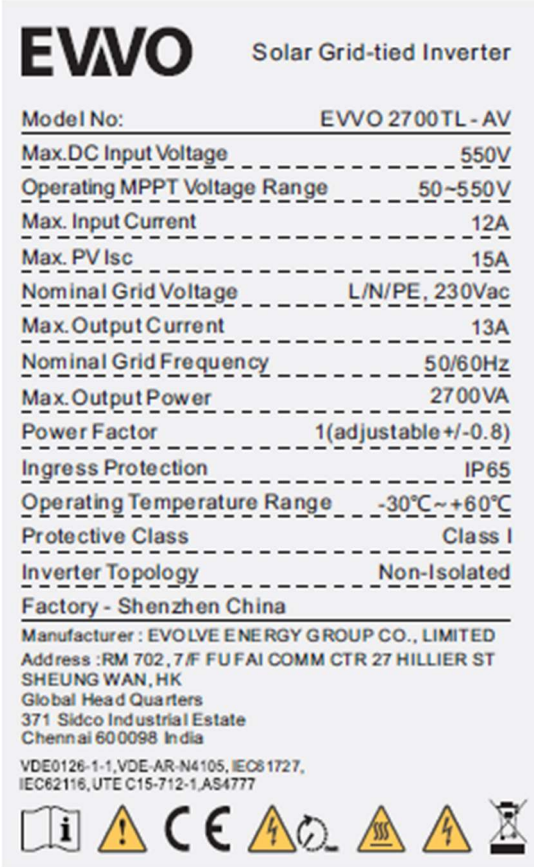
401, Building 4, AnTongDa Industrial Park, District 68, XingDong Community, XinAn Street, BaoAn District, Shenzhen City, Guangdong Province, P.R. China

(All clauses)

Summary of compliance with National Differences:

No National Differences are addressed to this test report

Copy of marking plate(representative):



Note:

1. The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.
2. Label is attached on the side surface of enclosure and visible after installation
3. Labels of other models are as the same with EVVO 2700TL-AV's except the parameters of rating.

Test item particulars ..... :	Solar Grid-tied Inverter (Single Phase Inverter)
Classification of installation and use ..... :	Fixed (permanent connection)
Supply Connection ..... :	DC; PV
..... :	AC; Grid connection
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 ..... :	CTF Stage 1 procedure
Date of receipt of test item ..... :	N/A
Date (s) of performance of tests ..... :	From 11/06/2019

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) ..... :	Dongguan SOFAR SOLAR Co.,Ltd. 1F - 6F, Building E, No. 1 JinQi Road, Bihu Industrial Park, Wulian Village, Fenggang Town, Dongguan City,Guangdong Province,P.R. China.

General product information:

Product covered by this report is grid-connected PV inverter for indoor or outdoor installation. The connection to the DC input and AC output are through connectors.

The Solar inverter converts DC voltage into AC voltage.
The input and output are protected by varistors to Earth. The unit is providing EMC filtering at the output toward mains. The unit does not provide galvanic separation from input to output (transformerless). The output is switched off redundant by the high power switching bridge and a two relays. This assures that the opening of the output circuit can operate in case of one error.

Equipment Under Testing:

– EVVO 2700TL-AV

Variant models:

– EVVO 3200TL-AV
– EVVO 3000TL-AV
– EVVO 2200TL-AV
– EVVO 1600TL-AV
– EVVO 1100TL-AV

Model Number	EVVO 3200TL-AV	EVVO 3000TL-AV	EVVO 2700TL-AV	EVVO 2200TL-AV	EVVO 1600TL-AV	EVVO 1100TL-AV
Max. input voltage	550Vd.c.			500Vd.c		
Max. input current	12Ad.c.	12Ad.c.	12Ad.c.	12Ad.c.	12Ad.c.	12Ad.c.
Operating MPPT voltage range	50-550Vd.c.			50-500Vd.c.		
Full load DC Voltage Range	300-500 Vd.c.	275-500 Vd.c.	250-500 Vd.c.	200-450 Vd.c.	150-450 Vd.c.	110-450 Vd.c.
Rated voltage	360V					
Rated grid voltage	230Va.c.					
Rated grid frequency	50Hz					
Rated output power	3.3kW	3.0kW	2.7kW	2.2kW	1.6kW	1.1kW
Rated output current	13Aa.c.	13 Aa.c.	11.8Aa.c.	9.6Aa.c.	7Aa.c.	4.8Aa.c.
Max. Output Current	16Aa.c.	14.5 Aa.c.	13Aa.c.	10.6Aa.c.	7.7Aa.c.	5.3Aa.c.
Power factor	0.8 leading to 0.8 lagging					
Ambient temperature	-30 ºC ~60ºC					
Ingress protection	IP65					
Protective class	Class I					

The variants models have been included in this test report without tests because the following features don´t change regarding to the tested model:

- Same connection system and hardware topology
- Same control algorithm.
- Output power within 2,5 and 2/3 of the EUT or Modular inverters.
- Same Firmware Version

IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict
4	**Testing circuit**		
	The testing circuit shown in Figure 1 is employed.		P
	Similar circuits are used for three-phase output.		P
	Parameters to be measured are shown in Table 1 and Figure 1. Parameters to be recorded in the test report are discussed in Clause 7.		P
5	**Testing equipment**		
5.1	**Measuring instruments**		**P**
	The waveform measurement/capture device is able to record the waveform from the beginning of the islanding test until the EUT ceases to energize the island.	Oscillograph and Power analyzer equipped with memory function Waveform caught from the switch open and the EUT cease to energize	P
	For multi-phase EUT, all phases are monitored.		P
	A waveform monitor designed to detect and calculate the run-on time may be used.	See Annex IV for testing equipment information	P
	For multi-phase EUT, the test and measurement equipment is recorded each phase current and each phase-to-neutral or phase-to-phase voltage, as appropriate, to determine fundamental frequency active and reactive power flow over the duration of the test.		P
	A sampling rate of 10 kHz or higher is recommended. The minimum measurement accuracy is 1 % or less of rated EUT nominal output voltage and 1 % or less of rated EUT output current	Less than 1% of the rated EUT output current	P
	Current, active power, and reactive power measurements through switch S1 used to determine the circuit balance conditions report the fundamental (50 Hz or 60 Hz) component.		P
5.2	**DC power source**		
5.2.1	**General**		**P**
	A PV array or PV array simulator (preferred) may be used. If the EUT can operate in utility-interconnected mode from a storage battery, a DC power source may be used in lieu of a battery as long as the DC power source is not the limiting device as far as the maximum EUT input current is concerned.	Chroma PV simulator used	P
	The DC power source provides voltage and current necessary to meet the testing requirements described in Clause 6.		P
5.2.2	**PV array simulator**		P
	The tests are conducted at the input voltage defined in Table 2 below, and the current is limited to 1,5 times the rated photovoltaic input current, except when specified otherwise by the test requirements.		P
	A PV array simulator is recommended, however, any type of power source may be used if it does not influence the test results.		P
5.2.3	**Current and voltage limited DC power supply with series resistance**		N/A

IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict
	A DC power source used as the EUT input source is capable of EUT maximum input power (so as to achieve EUT maximum output power) at minimum and maximum EUT input operating voltage.		N/A
	The power source provides adjustable current and voltage limit, set to provide the desired short circuit current and open circuit voltage when combined with the series and shunt resistance described below.		N/A
	A series resistance (and, optionally, a shunt resistance) is selected to provide a fill factor within the range: Output power: Sufficient to provide maximum EUT output power and other levels specified by test conditions of table 5. Response speed: The response time of a simulator to a step in output voltage, due to a 5% load change, results in a settling of the output current to within 10% of its final value in less than 1ms. Stability: Excluding the variations caused by the EUT MPPT, simulator output power remains stable within 2 % of specified power level over the duration of the test: from the point where load balance is achieved until the island condition is cleared or the allowable run-on time is exceeded. Power factor: 0.25 to 0.8		N/A
5.2.4	**PV array**		N/A
	A PV array used as the EUT input source is capable of EUT maximum input power at minimum and maximum EUT input operating voltage.		N/A
	Testing is limited to times when the irradiance varies by no more than 2 % over the duration of the test as measured by a silicon-type pyranometer or reference device. It may be necessary to adjust the array configuration to achieve the input voltage and power levels prescribed in 6.1.		N/A
5.3	**AC power source**		
	The utility grid or other AC power source may be used as long as it meets the conditions specified in Table 4. **Table 4 – AC power source requirements** Items: Voltage — Conditions: Nominal ±2,0 % Items: Voltage THD — Conditions: < 2,5 % Items: Frequency — Conditions: Nominal ±0,1 Hz Items: Phase angle distance [1] — Conditions: 120 ° ± 1,5 ° [1] Three-phase case only	AC power source used meets the conditions specified Refer to ATTACHMENT IV Section 4	P
5.4	**AC loads**		

IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict
	On the AC side of the EUT, variable resistance, capacitance, and inductance are connected in parallel as loads between the EUT and the AC power source. Other sources of load, such as electronic loads, may be used if it can be shown that the source does not cause results that are different than would be obtained with passive resistors, inductors, and capacitors.	Passive loads (variable resistance, capacitance and inductance) have been connected.	P
	All AC loads are rated for and adjustable to all test conditions. The equations for Qf are based upon an ideal parallel RLC circuit. For this reason, non-inductive resistors, low loss (high Qf) inductors, and capacitors with low effective series resistance and effective series inductance are utilized in the test circuit. Iron core inductors, if used, are not exceed a current THD of 2 % when operated at nominal voltage. Load components are conservatively rated for the voltage and power levels expected. Resistor power ratings are chosen so as to minimize thermally-induced drift in esistance values during the course of the test.		P
	Active and reactive power is calculated (using the measurements provided in Table 1) in each of the R, L and C legs of the load so that these parasitic parameters (and parasitics introduced by variacs or autotransformers) are properly accounted for when calculating Qf.		P
6	**Test for single or multi-phase inverter**		
6.1	**Test procedure**	**(see appended table)**	**P**
	The test uses an RLC load, resonant at the EUT nominal frequency (50 Hz or 60 Hz) and matched to the EUT output power.		P
	For multi-phase EUT, the load is balanced across all phases and the switch S1 as in Figure 1 opens all phases		P
	This test is performed with the EUT conditions as in Table 5, where power and voltage values are given as a percent of EUT full output rating.		P
	a)..Determine EUT test output power		P
	b) .Adjusting the DC input source		P
	c)..Turn off the EUT and open S1		P
	d) .Adjust the RLC circuit to have Qf = 1.0 ±0.05		P
	e)..Connect the RLC load configured in step d) to the EUT by closing S2		P
	f)...Open the utility-disconnect switch S1 to initiate the test, Run-on time is recorded.		P
	g)..For test condition A, adjust the real load and only one of the reactive load components to each of the load imbalance conditions shown in the shaded portion of table 6. 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.		P

IEC 62116			
Clause	Requirement + Test	Result - Remark	Verdict
	h) For test condition B and C, adjust the only one reactive load components by approximately 1,0% per test, within a total range of 95% to 105% of the operating point. If run-on times are still increasing at the 95% or 105% points, additional 1% increments have to be taken until run-on times begin decreasing.		P
6.2	**Pass/fail criteria**		
	An EUT is considered to comply with the requirements for islanding protection when each case of recorded run-on time is less than 2 s or meets the requirements of local codes.	Run-on time is less than 2s in any case	P
7	**Documentation**		
	At a minimum, the following information is recorded and maintained in the test report.		P
	a) Specifications of EUT. Table 8 provides an example of the type of information that is provided.		P
	b) Measurement results. Table 9 provides an example of the type of information that is provided. Actual measured values is to be recorded.		P
	c) Block diagram of test circuit.		P
	d) Specifications of the test and measurement equipment. Table 10 provides an example of the type of information that is provided.		P
	e) Any test configuration or procedure details such as methods of achieving specified load and EUT output conditions.		P
	f) Any additional information required by the testing laboratory's accreditation.		P
	g) Specify the evaluation criterion from clause 6.2 that was utilized to determine if the product passed or failed the test.		P
Annex A	Islanding as it applies to PV systems(Informative)		--
A.1	General		--
A.2	Impact of distortion on islanding		--
Annex B	Test for independent islanding detection device (relay)(Informative)		--
B.1	Introduction		--
B.2	Testing circuit		--
B.3	Testing equipment		--
B.4	Testing procedure		--
B.5	Documentation		--

6.1	Table: tested condition and run-on time								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	V_{DC} (d.c.V)	Which load is selected to be adjusted (R or L)
Test condtion A									
1	100	100	0	0	408	2698	1.00	464.9	--
2	100	100	-5	-5	324	2701	1.05	465.9	R/L
3	100	100	-5	0	364	2700	1.05	465.9	R
4	100	100	-5	+5	320	2701	1.02	466.1	R/L
5	100	100	0	-5	284	2698	1.03	465.0	L
6	100	100	0	+5	322	2689	0.98	460.3	L
7	100	100	+5	-5	318	2689	0.98	460.0	R/L
8	100	100	+5	0	332	2675	0.96	455.3	R
9	100	100	+5	+5	288	2696	0.95	462.9	R/L
10	100	100	-10	+10	--	--	--	--	R/L
11	100	100	-5	+10	--	--	--	--	R/L
12	100	100	0	+10	--	--	--	--	L
13	100	100	+10	+10	--	--	--	--	R/L
14	100	100	+10	+5	--	--	--	--	R/L
15	100	100	+10	0	--	--	--	--	R
16	100	100	+10	-5	--	--	--	--	R/L
17	100	100	+10	-10	--	--	--	--	R/L
18	100	100	+5	-10	--	--	--	--	R/L
19	100	100	+5	10	--	--	--	--	R/L
20	100	100	0	-10	--	--	--	--	L
21	100	100	-5	-10	--	--	--	--	R/L
22	100	100	-10	-10	--	--	--	--	R/L
23	100	100	-10	-5	--	--	--	--	R/L
24	100	100	-10	0	--	--	--	--	R/L
25	100	100	-10	+5	--	--	--	--	R/L
Test condtion B									

10	66	66	0	0	434	299.6	1.00	1783	--
11	66	66	0	-5	292	299.5	1.02	1783	L
12	66	66	0	-4	352	299.4	1.02	1782	L
13	66	66	0	-3	338	298.1	1.01	1782	L
14	66	66	0	-2	340	298.6	1.01	1783	L
15	66	66	0	-1	308	299.6	1.00	1782	L
16	66	66	0	1	352	300.1	1.00	1782	L
17	66	66	0	2	344	298.9	0.99	1782	L
18	66	66	0	3	312	299.8	0.99	1783	L
19	66	66	0	4	360	298.0	0.99	1781	L
20	66	66	0	5	314	297.6	0.98	1780	L
21	66	66	0	6	--	--	--	--	L
Test condition C									
22	33	33	0	0	332	143.9	1.00	904	--
24	33	33	0	-5	264	143.6	1.03	897	L
25	33	33	0	-4	318	144.1	1.02	897	L
26	33	33	0	-3	330	143.9	1.01	897	L
27	33	33	0	-2	316	144.2	1.01	899	L
28	33	33	0	-1	326	145.2	1.01	899	L
29	33	33	0	1	314	143.0	1.00	900	L
30	33	33	0	2	312	144.9	0.99	903	L
31	33	33	0	3	300	143.3	0.99	901	L
32	33	33	0	4	286	144.2	0.98	903	L
33	33	33	0	5	142	143.6	0.97	900	L
34	33	33	0	6	--	--	--	--	L

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.

--- End of test report---

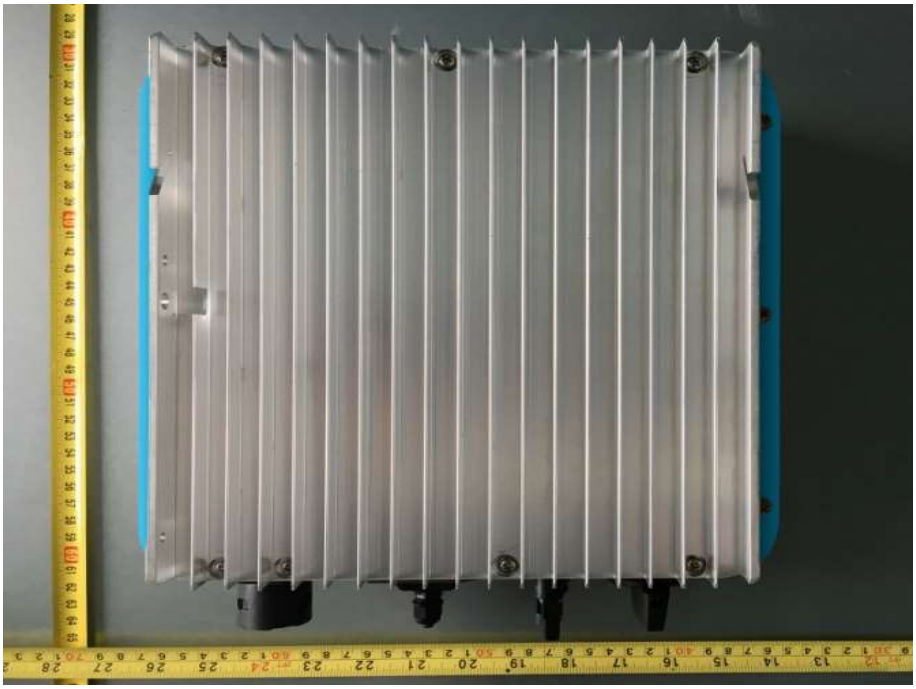
ATTACHMENT I

(Pictures of the EUT and Electrical Schemes)

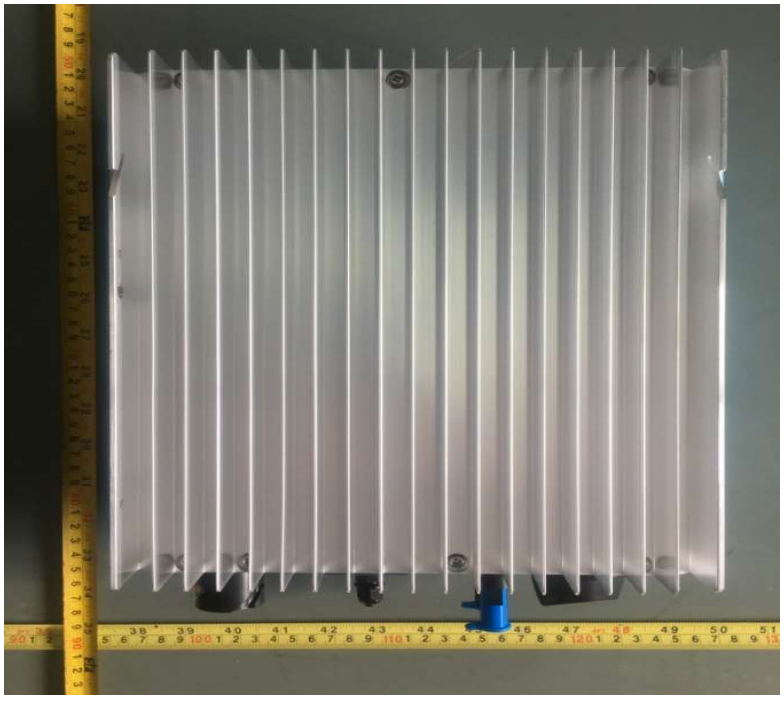
1 PICTURES

Front view 1(EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)

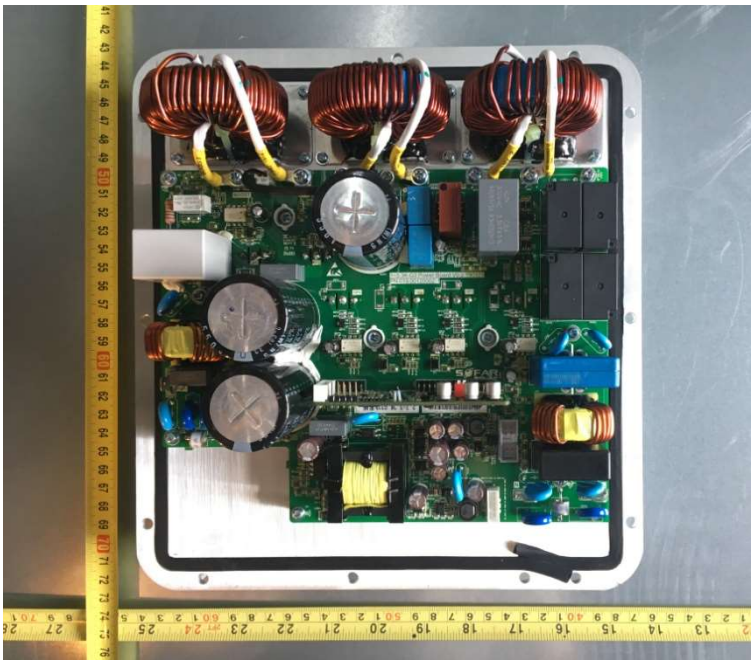
Back view 1(EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)



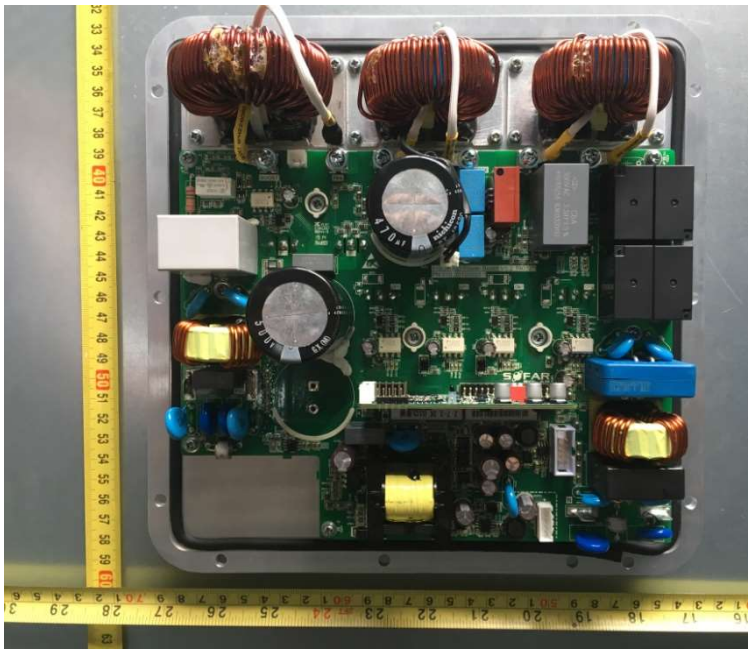
Front view 2 (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)

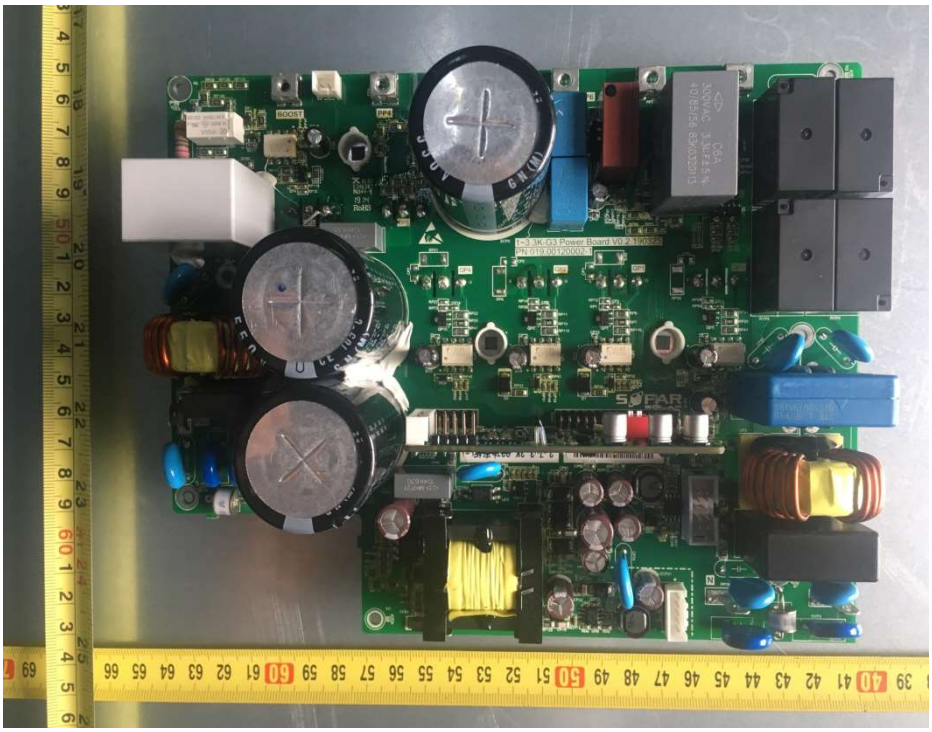
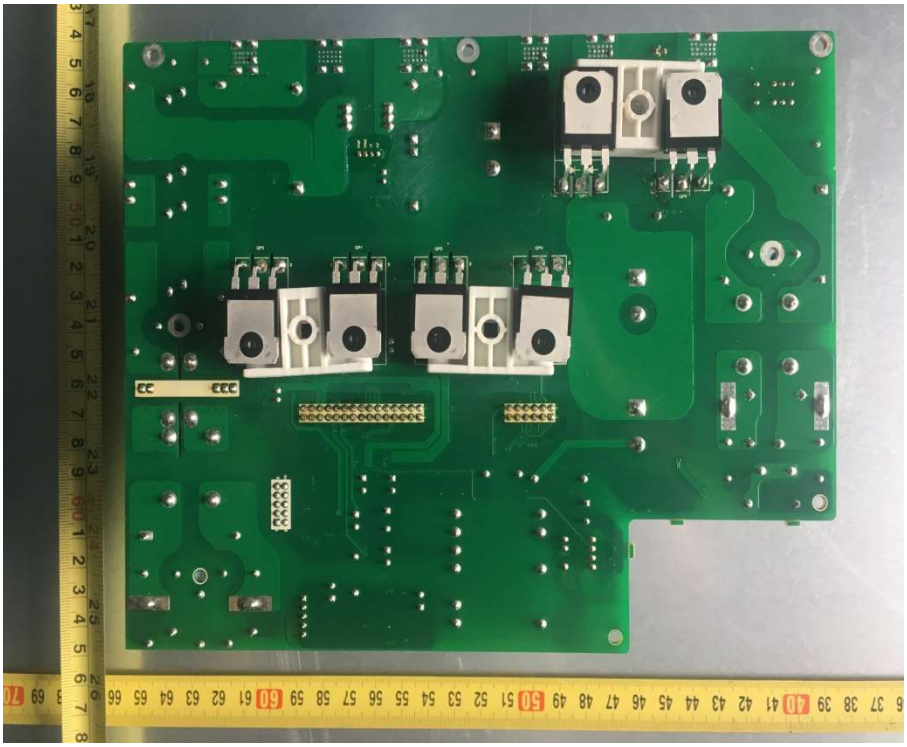
Back view 2 (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)


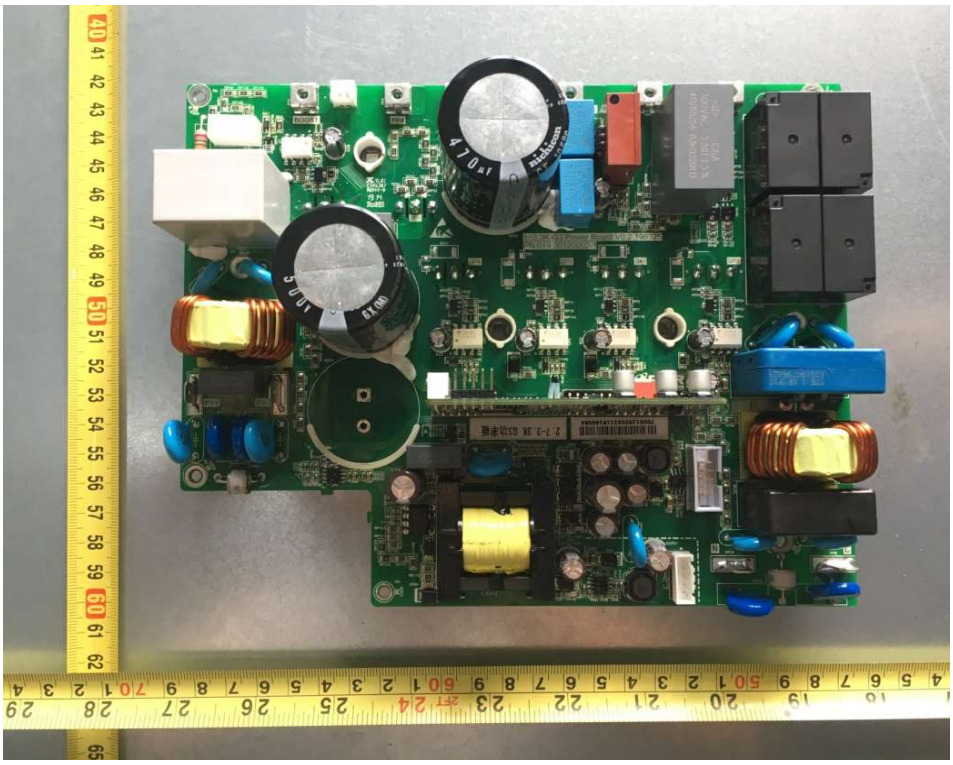
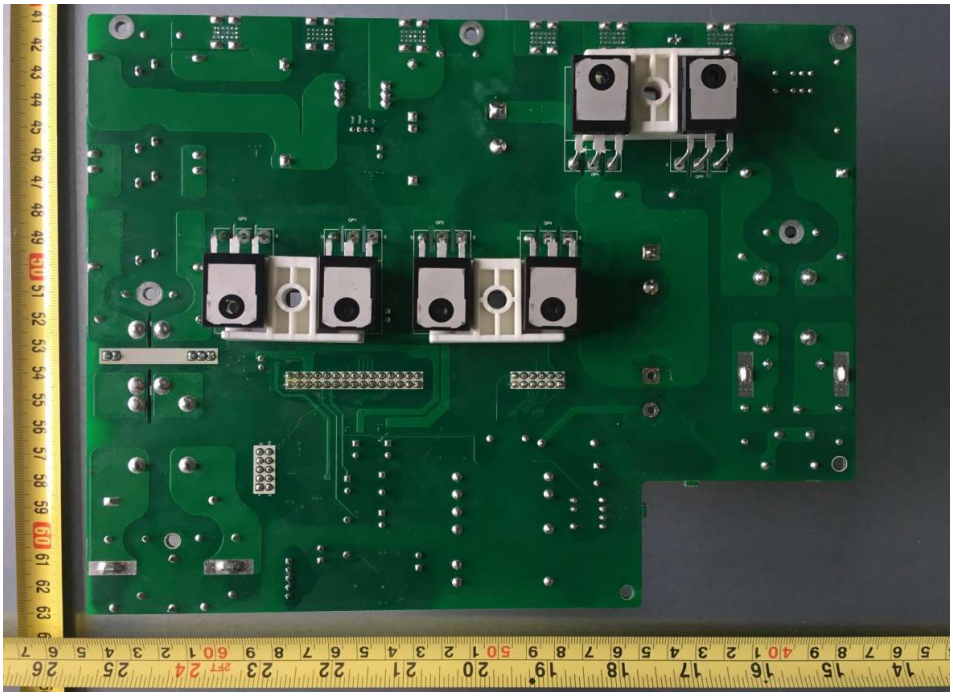
Internal view of enclosure (EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)

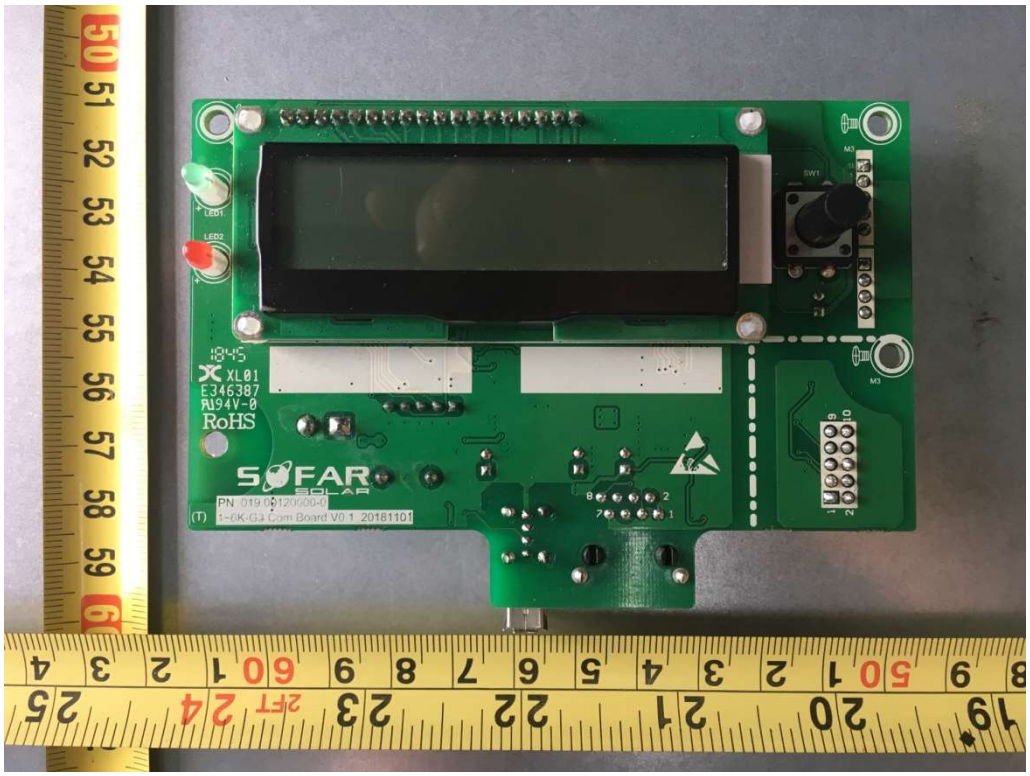
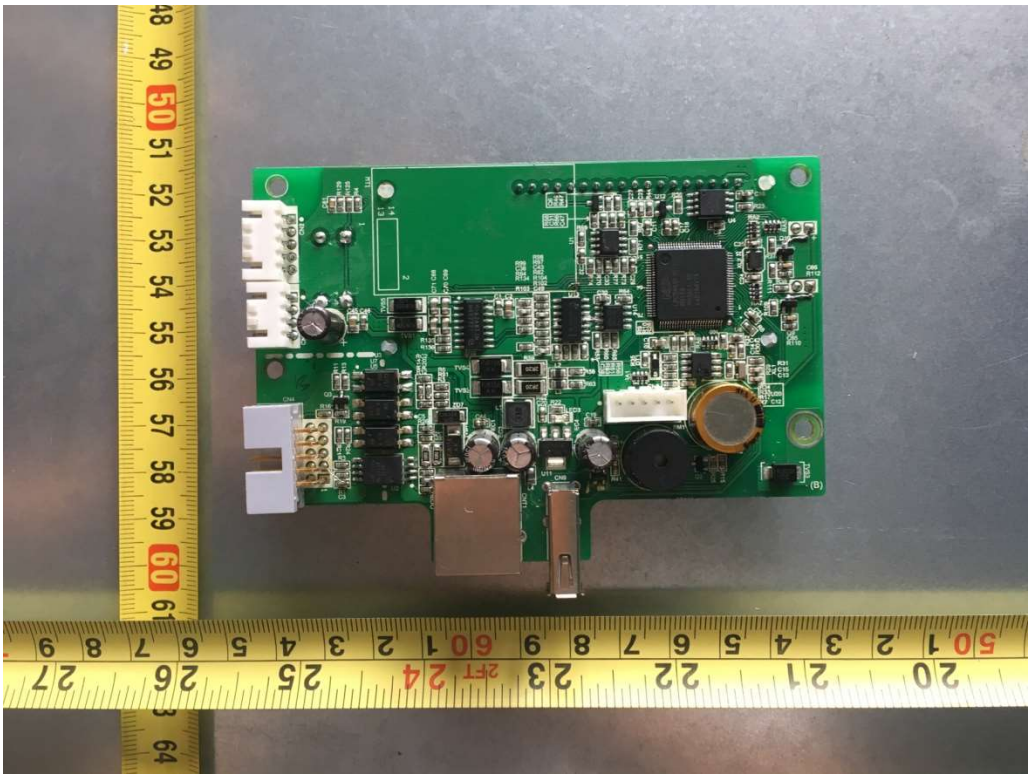


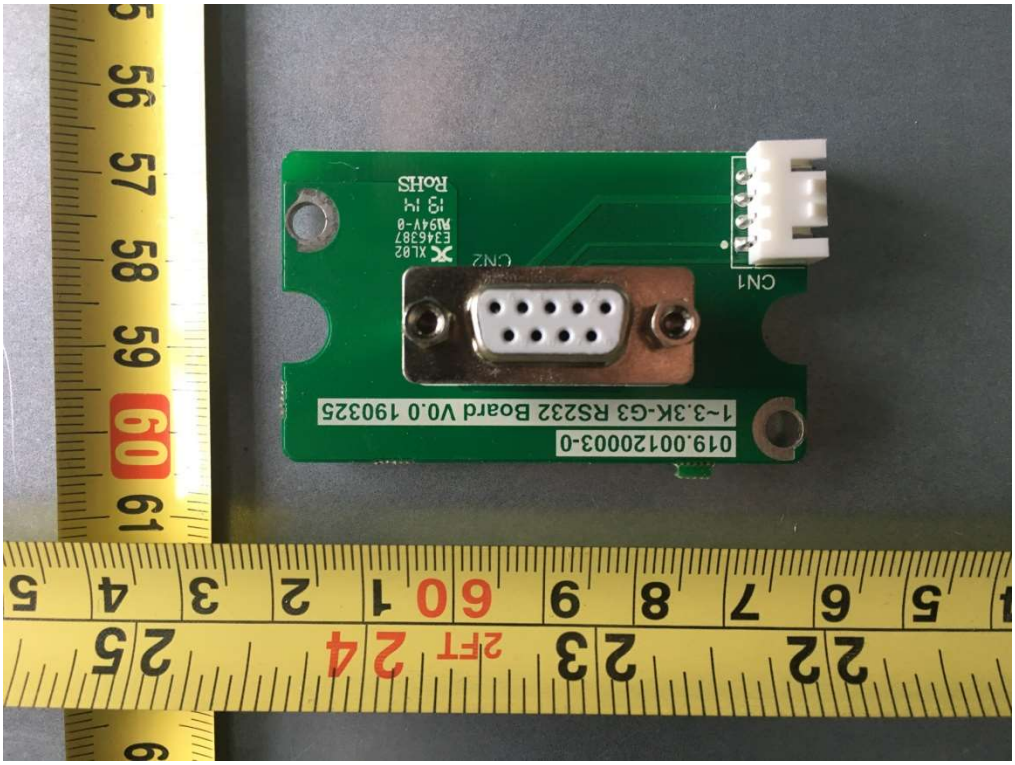
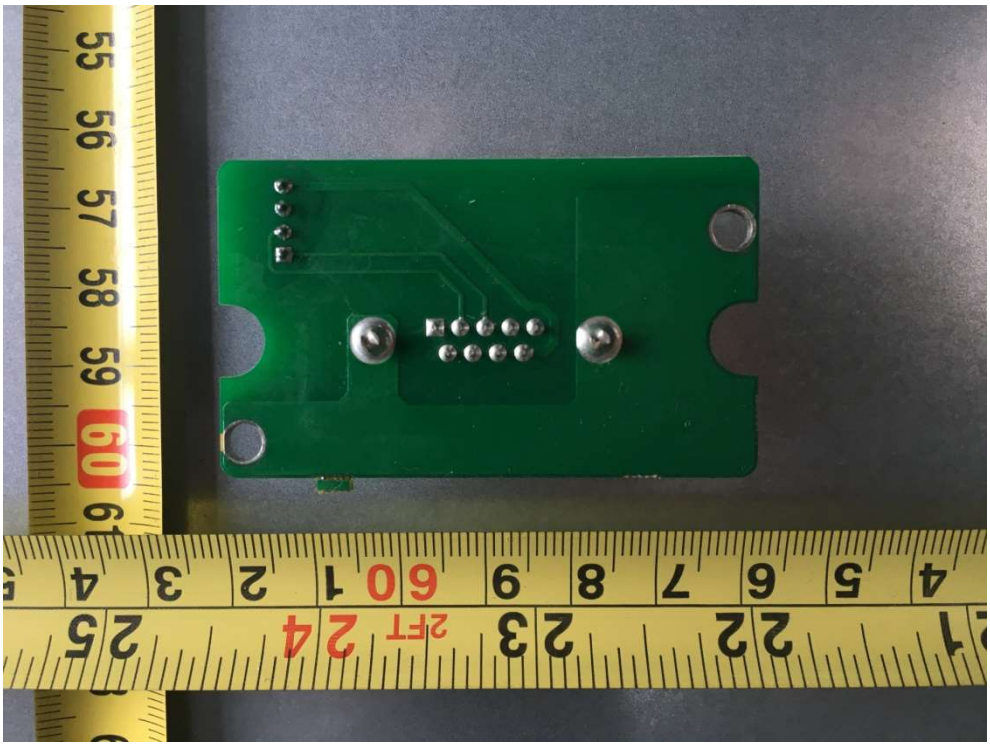
Internal view of enclosure (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)



Front side of main board 1(EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)

Back side of main board 1(EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)


Front side of main board 2 (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)

Back side of main board (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)


Front side of Control board

Back side of Control board


Front view of RS 232 board

Back view of RS 232 board


Connection interface

Side View

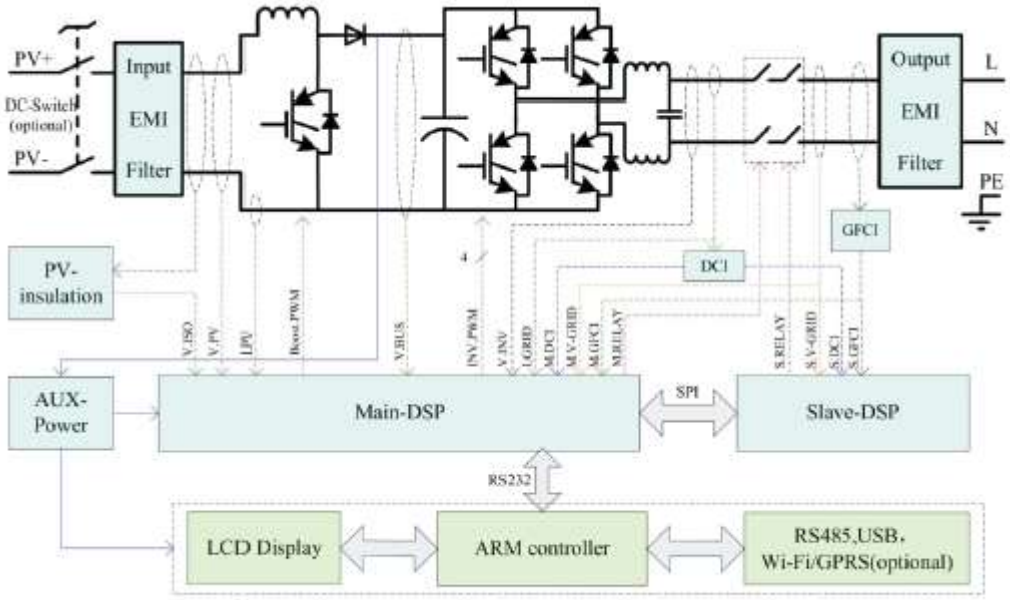

Grounding

Software Number (EVVO 2700TL-AV, EVVO 3000TL-AV, EVVO 3200TL-AV)

Software Number (EVVO 1100TL-AV, EVVO 1600TL-AV, EVVO 2200TL-AV)

Software version

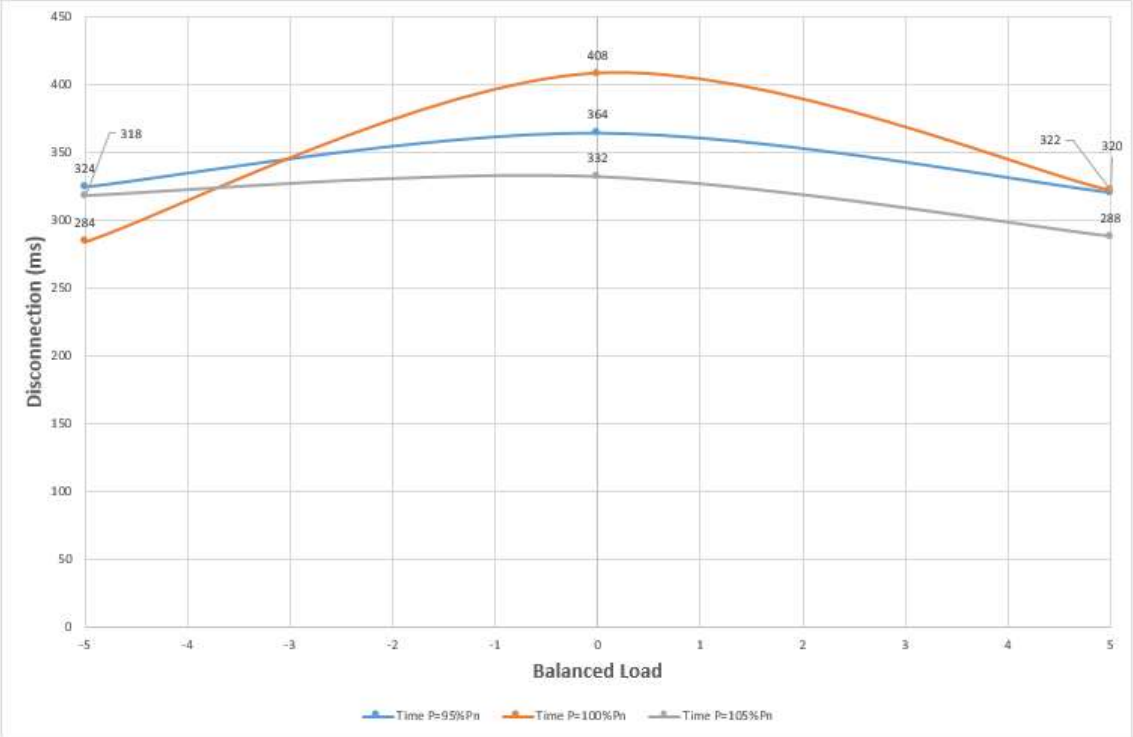

Electrical Schemes



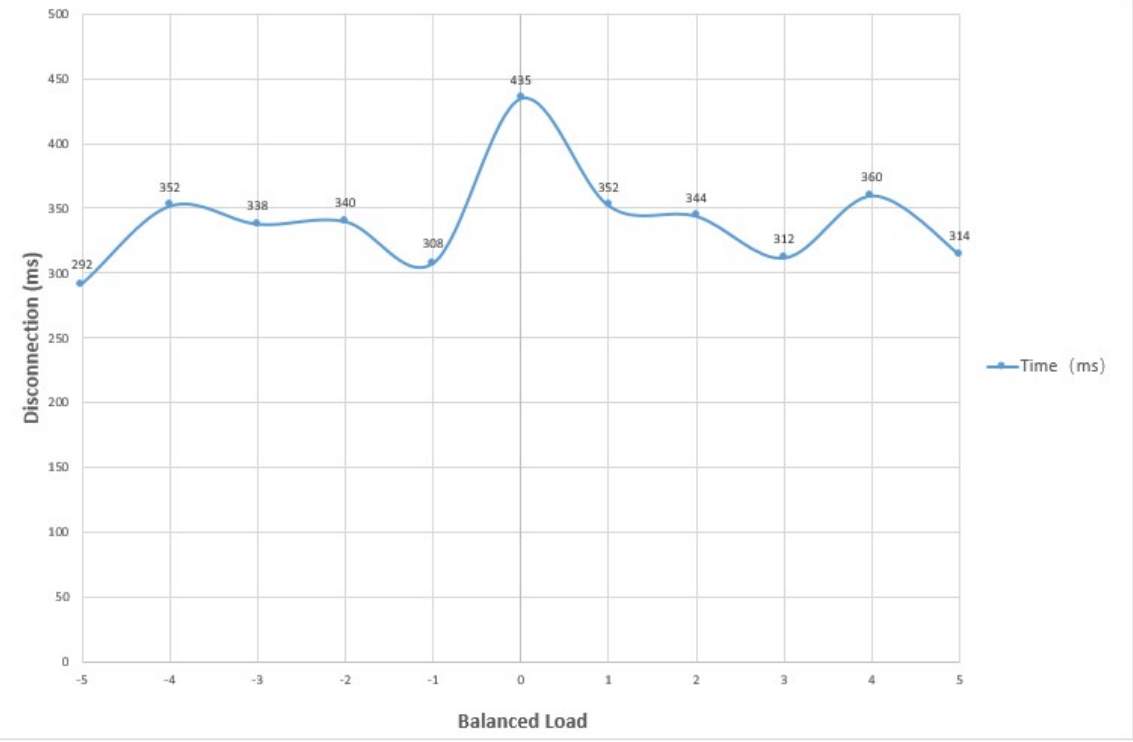
ATTACHMENT II

(GRAPHICS OF THE TEST RESULTS)

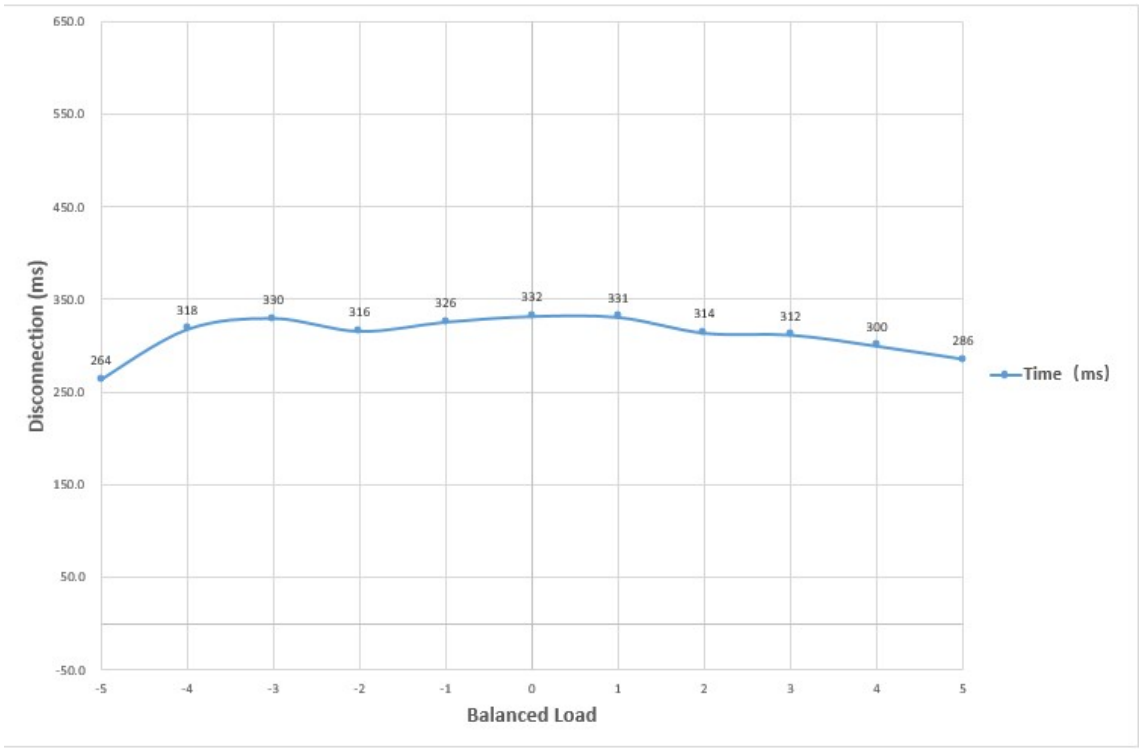
Test Condition A



Test Condition B



Test Condition C



ATTACHMENT III

(GRAPHICS OF THE ISLANDING BEHAVIOR DETECTION)

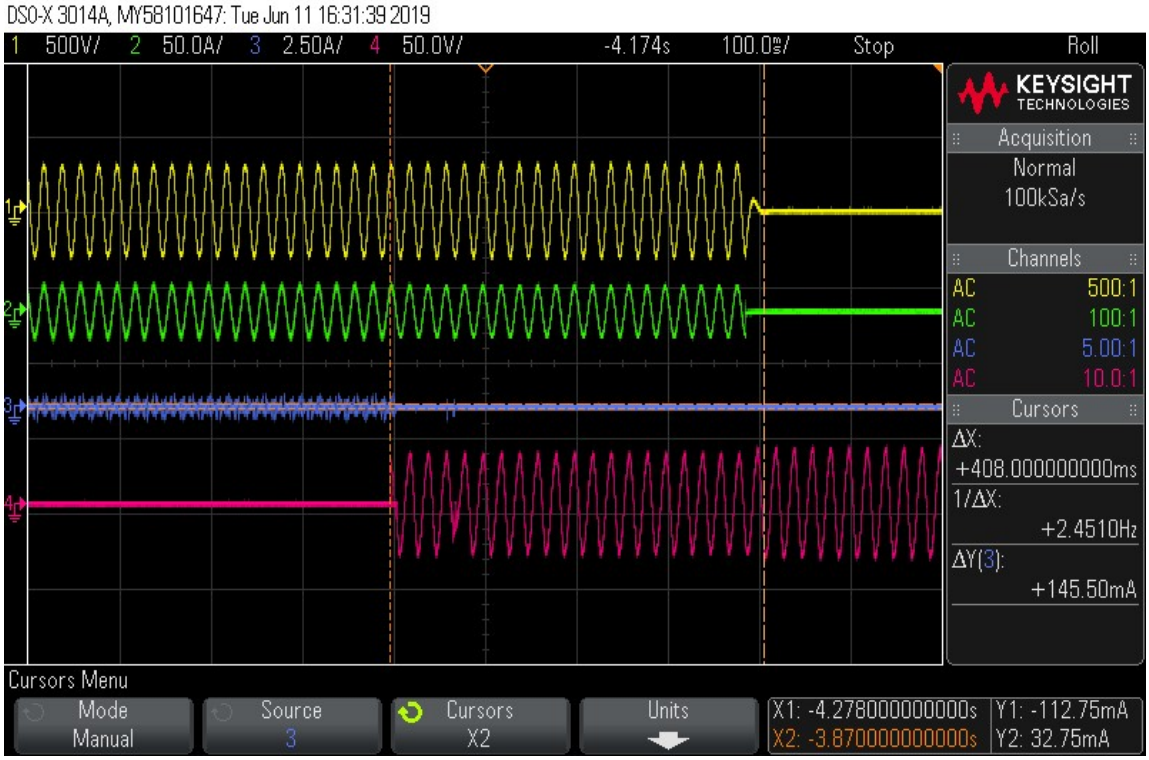
1 DEFINITIONS

M It represents the % change in active load from nominal output power

N It represents the % change in reactive load from nominal output power

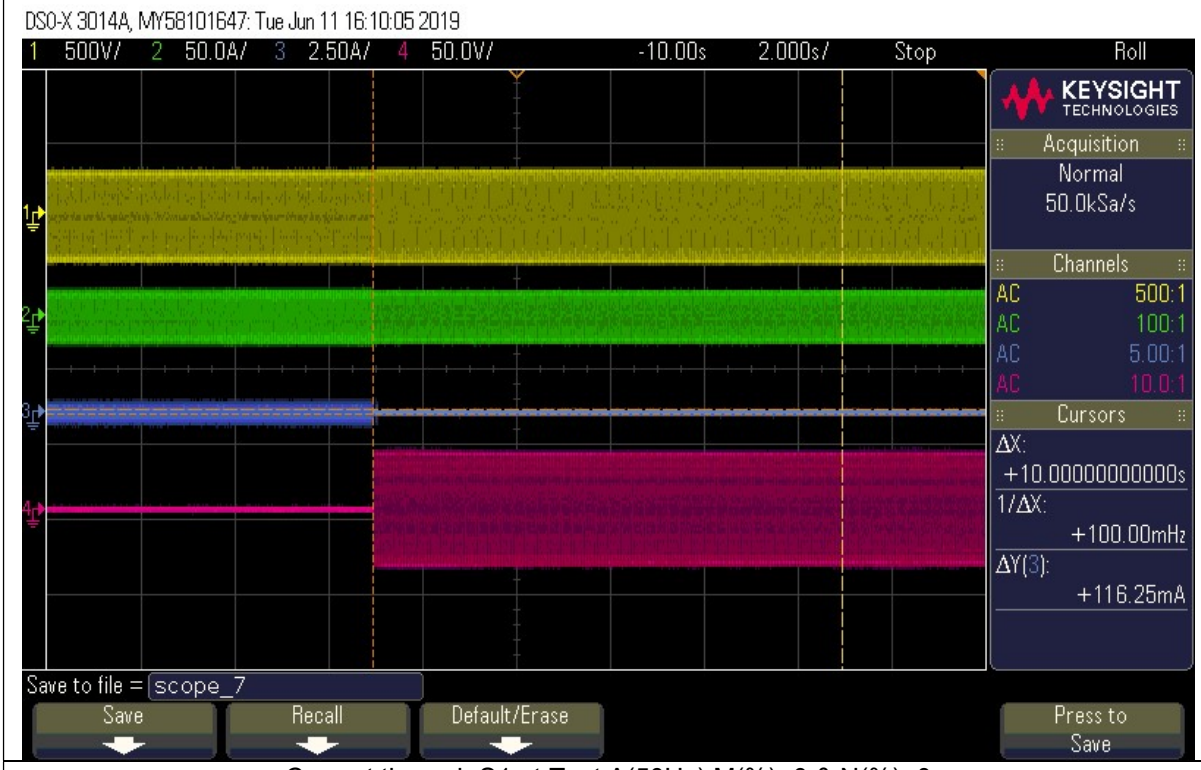
2 LEGEND

Legend

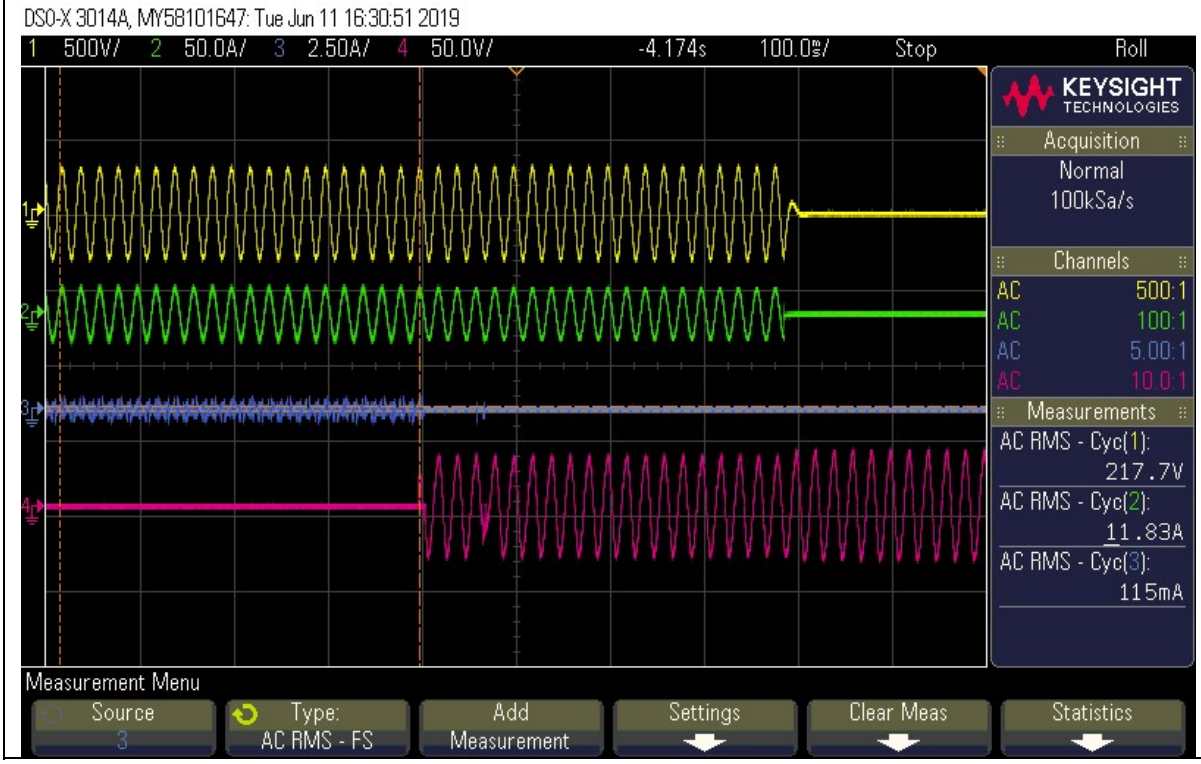


Colour	Label	Definition
	CH1	**Output Voltage**
	CH2	**Output Current**
	CH4	**Grid Switch**

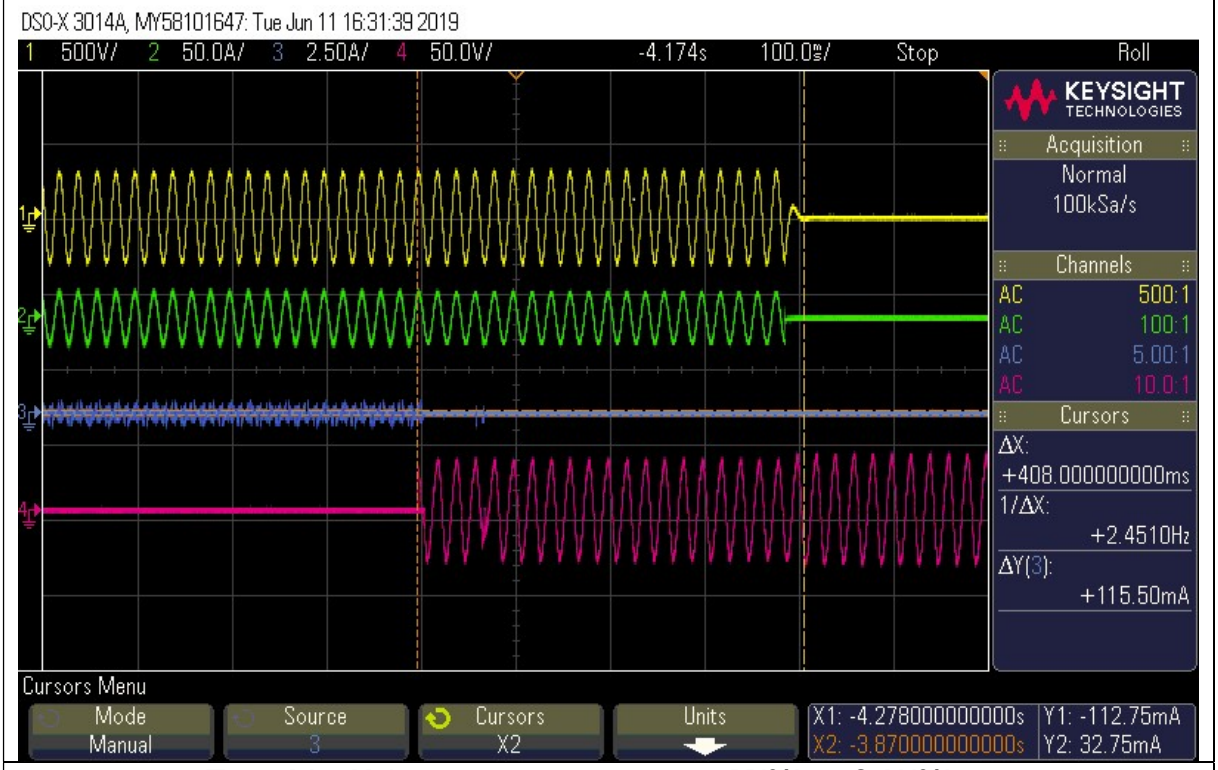
Test A(50Hz) M(%)=0 & N(%)=0 with De-activating anti-islanding protection



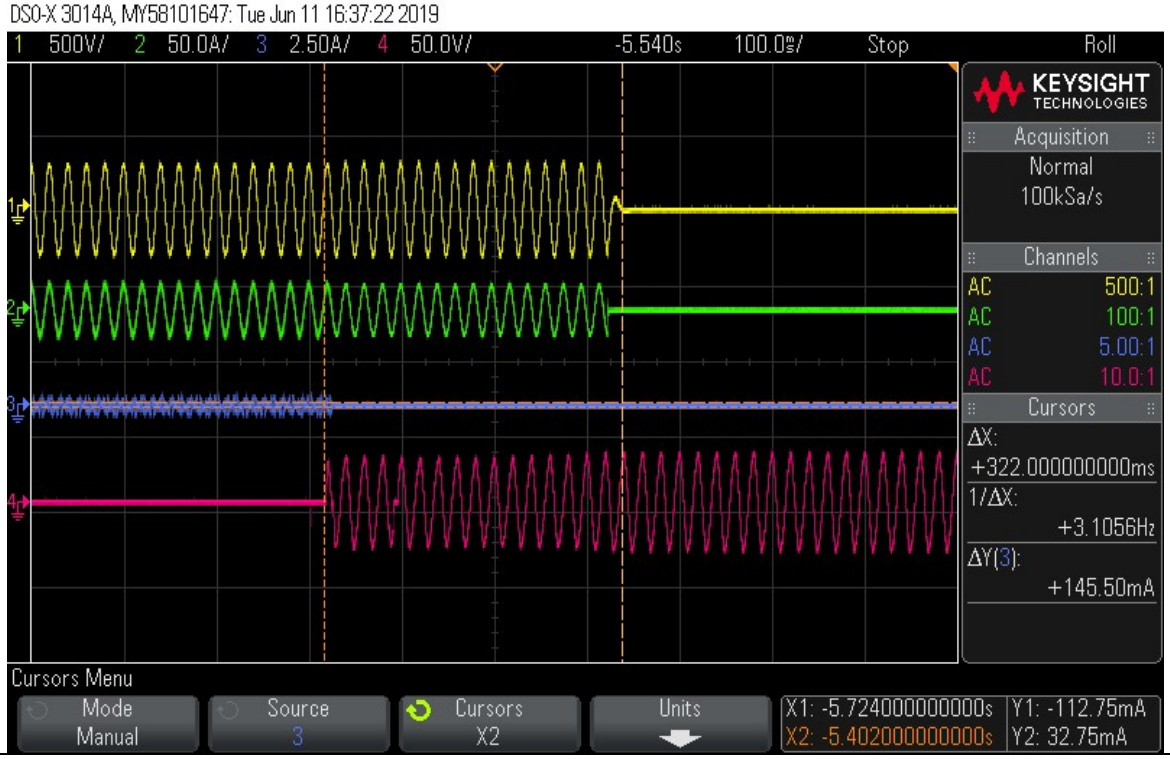
Current through S1 at Test A(50Hz) M(%)=0 & N(%)=0



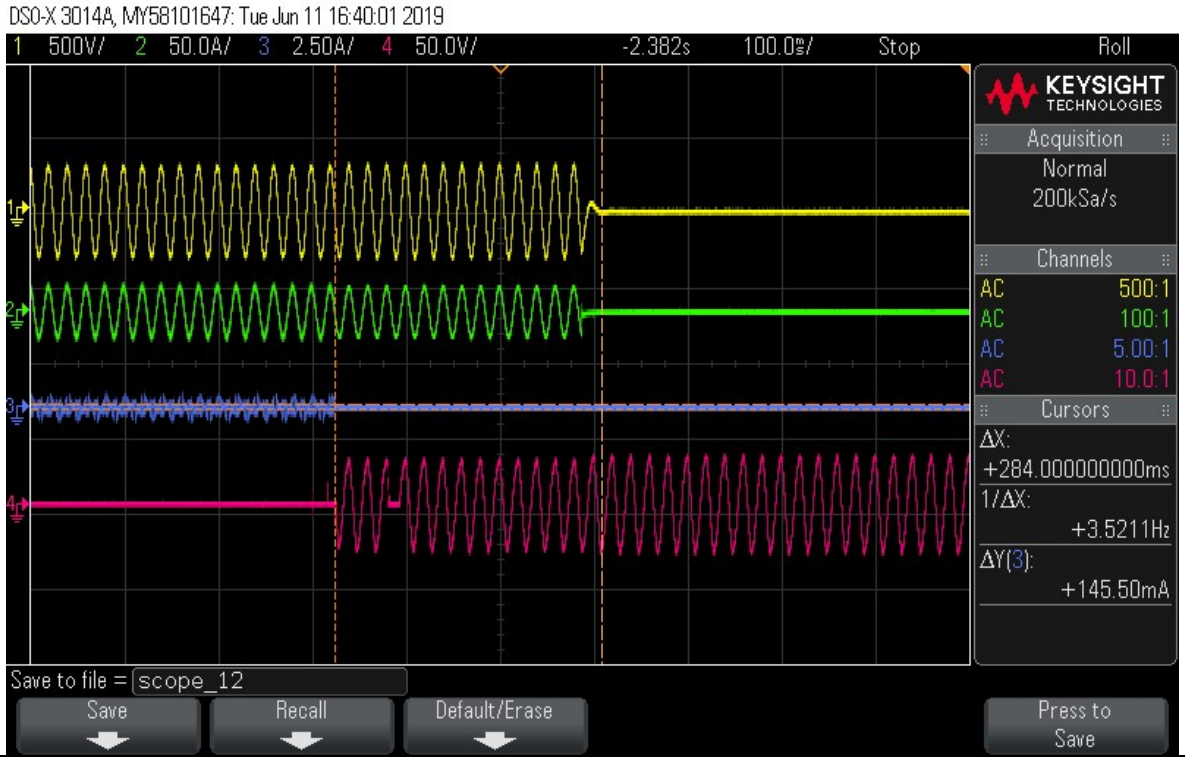
Test A(50Hz)	M(%)=0 & N(%)=0



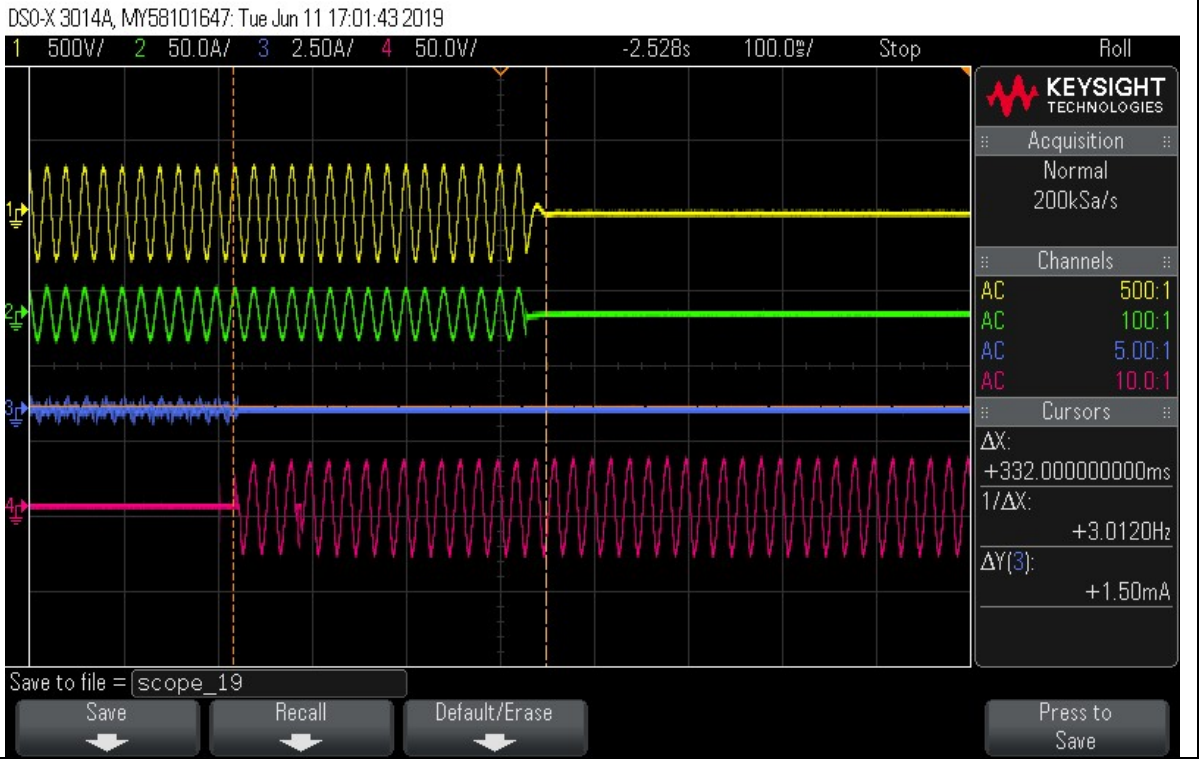
Test A(50Hz)	M(%)=0 & N(%)=+5



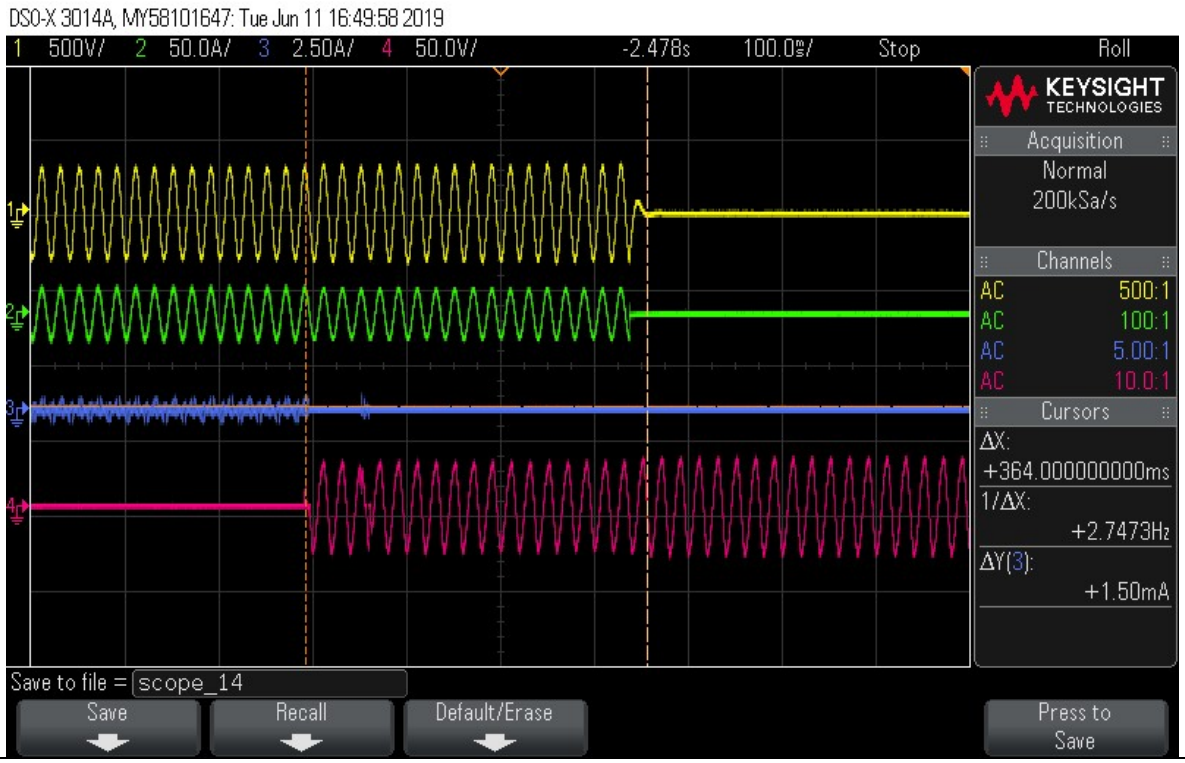
Test A(50Hz)	M(%)=0 & N(%)=-5



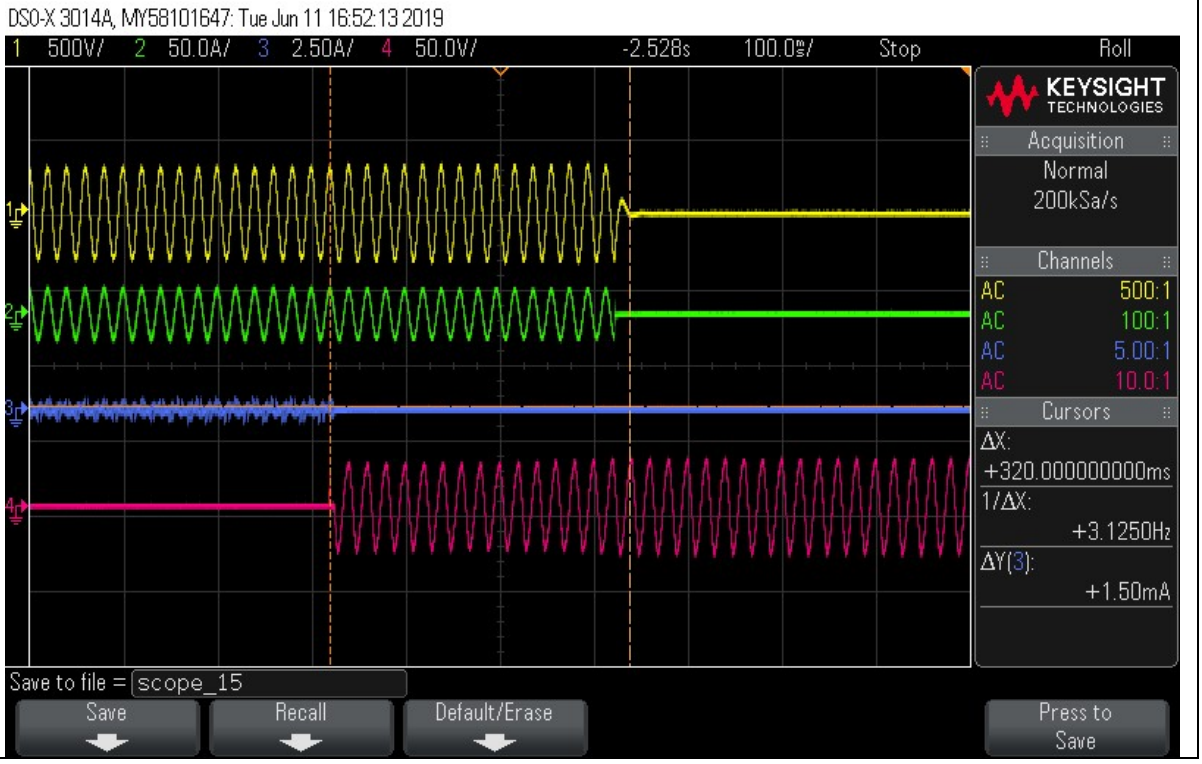
Test A(50Hz)	M(%)=+5 & N(%)=0



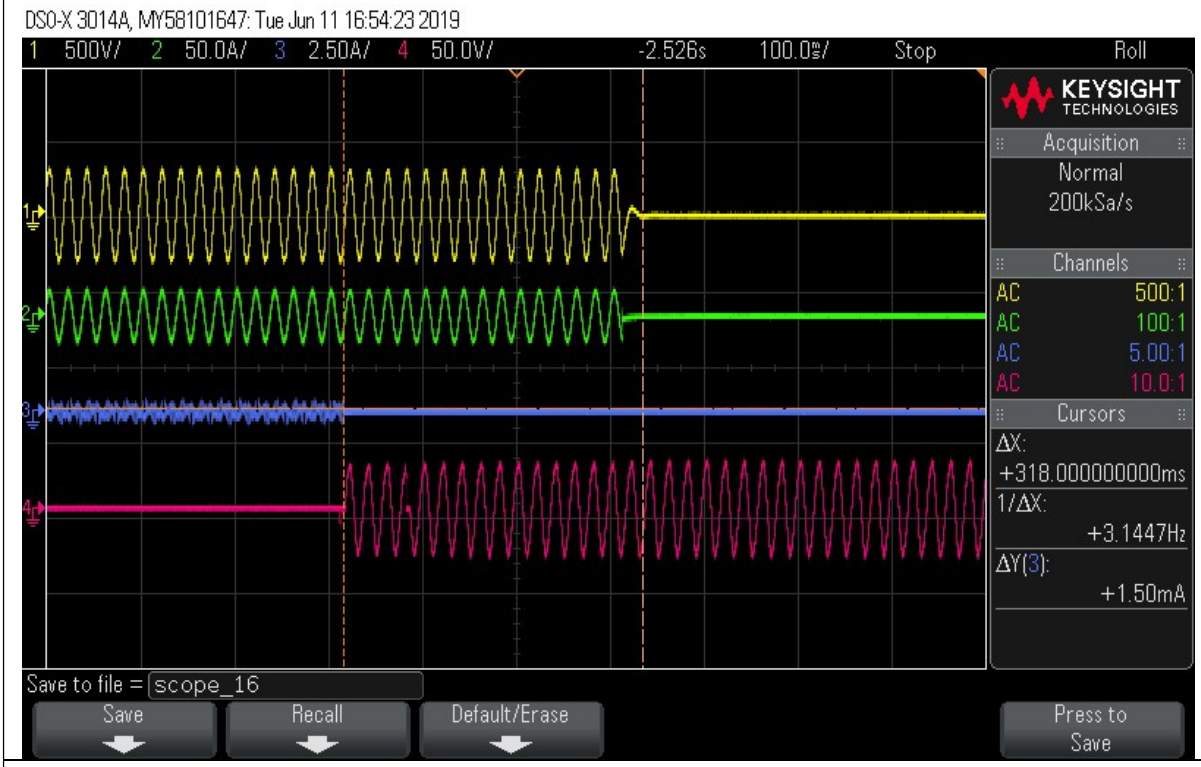
Test A(50Hz)	M(%)=-5 & N(%)=0



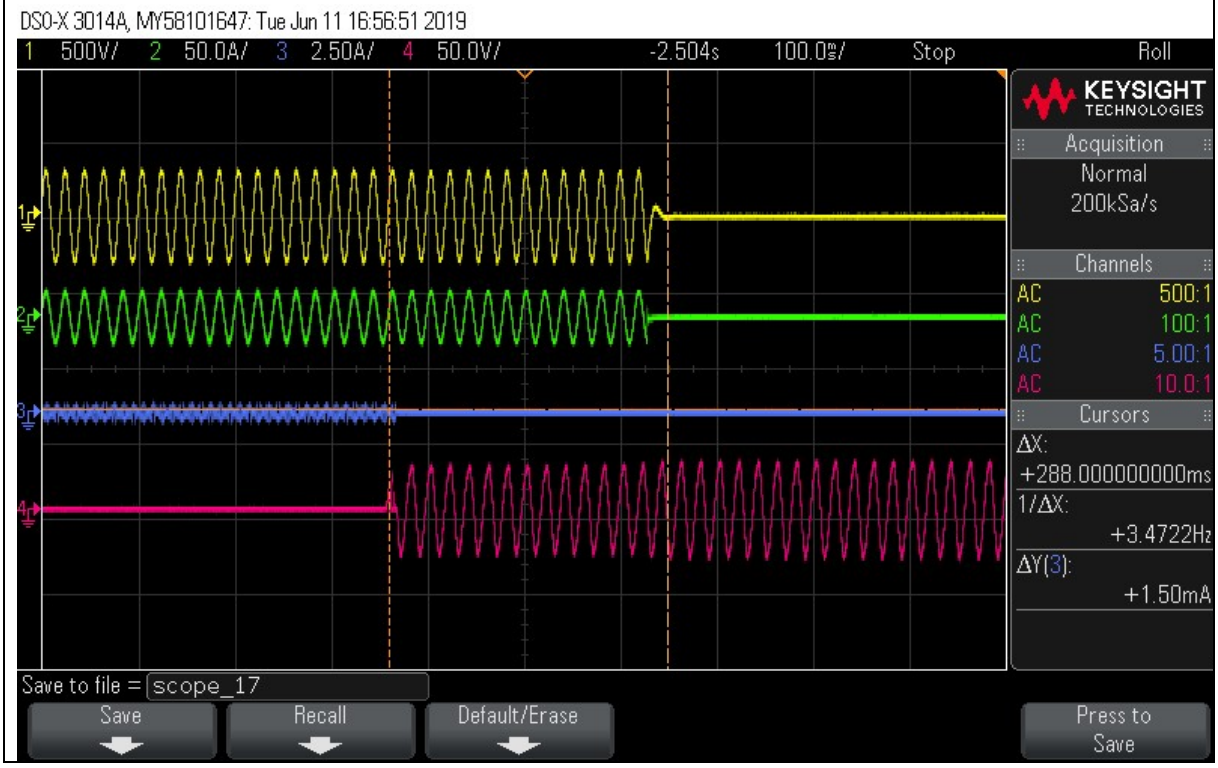
Test A(50Hz)	M(%)=-5 & N(%)=+5



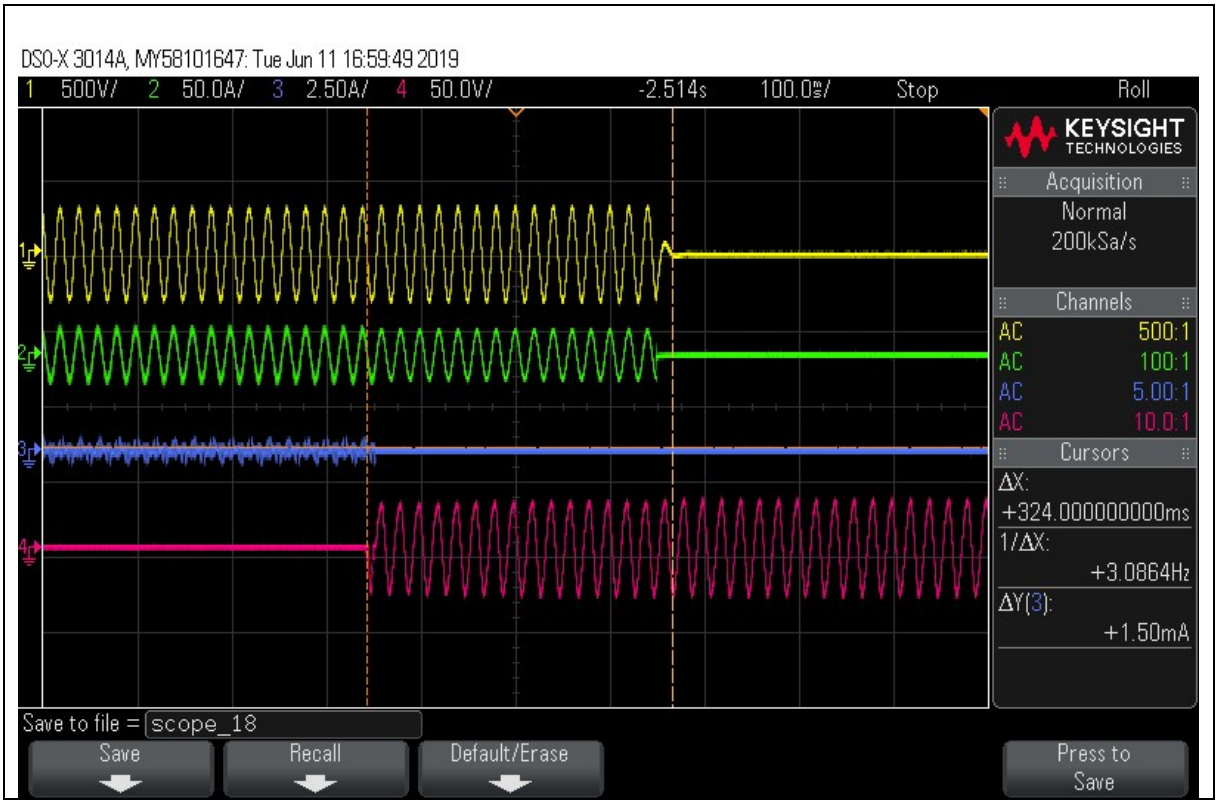
Test A(50Hz)	M(%)=+5 & N(%)=-5



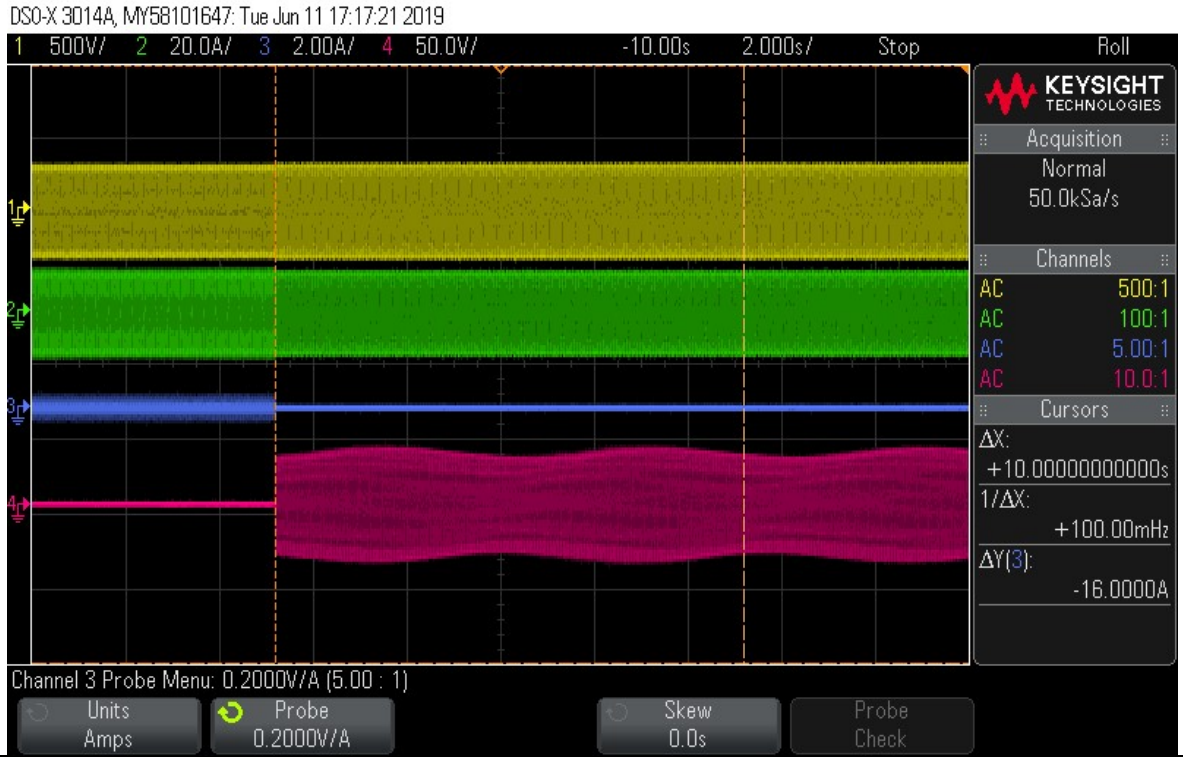
Test A(50Hz) **M(%)=+5 & N(%)=+5**



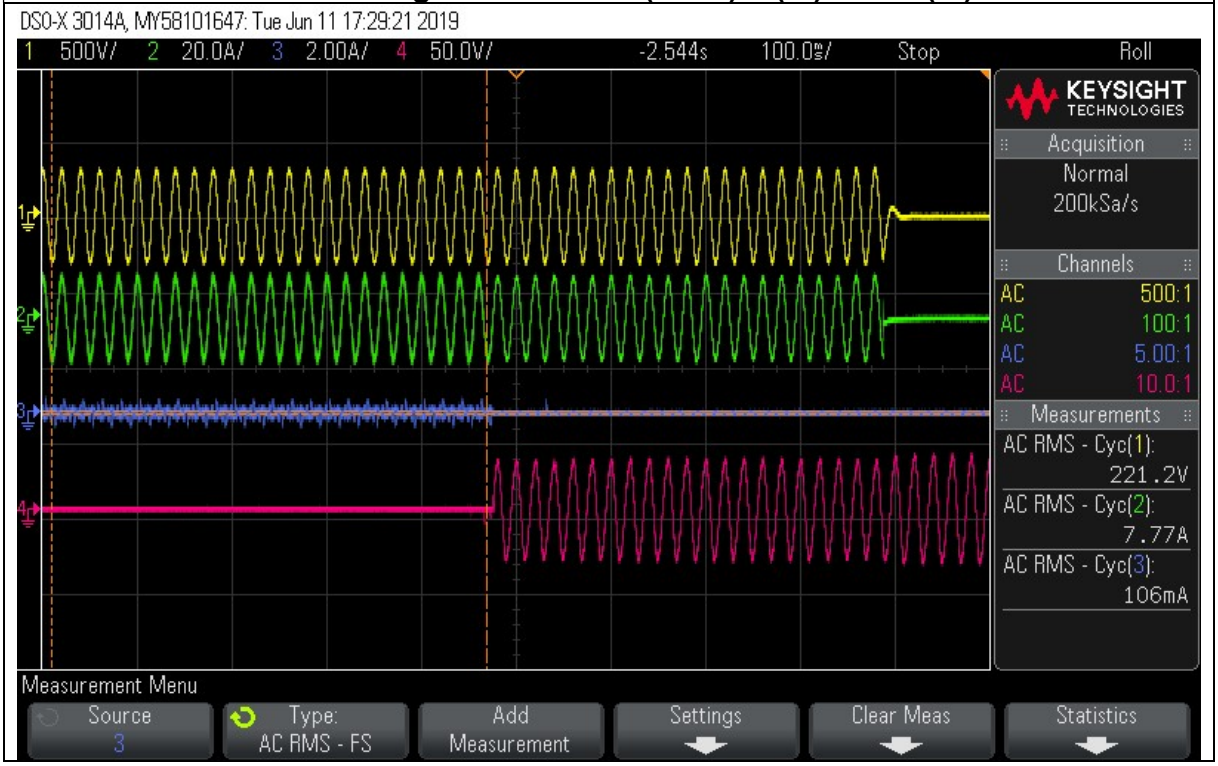
Test A(50Hz) **M(%)=-5 & N(%)=-5**


DSO-X 3014A, MY58101647: Tue Jun 11 16:59:49 2019
1 500V/ 2 50.0A/ 3 2.50A/ 4 50.0V/ -2.514s 100.0ms/ Stop Roll
KEYSIGHT TECHNOLOGIES
Acquisition
Normal
200kSa/s
Channels
AC 500:1
AC 100:1
AC 5.00:1
AC 10.0:1
Cursors
ΔX:
+324.000000000ms
1/ΔX:
+3.0864Hz
ΔY(3):
+1.50mA
Save to file = scope_18
Save
Recall
Default/Erase
Press to Save

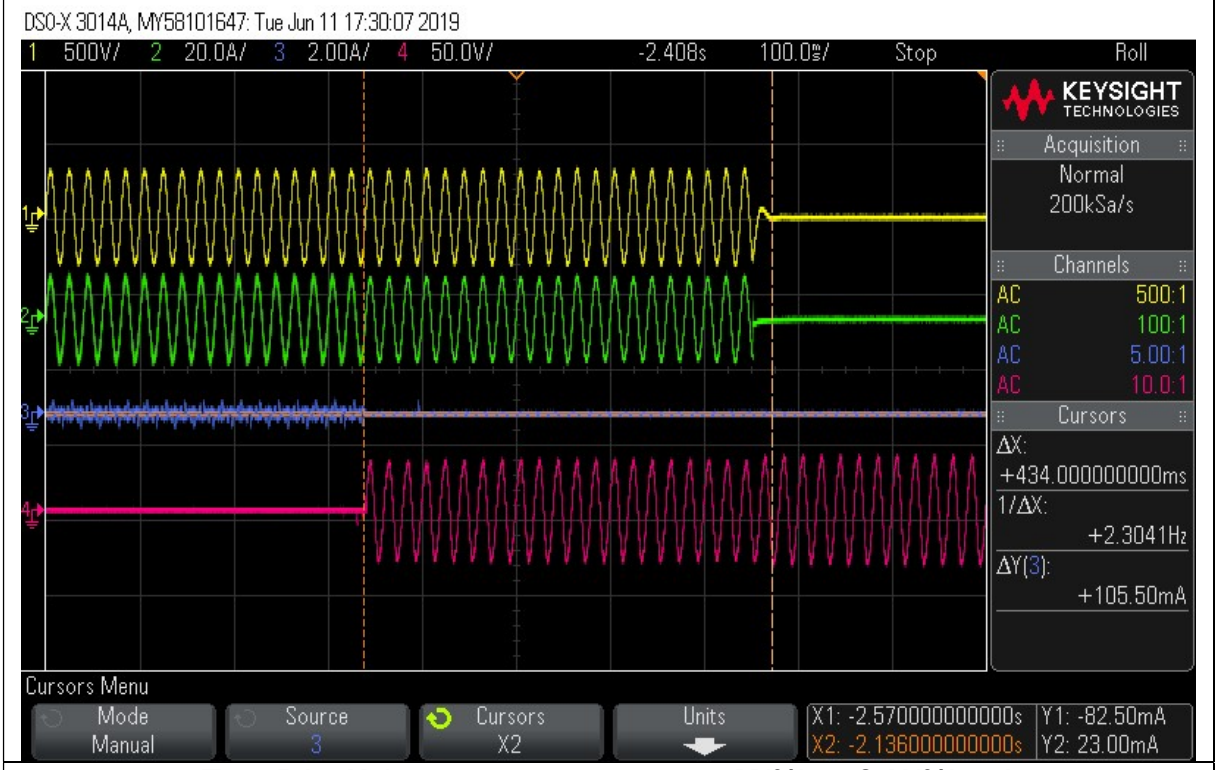
Test B(50Hz) M(%)=0 & N(%)=0 with De-activating anti-islanding protection



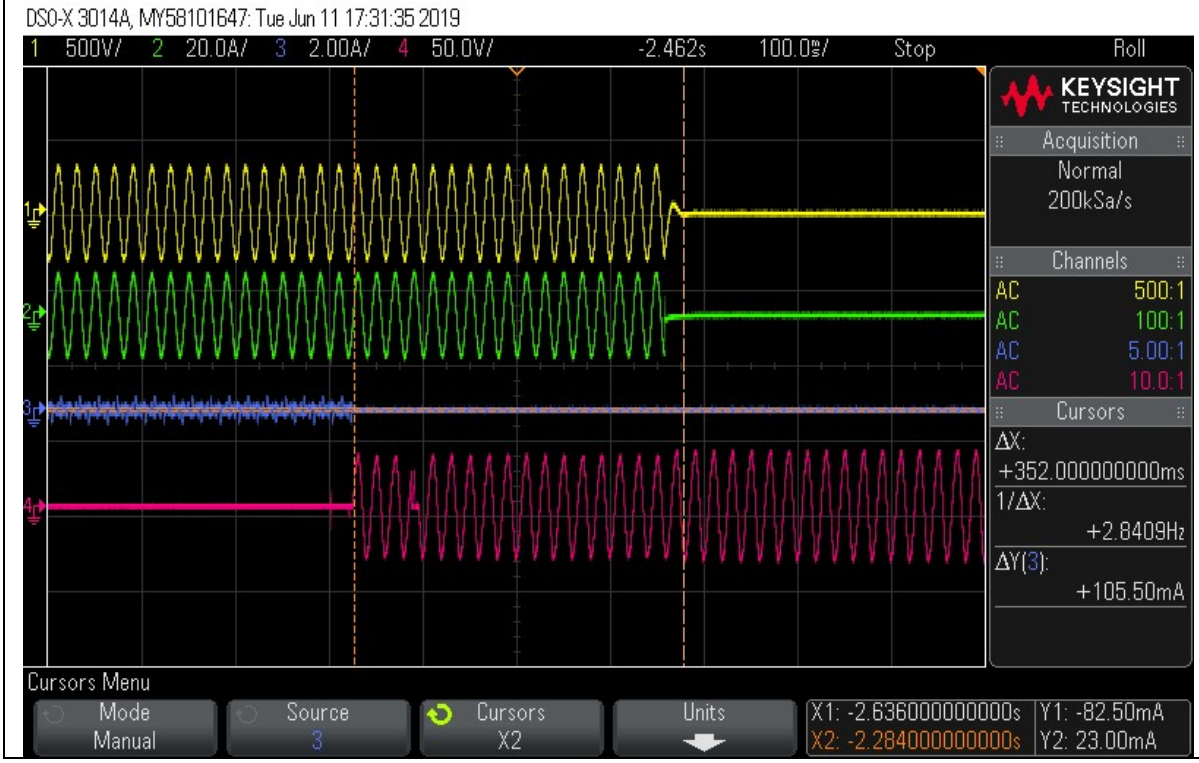
Current through S1 at Test B(50Hz) M(%)=0 & N(%)=0



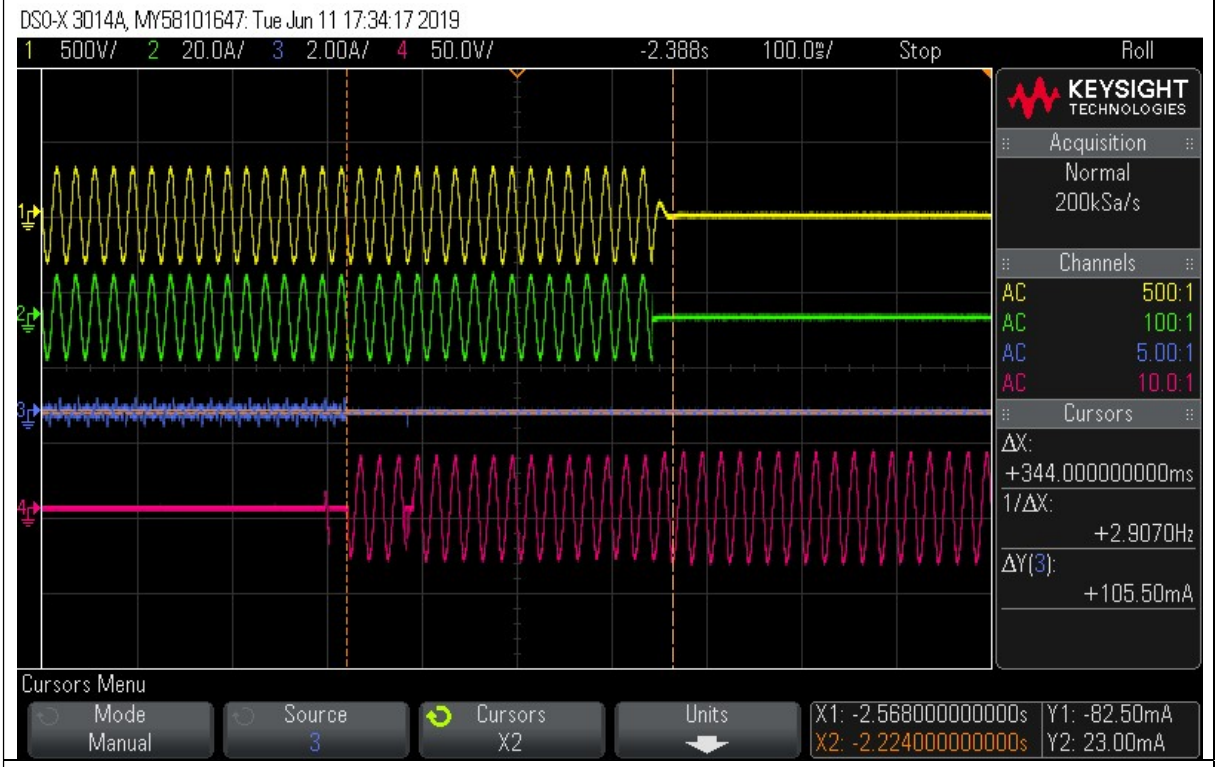
Test B(50Hz)	M(%)=0 & N(%)=0



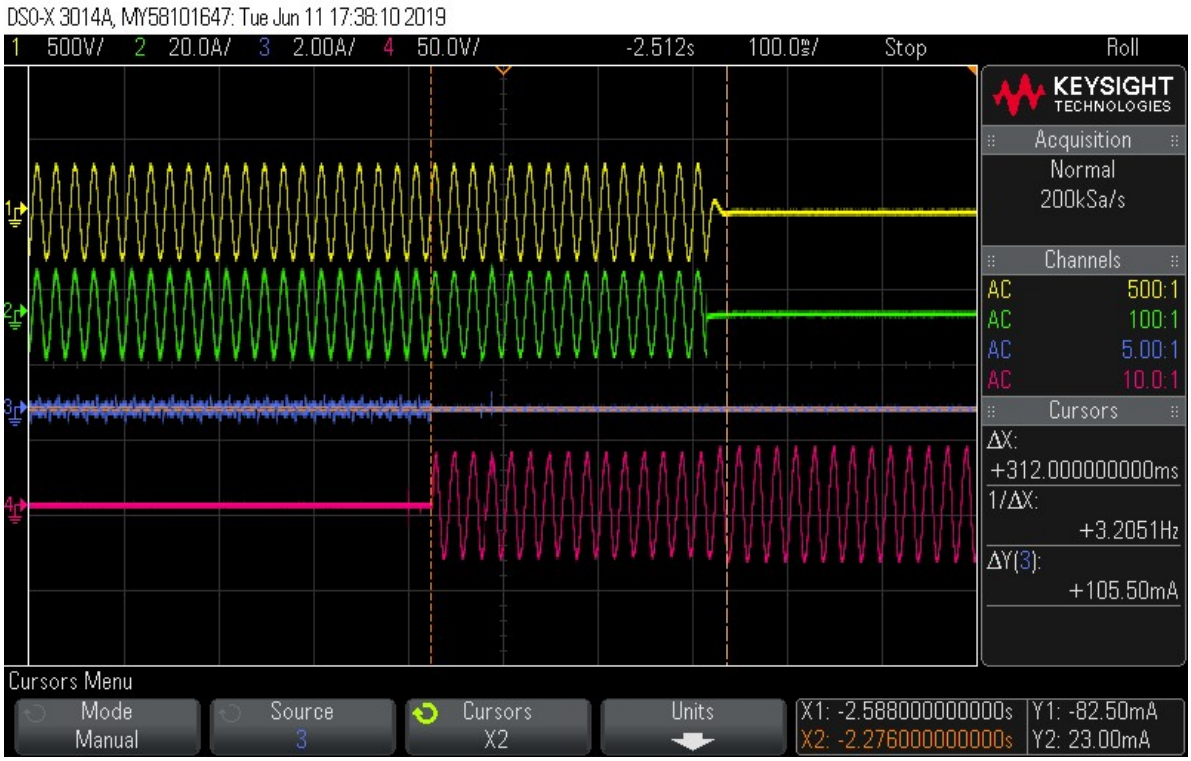
Test B(50Hz)	M(%)=0 & N(%)=+1



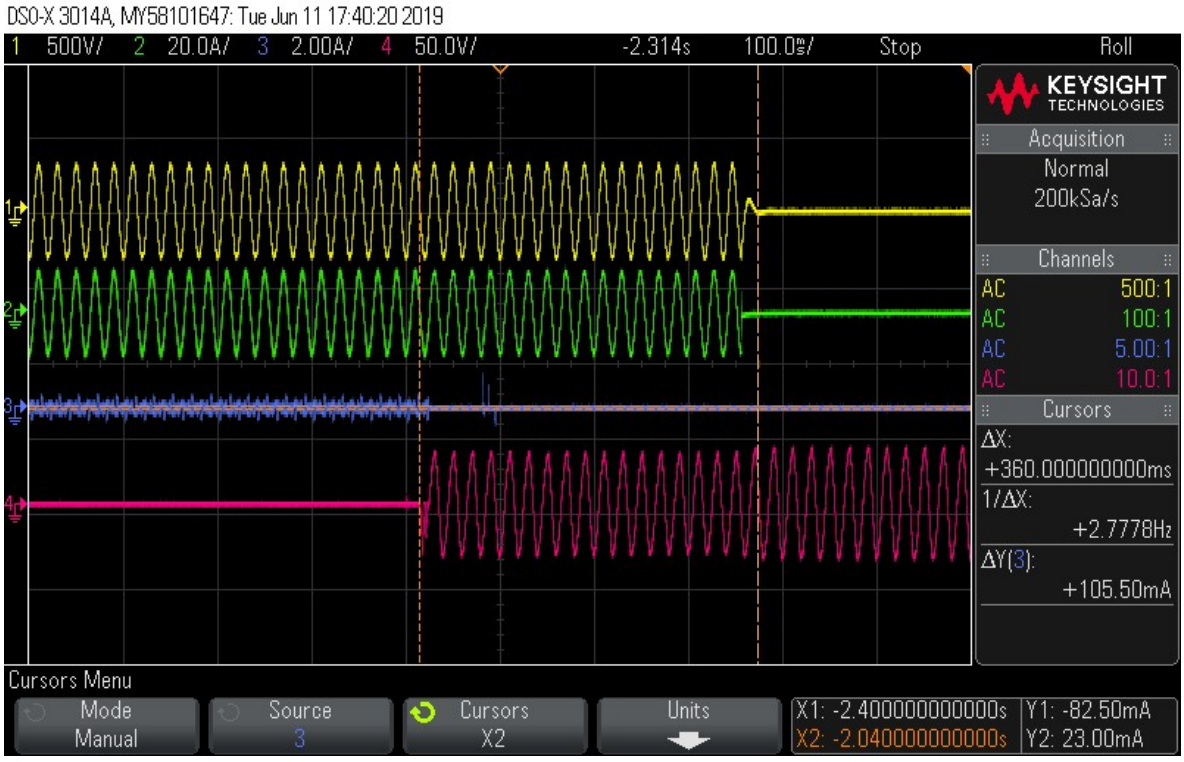
Test B(50Hz)	M(%)=0 & N(%)=+2



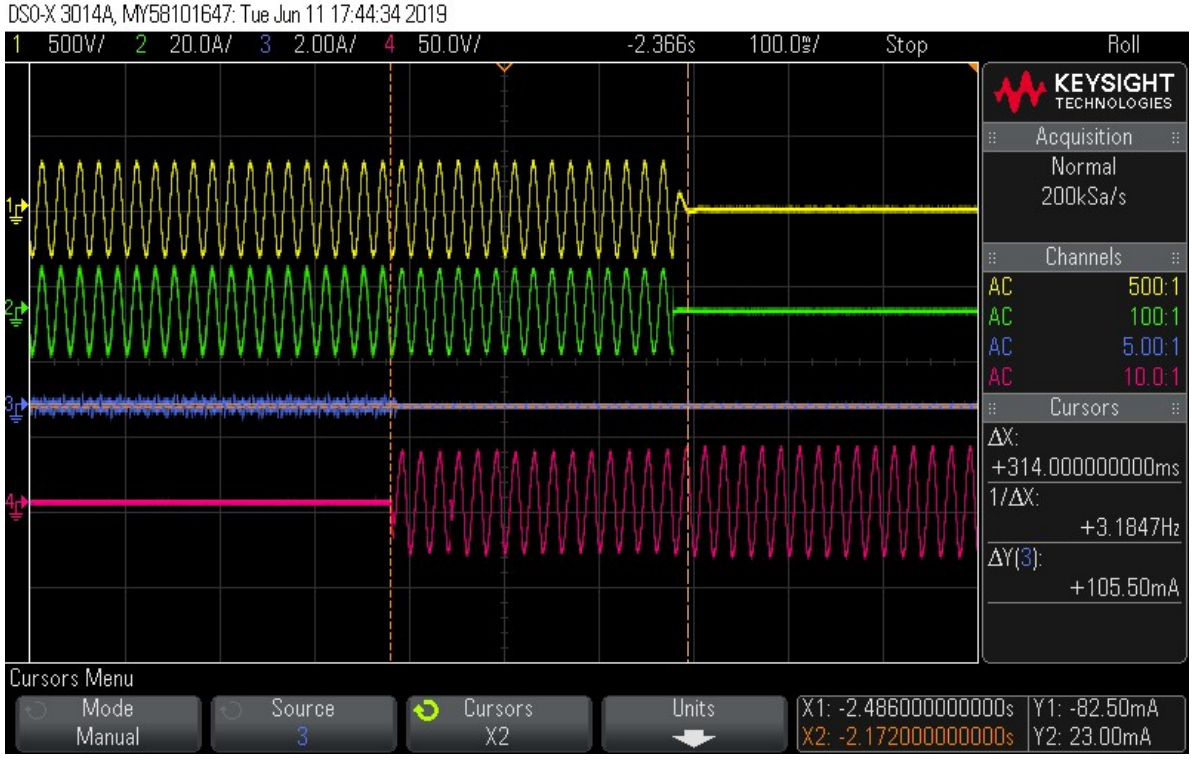
Test B(50Hz) **M(%)=0 & N(%)=+3**



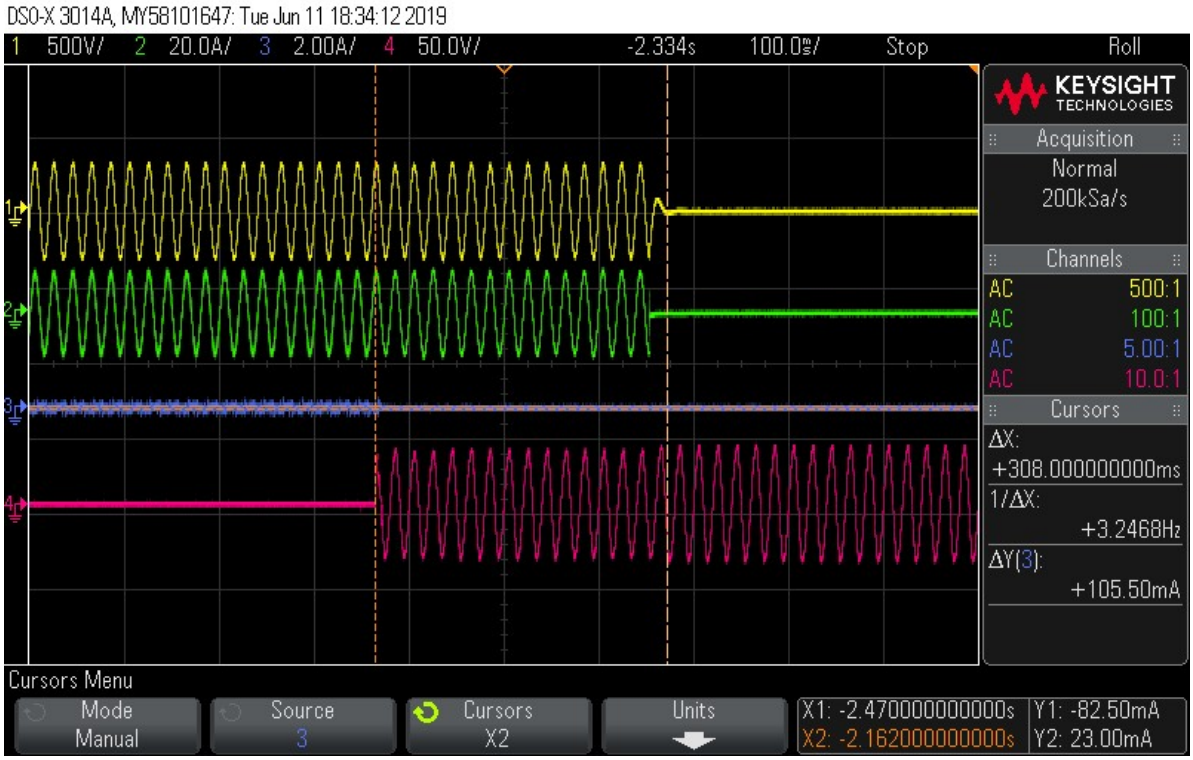
Test B(50Hz) **M(%)=0 & N(%)=+4**



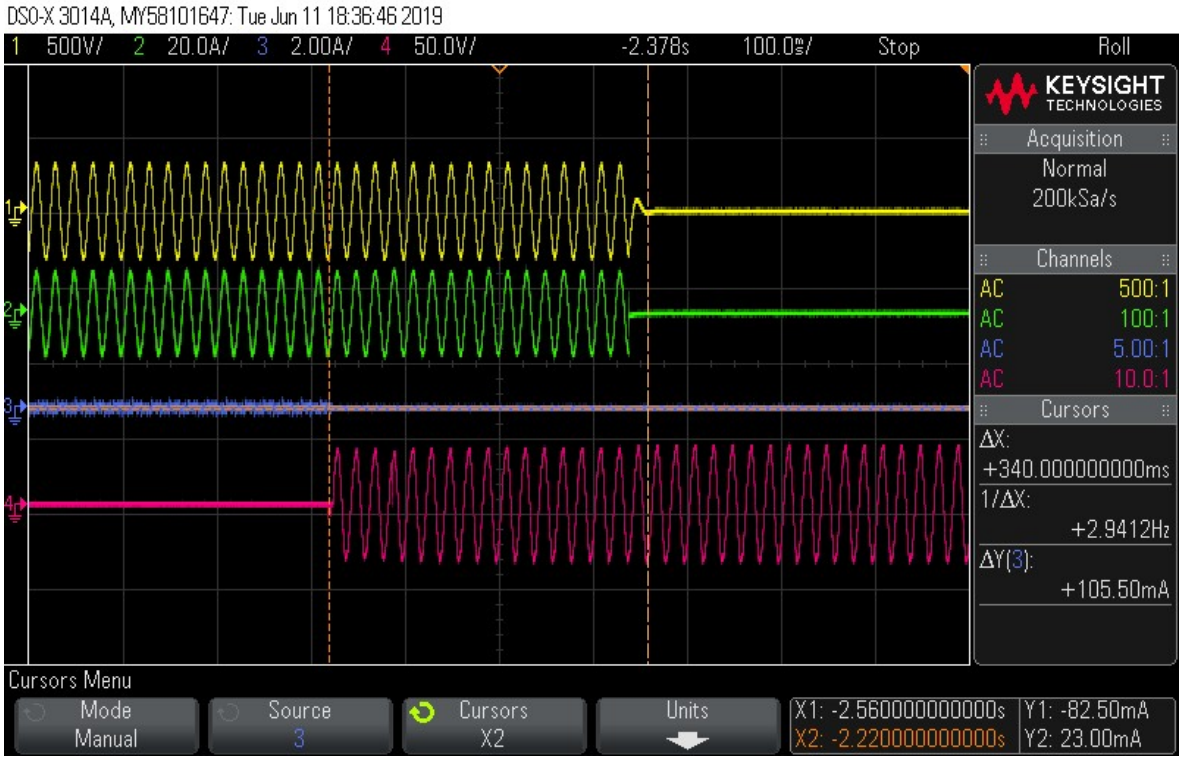
Test B(50Hz) **M(%)=0 & N(%)=+5**



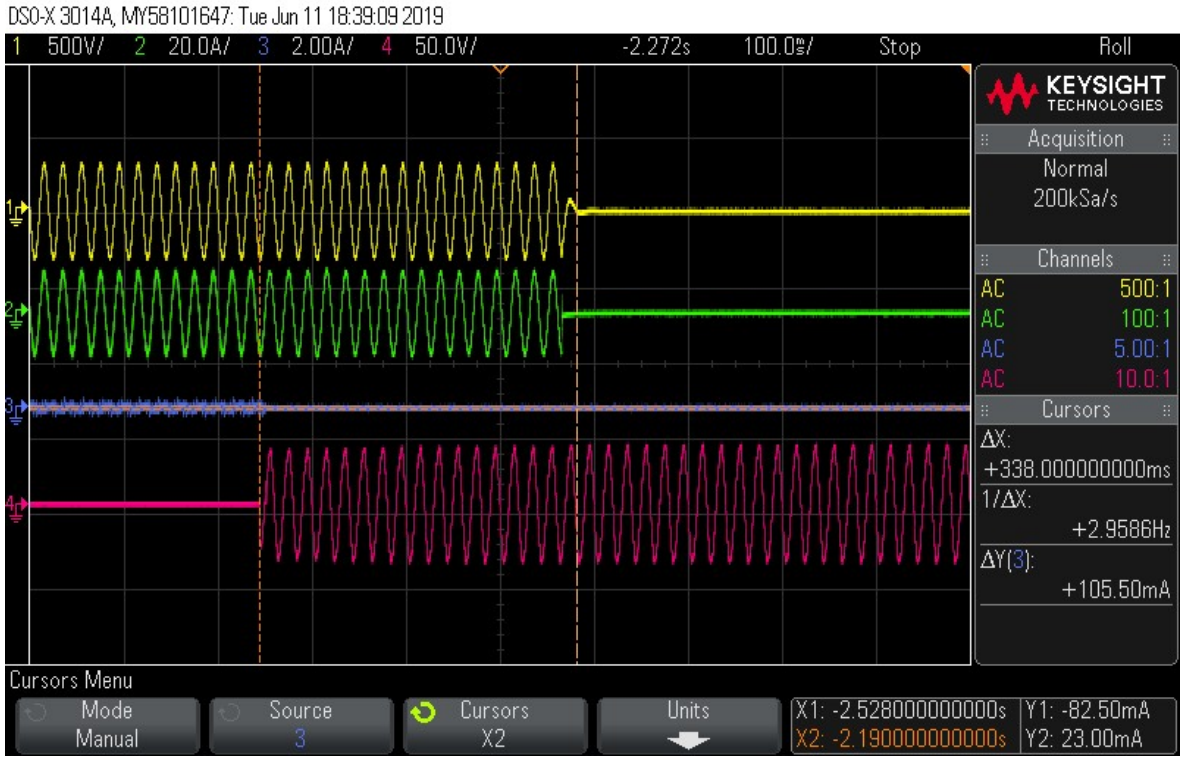
Test B(50Hz) **M(%)=0 & N(%)=-1**



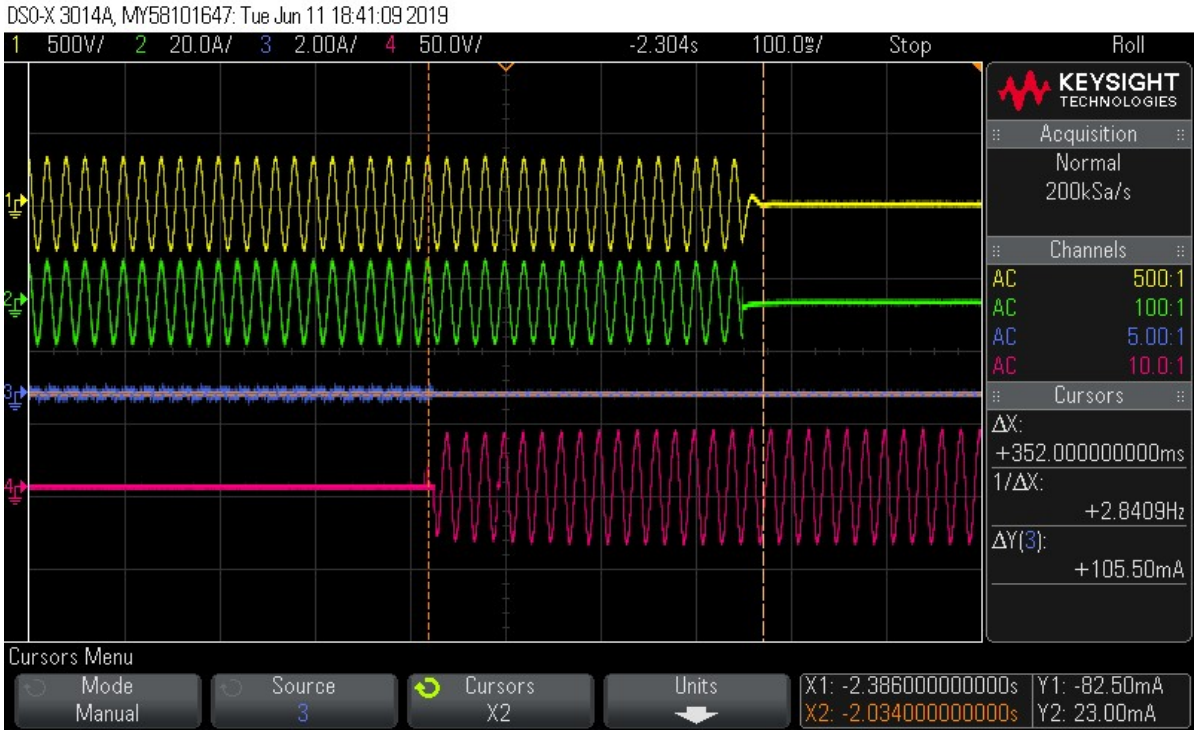
Test B(50Hz)	M(%)=0 & N(%)=-2



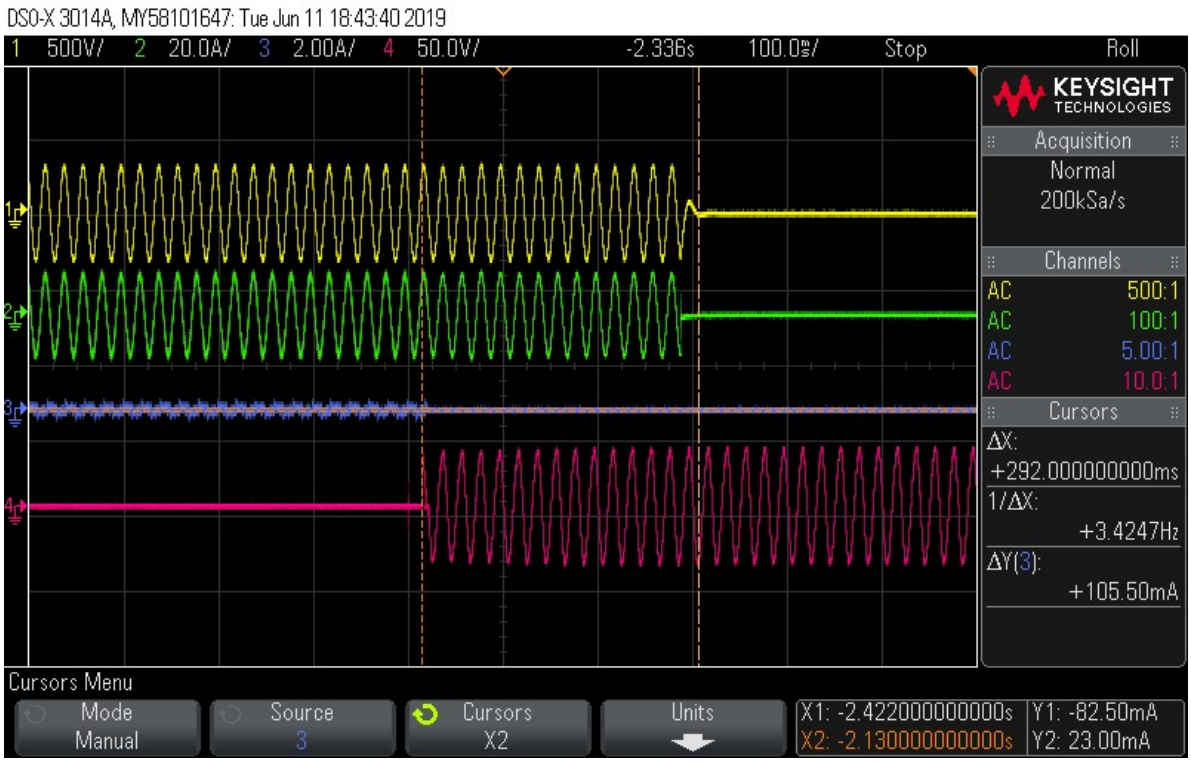
Test B(50Hz)	M(%)=0 & N(%)=-3



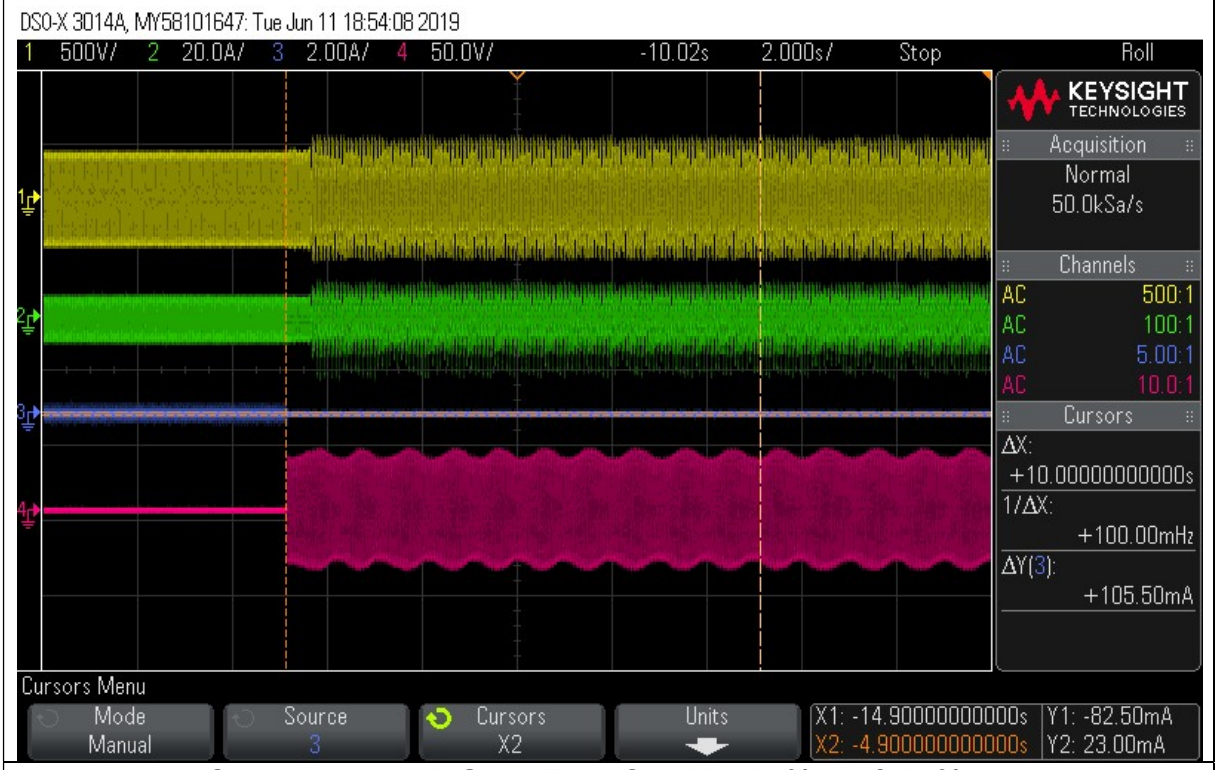
Test B(50Hz) **M(%)=0 & N(%)=-4**



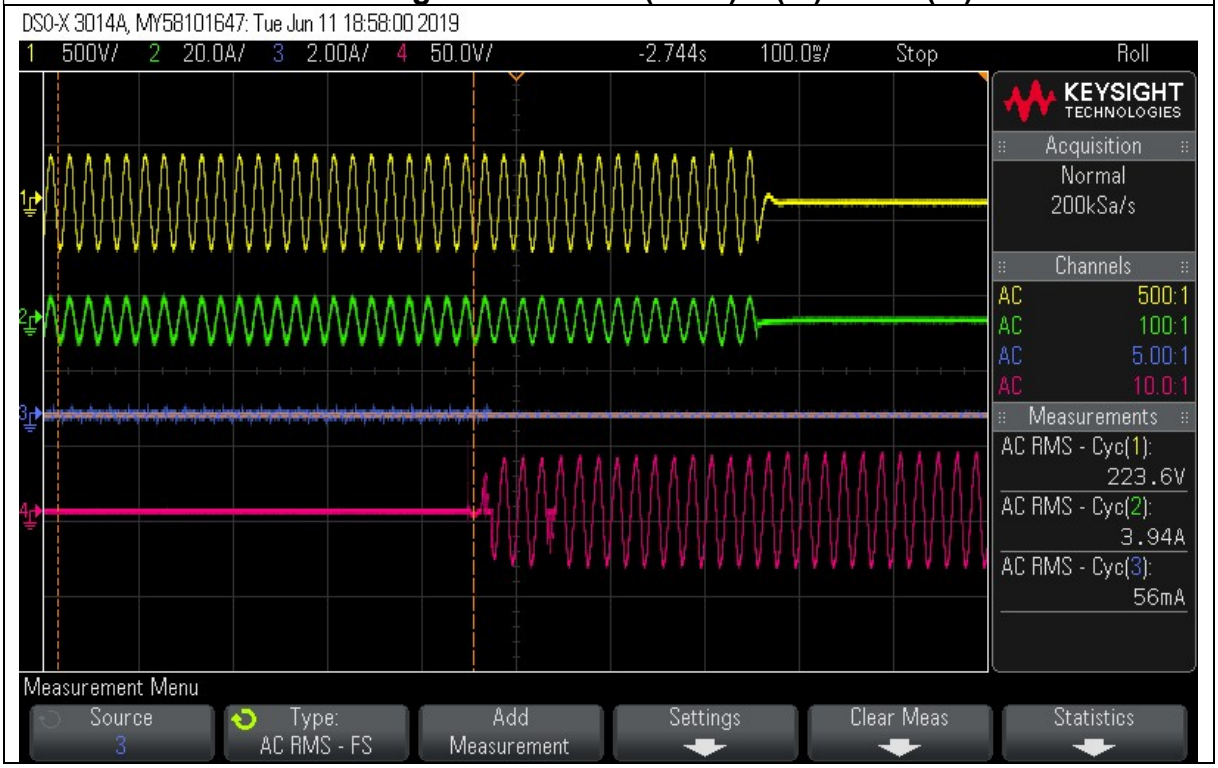
Test B(50Hz)	M(%)=0 & N(%)=-5



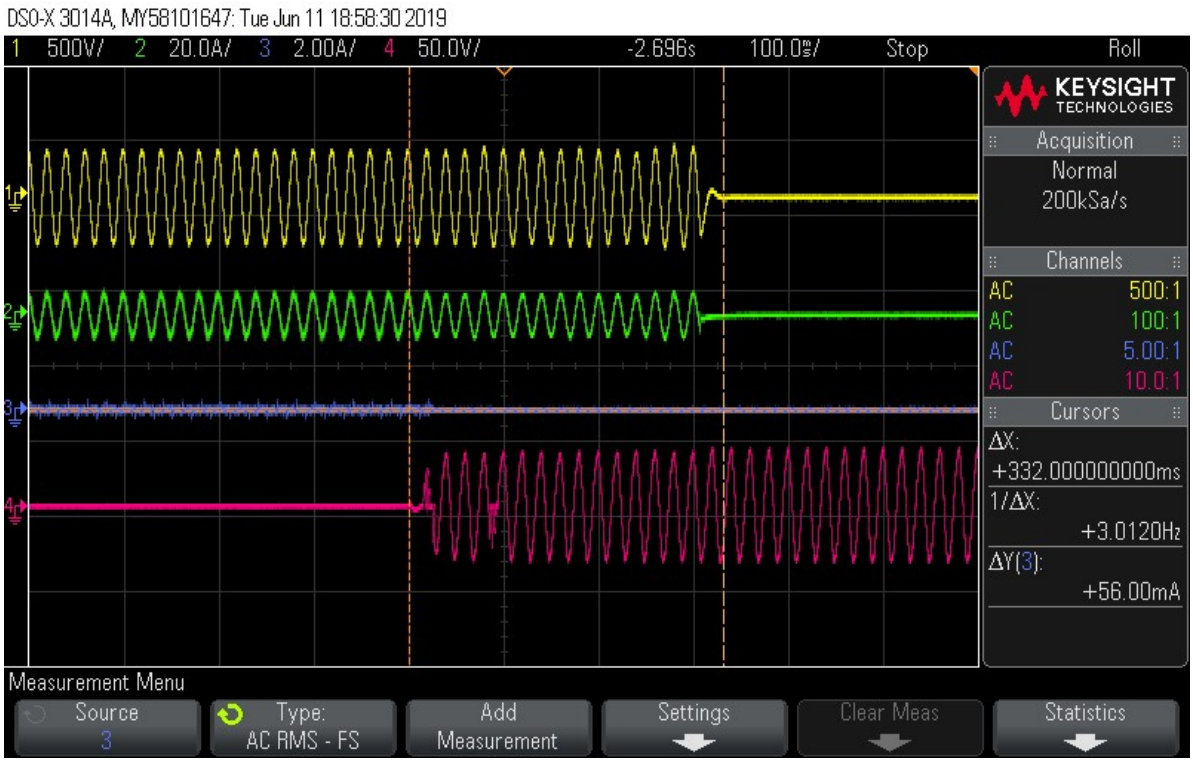
Test C(50Hz) M(%)=0 & N(%)=0 with De-activating anti-islanding protection



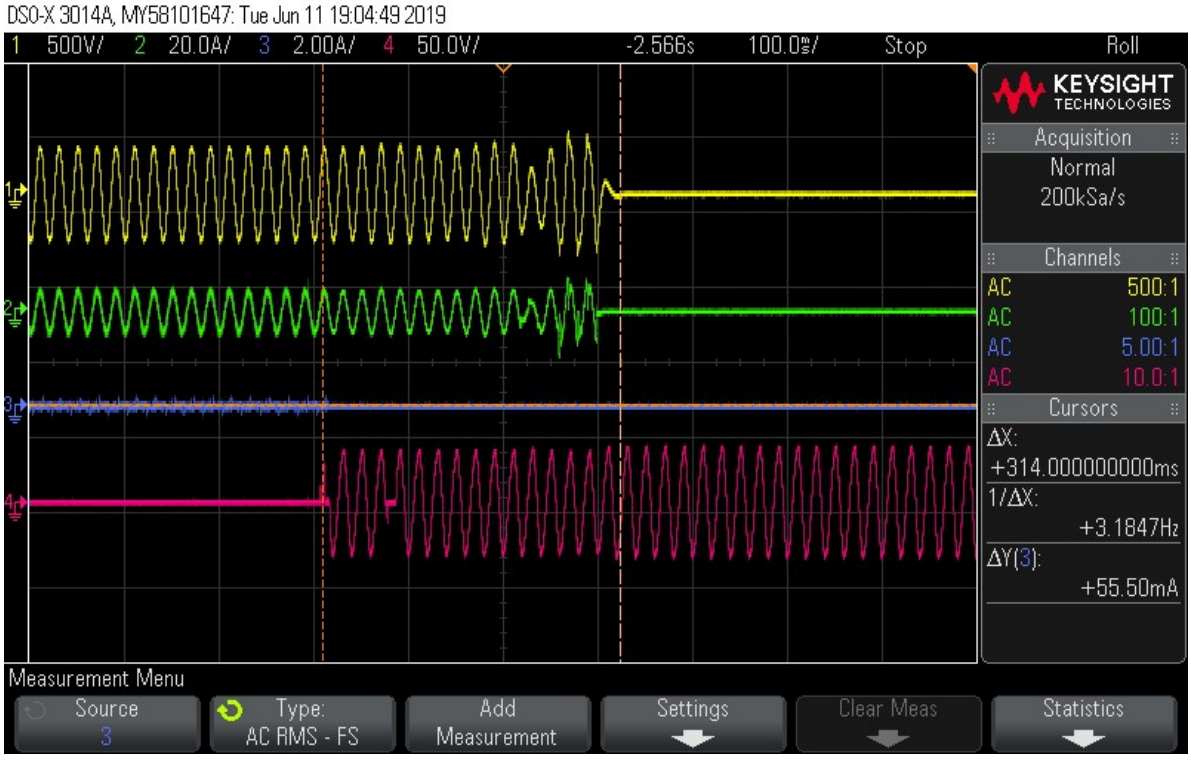
Current through S1 at Test C(50Hz) M(%)=0 & N(%)=0



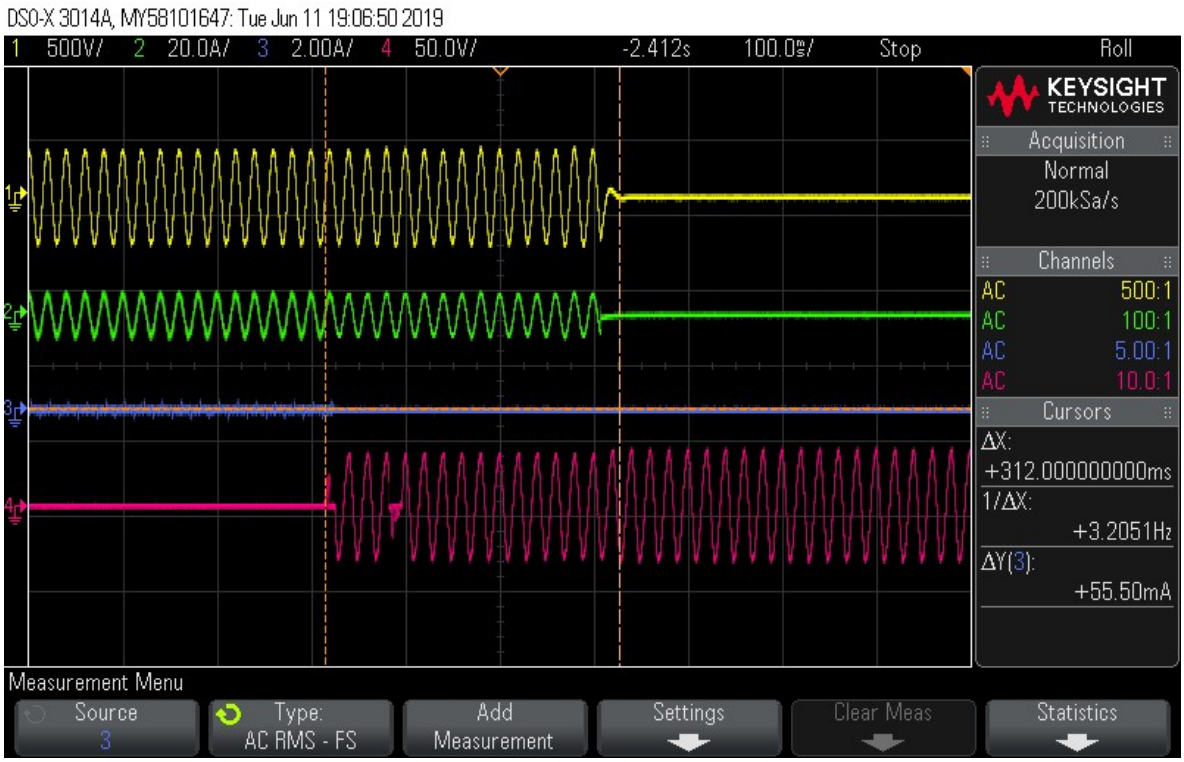
Test C(50Hz)	M(%)=0 & N(%)=0



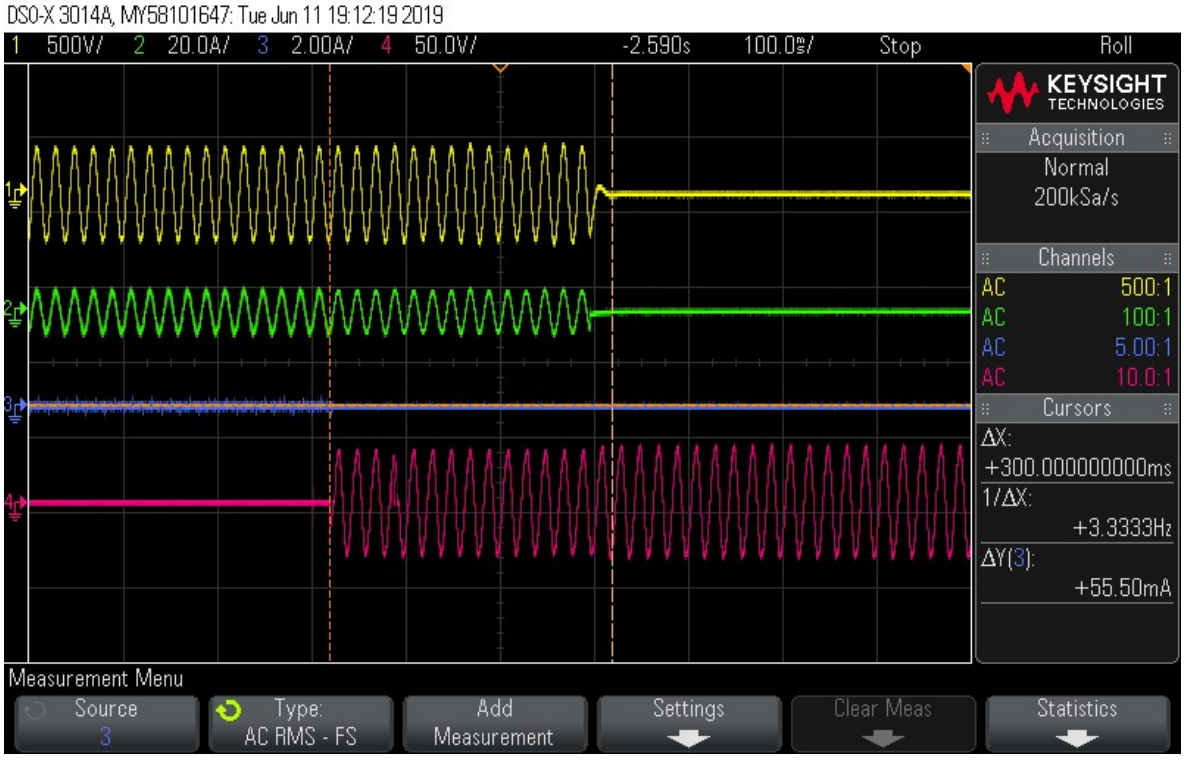
Test C(50Hz)	M(%)=0 & N(%)=+1



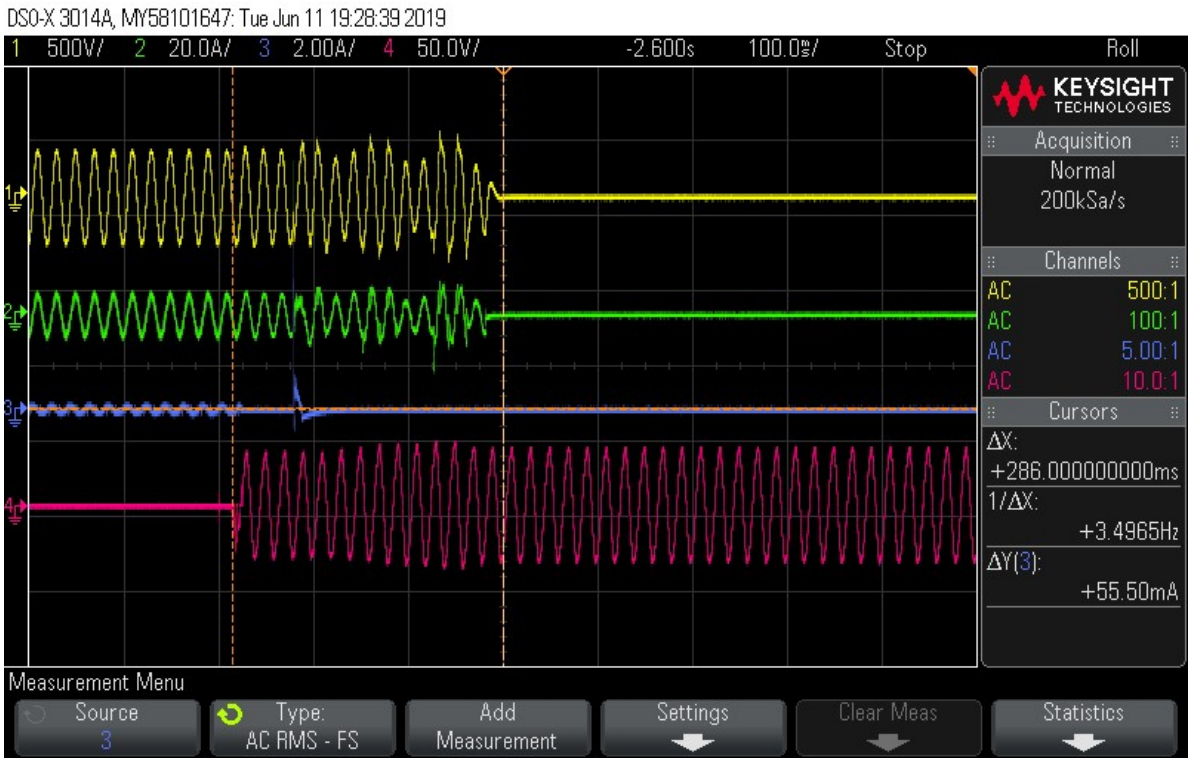
Test C(50Hz)	M(%)=0 & N(%)=+2



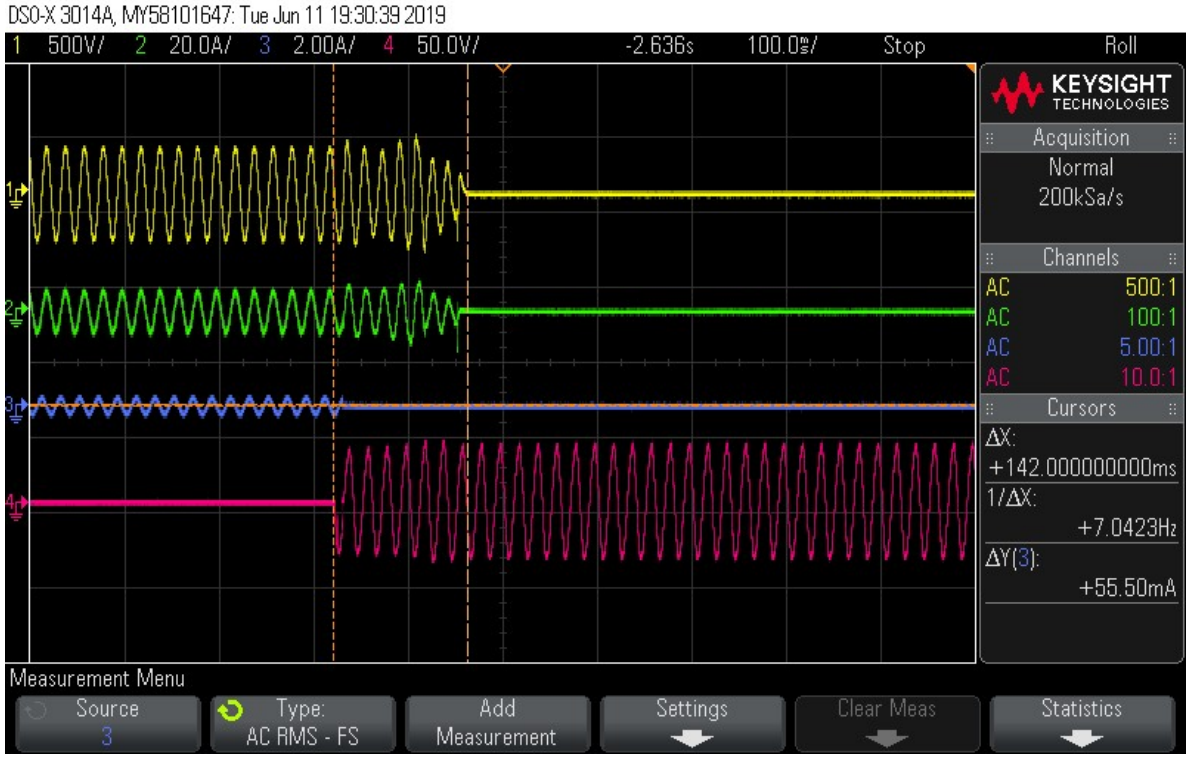
Test C(50Hz)	M(%)=0 & N(%)=+3



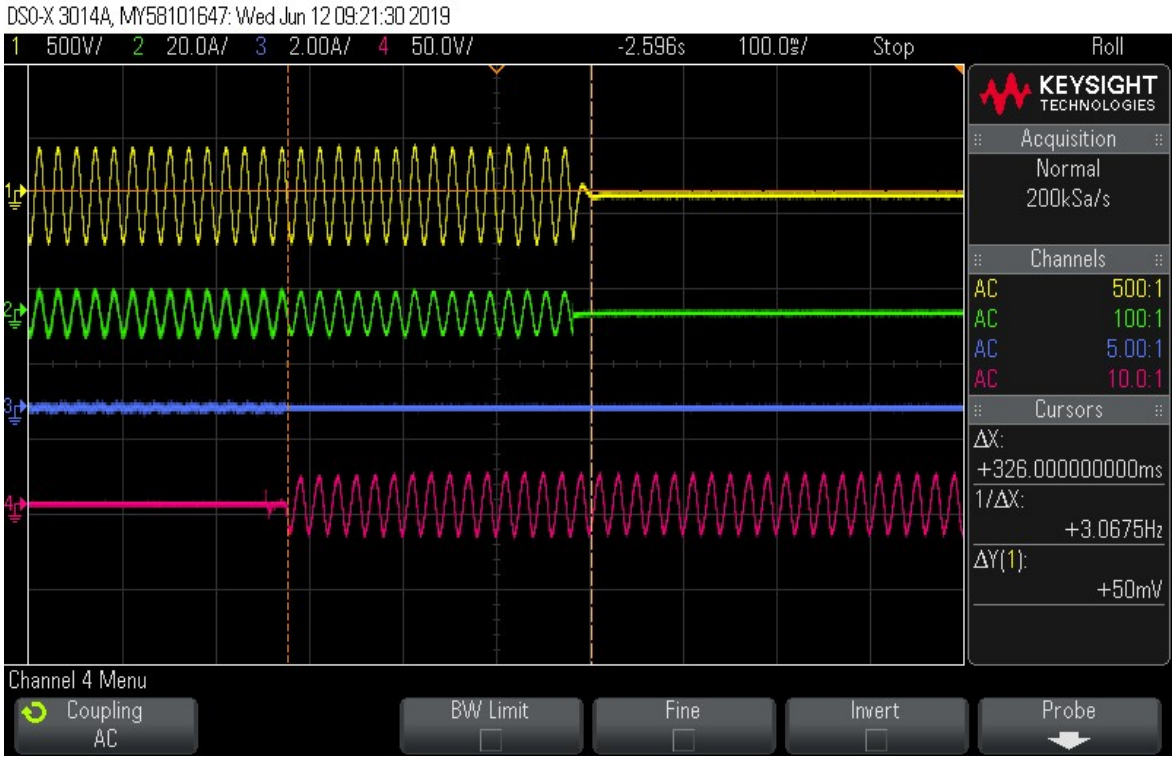
Test C(50Hz)	M(%)=0 & N(%)=+4



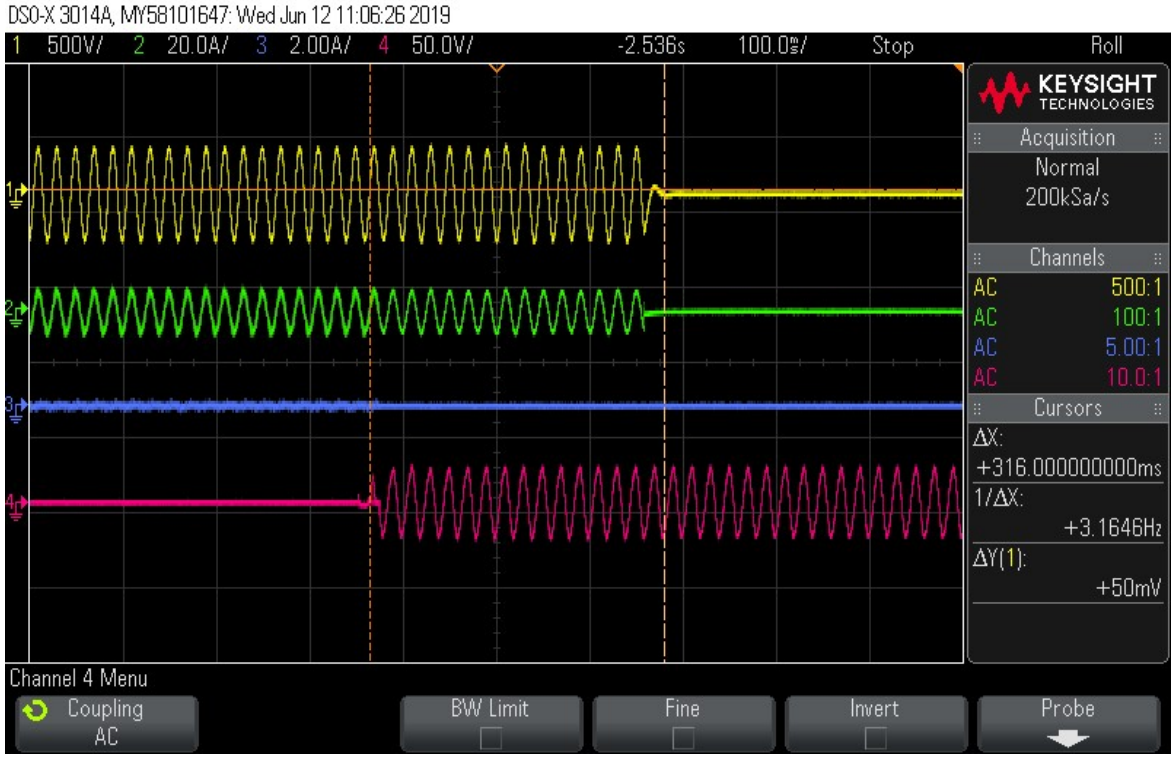
Test C(50Hz)	M(%)=0 & N(%)=+5



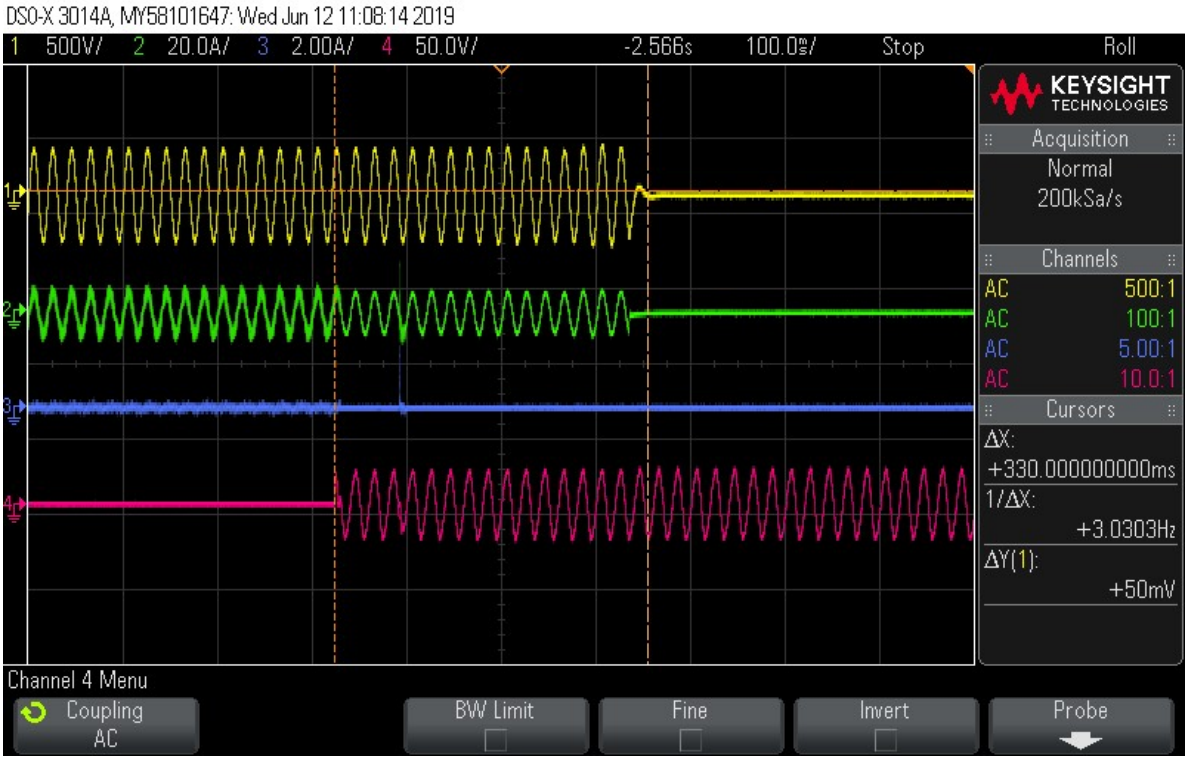
Test C(50Hz)	M(%)=0 & N(%)=-1



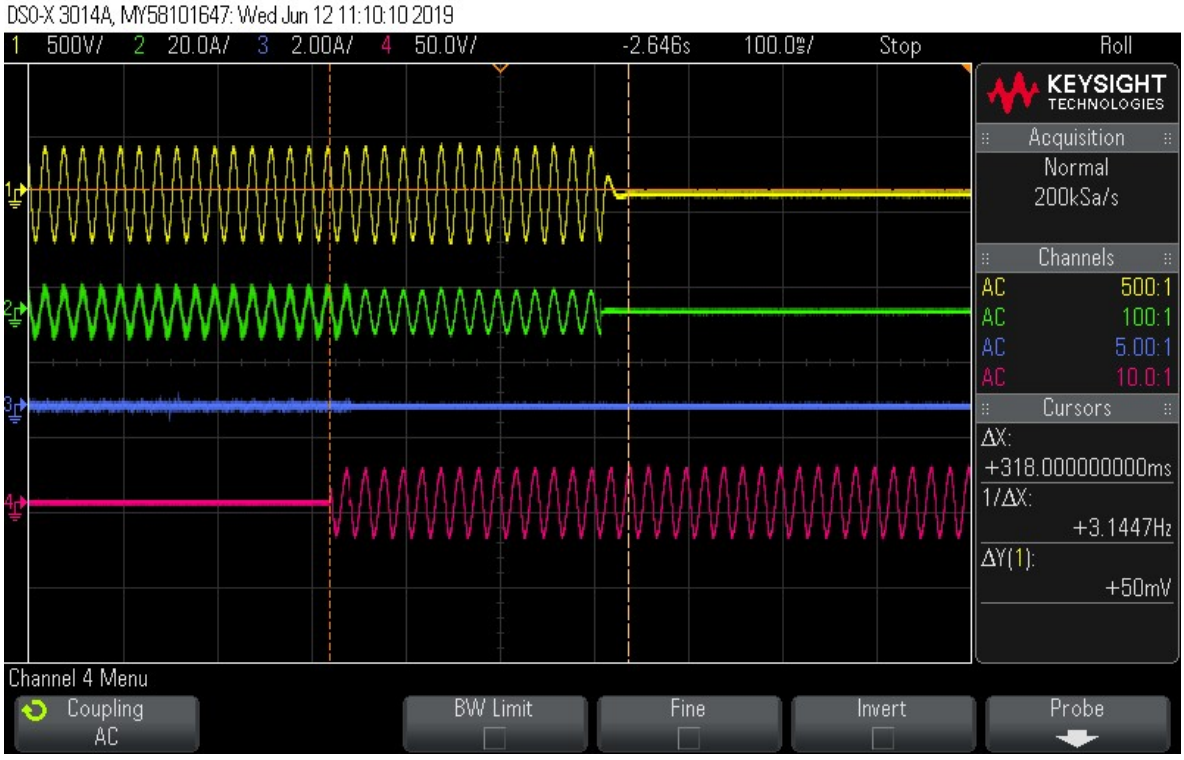
Test C(50Hz)	M(%)=0 & N(%)=-2



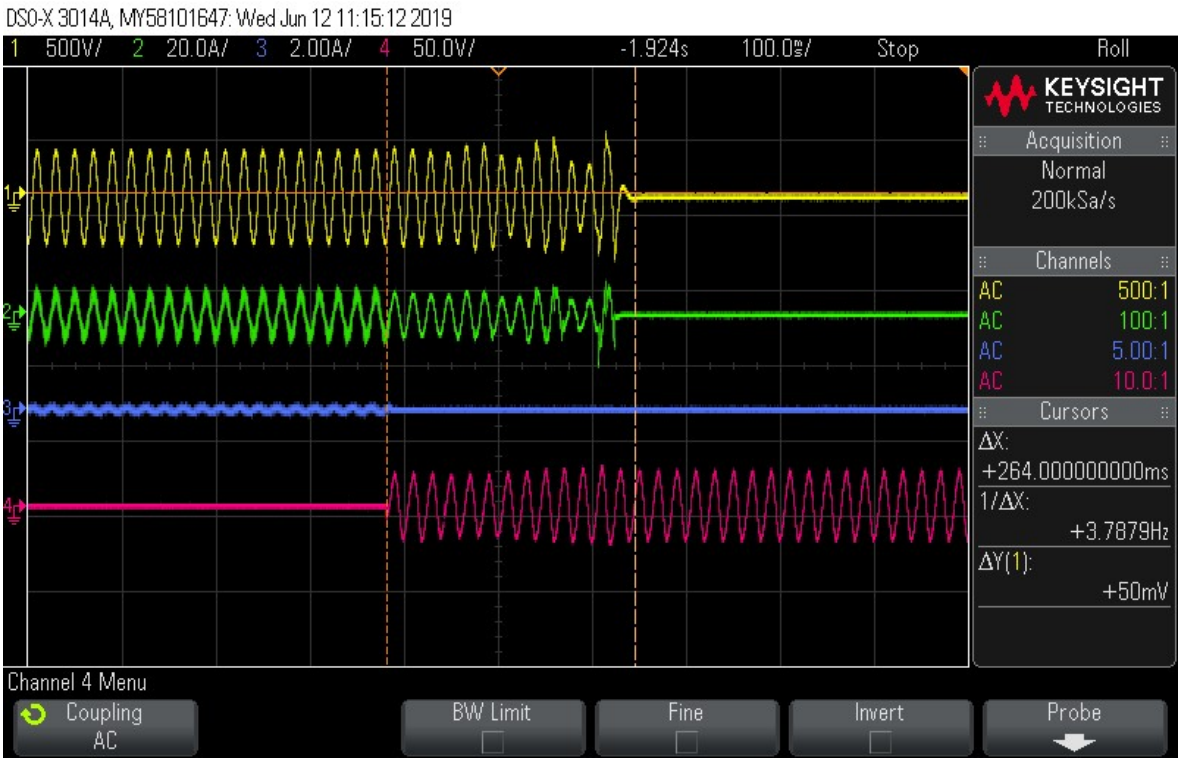
Test C(50Hz)	M(%)=0 & N(%)=-3



Test C(50Hz)	M(%)=0 & N(%)=-4



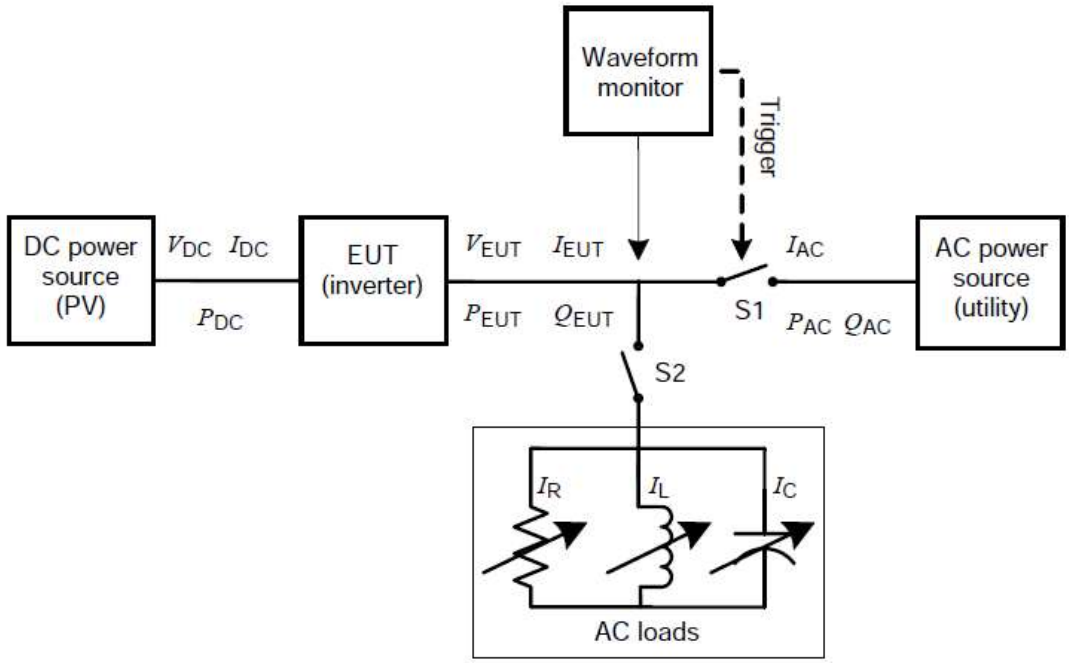
Test C(50Hz)	M(%)=0 & N(%)=-5



ATTACHMENT IV

(Testing information)

1 TESTING CIRCUIT



Current and voltage clamps have been connected to the inverter input/output for all the tests.

All the tests and checks have been performed in accordance with the reference standard under testing.

2 TESTING EQUIPMENT

From	No.	Equipment Name	Model No.	Equipment No.	Calibration Date	Equipment calibration due date
Sofarsolar	1	Digital oscilloscope	DS05014A	MY50070266	2019-02-13	2020-02-12
	2	Voltage probe	SI-9110	111541	2019-02-13	2020-02-12
	3	Voltage probe	SI-9110	152627	2019-02-13	2020-02-12
	4	Voltage probe	SI-9110	111134	2019-02-13	2020-02-12
	5	Power analyzer	WT3000	91N610888	2019-02-13	2020-02-12
	6	Current probe	i1000s	29503223	2019-02-13	2020-02-12
	7	Current probe	i1000s	30413448	2019-02-13	2020-02-12
	8	Current probe	CP5150	C150150008	2019-02-13	2020-02-12
	9	Temperature & Humidity meter	TH101B	201030245220	2019-02-13	2020-02-12
	10	Temperature & Humidity Chamber	HGTP-225R	HG13030801	2019-02-13	2020-02-12
SGS	11	True RMS Multimeter	Fluke / 289C	GZE012-53	2019-02-26	2020-02-25

Items	Specifications
1) PV array simulator	
a) Voltage range	0 – 1000Vdc (0.01V step)
b) Current range	0 – 40A (0.01A step)
2) AC power source	
a) Output wiring	Three phase
b) Output capacity	100KVA
c) Output voltage	10-300Vrms
d) Output frequency	45-65Hz
e) Voltage stability	± 100ppm/℃
f) Output voltage distortion	0.05% max.
3) Digital meter	
a) Voltage range	0 – 1000Vdc, 0 – 600Vrms
b) Current range	0 – 30A
c) Frequency range (accuracy)	0.2%
d) Measurement items	Voltage (V) Current (A) Active power (W) Reactive power (Var) Volt-ampere (VA) Power factor (PF) Frequency (Hz) Electric energy (Wh)
4) Waveform recorder	
a) Sampling speed	1M/s
b) Recording device	Memory record and USB reading
c) Time accuracy	± 500ppm
5) AC load	
a) Resistive load	Maximum voltage: 300Vrms Current range: 0 – 100A Capacity: 100KW
b) Inductive load	Maximum voltage: 300Vrms Current range: 0 – 100A Capacity: 100KVA
c) Capacitive load	Maximum voltage: 300Vrms Current range: 0 – 100A Capacity: 100KVA

3 MEASUREMENT UNCERTAINTY

	Voltage measurement uncertainty	±1.5 %
	Current measurement uncertainty	±2.0 %
	Frequency measurement uncertainty	±0.2 %
	Time measurement uncertainty	±0.2 %
	Power measurement uncertainty	±2.5 %
	Phase Angle	±1º
	cosφ	±0.01

Note1: Measurements uncertainties showed in this table are maximum allowable uncertainties. The measurement uncertainties associated with other parameters measured during the tests are in the laboratory at disposal of the solicitant.

Note2: Where the standard requires lower uncertainties that those in this table. Most restrictive uncertainty has been considered.

4 MEASUREMENT OF AC SOURCE USED FOR TEST

Items	Desired	Measured	Deviation	Limited
Voltage(V)	230	229.9	0.04%	±2%
Voltage THD (%)	<2.5%	0.03%		<2.5%
Frequency	50	50	0.0Hz	±0.1Hz
Phase angle distance	120°	--	--	± 1.5°

AC source measurement result.

Normal Mode Uover:▬ ▬ ▬ Update:500msec EAMP YOKOGAWA
Iover:▬ ▬ ▬ Integ:Reset

change items
PLL U1
Freq 50.000 Hz
Urms1 229.937 V
Irms1 0.3661 A
P1 -0.0116kW
S1 0.0842kVA
Q1 0.0834kvar
λ1 -0.13723
ϕ1 G 97.888 °
Uthd1 0.033 %
Ithd1 25.176 %
Pthd1 0.007 %
Uthf1 0.023 %
Ithf1 3.823 %
Utif1 1.082
Itif1 164.949

Or.	U1 [V]	hdf[%]	Or.	U1 [V]	hdf[%]
	229.937		dc	---------	--------
1	229.944	100.000	2	0.029	0.013
3	0.021	0.009	4	0.028	0.012
5	0.037	0.016	6	0.022	0.010
7	0.025	0.011	8	0.010	0.005
9	0.008	0.003	10	0.005	0.002
11	0.007	0.003	12	0.003	0.001
13	0.007	0.003	14	0.004	0.002
15	0.006	0.002	16	0.001	0.000
17	0.002	0.001	18	0.001	0.000
19	0.004	0.002	20	0.006	0.003
21	0.007	0.003	22	0.003	0.001
23	0.005	0.002	24	0.007	0.003
25	0.003	0.001	26	0.003	0.001
27	0.006	0.003	28	0.006	0.003
29	0.003	0.001	30	0.006	0.003
31	0.010	0.004	32	0.003	0.001
33	0.005	0.002	34	0.002	0.001
35	0.006	0.003	36	0.002	0.001
37	0.004	0.002	38	0.005	0.002
39	0.004	0.002	40	0.003	0.001

Element1
U1 600Vrms
I1 30Arms
Element2
U2 600Vrms
I2 30Arms
Element3
U3 600Vrms
I3 30Arms
Element4
U4 600Vrms
I4 30Arms
Integ:Reset
Time
-----:--:--
Timer
0:03:00

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Normal Mode Uover:▬ ▬ ▬ Update:500msec EAMP YOKOGAWA
Iover:▬ ▬ ▬ Integ:Reset

change items
PLL U1
Freq 50.000 Hz
Urms1 229.937 V
Irms1 0.3661 A
P1 -0.0116kW
S1 0.0842kVA
Q1 0.0834kvar
λ1 -0.13723
ϕ1 G 97.888 °
Uthd1 0.033 %
Ithd1 25.176 %
Pthd1 0.007 %
Uthf1 0.023 %
Ithf1 3.823 %
Utif1 1.082
Itif1 164.949

Or.	U1 [V]	hdf[%]	Or.	U1 [V]	hdf[%]
	229.937		dc	---------	--------
41	0.003	0.001	42	0.002	0.001
43	0.002	0.001	44	0.003	0.001
45	0.001	0.001	46	0.004	0.002
47	0.004	0.002	48	0.005	0.002
49	0.005	0.002	50	0.003	0.001
51	0.008	0.004	52	0.006	0.003
53	0.003	0.001	54	0.004	0.002
55	0.003	0.001	56	0.003	0.001
57	0.002	0.001	58	0.005	0.002
59	0.002	0.001	60	0.003	0.001
61	---------	--------	62	---------	--------
63	---------	--------	64	---------	--------
65	---------	--------	66	---------	--------
67	---------	--------	68	---------	--------
69	---------	--------	70	---------	--------
71	---------	--------	72	---------	--------
73	---------	--------	74	---------	--------
75	---------	--------	76	---------	--------
77	---------	--------	78	---------	--------
79	---------	--------	80	---------	--------

Element1
U1 600Vrms
I1 30Arms
Element2
U2 600Vrms
I2 30Arms
Element3
U3 600Vrms
I3 30Arms
Element4
U4 600Vrms
I4 30Arms
Integ:Reset
Time
-----:--:--
Timer
0:03:00

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