



Tesla AC Powerwall2 (4.8 kVA)
連系協議用資料—代表機試験結果 (60Hz)
Ver1.0

装置型式：

AC Powerwall2 model: 1092170-xx-y,2012170-xx-y,3012170-xx-y

1. Summary

Confirmation test on system interconnection protection of this equipment is tested under the test conditions, test methods, and judgment criteria of the following documents.

- JETGR0002-1-11.0 (2020.01) Test method for grid interconnection protection device etc. for compact dispersed power generation system General rules
- JETGR0003-5-9.0 (2020.01) Individual test method such as system interconnection protection device for storage battery system

本装置の系統連系保護の確認試験に関しては、下記資料の試験条件、試験方法、判定基準のもと試験を行う。

- JETGR0002-1-11.0 (2020.01) 小型分散型発電システム用系統連系保護装置等の試験方法通則
- JETGR0003-5-9.0 (2020.01) 蓄電池システム用系統連系保護装置等の個別試験方法

2. Sample information 装置シリアル番号

Product 品名	S/N	Remarks 備考
AC Powerwall 2	T1710013744, T17B00000035, TG120184001J07	

3. Measurement Device / Equipment List 計測器

Sr. No.	Description 計測器名	Manufacturer メーカー	Model 型名	Serial シリアル	Cal Date 校正日	Cal Due 校正期限日
1	Power Analyzer	Yokogawa	WT3000E	91UA13165	12/2/2019	12/2/2020
2	Current Probe	Yokogawa	701930	180828556	5/14/2019	5/14/2021
3	Current Probe	Yokogawa	701930	180828214	5/14/2019	5/14/2021
4	Temperature and Humidity measurement	Vaisala	HM24Probe	L0830459	12/4/2019	12/4/2020
5	Scope	Yokogawa	DL850EV	91U616293	7/29/2019	7/29/2020
6	Differential Probe	Yokogawa	700924	1900535	3/14/2020	3/14/2021
7	Differential Probe	Yokogawa	700924	1803221	7/11/2019	7/11/2020
8	Differential Probe	Yokogawa	700924	1803234	7/11/2019	7/11/2020
9	Differential Probe	Yokogawa	700924	1810859	3/14/2020	3/14/2021
10	Power Analyzer	Yokogawa	WT3000E	91W217312	3/11/2020	3/11/2021
11	Scope	Yokogawa	DL850EV	91V119360	07/24/2019	07/24/2021

4. Test Results

Section Number	Test Description	Completion date	Pass/Fail
3.1.3	Direct Current Component Detection Test 直流分検出試験	8/12/2020	Pass
3.2.1	Alternative Current Overvoltage and Undervoltage Test (Magnitude) 交流過電圧及び不足電圧試験（しきい値）	7/13/2020	Pass
3.2.1	Alternative Current Overvoltage and Undervoltage Test (Time) 交流過電圧及び不足電圧試験（時限）	7/18/2020	Pass
3.2.2	Test procedure for Frequency tripping Thresholds 周波数上昇及び低下試験（しきい値）	1/31/2020	Pass
3.2.2	Test procedure for measuring Frequency trip time 周波数上昇及び低下試験（時限）	1/31/2020	Pass
3.2.9.1	Test for Preventing Power-On for a Certain Period After Recovery (without Excursion) 復電後の一定時間投入阻止試験 1	7/10/2020	Pass
3.2.9.2	Test for Preventing Power-On for a Certain Period After Recovery (with Excursion) 復電後の一定時間投入阻止試験 2	7/9/2020	Pass
3.2.10	Instantaneous (Unbalanced) Overvoltage Test 瞬時(不平衡)過電圧試験	7/13/2020	Pass
4.3	Power Factor Operation Test 運転力率試験	7/23/2020	Pass
4.4	Output Harmonic Current Test 出力高調波電流試験	7/23/2020	Pass
4.8	Soft Start Function Test ソフトスタート機能試験	7/10/2020	Pass
5.1	Rapid Input Power Change and Rapid Load Change Test 入力電力急変試験及び負荷急変試験	09/04/2020	Pass
6.3	Instantaneous Voltage Drop Test (FRT)	8/11/2020	Pass

	瞬時電圧低下試験 (FRT 試験)		
6.4	Frequency Fluctuation Test (FRT) 周波数変動試験 (FRT 試験)	2/05/2020	Pass
12.1	Switching to Backup operation mode 自立運転切換試験	07/30/2020	Pass
12.2	Automatic switching to backup mode 自立運転自動切換試験	07/30/2020	Pass
12.4	Independent disconnection signal disruption test 自立解列信号途絶試験	09/04/2020	Pass

3.1.3 DC Injection Test 直流分検出試験

Test Parameters 設定値

DC Injection	Vac 交流電圧	Prated 出力	Irated 定格電流	Threshold 検出値	Detection Time 検出時間
	101(L-N)	4800W	24A	0.24A	0.5s

Test Result 試験結果：

Phase AB

Actual Set point (A) (1% Irated) 直流分電流	0.24	Pass / Fail 判定
Output Power (kW) (100%) パワコン出力	4800	
Measured Value (A) 計測値	0.190	Pass
Remarks 備考		
Actual Set point (s) (jump from 0% to 110% of DC set point) 直流分電流	0.5s	
Time to Trip (s) Gate block stop 検出時限 (GB 時限)	0.0456	Pass
Time to open the relay (s) 検出時限 (RY 解列時限)	0.0456	Pass
Remarks 備考		

3.2.1 Over Voltage And Under Voltage Test 交流過電圧及び不足電圧試験

Over Voltage Test Parameters: 過電圧設定値

	Threshold 検出値	Detection Time 時限	Re-connection Time 再並列阻止時間
OVR	121.2Vrms	1s	10s

OVR detection threshold test:

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験相	Measurement (Vrms) 測定結果	Pass / Fail 判定 (121.2±2.424Vrms)	Remarks 備考
A: 115.14Vrms (95%)↑ B: 101Vrms	-4.8kW	60 Hz	Charge 充電	A	123.202	Pass	
A: 101Vrms B: 115.14Vrms (95%)↑				B	122.49	Pass	
A: 115.14Vrms (95%)↑ B: 115.14Vrms (95%)↑				AB	122.377 122.218	Pass	
A: 115.14Vrms (95%)↑ B: 101Vrms	4.8kW	60 Hz	Discharge 放電	A	119.347	Pass	
A: 101Vrms B: 115.14Vrms (95%)↑				B	120.499	Pass	
A: 115.14Vrms (95%)↑ B: 115.14Vrms (95%)↑				AB	120.093 119.999	Pass	

OVR Time Trips OVR 検出時限確認及び再投入時間確認：

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験相	Measurement			Pass / Fail 判定 ¹ GB success ² 1.0s±0.1s ³ more than 10s	Remarks 備考
					Gate Block (s) ¹ GB 時限	Relay open time (s) ² Ry 解列時限	Recon time (s) ³ 再並列阻止時間		
AB: 101Vrms →111.1Vrms (110%)↑	-4.8kW	60 Hz	Charge 充電	AB	1.046	1.046	12.398	Pass	
AB: 101Vrms →111.1Vrms (110%)↑	4.8kW		Discharge 放電	AB	1.070	1.070	12.446	Pass	

Under Voltage Test Parameters 不足電圧設定値

	Threshold 検出値	Detection Time 検出時限	Re-connection Time 再並列阻止時間
UVR	80.8Vrms	1s	10s

UVR Default detection threshold test UVR 検出レベル確認:

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験相	Measurement (Vrms) 試験結果	Pass / Fail (80.8±1.616Vrms) 判定	Remarks 備考
A: 84.84Vrms (105%)↓ B: 101Vrms	-4.8kW	60 Hz	Charge 充電	A	80.669	Pass	
A: 101Vrms B: 84.84Vrms (105%)↓				B	81.544	Pass	
A: 84.84Vrms (105%)↓ B: 84.84Vrms (105%)↓				AB	80.406 80.16	Pass	
A: 84.84Vrms (105%)↓ B: 101Vrms	4.8kW	60 Hz	Discharge 放電	A	79.486	Pass	
A: 101Vrms B: 84.84Vrms (105%)↓				B	81.429	Pass	
A: 84.84Vrms (105%)↓ B: 84.84Vrms (105%)↓				AB	81.999 82.159	Pass	

UVR Time Trips UVR 検出時限確認及び再投入時間確認：

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験相	Measurement			Pass / Fail 判定 ¹ GB success ² 1.0s±0.1s ³ more than 10s	Remarks 備考
					Gate Block (s) ¹ GB 時限	Relay open time (s) ² Ry 解列時限	Recon time (s) ³ 再並列阻止時間		
AB:101Vrms→76.76 Vrms(95%)↓	-4.8 kW	60 Hz	Charge 充電	AB	1.063	1.063	12.298	Pass	
AB:101Vrms→193.04 Vrms(95%)↓	4.8 kW		Discharge 放電	AB	1.098	1.098	12.299	Pass	

3.2.2 Frequency Functional Test 周波数上昇及び低下試験

Over Frequency Test 周波数上昇試験結果

Parameter 設定値:

	Threshold 検出値	Detection Time 検出時限	Reconnect time 再並列阻止時間
OFR	61.8 Hz	1s	10s

OFR Detection Threshold Test OFR 検出レベル確認 :

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験相	Measurement 測定結果	Pass / Fail 判定 (61.8±0.1 Hz)	Remarks 備考
Phase A: 101Vrms Phase B: 101Vrms	- 4.8kW	61Hz↑	Charge 充電	AB	61.81	Pass	
	4.8kW		Discharge 放電	AB	61.89	Pass	

OFR trip time OFR 検出時限確認及び再投入時間確認 :

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験相	Measurement			Pass / Fail 判定 ¹ GB success ² 1.0s±0.1s ³ more than 10s	Remarks 備考
					Gate Block (s) ¹ GB 時限	Relay open time (s) ² Ry 解列時限	Recon time (s) ³ 再並列阻止時間		
Phase A: 101Vrms Phase B: 101Vrms	- 4.8kW	60.0Hz →64.89(105%)	Charge 充電	AB	1.026	1.04	11.47	Pass	
	4.8kW		Discharge 放電	AB	1.08	1.088	11.8	Pass	

Under Frequency Test 周波数低下試験結果

Parameter 設定値：

	Threshold	Detection Time	Reconnect time
UFR	58.2 Hz	1s	10s

UFR Detection Threshold Test 検出レベル確認：

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験相	Measurement 測定結果	Pass / Fail 判定 (58.2±0.1 Hz)	Remarks 備考
Phase A: 101Vrms Phase B: 101Vrms	- 4.8kW	59Hz ↓	Charge 充電	AB	58.17	Pass	
	4.8kW		Discharge 放電	AB	58.19	Pass	

UFR trip time 検出時限確認及び再投入時間確認：

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験相	Measurement			Pass / Fail 判定 ¹ GB success ² 1.0s±0.1s ³ more than 10s	Remarks 備考
					Gate Block (s) ¹ GB 時限	Relay open time (s) ² Ry 解列時限	Recon time (s) ³ 再並列阻止時間		
Phase A: 101Vrms Phase B: 101Vrms	- 4.8kW	60.0Hz → 55.29Hz↓	Charge 充電	AB	1.02	1.03	11.51	Pass	
	4.8kW		Discharge 放電	AB	1	1.0	11.82	Pass	

3.2.9.1 Constant-time input blocking Test after power reconnection 1

復電後の一定時間投入阻止試験 1

Parameter:

Reconnection Testing 再並列阻止時間試験	Time Set Point 待機時間
Reconnection Time 1	300s

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Mode 動作モード	Measurement 試験結果	Pass / Fail 判定	Remarks 備考
				Reconnection Time 再並列阻止時間	>300s	
Phase A: 101Vrms Phase B: 101Vrms	4.8 kW	60 Hz	Discharge	301.446 s	Pass	
	-4.8 kW		Charge	301.483 s	Pass	

3.2.9.2 Constant-time input blocking Test after power reconnection 2

復電後の一定時間投入阻止試験 2

Parameter 設定値:

Reconnection Testing 再並列阻止時間試験	Time Set Point
Reconnection Time 2	300s

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Measurement 試験結果	Pass / Fail 判定	Remarks 備考
				Reconnection Time 再並列阻止時間	>300s	
Phase A: 101Vrms Phase B: 101Vrms	4.8 kW	60 Hz	Discharge	301.394 s	Pass	



3.2.10 Instantaneous (Unbalanced) Overvoltage Test - 瞬時(不平衡)過電圧試験

Over Voltage Test Parameters: 過電圧設定値

	Threshold 検出値	Detection Time 時限	Re-connection Time 再並列阻止時間
OVR	121.2Vrms	<1s	10s

OVR detection threshold test OVR 検出レベル確認：

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験 相	Measurement (Vrms) 測定結果	Pass / Fail 判定 (121.2±2.424Vrms)
A: 109.08Vrms (90%)↑ B: 101Vrms	-4.8kW	60 Hz	Charge 充電	A	123.138	Pass
A: 101Vrms B: 109.08Vrms (90%)↑				B	123.047	Pass
A: 109.08Vrms (90%)↑ B: 101Vrms	4.8kW	60 Hz	Discharge 放電	A	119.363	Pass
A: 101Vrms B: 109.08Vrms (90%)↑				B	119.981	Pass



Instantaneous (Unbalanced) Overvoltage trip time OVR 検出時限確認及び再投入時間確認

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Operation Mode 動作モード	Tested Phase 試験相	Measurement (Time)	Pass / Fail	Remarks 備考
A: 109.08Vrms (90%)↑ B: 101Vrms	-4.8kW	60 Hz	Charge 充電	A	0.953	Pass	
A: 101Vrms B: 109.08Vrms (90%)↑				B	0.946	Pass	
A: 109.08Vrms (90%)↑ B: 101Vrms	4.8kW	60 Hz	Discharge 放電	A	0.884	Pass	
A: 101Vrms B: 109.08Vrms (90%)↑				B	0.870	Pass	



4.3 Power Factor Operation Test 運転力率試験

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Measurement 試験結果		Pass / Fail 判定	Remarks 備考
			Power 出力電力	PF 力率一定	>0.95	
Phase A: 101Vrms Phase B: 101Vrms	4800 W	60 Hz	4848 W	0.9983	Pass	



4.4 Output Harmonic Current Test 出力高調波電流試験

AC Voltage 交流電圧	Output Power 出力電力	Frequency 周波数	Phase 試験相	Operation Mode 動作モード	Measurement 試験結果			Pass / Fail 判定	Remarks 備考
					THD % 歪み率	PF 力率	Highest Harm with Order 電流歪率 (各次)	THD<5% PF>0.95 Individual Harmonics<3%	
Phase A: 101Vrms Phase B: 101Vrms	4.8 kW	60 Hz	A	Discharge 放電	4.631	1.00	3 rd : 2.6%	Pass	See Below
			B		4.633	1.00	3 rd : 3.3%	Pass	

Detailed reference data of each harmonic (output current distortion ratio)						Rated output current = 21A					
Phase	Order	1	2	3	4	5	6	7	8	9	10
A	Harmonic current A	21.360	0.004	0.549	0.020	0.418	0.010	0.199	-0.008	0.139	-0.005
	Order	11	12	13	14	15	16	17	18	19	20
	Harmonic current A	0.078	-0.011	0.085	-0.009	0.060	-0.010	0.047	-0.011	0.024	-0.011
	Order	21	22	23	24	25	26	27	28	29	30
	Harmonic current A	0.005	-0.008	0.005	-0.008	-0.002	-0.005	-0.002	-0.012	-0.007	-0.011
	Order	31	32	33	34	35	36	37	38	39	40
	Harmonic current A	-0.003	-0.010	-0.004	-0.018	-0.005	-0.010	-0.009	-0.009	-0.004	-0.012
Phase	Order	1	2	3	4	5	6	7	8	9	10
B	Harmonic current A	21.359	0.020	0.565	0.022	0.388	0.009	0.233	-0.005	0.110	-0.002
	Order	11	12	13	14	15	16	17	18	19	20
	Harmonic current A	0.097	-0.006	0.084	-0.014	0.072	-0.010	0.041	-0.010	0.027	-0.006
	Order	21	22	23	24	25	26	27	28	29	30
	Harmonic current A	0.019	-0.007	0.003	-0.008	0.008	-0.008	0.001	-0.011	-0.009	-0.017
	Order	31	32	33	34	35	36	37	38	39	40
	Harmonic current A	-0.011	-0.010	-0.008	-0.008	-0.010	-0.005	-0.002	-0.010	-0.005	-0.011

4.8 Soft Start Function Test ソフトスタート機能試験

AC Voltage	Output Power	Operation Mode	Frequency	% of output fluctuation		Pass / Fail ¹ No Overcurrent ¹ Is 150% or less of the rated current, ² The time exceeding 100% is within 0.5 seconds	Remarks
				Output Fluctuation ¹	Time spent over 100% of nominal current (sec) ²		
Phase A: 101Vrms Phase B: 101Vrms	4.8 kW	Discharge 放電	60 Hz	0%	0	Pass	Figure 4.8

Scope Channel Description:

Channel 1_1: Phase A Current

Channel 1_2: Phase A Voltage

Channel 2_1: Phase B Current

Channel 2_2: Phase B Voltage

Relay: Relay Signal

Gate drive: Gate Signal

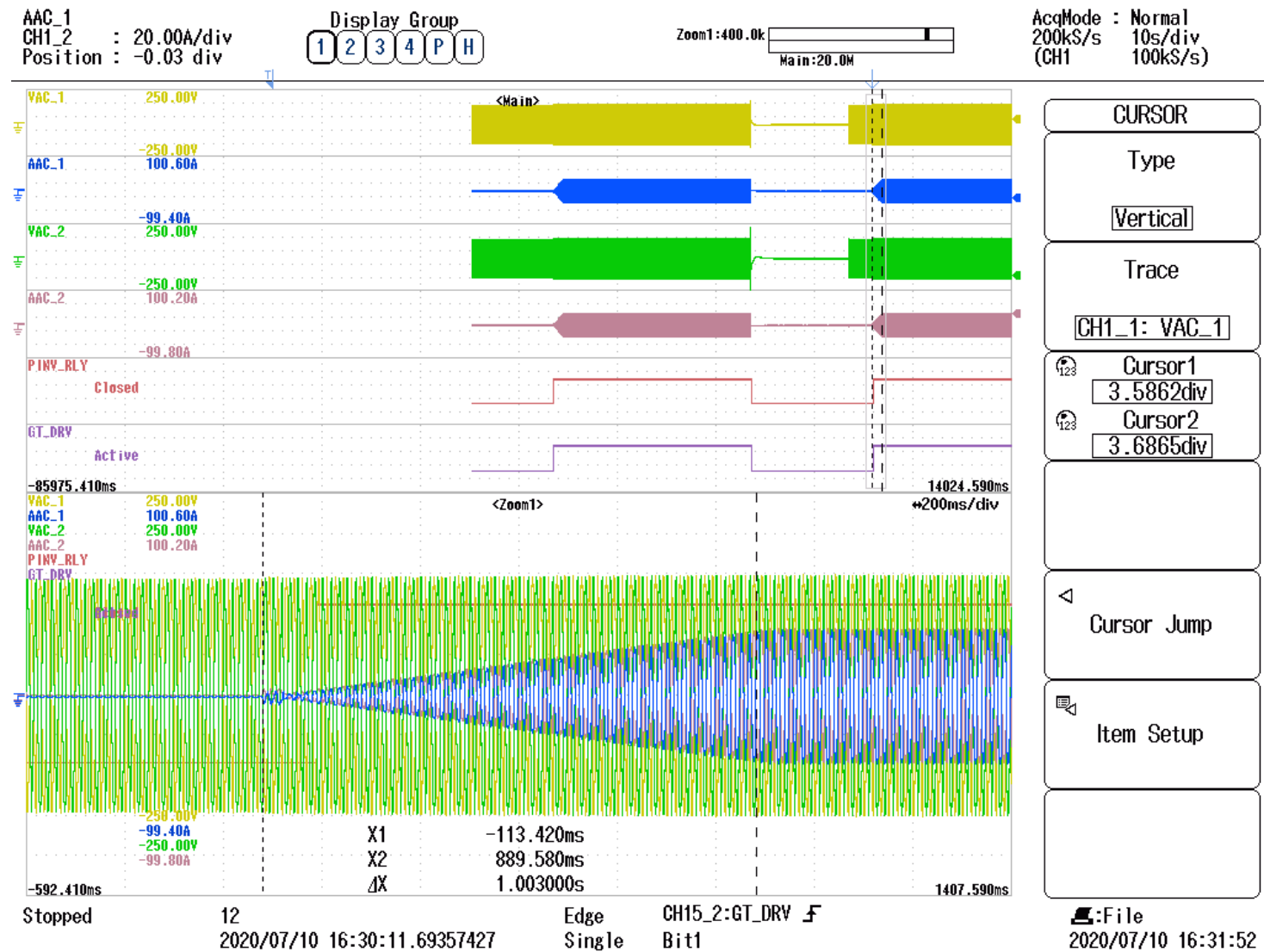


Figure: 4.8 Soft start function (Time to 100% Power= 1.003 sec)

5.1 Rapid Input Power Change and Rapid Load Change Test

入力電力急変試験及び負荷急変試験

EUT set power (% of EUT name plate power rating)	Load setting (% of EUT name plate power rating)	Voltage (V)	Frequency (Hz)	EUT Power (W)	EUT Power (% of EUT nameplate)	EUT Current (A)	EUT Current (% of EUT nameplate)	Time Spent over 100% (ms)	Remarks
50	50	102.038	60.011	2403.700	0.501	11.839	0.493	--	
50	75	102.500	59.993	3609.100	0.752	17.658	0.736	--	Fig: 5.1.1
50	50	102.045	60.000	2403.800	0.501	11.837	0.493	--	
50	50	102.051	59.996	2414.800	0.503	11.902	0.496	--	
50	25	101.890	60.001	1187.800	0.247	5.930	0.247	--	Fig: 5.1.2
50	50	102.014	60.002	2423.700	0.505	11.945	0.498	--	
100	100	102.816	60.011	4903.7	1.02	23.891	0.995	--	
100	0	101.049	59.991	-0.5	0.000	1.0132	0.04	--	Fig: 5.1.3
100	100	102.807	60.006	4920.8	1.025166667	23.79	0.99125	--	



Fig: 5.1.1 Load follwing from 50% to 75%

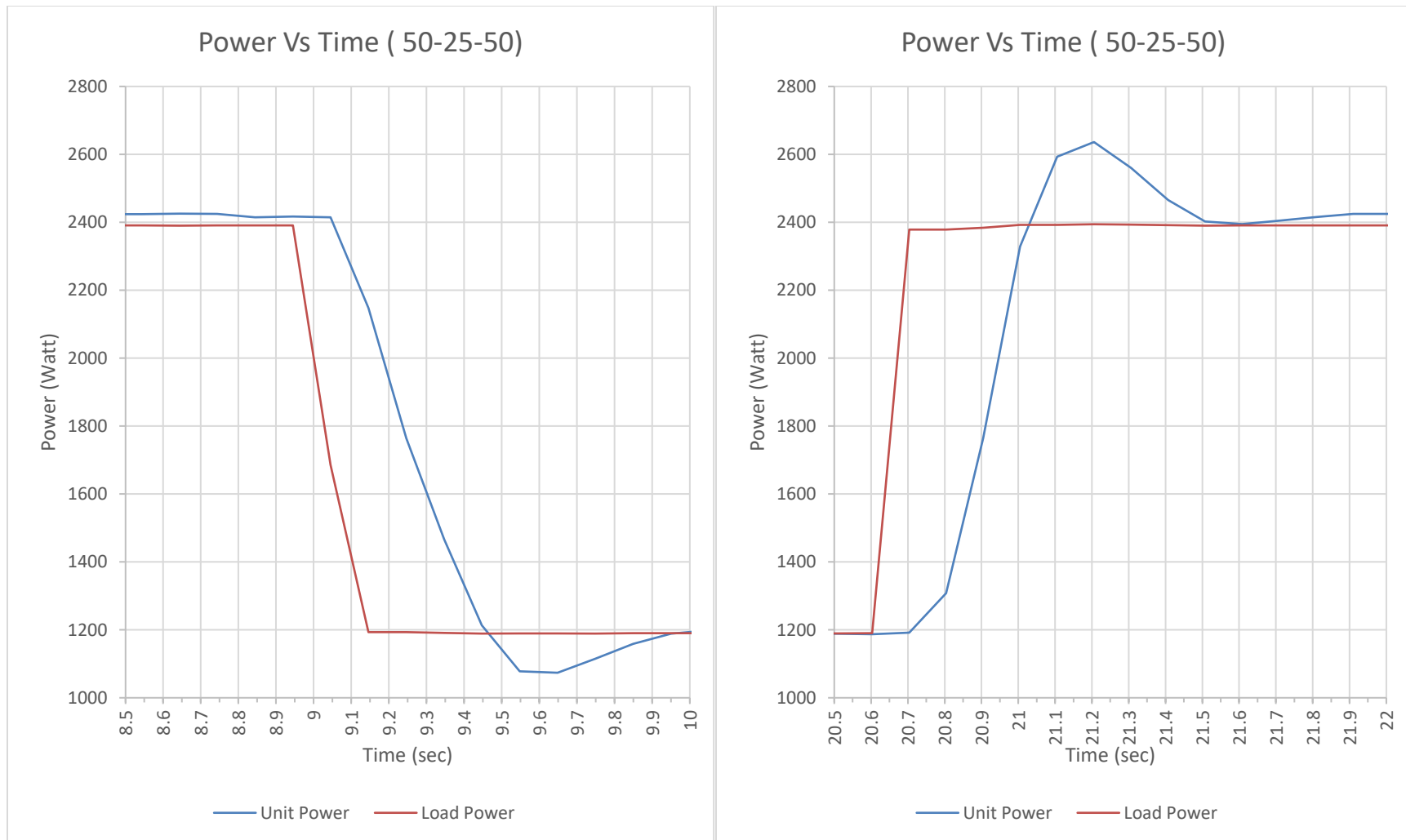


Fig: 5.1.2 Load following from 50% to 25%



Fig: 5.1.3 Load follwing from 100% to 0%

6.3 Instantaneous Voltage Drop Test 瞬時電圧低下試験 (FRT 試験)

Voltage Drop To 20% (Nominal voltage = 94%Vn = 94.94Vrms) 残電圧 20%時

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Entry Angle 位相	Measurement 試験結果				Pass / Fail 判定 ¹ <100ms ² <150% of Irated ³ <500ms	Remarks 備考
					80% Output Recovering time 出力復帰時間	Over Current (A(%)) 過電流値	Time Spent over 100% (ms) 100%を超える時間	Operation is Continuous? 電圧低下後の運転継続?		
94.94Vrms (A,B) → 20.2Vrms (A,B) → 94.94Vrms (A,B)L-N	4.8kW	Discharge 放電	60 Hz	0	0.1	22.04 A (91.83%)	0	Yes	Pass	Fig 6.3.1
				45	0.1	20.522 A (85.51%)	0	Yes	Pass	Fig 6.3.2
				90	0.05	20.388 A (84.95%)	0	Yes	Pass	Fig 6.3.3



Voltage Drop To 20% (Nominal voltage = $V_n = 101V_{rms}$) 残電圧 20%時

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Entry Angle 位相	Measurement 試験結果				Pass / Fail 判定 ¹ <100ms ² <150% of I_{rated} ³ <500ms	Remarks 備考
					80% Output Recovering time 出力復帰時間	Over Current (A(%)) 過電流値	Time Spent over 100% (ms) 100%を超える時間	Operation is Continuous? 電圧低下後の運転継続?		
101Vrms (A,B) → 20.2Vrms (A,B) → 101Vrms (A,B)L-N	4.8kW	Discharge 放電	60 Hz	0	0.1	20.15 A (83.96%)	0	Yes	Pass	
				45	0.1	21.124 A (88.02%)	0	Yes	Pass	
				90	0.05	19.865 A (82.77%)	0	Yes	Pass	



Voltage Drop To 20% (Nominal voltage = 106%Vn = 107.06Vrms) 残電圧 20%時

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Entry Angle 位相	Measurement 試験結果				Pass / Fail 判定 ¹ <100ms ² <150% of Irated ³ <500ms	Remarks 備考
					80% Output Recovering time 出力復帰時間	Over Current (A(%)) 過電流値	Time Spent over 100% (ms) 100%を超える時間	Operation is Continuous? 電圧低下後の運転継続?		
107.06Vrms (A,B) → 20.2Vrms (A,B) → 107.06Vrms (A,B)L-N	4.8kW	Discharge 放電	60 Hz	0	0.2	20.051 A (83.55%)	0	Yes	Pass	
				45	0.1	19.749 A (82.29%)	0	Yes	Pass	
				90	0.15	19.71 A (82.13%)	0	Yes	Pass	

Scope Channel Description:

Channel 1_1: Phase A Voltage

Channel 1_2: Phase A Current

Channel 2_1: Phase B Voltage

Channel 2_2: Phase B Current

PINV_RLY: Relay Signal

GT_DR: Gate Signal

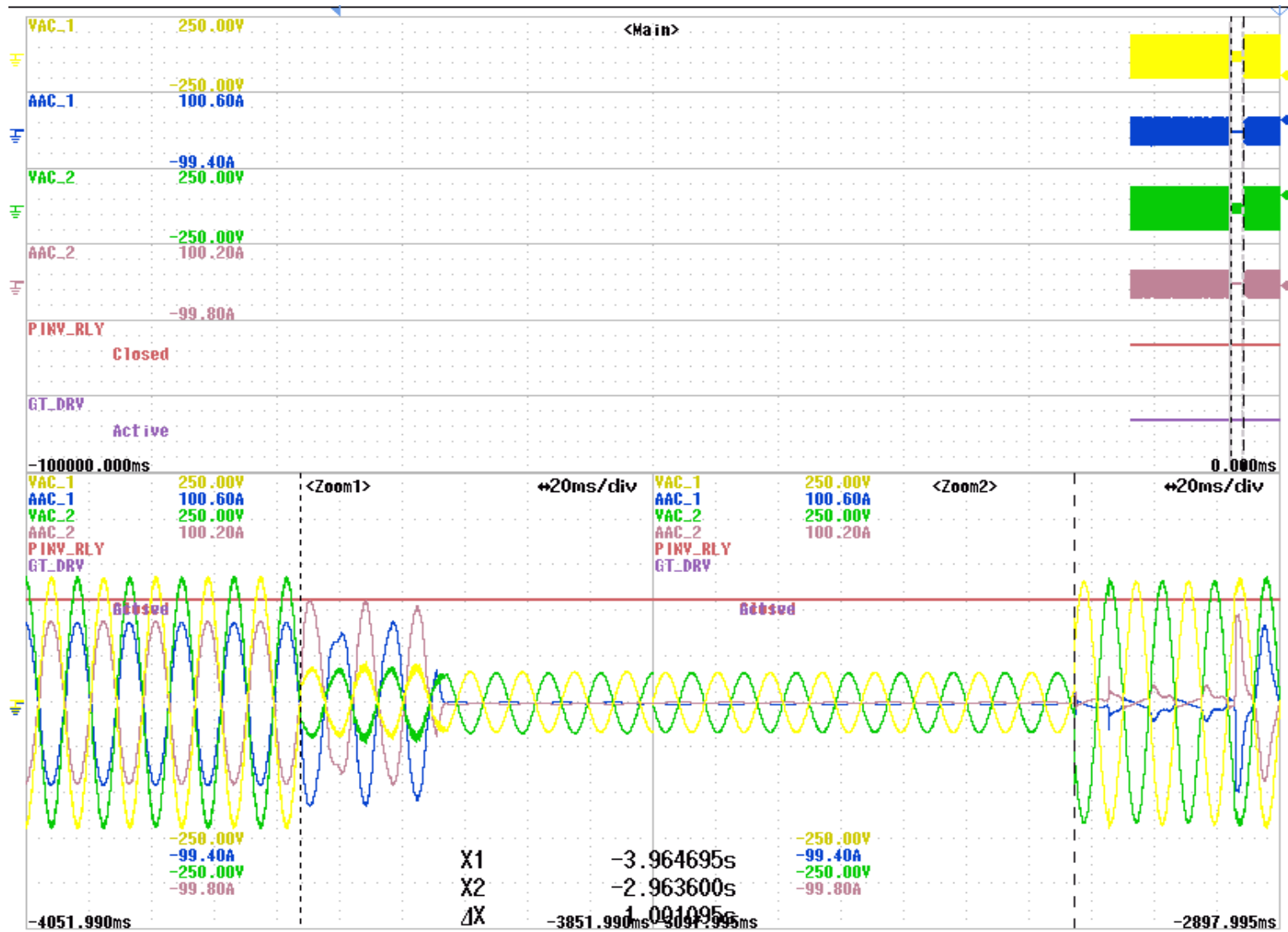


Figure 6.3.1 Instantaneous voltage drop at 0° entry angle (94.94Vrms → 20.2Vrms → 94.94Vrms)

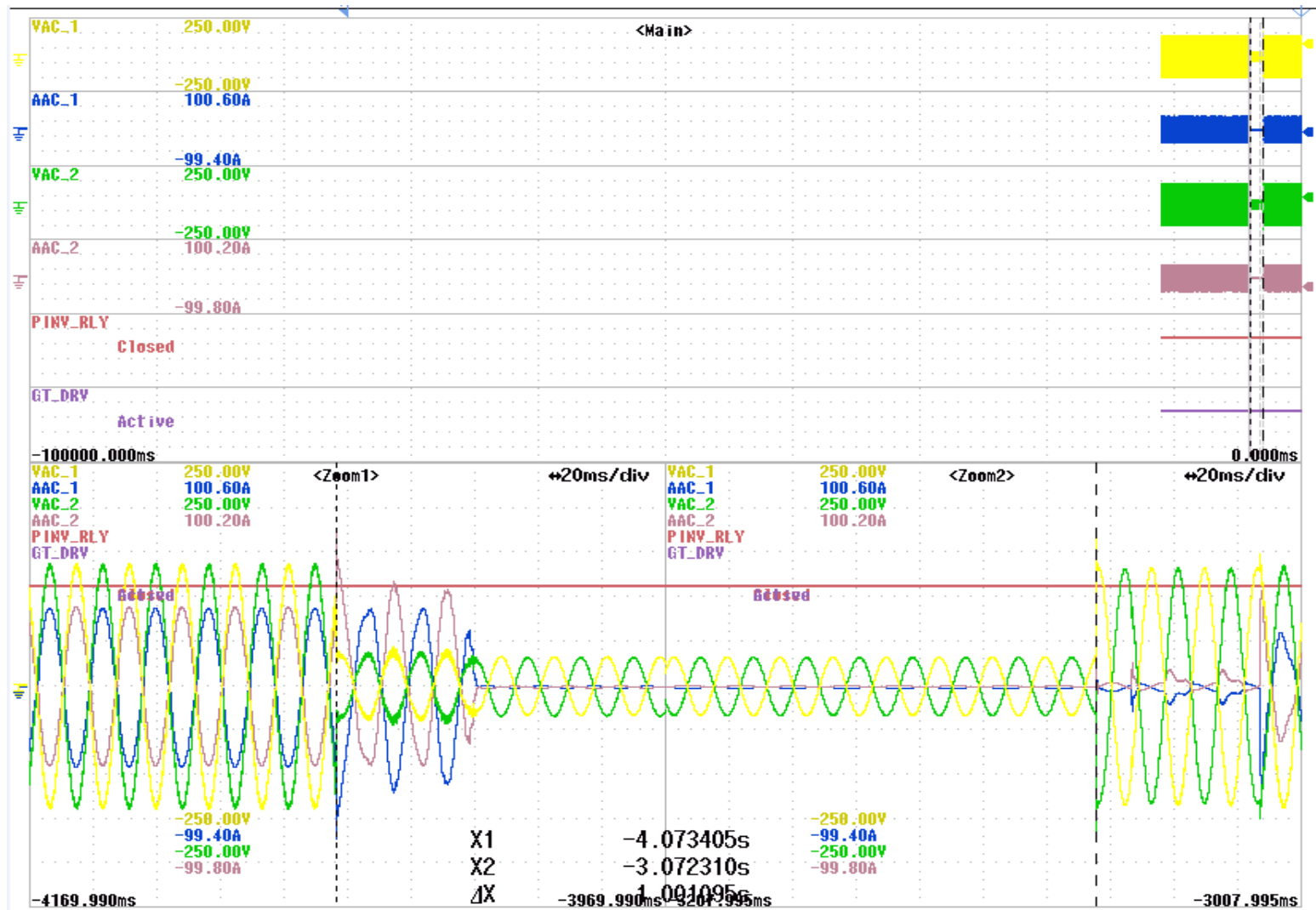


Figure 6.3.2 Instantaneous voltage drop at 45° entry angle (94.94Vrms → 20.2Vrms → 94.94Vrms)

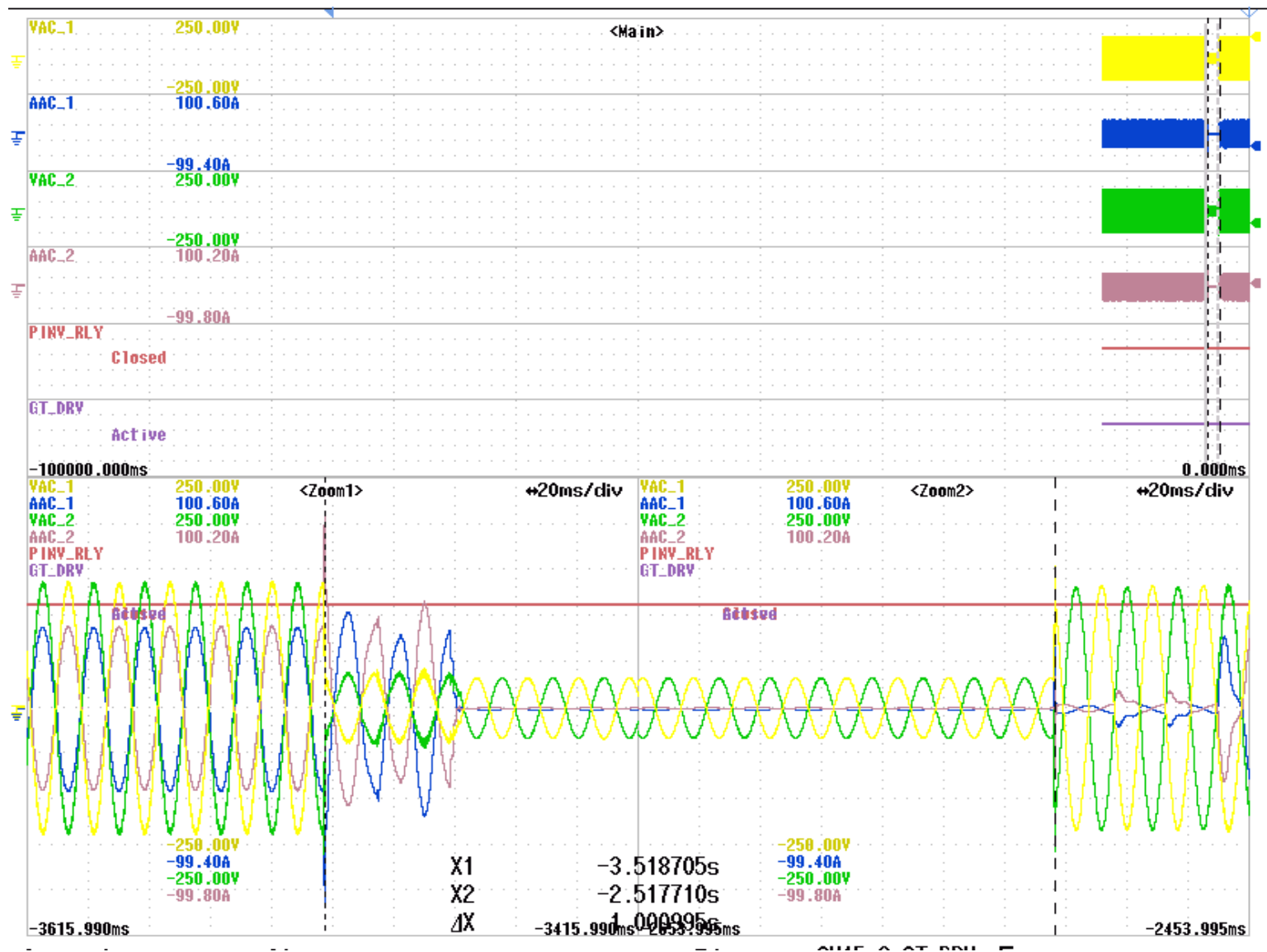


Figure 6.3.3 Instantaneous voltage drop at 90° entry angle (94.94Vrms → 20.2Vrms → 94.94Vrms)



Voltage Drop To 0% (Nominal voltage = 94%Vn = 94.94Vrms) 残電圧 0 %

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Entry Angle 位相	Measurement 試験結果				Pass / Fail 判定 ¹ <100ms ² <150% of Irated ³ <500ms	Remarks 備考
					80% Output Recovering time 出力復帰時間	Over Current (A(%)) 過電流値	Time Spent over 100% (ms) 100% を超える 時間	Operation is Continuous? 電圧低下後 の運転継続?		
101Vrms (A,B,C) → 0Vrms (A,B,C) → 101Vrms (A,B,C)	4.8 kW	Discharge 放電	60 Hz	0	0.15	20.096 (83.73%)	0	Yes	Pass	Fig 6.3.4
				45	0.15	20.004 (83.55%)	0	Yes	Pass	Fig 6.3.5
				90	0.1	20.353 (84.80%)	0	Yes	Pass	Fig 6.3.6



Voltage Drop To 0% (Nominal voltage = $V_n = 101V_{rms}$) 残電圧 0 %

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Entry Angle 位相	Measurement 試験結果				Pass / Fail 判定 ¹ <100ms ² <150% of I_{rated} ³ <500ms	Remarks 備考
					80% Output Recovering time 出力復帰時間	Over Current (A(%)) 過電流値	Time Spent over 100% (ms) 100%を超える時間	Operation is Continuous? 電圧低下後の運転継続?		
101Vrms (A,B,C) → 0Vrms (A,B,C) → 101Vrms (A,B,C)	4.8 kW	Discharge 放電	60 Hz	0	0.15	19.86 (82.75%)	0	Yes	Pass	
				45	0.05	19.302 (80.43%)	0	Yes	Pass	
				90	0.1	19.71 (82.13%)	0	Yes	Pass	



Voltage Drop To 0% (Nominal voltage = 106%Vn = 107.06Vrms) 残電圧 0 %

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Entry Angle 位相	Measurement 試験結果				Pass / Fail 判定 ¹ <100ms ² <150% of Irated ³ <500ms	Remarks 備考
					80% Output Recovering time 出力復帰時間	Over Current (A(%)) 過電流値	Time Spent over 100% (ms) 100%を超える時間	Operation is Continuous? 電圧低下後の運転継続?		
101Vrms (A,B,C) → 0Vrms (A,B,C) → 101Vrms (A,B,C)	4.8 kW	Discharge 放電	60 Hz	0	0.15	19.86 (82.75%)	0	Yes	Pass	
				45	0.15	19.302 (80.43%)	0	Yes	Pass	
				90	0.25	20.29 (84.54%)	0	Yes	Pass	

Scope Channel Description:
Channel 1_1: Phase A Current
Channel 1_2: Phase A Voltage
Channel 2_1: Phase B Current
Channel 2_2: Phase B Voltage

PINV_RLY0: Relay Signal
GT_DRV0: Gate Signal

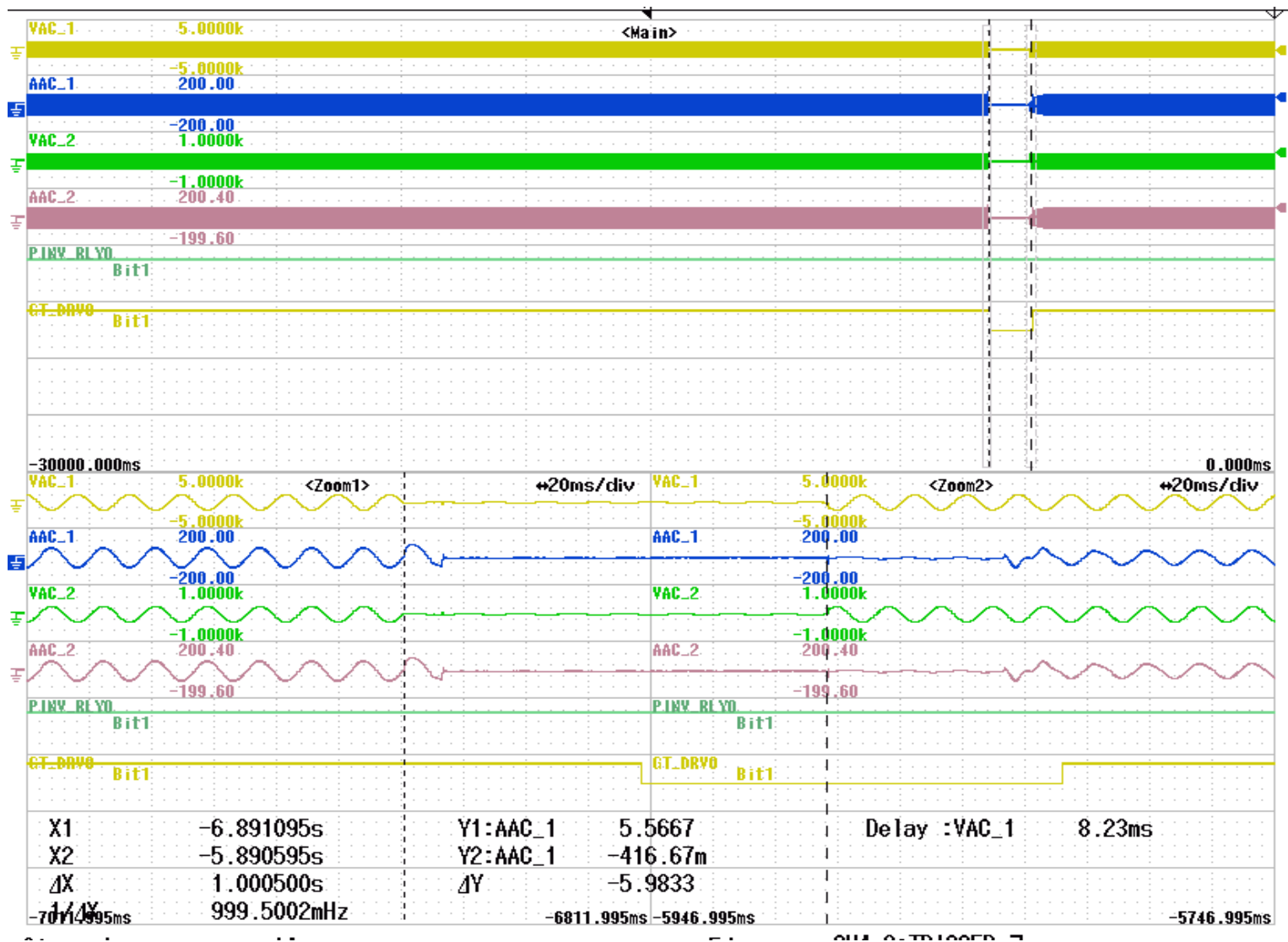


Figure 6.3.4 Instantaneous voltage drop at 0° entry angle (101Vrms → 0Vrms → 101Vrms)

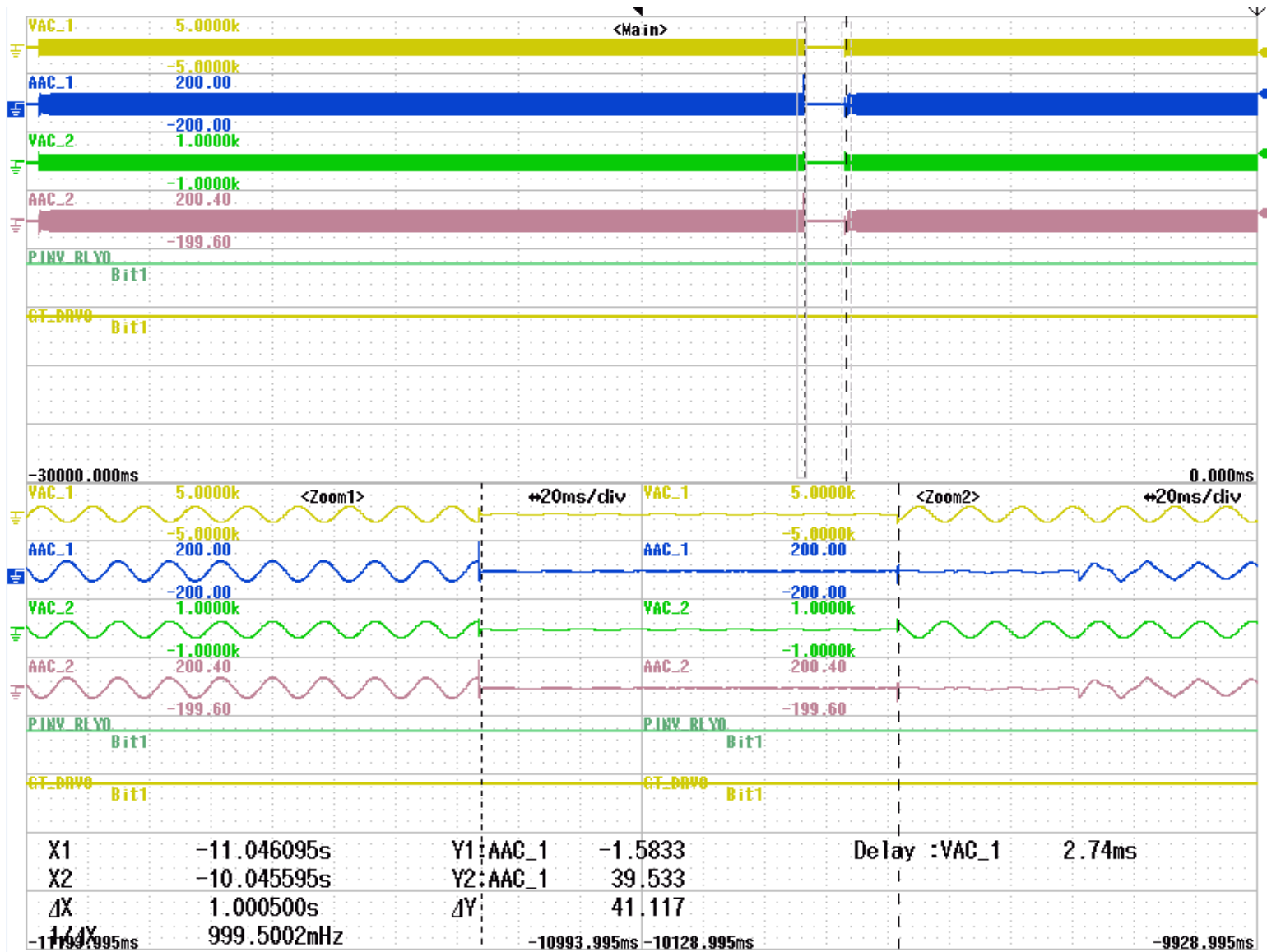


Figure 6.3.6 Instantaneous voltage drop at 90° entry angle (101Vrms → 0Vrms → 101Vrms)



Voltage Drop To 52% (Nominal voltage = 94%Vn = 94.94Vrms) % 残電圧 52 %

Phase jump 0 to 41° 位相変化 41°

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Entry Angle 位相	Measurement 試験結果				Pass / Fail 判定 ¹ <100ms ² <150% of Irated ³ <500ms	Remarks 備考
					80% Output Recovering time 出力復帰時間	Over Current (A(%)) 過電流値	Time Spent over 100% (ms) 100%を超える時間	Operation is Continuous? 電圧低下後の運転継続?		
94.94Vrms (A,B) → 52.52Vrms (A,B) → 94.94Vrms (A,B)L-N	4.8kW	Discharge 放電	60 Hz	0	-	24.019 A (100.08%)	0	Yes	Pass	Fig 6.3.7
				45	-	23.667 A (98.61%)	0	Yes	Pass	Fig 6.3.8
				90	-	21.099 A (87.91%)	0	Yes	Pass	Fig 6.3.9



Voltage Drop To 52% (Nominal voltage = $V_n = 101V_{rms}$) % 残電圧 52 %

Phase jump 0 to 41° 位相変化 41°

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Entry Angle 位相	Measurement 試験結果				Pass / Fail 判定 ¹ <100ms ² <150% of I_{rated} ³ <500ms	Remarks 備考
					80% Output Recovering time 出力復帰時間	Over Current (A(%)) 過電流値	Time Spent over 100% (ms) 100%を超える時間	Operation is Continuous? 電圧低下後の運転継続?		
101Vrms (A,B) → 52.52Vrms (A,B) → 101Vrms (A,B)L-N	4.8kW	Discharge 放電	60 Hz	0	-	23.813A (99.22%)	0	Yes	Pass	
				45	-	24.54A (102.25%)	0	Yes	Pass	
				90	-	23.283 A (97.01%)	0	Yes	Pass	



Voltage Drop To 52% (Nominal voltage = 106%Vn = 107.06Vrms) % 残電圧 5 2 %

Phase jump 0 to 41° 位相変化 4 1 °

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Entry Angle 位相	Measurement 試験結果				Pass / Fail 判定 ¹ <100ms ² <150% of Irated ³ <500ms	Remarks 備考
					80% Output Recovering time 出力復帰時間	Over Current (A(%)) 過電流値	Time Spent over 100% (ms) 1 0 0 % を超える時間	Operation is Continuous? 電圧低下後の運転継続?		
107.06Vrms (A,B) → 52.52Vrms (A,B) → 107.06Vrms (A,B)L-N	4.8kW	Discharge 放電	60 Hz	0	-	23.54 A (98.08%)	0	Yes	Pass	
				45	-	23.166 A (96.53%)	0	Yes	Pass	
				90	-	22.172 A (92.38%)	0	Yes	Pass	

Scope Channel Description: s
Channel 1_1: Phase A Voltage
Channel 1_2: Phase A Current
Channel 2_1: Phase B Voltage
Channel 2_2: Phase B Current

PINV_RLY: Relay Signal
GT_DRV: Gate Signal

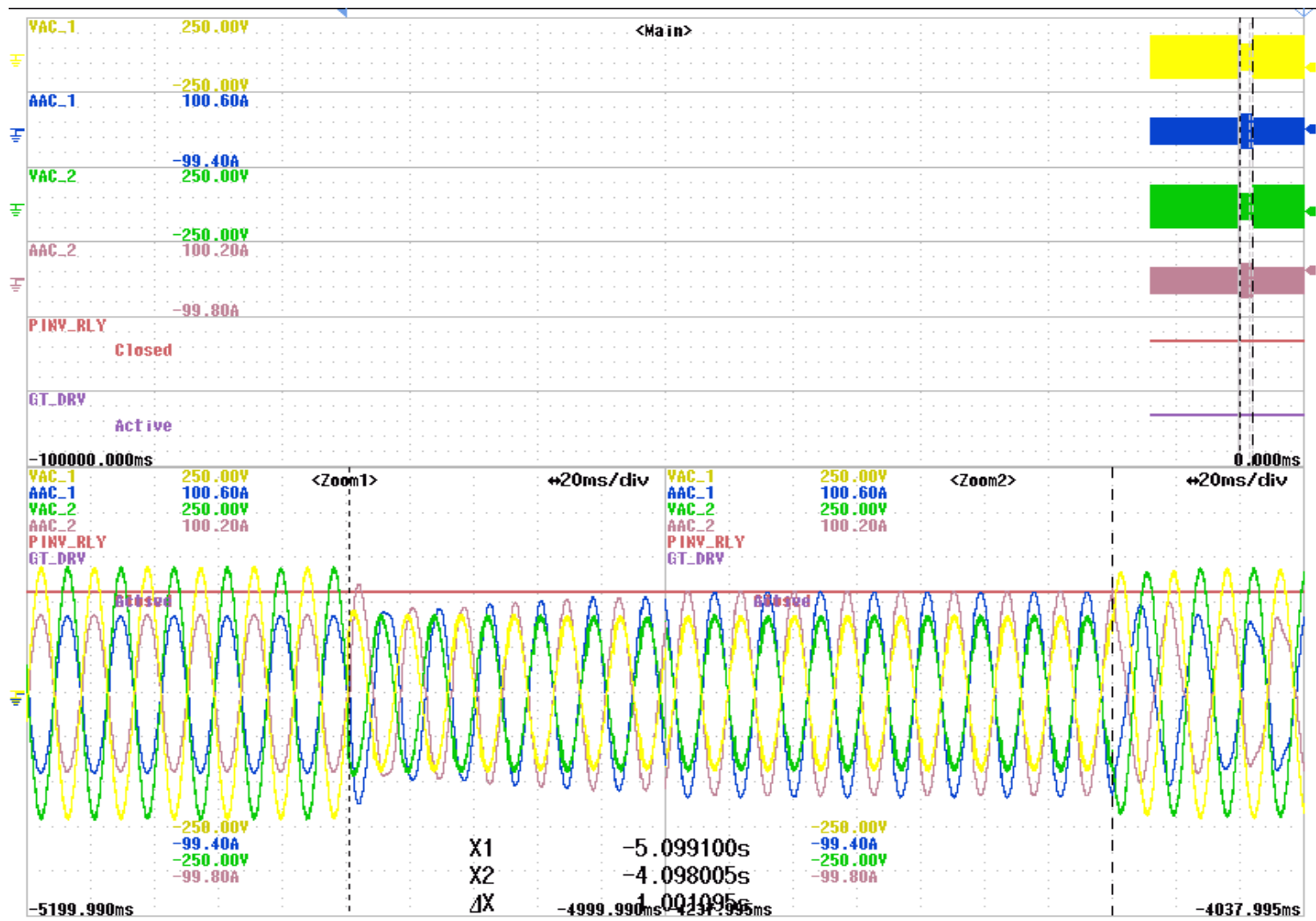


Figure 6.3.7 Instantaneous voltage drop at 0° entry angle (94.94Vrms → 52.52Vrms → 94.94Vrms)

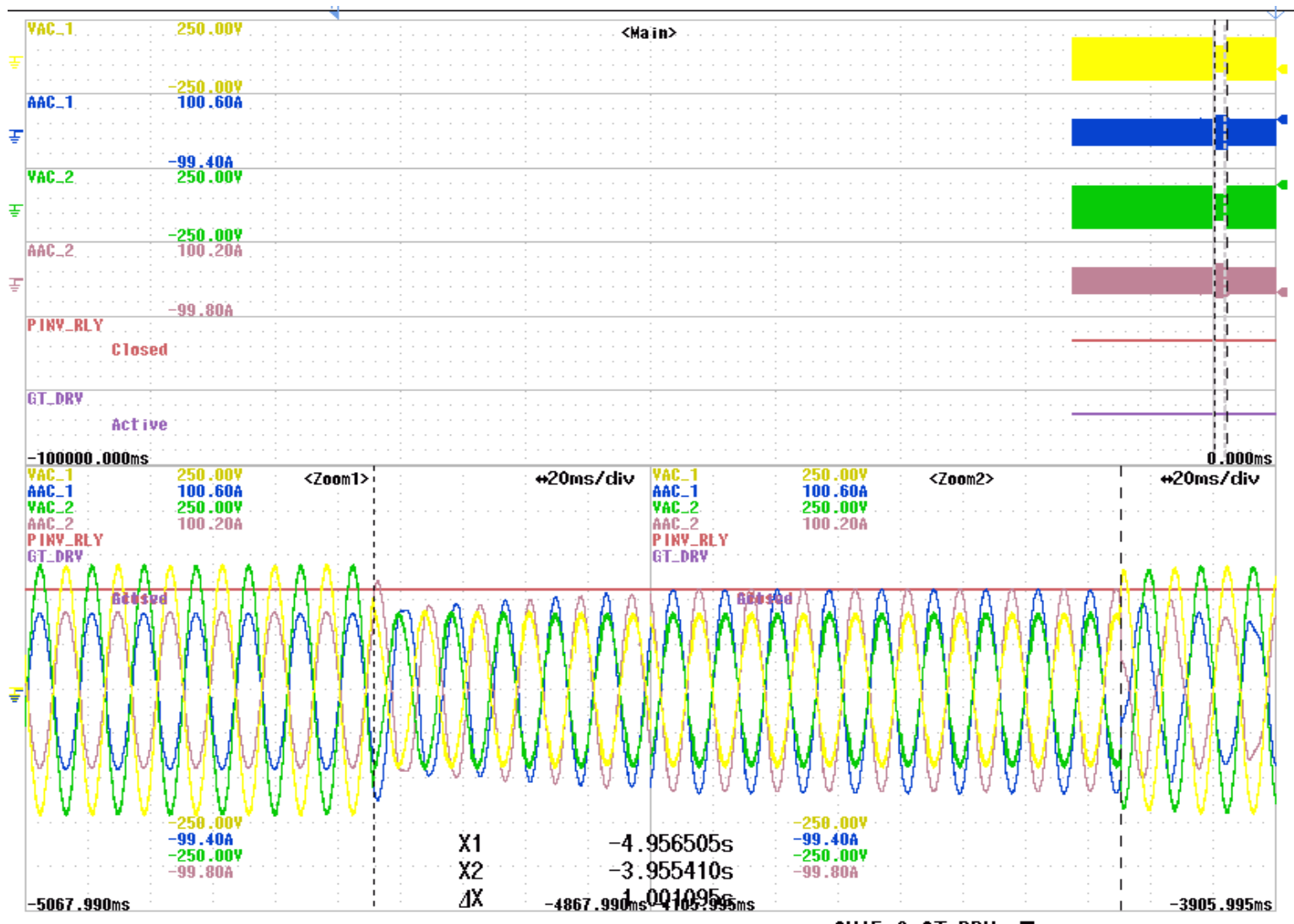


Figure 6.3.8 Instantaneous voltage drop at 45° entry angle (94.94Vrms → 52.52Vrms → 94.94Vrms)

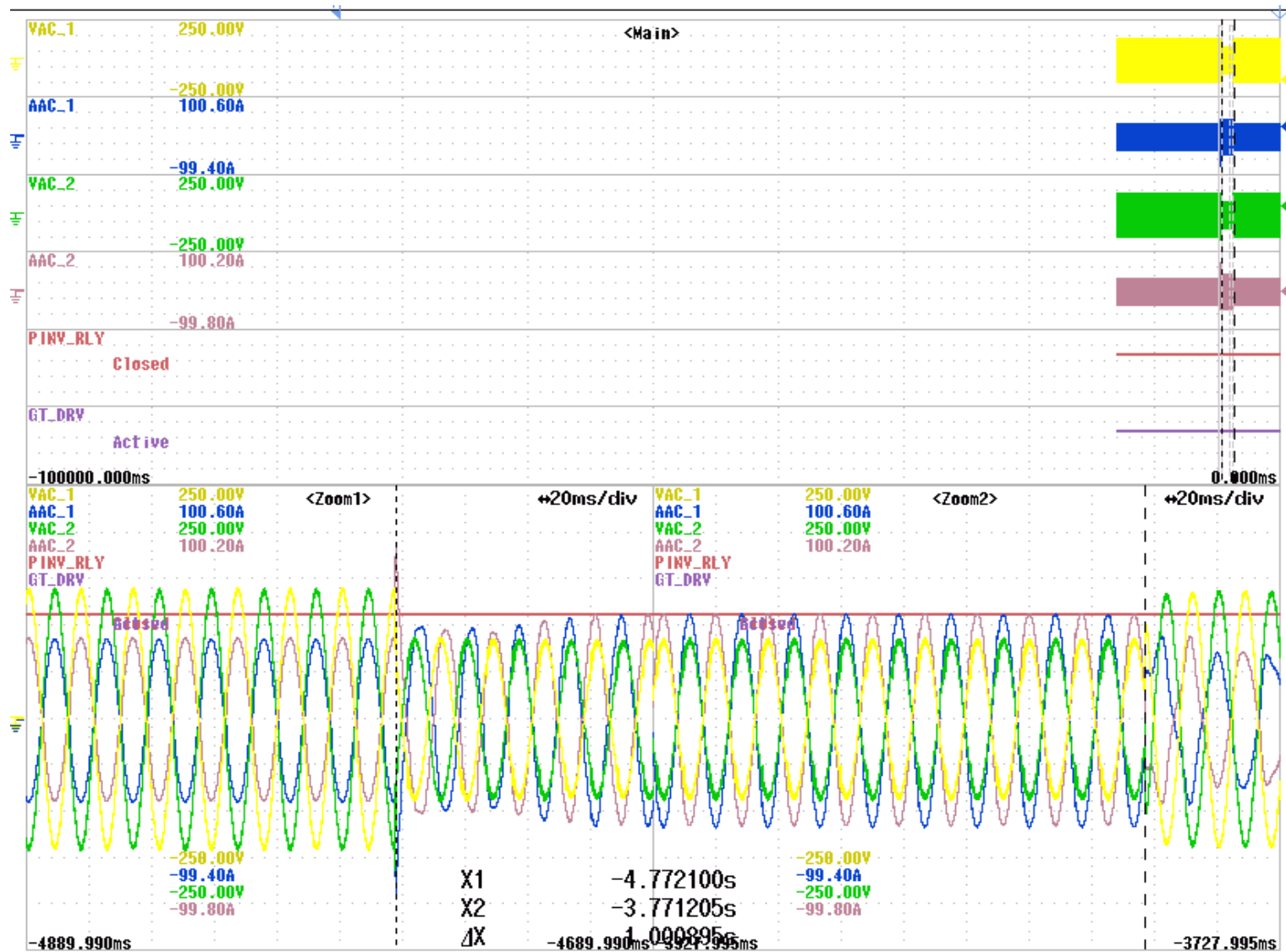


Figure 6.3.9 Instantaneous voltage drop at 90° entry angle (94.94Vrms → 52.52Vrms → 94.94Vrms)



6.4 Frequency Step Change Test(60Hz) 周波数変動試験

AC Voltage 交流電圧	Output Power 出力電力	Operation Mode 動作モード	Frequency 周波数	Frequency Change 周波数変動	Frequency Deviation(Hz) 変動周波数(Hz)	Freq. Chang Duration 変動時間	Inverter Continue? 運転継続	Pass / Fail 判定	Remarks 備考
Phase A: 101Vrms Phase B: 101Vrms	4.8 kW	Discharge	60 Hz	Step Change	+1.0 Hz	0.05s	Yes	Pass	Figure 6.4.7 – 6.4.8

Scope Channel Description:

Channel 1_1: Phase A Current

Channel 1_2: Phase A Voltage

Channel 2_1: Phase B Current

Channel 2_2: Phase B Voltage

Relay: Relay Signal

Gate drive: Gate

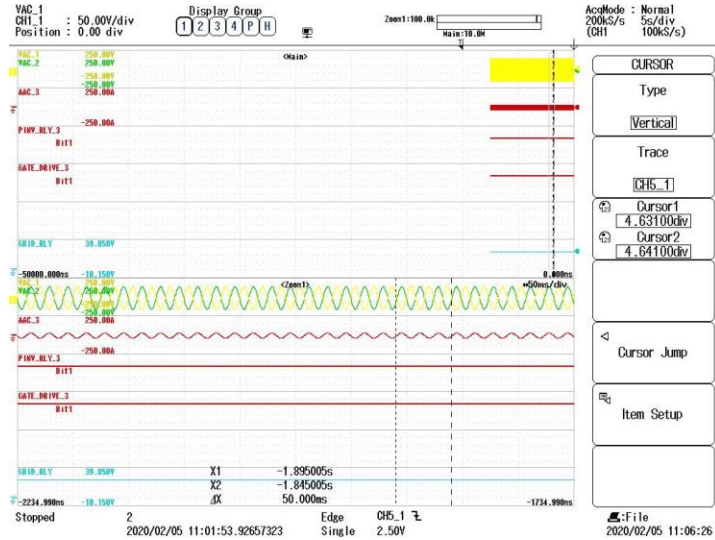


Figure: 6.4.7 Frequency Step Change (60.0Hz → 61Hz)

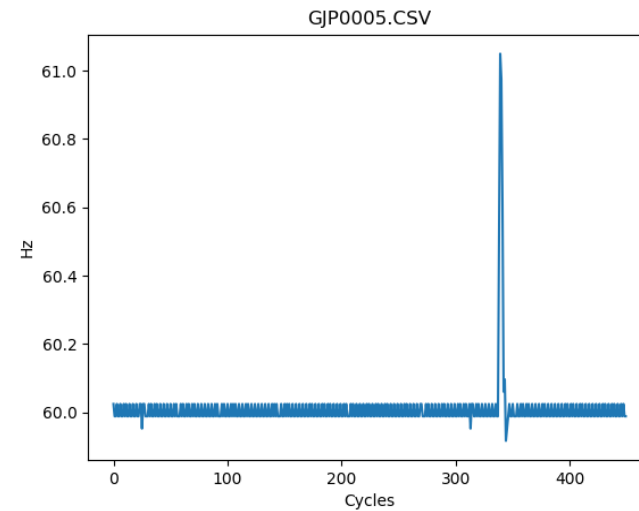


Figure: 6.4.8 Frequency Step Change (60.0Hz → 61Hz)

Ramp Change: ランプ状変化

AC Voltage 交流電圧	Output Power 出力電力	Mode	Frequency 周波数	Frequency Change 周波数変動	Frequency Deviation 変動周波数	Freq. Chang Duration 変動時間	Continuous operation during Freq. deviation?	Pass / Fail 判定	Remarks 備考
Phase A: 101Vrms Phase B: 101Vrms	4.8 kW	Discharge	60 Hz	Ramp Change ランプ状変化	+1.8	0.9	Yes	Pass	Figure 6.4.9 – 6.4.10
					-3	1.5	Yes	Pass	Figure 6.4.11 – 6.4.12

Scope Channel Description:

Channel 1_1: Phase A Current

Channel 1_2: Phase A Voltage

Channel 2_1: Phase B Current

Channel 2_2: Phase B Voltage

Relay: Relay Signal

Gate drive: Gate

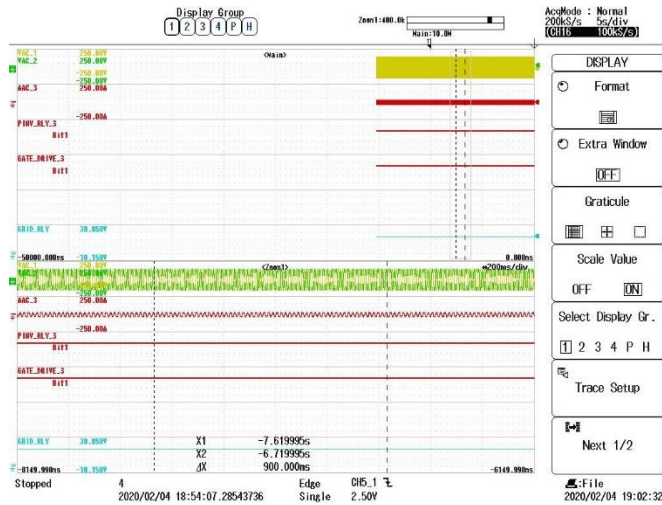


Figure 6.4.9 Frequency Ramp Change (60.0Hz→61.8Hz)

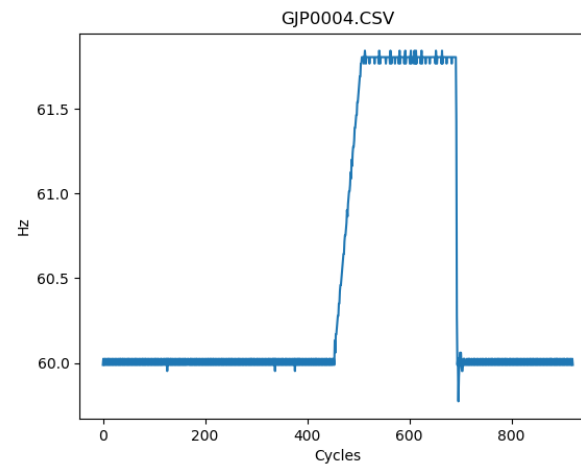


Figure 6.4.10 Frequency Ramp Change (60.0Hz→61.8Hz)

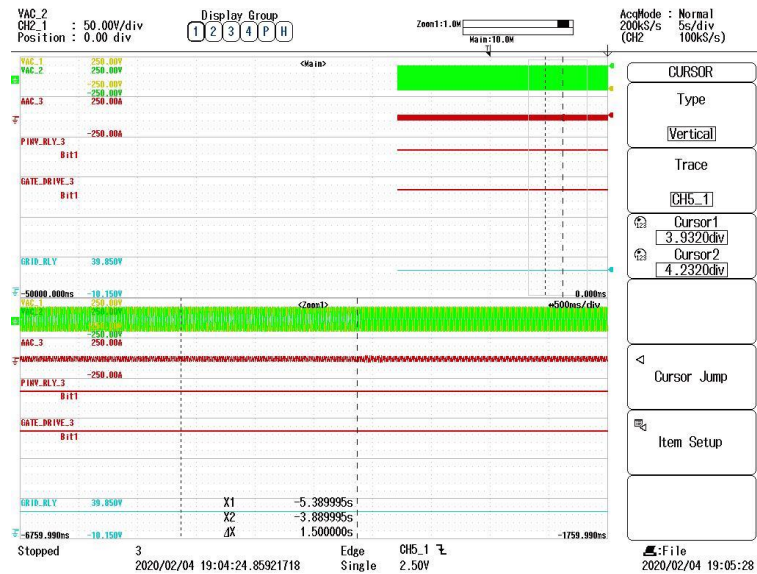


Figure 6.4.11 Frequency Ramp Change (60.0Hz→57Hz)

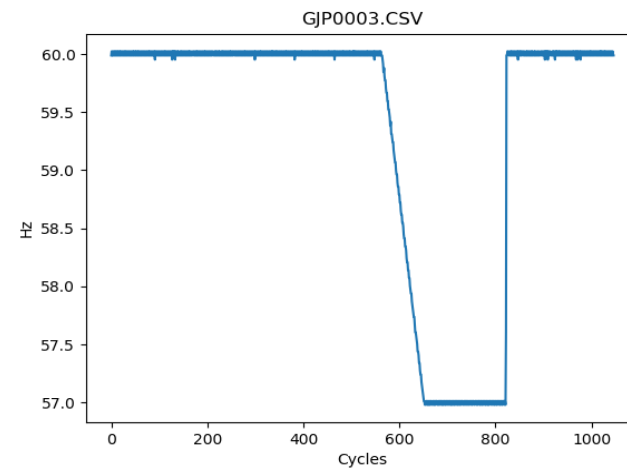


Figure 6.4.12 Frequency Ramp Change (60.0Hz→57Hz)

12.1 Switching to Backup operation mode 自立運転切換試験

Step (Refer Fig: 12.1.1)	Grid	ACPW	Gate Drive	ACPW Operation mode	Time to Transition (s)	Remarks
1	ON	ON	ON	Normal	--	Fig: 12.1.2
2	OFF	OFF	OFF	Normal	--	--
3	OFF	ON	ON	Backup	4.19	Fig: 12.1.3
4	ON	ON	ON	Backup	301.26	Fig: 12.1.4
5	ON	OFF	OFF/ON	Normal	2.47	Fig: 12.1.5
6	ON	ON	ON	Normal	299.22	Fig: 12.1.6

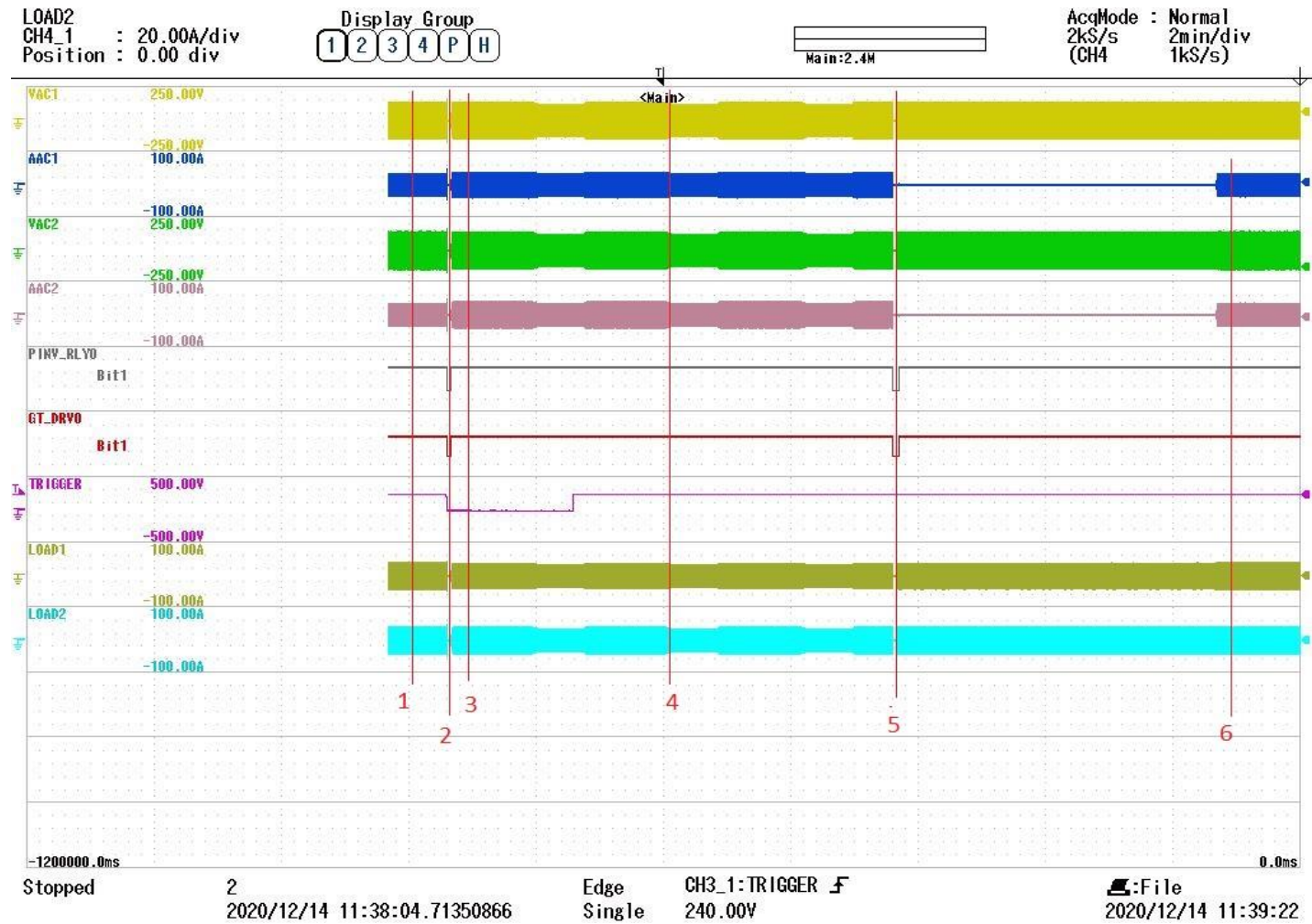


Fig: 12.1.1 Reference

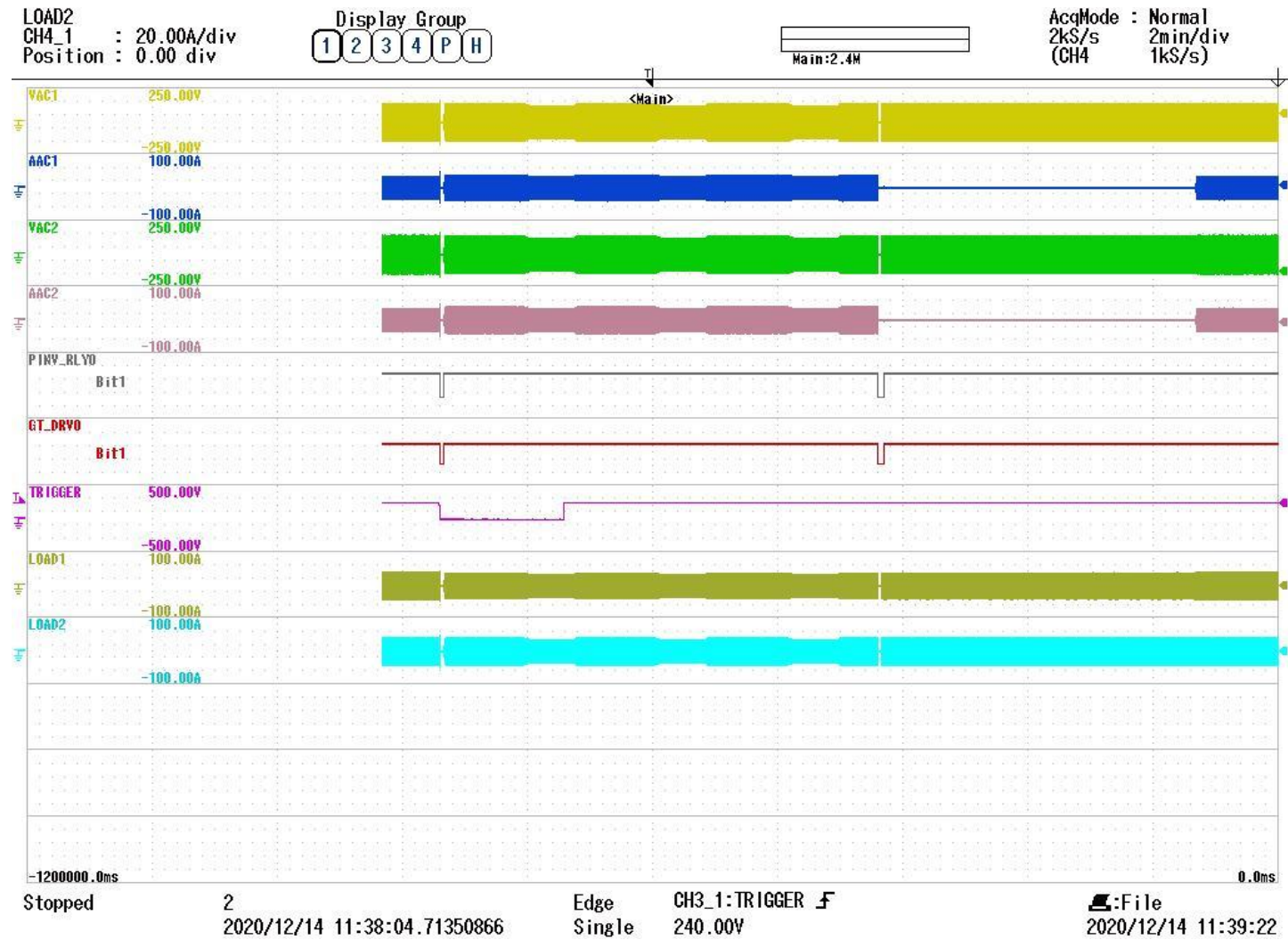
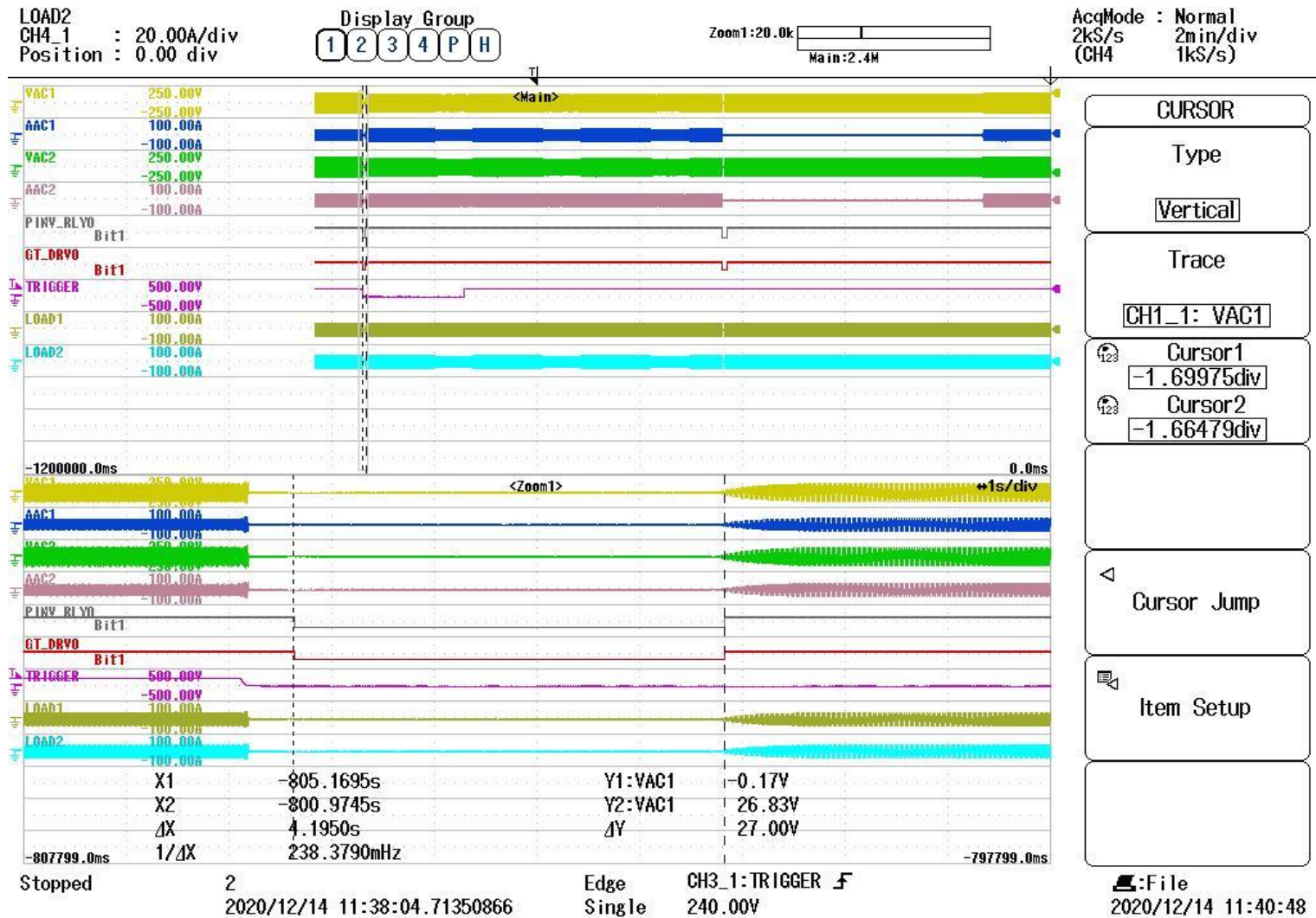


Fig: 12.1.2 Normal Operation



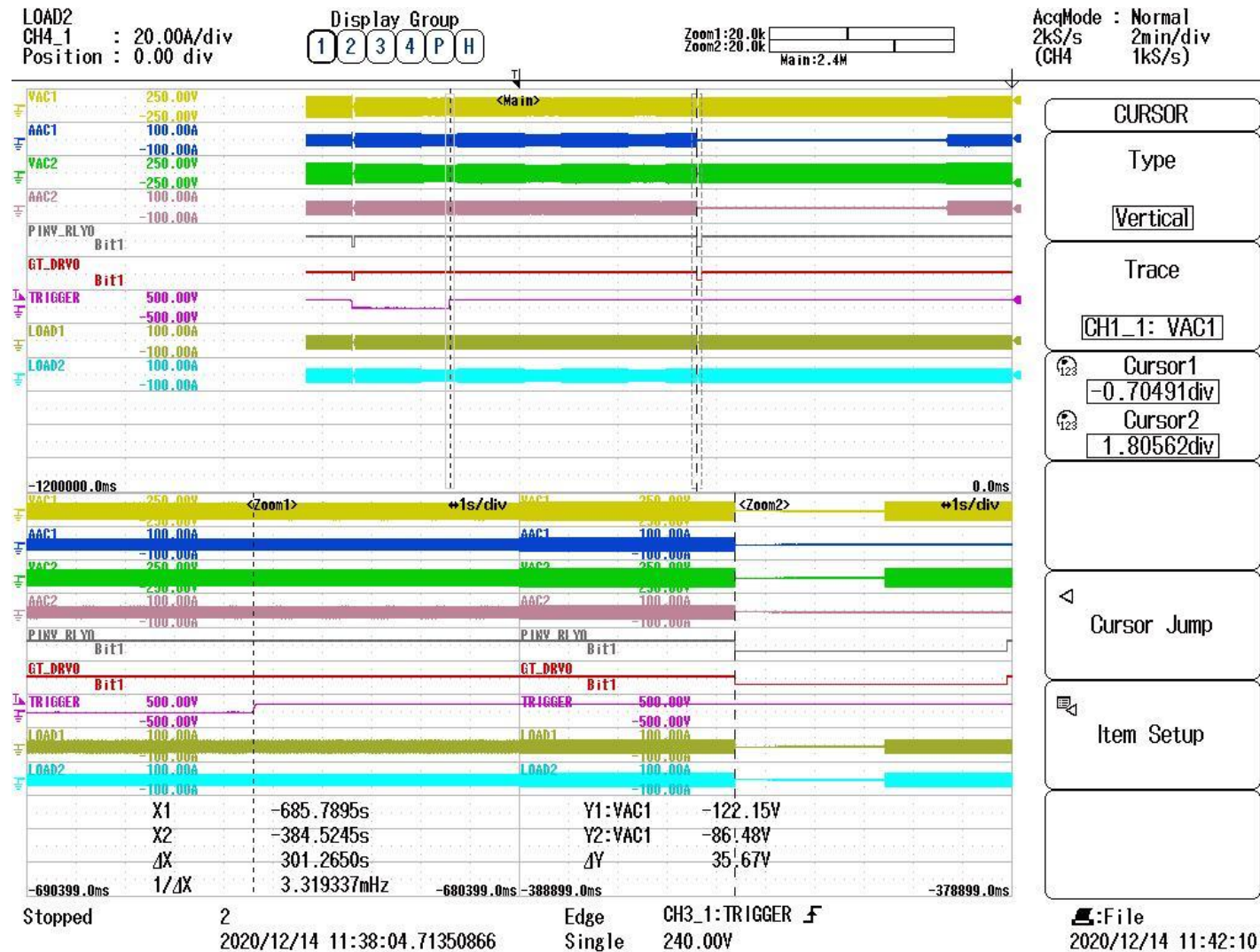


Fig: 12.1.4 Backup to Grid following mode: Relay & Gate block signal:Closed(301.26 secs)

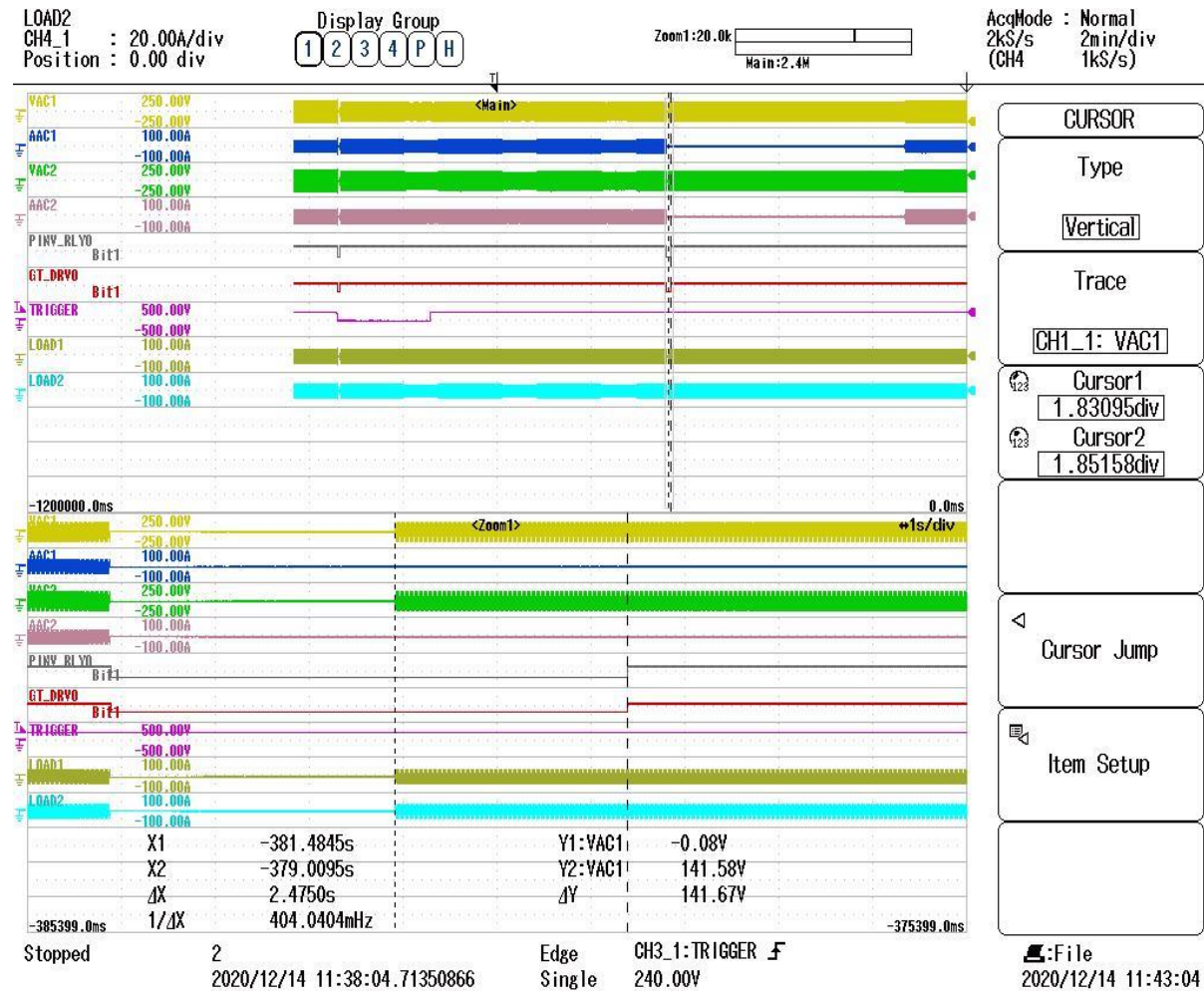


Fig: 12.1.5 Disabled to Grid following mode: Relay & Gate block signal:Open---Closed

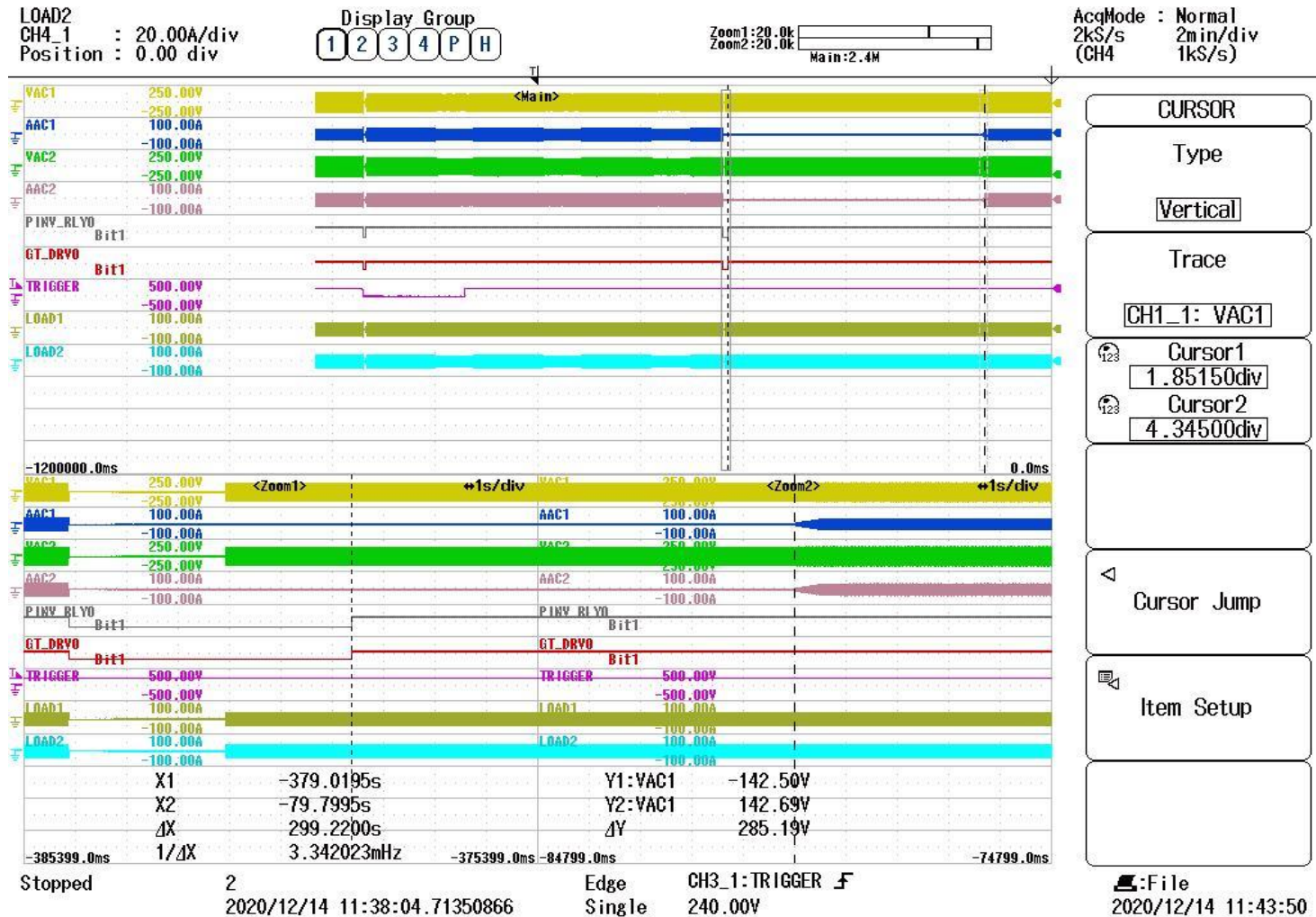


Fig: 12.1.6 Disabled to Grid following mode: Relay & Gate block signal:Closed(299.2secs)

12.2 Automatic switching to backup mode 自立運転自動切換試験

Load setting (% of EUT name plate power rating)	EUT set power (%of EUT name plate power rating)	Voltage (V)	Frequency (Hz)	EUT Power (W)	EUT Power (% of EUT nameplate)	EUT Current (A)	EUT Current (% of EUT nameplate)	Remarks
100	100	200.615	60.003	-0.3	-0.00625	0.2306	0.960833333	Before Backup
100	100	202.275	59.998	4773.3	99.44375	23.361	97.3375	After Backup

12.4 Independent disconnection signal disruption test 自立解列信号途絶試験

Test 1: Disconnection of Communication line before backup

Before Backup operation mode	Load setting (% of EUT name plate power rating)	EUT set power (%of EUT name plate power rating)	Voltage (V)	Frequency (Hz)	EUT Power (W)	EUT Power (% of EUT nameplate)	EUT Current (A)	EUT Current (% of EUT nameplate)	Remarks
With Comms. Cable	100	100	204.3	60.002	4803.6	100.075	23.3938	97.4741	Fig: 12.4.1
Without Comms. Cable	100	100	0	0	0	0	0	0	

Test 2: Disconnection of communication line after backup

During Backup operation mode	Load setting (% of EUT name plate power rating)	EUT set power (%of EUT name plate power rating)	Voltage (V)	Frequency (Hz)	EUT Power (W)	EUT Power (% of EUT nameplate)	EUT Current (A)	EUT Current (% of EUT nameplate)	Remarks
With Comms. Cable	100	100	194.731	59.886	4612	96.08333333	23.2014	96.6725	Fig: 12.4.2
Without Comms. Cable	100	100	0	0	0	0	0	0	



Scope Channel Description:

Channel 1_1: Phase A Current

Channel 1_2: Phase A Voltage

Channel 2_1: Phase B Current

Channel 2_2: Phase B Voltage

PINV_RLY0: Relay Signal

GT_DRV0: Gate Signal

GRD_REL: Grid open signal

Load Curr: Load Current

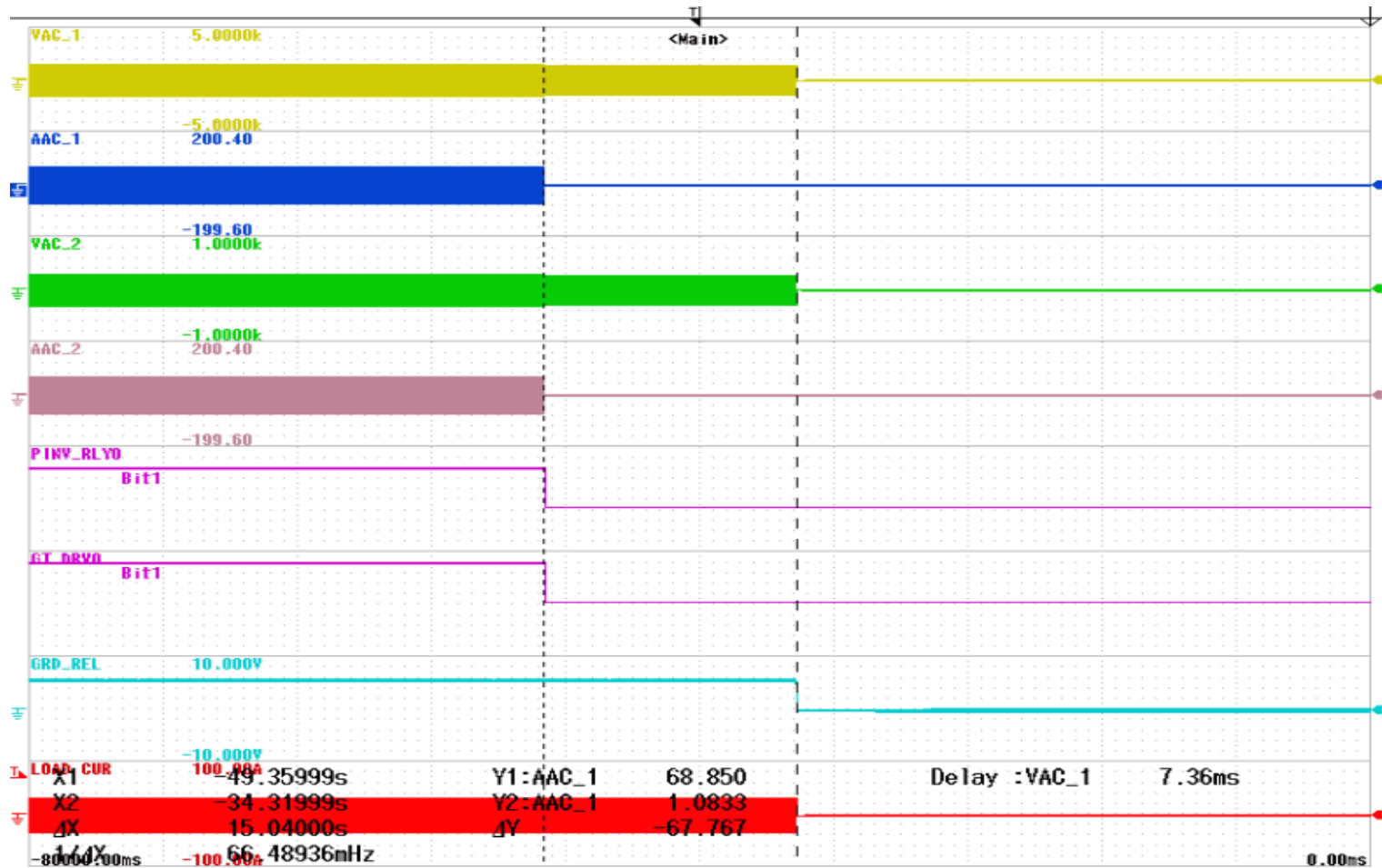


Fig: 12.4.1 Communication removed before backup operation (After Communication cable is disconnected, Gate and relay signal drops low, GRD_REL describes opening of Grid SWCB, unit does not go to backup operation mode)

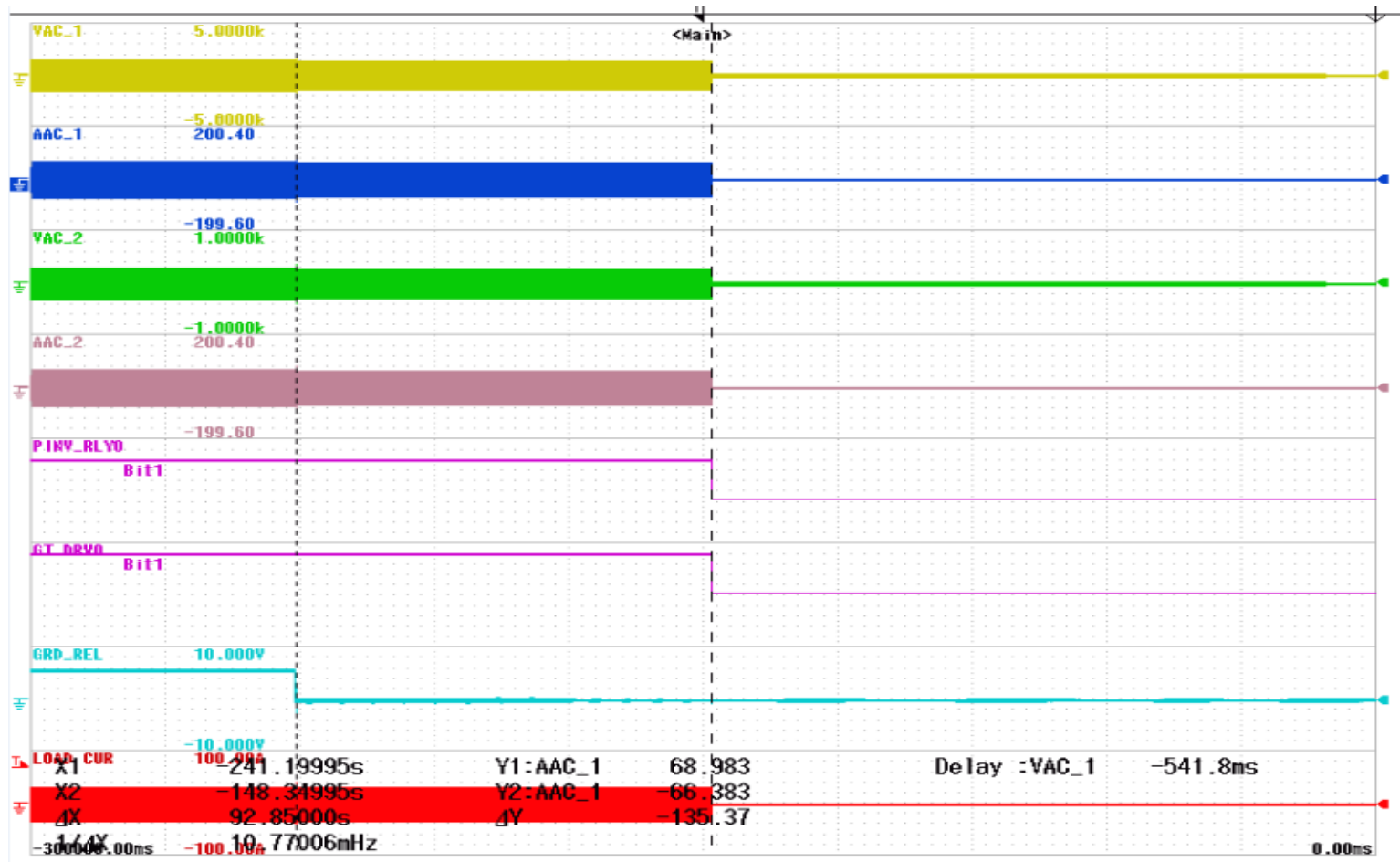


Fig: 12.4.2 Communication removed after backup operation (After Communication cable is disconnected, Gate and relay signal drops low, Unit stops expirting power to the load in backup mode)