Fronius
SHIFTING THE LIMITS

Wels, February 13th 2014

RIDE-THROUGH CAPABILITIES FRONIUS SYMO 10.0-3 – 24.0-3

Fronius International GmbH

hereby confirms, that the inverters

/ **Fronius Symo 10.0-3 208/240, 10.0-3 480, 12.0-3 208/240, 12.5-3 480, 15.0-3 480, 17.5-3 480, 20.0-3 480, 22.7-3 480, 24.0-3 480**

Are capable of meeting the following ride-through and trip settings:

Operating Region	Range (Hz)	Operating Mode	Duration (s)	
			Ride Through	Trip
OFR2	f > 64	Cease to Energize		0.1667
OFR1	63 < f < = 64	Ride Through	20	21
NORH	63 >= f > 60	Normal Operation	Indefinite	Indefinite
NORL	57 <= f < = 60	Normal Operation	Indefinite	Indefinite
UFR1	56 <= f < 57	Ride Through	20	21
UFR2	f < 56	Cease to Energize		0.01667

Operating Region	Range (%)	Operating Mode	Duration (s)	
			Ride Through	Trip
OVR2	V > 120	Cease to Energize		0.1667
OVR1	120 >= V > 110	Ride Through	.92	1
NORH	110 >= V > 100	Normal Operation	Indefinite	Indefinite
NORL	100 >= V >= 88	Normal Operation	Indefinite	Indefinite
UVR1	88 > V >= 70	Ride Through	20	21
UVR2	70 > V >= 50	Ride Through	20	21
UVR3	V < 50	Permissive Operation		0.5

Additionally, the inverters can meet Return to Service requirements of 60.1 ≥ f ≥ 59.9, 110 ≥ V ≥ 88 and 300 – 600s. The inverters can meet frequency ride-through requirements in the range of 55 – 65 Hz.

At a voltage drop down to 50% of the nominal voltage the inverter is capable of staying connected for at least 21 sec.

At a frequency drop down to 55 Hz the inverter is capable of staying connected for at least 20 sec. At a frequency rise of 65 Hz the inverter is capable of staying connected for at least 20 sec.

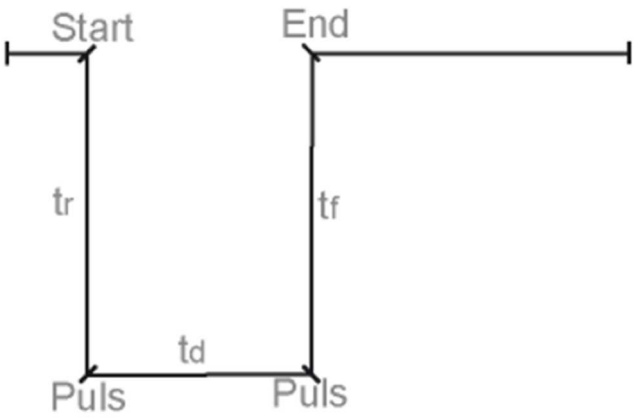
The trip limits of the inverter have to be set in a way not contradicting this behavior.

To demonstrate this behavior test results are shown in this certificate.

Test Data

Fronius has collected test data on representative samples of the Symo 12.0-3 208/240 and 24.0-3 480 to verify ride-through behavior based on voltage and frequency variation tests described as follows. Other Symo power classes were not tested as the hardware is the same as one of the two models tested (only peak power output differs).

Each test uses an AC grid simulator to achieve a step or ramp function depicted at right.



Voltage Ride-Through Test

Model: Fronius Symo 24.0-3 480 (Setup 480N)

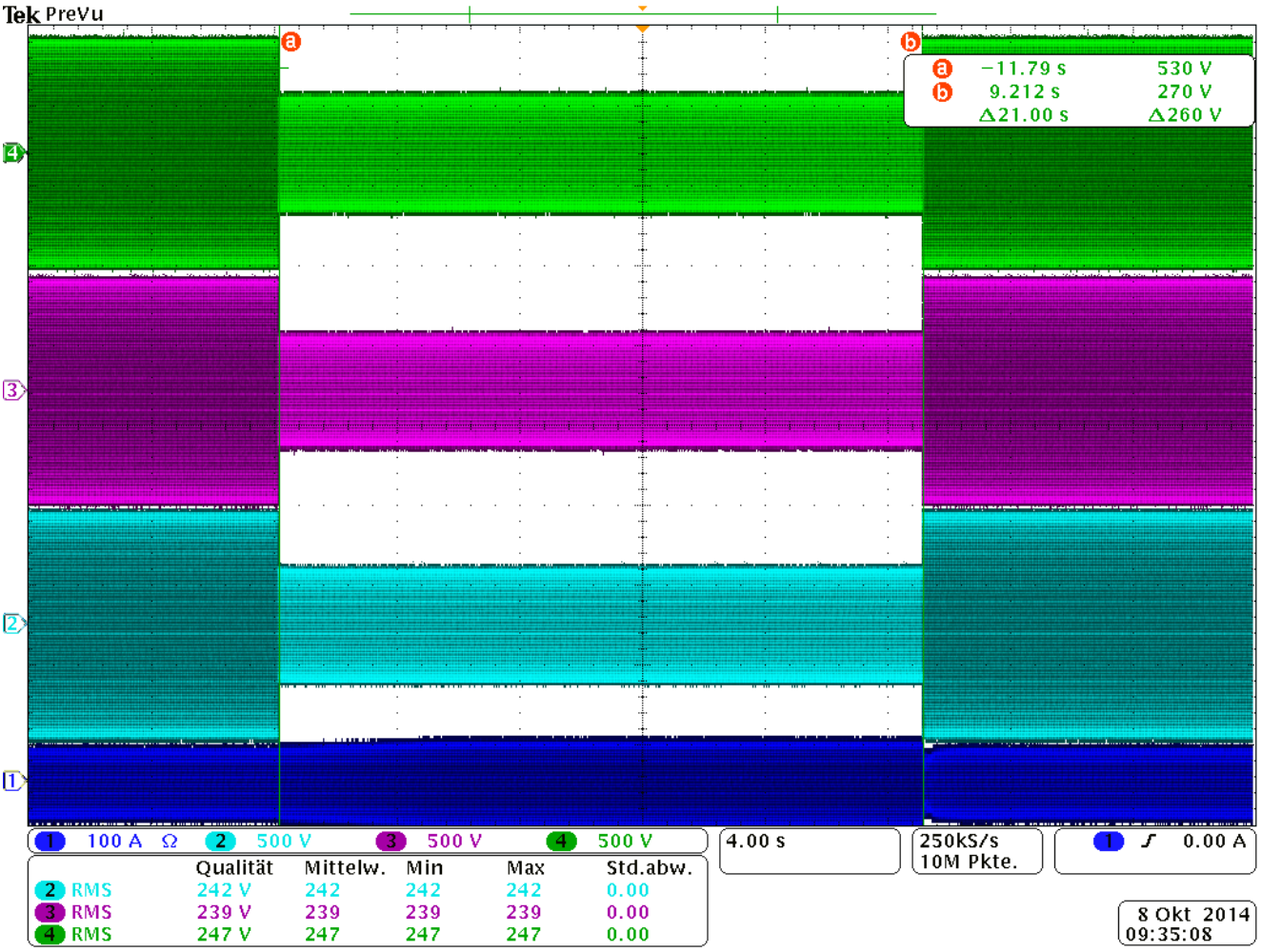
Test Conditions: 480VAC (phase to phase), 60Hz, 24000W output

Step:

Start: 480V (Phase to Phase) t_r: 0s
Pulse: 240V (Phase to Phase) t_d: 21s
End: 480V (Phase to Phase) t_f: 0s

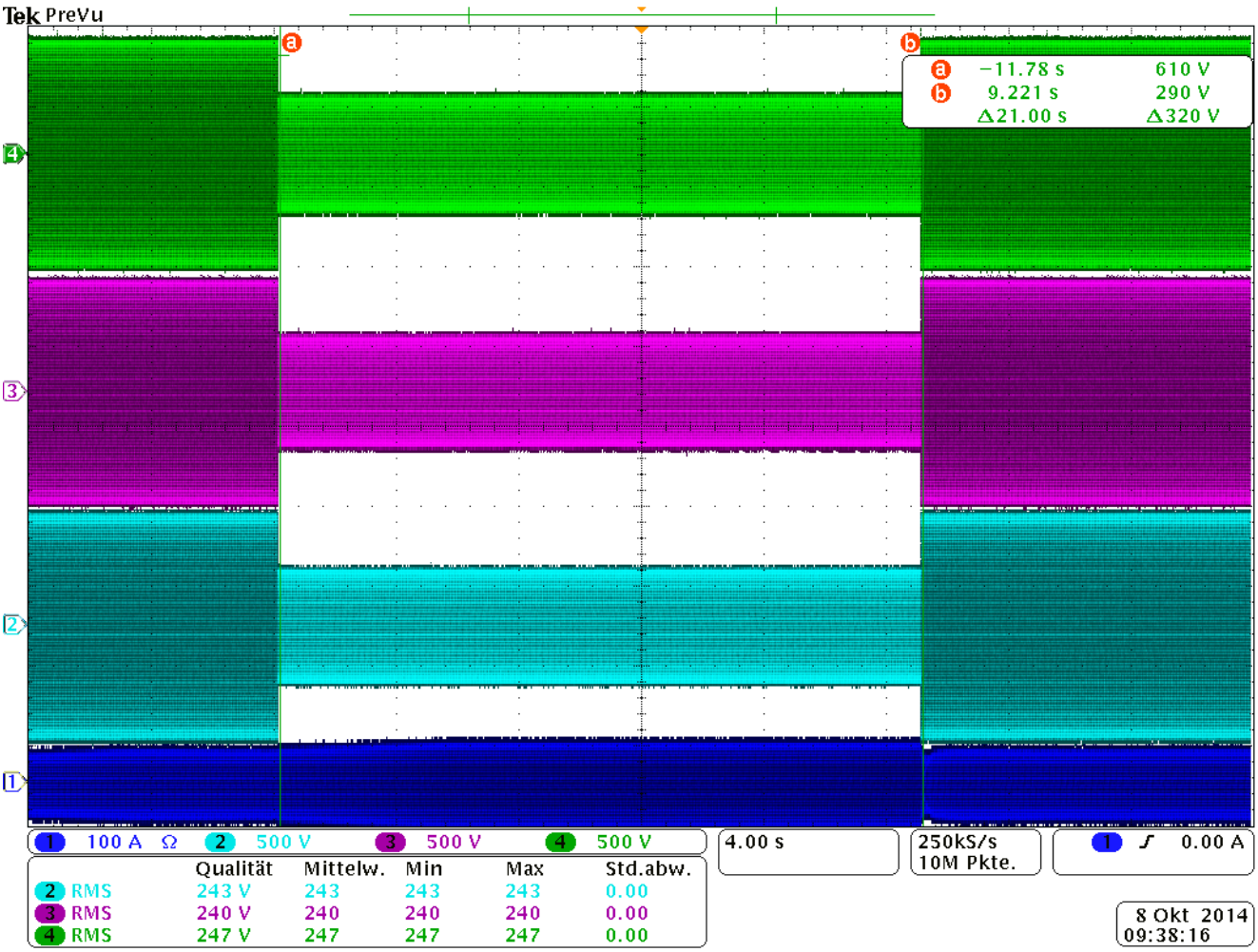
Oscillograms:

TEST 1



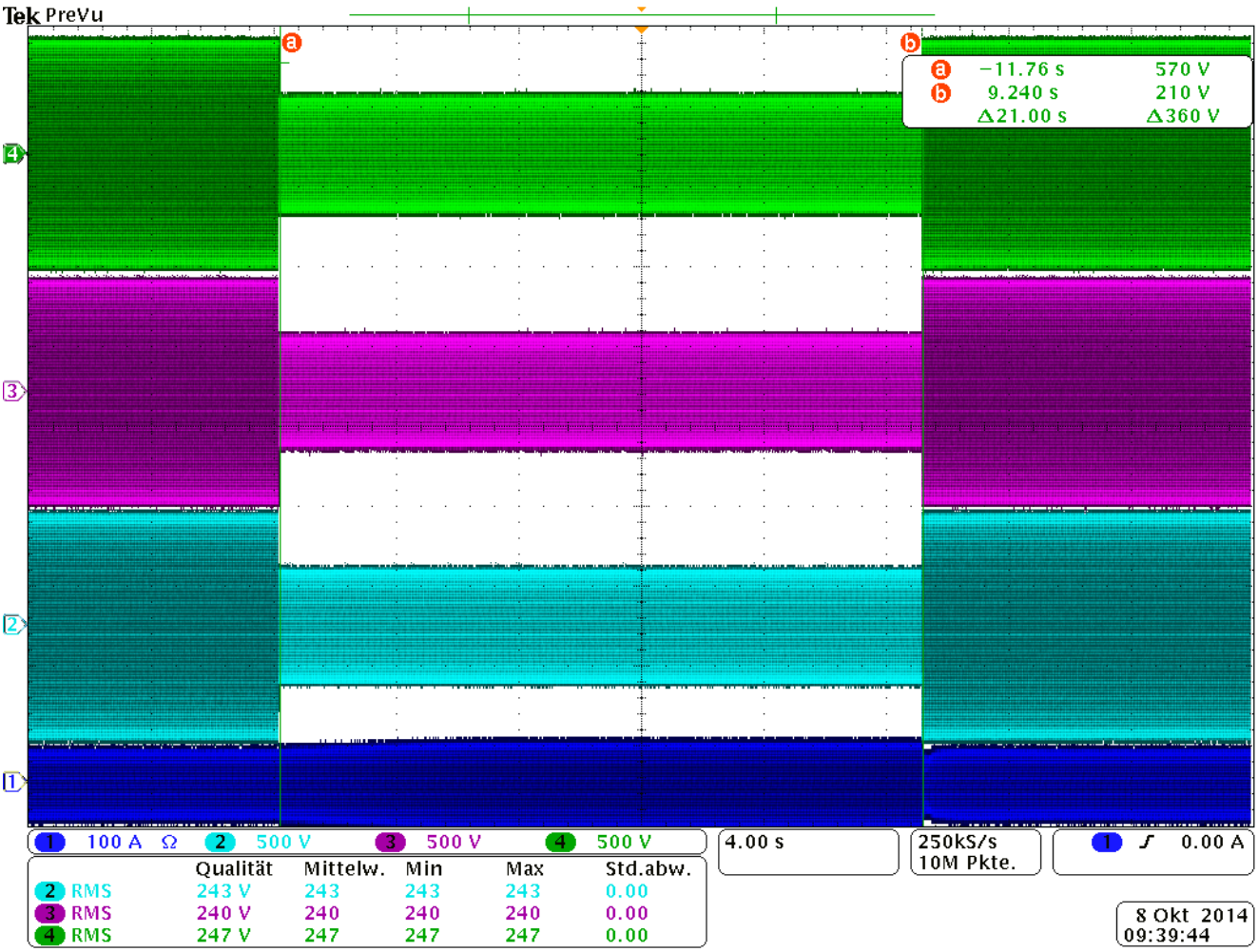
Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 2



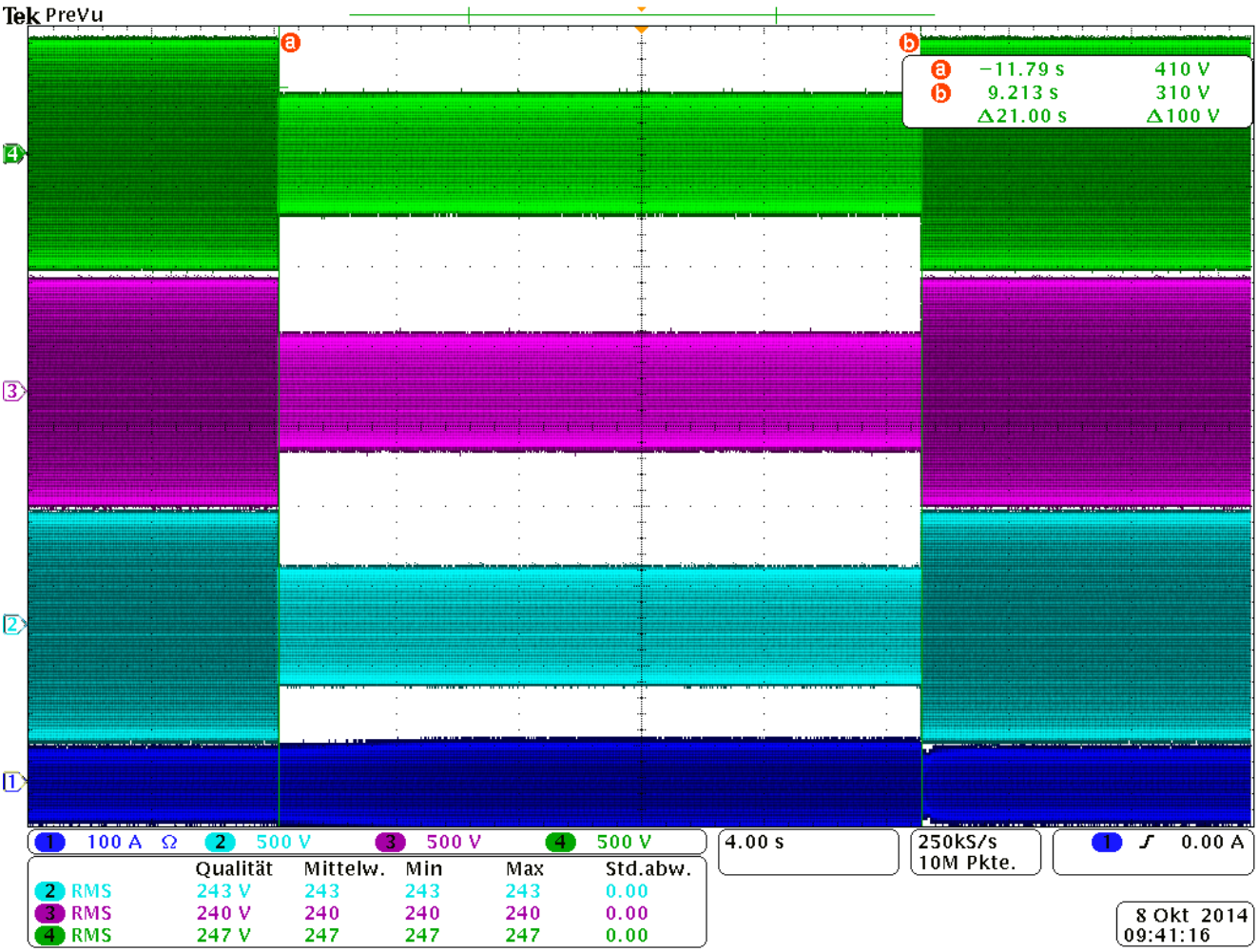
Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 3



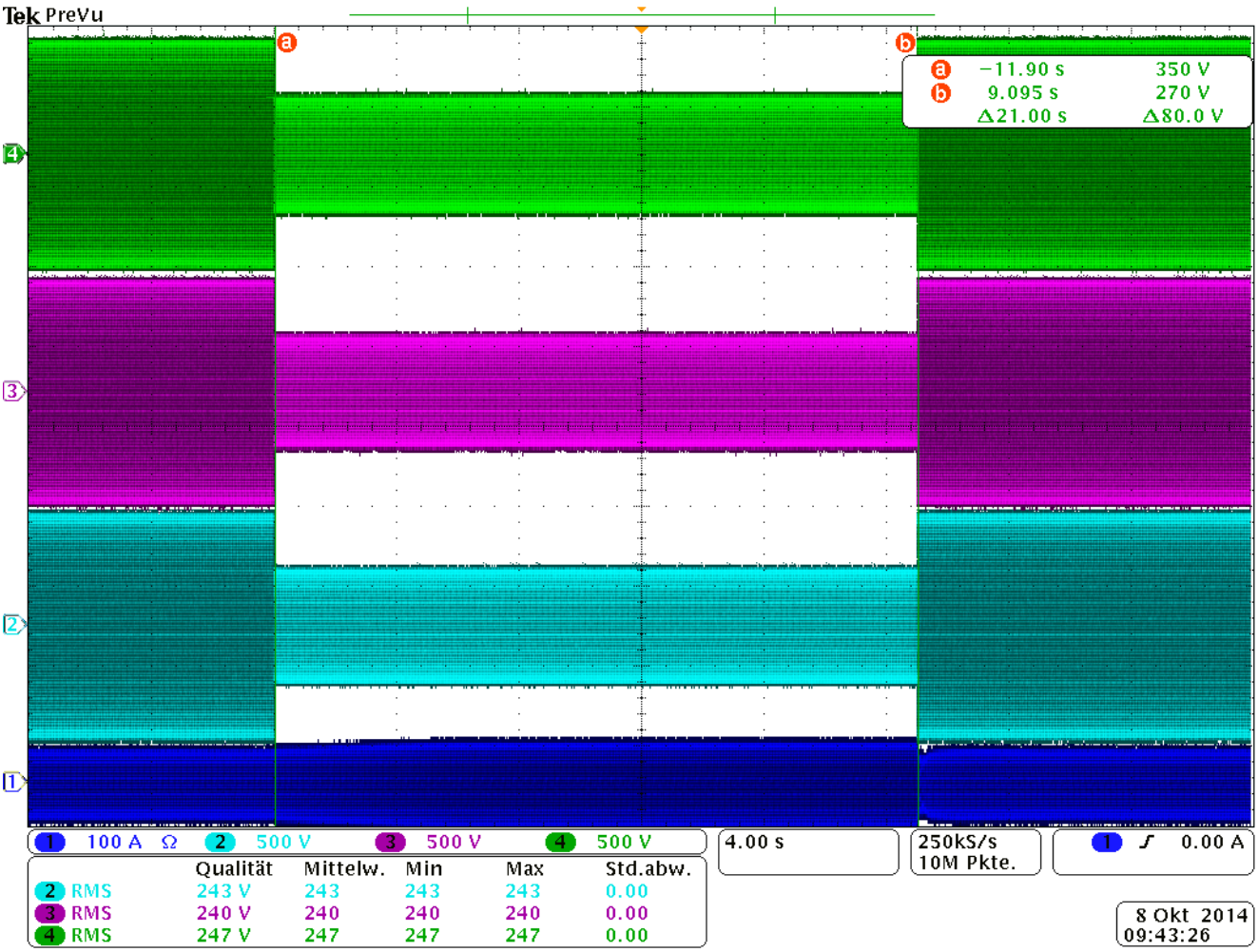
Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 4



Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 5



Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

Model: Fronius Symo 12.0-3 208/240 (Setup 208N)

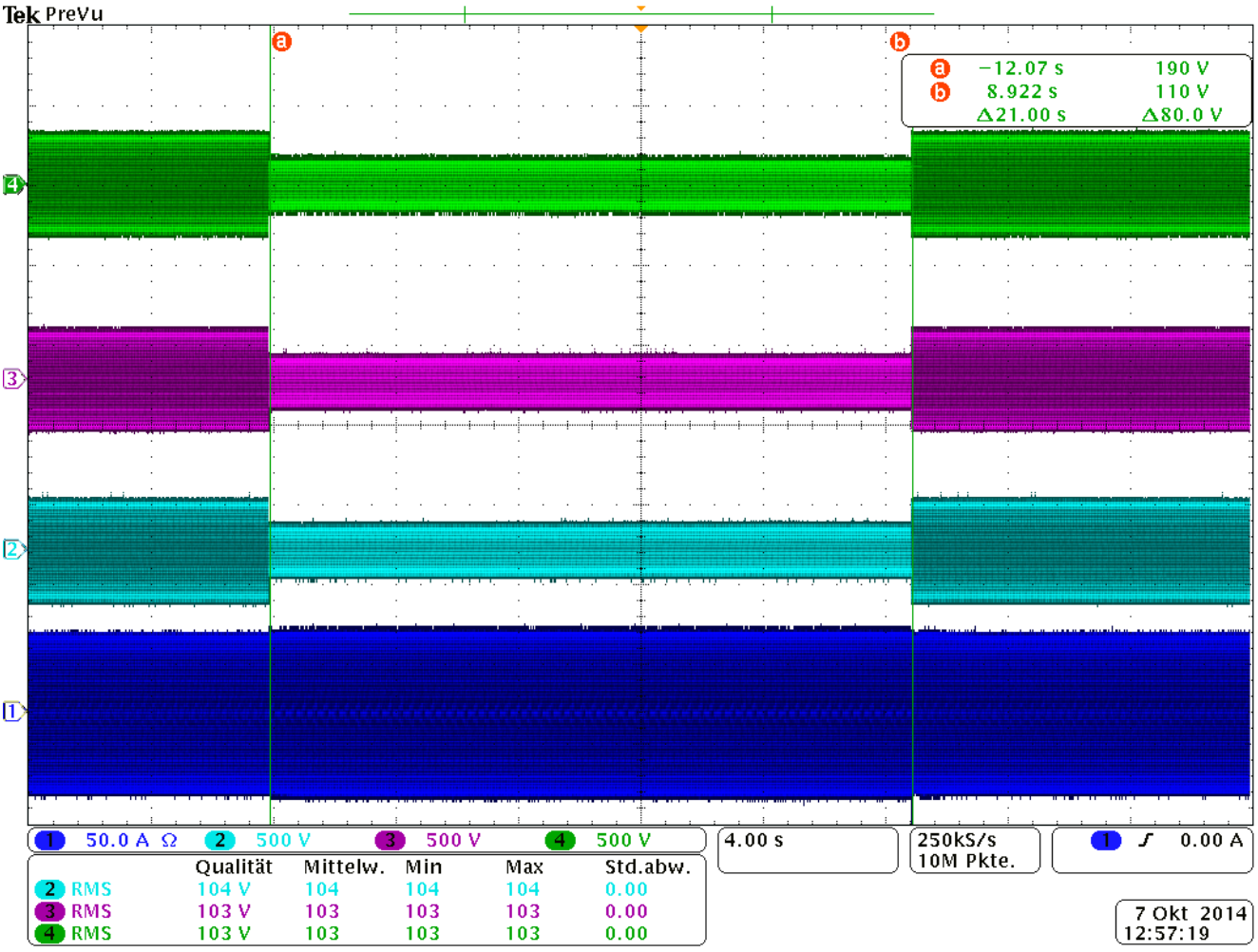
Test Conditions: 208VAC (phase to phase), 60Hz, 12000W output

Step:

Start: 208V (Phase to Phase) t_r: 0s
Pulse: 104V (Phase to Phase) t_d: 21s
End: 208V (Phase to Phase) t_f: 0s

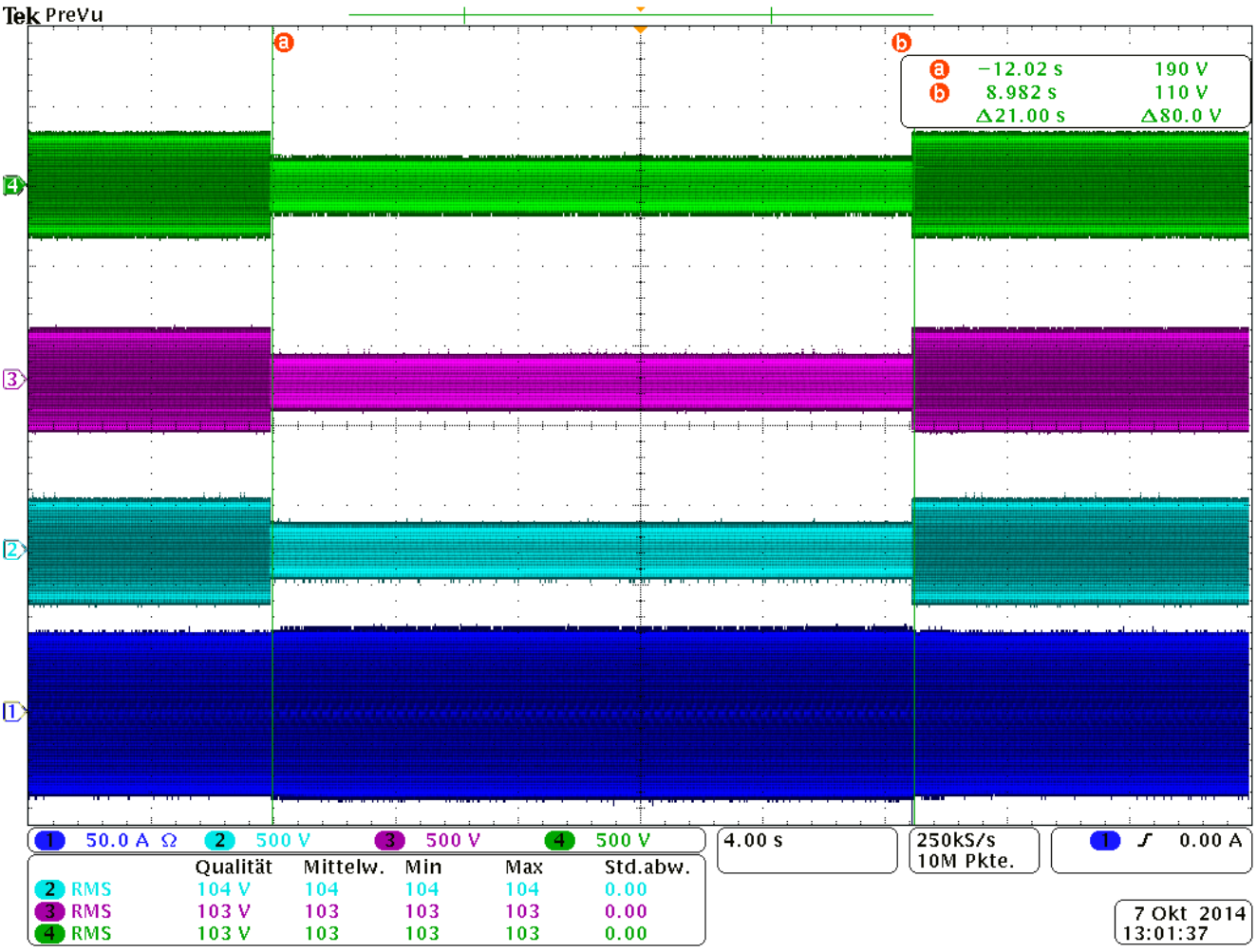
Oscillograms:

TEST 1



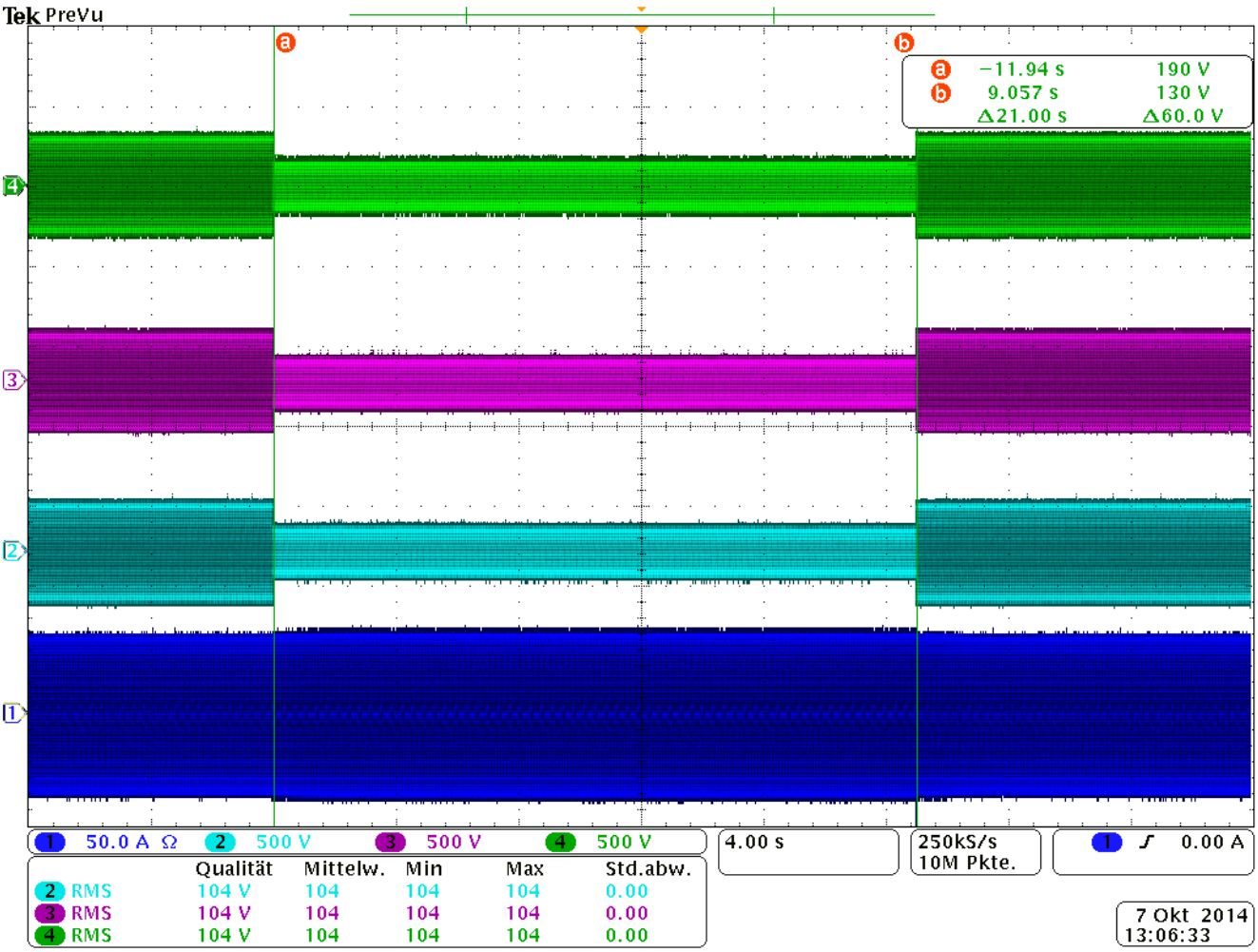
Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 2



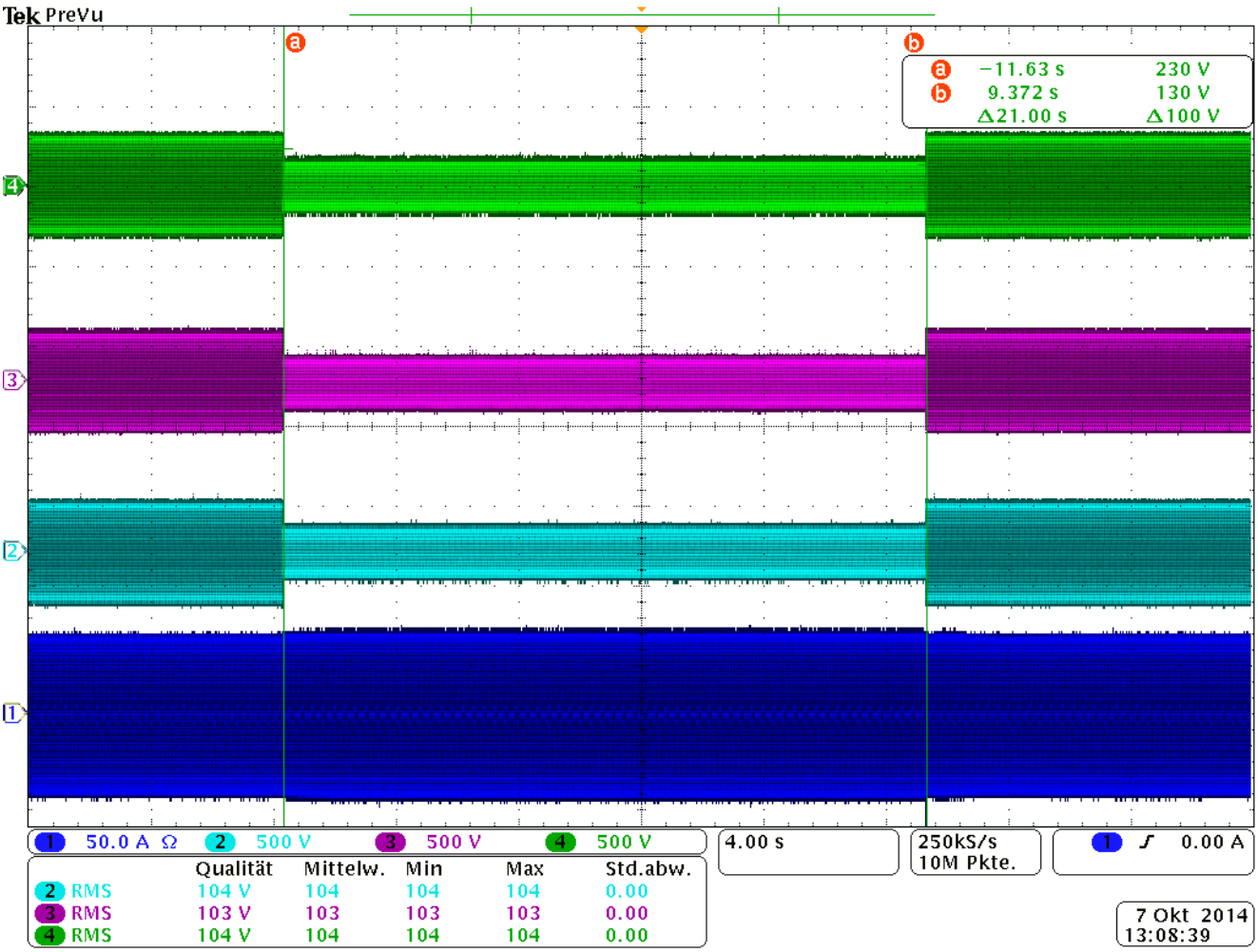
Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 3



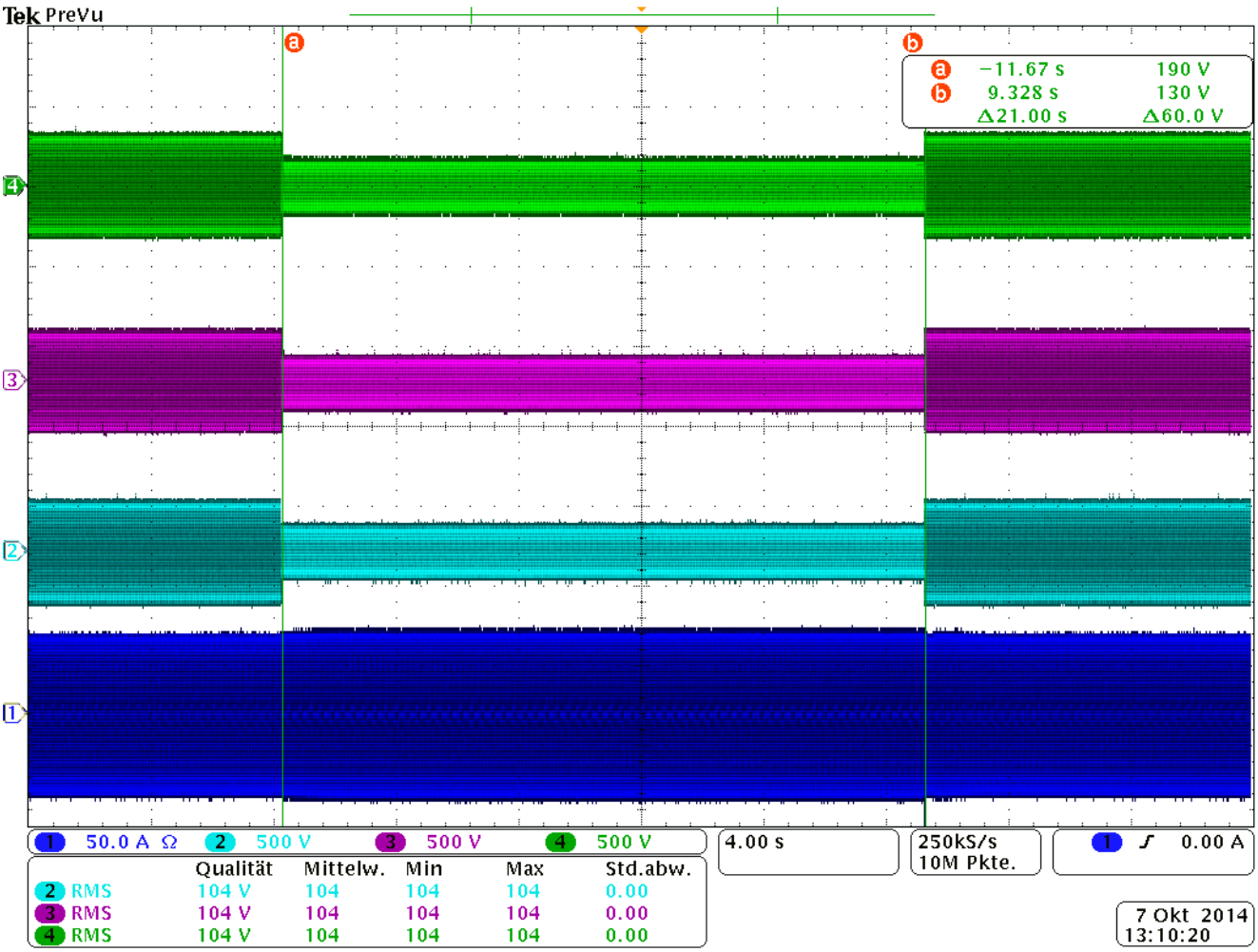
Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 4



Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 5



Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

Model: Fronius Symo 12.0-3 208/240 (Setup 240)

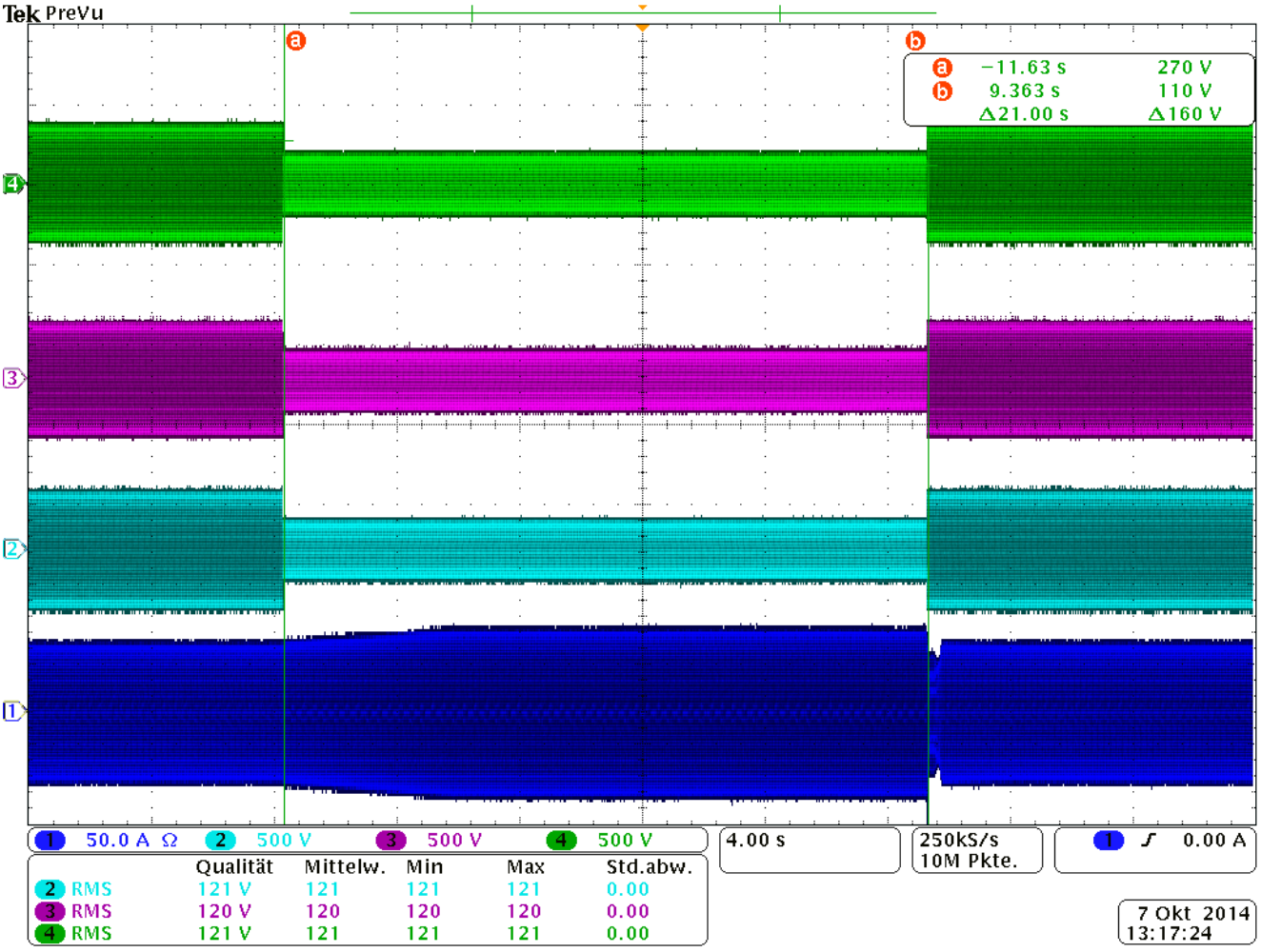
Test Conditions: 240VAC (phase to phase), 60Hz, 12000W output

Step:

Start: 240V (Phase to Phase) t_r: 0s
Pulse: 120V (Phase to Phase) t_d: 21s
End: 240V (Phase to Phase) t_f: 0s

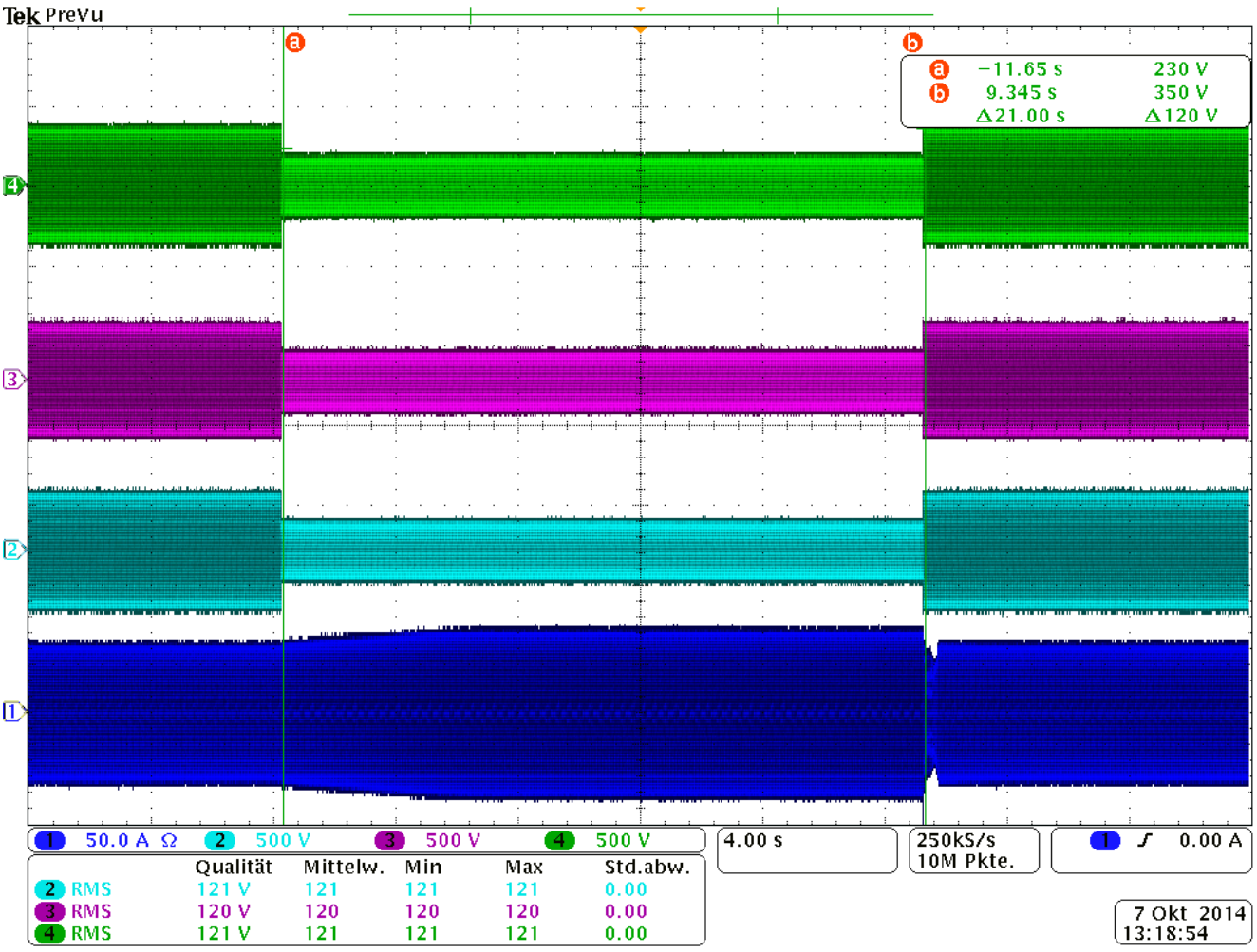
Oscillograms:

TEST 1



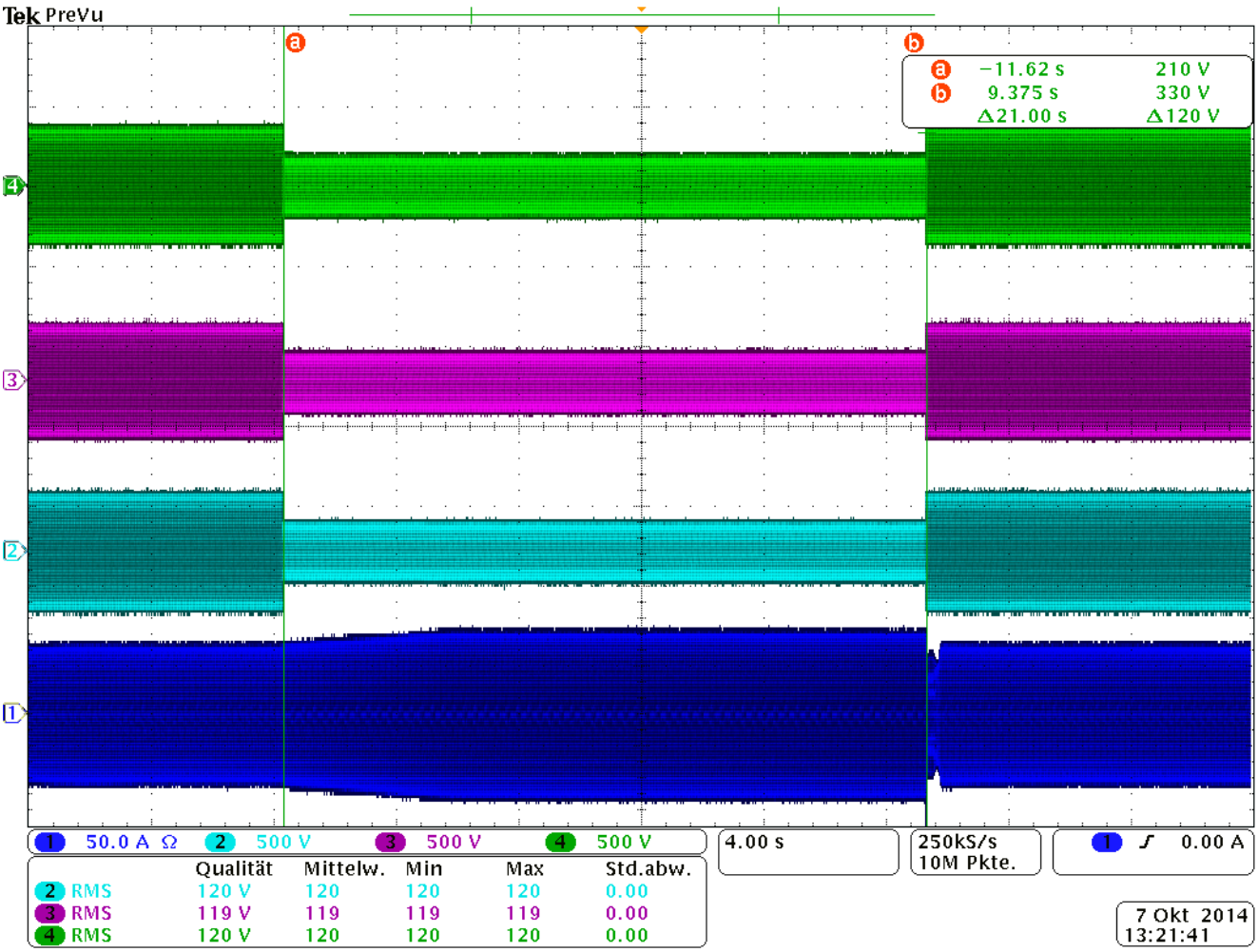
Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 2



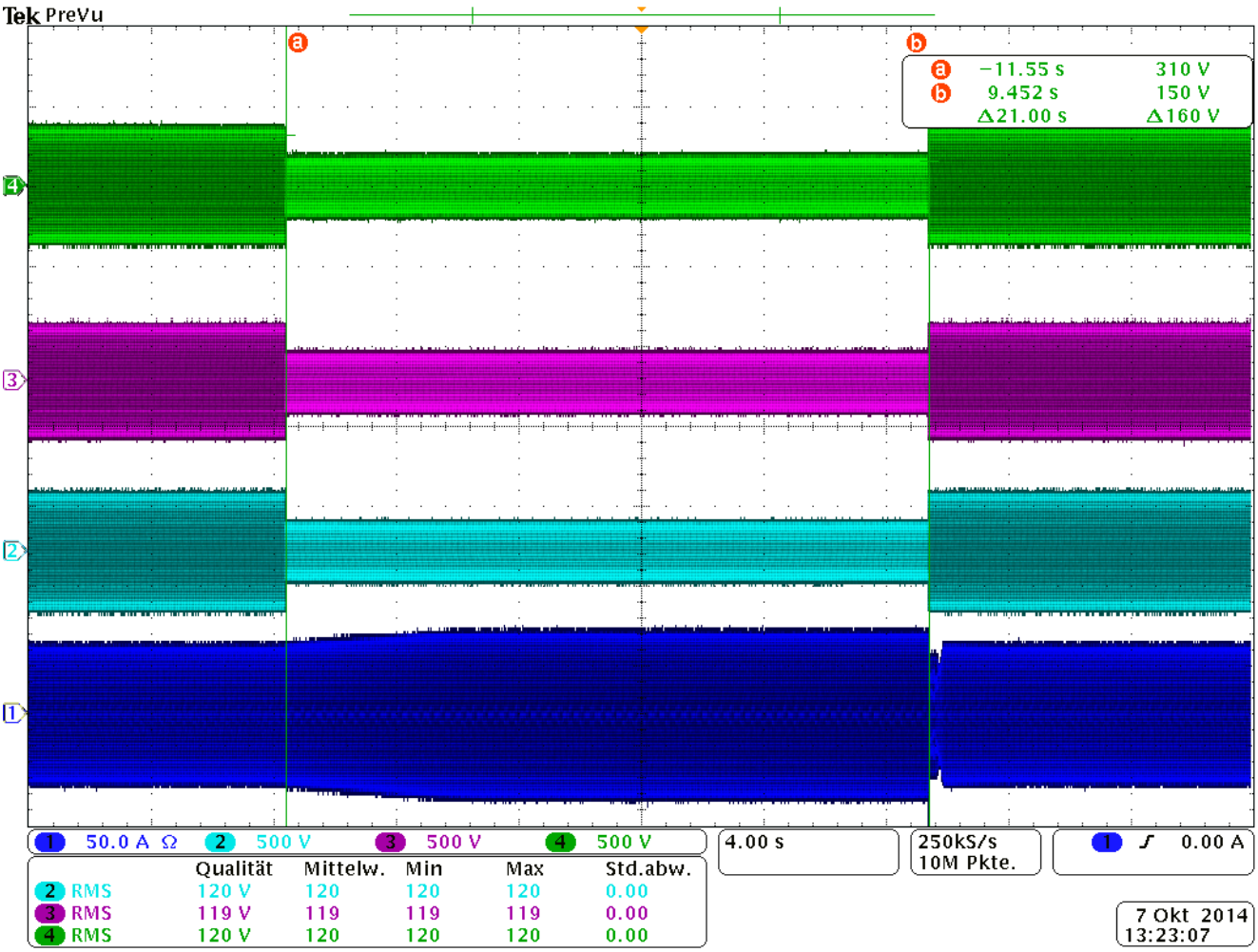
Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 3



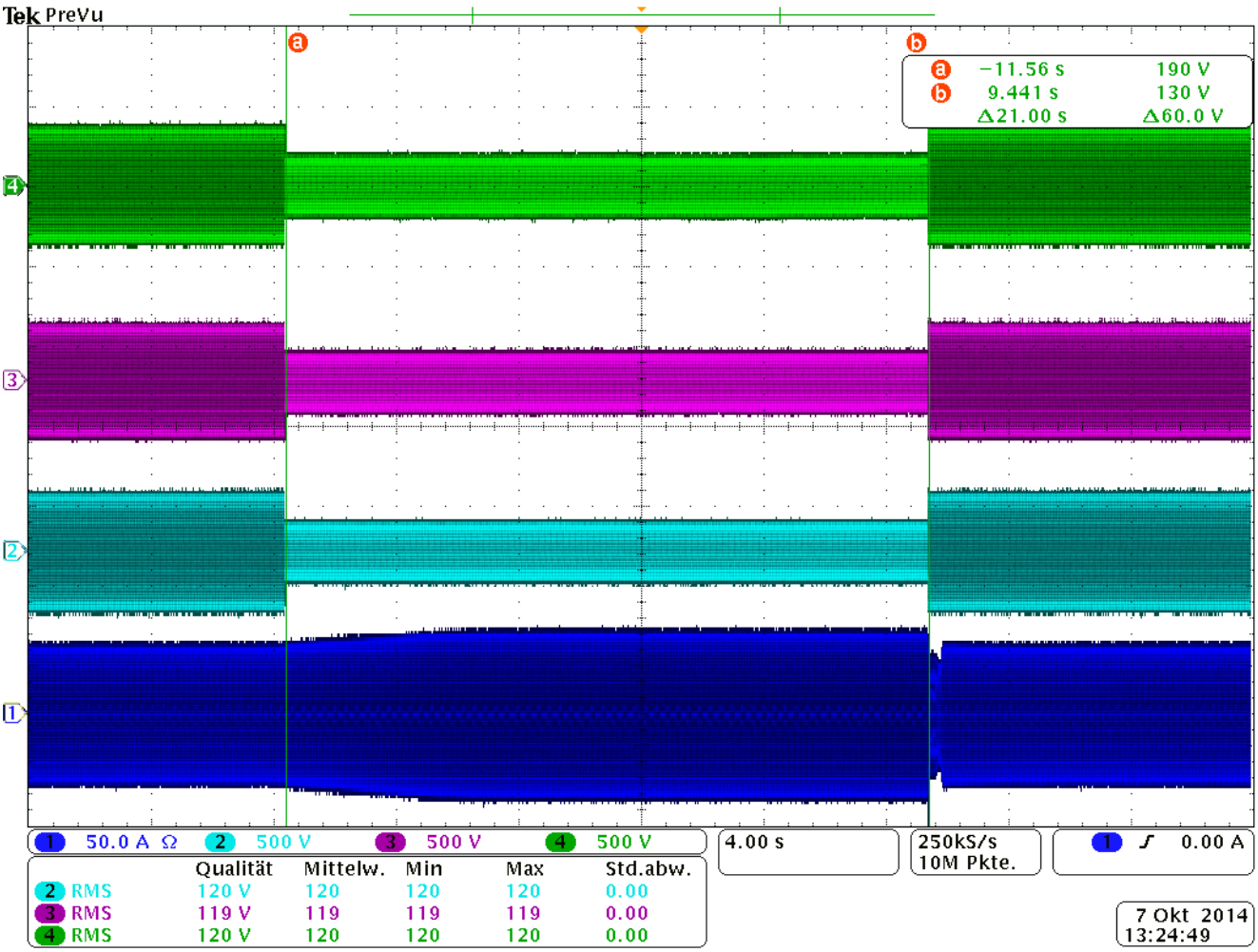
Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 4



Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

TEST 5



Chanel 1: Current on Phase 1
Chanel 2: Voltage Phase 1 to Phase 2
Chanel 3: Voltage Phase 2 to Phase 3
Chanel 4: Voltage Phase 3 to Phase 1

Conclusion:
After all tests both inverters did not stop feeding in but return to normal operation immediately. The requirements for a 50% Low Voltage Ride-Through are fulfilled.

High Frequency Ride-Through Test

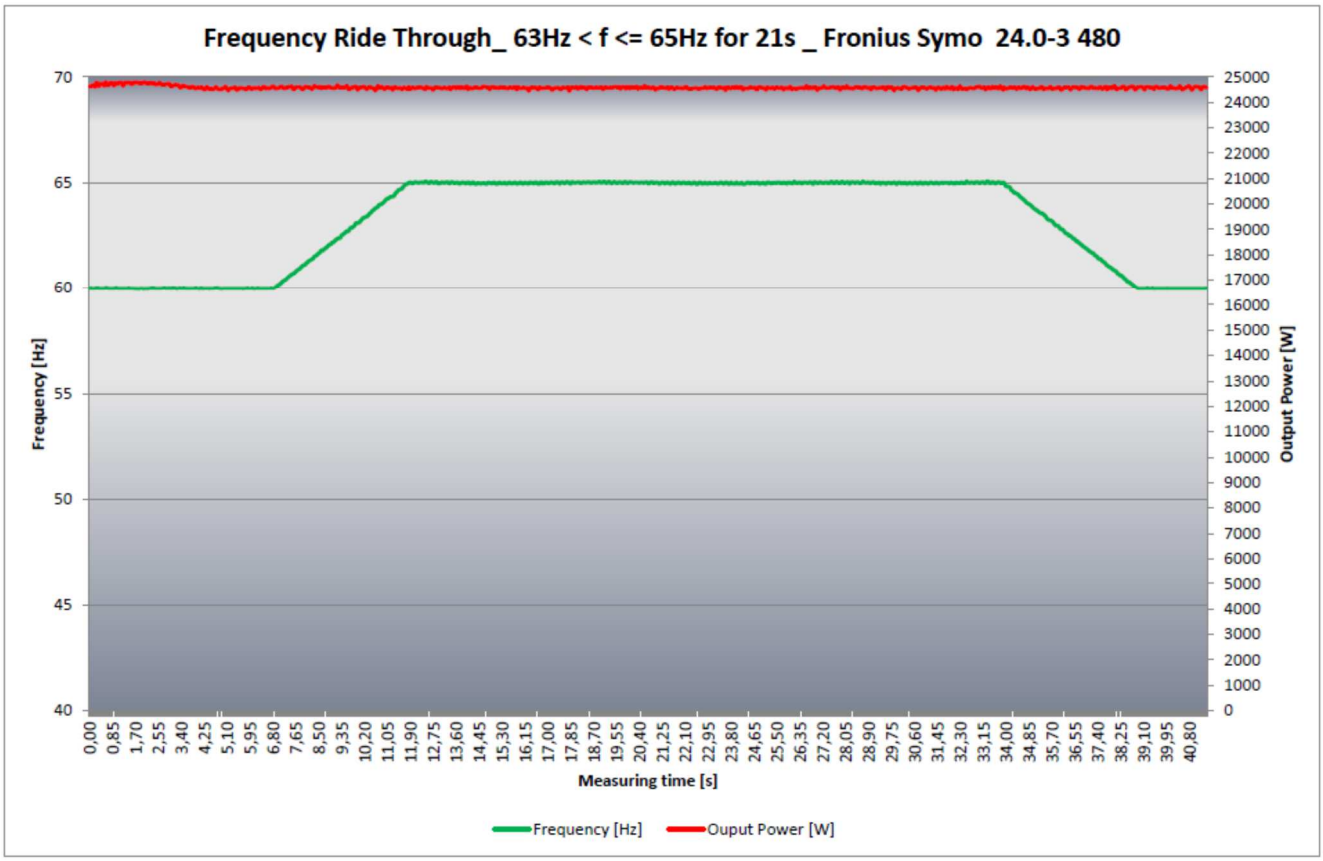
Model: Fronius Symo 24.0-3 480 (Setup 480N)

Test Conditions: 480VAC (phase to phase), 60Hz, 24000W output

Ramp:

Start: 60 Hz t_r: 5s
Pulse: 65 Hz t_d: 20s
End: 60 Hz t_f: 5s

Oscillogram:



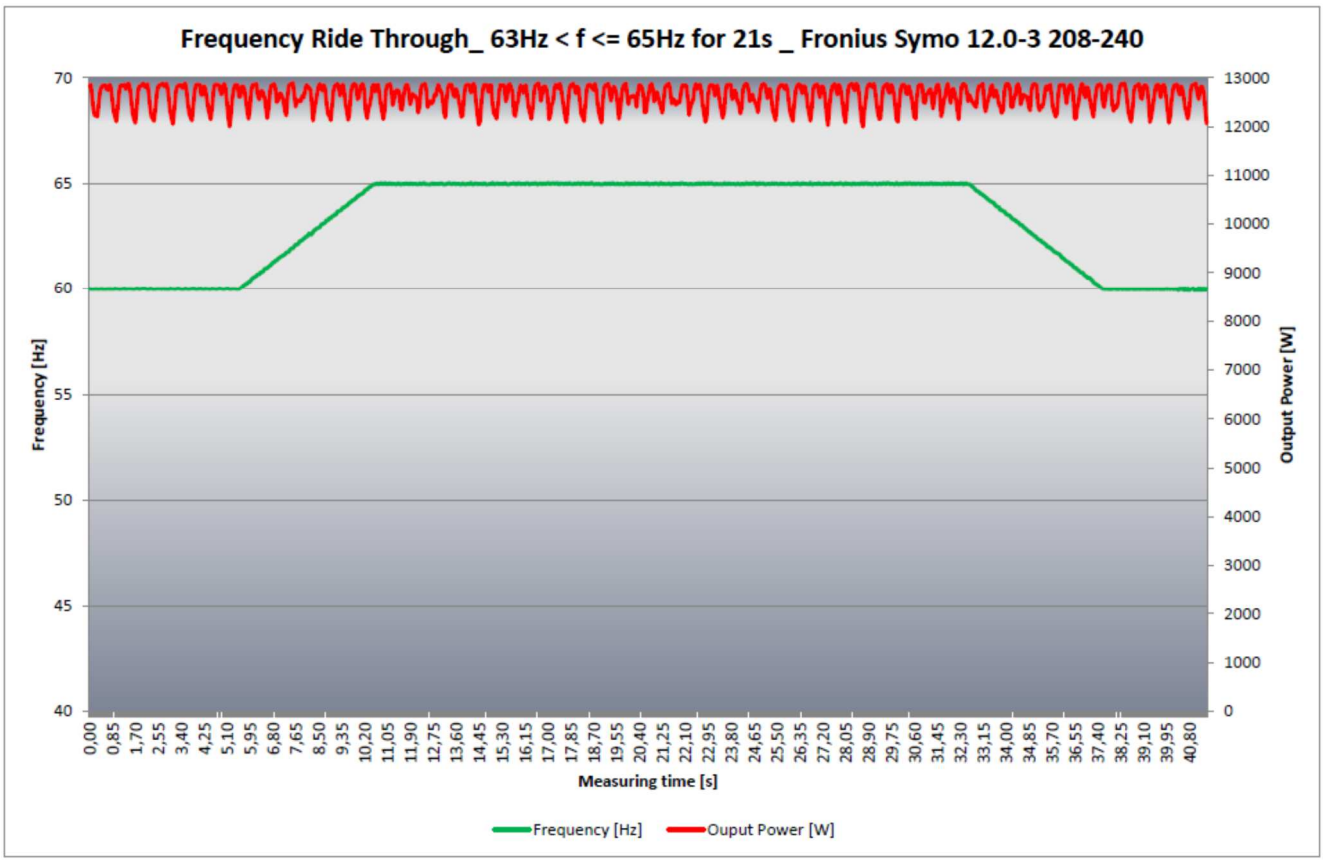
Model: Fronius Symo 12.0-3 208/240 (Setup 208N)

Test Conditions: 208VAC (phase to phase), 60Hz, 12000W output

Ramp:

Start: 60 Hz t_r: 5s
Pulse: 65 Hz t_d: 20s
End: 60 Hz t_f: 5s

Oscillogram:



Conclusion:
After all tests the inverters did not stop feeding in but maintain normal operation. The requirements for High Frequency Ride-Through are fulfilled.

Low Frequency Ride-Through Test

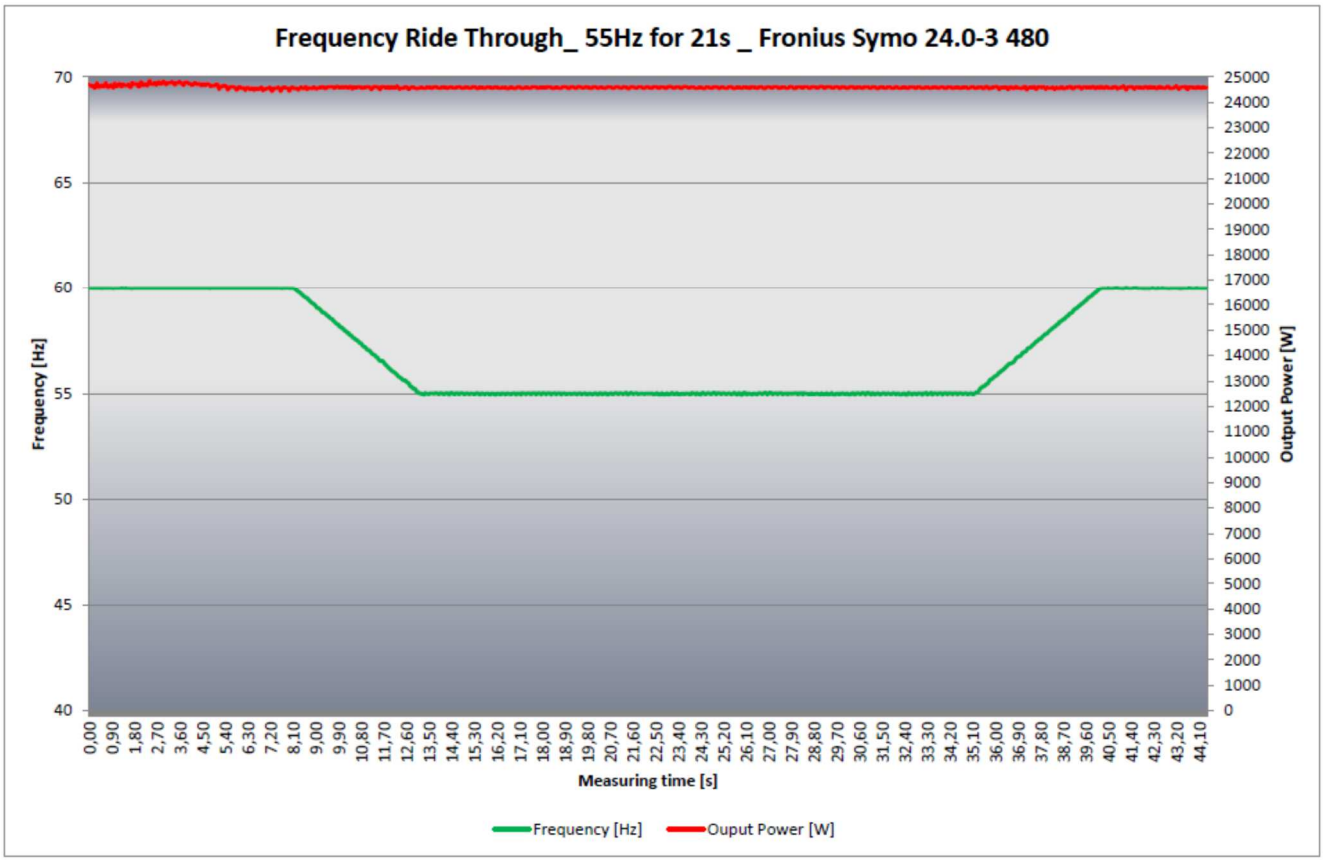
Model: Fronius Symo 24.0-3 480 (Setup 480N)

Test Conditions: 480VAC (phase to phase), 60Hz, 24000W output

Ramp:

Start: 60 Hz t_r: 5s
Pulse: 55 Hz t_d: 20s
End: 60 Hz t_r: 5s

Oscillogram:



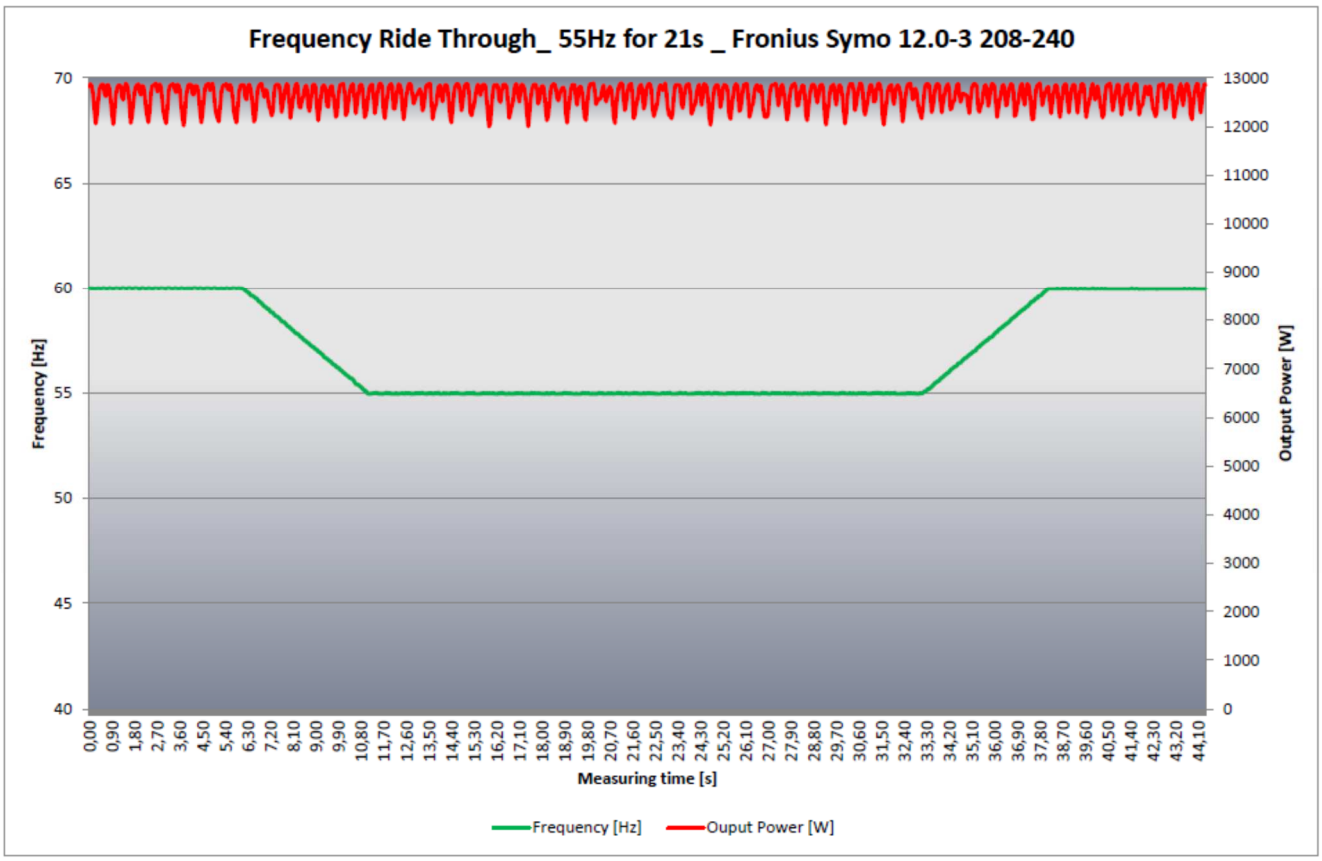
Model: Fronius Symo 12.0-3 208/240 (Setup 208N)

Test Conditions: 208VAC (phase to phase), 60Hz, 12000W output

Ramp:

Start: 60 Hz t_r: 5s
Pulse: 55 Hz t_d: 20s
End: 60 Hz t_f: 5s

Oscillogram:



Conclusion:
After all tests the inverters did not stop feeding in but maintain normal operation. The requirements for Low Frequency Ride-Through are fulfilled.

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