

FRT TESTING FOR THE VERIFICATION OF COMPLIANCE OF GRID CONNECTED POWER CONVERSION SYSTEM WITH:

**FGW TG3: DETERMINATION OF THE ELECTRICAL
CHARACTERISTICS OF POWER GENERATING UNITS
AND SYSTEMS, STORAGE SYSTEMS AS WELL FOR
THEIR COMPONENTS IN MV, HV AND EHV GRIDS.
(REV. 25 DATED ON 01/09/2018 + SUPPLEMENT 1 DATED
ON 22/01/2019)**

Procedure: PE.T-LE-62

Test Report Number: **2221 / 0124 – 1 - Att1 Rev0**
Type: **3 Phase Grid Connected PV Inverter**
Tested Model: **SG3125HV-30**
Variant Models: **SG3000HV-30 and SG3400HV-30**

APPLICANT

Name: **SUNGROW POWER SUPPLY CO., LTD.**
Address: **No.1699 Xiyou Rd., New & High Technology Industrial
Development Zone Hefei, Anhui 230088, P. R. China**

TESTING LABORATORY

Name: **SGS Tecnos, S.A. (Electrical Testing Laboratory)**
Address: **C/ Trespaderne, 29 - Edificio Barajas 1
28042 Madrid (Spain)**

Conducted (tested) by: **Michael Tong**
(Project Engineer)



Reviewed and Approved by: **Omar Kalim**
(Technical Reviewer)



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FRT test in FGW-TG3+SP1: Grid Fault Tests Results		

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1 SCOPE

SGS Tecnos, S.A. (Electrical Testing Laboratory) has been contracted by SUNGROW POWER SUPPLY CO., LTD. to perform 'RESPONSE DURING GRID FAULTS' testing according to FGW-TG3: Technical Guidelines for Power Generating Units and Systems. TG3 (Revision 25 Dated 01/09/2018 + Supplement 1 Dated 22/01/2019): Determination of Electrical Characteristics of Power Generating Units and Systems, Storage Systems as well for their Components in MV, HV and EHV grids.

The following standards are covered with testing of FGW-TG3 (Revision 25 Dated 01/09/2018) (*):

- VDE-AR-N 4110: 2018-11. Technical requirements for the connection and operation of customer installations to the medium voltage network (TAR medium voltage).
- VDE-AR-N 4120: 2018-11. Technical requirements for the connection and operation of customer installations to the high voltage network (TAR high voltage).

(*) As stated in chapter 11.2.1 of both covered standards.

This is an attachment to Test Report 2221/0124-1 that has been prepared to show the results for RESPONSE DURING GRID FAULTS test (clause 4.6 of the standard).

2 GENERAL INFORMATION

2.1 TESTING PERIOD AND CLIMATIC CONDITIONS

The necessary testing has been performed between the 25th of September of 2020 to 10th of November of 2020 and on 20th of March of 2021 and on 19th of August of 2021.

All the tests and checks have been performed at 25 ± 10 °C, $90 \text{ kPa} \pm 10 \text{ kPa}$ and $50 \%RH \pm 20 \%RH$.

SITE TEST

Name.....: Shanghai Testing & Inspection Institute for Electrical Equipment Co., Ltd

Address: 505 Wuning Road, Shanghai/358 North Huancheng Road, Shanghai, P.R. China

2.2 EQUIPMENT UNDER TESTING

Apparatus type: Grid Connected PV Inverter

Installation: 3 Phase ~ / Fixed installation

Manufacturer: SUNGROW POWER SUPPLY CO., LTD.

Trade mark.....: 

Model / Type reference: SG3125HV-30

Serial Number: A20B2902750

Software Version.....: LCD_SG3125HV-30_V1_A,
DSP_SG3125HV-30_V1_A

Rated Characteristics.....: Input: $1500 V_{dc}$ Max (875-1300 V_{dc} MPPT); 3997 A_{dc} Max
Output: 3~ 600 V_{ac} ; 50 Hz; 3007 A_{ac} (*) (3308 A_{ac} Max); 3125 KW (3437 kVA Max).
(*) The rated output current is calculated using rated voltage and power.

Date of manufacturing: 2020

Test item particulars

Input: DC

Output.....: 3~/PE

Class of protection against electric shock...: Class I

Degree of protection against moisture: IP65

Type of connection to the main supply: Three-phase – Fixed installation

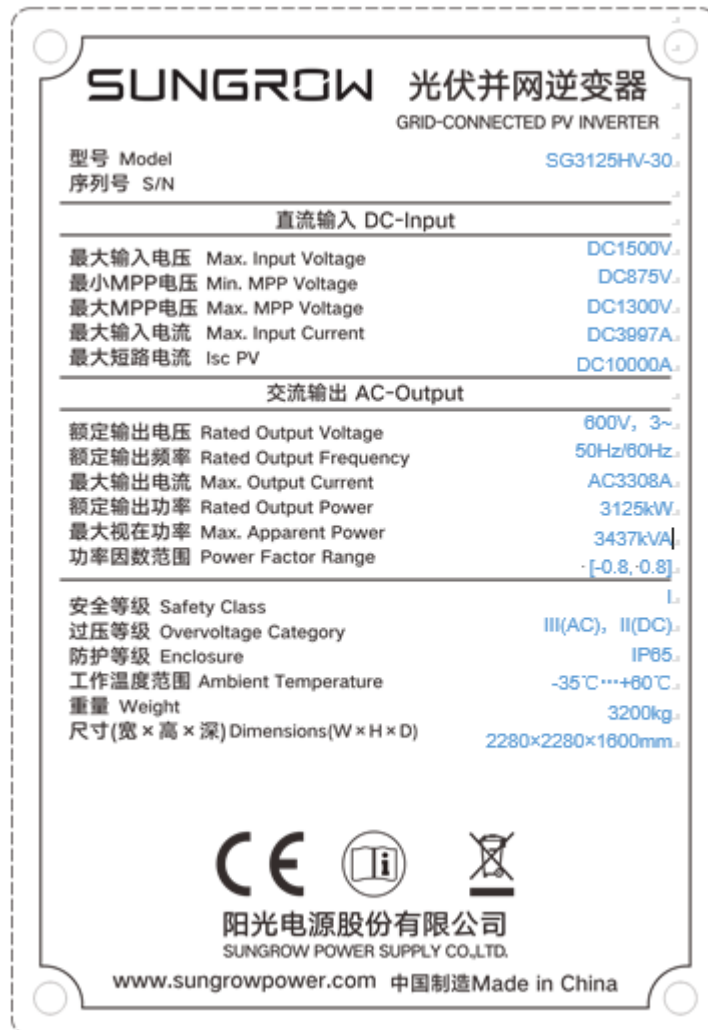
Cooling group.....: Forced ventilation (Fans)

Modular: Yes

Internal Transformer.....: No

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Copy of marking plate:



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 SG3125HV-30's except the parameters of rating.

Equipment under testing:

- SG3125HV-30

The variants models are:

- SG3000HV-30
- SG3400HV-30

Note: The EUT is composed of two same structure modules, only one module was tested in all tests. This corresponds with half of the rated power of the complete unit.

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The complete structure of two modules can be included in this test report without tests because the following features don't change regarding to results obtained over just one model:

- Same connection system and hardware topology.
- Same control algorithm.
- Output power within 1/√10 and 2 times of the rated output power or the EUT or Modular inverters.
- Same Firmware Version.

The results obtained apply only to the particular sample tested that is the subject of the present test report.

The most unfavorable result values of the verifications and tests performed are contained herein. Throughout this report a point (comma) is used as the decimal separator.

The parameters of the PV Inverter models are as following:

Product Model	SG3125HV-30	SG3000HV-30	SG3400HV-30
Input (DC)			
Max.DC Voltage	1500 V	1500 V	1500 V
MPPT Voltage Range	875-1300 V	875 -1300 V	875 - 1300 V
Max Input Current	3997 A	3500 A	3997 A
Max short-circuit Current (Isc)	10000 A	10000 A	10000 A
Output (AC)			
Max AC Output Power	3437 kVA	3000 kVA	3437 kVA
Max AC Output Current	3308 A	2887 A	3308 A
Rated AC Output Power	3125 kW	3000 kW	3437 kW
Rated AC Output Current	3007 A	2887 A	3308 A
Rated Grid Voltage	600 V (3 ~)	600 V (3 ~)	600 V (3 ~)
Rated Frequency	50 Hz	50 Hz	50 Hz
Power Factor	[-0.8, 0.8]	[-0.8, 0.8]	[-0.8, 0.8]
Operating Temperature Range	-35°C ~ 60°C	-35°C ~ 60°C	-35°C ~ 60°C
Degree of Protection	IP65	IP65	IP65
Protective Class	Class I	Class I	Class I

2.2.1 Reference Values

The values presented in the following table have been used for calculation of referenced values (p.u.; %) through the report.

Reference Values for the whole EUT	
Rated power, P_n in kW	3125
Rated apparent power, S_n in kVA	3125
Maximum power, P_{max} in kW	3437
Maximum apparent power, S_{max} in kVA	3437
Rated wind speed (only WT), v_n in m/s	N/A
Rated current (determined), I_n in A ⁽¹⁾	3007
Rated output voltage, (phase to phase) U_n in Vac	600
Rated output voltage, (Line to Neutral) U_n in Vac ⁽²⁾	346.4
Note: In this report p.u. values are calculated as follows: -For Active & Reactive Power p.u values are reference to P_n -For Currents p.u values, the reference is always I_n -For Voltages p.u values, the reference is always U_n	

Reference Values for the tested one module of the EUT	
Rated power, P_n in kW	1562.5
Rated apparent power, S_n in kVA	1562.5
Maximum power, P_{max} in kW	1718.5
Maximum apparent power, S_{max} in kVA	1718.5
Rated wind speed (only WT), v_n in m/s	N/A
Rated current (determined), I_n in A ⁽¹⁾	1503.5
Rated output voltage, (phase to phase) U_n in Vac	600
Rated output voltage, (Line to Neutral) U_n in Vac ⁽²⁾	346.4
Note: In this report p.u. values are calculated as follows: -For Active & Reactive Power p.u values are reference to P_n -For Currents p.u values, the reference is always I_n -For Voltages p.u values, the reference is always U_n	

⁽¹⁾ The rated output current is calculated using rated voltage and power.

⁽²⁾ Virtual neutral had been used to change 3/PE wiring to 3/N/PE wiring since limitation of the test bench.

2.3 TEST EQUIPMENT LIST

Owner	No.	EQUIPMENT	MARK/MODEL	S/N	CALIBRATION PERIOD
STIEE	1	Wave Recorder	Yokogawa / DL850E	91V809389	2019/11/27 to 2020/11/26 2020/11/04 to 2021/11/03
	2	Power Analyzer	Yokogawa / WT3000E	91W513917	2020/09/08 to 2021/09/07
	3	Power Analyzer	DEWE2-A7	B4190047-CHN	2019/11/15 to 2020/11/14
	4	Power Analyzer	DEWE2-A7	B419007-CHN	2020/09/29 to 2021/09/28
	5	Current Probe	Senshe / CHB-3KB/SP10	SS1907194D00 1	2019/10/28 to 2020/10/27 2020/11/03 to 2021/11/02
	6	Current Probe	Senshe / CHB-3KB/SP10	SS1907194D00 6	2019/10/28 to 2020/10/27 2020/11/03 to 2021/11/02
	7	Current Probe	Senshe / CHB-3KB/SP10	SS1907194D00 4	2019/10/28 to 2020/10/27 2020/11/03 to 2021/11/02
	8	Current Probe	Senshe / CHB-3KB/SP10	SS1907194D00 5	2019/11/15 to 2020/10/27 2020/11/03 to 2021/11/02
	9	Voltage Probe	Yokogawa / 701926	1905983	2019/11/14 to 2020/11/13 2020/10/28 to 2021/10/27
	10	Voltage Probe	Yokogawa / 701926	1905979	2019/11/14 to 2020/11/13 2020/11/03 to 2021/11/02
	11	Voltage Probe	Yokogawa / 701926	1905988	2019/11/14 to 2020/11/13 2020/10/28 to 2021/10/27
	12	Temperature Chamber	MEITAIKE / MHPW-192-DW	MT2019102501	2019/11/15 to 2020/11/14 2020/11/14 to 2021/11/13
	13	Temperature & Humidity meter	Shanghaiqixiang / HM10	090	2019/11/14 to 2020/11/13 2020/10/28 to 2021/10/27
SGS	14	Multimeter	Fluke / 289C	SHES500602	2020/06/12 to 2021/06/11 2021/06/06 to 2022/06/05
	--	Matlab function	SGS / RMS+POWER	DIE.001461-1	2019/02/15 to --
	--	Matlab function	SGS / VoltageChangeMeasures	DIE 001461-2	2019/02/15 to --
	--	Matlab function	SGS / Sequences	DIE 001461-3	2019/03/07 to --
	--	Matlab function	SGS / Static+MobileWindow	DIE 001461-4	2019/06/10 to --
	--	Matlab function	SGS / Parameter	DIE 001461-5	2019/02/14 to --
	--	Matlab function	SGS / Rise&SettlingTime	DIE 001461-6	2019/05/09 to --

Note:

1. All measurement equipment was used inside their corresponding calibration period. Copy of all calibration certificates are available at the laboratory for reference.
2. Since those Matlab functions are mathematical functions there is no need to establish a final calibration date.

2.4 MEASUREMENT UNCERTAINTY AND DATA SAMPLING RATES

Associated uncertainties through measurements showed in this this report are the maximum allowable uncertainties.

Magnitude	Uncertainty
Voltage measurement	±1.5 %
Current measurement	±2.0 %
Frequency measurement	±0.2 %
Time measurement	±0.2 %
Power measurement	±2.5 %
Phase Angle	±1°
Temperature	±3 °C
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.	

2.5 TEST SET UP

The test bench used includes:

Test bench Equipment	Trademark / Model	Serial number / ID	Characteristics
DC Source	ACTIONPOWER/ PVDS3-2.0K/2000C	DY18080090 DY18090103	2MW Per Unit
		DY18080093 DY18090102	
AC Source	ACTIONPOWER/ PVDS3-2.0K/2000C	PVAS3-331300/400C	1.3MVA Per Unit

Test bench requirements according to Annex D from the standard.

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

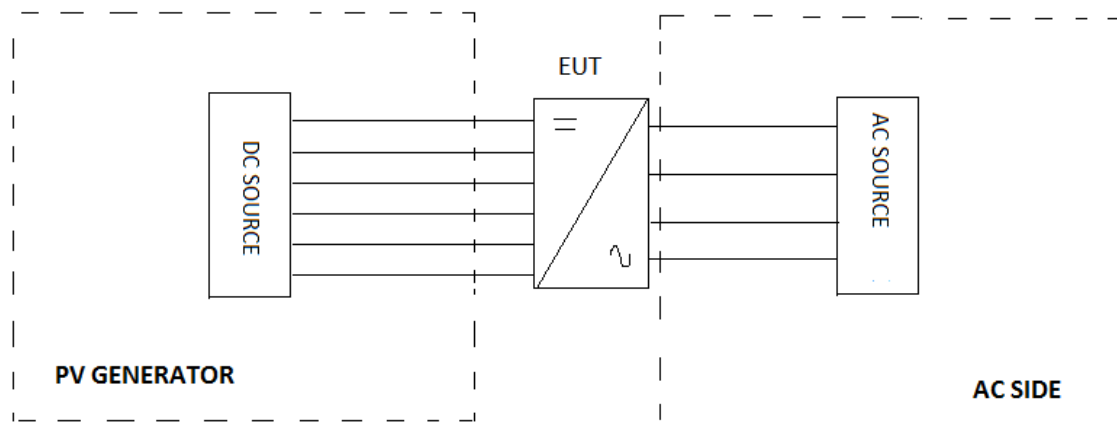
3 RESPONSE DURING GRID FAULTS

The aim of this test is to determinate whether the PGU is able to detect a voltage dip and to ride through this undamaged. This test has been done according to point 4.6 of the standard.

All the tests of this report have been performed with a deadband of $Un \pm 10 \%Un$. There is no command for negative sequence reactive current injection in any case.

The test has been carried out using a short circuit simulator which automatically adjusts the value of the series impedances and shot circuit impedances in order to obtain the type of fault configured for each test.

At the electric scheme below, it can be seen the connection configuration for this test, all the faults were simulated at the AC source.



In the page below it is provided a table with the test conditions based on the table 4-688 and 4-69 of the FGW-TG3 standard.

The signals definitions for all the diagrams shown in the report are provided below.

- R Voltage: Instantaneous phase-to-neutral voltages (phases 1-2).
- S Voltage: Instantaneous phase-to-neutral voltages (phases 2-3).
- T Voltage: Instantaneous phase-to-neutral voltages (phases 3-1).
- R Current: Instantaneous phase current (phase 1).
- S Current: Instantaneous phase current (phase 2).
- T Current: Instantaneous phase current (phase 3).
- RS RMS Voltage: RMS phase-to-phase voltage as moving averages over 20 ms (phases 1-2).
- ST RMS Voltage: RMS phase-to-phase voltage as moving averages over 20 ms (phases 2-3).
- TR RMS Voltage: RMS phase-to-phase voltage as moving averages over 20 ms (phases 3-1).
- RS RMS Current: RMS phase current as moving averages over 20 ms (phase 1).
- ST RMS Current: RMS phase current as moving averages over 20 ms (phase 2).
- TR RMS Current: RMS phase current as moving averages over 20 ms (phase 3).
- U+: Positive sequence voltage in per unit values.
- IQ+: Positive sequence reactive current.
- IP+: Positive sequence active current.
- P+: Positive sequence active power as moving averages over 20 ms.
- Q+: Positive sequence reactive power as moving averages over 20 ms.
- U-: Negative sequence voltage in per unit values.
- IQ-: Negative sequence reactive current.
- IP-: Negative sequence active current.
- P-: Negative sequence active power as moving averages over 20 ms.
- Q-: Negative sequence reactive power as moving averages over 20 ms.

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Results are exposed in tables below, each table results are divided in different groups of information: General Information, Before t1, From t1 to t2 and after t2.

For voltage results it is necessary to point out that Total values are referred to real RMS measured values; in case of asymmetrical faults, Total refers to the average value of the 2 phases where the voltage dip has been applied.

For calculating the K factors of the rise and settling times, the voltage dip depth for two-phase faults and three-phase faults is determined from the voltages in the positive and negative phase sequence systems over a period of time from 100 ms after fault occurrence until 20 ms before fault clearance.

Remaining phase-to-phase voltage [p.u.]	Fault type	Fault duration compliant with ⁽¹⁾ :		Load	Reactive power Q/Pn	K	Test no.			
		VDE-AR-N-4110 [ms]	VDE-AR-N-4120 VDE-AR-N-4130 [ms]							
≤ 0.05	Three phase	Not required	≥ 150 (for U=0) ≥ 318 (for U=0.05)	Full load	0 % - ±10 %	K = 2	0.1			
				Partial load			0.2			
	Two phase		≥ 220 (for U=0) ≥ 406 (for U=0.05)	Full load			0.3			
				Partial load			0.4			
0.20 – 0.30	Three phase	≥ 354 (for U=0.2) ≥ 760 (for U=0.3)	≥ 821 (for U=0.2) ≥ 1156 (for U=0.3)	Full load	0 % - ±10 %	K = 2	25.1			
				Partial load			25.2			
		Optional: Test sequence for multiple faults: Duration: 140 - 160 Pause: 300 - 2000 Duration: 550 - 600 Pause: 20 s - 30 s Duration: 950 - 1050 Pause: 20 s - 30s Duration: 140 - 160 Pause: 300 - 2000 Duration: 950 – 1050		P>0.7Pn			25.3			
	Two phase	≥ 452 (for U=0.2) ≥ 915 (for U=0.3)	≥ 962 (for U=0.2) ≥ 1332 (for U=0.3)	Full load				25.4		
				Partial load				25.5		
	0.45 - 0.60	Three phase	≥ 1371(for U=0.45) ≥ 1982 (for U=0.6)	≥ 1659 (for U=0.45) ≥ 2162 (for U=0.6)			Full load	0 % - ±10 %	K = 2	50.1
							Partial load			50.2
Two phase		≥ 1610 (for U=0.45) ≥ 2305 (for U=0.6)	≥ 1888 (for U=0.45) ≥ 2444 (for U=0.6)	Full load	50.3					
				Partial load	50.4					
Three phase		≥ 1371 (for U=0.45) ≥ 1982 (for U=0.6)	-	Full load	0 % - ±10 %	K = 2	50.5 ₍₂₎			
Two phase		≥ 1610 (for U=0.45) ≥ 2305 (for U=0.6)	-	Full load	0 % - ±10 %	K = 2	50.6 ₍₂₎			
0.70 – 0.80	Three phase	≥ 2389 (for U=0.7) ≥ 2796 (for U=0.8)	≥ 2498 (for U=0.7) ≥ 2833 (for U=0.8)	Full load	0 % - ±10 %	K = 2	75.1			
				Partial load	0 % - ±10 %		75.2			
					Max.underexcited		75.3			
					Max.overexcited		75.4			
	(P>0.1Pn)	0 % - ±10 %	K = 4	75.5						
	Two phase	≥ 2764 (for U=0.7) ≥ 3000 (for U=0.8)	≥ 2815 (for U=0.7) ≥ 3000 (for U=0.8)	Full load	0 % - ±10 %	K = 2	75.6			
				Partial load			75.7			
(P>0.1Pn)		K = 4	75.8							
0.75 – 0.85	Three phase	≥ 2593 (for U=0.75) ≥ 3000 (for U=0.85)	-	Full load	0 % - ±10 %	K = 2	80.1 ₍₂₎			
		≥ 3000			≤ 0.1	K = 0	80.2 ₍₂₎			
0.85 – 0.90	Three phase	≥ 60000 s		(P>0.1Pn)	0 % - ±10 %	K = 2	85.1			

⁽¹⁾ Only VDE-AR-N-4110 and VDE-AR-N-4120 have been evaluated in this report.

⁽²⁾ These cases were performed under Limited dynamic grid support function activated: Active and reactive current component = 0 A, max. feed-in of an apparent current of 10% In.

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Remaining phase-to-phase voltage [p.u.]	Fault type	Fault duration compliant with ⁽¹⁾ :			Load	Reactive power Q/Pn	K	Test no.
		VDE-AR-N-4110 [ms]	VDE-AR-N-4120 [ms]	VDE-AR-N-4130 [ms]				
Increase by ≥ 0.1 to a value > 1.10	Three phase	≥ 5000			Full load	0 % - ± 10 %	K = 2	115.1
					Partial Load			115.2
Rise by ≥ 0.1 to a value ≥ 1.10 as largest external conductor voltage	Two phase	≥ 5000			Full load	0 % - ± 10 %	K = 2	110.1
					Partial Load			110.2
> 1.10	Three phase	≥ 60000			(P>0.1Pn)	0 % - ± 10 %	K = 2	110.3
From around 1.05 to ≥ 1.10	Two phase	-	-	≥ 5000	(P>0.1Pn)	0 % - ± 10 %	K = 4	110.4 ⁽³⁾
From around 1.05 to ≥ 1.10	Three phase	-	-	≥ 5000	(P>0.1Pn)	0 % - ± 10 %	K = 4	115.1 ⁽³⁾

⁽¹⁾ Only VDE-AR-N-4110 and VDE-AR-N-4120 have been evaluated in this report.

⁽²⁾ These cases were performed under Limited dynamic grid support function activated: Active and reactive current component = 0 A, max. feed-in of an apparent current of 10% I_n.

⁽³⁾ These two tests are only required for VDE-AR-N 4130 and have been eliminated in Supplement 1.

Additionally, the following conditions have been used for identifying the different FRT cases when occurrence of an abrupt voltage change (the manufacturer parameters settings are same with the standard required, tolerance band of at least 5 %):

Abrupt voltage change voltage [p.u.]	Fault type	Fault duration compliant with ⁽¹⁾ :		Load	Reactive power Q/Pn	K	Test no.
		VDE-AR-N-4110 [ms]	VDE-AR-N-4120 VDE-AR-N-4130 [ms]				
≥ 0.05 (from 0.95 to 1.05)	Three phase	-	-	No load	0 % - ± 10 %	K = 2	95.0
≥ 0.05 (from 0.95 to 1.05)	Three phase	-	-	Full load	0 % - ± 10 %	K = 2	95.1
≥ 0.05 (from 0.95 to 1.05)	Three phase	-	-	Partial Load	0 % - ± 10 %	K = 2	95.2
≥ 0.05 (from 1.05 to 0.95)	Three phase	-	-	No load	0 % - ± 10 %	K = 2	105.0
≥ 0.05 (from 1.05 to 0.95)	Three phase	-	-	Full load	0 % - ± 10 %	K = 2	105.1
≥ 0.05 (from 1.05 to 0.95)	Three phase	-	-	Partial Load	0 % - ± 10 %	K = 2	105.2

⁽¹⁾ Only VDE-AR-N-4110 and VDE-AR-N-4120 have been evaluated in this report.

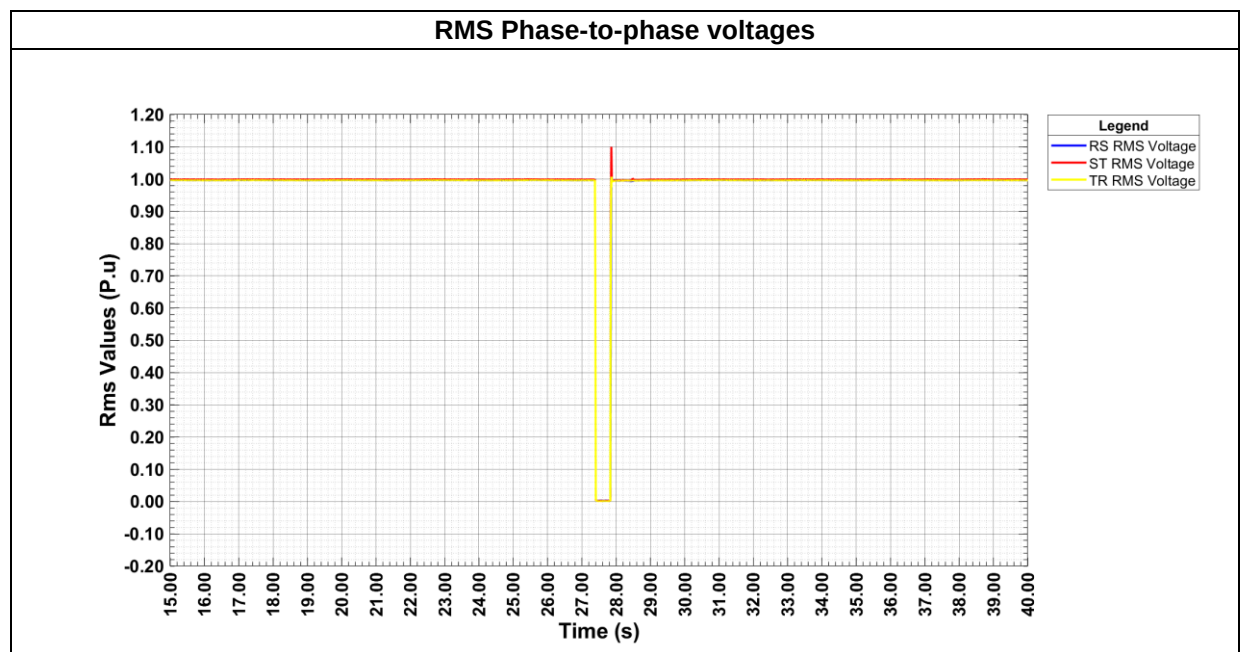
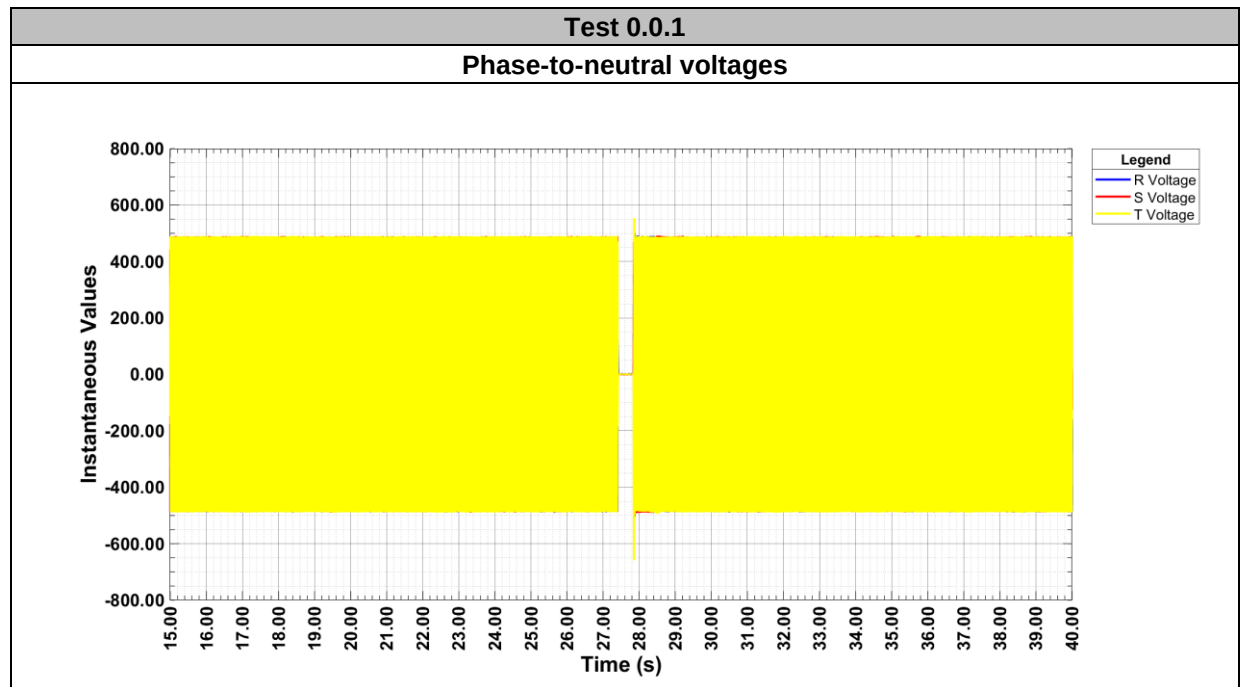
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

3.1 LVRT

3.1.1 No load tests

No load tests have been performed to check that the settings for each test are correctly set in accordance with the standard requirements. In the table below of point 3.1.1, the second 0 makes reference for the no load test equivalent to the code stated in table 4-688 of the standard. And for the Phase-to-neutral voltages, the unit is V.

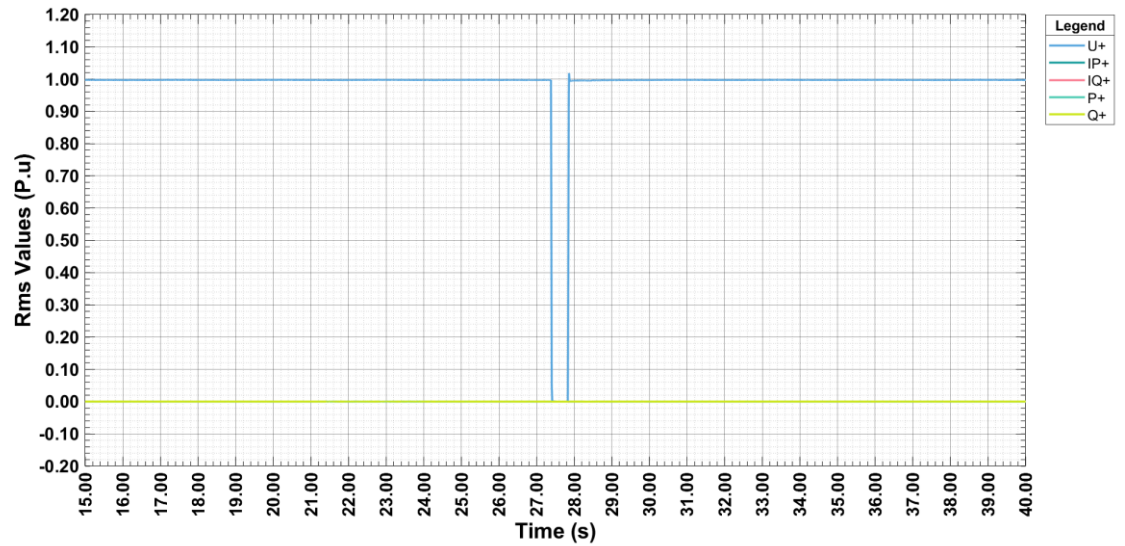
3.1.1.1 Fault type: 3 phases; Dip depth 0 %Un



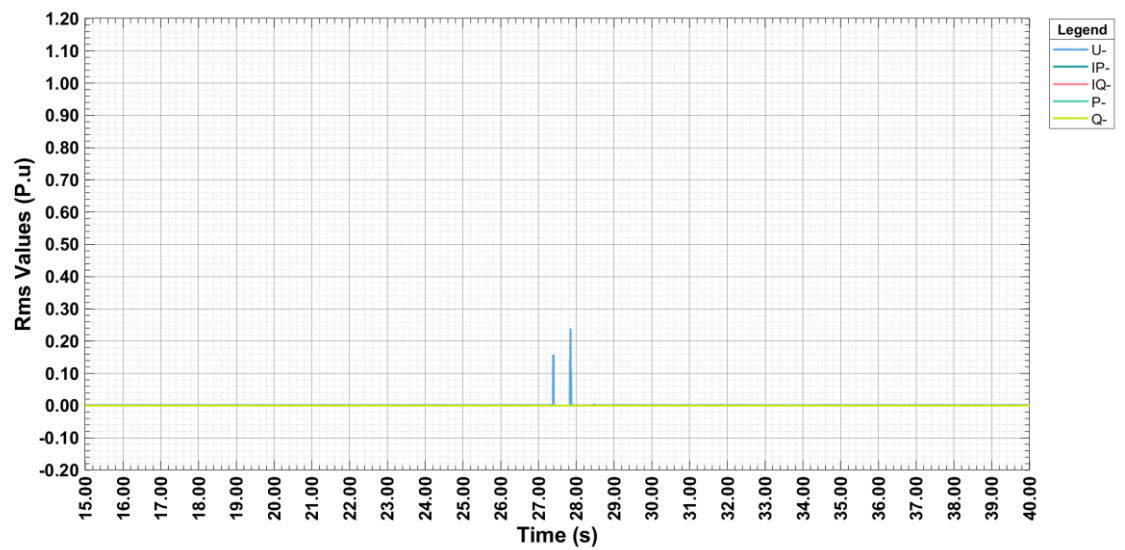
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.0.1

Positive sequences

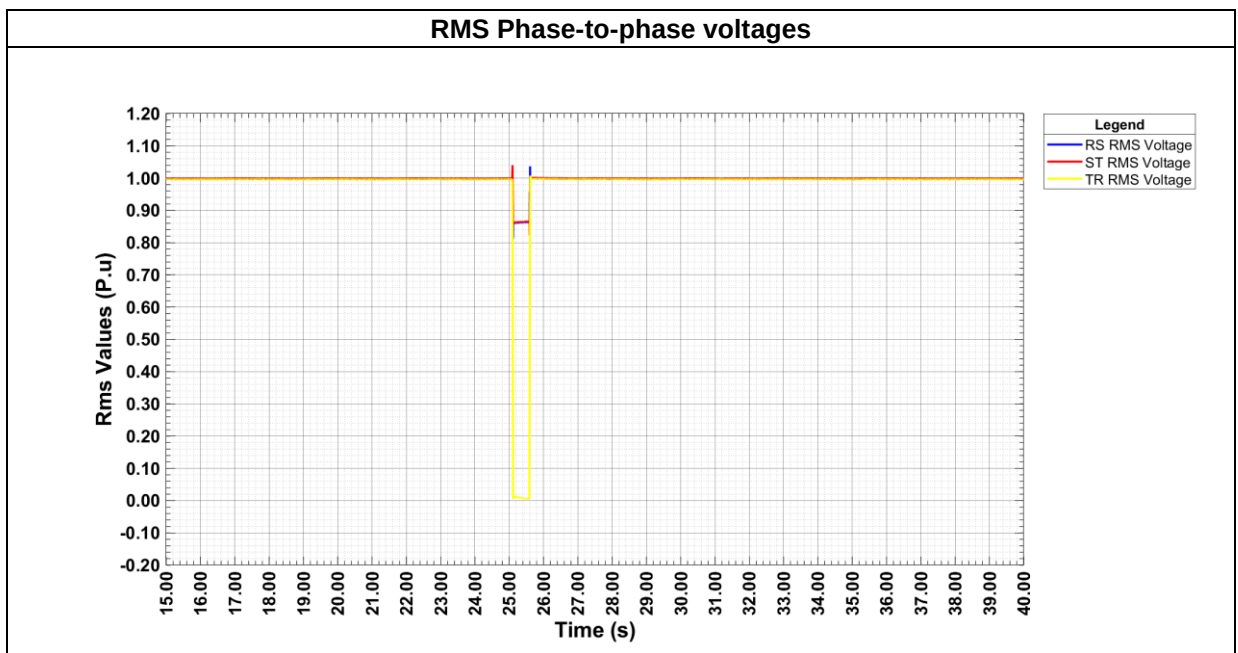
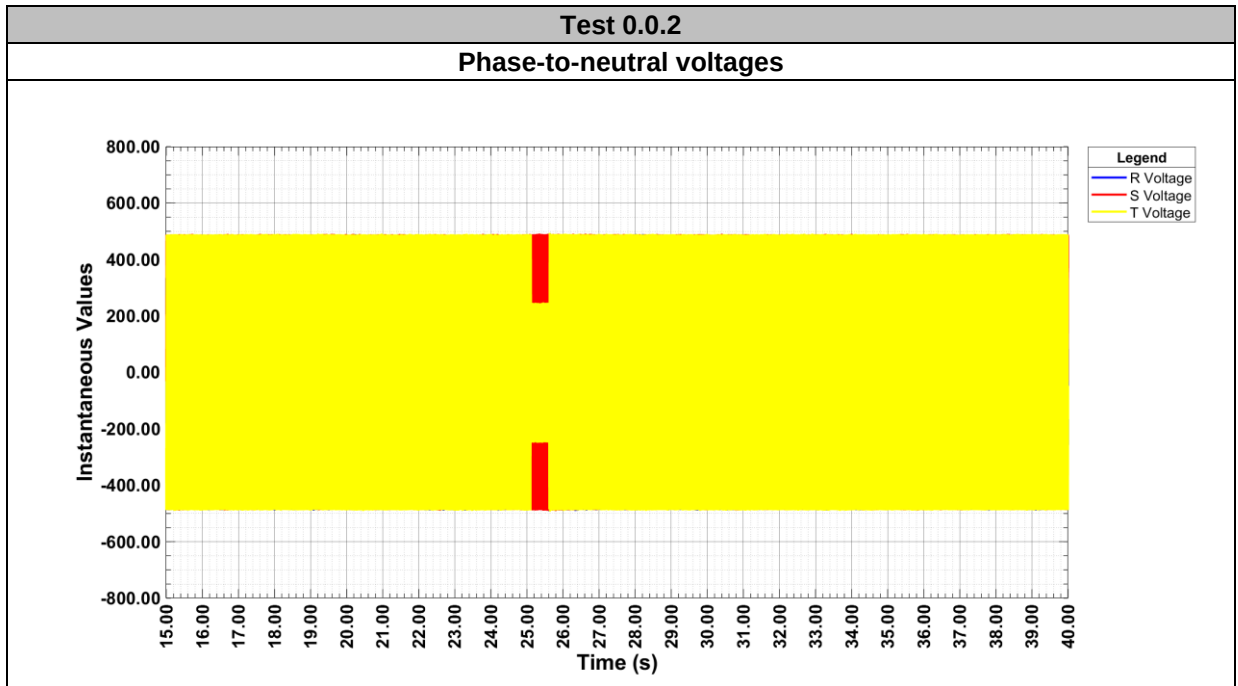


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

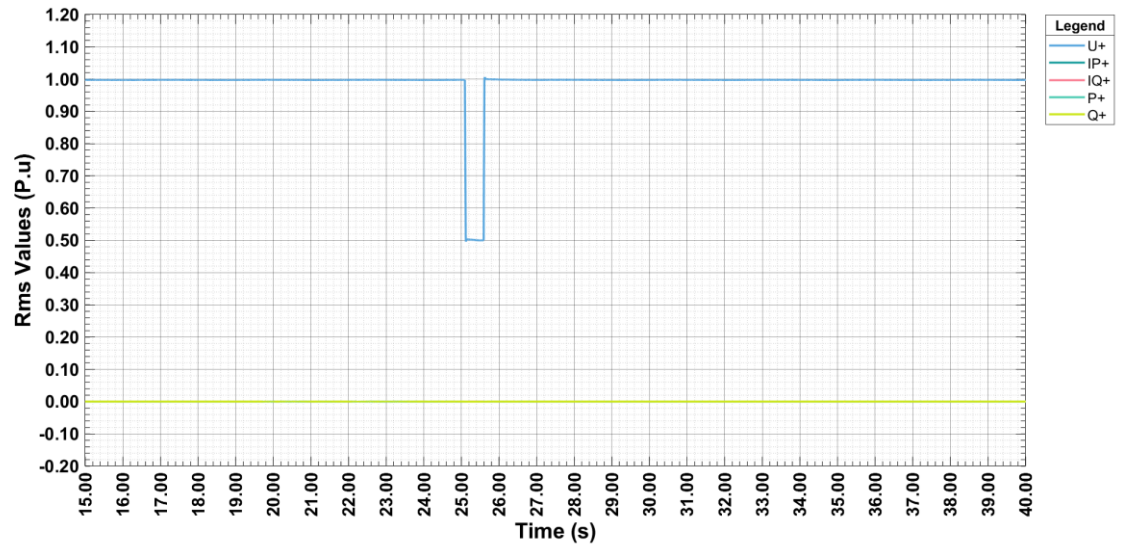
3.1.1.2 Fault type: 2 phases; Dip depth 0 %Un



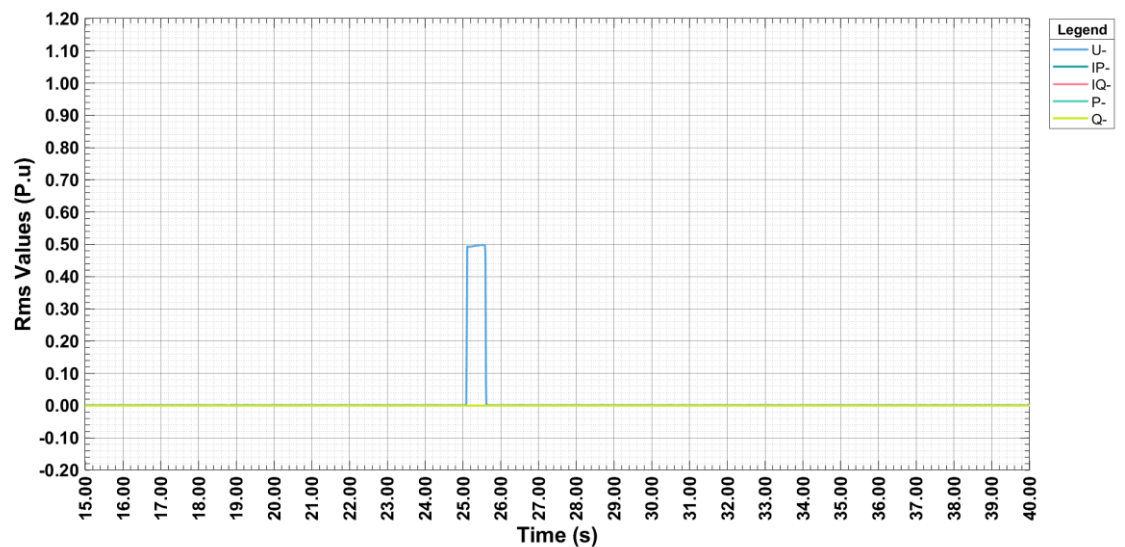
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.0.2

Positive sequences

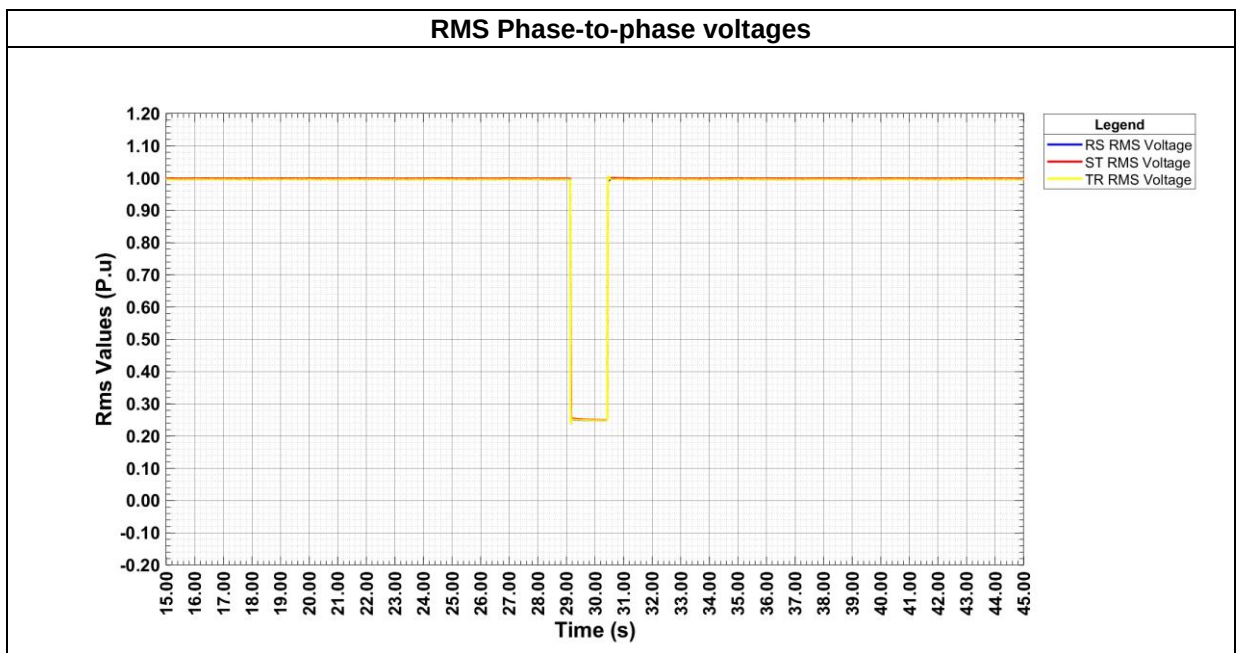
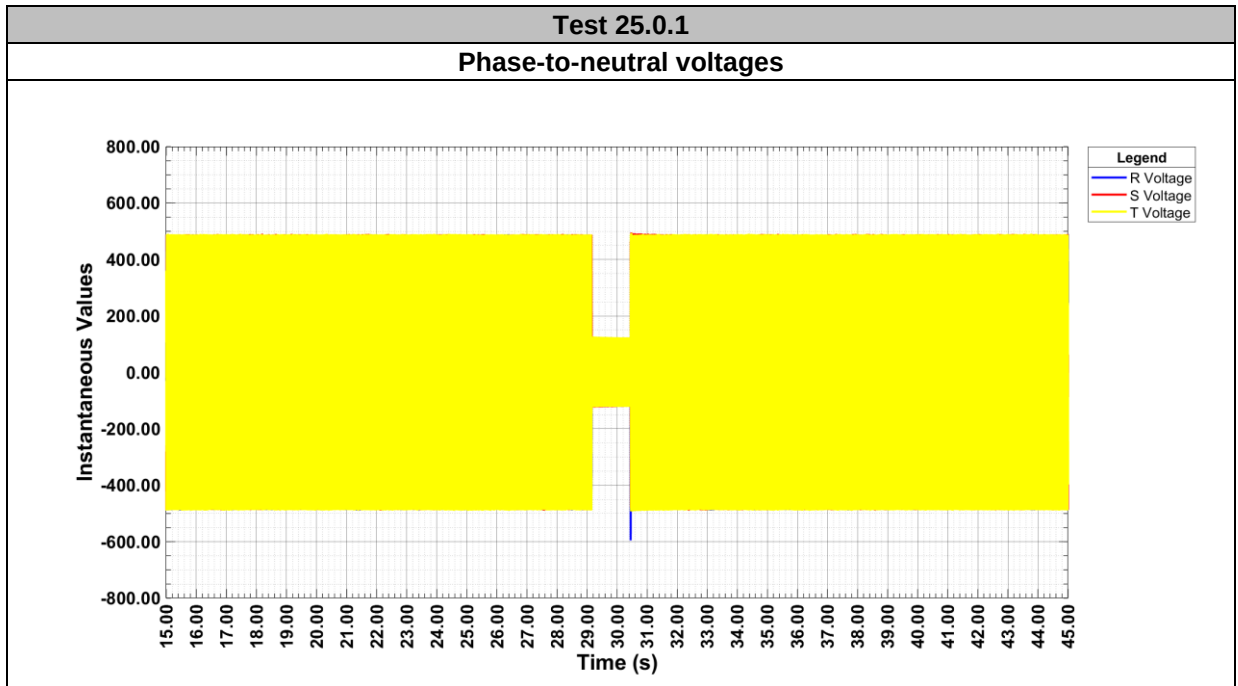


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

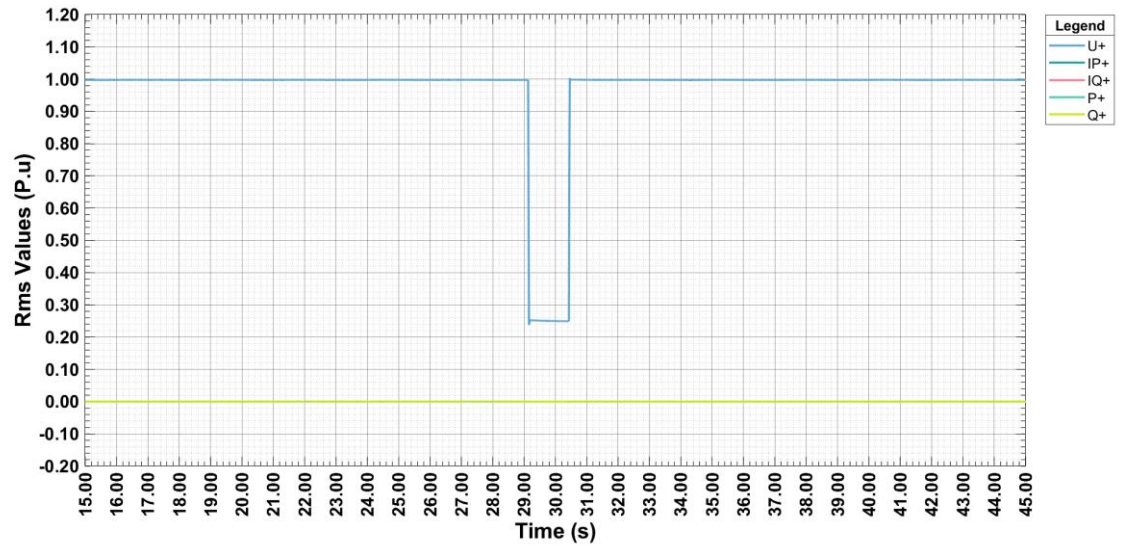
3.1.1.3 Fault type: 3 phases; Dip depth 25 %Un



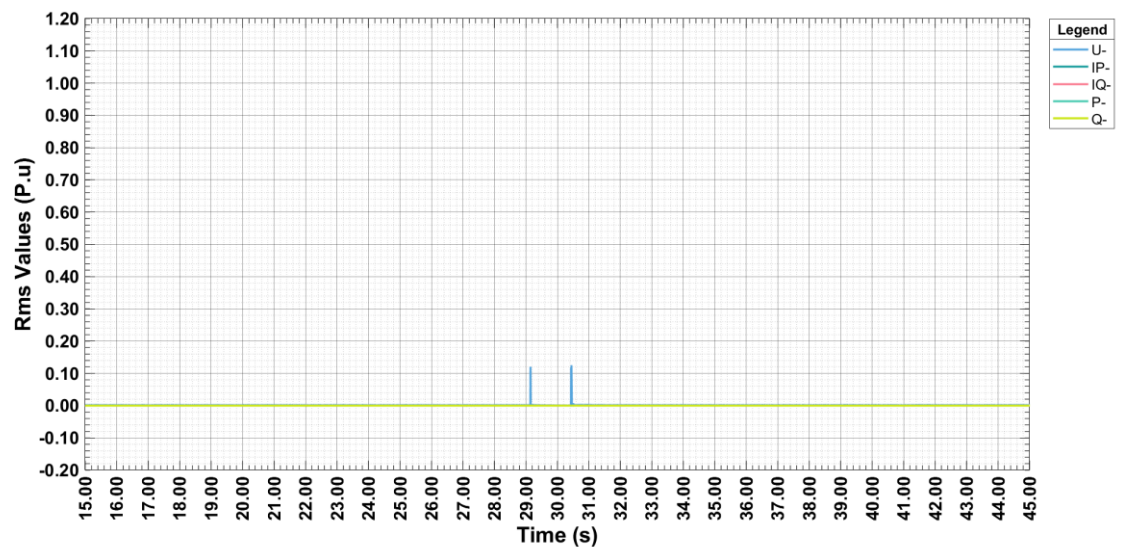
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.0.1

Positive sequences

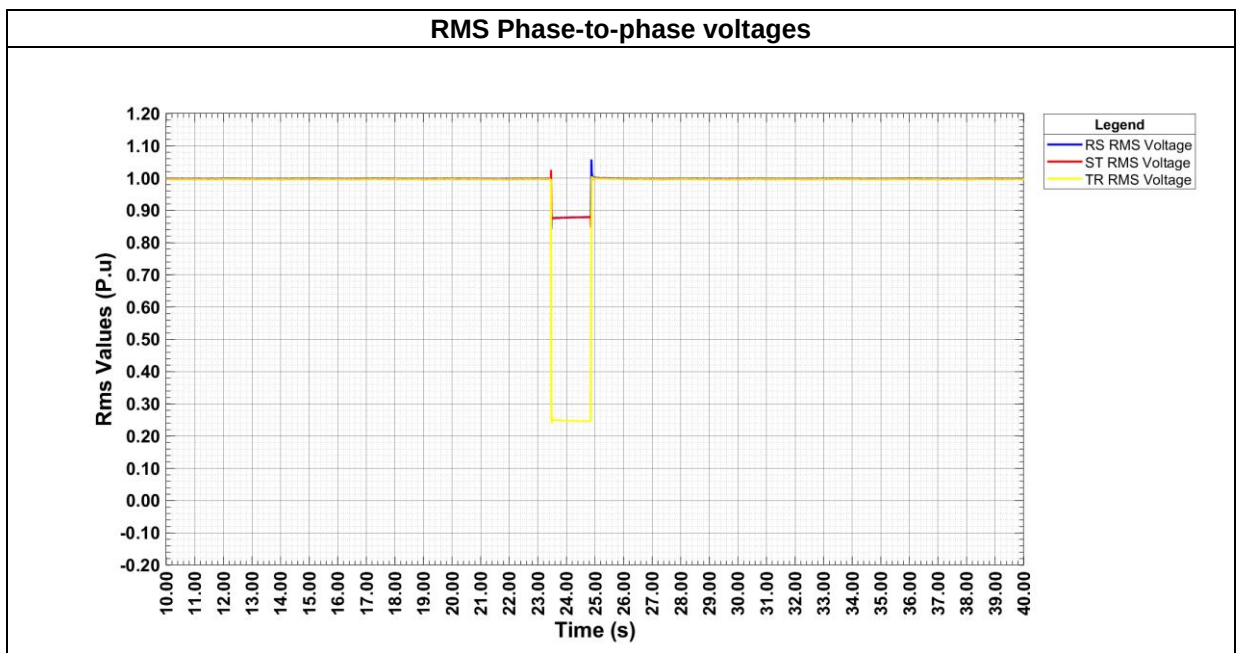
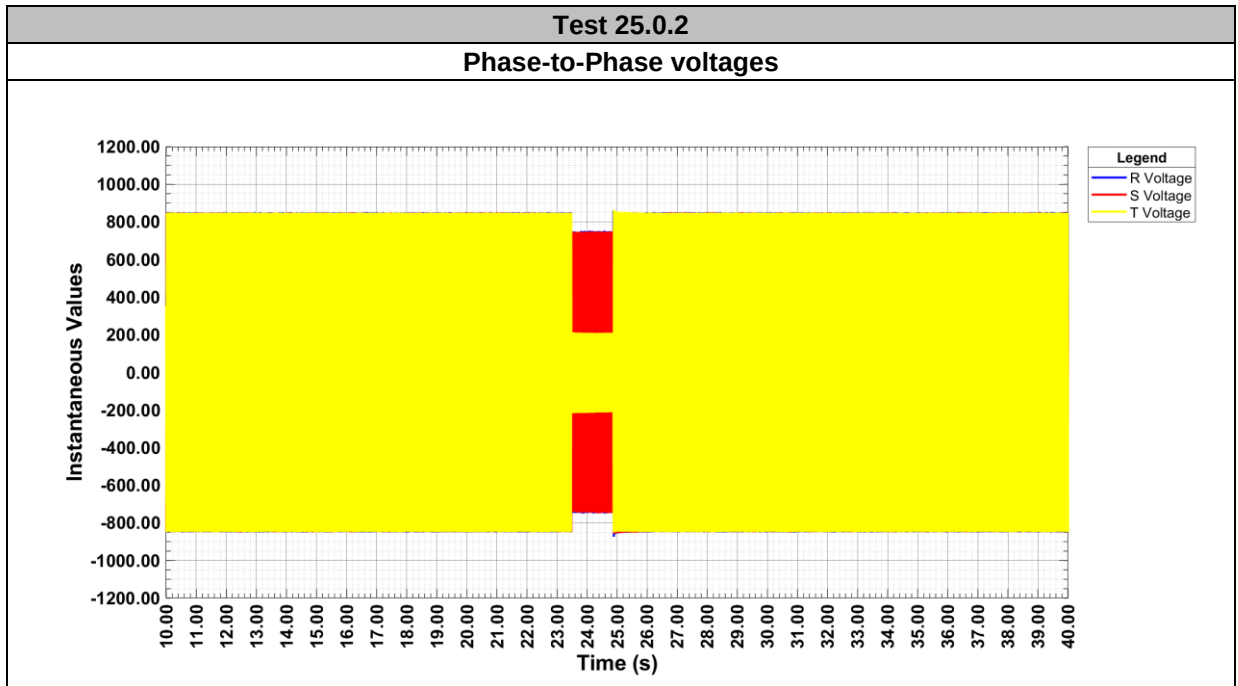


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

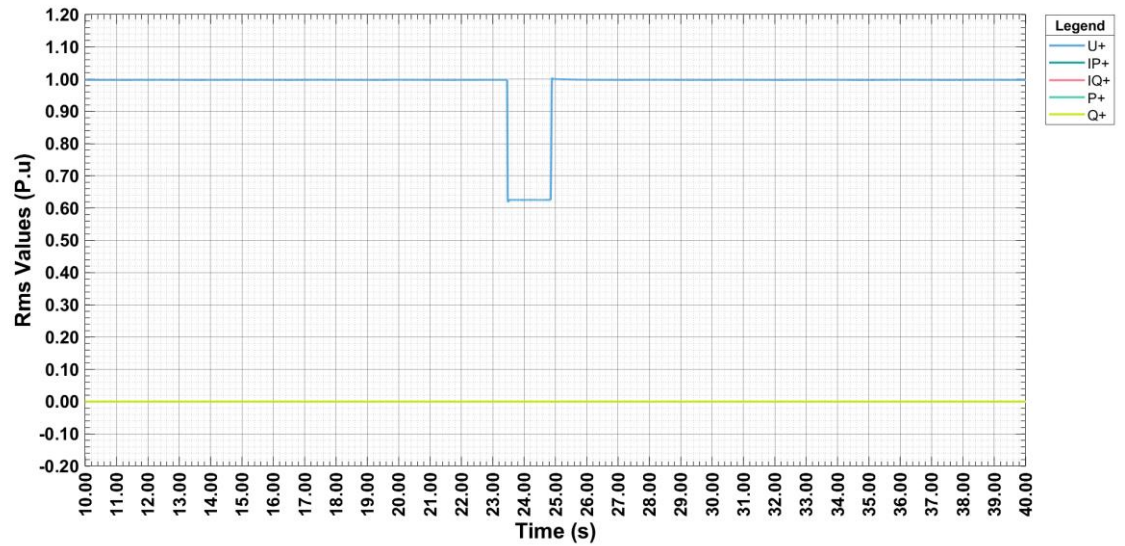
3.1.1.4 Fault type: 2 phases; Dip depth 25 %Un



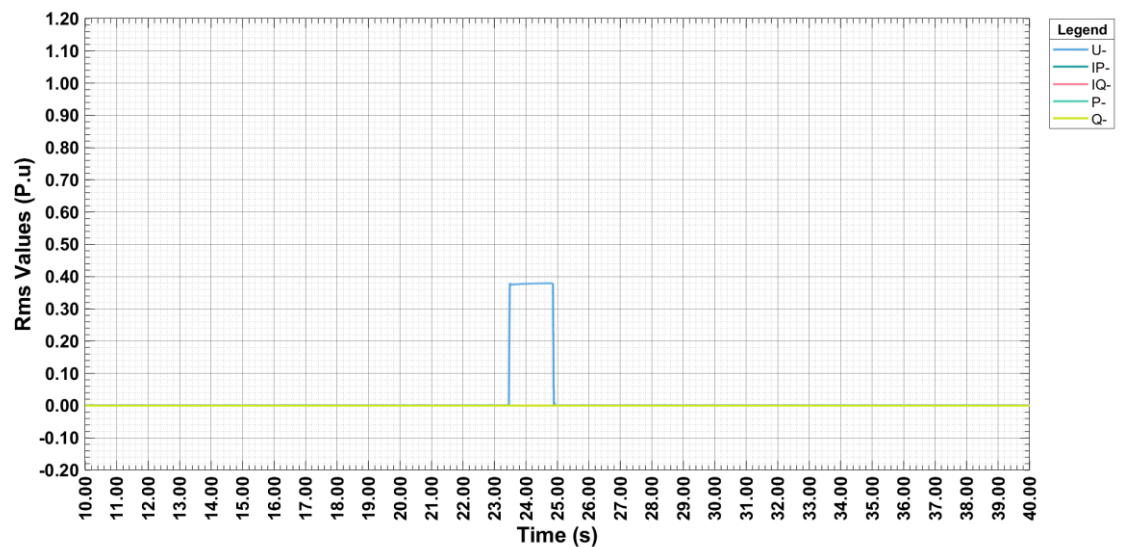
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.0.2

Positive sequences

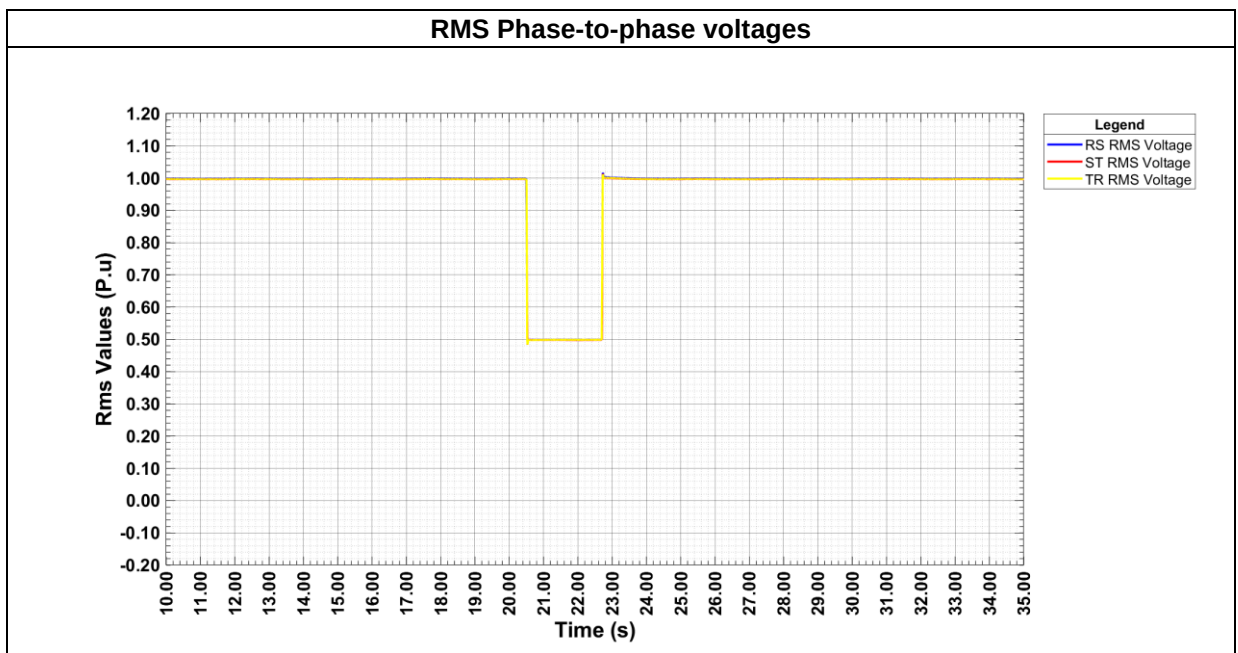
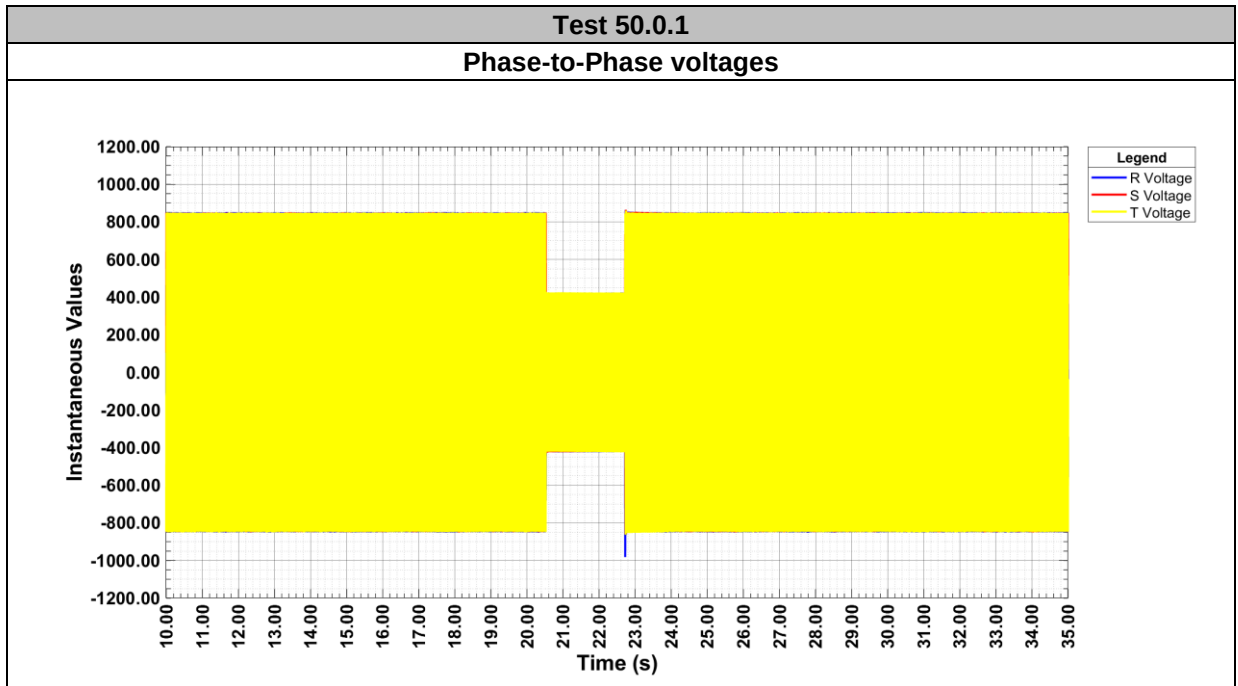


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

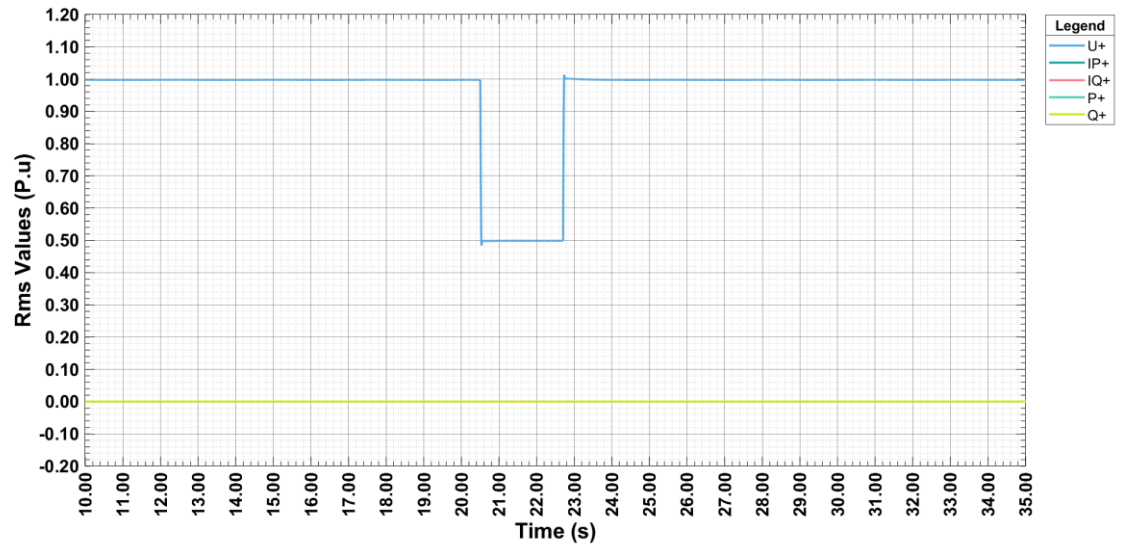
3.1.1.5 Fault type: 3 phases; Dip depth 50 %Un



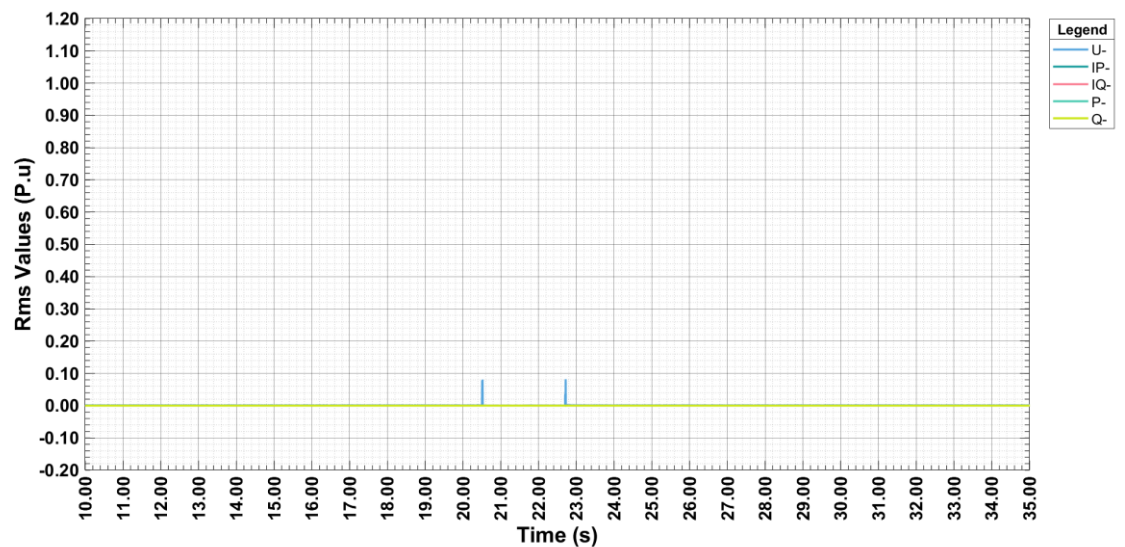
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.0.1

Positive sequences

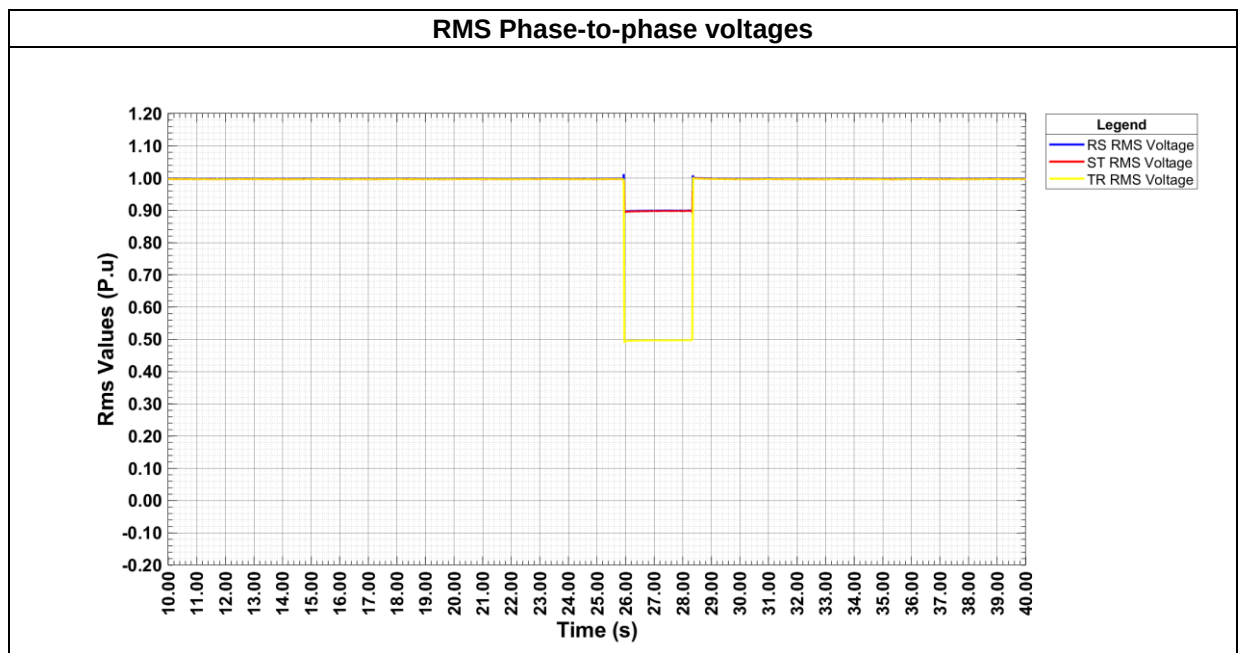
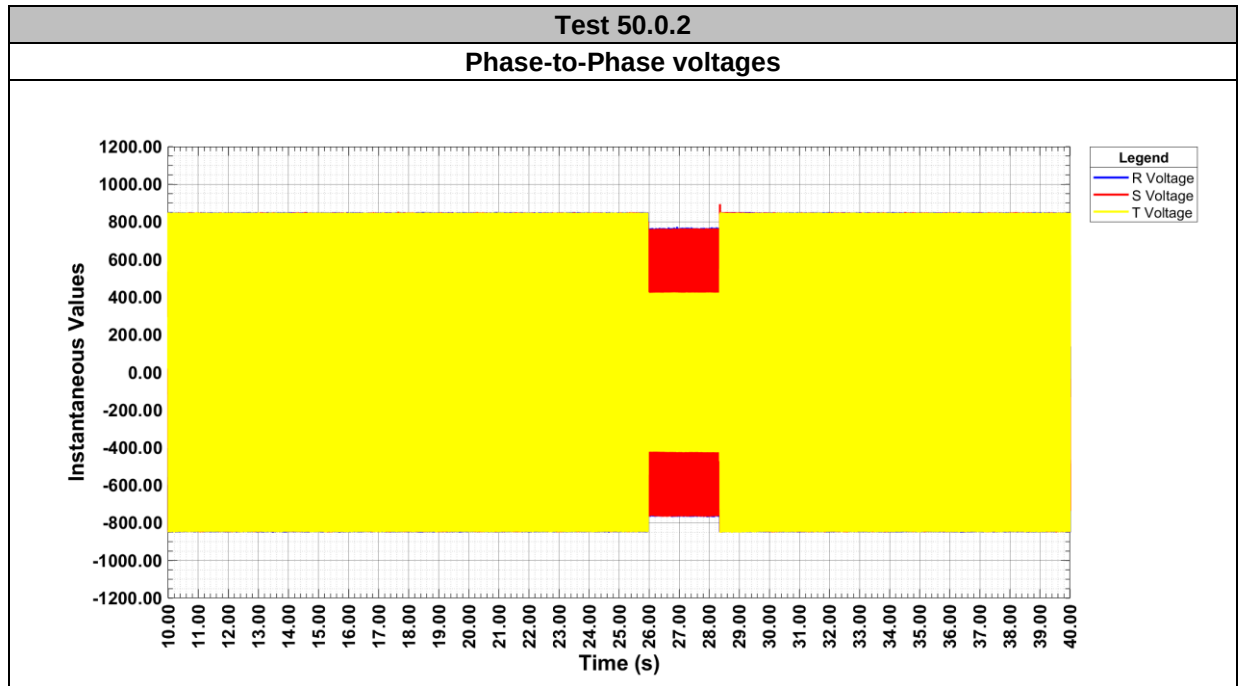


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

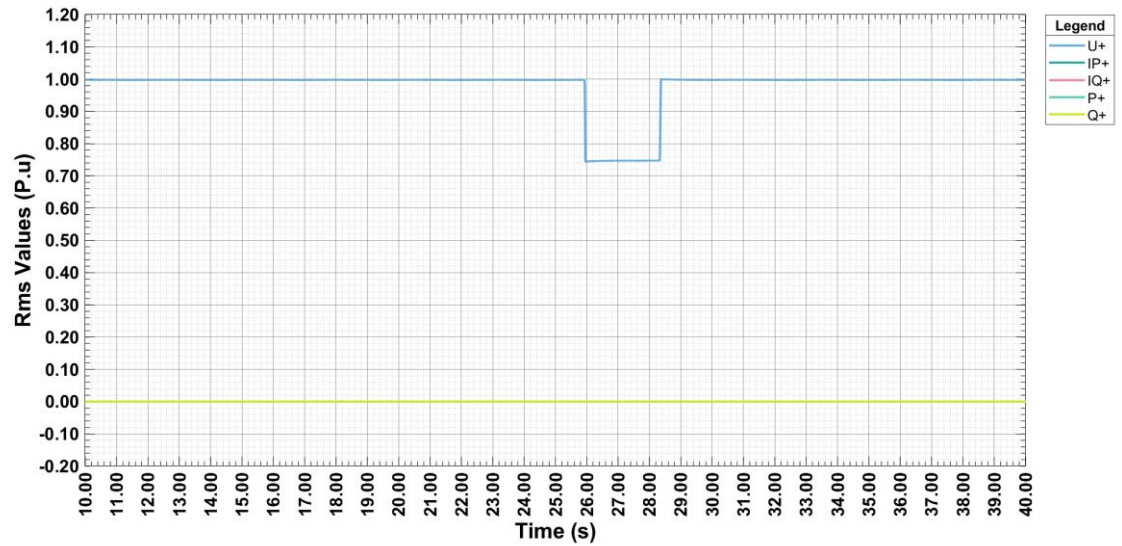
3.1.1.6 Fault type: 2 phases; Dip depth 50 %Un



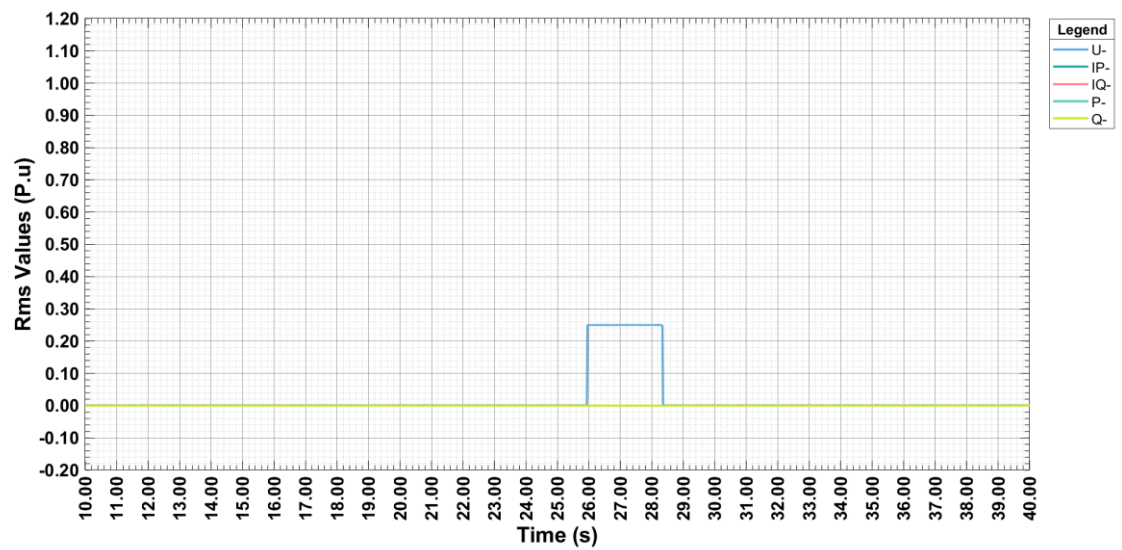
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.0.2

Positive sequences

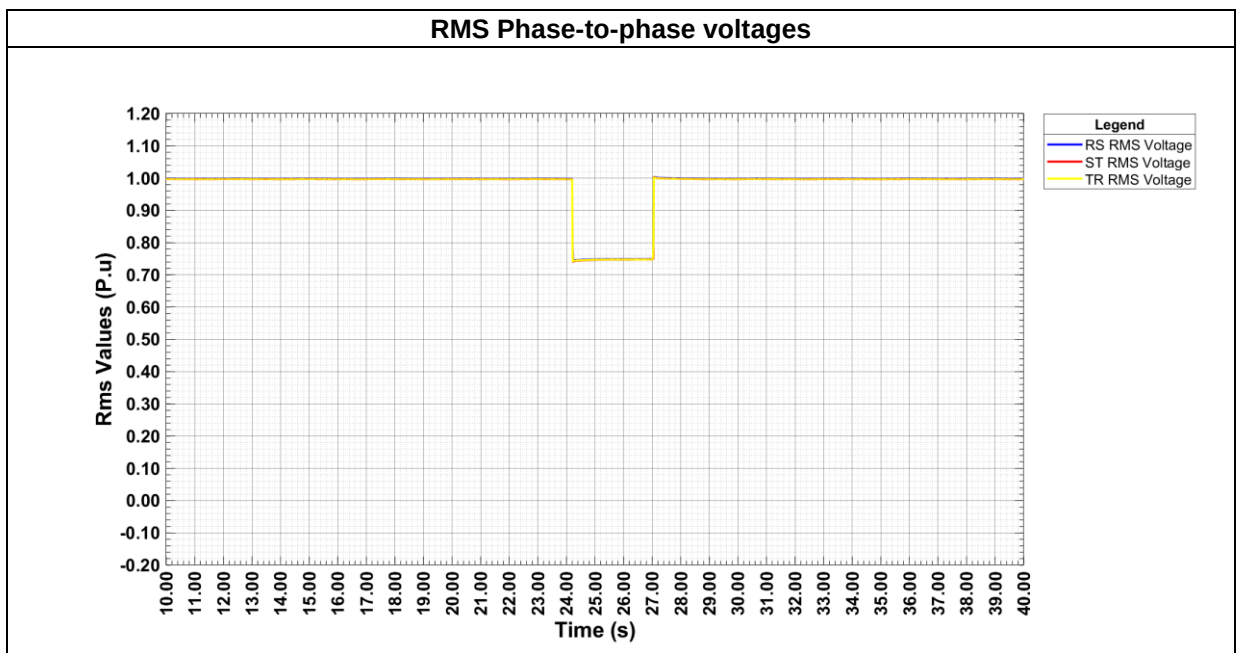
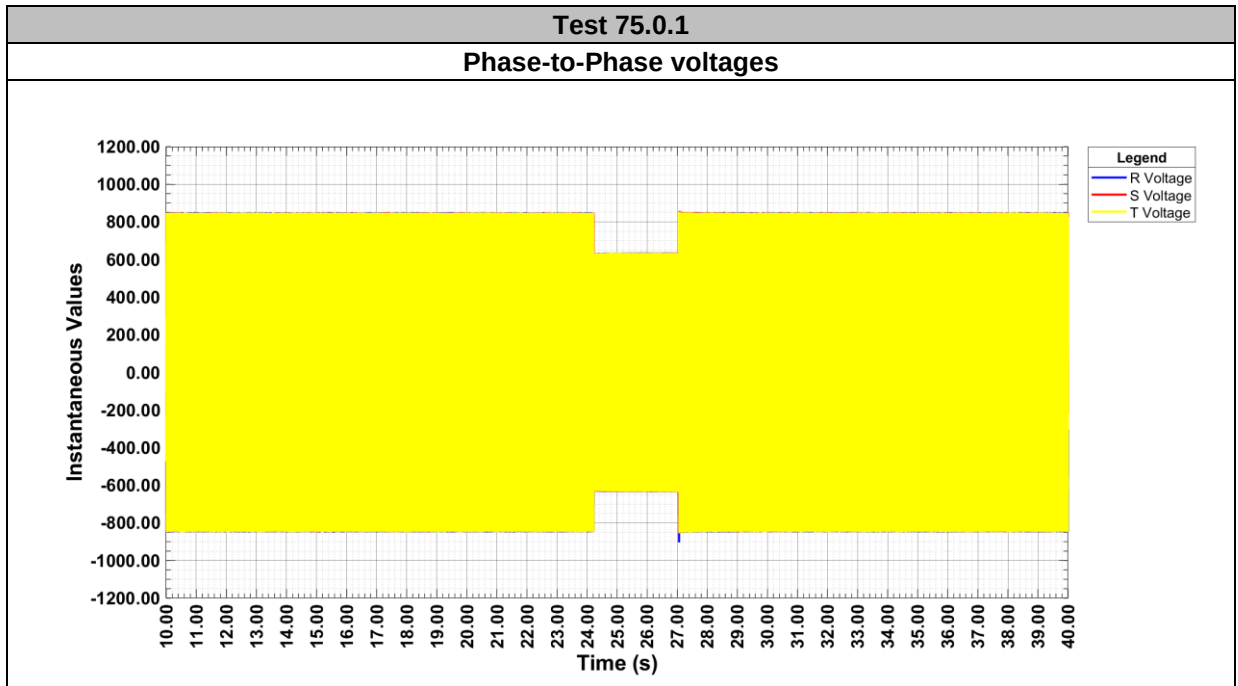


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

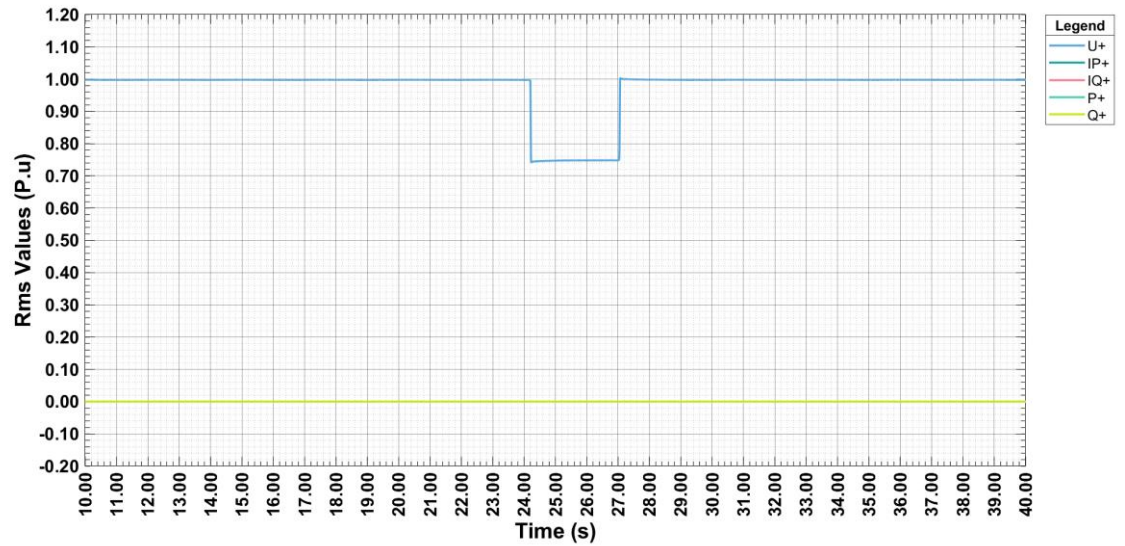
3.1.1.7 Fault type: 3 phases; Dip depth 75 %Un



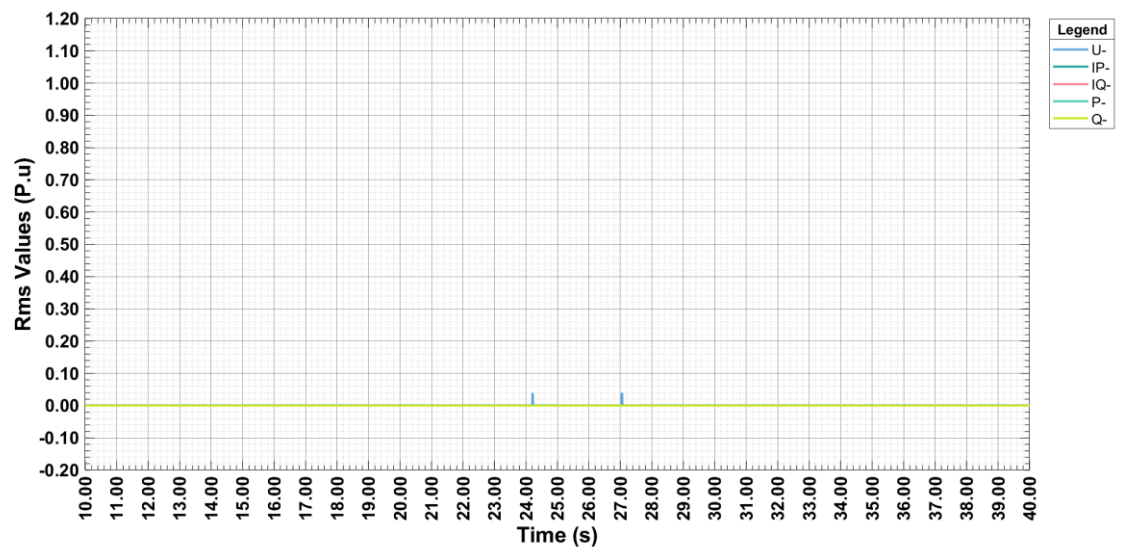
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.0.1

Positive sequences

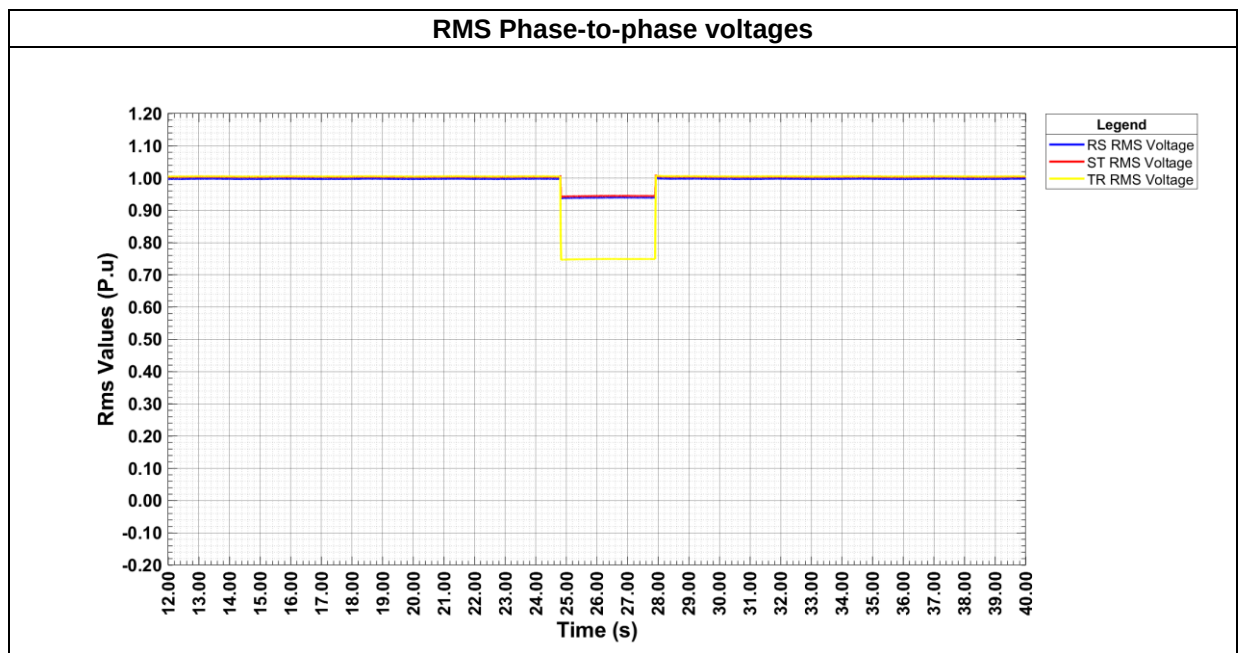
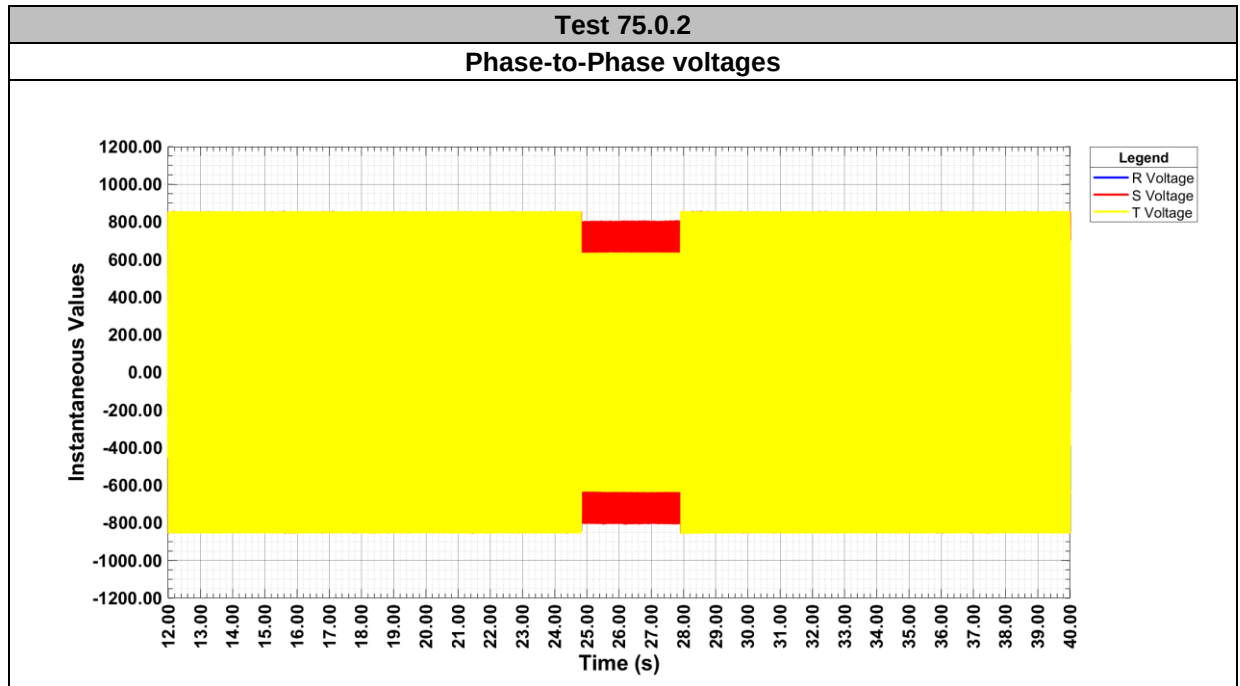


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

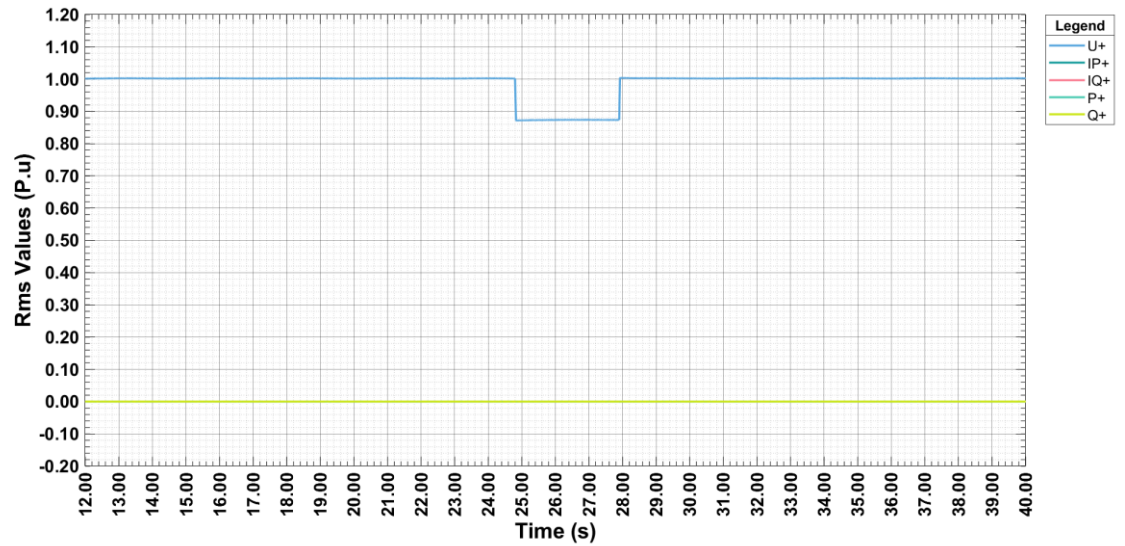
3.1.1.8 Fault type: 2 phases; Dip depth 75 %Un



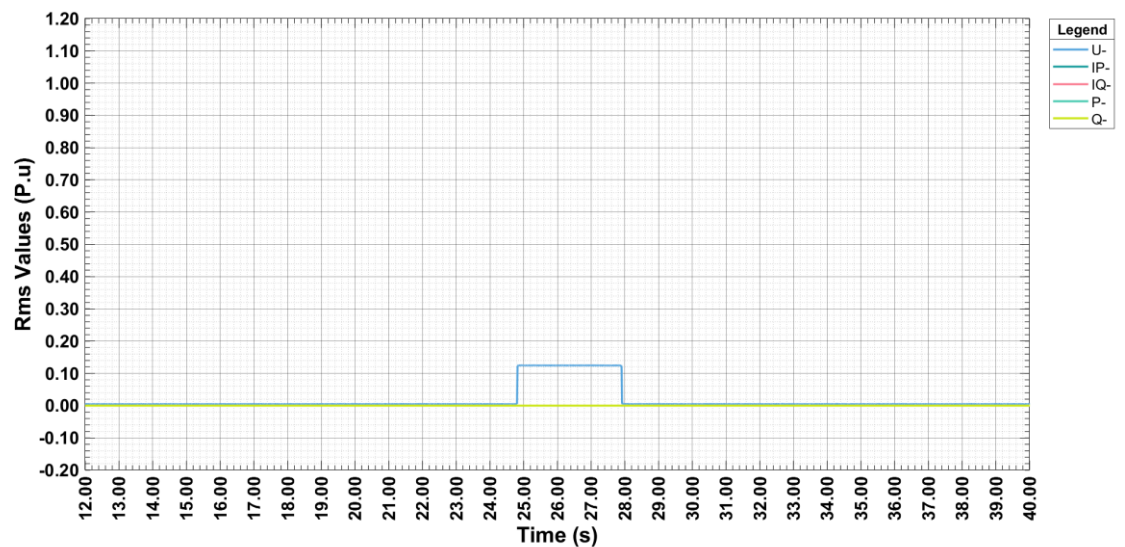
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.0.2

Positive sequences

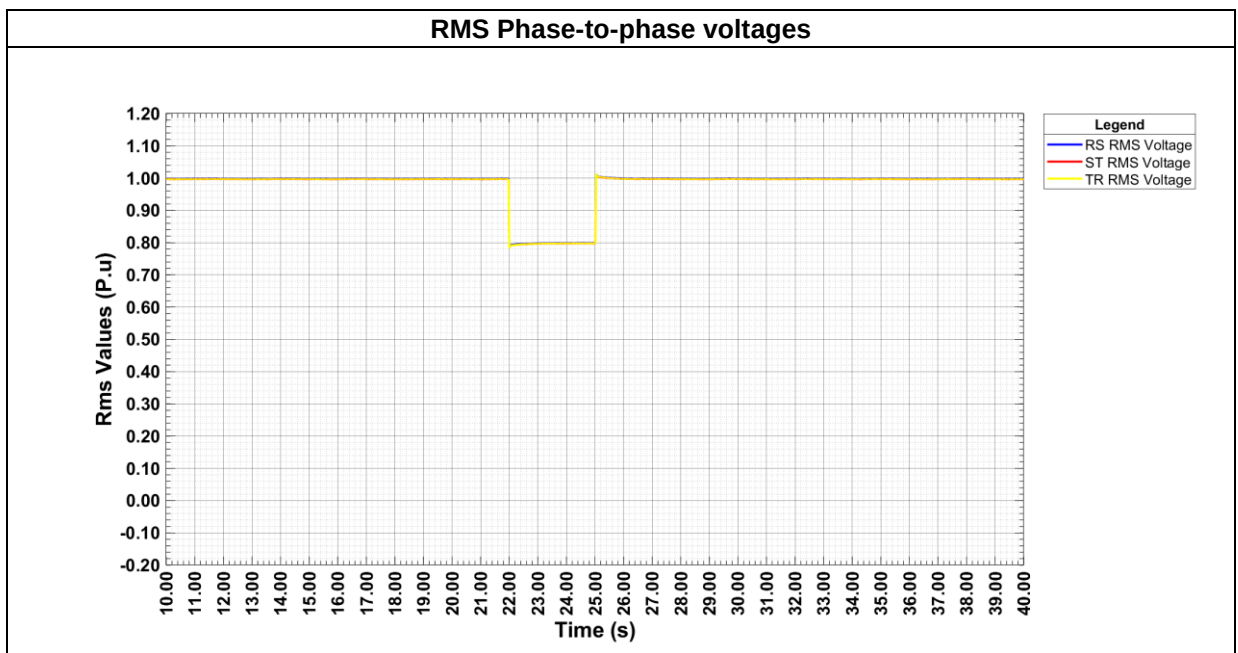
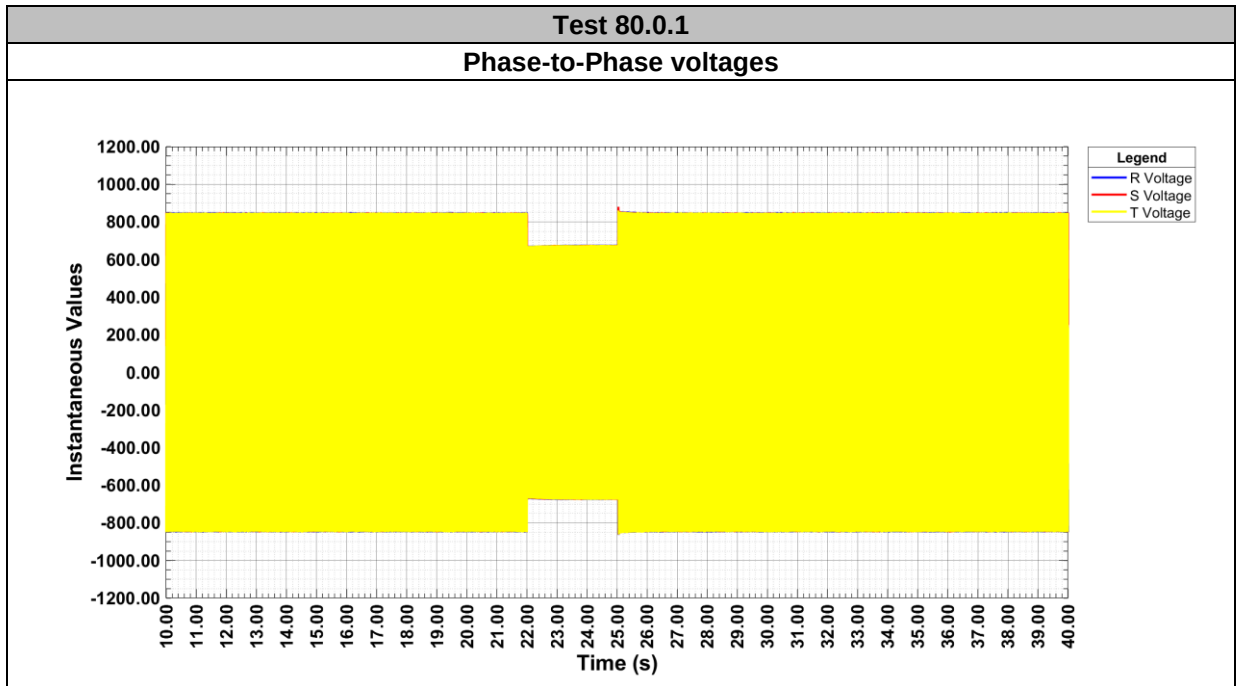


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

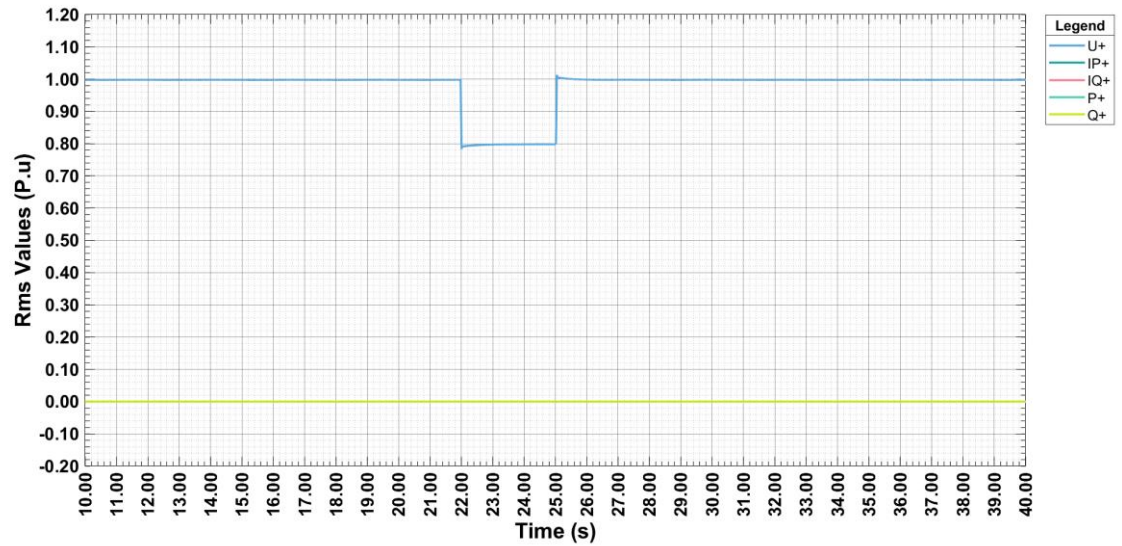
3.1.1.9 Fault type: 3 phases; Dip depth 80 %Un



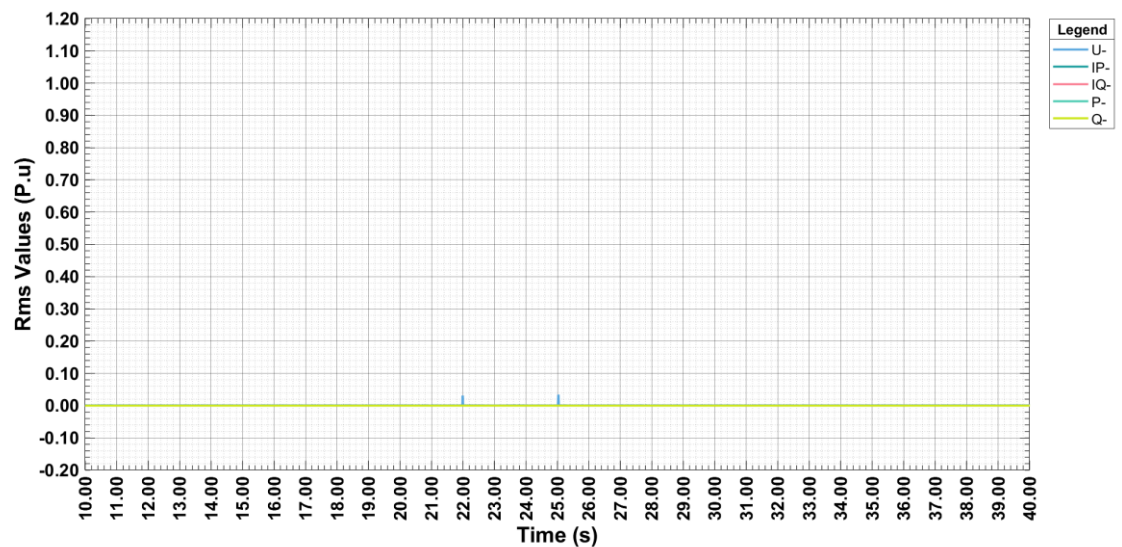
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.0.1

Positive sequences

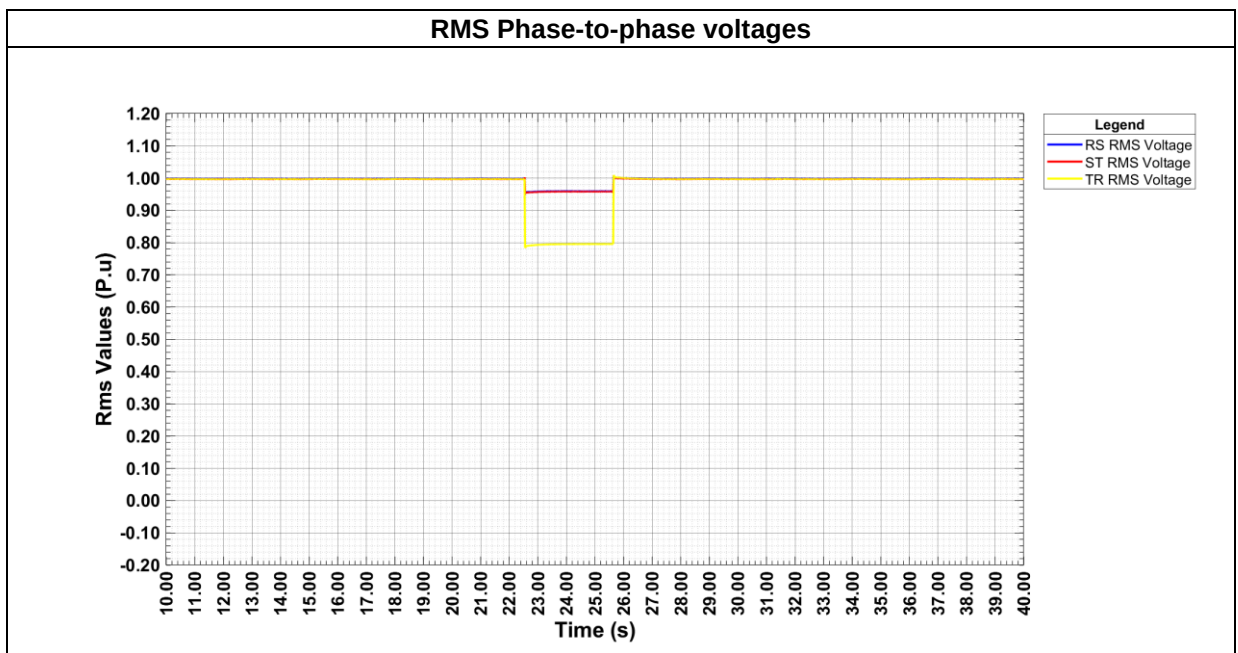
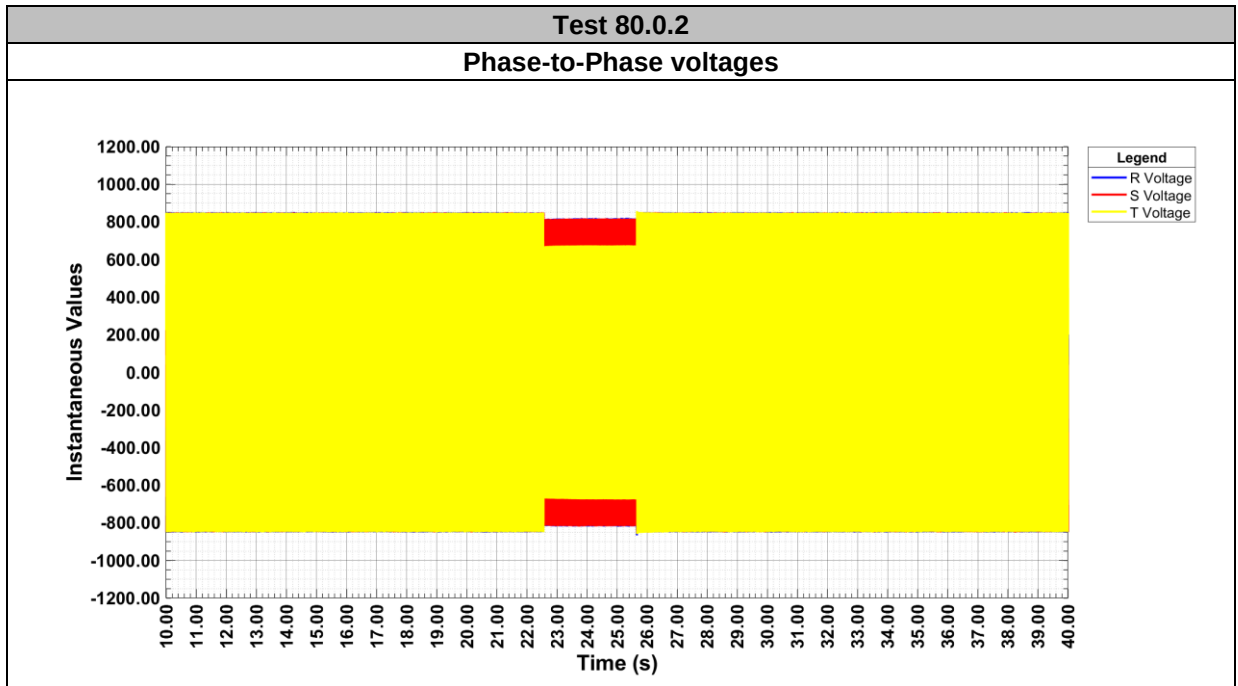


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

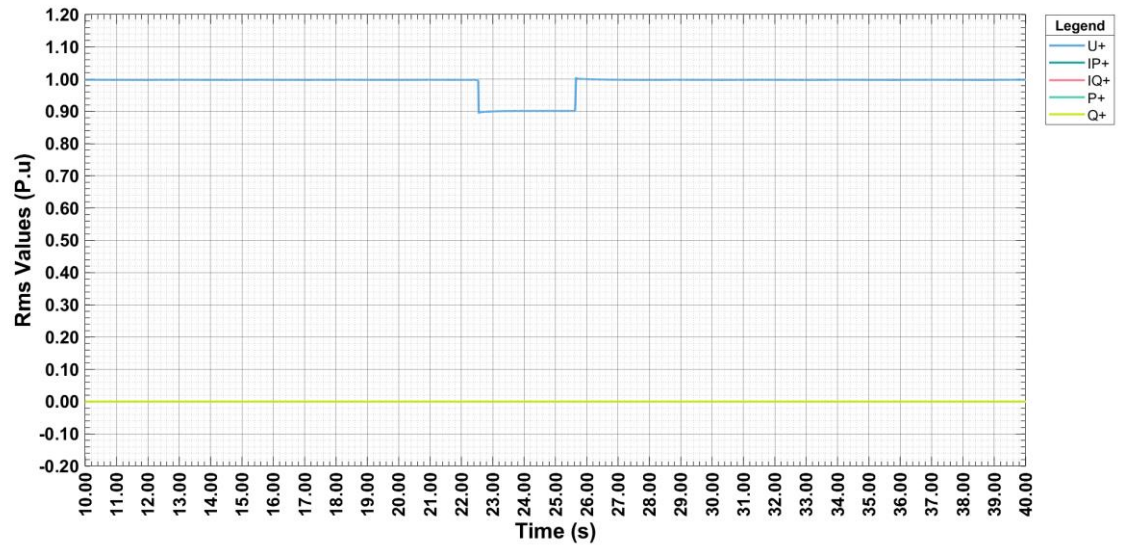
3.1.1.10 Fault type: 2 phases; Dip depth 80 %Un



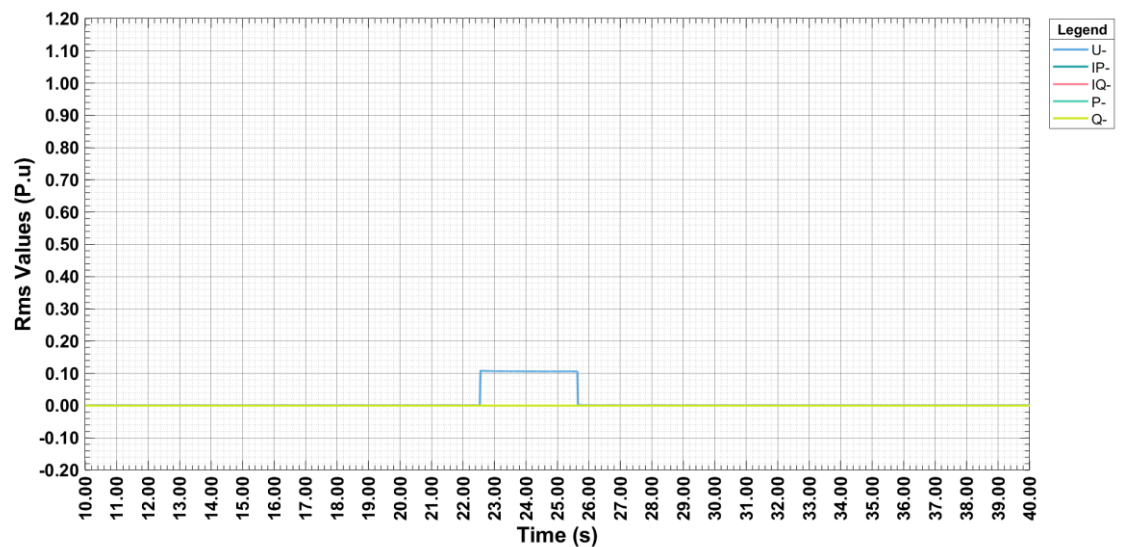
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.0.2

Positive sequences

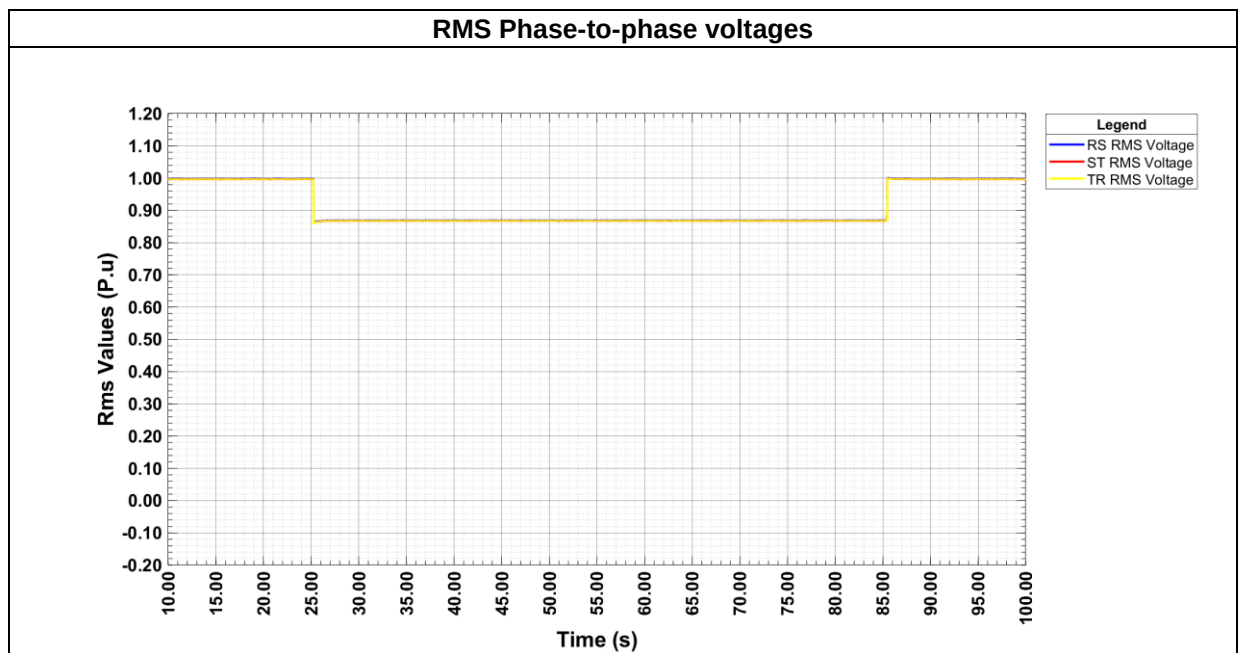
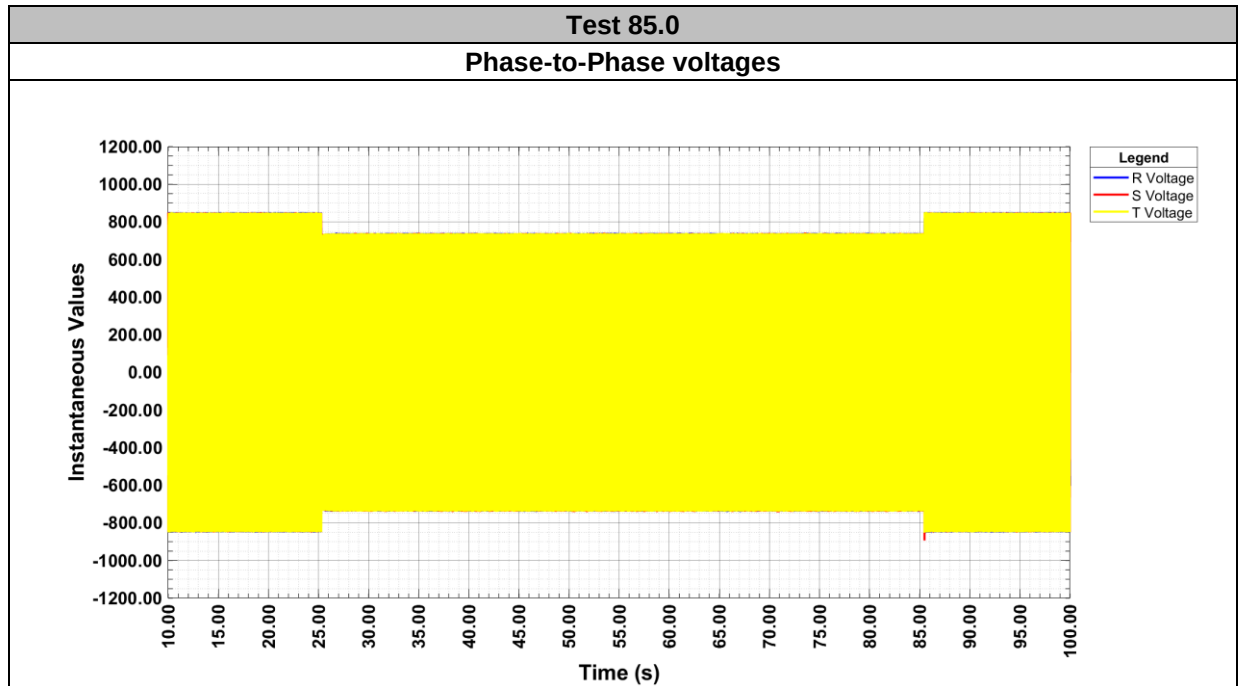


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

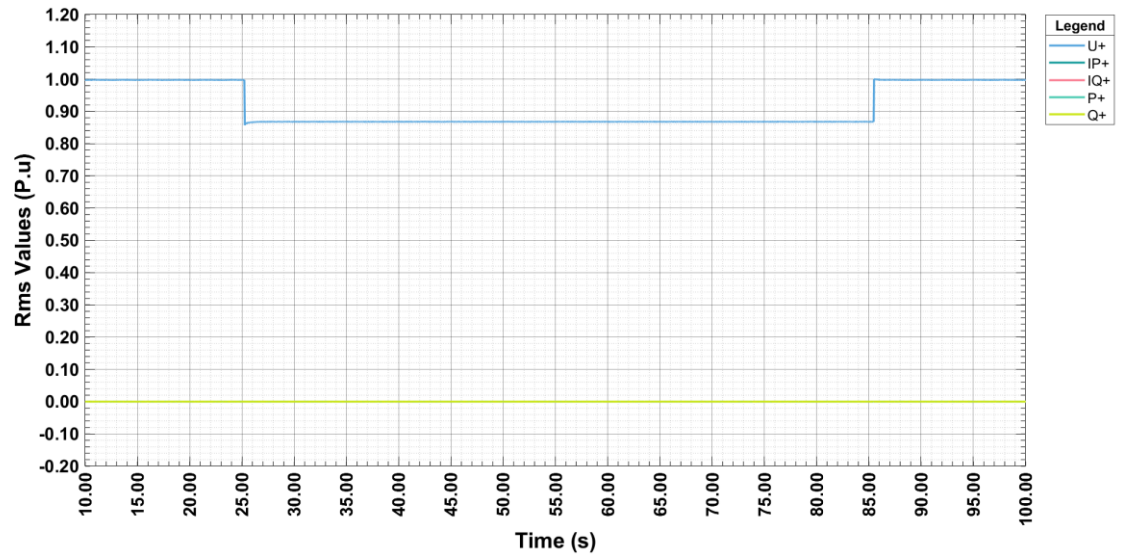
3.1.1.11 Fault type: 3 phases; Dip depth 85 %Un



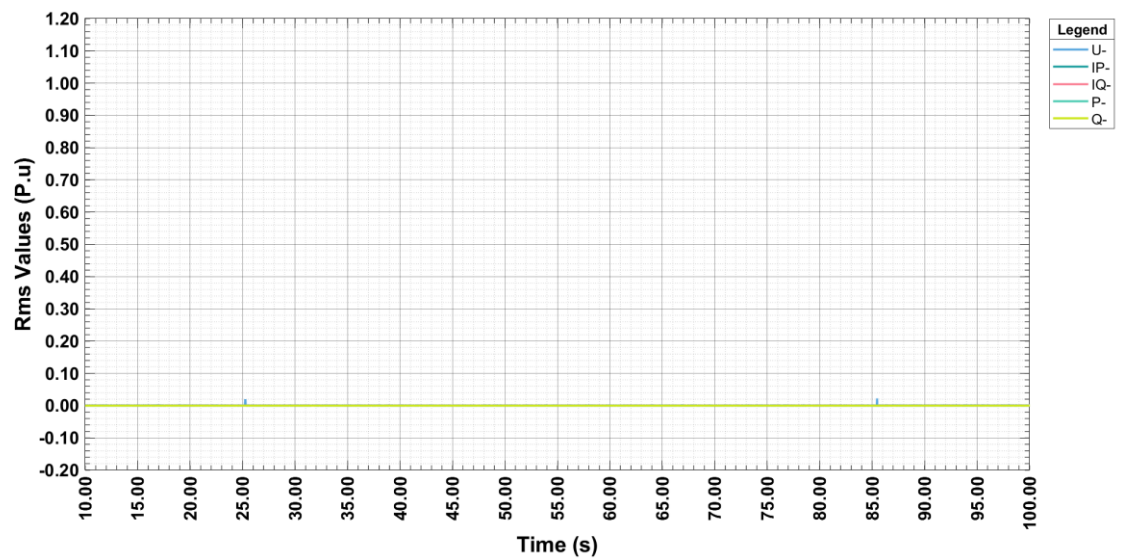
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 85.0

Positive sequences



Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.2 Load tests: Dip depth 0 %Un

In this chapter of the test report are shown the test results and diagrams for the tests done with a dip depth of 0 %Un. There are included at this point the tests 0.1, 0.2, 0.3 and 0.4 according to table 4-688 of the standard. For the voltages and currents in the below pictures and tables, the units are V and A.

3.1.2.1 Test 0.1 Fault type: 3 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	0.1
	Date		-	[dd.mm.yyyy]	28.09.2020
	Time		-	[hh:mm:ss]	10:48:21
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.000
	Drop duration setpoint		-	[ms]	318
	Series impedance switched in (t0)			[ms]	-
	Fault occurrence (t1)		-	[ms]	24474
	Fault clearance (t2)		-	[ms]	24940
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	466
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.085 /1.007 ⁽¹⁾
		Pos. seq.		[p.u.]	0.075 /1.007

⁽¹⁾ The fault voltage was confirmed ≤ 0.05 during the No-Load test in case 0.0.1. Because of test bench limitations, the fault voltage was measured above the required value. However, the result was accepted since the actual fault duration was measured 466 ms in this case, which is longer than needed for this test value.

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.007
		Neg. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.007
		Pos. seq.	t1-1 s to t1	[p.u.]	1.007
		Neg. seq.	t1-1 s to t1	[p.u.]	0.006
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.997
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.020
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.020
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.004
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.997
	Active Power	Total	t1-10 s to t1	[p.u.]	1.003
		Total	t1-2 s to t1	[p.u.]	1.003
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.003
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.020
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.160
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	39
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	39
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.056
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.008
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.083
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.004
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.089
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.011
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.001
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001

Note: The determined K-factor is lower than the configured in the EUT ($K = 2$) because the current is limited.

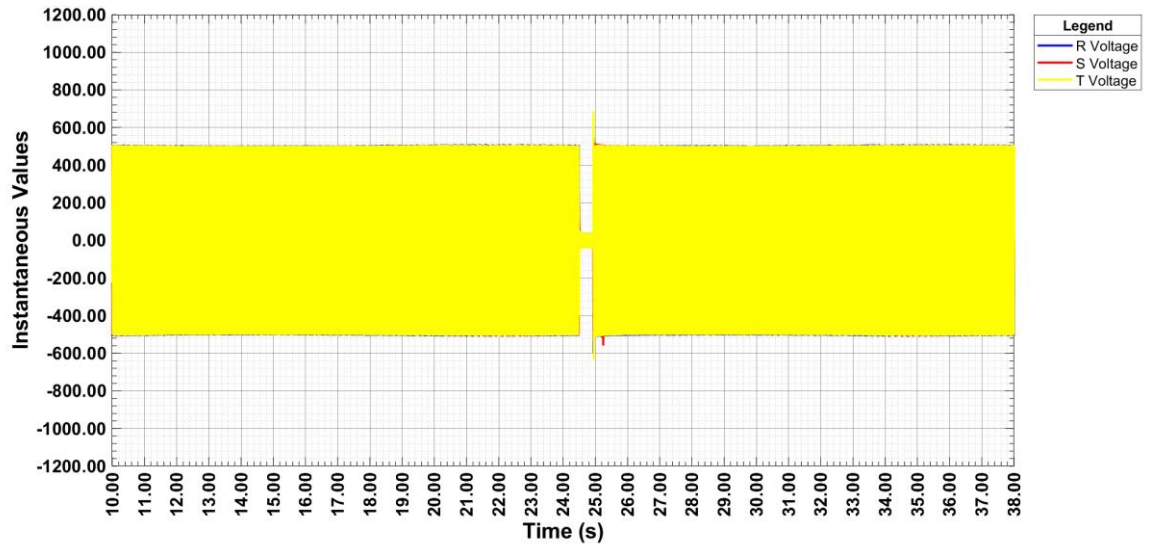
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1646
		Phase 2	t1 to t1+20 ms	[A]	1513
		Phase 3	t1 to t1+20 ms	[A]	1601
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.490
		Phase 2	t1 + 20 ms	[p.u.]	0.719
		Phase 3	t1 + 20 ms	[p.u.]	1.067
		Phase 1	t1 + 100 ms	[p.u.]	1.131
		Phase 2	t1 + 100 ms	[p.u.]	1.092
		Phase 3	t1 + 100 ms	[p.u.]	1.067
		Phase 1	t1 + 150 ms	[p.u.]	1.116
		Phase 2	t1 + 150 ms	[p.u.]	1.087
		Phase 3	t1 + 150 ms	[p.u.]	1.063
		Phase 1	t1 + 300 ms	[p.u.]	1.101
		Phase 2	t1 + 300 ms	[p.u.]	1.094
		Phase 3	t1 + 300 ms	[p.u.]	1.082
		Phase 1	t1 + 500 ms	[p.u.]	0.245
		Phase 2	t1 + 500 ms	[p.u.]	0.230
		Phase 3	t1 + 500 ms	[p.u.]	0.223
		Phase 1	t1 + 1000 ms	[p.u.]	1.022
		Phase 2	t1 + 1000 ms	[p.u.]	0.994
		Phase 3	t1 + 1000 ms	[p.u.]	0.981
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.004
Active current rise time	Pos. seq.			[s]	0.240

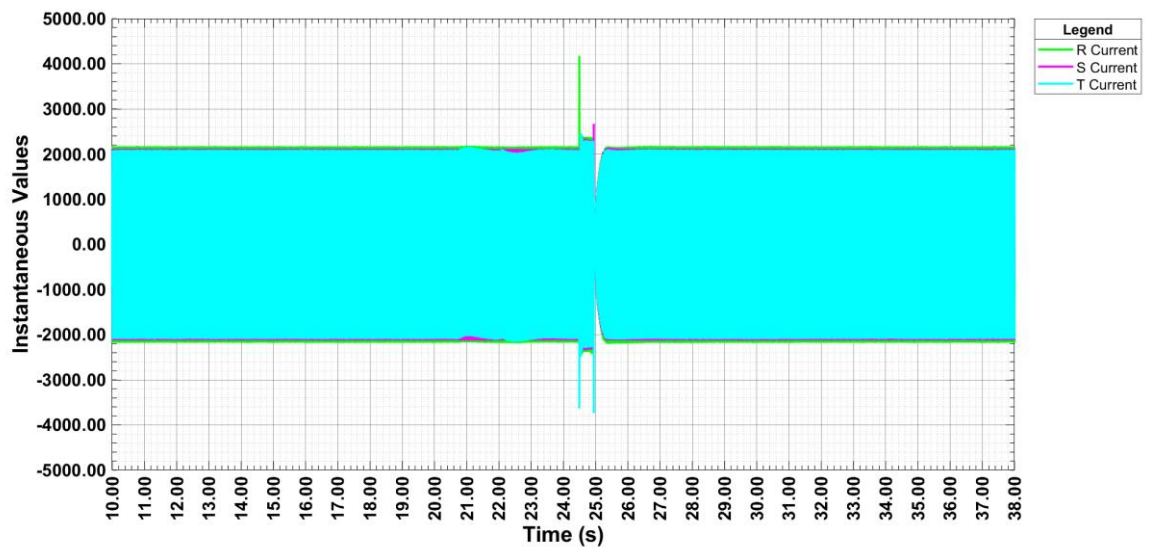
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.1

Phase-to-neutral voltages



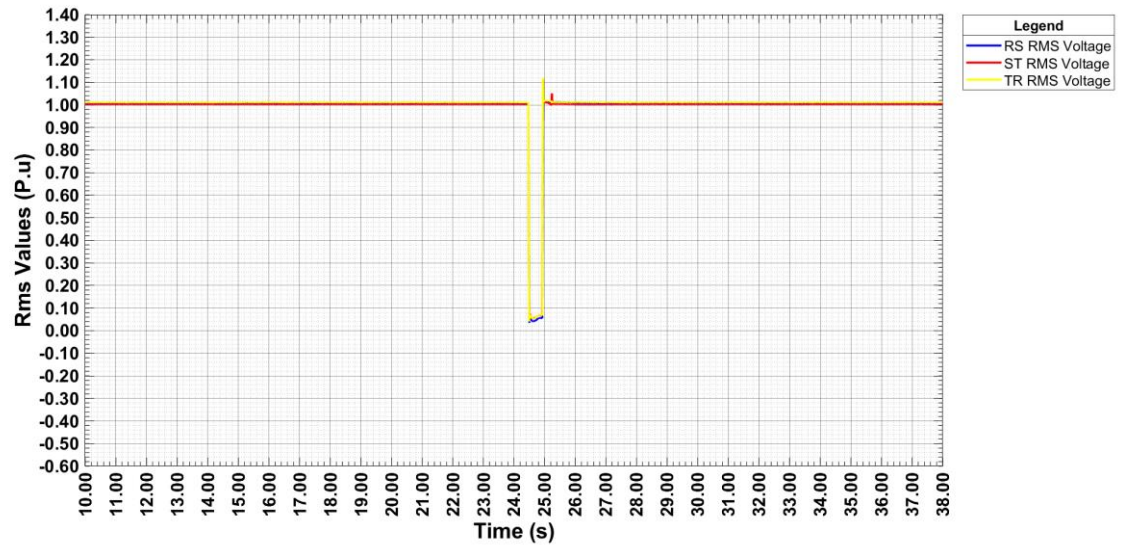
Phase currents



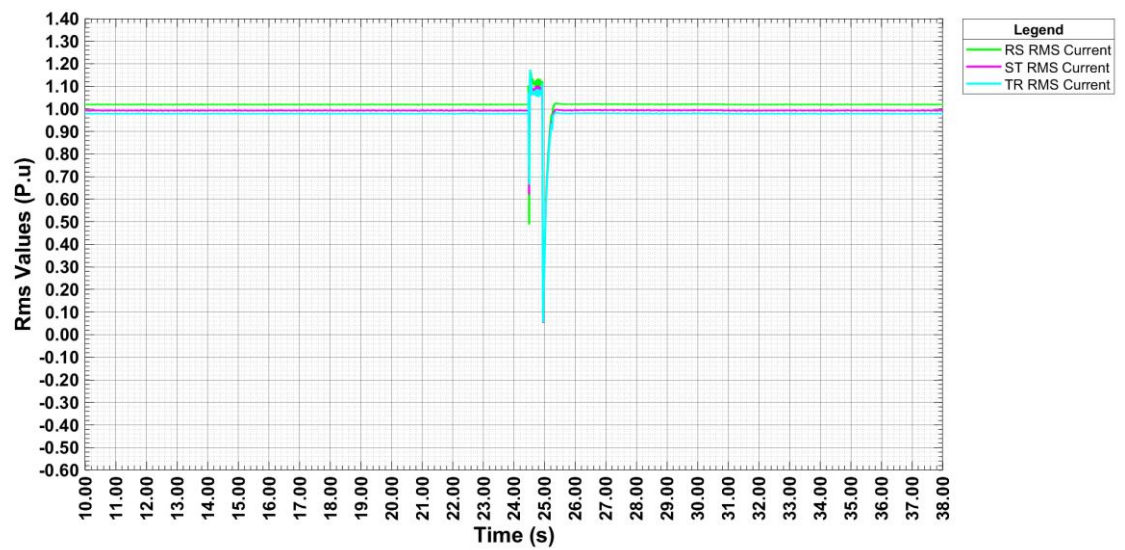
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.1

RMS Phase to phase voltages



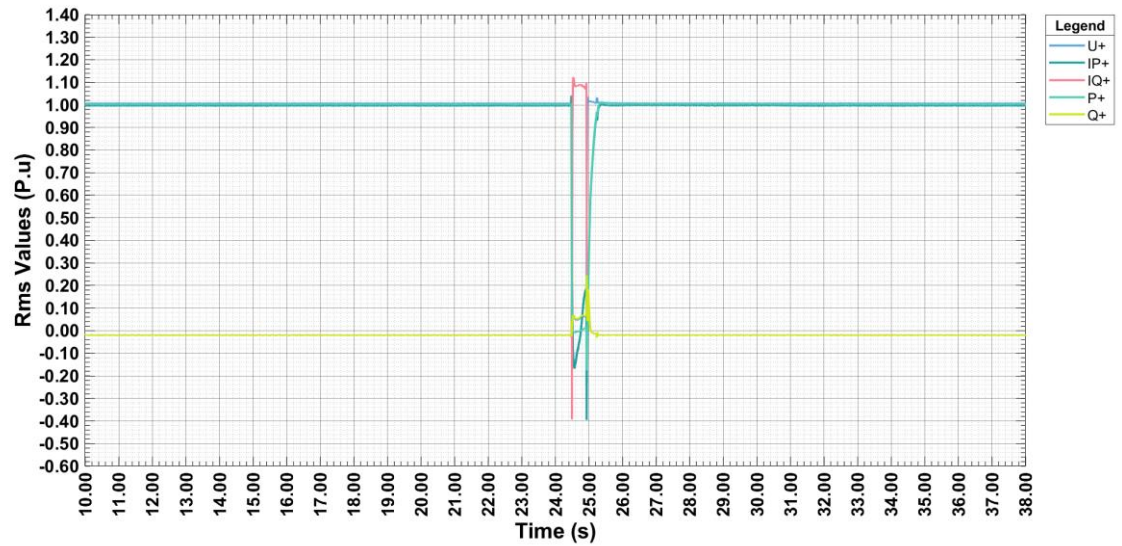
RMS Phase currents



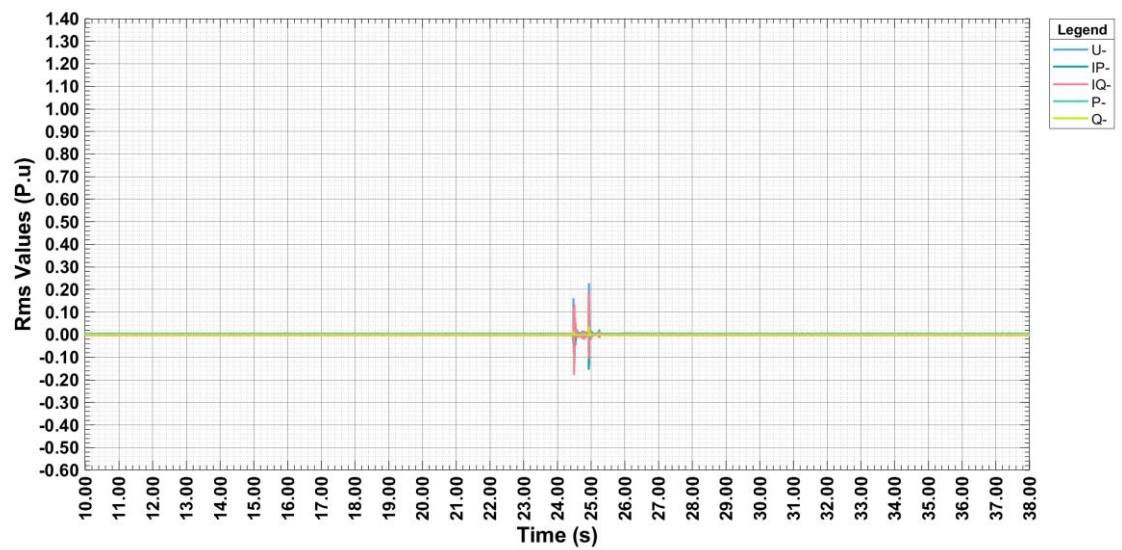
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.1

Positive sequences



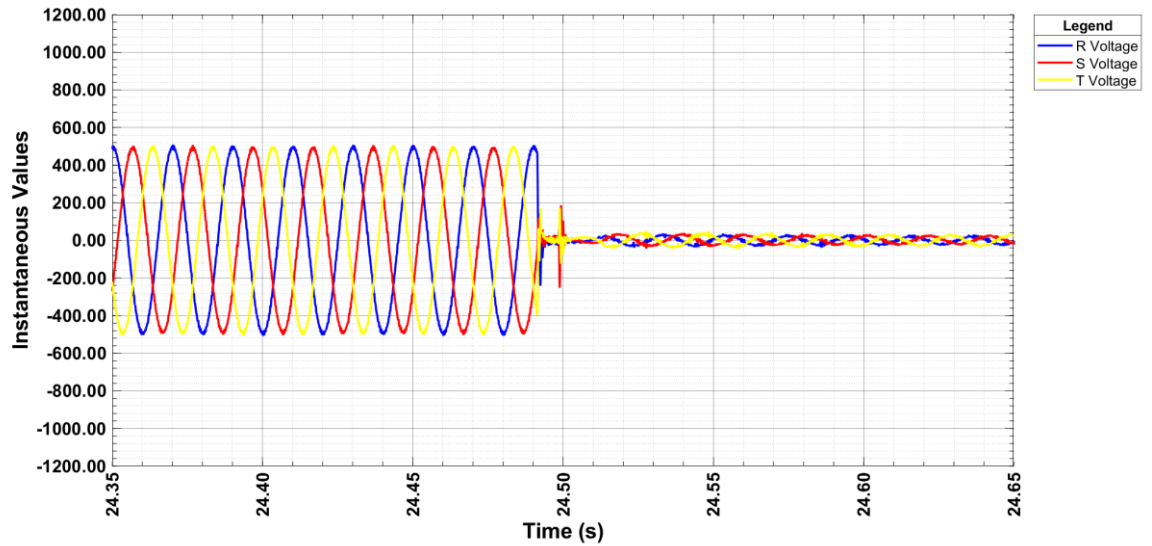
Negative sequences



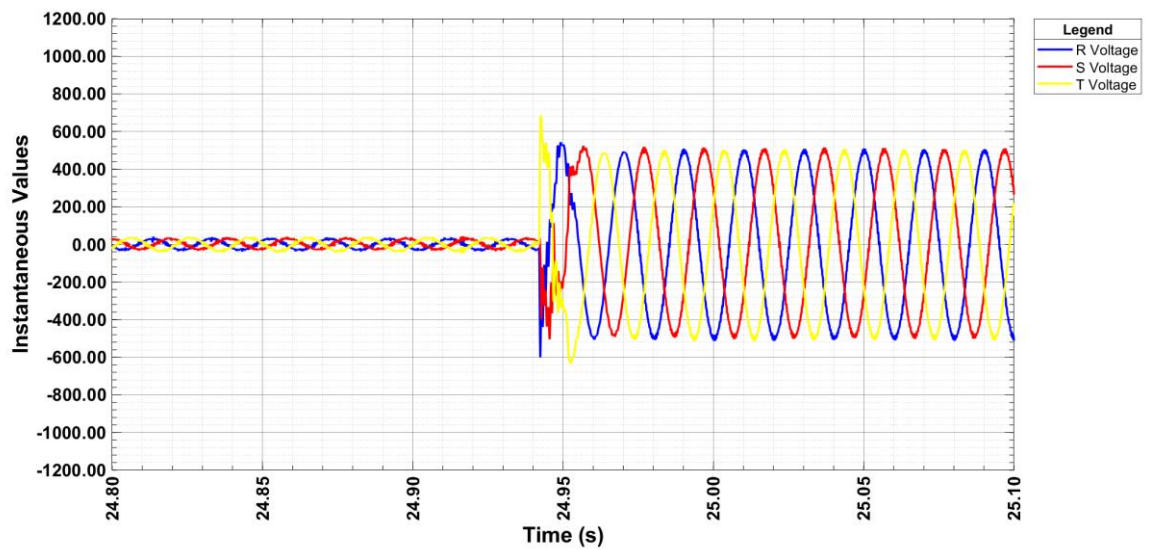
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.1

Transient voltage: Fault beginning



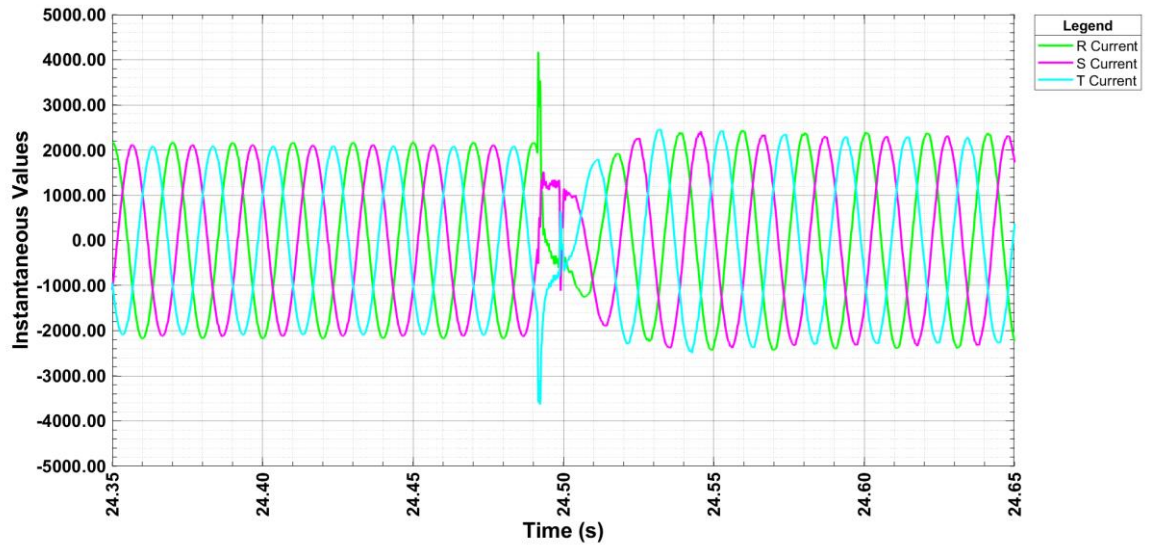
Transient voltage: Fault end



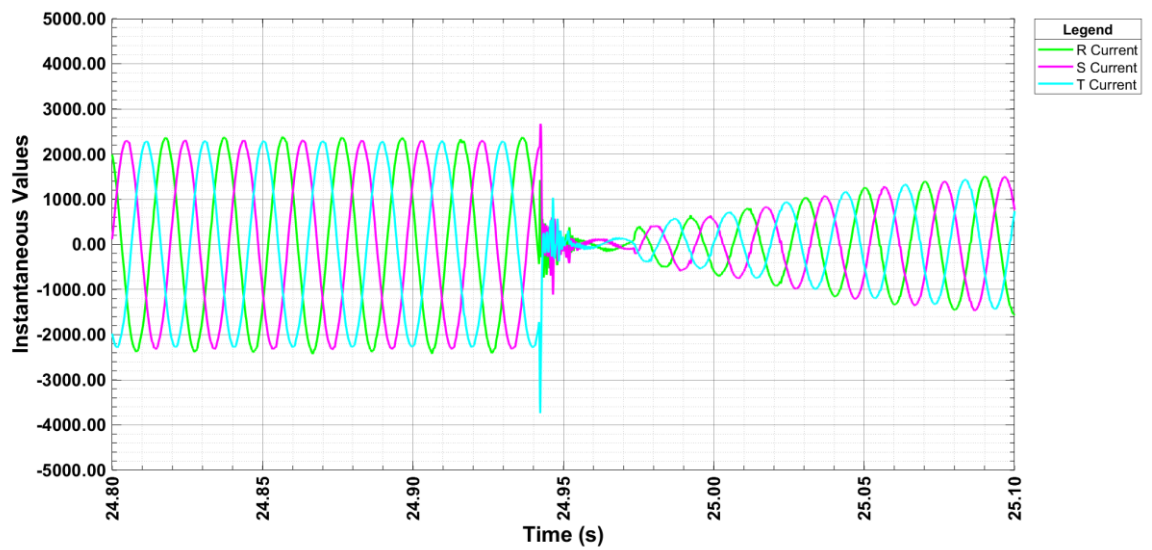
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.1

Transient current: Fault beginning



Transient current: Fault end



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FRT test in FGW-TG3+SP1: Grid Fault Tests Results		

3.1.2.2 Test 0.2 Fault type: 3 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number	-	-	-	0.2
	Date	-	-	[dd.mm.yyyy]	27.09.2020
	Time	-	-	[hh:mm:ss]	14:23:04
	Type of fault (number of affected phases)	-	-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.000
	Drop duration setpoint		-	[ms]	318
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	26084
	Fault clearance (t2)		-	[ms]	26520
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	435
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.085 /1.000 ⁽¹⁾
		Pos. seq.		[p.u.]	0.074 /0.999

⁽¹⁾ The fault voltage was confirmed ≤ 0.05 during the No-Load test in case 0.0.1. Because of test bench limitations, the fault voltage was measured above the required value. However, the result was accepted since the actual fault duration was measured 435 ms in this case, which is longer than needed for this test value.

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.999
		Neg. seq.	t1-60 s to t1	[p.u.]	0.002
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.999
		Pos. seq.	t1-1 s to t1	[p.u.]	0.999
		Neg. seq.	t1-1 s to t1	[p.u.]	0.002
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.204
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.001
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.204
	Active Power	Total	t1-10 s to t1	[p.u.]	0.204
		Total	t1-2 s to t1	[p.u.]	0.204
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.204
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.001
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.130
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	43
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	43
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.053
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.008
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.065
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.001
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.068
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.009
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	-0.002
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.002

Note: The determined K-factor is lower than the configured in the EUT (K = 2) because the current is limited.

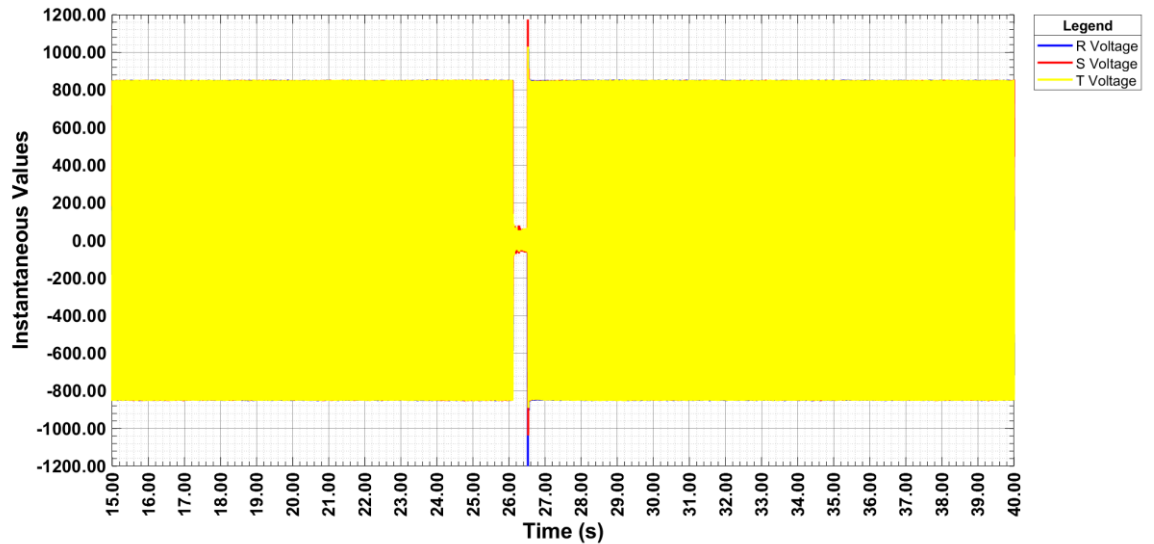
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	876
		Phase 2	t1 to t1+20 ms	[A]	852
		Phase 3	t1 to t1+20 ms	[A]	626
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.582
		Phase 2	t1 + 20 ms	[p.u.]	0.508
		Phase 3	t1 + 20 ms	[p.u.]	1.095
		Phase 1	t1 + 100 ms	[p.u.]	1.076
		Phase 2	t1 + 100 ms	[p.u.]	1.073
		Phase 3	t1 + 100 ms	[p.u.]	1.095
		Phase 1	t1 + 150 ms	[p.u.]	1.064
		Phase 2	t1 + 150 ms	[p.u.]	1.060
		Phase 3	t1 + 150 ms	[p.u.]	1.068
		Phase 1	t1 + 300 ms	[p.u.]	1.072
		Phase 2	t1 + 300 ms	[p.u.]	1.075
		Phase 3	t1 + 300 ms	[p.u.]	1.055
		Phase 1	t1 + 500 ms	[p.u.]	0.223
		Phase 2	t1 + 500 ms	[p.u.]	0.231
		Phase 3	t1 + 500 ms	[p.u.]	0.229
		Phase 1	t1 + 1000 ms	[p.u.]	0.222
		Phase 2	t1 + 1000 ms	[p.u.]	0.221
		Phase 3	t1 + 1000 ms	[p.u.]	0.221
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.214
Active current rise time	Pos. seq.			[s]	0.046

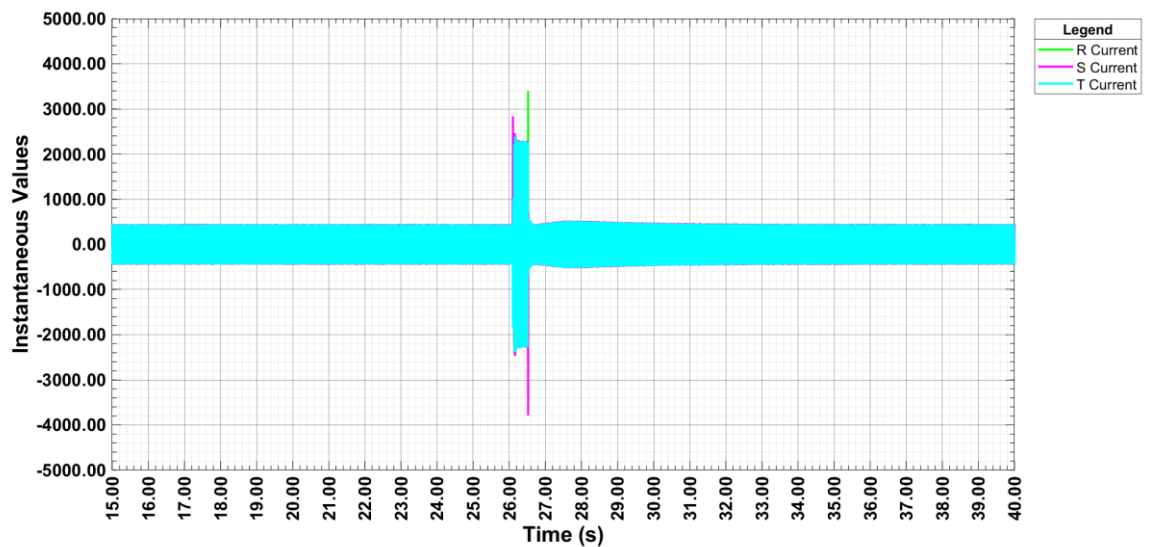
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.2

Phase-to-Phase voltages



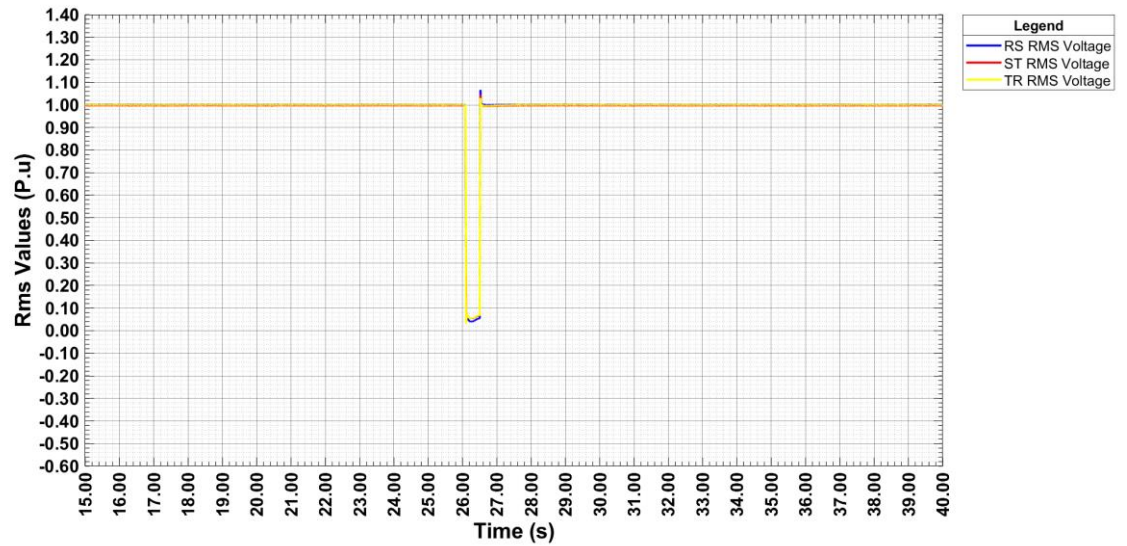
Phase currents



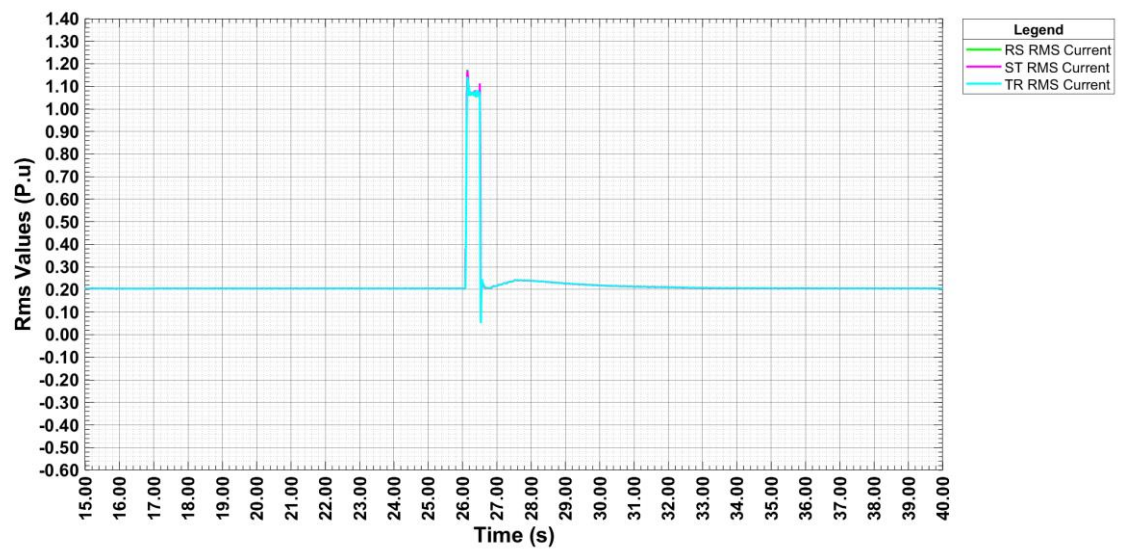
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.2

RMS Phase to phase voltages



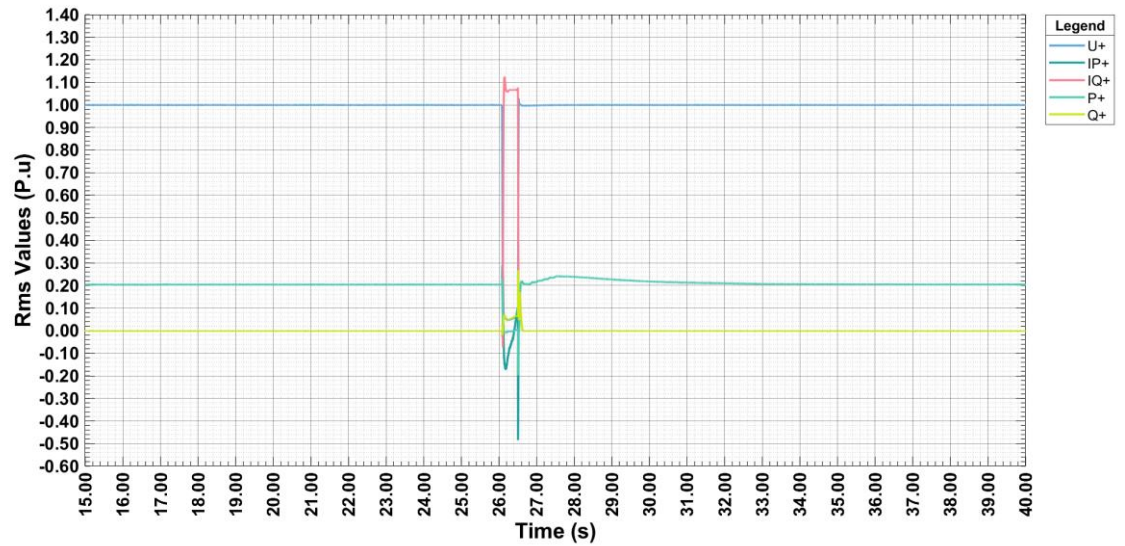
RMS Phase currents



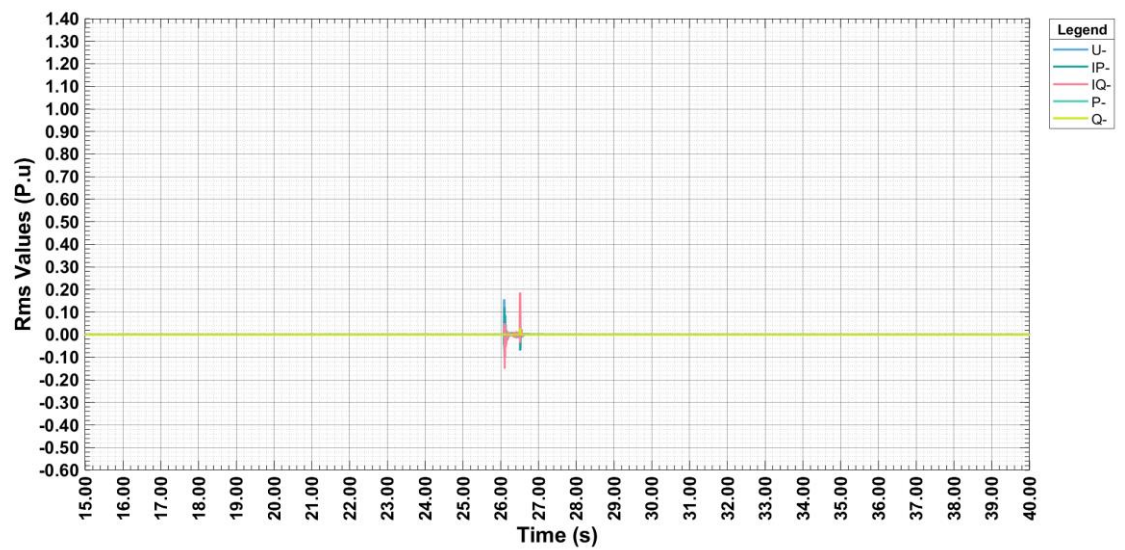
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.2

Positive sequences



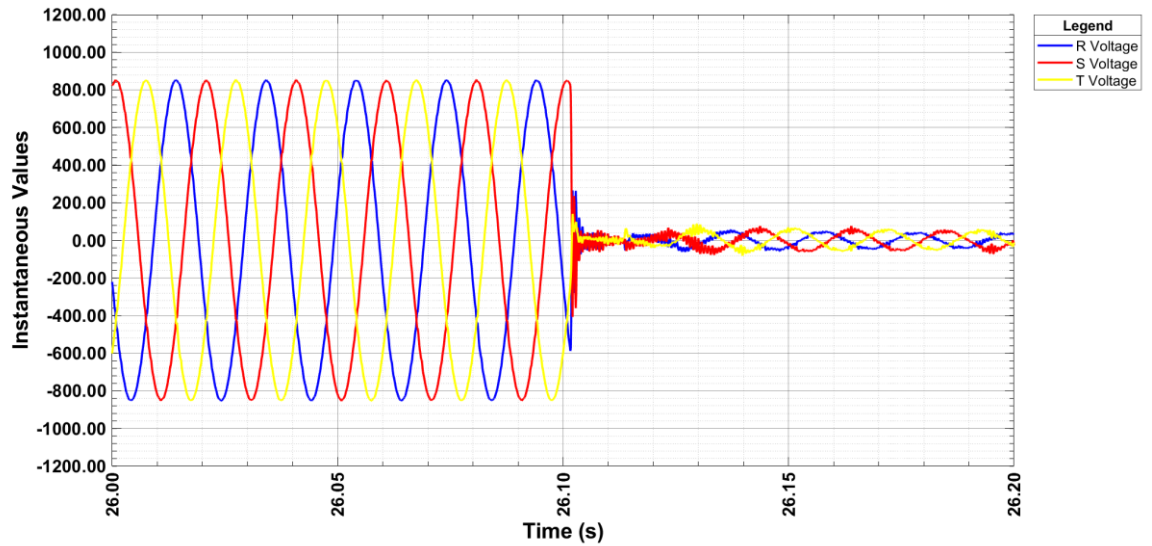
Negative sequences



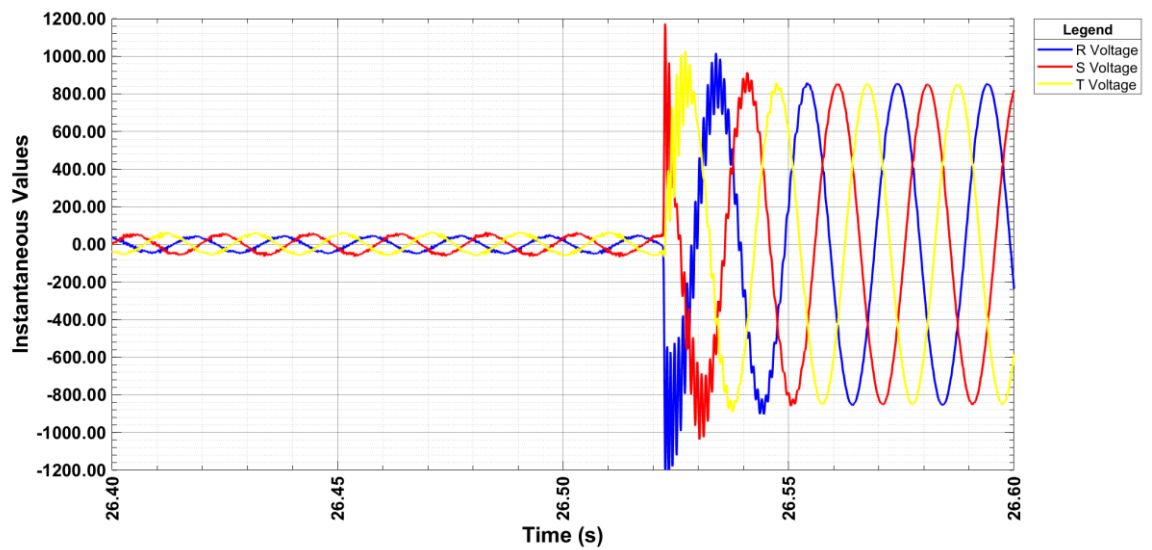
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.2

Transient voltage: Fault beginning



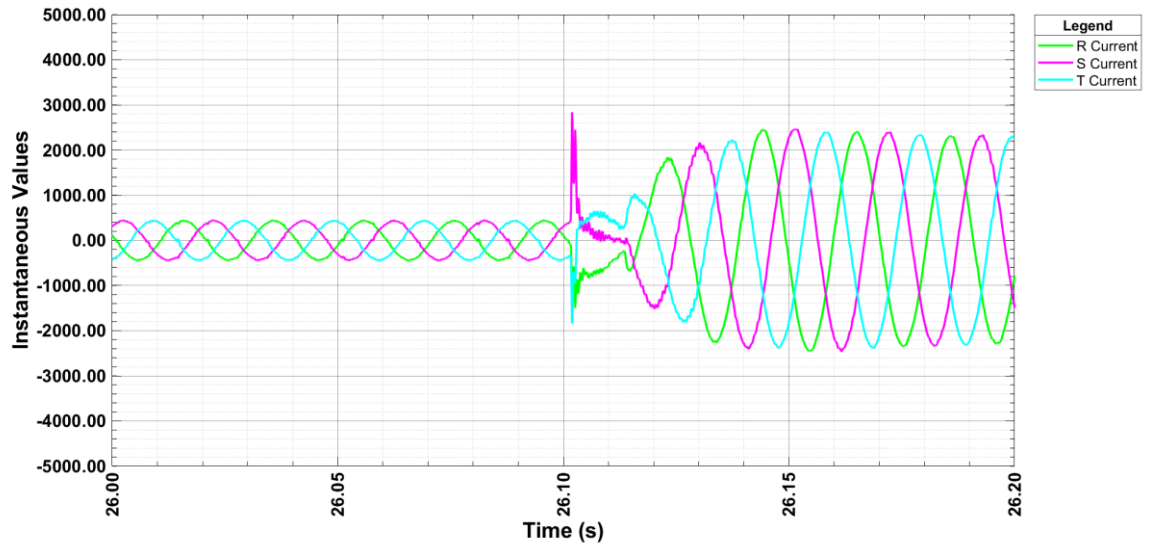
Transient voltage: Fault end



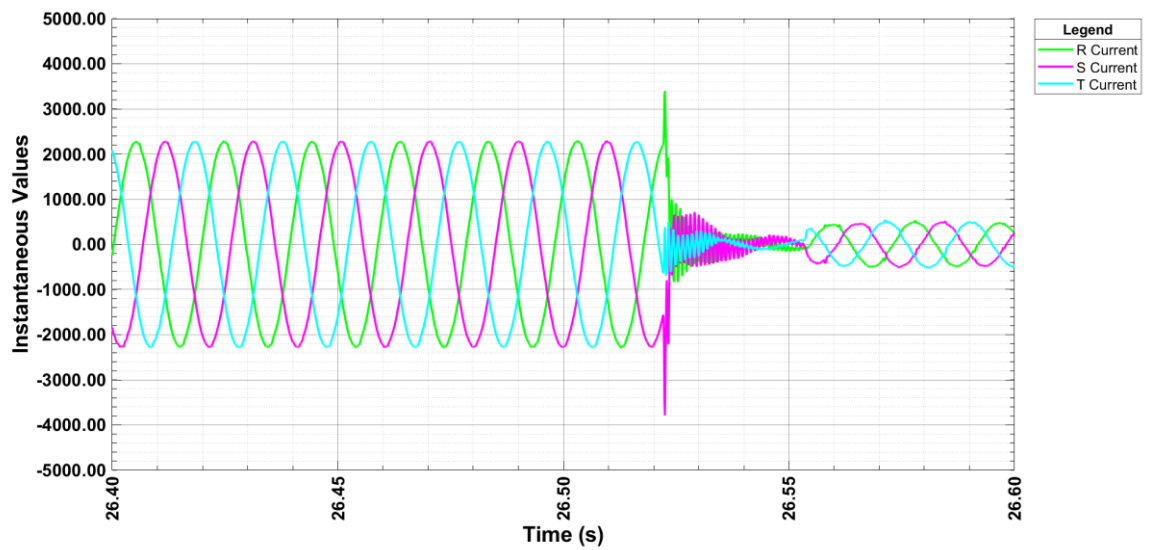
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.2

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.2.3 Test 0.3 Fault type: 2 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	0.3
	Date		-	[dd.mm.yyyy]	19.08.2021
	Time		-	[hh:mm:ss]	21:29:15
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.000
	Drop duration setpoint		-	[ms]	406
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	16555
	Fault clearance (t2)		-	[ms]	17071
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	516
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.047 /0.996
		Pos. seq.		[p.u.]	0.517 /0.998

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.998
		Neg. seq.	t1-60 s to t1	[p.u.]	0.002
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.998
		Pos. seq.	t1-1 s to t1	[p.u.]	0.998
		Neg. seq.	t1-1 s to t1	[p.u.]	0.003
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.999
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1
	Active Power	Total	t1-10 s to t1	[p.u.]	0.998
		Total	t1-2 s to t1	[p.u.]	0.998
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.998
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.037
		Neg. seq.	-	-	-1.046
	Reactive current settling up time	Pos. seq.	-	[ms]	31
		Neg. seq.	-	[ms]	31
	Reactive current settling time	Pos. seq.	-	[ms]	31
		Neg. seq.	-	[ms]	31
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.508
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.488
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.517
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.513
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.526
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.513
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.054
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.048

Note: The determined K-factor is lower than the configured in the EUT ($K = 2$) because the current is limited.

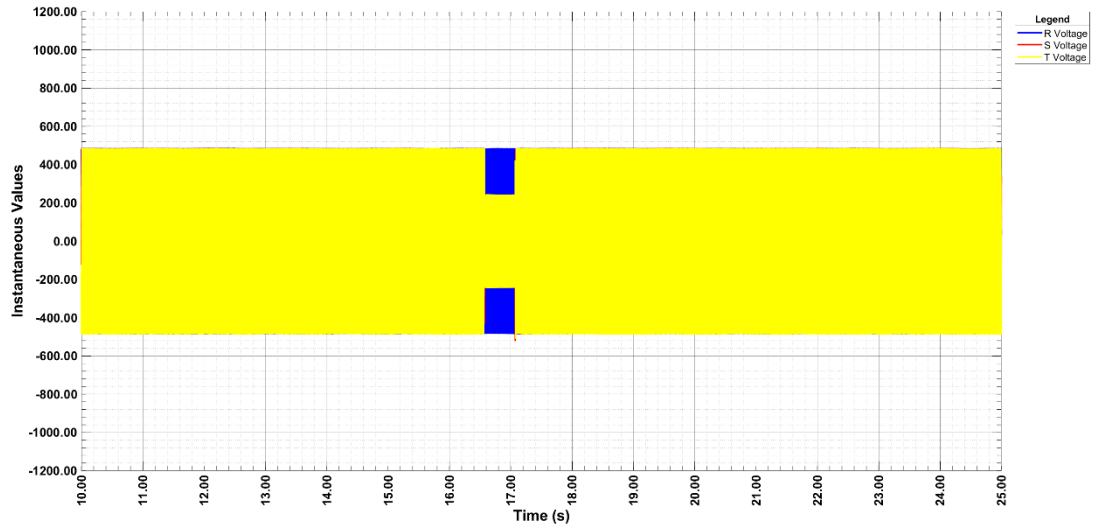
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1478
		Phase 2	t1 to t1+20 ms	[A]	1614
		Phase 3	t1 to t1+20 ms	[A]	1538
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.254
		Phase 2	t1 + 20 ms	[p.u.]	0.798
		Phase 3	t1 + 20 ms	[p.u.]	0.842
		Phase 1	t1 + 100 ms	[p.u.]	0.113
		Phase 2	t1 + 100 ms	[p.u.]	0.950
		Phase 3	t1 + 100 ms	[p.u.]	0.842
		Phase 1	t1 + 150 ms	[p.u.]	0.111
		Phase 2	t1 + 150 ms	[p.u.]	0.949
		Phase 3	t1 + 150 ms	[p.u.]	0.844
		Phase 1	t1 + 300 ms	[p.u.]	0.112
		Phase 2	t1 + 300 ms	[p.u.]	0.949
		Phase 3	t1 + 300 ms	[p.u.]	0.843
		Phase 1	t1 + 500 ms	[p.u.]	0.105
		Phase 2	t1 + 500 ms	[p.u.]	0.957
		Phase 3	t1 + 500 ms	[p.u.]	0.862
		Phase 1	t1 + 1000 ms	[p.u.]	0.990
		Phase 2	t1 + 1000 ms	[p.u.]	0.993
		Phase 3	t1 + 1000 ms	[p.u.]	0.990
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.997
Active current rise time	Pos. seq.			[s]	0.410

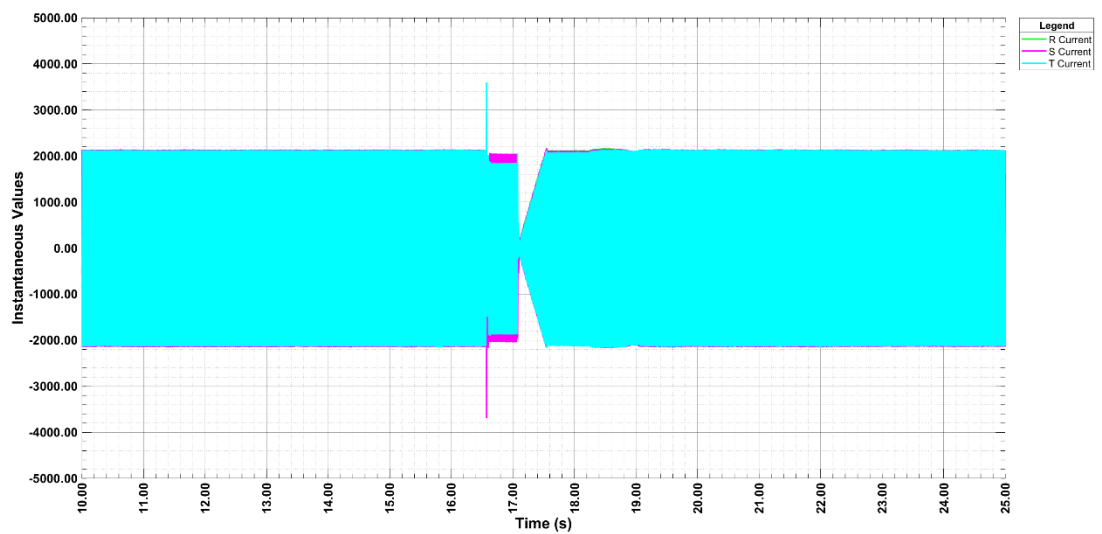
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.3

Phase-to-Phase voltages



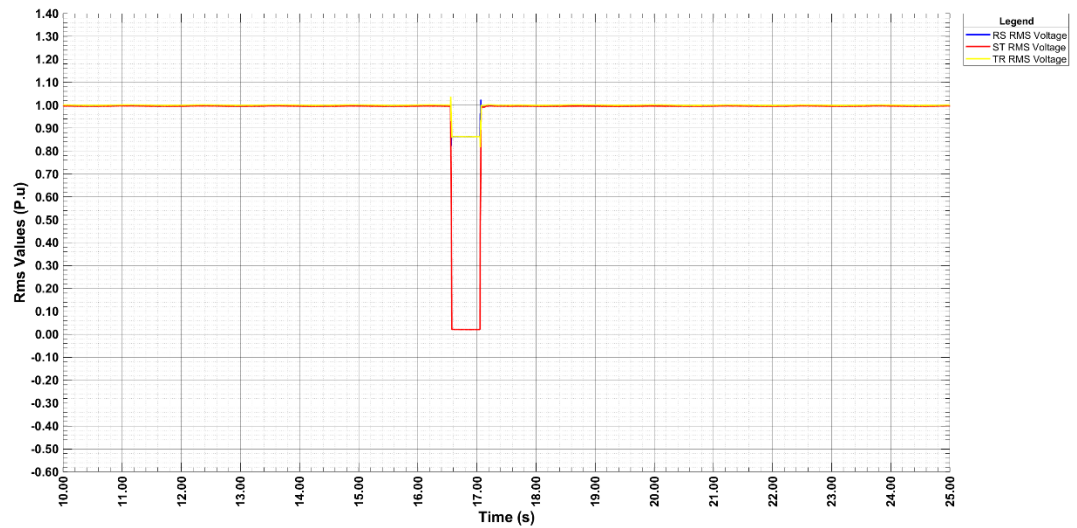
Phase currents



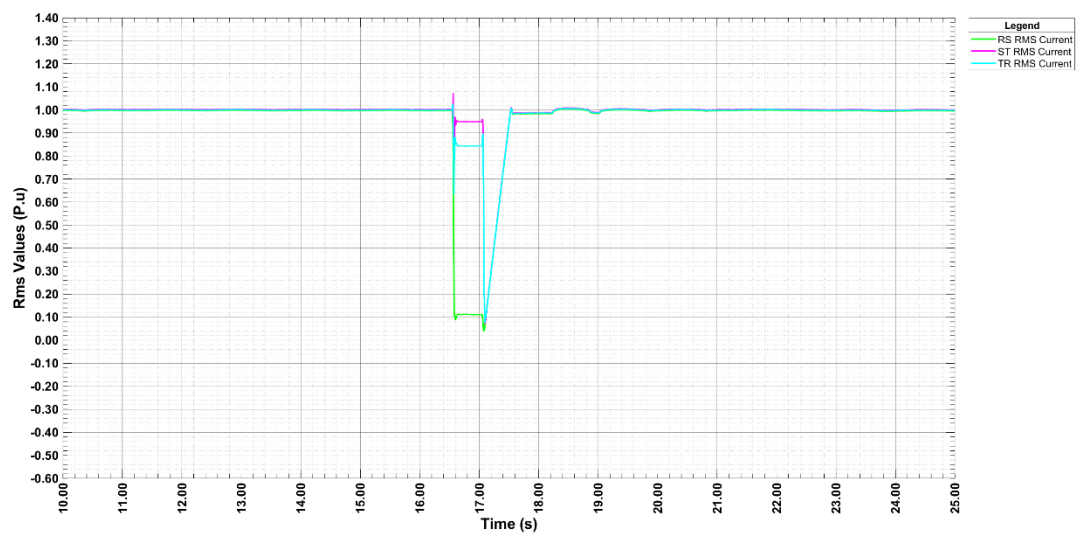
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.3

RMS Phase to phase voltages



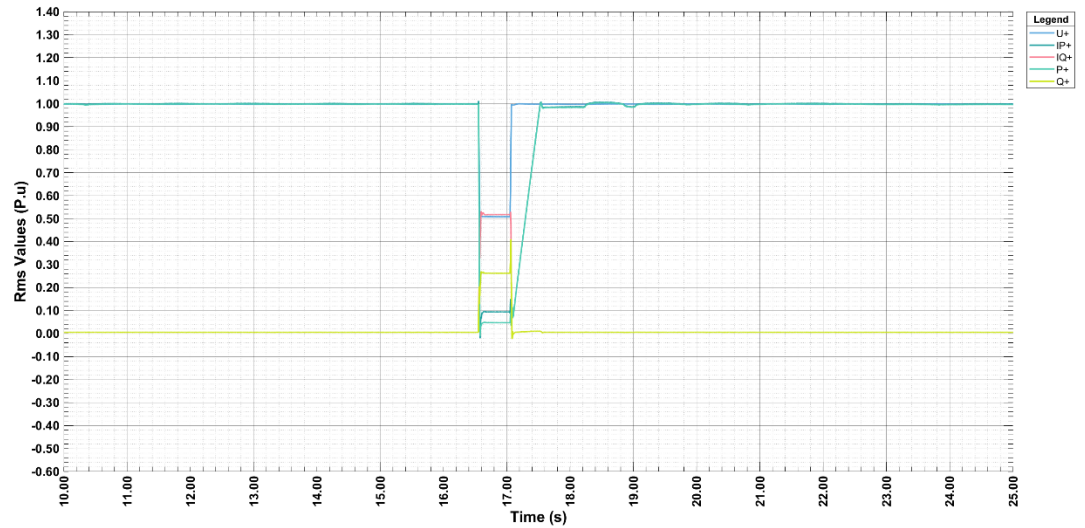
RMS Phase currents



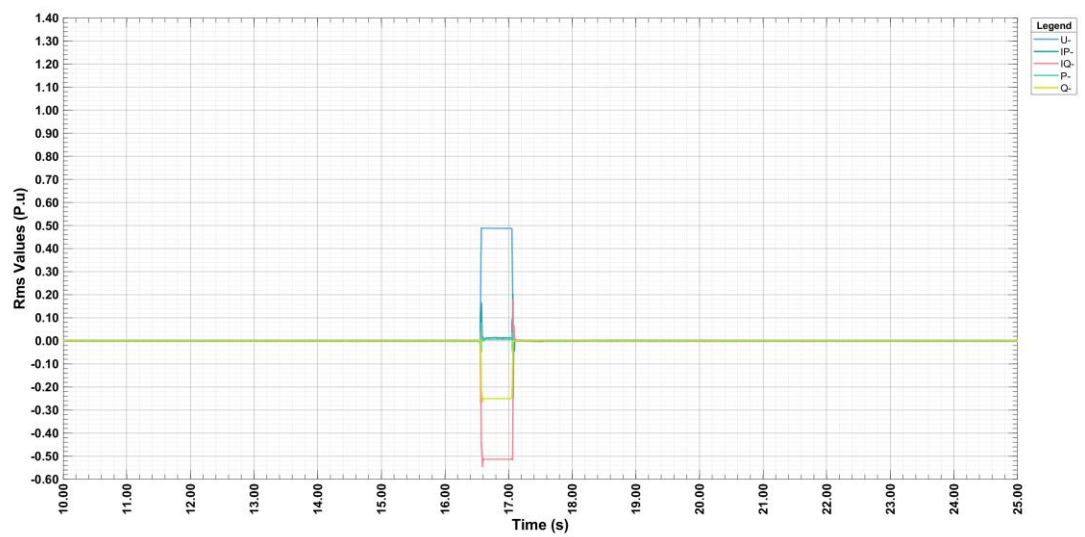
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.3

Positive sequences



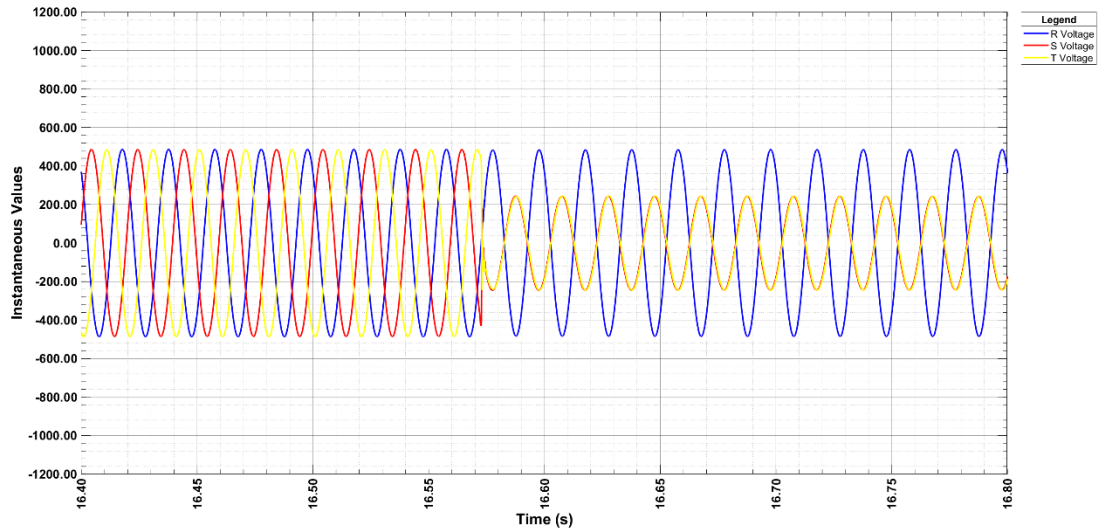
Negative sequences



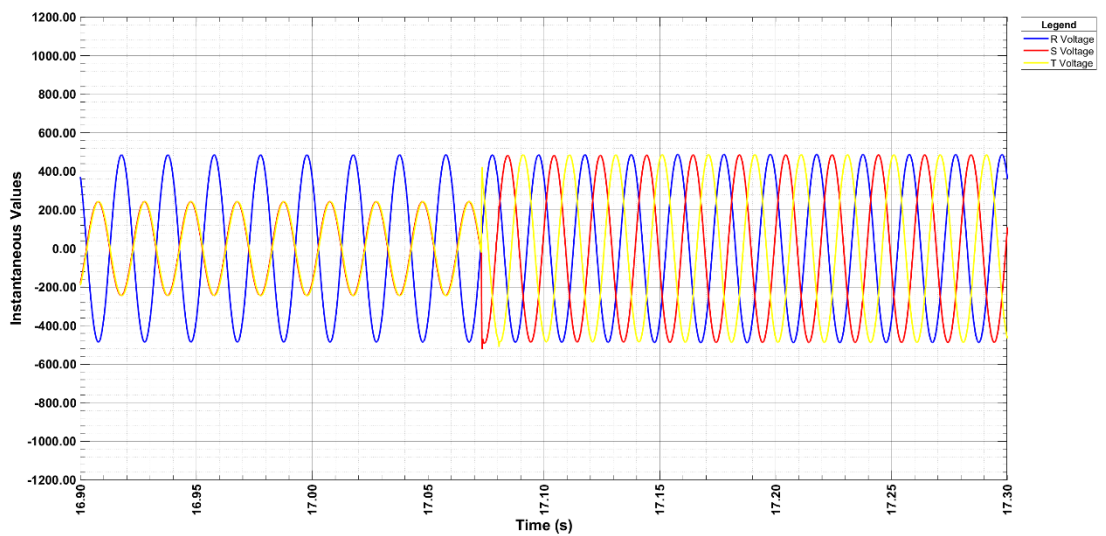
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.3

Transient voltage: Fault beginning



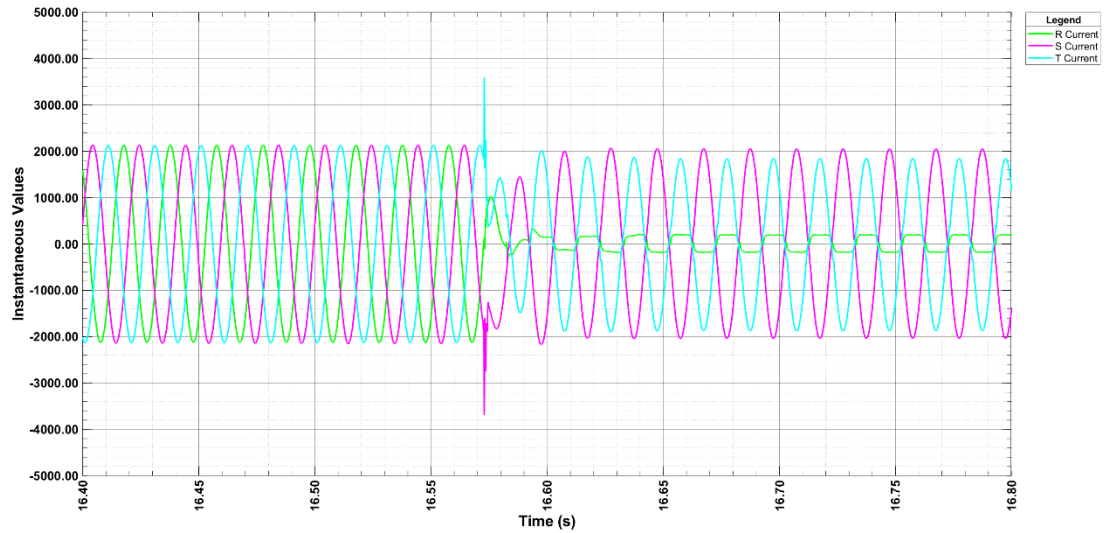
Transient voltage: Fault end



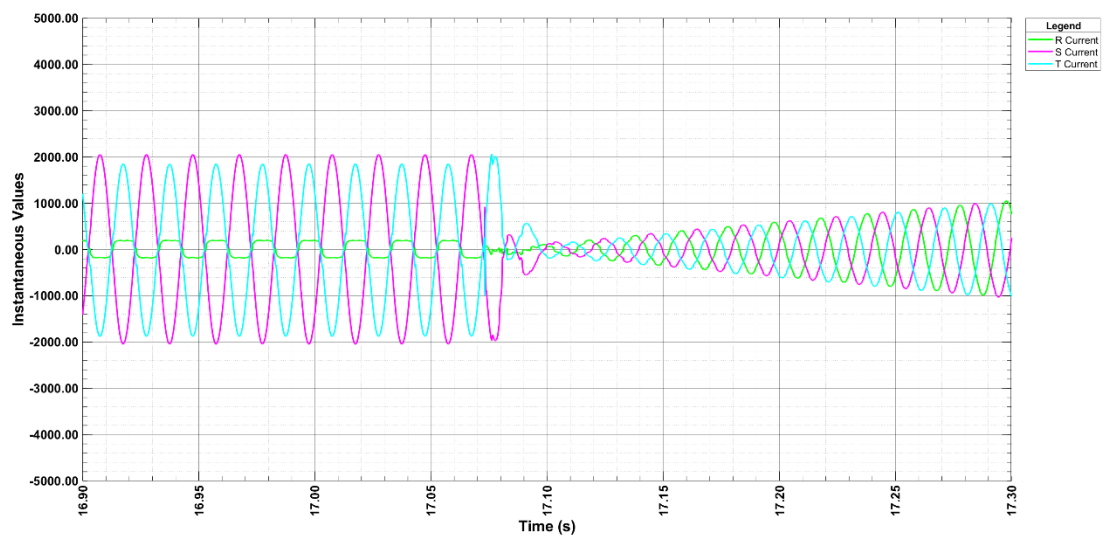
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.3

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.2.4 Test 0.4 Fault type: 2 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	0.4
	Date		-	[dd.mm.yyyy]	19.08.2021
	Time		-	[hh:mm:ss]	22:34:57
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.000
	Drop duration setpoint		-	[ms]	406
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	16794
	Fault clearance (t2)		-	[ms]	17310
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	516
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.047 /0.996
		Pos. seq.		[p.u.]	0.518 /0.997

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.997
		Neg. seq.	t1-60 s to t1	[p.u.]	0.002
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.997
		Pos. seq.	t1-1 s to t1	[p.u.]	0.997
		Neg. seq.	t1-1 s to t1	[p.u.]	0.002
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.218
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.002
		Pos. seq.	t1-1 s to t1	[p.u.]	0.002
		Neg. seq.	t1-1 s to t1	[p.u.]	0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.218
	Active Power	Total	t1-10 s to t1	[p.u.]	0.217
		Total	t1-2 s to t1	[p.u.]	0.217
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.217
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.002
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.058
		Neg. seq.	-	-	-1.066
	Reactive current settling up time	Pos. seq.	-	[ms]	24
		Neg. seq.	-	[ms]	31
	Reactive current settling time	Pos. seq.	-	[ms]	24
		Neg. seq.	-	[ms]	31
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.508
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.488
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.519
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.518
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.527
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.518
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.049
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.045

Note: The determined K-factor is lower than the configured in the EUT (K = 2) because the current is limited.

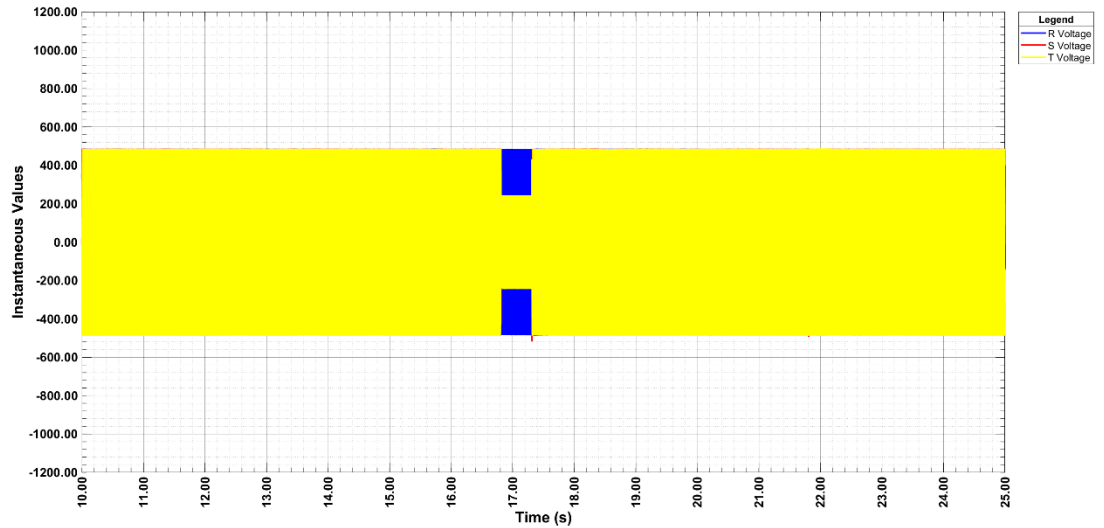
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	363
		Phase 2	t1 to t1+20 ms	[A]	1275
		Phase 3	t1 to t1+20 ms	[A]	1119
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.173
		Phase 2	t1 + 20 ms	[p.u.]	0.841
		Phase 3	t1 + 20 ms	[p.u.]	0.854
		Phase 1	t1 + 100 ms	[p.u.]	0.101
		Phase 2	t1 + 100 ms	[p.u.]	0.950
		Phase 3	t1 + 100 ms	[p.u.]	0.854
		Phase 1	t1 + 150 ms	[p.u.]	0.101
		Phase 2	t1 + 150 ms	[p.u.]	0.950
		Phase 3	t1 + 150 ms	[p.u.]	0.854
		Phase 1	t1 + 300 ms	[p.u.]	0.102
		Phase 2	t1 + 300 ms	[p.u.]	0.951
		Phase 3	t1 + 300 ms	[p.u.]	0.854
		Phase 1	t1 + 500 ms	[p.u.]	0.096
		Phase 2	t1 + 500 ms	[p.u.]	0.957
		Phase 3	t1 + 500 ms	[p.u.]	0.868
		Phase 1	t1 + 1000 ms	[p.u.]	0.216
		Phase 2	t1 + 1000 ms	[p.u.]	0.218
		Phase 3	t1 + 1000 ms	[p.u.]	0.218
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.217
Active current rise time	Pos. seq.			[s]	0.011

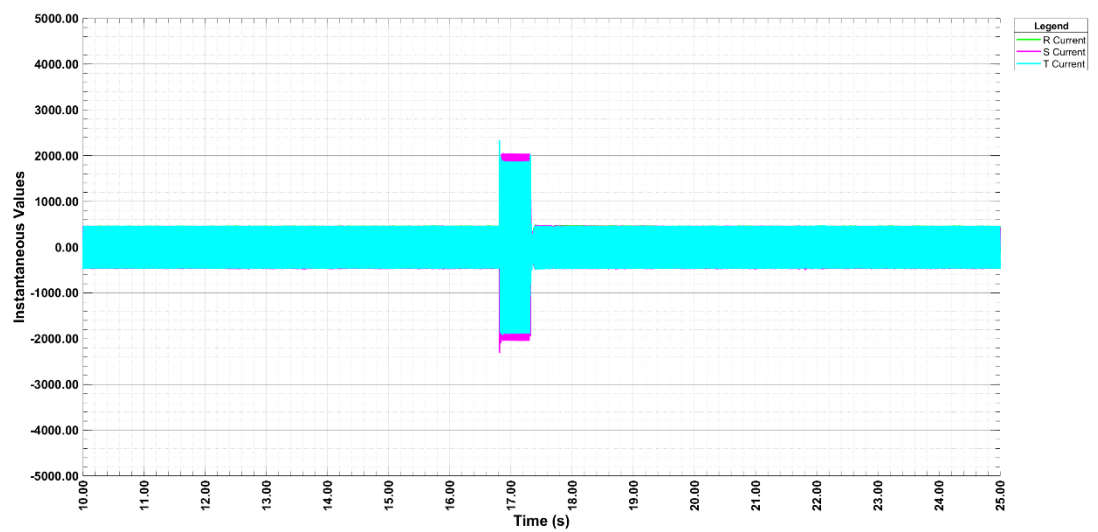
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.4

Phase-to-neutral voltages



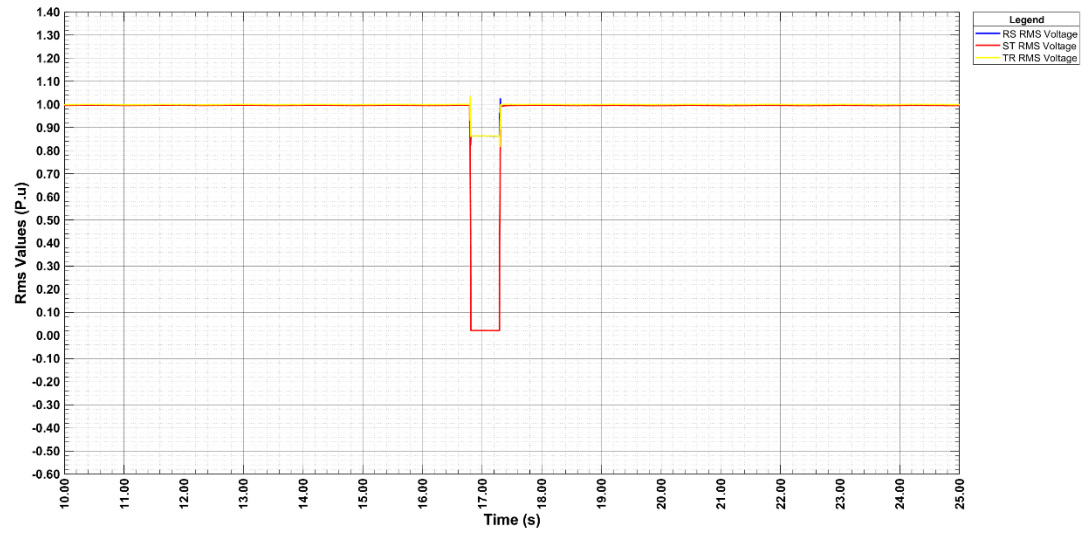
Phase currents



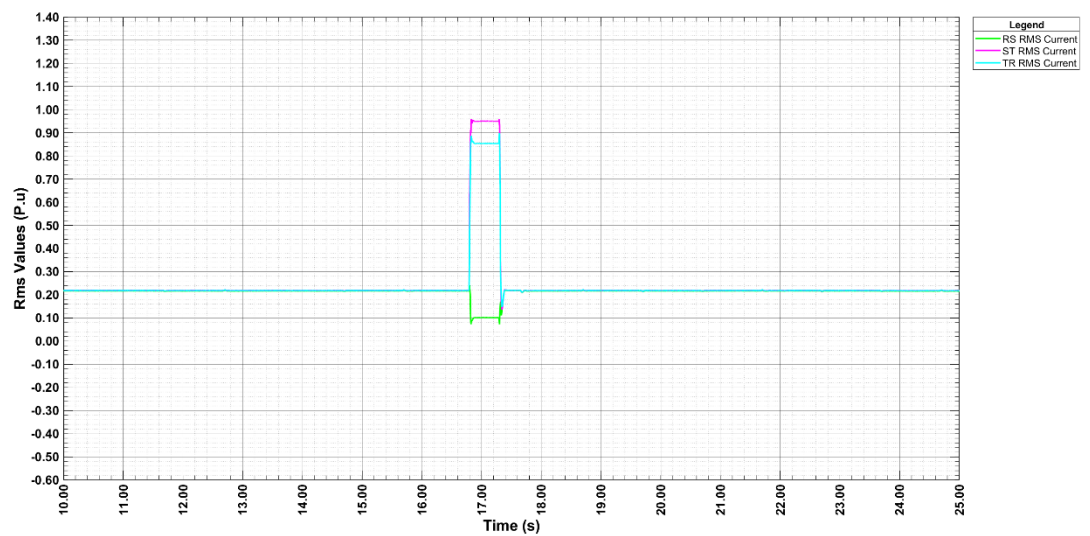
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.4

RMS Phase to phase voltages



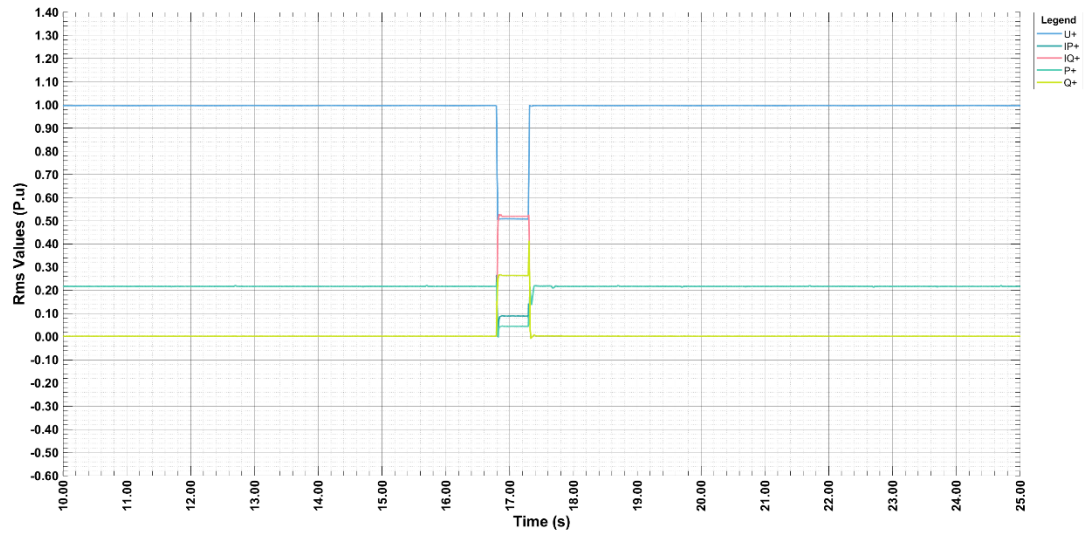
RMS Phase currents



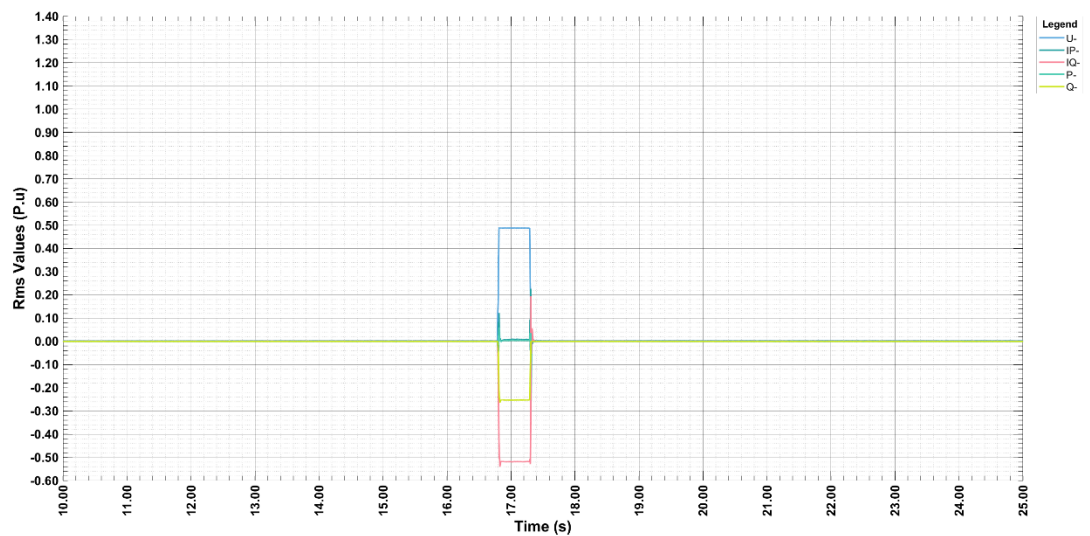
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.4

Positive sequences



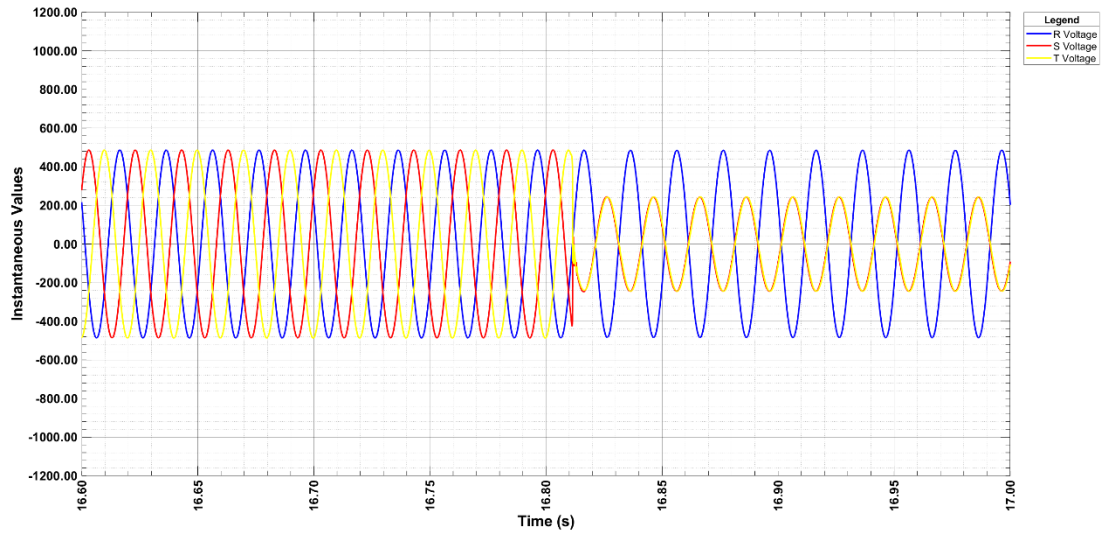
Negative sequences



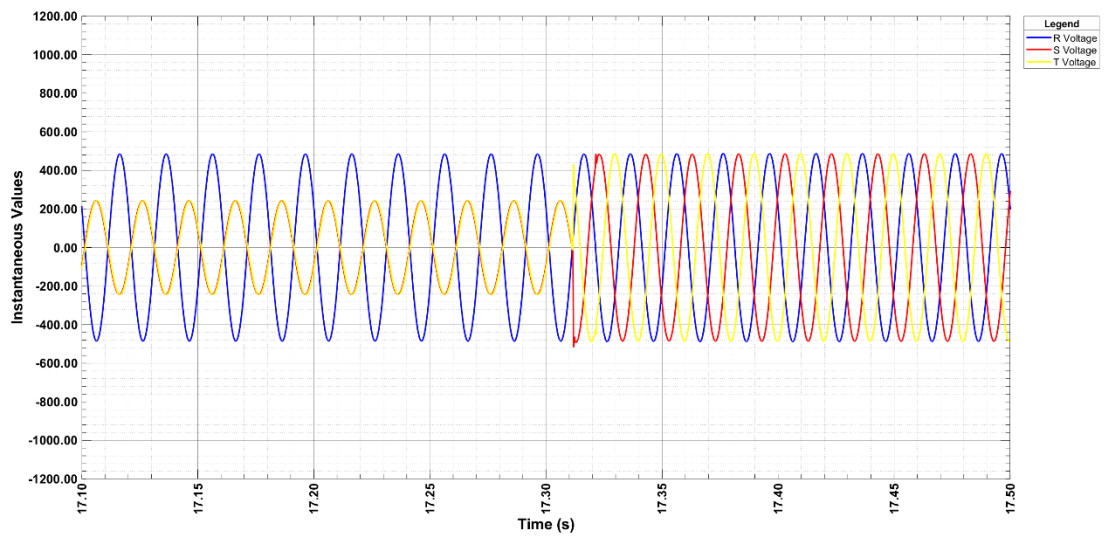
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.4

Transient voltage: Fault beginning



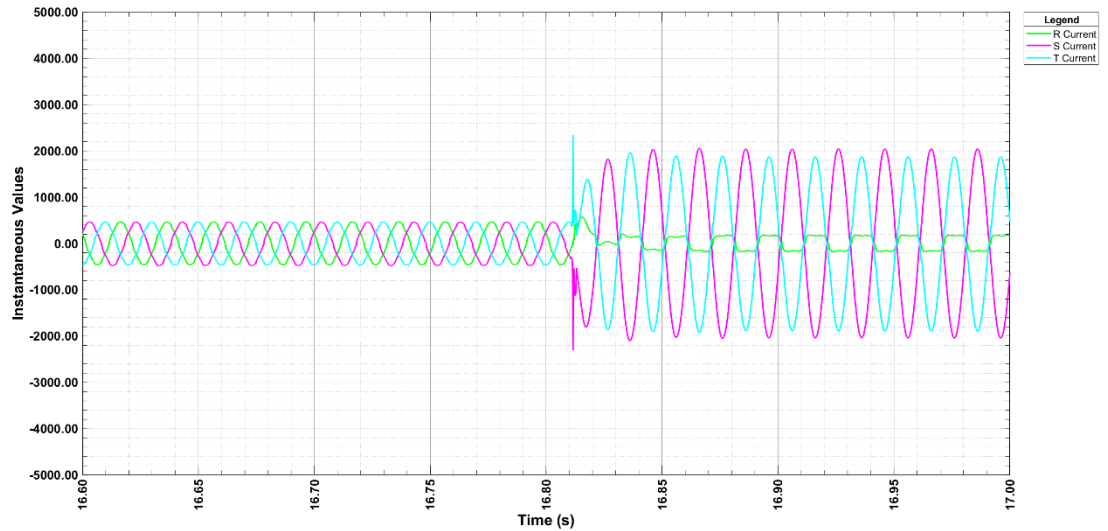
Transient voltage: Fault end



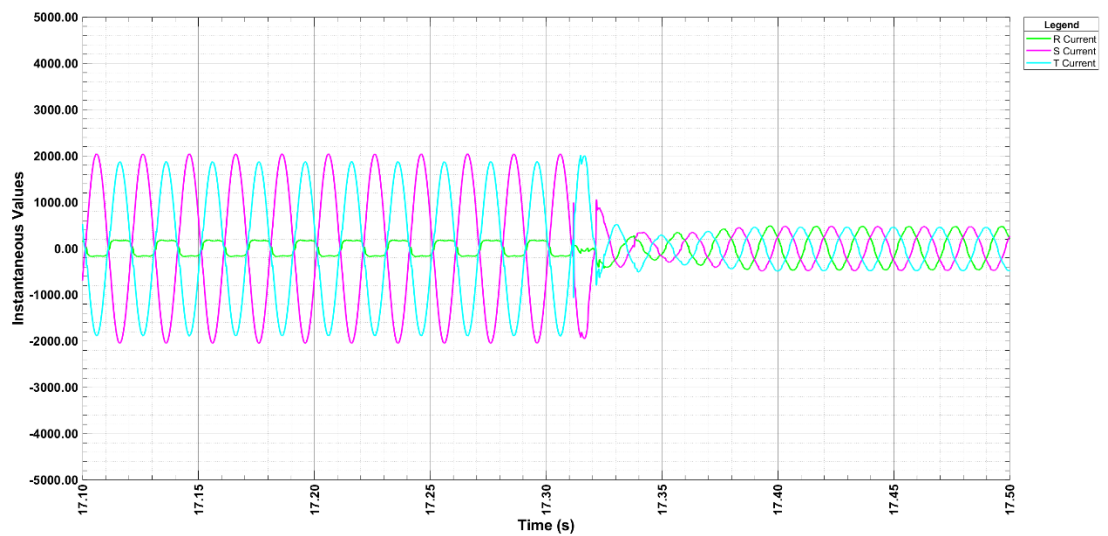
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 0.4

Transient current: Fault beginning



Transient current: Fault end



3.1.3 Load tests: Dip depth 25 %Un

In this chapter of the test report are shown the test results and diagrams for the load tests configured with a dip depth of 25 %Un. There are included in this point the tests 25.1, 25.2, 25.3, 25.4 and 25.5 in accordance with the table 4-67 of the standard. For the voltages and currents in the below pictures and tables, the unit is V and A.

Note: Test 25.3 is optional. In this case, this test was performed and recorded in this report.

3.1.3.1 Test 25.1 Fault type: 3 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	25.1
	Date		-	[dd.mm.yyyy]	10.10.2020
	Time		-	[hh:mm:ss]	11:32:48
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.300
	Drop duration setpoint		-	[ms]	1156
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	40535
	Fault clearance (t2)		-	[ms]	41847
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	1313
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.309/1.007 ⁽¹⁾
		Pos. seq.		[p.u.]	0.307/1.007

⁽¹⁾ The fault voltage was confirmed ≤ 0.05 during the No-Load test in case 25.0.1. Because of test bench limitations, the fault voltage was measured above the required value. However, the result was accepted since the actual fault duration was measured 1313 ms in this case, which is longer than needed for this test value.

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.007
		Neg. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.007
		Pos. seq.	t1-1 s to t1	[p.u.]	1.006
		Neg. seq.	t1-1 s to t1	[p.u.]	0.005
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.994
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.019
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.019
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.002
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.994
	Active Power	Total	t1-10 s to t1	[p.u.]	1.001
		Total	t1-2 s to t1	[p.u.]	1.000
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.001
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.019
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.579
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	36
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	36
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.304
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.008
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.085
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.002
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.087
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.004
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.019
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.019

Note: The determined K-factor is lower than the configured in the EUT ($K = 2$) because the current is limited.

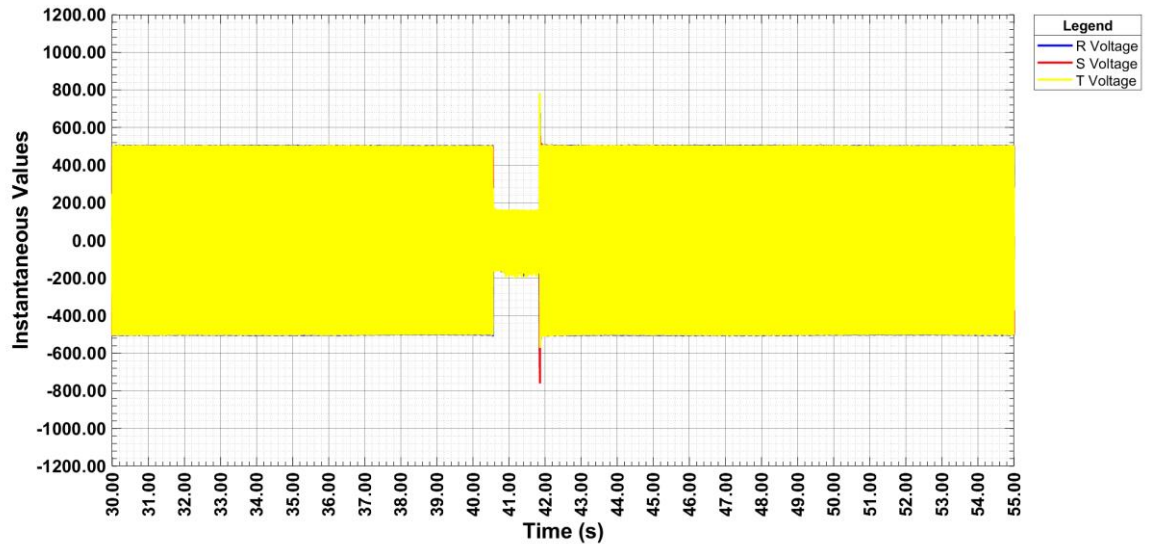
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1598
		Phase 2	t1 to t1+20 ms	[A]	1514
		Phase 3	t1 to t1+20 ms	[A]	1514
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.543
		Phase 2	t1 + 20 ms	[p.u.]	0.748
		Phase 3	t1 + 20 ms	[p.u.]	1.075
		Phase 1	t1 + 100 ms	[p.u.]	1.125
		Phase 2	t1 + 100 ms	[p.u.]	1.097
		Phase 3	t1 + 100 ms	[p.u.]	1.075
		Phase 1	t1 + 150 ms	[p.u.]	1.103
		Phase 2	t1 + 150 ms	[p.u.]	1.085
		Phase 3	t1 + 150 ms	[p.u.]	1.072
		Phase 1	t1 + 300 ms	[p.u.]	1.104
		Phase 2	t1 + 300 ms	[p.u.]	1.086
		Phase 3	t1 + 300 ms	[p.u.]	1.069
		Phase 1	t1 + 500 ms	[p.u.]	1.104
		Phase 2	t1 + 500 ms	[p.u.]	1.084
		Phase 3	t1 + 500 ms	[p.u.]	1.072
		Phase 1	t1 + 1000 ms	[p.u.]	1.102
		Phase 2	t1 + 1000 ms	[p.u.]	1.084
		Phase 3	t1 + 1000 ms	[p.u.]	1.070
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.001
Active current rise time	Pos. seq.			[s]	0.234

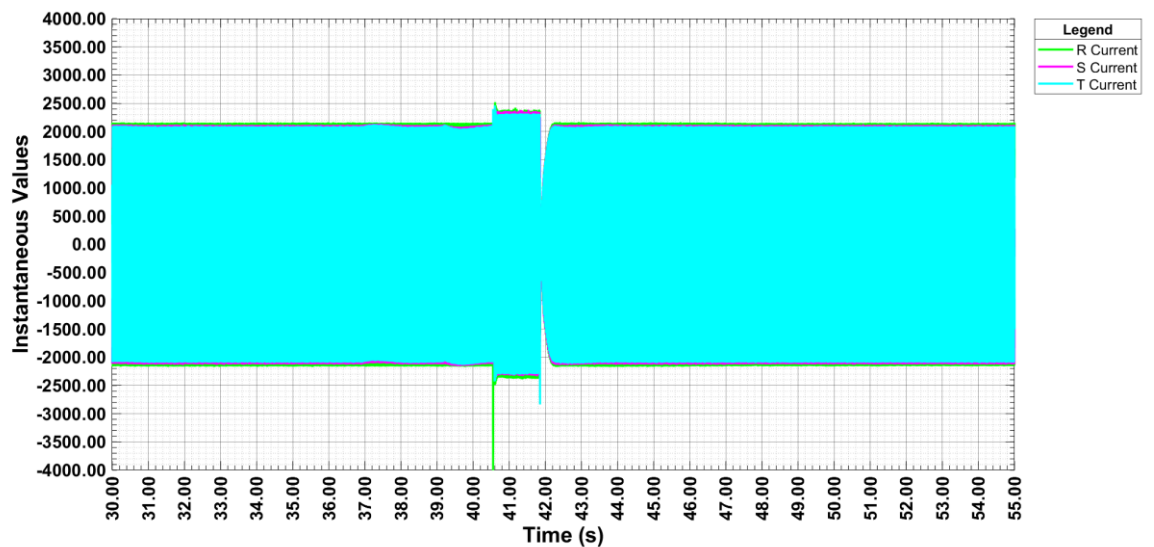
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.1

Phase-to-neutral voltages



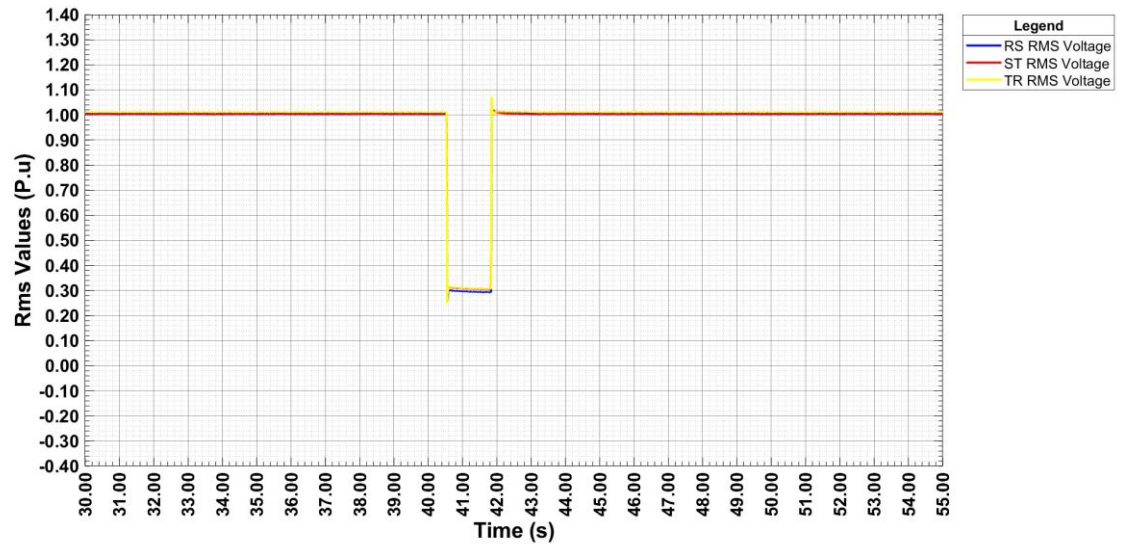
Phase currents



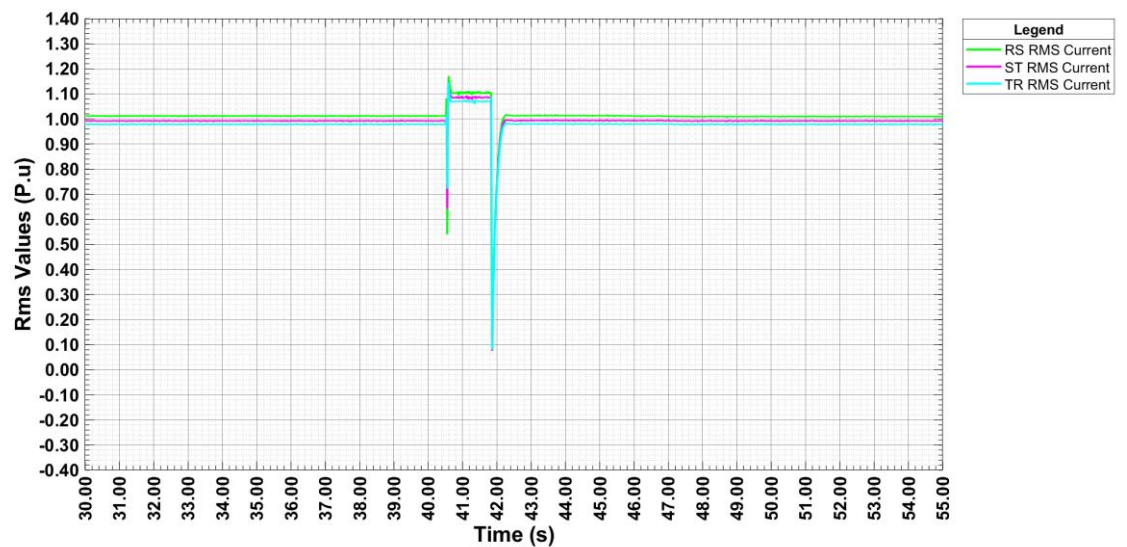
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.1

RMS Phase to phase voltages



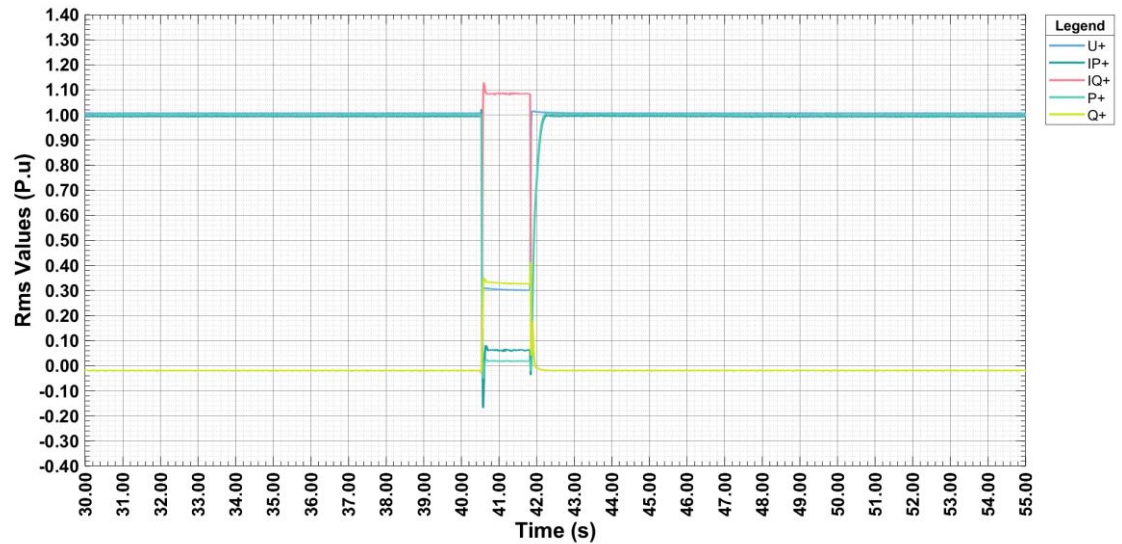
RMS Phase currents



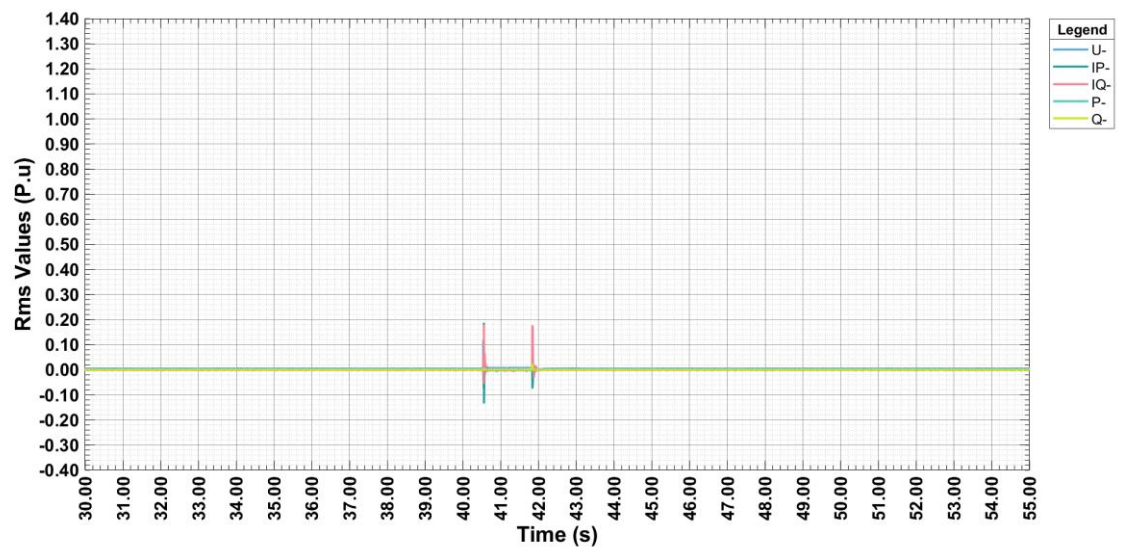
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.1

Positive sequences



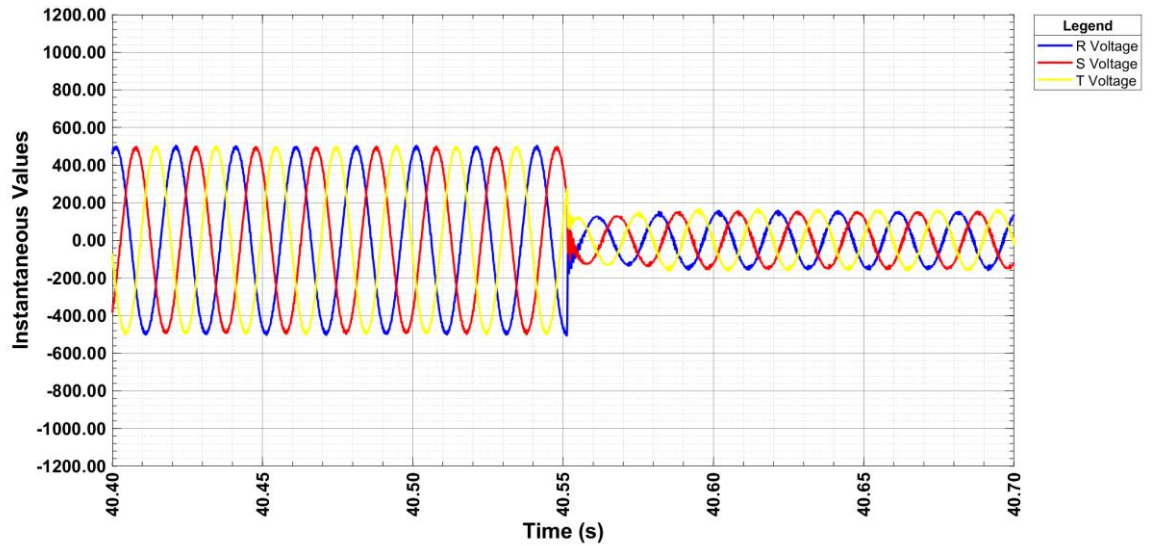
Negative sequences



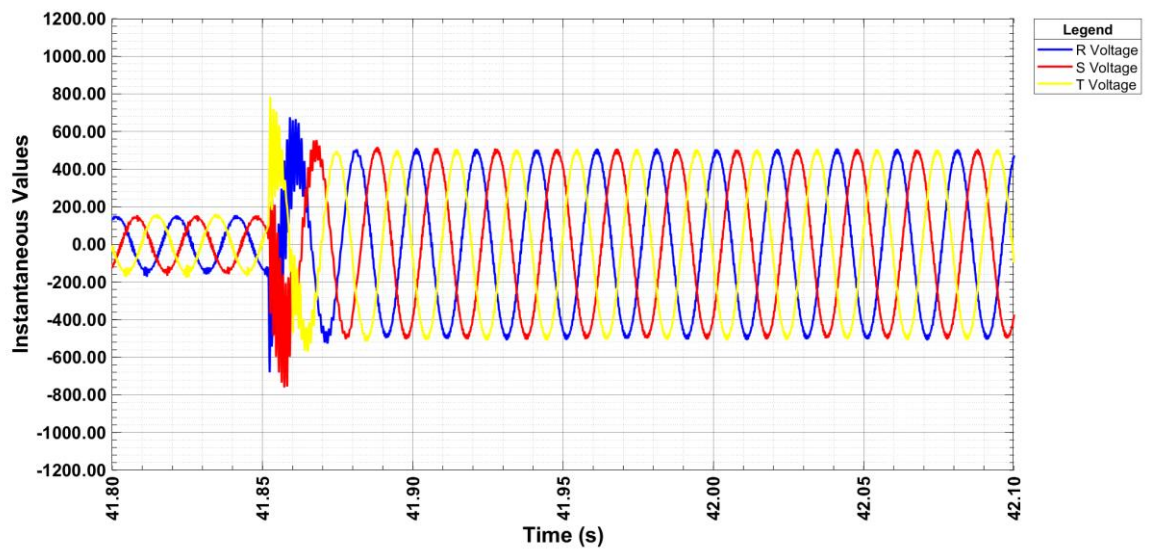
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.1

Transient voltage: Fault beginning



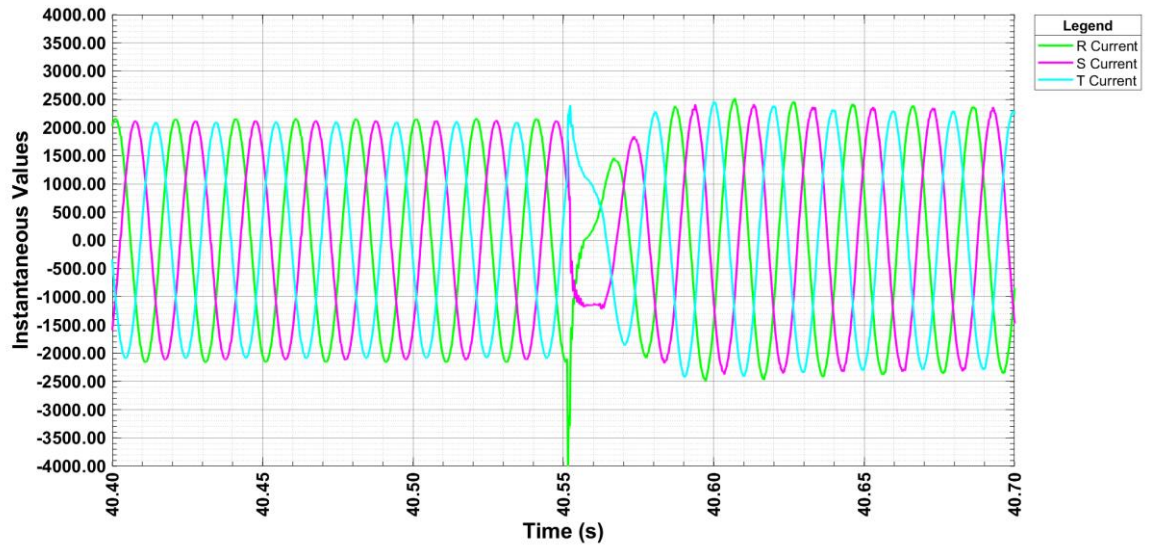
Transient voltage: Fault end



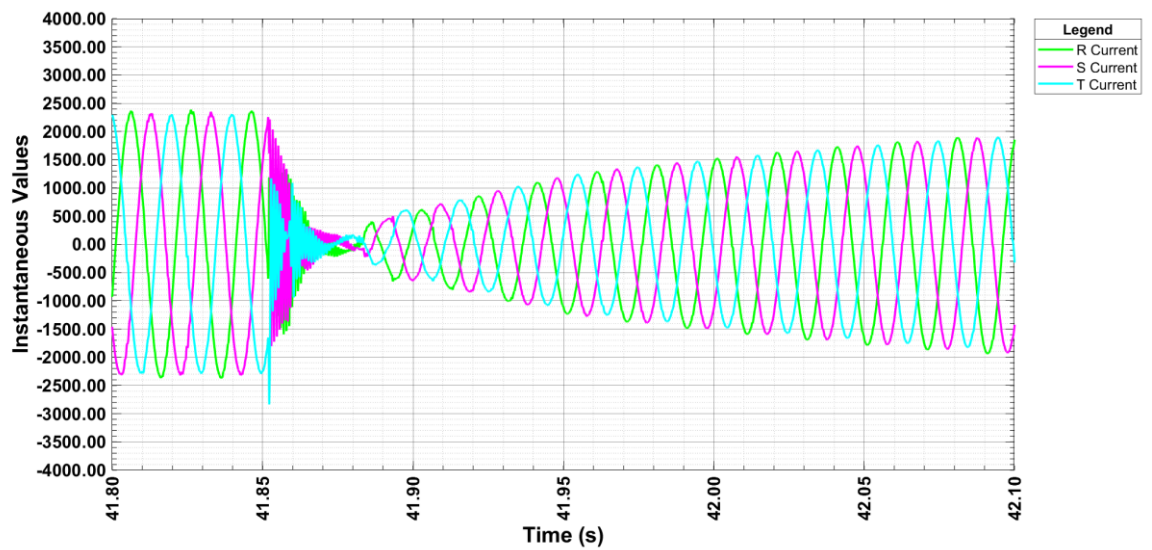
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.1

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.3.2 Test 25.2 Fault type: 3 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	25.2
	Date		-	[dd.mm.yyyy]	10.10.2020
	Time		-	[hh:mm:ss]	11:30:06
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.250
	Drop duration setpoint		-	[ms]	1156
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	25115
	Fault clearance (t2)		-	[ms]	26432
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	1317
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.308 /0.999 ⁽¹⁾
		Pos. seq.		[p.u.]	0.305 /0.999

⁽¹⁾ The fault voltage was confirmed ≤ 0.05 during the No-Load test in case 25.0.1. Because of test bench limitations, the fault voltage was measured above the required value. However, the result was accepted since the actual fault duration was measured 1317 ms in this case, which is longer than needed for this test value.

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.999
		Neg. seq.	t1-60 s to t1	[p.u.]	0.001
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.000
		Pos. seq.	t1-1 s to t1	[p.u.]	0.999
		Neg. seq.	t1-1 s to t1	[p.u.]	0.001
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.208
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.006
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.006
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.208
	Active Power	Total	t1-10 s to t1	[p.u.]	0.208
		Total	t1-2 s to t1	[p.u.]	0.208
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.208
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.006
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.558
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	34
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	34
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.301
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.009
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.083
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.002
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.085
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.004
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.019
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.019

Note: The determined K-factor is lower than the configured in the EUT ($K = 2$) because the current is limited.

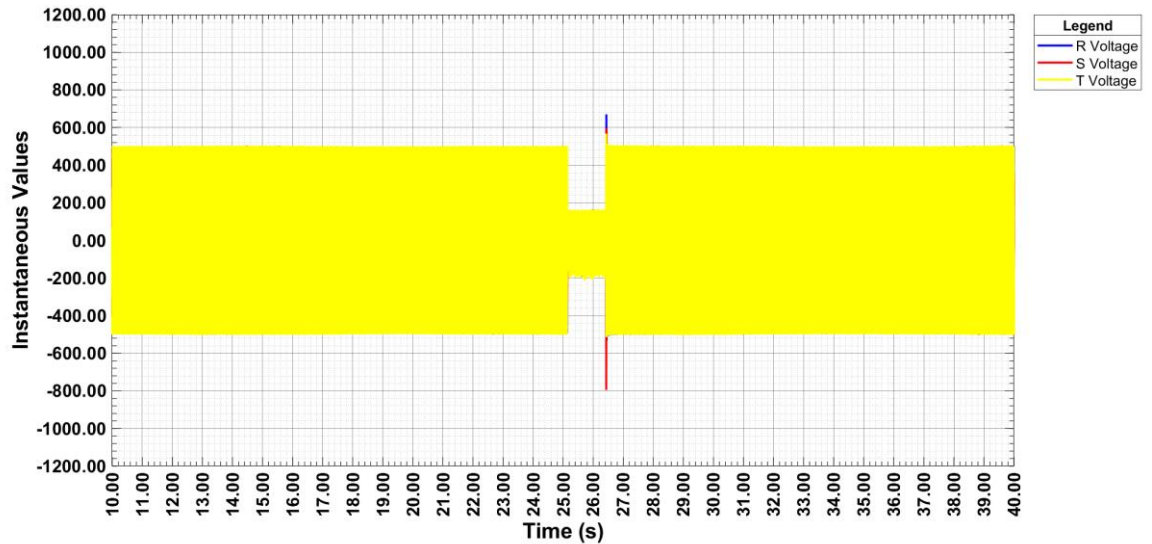
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1050
		Phase 2	t1 to t1+20 ms	[A]	1087
		Phase 3	t1 to t1+20 ms	[A]	798
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.699
		Phase 2	t1 + 20 ms	[p.u.]	0.723
		Phase 3	t1 + 20 ms	[p.u.]	1.083
		Phase 1	t1 + 100 ms	[p.u.]	1.118
		Phase 2	t1 + 100 ms	[p.u.]	1.093
		Phase 3	t1 + 100 ms	[p.u.]	1.083
		Phase 1	t1 + 150 ms	[p.u.]	1.103
		Phase 2	t1 + 150 ms	[p.u.]	1.083
		Phase 3	t1 + 150 ms	[p.u.]	1.069
		Phase 1	t1 + 300 ms	[p.u.]	1.102
		Phase 2	t1 + 300 ms	[p.u.]	1.082
		Phase 3	t1 + 300 ms	[p.u.]	1.066
		Phase 1	t1 + 500 ms	[p.u.]	1.106
		Phase 2	t1 + 500 ms	[p.u.]	1.085
		Phase 3	t1 + 500 ms	[p.u.]	1.070
		Phase 1	t1 + 1000 ms	[p.u.]	1.103
		Phase 2	t1 + 1000 ms	[p.u.]	1.083
		Phase 3	t1 + 1000 ms	[p.u.]	1.067
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.208
Active current rise time	Pos. seq.			[s]	0.035

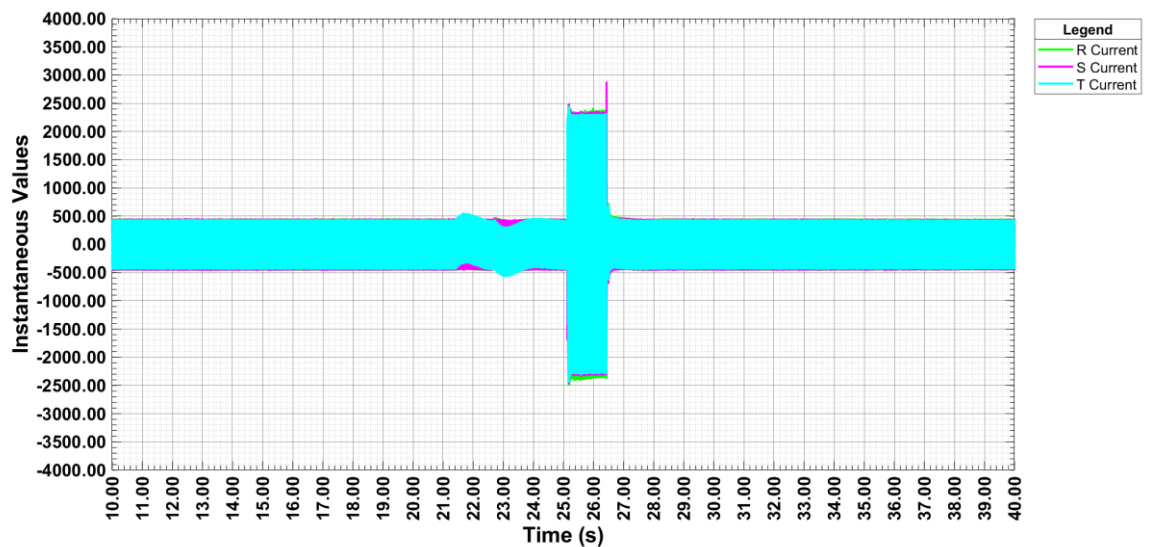
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.2

Phase-to-neutral voltages



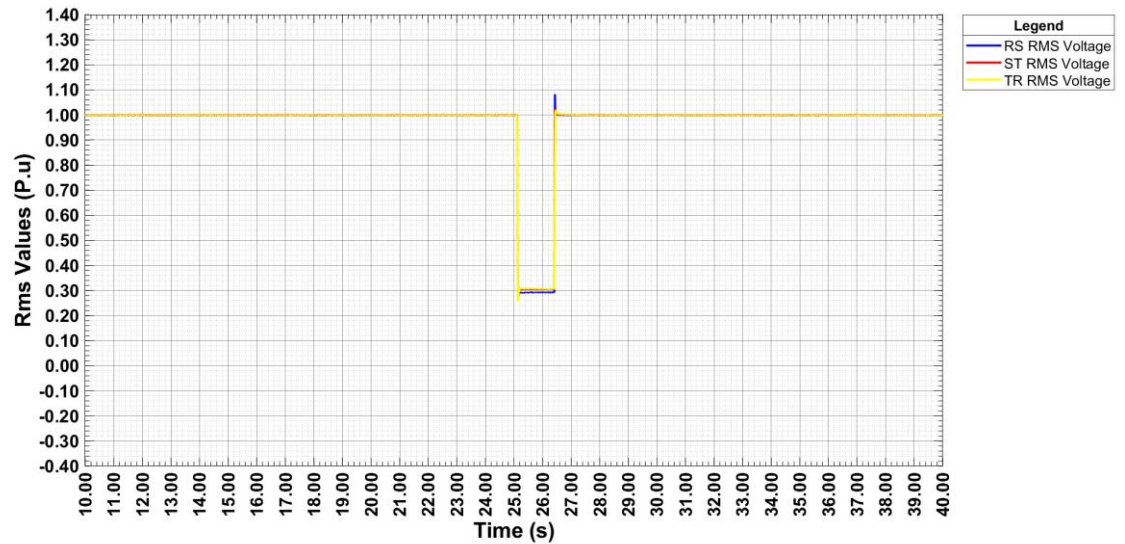
Phase currents



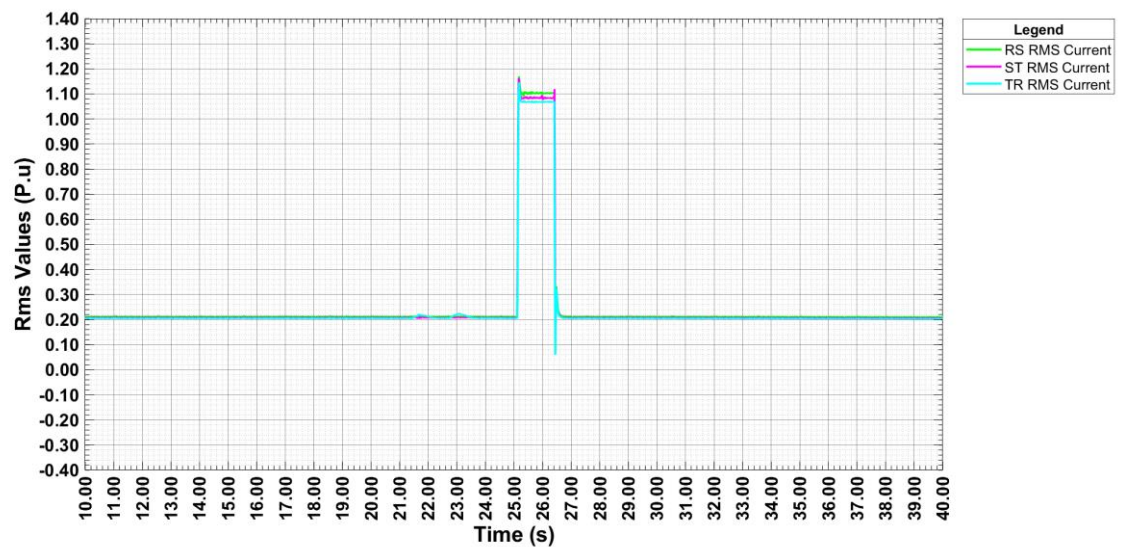
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.2

RMS Phase to phase voltages



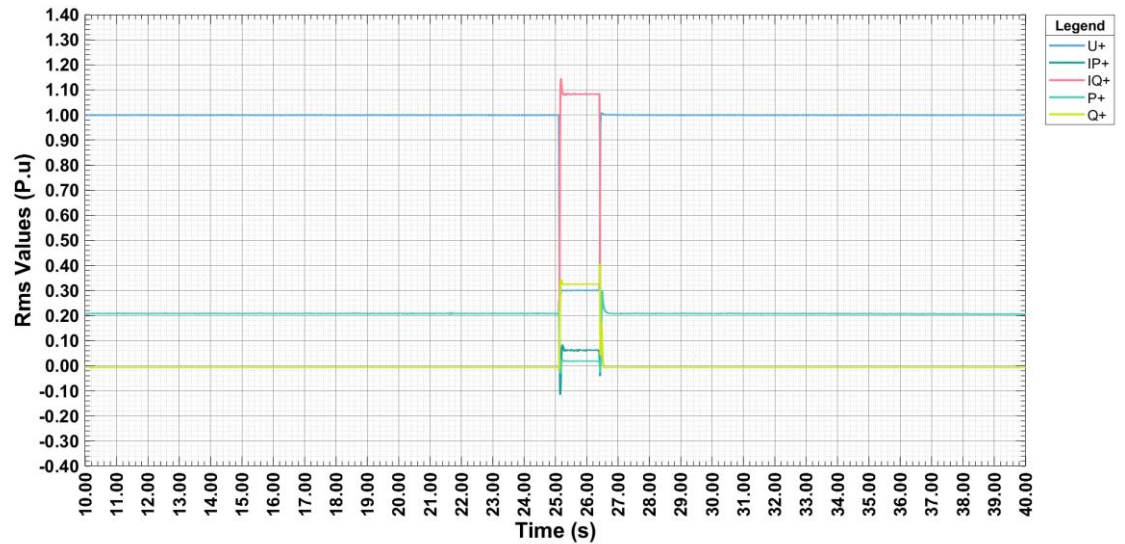
RMS Phase currents



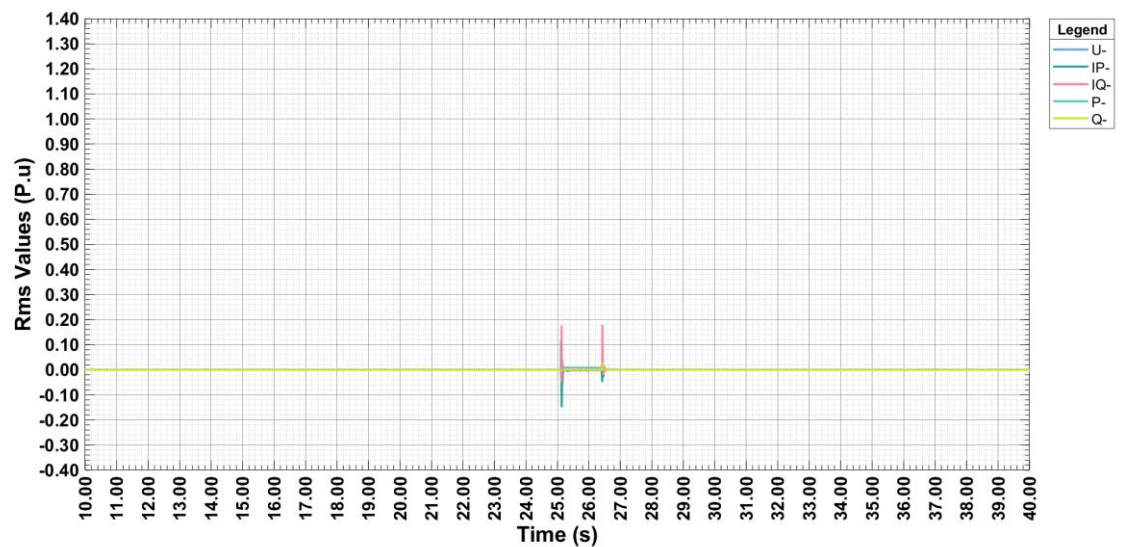
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.2

Positive sequences



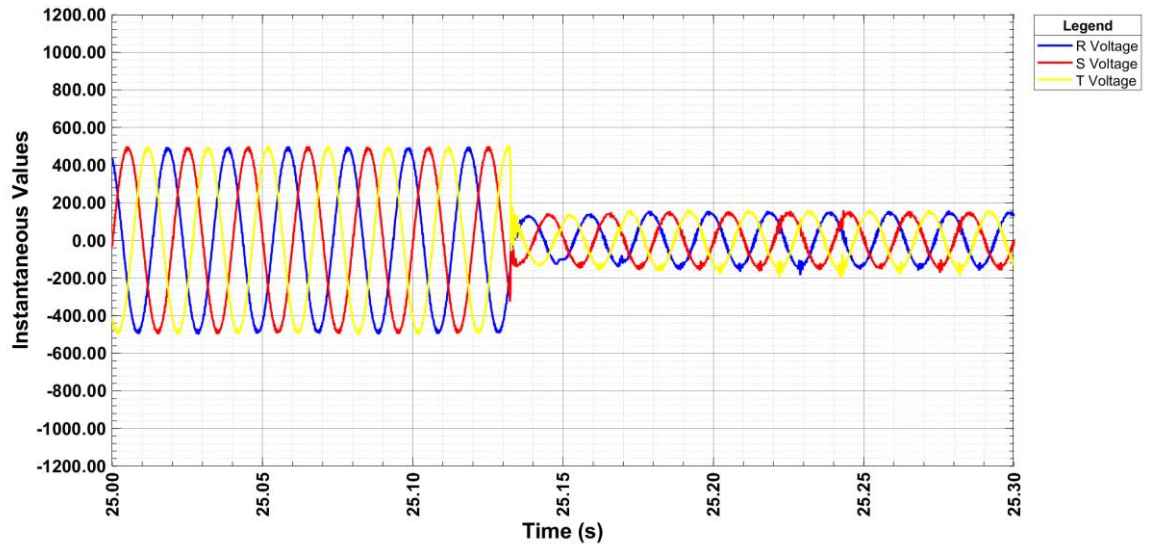
Negative sequences



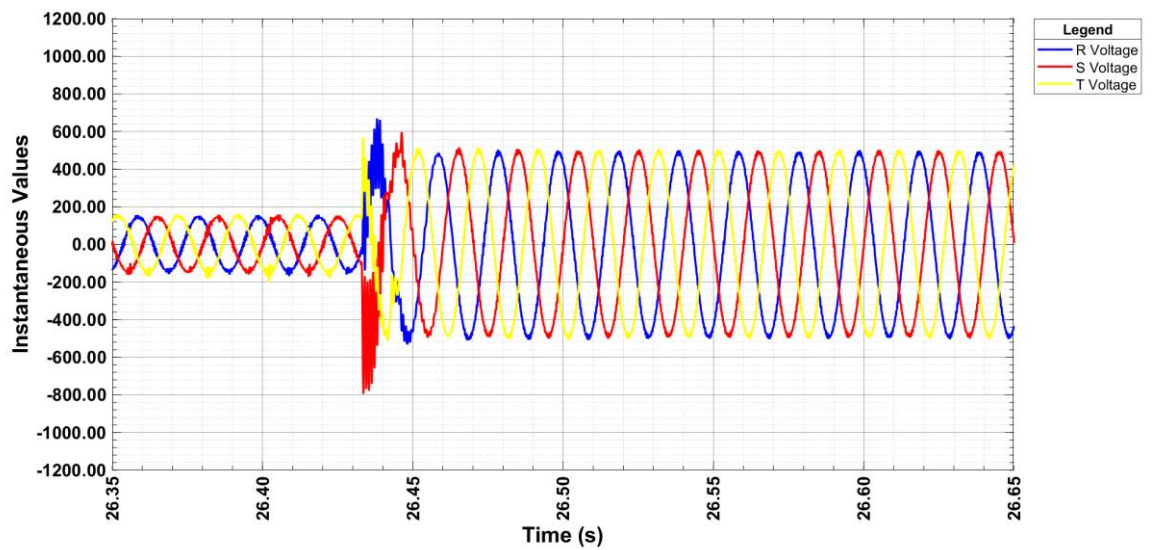
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.2

Transient voltage: Fault beginning



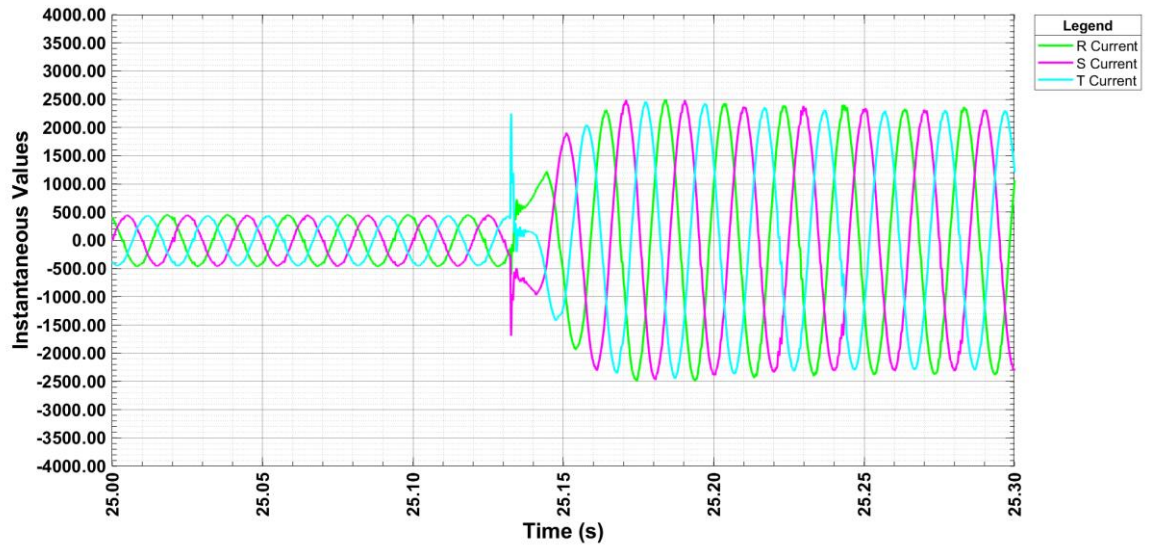
Transient voltage: Fault end



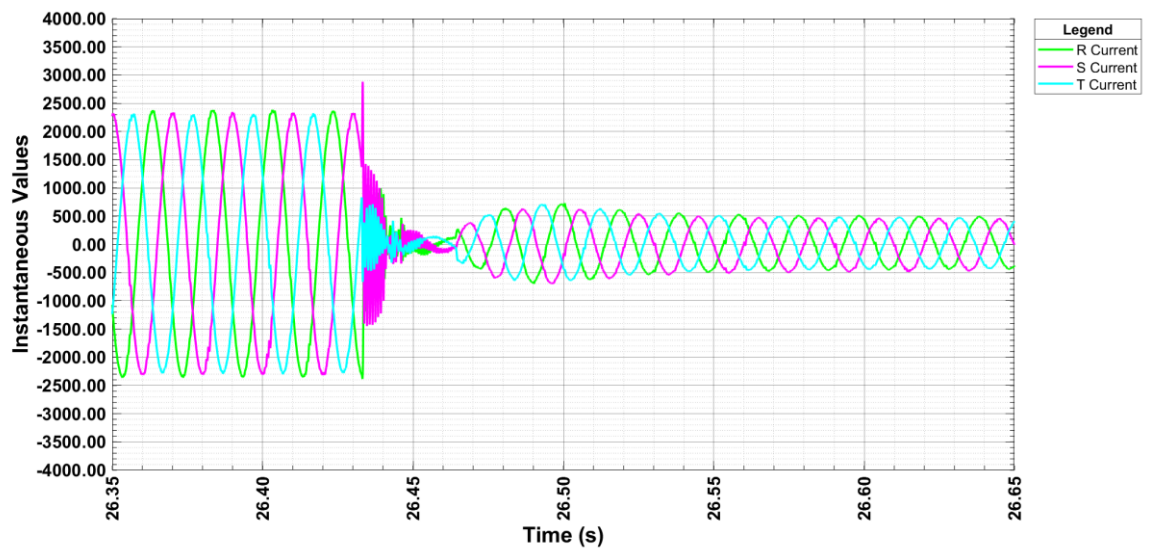
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.2

Transient current: Fault beginning



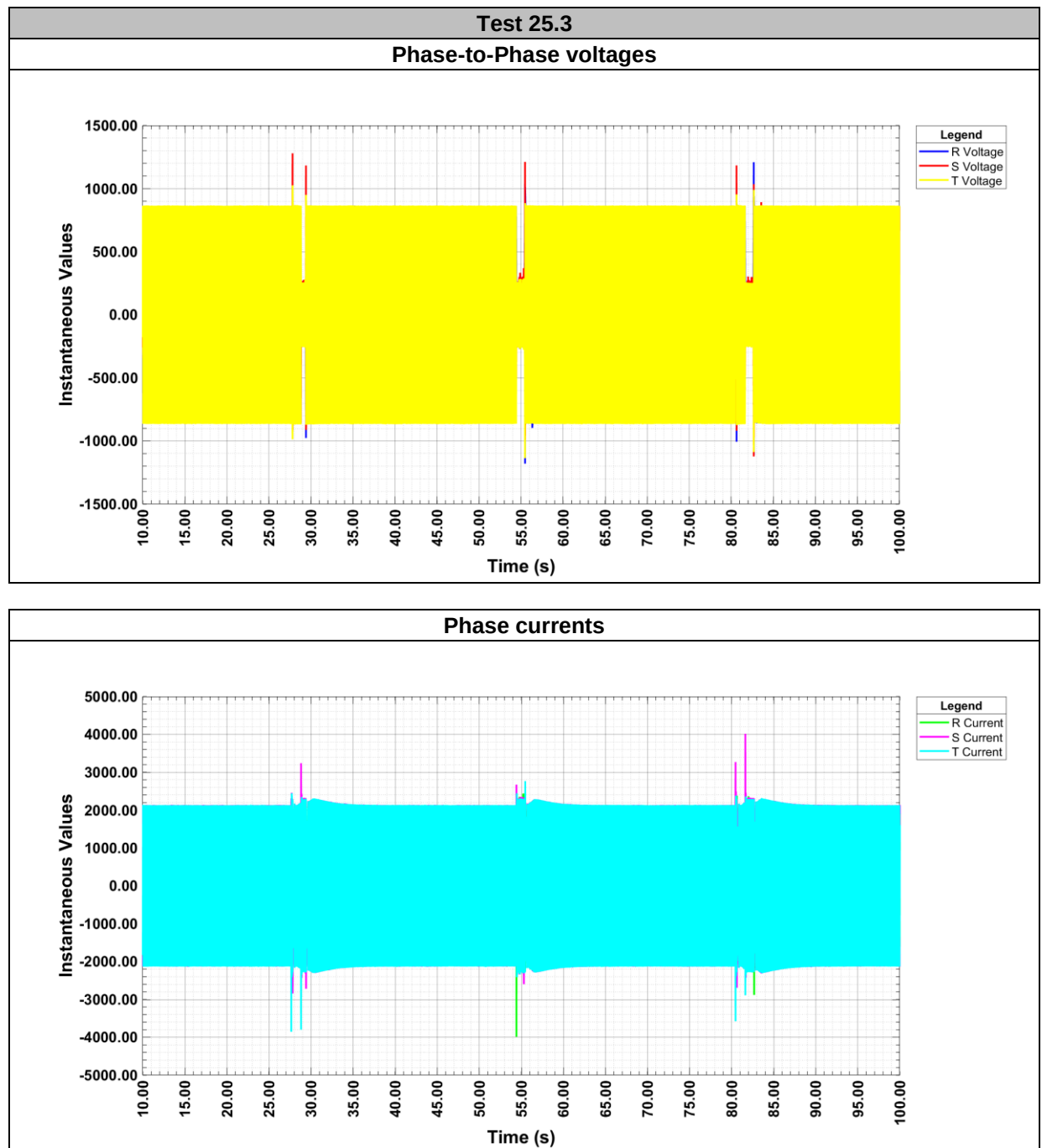
Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.3.3 Test 25.3 Fault type: 3 phases, Full load, Test sequence for multiple faults

Test Sequence:

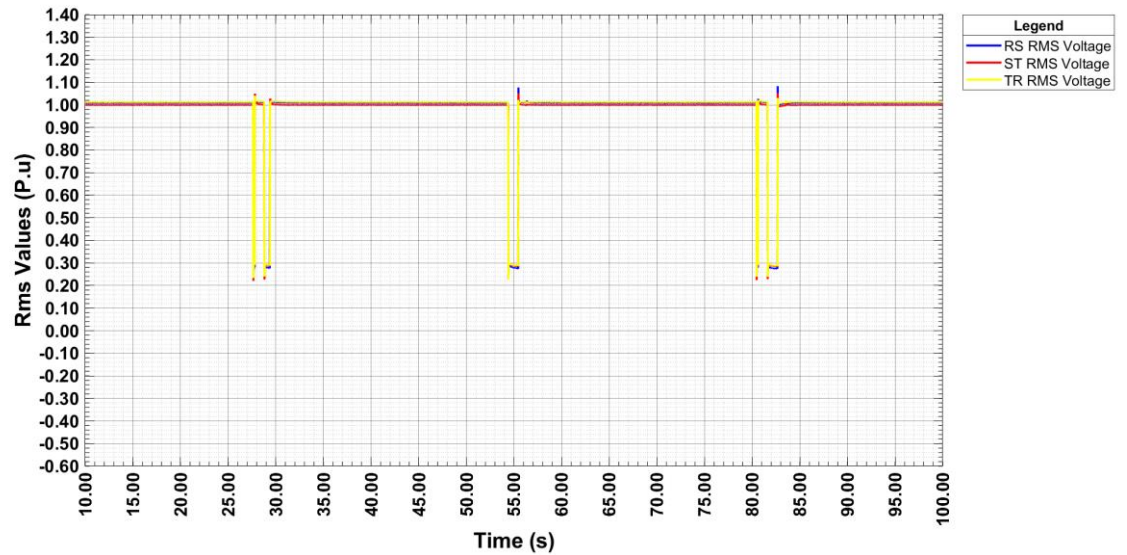
- First fault duration 160 ms, and then pause 2 s;
- Second fault duration 600 ms, and then pause 30 s;
- Third fault duration 1050 ms, and then pause 30 s;
- Fourth fault duration 160 ms, and then pause 2 s;
- Fifth fault duration 1050 ms, and then stop test.



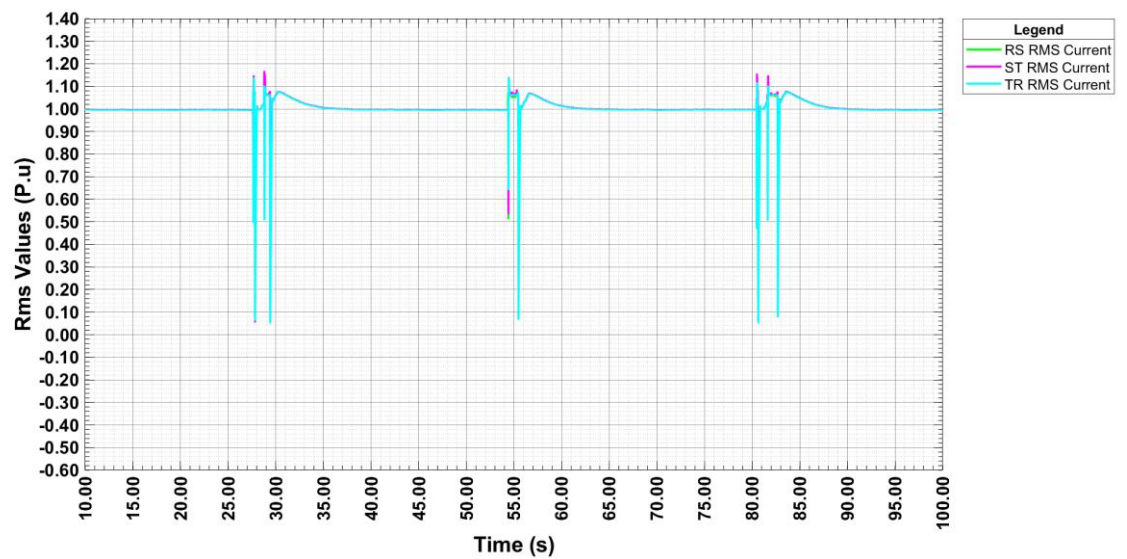
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.3

RMS Phase to phase voltages



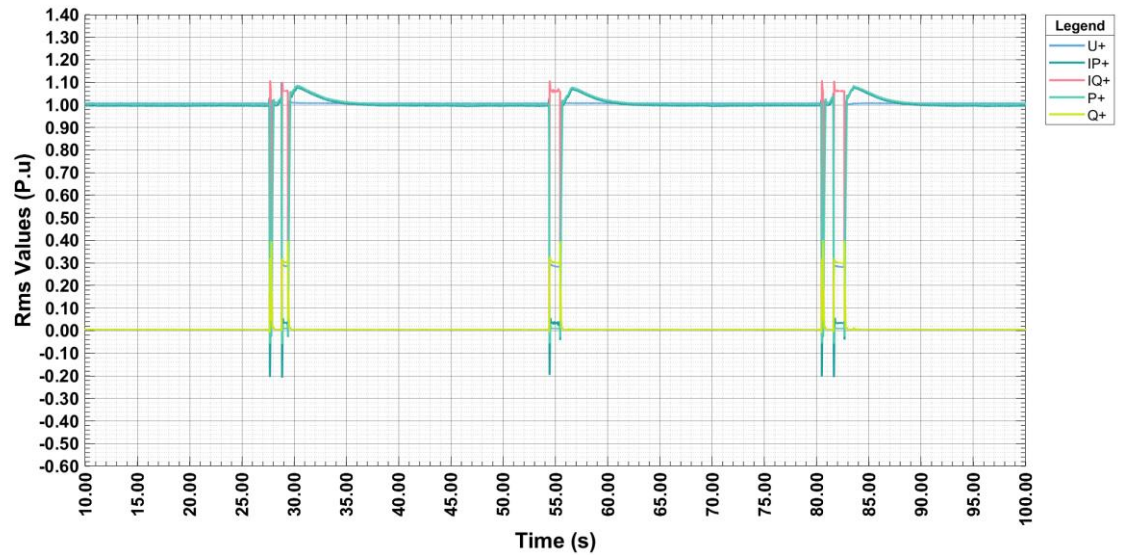
RMS Phase currents



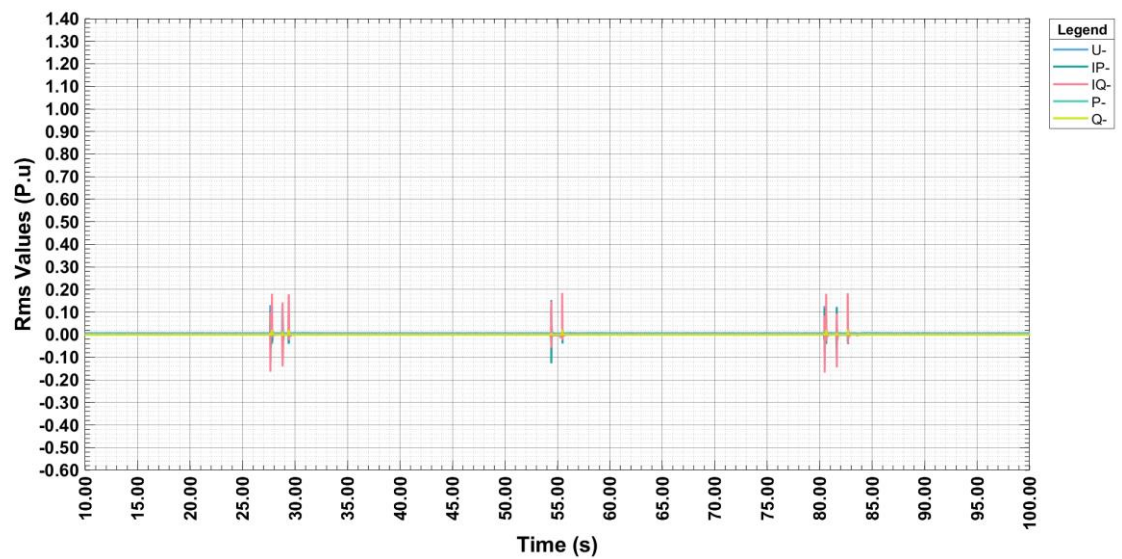
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.3

Positive sequences



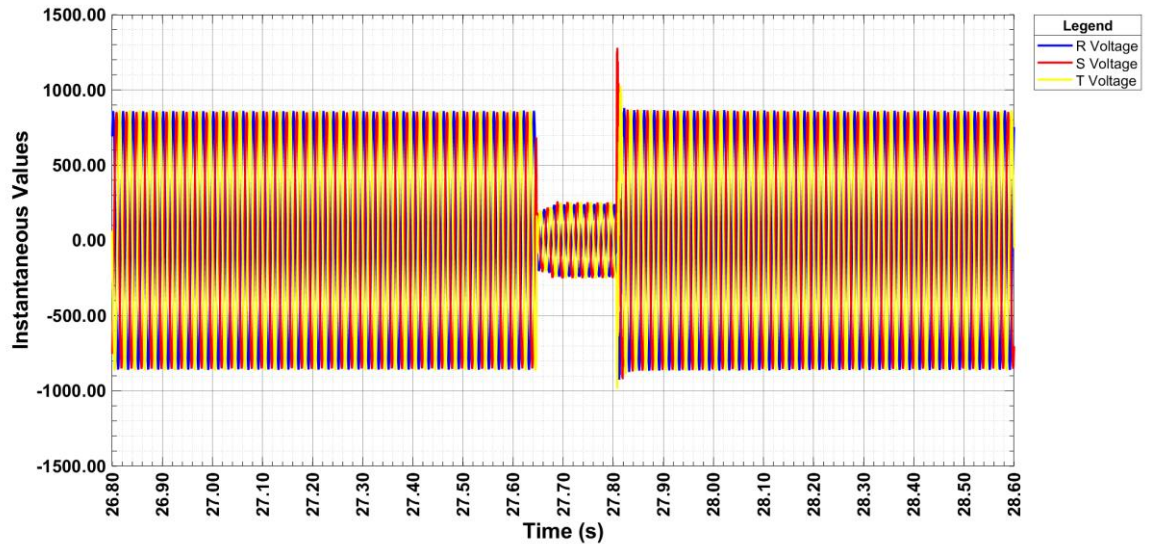
Negative sequences



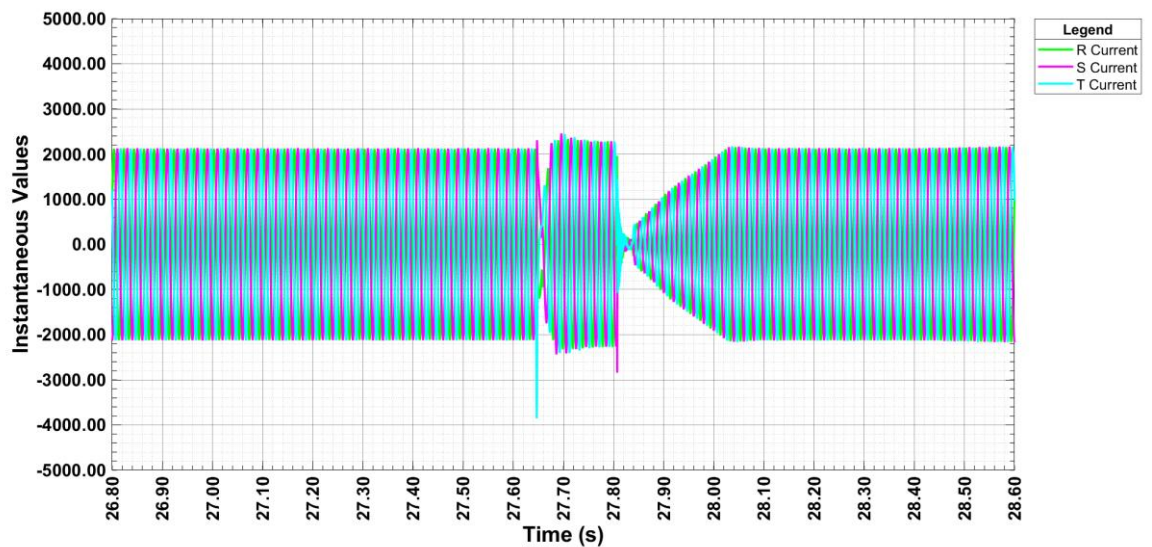
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.3

Transient Voltage: First Fault



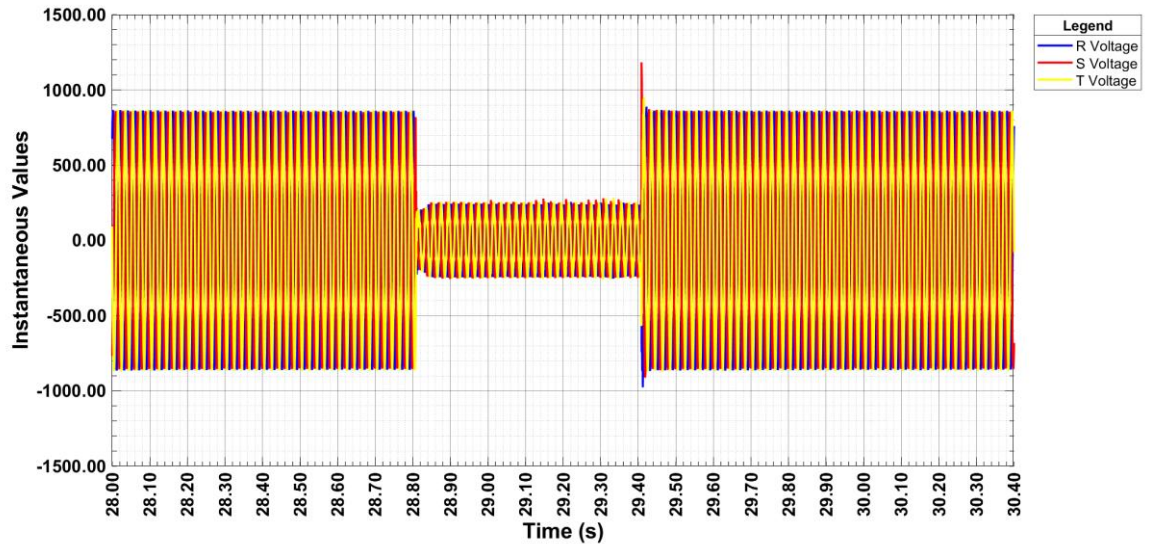
Transient Current: First Fault



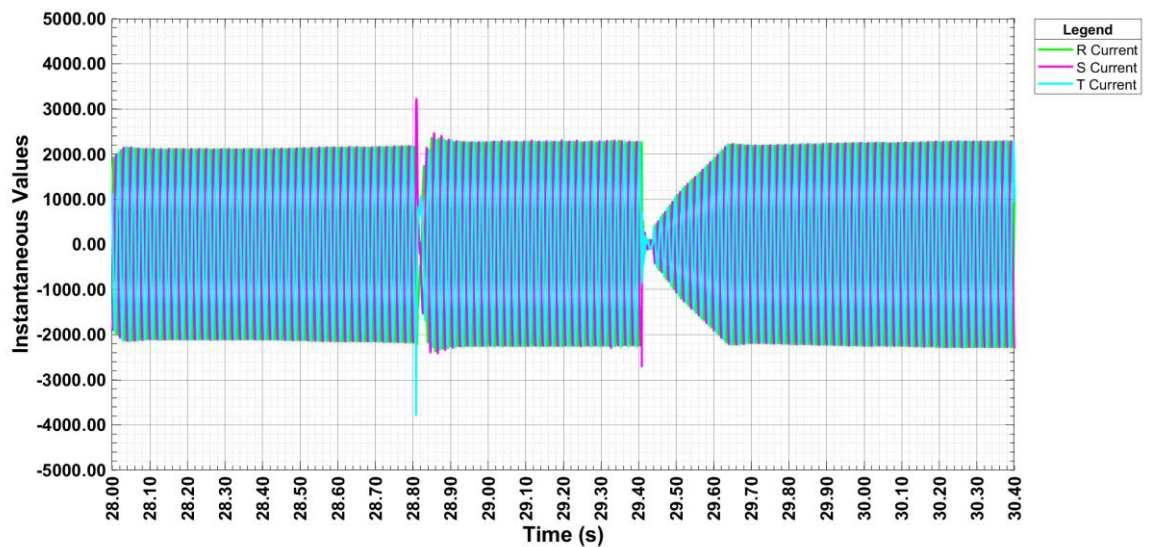
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.3

Transient Voltage: Second Fault



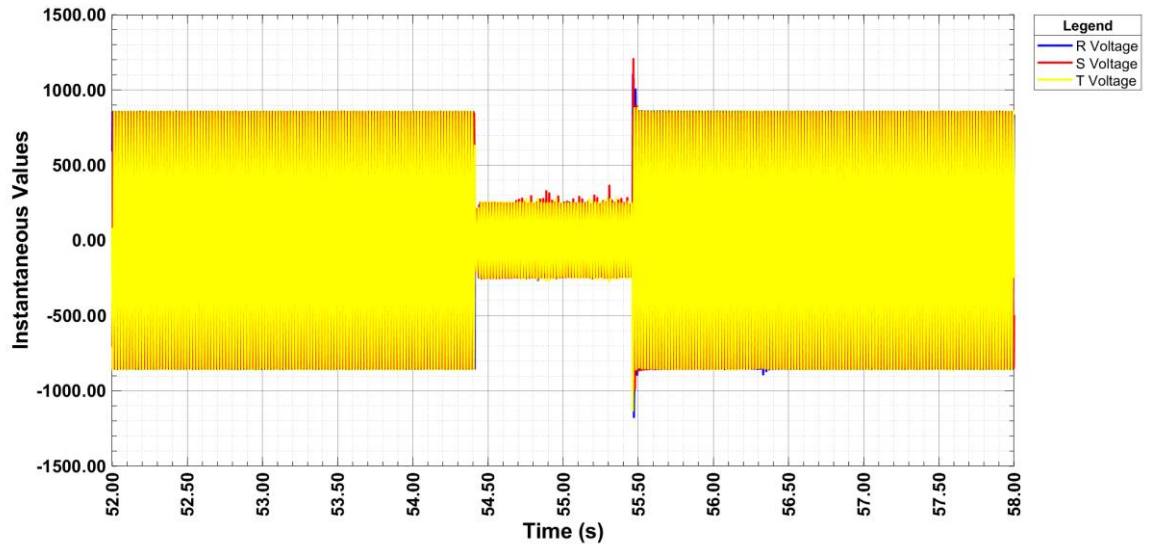
Transient Current: Second Fault



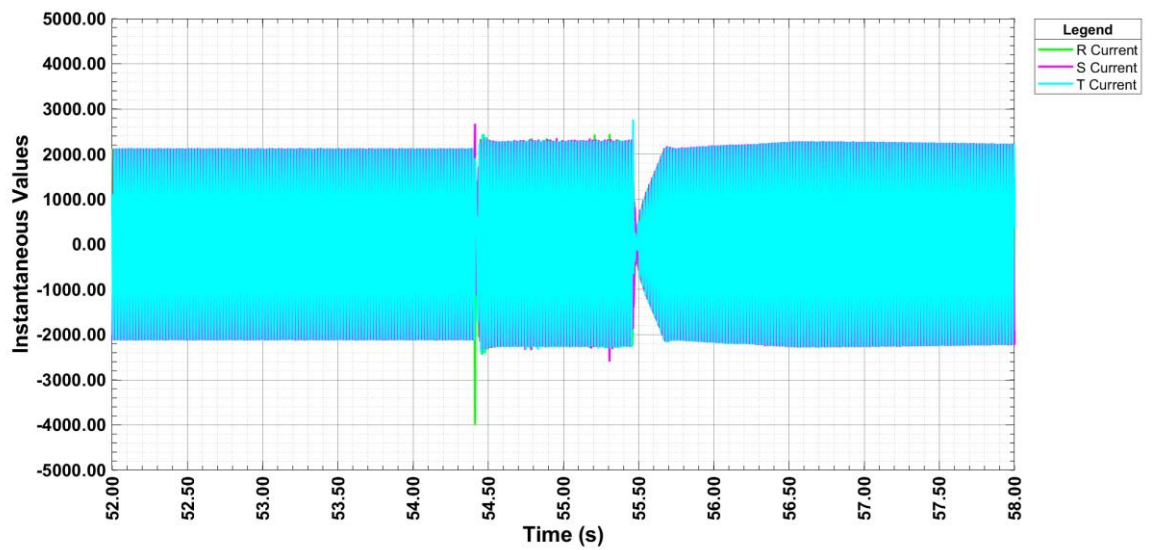
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.3

Transient Voltage: Third Fault



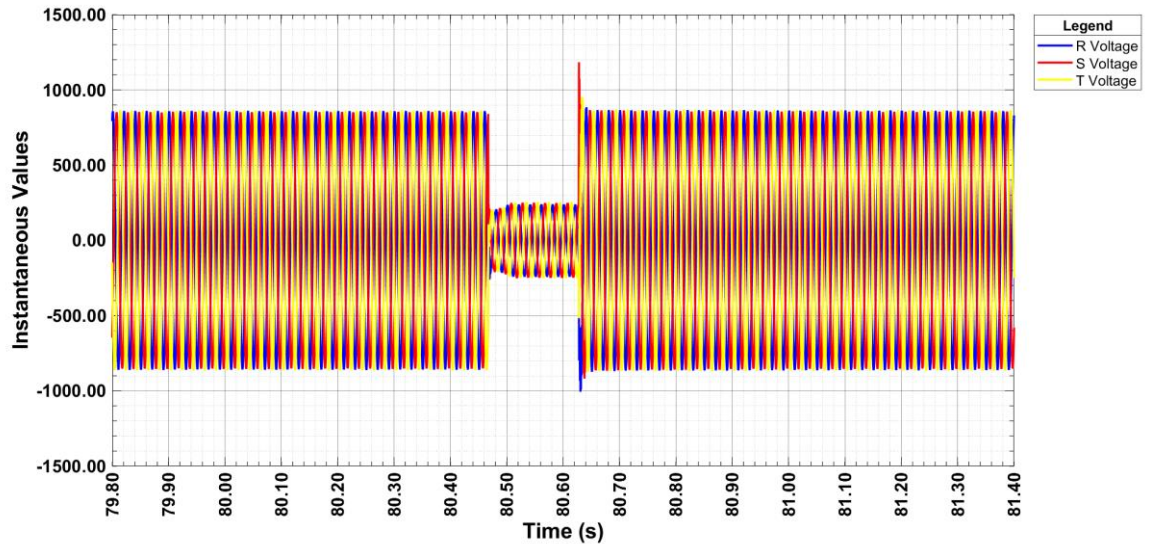
Transient Current: Third Fault



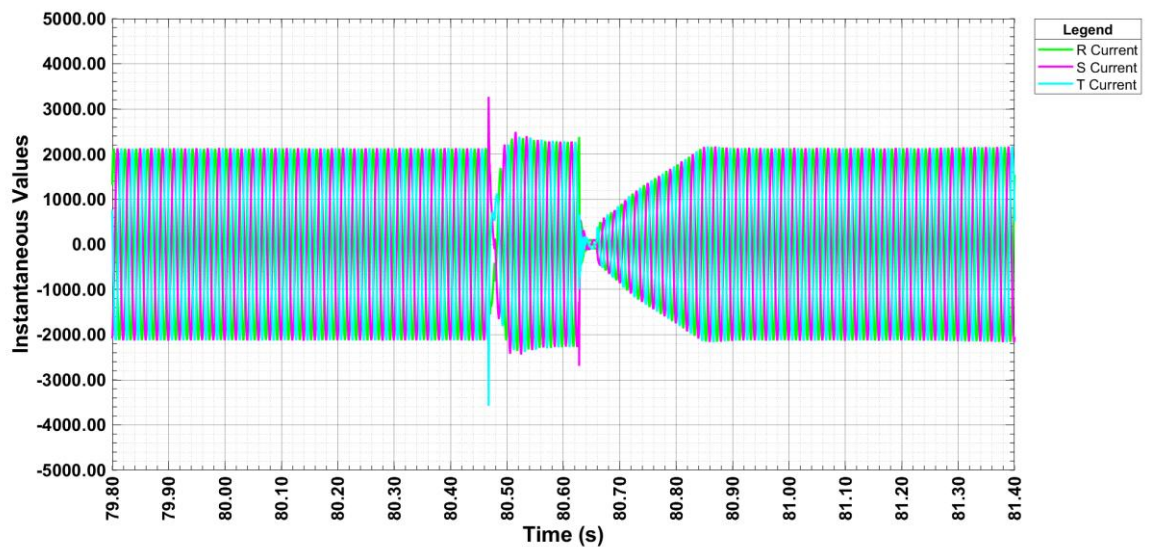
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.3

Transient Voltage: Fourth Fault



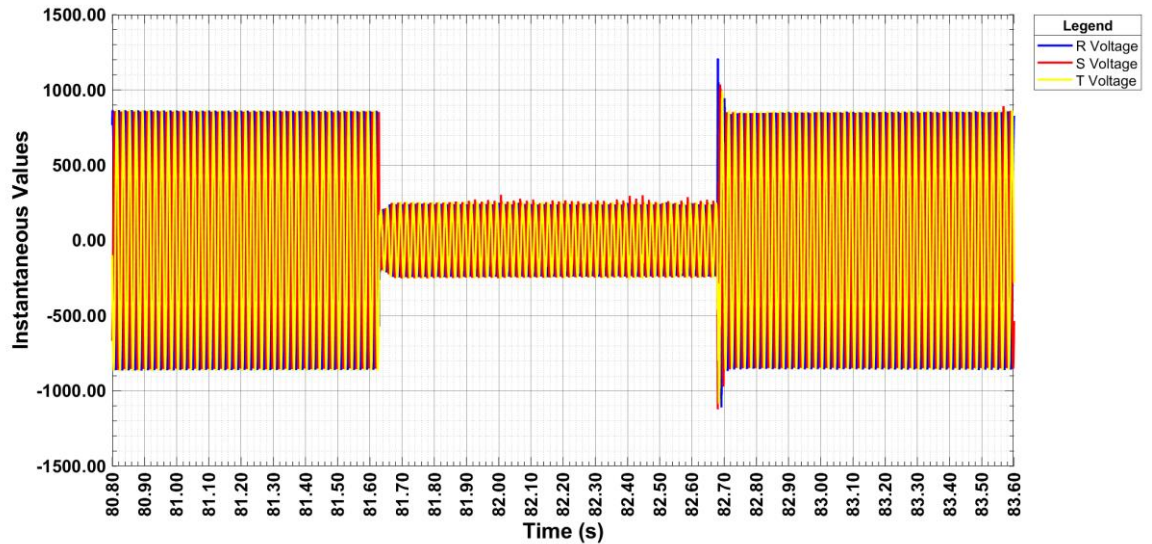
Transient Current: Fourth Fault



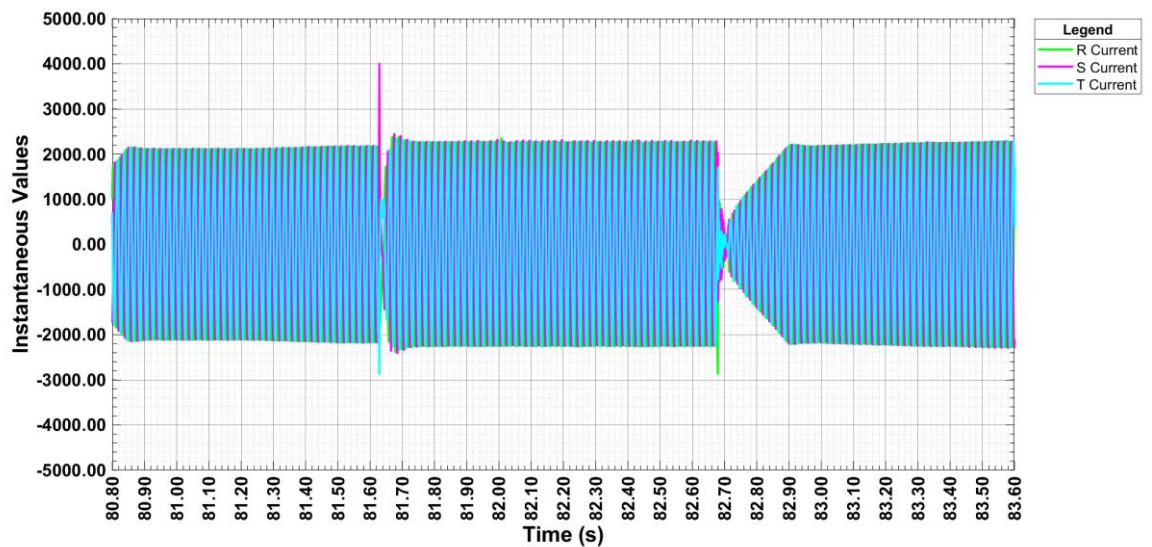
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.3

Transient Voltage: Fifth Fault



Transient Current: Fifth Fault



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.3.4 Test 25.4 Fault type: 2 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	25.4
	Date		-	[dd.mm.yyyy]	29.09.2020
	Time		-	[hh:mm:ss]	19:25:32
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.250
	Drop duration setpoint		-	[ms]	1332
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	25762
	Fault clearance (t2)		-	[ms]	27172
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	1410
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.276 /1.008
		Pos. seq.		[p.u.]	0.637 /1.007

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.007
		Neg. seq.	t1-60 s to t1	[p.u.]	0.003
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.007
		Pos. seq.	t1-1 s to t1	[p.u.]	1.006
		Neg. seq.	t1-1 s to t1	[p.u.]	0.004
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.022
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.023
	Active Power	Total	t1-10 s to t1	[p.u.]	1.029
		Total	t1-2 s to t1	[p.u.]	1.029
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.029
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.397
		Neg. seq.	-	-	-1.318
	Reactive current settling up time	Pos. seq.	-	[ms]	36
		Neg. seq.	-	[ms]	36
	Reactive current settling time	Pos. seq.	-	[ms]	36
		Neg. seq.	-	[ms]	36
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.635
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.364
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.507
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.479
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.509
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.479
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.029
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.027

Note: The determined K-factor is lower than the configured in the EUT (K = 2) because the current is limited.

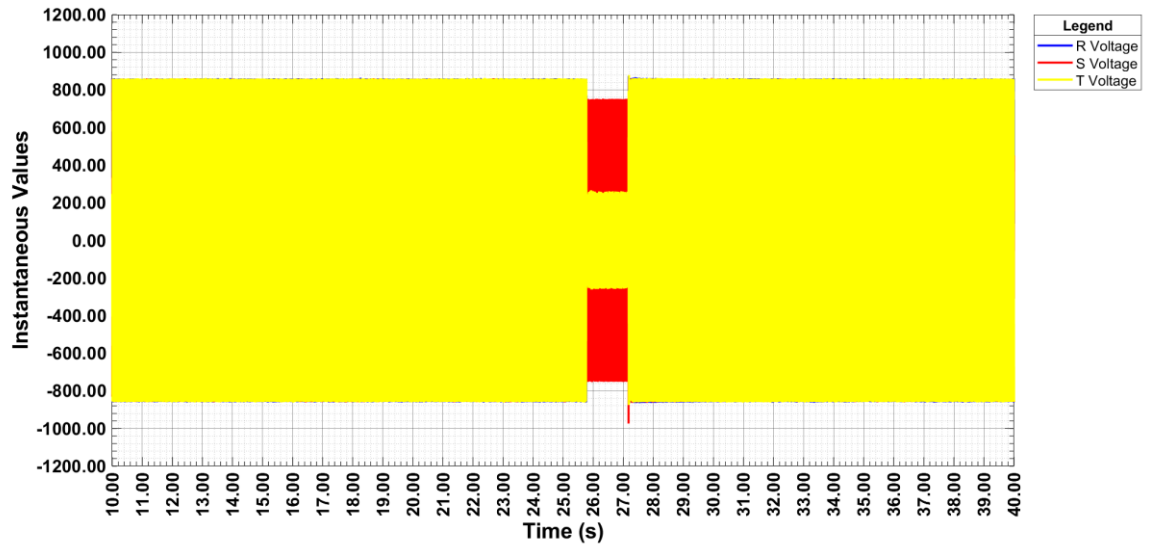
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1628
		Phase 2	t1 to t1+20 ms	[A]	1510
		Phase 3	t1 to t1+20 ms	[A]	1609
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.520
		Phase 2	t1 + 20 ms	[p.u.]	0.264
		Phase 3	t1 + 20 ms	[p.u.]	0.889
		Phase 1	t1 + 100 ms	[p.u.]	0.860
		Phase 2	t1 + 100 ms	[p.u.]	0.047
		Phase 3	t1 + 100 ms	[p.u.]	0.889
		Phase 1	t1 + 150 ms	[p.u.]	0.842
		Phase 2	t1 + 150 ms	[p.u.]	0.052
		Phase 3	t1 + 150 ms	[p.u.]	0.867
		Phase 1	t1 + 300 ms	[p.u.]	0.841
		Phase 2	t1 + 300 ms	[p.u.]	0.046
		Phase 3	t1 + 300 ms	[p.u.]	0.870
		Phase 1	t1 + 500 ms	[p.u.]	0.841
		Phase 2	t1 + 500 ms	[p.u.]	0.046
		Phase 3	t1 + 500 ms	[p.u.]	0.870
		Phase 1	t1 + 1000 ms	[p.u.]	0.839
		Phase 2	t1 + 1000 ms	[p.u.]	0.044
		Phase 3	t1 + 1000 ms	[p.u.]	0.870
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.050
Active current rise time	Pos. seq.			[s]	0.188

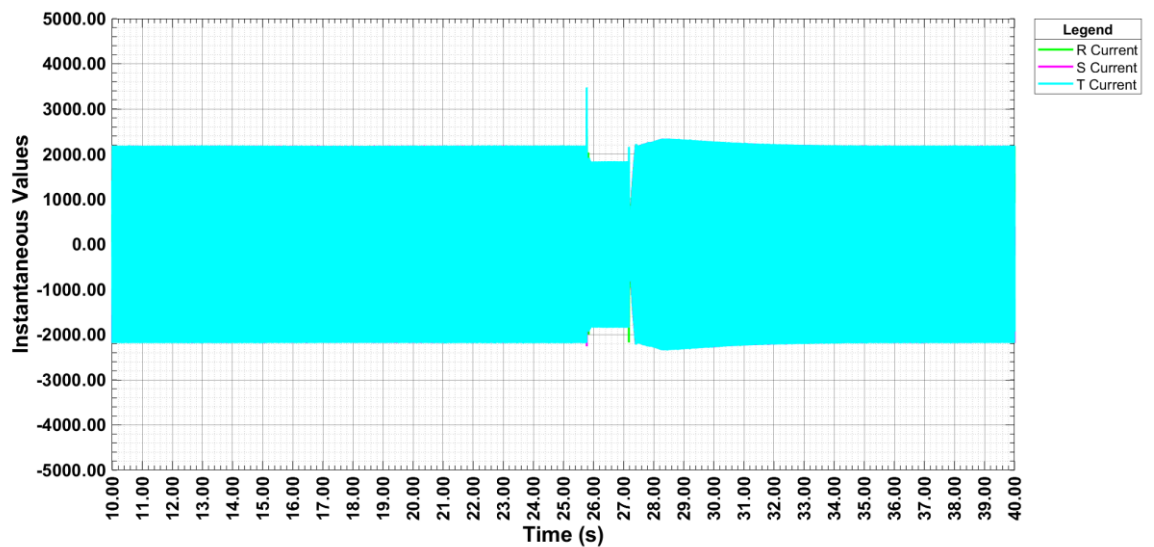
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.4

Phase-to-Phase voltages



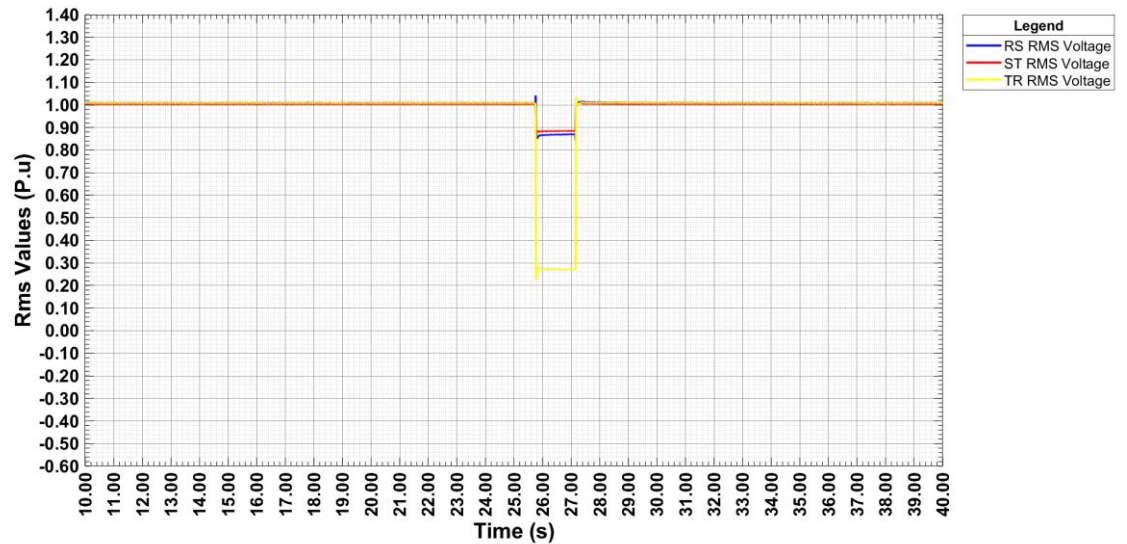
Phase currents



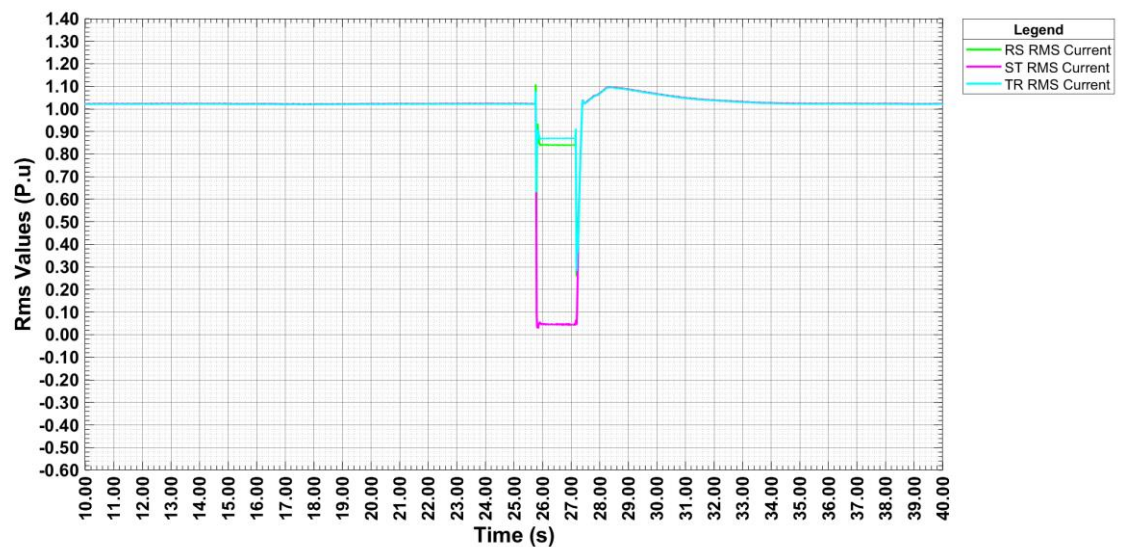
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.4

RMS Phase to phase voltages



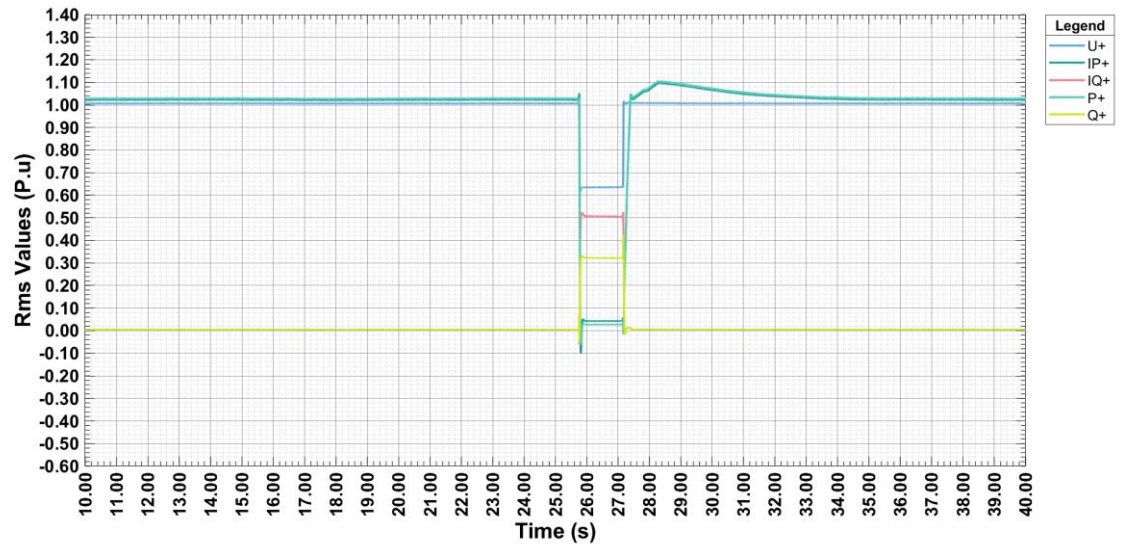
RMS Phase currents



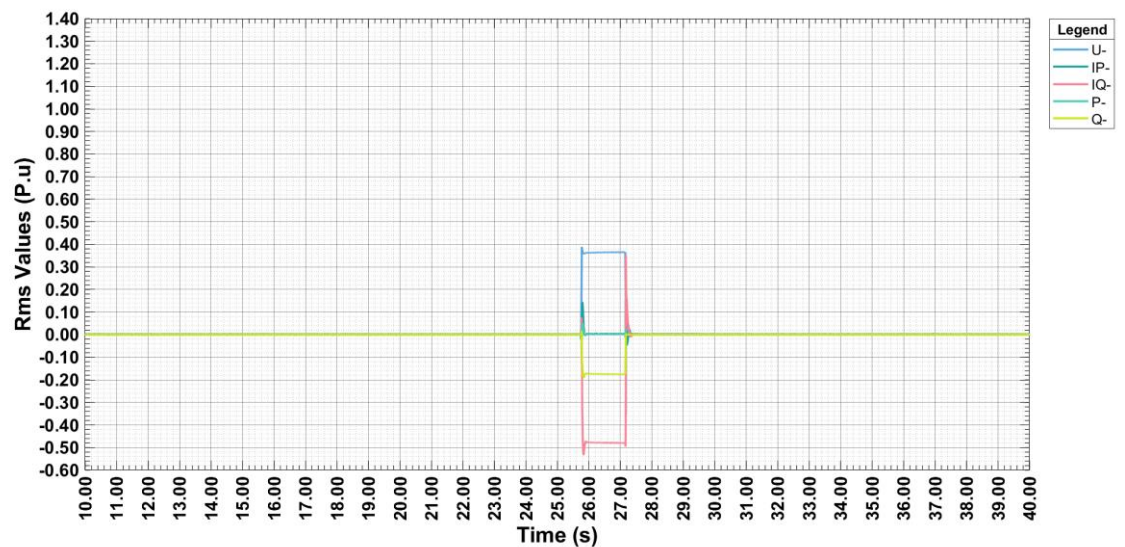
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.4

Positive sequences



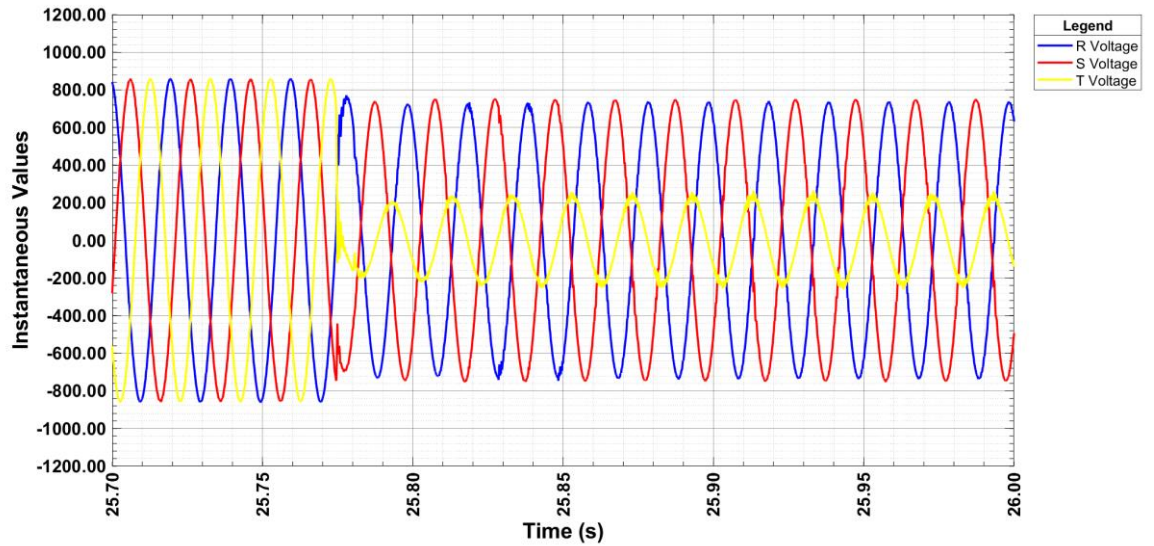
Negative sequences



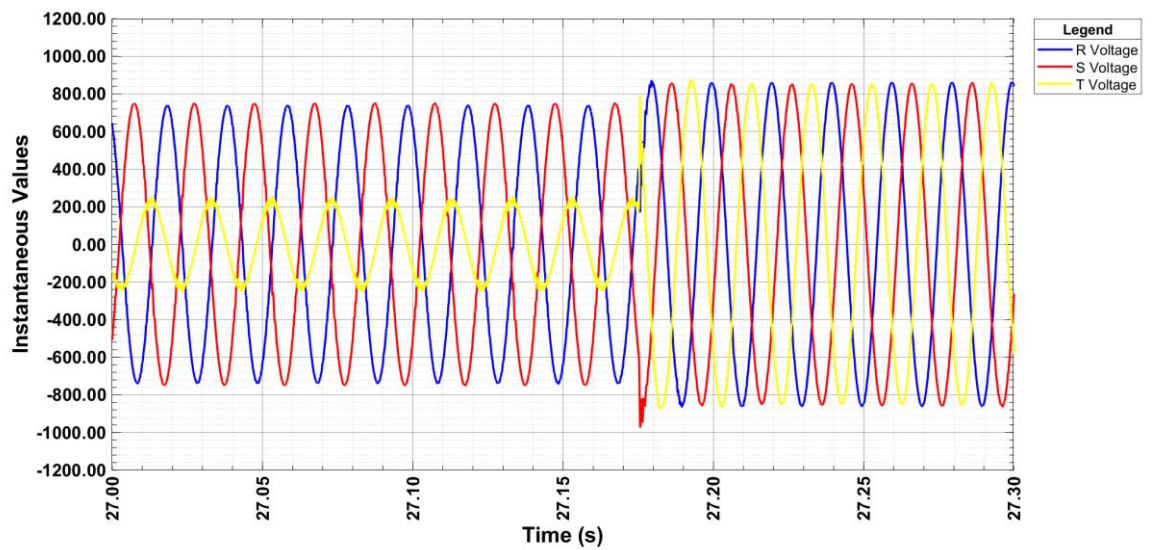
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.4

Transient voltage: Fault beginning



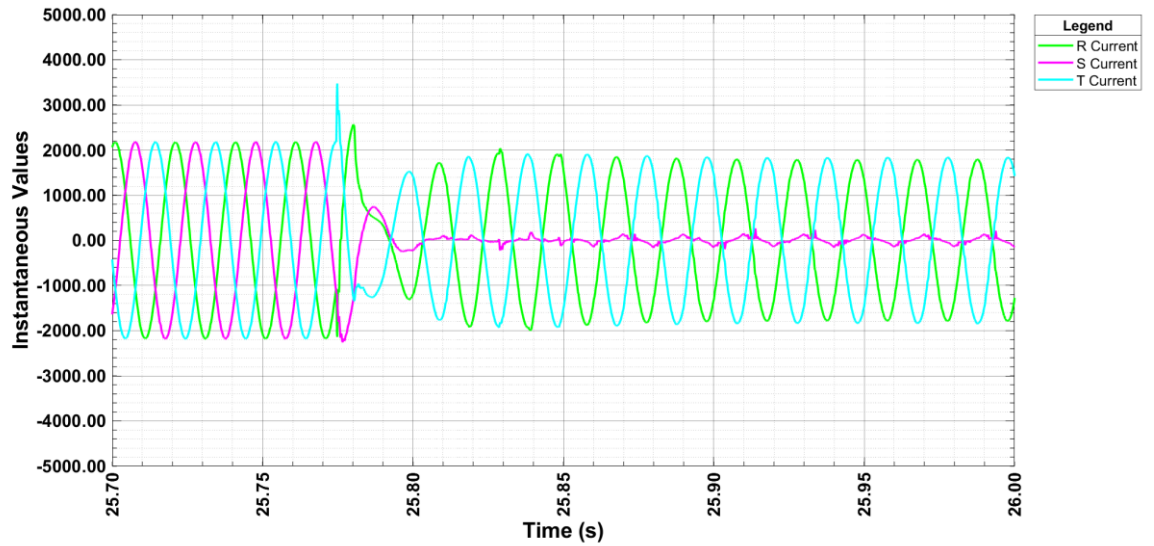
Transient voltage: Fault end



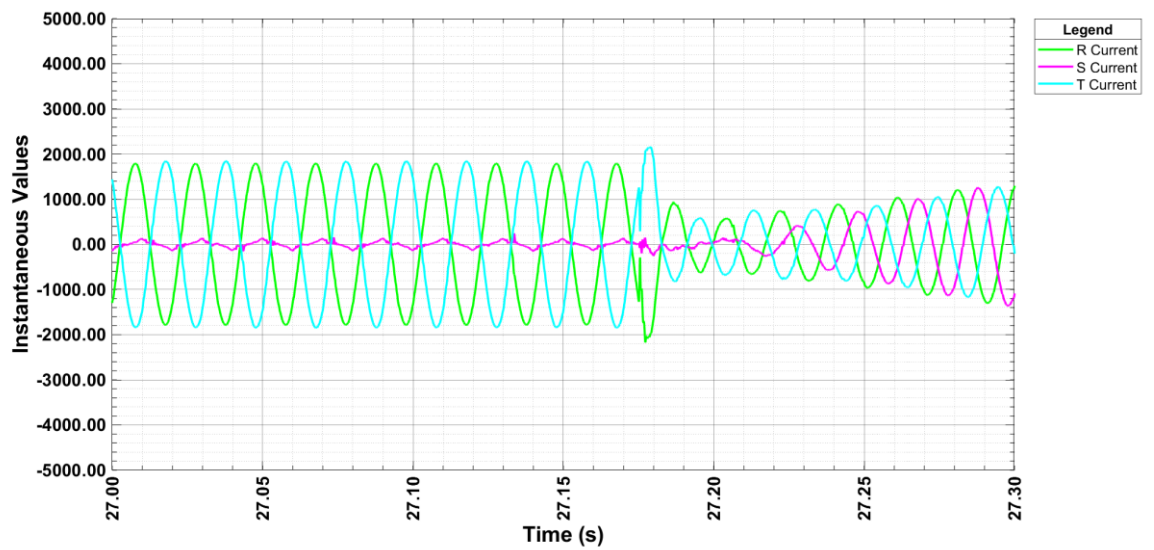
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.4

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.3.5 Test 25.5 Fault type: 2 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	25.5
	Date		-	[dd.mm.yyyy]	29.09.2020
	Time		-	[hh:mm:ss]	19:16:04
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.250
	Drop duration setpoint		-	[ms]	1332
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	33137
	Fault clearance (t2)		-	[ms]	34547
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	1411
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.274 /0.995
		Pos. seq.		[p.u.]	0.635 /0.999

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.999
		Neg. seq.	t1-60 s to t1	[p.u.]	0.004
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.998
		Pos. seq.	t1-1 s to t1	[p.u.]	0.998
		Neg. seq.	t1-1 s to t1	[p.u.]	0.004
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.206
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.001
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.206
	Active Power	Total	t1-10 s to t1	[p.u.]	0.206
		Total	t1-2 s to t1	[p.u.]	0.206
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.206
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.001
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.367
		Neg. seq.	-	-	-1.315
	Reactive current settling up time	Pos. seq.	-	[ms]	39
		Neg. seq.	-	[ms]	39
	Reactive current settling time	Pos. seq.	-	[ms]	39
		Neg. seq.	-	[ms]	39
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.634
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.365
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.499
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.482
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.501
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.482
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.029
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.027

Note: The determined K-factor is lower than the configured in the EUT ($K = 2$) because the current is limited.

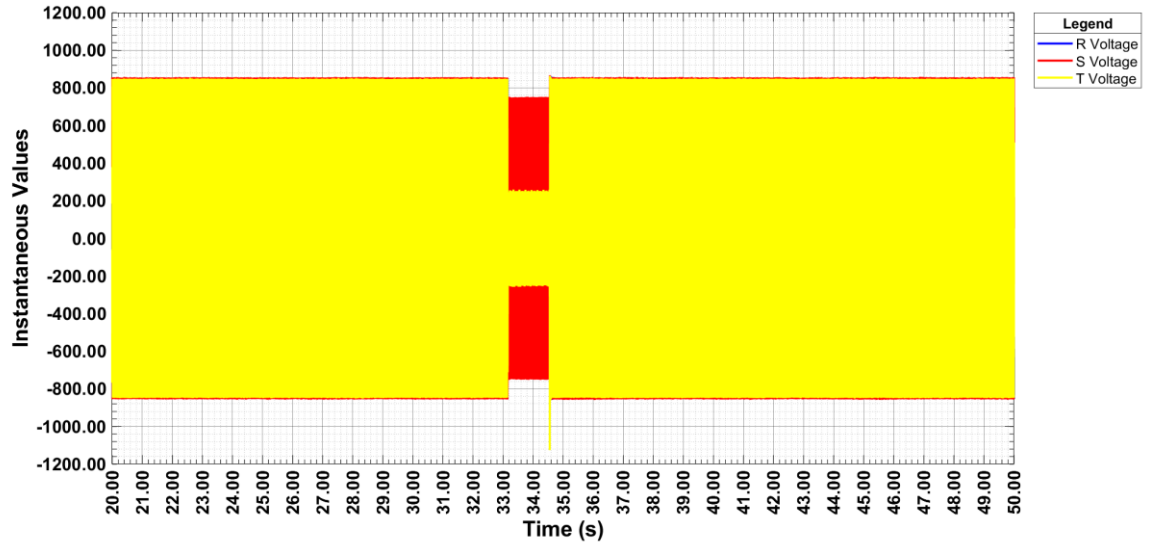
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	730
		Phase 2	t1 to t1+20 ms	[A]	311
		Phase 3	t1 to t1+20 ms	[A]	931
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.446
		Phase 2	t1 + 20 ms	[p.u.]	0.162
		Phase 3	t1 + 20 ms	[p.u.]	0.888
		Phase 1	t1 + 100 ms	[p.u.]	0.862
		Phase 2	t1 + 100 ms	[p.u.]	0.036
		Phase 3	t1 + 100 ms	[p.u.]	0.888
		Phase 1	t1 + 150 ms	[p.u.]	0.838
		Phase 2	t1 + 150 ms	[p.u.]	0.035
		Phase 3	t1 + 150 ms	[p.u.]	0.862
		Phase 1	t1 + 300 ms	[p.u.]	0.836
		Phase 2	t1 + 300 ms	[p.u.]	0.039
		Phase 3	t1 + 300 ms	[p.u.]	0.865
		Phase 1	t1 + 500 ms	[p.u.]	0.836
		Phase 2	t1 + 500 ms	[p.u.]	0.037
		Phase 3	t1 + 500 ms	[p.u.]	0.866
		Phase 1	t1 + 1000 ms	[p.u.]	0.836
		Phase 2	t1 + 1000 ms	[p.u.]	0.042
		Phase 3	t1 + 1000 ms	[p.u.]	0.866
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.214
Active current rise time	Pos. seq.			[s]	0.024

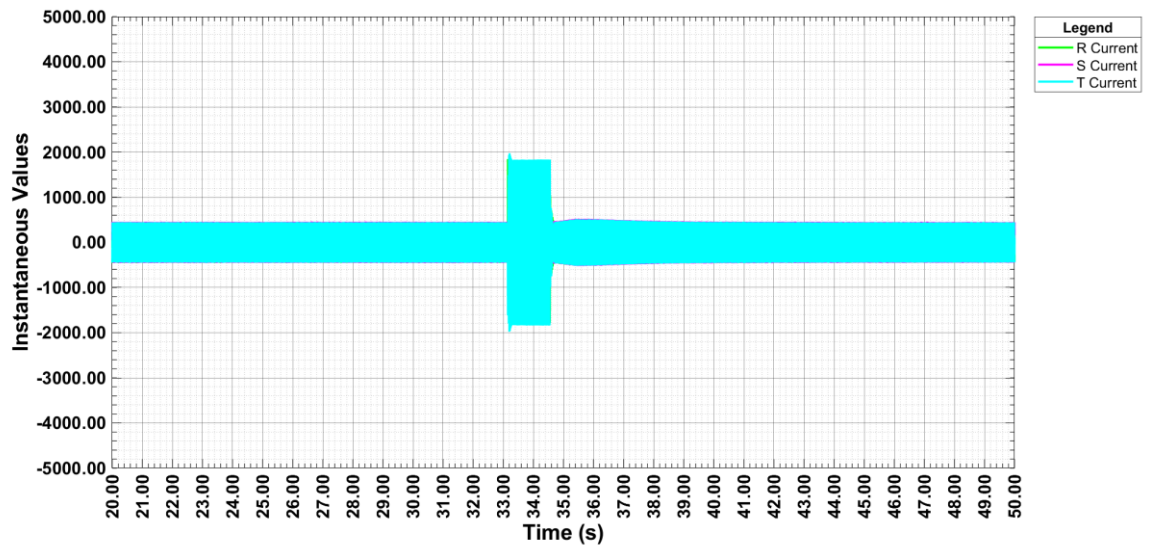
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.5

Phase-to-Phase voltages



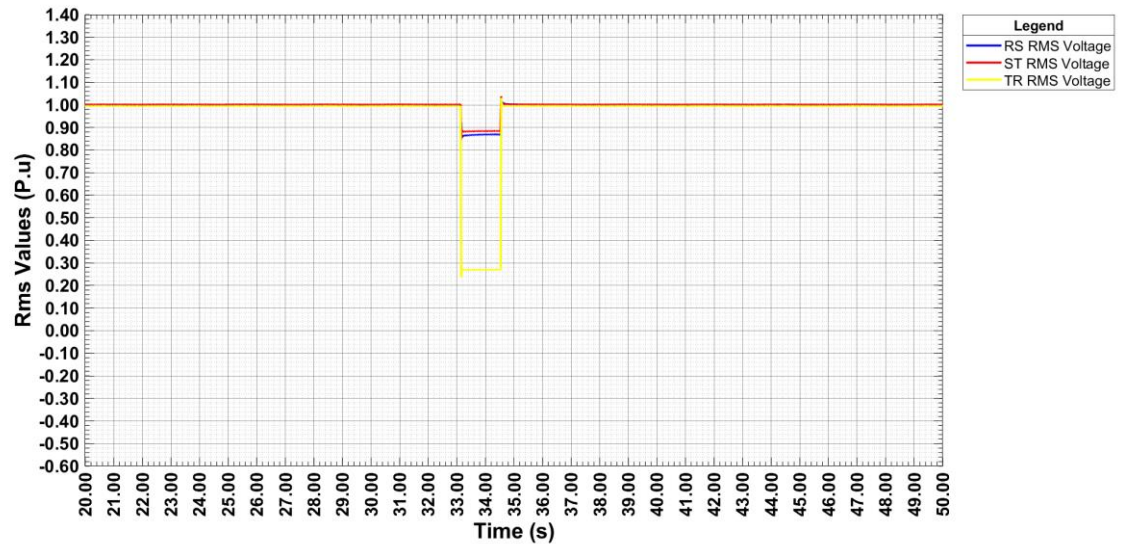
Phase currents



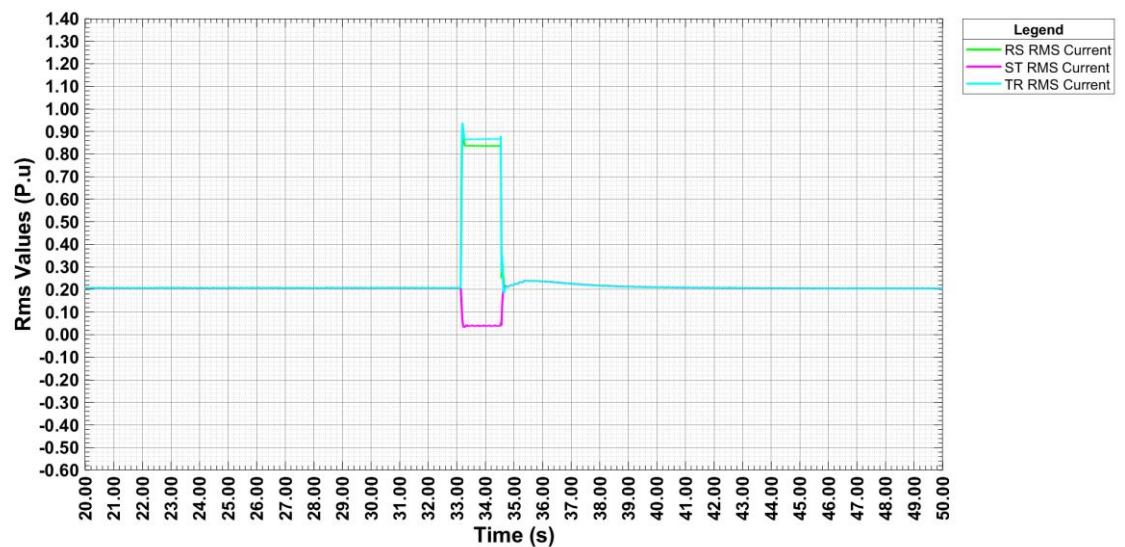
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.5

RMS Phase to phase voltages



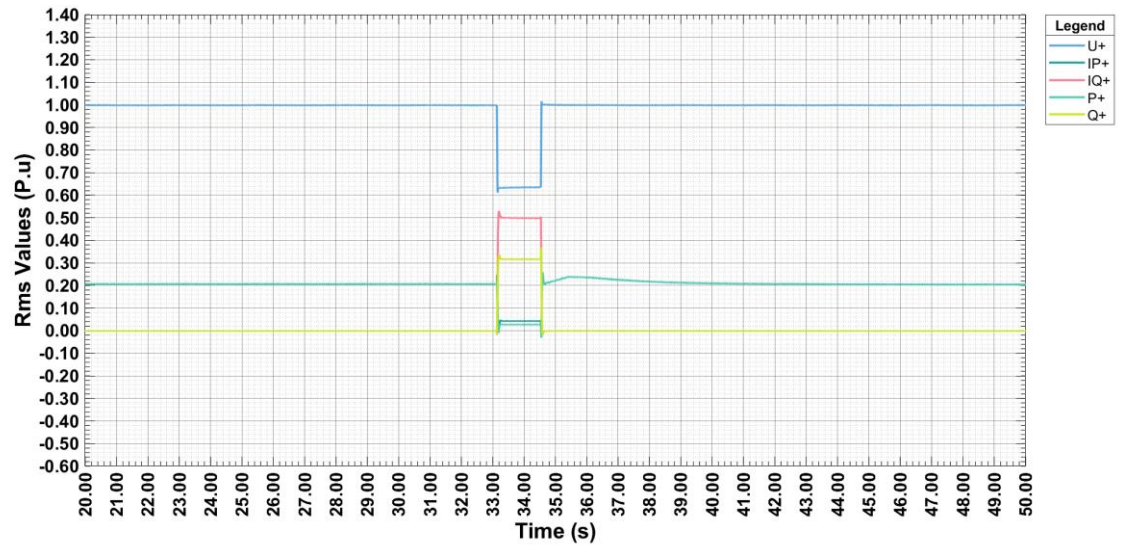
RMS Phase currents



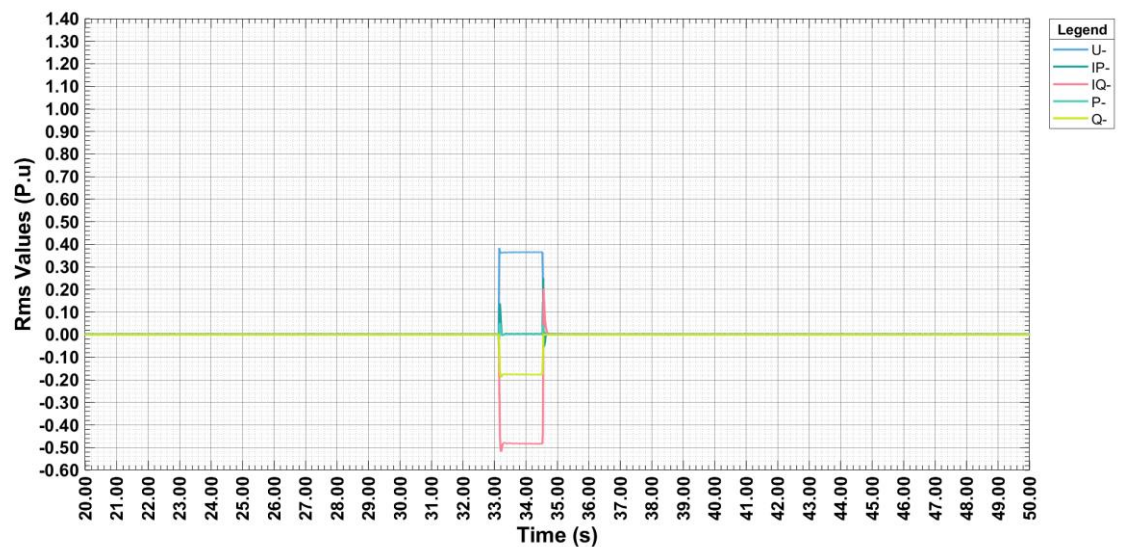
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.5

Positive sequences



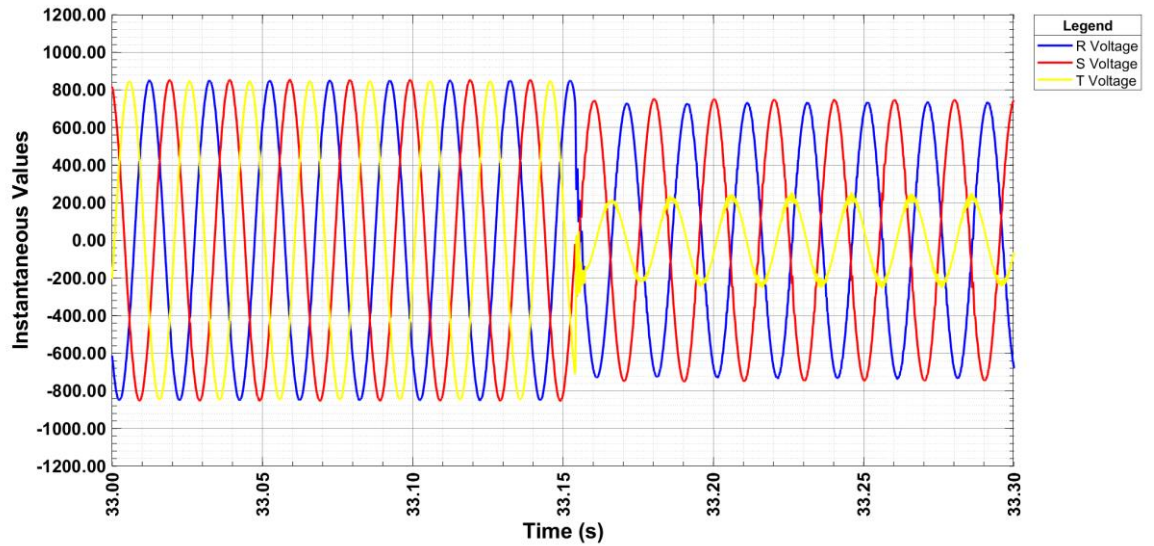
Negative sequences



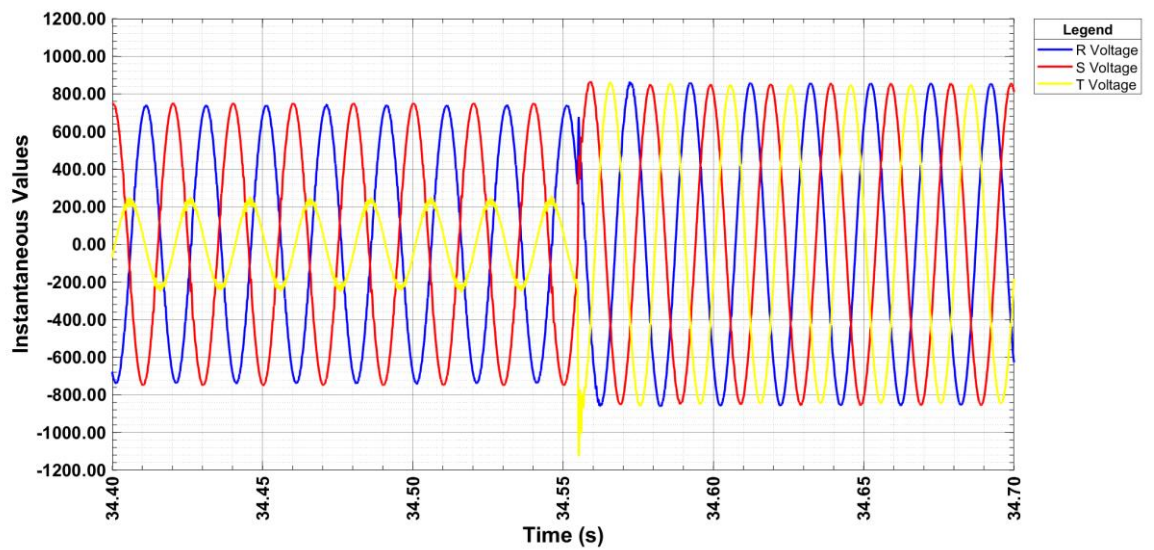
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.5

Transient voltage: Fault beginning



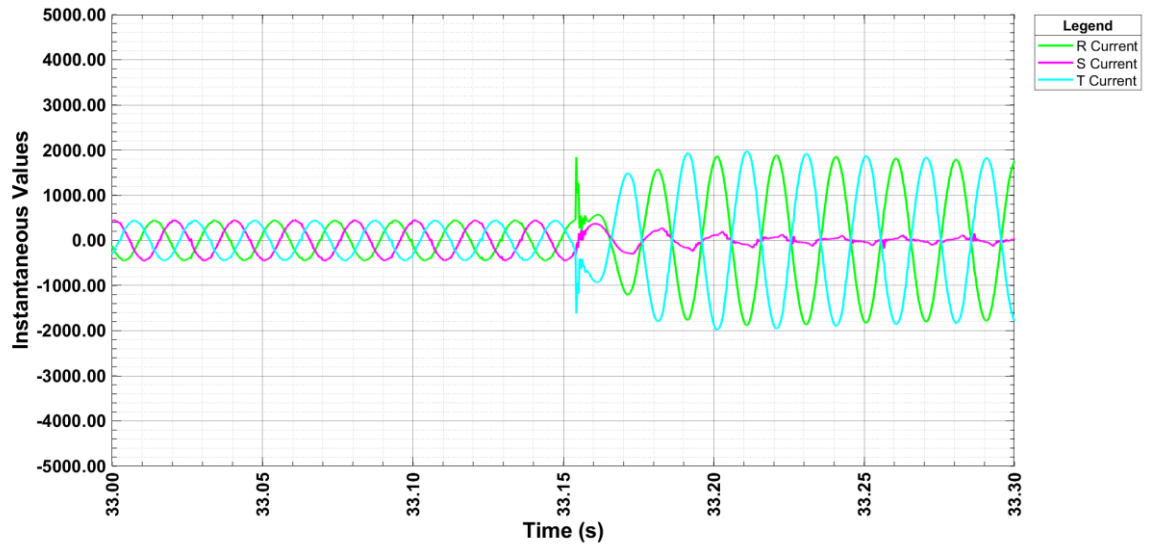
Transient voltage: Fault end



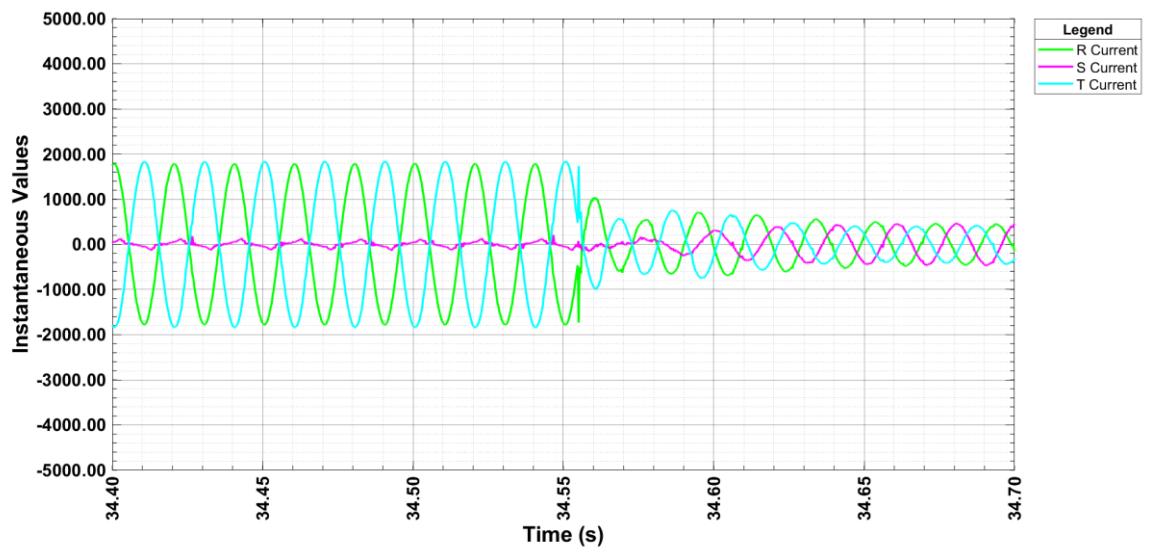
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 25.5

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.4 Load tests: Dip depth 50 %Un

In this chapter of the test report are shown the test results and diagrams for the load tests configured with a dip depth of 50 %Un. There are included in this point the tests 50.1, 50.2, 50.3, 50.4, 50.5 and 50.6 according to the table 4-67 of the standard. For the voltages and currents in the below pictures and tables, the unit is V and A.

3.1.4.1 Test 50.1 Fault type: 3 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	50.1
	Date		-	[dd.mm.yyyy]	27.09.2020
	Time		-	[hh:mm:ss]	09:56:00
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.500
	Drop duration setpoint		-	[ms]	2162
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24878
	Fault clearance (t2)		-	[ms]	27292
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2414
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.519 /1.007
		Pos. seq.		[p.u.]	0.518 /1.007

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.007
		Neg. seq.	t1-60 s to t1	[p.u.]	0.008
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.007
		Pos. seq.	t1-1 s to t1	[p.u.]	1.007
		Neg. seq.	t1-1 s to t1	[p.u.]	0.008
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.021
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.021
	Active Power	Total	t1-10 s to t1	[p.u.]	1.029
		Total	t1-2 s to t1	[p.u.]	1.029
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.028
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.986
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	32
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	32
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.517
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.007
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.966
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.001
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.967
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.006
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.019
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.019

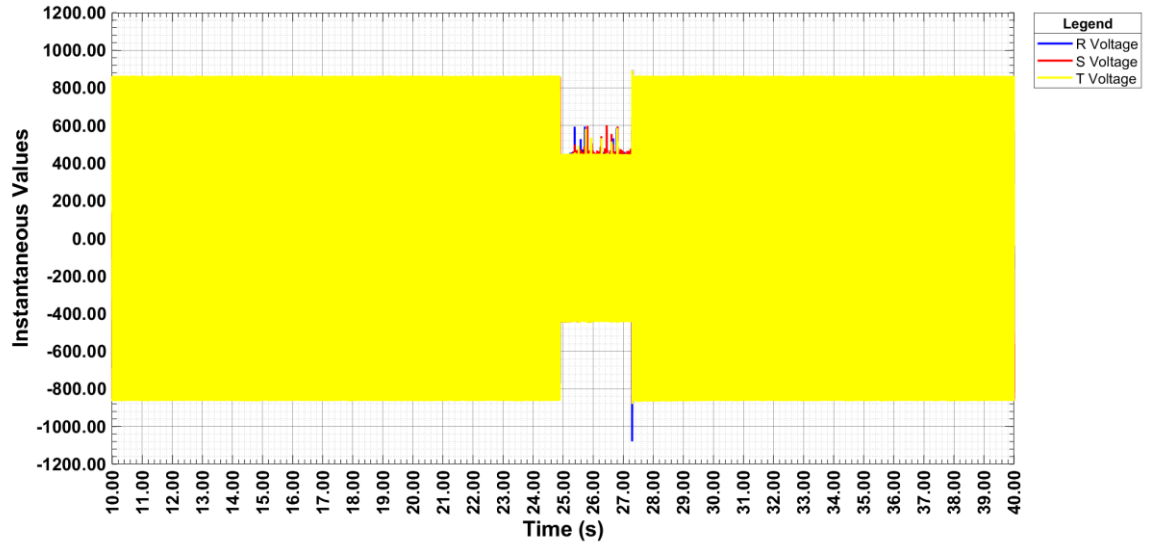
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1529
		Phase 2	t1 to t1+20 ms	[A]	1575
		Phase 3	t1 to t1+20 ms	[A]	1540
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.642
		Phase 2	t1 + 20 ms	[p.u.]	0.560
		Phase 3	t1 + 20 ms	[p.u.]	0.968
		Phase 1	t1 + 100 ms	[p.u.]	0.966
		Phase 2	t1 + 100 ms	[p.u.]	0.979
		Phase 3	t1 + 100 ms	[p.u.]	0.968
		Phase 1	t1 + 150 ms	[p.u.]	0.963
		Phase 2	t1 + 150 ms	[p.u.]	0.966
		Phase 3	t1 + 150 ms	[p.u.]	0.964
		Phase 1	t1 + 300 ms	[p.u.]	0.963
		Phase 2	t1 + 300 ms	[p.u.]	0.966
		Phase 3	t1 + 300 ms	[p.u.]	0.964
		Phase 1	t1 + 500 ms	[p.u.]	0.993
		Phase 2	t1 + 500 ms	[p.u.]	0.978
		Phase 3	t1 + 500 ms	[p.u.]	0.973
		Phase 1	t1 + 1000 ms	[p.u.]	0.966
		Phase 2	t1 + 1000 ms	[p.u.]	0.960
		Phase 3	t1 + 1000 ms	[p.u.]	0.974
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.055
Active current rise time	Pos. seq.			[s]	0.182

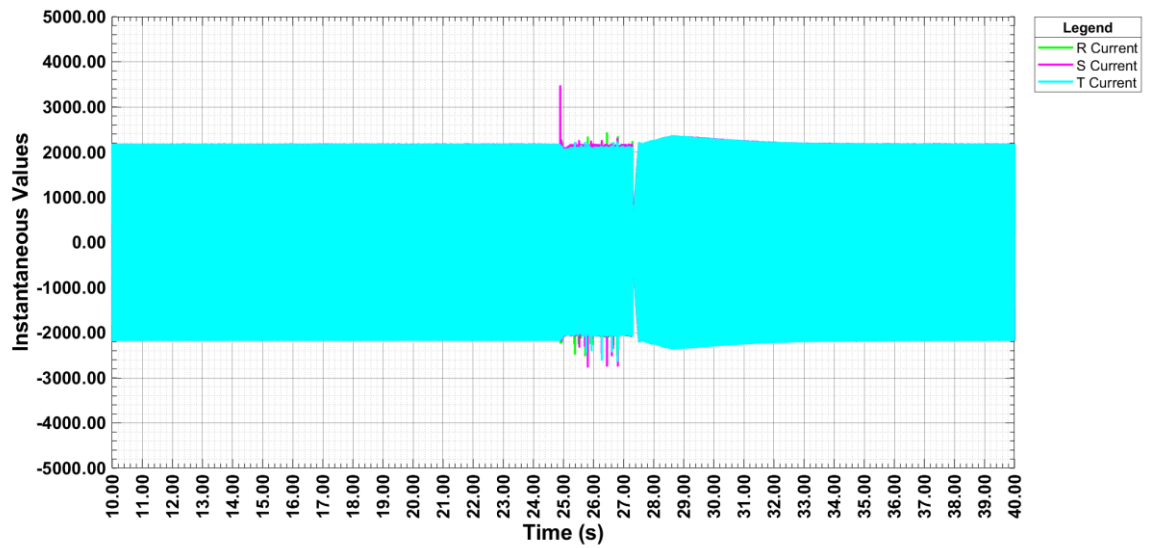
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.1

Phase-to-Phase voltages



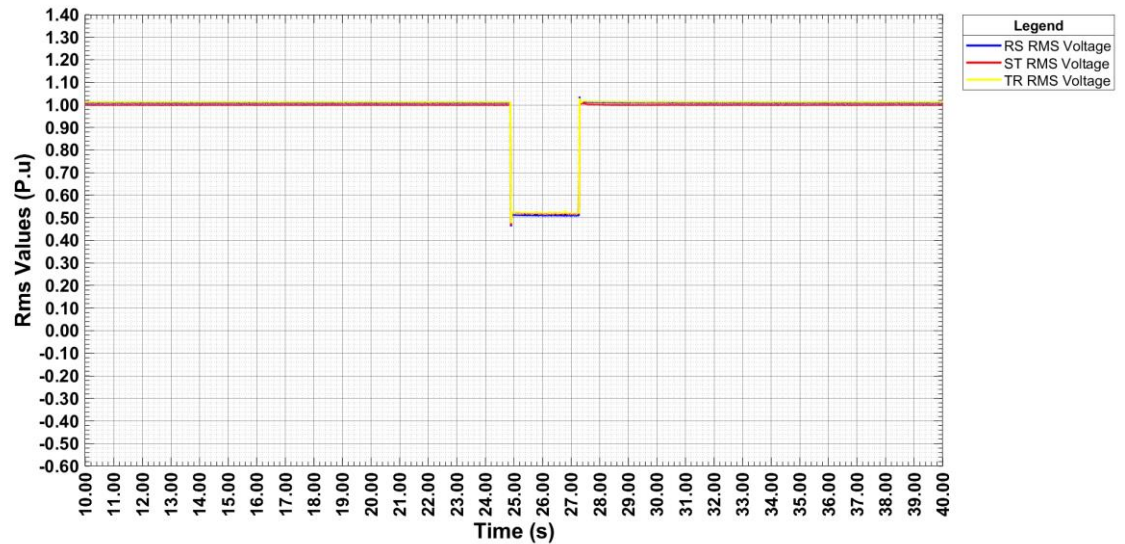
Phase currents



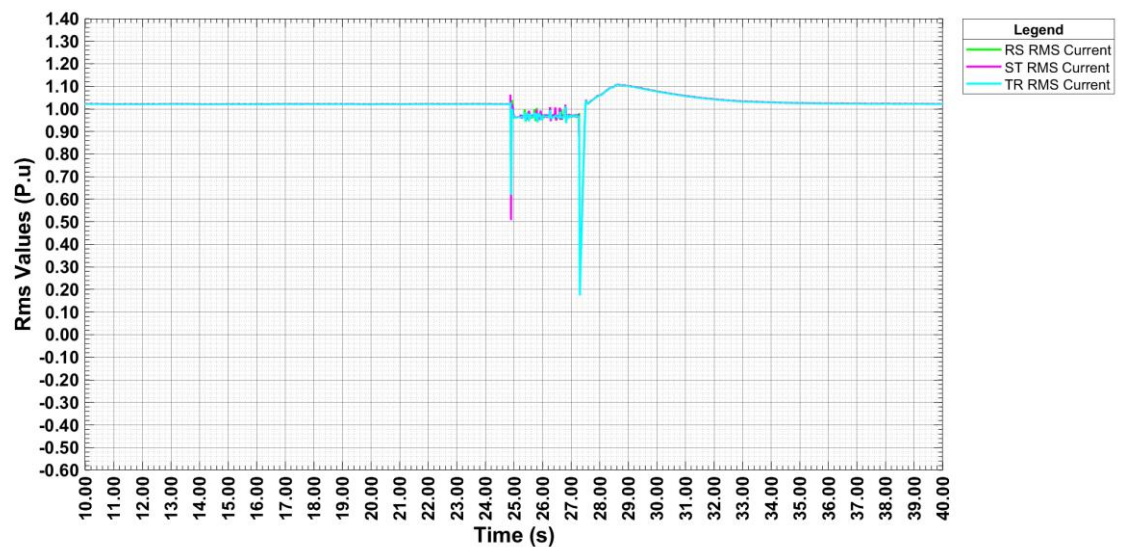
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.1

RMS Phase to phase voltages



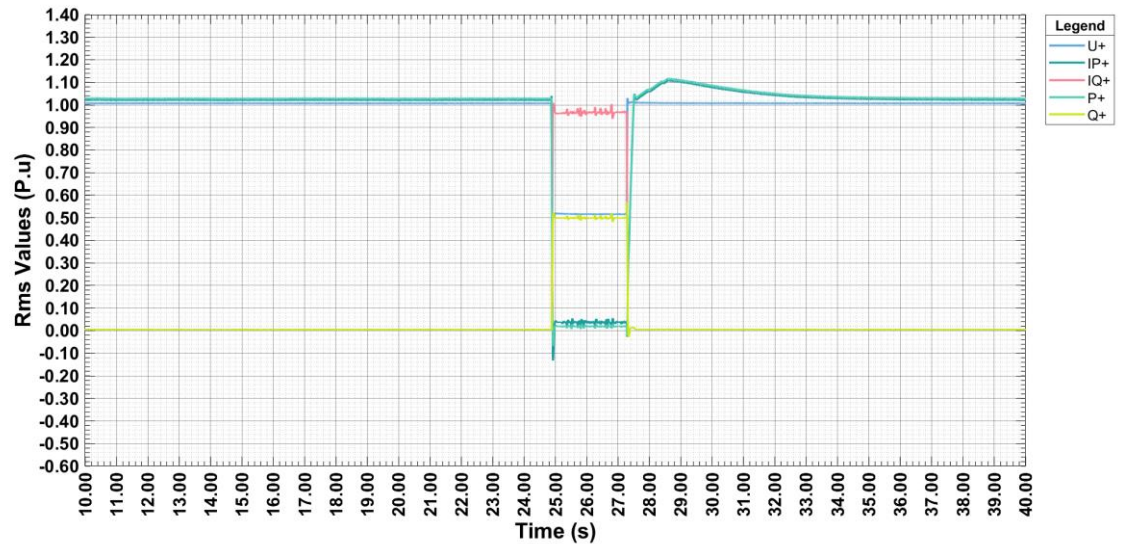
RMS Phase currents



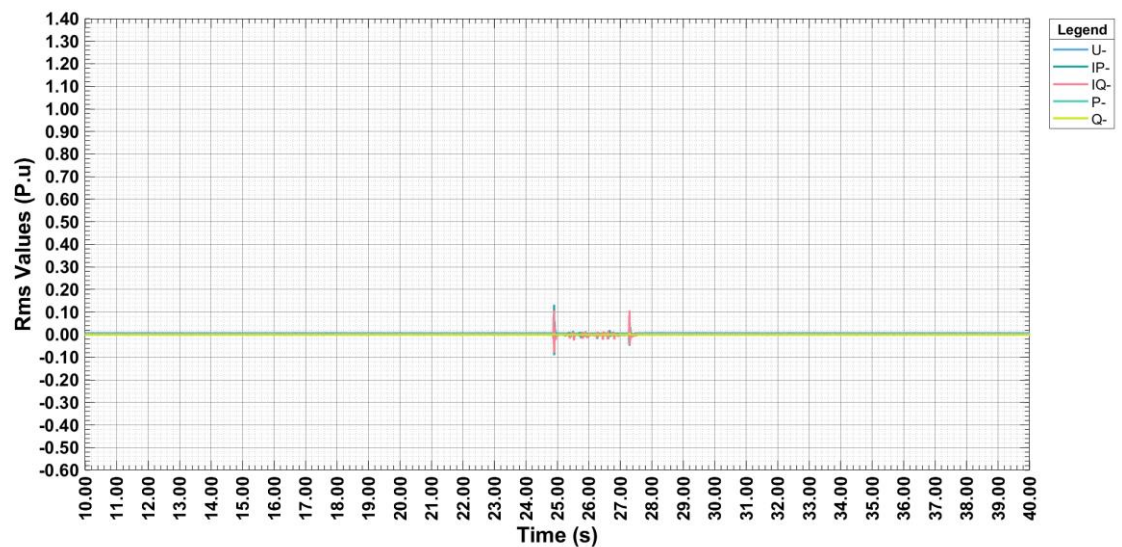
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.1

Positive sequences



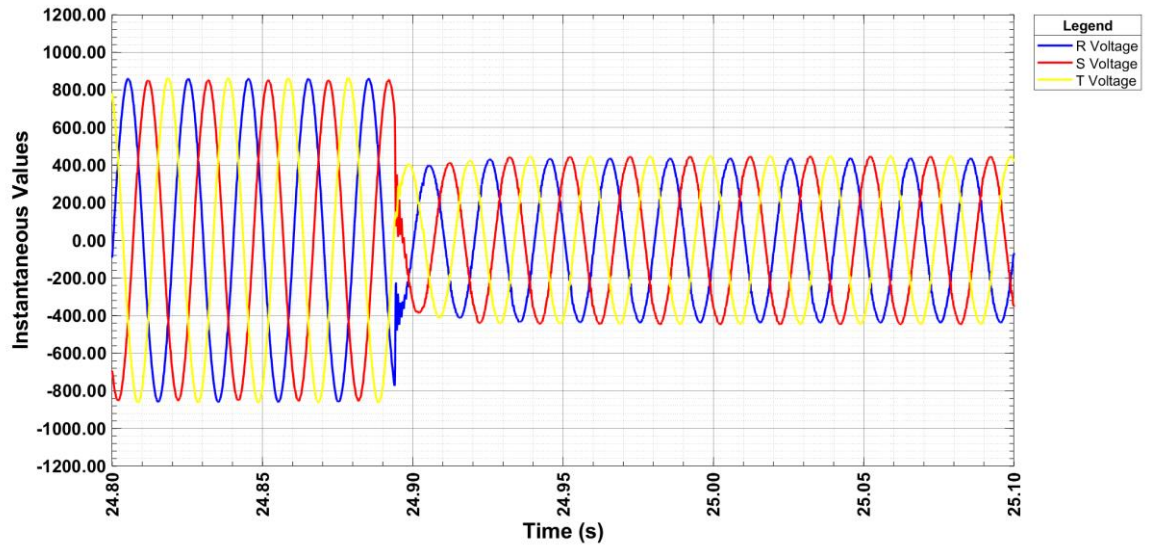
Negative sequences



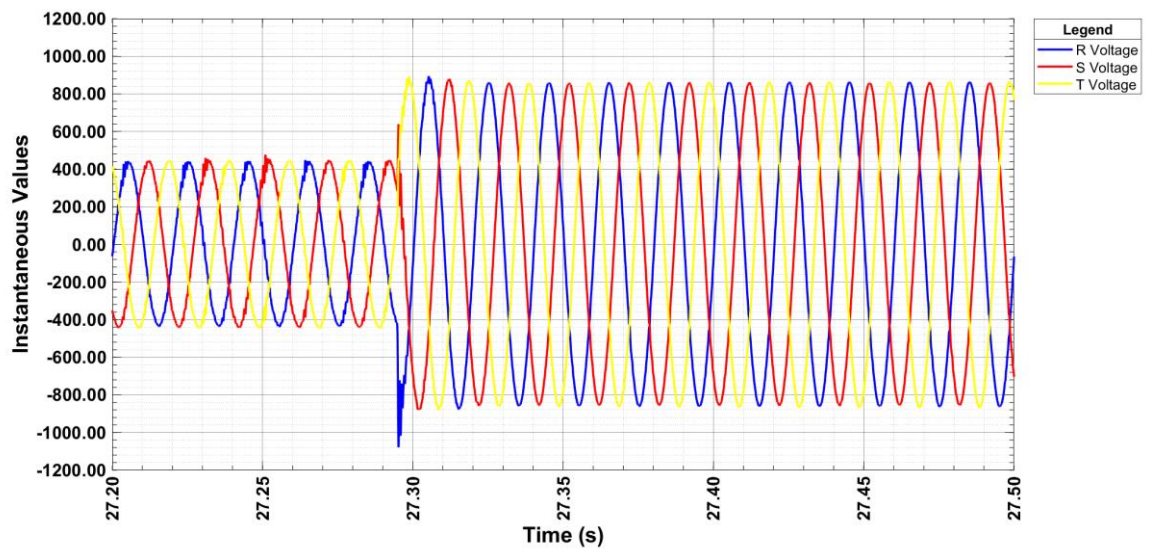
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.1

Transient voltage: Fault beginning



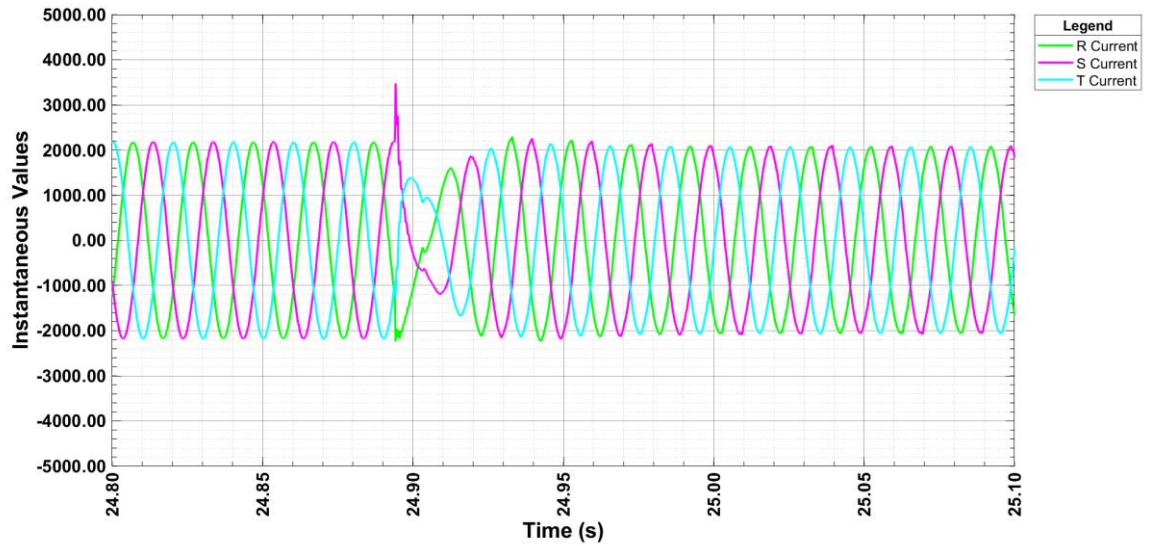
Transient voltage: Fault end



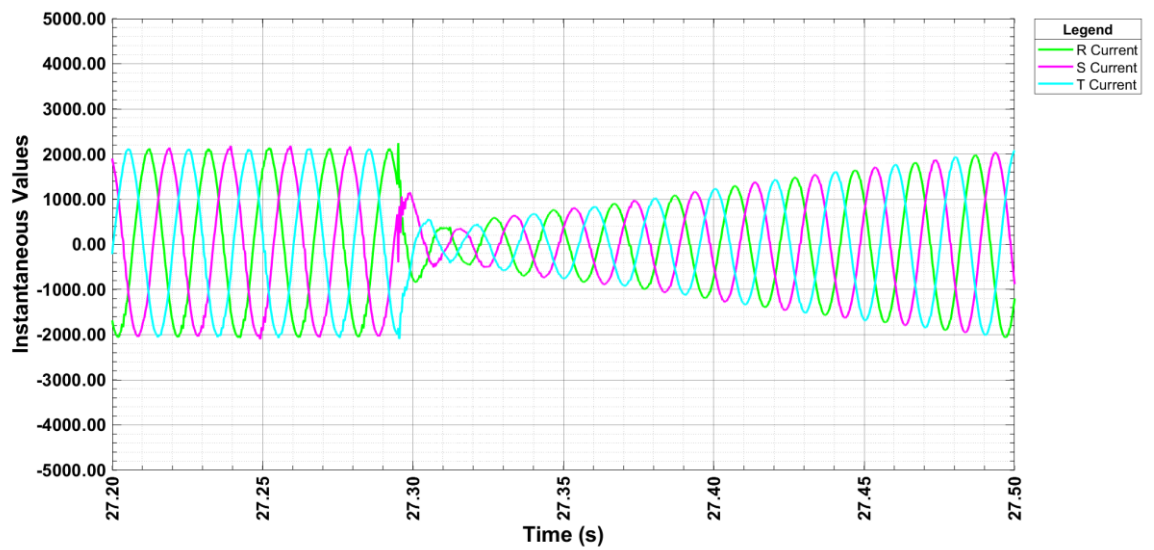
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.1

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.4.2 Test 50.2 Fault type: 3 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	50.2
	Date		-	[dd.mm.yyyy]	27.09.2020
	Time		-	[hh:mm:ss]	09:46:17
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.500
	Drop duration setpoint		-	[ms]	2162
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	25194
	Fault clearance (t2)		-	[ms]	27609
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2415
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.520 /1.000
		Pos. seq.		[p.u.]	0.519 /0.999

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.999
		Neg. seq.	t1-60 s to t1	[p.u.]	0.002
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.999
		Pos. seq.	t1-1 s to t1	[p.u.]	0.999
		Neg. seq.	t1-1 s to t1	[p.u.]	0.002
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.204
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.001
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.204
	Active Power	Total	t1-10 s to t1	[p.u.]	0.204
		Total	t1-2 s to t1	[p.u.]	0.204
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.204
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.001
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.989
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	31
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	31
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.517
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.007
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.963
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.001
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.964
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.005
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.019
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.019

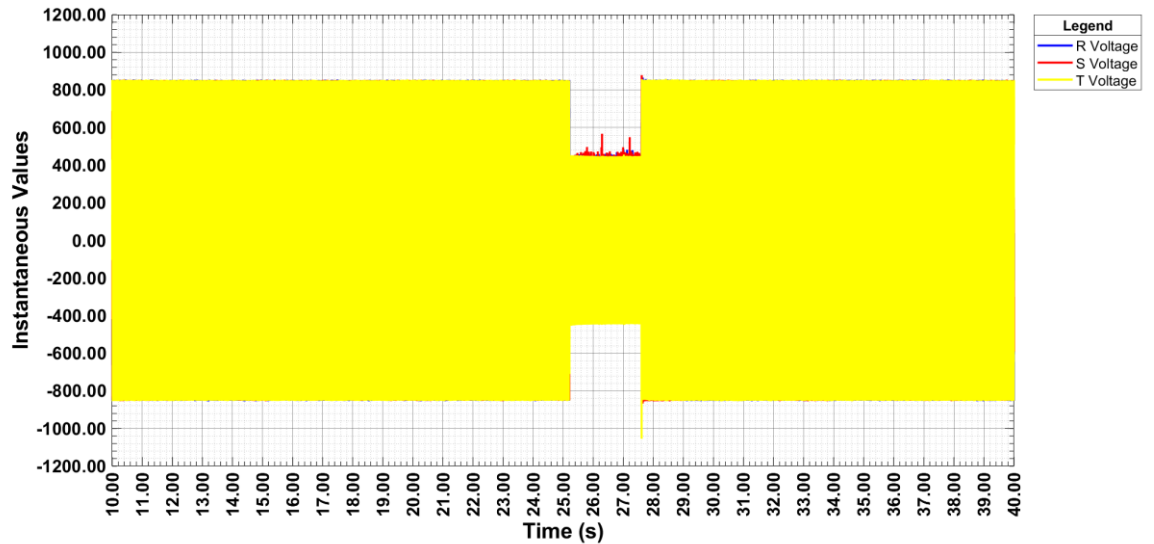
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	764
		Phase 2	t1 to t1+20 ms	[A]	963
		Phase 3	t1 to t1+20 ms	[A]	941
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.508
		Phase 2	t1 + 20 ms	[p.u.]	0.641
		Phase 3	t1 + 20 ms	[p.u.]	0.954
		Phase 1	t1 + 100 ms	[p.u.]	0.961
		Phase 2	t1 + 100 ms	[p.u.]	0.957
		Phase 3	t1 + 100 ms	[p.u.]	0.954
		Phase 1	t1 + 150 ms	[p.u.]	0.952
		Phase 2	t1 + 150 ms	[p.u.]	0.955
		Phase 3	t1 + 150 ms	[p.u.]	0.954
		Phase 1	t1 + 300 ms	[p.u.]	0.952
		Phase 2	t1 + 300 ms	[p.u.]	0.955
		Phase 3	t1 + 300 ms	[p.u.]	0.956
		Phase 1	t1 + 500 ms	[p.u.]	0.957
		Phase 2	t1 + 500 ms	[p.u.]	0.959
		Phase 3	t1 + 500 ms	[p.u.]	0.956
		Phase 1	t1 + 1000 ms	[p.u.]	0.969
		Phase 2	t1 + 1000 ms	[p.u.]	0.970
		Phase 3	t1 + 1000 ms	[p.u.]	0.968
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.215
Active current rise time	Pos. seq.			[s]	0.009

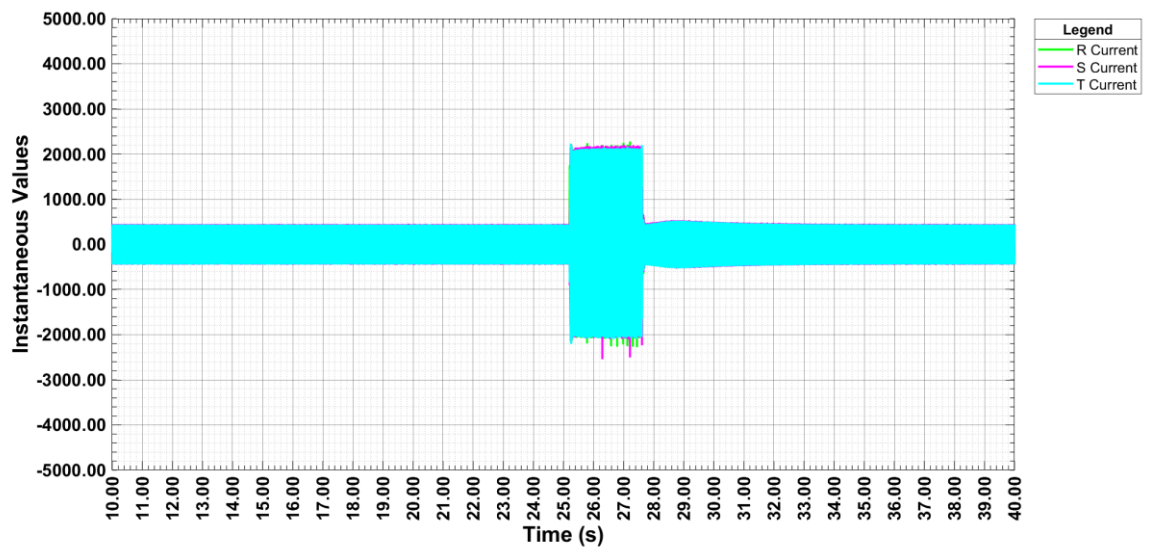
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.2

Phase-to-Phase voltages



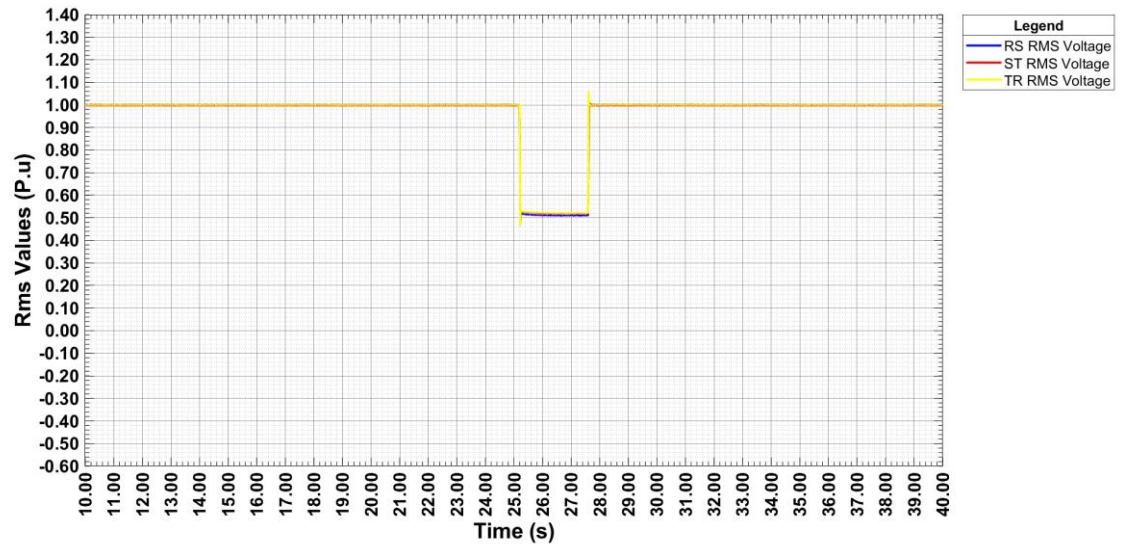
Phase currents



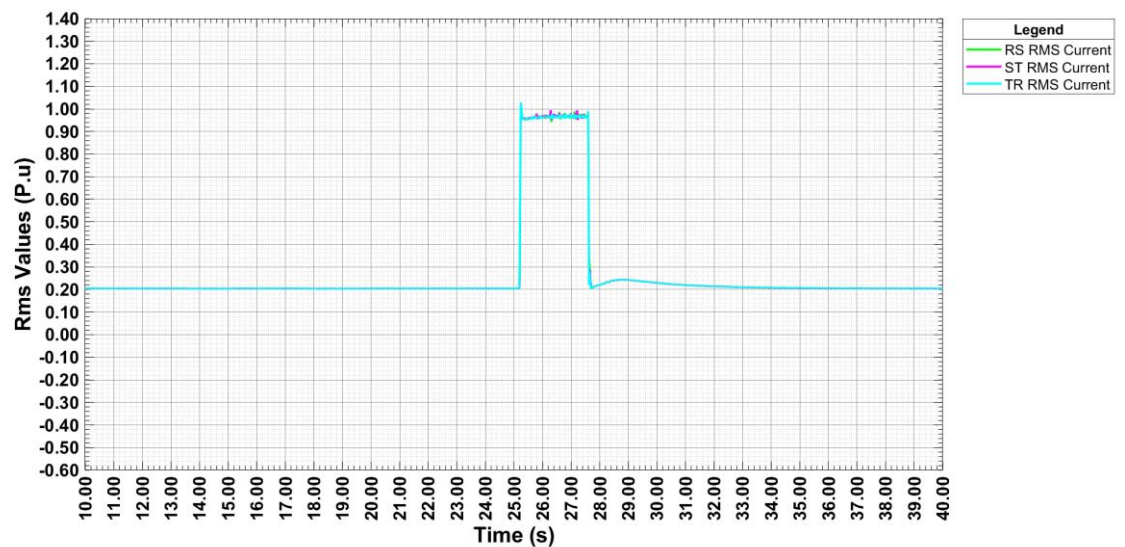
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.2

RMS Phase to phase voltages



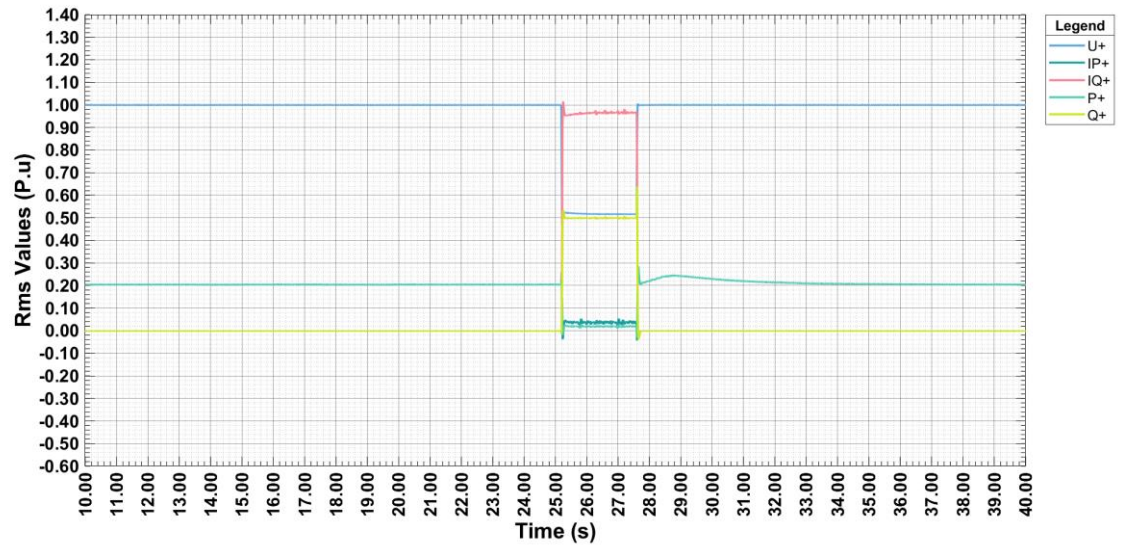
RMS Phase currents



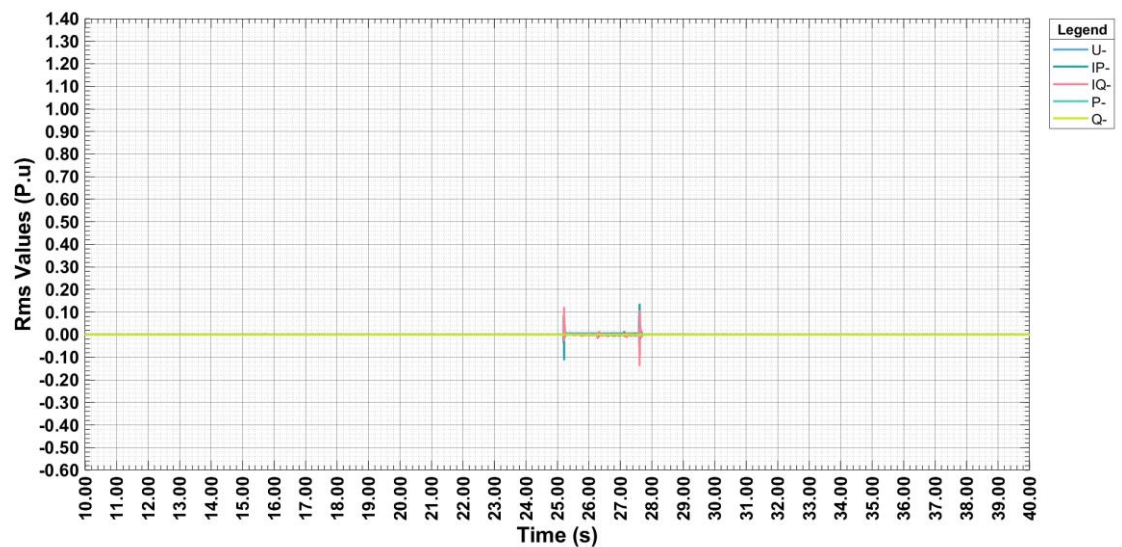
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.2

Positive sequences



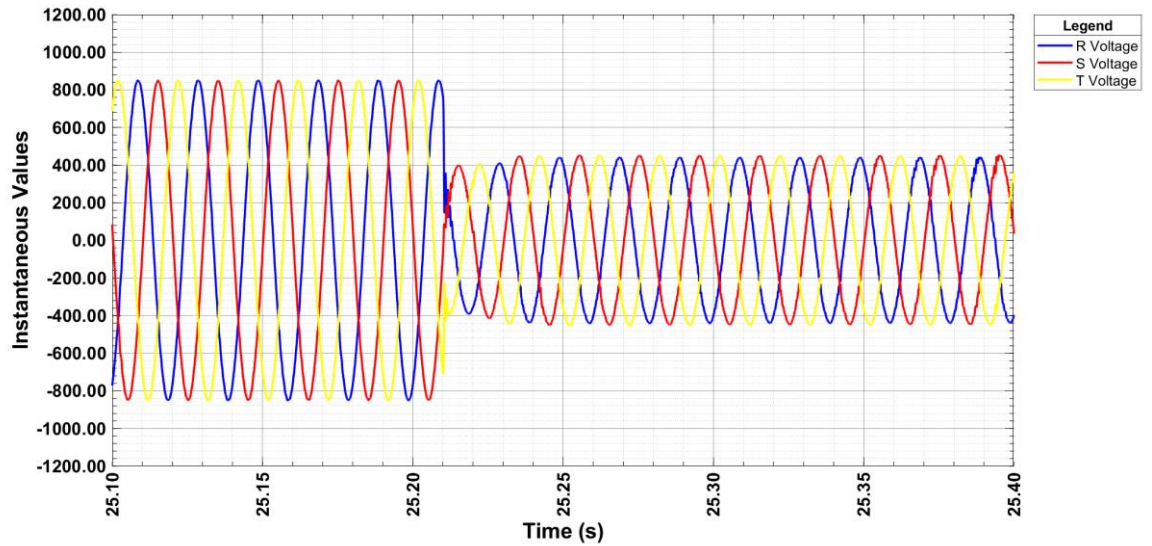
Negative sequences



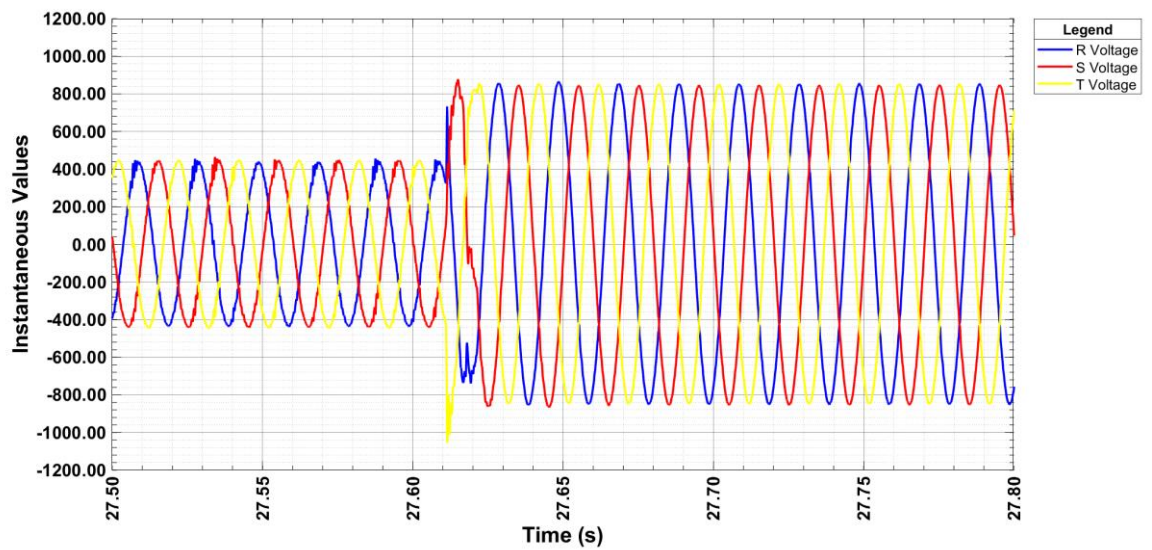
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.2

Transient voltage: Fault beginning



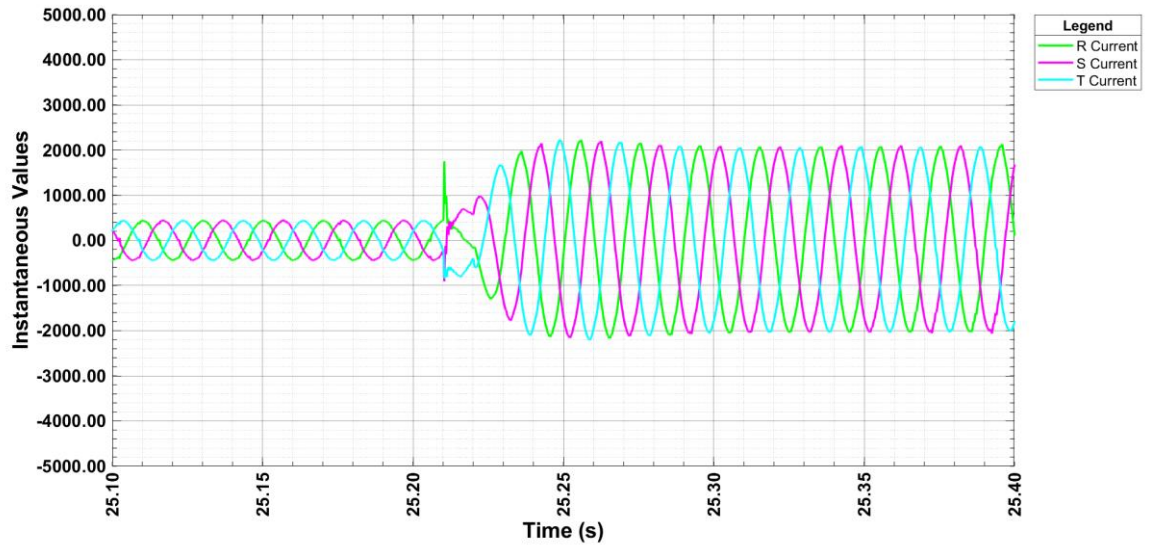
Transient voltage: Fault end



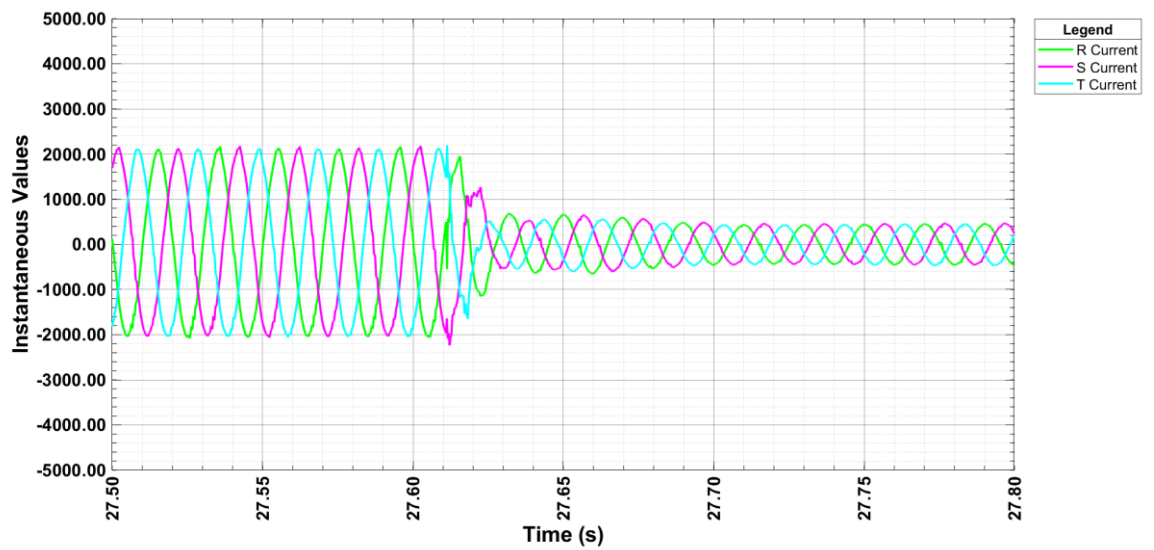
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.2

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.4.3 Test 50.3 Fault type: 2 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	50.3
	Date		-	[dd.mm.yyyy]	29.09.2020
	Time		-	[hh:mm:ss]	19:36:52
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.500
	Drop duration setpoint		-	[ms]	2444
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	26572
	Fault clearance (t2)		-	[ms]	29042
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2471
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.546 /1.001
		Pos. seq.		[p.u.]	0.771 /1.001

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.001
		Neg. seq.	t1-60 s to t1	[p.u.]	0.006
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.001
		Pos. seq.	t1-1 s to t1	[p.u.]	1.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.006
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.027
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.028
	Active Power	Total	t1-10 s to t1	[p.u.]	1.029
		Total	t1-2 s to t1	[p.u.]	1.029
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.029
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.001
		Neg. seq.	-	-	-1.944
	Reactive current settling up time	Pos. seq.	-	[ms]	25
		Neg. seq.	-	[ms]	26
	Reactive current settling time	Pos. seq.	-	[ms]	25
		Neg. seq.	-	[ms]	26
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.770
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.226
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.463
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.443
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.469
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.443
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.058
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.057

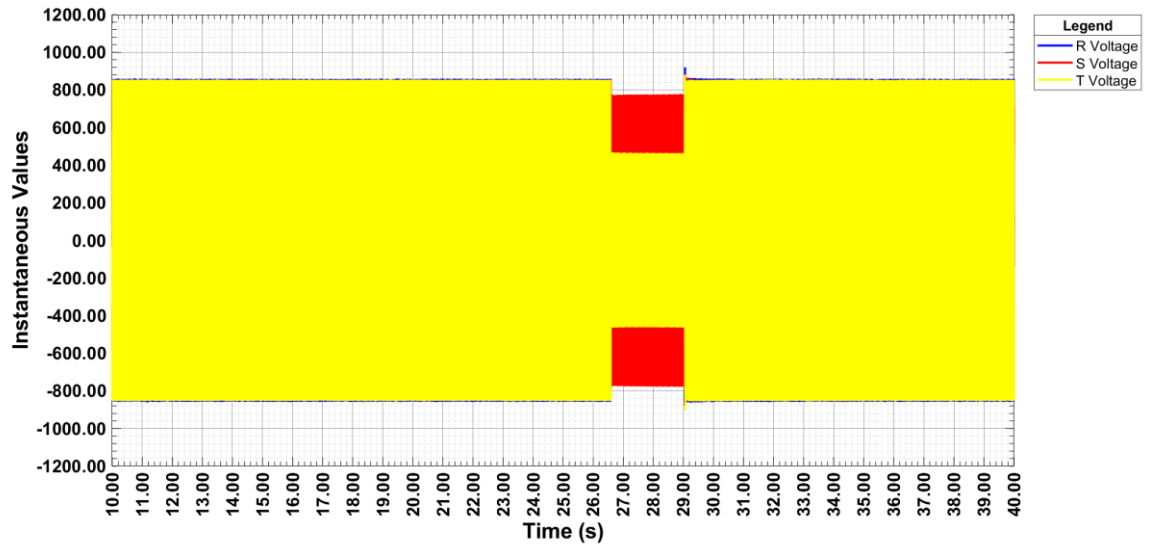
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1624
		Phase 2	t1 to t1+20 ms	[A]	1546
		Phase 3	t1 to t1+20 ms	[A]	1535
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.439
		Phase 2	t1 + 20 ms	[p.u.]	0.330
		Phase 3	t1 + 20 ms	[p.u.]	0.832
		Phase 1	t1 + 100 ms	[p.u.]	0.782
		Phase 2	t1 + 100 ms	[p.u.]	0.062
		Phase 3	t1 + 100 ms	[p.u.]	0.832
		Phase 1	t1 + 150 ms	[p.u.]	0.759
		Phase 2	t1 + 150 ms	[p.u.]	0.074
		Phase 3	t1 + 150 ms	[p.u.]	0.816
		Phase 1	t1 + 300 ms	[p.u.]	0.757
		Phase 2	t1 + 300 ms	[p.u.]	0.074
		Phase 3	t1 + 300 ms	[p.u.]	0.817
		Phase 1	t1 + 500 ms	[p.u.]	0.758
		Phase 2	t1 + 500 ms	[p.u.]	0.073
		Phase 3	t1 + 500 ms	[p.u.]	0.818
		Phase 1	t1 + 1000 ms	[p.u.]	0.759
		Phase 2	t1 + 1000 ms	[p.u.]	0.071
		Phase 3	t1 + 1000 ms	[p.u.]	0.820
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.050
Active current rise time	Pos. seq.			[s]	0.151

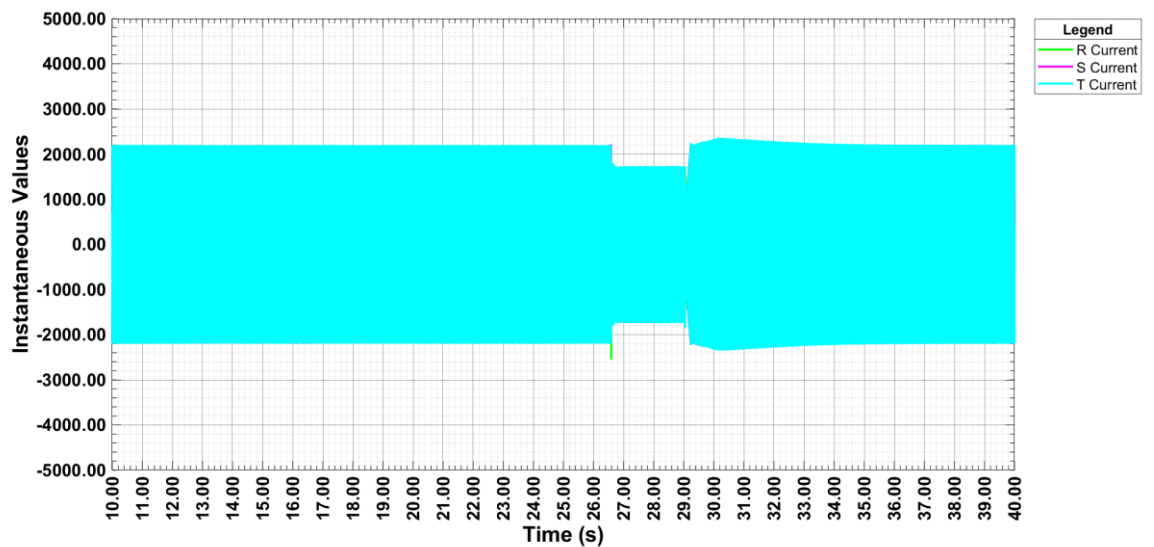
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.3

Phase-to-Phase voltages



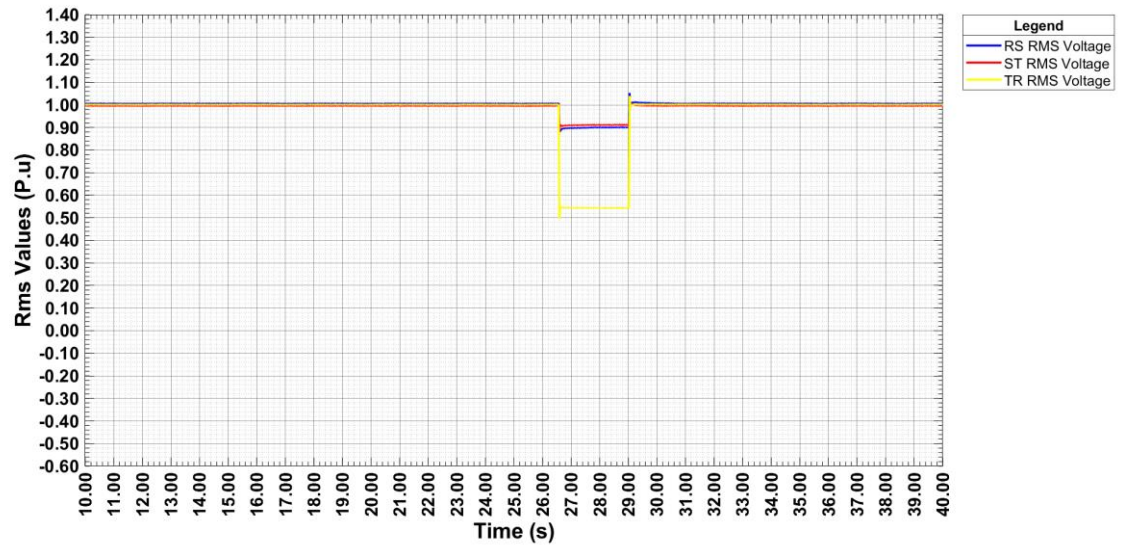
Phase currents



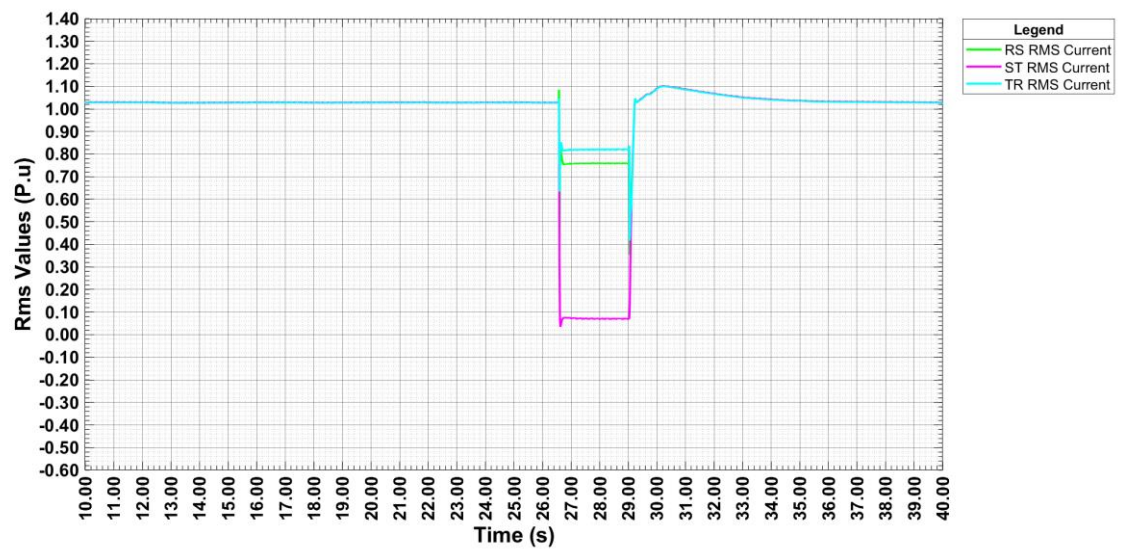
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.3

RMS Phase to phase voltages



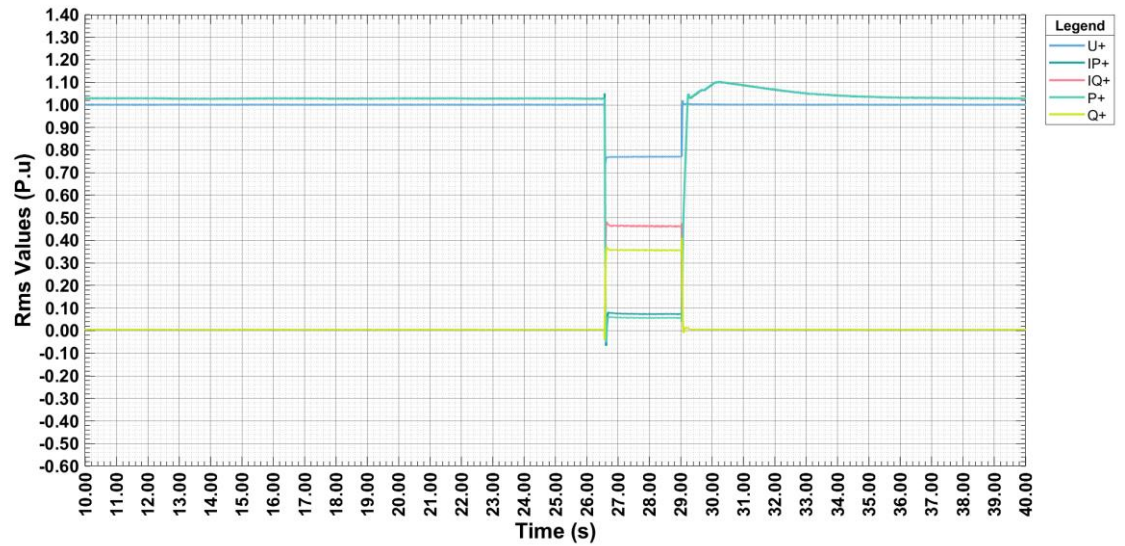
RMS Phase currents



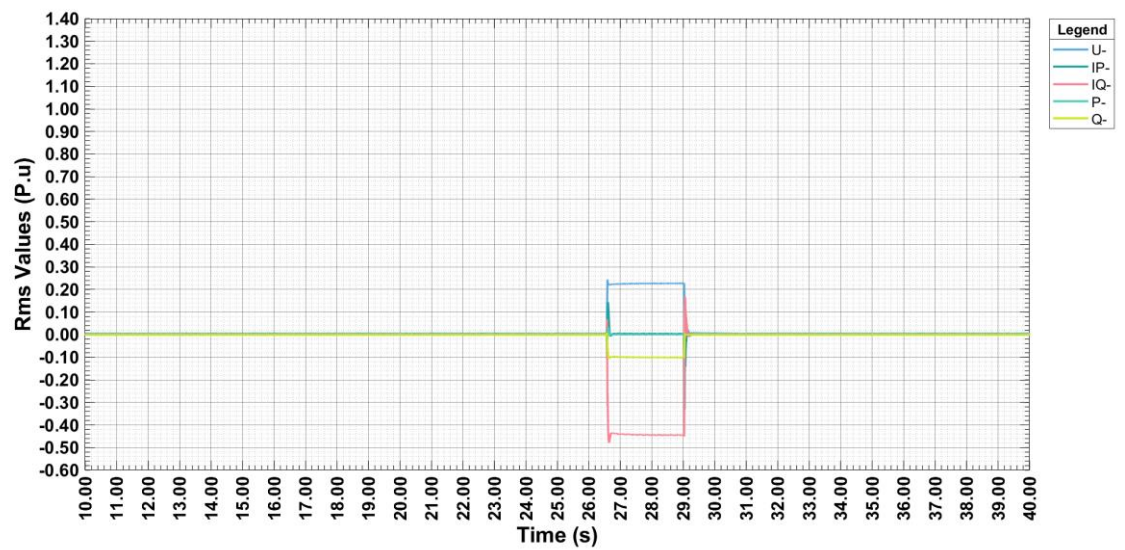
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.3

Positive sequences



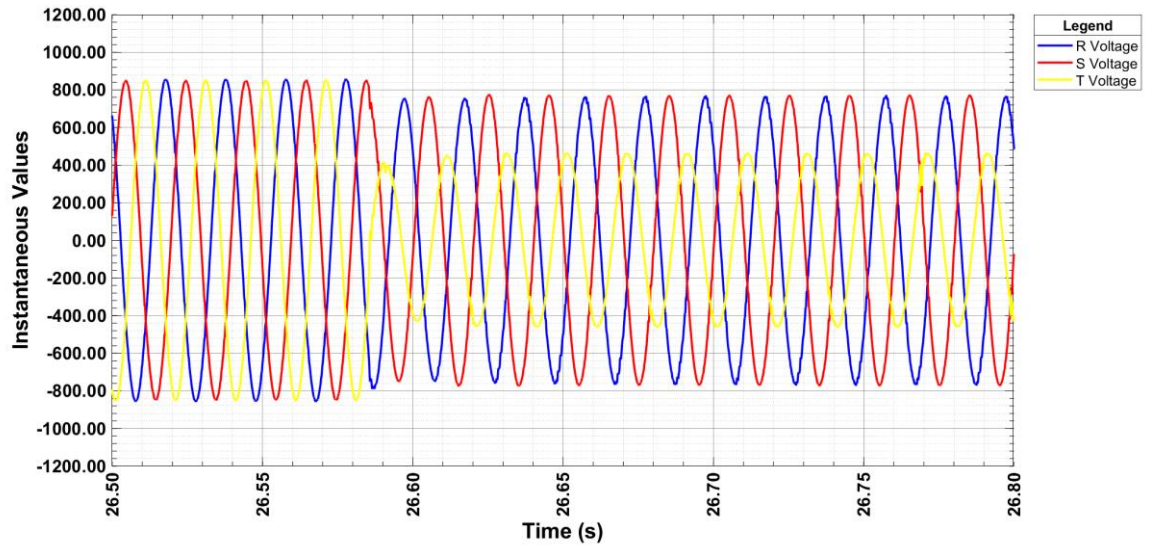
Negative sequences



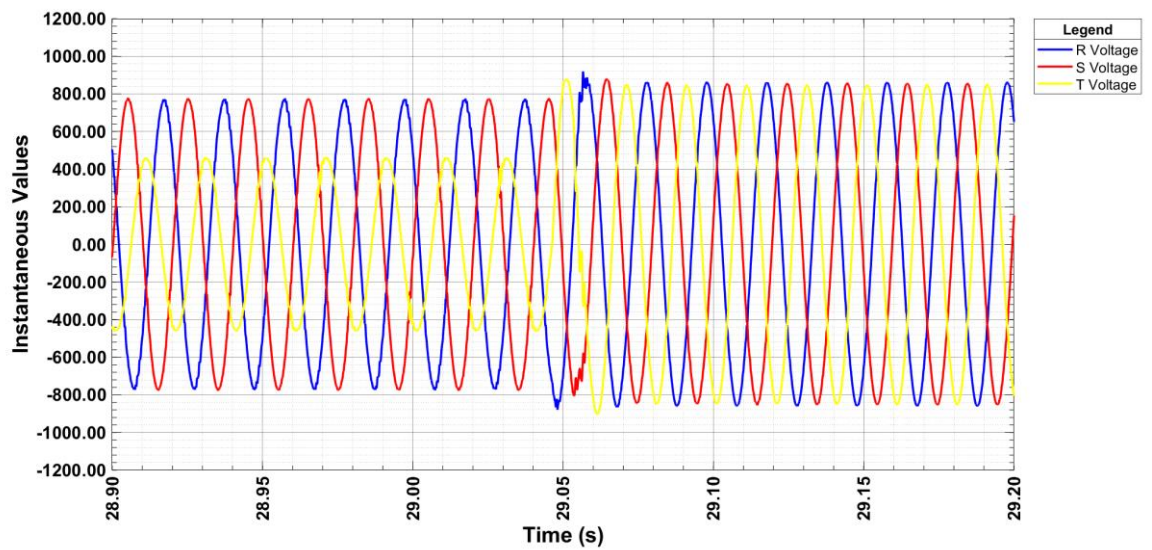
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.3

Transient voltage: Fault beginning



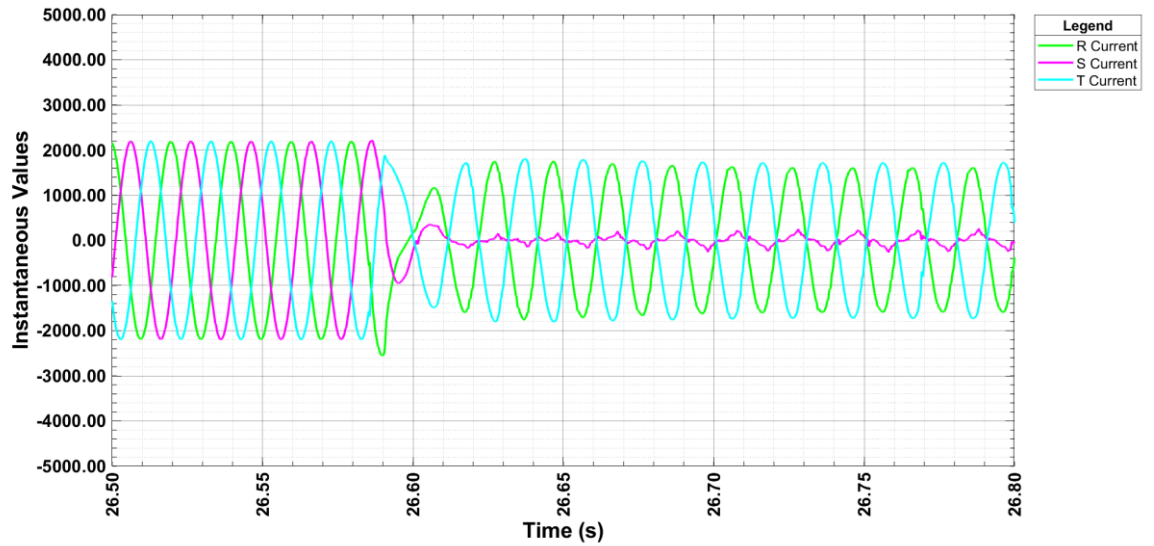
Transient voltage: Fault end



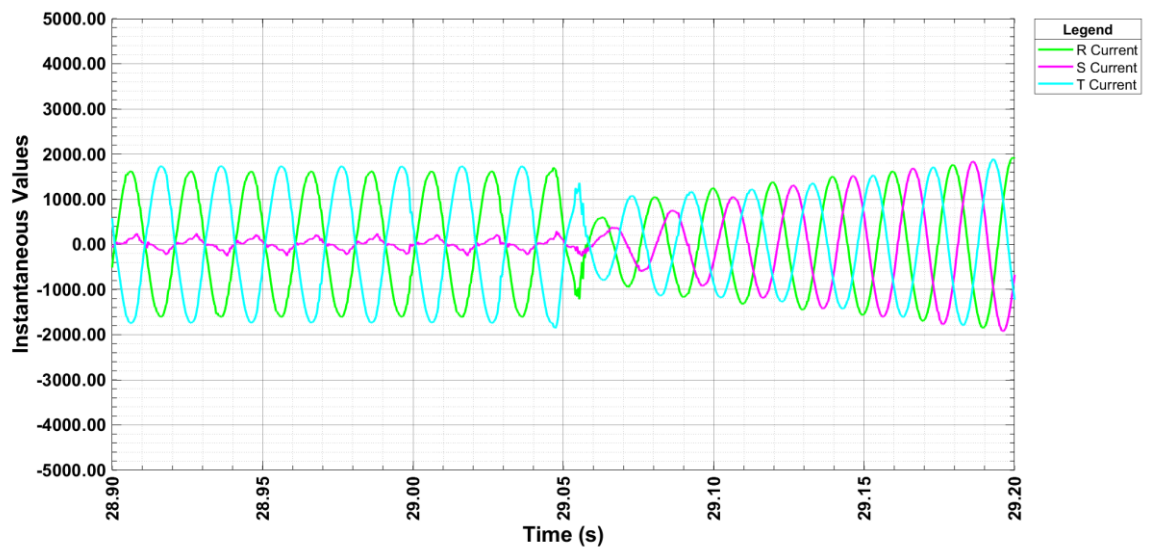
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.3

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.4.4 Test 50.4 Fault type: 2 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	50.4
	Date		-	[dd.mm.yyyy]	29.09.2020
	Time		-	[hh:mm:ss]	19:43:42
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.500
	Drop duration setpoint		-	[ms]	2444
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	23399
	Fault clearance (t2)		-	[ms]	25868
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2469
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.548 /0.995
		Pos. seq.		[p.u.]	0.774 /0.999

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.999
		Neg. seq.	t1-60 s to t1	[p.u.]	0.004
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.999
		Pos. seq.	t1-1 s to t1	[p.u.]	0.998
		Neg. seq.	t1-1 s to t1	[p.u.]	0.004
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.205
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.001
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.205
	Active Power	Total	t1-10 s to t1	[p.u.]	0.204
		Total	t1-2 s to t1	[p.u.]	0.205
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.205
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.001
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.986
		Neg. seq.	-	-	-1.940
	Reactive current settling up time	Pos. seq.	-	[ms]	20
		Neg. seq.	-	[ms]	27
	Reactive current settling time	Pos. seq.	-	[ms]	20
		Neg. seq.	-	[ms]	27
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.773
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.227
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.446
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.444
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.455
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.444
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.071
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.070

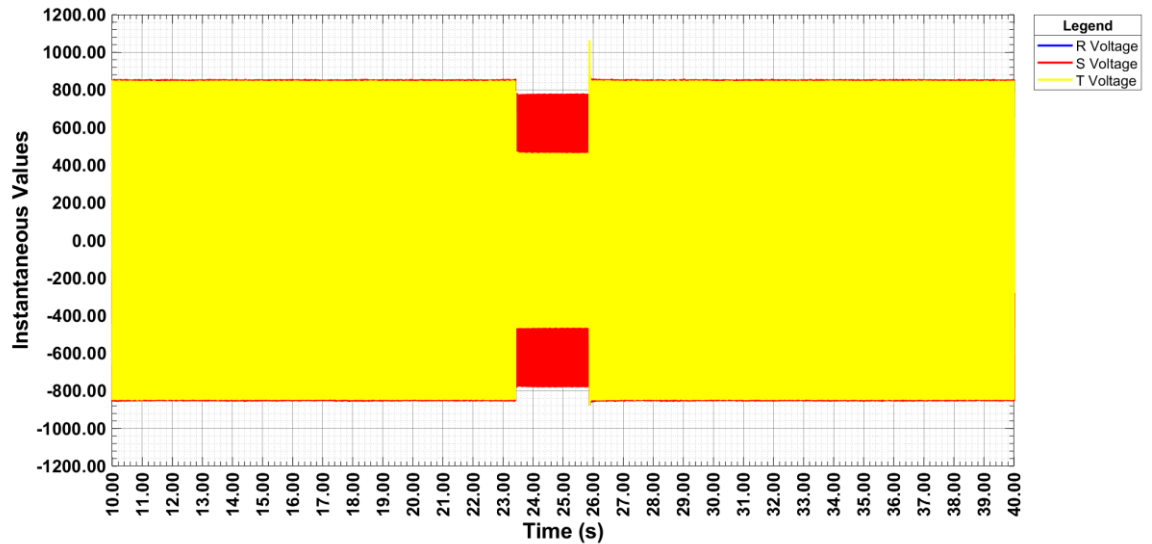
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	781
		Phase 2	t1 to t1+20 ms	[A]	362
		Phase 3	t1 to t1+20 ms	[A]	1033
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.519
		Phase 2	t1 + 20 ms	[p.u.]	0.187
		Phase 3	t1 + 20 ms	[p.u.]	0.826
		Phase 1	t1 + 100 ms	[p.u.]	0.751
		Phase 2	t1 + 100 ms	[p.u.]	0.080
		Phase 3	t1 + 100 ms	[p.u.]	0.826
		Phase 1	t1 + 150 ms	[p.u.]	0.737
		Phase 2	t1 + 150 ms	[p.u.]	0.081
		Phase 3	t1 + 150 ms	[p.u.]	0.810
		Phase 1	t1 + 300 ms	[p.u.]	0.736
		Phase 2	t1 + 300 ms	[p.u.]	0.081
		Phase 3	t1 + 300 ms	[p.u.]	0.811
		Phase 1	t1 + 500 ms	[p.u.]	0.736
		Phase 2	t1 + 500 ms	[p.u.]	0.080
		Phase 3	t1 + 500 ms	[p.u.]	0.811
		Phase 1	t1 + 1000 ms	[p.u.]	0.740
		Phase 2	t1 + 1000 ms	[p.u.]	0.080
		Phase 3	t1 + 1000 ms	[p.u.]	0.816
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.212
Active current rise time	Pos. seq.			[s]	0.019

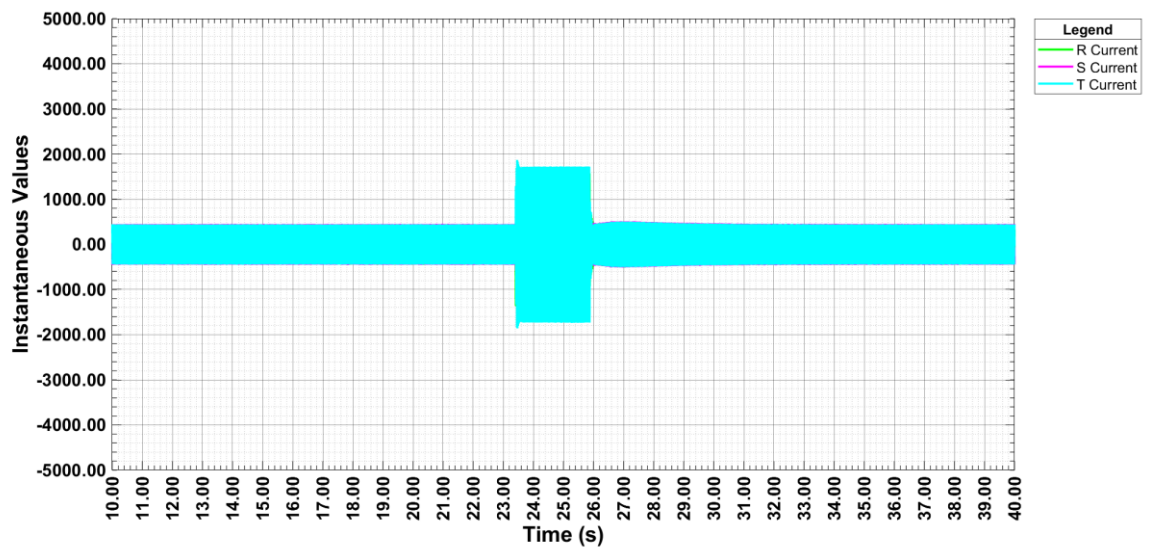
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.4

Phase-to-Phase voltages



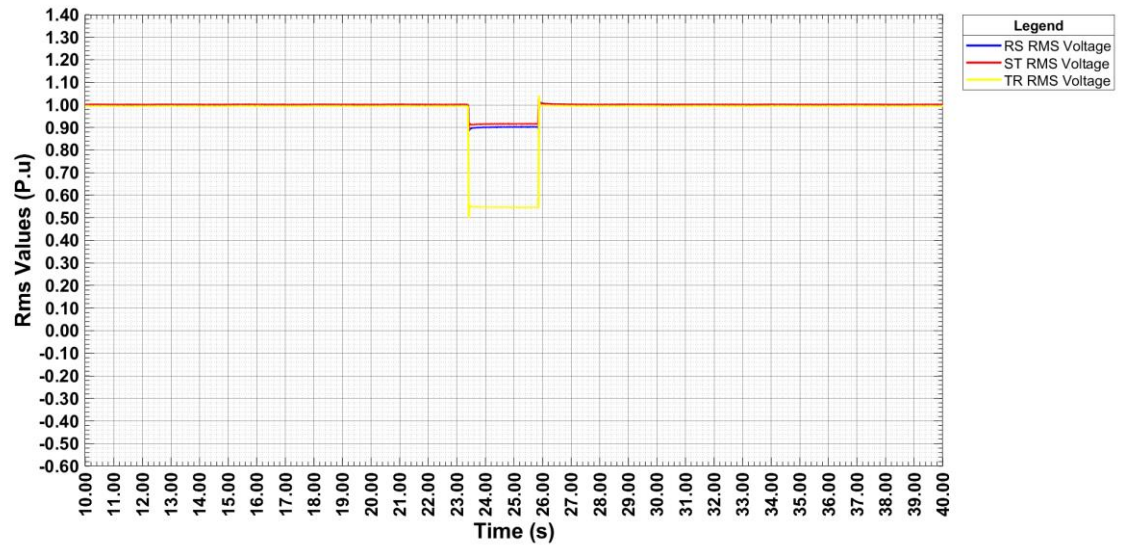
Phase currents



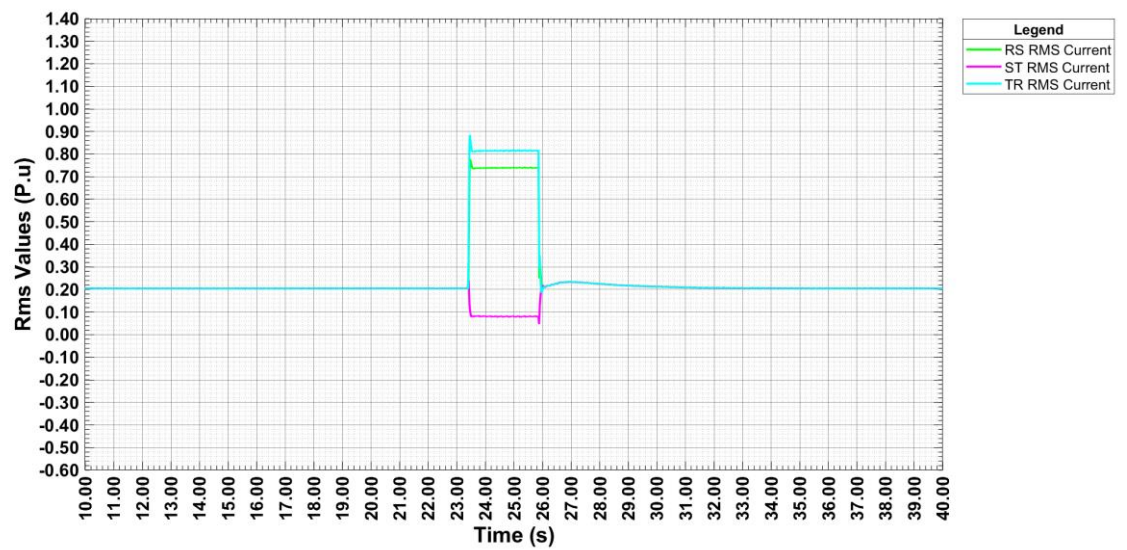
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.4

RMS Phase to phase voltages



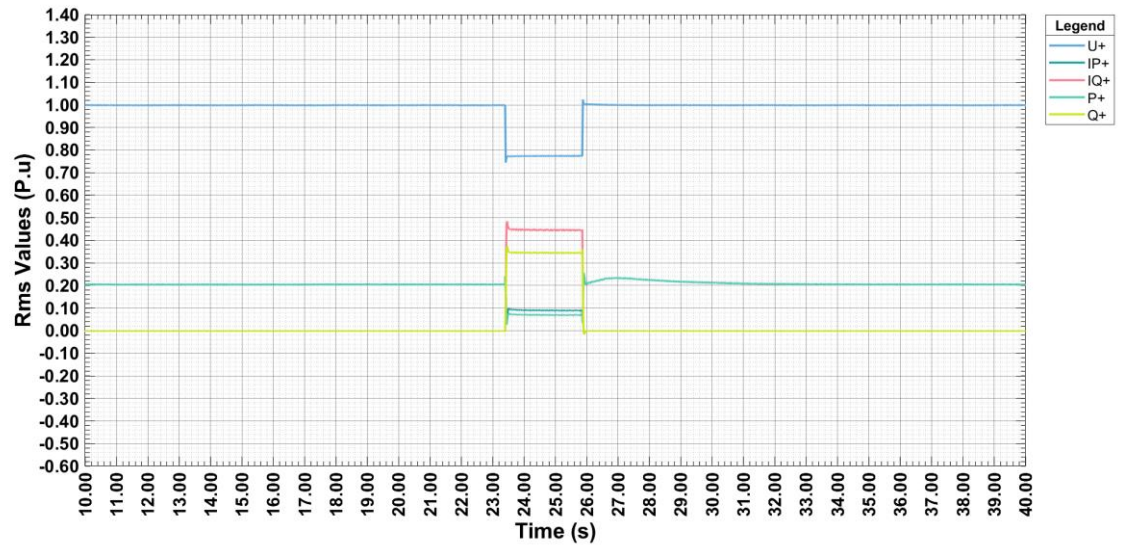
RMS Phase currents



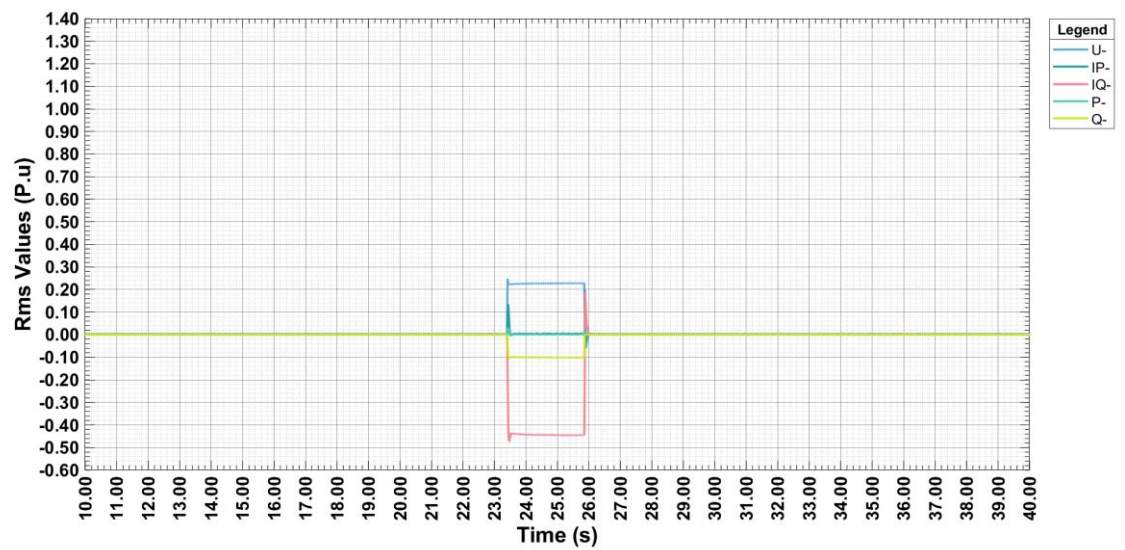
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.4

Positive sequences



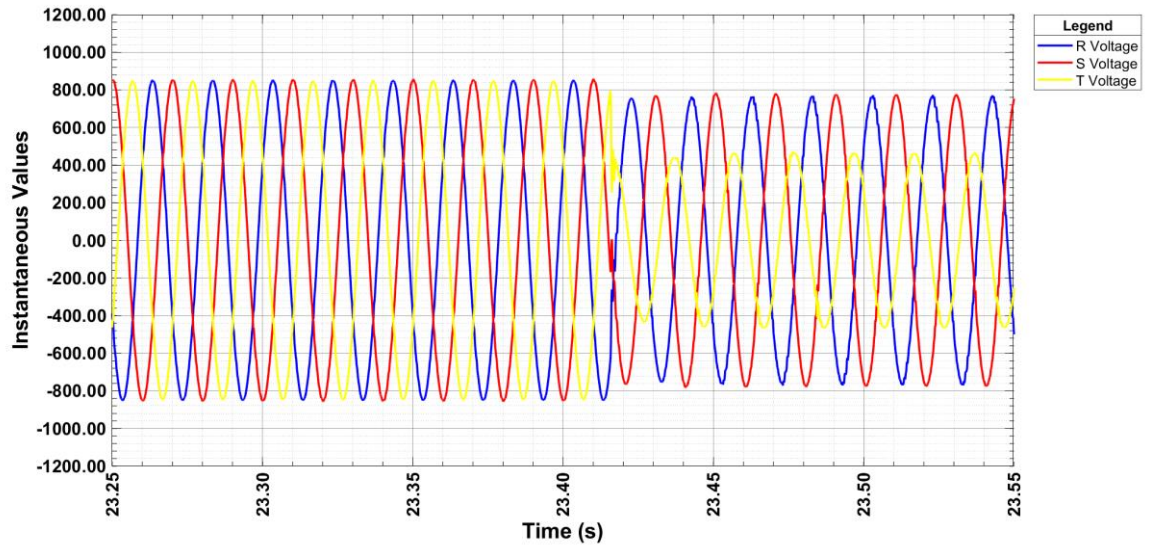
Negative sequences



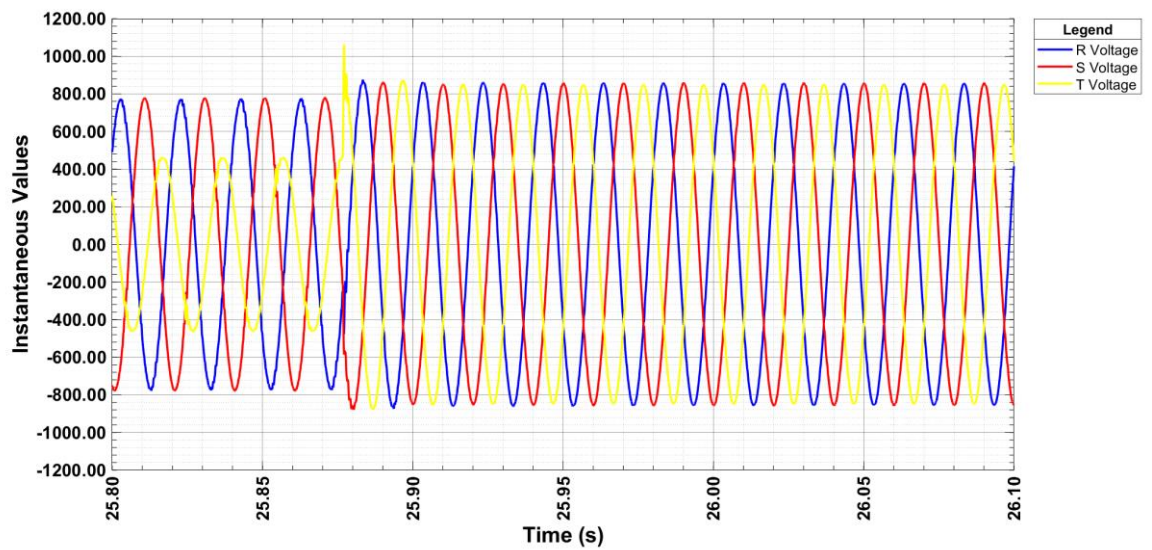
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.4

Transient voltage: Fault beginning



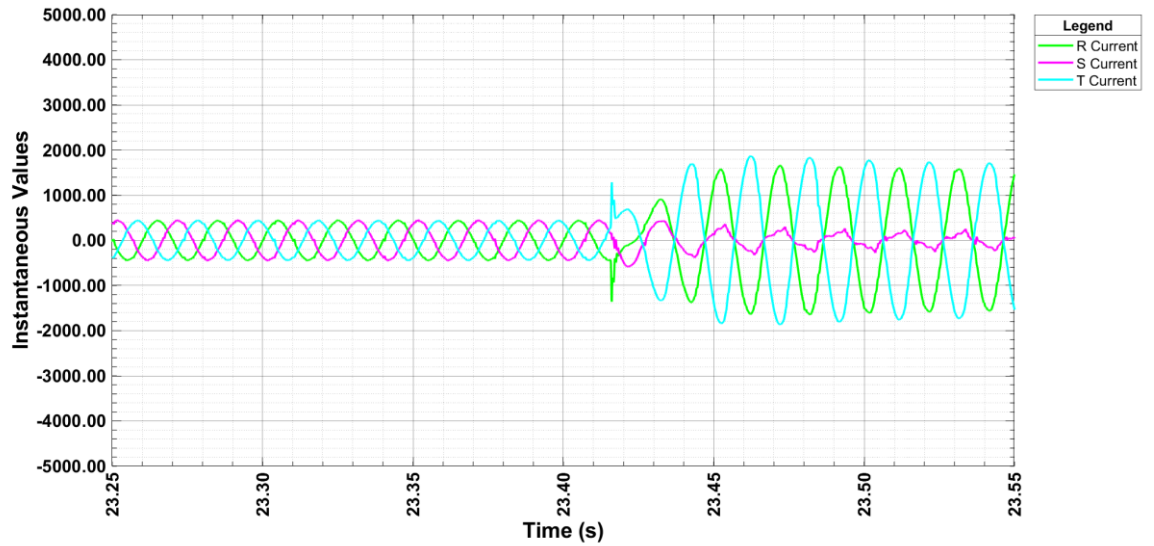
Transient voltage: Fault end



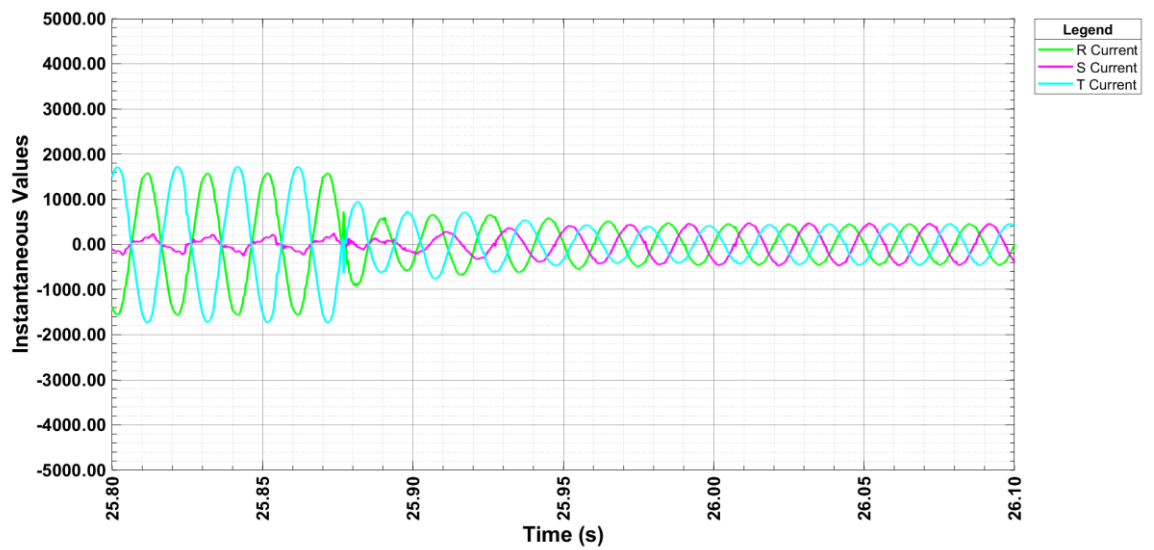
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.4

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.4.5 Test 50.5 Fault type: 3 phases, Full load, Limited dynamic grid support

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	50.5
	Date		-	[dd.mm.yyyy]	27.09.2020
	Time		-	[hh:mm:ss]	10:08:31
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.500
	Drop duration setpoint		-	[ms]	1982
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	23314
	Fault clearance (t2)		-	[ms]	25728
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2414
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.502 /1.007
		Pos. seq.		[p.u.]	0.501 /1.007

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.007
		Neg. seq.	t1-60 s to t1	[p.u.]	0.008
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.007
		Pos. seq.	t1-1 s to t1	[p.u.]	1.007
		Neg. seq.	t1-1 s to t1	[p.u.]	0.008
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.020
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.020
	Active Power	Total	t1-10 s to t1	[p.u.]	1.028
		Total	t1-2 s to t1	[p.u.]	1.027
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.027
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	-0.020
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	-
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	-
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.500
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.000
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.000
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.047
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.023
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.023

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1566
		Phase 2	t1 to t1+20 ms	[A]	1540
		Phase 3	t1 to t1+20 ms	[A]	1520
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.244
		Phase 2	t1 + 20 ms	[p.u.]	0.406
		Phase 3	t1 + 20 ms	[p.u.]	0.032
		Phase 1	t1 + 100 ms	[p.u.]	0.030
		Phase 2	t1 + 100 ms	[p.u.]	0.031
		Phase 3	t1 + 100 ms	[p.u.]	0.032
		Phase 1	t1 + 150 ms	[p.u.]	0.045
		Phase 2	t1 + 150 ms	[p.u.]	0.045
		Phase 3	t1 + 150 ms	[p.u.]	0.045
		Phase 1	t1 + 300 ms	[p.u.]	0.047
		Phase 2	t1 + 300 ms	[p.u.]	0.048
		Phase 3	t1 + 300 ms	[p.u.]	0.047
		Phase 1	t1 + 500 ms	[p.u.]	0.047
		Phase 2	t1 + 500 ms	[p.u.]	0.048
		Phase 3	t1 + 500 ms	[p.u.]	0.048
		Phase 1	t1 + 1000 ms	[p.u.]	0.047
		Phase 2	t1 + 1000 ms	[p.u.]	0.048
		Phase 3	t1 + 1000 ms	[p.u.]	0.047
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.051
Active current rise time	Pos. seq.			[s]	0.182

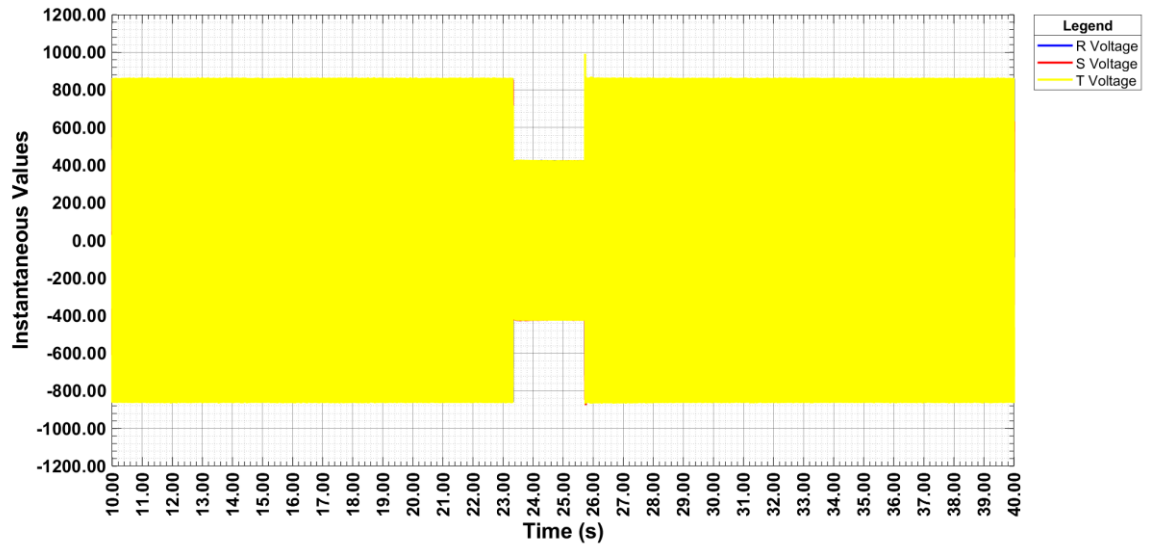
Note: As the standard requires, even with the requirement of limited dynamic grid support, the requirements for full dynamic grid support apply to generators with voltages above 0.7 U_c .

So, in this case, the Unit did not produce reactive current to support the grid.

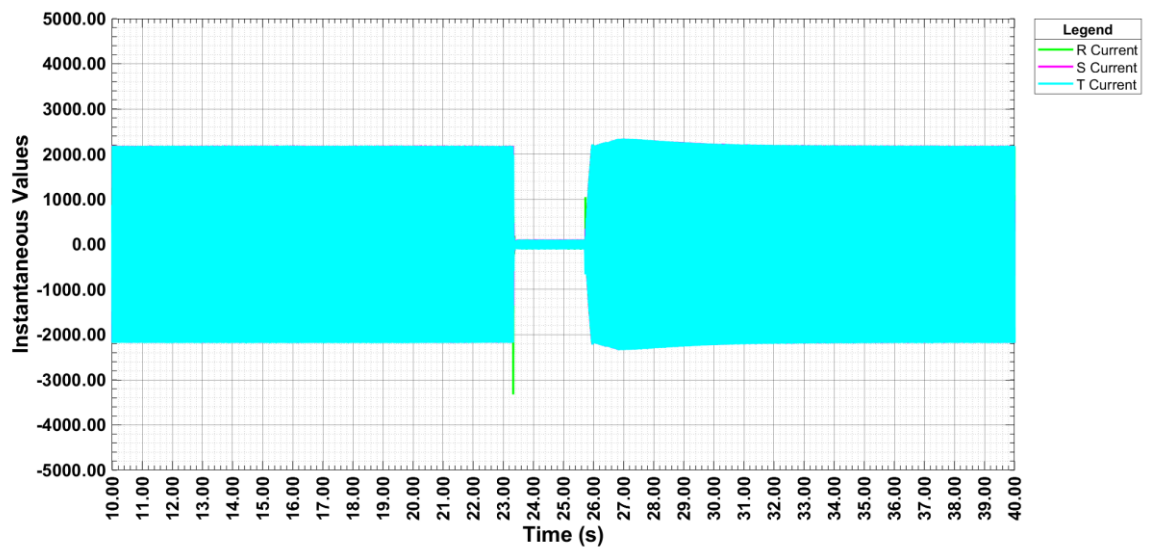
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.5

Phase-to-Phase voltages



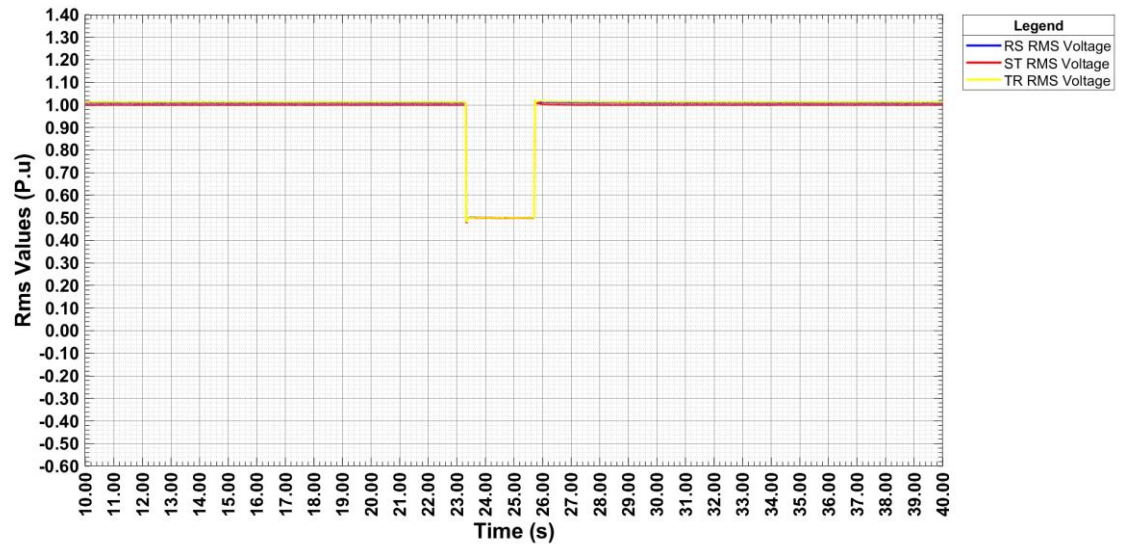
Phase currents



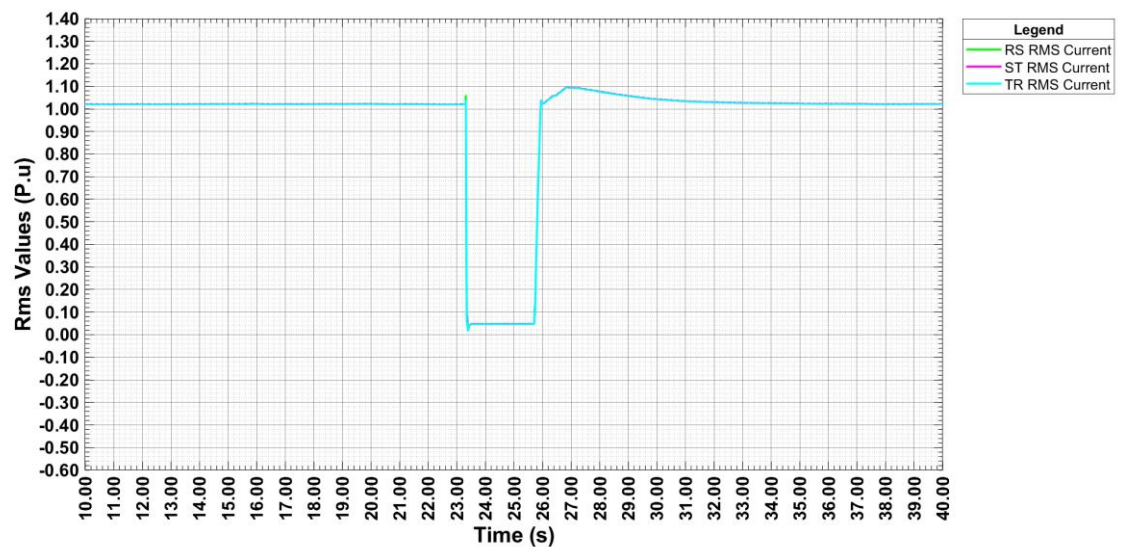
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.5

RMS Phase to phase voltages



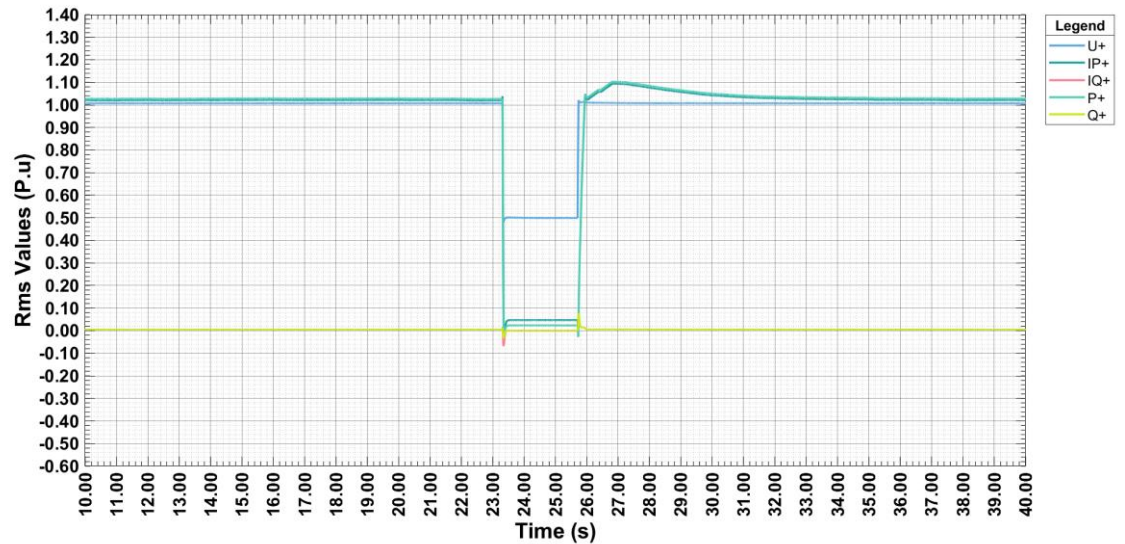
RMS Phase currents



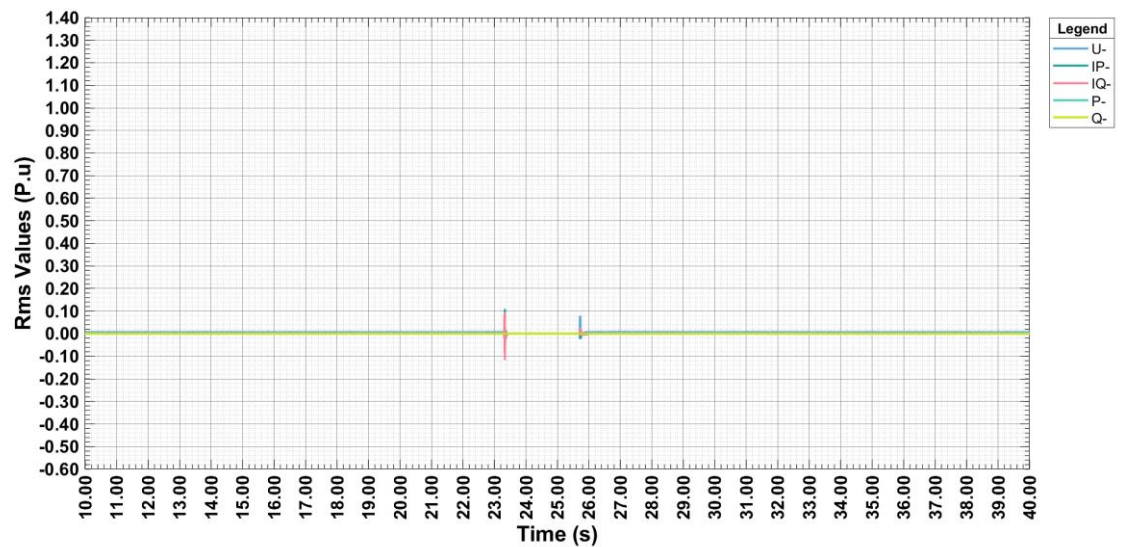
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.5

Positive sequences



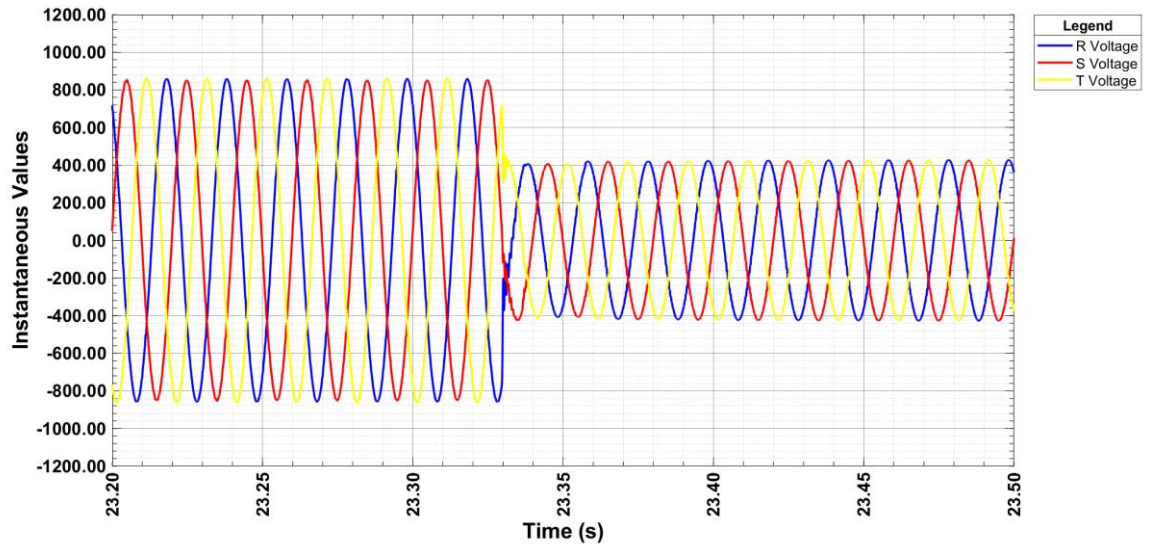
Negative sequences



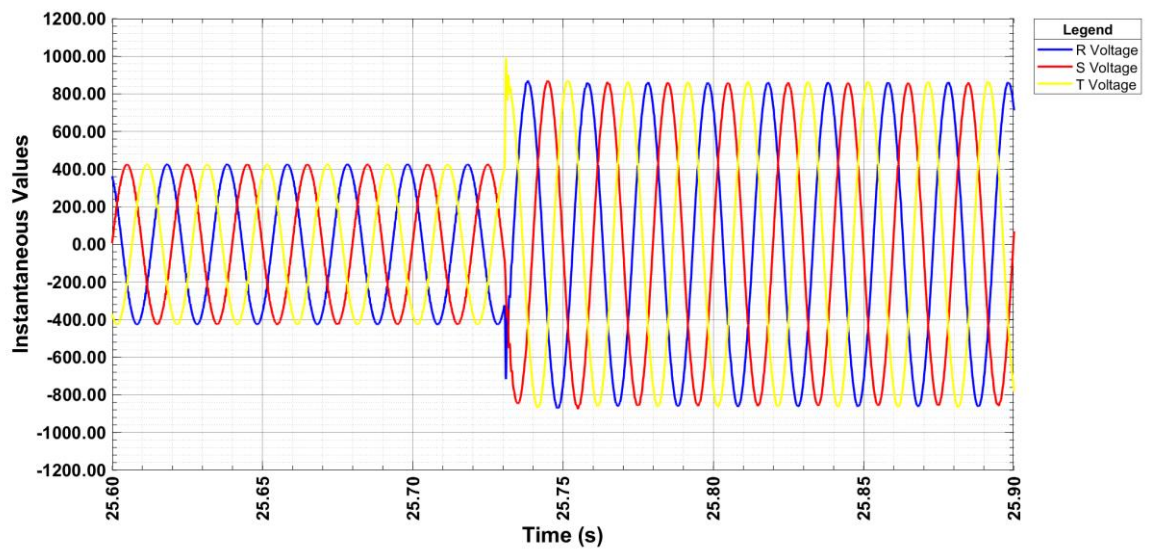
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.5

Transient voltage: Fault beginning



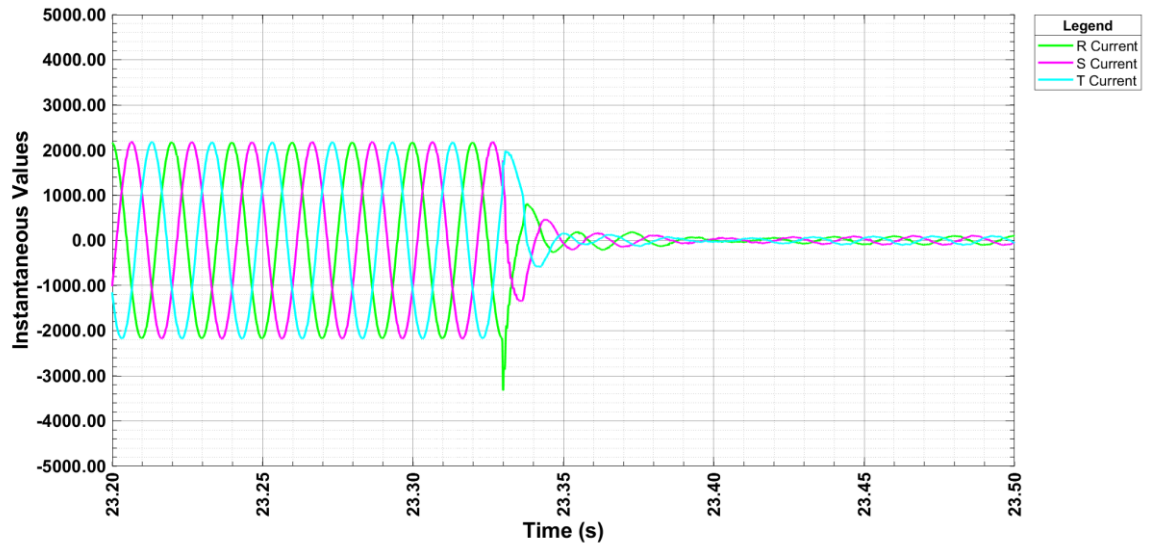
Transient voltage: Fault end



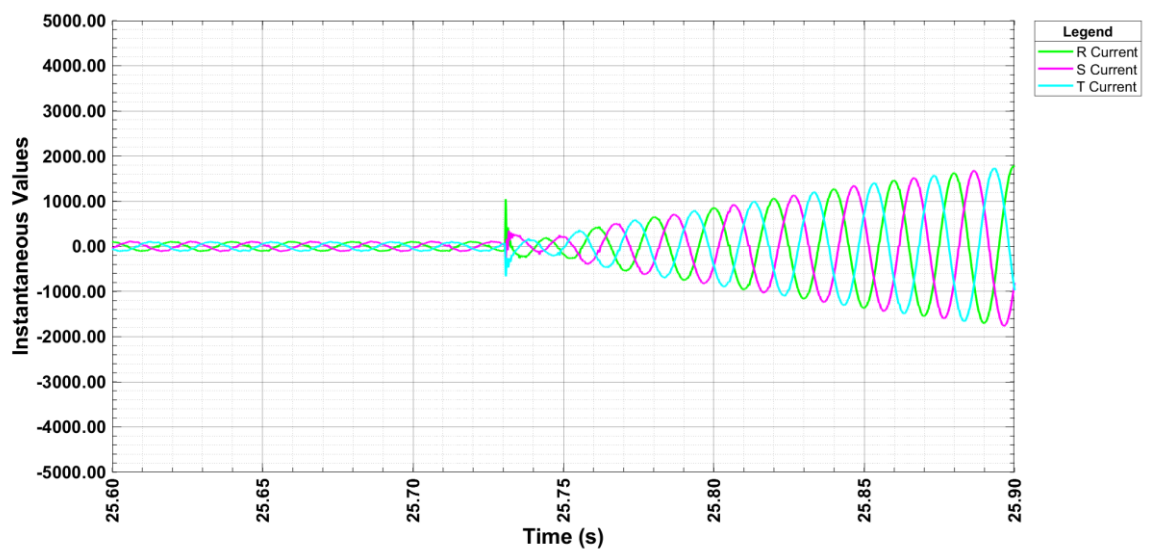
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.5

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.4.6 Test 50.6 Fault type: 2 phases, Full load, Limited dynamic grid support

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	50.6
	Date		-	[dd.mm.yyyy]	29.09.2020
	Time		-	[hh:mm:ss]	19:53:28
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.500
	Drop duration setpoint		-	[ms]	2305
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24079
	Fault clearance (t2)		-	[ms]	26548
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2470
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.496 /1.008
		Pos. seq.		[p.u.]	0.748 /1.007

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.007
		Neg. seq.	t1-60 s to t1	[p.u.]	0.003
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.007
		Pos. seq.	t1-1 s to t1	[p.u.]	1.007
		Neg. seq.	t1-1 s to t1	[p.u.]	0.003
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.022
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.022
	Active Power	Total	t1-10 s to t1	[p.u.]	1.029
		Total	t1-2 s to t1	[p.u.]	1.028
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.029
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	0.000
		Neg. seq.	-	-	0.040
	Reactive current settling up time	Pos. seq.	-	[ms]	-
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	-
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.747
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.253
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.001
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.012
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.048
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.012
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.036
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.035

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1617
		Phase 2	t1 to t1+20 ms	[A]	1523
		Phase 3	t1 to t1+20 ms	[A]	1513
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.411
		Phase 2	t1 + 20 ms	[p.u.]	0.337
		Phase 3	t1 + 20 ms	[p.u.]	0.042
		Phase 1	t1 + 100 ms	[p.u.]	0.059
		Phase 2	t1 + 100 ms	[p.u.]	0.023
		Phase 3	t1 + 100 ms	[p.u.]	0.042
		Phase 1	t1 + 150 ms	[p.u.]	0.062
		Phase 2	t1 + 150 ms	[p.u.]	0.047
		Phase 3	t1 + 150 ms	[p.u.]	0.034
		Phase 1	t1 + 300 ms	[p.u.]	0.059
		Phase 2	t1 + 300 ms	[p.u.]	0.049
		Phase 3	t1 + 300 ms	[p.u.]	0.039
		Phase 1	t1 + 500 ms	[p.u.]	0.059
		Phase 2	t1 + 500 ms	[p.u.]	0.049
		Phase 3	t1 + 500 ms	[p.u.]	0.039
		Phase 1	t1 + 1000 ms	[p.u.]	0.059
		Phase 2	t1 + 1000 ms	[p.u.]	0.050
		Phase 3	t1 + 1000 ms	[p.u.]	0.039
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.041
Active current rise time	Pos. seq.			[s]	0.187

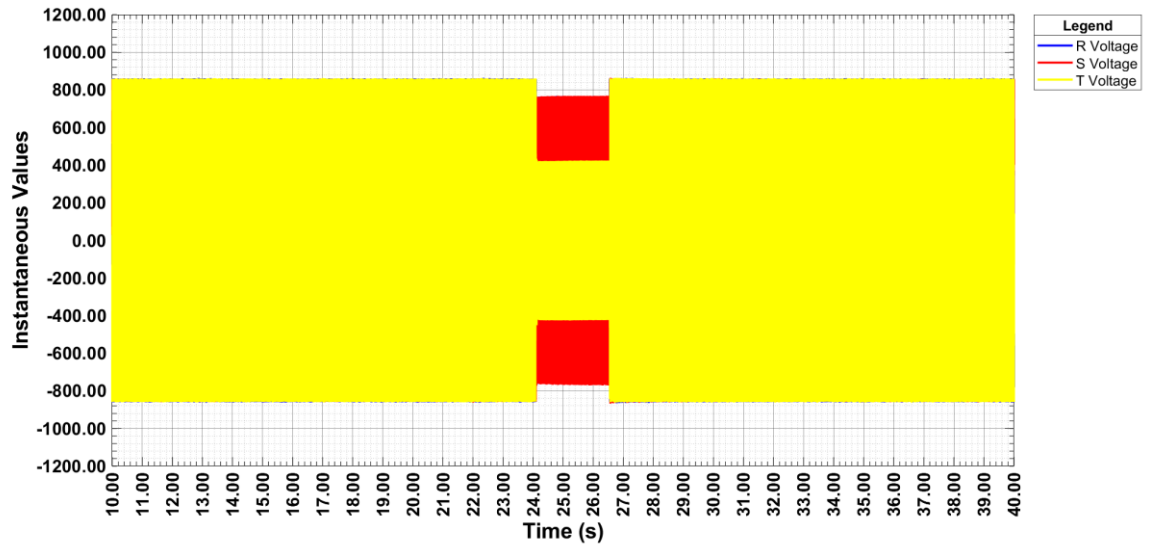
Note: As the standard requires, even with the requirement of limited dynamic grid support, the requirements for full dynamic grid support apply to generators with voltages above 0.7 U_c .

So, in this case, the Unit did not produce reactive current to support the grid.

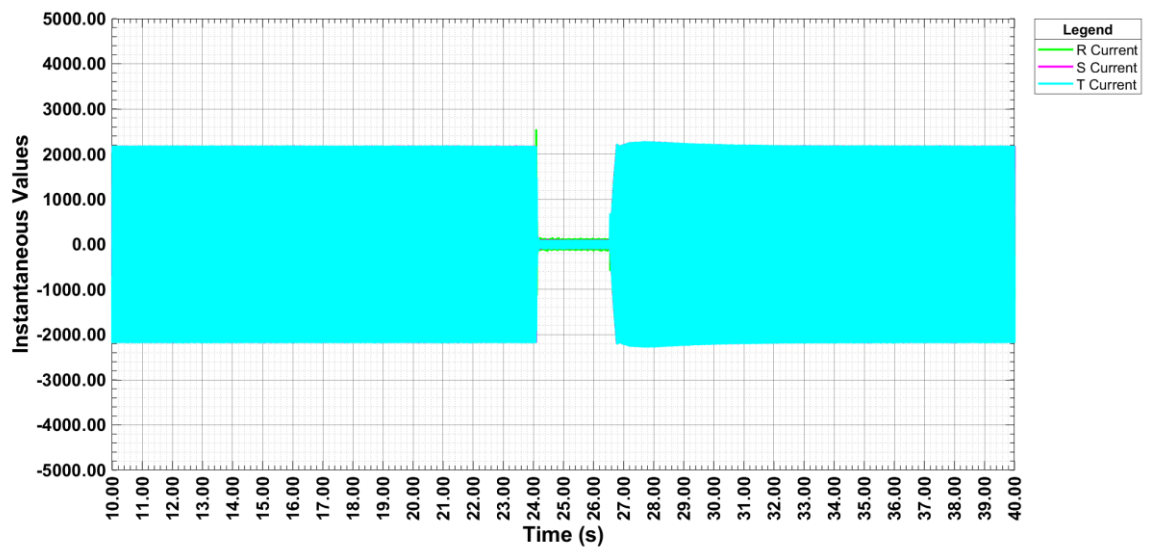
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.6

Phase-to-Phase voltages



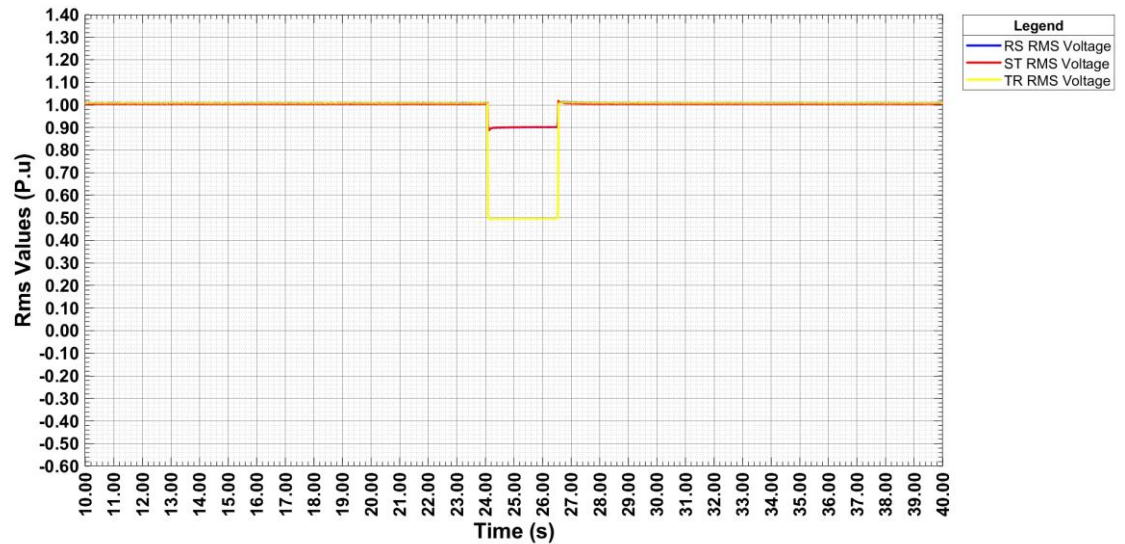
Phase currents



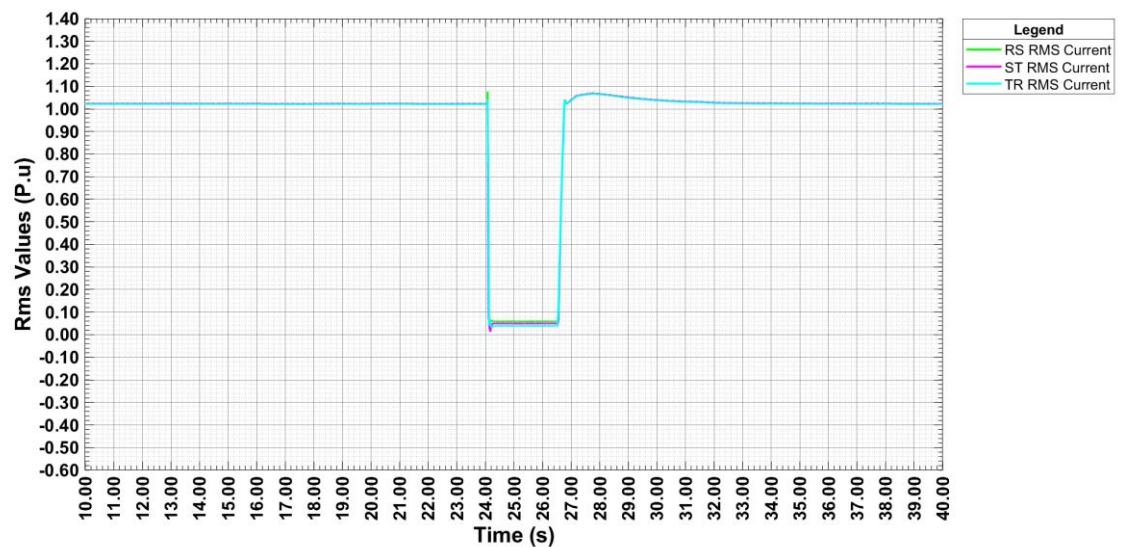
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.6

RMS Phase to phase voltages



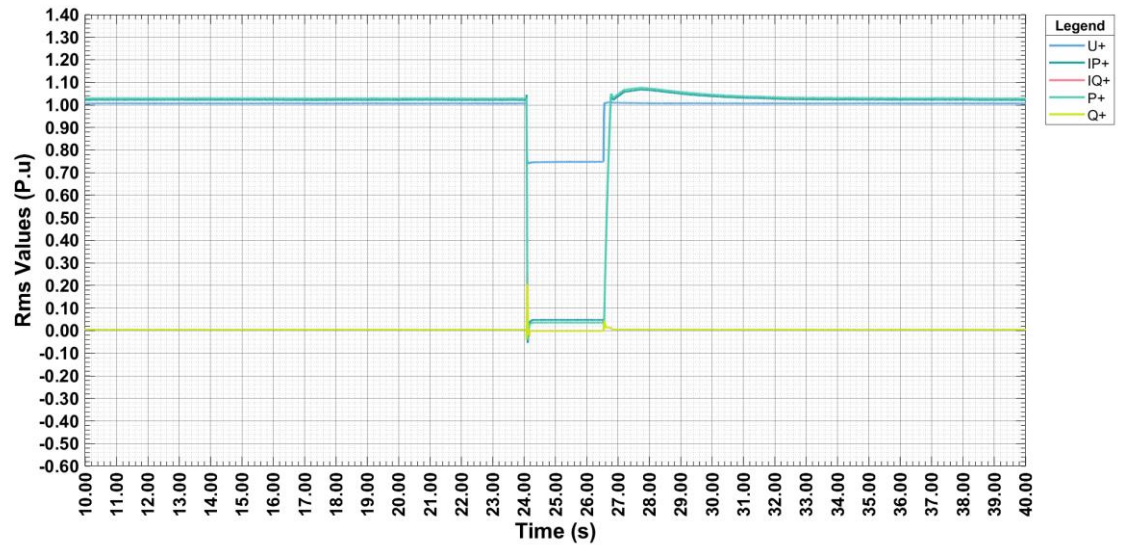
RMS Phase currents



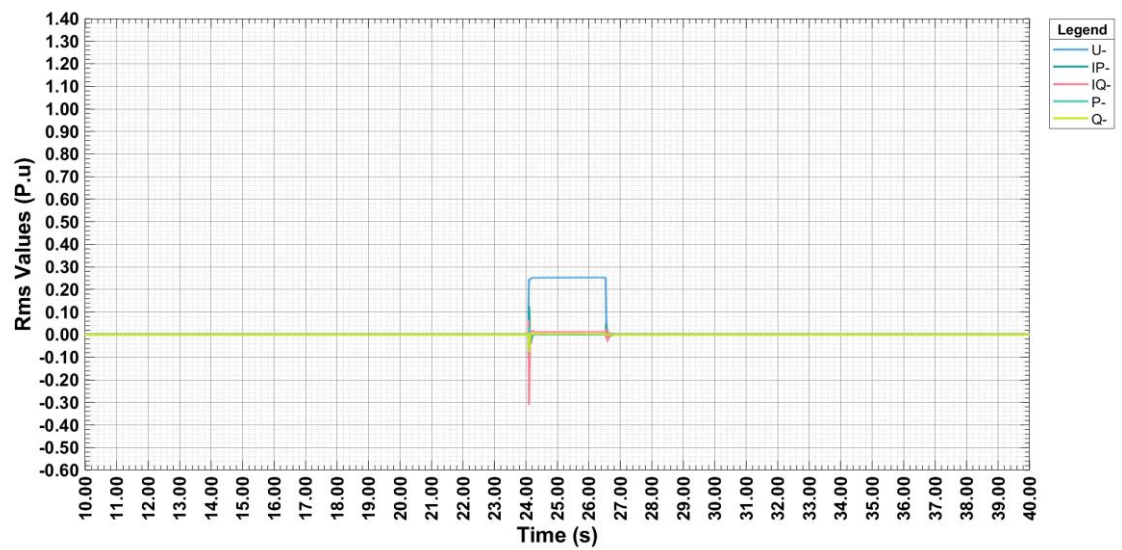
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.6

Positive sequences



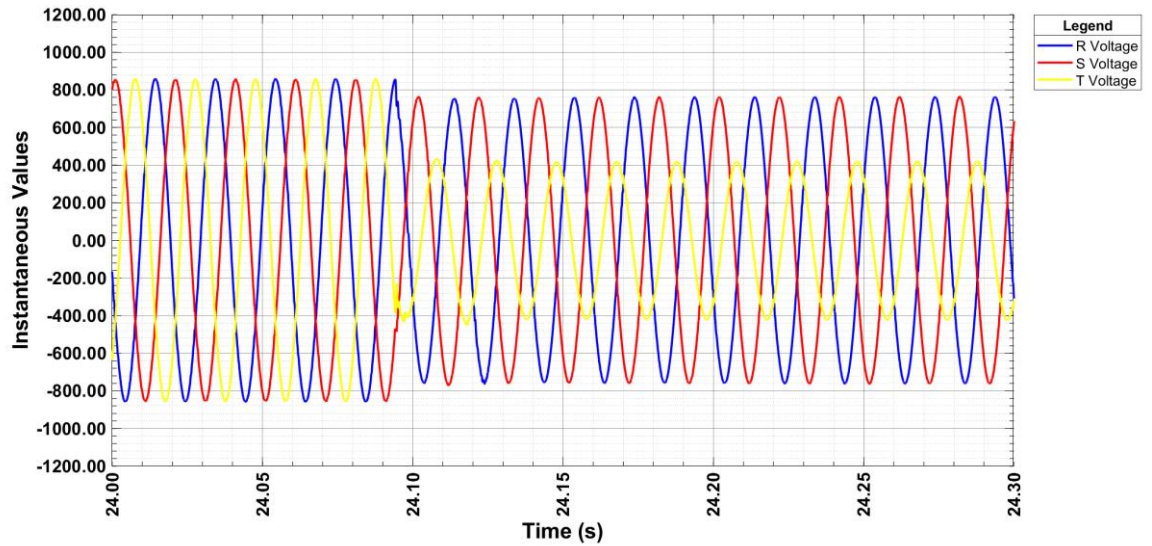
Negative sequences



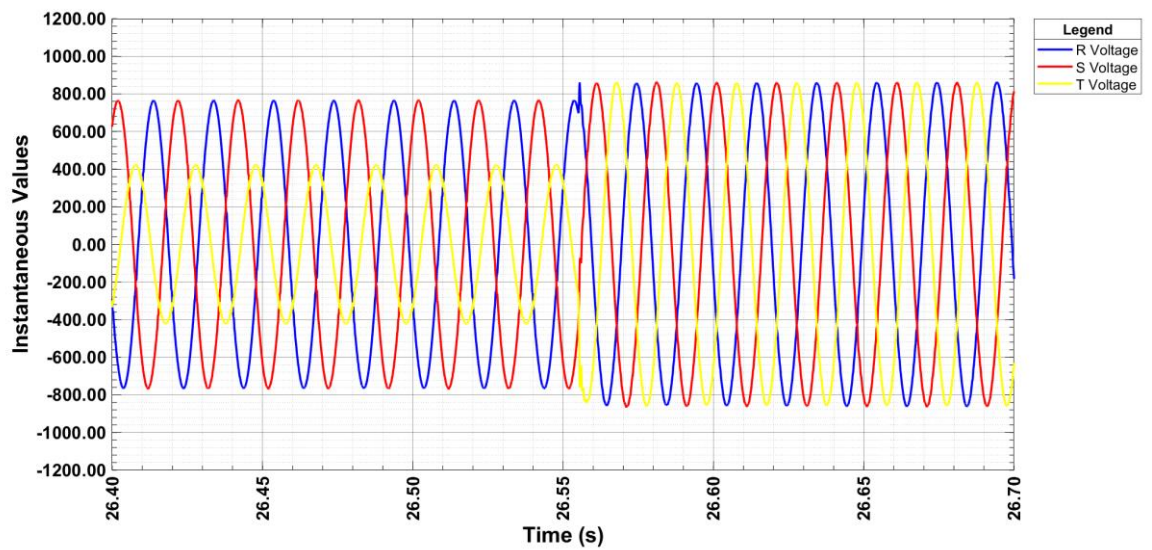
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.6

Transient voltage: Fault beginning



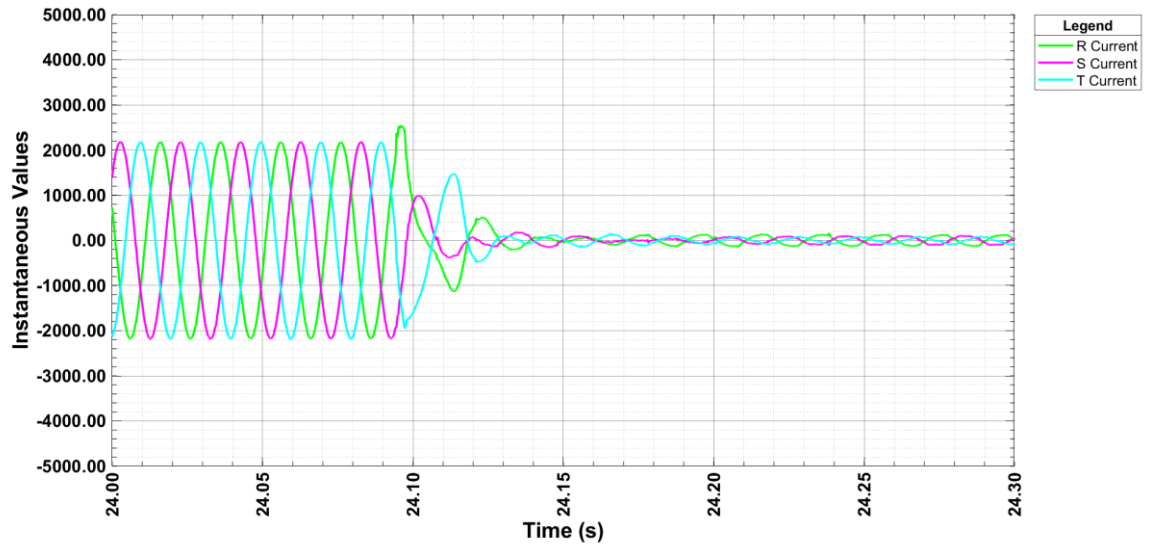
Transient voltage: Fault end



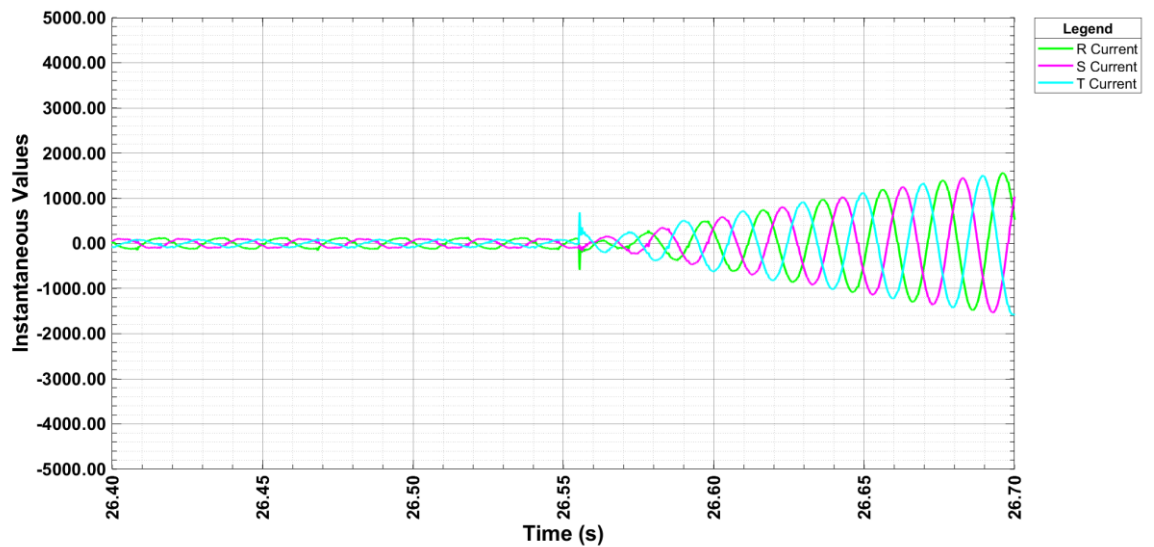
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 50.6

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.5 Load tests: Dip depth 75 %Un

In this chapter of the test report are shown the test results and diagrams for the load tests configured with a dip depth of 75 %Un. There are included in this point the tests 75.1, 75.2, 75.3, 75.4, 75.5, 75.6, 75.7 and 75.8 according to the table 4-67 of the standard. For the voltages and currents in the below pictures and tables, the unit is V and A.

3.1.5.1 Test 75.1 Fault type: 3 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	75.1
	Date		-	[dd.mm.yyyy]	25.09.2020
	Time		-	[hh:mm:ss]	18:40:33
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.750
	Drop duration setpoint		-	[ms]	2833
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24607
	Fault clearance (t2)		-	[ms]	27452
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2846
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.757 /1.007
		Pos. seq.		[p.u.]	0.757 /1.007

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.007
		Neg. seq.	t1-60 s to t1	[p.u.]	0.008
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.007
		Pos. seq.	t1-1 s to t1	[p.u.]	1.007
		Neg. seq.	t1-1 s to t1	[p.u.]	0.008
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.022
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.022
	Active Power	Total	t1-10 s to t1	[p.u.]	1.029
		Total	t1-2 s to t1	[p.u.]	1.029
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.029
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.057
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	23
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	23
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.757
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.005
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.503
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.001
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.709
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.378
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.378

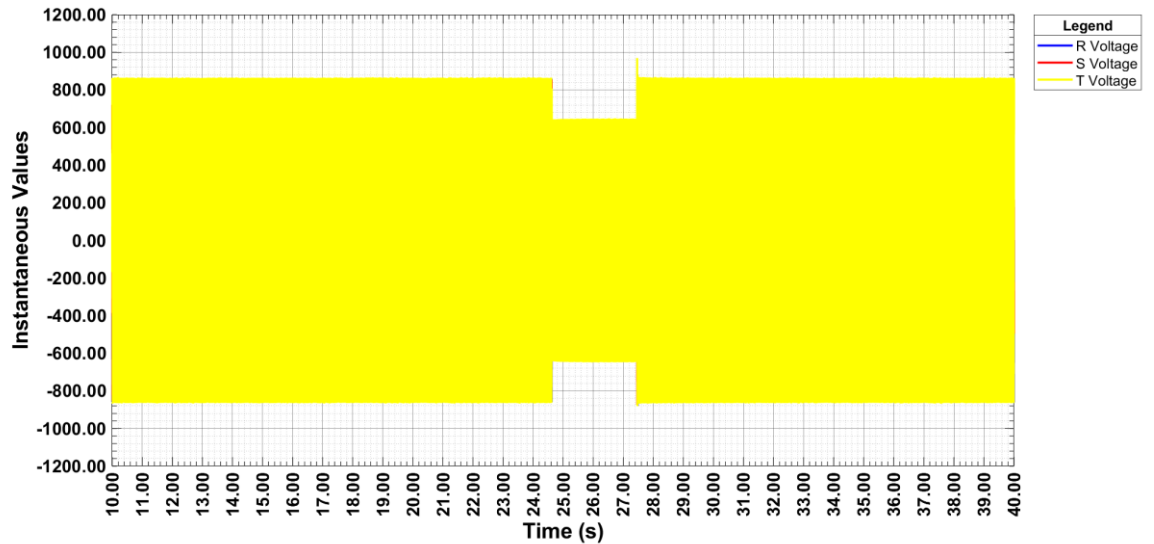
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1541
		Phase 2	t1 to t1+20 ms	[A]	1523
		Phase 3	t1 to t1+20 ms	[A]	1606
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.682
		Phase 2	t1 + 20 ms	[p.u.]	0.620
		Phase 3	t1 + 20 ms	[p.u.]	0.712
		Phase 1	t1 + 100 ms	[p.u.]	0.711
		Phase 2	t1 + 100 ms	[p.u.]	0.715
		Phase 3	t1 + 100 ms	[p.u.]	0.712
		Phase 1	t1 + 150 ms	[p.u.]	0.710
		Phase 2	t1 + 150 ms	[p.u.]	0.709
		Phase 3	t1 + 150 ms	[p.u.]	0.709
		Phase 1	t1 + 300 ms	[p.u.]	0.709
		Phase 2	t1 + 300 ms	[p.u.]	0.711
		Phase 3	t1 + 300 ms	[p.u.]	0.707
		Phase 1	t1 + 500 ms	[p.u.]	0.709
		Phase 2	t1 + 500 ms	[p.u.]	0.711
		Phase 3	t1 + 500 ms	[p.u.]	0.707
		Phase 1	t1 + 1000 ms	[p.u.]	0.709
		Phase 2	t1 + 1000 ms	[p.u.]	0.708
		Phase 3	t1 + 1000 ms	[p.u.]	0.709
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.048
Active current rise time	Pos. seq.			[s]	0.050

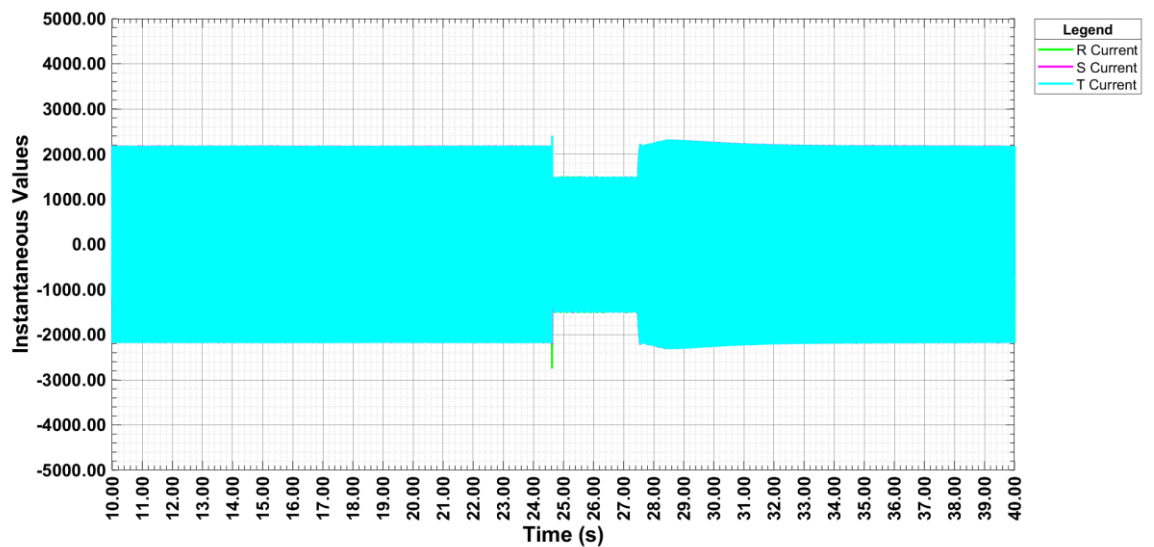
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.1

Phase-to-neutral voltages



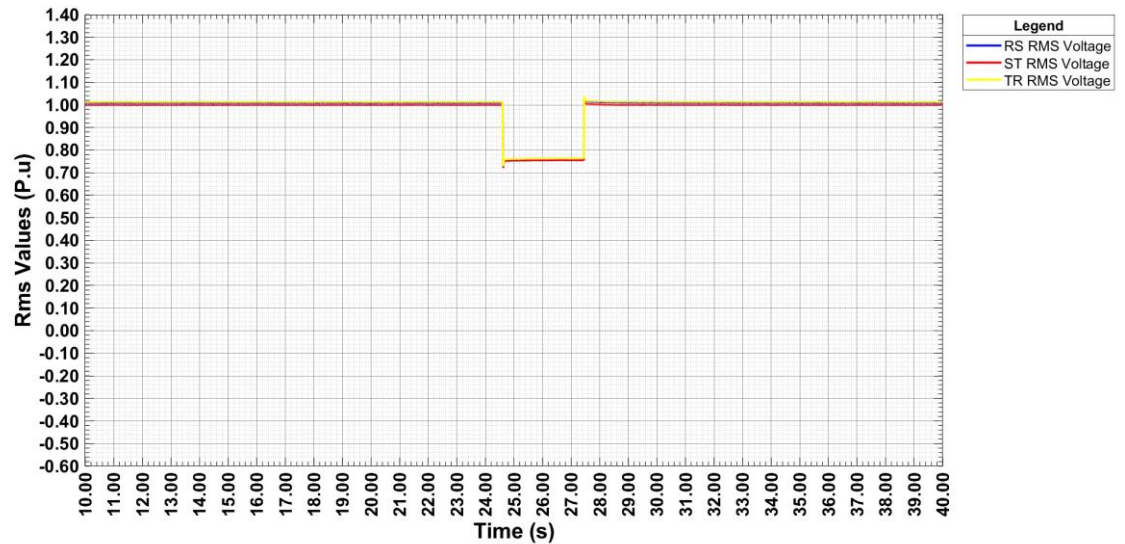
Phase currents



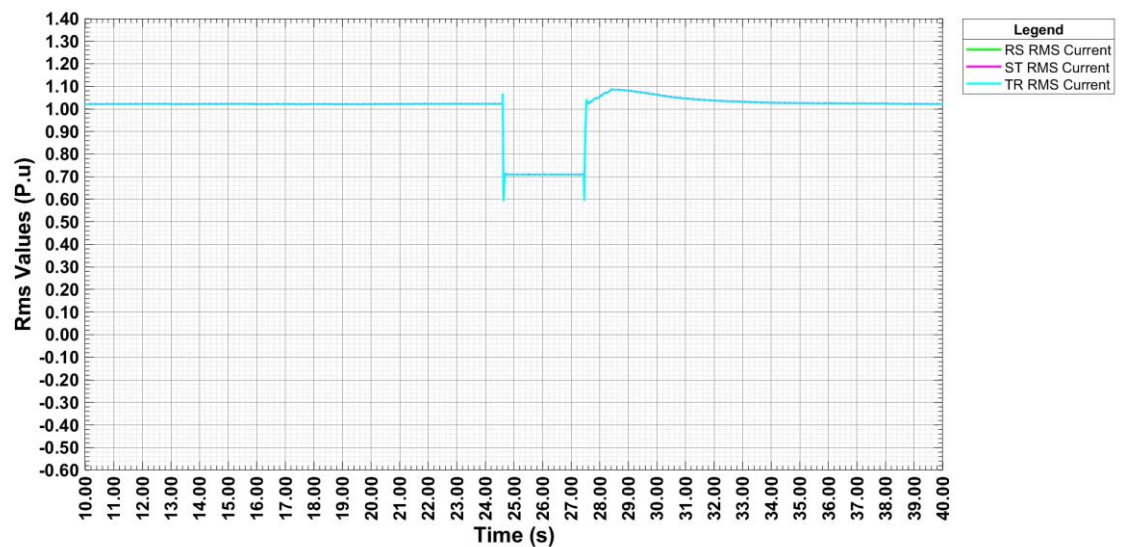
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.1

RMS Phase to phase voltages



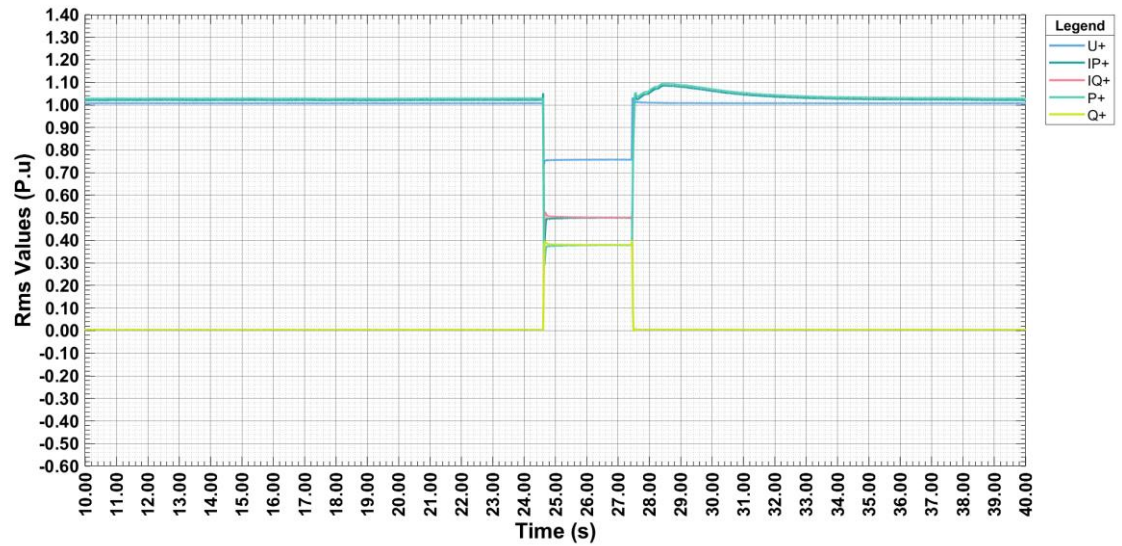
RMS Phase currents



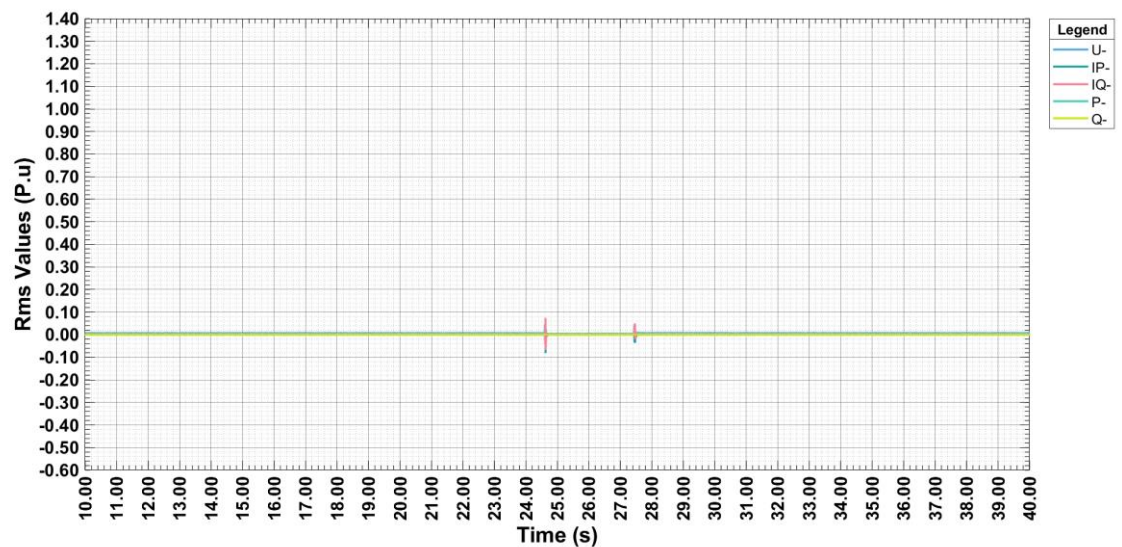
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.1

Positive sequences



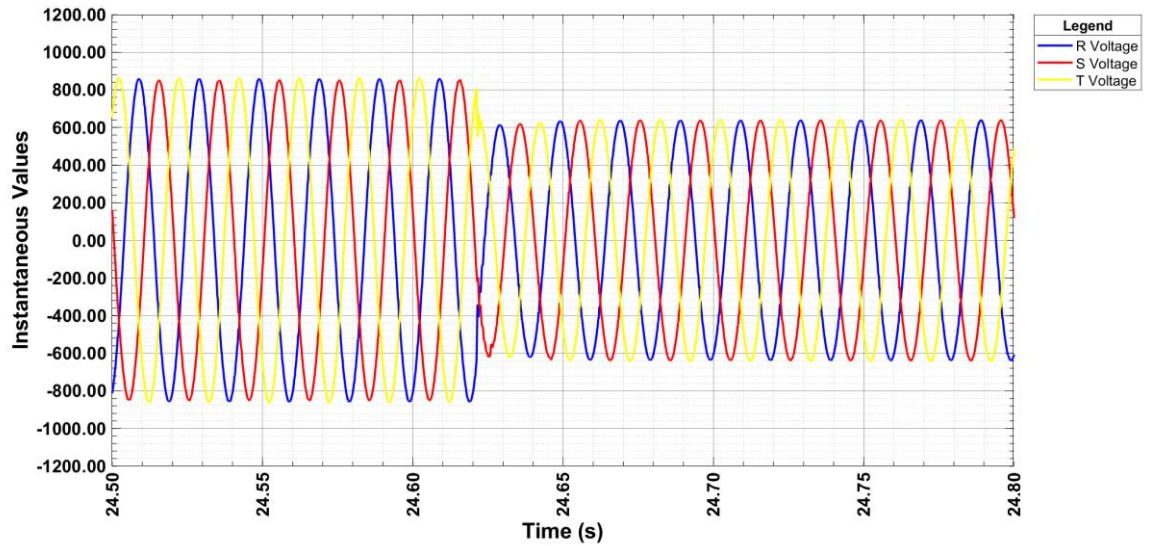
Negative sequences



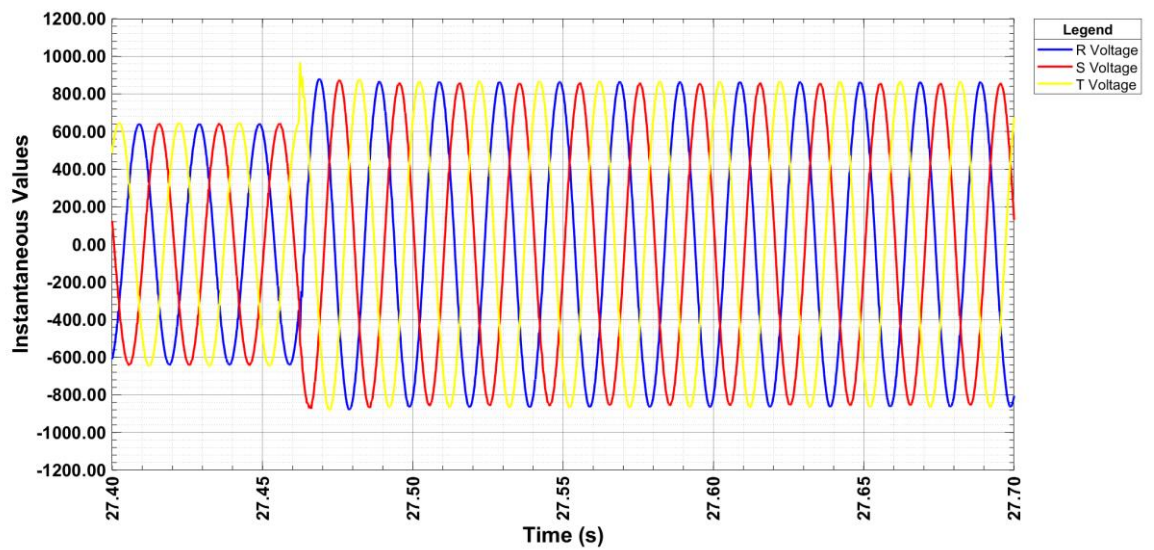
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.1

Transient voltage: Fault beginning



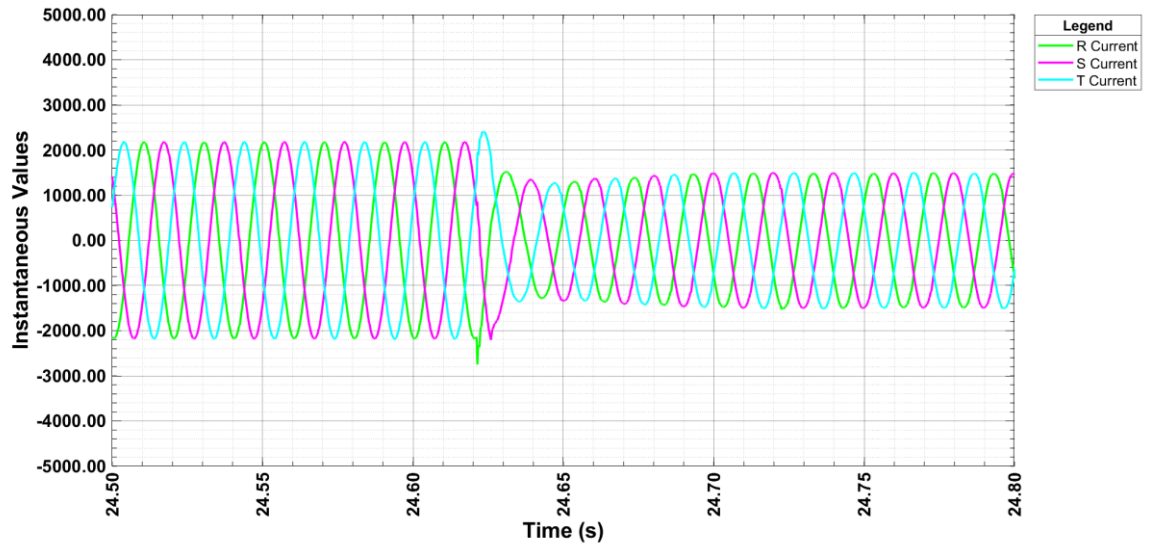
Transient voltage: Fault end



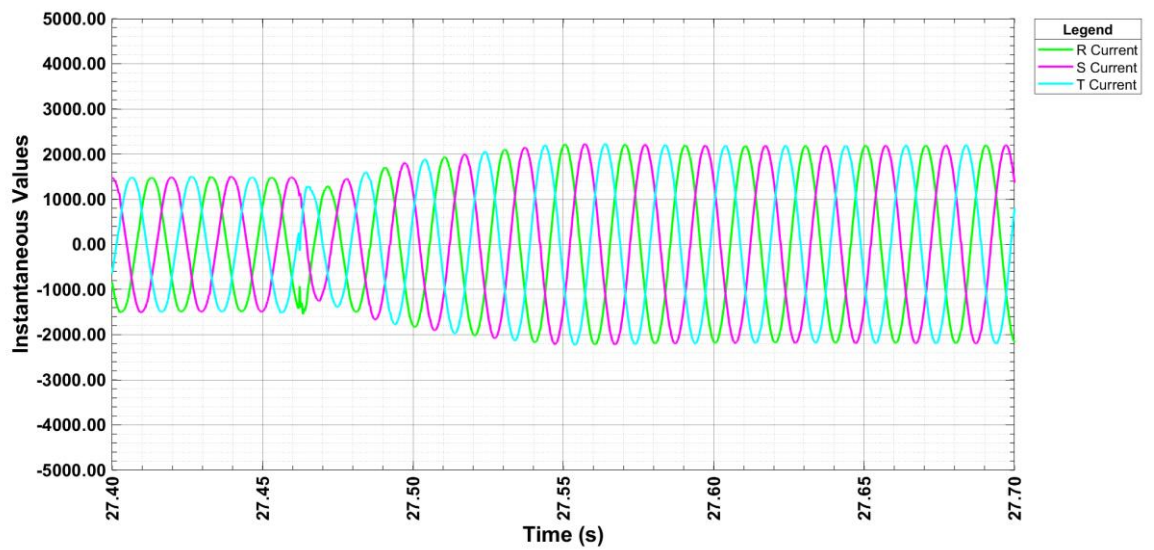
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.1

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.5.2 Test 75.2 Fault type: 3 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	75.2
	Date		-	[dd.mm.yyyy]	25.09.2020
	Time		-	[hh:mm:ss]	18:33:47
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.750
	Drop duration setpoint		-	[ms]	2833
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	22556
	Fault clearance (t2)		-	[ms]	25403
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2847
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.755 /1.000
		Pos. seq.		[p.u.]	0.755 /0.999

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.999
		Neg. seq.	t1-60 s to t1	[p.u.]	0.002
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.999
		Pos. seq.	t1-1 s to t1	[p.u.]	0.999
		Neg. seq.	t1-1 s to t1	[p.u.]	0.002
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.204
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.001
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.204
	Active Power	Total	t1-10 s to t1	[p.u.]	0.204
		Total	t1-2 s to t1	[p.u.]	0.204
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.204
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.001
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.078
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	24
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	24
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.755
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.004
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.505
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.001
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.544
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.152
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.152

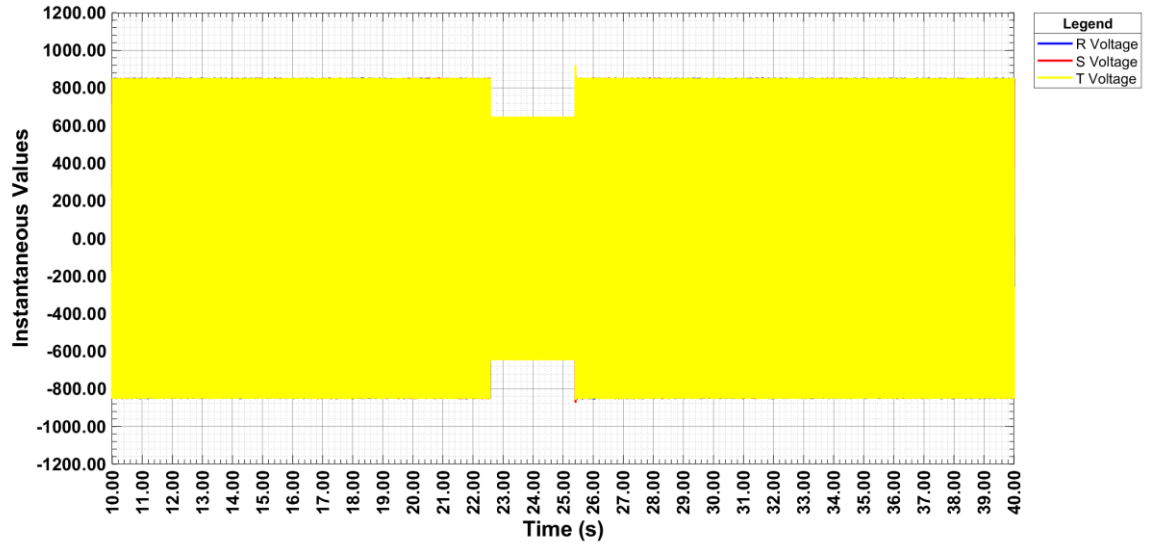
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	593
		Phase 2	t1 to t1+20 ms	[A]	573
		Phase 3	t1 to t1+20 ms	[A]	614
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.392
		Phase 2	t1 + 20 ms	[p.u.]	0.371
		Phase 3	t1 + 20 ms	[p.u.]	0.548
		Phase 1	t1 + 100 ms	[p.u.]	0.547
		Phase 2	t1 + 100 ms	[p.u.]	0.550
		Phase 3	t1 + 100 ms	[p.u.]	0.548
		Phase 1	t1 + 150 ms	[p.u.]	0.546
		Phase 2	t1 + 150 ms	[p.u.]	0.547
		Phase 3	t1 + 150 ms	[p.u.]	0.544
		Phase 1	t1 + 300 ms	[p.u.]	0.545
		Phase 2	t1 + 300 ms	[p.u.]	0.546
		Phase 3	t1 + 300 ms	[p.u.]	0.544
		Phase 1	t1 + 500 ms	[p.u.]	0.545
		Phase 2	t1 + 500 ms	[p.u.]	0.547
		Phase 3	t1 + 500 ms	[p.u.]	0.545
		Phase 1	t1 + 1000 ms	[p.u.]	0.545
		Phase 2	t1 + 1000 ms	[p.u.]	0.543
		Phase 3	t1 + 1000 ms	[p.u.]	0.544
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.209
Active current rise time	Pos. seq.			[s]	0.010

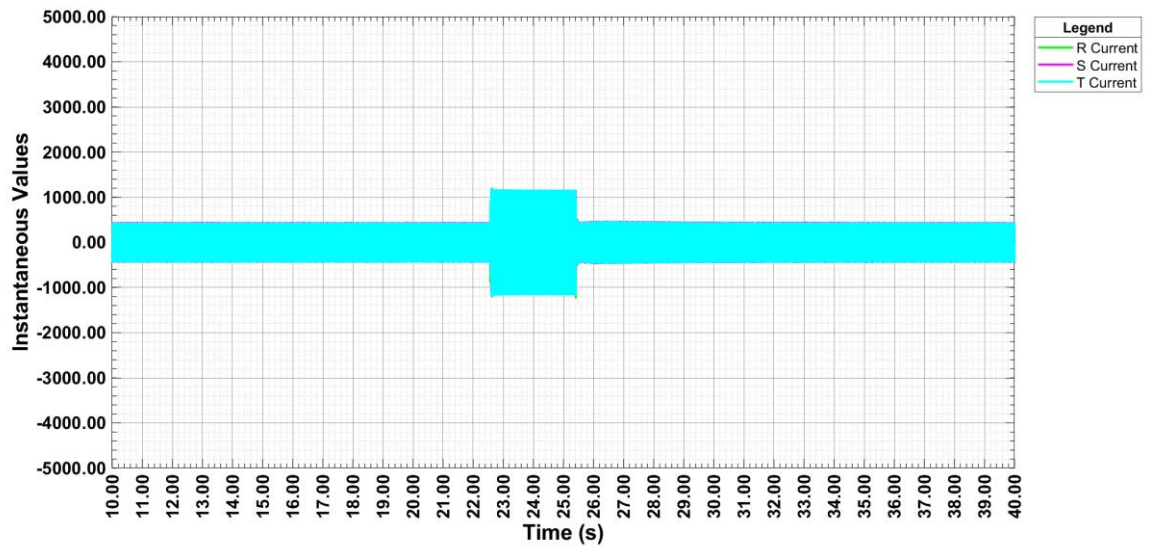
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.2

Phase-to-Phase voltages



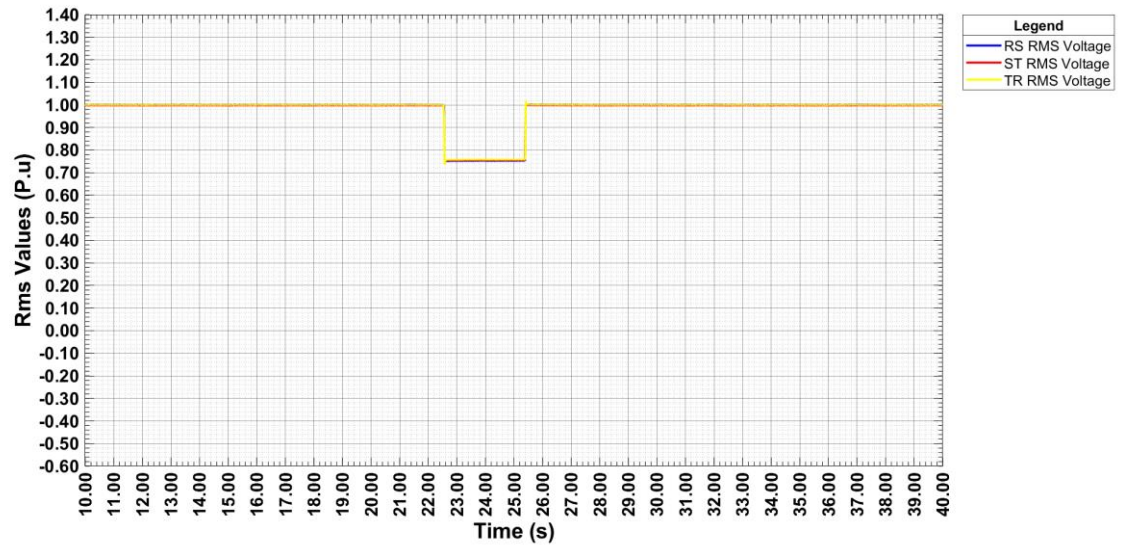
Phase currents



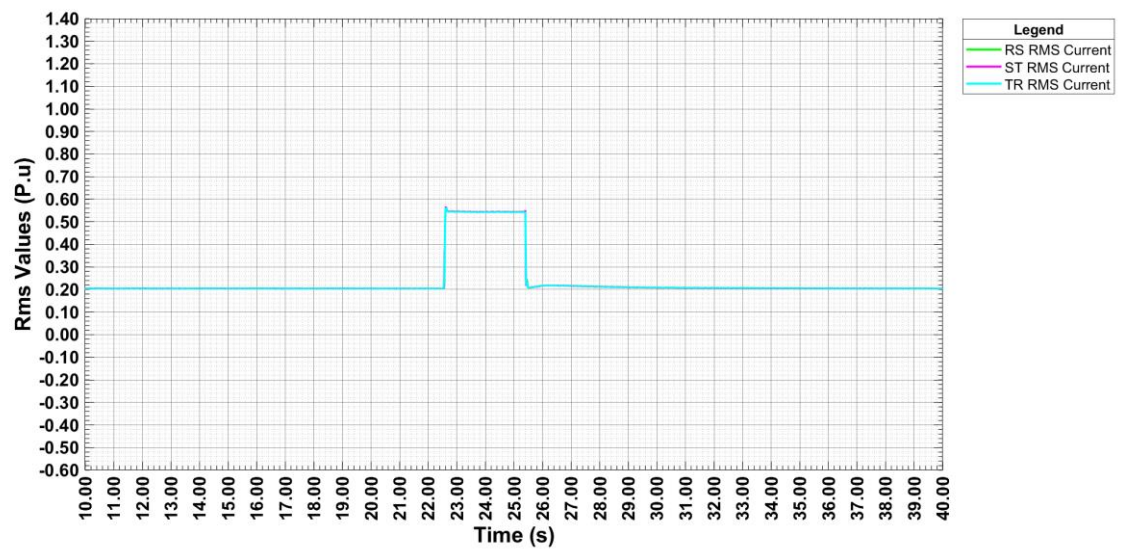
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.2

RMS Phase to phase voltages



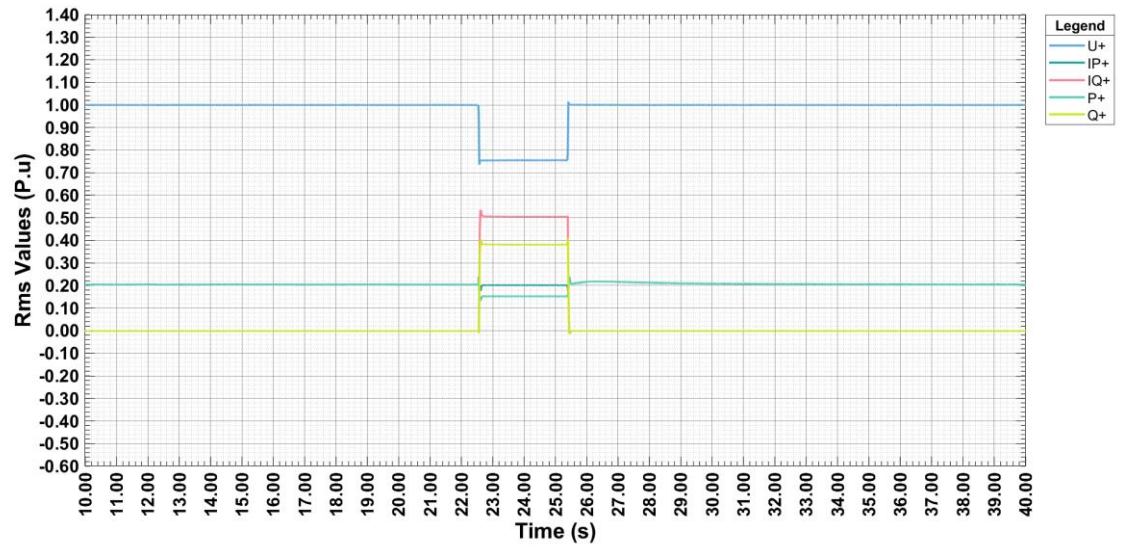
RMS Phase currents



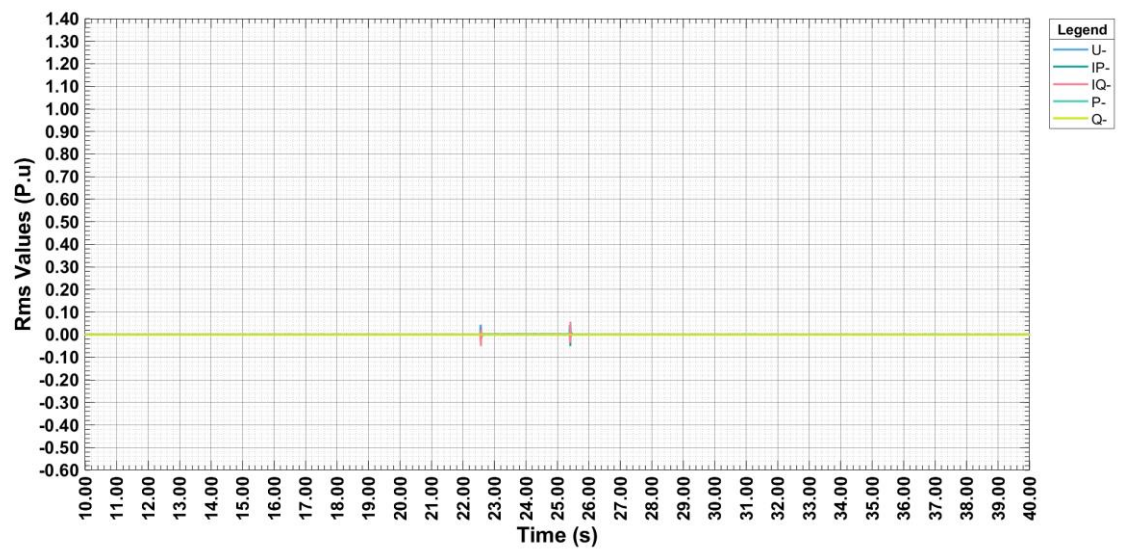
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.2

Positive sequences



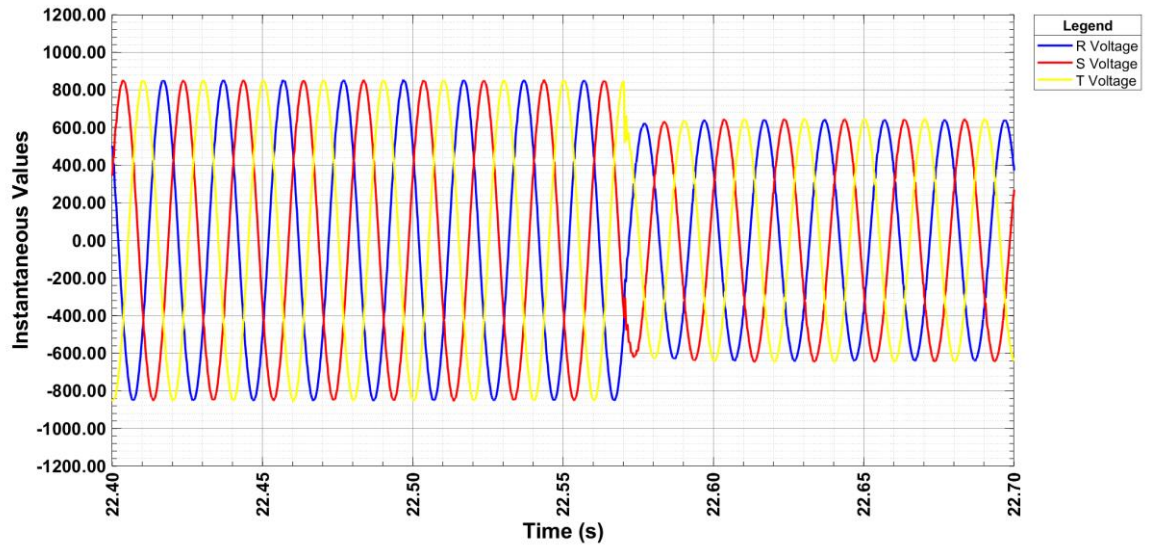
Negative sequences



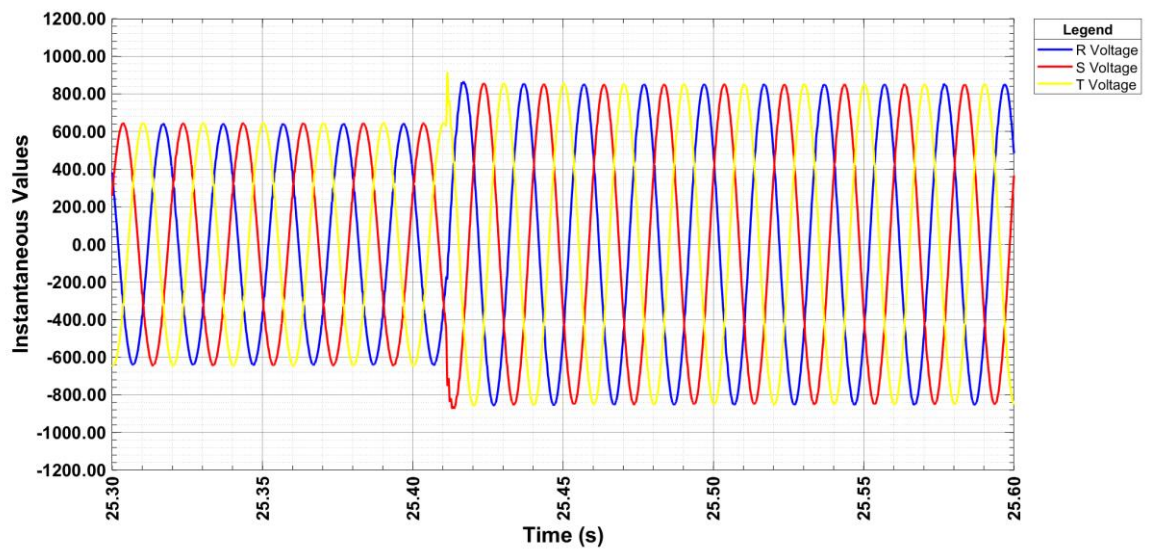
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.2

Transient voltage: Fault beginning



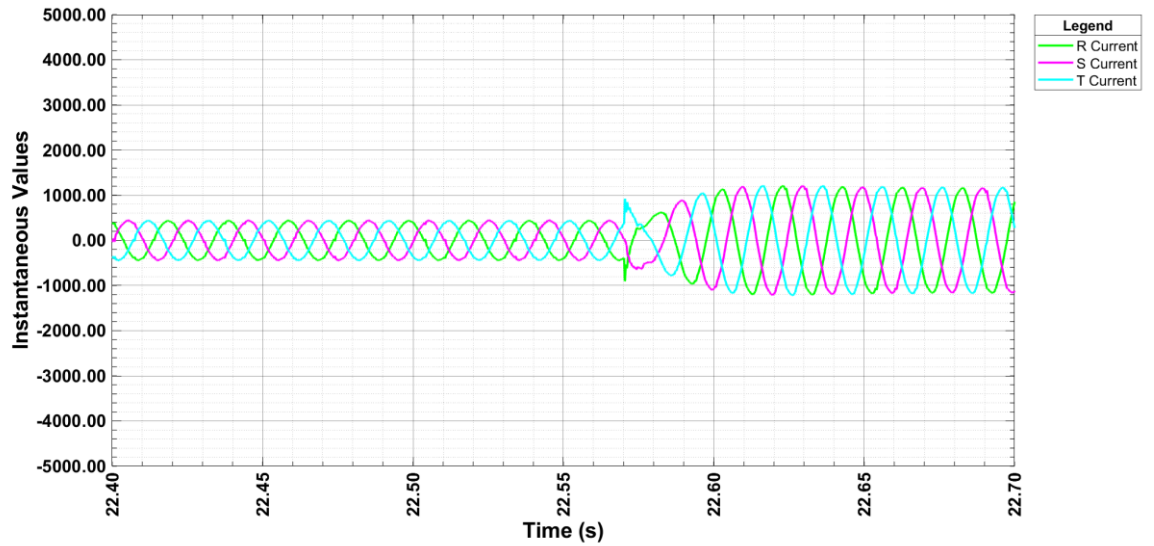
Transient voltage: Fault end



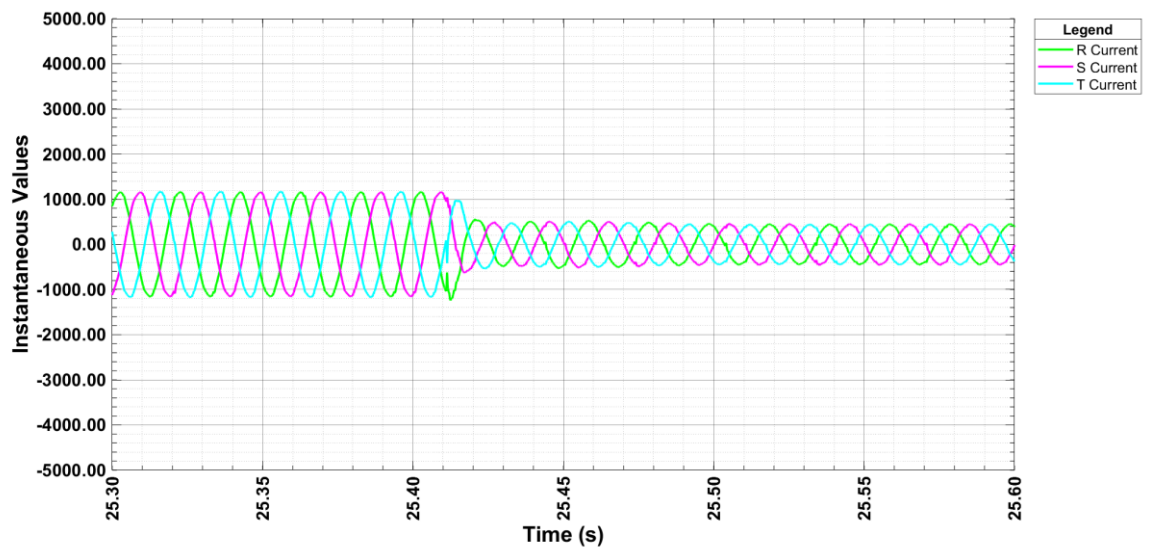
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.2

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.5.3 Test 75.3 Fault type: 3 phases, Partial load, Max. over-excited

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	75.3
	Date		-	[dd.mm.yyyy]	25.09.2020
	Time		-	[hh:mm:ss]	18:06:59
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.750
	Drop duration setpoint		-	[ms]	2833
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	40842
	Fault clearance (t2)		-	[ms]	43693
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2851
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.742 /0.966
		Pos. seq.		[p.u.]	0.742 /0.965

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.965
		Neg. seq.	t1-60 s to t1	[p.u.]	0.006
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.966
		Pos. seq.	t1-1 s to t1	[p.u.]	0.965
		Neg. seq.	t1-1 s to t1	[p.u.]	0.007
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.217
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.705
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.705
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.217
	Active Power	Total	t1-10 s to t1	[p.u.]	0.209
		Total	t1-2 s to t1	[p.u.]	0.209
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.209
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.681
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.129
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	27
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	27
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.742
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.003
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.164
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.000
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.270
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.159
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.159

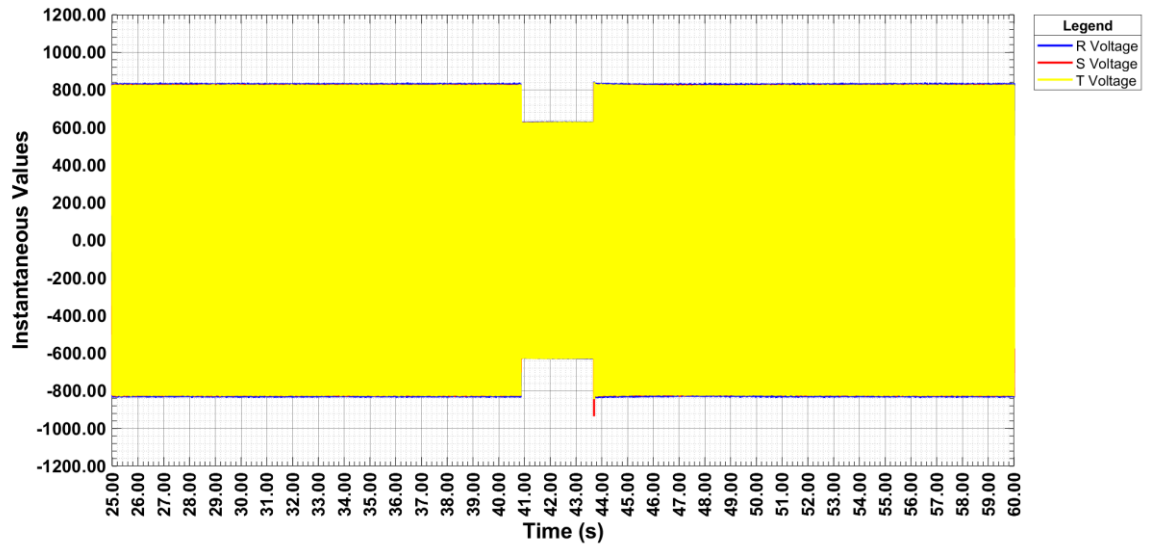
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1090
		Phase 2	t1 to t1+20 ms	[A]	1151
		Phase 3	t1 to t1+20 ms	[A]	1061
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.345
		Phase 2	t1 + 20 ms	[p.u.]	0.401
		Phase 3	t1 + 20 ms	[p.u.]	0.265
		Phase 1	t1 + 100 ms	[p.u.]	0.268
		Phase 2	t1 + 100 ms	[p.u.]	0.267
		Phase 3	t1 + 100 ms	[p.u.]	0.265
		Phase 1	t1 + 150 ms	[p.u.]	0.267
		Phase 2	t1 + 150 ms	[p.u.]	0.268
		Phase 3	t1 + 150 ms	[p.u.]	0.268
		Phase 1	t1 + 300 ms	[p.u.]	0.268
		Phase 2	t1 + 300 ms	[p.u.]	0.269
		Phase 3	t1 + 300 ms	[p.u.]	0.268
		Phase 1	t1 + 500 ms	[p.u.]	0.268
		Phase 2	t1 + 500 ms	[p.u.]	0.269
		Phase 3	t1 + 500 ms	[p.u.]	0.268
		Phase 1	t1 + 1000 ms	[p.u.]	0.270
		Phase 2	t1 + 1000 ms	[p.u.]	0.270
		Phase 3	t1 + 1000 ms	[p.u.]	0.269
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.214
Active current rise time	Pos. seq.			[s]	0.003

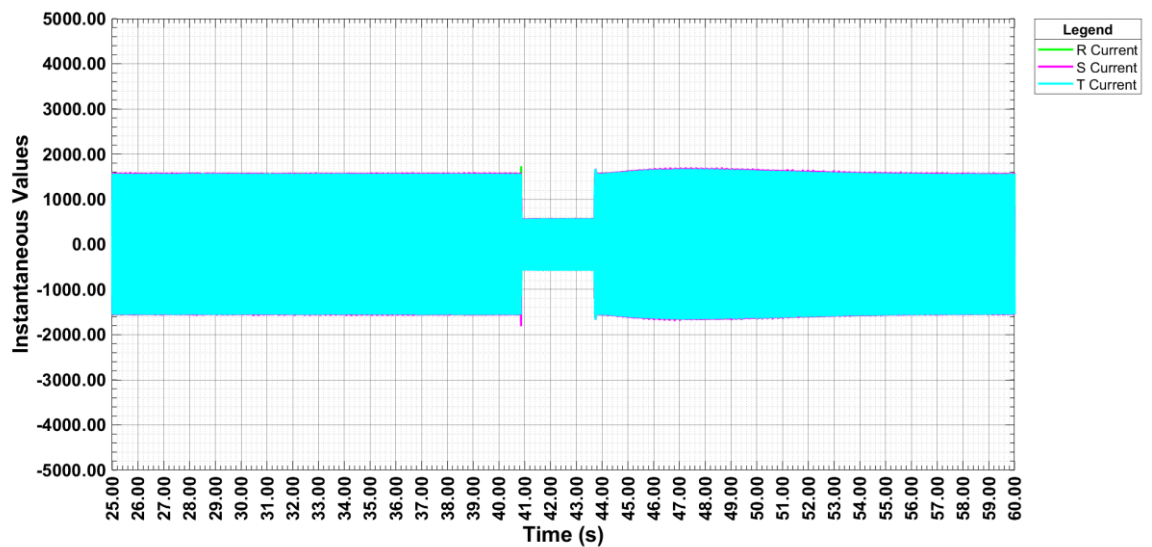
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.3

Phase-to-Phase voltages



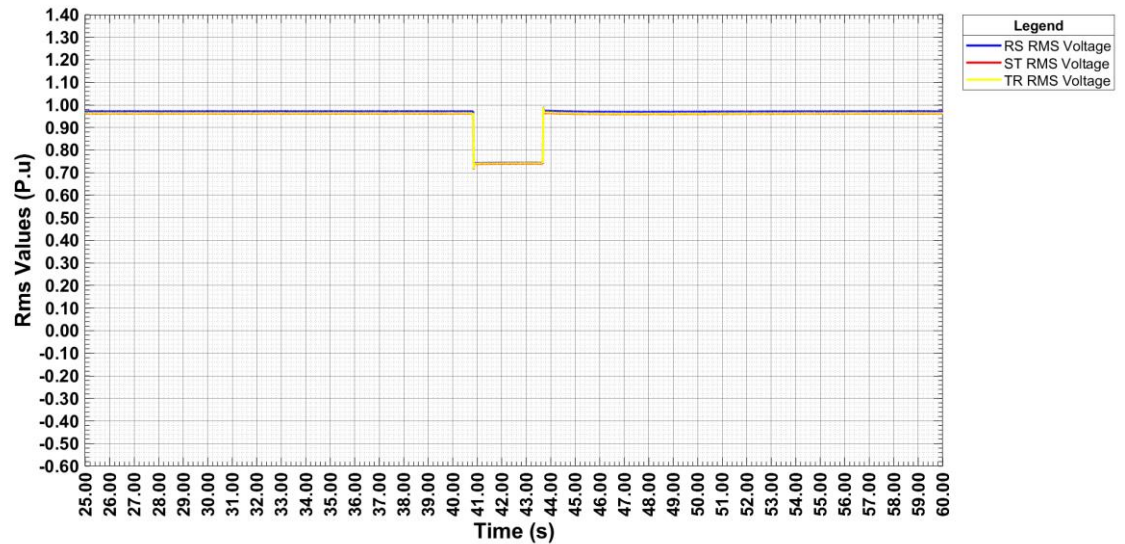
Phase currents



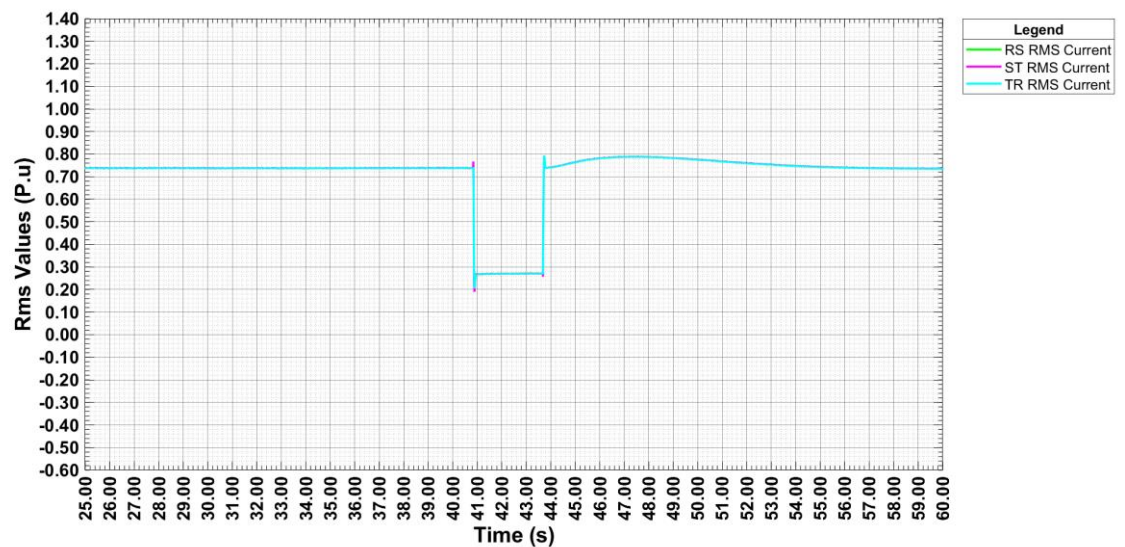
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.3

RMS Phase to phase voltages



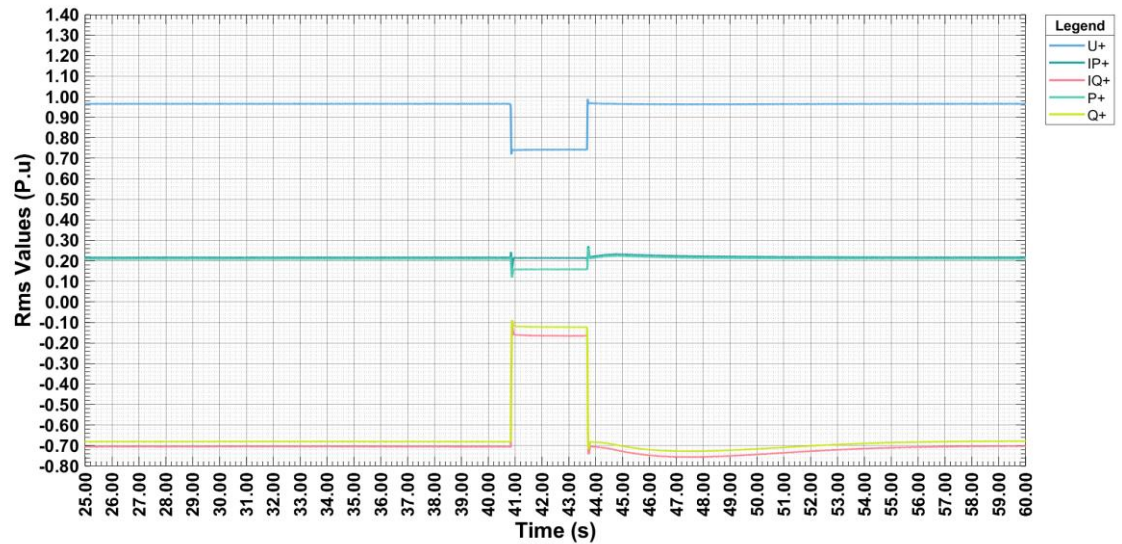
RMS Phase currents



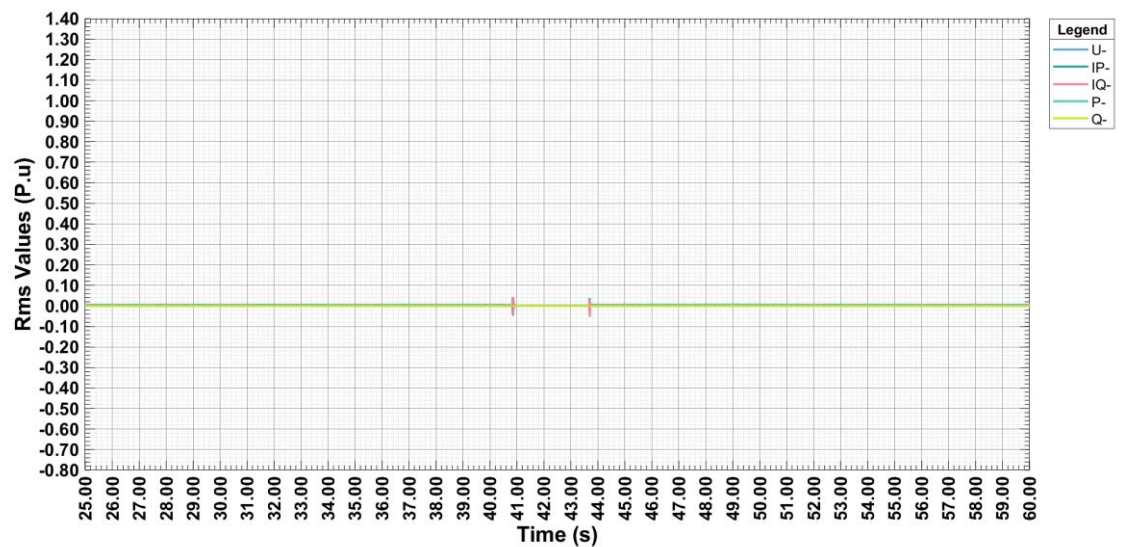
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.3

Positive sequences



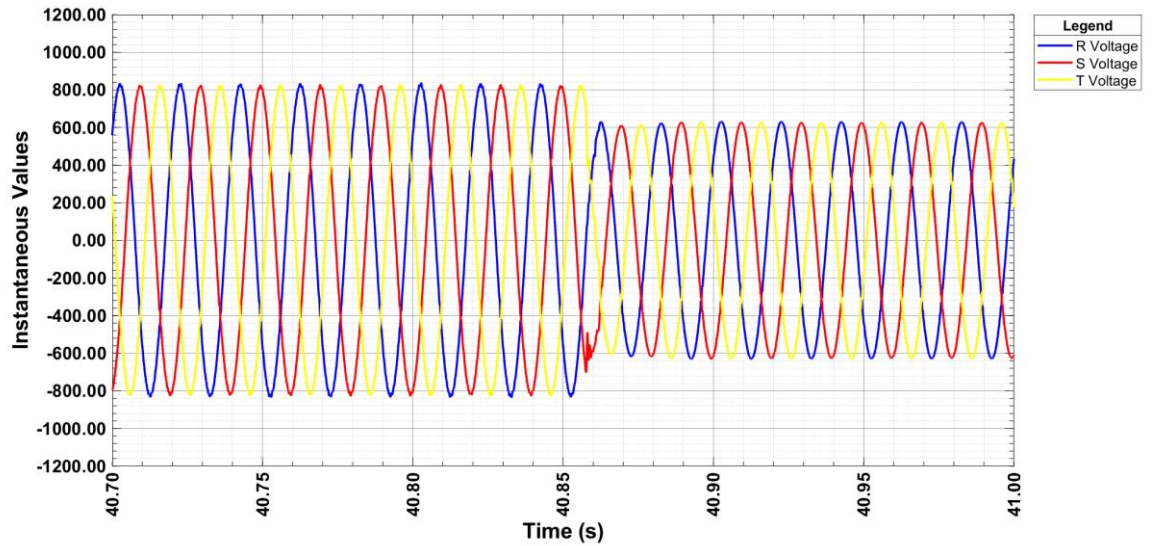
Negative sequences



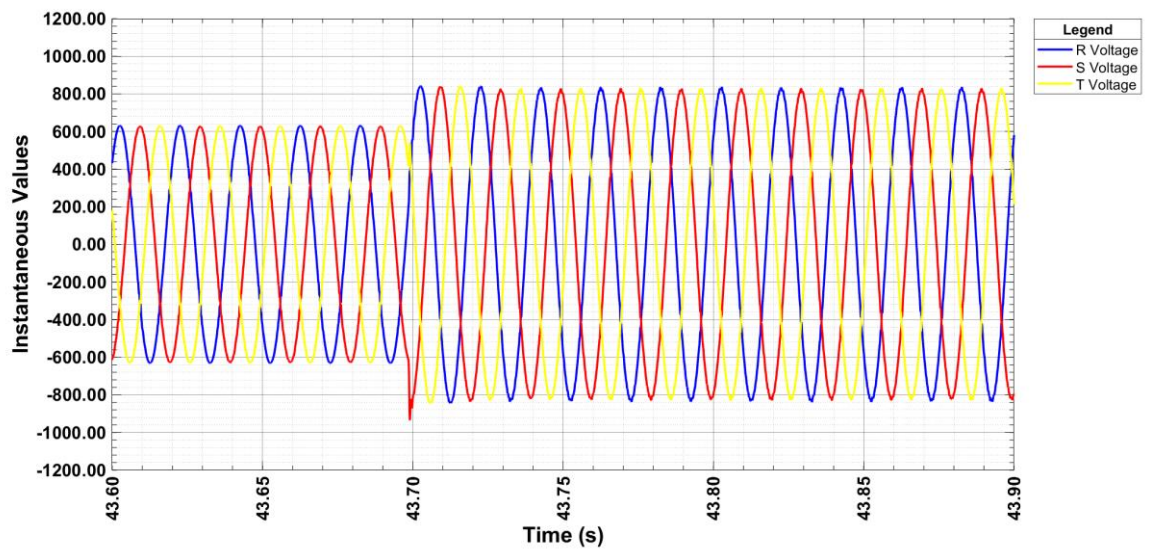
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.3

Transient voltage: Fault beginning



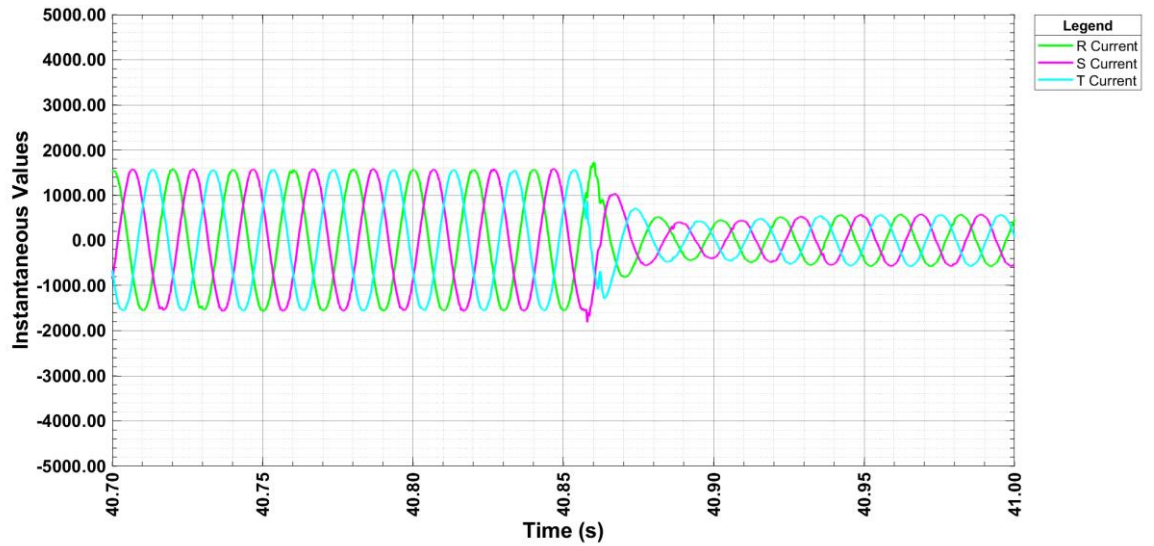
Transient voltage: Fault end



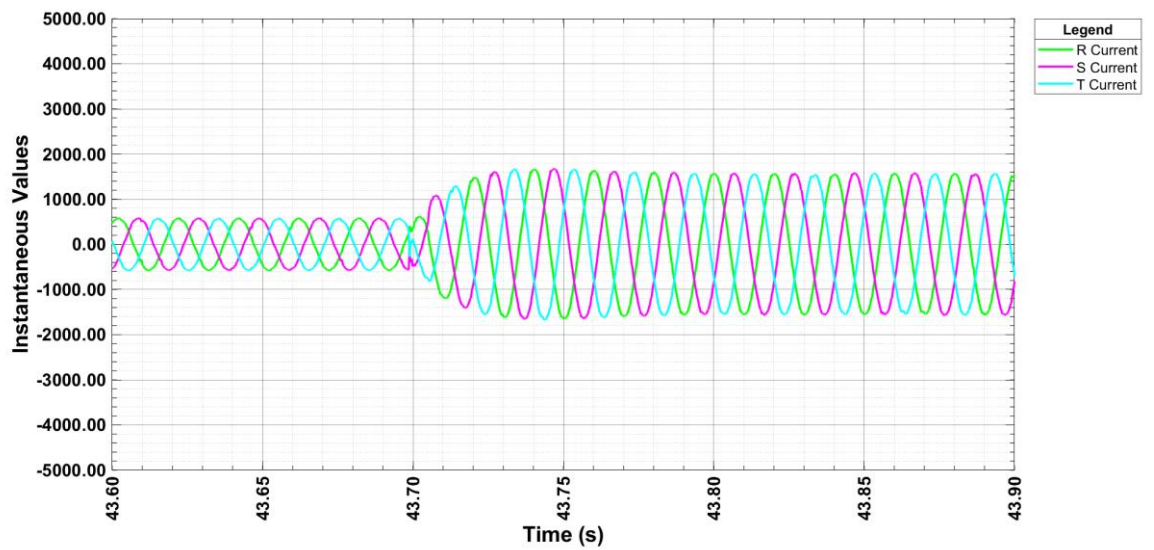
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.3

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.5.4 Test 75.4 Fault type: 3 phases, Partial load, Max. under-excited

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	75.4
	Date		-	[dd.mm.yyyy]	25.09.2020
	Time		-	[hh:mm:ss]	18:23:38
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.750
	Drop duration setpoint		-	[ms]	2833
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	23034
	Fault clearance (t2)		-	[ms]	25876
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2842
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.770 /1.031
		Pos. seq.		[p.u.]	0.770 /1.031

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.031
		Neg. seq.	t1-60 s to t1	[p.u.]	0.004
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.031
		Pos. seq.	t1-1 s to t1	[p.u.]	1.031
		Neg. seq.	t1-1 s to t1	[p.u.]	0.005
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.192
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.661
		Pos. seq.	t1-1 s to t1	[p.u.]	0.661
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.193
	Active Power	Total	t1-10 s to t1	[p.u.]	0.198
		Total	t1-2 s to t1	[p.u.]	0.198
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.198
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.682
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.735(*)
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	33
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	33
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.769
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.007
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.061
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.002
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.061
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.002
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.028
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.028

(*) Note: The determined K-factor is lower than the configured in the EUT (K = 2) because the current is limited.

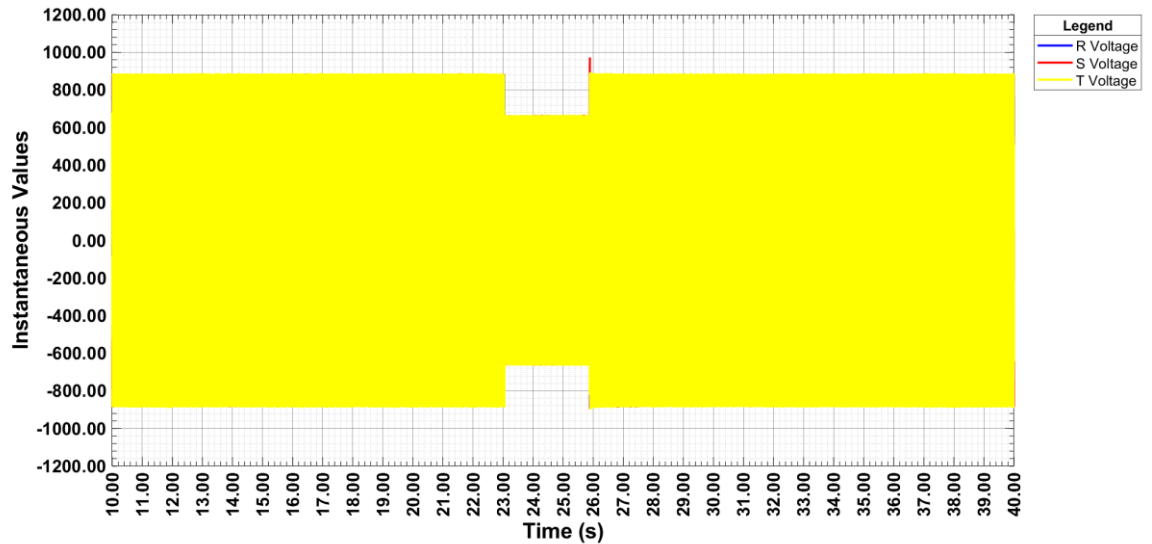
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1368
		Phase 2	t1 to t1+20 ms	[A]	1408
		Phase 3	t1 to t1+20 ms	[A]	1433
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.909
		Phase 2	t1 + 20 ms	[p.u.]	0.937
		Phase 3	t1 + 20 ms	[p.u.]	1.064
		Phase 1	t1 + 100 ms	[p.u.]	1.069
		Phase 2	t1 + 100 ms	[p.u.]	1.065
		Phase 3	t1 + 100 ms	[p.u.]	1.064
		Phase 1	t1 + 150 ms	[p.u.]	1.063
		Phase 2	t1 + 150 ms	[p.u.]	1.061
		Phase 3	t1 + 150 ms	[p.u.]	1.059
		Phase 1	t1 + 300 ms	[p.u.]	1.063
		Phase 2	t1 + 300 ms	[p.u.]	1.064
		Phase 3	t1 + 300 ms	[p.u.]	1.061
		Phase 1	t1 + 500 ms	[p.u.]	1.063
		Phase 2	t1 + 500 ms	[p.u.]	1.064
		Phase 3	t1 + 500 ms	[p.u.]	1.060
		Phase 1	t1 + 1000 ms	[p.u.]	1.059
		Phase 2	t1 + 1000 ms	[p.u.]	1.061
		Phase 3	t1 + 1000 ms	[p.u.]	1.061
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.206
Active current rise time	Pos. seq.			[s]	0.017

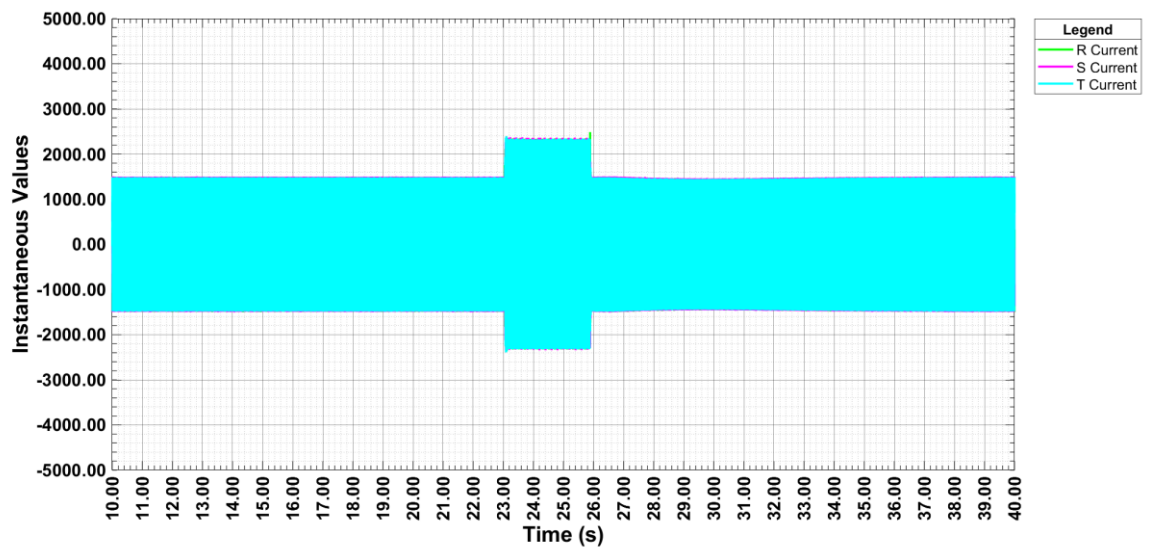
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.4

Phase-to-Phase voltages



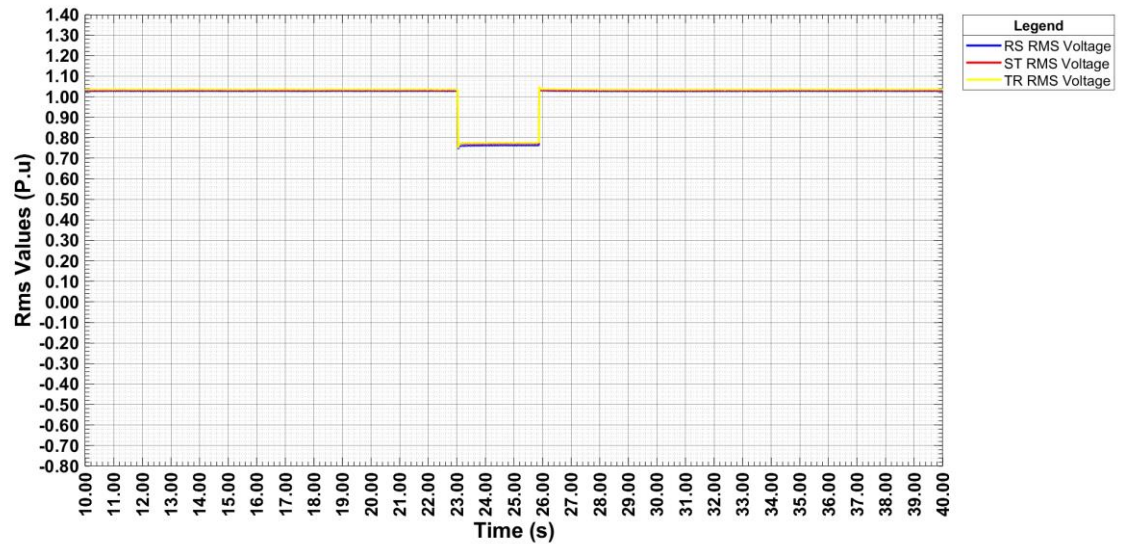
Phase currents



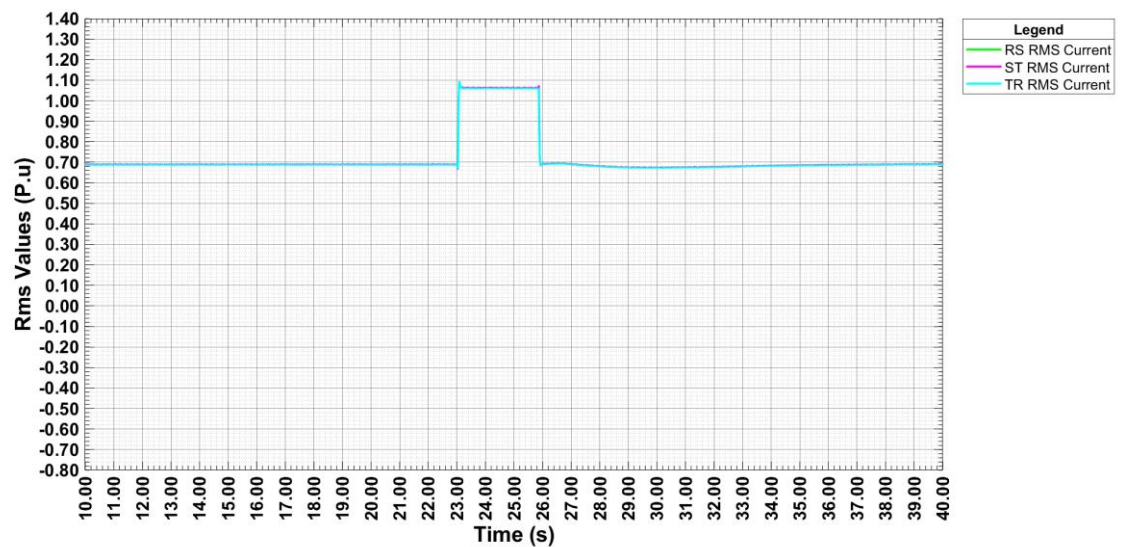
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.4

RMS Phase to phase voltages



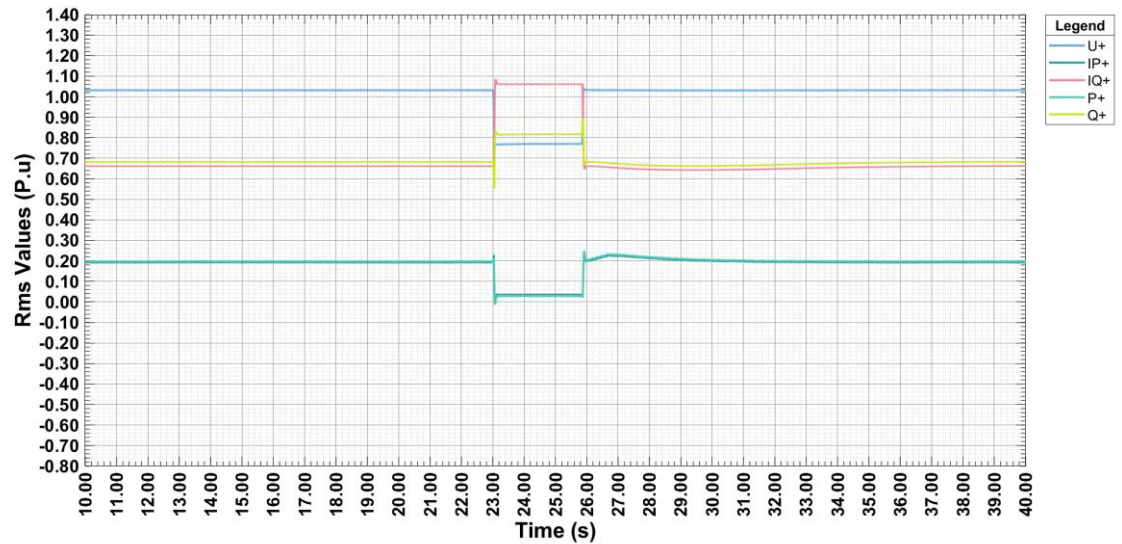
RMS Phase currents



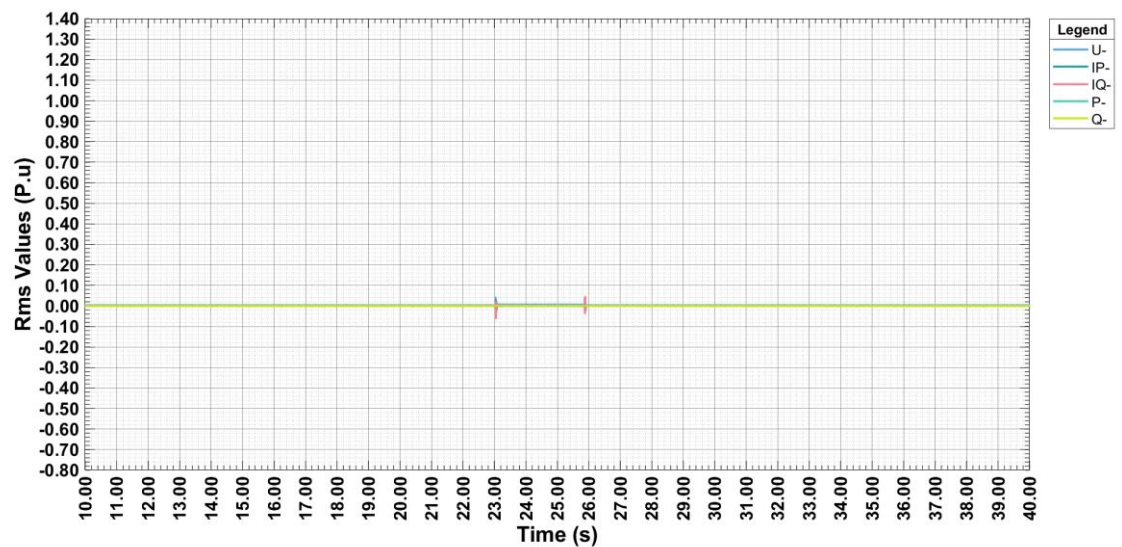
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.4

Positive sequences



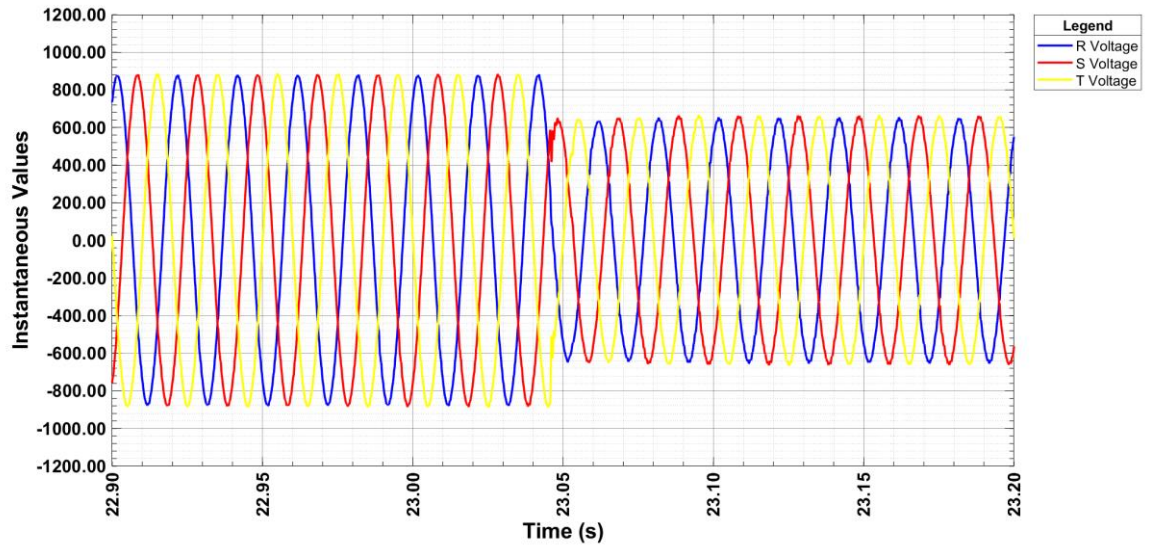
Negative sequences



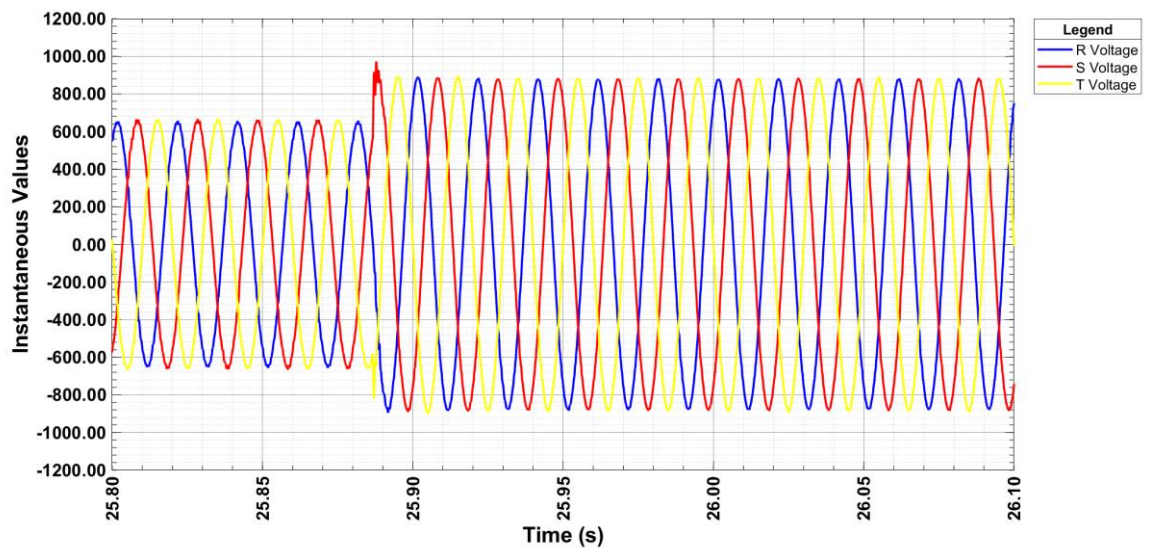
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.4

Transient voltage: Fault beginning



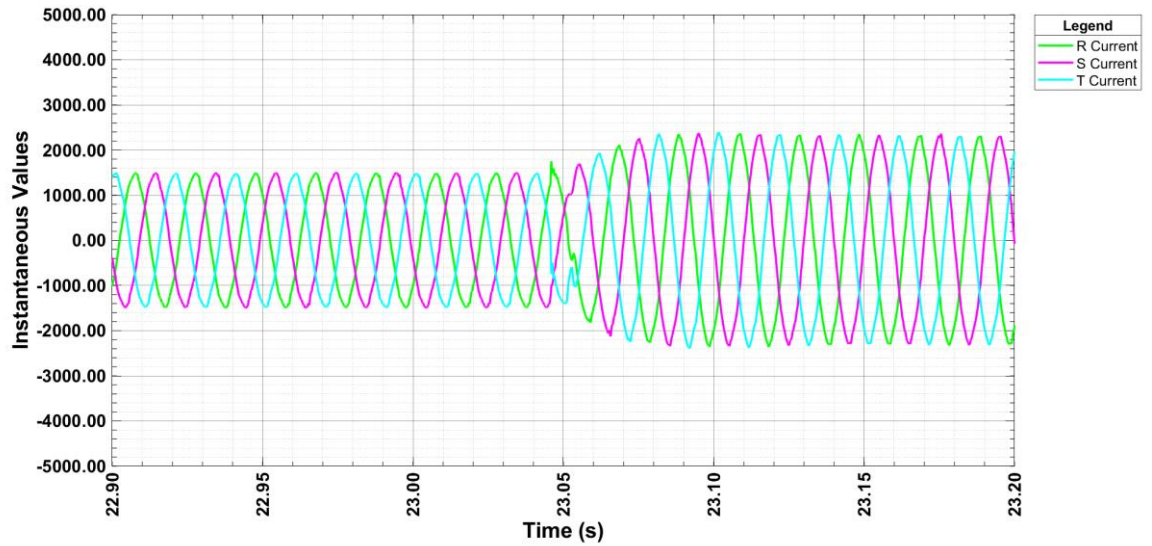
Transient voltage: Fault end



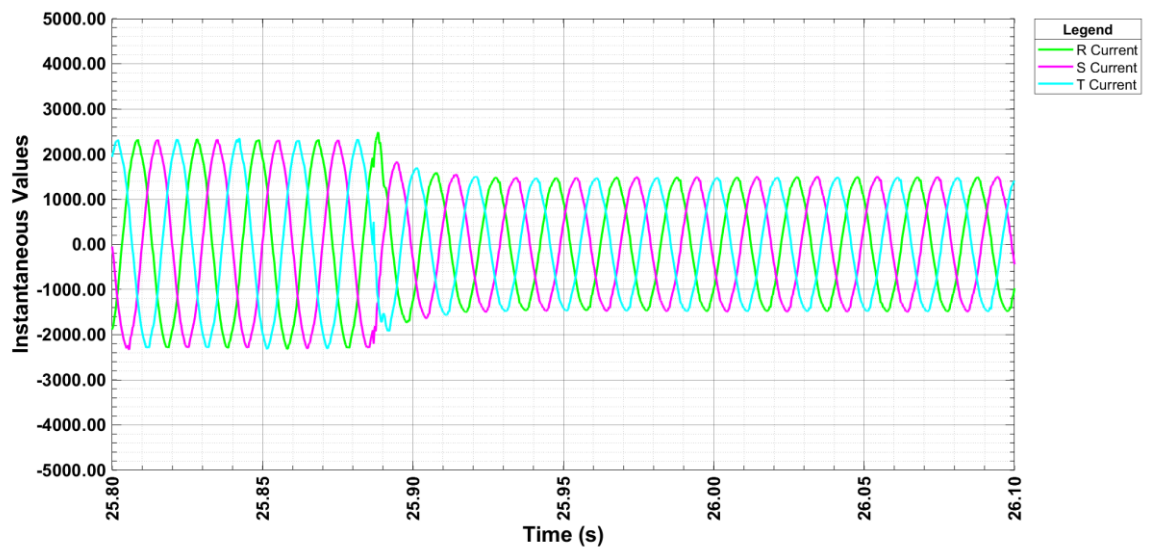
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.4

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.5.5 Test 75.5 Fault type: 3 phases, Partial load, k = 4

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	75.5
	Date		-	[dd.mm.yyyy]	03.11.2020
	Time		-	[hh:mm:ss]	16:58:35
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.750
	Drop duration setpoint		-	[ms]	2833
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	26634
	Fault clearance (t2)		-	[ms]	29502
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	2868
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.747 /0.999
		Pos. seq.		[p.u.]	0.746 /0.999

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.999
		Neg. seq.	t1-60 s to t1	[p.u.]	0.003
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.999
		Pos. seq.	t1-1 s to t1	[p.u.]	0.999
		Neg. seq.	t1-1 s to t1	[p.u.]	0.003
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.202
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.202
	Active Power	Total	t1-10 s to t1	[p.u.]	0.201
		Total	t1-2 s to t1	[p.u.]	0.201
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.201
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	4.017
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	25
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	25
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.746
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.007
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.024
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.002
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.025
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.013
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.043
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.043

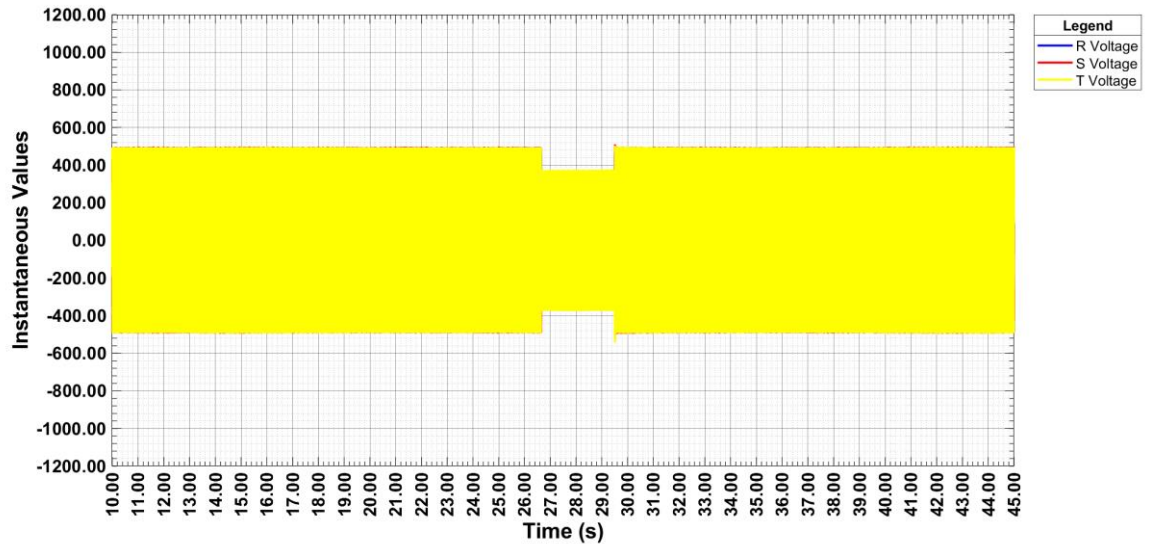
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1251
		Phase 2	t1 to t1+20 ms	[A]	1224
		Phase 3	t1 to t1+20 ms	[A]	1203
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.832
		Phase 2	t1 + 20 ms	[p.u.]	0.806
		Phase 3	t1 + 20 ms	[p.u.]	1.020
		Phase 1	t1 + 100 ms	[p.u.]	1.035
		Phase 2	t1 + 100 ms	[p.u.]	1.065
		Phase 3	t1 + 100 ms	[p.u.]	1.020
		Phase 1	t1 + 150 ms	[p.u.]	1.031
		Phase 2	t1 + 150 ms	[p.u.]	1.062
		Phase 3	t1 + 150 ms	[p.u.]	1.019
		Phase 1	t1 + 300 ms	[p.u.]	1.024
		Phase 2	t1 + 300 ms	[p.u.]	1.057
		Phase 3	t1 + 300 ms	[p.u.]	1.014
		Phase 1	t1 + 500 ms	[p.u.]	1.022
		Phase 2	t1 + 500 ms	[p.u.]	1.053
		Phase 3	t1 + 500 ms	[p.u.]	1.011
		Phase 1	t1 + 1000 ms	[p.u.]	1.019
		Phase 2	t1 + 1000 ms	[p.u.]	1.052
		Phase 3	t1 + 1000 ms	[p.u.]	1.006
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.201
Active current rise time	Pos. seq.			[s]	0.465

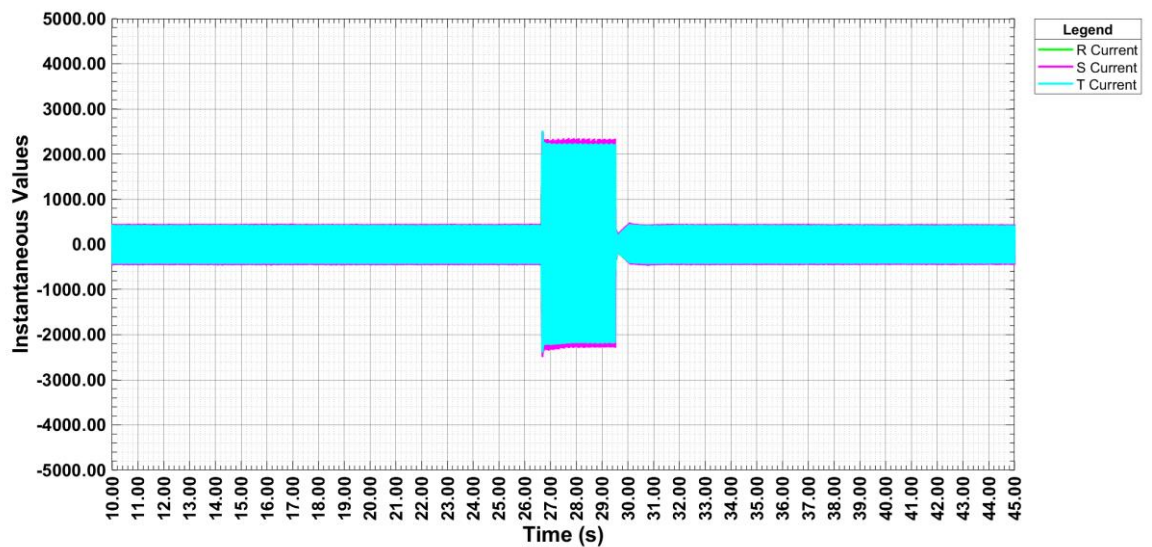
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.5

Phase-to-neutral voltages



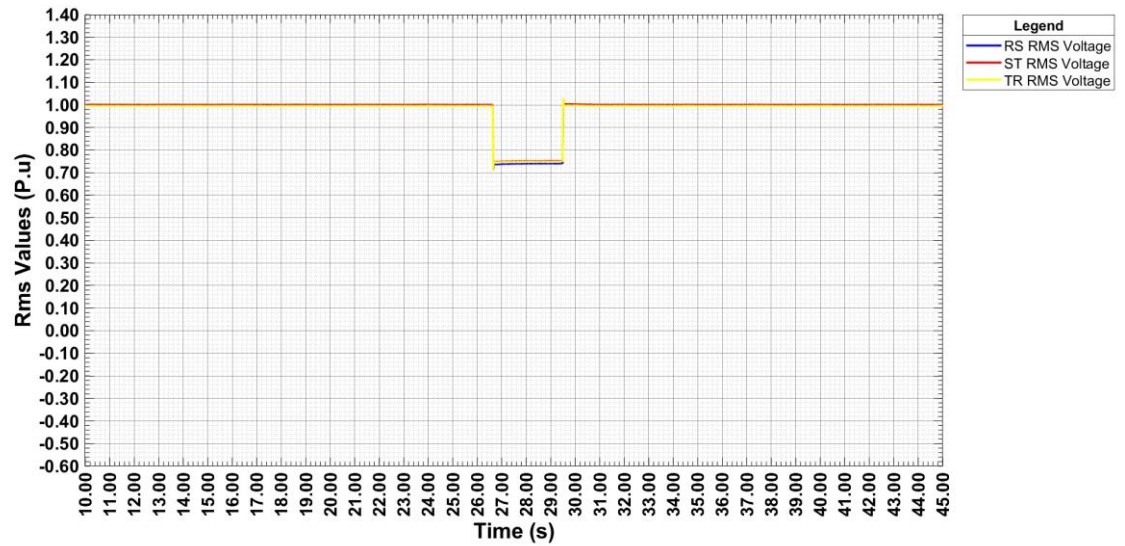
Phase currents



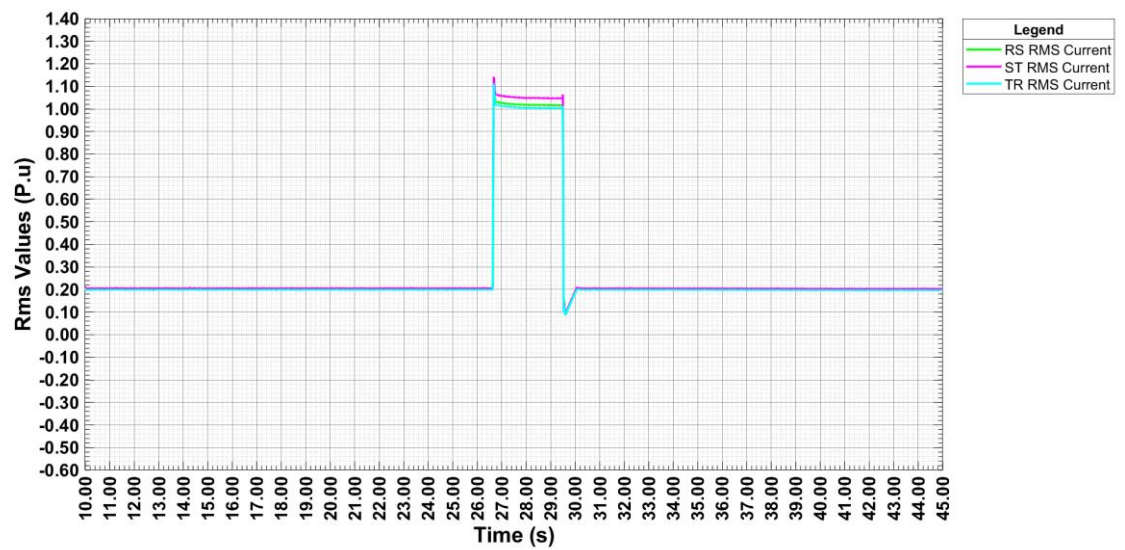
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.5

RMS Phase to phase voltages



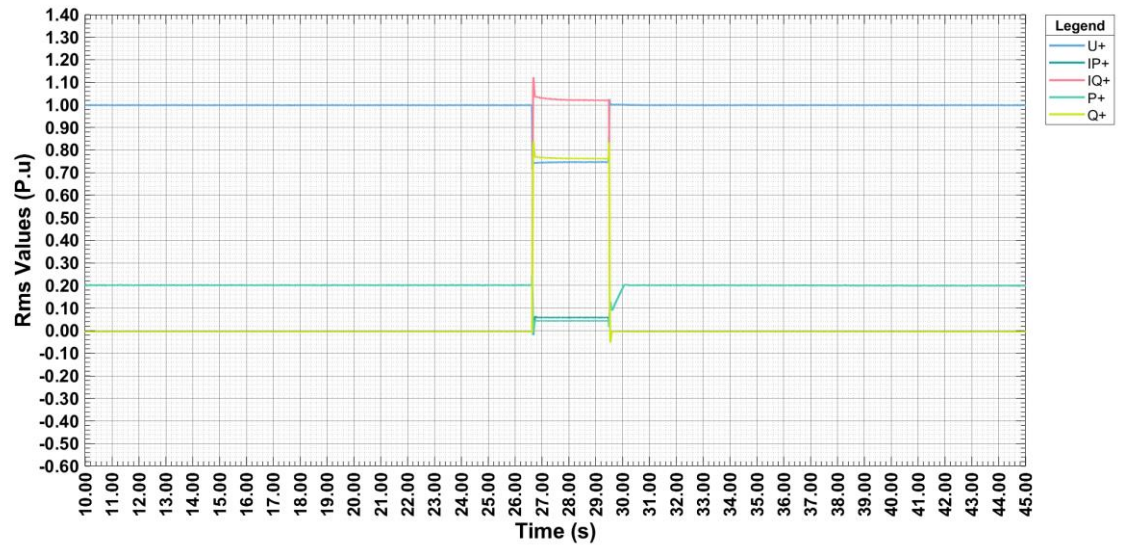
RMS Phase currents



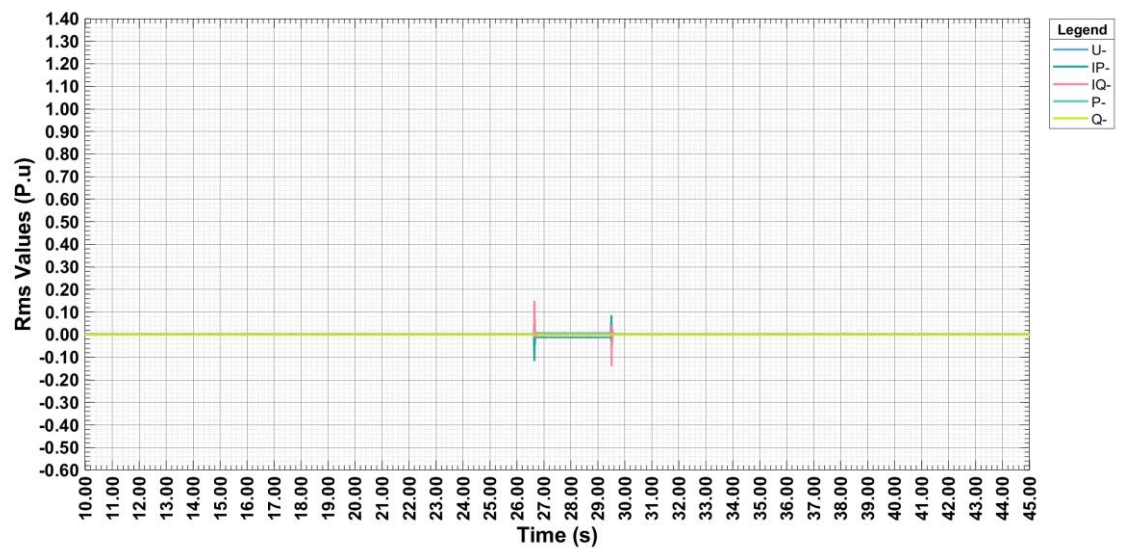
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.5

Positive sequences



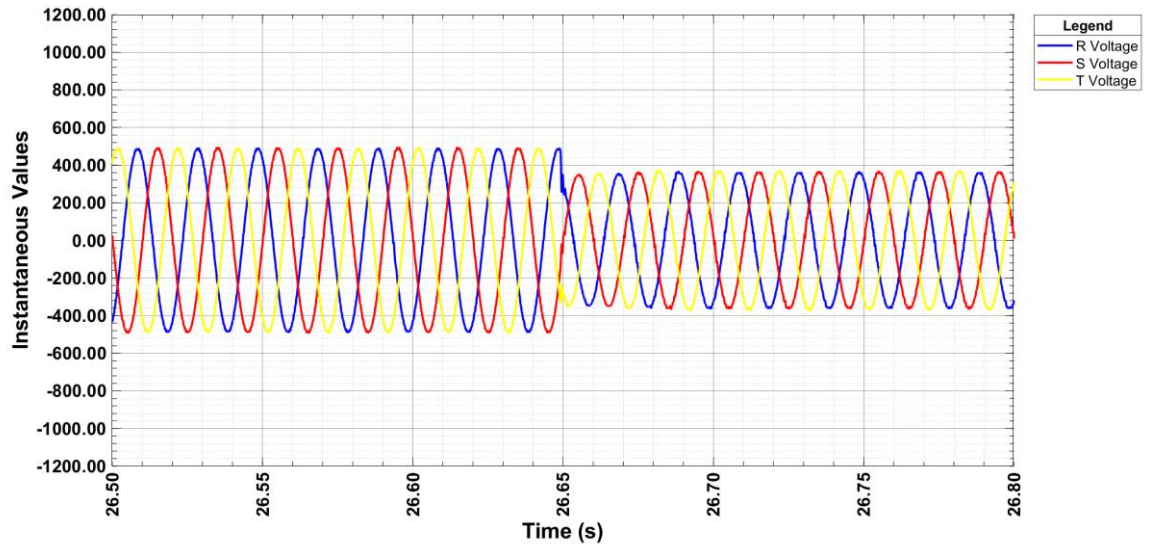
Negative sequences



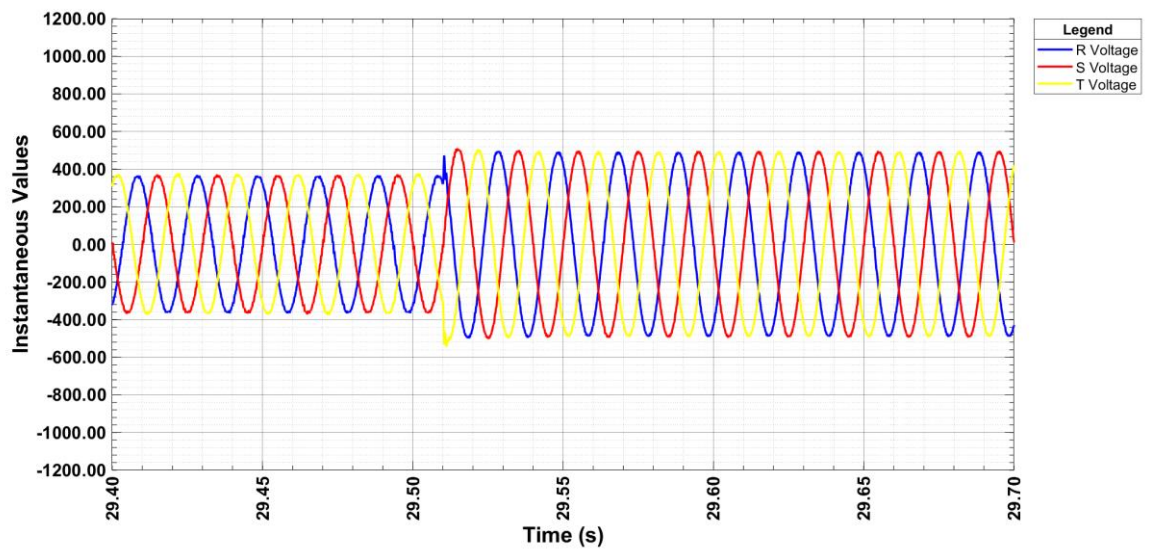
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.5

Transient voltage: Fault beginning



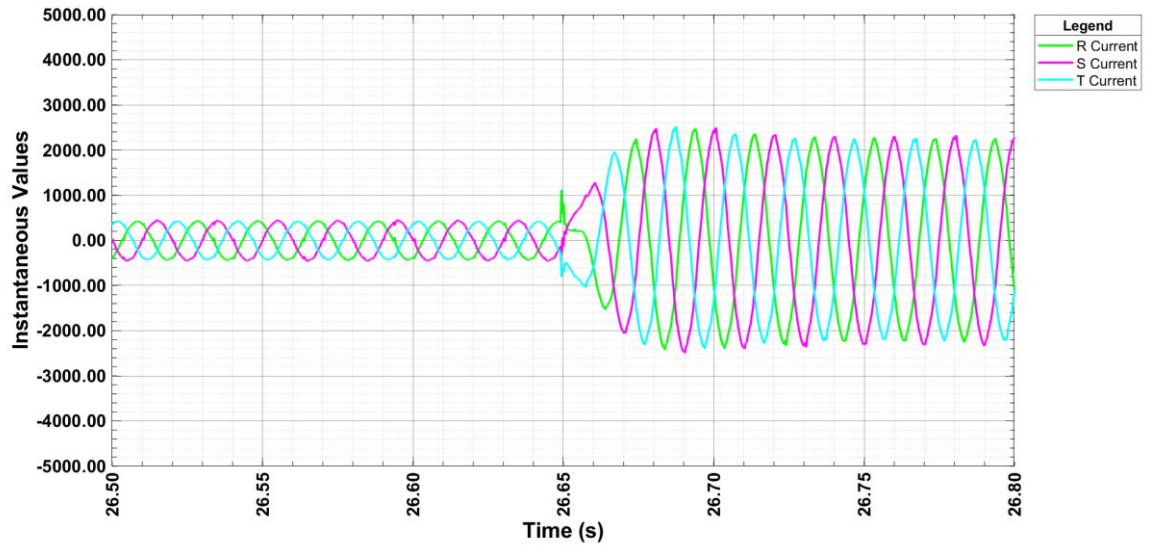
Transient voltage: Fault end



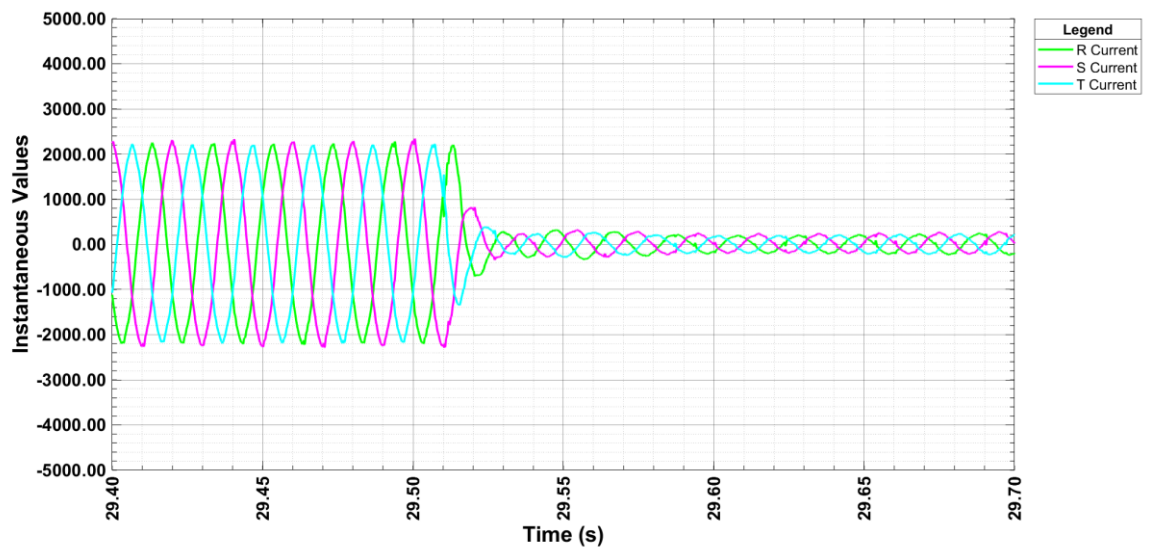
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.5

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.5.6 Test 75.6 Fault type: 2 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	75.6
	Date		-	[dd.mm.yyyy]	29.09.2020
	Time		-	[hh:mm:ss]	20:30:11
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.750
	Drop duration setpoint		-	[ms]	3000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24970
	Fault clearance (t2)		-	[ms]	28004
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	3034
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.769 /1.001
		Pos. seq.		[p.u.]	0.884 /1.001

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.001
		Neg. seq.	t1-60 s to t1	[p.u.]	0.003
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.001
		Pos. seq.	t1-1 s to t1	[p.u.]	1.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.004
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.029
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.029
	Active Power	Total	t1-10 s to t1	[p.u.]	1.029
		Total	t1-2 s to t1	[p.u.]	1.029
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.030
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.062
		Neg. seq.	-	-	-1.913
	Reactive current settling up time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	8
	Reactive current settling time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	8
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.884
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.115
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.238
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.225
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.581
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.225
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.468
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.468

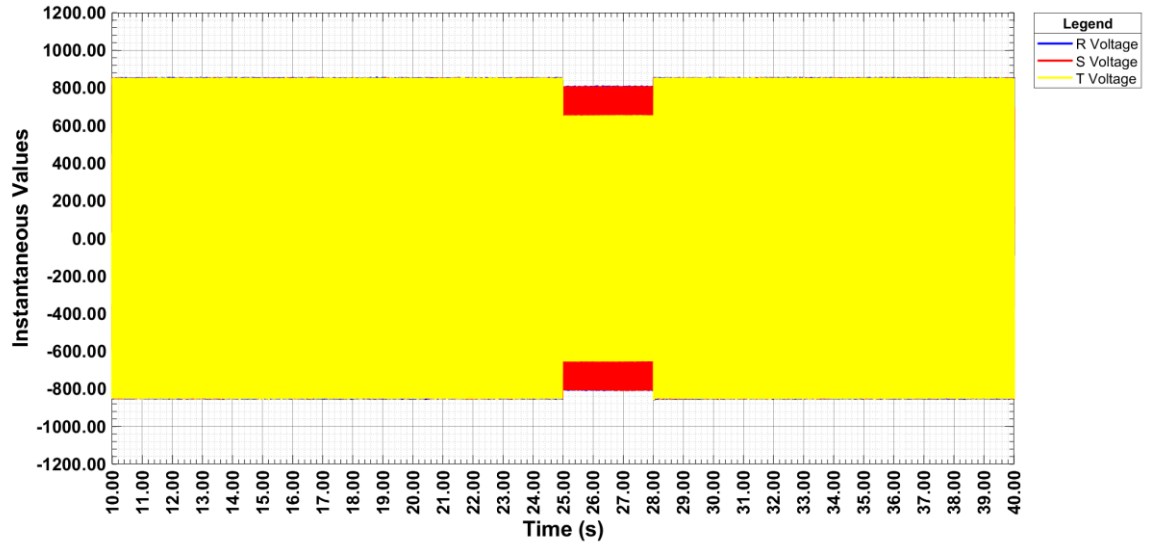
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1390
		Phase 2	t1 to t1+20 ms	[A]	1414
		Phase 3	t1 to t1+20 ms	[A]	1517
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.381
		Phase 2	t1 + 20 ms	[p.u.]	0.574
		Phase 3	t1 + 20 ms	[p.u.]	0.816
		Phase 1	t1 + 100 ms	[p.u.]	0.487
		Phase 2	t1 + 100 ms	[p.u.]	0.535
		Phase 3	t1 + 100 ms	[p.u.]	0.816
		Phase 1	t1 + 150 ms	[p.u.]	0.484
		Phase 2	t1 + 150 ms	[p.u.]	0.532
		Phase 3	t1 + 150 ms	[p.u.]	0.803
		Phase 1	t1 + 300 ms	[p.u.]	0.482
		Phase 2	t1 + 300 ms	[p.u.]	0.534
		Phase 3	t1 + 300 ms	[p.u.]	0.804
		Phase 1	t1 + 500 ms	[p.u.]	0.482
		Phase 2	t1 + 500 ms	[p.u.]	0.533
		Phase 3	t1 + 500 ms	[p.u.]	0.804
		Phase 1	t1 + 1000 ms	[p.u.]	0.483
		Phase 2	t1 + 1000 ms	[p.u.]	0.532
		Phase 3	t1 + 1000 ms	[p.u.]	0.805
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.046
Active current rise time	Pos. seq.			[s]	0.080

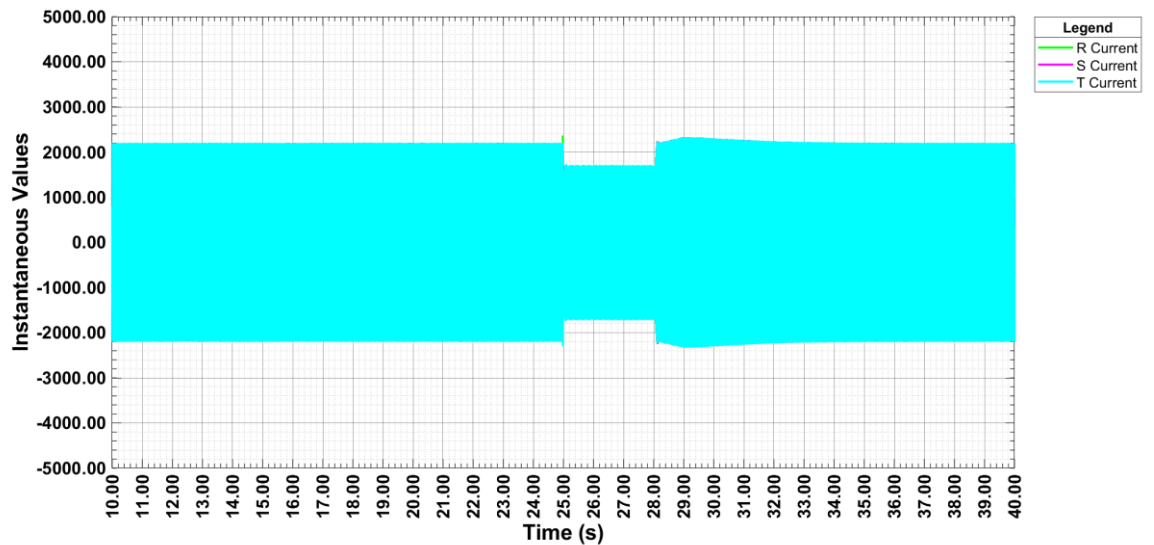
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.6

Phase-to-Phase voltages



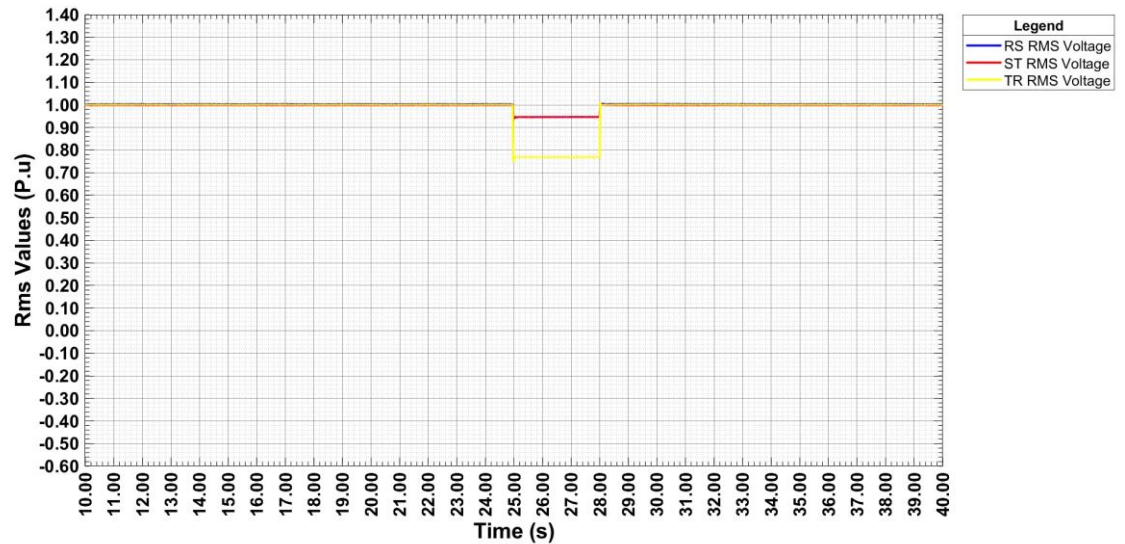
Phase currents



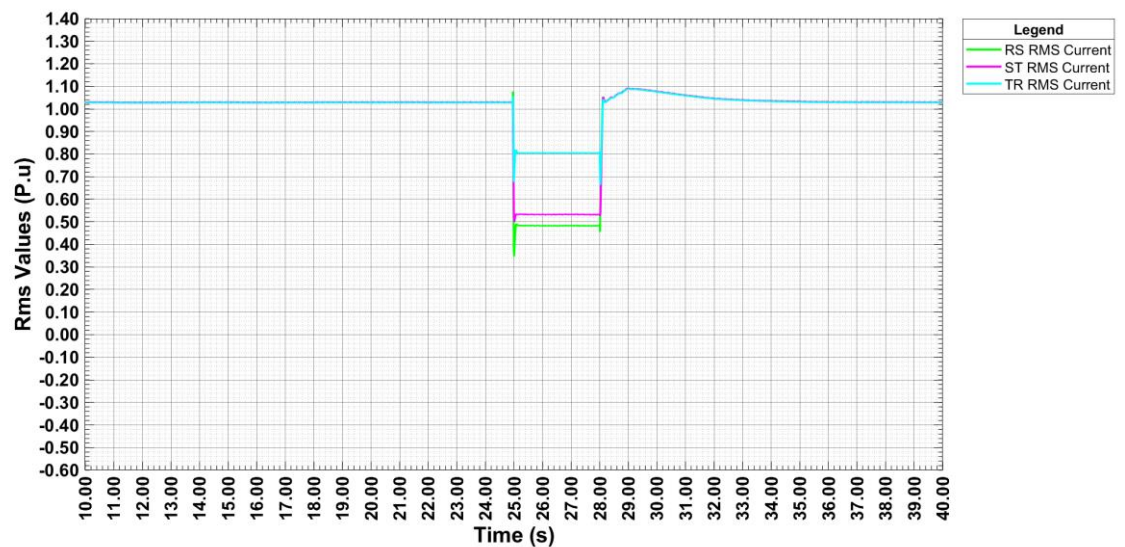
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.6

RMS Phase to phase voltages



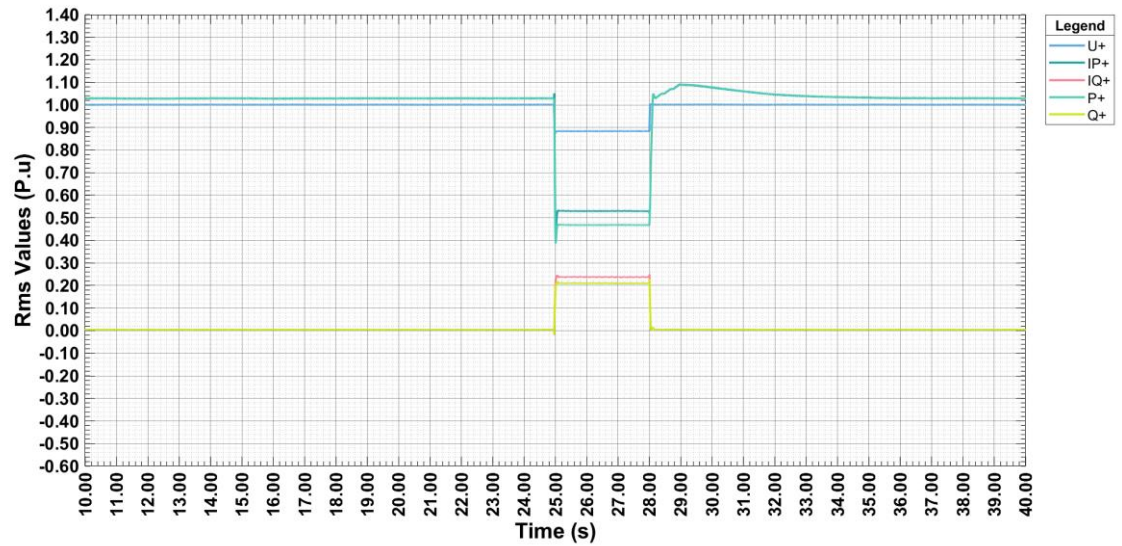
RMS Phase currents



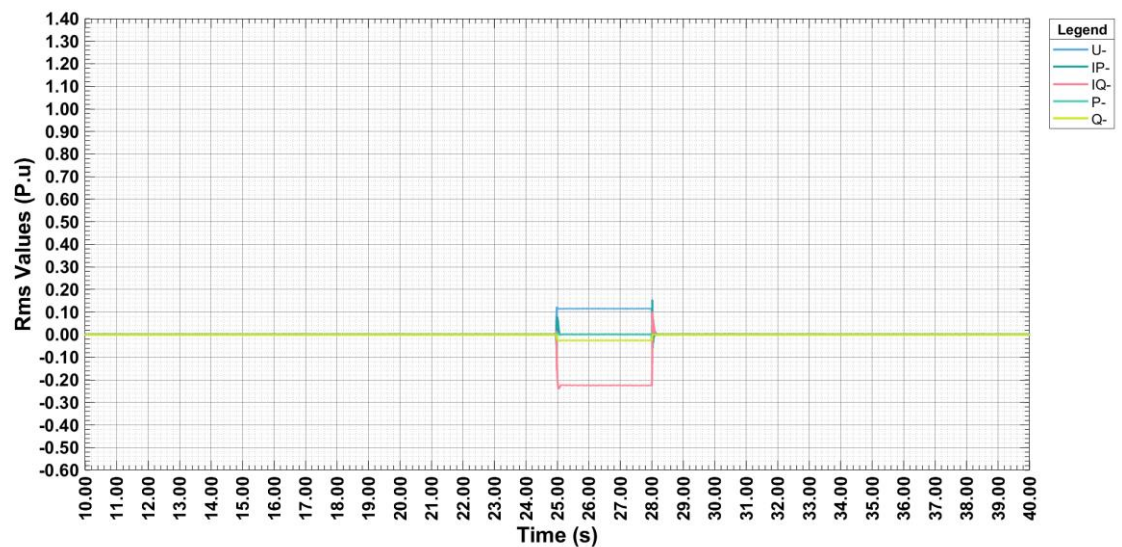
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.6

Positive sequences



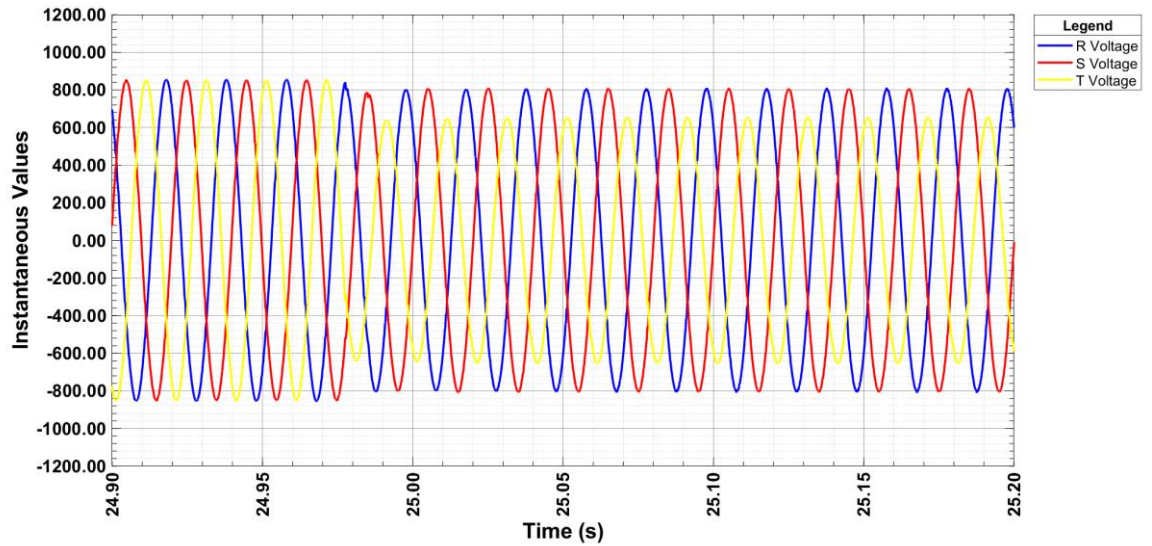
Negative sequences



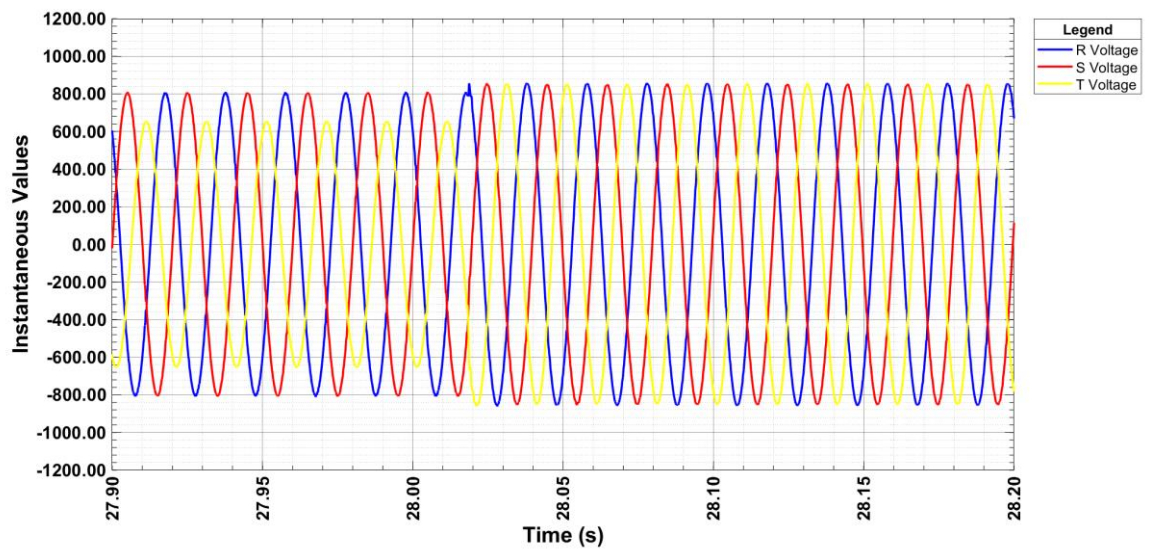
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.6

Transient voltage: Fault beginning



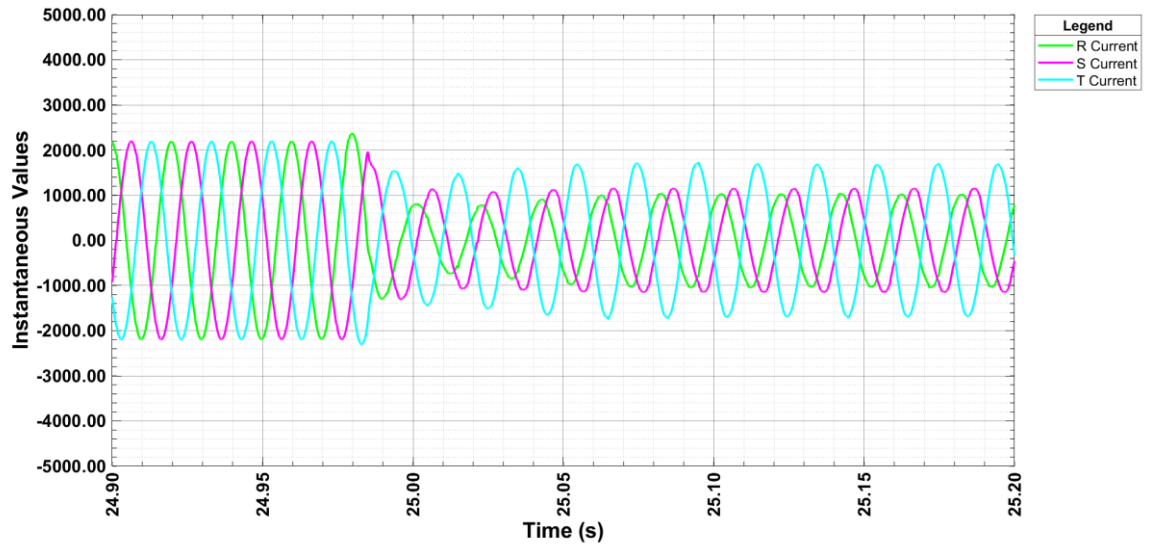
Transient voltage: Fault end



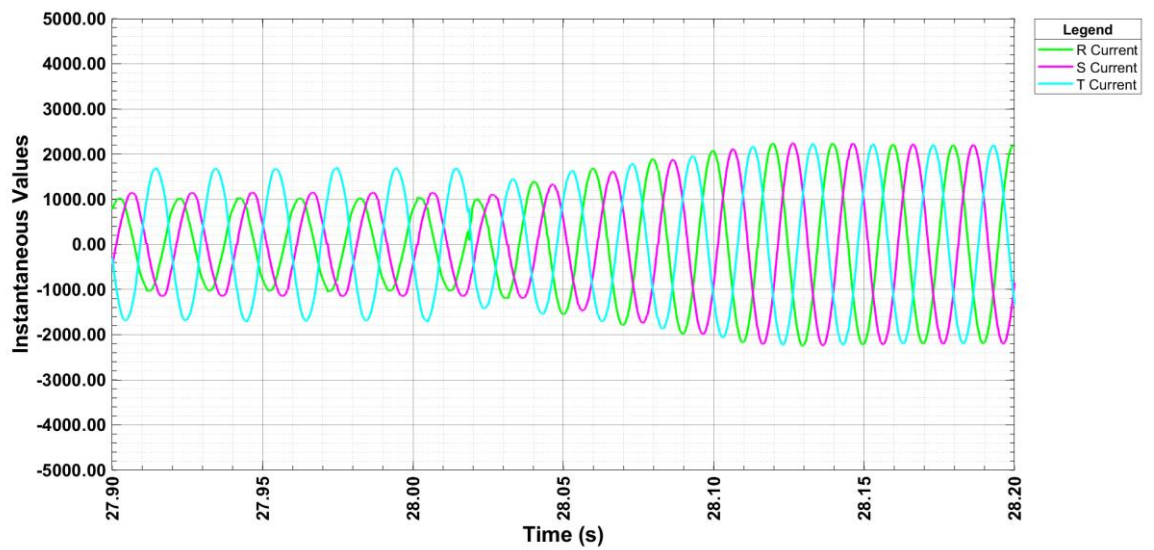
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.6

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.5.7 Test 75.7 Fault type: 2 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	75.7
	Date		-	[dd.mm.yyyy]	29.09.2020
	Time		-	[hh:mm:ss]	20:36:24
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.750
	Drop duration setpoint		-	[ms]	3000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	35553
	Fault clearance (t2)		-	[ms]	38587
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	3034
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.773 /1.002
		Pos. seq.		[p.u.]	0.885 /1.000

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.000
		Neg. seq.	t1-60 s to t1	[p.u.]	0.003
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.000
		Pos. seq.	t1-1 s to t1	[p.u.]	1.000
		Neg. seq.	t1-1 s to t1	[p.u.]	0.003
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.205
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.001
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.205
	Active Power	Total	t1-10 s to t1	[p.u.]	0.204
		Total	t1-2 s to t1	[p.u.]	0.204
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.205
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.001
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.996
		Neg. seq.	-	-	-1.967
	Reactive current settling up time	Pos. seq.	-	[ms]	13
		Neg. seq.	-	[ms]	13
	Reactive current settling time	Pos. seq.	-	[ms]	13
		Neg. seq.	-	[ms]	13
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.885
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.112
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.230
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.219
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.307
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.219
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.179
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.179

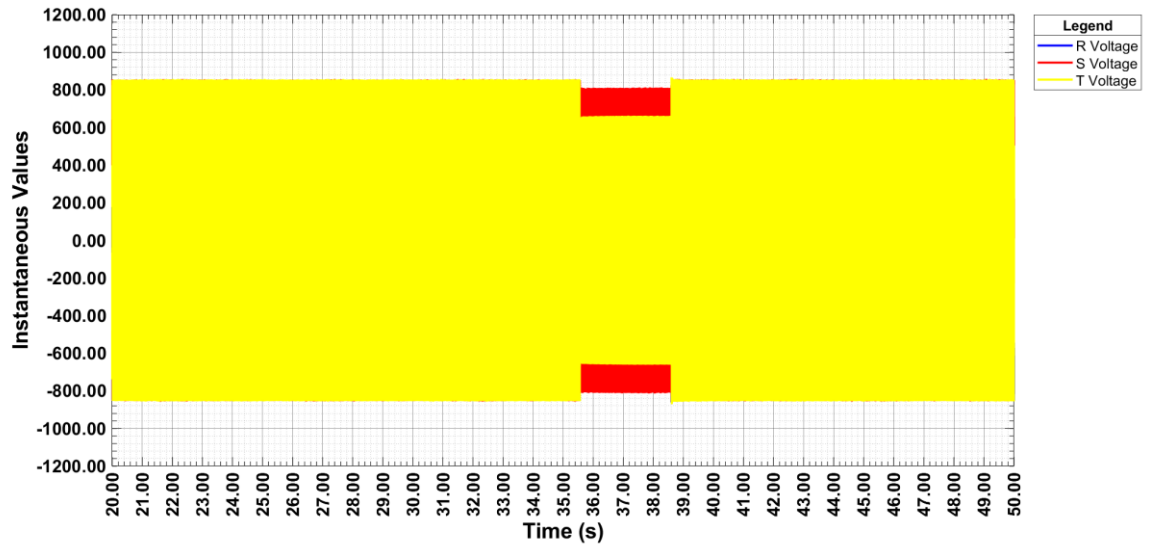
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	371
		Phase 2	t1 to t1+20 ms	[A]	359
		Phase 3	t1 to t1+20 ms	[A]	668
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.230
		Phase 2	t1 + 20 ms	[p.u.]	0.239
		Phase 3	t1 + 20 ms	[p.u.]	0.530
		Phase 1	t1 + 100 ms	[p.u.]	0.361
		Phase 2	t1 + 100 ms	[p.u.]	0.192
		Phase 3	t1 + 100 ms	[p.u.]	0.530
		Phase 1	t1 + 150 ms	[p.u.]	0.354
		Phase 2	t1 + 150 ms	[p.u.]	0.193
		Phase 3	t1 + 150 ms	[p.u.]	0.519
		Phase 1	t1 + 300 ms	[p.u.]	0.350
		Phase 2	t1 + 300 ms	[p.u.]	0.196
		Phase 3	t1 + 300 ms	[p.u.]	0.520
		Phase 1	t1 + 500 ms	[p.u.]	0.348
		Phase 2	t1 + 500 ms	[p.u.]	0.196
		Phase 3	t1 + 500 ms	[p.u.]	0.520
		Phase 1	t1 + 1000 ms	[p.u.]	0.349
		Phase 2	t1 + 1000 ms	[p.u.]	0.195
		Phase 3	t1 + 1000 ms	[p.u.]	0.518
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.206
Active current rise time	Pos. seq.			[s]	0.000

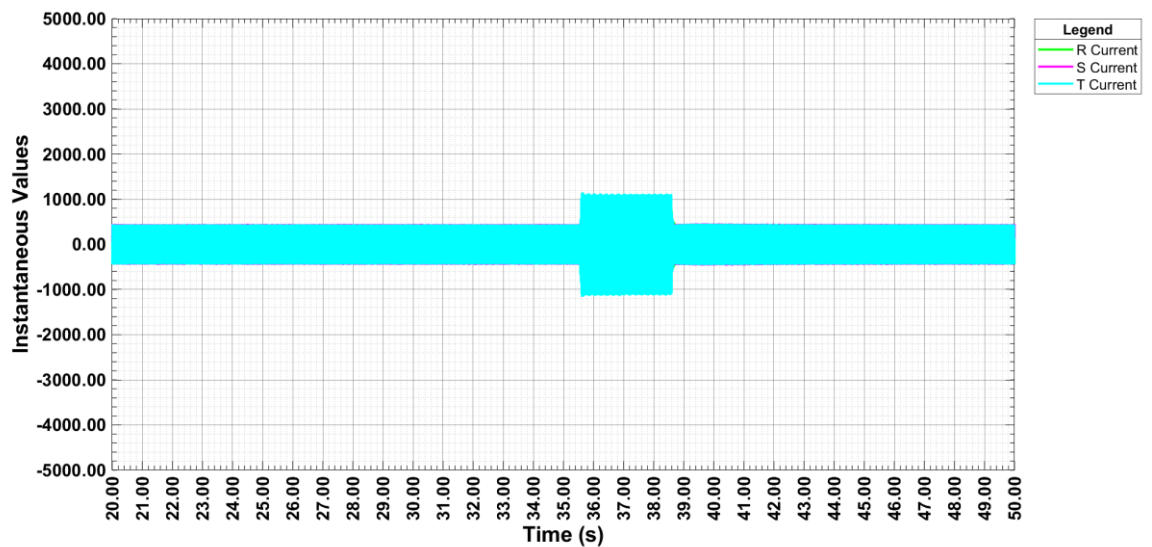
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.7

Phase-to-Phase voltages



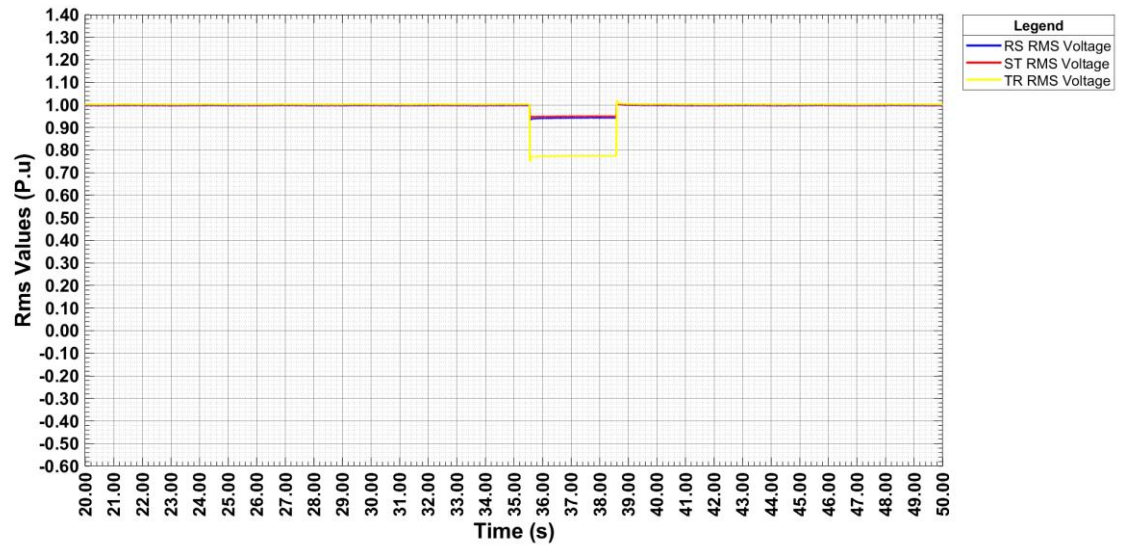
Phase currents



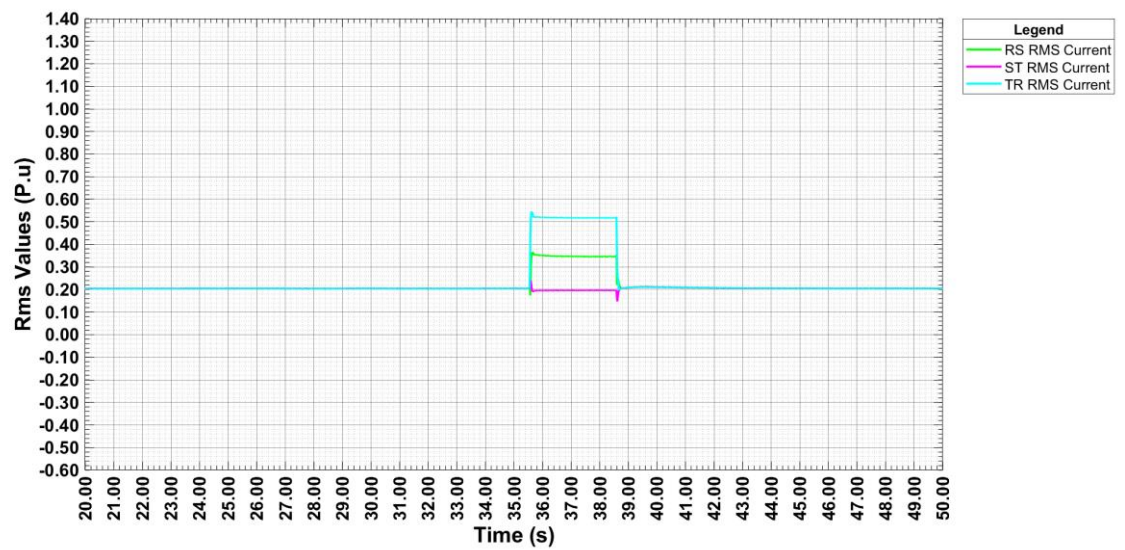
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.7

RMS Phase to phase voltages



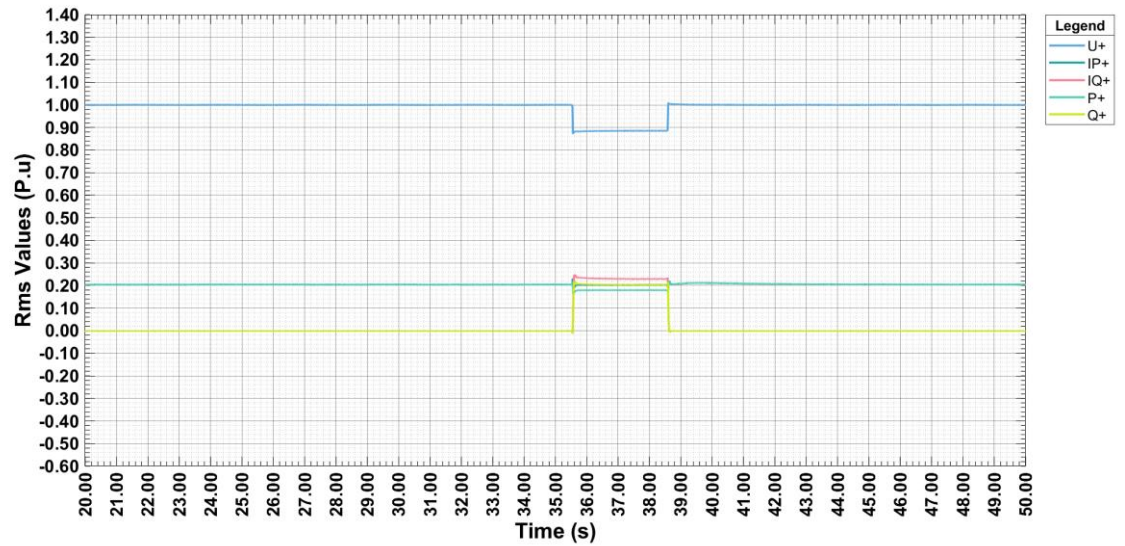
RMS Phase currents



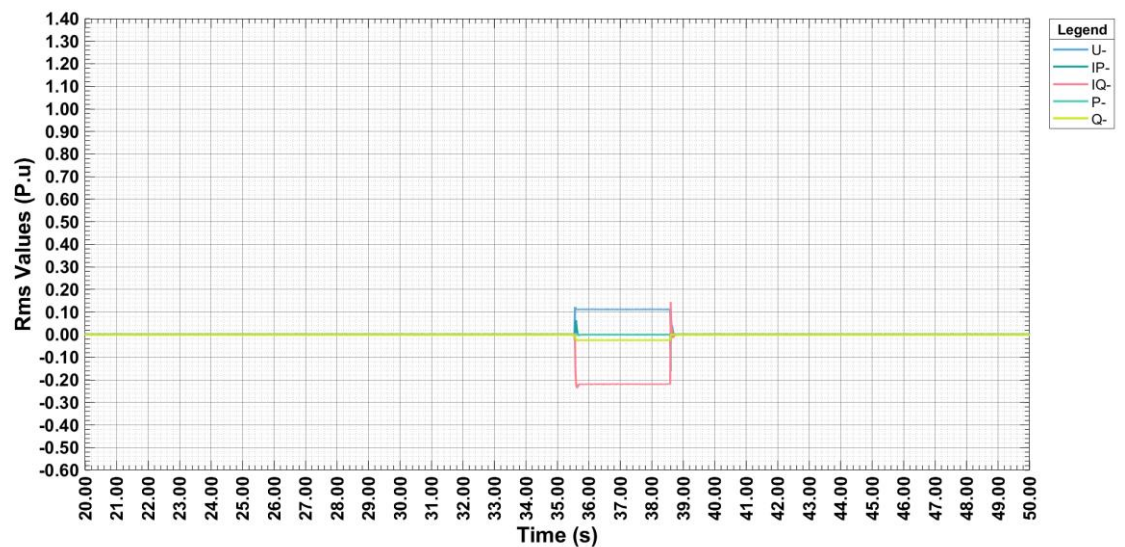
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.7

Positive sequences



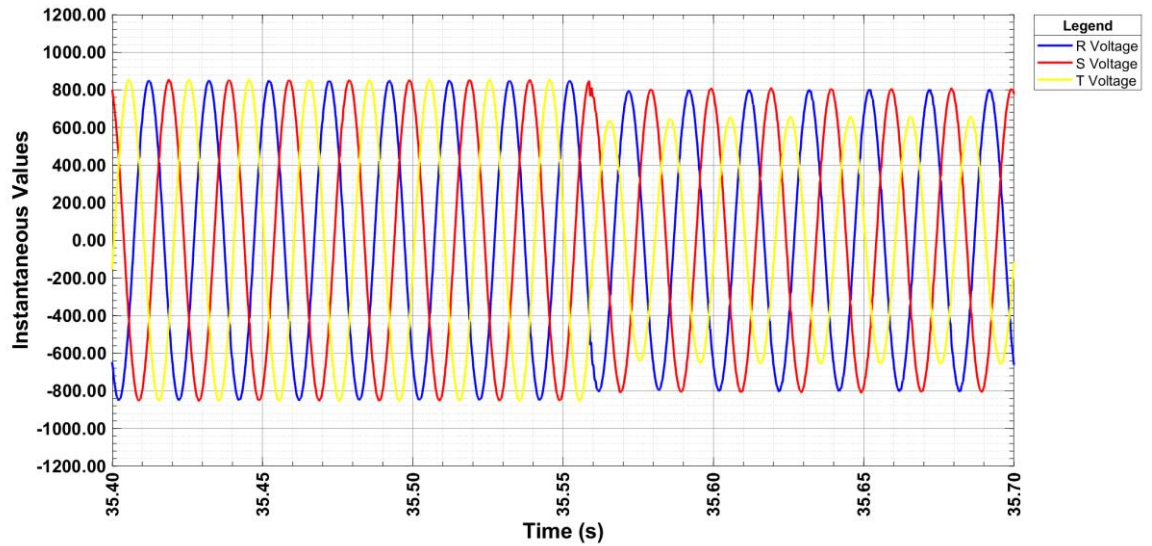
Negative sequences



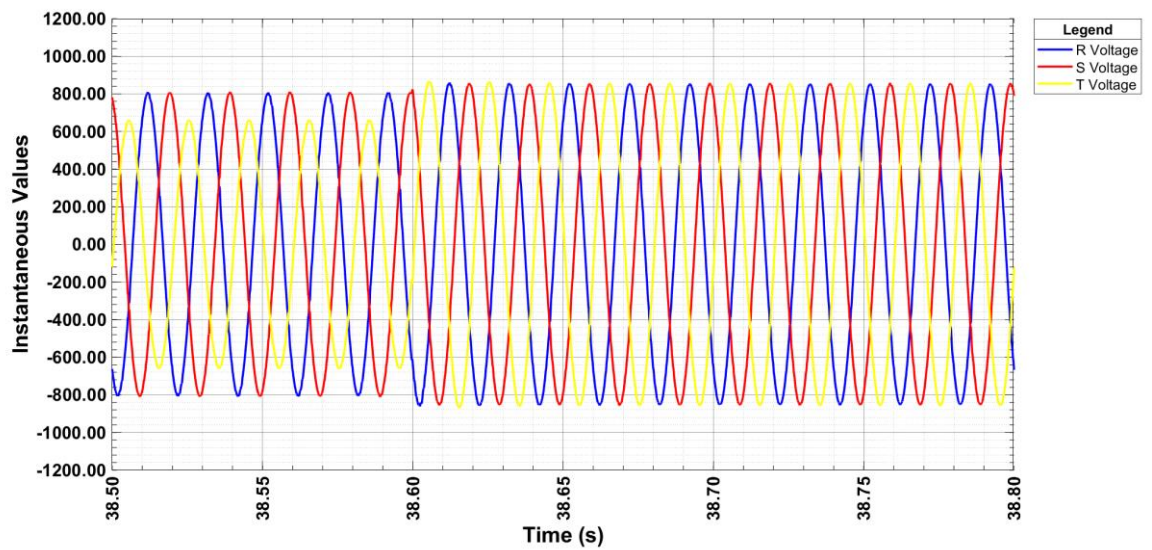
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.7

Transient voltage: Fault beginning



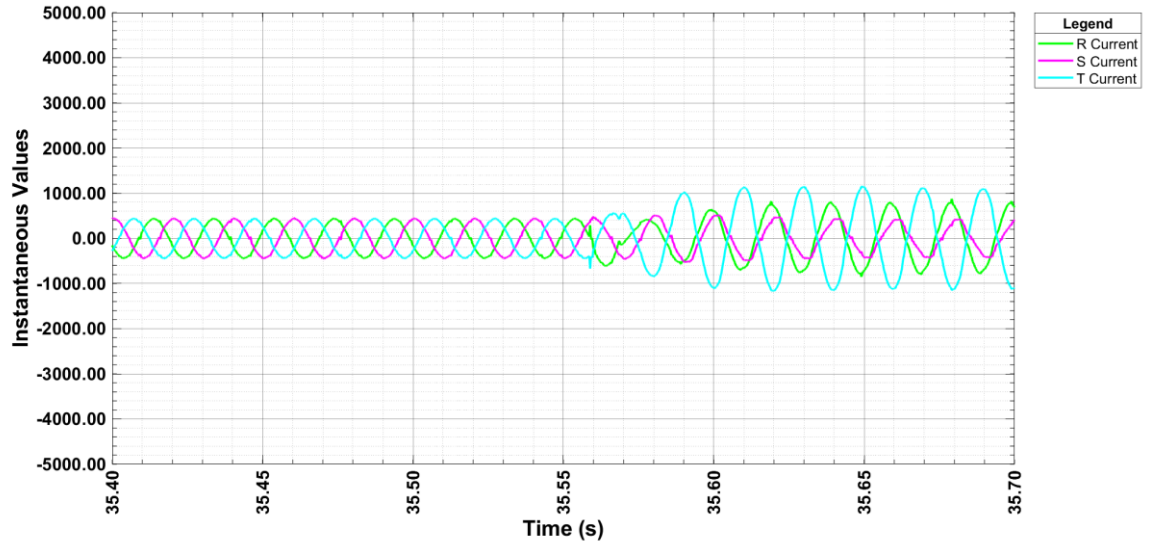
Transient voltage: Fault end



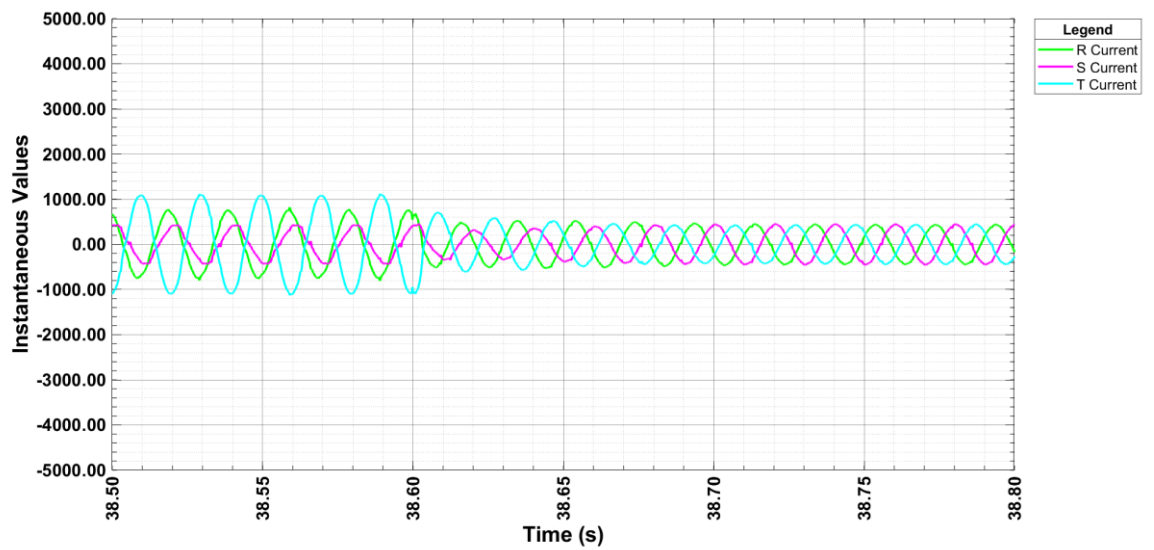
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.7

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.5.8 Test 75.8 Fault type: 2 phases, Partial load, k = 4

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	75.8
	Date		-	[dd.mm.yyyy]	29.10.2020
	Time		-	[hh:mm:ss]	16:49:39
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.750
	Drop duration setpoint		-	[ms]	3000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	25290
	Fault clearance (t2)		-	[ms]	28329
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	3039
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.748 / 0.996
		Pos. seq.		[p.u.]	0.872 / 0.999

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.999
		Neg. seq.	t1-60 s to t1	[p.u.]	0.003
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.999
		Pos. seq.	t1-1 s to t1	[p.u.]	0.998
		Neg. seq.	t1-1 s to t1	[p.u.]	0.003
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.202
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.202
	Active Power	Total	t1-10 s to t1	[p.u.]	0.201
		Total	t1-2 s to t1	[p.u.]	0.202
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.202
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	3.914
		Neg. seq.	-	-	-3.999
	Reactive current settling up time	Pos. seq.	-	[ms]	18
		Neg. seq.	-	[ms]	20
	Reactive current settling time	Pos. seq.	-	[ms]	18
		Neg. seq.	-	[ms]	20
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.872
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.125
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.501
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.499
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.504
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.499
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.048
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.047

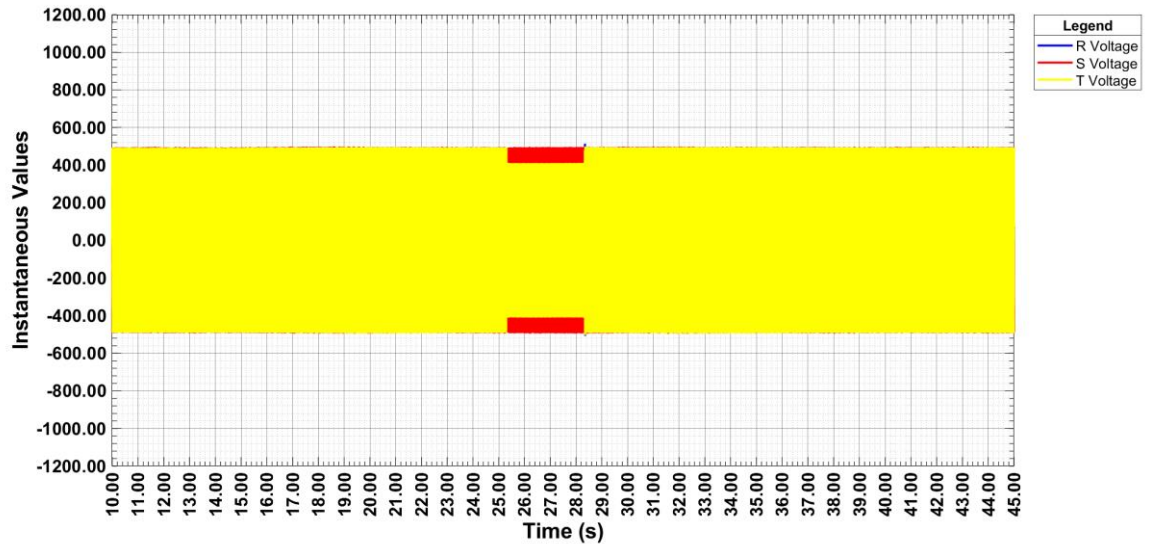
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1043
		Phase 2	t1 to t1+20 ms	[A]	282
		Phase 3	t1 to t1+20 ms	[A]	1198
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.694
		Phase 2	t1 + 20 ms	[p.u.]	0.141
		Phase 3	t1 + 20 ms	[p.u.]	0.885
		Phase 1	t1 + 100 ms	[p.u.]	0.886
		Phase 2	t1 + 100 ms	[p.u.]	0.046
		Phase 3	t1 + 100 ms	[p.u.]	0.885
		Phase 1	t1 + 150 ms	[p.u.]	0.864
		Phase 2	t1 + 150 ms	[p.u.]	0.048
		Phase 3	t1 + 150 ms	[p.u.]	0.867
		Phase 1	t1 + 300 ms	[p.u.]	0.867
		Phase 2	t1 + 300 ms	[p.u.]	0.049
		Phase 3	t1 + 300 ms	[p.u.]	0.873
		Phase 1	t1 + 500 ms	[p.u.]	0.867
		Phase 2	t1 + 500 ms	[p.u.]	0.049
		Phase 3	t1 + 500 ms	[p.u.]	0.873
		Phase 1	t1 + 1000 ms	[p.u.]	0.864
		Phase 2	t1 + 1000 ms	[p.u.]	0.048
		Phase 3	t1 + 1000 ms	[p.u.]	0.871
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.201
Active current rise time	Pos. seq.			[s]	0.017

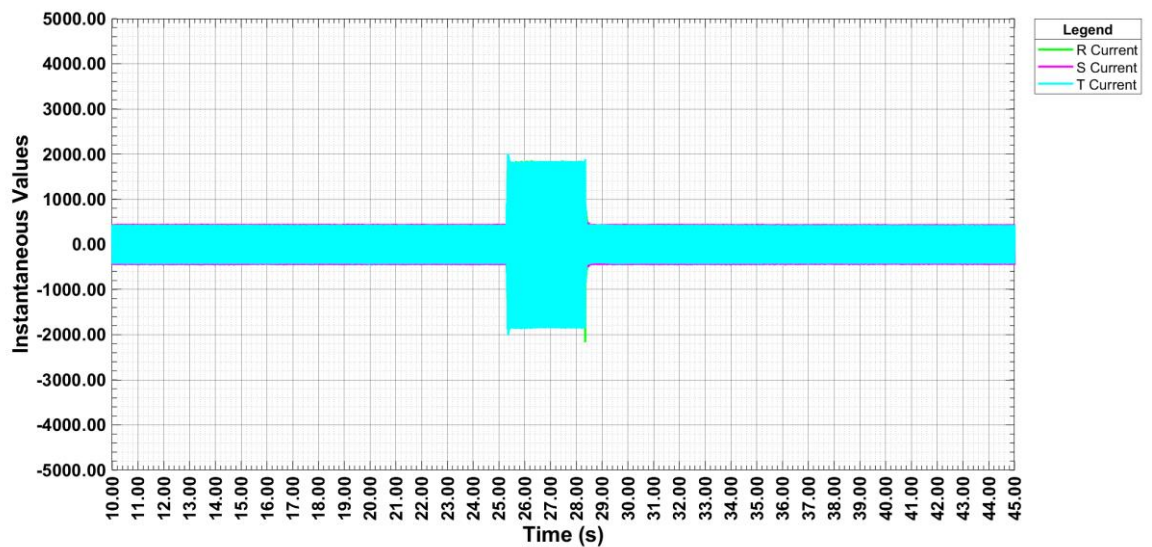
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.8

Phase-to-neutral voltages



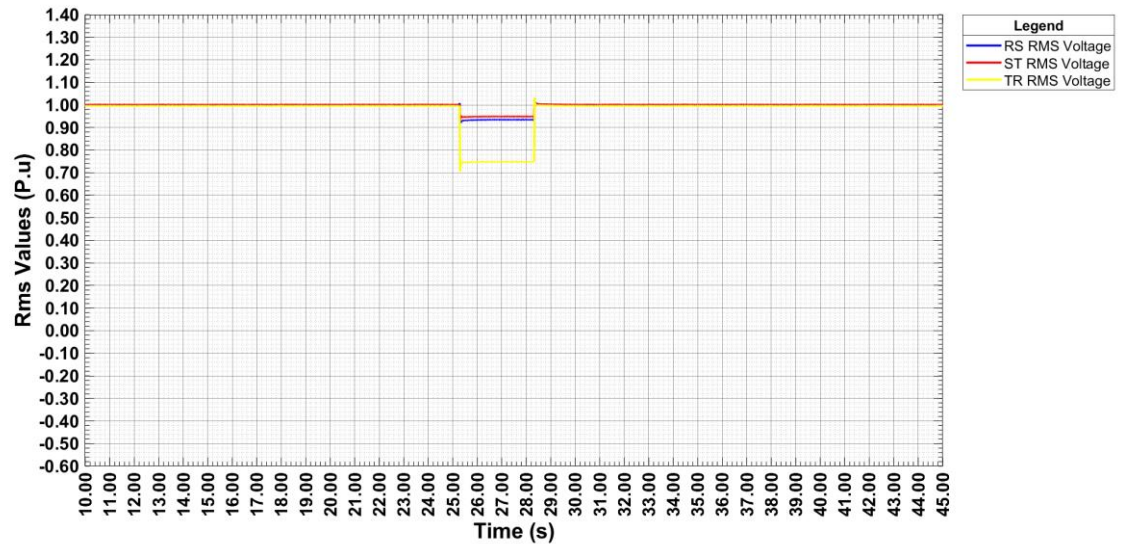
Phase currents



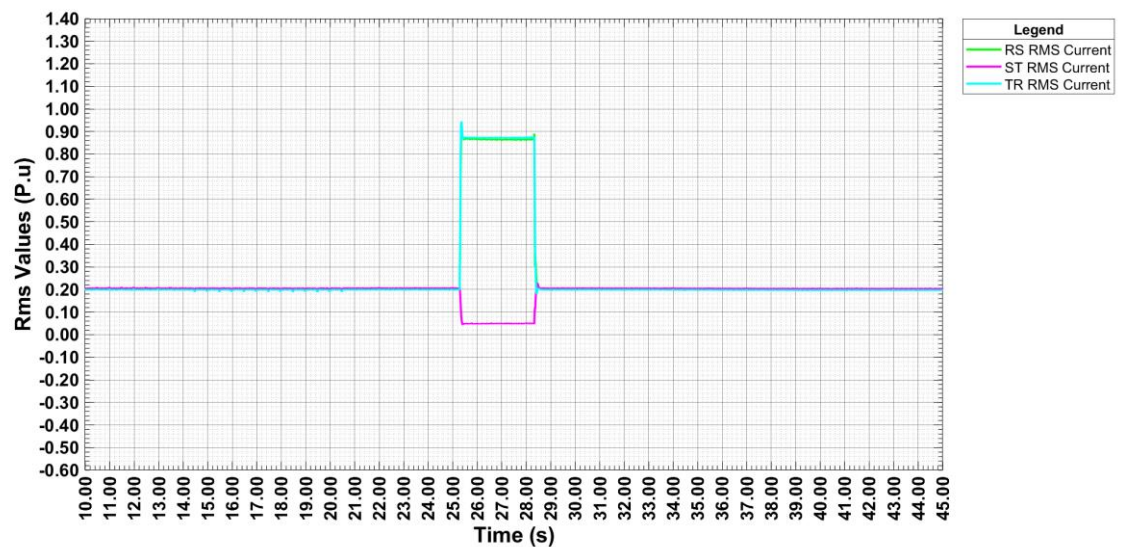
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.8

RMS Phase to phase voltages



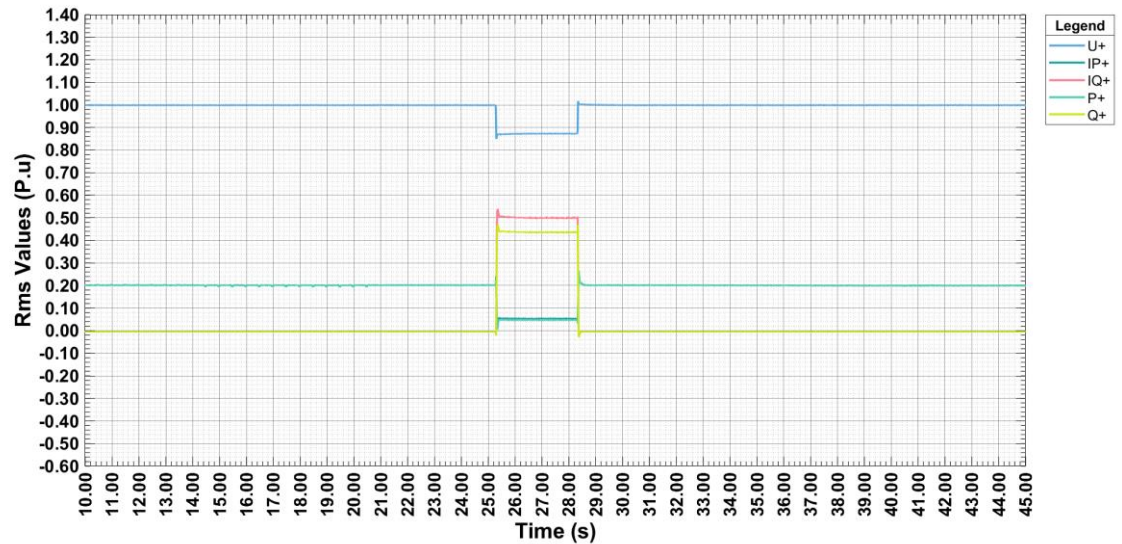
RMS Phase currents



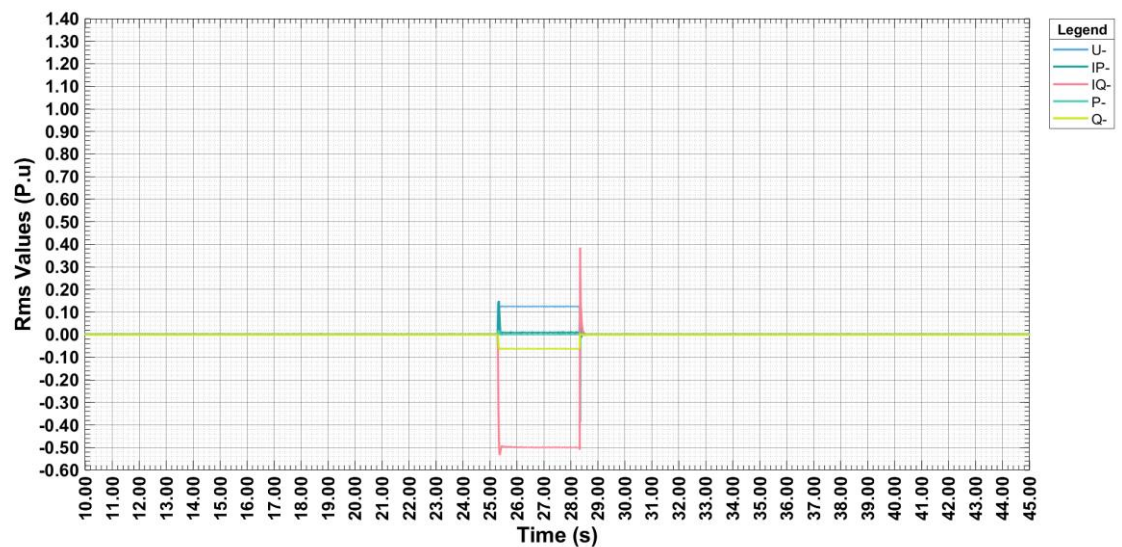
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.8

Positive sequences



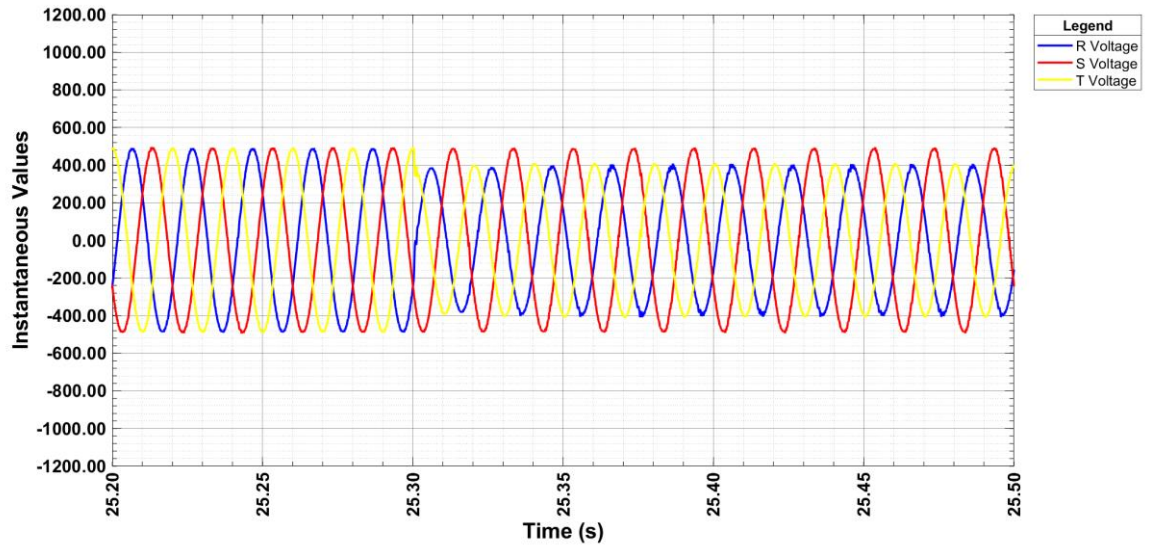
Negative sequences



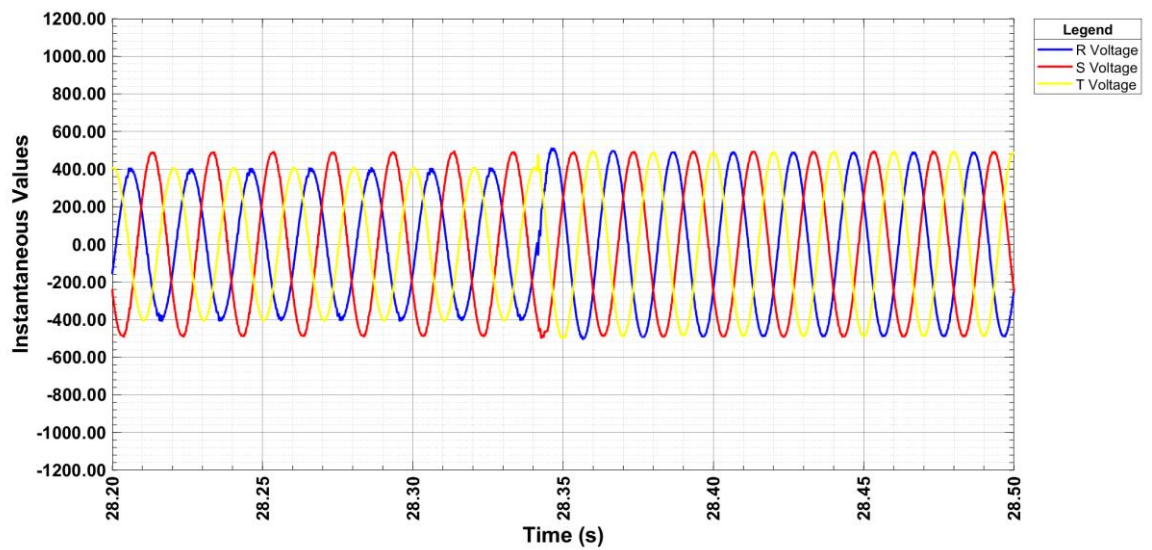
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.8

Transient voltage: Fault beginning



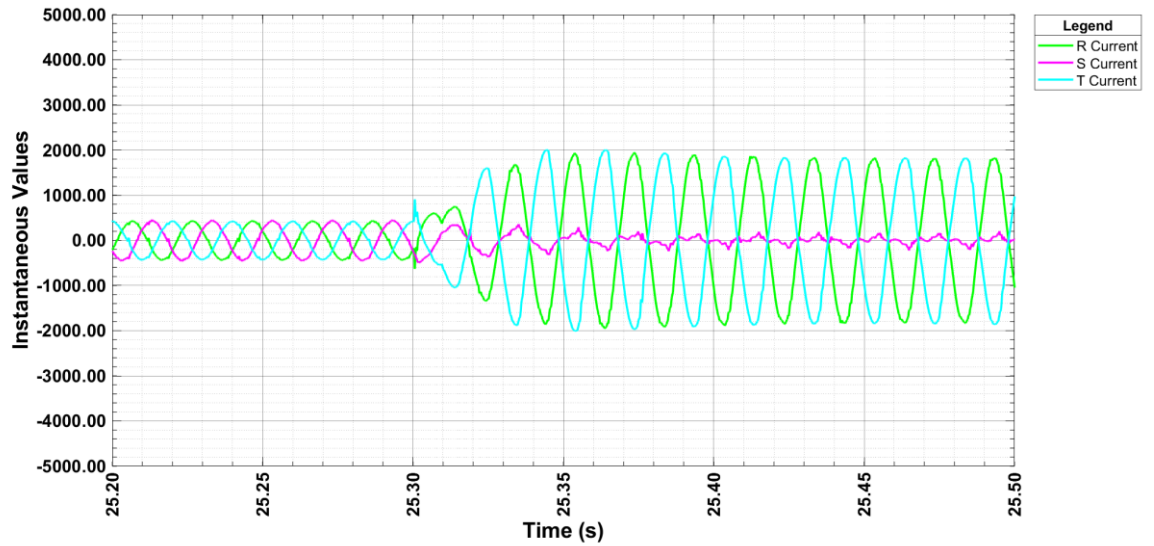
Transient voltage: Fault end



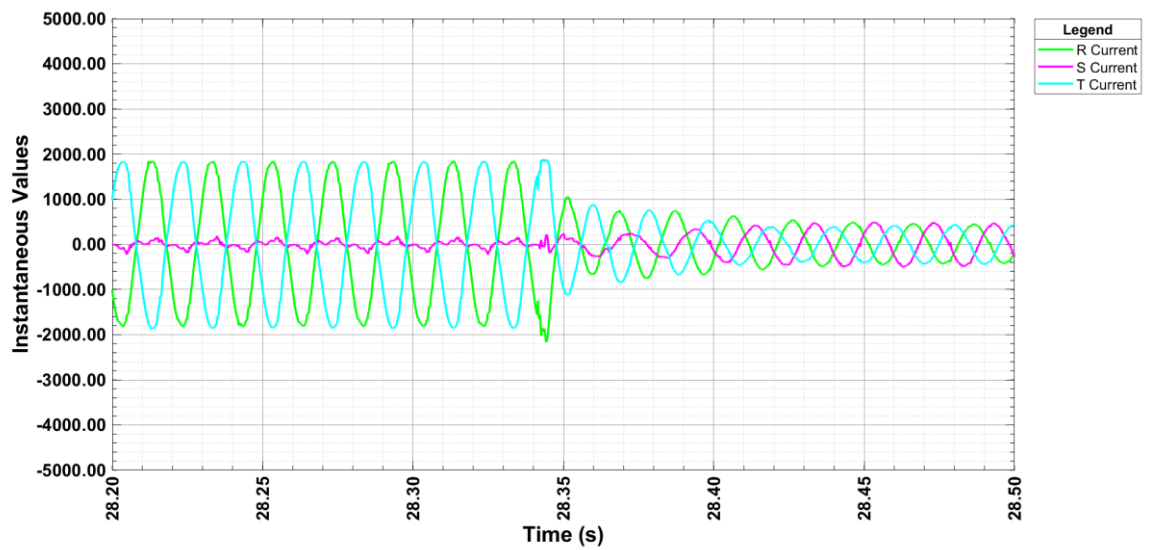
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 75.8

Transient current: Fault beginning



Transient current: Fault end



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FRT test in FGW-TG3+SP1: Grid Fault Tests Results		

3.1.6 Load tests: Dip depth 80 %Un

In this chapter of the test report are shown the test results and diagrams for the tests configured with a dip depth of 80 %Un. There are included in this point the tests 80.1 and 80.2 according to the table 4-67 of the standard. For the voltages and currents in the below pictures and tables, the unit is V and A.

3.1.6.1 Test 80.1 Fault type: 3 phases, Full load, Limited dynamic grid support

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	80.1
	Date		-	[dd.mm.yyyy]	03.11.2020
	Time		-	[hh:mm:ss]	17:31:31
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.800
	Drop duration setpoint		-	[ms]	3000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	25021
	Fault clearance (t2)		-	[ms]	28083
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	3061
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.799 /1.001
		Pos. seq.		[p.u.]	0.799 /1.001

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.001
		Neg. seq.	t1-60 s to t1	[p.u.]	0.004
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.001
		Pos. seq.	t1-1 s to t1	[p.u.]	1.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.005
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.001
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.016
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.016
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.009
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.001
	Active Power	Total	t1-10 s to t1	[p.u.]	1.002
		Total	t1-2 s to t1	[p.u.]	1.002
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.002
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.016
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.092
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	22
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	22
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.799
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.003
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.401
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.004
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.730
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.008
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.487
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.487

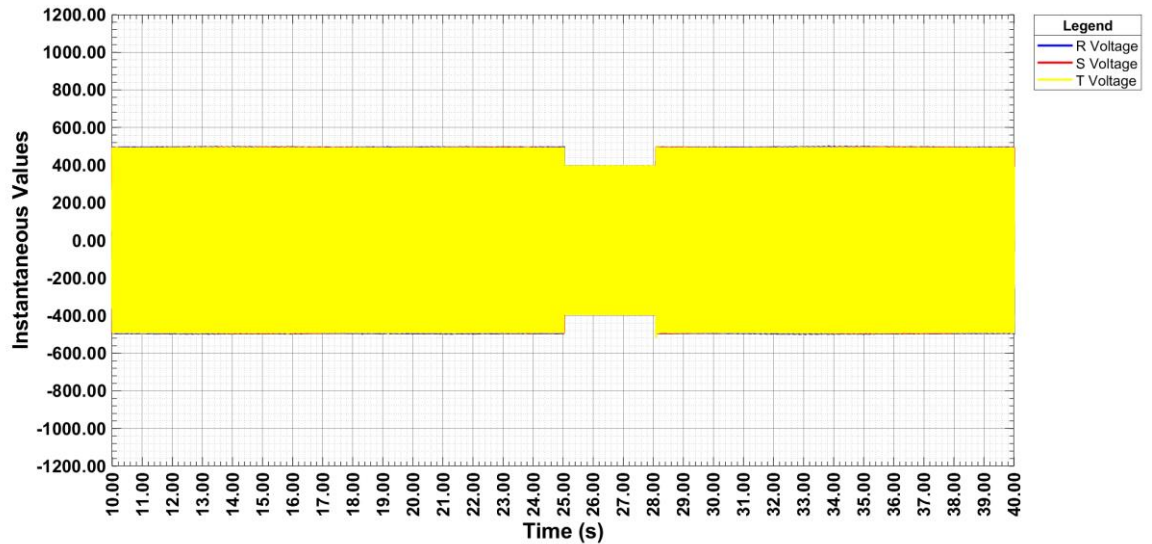
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1461
		Phase 2	t1 to t1+20 ms	[A]	1576
		Phase 3	t1 to t1+20 ms	[A]	1530
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.677
		Phase 2	t1 + 20 ms	[p.u.]	0.688
		Phase 3	t1 + 20 ms	[p.u.]	0.719
		Phase 1	t1 + 100 ms	[p.u.]	0.729
		Phase 2	t1 + 100 ms	[p.u.]	0.752
		Phase 3	t1 + 100 ms	[p.u.]	0.719
		Phase 1	t1 + 150 ms	[p.u.]	0.725
		Phase 2	t1 + 150 ms	[p.u.]	0.746
		Phase 3	t1 + 150 ms	[p.u.]	0.716
		Phase 1	t1 + 300 ms	[p.u.]	0.727
		Phase 2	t1 + 300 ms	[p.u.]	0.749
		Phase 3	t1 + 300 ms	[p.u.]	0.717
		Phase 1	t1 + 500 ms	[p.u.]	0.727
		Phase 2	t1 + 500 ms	[p.u.]	0.748
		Phase 3	t1 + 500 ms	[p.u.]	0.717
		Phase 1	t1 + 1000 ms	[p.u.]	0.728
		Phase 2	t1 + 1000 ms	[p.u.]	0.748
		Phase 3	t1 + 1000 ms	[p.u.]	0.718
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.002
Active current rise time	Pos. seq.			[s]	0.039

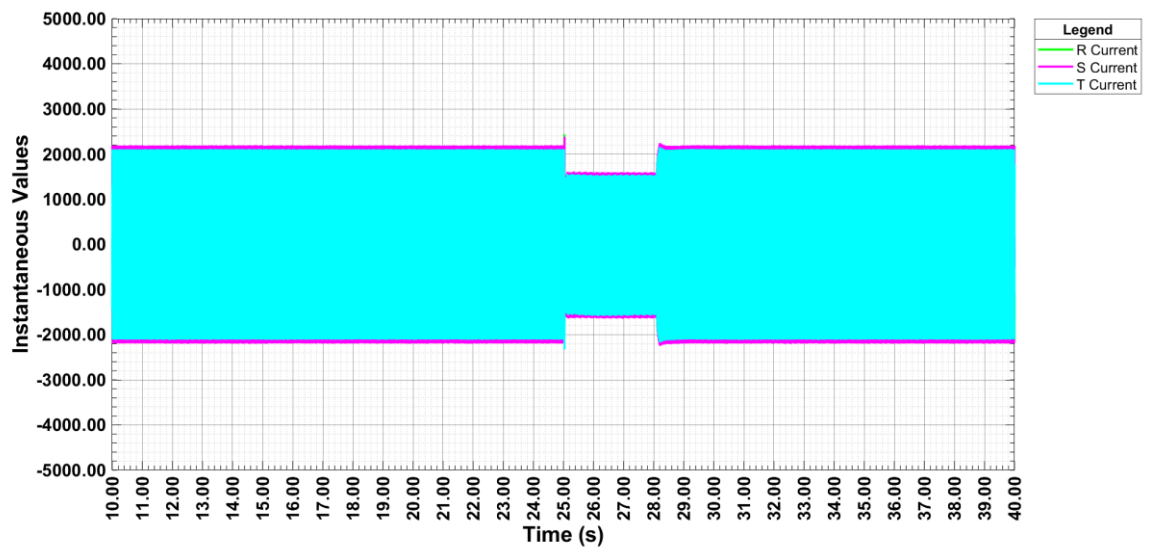
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.1

Phase-to-neutral voltages



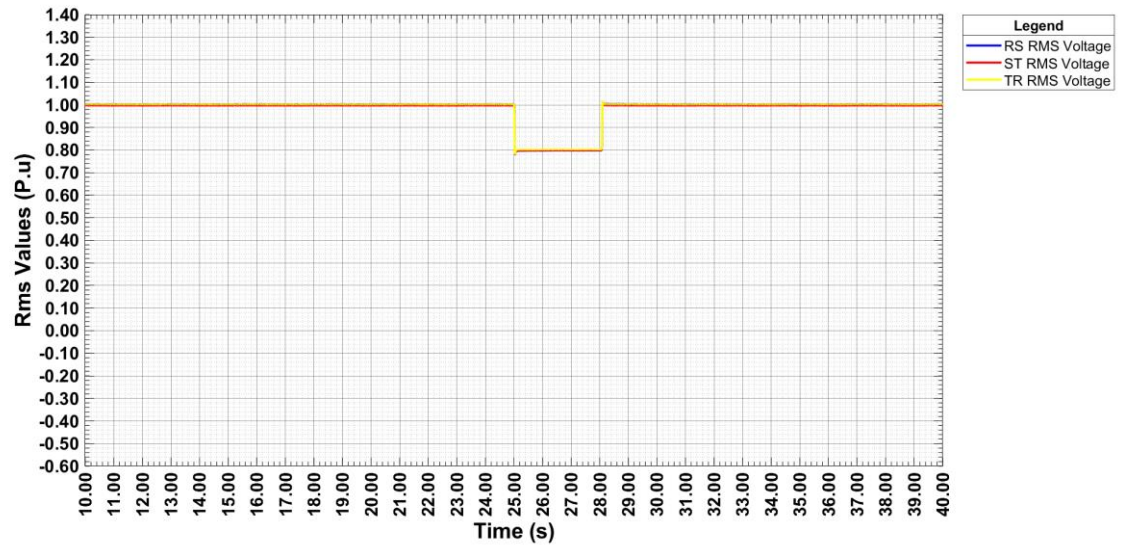
Phase currents



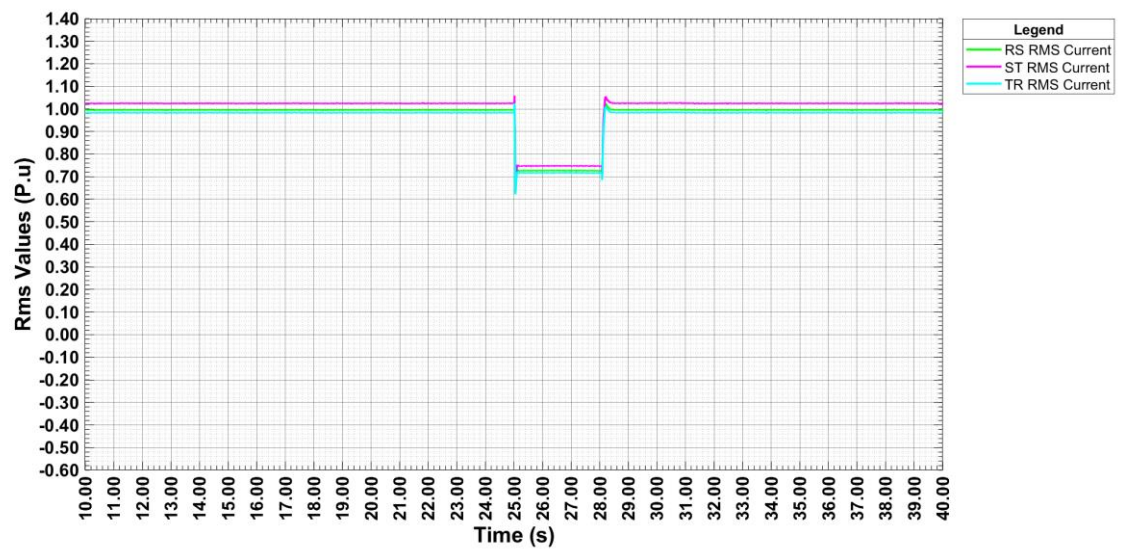
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.1

RMS Phase to phase voltages



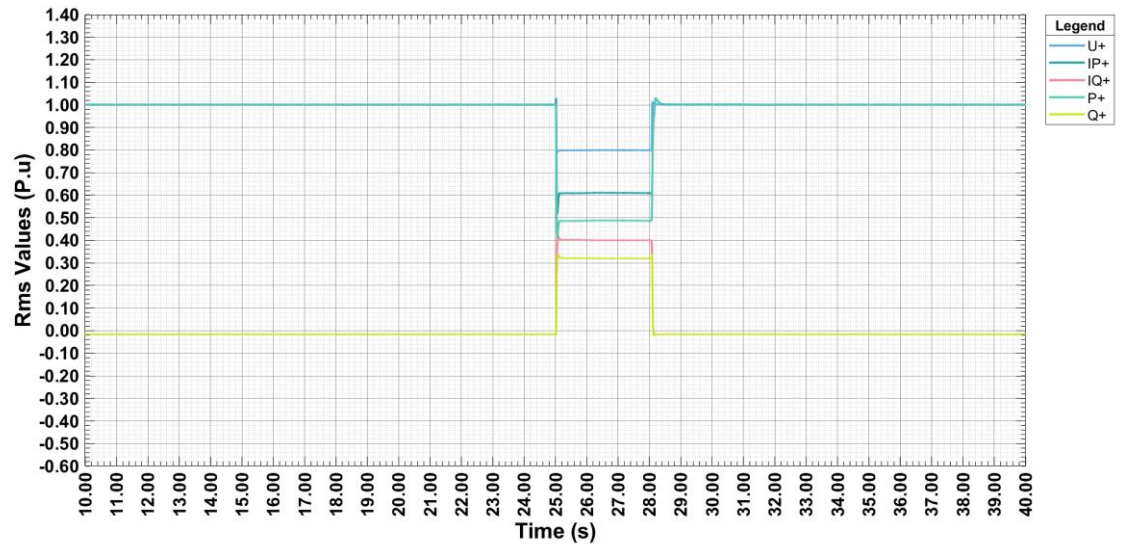
RMS Phase currents



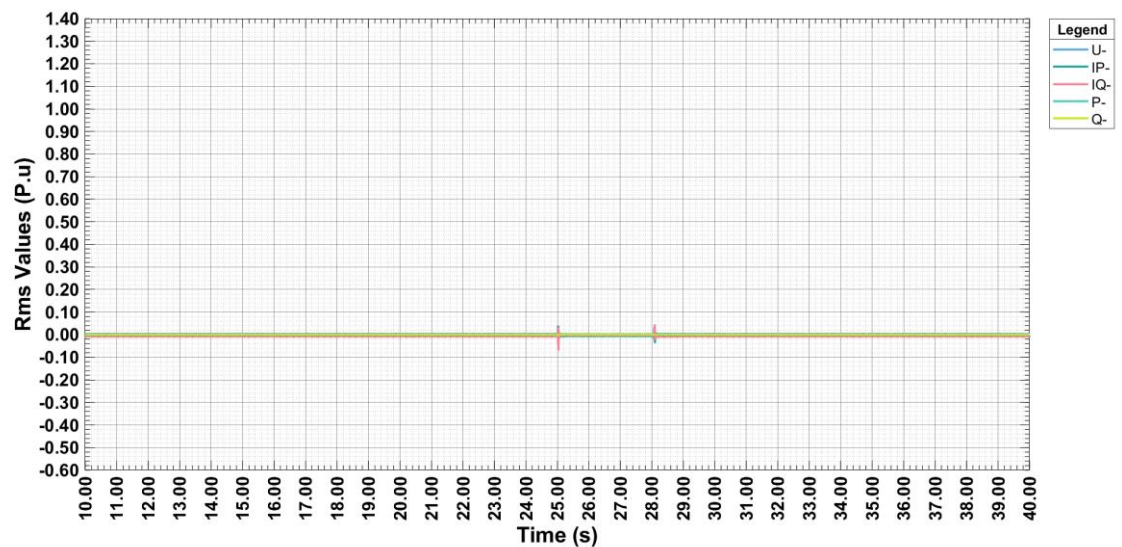
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.1

Positive sequences



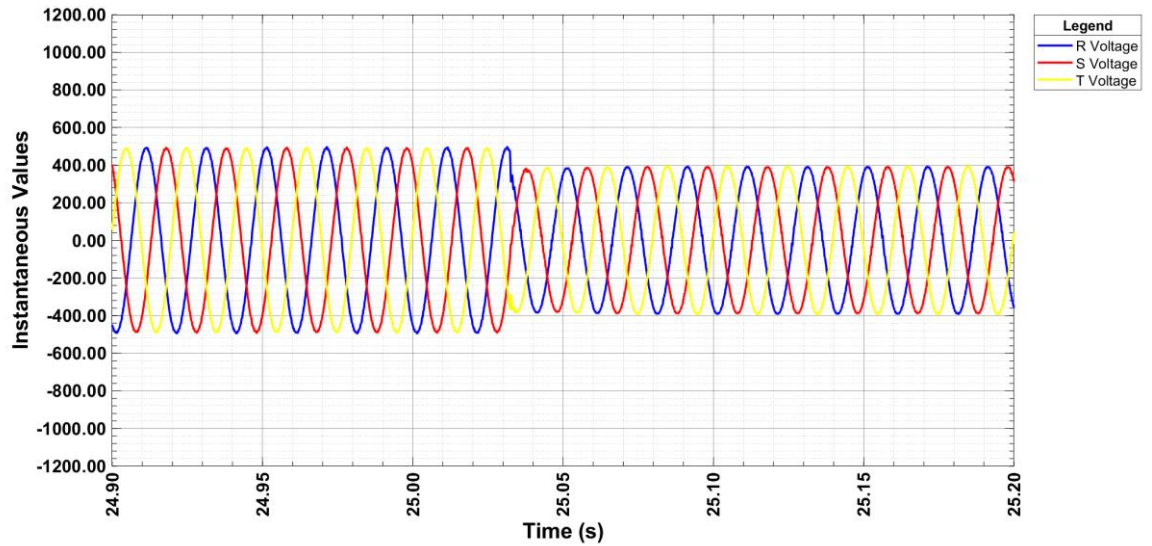
Negative sequences



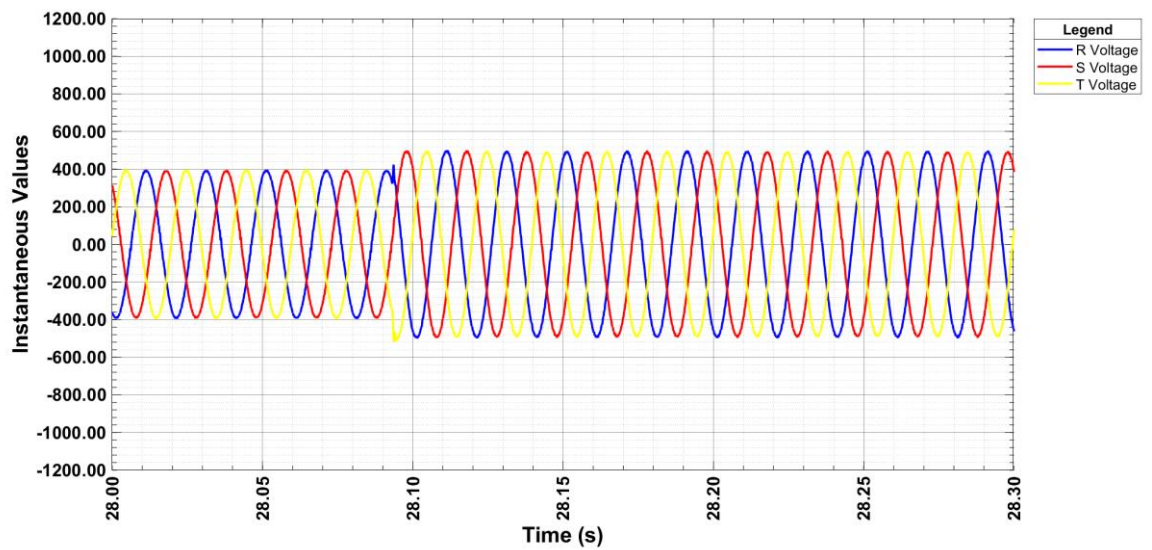
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.1

Transient voltage: Fault beginning



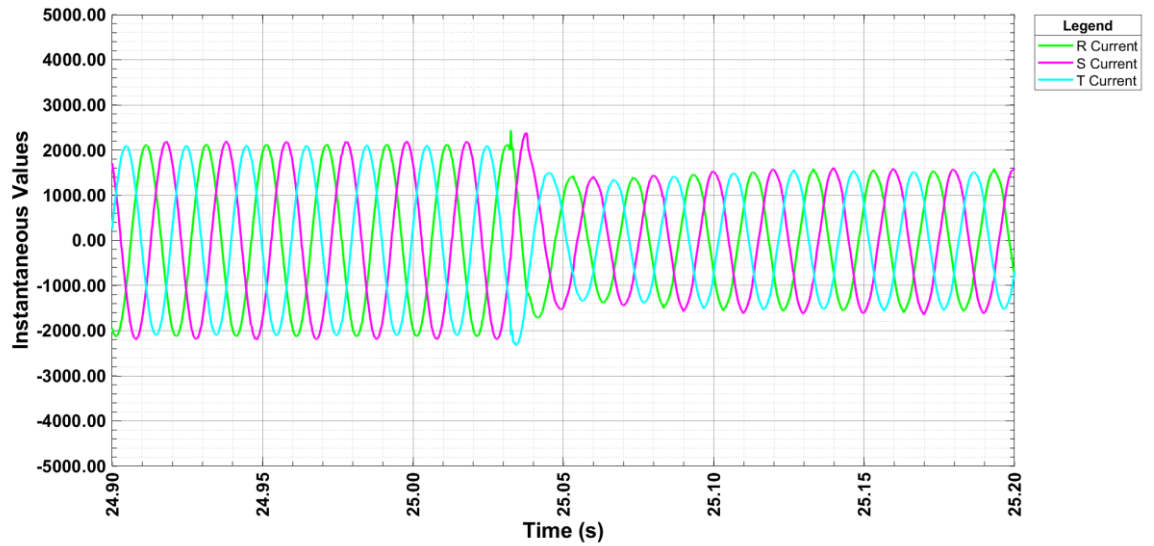
Transient voltage: Fault end



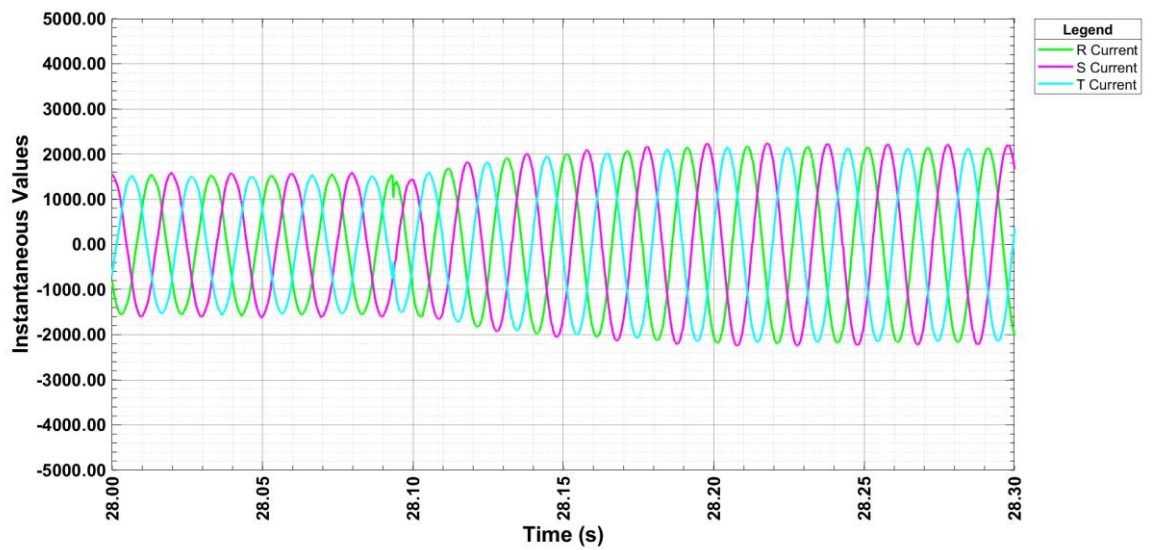
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.1

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.6.2 Test 80.2 Fault type: 2 phases, Full load, Limited dynamic grid support, $k = 0$

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	80.2
	Date		-	[dd.mm.yyyy]	22.10.2020
	Time		-	[hh:mm:ss]	10:03:16
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.800
	Drop duration setpoint		-	[ms]	3000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24828
	Fault clearance (t2)		-	[ms]	27872
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	3044
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.758 /1.008
		Pos. seq.		[p.u.]	0.879 /1.006

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.006
		Neg. seq.	t1-60 s to t1	[p.u.]	0.004
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.006
		Pos. seq.	t1-1 s to t1	[p.u.]	1.006
		Neg. seq.	t1-1 s to t1	[p.u.]	0.004
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.997
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.016
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.016
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.008
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.997
	Active Power	Total	t1-10 s to t1	[p.u.]	1.003
		Total	t1-2 s to t1	[p.u.]	1.003
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.003
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.016
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	0.000
		Neg. seq.	-	-	-0.082
	Reactive current settling up time	Pos. seq.	-	[ms]	-
		Neg. seq.	-	[ms]	-
	Reactive current settling time	Pos. seq.	-	[ms]	-
		Neg. seq.	-	[ms]	-
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.879
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.122
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.017
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.002
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.012
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.011
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.891
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.890

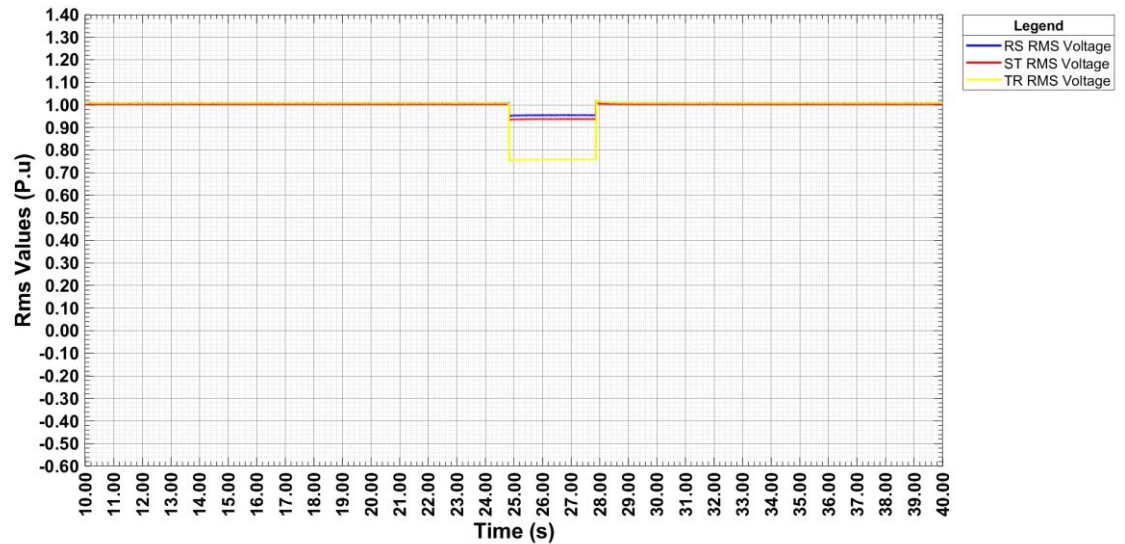
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1606
		Phase 2	t1 to t1+20 ms	[A]	1537
		Phase 3	t1 to t1+20 ms	[A]	1541
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	1.016
		Phase 2	t1 + 20 ms	[p.u.]	1.014
		Phase 3	t1 + 20 ms	[p.u.]	0.992
		Phase 1	t1 + 100 ms	[p.u.]	1.009
		Phase 2	t1 + 100 ms	[p.u.]	1.037
		Phase 3	t1 + 100 ms	[p.u.]	0.992
		Phase 1	t1 + 150 ms	[p.u.]	1.012
		Phase 2	t1 + 150 ms	[p.u.]	1.035
		Phase 3	t1 + 150 ms	[p.u.]	0.990
		Phase 1	t1 + 300 ms	[p.u.]	1.012
		Phase 2	t1 + 300 ms	[p.u.]	1.035
		Phase 3	t1 + 300 ms	[p.u.]	0.992
		Phase 1	t1 + 500 ms	[p.u.]	1.012
		Phase 2	t1 + 500 ms	[p.u.]	1.035
		Phase 3	t1 + 500 ms	[p.u.]	0.991
		Phase 1	t1 + 1000 ms	[p.u.]	1.011
		Phase 2	t1 + 1000 ms	[p.u.]	1.035
		Phase 3	t1 + 1000 ms	[p.u.]	0.991
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.003
Active current rise time	Pos. seq.			[s]	0.000

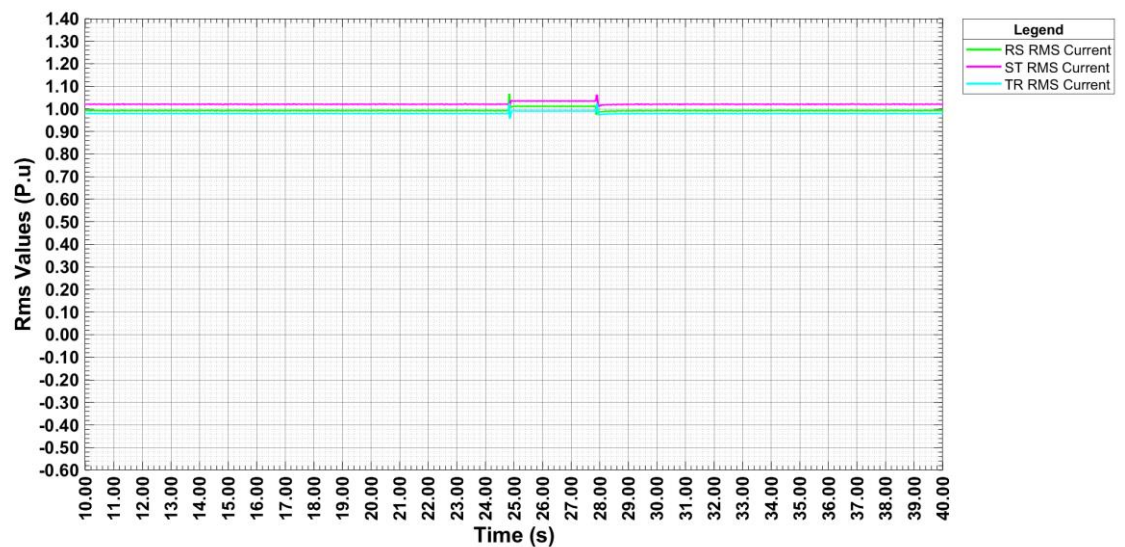
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.2

RMS Phase to phase voltages



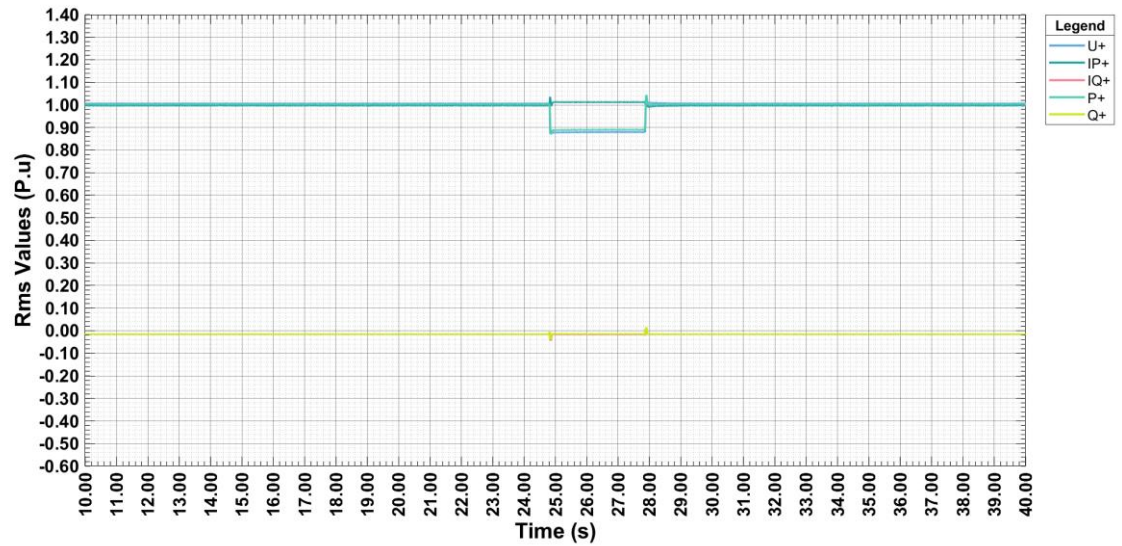
RMS Phase currents



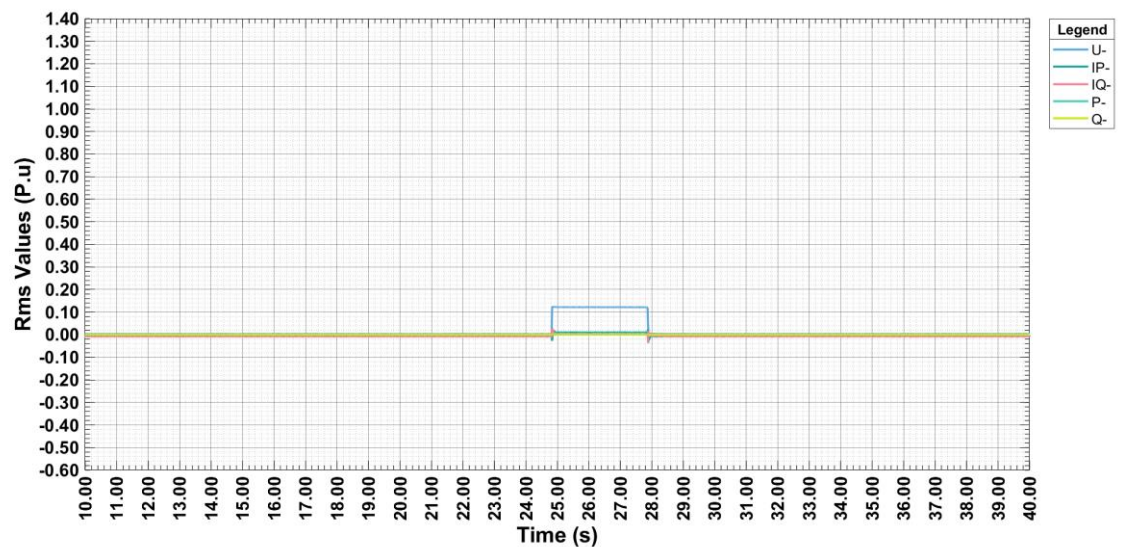
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.2

Positive sequences



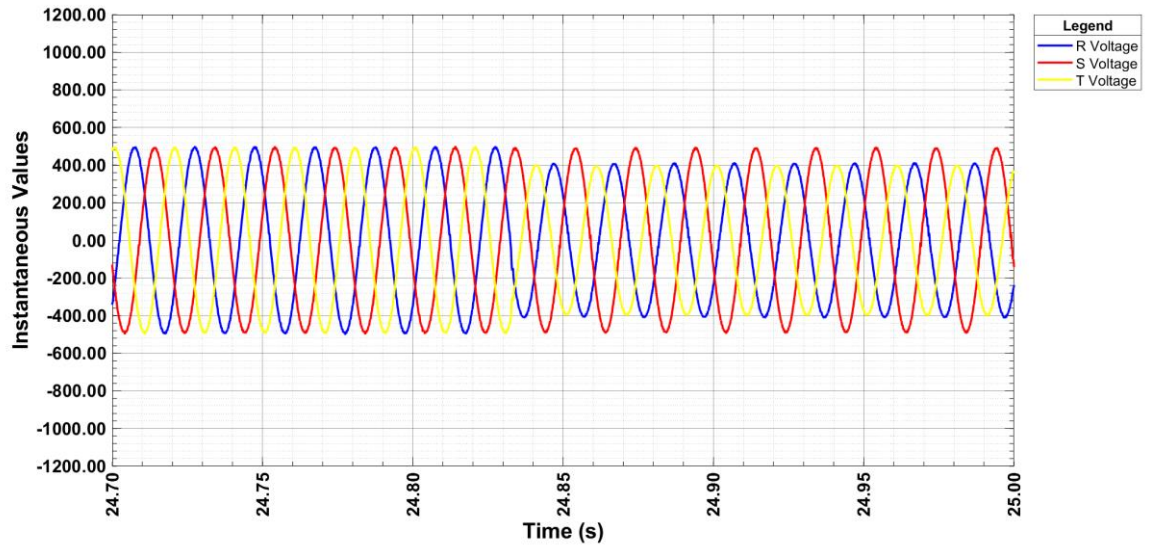
Negative sequences



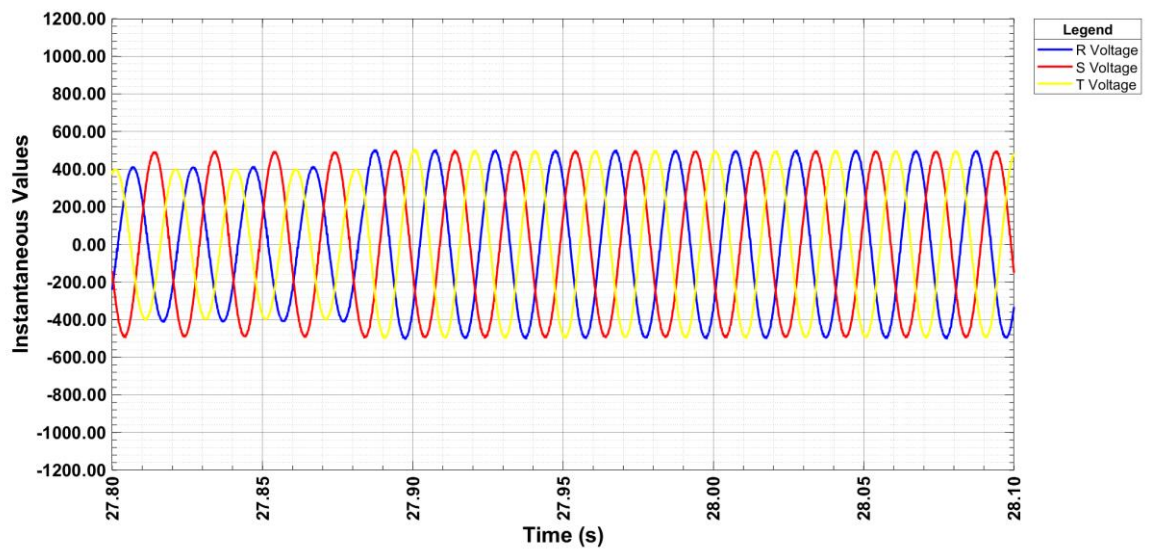
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.2

Transient voltage: Fault beginning



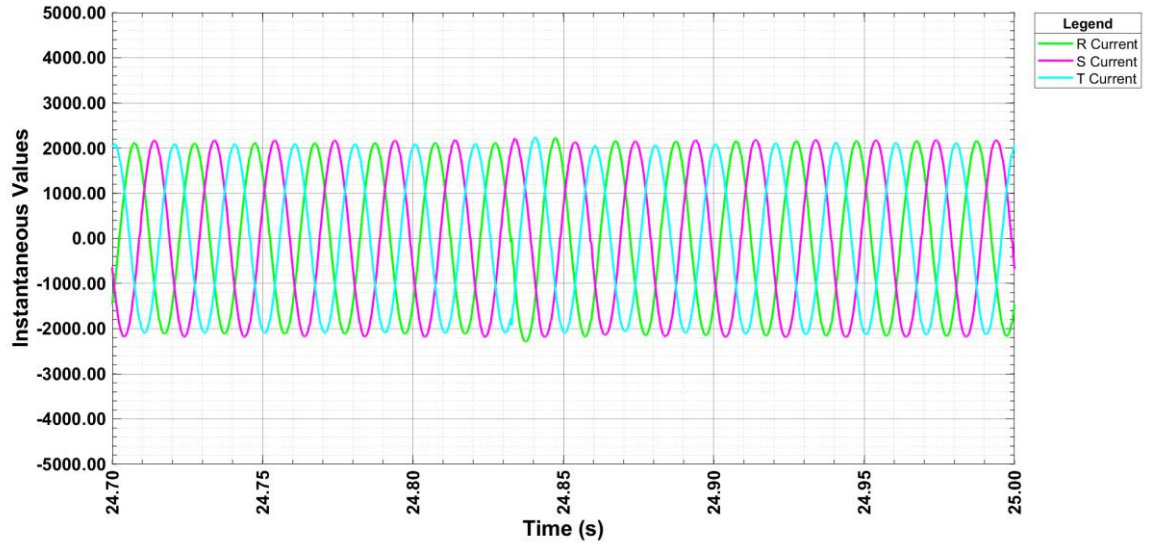
Transient voltage: Fault end



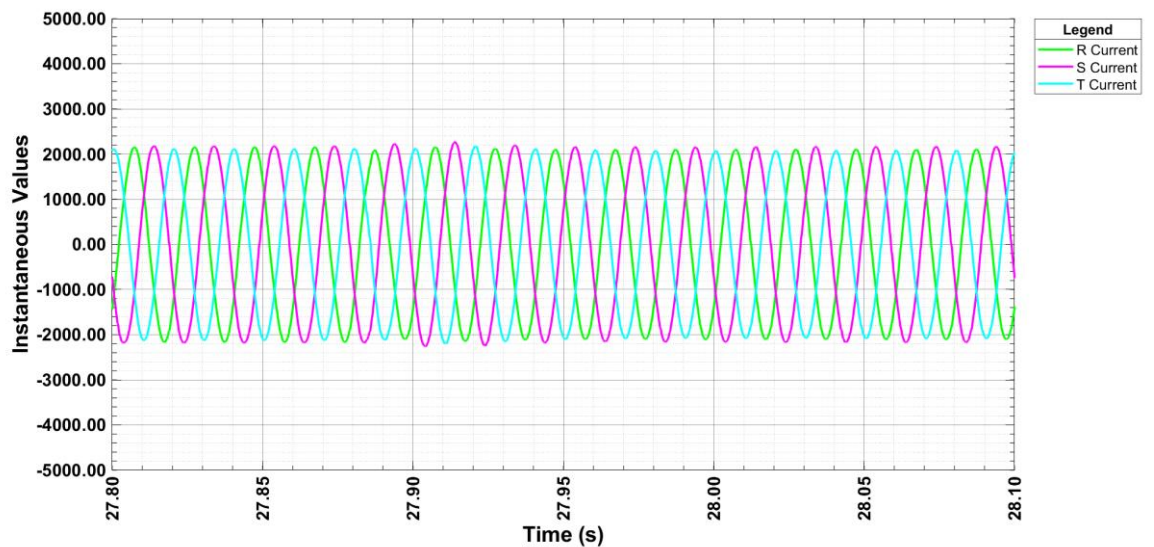
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 80.2

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.1.7 Load tests: Dip depth 85 %Un

In this chapter of the test report are shown the test results and diagrams for the tests configured with a dip depth of 85 %Un. There are included in this point the tests 85.1 according to the table 4-67 of the standard. For the voltages and currents in the below pictures and tables, the unit is V and A.

3.1.7.1 Test 85.1 Fault type: 3 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	85.1
	Date		-	[dd.mm.yyyy]	27.09.2020
	Time		-	[hh:mm:ss]	10:44:06
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.850
	Drop duration setpoint		-	[ms]	≥60000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24709
	Fault clearance (t2)		-	[ms]	85124
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	60415
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.886 /1.007
		Pos. seq.		[p.u.]	0.886 /1.007

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.007
		Neg. seq.	t1-60 s to t1	[p.u.]	0.008
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.007
		Pos. seq.	t1-1 s to t1	[p.u.]	1.007
		Neg. seq.	t1-1 s to t1	[p.u.]	0.008
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.023
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.005
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.023
	Active Power	Total	t1-10 s to t1	[p.u.]	1.029
		Total	t1-2 s to t1	[p.u.]	1.030
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.030
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.005
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.841
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	21
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	21
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.886
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.006
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.219
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.001
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.810
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.691
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.691

Note: The K-factor configured is 2. The deadband of voltage for starting the reactive current has been set at 5 %Un for this test.

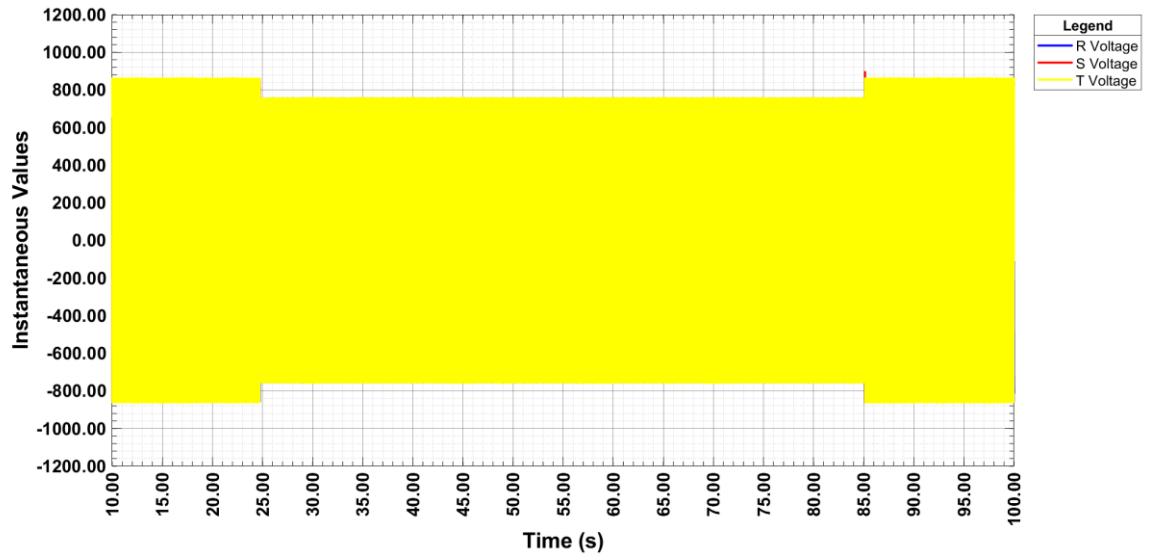
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1574
		Phase 2	t1 to t1+20 ms	[A]	1581
		Phase 3	t1 to t1+20 ms	[A]	1580
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.812
		Phase 2	t1 + 20 ms	[p.u.]	0.872
		Phase 3	t1 + 20 ms	[p.u.]	0.806
		Phase 1	t1 + 100 ms	[p.u.]	0.808
		Phase 2	t1 + 100 ms	[p.u.]	0.810
		Phase 3	t1 + 100 ms	[p.u.]	0.806
		Phase 1	t1 + 150 ms	[p.u.]	0.807
		Phase 2	t1 + 150 ms	[p.u.]	0.809
		Phase 3	t1 + 150 ms	[p.u.]	0.809
		Phase 1	t1 + 300 ms	[p.u.]	0.809
		Phase 2	t1 + 300 ms	[p.u.]	0.810
		Phase 3	t1 + 300 ms	[p.u.]	0.808
		Phase 1	t1 + 500 ms	[p.u.]	0.810
		Phase 2	t1 + 500 ms	[p.u.]	0.811
		Phase 3	t1 + 500 ms	[p.u.]	0.809
		Phase 1	t1 + 1000 ms	[p.u.]	0.810
		Phase 2	t1 + 1000 ms	[p.u.]	0.810
		Phase 3	t1 + 1000 ms	[p.u.]	0.809
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.043
Active current rise time	Pos. seq.			[s]	0.025

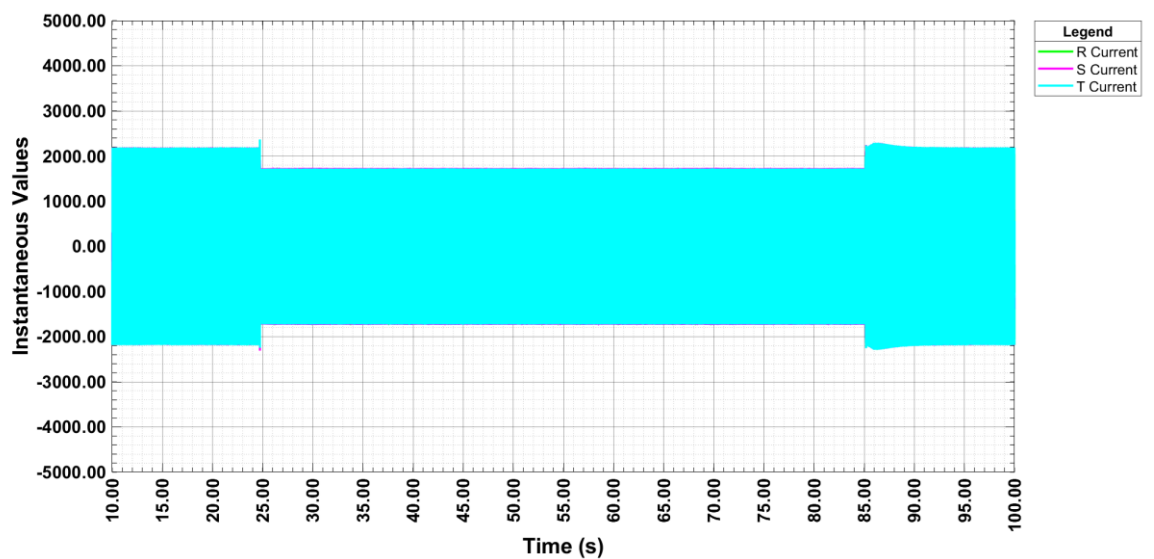
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 85.1

Phase-to-netutral voltages



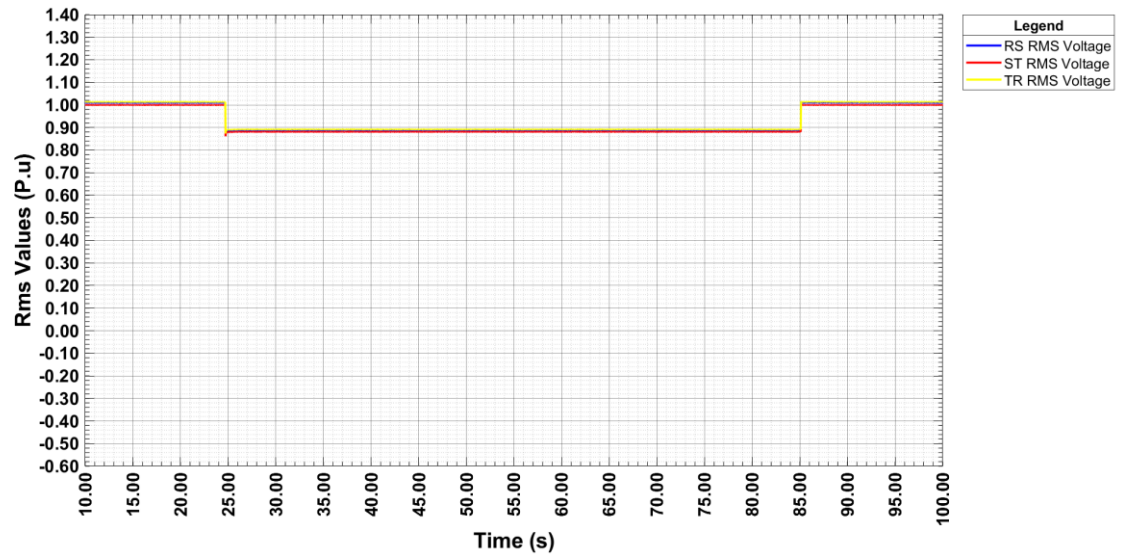
Phase currents



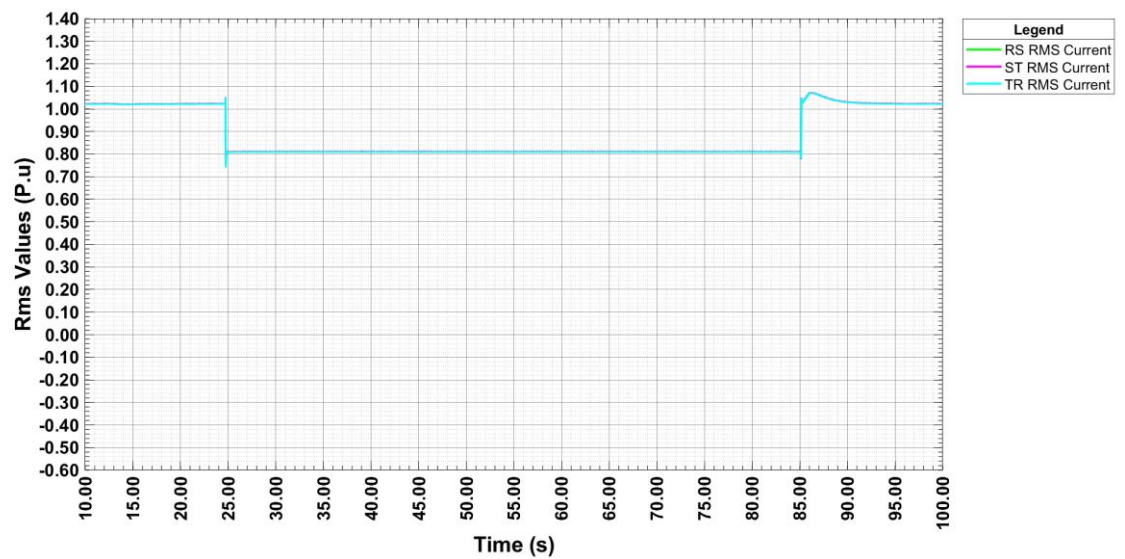
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 85.1

RMS Phase to phase voltages



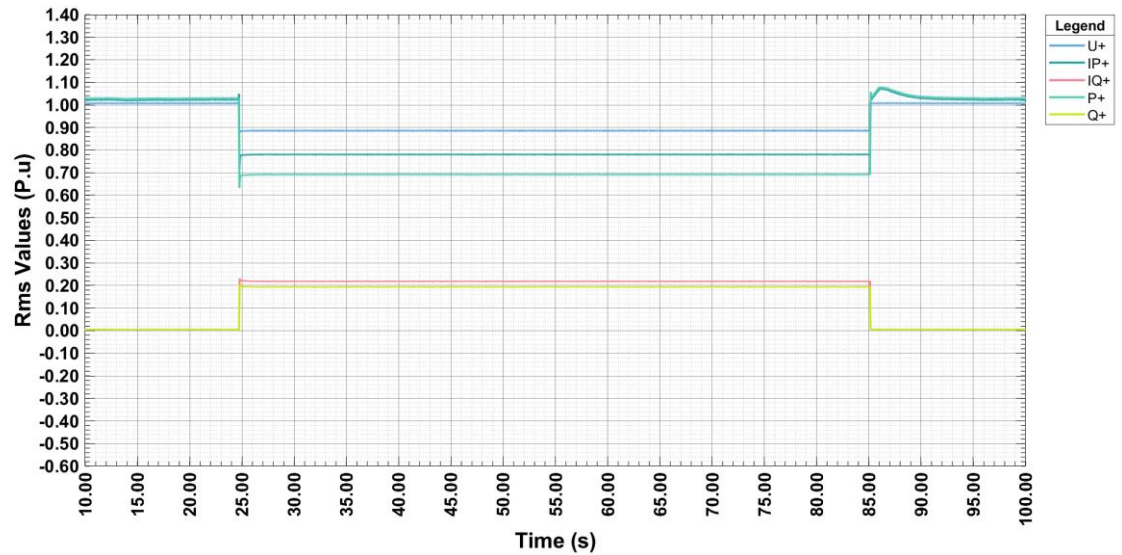
RMS Phase currents



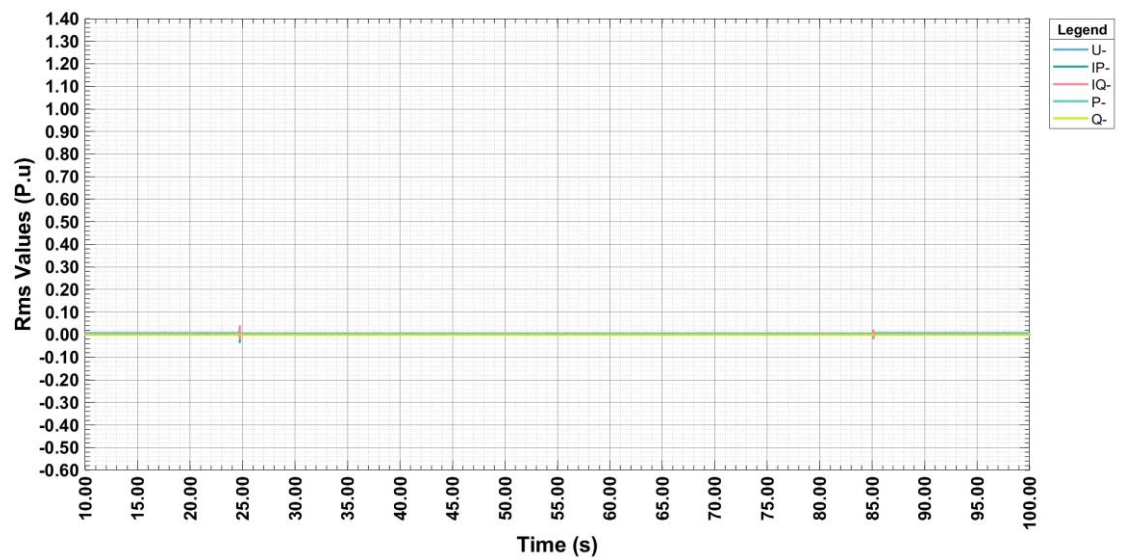
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 85.1

Positive sequences



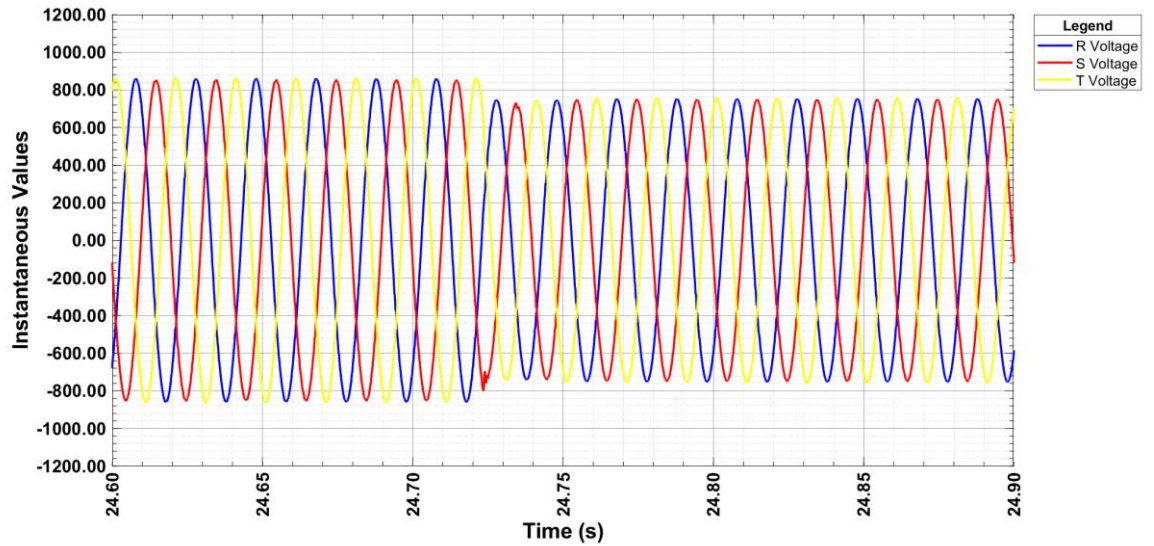
Negative sequences



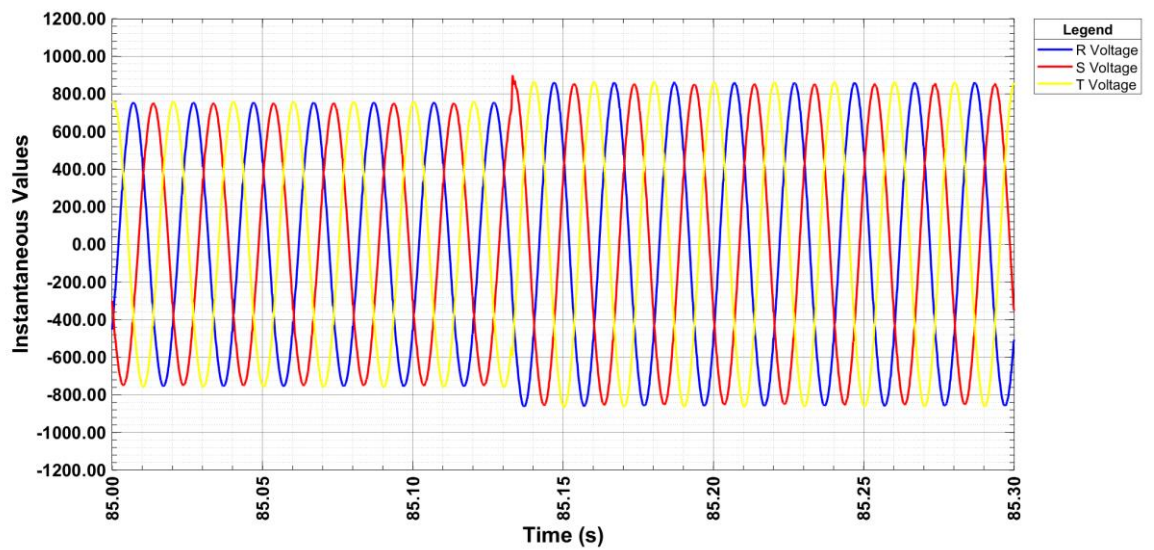
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 85.1

Transient voltage: Fault beginning



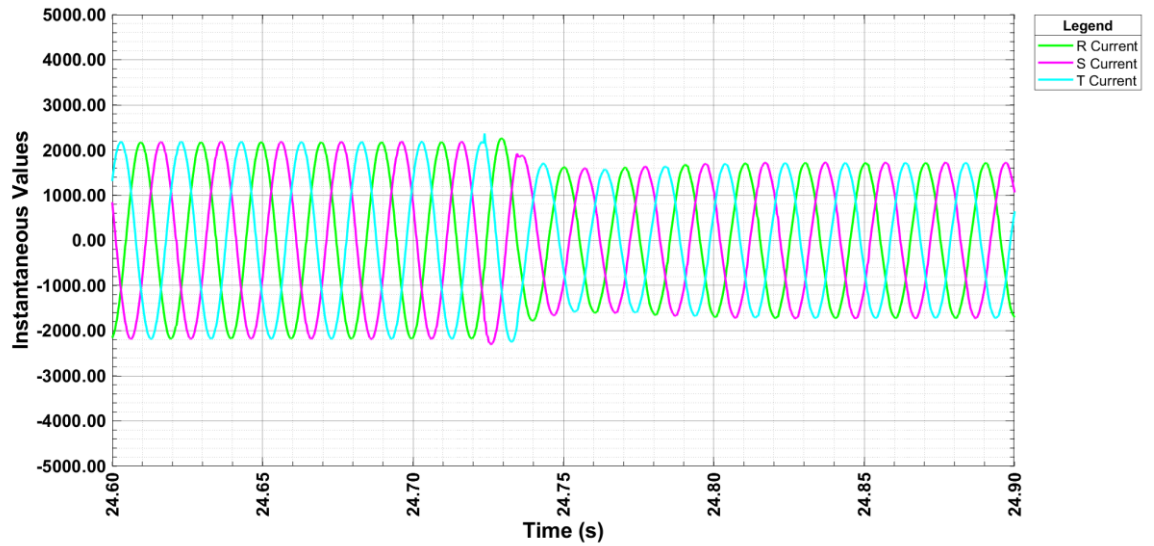
Transient voltage: Fault end



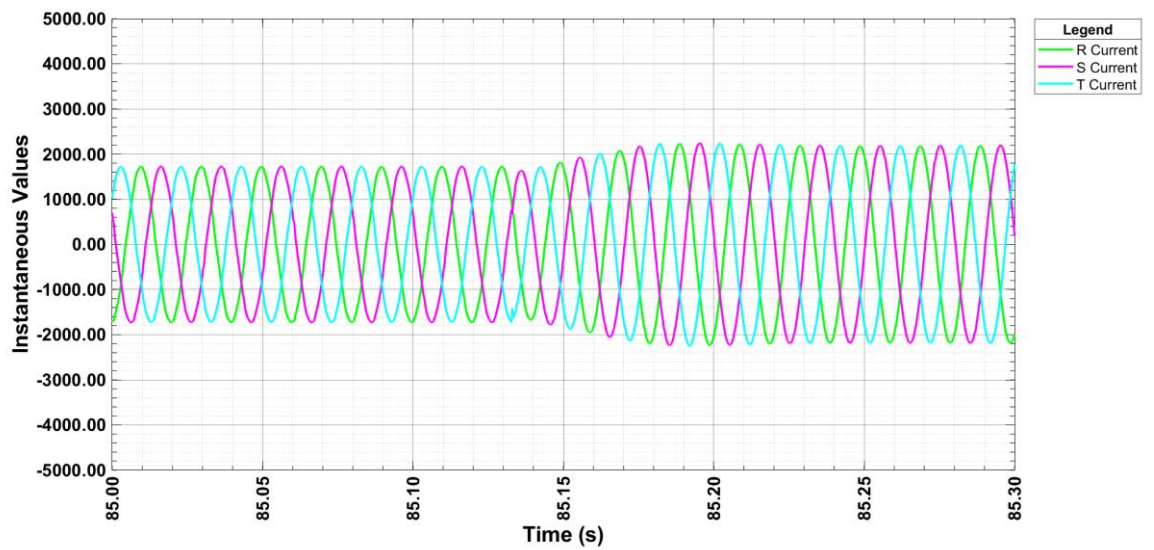
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 85.1

Transient current: Fault beginning



Transient current: Fault end



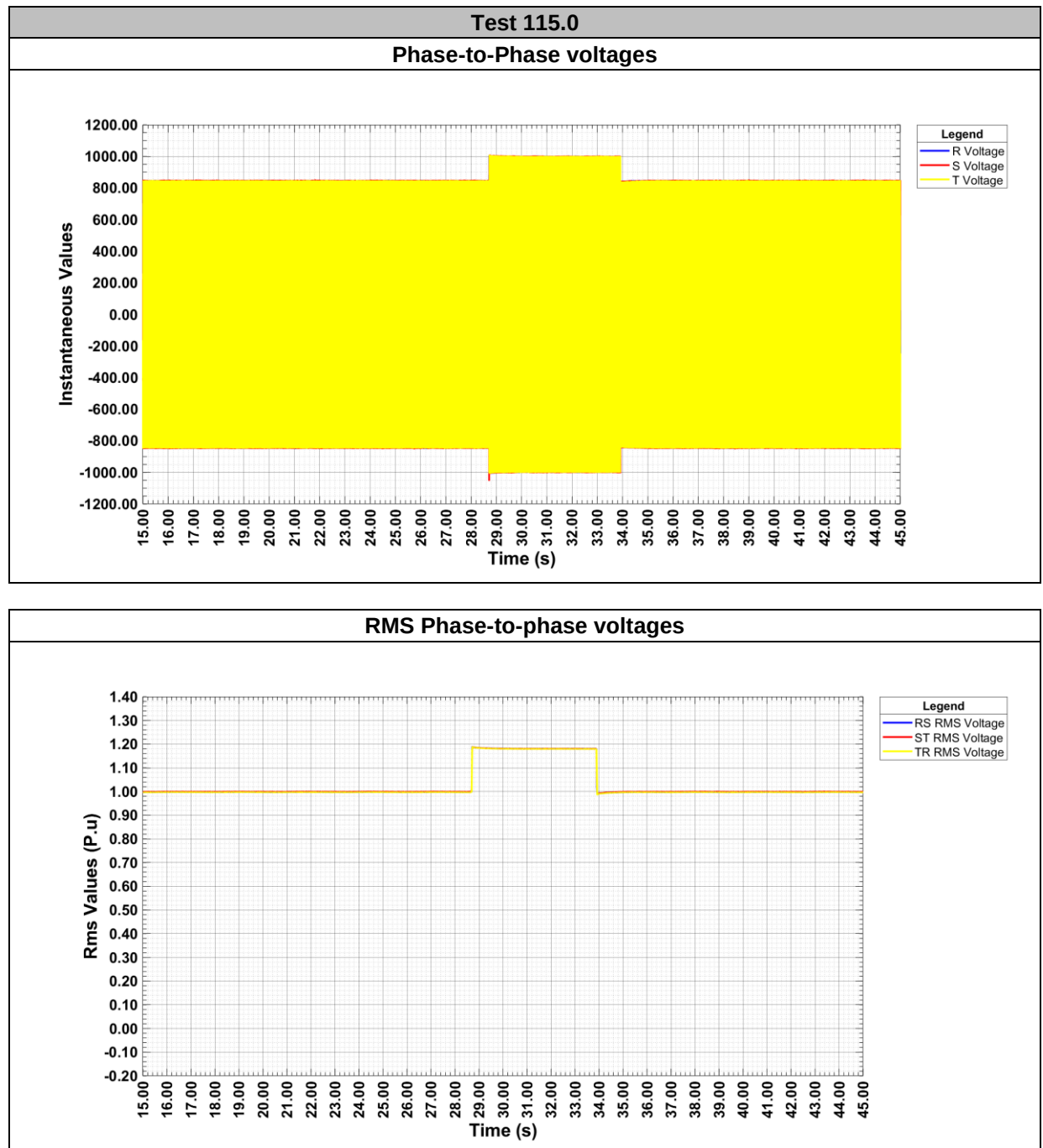
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

3.2 HVRT

3.2.1 No load tests

No load tests have been performed to check that the settings for each test are correctly set in accordance with the standard requirements. In the table below of point 3.2.1, the number 0 makes reference for the no load test equivalent to the code stated in table 4-69 of the standard. And for the Phase-to-neutral voltages, the unit is V.

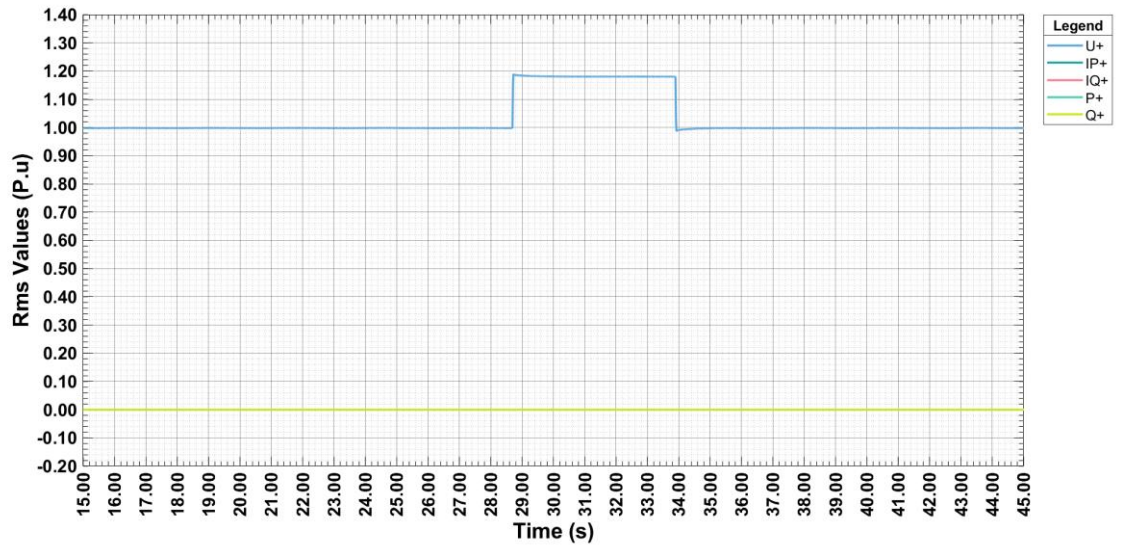
3.2.1.1 Test 115.0, 3 phases; Dip depth 115 %Un



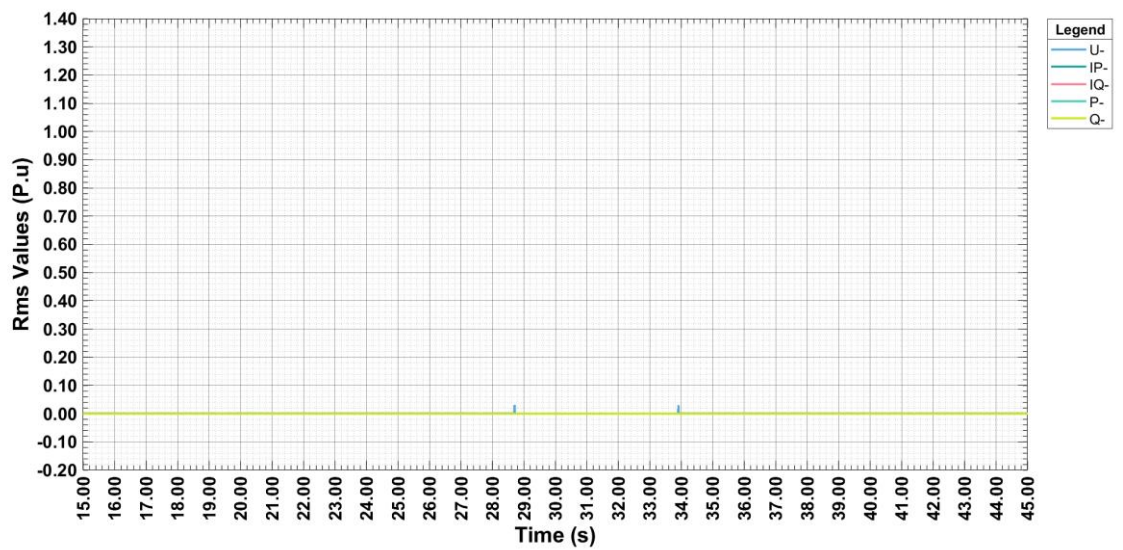
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.0

Positive sequences

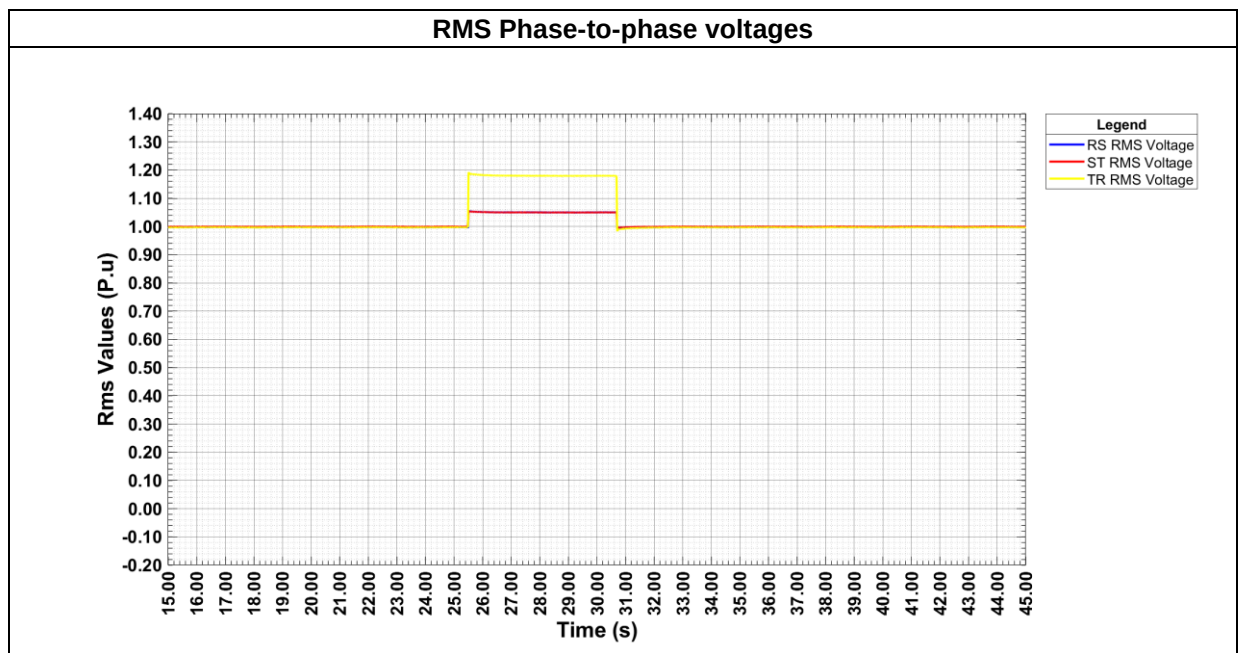
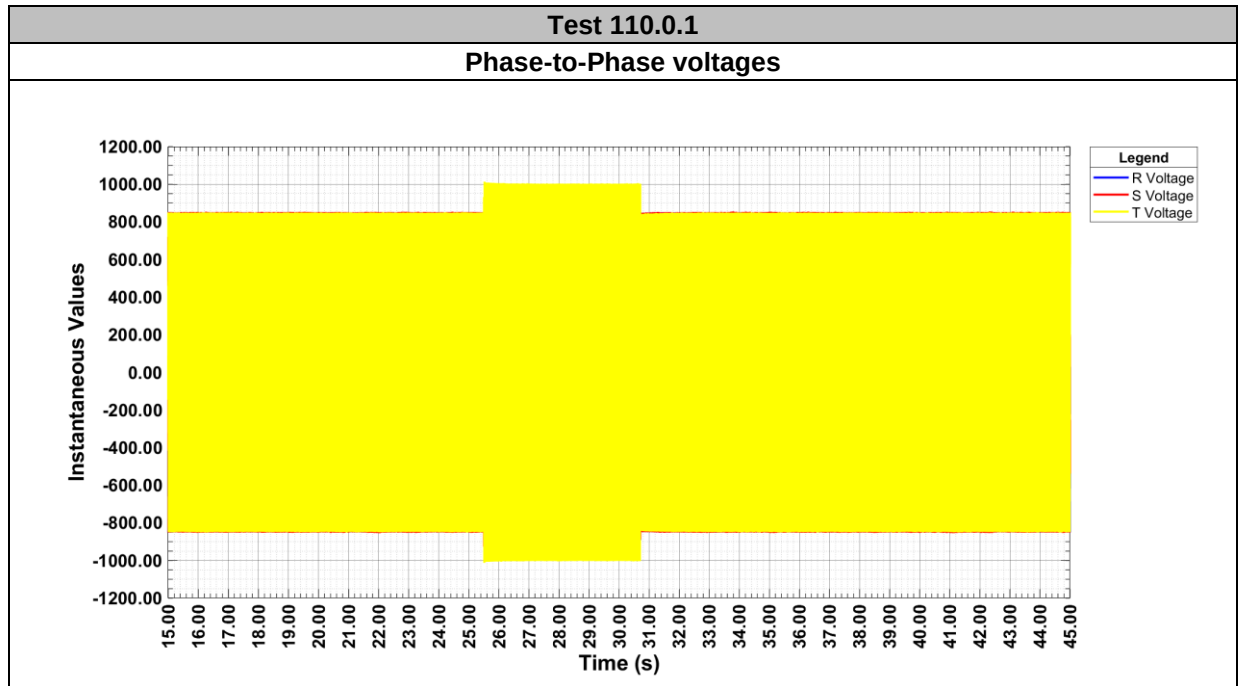


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

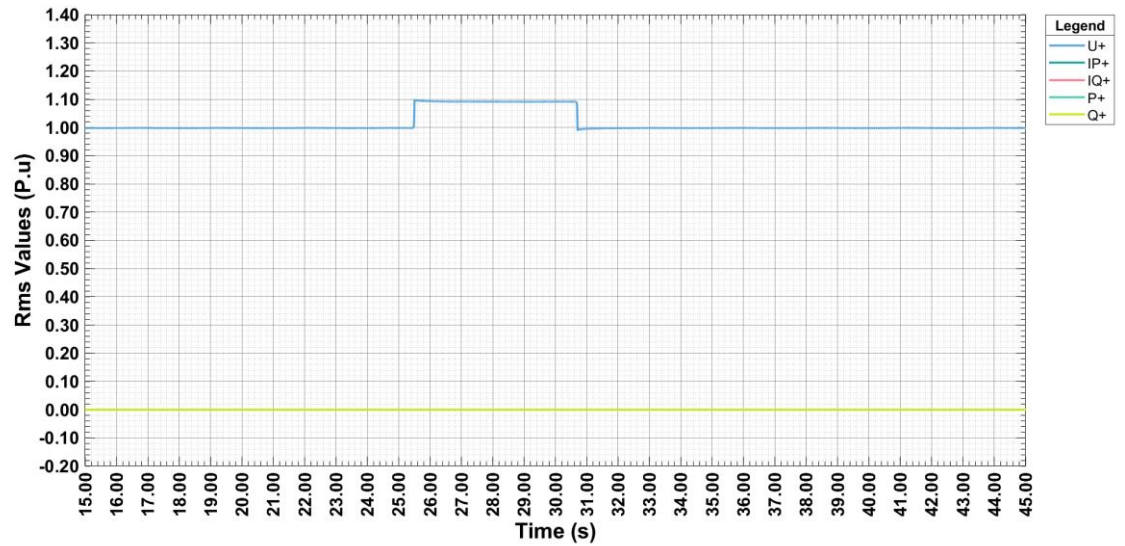
3.2.1.2 Test 110.0.1, 2 phases; Dip depth 110 %Un



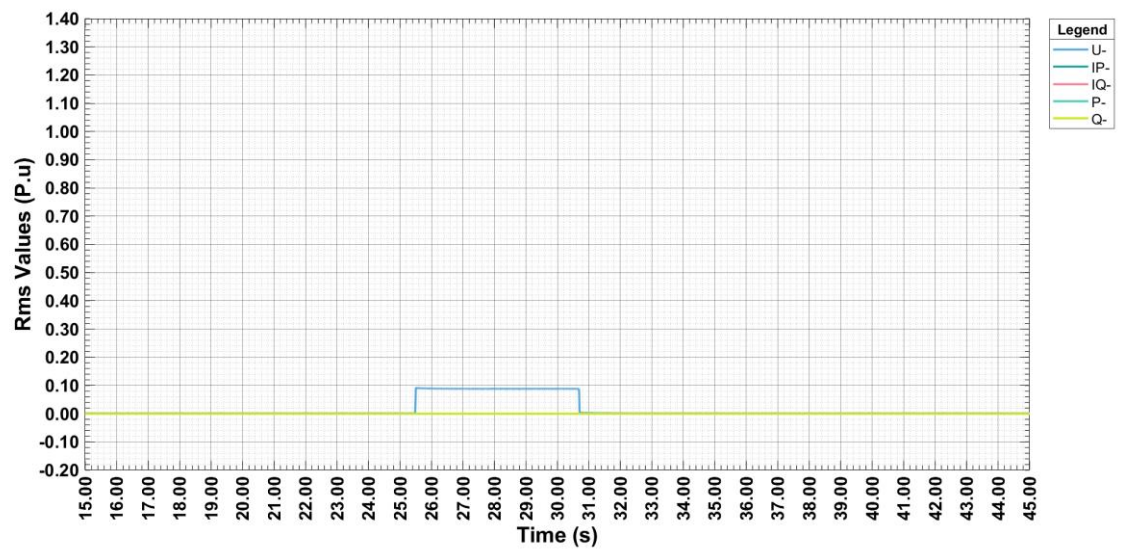
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.0.1

Positive sequences

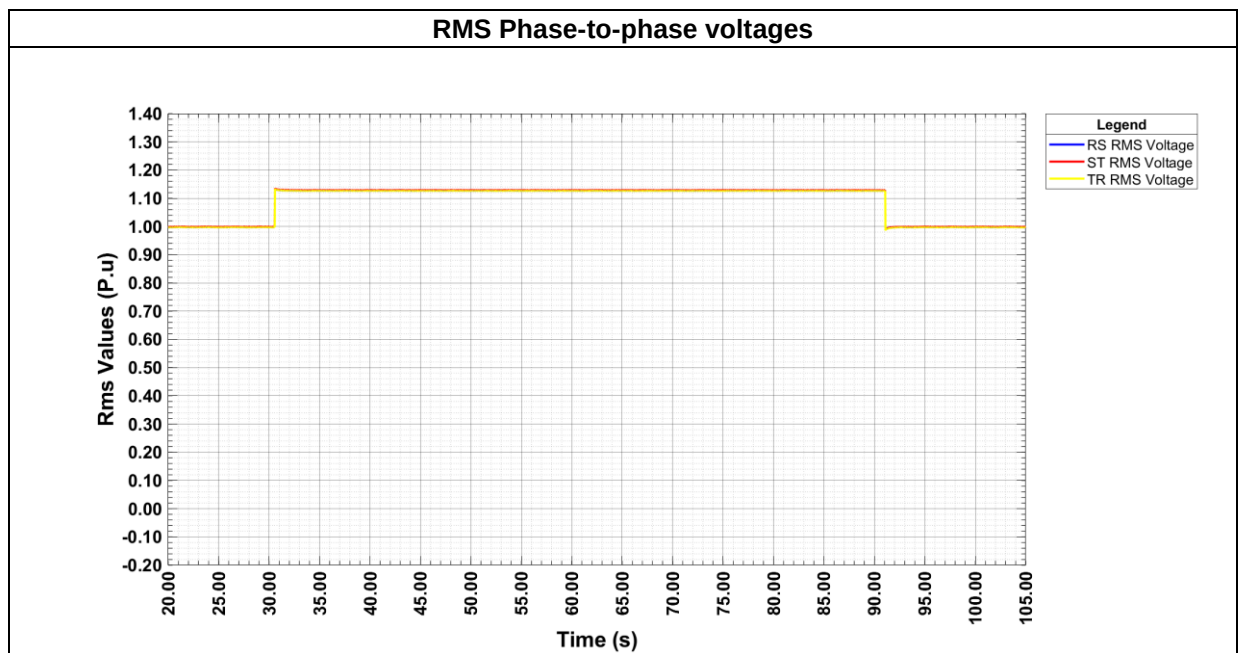
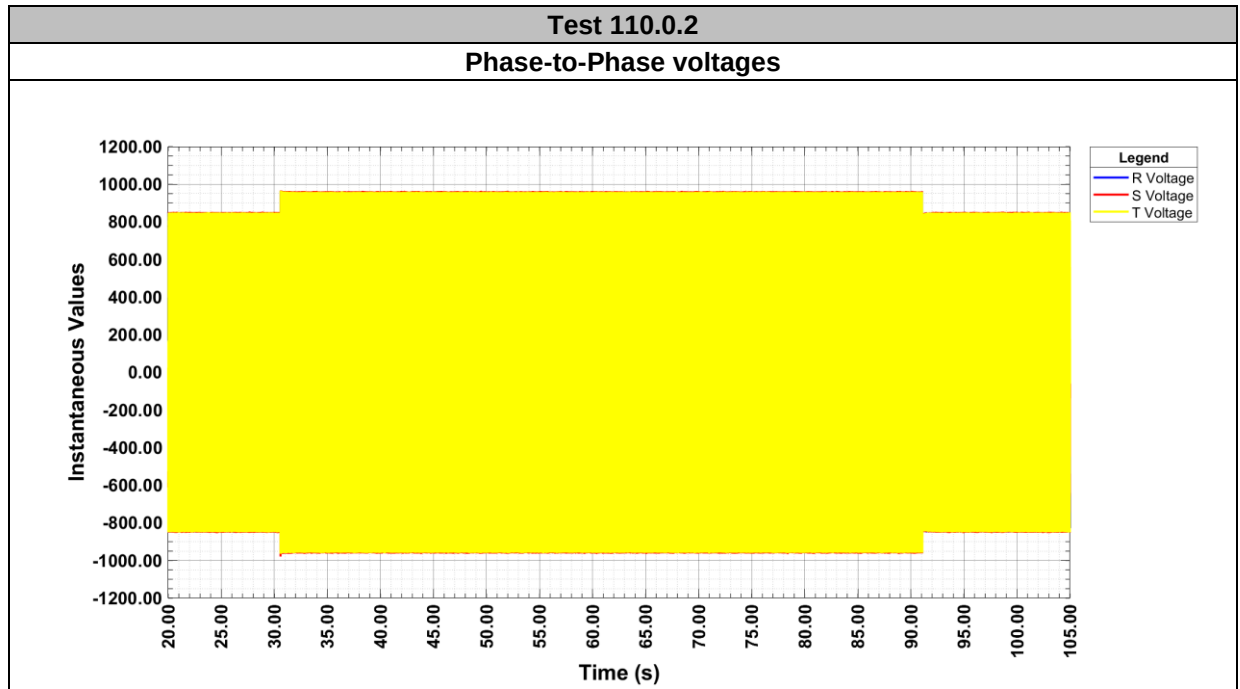


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

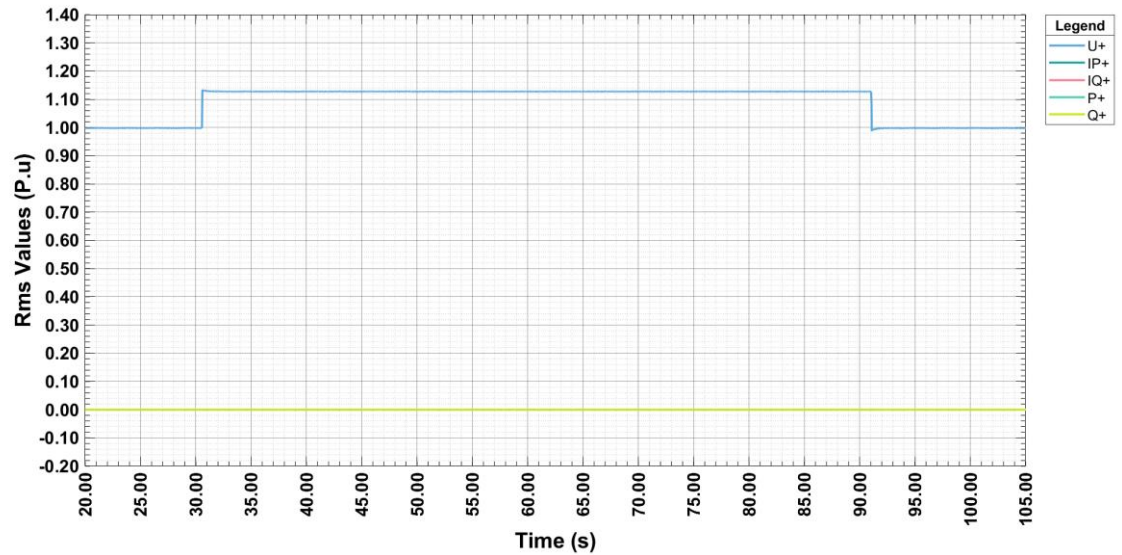
3.2.1.3 Test 110.0.2, 3 phases; Dip depth 110 %Un



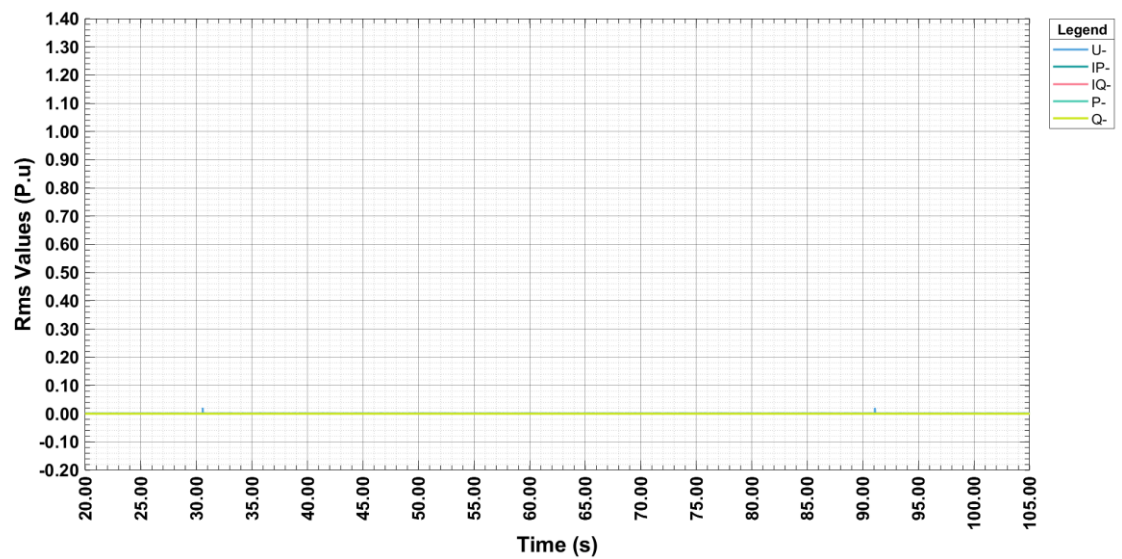
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.0.2

Positive sequences



Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.2.2 Load tests

For the voltages and currents in the below pictures and tables, the units are V and A.

3.2.2.1 Test 115.1, Fault type: 3 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	115.1
	Date		-	[dd.mm.yyyy]	06.11.2020
	Time		-	[hh:mm:ss]	16:51:57
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	1.150
	Drop duration setpoint		-	[ms]	5000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24973
	Fault clearance (t2)		-	[ms]	30177
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	5204
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	1.172 /1.008
		Pos. seq.		[p.u.]	1.171 /1.008

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.008
		Neg. seq.	t1-60 s to t1	[p.u.]	0.006
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.008
		Pos. seq.	t1-1 s to t1	[p.u.]	1.008
		Neg. seq.	t1-1 s to t1	[p.u.]	0.006
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.993
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.006
		Pos. seq.	t1-1 s to t1	[p.u.]	0.005
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.002
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.992
	Active Power	Total	t1-10 s to t1	[p.u.]	1.000
		Total	t1-2 s to t1	[p.u.]	1.000
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.000
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.006
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.982
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.172
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.006
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.329
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.001
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.752
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.792
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.792

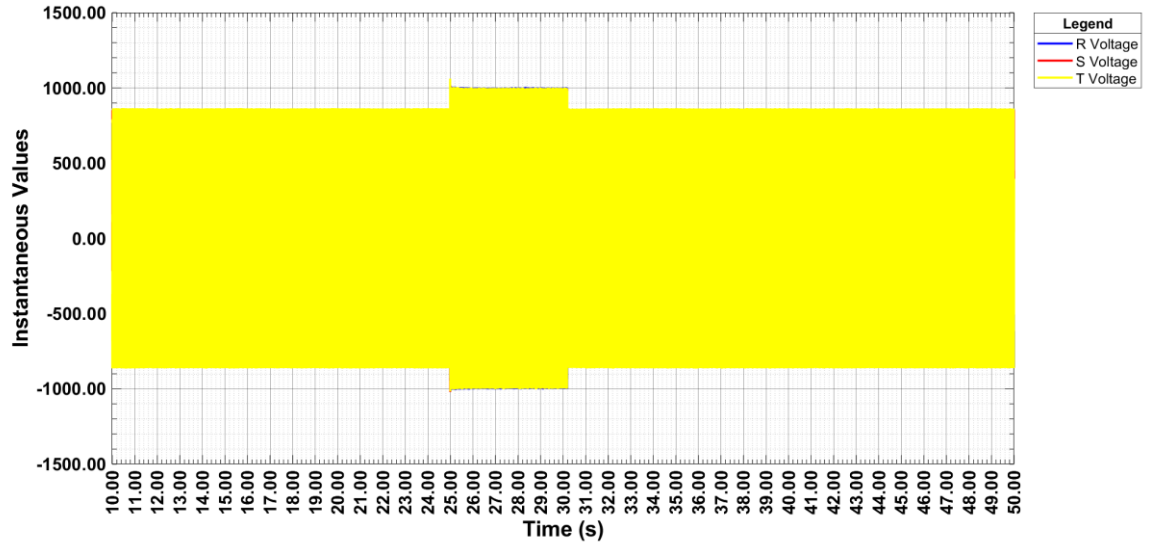
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1381
		Phase 2	t1 to t1+20 ms	[A]	1356
		Phase 3	t1 to t1+20 ms	[A]	1314
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.789
		Phase 2	t1 + 20 ms	[p.u.]	0.760
		Phase 3	t1 + 20 ms	[p.u.]	0.743
		Phase 1	t1 + 100 ms	[p.u.]	0.746
		Phase 2	t1 + 100 ms	[p.u.]	0.743
		Phase 3	t1 + 100 ms	[p.u.]	0.743
		Phase 1	t1 + 150 ms	[p.u.]	0.748
		Phase 2	t1 + 150 ms	[p.u.]	0.747
		Phase 3	t1 + 150 ms	[p.u.]	0.745
		Phase 1	t1 + 300 ms	[p.u.]	0.747
		Phase 2	t1 + 300 ms	[p.u.]	0.747
		Phase 3	t1 + 300 ms	[p.u.]	0.747
		Phase 1	t1 + 500 ms	[p.u.]	0.749
		Phase 2	t1 + 500 ms	[p.u.]	0.749
		Phase 3	t1 + 500 ms	[p.u.]	0.748
		Phase 1	t1 +1000 ms	[p.u.]	0.753
		Phase 2	t1 + 1000 ms	[p.u.]	0.752
		Phase 3	t1 +1000 ms	[p.u.]	0.749
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.000
Active current rise time	Pos. seq.			[s]	0.027

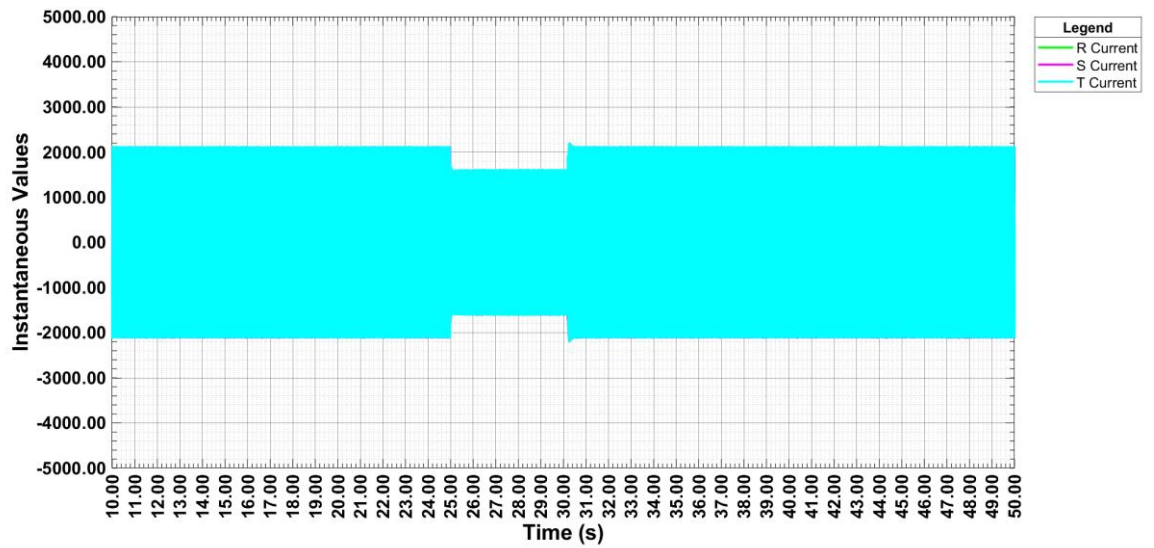
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.1

Phase-to-Phase voltages



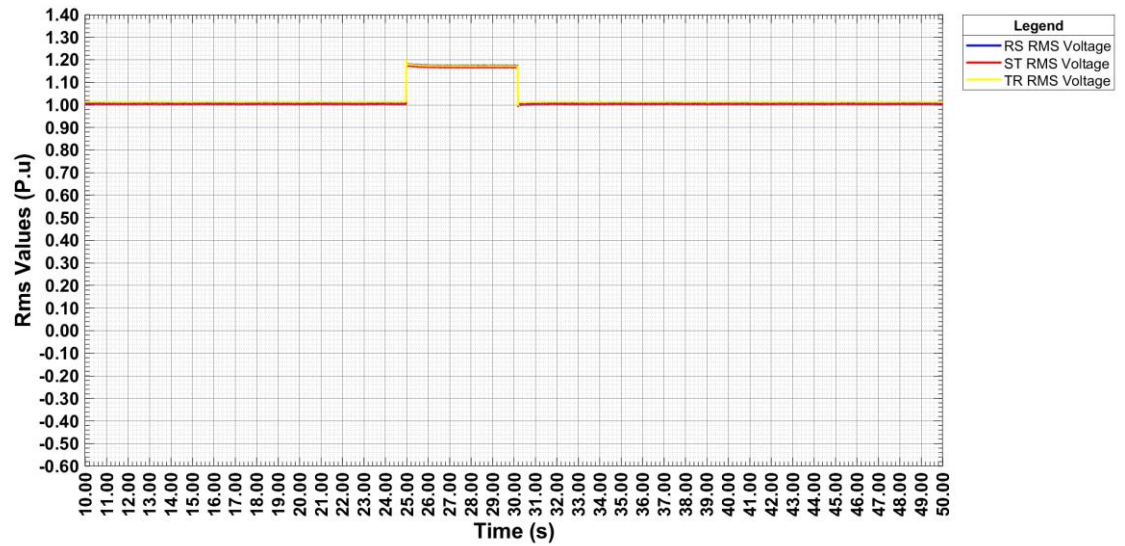
Phase currents



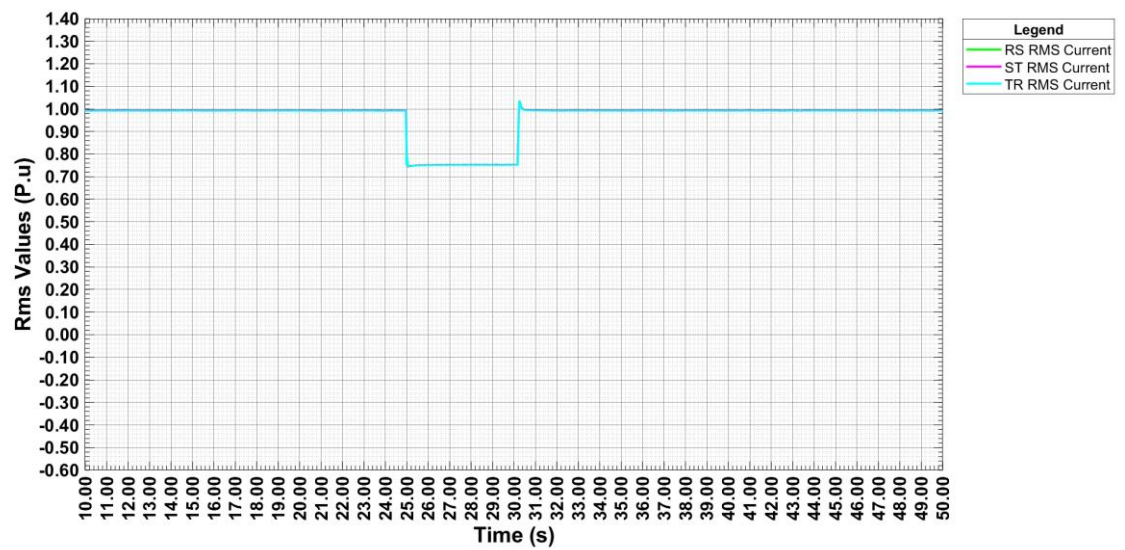
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.1

RMS Phase to phase voltages



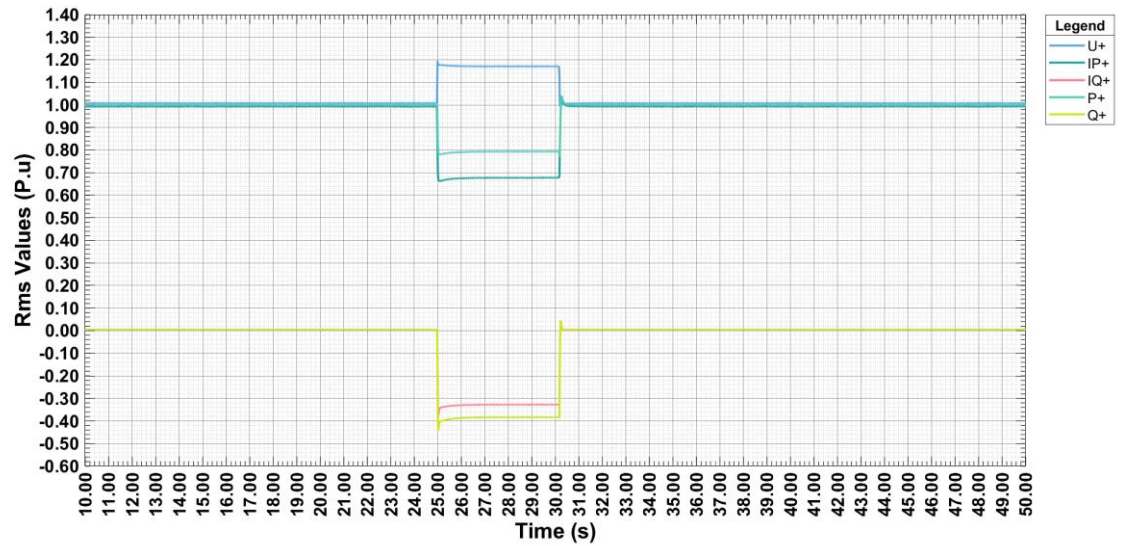
RMS Phase currents



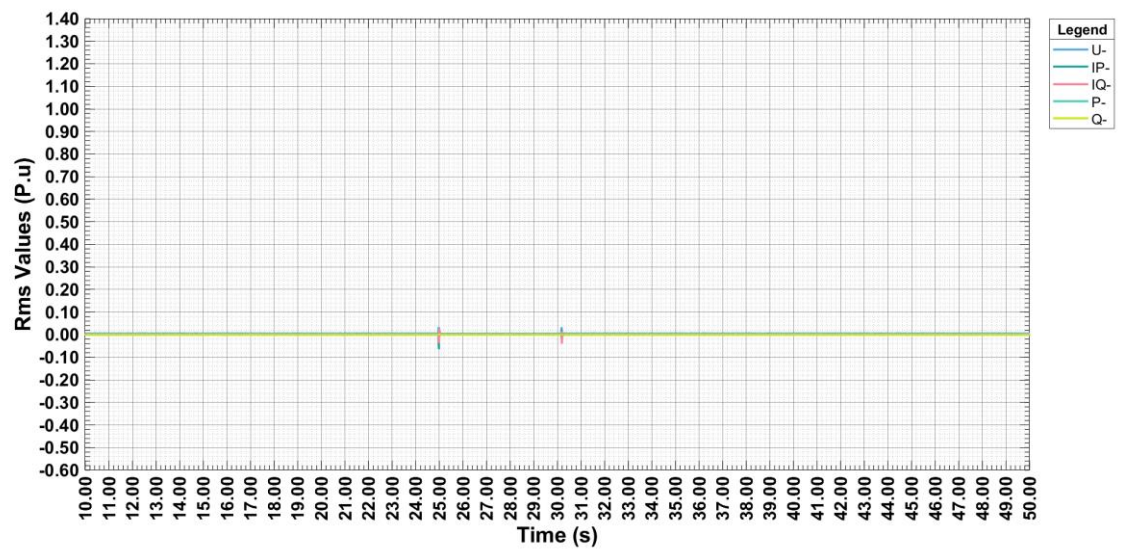
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.1

Positive sequences



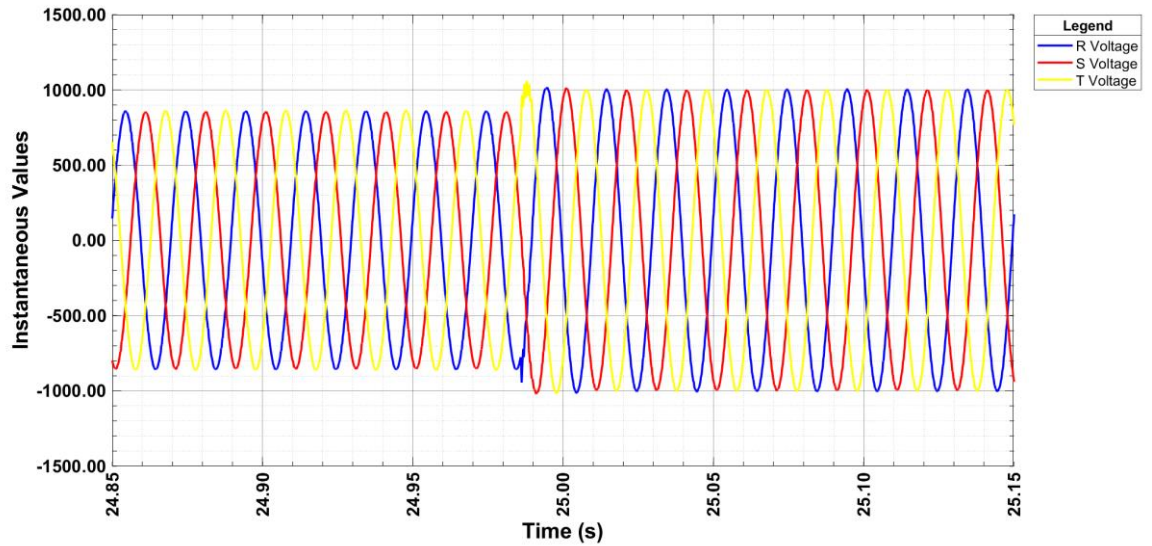
Negative sequences



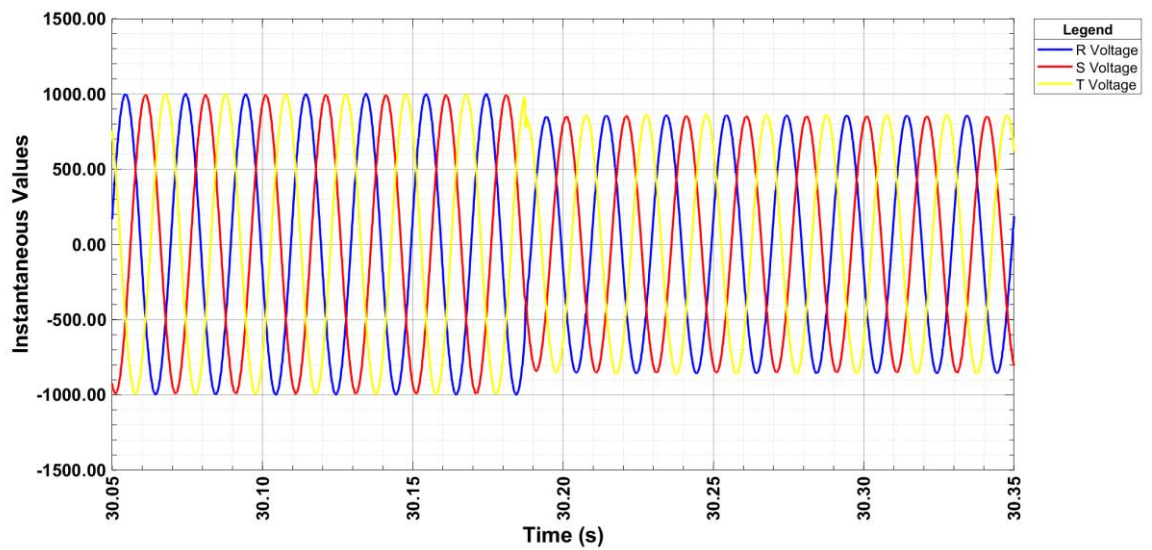
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.1

Transient voltage: Fault beginning



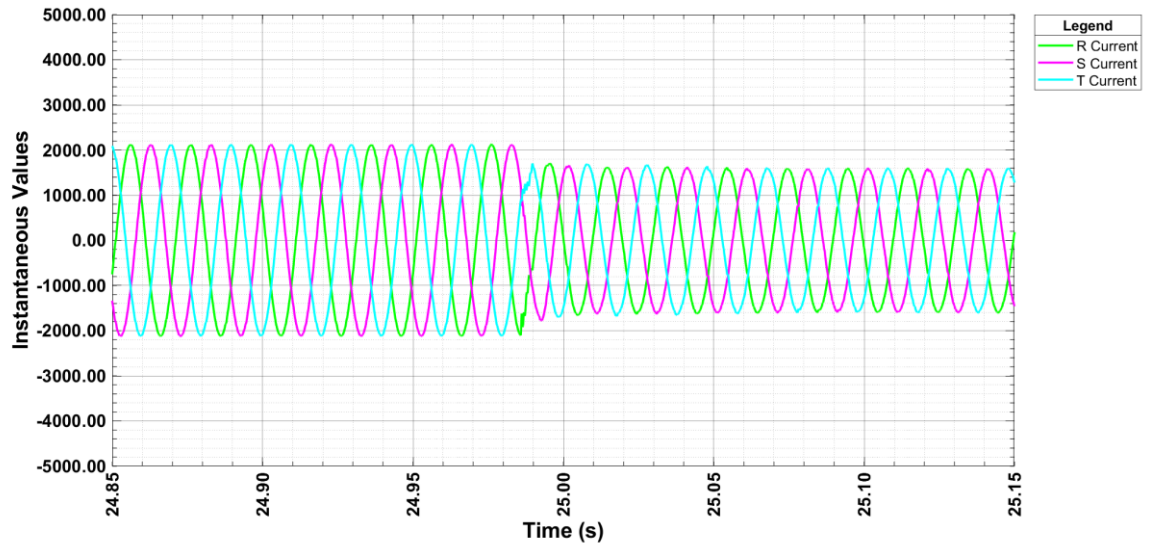
Transient voltage: Fault end



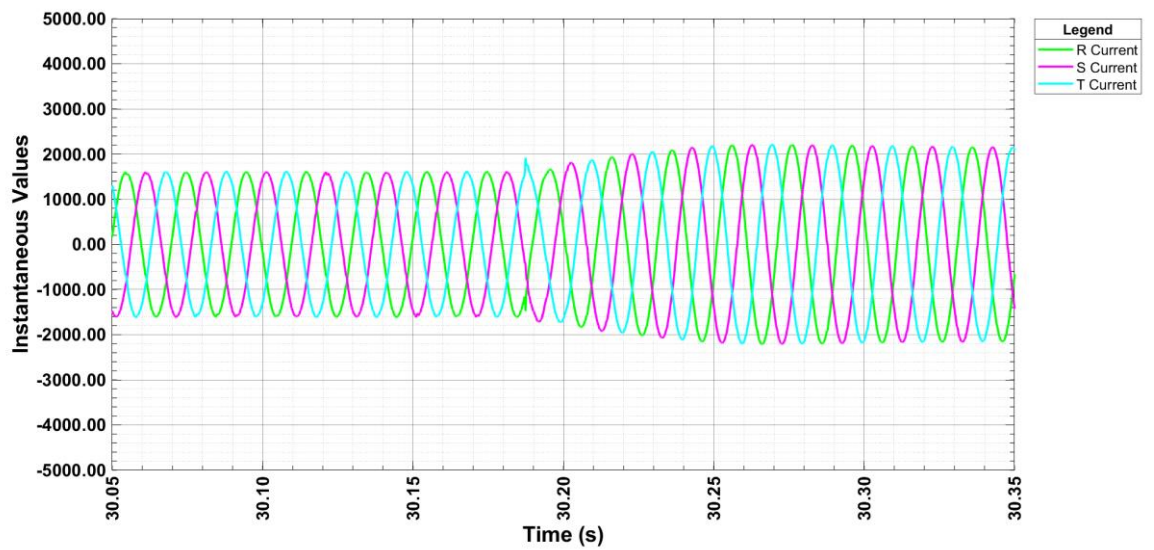
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.1

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.2.2.2 Test 115.2 Fault type: 3 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	115.2
	Date		-	[dd.mm.yyyy]	06.11.2020
	Time		-	[hh:mm:ss]	09:38:44
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	1.150
	Drop duration setpoint		-	[ms]	5000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	25477
	Fault clearance (t2)		-	[ms]	30677
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	5200
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	1.166 /1.000
		Pos. seq.		[p.u.]	1.165 /1.000

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.000
		Neg. seq.	t1-60 s to t1	[p.u.]	0.000
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.000
		Pos. seq.	t1-1 s to t1	[p.u.]	1.000
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.200
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.001
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.200
	Active Power	Total	t1-10 s to t1	[p.u.]	0.200
		Total	t1-2 s to t1	[p.u.]	0.200
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.200
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.001
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.054
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.166
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.003
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.337
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.000
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.377
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.197
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.197

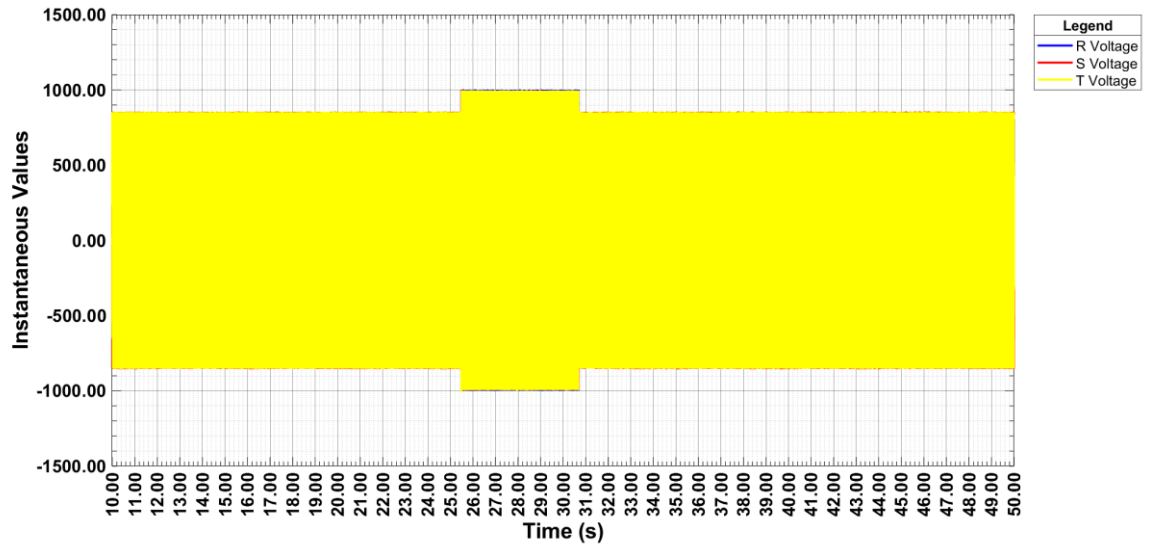
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	497
		Phase 2	t1 to t1+20 ms	[A]	503
		Phase 3	t1 to t1+20 ms	[A]	536
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.329
		Phase 2	t1 + 20 ms	[p.u.]	0.335
		Phase 3	t1 + 20 ms	[p.u.]	0.375
		Phase 1	t1 + 100 ms	[p.u.]	0.378
		Phase 2	t1 + 100 ms	[p.u.]	0.371
		Phase 3	t1 + 100 ms	[p.u.]	0.375
		Phase 1	t1 + 150 ms	[p.u.]	0.380
		Phase 2	t1 + 150 ms	[p.u.]	0.378
		Phase 3	t1 + 150 ms	[p.u.]	0.377
		Phase 1	t1 + 300 ms	[p.u.]	0.379
		Phase 2	t1 + 300 ms	[p.u.]	0.379
		Phase 3	t1 + 300 ms	[p.u.]	0.380
		Phase 1	t1 + 500 ms	[p.u.]	0.379
		Phase 2	t1 + 500 ms	[p.u.]	0.378
		Phase 3	t1 + 500 ms	[p.u.]	0.379
		Phase 1	t1 + 1000 ms	[p.u.]	0.378
		Phase 2	t1 + 1000 ms	[p.u.]	0.378
		Phase 3	t1 + 1000 ms	[p.u.]	0.378
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.200
Active current rise time	Pos. seq.			[s]	0.000

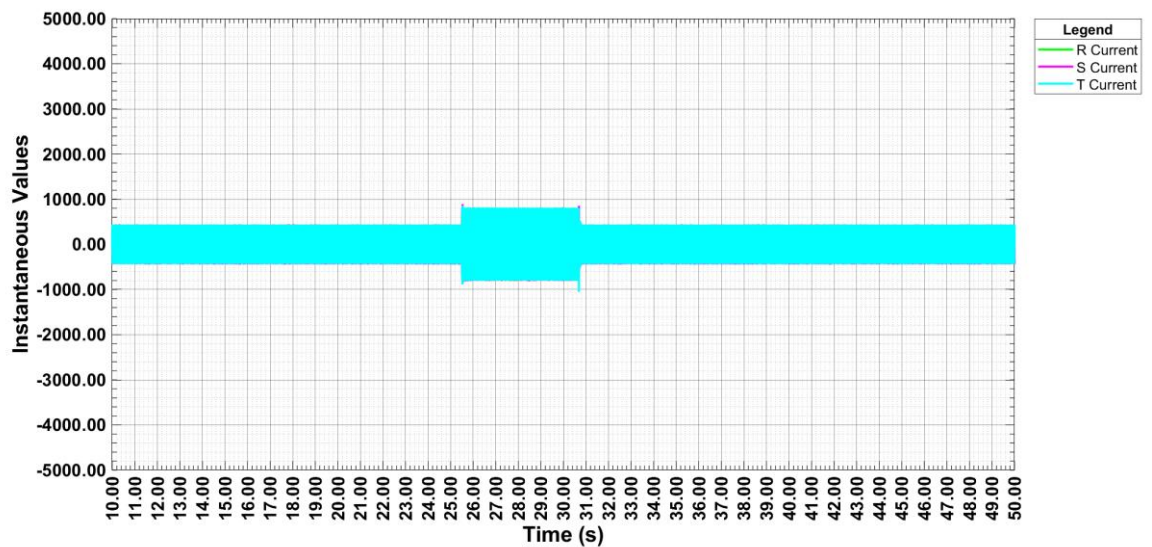
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.2

Phase-to-Phase voltages



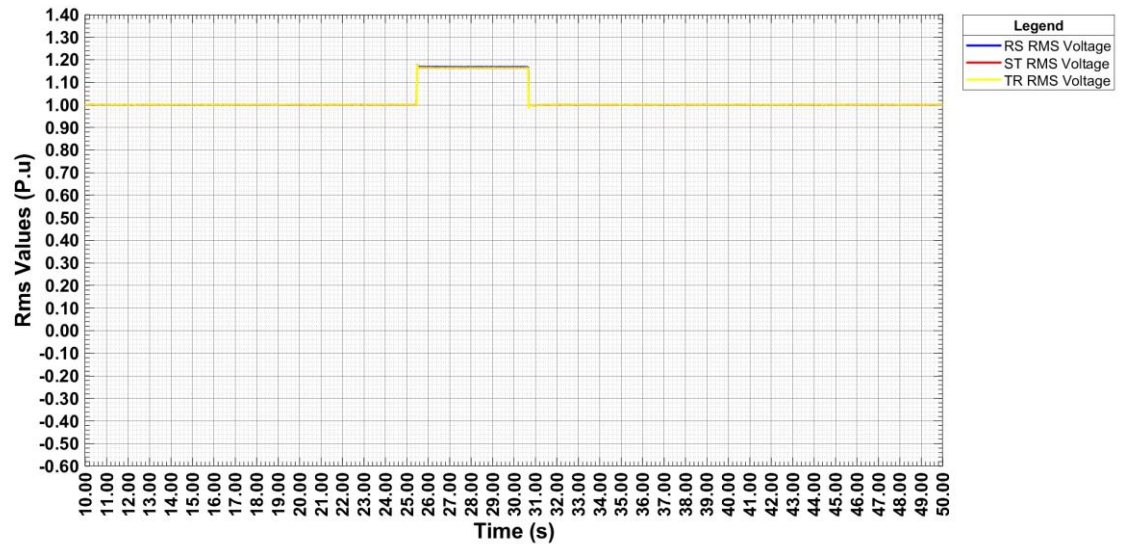
Phase currents



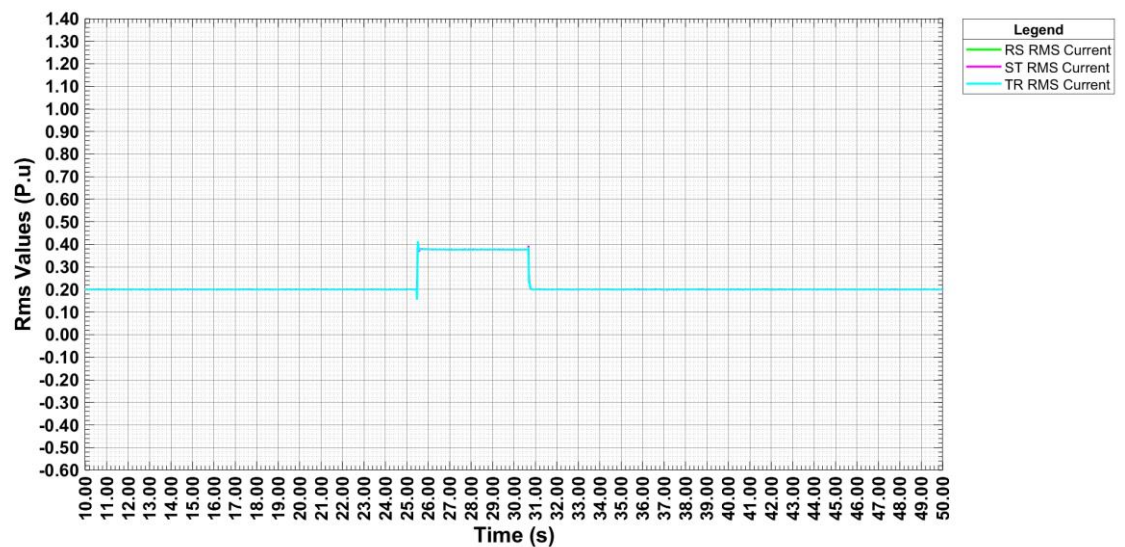
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.2

RMS Phase to phase voltages



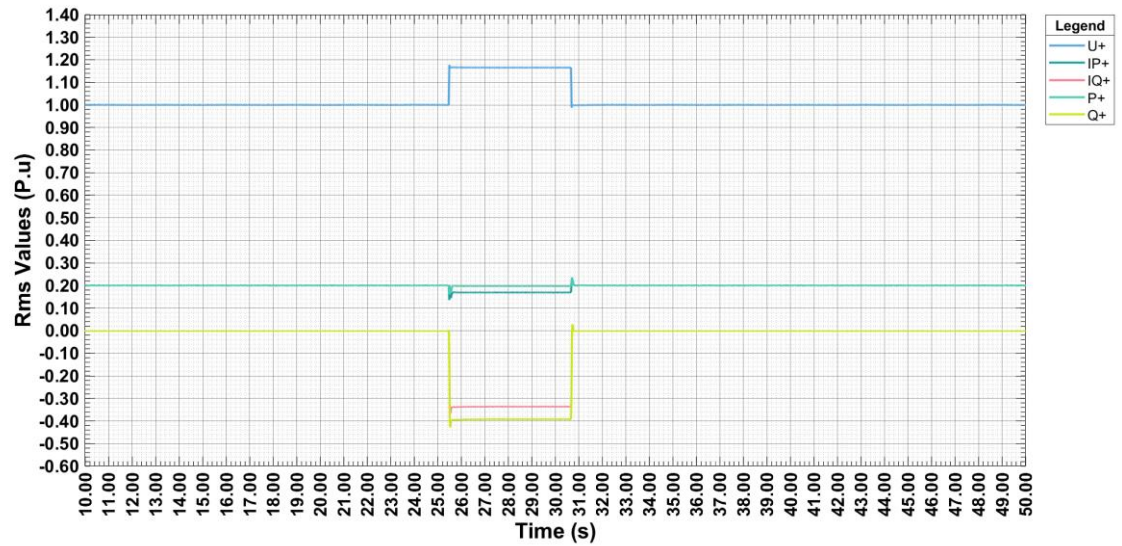
RMS Phase currents



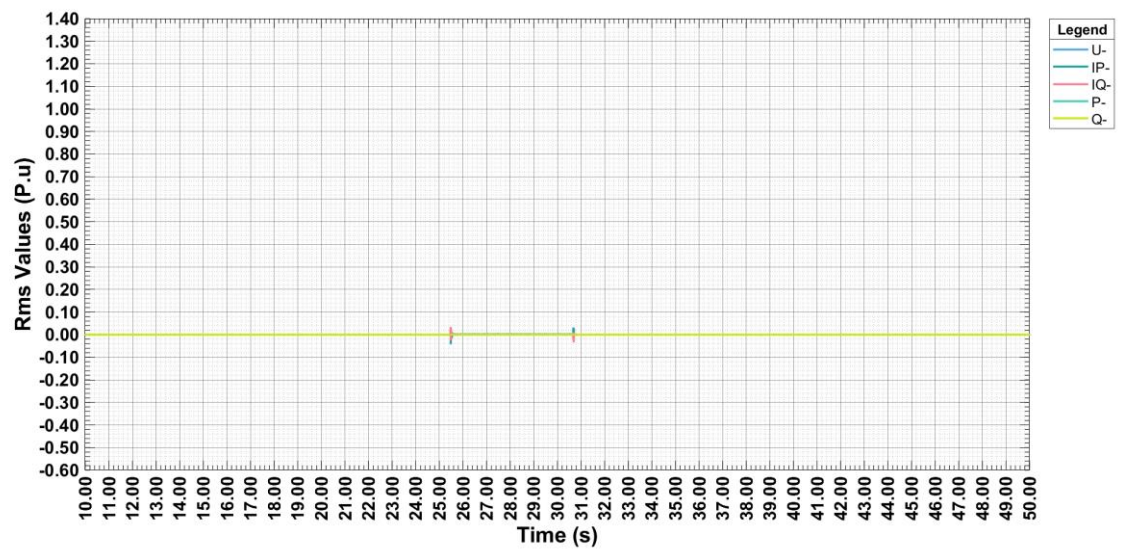
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.2

Positive sequences



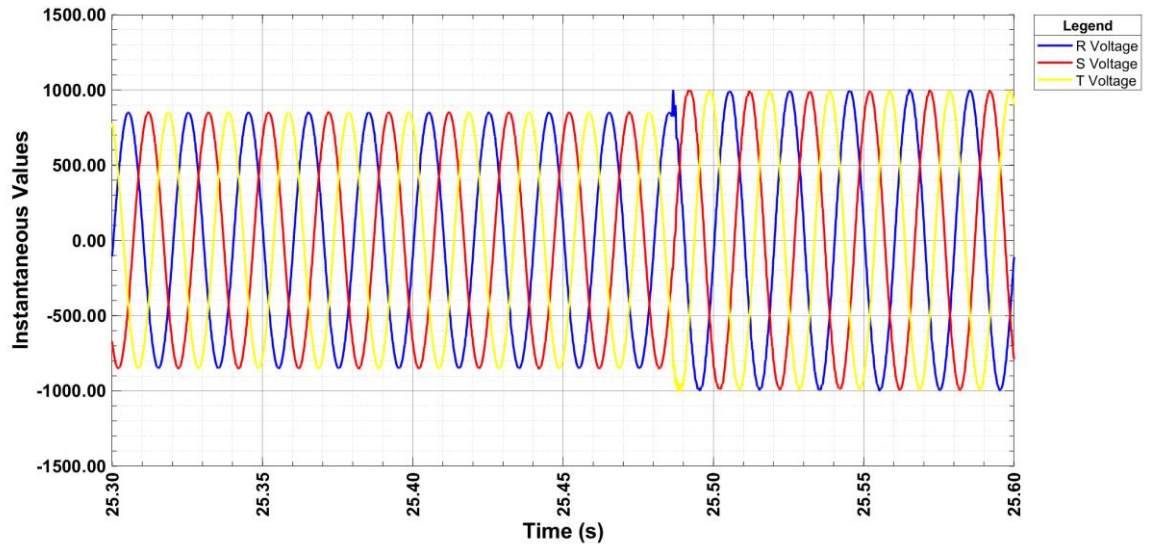
Negative sequences



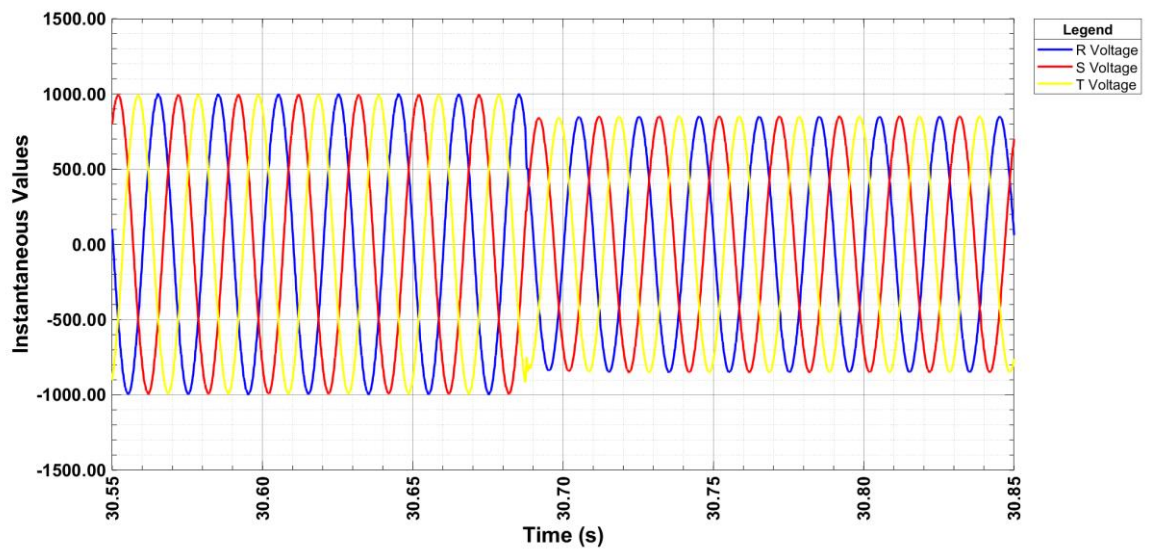
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.2

Transient voltage: Fault beginning



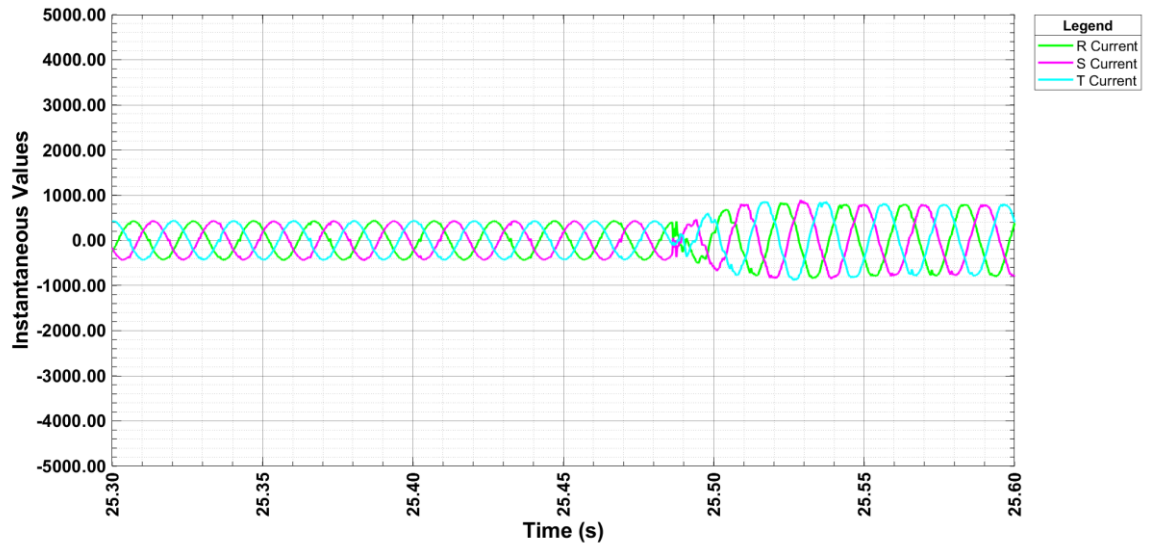
Transient voltage: Fault end



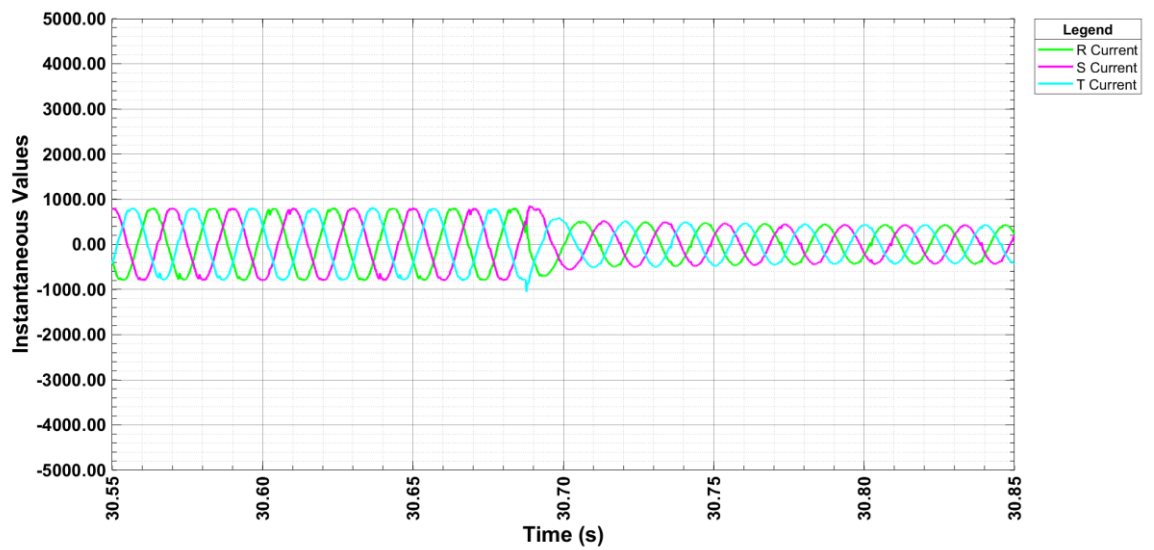
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 115.2

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.2.2.3 Test 110.1 Fault type: 2 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	110.1
	Date		-	[dd.mm.yyyy]	06.11.2020
	Time		-	[hh:mm:ss]	16:55:10
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	1.150
	Drop duration setpoint		-	[ms]	5000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24800
	Fault clearance (t2)		-	[ms]	30000
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	5200
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	1.173 /1.013
		Pos. seq.		[p.u.]	1.089 /1.008

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.008
		Neg. seq.	t1-60 s to t1	[p.u.]	0.006
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.008
		Pos. seq.	t1-1 s to t1	[p.u.]	1.008
		Neg. seq.	t1-1 s to t1	[p.u.]	0.006
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.993
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.006
		Pos. seq.	t1-1 s to t1	[p.u.]	0.006
		Neg. seq.	t1-1 s to t1	[p.u.]	-0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.993
	Active Power	Total	t1-10 s to t1	[p.u.]	1.000
		Total	t1-2 s to t1	[p.u.]	1.000
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.000
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.006
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	1.907
		Neg. seq.	-	-	-1.917
	Reactive current settling up time	Pos. seq.	-	[ms]	7
		Neg. seq.	-	[ms]	13
	Reactive current settling time	Pos. seq.	-	[ms]	7
		Neg. seq.	-	[ms]	13
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.089
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.083
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.162
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.164
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.693
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.164
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.734
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.734

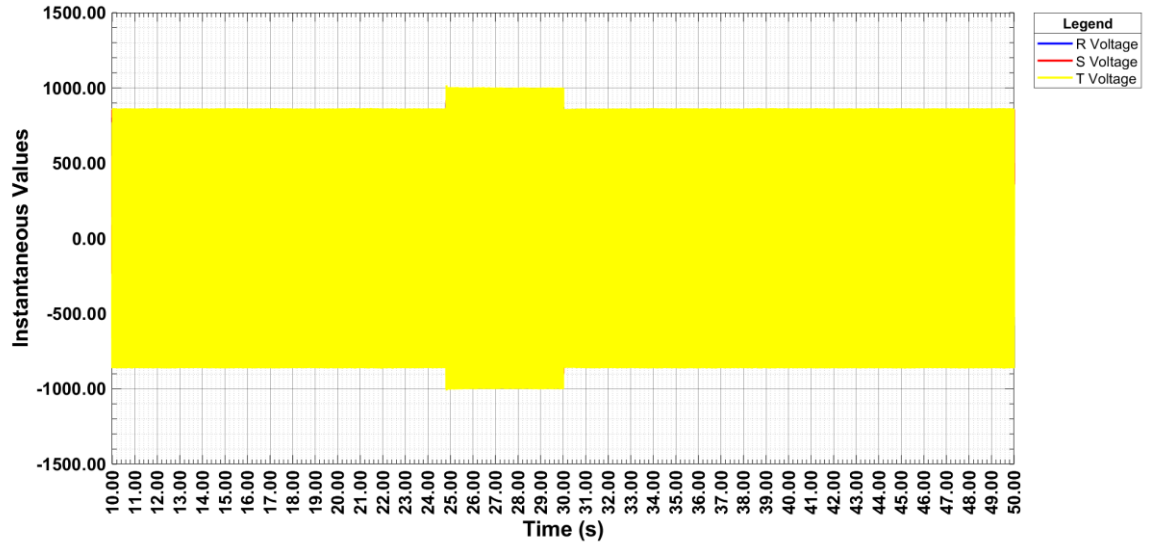
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1264
		Phase 2	t1 to t1+20 ms	[A]	1383
		Phase 3	t1 to t1+20 ms	[A]	1299
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.807
		Phase 2	t1 + 20 ms	[p.u.]	0.627
		Phase 3	t1 + 20 ms	[p.u.]	0.572
		Phase 1	t1 + 100 ms	[p.u.]	0.856
		Phase 2	t1 + 100 ms	[p.u.]	0.670
		Phase 3	t1 + 100 ms	[p.u.]	0.572
		Phase 1	t1 + 150 ms	[p.u.]	0.848
		Phase 2	t1 + 150 ms	[p.u.]	0.672
		Phase 3	t1 + 150 ms	[p.u.]	0.574
		Phase 1	t1 + 300 ms	[p.u.]	0.850
		Phase 2	t1 + 300 ms	[p.u.]	0.673
		Phase 3	t1 + 300 ms	[p.u.]	0.578
		Phase 1	t1 + 500 ms	[p.u.]	0.851
		Phase 2	t1 + 500 ms	[p.u.]	0.675
		Phase 3	t1 + 500 ms	[p.u.]	0.579
		Phase 1	t1 + 1000 ms	[p.u.]	0.851
		Phase 2	t1 + 1000 ms	[p.u.]	0.677
		Phase 3	t1 + 1000 ms	[p.u.]	0.583
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.000
Active current rise time	Pos. seq.			[s]	0.028

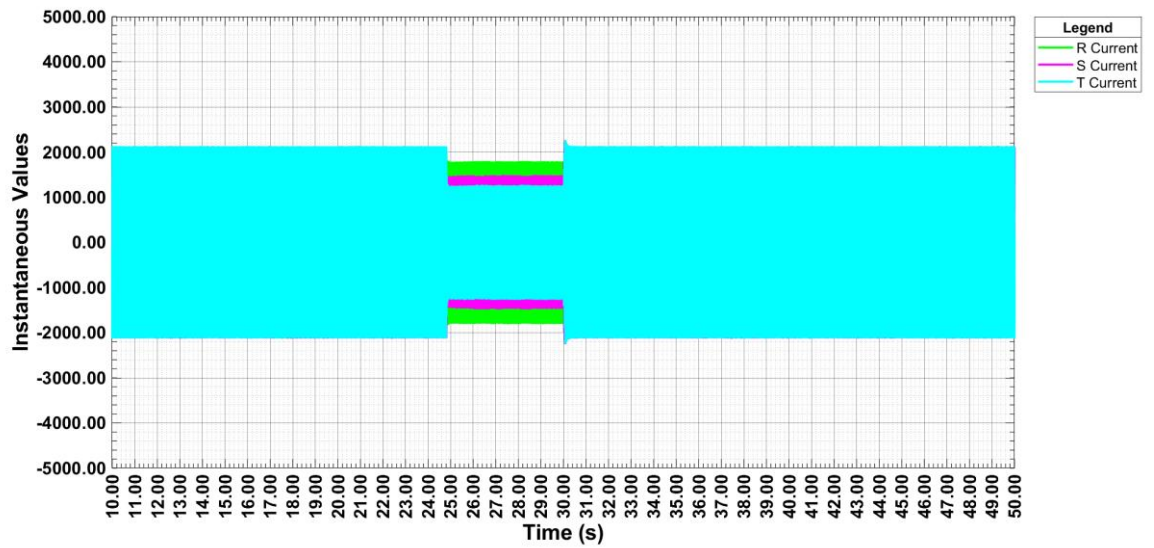
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.1

Phase-to-Phase voltages



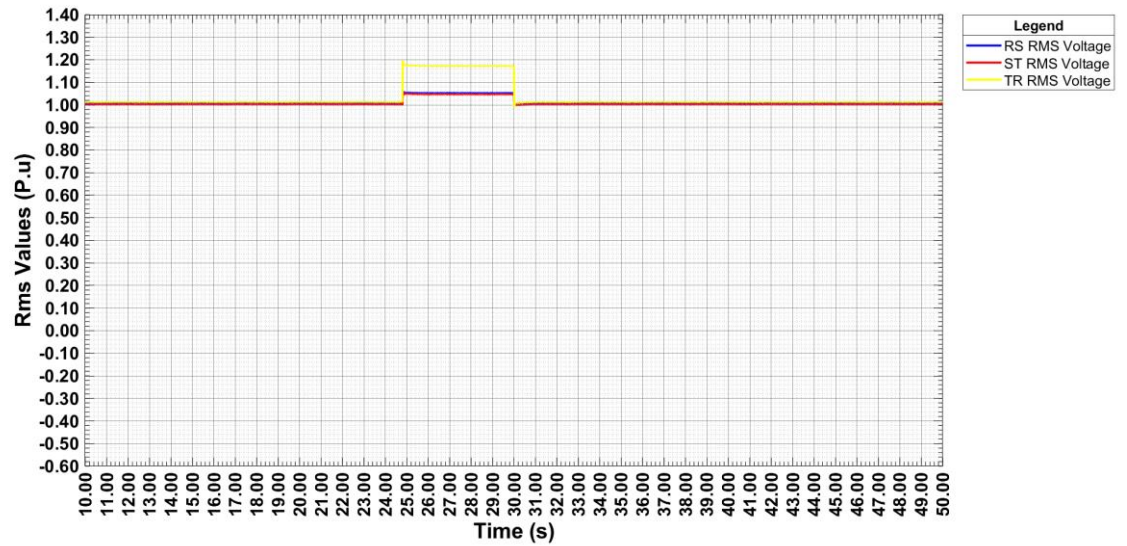
Phase currents



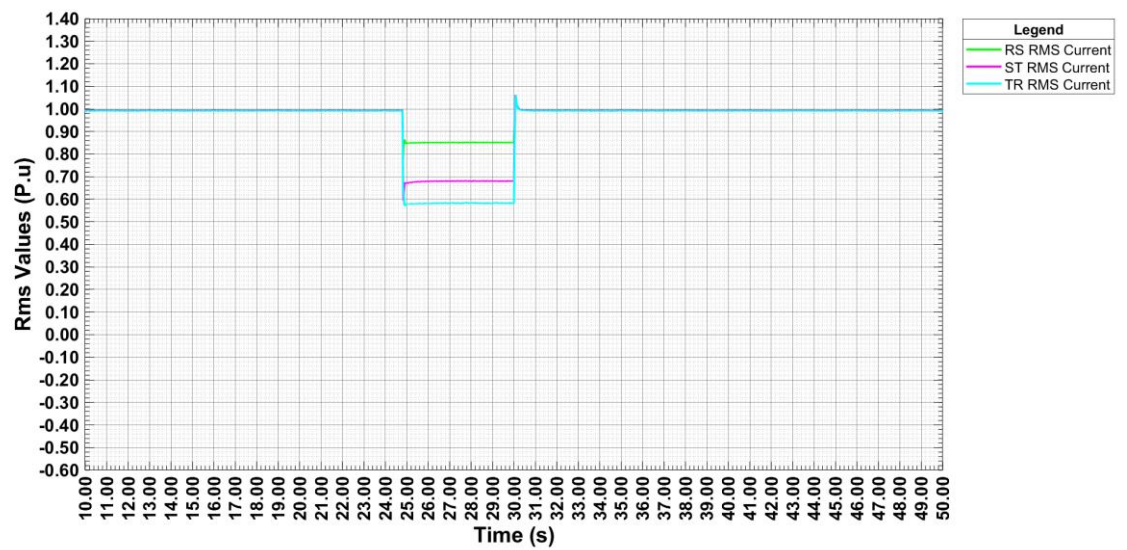
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.1

RMS Phase to phase voltages



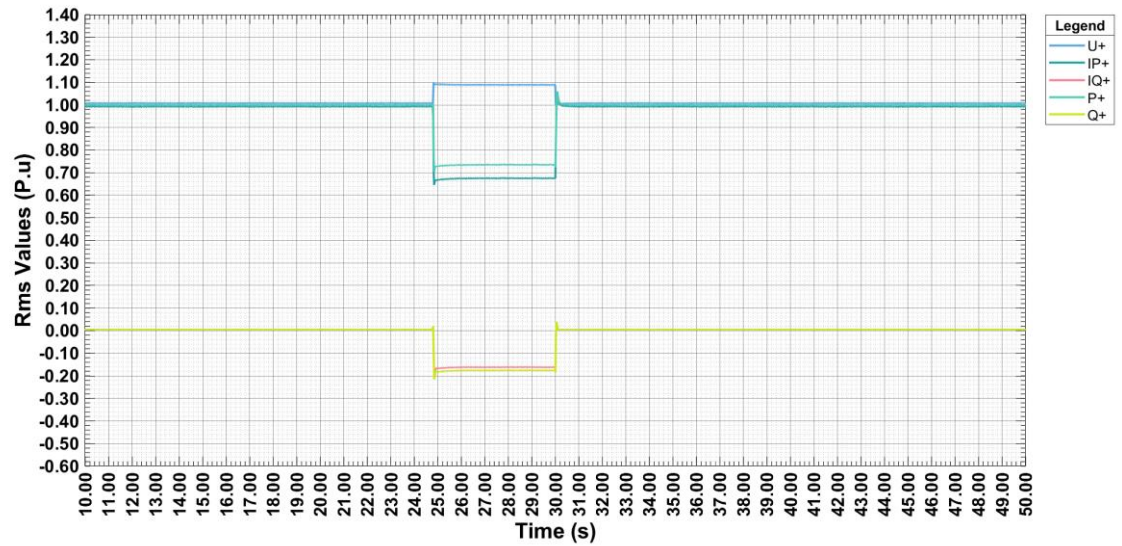
RMS Phase currents



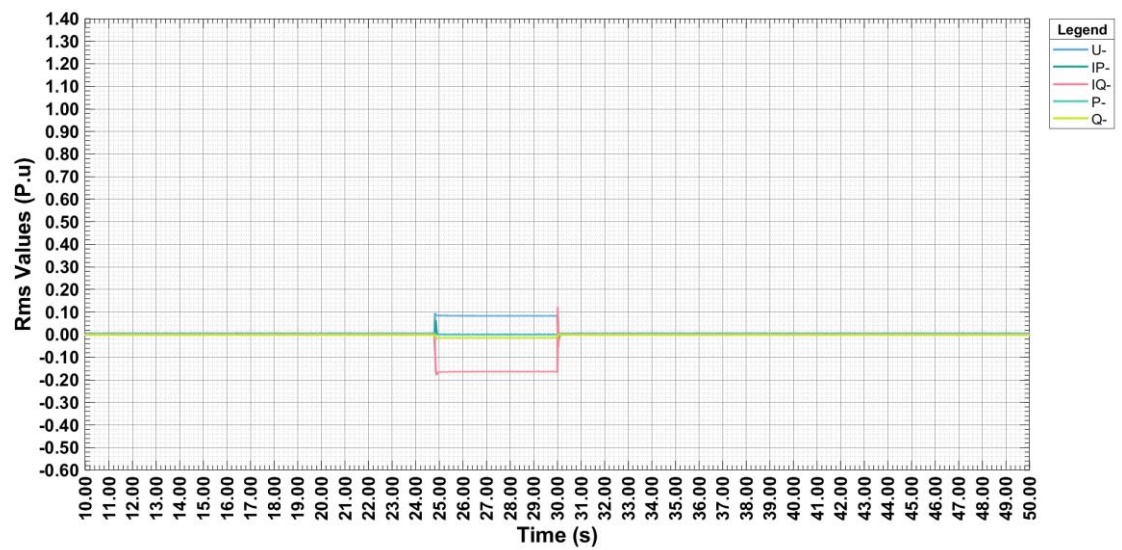
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.1

Positive sequences



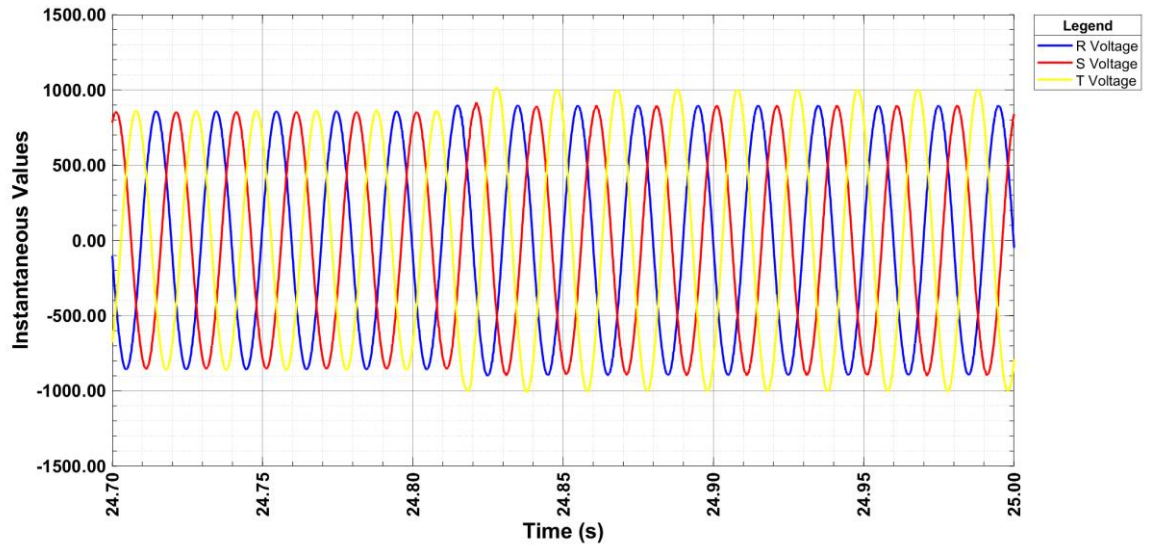
Negative sequences



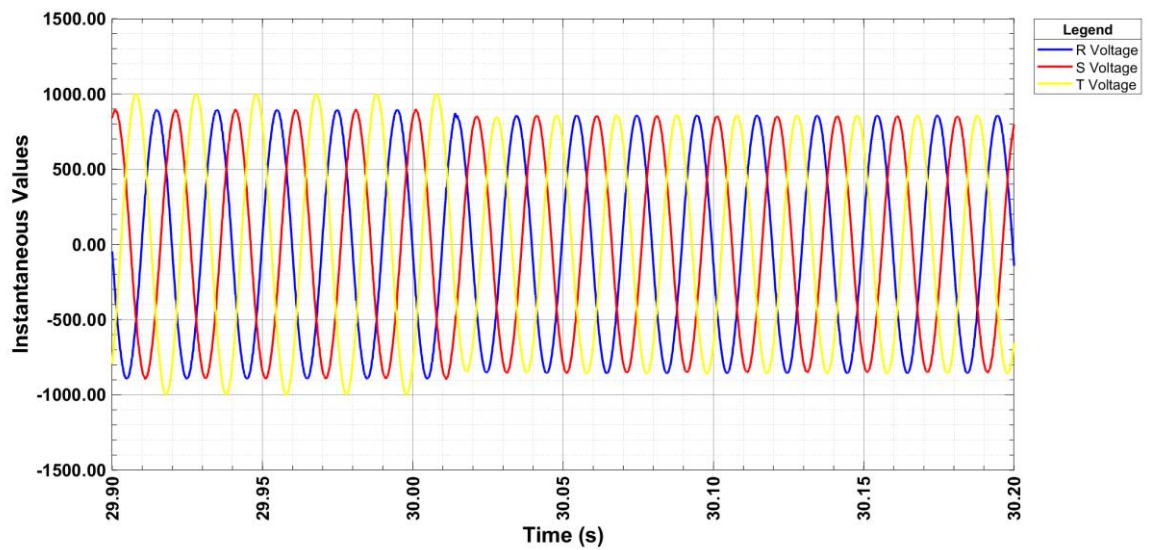
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.1

Transient voltage: Fault beginning



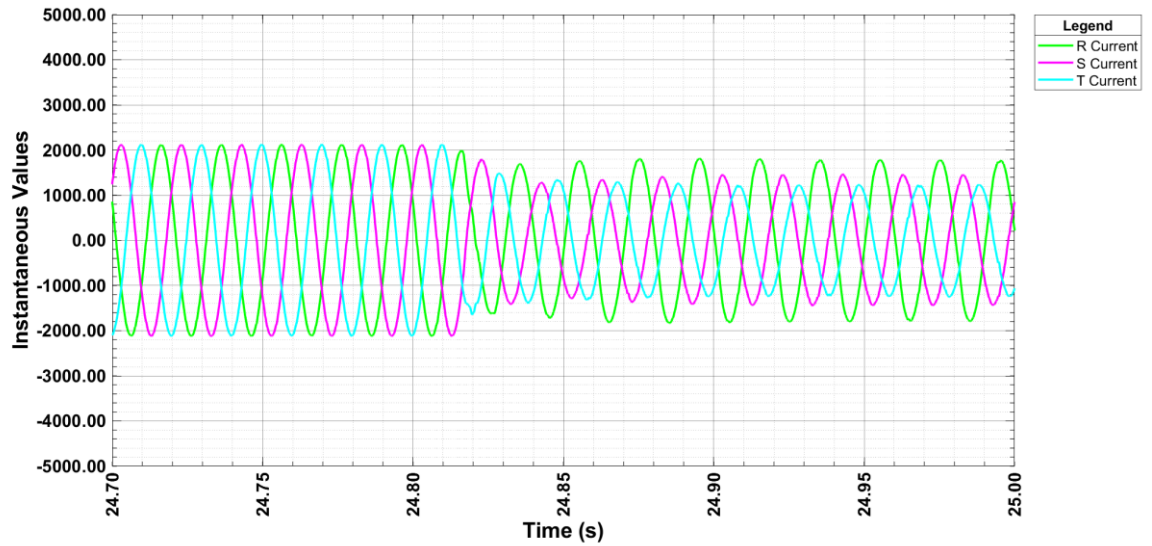
Transient voltage: Fault end



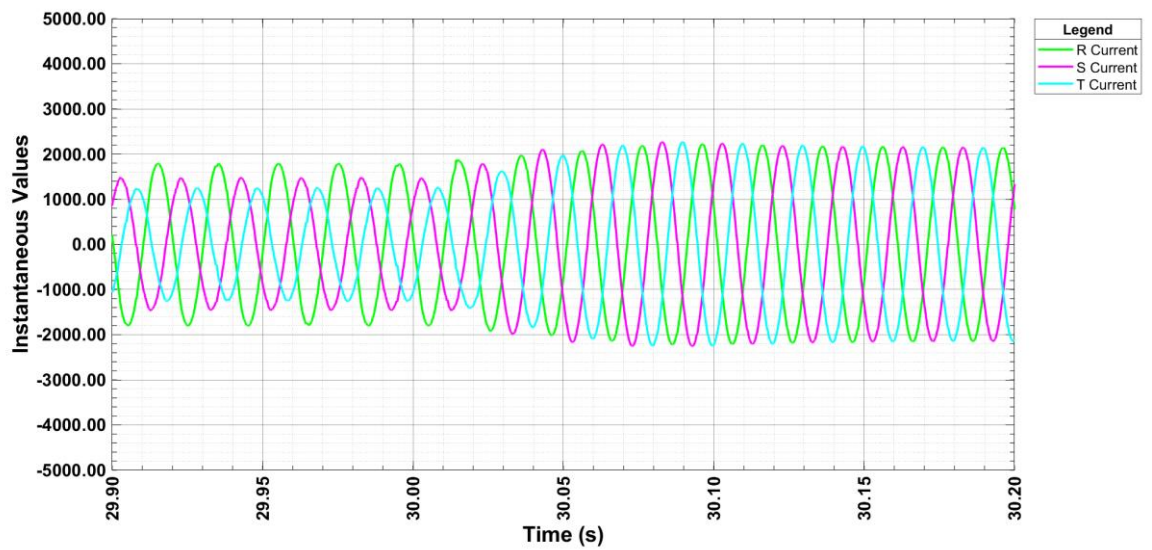
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.1

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.2.2.4 Test 110.2 Fault type: 2 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	110.2
	Date		-	[dd.mm.yyyy]	10.11.2020
	Time		-	[hh:mm:ss]	16:41:42
	Type of fault (number of affected phases)		-	-	2 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	1.150
	Drop duration setpoint		-	[ms]	5000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24927
	Fault clearance (t2)		-	[ms]	30126
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	5199
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	1.165 /1.000
		Pos. seq.		[p.u.]	1.084 /1.000

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.000
		Neg. seq.	t1-60 s to t1	[p.u.]	0.000
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.000
		Pos. seq.	t1-1 s to t1	[p.u.]	1.000
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.200
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.002
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.200
	Active Power	Total	t1-10 s to t1	[p.u.]	0.200
		Total	t1-2 s to t1	[p.u.]	0.200
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.200
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.002
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.032
		Neg. seq.	-	-	-1.968
	Reactive current settling up time	Pos. seq.	-	[ms]	16
		Neg. seq.	-	[ms]	17
	Reactive current settling time	Pos. seq.	-	[ms]	16
		Neg. seq.	-	[ms]	17
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.084
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.081
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.170
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.159
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.250
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.159
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.199
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.199

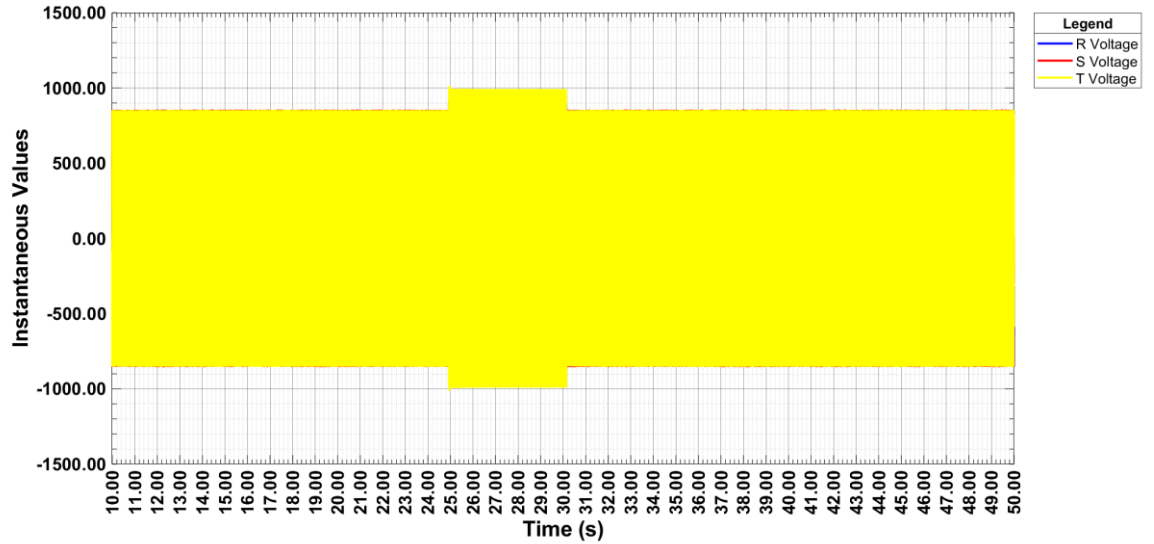
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	509
		Phase 2	t1 to t1+20 ms	[A]	317
		Phase 3	t1 to t1+20 ms	[A]	386
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.338
		Phase 2	t1 + 20 ms	[p.u.]	0.186
		Phase 3	t1 + 20 ms	[p.u.]	0.247
		Phase 1	t1 + 100 ms	[p.u.]	0.413
		Phase 2	t1 + 100 ms	[p.u.]	0.187
		Phase 3	t1 + 100 ms	[p.u.]	0.247
		Phase 1	t1 + 150 ms	[p.u.]	0.409
		Phase 2	t1 + 150 ms	[p.u.]	0.193
		Phase 3	t1 + 150 ms	[p.u.]	0.249
		Phase 1	t1 + 300 ms	[p.u.]	0.409
		Phase 2	t1 + 300 ms	[p.u.]	0.190
		Phase 3	t1 + 300 ms	[p.u.]	0.249
		Phase 1	t1 + 500 ms	[p.u.]	0.408
		Phase 2	t1 + 500 ms	[p.u.]	0.189
		Phase 3	t1 + 500 ms	[p.u.]	0.250
		Phase 1	t1 + 1000 ms	[p.u.]	0.410
		Phase 2	t1 + 1000 ms	[p.u.]	0.189
		Phase 3	t1 + 1000 ms	[p.u.]	0.252
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.200
Active current rise time	Pos. seq.			[s]	0.000

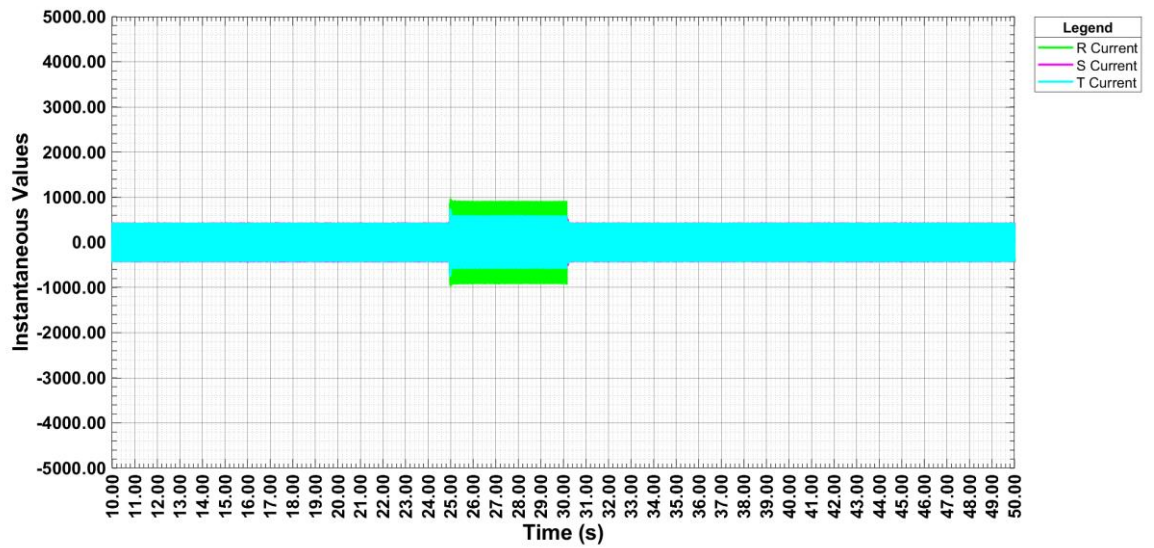
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.2

Phase-to-Phase voltages



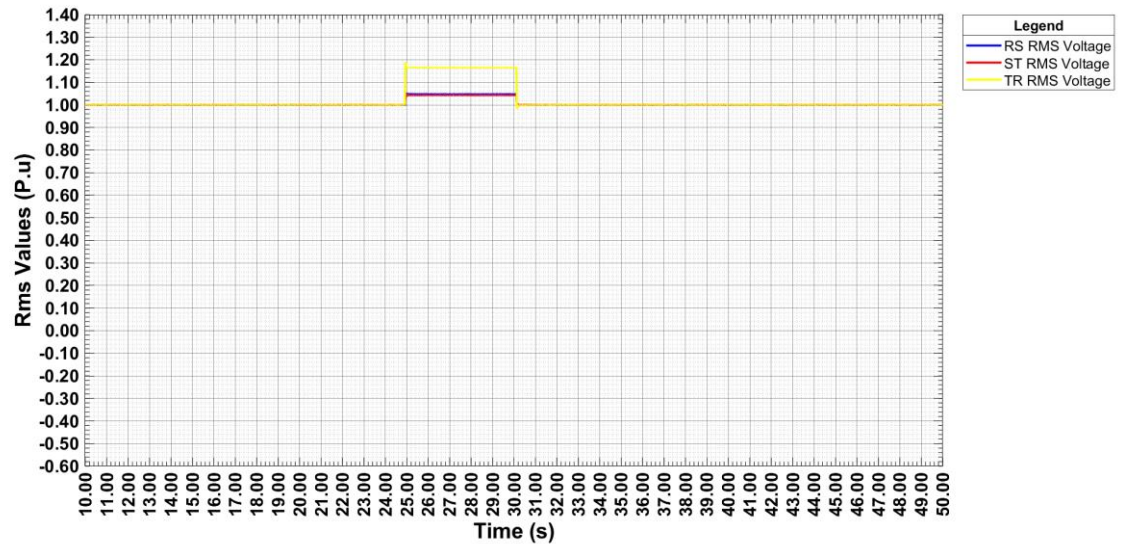
Phase currents



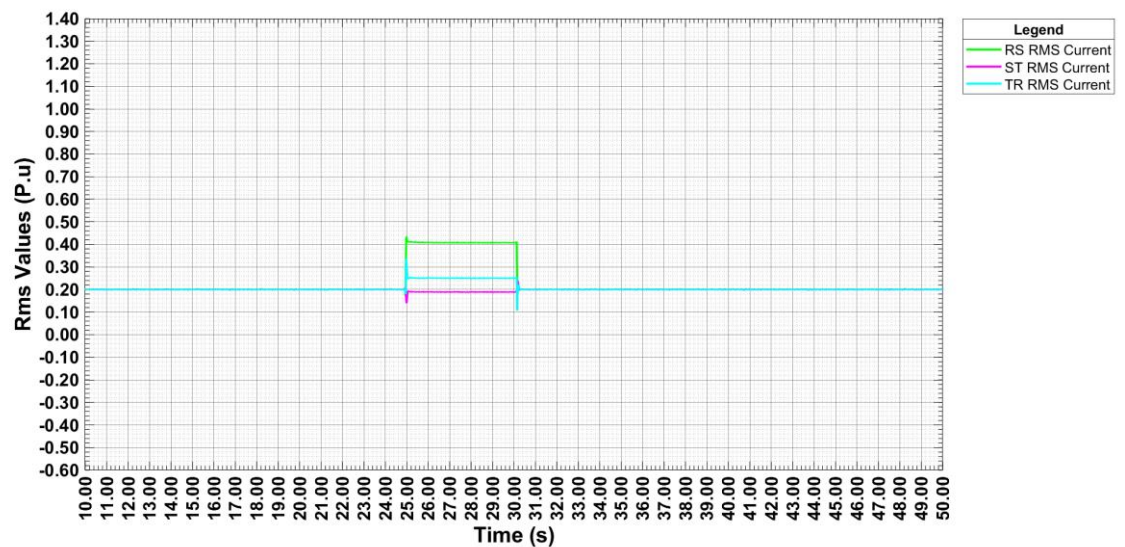
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.2

RMS Phase to phase voltages



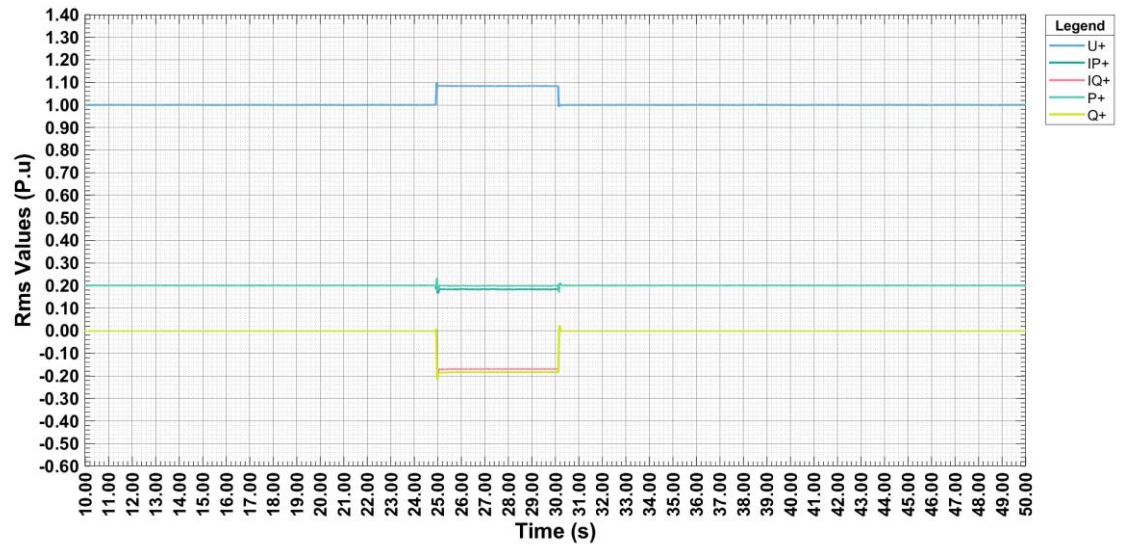
RMS Phase currents



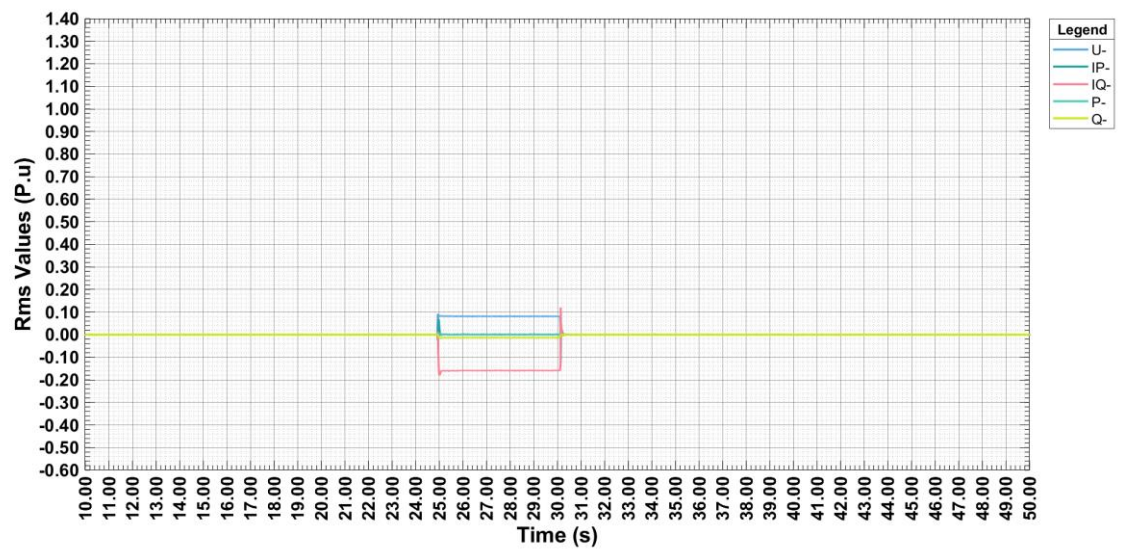
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.2

Positive sequences



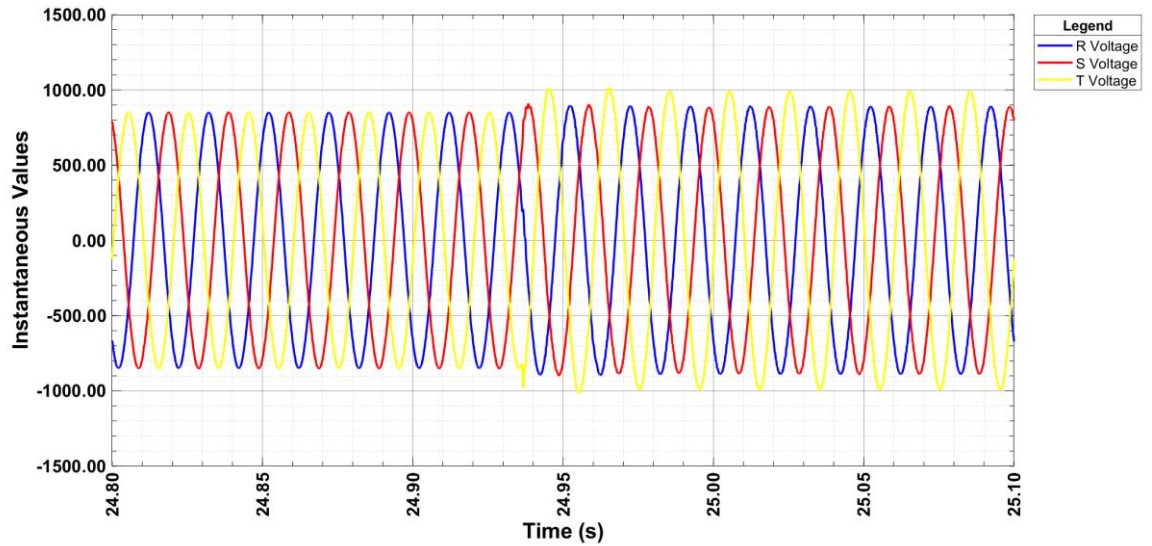
Negative sequences



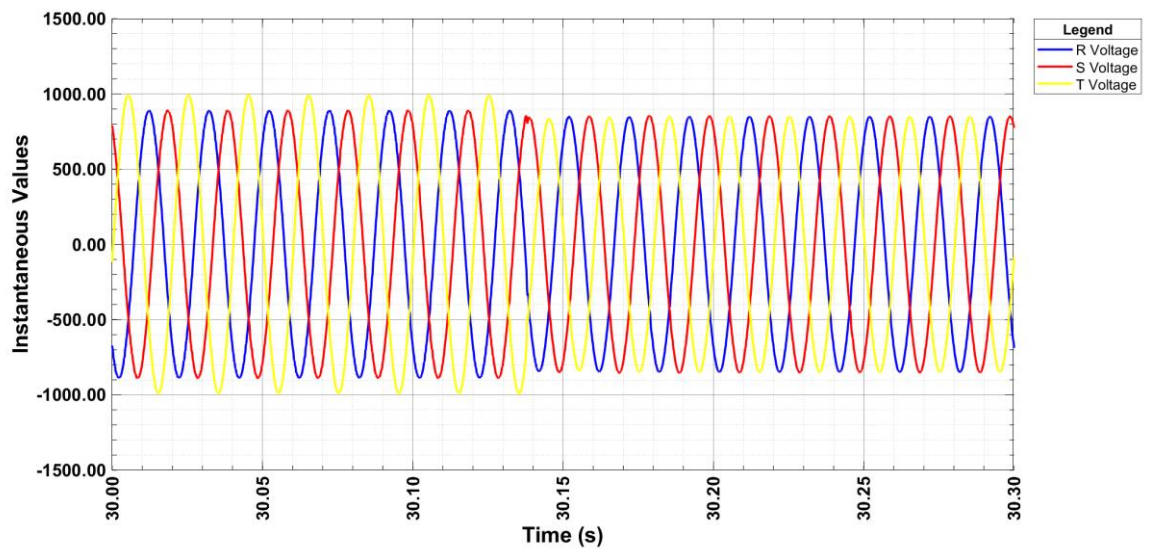
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.2

Transient voltage: Fault beginning



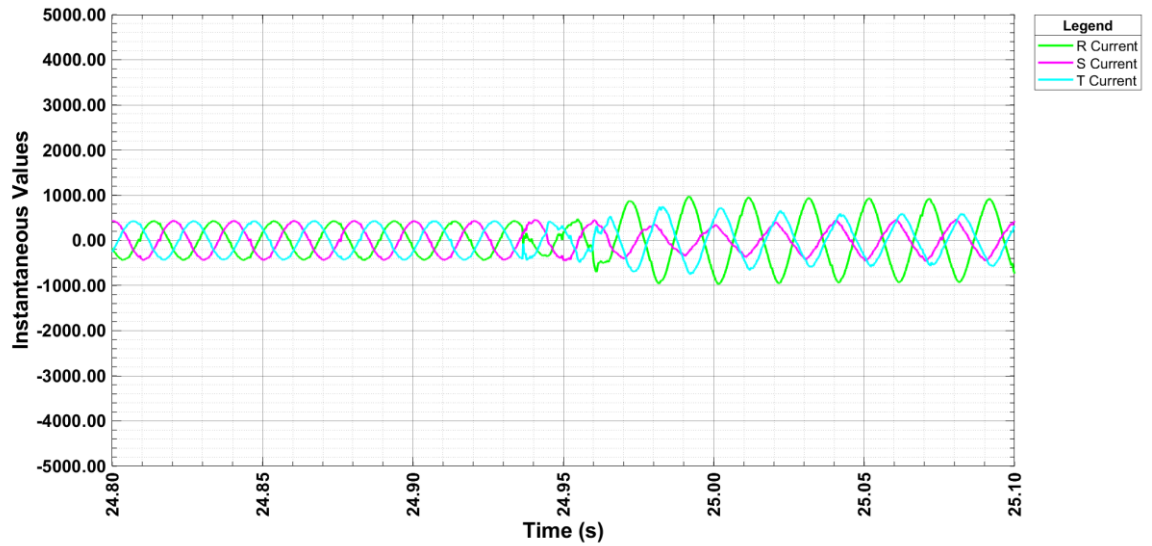
Transient voltage: Fault end



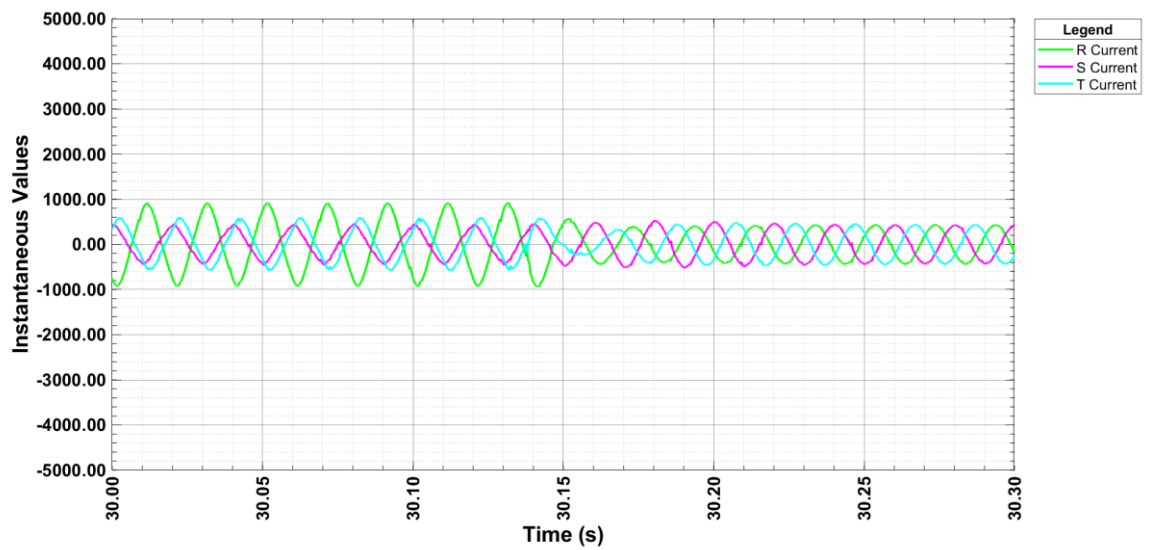
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.2

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.2.2.5 Test 110.3 Fault type: 3 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	110.3
	Date		-	[dd.mm.yyyy]	10.11.2020
	Time		-	[hh:mm:ss]	17:03:54
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	1.100
	Drop duration setpoint		-	[ms]	60000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	24635
	Fault clearance (t2)		-	[ms]	85141
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	60506
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	1.118 /1.000
		Pos. seq.		[p.u.]	1.118 /1.000

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.000
		Neg. seq.	t1-60 s to t1	[p.u.]	0.000
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.000
		Pos. seq.	t1-1 s to t1	[p.u.]	1.000
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.202
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.001
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.001
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.202
	Active Power	Total	t1-10 s to t1	[p.u.]	0.202
		Total	t1-2 s to t1	[p.u.]	0.202
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.202
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.001
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.042
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	9
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	9
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.118
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.002
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.239
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.000
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.299
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.201
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.201

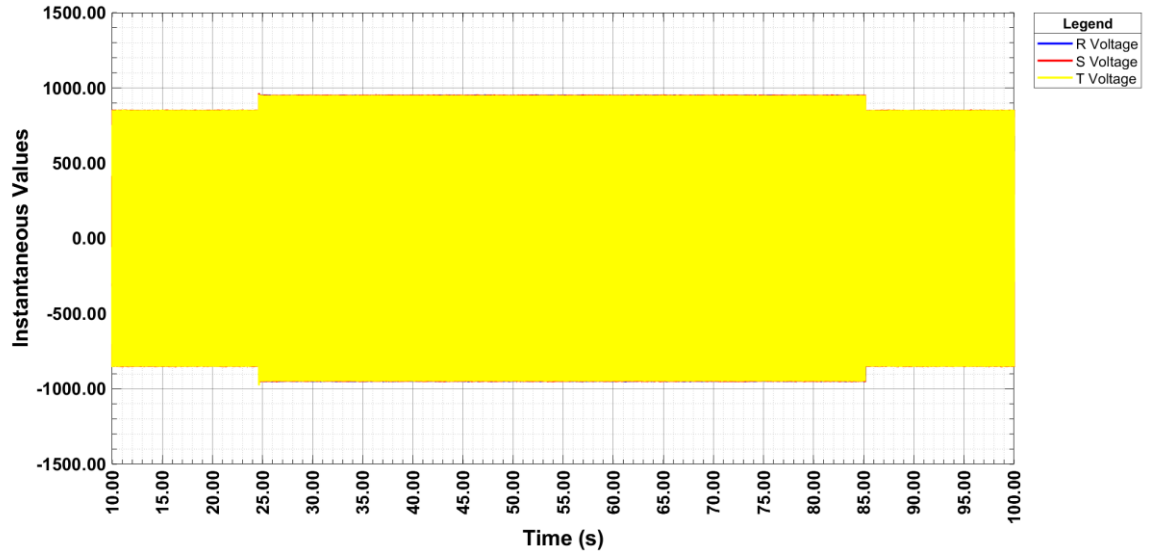
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	433
		Phase 2	t1 to t1+20 ms	[A]	452
		Phase 3	t1 to t1+20 ms	[A]	447
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.288
		Phase 2	t1 + 20 ms	[p.u.]	0.301
		Phase 3	t1 + 20 ms	[p.u.]	0.298
		Phase 1	t1 + 100 ms	[p.u.]	0.298
		Phase 2	t1 + 100 ms	[p.u.]	0.299
		Phase 3	t1 + 100 ms	[p.u.]	0.298
		Phase 1	t1 + 150 ms	[p.u.]	0.303
		Phase 2	t1 + 150 ms	[p.u.]	0.302
		Phase 3	t1 + 150 ms	[p.u.]	0.302
		Phase 1	t1 + 300 ms	[p.u.]	0.298
		Phase 2	t1 + 300 ms	[p.u.]	0.300
		Phase 3	t1 + 300 ms	[p.u.]	0.299
		Phase 1	t1 + 500 ms	[p.u.]	0.298
		Phase 2	t1 + 500 ms	[p.u.]	0.300
		Phase 3	t1 + 500 ms	[p.u.]	0.299
		Phase 1	t1 + 1000 ms	[p.u.]	0.301
		Phase 2	t1 + 1000 ms	[p.u.]	0.300
		Phase 3	t1 + 1000 ms	[p.u.]	0.298
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.202
Active current rise time	Pos. seq.			[s]	0.000

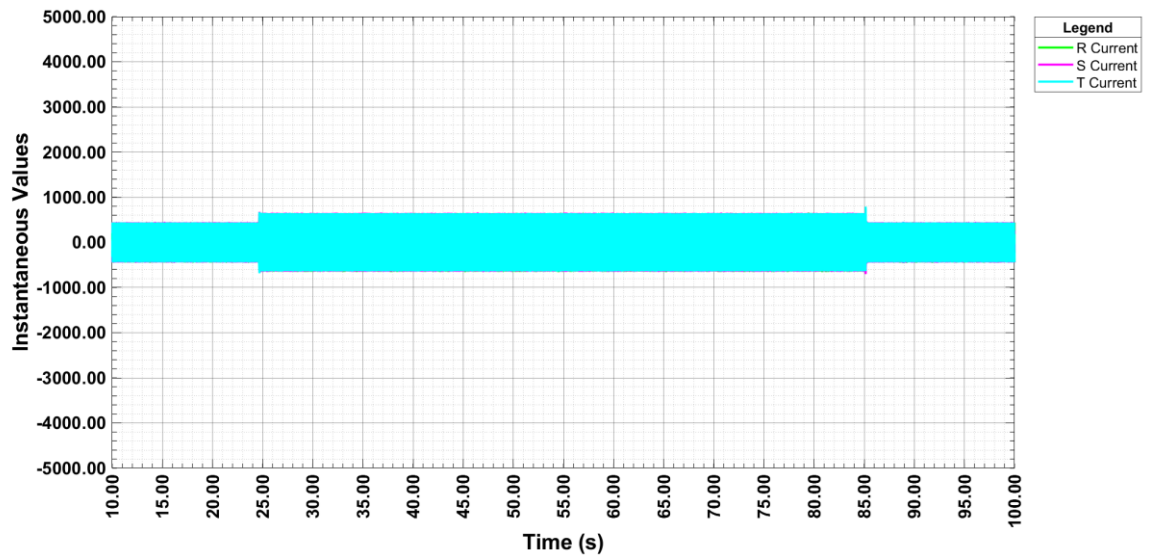
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.3

Phase-to-Phase voltages



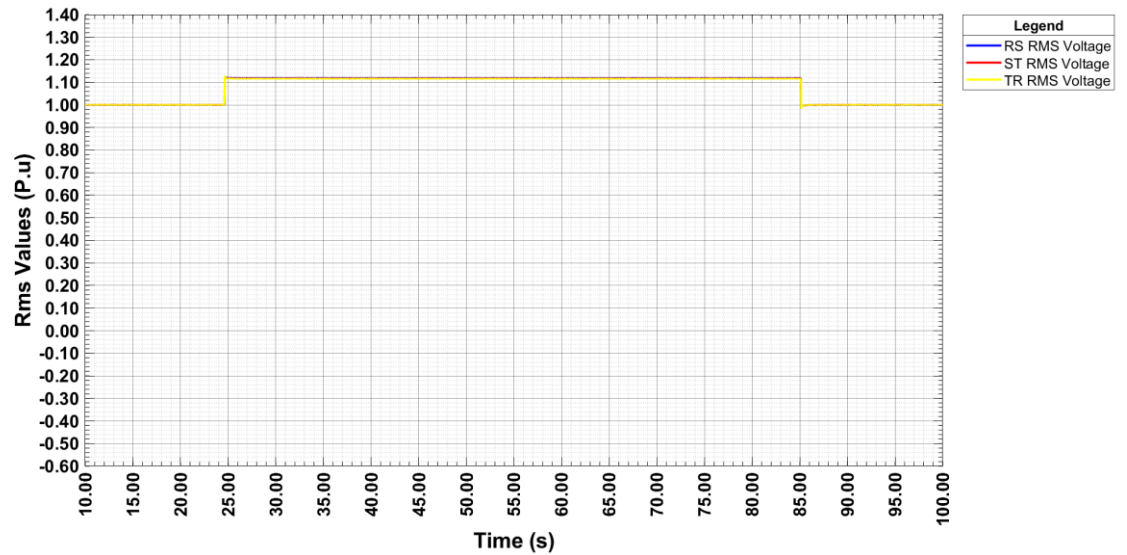
Phase currents



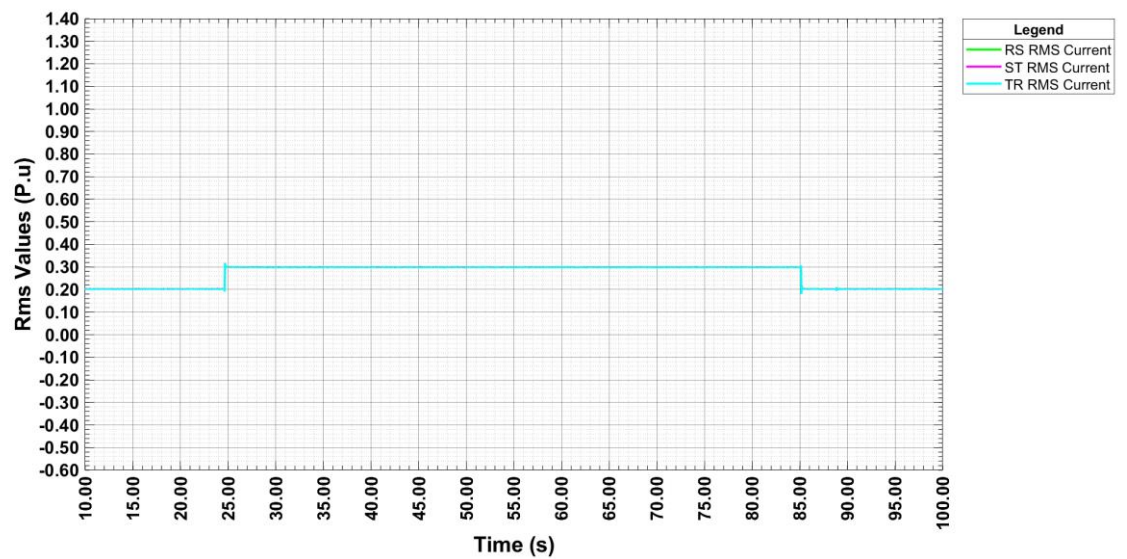
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.3

RMS Phase to phase voltages



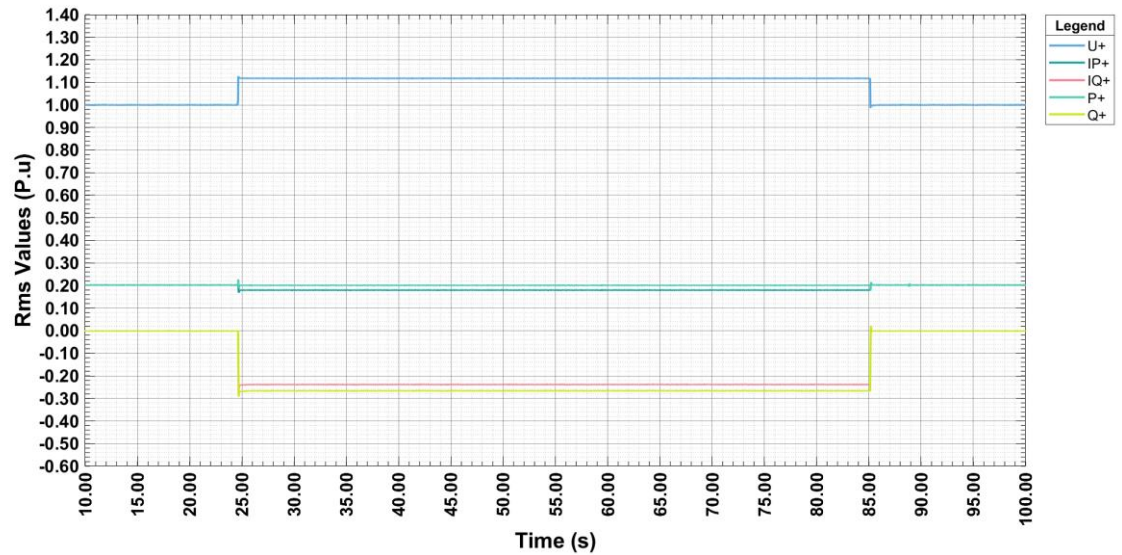
RMS Phase currents



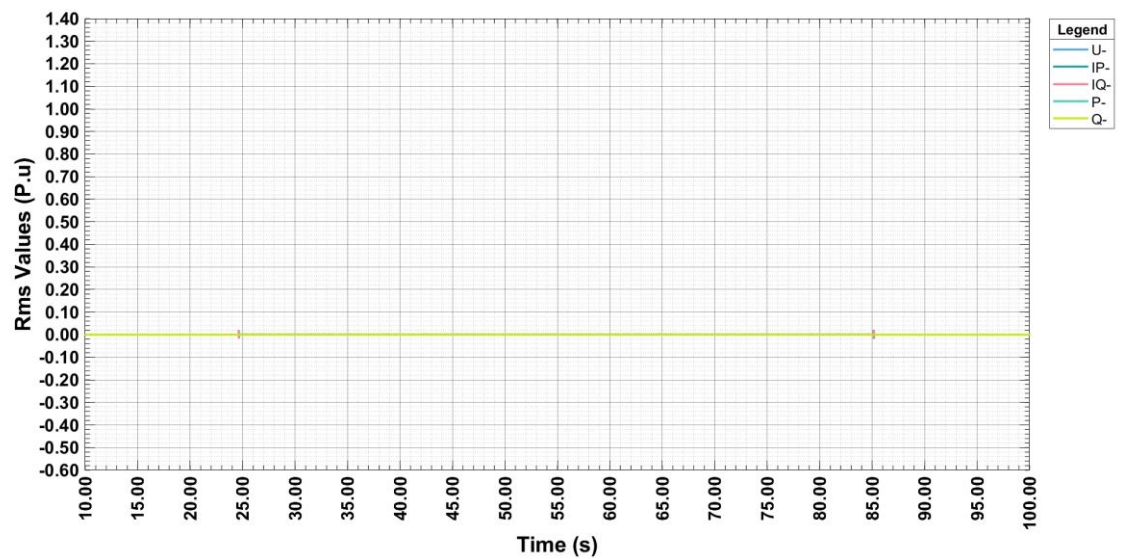
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.3

Positive sequences



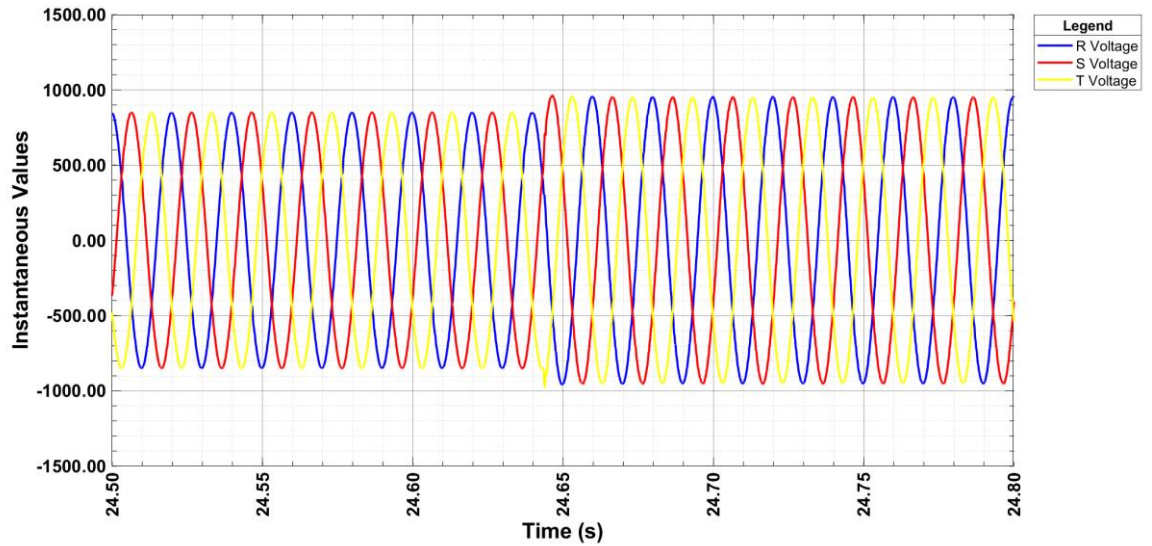
Negative sequences



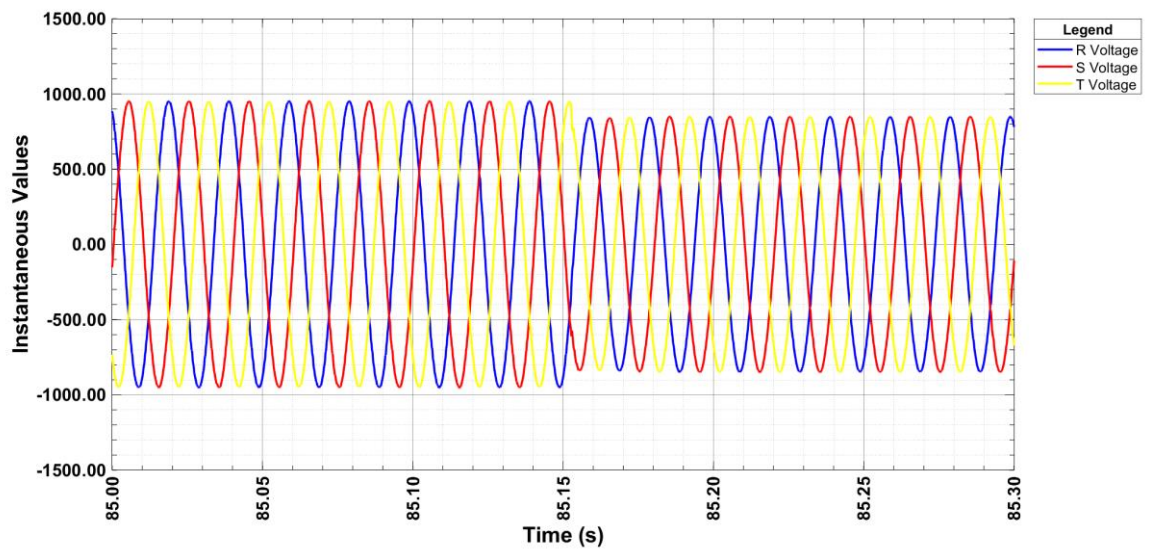
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.3

Transient voltage: Fault beginning



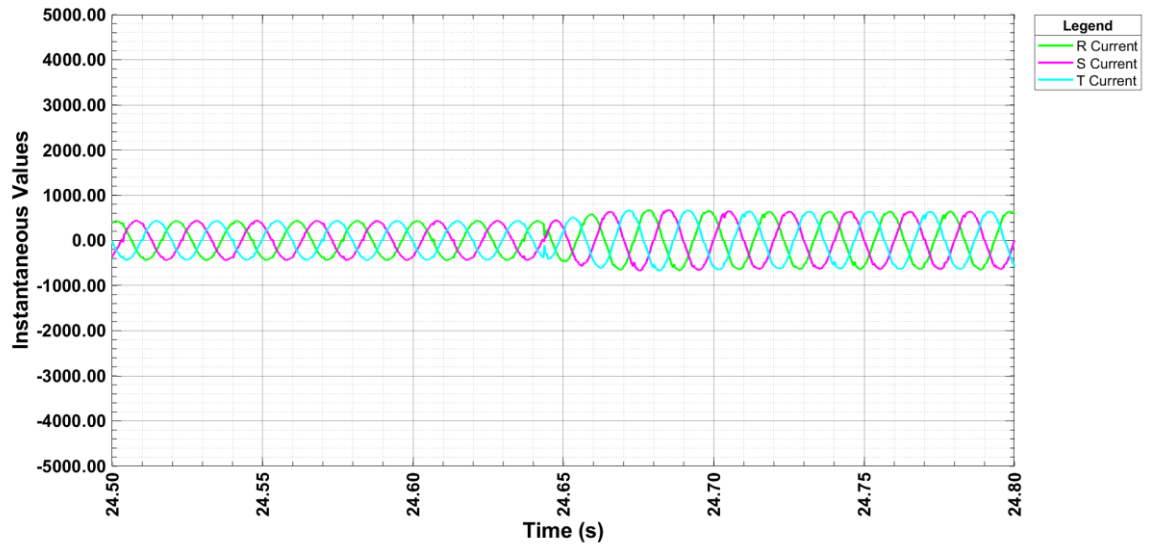
Transient voltage: Fault end



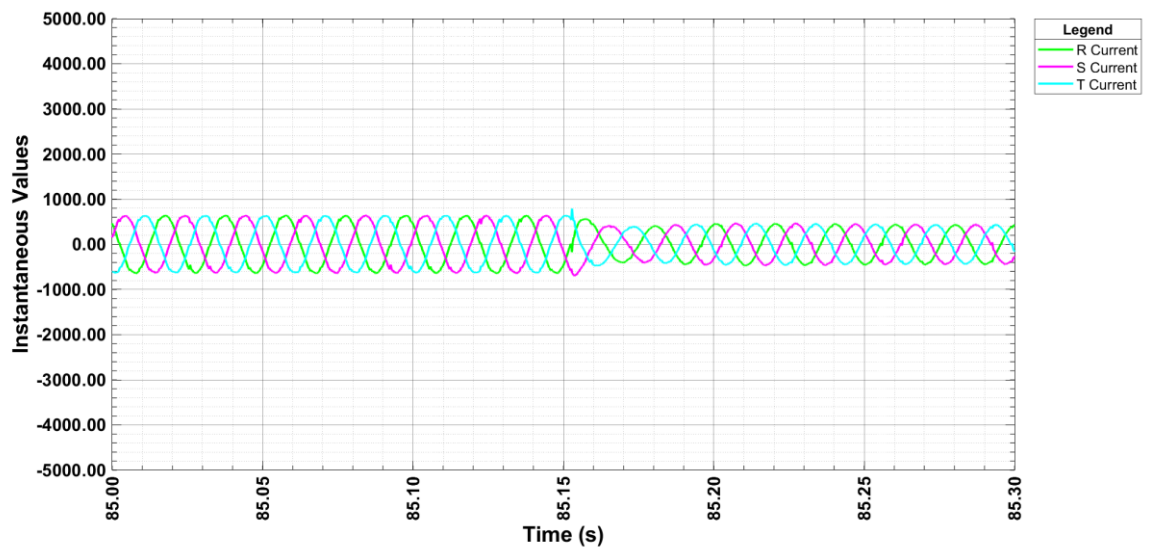
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 110.3

Transient current: Fault beginning



Transient current: Fault end



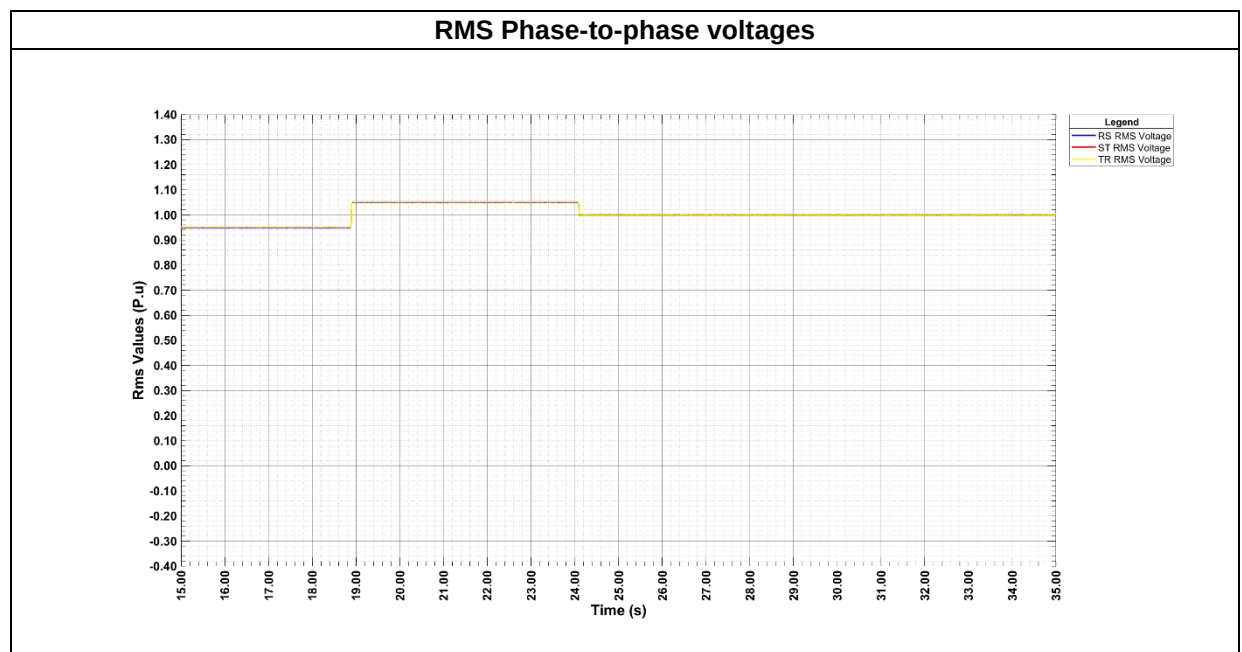
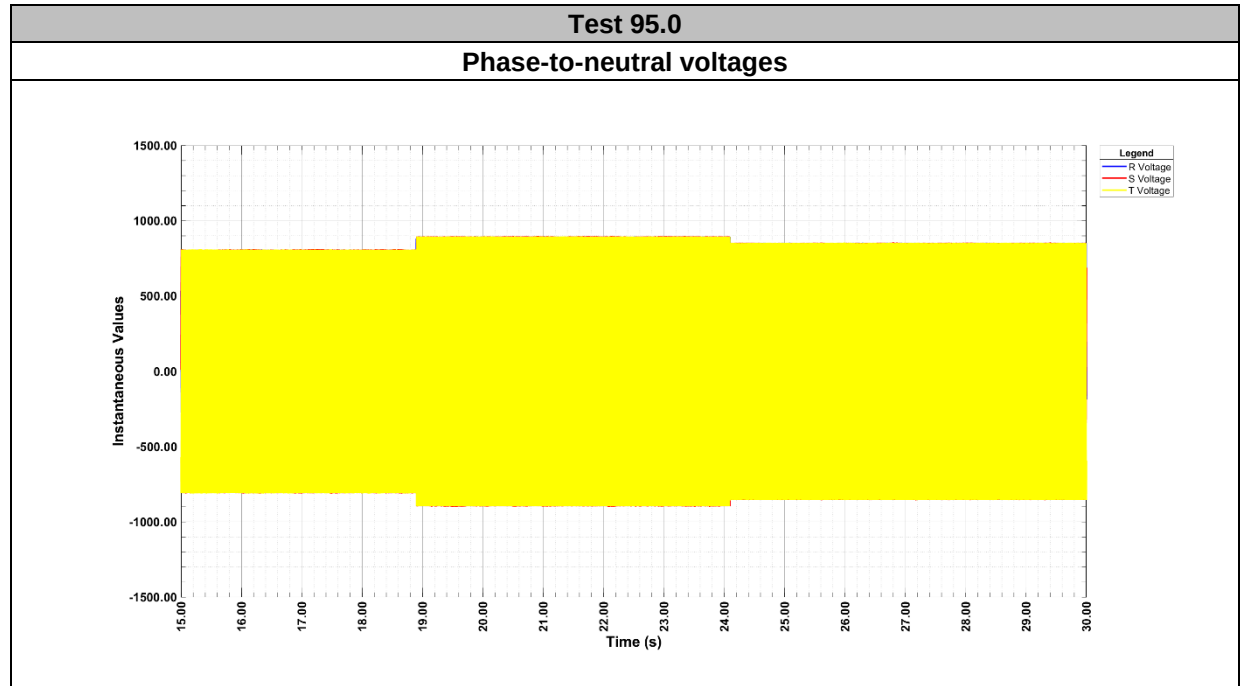
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

3.3 ADDITIONAL ABRUPT VOLTAGE CHANGE TESTS

3.3.1 No load tests

No load tests have been performed to check that the settings for each test are correctly set in accordance with the standard requirements. In the table below of point 3.3.1, the number 0 makes reference for the no load test equivalent to the code stated in page 14 of the report. And for the Phase-to-neutral voltages, the unit is V.

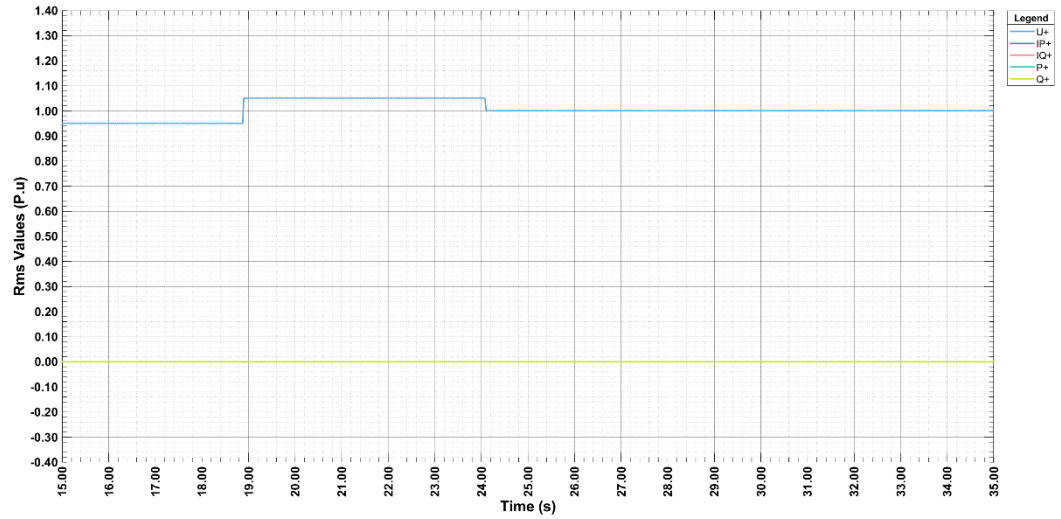
3.3.1.1 Test 95.0, 3 phases; Voltage changed from 0.95 Un to 1.05 Un



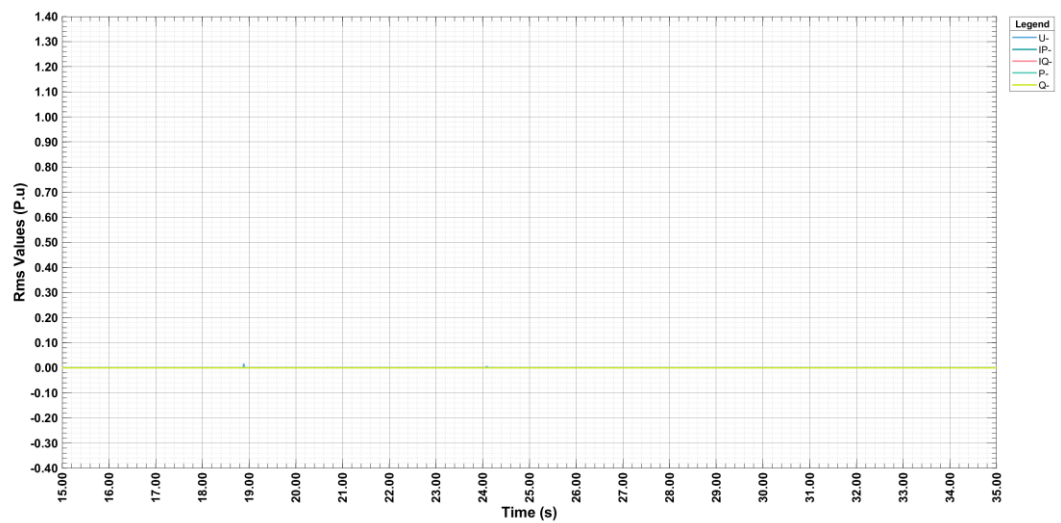
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.0

Positive sequences

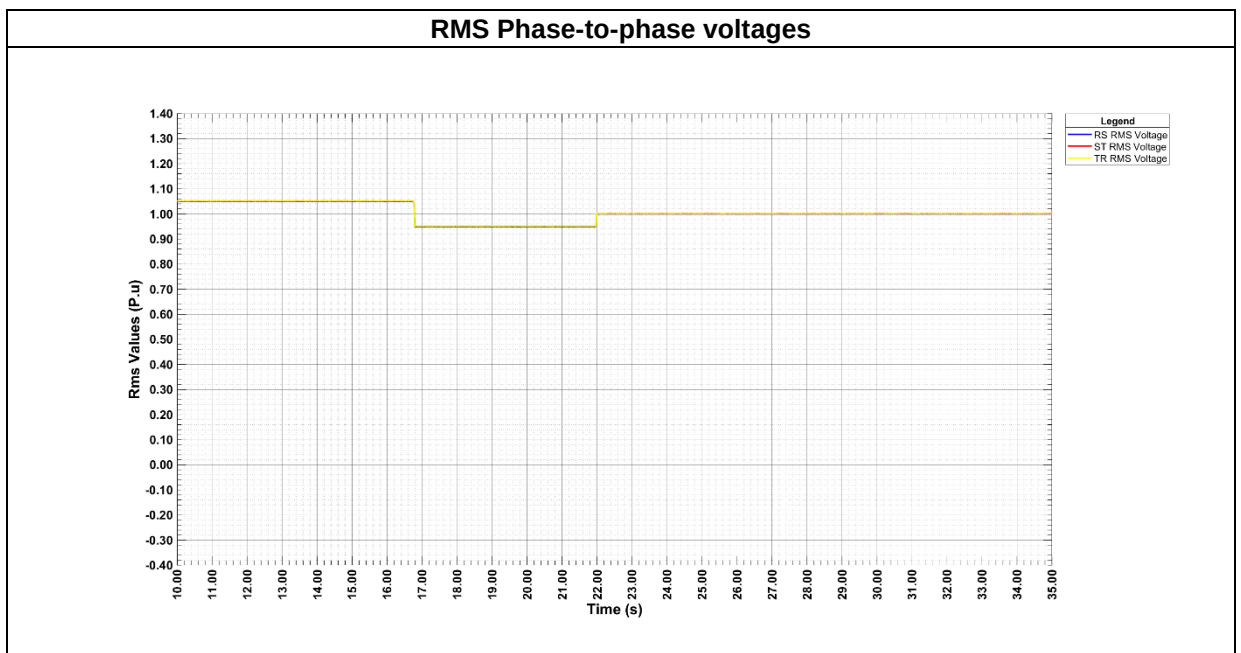
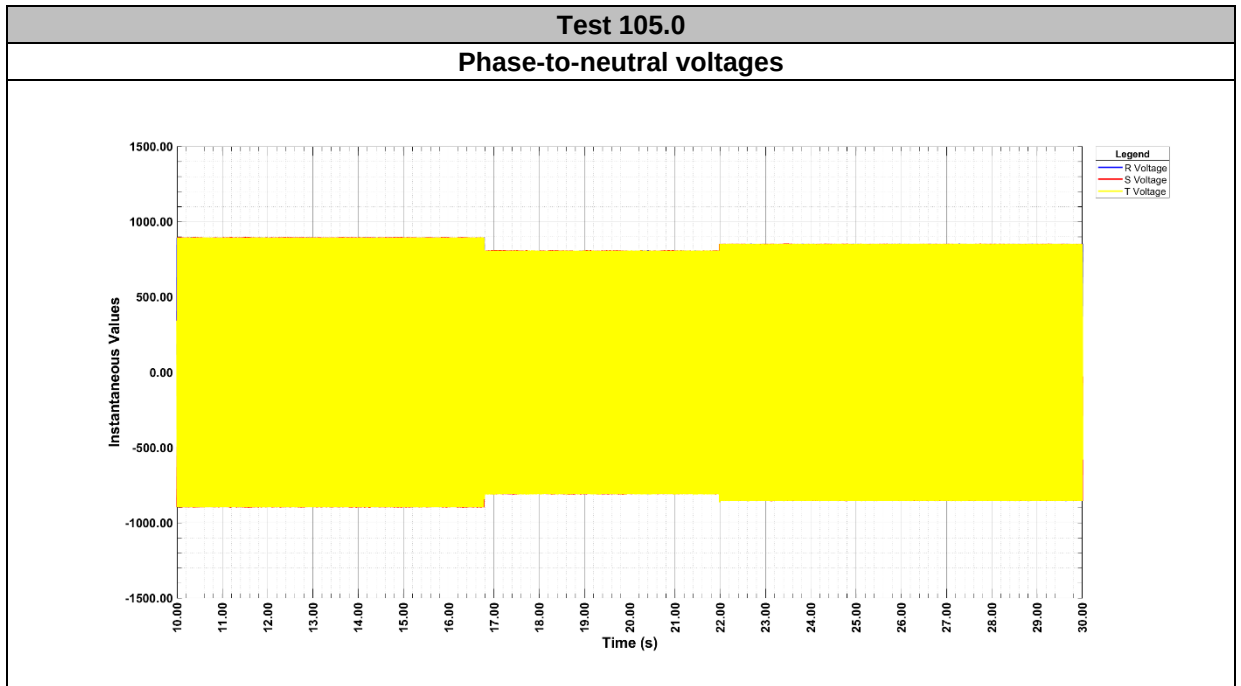


Negative sequences



FRT test in FGW-TG3+SP1: Grid Fault Tests Results

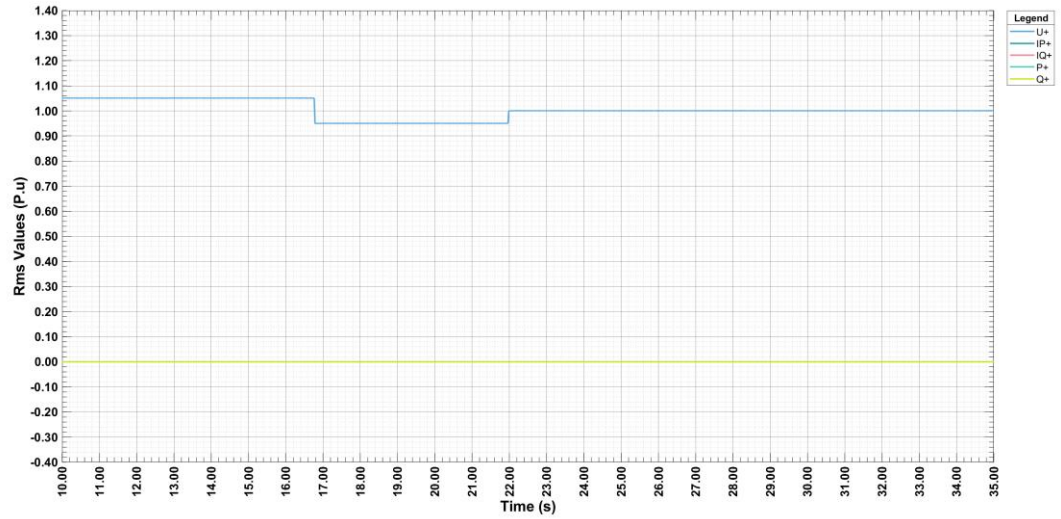
3.3.1.2 Test 105.0, 3 phases; Voltage changed from 1.05 Un to 0.95 Un



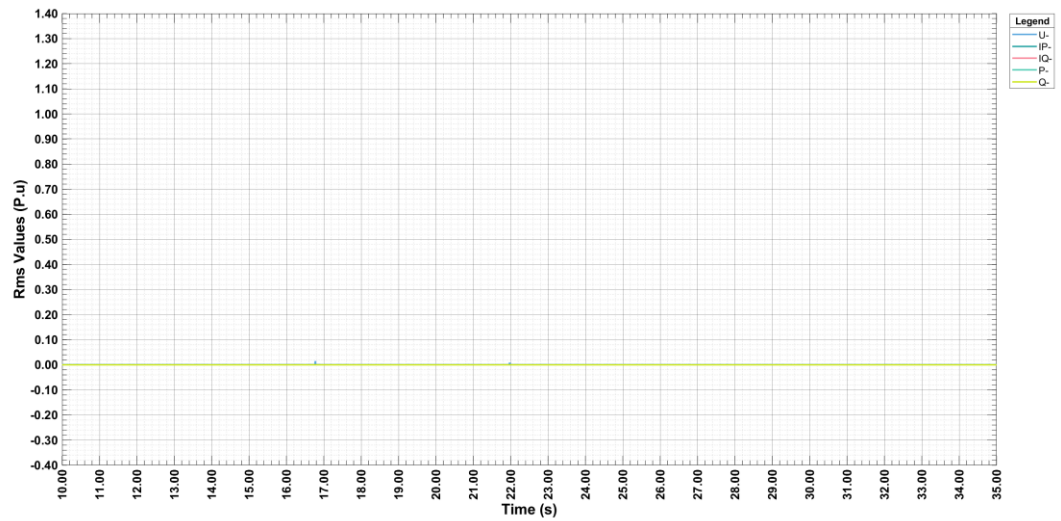
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.0

Positive sequences



Negative sequences



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FRT test in FGW-TG3+SP1: Grid Fault Tests Results		

3.3.2 Load tests: Voltage changed from 0.95 Un to 1.05 Un

In this chapter of the test report are shown the test results and diagrams for the load tests configured with Voltage changed from 0.95 Un to 1.05 Un. These are included in this point the tests 95.1 and 95.2 according to the table in page 14 of the report. For the voltages and currents in the below picture tables, the unit is V and A.

3.3.2.1 Test 95.1 Fault type: 3 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	95.1
	Date		-	[dd.mm.yyyy]	20.03.2021
	Time		-	[hh:mm:ss]	13:52:09
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.950 to 1.050
	Drop duration setpoint		-	[ms]	5000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	17612
	Fault clearance (t2)		-	[ms]	22808
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	5196
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	1.054 / 0.952
		Pos. seq.		[p.u.]	1.054 / 0.952

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.952
		Neg. seq.	t1-60 s to t1	[p.u.]	0.002
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.952
		Pos. seq.	t1-1 s to t1	[p.u.]	0.952
		Neg. seq.	t1-1 s to t1	[p.u.]	0.002
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.048
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.002
		Pos. seq.	t1-1 s to t1	[p.u.]	0.002
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	1.047
	Active Power	Total	t1-10 s to t1	[p.u.]	0.997
		Total	t1-2 s to t1	[p.u.]	0.997
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.997
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.002
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.000
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.054
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.003
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.204
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.816
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.002
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.834
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.834

Note: When the inverter detected an abrupt voltage situation as defined by the manufacturer, it will produce reactive current base on the difference between the changed voltage and the previous voltage. Therefore, the K factor was calculated base on this.

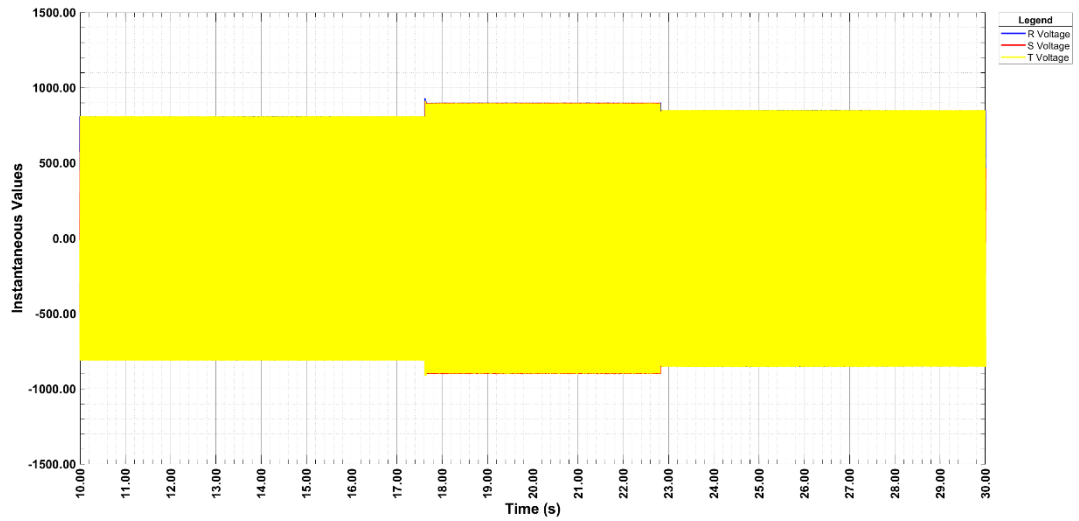
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1574
		Phase 2	t1 to t1+20 ms	[A]	1557
		Phase 3	t1 to t1+20 ms	[A]	1549
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.961
		Phase 2	t1 + 20 ms	[p.u.]	0.979
		Phase 3	t1 + 20 ms	[p.u.]	0.820
		Phase 1	t1 + 100 ms	[p.u.]	0.820
		Phase 2	t1 + 100 ms	[p.u.]	0.818
		Phase 3	t1 + 100 ms	[p.u.]	0.820
		Phase 1	t1 + 150 ms	[p.u.]	0.821
		Phase 2	t1 + 150 ms	[p.u.]	0.817
		Phase 3	t1 + 150 ms	[p.u.]	0.818
		Phase 1	t1 + 300 ms	[p.u.]	0.818
		Phase 2	t1 + 300 ms	[p.u.]	0.816
		Phase 3	t1 + 300 ms	[p.u.]	0.817
		Phase 1	t1 + 500 ms	[p.u.]	0.818
		Phase 2	t1 + 500 ms	[p.u.]	0.815
		Phase 3	t1 + 500 ms	[p.u.]	0.816
		Phase 1	t1 + 1000 ms	[p.u.]	0.818
		Phase 2	t1 + 1000 ms	[p.u.]	0.817
		Phase 3	t1 + 1000 ms	[p.u.]	0.815
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.021
Active current rise time	Pos. seq.			[s]	0.018

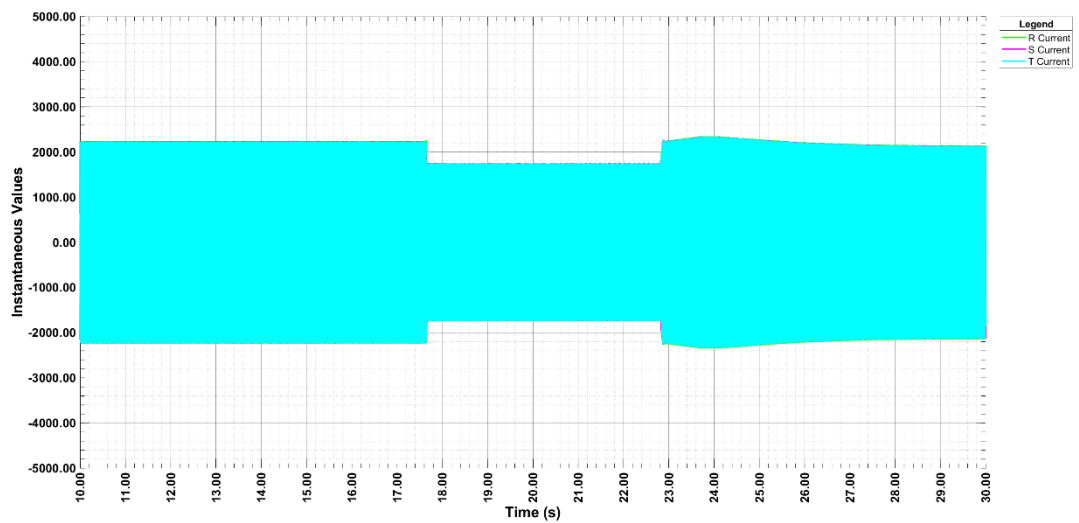
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.1

Phase-to-neutral voltages



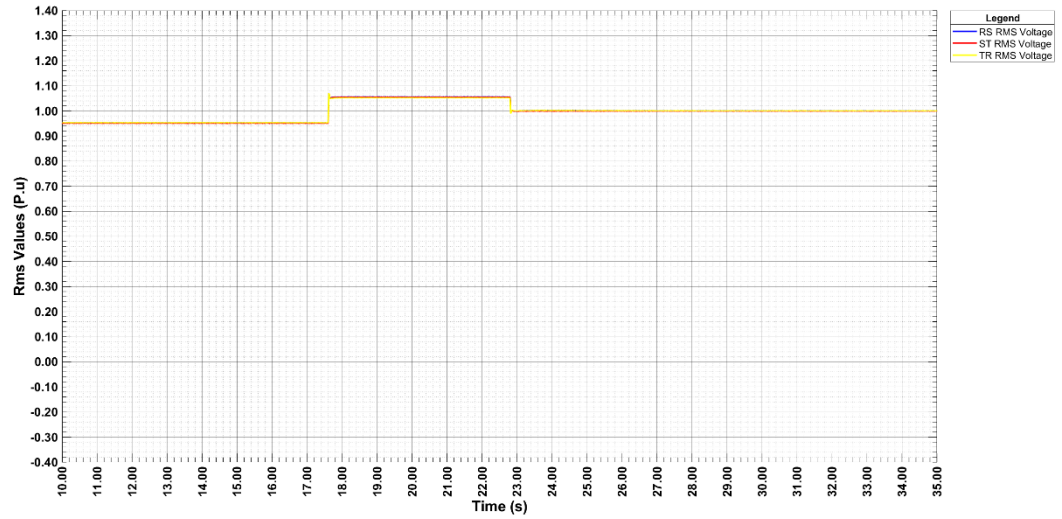
Phase currents



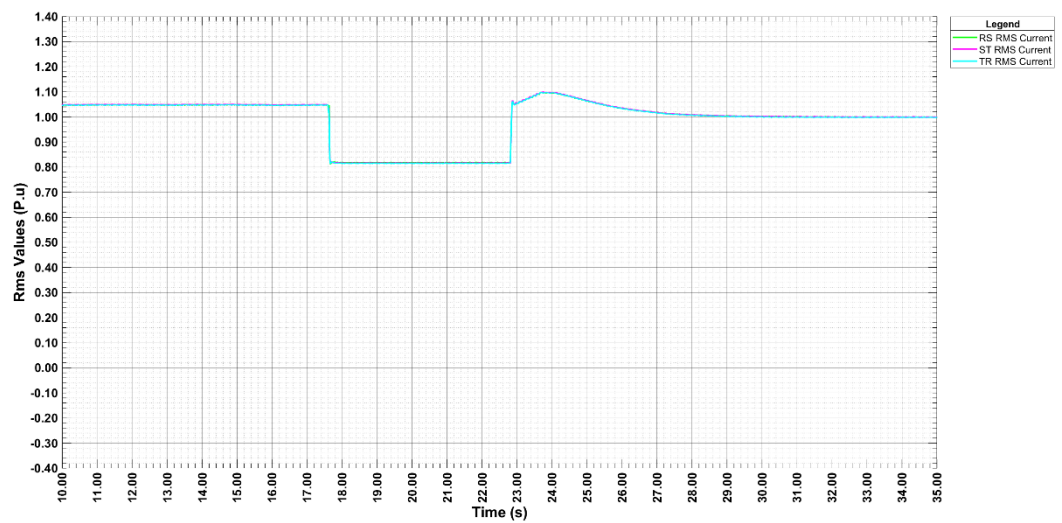
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.1

RMS Phase to phase voltages



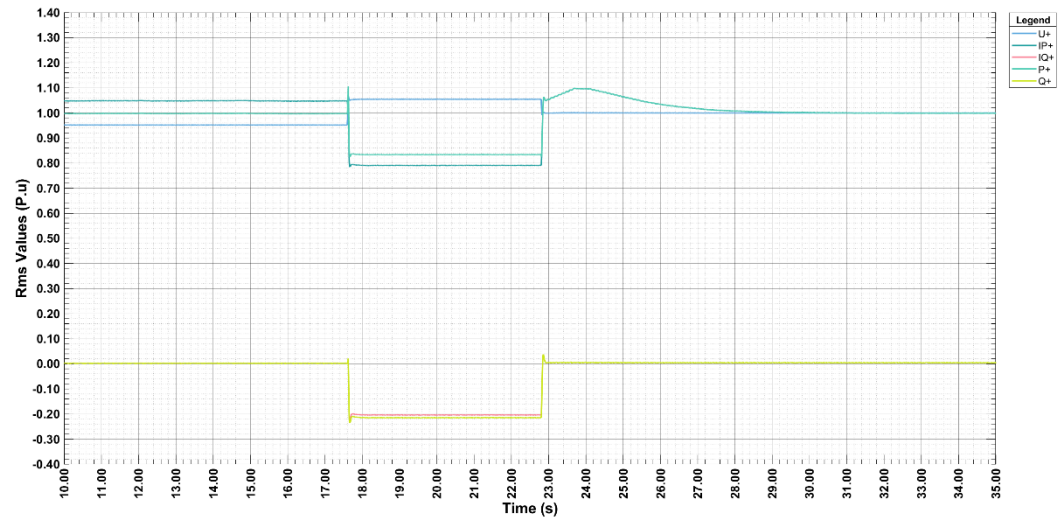
RMS Phase currents



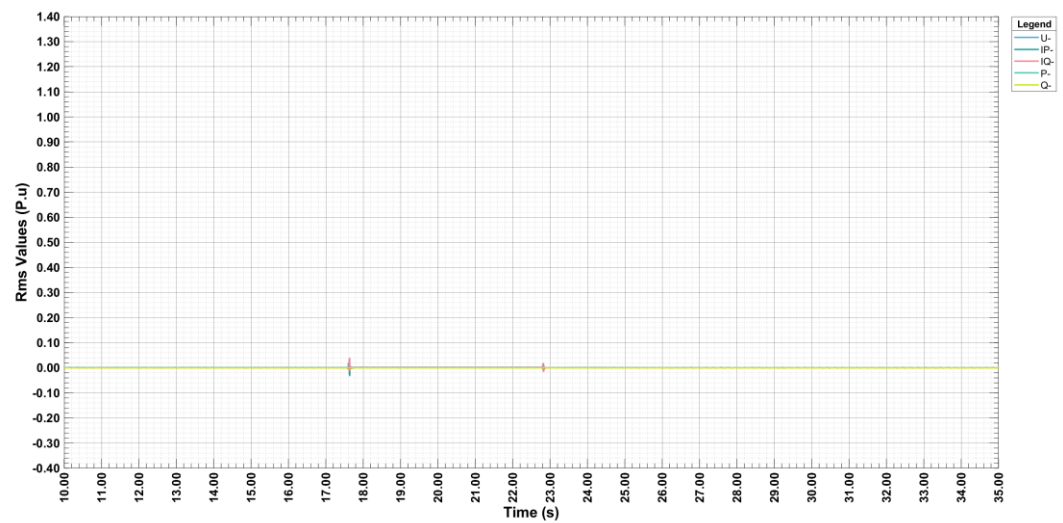
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.1

Positive sequences



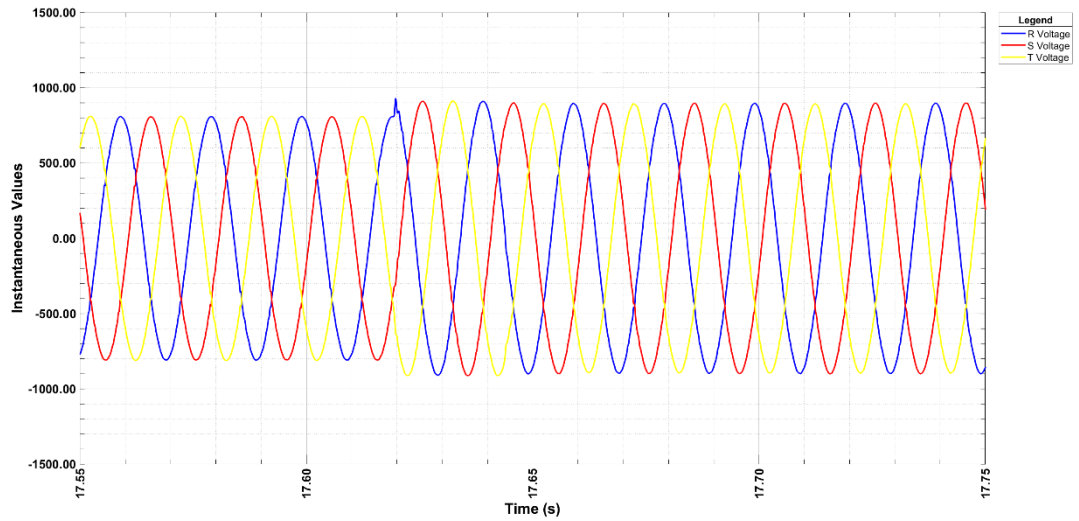
Negative sequences



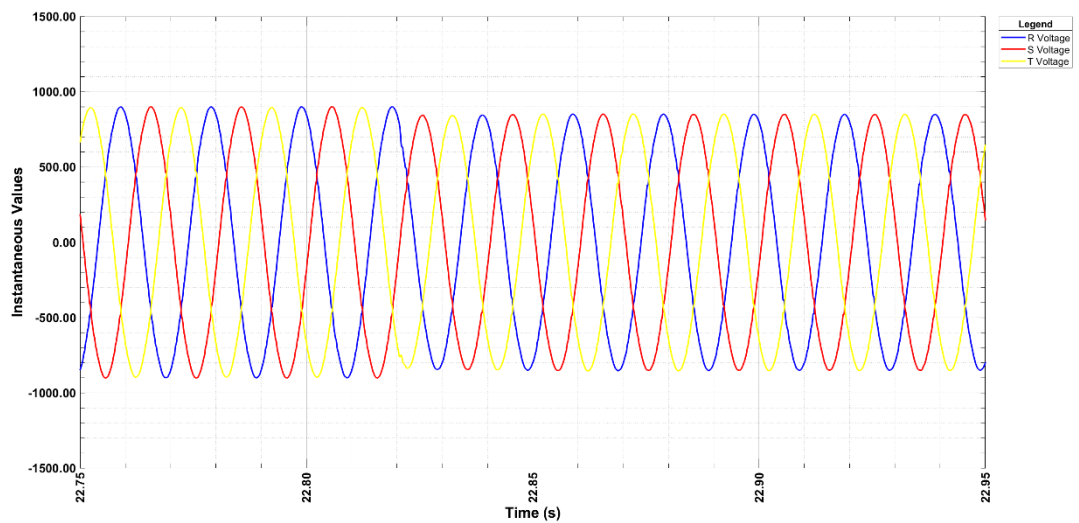
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.1

Transient voltage: Fault beginning



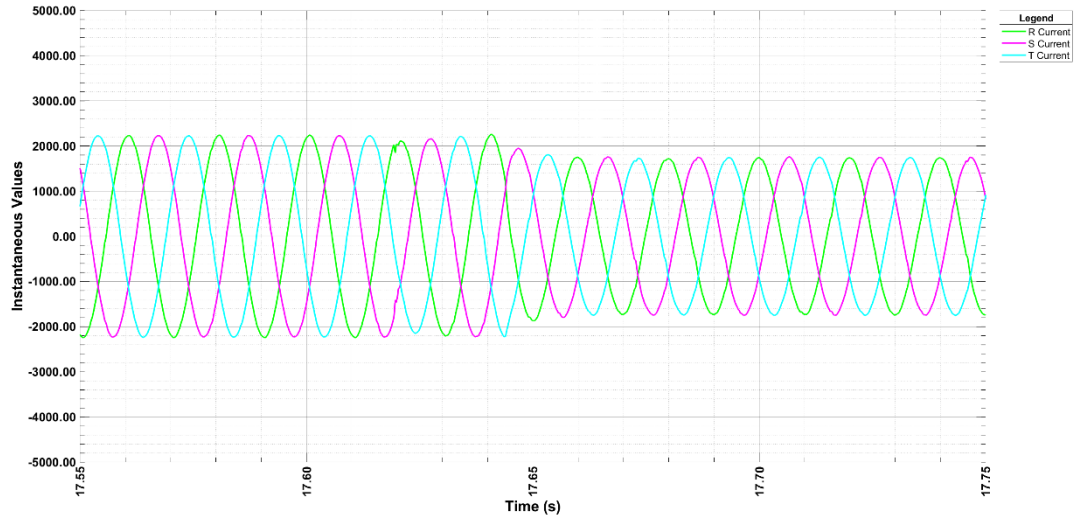
Transient voltage: Fault end



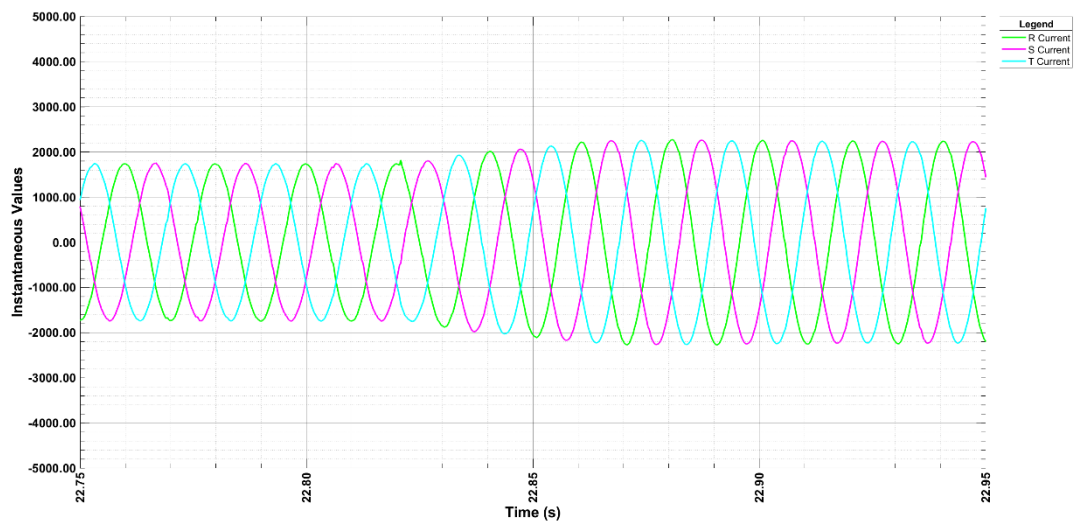
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.1

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.3.2.2 Test 95.2 Fault type: 3 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	95.2
	Date		-	[dd.mm.yyyy]	20.03.2021
	Time		-	[hh:mm:ss]	13:43:01
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	0.950 to 1.050
	Drop duration setpoint		-	[ms]	5000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	18254
	Fault clearance (t2)		-	[ms]	23450
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	5196
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	1.056/0.951
		Pos. seq.		[p.u.]	1.056/0.950

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	0.950
		Neg. seq.	t1-60 s to t1	[p.u.]	0.001
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.951
		Pos. seq.	t1-1 s to t1	[p.u.]	0.951
		Neg. seq.	t1-1 s to t1	[p.u.]	0.001
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.210
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	-0.002
		Pos. seq.	t1-1 s to t1	[p.u.]	-0.002
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.210
	Active Power	Total	t1-10 s to t1	[p.u.]	0.199
		Total	t1-2 s to t1	[p.u.]	0.199
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.200
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	-0.002
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.019
		Neg. seq.	-	-	0
	Reactive current settling up time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	14
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	1.056
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.003
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.214
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.000
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.300
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.222
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.222

Note: When the inverter detected an abrupt voltage situation as defined by the manufacturer, it will produce reactive current base on the difference between the changed voltage and the previous voltage. Therefore, the K factor was calculated base on this.

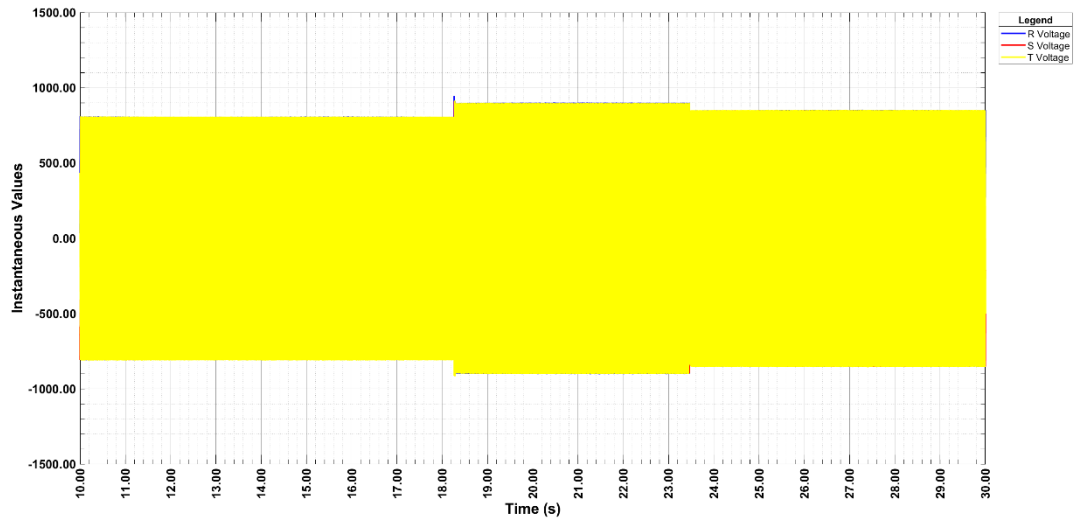
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	385
		Phase 2	t1 to t1+20 ms	[A]	370
		Phase 3	t1 to t1+20 ms	[A]	386
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.248
		Phase 2	t1 + 20 ms	[p.u.]	0.246
		Phase 3	t1 + 20 ms	[p.u.]	0.297
		Phase 1	t1 + 100 ms	[p.u.]	0.298
		Phase 2	t1 + 100 ms	[p.u.]	0.296
		Phase 3	t1 + 100 ms	[p.u.]	0.297
		Phase 1	t1 + 150 ms	[p.u.]	0.297
		Phase 2	t1 + 150 ms	[p.u.]	0.295
		Phase 3	t1 + 150 ms	[p.u.]	0.295
		Phase 1	t1 + 300 ms	[p.u.]	0.300
		Phase 2	t1 + 300 ms	[p.u.]	0.298
		Phase 3	t1 + 300 ms	[p.u.]	0.297
		Phase 1	t1 + 500 ms	[p.u.]	0.300
		Phase 2	t1 + 500 ms	[p.u.]	0.300
		Phase 3	t1 + 500 ms	[p.u.]	0.298
		Phase 1	t1 + 1000 ms	[p.u.]	0.301
		Phase 2	t1 + 1000 ms	[p.u.]	0.301
		Phase 3	t1 + 1000 ms	[p.u.]	0.301
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.200
Active current rise time	Pos. seq.			[s]	0.000

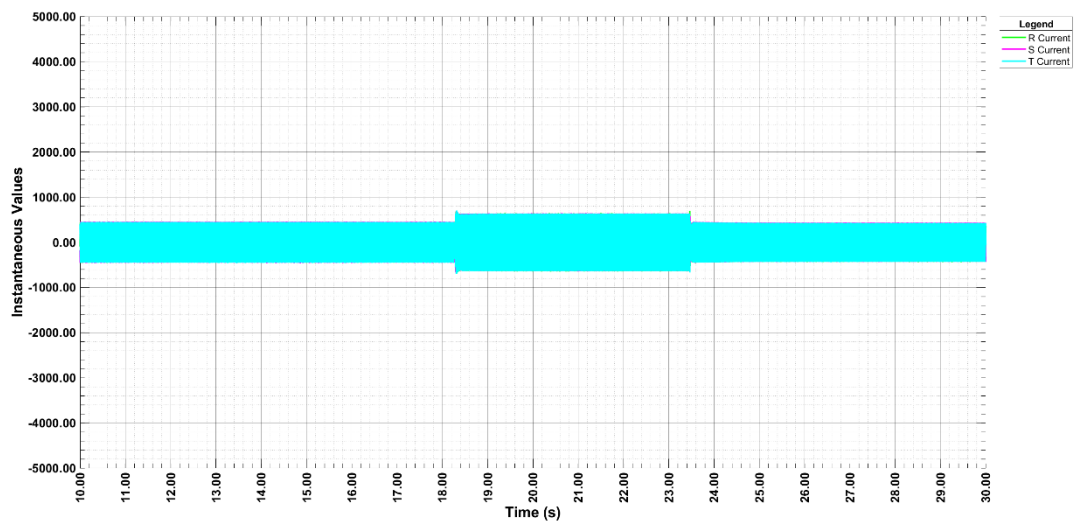
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.2

Phase-to-neutral voltages



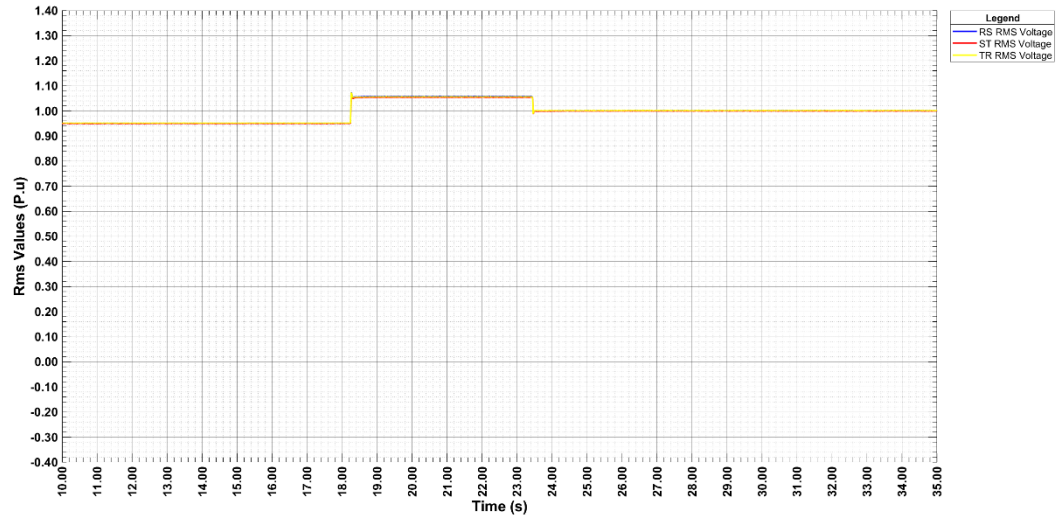
Phase currents



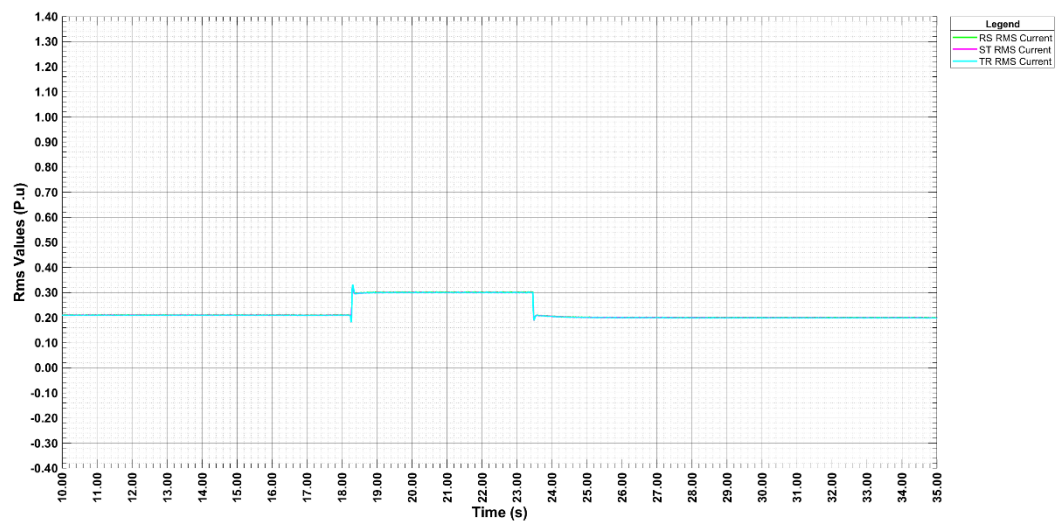
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.2

RMS Phase to phase voltages



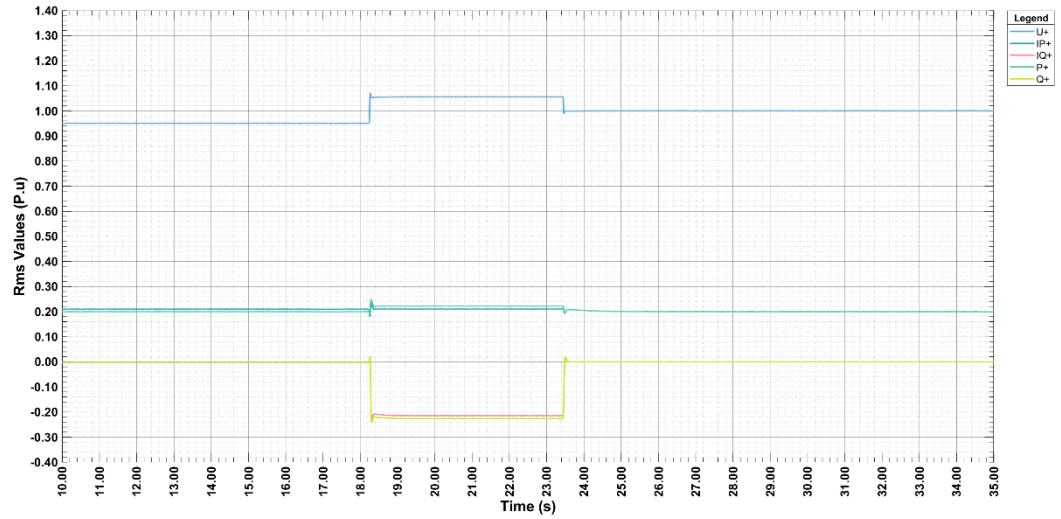
RMS Phase currents



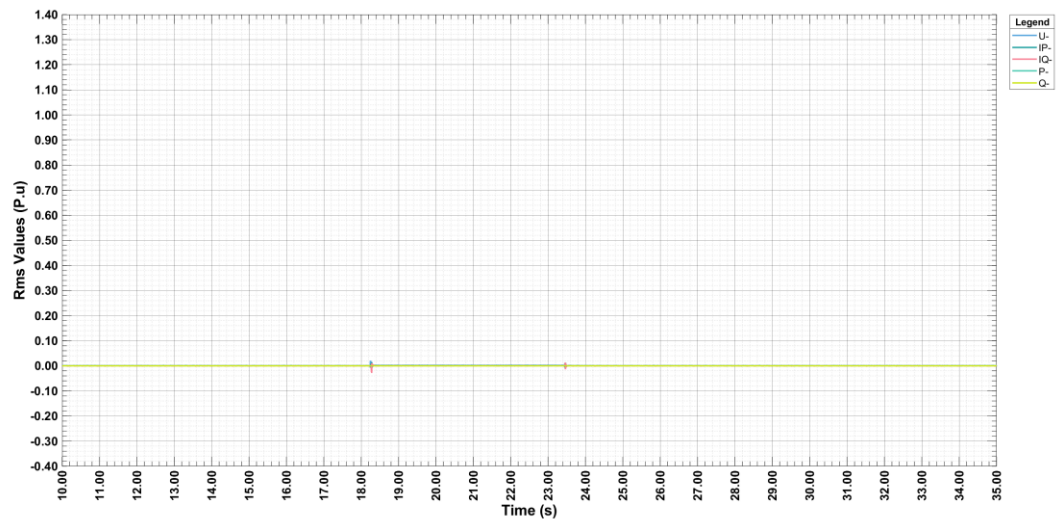
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.2

Positive sequences



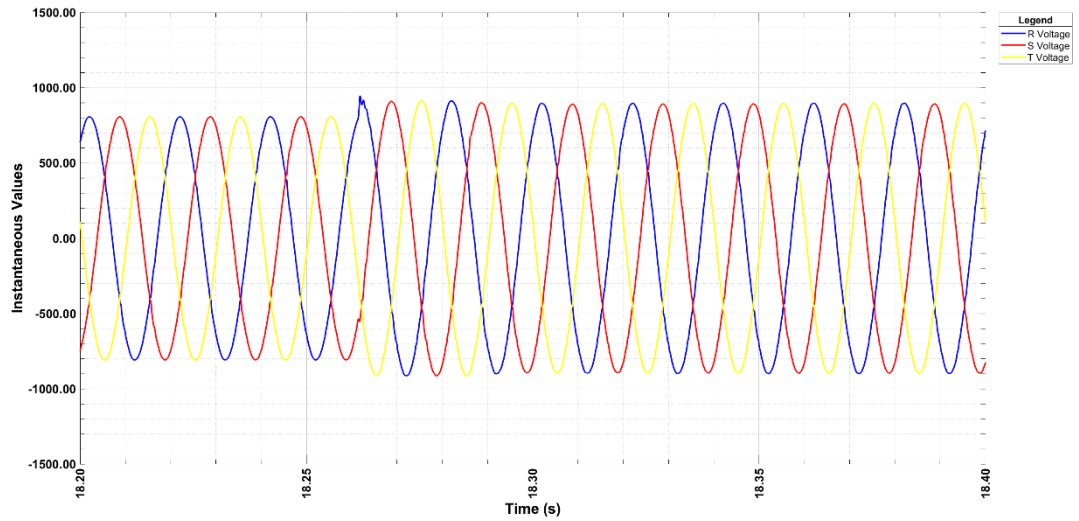
Negative sequences



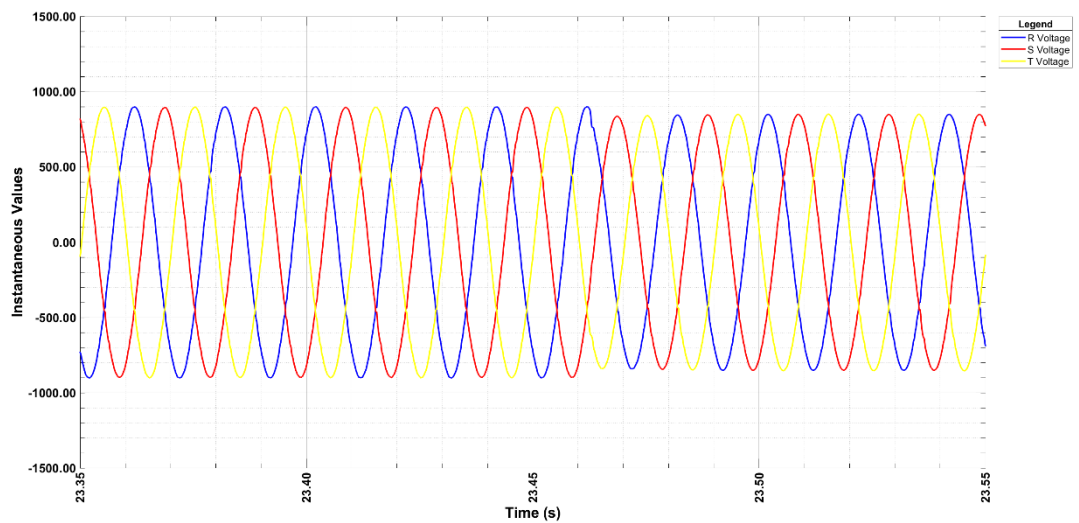
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.2

Transient voltage: Fault beginning



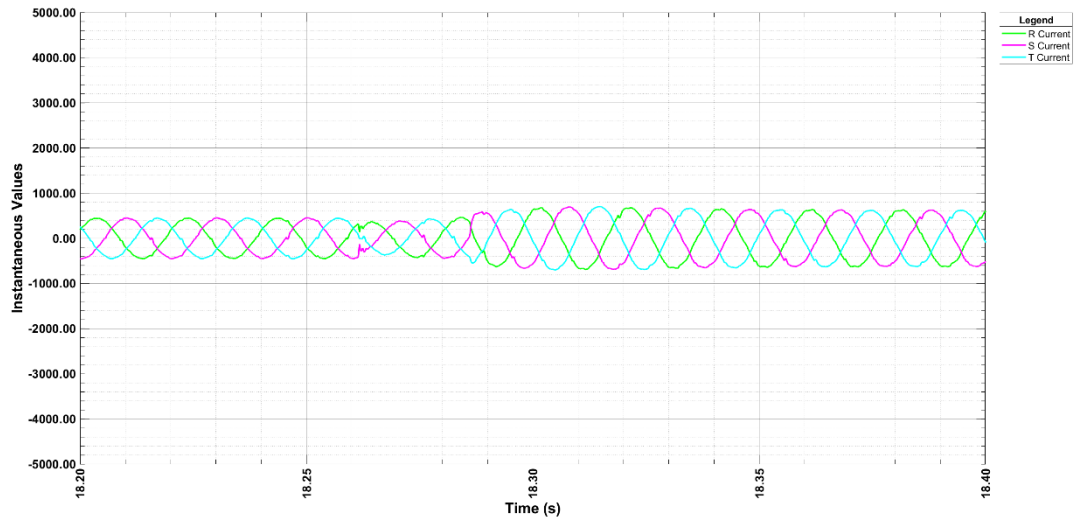
Transient voltage: Fault end



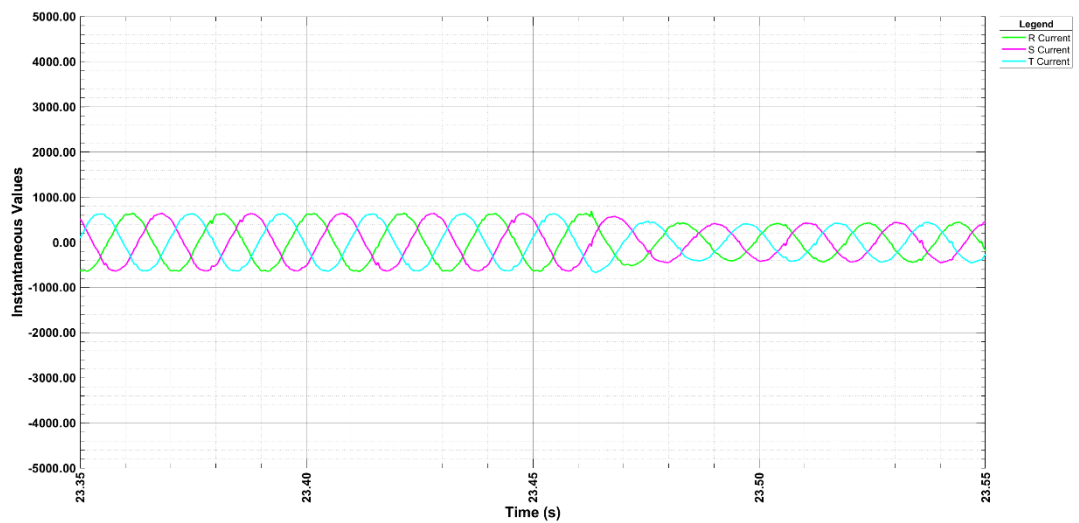
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 95.2

Transient current: Fault beginning



Transient current: Fault end



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FRT test in FGW-TG3+SP1: Grid Fault Tests Results		

3.3.3 Load tests: Voltage changed from 1.05 Un to 0.95 Un

In this chapter of the test report are shown the test results and diagrams for the load tests configured with Voltage changed from 1.05 Un to 0.95 Un. There are included in this point the tests 105.1 and 105.2 according to the table in page 14 of the report. For the voltages and currents in the below pictures and tables, the units are V and A.

3.3.3.1 Test 105.1 Fault type: 3 phases, Full load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	105.1
	Date		-	[dd.mm.yyyy]	20.03.2021
	Time		-	[hh:mm:ss]	13:53:05
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	1.050 to 0.950
	Drop duration setpoint		-	[ms]	5000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	18644
	Fault clearance (t2)		-	[ms]	23836
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	5191
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.953 / 1.049
		Pos. seq.		[p.u.]	0.953 / 1.049

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.049
		Neg. seq.	t1-60 s to t1	[p.u.]	0.000
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.049
		Pos. seq.	t1-1 s to t1	[p.u.]	1.048
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.950
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.007
		Pos. seq.	t1-1 s to t1	[p.u.]	0.007
		Neg. seq.	t1-1 s to t1	[p.u.]	0.001
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.951
	Active Power	Total	t1-10 s to t1	[p.u.]	0.998
		Total	t1-2 s to t1	[p.u.]	0.997
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.997
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.007
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.177
		Neg. seq.	-	-	0
	Reactive current settling up time	Pos. seq.	-	[ms]	18
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	18
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.953
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.002
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.209
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.000
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.816
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.002
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.751
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.751

Note: When the inverter detected an abrupt voltage situation as defined by the manufacturer, it will produce reactive current base on the difference between the changed voltage and the previous voltage. Therefore, the K factor was calculated base on this.

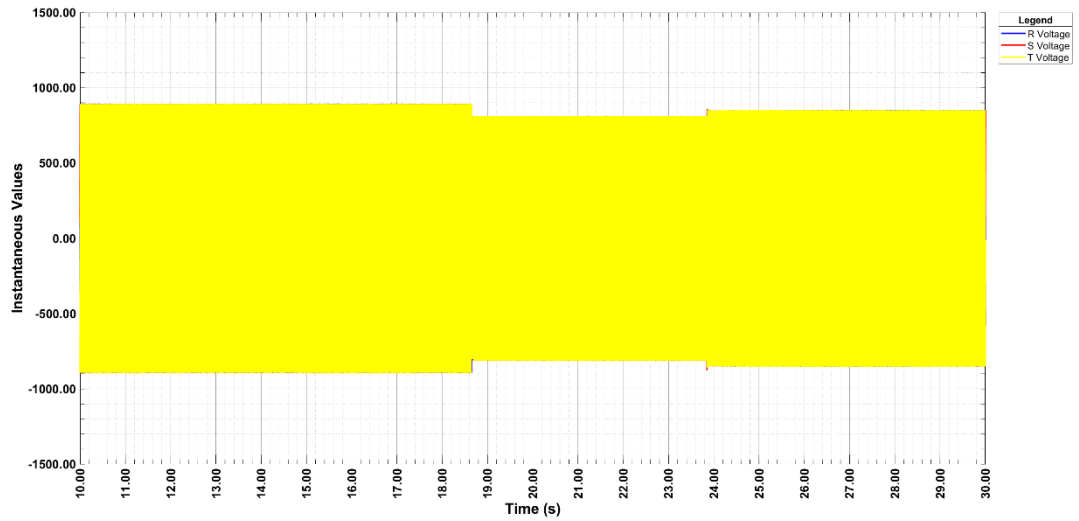
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	1471
		Phase 2	t1 to t1+20 ms	[A]	1470
		Phase 3	t1 to t1+20 ms	[A]	1472
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.855
		Phase 2	t1 + 20 ms	[p.u.]	0.862
		Phase 3	t1 + 20 ms	[p.u.]	0.814
		Phase 1	t1 + 100 ms	[p.u.]	0.818
		Phase 2	t1 + 100 ms	[p.u.]	0.815
		Phase 3	t1 + 100 ms	[p.u.]	0.814
		Phase 1	t1 + 150 ms	[p.u.]	0.818
		Phase 2	t1 + 150 ms	[p.u.]	0.818
		Phase 3	t1 + 150 ms	[p.u.]	0.816
		Phase 1	t1 + 300 ms	[p.u.]	0.818
		Phase 2	t1 + 300 ms	[p.u.]	0.816
		Phase 3	t1 + 300 ms	[p.u.]	0.816
		Phase 1	t1 + 500 ms	[p.u.]	0.818
		Phase 2	t1 + 500 ms	[p.u.]	0.816
		Phase 3	t1 + 500 ms	[p.u.]	0.815
		Phase 1	t1 + 1000 ms	[p.u.]	0.818
		Phase 2	t1 + 1000 ms	[p.u.]	0.816
		Phase 3	t1 + 1000 ms	[p.u.]	0.813
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	1.007
Active current rise time	Pos. seq.			[s]	0.019

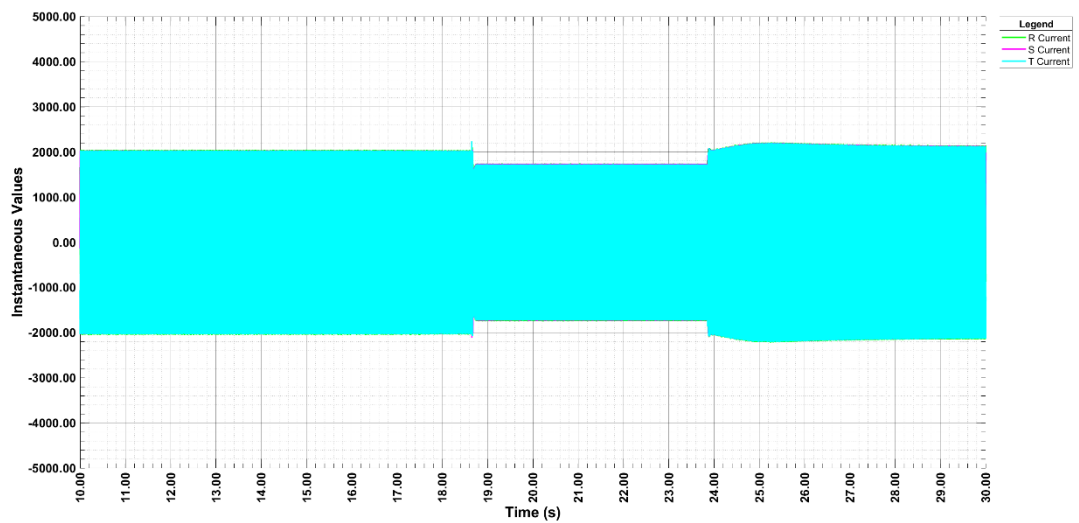
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.1

Phase-to-neutral voltages



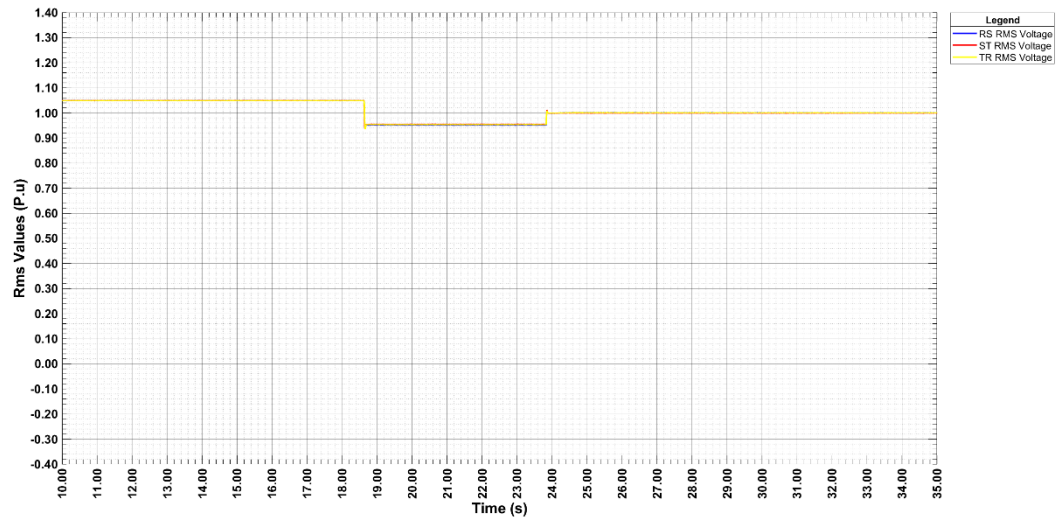
Phase currents



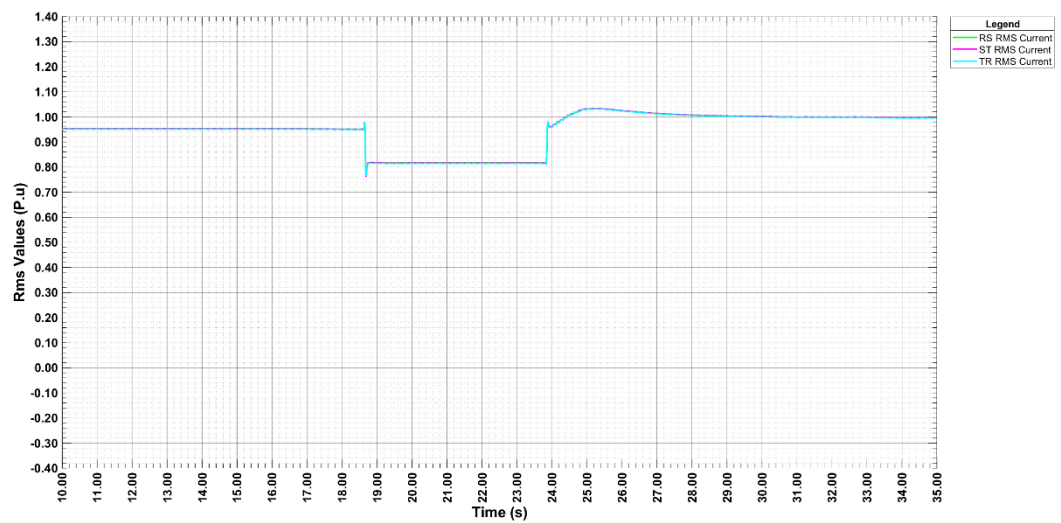
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.1

RMS Phase to phase voltages



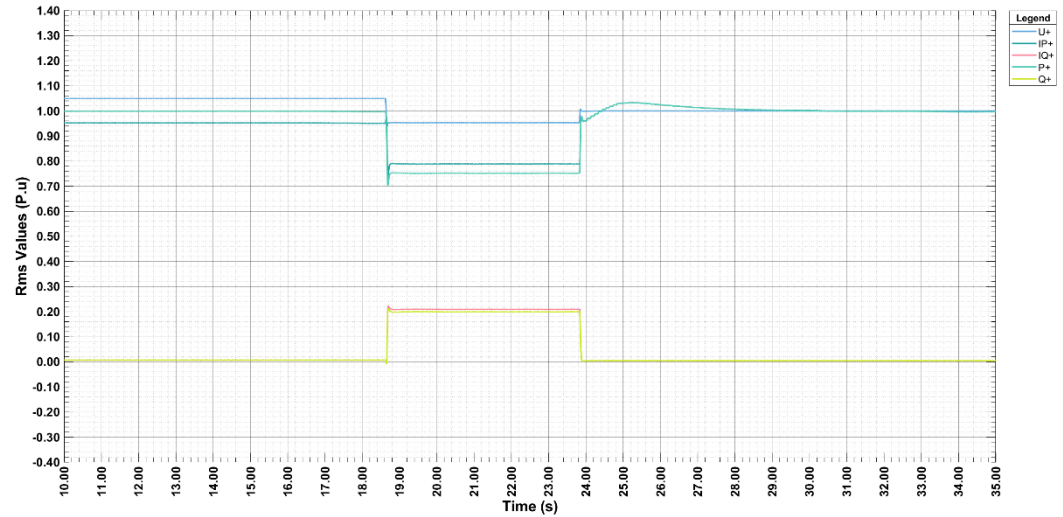
RMS Phase currents



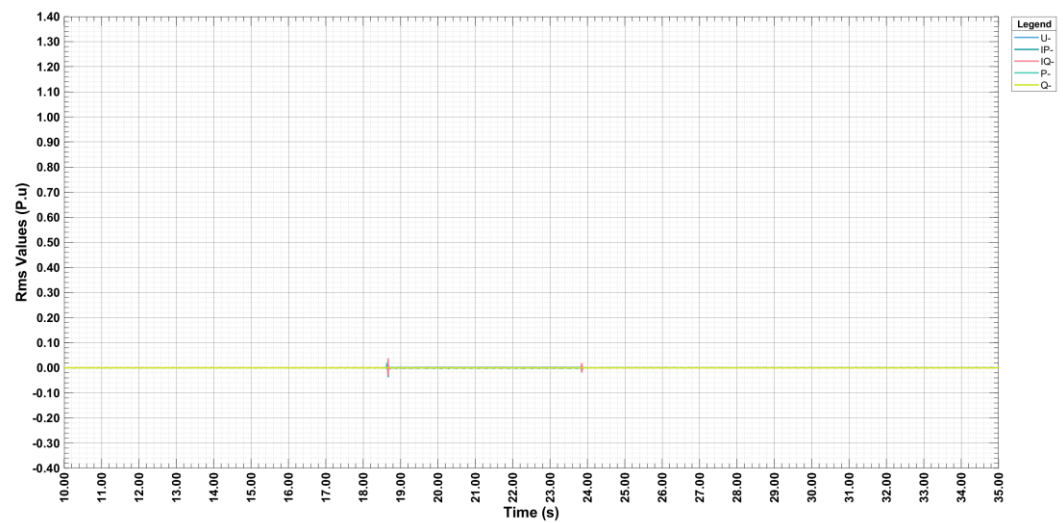
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.1

Positive sequences



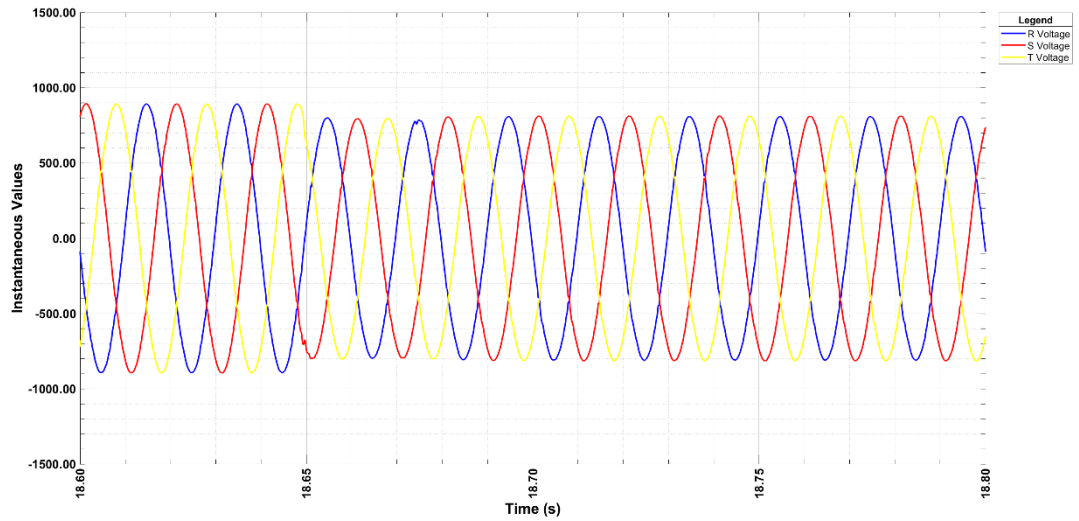
Negative sequences



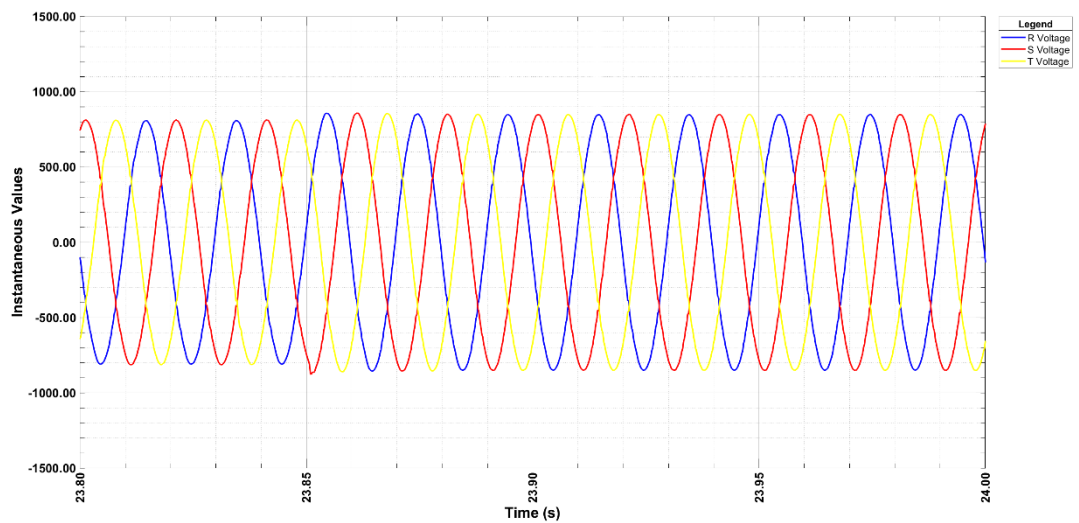
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.1

Transient voltage: Fault beginning



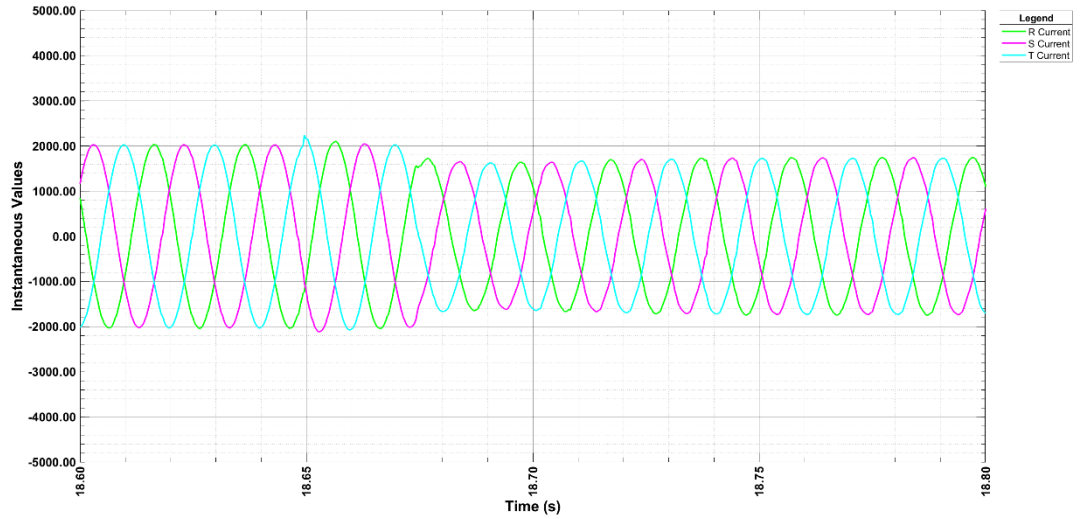
Transient voltage: Fault end



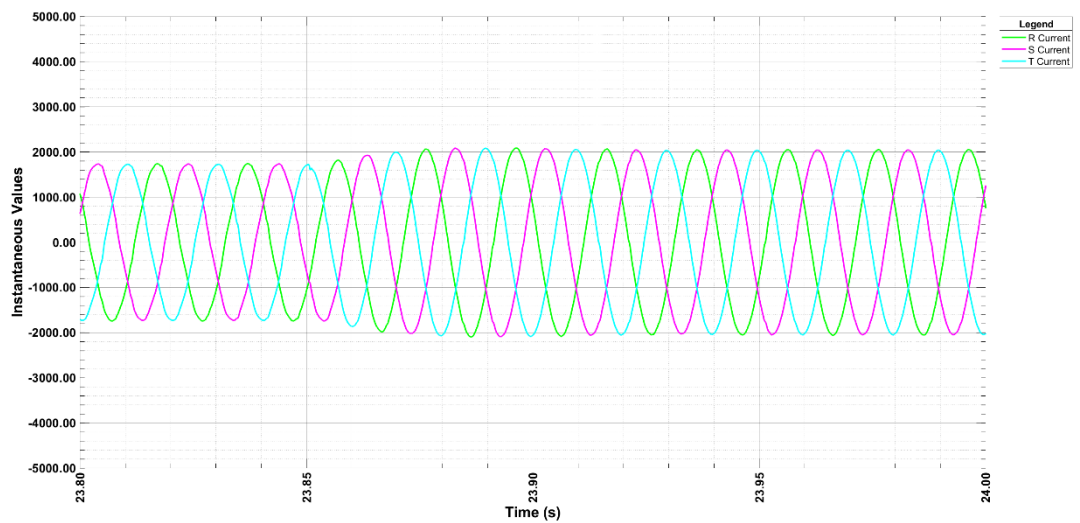
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.1

Transient current: Fault beginning



Transient current: Fault end



FRT test in FGW-TG3+SP1: Grid Fault Tests Results
3.3.3.2 Test 105.2 Fault type: 3 phases, Partial load

	Parameter	Phase reference	Reference time	Value [unit]	Measured
General information	Test number		-	-	105.2
	Date		-	[dd.mm.yyyy]	20.03.2021
	Time		-	[hh:mm:ss]	13:39:53
	Type of fault (number of affected phases)		-	-	3 phases
	Drop depth setpoint	Phase-conductor	-	[p.u.]	1.050 to 0.950
	Drop duration setpoint		-	[ms]	5000
	Series impedance switched in (t0)		-	[ms]	-
	Fault occurrence (t1)		-	[ms]	18347
	Fault clearance (t2)		-	[ms]	23540
	Bridging series impedance (t3)		-	[ms]	-
	Fault duration determined from test		-	[ms]	5192
	Actual value of voltage drop / voltage increase	Phase-conductor	t1+100 ms to t2 / t1-60 s to t1	[p.u.]	0.953 / 1.050
		Pos. seq.		[p.u.]	0.953 / 1.050

FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
Before t1	Voltage	Pos. seq.	t1-60 s to t1	[p.u.]	1.050
		Neg. seq.	t1-60 s to t1	[p.u.]	0.001
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	1.050
		Pos. seq.	t1-1 s to t1	[p.u.]	1.050
		Neg. seq.	t1-1 s to t1	[p.u.]	0.001
	Current	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.190
	Reactive current	Pos. seq.	t1-60 s to t1	[p.u.]	0.002
		Pos. seq.	t1-1 s to t1	[p.u.]	0.002
		Neg. seq.	t1-1 s to t1	[p.u.]	0.000
	Active current	Pos. seq.	t1-1 s to t1	[p.u.]	0.190
	Active Power	Total	t1-10 s to t1	[p.u.]	0.199
		Total	t1-2 s to t1	[p.u.]	0.200
		Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.200
	Reactive Power	Pos. seq.	t1-500 ms to t1-100 ms	[p.u.]	0.003
t1 to t2	Determined proportionality constant K-factor	Pos. seq.	-	-	2.124
		Neg. seq.	-	-	0.000
	Reactive current settling up time	Pos. seq.	-	[ms]	11
		Neg. seq.	-	[ms]	N/A
	Reactive current settling time	Pos. seq.	-	[ms]	11
		Neg. seq.	-	[ms]	N/A
	Voltage	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.953
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.002
	Reactive current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.206
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	-0.001
	Apparent current	Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.280
		Neg. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.001
	Active power	Total	t1+100 ms to t2-20 ms	[p.u.]	0.181
		Pos. seq.	t1+100 ms to t2-20 ms	[p.u.]	0.181

Note: When the inverter detected an abrupt voltage situation as defined by the manufacturer, it will produce reactive current base on the difference between the changed voltage and the previous voltage. Therefore, the K factor was calculated base on this.

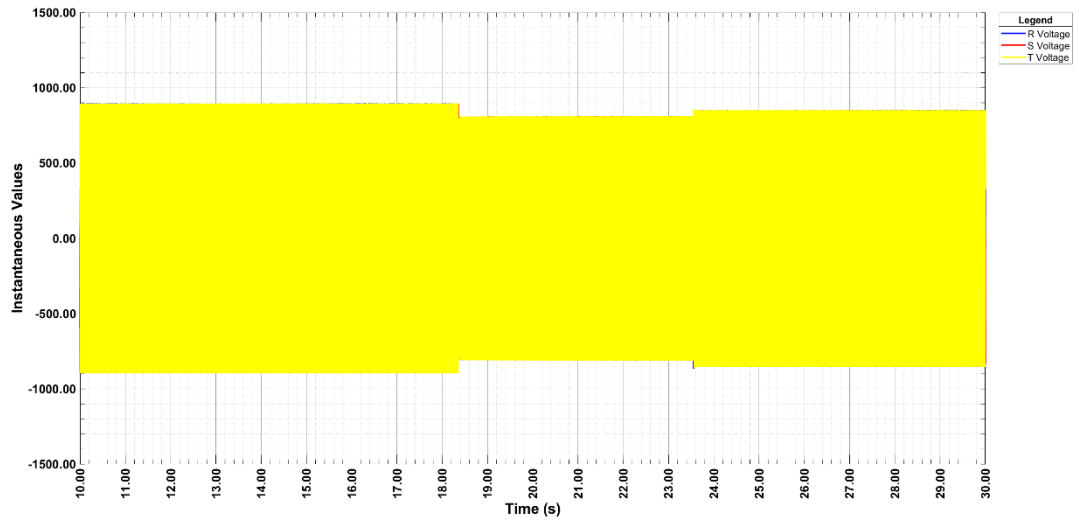
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

	Parameter	Phase reference	Reference time	Value [unit]	Measured
t1 to t2	Short-circuit currents. Highest instantaneous values of current	Phase 1	t1 to t1+20 ms	[A]	328
		Phase 2	t1 to t1+20 ms	[A]	335
		Phase 3	t1 to t1+20 ms	[A]	331
	Short-circuit currents 1-period rms values	Phase 1	t1 + 20 ms	[p.u.]	0.199
		Phase 2	t1 + 20 ms	[p.u.]	0.209
		Phase 3	t1 + 20 ms	[p.u.]	0.287
		Phase 1	t1 + 100 ms	[p.u.]	0.287
		Phase 2	t1 + 100 ms	[p.u.]	0.287
		Phase 3	t1 + 100 ms	[p.u.]	0.287
		Phase 1	t1 + 150 ms	[p.u.]	0.286
		Phase 2	t1 + 150 ms	[p.u.]	0.284
		Phase 3	t1 + 150 ms	[p.u.]	0.283
		Phase 1	t1 + 300 ms	[p.u.]	0.285
		Phase 2	t1 + 300 ms	[p.u.]	0.285
		Phase 3	t1 + 300 ms	[p.u.]	0.284
		Phase 1	t1 + 500 ms	[p.u.]	0.283
		Phase 2	t1 + 500 ms	[p.u.]	0.283
		Phase 3	t1 + 500 ms	[p.u.]	0.283
		Phase 1	t1 + 1000 ms	[p.u.]	0.282
		Phase 2	t1 + 1000 ms	[p.u.]	0.283
		Phase 3	t1 + 1000 ms	[p.u.]	0.279
After t2	Active Power	Total	t2+1 s to t2+10 s	[p.u.]	0.199
Active current rise time	Pos. seq.			[s]	0.000

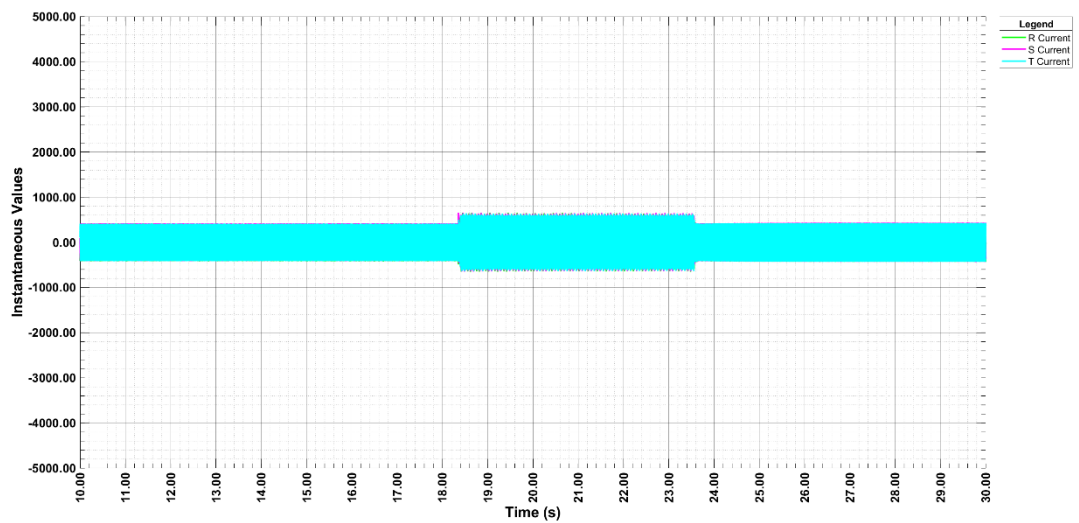
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.2

Phase-to-neutral voltages



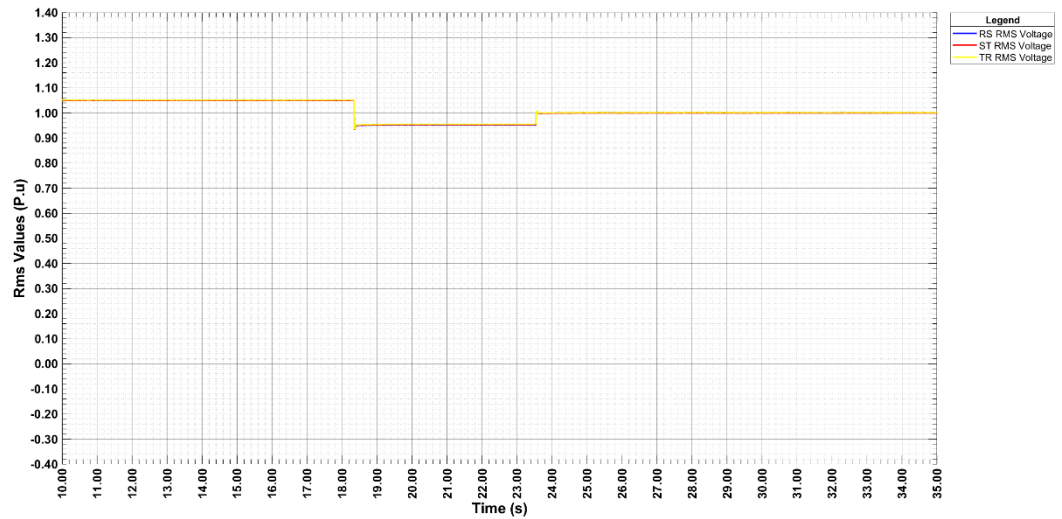
Phase currents



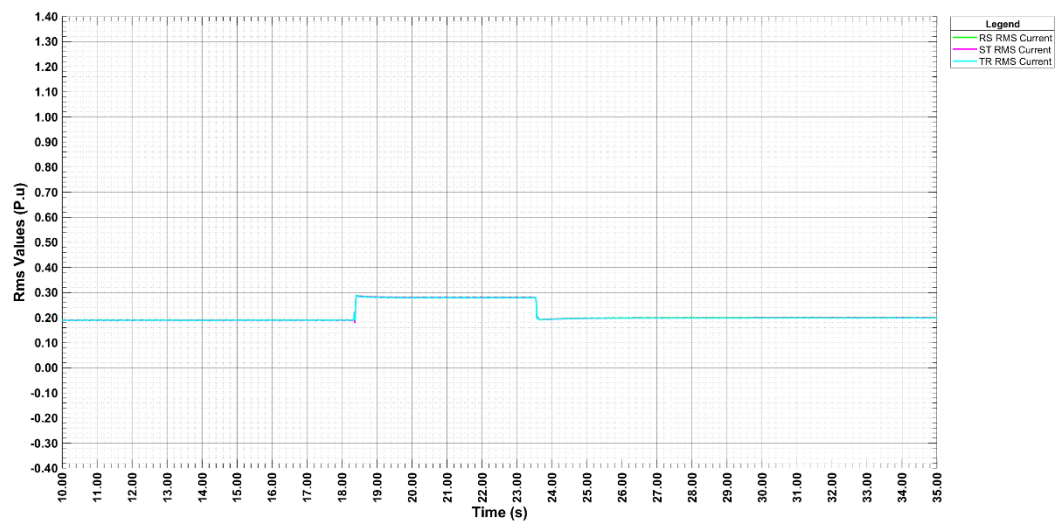
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.2

RMS Phase to phase voltages



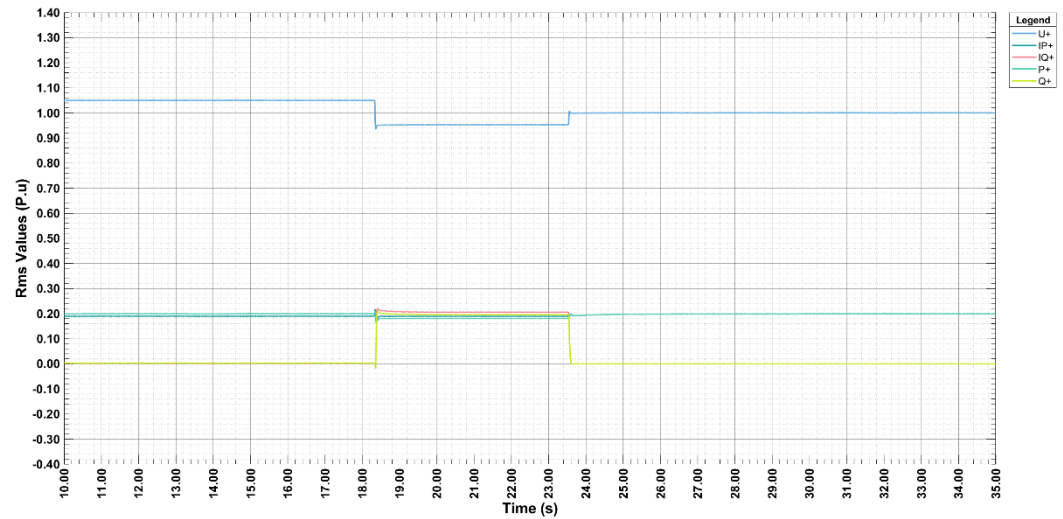
RMS Phase currents



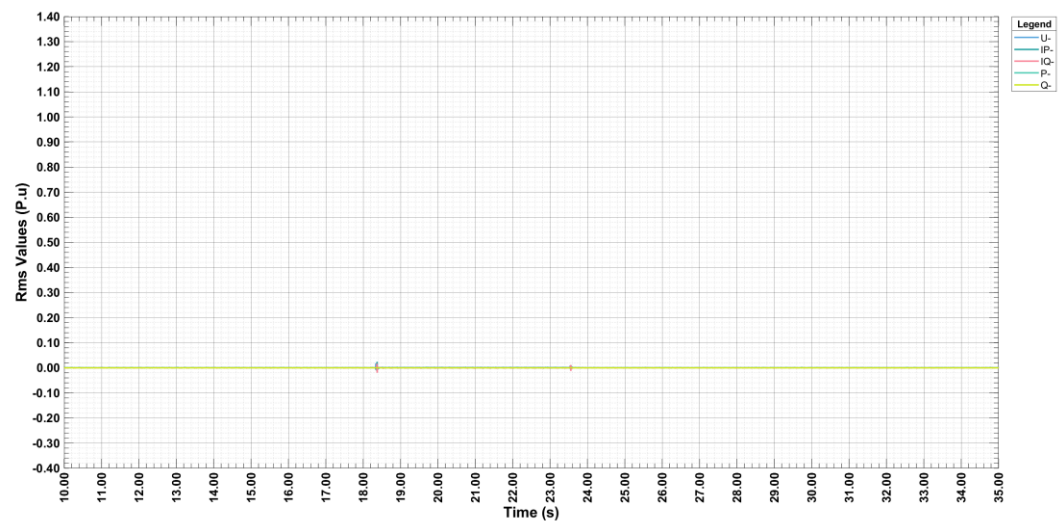
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.2

Positive sequences



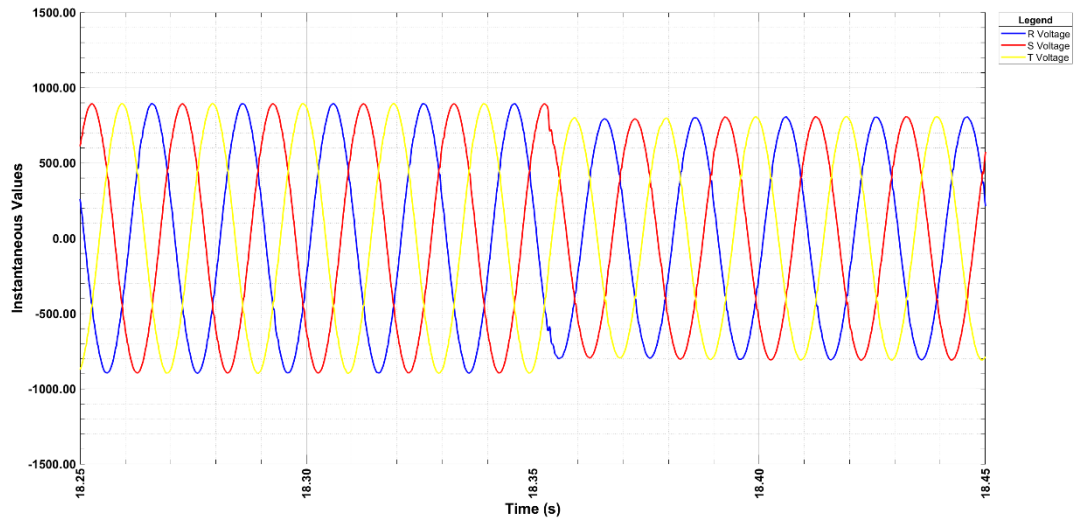
Negative sequences



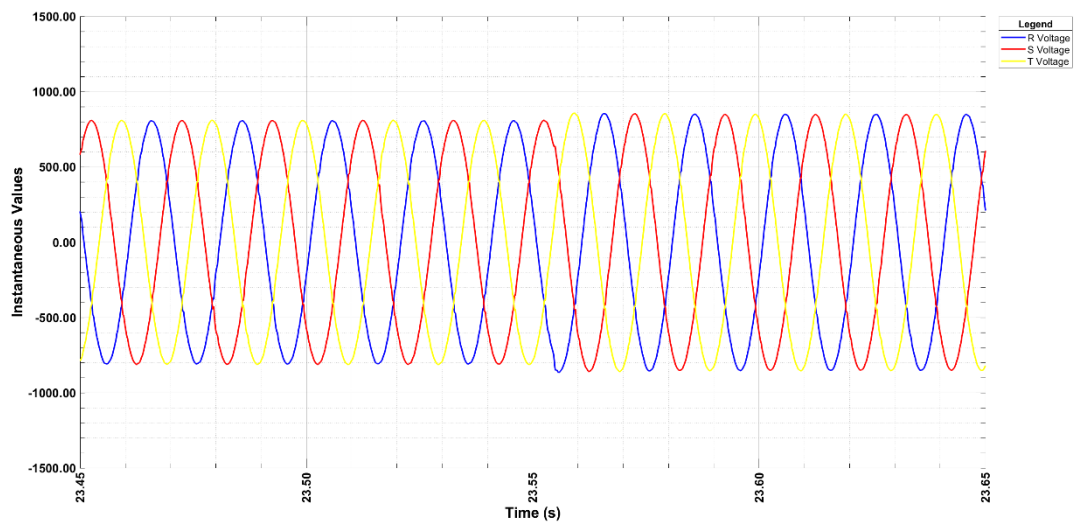
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.2

Transient voltage: Fault beginning



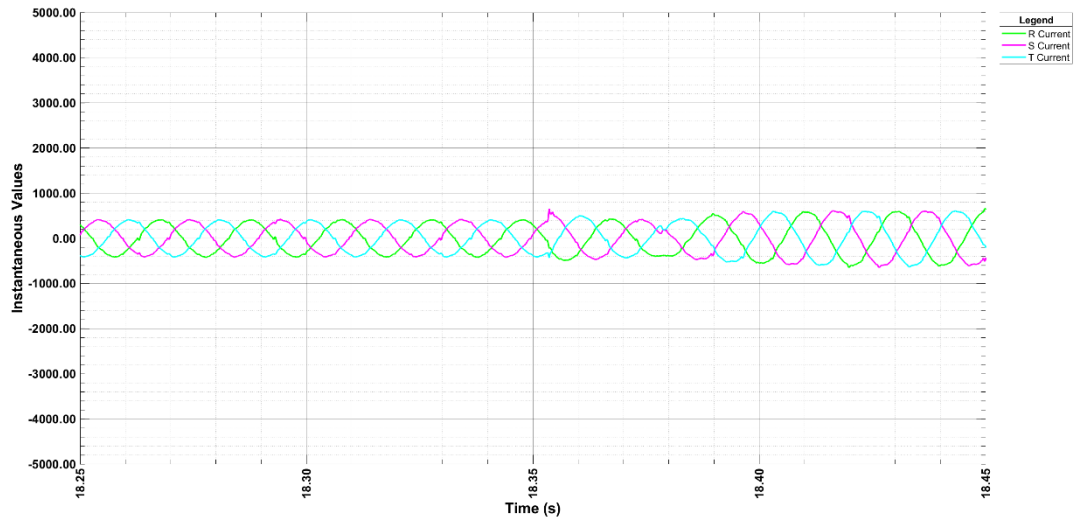
Transient voltage: Fault end



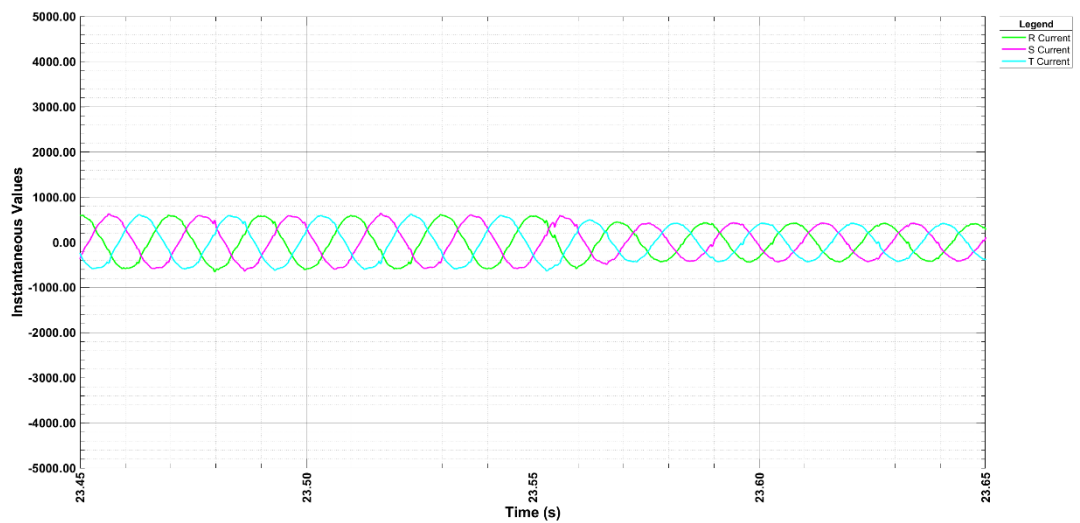
FRT test in FGW-TG3+SP1: Grid Fault Tests Results

Test 105.2

Transient current: Fault beginning



Transient current: Fault end



--- END OF THE ATTACHMENT ---