

Beckwith Electric Co., Inc.

IEEE C37.60 Recloser/Controller Tests



REPORT OF PERFORMANCE

CLIENT	Beckwith Electric Co. Inc. 6190 118th Avenue North Largo, FL 33773-3724 U.S.A.
MANUFACTURER	Recloser: G&W Electric 305 W Crossroads Parkway Bolingbrook, IL 60440 U.S.A. Recloser Controller: Beckwith Electric Co. Inc. 6190 118th Avenue North Largo, FL 33773-3724 U.S.A.
TEST OBJECT	Recloser: Type: VIP398ER-12-1-ST Rated Voltage: 38 kVrms Rated Current: 800 Arms continuous, 12.5 kArms interrupting BIL: 150 kV Serial №: E3759 Recloser Controller: Type: M7679 Serial №: M7679-V6L1ML6ELT2C0000 Firmware: D-0347V03.16.08 Hardware: M-2979-A32B01DW109SUTY0 Version 0
TESTED BY	Powertech Labs Inc. 12388 - 88 th Ave, Surrey, BC Canada V3W 7R7 www.powertechlabs.com
TEST DATE(S)	2017-06-07 to 2017-06-08
TEST SPECIFICATION	IEEE C37.60-2012, Section 6.103
TEST RESULT	Pass

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1 INTRODUCTION

At the request of Beckwith Electric Co. Inc., one three-phase vacuum recloser and one recloser controller were subjected to Rated symmetrical interrupting current tests in accordance with IEC 62271-111/IEEE C37.60-2012, Section 6.103.

2 TEST OBJECT INFORMATION

The test objects were identified based on the following information provided by the client:

Recloser:
Manufacturer: G&W Electric
Type: VIP398ER-12-1-ST
Rated Voltage: 38 kVrms
Rated Current: 800 Arms continuous, 12.5 kArms interrupting
BIL: 150 kV
Serial No: E3759

Recloser Controller:
Manufacturer: Beckwith Electric Co. Inc.
Type: M7679
Serial No: M7679-V6L1ML6ELT2C0000
Firmware: D-0347V03.16.08
Hardware: M-2979-A32B01DW109SUTY0 Version 0

3 GENERAL INFORMATION

2.1 Purpose

The purpose of the test was to verify the correct operation of the recloser controller with the recloser.

2.2 Witnesses

Name	Company
Joel Bryant	Beckwith Electric Co. Inc.

2.3 Tests Performed

Test Standards/Specifications
IEC 62271-111/IEEE C37.60-2012

Sections

6.103- Rated symmetrical interrupting current tests

4 RATED SYMMETRICAL INTERRUPTING CURRENT TESTS

General Information:

Standard	IEEE C37.60-2012, Section 6.103
Test Date	June 7-8, 2017
Test Leader	Qian (Eric) Li

Environmental Conditions:

Ambient temperature	17-25 °C
Relative Humidity	36-74 %

Test Conditions:

Specified Interruption Rating:	12.5 kA _{rms}
Test Voltage:	27 kV _{rms} phase-to-phase ¹⁾
Test Frequency:	60 Hz

Note:

¹⁾ The test was performed at 27 kV_{rms} because the purpose of the test was not to verify the performance of the recloser, but the correct operation of the recloser controller with the recloser.

Operating Duty T100 (90-100% of interruption rating):

Test current:	12.8 kA _{rms}	(≥ 12.5 kA _{rms} is required)
X/R:	17	(≥ 17 is required)
TRV peak:	AF = 1.61	(≥ 1.54 is required)
TRV rate of rise:	t ₃ = 43 μs	(≤ 47 μs is required)
Operations performed:	16	(16 required)

The test circuit is provided in Figure 1, the TRV waveform is provided in Figure 3 and sample test waveforms are provided in Figures 6 to 8. Per the requirements of the standard, a minimum of 2 operations were performed at maximum asymmetry.

Operating Duty T50 (45-55% of interruption rating):

Test current:	6.7 kA _{rms}	(5.6 to 6.9 kA _{rms} is required)
X/R:	9	(≥ 8 is required)
TRV peak:	AF = 1.71	(≥ 1.68 is required)
TRV rate of rise:	t ₃ = 41 μs	(< 27 μs is required)
Operations performed:	56	(56 required)

The test circuit is provided in Figure 1. Before each of the operating duty tests, the TRV was measured and adjusted using a current injection method. The TRV waveform is provided in Figure 4 and sample test waveforms are provided in Figures 9 to 11. Since the TRV voltage peak meets the peak voltage requirement u_c , it is permissible to use a higher value for t_3 as long as it is less than the value specified for T100 current level.

Operating Duty T20 (15-20% of interruption rating):

Test current	1.9 kA _{rms}	(1.9 to 2.5 kA _{rms} is required)
X/R	5.5	(≥ 4 is required)
TRV peak	AF = 1.88	(≥ 1.77 is required)
TRV rate of rise	t ₃ = 38 μs	(< 19 μs is required)
Operations performed	44	(44 required)

The test circuit is provided in Figure 2, the TRV waveform is provided in Figure 5 and sample test waveforms are provided in Figures 12 to 14. Per the requirements of the standard, the source and load neutrals were grounded for 12 operations (25%-30% of the operations). Since the TRV voltage peak meets the peak voltage requirement u_c , it is permissible to use a higher value for t_3 as long as it is less than the value specified for T100 current level.

Requirements:

After completion of the test sequence the recloser shall meet the following conditions:

- 1) The recloser functioned without failure, maintenance or replacement of parts during the tests.
- 2) Visual inspection of the recloser after the tests shall indicate substantially the same mechanical condition as before the tests. The recloser shall be capable of automatic and manual operation after the tests. The time-current characteristic of the recloser shall be substantially the same as the initial values.
- 3) The recloser shall be capable of withstanding 80% of the dry power-frequency insulation withstand test level for one minute.
- 4) The contact resistance shall be verified and shall not exceed the greater of 200% of the value before the test sequence, or 100 $\mu\Omega$ increase over the value before the test sequence.

Evaluation:

The recloser and the controller completed all the tests without failure, maintenance or replacement of parts.

Measurements of minimum arcing times performed during the rated symmetrical interrupting current tests proved that the tested design did not have critical current. As a result the critical current tests specified in Section 6.104 of the test standard are not required.

After completion of the tests, the recloser was visually inspected and there was no substantial mechanical damage observed. The recloser was successfully operated manually and automatically after the tests.

The recloser successfully completed a 60 second AC withstand test at 48 kV. The contact resistance of the recloser was measured before and after the tests using a 100 A, digital micro-ohmmeter.

Pole Resistance ($\mu\Omega$)						Maximum Resistance Increase (%)
Before			After			
A	B	C	A	B	C	
105	107	108	106	112	107	4.6

Result:

PASS

APPENDIX A – CIRCUIT DIAGRAMS

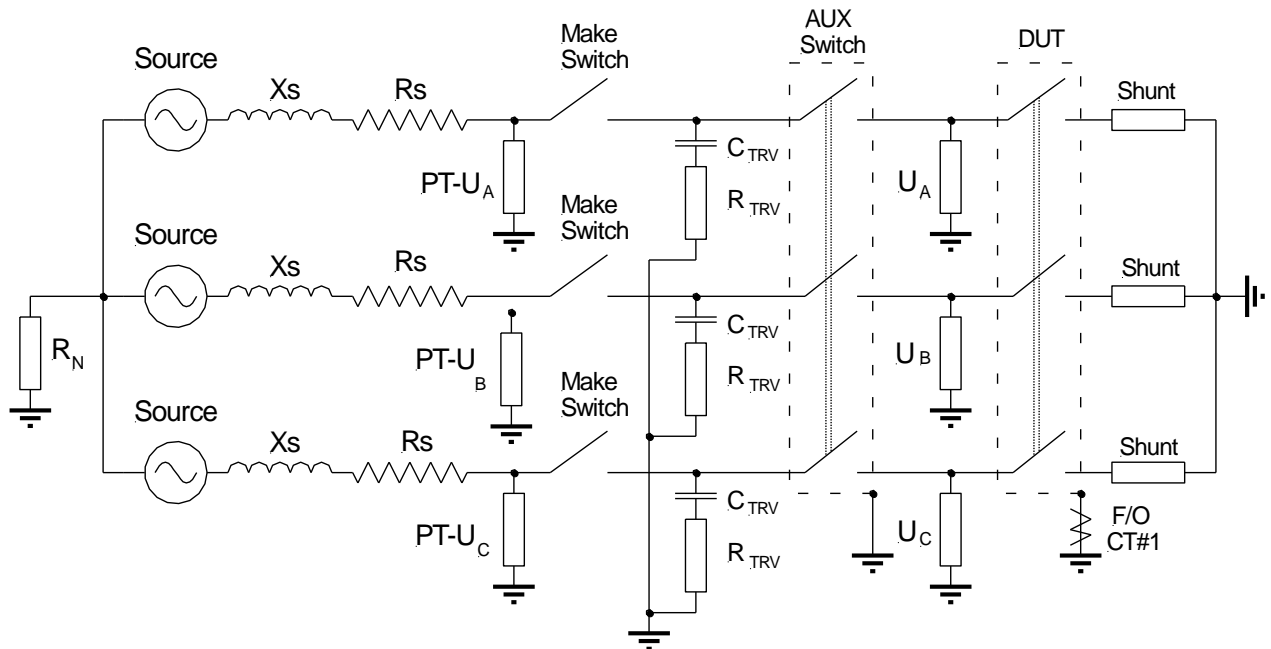


Figure 1: Test circuit schematic for rated symmetrical interrupting current tests at T50 and T100.

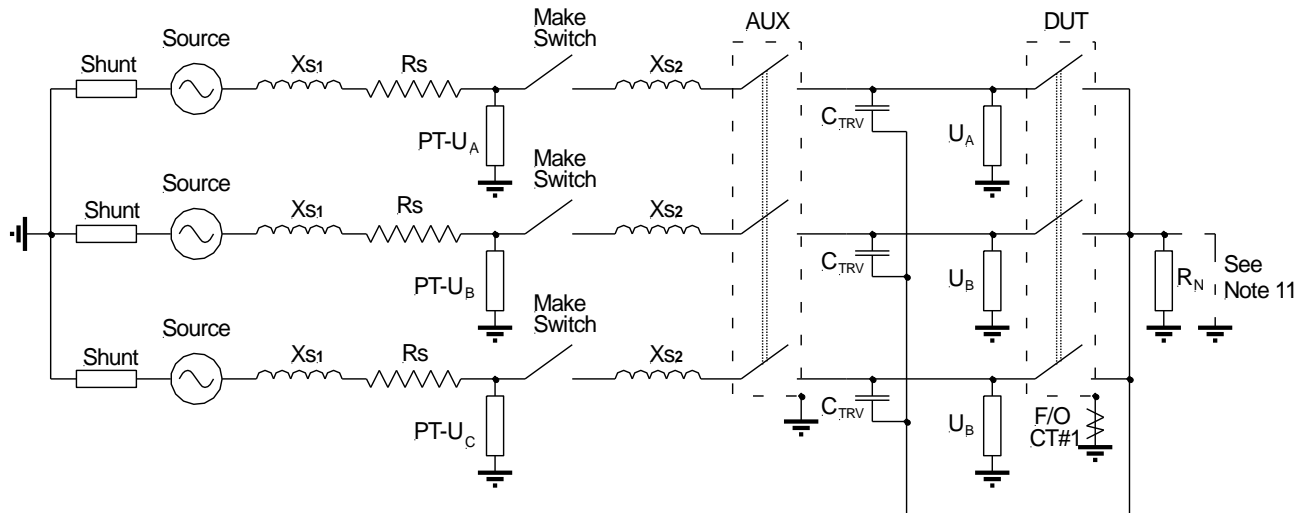


Figure 2: Test circuit schematic for rated symmetrical interrupting current tests at T20.

Notes:

1. R_N - Neutral resisto
2. X_S, X_{S1}, X_{S2} - Source reactances
3. R_S - Source resistance
4. $PT-U_A, PT-U_B, PT-U_C$ - Source voltage measurements
5. C_{TRV}, R_{TRV} - TRV control components
6. AUX Switch - Auxiliary circuit breaker (T50 & T20 only)

7. DUT - Device under test
8. U_A, U_B, U_C - DUT voltage measurement
9. Shunt - Current measurements
10. F/O CT#1 - Ground fault measurement
11. Load grounded for 25-30% of the operations per IEC 62271-111/IEEE C37.60-2012 Section 6.103.1.3

APPENDIX B – WAVEFORMS

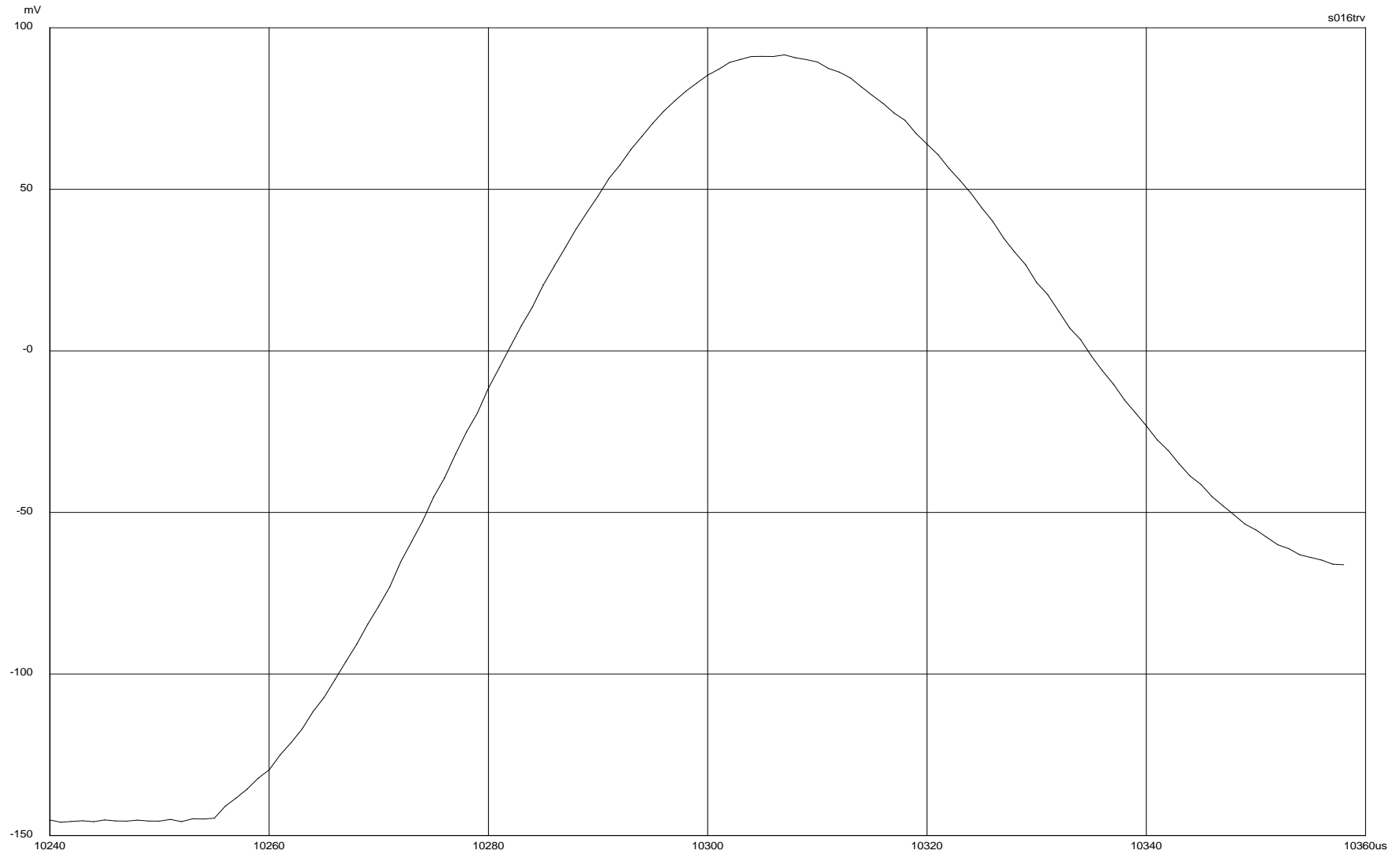


Figure 3: TRV waveform for operating duty at T100.

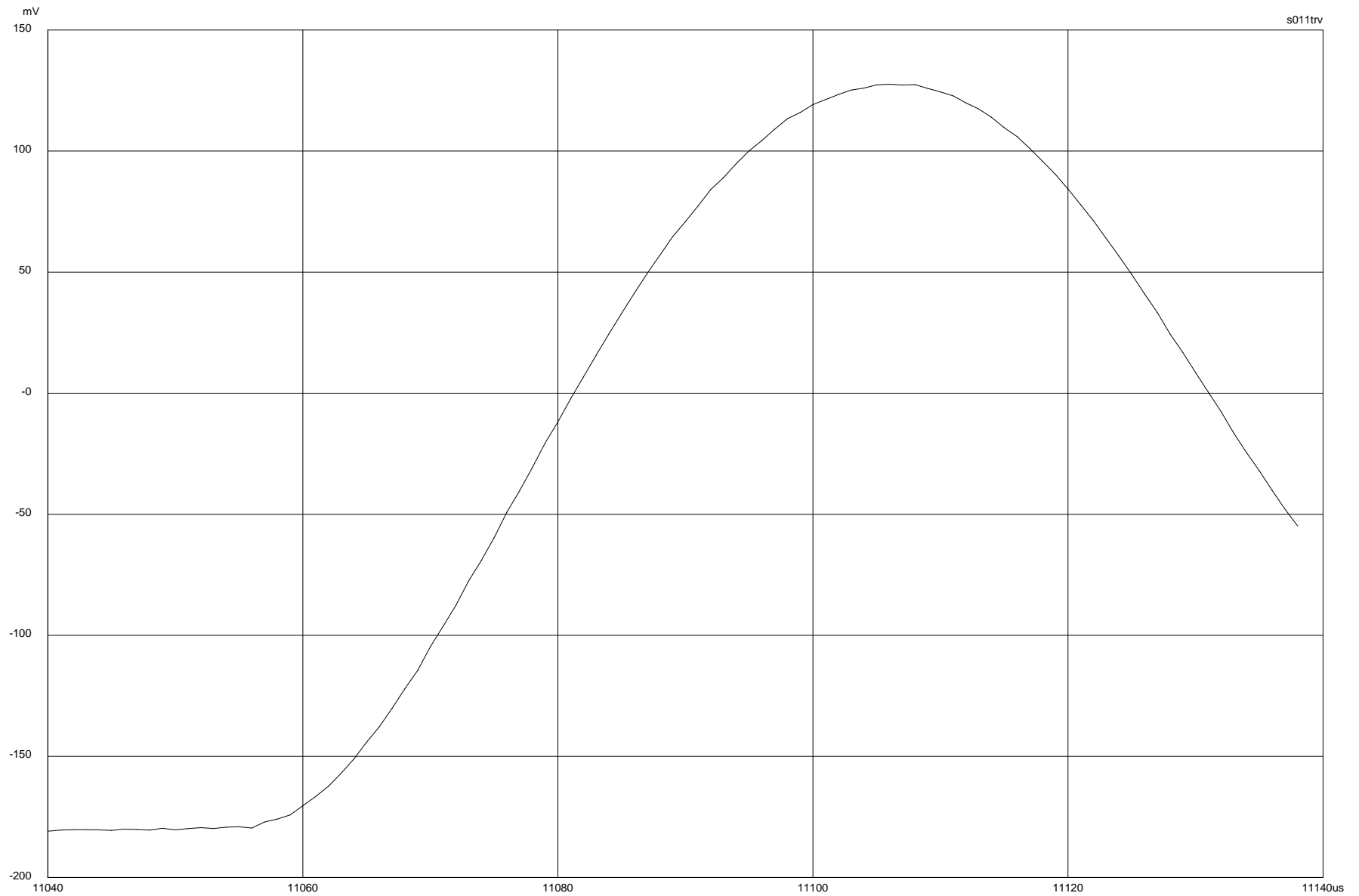


Figure 4: TRV waveform for operating duty at T50.

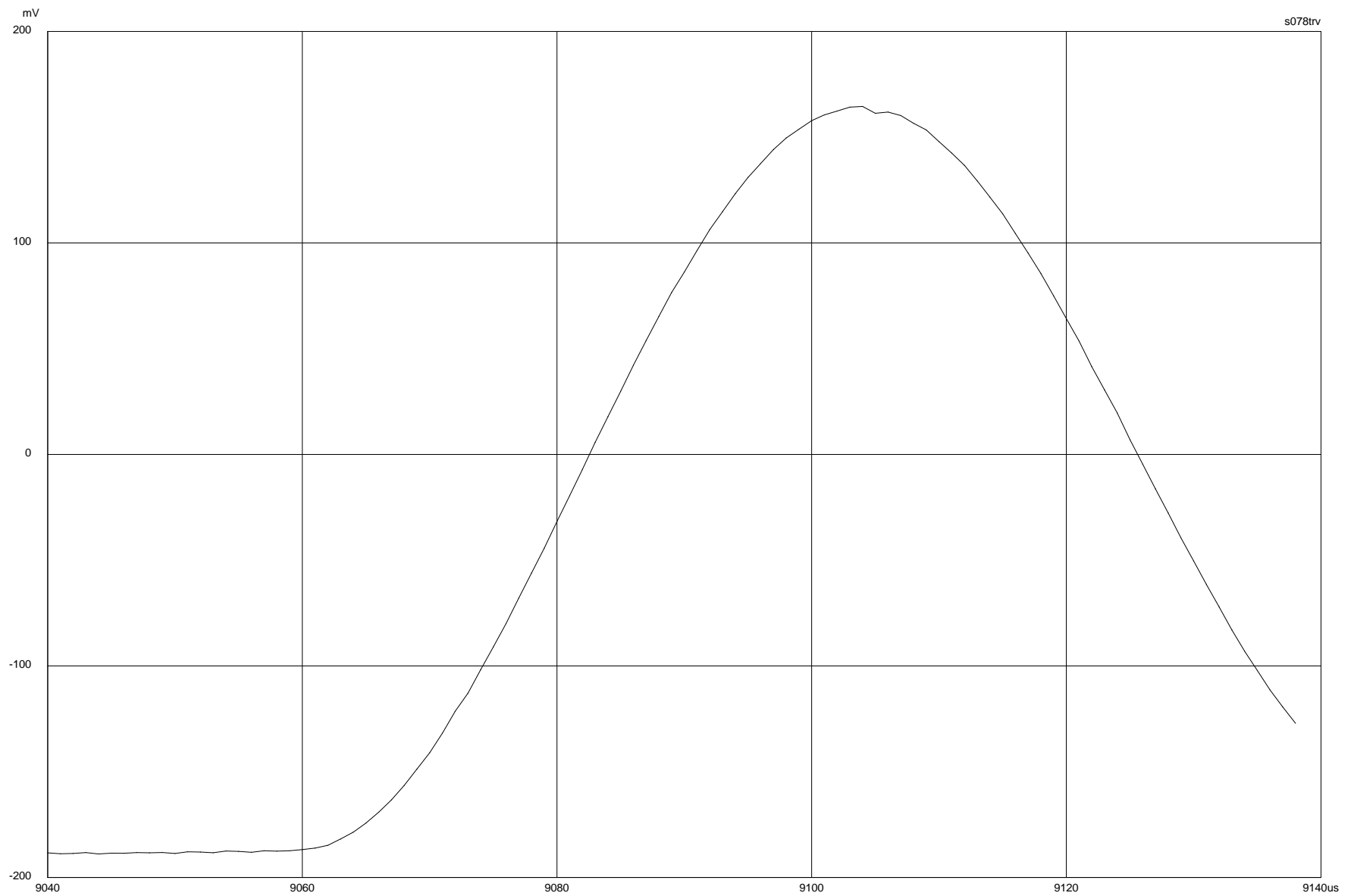


Figure 5: TRV waveform for operating duty at T20.

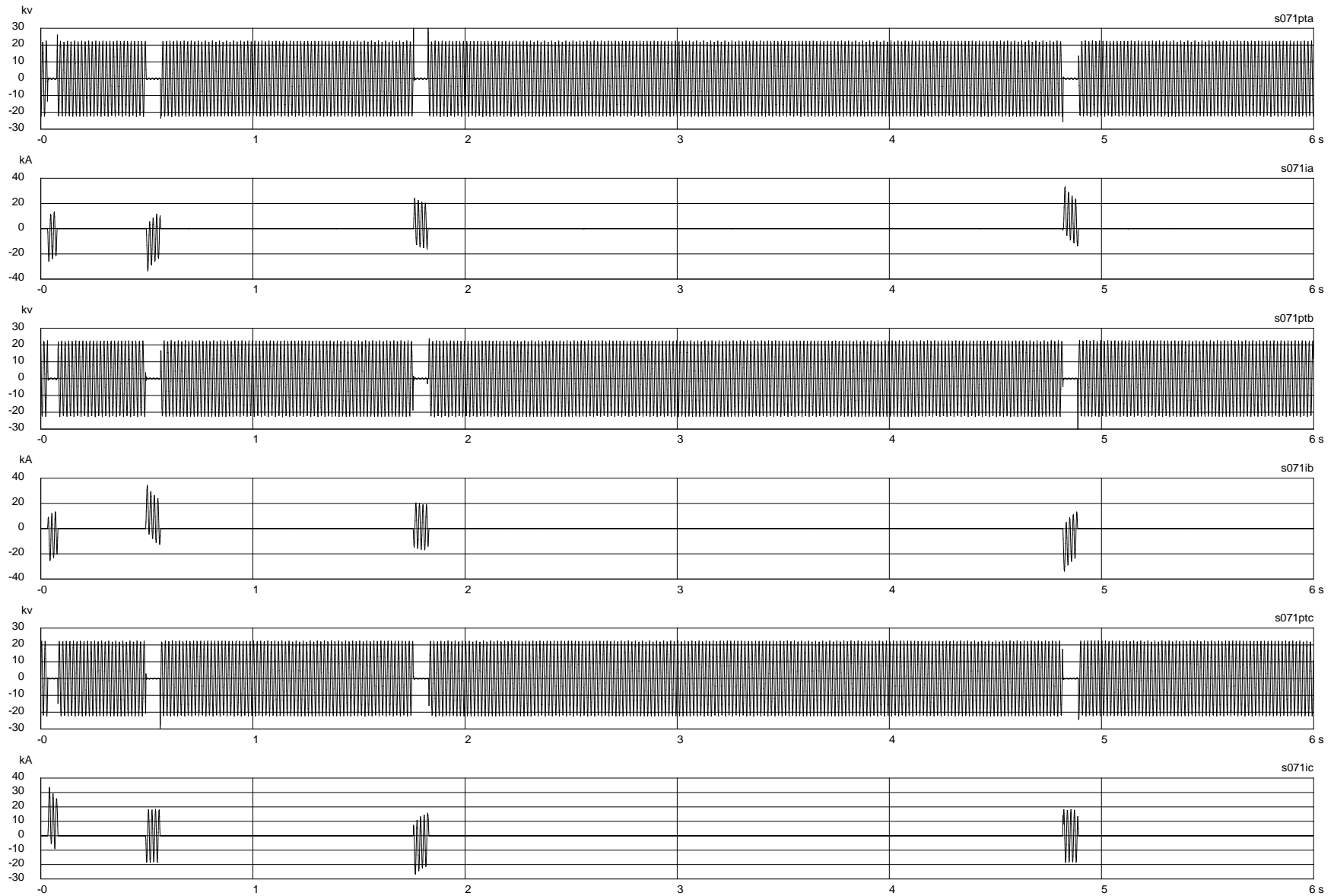


Figure 6: Sample waveform for reclose sequence at operating duty T100.

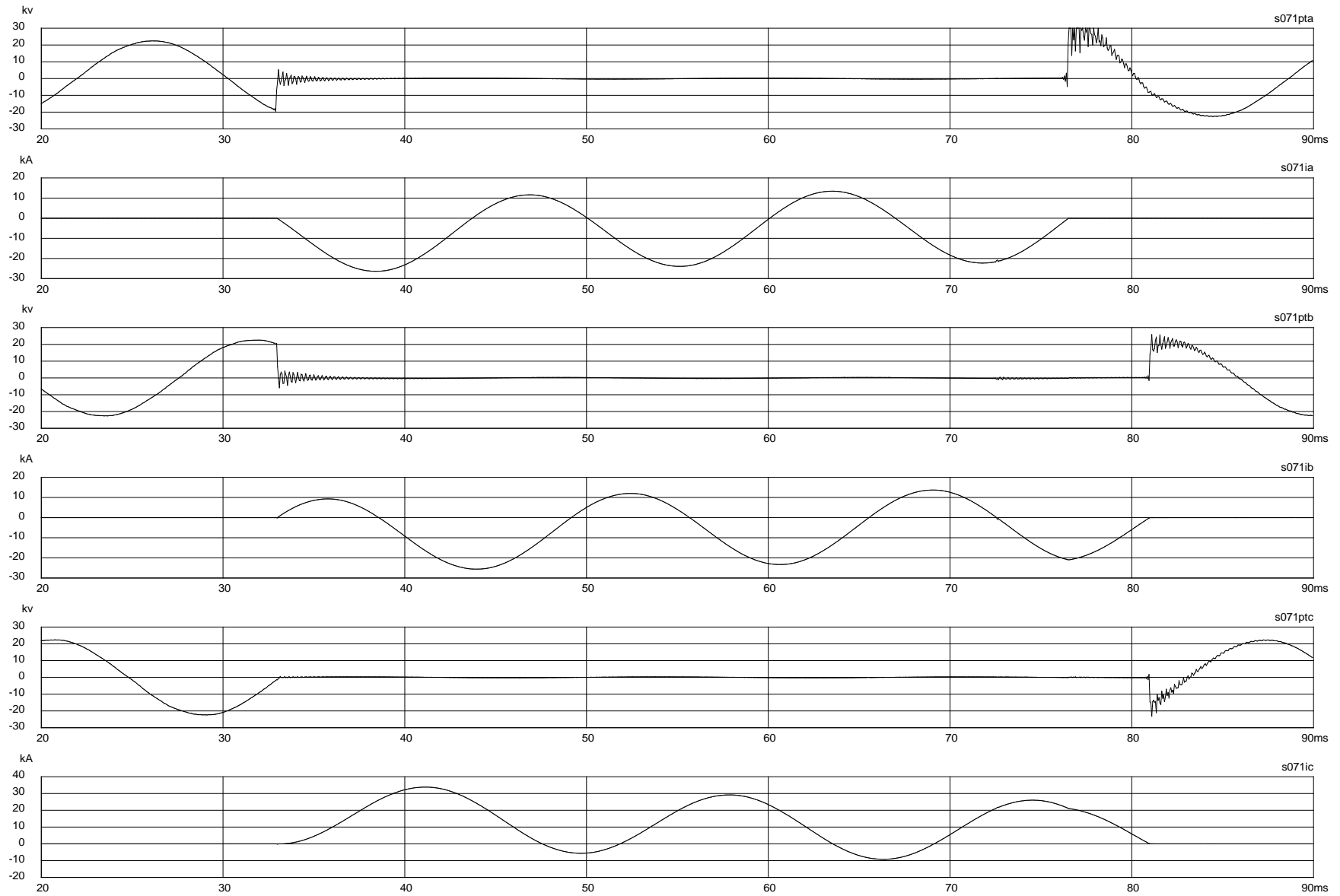


Figure 7: Sample waveform for open operation at operating duty T100.

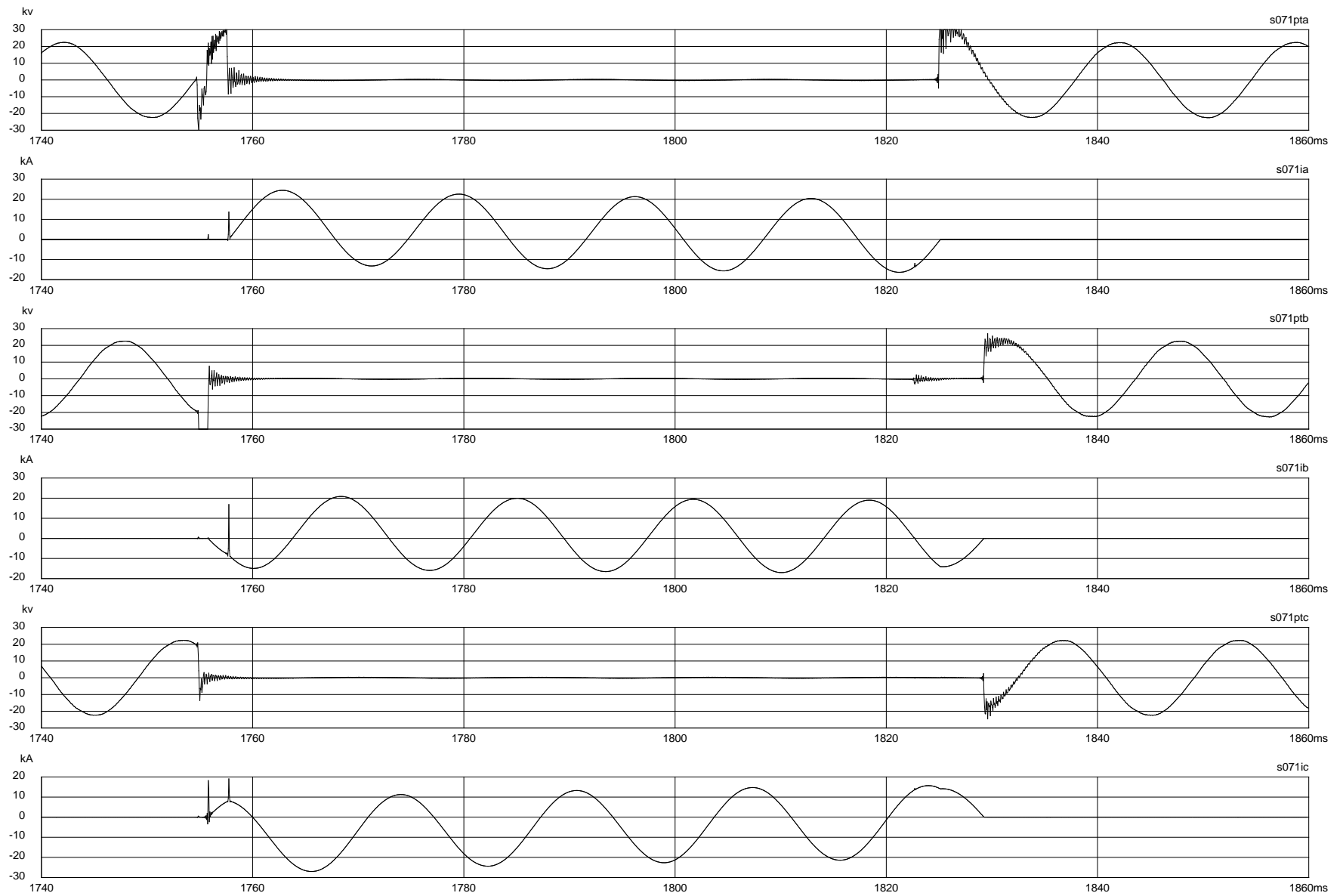


Figure 8: Sample waveform for close-open operation at operating duty T100.

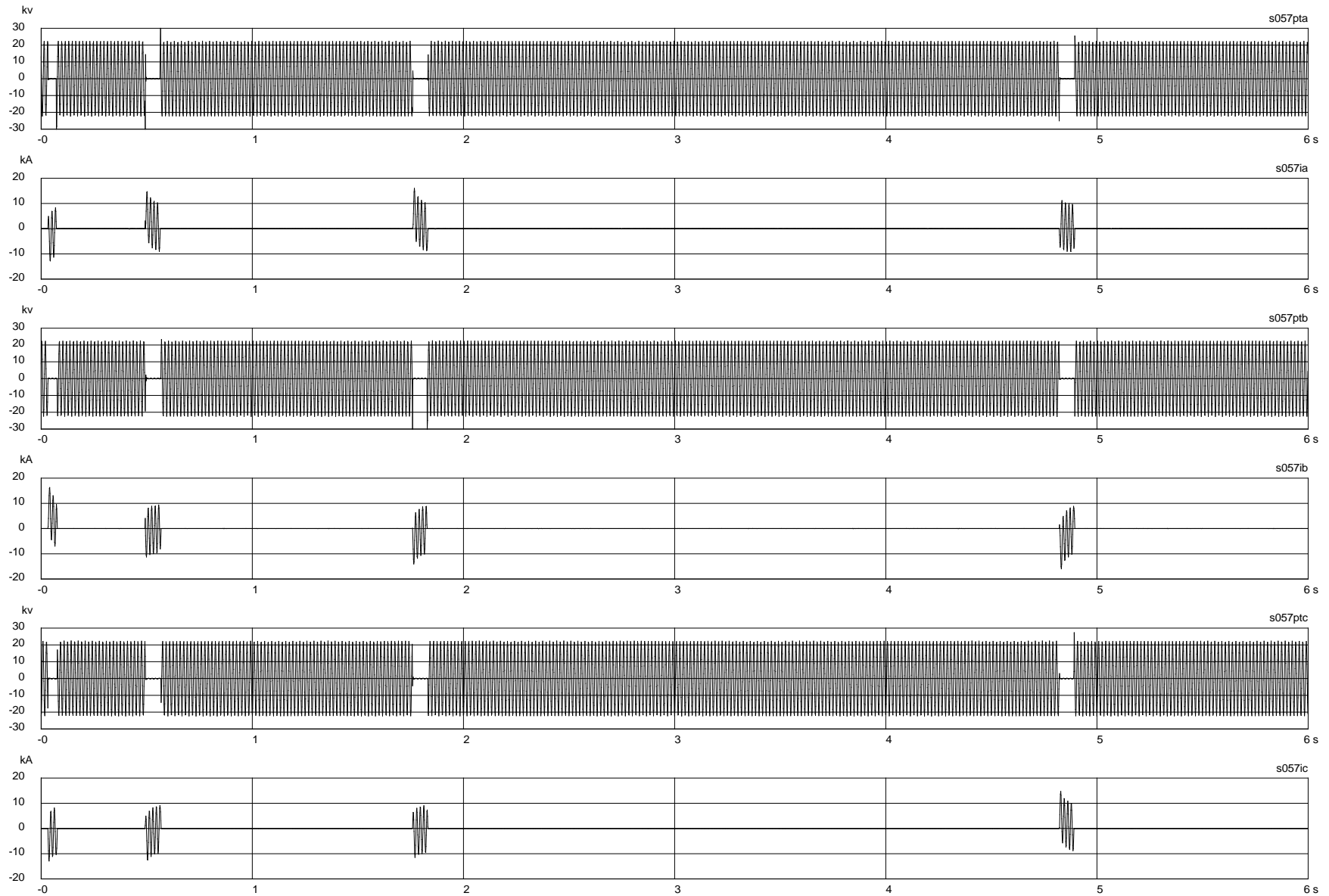


Figure 9: Sample waveform for reclose sequence at operating duty T50.

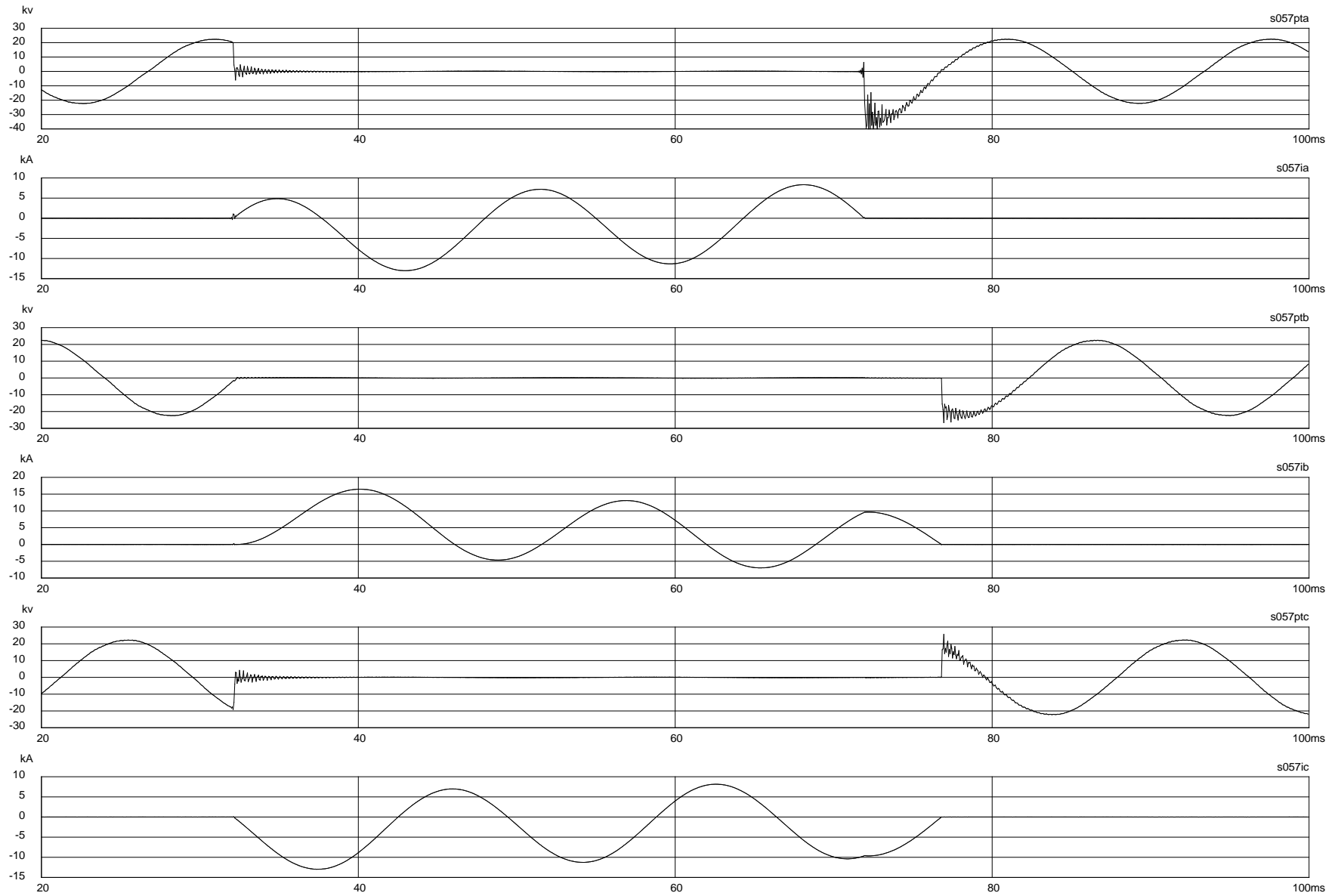


Figure 10: Sample waveform for open operation at operating duty T50.

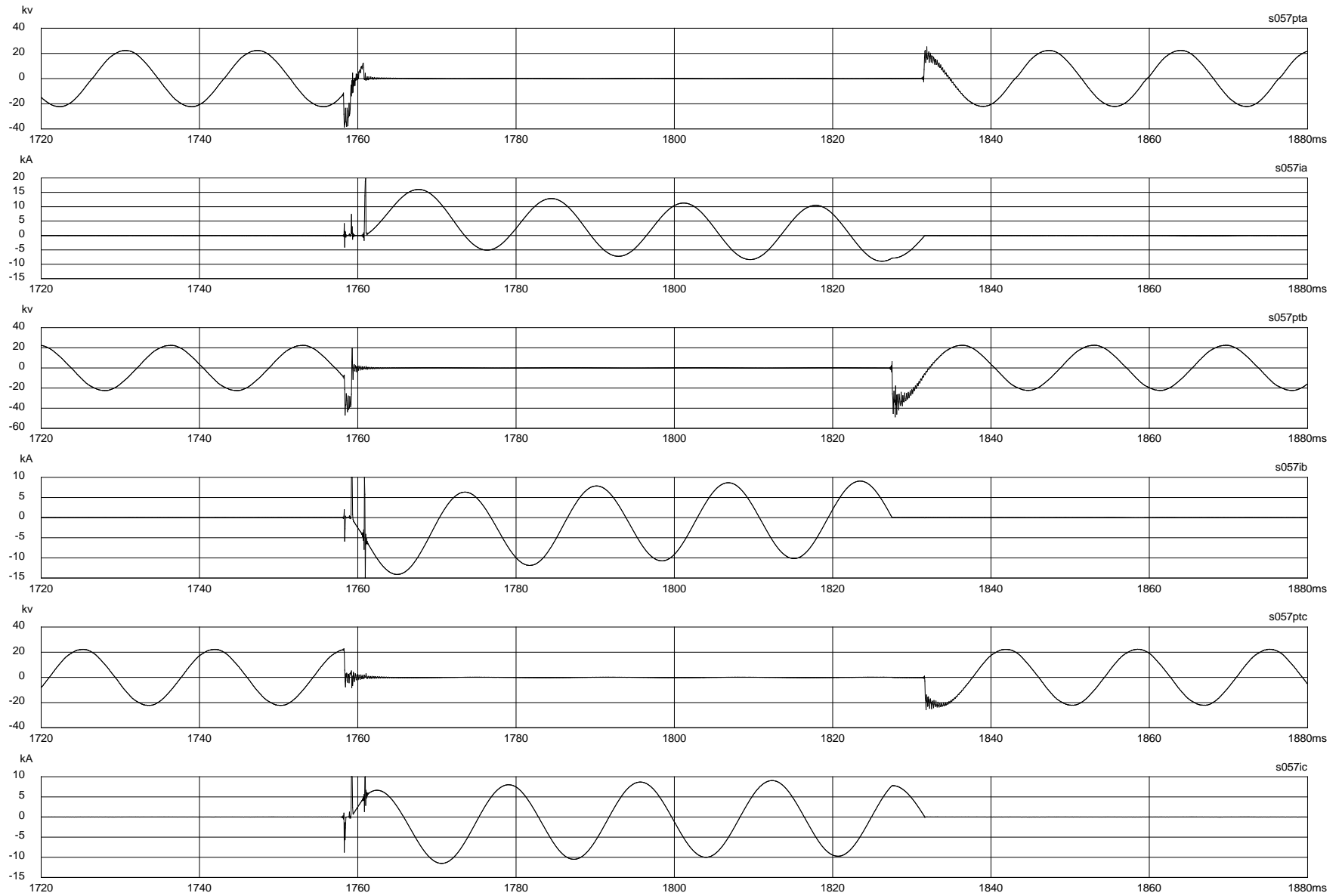


Figure 11: Sample waveform for close-open operation at operating duty T50.

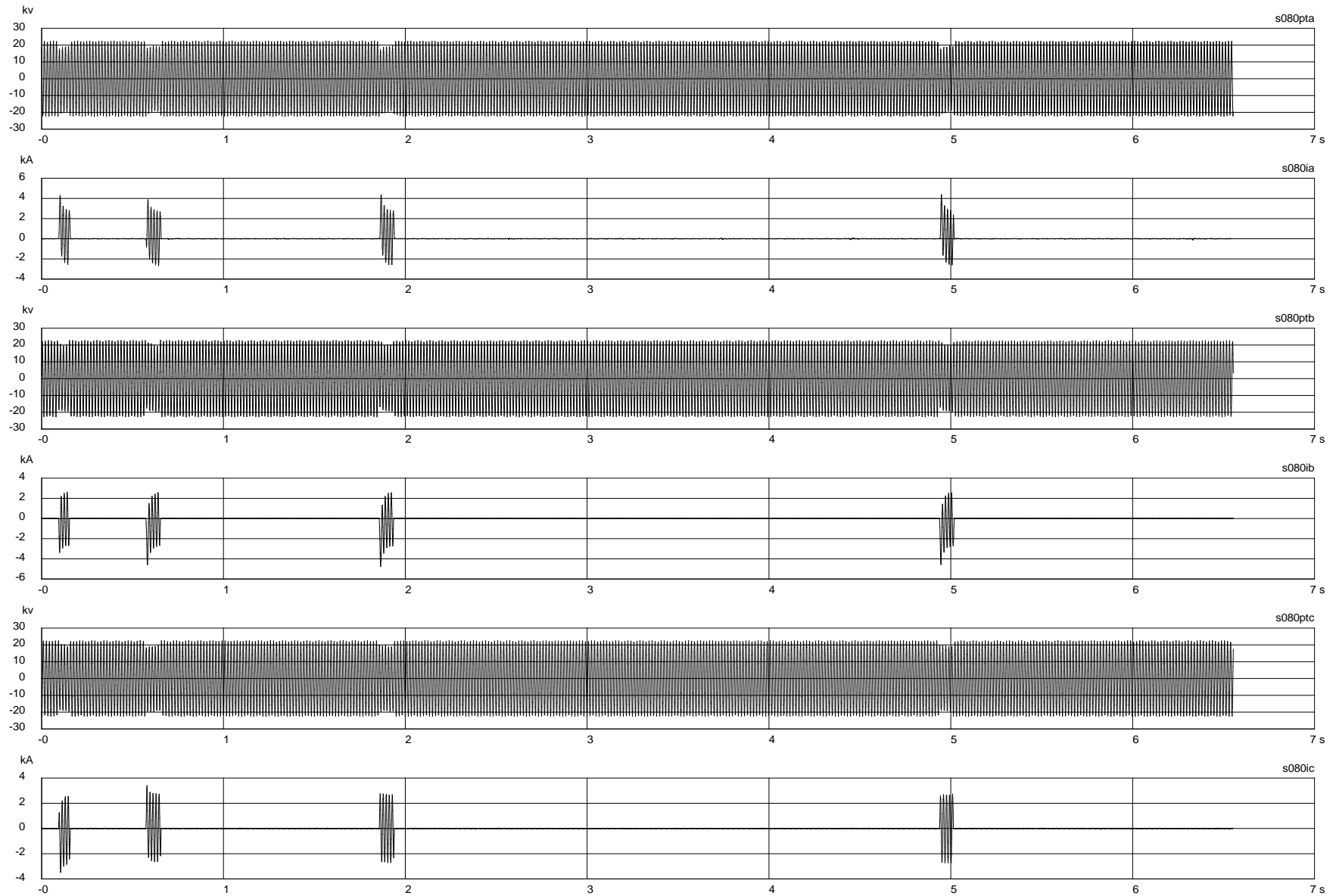


Figure 12: Sample waveform for reclose sequence at operating duty T20.

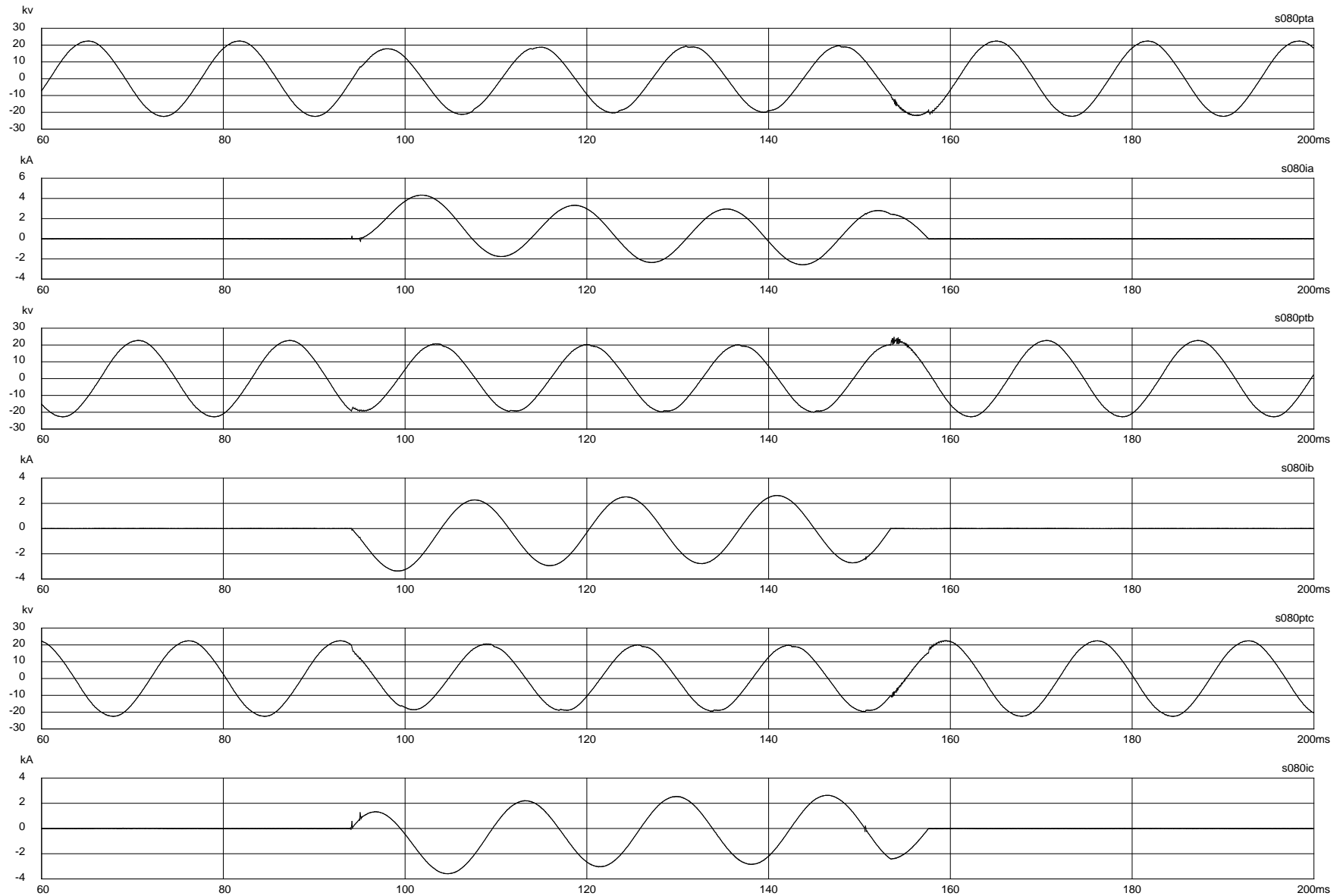


Figure 13: Sample waveform for open operation at operating duty T20.

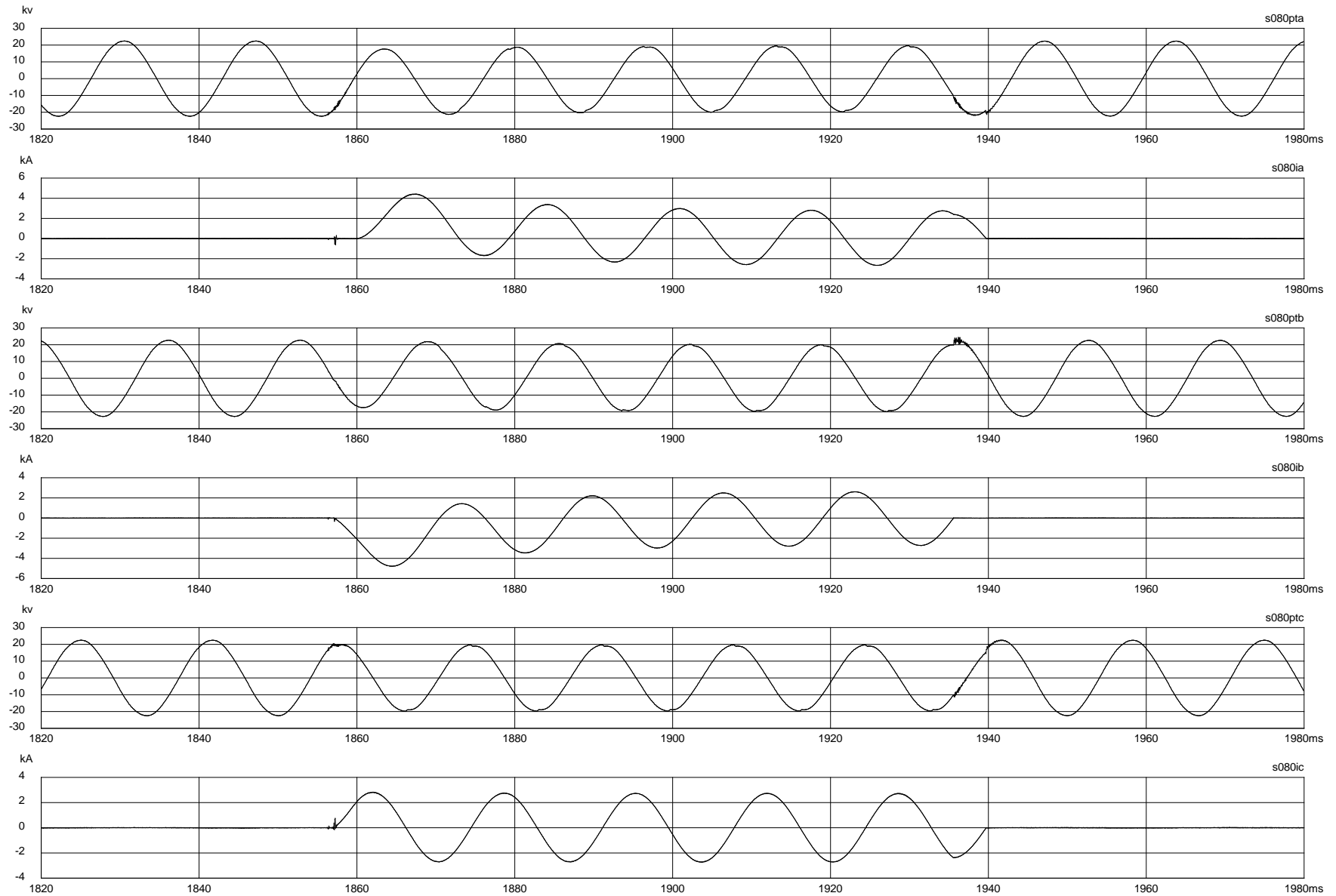


Figure 14: Sample waveform for close-open operation at operating duty T20.

APPENDIX C – PHOTOGRAPHS OF THE TEST OBJECT

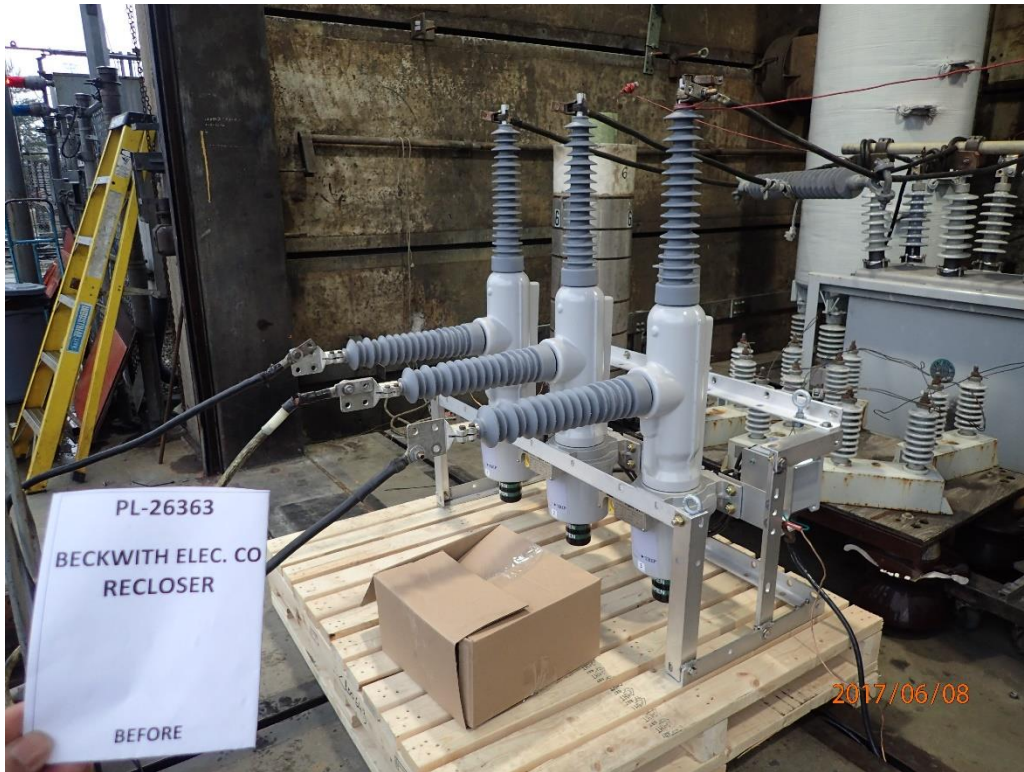


Figure 15: Overall view of the tested recloser.

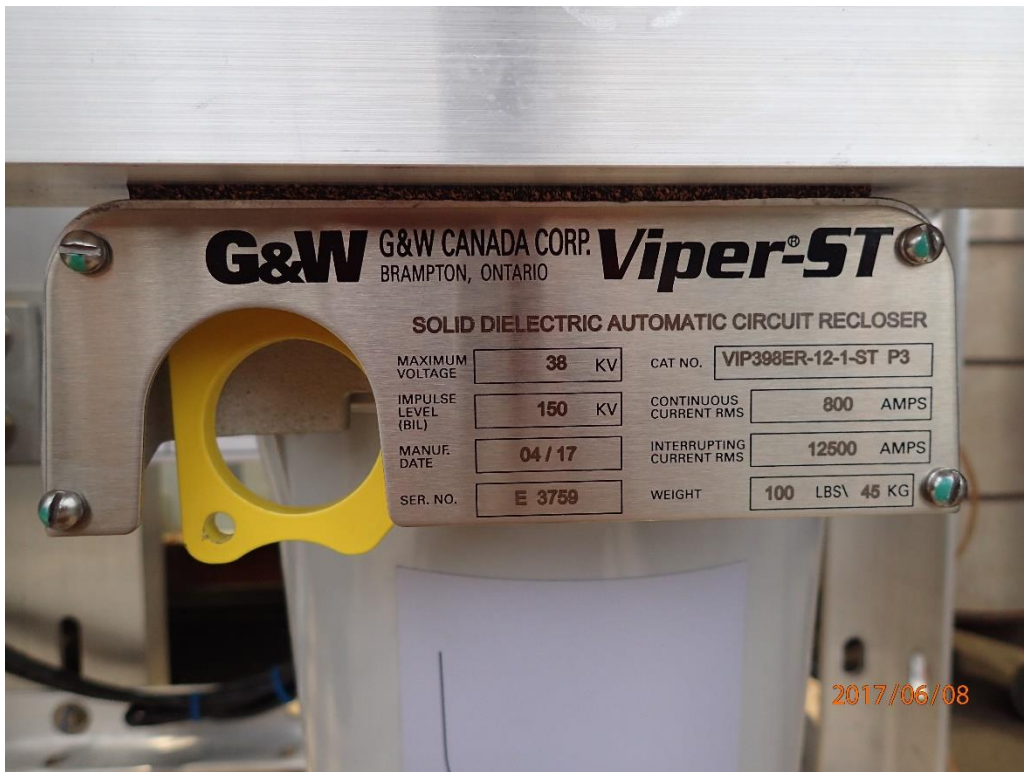


Figure 16: Nameplate of the tested recloser.



Figure 17: Overall view of the tested recloser controller.



Figure 18: Nameplate of the tested recloser controller.



Figure 19: Setup of rated symmetrical interrupting current tests, Duty T100 and T50.



Figure 20: Setup of rated symmetrical interrupting current tests, Duty T20.