Type test report no. VR 5E 001e

Mechanical tests of diverter switch

Product Approval
CTTP/Wag
15.02.2018

Type test for types:	Diverter switches VACUTAP® VRS / VRM / VRL / VRH / VRX with - single-sector, two-sector or three-sector design, - maximum rated through-current up to 1300 A / 2600 A[1].
Test specification:	IEC 60214-1:2014, sub-clause 5.2.6: “Mechanical tests”.
Test samples:	Diverter switches VACUTAP® VRL III 1300 Y – 170, S/N: 1734906 VACUTAP® VRS II 1002 – 72.5, S/N: 1734904 VACUTAP® VRM I 1001 – 72.5, S/N: 1734903
Manufacturer:	Maschinenfabrik Reinhausen GmbH, Regensburg, Germany.
Date of test:	September 2016 to January 2017.
Place of test:	Maschinenfabrik Reinhausen GmbH, Regensburg, Germany.
Tests performed:	
Simulation of the transformer drying procedure:	Prior the mechanical tests the transformer drying procedure was simulated with all test samples.
Mechanical endurance test with sequence test:	500,000 operations were performed in a test tank with clean insulation liquid. Half the number of operations was performed at a temperature not less than 75 °C and half at a lower temperature. The switching sequence was recorded. 100 operations were performed in clean insulation liquid at 115 °C. 100 operations were performed in clean insulation liquid at -25 °C.
Operation under maximum allowable static pressure:	Each 100 operations were performed at ambient temperature at the highest allowed pressure stated by the manufacturer of the on-load tap-changer.
Pressure and vacuum test:	Pressure test with differential pressure 0.6 bar. Vacuum test with differential pressure 1.0 bar.
Test results:	The requirements of IEC 60214-1:2014 were met: The mechanical endurance test, the sequence test, the operation test at maximum allowable static pressure and the pressure and vacuum test were passed successfully.

[1] Single phase design with two current paths of identical design (2 x 1300 A) for applications with enforced current splitting.

This report contains 66 pages.

i. V. Dr. Thomas Strof
[valid without signature]

Maschinenfabrik Reinhausen GmbH
- PRODUCT APPROVAL -

1. Test specification

The type test was performed in accordance with IEC 60214-1:2014 “Tap-changers - Part 1: Performance requirements and test methods”, sub-clause 5.2.6: “Mechanical tests”.

2. Data of test samples

Test sample 1

Type designation:	VACUTAP® VRL III 1300 Y – 170
Type characteristics:	Diverter switch
Serial number:	1734906
IBASE:	573332968, 572941417, 571944984, 571613064
Year of manufacture:	2016
Manufacturer:	Maschinenfabrik Reinhausen GmbH, Regensburg, Germany.

Test sample 2

Type designation:	VACUTAP® VRS II 1002 – 72.5
Type characteristics:	Diverter switch
Serial number:	1734904
IBASE:	546123137, 546285264
Year of manufacture:	2016
Manufacturer:	Maschinenfabrik Reinhausen GmbH, Regensburg, Germany.

Test sample 3

Type designation:	VACUTAP® VRM I 1001 – 72.5
Type characteristics:	Diverter switch
Serial number:	1734903
IBASE:	544700962, 544700864, 543703214, 543703070
Year of manufacture:	2016
Manufacturer:	Maschinenfabrik Reinhausen GmbH, Regensburg, Germany.

3. Scope of application

Diverter switches type VACUTAP® VR are available in the basic design variants VACUTAP® VRS, VACUTAP® VRM, VACUTAP® VRL, VACUTAP® VRH and VACUTAP® VRX.

The mechanical stress of diverter switches type VACUTAP® VRS / VRM / VRL / VRH / VRX depends on the number of sectors (current paths) and (because of different designs of the main contacts) on the maximum rated through-current of sectors, but it does not depend on the basic design variant (VACUTAP® VRS, VACUTAP® VRM, VACUTAP® VRL, VACUTAP® VRH and VACUTAP® VRX).

The design of mechanical parts of sectors, relevant for the mechanical tests, is identical for all diverter switches type VACUTAP® VRS / VRM / VRL / VRH / VRX with maximum rated through-current 700 A and 1000 A as well as for all diverter switches type VACUTAP® VRS / VRM / VRL / VRH with maximum rated through-current 1300 A and 2600 A[1].

Thus, the mechanical endurance test (incl. the operation test at 115 °C), the sequence test and the operation test at the maximum allowable static pressure were performed with following samples:

- Test sample 1: Three-sector design with maximum rated through-current 1300 A
  (highest required mechanical energy for tap changing operation)
- Test sample 3: Single-sector design with maximum rated through-current 1000 A
  (lowest required mechanical energy for tap changing operation)

Therefore all diverter switches type VACUTAP® VRS / VRM / VRL / VRH / VRX with single-sector design, two-sector design and three-sector design are covered by these tests.

The operation test at -25 °C was performed with test sample 1 (three-sector design), test sample 2 (two-sector design) and test sample 3 (single-sector design) to consider the different required energies for tap changing operations. Therefore all diverter switches type VACUTAP® VRS / VRM / VRL / VRH / VRX with single-sector design, two-sector design and three-sector design are covered by these tests.

The diverter switch oil compartment is available in three sizes: Large size (VACUTAP® VRL / VRH 1300 / VRH 2600), medium size (VACUTAP® VRM / VRX 650 / VRH 650) and small size (VACUTAP® VRS).
The pressure and vacuum test does not depend on the size of the diverter switch oil compartment because the design of the bushings, the design of the head and the number of bushings are identical for all oil compartment sizes. Thus, the pressure and vacuum test was exemplary carried out on test sample 1 (large size).

The transformer drying procedure was simulated with all test samples.

The length of the drive shaft, depending upon the highest voltage for equipment of the diverter switch, is not relevant for the mechanical tests.

Therefore, this type test report is valid for all diverter switches type VACUTAP® VR with following characteristics:

- Design variants: VRS, VRM, VRL, VRH or VRX
- Number of phases: 1, 2 or 3
- Number of sectors: 1, 2 or 3
- Maximum rated through-current: up to 1300 A / 2600 A[1]

4. Test setup / test arrangement

4.1 Simulation of the transformer drying procedure

Prior the mechanical tests the transformer drying procedure was simulated with all test samples. The test samples were placed inside the vessel of a drying apparatus and kerosene dried according to the operating instructions of the manufacturer (see sub-clause 5.1).

4.2 Mechanical endurance test with sequence test

Test conditions:	The test was performed with test sample 1 (three-sector design) and test sample 3 (single-sector design). The test samples were assembled in a manner similar to that in service. The contacts were not energized. Test setup see appendix, picture 1.
Filling of oil compartment:	Transformer oil Nynas Nytro Taurus.
Oil temperature:	Half the number of operations was performed at a temperature not less than 75 °C and half at a lower temperature[2].
Servicing during the test:	According to the maintenance instructions of VACUTAP® VR.
Measurement of oil temperature:	The oil temperature inside the oil compartment of the test samples was measured by means of resistance thermo-meters (Pt-1000).
Recording and evaluation:	The tests were recorded and evaluated by a transient recorder.

4.3 Operation test at 115 °C

Test conditions:	The test was performed with test sample 1 (three-sector design) and test sample 3 (single-sector design). The contacts were not energized. The test samples were assembled in a climatic chamber in a manner similar to that in service. Test setup see appendix, picture 2.
Filling of oil compartment:	Transformer oil Petro 45X.
Oil temperature:	115 °C
Measurement of oil temperature:	The oil temperature inside the oil compartment of the test samples was measured by means of resistance thermo-meters (Pt-1000).
Recording and evaluation:	The tests were recorded and evaluated by a transient recorder.

4.4 Operation test at -25 °C

Test conditions:	The test was performed with test sample 1 (three-sector design), test sample 2 (two-sector design) and test sample 3 (single-sector design). The contacts were not energized. The test samples were assembled in a climatic chamber in a manner similar to that in service. Test setup see appendix, picture 2. The oil inside the oil compartment of the test samples was cooled down from approx. 20 °C to -25 °C. The temperature was held at least 3 hours before the test was started.
Filling of oil compartment:	Transformer oil Petro 45X.
Oil temperature:	-25 °C
Measurement of oil temperature:	The oil temperature inside the oil compartment of the test samples was measured by means of resistance thermo-meters (Pt-1000).
Recording and evaluation:	The test was recorded and evaluated by a transient recorder.

4.5 Operation test under maximum allowable static pressure

Test conditions:	The test was performed with test sample 1 (three-sector design) and test sample 3 (single-sector design). The contacts were not energized. The test samples were assembled in a climatic chamber in a manner similar to that in service. Test setup see appendix, picture 2. The static pressure was simulated by an external oil conservator, mounted above the test sample, controlled by a pressure control unit.
Filling of oil compartment:	Transformer oil Petro 45X.
Oil temperature:	25 °C
Tested static absolute pressure:	2.0 bar
Measurement of oil temperature:	The oil temperature inside the oil compartment of the test samples was measured by means of resistance thermo-meters (Pt-1000).
Recording and evaluation:	The test was recorded and evaluated by a transient recorder.

4.6 Pressure and vacuum test

Pressure test:	The pressure resistance (inside → outside) was tested under a differential pressure of 0.6 bar with a helium-air mixture (10 % helium content). The ambient medium (outside) was vacuum. The helium content in vacuum was measured with a leak detector. Based on the measured helium content, the leakage rate was calculated and compared with the limit leakage rate (Q_L).
Vacuum test:	The vacuum test (outside → inside) was performed by measurement of the pressure increase inside the test tank over time (30 s) with a Pirani-sensor. The pressure outside the test tank was 1.0 bar (inside vacuum). The measured pressure increase was compared with the limit leakage rate (Δp).

[1] Single phase design with two current paths of identical design (2 x 1300 A) for applications with enforced current splitting.

[2] With test sample 3 all operations were carried out at a temperature not less than 75 °C.

5. Tests performed

5.1 Simulation of the transformer drying procedure

Drying objects:	Test sample 1	Test sample 2	Test sample 3
Drying method:	Kerosene drying procedure		
Heating phase:	80 / 90 / 100 / 110 / 120 °C for 1 h each Following: 140 °C for further 7 h (total heating time:12 h)		
Pressure lowering phase:	2 h at ≤ 15 mbar	2 h at ≤ 15 mbar	2 h at ≤ 15 mbar
Medium vacuum phase:	36 h at ≤ 1.65 mbar	48 h at ≤ 1.65 mbar	36 h at ≤ 1.65 mbar
Total drying time:	50 h	62 h	50 h

Table 1: Simulation of the transformer drying procedure with test samples 1, 2 and 3.

5.2 Mechanical endurance test with sequence test

Number of operations:

Test sample 3:
250,000 operations performed at ≥ 75 °C
250,000 operations performed at < 75 °C

Test sample 1:
500,000 operations performed at ≥ 75 °C.

Test arrangement / conditions: See sub-clause 4.2.

Switching sequence: See appendix, fig. 1.

Mechanical endurance test with sequence test: The test samples were switched from position “A” to “B” and vice versa, until 500,000 operations were performed.

For each test, 100 operations were recorded at the start and at the end of the mechanical endurance test. Based on these recordings the switching times were evaluated.

Tables 2 and 3 show, that all switching times were within their permissible range.

Comparison of ten timing oscillograms taken at the start of the mechanical endurance test with ten taken at the end of the test showed no significant difference:
- Test sample 1: See figs. 2.1 to 2.20
- Test sample 3: See figs. 3.1 to 3.20

The time steps according to tables 2 and 3 are exemplary shown in figs. 2.1 and 3.1 for test samples 1 and 3.

	MSV opens - TTV closes	TTV closes - TTV opens	MSV closes - MDC opens
Time step	t1 – t2	t2 – t3	t4 – t5
Permissible values (Nynas Nytro Taurus at >0 °C … ≤80 °C)	> 13.5 ms < 30.5 ms	> 6.7 ms < 20.0 ms	> 12.7 ms
Measured values at beginning of the test (Nynas Nytro Taurus at 80 °C)	> 18.6 ms < 22.9 ms	> 12.0 ms < 14.9 ms	> 19.1 ms
Measured values at 500,000 operations (Nynas Nytro Taurus at 80 °C)	> 16.6 ms < 22.7 ms	> 13.3 ms < 18.1 ms	> 19.9 ms

Table 2: Mechanical endurance test - Relevant switching times of test sample 1 (three-sector design).

	MSV opens - TTV closes	TTV closes - TTV opens	MSV closes - MDC opens
Time step	t1 – t2	t2 – t3	t4 – t5
Permissible values (Nynas Nytro Taurus at >0 °C … ≤80 °C)	> 13.5 ms < 30.5 ms	> 6.7 ms < 20.0 ms	> 12.7 ms
Measured values at beginning of the test (Nynas Nytro Taurus at 80 °C)	> 22.1 ms < 24.5 ms	> 9.4 ms < 10.3 ms	> 18.8 ms
Measured values at 500,000 operations (Nynas Nytro Taurus at 80 °C)	> 21.4 ms < 23.9 ms	> 11.1 ms < 12.0 ms	> 20.3 ms

Table 3: Mechanical endurance test - Relevant switching times of test sample 3 (single-sector design).

5.3 Operation test at 115 °C

Number of operations: 100 operations
The test was performed with test sample 1 and test sample 3.

Test arrangement / conditions: See sub-clause 4.3.

Switching sequence: See appendix, fig. 1.

Operation test: The test samples were switched from position “A” to “B” and vice versa, until 100 operations were performed.

Recordings: For each test, 100 operations were recorded. Based on these recordings the switching times were evaluated.

Tables 4 and 5 show, that all switching times were within their permissible range.

Comparison of ten timing oscillograms taken during the operation test at 115 °C with each ten obtained at the start and the end of the mechanical endurance test showed suitability for service:
- Test sample 1: See figs. 4.1 to 4.10 and 2.1 to 2.20
- Test sample 3: See figs. 5.1 to 5.10 and 3.1 to 3.20

The time steps according to tables 4 and 5 are exemplary shown in figs. 4.1 and 5.1 for test samples 1 and 3.

	MSV opens - TTV closes	TTV closes - TTV opens	MSV closes - MDC opens
Time step	t1 – t2	t2 – t3	t4 – t5
Permissible values (Petro 45X at >80 °C … 130 °C)	> 13.5 ms < 45.8 ms	> 6.7 ms < 30.0 ms	> 12.7 ms
Measured values at the operating test (Petro 45X at 115 °C)	> 18.6 ms < 23.3 ms	> 11.5 ms < 14.8 ms	> 17.9 ms

Table 4: Operation test at 115 °C - Relevant switching times of test sample 1 (three-sector design).

	MSV opens - TTV closes	TTV closes - TTV opens	MSV closes - MDC opens
Time step	t1 – t2	t2 – t3	t4 – t5
Permissible values (Petro 45X at >80 °C … 130 °C)	> 13.5 ms < 45.8 ms	> 6.7 ms < 30.0 ms	> 12.7 ms
Measured values at the operating test (Petro 45X at 115 °C)	> 21.7 ms < 24.6 ms	> 9.1 ms < 10.0 ms	> 19.2 ms

Table 5: Operation test at 115 °C - Relevant switching times of test sample 3 (single-sector design).

5.4 Operation test at -25 °C

Number of operations:	100 operations The test was performed with test samples 1, 2 and 3.
Test arrangement / conditions:	See sub-clause 4.4.
Switching sequence:	See appendix, fig. 1.
Viscosity of transformer oil:	The viscosity of the insulation medium at -25 °C was 750 mm^2/s.
Operation test:	The test samples were switched from position “A” to “B” and vice versa, until 100 operations were performed.
Recordings:	For each test, 100 operations were recorded. Based on these recordings the switching times were evaluated.

Tables 6, 7 and 8 show, that all switching times were within their permissible range.

Comparison of ten timing oscillograms taken during the operation test at -25 °C with those taken during the mechanical endurance test and the operation test at 115 °C showed suitability for service:
- Test sample 1: See figs. 6.1 to 6.10, 4.1 to 4.10 and 2.1 to 2.20
- Test sample 3: See figs. 7.1 to 7.10, 5.1 to 5.10 and 3.1 to 3.20
- Test sample 2: See figs. 8.1 to 8.10

The time steps according to tables 6, 7 and 8 are exemplary shown in figs. 6.1, 7.1 and 8.1 for test sample 1, 2 and 3.

	MSV opens - TTV closes	TTV closes - TTV opens	MSV closes - MDC opens
Time step	t1 – t2	t2 – t3	t4 – t5
Permissible values (Petro 45X at -25 °C … ≤0 °C)	> 13.5 ms < 76.3 ms	> 6.6 ms < 50.0 ms	> 12.7 ms
Measured values at the operating test (Petro 45X at -25 °C)	> 32.2 ms < 40.1 ms	> 15.3 ms < 19.1 ms	> 26.3 ms

Table 6: Operation test at -25 °C - Relevant switching times of test sample 1 (three-sector design).

	MSV opens - TTV closes	TTV closes - TTV opens	MSV closes - MDC opens
Time step	t1 – t2	t2 – t3	t4 – t5
Permissible values (Petro 45X at -25 °C … ≤0 °C)	> 13.5 ms < 76.3 ms	> 6.6 ms < 50.0 ms	> 12.7 ms
Measured values at the operating test (Petro 45X at -25 °C)	> 28.1 ms < 31.8 ms	> 9.4 ms < 10.0 ms	> 26.8 ms

Table 7: Operation test at -25 °C - Relevant switching times of test sample 3 (single-sector design).

	MSV opens - TTV closes	TTV closes - TTV opens	MSV closes - MDC opens
Time step	t1 – t2	t2 – t3	t4 – t5
Permissible values (Petro 45X at -25 °C … ≤0 °C)	> 13.5 ms < 76.3 ms	> 6.6 ms < 50.0 ms	> 12.7 ms
Measured values at the operating test (Petro 45X at -25 °C)	> 26.3 ms < 32.7 ms	> 10.1 ms < 11.1 ms	> 24.4 ms

Table 8: Operation test at -25 °C - Relevant switching times of test sample 2 (two-sector design).

5.5 Operation test under maximum allowable static pressure

Number of operations:	100 operations at maximum allowable static pressure (2.0 bar) The test was performed with test sample 1 and test sample 3.
Test arrangement / conditions:	See sub-clause 4.5.
Switching sequence:	See appendix, fig. 1.
Operation test:	The test samples were switched from position “A” to “B” and vice versa, until 100 operations were performed.
Recordings:	For each test, 100 operations were recorded. Based on these recordings the switching times were evaluated.

Tables 9 and 10 show, that all switching times were within their permissible range.

Comparison of ten timing oscillograms taken during the tests with those obtained in normal atmospheric pressure at ambient temperature showed suitability for service:
- Test sample 1: See figs. 9.1 to 9.10 and 2.1 to 2.20
- Test sample 3: See figs. 10.1 to 10.10 and 3.1 to 3.20

The time steps according to tables 9 and 10 are exemplary shown in figs. 9.1 and 10.1 for test samples 1 and 3.

	MSV opens - TTV closes	TTV closes - TTV opens	MSV closes - MDC opens
Time step	t1 – t2	t2 – t3	t4 – t5
Permissible values (Nynas Nytro Taurus at >0 °C … ≤80 °C)	> 13.5 ms < 30.5 ms	> 6.7 ms < 20.0 ms	> 12.7 ms
Measured values at the operation test (Nynas Nytro Taurus at 25 °C)	> 19.4 ms < 25.6 ms	> 12.0 ms < 15.4 ms	> 18.5 ms

Table 9: Operation test under max. allowable static pressure - Relevant switching times of test sample 1 (three-sector design).

	MSV opens - TTV closes	TTV closes - TTV opens	MSV closes - MDC opens
Time step	t1 – t2	t2 – t3	t4 – t5
Permissible values (Nynas Nytro Taurus at >0 °C … ≤80 °C)	> 13.5 ms < 30.5 ms	> 6.7 ms < 20.0 ms	> 12.7 ms
Measured values at the operation test (Nynas Nytro Taurus at 25 °C)	>19.1 ms < 22.0 ms	> 8.6 ms < 9.4 ms	> 19.3 ms

Table 10: Operation test under max. allowable static pressure - Relevant switching times of test sample 3 (single-sector design).

5.6 Pressure and vacuum test

Test sample:	The pressure and vacuum test was carried out on test sample 1.
Test arrangement / conditions:	See sub-clause 4.6.
Test results:	The pressure and vacuum test proved the pressure and vacuum resistance of the head and all bushings of the diverter switch oil compartment, see table 11.

Pressure test (inside → outside)	
Pressure inside the test tank:	0.6 bar
Pressure outside the test tank:	Vacuum
Medium inside the test tank:	Helium-air mixture
Ambient medium:	Air
Limit leakage rate:	4.00×10^{-5} mbar x l / s
Measured leakage rate:	1.68×10^{-5} mbar x l / s
Vacuum test (outside → inside)	
Pressure inside the test tank:	Vacuum
Pressure outside the test tank:	1.0 bar [3]
Medium outside the test tank:	Air
Limit leakage rate (Δp):	1.00 mbar / 30 s
Measured leakage rate (Δp):	0.58 mbar / 30 s

Table 11: Test results for the pressure and vacuum test of test sample 1.

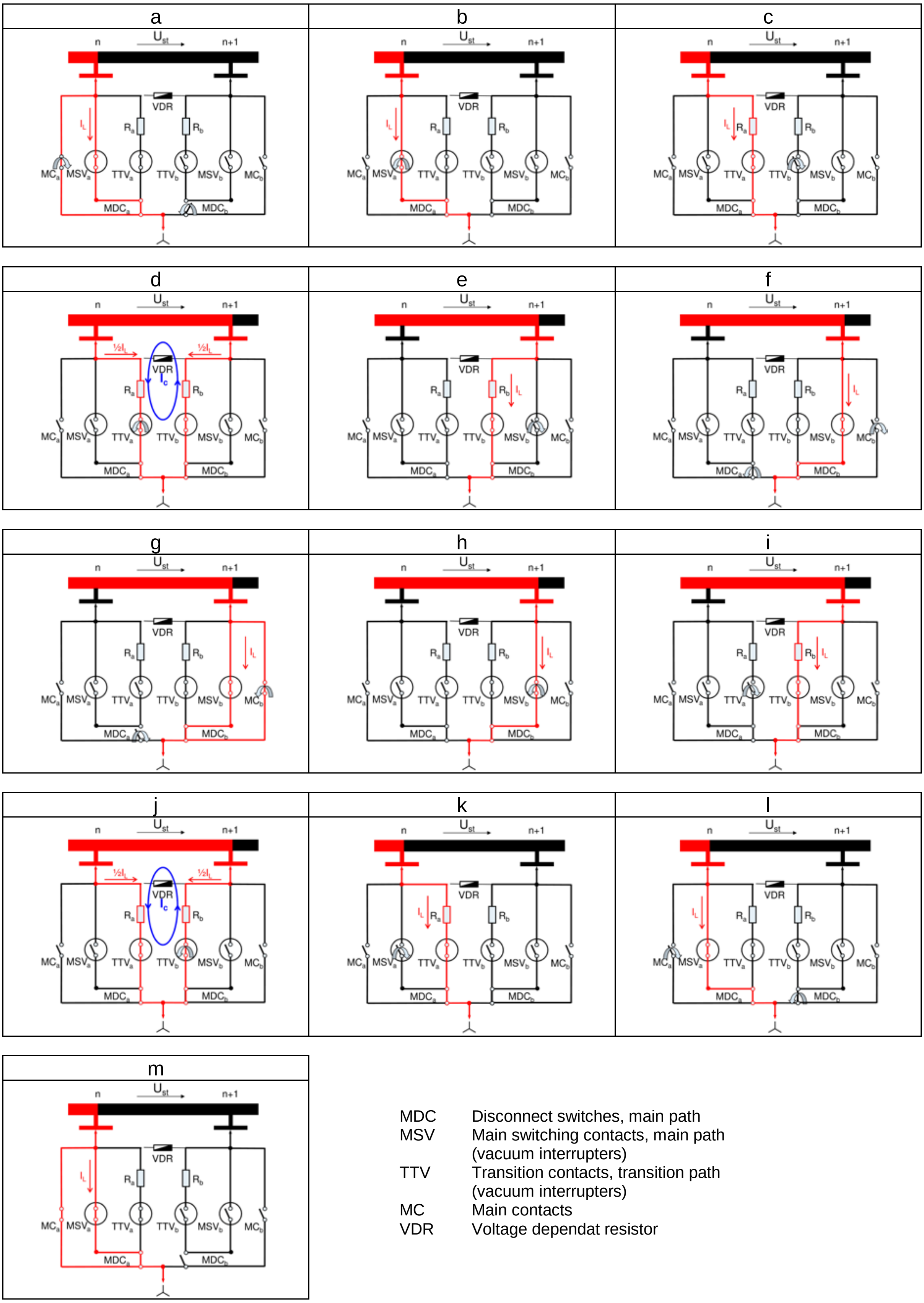
[3] Difference value of 1.0 bar represents a theoretical value, depending on atmospheric pressure.

6. Test results

The requirements of IEC 60214-1:2014 “Tap changers Part 1: Performance requirements and test methods”, sub-clause 5.2.6: “Mechanical tests” were met, e.g.:

- Each ten timing oscillograms taken at the start and at the end of the mechanical endurance test showed no significant difference. All relevant switching times were within their permissible limits.
- Comparison of ten timing oscillograms taken during the operation test at 115 °C with those obtained at the start and the end of the mechanical endurance test showed suitability for service. All relevant switching times were within their permissible limits.
- Comparison of ten timing oscillograms taken during the operation test at -25 °C with those taken during the mechanical endurance test and at the operation test at 115 °C showed suitability for service. All relevant switching times were within their permissible limits.
- Comparison of each ten timing oscillograms taken during the operation tests at the maximum allowable static pressure with those obtained in normal atmospheric pressure at ambient temperature showed suitability for service. All relevant switching times were within their permissible limits.
- The pressure and vacuum test proved the pressure and vacuum resistance of the head and all bushings of the diverter switch oil compartment.
- Further, during the performed tests, there was no failure or undue wear of the contacts or mechanical parts that would lead to mechanical failure if operation continued.

7. Appendix



MDC	Disconnect switches, main path
MSV	Main switching contacts, main path (vacuum interrupters)
TTV	Transition contacts, transition path (vacuum interrupters)
MC	Main contacts
VDR	Voltage dependat resistor

Fig. 1: Switching sequence of diverter switch type VACUTAP® VRS / VRM / VRL / VRH / VRX.

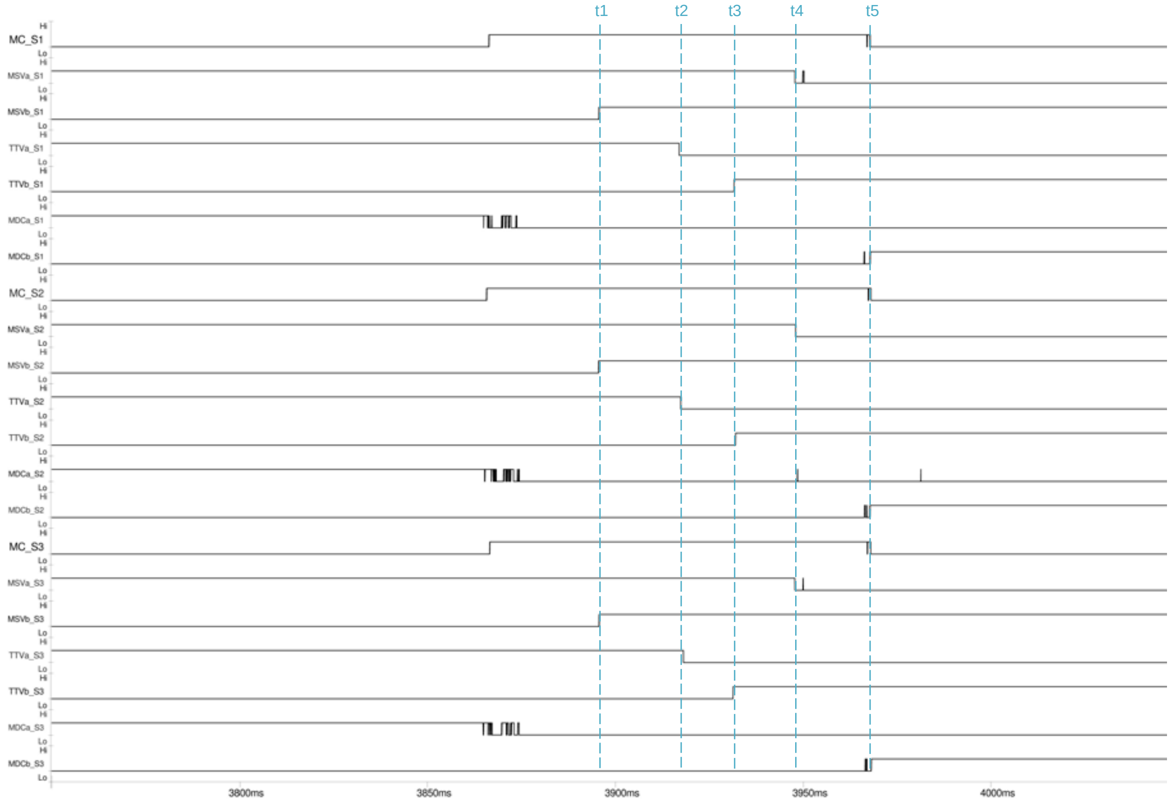


Fig. 2.1: Mechanical endurance test with test sample 1– Oscillogram no. 1 taken at the beginning of the test.

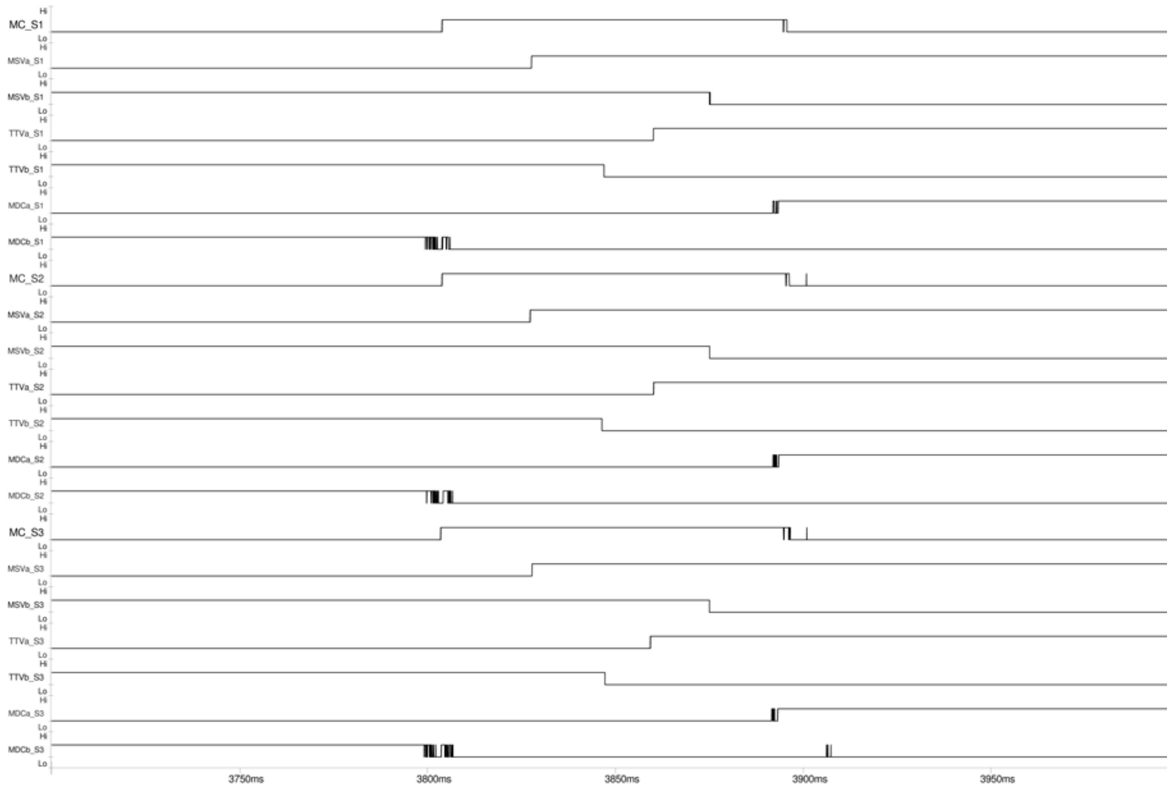


Fig. 2.2: Mechanical endurance test with test sample 1 – Oscillogram no. 2 taken at the beginning of the test.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

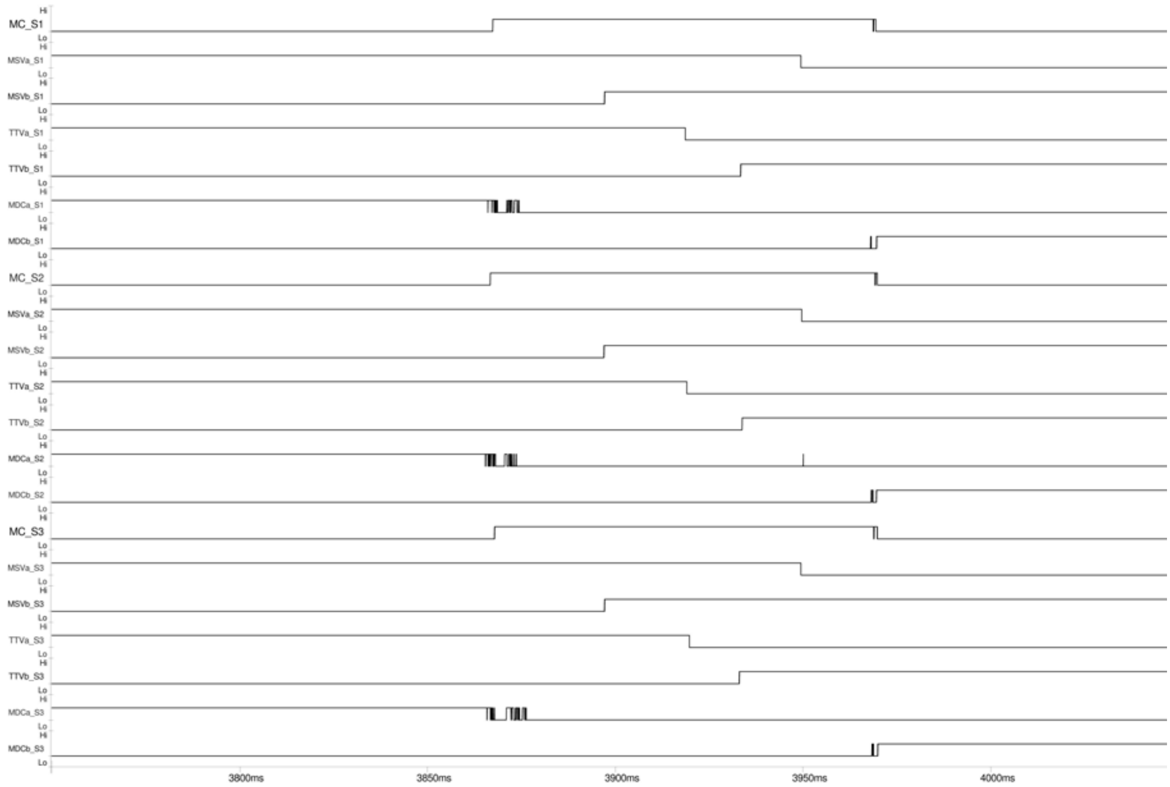


Fig. 2.3: Mechanical endurance test with test sample 1 – Oscillogram no. 3 taken at the beginning of the test.

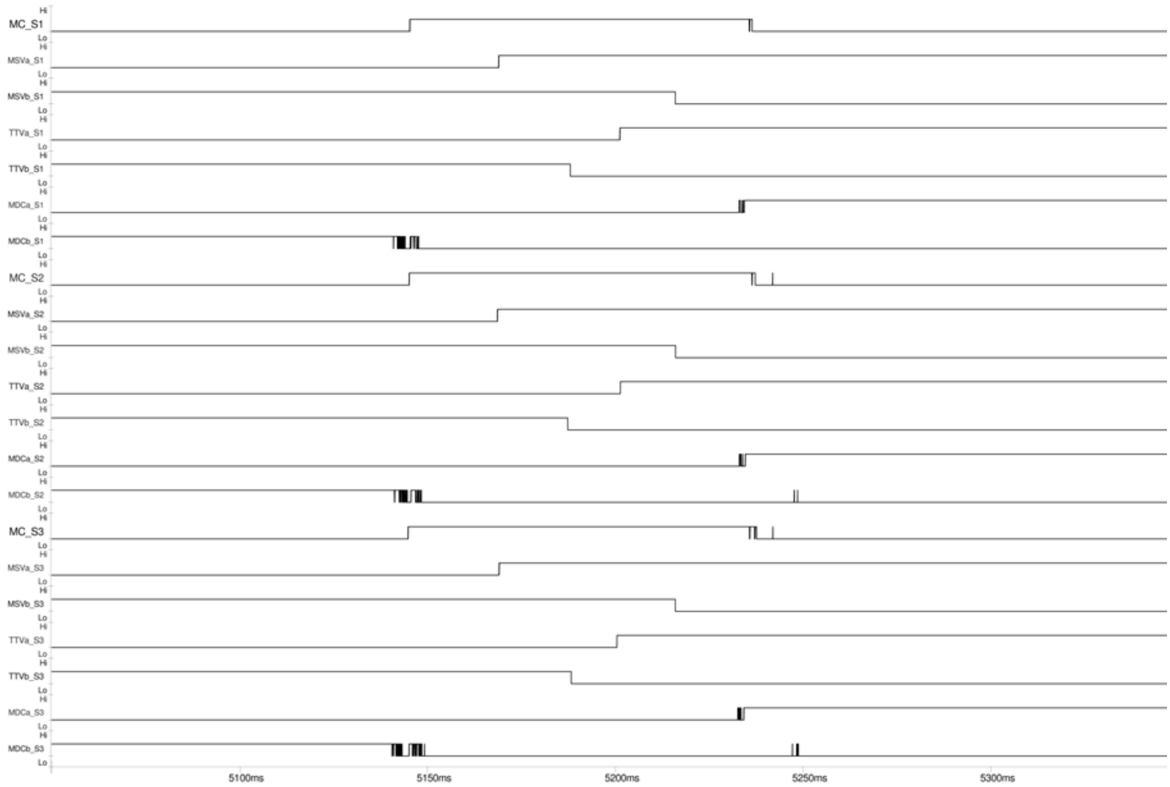
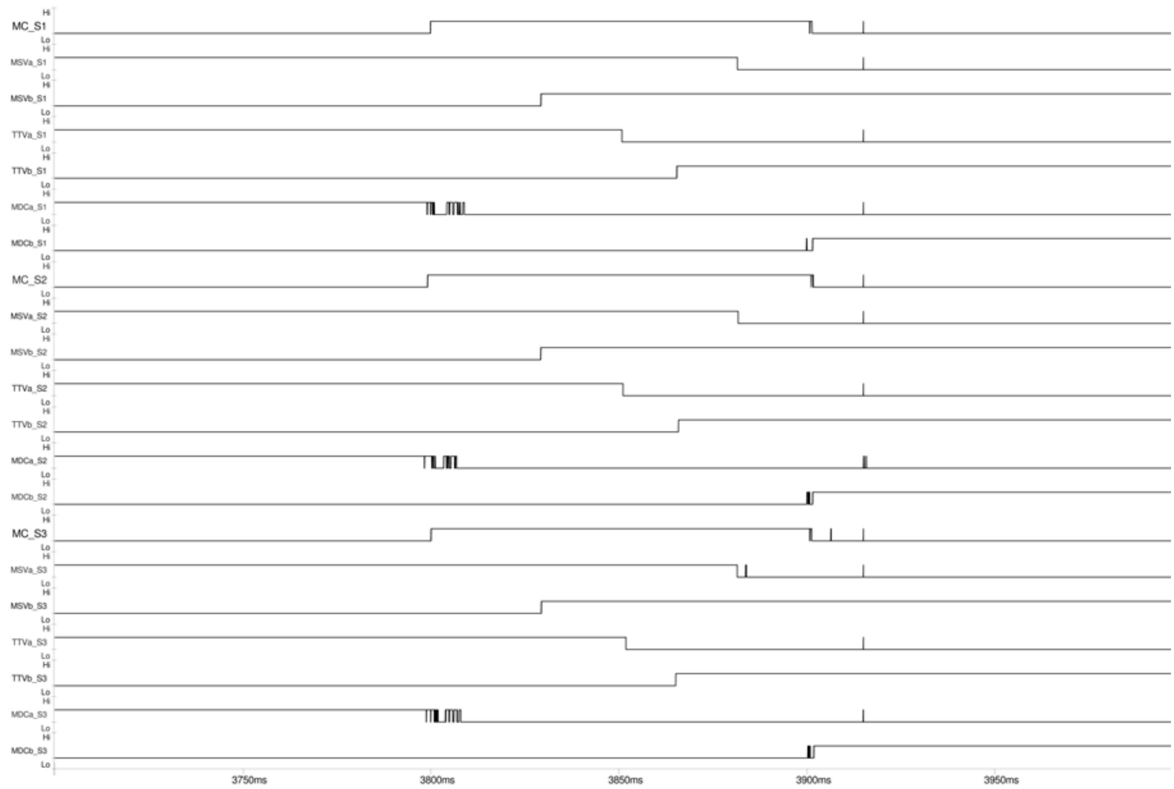
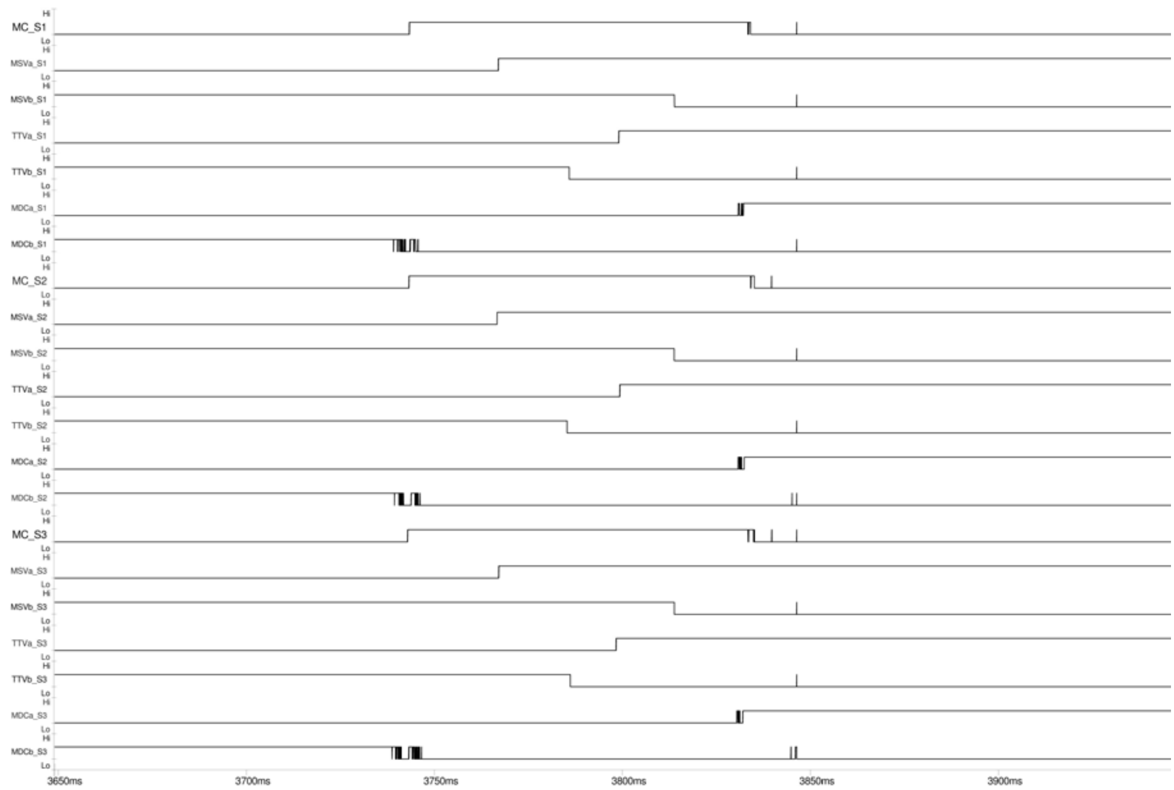


Fig. 2.4: Mechanical endurance test with test sample 1 – Oscillogram no. 4 taken at the beginning of the test.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		



<u>Fig. 2.5:</u> Mechanical endurance test with test sample 1 – Oscillogram no. 5 taken at the beginning of the test.



<u>Fig. 2.6: Mechanical endurance test with test sample 1 – Oscillogram no. 6 taken at the beginning of the test.</u>

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

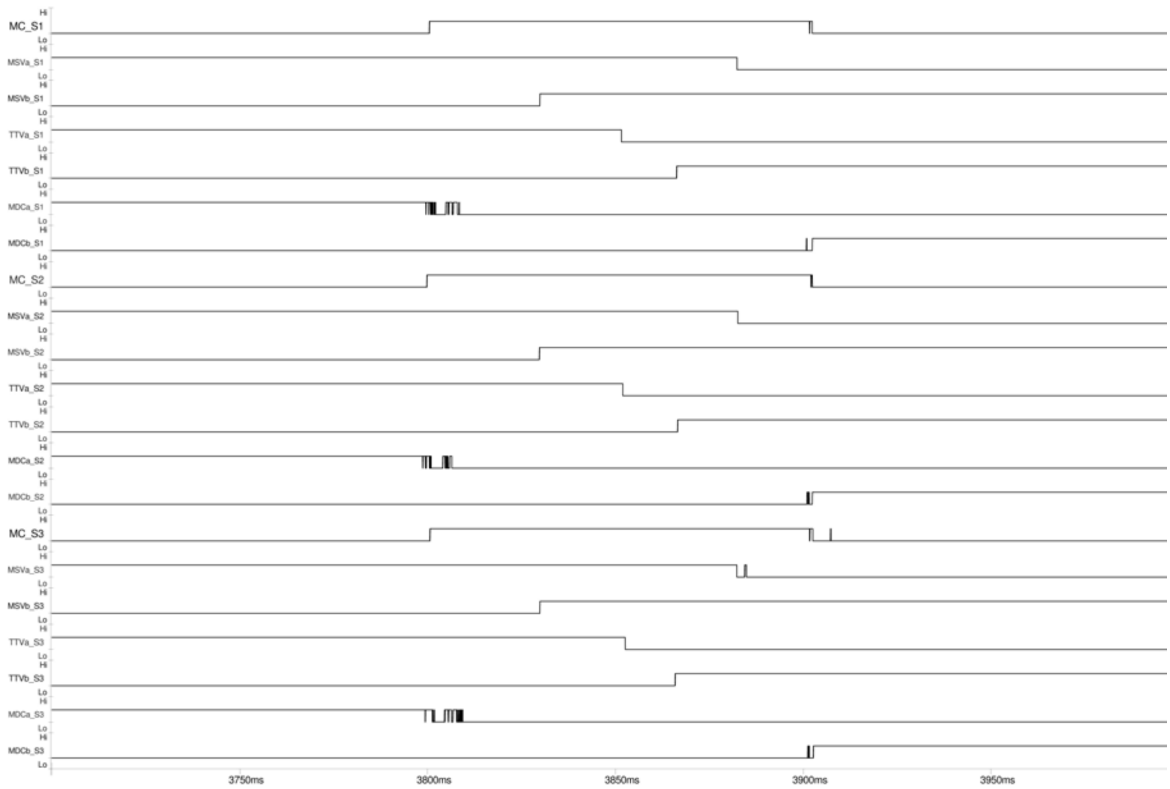


Fig. 2.7: Mechanical endurance test with test sample 1 – Oscillogram no. 7 taken at the beginning of the test.

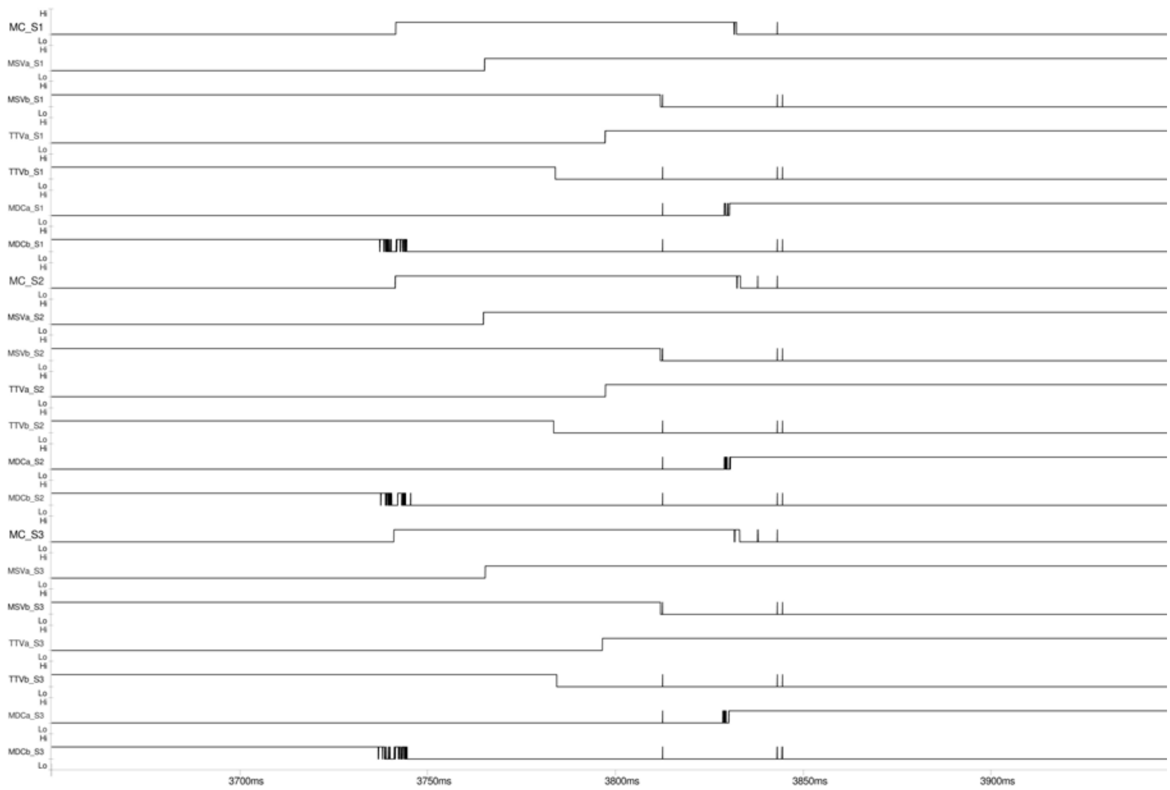


Fig. 2.8: Mechanical endurance test with test sample 1 – Oscillogram no. 8 taken at the beginning of the test.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

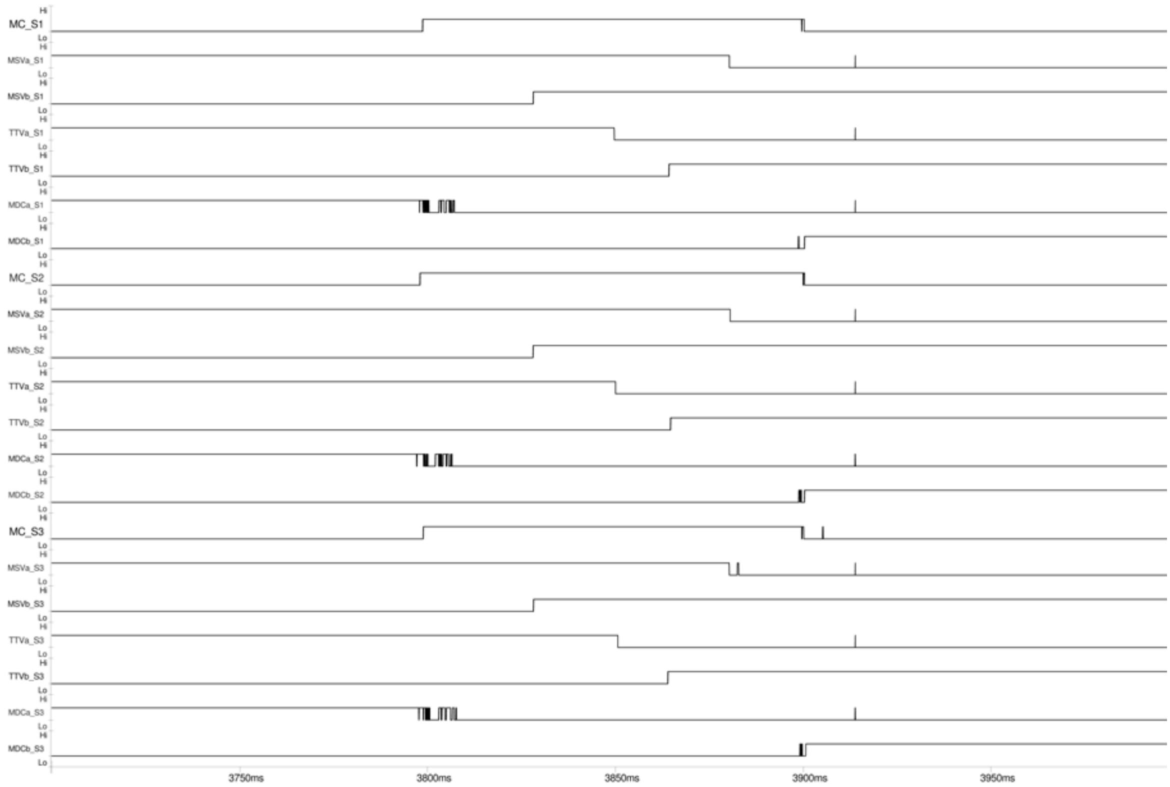


Fig. 2.9: Mechanical endurance test with test sample 1 – Oscillogram no. 9 taken at the beginning of the test.

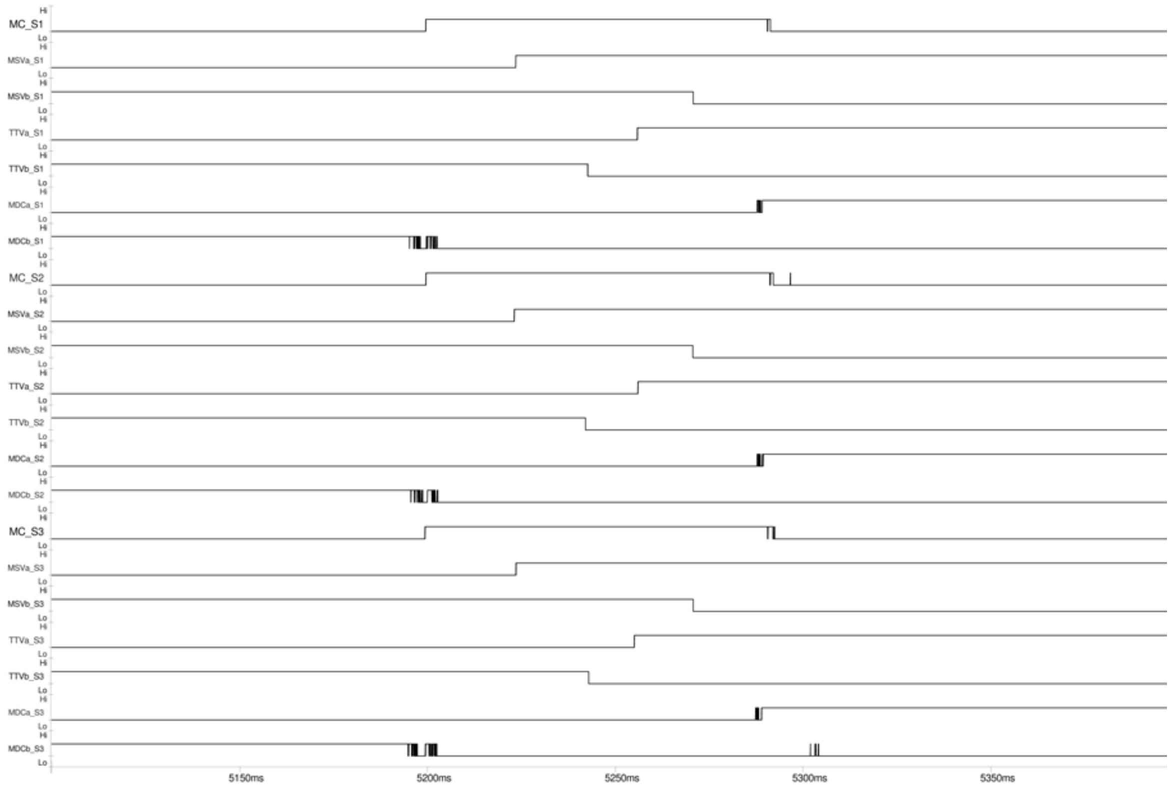


Fig. 2.10: Mechanical endurance test with test sample 1 – Oscillogram no. 10 taken at the beginning of the test.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

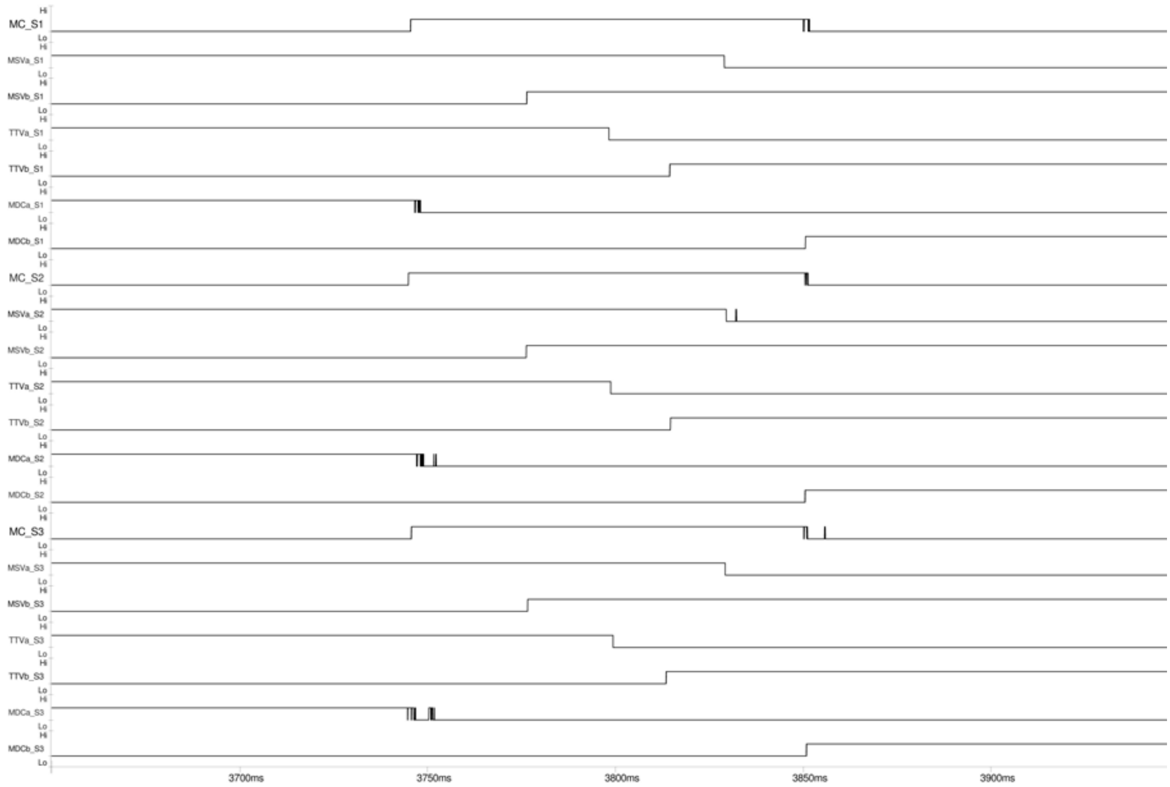


Fig. 2.11: Mechanical endurance test with test sample 1 – Oscillogram no. 1 taken at 500,000 operations.

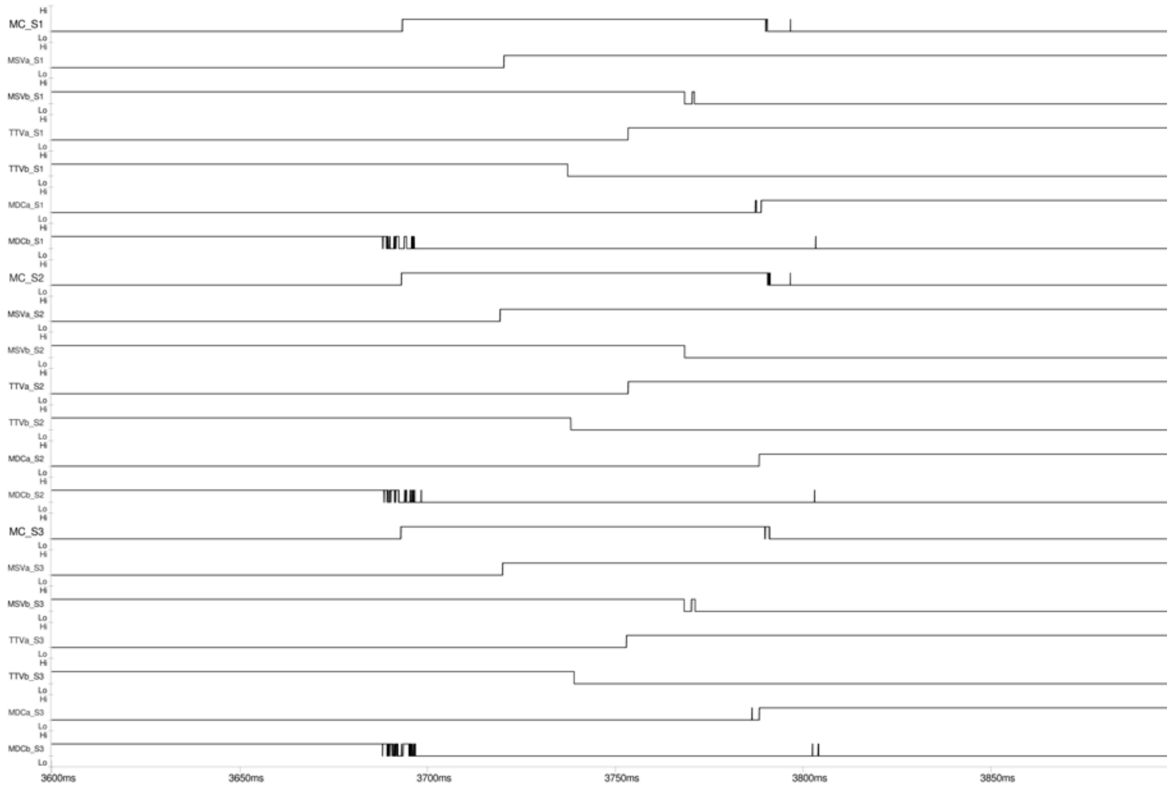


Fig. 2.12: Mechanical endurance test with test sample 1 – Oscillogram no. 2 taken at 500,000 operations.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

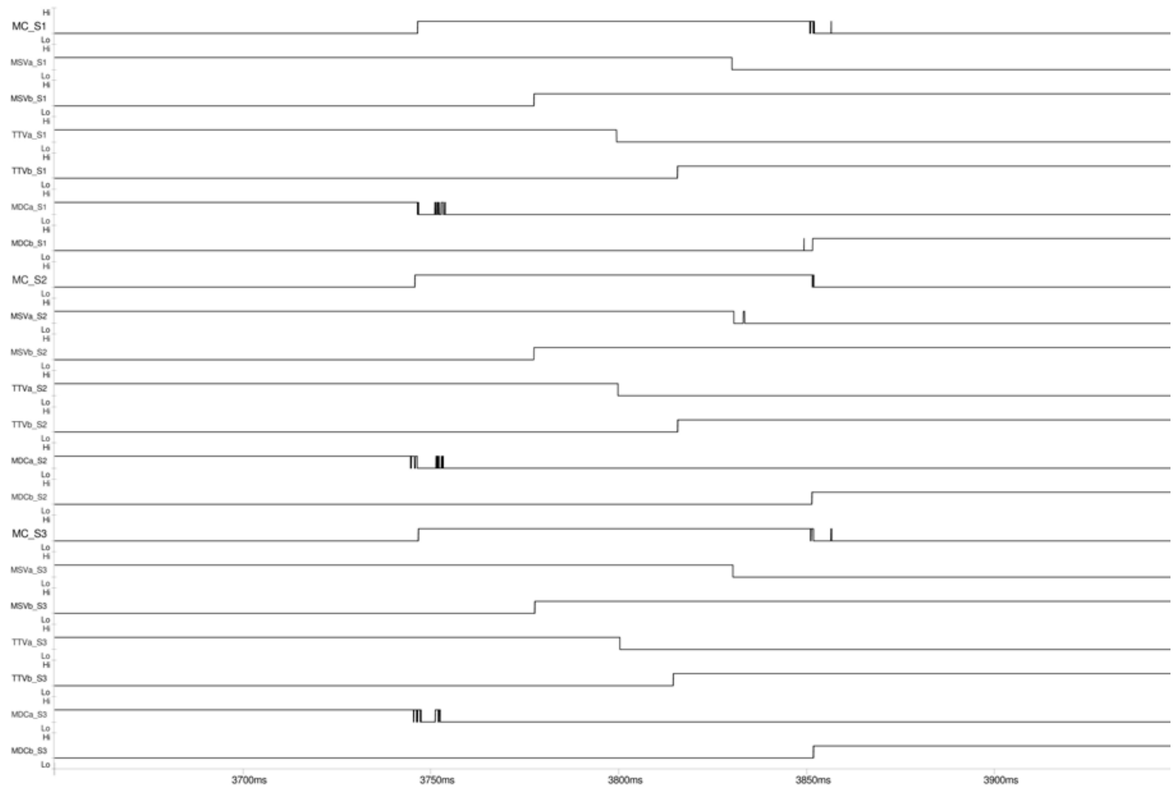


Fig. 2.13: Mechanical endurance test with test sample 1 – Oscillogram no. 3 taken at 500,000 operations.

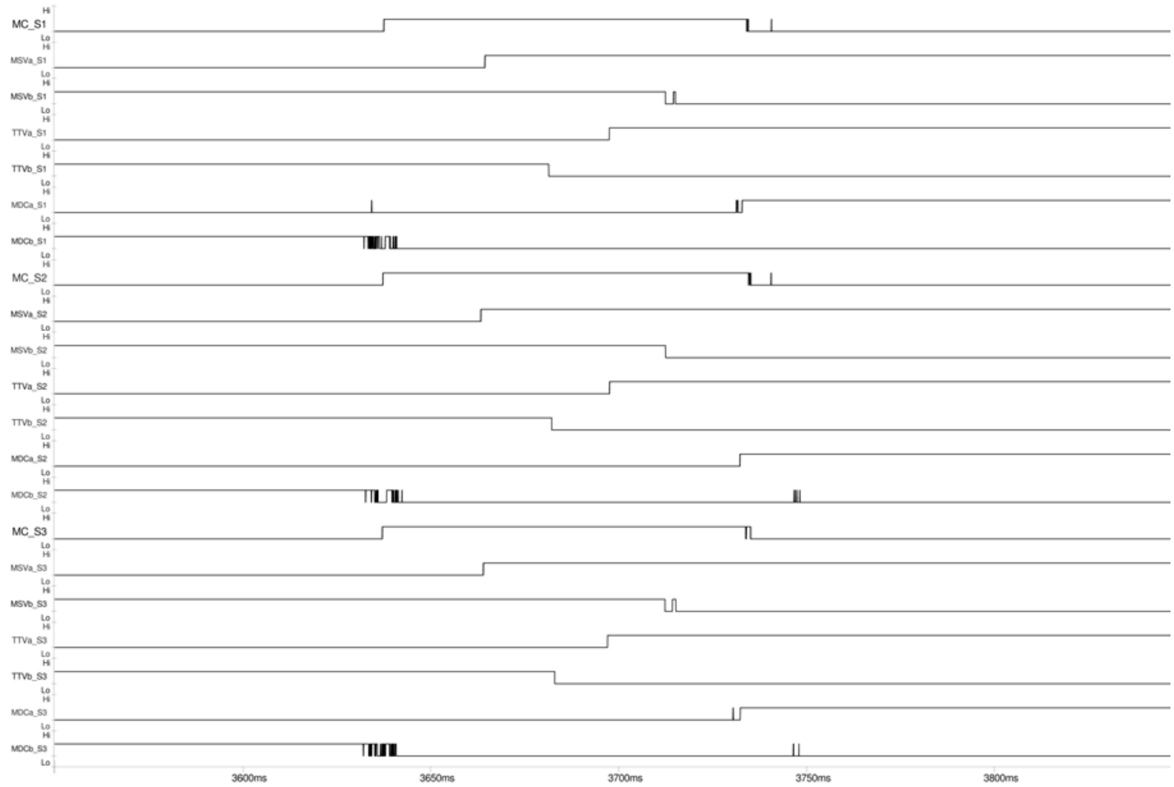


Fig. 2.14: Mechanical endurance test with test sample 1 – Oscillogram no. 4 taken at 500,000 operations.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

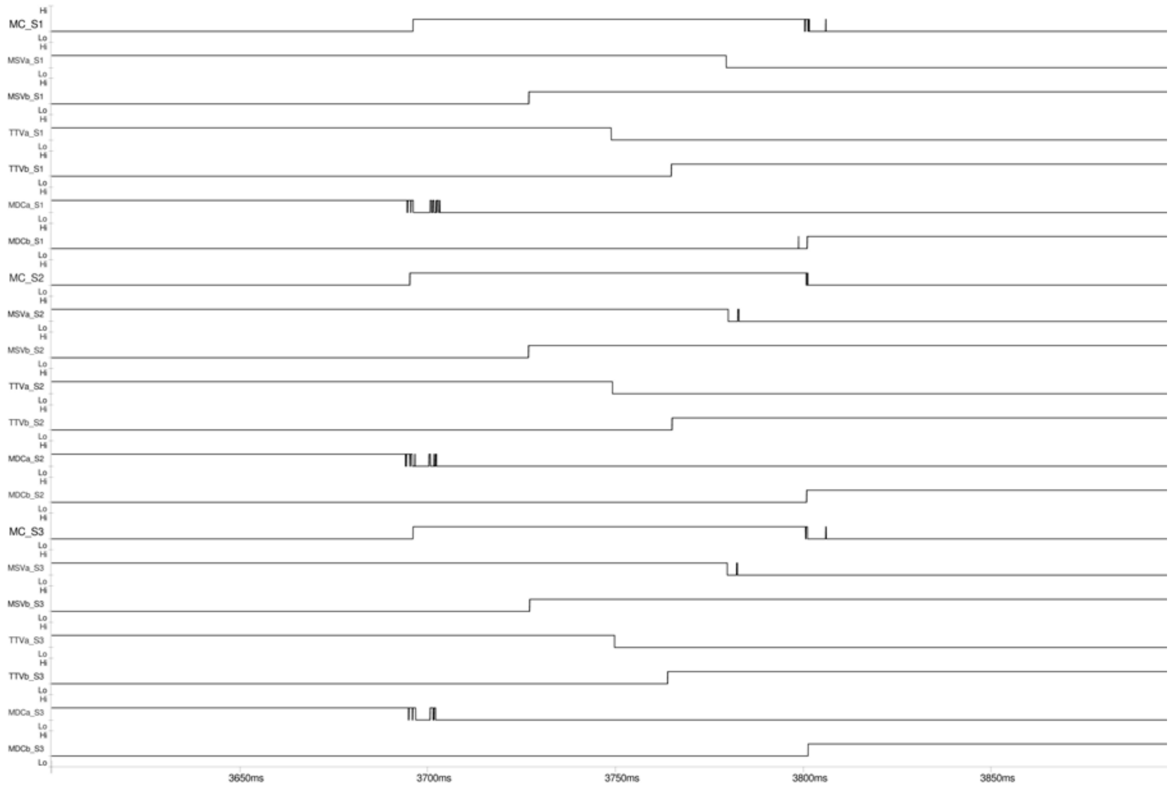


Fig. 2.15: Mechanical endurance test with test sample 1 – Oscillogram no. 5 taken at 500,000 operations.

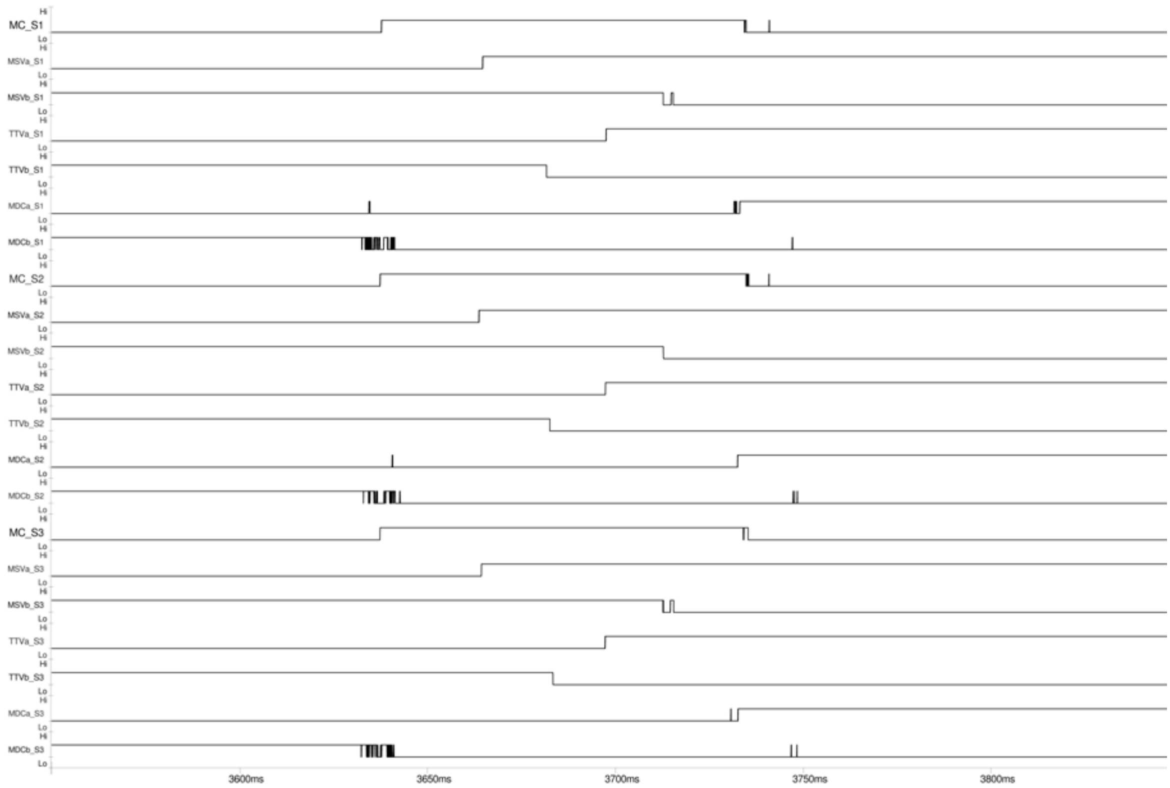


Fig. 2.16: Mechanical endurance test with test sample 1 – Oscillogram no. 6 taken at 500,000 operations.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

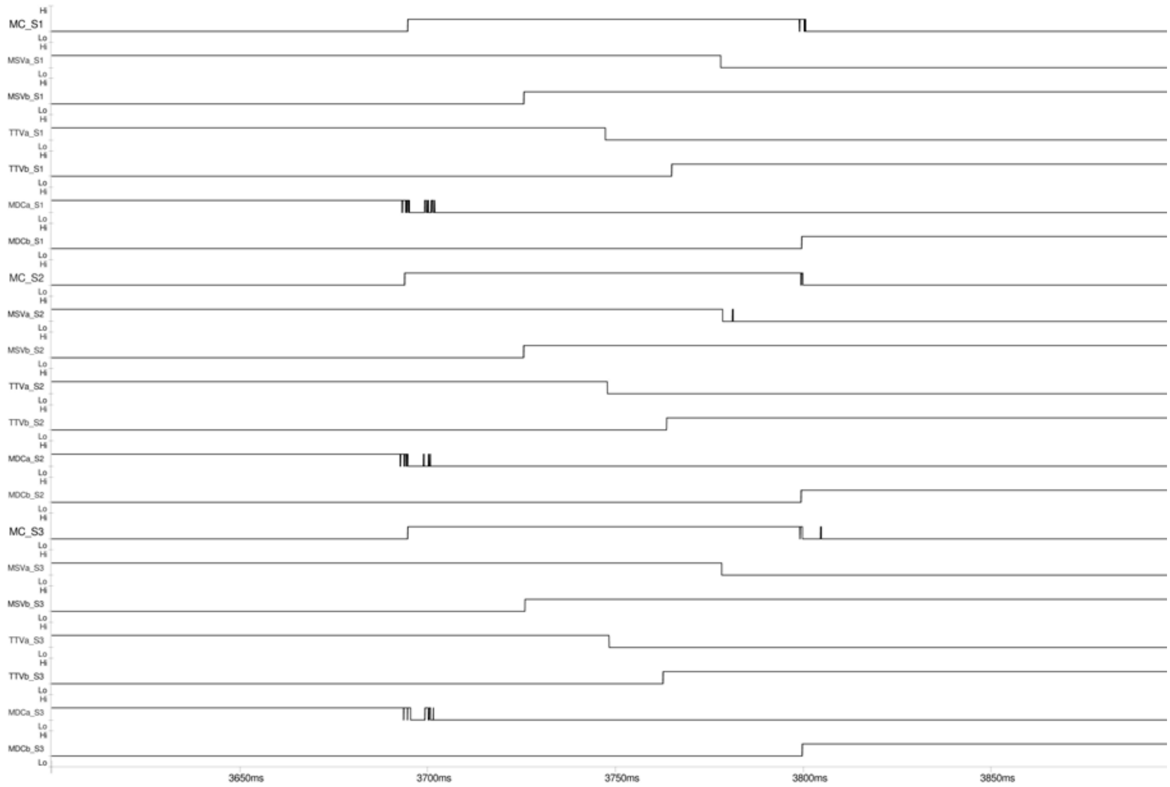


Fig. 2.17: Mechanical endurance test with test sample 1 – Oscillogram no. 7 taken at 500,000 operations.

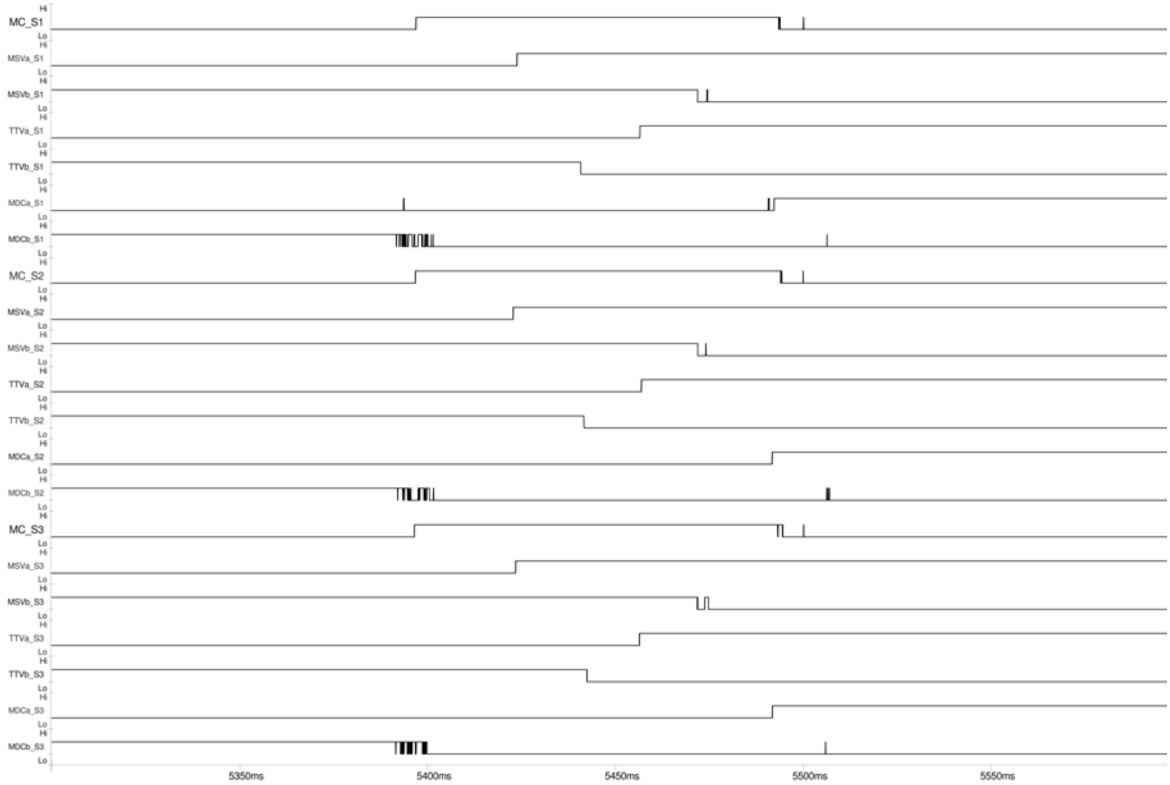


Fig. 2.18: Mechanical endurance test with test sample 1 – Oscillogram no. 8 taken at 500,000 operations.

MC:	Main contacts
MDCa, MDCb:	Main path, disconnect switch
S1, S2, S3:	Sector 1, Sector 2, Sector 3
MSVa, MSVb:	Main path, switching contacts
TTVa, TTVb:	Transition path, transition contacts

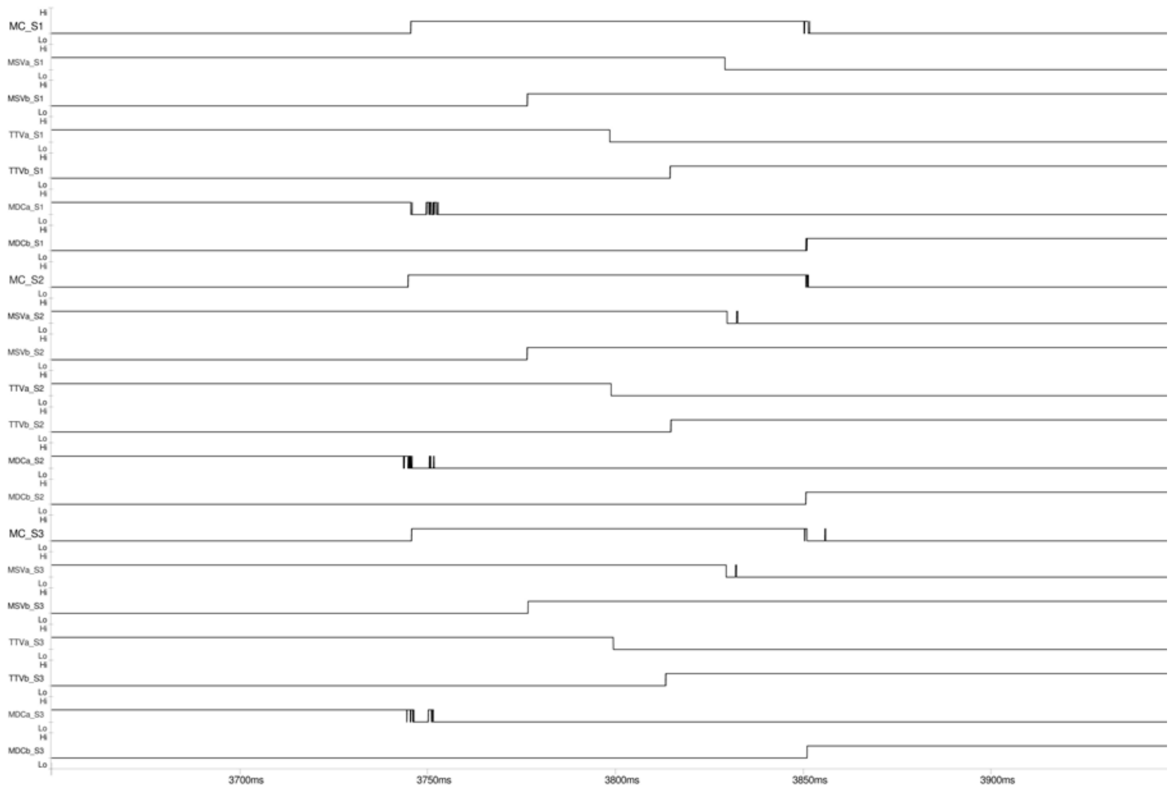


Fig. 2.19: Mechanical endurance test with test sample 1 – Oscillogram no. 9 taken at 500,000 operations.

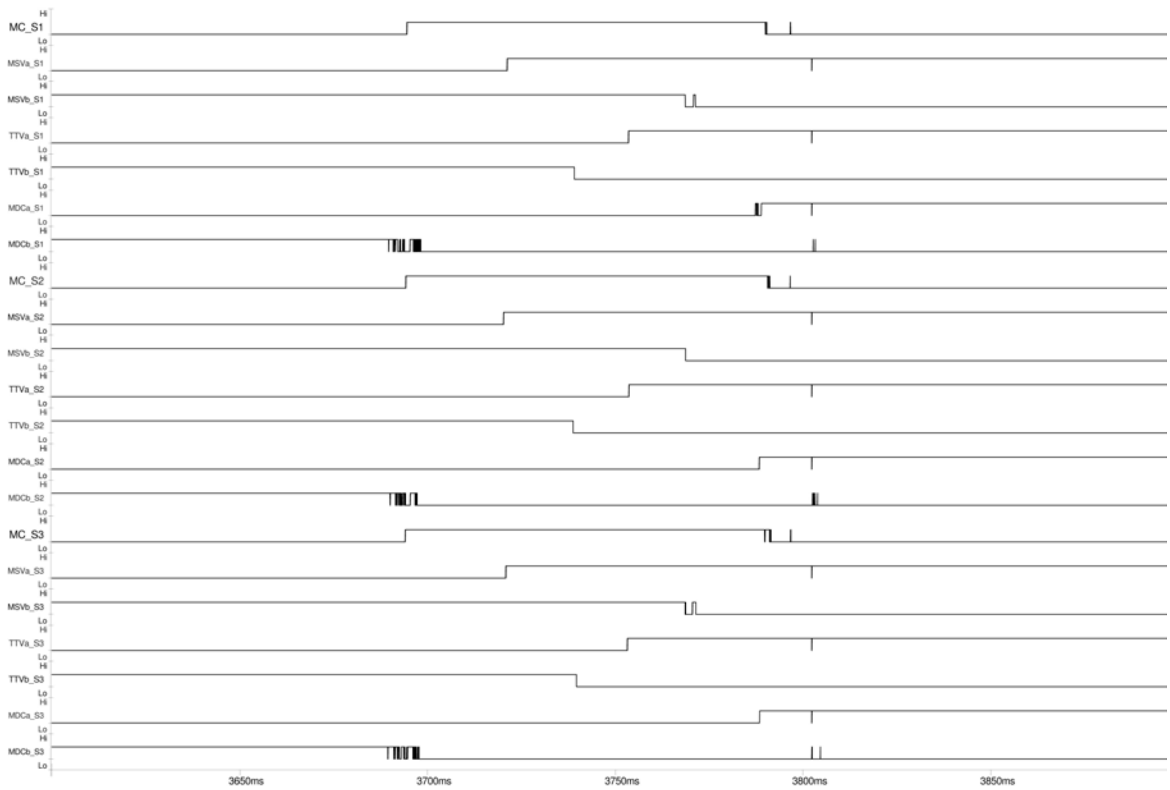


Fig. 2.20: Mechanical endurance test with test sample 1 – Oscillogram no. 10 taken at 500,000 operations.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

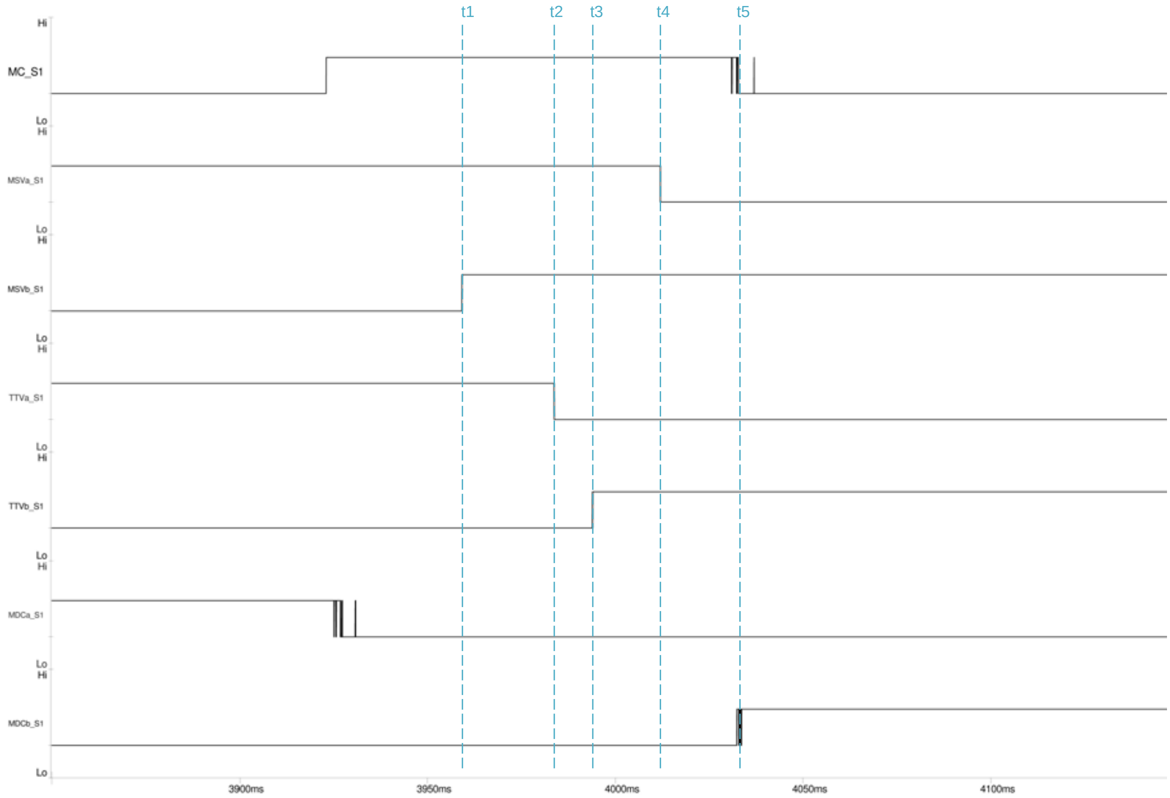


Fig. 3.1: Mechanical endurance test with test sample 3 – Oscillogram no. 1 taken at the beginning of the test.

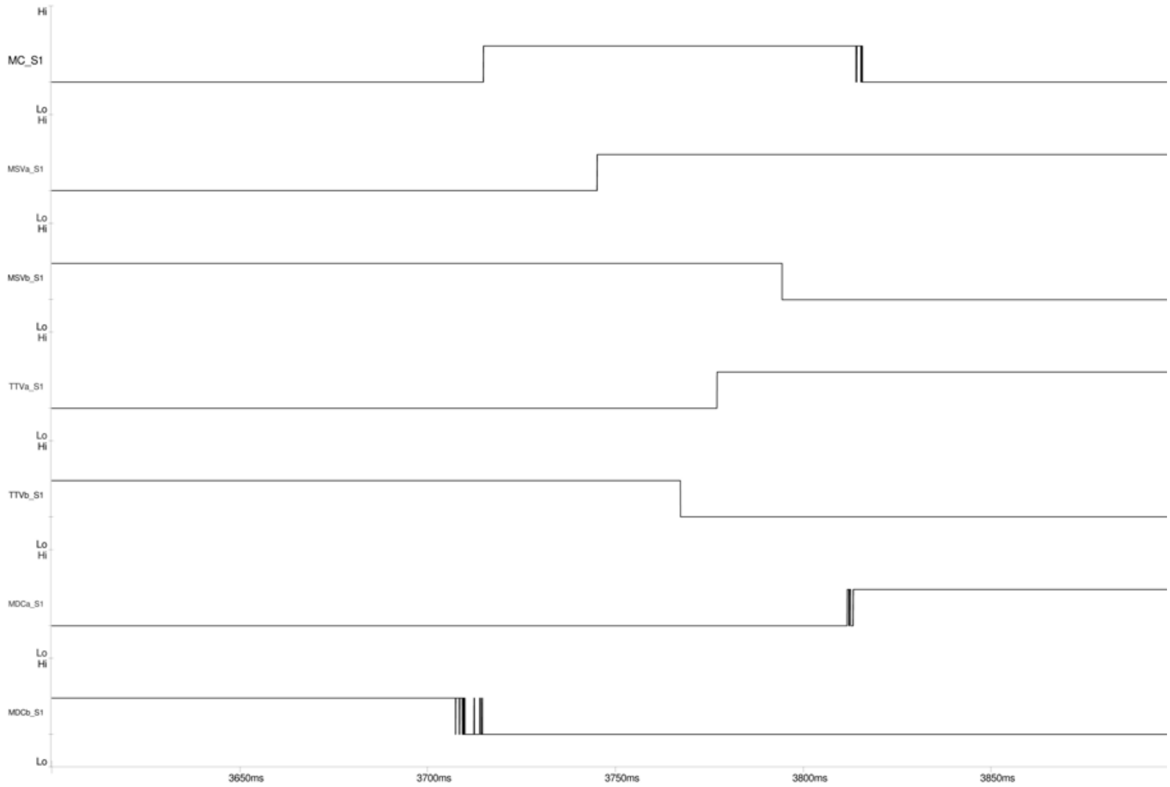


Fig. 3.2: Mechanical endurance test with test sample 3 – Oscillogram no. 2 taken at the beginning of the test.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1, Sector 2, Sector 3		

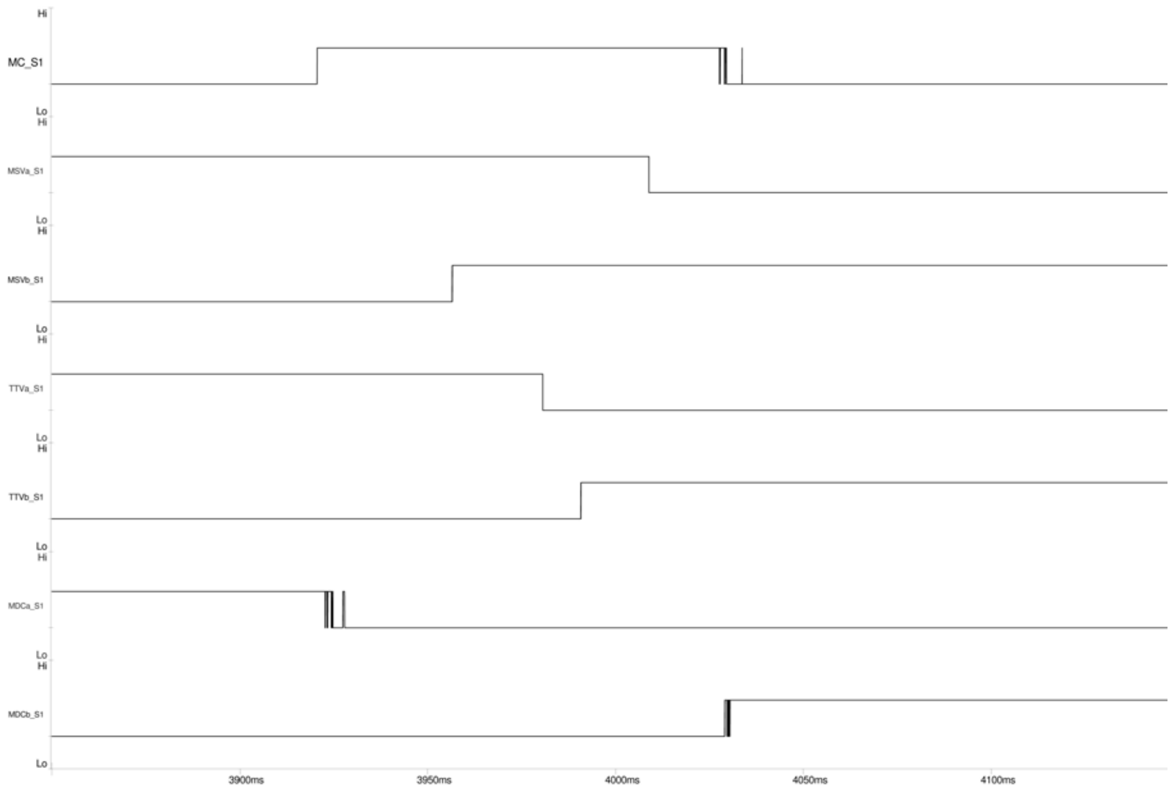


Fig. 3.3: Mechanical endurance test with test sample 3 – Oscillogram no. 3 taken at the beginning of the test.

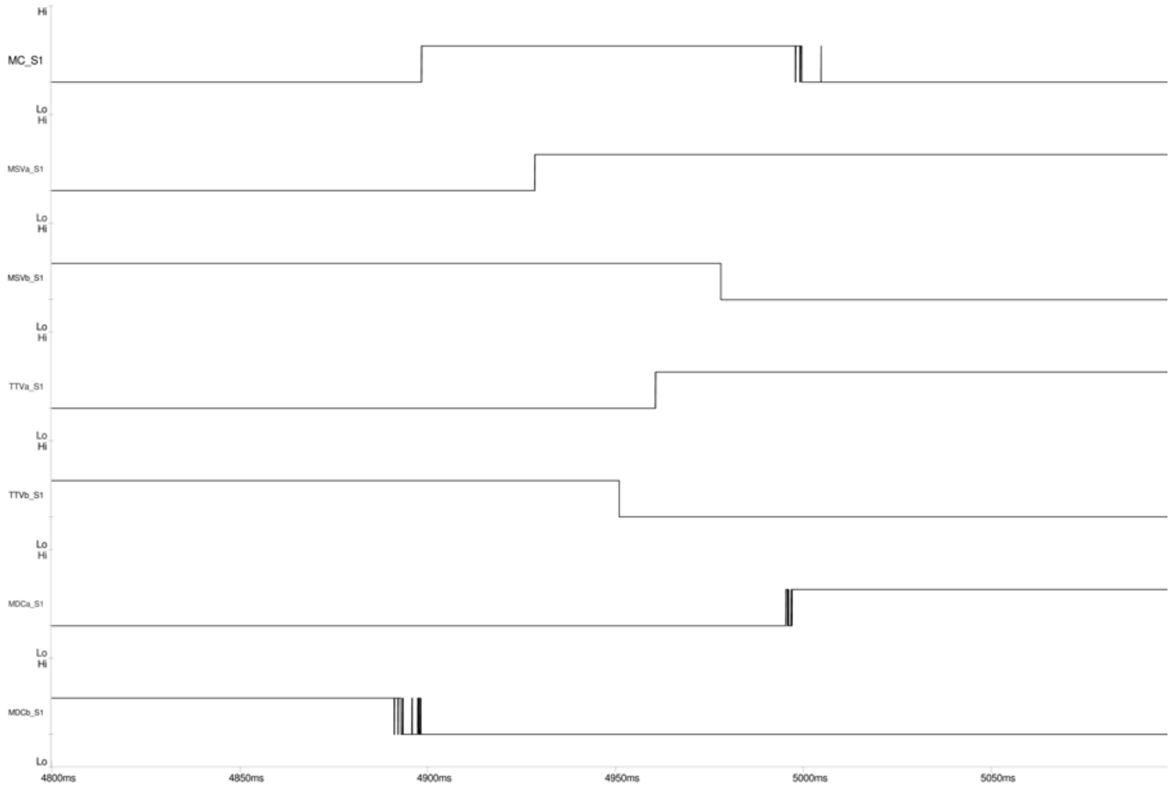


Fig. 3.4: Mechanical endurance test with test sample 3 – Oscillogram no. 4 taken at the beginning of the test.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

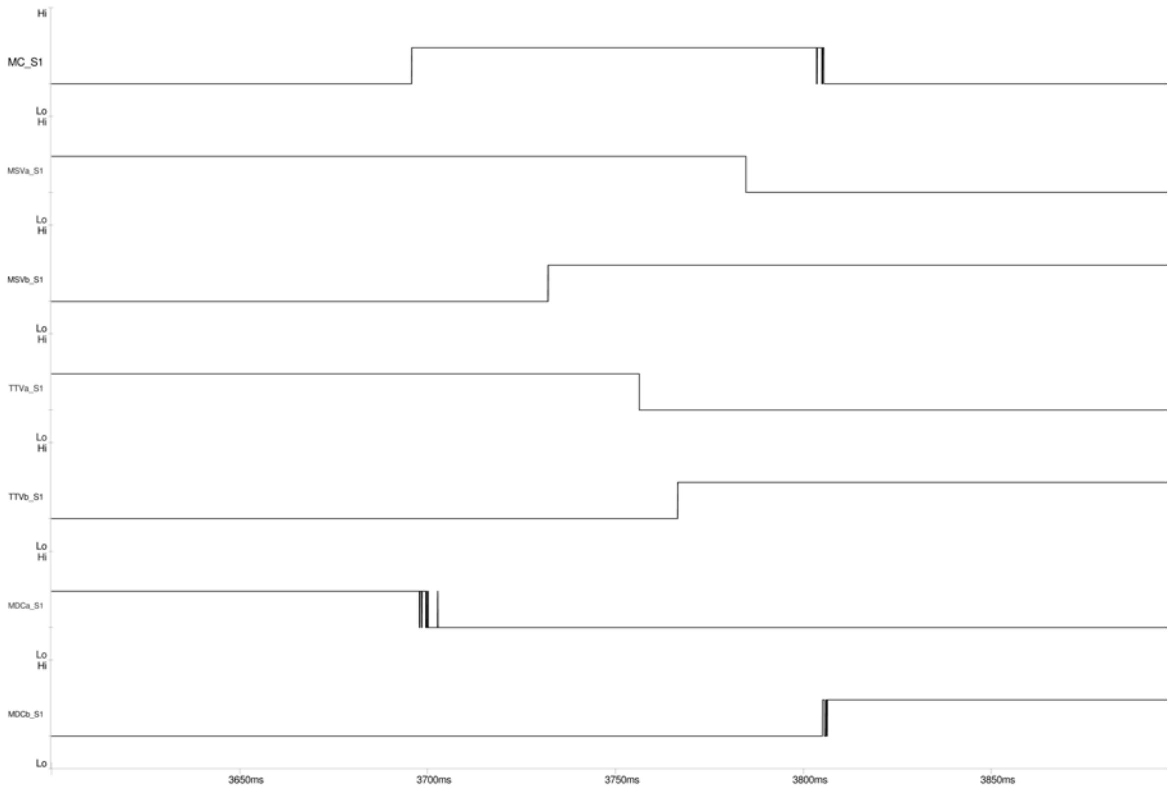


Fig. 3.5: Mechanical endurance test with test sample 3 – Oscillogram no. 5 taken at the beginning of the test.

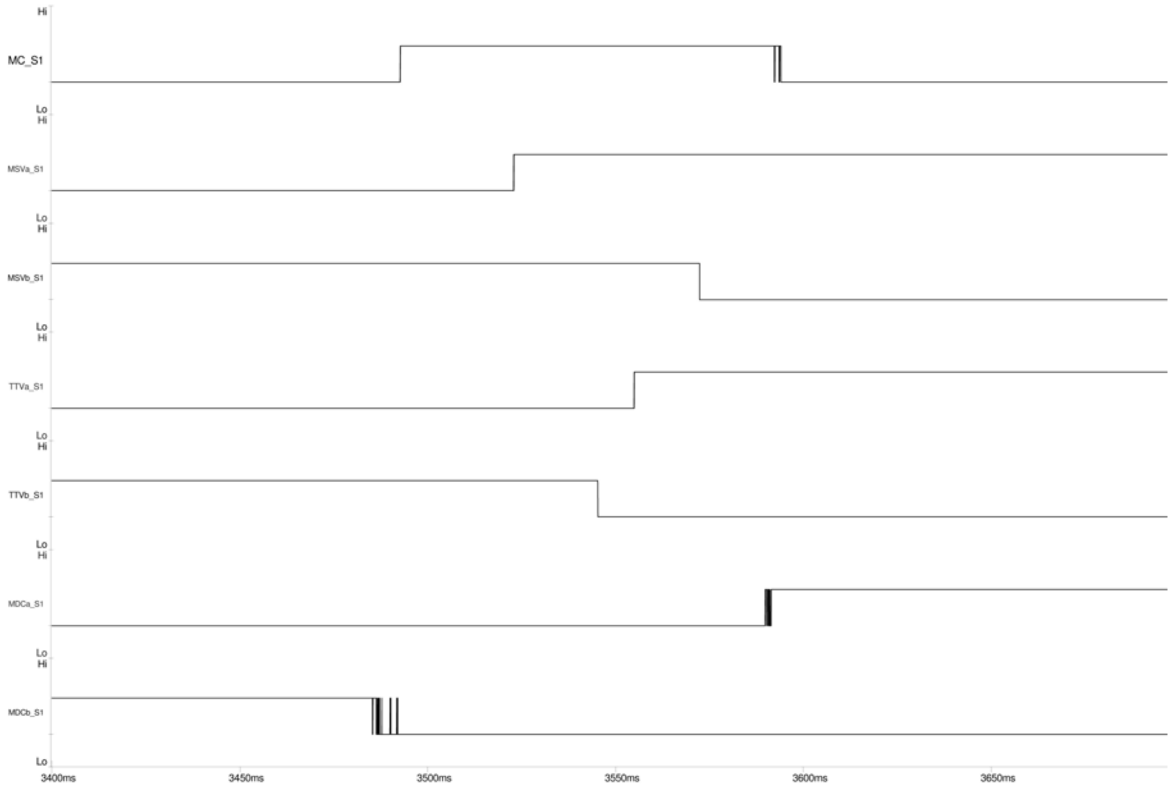


Fig. 3.6: Mechanical endurance test with test sample 3 – Oscillogram no. 6 taken at the beginning of the test.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

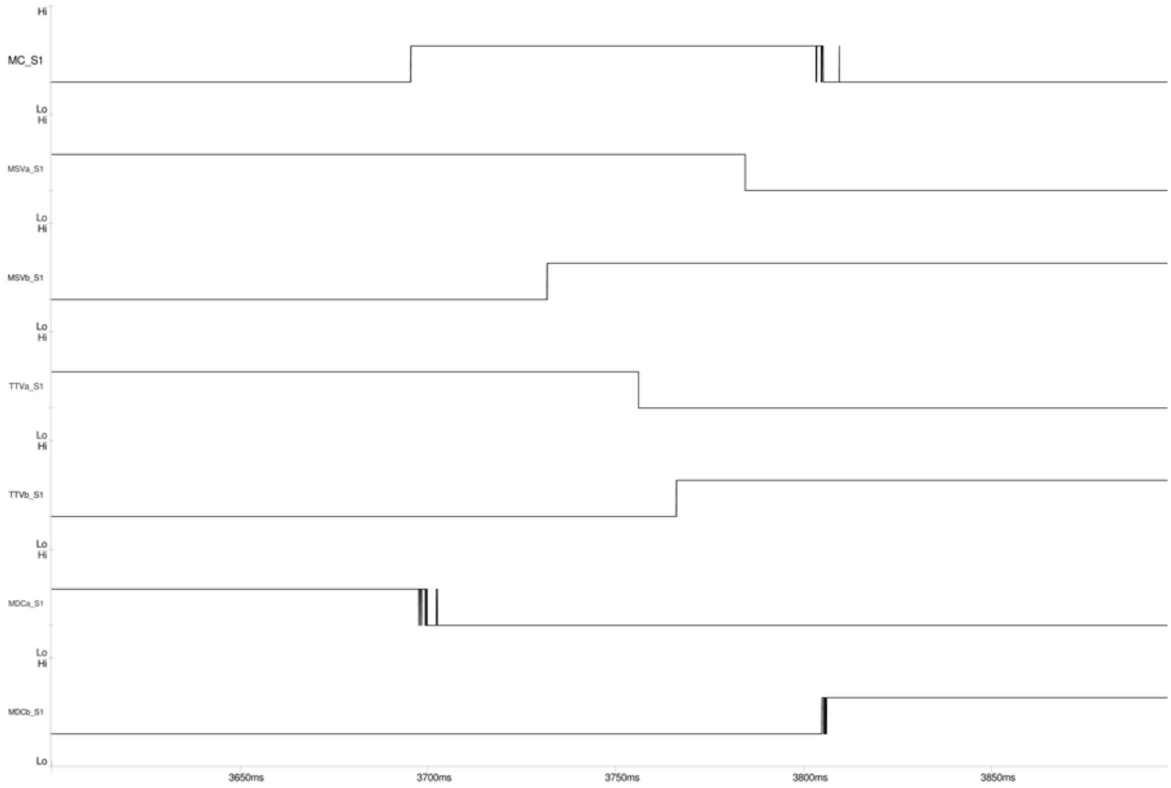


Fig. 3.7: Mechanical endurance test with test sample 3 – Oscillogram no. 7 taken at the beginning of the test.

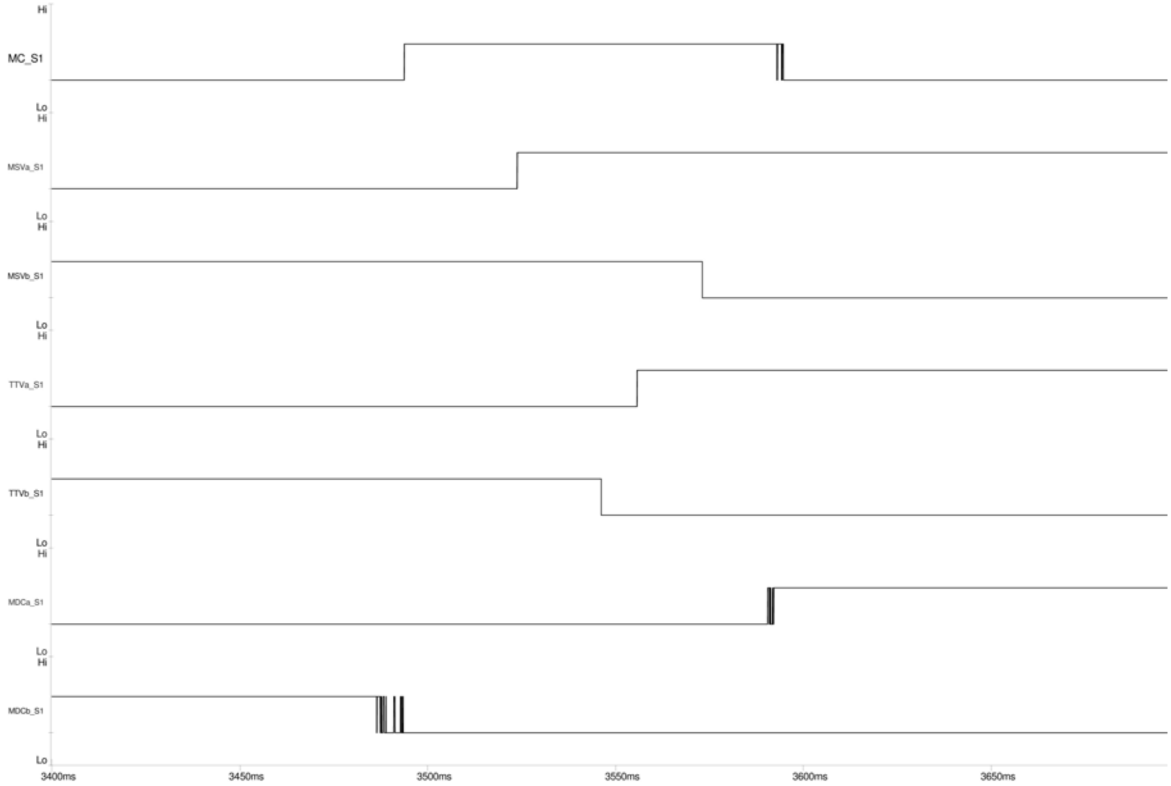


Fig. 3.8: Mechanical endurance test with test sample 3 – Oscillogram no. 8 taken at the beginning of the test.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1, Sector 2, Sector 3		

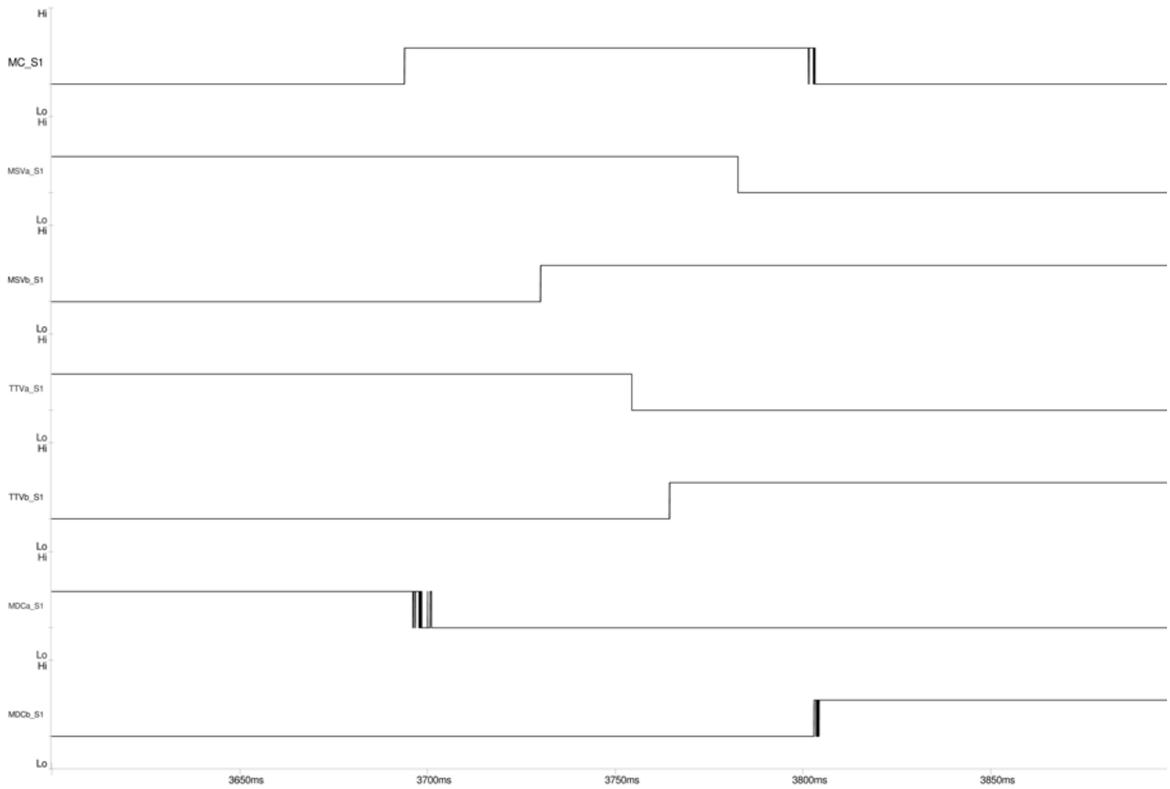


Fig. 3.9: Mechanical endurance test with test sample 3 – Oscillogram no. 9 taken at the beginning of the test.

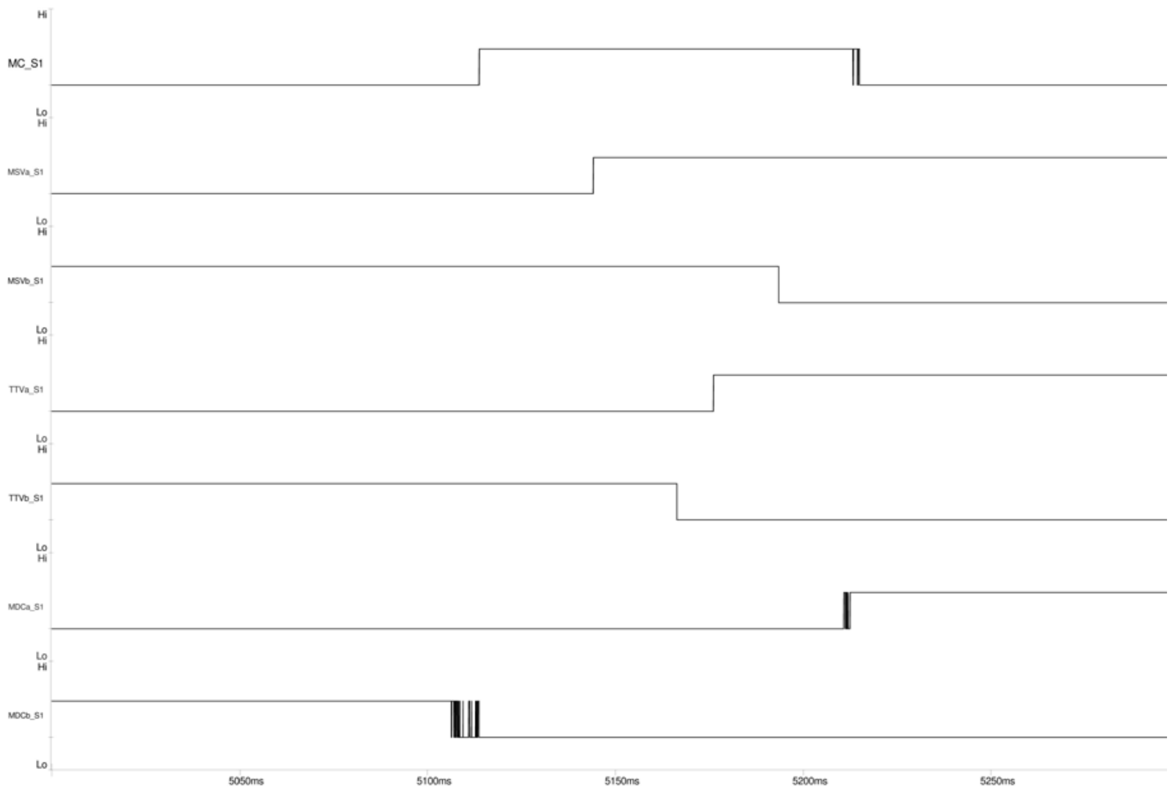


Fig. 3.10: Mechanical endurance test with test sample 3 – Oscillogram no. 10 taken at the beginning of the test.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1, Sector 2, Sector 3		

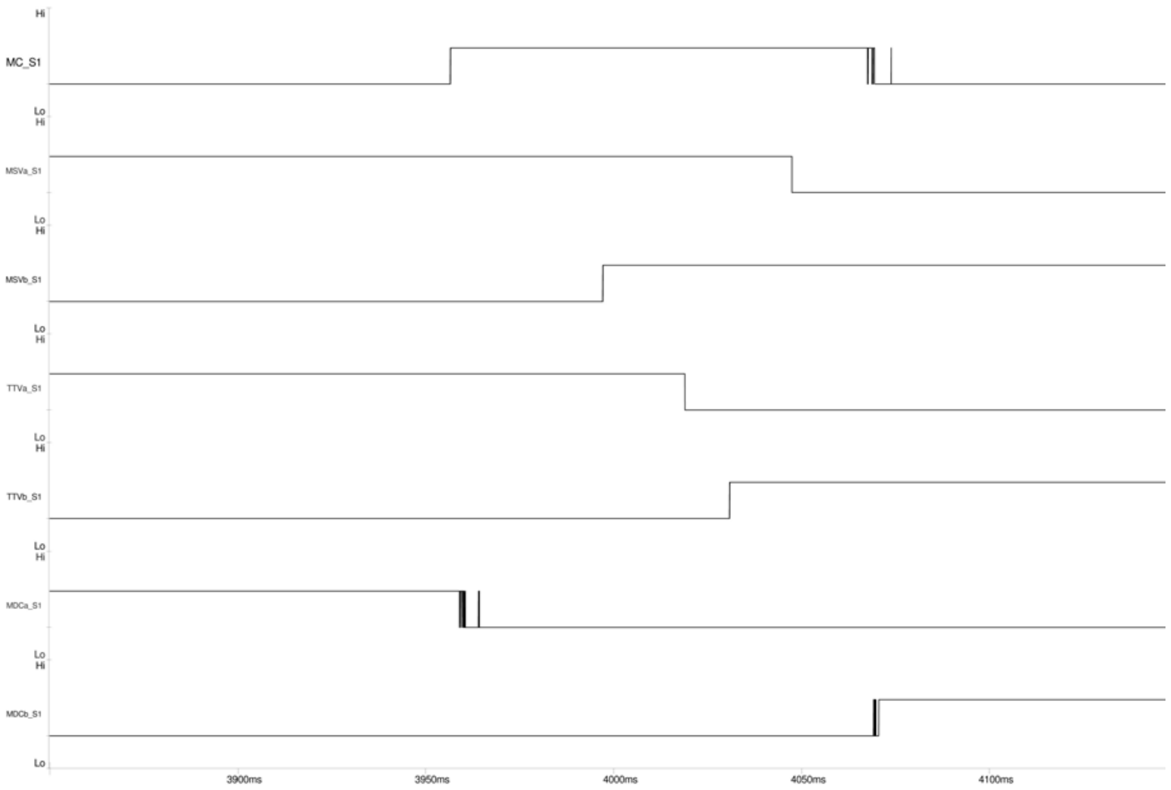


Fig. 3.11: Mechanical endurance test with test sample 3 – Oscillogram no. 1 taken at 500,000 operations.

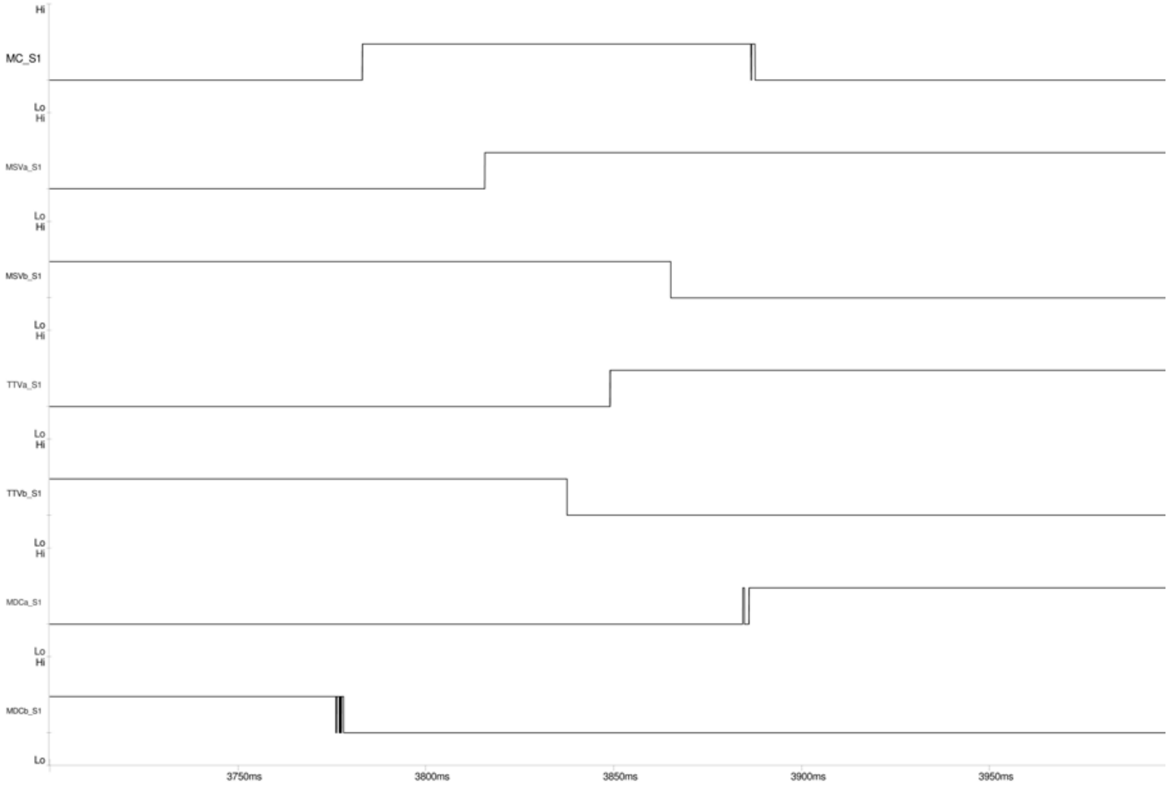


Fig. 3.12: Mechanical endurance test with test sample 3 – Oscillogram no. 2 taken at 500,000 operations.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

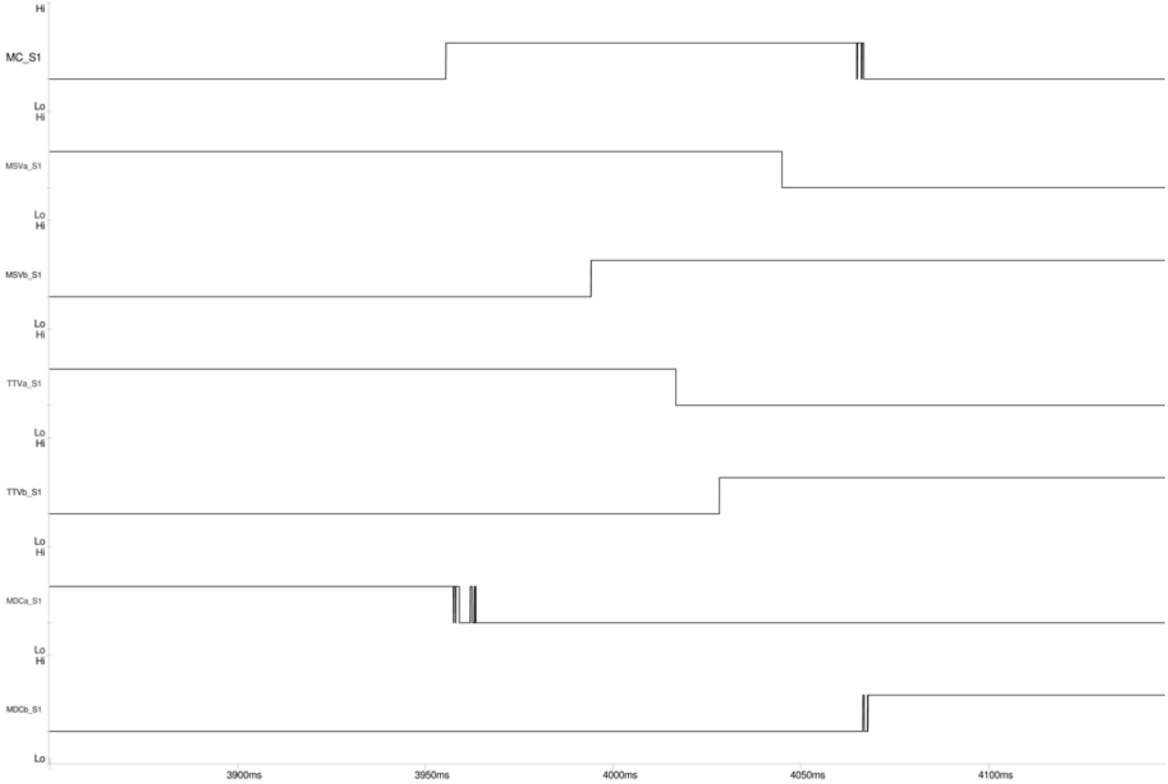


Fig. 3.13: Mechanical endurance test with test sample 3 – Oscillogram no. 3 taken at 500,000 operations.

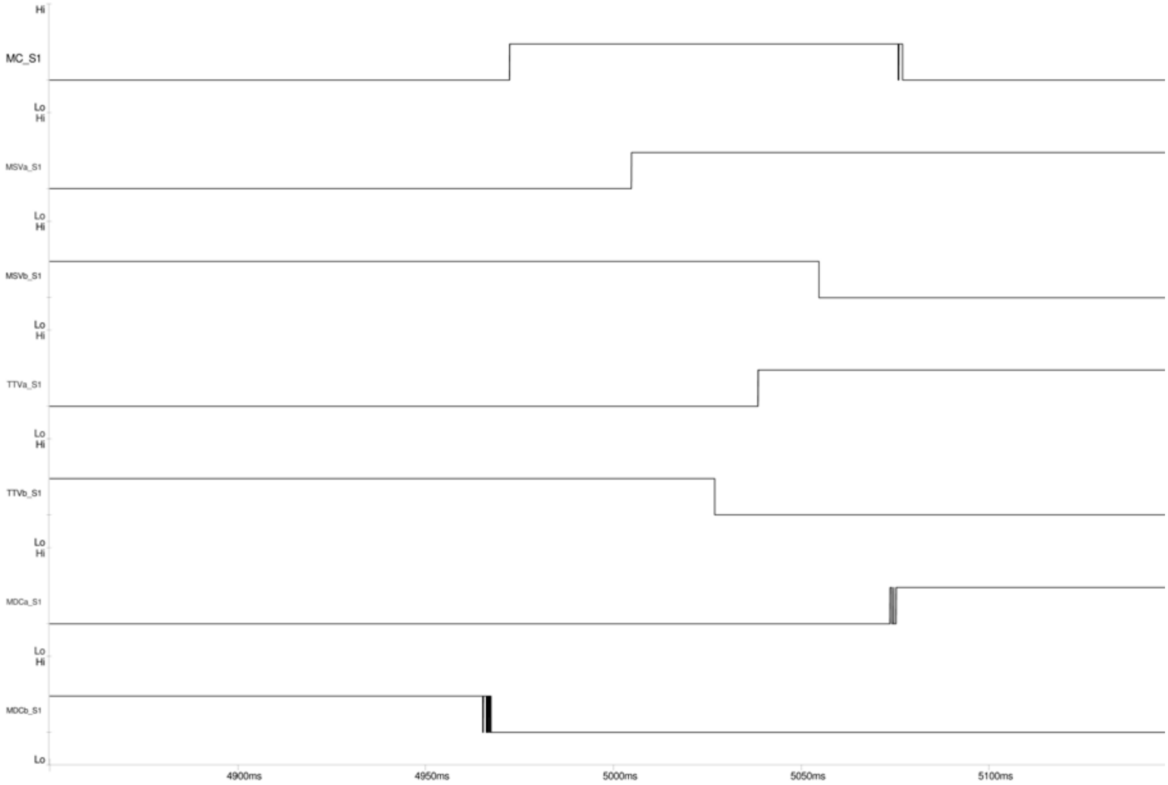
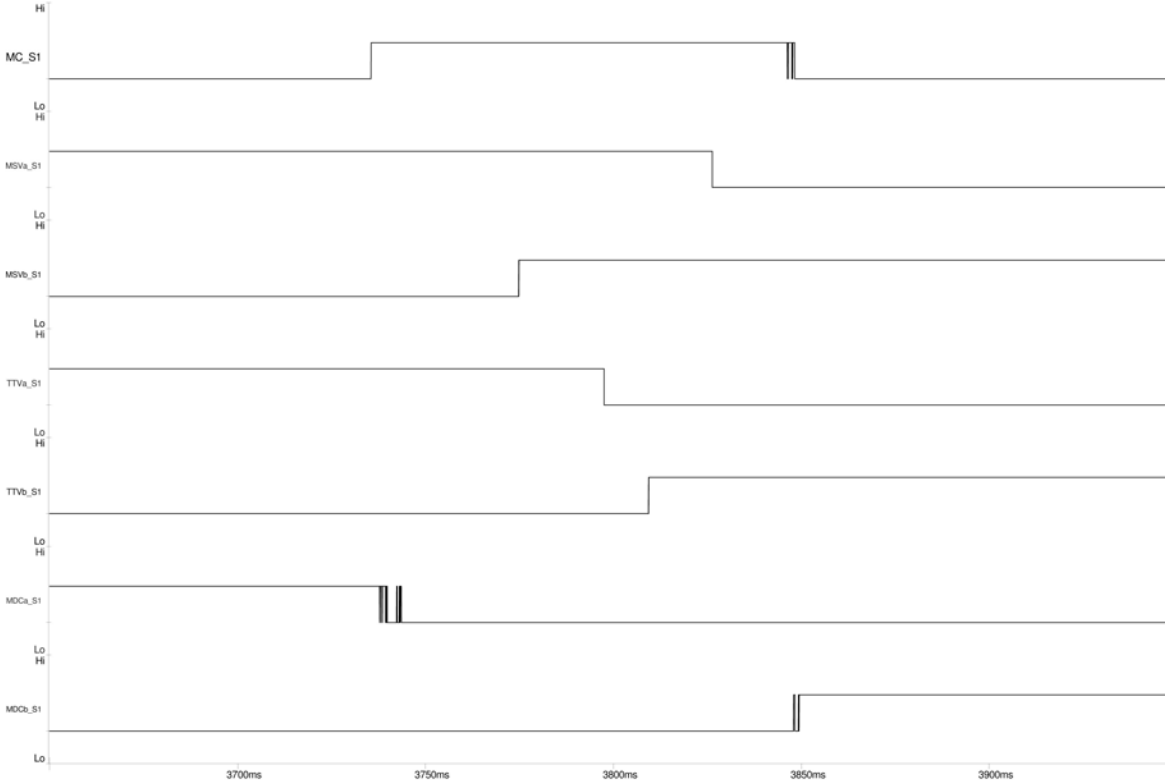
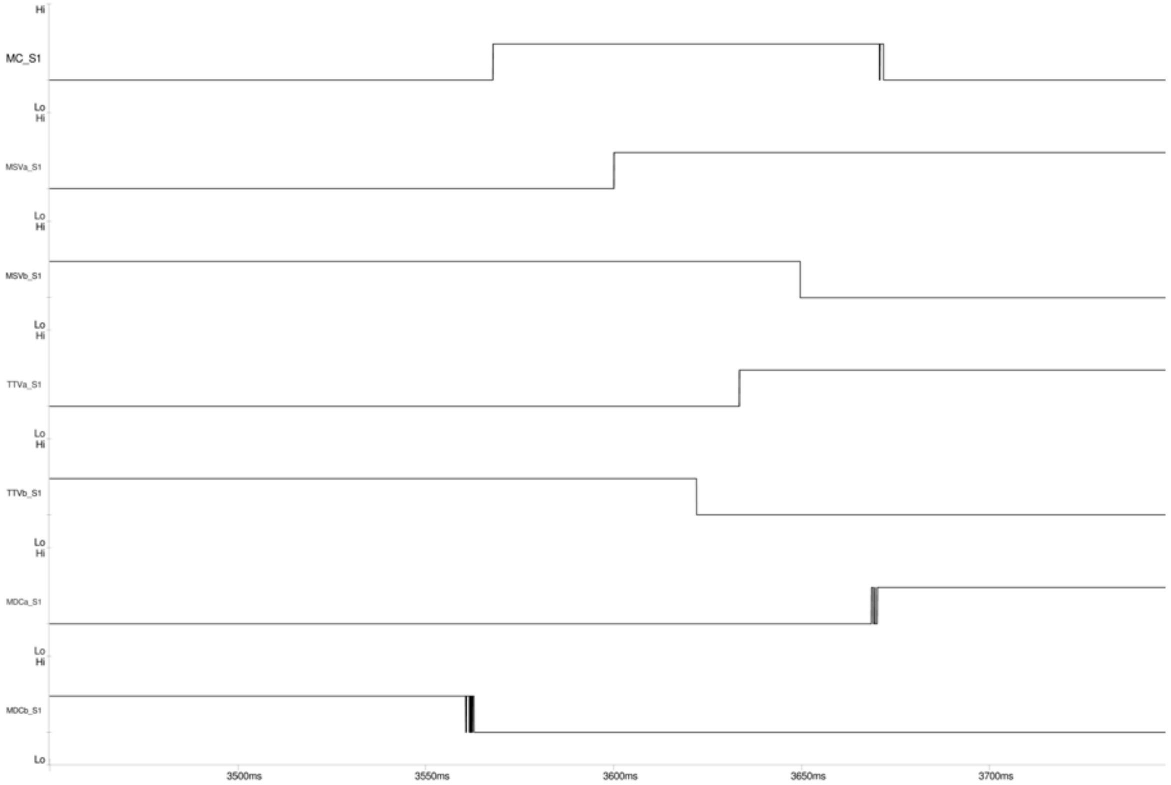


Fig. 3.14: Mechanical endurance test with test sample 3 – Oscillogram no. 4 taken at 500,000 operations.

MC:	Main contacts
MDCa, MDCb:	Main path, disconnect switch
S1:	Sector 1
MSVa, MSVb:	Main path, switching contacts
TTVa, TTVb:	Transition path, transition contacts



<u>Fig. 3.15:</u> Mechanical endurance test with test sample 3 – Oscillogram no. 5 taken at 500,000 operations.



<u>Fig. 3.16:</u> Mechanical endurance test with test sample 3 – Oscillogram no. 6 taken at 500,000 operations.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

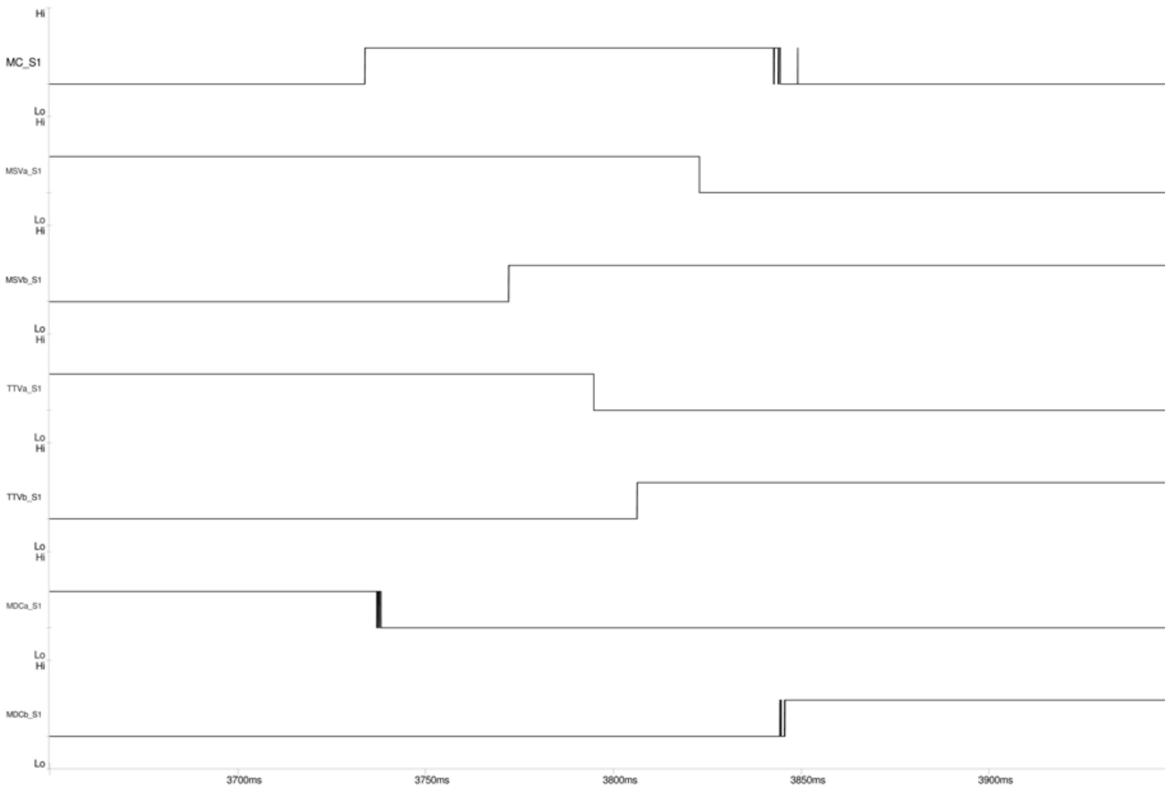


Fig. 3.17: Mechanical endurance test with test sample 3 – Oscillogram no. 7 taken at 500,000 operations.

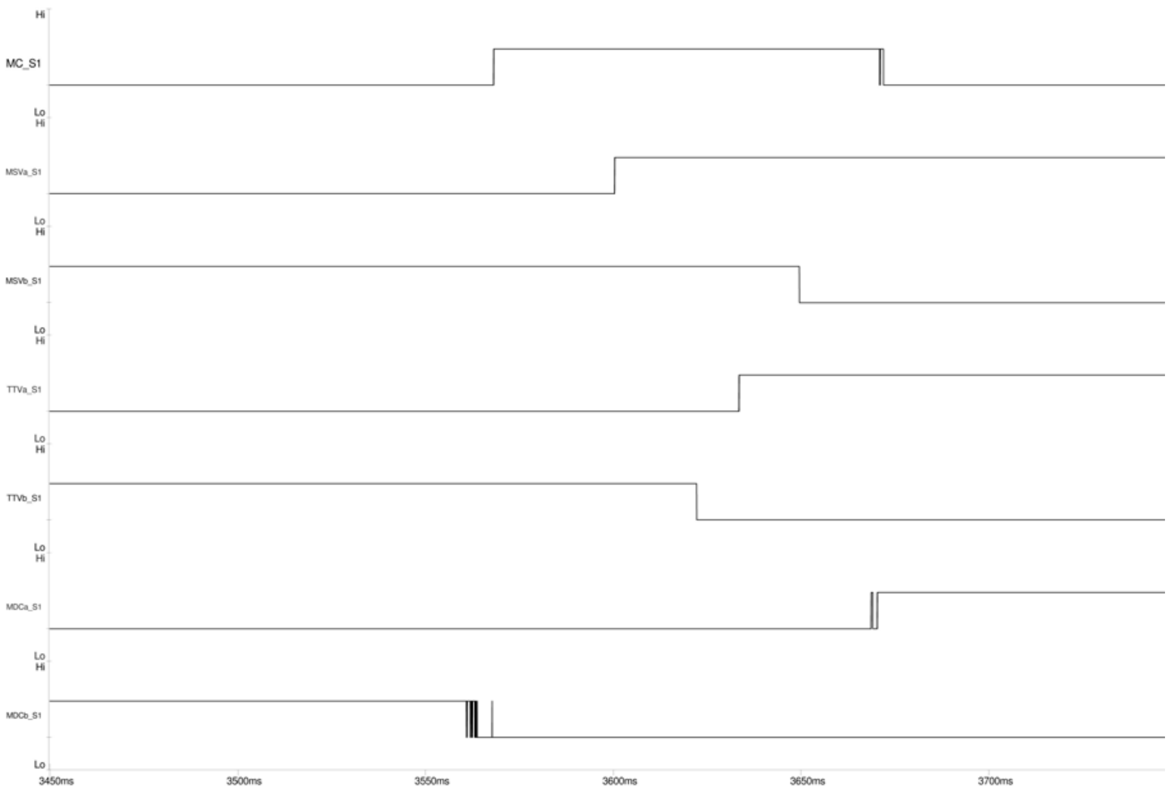


Fig. 3.18: Mechanical endurance test with test sample 3 – Oscillogram no. 8 taken at 500,000 operations.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

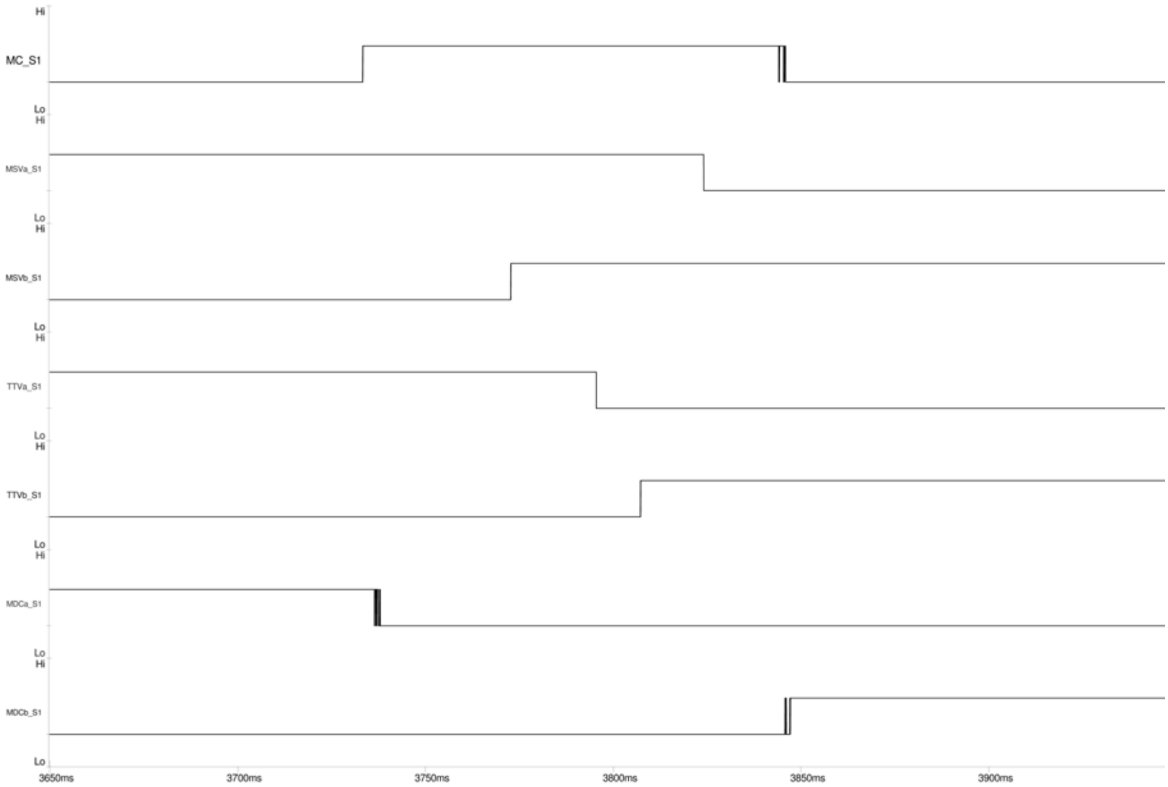


Fig. 3.19: Mechanical endurance test with test sample 3 – Oscillogram no. 9 taken at 500,000 operations.

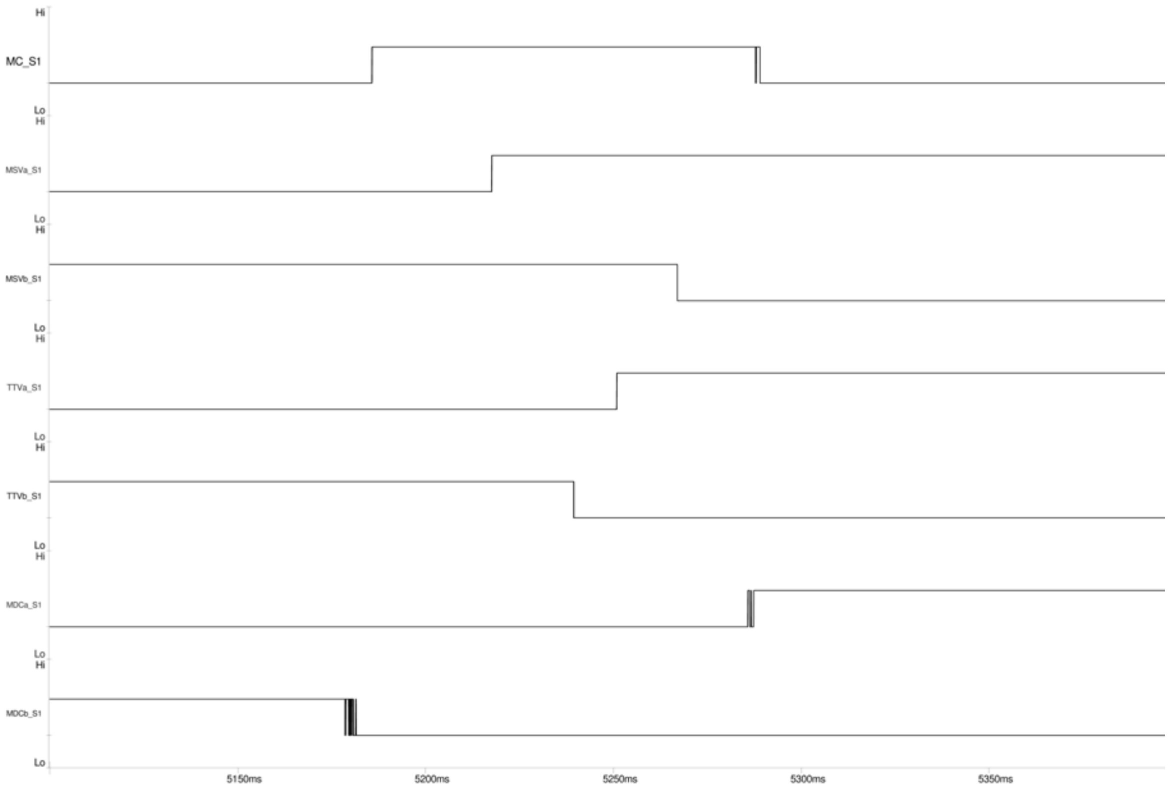


Fig. 3.20: Mechanical endurance test with test sample 3 – Oscillogram no. 10 taken at 500,000 operations.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

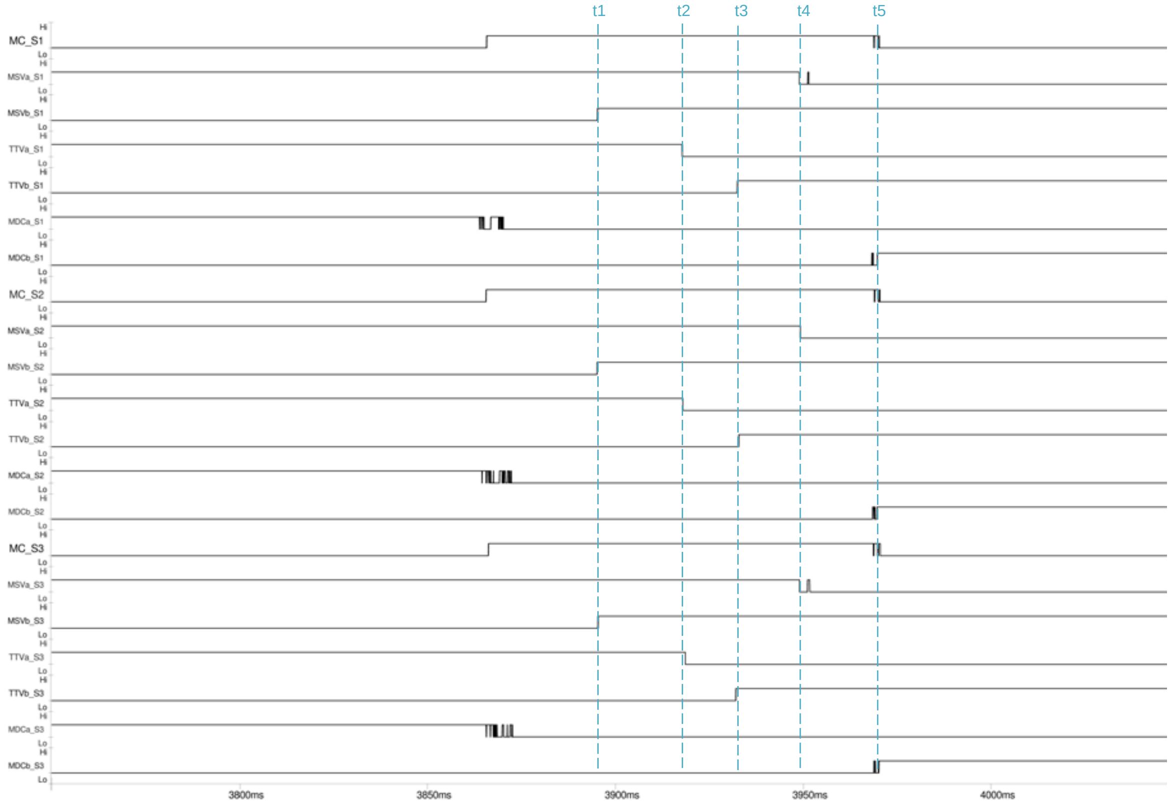


Fig. 4.1: Operation test at 115 °C with test sample 1 – Oscillogram no. 1.

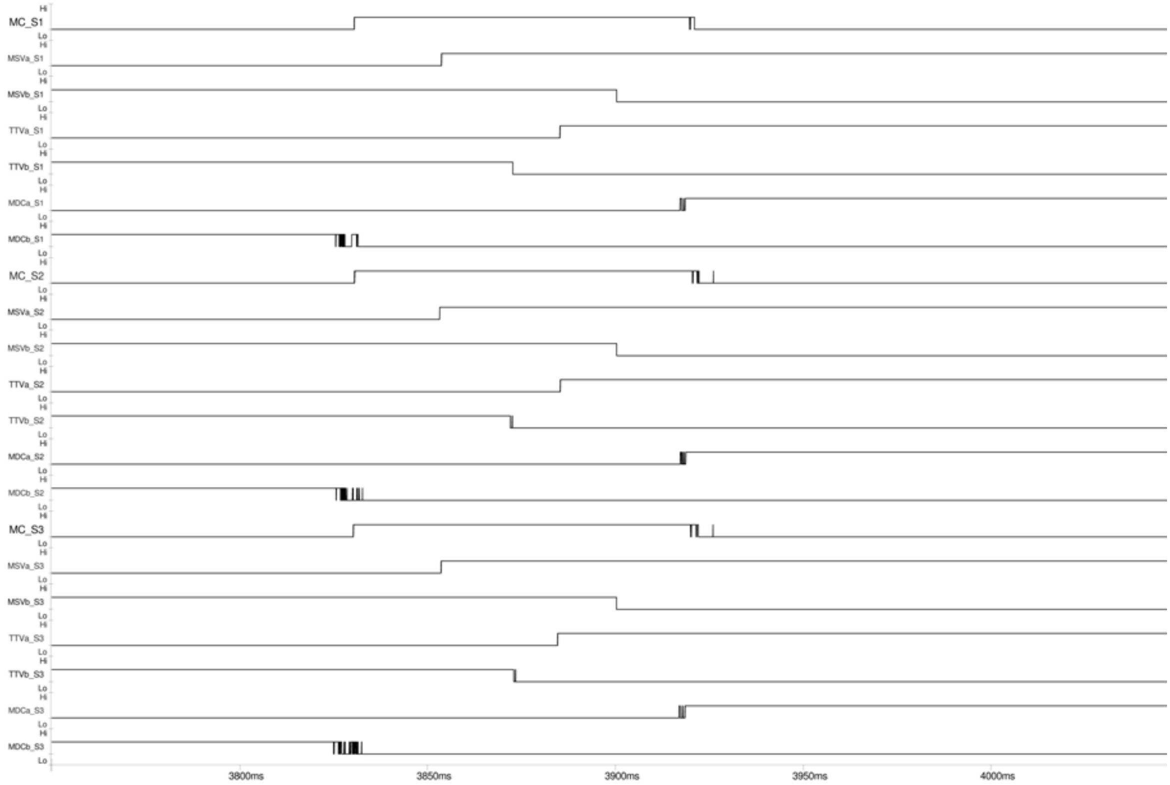


Fig. 4.2: Operation test at 115 °C with test sample 1 – Oscillogram no. 2.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

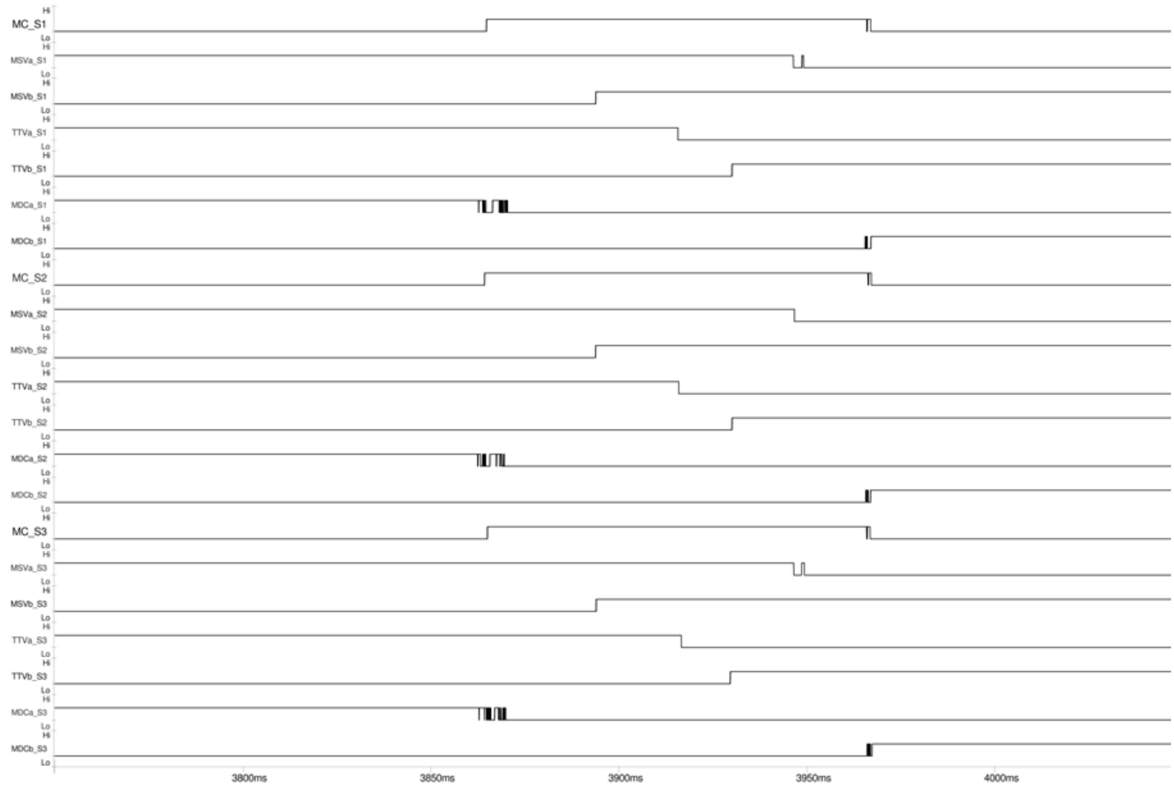


Fig. 4.3: Operation test at 115 °C with test sample 1 – Oscillogram no. 3.

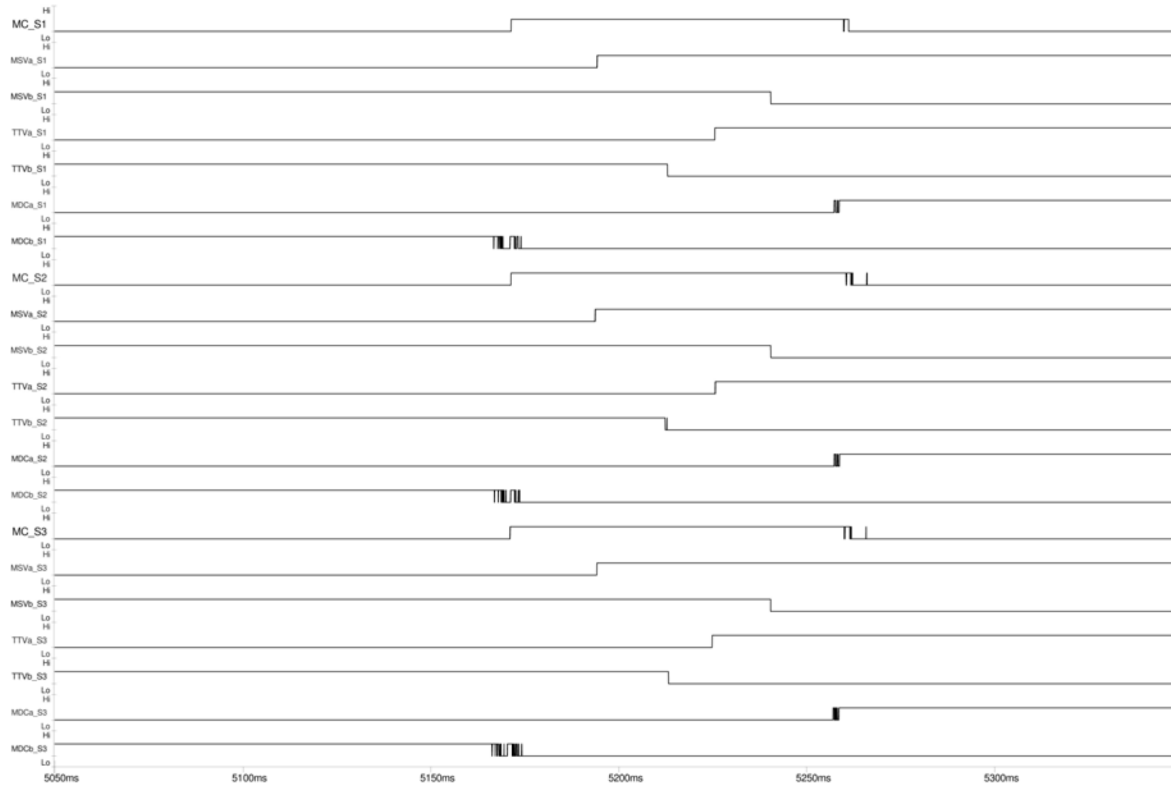


Fig. 4.4: Operation test at 115 °C with test sample 1 – Oscillogram no. 4.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

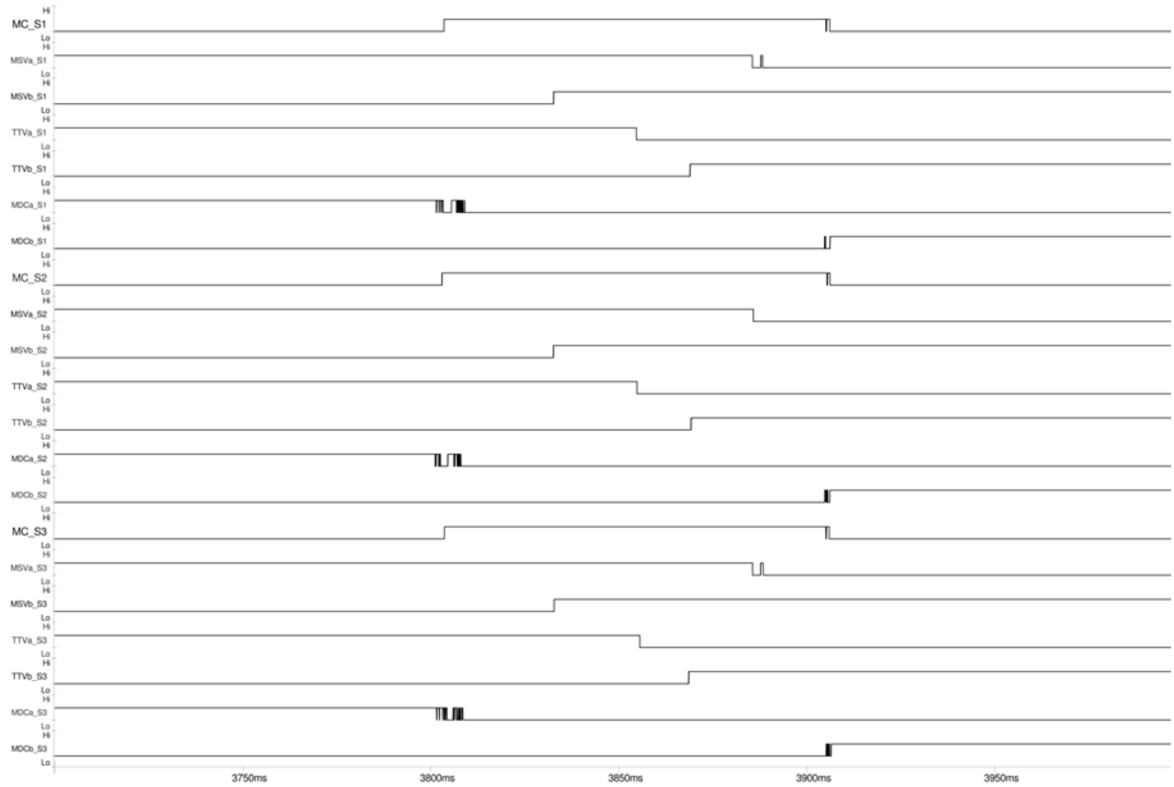


Fig. 4.5: Operation test at 115 °C with test sample 1 – Oscillogram no. 5.

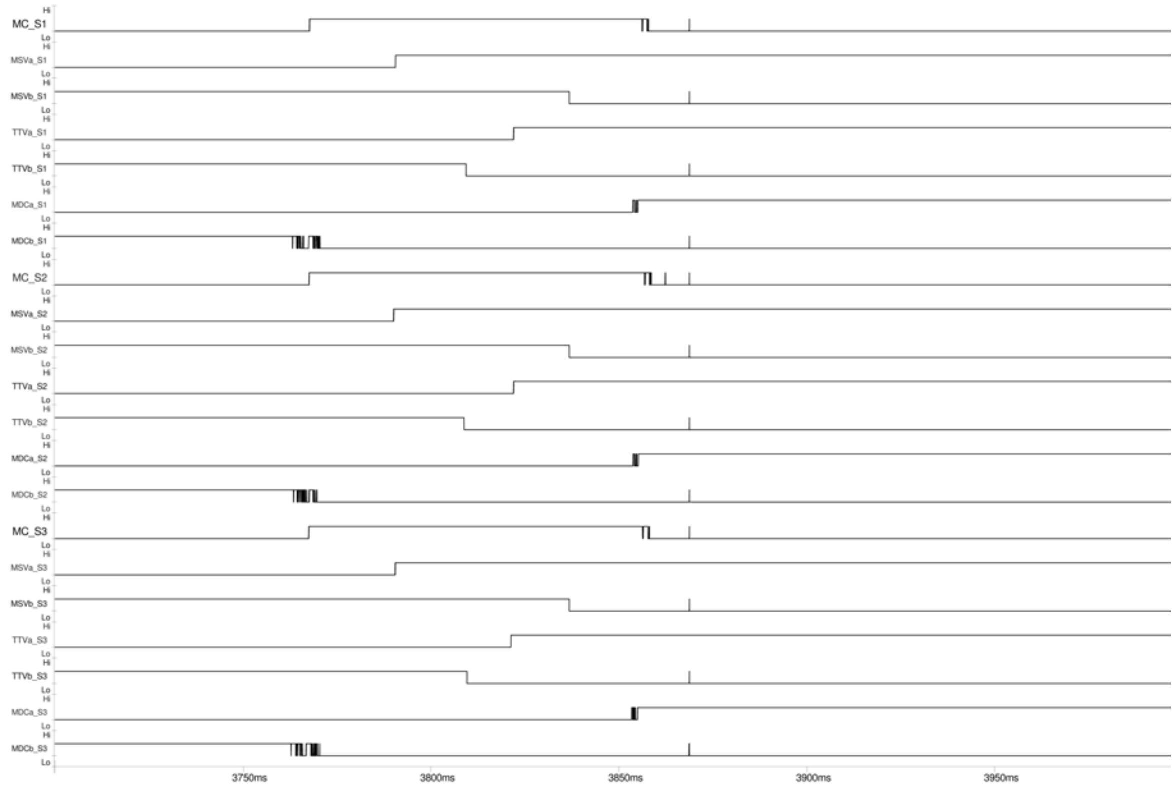


Fig. 4.6: Operation test at 115 °C with test sample 1 – Oscillogram no. 6.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

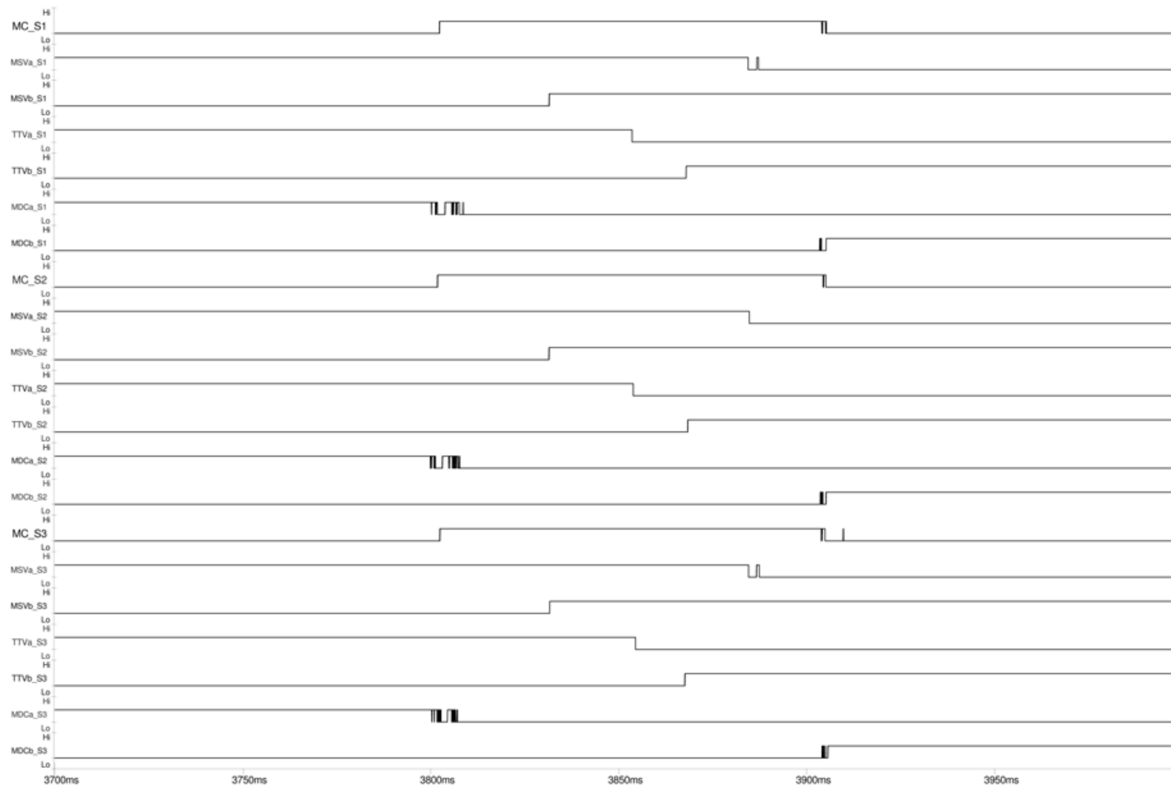


Fig. 4.7: Operation test at 115 °C with test sample 1 – Oscillogram no. 7.

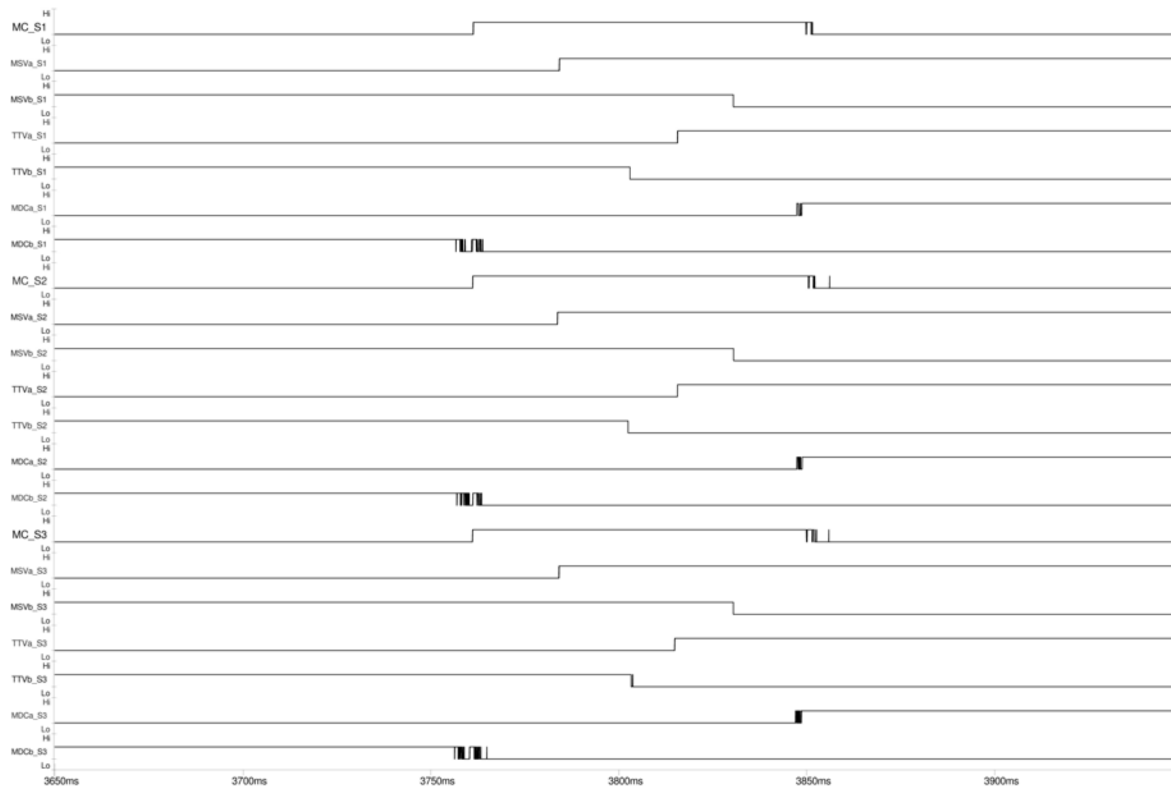


Fig. 4.8: Operation test at 115 °C with test sample 1 – Oscillogram no. 8.

MC: Main contacts
MDCa, MDCb: Main path, disconnect switch
S1, S2, S3: Sector 1, Sector 2, Sector 3
MSVa, MSVb: Main path, switching contacts
TTVa, TTVb: Transition path, transition contacts

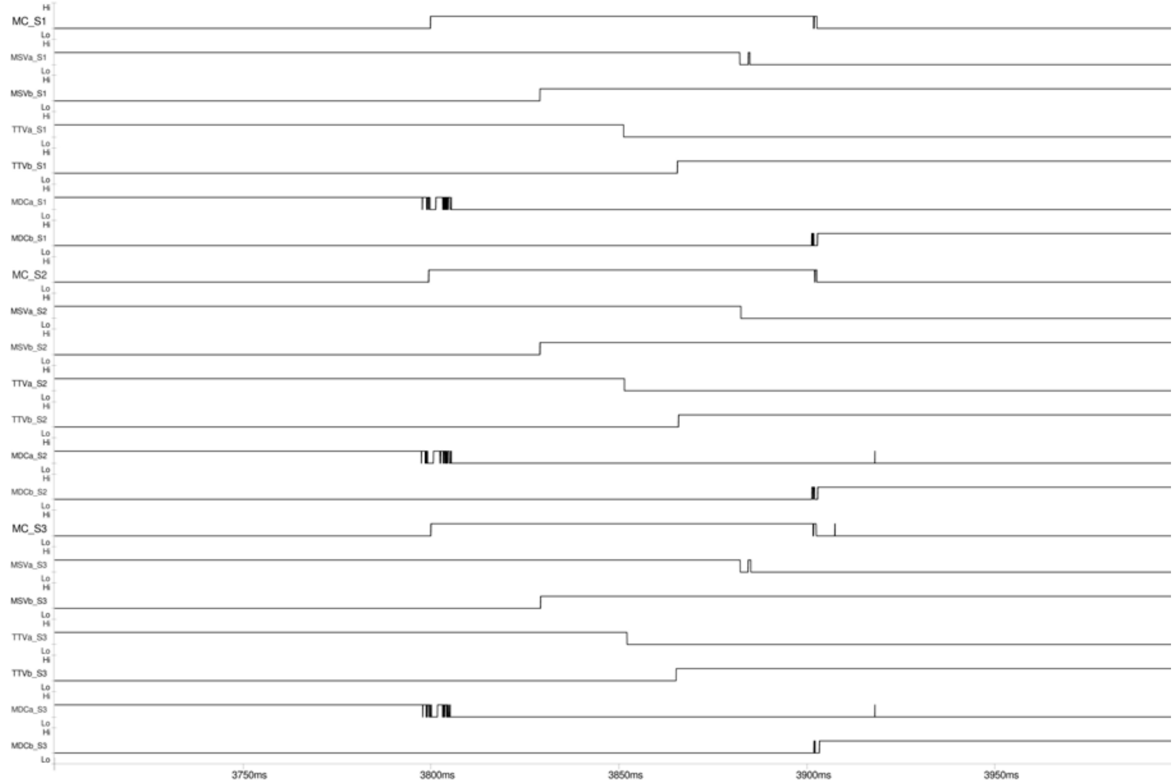


Fig. 4.9: Operation test at 115 °C with test sample 1 – Oscillogram no. 9.

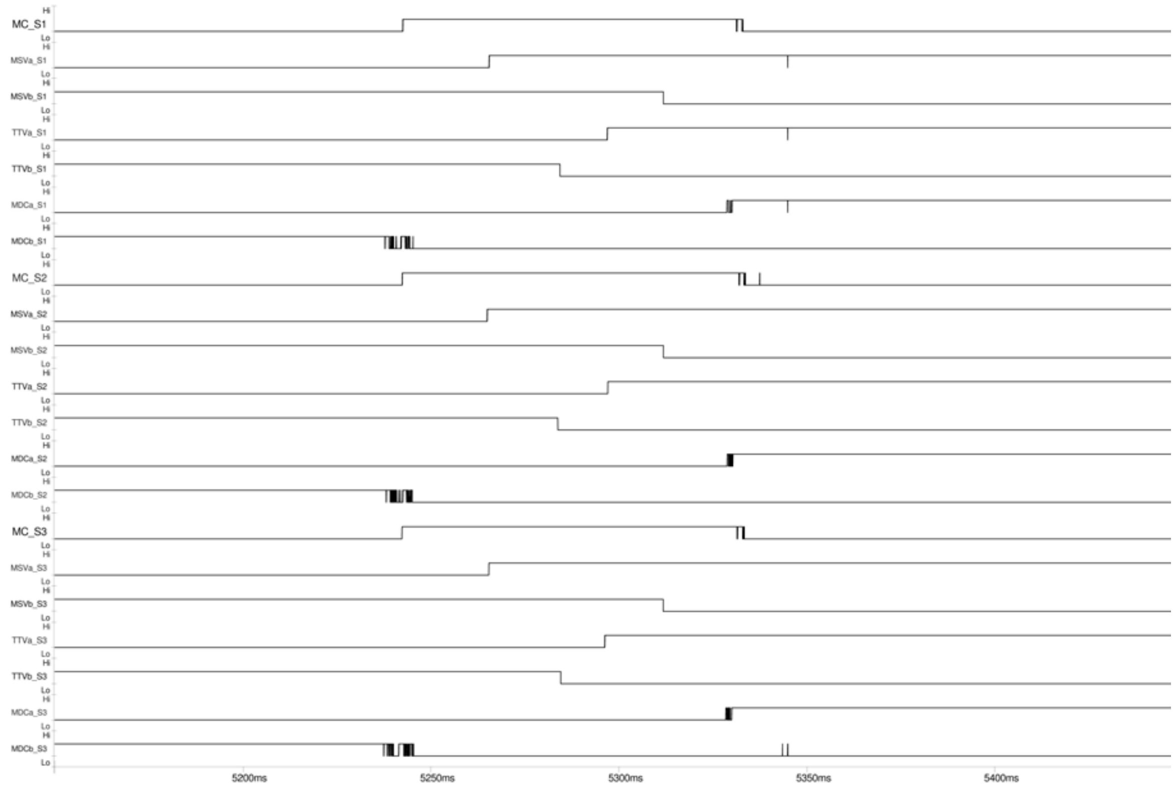


Fig. 4.10: Operation test at 115 °C with test sample 1 – Oscillogram no. 10.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

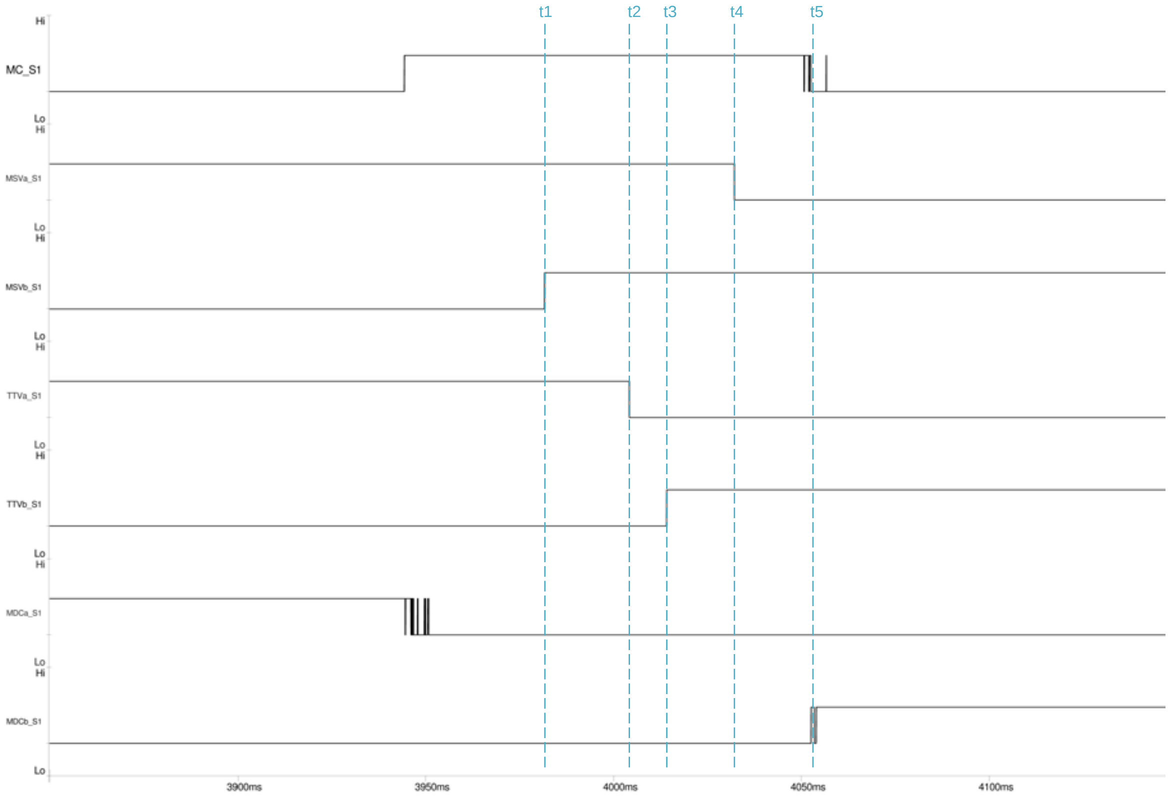


Fig. 5.1: Operation test at 115 °C with test sample 3 – Oscillogram no. 1.

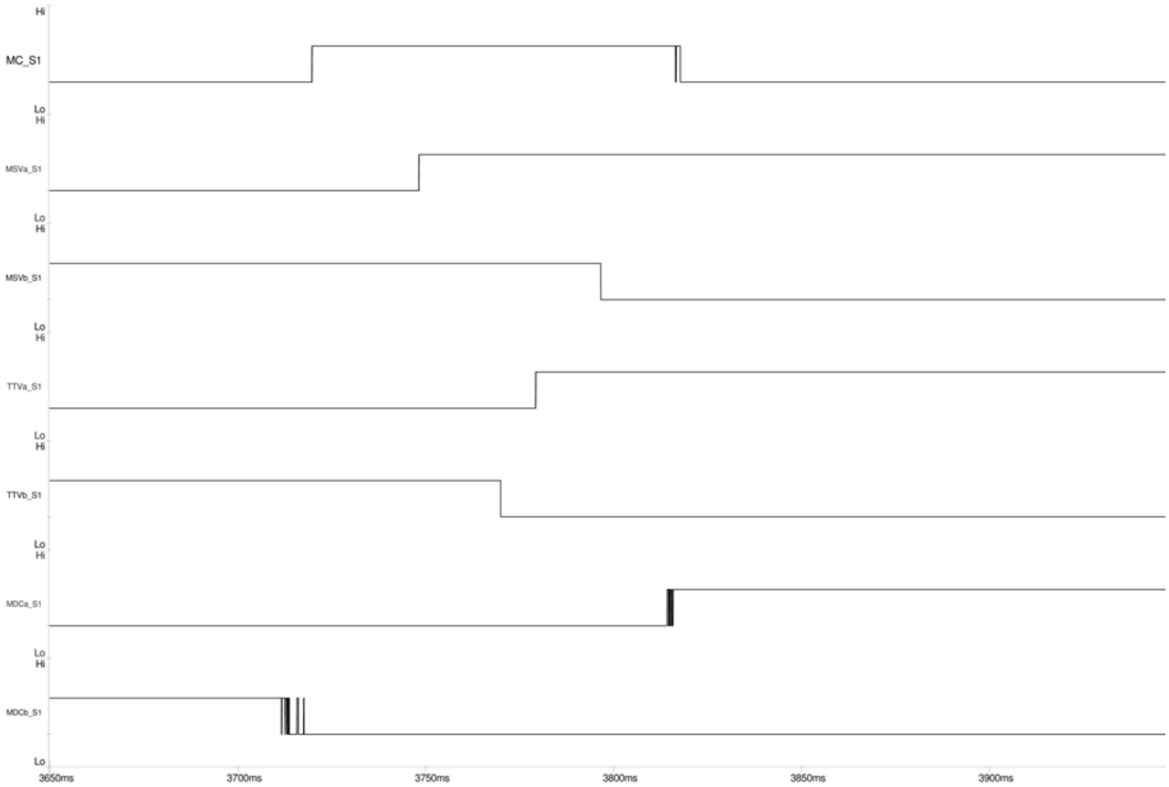


Fig. 5.2: Operation test at 115 °C with test sample 3 – Oscillogram no. 2.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

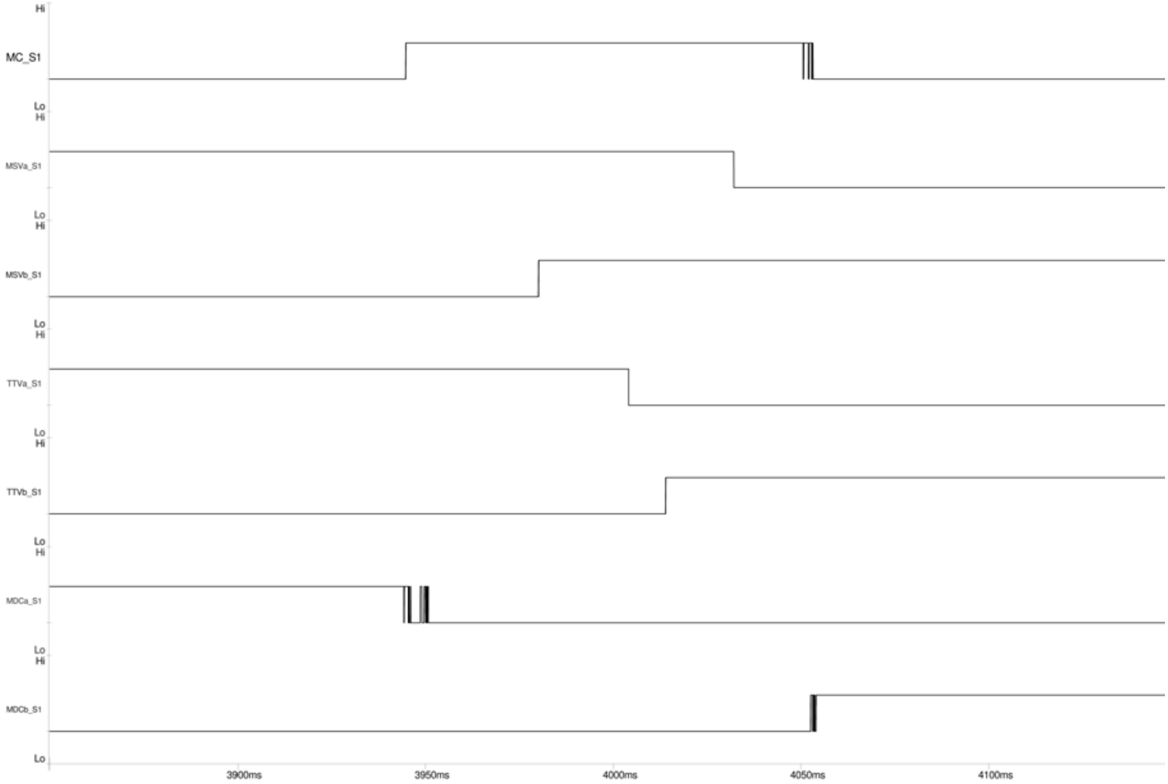


Fig. 5.3: Operation test at 115 °C with test sample 3 – Oscillogram no. 3.

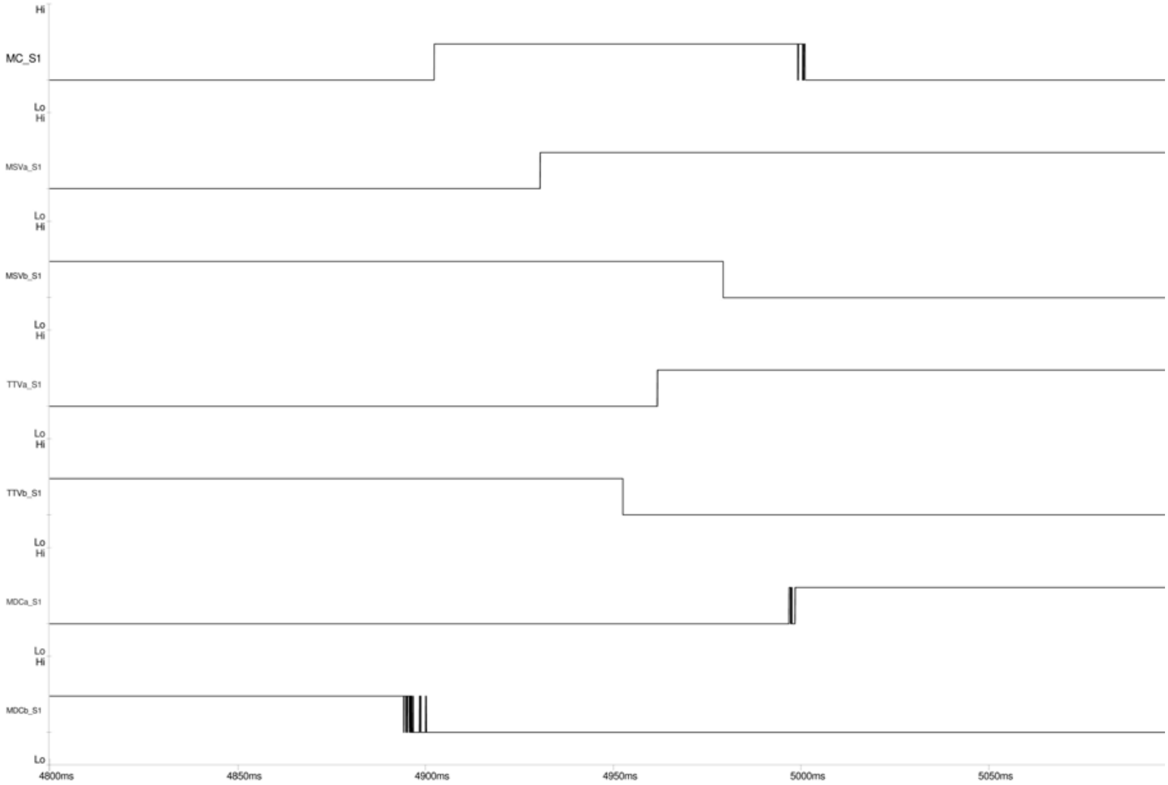


Fig. 5.4: Operation test at 115 °C with test sample 3 – Oscillogram no. 4.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

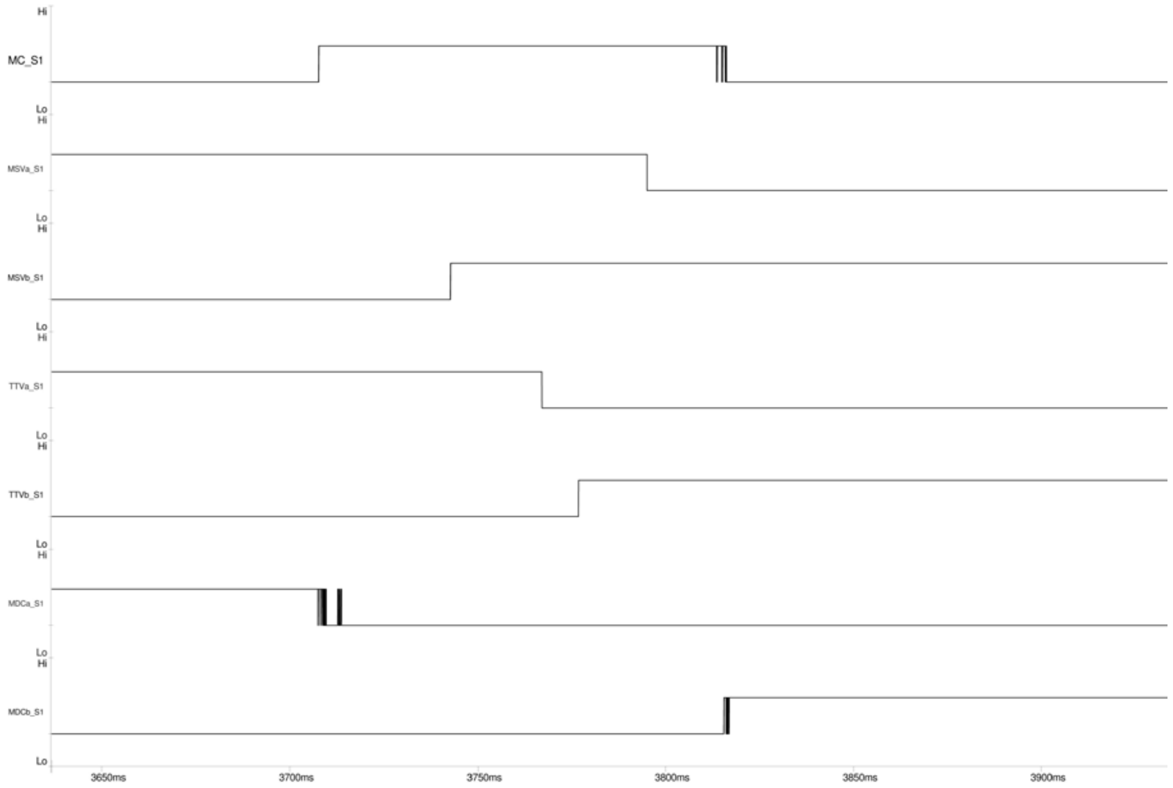


Fig. 5.5: Operation test at 115 °C with test sample 3 – Oscillogram no. 5.

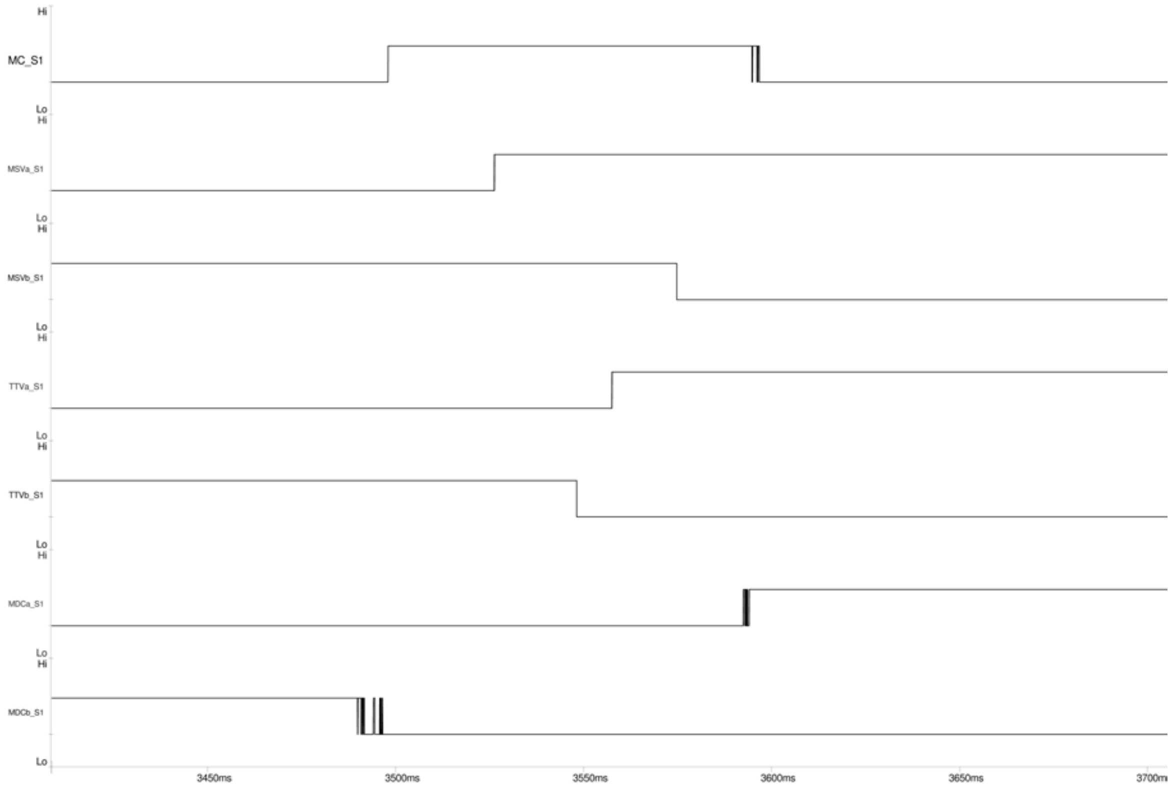


Fig. 5.6: Operation test at 115 °C with test sample 3 – Oscillogram no. 6.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

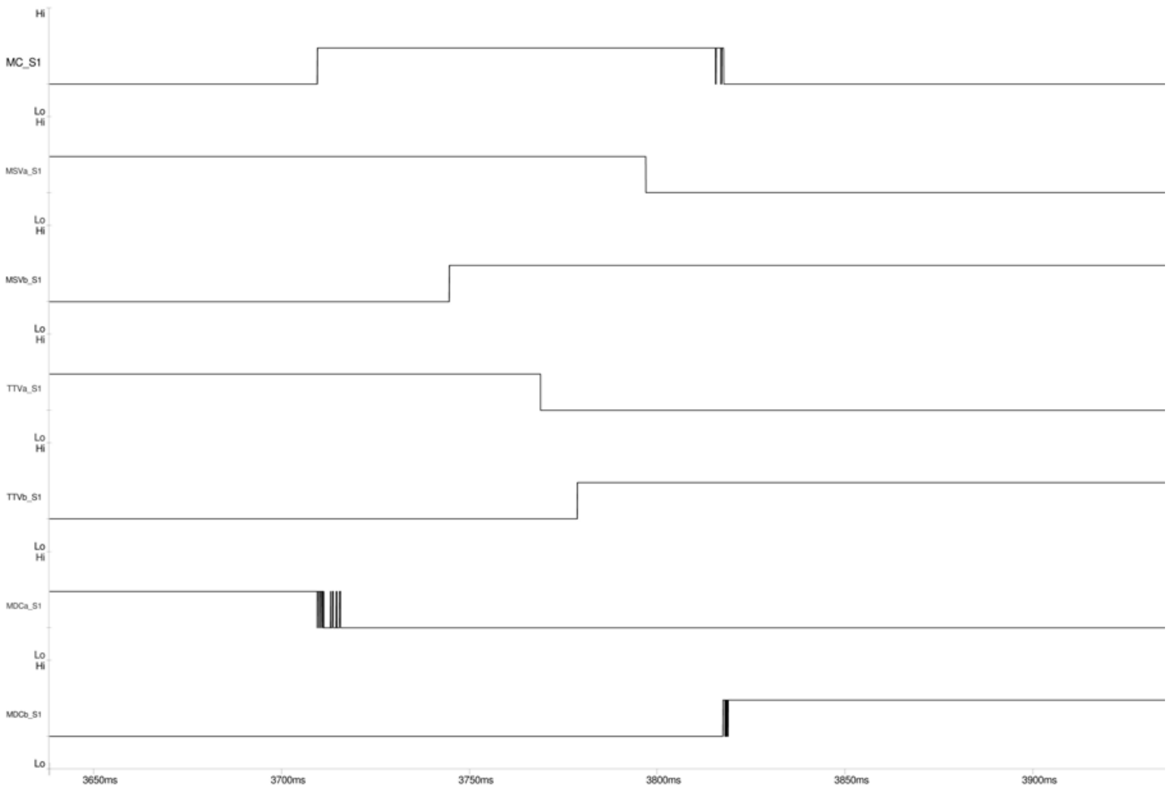


Fig. 5.7: Operation test at 115 °C with test sample 3 – Oscillogram no. 7.

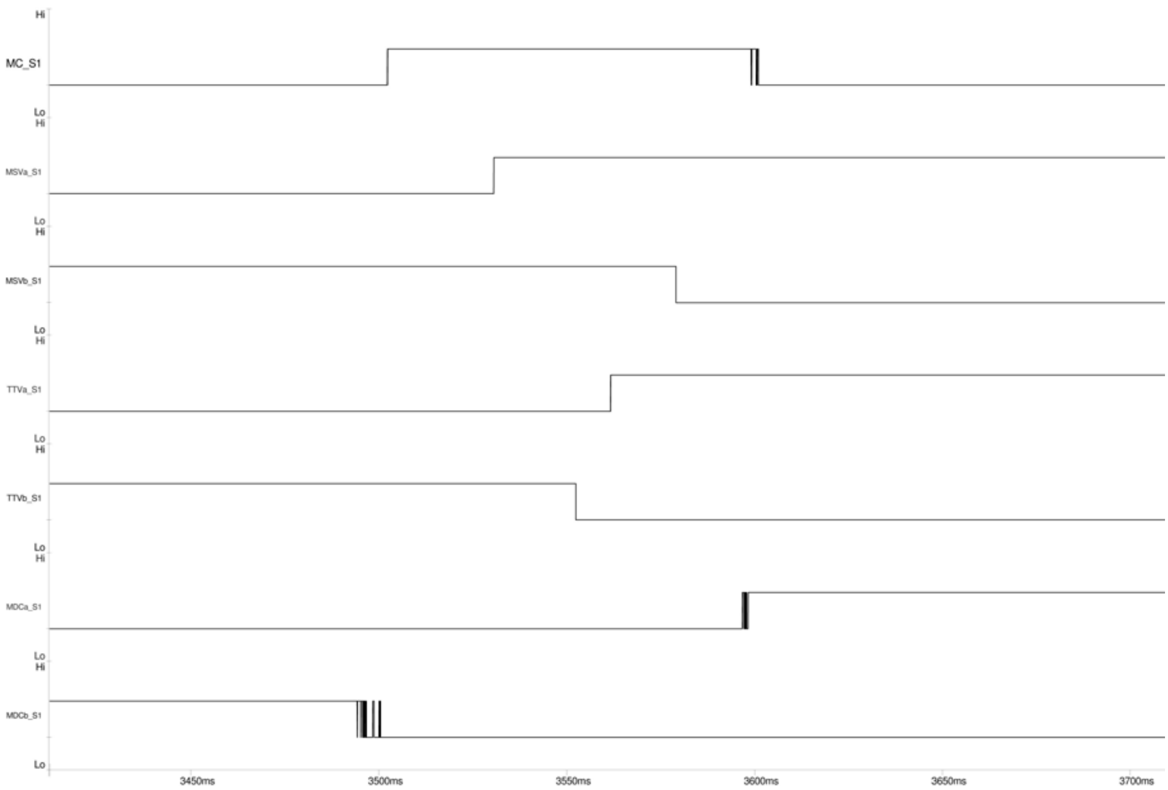


Fig. 5.8: Operation test at 115 °C with test sample 3 – Oscillogram no. 8.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

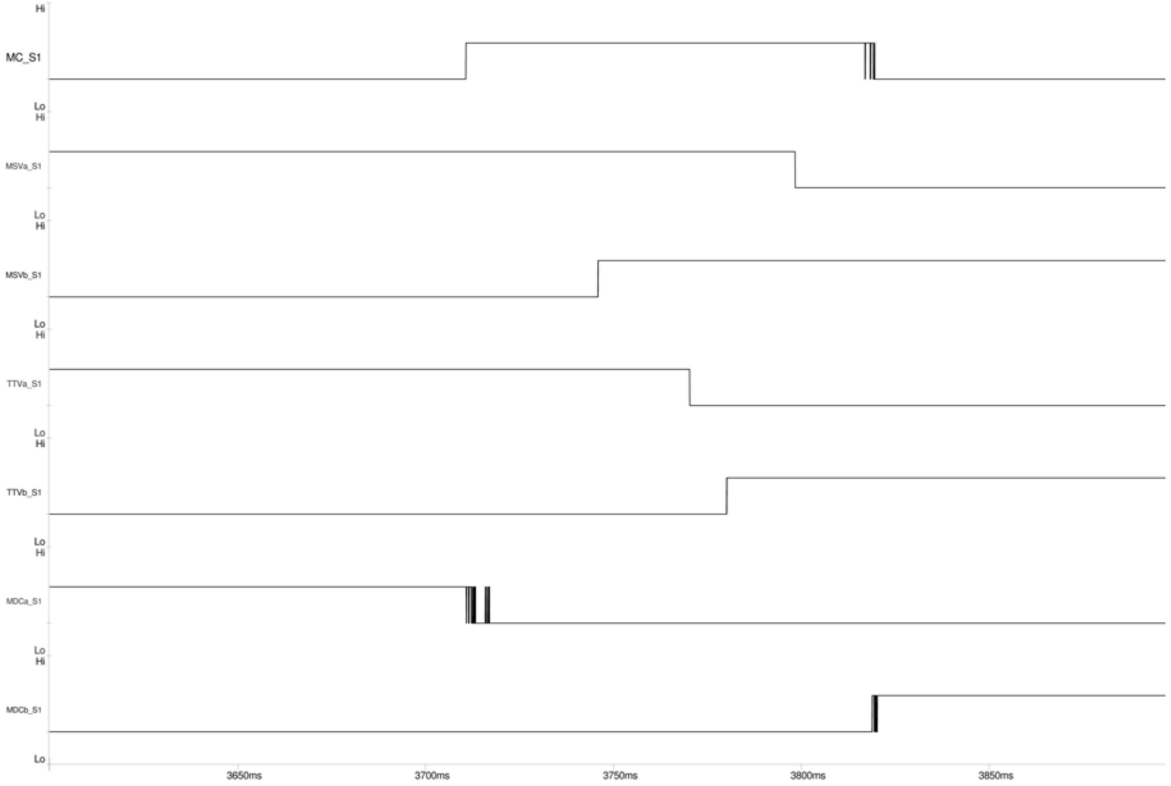


Fig. 5.9: Operation test at 115 °C with test sample 3 – Oscillogram no. 9.

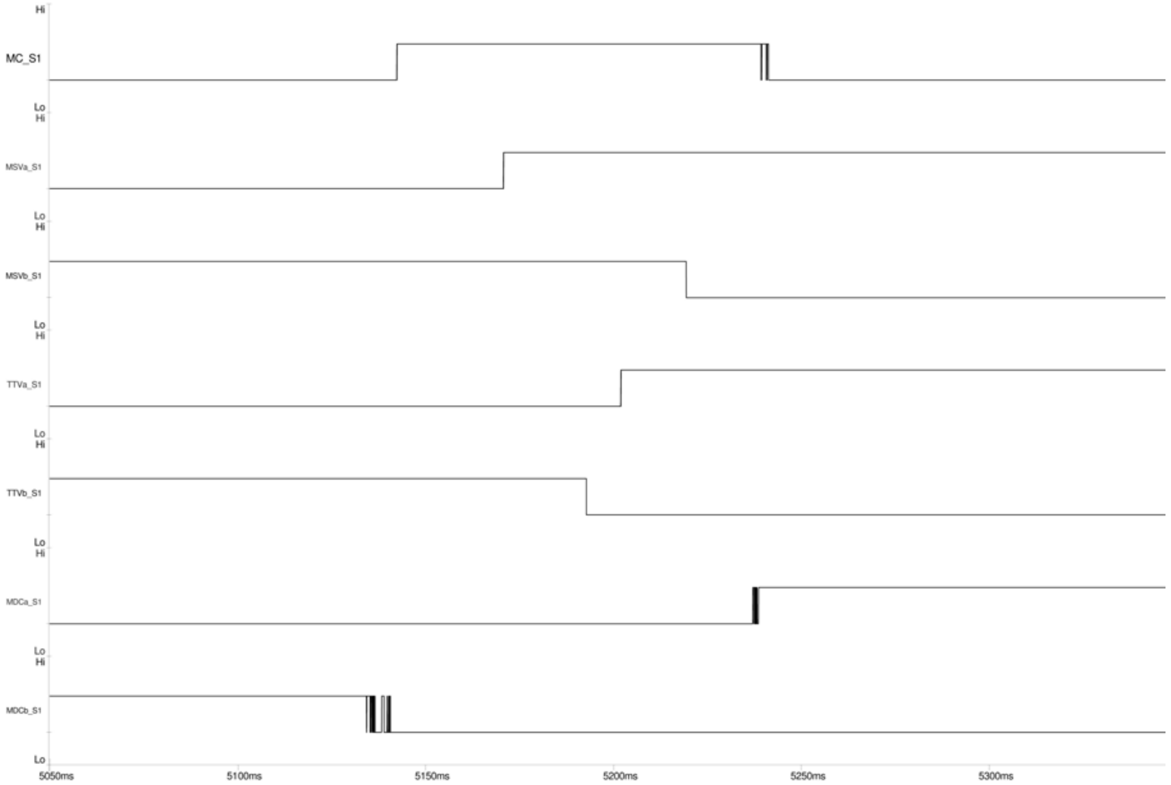


Fig. 5.10: Operation test at 115 °C with test sample 3 – Oscillogram no. 10.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

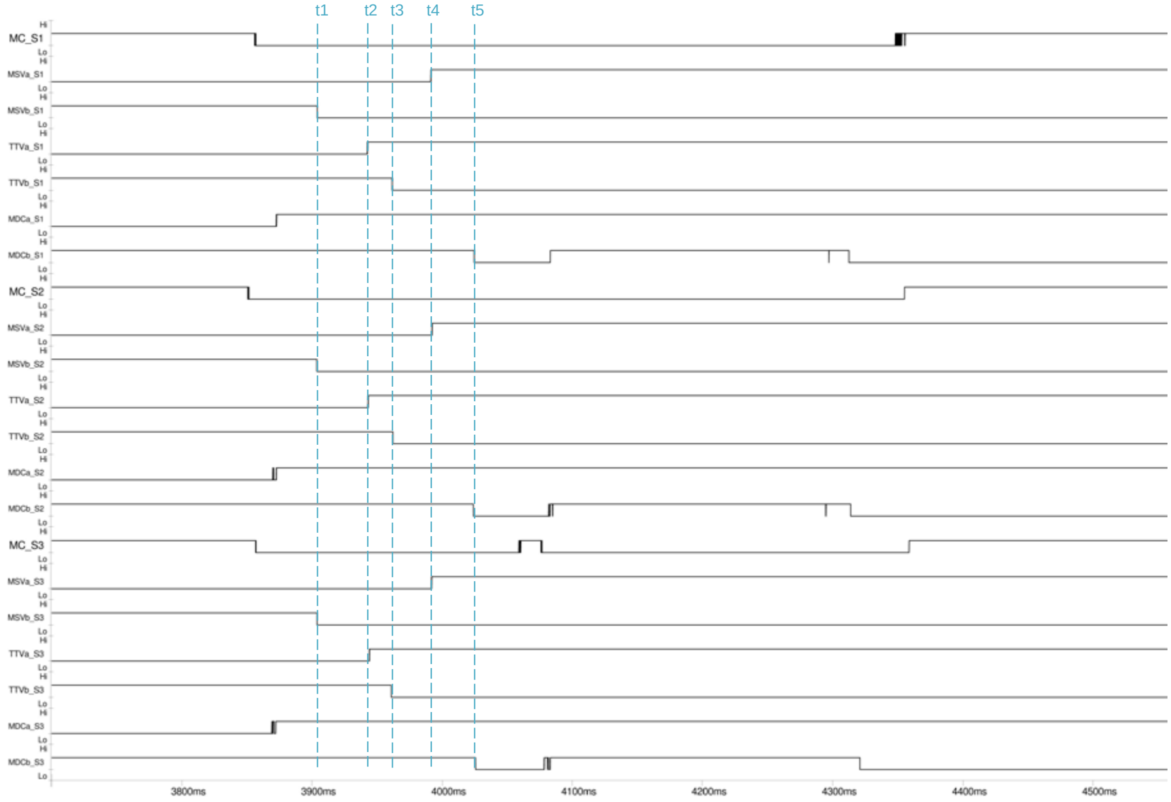


Fig. 6.1: Operation test at -25 °C with test sample 1 – Oscillogram no. 1.

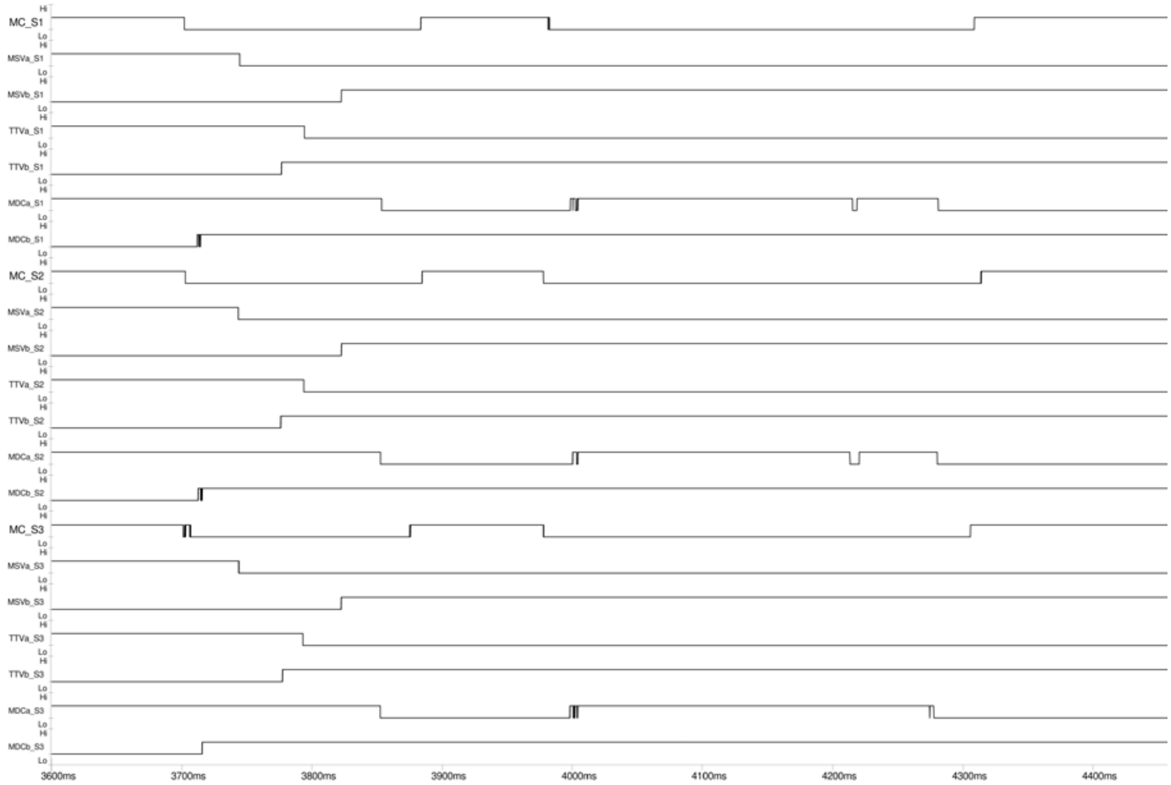


Fig. 6.2: Operation test at -25 °C with test sample 1 – Oscillogram no. 2.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

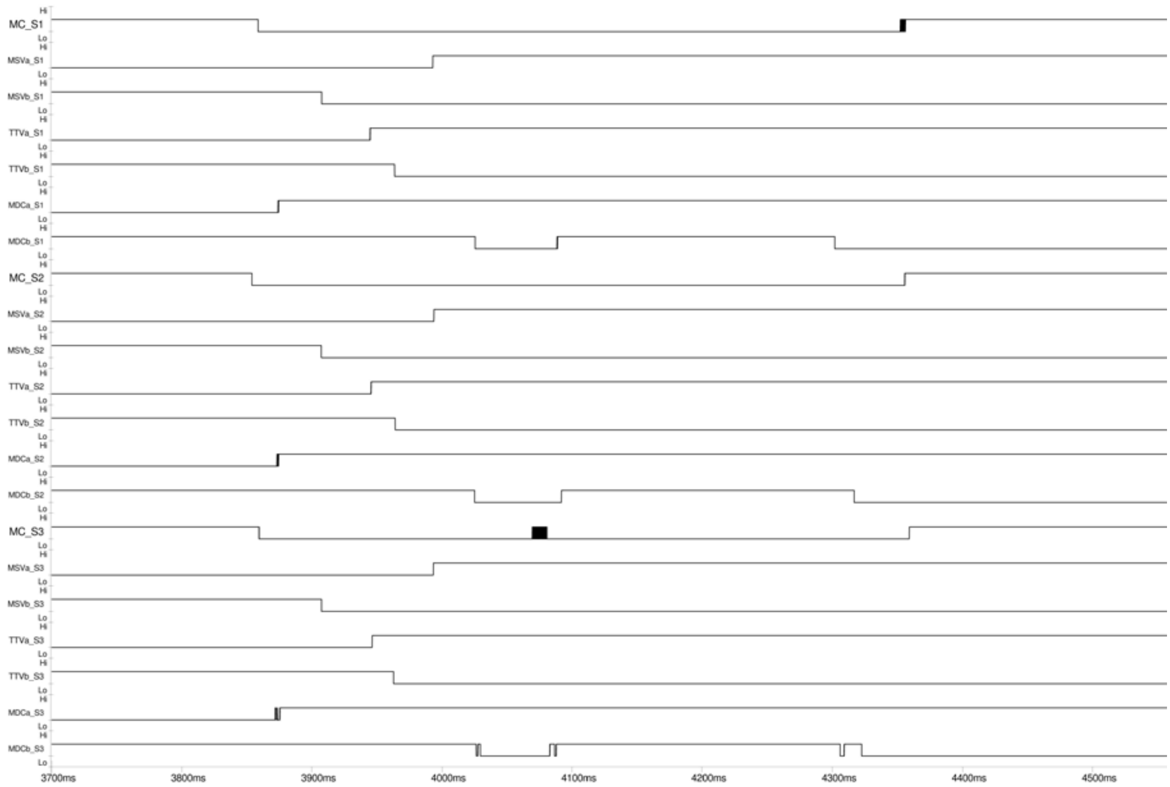


Fig. 6.3: Operation test at -25 °C with test sample 1 – Oscillogram no. 3.

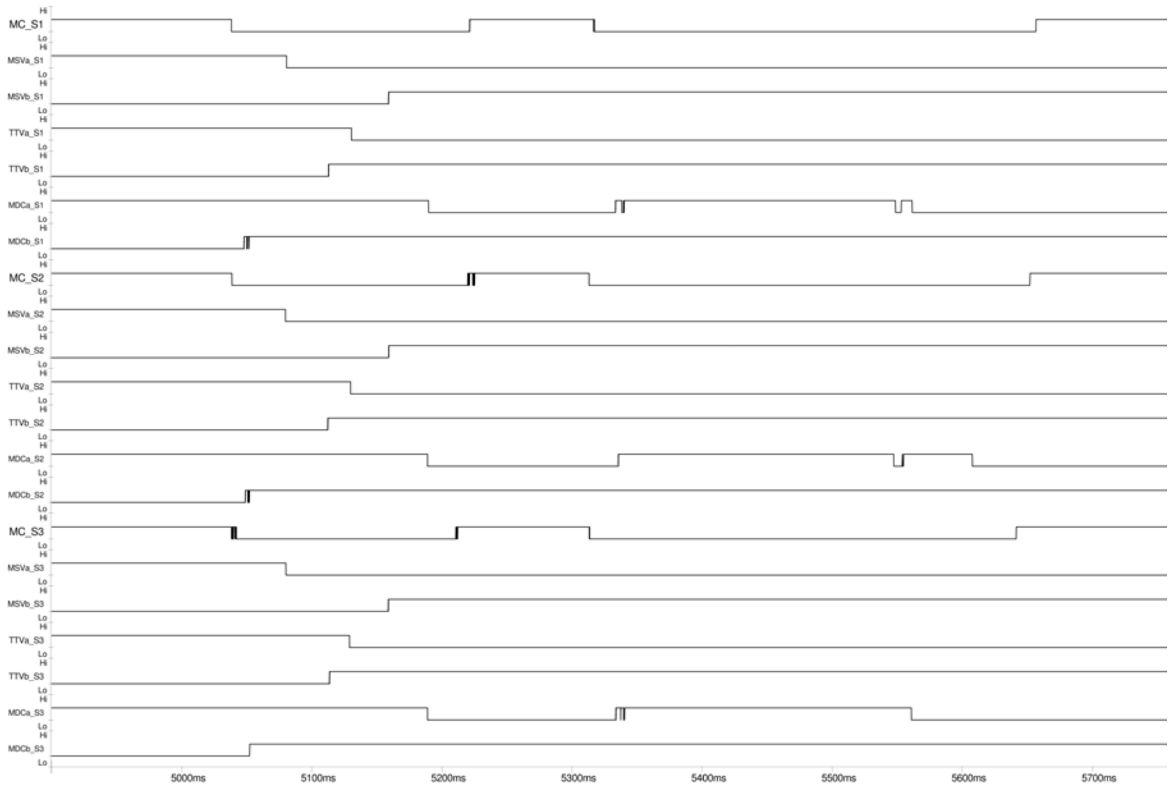


Fig. 6.4: Operation test at -25 °C with test sample 1 – Oscillogram no. 4.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

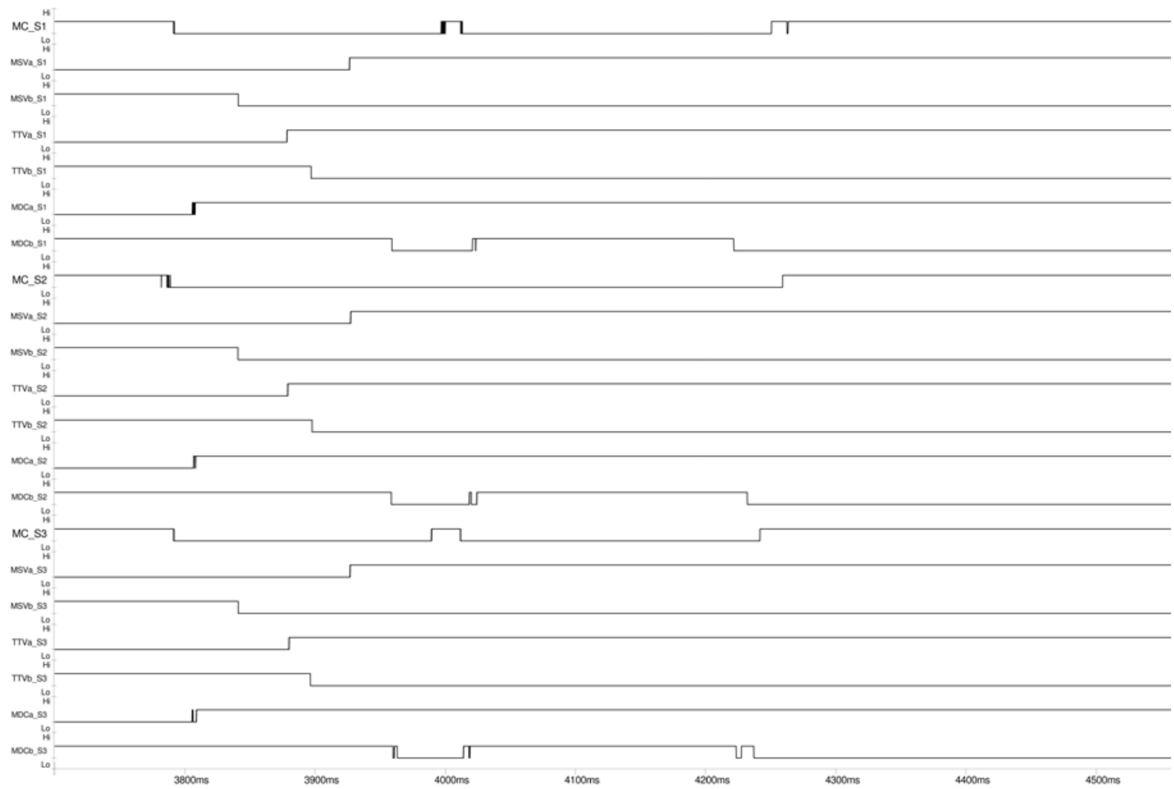


Fig. 6.5: Operation test at -25 °C with test sample 1 – Oscillogram no. 5.

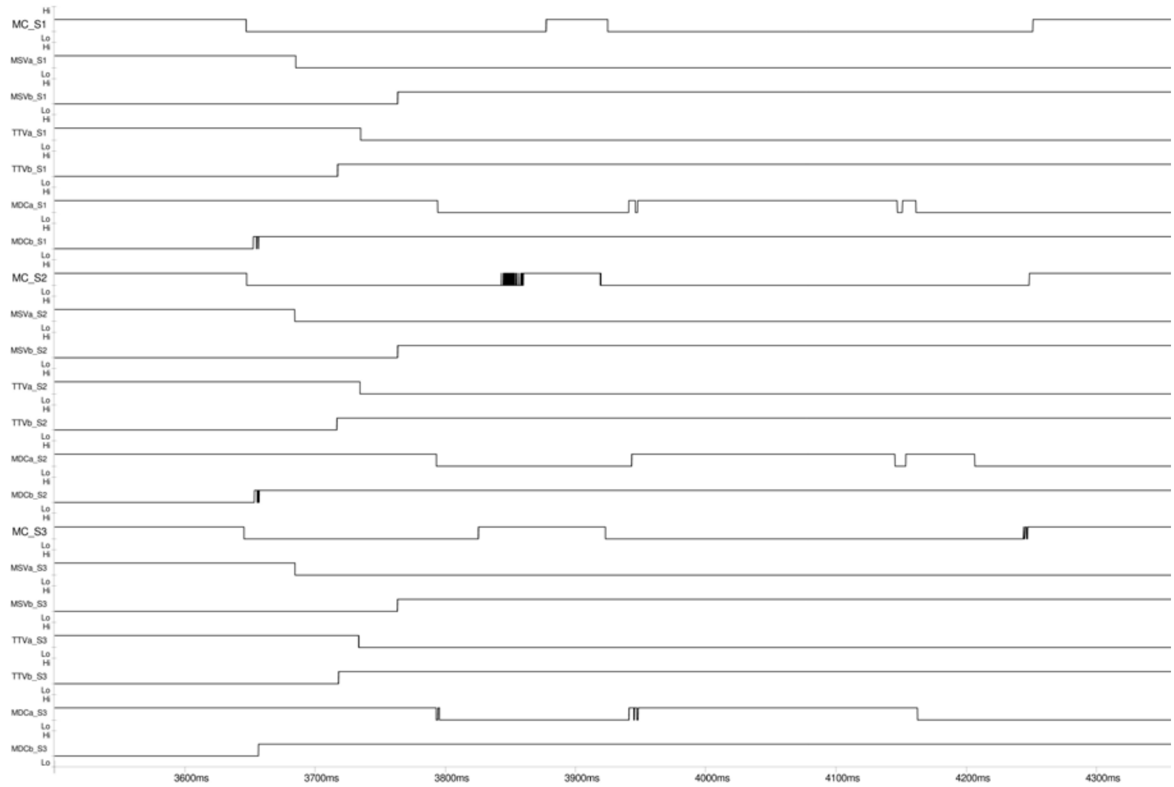


Fig. 6.6: Operation test at -25 °C with test sample 1 – Oscillogram no. 6.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

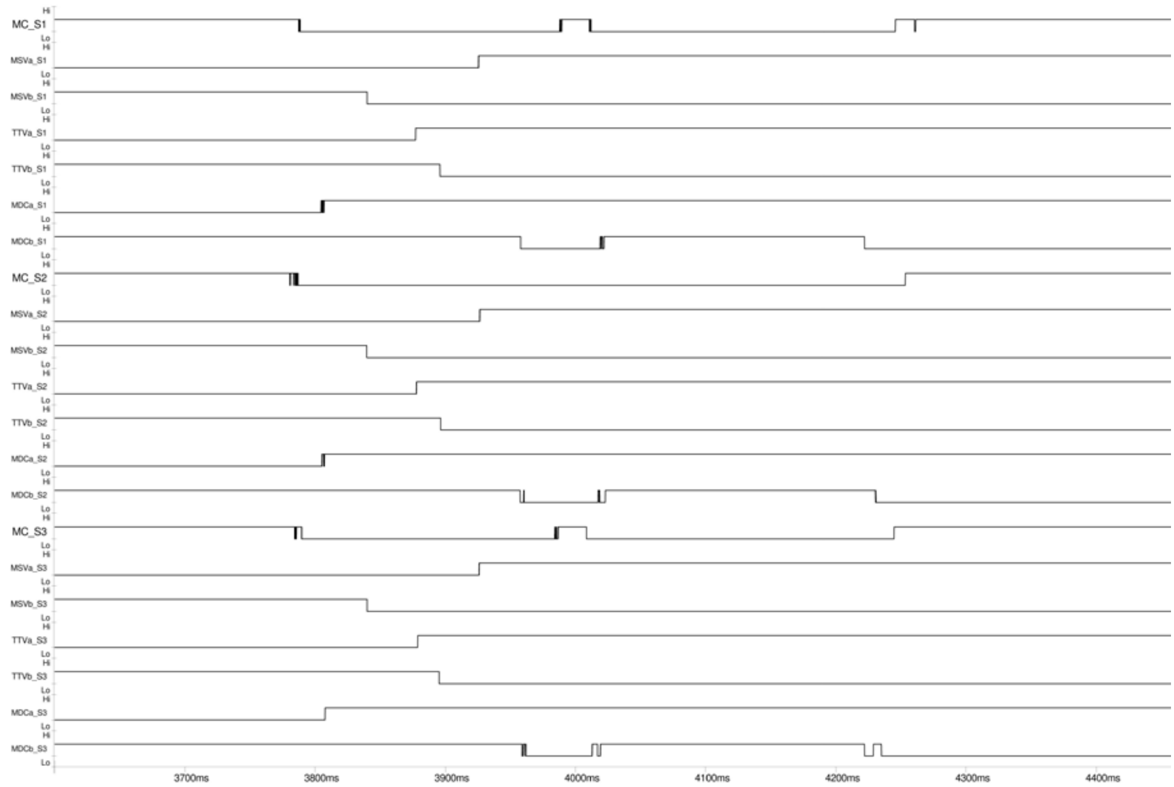


Fig. 6.7: Operation test at -25 °C with test sample 1 – Oscillogram no. 7.

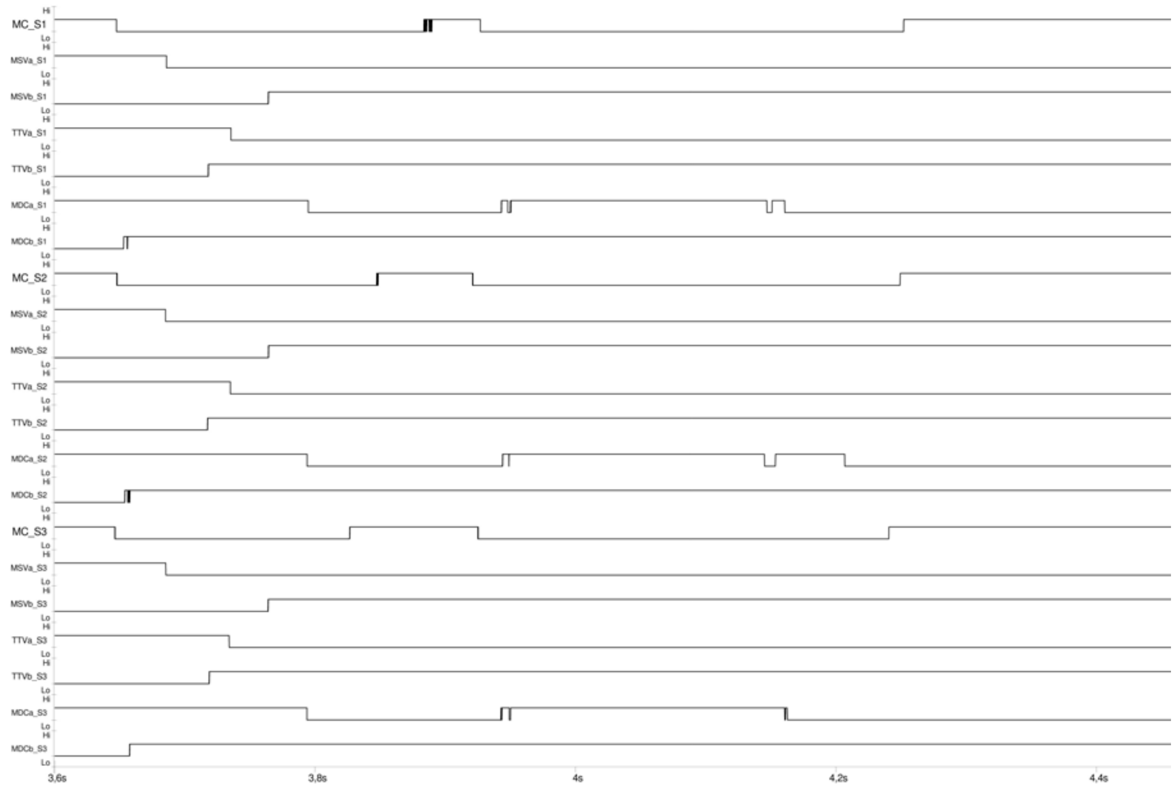


Fig. 6.8: Operation test at -25 °C with test sample 1 – Oscillogram no. 8.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

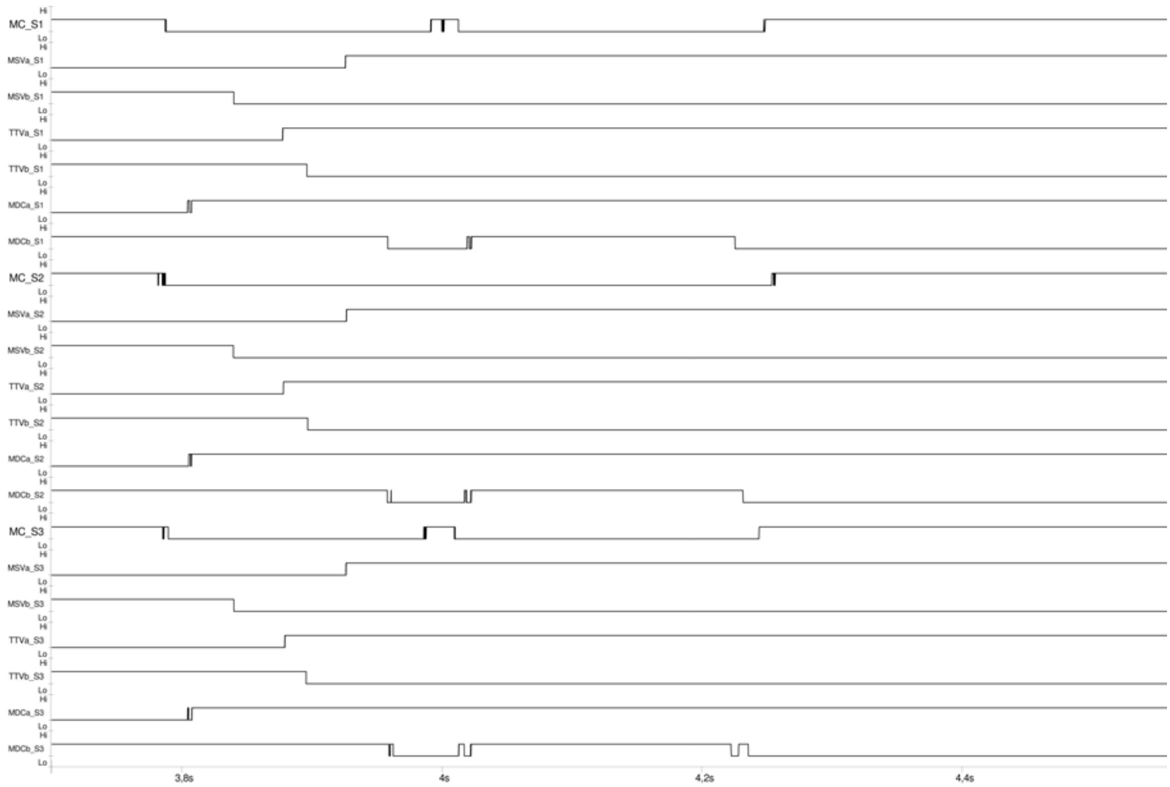


Fig. 6.9: Operation test at -25 °C with test sample 1 – Oscillogram no. 9.

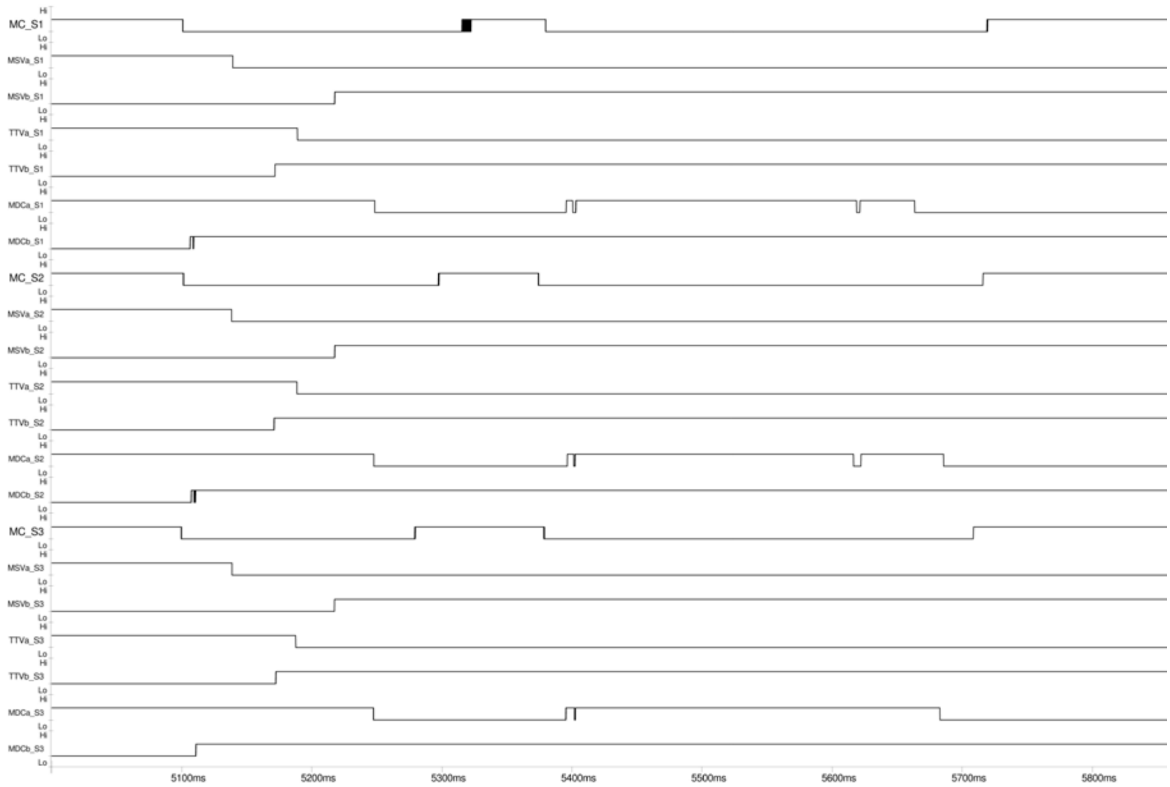


Fig. 6.10: Operation test at -25 °C with test sample 1 – Oscillogram no. 10.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

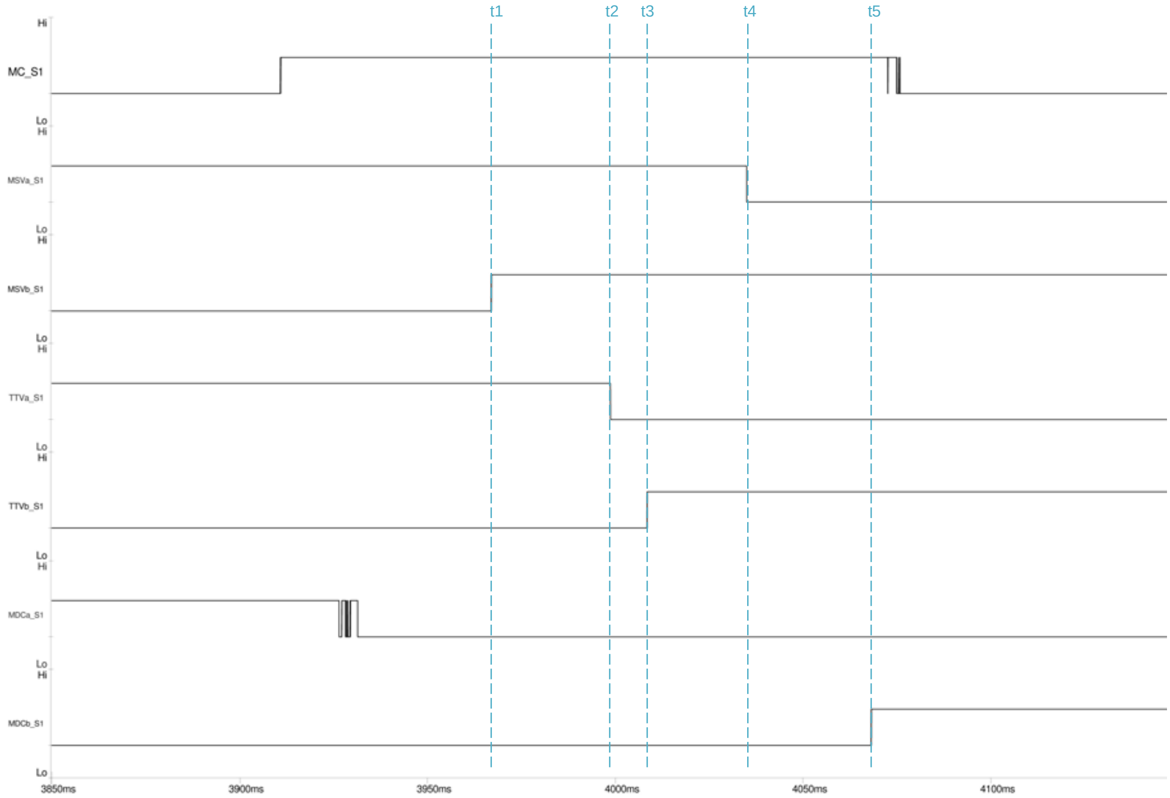


Fig. 7.1: Operation test at -25 °C with test sample 3 – Oscillogram no. 1.

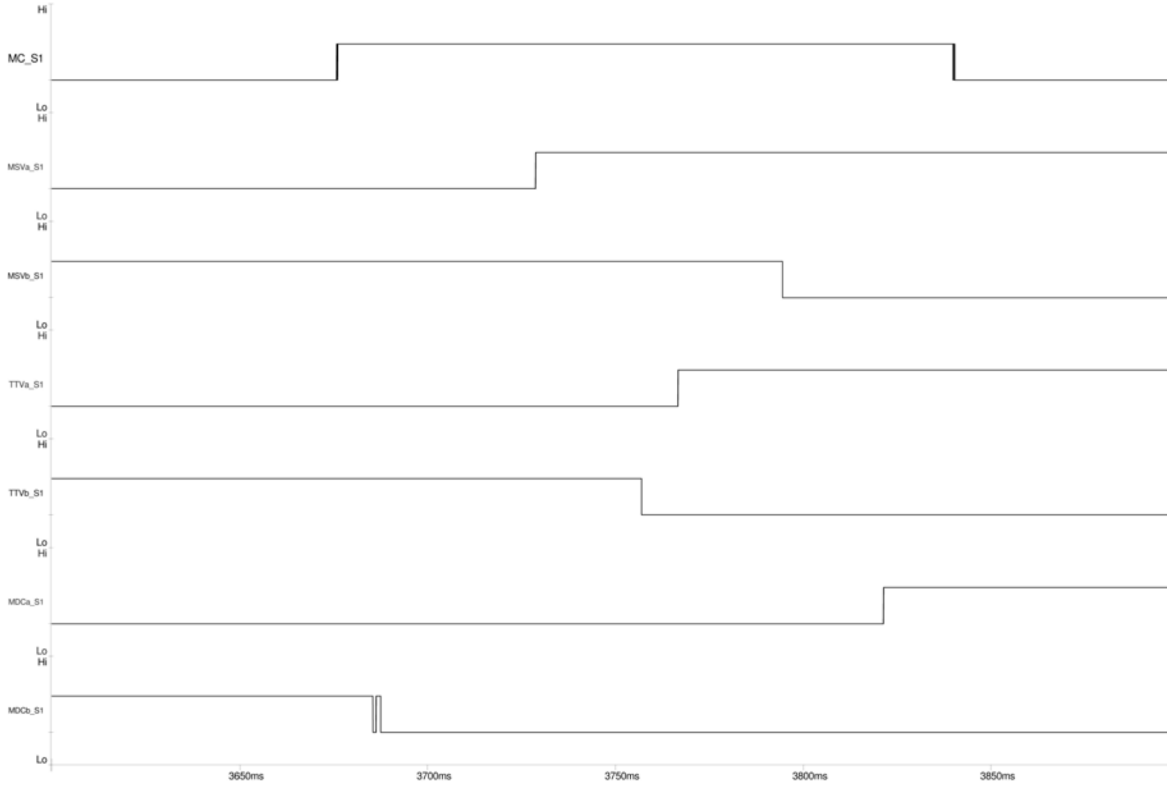


Fig. 7.2: Operation test at -25 °C with test sample 3 – Oscillogram no. 2.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

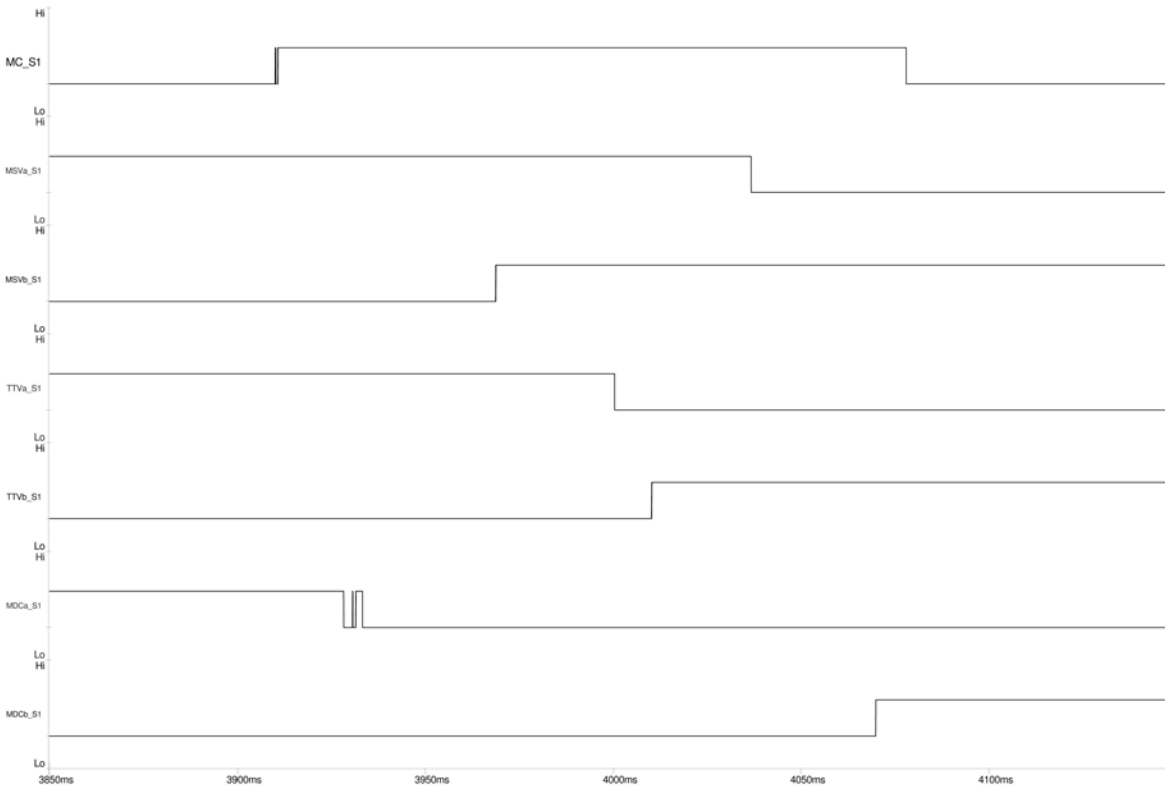


Fig. 7.3: Operation test at -25 °C with test sample 3 – Oscillogram no. 3.

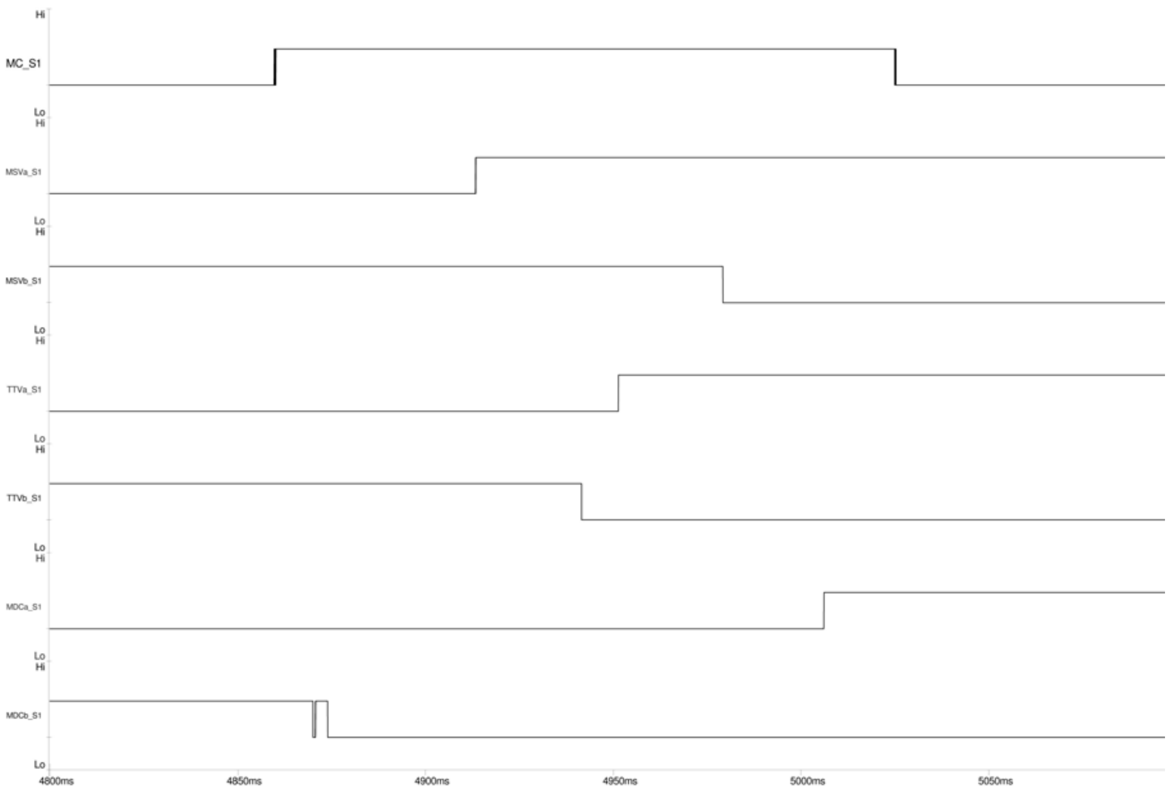


Fig. 7.4: Operation test at -25 °C with test sample 3 – Oscillogram no. 4.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

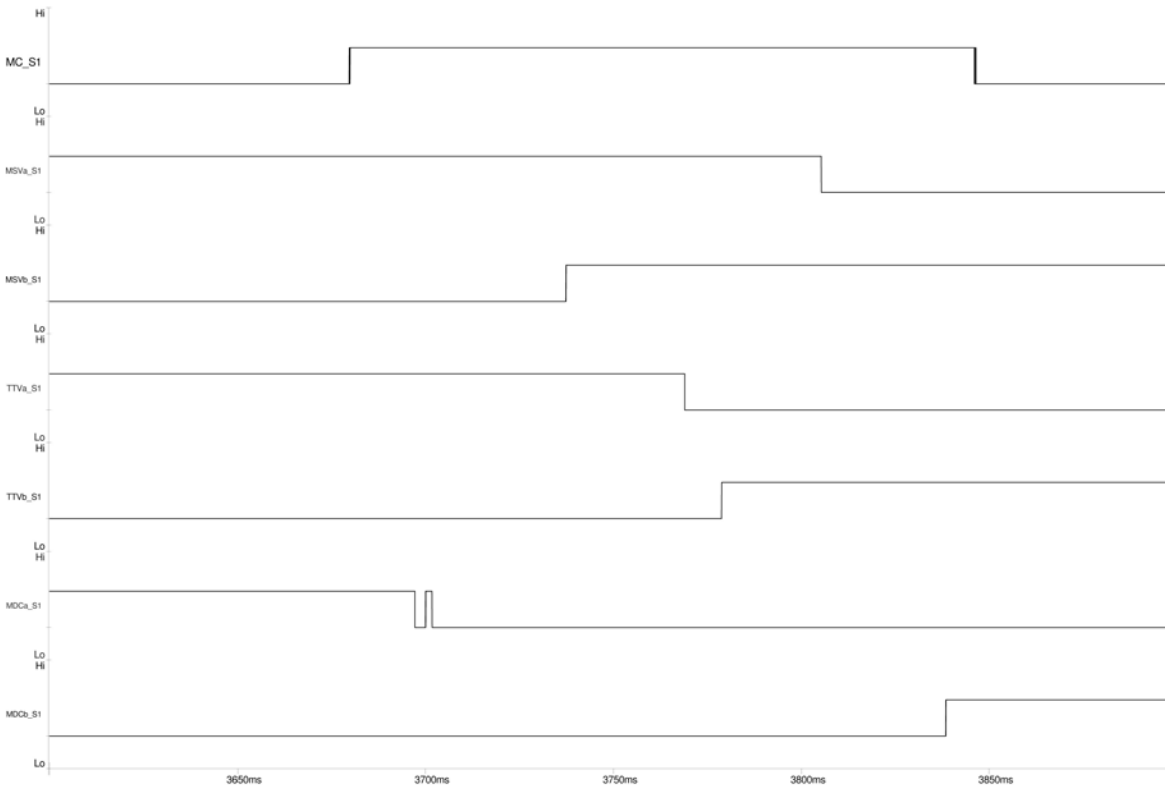


Fig. 7.5: Operation test at -25 °C with test sample 3 – Oscillogram no. 5.

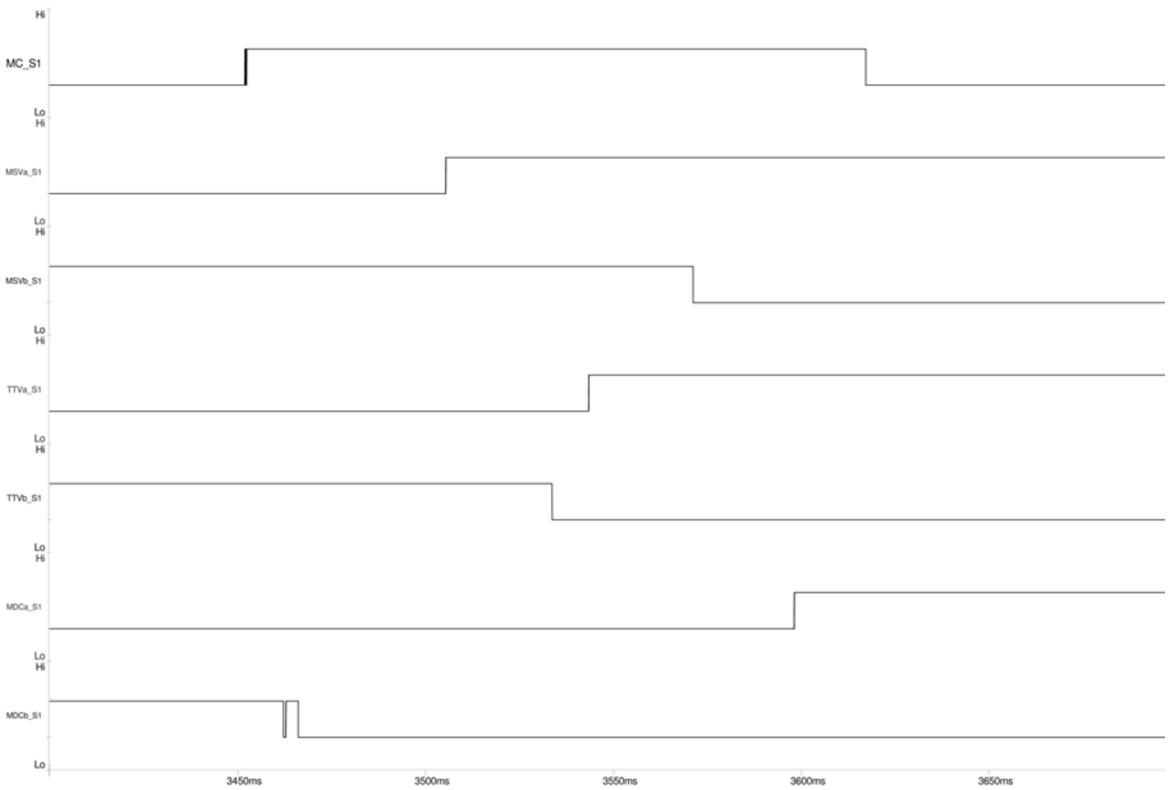
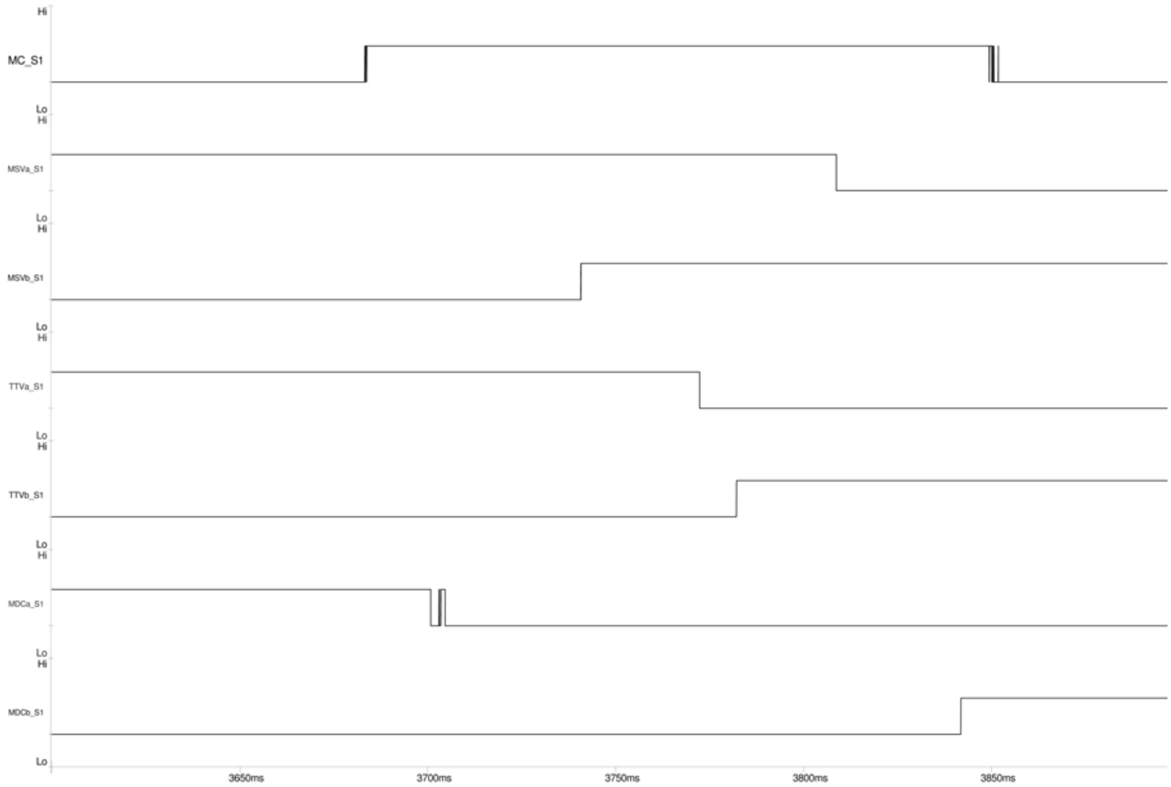
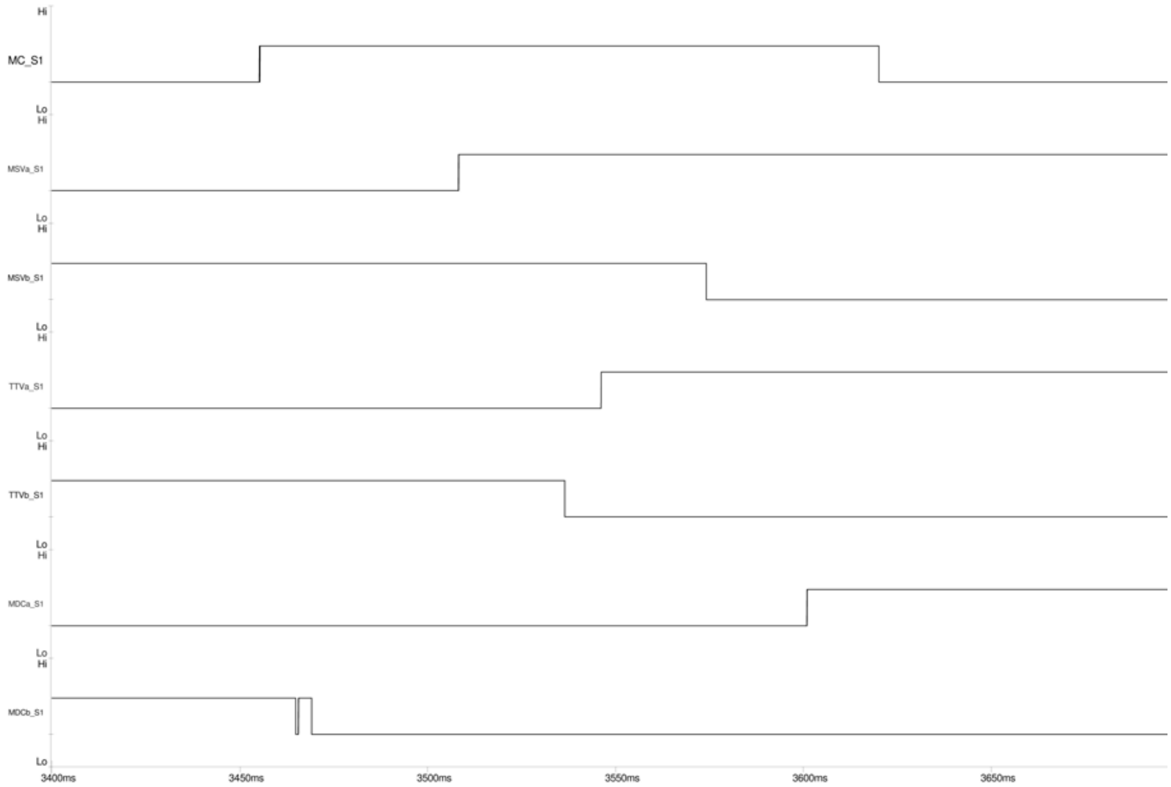


Fig. 7.6: Operation test at -25 °C with test sample 3 – Oscillogram no. 6.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		



<u>Fig. 7.7:</u> Operation test at -25 °C with test sample 3 – Oscillogram no. 7.



<u>Fig. 7.8:</u> Operation test at -25 °C with test sample 3 – Oscillogram no. 8.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

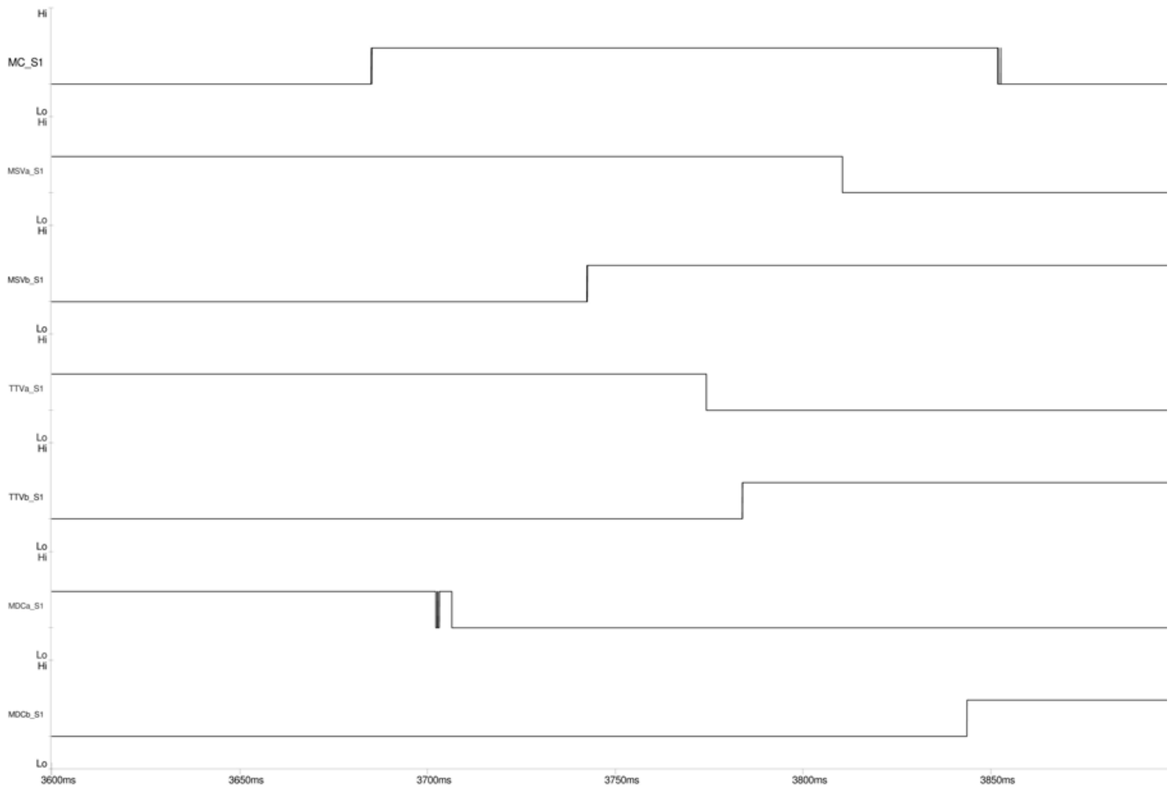


Fig. 7.9: Operation test at -25 °C with test sample 3 – Oscillogram no. 9.

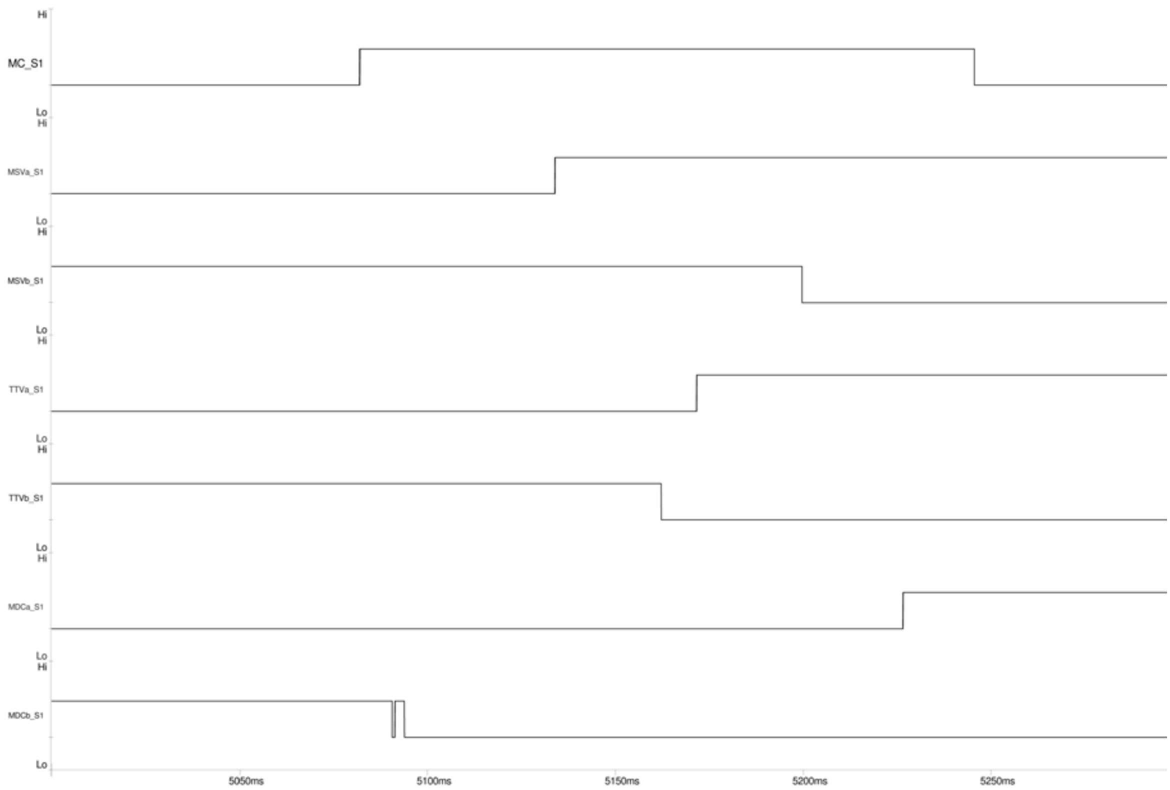


Fig. 7.10: Operation test at -25 °C with test sample 3 – Oscillogram no. 10.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

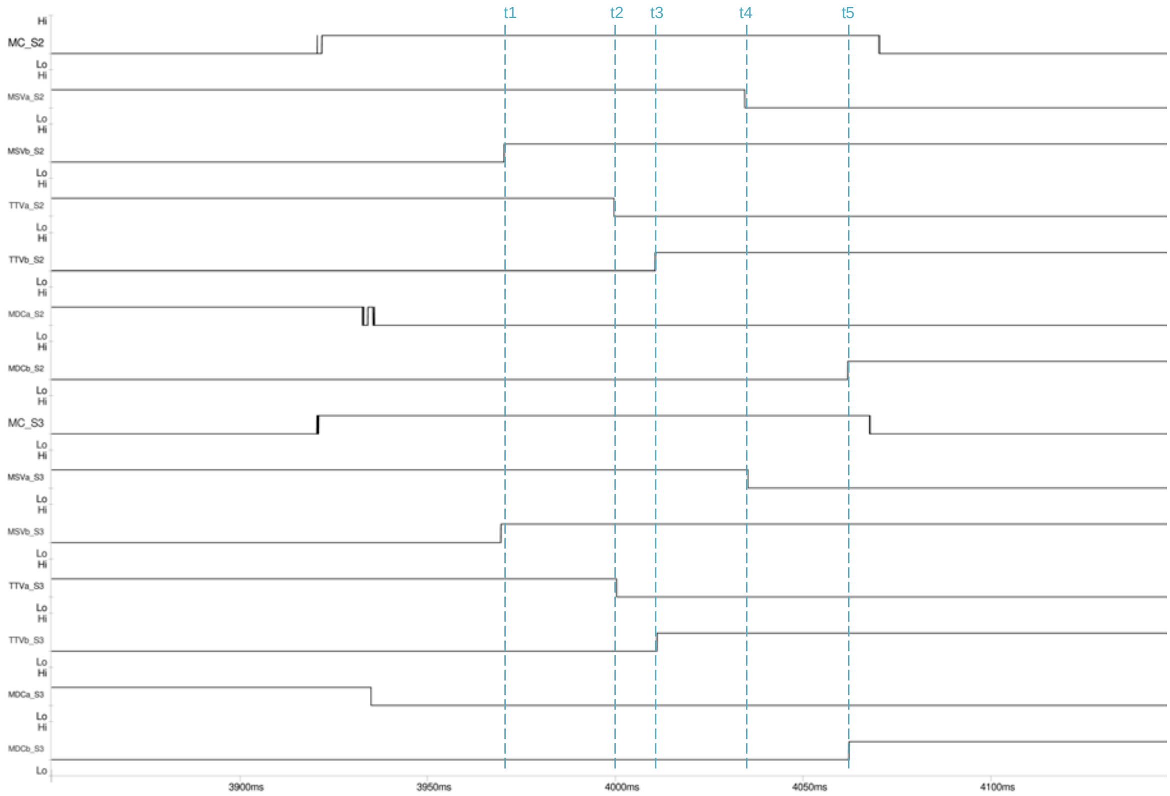


Fig. 8.1: Operation test at -25 °C with test sample 2 – Oscillogram no. 1.

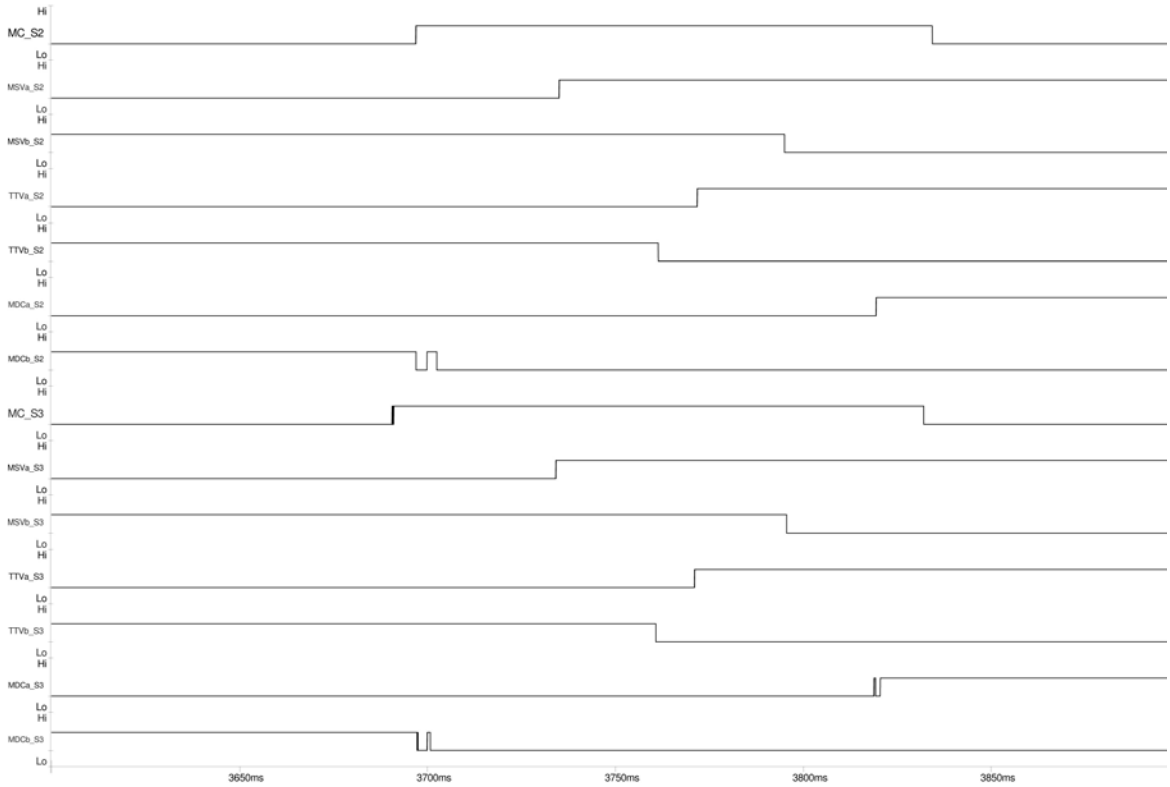


Fig. 8.2: Operation test at -25 °C with test sample 2 – Oscillogram no. 2.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2:	Sector 1, Sector 2		

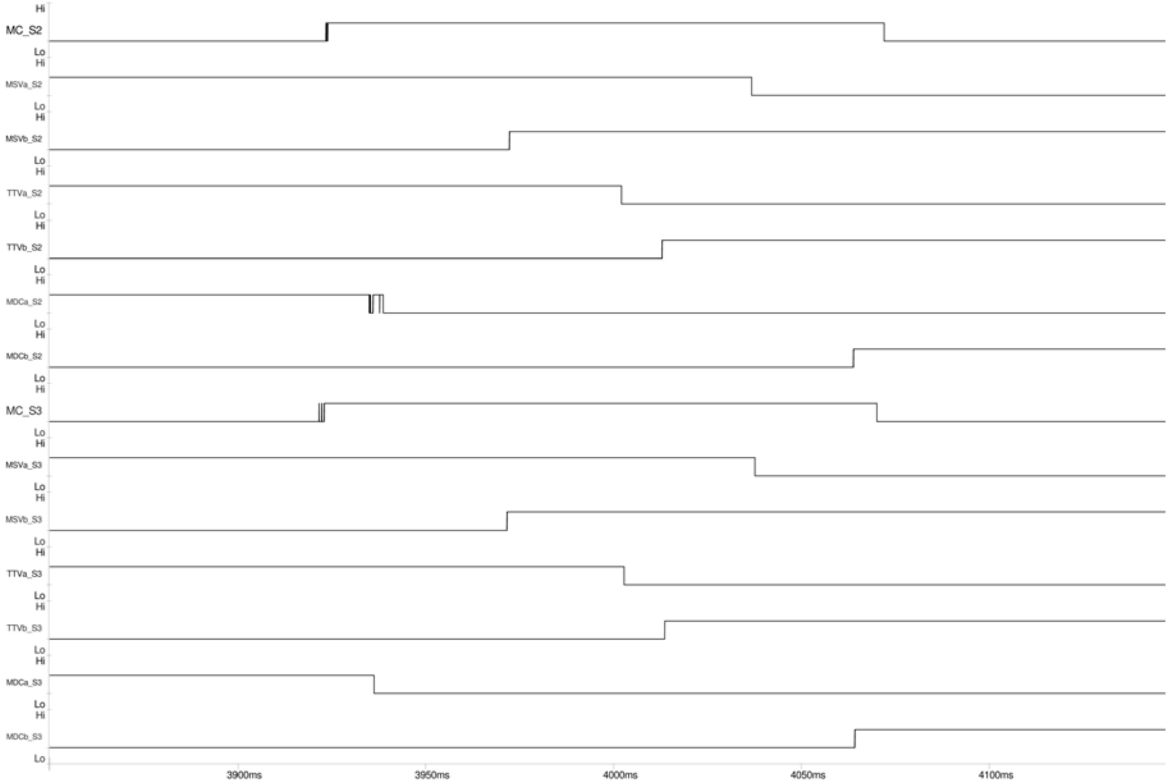


Fig. 8.3: Operation test at -25 °C with test sample 2 – Oscillogram no. 3.

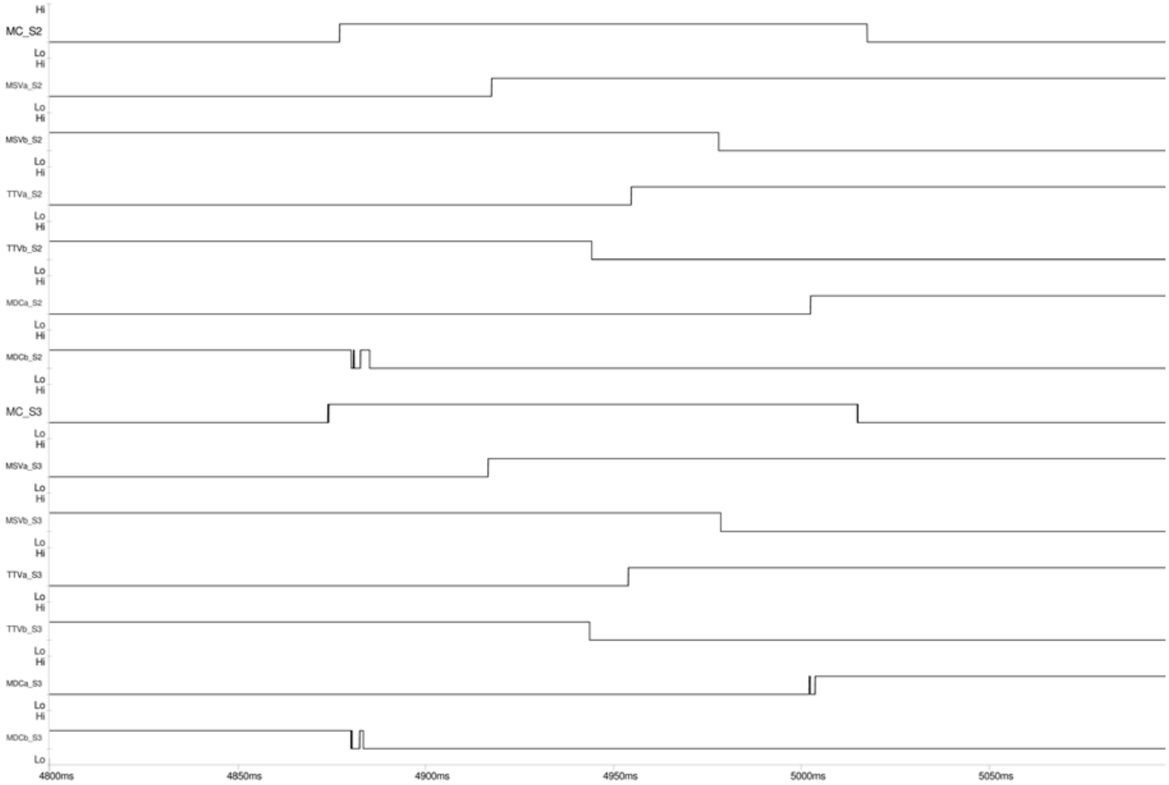


Fig. 8.4: Operation test at -25 °C with test sample 2 – Oscillogram no. 4.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2:	Sector 1, Sector 2		

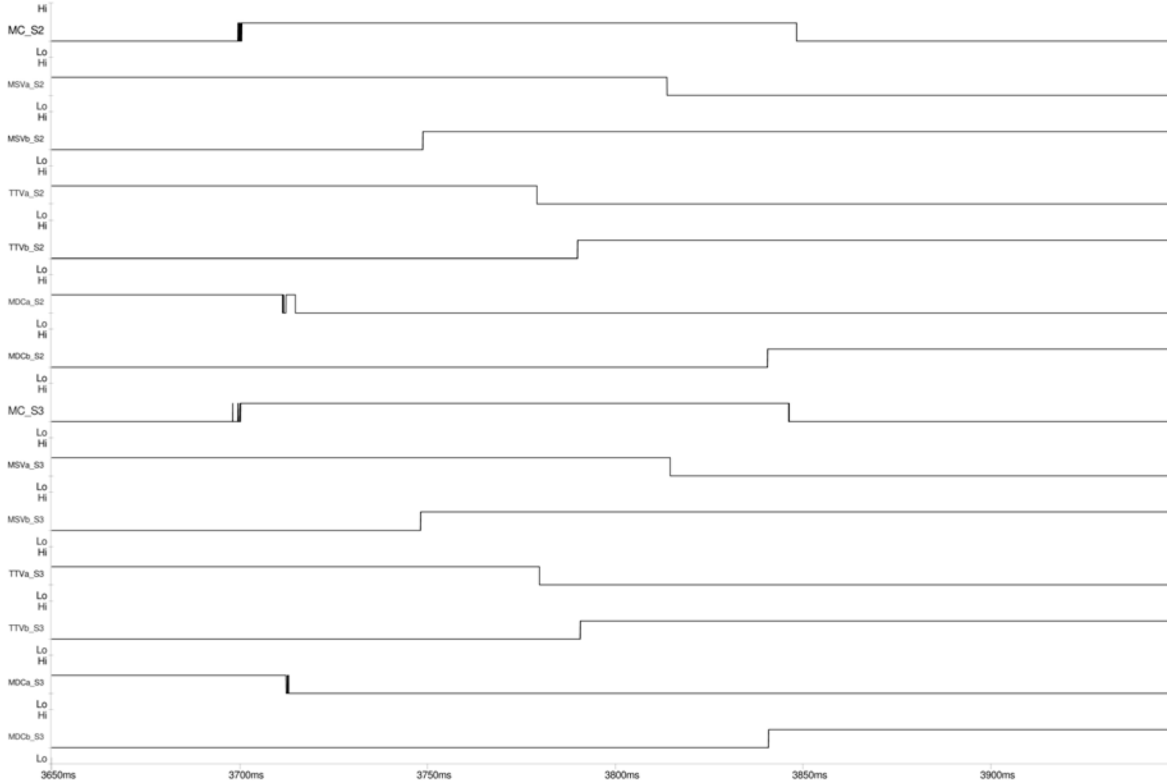


Fig. 8.5: Operation test at -25 °C with test sample 2 – Oscillogram no. 5.

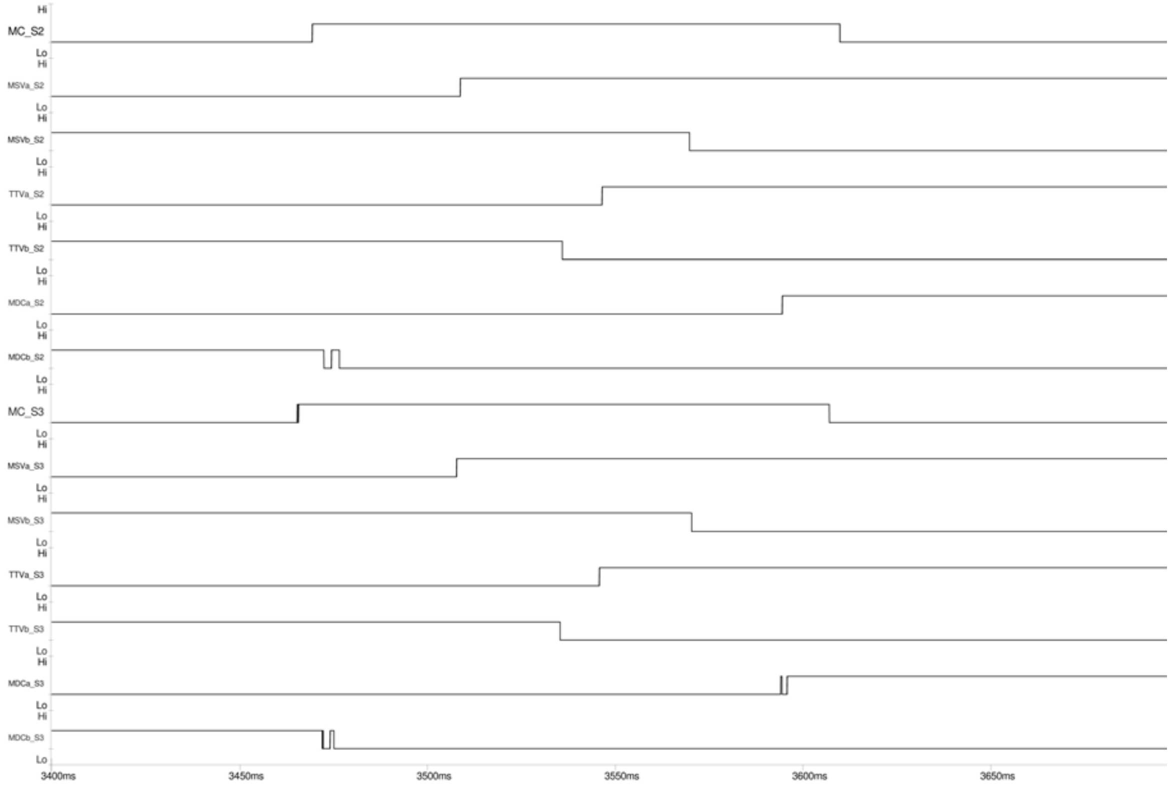
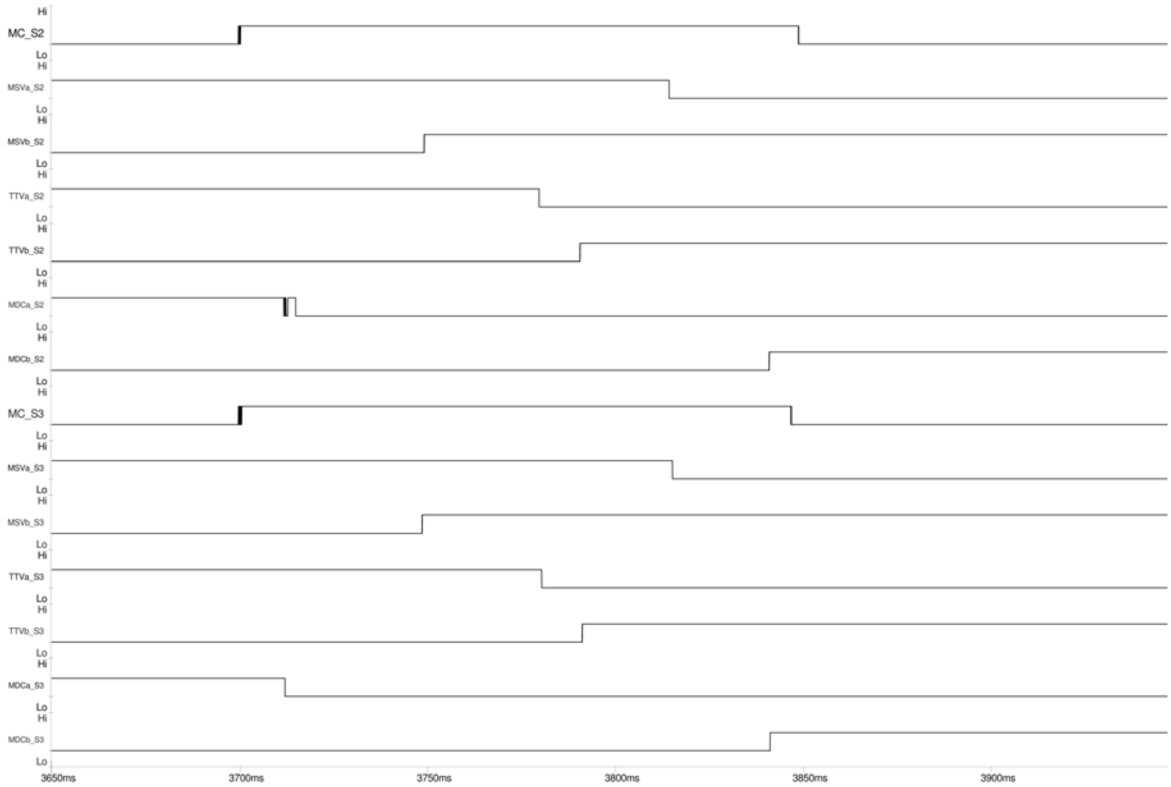
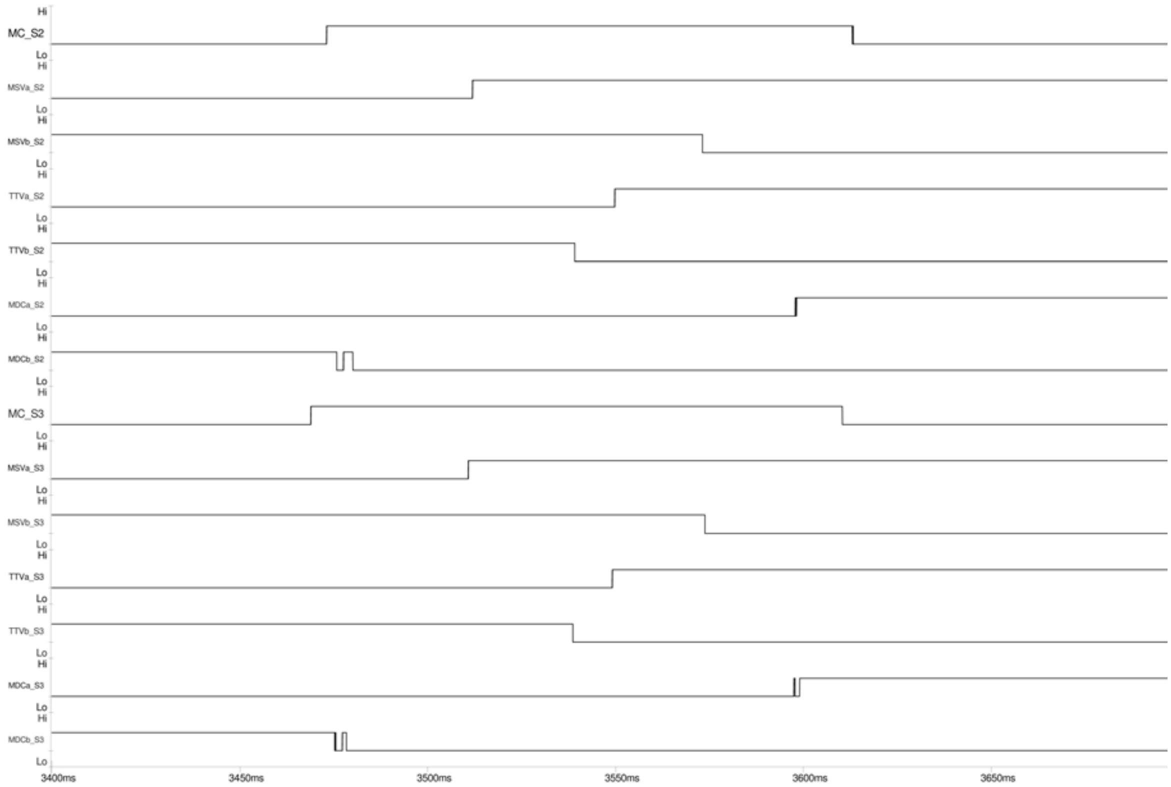


Fig. 8.6: Operation test at -25 °C with test sample 2 – Oscillogram no. 6.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2:	Sector 1, Sector 2		



<u>Fig. 8.7:</u> Operation test at -25 °C with test sample 2 – Oscillogram no. 7.



<u>Fig. 8.8:</u> Operation test at -25 °C with test sample 2 – Oscillogram no. 8.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2:	Sector 1, Sector 2		

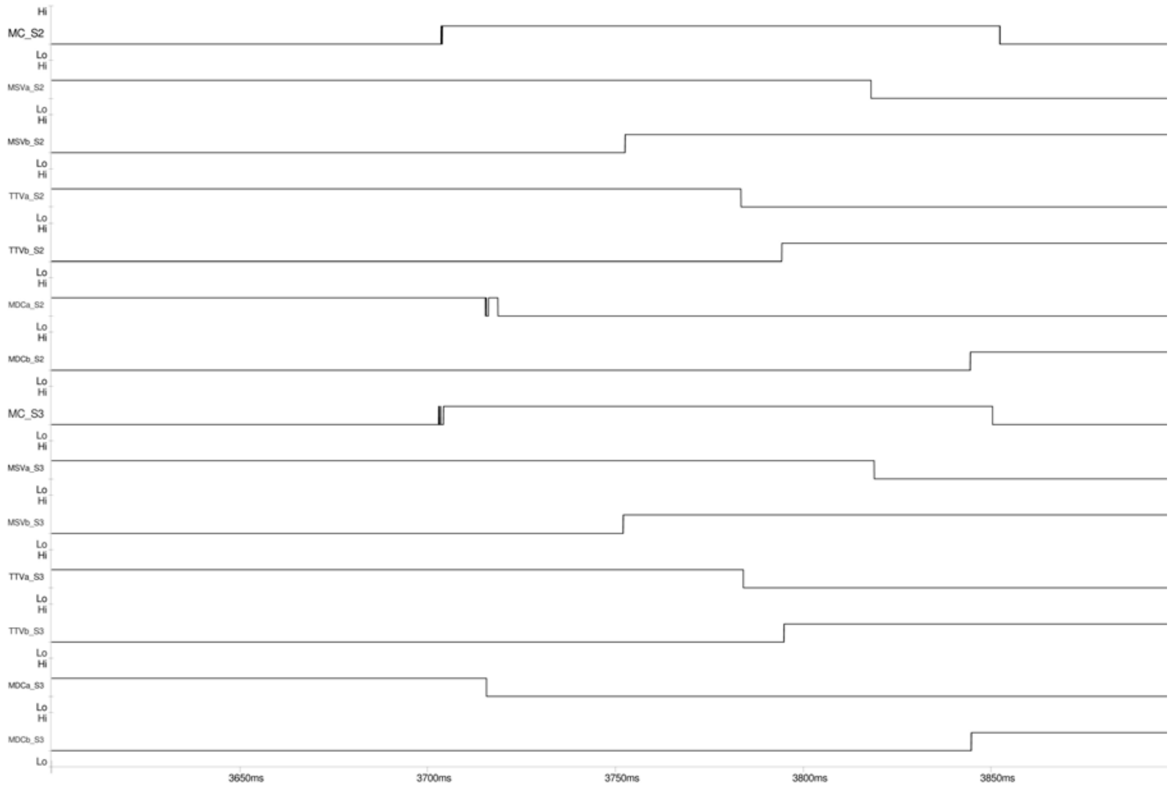


Fig. 8.9: Operation test at -25 °C with test sample 2 – Oscillogram no. 9.

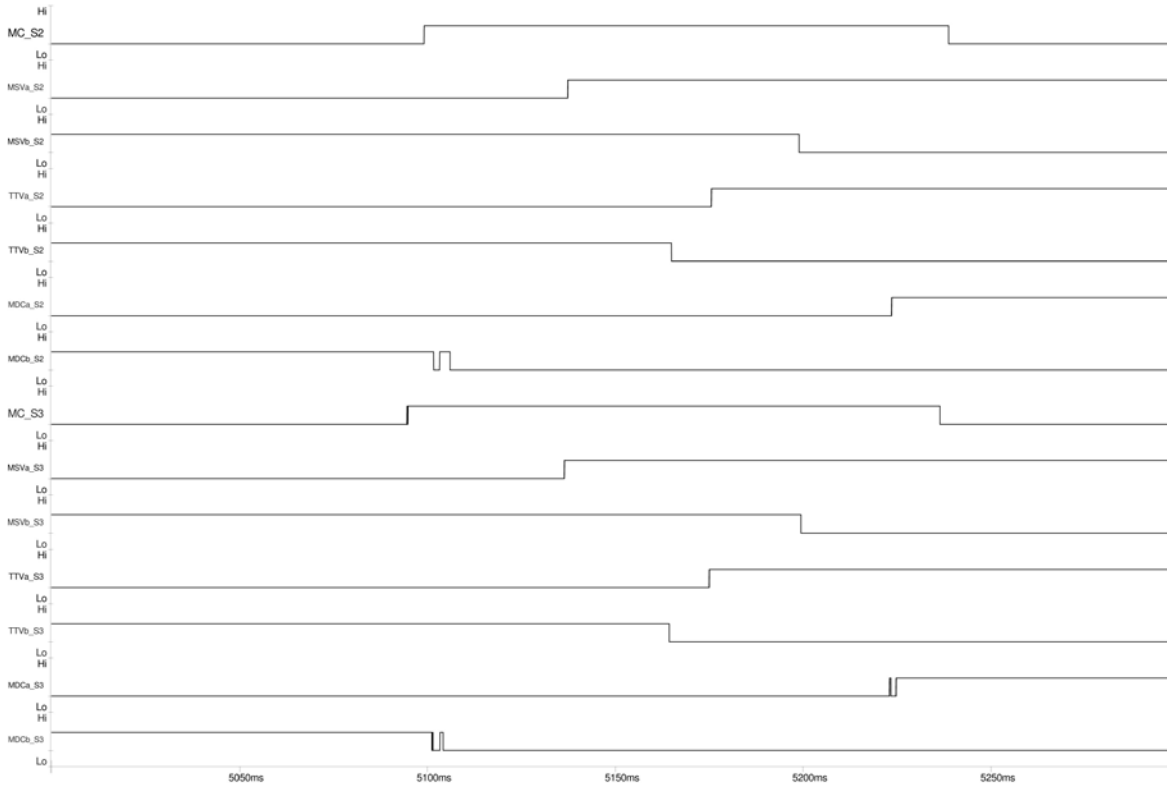


Fig. 8.10: Operation test at -25 °C with test sample 2 – Oscillogram no. 10.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2:	Sector 1, Sector 2		

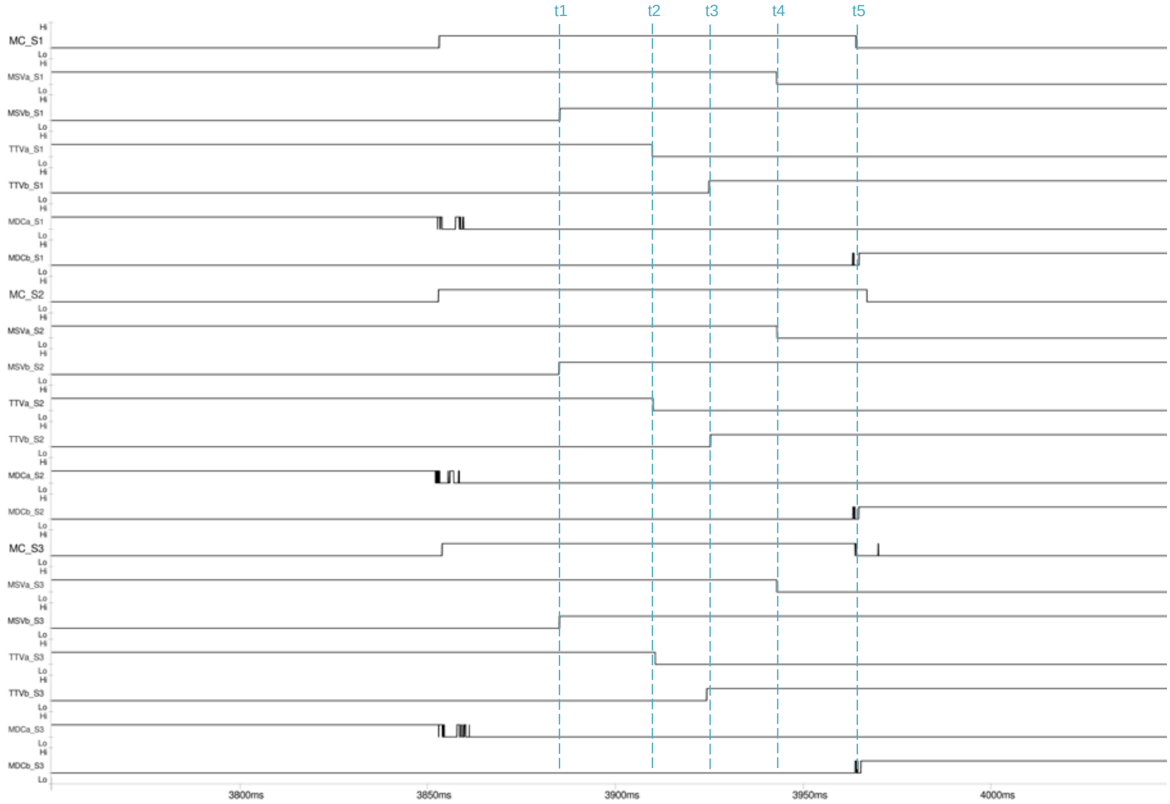


Fig. 9.1: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 1.

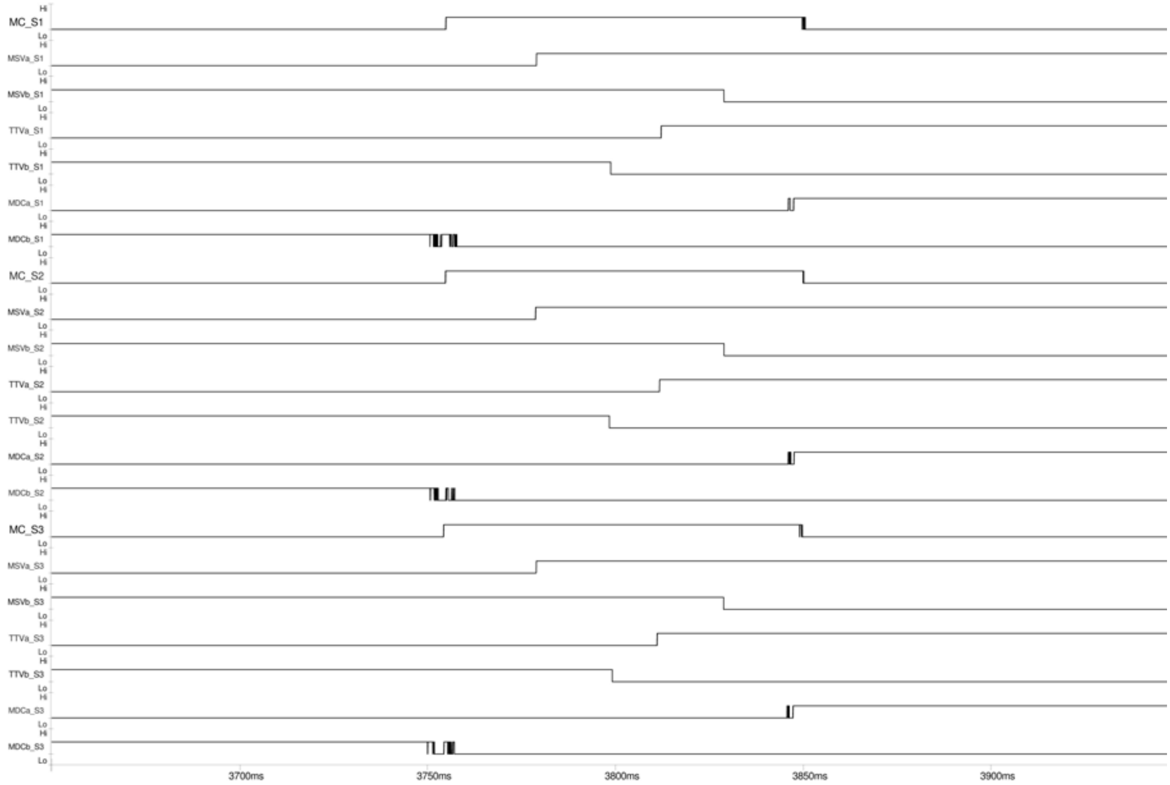


Fig. 9.2: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 2.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

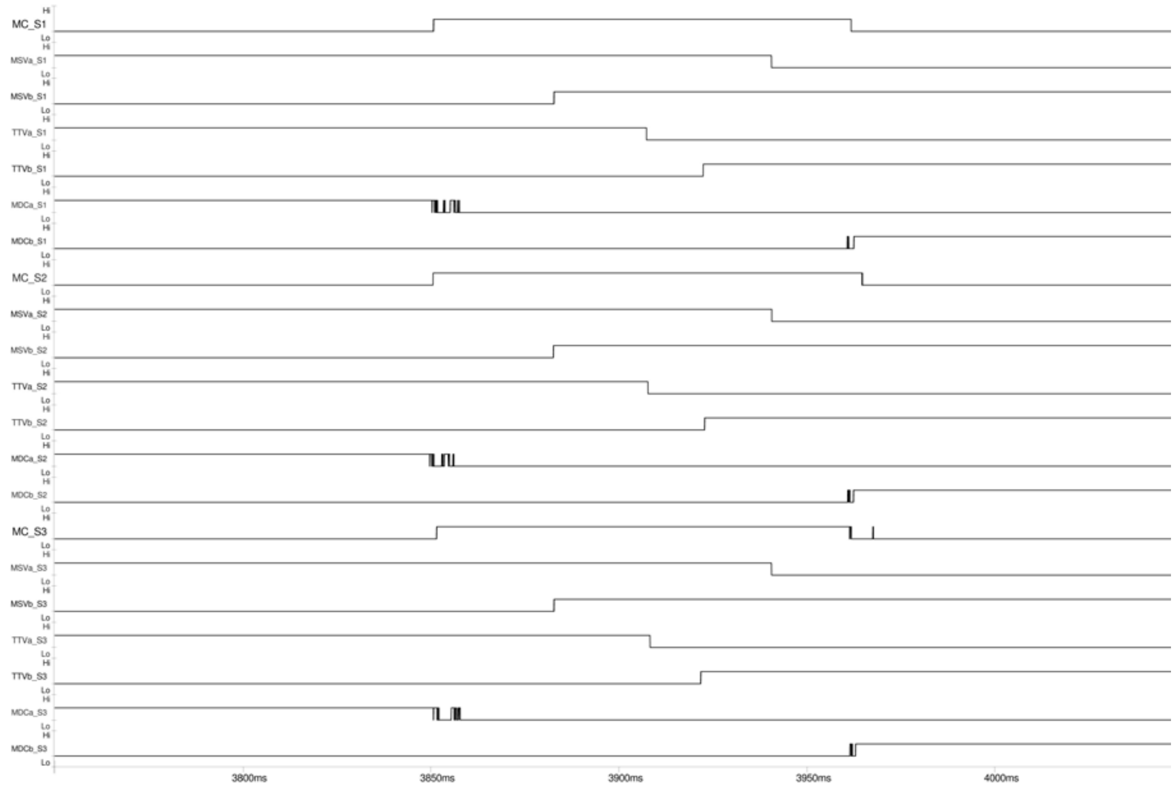


Fig. 9.3: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 3.

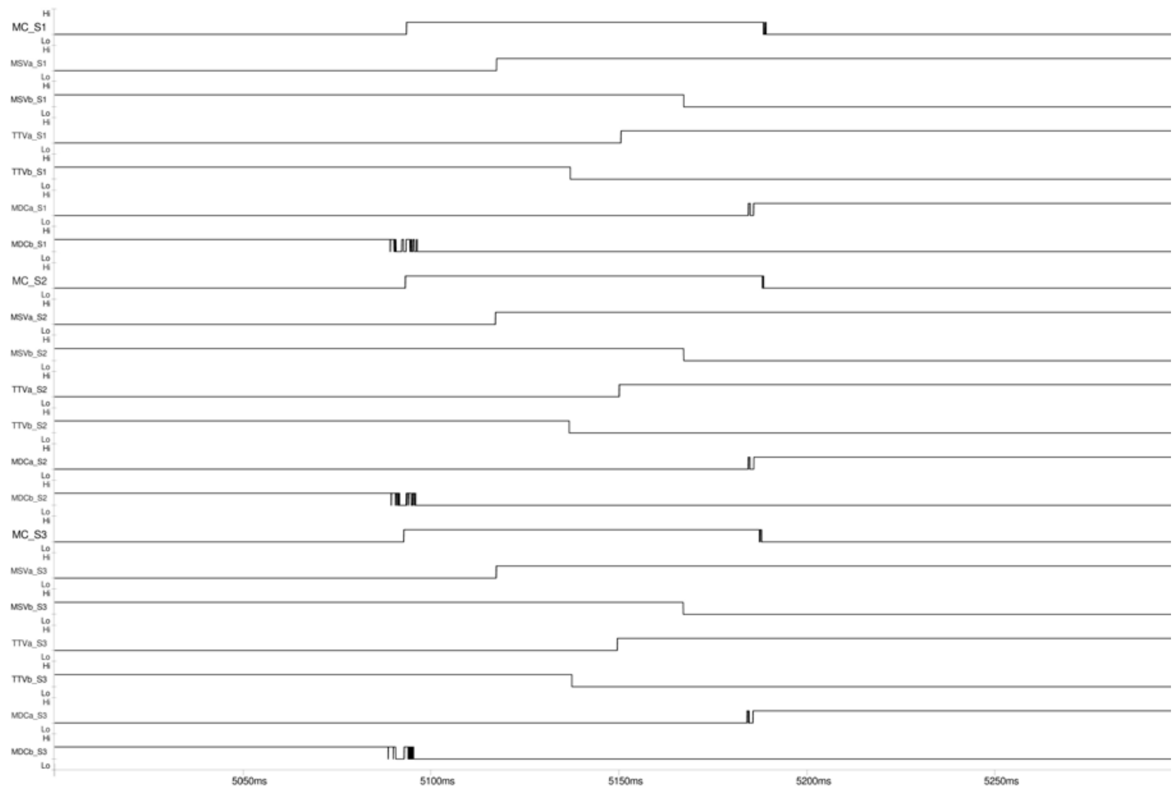


Fig. 9.4: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 4.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

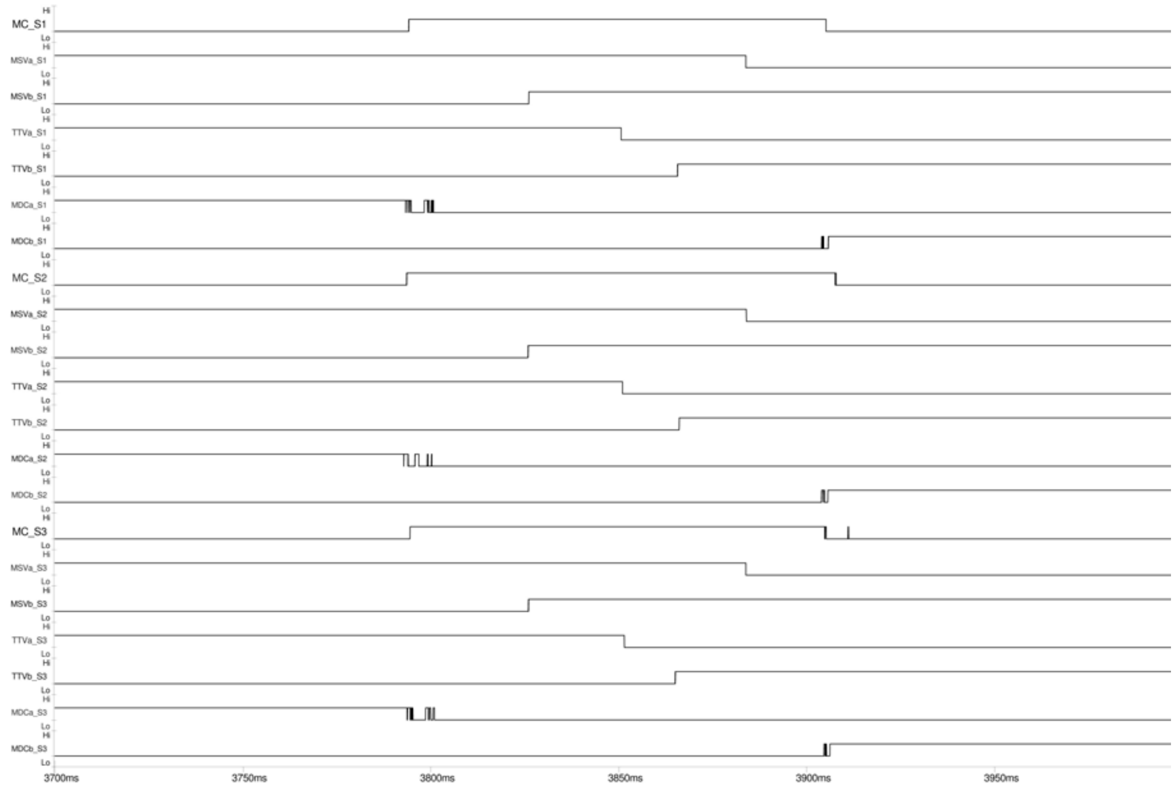


Fig. 9.5: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 5.

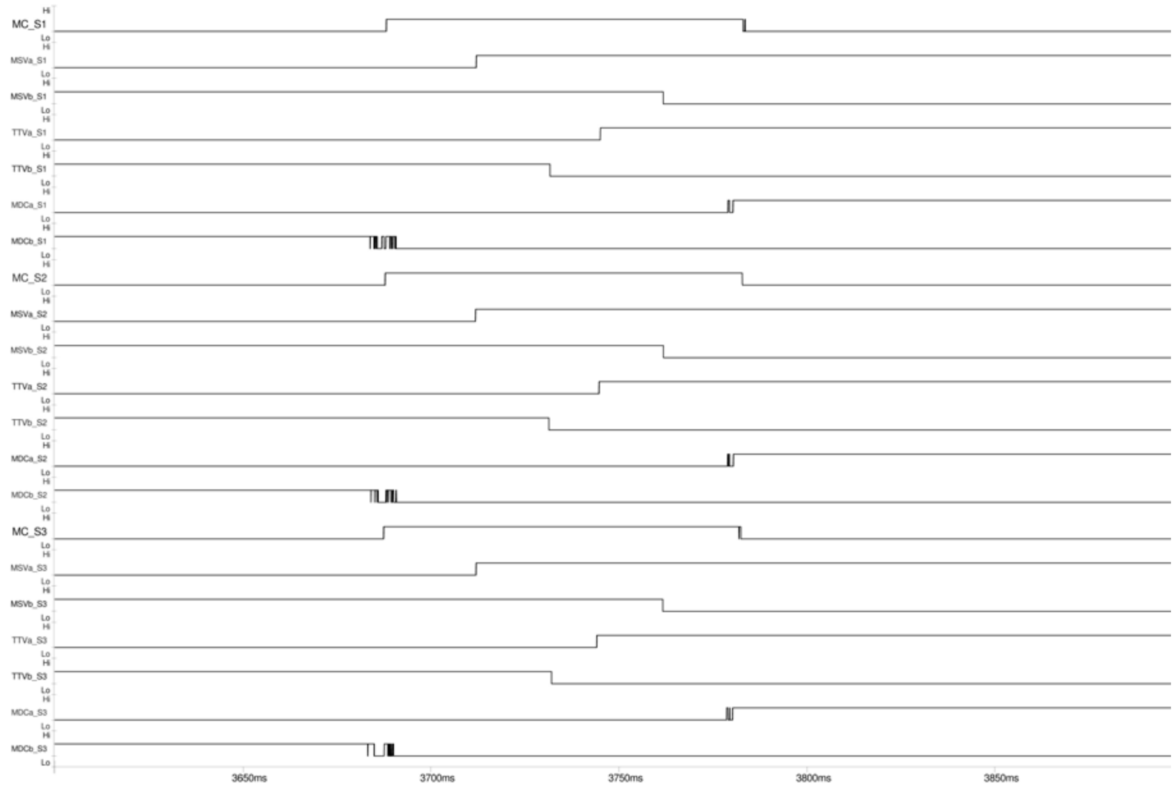


Fig. 9.6: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 6.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

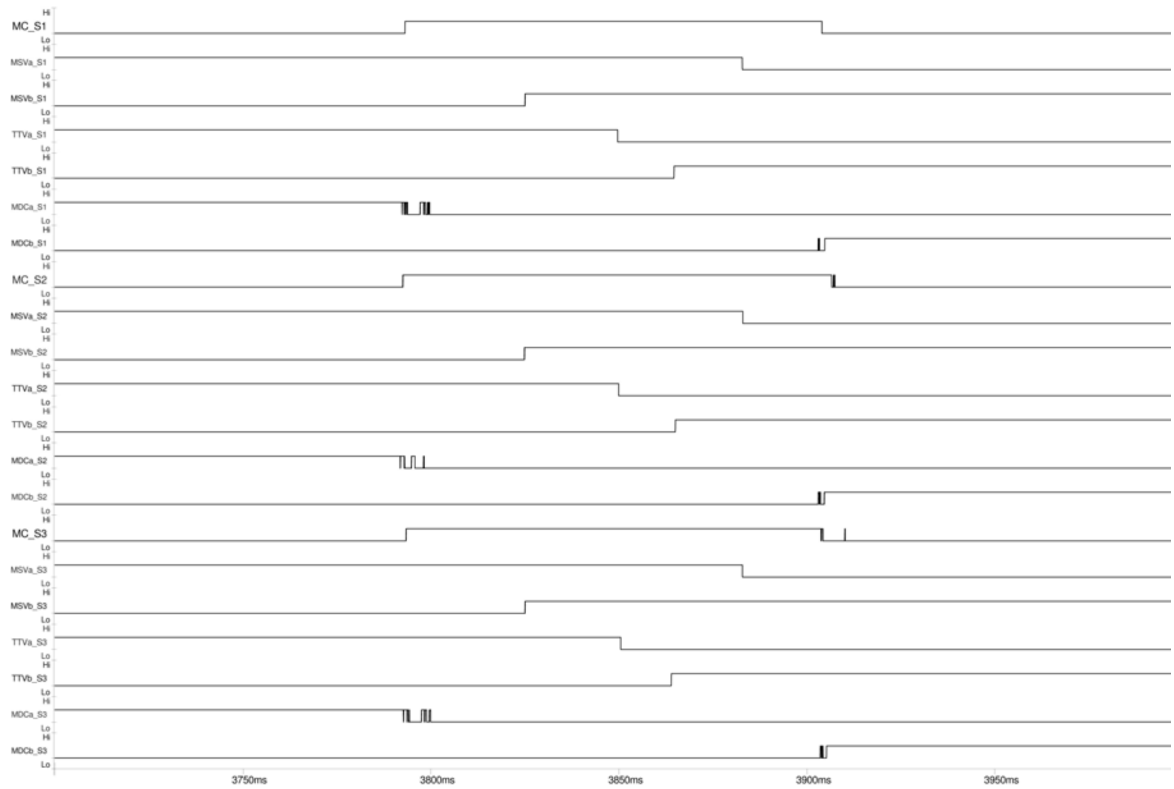


Fig. 9.7: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 7.

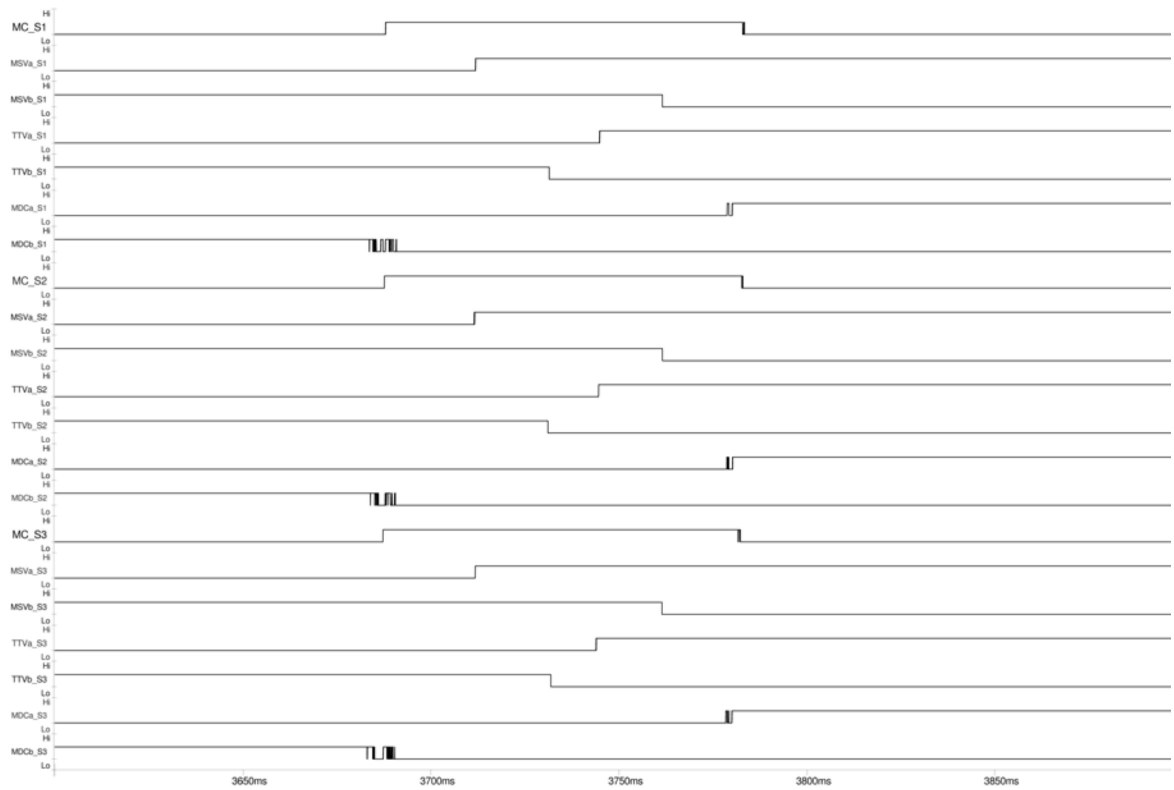


Fig. 9.8: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 8.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

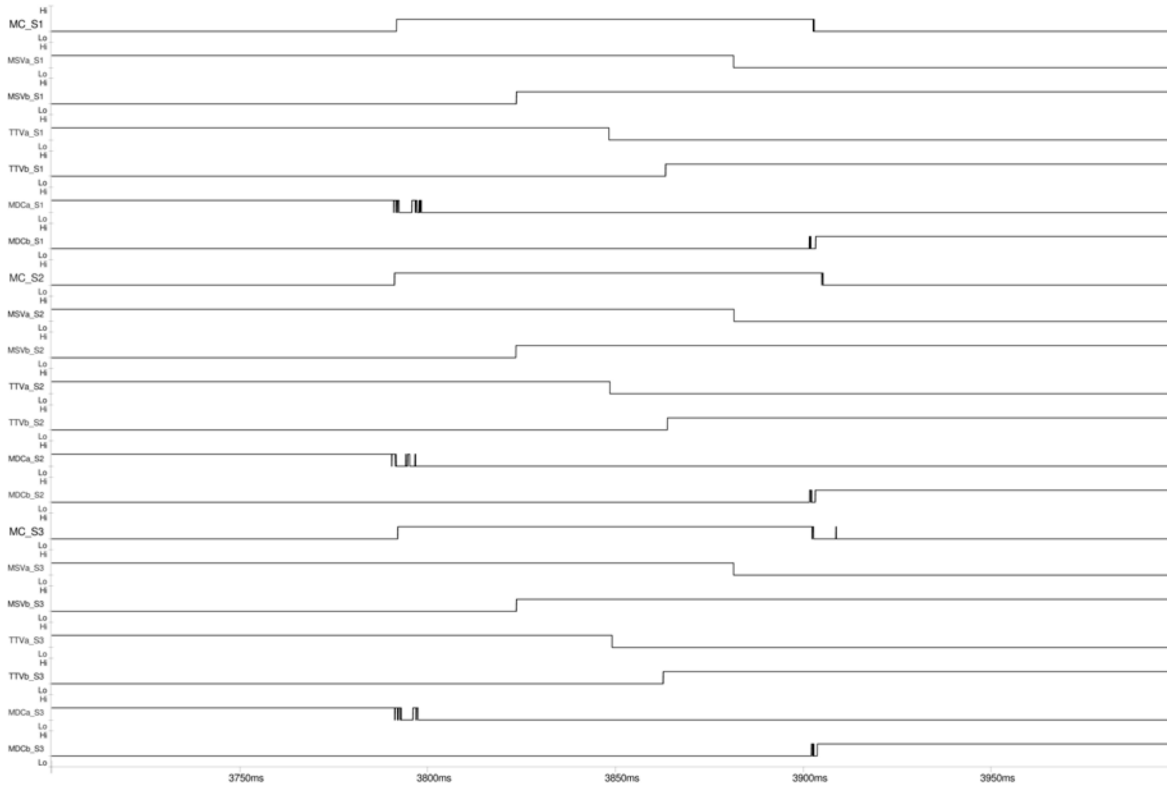


Fig. 9.9: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 9.

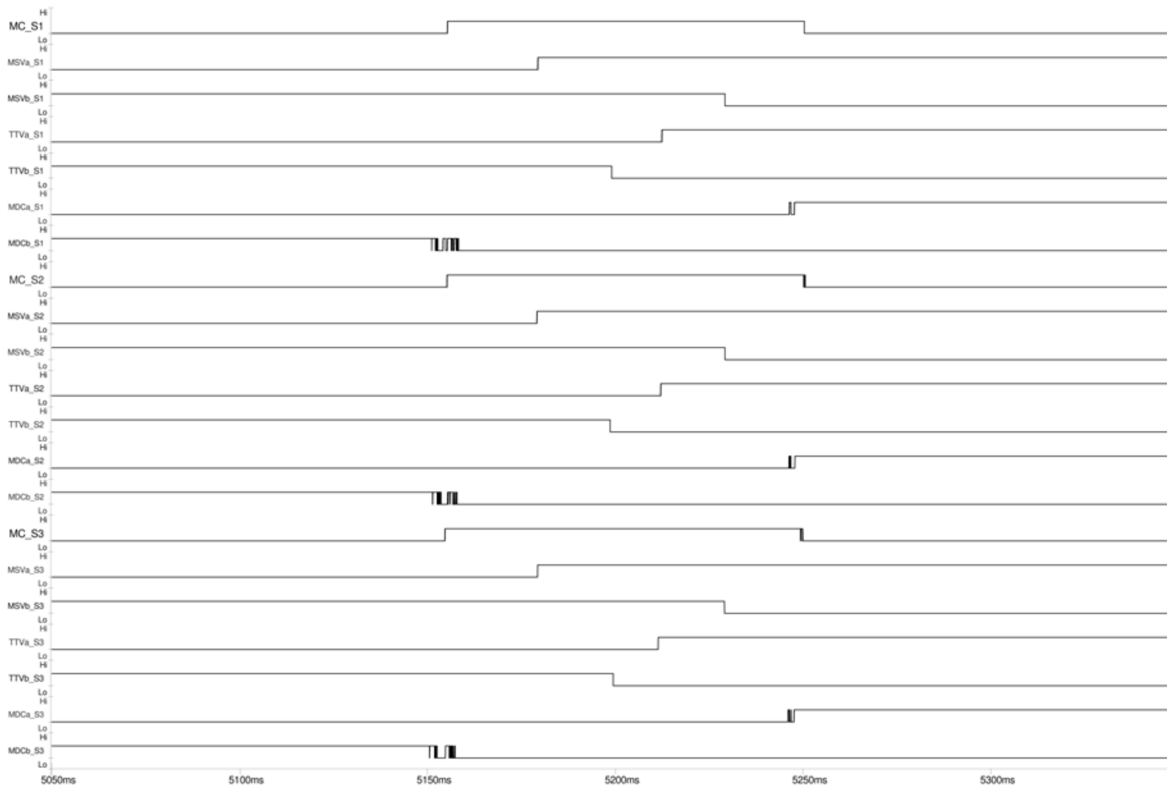


Fig. 9.10: Operation test under max. allowable static pressure with test sample 1 – Oscillogram no. 10.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1, S2, S3:	Sector 1, Sector 2, Sector 3		

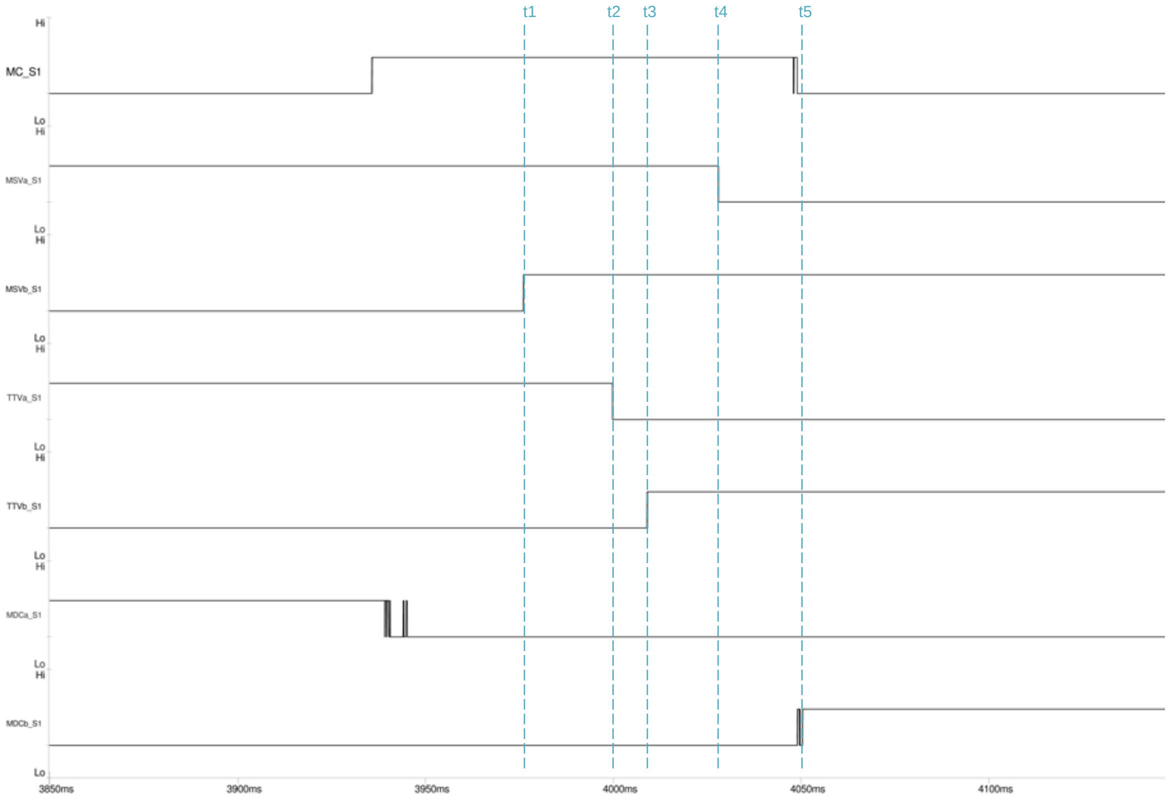


Fig. 10.1: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 1.

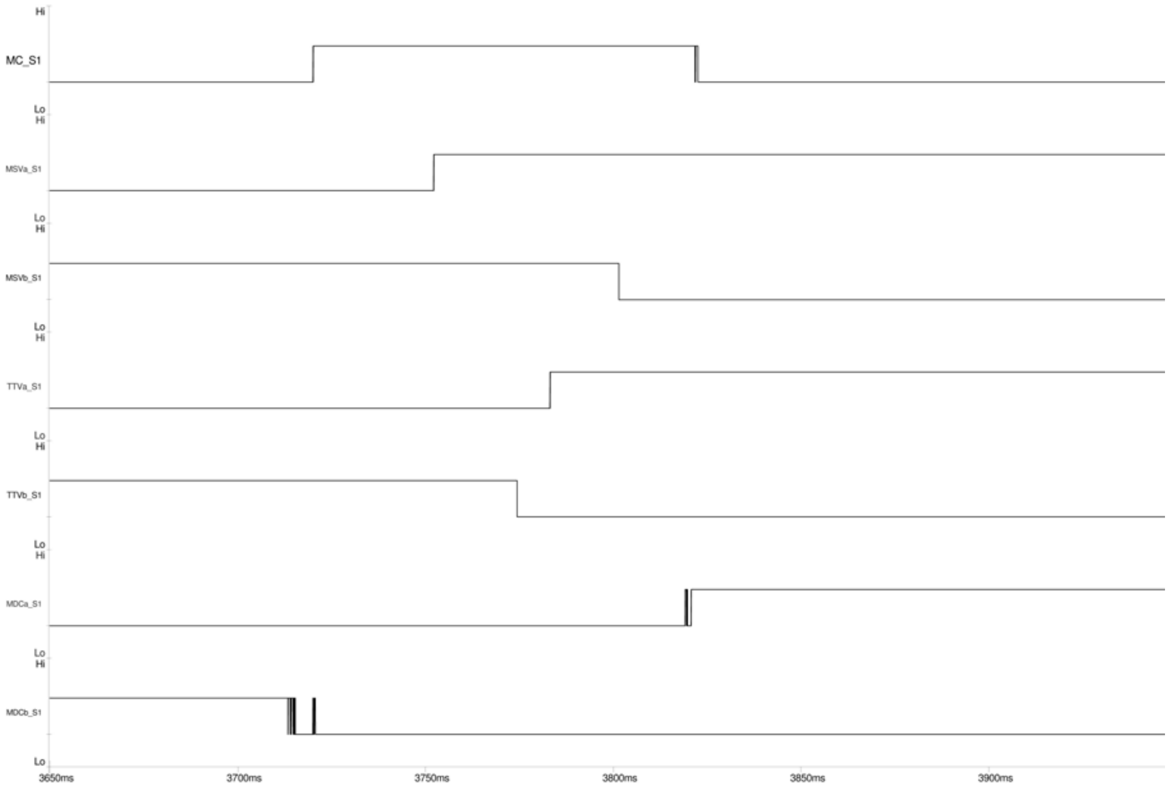


Fig. 10.2: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 2.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

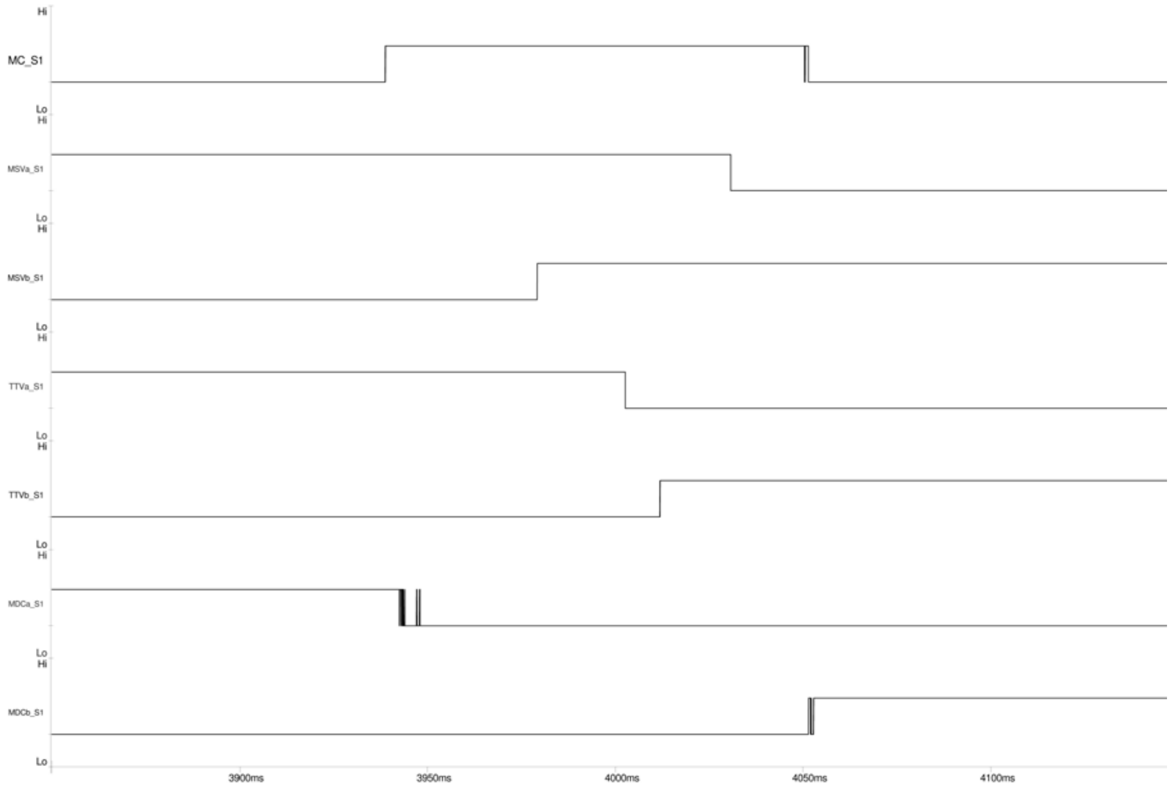


Fig. 10.3: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 3.

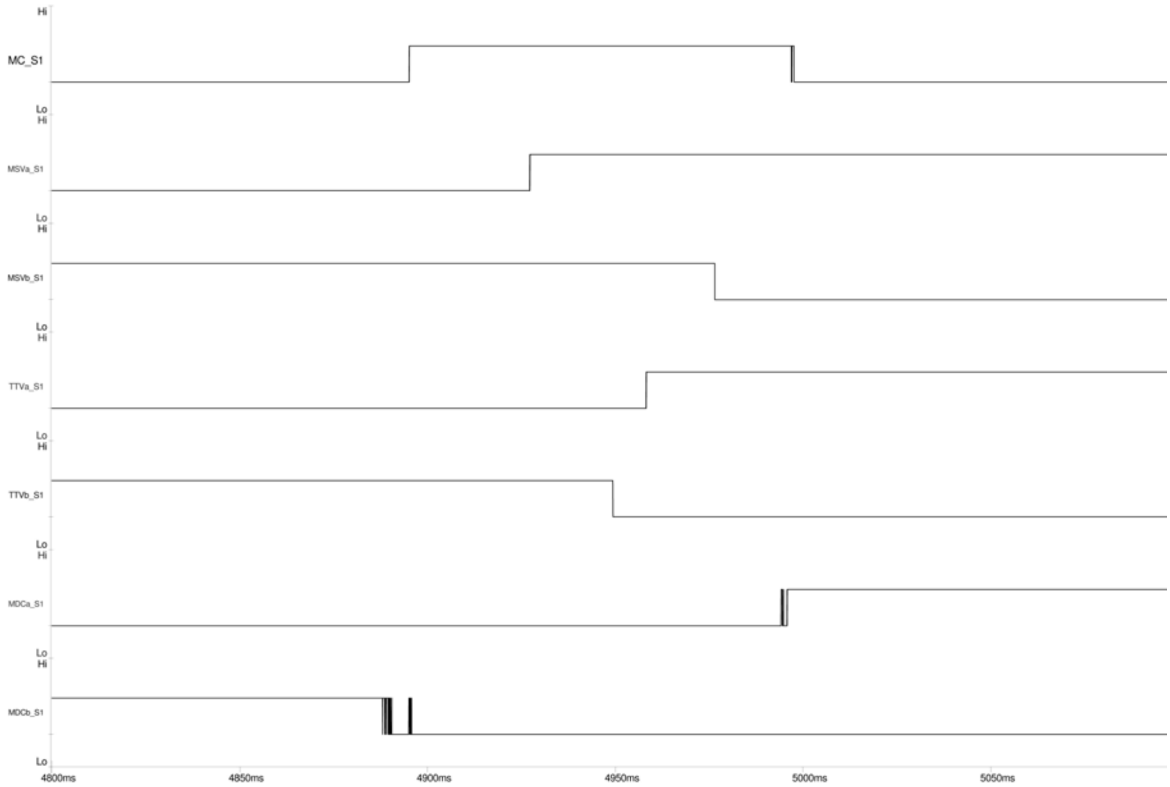


Fig. 10.4: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 4.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

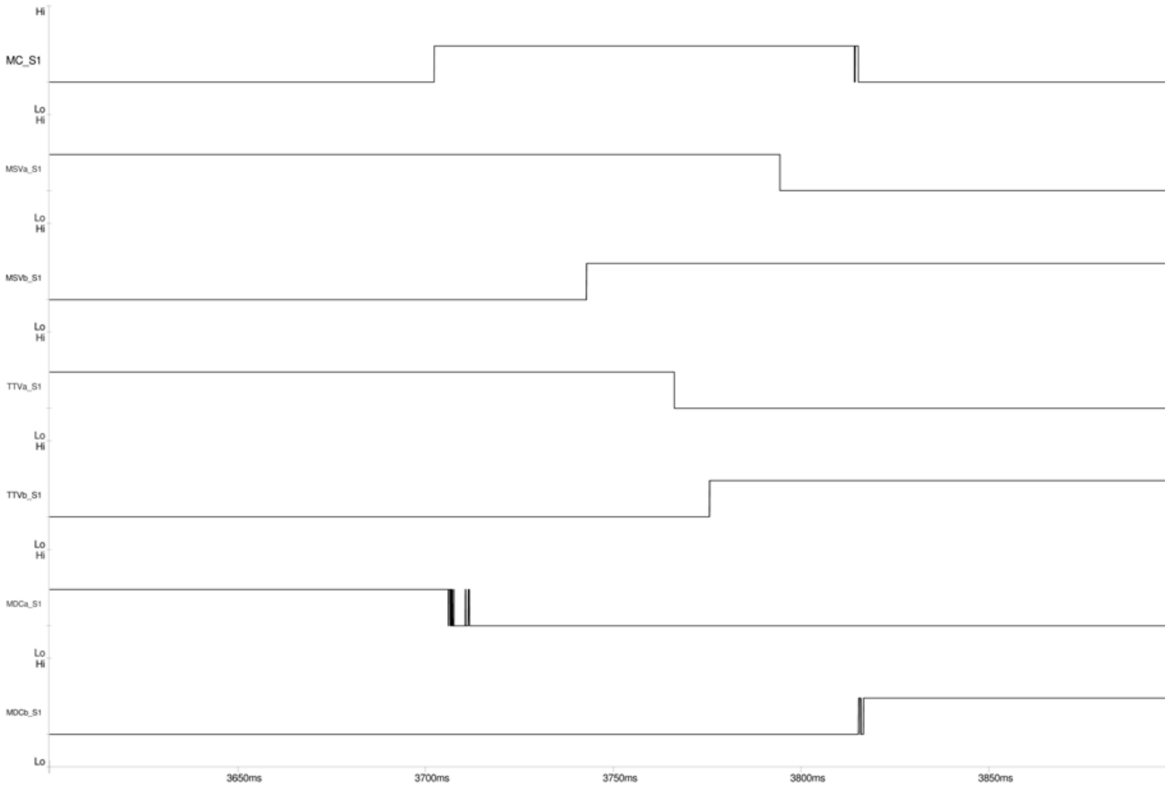


Fig. 10.5: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 5.

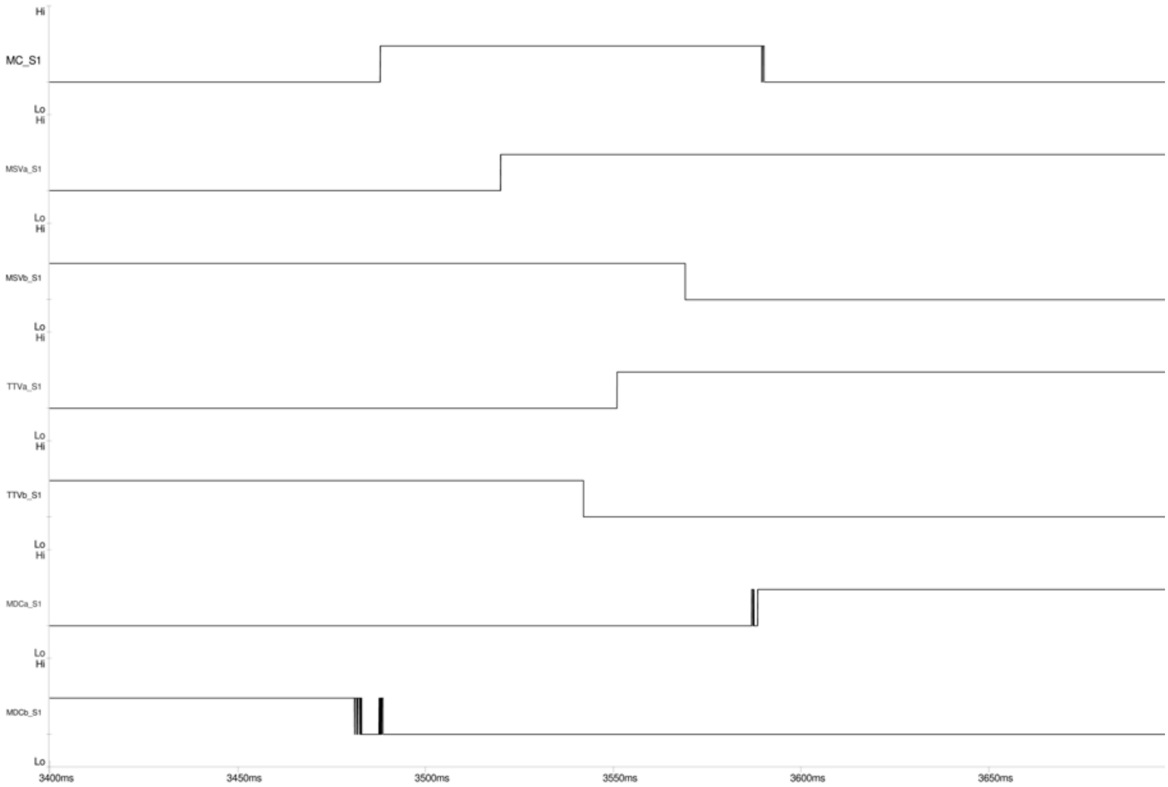


Fig. 10.6: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 6.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

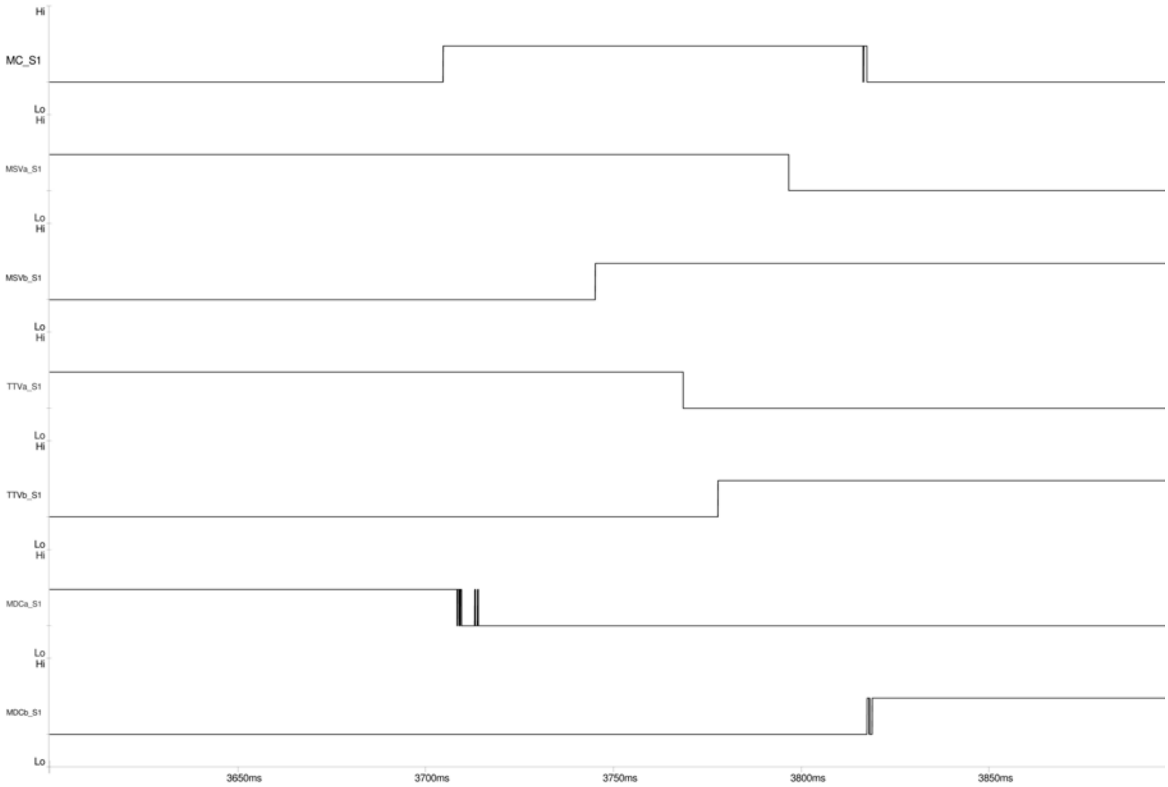


Fig. 10.7: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 7.

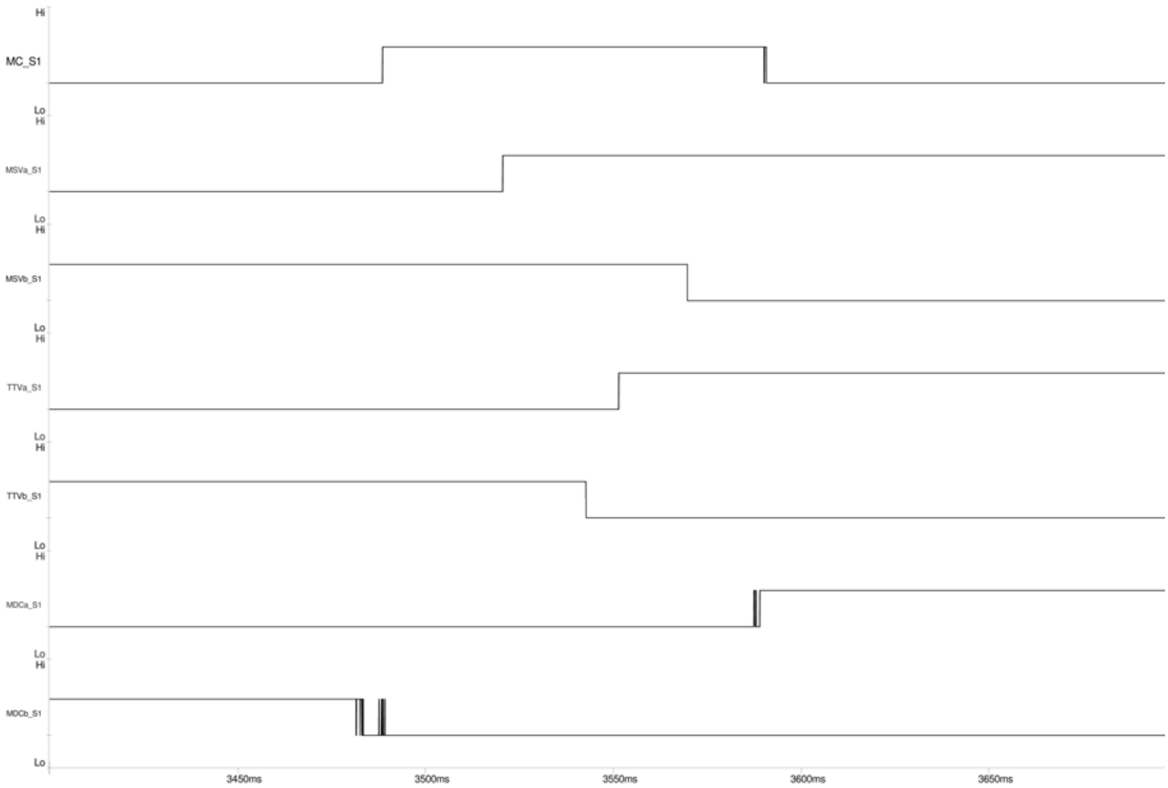


Fig. 10.8: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 8.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

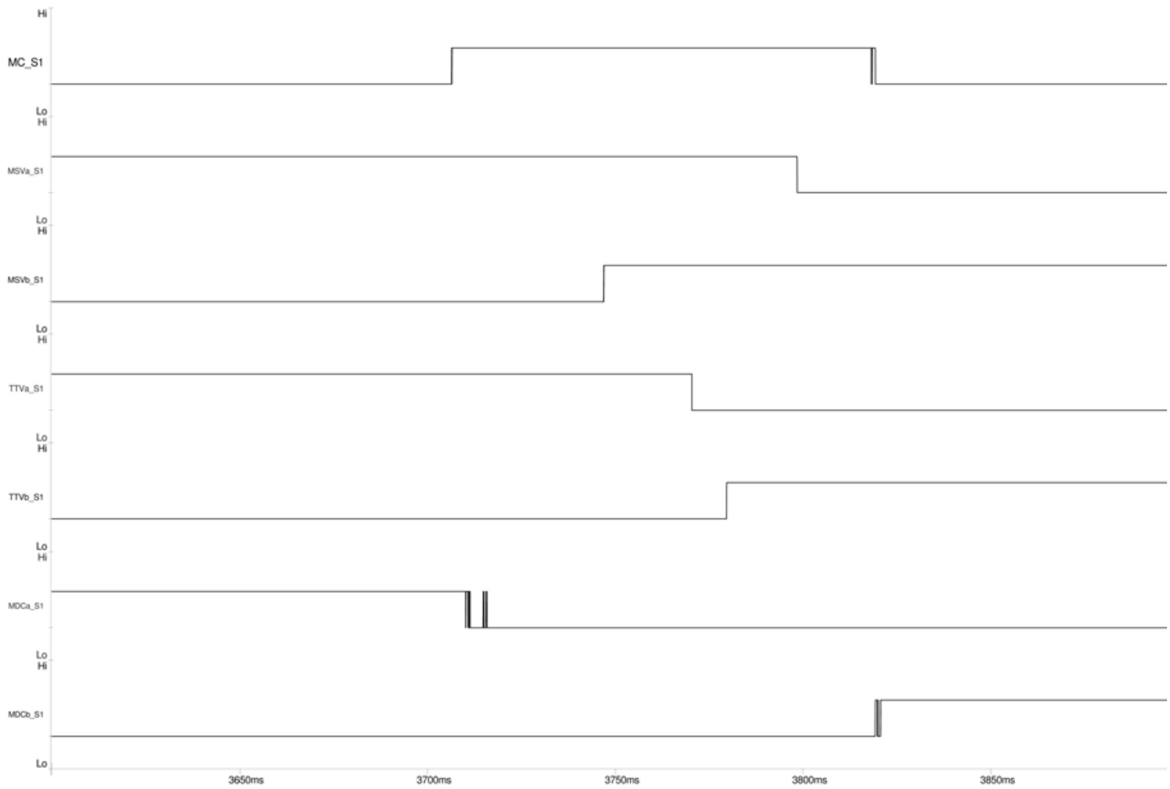


Fig. 10.9: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 9.

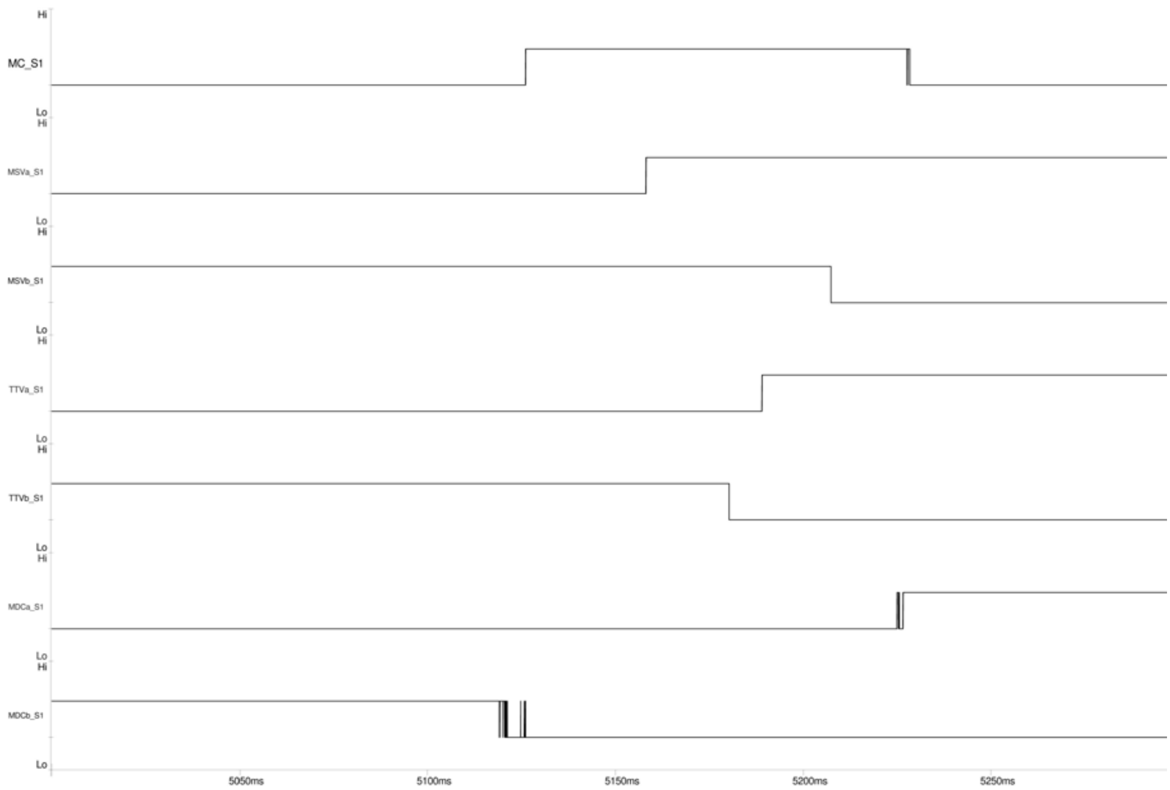


Fig. 10.10: Operation test under max. allowable static pressure with test sample 3 – Oscillogram no. 10.

MC:	Main contacts	MSVa, MSVb:	Main path, switching contacts
MDCa, MDCb:	Main path, disconnect switch	TTVa, TTVb:	Transition path, transition contacts
S1:	Sector 1		

Picture 1: Test setup for the mechanical endurance test (heatable test vessel).

Picture 2: Test setup in a climatic chamber for the operation tests at -25 °C and 115 °C and the operation test at maximum allowable static pressure.