

ON LOAD TAP CHANGERS

TYPE RSV 9.3



VOLTA P
E L P R O M

**ON LOAD TAP
CHANGERS
RSV 9.3
TECHNICAL DATA**

Elprom Heavy Industries

2023

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Notes:

- 1) This technical data catalog is intended to be used by transformer designers as well as other technical personnel responsible for maintenance, diagnostics and operation of OLTCs.
- 2) Elprom Heavy Industries reserves the right to make changes in the overall dimension drawings and connection diagrams without prior notice. Updated drawings are provided as part of the technical documentation received by the customer at the time of the product delivery; updated drawings can be provided also to potential customers on request.
- 3) The OLTC is manufactured according to the specific data in the order specification sheet filled in by the client.
- 4) Elprom Heavy Industries is not responsible for the client’s improper selection of an OLTC.

1. Basic characteristics

The Voltap OLTCs meet the requirements of the IEC 60214-1 standard.

1.1. Basic technical data

Table 1

OLTC type		RSV 9.3 III – 400	RSV 9.3 III – 550	RSV 9.3 III – 700	RSV 9.3* I – 400	RSV 9.3 I – 550	RSV 9.3 I – 700	RSV 9.3 I – 1200	RSV 9.3 I – 1500
Number of phases and application		3 – in the neutral			1 phase – at any point on the winding				
Maximum rated through current (A)		400	550	700	400	550	700	1200	1500
Short circuit withstand current (kA)	R.m.s. value (3 s duration)	6	8	10	6	8	10	15	15
	Peak value	15	20	25	15	20	25	37,5	37,5
Maximum rated step voltage per phase (V)		3500	3000	3200	3500	3000	3200	3000	2300
Rated step capacity (kVA)		1400	1650	2240	1400	1650	2240	3600	3450
Rated frequency (Hz)		50...60							
Insulation to earth	Highest voltage for equipment Um (kV,r.m.s.) ¹⁾	72.5	123	170	245	300			
	Rated separate source AC withstand voltage , 1min duration (kV, r.m.s.,)	140	230	325	460	460			
	Rated switching impulse withstand voltage (kV, 250/2500 μs)	–	–	–	850	850			
	Rated lighting impulse withstand voltage (kV, 1,2/50 μs)	350	550	750	1050	1050			
Number of operating positions		Without change-over selector – max. of 18 With change-over selector – max. of 35							
Tap selector		Five tap selector sizes (K, L, M, N, P) are available corresponding to the requirements of the voltage stress across the regulating winding. The tap selector insulation level can be chosen independently from the maximum operating voltage to earth. For the test voltages, see Section 1.4.							
Oil pressure in the diverter switch oil compartment		Operating oil pressure up to 0,3x10 ⁵ Pa (testing pressure – 0,6x10 ⁵ Pa). Vacuum-proof for drying.							
Siphon for draining the oil from the diverter switch oil compartment		Basic design – left or right							
Drying		In vacuum furnace – up to 110° C In kerosene vapour – up to 125° C							
OLTC type		RSV 9.3 III– 400/550/700				RSV 9.3 I–400/550/700			
Tap selector sizes		K	L	M	N	K	L	M	N
Weight in kg (approximately)		268	272	278	286	218	224	229	235
Displacement volume in dm ³ (approx.)	72,5 kV	168	173	178	188	148	153	158	163
	123 kV	178	183	188	198	158	163	168	173
	170 kV	-	193	198	208	-	183	188	193
	245 kV	-	-	213	223	-	-	208	213
	300 kV	-	-	-	-	-	-	223	228
Oil filling quantity of the diverter switch oil compartment Vs in dm ³ (approx.)		130	140	160	175	110	125	140	160
		185	165	185		130	140	160	175

1) In accordance with IEC 60214-1, chapter 3.60 highest effective value for phase-to-phase voltage in a three-phase system for which an on-load tap-changer is designed with respect to its insulation.

* Suitable for operation in natural esters - Envirotemp FR3 fluid

- Notes:**
1. Minimum volume of the conservator, considering the temperature oil expansion when the temperature changes from -30° C to +100° C: $\Delta V = 0,1V_s + 5$ (dm³).
 2. The RSV 9.3 OLTC can operate with a rated load at oil temperature from -25° C to +105° C.

ON LOAD TAP CHANGERS
TYPE RS 9.3 / RS 9

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1.2. Rated through current (I_u), rated step voltages (U_i), rated step capacity (P_{stN})

Table 2 shows the maximum values of I_u , the corresponding step voltage U_i and the rated step capacity P_{stN} .

Table 2: Maximum rated through current (I_{um}), rated step voltages (U_i), rated step capacity (P_{stN})

OLTC	RSV 9.3 – III			RSV 9.3 – I				
I_{um} (A)	400	550	700	400	550	700	1200	1500
U_i (V)	3500	3000	3200	3500	3000	3200	3000	2300
P_{stN} (kVA)	1400	1650	2240	1400	1650	2240	3600	3450

The rated through current I_u and its corresponding rated step voltage U_i are determined by the curve of the rated step capacity (Fig. 1).

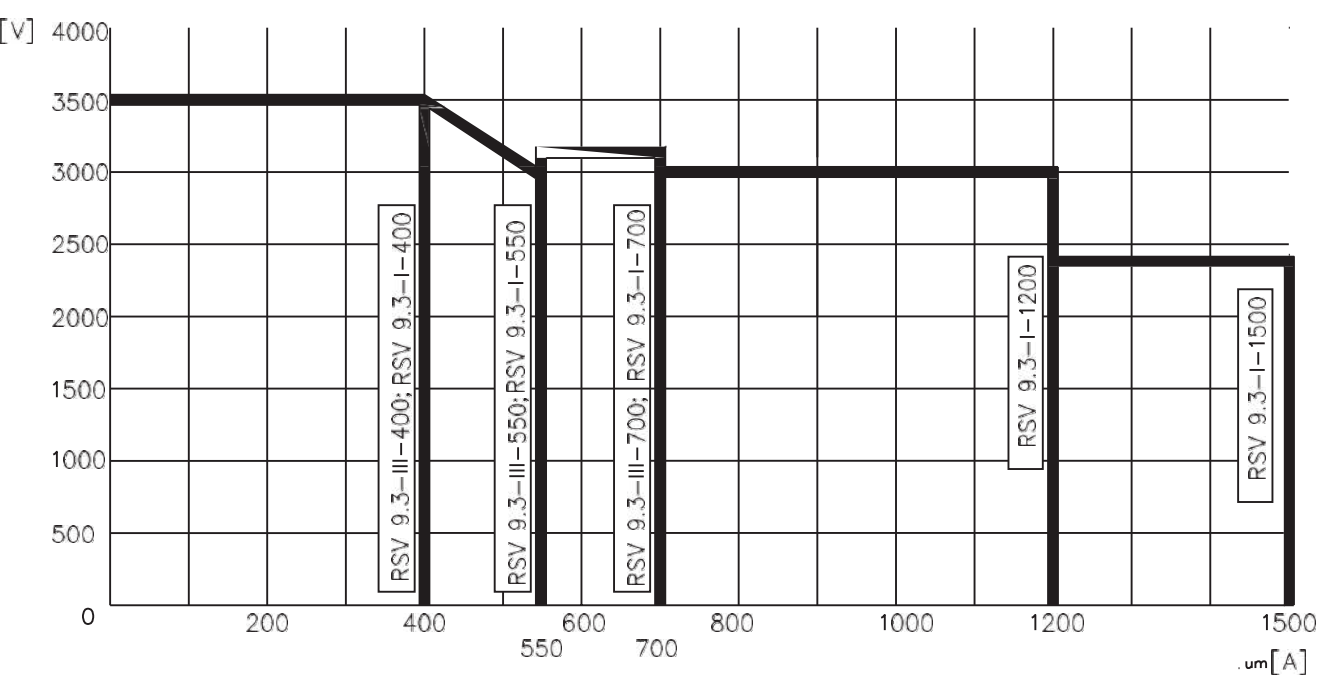


Fig. 1: Step capacities (rated through current I_u [A]; rated step voltages U_i [V])

In case of overexcitation of the transformer, the maximum step voltage can be increased with 10 % under the condition that the step capacity is limited to its rated value.

The specific commutation regimes are clarified in the technical data catalog for all Voltap OLTCs.

1. 3. Electrical and mechanical endurance

Table 3 gives the average values for the number of switching operations till inspection of the diverter switch and replacement of the vacuum interrupter. These values have been obtained as a result of experimenting with real loads under maximum rated through current I_{um} (A), rated step voltage U_i (V) and $\cos\phi = 1$.

Table 3: Electrical and mechanical endurance

OLTC	RSV 9.3 – III , RSV 9.3 – I			RSV9.3 – I	
	400 A	550 A	700 A	1200 A	1500 A
Number of switching operations till inspection	300 000	300 000	250 000	150 000	150 000
Number of switching operations till replacement of vacuum interrupters	600 000	500 000	500 000	500 000	300 000
Mechanical endurance – number of switching operations	1 200 000			800 000	800 000

Detailed information about the number of switching operations till inspection for the different tap changers is given in the RS 9.3/RSV 9.3 Installation and Operation Manual.

1.4. Insulation level

The insulation level of the OLTC is determined by a number of withstand voltage values.

The rated withstand voltage values to earth are given in Table 1. These voltages are determined by national and international standards.

The internal insulation is dimensioned depending on the voltages defined by the transformer winding taps to the different parts of the selector, change-over selector and the diverter switch.

Fig. 2 and 3 show the main connection diagrams and the typical insulation distances to them.

The withstand voltage values from the different insulation distances are given in Table 4. For a correct OLTC selection, these voltage values should correspond to the voltage values that occur during the lightning impulse test, the induced voltage test and the power frequency voltage test of the transformer. The least favorable position of the OLTC should be taken into account.

The insulation to earth and the tap selector insulation size are not mutually connected and can be selected in accordance with the specific requirements.

ON LOAD TAP CHANGERS
TYPE RSV 9.3

EA 751/15 ENG

RSV 9.3 - III - 400/550/700 OLTCs

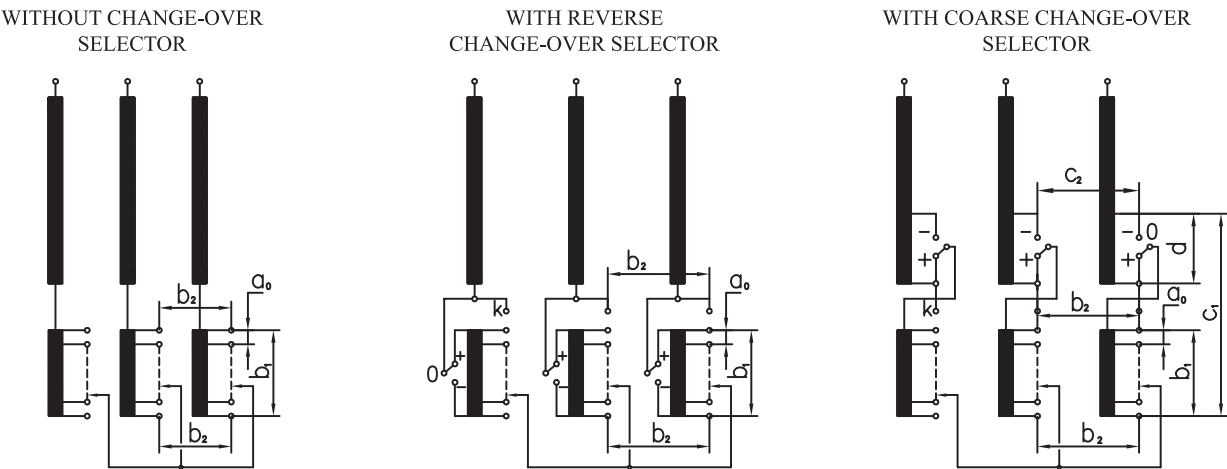


Fig. 2: Insulation distances of the transformer windings

RSV 9.3 - I - 400/550/700/1200/1500 OLTCs

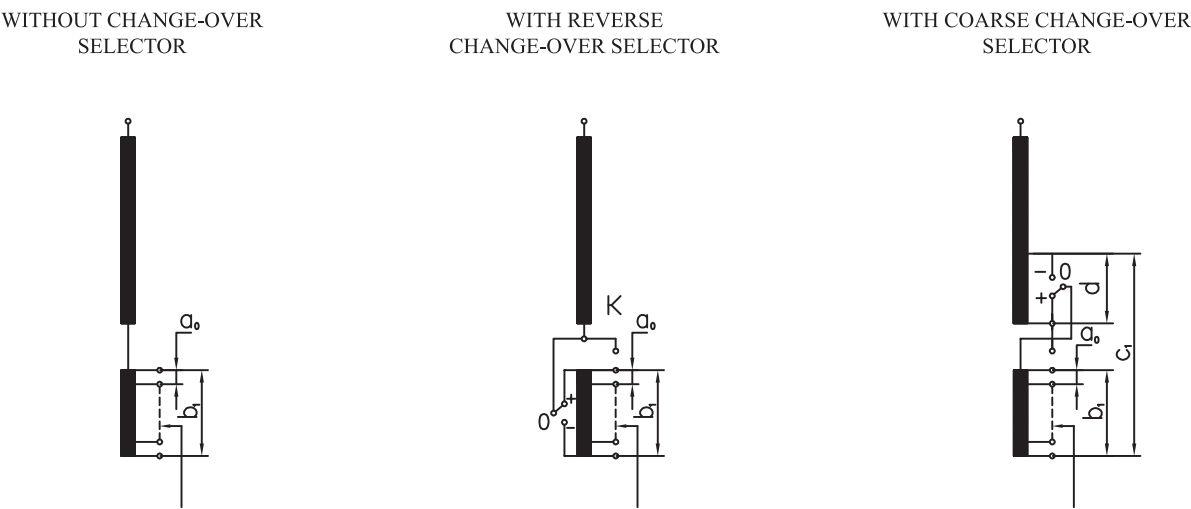


Fig. 3: Insulation distances of the transformer windings

Table 4: Rated withstand voltages

Insulation distances	Rated withstand voltages (kV)									
	Tap selector size – K		Tap selector size – L		Tap selector size – M		Tap selector size – N		Tap selector size – P	
	1,2/50 μ s	50 Hz 1min	1,2/50 μ s	50 Hz 1min	1,2/50 μ s	50 Hz 1min	1,2/50 μ s	50 Hz 1min	1,2/50 μ s	50 Hz 1min
a ₀	100	25	120	35	130	40	130	40	140	40
b ₁	230	55	290	80	340	100	410	120	490	140
b ₂	230	55	290	80	340	100	410	120	490	140
c ₁	290	65	390	120	450	130	520	150	-	-
c ₂	290	65	390	120	450	130	520	150	-	-
d	290	80	290	80	410	120	410	120	490	140

2. Review of the RSV 9.3 types
2.1. Main dimensions¹⁾

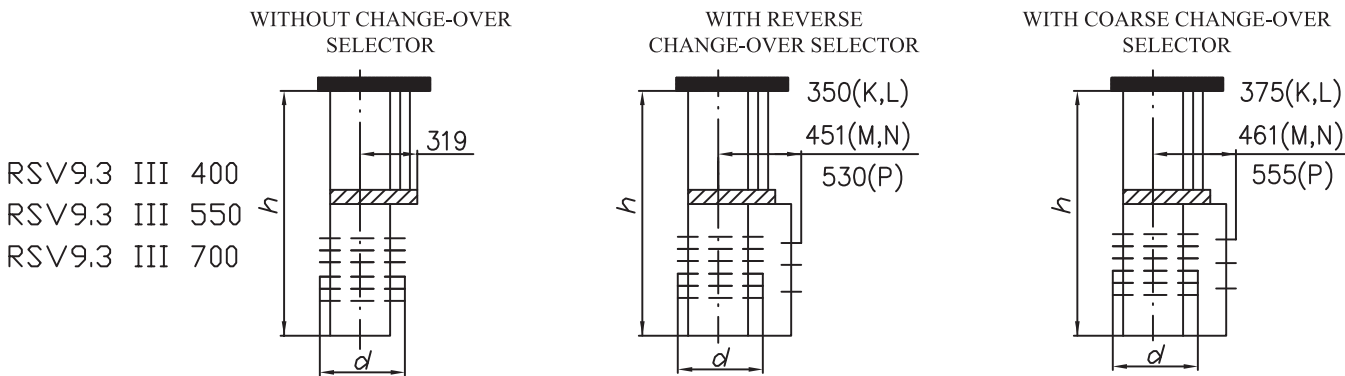


Fig. 4: RSV 9.3 – III

Table 5: RSV 9.3 – III

Um	Insulation level of the selector									
	K		L		M		N		P	
	h	d	h	d	h	d	h	d	h	d
72.5 kV	1741	386	1896	386	2011	480	2201	480	2514	558
123 kV	1791	386	1946	386	2061	480	2251	480	2564	558
170 kV	-	-	2102	386	2217	480	2407	480	2720	558
245 kV	-	-	-	-	2317	480	2507	480	2820	558

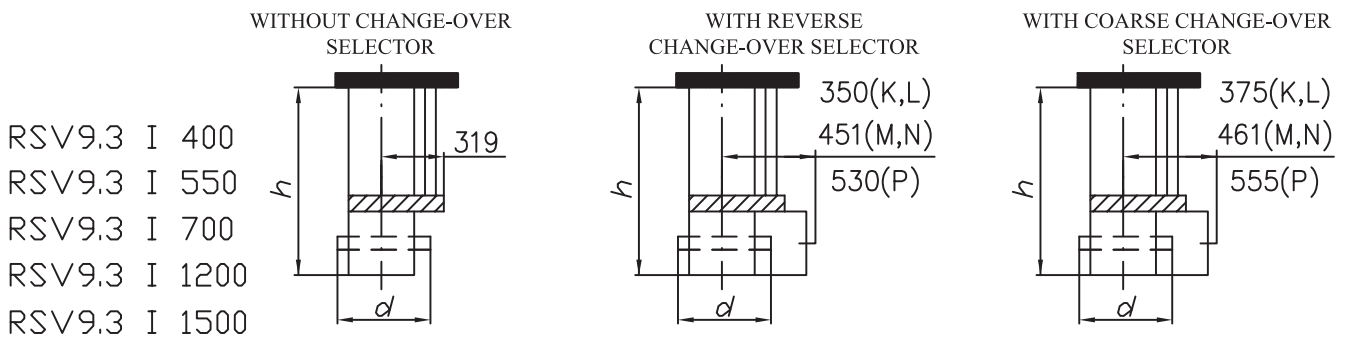


Fig.5: RSV 9.3 – I

Table 6: RSV 9.3 – I

Um	Insulation level of the selector									
	K		L		M		N		P	
	h	d	h	d	h	d	h	d	h	d
72.5 kV	1202	386	1297	386	1352	480	1462	480	1695	558
123 kV	1401	386	1496	386	1551	480	1661	480	1894	558
170 kV	-	-	1596	386	1651	480	1761	480	1994	558
245	-	-	-	-	1751	480	1861	480	2094	558

1) For the rest of the dimensions see appendices

ON LOAD TAP CHANGERS
TYPE RS 9.3 / RS 9

EA 751/15 ENG

2.2 Number of steps and basic connection diagrams

Fig. 6, 6a and 6b show the basic connection diagrams where the selector contacts are designated according to the overall dimension drawings.

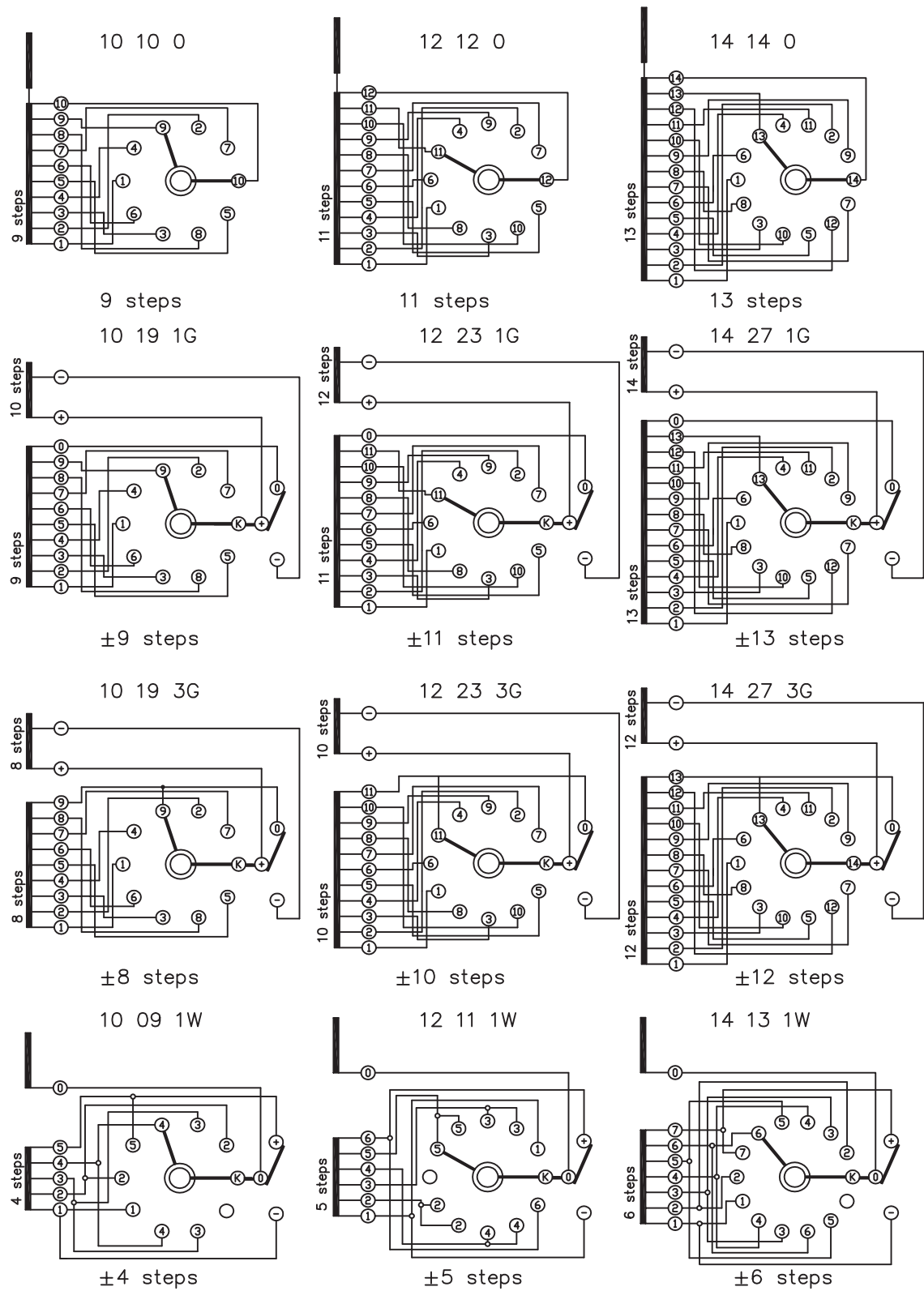


Fig. 6: Basic connection diagrams

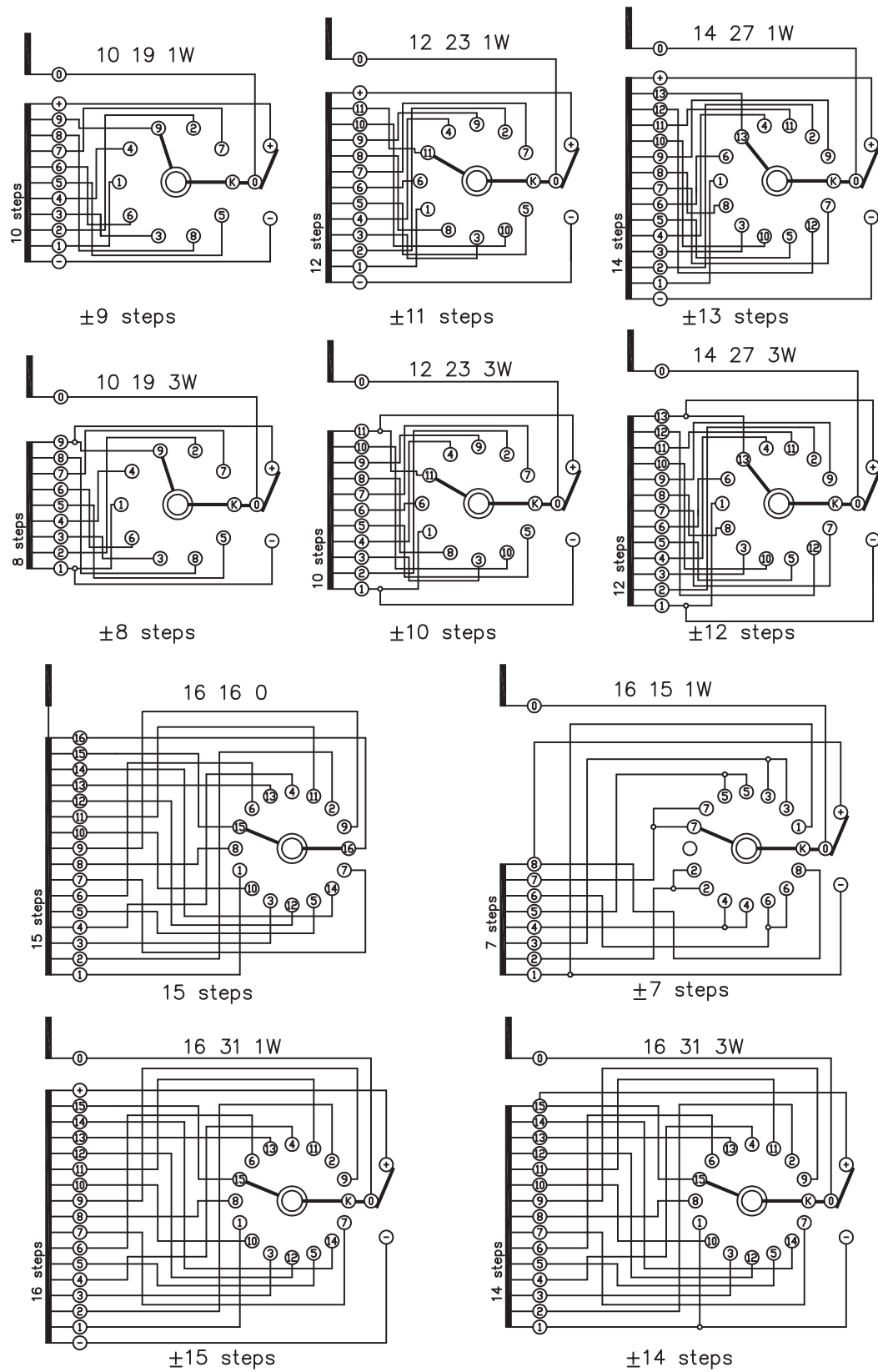


Fig. 6a: Basic connection diagrams

ON LOAD TAP CHANGERS
TYPE RS 9.3 / RS 9

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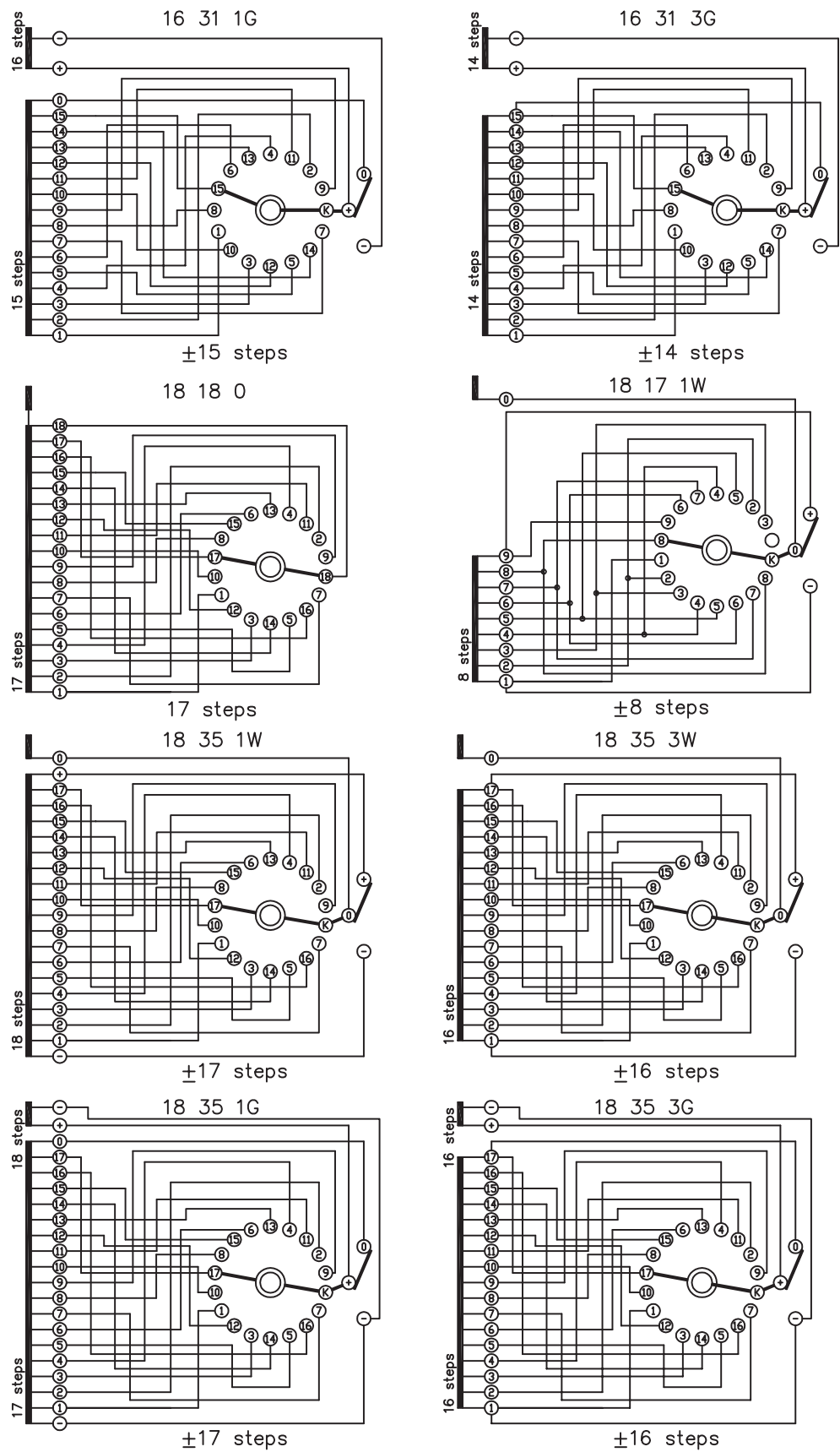


Fig. 6b: Basic connection diagrams

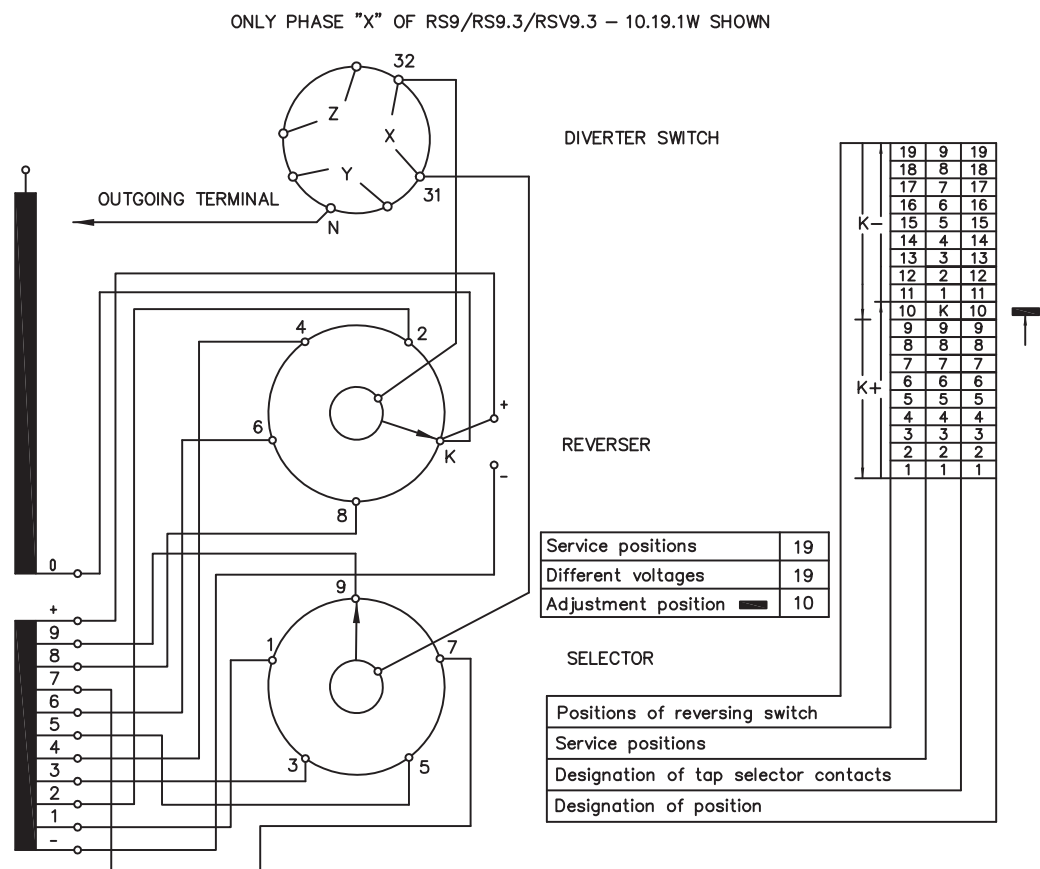


Fig. 7: Basic connection diagram 10 19 1W

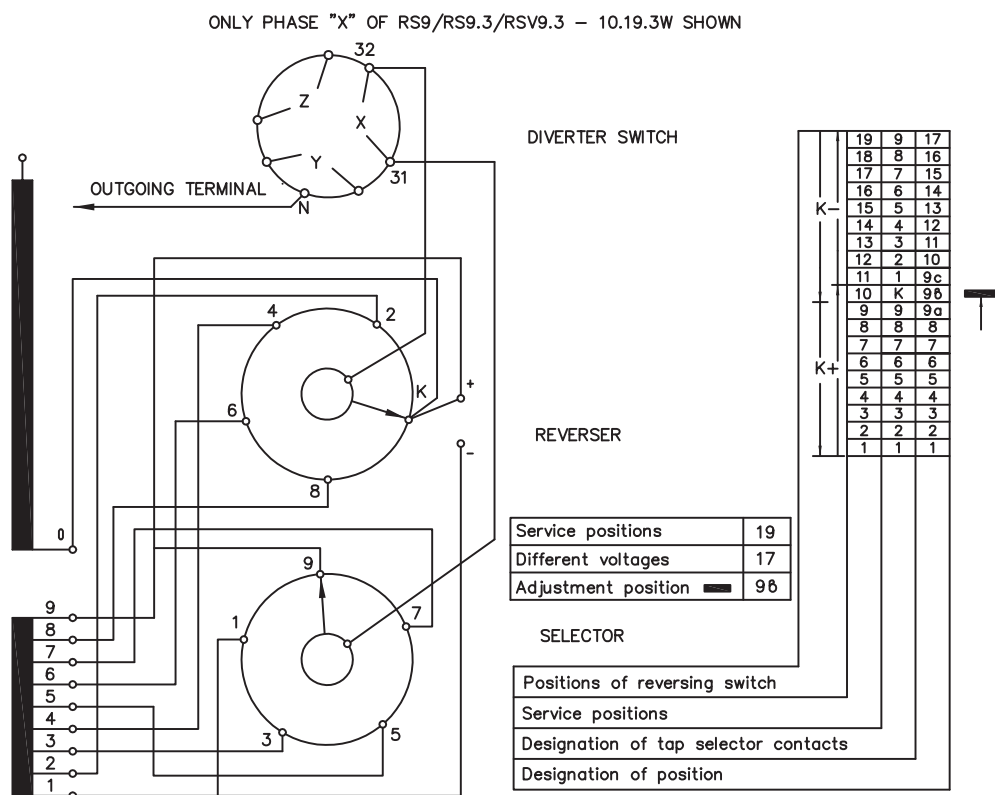


Fig. 8: Basic connection diagram 10 19 3W

ON LOAD TAP CHANGERS
TYPE RS 9.3 / RS 9

EA 751/15 ENG

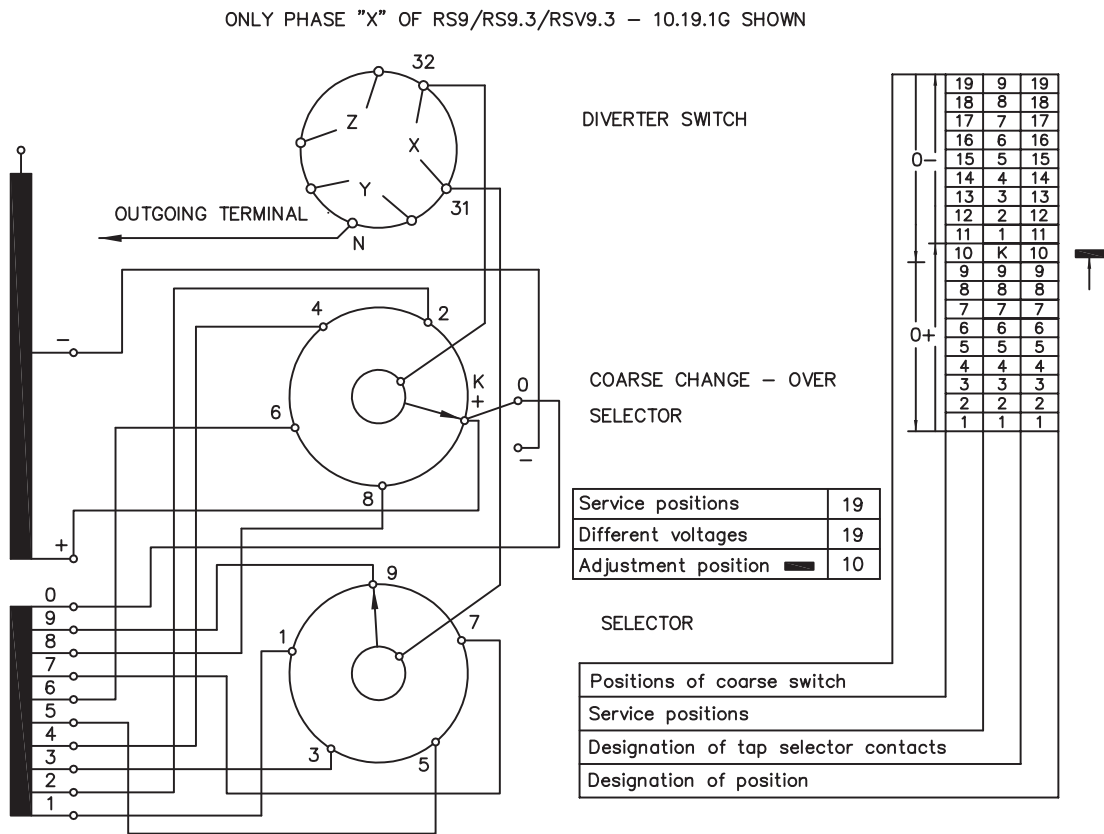


Fig. 9: Basic connection diagram 10 19 1G

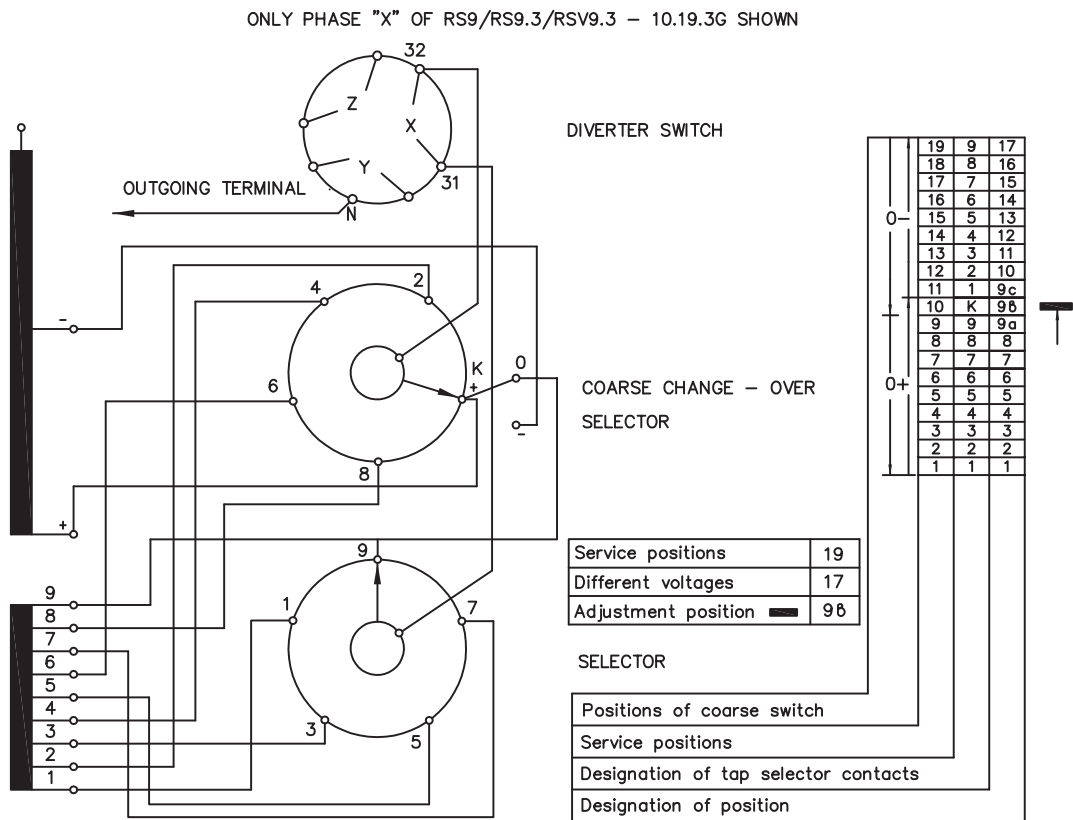


Fig. 10: Basic connection diagram 10 19 3G

3. Appendices

3.1. Overall dimension drawings of OLTCs

RSV 9.3 – III – 400/550/700	№1075
RSV 9.3 – III – 400/550/700-P	№1078
RSV 9.3 – I – 400/550/700	№1074
RSV 9.3 – I – 400/550/700-P	№1079
RSV 9.3 – II – 400/550/700	№1076
RSV 9.3 – I – 1200	№1077
RSV 9.3 – I – 1200 245/P-10.19.3 W	№1080
RSV 9.3 – I – 1500	№1084
OLTCs with pressure relief device and tie-in resistors	№310Q
OLTCs RS 9.3 /RSV 9.3 flange's configuration	№999

3.2. Additional drawings of OLTCs

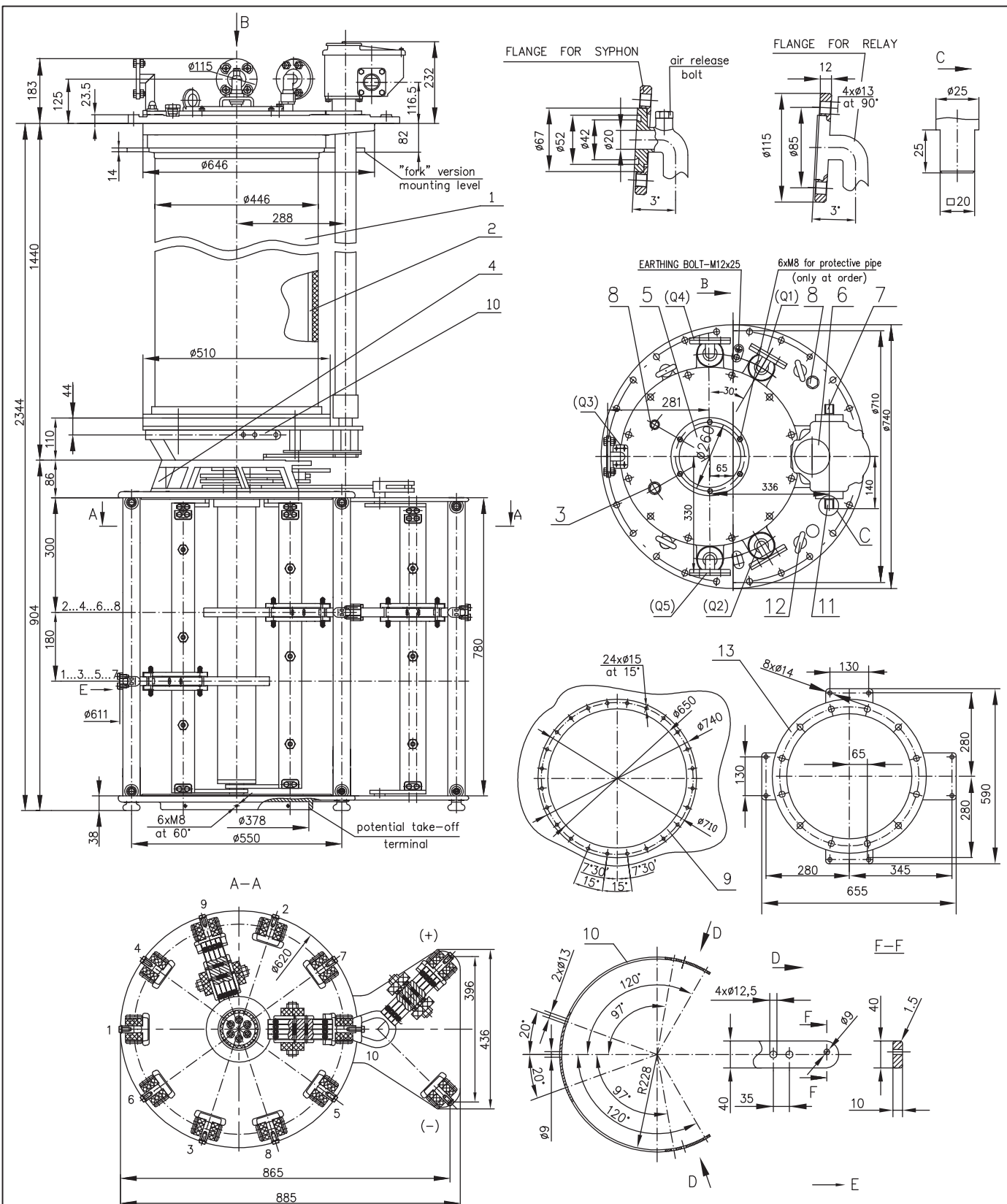
RS 9.3/RSV 9.3 – III – 10, 12, 14 – arrangement of the selector contacts	№374
RS 9.3/RSV 9.3 – III – 16, 18 – arrangement of the selector contacts	№375
RS 9.3/RSV 9.3 – I – 10, 12, 14 – arrangement of the selector contacts	№376
RS 9.3/RSV 9.3 – I – 16, 18 – arrangement of the selector contacts	№377

3.3. OLTC type RS 9.3 – driving shafts arrangement	№209.3
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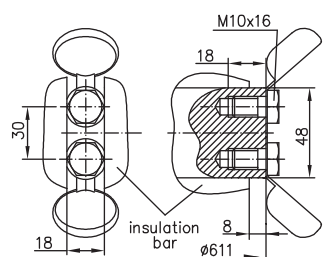






1. Diverter switch oil vessel
2. Diverter switch
3. Opening for temperature sensor
4. Selector with reverser
5. Protective membrane
6. Position indicator
7. Incoming shaft at right side driving
8. Bleeding of the OLTC
9. Disposal of the openings for fixing to the transformer tank
10. Current take-off terminal
11. Incoming shaft at left side driving

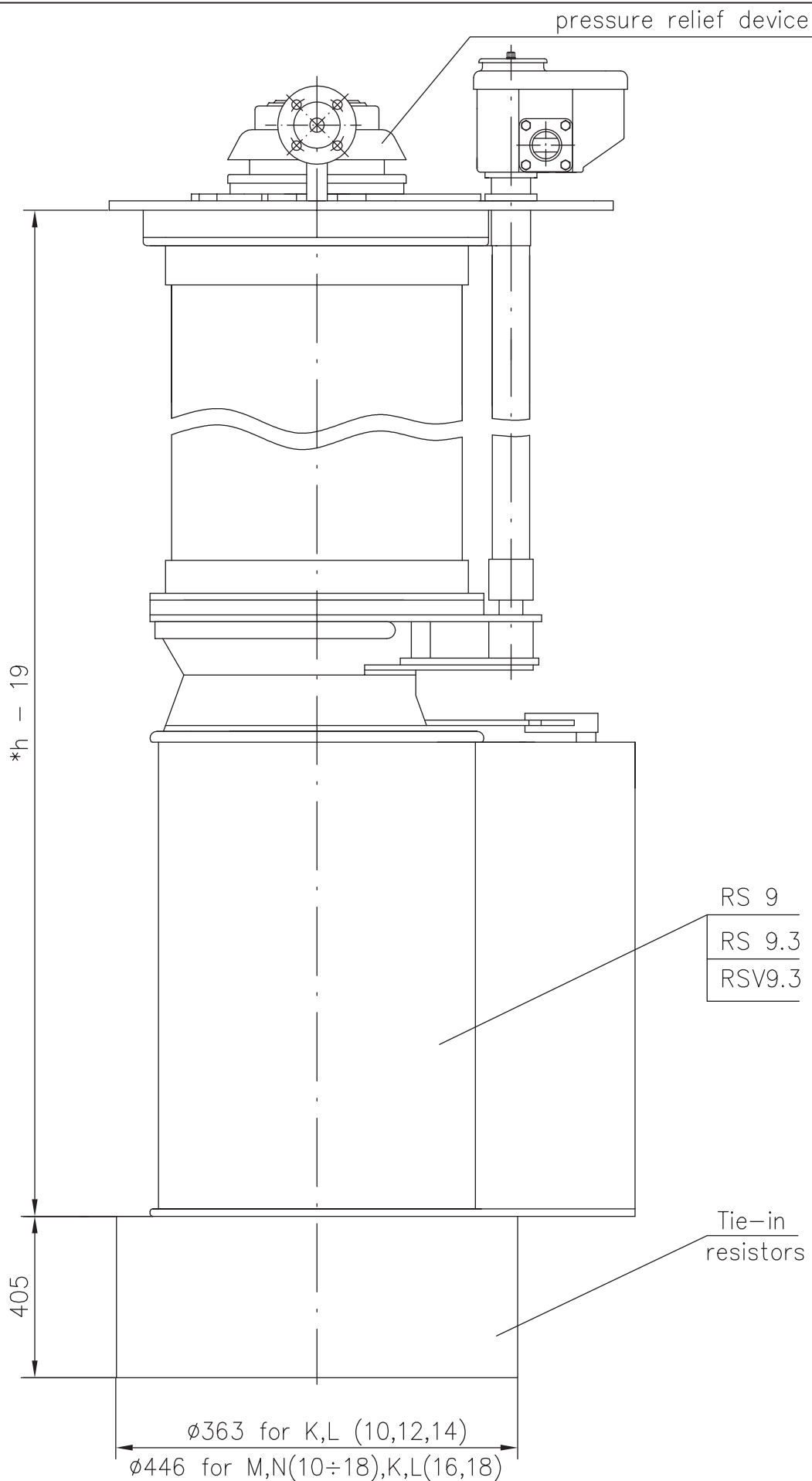
12. Lifting hook 4x35 mm
 13. Disposal of the openings for "fork" mounting
- NOTE: Additional information about Q1,Q2,Q3,Q4,Q5: dwg. N°999



VOLTA P
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ON LOAD TAP CHANGER
RSV 9.3 - I - 1200-245/P-10.19.3 W

№ 1080
2023



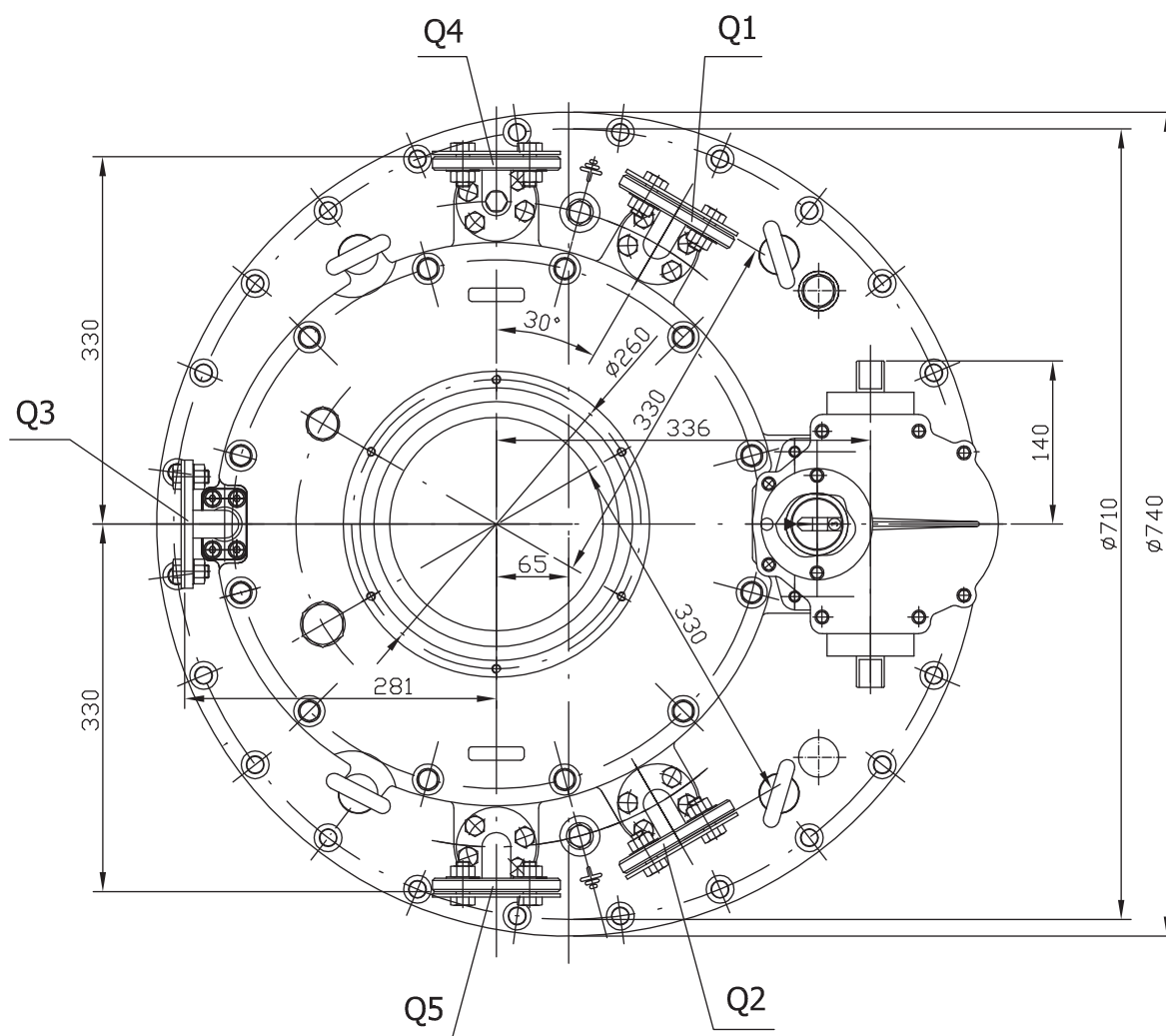
*h - See Drawings in the RS9/RS9.3/RSV9.3 Technical Data Catalogs

VOLTA P
E L P R O M

**ON LOAD TAP CHANGER RS 9/RS 9.3/RSV 9.3
WITH PRESSURE RELIEF DEVICE
AND TIE-IN RESISTORS**

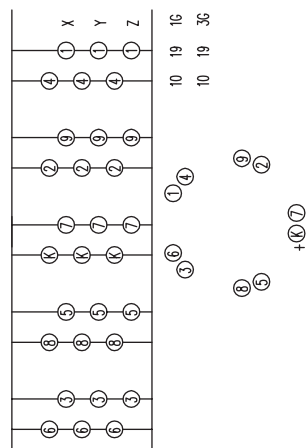
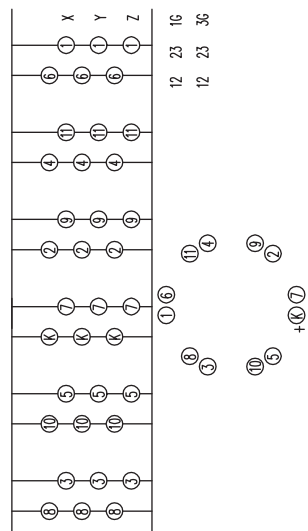
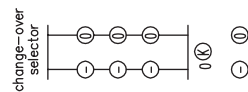
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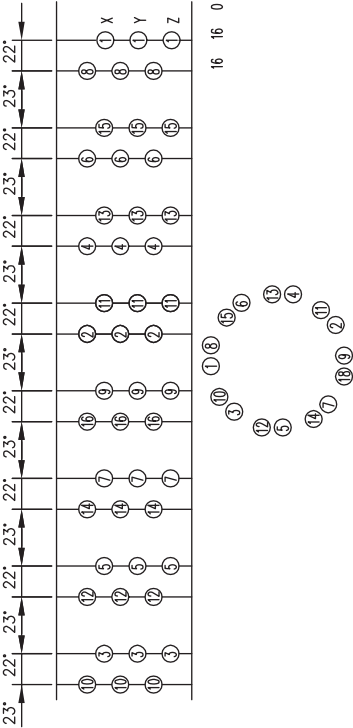
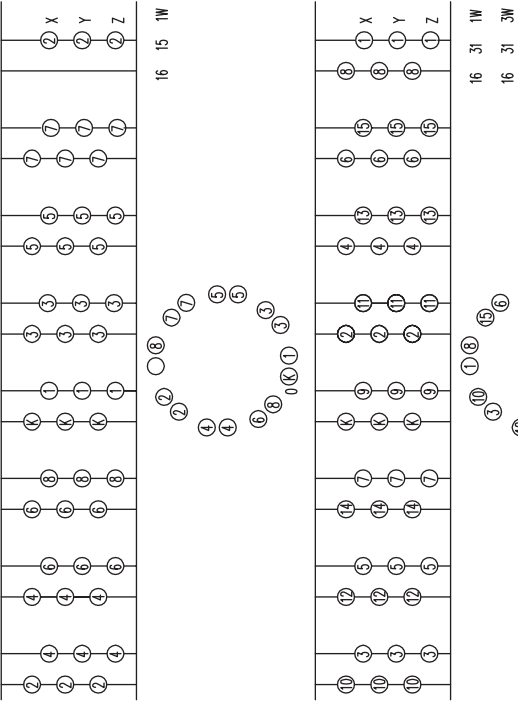
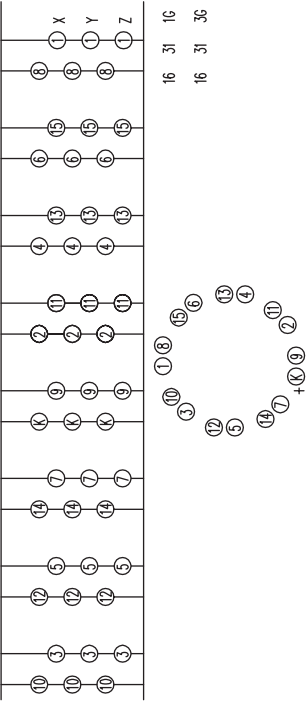
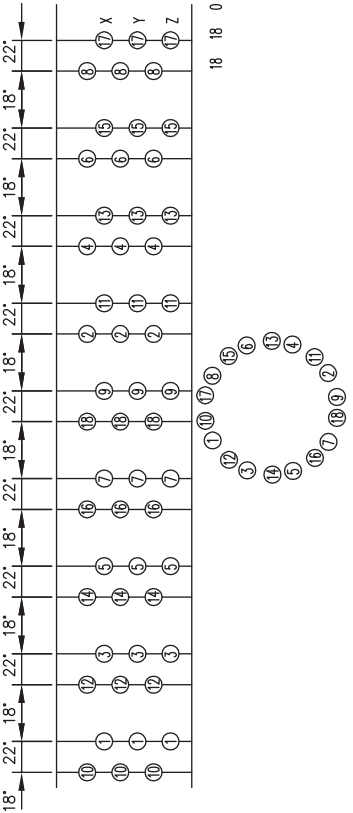
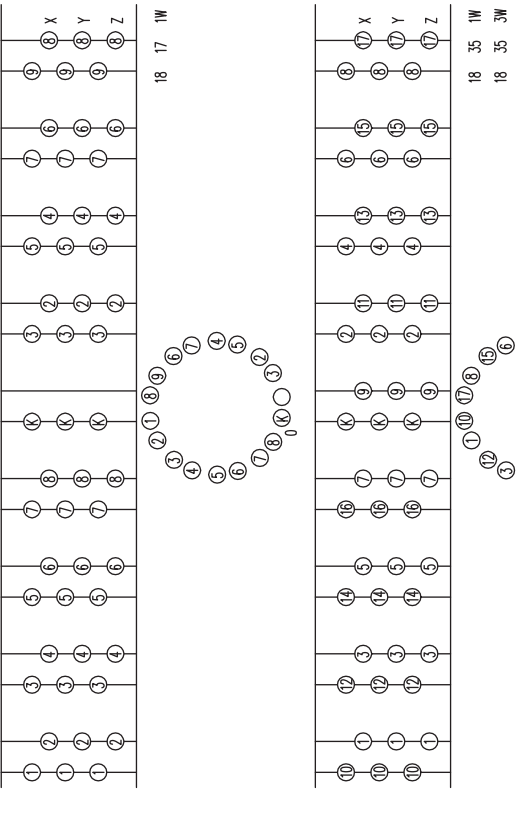
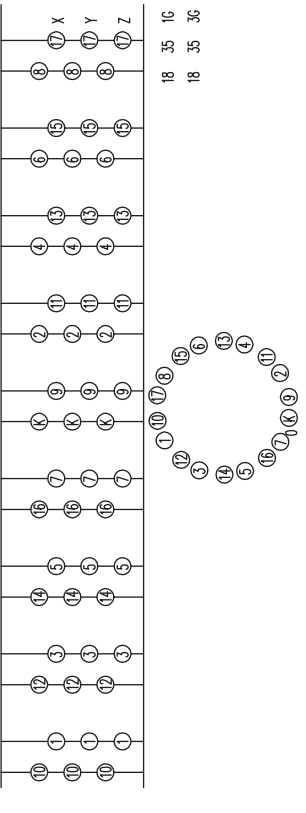
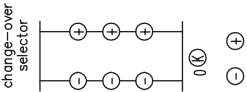
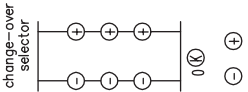
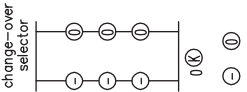
2023



Q1, Q2 - FLANGE FOR A PROTECTIVE RELAY OR AN OIL FILTER (ROTATING)
 Q3 - FLANGE FOR A PROTECTIVE RELAY OR AN OIL FILTER (NON-ROTATING)
 Q4, Q5 - FLANGE FOR A SIPHON OR PROTECTIVE RELAY.

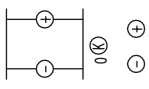
NOTE: IN THE ORDER SPECIFICATION SHEET, PLEASE FILL IN
 THE DESIGNATION SYMBOLS OF THE CONNECTING FLANGES (Q1,Q2,Q3,Q4,Q5)
 WHICH YOU HAVE SELECTED FOR YOUR ORDER.



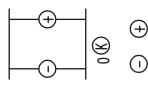
 E L P R O M	OLTC RS 9.3/RS 9 – III – 16, 18 ARRANGEMENT OF TAP SELECTOR TERMINALS	№ 375 2023
		
		
change-over selector 	change-over selector 	change-over selector 

22° 50' 22° 50'</

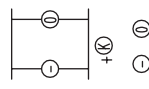
change-over
selector



change-over
selector

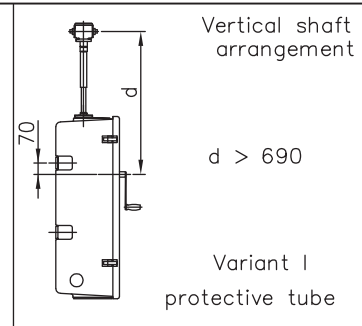
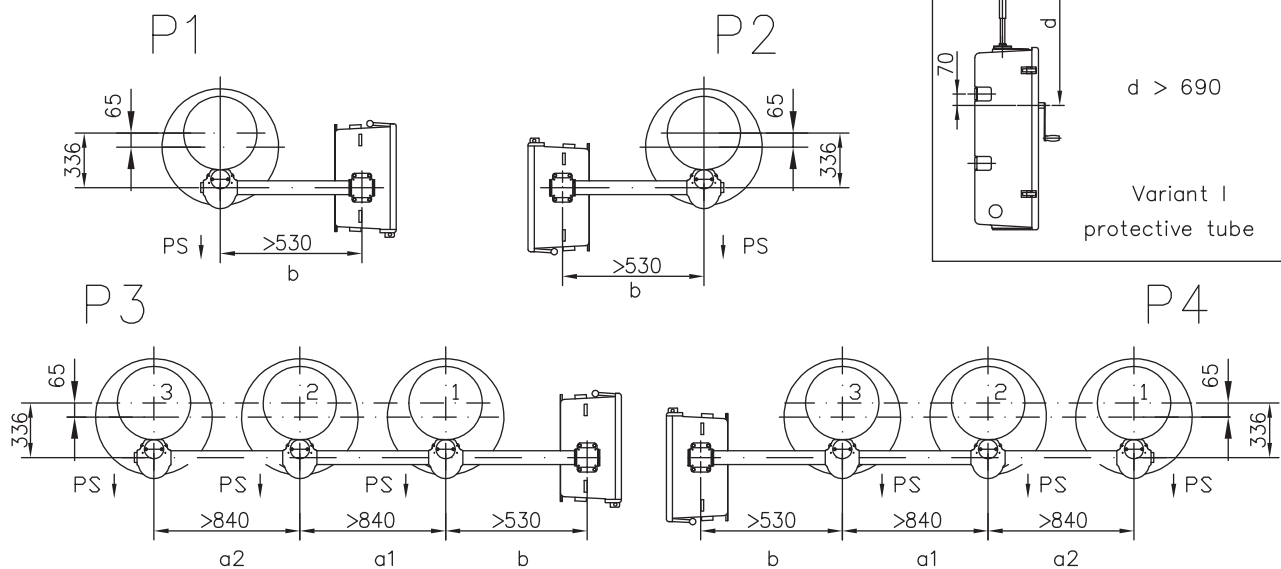


change-over
selector

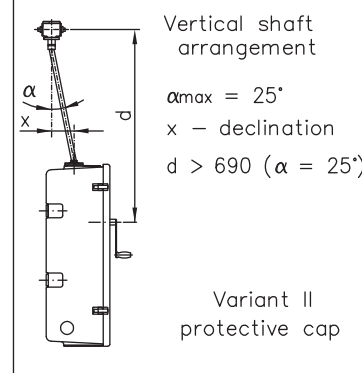
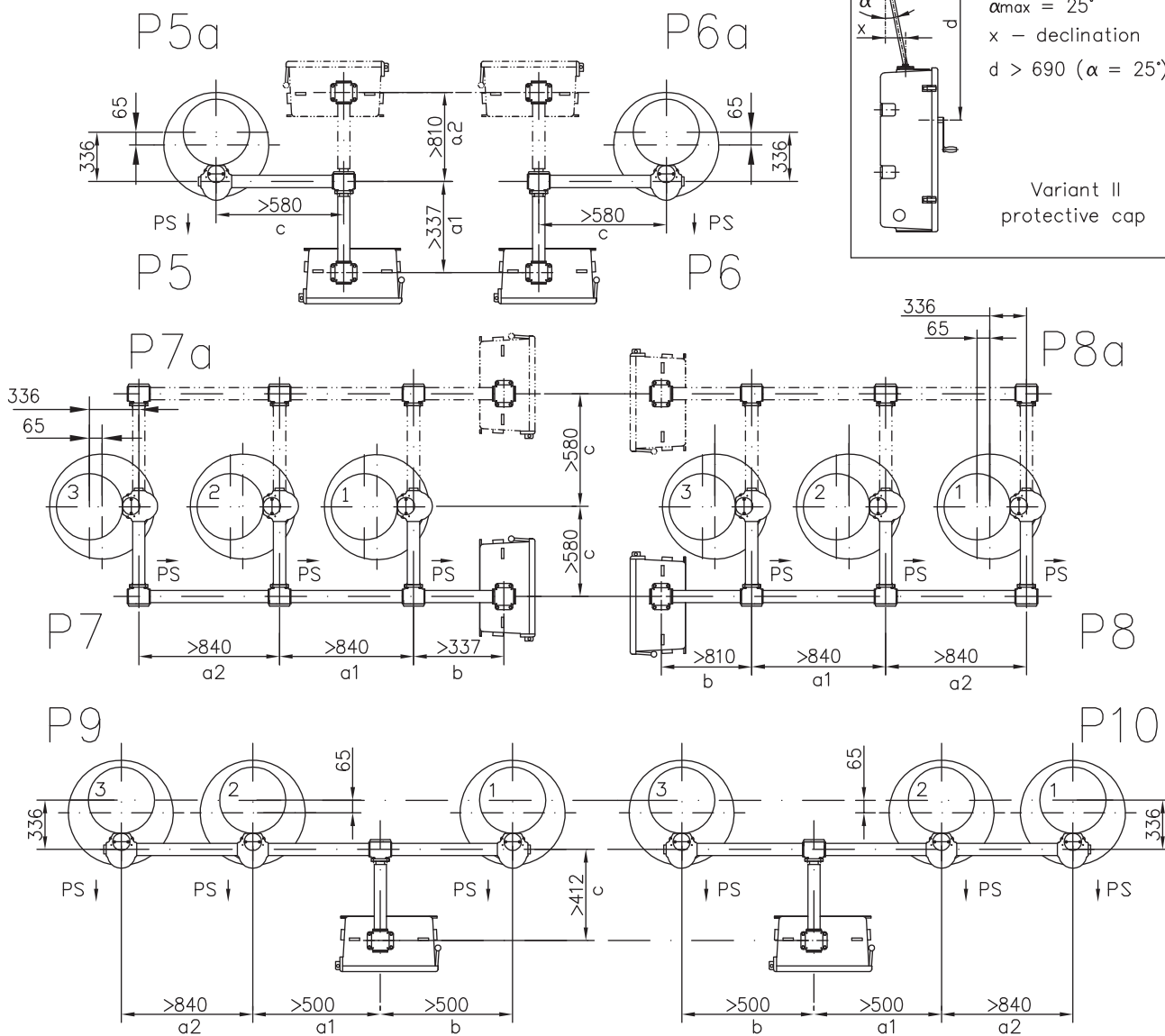


E L P R O M	OLTC RS 9.3/RS 9 – I – 16, 18 ARRANGEMENT OF TAP SELECTOR TERMINALS	№ 377 2023
16 16 0	16 15 1W	16 31 16
18 18 0	18 17 1W	18 35 16
change-over selector	change-over selector	change-over selector

STANDARD DESIGN



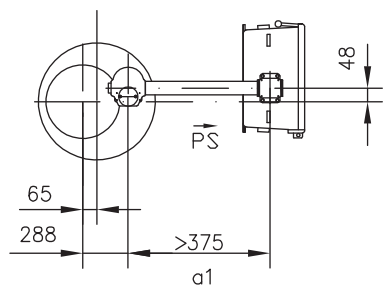
SPECIAL DESIGN



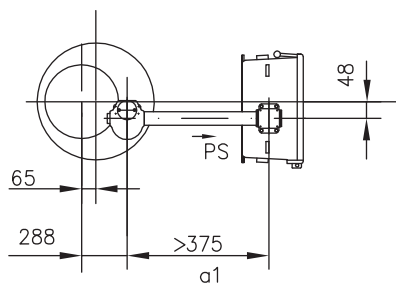
see notes on N*209.3 sheet 2

SPECIAL DESIGN

P11



P12



CALCULATION (FORMULAS)

Arrangement Lenght	P1	P2	P3	P4	P5	P5a	P6	P6a
La1	—	—	a1–345		a1–280	—	a1–280	—
La2	—	—	a2–345		—	a2–280	—	a2–280
Lb	b–315				—	—	—	—
Lc	—	—	—	—	c–386			
Ld	$\frac{d-582}{\cos\alpha}$; (a _{max} =25 °)							

Arrangement Lenght	P7	P7a	P8	P8a	P9	P10	P11	P12
La1	a1–280				a1–315			
La2	a2–280				a2–345	—	—	—
Lb	b–280				b–315	—	—	—
Lc	c–386				c–352	—	—	—
Ld	$\frac{d-582}{\cos\alpha}$; ($\alpha_{max}=25^\circ$)							

NOTES:

- 1. "L"—Driving shaft length
- 2. PS —Disposal of change–over selector
- 3. In case of two units – numbers 3 or 1 are omitted
- 4. Distances are determined for mechanical reasons.

The insulating distances are not considered

ON LOAD TAP CHANGERS

TYPE RSV 9.3

VOLTAP
E L P R O M

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