TECHNICAL DATA

TYPE CM

OIL-IMMERSED ON-LOAD TAP CHANGER

HM0.154.301

SHANGHAI HUAMING POWER EQUIPMENT CO., LTD.

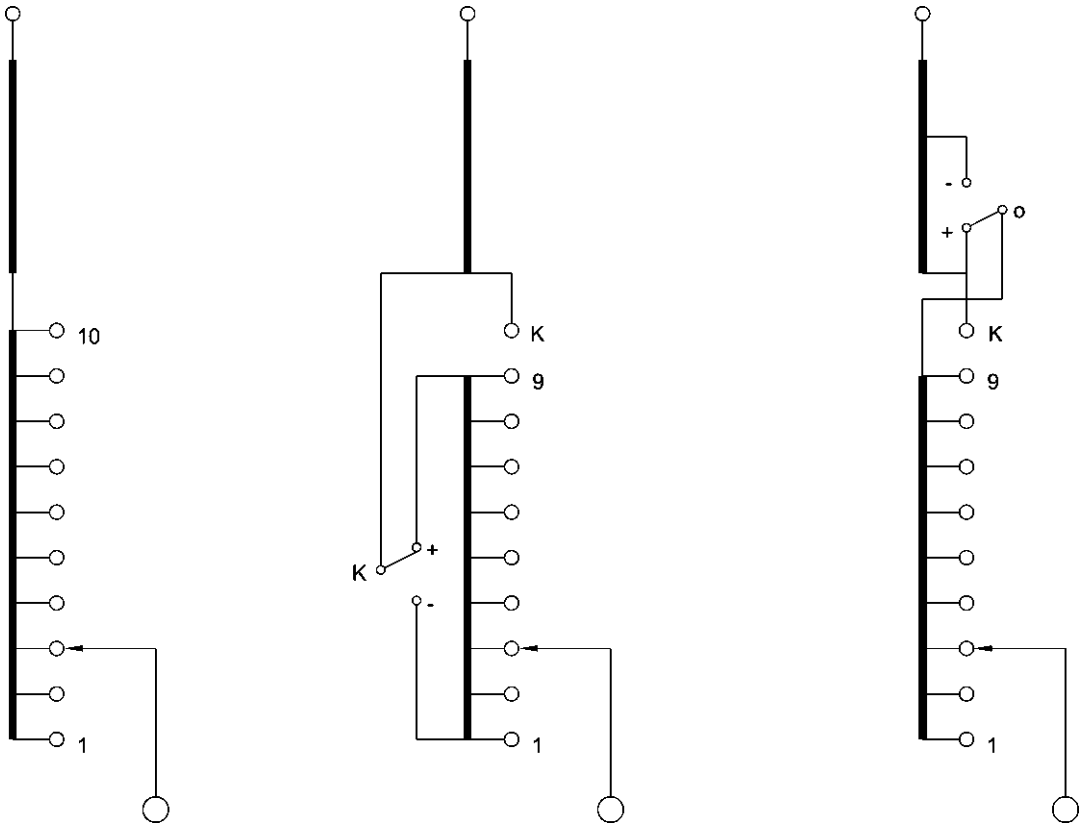
General

1. General

Type CM On-Load Tap Changer (hereinafter referred as CM or CM OLTC) is a typical combined-structure tap changer applicable in oil-immersed transformer, comprising of two major parts: diverter switch and tap selector. The CM OLTC is put in transformer oil tank and its diverter switch has a separate oil compartment from transformer tank, while tap selector, together with transformer windings, is completely laid inside the tank. OLTC's installation is divided into two types - standard tank flange and bell-type flange.

Three-phase CM OLTC could be used at neutral point of star-connection, and a combination of three units of single-phase CM OLTC is designed for any selectable winding connection.

Basic connections of tap winding as in fig.1



a) Without change-over selector b) With reversing switch c) With coarse tap selector

Fig.1 Basic Connections of Tap Winding

a) without change-over selector
This linear regulation can be designed by a maximum of 9, 11,13,15 or 17 steps, namely 10, 12,14,16 or 18 operating positions at maximum.

b) with change-over selector
With reversing switch or coarse tap selector, the regulating range will be doubled to maximum ±9,±11, ±13,±15 or ±17 steps, namely 19,23,27,31 or 35 operating positions at maximum, when actual positions are less than above mentioned ones, it can be easily obtained passing by the positions.

c) Multiple coarse tap selector

With multiple coarse tap selector , CM OLTC can be reached to maximum 106 steps, i.e. 107 operation positions at maximum.

d) Multiple linear voltage regulation

A special design of tap selector can make OLTC have up to maximum 33 steps, i.e. 34 operation positions at maximum.

2. Technical specification

Type CM OLTC complies with IEC60214-1 (2003), please refer to below table 1.

Tabe1 CM Series OLTC Main Technical Specifications

Item	Specification		CMIII 500Y CM I 500	CMIII 600Y CM I 600	CM I 800	CM I 1200	CM I 1500
1	Max. rated through-current (A)		500	600	800	1200	1500
2	Rated frequency		50 or 60				
3	Connection		Three-phases for neutral point of star connection Single-phase for any selectable winding connection				
4	Max. rated step voltage (V)		3300				
5	Rated step capacity (kVA)		1400	1500	2000	3100	3500
6	Short-circuit current test (kA)	Thermal (3s)	8	8	16	24	24
		Dynamic (Peak)	20	20	40	60	60
7	Max. Operating Positions	Without change-over selector	18 (special linear regulation can be up to 34)				
		With change-over selector	35 (special multiple coarse regulation can be up to 107)				
8	Insulation to ground (kV)	Highest voltage for equipment Um	72.5	126	170	252	300
		Rated separate source AC withstand voltage(kV/50Hz,1min)	140	230	325	460	480
		Rated lightning impulse withstand voltage (kV,1.2/50μs)	350	550	750	1050	1100
9	Tap selector		4 grades of B, C, D and DE according to insulation level				
10	Mechanical life		Not less than 800,000 operations				
11	Contact life		Not less than 200,000 operations				
12	Oil compartment of diverter switch	Service pressure	0.03Mpa				
		Leakage test	No leakage under 0.08Mpa for 24 hours				
		Over pressure protection	Bursting cap busts at 300 ± 20%kPa				
		Protection relay	Oil flow speed set at 1.0m/s ±10%				
13	Motor drive unit		SHM-III or CMA7				
14	Oil filter plant		ZXJY-1 /ZXJY-2 /ZXJY-3 according to requirement				

3. Model designation

3.1 Model designation

Type CM OLTC models varies with number of phase, maximum.rated through current, highest voltage for equipment, insulation level of tap selector and connection ways, etc.The parameters are represented as in Fig.2 below.

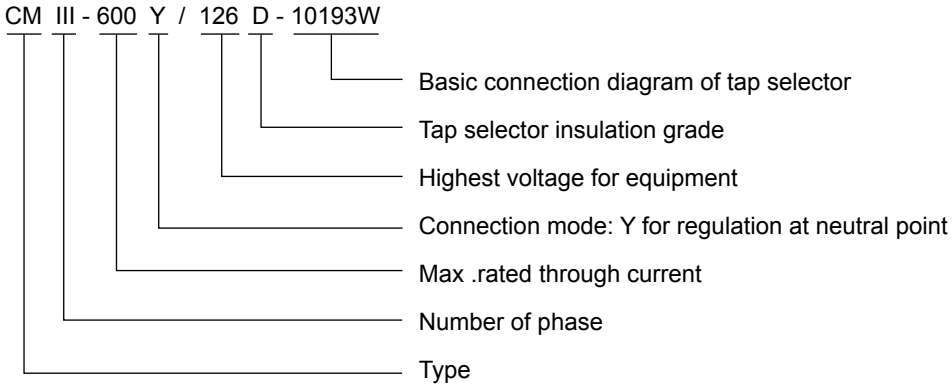


Fig.2 Designation of CM OLTC

3.2 Designation of basic connection diagram of tap selector

The tap selector may have different spec with respect to the number of the steps required and connection of the tap winding. The basic connection diagrams reflects the relevant pitch of the contact circuit, the number of operating positions, the number of mid-positions and type of change-over selector. The designation of the basic connection diagram is according to Fig.3.

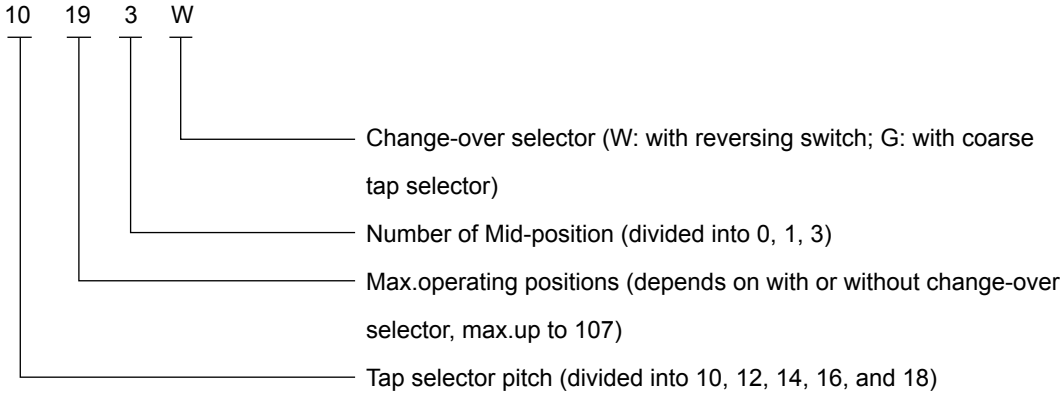


Fig.3 Designation of Basic Connection Diagram of Tap Selector

3.3 Survey of basic connection diagram of tap selector

Different numbers of taps correspond to different connection diagram. Fig.4 shows regular basic connection diagrams of the tap selector, and special design depends on the requirement.

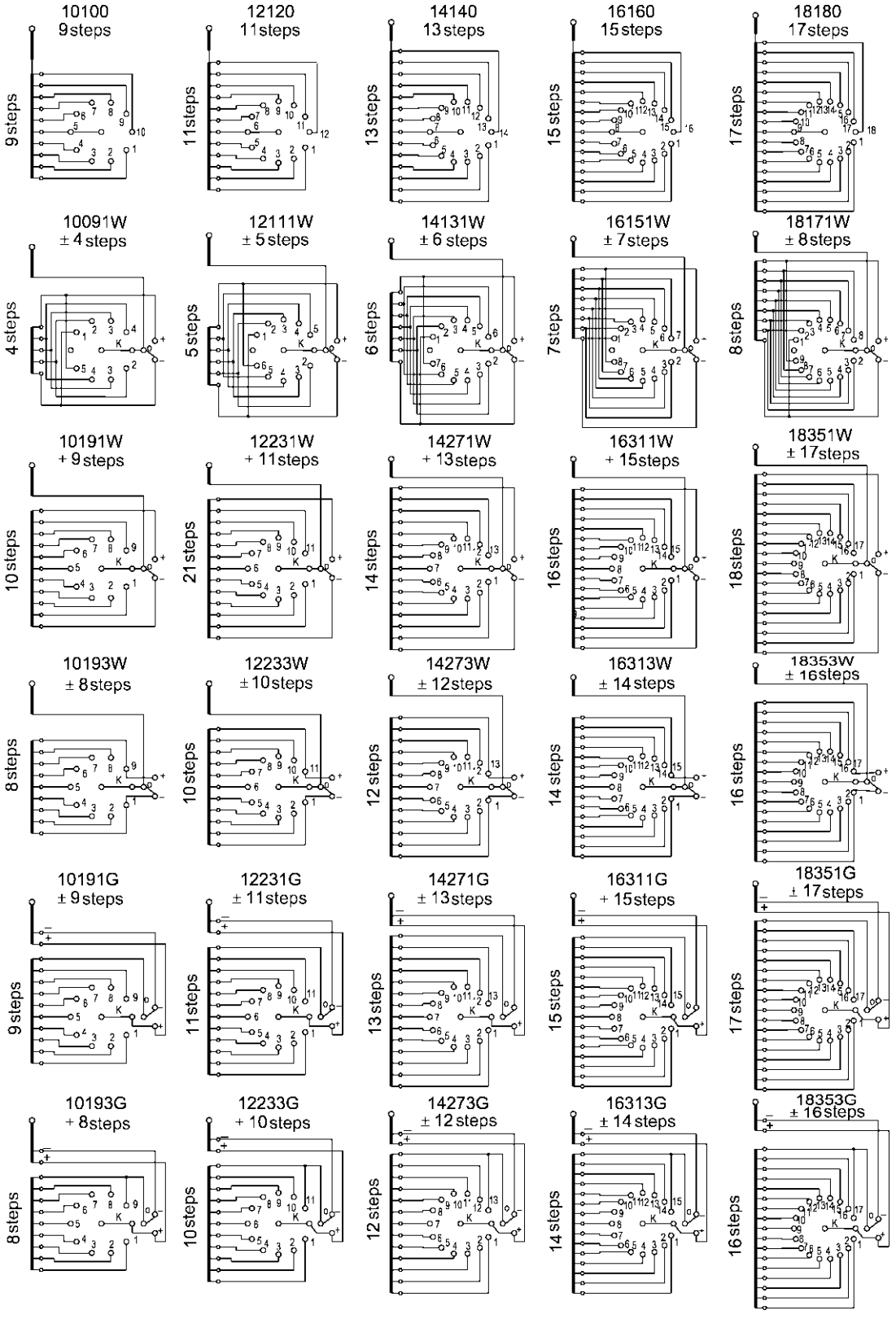


Fig.4 Survey of Basic Connection Diagram of Tap Selector

4. Terms and definitions

4.1 Through current

Rated through current (I_u) : The current flowing through an on-load tap-changer towards the external circuit, which the apparatus is capable of transferring from one tap to the other at the relevant rated step voltage and which can be carried continuously while meeting the requirements of the standard.

Max. rated though-current (I_{um}): The highest rated through-current for which the tap-changer is designed for and which forms the basis for all current related tests.

4.2 Step voltage

Rated step voltage (U_i): For each value of rated through-current, the highest permissible voltage between terminals which are intended to be connected to successive taps of the transformer.

Maximum rated step voltage (U_{im}): The highest value of the rated step voltage for which the tap-changer is designed. The maximum rated step voltage of type CM is 3300 volt.

4.3 Rated step capacity Pstn

The step capacity equals to product of step voltage multiplied by current. While the rated step capacity of OLTC is a permissible maximum step capacity during continuous operation. That is $P_{stn}=U_i\ I_u$,The rated step capacity refers to fig.5.

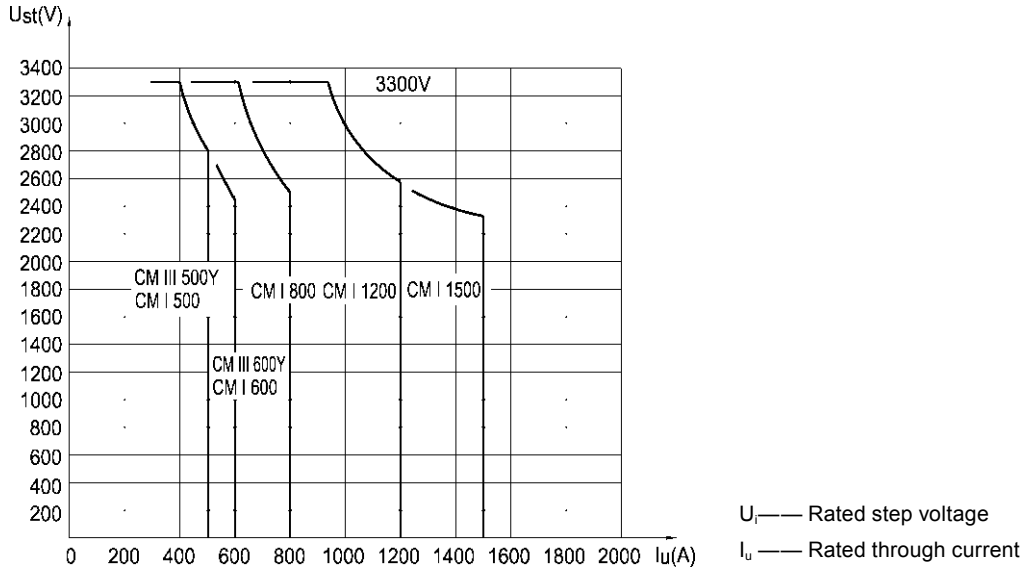


Fig. 5 Curve of The Rated Step Capacity of CM OLTC

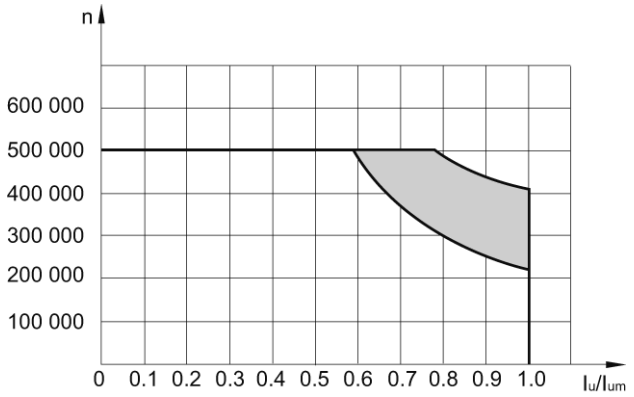
4.4 Breaking capacity

The breaking capacity refers to the maximum switching capacity under the safe changeover load, according to IEC60214-1(2003) stipulation, 40-time breaking switches shall be performed at a current corresponding to twice the maximum rated through-current (I_{um}) and at its relevant rated step voltage(U_i).

The breaking capacity of CM OLTC: $P_{stmax} = 2P_{stn} \approx 2I_{um} \times U_{stn}$
P_{stn}: Rated step capacity
I_{um}: Max. rated through current
U_{stn}: relevant step voltage

4.5 Electrical life of arcing contact

The main expected electrical life of the arcing contacts can be estimated based on the relevant load (I_u/I_{um}) shown in below fig.6, whereas actual burn of arcing contacts may depend on many influencing factors such as contact material, matching of transition resistance, operation status and so on, fig.6 is only an approximate value of contact life.



n: number of operation
I_u: Rated through current
I_{um}: Maximum rated through current

Fig.6 Average Expected Contact Life under Average Load Condition

4.6 Short-circuit current test

According to IEC 60214-1: 2003, all contacts continuously carrying the current shall be able to withstand 2s (±10%) short circuit test current without melting, deformation or mechanical damage. Meanwhile the starting peak current value shall be 2.5 (±5%) times of the root means square value of rated short circuit test current. Refer the short circuit test current values to Table 1. CM Series OLTC Main Technical Specifications.

4.7 Conditions for OLTC's operations

4.7.1 Oil temperature for OLTC's operation ranges from -25℃ to 105℃ .
4.7.2 Ambient air temperature for OLTC's operation ranges from -25℃ to 40℃ .
4.7.3 The vertical inclination level of OLTC being installed into **transformer** towards ground should be less than 2%
4.7.4 The installation site should be free of heavy dust, explosive or corrosive gas.
Note: Please contact us if special application required.

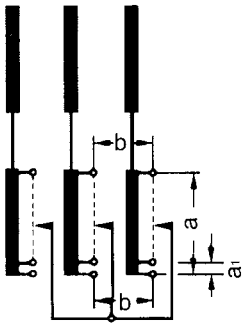
4.8 Internal insulation level

The internal insulation of CM OLTC is divided into four levels from low to high: B, C, D and DE.The withstand voltage is different between adjacent taps, max. and min. taps and between phases for tap changers with different insulation grade, Fig.7 shows the potential distribution of various parts after tap changer has been connected to voltage regulation winding. Table 2 gives CM OLTC power frequency withstand voltages and BIL values according to different insulation distance.

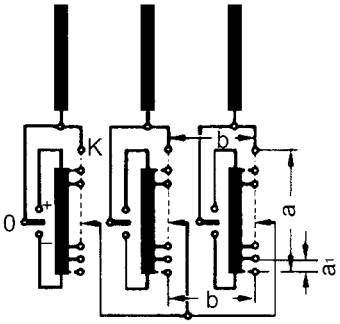
4.9 Insulation level to ground

The insulation level to ground refers to insulation of OLTC live parts against grounding parts, the rated value of which depends on dielectric tests according to IEC-60214-1(2003), please refer to table 3.

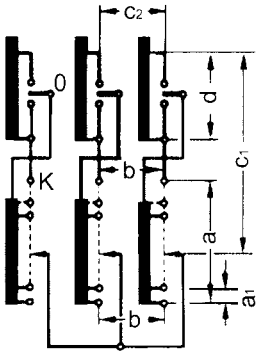
The requirement of insulation to earth for OLTC is relevant to OLTC connection location at transformer tap winding, regulation range and mode, tap winding connection model and structure, as well as the rated voltage of transformer tap winding, anyhow, it is determined by insulation to ground of transformer voltage regulating winding.



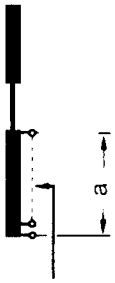
10 10 0 … 18 18 0



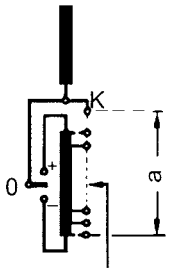
10 09 1W … 18 17 1W
10 19 1W … 18 35 1W
10 19 3W … 18 35 3W



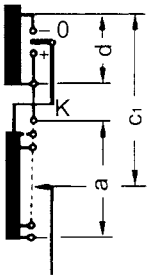
10 19 1G … 18 35 1G
10 19 3G … 18 35 3G



10 10 0 … 18 18 0



10 09 1W … 18 17 1W
10 19 1W … 18 35 1W
10 19 3W … 18 35 3W

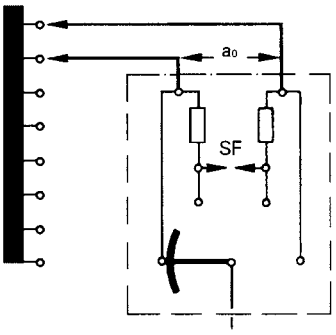


10 19 1G … 18 35 1G
10 19 3G … 18 35 3G

1. Linear regulation

2. With reversing switch

3. With coarse change-over selector



4. Diverter switch

Explanation of designation code:

a: across regulation winding for the same phase

a1: between any selected and preselected taps of the tap selector

b: between any two taps of different phases

a0: between any adjacent taps of diverter switch

c1: between the beginning of coarse tap winding and neutral of fine tap winding of the same phase

c2: between beginnings of coarse tap winding of different phases

d: between begining and end of coarse tap winding of the same phase

SF: spark gap

Fig. 7 The Rated Voltage Stress on Tap Winding

Table 2 CM OLTC internal Insulation

(unit: kV)

Designation code	Tap selector size B		Tap selector size C		Tap selector size D		Tap selector size DE	
	1.2/50μs	50Hz 1min	1.2/50μs	50Hz 1min	1.2/50μs	50Hz 1min	1.2/50μs	50Hz 1min
a	265	50	350	82	460	105	550	120
b	265	50	350	82	460	146	550	160
a_0	90	20	90	20	90	20	90	20
a_1	150	30	150	30	150	30	150	30
c_1	485	143	545	178	590	208	660	230
c_2	495	150	550	182	590	225	660	250
d	265	50	350	82	460	105	550	120

a_0: The inherent insulation level refers to insulation level with spark gap protection when full wave voltage impulse is 130kV, the spark gap will response 100%

Table 3 Insulation Level to Ground of OLTC (unit: kV)

The highest voltage for equipment Um	Rated separate source AC withstand voltage(kV/50Hz,1min)	Rated lightning impulse withstand voltage (1.2/50μs)
72.5	140	350
126	230	550
170	325	750
252	460	1050
300	480	1100

4.10 Installation models

Type CM OLTC is mounted onto the transformer cover by tap changer head, a mounting flange (see appendix) must be provided by transformer producer for connection. CM OLTC is suitable for either standard tank or bell-type mounting. For bell-type tank transformer, the OLTC support flange is supplied as a temporary support, OLTC will be secured onto transformer mounting flange after complete installation of transformer bell-tank.

5 Special designs

5.1 Potential connection of the tap winding

For high voltage or wide regulation range on-load regulating transformer, during the operation of the change-over selector the tap winding is disconnected momentarily from the main winding, the regulating section will be broken away from the main coil and at status of "suspend", thus voltage regulating winding will gain the new potential that depends upon coupling capacities Ce (to ground) and Cw (between adjacent tap winding), refer to Fig.9. Generally this potential is different from the one of voltage regulating winding before change-over selector acting, the difference of them is designated as recovery voltage. This recovery voltage is produced at the breaking point of the separated contacts during the operation of change-over selector. If these differential voltages exceed a certain limit value, it may cause flashover on change-over selector and bring gas, it will be the serious problem. Therefore measures regarding potential connection of the winding must be taken.

CM OLTC could withstand a limit value of bias voltage of 35 kV, when the potential is expected to overrun the limit value, tap winding should be permanently connected to a fixed potential resistance via a tie-in resistor, see fig.8. For

mounting location and dimensions of CM OLTC tie-in resistors, please refer to appendix 9.16
For calculating the change-over selector stress and dimensioning the tie-in resistors, the following details of the transformer specifications required when ordering:

a) Complete transformer parameter: rated capacity, rated voltage, voltage regulating range, winding connection model, insulation level and so on
b) Arrangement of the windings, i.e. the relative position of the tap winding to the adjacent coil or winding parts
c) Operating A.C.voltage across windings or layers of windings adjacent to the tap windings
d) Capacitance of the tap winding to adjacent windings(Cw)
e) Capacitance of the tap winding to ground or grounded adjacent windings (if exist) (Ce)
f) Voltage stress across half the tap winding at lightning impulse voltage test
g) A.C.voltage across half the tap winding under operation and test conditions.(is normally derived from order specification sheet for tap changer)

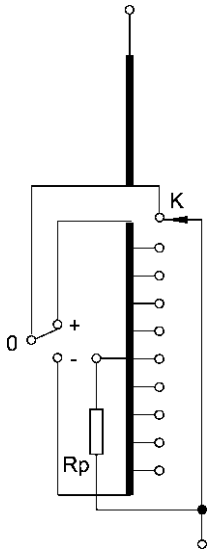


Fig.8 Potential Connection by Tie-In Resistor Rp

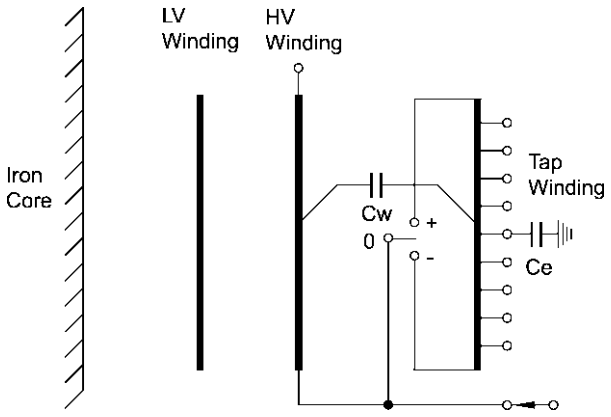
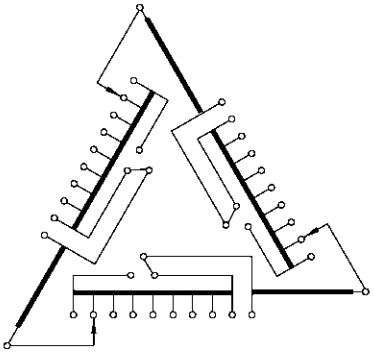
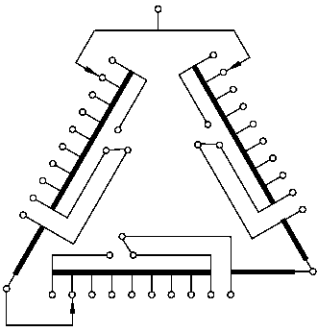


Fig.9 Arrangement of Winding and Coupling Capacitance

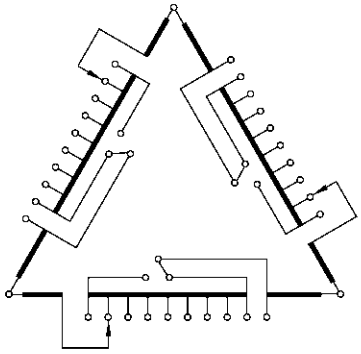
5.2 Special CM OLTC combinations (3×CMI or CMI+CMII), driven by one or separated motor drive units and used for delta connection of windings or others except neutral point.



Regulating at Coil End of 3-Phase Delta Connection



OLTC Combination (CMI+CMII) for the Specific Delta Connection



Regulating at Middle of 3-Phase Delta Connection

Fig.10 Connection Diagram for Multiple CM OLTC Applications

6. Motor drive unit

CM OLTC may operated by SHM-III or CMA7 motor drive unit according to the requirement, please refer to table 4 for technical data.

Table 4 Technical Data of Motor Drive Unit

Motor drive unit		SHM-III		CMA7	
Motor	Rated power (W)	750	1100	750	1100
	Rated voltage (V)	380,3AC/N		380/3AC	
	Rated current (A)	2.1	2.8	2.0	2.8
	Rate frequency(Hz)	50 or 60		50 or 60	
	Rotate speed (r.p.m.)	1400		1400	
Rated torque on drive shaft (Nm)		45	66	18	26
Revolution of the drive shaft per switching operation		33		33	
Revolution of the hand crank per switching operation		33		33	
Running time per switching operation (S)		5.6		About 5	
Max. operation positions		35		107	
Voltage for control circuit and heater circuit (V)		220/AC		220/AC	
Heater power (W)		50		50	
A.C. voltage test to ground (kV/50Hz, 1min)		2		2	
Approx. weight (kg)		73		90	
Protective degree		IP66		IP56	
Mechanical endurance (operations)		Not less than 2,000,000		Not less than 800,000	

Note: Please specify if special voltage required for motor, and control & heater circuit.

7. Controllers for On-Load tap changer

7.1 HMK8 controller

HMK8 controller is the device for remote control of SHM-III motor drive unit; it realizes OLTC switching operation through SHM-III. HMK8 can display the OLTC switching operation status and tap positions.

HMK8 has BCD code position signal output (contact capacity: AC250V/5A or DC30V/5A) and remote control signal input (non potential contact), it can also communicate with host computer via RS485 interface to realize remote supervising of OLTC position.

HMK8 main technical data is as below, refer to HMK8 manual for more details.
Working voltage: 380V, 3AC/N
Power frequency: 50Hz/60Hz
Maximum operation positions: 35
Environment temperature: -10˚C to 40˚C Indoor

7.2 HMC-3C position indicator

HMC-3C OLTC position indicator is a support fitting for CMA7 and CMA9 motor drive unit, it can be used to indicate the OLTC step, and has the function of "1→ N", "STOP", "N→ 1" control as well as remote control indicator lamp, its input is decimal code and output is BCD code. Please refer to HMC-3C manual for details.

HMC-3C technical data is as below, refer to manual for more details.
Working voltage: 220V AC
Power frequency: 50Hz
Maximum operation positions: 107
Environment temperature: -10˚C to 40˚C Indoor

7.3 Automatic voltage regulator ET-SZ6 and HMK-2A

Automatic voltage regulator ET-SZ6 and HMK-2A is adopted for OLTC automatic voltage regulation, ET-SZ6 can be used for parallel operation in model of master and slave, please refer to relevant manual for details.

8. OLTC accessories

8.1 Bevel gear unit

Bevel gear unit is used for connection horizontal shaft and vertical shaft between OLTC body and motor drive unit, thus driving torque of motor drive unit can be transmitted to on-load tap changer, the overall dimensions of bevel gear unit is shown on appendix 9.26

8.2 Protective Relay

Protective relay is the one of protective devices for oil-immersed on-load tap changer, when OLTC interior failure produces gas and oil surge, the protective relay contact acts, and switches on to the tripping circuit of the transformer circuit breaker, the transformer will be cut off at once.

Protective relay is mounted onto the connection pipe between OLTC head and conservator, make sure that protective relay marked with arrowhead side shall be connected to conservator. Huaming provides two types of protective relay which are QJ4G-25 (with 1 pair of trip contact) and QJ6-25 (with 2 pairs of trip contact), please refer to appendix 9.28

8.3 Pressure relief devices

Pressure relief valve and pressure release cover is the security protective device for oil-immersed OLTC, when OLTC interior fails, oil in oil chamber is gasified and a number of gases produced, thus oil pressure of oil chamber is increased rapidly, OLTC oil compartment will be deformation even explosion if the pressure inside is not released in time, therefore, pressure relief device is necessary to install to avoid failures extending.

Pressure relief valve is a auto-sealed valve, when over pressure, the cover is open and pressure will be released, and then it will close again. It can be used repeatedly, and the liquid lost could be controlled to minimum volume when it is acting.

Pressure release cover is the weak portion on the OLTC head cover, once oil chamber pressure exceeds adjusted value, the pressure release cover will be broken, thus over-pressure is released, and OLTC oil compartment is protected.

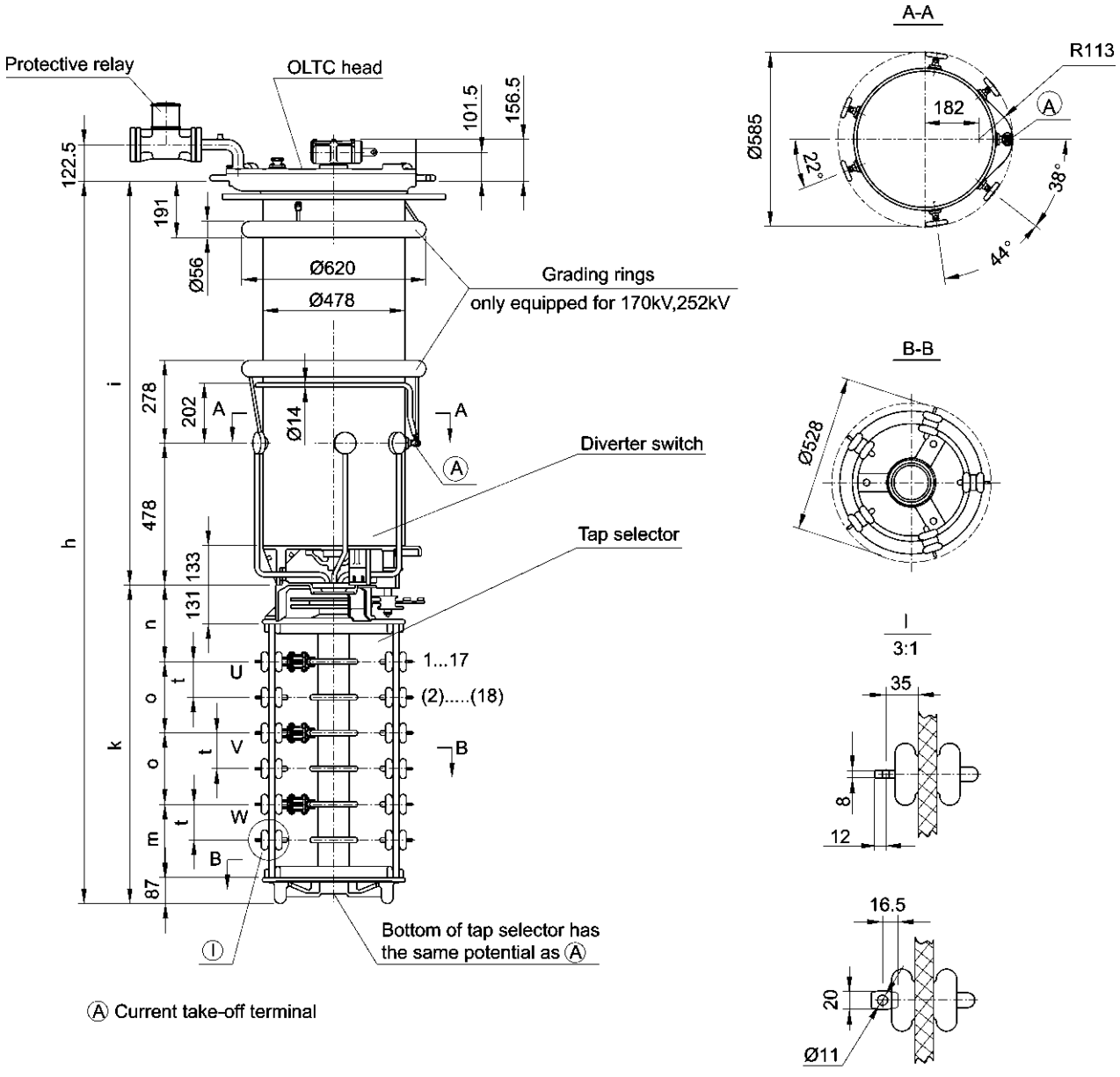
Pressure relief valve is a device for low energy failure, and pressure release cover is the device for high energy failure, whereas most of failure of OLTC body is of high energy failure, so our standard offer is OLTC equipped with pressure release cover, and pressure relief valve is only provided when customer specifies.

8.4 Oil filter plant

Oil filter plant is applied to filter out metal particles and uncombined carbon, and moisture from transformer oil in OLTC oil compartment while OLTC in operation, as a result, OLTC operation reliability has been improved and maintenance interval will be prolonged. It is proposed that those OLTCs for furnace transformer, rectification transformer, which operates in relatively frequent situation, should be fit up with oil filter plant, in addition, there is a must for those OLTCs in ultra-high voltage transformers to furnish with it.

9. Appendixes

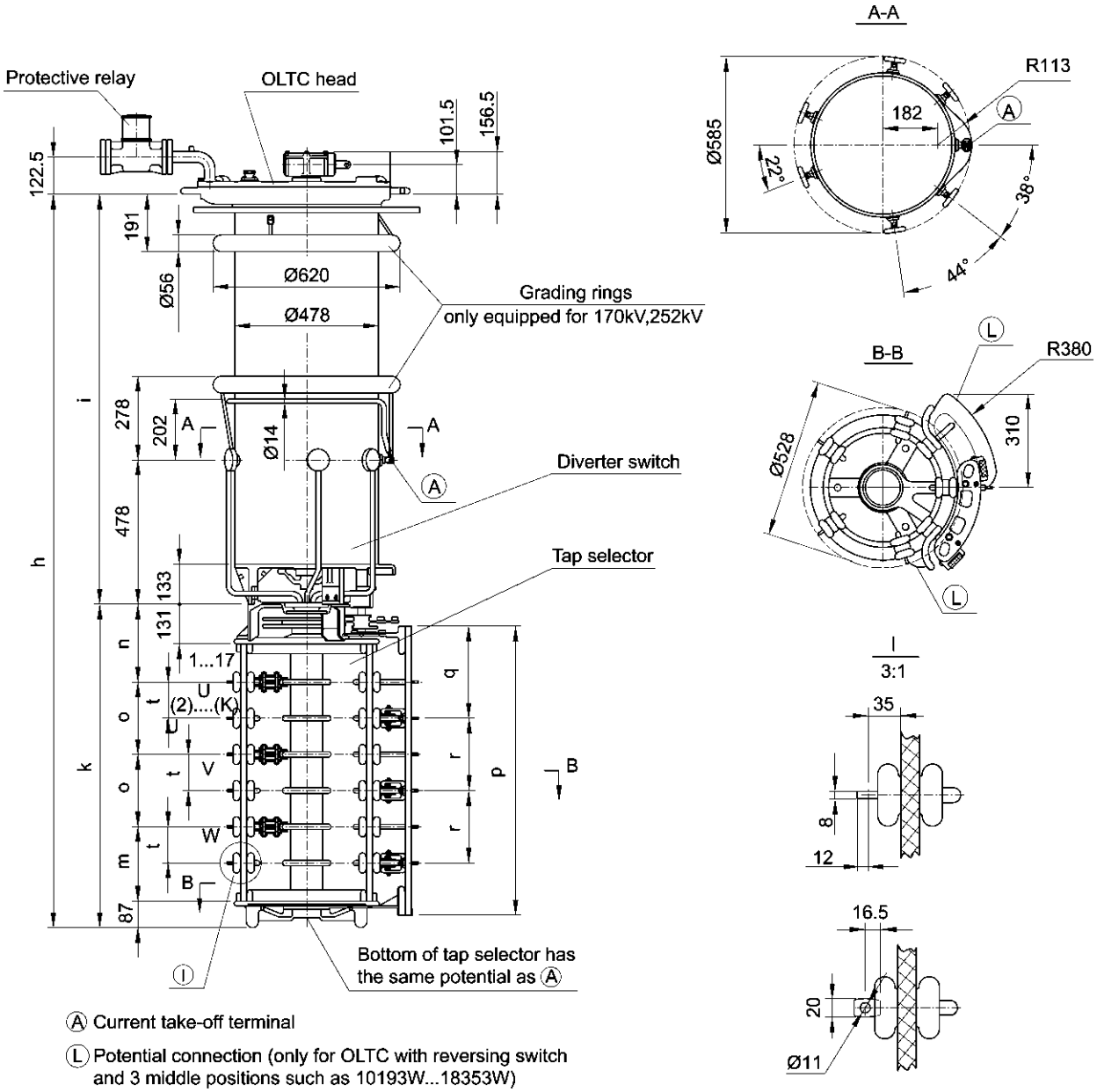
9.1. CM III 500Y/600Y without change-over selector, overall dimensions



Model		CMIII500Y/600Y-72.5-252/B				CMIII500Y/600Y-72.5-252/C				CMIII500Y/600Y-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1897	2027	2157	2257	2072	2202	2332	2432	2527	2657	2787	2887
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	897				1072				1527			
	n	233				258				323			
	o	190				240				370			
	t	95				120				185			
	m	197				247				377			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		194	219	239	259	195	220	240	260	198	223	243	263
Weight (kg)		260				265				275			

Unit: mm

9.2. CM III 500Y / 600Y with reversing switch, overall dimensions



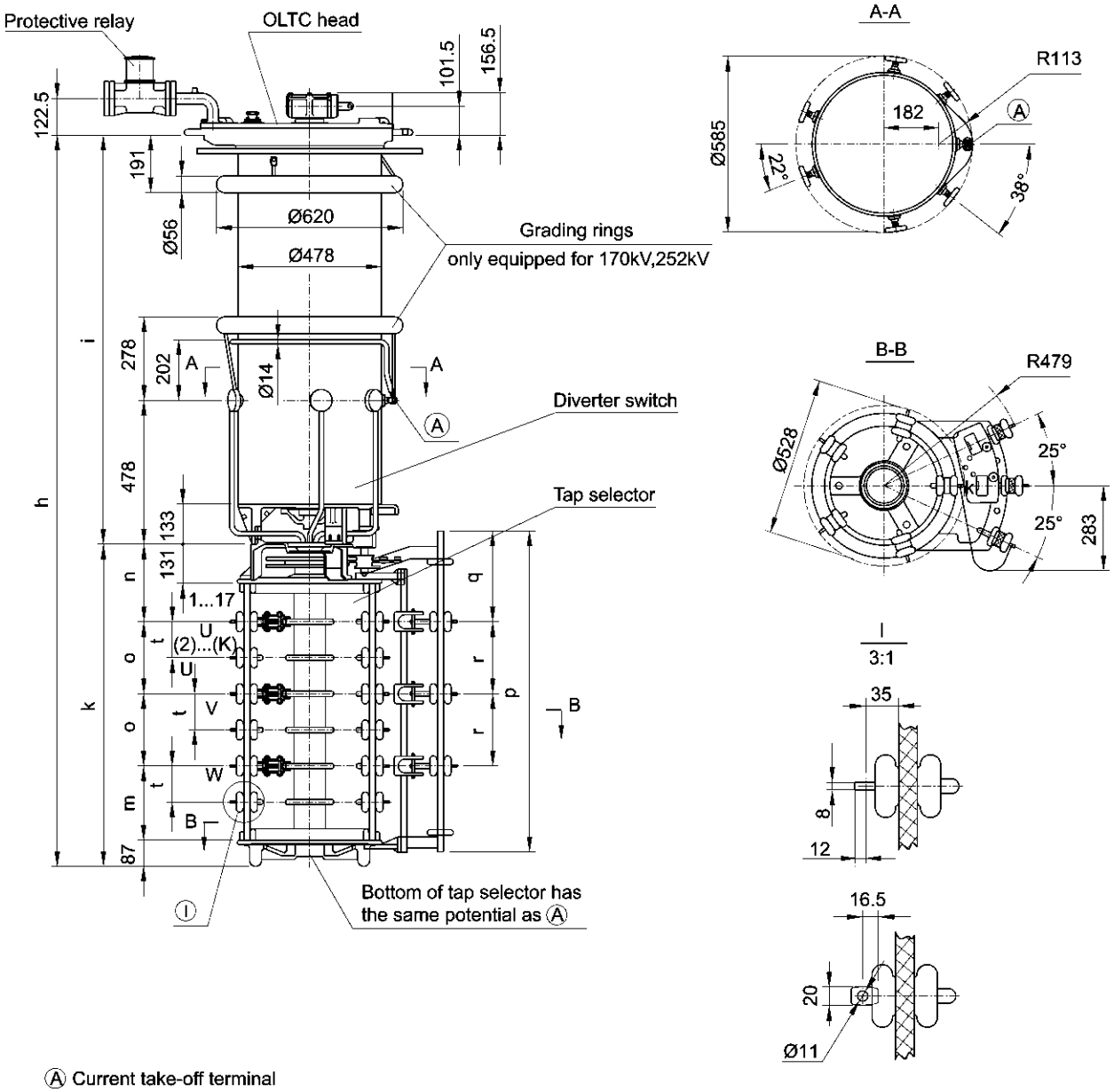
Ⓐ Current take-off terminal

Ⓛ Potential connection (only for OLTC with reversing switch and 3 middle positions such as 10193W...18353W)

Model		CMIII500Y/600Y-72.5-252/B				CMIII500Y/600Y-72.5-252/C				CMIII500Y/600Y-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1897	2027	2157	2257	2072	2202	2332	2432	2527	2657	2787	2887
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	897				1072				1527			
	n	233				258				323			
	o	190				240				370			
	t	95				120				185			
	m	197				247				377			
	r	190				240				370			
	q	255				305				435			
	p	783				958				1413			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		199	224	244	264	200	225	245	265	207	232	252	272
Weight (kg)		275				285				310			

Unit: mm

9.3. CM III 500Y / 600Y with coarse change-over selector, overall dimensions

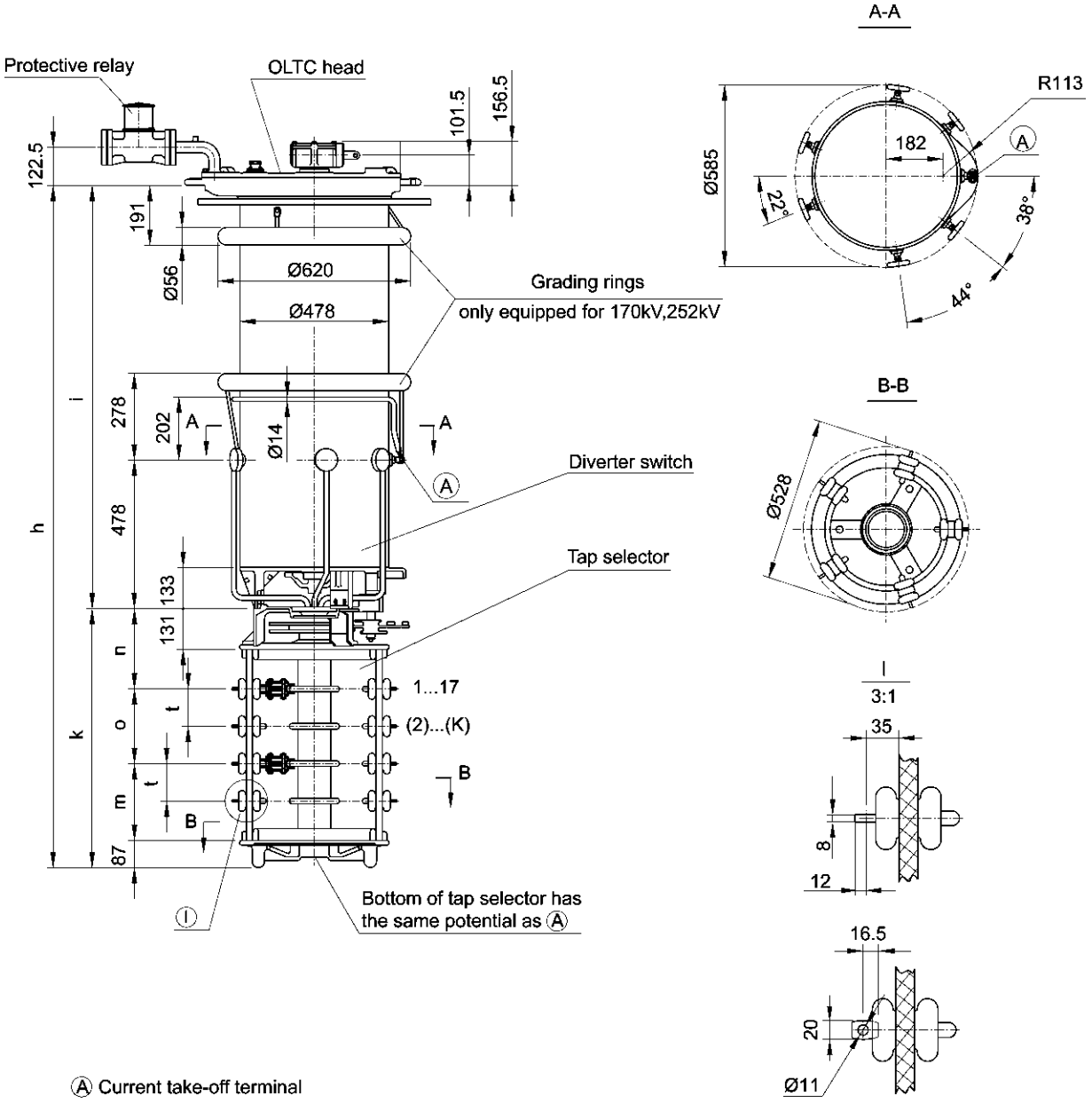


Ⓐ Current take-off terminal

Model		CMIII500Y/600Y-72.5-252/B				CMIII500Y/600Y-72.5-252/C				CMIII500Y/600Y-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1897	2027	2157	2257	2072	2202	2332	2432	2527	2657	2787	2887
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	897				1072				1527			
	n	233				258				323			
	o	190				240				370			
	t	95				120				185			
	m	197				247				377			
	r	190				240				370			
	q	276.5				301.5				366.5			
	p	892				1067				1522			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		199	224	244	264	199	224	244	264	207	232	252	272
Weight (kg)		275				280				305			

Unit: mm

9.4. CM II 500 / 600 without change-over selector, overall dimensions

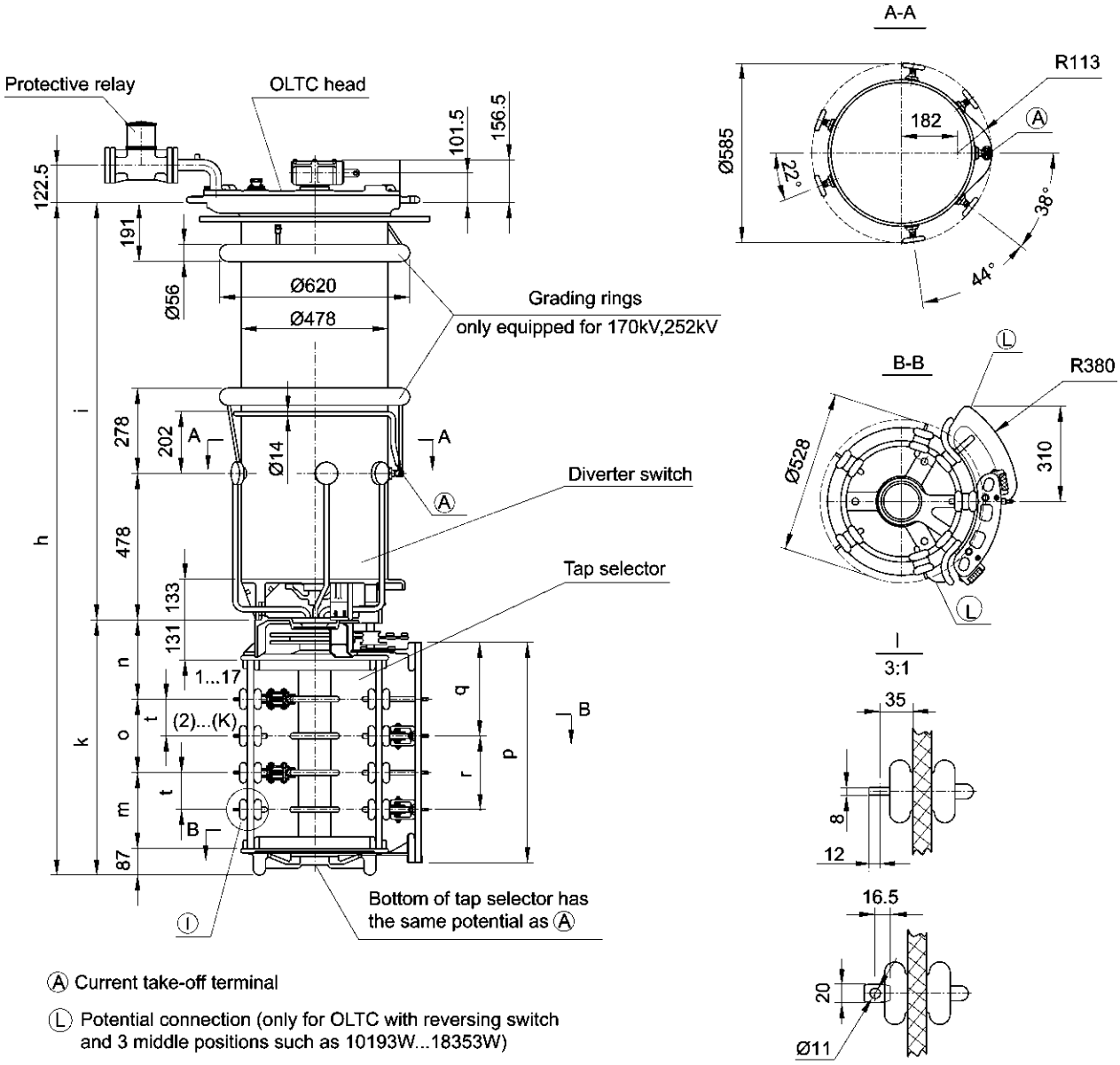


Ⓐ Current take-off terminal

Model		CMII500/600-72.5-252/B				CMII500/600-72.5-252/C				CMII500/600-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1707	1837	1967	2067	1832	1962	2092	2192	2157	2287	2417	2517
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	707				832				1157			
	n	233				258				323			
	o	190				240				370			
	t	95				120				185			
	m	197				247				377			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		194	219	239	259	195	220	240	260	198	223	243	263
Weight (kg)		260				265				275			

Unit: mm

9.5. CM II 500 / 600 with reversing switch,overall dimensions



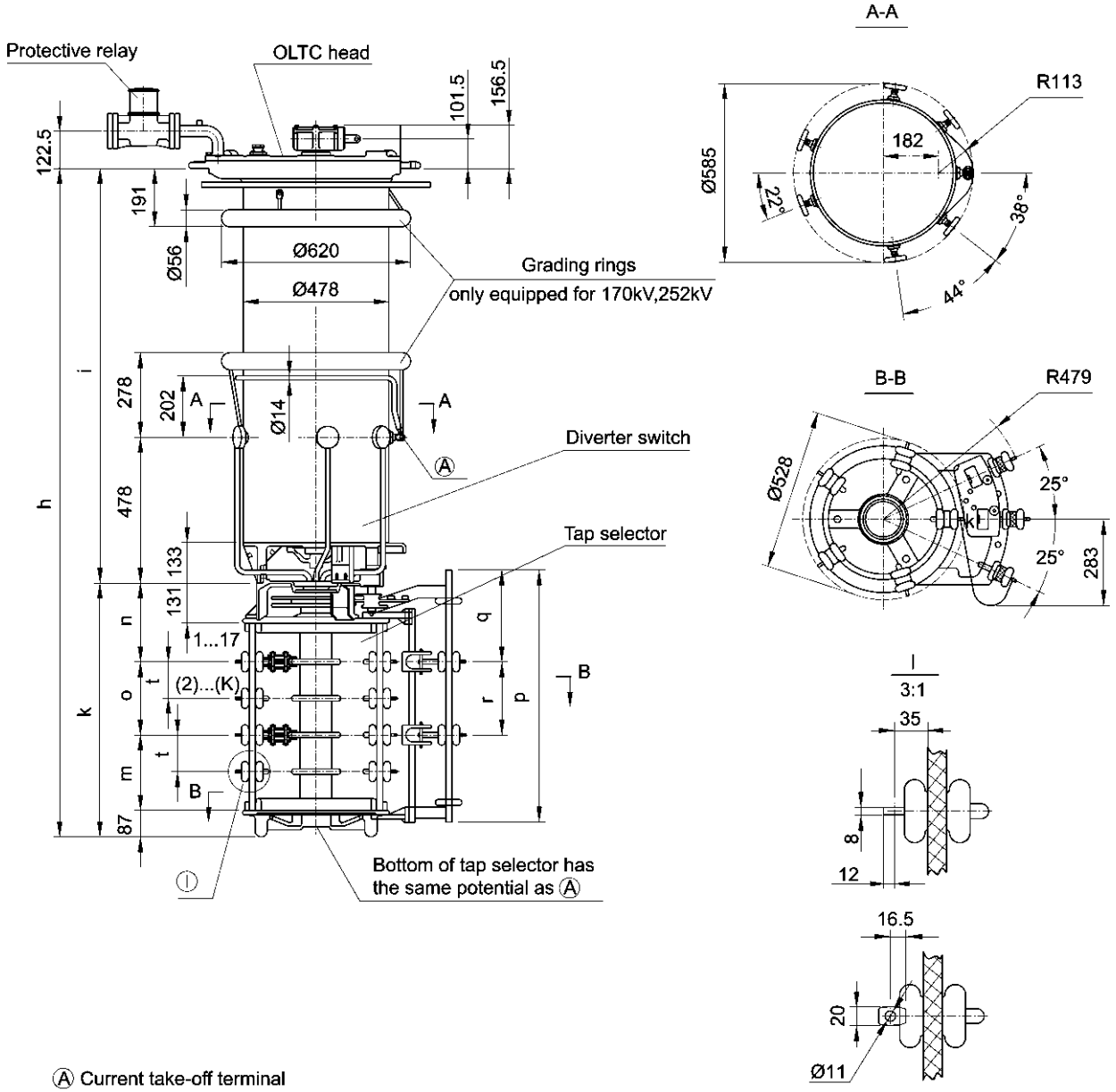
Ⓐ Current take-off terminal

Ⓛ Potential connection (only for OLTC with reversing switch and 3 middle positions such as 10193W...18353W)

Model		CM II 500/600-72.5-252/B				CM II 500/600-72 5-252/C				CM II 500/600-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1707	1837	1967	2067	1832	1962	2092	2192	2157	2287	2417	2517
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	707				832				1157			
	n	233				258				323			
	o	190				240				370			
	t	95				120				185			
	m	197				247				377			
	r	190				240				370			
	q	255				305				435			
	p	783				958				1413			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		199	224	244	264	200	225	245	265	207	232	252	272
Weight (kg)		275				285				310			

Unit: mm

9.6. CM II 500 / 600 with coarse change-over selector, overall dimensions

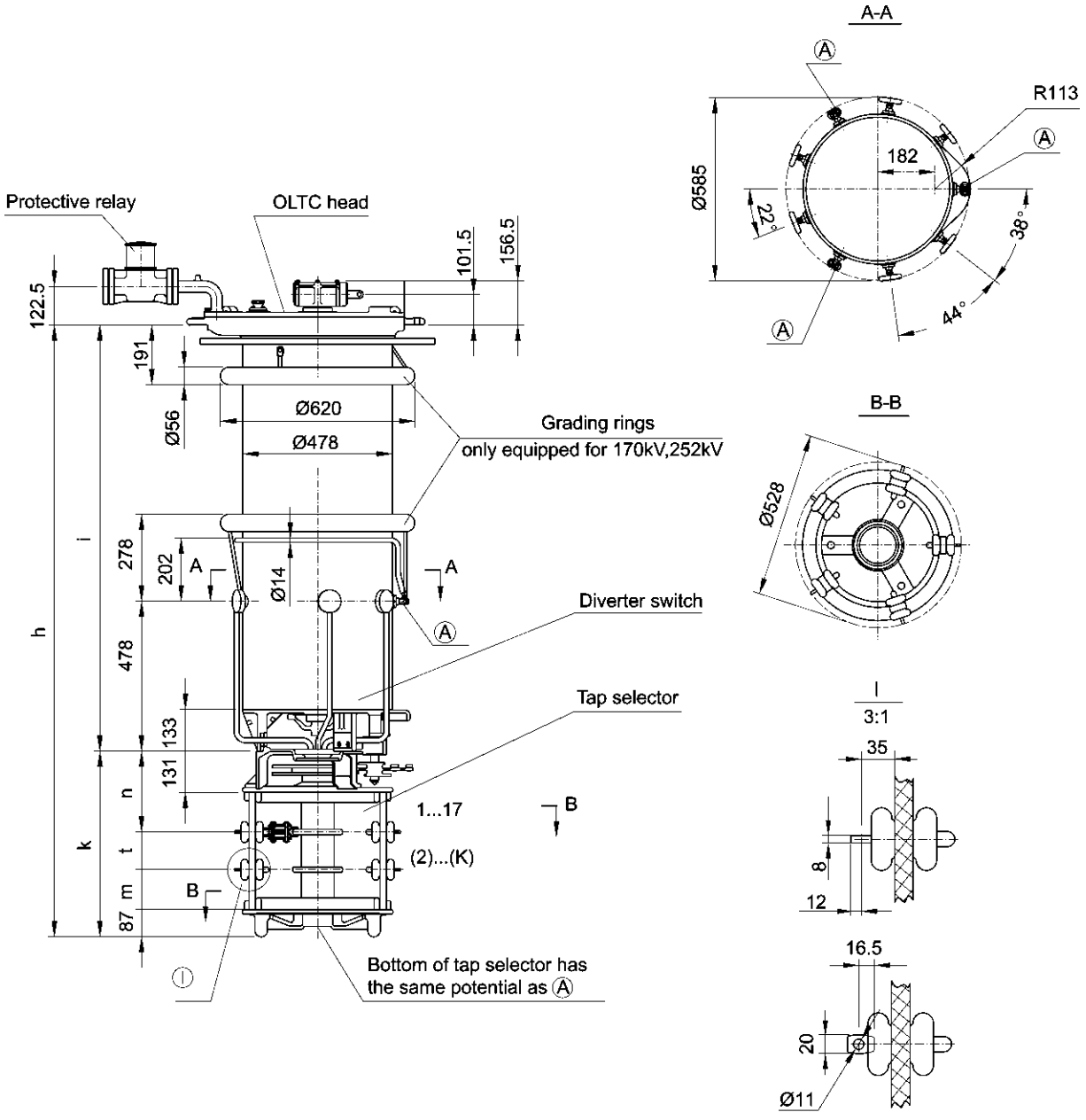


Ⓐ Current take-off terminal

Model		CMII 500/600-72.5-252/B				CMII 500/600-72.5-252/C				CMII 500/600-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1707	1837	1967	2067	1832	1962	2092	2192	2157	2287	2417	2517
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	707				832				1157			
	n	233				258				323			
	o	190				240				370			
	t	95				120				185			
	m	197				247				377			
	r	190				240				370			
	q	276.5				301.5				366.5			
	p	892				1067				1522			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		199	224	244	264	199	224	244	264	207	232	252	272
Weight (kg)		275				280				305			

Unit: mm

9.7. CM I 500 / 600 without change-over selector, overall dimensions

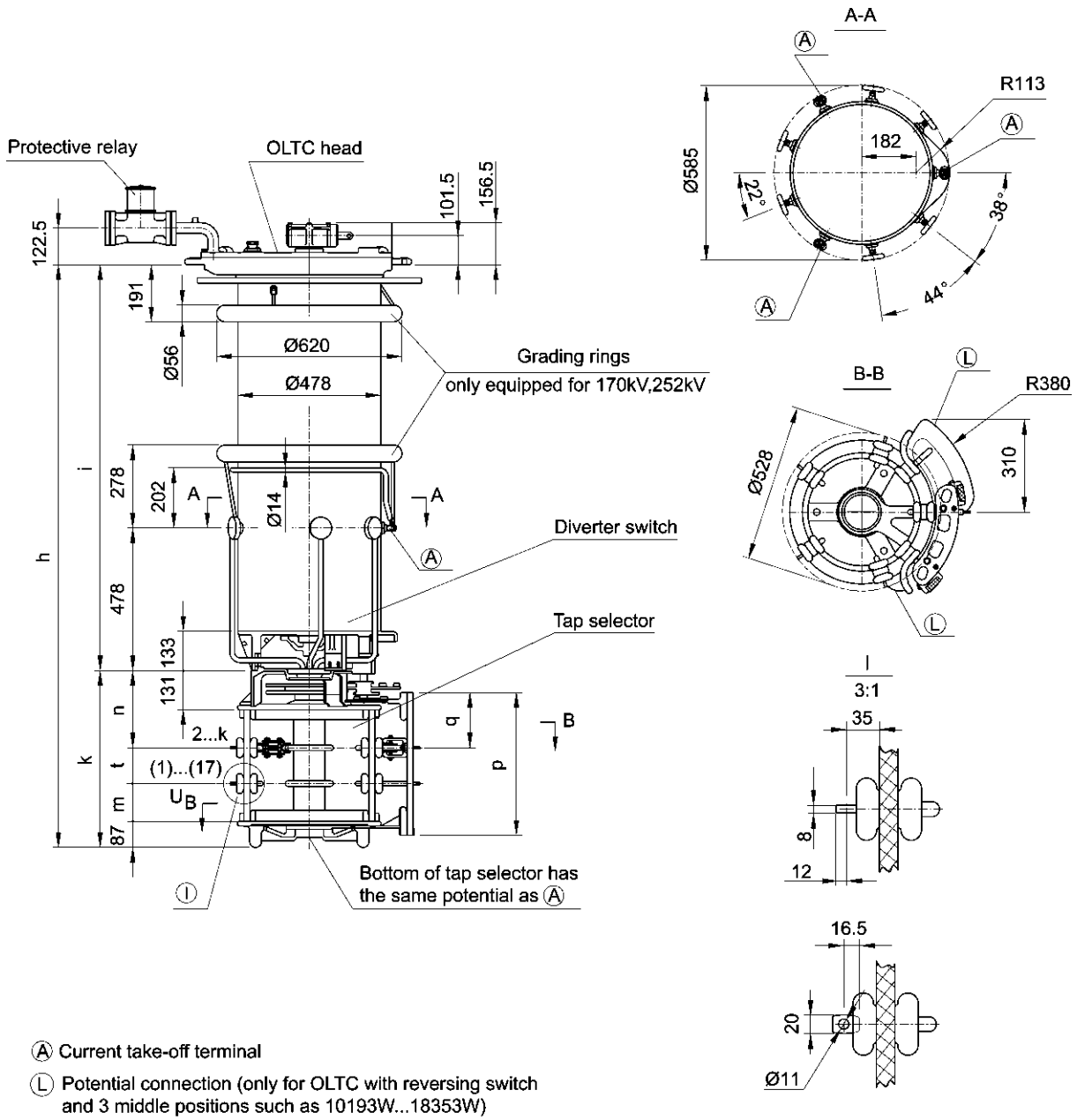


Ⓐ Current take-off terminal

Model		CM I 500/600-72.5-252/B				CM I 500/600-72.5-252/C				CM I 500/600-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1517	1647	1777	1877	1592	1722	1852	1952	1787	1917	2047	2147
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	517				592				787			
	n	233				258				323			
	t	95				120				185			
	m	102				127				192			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		189	214	234	254	189	214	234	254	190	215	235	255
Weight (kg)		240				240				245			

Unit: mm

9.8. CM I 500 / 600 with reversing switch, overall dimensions



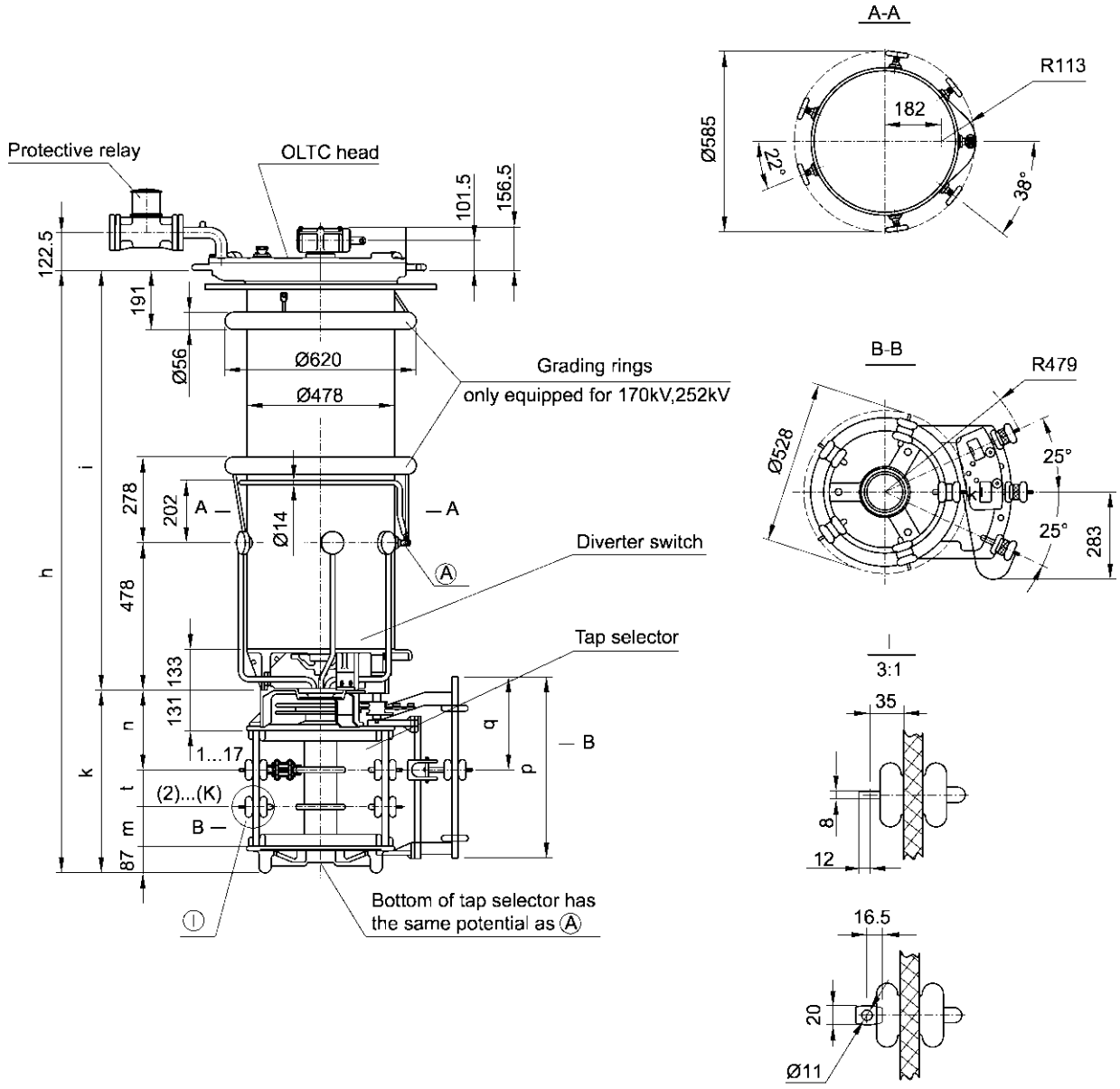
Ⓐ Current take-off terminal

Ⓛ Potential connection (only for OLTC with reversing switch and 3 middle positions such as 10193W...18353W)

Model		CMI 500/600-72.5-252/B				CMI 500/600-72.5-252/C				CMI 500/600-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1517	1647	1777	1877	1592	1722	1852	1952	1787	1917	2047	2147
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	517				592				787			
	n	233				258				323			
	m	102				127				192			
	t	95				120				185			
	q	160				185				250			
	p	403				478				673			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		191	216	244	264	192	217	237	257	193	218	238	258
Weight (kg)		250				255				260			

Unit: mm

9.9. CM I 500 / 600 with coarse change-over selector, overall dimensions

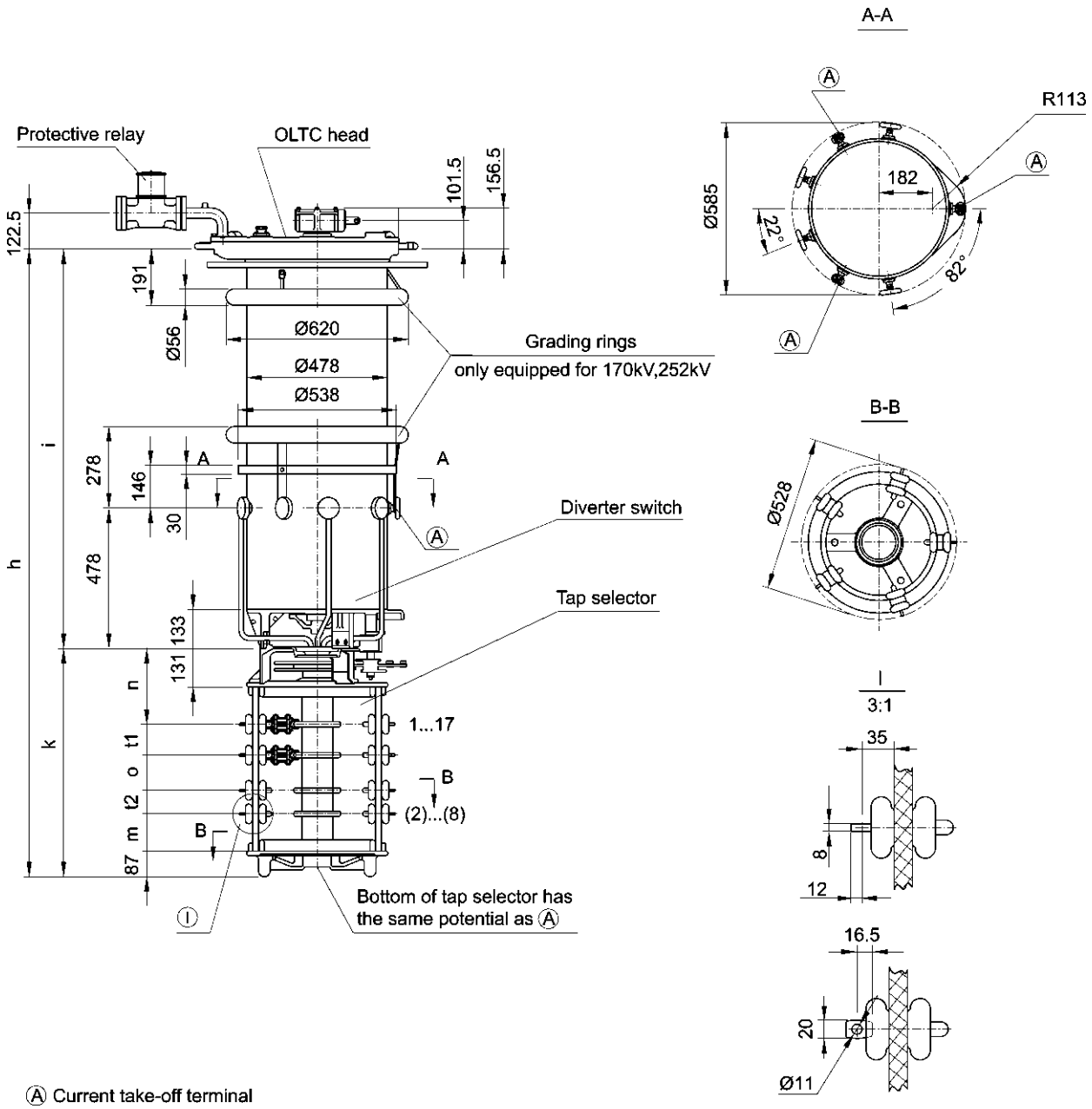


Ⓐ Current take-off terminal

Model		CM I 500/600-72.5-252/B				CM I 500/600-72.5-252/C				CM I 500/600-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1517	1647	1777	1877	1592	1722	1852	1952	1787	1917	2047	2147
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	517				592				787			
	n	233				258				323			
	m	102				127				192			
	t	95				120				185			
	q	276.5				301.5				366.5			
	p	512				587				782			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		193	218	238	258	193	218	238	258	195	220	240	260
Weight (kg)		260				260				265			

Unit: mm

9.10. CM I 800 without change-over selector, overall dimensions

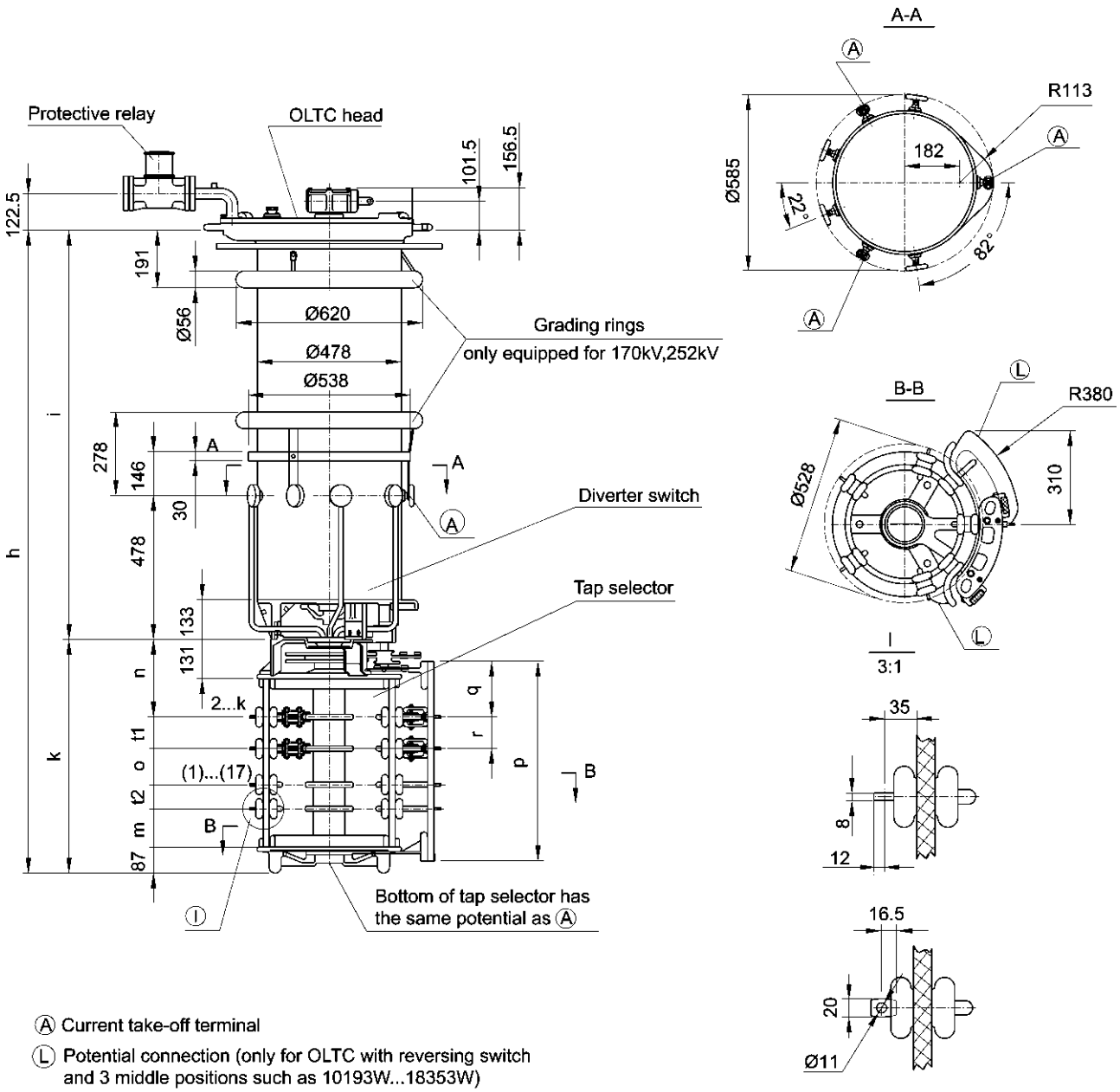


Ⓐ Current take-off terminal

Model		CMI 800-72.5-252/B				CMI 800-72.5-252/C				CMI 800-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1702	1832	1962	2062	1777	1907	2037	2137	1972	2102	2232	2332
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	702				777				972			
	n	233				258				323			
	o	95				120				185			
	m	102				127				192			
	t1	105				105				105			
	t2	80				80				80			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		191	216	236	256	191	216	236	256	193	218	238	258
Weight (kg)		250				250				260			

Unit: mm

9.11. CM I 800 with reversing switch, overall dimensions



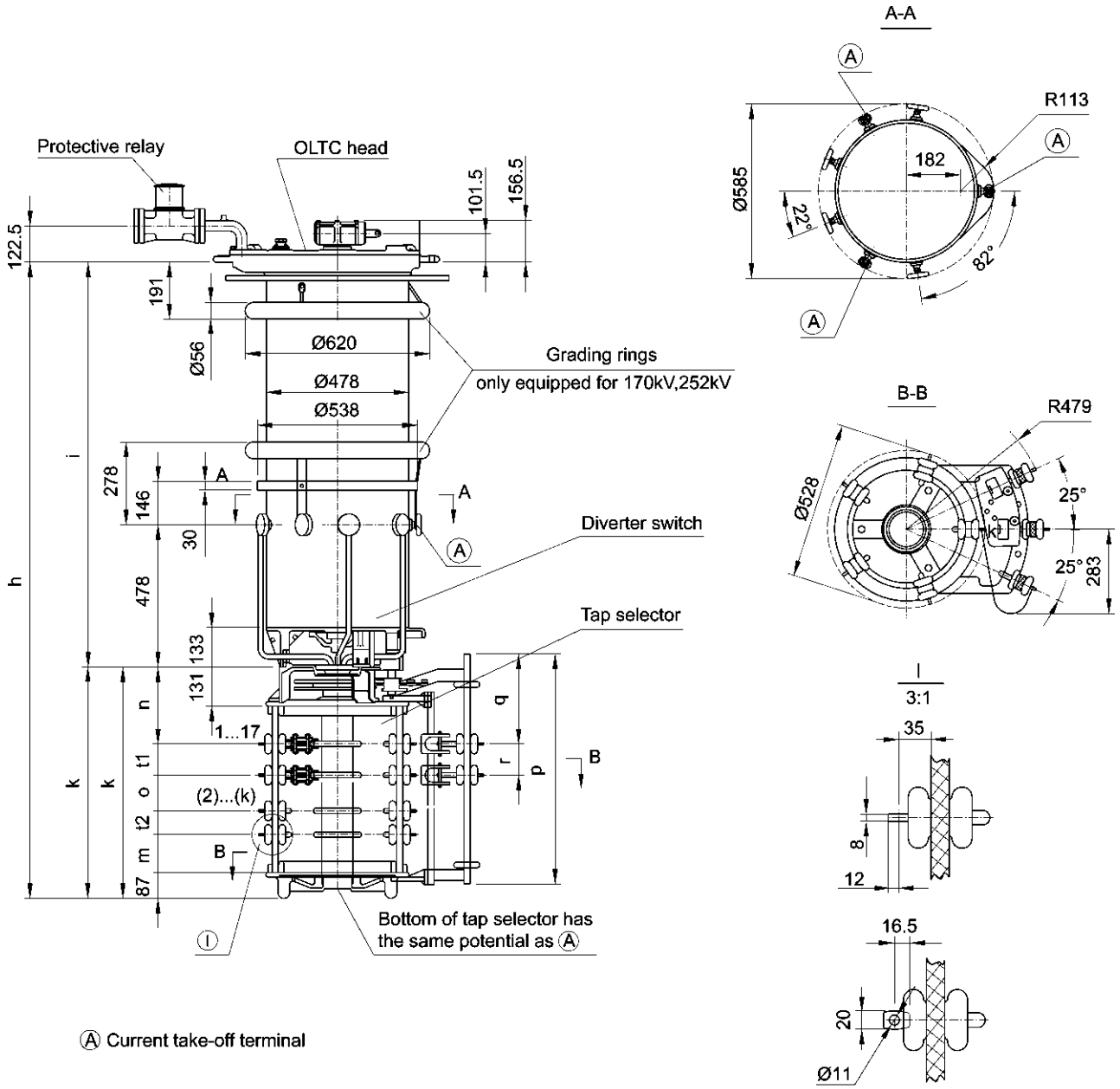
Ⓐ Current take-off terminal

Ⓛ Potential connection (only for OLTC with reversing switch and 3 middle positions such as 10193W...18353W)

Model		CMI800-72.5-252/B				CMI800-72.5-252/C				CMI800-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1702	1832	1962	2062	1777	1907	2037	2137	1972	2102	2232	2332
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	702				777				972			
	n	233				258				323			
	o	95				120				185			
	m	102				127				192			
	t1	105				105				105			
	t2	80				80				80			
	r	105				105				105			
	q	160				185				250			
	p	588				663				858			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		195	220	240	260	196	221	241	261	199	224	244	264
Weight (kg)		265				270				275			

Unit: mm

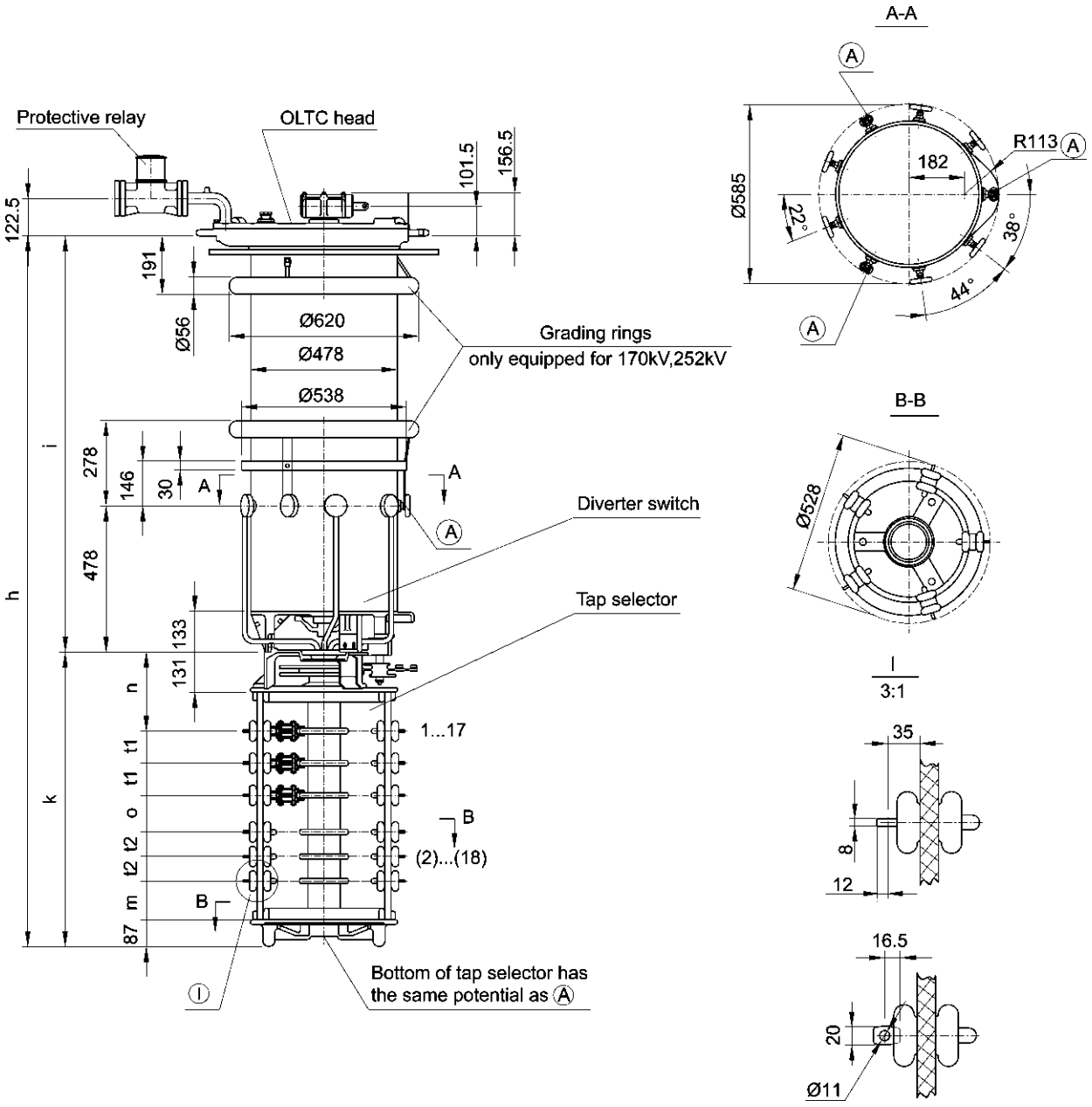
9.12. CM I 800 with coarse change-over selector, overall dimensions



Model		CM I 800-72.5-252/B				CM I 800-72.5-252/C				CM I 800-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1702	1832	1962	2062	1777	1907	2037	2137	1972	2102	2232	2332
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	702				777				972			
	n	233				258				323			
	o	95				120				185			
	m	102				127				192			
	t1	105				105				105			
	t2	80				80				80			
	r	105				105				105			
	q	276.5				301.5				366.5			
	p	697				772				967			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		196	221	241	261	196	221	241	261	199	224	244	264
Weight (kg)		270				270				280			

Unit: mm

9.13. CM I 1200 / 1500 without change-over selector, overall dimensions

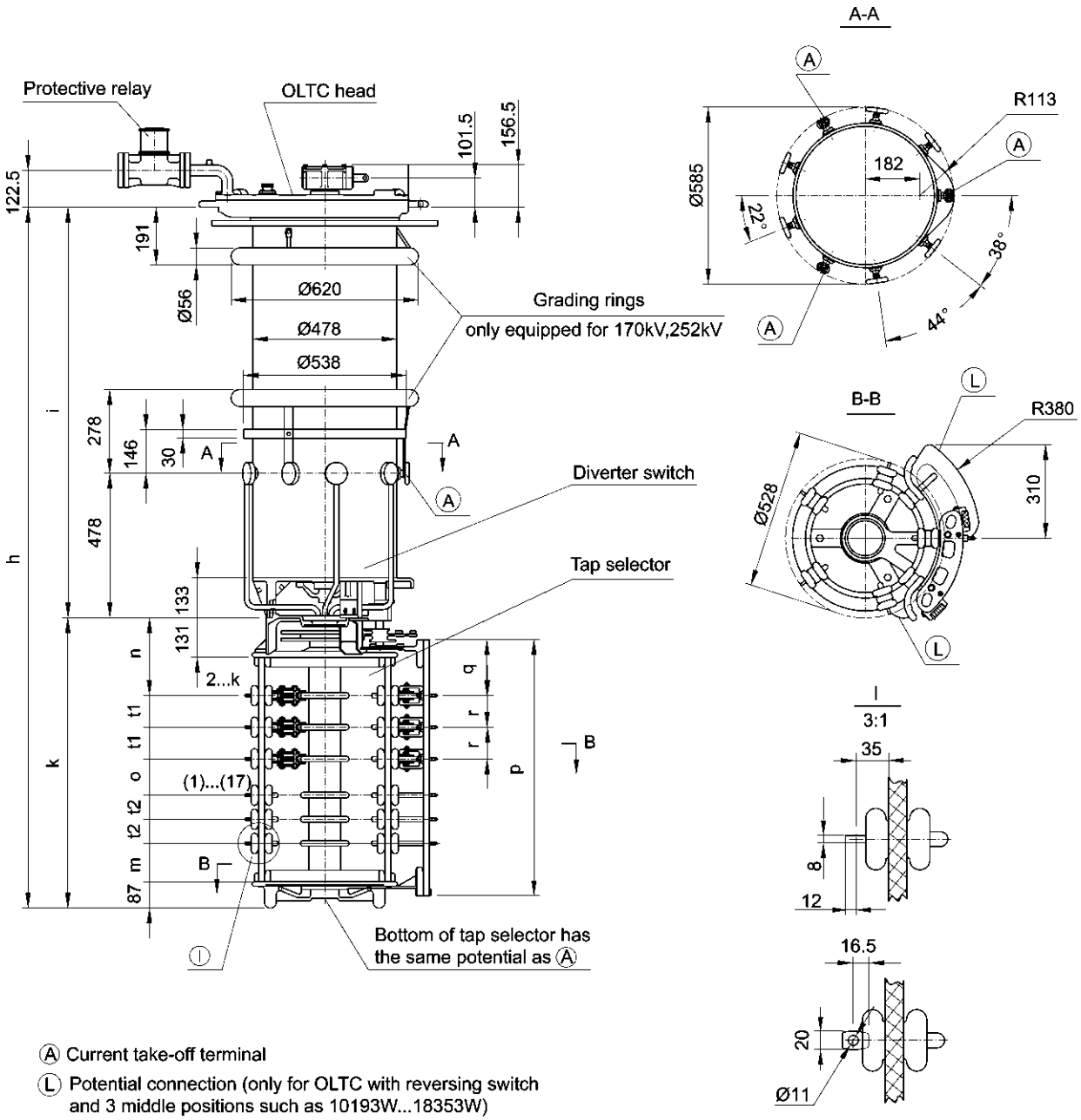


Ⓐ Current take-off terminal

Model		CMI 1200/1500-72.5-252/B				CMI 1200/1500-72.5-252/C				CMI 1200/1500-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1887	2017	2147	2247	1962	2092	2222	2322	2157	2287	2417	2517
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	887				962				1157			
	n	233				258				323			
	o	95				120				185			
	t1	105				105				105			
	t2	80				80				80			
	m	102				127				192			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		194	219	239	259	194	219	239	259	195	221	241	261
Weight (kg)		260				260				270			

Unit: mm

9.14. CM I 1200 / 1500 with reversing switch, overall dimensions



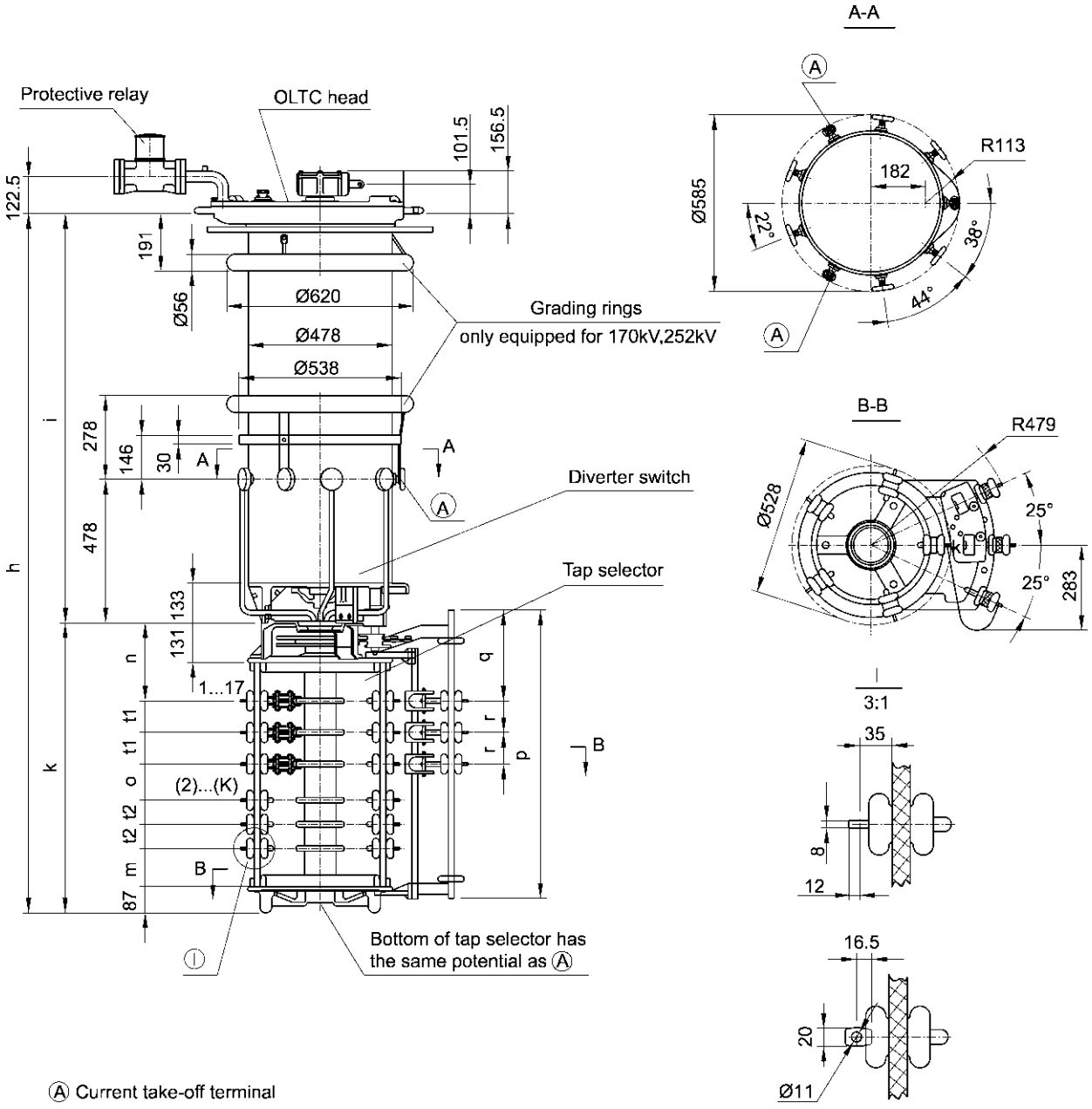
Ⓐ Current take-off terminal

Ⓛ Potential connection (only for OLTC with reversing switch and 3 middle positions such as 10193W...18353W)

Model		CMI 1200/1500-72.5-252/B				CMI 1200/1500-72.5-252/C				CMI 1200/1500-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1887	2017	2147	2247	1962	2092	2222	2322	2157	2287	2417	2517
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	887				962				1157			
	n	233				258				323			
	o	95				120				185			
	t1	105				105				105			
	t2	80				80				80			
	m	102				127				192			
	r	105				105				105			
	q	160				185				250			
	p	773				848				1043			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		199	224	244	264	200	225	245	265	202	227	247	267
Weight (kg)		280				280				290			

Unit: mm

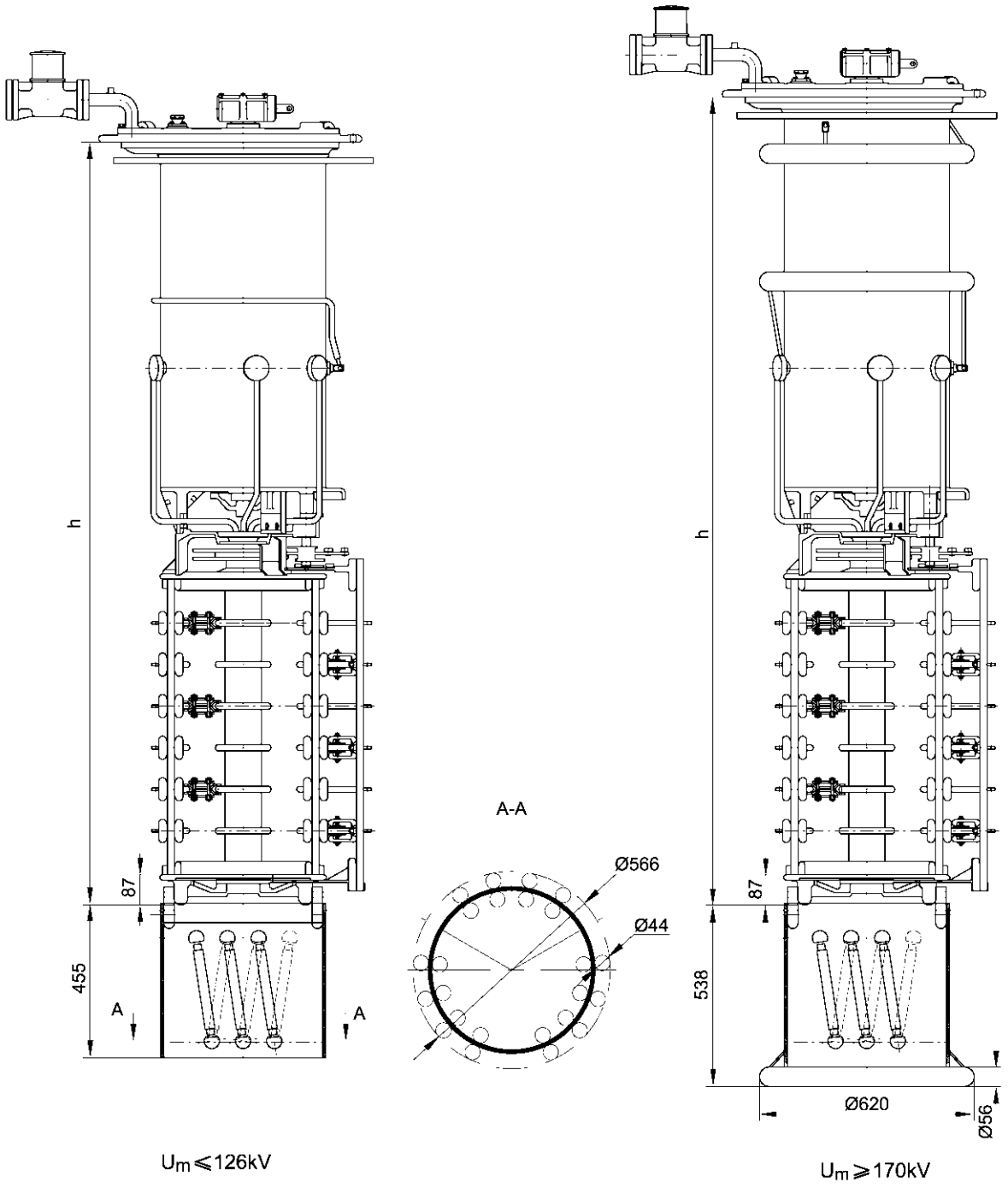
9.15. CM I 1200 / 1500 with coarse change-over selector, overall dimensions



Model		CM I 1200/1500-72.5-252/B				CM I 1200/1500-72.5-252/C				CM I 1200/1500-72.5-252/D(DE)			
U_m in kV		72.5	126	170	252	72.5	126	170	252	72.5	126	170	252
Dimensions (mm)	h	1887	2017	2147	2247	1962	2092	2222	2322	2157	2287	2417	2517
	i	1000	1130	1260	1360	1000	1130	1260	1360	1000	1130	1260	1360
	k	887				962				1157			
	n	233				258				323			
	o	95				120				185			
	t1	105				105				105			
	t2	80				80				80			
	m	102				127				192			
	r	105				105				105			
	q	276.5				301.5				366.5			
	p	882				957				1152			
Oil filling (dm³)		130	150	170	190	130	150	170	190	130	150	170	190
Displacement (dm³)		200	225	245	265	200	225	245	265	204	229	249	269
Weight (kg)		285				285				295			

Unit: mm

9.16. CM OLTC mounted with tie-in resistor, overall dimensions



$U_m \leqslant 126kV$

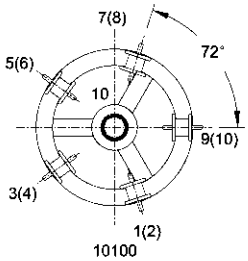
$U_m \geqslant 170kV$

h——the OLTC height excluding tie-in resistor

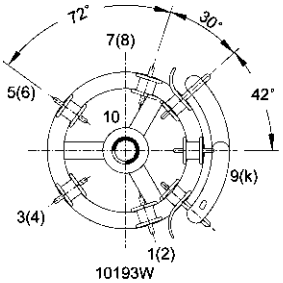
Special design may depend on the requirement

Unit: mm

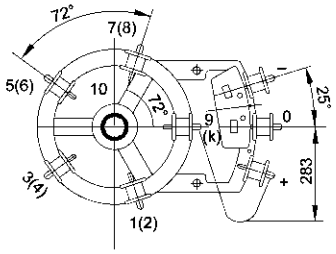
9.17. CM tap selector contacts arrangement



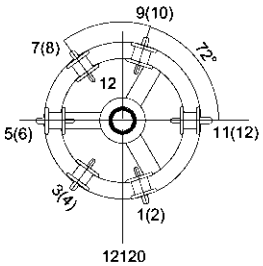
10100
(9Steps)



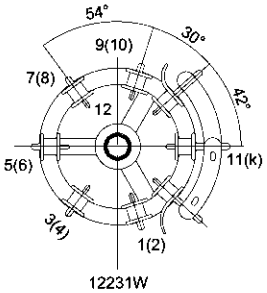
10193W
(±Steps)



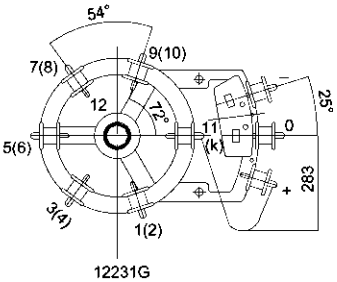
10193G
(±8Steps)



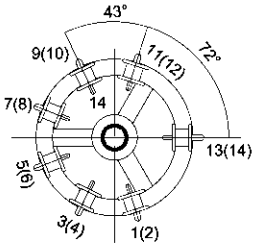
12120
(11Steps)



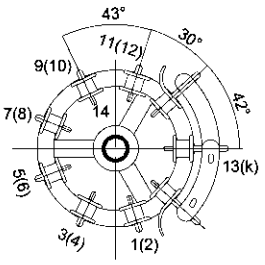
12231W
(±11Steps)



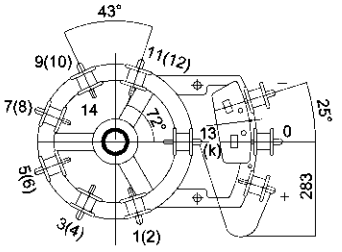
12231G
(±11Steps)



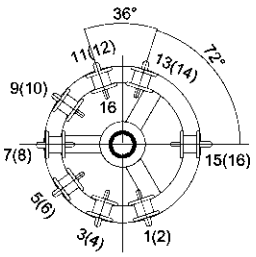
14140
(13Steps)



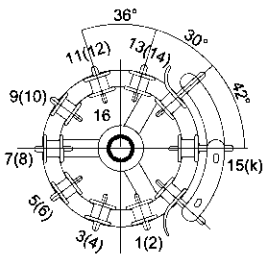
14271W
(±13Steps)



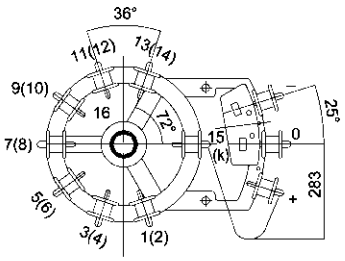
14271G
(±13Steps)



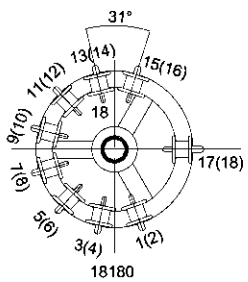
16160
(15Steps)



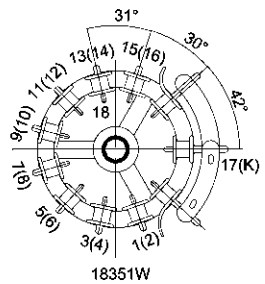
16311W
(±15Steps)



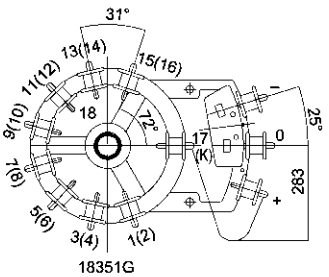
16311G
(±15Steps)



18180
(17Steps)



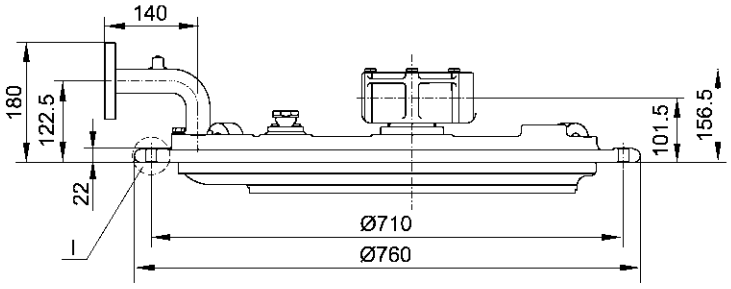
18351W
(±17Steps)

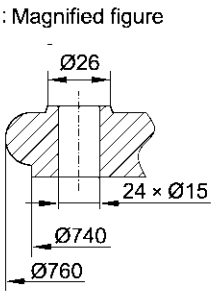


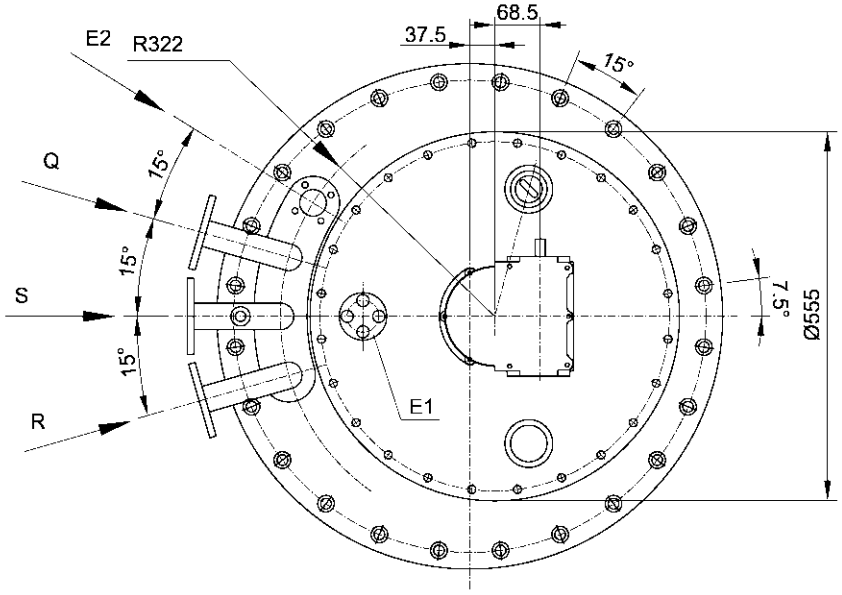
18351G
(±17Steps)

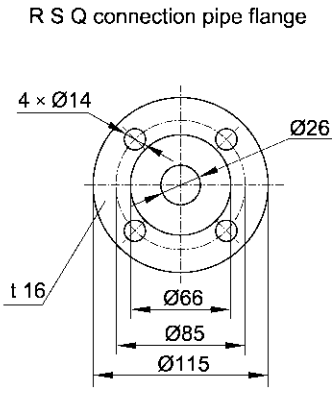
Unit: mm

9.18. CM OLTC head flange for standard tank type, overall dimensions





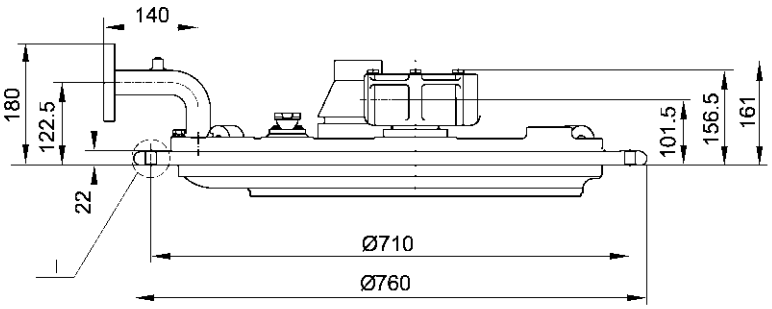




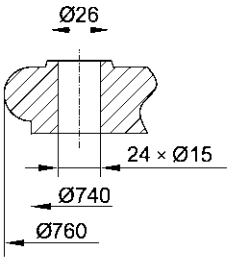
E1: Bleeding for on-load tap changer
E2: Bleeding for transformer oil tank
R: Connection flange for protective relay
S: Connection flange for oil suction pipe
Q: Connection flange for oil return pipe

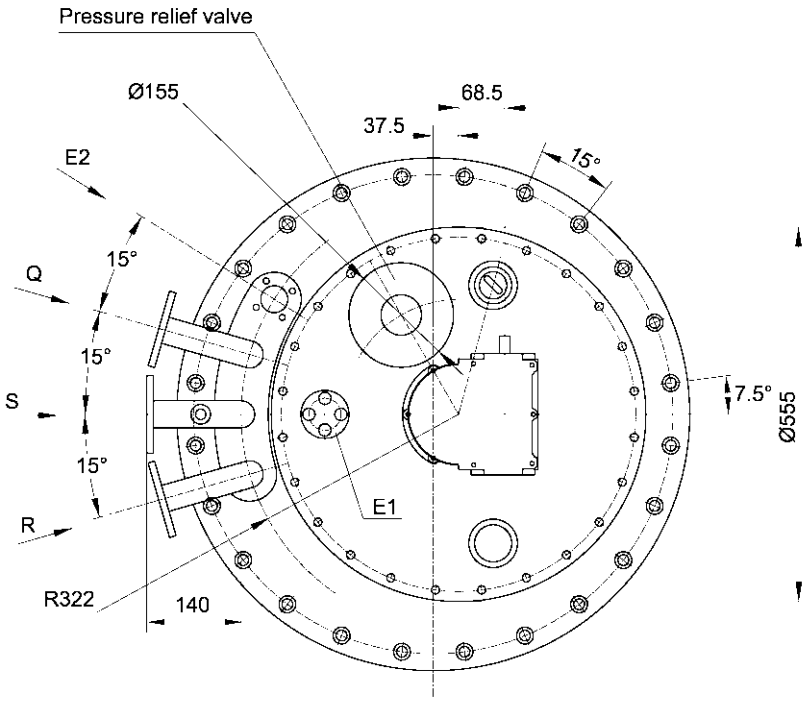
Unit: mm

9.19. CM OLTC head flange with pressure relief valve, overall dimensions

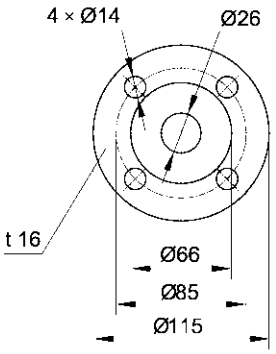


I: Magnified figure





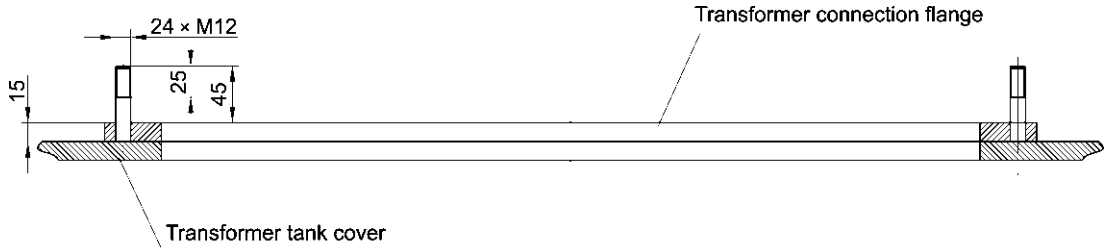
R S Q connection pipe flange

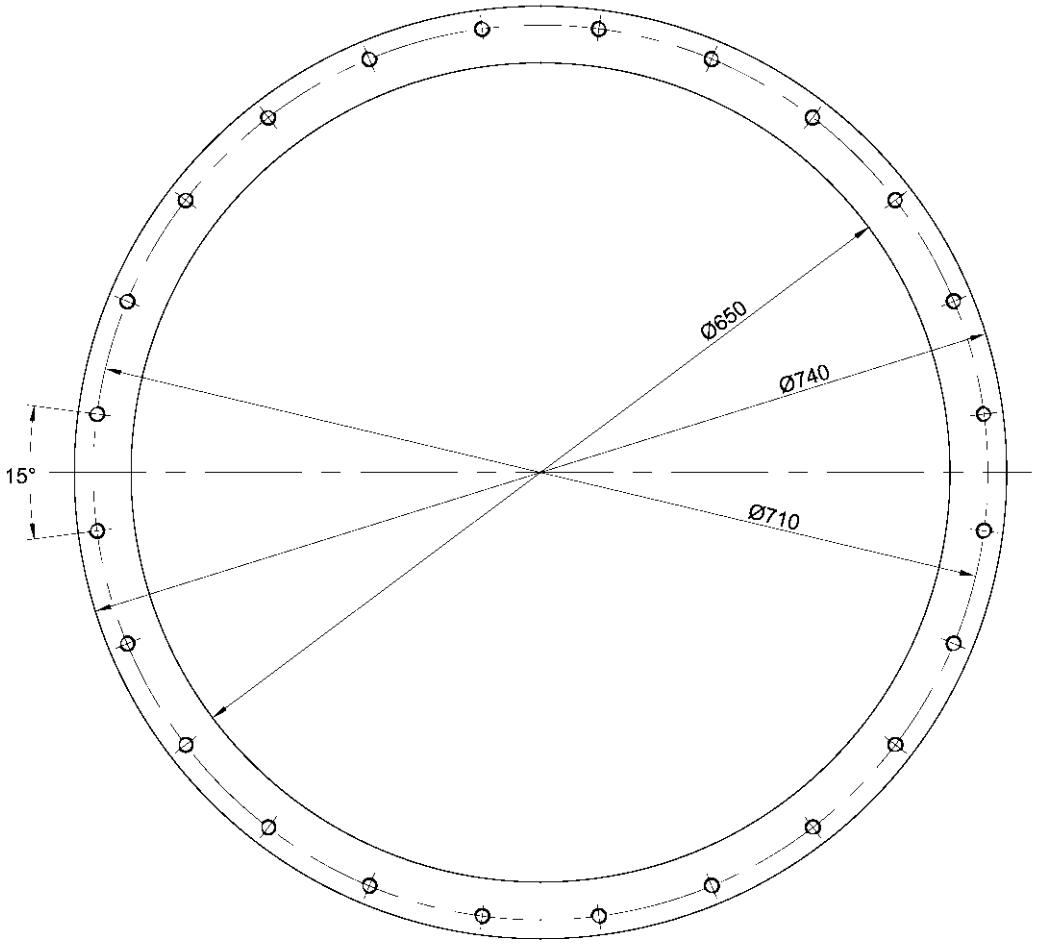


E1: Bleeding for on-load tap changer
E2: Bleeding for transformer oil tank
R: Connection flange for protective relay
S: Connection flange for oil suction pipe
Q: Connection flange for oil return pipe

Unit: mm

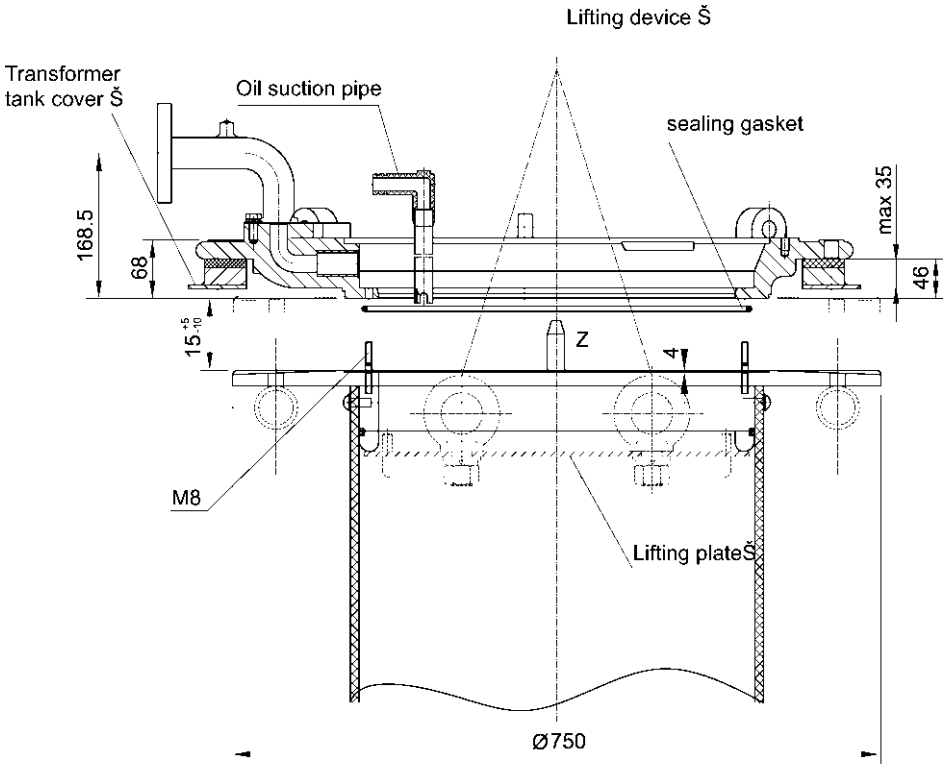
9.20. Transformer connection flange for CM OLTC, overall dimensions

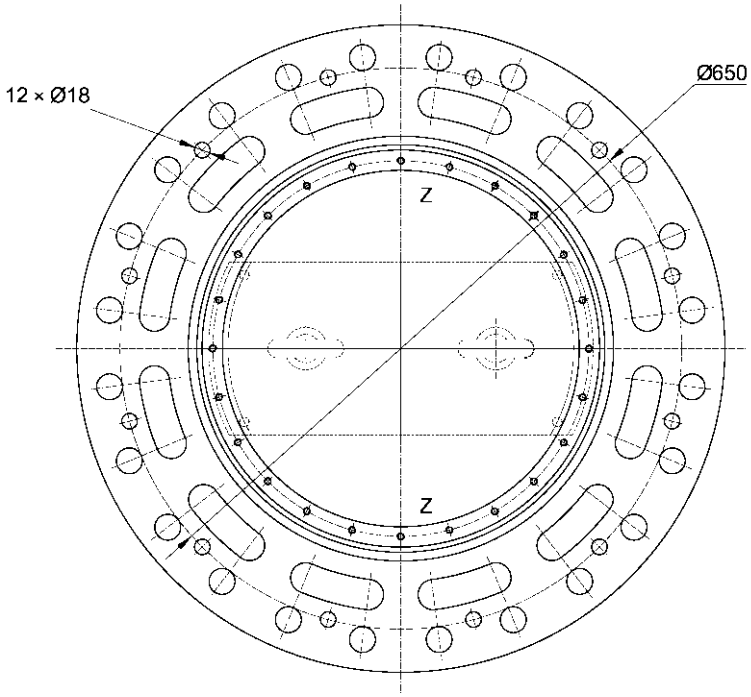




Unit: mm

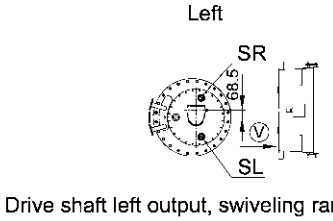
9.21. CM OLTC head flange installation for bell-type, overall dimensions



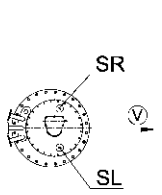


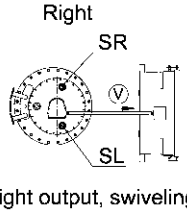
Unit: mm

9.22. Upper gear unit, arrangement and swiveling range

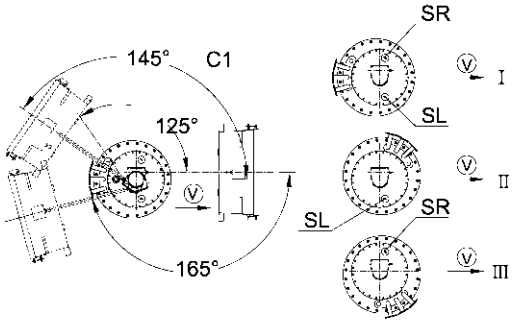


Drive shaft left output, swiveling range

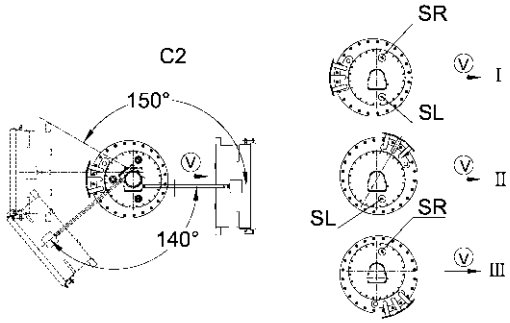




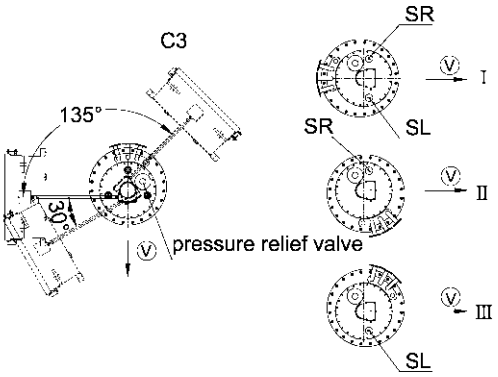
Drive shaft right output, swiveling range



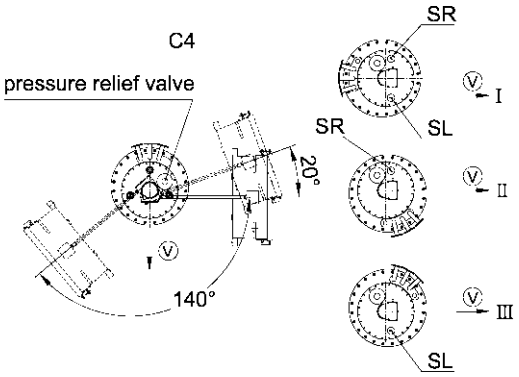
Drive shaft left output, with pressure relief valve, swiveling range



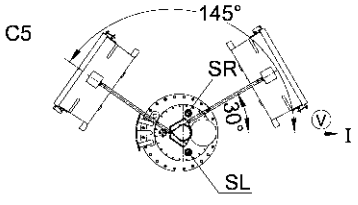
Drive shaft right output, with pressure relief valve, swiveling range

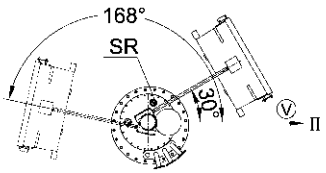


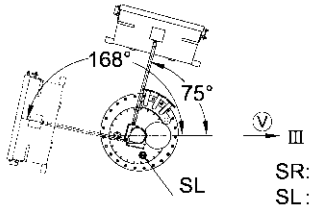
Drive shaft left output, with elevated holder for pressure relief valve, swiveling range

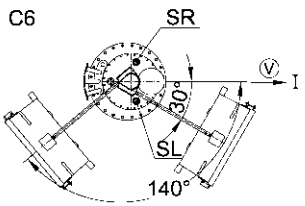


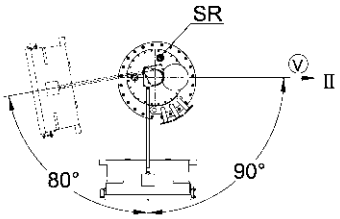
Drive shaft right output, with elevated holder for pressure relief valve, swiveling range

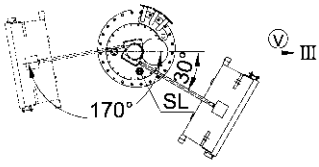








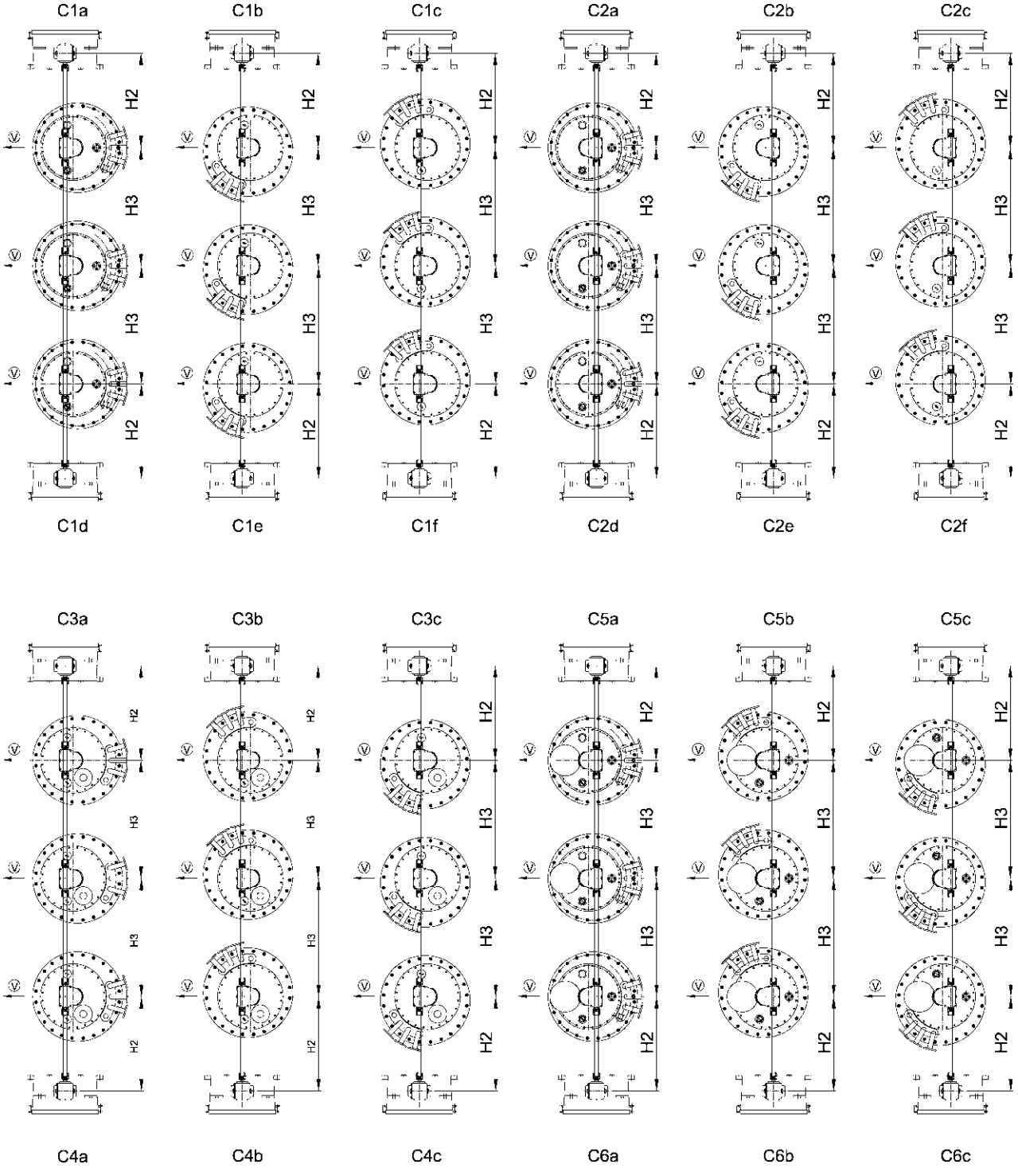




SR: Inspection window on the right
SL: Inspection window on the left
Ⓥ: Tap selector driving side

Unit: mm

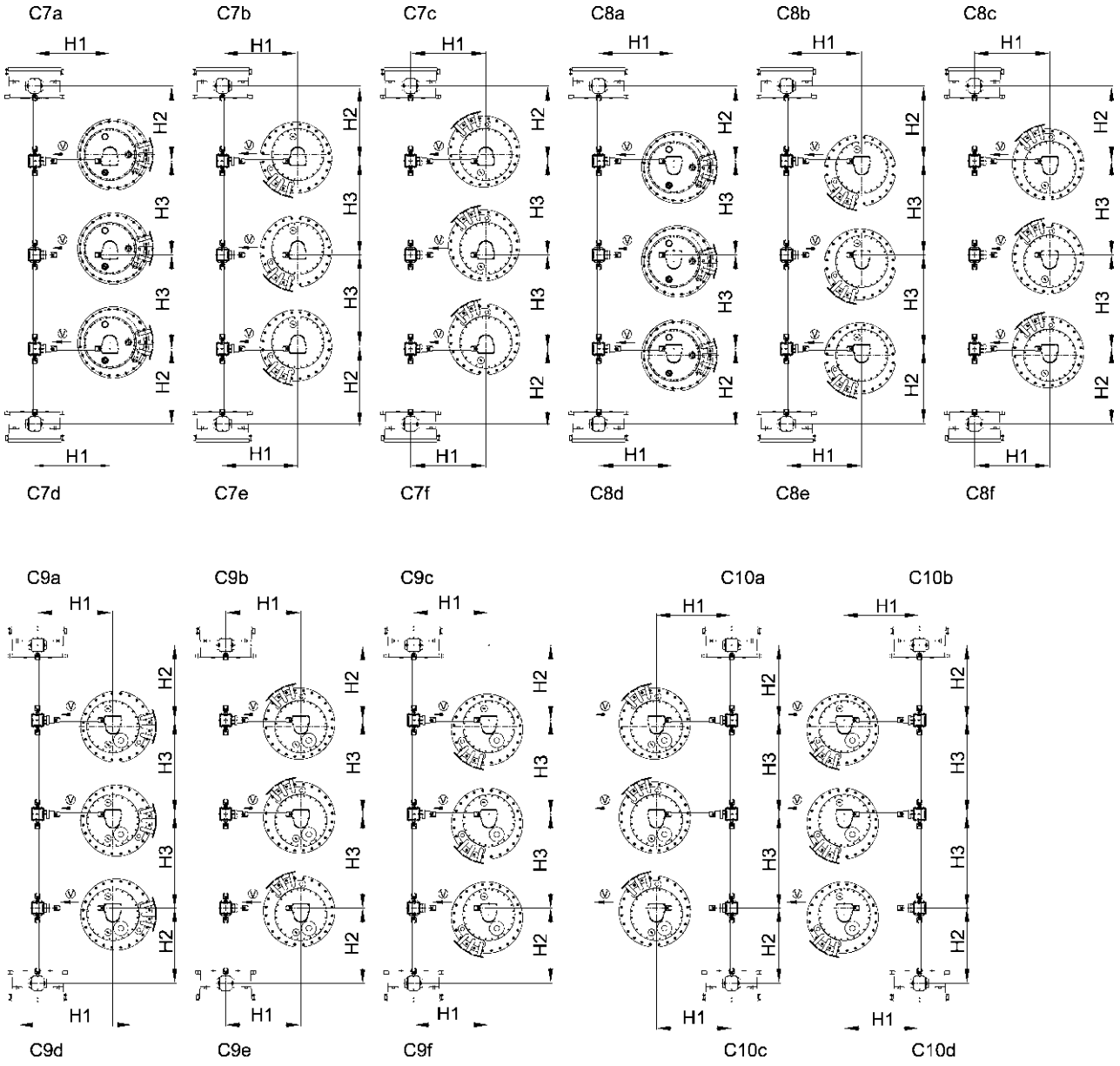
9.23-1. CM OLTC arrangement drawing-1



Item \ Dimensions	H1>	H2>	H3>
Min. mechanical size	535	515	840

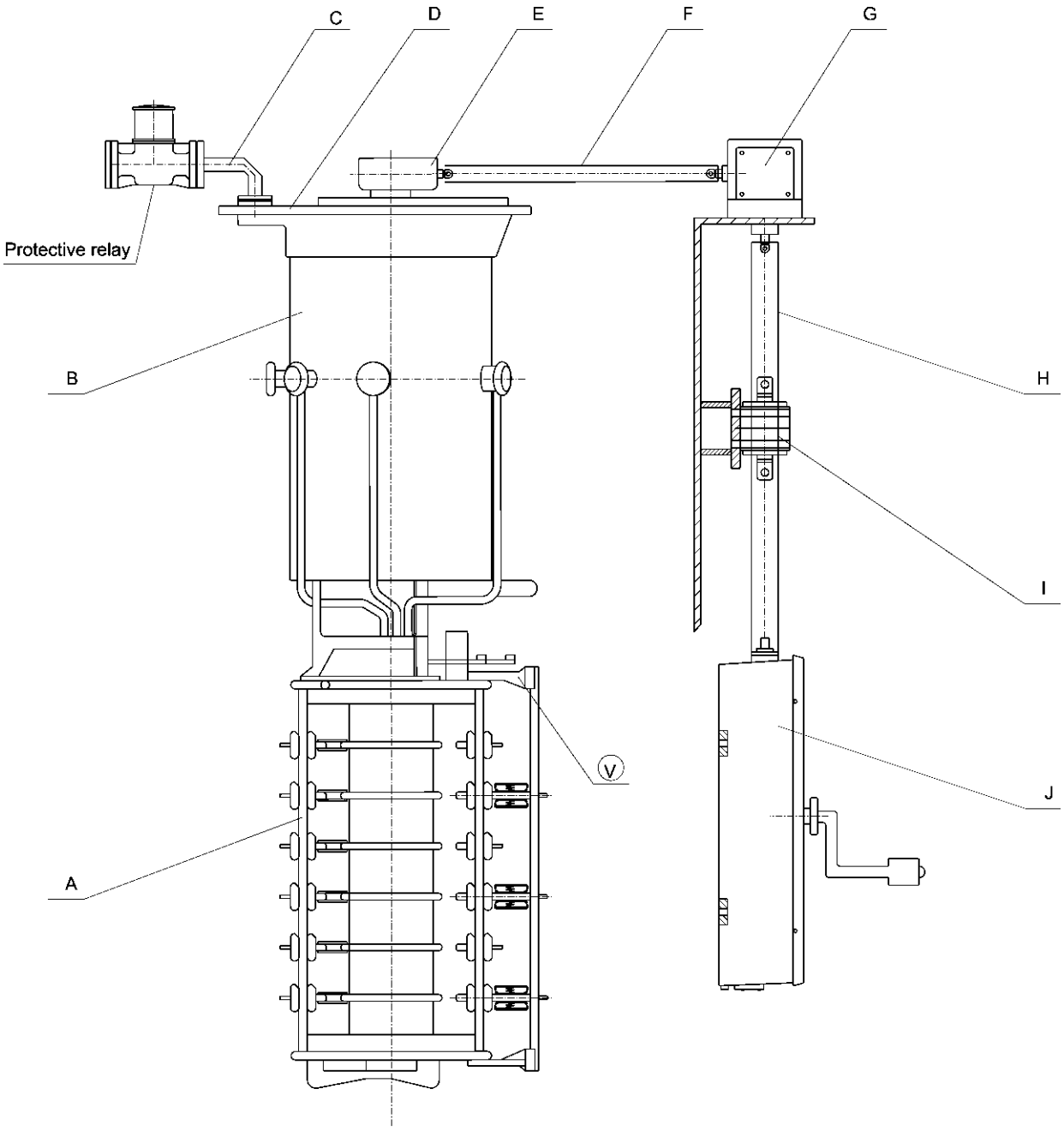
Unit: mm

9.23-2. CM OLTC arrangement drawing-2



Item \ Dimensions	H1>	H2>	H3>
Min. mechanical size	535	515	840

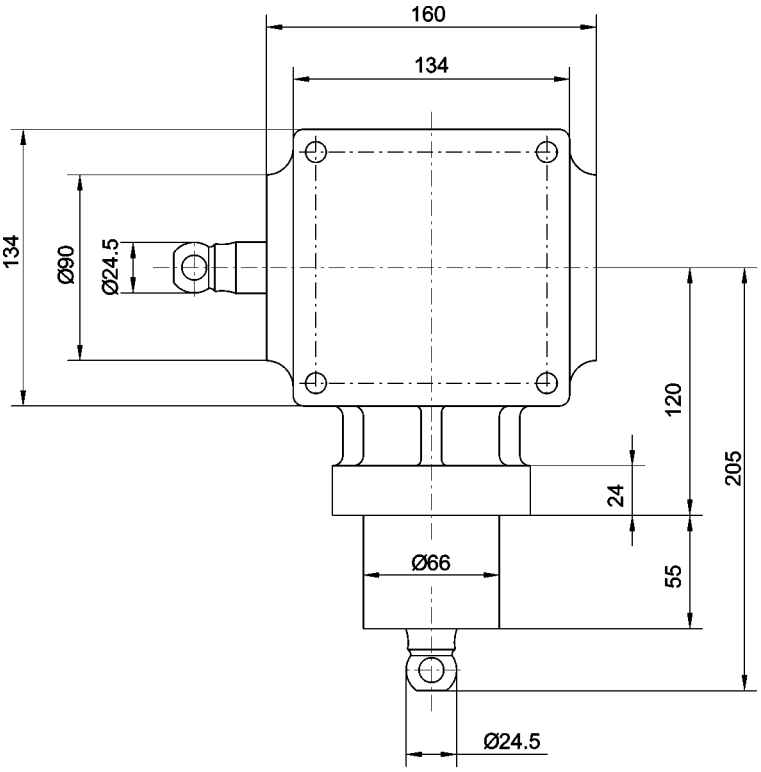
Unit: mm

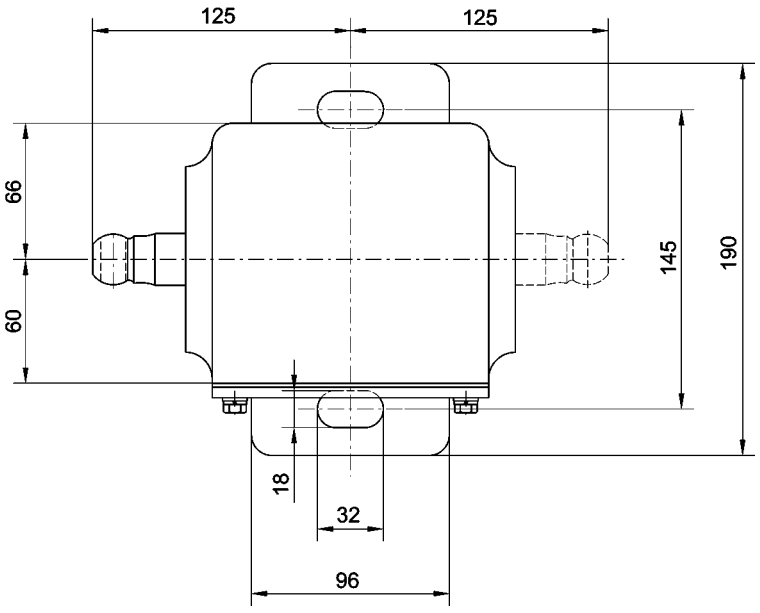


A: Tap selector
B: Diverter switch oil compartment
C: Pipe connections (R,S,Q,E2)
D: Tap changer head cover
E: Upper gear unit
F: Horizontal drive shaft
G: Bevel gear unit
H: Vertical drive shaft
I: Intermediate bearing (applied when shaft >2000mm only)
J: Motor drive unit
V: Driving side of tap selector

Unit: mm

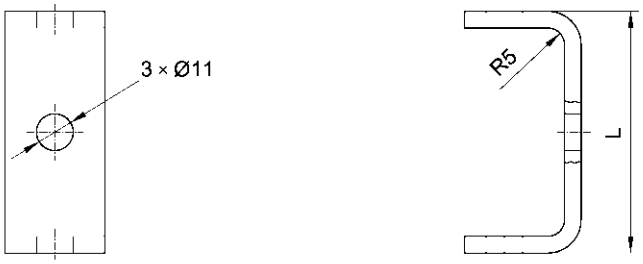
9.25. Bevel gear unit, overall & installation dimensions

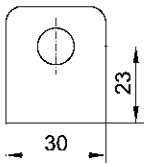




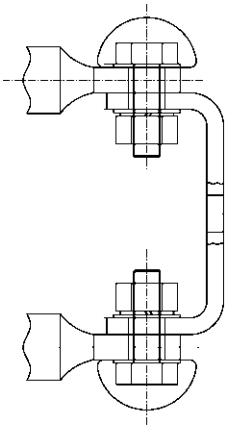
Unit: mm

9.26. CM I 800 / 1200 / 1500 OLTC, parallel connection plate of tap selector terminals, overall dimensions

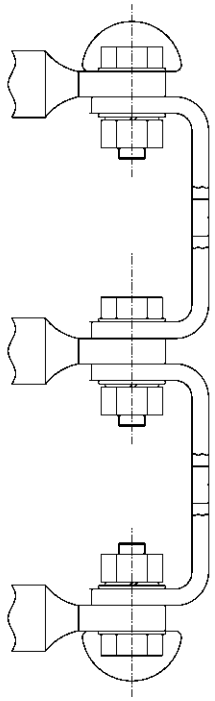




Connection plate



CM I 800 contacts connection drawing

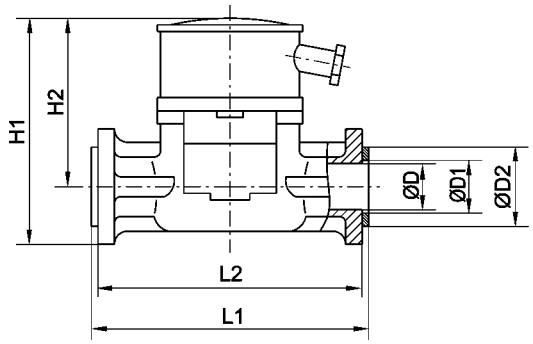


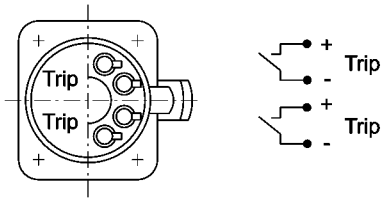
CM I 1200/1500 contacts connection drawing

Unit: mm

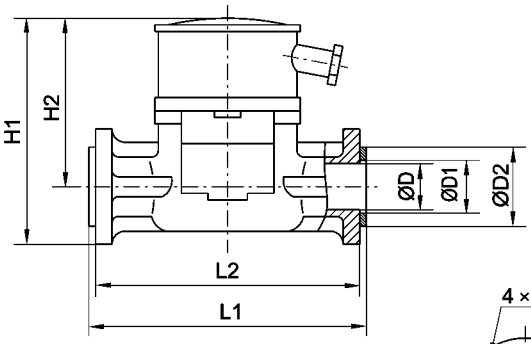
9.27. Protective relay, overall & installation dimensions

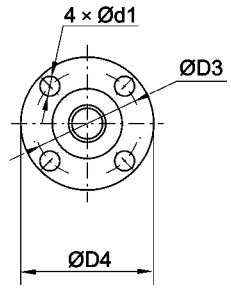
Type QJ6-25 protective relay

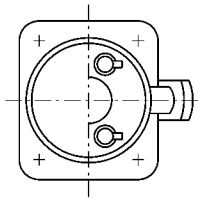


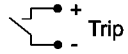


Type QJ4G-25 protective relay









Model	D	D1	D2	D3	D4	d1	H1	H2	L1	L2	Remark
QJ4G-25	25	35	65	85	115	14	195	133	208	200	With one pair of trip signal
QJ6-25	25	35	65	85	115	14	215	153	208	200	With two pairs of trip signals

Unit: mm

9.28. CM OLTC with multiple coarse and fine tap selector

To meet demand of industrial development, the industrial transformers are needed to provide widely voltage regulation range, CM OLTC can be designed with 106 steps for multiple and fine regulation.

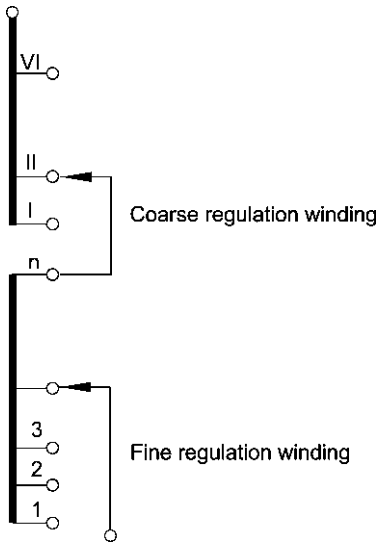
The general performances of CM on-load tap changer with multiple coarse and fine tap selector is the same as regular models of CM tap changer.

For CM on-load tap changer with multiple coarse and fine regulation, the number of regulation steps can be obtained according to combinations of fine taps and coarse taps, see table 5 below

Table 5 Combinations of Fine Taps and Coarse Taps

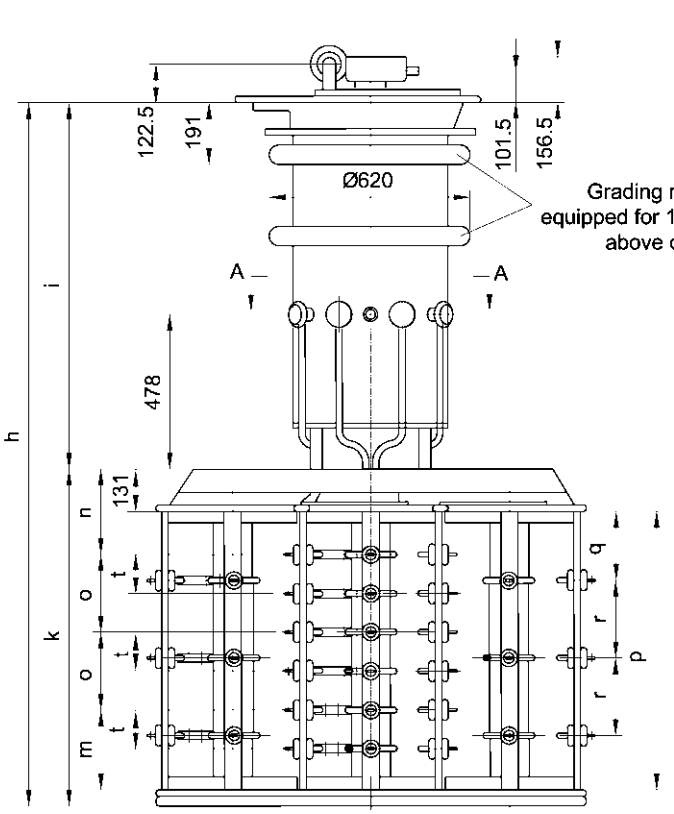
Operation positions / No. of fine tap positions / No. of coarse tap positions	10	12	14	16	18
3	29	35	41	47	53
4	39	47	55	63	71
5	49	59	69	79	89
6	59	71	83	95	107

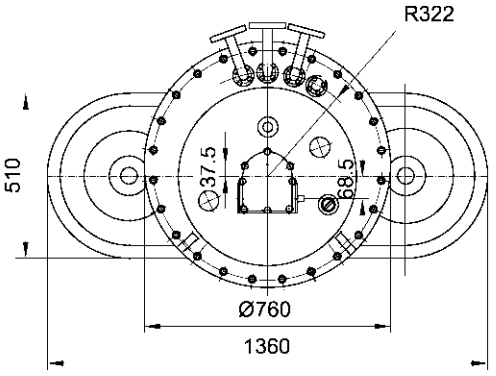
Principle diagram of wiring



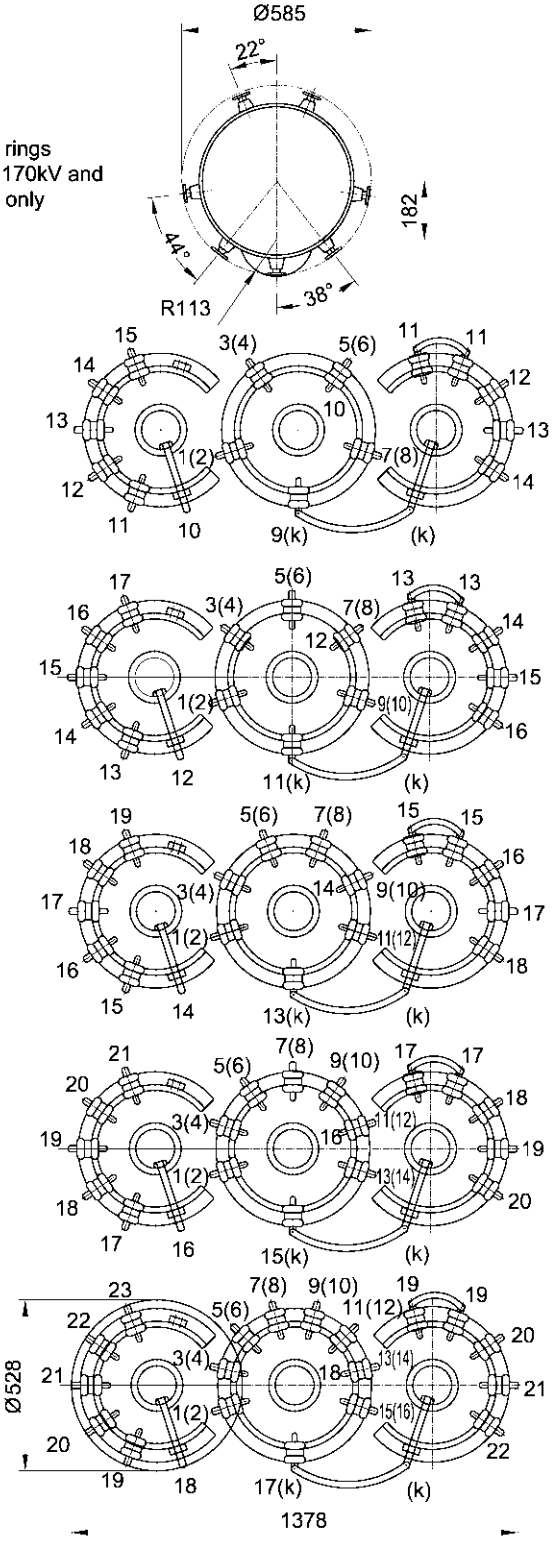
Unit: mm

9.29. CM III 500Y/600Y with multiple coarse and fine tap selector, overall dimensions





A-A section view

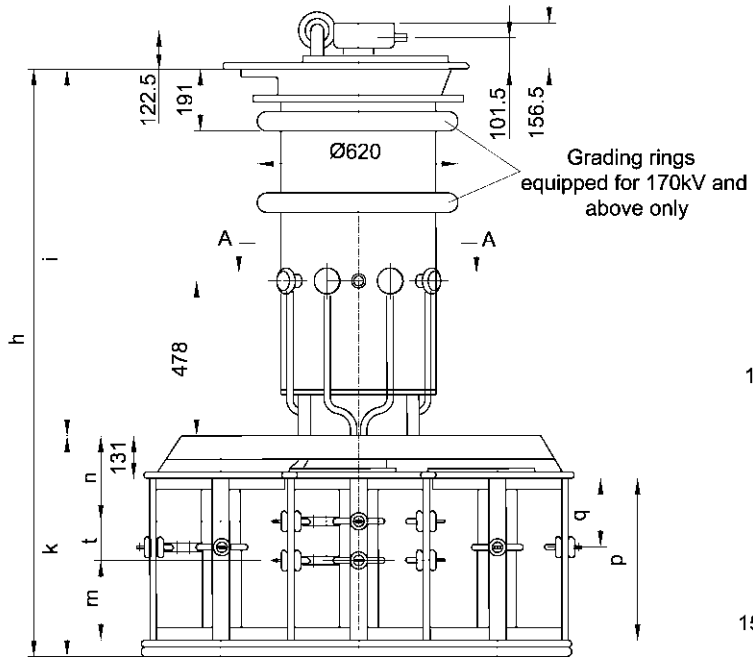


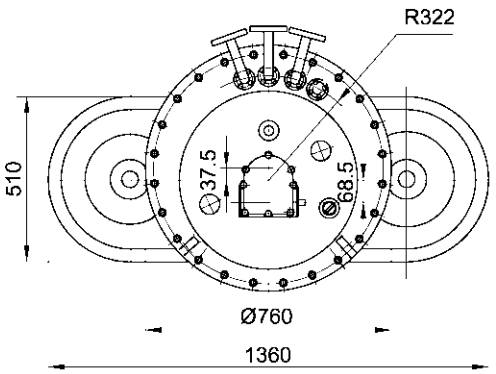
Model		CMIII500Y/600Y-72.5-252B				CMIII500Y/600Y-72.5-252C			
The highest voltage for equipment (kV)		72.5	126	170	252	72.5	126	170	252
Dimensions	h	1860	1990	2120	2220	2035	2165	2295	2395
	i	1000	1130	1260	1360	1000	1130	1260	1360
	k	860				1035			
	n	233				258			
	o	190				240			
	t	95				120			
	m	197				247			
	r	166				210			
	q	173				217			
	p	679				854			

1, 3, 5 —— Upper layer terminal numbers of tap selector
(2),(4),(6) —— Lower layer terminal numbers of tap selector

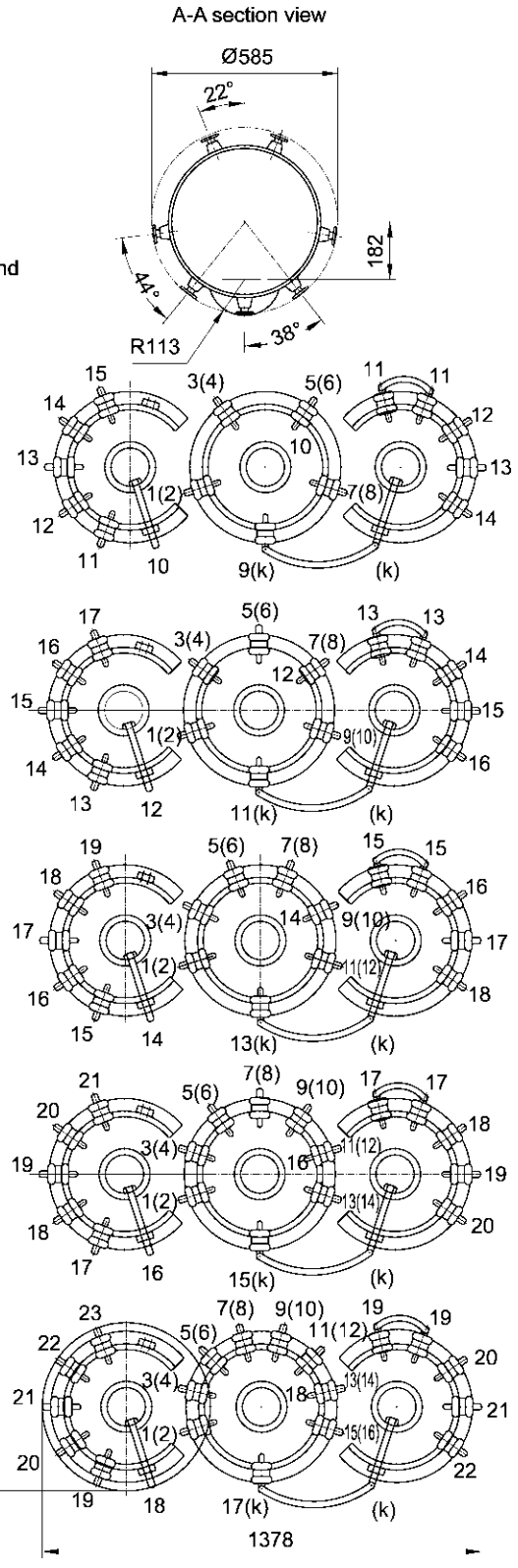
Unit: mm

9.30. CM I 500/600 with multiple coarse and fine tap selector, overall dimensions





A-A section view

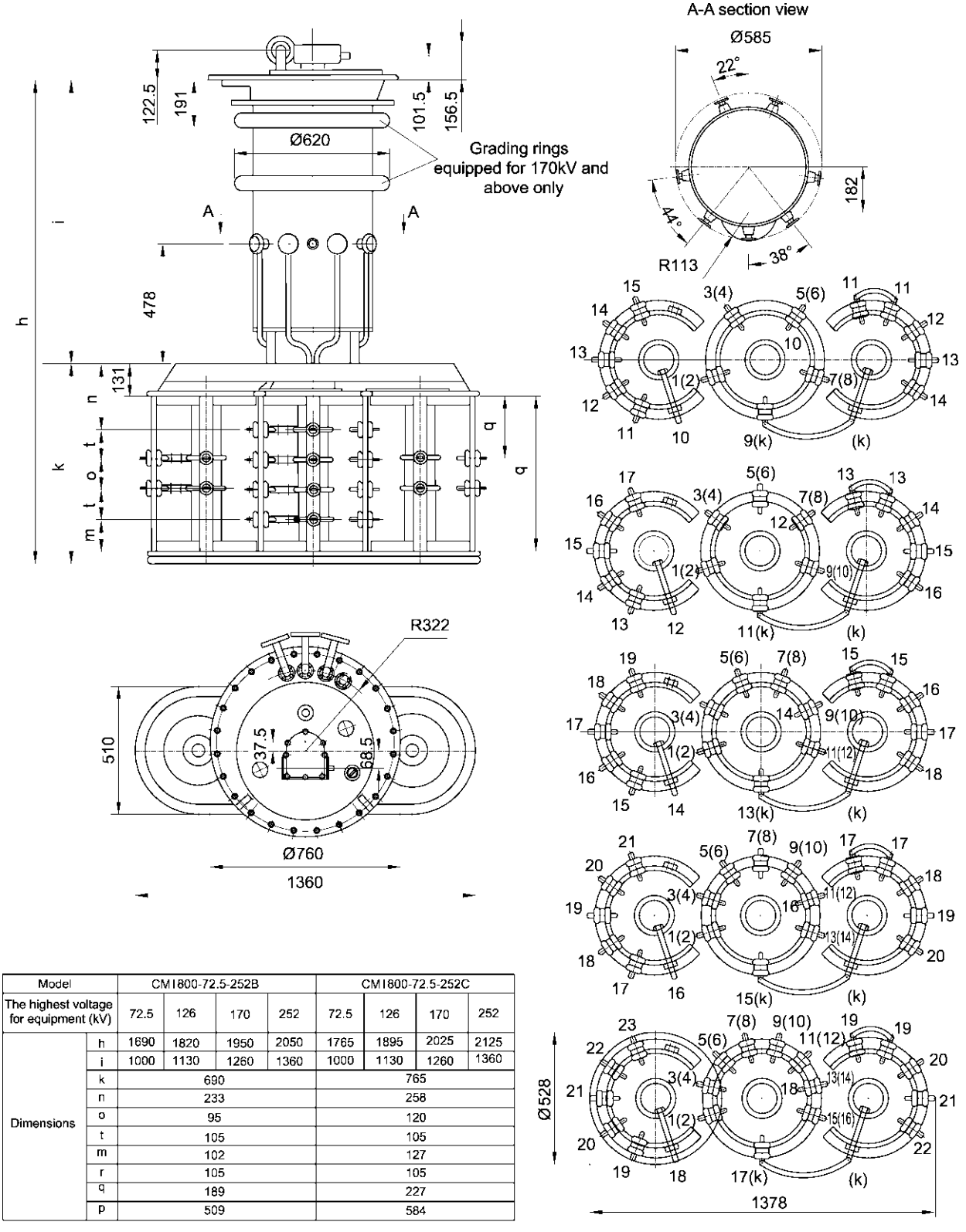


Model		CMI500/600-72.5-252B				CMI500/600-72.5-252C			
The highest voltage for equipment (kV)		72.5	126	170	252	72.5	126	170	252
Dimensions	h	1480	1610	1740	1840	1555	1685	1815	2067
	i	1000	1130	1260	1360	1000	1130	1260	1360
	k	480				555			
	n	233				258			
	t	95				120			
	m	102				127			
	q	149				187			
	p	299				374			

1, 3, 5 —— Upper layer terminal numbers of tap selector
(2),(4),(6) —— Lower layer terminal numbers of tap selector

Unit: mm

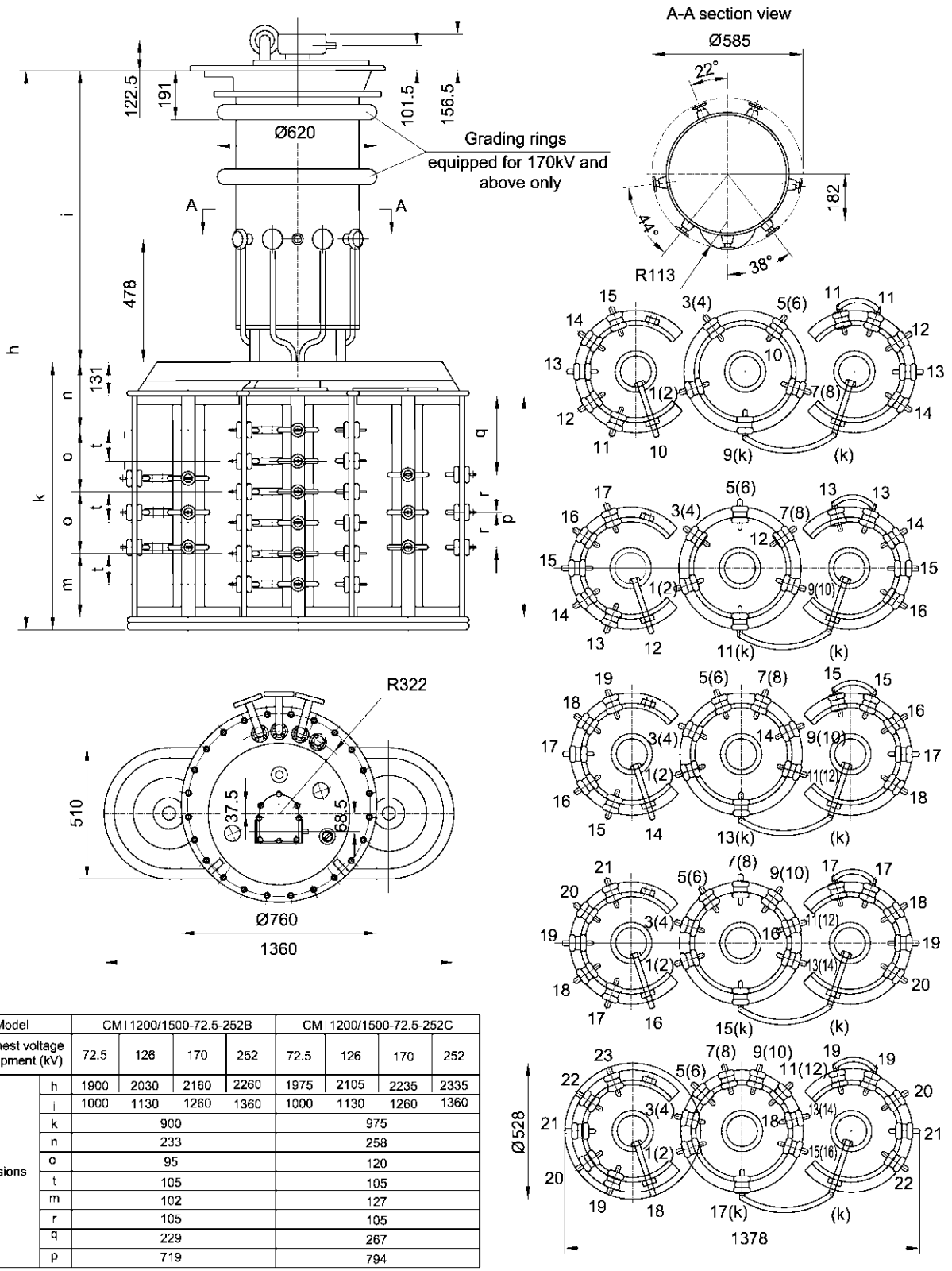
9.31. CM I 800 with multiple coarse and fine tap selector, overall dimensions



Model		CMI800-72.5-252B				CMI800-72.5-252C			
The highest voltage for equipment (kV)		72.5	126	170	252	72.5	126	170	252
Dimensions	h	1690	1820	1950	2050	1765	1895	2025	2125
	i	1000	1130	1260	1360	1000	1130	1260	1360
	k	690				765			
	n	233				258			
	o	95				120			
	t	105				105			
	m	102				127			
	r	105				105			
	q	189				227			
	p	509				584			

Unit: mm

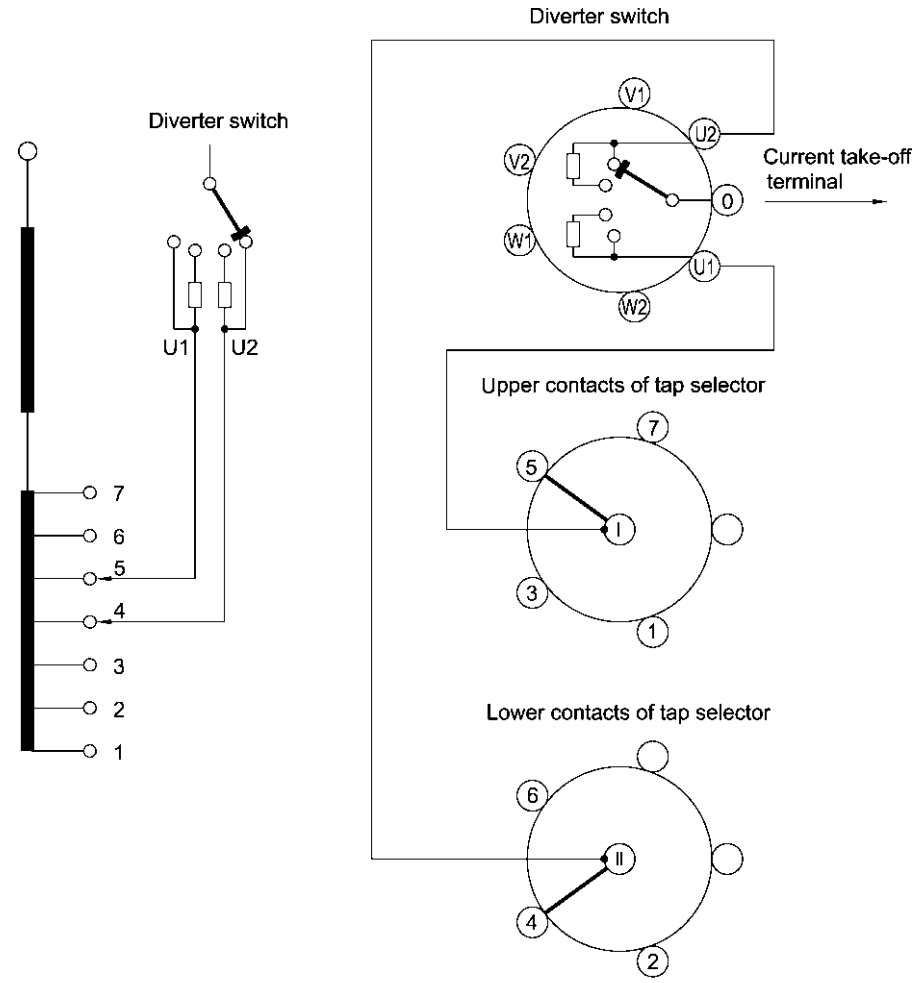
9.32. CM I 1200/1500 with multiple coarse and fine tap selector, overall dimensions



Model		CM I 1200/1500-72.5-252B				CM I 1200/1500-72.5-252C			
The highest voltage for equipment (kV)		72.5	126	170	252	72.5	126	170	252
Dimensions	h	1900	2030	2160	2260	1975	2105	2235	2335
	i	1000	1130	1260	1360	1000	1130	1260	1360
	k	900				975			
	n	233				258			
	o	95				120			
	t	105				105			
	m	102				127			
	r	105				105			
	q	229				267			
	p	719				794			

Unit: mm

9.33. CM(10070) operating position table and connection diagram



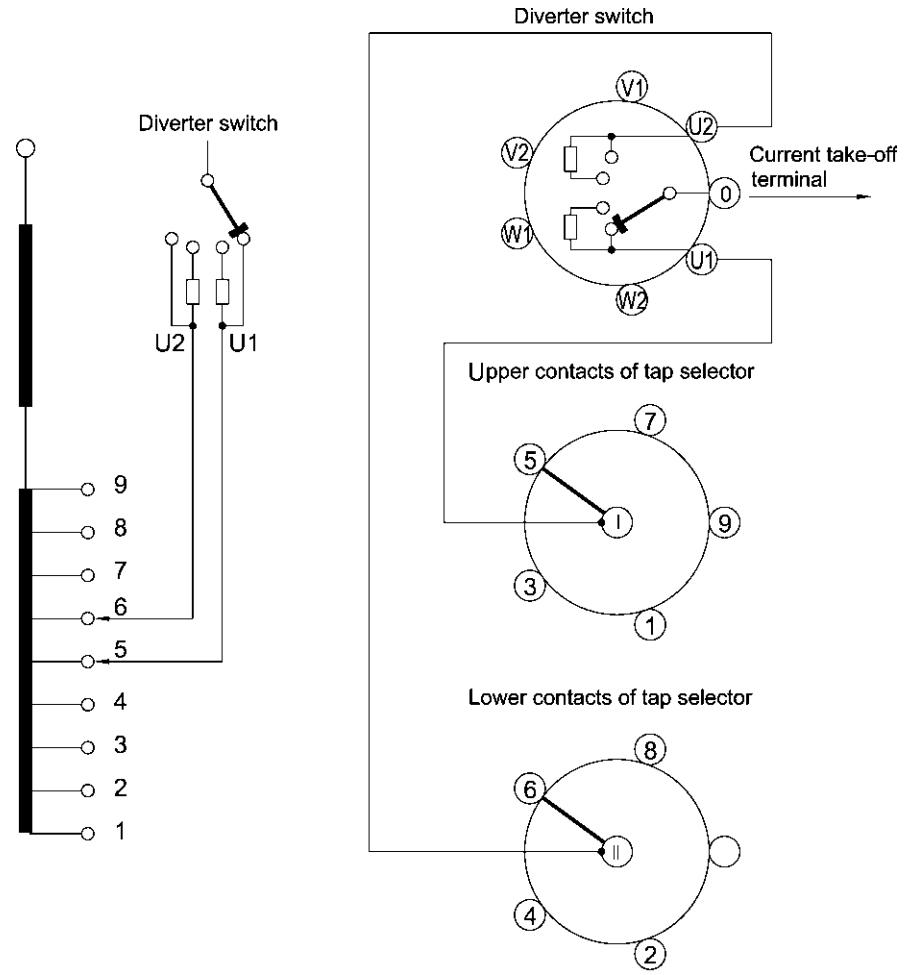
Operation position number	7
Different voltage number	7
Set position ●	4

Tap selector contact position	1	2	3	4	5	6	7
Display position	1	2	3	4	5	6	7

● ←

● Drawing is shown at the set position

9.34. CM(10090) operating position table and connection diagram

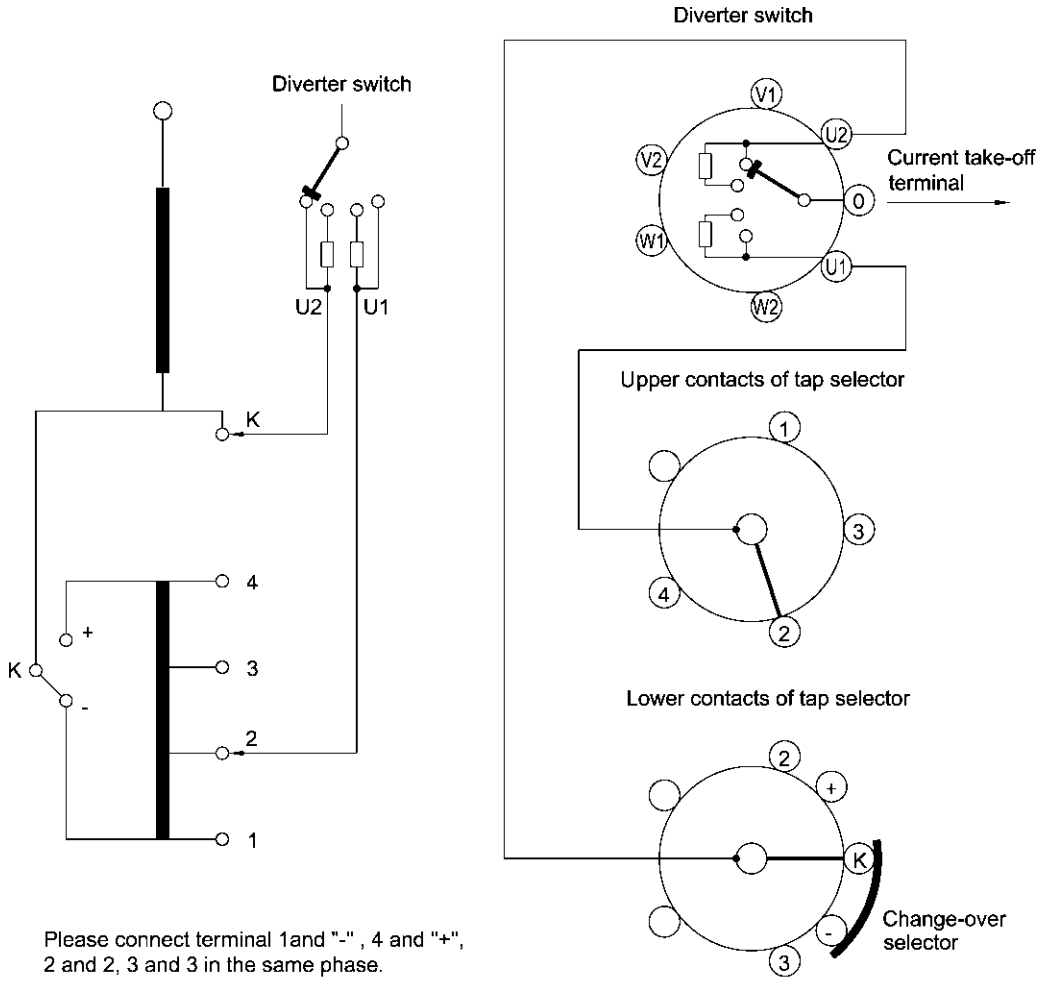


Operation position number	9
Different voltage number	9
Set position ●	5

Tap selector contact position	1	2	3	4	5	6	7	8	9
Display position	1	2	3	4	5	6	7	8	9

● Drawing is shown at the set position

9.35. CM(10071W) operating position table and connection diagram



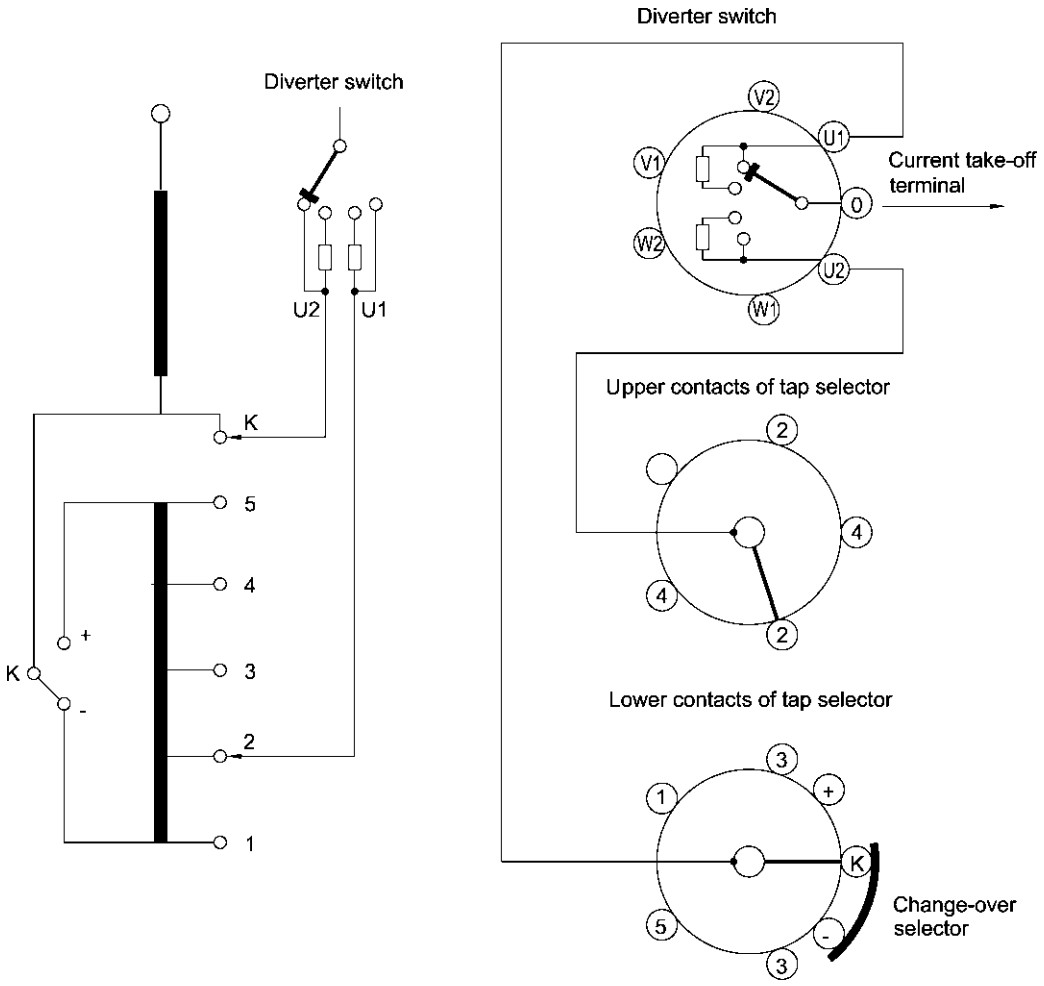
Please connect terminal 1and "-" , 4 and "+", 2 and 2, 3 and 3 in the same phase.

Operation position number	7
Different voltage number	7
Set position	4

Change-over selector location	K+				K-		
Tap changer position	1	2	3	4	5	6	7
Tap selector contact position	1	2	3	K	2	3	4
Display position	1	2	3	4	5	6	7

● Drawing is shown at the set position

9.36. CM(10091W) operating position table and connection diagram



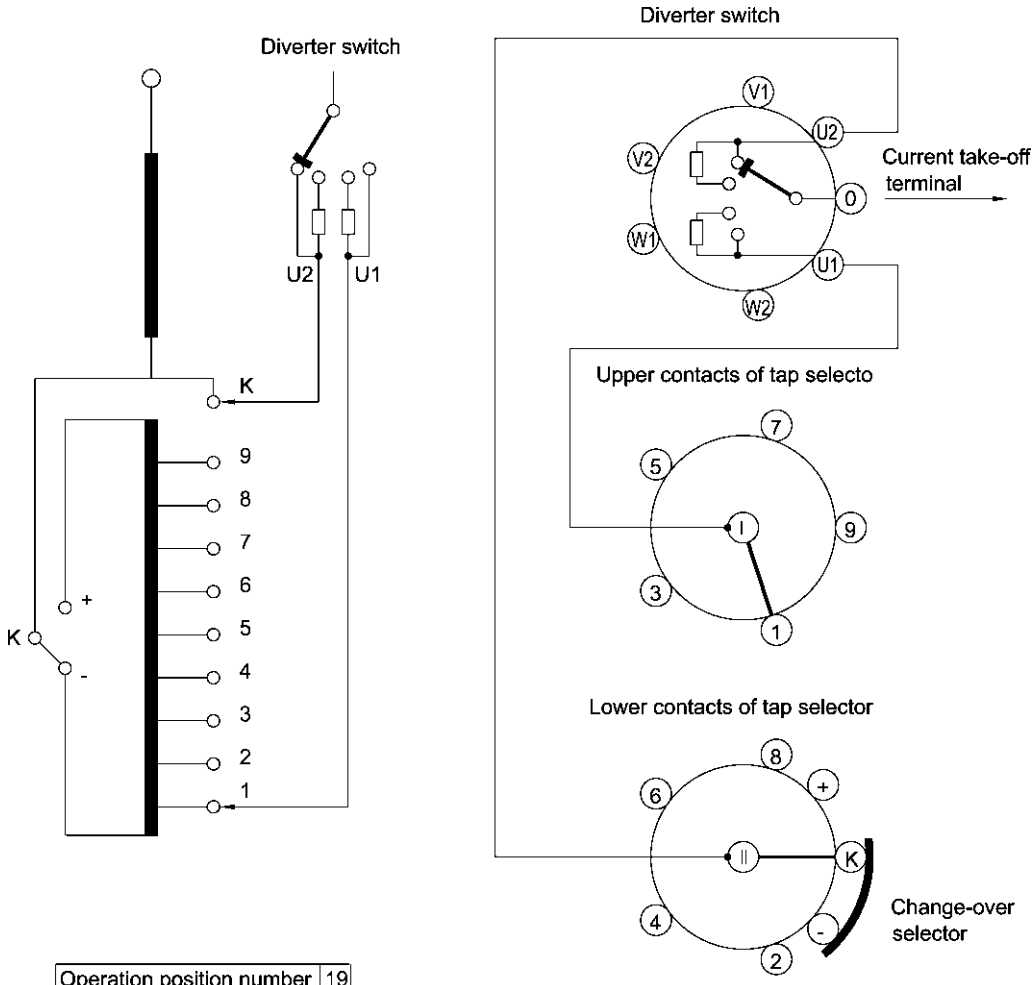
Please connect terminal 1 and "-",5 and "+",
2 and 2, 3 and 3, 4 and 4 in the same phase.

Operation position number	9
Different voltage number	9
Set position ●	5

Change-over selector location	K+				K-				
Tap changer position	1	2	3	4	5	6	7	8	9
Tap selector contact position	1	2	3	4	K	2	3	4	5
Display position	1	2	3	4	5	6	7	8	9

● Drawing is shown at the set position

9.37. CM(10191W) operating position table and connection diagram

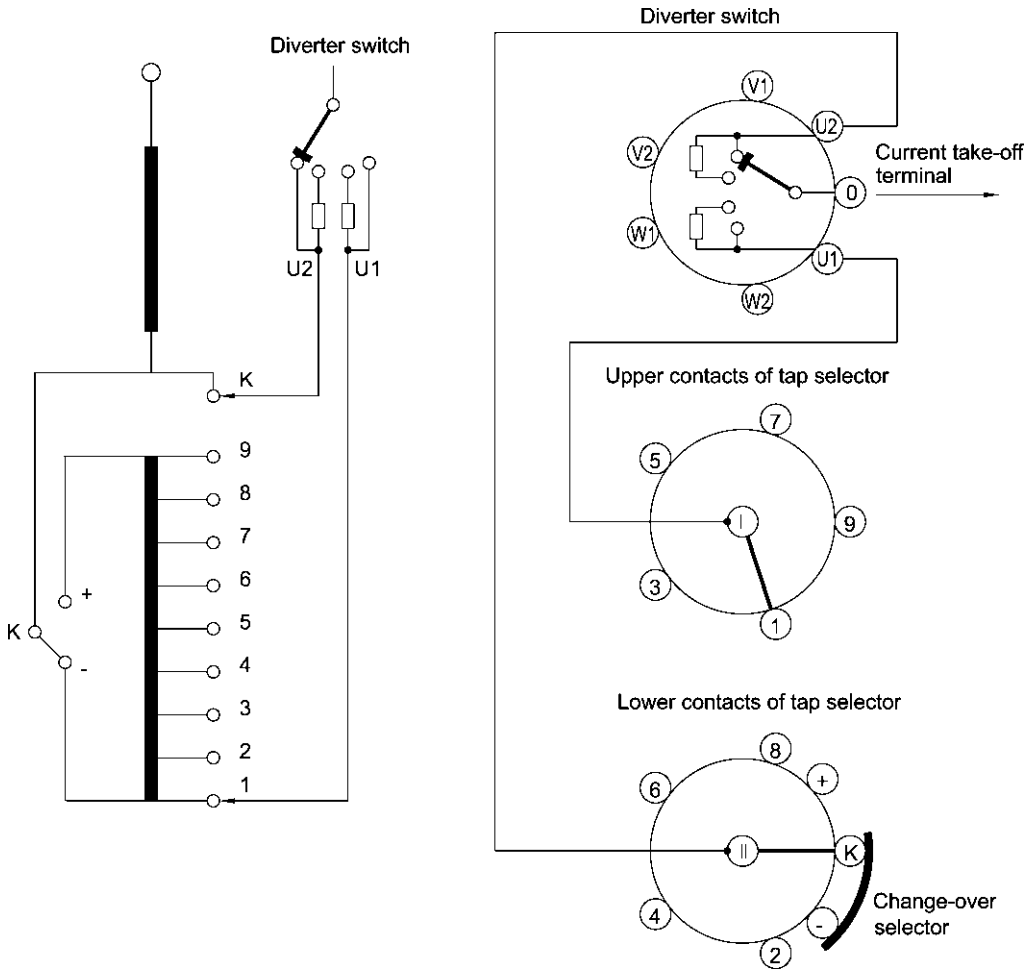


Operation position number	19
Different voltage number	19
Set position ●	10

Change-over selector location	K+									K-									
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Tap selector contact position	1	2	3	4	5	6	7	8	9	K	1	2	3	4	5	6	7	8	9
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

● Drawing is shown at the set position

9.38. CM(10193W) operating position table and connection diagram

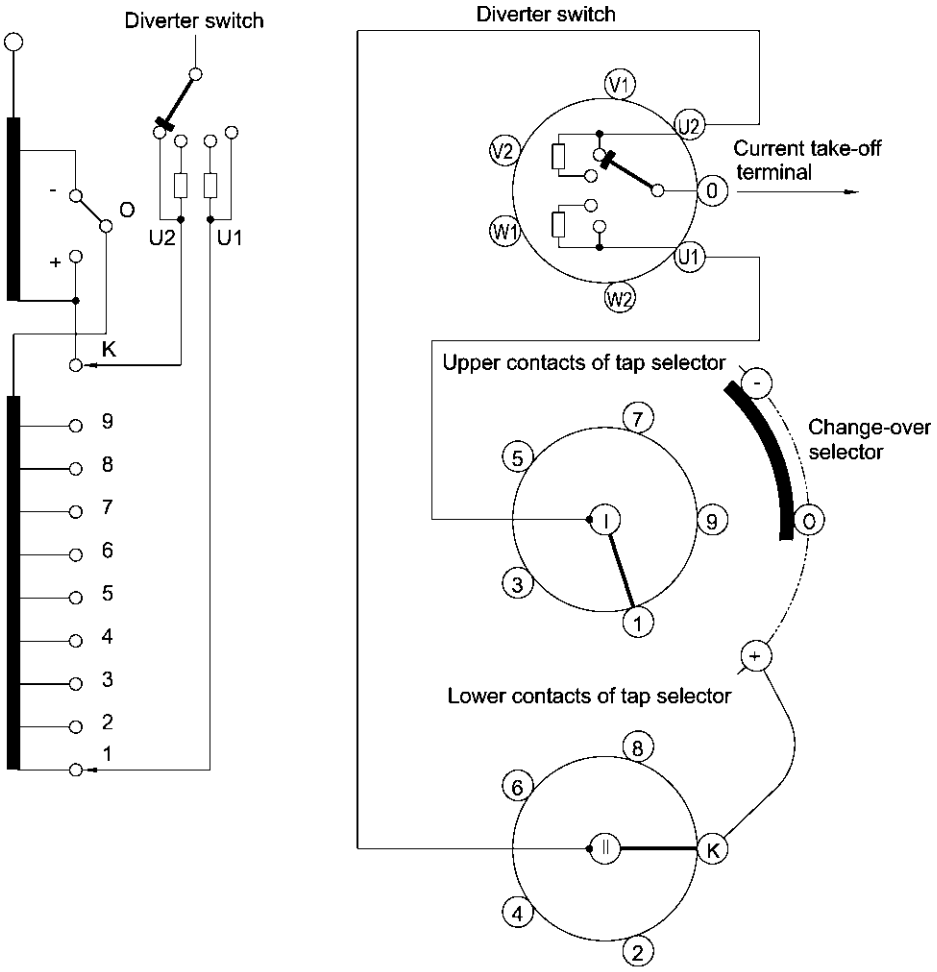


Operation position number	19
Different voltage number	17
Set position ●	9b

Change-over selector location	K+																		K-
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Tap selector contact position	1	2	3	4	5	6	7	8	9	K	1	2	3	4	5	6	7	8	9
Display position	1	2	3	4	5	6	7	8	9a	9b	9c	10	11	12	13	14	15	16	17

● Drawing is shown at the set position

9.39. CM(10191G) operating position table and connection diagram

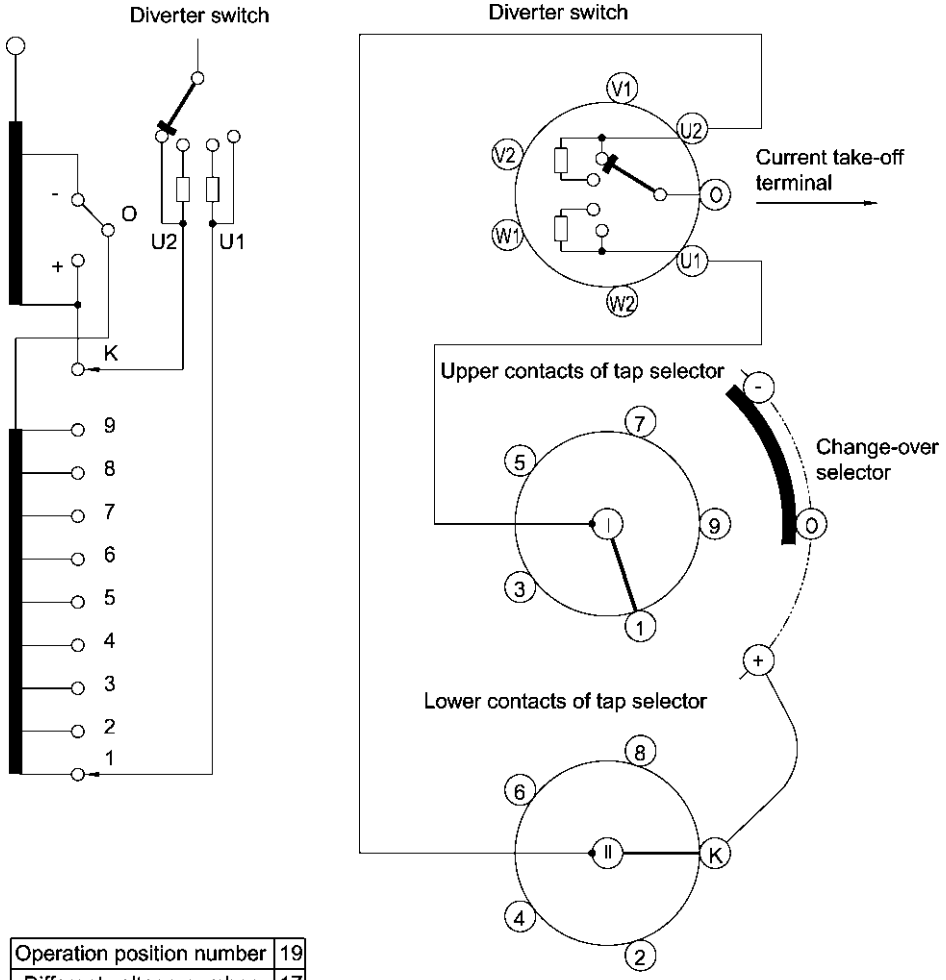


Operation position number	19
Different voltage number	19
Set position ●	10

Change-over selector location	← 0 + →									← 0 - →									
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Tap selector contact position	1	2	3	4	5	6	7	8	9	K	1	2	3	4	5	6	7	8	9
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
										● ←									

● Drawing is shown at the set position

9.40. CM(10193G) operating position table and connection diagram

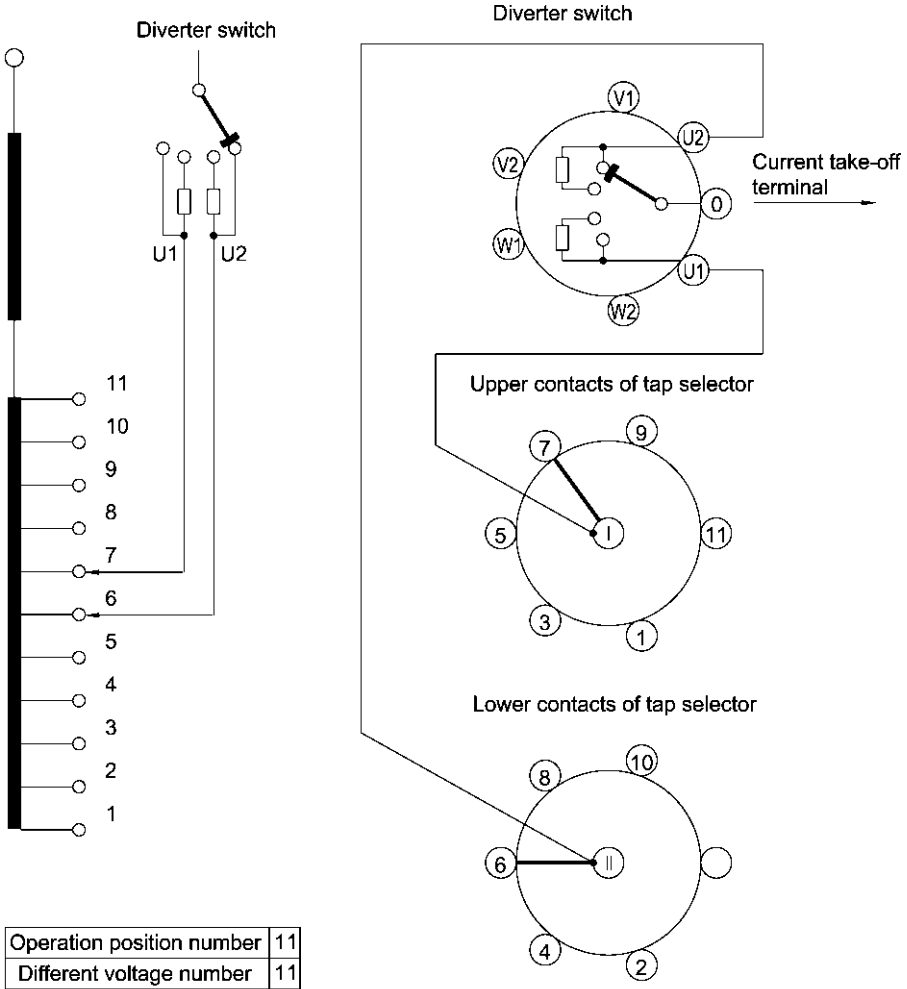


Operation position number	19
Different voltage number	17
Set position ●	9b

Change-over selector location	O+																		O-
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Tap selector contact position	1	2	3	4	5	6	7	8	9	K	1	2	3	4	5	6	7	8	9
Display position	1	2	3	4	5	6	7	8	9a	9b	9c	10	11	12	13	14	15	16	17

● Drawing is shown at the set position

9.41. CM(12110) operating position table and connection diagram

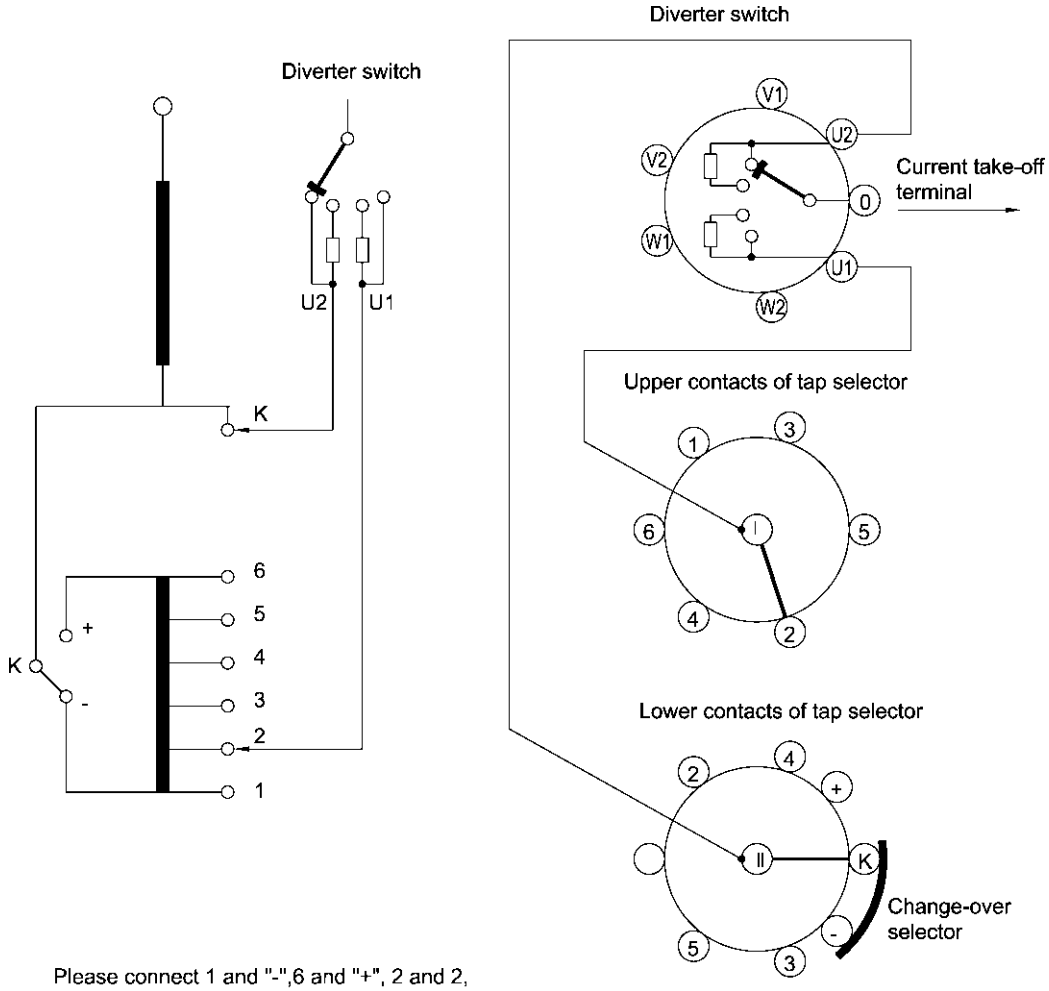


Operation position number	11
Different voltage number	11
Set position ●	6

Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11
Display position	1	2	3	4	5	6	7	8	9	10	11

● Drawing is shown at the set position

9.42. CM(12111W) operating position table and connection diagram



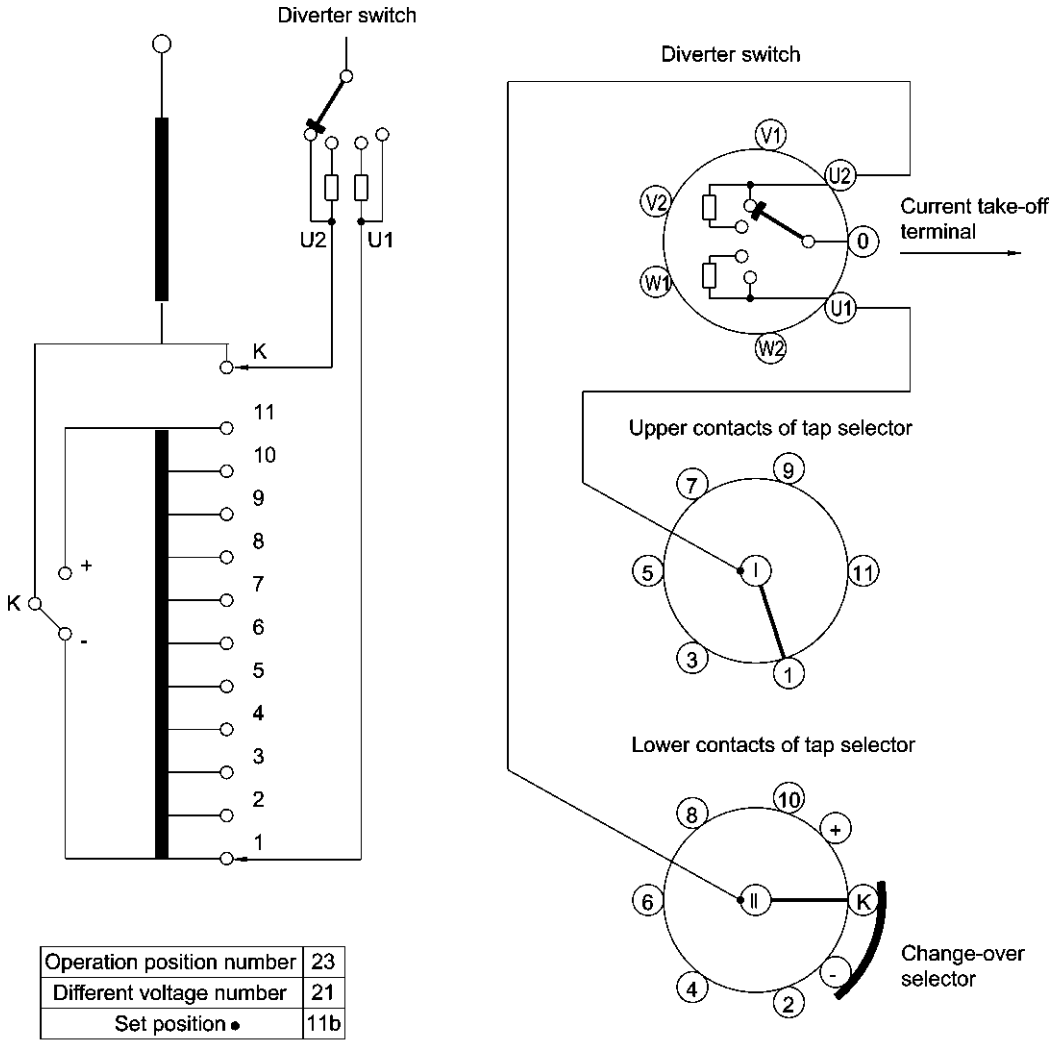
Please connect 1 and "-",6 and "+", 2 and 2, 3 and 3, 4 and 4, 5 and 5 in the same phase.

Operation position number	11
Different voltage number	11
Set position ●	6

Change-over selector location	K+						K-				
Tap changer position	1	2	3	4	5	6	7	8	9	10	11
Tap selector contact position	1	2	3	4	5	K	2	3	4	5	6
Display position	1	2	3	4	5	6	7	8	9	10	11

● Drawing is shown at the set position

9.43. CM(12233W) operating position table and connection diagram

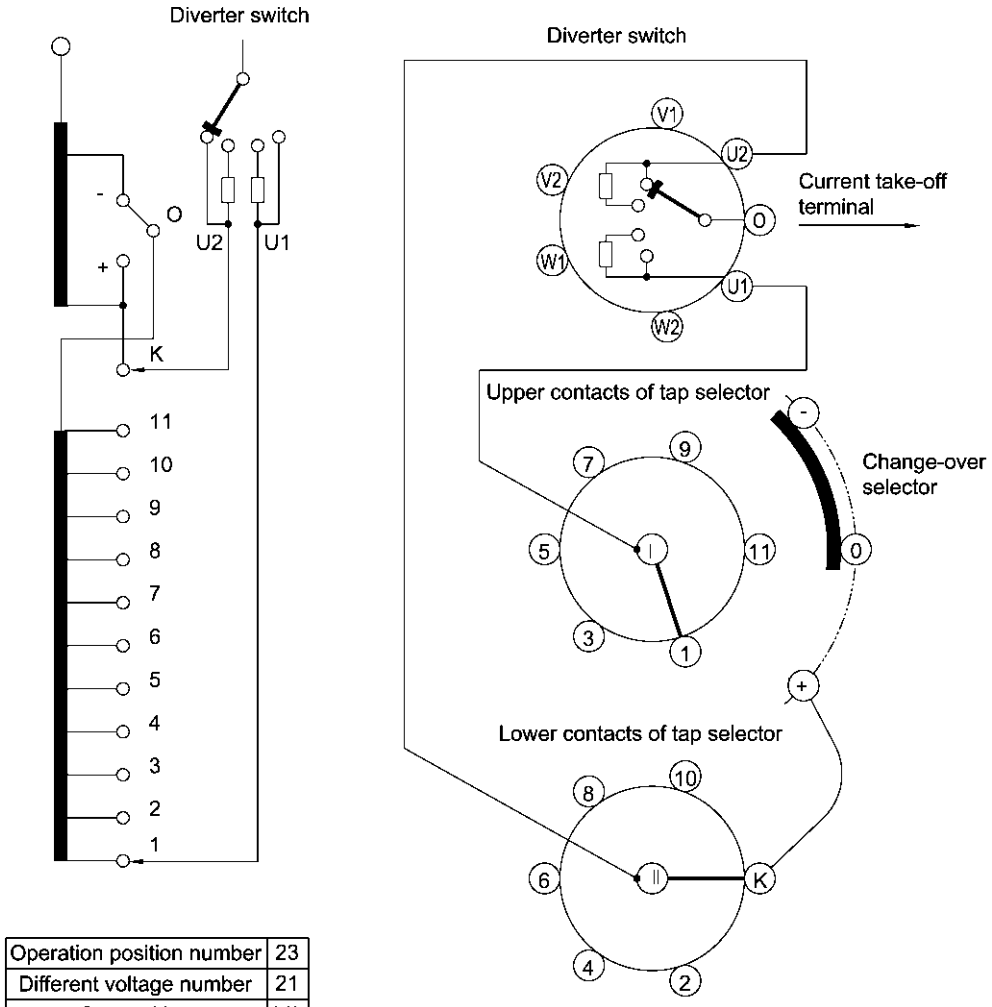


Operation position number	23
Different voltage number	21
Set position ●	11b

Change-over selector location	K+																						
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	K	1	2	3	4	5	6	7	8	9	10	11
Display position	1	2	3	4	5	6	7	8	9	10	11a	11b	11c	12	13	14	15	16	17	18	19	20	21

● Drawing is shown at the set position

9.44. CM(12233G) operating position table and connection diagram

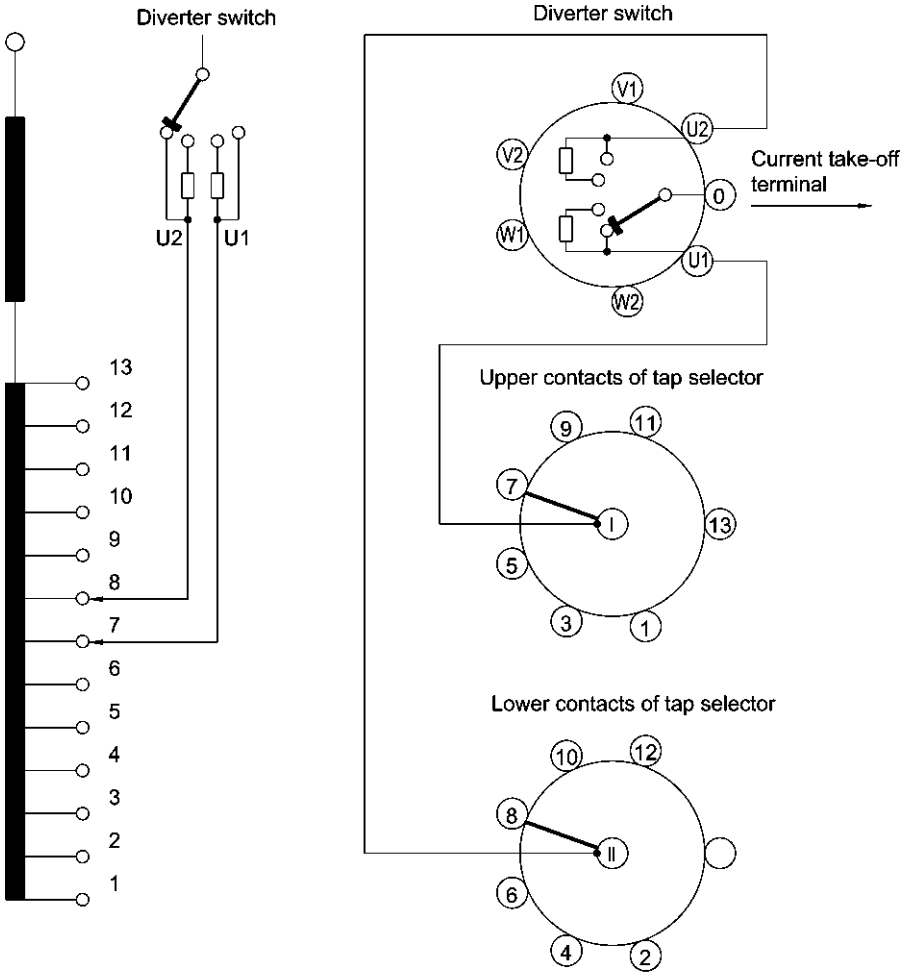


Operation position number	23
Different voltage number	21
Set position ●	11b

Change-over selector location	0 +																0 -						
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	K	1	2	3	4	5	6	7	8	9	10	11
Display position	1	2	3	4	5	6	7	8	9	10	11a	11b	11c	12	13	14	15	16	17	18	19	20	21
												●											

● Drawing is shown at the set position

9.45. CM(14130) operating position table and connection diagram



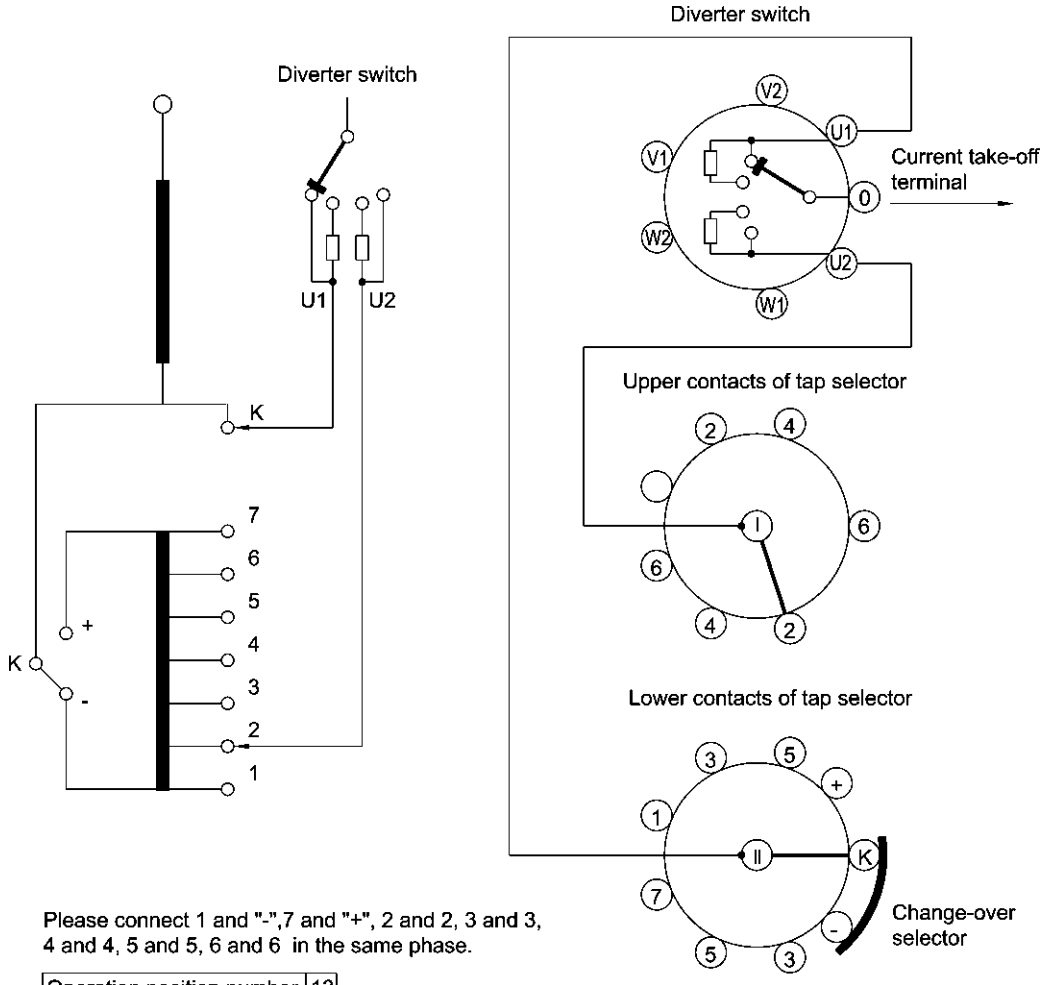
Operation position number	13
Different voltage number	13
Set position ●	7

Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	12	13
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13

● ←

● Drawing is shown at the set position

9.46. CM(14131W) operating position table and connection diagram



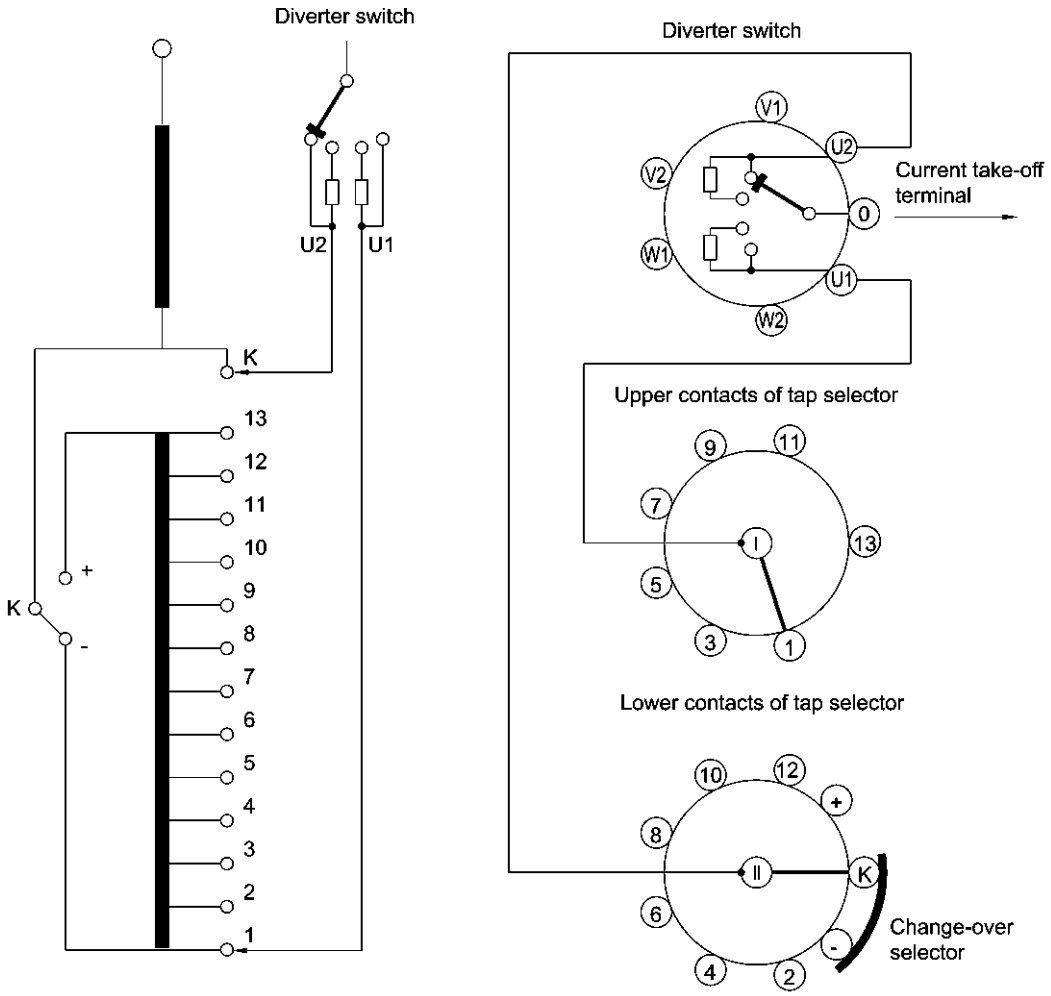
Please connect 1 and "-",7 and "+", 2 and 2, 3 and 3, 4 and 4, 5 and 5, 6 and 6 in the same phase.

Operation position number	13
Different voltage number	13
Set position ●	7

Change-over selector location	K+									K-			
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13
Tap selector contact position	1	2	3	4	5	6	K	2	3	4	5	6	7
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13

● Drawing is shown at the set position

9.47. CM(14273W) operating position table and connection diagram

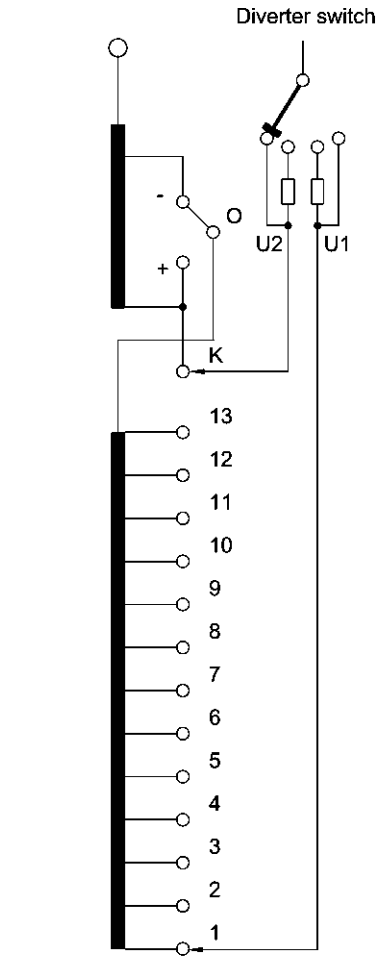


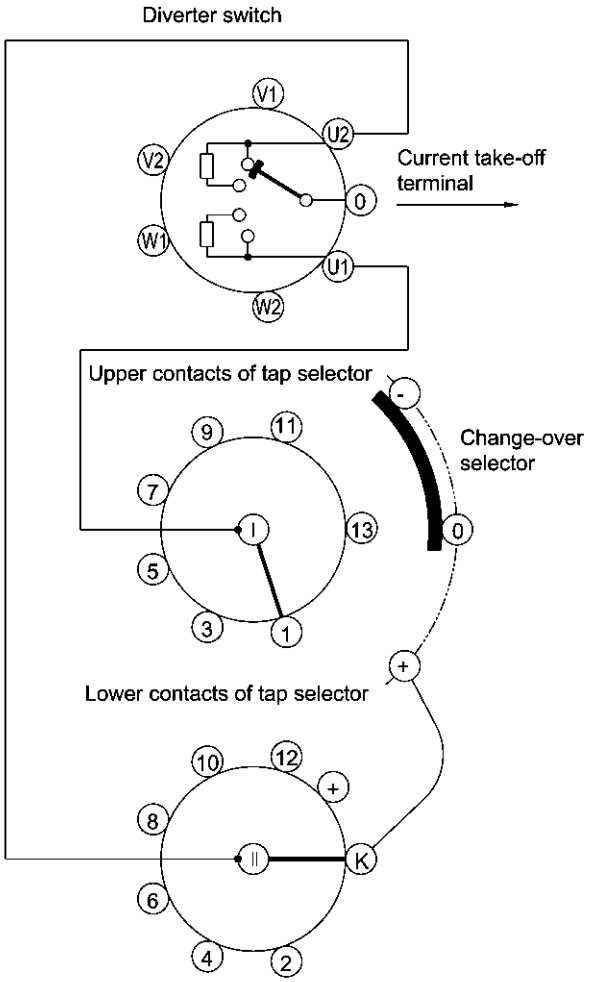
Operation position number	27
Different voltage number	25
Set position ●	13b

Change-over selector location	K+														K-												
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	12	13	K	1	2	3	4	5	6	7	8	9	10	11	12	13
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13a	13b	13c	14	15	16	17	18	19	20	21	22	23	24	25

● Drawing is shown at the set position

9.48. CM(14273G) operating position table and connection diagram



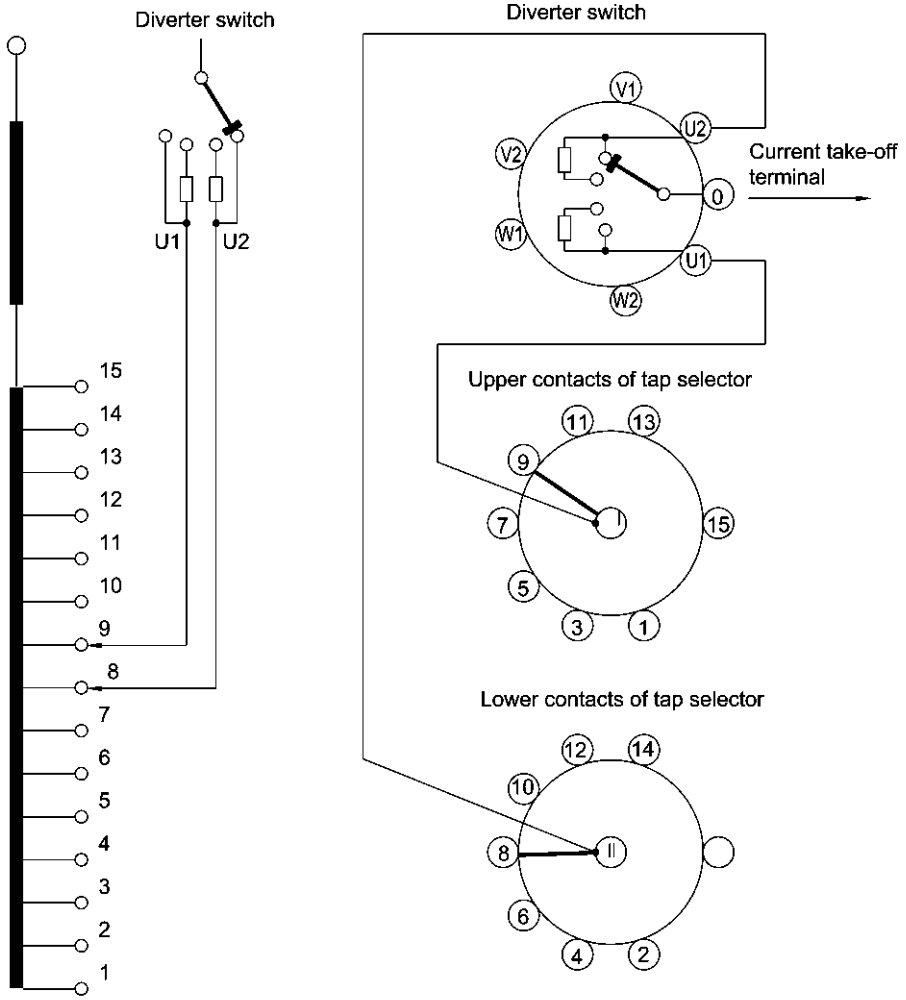


Operation position number	27
Different voltage number	25
Set position ●	13b

Change-over selector location	0+														0-												
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	12	13	K	1	2	3	4	5	6	7	8	9	10	11	12	13
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13a	13b	13c	14	15	16	17	18	19	20	21	22	23	24	25

● Drawing is shown at the set position

9.49. CM(16150) operating position table and connection diagram



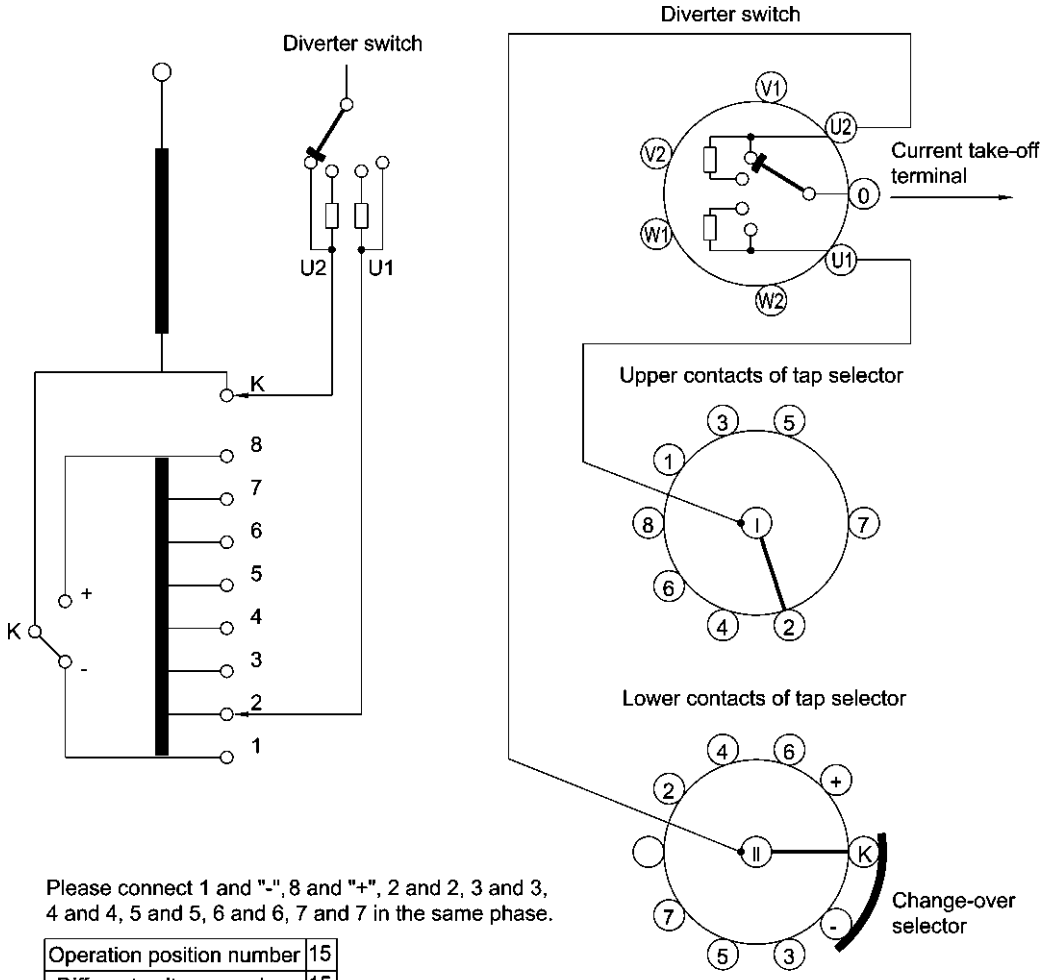
Operation position number	15
Different voltage number	15
Set position ●	8

Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

● ←

● Drawing is shown at the set position

9.50. CM(16151W) operating position table and connection diagram



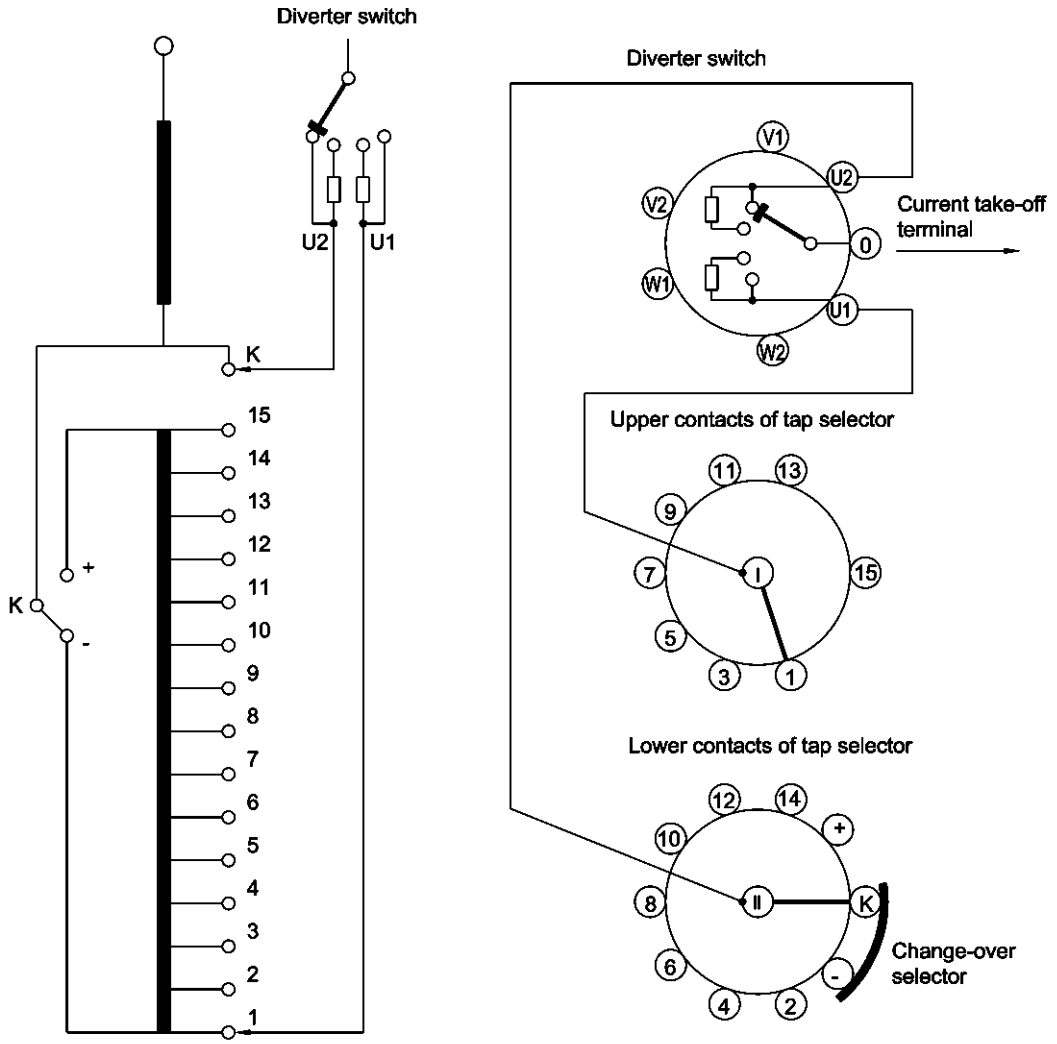
Please connect 1 and "-", 8 and "+", 2 and 2, 3 and 3, 4 and 4, 5 and 5, 6 and 6, 7 and 7 in the same phase.

Operation position number	15
Different voltage number	15
Set position ●	8

Change-over selector location	K+								K-						
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Tap selector contact position	1	2	3	4	5	6	7	K	2	3	4	5	6	7	8
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

● Drawing is shown at the set position

9.51. CM(16313W) operating position table and connection diagram

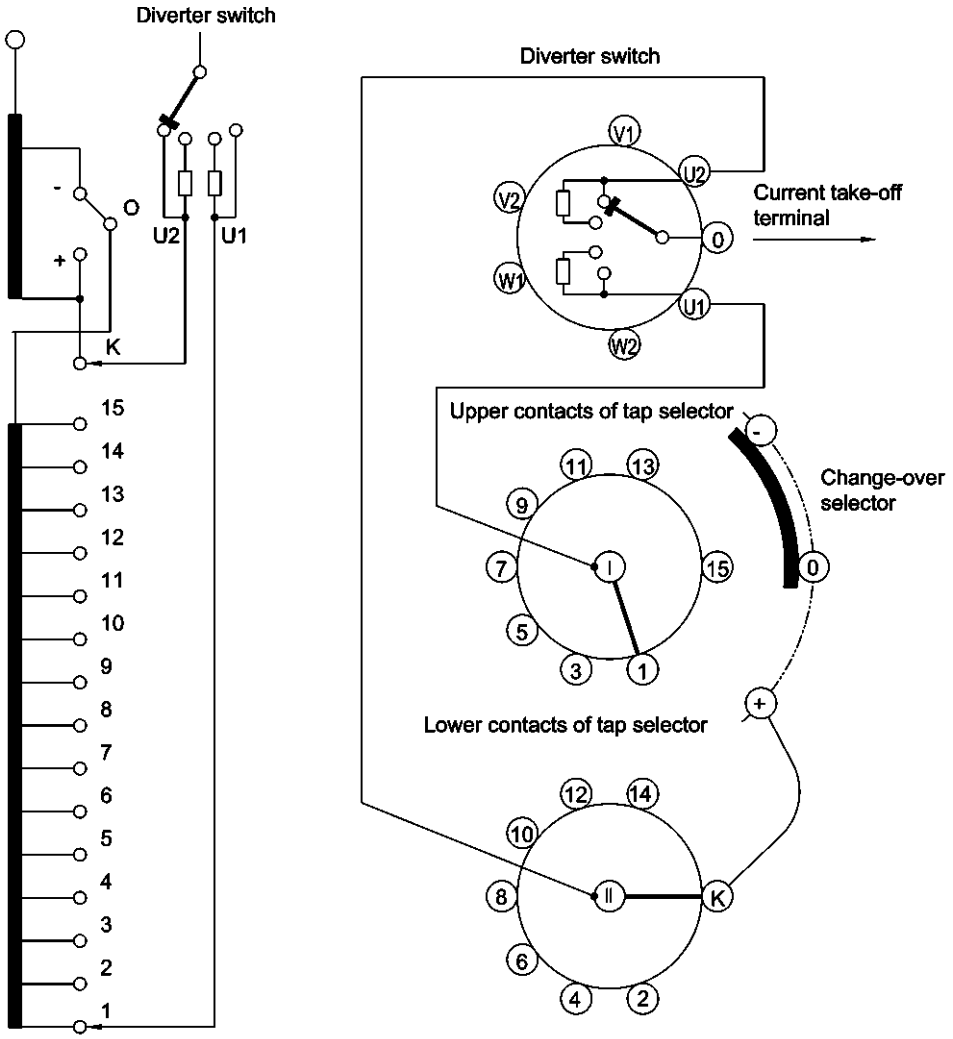


Operation position number	31
Different voltage number	29
Set position●	15b

Change-over selector location	K+															K-															
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	K	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15a	15b	15c	16	17	18	19	20	21	22	23	24	25	26	27	28	29

● Drawing is shown at the set position

9.52. CM(16313G) operating position table and connection diagram

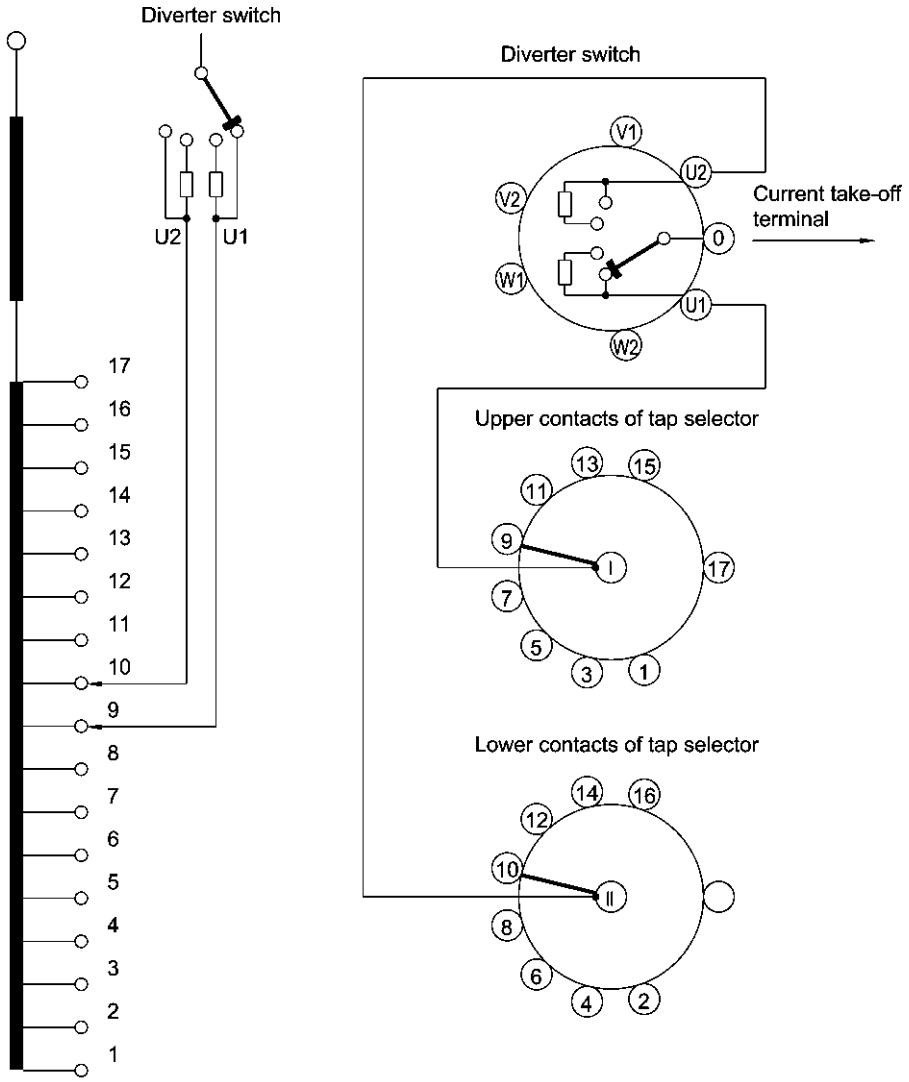


Operation position number	31
Different voltage number	29
Set position ●	15b

Change-over selector location	0 +																													
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	K	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15a	15b	15c	16	17	18	19	20	21	22	23	24	25	26	27	28	29
																●															

● Drawing is shown at the set position

9.53. CM(18170) operating position table and connection diagram

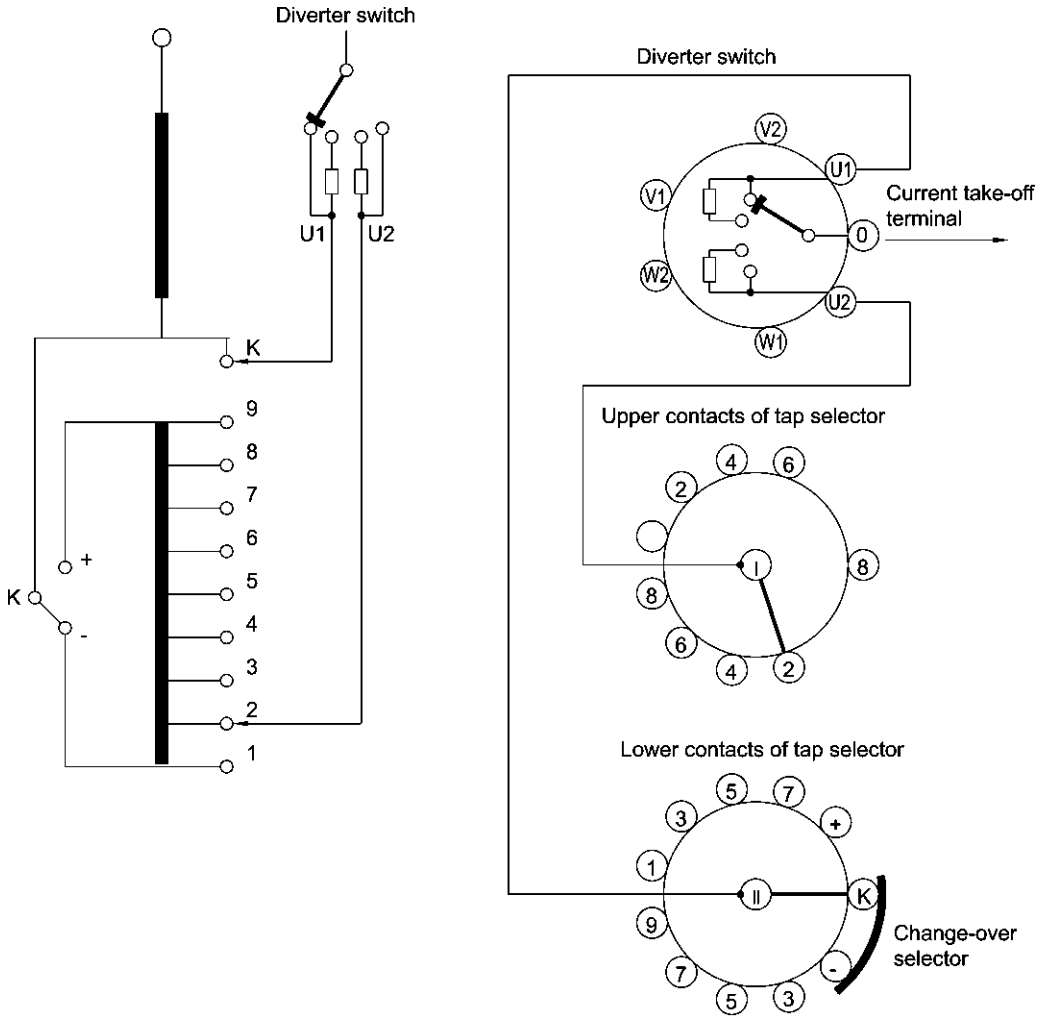


Operation position number	17
Different voltage number	17
Set position ●	9

Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

● Drawing is shown at the set position

9.54. CM(18171W) operating position table and connection diagram



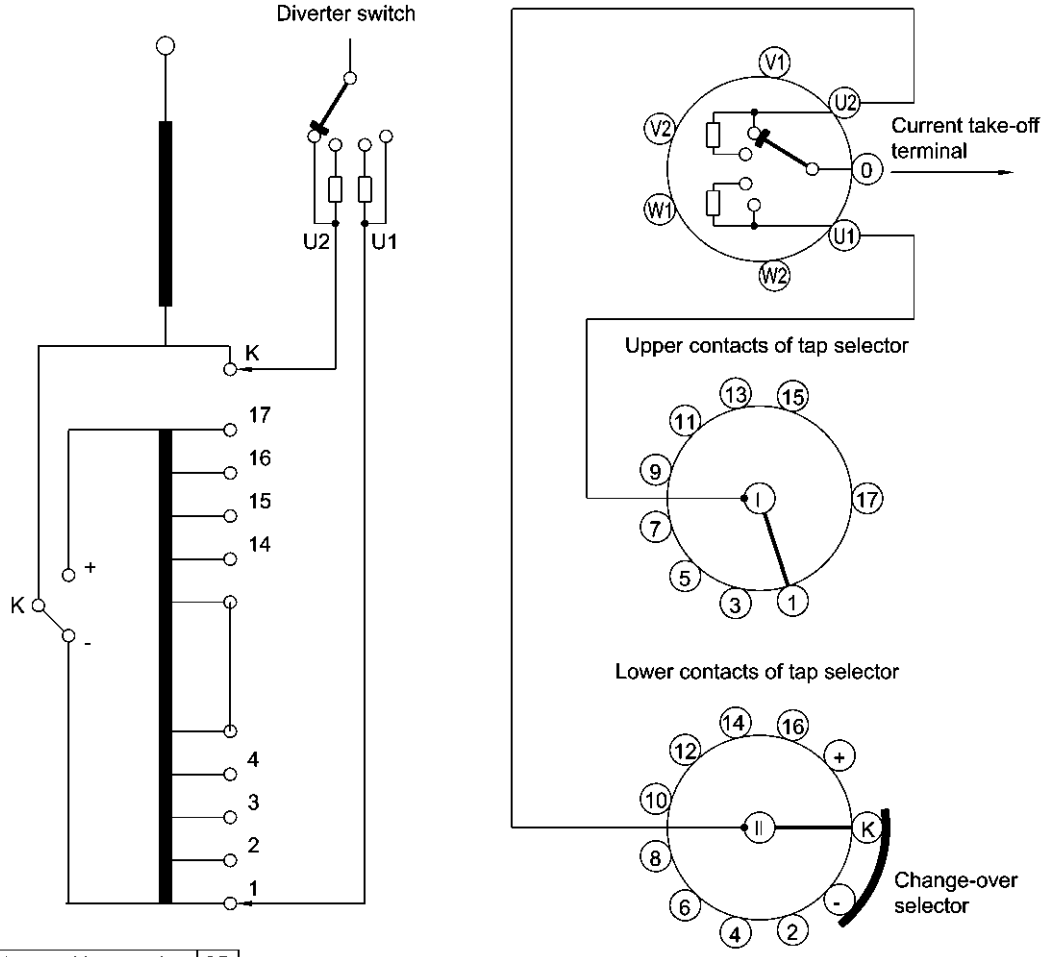
Please connect 1 and "-",9 and "+", 2 and 2, 3 and 3,
4 and 4, 5 and 5, 6 and 6, 7 and 7, 8 and 8 in the same phase.

Operation position number	17
Different voltage number	17
Set position ●	9

Change-over selector location	K+								K-								
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Tap selector contact position	1	2	3	4	5	6	7	8	K	2	3	4	5	6	7	8	9
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

● Drawing is shown at the set position

9.55. CM(18353W) operating position table and connection diagram

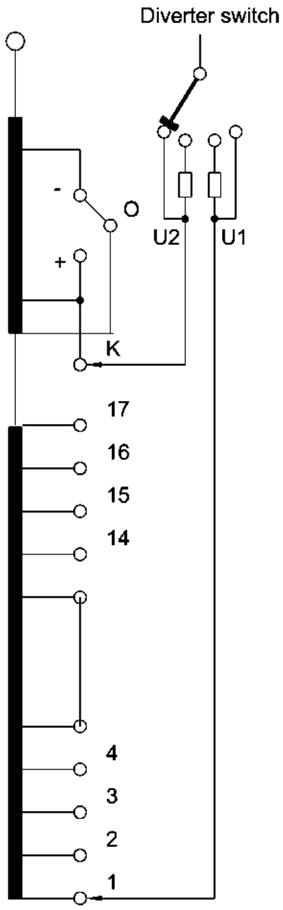


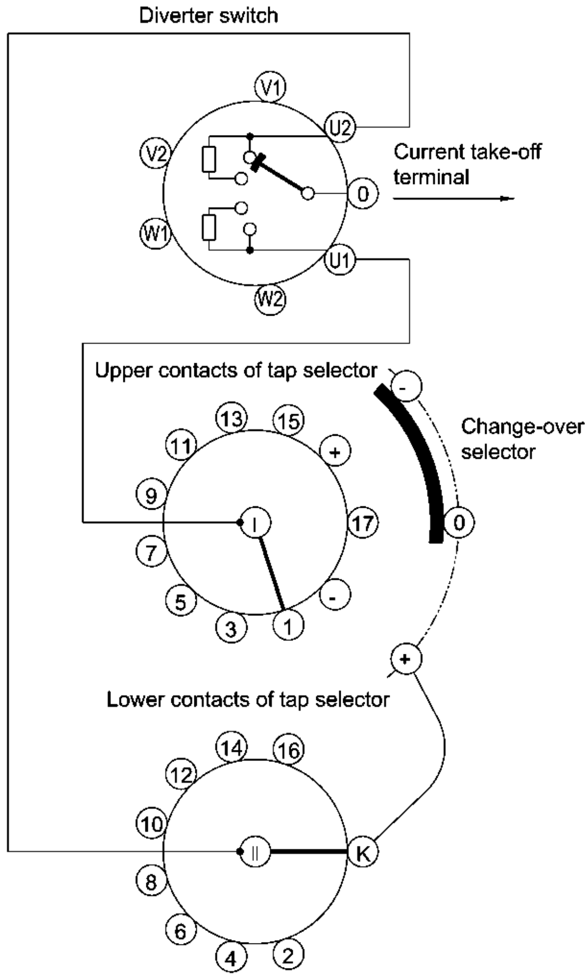
Operation position number	35
Different voltage number	33
Set position ●	17b

Change-over selector location	K+																																		
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	k	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17a	17b	17c	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

● Drawing is shown at the set position

9.56. CM(18353G) operating position table and connection diagram



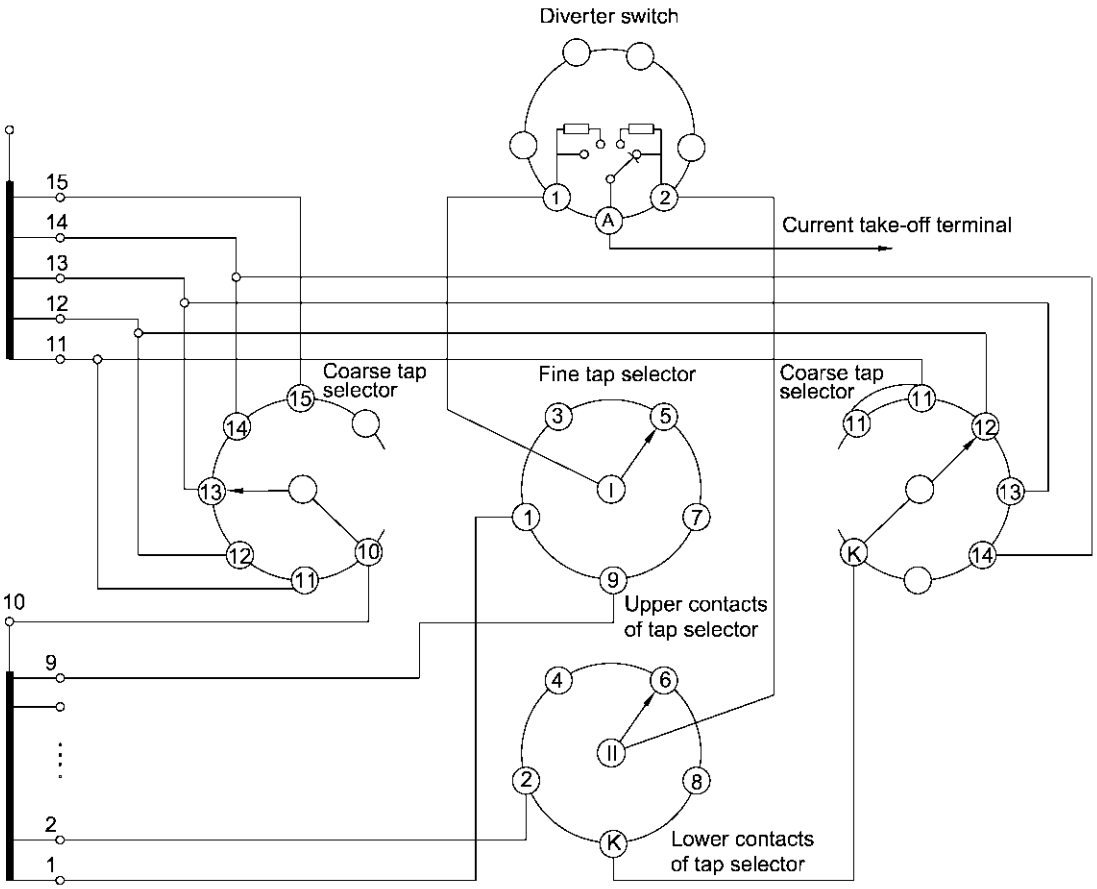


Operation position number	35
Different voltage number	33
Set position ●	17b

Change-over selector location	0+																		0-																	
Tap changer position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Tap selector contact position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	k	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17a	17b	17c	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33

● Drawing is shown at the set position

9.57. CM(10491G) connectiondiagram



Set position shown in above diagram

9.58. CM(10491G) operating position table

Voltage regulation positions	1	2	3	4	5	6	7	8	9	10
Fine tap positions	1	2	3	4	5	6	7	8	9	K
Coarse tap positions	K--11									
	10--11									

11	12	13	14	15	16	17	18	19	20
1	2	3	4	5	6	7	8	9	K
K--11									
10--12									

21	22	23	24	25	26	27	28	29	30
1	2	3	4	5	6	7	8	9	K
K--12									
10--13									

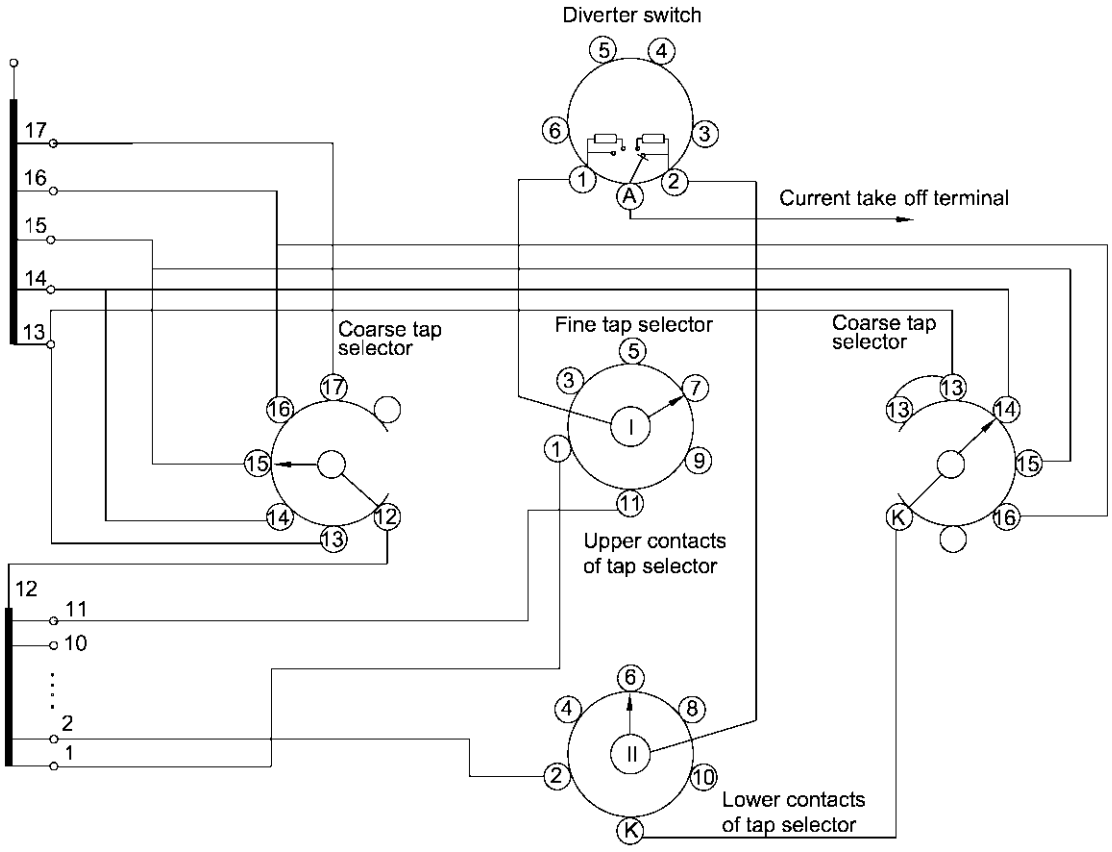
○ ←

31	32	33	34	35	36	37	38	39	40
1	2	3	4	5	6	7	8	9	K
K--13									
10--14									

41	42	43	44	45	46	47	48	49
1	2	3	4	5	6	7	8	9
K--14								
10--15								

(○ Set position)

9.59. CM(12591G) connectiondiagram



Set position shown in above diagram

9.60. CM(12591G) operating position table

Voltage regulation positions	1	2	3	4	5	6	7	8	9	10	11	12
Fine tap positions	1	2	3	4	5	6	7	8	9	10	11	K
Coarse tap positions	K--13											
	12--13											

13	14	15	16	17	18	19	20	21	22	23	24
1	2	3	4	5	6	7	8	9	10	11	K
K--13											
12--14											

25	26	27	28	29	30	31	32	33	34	35	36
1	2	3	4	5	6	7	8	9	10	11	K
K--14											
12--15											

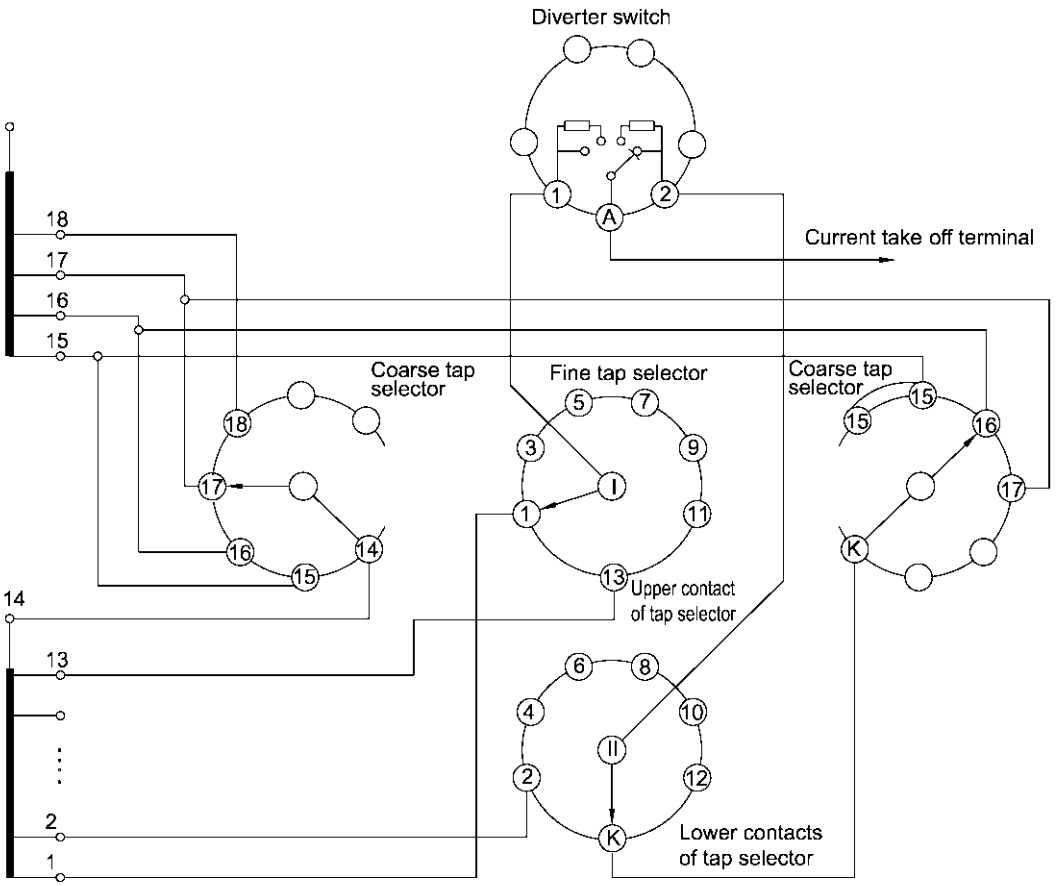
○ ←

37	38	39	40	41	42	43	44	45	46	47	48
1	2	3	4	5	6	7	8	9	10	11	K
K--15											
12--16											

49	50	51	52	53	54	55	56	57	58	59
1	2	3	4	5	6	7	8	9	10	11
K--16										
12--17										

(○ Set position)

9.61. CM(14551G) connectiondiagram



Set position shown in above diagram

9.62. CM(14551G) operating position table

Voltage regulation positions	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Fine tap positions	1	2	3	4	5	6	7	8	9	10	11	12	13	K
Coarse tap positions	K--15													
	14--15													

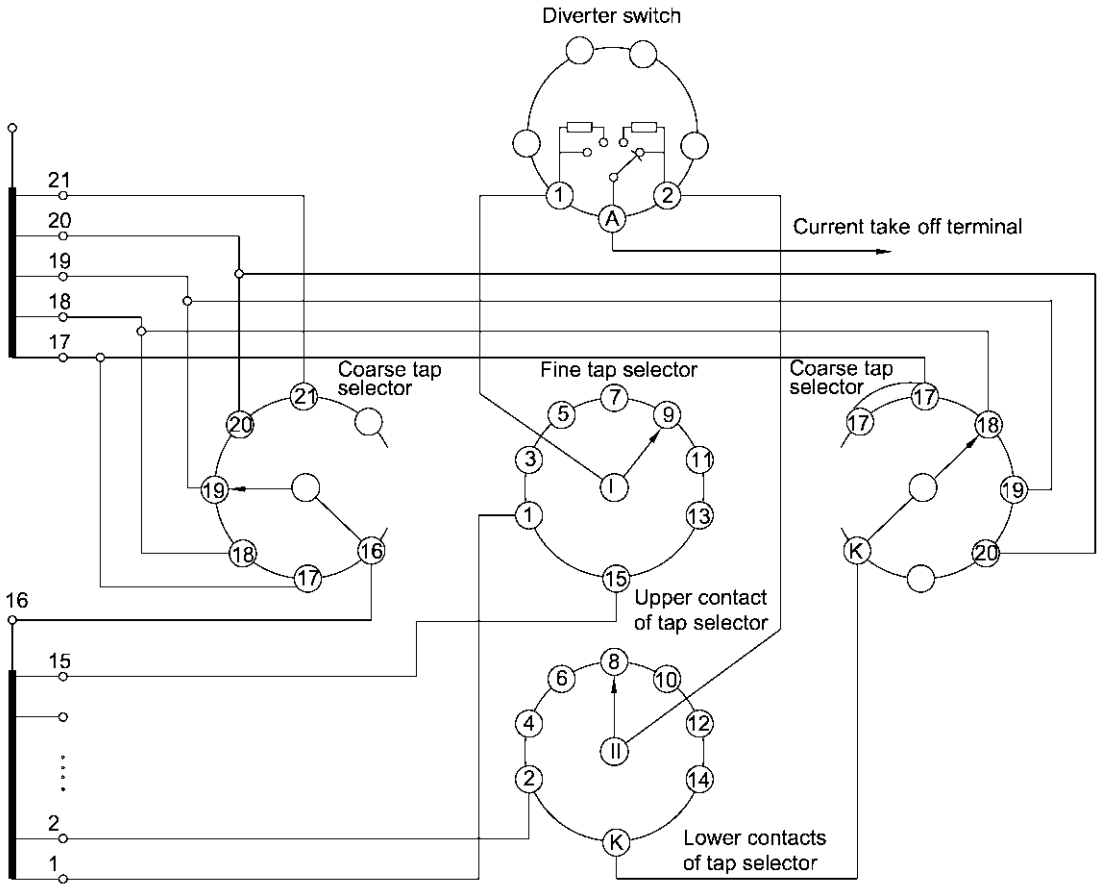
15	16	17	18	19	20	21	22	23	24	25	26	27	28
1	2	3	4	5	6	7	8	9	10	11	12	13	K
K--15													
14--16													

○ ←

29	30	31	32	33	34	35	36	37	38	39	40	41	42
1	2	3	4	5	6	7	8	9	10	11	12	13	K
K--16													
14--17													

43	44	45	46	47	48	49	50	51	52	53	54	55
1	2	3	4	5	6	7	8	9	10	11	12	13
K--17												
14--18												

(○ Set position)



Set position shown in above diagram

9.64. CM(16791G) operating position table

Voltage regulation positions	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Fine tap positions	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	K
Coarse tap positions	K--17															
	16--17															

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	K
K--17															
16--18															

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	K
K--18															
16--19															

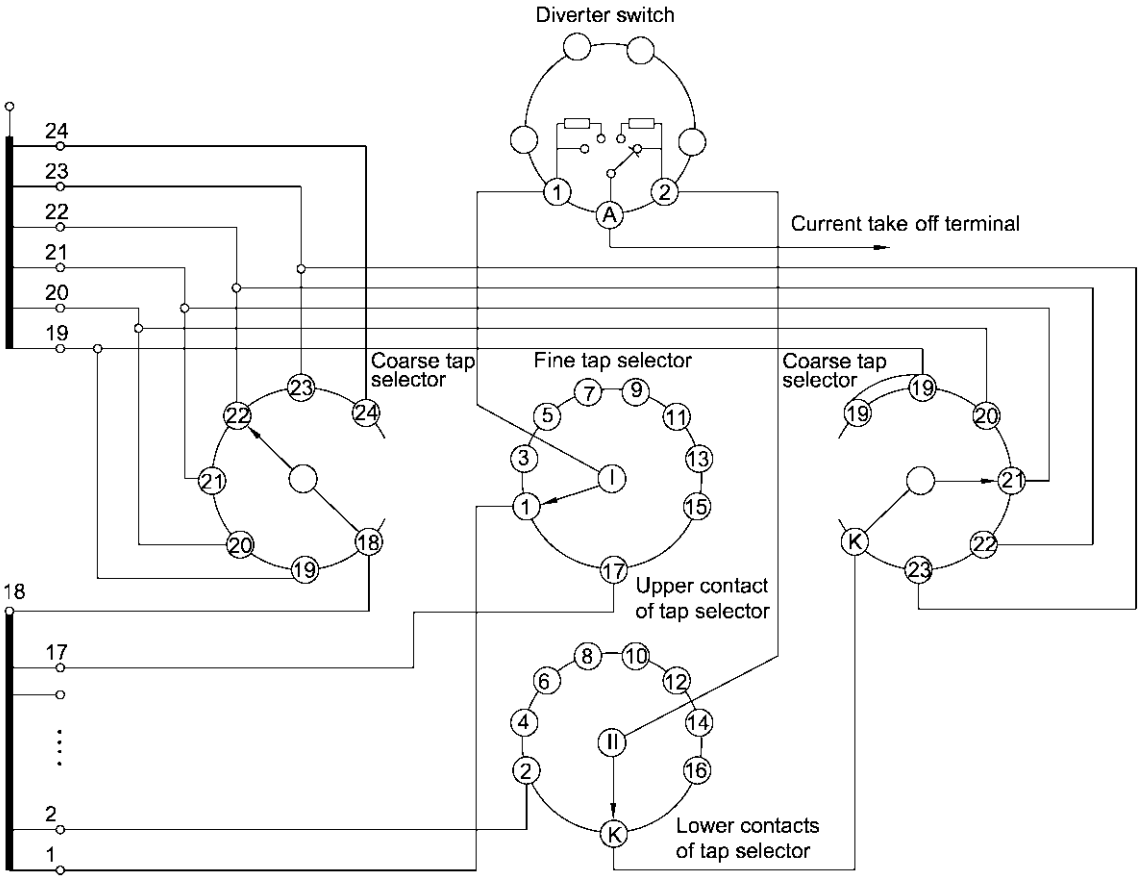
○←

49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	K
K--19															
16--20															

65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
K--20														
16--21														

(○ Set position)

9.65. CM(181071G) connectiondiagram



9.66. CM(181071G) operating position table

Voltage regulation positions	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Fine tap positions	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	K
Coarse tap positions	K--19																	
	18--19																	

19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	K
K--19																	
18--20																	

37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	K
K--20																	
18--21																	

○ ←

55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	K
K--21																	
18--22																	

73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	K
K--22																	
18--23																	

91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
K--23																
18--24																

(○ Set position)

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