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NISSIN ELECTRIC

CAPACITOR VOLTAGE TRANSFORMER

Description

1 General

Capacitor voltage transformers(CVT) will be used for

- metering
- protection relaying
- synchronizing

And CVTs can be used simultaneously as coupling capacitors for power line carrier coupling applications for

- telecommunication
- telemetering
- supervisory control
- selective line protection

CVTs are also used for tariff metering in combination with current transformers. CVTs have definite economical advantages at higher voltages in comparison with conventional inductive voltage transformers.

CTVs are more economical and expected to save a considerably large amount of capital investments taking into consideration of dual purpose of voltage transformer application and carrier coupling application.

Over the last 30 years, Nissin has manufactured and delivered CVTs not only to Japanese power utilities but also to those utilities all over the world. Particularly, all the CVTs in Japanese 500kV networks are supplied by Nissin in recognition of the high reliability and excellent performance.

Nissin has continuously made efforts to accomplish many improvements of technical characteristics, modern quality control and modern production techniques.

2 Application

- Highest system voltage 72.5kV～800kV
- Rated secondary voltage
  - IEC standard : 110, 110/$\sqrt{3}$ V
  - ANSI standard : 115－66.4V
  - JEC standard : 110, 110/$\sqrt{3}$, 110/3 V
- Accuracy class
  - IEC standard : 0.2, 0.5, 1.0, 3P, 6P
  - ANSI standard : 0.3, 0.6, 1.2, 1.2R
  - JEC standard : 1P

3 Service conditions

The usual service conditions are as follows, but CVTs to be used beyond the limits of the following conditions will be manufactured by request.

- Ambient temperature
  max. 40°C
  min. －20°C
- Altitude above sea level : max. 1 000m
- System earthing condition:
  effectively earthed neutral system
- Pollution
  Two standard series for normal and polluted atmosphere are available.
- Rated frequency : 50 Hz or 60Hz

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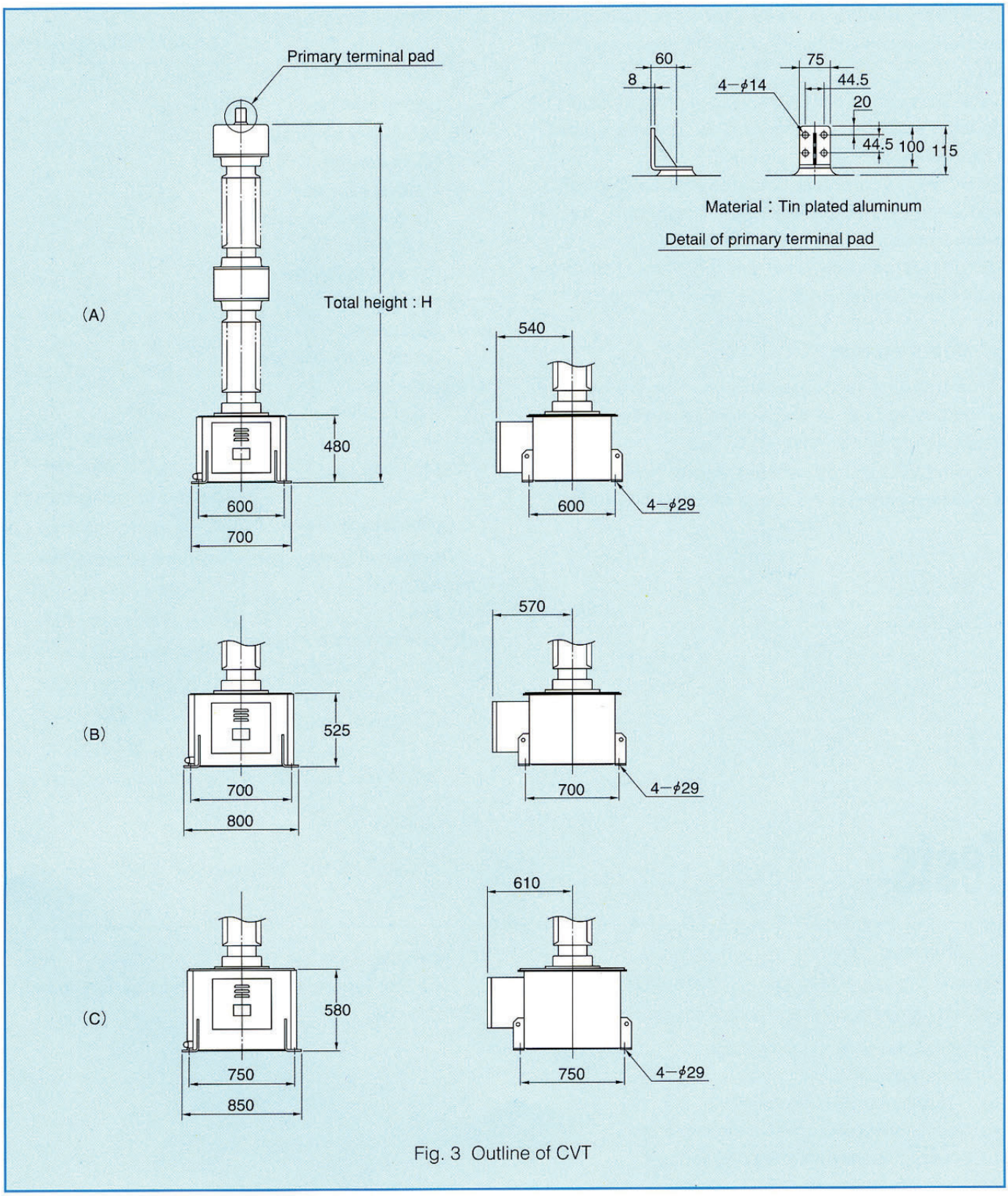


Fig. 3 Outline of CVT

Construction

The CVT consists of a capacitor voltage divider (Capacitor stack) and a transformer unit. The principle arrangement is shown in Fig. 1 and Fig. 2

1. Capacitor stack

The capacitor stack consists of 1 to 5 porcelain shell units placed on top of the other. Each unit contains a large number of series connected capacitor elements which is insulated with polypropylene film / paper and inpregnated with synthetic oil, and hermelically sealed.

Each porcelain shell unit is provided with an oil volume adjusting device, which consists of stainless steel bellows and always maintains the oil pressure with a slight positive pressure at any temperature in the operating temperature range.

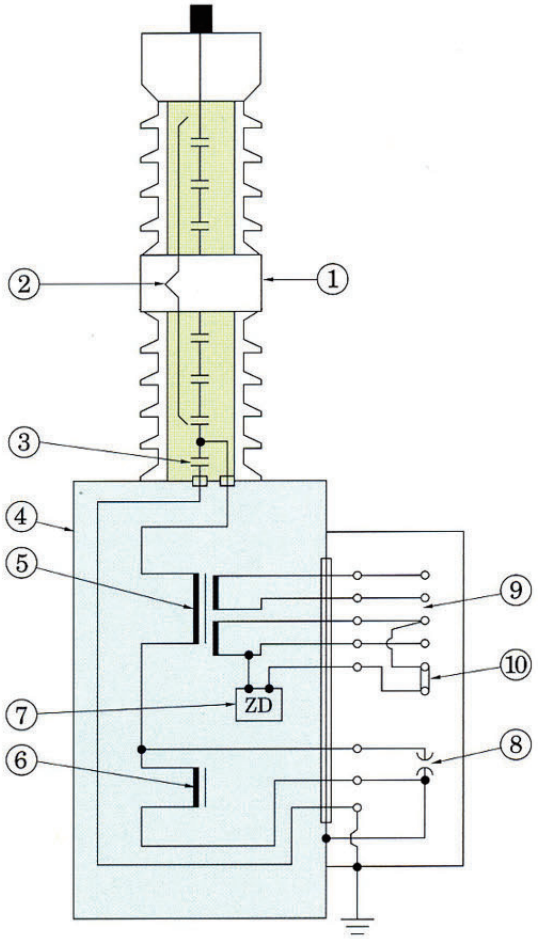
2. Transformer unit

The transformer, the tuning reactor and the damping burden for ferro-resonance suppression are enclosed in the steel base tank. The base tank is filled with mineral oil and hermetically sealed. The oil volume adjustment is nitrogen gas in the base tank.

The protective gap is inserted across the tuning reactor not to break down the intermediate voltage circuit components by the voltage-rise due to secondary short circuits.

As shown in Fig. 2, the intermediate voltage circuit is insulated by mineral oil and hermetically sealed, so it is not exposed to the atmosphere and the reliability of insulation of the intermediate circuit is extremly high.

Furthermore it is essentially a extrem safe



1. Capacitor voltage divider (capacitor stack)
2. High voltage capacitor
3. Intermediate voltage capacitor
4. Transformer unit
5. Transformer
6. Tuning reactor
7. Damping burden(ZD)
8. Protective gap for secondary short circuit
9. Secondary terminals
10. Joint for ZD

NOTE :
The low voltage terminal must be erathed, when carrier equipment is not required.

Fig. 1 Typical connection diagram of CVT

construction because of non-possibility to touch the live intermediate voltage circuit.

Therefore, a transformer grounding switch for transformer primary is needless and not provided.

3. Carrier accessories

The following carrier accessories will be provided by request.

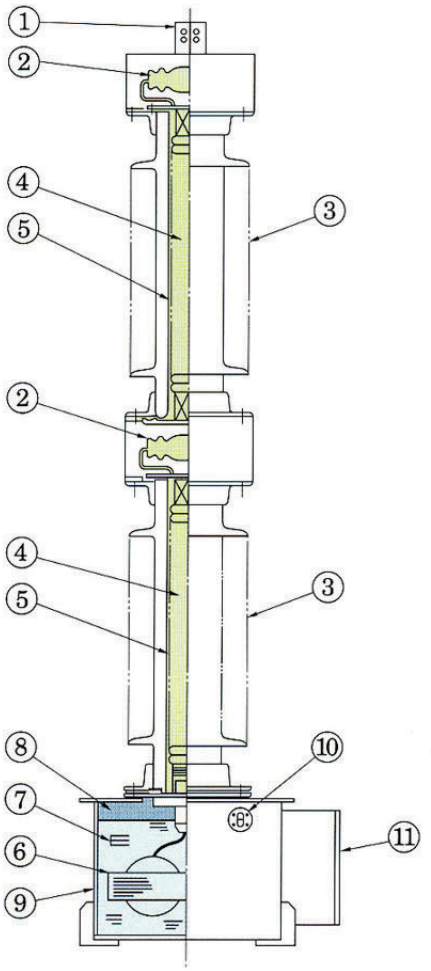
- a carrier grounding switch
- a carrier protective gap
- a drain coil
- a carrier terminal

As a transformer grounding switch for transformer primary is not provided, carrier currents always flow without interception even with no choke coil in the intermediate voltage circuit and an influence on loss in power line carrier characteristics is negligibly small.

4. Surface treatment

Flanges for porcelain shells are hot-dip galvanized and other ferrous parts are painted for anti-corrosion.

No treatment is done on stainless steel parts.



1. Primary terminal pad
2. Oil volume adjusting device
3. Porcelain shell
4. Capacitor element
5. Insulating oil of capacitor stack
6. Transformer
7. Insulating oil of transformer unit
8. Nitrogen gas
9. Base tank
10. Oil level indicator
11. Secondary terminal box

Fig. 2 Typical sectional sketch of CVT

Technical particulars

Table 1. Typical electrical characteristics

No.	Type	Highest system voltage (kV)	Withstand voltage				Rated capaci-tance (μF)	Number of porcelain shell	Creepage distance (normal/pollution) (mm)
			BIL (kV)	Sw.impulse (kV)	Power frequency				
					Dry (kV)	Wet (kV)			
1	IM72	72.5	325	—	140	140	0.0106	1	1 245/1 775
2							0.0212		
3									
4	IM123	123	550	—	230	230	0.0076	1	1 975/2 985
5							0.0152		
6									
7	IM145	145	650	—	275	275	0.0066	1	2 700/4 015
8							0.0132		
9									
10	IM170	170	750	—	325	325	0.0058	1	3 040/4 620
11							0.0116		
12									
13	IM245	245	1 050	—	460	460	0.0041	1	4 085/6 110
14							0.0082		
15									
16	IM300	300	1 050	850	460	460	0.0035	2	4 675/7 000
17							0.007		
18									
19	IM362	362	1 175	950	510	510	0.00285	2	5 400/8 030
20							0.0057		
21									
22	IM420	420	1 425	1 050	630	630	0.0025	2	6 080/9 240
23							0.005		
24									
25	IM550	550	1 550	1 175	680	680	0.002	2	7 430/11 155
26							0.004		
27									

Note : If withstand voltage differ from above value, the dimention and weight will be changed.

	Outline	Total height; H (mm)	Total weight (normal/pollution) (kg)	Oil Volume (liter)	Total simultaneous burden (VA)					
					Accuracy of IEC			Accuracy of ANSI		
					0.2	0.5	1.0	0.3	0.6	1.2
	(A)	1 540	410/420	110	—	100	200	—	Y	Z
	(B)	1 595	615/625	170	100	300	600	Z	ZZ	—
	(C)	1 650	785/795	210	250	600	1 000	ZZ	—	—
	(A)	1 900	435/450	120	—	100	200	—	Y	Z
	(B)	1 955	640/660	180	100	300	600	Z	ZZ	—
	(C)	2 010	810/830	210	250	600	1 000	ZZ	—	—
	(A)	2 225	455/480	120	—	100	200	—	Y	Z
	(B)	2 280	670/695	180	100	300	600	Z	ZZ	—
	(C)	2 335	840/865	220	250	600	1 000	ZZ	—	—
	(A)	2 405	465/490	120	—	100	200	—	Y	Z
	(B)	2 460	685/715	190	100	300	600	Z	ZZ	—
	(C)	2 515	855/885	220	250	600	1 000	ZZ	—	—
	(A)	2 905	505/530	130	—	100	200	—	Y	Z
	(B)	2 960	735/770	200	100	300	600	Z	ZZ	—
	(C)	3 015	905/940	240	250	600	1 000	ZZ	—	—
	(A)	3 610	585/625	130	—	100	200	—	Y	Z
	(B)	3 675	815/860	210	100	300	600	Z	ZZ	—
	(C)	3 730	985/1 030	240	250	600	1 000	ZZ	—	—
	(A)	3 935	605/655	130	—	100	200	—	Y	Z
	(B)	4 000	845/895	210	100	300	600	Z	ZZ	—
	(C)	4 055	1 015/1 065	250	250	600	1 000	ZZ	—	—
	(A)	4 295	625/675	140	—	100	200	—	Y	Z
	(B)	4 360	875/935	220	100	300	600	Z	ZZ	—
	(C)	4 415	1 045/1 105	250	250	600	1 000	ZZ	—	—
	(A)	4 935	680/735	150	—	100	200	—	Y	Z
	(B)	5 000	945/1 010	240	100	300	600	Z	ZZ	—
	(C)	5 055	1 115/1 180	280	250	600	1 000	ZZ	—	—

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Performance

1. Ferro-resonance

CVTs which consist of non-linear inductance and capacitance have in itself a possibility of ferro-resonance oscillations, if no special measures were taken.

The damping burden (ZD) is used in order to suppress the ferro-resonance oscillations. The burden consists of a saturable reactor and a resistance.

Therefore, various overvoltages resulting in ferro-resonance oscillations saturate the saturable reactor before the main transformer is saturated.

Nissin CVTs can fully meet the requirement of ferro-resonance specified in the clause 45 of IEC 186-1987.

2. Transient response

The transient response is defined as the residual secondary voltage at a specified time after a short-circuit of the primary voltage in CVTs.

Nissin CVTs can fully meet the requirement of transient response specified in the clause 46 of IEC 186-1987.

Accessories

1. Standard accessories

The following accessories are normally provided.

1) Rating plate(in English)	1 pce.
2) Lifting lugs	1 set
3) Earth terminal (clamp type for 22~250㎟)	1 pce.
4) Secondary terminal box	1 set
5) Secondary terminal block	1 set
6) Oil level indicator (for the transformer unit)	1 pce.
7) Drain plug (for the transformer unit)	1 pce.
8) Filling plug	1 set
9) Gap gauge (for the protective gap)	1 pce.
10) Line terminal pad (NEMA standard, 4 holes)	1 pce.
11) Undrilles plate for cable entry	1 pce.
12) Mounting bolt	1 set

2. Optional accessories

The following accessories will be provided by request.

1) Fuse
2) Line terminal connector
3) Carrier accessories
   - i) Carrier grounding switch
   - ii) Carrier protective gap
   - iii) Drain coil
   - iv) Carrier terminal

Tests

1. Routine tests

Before shipment from factory, the following routine tests are carried out on each complete assembled CVT.

1) Verification of terminal markings
2) Polarity check
3) Capacitance measurement
4) Measurement of tangent of the loss angle
5) Power-frequency withstand voltage test
6) Accuracy measurement

2. Type tests

Type test reports will be submitted by request with extra charge.

Inquiry and ordering information

The following information should be at least specified when inquiring and ordering CVTs.

Required information	Data
1. General data	
1) Quantity	----------
2) Delivery time	----------
3) Destination	----------
4) Service condition	
· Ambient temperature (max.and min.)	---------- °C
· Altitude	---------- m
5) Applicable standard	----------
6) Colour of porcelain shells	----------
7) System earthing condition	----------
2. Electrical data	
1) Rated frequency, 50Hz or 60Hz	---------- Hz
2) Highest system voltage	---------- kV
3) Impulse withstand voltage	---------- kV peak
4) Power-frequency withstand voltage, dry or wet.	---------- kV rms
5) Rated primary voltage	---------- kV
6) Rated secondary voltage	---------- V
7) Rated tertiary voltage	---------- V
8) Rated secondary burden and accuracy	---------- VA/—
9) Rated tertiary burden and accuracy	---------- VA/—
10) Total simultaneous burden	---------- VA
11) Min. creepage distance	---------- mm
3. Others	
If other additional specifications are required, they must be informed.	----------
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