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1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

TYPE LV-6 HIGH VOLTAGE POWER CAPACITORS & REACTORS

• HIGH VOLTAGE POWER CAPACITORS

Type LV-6 high voltage power factor correction capacitors employ the plastic film only having superior dielectric strength and utilize the electrodes of unique construction, achieving low loss (as low as approx. 1/3 of our conventional capacitors) and significantly high current handling capability.



FEATURES

① Extremely Low Loss to Save Energy

The use of all plastic film dielectrics and proprietary electrode construction has reduced the loss of film itself to approximately 1/3 of our conventional design, offering significant saving in capacitor operation cost.

② Higher Safety Factor for Temperature against Harmonics

Temperature rise has been reduced considerably (to approximately 1/2 of our conventional design) due to lower loss, providing a higher safety factor for temperature against overload caused by harmonic currents. In addition, the capacitors can be operated at up to 50°C (temperature class B) due to lower temperature rise during operation.

③ Enhanced Current Handling Capability

The proprietary extended foil construction has enhanced greatly the capability to handle inrush current appearing when the capacitors are switched on or off.

④ Superior Reliability

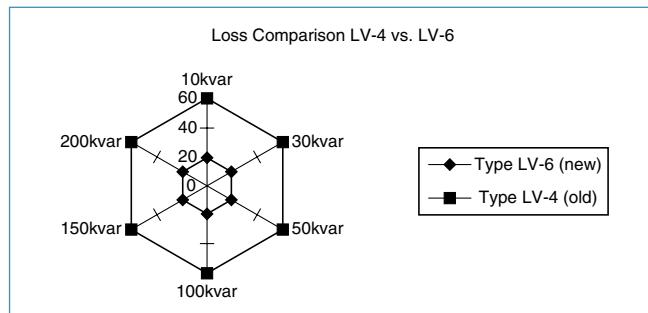
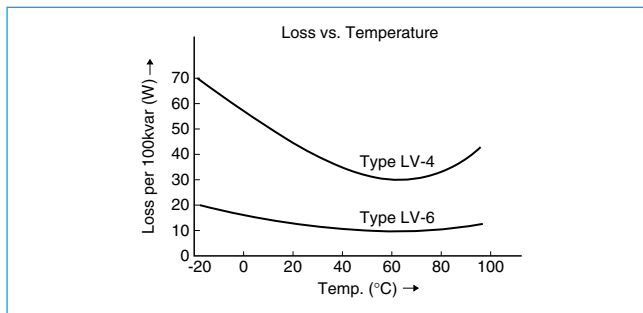
The use of polypropylene film dielectrics with excellent electrical performances has enhanced dielectric strength and reliability.

⑤ Fault Detector (MDA-1) for 150kvar or more

The fault detector is free of leaks to provide high reliability, with its simple construction to facilitate maintenance and easy mounting.

ENERGY SAVING

If LV-4 100kvar x 10 units are replaced with type LV-6, annual energy saving will amount to (60-20) W x 10 units x 24 hr x 365 days = 3,504kWhr.



HOW TO DETERMINE CAPACITOR OUTPUT

(percentage of load kW)

	1.0	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.92	0.91	0.9	0.875	0.85	0.825	0.8	0.775	0.75	0.725	0.7	0.675	0.65	0.625	0.6	0.575	0.55	0.525	0.5	0.475	0.45	0.425	
0.4	230	216	210	205	201	197	194	190	187	184	182	175	168	161	155	149	142	135	128	121	113	105	96	88	78	68	57	45	32	17	
0.45	198	183	177	173	168	165	161	158	155	152	149	142	136	129	123	116	110	103	96	89	81	73	64	56	46	36	24	12			
0.5	173	159	153	148	144	140	137	134	130	128	125	118	111	104	98	92	85	78	71	64	56	48	40	31	21	11					
0.55	152	138	132	127	123	119	116	112	109	106	104	97	90	83	77	71	64	57	50	43	35	27	19	10							
0.6	133	119	113	108	104	101	97	94	91	88	85	78	71	65	58	52	46	39	32	24	16	8.5									
0.65	117	103	97	92	88	84	81	77	74	71	69	62	55	48	42	36	29	22	15	8											
0.7	102	88	81	77	73	69	66	62	59	56	54	46	40	33	27	20	14	7													
0.75	88	74	67	63	58	55	52	49	45	43	40	33	26	19	13	6.5															
0.8	75	61	54	50	46	42	39	35	32	29	27	19	13	6																	
0.85	62	48	42	37	33	29	26	22	19	16	14	7																			
0.9	48	34	28	23	19	16	12	9	6	2.8																					
0.92	43	28	22	18	13	10	6	3.1																							
0.94	36	22	16	11	7	3.6																									
0.95	33	18	12	8	3.5																										
0.96	29	15	9	4																											
0.97	25	11	5																												
0.98	20	6																													
0.99	14																														

Example

① To improve power factor from 0.75 for 500kW load to 0.95, the table gives a percentage of 55%.

Required capacitor output = 500kW x 0.55 = 275kvar

② For loads rated at kVA, calculate in a manner to similar to ① by converting kW=kVAx $\cos\phi$.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

• TYPE LR-3 SERIES REACTORS

Multiple capacitors connected to a circuit for power factor correction may cause the waveform of the circuit voltage especially the 5th harmonic to be distorted more. This is because the capacitors connected make the impedance of the circuit capacitive. Harmonics contained in the voltage waveform may increase noise in a transformer, or may cause an excessive current to flow through the capacitor circuit resulting in a failure of the capacitors. To solve these problems, reactors should be added in series with the capacitors to make the impedance of the circuit inductive for harmonics for the improvement of the distorted waveform.

Series reactors are used for this purpose. Series reactor will improve not only the waveform but also will help reduce the inrush current that will flow through capacitors when the capacitors are switched on or prevent switches from restriking when the capacitors are switched off.



APPLICATION NOTES

• Noise

Series reactors are constructed to provide air gap in the core. Special consideration is given to the design and manufacture of the series reactors to minimize buzzing to be generated by the air gap. When series reactor are installed in a small sealed room, buzzing may be echoed or resonate with that of the existing transformer resulting in amplified buzzing. To prevent this problem, it is recommended to secure reactors on the floor tightly by foundation bolts. If buzzing is still audible, add a rubber pad. Higher content of harmonics may cause a higher noise, but does not affect the performance or life of the reactors adversely as long as the current flowing in the reactor does not exceed the permissible limit.

• Matching with capacitor output

Series reactors are intended to be connected in series with other device, and work effectively when combined with a capacitor whose output matches with that of the reactor.

For example, a 6.38kvar reactor will have 6% reactance to improve the waveform of the 5th harmonic only when connected to a 106kvar capacitor. When connected to a 53.2kvar capacitor, the 6.38kvar reactor will have an output of

$$6.38\text{kvar} \times \left(\frac{53.2\text{kvar}}{106\text{kvar}} \right)^2 = 1.61\text{kvar}$$

Therefore, it will have 3% reactance for the 53.2kvar capacitor and will not work effectively for the 5th harmonic. It may amplify harmonics.

• Addition of series reactor to some of capacitors

If some of capacitors installed in the same system do not have series reactors, harmonics may be amplified depending on percentage of capacitors without reactors. It is recommended that the capacitors which account for at least 2/3 of the total output be provided with a reactor.

CIRCUIT PROTECTION

When harmonic current exceeding the limit flows in the reactor, the reactor may burn out. Connect the Thermal Sensor attached to the reactor to a circuit breaker to protect the reactor. See page 12.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

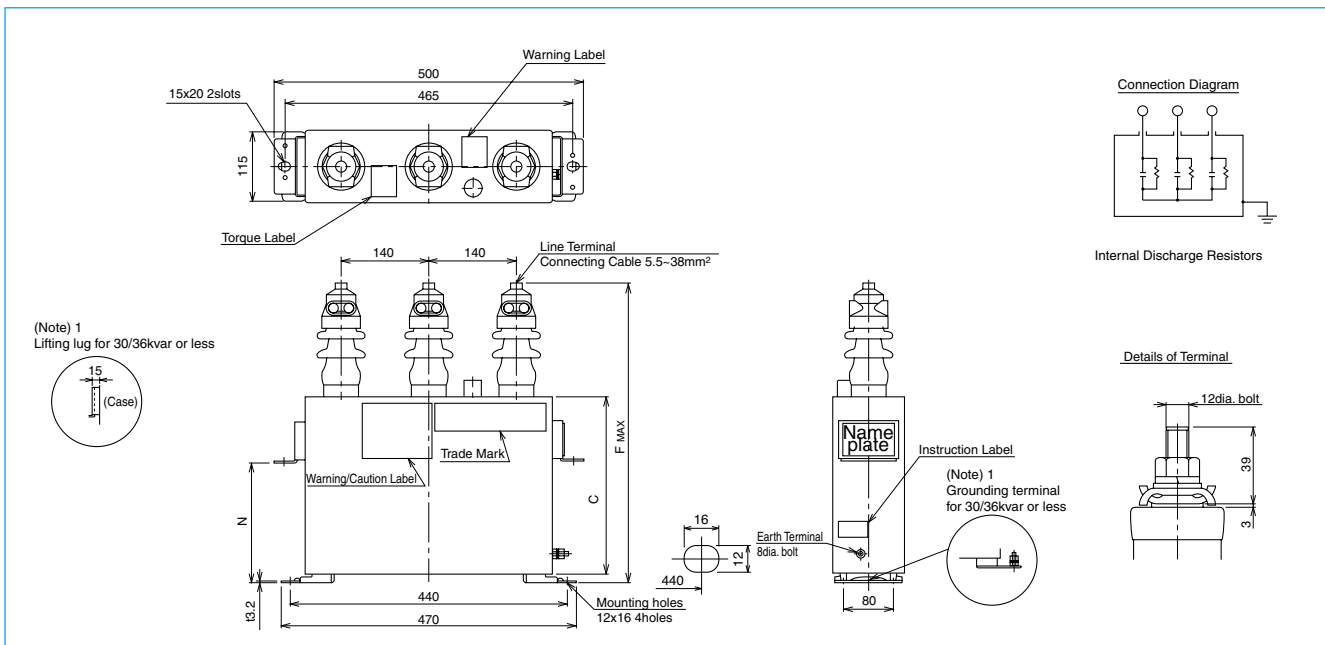
TYPE LV-6 HIGH VOLTAGE CAPACITORS (for L=6%) Combined Output 10-100kvar

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	LV-6, oil filled and self cooled	Insulation Level	16/45kV, 22/60kV
Installation Location	Indoor & outdoor	Dissipation Factor	0.025% max. at 20°C
Temperature Class	-20/B (Ambient temperature -20°C to +50°C, provided 24 hour average is 45°C max.)	Permissible Overload	110% of rating (12 hours max. per 24 hours)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)	Permissible Overload	130% of rating (not including current due to cap. tol.)
Voltage Withstand	T - T : 2 x rated voltage T - C : 16kV (for 3510V) 22kV (for 7020V)	Discharge Resistors	Discharge to 50V or less in 5 minutes
		Paint Color	Munsell 5Y7/1
		Applicable Standard	JIS C 4902-1998

DIMENSIONS (mm)



- (Notes) 1. The units with combined output of 30/36kvar or less do not have lifting lugs. The grounding terminal is located at the mounting foot.
 2. To assemble two or more capacitors, secure the spacing of 50mm or more between units.
 3. Permissible limit for bulge (one side) in case is 10mm for combined output of 10/12-50kvar and 15mm for 75-100kvar.
 4. For protection of the system, see page 12.

RATINGS LV-6 (for L=6%) 10-100kvar

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)			Gross mass (kg)
					3300V	6600V	C	F	N	
7020 or 3510	10/12	10.6/12.8	50/60	LV6★CC010R26E	1.75/2.10	0.875/1.05	150	350	—	15
	15/18	16.0/19.1	50/60	LV6★CC015R26E	2.62/3.15	1.31/1.57	150	350	—	15
	20/24	21.3/25.5	50/60	LV6★CC020R26E	3.50/4.20	1.75/2.10	150	350	—	15
	25/30	26.6/31.9	50/60	LV6★CC025R26E	4.37/5.25	2.19/2.62	150	350	—	15
	30/36	31.9/38.3	50/60	LV6★CC030R26E	5.25/6.30	2.62/3.15	170	370	—	16
	50	53.2	50	LV6★C5050R26E	8.75	4.37	220	420	140	19
			60	LV6★C6050R26E			200	400	120	18
	75	79.8	50	LV6★C5075R26E	13.1	6.56	310	510	220	25
			60	LV6★C6075R26E			275	475	200	23
	100	106	50	LV6★C5100R26E	17.5	8.75	375	575	290	30
60			LV6★C6100R26E	335			535	230	27	

- (Note) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

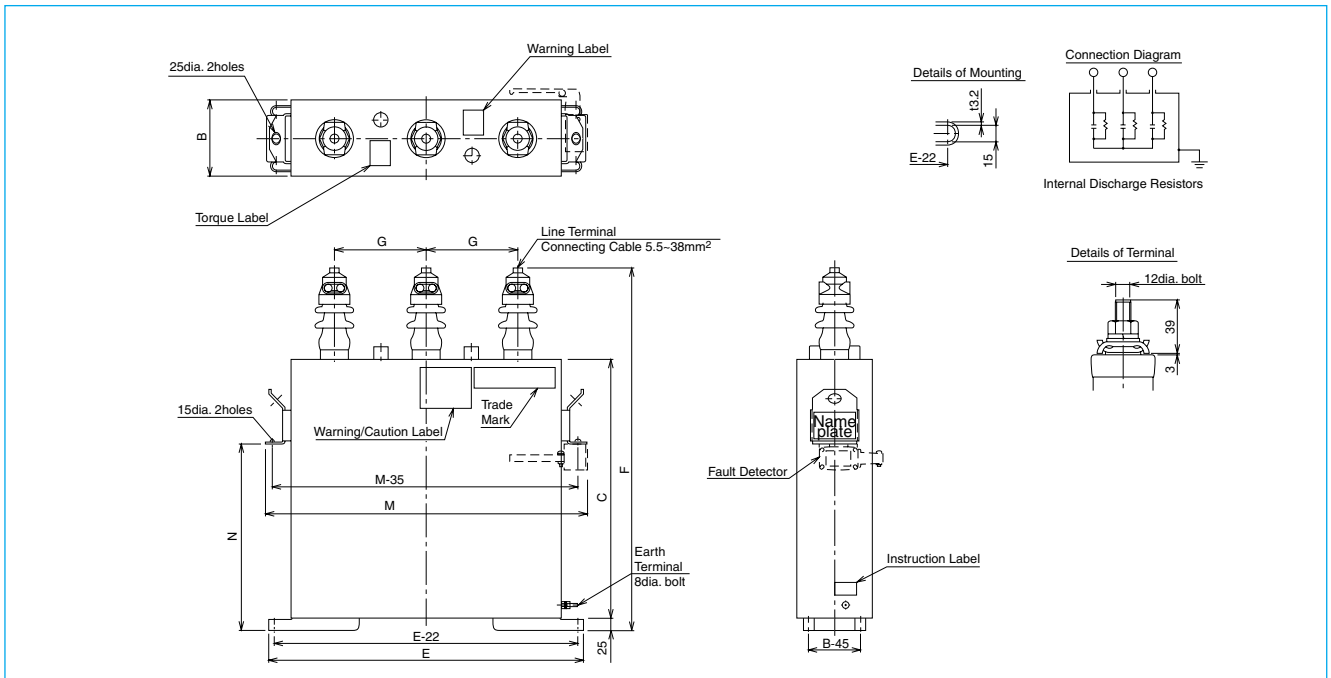
TYPE LV-6 HIGH VOLTAGE CAPACITORS (for L=6%) Combined Output 150-500kvar

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	LV-6, oil filled and self cooled	Insulation Level	16/45kV, 22/60kV
Installation Location	Indoor & outdoor	Dissipation Factor	0.025% max. at 20°C
Temperature Class	-20/B (Ambient temperature -20°C to +50°C, provided 24 hour average is 45°C max.)	Permissible Overload	110% of rating (12 hours max. per 24 hours)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)	Permissible Overload	130% of rating (not including current due to cap. tol.)
Voltage Withstand	T - T : 2 x rated voltage T - C : 16kV (for 3510V) 22kV (for 7020V)	Discharge Resistors	Discharge to 50V or less in 5 minutes
		Paint Color	Munsell 5Y7/1
		Applicable Standard	JIS C 4902-1998

DIMENSIONS (mm)



- (Notes) 1. To assemble two or more capacitors, secure the spacing of 80mm or more between the units for the combined output of 150-300kvar and 100mm or more for 400-500kvar.
2. Permissible limit for bulge (one side) in case is 20mm for combined output of 150-300kvar and 25mm for 400-500kvar.
3. For protection of the system, see page 12.

RATINGS LV-6 (for L=6%) 150-500kvar

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)						Gross mass (kg)	
					3300V	6600V	B	C	E	F	G	M		N
7020 or 3510	150	160	50	LV6★C5150R26E	26.2	13.1	150	380	620	590	180	635	250	49
			60	LV6★C6150R26E			150	340	620	550	180	635	220	44
	200	213	50	LV6★C5200R26E	35.0	17.5	150	450	620	660	180	635	320	57
			60	LV6★C6200R26E			150	410	620	620	180	635	270	53
	250	266	50	LV6★C5250R26E	43.7	21.9	150	550	620	760	180	635	370	69
			60	LV6★C6250R26E			150	485	620	695	180	635	340	61
	300	319	50	LV6★C5300R26E	52.5	26.2	150	620	620	830	180	635	450	77
			60	LV6★C6300R26E			150	550	620	760	180	635	370	69
	400	426	50	LV6★C5400R26E	70.0	35.0	180	600	820	810	230	835	440	120
			60	LV6★C6400R26E			180	500	820	710	230	835	330	100
	500	532	50	LV6★C5500R26E	87.5	43.7	180	780	820	990	230	835	500	146
			60	LV6★C6500R26E			180	600	820	810	230	835	440	120

- (Note) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

TYPE LR-3 SERIES REACTORS (for L=6%, Is=55%) Combined Output 10-1000kvar

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	LR-3, oil filled & self-cooled	Reactance	6% of capacitor reactance
Installation Location	Indoor & Outdoor	Permissible Overload	Class II:130% of rating (5th Maximum Current harmonic current - not more than 55% of the fundamental current)
Temperature Class	-20/A (Ambient temperature -20°C to +40°C, provided 24 hour average is 35°C max.)	Temperature Rise	55°C max. at the coils (per resistance method)
Insulation Level	16/45kV, 22/60kV	Paint Color	Munsell 5Y7/1
System Voltage	3300V or 6600V	Applicable Standard	JIS C 4902-1998
Number of Phases	3 phase		
Rated Frequency	50Hz or 60Hz		

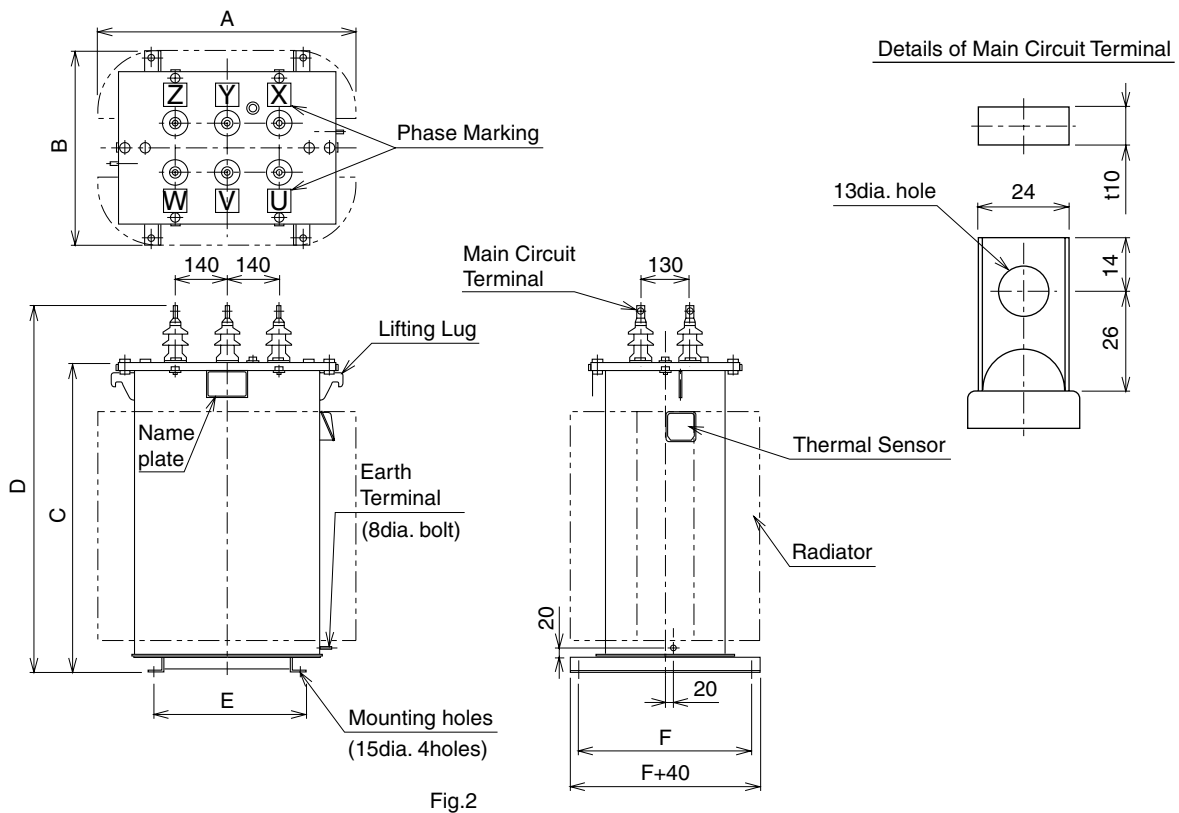
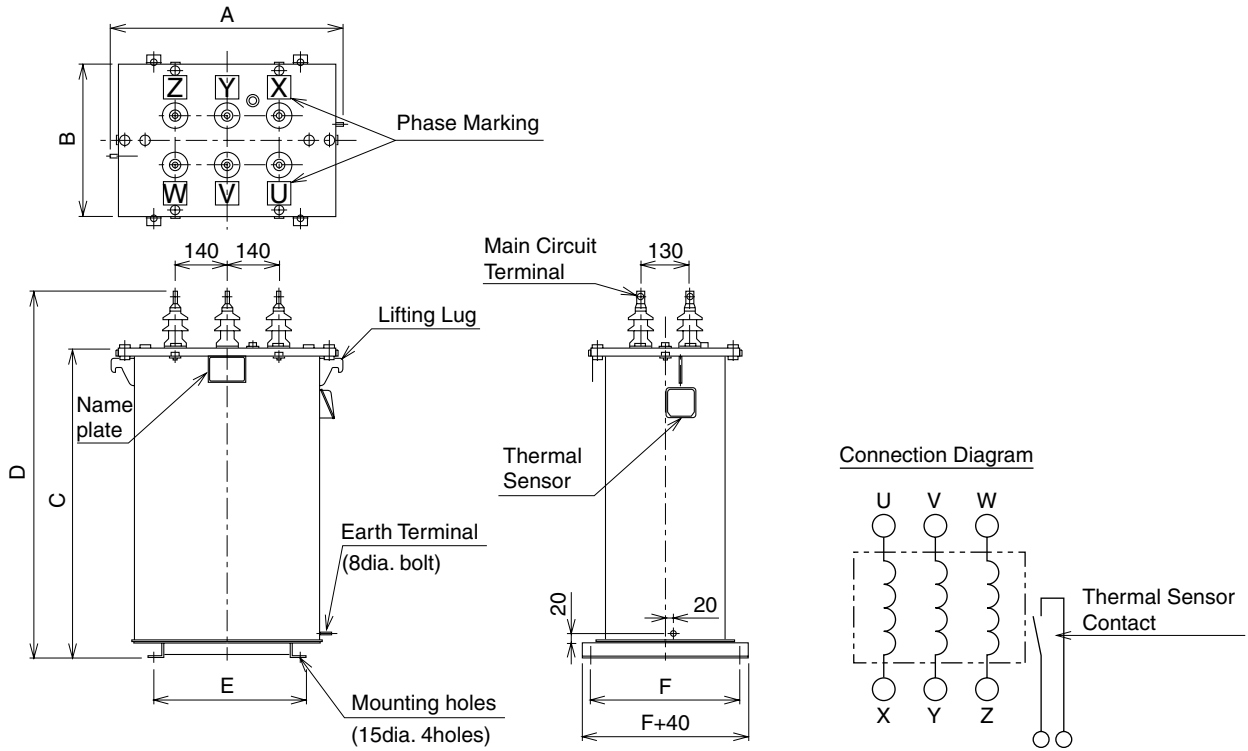
RATINGS LR-3 (L=6%) Rated Voltage : 6600V-243V, 3300V-122V

System Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)						Oil Vol. (L)	Gross mass (kg)	Fig.
					3300V	6600V	A	B	C	D	E	F			
6600 or 3300	10	0.638	50	LR3★C5010N26E	1.75	0.875	500	325	560	705	350	300	30	110	1
	12	0.766	60	LR3★C6012N26E	2.10	1.05	500	325	560	705	350	300	30	110	
	15	0.957	50	LR3★C5015N26E	2.62	1.31	500	325	560	705	350	300	30	110	
	18	1.15	60	LR3★C6018N26E	3.15	1.57	500	325	560	705	350	300	30	110	
	20	1.28	50	LR3★C5020N26E	3.50	1.75	500	325	560	705	350	300	30	110	
	24	1.53	60	LR3★C6024N26E	4.20	2.10	500	325	560	705	350	300	30	110	
	25	1.60	50	LR3★C5025N26E	4.37	2.19	500	325	560	705	350	300	30	110	
	30	1.91	60	LR3★C6030N26E	5.25	2.62	500	325	560	705	350	300	30	110	
	30	1.91	50	LR3★C5030N26E	5.25	2.62	500	325	560	705	350	300	30	110	
	36	2.30	60	LR3★C6036N26E	6.30	3.15	500	325	560	705	350	300	30	110	
	50	3.19	50/60	LR3★C * 050N26E	8.75	4.37	500	325	560	705	350	300	30	110	
	75	4.79	50/60	LR3★C * 075N26E	13.1	6.56	500	325	660	805	350	300	35	130	
	100	6.38	50/60	LR3★C * 100N26E	17.5	8.75	500	325	760	905	350	300	40	145	
	150	9.57	50/60	LR3★C * 150N26E	26.2	13.1	570	390	660	805	400	350	50	195	
	200	12.8	50/60	LR3★C * 200N26E	35.0	17.5	570	390	710	855	400	350	55	210	
	250	16.0	50/60	LR3★C * 250N26E	43.7	21.9	620	420	710	855	400	380	70	250	
	300	19.1	50/60	LR3★C * 300N26E	52.5	26.2	620	420	760	905	400	380	75	270	
	400	25.5	50/60	LR3★C * 400N26E	70.0	35.0	620	440	860	1005	400	400	90	320	
	500	31.9	50/60	LR3★C * 500N26E	87.5	43.7	680	500	860	1005	400	460	95	360	
	600	38.3	50/60	LR3★C * 600N26E	105	52.5	680	540	860	1005	400	500	105	410	
700	44.7	50/60	LR3★C * 700N26E	122	61.2	680	540	960	1105	400	500	120	460		
750	47.9	50/60	LR3★C * 750N26E	131	65.6	680	540	960	1105	400	500	120	475		
800	51.1	50/60	LR3★C * 800N26E	140	70.0	740	600	1010	1155	400	560	130	520		
900	57.4	50/60	LR3★C * 900N26E	157	78.7	740	600	1010	1155	400	560	130	540		
1000	63.8	50/60	LR3★C * 10EN26E	175	87.5	740	600	1010	1155	400	560	130	550		

- (Notes) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.
 2. The mark * denotes frequency. 5 and 6 represent 50Hz and 60Hz respectively.
 3. The units with a dial thermometer (for outdoor or indoor) are also available.
 4. Class I reactors (Is=35%) are also available.
 5. Reactors with Is=70% are also available.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

DIMENSIONS (mm)



(Note) For protection of circuit, see page 12.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

TYPE LV-6 HIGH VOLTAGE CAPACITORS (for L=13%) Combined Output 10-500kvar

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	LV-6, oil filled and self cooled	Insulation Level	16/45kV, 22/60kV
Installation Location	Indoor & outdoor	Dissipation Factor	0.025% max. at 20°C
Temperature Class	-20/B (Ambient temperature -20°C to +50°C, provided 24 hour average is 45°C max.)	Permissible Overload	110% of rating (12 hours max. per 24 hours)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)	Permissible Overload	130% of rating (not including current due to cap. tol.)
Voltage Withstand	T - T : 2 x rated voltage T - C : 16kV (for 3510V) 22kV (for 7020V)	Discharge Resistors	Discharge to 50V or less in 5 minutes
		Paint Color	Munsell 5Y7/1
		Applicable Standard	JIS C 4902-1998

RATINGS LV-6 (for L=13%) 10-500kvar

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)			Gross mass (kg)	Fig.
					3300V	6600V	C	F	N		
7590 or 3790	10/12	11.5/13.8	50/60	LV6★CC010R13E	1.75/2.10	0.875/1.05	150	350	-	15	1
	15/18	17.2/20.7	50/60	LV6★CC015R13E	2.62/3.15	1.31/1.57	150	350	-	15	
	20/24	23.0/27.6	50/60	LV6★CC020R13E	3.50/4.20	1.75/2.10	150	350	-	15	
	25/30	28.7/34.5	50/60	LV6★CC025R13E	4.37/5.25	2.19/2.62	150	350	-	15	
	30/36	34.5/41.4	50/60	LV6★CC030R13E	5.25/6.30	2.62/3.15	170	370	-	16	2
	50	57.5	50	LV6★C5050R13E	8.75	4.37	250	450	170	21	
			60	LV6★C6050R13E			210	410	130	19	
	75	86.2	50	LV6★C5075R13E	13.1	6.56	335	535	230	27	
			60	LV6★C6075R13E			310	510	220	25	
	100	115	50	LV6★C5100R13E	17.5	8.75	440	640	330	33	
			60	LV6★C6100R13E			360	560	240	28	
	150	172	50	LV6★C5150R13E	26.2	13.1	400	610	270	51	
			60	LV6★C6150R13E			360	570	220	47	
	200	230	50	LV6★C5200R13E	35.0	17.5	510	720	370	64	
			60	LV6★C6200R13E			430	640	270	54	
	250	287	50	LV6★C5250R13E	43.7	21.9	590	800	430	73	
			60	LV6★C6250R13E			520	730	370	65	
	300	345	50	LV6★C5300R13E	52.5	26.2	690	900	450	85	
			60	LV6★C6300R13E			590	800	430	73	
	400	460	50	LV6★C5400R13E	70.0	35.0	680	890	450	135	
			60	LV6★C6400R13E			540	750	390	108	
	500	575	50	LV6★C5500R13E	87.5	43.7	840	1050	550	165	
			60	LV6★C6500R13E			720	930	500	142	

(Note) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

DIMENSIONS (mm)

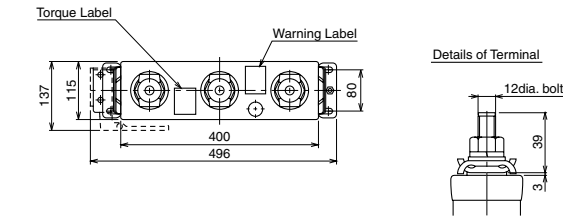


Fig. 1

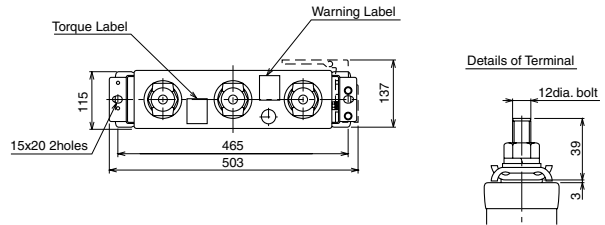
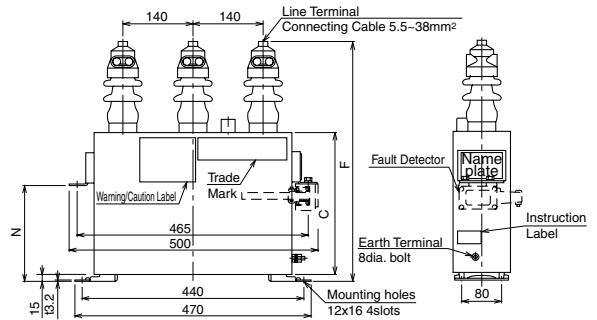
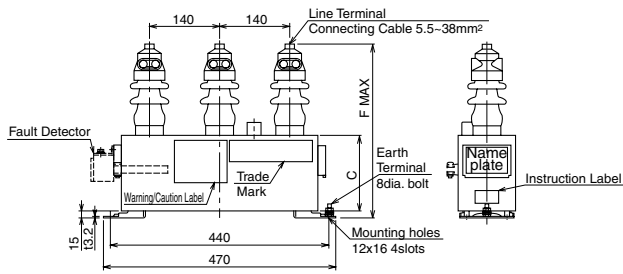
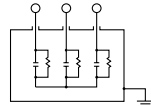


Fig. 2



Connection Diagram



Internal Discharge Resistors

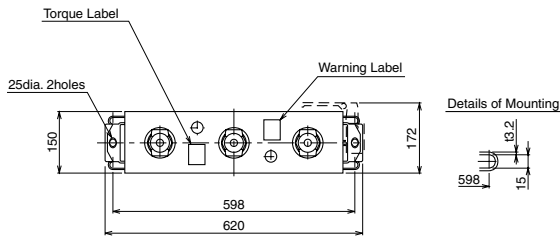


Fig. 3

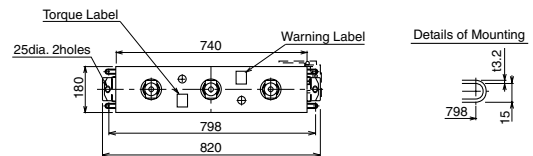
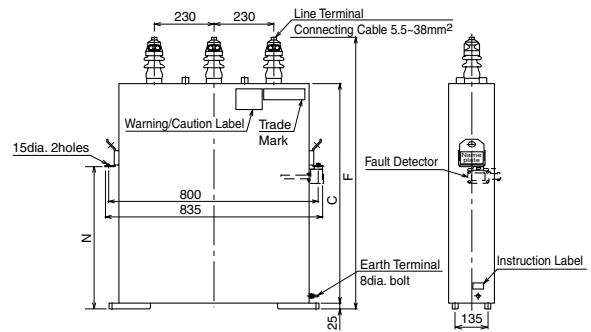
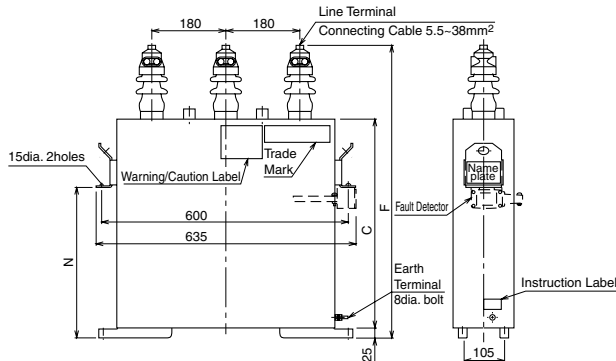


Fig. 4



(Note) For protection of circuit, see page 12.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

TYPE LR-3 SERIES REACTORS (for L=13%, Is=35%) Combined Output 10-500kvar

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	LR-3, oil filled & self-cooled	Reactance	13% of capacitor reactance
Installation Location	Indoor & Outdoor	Permissible Overload	Class I:120% of rating (5th
Temperature Class	-20/A	Maximum Current	harmonic current - not
(Ambient temperature	-20°C to +40°C, provided 24		more than 35% of the
	hour average is 35°C max.)		fundamental current)
Insulation Level	16/45kV, 22/60kV	Temperature Rise	55°C max. at the coils (per
System Voltage	3300V or 6600V		resistance method)
Number of Phases	3 phase	Paint Color	Munsell 5Y7/1
Rated Frequency	50Hz or 60Hz	Applicable Standard	JIS C 4902-1998

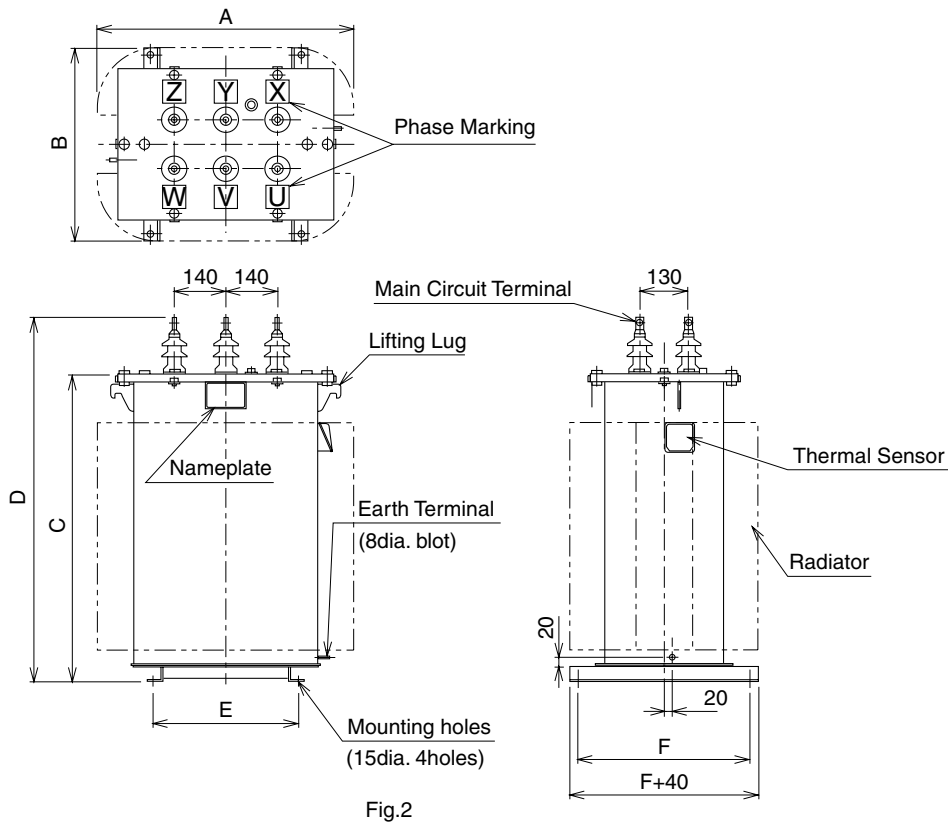
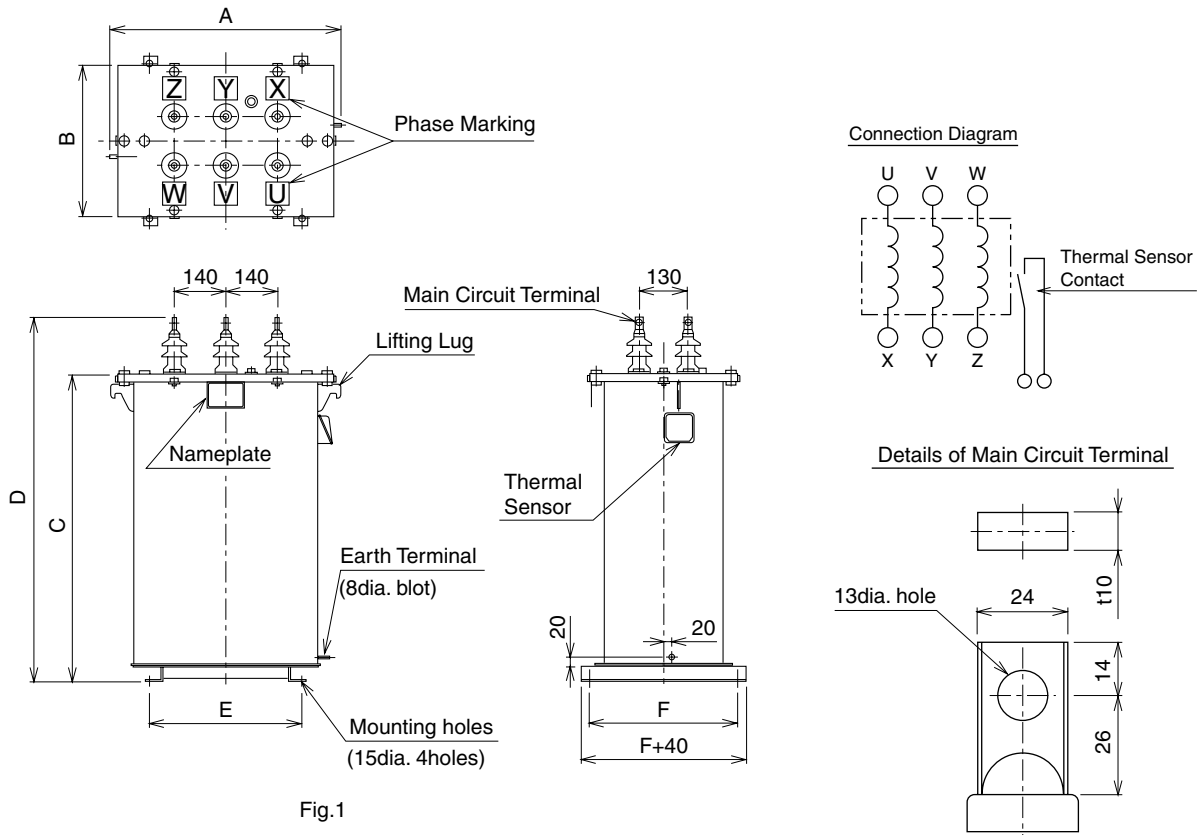
RATINGS LR-3 (L=13%) Rated Voltage : 6600V-569V, 3300V-285V

System Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)						Oil Vol. (L)	Gross mass (kg)	Fig.
					3300V	6600V	A	B	C	D	E	F			
6600 or 3300	10	1.49	50	LR3★C5010N13E	1.75	0.875	500	325	560	705	350	300	25	110	1
	12	1.79	60	LR3★C6012N13E	2.10	1.05	500	325	560	705	350	300	25	110	
	15	2.24	50	LR3★C5015N13E	2.62	1.31	500	325	560	705	350	300	25	110	
	18	2.69	60	LR3★C6018N13E	3.15	1.57	500	325	560	705	350	300	25	110	
	20	2.99	50	LR3★C5020N13E	3.50	1.75	500	325	560	705	350	300	25	110	
	24	3.59	60	LR3★C6024N13E	4.20	2.10	500	325	660	805	350	300	30	130	
	25	3.74	50	LR3★C5025N13E	4.37	2.19	500	325	660	805	350	300	30	130	
	30	4.48	60	LR3★C6030N13E	5.25	2.62	500	325	660	805	350	300	30	130	
	30	4.48	50	LR3★C5030N13E	5.25	2.62	500	325	660	805	350	300	30	130	
	36	5.38	60	LR3★C6036N13E	6.30	3.15	500	325	660	805	350	300	30	130	
	50	7.47	50/60	LR3★C★*050N13E	8.75	4.37	570	390	660	805	400	350	50	185	2
	75	11.2	50/60	LR3★C★*075N13E	13.1	6.56	570	390	660	805	400	350	50	190	
	100	14.9	50/60	LR3★C★*100N13E	17.5	8.75	570	390	660	805	400	350	50	200	
	150	22.4	50/60	LR3★C★*150N13E	26.2	13.1	620	420	710	855	400	380	65	260	
	200	29.9	50/60	LR3★C★*200N13E	35.0	17.5	620	440	860	1005	400	400	90	310	
	250	37.4	50/60	LR3★C★*250N13E	43.7	21.9	680	500	860	1005	400	460	95	350	
	300	44.8	50/60	LR3★C★*300N13E	52.5	26.2	680	540	860	1005	400	500	100	400	
	400	59.8	50/60	LR3★C★*400N13E	70.0	35.0	680	540	960	1105	400	500	120	455	
500	74.7	50/60	LR3★C★*500N13E	87.5	43.7	740	600	1010	1155	400	560	130	535		

- (Notes) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.
 2. The mark * denotes frequency. 5 and 6 represent 50Hz and 60Hz respectively.
 3. The units with a dial thermometer (for outdoor or indoor) are also available.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

DIMENSIONS (mm)



(Note) For protection of circuit, see page 12.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

PROTECTION OF HIGH VOLTAGE CAPACITORS & REACTORS

High voltage power capacitors can be said to be a static apparatus with extremely high reliability. However, overheat, burning out, short circuit or case rupture may occur, should a capacitor fail due to service conditions including overvoltage and excessive harmonics. Therefore, it is required that capacitors be protected against failure. Protection should be coordinated with failure characteristics of capacitor equipment and the following protections are recommended.

Rated Equipment Output	Recommended Protection
10kvar - 100kvar	Current limiting fuses & thermal sensors
150kvar - 500kvar	Fault Detector (MDA-1), current limiting fuses & thermal sensor

- (Notes) 1. For recommended rated current of fuses, refer to the recommendation of the fuse manufacturers.
 2. Install fuses at the power supply side of series reactors.
 3. Capacitors rated at 200kvar or more can be supplied with double star connection.

• HIGH VOLTAGE CAPACITORS

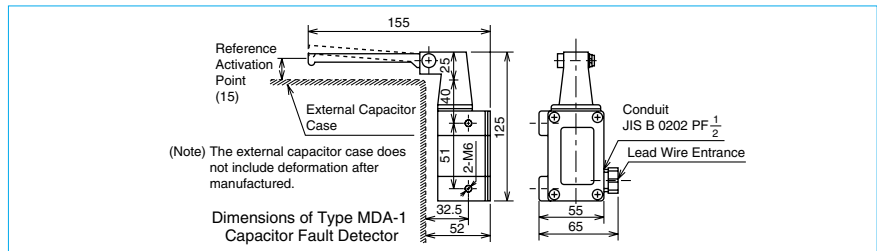
Fault Detectors (MDA-1)

Large kvar capacitors will develop a zone where the case rupture can not be protected by current limiting fuses if the breakdown will last for a long time. Conveniently, it is known that the larger the capacitor kvar or for capacitors with star connection, the more the case bulges. Type MDA-1 fault detector will sense the bulge in case to protect the case rupture. Excessive bulge in the case caused by failure in the capacitor will activate the micro switch which will then generate the signal to trip a circuit breaker.

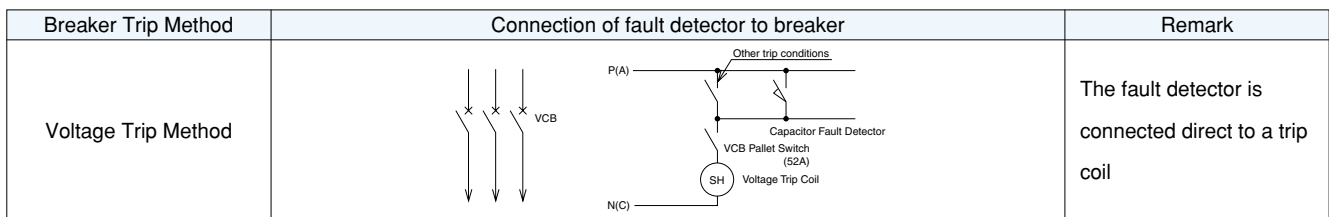


Type of Contact	1a+1b			
Contact Voltage(V)	125(AC)	250(AC)	110(DC)	220(DC)
Capacity Current(A)	10	10	5	5
Dielectric Strength	2000VAC, 1 minute			

- (Notes) 1. The currents are momentary when the circuit breaker is tripped.
 2. The fault detector is packed separately from the capacitor. Mount it when the capacitor is installed.



TYPICAL CONNECTION OF FAULT DETECTOR TO CIRCUIT BREAKER



• SERIES REACTORS

Protection Method

JIS C 4902 specifies that series reactors for power capacitors shall be operated at a current which contains the 5th harmonic current of not more than 55% of the fundamental current with the root of the sum of the squares limited to not more than 130% of the rated current. If the 5thth harmonic voltage distortion is excessively high, some current exceeding the limit will flow through the reactor possibly causing excessive temperature rise to burn out the reactor.

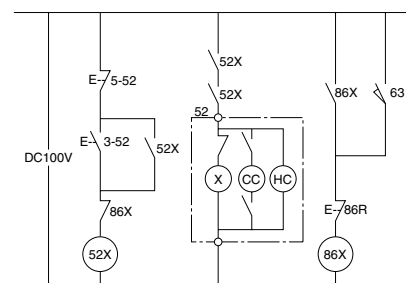
The reactors are equipped with a Thermal Sensor to detect excessive temperature rise. Connect the sensor to a circuit breaker (or a switching device) located in the upper stream to disconnect the reactor from the power source. Reactors with a dial thermometer is also available as an option.

Method	Thermal Sensor
Contact Capacity	AC 125V 8.0A DC 125V 0.2A
Contact Arrangement	
Activating Temperature	85°C

Application Notes for Protective Contacts

Connect the capacitor fault detectors and the reactor Thermal Sensors to the trip circuit of circuit breakers or switching devices. The activation of the above contacts to trip the circuit is considered a major failure. Consideration should be given to the protective circuit as shown below to prevent reclosing as it is.

Typical Circuit to Prevent Reclosing after Tripped by Protective Contacts



- 52 : Capacitor Switching Device
 52X : Auxiliary Relay
 3-52 : Closing Switch
 5-52 : Opening Switching
 63 : Fault Detector (Capacitor) or Thermal Sensor (Reactor)
 86X : Auxiliary Relay
 86R : Reset Switch

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

TYPE LV-6 CAPACITOR BANKS (DOUBLE STAR CONNECTED) (for L=6%) Combined Output 200-300kvar

The capacitor consists of two star-connected capacitors with the neutrals connected together. When the capacitor fails, a current will flow between the neutrals. The current will be sensed and used as a signal to trip a circuit breaker.

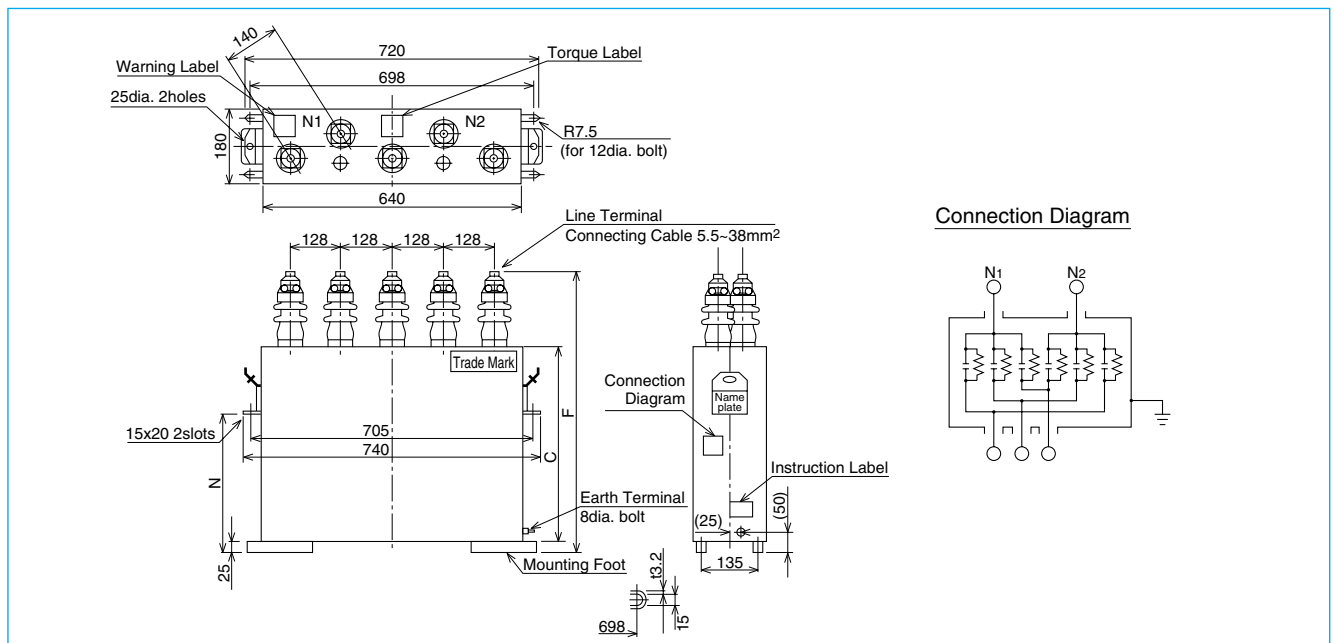
The protection scheme has been implemented to protect extra-high voltage capacitors and work very well to detect capacitor failure in early stage.

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	LV-6, oil filled and self cooled	Insulation Level	16/45kV, 22/60kV
Installation Location	Indoor & outdoor	Dissipation Factor	0.025% max. at 20°C
Temperature Class	-20/B (Ambient temperature -20°C to +50°C, provided 24 hour average is 45°C max.)	Permissible Overload	110% of rating (12 hours max. per 24 hours)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)	Permissible Overload	130% of rating (not including current due to cap. tol.)
Voltage Withstand	T - T : 2 x rated voltage T - C : 16kV (for 3510V) 22kV (for 7020V)	Discharge Resistors	Discharge to 50V or less in 5 minutes
		Paint Color	Munsell 5Y7/1
		Applicable Standard	JIS C 4902-1998

DIMENSIONS (mm)



RATINGS LV-6 (Double Star Connected)

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)			Gross mass (kg)	Oil Vol. (L)
					3510V	7020V	C	F	N		
3510 or 7020	200	213	50	LV6★C5200R26AE	35.0	17.5	390	600	270	67	23
			60	LV6★C6200R26AE			340	550	220	59	20
	250	266	50	LV6★C5250R26AE	43.7	21.9	420	630	280	74	22
			60	LV6★C6250R26AE			410	610	270	71	23
	300	319	50	LV6★C5300R26AE	52.5	26.2	480	690	340	81	24
			60	LV6★C6300R26AE			420	630	280	74	22

(Notes) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.
2. The ratings are for capacitors to be connected in series with a 6% reactor.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

TYPE FHZ HIGH VOLTAGE CAPACITORS (for L=6%) Combined Output 1000-3000kvar

Type FHZ high output capacitors offer the advantages given by high output units, making use of high performance of film dielectric layers.

FEATURES

① Low Power Loss

Running power can be saved as the loss is reduced to approximately 1/2 of the conventional paper capacitors.

② High Resistance for Contamination

Number of bushings is minimized as the capacitors are enclosed in a large tank. In addition, the capacitors are

immune to leaks resulting from rust due to thick tank plates used. It is recommended to install the capacitors especially at any contaminated locations.

③ Easy maintenance

Daily maintenance is not required due to the simple external construction.

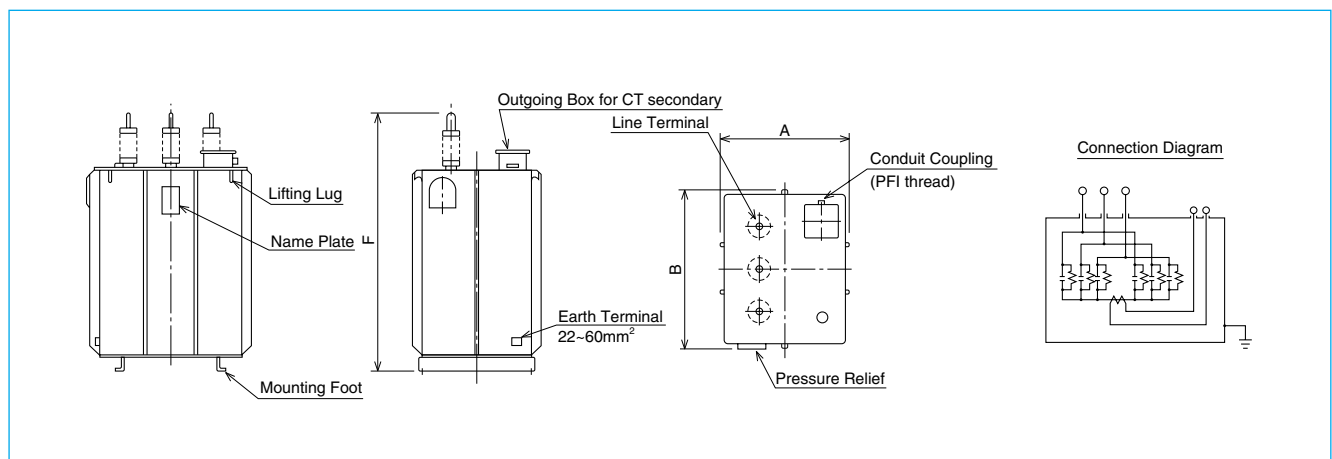
SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	FHZ, oil filled and self cooled
Installation Location	Indoor & outdoor
Temperature Class	-20/A (Ambient temperature -20°C to +40°C, provided 24 hour average is 35°C max.)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)
Voltage Withstand	T - T : 2 x rated voltage T - C : 16kV (for 3510V) 22kV (for 7020V)

Insulation Level	16/45kV, 22/60kV
Dissipation Factor	0.15% max. at 20°C
Permissible Overload	110% of rating (12 hours max. per 24 hours)
Maximum Voltage	per 24 hours)
Permissible Overload	130% of rating (not including current due to cap. tol.)
Maximum Current	current due to cap. tol.)
Discharge Resistors	Discharge to 50V or less in 5 minutes
Protection Scheme	Detection of current between the double star-connected neutrals
Paint Color	Munsell 5Y7/1
Applicable Standard	JIS C 4902-1998

DIMENSIONS (mm)



RATINGS LV-6 (Double Star Connected)

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)			Gross mass (kg)	Oil Vol. (L)
					3510V	7020V	A	B	F		
3510 or 7020	1000	1060	50	FHZ★C510ER26E	175	87.5	970	990	1,690	1,250	390
			60	FHZ★C610ER26E			970	990	1,560	1,110	360
	2000	2130	50	FHZ★C520ER26E	350	175	970	1,290	2,580	2,800	940
			60	FHZ★C620ER26E			970	1,170	2,580	2,600	880
	3000	3190	50	FHZ★C530ER26E	325	262	1,280	1,380	2,580	4,100	1360
			60	FHZ★C630ER26E			1,160	1,380	2,580	3,600	1280

- (Notes) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.
2. The ratings are for capacitors to be connected in series with a 6% reactor.
3. High output single units and extra-high voltage units not shown above are also available.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

TYPE Q-PAC-1B HIGH VOLTAGE CAPACITOR EQUIPMENT (for L=6%, Is=55%) Combined Output 100-1000kvar

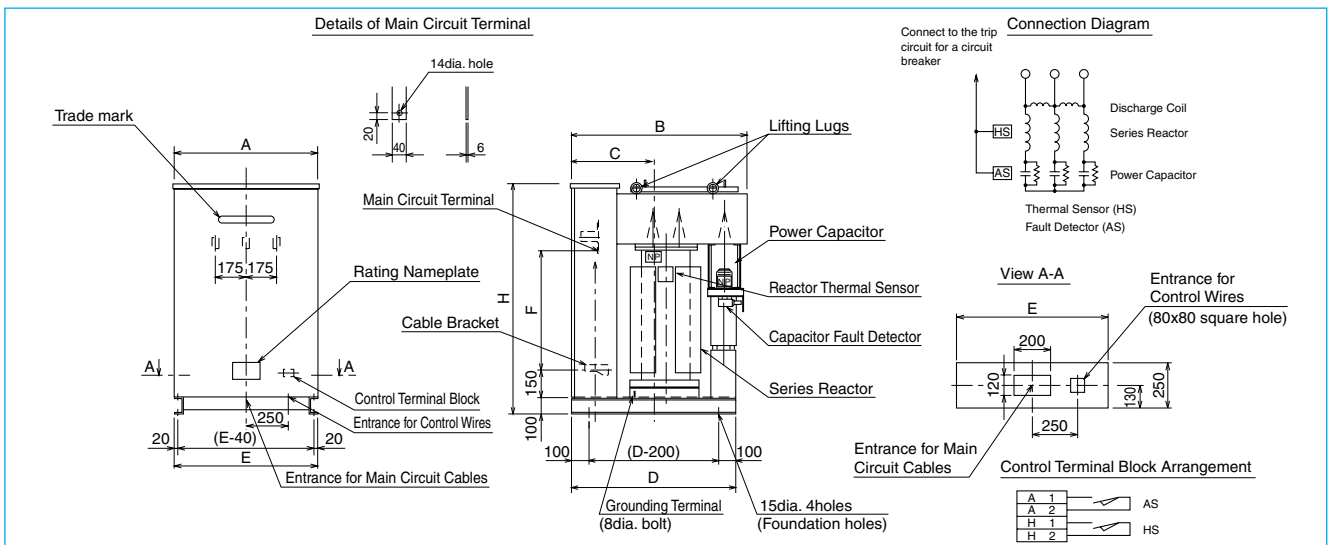
Type Q-PAC is compact capacitor equipment with the live parts shielded completely, which has integrated high voltage capacitors, a series reactors, a switching device, a discharge coil and capacitor protective devices.

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	Q-PAC-1B	Installation Location	Indoor & outdoor
System Voltage	3300V or 6600V	Service Temperature	-20°C to +40°C
Number of Phases	3 phase	Paint Color	Munsell 5Y7/1 (semi-gloss)
Frequency	50Hz or 60Hz	Applicable Standard	JIS C 4902-1998
Series Reactors	6% of capacitor reactance		
Discharge Coil	Discharge to 50V or less in 5 seconds		

DIMENSIONS (mm)



RATINGS Q-PAC-1B

Combined Output (kvar)	Capacitor Rated Output (kvar)	Reactor Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)								Gross mass (kg)	No. of Capacitors	
					3300V	6600V	A	B	C	D	E	F	H	Output (kvar)		Qty	
100	106	6.38	50	QP1★C*100R26CK	17.5	8.75	760	935	445	870	740	670	1300	330	106	1	
			60											325			
150	160	9.57	50	QP1★C*150R26CK	26.2	13.1	760	1015	485	950	740	670	1300	425	160	1	
			60											420			
200	213	12.8	50	QP1★C*200R26CK	35.0	17.5	760	1015	485	950	740	770	1450	460	213	1	
			60											455			
250	266	16.0	50	QP1★C*250R26CK	43.7	21.9	760	1065	510	1000	740	770	1450	520	266	1	
			60											510			
300	319	19.1	50	QP1★C*300R26CK	52.5	26.2	760	1065	510	1000	740	770	1450	535	319	1	
			60											530			
400	426	25.5	50	QP1★C*400R26CK	70.0	35.0	860	1065	510	1000	840	770	1450	620	426	1	
			60											600			
500	532	31.9	50	QP1★C*500R26CK	87.5	43.7	860	1125	540	1060	840	770	1450	680	532	1	
			60											660			
600	638	38.3	50	QP1★C*600R26CK	105	52.5	860	1385	670	1320	840	770	1450	800	319	2	
			60											790			
750	798	47.9	50	QP1★C*750R26CK	131	65.6	860	1385	670	1320	840	770	1450	910	399	2	
			60											870			
800	851	51.1	50	QP1★C*800R26CK	140	70.0	860	1445	700	1380	840	770	1450	960	426	2	
			60											920			
900	957	57.4	50	QP1★C*900R26CK	157	78.7	860	1445	700	1380	840	770	1450	1000	479	2	
			60											970			
1000	1060	63.8	50	QP1★C*10ER26CK	175	87.5	860	1445	700	1380	840	770	1450	1030	532	2	
			60											990			

(Notes) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.
 2. The ratings are for capacitors to be connected in series with a 6% reactor.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

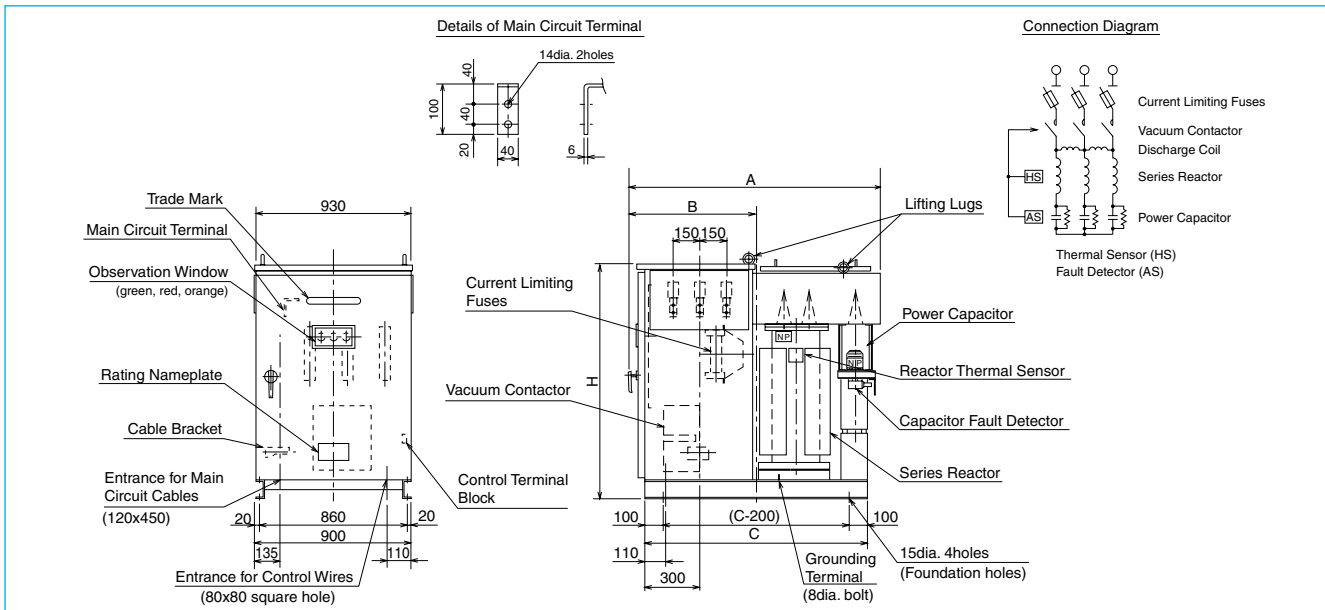
TYPE Q-PAC-2B HIGH VOLTAGE CAPACITOR EQUIPMENT (for L=6%, Is=55%) Combined Output 100-1000kvar

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	Q-PAC-2B	Installation Location	Indoor & outdoor
System Voltage	3300V or 6600V	Service Temperature	-20°C to +40°C
Number of Phases	3 phase	Discharge Coil	Discharge to 50V or less in 5 seconds
Frequency	50Hz or 60Hz	Paint Color	Munsell 5Y7/1 (semi-gloss)
Series Reactors	6% of capacitor reactance	Applicable Standard	JIS C 4902-1998, JEM 1167
Switching Device	Vacuum Contactor		
Operation Method	Constant excitation or moment excitation		
Operation Voltage	100V & 200V DC or 100V & 200V AC		

DIMENSIONS (mm)



RATINGS Q-PAC-2B

Combined Output (kvar)	Capacitor Rated Output (kvar)	Reactor Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)				Gross mass (kg)	No. of Capacitors	
					3300V	6600V	A	B	C	H		Output (kvar)	Qty
100	106	6.38	50	QP2★C*100R26CK	17.5	8.75	1360	695	1220	1300	455	106	1
			60								450		
150	160	9.57	50	QP2★C*150R26CK	26.2	13.1	1440	735	1300	1300	545	160	1
			60								540		
200	213	12.8	50	QP2★C*200R26CK	35.0	17.5	1440	735	1300	1450	585	213	1
			60								580		
250	266	16.0	50	QP2★C*250R26CK	43.7	21.9	1490	760	1350	1450	640	266	1
			60								635		
300	319	19.1	50	QP2★C*300R26CK	52.5	26.2	1490	760	1350	1450	660	319	1
			60								650		
400	426	25.5	50	QP2★C*400R26CK	70.0	35.0	1490	760	1350	1450	740	426	1
			60								720		
500	532	31.9	50	QP2★C*500R26CK	87.5	43.7	1550	790	1410	1450	800	532	1
			60								780		
600	638	38.3	50	QP2★C*600R26CK	105	52.5	1810	920	1670	1450	940	319	2
			60								930		
750	798	47.9	50	QP2★C*750R26CK	131	65.6	1810	920	1670	1450	1050	399	2
			60								1010		
800	851	51.1	50	QP2★C*800R26CK	140	70.0	1870	950	1730	1450	1100	426	2
			60								1060		
900	957	57.4	50	QP2★C*900R26CK	157	78.7	1870	950	1730	1450	1140	479	2
			60								1110		
1000	1060	63.8	50	QP2★C*10ER26CK	175	87.5	1870	950	1730	1450	1170	532	2
			60								1130		

(Notes) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.
2. The ratings are for capacitors to be connected in series with a 6% reactor.

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

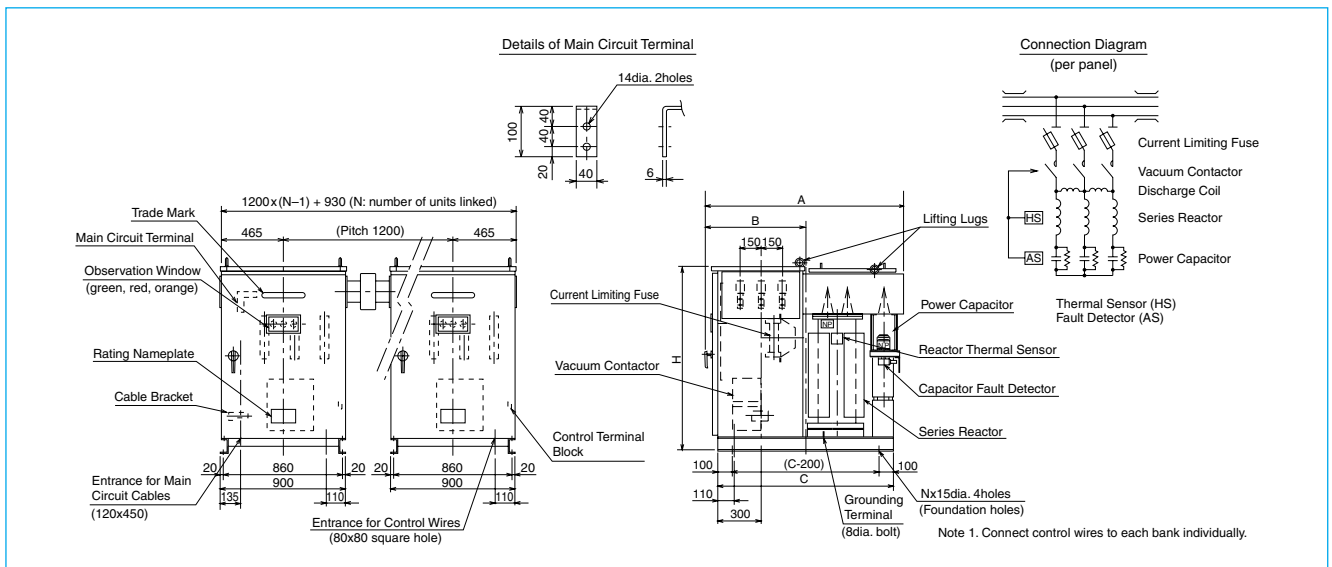
TYPE Q-PAC-2B HIGH VOLTAGE CAPACITOR EQUIPMENT COUPLED WITH DUCT (for L=6%, Is=55%) Combined Output 100-1000kvar

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	Q-PAC-2B, coupled with duct	Installation Location	Indoor & outdoor
System Voltage	3300V or 6600V	Service Temperature	-20°C to +40°C
Number of Phases	3 phase	Discharge Coi	Discharge to 50V or less in 5 seconds
Frequency	50Hz or 60Hz	Paint Color	Munsell 5Y7/1 (semi-gloss)
Series Reactors	6% of capacitor reactance	Applicable Standard	JIS C 4902-1998, JEM 1167
Switching Device	Vacuum Contactor		
Operation Method	Constant excitation or moment excitation		
Operation Voltage	100V & 200V DC or 100V & 200V AC		

DIMENSIONS (mm)



RATINGS Q-PAC-2B Coupled with Duct

Combined Output (kvar)	Capacitor Rated Output (kvar)	Reactor Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)				Gross mass (kg)	No. of Capacitors	
					3300V	6600V	A	B	C	H		Output (kvar)	Qty
100	106	6.38	50	QP2★C*100R26JL	17.5	8.75	1360	695	1220	1300	465	106	1
			60										
150	160	9.57	50	QP2★C*150R26JL	26.2	13.1	1440	735	1300	1300	555	160	1
			60								550		
200	213	12.8	50	QP2★C*200R26JL	35.0	17.5	1440	735	1300	1450	595	213	1
			60								590		
250	266	16.0	50	QP2★C*250R26JL	43.7	21.9	1490	760	1350	1450	650	266	1
			60								645		
300	319	19.1	50	QP2★C*300R26JL	52.5	26.2	1490	760	1350	1450	670	319	1
			60								660		
400	426	25.5	50	QP2★C*400R26JL	70.0	35.0	1490	760	1350	1450	750	426	1
			60								730		
500	532	31.9	50	QP2★C*500R26JL	87.5	43.7	1550	790	1410	1450	810	532	1
			60								790		
600	638	38.3	50	QP2★C*600R26JL	105	52.5	1810	920	1670	1450	950	319	2
			60								940		
750	798	47.9	50	QP2★C*750R26JL	131	65.6	1810	920	1670	1450	1060	399	2
			60								1020		
800	851	51.1	50	QP2★C*800R26JL	140	70.0	1870	950	1730	1450	1110	426	2
			60								1070		
900	957	57.4	50	QP2★C*900R26JL	157	78.7	1870	950	1730	1450	1150	479	2
			60								1120		
1000	1060	63.8	50	QP2★C*10ER26JL	175	87.5	1870	950	1730	1450	1180	532	2
			60								1140		

- (Notes) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.
 2. The ratings are for capacitors to be connected in series with a 6% reactor.
 3. The maximum total combined output is as follows.
 3000kvar (3300V), 6000kvar (6600V)

1 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (Oil Filled & Self-cooled)

TYPE HA-PAC HIGH VOLTAGE CAPACITOR EQUIPMENT WITH AUTOMATIC CAPACITOR CONTROL (for L=6%, Is=55%) Combined Output 200-600kvar

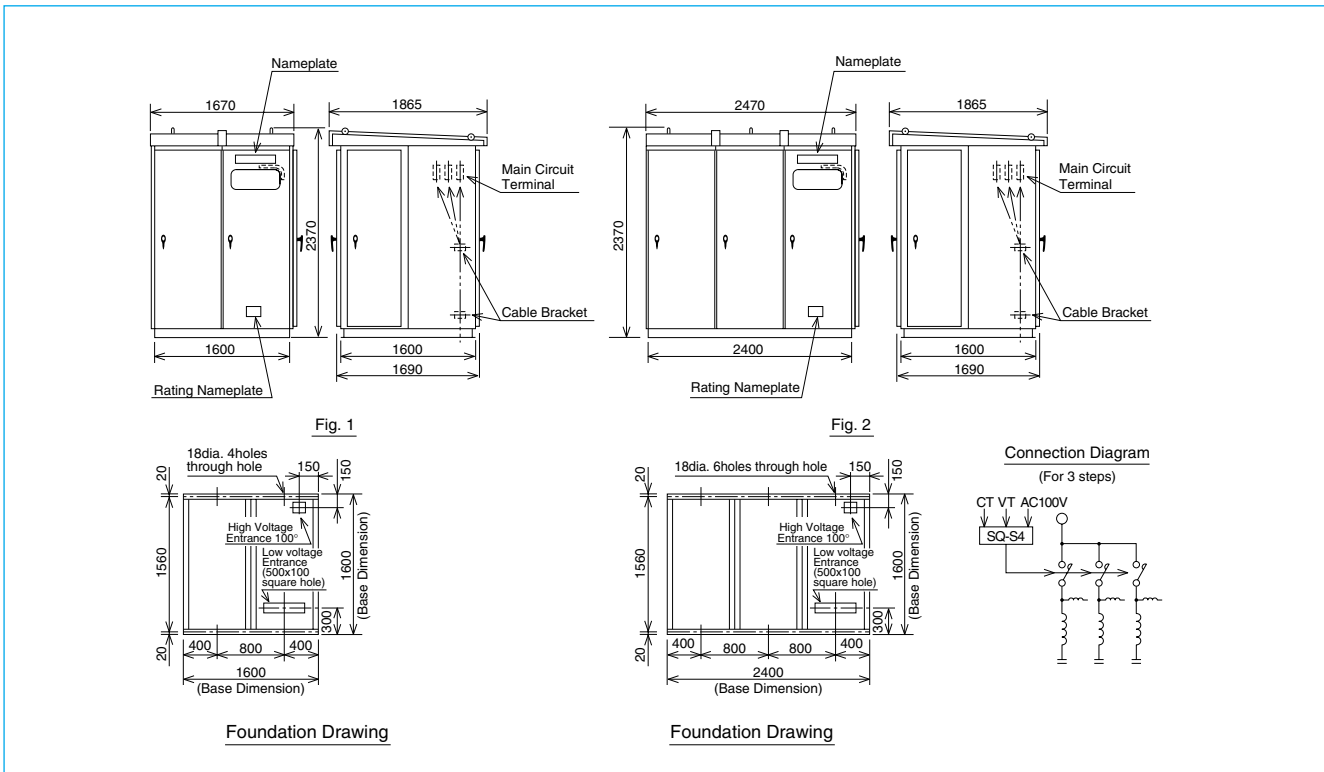
SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	HA-PAC
System Voltage	3300V or 6600V
Number of Phases	3 phase
Frequency	50Hz or 60Hz
Series Reactors	6% of capacitor reactance
Switching Device	Vacuum Contactor
Discharge Coil	Discharge to 50V or less in 5 seconds

Automatic Capacitor Control	SQ-S4 (reactive power control)
Installation Location	Indoor & outdoor
Service Temperature	-20°C to +40°C
Paint Color	Munsell 5Y7/1
Applicable Standard	JIS C 4902-1998, JEM 1167

DIMENSIONS (mm)



RATINGS HA-PAC

System Voltage (V)	Frequency (Hz)	Combined Output (kvar)	Rated Current (A)		No. of Capacitors (kvar x No. of steps)	Gross mass (kg)	Fig.
			3300V	6600V			
3300 or 6600	50	200	35.0	17.5	100 x 2	1220	1
	60						
	50	300	52.5	26.2	150 x 2	1240	
	60						
	50	400	70.0	35.0	200 x 2	1360	
	60						
	50	300	52.5	26.2	100 x 3	1500	
	60						
	50	450	78.7	39.4	150 x 3	1670	
	60						
50	600	105	52.5	200 x 3	1950	2	
60							

2 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (DRY)

TYPE GFC-5 GAS FILLED HIGH VOLTAGE CAPACITORS (for L=6%) Combined Output 10-300kvar

Buildings and hotels being built near big cities are becoming more high-rise due to high land price, and public facilities and underground shopping centers are also becoming large. A large number of people gather at these facilities. The power receiving and distribution equipment installed at the facilities to support fundamental urban function require high safety and reliability. In particular, large stores, department stores, tenant buildings, welfare facilities and underground shopping centers require all possible measures against fires. Once a fire occurs, it will lead to a substantial social loss. The gas filled power capacitors are ideal for application at these facilities due to flame retardant properties.



FEATURES

- ① The capacitors are filled with harmless, incombustible and non-explosive gas, and are safe and immune to second disaster such as fires.
- ② Using the self-healing metallized film dielectrics, the capacitors provide high performances and reliability.
- ③ To assure safety, the capacitors are provided with a lower pressure limit switch which activates at reduced gas pressure and with a safety valve and a upper pressure limit switch which activates at excessively increased pressure.
- ④ SF6 gas is sealed inside the case at pressure slightly higher than ambient pressure. The capacitors will sustain the properties in case of reduction in gas pressure.
- ⑤ Totally sealed case and line terminals with high sealing effect offer reliability for gas leaks, eliminating the requirement for maintenance.
- ⑥ The capacitors require small mounting space and can be installed in a slim distribution panel.

SPECIFICATIONS

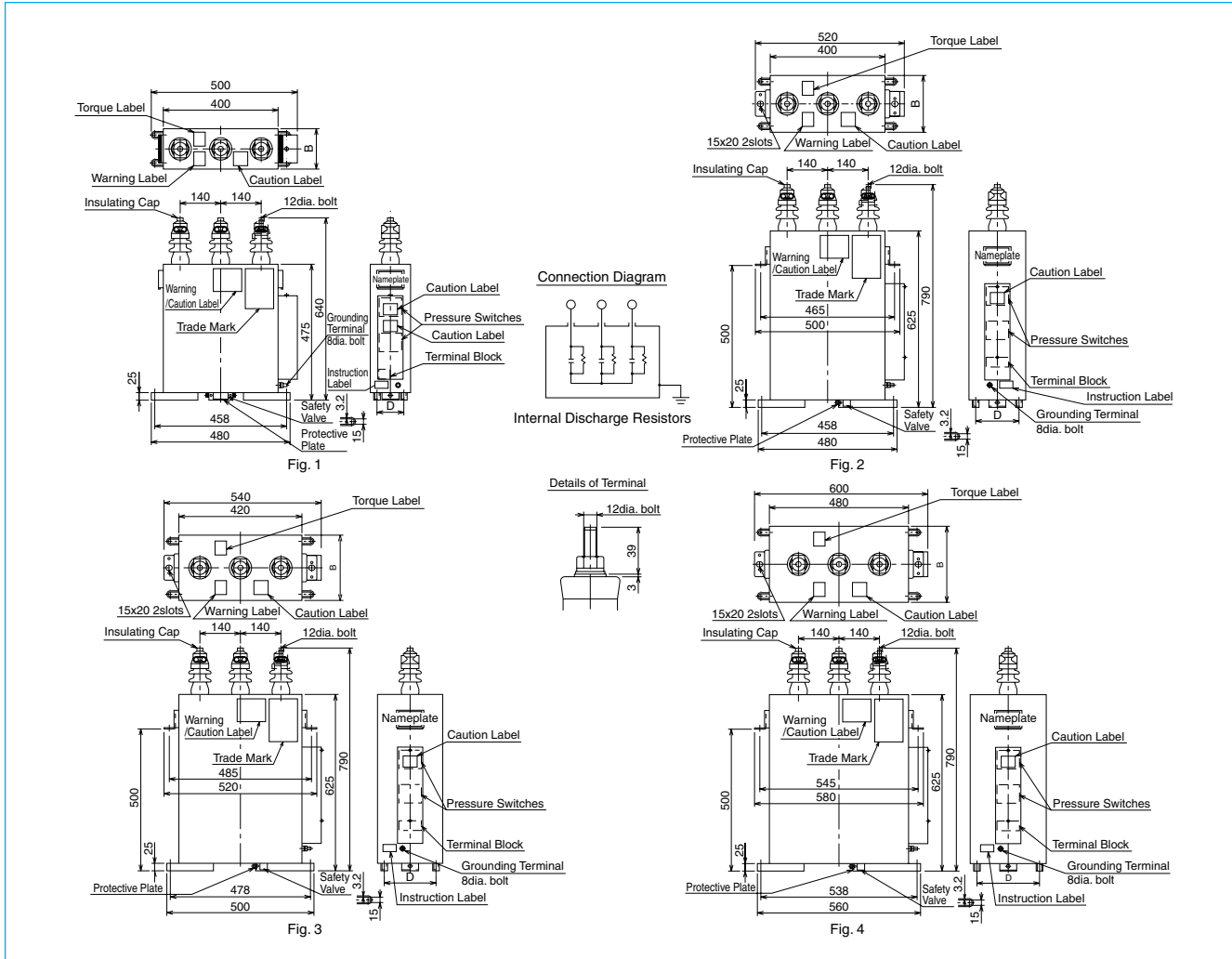
System Voltage : 3300V or 6600V

Type	GFC-5, gas filled
Installation Location	Indoor only
Temperature Class	-20/B
(Ambient temperature	-20°C to +50°C, provided 24
	hour average is 45°C max.)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)
Voltage Withstand	T - T : 2 x rated voltage T - C : 16kV (for 3510V) 22kV (for 7020V)

Insulation Level	16/45kV, 22/60kV
Dissipation Factor	0.05% max. at 20°C
Permissible Overload	110% of rating (12 hours max. per 24 hours)
Permissible Overload	130% of rating (not including maximum current)
Discharge Resistors	Discharge to 50V or less in 5 minutes
Paint Color	Munsell 5Y7/1
Applicable Standard	JIS C 4902-1998

2 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (DRY)

DIMENSIONS (mm)



RATINGS GFC-5 (L=6%) 10-300kvar

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)		Gross mass (kg)	Fig.
					3300V	6600V	B	D		
7020 or 3510	10/12	10.6/12.8	50/60	GF5★CC010R26E	1.75/2.10	0.875/1.05	115	70	21	1
	15/18	16.0/19.1	50/60	GF5★CC015R26E	2.62/3.15	1.31/1.57	115	70	21	
	20/24	21.3/25.5	50/60	GF5★CC020R26E	3.50/4.20	1.75/2.10	115	70	22	
	25/30	26.6/31.9	50/60	GF5★CC025R26E	4.37/5.25	2.19/2.62	115	70	23	
	30/36	31.9/38.3	50/60	GF5★CC030R26E	5.25/6.30	2.62/3.15	115	70	24	
	2	50	53.2	50	GF5★C5050R26E	8.75	4.37	140	95	27
				60	GF5★C6050R26E					26
		75	79.8	50	GF5★C5075R26E	13.1	6.56	180	135	48
				60	GF5★C6075R26E					47
		100	106	50	GF5★C5100R26E	17.5	8.75	200	155	51
				60	GF5★C6100R26E					49
	150	160	50	GF5★C5150R26E	26.2	13.1	230	185	60	
			60	GF5★C6150R26E					58	
	200	213	50	GF5★C5200R26E	35.0	17.5	250	205	66	
			60	GF5★C6200R26E					63	
	250	266	50	GF5★C5250R26E	43.7	21.9	270	225	76	
60			GF5★C6250R26E	72						
300	319	50	GF5★C5300R26E	52.5	26.2	290	245	83		
		60	GF5★C6300R26E					78		

(Note) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.

CIRCUIT PROTECTION

(Note) For protection of circuit, see page 25.

2 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (DRY)

TYPE LR-MB SERIES REACTORS (for L=6%, I_s=55%) Combined Output 10-1000kvar

FEATURES

- Compact and lightweight to save mounting space
- Provided with a cushion rubber pad and a protective cover
- Self-extinguishing and flame retardant
- Provided with protection functions
- Very little insulation degradation caused by humidity absorption

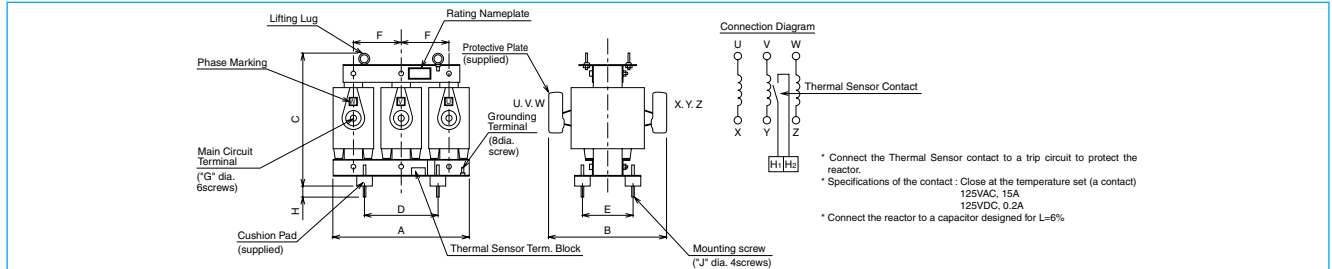


SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	LR-MB, dry & molded	Rated Frequency	50Hz or 60Hz
Installation Location	Indoor only	Reactance	6% of capacitor reactance
Temperature Class	-20/B (Ambient temperature -20°C to +50°C, provided 24 hour average is 45°C max.)	Permissible Overload	Class II : 130% of rating (5th Maximum Current harmonic current-not more than 55% of the fundamental current)
Insulation Class	Class F	Temperature Rise	85°C max. at the coils (per resistance method)
Insulation Level	16/45kV, 22/60kV	Applicable Standard	JIS C 4902-1998
System Voltage	3300V or 6600V		
Number of Phases	3 phase		

DIMENSIONS (mm)



(Note) For protection of circuit, see page 25.

RATINGS LR-MB (L=6%) : 6600V-243V, 3300V-122V

System Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)										Gross mass (kg)
					3300V	6600V	A	B	C	D	E	F	G	H	J		
6600 or 3300	10	0.638	50	MR1★C5010N26E	1.75	0.875	322	325	340	180	130	115	M8	35	M12	34	
	12	0.766	60	MR1★C6012N26E	2.10	1.05	322	325	340	180	130	115	M8	35	M12	34	
	15	0.957	50	MR1★C5015N26E	2.62	1.31	322	325	340	180	130	115	M8	35	M12	34	
	18	1.15	60	MR1★C6018N26E	3.15	1.57	322	325	340	180	130	115	M8	35	M12	34	
	20	1.28	50	MR1★C5020N26E	3.50	1.75	322	325	340	180	130	115	M8	35	M12	34	
	24	1.53	60	MR1★C6024N26E	4.20	2.10	322	325	340	180	130	115	M8	35	M12	34	
	25	1.60	50	MR1★C5025N26E	4.37	2.19	354	340	370	200	135	125	M8	35	M12	46	
	30	1.91	60	MR1★C6030N26E	5.25	2.62	354	340	370	200	135	125	M8	35	M12	46	
	30	1.91	50	MR1★C5030N26E	5.25	2.62	354	340	370	200	135	125	M8	35	M12	46	
	36	2.30	60	MR1★C6036N26E	6.30	3.15	354	340	370	200	135	125	M8	35	M12	46	
	50	3.19	50/60	MR1★C*050N26E	8.75	4.37	370	345	385	200	140	130	M8	35	M12	57	
	75	4.79	50/60	MR1★C*075N26E	13.1	6.56	384	370	415	200	150	135	M8	35	M12	77	
	100	6.38	50/60	MR1★C*100N26E	17.5	8.75	402	375	453	200	160	140	M8	35	M12	98	
	150	9.57	50/60	MR1★C*150N26E	26.2	13.1	446	410	500	220	185	155	M10	35	M12	145	
	200	12.8	50/60	MR1★C*200N26E	35.0	17.5	446	410	500	220	185	155	M10	35	M12	150	
	250	16.0	50/60	MR1★C*250N26E	43.7	21.9	630	355	610	240	180	215	M12	35	M12	220	
	300	19.1	50/60	MR1★C*300N26E	52.5	26.2	630	355	610	240	180	215	M12	35	M12	220	
	400	25.5	50/60	MR1★C*400N26E	70.0	35.0	680	380	620	240	200	230	M12	35	M12	260	
	500	31.9	50/60	MR1★C*500N26E	87.5	43.7	752	465	740	350	200	255	M12	35	M12	420	
	600	38.3	50/60	MR1★C*600N26E	105	52.5	752	465	740	350	200	255	M12	35	M12	420	
700	44.7	50/60	MR1★C*700N26E	122	61.2	752	465	740	350	200	255	M12	35	M12	425		
750	47.9	50/60	MR1★C*750N26E	131	65.6	752	465	740	350	200	255	M12	35	M12	430		
800	51.1	50/60	MR1★C*800N26E	140	70.0	790	530	790	540	320	270	M12	35	M12	480		
900	57.4	50/60	MR1★C*900N26E	157	78.7	890	580	930	500	360	305	M12	35	M12	580		
1000	63.8	50/60	MR1★C*10EN26E	175	87.5	890	580	930	500	360	305	M12	35	M12	580		

- (Notes) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.
 2. The mark * denotes frequency. 5 and 6 represent 50Hz and 60Hz respectively.
 3. The units with a dial thermometer (for outdoor or indoor) are also available.
 4. Class I reactors (I_s=35%) are also available.
 5. Reactors with I_s=70% are also available.

2 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (DRY)

TYPE GFC-5 GAS FILLED HIGH VOLTAGE CAPACITORS (for L=13%) Combined Output 10-300kvar

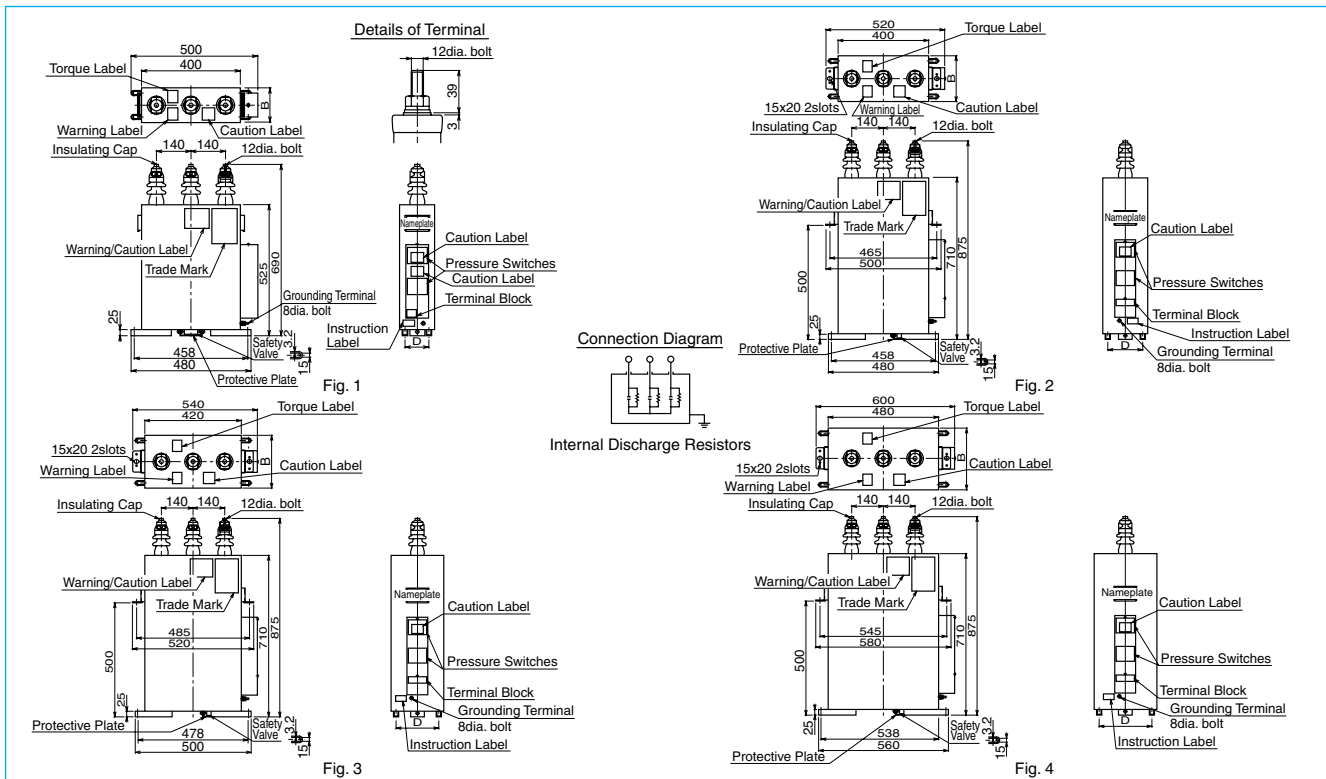
SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	GFC-5, gas filled
Installation Location	Indoor only
Temperature Class	-20/B (Ambient temperature -20°C to +50°C, provided 24 hour average is 45°C max.)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)
Voltage Withstand	T - T : 2 x rated voltage T - C : 16kV (for 3790V) 22kV (for 7590V)

Insulation Level	16/45kV, 22/60kV
Dissipation Factor	0.05% max. at 20°C
Permissible Overloads	110% of rating (12 hours max. per 24 hours)
Maximum Voltage	per 24 hours)
Permissible Overloads	130% of rating (not including current due to cap. tol.)
Maximum Current	current due to cap. tol.)
Discharge Resistors	Discharge to 50V or less in 5 minutes
Paint Color	Munsell 5Y7/1
Applicable Standard	JIS C 4902-1998

DIMENSIONS (mm)



(Note) For protection of circuit, see page 25.

RATINGS GFC-5 (L=13%) 10-300kvar

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)		Gross mass (kg)	Fig.
					3300V	6600V	B	D		
7590 or 3790	10/12	11.5/13.8	50/60	GF5★CC010R13E	1.75/2.10	0.875/1.05	115	70	22	1
	15/18	17.2/20.7	50/60	GF5★CC015R13E	2.62/3.15	1.31/1.57	115	70	22	
	20/24	23.0/27.6	50/60	GF5★CC020R13E	3.50/4.20	1.75/2.10	115	70	23	
	25/30	28.7/34.5	50/60	GF5★CC025R13E	4.37/5.25	2.19/2.62	115	70	25	
	30/36	34.5/41.4	50/60	GF5★CC030R13E	5.25/6.30	2.62/3.15	115	70	26	
	50	57.5	50	GF5★C5050R13E	8.75	4.37	160	115	30	
	2	75	86.2	60	GF5★C6050R13E					29
				50	GF5★C5075R13E	13.1	6.56	180	135	53
		100	115	60	GF5★C6075R13E					51
				50	GF5★C5100R13E	17.5	8.75	200	155	57
		150	172	60	GF5★C6100R13E					54
				50	GF5★C5150R13E	26.2	13.1	230	185	67
200	230	60	GF5★C6150R13E					64		
		50	GF5★C5200R13E	35.0	17.5	250	205	74		
250	287	60	GF5★C6200R13E					70		
		50	GF5★C5250R13E	43.7	21.9	270	225	85		
300	345	60	GF5★C6250R13E					80		
		50	GF5★C5300R13E	52.6	26.2	290	245	93		
									87	4

(Note) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.

2 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (DRY)

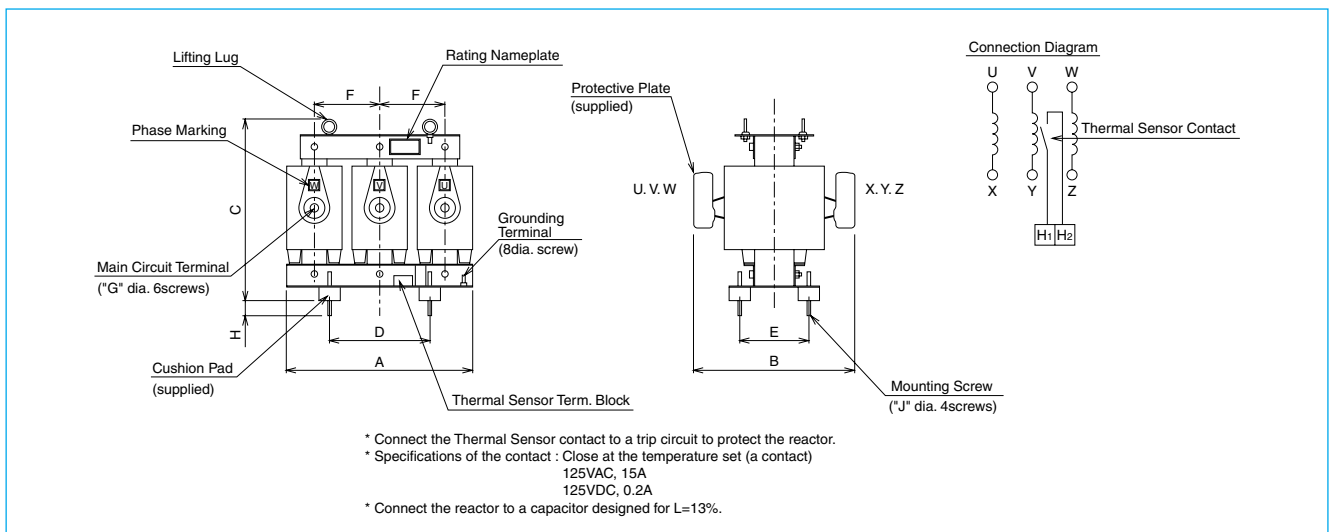
TYPE LR-MB SERIES REACTORS (for L=13%, I_s=35%) Combined Output 10-500kvar

SPECIFICATIONS

System Voltage : 3300V or 6600V

Type	LR-MB, dry & molded	Rated Frequency	50Hz or 60Hz
Installation Location	Indoor only	Reactance	13% of capacitor reactance
Temperature Class	-20/B (Ambient temperature -20°C to +50°C, provided 24 hour average is 45°C max.)	Permissible Overload Maximum Current	Class I : 120% of rating (5th harmonic current - not more than 35% of the fundamental current)
Insulation Class	Class F	Temperature Rise	85°C max. at the coils (per resistance method)
Insulation Level	16/45kV, 22/60kV	Applicable Standard	JIS C 4902-1998
System Voltage	3300V or 6600V		
Number of Phases	3 phase		

DIMENSIONS (mm)



(Note) For protection of circuit, see page 25.

RATINGS LR-MB (L=13%) : 6600V-569V, 3300V-285V

System Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)										Gross mass (kg)
					3300V	6600V	A	B	C	D	E	F	G	H	J		
6600 or 3300	10	1.49	50	MR1★C5010N13E	1.75	0.875	354	340	370	200	135	125	M8	35	M12	45	
	12	1.79	60	MR1★C6012N13E	2.10	1.05	354	340	370	200	135	125	M8	35	M12	45	
	15	2.24	50	MR1★C5015N13E	2.62	1.31	354	340	370	200	135	125	M8	35	M12	45	
	18	2.69	60	MR1★C6018N13E	3.15	1.57	354	340	370	200	135	125	M8	35	M12	45	
	20	2.99	50	MR1★C5020N13E	3.50	1.75	370	345	385	200	140	130	M8	35	M12	57	
	24	3.59	60	MR1★C6024N13E	4.20	2.10	370	345	385	200	140	130	M8	35	M12	57	
	25	3.74	50	MR1★C5025N13E	4.37	2.19	384	370	415	200	150	135	M8	35	M12	76	
	30	4.48	60	MR1★C6030N13E	5.25	2.62	384	370	415	200	150	135	M8	35	M12	76	
	30	4.48	50	MR1★C5030N13E	5.25	2.62	384	370	415	200	150	135	M8	35	M12	76	
	36	5.38	60	MR1★C6036N13E	6.30	3.15	384	370	415	200	150	135	M8	35	M12	76	
	50	7.47	50/60	MR1★C*050N13E	8.75	4.37	402	375	453	200	160	140	M8	35	M12	96	
	75	11.2	50/60	MR1★C*075N13E	13.1	6.56	415	390	460	220	175	145	M10	35	M12	116	
	100	14.9	50/60	MR1★C*100N13E	17.5	8.75	446	410	500	220	185	155	M10	35	M12	145	
	150	22.4	50/60	MR1★C*150N13E	26.2	13.1	630	355	610	240	180	215	M12	35	M12	215	
	200	29.9	50/60	MR1★C*200N13E	35.0	17.5	680	380	620	240	200	230	M12	35	M12	250	
	250	37.4	50/60	MR1★C*250N13E	43.7	21.9	752	465	740	350	200	255	M12	35	M12	415	
	300	44.8	50/60	MR1★C*300N13E	52.5	26.2	752	465	740	350	200	255	M12	35	M12	425	
400	59.8	50/60	MR1★C*400N13E	70.0	35.0	790	460	805	540	320	270	M12	35	M12	430		
500	74.7	50/60	MR1★C*500N13E	87.5	43.7	790	460	825	540	320	270	M12	35	M12	480		

(Notes) 1. The asterisk ★ denotes voltage. 33 and 66 represent 3300V and 6600V respectively.
 2. The mark * denotes frequency. 5 and 6 represent 50Hz and 60Hz respectively.
 3. The units with a dial thermometer are also available.

2 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (DRY)

TYPE DCM-B POWER CAPACITOR DISCHARGE COILS

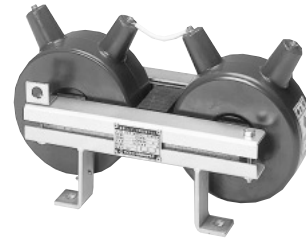
FEATURES

① Flame Retardant and Non-explosive

There is no risk of a fire owing to flame retardant and self-extinguishing epoxy used.

② Easy to Mount and Maintain

It is easy to mount the discharge coils which are compact, lightweight and can be mounted in any direction.

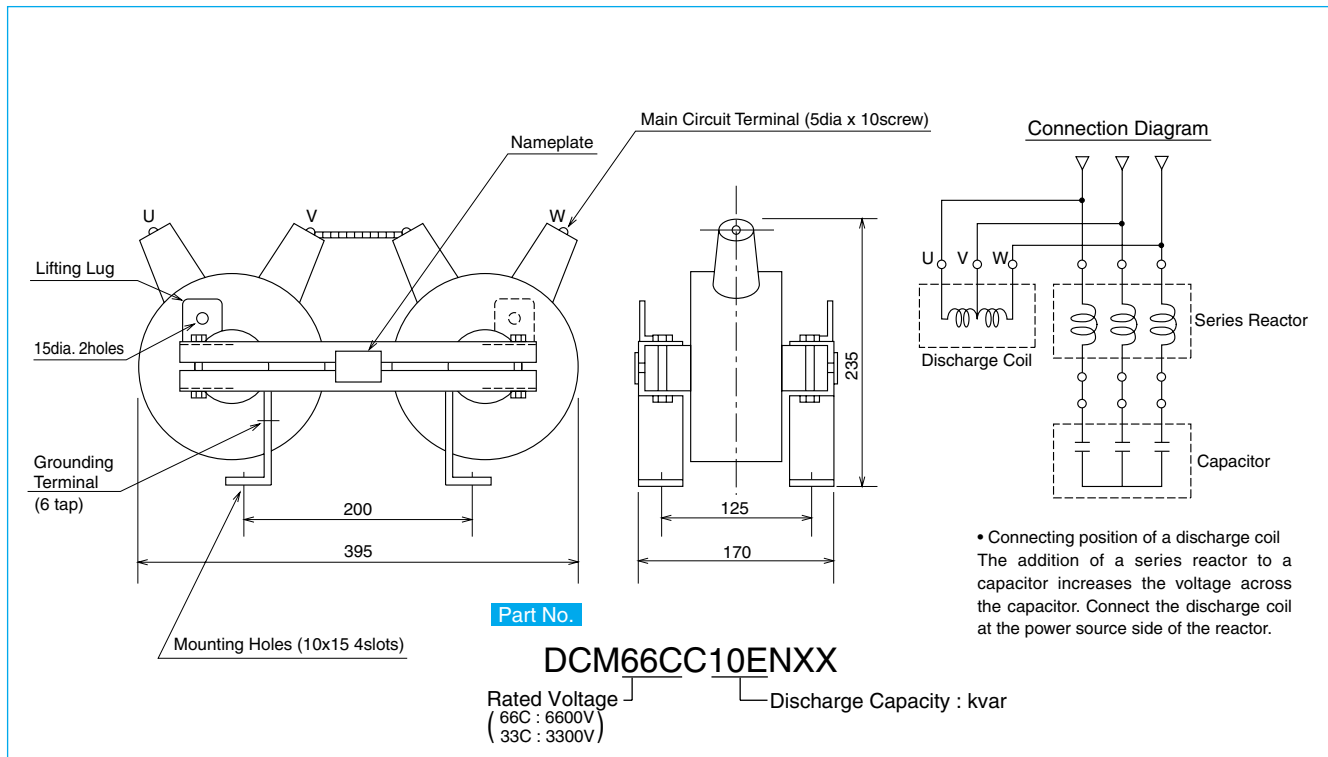


SPECIFICATIONS

Type	DCM-B, dry & molded
Installation Location	Indoor only
Temperature Class	-20/B (Ambient temperature -20°C to +50°C, provided 24 hour average is 45°C max.)
Insulation Level	22/60kV

System Voltage	6600V
Number of Phases	3 phase
Rated Frequency	50Hz or 60Hz
Discharge Capacity	1000kvar
Gross mass	19kg
Applicable Standard	JIS C 4902-1998

DIMENSIONS (mm)



(Note) The coils for 3300V rating are also available.

2 HIGH VOLTAGE POWER CAPACITOR EQUIPMENT (DRY)

PROTECTION OF GAS FILLED HIGH VOLTAGE CAPACITORS & REACTORS

• GAS FILLED CAPACITORS

Gas filled capacitors are designed to give high performance and reliability including tight gas seal capability and self-healing properties by the implementation of totally sealed construction and metallized film dielectrics. However, the following protection schemes are implemented just in case any failure occurs.

(1) If gas leakage occurs,

The lower pressure limit switch will be activated when the capacitor's internal pressure will be reduced to the ambient pressure. Use the contact circuit of the pressure switch to give an alarm or disconnect the capacitor.

The capacitor will not need to be disconnected immediately after the alarm sounds. However, it is recommended to disconnect the capacitor within 24 hours.

(2) If the capacitor be internally broken down,

When the internal windings will be broken down, a fault current will flow and the decomposed gas will gradually increase the internal pressure.

The upper pressure limit switch will be activated when the internal pressure reaches the specified level. Use the contact circuit of the pressure switch to open a capacitor switching device or a circuit breaker in the upper stream.

Install current limiting fuses to protect capacitors from momentary short failure in the capacitor. Selection of fuses should be made in the same manner as the oil filled capacitors.

Contact Capacity	AC 125V 8.0A DC 125V 0.2A
Connection	
Activating Pressure	Up-78kPa Down-6kPa

• SERIES REACTORS

Protection Method

JIS C 4902 specifies that series reactors for power capacitors shall be operated at a current which contains the 5th harmonic current of not more than 55% of the fundamental current with the root of the sum of the squares limited to not more than 130% of the rated current. If the 5th harmonic voltage distortion is excessively high, some current exceeding the limit will flow through the reactor possibly causing excessive temperature rise to burn out the reactor.

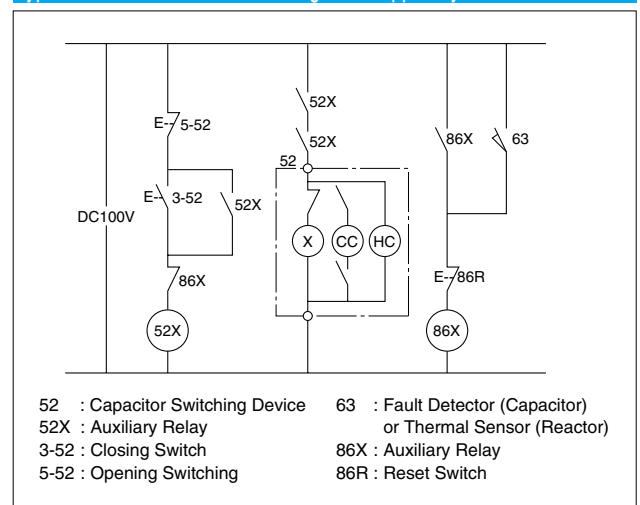
The reactors are equipped with a Thermal Sensor to detect excessive temperature rise. Connect the sensor to a circuit breaker (or a switching device) located in the upper stream to disconnect the reactor from the power source. Reactors with a dial thermometer is also available as an option.

Method	Thermal Sensor
Contact Capacity	AC 125V 15.0A DC 125V 0.2A
Arrangement	
Operating Temperature	100°C

• Application Notes for Protective Contacts

Connect the capacitor fault detectors and the reactor Thermal Sensors to the trip circuit of circuit breakers or switching devices. The activation of the above contacts to trip the circuit is considered a major failure. Consideration should be given to the protective circuit as shown below to prevent reclosing as it is.

Typical Circuit to Prevent Reclosing after Tripped by Protective Contacts



3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

TYPE N2 (200V) & E (200V, 400V) LOW VOLTAGE POWER CAPACITORS



TYPE E



TYPE N2



TYPE E

Shizuki Low Voltage Power Capacitors are the most economical means to save electrical power.

BENEFITS

① Electric Power Bills Are Reduced.

The installation of power factor correction capacitors will raise the power factor. For a higher power factor attained by users, lower electrical charges are generally offered by utility companies.

② Equipment Cost Is Reduced.

When power factor capacitors are added to new installation of plant equipment including welding machines that draw a high current, they will not only improve a power factor but also reduce a line current, saving the cost for distribution equipment.

③ Productivity Is Improved and Quality Becomes Consistent.

Power factor correction will help raise the voltage across a motor, increasing rotation torque and reduce voltage fluctuation, keeping consistent speed. Hence, productivity will be increased and quality will become consistent.

④ System Capacity Is Gained.

Improved power factor reduces line current. Power factor correction capacitors will relieve the capacity of distribution equipment (transformers, switching devices), and installation of the capacitors will enable new loads to be added without increasing the capacity of the existing distribution equipment.

STANDARD CAPACITOR OUTPUT

① Induction Motors (a) 200V 3 Phase Motors

(b) 200V 1 Phase Motors

Motor	kW	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	19	22	30	37	55
	HP	1/4	1/2	1	2	3	5	7.5	10	15	20	25	30	40	50	75
Capacitor uF	50Hz	15	20	30	40	50	75	100	150	200	250	300	400	500	600	900
	60Hz	10	15	20	30	40	50	75	100	150	200	250	300	400	500	750

Motor	kW	0.1	0.2	0.4	0.75
	HP	1/8	1/4	1/2	1
Capacitor uF	50Hz	20	20	30	40
	60Hz	20	20	20	30

(c)400V 3Phase Motors

Motor	kW	0.75	1.5	2.2	3.7	5.5	7.5	11	15	19	22	30	37	55
	HP	1	2	3	5	7.5	10	15	20	25	30	40	50	75
Capacitor uF	50Hz	7.5	10	15	20	30	40	50	75	75	100	125	150	250
	60Hz	5	7.5	10	15	20	30	40	50	75	75	100	125	200

② AC Arc Welders 200V

Max. Input (kVA)	3 min.	5 min.	7.5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min. below 50
Capacitor uF	100	150	200	250	300	400	500	600	700	800	900

(Note) The same capacitance applies to 50Hz and 60Hz. Use a capacitor with 50% of the above capacitance for AC resistance welders and DC arc welders.

APPLICATION NOTES

Do not place the capacitors at the following locations.

- ① where rain or water drop falls
- ② where there is heavy iron powder or dust
- ③ areas with high relative humidity
- ④ area with corrosive gases
- ⑤ where condensation of humidity occurs
- ⑥ where salt damage is expected
- ⑦ where vibration occurs
- ⑧ where the ambient temperature is not within -25°C to +45°C and direct sunlight is present

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

INSTALLATION WORKS

- ① When installing two or more capacitors at the same location, secure the spacing between units of 25mm or more. For capacitors rated at 20kvar or more (220V & 400V), the spacing should be 50mm or more.
- ※ Type N2 does not require

SWITCHING OF CAPACITORS

To switch off an apparatus to which a capacitor is connected, be sure to disconnect the capacitor from the power source at the same

PROTECTIVE DEVICE

The capacitors have an internal protective device. Should a failure (breakdown of the internal windings) occurs in the capacitor, the protective device will activate to disconnect the

CONNECTION TO INDUCTION MOTORS WITH A STAR-DELTA STARTER

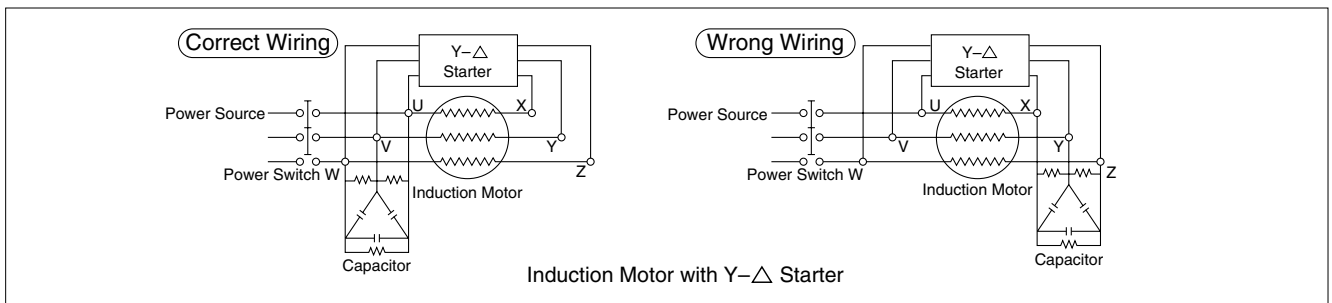
Wrong wiring of low voltage capacitor to an induction motor with a star-delta starter would cause the capacitor to

- ② Ensure to fasten the screws to connect cables.
- ③ Do not mount type E horizontally
- ④ Ground type E capacitors using the grounding terminal.

time. If the capacitor remains connected to power source, the power source as well as the capacitor would be affected adversely.

capacitor from the line. Be sure to replace the failed capacitor with a new one.

breakdown. Be sure to do the correct wiring as shown below.



• TYPE N2 (200V), TYPE E(200V)

FEATURES

TYPE N2

- ① Idea for mounting in a panel. The capacitors can be mounted on a 35mm rail per IEC easily to save labor.
- ② Can be mounted in any directions.
- ③ Provides a high safety due to dry type not using oil and internal protective device.

TYPE E

- ① Smaller by 15-30% than our conventional design due to the low loss dielectrics used.
- ② Enhanced reliability for connection due to the quick-connect terminal blocks used.

SPECIFICATIONS

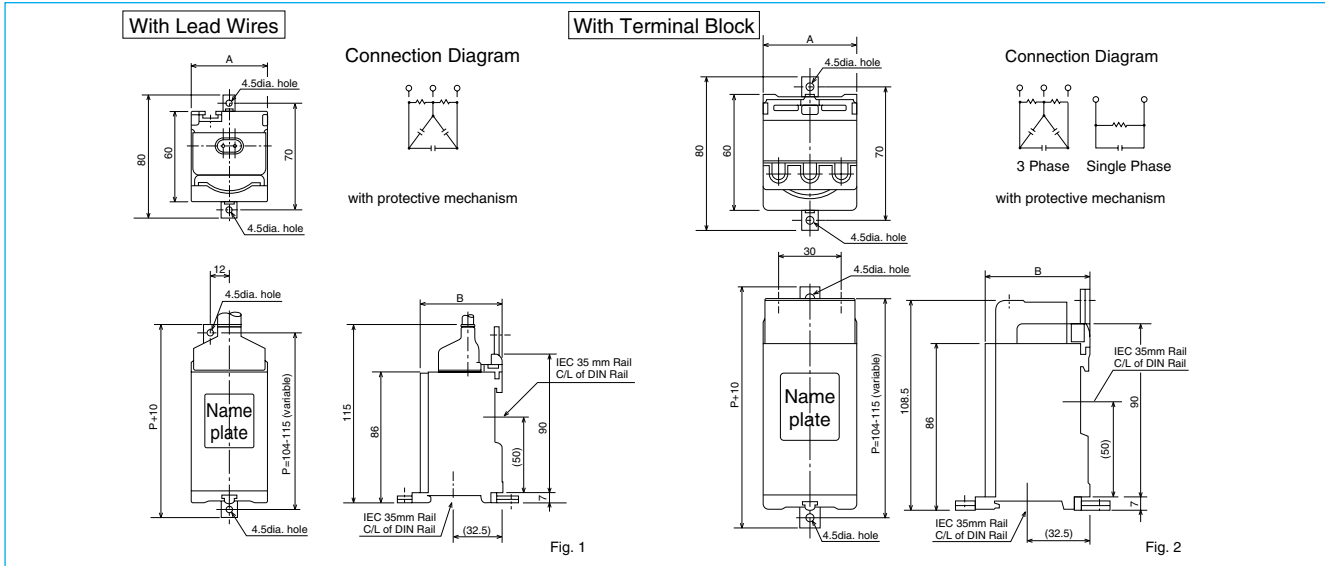
System Voltage : 200VuF

Type	N2 & E
Installation Location	Indoor only, altitude : 2000m max.
Ambient temperature	-25°C to +45°C (24 hour average : 35°C max., annual average : 25°C max.)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)
Voltage Withstand	T - T : 2.15 x rated voltage for 2 seconds T - C : 3000V for 10 seconds (Type E)
Dissipation Factor	0.12% max. at 20°C

Permissible Overloads	110% of rating (8 hours max. per 24 hours)
Maximum Voltage	115% of rating (30 minutes max. per 24 hours) 120% of rating (5 minutes max.) 130% of rating (1 minute max.) overvoltage exceeding 115% : 200 times max.
Maximum Current	130% max. of rating
Discharge Resistors	Discharge to 75V or less in 3 minutes
Safety Test	Per para. 8.12 of JIS C 4901
Paint Color	Munsell 5Y7/1 (Type E)
Applicable Standard	JIS C 4901-2000

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

DIMENSIONS (TYPE N2) (mm)



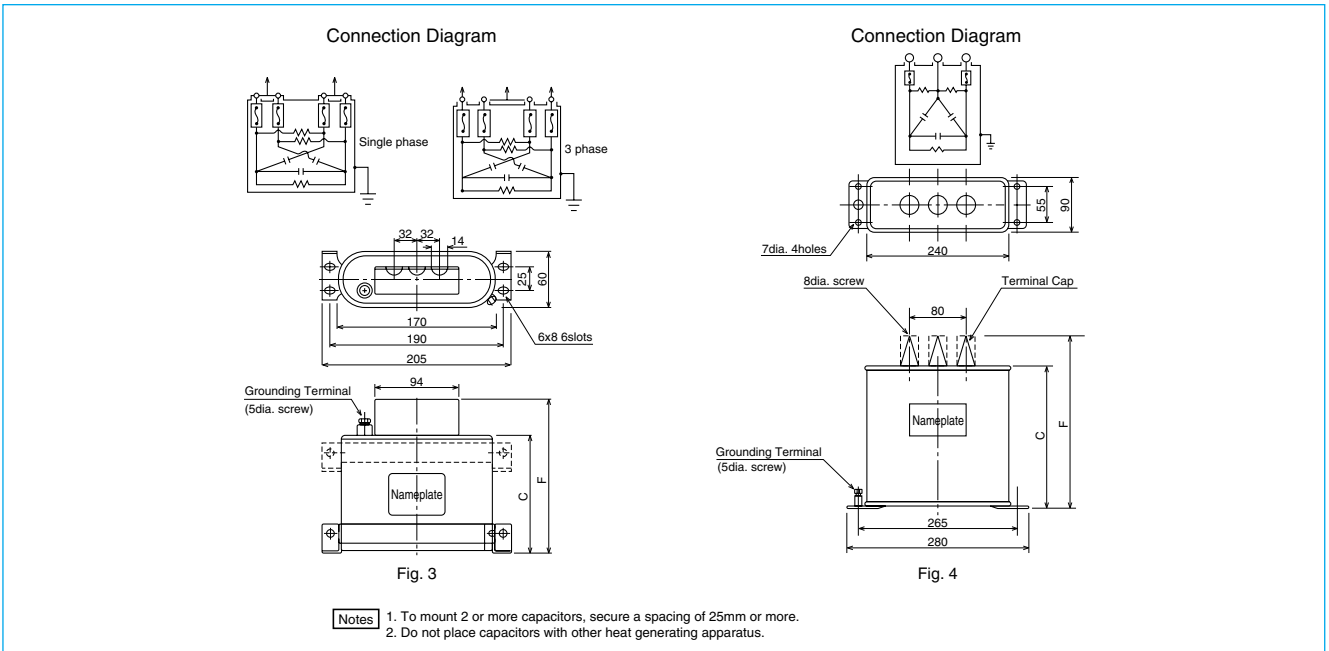
RATINGS

Type	Terminal Style	Part Number	Rated Voltage (V)	No. of Phases	Rated Capacitance (uF)	50Hz			60Hz			Dimensions (mm)		Gross mass (g)	Fig.
						kvar	3 phase (A)	Single phase (A)	kvar	3 phase (A)	Single phase (A)	A	B		
SH (MF) N2	With Lead Wires	FF2010TLE	200	3 phase	10	0.13	0.36	-	0.15	0.44	-	48	54.5	320	1
		FF2015TLE	200	3 phase	15	0.19	0.54	-	0.23	0.65	-	48	54.5	320	
		FF2020TLE	200	3 phase	20	0.25	0.73	-	0.30	0.87	-	48	54.5	320	
		FF2030TLE	200	3 phase	30	0.38	1.09	-	0.45	1.31	-	48	54.5	320	
		FF2040TLE	200	3 phase	40	0.50	1.45	-	0.60	1.74	-	48	54.5	320	
		FF2050TLE	200	3 phase	50	0.63	1.81	-	0.75	2.18	-	48	54.5	320	
		FF2075TLE	200	3 phase	75	0.94	2.72	-	1.13	3.26	-	67	60	420	
		FF2100TLE	200	3 phase	100	1.26	3.63	-	1.51	4.35	-	67	60	420	
	With Terminal Block	FF2010TXE	200	3 phase	10	0.13	0.36	-	0.15	0.44	-	48	54.5	320	2
		FF2015TXE	200	3 phase	15	0.19	0.54	-	0.23	0.65	-	48	54.5	320	
		FF2020TXE	200	3 phase	20	0.25	0.73	-	0.30	0.87	-	48	54.5	320	
		FF2030TXE	200	3 phase	30	0.38	1.09	-	0.45	1.31	-	48	54.5	320	
		FF2040TXE	200	3 phase	40	0.50	1.45	-	0.60	1.74	-	48	54.5	320	
		FF2050TXE	200	3 phase	50	0.63	1.81	-	0.75	2.18	-	48	54.5	320	
		FF2075TXE	200	3 phase	75	0.94	2.72	-	1.13	3.26	-	67	60	420	
		FF2100TXE	200	3 phase	100	1.26	3.63	-	1.51	4.35	-	67	60	420	
	With Terminal Block	FF2010SXE	200	Single phase	10	0.13	-	0.65	0.15	-	0.75	48	54.5	320	2
		FF2015SXE	200	Single phase	15	0.19	-	0.94	0.23	-	1.13	48	54.5	320	
		FF2020SXE	200	Single phase	20	0.25	-	1.26	0.30	-	1.51	48	54.5	320	
		FF2030SXE	200	Single phase	30	0.38	-	1.89	0.45	-	2.26	48	54.5	320	
		FF2040SXE	200	Single phase	40	0.50	-	2.51	0.60	-	3.02	48	54.5	320	
FF2050SXE		200	Single phase	50	0.63	-	3.14	0.75	-	3.77	48	54.5	320		
FF2075SXE		200	Single phase	75	0.94	-	4.71	1.13	-	5.65	67	60	420		
FF2100SXE		200	Single phase	100	1.26	-	6.28	1.51	-	7.54	67	60	420		

- (Notes) 1. All the parts have internal resistors.
 2. The 200V ratings can also be used for the 100V ratings.
 3. Ratings other 200V are also available if requested.

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

DIMENSIONS (TYPE E) (mm)



RATINGS

Type	Part Number	Rated Voltage (V)	No. of Phases	Rated Capacitance (uF)	50Hz			60Hz			Dimensions (mm)		Gross mass (kg)	Fig.
					(kvar)	3 phase (A)	Single phase (A)	(kvar)	3 phase (A)	Single phase (A)	C	F		
SH (MF) E	FE2150KEE	200	Single & 3 phase	150	1.89	5.4	9.4	2.26	6.5	11.3	107	160	1.2	3
	FE2200KEE	200	Single & 3 phase	200	2.51	7.3	12.6	3.02	8.7	15.1	107	160	1.2	
	FE2250KEE	200	Single & 3 phase	250	3.14	9.1	15.7	3.77	10.9	18.9	127	180	1.4	
	FE2300KEE	200	Single & 3 phase	300	3.77	10.9	18.9	4.52	13.1	22.6	127	180	1.4	
	FE2400KEE	200	Single & 3 phase	400	5.03	14.5	25.1	6.03	17.4	30.2	147	200	1.6	
	FE2500KEE	200	Single & 3 phase	500	6.28	18.1	31.4	7.54	21.8	37.2	167	220	1.8	
	FE2600KEE	200	Single & 3 phase	600	7.54	21.8	37.7	9.05	26.1	45.2	207	260	2.1	4
	FE200707JE	200	3 phase	700	8.80	25.4	—	10.6	30.5	—	200	260	5.0	
	FE200757JE	200	3 phase	750	9.42	27.2	—	11.3	32.7	—	200	260	5.0	
	FE200807JE	200	3 phase	800	10.0	29.0	—	12.1	34.8	—	200	260	5.0	
FE200907JE	200	3 phase	900	11.3	32.7	—	13.6	39.2	—	230	290	5.5		
FE200108JE	200	3 phase	1000	12.6	36.3	—	15.1	43.5	—	230	290	5.5		

* Dual phase units (single & 3 phase) are shipped with 3 phase connection.

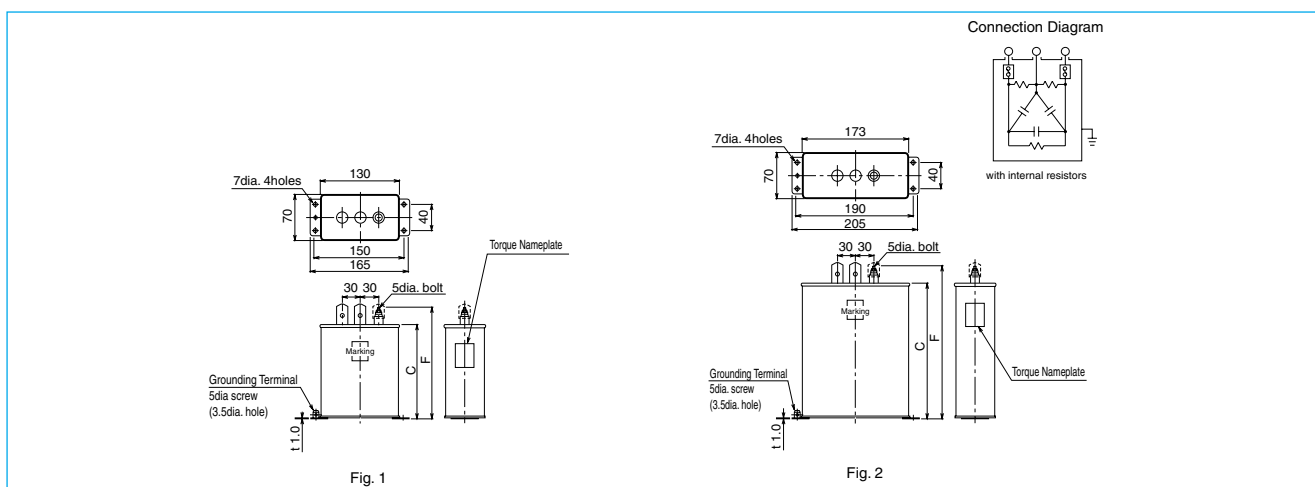
3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

SPECIFICATIONS System Voltage : 400VuF

Type	RG-2
Installation Location	Indoor only, altitude : 2000m max.
Ambient temperature	-25°C to +45°C (24 hour average : 35°C max., annual average : 25°C max.)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)
Voltage Withstand	T - T : 2.15 x rated voltage for 2 seconds T - C : 3000V for 10 seconds (Type E)
Dissipation Factor	0.2% max. at 20°C

Permissible Overloads	110% of rating (8 hours max. per 24 hours)
Maximum Voltage	115% of rating (30 minutes max. per 24 hours) 120% of rating (5 minutes max.) 130% of rating (1 minute max.) overvoltage exceeding 115% : 200 times max.
Maximum Current	130% max. of rating
Discharge Resistors	Discharge to 75V or less in 3 minutes
Safety Test	Per para. 8.12 of JIS C 4901
Paint Color	Munsell 5Y7/1
Applicable Standard	JIS C 4901-2000

DIMENSIONS (TYPE N2) (mm)



RATINGS (400V-460V, 50/60Hz)

Part Number	Rated Capacitance (uF)	Rated Current (A)								Dimensions (mm)		Gross mass (kg)	Fig.
		50Hz				60Hz				C	F		
		400V	415V	440V	460V	400V	415V	440V	460V				
RG2460505 JE	5	0.36	0.38	0.40	0.42	0.44	0.45	0.49	0.50	80	105	1.1	1
RG2460755 JE	7.5	0.54	0.56	0.60	0.63	0.65	0.68	0.72	0.75	80	105	1.1	
RG2460106 JE	10	0.73	0.75	0.80	0.83	0.87	0.90	0.96	1.00	100	125	1.3	
RG2460156 JE	15	1.09	1.13	11.20	1.25	1.31	1.35	1.44	1.50	100	125	1.3	
RG2460206 JE	20	1.45	1.51	1.60	1.67	1.74	1.81	1.92	2.00	100	125	1.3	
RG2460256 JE	25	1.81	1.88	2.00	2.09	2.18	2.26	2.39	2.50	100	125	1.3	
RG2460306 JE	30	2.18	2.26	2.39	2.50	2.61	2.71	2.87	3.00	100	125	1.3	
RG2460406 JE	40	2.90	3.01	3.19	3.34	3.48	3.61	3.83	4.00	120	145	1.6	
RG2460506 JE	50	3.63	3.76	3.99	4.17	4.35	4.52	4.79	5.01	120	145	1.6	
RG2460756 JE	75	5.44	5.65	5.99	6.26	6.53	6.77	7.18	7.51	150	175	1.9	
RG2460107 JE	100	7.26	7.53	7.98	8.34	8.71	9.03	9.58	10.0	180	205	2.3	
RG2460137 JE	125	9.07	9.41	9.98	10.4	10.9	11.3	12.0	12.5	210	235	3.5	
RG2460157 JE	150	10.9	11.3	12.0	12.5	13.1	13.5	14.4	15.0	210	235	3.5	
RG2460207 JE	200	14.5	15.1	16.0	16.7	17.4	18.1	19.2	20.0	270	295	4.5	
RG2460257 JE	250	18.1	18.8	20.0	20.9	21.8	22.6	23.9	25.0	270	295	4.5	

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

TYPE RG-2 LOW VOLTAGE POWER CAPACITORS (for L=6%) Combined Output 10-50kvar

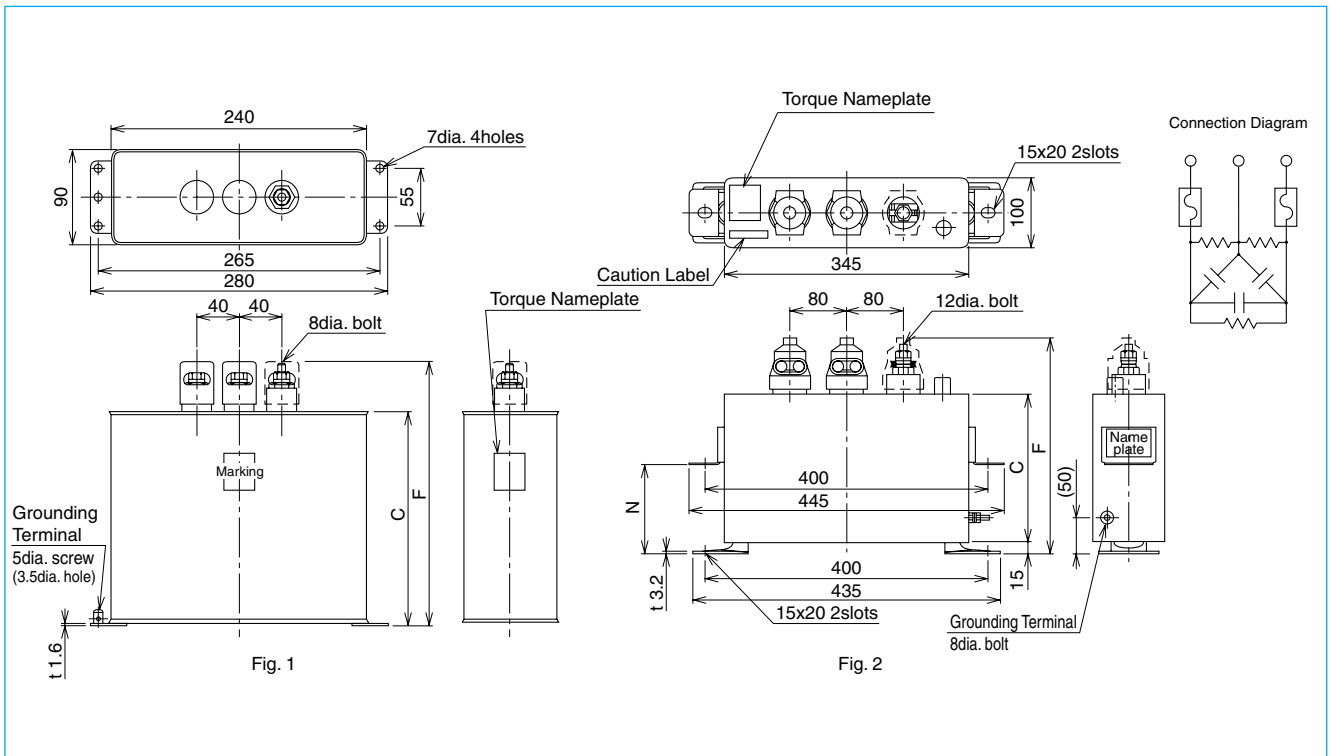
SPECIFICATIONS

System Voltage : 220V

Type	RG-2, oil filled
Installation Location	Indoor only, altitude 2000m max.
Ambient temperature	-25°C to +45°C (24 hour average : 35°C max., annual average : 25°C max.)
Tolerance	-5% to +15% of rated output Phase unbalance : 108% max. (3 phase)
Voltage Withstand	T - T : 2.15 x rated voltage for 2 seconds T - C : 3000V for 10 seconds
Dissipation Factor	0.2% max. at 20°C

Permissible Overload	110% of rating (8 hours max. per 24 hours)
Maximum Voltage	115% of rating (30 minutes max. per 24 hours) 120% of rating (5 minutes max.) 130% of rating (1 minute max.) overvoltage exceeding 115% : 200 times max. over life
Maximum Current	130% max. of rating
Discharge Resistors	Discharge to 75V or less in 3 minutes
Safety Test	Per para. 8.12 of JIS C 4901
Paint Color	Munsell 5Y7/1
Applicable Standard	JIS C 4901-2000

DIMENSIONS (mm)



RATINGS RG-2 (L=6%) 10-50kvar

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)	Dimensions (mm)			Gross mass (kg)	Fig.
						C	F	N		
234	10/12	10.6/12.8	50/60	RG222BC010R26E	26.2/31.5	200	250	-	5.0	1
	15/18	16.0/19.1	50/60	RG222BC015R26E	39.4/47.2	250	295	-	6.0	
	20/24	21.3/25.5	50/60	RG222BC020R26E	52.5/63.0	250	340	165	15	
	25/30	26.6/31.9	50/60	RG222BC025R26E	65.6/78.7	290	380	205	17	
	30/36	31.9/38.3	50/60	RG222BC030R26E	78.7/94.5	360	450	275	20	
50	53.2		50	RG222B5050R26E	131	510	600	425	27	2
			60	RG222B6050R26E		420	510	335	23	

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

TYPE RG-2 LOW VOLTAGE POWER CAPACITORS (for L=6%) Combined Output 10-100kvar

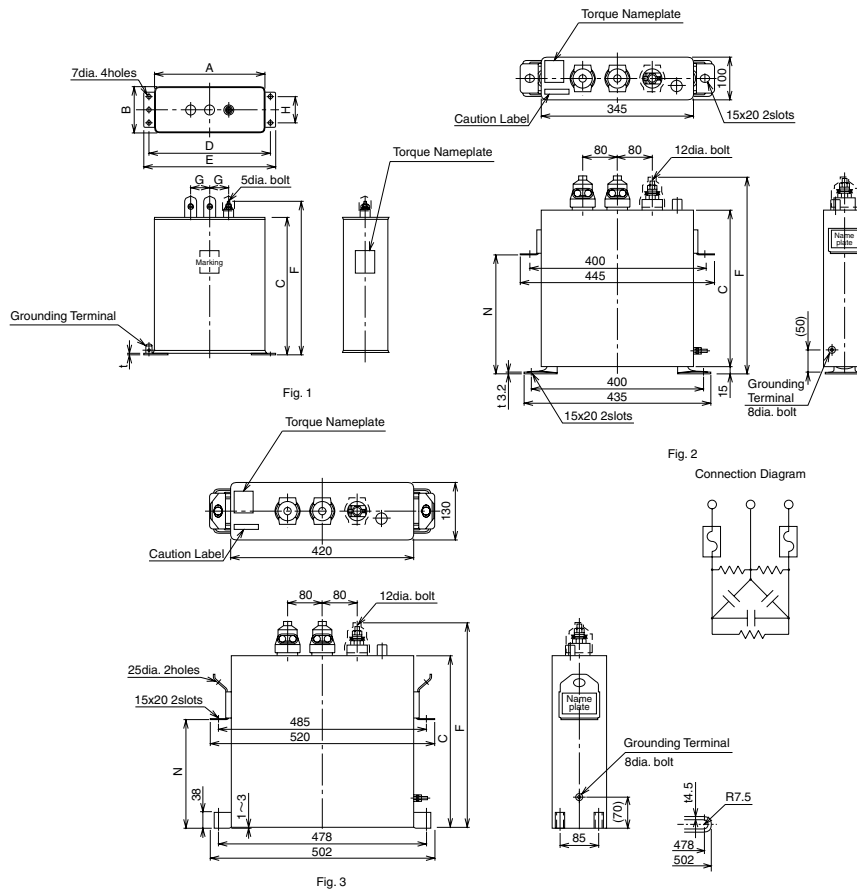
SPECIFICATIONS

System Voltage : 440V

Type	RG-2, oil filled
Installation Location	Indoor only, altitude 2000m max.
Ambient temperature	-25°C to +45°C (24 hour average : 35°C max., annual average : 25°C max.)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)
Voltage Withstand	T - T : 2.15 x rated voltage for 2 seconds T - C : 3000V for 10 seconds
Dissipation Factor	0.2% max. at 20°C

Permissible Overloads	110% of rating (8 hours max. per 24 hours)
Maximum Voltage	115% of rating (30 minutes max. per 24 hours) 120% of rating (5 minutes max.) 130% of rating (1 minute max.) overvoltage exceeding 115% : 200 times max. over life
Maximum Current	130% max. of rating
Discharge Resistors	Discharge to 75V or less in 3 minutes
Safety Test	Per para. 8.12 of JIS C 4901
Paint Color	Munsell 5Y7/1
Applicable Standard	JIS C 4901-2000

DIMENSIONS (mm)



RATINGS RG-2 (L=6%) 10-100kvar

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)	Dimensions (mm)										Gross mass (kg)	Fig.
						A	B	C	D	E	F	G	H	N	t		
468	10/12	10.6/12.8	50/60	RG244BC010R26E	13.1/15.7	173	70	210	190	205	235	30	40	-	1.0	3.5	1
	15/18	16.0/19.1	50/60	RG244BC015R26E	19.7/23.6	240	90	180	265	280	205	30	55	-	1.6	5.5	
	20/24	21.3/25.5	50/60	RG244BC020R26E	26.2/31.5	-	-	210	-	300	-	-	-	125	-	13	
	25/30	26.6/31.9	50/60	RG244BC025R26E	32.8/39.4	-	-	250	-	340	-	-	-	165	-	15	
	30/36	31.9/38.3	50/60	RG244BC030R26E	39.4/47.2	-	-	250	-	340	-	-	-	165	-	15	
	50	53.2	50	RG244B5050R26E	65.6	-	-	360	-	450	-	-	-	275	-	20	
	75	79.8	60	RG244B6050R26E	98.4	-	-	290	-	380	-	-	-	425	-	17	
			50	RG244B5075R26E		-	-	510	-	600	-	250	-	27			
	100	106	60	RG244B6075R26E	131	-	-	420	-	510	-	-	-	205	-	23	
			50	RG244B5100R26E		-	-	400	-	475	-	335	-	35	3		
	60	RG244B6100R26E	-	-	510	-	600	-	425	-	27	2					

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

DRY TYPE GFC-5 LOW VOLTAGE POWER CAPACITORS (for L=6%) Combined Output 10-50kvar

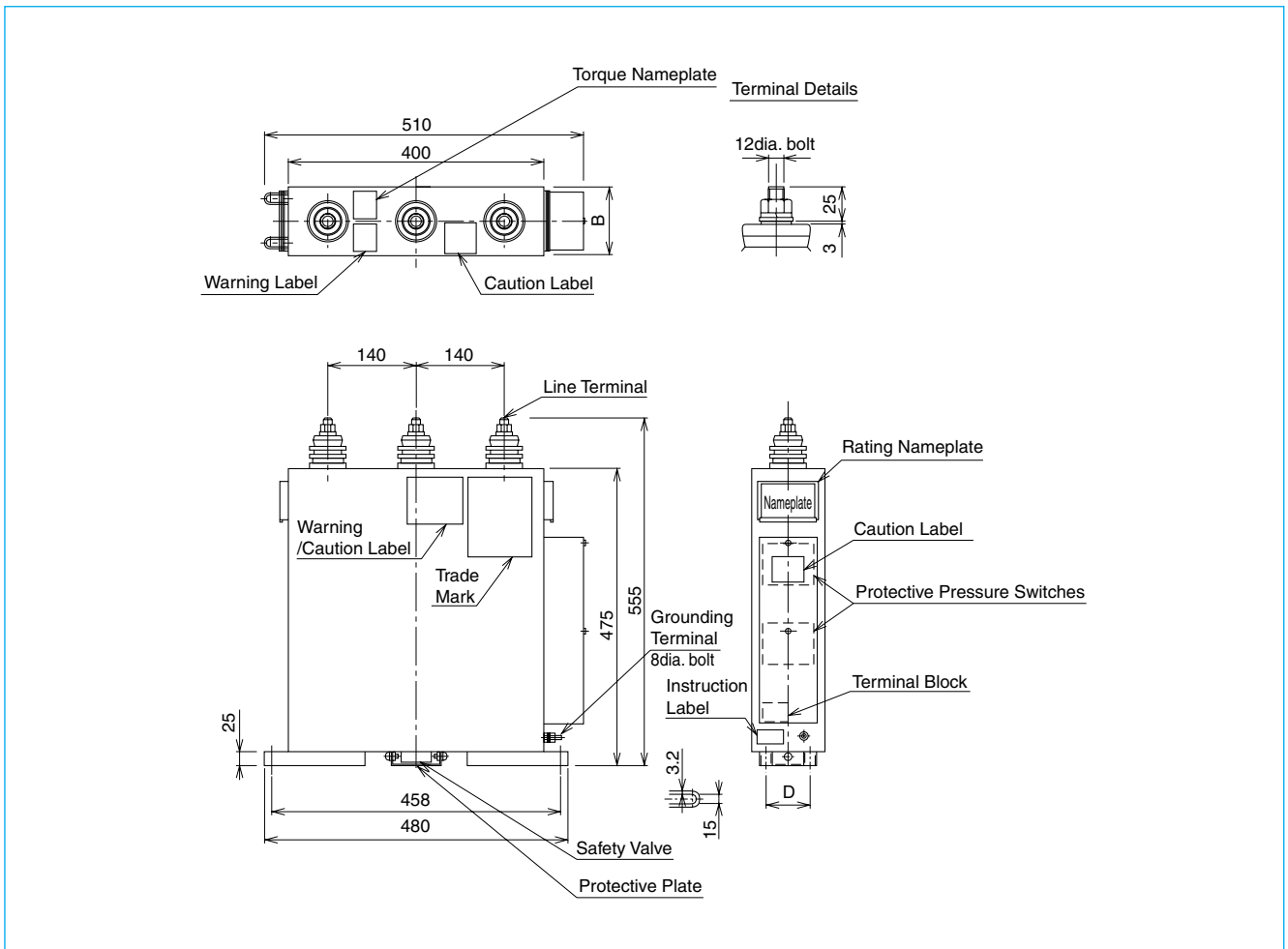
SPECIFICATIONS

System Voltage : 220V

Type	GFC-5, gas filled
Installation Location	Indoor only, altitude 2000m max.
Ambient temperature	-25°C to +50°C (24 hour average : 35°C max., annual average : 25°C max.)
Output Tolerance	-5% to +15% of rated output (Unbalance among phases 1.08 or less)
Voltage Withstand	T - T : 2.15 x rated voltage for 2 seconds T - C : 3000V for 10 seconds
Dissipation Factor	0.12% max. at 20°C

Permissible Overload	110% of rating (8 hours max. per 24 hours)
Maximum Voltage	115% of rating (30 minutes max. per 24 hours) 120% of rating (5 minutes max.) 130% of rating (1 minute max.) overvoltage exceeding 115% : 200 times max. over life
Maximum Current	130% max. of rating
Discharge Resistors	Discharge to 75V or less in 3 minutes
Protective Device	Upper & lower pressure limit switch
Paint Color	Munsell 5Y7/1
Applicable Standard	JIS C 4901-2000

DIMENSIONS (mm)



RATINGS GFC-5 (L=6%) 10-50kvar

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)	Dimensions (mm)		Gross mass (kg)
						B	D	
234	10/12	10.6/12.8	50/60	GF522BC010R26E	26.2/31.5	115	70	20
	15/18	16.0/19.1	50/60	GF522BC015R26E	39.4/47.2	115	70	22
	20/24	21.3/25.5	50/60	GF522BC020R26E	52.5/63.0	115	70	22
	25/30	26.6/31.9	50/60	GF522BC025R26E	65.5/78.7	115	70	23
	30/36	31.9/38.3	50/60	GF522BC030R26E	78.7/94.5	115	70	23
	50	53.2	50	GF522B5050R26E	131	140	95	25
		60	GF522B6050R26E	25				

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

DRY TYPE GFC-5 LOW VOLTAGE POWER CAPACITORS (for L=6%) Combined Output 20-100kvar

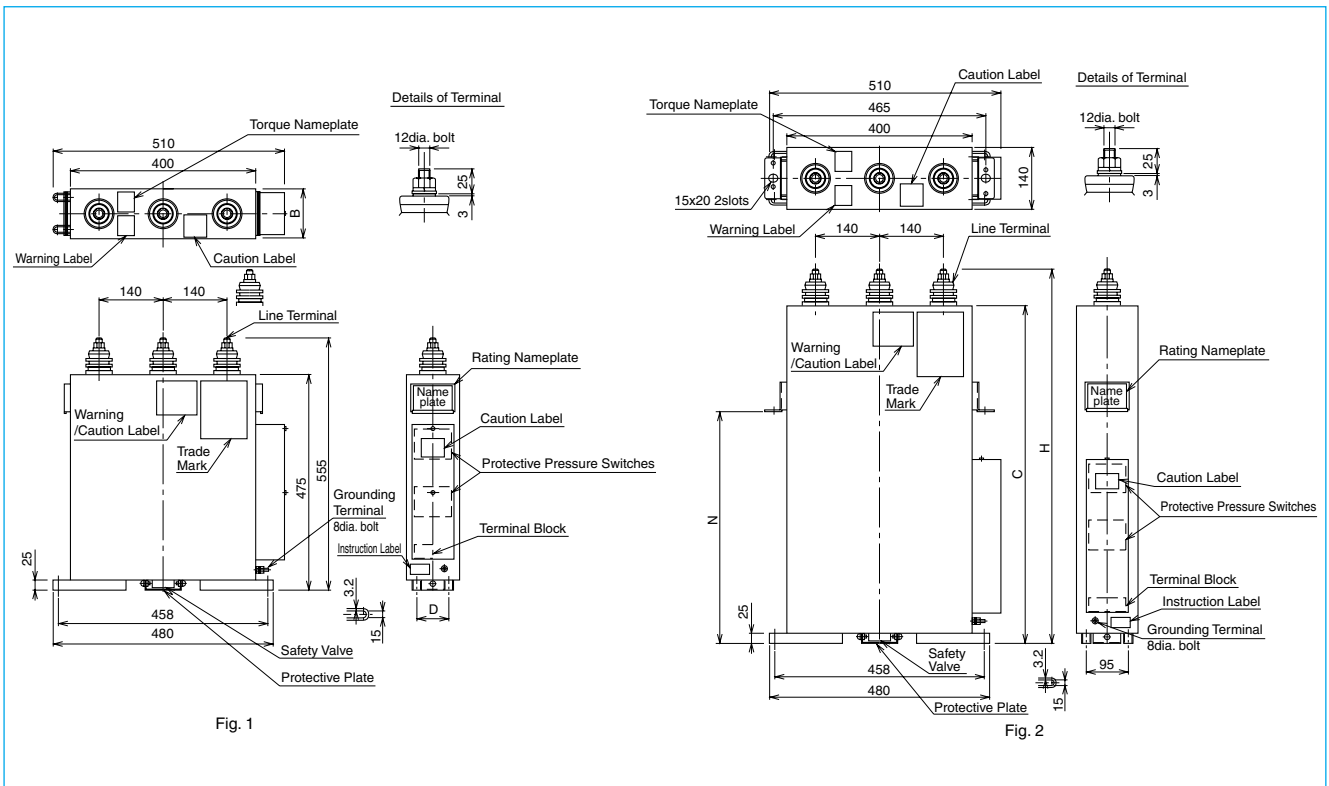
SPECIFICATIONS

System Voltage : 440V

Type	GFC-5, gas filled
Installation Location	Indoor only, altitude 2000m max.
Ambient temperature	-25°C to +50°C (24 hour average : 35°C max., annual average : 25°C max.)
Output Tolerance	-5% to +15% of rated output (Phase unbalance : 108% max. (3 phase))
Voltage Withstand	T - T : 2.15 x rated voltage for 2 seconds T - C : 3000V for 10 seconds
Dissipation Factor	0.12% max. at 20°C

Permissible Overload	110% of rating (8 hours max. per 24 hours)
Maximum Voltage	115% of rating (30 minutes max. per 24 hours) 120% of rating (5 minutes max.) 130% of rating (1 minute max.) overvoltage exceeding 115% : 200 times max. over life
Maximum Current	130% max. of rating
Discharge Resistors	Discharge to 75V or less in 3 minutes
Protective Device	Upper & lower pressure limit switch
Paint Color	Munsell 5Y7/1
Applicable Standard	JIS C 4901-2000

DIMENSIONS (mm)



RATINGS GFC-5 (L=6%) 20-100kvar

Rated Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)	Dimensions (mm)					Gross mass (kg)	Fig.	
						B	C	D	H	N			
468	20/24	21.3/25.5	50/60	GF544BC020R26E	26.2/31.5	115	-	70	-	-	20	1	
	25/30	26.6/31.9	50/60	GF544BC025R26E	32.8/39.4	115	-	70	-	-	20		
	30/36	31.9/38.3	50/60	GF544BC030R26E	39.4/47.2	115	-	70	-	-	22		
	75	53.2	53.2	50	GF544B5050R26E	65.6	140	-	95	-	-	25	2
				60	GF544B6050R26E		140	-	95	-	-	25	
				50	GF544B5075R26E		-	605	-	685	415	37	
100	79.8	79.8	60	GF544B6075R26E	98.4	-	545	-	625	415	36		
			50	GF544B5100R26E		-	745	-	825	515	42		
100	106	106	60	GF544B6100R26E	131	-	685	-	765	515	39		

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

TYPE DR-1 SERIES REACTORS (for L=6%, Is=55%) Combined Output 10-300kvar

SPECIFICATIONS

System Voltage : 220V or 440V

Type	DR-1, dry type
Installation Location	Indoor only, altitude : 2000m max.
Ambient temperature	-20°C to +45°C (24 hour average : 35°C max., annual average : 25°C max.)
Insulation Class	Class H
System Voltage	220V or 440V
Number of Phases	3 phase

Rated Frequency	50Hz or 60Hz
Reactance	6% of capacitor reactance
Permissible Overload	130% of rating (5th harmonic current - not more than 55% of the fundamental current)
Maximum Current	more than 55% of the fundamental current)
Temperature Rise	115°C max. at the coils (per resistance method)
Applicable Standard	JIS C 4901-2000

DIMENSIONS (mm)

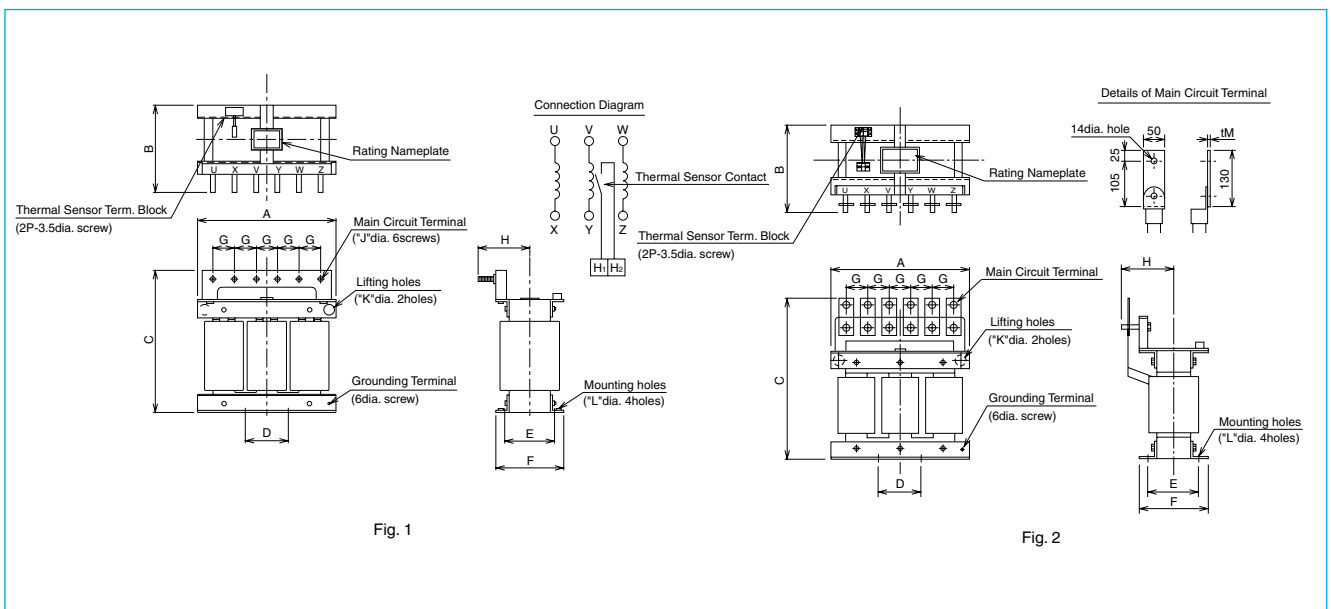


Fig. 1

Fig. 2

RATINGS DR-1 (L=6%) Rated Voltage : 220V-8.11V, 440V-16.2V

System Voltage (V)	Combined Output (kvar)	Rated Output (kvar)	Rated Frequency (Hz)	Part Number	Rated Current (A)		Dimensions (mm)													Gross mass (kg)	Fig.	
					220V	440V	A	B	C	D	E	F	G	H	J	K	L	M	220V		440V	
220 or 440	10	0.638	50	DR1★B5010N26E	26.2	13.1	210	150	200	70	95	125	35	90	M8	16	10	-	12	1	1	
	12	0.766	60	DR1★B6012N26E	31.5	15.7	210	150	200	70	95	125	35	90	M8	16	10	-	12			
	15	0.957	50	DR1★B5015N26E	39.4	19.7	210	150	200	70	95	125	35	90	M8	16	10	-	16			
	18	1.15	60	DR1★B6018N26E	47.2	23.6	250	170	240	80	100	130	35	100	M8	20	10	-	16			
	20	1.28	50	DR1★B5020N26E	52.5	26.2	250	170	240	80	100	130	35	100	M8	20	10	-	19			
	24	1.53	60	DR1★B6024N26E	63.0	31.5	270	180	280	90	100	130	35	100	M8	20	10	-	21			
	25	1.60	50	DR1★B5025N26E	65.6	32.8	270	180	280	90	110	140	35	100	M8	20	10	-	23			
	30	1.91	60	DR1★B6030N26E	78.7	39.4	270	180	280	90	110	140	35	100	M8	20	10	-	25			
	30	1.91	50	DR1★B5030N26E	78.7	39.4	270	180	280	90	110	140	35	100	M8	20	10	-	26			
	36	2.30	60	DR1★B6036N26E	94.5	47.2	320	200	330	100	120	160	50	120	M10	25	12	-	30			
	50	3.19	50/60	DR1★B*050N26E	131	65.6	320	200	330	100	120	160	50	120	M10	25	12	-	35			
	75	4.79	50/60	DR122B*075N26E	197	-	450	240	435	100	150	190	75	140	-	25	12	6	45			
	75	4.79	50/60	DR144B*075N26E	-	98.4	320	240	360	100	150	190	50	140	M10	25	12	-	45			
	100	6.38	50/60	DR122B*100N26E	262	-	450	250	475	200	150	200	75	150	-	25	12	6	67			
	100	6.38	50/60	DR144B*100N26E	-	131	380	250	400	200	150	200	60	150	M12	25	12	-	67			
	150	9.57	50/60	DR122B*150N26E	394	-	450	260	535	200	160	200	75	150	-	25	12	8	98			
	150	9.57	50/60	DR144B*150N26E	-	197	450	260	535	200	160	200	75	150	-	25	12	6	98			
	200	12.8	50/60	DR144B*200N26E	-	262	450	270	545	250	170	200	75	160	-	25	12	6	130			
250	16.0	50/60	DR144B*250N26E	-	328	450	280	555	300	170	200	75	160	-	25	12	8	145				
300	19.1	50/60	DR144B*300N26E	-	394	470	300	645	300	180	220	75	200	-	25	12	8	170				

- (Notes) 1. The asterisk ★ denotes voltage. 22 and 44 represent 220V and 440V respectively.
 2. The mark * denotes frequency. 5 and 6 represent 50Hz and 60Hz respectively.
 3. Class I reactors (Is=35%) are also available.
 4. Reactors with Is=70% are also available.

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

OIL-LESS V-PAC FOR INSTALLATION IN PANELS (with L=6%, I₅=55%)



FEATURES

- Enhanced Harmonic Withstand Capability**
The equipment now employs series reactors which have enhanced harmonic withstand capability of I₅=55% in accordance with the new standard JIS C 4902.
- Oil-less Type**
No insulation oils are used in the equipment to offer excellent safety.
- Micro Miniatures**
The equipment can be placed in a 700mm deep panel.
- Standardized Units**
15 - 150 kvar units are available by combing the standard units of 15 kvar, 25 kvar and 50 kvar.

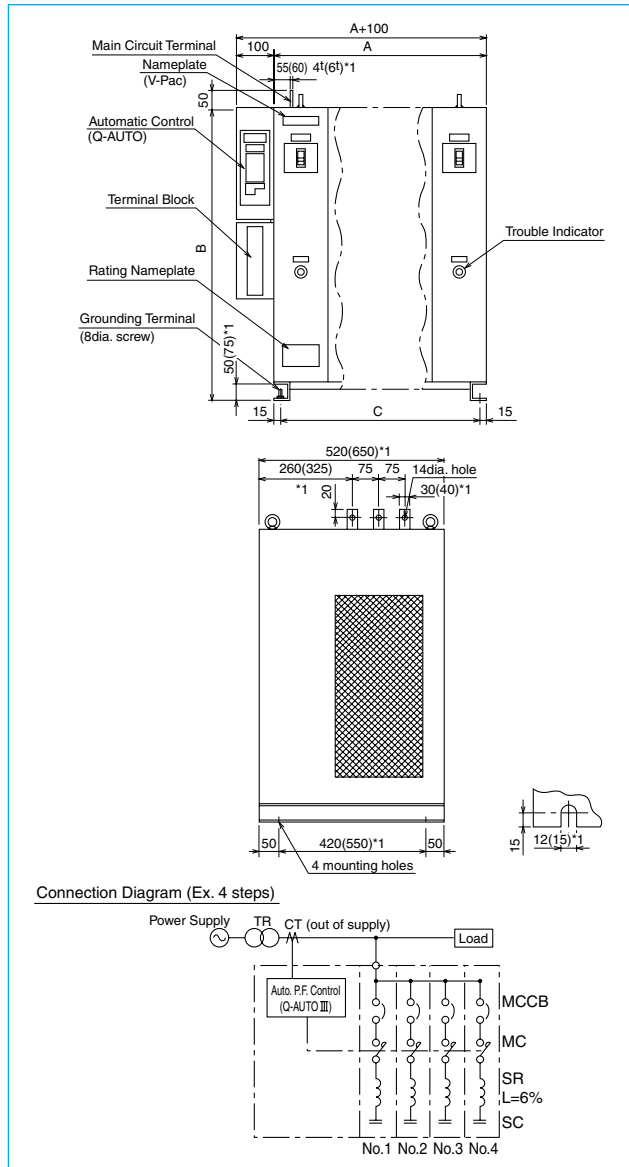
SPECIFICATIONS

Mounting Location	Restricted to installation inside a panel
System Voltage	220V or 440V
No. of Phases	3 phase
Control Method	Power factor detection type, sequence switching control
Device	MCCB
Protection	Capacitors Built-in protective function
	Reactors Thermal Sensor
Ambient Temperature	-10°C to +45°C
Harmonic Withstand Capability	5th harmonic content 55%
Color of Paint	Munsell 5Y7/1 (semi-gloss)

RATINGS V-Pac

System Voltage (V)	Transformer (kVA)	Frequency (Hz)	Combined Output (kvar)	No. of Steps	Rated Current (A)	Dimensions (mm)			Gross mass (kg)
						A	B	C	
220	50	50/60	15	15kvar×1	39.4	150	850	120	65
	75	50/60	25	25kvar×1	65.6	150	850	120	70
	100	50/60	30	15kvar×2	78.7	300	850	270	110
	150	50/60	50	25kvar×2	131	300	850	270	120
	200	50/60	75	25kvar×3	197	450	850	420	170
	300	50/60	100	25kvar×4	262	600	850	570	220
	500	50/60	150	50kvar×3	394	600	1175	570	350
	750	50/60	250	50kvar×5	656	400 + 600	1175	370 + 570	600
	1000	50/60	300	50kvar×6	787	600 + 600	1175	570 + 570	700
440	300	50/60	100	50kvar×2	131	400	1175	370	250
	500	50/60	150	50kvar×3	197	600	1175	570	350
	750	50/60	250	50kvar×5	328	400 + 600	1175	370 + 570	600
	1000	50/60	300	50kvar×6	394	600 + 600	1175	570 + 570	700

DIMENSIONS (mm)



*1 Dimensions in () are for 50kvar x 3, 5, 6 steps.

APPLICATION NOTES

- Be sure to install the equipment in a panel.
- Do not stack the equipment in double tiers.
- Consideration should be given to the adequate ventilation inside the panel that will help reduce the temperature rise caused by heat of the equipment and other apparatus.
- For heat generated by the equipment to calculate ventilation inside the panel, refer to the product specification for V-Pac.
- If the breaking capacity of the MCCB is not sufficient, advise us of the rated breaking capacity required. Alternatively, mount a circuit breaker upstream in the line to form cascade breaking system to meet the breaking capacity required.
- Standard breaking capacity is as follows.
 - 30kA for 220V, 15kvar units
 - 30kA for 220V, 25kvar units
 - 35kA for 220V, 50kvar units
 - 25kA for 440V, 50kvar units
- Be sure to connect a CT (out of supply) to detect load current to the phase R.
- It is required to adjust (set) the sensitivity of control current before operation. For a value to be set at, refer to the Operating Instructions.

3 LOW VOLTAGE POWER CAPACITOR EQUIPMENT

FREE STANDING ENCLOSED V-PAC II (with L=6%, I_s=55%)

The Shizuki V-PAC II low voltage power factor correction equipment has achieved the utmost effect to save electric power. The equipment consists of the control unit to detect and control power factor, the thyristor switches to switch on and off the capacitors with solid-state switches, and the capacitors combined with the reactors. The equipment has automatically maintained the desired power factor level, adjusting to the system load requirements.



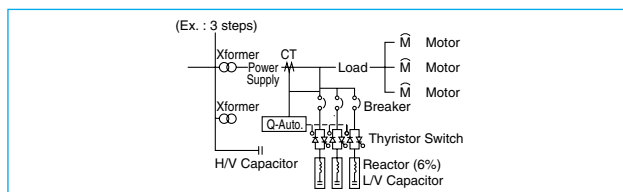
FEATURES

- ① The capacitor switches use contactless thyristors with no mechanical moving parts, providing a semi-permanent life. In addition, the employment of soft-start circuit smoothes the building-up of current waveform, eliminating inrush current.
- ② The series reactors (6%) combined with the capacitor suppress the amplification of harmonics present on the line and reduce inrush current flowing from the line.
- ③ The automatic capacitor control unit Q-AUTO with a built-in microcomputer maintains the system power factor at nearly 100%.
- ④ Special care is given to the safety design, employing the capacitors with a built-in protective device and incorporating alarm contacts in the automatic capacitor control unit to monitor low power factor.

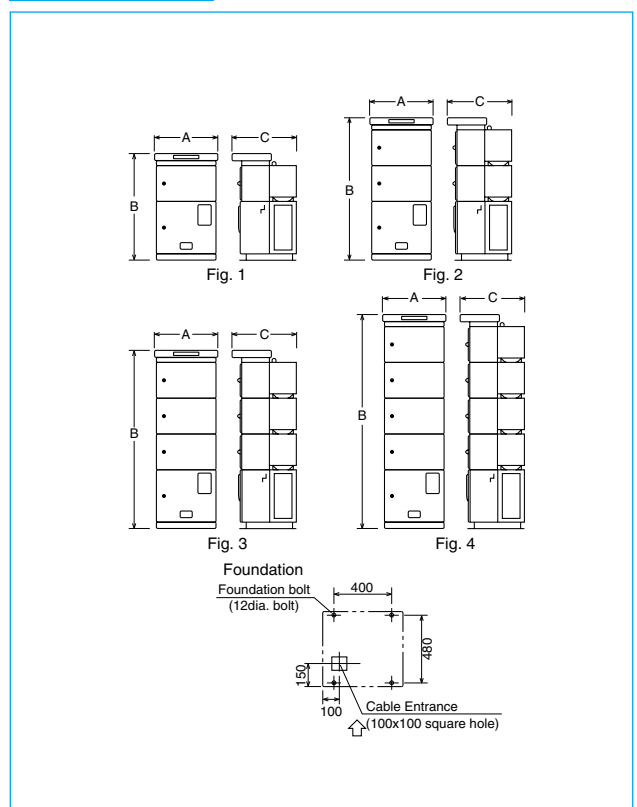
SPECIFICATIONS

Type	V-PAC II
System Voltage	220V
Installation Location	Indoor and outdoor
Ambient Temperature	-10°C to +40°C
Control of Capacitor Switching	
Power Factor Detection	Voltage detection System voltage Current detection CT(not supplied)
Control Method	Sequence control
Switching Device	Solid-state (thyristor)
Power Supply	System voltage
Protection	
Device	MCCB
Capacitors	Built-in protective function
Color of Paint	Munsell 5Y7/1 (semi-gloss)

CIRCUIT CONFIGURATION



DIMENSIONS (mm)



RATINGS V-Pac II

Combined Output (kvar)	Dimensions (mm)			No. of Steps	Gross mass (kg)	Fig.
	A	B	C			
15	570	1000	600	15kvar x 1	130	1
30	570	1340	600	15kvar x 2	200	2
45	570	1680	600	15kvar x 3	270	3
60	570	2020	600	15kvar x 4	340	4

4 SURGE ABSORBING CAPACITORS & GROUNDING CAPACITORS

• TYPE NV-2 Surge Absorbing Capacitors

Abnormal voltage appearing on the line is caused by the internal factors including switching of the circuit, open-circuit, short-circuit and grounding or by the external factor of lightning. The abnormal voltage is propagated on the line to apply excessive voltage to transformers, circuit breakers, potential transformers and current transformers installed at a power plant, and is further transmitted to the generators or rotating machines through the secondary of the transformer, damaging them.

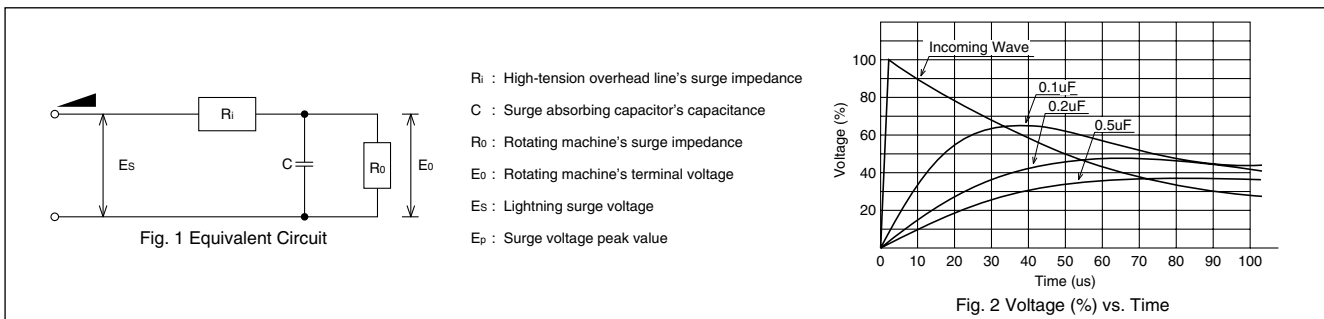
Rotating machines and transformers are generally installed in a narrow facility. Therefore, it is hard to enhance the dielectric strength of the apparatus. Surge absorbing capacitors help protect the apparatus from the abnormal voltage more effectively than any other methods. Described below are the benefits and characteristics of our surge absorbing capacitors.

Fig.1 shows the circuit where a surge absorbing capacitor is connected on parallel with a lumped resistance R which represents loads such as generator or transformers. Assuming transmitted wave $E_0=e^{-\alpha t}-e^{-\beta t}$, the terminal voltage across the load E will be

$$E_s = E_p(e^{-\alpha t} - e^{-\beta t})$$

$$E_0 = E_p \frac{1}{CR_i(\gamma - \alpha)} (e^{-\alpha t} - e^{-\gamma t})$$

To find out how the capacitor helps reduce a surge, let us assume in Fig.1 the surge impedance at the side of the transmission line $Z=200\Omega$ and the surge impedance of the apparatus to be protected $R=2,000\Omega$. The results of calculation are shown in Fig.2 which tells us that the sharper the transmitted waveform is or the larger the capacitance is, the more effectively the capacitor works.

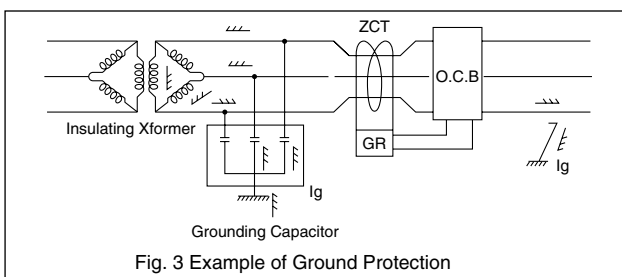


- Ri : High-tension overhead line's surge impedance
- C : Surge absorbing capacitor's capacitance
- Ro : Rotating machine's surge impedance
- Eo : Rotating machine's terminal voltage
- Es : Lightning surge voltage
- Ep : Surge voltage peak value

• TYPE NVG-2 Grounding Capacitors

A ground relay to activate the zero-phase-sequence current transformer is installed at the secondary of the step-down insulating transformer in a facility to protect the equipment. In this case, a grounding capacitor needs

to be added at the power source side of ZCT to obtain a zero-phase current for detection as shown in Fig.3. The capacitance required can be calculated from the following equation.



$$C \geq \frac{I_g \times 10^3}{\sqrt{3} \times 2\pi f E} \text{ (}\mu\text{F)}$$

- where C : Capacitance per phase of the capacitor [μF]
- E : Line-to-line voltage [V]
- I_g : Operating current of the g round relay [mA]
- F : Frequency [Hz]

SPECIFICATIONS

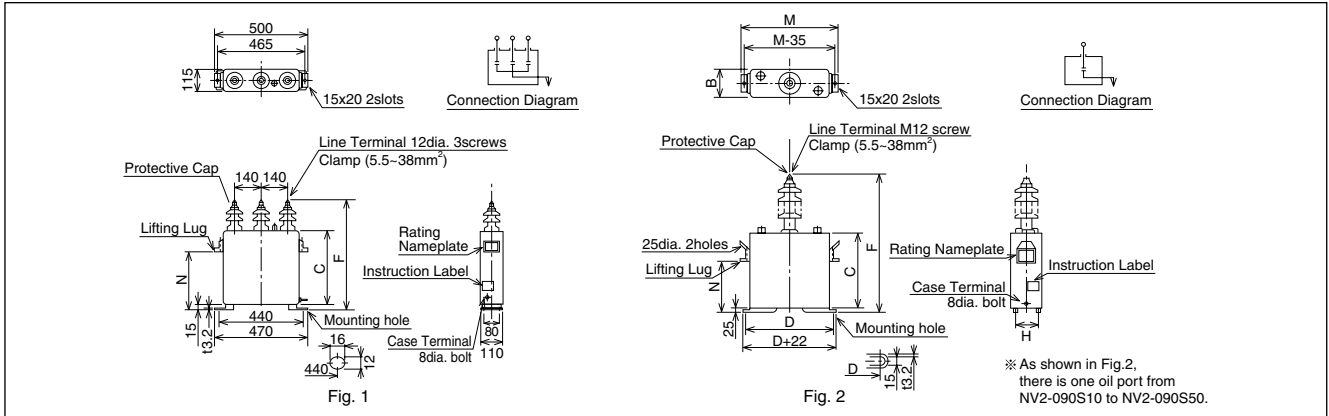
Type	NV-2/NVG-2, oil filled
Installation Location	Indoor and Outdoor
Ambient temperature	-20°C to +50°C
Capacitance Tolerance	-5% to +15% of rating
Max. Permissible Voltage	110% of rating (12 hours max. per 24 hours)
Paint Color	Munsell 5Y7/1
Applicable Standard	JEM 1362-1999

Voltage Test Between Terminals, and Between Terminals and Case

Type	Rated Voltage	Test Voltage	
Surge Absorbing Capacitors	3300/ $\sqrt{3}$ V	16kVAC (1 minute)	45kVDC (10 seconds)
	6600/ $\sqrt{3}$ V	22kVAC (1 minute)	60kVDC (10 seconds)
	11000/ $\sqrt{3}$ V	28kVAC (1 minute)	90kVDC (10 seconds)
	22000/ $\sqrt{3}$ V	50kVAC (1 minute)	150kVDC (10 seconds)
Grounding Capacitors	3300/ $\sqrt{3}$ V	70kVAC (1 minute)	200kVDC (10 seconds)
	6600/ $\sqrt{3}$ V	10kVAC (1 minute)	30kVDC (10 seconds)
		16kVAC (1 minute)	45kVDC (10 seconds)

4 SURGE ABSORBING CAPACITORS & GROUNDING CAPACITORS

DIMENSIONS (mm)



RATINGS (50/60Hz)

TYPE NV-2 Surge Absorbing Capacitors

Rated Voltage (V)	Insulation Level	Capacitance (uF)	Part No.	Dimensions (mm)			Gross mass (kg)	Fig.
				C	F	N		
3300/√3	16/45kV	0.1×3	NV2-045T10E	150	350	—	15	1
		0.2×3	NV2-045T20E	170	370	—	16	
		0.3×3	NV2-045T30E	190	390	—	18	
		0.4×3	NV2-045T40E	250	450	170	21	
		0.5×3	NV2-045T50E	280	480	200	23	
6600/√3	22/60kV	0.1×3	NV2-060T10E	150	350	—	15	
		0.2×3	NV2-060T20E	210	410	130	19	
		0.3×3	NV2-060T30E	300	500	210	24	
		0.4×3	NV2-060T40E	360	560	240	28	
		0.5×3	NV2-060T50E	410	610	310	30	

The 3300/√3V 0.1uFx3 - 0.3uFx3 and 6600/√3V 0.1uFx3 parts are not provided with lifting lugs. The case terminal is located at the mounting foot.

Rated Voltage (V)	Insulation Level	Capacitance (uF)	Part No.	Dimensions (mm)								Gross mass (kg)	Fig.
				B	C	D	F	H	M	N			
11000/√3	28/90kV	0.1	NV2-090S10E	160	200	375	475	115	430	—	—	20	2
		0.2	NV2-090S20E	160	200	375	475	115	430	—	—	20	
		0.3	NV2-090S30E	160	250	375	525	115	430	130	—	22	
		0.5	NV2-090S50E	160	350	375	625	115	430	230	—	28	
22000/√3	50/150kV	0.1	NV2-150S10E	160	250	465	620	115	520	130	—	25	
		0.2	NV2-150S20E	160	350	465	720	115	520	230	—	35	
		0.3	NV2-150S30E	160	450	465	820	115	520	330	—	44	
		0.5	NV2-150S50E	150	600	598	970	105	640	430	—	68	
33000/√3	70/200kV	0.1	NV2-200S10E	190	300	605	770	145	660	180	—	47	
		0.2	NV2-200S20E	190	400	605	870	145	660	280	—	62	
		0.3	NV2-200S30E	190	500	605	970	145	660	370	—	76	
		0.5	NV2-200S50E	190	650	705	1120	145	760	470	—	113	

The 11000/√3V 0.1u and 0.2uF parts are not provided with lifting lugs.

TYPE NVG-1 Grounding Capacitors

Rated Voltage (V)	Insulation Level	Capacitance (uF)	Part No.	Dimensions (mm)			Gross mass (kg)	Fig.
				C	F	N		
3300/√3	10/30kV	0.1×3	NVG2-030T10E	150	350	—	15	1
		0.2×3	NVG2-030T20E	150	350	—	15	
		0.3×3	NVG2-030T30E	150	350	—	15	
		0.4×3	NVG2-030T40E	180	380	—	17	
		0.5×3	NVG2-030T50E	180	380	—	17	
6600/√3	16/45kV	0.1×3	NVG2-045T10E	150	350	—	15	
		0.2×3	NVG2-045T20E	170	370	—	16	
		0.3×3	NVG2-045T30E	190	390	—	18	
		0.4×3	NVG2-045T40E	250	450	170	21	
		0.5×3	NVG2-045T50E	280	480	200	23	

The 3300/√3V 0.1uFx3 - 0.5uFx3 and 6600/√3V 0.1uFx3 - 0.3uFx3 parts are not provided with lifting lugs. The case terminal is located at the mounting foot.

5 HIGH FREQUENCY CAPACITORS

PLASTIC FILM CAPACITORS (ETHY-CON)

Our polyethylene film capacitors were originally developed for the integrating circuit of analog computers. The application was later expanded, because of its low dissipation factor, to include power factor improvement in the high frequency SCR and Motor Generator (MG) type electric furnace heating equipment, and in vacuum tube high frequency oscillators for oscillation, bypassing, or blocking. The capacitors, called "Ethy-con", have enjoyed good customer acceptance.

With the introduction of electrical grade polypropylene film offering a unique characteristic, our efforts made it possible to successfully develop and market polypropylene capacitors for application in the MG type high frequency electric furnace to improve power factor over the range from 1 KHz to 10 KHz.

Both polyethylene and polypropylene film capacitors have been found to be acceptable among customers for high frequency applications.

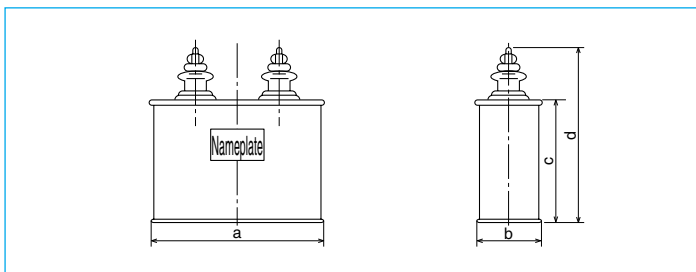


SPECIFICATIONS

Installation Location	Indoors only
Operating Ambient Temperature	-10°C to +40°C
Capacitance Tolerance	+10% to -10% of rating

Dissipation Factor	0.03% maximum at 20°C, 1KHz
Applicable Standard	IEC Pub 60110

DIMENSIONS



RATINGS (For Vacuum Tube Oscillators)

Rated Frequency (kHz)	Rated Capacitance (uF)	Test Voltage (kVDC)	Rated Current (A)	Dimensions (mm)				
				a	b	c	d	
50~400	0.01	10	5	90	50	100	155	
100~400			10	90	50	100	155	
30~400	0.02		5	90	50	100	155	
50~400			10	90	50	100	155	
20~400	0.05		5	90	50	100	155	
30~400			10	90	50	100	155	
10~400	0.1		5	90	50	150	205	
15~400			10	90	50	150	205	
50~400	0.01		20	10	130	70	100	185
100~400				20	130	70	100	185
40~400	0.02			10	130	70	100	185
70~400				20	130	70	100	185
15~400	0.05	10		130	70	160	245	
30~400		20		130	70	160	245	
10~400	0.1	10		173	70	180	265	
15~400		20		173	70	180	265	
60~400	0.01	30		15	173	70	130	225
200~400				30	173	70	130	225
30~400	0.02			15	173	70	180	275
70~400				30	173	70	180	275
20~400	0.05		15	173	70	180	275	
35~400			30	173	70	180	275	
10~400	0.1		15	320	90	180	275	
20~400			30	320	90	180	275	
60~400	0.01		40	20	240	90	130	270
200~400				40	240	90	130	270
30~400	0.02			20	240	90	180	320
80~400				40	240	90	180	320
15~400	0.05	20		240	90	180	320	
35~400		40		240	90	180	320	
10~400	0.1	20		350	150	180	320	
15~400		40		350	150	180	320	

(Note) To assemble two or more capacitors, secure the spacing between walls of 50mm or more.

RATINGS (For MG & SCR P.F. Correction)

Rated Frequency (kHz)	Rated Capacitance (uF) (division number)	Rated Voltage (V)	Rated Current (A)	Rated Output (kvar)	Dimensions (mm)			
					a	b	c	d
1 (1.2)	136 (34X4)	400	340	136	380	180	500	590
	100 (50X2)	500	314	157	380	180	500	590
	80 (20X4)	600	300	180	380	180	500	590
	52 (13X4)	800	261	209	380	180	500	590
	36 (9X4)	1000	226	226	380	180	500	590
	26 (13X2)	1200	196	236	380	180	500	590
3	20 (10X2)	1400	176	246	380	180	500	590
	80 (11.4X7)	400	600	240	350	150	500	580
	60 (10X6)	500	560	280	350	150	500	580
	50 (8.4X6)	600	565	340	350	150	500	580
	28 (4.7X6)	800	425	340	350	150	500	580
	18 (4.5X4)	1000	340	340	350	150	500	590
10 (9.6)	12.5 (3.13X4)	1200	283	340	350	150	500	590
	9.2 (2.3X4)	1400	242	340	350	150	500	590
	24.5 (3.5X7)	400	615	245	350	150	300	380
	19 (2.7X7)	500	600	300	350	150	340	420
	13.8 (2.3X6)	600	500	300	350	150	340	420
	7.5 (1.25X6)	800	375	300	350	150	340	420
	4.8 (1.2X4)	1000	300	300	350	150	340	430
	3.4 (0.85X4)	1200	250	300	350	150	340	430
	2.4 (0.6X4)	1400	215	300	350	150	340	430

5 HIGH FREQUENCY CAPACITORS

WATER COOLED CAPACITORS

SPECIFICATIONS

Installation Location	Indoors only
Operating Ambient Temperature	0°C to +50°C
Capacitance Tolerance	+10% to -10% of rating
Voltage Withstand	2 times the rated voltage (60Hz)
Cooling Water	45°C maximum at water outlet
Flow Rate of Cooling Water	5 liters minimum per minute
Pressure of Cooling Water	5 kg minimum per cm ²
Paint	No paint

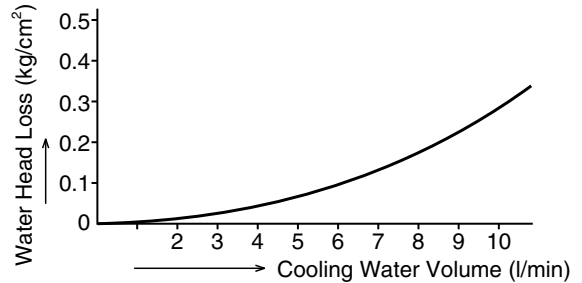
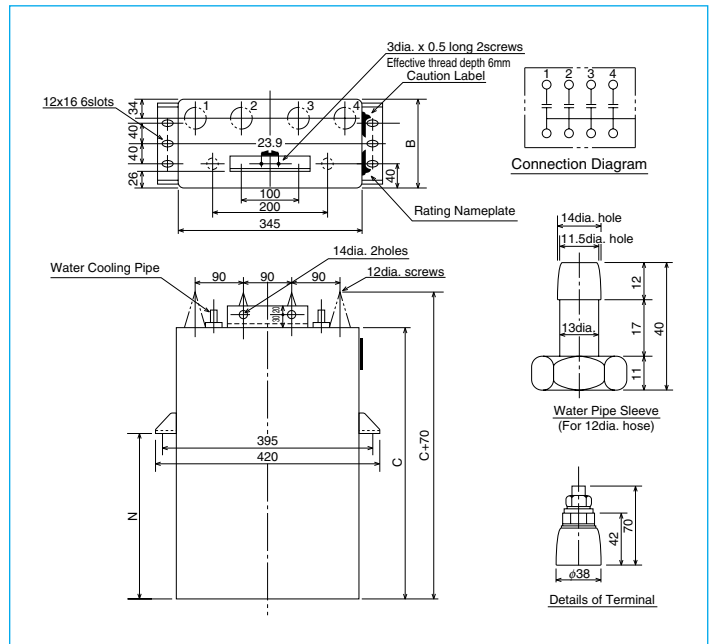


Fig. 1

APPLICATION NOTES

- The case forms one of the two electrodes and should be mounted on an insulating rack to isolate from ground before capacitors are placed in operation.
- When two capacitor units or more are installed side by side, the clearance of 35mm or more should be provided between the walls of adjoining units.
- The cooling water flow rate should be not less than 5 liters per minute. The outgoing water temperature should not exceed 45°C. The temperature rise of cooling water is 1°C in average per capacitor unit (1,000 kVA).
- The pressure drop of the cooling coil is as shown in Fig.1.
- If the capacitors are to be left idle in a freezing temperature after they have been in operation, the cooling coil should be blown free of water to prevent the water from freezing in the coil.
- Low voltage terminals use aluminum conductors. Hence, when connecting low voltage terminals, the terminals should be coated with aluminum compound.

DIMENSIONS (mm)



RATINGS (For Multi-Frequency Water Cooled Capacitors)

Rated Capacitance (uF)	Dimensions (mm)			Gross mass (kg)	Rated Frequency (kHz)	Rated Voltage (V)	Rated Current (A)	Rated Output (kvar)
	B	C	N					
250 (4×62.5)	160	500	305	38	1	800	1250	1000
					2	400	1250	500
					2.5	320	1250	400
					3	266	1250	333
					4	200	1250	250
					8	100	1250	125
160 (4×40)	160	330	190	26	10	80	1250	100
					1	1000	1000	1000
					2	626	1250	782
					2.5	500	1250	626
					3	417	1250	521
					4	313	1250	391
110 (4×27.5)	160	330	190	26	8	156	1250	196
					10	125	1250	156
					1	1200	833	1000
					2	847	1181	1000
					2.5	717	1250	896
					3	597	1250	747
83 (4×20.75)	140	250	100	20	4	448	1250	560
					8	224	1250	280
					10	179	1250	224
					1	1000	522	522
					2	979	1021	1000
					2.5	876	1142	1000

Rated Capacitance (uF)	Dimensions (mm)			Gross mass (kg)	Rated Frequency (kHz)	Rated Voltage (V)	Rated Current (A)	Rated Output (kvar)
	B	C	N					
53 (4×13.3)	140	250	100	20	1	1300	432	563
					2	1225	816	1000
					2.5	1096	912	1000
					3	1000	1000	1000
					4	866	1154	1000
					8	469	1250	586
33 (4×8.25)	140	250	100	20	10	375	1250	469
					1	1400	290	406
					2	1400	581	813
					2.5	1389	720	1000
					3	1268	789	1000
					4	1098	911	1000
25 (4×6.25)	140	250	100	20	8	753	1250	940
					10	600	1250	750
					1	1700	267	454
					2	1700	534	908
					2.5	1596	627	1000
					3	1457	686	1000
	140	250	100	20	4	1262	793	1000
					8	892	1121	1000
					8	892	1121	1000
					10	800	1250	1000

The other ratings are also available.

6 AUTOMATIC CAPACITOR CONTROLLERS

Type SQ-S4

Type SQ-S4 has automatically controlled the switching of power capacitors to control power factor automatically, saving electric bills.



FEATURES

① Easy to Set

- Control is made aiming at target power factor of 100% by setting the primary and secondary voltages.
- Complicated calculation of VCT ratio or target reactive power is not required.

In addition, setting of capacitance is not also required as the controller identifies the capacitance required automatically.

② Can be used for both of 3-phase 3-wire and 3-phase 4-wire systems.

- The controller can be used either for balanced loads or unbalanced loads in a 3-phase 3-wire circuit or for 3-phase 4-wire circuits.

③ Can be used even for negative-phase-sequence.

- The controller detects negative-phase-sequence to change over internally to positive-phase-sequence automatically. Any works to change the phase sequence is not required.

④ Capacitors can be disconnected under light load conditions.

- The controller detects light load and disconnects capacitors automatically to prevent excessive lead power factor.

- Capacitors can be disconnected at night by the signal from an external time switch to prevent excessive lead. (with the forced breaking circuit)

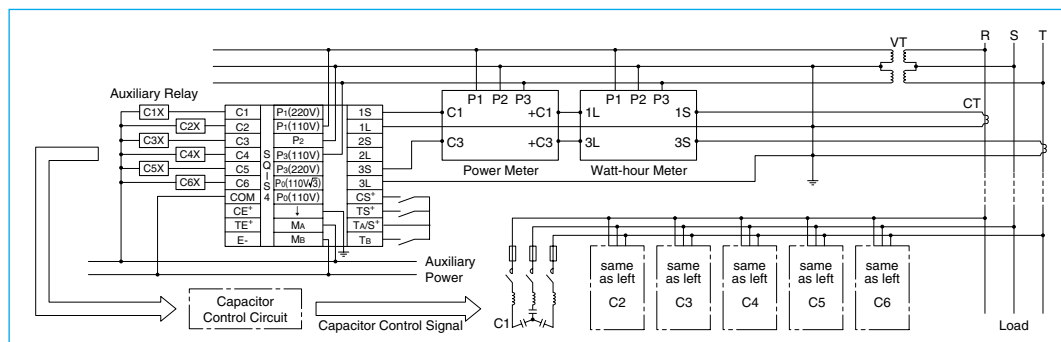
⑤ Control method to suit load can be selected.

- Operation mode can be selected from one of cyclic mode, priority mode and optimum mode.
- Operation to suit capacitor output and load conditions is possible.
- Setting at 6 steps maximum. For more settings, use the two units.

⑥ Can display the measurements.

- Current (I_R, I_S, I_T)
- Voltage ($V_{R-S}, V_{S-T}, V_{T-R}$)
- Power (kW)
- Reactive power (kvar)
- Power factor ($\cos\phi$)
- Apparent power (kVA)

CONNECTION DIAGRAM

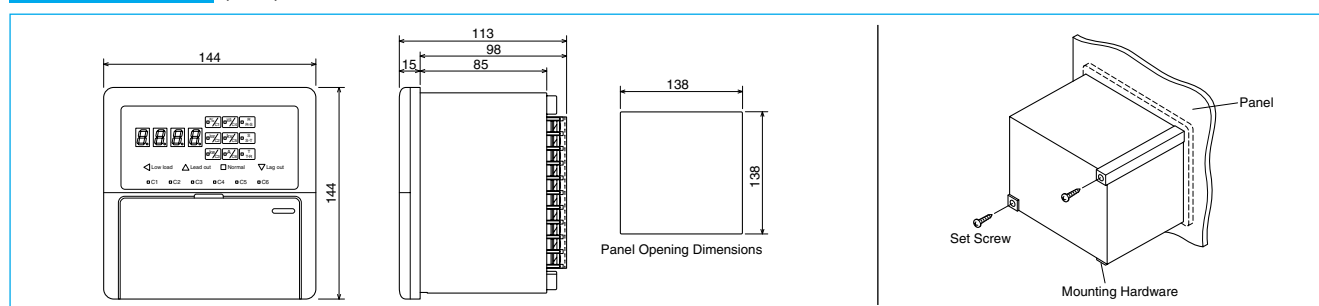


SPECIFICATIONS

Type	SQ-S4
Installation Location	Indoor only
Operating Ambient Temperature	-5°C to +50°C
Input Ratings	Voltage : 110VAC, 0.3A or 220VAC, 0.6A Current : 5AAC, 0.1VA
Settings	Essential Primary voltage (preset at 6600V when shipped) Primary current (preset at 100A when shipped) Discretionary Target power factor LAG100-85% (preset at 100% when shipped) Timer 1 minute/5 minutes (preset at 5 minutes when shipped) Breaking Power Ratio (light load) 0-35% (preset at 10% when shipped)
Operation Mode	Automatic cyclic/priority/optimum Manual manual ON/automatic/manual OFF

Output	Output contact Continuous exciting output, normally open, 6 circuits, one side common Contact capacity 250VAC, 1A; 110VDC, 0.1A
Display	State Control output, lead, lag, proper, light load Accuracy Current, voltage, reactive/apparent power $\pm 2.5\%$ per JIS C 1102 power factor $\pm 5.0\%$
Data	Current (I_R, I_S, I_T), voltage ($V_{R-S}, V_{S-T}, V_{T-R}$), power (kW) reactive power (kvar), power factor (%), apparent power (kVA), LED segments 4 digits
Capacitor control Signal output	ON/OFF signal output condition (C1-C6)
Auxiliary Power Supply	100-240VAC, 50-60Hz (Burden : 13VA at 110V, 26VA at 220V)
Insulation Resistance	10M Ω at 500VDC (elec. circuit to case)
Gross mass	1.5 kg

DIMENSIONS (mm)



6 AUTOMATIC CAPACITOR CONTROLLERS

Type Q-AUTOMAT III

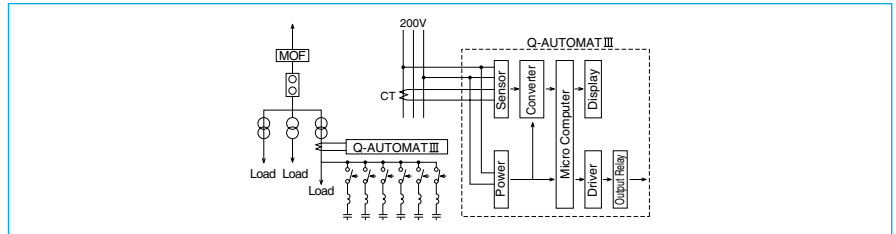
Incorporating a built-in microprocessor, Shizuki automatic capacitor controllers Q-AUTOMAT III always maintain high power factor and provide the best solution to save energy.



FEATURES

- ① Can control 1 step to 6 steps automatically.
- ② Incorporates a built-in microprocessor to achieve compact size and enhanced reliability.
- ③ Processes time to switch in capacitors automatically in such a manner that the time will be shorter for low power factor and longer for high power factor.
- ④ Changes over frequency automatically.
- ⑤ Provides two operation modes; up-down mode and circular mode.
- ⑥ Displays power factor at all times.
- ⑦ Can switch in and off capacitors manually.
- ⑧ Has alarm contacts. (which will activate when power factor remains at 85% or less for 3 minutes or more.)

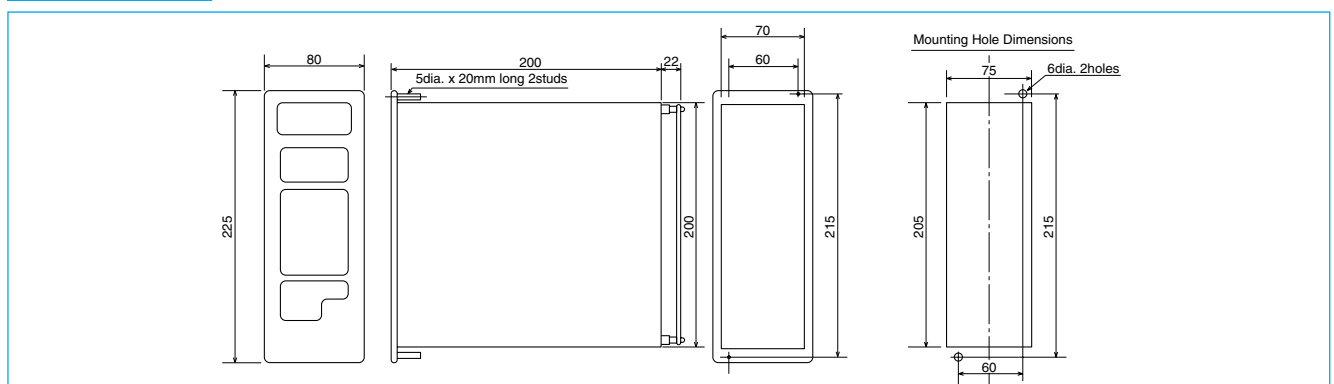
CIRCUIT CONFIGURATION



SPECIFICATIONS

Type	Q-AUTOMAT III	Current Input	External CT (phase R), secondary current 5A Burden 5VA
Installation Location	Indoor only	Power Factor Display	LED indicator; lag (red), lead (green)
Operating Ambient Temperature	-5°C to +50°C	No. of Steps	1 - 6 steps
Power Supply	100V/110VAC or 200/220VAC	Output Contact Capacity	240VAC, 5A (cos θ =0.4)
Power Factor Setting	Microcomputer computes and sets at 0.99.	Alarm Output Terminals	The contacts will be on when power factor remains at 0.85 or less (lead or lag) for 3 minutes or more.
Applicable Load	3 phase balanced loads, single phase loads Does not work properly if phases are unbalanced	Others	With the function to prevent hunting at light load
Voltage Input	System voltage (phase R - T) 100/110VAC or 200/220VAC Burden 15VA		

DIMENSIONS (mm)





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