Nishitei **PHF Series**

Power Harmonics Filters

for VFD • Inverter Drives

Suppress VFD input current harmonics and convert close to sine wave

- Deal with Japanese Government guideline for harmonics current suppression
- Reduce power supply transformer capacity by suppressing harmonics current and improving total power factor
- Long-life with high reliable reactors and metalized film capacitors applied

Nishitei Co. Ltd., Japan

Catalog No. NS-B-0001E

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1. About Harmonics Suppression Filters

1-1 Solution of harmonics problems of harmonics generating equipment

Harmonic Filters are able to suppress unwanted harmonics caused by harmonic generating equipment in a factory low enough to comply with the guideline for harmonic suppression. Harmonic Filters solve harmonics problems of factory's power distribution system, also improves reliability and energy efficiency of electrical equipment.

1-2 Best solution for harmonics caused by general-purpose VFD

These harmonic filters are suitable for harmonic suppression when industrial machines, such as fans, pumps, compressors, conveyors, and many others are operated at variable speed. Also, the filters are applicable regardless of such conditions as whether or not DC reactors are used in VFD's DC bus line, or whether the converter components are Thyristors or diode rectifiers.

1-3 Problems of harmonics

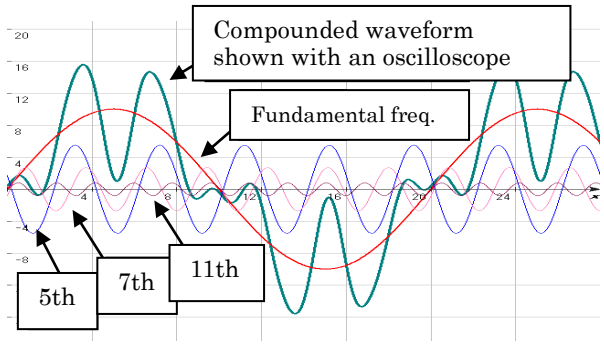
Unlike noise (between approx. 150kHz and 30 MHz), harmonics (150 –3000Hz) have characteristics of "being proportional to load current," "having power enough to affect long distance," and "being quantitatively measurable." If there are harmonics generating equipment including VFD, supply voltage distortion occurs and input current of harmonics generating equipment increases, which have multiple effects on factory facilities and control equipment. In addition, harmonics flow out from the user's power receiving point to the outside distribution system, and affect power factor correction capacitors, reactors and other equipment in the neighborhood.

1-4 Dealing with Government's guideline for harmonic suppression

When specified users who receive power at medium or high voltage newly install / add / replace harmonics generating equipment, upper limits of harmonic currents coming out from the users are notified by the Agency for Natural Resources and Energy as "Guideline for Harmonic Suppression." According to the criteria given through calculation designated by this guideline, the users are required to take countermeasures in order to maintain under the upper limits on harmonic currents flowing out from the power receiving point. The harmonic filters are products to suppress these harmonic currents.

Example: Harmonics current waveform (50Hz)

The figure below shows waveforms indicated by when the 5th (250Hz), 7th (350Hz) and 11th (550Hz) harmonic current simultaneously flow along with the fundamental frequency. Meanwhile, the waveform such as input current of VFD and others displayed by the oscilloscope, is compounded by frequencies of the fundamental, 5 times, 7 times, 11 times and higher frequencies of the fundamental.



Comparison of Harmonics in the Guideline

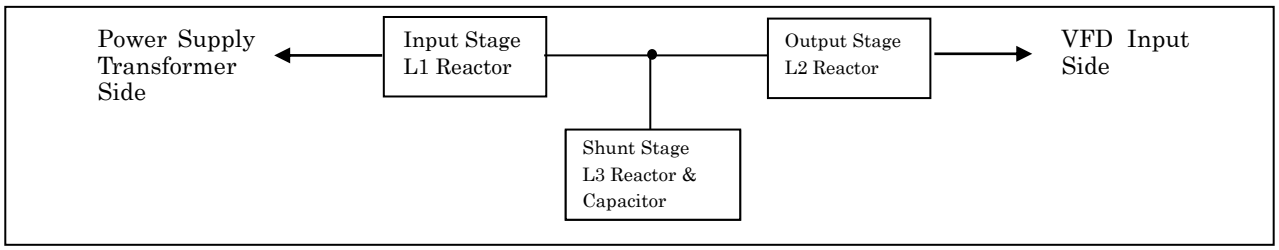
Harmonics Content with VFDs		
Solutions for harmonics suppression	THD-i (%)*	Ki figure *
Without reactors	78	3.4
A reactor in AC Side	42	1.8
With a DC reactor	35	1.8
Reactors in AC Side and DC Side	31	1.4
PHF Harmonic Filter (KS type)	6	0.4
PHF Harmonic Filter (KB type)	8	0.5

*THD-i: Total Harmonic Distortion on currents

*Ki figures: Conversion factors based on JEM-TR201 that indicates degrees of harmonic generation against a 6-pulse rectifier.

2 PHF Series - Harmonics Suppression Performance

2-1 Configuration of PHF Series Harmonic Filter

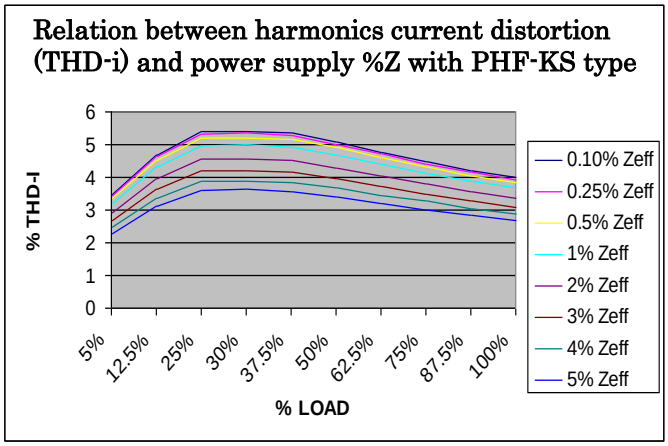


Whole configuration	・T-shape filter, with series reactors placed on both input and load side, and having a reactor and a capacitor set in parallel from the midpoint. ・Most of harmonic currents generated by using 6-pulse rectifier system, is eliminated.
Input stage	・Suppress harmonic currents inflow from power supply side, and prevent resonance with power supply equipment ・Protect the load and the capacitors in the filters from transient phenomena.
Output stage	・Suppress outflowing harmonic currents from the load (VFD), and reduce the burden of shunt stage harmonics suppression. ・Prevent resonance between the shunt stage and the load (VFD).
Shunt stage	・Absorb residual harmonics from input/output stages and minimize harmonics current distortion.

2-2 Characteristics of harmonics filters

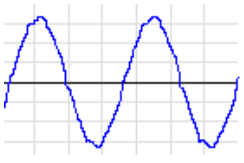
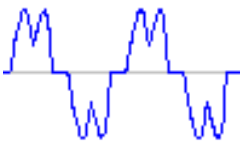
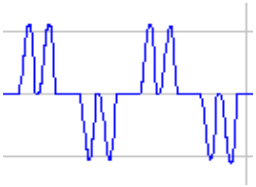
Harmonic filter PHF-KS type (3-reactor type) suppresses harmonics current distortion of VFD at 6% or less. As referential characteristics of harmonics, the right figure shows distortion factors in case of load fluctuation of 0% - 100% while %impedance of power supply transformer is between 0.1%Z and 5%Z. Because of these characteristics, it is possible to clear the requirement of harmonics current outflow limit specified in the guideline for harmonics suppression when VFD are used.

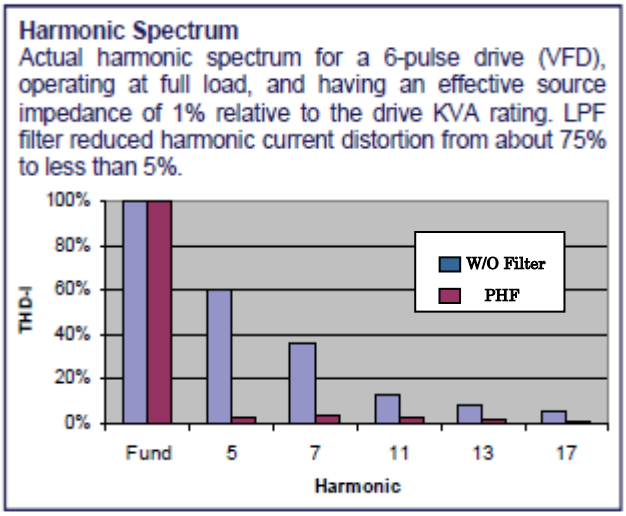
In case that the DC reactor is embedded in VFD, PHF-KB type (2-reactor type) is available, which shows nearly the same characteristics.



Zeff: Effective impedance of power supply transformers

2-3 Comparison of harmonics suppression solutions when VFD used

PHF filters used, harmonics current distortion 6%	
5% Line reactor used, harmonics current distortion 35%	
Without filters, harmonics current distortion 78% (%Z of power supply = 0.5%)	



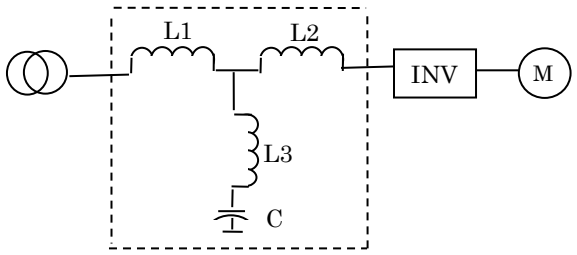
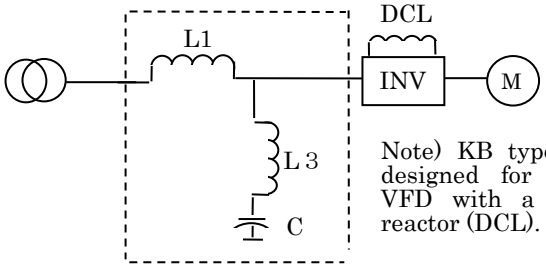
3 Outline of PHF Series Harmonics Filters

3-1 PHF Series line-up

PHF Series are harmonics suppression filters for VFD, categorized into two types by circuit mode, namely "KS type" and "KB type."

KS type has a T-shape structure, having L1 and L2 reactors connected in series at power supply line of VFD, as well as having a L3 reactor and capacitors to configure a shunt circuit between L1 and L2.

KB type is applied without L2 in case that the VFD includes a DC reactor (DCL) for total power factor improvement. Besides, each model has a different model No. by voltage and frequency as follow.

Type	Circuit Mode	Voltage	Frequency	Model No.
KS type		200V 級	50Hz	PHF＊＊＊＊KW235KS
			60Hz	PHF＊＊＊＊KW236KS
		400V 級	50Hz	PHF＊＊＊＊KW435KS
			60Hz	PHF＊＊＊＊KW436KS
KB type	 Note) KB type is designed for the VFD with a DC reactor (DCL).	200V 級	50Hz	PHF＊＊＊＊KW235KB
			60Hz	PHF＊＊＊＊KW236KB
		400V 級	50Hz	PHF＊＊＊＊KW435KB
			60Hz	PHF＊＊＊＊KW436KB

3-2 PHF Series Model No.

PHF0008KW236KS

Harmonics Suppression Filters

Applicable Motor Capacity
0004KW : 3.7kw
0006KW : 5.5kw
0008KW : 7.5kw
0011KW : 11kw
・
・
See 4-2 rating table for details

No.	Filter Composition
KS	3-reactor type
KB	2-reactor type

No.	Frequency
5	50Hz
6	60Hz

No.	Power System
3	3 Phase

No.	Voltage
2	AC 3 Phase 200 V
4	AC 3 Phase 400 V

- Capacitor Unit Model No.-

Example) C0008KW236A3 (*)

Capacitor Unit

Same as PHF Filter

No.	Cap. Qty.	No.	Cap. Qty.
A1	1 pc	B1	1 pc
A2	2 pcs	B2	2 pcs
A3	3 pcs	B3	3 pcs
A4	4 pcs	B4	4 pcs
A5	5 pcs	B5	5 pcs

(*) If the capacitor unit "A" has two sets, each of which has the same quantity of capacitors, the second capacitor unit is displayed with "B."

4 Standard Specifications of PHF Series

4-1 Standard specifications

The standard specifications of the PHF harmonics filters are shown as below.

Specification Items	Description	Remarks
Rated Voltage, Frequency	200V, 50Hz, 3 ph. 200 – 220V, 60Hz, 3 ph. 400V, 50Hz, 3 ph. 400 – 440V, 60Hz, 3 ph.	In 50Hz and 60Hz, the following voltages are also available. 208V, 240V, 380V,480V, 600V, 660V, 690V
Allowable supply voltage fluctuation	±5%	
Phase voltage unbalance	3% or less	The greater the voltage unbalance becomes, the more the harmonic current distortion is magnified.
Filter output voltage fluctuation	±5%(No load ~ Full load)	
Allowable supply frequency fluctuation	50Hz±1Hz、60Hz±1Hz	
Load	VFD with DC Reactor (DCL), 6-pulse rectifier type	
Residual harmonics current distortion	KS type: 4~6% KB type: 5~8%	In case of KB type and without DCL: 8 – 12%
Power Loss	1% (Typical)	
Altitude	1000m or less	
Humidity	95%RH or less	To be no condensation
Ambient temperature	-10 ~ +40℃	
Allowable temperature in a control panel	-10 ~ +50℃ (Temperature in the panel)	
Standard	IEC	
Reactor	IEC60076, IEC60289	H class insulation
Capacitor	IEC60831(200V) UL(600V)	Metalized film capacitor Allowable temperature: 75℃

Precautions about installing locations

1) Avoid the environment of dew condensation, salt or corrosive gas.
2) Install in a clean space without airborne matters including oil mist or dust, or use a totally-closed type panel that shuts out airborne matters.
3) Take a special care for installation and operation of the harmonics filter to make sure no impurities such as metal powder, oil, water to enter inside the filter.
4) Do not install to flammables including wooden objects.
5) Install in a space free from radioactive substance or flammables.
6) Install in a space free from toxic gas / liquid.
7) Install in a vibration-free space.
8) Install in a space with low salt concentration.
9) Install in a space away from direct sunlight.

Precautions in installation:

1) Install a capacitor below a reactor so that the heat generated from the reactor does not directly affect the capacitor's temperature.
2) In case of installing in an enclosed panel, use a fan or a cooler in order to keep the temperature inside the panel lower than 55℃.

4-2 Ratings, Specifications

50Hz 200V Class

	Rated 3 Ph. Curr. (A)	Max. Applicable Motor Cap. (kW) (Ref.only)	*Model No. for Order	Parts Model No. ,Quantity						
				Reactors					Capacitor Unit	
				In Power line L1･L2	KS type	KB type	Shunt Ckt. L3	Qty.	Shunt Ckt. C	Qty.
Supply Voltage, Freq.	32	7.5	PHF0008KW235K*	L1/20032BA0	2	1	L30032BA0	1	C0008KW235A2	1
	53	11	PHF0011KW235K*	L1/20053BA0	2	1	L30053BA0	1	C0011KW235A3	1
	70	15	PHF0015KW235K*	L1/20070BA0	2	1	L30070BA0	1	C0015KW235A3	1
	84	18.5	PHF0019KW235K*	L1/20084BA0	2	1	L30084BA0	1	C0019KW235A3	1
	112	22	PHF0022KW235K*	L1/20112BA0	2	1	L30112BA0	1	C0022KW235A3	1
	126	30	PHF0030KW235K*	L1/20126BA0	2	1	L30126BA0	1	C0030KW235A4	1
	150	37	PHF0037KW235K*	L1/20150BA0	2	1	L30150BA0	1	C0037KW235A4	1
	211	45	PHF0045KW235K*	L1/20211BA0	2	1	L30211BA0	1	C0045KW235A5	1
	267	55	PHF0055KW235K*	L1/20267BA0	2	1	L30267BA0	1	C0055KW235A5	1
	295	75	PHF0075KW235K*	L1/20295BA0	2	1	L30295BA0	1	C0075KW235A4 C0075KW235A3	1
	396	90	PHF0090KW235K*	L1/20396BA0	2	1	L30396BA0	1	C0090KW235A4 C0090KW235A5	1
	465	110	PHF0110KW235K*	L1/20465BA0	2	1	L30465BA0	1	C0110KW235A5 C0110KW235B5	1
	591	150	PHF0150KW235K*	L1/20591BA0	2	1	L30591BA0	1	C0150KW235A3 C0150KW235A5 C0150KW235B5	1

60Hz 200-220V Class

Supply Voltage, Freq.	32	7.5	PHF0008KW236K*	L1/20032BA0	2	1	L30032BA0	1	C0008KW236A2	1
	53	11	PHF0011KW236K*	L1/20053BA0	2	1	L30053BA0	1	C0011KW236A2	1
	70	15	PHF0015KW236K*	L1/20070BA0	2	1	L30070BA0	1	C0015KW236A3	1
	84	18.5	PHF0019KW236K*	L1/20084BA0	2	1	L30084BA0	1	C0019KW236A3	1
	112	22	PHF0022KW236K*	L1/20112BA0	2	1	L30112BA0	1	C0022KW236A3	1
	126	30	PHF0030KW236K*	L1/20126BA0	2	1	L30126BA0	1	C0030KW236A3	1
	150	37	PHF0037KW236K*	L1/20037BA0	2	1	L30150BA0	1	C0037KW236A3	1
	211	45	PHF0045KW236K*	L1/20211BA0	2	1	L30211BA0	1	C0045KW236A4	1
	267	55	PHF0055KW236K*	L1/20267BA0	2	1	L30267BA0	1	C0055KW236A5	1
	295	75	PHF0075KW236K*	L1/20295BA0	2	1	L30295BA0	1	C0075KW236A5	1
	396	90	PHF0090KW236K*	L1/20396BA0	2	1	L30396BA0	1	C0090KW236A5	1
	465	110	PHF0110KW236K*	L1/20465BA0	2	1	L30465BA0	1	C0110KW236A3 C0110KW236A4	1 1
	591	150	PHF0150KW236K*	L1/20591BA0	2	1	L30591BA0	1	C0150KW236A4 C0150KW236A5	1 1

*Model No.: Refer to “3-2 PHF Series Model No.” in the page 5.

50Hz 400V Class

	Rated 3 Ph. Curr. (A)	Max. Applicable Motor Cap. (kW) (Ref.only)	*Model No. for Order	Parts Model No. ,Quantity						
				Reactors					Capacitor Unit	
				In Power line L1･L2	KS type	KB type	Shunt Ckt L3	Qty.	Shunt Ckt. C	Qty.
Supply Voltage, Freq.	39	18.5	PHF0019KW435K*	L1/20039AA0	2	1	L30039AA0	1	C0019KW435A2	1
	59	30	PHF0030KW435K*	L1/20059AA0	2	1	L30059AA0	1	C0030KW435A2	1
	78	37	PHF0037KW435K*	L1/20078AA0	2	1	L30078AA0	1	C0037KW435A2	1
	98	45	PHF0045KW435K*	L1/20098AA0	2	1	L30098AA0	1	C0045KW435A3	1
	117	55	PHF0055KW435K*	L1/20117AA0	2	1	L30117AA0	1	C0055KW435A3	1
	156	75	PHF0075KW435K*	L1/20156AA0	2	1	L30156AA0	1	C0075KW435A4	1
	176	90	PHF0090KW435K*	L1/20176AA0	2	1	L30176AA0	1	C0090KW435A5	1
	215	110	PHF0110KW435K*	L1/20215AA0	2	1	L30215AA0	1	C0110KW435A6	1
	273	135	PHF0135KW435K*	L1/20273AA0	2	1	L30273AA0	1	C0135KW435A3	1
									C0135KW435A4	1
	312	160	PHF0160KW435K*	L1/20312AA0	2	1	L30312AA0	1	C0160KW435A4	1
									C0160KW435B4	1
	371	190	PHF0190KW435K*	L1/20371AA0	2	1	L30371AA0	1	C0190KW435A5	1
									C0190KW435B5	1
	449	220	PHF0220KW435K*	L1/20449AA0	2	1	L30449AA0	1	C0220KW435A5	1
									C0220KW435A6	1
	527	250	PHF0250KW435K*	L1/20527AA0	2	1	L30527AA0	1	C0250KW435A4	1
									C0250KW435B4	1
									C0250KW435A5	1
	625	315	PHF0315KW435K*	L1/20625AA0	2	1	L30625AA0	1	C0315KW435A5	1
									C0315KW435B5	1
									C0315KW435A6	1
	781	380	PHF0380KW435K*	L1/20781AA0	2	1	L30781AA0	1	C0380KW435A4	1
									C0380KW435A5	1
									C0380KW435B5	1
									C0380KW435C5	1

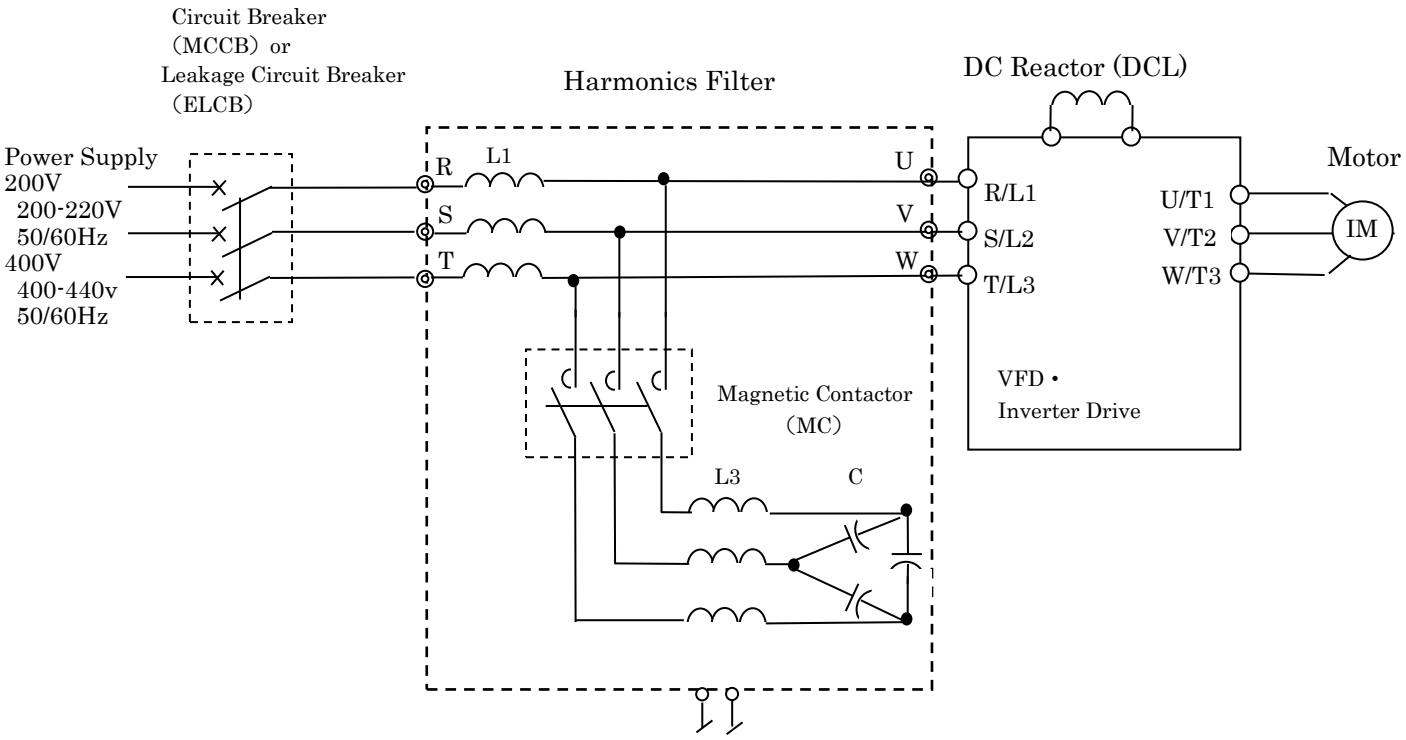
60Hz 400-440V Class

Supply Voltage, Freq.	39	18.5	PHF0019KW436K*	L1/20039AA0	2	1	L30039AA0	1	C0019KW436A1	1
	59	30	PHF0030KW436K*	L1/20059AA0	2	1	L30059AA0	1	C0030KW436A1	1
	78	37	PHF0037KW436K*	L1/20078AA0	2	1	L30078AA0	1	C0037KW436A2	1
	98	45	PHF0045KW436K*	L1/20098AA0	2	1	L30098AA0	1	C0045KW436A2	1
	117	55	PHF0055KW436K*	L1/20117AA0	2	1	L30117AA0	1	C0055KW436A2	1
	156	75	PHF0075KW436K*	L1/20156AA0	2	1	L30156AA0	1	C0075KW436A3	1
	176	90	PHF0090KW436K*	L1/20176AA0	2	1	L30176AA0	1	C0090KW436A3	1
	215	110	PHF0110KW436K*	L1/20215AA0	2	1	L30215AA0	1	C0110KW436A4	1
	273	135	PHF0135KW436K*	L1/20273AA0	2	1	L30273AA0	1	C0135KW436A5	1
	312	160	PHF0160KW436K*	L1/20312AA0	2	1	L30312AA0	1	C0160KW436A6	1
	371	190	PHF0190KW435K*	L1/20371AA0	2	1	L30371AA0	1	C0190KW436A3	1
									C0190KW436A4	1
	449	220	PHF0220KW436K*	L1/20449AA0	2	1	L30449AA0	1	C0220KW436A4	1
									C0220KW436B4	1
	527	250	PHF0250KW436K*	L1/20527AA0	2	1	L30527AA0	1	C0250KW436A5	1
									C0250KW436B5	1
	625	315	PHF0315KW436K*	L1/20625AA0	2	1	L30625AA0	1	C0315KW436A5	1
									C0315KW436B6	1
	781	380	PHF0380KW436K*	L1/20781AA0	2	1	L30781AA0	1	C0380KW436A4	1
									C0380KW436A5	1
									C0380KW436B5	1

*Model No.: Refer to “3-2 PHF Series Model No.” in the page 5.

5-1 Connection with VFD

Connection of Harmonics Filter to VFD



5-2 Precautions while connecting

Note:

a. Connect RST terminal to power supply side, UVW terminal to VFD side.

b. This Harmonic Filter is 2-reactor model. Shunt reactor L3 and capacitor C are connected in parallel at DC reactor L1 and its downstream side.

c. Capacitor is in delta connection with output side of shunt reactor L3.

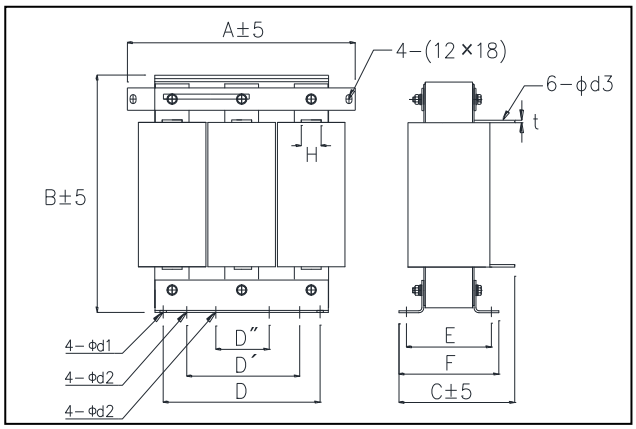
d. This Harmonic Filter is to be used in case that VFD is connected with DC reactor. In case that VFD is not connected with DC reactor, use 3-reactor type that is to be prepared separately.

e. L3 is embedded with temperature switch which gets activated in case of abnormal overheat. This switch is normally open contact and opens when abnormal overheat is detected.

* Temperature switch is activated (opens) at a temperature between 174 and 186℃ and automatically return (closes) at a temperature between 120 and 170℃.

* Contact switching capacity of this temperature switch is AC250V1A.

f. "Leakage Circuit Breaker" is recommended for circuit breaker, because of adding ground fault protection.



6-1 Reactors

◆ 200V Dimensions

200V Class L1

Filter Model No. *	Reactor model No.	Dimensions (mm)													WT (kg)	Loss (W)
		A	B	C	D	D'	D''	E	F	H	t	d1 (φ)	d2 (φ)	d3 (φ)		
PHF0008KW 23※K*	L1/20032 BA0	175	159	121	136	100	60	76	95	20	3	7	9	9	10	90
PHF0011KW 23※K*	L1/20053 BA0	223	162	141	176	150	76	95	114	20	3	7	11	9	15	110
PHF0015KW 23※K*	L1/20070 BA0	214	201	136	176	150	76	95	114	20	3	7	11	9	18	160
PHF0019KW 23※K*	L1/20084 BA0	220	202	140	176	150	76	95	114	20	3	7	11	9	18	170
PHF0022KW 23※K*	L1/20112 BA0	248	213	139	185	150	80	88	110	20	3	9	11	9	20	210
PHF0030KW 23※K*	L1/20126 BA0	248	213	150	185	150	80	98	120	20	3	9	11	9	23	210
PHF0037KW 23※K*	L1/20150 BA0	248	244	160	185	150	80	98	120	30	3	9	11	11	26	240
PHF0045KW 23※K*	L1/20211 BA0	308	235	205	224	150	100	134	162	40	3	10	11	14	40	270
PHF0055KW 23※K*	L1/20267 BA0	308	295	185	224	150	100	119	147	30	5	10	11	11	44	320
PHF0075KW 23※K*	L1/20295 BA0	308	298	194	224	150	100	119	147	40	4	10	11	14	45	380
PHF0090KW 23※K*	L1/20396 BA0	308	330	220	224	150	100	134	162	50	5	10	11	14	60	480
PHF0110KW 23※K*	L1/20465 BA0	308	330	230	224	150	100	144	172	40	8	10	11	14	65	520
PHF0150KW 23※K*	L1/20591 BA0	308	424	227	224	150	100	144	172	40	8	10	11	14	81	620

200V Class L3

PHF0008KW 23※K*	L30032 BA0	178	159	123	136	100	60	76	95	20	3	7	9	9	10	70
PHF0011KW 23※K*	L30053 BA0	214	162	136	176	150	76	95	114	20	3	7	11	9	15	120
PHF0015KW 23※K*	L30070 BA0	223	204	117	176	150	76	70	89	20	3	7	11	9	12	150
PHF0019KW 23※K*	L30084 BA0	208	202	133	176	150	76	95	114	20	3	7	11	9	18	170
PHF0022KW 23※K*	L30112 BA0	238	203	142	176	150	76	95	114	20	3	7	11	9	19	170
PHF0030KW 23※K*	L30126 BA0	248	214	138	185	150	80	88	110	20	3	9	11	9	20	190
PHF0037KW 23※K*	L30150 BA0	248	213	147	185	150	80	98	120	20	3	9	11	9	22	220
PHF0045KW 23※K*	L30211 BA0	308	235	165	224	150	100	119	147	20	3	10	11	9	33	270
PHF0055KW 23※K*	L30267 BA0	308	265	180	224	150	100	119	147	30	3	10	11	11	37	320
PHF0075KW 23※K*	L30295 BA0	308	267	180	224	150	100	119	147	30	3	10	11	11	39	330
PHF0090KW 23※K*	L30396 BA0	308	330	200	224	150	100	134	162	40	3	10	11	14	54	410
PHF0110KW 23※K*	L30465 BA0	308	330	200	224	150	100	134	162	30	5	10	11	11	55	470
PHF0150KW 23※K*	L30591 BA0	308	331	239	224	150	100	166	194	40	5	10	11	14	72	570

* Regarding selection of the PHF model No., check “3-2 Model No. of PHF series” in page 5.

◆ 400V Dimensions

400V Class L1

Filter Model No. *	Reactor model No.	Dimensions (mm)													WT (kg)	Loss (W)
		A	B	C	D	D'	D''	E	F	H	t	d1 (φ)	d2 (φ)	d3 (φ)		
PHF0019KW 43※K*	L1/20039 AA0	225	205	140	176	150	–	93	114	20	3	7	11	9	18	170
PHF0030KW 43※K*	L1/20059 AA0	248	210	150	185	150	–	103	123	20	3	9	11	9	22	210
PHF0037KW 43※K*	L1/20078 AA0	268	234	155	200	150	88	104	132	20	3	10	11	9	28	250
PHF0045KW 43※K*	L1/20098 AA0	308	235	170	224	150	–	119	147	20	3	10	11	9	34	260
PHF0055KW 43※K*	L1/20117 AA0	308	235	185	224	150	–	134	162	20	3	10	11	9	40	300
PHF0075KW 43※K*	L1/20156 AA0	308	265	195	224	150	–	134	162	30	3	10	11	9	46	370
PHF0090KW 43※K*	L1/20176 AA0	308	290	195	224	150	100	134	162	30	3	10	11	11	51	400
PHF0110KW 43※K*	L1/20215 AA0	308	325	205	224	150	–	134	162	40	3	10	11	14	56	510
PHF0135KW 43※K*	L1/20273 AA0	355	350	225	264	120	–	154	182	30	5	10	13	11	73	570
PHF0160KW 43※K*	L1/20312 AA0	420	400	240	349	316	–	174	204	40	4	13	–	14	101	620
PHF0190KW 43※K*	L1/L2371 AA0	248	515	245	185	150	–	174	194	40	5	9	11	14	95	900
PHF0220KW 43※K*	L1/20449 AA0	415	460	255	316	140	–	171	201	50	5	13	13	14×2	124	850
PHF0250KW 43※K*	L1/20527 AA0	420	465	265	316	140	–	171	201	50	5	13	13	14×2	126	920
PHF0315KW 43※K*	L1/20625 AA0	480	485	280	356	–	–	183	219	60	5	13	–	14×2	160	1000
PHF0380KW 43※K*	L1/20781 AA0	480	515	300	356	–	–	217	253	40	10	13	–	14×2	203	1240

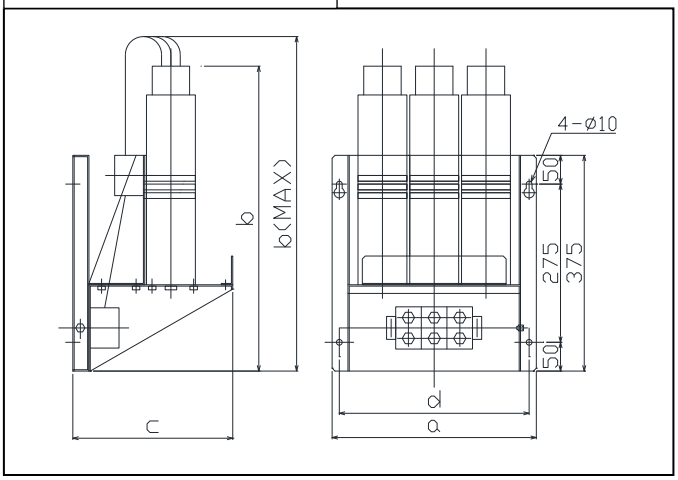
400V Class L3

PHF0019KW 43※K*	L30039 AA0-R1	223	163	141	176	150	76	95	114	20	3	7	11	9	15	130
PHF0030KW 43※K*	L30059 AA0-R1	225	205	140	176	150	76	95	114	20	3	7	11	9	19	180
PHF0037KW 43※K*	L30078 AA0-R1	248	210	150	185	150	80	100	120	20	3	9	11	9	22	210
PHF0045KW 43※K*	L30098 AA0-R1	272	240	155	200	150	88	102	132	20	3	10	11	9	27	240
PHF0055KW 43※K*	L30117 AA0-R1	308	235	170	224	150	100	119	147	20	3	10	11	9	33	270
PHF0075KW 43※K*	L30156 AA0-R1	308	240	185	224	150	100	134	162	20	3	10	11	9	43	310
PHF0090KW 43※K*	L30176 AA0-R1	308	265	185	224	150	100	134	162	20	3	10	11	9	43	360
PHF0110KW 43※K*	L30215 AA0-R1	308	300	185	224	150	100	134	162	20	3	10	11	9	48	430
PHF0135KW 43※K*	L30273 AA0-R1	308	331	182	224	150	100	134	162	20	3	10	11	9	54	520
PHF0160KW 43※K*	L30312 AA0-R1	300	330	205	224	150	100	144	172	30	3	10	11	11	60	560
PHF0190KW 43※K*	L30371 AA0-R1	408	367	220	316	140	–	173	201	30	3	13	13	11	92	630
PHF0220KW 43※K*	L30449 AA0-R1	415	400	235	316	140	–	171	201	40	3	13	13	14	99	720
PHF0250KW 43※K*	L30527 AA0-R1	465	490	285	356	160	–	213	249	40	5	13	13	14	196	1100
PHF0315KW 43※K*	L30625 AA0-R1	465	520	295	356	160	–	213	249	50	5	13	13	14	210	1350
PHF0380KW 43※K*	L30781 AA0-R1	458	615	300	356	160	–	213	249	60	5	13	13	14×2	238	1700

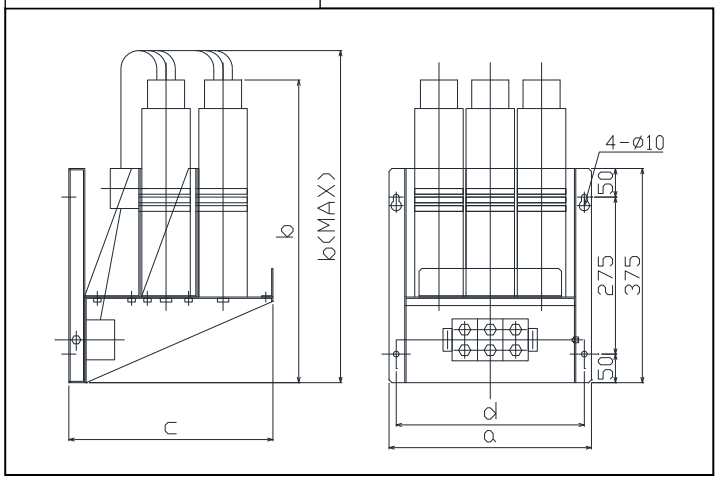
* Regarding selection of the PHF model No., check “3-2 Model No. of PHF series” in page 5.

6-2 Capacitor Units ◆ Capacitor Units

Dimension Diagram Ⅰ



Dimension Diagram Ⅱ

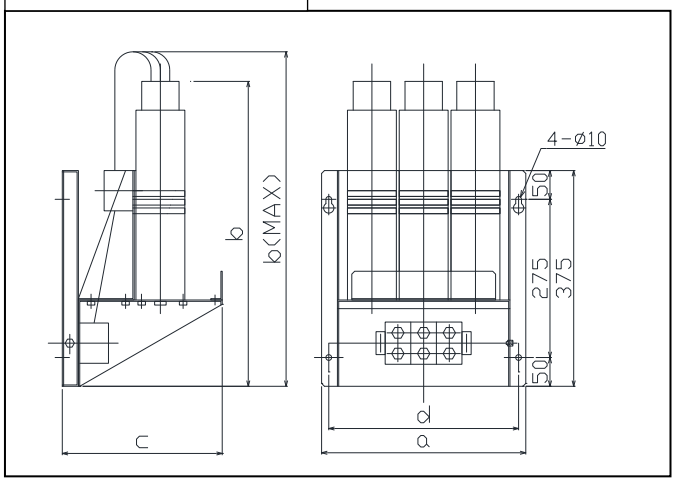


Power Supply	Model No. *	Capacitor Unit Model No.	Dim. No.	Dimensions (mm)					No. of Cells	Wt. (kg)	Loss (W)
				a	b	b (MAX)	c	d			
200V 50Hz	PHF0008KW235K*	C0008KW235A2	Ⅰ	355	515	595	278	330	2	13	16.3
	PHF0011KW235K*	C0011KW235A3	Ⅰ	355	453	533	278	330	3	13	16.2
	PHF0015KW235K*	C0015KW235A3	Ⅰ	355	473	553	278	330	3	15	27.2
	PHF0019KW235K*	C0019KW235A3	Ⅰ	355	515	595	278	330	3	15	29.6
	PHF0022KW235K*	C0022KW235A3	Ⅰ	355	515	595	278	330	3	16	33.7
	PHF0030KW235K*	C0030KW235A4	Ⅱ	355	515	595	358	330	4	19	39.6
	PHF0037KW235K*	C0037KW235A4	Ⅱ	355	515	595	358	330	4	20	46.6
	PHF0045KW235K*	C0045KW235A5	Ⅱ	355	515	595	358	330	5	22	62.4
	PHF0055KW235K*	C0055KW235A6	Ⅱ	355	515	595	358	330	6	25	77.2
	PHF0075KW235K*	C0075KW235A4	Ⅱ	355	515	595	358	330	4	20	53.3
		C0075KW235A3	Ⅰ	355	515	595	278	330	3	15	32.0
	PHF0090KW235K*	C0090KW235A4	Ⅱ	355	515	595	358	330	4	20	53.3
		C0090KW235A5	Ⅱ	355	515	595	358	330	5	23	62.0
	PHF0110KW235K*	C0110KW235A5	Ⅱ	355	515	595	358	330	5	23	66.6
		C0110KW235B5	Ⅱ	355	515	595	358	330	5	23	66.6
	PHF0150KW235K※	C0150KW235A3	Ⅰ	355	515	595	278	330	3	16	37.2
		C0150KW235A5	Ⅱ	355	515	595	358	330	5	23	66.6
		C0150KW235B5	Ⅱ	355	515	595	358	330	5	23	66.6

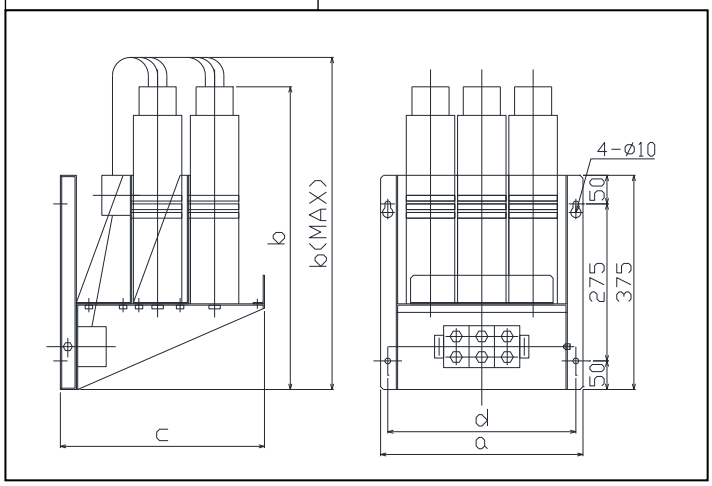
Power Supply	Model No. *	Capacitor Unit Model No.	Dim. No.	Dimensions (mm)					No. of Cells	Wt. (kg)	Loss (W)
				a	b	b (MAX)	c	d			
200-220V 60Hz	PHF0008KW236K*	C0008KW236A2	Ⅰ	355	453	533	278	330	2	12	10.0
	PHF0011KW236K*	C0011KW236A2	Ⅰ	355	515	595	278	330	2	13	17.5
	PHF0015KW236K*	C0015KW236A3	Ⅰ	355	515	595	278	330	3	16	31.3
	PHF0019KW236K*	C0019KW236A3	Ⅰ	355	515	595	278	330	3	15	23.7
	PHF0022KW236K*	C0022KW236A3	Ⅰ	355	473	553	278	330	3	14	24.4
	PHF0030KW236K*	C0030KW236A3	Ⅰ	355	515	595	278	330	3	15	26.6
	PHF0037KW236K*	C0037KW236A3	Ⅰ	355	515	595	278	330	3	16	33.3
	PHF0045KW236K*	C0045KW236A4	Ⅱ	355	515	595	358	330	4	19	43.8
	PHF0055KW236K*	C0055KW236A5	Ⅱ	355	515	595	358	330	5	21	55.2
	PHF0075KW236K*	C0075KW236A5	Ⅱ	355	515	595	358	330	5	22	60.4
	PHF0090KW236K*	C0090KW236A6	Ⅱ	355	515	595	358	330	6	25	79.9
	PHF0110KW236K*	C0110KW236A3	Ⅰ	355	515	595	278	330	3	16	39.0
		C0110KW236A4	Ⅱ	355	515	595	358	330	4	20	53.3
	PHF0150KW236K*	C0150KW236A4	Ⅱ	355	515	595	358	330	4	20	51.4
		C0150KW236A5	Ⅱ	355	515	595	358	33	5	23	66.6

* Regarding selection of the PHF model No., check “3-2 Model No. of PHF series” in page 5.

Dimension Diagram Ⅰ



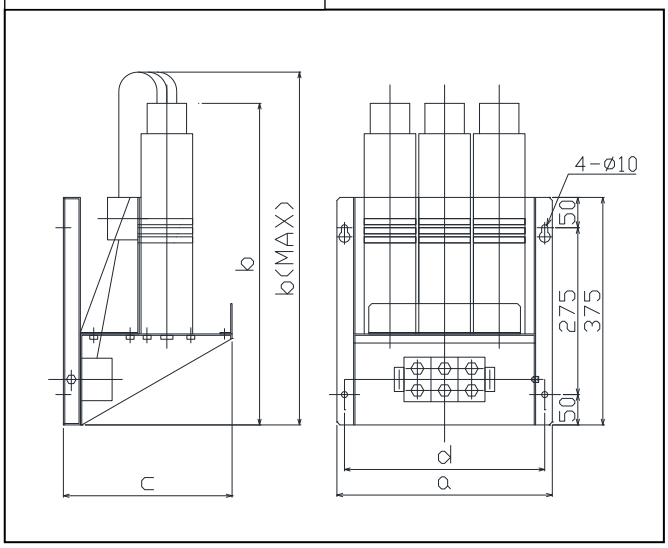
Dimension Diagram Ⅱ



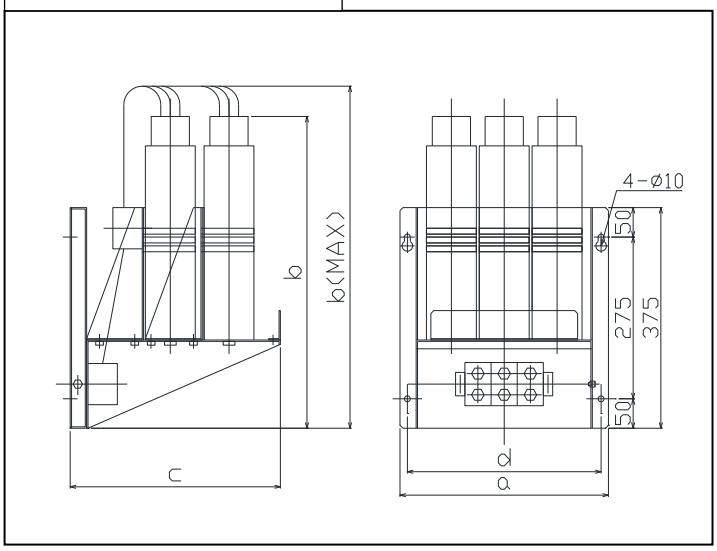
Power Supply	Model No. *	Capacitor Unit Model No.	Dim. No.	Dimensions (mm) a	b	b (MAX)	c	d	No. of Cells	Wt. (kg)	Loss (W)
400V 50Hz	PHF0019KW435K*	C0019KW435A2	Ⅰ	355	508	588	278	330	2	13	9.6
	PHF0030KW435K*	C0030KW435A2	Ⅰ	355	550	630	278	330	2	14	14.4
	PHF0037KW435K*	C0037KW435A2	Ⅰ	355	550	630	278	330	2	14	19.0
	PHF0045KW435K*	C0045KW435A3	Ⅰ	355	508	588	278	330	3	16	24.0
	PHF0055KW435K*	C0055KW435A3	Ⅰ	355	550	630	278	330	3	17	28.7
	PHF0075KW435K*	C0075KW435A4	Ⅱ	355	550	630	358	330	4	21	38.1
	PHF0090KW435K*	C0090KW435A5	Ⅱ	355	550	630	358	330	5	22	43.0
	PHF0110KW435K*	C0110KW435A6	Ⅱ	355	550	630	358	330	6	24	52.0
	PHF0135KW435K*	C0135KW435A3	Ⅰ	355	550	630	278	330	3	17	29.4
		C0135KW435A4	Ⅱ	355	550	630	358	330	4	21	37.4
	PHF0160KW435K*	C0160KW435A4	Ⅱ	355	550	630	358	330	4	21	37.4
		C0160KW435B4	Ⅱ	355	550	630	358	330	4	21	38.7
	PHF0190KW435K*	C0190KW435A5	Ⅱ	355	550	630	358	330	5	23	45.0
		C0190KW435B5	Ⅱ	355	550	630	358	330	5	23	45.0
	PHF0220KW435K*	C0220KW435A5	Ⅱ	355	550	630	358	330	5	23	50.0
		C0220KW435A6	Ⅱ	355	550	630	358	330	6	25	60.0
	PHF0250KW435K*	C0250KW435A4	Ⅱ	355	550	630	358	330	4	21	38.7
		C0250KW435B4	Ⅱ	355	550	630	358	330	4	21	40.0
		C0250KW435A5	Ⅱ	355	550	630	358	330	5	23	50.0
	PHF0315KW435K*	C0315KW435A5	Ⅱ	355	550	630	358	330	5	23	46.8
		C0315KW435B5	Ⅱ	355	550	630	358	330	5	23	49.4
		C0315KW435A6	Ⅱ	355	550	630	358	330	6	25	56.2
	PHF0380KW435K*	C0380KW435A4	Ⅱ	355	550	630	358	330	4	21	40.0
		C0380KW435A5	Ⅱ	355	550	630	358	330	5	23	50.0
		C0380KW435B5	Ⅱ	355	550	630	358	330	5	23	50.0
		C0380KW435C5	Ⅱ	355	550	630	358	330	5	23	50.0

* Regarding selection of the PHF model No., check “3-2 Model No. of PHF series” in page 5.

Dimension Diagram Ⅰ



Dimension Diagram Ⅱ



Power Supply	Model No. *	Capacitor Unit Model No.	Dim. No.	Dimensions (mm) a	b	b (MAX)	c	d	No. of Cells	Wt. (kg)	Loss (W)
400-440V 60Hz	PHF0019KW436K*	C0019KW436A1	Ⅰ	355	508	588	278	330	1	12	6.7
	PHF0030KW436K*	C0030KW436A1	Ⅰ	355	550	630	278	330	1	12	10.0
	PHF0037KW436K*	C0037KW436A2	Ⅰ	355	508	588	278	330	2	14	13.4
	PHF0045KW436K*	C0045KW436A2	Ⅰ	355	550	630	278	330	2	14	16.7
	PHF0055KW436K*	C0055KW436A2	Ⅰ	355	550	630	278	330	2	14	20.0
	PHF0075KW436K*	C0075KW436A3	Ⅰ	355	550	630	278	330	3	14	26.4
	PHF0090KW436K*	C0090KW436A3	Ⅰ	355	550	630	278	330	3	17	30.0
	PHF0110KW436K*	C0110KW436A4	Ⅱ	355	550	630	358	330	4	21	36.4
	PHF0135KW436K*	C0135KW436A5	Ⅱ	355	550	630	358	330	5	23	46.1
	PHF0160KW436K*	C0160KW436A6	Ⅱ	355	550	630	358	330	6	25	53.0
	PHF0190KW436K*	C0190KW436A3	Ⅰ	355	550	630	278	330	3	17	27.0
		C0190KW436A4	Ⅱ	355	550	630	358	330	4	21	36.0
	PHF0220KW436K*	C0220KW436A4	Ⅱ	355	550	630	358	330	4	21	37.4
		C0220KW436B4	Ⅱ	355	550	630	358	330	4	21	38.7
	PHF0250KW436K*	C0250KW436A5	Ⅱ	355	550	630	358	330	5	23	45.0
		C0250KW436B5	Ⅱ	355	550	630	358	330	5	23	45.0
	PHF0315KW436K*	C0315KW436A5	Ⅱ	355	550	630	358	330	5	23	45.0
		C0315KW436A6	Ⅱ	355	550	630	358	330	6	25	60.0
	PHF0380KW436K*	C0380KW436A4	Ⅱ	355	550	630	358	330	4	21	38.7
		C0380KW436A5	Ⅱ	355	550	630	358	330	5	23	46.8
		C0380KW436B5	Ⅱ	355	550	630	358	330	5	23	46.8

* Regarding selection of the PHF model No., check “3-2 Model No. of PHF series” in page 5.

7 Components of PHF Series Harmonic Filters

・PHF Series Harmonics Filters are composed of high precision 3-phase balance reactors and high performance capacitors. These are designed as natural convection cooling type and applicable up to 40℃ of ambient temperature (55℃ in-panel). They do not require fans, hence, realize high efficiency and high reliability.

・ For the reactor, in order to achieve low loss and well-balanced inductance, split gap core structure technology is applied. Tolerance of inductance (mH) between three phases is +/-3% or less.

Appearance of a Reactor

・ The capacitor cell is a 3-phase capacitor (Δ internal connection structure) of metallic can containing metallized film.
- Self-healing function in case of overvoltage
- Circuit separation structure when inner pressure rises
- The structure that contains damages by segment films
- Display in case of failure: Pop-up of a terminal part

Appearance of a Capacitor

Appearance of a Capacitor Unit

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