



VISHAY INTERTECHNOLOGY, INC.

DATA BOOK



CAPACITORS FOR INDUCTION EQUIPMENT

General Technical Information

Line-Frequency Capacitors

Medium-Frequency Capacitors

VISHAY INTERTECHNOLOGY, INC.

DISCRETE SEMICONDUCTORS

RECTIFIERS	Schottky (single, dual) Standard, Fast and Ultra-Fast Recovery (single, dual) Clamper/Damper Bridge Superectifier®
SMALL-SIGNAL DIODES	Schottky and Switching (single, dual) Tuner/Capacitance (single, dual) Bandswitching PIN
ZENER & SUPPRESSOR DIODES	Zener Diodes (single, dual) TVS (TransZorb®, Automotive, Arrays)
MOSFETs	Power MOSFETs JFETs
RF TRANSISTORS	Bipolar RF Transistors (AF and RF) Dual Gate MOSFETs MOSMICs®
OPTOELECTRONICS	IR Emitters, Detectors and IR Receiver Modules Opto Couplers and Solid State Relays Optical Sensors LEDs and 7 Segment Displays Infrared Data Transceiver Modules Custom products
ICs	Power ICs Analog Switches

PASSIVE COMPONENTS

CAPACITORS	Tantalum Capacitors Solid Tantalum Capacitors Wet Tantalum Capacitors Ceramic Capacitors Multilayer Chip Capacitors Disc Capacitors Film Capacitors Power Capacitors Heavy Current Capacitors Aluminum Capacitors
RESISTIVE PRODUCTS	Foil Resistors Film Resistors Thin Film Resistors Thick Film Resistors Metal Oxide Film Resistors Carbon Film Resistors Wirewound Resistors Variable Resistors Cermet Variable Resistors Wirewound Variable Resistors Conductive Plastic Variable Resistors Networks/Arrays Non-Linear Resistors NTC Thermistors PTC Thermistors
MAGNETICS	Inductors Transformers

INTEGRATED MODULES

MEASUREMENT SENSORS AND EQUIPMENT

DC/DC CONVERTERS	
STRAIN GAGES	Stress Analysis Transducer-Class® Installation Accessories
INSTRUMENTATION	Strain Indicators Amplifiers Data Systems
PHOTOSTRESS® PRODUCTS	Polariscopes Plastics
TRANSDUCERS	Load Cells Linear Displacement Sensors

ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS

Capacitors for Induction Equipment Vishay ESTA

Vishay Electronic GmbH
Division ESTA
Hofmark-Aich-Strasse 36
D-84030 Landshut
Germany

Phone: + 49 871 86-0
Fax: + 49 871 86-25 38
www.vishay.com

NOTICE

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.



Capacitors for Induction Equipment

GENERAL TECHNICAL INFORMATION

Production program 2
Trade names 2
Standards 2
Test/Quality 2
Rating limits 2
Cooling methods 2
Construction 4
Remarks 6

LINE-FREQUENCY CAPACITORS

Phmkp ESTAprop[®] 230-525V 7
Phmkp/Phmkpg ESTAprop[®]/ESTAdry[®] 200-1000V 9
Phao ESTAfilm[®] 850-3000V 11

MEDIUM-FREQUENCY CAPACITORS

Phawo...k ESTAfilm[®] without subdivision 150-5000Hz 13
Phawo...kS ESTAfilm[®] subdivided 150-10000Hz 16
Phawoz ESTAfilm[®] twin outputs 1000-10000Hz 19
Phawoc ESTAfilm[®] subdivided 10000-100000Hz 22
Phao.../... μ F ESTAfilm[®] air-cooled small outputs 24

Capacitors For Induction Equipment

PRODUCTION PROGRAM

“NF” = Line frequency 50/60Hz : 200 - 3000V

“MF” = Medium frequency 100 - 100000Hz : 100 - 3000V

TRADE NAMES

ESTAdry = MKP-type capacitor, dry,
use at line frequency 50/60Hz,
voltage range 200 up to 1000V.

ESTAprop = MKP-type capacitor, impregnated,
use at line frequency 50/60Hz,
voltage range 200 up to 1000V.

ESTAfilm = all-film capacitor, impregnated,
use at line frequency 50/60Hz,
voltage range 800 up to 3000V
medium frequency, all ranges.

STANDARDS

EN 60110-1/-2 applicable for frequencies
IEC 60110-1 up to 50000Hz.

ESTA capacitors for frequencies > 50000Hz are manufactured and tested in accordance with these standards, because no standard exists for this frequency range.

TESTING/QUALITY

Before shipping, each capacitor unit is subjected to the following tests: -

- leakage from the capacitor casing
- leakage from the cooling tubing
- capacitance measurement
- loss factor measurement
- dielectric test between terminals
- dielectric test between terminals and casing
(for capacitors with insulated casing)

Customer-specific tests can be carried out upon agreement.

QUALITY ASSURANCE SYSTEM ISO 9001

Power capacitors for induction furnaces (furnace capacitors) cannot be provided with the CE-marking because they are not included in the scope of the European Community guidelines according to the EU Commission's manual.

RATING LIMITS

Voltage : U_N continuous,
1.05 x U_N up to 12 hours per day.

Current : 1.2 x I_N permanent for $f_N \leq 60$ Hz.
: 1.15 x I_N for $f_N > 60$ Hz

Temperature: Self-cooling ESTAprop®/ESTAdry: - 25/45°C
Self-cooling ESTAfilm®: - 25/40°C
Liquid cooled ESTAprop®/ESTAfilm®:
outflowing coolant: 40°C
ambient air: 50°C
For specific data, refer to 'Cooling methods'.

COOLING METHODS

SELF-COOLING (AN)

Cooling is obtained by natural air circulation. The ambient air temperature shall not exceed 40°C (unless otherwise specified). It is measured at the warmest spot of the capacitor bank in the center of the clearance between two units at 2/3 of the height of the capacitor casings.

FORCED VENTILATION (AF)

Cooling air is directed forcefully onto the individual capacitor casings, e.g. by means of ventilators. During continuous operation, the maximum temperature of the outflowing air shall not exceed 40°C.

LIQUID COOLING (WF)

The liquid (usually water) cools the capacitor either at the surface or inside the casing. Maximum temperature of the outflowing cooling liquid shall not exceed 40°C, while the temperature of the ambient air shall not exceed 50°C.

REMARKS ON WATER COOLING

COOLING WATER QUALITY

- mechanically pure (mesh size 0.38mm)
- chemically neutral
- carbonate hardness 8°DH maximum
- electrical conductivity 500µS/cm maximum

MAXIMUM PERMISSIBLE INDIVIDUAL VALUES			
With carbonate hardness	8°DH	6°DH	4°DH
PH value	7.8	8.1	8.3
Free carbon dioxide (CO ₂)	8mg/l	4mg/l	3mg/l
Aggressive carbon dioxide	not permitted		
Ammonia (NH ₃)	not permitted		
Nitrides (NO ₂)	0.04mg/l		
Iron	0.3mg/l		
Manganese	0.05mg/l		
Sulfates	250mg/l		
Chlorides	150mg/l		
KMnO ₄ consumption	15mg/l		

GENERAL

The water temperature at the outlet is a function of the flow rate and of the inlet temperature. The minimum flow rate per capacitor is 1.5 l/minute, and the maximum flow rate shall not exceed 12.5 l/minute. The maximum water pressure at the entrance of the cooling system of a capacitor shall not exceed 8 bar.

Cooling systems of individual capacitors may be connected in series externally (6 units maximum). The pressure drop in the cooling system must be taken into account (refer to Fig. 1). The specific electric resistance of water is the basis for defining the hose length for the conductive water lines (refer to Fig. 2).

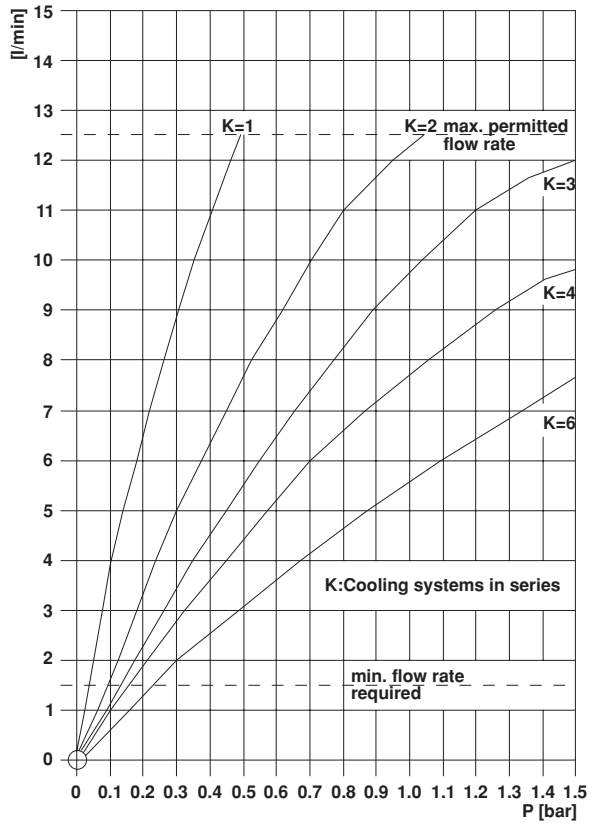


Fig. 1

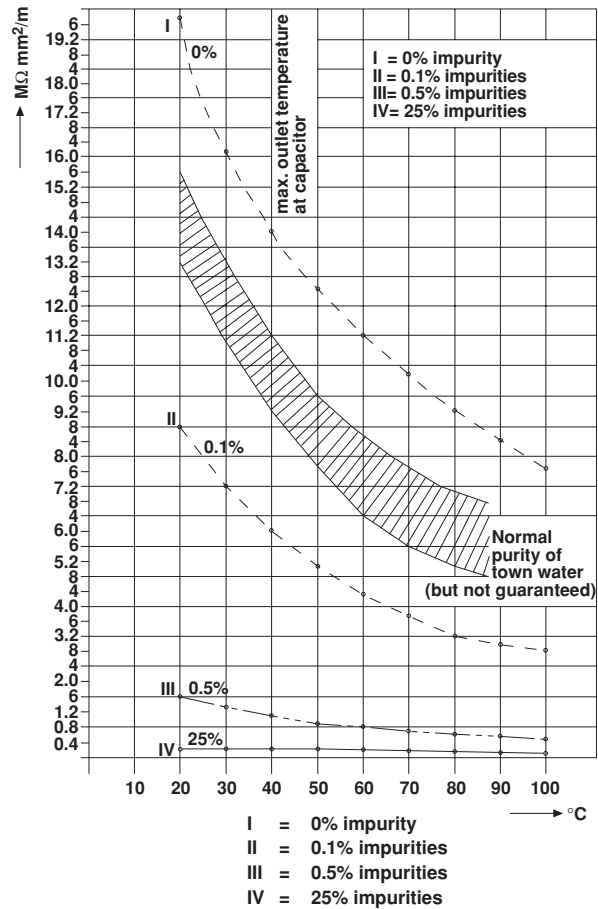


Fig. 2

CONSTRUCTION

Casing for line frequency capacitors:

steel sheet or high-quality steel sheet with multi-layer varnish

RAL 7033 for a rated current < 750A, brass sheet with multi-layer varnish RAL 7033 for a rated current ≥ 750A.

Preferred bottom sizes: 345 x 135mm
345 x 175mm

Casing for medium frequency capacitors:

brass sheet with multi-layer varnish RAL 7033.

Preferred bottom sizes: 369 x 165mm
354 x 142mm

Other sizes, and a variety of mounting accessories are available upon consultation.

MKP

Metallized polypropylene film.

The dielectric consists of a single-layer of polypropylene film to which is applied an evaporated metal coating, and then wound into cylindrical elements. Electrode contacts are achieved by spraying onto the two end faces of the winding element a metal coating (= Schoop metallizing; Fig. 4).

A property of these capacitors is the self-healing effect: in case of an electric breakdown, the suddenly appearing arc evaporates the metal coating of the dielectric film in the area of the puncture. As a consequence, a non-conductive spot is created, free of metal, and the capacitor remains fully operational (Fig. 5).

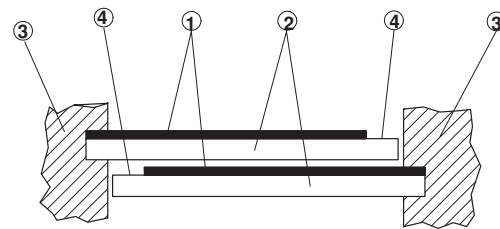


Fig. 4

Design of a MKP capacitor

- 1 metallized electrodes
- 2 polypropylene film
- 3 electric contact (schooping)
- 4 non-metallized edge

DIELECTRIC

ALL-FILM

The dielectric of ESTAFilm® capacitors consists of a single-layer or multiple-layer polypropylene film. The film is made rough by a special surface treatment, permitting an even and thorough impregnation of the capacitor. The all-film capacitors are characterized by extremely low dielectric losses. The use of aluminium foils results in a high current-carrying capacity. This arrangement is used particularly in the field of medium-frequency applications (Fig. 3).

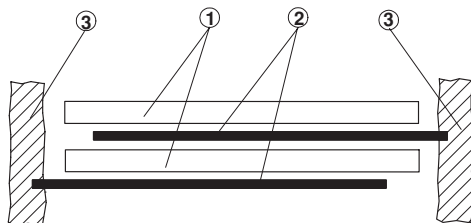


Fig. 3

Extended foil

- 1 dielectric
- 2 aluminium electrode
- 3 tin solder

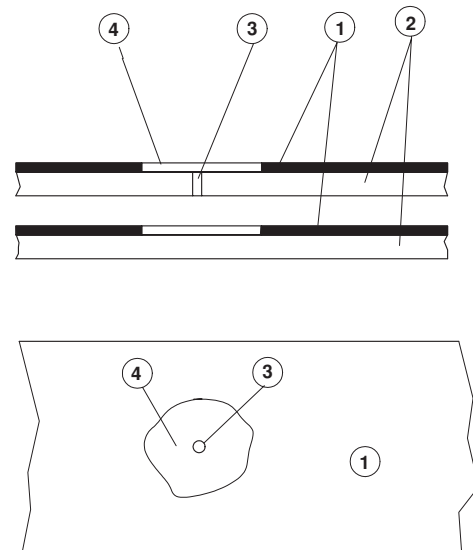


Fig. 5

Self healing breakdown on a MKP capacitor

- 1 metallized electrodes
- 2 polypropylene film
- 3 point of breakdown
- 4 non-conductive insulating crescent

DIELECTRICS' CHARACTERISTICS

MKP-TYPE ESTAdry[®] / ESTAprop[®]

ALL-FILM ESTAfilm[®]

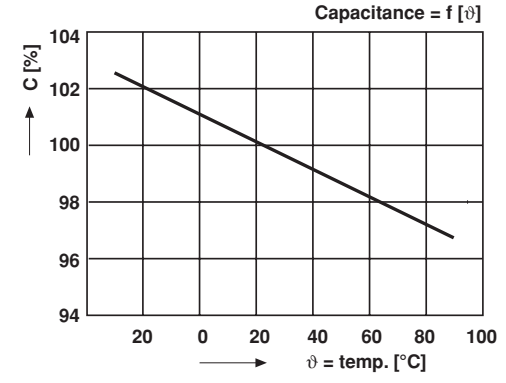
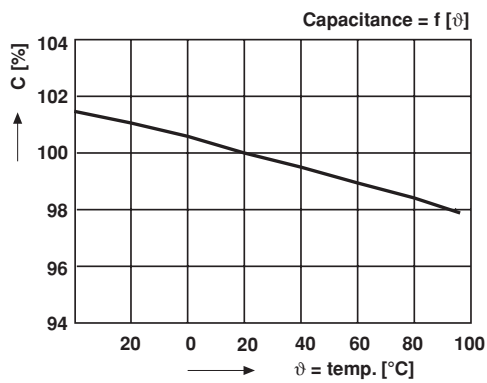
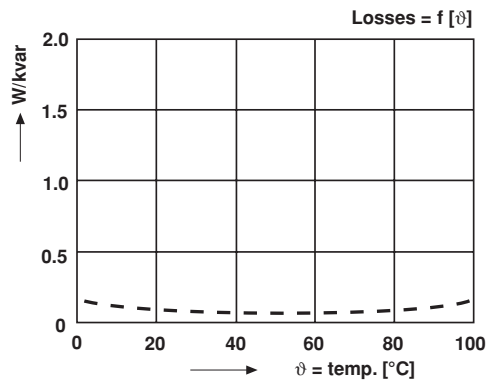
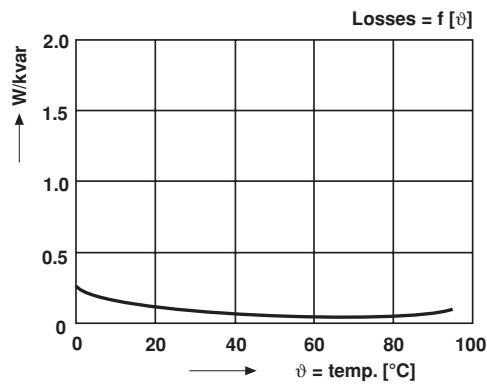
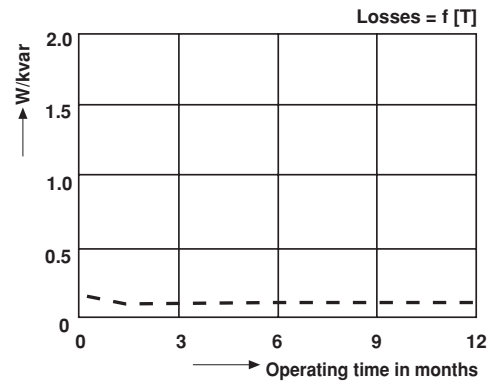
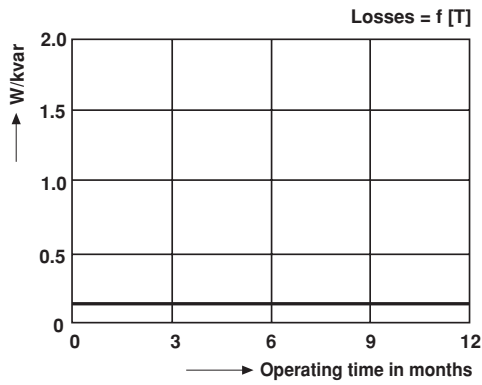


Fig. 6

Fig. 7



FILLERS

ESTAprop[®] = insulating oil on vegetable base, non-PCB,
flash point : 285°C
ignition point : 315°C

ESTAdry[®] = casting compound (resin).
The excellent heat conductivity of the resin
enables maximum capacitor loads under
high temperature stress conditions.

ESTAfilm[®] = non-chlorinated insulating oil, non-PCB,
high thermal stability,
good hydrogen gas-absorbing capacity,
flash point : 146°C
ignition point : 154°C

All the filling agents employed are biodegradable and
non-toxic.

A little "g" shows the difference in the type designation
between ESTAprop[®] (Phmkp...) and ESTAdry[®] (Phmkpg...).

REMARKS

Before working on a capacitor or a capacitor bank, the
equipment should be discharged and short-circuited.

Capacitors are supplied without discharging devices (unless
otherwise agreed).

Terminals should be properly tightened while observing the
maximum permissible fastening torque.

For medium-frequency applications, only connecting parts
(nuts, screws, washers) made of non-magnetic material
shall be used.

Water lines are current carrying (special versions with
insulated water lines can be supplied upon request).

Depending on the type (e.g. type Phawos), even the
casings may be current carrying (live case).

In addition, the Mounting and Maintenance Instructions
MW 110 (natural air-cooled) or MW 310 (water-cooled),
attached to all order acknowledgments, must be
observed.

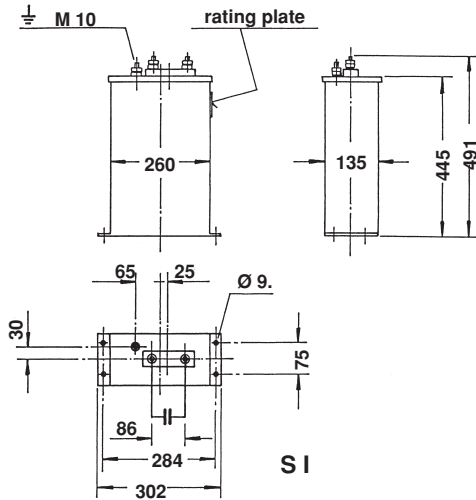
Line Frequency Capacitors 50/60Hz

ESTAprop[®], 230 - 525V, SELF-COOLING, SINGLE-PHASE

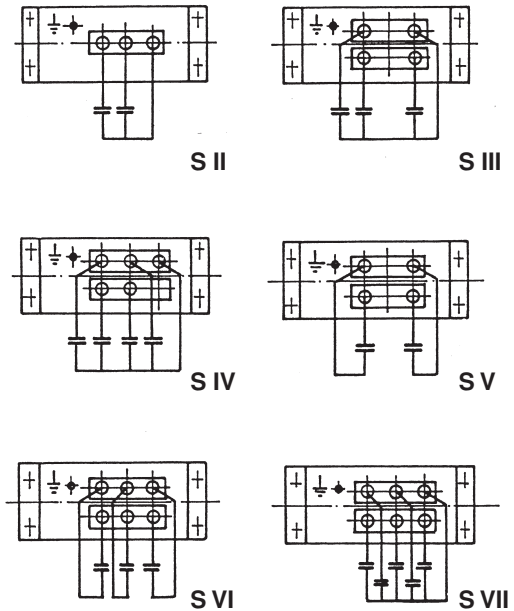
DESIGN

- MKP-type cup capacitor elements assembled and interconnected in steel sheet riveted casing;
- Casing varnish RAL 7033;
- IP 00, indoor, - 25°C/+ 45°C (unless otherwise confirmed);
- Self-healing, with internal overpressure tear-off fuse in each cup;
- Connection bolt M12, and grounding bolt M10;
- Mounting in the upright position, or horizontally on the narrow side.

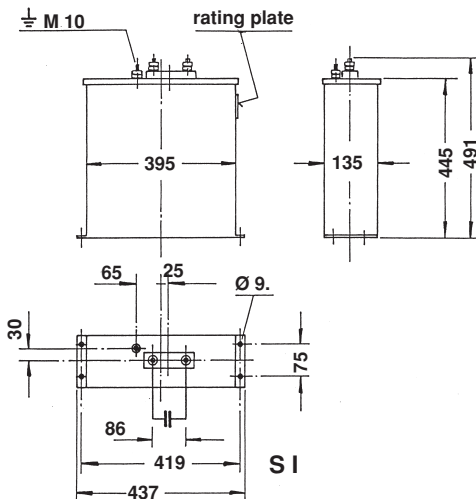
VERSION A/CIRCUITRY S I



ADDITIONAL CIRCUITRY VERSIONS



VERSION B/CIRCUITRY S I



230 - 525V, 50Hz (60Hz on request)

U_N (V)	Q_N (kVAr)	C_N (μ F)	I_N (A)	VERSION/ CIRCUITRY	TYPE Phmkp . . .
230	40	2407	174	A / S I	..230/40/1
230	60	3610	261	B / S I	..230/60/1
400	80	1592	200	A / S I	..400/80/1
400	120	2387	300	B / S I	..400/120/1
500	72	917	144	A / S I	..500/72/1
500	108	1375	216	B / S I	..500/108/1
525	80	924	152	A / S I	..525/80/1
525	120	1386	229	B / S I	..525/120/1

Shown are the maximum power ratings, other power ratings, voltages, and subdivisions on request.

Line Frequency Capacitors 50/60Hz

ESTAprop®/ESTAdry® 200 - 1000V, SELF-COOLING, SINGLE-PHASE

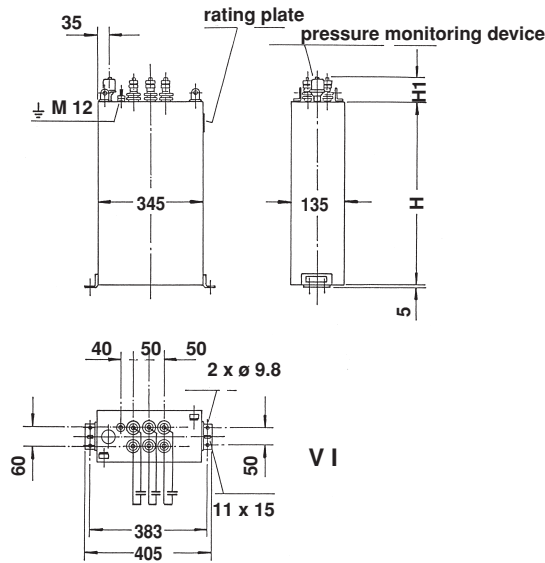
DESIGN

- MKP-type wound elements in high-quality steel sheet or brass sheet welded casing;
- Casing varnish RAL 7033;
- IP00, indoor, - 25°C/+ 45° C (unless otherwise confirmed);
- Self-healing, with overpressure switch ("DR") or tear-off fuse ("A")*,(*available only for a limited number of types!);

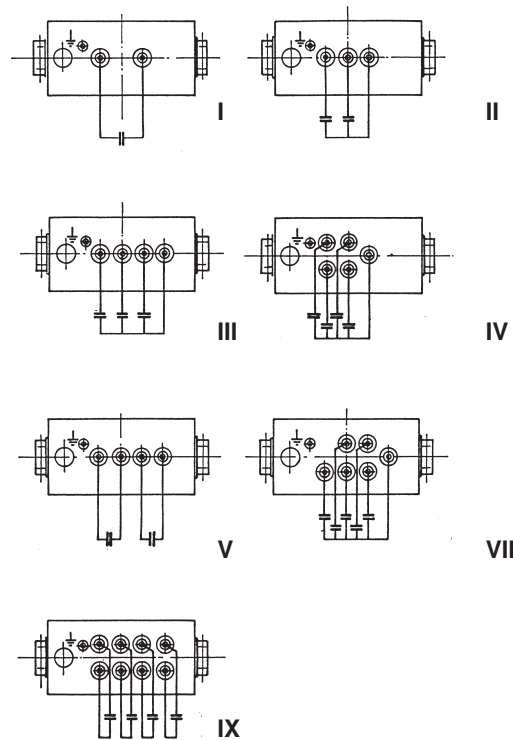
- Connection bolt M12, or M20 (depending on application current);
- Grounding bolt M12;
- Mounting in the upright position, or horizontally on the narrow side.

Water-cooled capacitors can be supplied upon request.

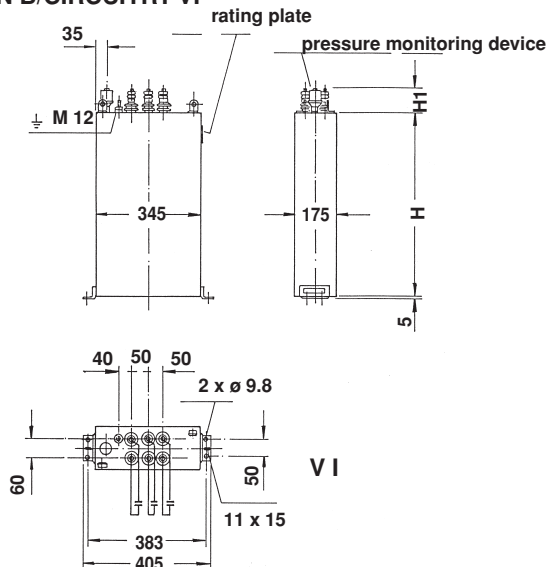
VERSION A/CIRCUITRY VI



ADDITIONAL CIRCUITRY VERSIONS



VERSION B/CIRCUITRY VI



200 – 1000V, 50Hz (60Hz on request)								
U _N (V)	Q _N (kVAr)	SUBDIVISIONS .. x ..kVAr	C _N (μF)	I _N (A)	VERSION/ CIRCUITRY	H mm	BUSHING	TYPE Phmkp ...
200	200	3 x 67	15915	1000	A / VI	900	M12	..200/200/1 S-DR
200	200	3 x 67	15915	1000	B / VI	730	M 12	..200/200/1 S-DR
250	250	3 x 83	12732	1000	A / VI	720	M 12	..250/250/1 S-DR
250	250	3 x 83	12732	1000	B / VI	570	M 12	..250/250/1 S-DR
400	400	3 x 133	7958	1000	A / VI	650	M 12	..400/400/1 S-DR
400	400	3 x 133	7958	1000	B / VI	570	M 12	..400/400/1 S-DR
440	440	3 x 147	7234	1000	A / VI	720	M 12	..440/440/1 S-DR
440	440	3 x 147	7234	1000	B / VI	560	M 12	..440/440/1 S-DR
500	500	3 x 167	6366	1000	A / VI	910	M 12	..500/500/1 S-DR
500	500	3 x 167	6366	1000	B / VI	720	M 12	..500/500/1 S-DR
550	510	3 x 170	5367	927	A / VI	970	M 12	..550/510/1 S-DR
550	550	3 x 183	5787	1000	B / VI	800	M 12	..550/550/1 S-DR
600	510	3 x 170	4509	850	A / VI	970	M 12	..600/510/1 S-DR
600	550	3 x 183	4863	917	B / VI	820	M 12	..600/550/1 S-DR
660	420	2 x 210	3069	636	A / V	960	M 12	..660/420/1 S-DR
660	550	3 x 183	4019	833	B / VI	970	M 12	..660/550/1 S-DR
750	550	3 x 183	3112	733	A / VI	970	M 12	..750/550/1 S-DR
750	600	3 x 200	3395	800	B / VI	860	M 12	..750/600/1 S-DR
800	600	3 x 200	2984	750	A / VI	950	M 12	..800/600/1 S-DR
800	630	3 x 210	3133	788	B / VI	790	M 12	..800/630/1 S-DR
900	630	3 x 210	2476	700	A / VI	910	M 12	..900/630/1 S-DR
900	675	3 x 225	2653	750	B / VI	790	M 12	..900/675/1 S-DR
1000	555	3 x 185	1767	555	A / VI	970	M 12	..1/555/1 S-DR
1000	675	3 x 225	2149	675	B / VI	940	M 12	..1/675/1 S-DR

Shown are the maximum power ratings, other power ratings, voltages, and subdivisions on request.

Line Frequency Capacitors 50/60Hz

ESTAfilm[®], 850 - 3000V, SELF-COOLING, SINGLE-PHASE

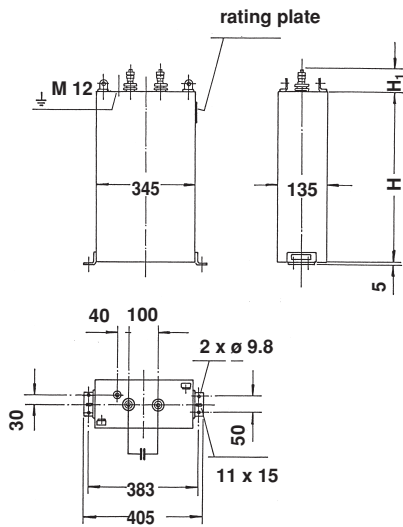
DESIGN

- All-film wound elements in high-quality steel sheet welded casings;
- Casing varnish RAL 7033;
- IP00, indoor, - 25°C/+ 40°C (unless otherwise confirmed);
- Winding elements provided with internal fuses;

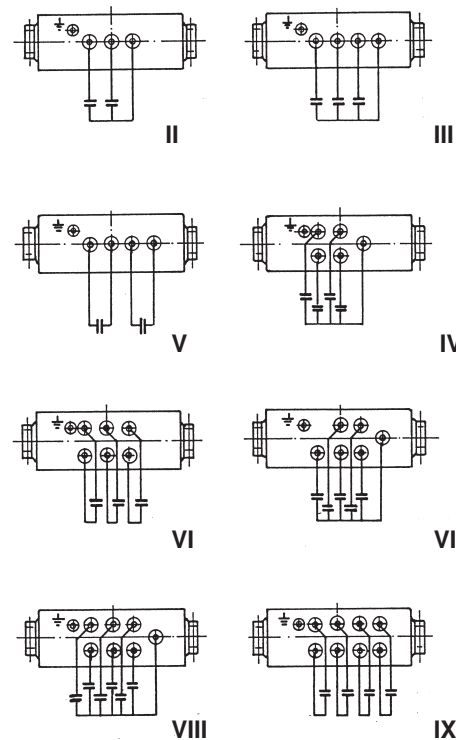
- Connection bolt M12, or M20 (depending on application current);
- Grounding bolt M12;
- Mounting in the upright position, or horizontally on the narrow side.

Water-cooled capacitors can be supplied upon request.

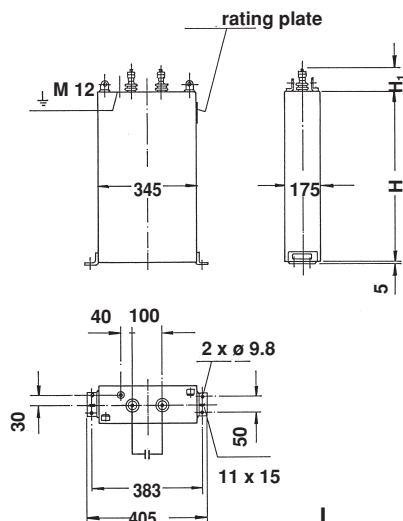
VERSION A/CIRCUITRY I



ADDITIONAL CIRCUITRY VERSIONS



VERSION B/CIRCUITRY I



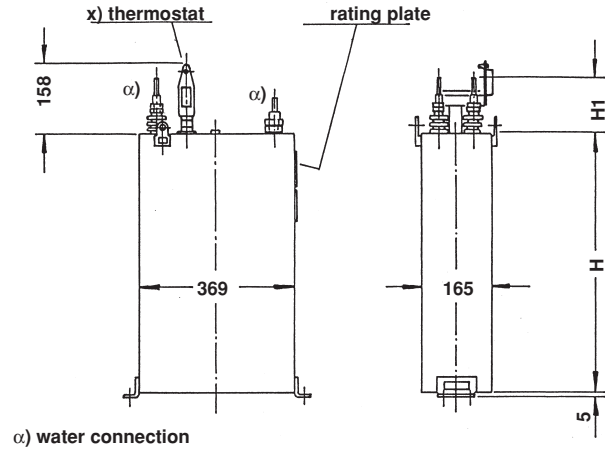
850 – 3000V, 50Hz (60Hz on request)								
U_N (V)	Q_N (kVAr)	SUBDIVISIONS .. x ..kVAr	C_N (μF)	I_N (A)	VERSION/ CIRCUITRY	H mm	BUSHING	TYPE Phao . . .
850	370	no	1630	435	A / I	1000	M 20	..850/370/1
850	500	2 x 250	2203	588	B / V	1000	M 12	..850/500/1 S
900	360	no	1415	400	A / I	985	M 20	..900/360/1
900	490	2 x 245	1926	544	B / V	1000	M 12	..900/490/1 S
1000	380	no	1210	380	A / I	985	M 20	..1/380/1
1000	520	2 x 260	1655	520	B / V	1000	M 12	..1/520/1 S
1200	480	no	1061	400	A / I	990	M 20	..1.2/480/1
1200	650	2 x 325	1437	542	B / V	995	M 12	..1.2/650/1S
1350	500	no	873	370	A / I	1000	M 12	..1.35/500/1
1350	660	2 x 330	1153	489	B / V	980	M 12	..1.35/660/1S
1500	520	no	736	347	A / I	1000	M 12	..1.5/520/1
1500	700	2 x 350	990	467	B / V	1000	M 12	..1.5/700/1
1750	490	no	509	280	A / I	1000	M 12	..1.75/490/1
1750	660	no	686	377	B / I	1000	M 20	..1.75/660/1
2000	530	no	422	265	A / I	990	M 12	..2/530/1
2000	700	no	557	350	B / I	985	M 12	..2/700/1
2200	550	no	362	250	A / I	990	M 12	..2.2/550/1
2200	740	no	487	336	B / I	1000	M 12	..2.2/740/1
2400	730	no	403	304	B / I	995	M 12	..2.4/730/1
2500	720	no	367	288	B / I	985	M 12	..2.5/720/1
2700	660	no	288	244	B / I	990	M 12	..2.7/660/1
3000	690	no	244	230	B / I	1000	M 12	..3/690/1

Shown are the maximum power ratings, other power ratings, voltages, and subdivisions on request.

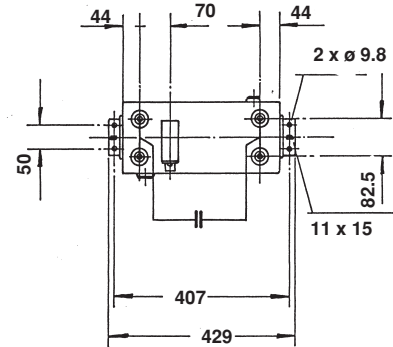
Medium Frequency Capacitors, Water Cooled

ESTafilm[®], SINGLE OUTPUTS NOT SUBDIVIDED, 150 - 5000Hz
DESIGN

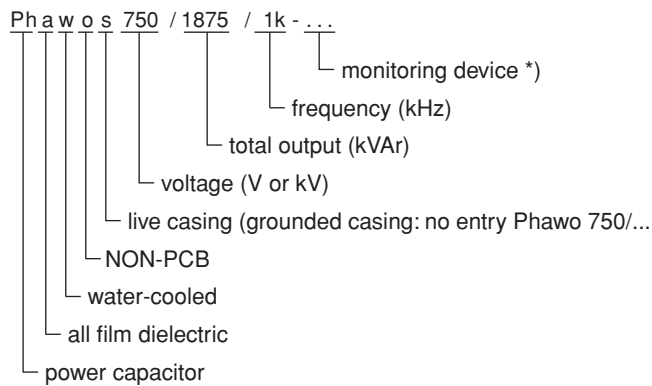
- All-film winding in brass sheet welded casing;
- Casing conductive, or grounded;
- Casing varnish RAL 7033;
- IP00, indoor;
- Ambient temperature 1°C 50°C;
- Outflowing water temperature 40° C maximum;
- 2 water-cooled current connections M20;
- Water tubing conductive;
- Mounting in the upright or horizontal position;
- Upon request, temperature or pressure monitoring;



α) water connection



x) upon request

TYPE DESIGNATION


*) – ST = thermostat
 – DR = pressure switch } Not all types available.

**150 - 5000Hz NOT SUBDIVIDED**

F _N (Hz)	U _N (V)	Q _N (kVAR)	C _N (μF)	I _N (A)	CASING		H (mm)
					CONDUCTIVE	GROUNDED	
150	600	800	2358	1333	X	X	1000
	1000	1400	1485	1400	X	X	1000
	1500	1800	849	1200	X	X	1000
	2000	1720	456	860	X	X	1000
	2500	1350	229	540	X	X	1000
	3000	2000	236	667	X	X	1000
250	600	1120	1981	1867	X	X	1000
	1000	2000	1273	2000	X	X	1000
	1500	2750	778	1833	X	X	1000
	2000	2600	414	1300	X	X	1000
	2500	2000	204	800	X	X	1000
	3000	3333	236	1111	X	X	1000
300	600	1375	2026	2292	X	X	1000
	1000	2400	1273	2400	X	X	1000
	1500	3000	707	2000	X	X	1000
	2000	3150	418	1575	X	X	1000
	2500	2350	200	940	X	X	1000
	3000	4000	236	1333	X	X	1000
500	250	460	2343	1840	X	X	1000
	600	1500	1326	2500	X	X	800
	1000	2500	796	2500	X	X	700
	1500	3750	531	2500	X	X	800
	2000	4900	390	2450	X	X	1000
	2500	3700	188	1480	X	X	1000
	3000	6666	236	2222	X	X	1000
600	250	560	2377	2240	X	X	1000
	600	1500	1105	2500	X	X	700
	1000	2500	663	2500	X	X	600
	1500	3750	442	2500	X	X	700
	2000	5000	332	2500	X	X	900
	2500	4200	178	1680	X	X	1000
	3000	8000	236	2667	X	X	1000



150 - 5000Hz NOT SUBDIVIDED							
F _N (Hz)	U _N (V)	Q _N (kVAR)	C _N (µF)	I _N (A)	CASING		H (mm)
					CONDUCTIVE	GROUNDED	
1000	250	625	1592	2500	X	X	700
	600	1500	663	2500	X	X	500
	750	1875	531	2500	X	X	450
	1000	2500	398	2500	X	X	450
	1500	3750	265	2500	X	X	600
	2000	5000	199	2500	X	X	750
	2500	6250	159	2500	X	X	950
2000	250	625	796	2500	X	X	500
	600	1500	332	2500	X	X	500
	750	1875	265	2500	X	X	500
	1000	2500	199	2500	X	X	450
	1500	3750	133	2500	X	X	450
	2000	5000	99	2500	X	X	500
	2400	6000	83	2500	X	X	600
3000	250	625	531	2500	X	X	500
	600	1500	221	2500	X	X	500
	750	1875	177	2500	X	X	500
	1000	2500	133	2500	X	X	500
	1500	3750	88	2500	X	X	550
	2000	5000	66	2500	X	X	500
4000	250	625	398	2500	X	X	550
	600	1500	166	2500	X	X	550
	750	1875	133	2500	X	X	500
	1000	2500	99	2500	X	X	500
	1500	3750	66	2500	X	X	550
	2000	5000	50	2500	X	X	600
5000	250	600	306	2400	X	X	550
	600	1440	127	2400	X	X	550
	750	1800	102	2400	X	X	500
	1000	2400	76	2400	X	X	550
	1500	3600	51	2400	X	X	500
	2000	4800	38	2400	X	X	550

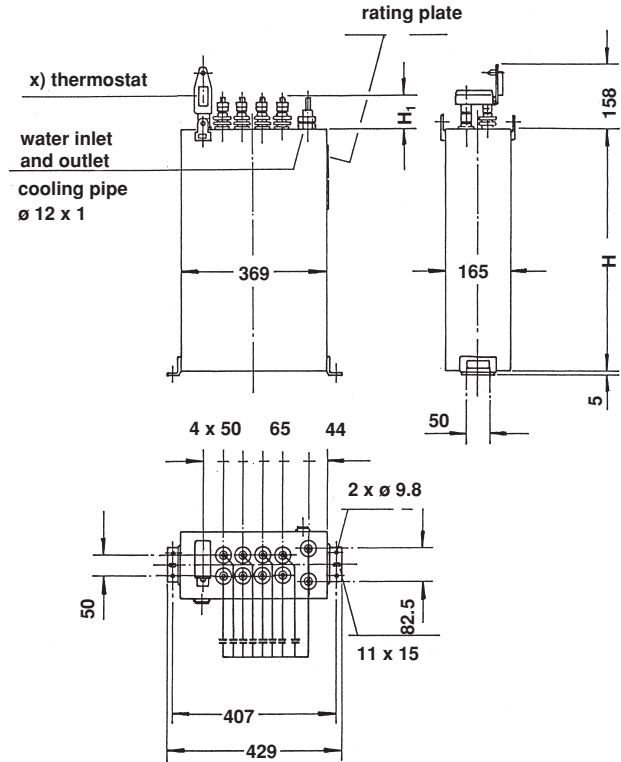
Shown are the maximum power ratings, other power ratings, voltages, and frequencies on request.

Medium Frequency Capacitors Water Cooled

ESTAFilm®, SUBDIVIDED IN PARTIAL OUTPUTS, 150 - 10000Hz

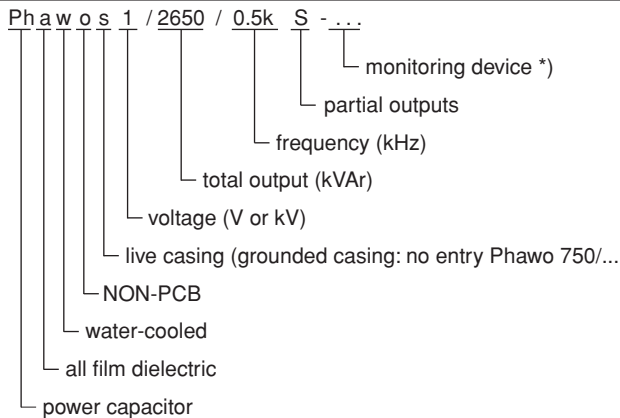
DESIGN

- All-film winding in brass sheet welded casing;
- Casing conductive, or grounded;
- Casing varnish RAL 7033;
- IP00, indoor;
- Ambient temperature 1°C 50°C;
- Outflowing water temperature 40°C maximum;
- Common terminal with 2 water-cooled current connections M20;
- Water tubing conductive;
- A maximum of 8 partial outputs with connection bolts M12 or M20 (depending on application current);
- Mounting in the upright or horizontal position;
- Upon request, temperature or pressure monitoring;



x) upon request

TYPE DESIGNATION



*) - ST = thermostat } Not all types available.
 - DR = pressure switch



150-10000Hz SUBDIVIDED IN PARTIAL OUTPUTS							
F _N (Hz)	U _N (V)	Q _N (kVAr)	C _N (µF)	I _N (A)	CASING		H (mm)
					CONDUCTIVE	GROUNDED	
150	600	760	2240	1267	X	X	1000
	1000	1320	1401	1320	X	X	1000
	1500	1720	811	1147	X	X	1000
	2000	1650	438	825	X	X	1000
	2500	1300	221	520	X	X	1000
	3000	2000	236	667	X	X	1000
250	600	1000	1768	1667	X	X	950
	1000	1700	1082	1700	X	X	900
	1500	2550	722	1700	X	X	1000
	2000	2520	401	1260	X	X	1000
	2500	2000	204	800	X	X	1000
	3000	3333	236	1111	X	X	1000
300	600	1020	1503	1700	X	X	800
	1000	1760	934	1760	X	X	1000
	1500	2550	601	1700	X	X	950
	2000	3000	398	1500	X	X	1000
	2500	2240	190	896	X	X	1000
	3000	3950	233	1317	X	X	1000
500	600	4000	236	1333	X		1000
	250	420	2139	1680	X	X	950
	600	1320	1167	2200	X	X	950
	600	1460	1291	2433	X		1000
	1000	2200	700	2200	X	X	800
	1000	2650	844	2650	X		900
600	1500	3300	467	2200	X	X	950
	1500	3600	509	2400	X		1000
	2000	3600	287	1800	X	X	1000
	2500	3000	153	1200	X	X	950
	3000	6000	212	2000	X	X	950
	250	420	1783	1680	X	X	850
1000	600	1320	973	2200	X	X	800
	600	1560	1149	2600	X		900
	1000	2200	584	2200	X	X	700
	1000	2650	703	2650	X		800
	1500	3300	389	2200	X	X	800
	1500	4000	472	2667	X		950
1000	2000	4160	276	2080	X	X	1000
	2500	3400	144	1360	X	X	1000
	3000	6000	177	2000	X	X	800
	250	550	1401	2200	X	X	850
	250	660	1681	2640	X		1000
	600	1320	584	2200	X	X	600
1000	600	1600	707	2667	X		700
	750	1650	467	2200	X	X	500
	750	1980	560	2640	X		600
	1000	2200	350	2200	X	X	500
	1000	2650	422	2650	X		550
	1500	3300	233	2200	X	X	600
1000	1500	3950	279	2633	X		650
	2000	4400	175	2200	X	X	750
	2000	5300	211	2650	X		850
	2450	4900	130	2000	X	X	1000

**150-10000Hz SUBDIVIDED IN PARTIAL OUTPUTS**

F _N (Hz)	U _N (V)	Q _N (kVA _r)	C _N (μF)	I _N (A)	CASING		H (mm)	
					CONDUCTIVE	GROUNDED		
2000	250	500	637	2000	X	X	450	
	250	660	840	2640	X		550	
	600	1200	265	2000	X	X	350	
	600	1600	354	2667	X		400	
	750	1500	212	2000	X	X	350	
	750	2000	283	2667	X		400	
	1000	2000	159	2000	X	X	300	
	1000	2650	211	2650	X		350	
	1500	3000	106	2000	X	X	350	
	1500	3975	141	2650	X		450	
	2000	4000	80	2000	X	X	450	
	2000	5300	105	2650	X		550	
	2400	4800	66	2000	X	X	600	
	2400	6360	88	2650	X		700	
	3000	250	480	407	1920	X	X	350
250		660	560	2640	X		400	
600		1160	171	1933	X	X	300	
600		1600	236	2667	X		350	
750		1470	139	1960	X	X	250	
750		2000	189	2667	X		350	
1000		1950	104	1950	X	X	300	
1000		2650	141	2650	X		350	
1500		2940	69	1960	X	X	300	
1500		3960	93	2640	X		350	
4000		250	470	299	1880	X	X	300
		250	660	420	2640	X		350
		600	1120	124	1867	X	X	250
		600	1600	177	2667	X		350
		750	1400	99	1867	X	X	250
	750	1980	140	2640	X		300	
	1000	1900	76	1900	X	X	250	
	1000	2650	105	2650	X		300	
	1500	2840	50	1893	X	X	250	
	1500	3960	70	2640	X		300	
	5000	250	460	234	1840	X	X	250
		250	640	326	2560	X		300
		600	1100	97	1833	X	X	250
		600	1520	134	2533	X		300
		1000	1850	59	1850	X	X	250
1000		2560	81	2560	X		250	
1500		2770	39	1847	X	X	300	
1500		3840	54	2560	X		350	
8000		250	420	134	1680	X	X	250
		250	600	191	2400	X		250
		600	1040	57	1733	X	X	200
		600	1420	78	2367	X		250
		1000	1740	35	1740	X	X	250
		1000	2400	48	2400	X		300
		1500	2600	23	1733	X	X	250
	1500	3500	31	2333	X		300	
	10000	250	420	107	1680	X	X	250
		250	570	145	2280	X		300
		500	850	54	1700	X	X	200
		500	1140	73	2280	X		250
		600	1020	45	1700	X	X	200
		600	1360	60	2267	X		250
		750	1275	36	1700	X	X	200
750		1720	49	2293	X		250	
1000		1700	27	1700	X	X	200	
1000		2300	37	2300	X		250	
1500		2550	18	1700	X	X	250	
1500		3400	24	2267	X		300	

Shown are the maximum power ratings, other power ratings, voltages, and frequencies on request.

Medium Frequency Capacitors, Water Cooled

ESTafilm[®], TWIN OUTPUTS FOR EXTREME CURRENT LOADING, 1000 - 10000Hz

VERSION A

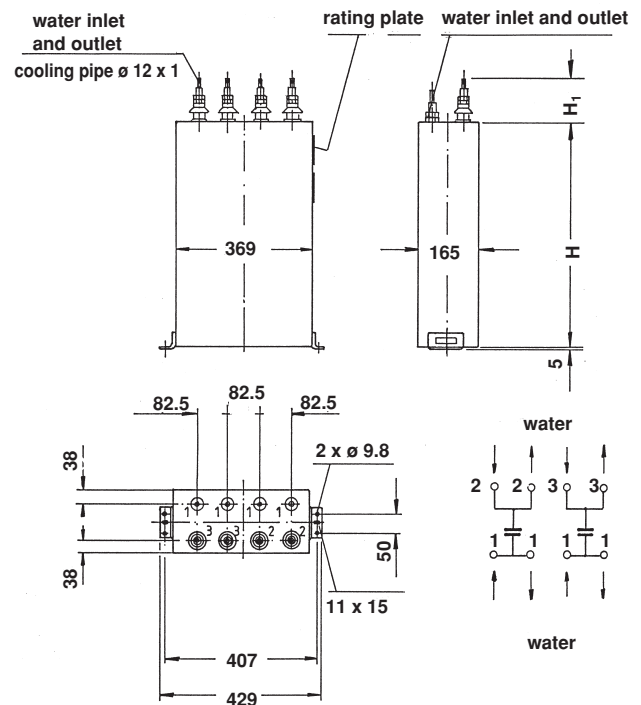
Total output subdivided in 2 sections of equal capacity

VERSION B

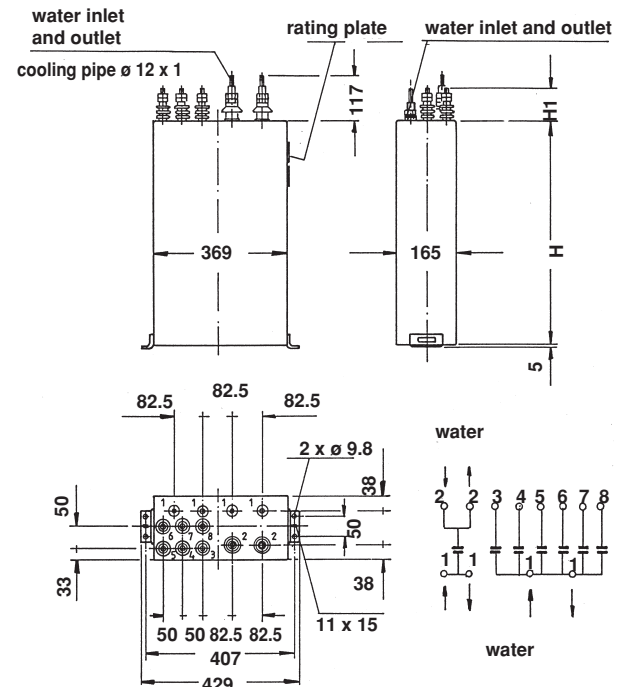
Total output subdivided in 2 sections of equal capacity, with one of the two sections subdivided in 6 equal-size partial outputs.

DESIGN

- All-film winding in brass sheet welded casing;
- Casing conductive;
- Casing varnish RAL 7033;
- IP00, indoor;
- Ambient temperature 1°C 50°C;
- Outflowing water temperature 40° C maximum;
- Water-cooled current connections M20;
- Water tubing conductive;
- Partial outputs of version B provided with connection bolts M12 or M20 (depending on application current);
- Mounting in the upright or horizontal position;
- Upon request, pressure monitoring;

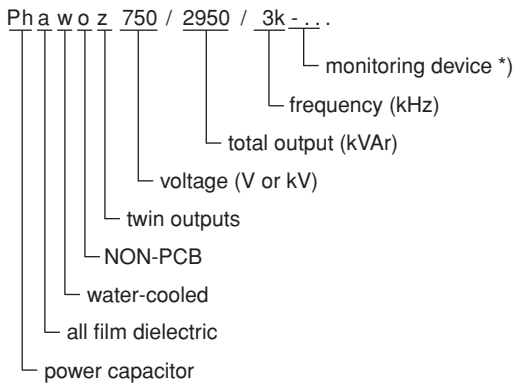


Version A

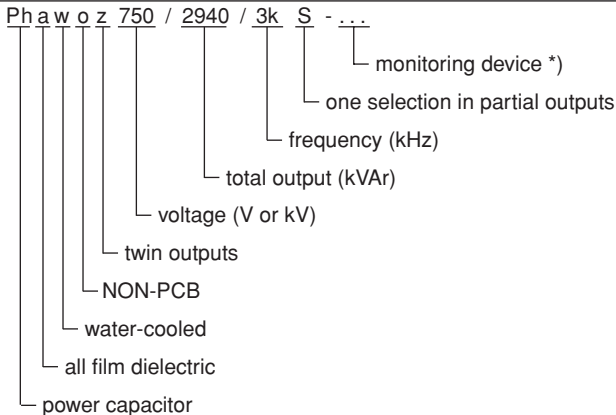


Version B

TYPE DESIGNATION: VERSION A



TYPE DESIGNATION: VERSION B



*) - DR = pressure switch

1000-10000Hz TWIN OUTPUTS

F_N (Hz)	U_N (V)	Q_N (kVAR)	C_N (μ F)	I_N (A)	H (mm)	VERSION
1000	250	700	1783	2800	1000	A
	250	680	1732	2720	1000	B
	600	2500	1105	4167	1000	A
	600	2400	1061	4000	1000	B
	750	3375	955	4500	900	A
	750	3360	951	4480	900	B
	1000	4500	716	4500	850	A
	1000	4500	716	4500	900	B
	1500	6750	478	4500	1000	A
	1500	6540	463	4360	1000	B
	2000	6500	259	3250	1000	A
	2000	6400	255	3200	1000	B
2000	250	1000	1273	4000	750	A
	250	1000	1273	4000	800	B
	600	2500	553	4167	550	A
	600	2400	531	4000	600	B
	750	3000	424	4000	500	A
	750	3000	424	4000	550	B
	1000	4100	326	4100	500	A
	1000	4000	318	4000	550	B
	1500	6000	212	4000	550	A
	1500	6000	212	4000	650	B
	2000	8000	159	4000	700	A
	2000	8000	159	4000	800	B
	2400	9600	133	4000	1000	A
	2400	8800	122	3667	1000	B
3000	250	980	832	3920	550	A
	250	980	832	3920	550	B
	600	2300	339	3833	450	A
	600	2300	339	3833	450	B
	750	2950	278	3933	450	A
	750	2940	277	3920	450	B
	1000	3900	207	3900	400	A
	1000	3900	207	3900	450	B
	1500	5900	139	3933	400	A
	1500	5900	139	3933	450	B
	2000	7800	104	3900	550	A
	2000	7800	104	3900	600	B



1000-10000Hz TWIN OUTPUTS						
F_N (Hz)	U_N (V)	Q_N (kVAr)	C_N (µF)	I_N (A)	H (mm)	VERSION
4000	250	940	598	3760	400	A
	250	940	598	3760	450	B
	600	2200	243	3667	400	A
	600	2200	243	3667	400	B
	750	2800	198	3733	400	A
	750	2800	198	3733	400	B
	1000	3800	151	3800	450	A
	1000	3800	151	3800	450	B
	1500	5600	99	3733	400	A
	1500	5600	99	3733	500	B
	2000	7500	75	3750	450	A
	2000	7500	75	3750	650	B
5000	250	920	469	3680	450	A
	250	920	469	3680	450	B
	600	2200	195	3667	400	A
	600	2200	195	3667	400	B
	750	2700	153	3600	400	A
	750	2700	153	3600	450	B
	1000	3600	115	3600	450	A
	1000	3600	115	3600	400	B
	1500	5500	78	3667	450	A
	1500	5500	78	3667	550	B
	2000	7300	58	3650	400	A
	2000	7300	58	3650	650	B
8000	250	860	274	3440	450	A
	250	860	274	3440	450	B
	600	2000	111	3333	400	A
	600	2000	111	3333	400	B
	750	2500	88	3333	400	A
	750	2500	88	3333	400	B
	1000	3400	68	3400	450	A
	1000	3400	68	3400	400	B
	1500	5000	44	3333	400	A
	1500	5000	44	3333	400	B
10000	250	820	209	3280	450	A
	250	820	209	3280	400	B
	600	2000	88	3333	450	A
	600	2000	88	3333	450	B
	750	2400	68	3200	400	A
	750	2400	68	3200	400	B
	1000	3300	53	3300	450	A
	1000	3300	53	3300	400	B
	1500	5000	35	3333	450	A
	1500	5000	35	3333	450	B

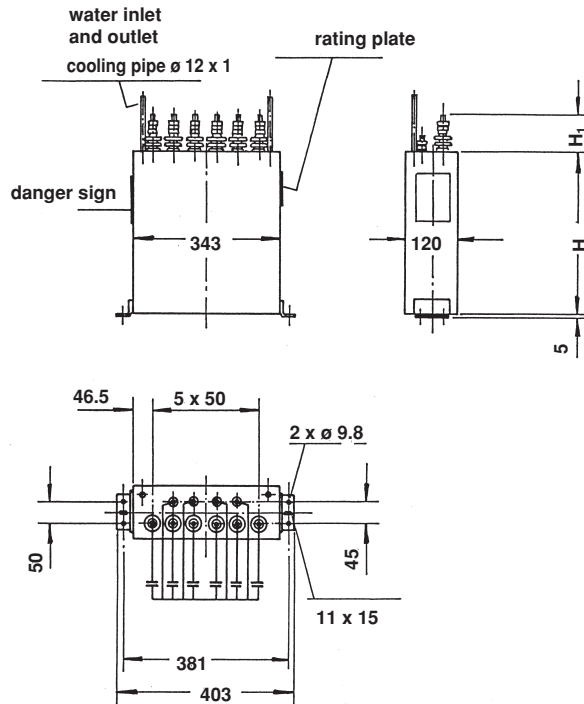
Shown are the maximum power ratings, other power ratings, voltages, and frequencies on request.

Medium Frequency Capacitors, Water Cooled

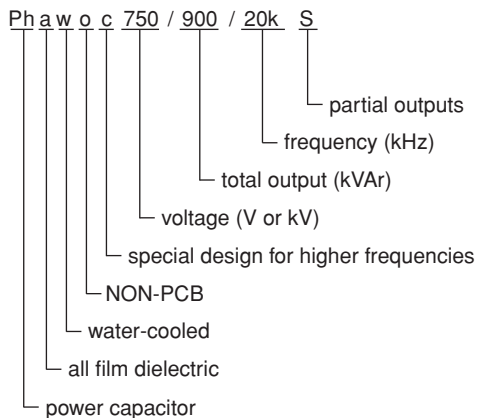
ESTAFilm[®], SUBDIVIDED IN PARTIAL OUTPUTS, 10000 – 100000Hz

DESIGN

- All-film windings in brass sheet welded casing;
- Extremely low-inductance version;
- Casing conductive;
- Casing varnish RAL 7033;
- 6 equal partial outputs;
- IP00, indoor;
- Ambient temperature 1°C 50°C;
- Outflowing water temperature 40°C maximum;
- Water tubing conductive;
- 4 casing connection bolts M12 x 30mm;
- Partial outputs with connection bolts M12 or M20 (depending on application current).



TYPE DESIGNATION





10000-100000Hz SUBDIVIDED IN PARTIAL OUTPUTS					
F_N (Hz)	U_N (V)	Q_N (kVAr)	C_N (μ F)	I_N (A)	H (mm)
10000	500	980	62.4	1960	300
	650	1280	48.2	1969	250
	750	1470	41.6	1960	250
	1000	1970	31.4	1970	250
20000	500	900	28.7	1800	250
	650	1170	22.0	1800	250
	750	1350	19.1	1800	250
	1000	1800	14.3	1800	200
30000	500	840	17.8	1680	250
	650	1100	13.8	1692	200
	750	1270	12.0	1693	200
	1000	1700	9.0	1700	250
40000	500	810	12.9	1620	200
	650	1050	9.9	1615	200
	750	1220	8.6	1627	250
	1000	1620	6.4	1620	200
50000	500	780	9.9	1560	200
	650	1020	7.7	1569	200
	750	1170	6.6	1560	200
	1000	1570	5.0	1570	200
60000	500	760	8.1	1520	200
	650	990	6.2	1523	200
	750	1140	5.4	1520	200
	1000	1520	4.0	1520	200
80000	500	720	5.7	1440	200
	650	940	4.4	1446	200
	750	1090	3.9	1453	200
	1000	1450	2.9	1450	250
100000	500	700	4.5	1400	200
	650	910	3.4	1400	200
	750	1050	3.0	1400	250

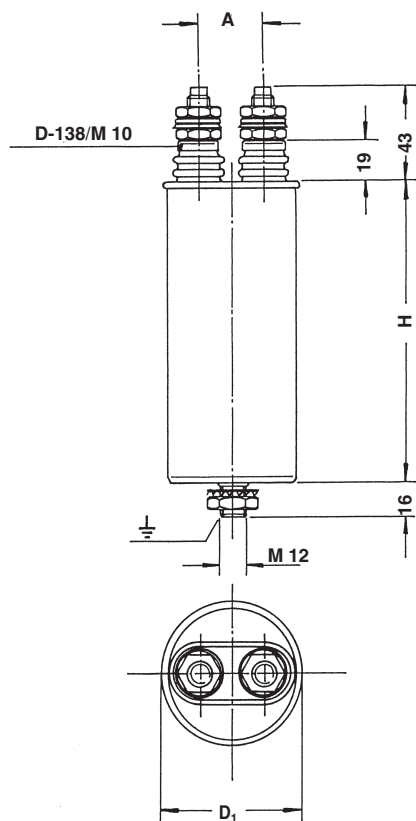
Shown are the maximum power ratings, other power ratings, voltages, and frequencies on request.

Medium Frequency Capacitors

MEDIUM-FREQUENCY CAPACITORS, SELF-COOLED, SMALL CAPACITIES FOR COMPLETING FRACTIONAL OUTPUTS

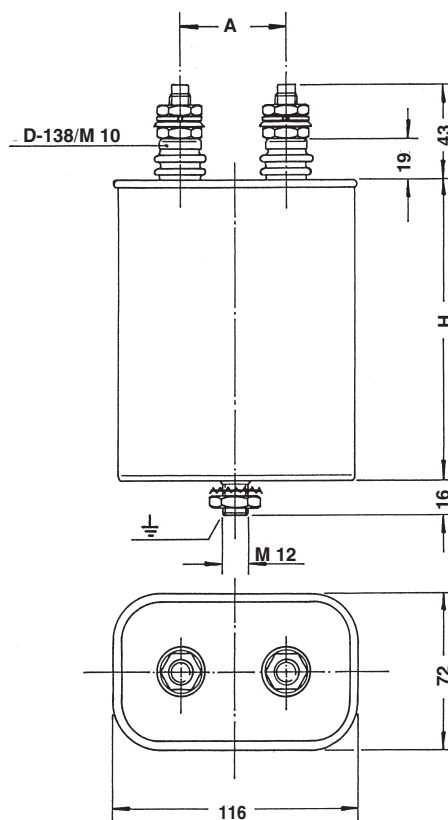
DESIGN

- All-film winding in insulated aluminum casing with non-magnetic lid;
- IP00, indoor;
- Operating temperature - 10°C/+ 65°C (= maximum temperature at surface of casing);
- Porcelain terminals with bolts M10;
- The maximum permissible values U_N max., P_V max., and I_{max} must be observed.



Version A

$I_{max} = 80A$
 $D1 \times H = 60 \times 109mm$



Version B

$I_{max} = 80A$
 $H = 180mm$

SMALL CAPACITORS SELF-COOLED					
U_N MAX. (V)	C_N (μF)	R_S (Ohm)	P_V MAX. (W)	VERSION	TYPE Phao . . .
2200	0.22	1 x 10 ⁻³	3	A	.. 2.2/0.22μF
1800	0.45	1 x 10 ⁻³	3	A	.. 1.8/0.45μF
1500	1.00	1 x 10 ⁻³	3	A	.. 1.5/1.00μF
1300	2.00	1 x 10 ⁻³	3	A	.. 1.3/2.00μF
900	4.00	1 x 10 ⁻³	3	A	.. 900/4.00μF
2200	1.00	5 x 10 ⁻⁴	9	B	.. 2.2/1.00μF
2200	1.50	5 x 10 ⁻⁴	9	B	.. 2.2/1.50μF
2200	2.00	5 x 10 ⁻⁴	9	B	.. 2.2/2.00μF
2200	3.00	5 x 10 ⁻⁴	9	B	.. 2.2/3.00μF
1800	4.00	5 x 10 ⁻⁴	9	B	.. 1.8/4.00μF

Formula for calculating P_v(W) and I(A) :

$$Q = 2 \pi \times f \times U^2 \times C \times 10^{-9} \text{ (kVAr)}$$

$$I = Q/U \text{ (A)}$$

$$P_v = I^2 \times R_s + Q \times 10^{-4} \text{ (W)}$$

EXAMPLE

Type Phao 1.5/1μF(= version A) on U = 1000V and f = 4000Hz ?

$$Q = 2 \pi \times 4000 \times 1000^2 \times 10^{-6} \text{ (Var)} = 25130 \text{ Var}$$

$$I = 25130/1000 = 25.13\text{A}$$

$$P_v = 25.13^2 \times 1 \times 10^{-3} + 25130 \times 10^{-4} = 3.145\text{W}$$

= > version A not suitable, take version B type Phao 2.2/1μF.

CERTIFICATE

Registration-Number: 2556/QM/03.94

This is to certify that the company

VISHAY

VISHAY ELECTRONIC GmbH
Division ESTA

at the following locations

Riegrova 1231, CZ-38801 Blatna
Pasticka 1243, CZ-38801 Blatna
Hofmark-Aich-Straße 36, D-84030 Landshut

has implemented and maintains a
Quality-Management System for the following scope:

Heavy Current Capacitors
High Voltage Units

This QM-System complies with the requirements of:

DIN EN ISO 9001:2000

This Certificate is valid until 19.03.2006

VDE Testing and Certification Institute
Certification



D-63069 Offenbach/Main, Merianstraße 28
Date: 02.04.2003
2556-9110-0004/27625

The VDE Testing and Certification Institute is accredited by DAR Accreditation Bodies according to DIN EN 45012 and notified in the EU under ID. No. 0366.



FLUORESCENT LAMP/MOTOR CAPACITORS



POWER-FACTOR CONTROLLER



FURNANCE CAPACITORS



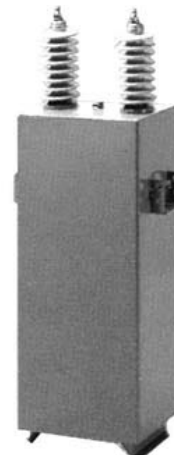
POWER ELECTRONIC CAPACITORS



LOW VOLTAGE CAPACITOR SYSTEMS



HIGH-VOLTAGE CAPACITORS









WORLDWIDE SALES CONTACTS

DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS

THE AMERICAS

VISHAY AMERICAS

2100 WEST FRONT STREET
STATESVILLE, NC 28677
UNITED STATES
PH: +1-704-872-8101
FAX: +1-704-873-8847

ASIA

VISHAY INTERTECHNOLOGY ASIA PTE LTD.

25 TAMPINES STREET 92
KEPPEL BUILDING #02-00
SINGAPORE 528877
PH: +65-6788-6668
FAX: +65-6788-0988

JAPAN

VISHAY JAPAN CO., LTD.

SHIBUYA 3F, GE EDISON BUILDING
3-5-16 SHIBUYA
SHIBUYA-KU
TOKYO 150-0002
JAPAN
PH: +81-3-5464-6411
FAX: +81-3-5464-6433

EUROPE

VISHAY ELECTRONIC GmbH

Division ESTA
HOFMARK-AICH-STRASSE 36
84030 LANDSHUT
GERMANY
PH: +49-871-86-0
FAX: +49-871-86 25 06

VISHAY S.A.

4, RUE DE SALONIQUE
95101 ARGENTEUIL
FRANCE
PH: +33-1-39-98-22-00
FAX: +33-1-39-98-22-05

VISHAY LTD.

PALLION INDUSTRIAL ESTATE
SUNDERLAND, SR4 6SU
GREAT BRITAIN
PH: +44-191-514-4155
FAX: +44-191-567-8262

ONLINE INFORMATION

For product information and a current list of sales reps and distributors, visit our website:

www.vishay.com

ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS



VISHAY INTERTECHNOLOGY, INC.

World Headquarters

63 Lincoln Highway

Malvern, PA 19355-2143

United States

www.vishay.com

© Copyright Vishay Intertechnology, Inc.
Registered Trademarks of Vishay Intertechnology, Inc.
All rights reserved. Printed in Germany.
Specifications subject to change without notice.

Databook VSD-DB0042-0208