High Voltage Ceramic Capacitors Radial-Leaded Singlelayer Disc

FEATURES

- Ceramic singlelayer DC disc / AC disc capacitor
- High reliability
- High capacitance values up to 2 nF
- Small sizes
- Low losses
- Radial leads
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS
COMPLIANT

DESIGN SUPPORT TOOLS

click logo to get started

3D Models Available

OPTIONS (on request)

- 20 kV rated voltage
- ± 10 % tolerance on nominal C-value
- Customized lead styles

APPLICATIONS

High voltage power supplies for x-ray sources and pulsed lasers

- Baggage scanner
- Medical x-ray
- Industrial laser

QUICK REFERENCE DATA

DESCRIPTION	VALUE	
Ceramic Class	2	
Ceramic Dielectric	Y6P	
Temperature Coefficient of Capacitance	± 10 % within -30 °C and +105 °C	
Voltage ($U_{rated, DC}$)	10 000	15 000
Min. Capacitance (pF)	100	100
Max. Capacitance (pF)	2000	2000
Capacitance Tolerance	± 20 %	
Max. Dissipation Factor (%)	1.0 and 1.5	
Min. Insulation Resistance (GΩ)	200	
Operating Temperature (°C)	-30 to +105	
Mounting	Radial	

DESIGN

The capacitors consist of a ceramic disc of which both sides are silver-plated. Connection leads are made of tinned copper clad steel wire having diameters of 0.02" (0.6 mm) and 0.03" (0.8 mm).

The capacitors may be supplied with straight leads having lead spacing of 0.37" (9.5 mm) and 0.49" (12.5 mm).

Coating is made of flame retardant epoxy resin in accordance with "UL 94 V-0".

INSULATION RESISTANCE

Min. 200 000 MΩ at 500 V_{DC} / 60 s max.

TOLERANCE ON CAPACITANCE

± 20 %

DISSIPATION FACTOR

≤ 1 nF: max. 1.0 %

> 1 nF: max. 1.5 %

OPERATING TEMPERATURE RANGE

-30 °C to +105 °C

CAPACITANCE RANGE

100 pF to 2000 pF

DIELECTRIC STRENGTH BETWEEN LEADS

1.5 x $U_{rated, DC}$ for maximum 60 s in insulation liquid

Test voltage: customer re-test 1.35 x $U_{rated, DC}$ for maximum 60 s in insulated liquid

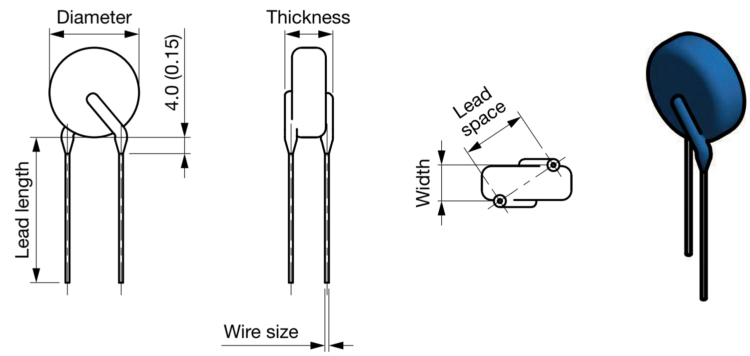
Note

- Considered as destructive test

CERAMIC DIELECTRIC

Y6P (± 10 % within -30 °C and +105 °C)

DIMENSIONS in millimeters (inches)



ORDERING INFORMATION, CERAMIC 10 kV_{DC}

C (pF)	TOL. (%)	MAXIMUM DIAMETER		MAXIMUM THICKNESS		LEAD SPACE ± 1 mm (± 0.04")		WIRE SIZE ± 0.05 mm (± 0.002") (1)		LEAD LENGTH -3 mm (-0.12")		WIDTH ± 0.5 mm (± 0.02")		ORDERING CODE
		mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	
100	± 20	8	0.31	7.5	0.30	12.5 and 9.5	0.49 and 0.37	0.8 and 0.6	0.032 and 0.024	30	1.18	5.3	0.21	HVCC103Y6P101####
150		8	0.31									4.5	0.18	HVCC103Y6P151####
220		9	0.35									4.5	0.18	HVCC103Y6P221####
330		10	0.39									4.3	0.17	HVCC103Y6P331####
470		12	0.47									4.3	0.17	HVCC103Y6P471####
680		13	0.51									3.8	0.15	HVCC103Y6P681####
1000		15	0.59									3.8	0.15	HVCC103Y6P102####
1500		17	0.67									3.8	0.15	HVCC103Y6P152####
2000		18	0.71									3.8	0.15	HVCC103Y6P202####

ORDERING INFORMATION, CERAMIC 15 kV_{DC}

C (pF)	TOL. (%)	MAXIMUM DIAMETER		MAXIMUM THICKNESS		LEAD SPACE ± 1 mm (± 0.04")		WIRE SIZE ± 0.05 mm (± 0.002") (1)		LEAD LENGTH -3 mm (-0.12")		WIDTH ± 0.5 mm (± 0.02")		ORDERING CODE
		mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	
100	± 20	8	0.31	8	0.31	12.5 and 9.5	0.49 and 0.37	0.8 and 0.6	0.032 and 0.024	30	1.18	5.3	0.21	HVCC153Y6P101####
150		8	0.31									4.5	0.18	HVCC153Y6P151####
220		9	0.35									4.5	0.18	HVCC153Y6P221####
330		10	0.39									4.3	0.17	HVCC153Y6P331####
470		12	0.47									4.3	0.17	HVCC153Y6P471####
680		13	0.51									4.3	0.17	HVCC153Y6P681####
1000		15	0.59									4.3	0.17	HVCC153Y6P102####
1500		19	0.75									4.3	0.17	HVCC153Y6P152####
2000		19	0.75									4.3	0.17	HVCC153Y6P202####

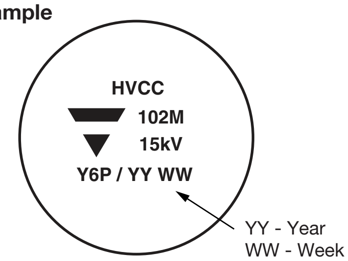
Notes

- 20 kV, customized lead styles, and ± 10 % tolerance are available upon request

(1) #20 AWG = 0.8 mm
#22 AWG = 0.6 mm

MARKING

Sample



ORDERING CODE

H	V	C	C	1	5	3	Y	6	P	1	0	2	M	E	A	X
1				2			3			4			5	6		7

1	2	3	4	5	6	7
SERIES (**H**IGH **V**OLTAGE **C**ERAMIC **C**APACITOR)	RATED VOLTAGE	TEMPERATURE CHARACTERISTICS	CAPACITANCE VALUE	CAPACITANCE TOLERANCE	1st DIGIT: LEAD TYPE / LEAD SPACING / GAUGE 2nd DIGIT: LEAD LENGTH	PACKAGING

LEAD TYPE (position 6)

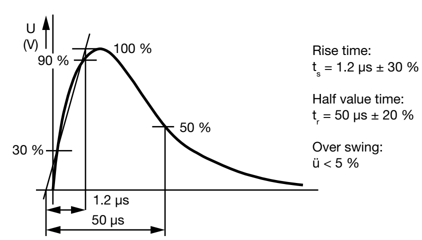
STANDARD TYPE						
CODE	**LEAD TYPE**	**LEAD SPACING (mm)**	**LEAD DIAMETER (mm)**	**# GAUGE**	**MATERIAL**	**LEAD LENGTH (mm)**
AA	Straight LL	9.5 ± 1.0	0.8	20	TCCSW	30 - 3
AB	Straight SL	9.5 ± 1.0	0.8	20	TCCSW	3.5 ± 1
BA	Inline LL	9.5 ± 1.0	0.8	20	TCCSW	30 - 3
BB	Inline SL	9.5 ± 1.0	0.8	20	TCCSW	3.5 ± 1
CA	Straight LL	9.5 ± 1.0	0.6	22	TCCSW	30 - 3
CB	Straight SL	9.5 ± 1.0	0.6	22	TCCSW	3.5 ± 1
DA	Inline LL	9.5 ± 1.0	0.6	22	TCCSW	30 - 3
DB	Inline SL	9.5 ± 1.0	0.6	22	TCCSW	3.5 ± 1
EA	Straight LL	12.5 ± 1.0	0.8	20	TCCSW	30 - 3
EB	Straight SL	12.5 ± 1.0	0.8	20	TCCSW	3.5 ± 1
FA	Inline LL	12.5 ± 1.0	0.8	20	TCCSW	30 - 3
FB	Inline SL	12.5 ± 1.0	0.8	20	TCCSW	3.5 ± 1
GA	Straight LL	12.5 ± 1.0	0.6	22	TCCSW	30 - 3
GB	Straight SL	12.5 ± 1.0	0.6	22	TCCSW	3.5 ± 1
HA	Inline LL	12.5 ± 1.0	0.6	22	TCCSW	30 - 3
HB	Inline SL	12.5 ± 1.0	0.6	22	TCCSW	3.5 ± 1

Notes

- 1th digit: lead type / lead spacing / gauge
  2nd digit: A = long leads, B = short leads
- LL = long leads
  SL = short leads
- TCCSW = **t**inned **c**opper **c**lad **s**teel **w**ire

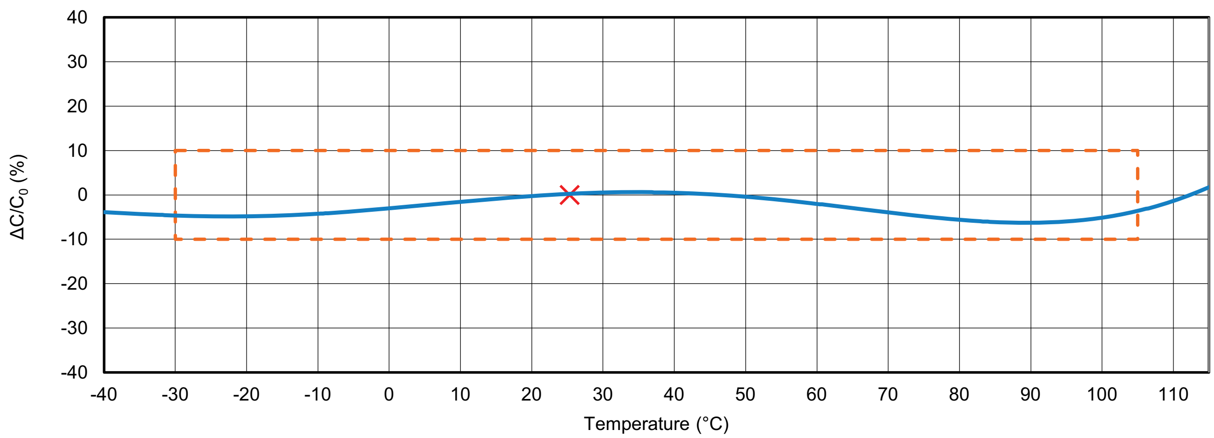
PACKAGING (position 7)	
CODE	**VERSION**
X	Bulk

PERFORMANCE

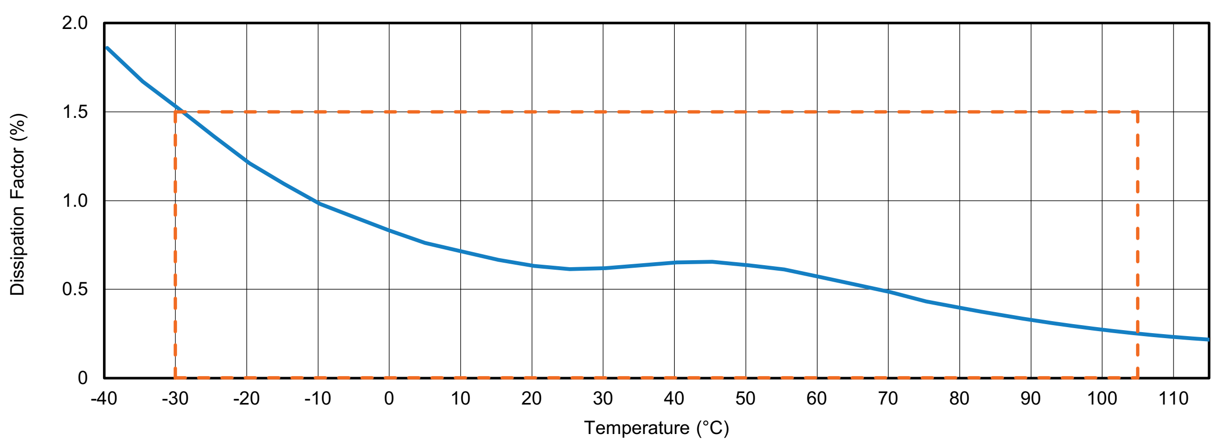
NO.	PARAMETER	SPECIFICATION	
		TEST CONDITIONS	**METHOD AND NOTES**
1	Capacitance	Tol. K = ± 10 % at 1000 h Tol. M = ± 20 % at 1000 h	Components are measured with a LCR-meter. Consider aging of ceramic. Given tolerance is valid 1000 h ± 24 h after last heating. Before and after that moment, aging offset has to be considered. (See general information for further instructions)
2	Dissipation factor	DF / tan δ = max. 1.5 %	
3	Insulation resistance	I_R = min. 10 GΩ t = 5 s U = 500 V_{DC} ± 10 V_{DC}	NOTE: very high resistances are sensitive to the surrounding area may lead to unstable measurement values
4	Dielectric strength (between lead wires)	U1 = +1.75 x U_{RDC} U2 = -1.75 x U_{RDC} t_{U1} = t_{U2} = 5 s $I_{max.}$ = 50 mA	1. Apply +1.75 x U_{RDC} for max. 5 s 2. Unload part ($I_{max.}$ = 50 mA) 3. Apply -1.75 x U_{RDC} for max. 5 s 4. Unload part ($I_{max.}$ = 50 mA) 5. Avoid current spikes higher than 50 mA
5	Appearance and marking	No visible damage. The marking shall be legible	Visual inspection by AOI
6	Dimensions	Dimensions are within specification	Measurement by AOI
7.1	Temperature characteristics / **TCC**	EIA code = Y6P $\Delta C/C_0$ = ± 10 % Temp. range = -30 °C to 105 °C	Measurement is done from cooler temperatures to hotter temperatures in reasonable temperature steps. Other way round you get have to consider deaging effects.
7.2	Temperature characteristics / **TCDF**	DF / tan δ = max. 1.5 % Temp. range = 20 °C to 105 °C	
8.1	Dielectric strength between lead wires	U = 1.5 x U_{RDC} t = 60 s $I_{max.}$ = 50 mA	1. Apply 1.5 x U for max. 60 s 2. Avoid current spikes higher than 50 mA 3. Voltage breakdowns are not accepted NOTE: considered as destructive test
8.2		U = 1.5 x U_{NAC} t = 60 s	
8.3	Dielectric strength of body insulation	U = 5000 V_{DC} t = 60 s	1. Connect both lead wires together 2. Dip component headfirst into a bath with oil and metal balls (fig.) 3. Apply voltage between lead wires and metal balls
9	Pulse test	t_r = 1.2 µs t_f = 50 µs U = 1.5 x U_{RDC} n = 50 x single polarity	
10	Life test	U = 1.5 x U_{RDC} t = min. 1000 h T = max. 105 °C $I_{max.}$ = 50 mA	1. Initial measurement including no. 1, 2, 3, and 8.1 2. Condition the components to test temperature 3. Carry out life test / avoid 0 Ω short circuit 4. Final measurement including no. 1, 2, 3, and 8.1 Result: voltage breakdowns are not accepted
11	Steady state test (without load)	T = 40 °C RH = 93 % t = 240 h / 10 days U = 1.5 x U_{RDC}	1. Initial measurement including no. 1, 2, 3, and 8.1 2. Carry out steady state test 3. Final measurement including no. 1, 2, 3, and 8.1 Result: voltage breakdowns are not accepted

PERFORMANCE			
NO.	PARAMETER	SPECIFICATION	
		TEST CONDITIONS	METHOD AND NOTES
12	Temperature cycle	T_{LOW} = -40 °C T_{HIGH} = +105 °C t_{DWELL} = 1800 s t_{CHANGE} = about 300 s n = 50 x	1. Initial measurement including no. 1, 2, 3, and 8.1 2. Carry out temperature cycle 3. Final measurement including no. 1, 2, 3, and 8.1 Result: voltage breakdowns and cracks in coating are not accepted
13	Solderability	T_{SOLDER} = max. 250 °C t = max. 3 s dist. solder-epoxy = min. 2 mm	1. Initial measurement incl. no. 1, 2, 3, and 8.1 2. Carry out test (solder material: no known restrictions) 3. Final measurement incl. 1, 2, 3, and 8.1 Result: voltage breakdowns are not accepted
14	Strength of lead wire / pulling	F_{PULL} = max. 10 N t_{PULL} = max. 10 s	Fix the body of component, apply a tensile weight gradually to each lead wire in the radial direction of capacitor up to 20 N, and keep it for 10 s ± 1 s
15	Strength of lead wire / bending	F_{BEND} = max. 5 N t_{BEND} = 2 s to 3 s	Bending each lead wire to 90° from the lead egress with 2.5 N force, then back to original position and bent again from the same direction. Totally 3 bends, 3 s each time. 1 bend: bending to 90° the return to normal position is one bend. Start from 1.6 mm to 3.2 mm from the part body

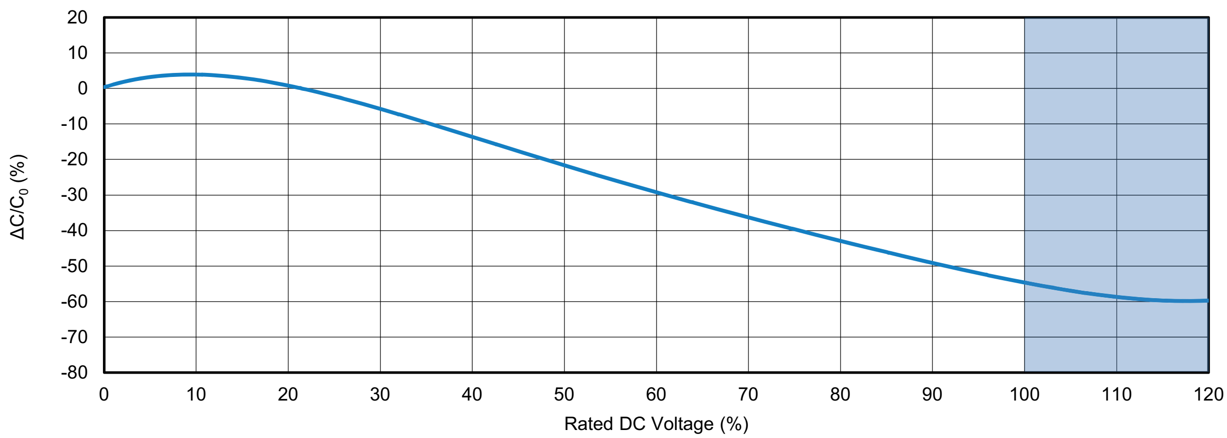
TYPICAL TCC Y6P



TYPICAL TCDF Y6P



TYPICAL Y6P - $\Delta C/C_0$ / % VS. $U_{rated, DC}$



1. QUALIFICATION

1.1 BASICS

All components are tested according to the related testing plan, which you find in series datasheet. The test procedures are more severe than noted in the datasheet due to aging and storage effects of the components. We do not guarantee if any limit is exceeded.

1.2 LIMITS OF APPLICATION

Please take care whilst designing our parts into one of these applications, which require highest reliability and possible errors might harm life, body or property of a third party.

- Transportation (aerospace, aircraft, train, ship, submarine, etc.)
- Medical equipment
- Critical control equipment (power plant, traffic signals, disaster prevention)
- Other application requiring similar reliability characteristics

2. STORAGE

2.1 ORIGINAL PACKAGING

Storing in the sealed original packages is preferred.

2.2 STORING CONDITIONS

Epoxy coating does not protect perfectly from all environmental conditions. Some materials can penetrate the epoxy and harm the performance of the parts. Therefore it is not recommended to use or store the parts in corrosive or humid atmosphere.

Optimal storing conditions should not exceed -10 °C to +40 °C and 15 % to 85 % relative humidity. When following these recommendations it is impossible, drying at 150 °C / 60 min is recommended before assembly.

3. ASSEMBLY

3.1 WIRE FORMING

If wire forming is needed, excessive mechanical force to the component body must be avoided as it might cause cracks in the ceramic element.

Do not crack coating extension of the epoxy layer, when applying force onto the wire.

3.2 SOLDERING

Do not exceed resistance to soldering heat specification of the component. Subjecting this product to excessive heating could melt the internal junction solder and may result in thermal shocks that can crack the ceramic element.

Manual Soldering / Rework

Set the soldering iron (50 W max.) to less than 400 °C and solder the wires within 4 seconds onto the PCB. Exceeding that recommendations might reduce the electrical performance of the component.

Wave Soldering

Most common way to assemble these kind of components is carried out in 4 steps:

1. Increasing temperature to 120 °C within about 20 s
2. Preheating at 120 °C for about 60 s
3. Soldering at 260 °C in less than 10 s
4. Gradual air cooling in constant air flow

Reflow Soldering

It is not recommended to use reflow soldering with these components.

3.3 MOLDING AND COATING

Molding and / or applying another coating material might harm the performance of the components. Therefore it is recommended to test the electrical characteristics of the molded / coated part in advance.

Typical error is a reduced withstand voltage because of an inadequate solvent in the molding material, which penetrates the epoxy coating. A similar result can be caused by an inadequate coating material, which might pull the original epoxy off the ceramic element.

4. CLEANING AND DRYING

4.1 CLEANING AGENTS

Cleaning agents might have an influence to the performance of the components after washing and after unsuitable drying. The following agents have been tested and classified:

Recommended

- DI water
- Isopropanol
- Ethanol
- Ehtyl alcohol
- ...

Not Recommended

- Acetone
- ...

4.2 ULTRASONIC

Settings for ultrasonic cleaning

Rinse bath capacity: output of 20 Watts per liter or less

Rinsing time: 5 min max.

Do not vibrate the PCB / PWB directly.

Excessive ultrasonic cleaning may lead to permanent destruction of the component.

4.3 DRYING

It is recommended to dry the assembled PCB (washed components) for 1 hour at a temperature of 20 °C higher than the boiling point of the used cleaning agent. Exceeding 150 °C permanently should be avoided.

5. TESTING AND OPERATION

5.1 SHORT CIRCUIT

Avoid repetitive zero-ohm-short circuits because they might harm the components core construction, such as arcs between lead wires because of inadequate insulation material (e.g air).

5.2 INSULATION

During operation, components should be surrounded by adequate insulating material (silicone oil, epoxy or molding material). Voltage breakdowns or leakage current through this material (between lead wires or to ground) is not acceptable.

5.3 APPLIED VOLTAGE

When using DC-rated components in AC applications (also ripple) the peak to peak voltage should not exceed the nominal DC-rating of the component.

For technical questions, contact: slcap@vishay.com

5.4 FREQUENCY AND SELF HEATING

Applying higher frequencies (> 50 Hz) does also lead to higher losses and to self heating of the component. The surface temperature of the component must be kept below the maximum operating temperature. Adaptation of the insulation media might increase cooling effect.

6. CAUTION

6.1 OPERATING VOLTAGE AND FREQUENCY CHARACTERISTIC

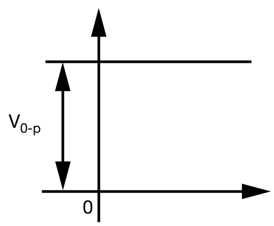
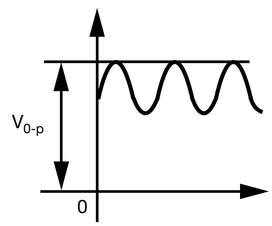
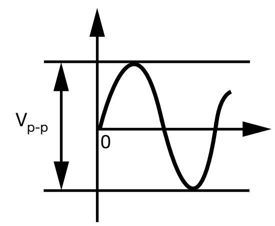
When sinusoidal or ripple voltage applied to DC ceramic disc capacitors, be sure to maintain the peak-to-peak value or the peak value of the sum of both AC + DC within the rated voltage.

When start or stop applying the voltage, resonance may generate irregular voltage.

When rectangular or pulse wave voltage is applied to DC ceramic disc capacitors, the self-heating generated by the capacitor is higher than the sinusoidal application with the same frequency. The allowable voltage rating for the rectangular or pulse wave corresponds approximately with the allowable voltage of a sinusoidal wave with the double fundamental frequency.

The allowable voltage varies, depending on the voltage and the waveform.

Diagrams of the limiting values are available for each capacitor series on request.

VOLTAGE	DC	DC + AC	AC
Waveform figure			

6.2 OPERATING TEMPERATURE AND SELF-GENERATED HEAT

The surface temperature of the capacitors must not exceed the upper limit of its rated operating temperature.

During operation in a high-frequency circuit or a pulse signal circuit, the capacitor itself generate heat due to dielectric losses.

Applied voltage should be the load such as self-generated heat is within 20 °C on the condition of environmental temperature 25 °C.

Note, that excessive heat may lead to deterioration of the capacitor's characteristics.

RELATED DOCUMENTS	
General Information	www.vishay.com/doc?22001
Product Sheet	www.vishay.com/doc?
Infographic	www.vishay.com/doc?48450

SAMPLE KIT	
Part Number	HVCC-KIT-HV
Link	www.vishay.com/doc?45251

For technical questions, contact: slcap@vishay.com

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