Ceramic DC Disc, RFI, and Safety Capacitors

IN ACCORDANCE WITH IEC RECOMMENDATIONS CERAMIC CAPACITORS ARE SUBDIVIDED INTO TWO CLASSES:

- CERAMIC CLASS 1 or low-K capacitors are mainly manufactured of titanium dioxide or magnesium silicate
- CERAMIC CLASS 2 or high-K capacitors contain mostly alkaline titanates

MAIN FEATURES		
	CLASS 1	**CLASS 2**
APPLICATION	For temperature compensation of frequency discriminating circuits and filters, coupling and decoupling in high-frequency circuits where low losses and narrow capacitance tolerances are demanded. As RFI and safety capacitors.	As coupling and decoupling capacitors for such application where higher losses and a reduced capacitance stability are required. As RFI and safety capacitors
PROPERTIES Temperature Dependence Capacitance	High stability of capacitance. Low dissipation factor up to higher frequencies. Defined temperature coefficient of capacitance, positive or negative, linear and reversible. High insulation resistance. No voltage dependence. High long-term stability of electrical values.	High capacitance values with small dimensions. Non-linear dependence of capacitance on temperature.
DC VOLTAGE CAPACITANCE DEPENDENCE	None	Increasing with ε
DISSIPATION FACTOR tan δ	Max. 0.0015 (typical)	Max. 0.035 (typical)
INSULATION RESISTANCE	Min. 10 000 MΩ to 200 000 MΩ	Min. 10 000 MΩ to 200 000 MΩ
CAPACITANCE TOLERANCES	< 10 pF: ± 0.25 pF, ± 0.5 pF, ± 1 pF ≥ 10 pF: ± 2 %, ± 5 %, ± 10 %, ± 20 %	± 10 %, ± 20 %, (+ 50 - 20) %, (+ 80 - 20) %
RATED VOLTAGE	100 V_{DC} up to 15 kV_{DC}	100 V_{DC} up to 15 kV_{DC}

STANDARDS AND SPECIFICATIONS	
GENERAL STANDARDS	
IEC 60062	Marking codes for resistors and capacitors
IEC 60068	Basic environmental testing procedures
SPECIAL STANDARDS FOR CERAMIC CAPACITORS	
IEC 60384-8	Fixed capacitors of ceramic dielectric, class 1
IEC 60384-9	Fixed capacitors of ceramic dielectric, class 2
STANDARDS FOR SPECIAL APPLICATION PURPOSES	
UL 60384-14	RFI - and safety capacitors
CSA 60384-14	
IEC 60384-1	
IEC 60384-14.4	
IEC 60065	

MEASURING AND TESTING CONDITIONS		
CAPACITANCE AND DISSIPATION FACTOR	Class 1 C ≥ 1000 pF: 1 kHz, 1 V_{RMS} to 5 V_{RMS} C < 1000 pF: 1 MHz, 1 V_{RMS} to 5 V_{RMS}	Class 2 C ≥ 100 pF: 1 kHz, 1.0 V_{RMS} ± 0.2 V_{RMS} C < 100 pF: 1 MHz, 1.0 V_{RMS} ± 0.2 V_{RMS}
INSULATION RESISTANCE	Rated voltage: < 100 V: measuring voltage = (10 ± 1) V ≥ 100 V to < 500 V: measuring voltage = (100 ± 15) V ≥ 500 V: measuring voltage = (500 ± 50) V Test time: 60 s ± 5 s	
DIELECTRIC STRENGTH	Rated voltage: ≤ 500 V: test voltage = 2.5 x U_R > 500 V: test voltage = 1.5 x U_R Test time: 2 s	

Notes

- Climatic test conditions: temperature 20 °C to 25 °C
- Relative humidity 50 % to 70 %

NOMINAL VALUE SERIES ACCORDING TO IEC 60063		
E6 (± 20 % TOLERANCE)	**E12 (± 10 % TOLERANCE)**	**E24 (± 5 % TOLERANCE)**
100	100	100
		110
	120	120
		130
150	150	150
		160
	180	180
		200
220	220	220
		240
	270	270
		300
330	330	330
		360
	390	390
		430
470	470	470
		510
	560	560
		620
680	680	680
		750
	820	820
		910

Note

- E6 values preferred

CAPACITANCE CODE SYSTEM ACCORDING TO IEC 60062			
CAPACITANCE VALUE	**CODE**	**VALUE**	
	p33	0.33 pF	
	3p3	3.3 pF	
	33p	33 pF	
	330p	330 pF	
	n33	330 pF (0.33 nF)	
	3n3	3300 pF (3.3 nF)	
	33n	33 000 pF (33 nF)	
	330n	330 000 pF (330 nF)	
	µ33	0.33 µF	
	3µ3	3.3 µF	
CAPACITANCE TOLERANCE	**CODE**	**< 10 pF: IN pF**	**≥ 10 pF: IN %**
	C	± 0.25	-
	D	± 0.5	-
	J		± 5
	K		± 10
	M		± 20
	Y		+ 50 / - 20
	Z		+ 80 / - 20
	P		+ 100 / - 0

CAPACITANCE CODING SYSTEM ACCORDING TO CERA-MITE STANDARD		
CODE	**CAPACITANCE VALUE**	**DIVIDER**
Q 68	e.g. 0.000068 = 68 pF	"Quad" = Q
T 68	0.00068 = 680 pF	"Triple" = T
D 68	0.0068 = 6800 pF	"Double" = D
S 68	0.068 = 68 000 pF	"Single" = S

The two digits are the significant figures of the figures of the capacitance

"Divider" - Number of zeros following the decimal point of the number of zeros following
Basis is the capacitance given in µF

CERAMIC DIELECTRIC CODING SYSTEM				
CLASS 1			**CLASS 2**	
INDUSTRY CODE	**EIA CODE**	**CODE LETTER**	**EIA CODE**	**CODE LETTER**
P100	C0K	----	X5F	B
NP0	C0G	A	X7R	C
N750	U2J	U	X7S	C
N1000	M3K	V	Y5U	E
N1500	P3K	W	Y5V	F
N2000	R3L	----	Z5U	E
N2200	R3L	X		
N2500	R3M	----		
N2800	R3M	----		
N3300	S3N	Y		
N4700	T3M	Z		

TEMPERATURE CHARACTERISTIC OF CAPACITANCE FOR CLASS 1 AND CLASS 2

CLASS 1 CERAMICS ACCORDING TO EIA-198-1, -2, -3

C **0** **G**

Significant digits of temperature coefficient

Multiplier
Multiplication by significant digits gives the TC in ppm/°C

Tolerance in ppm/°C

TOLERANCE	CODE LETTER
0.0	C
1.0	M
1.5	P
2.2	R
3.3	S
4.7	T
7.5	U

DIGIT	MULTIPLIER
0	-1
1	-10
2	-100
3	-1000
5	+1
6	+10
7	+100
8	+1000

TOLERANCE	CODE LETTER
± 30	G
± 60	H
± 120	J
± 250	K
± 500	L
± 1000	M
± 2500	N

Note

- The rated values of the TC and the accompanying limit deviations are defined using the capacitance change between +20 °C to +85 °C.

CLASS 2 CERAMICS ACCORDING TO EIA-198-1, -2, -3

Y **5** **S**

Low category temperature

Upper category temperature

Admissible capacitance change related to 25 °C over the entire temperature range

TEMPERATURE	CODE LETTER
-55 °C	X
-30 °C	Y
+10 °C	Z

TEMPERATURE	CODE FIGURE
+45 °C	2
+65 °C	4
+85 °C	5
+105 °C	6
+125 °C	7

CHANGE	CODE LETTER
± 1 %	A
± 1.5 %	B
± 2.2 %	C
± 3.3 %	D
± 4.7 %	E
± 7.5 %	F
± 10 %	P
± 15 %	R
± 22 %	S
+ 22 % / - 33 %	T
+ 22 % / - 56 %	U
+ 22 % / - 82 %	V

CLASS 1 CERAMIC TYPE
TEMPERATURE COEFFICIENT OF THE CAPACITANCE

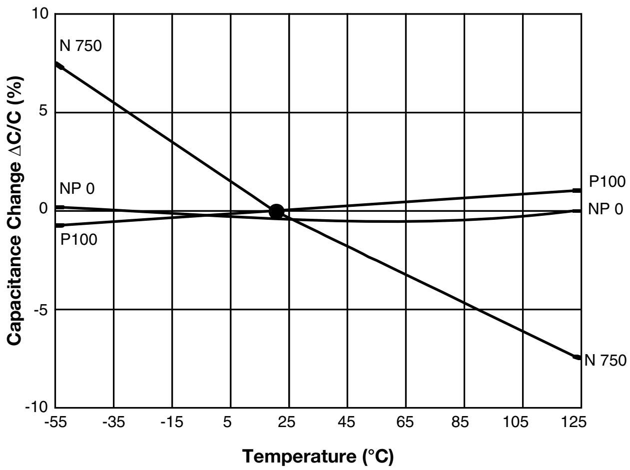
$$\frac{\Delta C}{C}[\%] = 100 \text{ x } \alpha \text{ x } \Delta\vartheta$$

ΔC = capacitance change

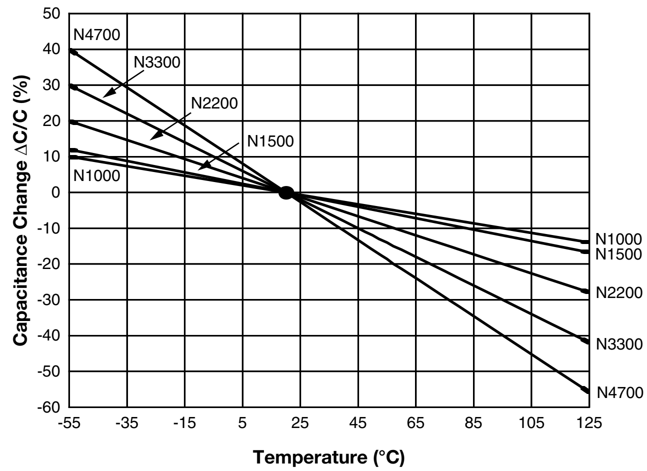
α = temperature coefficient in 10^{-6}/°C

ΔJ = temperature change in °C

Temperature coefficient of the capacitance



Temperature coefficient of the capacitance



VOLTAGE DEPENDENCE OF CAPACITANCE

None

FREQUENCY DEPENDENCE OF CAPACITANCE

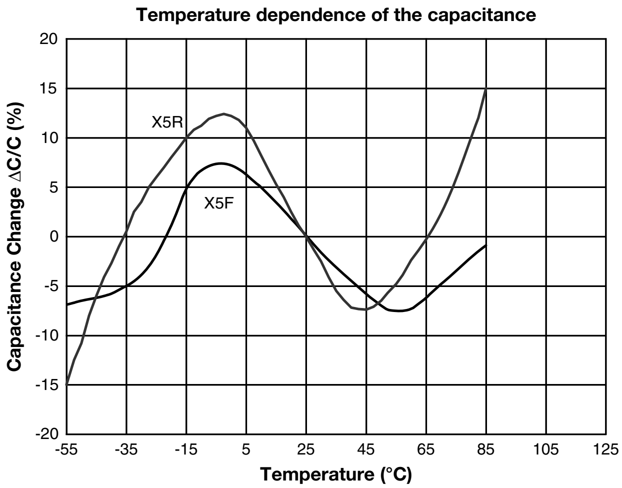
See page 8.

DISSIPATION FACTOR

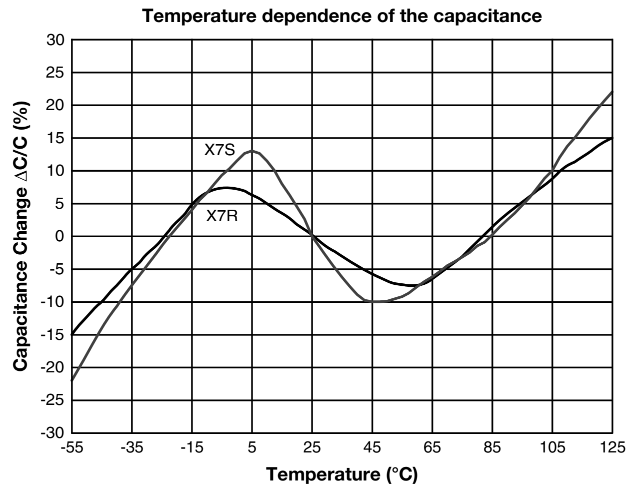
- For values greater than 50 pF: see datasheet.
- For lower values the dissipation factor is calculated according to the type of ceramic (rated temperature coefficient) under consideration of the capacitance according to EN 130600.
- The dissipation factor as well as the measuring method to be agreed between manufacturer and user for values lower than 5 pF.

CLASS 2 CERAMIC TYPE
CAPACITANCE CHANGE VS. TEMPERATURE (TYPICAL)

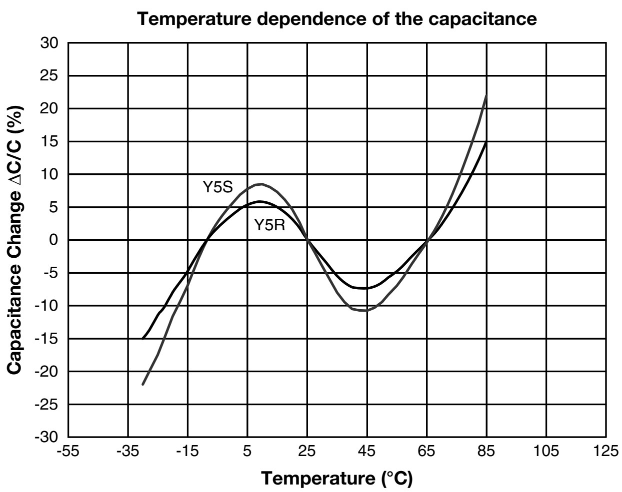
CERAMIC DIELECTRIC: X5F AND X5R



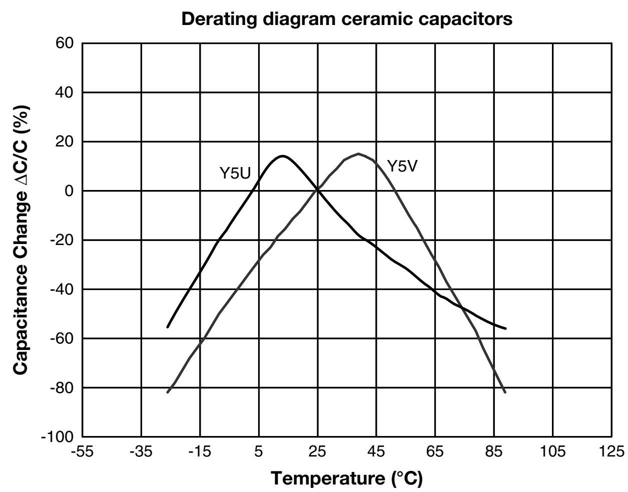
CERAMIC DIELECTRIC: X7R AND X7S



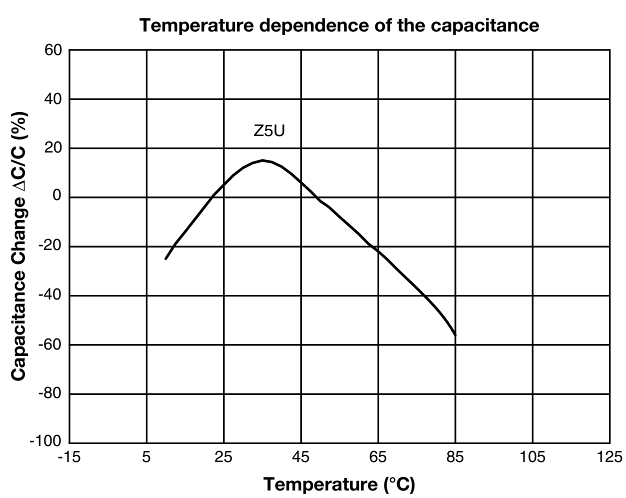
CERAMIC DIELECTRIC: Y5R AND Y5S



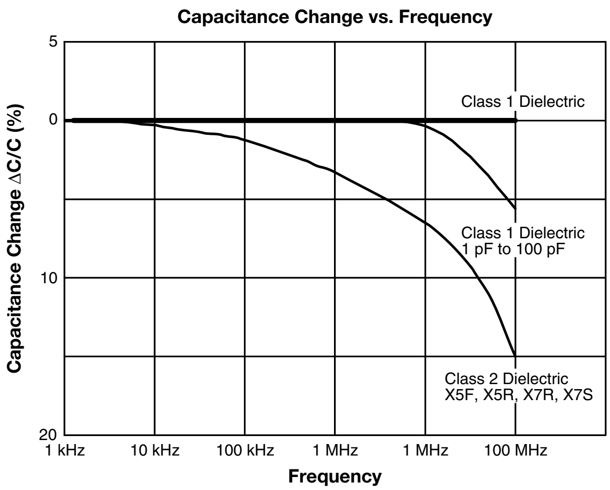
CERAMIC DIELECTRIC: Y5U AND Y5V

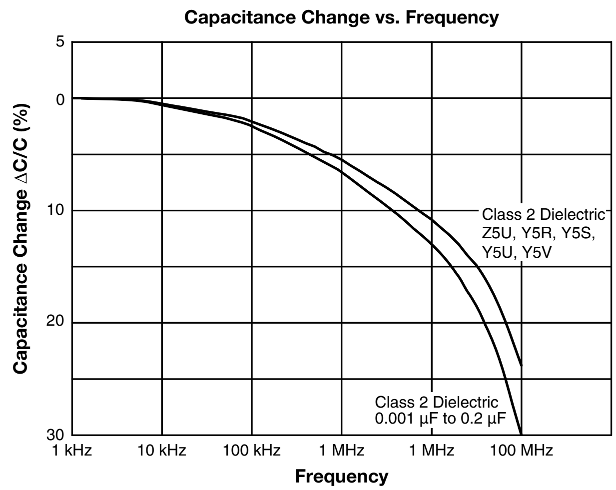


CERAMIC DIELECTRIC: Z5U

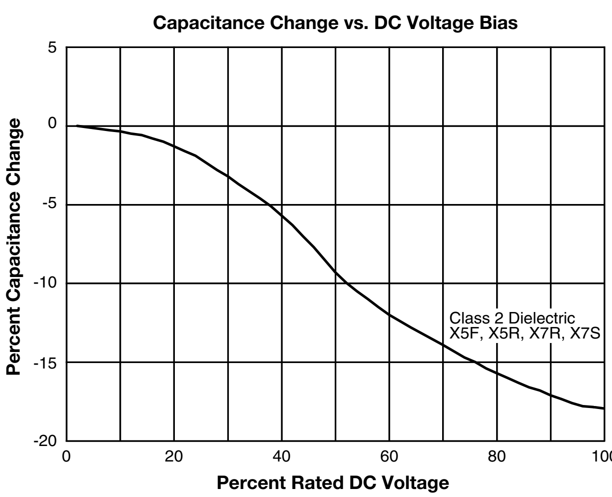


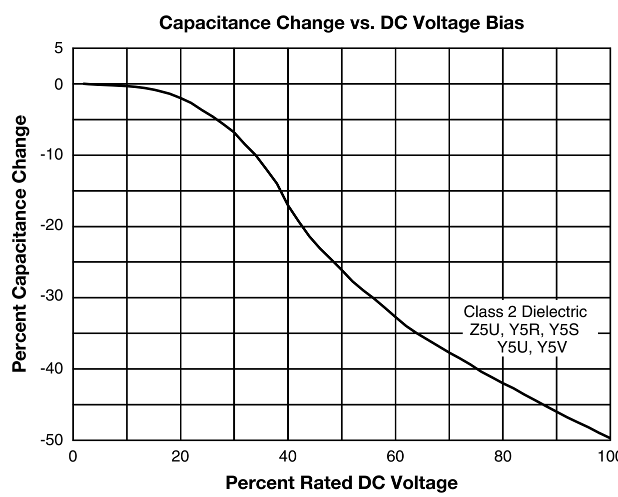
CLASS 2 CERAMIC TYPE
CAPACITANCE CHANGE VS. FREQUENCY (TYPICAL)





CAPACITANCE DECREASE VS. DC VOLTAGE BIAS (TYPICAL)





CAPACITANCE "AGING" OF CERAMIC CAPACITORS

Following the final heat treatment, all class 2 ceramic capacitors reduce their capacitance value. According to logarithmic law, this is due to their special crystalline construction. This change is called "aging". If the capacitors are heat treated (for example when soldering), the capacitance increases again to a higher value deaging, and the aging process begins again.

Note:
The level of this deaging is dependent on the temperature and the duration of the heat; an almost complete deaging is achieved at the upper category temperature in one hour. These conditions also form the basis for reference measurements when testing. The capacitance change per time decade (aging constant) differs for the various types of ceramic, but typical values can be taken from the table below.

CERAMIC MATERIAL	X5F	X7R	X7S	Y5U	Y5V	Z5U
AGING KONSTANT k	-1.5 %	-2.0 %	-3.0 %	-2.0 %	-2.5 %	-2.8 %

$$k = \frac{100 \text{ x } (C_{t1} - C_{t2})}{C_{t1} \text{ x } \log 10 \, (t_1/t_2)}$$

$$C_{t2} = C_{t1} \times (1 - k/100 \times \log 10[t_1/t_2])$$

t_1, t_2 = measuring time point (h)

C_{t1}, C_{t2} = capacitance values for the times t_1, t_2

k = aging constant (%)

REFERENCE MEASUREMENT

Due to aging, it is necessary to quote an age for reference measurements which can be related to the capacitance with fixed tolerance. According to EN 130700, this time period is 1000 hours.

If the shelf-life of the capacitor is known, the capacitance for t = 1000 h can be calculated with the aging constant.

In order to avoid the influence of aging, it is important to deage the capacitors before stress-testing. The following procedure is adopted (see also EN 130700):

- Deaging at upper category temperature, 1 hour
- Storage for 24 hours at normal climate temperature
- Initial measurement
- Stress
- Deaging at upper category temperature, 1 hour
- Storage for 24 hours at normal climate temperature
- Final measurement

COMPONENT CLIMATIC CATEGORY

40/085/21

1st SET
Minimum ambient temperature of operation (test cold)

2nd SET
Maximum ambient temperature of operation (dry heat test)

3rd SET
Number of days (steady test state)

The large number of possible combinations of tests and severities may be reduced by the selection of a few standard groupings according to IEC 60068-1.

CATEGORY EXAMPLES ACCORDING TO IEC 60068-1
25/085/04
25/085/21
40/085/21
55/125/21
55/125/56

First set: two digits denoting the minimum ambient temperature of operation (cold test)

65	-65 °C
55	-55 °C
40	-40 °C
25	-25 °C
10	-10 °C
00	0 °C
05	+5 °C

Second set: three digits denoting the maximum ambient temperature (dry heat test)

155	+155 °C
125	+125 °C
110	+110 °C
90	+90 °C
85	+85 °C
80	+80 °C
75	+75 °C
70	+70 °C
65	+65 °C
60	+60 °C
55	+55 °C

Third set: two digits denoting the number of days of the damp heat steady state test (Ca)

56	56 days
21	21 days
10	10 days
04	4 days
00	The component is not required to be exposed to damp heat

STORAGE

The capacitors must not be stored in a corrosive atmosphere, where sulphide or chloride gas, acid, alkali or salt are present. Exposure of the components to moisture, should be avoided. The solderability of the leads is not affected by storage of up to 24 months (temperature +10 °C to +40 °C, relative humidity up to 60 % RH). Class 2 ceramic dielectric capacitors are also subject to aging see previous page.

SOLDERING

SOLDERING SPECIFICATIONS Soldering test for capacitors with wire leads: (according to IEC 60068-2-20, solder bath method)		
	SOLDERABILITY	**RESISTANCE TO SOLDERING HEAT**
Soldering temperature	(235 ± 5) °C	(260 ± 5) °C
Soldering duration	(2 ± 0.5) s	(10 ± 1) s
Distance from component body	≥ 2 mm	≥ 5 mm

SOLDERING RECOMMENDATIONS

Ceramic capacitors are very sensitive to rapid changes in temperature (thermal shock) therefore the solder heat resistance specification (see table above) should not be exceeded. Exposing the capacitor to excessive heating may result in thermal shocks that can crack the ceramic body. Similarly, excessive heating can cause the internal solder junction to melt.

When soldering radial leaded ceramic capacitors with a soldering iron, it should be performed under the following conditions and should not exceed:

- Maximum temperature of iron-tip: 400 °C
- Maximum soldering iron wattage: 50 W
- Maximum soldering time: 3.5 s

Failure to follow the above cautions may result, in worst case, in short circuit or cause fuming or thermo-mechanical damage when the product is used.

Leaded ceramic capacitors are not designed for reflow process or dipping the body into a solder melt.

CLEANING

The components should be cleaned immediately following the soldering operation with vapor degreasers.

CLEANING (ULTRASONIC CLEANING)

To perform ultrasonic cleaning, observe the following conditions:

- Maximum rinse bath capacity output: 20 W/liter
- Maximum rinsing time: 300 s
- Do not vibrate the PCB/PWB directly
- Excessive ultrasonic cleaning may lead to mechanical damage

SOLVENT RESISTANCE

The coating and marking of the capacitors are resistant to the following test method:

IEC 60068-2-45 (method XA)

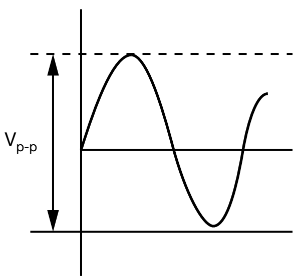
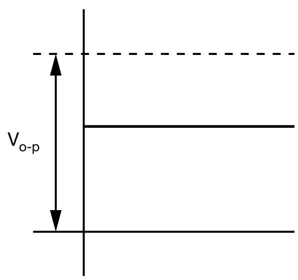
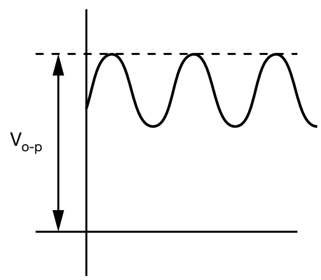
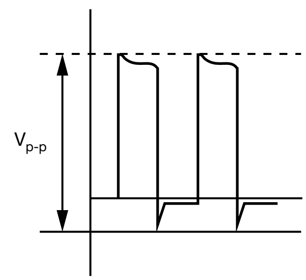
MOUNTING

We do not recommend modifying the lead terminals, e.g. bending or cropping. This action could break the coating or crack the ceramic insert. In order to avoid such failures we are offering different lead wire designs (e.g. straight, inline, inside crimp, outside crimp etc.) If however, the lead must be modified in any way, we recommend support of the lead with a clamping fixture next to the coating.

OPERATING VOLTAGE

Assuming that DC-rated capacitors are used in AC or ripple current circuits, be sure to maintain the V_{p-p} value of the applied voltage or the V_{o-p} that contains DC bias within the rated voltage range.

In case the voltage is applied to the circuit, starting as well as stopping, may generate irregular voltage for a transit period because of resonance or switching. Be sure to use a capacitor with a rated voltage range that includes these irregular voltages.

KIND OF SIGNAL			
AC VOLTAGE	**DC VOLTAGE**	**AC + DC VOLTAGE**	**PULSE VOLTAGE**
			

OPERATING TEMPERATURE AND SELF-GENERATED HEAT

Keep the surface temperature of a capacitor below the upper limit of its rated operating temperature range. Be sure to take into account the heat generated by the capacitor itself. When the capacitor is used in a high frequency, pulse, or similar application, it may have self-generated heat due to dielectric dissipation.

Temperature increase due to self-generated heating should not exceed 20 °C while operating at an atmosphere temperature of 25 °C.

When measuring, the surface temperature, make sure that the capacitor is not affected by radiant, conductive and convective heat by its surroundings. Excessive heat may lead to thermo-mechanical deterioration of the capacitor's characteristics and reliability.

ESD - ELECTROSTATIC DISCHARGE

ESD is not applicable for single layer ceramic capacitors.

MSL - MOISTURE SENSITIVITY LEVEL

MSL is not applicable for leaded ceramic capacitors.

AOQ - AVERAGE OUTGOING QUALITY

In the final control all lots (100 % lot-by-lot) are tested on sample base.

All possible defects are classified into minor and major defects.

They are defined as follows:

MAJOR DEFECTS

- Defects from which is to assume or known that they create dangerous situations for humans
- Defects which may create considerable property damage
- Defects from which is to expect that the pertain equipment will fail
- Defects which create essential reduction of the usability for the planned application

Lots with major defects always will be rejected.

It is essential: target = zero defect

MINOR DEFECTS

- Defects which do not create essential reduce the usability for the planned application
- Defects which affect the usability, function or assembly of the pertain equipment slightly
- Defects which increase substantial the internal (Vishay's) rejects

Minor defects shall not exceed the acceptance of the required sampling plan otherwise the lot will be rejected.

The AOQ is calculated on a quarterly basis for mechanical and electrical defects.

All lots with major defects and all lots with more minor defects as accepted in the relevant sampling plan will be rejected. That will be set to the ratio with the number of tested parts.

Actual the AOQ is

$AOQ_{mechanical}$: < 50 ppm

$AOQ_{electrical}$: < 150 ppm

These values are the End of Line Quality. The customer may expect lower AOQ levels.

RELIABILITY

Because of controlled manufacturing processes the quality of the ceramic capacitors is maintained on a high level.

The reliability data will be determined from the results of electrical endurance tests according the relevant national or international specification.

The endurance tests are performed on the upper category temperature and with applied load according the relevant specification. The applied voltage is up to 1.5 times of rated voltage. It depends on the specification.

As failure criterion is fixed:
Short circuit during test, 2 times the required limits according the relevant specification.

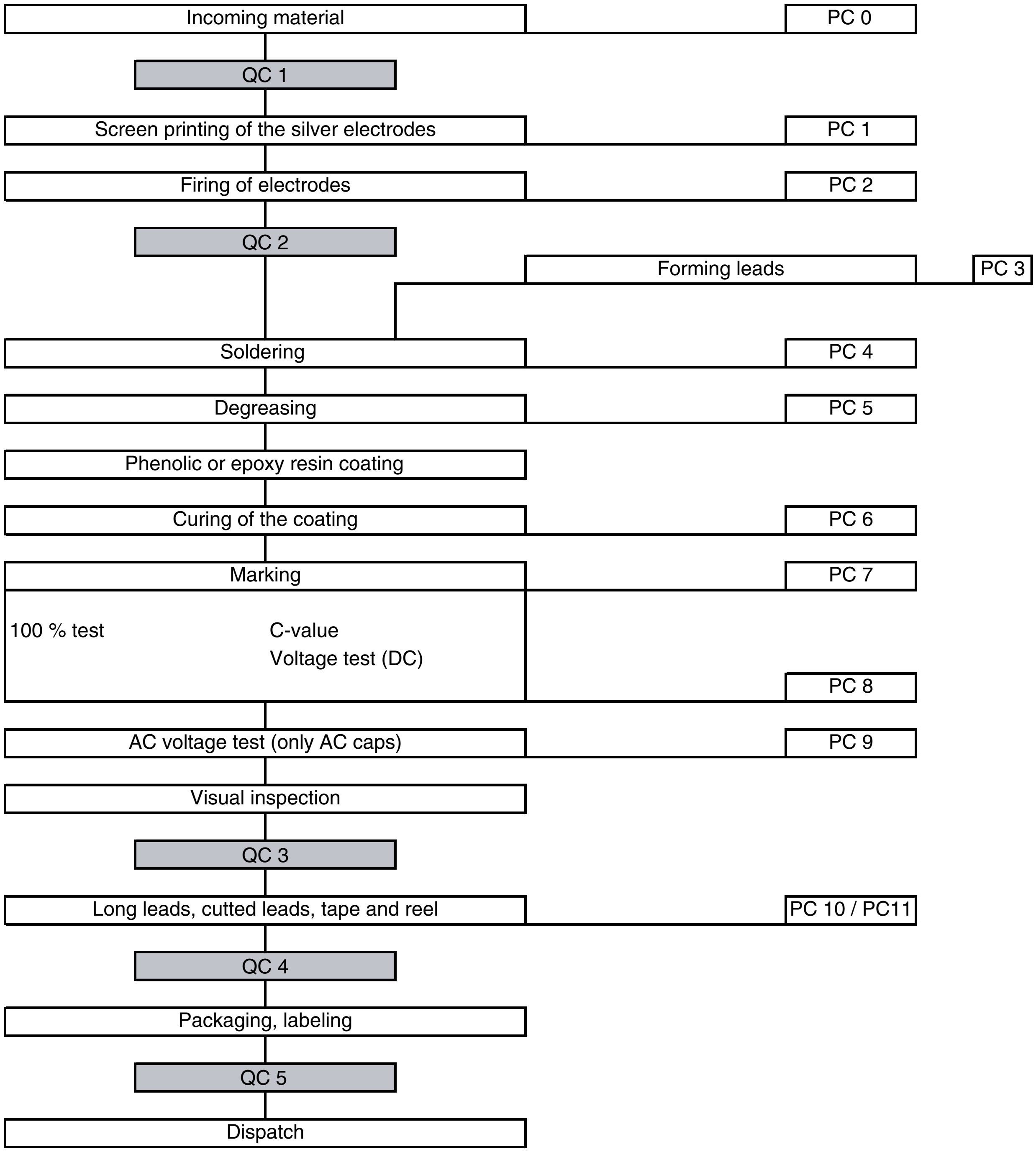
Base for reliability calculation is the international specification IEC 61709.

The failure rate of our ceramic capacitors is

CD capacitors class 1 ceramic dielectric:	100 fit
CD capacitors class 2 ceramic dielectric:	500 fit
AC line rated capacitors:	5 fit

Detailed information is available on request.

PRODUCTION FLOWCHART



PC = production control

QC = quality control

WIRE LEAD OPTIONS

Radial leaded capacitors may be ordered with various wire lead options by adding appropriate suffix code to the catalog part number.

Example: 564R30GAD22 GJ (suffix code) specifies:
#20 AWG wire; LS = 0.375"; inside crimp; short cut lead length

100 V_{DC} TO 1000 V_{DC} CAPACITORS			SUFFIX CODES FOR VARIOUS LEAD SPACING (LS) AND WIRE SIZE (AWG) VOLT CAPACITORS						
WIRE FORM DESCRIPTION	FIG.	LEAD LENGTH	0.200" (5.0)		0.250" (6.3)		0.300" (7.5)	0.375" (9.5)	0.400" (10.0)
			#22 AWG	#24 AWG	#22 AWG	#24 AWG	#22 AWG	#22 AWG	#22 AWG
Straight wire	11	Long “LL”	MA	PA	UB	UA	BK	BJ	BL
Steeple wire	12	Long “LL”	CL	PT	CJ	CH	CA	CK	CB
		Cut “CL”	NB	PK	NK	NG	NC	ND	NE
Step wire	14	Long “LL”	VD	VK	VB	PQ	VF	VG	VH
		Cut “CL”	PG	PU	PR	PL	PH	PS	PJ
Inside crimp	15	Long “LL”	JQ	JT	JC	JF	JL	JS	JP
		Cut “CL”	JA	JD	JK	JY	JR	JJ	JB

2 kV_{DC} TO 3 kV_{DC} CAPACITORS			SUFFIX CODES FOR VARIOUS LEAD SPACING (LS) AND WIRE SIZE (AWG) VOLT CAPACITORS										
WIRE FORM DESCRIPTION	FIG.	LEAD LENGTH	0.250" (6.3)		0.300" (7.5)		0.375" (9.5)		0.400" (10.0)		0.500" (12.7)		0.750" (19)
			#20 AWG	#22 AWG	#20 AWG	#22 AWG	#20 AWG	#22 AWG	#20 AWG	#22 AWG	#20 AWG	#22 AWG	#20 AWG
Straight wire	11	Long “LL”	AA	UB	AE	BK	AJ	BJ	AD	BL	AM	BM	AB
Inline wire	13	Long “LL”	XW	XY	UC	UE	UG	UJ	UL	UM	UQ	US	-
		Cut “CL”	XX	XZ	DU	UF	UH	UK	UN	UP	UR	UT	-
Inside crimp	15	Long “LL”	GB	JC	GC	JL	GN	JS	GD	JP	GF	JN	-
		Cut “CL”	GE	JK	JH	JR	GJ	JJ	JG	JB	GM	JM	-

Notes

- Popular wire lead form options are described above; consult factory for other available forms.
- Practical consideration may limit wire options depending on capacitor size - verify special requirements with factory.

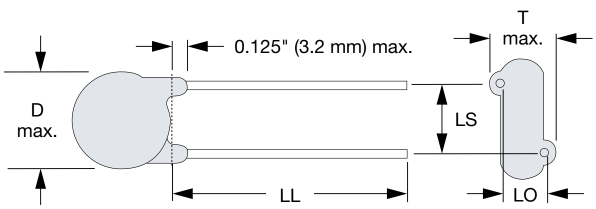
WIRE INFORMATION	
#20 AWG	0.032" (0.81) copper wire
#22 AWG	0.025" (0.64) copper wire
#24 AWG	0.020" (0.51) copper clad steel wire

LEAD LENGTH INFORMATION

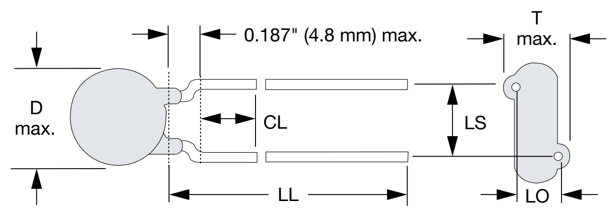
- Standard long lead “LL” length = 1.250" (32 mm) minimum
- Cut lead “CL” length may be user specified; if unspecified, Vishay Cera-Mite supplies 0.187" (4.8 mm) EIA standard
- Cut lead lengths are measured from bottom of wire seating plane (wire support point on circuit board)
- Minimum cut lead lengths “CL min” are contained in wire figures 12 thru 15
- Cut lead length tolerance: + 0.031" / - 0.015" (0.8 mm / - 0.4 mm)

STANDARD LEAD CONFIGURATIONS

Straight Fig. 11

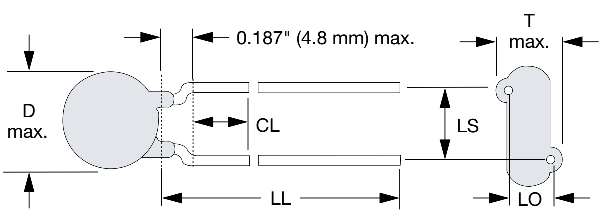


Step Low Voltage Fig. 14



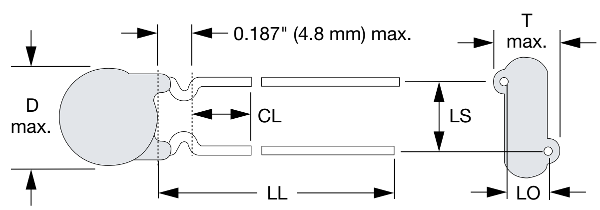
Minimum CL = 0.140" (3.6 mm)

Steeple Fig. 12



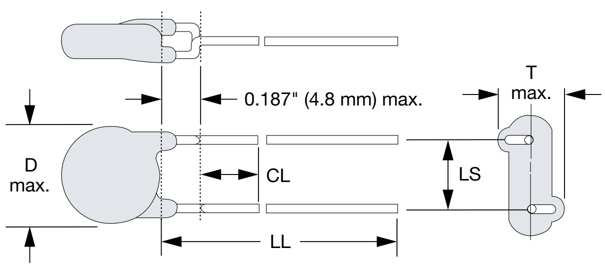
Minimum CL = 0.140" (3.6 mm)

Inside Crimp Fig. 15



Minimum CL = 0.120" (3 mm)

Inline Fig. 13



Minimum CL = 0.120" (3 mm) inline wire, LO = 0

For technical questions, contact: ceramitesupport@vishay.com

PACKAGING OPTIONS

Parts will be bulk packaged in cartons or plastic bags unless optional packaging is specified.
Consult factory for other packaging options such as taped and reeled or ammopack.

TAPE AND REEL OPTIONS

Radial leaded parts may be ordered with tape and reel packaging by adding appropriate suffix code to part number.

Example: 562R5GAS10QR (suffix code) specifies:
#22 AWG wire; straight lead form; LS = 5 mm; tape and reel per EIA 468B.

TAPE AND REEL PACKAGING PART NUMBER SUFFIX				TAPE AND REEL SUFFIX CODES FOR VARIOUS WIRE FORMS AND SIZES												
TAPE AND REEL FIG.	LS (mm)	MAX. DISC DIAMETER		TAPE AND REEL STANDARD FIG. 16	STRAIGHT WIRE FIG. 11			STEEPLE WIRE FIG. 12		INLINE WIRE FIG. 13		STEP WIRE FIG. 14		INSIDE CRIMP WIRE FIG. 15		
		(in)	(mm)		#20 AWG	#22 AWG	#24 AWG	#22 AWG	#24 AWG	#20 AWG	#22 AWG	#22 AWG	#24 AWG	#20 AWG	#22 AWG	#24 AWG
A	5.0	0.490	12.4	C-M	QG	QA	QB	TK	WK	XA	ZA	VC	VQ	RA	RE	RB
				EIA	QH	QR	QD	TR	TX	XB	XN	VZ	VE	RC	RR	LA
B	7.5	0.530	13.5	C-M	QP	QK	-	-	-	XG	ZC	-	-	RP	RK	-
				EIA	QS	QF	-	-	-	XH	XR	-	-	RX	RL	-
C	10.5	0.708	18.0	C-M	QQ	QM	-	-	-	XJ	XS	-	-	RQ	RM	-
				EIA	AP	QX	-	-	-	XK	XT	-	-	RJ	RU	-
D	7.5	0.708	18.0	C-M	QW	QN	-	-	-	XL	XU	-	-	RW	RN	-
				EIA	AQ	QE	-	-	-	XM	XV	-	-	RV	RD	-

WIRE INFORMATION

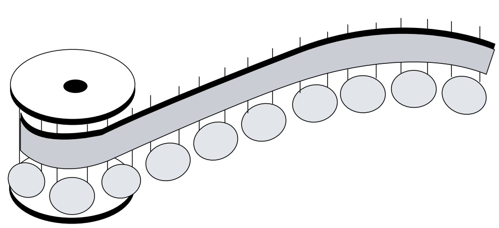
#20 AWG	0.032" (0.81) copper wire
#22 AWG	0.025" (0.64) copper wire
#24 AWG	0.020" (0.51) copper clad steel wire

REELING STANDARD CERA-MITE VS. EIA-468B

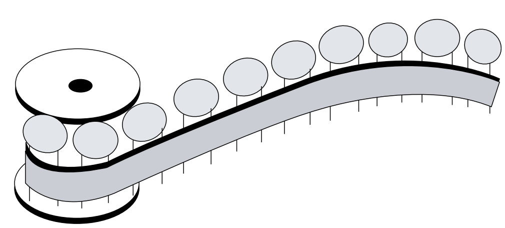
EIA lead spacings for tape and reel are based on multiples of 0.100" (2.5 mm) to coordinate with automatic insertion machinery and boards using 0.100" grid convention.

Fig. 16 - Vishay Cera-Mite standard is a reverse reeled version of EIA 468B.

VISHAY CERA-MITE STANDARD
Suffix QA RE TK



EIA-468B STANDARD
Suffix QR RR TR



TAPE AND REEL OPTIONS

Fig. A

Lead space LS	5.0 mm
Pitch	0.5" (12.7 mm)

AVAILABLE SERIES	
Disc diameter	12.4 mm or less
Series	100 V_{DC} to 3 kV_{DC}

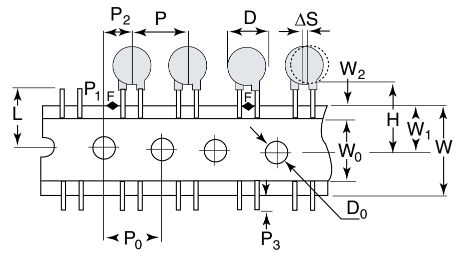


Fig. B

Lead space LS	7.5 mm
Pitch	(15.0 mm)

AVAILABLE SERIES	
Disc diameter	13.5 mm or less
Series	100 V_{DC} to 3 kV_{DC} and AC rated caps

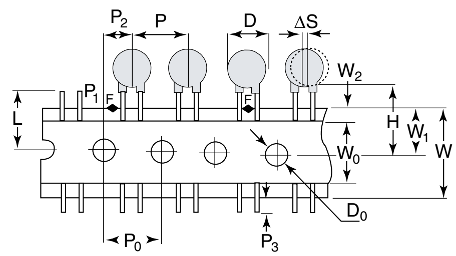


Fig. C

Lead space LS	10.0 mm
Pitch	1.0" (25.4 mm)

AVAILABLE SERIES	
Disc diameter	18.0 mm or less
Series	100 kV_{DC} to 6 kV_{DC} and AC rated caps

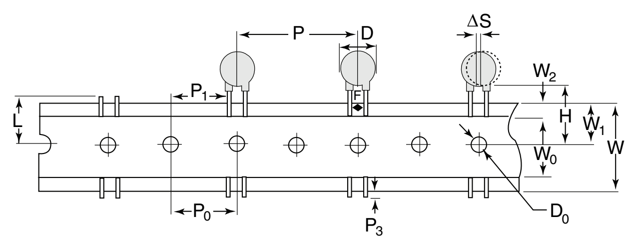
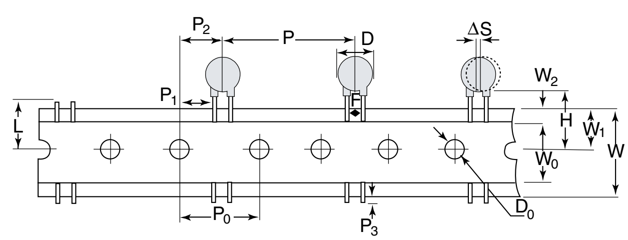


Fig. D

Lead space LS	7.5 mm
Pitch	30.0 mm

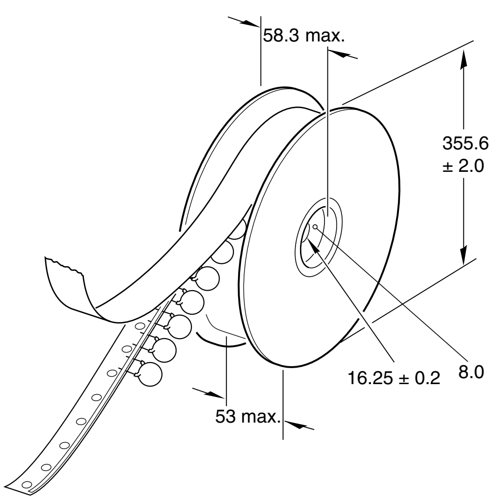
AVAILABLE SERIES	
Disc diameter	18.0 mm or less
Series	100 V_{DC} to 6 kV_{DC} and AC rated caps



TAPE AND REEL OPTIONS					
ITEM	CODE	FIG. A	FIG. B	FIG. C	FIG. D
		DIMENSIONS (mm)			
Pitch of component	P	12.7	15.0	25.4	30.0
Pitch of sprocket hole	P_0	12.7 ± 0.3	15.0 ± 0.3	12.7 ± 0.4	15.0 ± 0.4
Lead spacing	F	5.0 + 0.8 / - 0.2	7.5 ± 1.0	10.0 ± 1.0	7.5 ± 1.0
Length from hole center to component center	P_2	6.35 ± 1.3	7.5 ± 1.5	-	7.5 ± 1.5
Length from hole center to component lead	P_1	3.85 ± 0.7	3.75 ± 1.0	7.7 ± 1.5	3.75 ± 1.0
Disc diameter	D	See individual product specification			
Deviation along tape, left / right	ΔS	0 ± 1.3	0 ± 2.0		
Component alignment	Δh	0 ± 1.0			
Carrier tape width	W	18.0 ± 0.5			
Position of sprocket hole	W_1	9.0 - 0.5 / + 0.75			
Height to component body (lead Fig. 11)	H	20.0 + 1.5 / - 1.0	20.0 + 1.5 / - 1.0	18.0 + 2.0 / - 1.0	20.0 + 1.5 / - 1.0
Height to seating plane (lead Fig. 12 to 15)	H	16.0 ± 0.5			
Protrusion length	P_3	3.0 max.			
Diameter of sprocket hole	D_0	4.0 ± 0.2			
Total tape thickness	t_1	0.6 ± 0.3			
Total thickness, tape and lead wire	t_2	1.5 max.			
Portion to cut	L	11.0 max.			
Hold down tape width	W_0	11.5 max.			
Hold down tape position	W_2	1.5 ± 1.5			

PACKAGING OPTIONS

Reel Packaging



Ammo Packaging

Consult us for other packaging options, such as ammo pack cartons.

ORDERING CODE CATALOG PART NUMBER DC CAPACITORS

564R	5	GA	D	68	VJ
SERIES	**RATED VOLTAGE**	**CERAMIC CODE**	**CAPACITANCE VALUE**		**WIRE / TAPE OPTIONS**
			DIVIDER	**VALUE**	
561R All class 1 dielectric and 1000 V_{DC} precision and 1 kV_{DC} low DF 562R General purpose 100 V_{DC} thru 1000 V_{DC} class 2 dielectric 565R Dual parallel discs 564R High voltage 2 kV_{DC} thru 7.5 kV_{DC} 615R High voltage 10 kV_{DC} thru 15 kV_{DC} "R" indicates an RoHS compliant component	None = 100 V 1 = 1000 V 2 = 2000 V 3 = 3000 V 5 = 500 V 10 = 1 kV_{DC} 20 = 2 kV_{DC} 30 = 3 kV_{DC} 60 = 6 kV_{DC} 75 = 7.5 kV_{DC} 100 = 10 kV_{DC} 150 = 15 kV_{DC}	See individual datasheets	"Quad" = Q "Triple" = T "Double" = D "Single" = S Number of zeros following the decimal point of the capacitance value. e.g. 0.000068 = 68 pF 0.00068 = 680 pF 0.0068 = 6800 pF 0.068 = 68 000 pF Basis is the capacitance given in µF	The two digits are the significant figures of the capacitance	(Optional)

ORDERING CODE CATALOG PART NUMBER AC LINE RATED CAPACITORS

440L	S	10	AM	-R
SERIES	**CAPACITANCE VALUE**		**WIRE / TAPE OPTIONS**	**RoHS**
	DIVIDER	**VALUE**		
440L X1/Y1 safety approved 30LV X1/Y2 safety approved 30LVS X1/Y2 safety approved 25Y X1/Y2 safety approved 125L X1/Y4 safety approved 20VL X2 EMI filter	"Quad" = Q "Triple" = T "Double" = D "Single" = S Number of zeros following the decimal point of the capacitance value e.g. 0.00001 = 10 pF 0.0001 = 100 pF 0.001 = 1000 pF 0.01 = 10 000 pF Basis is the capacitance given in µF	The two digits are the significant figures of the capacitance.	(Optional)	"R" indicates an RoHS compliant component

ORDERING CODE CUSTOM PART PART NUMBER

564R	Y5P	JR	303	E	E	680	K
SERIES	**TEMP. CHARACT.**	**WIRE LEAD AND PACKAGING CODE**	**RATED VOLTAGE**	**COATING MATERIAL**	**BODY SIZE**	**CAPACITANCE VALUE**	**TOL.**
561R All class 1 dielectric and 1000 V_{DC} precision and 1 kV_{DC} low DF 562R General purpose 100 V_{DC} thru 1000 V_{DC} class 2 dielectric 565R Dual parallel discs 564R High voltage 2 kV_{DC} thru 7.5 kV_{DC} 615R High voltage 10 kV_{DC} thru 15 kV_{DC} "R" indicates an RoHS compliant component	See table on page 4 and on individual datasheets	See table on pages 14 to 16	First two digits are significant numbers Last digit specifies the numbers of zeros (Voltage given in "Volts")	E = epoxy A = phenolic	Disc diameter code letter	First two digits are significant numbers. Last digit specifies the numbers of zeros. For values below 10 pF, use letter "R" For values decimal point e.g. 2R2 = 2.2 pF	see table on page 4

CUSTOM DESIGNS

Vishay Cera-Mite's most popular 100 V to 15 000 V values and constructions are shown as standard part numbers in this catalog. Many other values and lead styles are available. Other capacitance ranges and styles are available on request. Various wire lead forms and packaging options are detailed on the previous pages. Part numbers for custom capacitors consist of an 18-character designator assigned by our application engineering group. Vishay Cera-Mite will provide a certified outline drawing and complete part number covering custom options specified. Customer approval of the outline is usually requested to guarantee satisfaction. All performance characteristics shown in this catalog apply to the options unless otherwise stated on the outline drawing.

MARKING INFORMATION

CM	Y5R (OR C)	01	M	1 kV
MANUFACTURER IDENTIFICATION	TEMPERATURE COEFFICIENT	CAPACITANCE	CAPACITANCE TOLERANCE	VOLTAGE
"Cera-Mite" or the identification "CM"	See chart on page 4	Expressed in pF or µF. Example: 680 = 680 pF 0047 = 0.0047 µF	C = ± 0.25 pF D = ± 0.5 pF J = ± 5 % K = ± 10 % M = ± 20 % P = +100 % to -0 % Y = -20 % to +50 % Z = -20 % to +80 %	Rating normally DC volts. AC voltage rating marked AC or ~; If no voltage is marked, part is 500 V_{DC}

Notes

- Wire leaded DC rated, disc capacitors are marked with a code identifying the manufacturer, capacitance, tolerance, voltage, and type of ceramic.
- Specially types such as AC rated are marked as described in the individual datasheets.