

AC Line Rated Ceramic Disc Capacitors for Automotive Class X1, 440 V_{AC}, Class Y2, 300 V_{AC}



RoHS
COMPLIANT
HALOGEN
FREE
Available

FEATURES

- AEC-Q200 qualified
- Temperature cycle: 1000 cycles (-55 °C to +125 °C)
- Complies with IEC 60384-14, 3rd edition
- High reliability
- Straight leads
- Singlelayer AC Disc capacitors
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

APPLICATIONS

- X1, Y2 according to IEC 60384-14.3
- Application as Y capacitors for AC line filter and primary-secondary coupling on battery chargers for PHEV/EV
- Application as a filter capacitors on DC/DC converters for PHEV/EV and HEV

DESIGN

The capacitors consist of a ceramic disc both sides of which are silver-plated. Connection leads are made of tin plated copper-clad steel having a diameter of 0.6 mm.

The capacitors may be supplied with straight leads having a lead spacing of 5 mm, 7.5 mm and 10.0 mm. Encapsulation is made of flammable resistant epoxy resin in accordance with "UL 94 V-0".

CAPACITANCE RANGE

10 pF to 4700 pF

RATED VOLTAGE U_R

IEC 60384-14.3:

(X1): 440 V_{AC}, 50 Hz

(Y2): 300 V_{AC}, 50 Hz

TEST VOLTAGE

Component test (100 %):

2600 V_{AC}, 50 Hz, 2 s

Random sampling test (destructive test):

2600 V_{AC}, 50 Hz, 60 s

Voltage proof of coating (destructive test):

2600 V_{AC}, 50 Hz, 60 s

INSULATION RESISTANCE

10 000 MΩ minimum

TOLERANCE OF CAPACITANCE

± 20 % (code M); ± 10 % (code K)

DISSIPATION FACTOR

2.5 % maximum

QUICK REFERENCE DATA				
DESCRIPTION	VALUE			
Ceramic Class	1		2	
Ceramic Dielectric	U2J	U2J	Y5S, Y5U	Y5S, Y5U
Voltage (V _{AC})	300	440	300	440
Min. Capacitance (pF)	10		68	
Max. Capacitance (pF)	47		4700	
Mounting	Radial			

OPERATING TEMPERATURE RANGE

-55 °C to +125 °C

TEMPERATURE CHARACTERISTICS

See Ordering Information table

CLIMATIC CATEGORY

40/125/21 according to EN 60068-1

COATING

According to UL 94 V-0

Epoxy resin, isolating, flame retardant

APPROVALS

IEC 60384-14.3

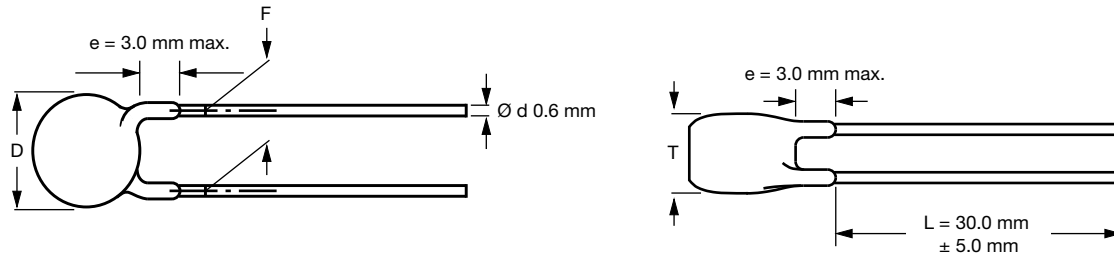
UL 60384-14

DIN EN 60384-14

CSA E60384-1:03, CSA E60384-14:09

PACKAGING

Bulk, tape and reel, taped ammpack

DIMENSIONS


Capacitors with 5.0 mm, 7.5 mm and 10.0 mm lead spacing

ORDERING INFORMATION

C (pF)	TOL. (%)	TEMP. COEFFICIENT	BODY DIAMETER $D_{\text{MAX.}}$ (mm)	BODY THICKNESS $T_{\text{MAX.}}$ (mm)	CLEAR TEXT CODE					
					15 TH DIGIT: T = REEL; U = AMMO; 3 = BULK ⁽¹⁾					
					LEAD SPACING 5.0 mm	LEAD SPACING 7.5 mm	LEAD SPACING 10.0 mm			
10	± 10	U2J (N750)	7.5	5	AY2100K29U2JS6*L5	AY2100K29U2JS6*L7	AY2100K29U2JS6*L0			
15					AY2150K29U2JS6*L5	AY2150K29U2JS6*L7	AY2150K29U2JS6*L0			
22					AY2220K29U2JS6*L5	AY2220K29U2JS6*L7	AY2220K29U2JS6*L0			
33					AY2330K29U2JS6*L5	AY2330K29U2JS6*L7	AY2330K29U2JS6*L0			
47					AY2470K29U2JS6*L5	AY2470K29U2JS6*L7	AY2470K29U2JS6*L0			
68					Y5S (2C3)	7.5	5	AY2680K29Y5SS6*L5	AY2680K29Y5SS6*L7	AY2680K29Y5SS6*L0
100		AY2101K29Y5SS6*L5	AY2101K29Y5SS6*L7	AY2101K29Y5SS6*L0						
150		AY2151K29Y5SS6*L5	AY2151K29Y5SS6*L7	AY2151K29Y5SS6*L0						
220		AY2221K29Y5SS6*L5	AY2221K29Y5SS6*L7	AY2221K29Y5SS6*L0						
330		AY2331K29Y5SS6*L5	AY2331K29Y5SS6*L7	AY2331K29Y5SS6*L0						
470		AY2471K29Y5SS6*L5	AY2471K29Y5SS6*L7	AY2471K29Y5SS6*L0						
680		Y5U (2E3)	7.5	5				AY2681M29Y5US6*L5	AY2681M29Y5US6*L7	AY2681M29Y5US6*L0
1000								AY2102M29Y5US6*L5	AY2102M29Y5US6*L7	AY2102M29Y5US6*L0
1500			AY2152M31Y5US6*L5		AY2152M31Y5US6*L7	AY2152M31Y5US6*L0				
2200	AY2222M35Y5US6*L5		AY2222M35Y5US6*L7		AY2222M35Y5US6*L0					
3300	AY2332M41Y5US6*L5		AY2332M41Y5US6*L7		AY2332M41Y5US6*L0					
3900	AY2392M43Y5US6*L5		AY2392M43Y5US6*L7		AY2392M43Y5US6*L0					
4700	12.5		AY2472M49Y5US6*L5		AY2472M49Y5US6*L7	AY2472M49Y5US6*L0				
	10.0		AY2472M49Y5US6*L5		AY2472M49Y5US6*L7	AY2472M49Y5US6*L0				

Notes

- On request available: ± 10 % tolerance
- ⁽¹⁾ 15th digit of the clear text code number to be completed with the packaging code

PACKAGING

CAPACITANCE VALUE	SIZE CODE	BODY DIAMETER $D_{\text{MAX.}}$ (mm)	PACKAGING QUANTITIES		
			BULK	REEL	AMMO
10 pF to 2200 pF	31 to 47	12.0	1000	500	750
3300 pF to 4700 pF	51 to 63	16.0	500	500	750

Note

- The capacitors are supplied in bulk packaging (cardboard boxes), in tape on reel in ammpack

STRAIGHT LEADS

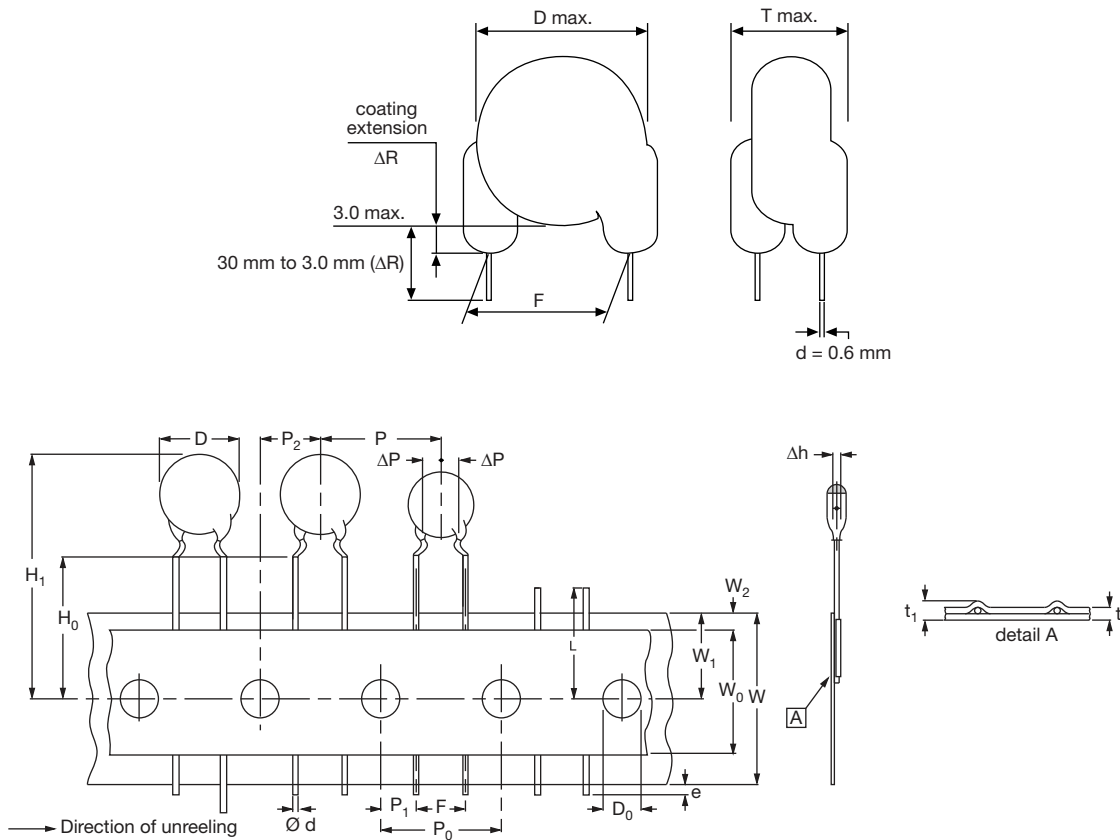


Fig. 1 - Kinked capacitors on tape, lead spacing 5.0 mm (0.2") and 7.5 mm (0.3")

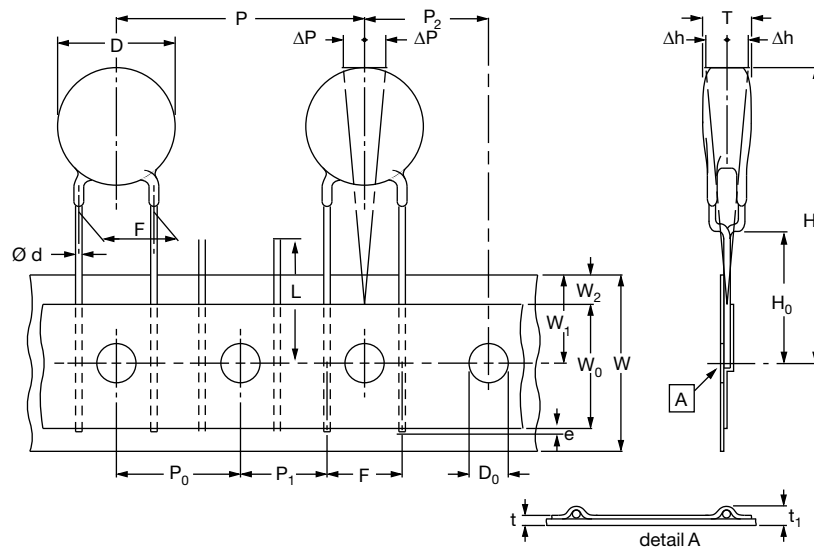
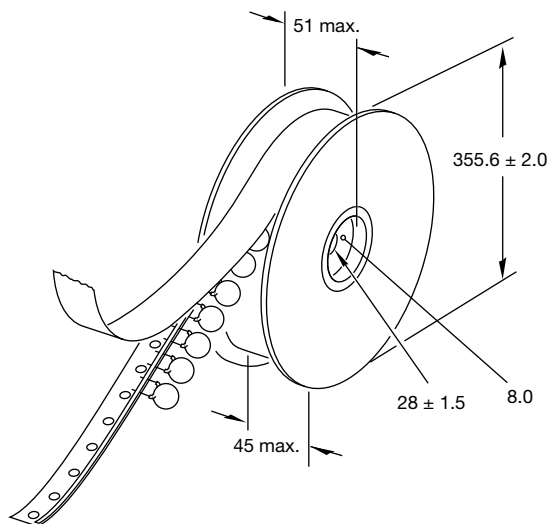


Fig. 2 - Lead spacing 10.0 mm, components pitch 25.04 mm

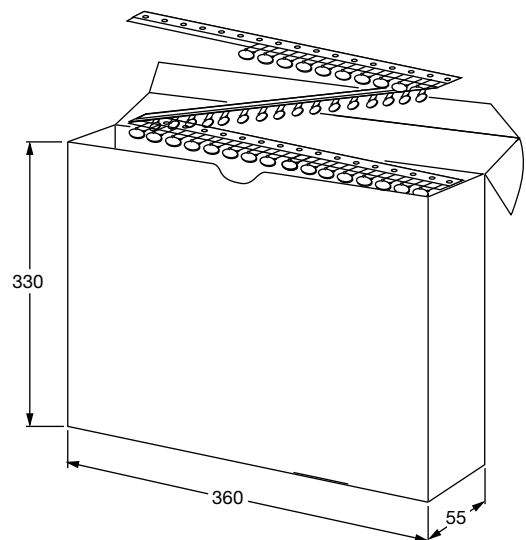
DIMENSION OF TAPE				
SYMBOL	PARAMETER	DIMENSIONS (mm)		
		FIG. 1 (5 mm)	FIG. 1 (7.5 mm)	FIG. 2 (10 mm)
D ⁽¹⁾	Body diameter	11.0 max.	14.0 max.	16.0 max.
d	Lead diameter	0.6 ± 0.05	0.6 ± 0.05	0.6 ± 0.05
P	Pitch of component	12.7 ± 1	15.0 ± 1	25.4 ± 1
P ₀ ⁽²⁾	Pitch of sprocket hole	12.7 ± 0.3	15.0 ± 0.3	12.7 ± 0.3
P ₁ ⁽³⁾	Distance, hole center to lead	3.85 ± 0.7	3.75 ± 0.7	7.7 ± 1.0
P ₂ ⁽³⁾	Distance, hole to center of component	6.35 ± 1.3	7.5 ± 1.5	12.7 ± 1.5
F	Lead spacing	5.0 (+ 0.6/- 0.4)	7.5 (+ 0.6/- 0.4)	10.0 (+ 0.6/- 0.4)
Δh	Average deviation across tape	± 1.0 max.	± 1.0 max.	± 1.0 max.
ΔP	Average deviation in direction of reeling	± 1.0 max.	± 1.0 max.	± 1.0 max.
W	Carrier tape width	18.0 + 1/- 0.5	18.0 + 1/- 0.5	18.0 + 1/- 0.5
W ₀	Hold-down tape width	5.0 min.	5.0 min.	5.0 min.
W ₁	Position of sprocket hole	9.0 + 0.75/- 0.5	9.0 + 0.75/- 0.5	9.0 + 0.75/- 0.5
W ₂	Distance of hold-down tape	3.0 max.	3.0 max.	3.0 max.
H ₁	Maximum component height	32	40	40
H ₀	Height to seating plane (for kinked leads)	16.0 ± 0.5	16.0 ± 0.5	16.0 ± 0.5
H ₀	Height to seating plane (for straight leads)	20.0 ± 0.5	20.0 ± 0.5	20.0 ± 0.5
L	Length of cut leads	11.0 max.	11.0 max.	11.0 max.
e	Length of lead protrusion	1.0 max.	1.0 max.	1.0 max.
D ₀	Diameter of sprocket hole	4.0 ± 0.2	4.0 ± 0.2	4.0 ± 0.2
t	Total tape thickness	0.9 max.	0.9 max.	0.9 max.
t ₁	Maximum thickness of tape and wires	1.5 max.	1.5 max.	1.5 max.

Notes

- (1) See "Ordering Information" table
 (2) Cumulative pitch error: ± 1 mm/20 pitches
 (3) Obliquity maximum 3°

REEL AND TAPE DATA in millimeters


Reel with capacitors on tape

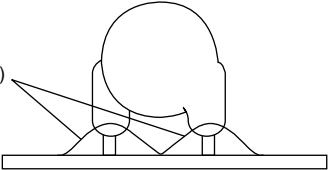


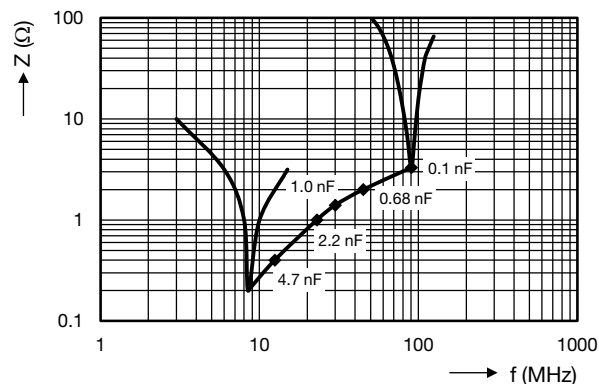
Ammpack with capacitors on tape

APPROVALS				
IEC 60384-14.3 - Safety tests This approval together with CB test certificate substitutes all national approvals.				
CB Certificate				
Y2-capacitor: CB test certificate:	US-19599-A2-UL	10 pF to 10 nF	300 V _{AC}	
X1-capacitor: CB test certificate:	US-19599-A2-UL	10 pF to 10 nF	440 V _{AC}	
VDE				
Y2-capacitor: VDE marks approval:	40009669	10 pF to 10 nF	300 V _{AC}	
X1-capacitor: VDE marks approval:	40009669	10 pF to 10 nF	440 V _{AC}	
DIN EN 60384-14 VDE 0565-1-1:2006-04 - Safety tests				
Underwriters Laboratories Inc./Canadian Standards Association				
Y2-capacitor: UL-test certificate:	E183844	10 pF to 10 nF	300 V _{AC}	
X1-capacitor: UL-test certificate:	E183844	10 pF to 10 nF	440 V _{AC}	
UL 60384-14, CSA E60384-1:03 2 nd edition, CSA E60384-14:09 2 nd edition Across-the-line, antenna-coupling and line-by-pass component				
CQC				
Y2-capacitor: CQC test certificate:	C0046379	10 pF to 10 nF	300 V _{AC}	
X1-capacitor: CQC test certificate:	C0046379	10 pF to 10 nF	440 V _{AC}	

MARKING	
<p>Sample (2 sides)</p>	<p>PN: AY2472M49Y5US63LD Lot1: 14Z551S12 DC1: 0601 QTY: 225 Lot2: DC2: PO: Batch: 200601CN SO: Region: 9520 SL: 0010 Ser.No: 0601H69340</p> <p> 1/1</p>

PERFORMANCE		
TEST	TEST CONDITION	TEST LIMITS
Visual and mechanical inspection	Optical inspection, dimensions measured with caliper	No visible damage, marking legible
Capacitance (C)	25 °C ± 3 °C , relative humidity (RH) ≤ 75 %, 1.0 V _{RMS} ± 0.2 V _{RMS} at 1 kHz for Y5U and Y5S, and 1 MHz for U2J	Capacitance within specified tolerance
Dissipation factor (DF)		DF ≤ 0.3 % for U2J and DF ≤ 2.5 % for Y5S and Y5U
Insulation resistance (IR)	Measured within 60 s ± 5 s after charging at 500 V _{DC}	10 000 MΩ min.
Dielectric strength	2600 V _{AC} (2200 V _{AC} for lead spacing 5.0 mm) at 50 Hz/60 Hz for 1 min, 50 mA max.	No failure
Temperature characteristic	RH ≤ 75 %, 1.0 V _{RMS} ± 0.2 V _{RMS} at 1 kHz for Y5U and Y5S, and 1 MHz for U2J	U2J: -750 ppm ± 120 ppm Y5S: ± 22 % Y5U: +22 %/-56 %

PERFORMANCE		
TEST	TEST CONDITION	TEST LIMITS
Impulse voltage	3 pulses of 5 kV	No failure
Life test	1000 h at $125\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, $550\text{ V}_{AC}/50\text{ Hz}$; once every hour 1000 V_{AC} for 0.1 s	External appearance: no visible damage $\Delta C \leq \pm 15\%$ $DF \leq 0.5\%$ for U2J and $\leq 5\%$ for Y5S and Y5U $IR \geq 3000\text{ M}\Omega$ Dielectric strength: no failure
Humidity test	500 h at 440 V_{AC} , 50 Hz and 500 h unloaded $40\text{ }^{\circ}\text{C}$, RH = 90 % to 95%	External appearance: no visible damage $\Delta C \leq \pm 10\%$ for U2J and $\leq \pm 15\%$ for Y5S and Y5U $DF \leq 0.5\%$ for U2J and $\leq 5\%$ for Y5S and Y5U $IR \geq 3000\text{ M}\Omega$ Dielectric strength: no failure
Robustness of termination	Pull test: 0.5 kg tensile weight in radial direction for $10\text{ s} \pm 1\text{ s}$ Bending strength: capacitor body rotated by 90° in both directions	No damage to capacitor body and lead wire
Soldering effect	Immersion of lead wires into $260\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ solder for $10\text{ s} \pm 2\text{ s}$; min. distance from body: 1.5 mm Hand soldering at $400\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ for 3 s to 4 s; min. distance from body: 1.5 mm	External appearance: no visible damage $\Delta C \leq \pm 5\%$ for U2J and $\leq \pm 10\%$ for Y5S and Y5U Dielectric strength: no failure
Vibration test	 <p>Solder the capacitor onto test jig (glass epoxy body) and use resin (adhesive) to stick the body to the test jig. The capacitor must be soldered firmly to the supporting lead wire. Vibration change from 10 Hz to 2000 Hz and back to 10 Hz; Total amplitude: 1.5 mm; Acceleration: 100 m/s^2; Sweep rate: 1 oct/min, each axis 2 h (6 h in total)</p>	External appearance: no visible damage Capacitance within specified tolerance $DF \leq 0.3\%$ for U2J and $\leq 2.5\%$ for Y5S and Y5U $IR \geq 10\text{ }000\text{ G}\Omega$

IMPEDANCE VS. FREQUENCY (Typical)


Lead configuration: length = 30 mm, lead spacing: standard, lead diameter: standard, inline crimp

Note

- The capacitors meet the essential requirements of "EIA 198". Unless stated otherwise all electrical values apply at an ambient temperature of $25\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$, at normal atmospheric conditions.