Metallized Polypropylene Film EMI Suppression Capacitors

R4Y, THB Grade IIB, Class Y1, 500 VAC, 125°C (Automotive Grade)

Overview

The R4Y is constructed of metallized polypropylene film, encapsulated with self-extinguishing resin, in a box of material meeting the requirements of UL 94 V–0.

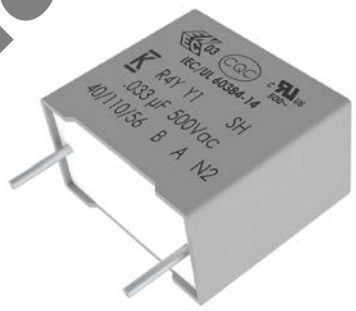
Automotive Grade devices meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.

Applications

For use in electromagnetic interference (EMI) suppression filter in "line-to-ground" applications, requiring Y1 safety classification. Suitable for use in situations where failure of the capacitor could lead to danger of electric shock.

Benefits

- Approvals: ENEC, UL, cUL, CQC
- Class Y1 (IEC 60384-14)
- THB Grade IIB: 85°C, 85% RH, 500 hours at 500 V URAC , acc. to IEC 60384-14
- Rated voltage: 500 VAC 50/60 Hz
- Capacitance range: 0.00047 – 0.033 µF
- Lead spacing: 15 – 22.5 mm
- Capacitance tolerance: ±20%, ±10%
- Climatic category 40/110/56, IEC 60068-1
- Tape and reel in accordance with IEC 60286-2
- RoHS compliant and lead-free terminations
- Operating temperature range of −40˚C to +125˚C
- Self-healing properties
- Automotive (AEC–Q200) grade



Part Number System

R4Y	5	I	2100	00	00	M
Series	Rated Voltage (VAC)	Lead Spacing (mm)	Capacitance Code (pF)	Packaging	Internal Use	Capacitance Tolerance
Y1, Metallized Polypropylene	5 = 500	I = 15.0 N = 22.5	The last three digits represent significant figures. The first digit specifies number of zeros to be added.	See Ordering Options Table	00	K = ±10% M = ±20%

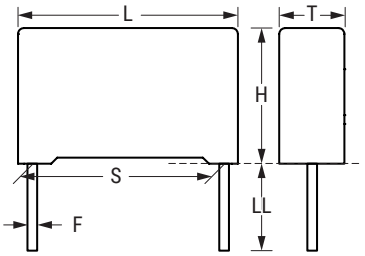
Ordering Options Table

Lead Spacing Nominal (mm)	Type of Leads and Packaging	Lead Length (mm)	Lead and Packaging Code
15 22.5	**Standard Lead and Packaging Options**		
	Bulk (Bag) – Short Leads	4 +2/−0	00
	Ammo Pack	H_0 = 18.5 ±0.5	DQ[1]
	Other Lead and Packaging Options		
	Tape & Reel (Large Reel)	H_0 = 18.5 ±0.5	CK
	Tape & Reel (Standard Reel)	H_0 = 18.5 ±0.5	GY
	Pizza-Short Leads	3.2 +0.3/−0.2	HA
	Bulk (Bag)[2] – Short Leads	3.5 +0.5/−0	JB
	Bulk (Bag)[2] – Short Leads	4.0 +0.5/−0	JE
	Bulk (Bag)[2] – Short Leads	3.2 +0.3/−0.2	JH
	Bulk (Bag) – Long Leads	18 ±1	JM
	Bulk (Bag) – Long Leads	30 +5/−0	40
	Bulk (Bag) – Long Leads	25 +2/−1	50

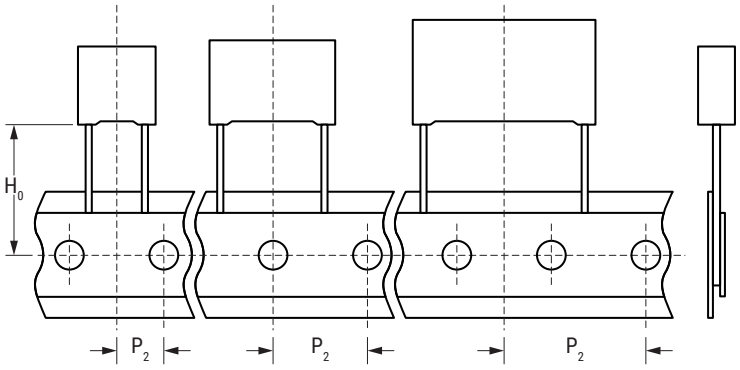
[1] Not for all sizes, see "Packaging Quantities" table
*[2] For lead spacing 22.5 case sizes ≥ 8.5*17*26.5 the parts are packed in a Pizza box 335*320*34 mm*

Dimensions – Millimeters

Loose



Taped



S		T		H		L		F	
Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
15.0	±0.4	5.0	+0.2/−0.5	11.0	+0.1/−0.5	18.0	+0.3/−0.5	0.8	±0.05
15.0	±0.4	6.0	+0.2/−0.5	12.0	+0.1/−0.5	18.0	+0.3/−0.5	0.8	±0.05
15.0	±0.4	7.5	+0.2/−0.5	13.5	+0.1/−0.5	18.0	+0.3/−0.5	0.8	±0.05
15.0	±0.4	8.5	+0.2/−0.5	14.5	+0.1/−0.5	18.0	+0.3/−0.5	0.8	±0.05
15.0	±0.4	10.0	+0.2/−0.5	16.0	+0.1/−0.5	18.0	+0.3/−0.5	0.8	±0.05
15.0	±0.4	11.0	+0.2/−0.5	19.0	+0.1/−0.5	18.0	+0.3/−0.5	0.8	±0.05
22.5	±0.4	6.0	+0.2/−0.5	15.0	+0.1/−0.5	26.5	+0.3/−0.5	0.8	±0.05
22.5	±0.4	7.0	+0.2/−0.5	16.0	+0.1/−0.5	26.5	+0.3/−0.5	0.8	±0.05
22.5	±0.4	8.5	+0.2/−0.5	17.0	+0.1/−0.5	26.5	+0.3/−0.5	0.8	±0.05
22.5	±0.4	10.0	+0.2/−0.5	18.5	+0.1/−0.5	26.5	+0.3/−0.5	0.8	±0.05
22.5	±0.4	11.0	+0.2/−0.5	20.0	+0.1/−0.5	26.5	+0.3/−0.5	0.8	±0.05
22.5	±0.4	13.0	+0.2/−0.5	22.0	+0.1/−0.5	26.5	+0.3/−0.5	0.8	±0.05

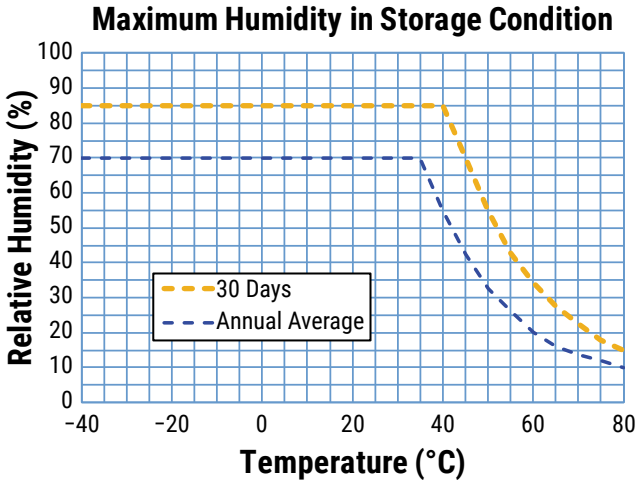
Note: See Ordering Options Table for lead length (LL/H_0) options.

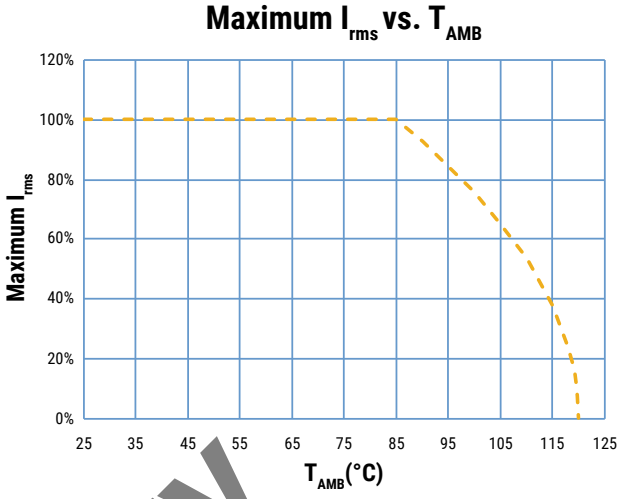
Performance Characteristics

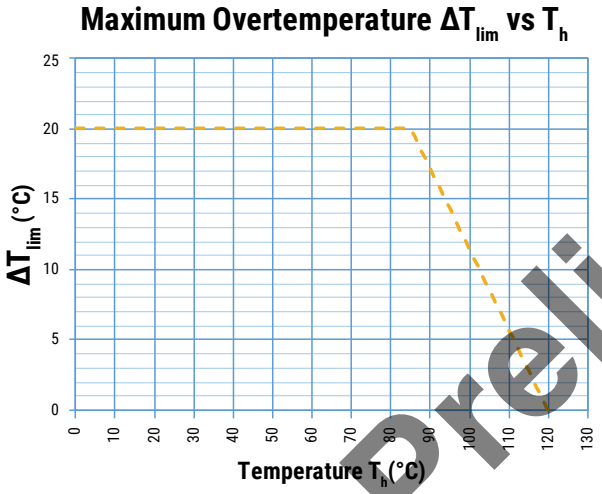
Dielectric	Polypropylene film			
Plates	Metal layer deposited by evaporation under vacum			
Winding	Non-inductive type			
Leads	Tinned wire			
Protection	Plastic case, thermosetting resin filled. Box material is solvent resistant and flame retardant according to UL 94			
Related Documents	IEC 60384-14, EN 60384-14			
Rated Voltage V_R	500 VAC (50/60 Hz)			
Maximum Continuous AC Voltage	750 VAC (50/60 Hz) (1,000 h)			
Maximum Continuous DC Voltage	3,000 VDC at 85°C (1,000 h), +85°C to +125°C, 1.5% /°C derating			
Capacitance Range	0.00047 – 0.033 µF			
Capacitance Values	E6 series (IEC 60063)			
Capacitance Tolerance	±10%, ±20%			
Temperature Range	−40°C to +125°C			
Climatic Category	40/110/56 IEC 60068-1			
Reliability	Operational life at rated voltage: 100,000 hours at 85°C; 2,000 hours at 125°C			
Storage Conditions	Storage time: ≤ 24 months from the date marked on the label package			
	Average relative humidity per year ≤ 70%			
	RH ≤ 85% for 30 days randomly distributed throughout the year			
	Dew is absent			
	Temperature: -40 to 80°C (see "Maximum Humidity in Storage Conditions" graph below)			
Approvals	ENEC, UL, cUL, CQC			
Dissipation Factor (tanδ) at 1 kHz	Maximum Values at +25°C ±5°C			
	Pitch = 15 mm		Pitch = 22.5 mm	
	1.0%		0.6%	
Insulation Resistance	Measured at +25°C ±5°C			
	Minimum Values Between Terminals			
	Voltage Charge	Voltage Charge Time	C ≤ 0.33 µF	
	500 VDC	1 minute	≥ 1 • 10^5 MΩ (≥ 5 • 10^5 MΩ)*	

** Typical value*

Performance Characteristics cont.

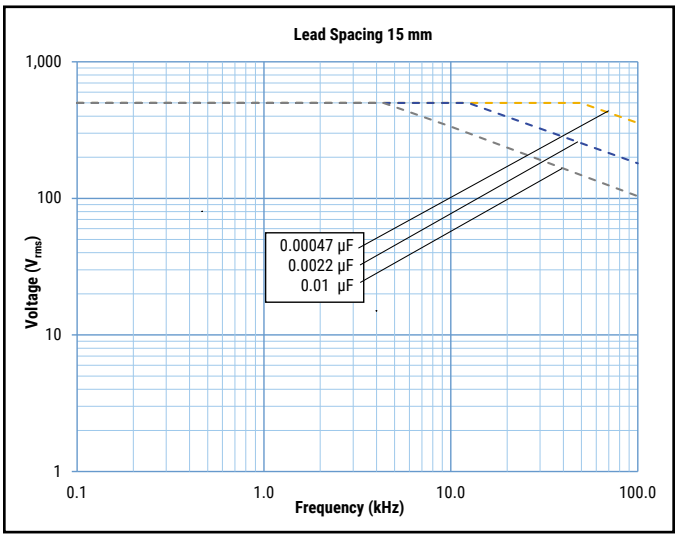


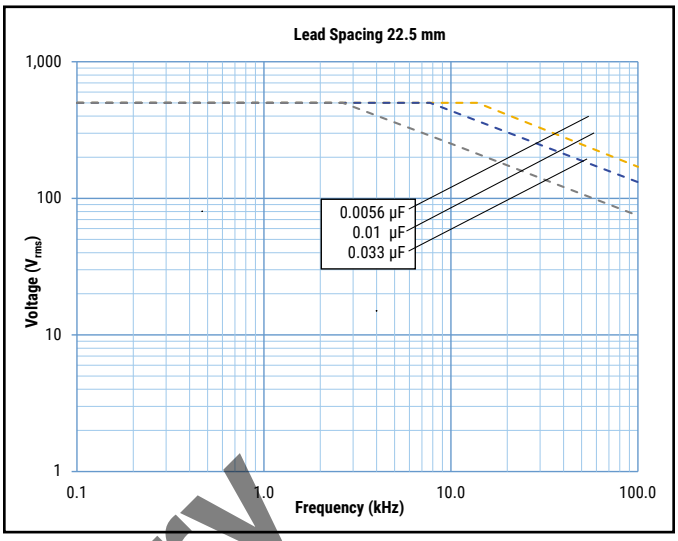




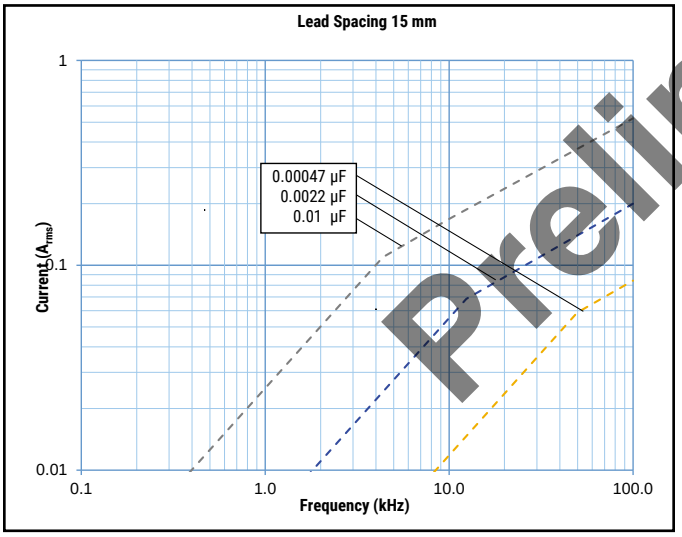
T_h is the maximum ambient temperature surrounding the capacitor or hottest contact point (e.g. tracks), whichever is higher, in the worst operation conditions in °C.

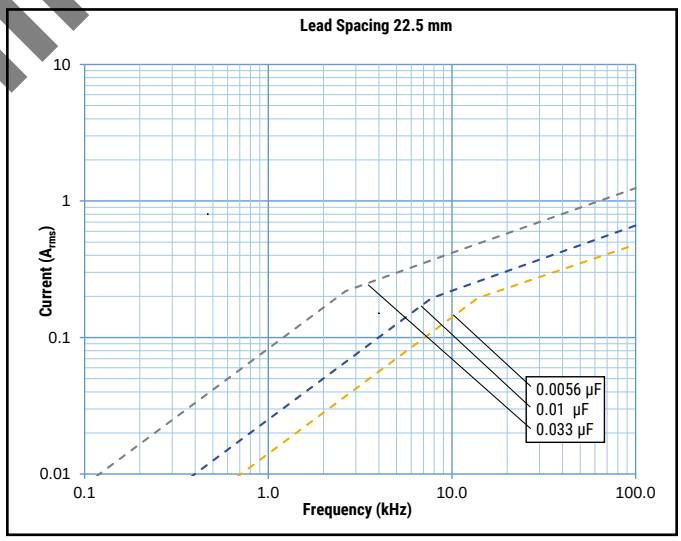
Maximum Voltage (V_{rms}) Versus Frequency (Sinusoidal Waveform/Th ≤ 85°C)





Maximum Current (I_{rms}) Versus Frequency (Sinusoidal Waveform/Th ≤ 85°C)





Qualification

Automotive grade products meet or exceed the requirements outlined by the Automotive Electronics Council. Details regarding test methods and conditions are referenced in document AEC–Q200, Stress Test Qualification for Passive Components. For additional information regarding the Automotive Electronics Council and AEC–Q200, please visit their website at www.aecouncil.com.

Environmental Test Data

Test	IEC Publication	Procedure
Endurance	IEC 60384-14	1.7 x V_R VAC 50 Hz, once every hour increase to 1,000 VAC for 0.1 second, 1,000 hours at upper rated temperature (110°C)
Vibration	MIL-STD-202 Method 204	5 G for 20 minutes, 12 cycles each of 3 orientations. Use 8"X5" PCB, 0.031" thick. 7 secure points on one 8" side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10 – 2,000 Hz.
Mechanical Shock	MIL-STD-202 Method 213	Figure 1 of Method 213. Condition C
Temperature Cycling	JESD22-Method JA-104	1,000 cycles (–40°C to 110°C) Note: Measurement at 24 ±4 hours after test conclusion. 30 minute maximum dwell time at each temperature extreme. 1 minute maximum transition time.
Passive Flammability	IEC 60384-14	IEC 60384-1, IEC 60695-11-5 Needle Flame Test
Biased Humidity	According to IEC 60384-14 Grade IIB	85°C, 85% RH and 500 VAC, 500 hours Capacitance change (Δ C/C): ≤ 10% Dissipation factor change (Δtanδ): ≤ 150 * 10^{-4} (at 1 kHz for Cap > 1 µF) Dissipation factor change (Δtanδ): ≤ 240 * 10^{-4} (at 10 kHz for Cap ≤ 1 µF) IR ≥ 50% of initial limit or minimum 200 MΩ

Approvals

Certification Body	Mark	Specification	File Number
IMQ S.p.A.		EN/IEC 60384-14	Pending
UL		UL 60384-14 and CAN/CSA E60384-14	Pending
CQC		IEC 60384-14	Pending

Environmental Compliance

RoHS

Table 1 – Ratings & Part Number Reference

Capacitance Value (µF)	Dimensions in mm			Lead Spacing (S)	dV/dt (V/µs)	KEMET Part Number	Customer Part Number
	T	H	L				
0.00047	5.0	11.0	18.0	15.0	3000	4Y5I0470(1)00(2)	R4Y5I0470(1)00(2)
0.00068	5.0	11.0	18.0	15.0	3000	4Y5I0680(1)00(2)	R4Y5I0680(1)00(2)
0.001	5.0	11.0	18.0	15.0	3000	4Y5I1100(1)00(2)	R4Y5I1100(1)00(2)
0.0015	5.0	11.0	18.0	15.0	3000	4Y5I1150(1)00(2)	R4Y5I1150(1)00(2)
0.0022	6.0	12.0	18.0	15.0	3000	4Y5I1220(1)00(2)	R4Y5I1220(1)00(2)
0.0033	7.5	13.5	18.0	15.0	3000	4Y5I1330(1)00(2)	R4Y5I1330(1)00(2)
0.0047	8.5	14.5	18.0	15.0	3000	4Y5I1470(1)00(2)	R4Y5I1470(1)00(2)
0.0068	10.0	16.0	18.0	15.0	3000	4Y5I1680(1)00(2)	R4Y5I1680(1)00(2)
0.01	11.0	19.0	18.0	15.0	3000	4Y5I2100(1)00(2)	R4Y5I2100(1)00(2)
0.0056	6.0	15.0	26.5	22.5	1000	4Y5N1560(1)00(2)	R4Y5N1560(1)00(2)
0.0068	7.0	16.0	26.5	22.5	1000	4Y5N1680(1)00(2)	R4Y5N1680(1)00(2)
0.01	8.5	17.0	26.5	22.5	1000	4Y5N2100(1)00(2)	R4Y5N2100(1)00(2)
0.015	10.0	18.5	26.5	22.5	1000	4Y5N2150(1)00(2)	R4Y5N2150(1)00(2)
0.022	11.0	20.0	26.5	22.5	1000	4Y5N2220(1)00(2)	R4Y5N2220(1)00(2)
0.033	13.0	22.0	26.5	22.5	1000	4Y5N2330(1)00(2)	R4Y5N2330(1)00(2)
Capacitance Value (µF)	**T (mm)**	**H (mm)**	**L (mm)**	**Lead Spacing (S)**	**dV/dt (V/µs)**	**KEMET Part Number**	**Customer Part Number**

(1) Insert lead and packaging code. See Ordering Options Table for available options.
(2) M = ±20%, K = ±10%

Soldering Process

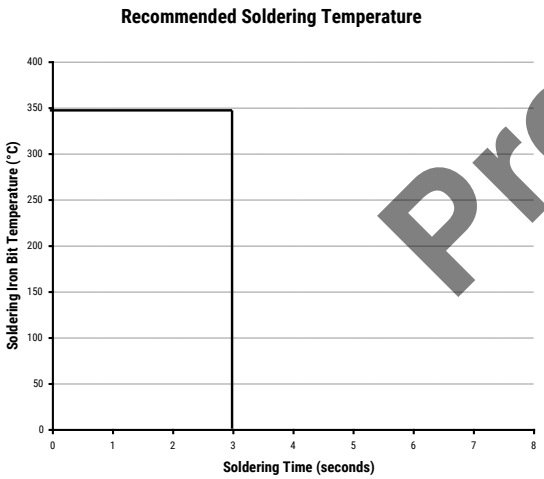
The implementation of the RoHS directive has resulted in the selection of SnAgCu (SAC) alloys or SnCu alloys as primary solder. This has increased the liquidus temperature from that of 183°C for SnPb eutectic alloy to 217 – 221°C for the new alloys. As a result, the heat stress to the components, even in wave soldering, has increased considerably due to higher pre-heat and wave temperatures. Polypropylene capacitors are especially sensitive to heat (the melting point of polypropylene is 160 – 170°C). Wave soldering can be destructive, especially for mechanically small polypropylene capacitors (with lead spacing of 5 mm to 15 mm), and great care has to be taken during soldering. The recommended solder profiles from KEMET should be used. Please consult KEMET with any questions. In general, the wave soldering curve from IEC Publication 61760-1 Edition 2 serves as a solid guideline for successful soldering. Please see Figure 1.

Reflow soldering is not recommended for through-hole film capacitors. Exposing capacitors to a soldering profile in excess of the above the recommended limits may result to degradation or permanent damage to the capacitors.

Do not place the polypropylene capacitor through an adhesive curing oven to cure resin for surface mount components. Insert through-hole parts after the curing of surface mount parts. Consult KEMET to discuss the actual temperature profile in the oven, if through-hole components must pass through the adhesive curing process. A maximum two soldering cycles is recommended. Please allow time for the capacitor surface temperature to return to a normal temperature before the second soldering cycle.

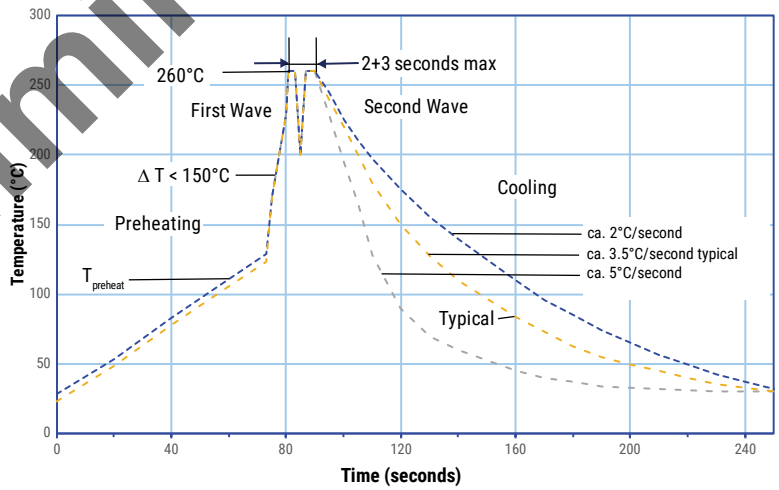
Manual Soldering Recommendations

The following is the recommendation for manual soldering with a soldering iron.



The soldering iron tip temperature should be set at 350°C (+10°C maximum) with the soldering duration not to exceed more than 3 seconds.

Wave Soldering Recommendations



Soldering Process cont.

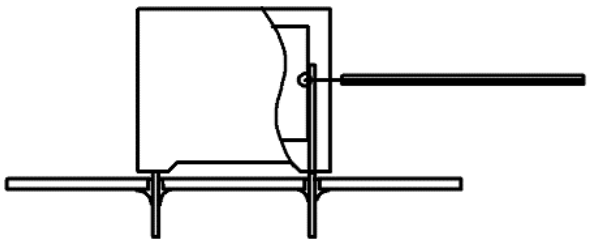
Wave Soldering Recommendations cont.

1. The table indicates the maximum set-up temperature of the soldering process
Figure 1

Dielectric Film Material	Maximum Preheat Temperature		Maximum Peak Soldering Temperature	
	Capacitor Pitch ≤ 15 mm	Capacitor Pitch > 15 mm	Capacitor Pitch ≤ 15 mm	Capacitor Pitch > 15 mm
Polyester	130°C	130°C	270°C	270°C
Polypropylene	125°C	130°C	260°C	270°C
Paper	130°C	140°C	270°C	270°C
Polyphenylene Sulphide	150°C	160°C	270°C	270°C

2. The maximum temperature measured inside the capacitor:
Set the temperature so that inside the element the maximum temperature is below the limit:

Dielectric Film Material	Maximum temperature measured inside the element
Polyester	160°C
Polypropylene	125°C
Paper	160°C
Polyphenylene sulphide	160°C



Temperature monitored inside the capacitor.

Selective Soldering Recommendations

Selective dip soldering is a variation of reflow soldering. In this method, the printed circuit board with through-hole components to be soldered is preheated and transported over the solder bath as in normal flow soldering without touching the solder. When the board is over the bath, it is stopped and pre-designed solder pots are lifted from the bath with molten solder only at the places of the selected components, and pressed against the lower surface of the board to solder the components.

The temperature profile for selective soldering is similar to the double wave flow soldering outlined in this document, **however, instead of two baths, there is only one bath with a time from 3 to 10 seconds.** In selective soldering, the risk of overheating is greater than in double wave flow soldering, and great care must be taken so that the parts are not overheated.

Mounting

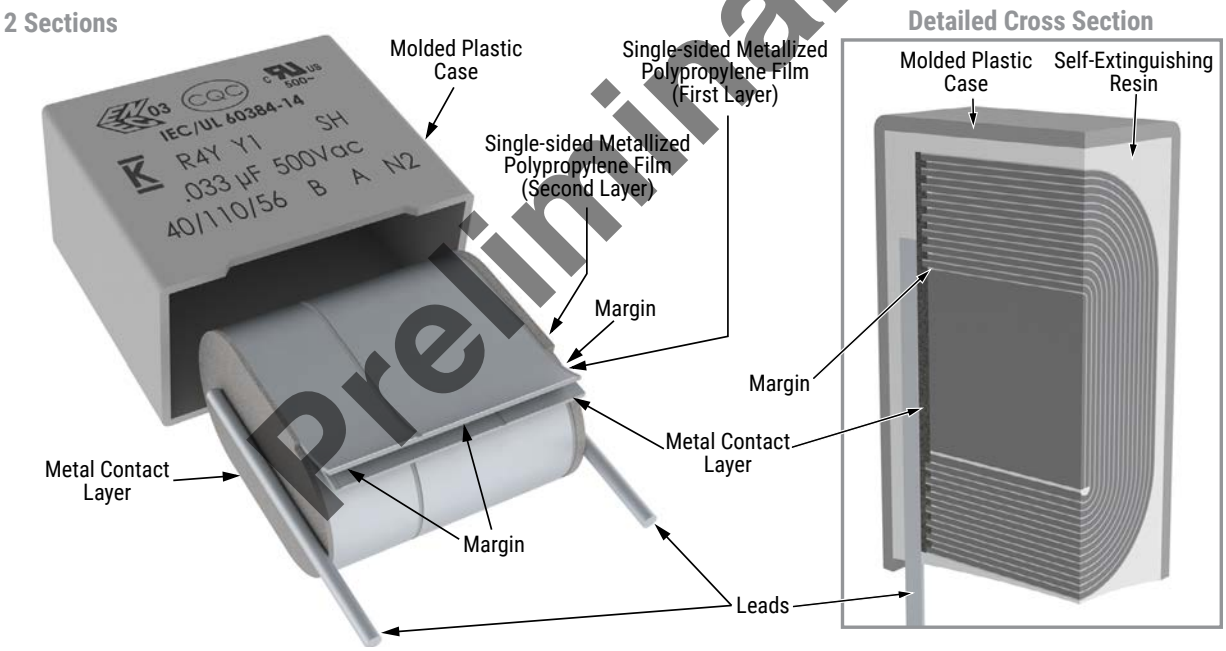
Resistance to Vibration and Mechanical Shock

AEC-Q200 Mechanical Stress Tests:

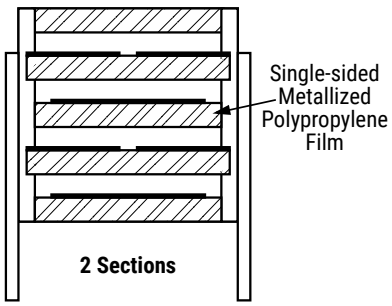
Mechanical Shock	**MIL-SDT-202 Method 213**	Test condition C Peak value 100 g, duration 6 ms, half-sine-wave (see MIL-HDBK for details)
Vibration	**MIL-SDT-202 Method 204**	5 g for 20 minutes, 12 cycles each of 3 orientations Use 8"X5" PCB, 0.031" thick. 7 secure points on one 8" side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10 – 2,000 Hz.

The capacitors are designed for PCB mounting. The stand-off pipes must be in good contact with the printed circuit board. The capacitor body has to be properly fixed (e.g. clamped or glued).

Construction

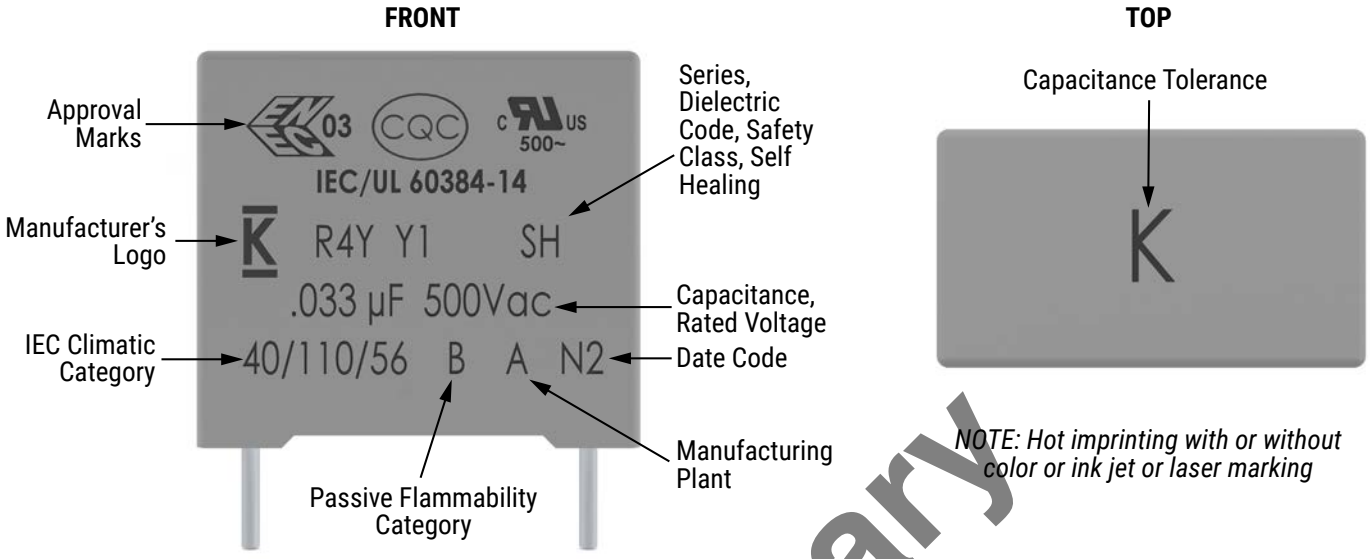


Winding Scheme



Marking

Lead Spacing 15 - 22.5 mm



Manufacturing Date Code (IEC 60062)									
Year	Code	Year	Code	Year	Code	Month	Code	Month	Code
2020	M	2027	V	2034	E	January	1	July	7
2021	N	2028	W	2035	F	February	2	August	8
2022	P	2029	X	2036	G	March	3	September	9
2023	R	2030	A	2037	H	April	4	October	O
2024	S	2031	B	2038	K	May	5	November	N
2025	T	2032	C	2039	L	June	6	December	D
2026	U	2033	D	2040	M				

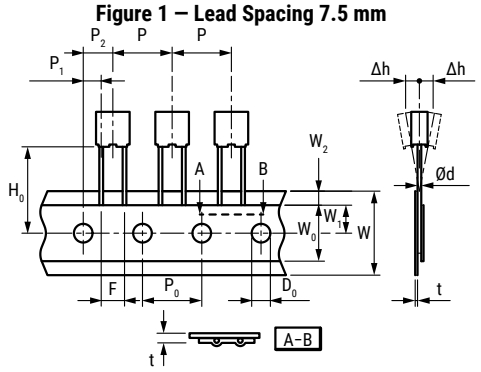
Packaging Quantities

Lead Spacing (mm)	Thickness (mm)	Height (mm)	Length (mm)	Bulk Short Leads[1]	Bulk Long Leads		Standard Reel ø 355 mm	Large Reel ø 500 mm	Ammo Taped	Pizza
Lead And Packaging Code:				00 - JA - JB JE - JH	40 - 50	JM	GY	CK	DQ	HA
15	5.0	11.0	18.0	2,000	1,000	1,250	600	1,250	800	1122
	6.0	12.0	18.0	1,750	900	1,000	500	1,000	680	935
	7.5	13.5	18.0	1,000	700	800	350	800	500	748
	8.5	14.5	18.0	1,000	500	650	270	700	440	663
	10.0	16.0	18.0	750	500	550	270	600	380	561
	11.0	19.0	18.0	450	350	400	270	500	340	510
22.5	6.0	15.0	26.5	805	500	450	300	700	464	660
	7.0	16.0	26.5	700	500	450	250	550	380	564
	8.5	17.0	26.5		300	350	250	450	280	468
	10.0	18.5	26.5		300	350	160	350	235	396
	11.0	20.0	26.5		250	200	160	350	217	360
	13.0	22.0	26.5		200	150	130	300	-	300

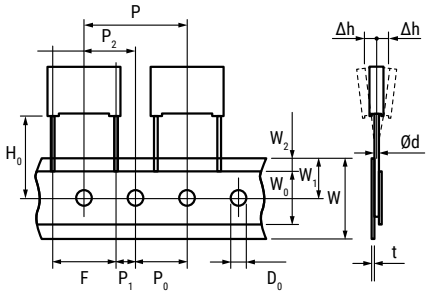
*1 For lead spacing 22.5 case sizes ≥8.5*17*26.5 the parts are packed in a Pizza box 335*320*34 mm*

Lead Taping & Packaging (IEC 60286–2)

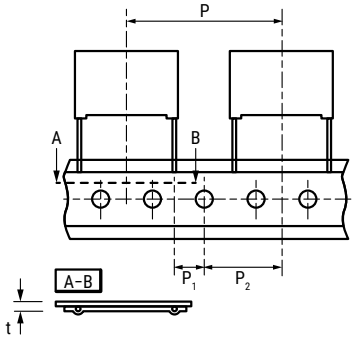
Figure 1 — Lead Spacing 7.5 mm



Lead Spacing 10 & 15 mm



Lead Spacing 22.5 & 27.5 mm



Taping Specification

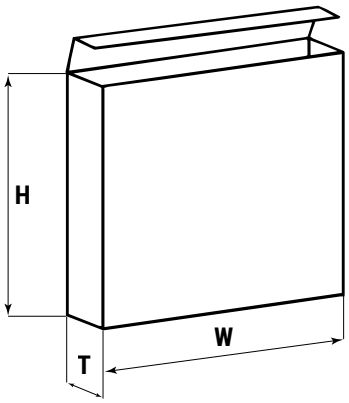
Description	Symbol	Dimensions (mm)					
		Lead Spacing					Tolerance
		7.5	10.0	15.0	22.5	27.5	
Lead wire diameter	d	0.5 – 0.6	0.6	0.6 – 0.8	0.8	0.8	±0.05
Taping lead space	P	12.7	25.4	25.4	38.1	38.1	±1
Feed hole lead space *	P_0	12.7	12.7	12.7	12.7	12.7	±0.2 **
Centering of the lead wire	P_1	2.6	7.7	5.2	7.8	5.3	±0.7
Centering of the body	P_2	6.35	12.7	12.7	19.05	19.05	±1.3
Lead spacing ***	F	7.5	10.0	15.0	22.5	27.5	+0.6/−0.1
Component alignment	Δh	0	0	0	0	0	±2
Component deviation	Δp	0	0	0	0	0	±1
Height of component from tape center	H_0****	18.5	18.5	18.5	18.5	18.5	±0.5
Carrier tape width	W	18	18	18	18	18	+1/−0.5
Hold down tape width	W_0	6	9	10	10	10	Minimum
Hole position	W_1	9	9	9	9	9	±0.5
Hold down tape position	W_2	3	3	3	3	3	Maximum
Feed hole diameter	D_0	4	4	4	4	4	±0.2
Total Tape thickness	t	0.7	0.7	0.7	0.7	0.7	±0.2

** Available also 15 mm.*
*** Maximum 1 mm on 20 lead spacing.*
**** 15 mm and 10 mm taped to 7.5 mm (crimped leads) available upon request.*
***** H_0 = 16.5 mm is available upon request.*

Lead Taping & Packaging (IEC 60286–2) cont.

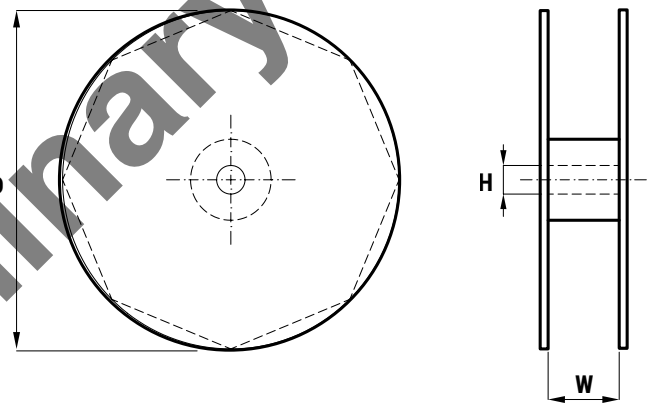
Ammo Specifications

Dimensions (mm)		
H	W	T
360	340	59



Reel Specifications

Reel Size	Dimensions (mm)		
	D	H	W
Standard	355	30	55 Maximum
Large	500	25	



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