

PHE429 Single Metallized Polypropylene Film, Optimized for SMPS PFC Applications

Overview

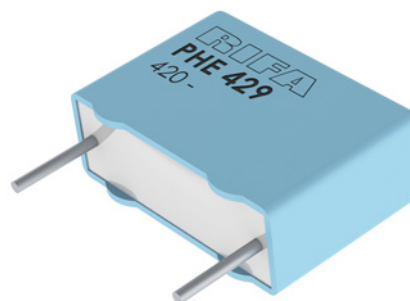
The PHE429 Series is a metallized polypropylene film encapsulated with self-extinguishing resin in a box of material meeting the requirements of UL 94 V-0.

Applications

Typical applications include power factor correction and pulse applications.

Benefits

- Rated voltage: 420 – 630 VDC
- Rated voltage: 220 – 275 VAC
- Capacitance range: 0.047 – 0.47 μ F
- Lead spacing: 15 mm
- Capacitance tolerance: \pm 10%, other tolerances on request
- Climatic category: 55/110/56, IEC 60068-1
- Tape & Reel packaging in accordance with IEC 60286-2
- RoHS Compliant and lead-free terminations
- Category temperature range of -55°C to +110°C



Customer Part Number

PHE429	K	B	6100	K	R06
Series	Rated Voltage (VDC)	Lead Spacing (mm)	Capacitance Code (pF)	Capacitance Tolerance	Packaging
Metallized Polypropylene	K = 420 M = 630	B = 15.0	The last three digits represent significant figures. The first digit specifies the total number of digits.	K = \pm 10% Other tolerances on request	See Ordering Options Table

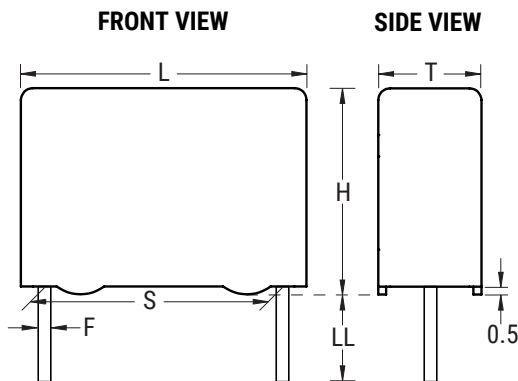
KEMET Internal Part Number

F	429	B	D	104	K	420	C
Capacitor Class	Series	Lead Spacing (mm)	Size Code	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VDC)	Packaging
F = Film	Metallized Polypropylene	B = 15.0	See Dimension Table	First two digits represent significant figures. Third digit specifies number of zeros.	K = \pm 10% Other tolerances on request	420 = 420 630 = 630	See Ordering Options Table

Ordering Options Table

Lead Spacing Nominal (mm)	Type of Leads and Packaging	Lead Length (mm)	KEMET Lead and Packaging Code	Legacy Lead and Packaging Code
15	Standard Lead and Packaging Options			
	Bulk (Bag) – Short Leads	6 +0/-1	C	R06
	Bulk (Bag) – Long Leads	30 +5/-0	A	R30
	Other Lead and Packaging Options			
	Bulk (Bag) – Maximum Length Leads	30 +5/-0	ALW0L	R30
	Tape & Reel (Standard Reel)	$H_0 = 18.5 \pm 0.5$	L	R17T0
	Tape & Reel (Large Reel)	$H_0 = 18.5 \pm 0.5$	P	R17T1
Native 15 formed to 7.5	Ammo Pack	$H_0 = 16.5 \pm 0.5$	XLAF1	R25XA
	Tape & Reel (Standard Reel)	$H_0 = 16.5 \pm 0.5$	XLTF1	R25X2

Dimensions – Millimeters



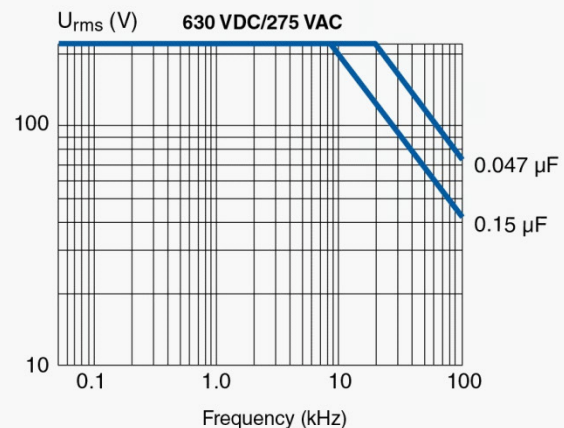
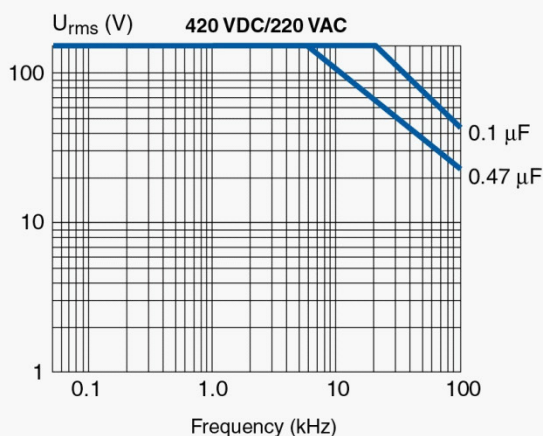
KEMET Size Code	Legacy Size Code	S		T		H		L		F	
		Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
BD	B04	15	±0.4	5.5	0/-0.5	10.5	0/-0.5	18	0/-0.5	0.8	±0.05
BG	B15	15	±0.4	6	0/-0.5	12	0/-0.5	18	0/-0.5	0.8	±0.05
BJ	B10	15	±0.4	6.5	0/-0.5	12.5	0/-0.5	18	0/-0.5	0.8	±0.05
BL	B06	15	±0.4	7.5	0/-0.5	14.5	0/-0.5	18	0/-0.5	0.8	±0.05
BM	B12	15	±0.4	8	0/-0.5	15	0/-0.5	18	0/-0.5	0.8	±0.05

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

Performance Characteristics

Voltage Range (VDC)	420	630
Voltage Range (VAC)	220	275
Capacitance Range (μF)	0.1 – 0.47	0.047 – 0.15
Capacitance Tolerance	$\pm 10\%$, other tolerances on request	
Category Temperature Range	-55°C to +110°C	
Rated Temperature	+85°C	
Voltage Derating	The rated voltage is decreased with 1.3%/°C between +85°C and +110°C	
Climatic Category	IEC 60068-1, 55/110/56	
Maximum Pulse Steepness	dV/dt according to Table 1. For peak to peak voltages lower than rated voltage ($V_{PP} < V_R$), the specified dV/dt can be multiplied by the factor V_R / V_{PP} .	
Self-Inductance	Approximately 6 nH/cm for the total length of capacitor winding and the leads	
Dissipation Factor $\tan\delta$	Maximum Values at +23°C	
	1 kHz	0.001
Insulation Resistance	Measured at +23°C, 100 VDC 60 seconds for $V_R < 500$ VDC and at 500 VDC for $V_R \geq 500$ VDC	
	Minimum Values Between Terminals	
	$C \leq 0.33 \mu\text{F}$	$\geq 100,000 \text{ M}\Omega$
	$C > 0.33 \mu\text{F}$	$\geq 30,000 \text{ M}\Omega \cdot \mu\text{F}$
	Minimum Values Between Terminals and Case	
	$\geq 100,000 \text{ M}\Omega$	

Derating of V_{RMS} vs. Frequency, +85°C Ambient Temperature and 10°C Internal Heating, Typical Values



Environmental Test Data

Test	IEC Publication	Procedure	Requirements
Voltage Proof	60384-1 Clause 4.6	$1.6 \times V_R$ after 60 seconds	The capacitors must withstand the voltage without breakdowns or flashovers and without decreased insulation resistance below the value in each detail specification. No visible damage
	Clause 4.6 2.3	$2 \times V_R$ (minimum 400 VDC to case) after 60 seconds	As above
Vibration	60068-2-6 Test Fc	6 hours with 10 – 500 Hz and 0.75 mm amplitude or 98 m/s ² depending on frequency	No visible damage $\tan\delta \leq 1.2 \times$ stated value at 100 kHz $\Delta C/C \leq \pm 0.5 \%$
Bump	60068-2-29 Test Eb	4,000 bumps with 390 m/s ² mounted on PCB	$\Delta C/C \leq \pm 0.5 \%$ $\tan\delta \leq 1.2 \times$ stated value at 100 kHz Insulation resistance: $\geq 100,000 \text{ M}\Omega$ for $C_R \leq 0.33 \mu\text{F}$ $\geq 30,000 \text{ M}\Omega \cdot \mu\text{F}$ for $C_R > 0.33 \mu\text{F}$
Resistance to Soldering Heat	60068-2-20 Method 1A	Solder bath at + 260°C \pm 5°C with screening	Immersion of the terminations into the solder bath shall be completed in a time not exceeding 1 second and the terminations shall remain immersed to the specified depth for 10 + 1 second and then be withdrawn. $\Delta C/C \leq \pm 1.0 \%$ $\tan\delta$ increase < 0.001 No visible damage
Climatic Sequence	60384-1 Paragraph 4:21	60068-2.2 dry heat 16 hours 60068-2-34 damp heat, one cycle 60068-2-1 Test Aa 2 hours	Insulation resistance: $\geq 100,000 \text{ M}\Omega$ for $C_R \leq 0.33 \mu\text{F}$ $\geq 30,000 \text{ M}\Omega \cdot \mu\text{F}$ for $C_R > 0.33 \mu\text{F}$ $\Delta C/C \leq \pm 0.5 \%$ $\tan\delta \leq 1.2 \times$ stated value at 100 kHz
Damp Heat Steady State	60068-2-3 Test Ca	+40°C and 90 – 95% RH	56 days no visible damage Insulation resistance: $\geq 50,000 \text{ M}\Omega$ for $C_R \leq 0.33 \mu\text{F}$ $\geq 15,000 \text{ M}\Omega \cdot \mu\text{F}$ for $C_R > 0.33 \mu\text{F}$ $\Delta C/C \leq \pm 1 \%$ $\tan\delta \leq 1.2 \times$ stated value at 100 kHz
Endurance, AC		1,000 hours at +85°C and $1.25 \times V_R$ AC	No visible damage $\Delta C/C \leq \pm 3 \%$ $\tan\delta \leq 1.5 \times$ stated value at 100 kHz Insulation resistance: $\geq 100,000 \text{ M}\Omega$ for $C_R \leq 0.33 \mu\text{F}$ $\geq 30,000 \text{ M}\Omega \cdot \mu\text{F}$ for $C_R > 0.33 \mu\text{F}$
Charge and Discharge	60384-17 Paragraph 4.13	10,000 pulses and with (2 x) dV/dt according to detail specification	$\tan\delta$ (100 kHz) $\leq 2 \times$ stated value (100 kHz) $\Delta C/C \leq \pm 0.5 \%$ Insulation resistance: $\geq 50,000 \text{ M}\Omega$ for $C_R \leq 0.33 \mu\text{F}$ $\geq 15,000 \text{ M}\Omega \cdot \mu\text{F}$ for $C_R > 0.33 \mu\text{F}$

Environmental Compliance

All KEMET pulse capacitors are RoHS Compliant.



Table 1 – Ratings & Part Number Reference

VDC	VAC	Cap Value (μF)	Dimensions in mm			Lead Space (S)	dV/dt (V/μs)	Size Code (New/Legacy)	R _{thha} °C/W 85°C 0.2m/s	KEMET Part Number	Legacy Part Number
			T	H	L						
420	220	0.10	5.5	10.5	18.0	15	150	BD/B04	99	F429BD104K420(1)	PHE429KB6100K(1)
420	220	0.15	5.5	10.5	18.0	15	150	BD/B04	99	F429BD154K420(1)	PHE429KB6150K(1)
420	220	0.22	6.0	12.0	18.0	15	150	BG/B15	83	F429BG224K420(1)	PHE429KB6220K(1)
420	220	0.33	7.5	14.5	18.0	15	150	BL/B06	74	F429BL334K420(1)	PHE429KB6330K(1)
420	220	0.47	8.0	15.0	18.0	15	150	BM/B12	71	F429BM474K420(1)	PHE429KB6470K(1)
630	275	0.047	5.5	10.5	18.0	15	250	BD/B04	99	F429BD473K630(1)	PHE429MB5470K(1)
630	275	0.068	5.5	10.5	18.0	15	250	BD/B04	99	F429BD683K630(1)	PHE429MB5680K(1)
630	275	0.10	5.5	10.5	18.0	15	250	BD/B04	99	F429BD104K630(1)	PHE429MB6100K(1)
630	275	0.15	6.5	12.5	18.0	15	250	BJ/B10	84	F429BJ154K630(1)	PHE429MB6150K(1)
VDC	VAC	Cap Value (μF)	T (mm)	H (mm)	L (mm)	Lead Space	dV/dt (V/μs)	Size Code (New/Legacy)	R _{thha} °C/W 85°C 0.2m/s	KEMET Part Number	Legacy Part Number

(1) Insert lead and packaging code. See Ordering Options Table for available options.

Soldering Process

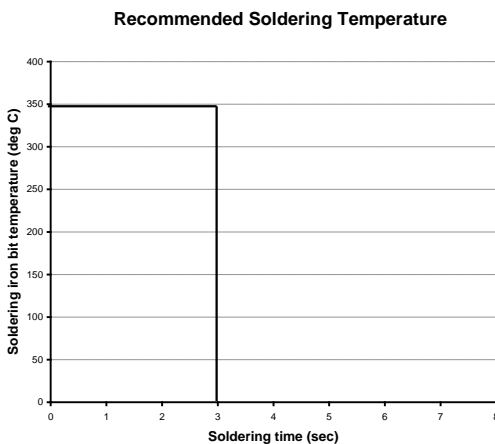
The implementation of the RoHS directive has resulted in the selection of SnAgCu (SAC) alloys or SnCu alloys as primary solder. This has increased the liquidus temperature from that of 183°C for SnPb eutectic alloy to 217 – 221°C for the new alloys. As a result, the heat stress to the components, even 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.

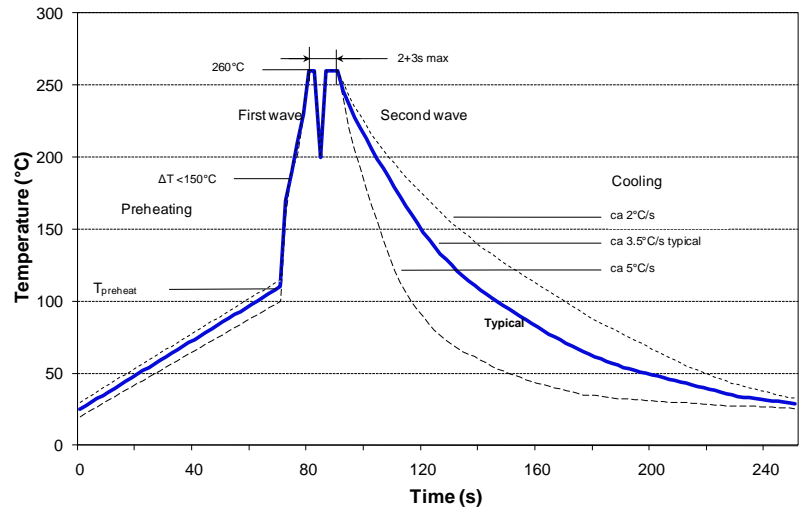
Manual Soldering Recommendations

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.

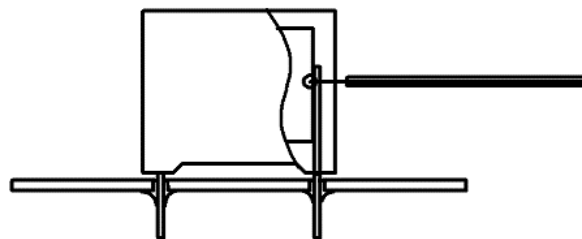
1. The table indicates the maximum set-up temperature of the soldering process
 Figure 1

Dielectric Film Material	Maximum Preheat Temperature			Maximum Peak Soldering Temperature	
	Capacitor Pitch ≤ 10 mm	Capacitor Pitch = 15 mm	Capacitor Pitch > 15 mm	Capacitor Pitch ≤ 15 mm	Capacitor Pitch > 15 mm
Polyester	130°C	130°C	130°C	270°C	270°C
Polypropylene	100°C	110°C	130°C	260°C	270°C
Paper	130°C	130°C	140°C	270°C	270°C
Polyphenylene Sulphide	150°C	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	110°C
Paper	160°C
Polyphenylene sulphide	160°C



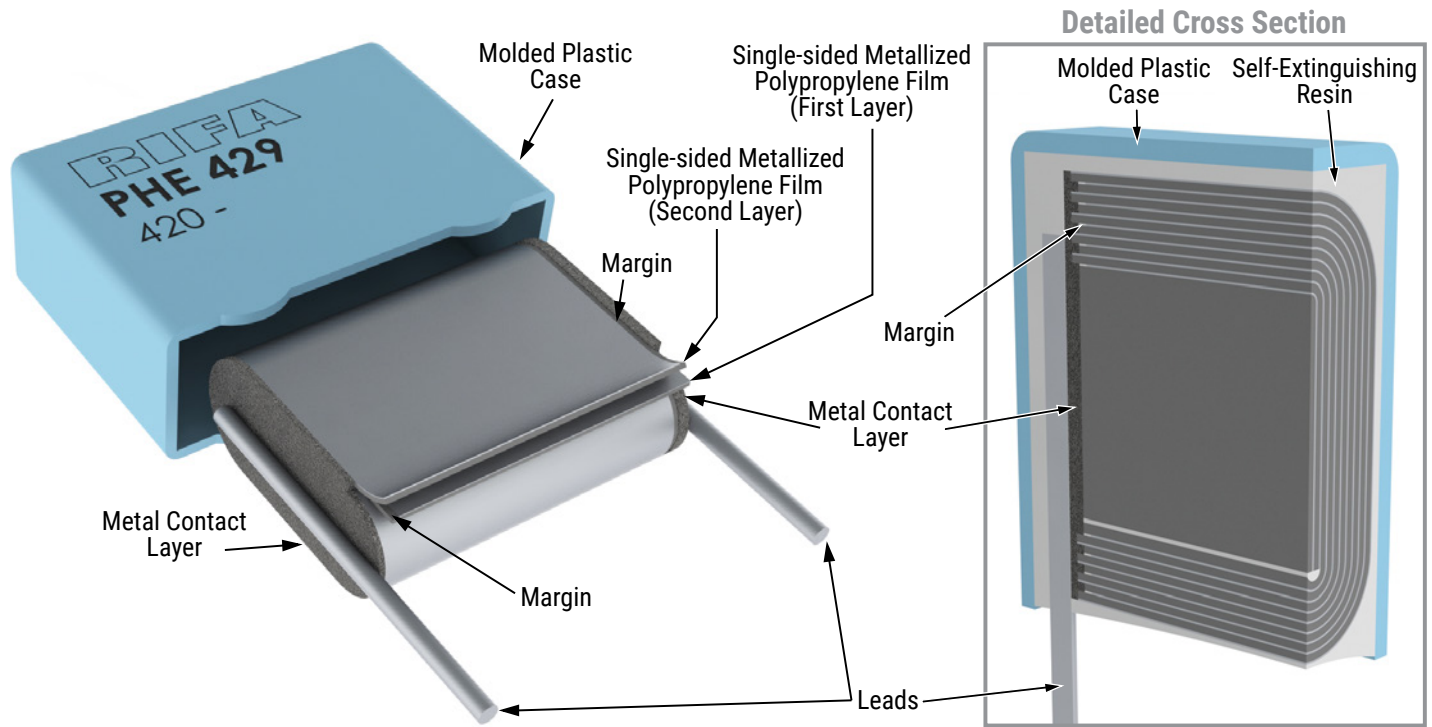
Temperature monitored inside the capacitor.

Selective Soldering Recommendations

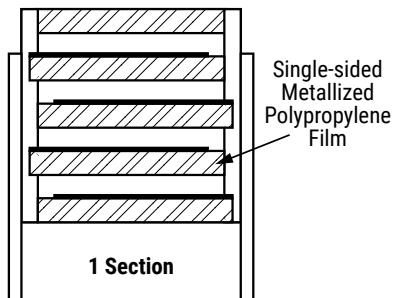
Selective dip soldering is a variation of reflow soldering. In this method, the printed circuit board with through-hole components to be soldered is preheated and transported over the solder bath as in normal flow soldering without touching the solder. When the board is over the bath, it is stopped and 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.

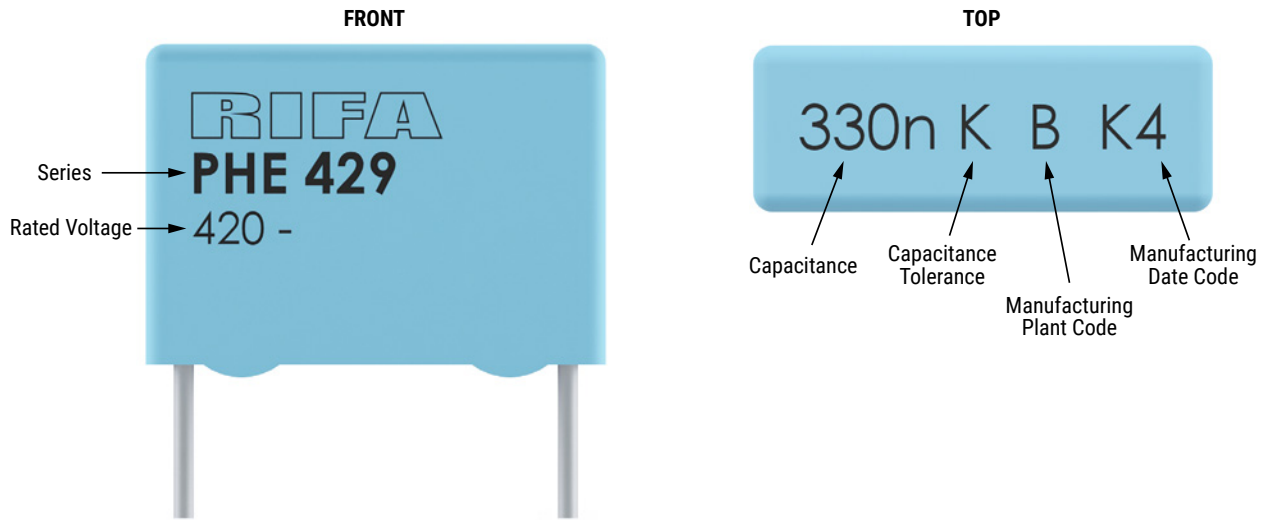
Construction



Winding Scheme



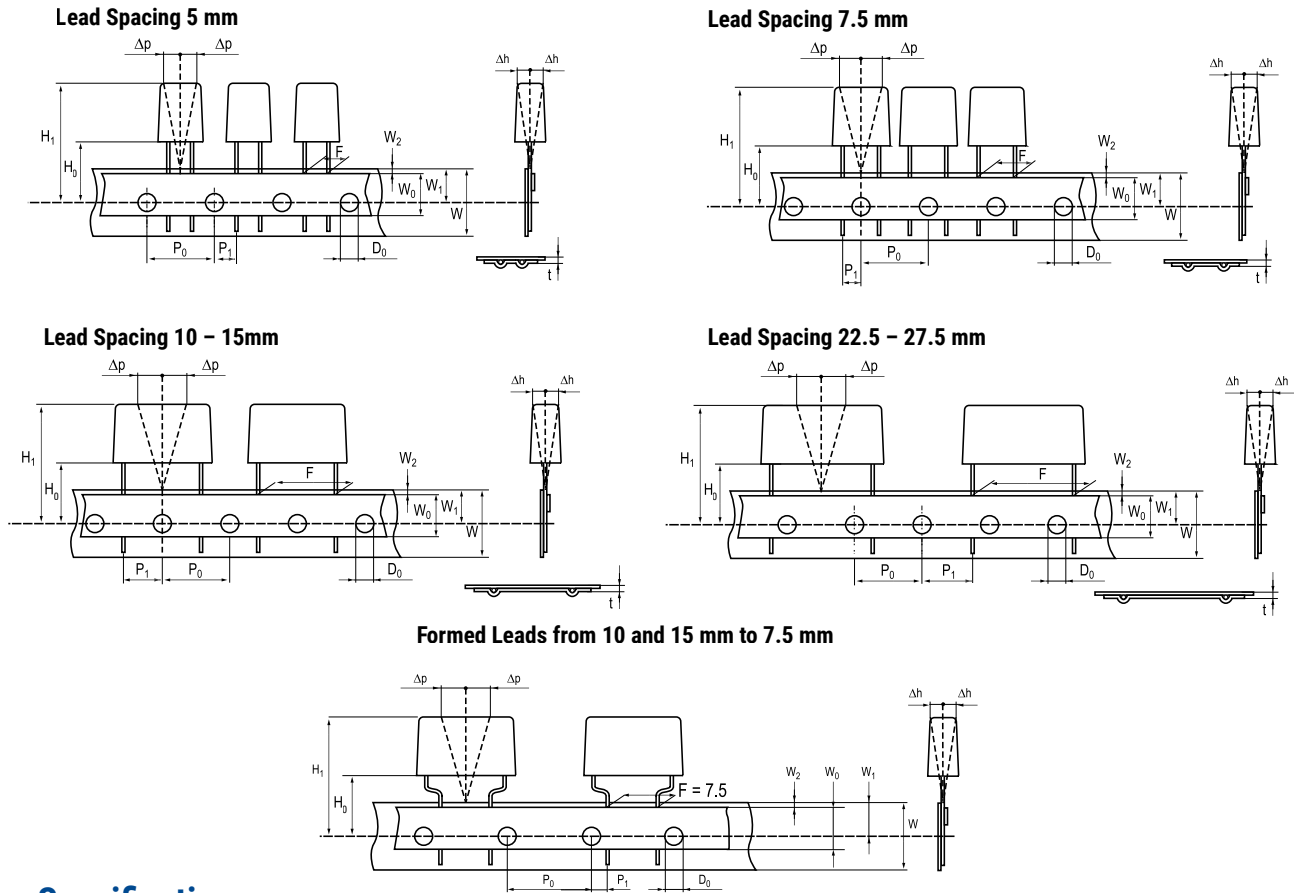
Marking



Packaging Quantities

KEMET Size Code	Legacy Size Code	Lead Spacing	Thickness (mm)	Height (mm)	Length (mm)	Bulk Short Leads	Bulk Long Leads	Standard Reel ø 360 mm	Large Reel ø 500 mm	Standard Reel Formed	Ammo Formed
BD	B04	15	5.5	10.5	18	1,000	800	600	1,200	550	570
BE	B05		5.5	12.5	18	1,000	800	600	1,200	550	570
BL	B06		7.5	14.5	18	800	400	400	800	350	378
BJ	B10		6.5	12.5	18	1,000	600	500	1,000	450	480
BQ	B11		8.5	16	18	600	400	400	800	350	324
BM	B12		8	15	18	600	400	400	800	350	351
BV	B14		9.5	17.5	18	500	300	350	700	250	297
BG	B15		6	12	18	1,000	800	500	1,000	450	520
BY	B16		11	19	18	450	250	300	600	250	252
BU	B17		13	12.5	18	400	300	250	500	200	216

Lead Taping & Packaging (IEC 60286-2)



Taping Specification

Dimensions in mm										Standard IEC 60286-2
Lead Spacing	+0.6/-0.1	F	5	7.5	Formed 7.5	10	15	22.5	27.5	F
Carrier Tape Width	±0.5	W	18	18	18	18	18	18	18	18±1/-0.5
Hold-down Tape Width	Minimum	W_0	5	5	5	5	5	5	5	
Position of Sprocket Hole	±0.5	W_1	9	9	9	9	9	9	9	9±0.75/-0.5
Distance Between Tapes	Maximum	W_2	3	3	3	3	3	3	3	3
Sprocket Hole Diameter	±0.2	D_0	4	4	4	4	4	4	4	4
Feed Hole Lead Spacing	±0.3	P_0 (1)	12.7	12.7	12.7 (4)	12.7	12.7	12.7	12.7	12.7
Distance Lead - Feed Hole	±0.7	P_1	3.85	3.75	3.75	7.7	5.2	5.3	5.3	P1
Deviation Tape - Plane	Maximum	Δp	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Lateral Deviation	Maximum	Δh	2	2	2	2	2	2	2	2
Total Thickness	±0.2	t	0.7	0.7	0.7	0.7	0.7	0.9 Maximum	0.9 Maximum	0.9 Maximum
Sprocket Hole/Cap Body	Nominal	H_0 (2)	18.5±0.5	18.5±0.5	18.5±0.5	18.5±0.5	18.5±0.5	18.5±0.5	18.5±0.5	18.0±2/-0
Sprocket Hole/Top of Cap Body	Maximum	H_1 (3)	32	31	43	43	43	58	58	58 Maximum

(1) Maximum cumulative feed hole error, 1 mm per 20 parts

(2) 16.5 mm available on request

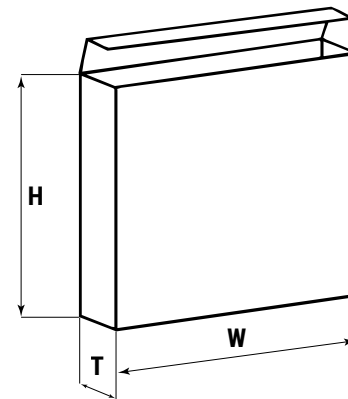
(3) Depending on case size

(4) 15 mm available on request

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

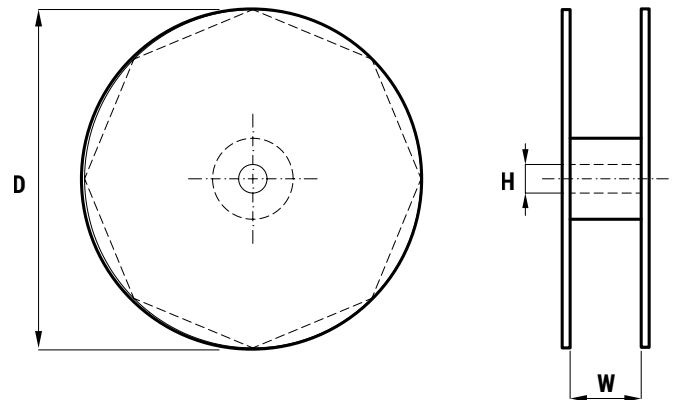
Ammo Specifications

Series	Dimensions (mm)		
	H	W	T
R4x, R4x+R, R7x, RSB	360	340	59
F5A, F5B, F5D			
F6xx, F8xx			
PHExxx, PMExxx, PMRxxx, SMR & PFR	330	330	50



Reel Specifications

Series	Dimensions (mm)		
	D	H	W
R4x, R4x+R, R7x, RSB	355 500	30	55 (Max)
F5A, F5B, F5D		25	
F6xx, F8xx			
PHExxx, PMExxx, PMRxxx, SMR & PFR	360 500	30	46 (Max)



Manufacturing Date Code (IEC-60062)

Y = Year, Z = Month			
Year	Code	Month	Code
2020	M	January	1
2021	N	February	2
2022	P	March	3
2023	R	April	4
2024	S	May	5
2025	T	June	6
2026	U	July	7
2027	V	August	8
2028	W	September	9
2029	X	October	0
2030	A	November	N
2031	B	December	D
2032	C		
2033	D		
2034	E		
2035	F		
2036	H		
2037	J		
2038	K		
2039	L		
2040	M		

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