F862 Series Metallized Polypropylene Film for Harsh Environmental Conditions, Class X2, 310 VAC (Automotive Grade)

Overview

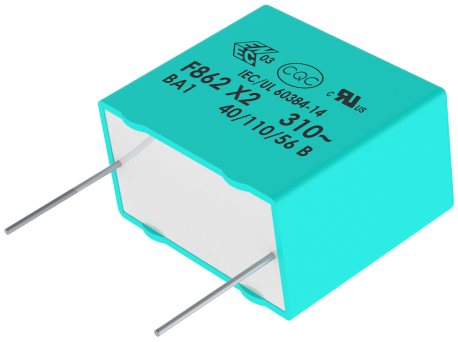
The F862 Series is constructed of metallized polypropylene film encapsulated with self-extinguishing resin in a box material recognized by UL 94 V–0. Harsh environmental conditions. Automotive grade devices are available and meet the demanding Automotive Electronics Council's AEC–Q200 qualification requirements.

Applications

Typical applications include connection in series with the mains, capacitive power supplies, and energy meters. High stability grade in severe ambient conditions.

Benefits

- Approvals: ENEC, UL, cUL, CQC
- Rated voltage: 310 VAC 50/60 Hz
- Capacitance range: 0.047 – 4.7 µF
- Lead spacing: 15.0 – 27.5 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 +110˚C
- 100% screening factory test at 1,900 VDC
- Automotive (AEC–Q200) grades available



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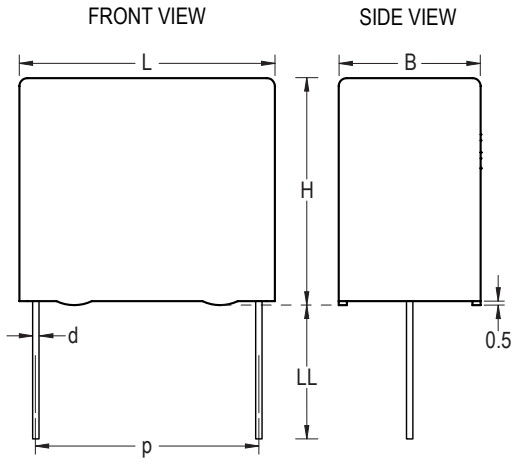
Part Number System

F	862	B	C	104	M	310	C
Capacitor Class	Series	Lead Spacing (mm)	Size Code	Capacitance Code (pF)	Capacitance Tolerance	Voltage (VAC)	Lead and Packaging Code
F = Film	X2, Metallized Polypropylene	B = 15 D = 22.5 F = 27.5	See Dimension Table	First two digits represent significant figures. Third digit specifies number of zeros.	K = ±10% M = ±20%	310	See Ordering Options Table

Ordering Options Table

Lead Spacing Nominal (mm)	Type of Leads and Packaging	Lead Length (mm)	Lead and Packaging Code
15	**Standard Lead and Packaging Options**		
	Bulk (Bag) – Short Leads	4 +2/-0	C
	Bulk (Bag) – Long Leads	17 +0/-1	A
	Tape & Reel (Standard Reel)	H_0= 18.5 +/-0.5	L
	Pizza Pack	4 +2/-0	Z
	Other Lead and Packaging Options		
	Pizza – Short Leads	3.2 +0.3/-0.2	ZL32K
	Bulk (Bag) – Maximum Length Leads	25 +5/-0	ALR0L
	Ammo Pack	H_0= 18.5 +/-0.5	R
	Tape & Reel (Large Reel)	H_0= 18.5 +/-0.5	P
22.5	**Standard Lead and Packaging Options**		
	Pizza – Long Leads	17 +0/-1	ZLH0J
	Pizza Pack	4 +2/-0	Z
	Other Lead and Packaging Options		
	Pizza – Short Leads	3.2 +0.3/-0.2	ZL32K
	Tape & Reel (Standard Reel)	H_0= 18.5 +/-0.5	L
	Tape & Reel (Large Reel)	H_0= 18.5 +/-0.5	P
	Ammo Pack	H_0= 18.5 +/-0.5	R
27.5	**Standard Lead and Packaging Options**		
	Pizza – Long Leads	17 +0/-1	ZLH0J
	Pizza Pack	4 +2/-0	Z
	Pizza – Short Leads	3.2 +0.3/-0.2	ZL32K

Dimensions – Millimeters



Size Code	p		B		H		L		d	
	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
BG	15.0	+/-0.4	6.0	Maximum	12.0	Maximum	18.0	Maximum	0.8	+/-0.05
BK	15.0	+/-0.4	7.5	Maximum	13.5	Maximum	18.0	Maximum	0.8	+/-0.05
BP	15.0	+/-0.4	8.5	Maximum	14.5	Maximum	18.0	Maximum	0.8	+/-0.05
BS	15.0	+/-0.4	10.0	Maximum	16.0	Maximum	18.0	Maximum	0.8	+/-0.05
BY	15.0	+/-0.4	11.0	Maximum	19.0	Maximum	18.0	Maximum	0.8	+/-0.05
BZ	15.0	+/-0.4	12.0	Maximum	20.0	Maximum	18.0	Maximum	0.8	+/-0.05
DB	22.5	+/-0.4	6.0	Maximum	14.5	Maximum	26.0	Maximum	0.8	+/-0.05
DI	22.5	+/-0.4	7.0	Maximum	16.0	Maximum	26.0	Maximum	0.8	+/-0.05
DJ	22.5	+/-0.4	8.5	Maximum	17.0	Maximum	26.0	Maximum	0.8	+/-0.05
DO	22.5	+/-0.4	10.0	Maximum	18.5	Maximum	26.0	Maximum	0.8	+/-0.05
DP	22.5	+/-0.4	11.0	Maximum	20.0	Maximum	26.0	Maximum	0.8	+/-0.05
DU	22.5	+/-0.4	13.0	Maximum	22.0	Maximum	26.0	Maximum	0.8	+/-0.05
FC	27.5	+/-0.4	11.0	Maximum	20.0	Maximum	31.5	Maximum	0.8	+/-0.05
FI	27.5	+/-0.4	13.0	Maximum	25.0	Maximum	31.5	Maximum	0.8	+/-0.05
FN	27.5	+/-0.4	14.0	Maximum	28.0	Maximum	31.5	Maximum	0.8	+/-0.05
FS	27.5	+/-0.4	19.0	Maximum	29.0	Maximum	31.5	Maximum	0.8	+/-0.05
FY	27.5	+/-0.4	22.0	Maximum	37.0	Maximum	31.5	Maximum	0.8	+/-0.05

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

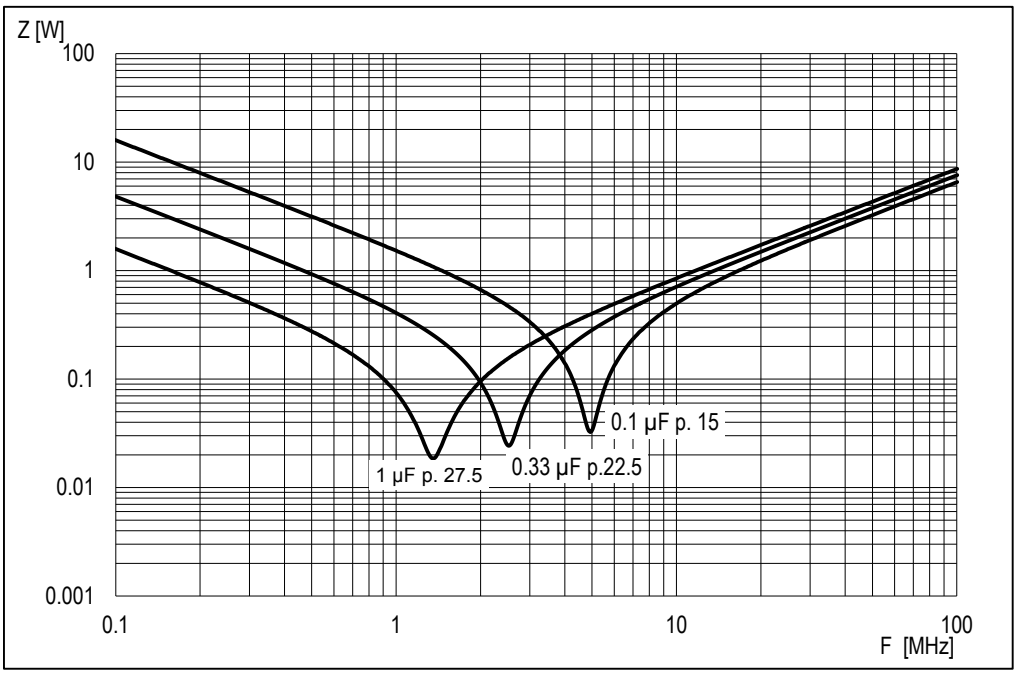
Approvals

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.

Performance Characteristics

Rated Voltage	310 VAC 50/60 Hz		
Capacitance Range	0.047 – 4.7 µF		
Capacitance Tolerance	±20%, ±10%		
Temperature Range	-40°C to +110°C		
Climatic Category	40/110/56		
Approvals	ENEC, UL, cUL, CQC		
Dissipation Factor	Maximum Values at +23°C		
		C ≤ 0.1 µF	C > 0.1 µF
	1 kHz	0.3%	0.2%
Test Voltage Between Terminals	The 100% screening factory test is carried out at 1,900 VDC. The voltage level is selected to meet the requirements in applicable equipment standards. All electrical characteristics are checked after the test. It is not permitted to repeat this test as there is a risk to damage the capacitor. KEMET is not liable in such case for any failures.		
Insulation Resistance	Minimum Values Between Terminals		
	C ≤ 0.33 µF	≥ 30,000 MΩ	
	C > 0.33 µF	≥ 10,000 MΩ • µF	
In DC Applications	Recommended voltage ≤ 630 VDC		

Impedance Graph



Environmental Test Data

Test	IEC Publication	Procedure
Endurance	IEC 60384–14	1.25 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
Vibration	IEC 60068–2–6 Test Fc	3 directions at 2 hours each 10 – 55 Hz at 0.75 mm or 98 m/s^2
Bump	IEC 60068–2–29 Test Eb	1,000 bumps at 390 m/s^2
Change of Temperature	IEC 60068–2–14 Test Na	Upper and lower rated temperature 5 cycles
Active Flammability	IEC 60384–14	V_R + 20 surge pulses at 2.5 kV (pulse every 5 seconds)
Passive Flammability	IEC 60384–14	IEC 60384–1, IEC 60695–11–5 Needle-flame test
Damp Heat Steady State	IEC 60068–2–78 Test Cab	+40°C and 93% RH, 56 days
THB Test		85°C, 85% RH and 240 VAC, 1,000 hours Capacitance change (ΔC/C): ≤ 10% Dissipation factor change (Δtan δ): ≤ 5 * 10^{-3} (at 1 kHz) Insulation resistance Rins or time constant τ = CR Rins: ≥ 50% of initial limit

Approvals

Mark	Specification	File Number
	EN/IEC 60384–14	V4413
c UL us	UL 60384–14 and CAN/CSA–E60384–14	E97797
CQC	IEC 60384-14	CQC14001105462 CQC14001105463 CQC14001105464 CQC14001105465 CQC14001105692

Environmental Compliance

All new KEMET EMI capacitors are RoHS Compliant and Halogen Free.

RoHS Compliant

Halogen Free

Table 1 – Ratings & Part Number Reference

Capacitance Value (µF)	Size Code	Maximum Dimensions in mm			Lead Spacing (p)	dV/dt (V/µs)	Part Number
		B	H	L			
0.047	**BG**	**6**	**12**	**18**	**15**	**400**	**F862BG473(1)310(2)**
0.068	**BG**	**6**	**12**	**18**	**15**	**400**	**F862BG683(1)310(2)**
0.1	BK	7.5	13.5	18	15	400	F862BK104(1)310(2)
0.12	**BK**	**7.5**	**13.5**	**18**	**15**	**400**	**F862BK124(1)310(2)**
0.15	**BK**	**7.5**	**13.5**	**18**	**15**	**400**	**F862BK154(1)310(2)**
0.18	**BP**	**8.5**	**14.5**	**18**	**15**	**400**	**F862BP184(1)310(2)**
0.22	BP	8.5	14.5	18	15	400	F862BP224(1)310(2)
0.33	BS	10	16	18	15	400	F862BS334(1)310(2)
0.39	**BS**	**10**	**16**	**18**	**15**	**400**	**F862BS394(1)310(2)**
0.47	BY	11	19	18	15	400	F862BY474(1)310(2)
0.56	BZ	12	20	18	15	400	F862BZ564(1)310(2)
0.15	**DB**	**6**	**14.5**	**26**	**22.5**	**200**	**F862DB154(1)310(2)**
0.22	**DI**	**7**	**16**	**26**	**22.5**	**200**	**F862DI224(1)310(2)**
0.33	**DJ**	**8.5**	**17**	**26**	**22.5**	**200**	**F862DJ334(1)310(2)**
0.39	**DJ**	**8.5**	**17**	**26**	**22.5**	**200**	**F862DJ394(1)310(2)**
0.47	DO	10	18.5	26	22.5	200	F862DO474(1)310(2)
0.56	DO	10	18.5	26	22.5	200	F862DO564(1)310(2)
0.68	DP	11	20	26	22.5	200	F862DP684(1)310(2)
0.82	**DP**	**11**	**20**	**26**	**22.5**	**200**	**F862DP824(1)310(2)**
1	DU	13	22	26	22.5	200	F862DU105(1)310(2)
1.2	DU	13	22	26	22.5	200	F862DU125(1)310(2)
1	**FC**	**11**	**20**	**31.5**	**27.5**	**150**	**F862FC105(1)310(2)**
1.5	**FI**	**13**	**25**	**31.5**	**27.5**	**150**	**F862FI155(1)310(2)**
2.2	**FN**	**14**	**28**	**31.5**	**27.5**	**150**	**F862FN225(1)310(2)**
3.3	**FS**	**19**	**29**	**31.5**	**27.5**	**150**	**F862FS335(1)310(2)**
4.7	**FY**	**22**	**37**	**31.5**	**27.5**	**150**	**F862FY475(1)310(2)**
Capacitance Value (µF)	**Size Code**	**B (mm)**	**H (mm)**	**L (mm)**	**Lead Spacing (p)**	**dV/dt (V/µs)**	**Part Number**

(1) M = ±20%, K = ±10%.

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

Bold blue text = In progress, samples available.

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 183ºC for SnPb eutectic alloy to 217 – 221ºC 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 – 170ºC). 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.

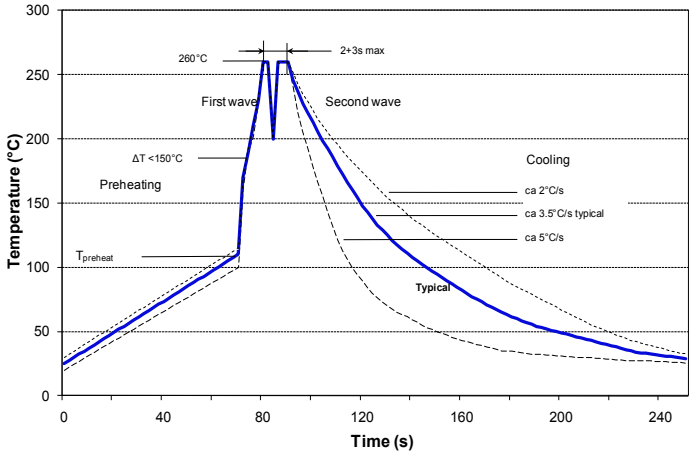
Reflow soldering is not recommended for through-hole film capacitors. Exposing capacitors to a soldering profile in excess of the above the recommended limits may result to degradation or permanent damage to the capacitors.

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.

Figure 1

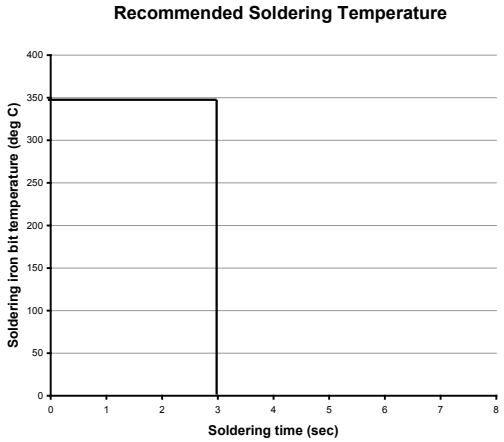
Dielectric Film Material	Maximum Preheat Temperature			Maximum Peak Soldering Temperature	
	Capacitor Lead Spacing <10 mm	Capacitor Lead Spacing = 15 mm	Capacitor Lead Spacing >15 mm	Capacitor Lead Spacing <15 mm	Capacitor Lead Spacing >15 mm
Polyester	130°C	130°C	130°C	270°C	270°C
Polypropylene	100°C	110°C	130°C	260°C	270°C
Polyphenylene Sulphide	150°C	150°C	160°C	270°C	270°C

Wave Soldering Recommendations



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.

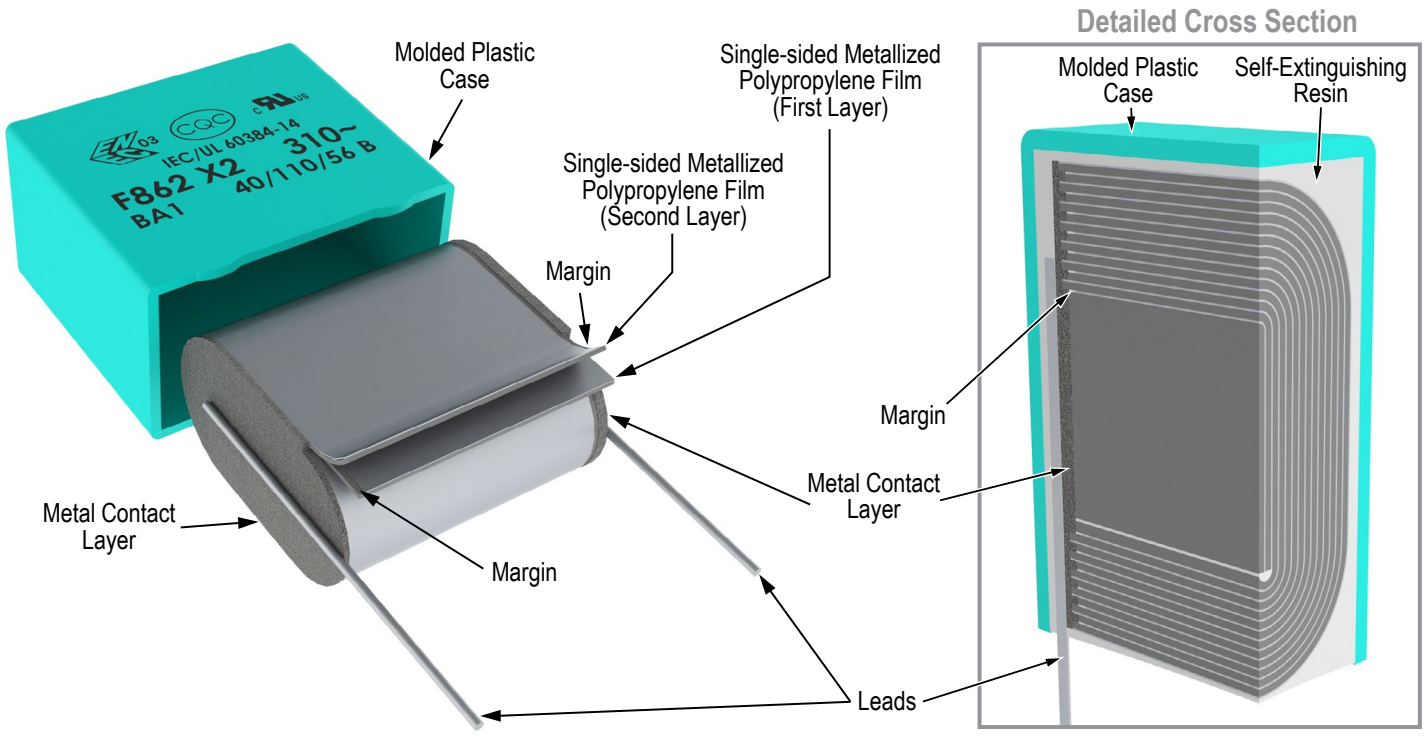
Soldering Process cont'd

Selective Soldering Recommendations

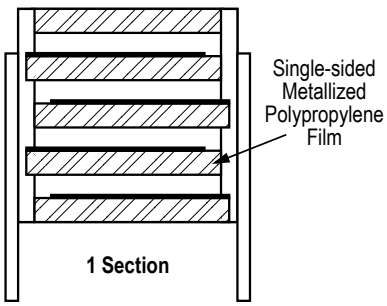
Selective dip soldering is a variation of reflow soldering. In this method, the printed circuit board with through-hole components to be soldered is preheated and transported over the solder bath as in normal flow soldering without touching the solder. When the board is over the bath, it is stopped and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

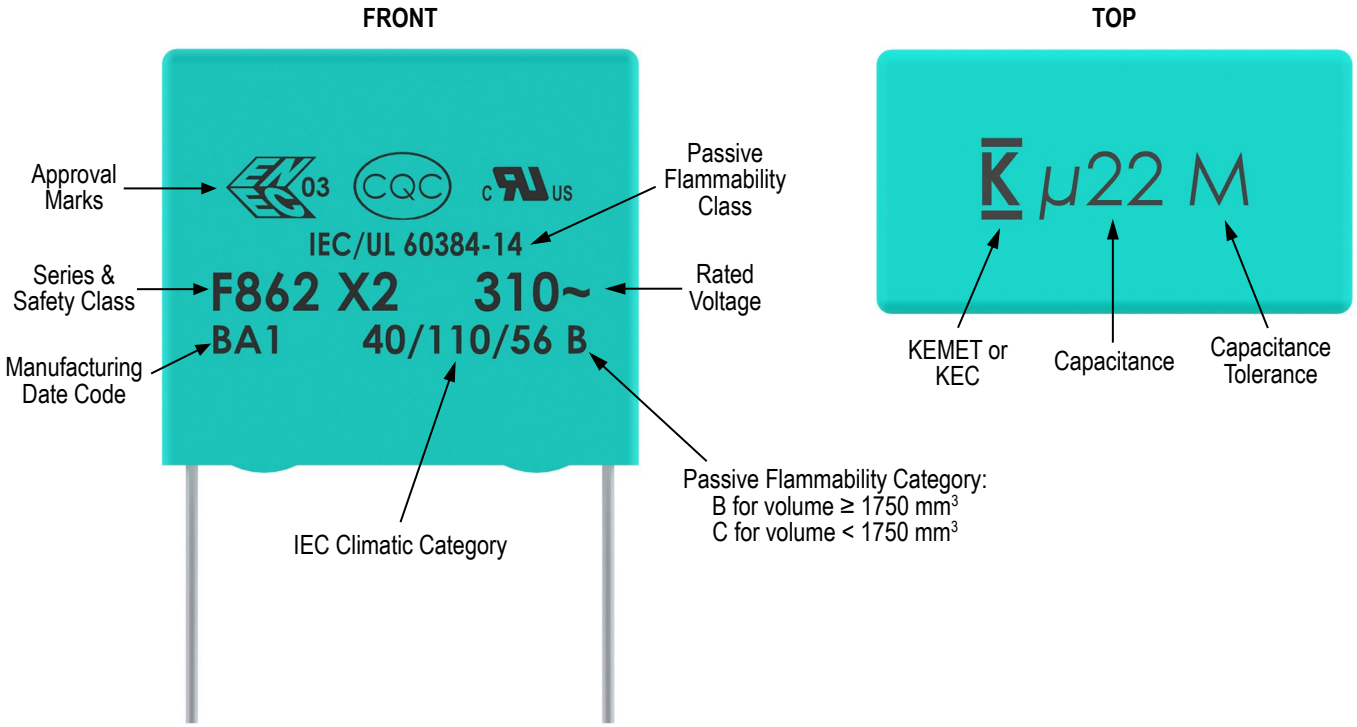
Construction



Winding Scheme



Marking

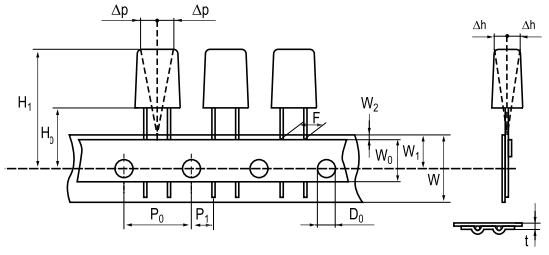

FRONT
TOP
Approval Marks
Passive Flammability Class
IEC/UL 60384-14
Series & Safety Class
F862 X2
310~
Rated Voltage
Manufacturing Date Code
BA1
40/110/56 B
IEC Climatic Category
Passive Flammability Category:
B for volume ≥ 1750 mm3
C for volume < 1750 mm3
K µ22 M
KEMET or KEC
Capacitance
Capacitance Tolerance

Packaging Quantities

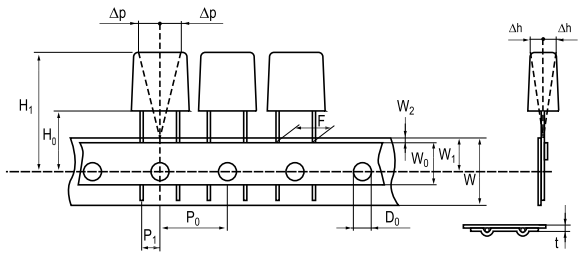
Size Code	Lead Spacing	Thickness (mm)	Height (mm)	Length (mm)	Bulk Short Leads	Bulk Long Leads	Standard Reel ø 355 mm	Large Reel ø 500 mm	Ammo	Pizza
BG	15	6	12	18	1750	1000	500	1000	680	935
BK		7.5	13.5	18	1000	800	350	800	500	748
BP		8.5	14.5	18	1000	650	300	700	440	663
BS		10	16	18	750	550	300	600	380	561
BY		11	19	18	450	400	250	500	340	510
BZ		12	20	18	350	300	220	450	330	459
DB	22.5	6	14.5	26	805	450	300	700	464	660
DI		7	16	26	700	450	250	550	380	564
DJ		8.5	17	26	450	350	250	450	280	468
DO		10	18.5	26	360	350	160	350	235	396
DP		11	20	26	300	200	190	350	217	360
DU		13	22	26	230	150	150	300	200	300
FC	27.5	11.0	20.0	31.5						300
FI		13.0	25.0	31.5						250
FN		14.0	28.0	31.5						230
FS		19.0	29.0	31.5						170
FY		22.0	37.0	31.5						150

Lead Taping & Packaging (IEC 60286–2)

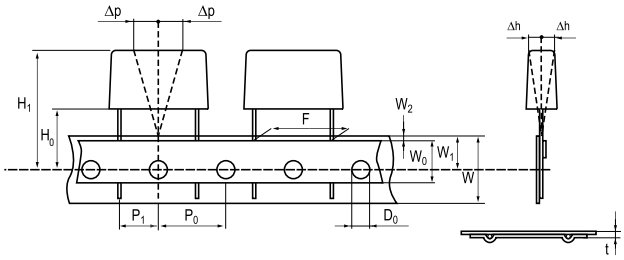
Lead Spacing 5 mm



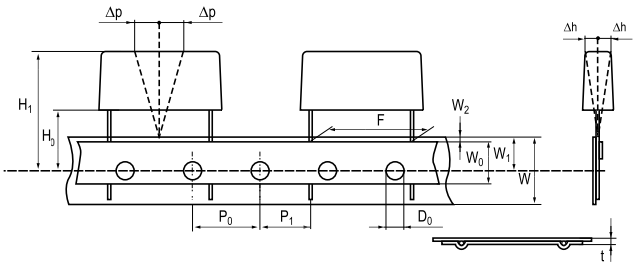
Lead Spacing 7.5 mm



Lead Spacing 10 – 15 mm



Lead Spacing 22.5 – 27.5 mm



Taping Specification

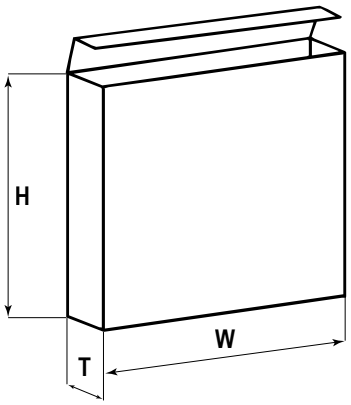
Dimensions in mm									Standard IEC 60286–2
Lead spacing	+6/-0.1	F	5	7.5	10	15	22.5	27.5	F
Carrier tape width	+1/-0.5	W	18	18	18	18	18	18	$18^{+1/-0.5}$
Hold-down tape width	Minimum	W_0	6	6	9	10	10	10	
Position of sprocket hole	+/-0.5	W_1	9	9	9	9	9	9	$9^{+0.75/-0.5}$
Distance between tapes	Maximum	W_2	3	3	3	3	3	3	3
Sprocket hole diameter	+/-0.2	D_0	4	4	4	4	4	4	4
Feed hole lead spacing	+/-0.2(1)	P_0(3)	12.7	12.7	12.7	12.7	12.7	12.7	12.7
Distance lead – feed hole	+/-0.7	P_1	3.85	3.75	7.7	5.2	7.8	5.3	P1
Deviation tape – plane	Maximum	Δp	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Lateral deviation	+/-2	Δh	2	2	2	2	2	2	2
Total thickness	+/-0.2	t	0.7	0.7	0.7	0.7	0.9^{MAX}	0.9^{MAX}	0.9^{MAX}
Sprocket hole/cap body	+/-0.5	H_0(2)	$18.5^{+/-0.5}$	$18.5^{+/-0.5}$	$18.5^{+/-0.5}$	$18.5^{+/-0.5}$	$18.5^{+/-0.5}$	$18.5^{+/-0.5}$	$18^{+2/-0}$

(1) Maximum cumulative feed hole error, 1 mm per 20 parts.
(2) 16.5 mm available on request.
(3) 15 mm available on request (F ≥ 10 mm).

Lead Taping & Packaging (IEC 60286–2) cont'd

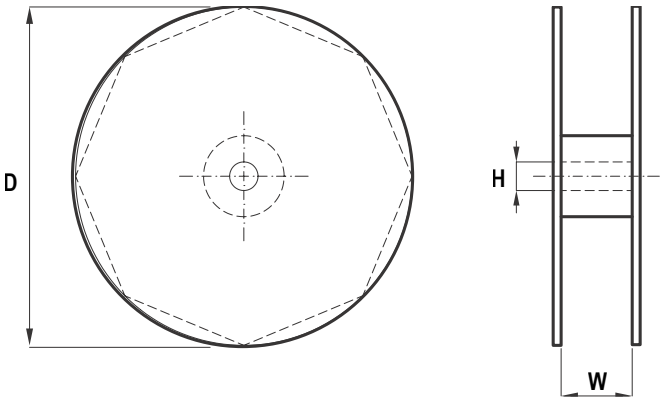
Ammo Specifications

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



Reel Specifications

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



Manufacturing Date Code (IEC–60062)

Y = Year, Z = Month			
Year	Code	Month	Code
2000	M	January	1
2001	N	February	2
2002	P	March	3
2003	R	April	4
2004	S	May	5
2005	T	June	6
2006	U	July	7
2007	V	August	8
2008	W	September	9
2009	X	October	O
2010	A	November	N
2011	B	December	D
2012	C		
2013	D		
2014	E		
2015	F		
2016	H		
2017	J		
2018	K		
2019	L		
2020	M		

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Novi, MI
Tel: 248-306-9353

West
Milpitas, CA
Tel: 408-433-9950

Mexico
Guadalajara, Jalisco
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Europe

Southern Europe
Paris, France
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Sasso Marconi, Italy
Tel: 39-051-939111

Central Europe
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