Metallized Polypropylene Film EMI Suppression Capacitors

PHE844 Series, Class X1, 440/480 VAC, 105°C

Electronic Components
KEMET CHARGED.

Overview

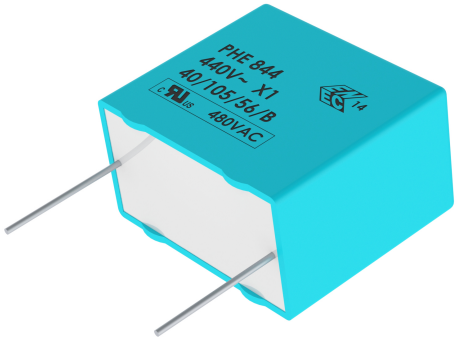
The PHE844 Series is constructed of metallized polypropylene film encapsulated with self-extinguishing resin in a box of material meeting the requirements of UL 94 V–0.

Applications

For use as a electromagnetic interference (EMI) suppression filter in across-the-line applications requiring X1 safety classification. Suitable for use in situations where failure of the capacitor would not lead to danger of electric shock.

Benefits

- Approvals: ENEC, UL, cUL
- Class X1 (IEC 60384-14)
- Rated Voltage: 440 VAC 50/60 Hz (ENEC), 480VAC 50/60 Hz (UL, cUL)
- Capacitance range: 0.1 – 2.2 µF
- Lead spacing: 22.5 – 37.5 mm
- Capacitance tolerance: ±20%, ±10%
- Climatic category 40/105/56/B, 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 +105˚C
- 100% screening factory test at 3,000 VDC
- Self-healing properties



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Legacy Part Number System

PHE844	R	D	6100	M	R06L2
Series	Rated Voltage (VAC)	Lead Spacing (mm)	Capacitance Code (pF)	Capacitance Tolerance	Packaging
X1, Metallized Polypropylene	R = 440	D = 22.5 F = 27.5 R = 37.5	The last three digits represent significant figures. The first digit specifies the total number of digits.	K = ±10% M = ±20%	See Ordering Options Table

New KEMET Part Number System

F	844	D	H	104	M	440	C
Capacitor Class	Series	Lead Spacing (mm)	Size Code	Capacitance Code (pF)	Capacitance Tolerance	Rated Voltage (VAC)	Packaging
F = Film	X1, Metallized Polypropylene	D = 22.5 F = 27.5 R = 37.5	See Dimension Table	First two digits represent significant figures. Third digit specifies number of zeros.	K = ±10% M = ±20%	440 = 440	See Ordering Options Table

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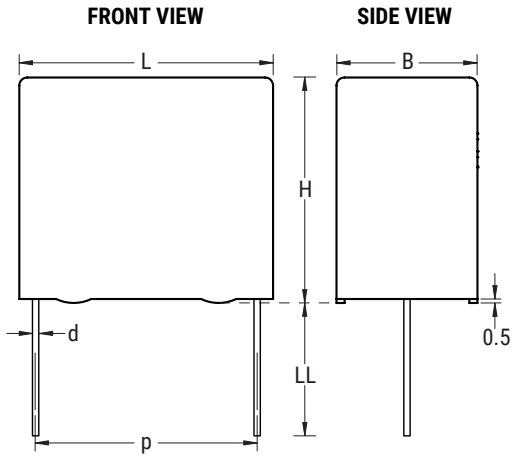
Ordering Options Table

Lead Spacing Nominal (mm)	Type of Leads and Packaging	Lead Length (mm)	KEMET Lead and Packaging Code	Legacy Lead and Packaging Code
22.5	**Standard Lead and Packaging Options**			
	Bulk (Tray)–Short Leads	6 +0/-1	C	R06L2(1)
	Other Lead and Packaging Options			
	Pizza Pack	6 +0/-1	Z	R06L2(1)
	Bulk (Tray)–Long Leads	30 +0/-1	ALW0L	R30L2
	Tape & Reel (Standard Reel)	H_0= 18.5 +/-0.5	L	R17T0
	Tape & Reel (Large Reel)	H_0= 18.5 +/-0.5	P	R17T1
27.5	**Standard Lead and Packaging Options**			
	Bulk (Tray)–Short Leads	6 +0/-1	C	R06L2(1)
	Other Lead and Packaging Options			
	Pizza Pack	6 +0/-1	Z	R06L2(1)
	Bulk (Tray)–Long Leads	30 +0/-1	ALW0L	R30L2
	Tape & Reel (Large Reel)	H_0= 18.5 +/-0.5	P	R17T1
37.5	**Standard Lead and Packaging Options**			
	Bulk (Tray)–Short Leads	6 +0/-1	C	R06L2(1)
	Other Lead and Packaging Options			
	Pizza Pack	6 +0/-1	Z	R06L2(1)

(1) Please specify Bulk (Tray) or Pizza Packaging

Dimensions – Millimeters



KEMET Size Code	Legacy Size Code	p		B		H		L		d	
		Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance	Nominal	Tolerance
DH	D14	22.5	+/- 0.4	8.0	Maximum	16.0	Maximum	26.0	Maximum	0.8	+/- 0.05
DM	D15	22.5	+/- 0.4	9.0	Maximum	18.5	Maximum	26.0	Maximum	0.8	+/- 0.05
DT	D16	22.5	+/- 0.4	11.0	Maximum	21.5	Maximum	26.0	Maximum	0.8	+/- 0.05
DW	D20	22.5	+/- 0.4	13.5	Maximum	23.0	Maximum	26.0	Maximum	0.8	+/- 0.05
DY	D19	22.5	+/- 0.4	15.5	Maximum	24.5	Maximum	26.0	Maximum	0.8	+/- 0.05
FE	F11	27.5	+/- 0.4	10.5	Maximum	20.5	Maximum	31.5	Maximum	0.8	+/- 0.05
FK	F03	27.5	+/- 0.4	13.5	Maximum	23.0	Maximum	31.5	Maximum	0.8	+/- 0.05
FM	F13	27.5	+/- 0.4	14.5	Maximum	24.5	Maximum	31.5	Maximum	0.8	+/- 0.05
FR	F14	27.5	+/- 0.4	17.5	Maximum	28.0	Maximum	31.5	Maximum	0.8	+/- 0.05
FV	F16	27.5	+/- 0.4	21.0	Maximum	30.0	Maximum	31.5	Maximum	0.8	+/- 0.05
RF	R05	37.5	+/- 0.5	13.0	Maximum	24.0	Maximum	41.0	Maximum	1.0	+/- 0.05
RH	R04	37.5	+/- 0.5	15.0	Maximum	26.0	Maximum	41.0	Maximum	1.0	+/- 0.05
RM	R03	37.5	+/- 0.5	19.0	Maximum	36.0	Maximum	41.0	Maximum	1.0	+/- 0.05
RP	R06	37.5	+/- 0.5	21.0	Maximum	38.0	Maximum	41.0	Maximum	1.0	+/- 0.05

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

Performance Characteristics

Dielectric	Polypropylene film
Plates	Metal layer deposited by evaporation under vacuum
Winding	Non-inductive type. Series design.
Leads	Tinned wire
Protection	Plastic case, thermosetting resin filled. Box material is solvent resistant and flame retardant according to UL94.
Rated Voltage (V_R)	440 VAC 50/60 Hz (ENEC) - 480 VAC 50/60 Hz (UL,cUL)
Capacitance Range	0.10 µF to 2.2 µF
Capacitance Values	E6 series (IEC 60063)
Capacitance Tolerance	±20% standard, ±10% option
Temperature Range	-40°C to 105°C
Climatic Category	40/105/56/B IEC 60068-1
Approvals	ENEC, UL, cUL
Related Documents	EN/IEC 60384-14:2005, UL 60384-14, CAN/CSA E60384-14:09

Dissipation Factor (tanδ) — Maximum Values at +23°C

Frequency	C ≤ 0.1 µF	0.1 µF < C ≤ 1 µF	C > 1 µF
1 kHz	0.1%	0.1%	0.1%
10 kHz	0.2%	0.4%	0.8%
100 kHz	0.6%	-	-

Test Voltage Between Terminals	The 100% screening factory test is carried out at 3,000 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.
Resonance Frequency	Tabulated self-resonance frequencies f_o (see Table 1 - Ratings & Part Number Reference)

Insulation Resistance — Measured at +25°C ±5°C, according to IEC 60384–2

Minimum Values Between Terminals	
C ≤ 0.33 µF	C > 0.33 µF
≥ 30,000 MΩ	≥ 10,000 MΩ • µF

In DC Applications	Recommended voltage ≤ 1,000 VDC

Environmental Test Data

Test	IEC Publication	Procedure
Endurance	IEC 60384-14:2005	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 No visible damage. No open or short circuit.
Bump	IEC 60068-2-29 Test Eb	1,000 bumps at 390 m/s^2 No visible damage. No open or short circuit.
Change of Temperature	IEC 60068-2-14 Test Na	Upper and lower rated temperature 5 cycles No visible damage.
Active Flammability	IEC 60384-14:2005	V_R + 20 surge pulses at 4 kV (pulse every 5 seconds)
Passive Flammability	IEC 60384-14:2005	IEC 60384–1, IEC 60695–11–5 Needle Flame Test
Damp Heat Steady State	IEC 60068-2-78 Test Cab	+40°C and 90 – 95% RH, 56 days

Approvals

Certification Body	Mark	Specification	File Number
Intertek Semko AB		EN/IEC 60384-14	SE/0140–1C
UL		UL 60384 and CAN/CSA E60384-14:09 (480 VAC)	E73869

Environmental Compliance

All KEMET EMI capacitors are RoHS Compliant.

Table 1 – Ratings & Part Number Reference

Capacitance Value (µF)	Size Code (New/ Legacy)	Maximum Dimensions in mm			Lead Spacing (p)	f_o (MHz)	dV/dt (V/ µs)	New KEMET Part Number	Legacy Part Number
		B	H	L					
0.10	DH/D14	8.0	16.0	26.0	22.5	3.2	100	F844DH104(1)440(2)	PHE844RD6100(1)(2)
0.15	DM/D15	9.0	18.5	26.0	22.5	2.6	100	F844DM154(1)440(2)	PHE844RD6150(1)(2)
0.22	DT/D16	11.0	21.5	26.0	22.5	2.1	100	F844DT224(1)440(2)	PHE844RD6220(1)(2)
0.33	DW/D20	13.5	23.0	26.0	22.5	1.8	100	F844DW334(1)440(2)	PHE844RD6330(1)(2)
0.47	DY/D19	15.5	24.5	26.0	22.5	1.5	100	F844DY474(1)440(2)	PHE844RD6470(1)(2)
0.22	FE/F11	10.5	20.5	31.5	27.5	2.2	100	F844FE224(1)440(2)	PHE844RF6220(1)(2)
0.33	FK/F03	13.5	23.0	31.5	27.5	1.7	100	F844FK334(1)440(2)	PHE844RF6330(1)(2)
0.47	FM/F13	14.5	24.5	31.5	27.5	1.4	100	F844FM474(1)440(2)	PHE844RF6470(1)(2)
0.68	FR/F14	17.5	28.0	31.5	27.5	1.1	100	F844FR684(1)440(2)	PHE844RF6680(1)(2)
1.0	FV/F16	21.0	30.0	31.5	27.5	1.0	100	F844FV105(1)440(2)	PHE844RF7100(1)(2)
0.47	RF/R05	13.0	24.0	41.0	37.5	1.3	100	F844RF474(1)440(2)	PHE844RR6470(1)(2)
0.68	RF/R05	13.0	24.0	41.0	37.5	1.1	100	F844RF684(1)440(2)	PHE844RR6680(1)(2)
1.0	RH/R04	15.0	26.0	41.0	37.5	0.92	100	F844RH105(1)440(2)	PHE844RR7100(1)(2)
1.5	RM/R03	19.0	36.0	41.0	37.5	0.74	100	F844RM155(1)440(2)	PHE844RR7150(1)(2)
2.2	RP/R06	21.0	38.0	41.0	37.5	0.60	100	F844RP225(1)440(2)	PHE844RR7220(1)(2)
Capacitance Value (µF)	**Size Code (New/ Legacy)**	**B (mm)**	**H (mm)**	**L (mm)**	**Lead Spacing (p)**	**f_o (MHz)**	**dV/dt (V/µs)**	**New KEMET Part Number**	**Legacy Part Number**

(1) M = ±20%, K = ±10%.

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

Soldering Process

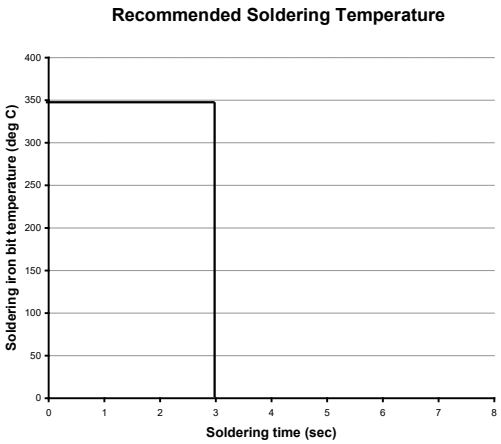
The implementation of the RoHS directive has resulted in the selection of SnAgCu (SAC) alloys or SnCu alloys as primary solder. This has increased the liquidus temperature from that of 183ºC for SnPb eutectic alloy to 217 – 221ºC for the new alloys. As a result, the heat stress to the components, even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

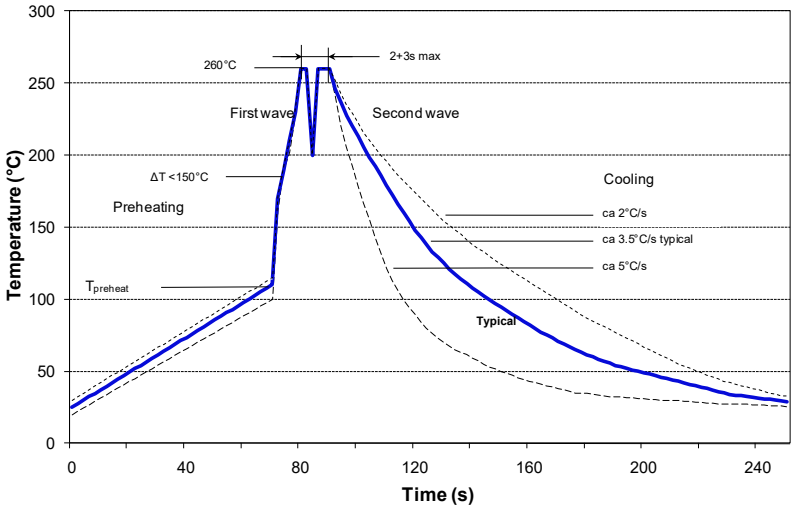
Manual Soldering Recommendations

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'd

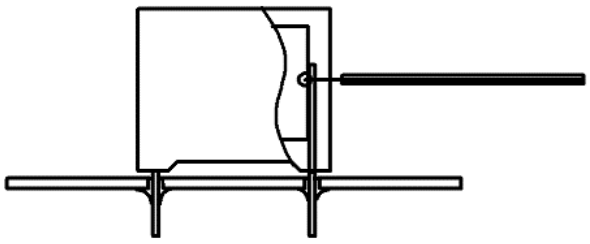
Wave Soldering Recommendations cont'd

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



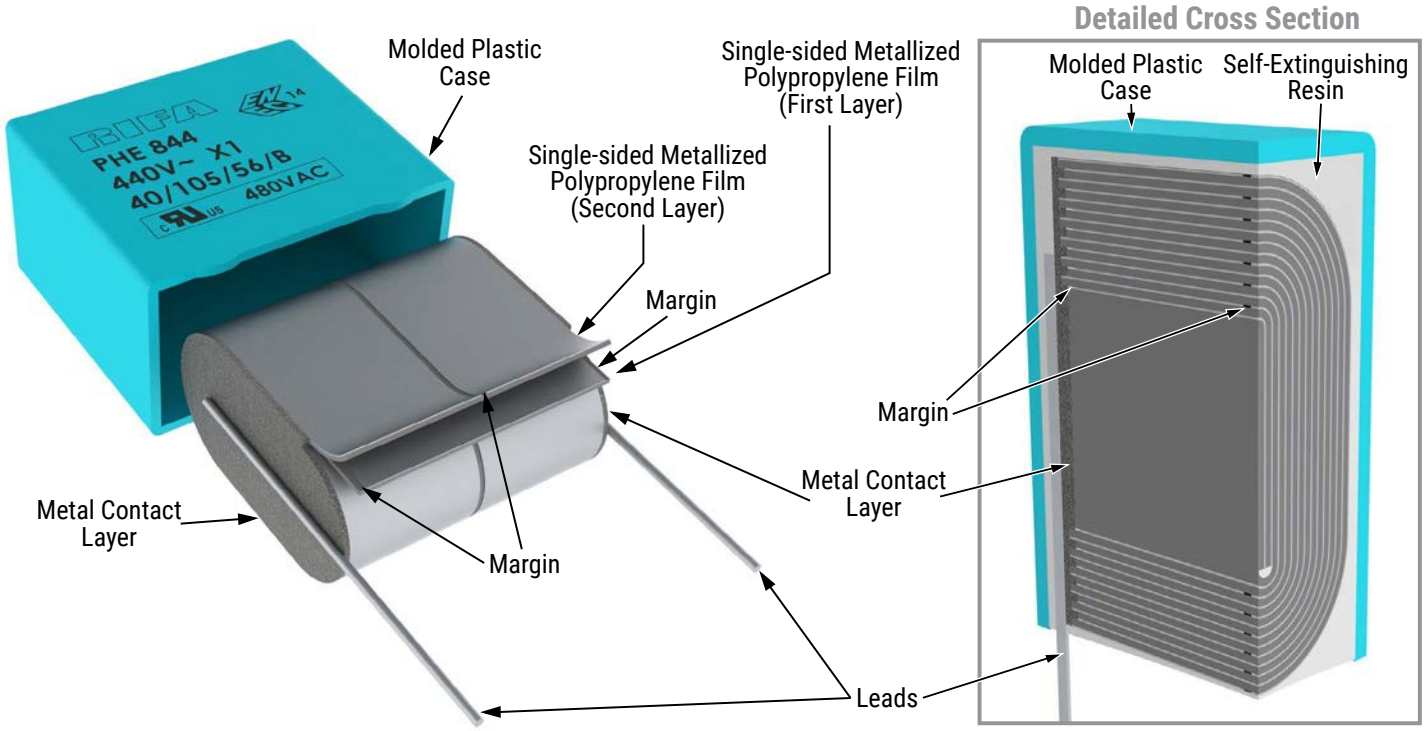
Temperature monitored inside the capacitor.

Selective Soldering Recommendations

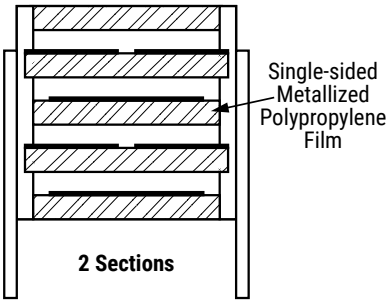
Selective dip soldering is a variation of reflow soldering. In this method, the printed circuit board with through-hole components to be soldered is preheated and transported over the solder bath as in normal flow soldering without touching the solder. When the board is over the bath, it is stopped and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

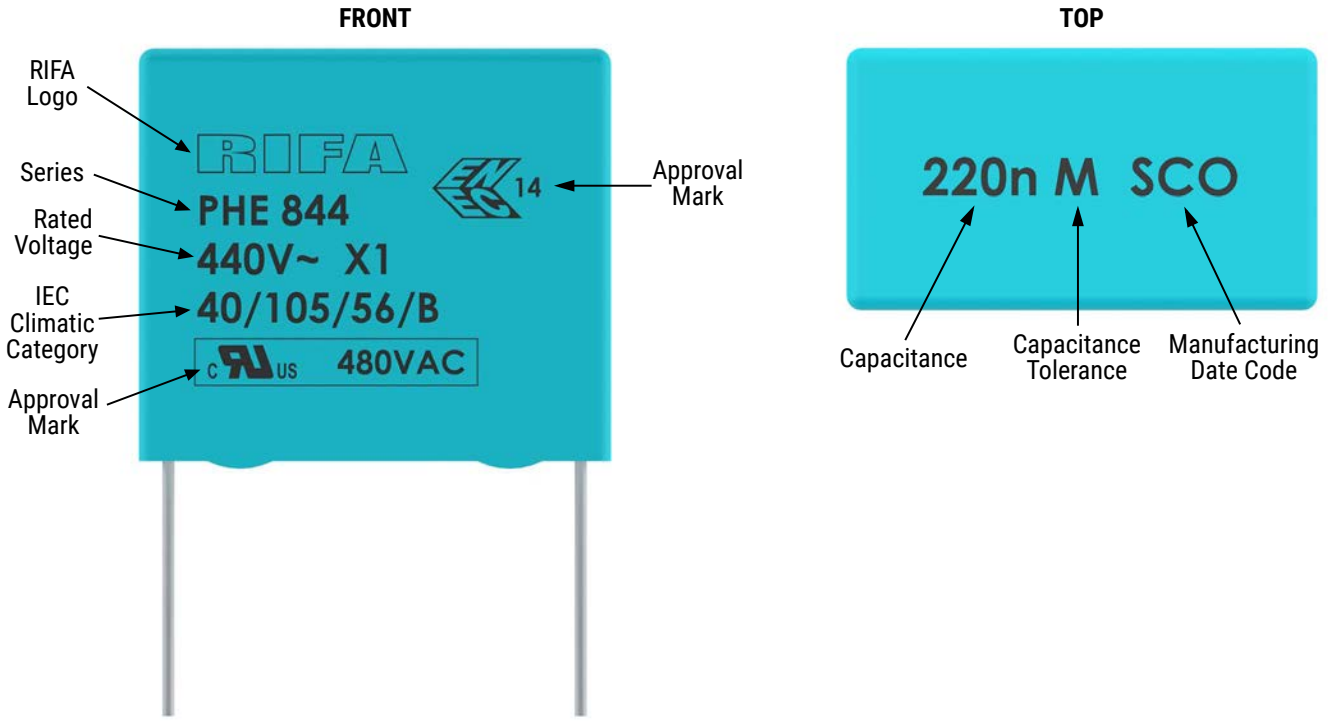
Construction



Winding Scheme



Marking



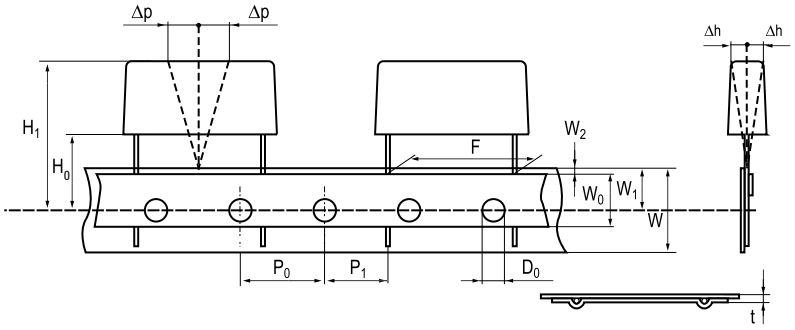
Manufacturing Date Code (IEC 60062)			
Y = Year, Z = Month			
Year	Code	Month	Code
2000	M	January	1
2001	N	February	2
2002	P	March	3
2003	R	April	4
2004	S	May	5
2005	T	June	6
2006	U	July	7
2007	V	August	8
2008	W	September	9
2009	X	October	O
2010	A	November	N
2011	B	December	D
2012	C		
2013	D		
2014	E		
2015	F		
2016	H		
2017	J		
2018	K		
2019	L		
2020	M		

Packaging Quantities

KEMET Size Code	Legacy Size Code	Lead Spacing	Thickness (mm)	Height (mm)	Length (mm)	Bulk Short Leads	Standard Reel ø 360 mm	Large Reel ø 500 mm	Ammo Bulk (Pizza)
DD	D13	22.5	6.5	14.5	26.0	234	300	600	440
DH	D14		8.0	16.0	26.0	186	250	500	352
DM	D15		9.0	18.5	26.0	308	250	500	308
DT	D16		11.0	21.5	26.0	253	200	400	253
DF	D17		7.0	16.5	26.0	216	300	600	396
DR	D18		10.5	19.0	26.0	264	200	400	264
DY	D19		15.5	24.5	26.0	176	110	250	176
DW	D20		13.5	23.0	26.0	209	160	300	209
FK	F03	27.5	13.5	23.0	31.5	171		250	171
FE	F11		10.5	20.5	31.5	216		350	216
FG	F12		11.5	22.5	31.5	198		300	198
FM	F13		14.5	24.5	31.5	153		250	153
FR	F14		17.5	28.0	31.5	126			126
FS	F15		19.0	29.0	31.5	117			117
FV	F16		21.0	30.0	31.5	108			108
FH	F17		21.0	12.5	31.5	108			108
FT	F18		31.0	18.5	31.5	72			72
FQ	F19		27.5	16.0	31.5	81			81
RK	R02	37.5	16.5	32.0	41.0	105			105
RM	R03		19.0	36.0	41.0	91			91
RH	R04		15.0	26.0	41.0	119			119
RF	R05		13.0	24.0	41.0	140			140
RP	R06		21.0	38.0	41.0	84			84
RS	R08		28.0	43.0	41.0	54			54

Lead Taping & Packaging (IEC 60286–2)

Lead Spacing 22.5 – 27.5 mm



Taping Specification

Description	Symbol	Dimensions (mm)		
		Lead Space		Tolerance
		22.5	27.5	
Lead spacing	F	22.5	27.5	+0.6/-0.1
Carrier tape width	W	18	18	+1/-0.5
Hold down tape width	W_0	10	10	Minimum
Hole position	W_1	9	9	+ 0.75/-0.5
Hold down tape position	W_2	3	3	Maximum
Feed hole diameter	D_0	4	4	± 0.2
Feed hole lead space*	P_0	12.7	12.7	± 0.2**
Centering of the lead wire	P_1	7.8	5.3	± 0.7
Component alignment	Δh	2	2	± 2
Deviation tape – plane	Δp	1.3	1.3	Maximum
Tape thickness	t	0.9	0.9	Maximum
Height of component from tape center	H_0***	18.5	18.5	± 0.5

**Available also 15mm.*
***Maximum 1 mm on 20 lead spaces.*
**** H_0 = 16.5 mm is available upon request.*

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