

Overview

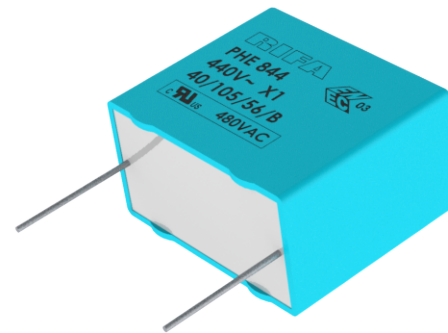
The PHE844 series is constructed of metallized polypropylene film encapsulated with self-extinguishing resin in a box of material that meets the requirements of UL 94 V-0.

Applications

For use as an electromagnetic interference (EMI) suppression filter in across-the-line applications that require X1 safety classification. Suitable for use in situations in which capacitor failure does not pose a danger of electric shock.

Benefits

- Approvals: ENEC, UL, cUL
- Class X1 (IEC 60384-14)
- THB Grade IA: 40°C, 93% RH, 500 hours at 480 V URAC acc. to IEC 60384-14
- Rated voltage: 440 VAC 50/60 Hz (ENEC), 480 VAC 50/60 Hz (UL, cUL)
- Capacitance range: 0.1 – 2.2 μ F
- Lead spacing: 22.5 – 37.5 mm
- Capacitance tolerance: \pm 20%, \pm 10%
- Climatic category 40/105/56/B, IEC 60068-1
- Tape & 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



Customer Part Number

| 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 = \pm 10% M = \pm 20% | See Ordering Options Table |

KEMET Internal Part Number

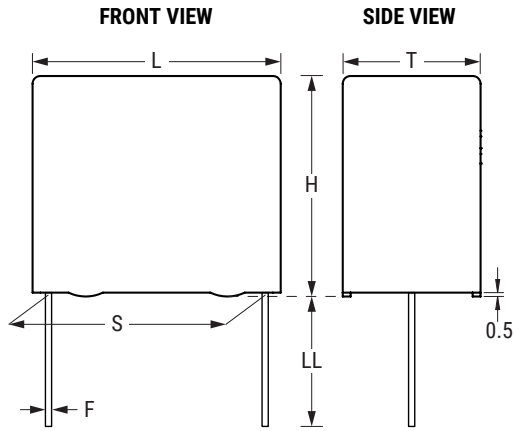
| F | 844 | D | H | 104 | M | 440 | C |
|-----------------|------------------------------|----------------------------------|---------------------|--|--------------------------------|---------------------|----------------------------|
| Capacitor Class | Series | Lead Spacing (mm) | Size Code | Capacitance 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 | The first two digits represent significant figures. The third digit specifies number of zeros. | K = \pm 10% M = \pm 20% | 440 = 440 | 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 |
|---------------------------|--|----------------------------|-------------------------------|--------------------------------|
| 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 +5/-0 | 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 +5/-0 | 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 | S | | T | | H | | L | | F | |
|-----------------|------------------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|
| | | 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 the 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 V-0. | | | |
| Rated Voltage V_R | 440 VAC 50/60 Hz (ENEC) – 480 VAC 50/60 Hz (UL,cUL) | | | |
| Capacitance Range | 0.10 – 2.2 μ F | | | |
| Capacitance Values | E6 series (IEC 60063) | | | |
| Capacitance Tolerance | \pm 20% standard, \pm 10% option | | | |
| Operating Temperature Range | -40°C to 105°C | | | |
| Rated Temperature | 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 ($\tan\delta$) | Maximum Values at +23°C | | | |
| | Frequency | $C \leq 0.1 \mu\text{F}$ | $0.1 \mu\text{F} < C \leq 1 \mu\text{F}$ | $C > 1 \mu\text{F}$ |
| | 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. Do not repeat this test, as there is a risk of damaging the capacitor. KEMET is not liable for any failures if the test has been repeated. | | | |
| Resonance Frequency | Tabulated Self-resonance Frequencies f_0 (see Table 1 – Ratings & Part Number Reference) | | | |
| Insulation Resistance | Measured at +25°C \pm 5°C, according to IEC 60384-2 | | | |
| | Minimum Values Between Terminals | | | |
| | $C \leq 0.33 \mu\text{F}$ | $C > 0.33 \mu\text{F}$ | | |
| | $\geq 30,000 \text{ M}\Omega$ | $\geq 10,000 \text{ M}\Omega \cdot \mu\text{F}$ | | |
| In DC Applications | Recommended voltage $\leq 1,000$ 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 |
| THB Test | According to Grade IA | +40°C and 90 - 95% RH, 21 days at rated AC-voltage Capacitance change ($\Delta C/C$): $\leq 10\%$ Dissipation factor change ($\Delta \tan \delta$): $\leq 24 * 10^{-3}$ (at 10 kHz) for C $\leq 1 \mu F$ Dissipation factor change ($\Delta \tan \delta$): $\leq 15 * 10^{-3}$ (at 1 kHz) for C $> 1 \mu F$ Insulation resistance IR in seconds or time constant $\tau = CR$ Rins: $\geq 50\%$ of initial limit |

Approvals

| Certification Body | Mark | Specification | File Number |
|--------------------|---|---|-------------|
| IMQ S.p.A. |  | EN/IEC 60384-14 | CA08.00255 |
| UL |  | UL 60384 and CAN/CSA E60384-14 (480 VAC)" | E73869 |

Environmental Compliance

All KEMET EMI capacitors are RoHS compliant.



Table 1 – Ratings & Part Number Reference

| Capacitance Value (µF) | Size Code (KEMET/ Legacy) | Maximum Dimensions in mm | | | Lead Spacing (S) | f _o (MHz) | dV/dt (V/µs) | KEMET Part Number | Legacy Part Number |
|------------------------|---------------------------|--------------------------|--------|--------|------------------|----------------------|--------------|--------------------|--------------------|
| | | T | 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 (KEMET/Legacy) | T (mm) | H (mm) | L (mm) | Lead Spacing (S) | f _o (MHz) | dV/dt (V/µs) | KEMET Part Number | Legacy Part Number |

(1) M = ±20%, K = ±10%.

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

Soldering Process

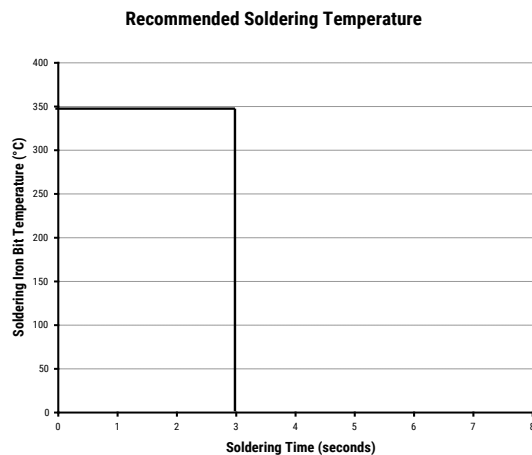
The implementation of the RoHS directive has resulted in the selection of SnAuCu (SAC) alloys or SnCu alloys as primary solder. This implementation has increased the liquidus temperature from 183°C for SnPb eutectic alloys to 217 – 221°C for the new alloys. As a result, the heat stress to the components, 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 – 15 mm), and great care must be taken during soldering. The recommended solder profiles from KEMET should be used. 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. See Figure 1.

Reflow soldering is not recommended for through-hole film capacitors. Exposing capacitors to a soldering profile in excess of the recommended limits may result in degradation of 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 curing the 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 of two soldering cycles is recommended. Allow time for the capacitor surface temperature to return to normal before the second soldering cycle.

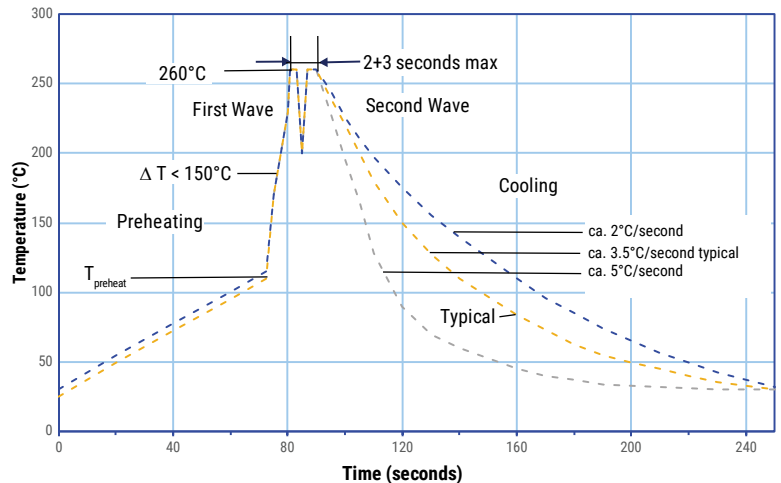
Manual Soldering Recommendations

Following is the recommendation for manual soldering with a soldering iron.



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

Wave Soldering Recommendations



Soldering Process cont.

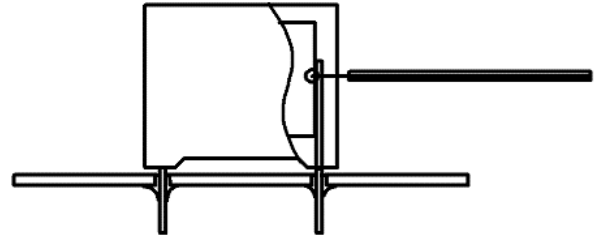
Wave Soldering Recommendations cont.

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 \geq 10 mm | Capacitor Pitch $>$ 15 mm | Capacitor Pitch \leq 15 mm | Capacitor Pitch $>$ 15 mm |
| Polyester | 130°C | 130°C | 270°C | 270°C |
| Polypropylene | 110°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 the maximum temperature is below the limit inside the element.

| 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

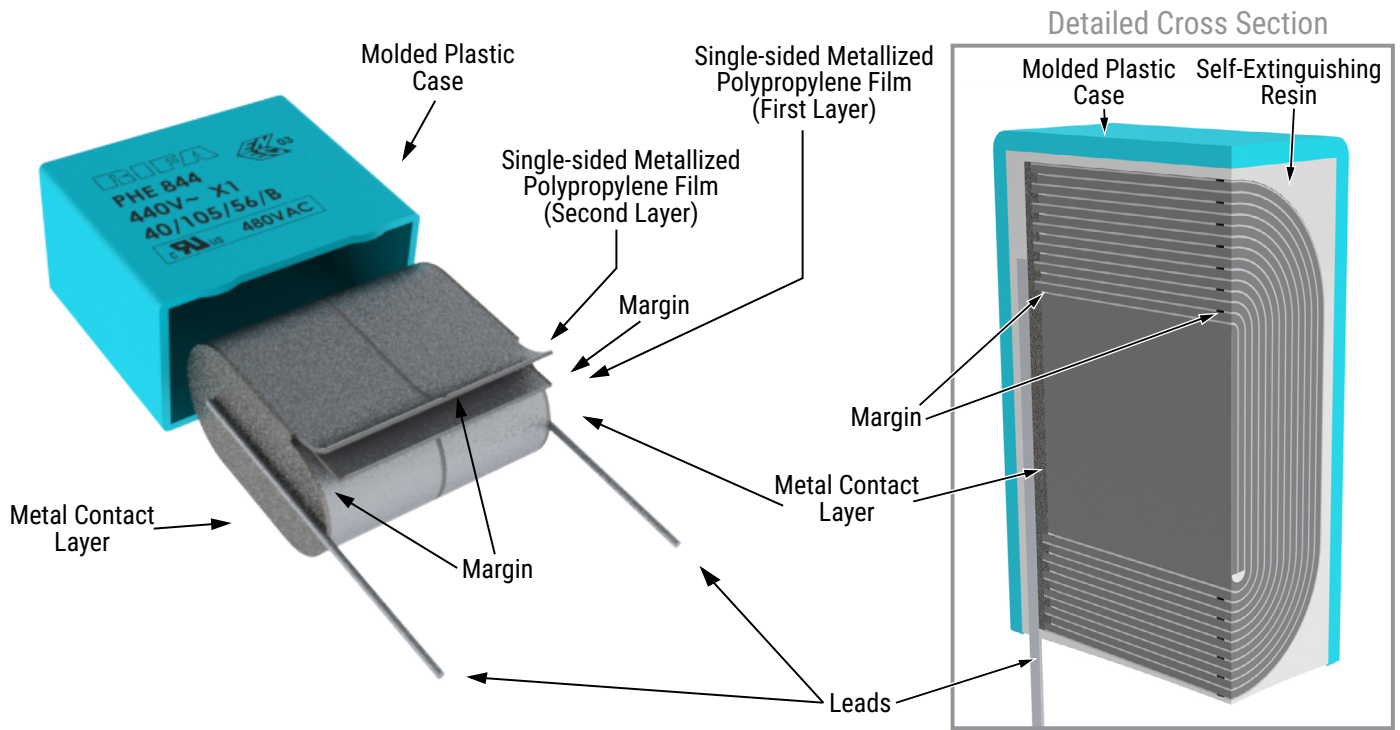
Selective dip soldering is a variation of reflow soldering. In this method, the printed circuit board with through-hole components to be soldered is preheated and transported over the solder bath, as in normal flow soldering, without touching the solder. When the board is over the bath, it is stopped. Pre-designed solder pots are lifted from the bath with molten solder only at the places of the selected components, and then 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 with a time from 3 to 10 seconds.** In selective soldering, the risk of overheating is greater than in double-wave flow soldering. Great care must be taken so that the parts do not overheat.

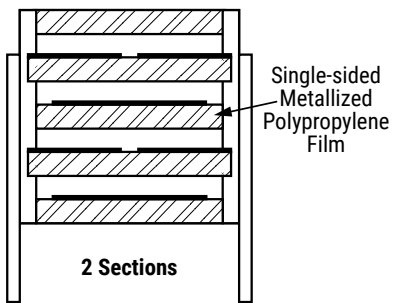
Metallized Polypropylene Film EMI Suppression Capacitors

PHE844, Class X1, 440/480 VAC, 105°C

Construction



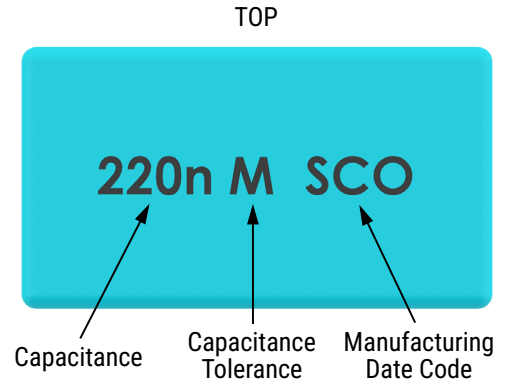
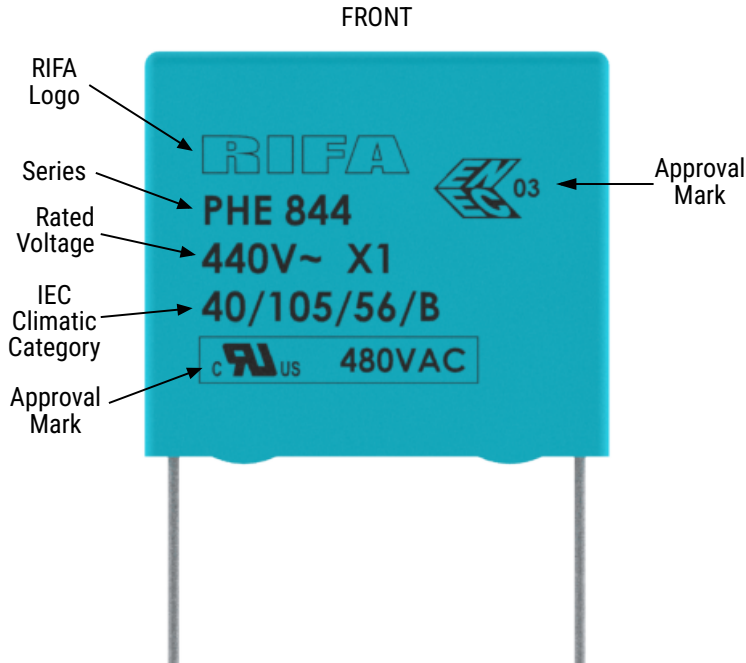
Winding Scheme



Metallized Polypropylene Film EMI Suppression Capacitors

PHE844, Class X1, 440/480 VAC, 105°C

Marking



Manufacturing Date Code (IEC-60062)

| 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 | | |

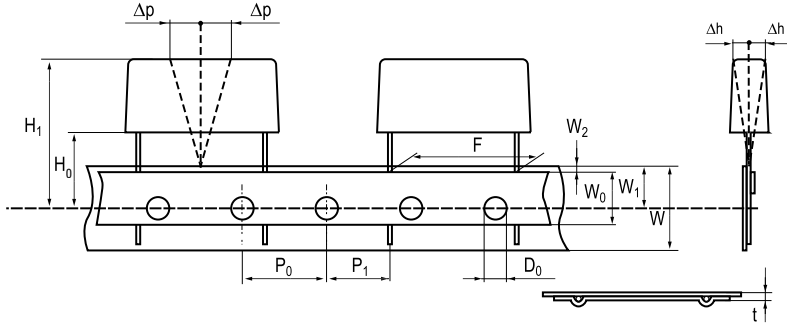
Metallized Polypropylene Film EMI Suppression Capacitors
PHE844, Class X1, 440/480 VAC, 105°C

Packaging Quantities

| Lead Spacing | KEMET Size Code | Legacy Size Code | Thickness (mm) | Height (mm) | Length (mm) | Bulk Short Leads | Standard Reel ø 355 mm | Large Reel ø 500 mm | Ammo Bulk (Pizza) |
|--------------|-----------------|------------------|----------------|-------------|-------------|------------------|---------------------------|------------------------|-------------------|
| 22.5 | DD | D13 | 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 |
| 27.5 | FK | F03 | 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 |
| 37.5 | RK | R02 | 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 | 5 | 5 | 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

*** H₀ = 16.5 mm is available upon request

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Although all product-related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.

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