AC Line EMI Suppression and RC Networks

PHZ9004 Series Metallized Polypropylene Film, 300 VAC
3x X2 with Separate Terminals for Three-Phase Filtering

Overview

The PHZ9004 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.

Benefits

- Rated voltage: 300 VAC 50/60 Hz
- Capacitance range: 3 x 1.0 µF
- Lead spacing: 27.5 mm
- Capacitance tolerance: ±20%, other tolerances on request
- Climatic category: 55/105/56, IEC 60068–1
- Tape and reel in accordance with IEC 60286–2
- RoHS Compliant and lead-free terminations
- Operating temperature range of -55˚C to +105˚C
- 100% screening factory test at 2,200 VDC

Applications

Typical applications include worldwide use as an electromagnetic interference suppressor in X2 and across-the-line applications for three phases.

Legacy Part Number System

<table>
<thead>
<tr>
<th>PHZ9004</th>
<th>E</th>
<th>F</th>
<th>7100</th>
<th>M</th>
<th>R06L2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td>Rated Voltage (VAC)</td>
<td>Lead Spacing (mm)</td>
<td>Capacitance Code (pF)</td>
<td>Capacitance Tolerance</td>
<td>Packaging</td>
</tr>
<tr>
<td>Triple Capacitor X2, Metallized Polypropylene</td>
<td>E = 300</td>
<td>F = 27.5</td>
<td></td>
<td>M = ±20%</td>
<td>See Ordering Options Table</td>
</tr>
</tbody>
</table>

New KEMET Part Number System

<table>
<thead>
<tr>
<th>9004</th>
<th>AA</th>
<th>105</th>
<th>M</th>
<th>300</th>
<th>C</th>
<th>DECT</th>
<th>V680</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacitor Class</td>
<td>Size Code</td>
<td>Capacitance Code (pF)</td>
<td>Capacitance Tolerance</td>
<td>Rated Voltage (VAC)</td>
<td>Packaging</td>
<td>C-Spec</td>
<td>V-Spec</td>
</tr>
<tr>
<td>Triple Capacitor X2, Metallized Polypropylene</td>
<td>See Dimension Table</td>
<td>First two digits represent significant figures. Third digit specifies number of zeros.</td>
<td>M = ±20%</td>
<td>300 = 300</td>
<td>See Ordering Options Table</td>
<td>Optional additional characters at KEMET's option</td>
<td>Part Number specific version code</td>
</tr>
</tbody>
</table>

Click image above for interactive 3D content
Open PDF in Adobe Reader for full functionality
Film Capacitors – AC Line EMI Suppression and RC Networks
PHZ9004 Series Metallized Polypropylene Film, 300 VAC 3x X2 with Separate Terminals for Three-Phase Filtering

Ordering Options Table

<table>
<thead>
<tr>
<th>Lead Spacing Nominal (mm)</th>
<th>Type of Leads and Packaging</th>
<th>Lead Length (mm)</th>
<th>KEMET Lead and Packaging Code</th>
<th>Legacy Lead and Packaging Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.5</td>
<td>Standard Lead and Packaging Options</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bulk (Tray) – Short Leads</td>
<td>6 +0/-1</td>
<td>C</td>
<td>R06L2</td>
</tr>
</tbody>
</table>

Dimensions – Millimeters

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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Voltage</td>
<td>300 VAC 50/60 Hz</td>
</tr>
<tr>
<td>Capacitance Range</td>
<td>3 x 1.0 µF</td>
</tr>
<tr>
<td>Capacitance Tolerance</td>
<td>±20%, other tolerances on request</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-55 to +105°C</td>
</tr>
<tr>
<td>Climatic Category</td>
<td>55/105/56</td>
</tr>
<tr>
<td>Dissipation Factor</td>
<td>Maximum Values at +23°C</td>
</tr>
<tr>
<td></td>
<td>1 kHz</td>
</tr>
<tr>
<td></td>
<td>0.10%</td>
</tr>
<tr>
<td></td>
<td>10 kHz</td>
</tr>
<tr>
<td></td>
<td>0.50%</td>
</tr>
<tr>
<td>Test Voltage Between Terminals</td>
<td>The 100% screening factory test is carried at 2,200 VDC. The voltage level is selected to meet the requirements in applicable equipment standards. All electrical characteristics are checked after the test. This test may not be repeated due to potential capacitor damage. KEMET is not liable in such case for any failures.</td>
</tr>
<tr>
<td>Insulation Resistance</td>
<td>Minimum Value Between Terminals</td>
</tr>
<tr>
<td></td>
<td>≥ 10,000 MΩ µF</td>
</tr>
<tr>
<td></td>
<td>Minimum Value Between Terminals and Case</td>
</tr>
<tr>
<td></td>
<td>≥ 100,000 MΩ</td>
</tr>
</tbody>
</table>

Environmental Test Data

<table>
<thead>
<tr>
<th>Test</th>
<th>IEC Publication</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endurance</td>
<td>IEC 60384–14</td>
<td>1.25 x V&lt;sub&gt;r&lt;/sub&gt; VAC 50 Hz, once every hour increase to 1,000 VAC for 0.1 second, 1,000 hours at upper rated temperature</td>
</tr>
<tr>
<td>Vibration</td>
<td>IEC 60068–2–6</td>
<td>3 directions at 2 hours each 10 – 55 Hz at 0.75 mm or 98 m/s&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Bump</td>
<td>IEC 60068–2–29</td>
<td>1,000 bumps at 390 m/s&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Change of Temperature</td>
<td>IEC 60068–2–14</td>
<td>Upper and lower rated temperature 5 cycles</td>
</tr>
<tr>
<td>Active Flammability</td>
<td>IEC 60384–14</td>
<td>V&lt;sub&gt;r&lt;/sub&gt; + 20 surge pulses at 2.5 kV (pulse every 5 seconds)</td>
</tr>
<tr>
<td>Passive Flammability</td>
<td>IEC 60384–14</td>
<td>IEC 60384–1, IEC 60695–11–5 Needle-flame test</td>
</tr>
<tr>
<td>Humidity</td>
<td>IEC 60068–2–3</td>
<td>+40°C and 90 – 95% RH, 56 days</td>
</tr>
</tbody>
</table>
Environmental Compliance

All KEMET EMI capacitors are RoHS Compliant.

Table 1 – Ratings & Part Number Reference

<table>
<thead>
<tr>
<th>VAC</th>
<th>Cap Value (µF)</th>
<th>Max Dimensions in mm</th>
<th>Lead Spacing (p)</th>
<th>Package Quantity C (R06I2)</th>
<th>dV/dt (V/µs)</th>
<th>New KEMET Part Number</th>
<th>Legacy Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>3 x 1.0</td>
<td>30.0</td>
<td>11.5</td>
<td>64.0</td>
<td>27.5</td>
<td>72</td>
<td>100</td>
</tr>
</tbody>
</table>

Film Capacitors – AC Line EMI Suppression and RC Networks

PHZ9004 Series Metallized Polypropylene Film, 300 VAC 3x X2 with Separate Terminals for Three-Phase Filtering
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.

![Recommended Soldering Temperature](image)

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

![Wave Soldering Recommendations](image)
Soldering Process cont'd

Wave Soldering Recommendations cont'd

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

Figure 1

<table>
<thead>
<tr>
<th>Dielectric Film Material</th>
<th>Maximum Preheat Temperature</th>
<th>Maximum Peak Soldering Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Capacitor Pitch ≤ 10 mm</td>
<td>Capacitor Pitch &gt; 15 mm</td>
</tr>
<tr>
<td>Polyester</td>
<td>130°C</td>
<td>130°C</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>100°C</td>
<td>110°C</td>
</tr>
<tr>
<td>Paper</td>
<td>130°C</td>
<td>130°C</td>
</tr>
<tr>
<td>Polyphenylene Sulphide</td>
<td>150°C</td>
<td>150°C</td>
</tr>
</tbody>
</table>

2. The maximum temperature measured inside the capacitor:

Set the temperature so that inside the element the maximum temperature is below the limit:

<table>
<thead>
<tr>
<th>Dielectric Film Material</th>
<th>Maximum temperature measured inside the element</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyester</td>
<td>160°C</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>110°C</td>
</tr>
<tr>
<td>Paper</td>
<td>160°C</td>
</tr>
<tr>
<td>Polyphenylene Sulphide</td>
<td>160°C</td>
</tr>
</tbody>
</table>

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**

**Detailed Cross Section**
- Molded Plastic Case
- Self-Extinguishing Resin
- Metal Contact Layer
- Margin
- Lead

**Winding Scheme**
- 1 Section
- Metallized Impregnated Paper

**Electrical Scheme**
- C C C

**Single-sided Metallized Polypropylene Film**
- (First Layer)
- (Second Layer)
PHZ9004 Series Metallized Polypropylene Film, 300 VAC 3x X2 with Separate Terminals for Three-Phase Filtering

Marking

- **TOP**
- **Series**
- **Rated Voltage**
- **Capcitance, Capacitance Tolerance**
- **Triple Capacitor**
- **3 x 1μF M**
- **300 VAC**

PHZ 9004
Film Capacitors – AC Line EMI Suppression and RC Networks

**PHZ9004 Series Metallized Polypropylene Film, 300 VAC 3x X2 with Separate Terminals for Three-Phase Filtering**

**KEMET Corporation**

**World Headquarters**

2835 KEMET Way
Simpsonville, SC 29681

Mailing Address:
P.O. Box 5928
Greenville, SC 29606

www.kemet.com
Tel: 864-963-6300
Fax: 864-963-6521

**Corporate Offices**

Fort Lauderdale, FL
Tel: 954-766-2800

**North America**

**Southeast**

Lake Mary, FL
Tel: 407-855-8886

**Northeast**

Wilmington, MA
Tel: 978-658-1663

**Central**

Novi, MI
Tel: 248-306-9353

**West**

Milpitas, CA
Tel: 408-433-9950

**Mexico**

Guadalajara, Jalisco
Tel: 52-33-3123-2141

**Europe**

**Southern Europe**

Sasso Marconi, Italy
Tel: 39-051-939111

Skopje, Macedonia
Tel: 389-2-55-14-623

**Central Europe**

Landsberg, Germany
Tel: 49-8191-3350800

Kamen, Germany
Tel: 49-2307-438110

**Northern Europe**

Harlow, United Kingdom
Tel: 44-1279-460122

Espoo, Finland
Tel: 358-9-5406-5000

**Asia**

**Northeast Asia**

Hong Kong
Tel: 852-2305-1168

Shenzhen, China
Tel: 86-755-2518-1306

**Europe**

**Central Europe**

Beijing, China
Tel: 86-10-5877-1075

Shanghai, China
Tel: 86-21-6447-0707

**Northern Europe**

Seoul, South Korea
Tel: 82-2-6294-0550

**Asia**

**Southeast Asia**

Taipei, Taiwan
Tel: 886-2-27528585

Singapore
Tel: 65-6701-8033

Penang, Malaysia
Tel: 60-4-6430200

Bangalore, India
Tel: 91-806-53-76817

Note: KEMET reserves the right to modify minor details of internal and external construction at any time in the interest of product improvement. KEMET does not assume any responsibility for infringement that might result from the use of KEMET Capacitors in potential circuit designs. KEMET is a registered trademark of KEMET Electronics Corporation.
Disclaimer

All product specifications, statements, information and data (collectively, the “Information”) in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed.

All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KEMET Electronics Corporation’s (“KEMET”) knowledge of typical operating conditions for such applications, but are not intended to constitute – and KEMET specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this information or otherwise provided by KEMET with reference to the use of KEMET’s products is given gratis, and KEMET assumes no obligation or liability for the advice given or results obtained.

Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

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