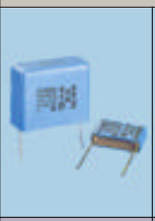
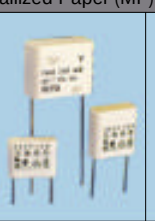
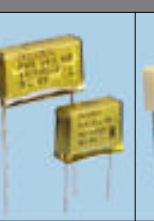
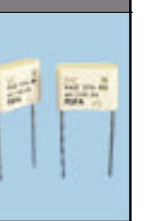
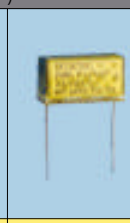
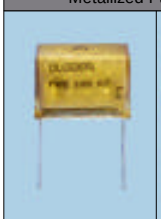
| | EMI SUPPRESSION CAPACITORS | | | | | |
|---|---|---|---|---|---|---|
| | X2 | | | | | |
| | Metallized Paper (MP) | | | Metallized Polyester (MKT) | | |
| |  |  |  |  |  |  |
| Type: | PME271M | PME285 | PME264 | PHE820M | PHE820E | PHE830 |
| International standard | IEC 384-14 X2 Across-the-line | IEC 384-14 X2 Across-the-line | IEC 384-14 X2 Across-the-line | IEC 384-14 X2 Across-the-line | IEC 384-14 X2 Across-the-line | IEC 384-14 X2 Across-the-line |
| Capacitance range, µF | 0.001-0.6 | 0.001-0.1 | 0.001-0.1 | 0.01-2.2 | 0.01-2.2 | 0.01-2.2 |
| Capacitance tolerance, ±% | 20, 10 | 20 | 20 | 20, 10 | 20, 10 | 20, 10 |
| Rated voltage, $V_{AC}$ $V_{DC}$ | 275 | 275 | 660 1600 | 275 | 300 | 250 (275 pending) |
| Test voltage (factory test) | 2150 $V_{DC}$ | 2150 $V_{DC}$ | 3000 $V_{DC}$ | 2150 $V_{DC}$ | 2150 $V_{DC}$ | 2150 $V_{DC}$ |
| Climatic Category according to IEC 68 | 40/100/56/B 0.1-0.33µF: 110°C | 40/100/56/C | 40/085/56/B | 40/100/56/C | 40/100/56/C | 40/100/56/C |
| Pulse rise time, V/µs max. dU/dt in operation | 400-1200 | 600-1200 | 600-2000 | 100 | 100 | 100 |
| Lead spacing, mm | 10.2, 15.2, 20.3, 22.5, 25.4 | 10.0, 15.0 | 15.2, 20.3, 25.4 | 15.0, 22.5, 27.5, 37.5 | 15.0, 22.5, 27.5, 37.5 | 15.0, 22.5, 27.5, 37.5 |
| Approvals/ Remarks | S, N, D, FI, VDE, SEV, ÖVE, IMQ, UL 1414, CSA, EN132400 | S, N, D, FI, VDE, SEV, ÖVE, IMQ, UL 1414, CSA, EN132400 | S, UL EN132400 | S, N, D, FI, VDE, SEV, ÖVE, IMQ, UL 1414, CSA, EN132400 | S, UL 1414, CSA EN132400 | S, N, D, FI, VDE, SEV, ÖVE, IMQ, UL 1414, CSA, EN132400 |
| Packing | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels |
| Page | 106 | 112 | 102 | 96 | 96 | 100 |

| | EMI SUPPRESSION CAPACITORS | | | | | | |
|---|---|---|---|---|---|---|---|
| | X1 | | Y2 | | | | Y1 |
| | Metallized Paper (MP) | | | | | | |
| |  |  |  |  |  |  |  |
| Type: | PME271E | PME278 | PME271Y | PME289 | PME290 | PME265 | PME294 |
| International standard | IEC 384-14 X1 Across-the-line | IEC 384-14 X1 Across-the-line | IEC 384-14 Y2 Line-to-earth | IEC 384-14 Y2, X1 Line-to-earth | IEC 65, 384-14 Y2, X1 Line-to-earth | IEC 65, 384-14 Y2 Line-to-earth | IEC 65, 384-14 Y1 Line-to-earth |
| Capacitance range, µF | 0.01-0.22 | 0.001-0.15 | 0.001-0.1 | 0.001-0.022 | 0.001-0.022 | 0.033-0.1 | 0.47-4.7nF |
| Capacitance tolerance, ±% | 20, 10 | 20 | 20 | 20 | 20 | 20 | 20 |
| Rated voltage, $V_{AC}$ $V_{DC}$ | 300 | 440 | 250 | Y2: 250 $V_{AC}$ X1: 300 $V_{AC}$ | Y2: 250 $V_{AC}$ X1: 300 $V_{AC}$ | Y2: 250 $V_{AC}$ X1: 300 $V_{AC}$ | 250/440 |
| Test voltage (factory test) | 2150 $V_{DC}$ | 2700 $V_{DC}$ | 2700 $V_{DC}$ | 2700 $V_{DC}$ | 3000 $V_{DC}$ 2000 $V_{AC}$ | 3000 $V_{DC}$ 2000 $V_{AC}$ | 4000 $V_{AC}$ |
| Climatic Category according to IEC 68 | 40/100/56/B | 40/110/56/B | 40/100/56/B | 40/100/56/C | 40/100/56/C | 40/085/21/B | 40/100/56/C |
| Pulse rise time, V/µs max. dU/dt in operation | 400-1200 | 600-2000 | 1000-2000 | 1400-2000 | 1400-2000 | 600-2000 | 2000 |
| Lead spacing, mm | 15.2, 20.3, 22.5, 25.4 | 10.2, 15.2, 20.3, 22.5, 25.4 | 10.2, 15.2, 20.3 22.5, 25.4 | 10.0, 15.0 | 10.0, 15.0 | 20.3, 25.4 | 15.0 |
| Approvals/ Remarks | S, N, D, FI, VDE, SEV, ÖVE, IMQ, UL EN132400 | S, N, D, FI, VDE, SEV, ÖVE EN132400 | S, N, D, FI, VDE, SEV, ÖVE, IMQ, CSA, UL EN132400 | S, N, D, FI, VDE, SEV, ÖVE, IMQ, UL 1414, CSA +X1 approvals EN132400 | S, N, D, FI, VDE, SEV, ÖVE, IMQ, UL 1414 +X1 approvals EN132400 | S, N, D, FI, VDE, SEV, ÖVE, UL 1414, CSA, EN132400 | S, N, D, FI, VDE, SEV, IMQ, UL 1414 Double protection, CSA EN132400 |
| Packing | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels |
| Page | 106 | 110 | 106 | 114 | 116 | 104 | 118 |

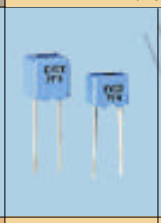
| | EMI SUPPRESSION CAPACITORS | | | | |
|---|---|---|---|---|---|
| | X2+2xY2 | RC | | | |
| | Metallized Paper (MP) | | | | |
| |  |  |  |  |  |
| Type: | PZB300 | PMR205 | PMR209 | PMR210 | PMZ2035 |
| International standard | IEC 384-14<br>X2+2Y2, Delta | – | IEC 384-14 X2<br>Across-the-line | IEC 65, X1<br>Line-to-earth | IEC 384-14 |
| Capacitance range, µF | X2: 0.1, 0.15<br>Y2: 0.0022, 0.0033, 0.0047 | 0.1-1.0<br>R:22-680Ω | 0.047-0.47<br>R:22-470Ω | 0.022-0.1<br>R:100Ω | 0.1-0.15<br>R:150-330Ω |
| Capacitance tolerance, ±% | 20 | 20<br>R: 30 | 20<br>R: 30 | 20<br>R: 30 | 20<br>R: 30 |
| Rated voltage, $V_{AC}$<br>$V_{DC}$ | 275 | 125<br>250 | 250<br>630 | 250<br>X1: 300 $V_{AC}$ | 440 |
| Test voltage (factory test) | X2: 1800 $V_{DC}$<br>Y2: 2700 $V_{DC}$ | 375 $V_{DC}$ | 1500 $V_{DC}$ | 3000 $V_{DC}$<br>2000 $V_{AC}$ | 1800 $V_{DC}$ |
| Climatic Category according to IEC 68 | 40/100/56/B | 40/085/56 | 40/085/56/B | 40/085/21/B | 40/085/56/B |
| Pulse rise time, V/µs max. dU/dt in operation | X2: 600<br>Y2: 1000 | | | | |
| Lead spacing, mm | 20.0 | 15.2, 20.3, 25.4 | 15.2, 20.3, 25.4 | 15.2, 20.3, 25.4 | 25.4 |
| Approvals/ Remarks | S, N, D, FI, VDE, SEV, ÖVE, IMQ, UL, CSA. Option: Fast-on connectors EN132400 | Integrated resistor | S, N, D, FI, VDE, SEV, UL Integrated resistor EN132400 | S, N, D, VDE, SEV, ÖVE, UL 1414. Integrated resistor. EN132400 | S, UL EN132400 |
| Packing | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | Bulk in boxes or on tray |
| Page | 122 | 128 | 130 | 132 | 134 |

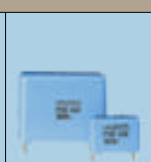
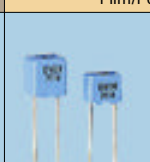
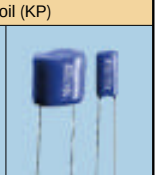
| | EMI SUPPRESSION CAPACITORS | | | |
|---|---|---|---|---|
| | General Purpose | | | |
| | Metallized Paper (MP) | | | |
| |  |  | | |
| Type: | PME260 | PME261 | | |
| International standard | – | – | | |
| Capacitance range, nF | 0.047-2.0 | 0.0082 -1.0 | 0.001 -0.15 | 0.001 -0.1 |
| Capacitance tolerance, ±% | 10 | 10, 5 | 20, 10 | 20, 10 |
| Rated voltage, $V_{DC}$<br>$V_{AC}$ | 125<br>250 | 220<br>400 | 300<br>630 | 500<br>1000 |
| Test voltage (factory test) | 375 $V_{DC}$ | 800 $V_{DC}$ | 1260 $V_{AC}$ | 2000 $V_{AC}$ |
| Climatic Category according to IEC 68 | 40/070/56 | 40/070/56 | | |
| Pulse rise time, V/µs | 150-1000 | 220-2000 | | |
| Lead spacing, mm | 10.2, 15.2, 20.3 25.4 | 10.2, 15.2, 20.3 25.4 | | |
| Approvals/ Remarks | | | | |
| Packing | Bulk in boxes, on tray or taped on reels | Bulk in boxes, on tray or taped on reels | | |
| Page | 68 | 70 | | |

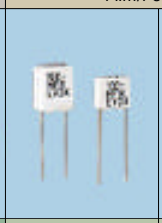
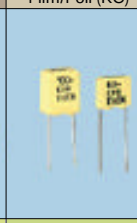
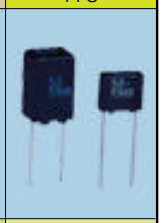
When the independent Swiss testing house, Quinel, performed extensive tests encompassing much of EN132400 on 9 capacitor series from 7 leading manufacturers, 5 of the 9 capacitor series failed to pass the test!

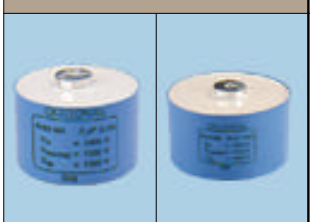
**Read about the Quinel test on our website (http.//www.rifa.se/test).**

If you don't have access to Internet, call us and we'll fax or mail it to you.

| | PRECISION CAPACITORS | | | | |
|---|---|---|---|---|---|
| | Polypropylene | | | Polystyrene | |
| | Metallized (MKP) | Film/Foil (KP) | | Film/Foil (KS) | |
| |  |  |  |  |  |
| EVOX Type: | PHE425 | PFR | PFA | SFA | SFR |
| International standard | CECC 31201-001<br>IEC 384-16<br>Stab. Class 1 | IEC 384-13 | DIN 40040<br>2.73 | DIN 40040<br>2.73 | DIN 40040<br>2.73 |
| Capacitance range, nF | 3.3-135 | 0.1-22.0 | 0.047-100 | 0.047-100 | 0.1-10.0 |
| Capacitance tolerance, ±% | 1, 2, 5 | 10, 5, 2.5, 2, 1 | 20, 10, 5, 2.5, 2, 1 or 1 pF | 20, 10, 5, 2.5, 2, 1 or 1 pF | 20, 10, 5, 2.5, 2, 1 |
| Rated voltage, $V_{DC}$<br>$V_{AC}$ | 63-400<br>40-220 | 63-1000<br>40-250 | 25-630<br>10-125 | 25-630<br>10-125 | 50-160<br>20-63 |
| Climatic Category according to IEC 68 | 55/085/56 | 55/100/56 | GPE<br>-40 to +85°C | JSG<br>-10 to +70°C | JSG<br>-10 to +70°C |
| Pulse rise time, V/µs | 10-40 | 1000 | | | |
| Lead spacing, mm | 7.5 | 5.0 | Axial | Axial | Adjustable<br>(min. 1 mm) |
| Approvals/ Remarks | MUAHAG | | | | |
| Packing | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes | Bulk in boxes | Bulk in boxes |
| Page | 186 | 166 | 176 | - | - |

| | PULSE AND HIGH FREQUENCY CAPACITORS | | | | |
|---|---|---|---|---|---|
| | Metallized Polypropylene (MKP) | | | Polypropylene<br>Film/Foil (KP) | |
| |  |  |  |  |  |
| Type: | PMR | PHE427 | PHE428 | PFR | CQ92P |
| International standard | IEC 384-16<br>Grade 1.1 | IEC 384-17<br>Grade 1.1 | IEC 384-17<br>Grade 1.1 | IEC 384-13 | IEC 384-13 |
| Capacitance range, µF | 0.001-12.0 | 0.00068-6.8 | 0.001-1.0 | 0.0001-0.022 | 0.00033-0.1 |
| Capacitance tolerance, ±% | 10, 5, 3.5, 2.5, 2 | 10, 5, 3.5, 2.5, 2 | 10, 5, 3.5, 2.5, 2 | 10, 5, 2.5, 2, 1 | 10, 5, 2 |
| Rated voltage, $V_{DC}$<br>$V_{AC}$ | 100-630<br>63-250 | 160-1000<br>100-375 | 630-2000<br>400-650 | 63-1000<br>40-250 | 50-250<br>30-160 |
| Climatic Category according to IEC 68 | 55/105/56 | 55/105/56 | 55/105/56 | 55/100/56 | 40/85/21 |
| Pulse rise time, V/µs | 20-200 | 50-2000 | 700-2500 | 1000 | |
| Lead spacing, mm | 5.0, 7.5, 10.0, 15.0, 22.5, 27.5, 37.5 | 7.5, 10.0, 15.0, 22.5, 27.5, 37.5 | 15.0, 22.5, 27.5, 37.5 | 5.0 | 3.5, 5.0, 5.5, 7.0, 7.5 |
| Packing | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion |
| Page | 142 | 152 | 160 | 166 | 170 |

| | COUPLING/DECOUPLING CAPACITORS | | | STABLE HIGH TEMPERATURE CAPACITORS | | |
|---|---|---|---|---|---|---|
| | Polyester | | | Polycarbonate | | Metallized |
| | Metallized (MKT) | Film/Foil (KT) | | Metallized (MKC) | Film/Foil (KC) | PPS |
| |  |  | |  |  |  |
| Type: | MMK | MFR | CQ92M/SCQ92M | CMK | CFR | SMR |
| International standard | CECC 30400<br>IEC 384-2<br>DIN 44122 | IEC 384-11 | JIS-C-5113<br>IEC 384-11 | CECC 30500<br>IEC 384-6 | IEC 384-12 | |
| Capacitance range, µF | 0.001-68 | 0.001-0.01 | 0.001-0.47 | 0.001-10.0 | 0.0001-0.015 | 0.0022-0.47 |
| Capacitance tolerance, ±% | 20, 10, 5 | 20, 10, 5 | 10, 5 | 20, 10, 5, 2.5 | 10, 5, 2.5 | 10, 5, 2.5, 2 |
| Rated voltage, $V_{DC}$<br>$V_{AC}$ | 50-1000<br>30-250 | 100-400<br>63-220 | 50-250<br>30-160 | 63-400<br>40-200 | 100-400<br>63-200 | 50-100<br>30-63 |
| Climatic Category according to IEC 68 | 55/100/56<br>(FME/DIN) | 55/100/56 | -40 to +85°C | 55/125/56<br>(FKD/DIN) | 55/125/56<br>(FKD/DIN) | 55/125/56<br>(FKD/DIN) |
| Pulse rise time, V/µs | 2-60 | 1000 | | 2-30 | 1000 | 6-15 |
| Lead spacing, mm | 5.0, 7.5, 10.0, 15.0, 22.5, 27.5, 37.5 | 5.0 | 3.5, 4.0, 4.5, 5.0, 5.5, 6.5, 7.5, 10.0 | 5.0, 7.5, 10.0, 15.0, 22.5, 27.5 | 5.0 | 5.0 |
| Approvals/ Remarks | CECC 30401-042 | | | CECC 30501-020 | | Polyphenylene sulfide<br>High temperature applications |
| Packing | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion | Bulk in boxes<br>Available taped for automatic insertion |
| Page | 26 | 58 | 60 | 44 | 64 | 54 |

| | POWER CAPACITORS | |
|---|---|---|
| | Metallized Polypropylene (MKP) | |
| |  | |
| Type: | PHG491 | PHG495 |
| Capacitance range, µF | 0.5-10, 0.22-6<br>0.5-4 | 10-25, 9-18, 5-10 |
| Capacitance tolerance, ±% | 5 | 10 |
| Rated voltage, $U_S$ (V), non repetitive | 1500, 2000, 2500 | 1500, 2000, 2500 |
| $U_{RMS}$ ($V_{AC}$, 50 Hz) | 550, 650, 750 | |
| $U_{DC}$ (V) | 1200, 1600, 2000 | 1000, 1350, 1650 |
| Climatic Category according to IEC 68 | 40/085/56 | 40/085/56 |
| Max RMS-current, A | 7-80 | 50-80 |
| Pulse rise time, V/µs | 500-750 | 25-55 |
| Mounting/ terminations | Screw M6, M8<br>inner thread | Screw M6, M8<br>inner thread |
| Page | 192 | - |

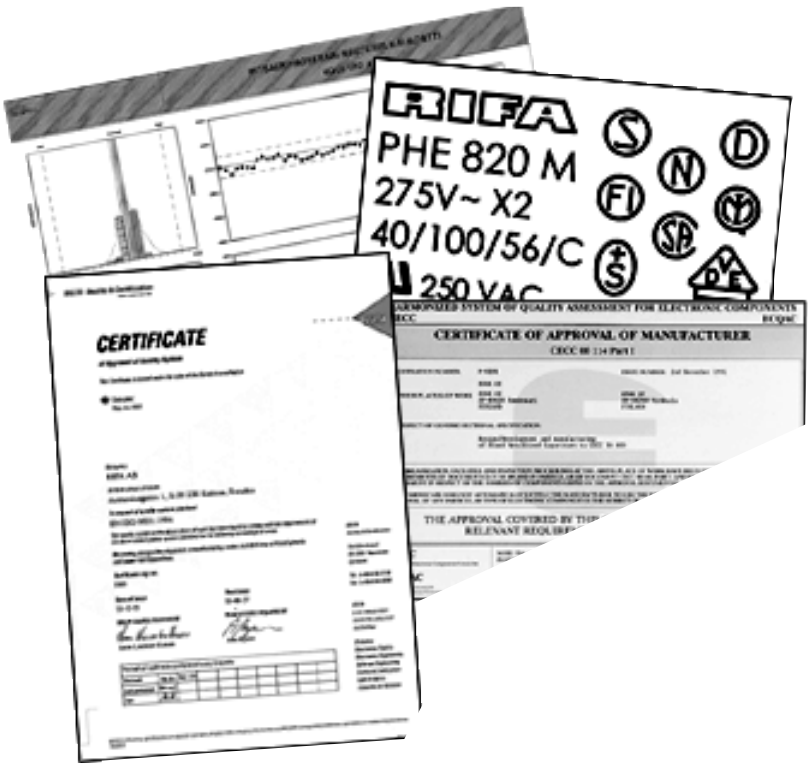
| | SMD Capacitors | | |
|---|---|---|---|
| | Metallized PET | Metallized PEN | Metallized PPS |
| |  | | |
| Type: | MMC | GMC | SMC |
| International standards | IEC 384-19<br>CECC 32200 | | IEC 384-20 |
| Capacitance range, µF | 0.001-10 | 0.001-10 | 0.001-0.22 |
| Capacitance tolerance, % | 20, 10 | 20, 10, 5 | 10, 5, 2.5, 2 |
| Rated voltage, $V_{DC}$<br>$V_{AC}$ | 50-400<br>30-200 | 50-400<br>30-200 | 50-250<br>30-160 |
| Climatic Category according to IEC 68 | 55/100/56 | 55/125/56 | 55/125/56 |
| Pulse rise time, V/µs | 5-50 | 5-50 | 6-20 |
| Lead spacing, mm | 5.7, 7.3, 10.2, 12.7, 16.5 | 5.7, 7.3, 10.2, 12.7, 16.5 | 5.7, 7.3 |
| Approvals/Remarks | | | 150°C<br>application possible |
| Packing | Taped for automatic insertion, bulk in boxes | Taped for automatic insertion, bulk in boxes | Taped for automatic insertion, bulk in boxes |
| Page | 76 | 82 | 86 |

## Evox Rifa product quality

The quality of Evox Rifa's products and services is based on a continuous strive towards excellency throughout the whole organization. Skilled and motivated personnel, technical know-how and modern equipment combined with extensive quality assurance make Evox Rifa the supplier of components of the highest quality.

The up-to date quality tools like Statistical Process Control (SPC) in various forms, Failure Mode and Effect Analysis (FMEA), Accelerated Reliability Testing and Zero Defect Acceptance concept in final testing are the corner stones of the every day quality work. Cross-functional teams are routinely used in Problem Solving (8D method) with effective Failure Analysis support.

As visible evidence of our quality, all the manufacturing units world wide are certified according to EN ISO 9001 or 9002. In Europe our manufacturing is also CECC approved with several qualified product families. Our world famous EMI capacitors carry all the important safety approval marks for world wide applications.




## Customer in focus


The only real measure of our total quality performance is the acceptance of our customers.

Evox Rifa's quality work has always been focused on the customer. We have actively made quality agreements with ambitious goal settings with World-Class Companies – small and large.

This active quality cooperation has been most fruitful to Evox Rifa by bringing in most modern quality tools, but especially by providing us with reliable feed back on the performance quality of our products and services.

The cooperation has not only lead to continuous improvement of the quality of our products, but sometimes also helped our customers to spot some weaknesses in their designs. A visible sign of these close links between Evox Rifa and various customers is the numerous approvals and the performance awards addressed to Evox Rifa.

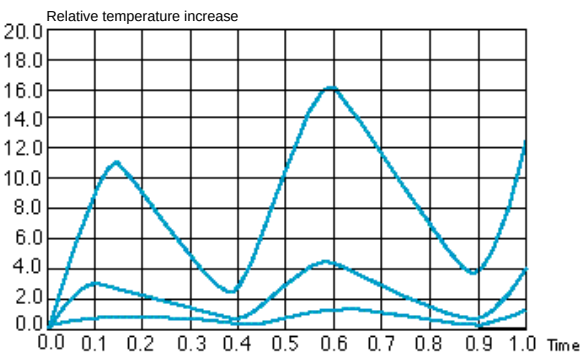
# In-House research and development for tomorrow's needs

Evox Rifa has over fifty years accumulated experience in developing a wide range of world-class capacitor products. Our leading position in the market with a wide product range is based on our deep knowledge of the materials and ways in which they can be used in capacitor designs to provide the best possible solutions.

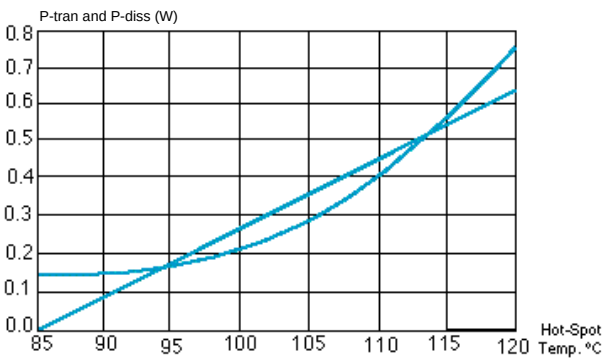
Evox Rifa invests substantial human and financial resources in finding new highly reliable and cost effective solutions for today's and tomorrow's needs. Our R&D department can simulate most operational conditions and apply our products to the envisaged working environment, giving to the customer optimized capacitors for a particular specification.

The simulation capabilities substantially shorten the design cycle of capacitors. To assist in shortening the design cycle of our customers, we have brought our R&D department to our customers by providing them with a CAD program, which allows them to select the most suitable capacitors for their application. Our fully equipped EMC laboratory is also at the disposal of our customers. Complete EMI filters can be designed and measured there enabling the customers to comply with the increasingly stringent EMI legislation throughout the world.

**Simulation examples:**




**Pulsed heat**




**Thermal stability**

## Product specific a t i o n

All descriptions, drawings and other particulars (including dimensions, materials and performance data) given by Evox Rifa are as accurate as possible but, being given for general information, are not binding on Evox Rifa unless specifically agreed in writing. All dimensions and materials are, unless otherwise stated, subject to reasonable variations resulting from the raw material available or arising in the ordinary course of manufacture. Any performance data are based upon Evox Rifa's experience and are such as Evox Rifa normally expects to achieve.

## Wa r r a n t y, product liability

Evox Rifa warrants that the goods manufactured by Evox Rifa are free from defects in design, material and workmanship.

Evox Rifa's liability under this warranty shall be limited to replacement or repair free of charge, at one of Evox Rifa's factories selected by Evox Rifa, provided that notification of such failure or defect is given to Evox Rifa immediately upon the same becoming apparent and that on Evox Rifa's request and instruction the goods are promptly returned to Evox Rifa carriage paid by buyer.

In case the goods thus returned as defective, prove to be without fault or defect, Evox Rifa is entitled to charge buyer 10% of the value of the returned goods.

If the goods supplied or part thereof are not manufactured by or branded Evox Rifa, Evox Rifa will only extend to the buyer the benefit of the warranty granted by the manufacturer of the goods.

Evox Rifa's liability is further limited to a period of 12 months from the date of shipment to buyer.

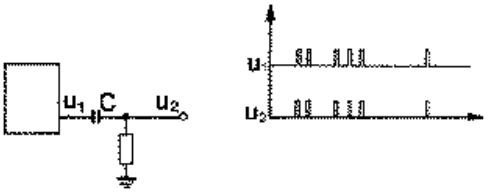
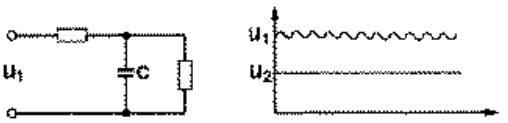
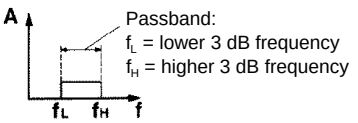
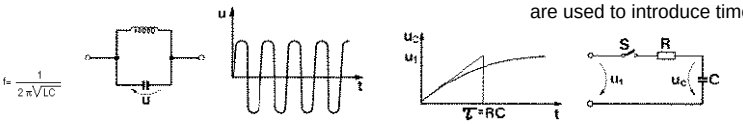
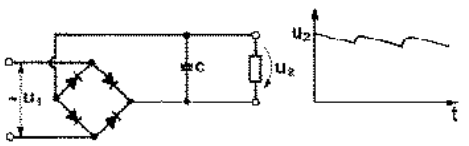
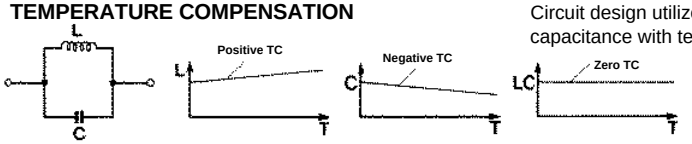
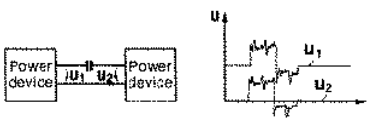
Evox Rifa shall not be liable for any defect which is due to accident, fair wear and tear, negligent use, tampering, improper handling, improper use, improper operation or improper storage or any other default on the part of any person other than Evox Rifa.

Evox Rifa shall have no other liabilities in case of defective goods than those stated above shall under no circumstances be liable for any consequential loss or damage arising from the use of goods sold by Evox Rifa. Liability under paragraph 823 BGB is expressly excluded.

The above limitations of Evox Rifa's liability for defective goods shall apply also with regard to product liability, and Evox Rifa shall have no responsibility for injury to persons or for damage to goods or property of any kind.

In case of product liability claims from third parties against Evox Rifa, not falling within Evox Rifa's liability in accordance with the above, buyer shall hold Evox Rifa harmless.

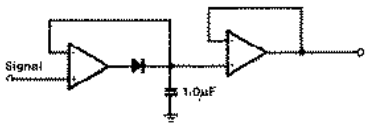
# Capacitor selection guide

| CAPACITOR FUNCTION | | CRITERIA |
|---|---|---|
| **BLOCKING AND COUPLING**<br>  | **Blocking:**<br>C provides a high series impedance for limiting the low-frequency AC or DC current.<br><br>**Coupling:**<br>C provides a low series impedance for transferring AC power or signal information from one circuit or system to another. | High insulation resistance<br><br>Low dissipation factor<br>Low inductance |
|  | C provides a low series impedance AC path around a given circuit element | Low dissipation factor<br>Low inductance<br>High capacitance tolerance |
| **FILTERING, FREQUENCY DISCRIMINATION**<br>  | Capacitor filter network designed for the frequency band $f_L$ - $f_H$ | Precision capacitor stability<br>Low dissipation factor<br>Close capacitance tolerance |
| **TIMING, OSCILLATION**<br>  | A timing element and a capacitor are used to introduce time delays. | Stability of electrical characteristics<br>Close capacitance tolerances |
| **SMOOTHING AND ENERGY STORAGE**<br>  | C maintains the working voltage of the controlled circuit and suppresses transient (high frequency) voltages. Charge of C enables (high) energy pulses. | Good pulse and AC characteristics<br>Low dissipation factor |
| **TEMPERATURE COMPENSATION**<br>  | Circuit design utilizes change of capacitance with temperature. | Linear temperature coefficient<br>Stability of electrical values |
| **PULSE COUPLING**<br>  | Coupling/decoupling of high energy, fast rise pulses. | Good pulse and AC characteristics<br>High voltage proof<br>Low dissipation factor |

# Typical applications of film capacitors

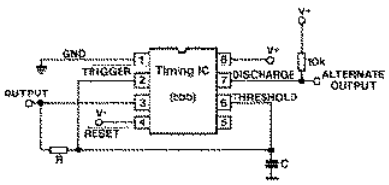
### Peak detector

In this application, C (e.g. 1.0 µF EVOX PMR or CMK) will charge to the peak value of the signal to be detected, and hold the voltage impressed upon it. A polypropylene or polycarbonate capacitor is recommended. Most other capacitors do not retain the stored voltage due to dielectric absorption. The capacitor acts in the energy storage mode.



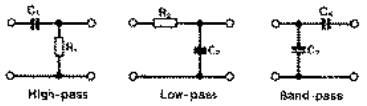

### Multivibrator

In this application, C (e.g. PFR, SMR or CMK) defines the multivibrator frequency f. CMK (PFR for values < 0.01 µF) is recommended due to its highly stable electrical value. The capacitor acts in the timing mode.



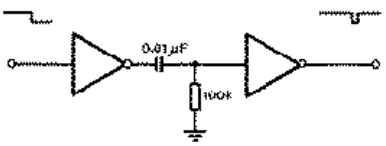

### Passive filters

In high-pass filter, $C_1$ forms an RC circuit, which carries frequencies higher than $f_L$. In a low-pass filter, $C_2$ forms an RC circuit, which carries frequencies lower than $f_H$. In a band-pass filter, the bandwidth is defined by $C_3$ and $C_4$. $C_4$ acts as a high-pass filter creating high impedance for low frequencies. $C_3$ shortcuts high frequencies to the ground. CMK capacitors are recommended due to their highly stable electrical values.



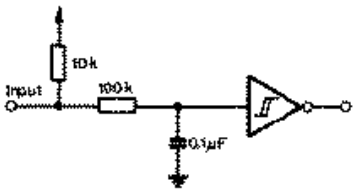

### Pulse forming circuit

In this application, C ( e.g. 0.01 µF MMK) charges according to the RC time constant and determines the output pulse duration. A polyester capacitor is recommended due to its stable capacitance values. The capacitor acts in the timing mode.



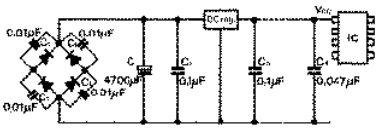

### Input card filtering in a microprocessor system

In this application, the high frequency interference of the microprocessor system input signal is coupled to the ground by C (e.g. 0.1 µF MMK). A polyester capacitor is recommended due to its low losses. The capacitor acts mainly in the bypass mode.



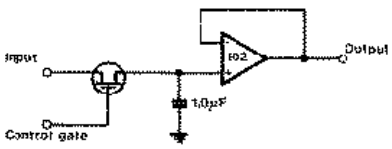

### Voltage regulator

In this application, $C_1$ (e.g. 0.01 µF MMK) protects the rectifier diodes by suppressing high frequency interference transient spikes. $C_2$ and $C_3$ (e.g. 0.1 µF MMK) are required as transient spike suppressors. $C_4$ (e.g. 0.047 µF EVOX PMR) acts as a current source for the highspeed IC switching spikes. MMK is recommended due to low inductance ($C_1$, $C_2$, $C_3$), EVOX PMR due to high insulation resistance and low losses ($C_4$).



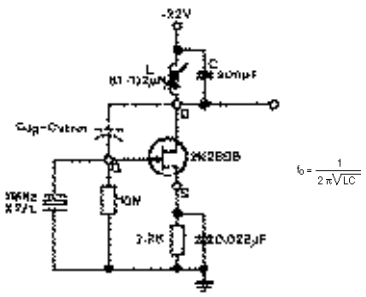

### Sample and hold circuit

In this application, C (e.g. 1.0 µF EVOX PMR) retains the stored voltage. PMR is recommended due to its extremely low dielectric absorption.




### 1 MHz FET Crystal Oscillator

In this application, C (e.g. 300 pF PFR) defines the oscillator frequency. The capacitor acts in the timing and temperature compensation modes. PFR is recommended due to its linear negative temperature coefficient and highly stable electrical values.




### Electromagnetic Interference Suppression.

Please see pages 93-94

***Capacitors are typically used in applications where more than one of these basic functions have been combined.***



EVOX RIFA

# Terms and definitions

## Rated capacitance ($C_R$)
The rated capacitance of a capacitor is the value which is indicated upon it. The capacitance is measured at 1 kHz and +23°C.

## Rated voltage ($U_R$)
The rated voltage is the maximum direct voltage or the maximum RMS alternating voltage which may be applied continuously to the terminals of the capacitor at any temperature within the rated temperature range.

## Rated temperature
The rated temperature is the maximum ambient temperature at which the rated voltage can be continuously applied.

## Climatic category
The climatic category states the category temperature range and the humidity class. For example 40/085/56 stands for – 40°C to + 85°C; 56 states that the steady state humidity test should take 56 days.

## Tangent of the loss angle (Dissipation factor, tanδ)
The tangent of the loss angle is the power loss of the capacitor divided by the reactive power of the capacitor at a sinusoidal voltage of specified frequency. The tangent of loss angle is given in percent (Eg 0.01 DF=1%).

The dissipation factor is of interest especially when the capacitor is operated on AC. The dielectric loss causes heating of the capacitor which under unfavourable circumstances may lead to a destructive breakdown. This will not happen if the capacitor is used within specified limits.

The ability to withstand short duration thermal and voltage overload is greater for small capacitors than for large ones.

## Insulation resistance
The values given in the catalogue indicate the insulation resistance after one minute of electrification at +23°C with the following voltages: 100 VDC for capacitors rated at 100 to 500 VDC and 500 VDC for capacitors rated at ≥ 500 VDC. Insulation resistance is temperature dependent and is approximately halved for each 7°C of temperature rise.

Multilayer construction provides insulation resistance higher than that of single-layer types.

## Pulse operation
Capacitors loaded with pulses with fast rise or fall times (high dU/dt) will be exposed to high current pulses. In order not to overload the internal connections the current must be limited. The current limits for a specific type are dependent upon:

- Amplitude and form of the pulse
- Rated voltage of the capacitor
- Capacitance
- Geometrical configuration of the winding

$dU/dt = U_R/(R \times C)$

$U_R$ = Rated voltage
R = Discharge resistor
C = Rated capacitance

At repeated pulse operation, self-heating, ambient temperature and cooling set the load limit.

Pulse current limits are commonly expressed in the form of max. permitted dU/dt in volts per microsecond. The figures stated in the type specifications refer to an unlimited number of pulses charging or discharging from rated voltage $U_R$.

## Passive flammability
The ability of a capacitor to burn with a flame as a consequence of the application of an external source of heat.

## Resonance frequency
The resonance frequency of a capacitor is reached when

$\omega L = 1/\omega C$

$\omega = 2\pi f$ (f=frequency)
L = inductance caused by the winding and the length of the leads
C = the capacitance at f.

## Properties of dielectrics

**POLYESTER (PET)**
**Metallized and Film/foil**
High dielectric constant and high dielectric strength provides good volumetric efficiency for metallized polyester film capacitors. Metallized polyester film has excellent self-healing properties.
Typical applications: Bypassing, coupling.

**POLYESTER (Polyethylene Naphthalate, PEN)**
**Metallized**
High temperature Polyester. Relatively high dielectric constant and dielectric strength, and availability of thin films, provide good volymeric efficiency for metallized construction. High melting point allowes SMD constructions and service in high ambient temperatures. General purpose capacitor.

**POLYPROPYLENE (PP)**
**Metallized and Film/foil**
Very low losses, low dielectric absorption, high dielectric strength, very high insulation resistance, and negative temperature coefficient.
Typical applications: Stable oscillators and filters. Sample & hold circuits, pulse handling circuits.

**POLYCARBONATE (PC)**
**Metallized and Film/foil**
Very low temperature dependency, wide operating temperature range, good long term stability, and low losses.Typical applications: Timers and filters. Applications in high ambient temperatures.

**POLYSTYRENE (PS)**
**Film/foil**
Extremely low losses, low dielectic absorption, good long term stability, very high insulation resistance, and a small, negative temperature coefficient. Typical applications: Timers and filters.

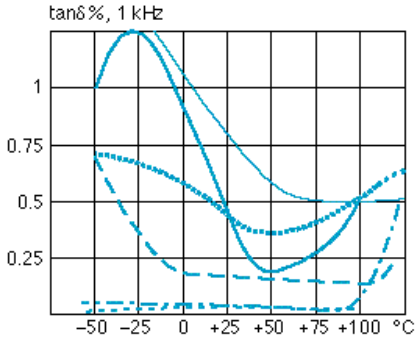
**POLYPHENYLENE SULPHIDE (PPS)**
**Metallized**
Low losses, wide operating temperature range, low temperature coefficient, good stability.
Typical applications: Timers and filters. Automotive and other applications in high ambient temperatures.

**PAPER**
**Metallized**
High dielectric constant. Excellent self-healing properties and transient handling capability. High ionisation level due to impregnated dielectric material. Outstanding reliability in mains connected and other low frequency applications.

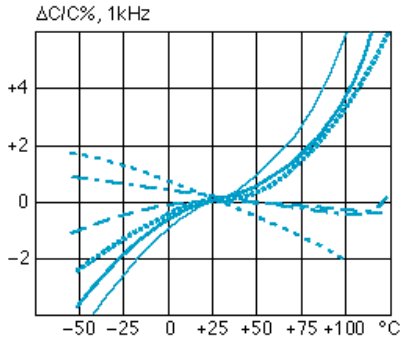
## Numerical comparison of film materials

| Material (Trade names) | Abbreviation | Min. film thickness (µm) | Dielectric constant at 1 kHz, +23°C | Operating temperature (°C) | Temperature coefficient (ppm/°C) | Dissipation factor at 1 kHz, +23°C | Insulation time constant (s) at +23°C | Dielectric absorption % |
|---|---|---|---|---|---|---|---|---|
| Polyester (Mylar, Lumirror, Hostaphan, Diafoil) | PET | 0.9 | 3.3 | –55 ... +100 (... +125) | +400 (±200) | 0.5% | 25 000 | 0.2 |
| Polyethylene Naphthalate | PEN | 1 | 3.0 | –55 ... +125 (... +150) | +200 (±150) | 0.4% | 25 000 | 1.2 |
| Polycarbonate (Capfilm) | PC | 1.5 | 2.8 | –55 ... +125 | 0 (±100) nonlinear | 0.15% | 25 000 | 0.06 |
| Polypropylene (Torayfan, Safidep, Trespaphan) | PP | 4 | 2.2 | –55 ... +85 (... +105) | –200 (–100, +50) almost linear | 0.03% | 100 000 | 0.01 |
| Polystyrene (Styroflex) | PS | 4 | 2.5 | –40 ... +70 (... +85) | –150 (±50) linear | 0.02% | 100 000 | 0.01 |
| Polyphenylene sulfide (Torelina) | PPS | 2 | 3.0 | –55 ... +125 (... +150) | 0 (–50) up to +100 | 0.06% | 10 000 | 0.05 |
| Paper Impregnated | | 7 | 5.5 | –40 ... +110 | +1200 (±200) | 0.8% | 15 000 | |

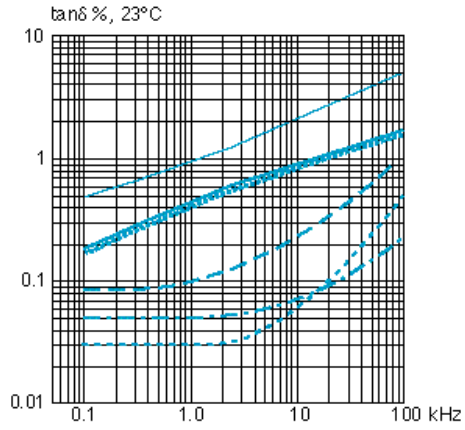
## Properties of dielectrics



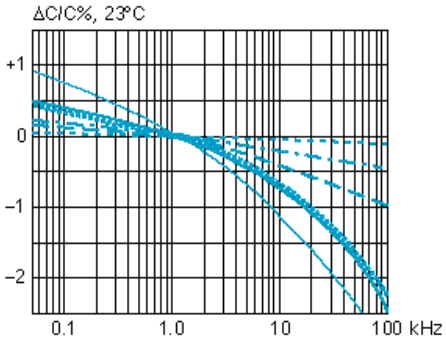

**Dissipation factor vs. temperature**



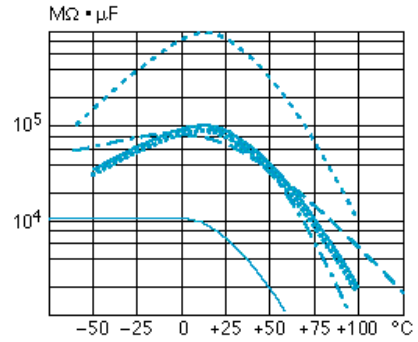

**Capacitance vs. temperature**



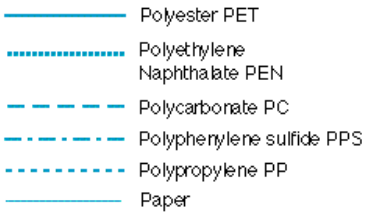

**Dissipation factor vs. frequency**



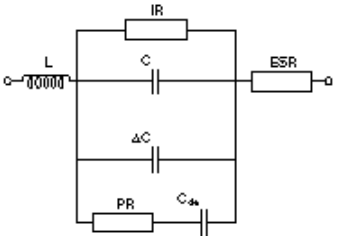

**Capacitance vs. frequency**




**Insulation resistance vs. temperature**




## Capacitor equivalent diagram




C = nominal value of the capacitor

L = inductance (leads, metallization, winding)

ESR = equivalent series resistance (leads, metallization, metal spraying)

IR = insulation resistance (properties of the dielectric material)

ΔC = variable capacitance (temperature, DC voltage, frequency changes)

PR = dielectric polarization resistance

$C_{da}$ = dielectric absorption

## Reliability

The reliability of a capacitor is mainly a function of:

- The construction; dielectric material and its thickness
- The manufacturing process
- The application; electrical stress and temperature

The failure rate, λ, vs. voltage and temperature for the most common dielectric materials is shown in the diagrams below. $U_R$ = rated voltage.

The operating life (L) can be calculated as:

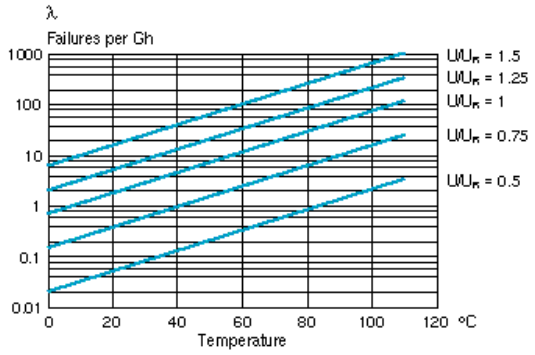
$$L = \frac{1}{\lambda} \times \ln \frac{1}{1 - F}$$

where F is the expected probability of failures.

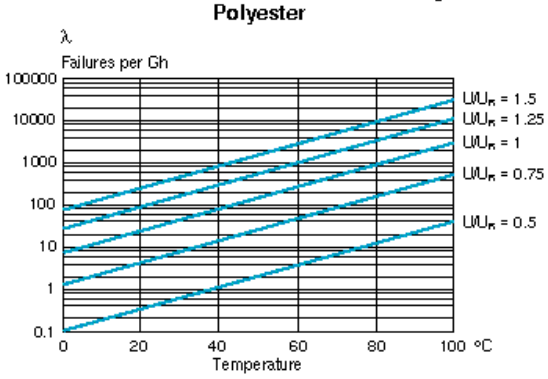
Example: If $\lambda = 20 \times 10^{-9}$ it takes 6 years to have F = 0.001 (0.1% failures) and 300 years to have F = 0.05 (5% failures)

MTBF (mean time between failures) = 1 / λ

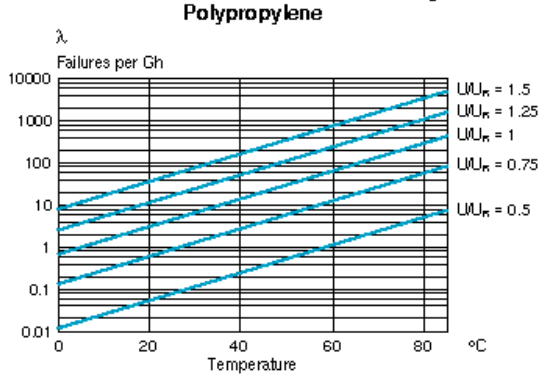
**Failure rates vs. temperature and voltage**
**Paper**



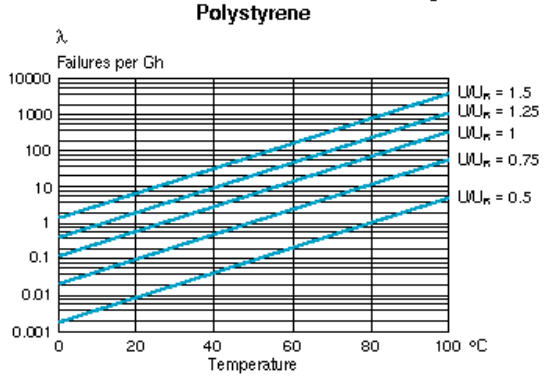

**Failure rates vs. temperature and voltage**
**Polyester**




**Failure rates vs. temperature and voltage**
**Polypropylene**

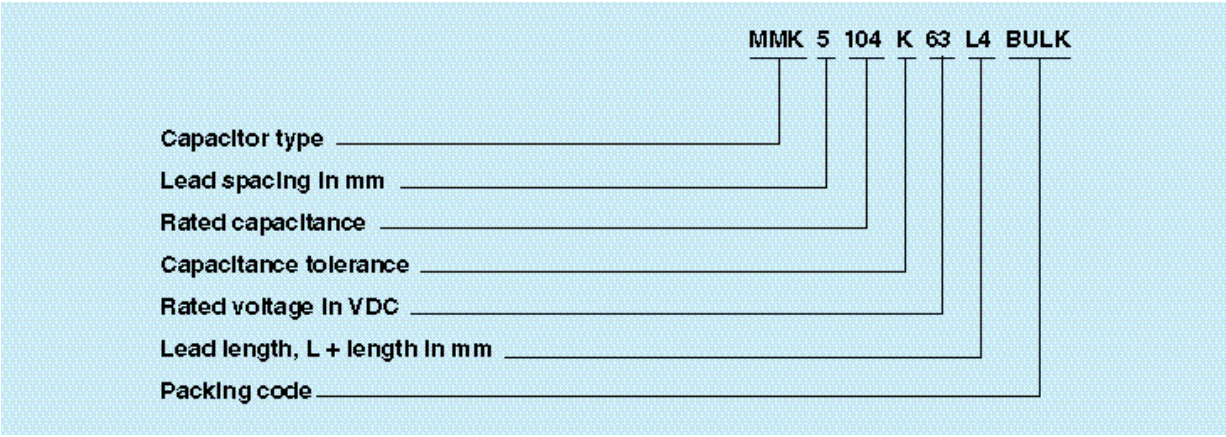



**Failure rates vs. temperature and voltage**
**Polystyrene**



# How to order EVOX capacitors

**The Evox article code includes all the information needed to specify the product characteristics and type of packing. Please see the example below.**




The first letter of the **capacitor type** code specifies the dielectric material: M for polyester (PET), C for polycarbonate, P for polypropylene, G for polyphenylene naphthalate and S for polyphenylene sulphide. The second letter indicates the electrode construction: M for metallized and F for film/foil.

The requested **lead spacing** is indicated in mm after the third letter.

The **rated capacitance** value of the product is indicated with three digits (four digits for some special capacitance values). The two first digits indicate the two most significant digits of the capacitance value, and the third digit gives the number of following zeroes. This gives the capacitance value expressed in picofarads.

Examples:

| | | | | |
|---|---|---|---|---|
| 103 | = | 10000 pF = | 10 nF = | 0.01 µF |
| 104 | = | 100000 pF = | 100 nF = | 0.1 µF |
| 106 | = | 10000000 pF = | 10000 nF = | 10 µF |

When three significant digits are needed to express the capacitance value, a four digit long code is used. Again, the last digit gives the amount of numbers after the two most significant digits. However, instead of adding just zeroes, the first number to be added is the third significant number.

Examples:

4582 =4580 pF = 4.58 nF =0.00458 µF
1464 =146000 pF = 146 nF =0.146 µF

The **capacitance tolerance** is expressed with letter codes:

| | | | |
|---|---|---|---|
| M | ± 20 % | J | ± 5 % |
| V | 0 to +20 % | X | ± 3.5 % |
| P | 0 to +10 % | H | ± 2.5 % |
| L | 0 to -10 % | G | ± 2 % |
| K | ± 10 % | F | ± 1 % |

The **rated voltage** of a capacitor is expressed with numbers specifying the voltage in DC volts.

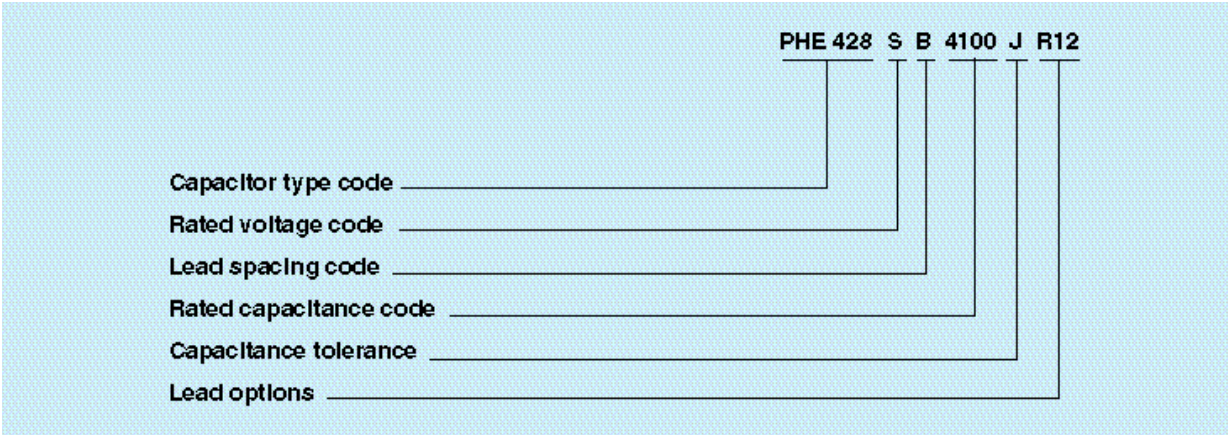
**Lead length** is expressed in mm, following the letter L. Standard lead length is $4.0^{+1.0}_{-0}$ mm. Other lead lengths are available on request.

Packing of the capacitors is specified by the **packing code**:

| | |
|---|---|
| **BULK** | loose capacitors in boxes |
| **TRAY** | capacitors with 22.5, 27.5 and 37.5 mm pitch on a tray |
| **TR16** | capacitors taped and reeled with H = 16.5 mm |
| **TR18** | capacitors taped and reeled with H = 18.5 mm |
| **TA16** | capacitors taped in ammo pack with H = 16.5 mm |
| **TA18** | capacitors taped in ammo pack with H = 18.5 mm |

# How to order RIFA Capacitors

**The Rifa article code includes all the information needed to specify the product characteristics and type of packing. Please see the example below.**




The article code consists of a maximum 20 positions divided in two blocks. The first 13 positions form the first block, which is given in each article table. There are a few exceptions to this system.

The six first digits specify the **capacitor type**.

The **rated voltage** in DC is expressed with a letter, being the seventh digit in the article code:

| | |
|---|---|
| C | 63 |
| D | 100 |
| F | 160 |
| H | 250 |

| | |
|---|---|
| K | 400 |
| M | 630 |
| P | 1000 |
| R | 1600 |
| S | 2000 |

The **lead spacing** in mm is specified with a letter in the eighth digit:

| | |
|---|---|
| K | 7.5 |
| A | 10 |
| B | 15 |
| C | 20.3 |

| | |
|---|---|
| D | 22.5 |
| E | 25.4 |
| F | 27.5 |
| R | 37.5 |

The **rated capacitance** is expressed in four digits, where the first digit is the number of digits in the capacitance value in pF, and the next three digits are the three significant digits in the capacitance value.

Examples:

| | | | | |
|---|---|---|---|---|
| 6100 | = | 100000 pF | = | 0.1 µF |
| 4625 | = | 6250 pF | = | 0.00625 µF |

The **capacitance tolerance** is expressed with letter codes:

| | |
|---|---|
| M | ± 20 % |
| K | ± 10 % |
| J | ± 5 % |
| X | ± 3.5 % |
| H | ± 2.5 % |
| G | ± 2 % |
| R | ± 1.25 % |

| | |
|---|---|
| F | ± 1 % |
| P | ± 0.625 % |
| D | ± 0.5 % |
| V | ± 5 pF |
| A | ± 1.5 pF |
| Y | ± 1 pF |

The second block, i.e.the digits 14 to 20, describes the **options** for each article, such as lead length, taping or insulated leads. Please see the Ordering Information for each article.

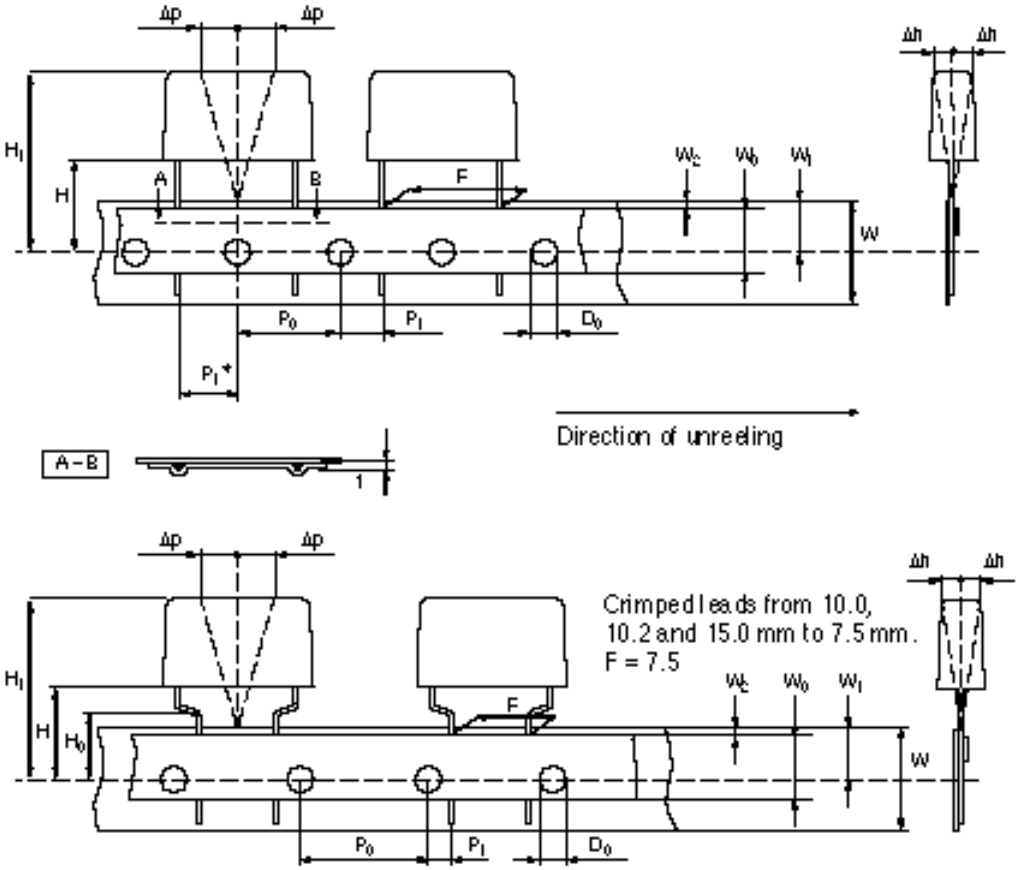
# The manufacturing code Y Z, according to IEC 62

where Y = year, Z = month.

| Year | Code | Year | Code | Year | Code | Month | Code | Month | Code |
|---|---|---|---|---|---|---|---|---|---|
| 1983 | R | 1990 | A | 1997 | J | Jan | 1 | July | 7 |
| 1984 | S | 1991 | B | 1998 | K | Febr | 2 | Aug | 8 |
| 1985 | T | 1992 | C | 1999 | L | March | 3 | Sept | 9 |
| 1986 | U | 1993 | D | 2000 | M | April | 4 | Oct | O |
| 1987 | V | 1994 | E | 2001 | N | May | 5 | Nov | N |
| 1988 | W | 1995 | F | 2002 | P | June | 6 | Dec | D |
| 1989 | X | 1996 | H | 2003 | R | | | | |

# Taping of Evox Rifa capacitors

The taping is carried out in accordance with IEC 2




## Taping specification

| Dimensions in mm | | | | | | IEC 286-2 |
|---|---|---|---|---|---|---|
| Lead spacing | F | 5.0/7.5 $^{+0.6}_{-0.1}$ | 7.5 $^{+0.6}_{-0.1}$ Crimped leads 4) | 10.0/15.0/ * $^{+0.6}_{-0.1}$ | 10.2/15.2/20.3 $^{+0.6}_{-0.1}$ | F $^{+0.6}_{-0.1}$ |
| Carrier tape width | W | 18 ± 0.5 | 18 ± 0.5 | 18 ± 0.5 | 18 ± 0.5 | 18 $^{+1.0}_{-0.5}$ |
| Hold-down tape width | $W_0$ | 9 ± 0.3 | 12 ± 0.3 | 12 ± 0.3 | 12 ± 0.3 | |
| Position of sprocket hole | $W_1$ | 9 ± 0.5 | 9 ± 0.5 | 9 ± 0.5 | 9 ± 0.5 | 9 $^{+0.75}_{-0.5}$ |
| Distance between tapes | $W_2$ | 3 max | 3 max | 3 max | 3 max | 3 max |
| Sprocket hole diameter | $D_0$ | 4 ± 0.2 | 4 ± 0.2 | 4 ± 0.2 | 4 ± 0.2 | 4 ± 0.2 |
| Feed hole pitch | $P_0$ 1) | 12.7 ± 0.3 | 15 ± 0.3 | 12.7 ± 0.3 | 12.7 ± 0.3 | 12.7 ± 0.3 |
| Distance lead – feed hole | $P_1$ | 3.85/3.75❖ ± 0.7 | 3.75 ± 0.7 | 7.7/5.2/7.8 ± 0.7 | 7.6/5.1/8.9 ± 0.7 | $P_1$ ± 0.7 |
| Max deviation tape – plane | Δp | 1.3 max | 1.3 max | 1.3 max | 1.3 max | 1.3 max |
| Max lateral deviation | Δh | 2 max | 2 max | 2 max | 2 max | 2 max |
| Total thickness | t | 0.7 ± 0.2 | 0.7 ± 0.2 | 0.7 ± 0.2 | 0.7 ± 0.2 | 0.9 max |
| Sprocket hole/cap body | H 2) | 18.5 ± 0.5<br>16.5 ± 0.5 | | 18.5 ± 0.5<br>16.5 ± 0.5<br>18.0 $^{+2}_{-0}$ | 18.0 $^{+2}_{-0}$ | 18.0 $^{+2}_{-0}$ |
| Sprocket hole/crimped leads | $H_0$ 2) | | 16 ± 0.5<br>18 ± 0.5 | | | 16 ± 0.5 |
| Sprocket hole/top of cap body | $H_1$ 3) | 32/31 max | 40 max | 43 max | 35 max | 58 max |

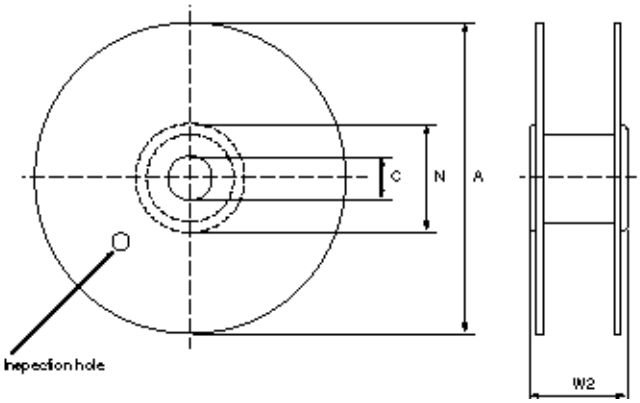
1) Cumulative pitch error
2) Alternatives for different insertion machines
3) Depending on case size
4) CQ/SCQ with crimped leads are taped like this with the following exceptions: $P_1$ = 3.85 and W = 18 $^{+1.0}_{-0.5}$
*) On request 22.5 mm

# Taping of Evox Rifa capacitors, continued

## Reel specification

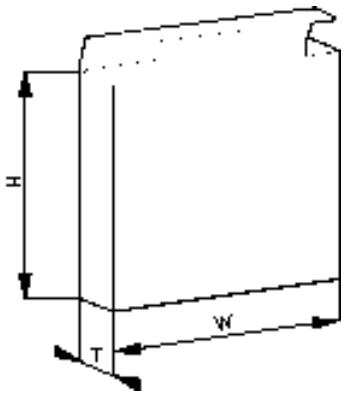
| Reel dimensions in mm | | | Tol. |
|---|---|---|---|
| Reel diameter | A | 360/500 | max |
| Hub diameter | N | 80 | min |
| Arbor hole | C | 30 | ± 1 |
| Total reel width measured at hub | W2 | 58 | max |

Quantity/reel in this catalogue is for 360 mm reel.
The quantity in 500 mm reel is 2x the given quantity.




## Ammo pack specification

| Ammo pack dimensions in mm | | | |
|---|---|---|---|
| Height | H | 330 | (135 or 200 for CQ/SCQ depending on capacitance value) |
| Width | W | 330 | (335 for CQ/SCQ) |
| Thickness | T | 50 | |




## Ordering codes

The following codes specify the taping options

| | | | |
|---|---|---|---|
| **RIFA** | T0 | Reel with | A = 360 mm |
| | T1 | | A = 500 mm |
| | X2 | Reel with | A = 360 mm, crimped leads, F = 7.5 (Crimped leads; from 10/10.2/15 to 7.5 mm) |
| **EVOX** | TR16 | Reel with | A = 360 mm and H = 16.5 mm |
| | TR18 | | A = 360 mm and H = 18.5 mm |
| | XR18 | | A = 360 mm, H = 18.5, F = 7.5, $P_0$ = 15 |
| | TA16 | Ammo with | H = 16.5 mm |
| | TA18 | | H = 18.5 mm |

How to use these codes:
See general ordering information and information for each article.

**Taping of SMD Capacitors; see page 75.**