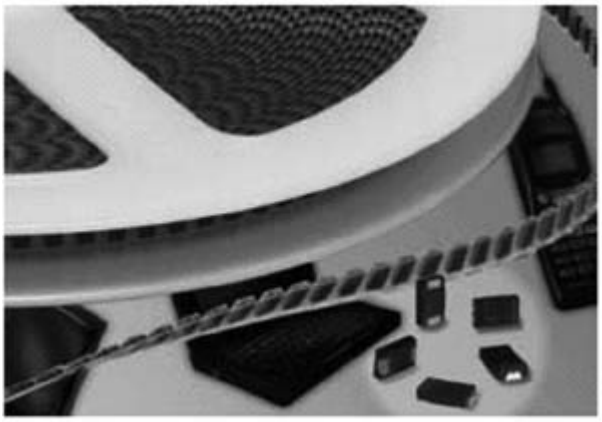
# SPA Capacitors Solid Polymer Aluminum Surface Mount Capacitors

*Extended Range Ratings, 20% More Capacitance*



## Highlights

- **Capacitance Range: 2.2 µF to 470 µf**
- **Ripple current ratings up to 4.0 Arms at 100 kHz and 105 ºC**
- **Low Impedance**
- **Ultra-Low ESR; 5 mΩ @ 100 kHz**
- **–55 ºC to 105 ºC operating temperature**
- **Voltage Range: 2.0 Vdc to 16 Vdc**
- **Solid electrolyte for extended life**
- **Footprint compatible with "D" and "E" case tantalum**
- **Flat Z and ESR vs. temperature**
- **Ignition free**

## Filtering power of 3 or more tantalum chips and 50 year life

Solid polymer aluminum capacitors combine the high capacitance capability of an electrolytic component with the high frequency performance of film capacitors. When the need for low impedance at high frequency is critical for your design, one SPA chip is capable of replacing several liquid electrolyte aluminum or tantalum capacitors connected in parallel. This is due to the ultra-low ESR which results in significantly lower impedance than either aluminum or tantalum capacitors at frequencies of 100 kHz and above. There is no longer a need to stack capacitors to lower the impedance at high frequency. The low ESR and high capacitance make them ideal for bypassing high frequency noise, and for switching frequency filtering in DC/ DC conversion. SPA capacitors are packaged in a molded resin case with the same footprint (7.3 x 4.3 mm) as the industry standard tantalum "D" and "E" case sizes. The solid electrolyte results in a capacitor with stable impedance and equivalent series resistance over the entire operating temperature range and they have more than twice the ripple current handling capability of tantalum capacitors. In addition, the solid electrolyte delivers a typical expected operating life of more than 50 years, and it is ignition free.

| CDE SPA Type Feature | ESRD High Voltage | ESRE High Capacitance | ESRH High Temperature | SPA Ultra-Low ESR |
|---|---|---|---|---|
| Length x Width | 7.3 x 4.3 | 7.3 x 4.3 | 7.3 x 4.3 | 7.3 x 4.3 |
| Height (mm) | 1.8, 2.8 | 4.1 | 2.8, 4.1 | 1.8, 1.9, 2.8, 4.2 |
| Temperature Range | –55 ºC +105 ºC | –55 ºC +105 ºC | –55 ºC +105 ºC /125 ºC ** | –40 ºC +105 ºC |
| Capacitance Range (µF) | 2.2 — 270 | 100 — 390 | 68 — 270 | 56 — 470 |
| Voltage Range (Vdc) | 2.0 — 16.0 | 2.0 — 8.0 | 2.0 — 8.0 | 2.0 — 6.3 |
| E.S.R. at 100 kHz (Ω) | 0.012 — 0.110 | .010 - .015 | 0.015 — 0.018 | 0.005 — 0.009 |
| Ripple Current at 100 kHz ($A_{rms}$) | 1.0 — 3.3 | 3.0 — 3.5 | 2.0 — 3.0 | 3.0 — 4.0 |

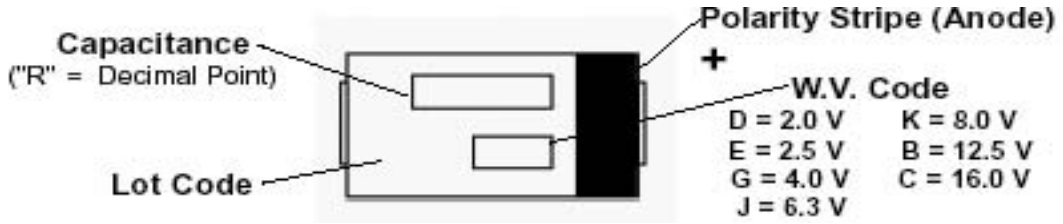
**Operates to +125 ºC @ 75% of rated voltage

## Applications

**Motherboard By-Pass**
**Switching Supply Input/Output Filters**
**Power Supply Decoupling**
**High Frequency Noise Reduction**

**Laptop LCD Displays**
**Automotive Digital Equipment**
**Portable Electronic Equipment**

## Markings




## Ordering Information

**ESRD** **4R7** **M** **16** **R**

**CDE Type**

**Capacitance Code**
**4R7** = 4.7 µF
**220** = 22 µF
**101** = 100 µF

**Capacitance Tolerance**
**M** = ± 20%

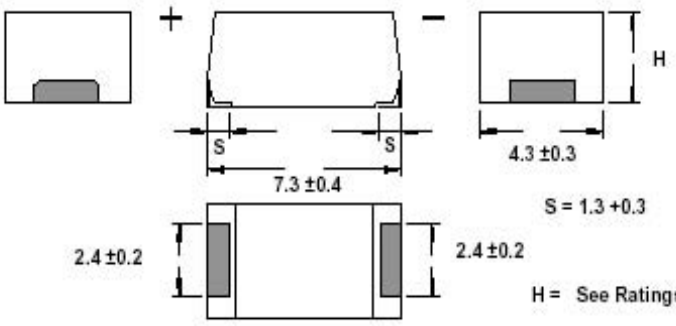
**WVDC Code**
**02** = 2.0 Vdc **08** = 8.0 Vdc
**0E** = 2.5 Vdc **12** = 12.5 Vdc
**04** = 4.0 Vdc **16** = 16.0 Vdc
**06** = 6.3 Vdc

**Packaging Code**
**R** = Tape & Reel
**ESRD** (1.8 mm Ht.): 3500 pcs/reel
**ESRD** (2.8 mm Ht.): 2000 pcs/reel
**ESRE**: 2000 pcs/reel
**ESRH**: 2000 pcs/reel
**SPA**: See catalog page

# SPA Capacitors Solid Polymer Aluminum Surface Mount Capacitors

## Type ESRD High Voltage

### Outline Drawing



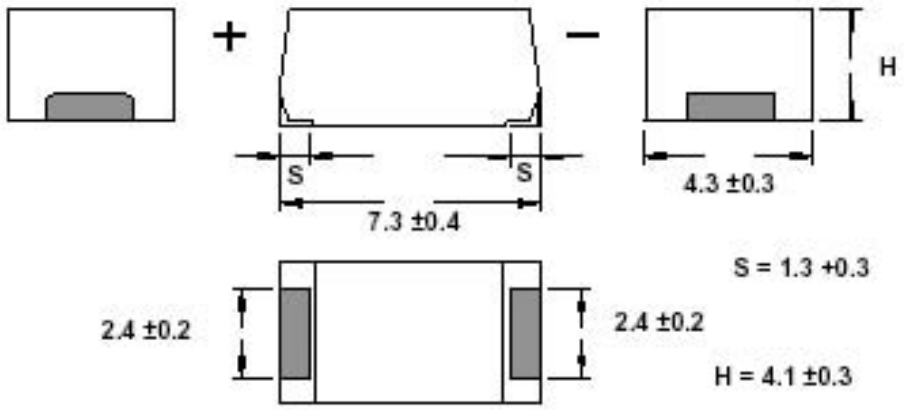

Dimensions in mm

### Ratings

| Capacitance (µF) | Catalog Part Number (Tape & Reel) | Maximum ESR 100 kHz/20 °C (Ω) | Maximum1 Ripple Current 100 kHz/105 °C (Amps) | Case Height H (mm) |
|---|---|---|---|---|
| | | **2.0 Vdc** | | |
| 100.0 | ESRD101M02R | 0.018 | 2.5 | 1.8 ±0.1 |
| 120.0 | ESRD121M02XR | 0.015 | 2.7 | 1.8 ±0.1 |
| 180.0 | ESRD181M02R | 0.015 | 3.0 | 2.8 ±0.2 |
| 220.0 | ESRD221M02R | 0.015 | 3.0 | 2.8 ±0.2 |
| 270.0 | ESRD271M02XR | 0.012 | 3.3 | 2.8 ±0.2 |
| | | **2.5 Vdc** | | |
| 82.0 | ESRD820M0ER | 0.018 | 2.5 | 1.8 ±0.1 |
| 100.0 | ESRD101M0EXR | 0.015 | 2.7 | 1.8 ±0.1 |
| 150.0 | ESRD151M0ER | 0.015 | 3.0 | 2.8 ±0.2 |
| 180.0 | ESRD181M0ER | 0.015 | 3.0 | 2.8 ±0.2 |
| 220.0 | ESRD221M0EXR | 0.012 | 3.3 | 2.8 ±0.2 |
| | | **4.0 Vdc** | | |
| 56.0 | ESRD560M04R | 0.018 | 2.5 | 1.8 ±0.1 |
| 82.0 | ESRD820M04XR | 0.015 | 2.7 | 1.8 ±0.1 |
| 120.0 | ESRD121M04R | 0.015 | 3.0 | 2.8 ±0.2 |
| 150.0 | ESRD151M04XR | 0.012 | 3.3 | 2.8 ±0.2 |
| | | **6.3 Vdc** | | |
| 10.0 | ESRD100M06R | 0.055 | 1.4 | 1.8 ±0.1 |
| 22.0 | ESRD220M06R | 0.040 | 1.6 | 1.8 ±0.1 |
| 33.0 | ESRD330M06R | 0.028 | 2.0 | 1.8 ±0.1 |
| 47.0 | ESRD470M06R | 0.018 | 2.5 | 1.8 ±0.1 |
| 68.0 | ESRD680M06XR | 0.015 | 2.7 | 1.8 ±0.1 |
| 100.0 | ESRD101M06R | 0.015 | 3.0 | 2.8 ±0.2 |
| 120.0 | ESRD121M06XR | 0.012 | 3.3 | 2.8 ±0.2 |
| | | **8.0 Vdc** | | |
| 8.2 | ESRD8R2M08R | 0.055 | 1.4 | 1.8 ±0.1 |
| 15.0 | ESRD150M08R | 0.040 | 1.6 | 1.8 ±0.1 |
| 22.0 | ESRD220M08R | 0.028 | 2.0 | 1.8 ±0.1 |
| 33.0 | ESRD330M08R | 0.018 | 2.5 | 1.8 ±0.1 |
| 68.0 | ESRD680M08R | 0.015 | 3.0 | 2.8 ±0.2 |
| | | **12.5 Vdc** | | |
| 4.7 | ESRD4R7M12R | 0.080 | 1.0 | 1.8 ±0.1 |
| 10.0 | ESRD100M12R | 0.060 | 1.0 | 1.8 ±0.1 |
| 15.0 | ESRD150M12R | 0.050 | 1.3 | 1.8 ±0.1 |
| 22.0 | ESRD220M12R | 0.030 | 1.6 | 1.8 ±0.1 |
| | | **16.05 Vdc** | | |
| 2.2 | ESRD2R2M16R | 0.110 | 1.0 | 1.8 ±0.1 |
| 4.7 | ESRD4R7M16R | 0.080 | 1.0 | 1.8 ±0.1 |
| 6.8 | ESRD6R8M16R | 0.070 | 1.0 | 1.8 ±0.1 |
| 8.2 | ESRD8R2M16R | 0.045 | 1.3 | 1.8 ±0.1 |

# Type ESRE Surface Mount, High Capacitance

## Outline Drawing




## Ratings

| Capacitance (µF) | Catalog Part Number | Maximum ESR 100 kHz/20 °C (Ω) | Maximum Ripple Current 100 kHz/105 °C |
|---|---|---|---|
| | **2.0 Vdc** | | |
| 270 | ESRE271M02R | 0.012 | 3.3 |
| 330 | ESRE331M02R | 0.012 | 3.3 |
| 390 | ESRE391M02XR | 0.010 | 3.5 |
| | **2.5 Vdc** | | |
| 220 | ESRE221M0ER | 0.012 | 3.3 |
| 270 | ESRE271M0ER | 0.012 | 3.3 |
| 330 | ESRE331M0EXR | 0.010 | 3.5 |
| | **4.0 Vdc** | | |
| 180 | ESRE181M04R | 0.012 | 3.3 |
| 220 | ESRE221M04XR | 0.010 | 3.5 |
| | **6.3 Vdc** | | |
| 150 | ESRE151M06R | 0.012 | 3.3 |
| 180 | ESRE181M06XR | 0.010 | 3.5 |
| | **8.0 Vdc** | | |
| 100 | ESRE101M08R | 0.012 | 3.3 |

# SPA Capacitors Solid Polymer Aluminum Surface Mount Capacitors

## Specifications

**Operating Temperature Range;**
–55 °C to +105 °C, at 100% rated voltage

**Surge Voltage;**
125% of the rated working Vdc

**Capacitance Range;**
2.2 µF to 470 µF

**Capacitance Tolerance;**
±20% at 120 Hz and +20 °C

**DC Leakage Current (DCL);**
After a two minute application of the rated working voltage at +20 °C:

2V — 4V: $I \leq 0.06CV$
6.3V — 16V: $I \leq 0.04CV$ or 3 µA
(whichever greater)

**Dissipation Factor (DF);**
The ratio of the capacitor's equivalent series resistance to its reactance at 120Hz and +20 ºC ESRD (1.8 mm ht.): DF is 0.06 Max. ESRE & ESRD (3.1 mm ht.): DF is 0.10 Max.

**Resistance to Soldering Heat;**
Heat the capacitors at 235 ºC in an oven for 200 seconds. The capacitors will meet the following limits after stabilizing at 20 ºC:

$\Delta C$ = ±10% of the initial measured value
DF ≤ the initial specified value
DCL ≤ the initial specified value

**Vibration;**
No abnormal change shall occur to capacitors that have been soldered (and attached) to a board when subjected to a vibration of 1.5 mm amplitude that is varied from 10 Hz to 2000 Hz in 20 min. cycles. The test duration is 2 hours for each right angle direction (total 6 hours). Capacitance is monitored during the last cycle of the test for stablilty.

**Moisture Resistance:**
After 500 hours storage at +60 ºC and 90% to 95% RH without load, the capacitor will meet the following limits:

$\Delta C$ = +70%/–20% of the initial measured value (2.0 Vdc, 2.5 Vdc), +60%/–20% of the initial measured value (4.0 Vdc), +50%/–20% of the initial measured value (6.3 Vdc), +40%/–20% of the initial measured value (all other voltages)
DF ≤ two times the initial specified value
DCL ≤ the initial specified value

**Life Test:**
Apply rated DC working voltage at 105 ºC for 1000 hours, and then stabilize them to +20 ºC. Capacitors will meet the following limits:

$\Delta C$ = ±10% of the initial measured value
DF ≤ the initial specified value
DCL ≤ the initial specified value

**Shelf Life Test:**
Shelf life is typically 5 to 10 years. Accelerated test: after 500 hours at 105 ºC, capacitors will meet the following limits after stabilization at 20 ºC:

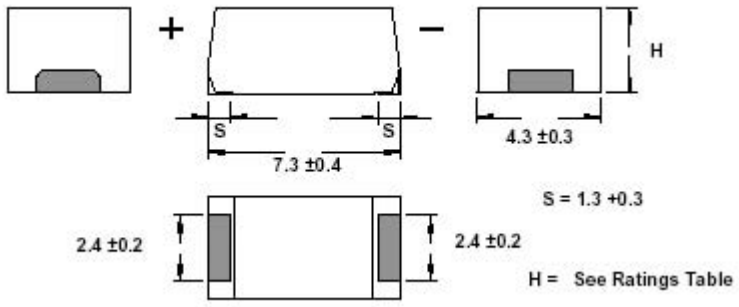
$\Delta C$ = ±10% of the initial measured value
DF ≤ the initial specified value
DCL ≤ the initial specified value

**Shear Test;**
No damage shall be visible after subjecting a mounted capacitor to a side force of 5 N for 10 seconds

# SPA Capacitors Solid Polymer Aluminum Surface Mount Capacitors

## Type ESRH Low E.S.R. and High Temperature

### Outline Drawing




### Ratings

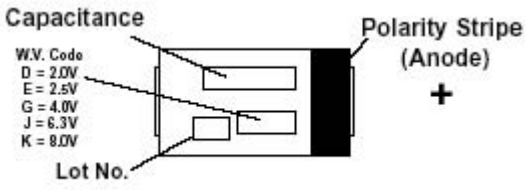
| Capacitance µF | Rated Voltage WVDC | Catalog Part Number Tape* and Reel 2000 pcs/reel) | Maximum ESR 100 kHz/20 °C (Ω) | Ripple Current at 100 kHz** +20 °C to + 125 °C Arms | H ±0.2 (mm) |
|---|---|---|---|---|---|
| 180 | 2.0 | ESRH181M02R | 0.015 | 2.5 | 2.8 |
| 150 | 2.5 | ESRH151M0ER | 0.015 | 2.5 | 2.8 |
| 120 | 4.0 | ESRH121M04R | 0.015 | 2.5 | 2.8 |
| 100 | 6.3 | ESRH101M06R | 0.015 | 2.5 | 2.8 |
| 68 | 8.0 | ESRH680M08R | 0.015 | 2.5 | 2.8 |
| 270 | 2.0 | ESRH101M06R | 0.012 | 3.0 | 4.1 |
| 220 | 2.5 | ESRH101M06R | 0.012 | 3.0 | 4.1 |
| 180 | 4.0 | ESRH101M06R | 0.012 | 3.0 | 4.1 |
| 150 | 6.3 | ESRH101M06R | 0.012 | 3.0 | 4.1 |
| 100 | 8.0 | ESRH101M06R | 0.012 | 3.0 | 4.1 |

*12mm wide tape — 13” diameter reel

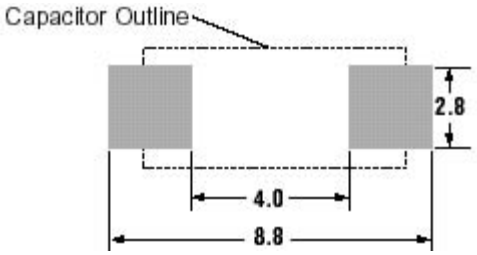
# SPA Capacitors Solid Polymer Aluminum Surface Mount Capacitors

# Type ESRH

## Marking




## Land Pattern




## Specifications (continued)

**Life Test:**
Apply rated DC working voltage at 105 ºC (or 0.75 x WVDC at 125 ºC) for 1000 hours, and then stabilize them to +20 ºC. Capacitors will meet the following limits:

ΔC = ±10% of the initial measured value
DF & DCL ≤ the initial specified value

**Shelf Life Test:**
Shelf life is typically 5 to 10 years. Accelerated test: after 500 hours at 125 ºC, capacitors will meet the following limits after stabilization at 20 ºC:

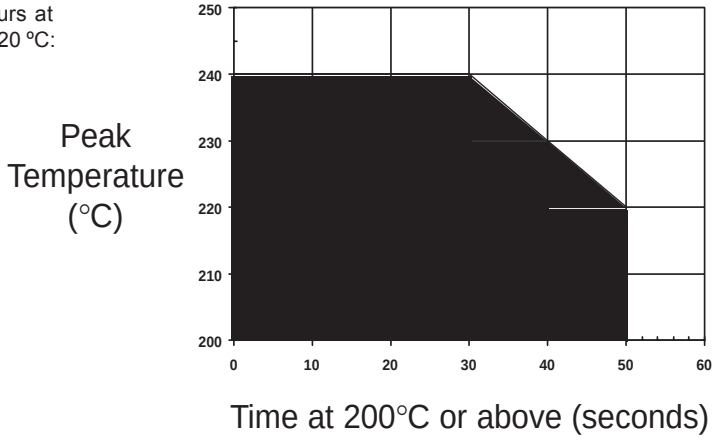
ΔC = ±10% of the initial measured value
DF & DCL ≤ the initial specified value

**Moisture Resistance:**
After 500 hours storage at +60 ºC and 90% R.H. without load, the capacitor will meet the following limits:

ΔC = +70%/–20% of the initial measured value (2.0 & 2.5 Vdc),
+60%/–20% of the initial measured value (4.0 Vdc),
+50%/–20% of the initial measured value (6.3 Vdc),
+40%/–20% of the initial measured value (8.0 Vdc).
DF ≤ two times the initial specified value
DCL ≤ the initial specified value

**Resistance to Soldering Heat:**
Capacitors withstand being heated in an oven at 235 ºC for 200 seconds.

**Soldering:**
SPA capacitors are designed for reflow soldering. Pr e h e a t t h e capacitors at 160 ºC for a maximum of 120 seconds. The time at or above 200 ºC on the surface of the capacitor should be per the following chart:




## Typical Impedance & ESR