

Super Capacitors

Super Capacitor



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FOR CORRECT USE OF SUPER CAPACITORS

1. Please confirm the operating conditions and the specifications of the Super Capacitors before using them.
2. The electrolyte of these Super Capacitors is sealed with material such as rubber. When you use the capacitors for a long time at high temperature, the moisture of the electrolyte evaporates and the equivalent series resistance (E.S.R.) increases. The fundamental failure mode is the open mode depending on E.S.R. increase.

When using a capacitor, please introduce a safe design assuming unexpected capacitor failure, such as redundancy in design and protection from fire and erroneous operation.
3. Please read 'Notes on Using the Super Capacitor' on page 60 when you design the circuits using the Super Capacitors.



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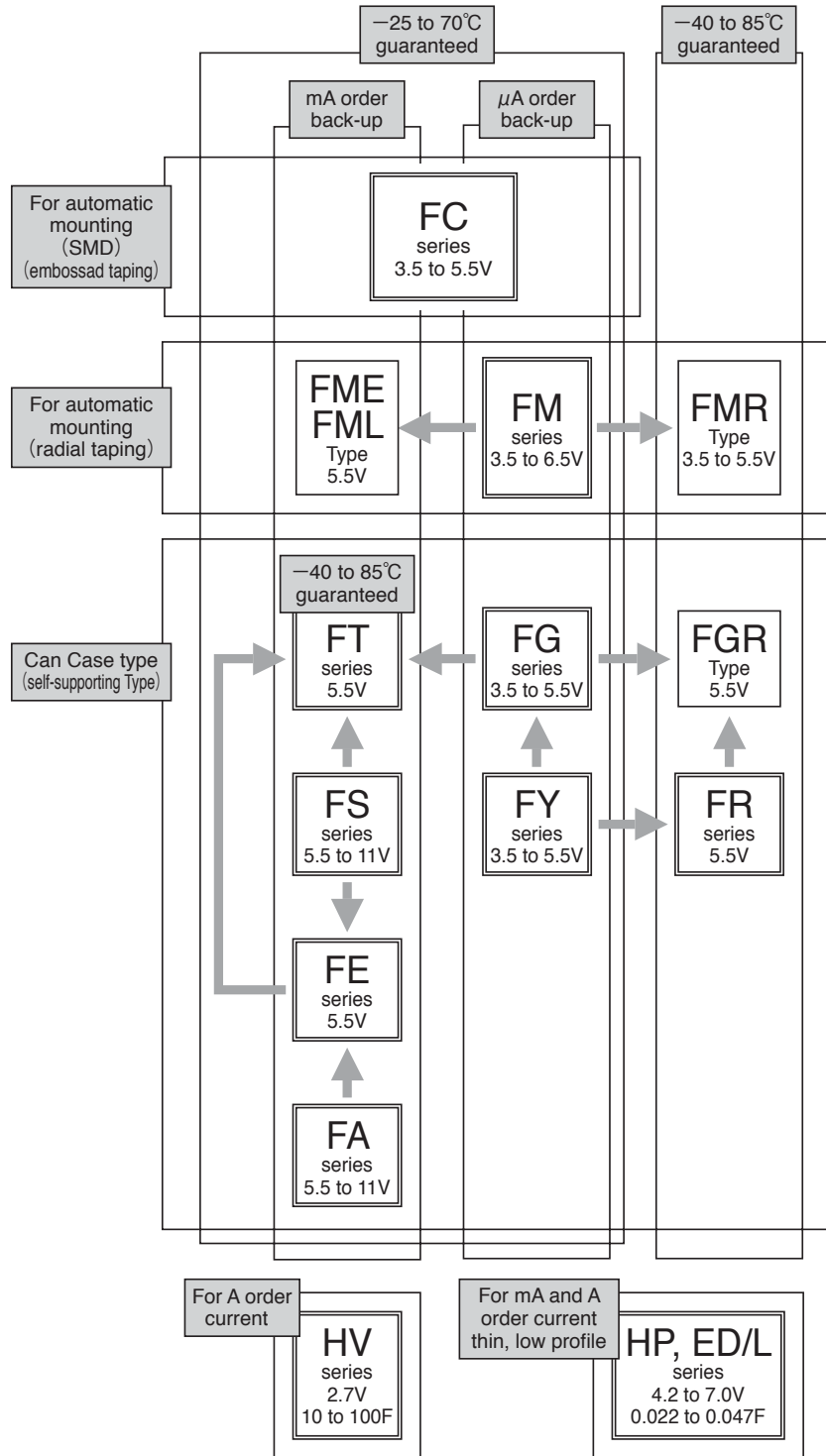
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1. Organization of Super Capacitor Series

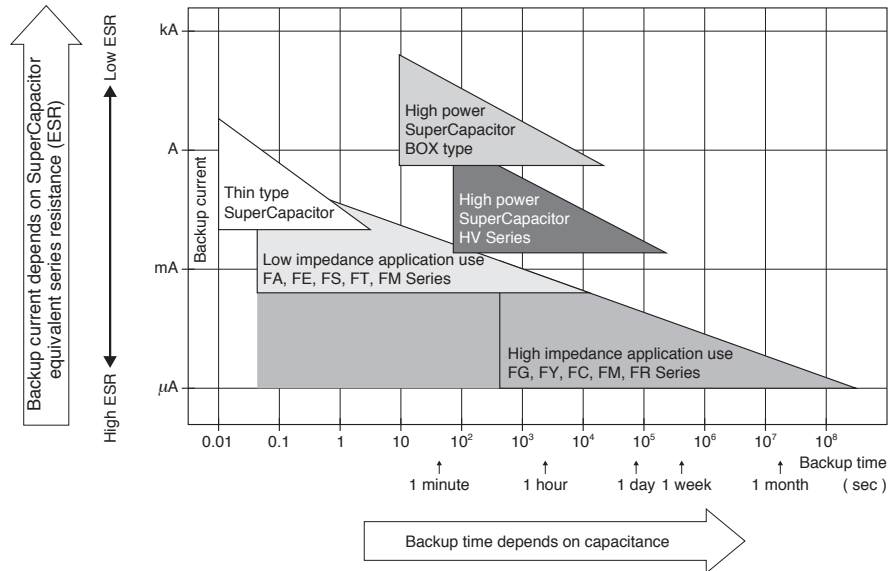


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2. Performance for Selection



3. Characteristics of Super Capacitor

Super Capacitor can not be used for applications in AC circuit such as ripple absorption because it has high internal resistance (several hundred $\text{m}\Omega$ to a hundred Ω) compared to aluminum electrolysis capacitor. Thus its main use would be similar to that of secondary battery such as power back-up in DC circuit. The following list shows the characteristics of Super Capacitors as compared to aluminum electrolyses capacitors for power back-up and secondary batteries.

| | Secondary battery | | Capacitor | |
|----------------------------------|--------------------|--|--------------------------------|-------------------------------|
| | NiCd battery | Lithium ion battery | Aluminum electrolysis capacito | Super Capacitor |
| Back-up ability | ◎ | ◎ | △ | ○ |
| Eco-hazard | Cd | — | — | — |
| Operating temperature range | -20 to 60 °C | -20 to 50 °C | -55 to 105 °C | -40 to 85 °C (FR, FT) |
| Charge time | few hours | few hours | few minutes | few minutes |
| Charge/discharge life time | approx. 500 times | approx. 500 to 1000 times | limitless (*1) | limitless (*1) |
| Restrictions on charge/discharge | yes | yes | none | none |
| Flow soldering | not applicable | not applicable | applicable | applicable |
| Automatic mounting | not applicable | not applicable | applicable | applicable (FM and FC series) |
| Safety risks | leakage, explosion | leakage, combustion, explosion, ignition | heat-up, explosion | gas emission (*2) |

(*1) Aluminum electrolysis capacitor and Super Capacitor has limited lifetime. However, when used under proper conditions, both can operate sufficiently within the designed lifetime of the set they are built in.

(*2) There is no harm as it is a mere leak of water vapor which transitioned from water contained in the electrolyte (diluted sulfuric acid). However, application of abnormal voltage surge exceeding maximum operating voltage may result in leakage and explosion.



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4. Typical Applications

As in the characteristics remarked previously, Super Capacitor has characteristics intermediate between general capacitors and batteries. Because of this, Super Capacitor can be used like a secondary battery when applied to DC circuit. The best suited applications of Super Capacitor are back-up device for the power shut-down of micro computers and RAM's. The list below shows main application examples.

Application Examples of Super Capacitor

| Intended use (guideline) | Power supply (guideline) | Application | Examples of equipments | Series |
|--------------------------------|--------------------------|---|--|--|
| Long time back-up | 500 μ A and below | · CMOS RAM, IC for clocks | · Measuring device, Control equipment, Communication device, Automotive power source | · FR series (85°C guaranteed) |
| | | · CMOS micro computer, IC for clocks | · CMOS micro computer · Static RAM/DTS (digital tuning system) | · FC series · FG series · FY series · FM series |
| Back-up for 1 hour or less | 50 mA and below | · Micro computer, RAM | · VCR, Microwave oven, Micro computer · Memory equipped device | · FT series · FS series |
| | | · Driving motor | · VCR, Printer, Projector · Video disk | |
| | | · Subsidiary power supply for driving motor during voltage drop | · Camera | |
| Back-up for 10 seconds or less | 1 A and below | · Power source of toys, LED, buzzer | · Toys, Display device, Alarm device | · FA series · FE series |
| | | · High current supply for a short amount of time | · Actuator, Relay solenoid, Gas igniter | |
| Peak assist | 100 mA to several A | · High speed charge/discharge, high current supply in ampere order · Subsidiary power supply for driving motor during voltage drop | · Mobile equipment, Mobile communication device, Wireless card, DSC, Mobile terminal | · HP series · ED/L series |
| Power assist | Up to several A | · Power supply, Subsidiary power supply | · Street sign, Display light, UPS | · HV series |

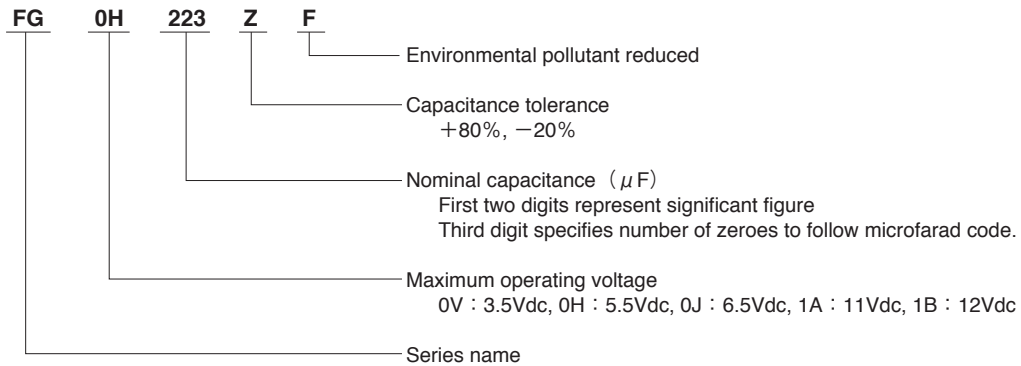


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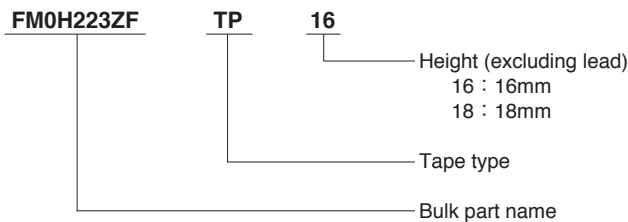
5. Part Number System

FM, FC, FT, FG, FS, FR, FY, FE, FA Series

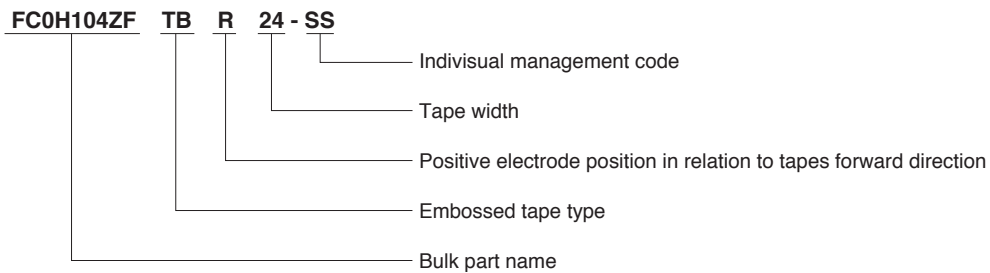
FG Series bulk type



FM Series tape type (Ammo pack)

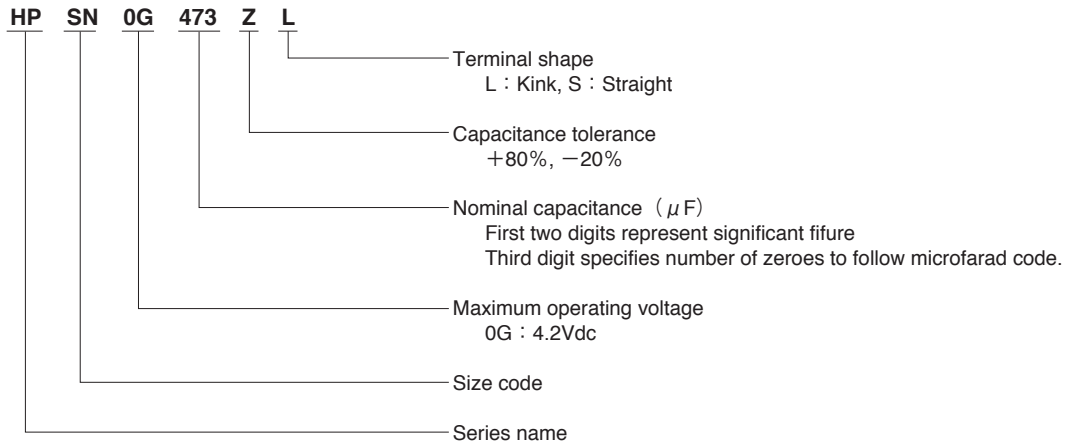


FC Series tape type (Embossed tape)

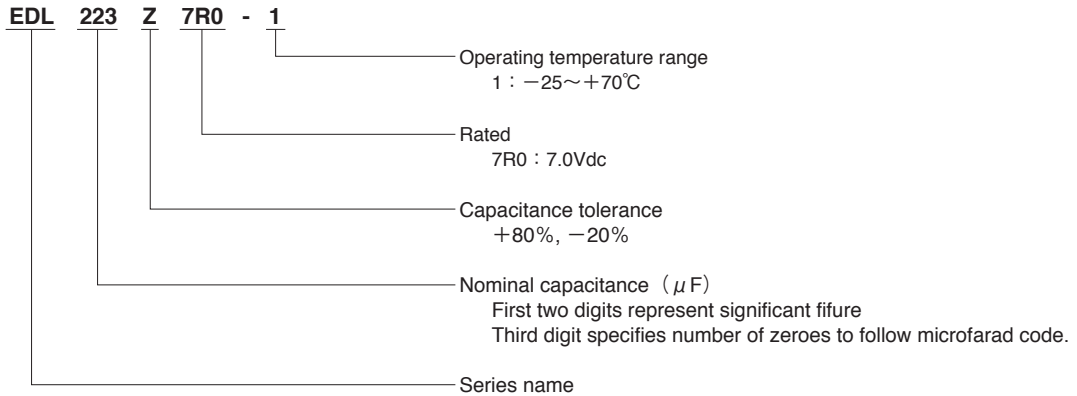


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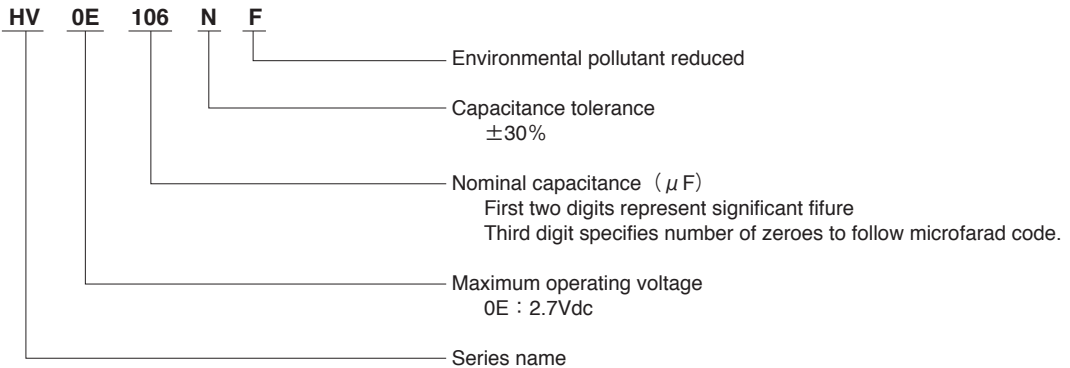
HP Series



ED/L Series



HV Series



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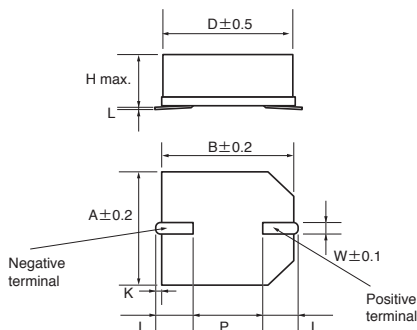
6. Rated Specifications

6.1 FC Series

Features

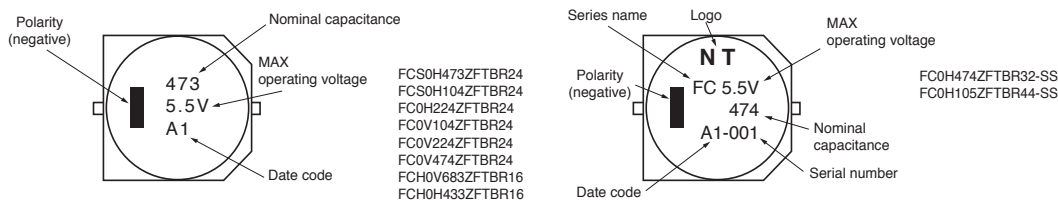
- Enables surface mounting.
- High rated voltage of 5.5V.
- High leakage reliability.

Dimensions



Markings

Displays nominal capacitance, MAX operating voltage serial number, polarity and etc.



Standard models

| Part Number | Max. Operating Voltage (Vdc) | Nominal Capacitance Discharge system (F) | Max. ESR (at 1kHz) (Ω) | Max. current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) | Dimension (Unit:mm) | | | | | | | | | Weight (g) |
|-------------------|------------------------------|--|------------------------|---------------------------------|---|---------------------|------|------|------|---------|-----|------|---------|-----------------------------------|------------|
| | | | | | | D | H | A | B | I | W | P | K | L | |
| FCS0H473ZFTBR24 | 5.5 | 0.047 | 100 | 0.071 | 4.2 | 10.7 | 5.5 | 10.8 | 10.8 | 3.9±0.5 | 1.2 | 5.0 | 0.9±0.3 | 0 ^{+0.3} _{-0.1} | 1.0 |
| FCS0H104ZFTBR24 | 5.5 | 0.10 | 50 | 0.15 | 4.2 | 10.7 | 5.5 | 10.8 | 10.8 | 3.9±0.5 | 1.2 | 5.0 | 0.9±0.3 | 0 ^{+0.3} _{-0.1} | 1.0 |
| FC0H224ZFTBR24 | 5.5 | 0.22 | 25 | 0.33 | 4.2 | 10.5 | 8.5 | 10.8 | 10.8 | 3.6±0.5 | 1.2 | 5.0 | 0.7±0.3 | 0 ^{+0.3} _{-0.1} | 1.4 |
| FC0H474ZFTBR32-SS | 5.5 | 0.47 | 13 | 0.71 | 4.2 | 16.0 | 9.5 | 16.3 | 16.3 | 6.8±1.0 | 1.2 | 5.0 | 1.2±0.5 | 0 ^{+0.3} _{-0.1} | 4.0 |
| FC0H105ZFTBR44-SS | 5.5 | 1.0 | 7 | 1.50 | 4.2 | 21.0 | 10.5 | 21.6 | 21.6 | 7.0±1.0 | 1.4 | 10.0 | 1.2±0.5 | 0 ^{+0.3} _{-0.1} | 6.7 |
| FC0V104ZFTBR24 | 3.5 | 0.10 | 50 | 0.09 | — | 10.5 | 5.5 | 10.8 | 10.8 | 3.6±0.5 | 1.2 | 5.0 | 0.7±0.3 | 0 ^{+0.3} _{-0.1} | 1.0 |
| FC0V224ZFTBR24 | 3.5 | 0.22 | 25 | 0.20 | — | 10.5 | 5.5 | 10.8 | 10.8 | 3.6±0.5 | 1.2 | 5.0 | 0.7±0.3 | 0 ^{+0.3} _{-0.1} | 1.0 |
| FC0V474ZFTBR24 | 3.5 | 0.47 | 25 | 0.42 | — | 10.5 | 8.5 | 10.8 | 10.8 | 3.6±0.5 | 1.2 | 5.0 | 0.7±0.3 | 0 ^{+0.3} _{-0.1} | 1.4 |
| FCH0V683ZFTBR16 | 3.6 | 0.068 | 40 | 0.062 | — | 6.8 | 3.7 | 6.8 | 6.8 | 2.9±0.5 | 0.7 | 2.5 | 0.7±0.3 | 0 ^{+0.3} _{-0.1} | 0.3 |
| FCH0H433ZFTBR16 | 5.5 | 0.043 | 50 | 0.065 | — | 6.8 | 5.0 | 6.8 | 6.8 | 2.9±0.5 | 0.7 | 2.5 | 0.7±0.3 | 0 ^{+0.3} _{-0.1} | 0.4 |



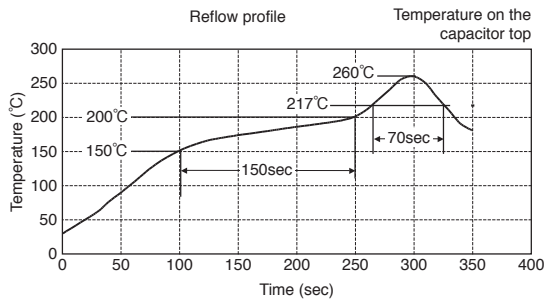
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Precautions for use

- This series is exclusively for reflow soldering. It is designed for thermal conduction system such as combination use of infrared ray and heat blow. Consult with NEC TOKIN before applying other methods.
- The reflow condition must be kept within reflow profile graphs shown below.
- Applying reflow soldering is limited to 2 times. After the first reflow, cool down the capacitor thoroughly to 5-35°C before the second reflow.

Always consult with NEC TOKIN when applying reflow soldering in a more severe condition than the condition described here.

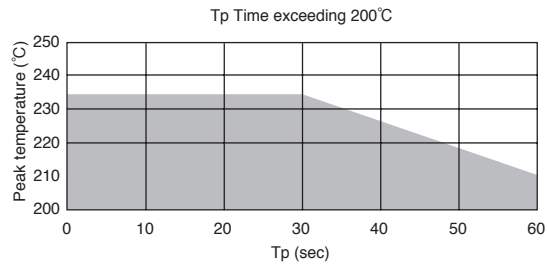
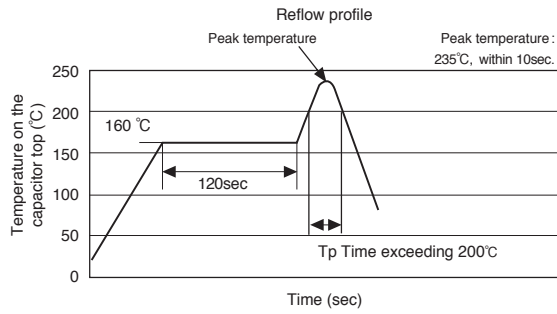
- FCS0H473ZFTBR24 and FCS0H104ZFTBR24



- Above "Reflow Profile" graph indicates temperature at the terminals and capacitor top.

| | |
|---|---------------|
| Peak temperature | Below 260 °C |
| Over 255 °C | Within 10sec. |
| Over 230 °C | Within 45sec. |
| Over 220 °C | Within 60sec. |
| Over 217 °C | Within 70sec. |
| Time between 150 °C to 200 °C (temperature zone over 170 °C =within 50sec.) | 150sec. |

- Other FC Series



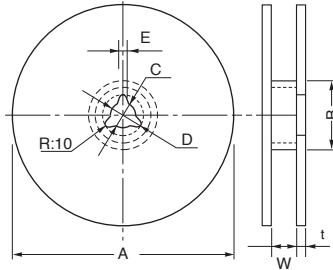
- Above "Reflow Profile" graph indicates temperature at the terminals and capacitor top.



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Tape and Reel Dimensions

[Reel Dimensions]

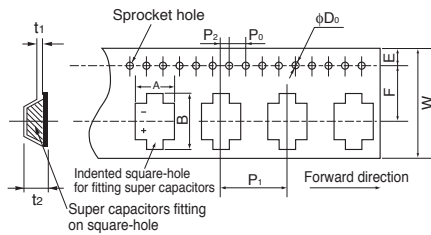


| Mark | TBR16 | TBR24 | | TBR32 | TBR44 |
|------|----------|----------------------|----------|----------|----------|
| A | 380±2 | 380±2 | | 330±2 | 380±2 |
| B | 80±1 | Product height 5.5mm | 80±1 | 100±1 | 100±1 |
| | | Product height 8.5mm | 100±1 | | |
| C | 13±0.5 | 13±0.5 | | 13±0.5 | 13±0.5 |
| D | 21±0.8 | 21±0.8 | | 21±0.8 | 21±0.8 |
| E | 2±0.5 | 2±0.5 | | 2±0.5 | 2±0.5 |
| W | 17.5±1.0 | Product height 5.5mm | 25.5±0.5 | 33.5±1.0 | 45.5±1.0 |
| | | Product height 8.5mm | 25.5±1.0 | | |
| t | 2.0 | 2.0 | | 2.0 | 2.0 |

Dimensions of indented [square-hole plastic tape]

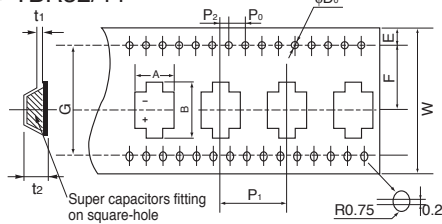
● TBR16/24

(mm)

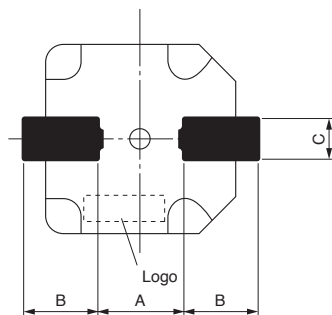


| Mark | TBR16 | TBR24 | TBR32 | TBR44 | |
|------|-------|----------------------|-------|-------|------|
| W | 16.0 | 24.0 | 32.0 | 44.0 | |
| A | 7.2 | 11.4 | 18.0 | 23.0 | |
| B | 9.0 | 13.0 | 20.0 | 25.0 | |
| P0 | 4.0 | 4.0 | 4.0 | 4.0 | |
| P1 | 12.0 | 16.0 | 24.0 | 32.0 | |
| P2 | 2.0 | 2.0 | 2.0 | 2.0 | |
| F | 7.5 | 11.5 | 14.2 | 20.2 | |
| φD0 | 1.55 | 1.55 | 1.55 | 1.55 | |
| t1 | 0.4 | 0.4 | 0.5 | 0.5 | |
| E | 1.75 | 1.75 | 1.75 | 1.75 | |
| t2 | 5.0 | Product height 5.5mm | 6.0 | 10.0 | 12.0 |
| | | Product height 8.5mm | 8.4 | | |
| G | - | - | 28.4 | 40.4 | |

● TBR32/44



Recommended land pattern



Land pattern

(mm)

| Part Number | A | B | C |
|-----------------|------|------|-----|
| FCSOH473ZFTBR24 | 5.0 | 4.9 | 2.5 |
| FCSOH104ZFTBR24 | 5.0 | 4.9 | 2.5 |
| FCOH224ZFTBR24 | 5.0 | 4.6 | 2.5 |
| FCOH474ZFTBR32 | 5.0 | 10.0 | 2.5 |
| FCOH105ZFTBR44 | 10.0 | 10.5 | 3.5 |
| FCOVH104ZFTBR24 | 5.0 | 4.6 | 2.5 |
| FCOV224ZFTBR24 | 5.0 | 4.6 | 2.5 |
| FCOV474ZFTBR24 | 5.0 | 4.6 | 2.5 |
| FCHOV683ZFTBR16 | 2.5 | 4.0 | 1.4 |
| FCHOH433ZFTBR16 | 2.5 | 4.0 | 1.4 |

Lead terminal

(mm)

| Part Number | A | B | C |
|-----------------|------|-----|-----|
| FCSOH473ZFTBR24 | 5.0 | 3.9 | 1.2 |
| FCSOH104ZFTBR24 | 5.0 | 3.9 | 1.2 |
| FCOH224ZFTBR24 | 5.0 | 3.6 | 1.2 |
| FCOH474ZFTBR32 | 5.0 | 6.8 | 1.2 |
| FCOH105ZFTBR44 | 10.0 | 7.0 | 1.4 |
| FCOV104ZFTBR24 | 5.0 | 3.6 | 1.2 |
| FCOV224ZFTBR24 | 5.0 | 3.6 | 1.2 |
| FCOV474ZFTBR24 | 5.0 | 3.6 | 1.2 |
| FCHOV683ZFTBR16 | 2.5 | 2.9 | 0.7 |
| FCHOH433ZFTBR16 | 2.5 | 2.9 | 0.7 |



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Specifications

| Item | | Series name | | FC | | Test conditions (conforming to JIS C 5101-1) |
|--|----------------------------|---------------------------------------|--|--|---|--|
| | | | | 5.5V type, 3.5V type | | |
| Category temperature range | | | | -25 °C to +70 °C | | |
| MAX operating voltage | | | | 5.5Vdc, 3.5Vdc | | |
| Capacitance | | | | Refer to standard ratings | | Refer to "Measurement Conditions" |
| Capacitance allowance | | | | +80 %, -20 % | | Refer to "Measurement Conditions" |
| ESR | | | | Refer to standard ratings | | Measured at 1kHz, 10mA ; See also "Measurement Conditions" |
| Current (30-minutes value) | | | | Refer to standard ratings | | Refer to "Measurement Conditions" |
| * Surge | Capacitance | | | More than 90% of initial ratings | | Conforms to 4.26 Surge voltage : 4.0V (3.5V type) : 6.3V (5.5V type) Charge : 30 sec. Discharge : 9min 30sec. Number of cycles : 1000 Series resistance : 0.043F, 0.047F 300 Ω : 0.068F 240 Ω : 0.10F 150 Ω : 0.22F 56 Ω : 0.47F 30 Ω : 1.0F 15 Ω Discharge resistance : 0 Ω Temperature : 70±2 °C |
| | ESR | | | Not to exceed 120% of initial ratings | | |
| | Current (30 minutes value) | | | Not to exceed 120% of initial ratings | | |
| | Appearance | | | No obvious abnormality | | |
| * Characteristics in different temperature | Capacitance | Phase 2 | 50% higher than initial value | | Conforms to 4.29 Phase1 : +25±2 °C Phase2 : -25±2 °C Phase4 : +25±2 °C Phase5 : +70±2 °C Phase6 : +25±2 °C | |
| | ESR | | 400% or less than initial value | | | |
| | Capacitance | Phase 3 | | | | |
| | ESR | | | | | |
| | Capacitance | Phase 5 | 200% or less than initial value | | | |
| | ESR | | Satisfy initial ratings | | | |
| | Current (30 minutes value) | | | 1.5CV (mA) or below | | |
| | Capacitance | Phase 6 | Within ±20% of initial value | | | |
| ESR | Satisfy initial ratings | | | | | |
| Current (30 minutes value) | Satisfy initial ratings | | | | | |
| * Vibration resistance | Capacitance | | | Conforms to 4.17 Frequency : 10 to 55 Hz Testing time : 6 hours | | |
| | ESR | Satisfy initial ratings | | | | |
| | Current (30 minutes value) | Satisfy initial ratings | | | | |
| | Appearance | No obvious abnormality | | | | |
| * Solder heat resistance | Capacitance | | | Cooled down to ambient temperature after reflow soldering, then the product must fulfill the condition stated left. (See page 10 for reflow condition) | | |
| | ESR | Satisfy initial ratings | | | | |
| | Current (30 minutes value) | Satisfy initial ratings | | | | |
| | Appearance | No obvious abnormality | | | | |
| * Temperature cycle | Capacitance | | | Conforms to 4.16 Temperature condition : -25 °C →Room temperature→ +70 °C →Room temperature Number of cycles : 5 Cycles | | |
| | ESR | Satisfy initial ratings | | | | |
| | Current (30 minutes value) | Satisfy initial ratings | | | | |
| | Appearance | No obvious abnormality | | | | |
| * High temp. and high humidity resistance | Capacitance | Within ±20% of initial value | | Conforms to 4.22 Temperature : 40±2 °C Relative humidity : 90 to 95 %RH Testing time : 240±8 hours | | |
| | ESR | Not to exceed 120% of initial ratings | | | | |
| | Current (30 minutes value) | Not to exceed 120% of initial ratings | | | | |
| | Appearance | No obvious abnormality | | | | |
| * High temperature load | Capacitance | Within ±30% of initial value | | Conforms to 4.23 Voltage applied : MAX operating voltage Series protection resistance : 0 Ω Testing time : 1000 ^{***} Hours | | |
| | ESR | Below 200% of initial ratings | | | | |
| | Current (30 minutes value) | Below 200% of initial ratings | | | | |
| | Appearance | No obvious abnormality | | | | |
| * Self discharge characteristics (voltage holding characteristics) | | | 5.5V type: Voltage between terminal leads higher than 4.2V | | Charging condition Voltage applied : 5.0Vdc (Terminal at the case's side be negative) Series resistance : 0 Ω Charging time : 24 hours | |
| | | | 3.5V type: Not specified | | Storage Let stand for 24 hours in condition described below with terminals opened. Ambient temperature : Lower than 25 °C Relative humidity : Lower than 70%RH | |

As for items with "***" , it must fulfill the above condition after the reflow soldering. (See page 10 for reflow conditions)

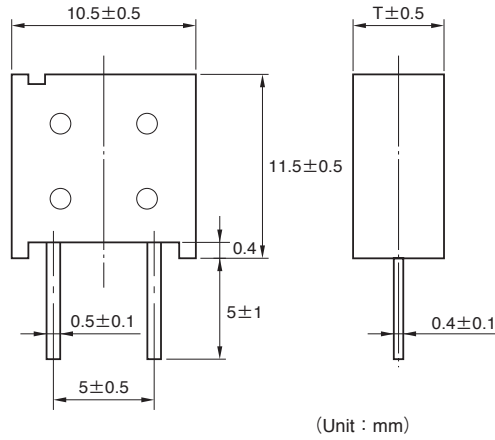
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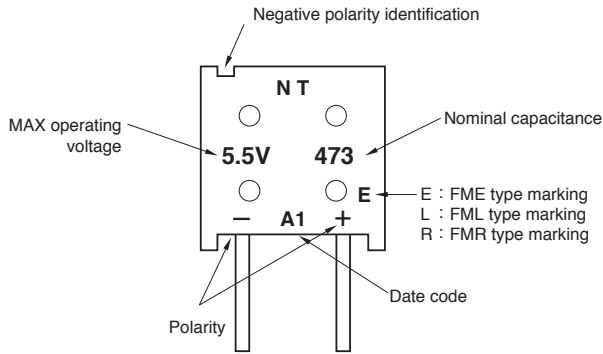
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6.2 FM Series

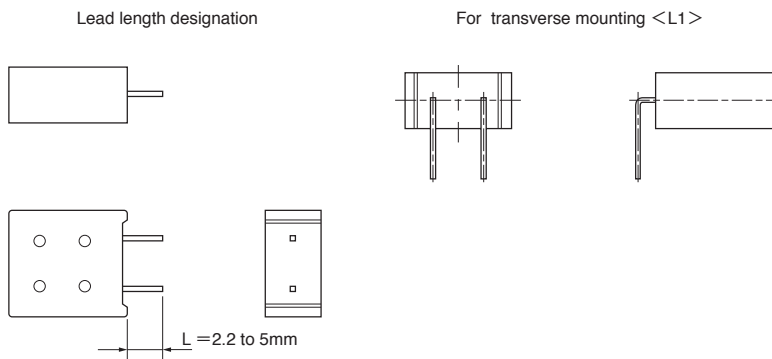
Dimensions



Markings



Lead terminal forming example



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Specifications

● 5.5V Type

| Part Number | | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | T (mm) | Weight (g) |
|-------------|-----------------|-----------------------------|---------------------|---------------------|------------------------|-----------------------------|-------------------------------------|--------|------------|
| Bulk | Ammo pack | | Charge system(F) | Discharge system(F) | | | | | |
| FM0H103ZF | FM0H103ZFTP () | 5.5 | 0.01 | 0.014 | 300 | 0.015 | 4.2 | 5.0 | 1.3 |
| FM0H223ZF | FM0H223ZFTP () | 5.5 | 0.022 | 0.028 | 200 | 0.033 | 4.2 | 5.0 | 1.3 |
| FM0H473ZF | FM0H473ZFTP () | 5.5 | 0.047 | 0.06 | 200 | 0.071 | 4.2 | 5.0 | 1.3 |
| FM0H104ZF | FM0H104ZFTP () | 5.5 | 0.10 | 0.13 | 100 | 0.15 | 4.2 | 6.5 | 1.6 |
| FM0H224ZF | FM0H224ZFTP () | 5.5 | — | 0.22 | 100 | 0.33 | 4.2 | 6.5 | 1.6 |

To complete the part number, insert lead length (16mm or 18mm) in to the "()"

● 3.5V Type

| Part Number | | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | T (mm) | Weight (g) |
|-------------|-----------------|-----------------------------|---------------------|---------------------|------------------------|-----------------------------|--------|------------|
| Bulk | Ammo pack | | Charge system(F) | Discharge system(F) | | | | |
| FM0V473ZF | FM0V473ZFTP () | 3.5 | 0.047 | 0.06 | 200 | 0.042 | 5.0 | 1.3 |
| FM0V104ZF | FM0V104ZFTP () | 3.5 | 0.10 | 0.13 | 100 | 0.090 | 5.0 | 1.3 |
| FM0V224ZF | FM0V224ZFTP () | 3.5 | 0.22 | 0.30 | 100 | 0.20 | 6.5 | 1.6 |

To complete the part number, insert lead length (16mm or 18mm) in to the "()"

● 6.5V Type

| Part Number | | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | T (mm) | Weight (g) |
|-------------|-----------------|-----------------------------|---------------------|---------------------|------------------------|-----------------------------|--------|------------|
| Bulk | Ammo pack | | Charge system(F) | Discharge system(F) | | | | |
| FM0J473ZF | FM0J473ZFTP () | 6.5 | 0.047 | 0.062 | 200 | 0.071 | 6.5 | 1.6 |

To complete the part number, insert lead length (16mm or 18mm) in to the "()"

● FME, FML Type (Buckup Large Current, mA Order)

| Part Number | | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | T (mm) | Weight (g) |
|-------------|------------------|-----------------------------|---------------------|---------------------|------------------------|-----------------------------|--------|------------|
| Bulk | Ammo pack | | Charge system(F) | Discharge system(F) | | | | |
| FME0H223ZF | FME0H223ZFTP () | 5.5 | 0.022 | 0.028 | 40 | 0.033 | 5.0 | 1.3 |
| FME0H473ZF | FME0H473ZFTP () | 5.5 | 0.047 | 0.06 | 20 | 0.071 | 5.0 | 1.3 |
| FML0H333ZF | FML0H333ZFTP () | 5.5 | 0.033 | | 6.5 | 0.050 | 5.0 | 1.3 |

To complete the part number, insert lead length (16mm or 18mm) in to the "()"

● FMR Type (MAX Operating Temperature 85°C Type)

| Part Number | | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | T (mm) | Weight (g) |
|-------------|------------------|-----------------------------|---------------------|---------------------|------------------------|-----------------------------|-------------------------------------|--------|------------|
| Bulk | Ammo pack | | Charge system(F) | Discharge system(F) | | | | | |
| FMR0H473ZF | FMR0H473ZFTP () | 5.5 | 0.047 | 0.062 | 200 | 0.071 | 4.2 | 6.5 | 1.6 |
| FMR0H104ZF | FMR0H104ZFTP () | 5.5 | 0.10 | | 50 | 0.15 | 4.2 | 6.5 | 1.6 |
| FMR0V104ZF | FMR0V104ZFTP () | 3.5 | 0.10 | | 50 | 0.090 | — | 6.5 | 1.6 |

To complete the part number, insert lead length (16mm or 18mm) in to the "()"

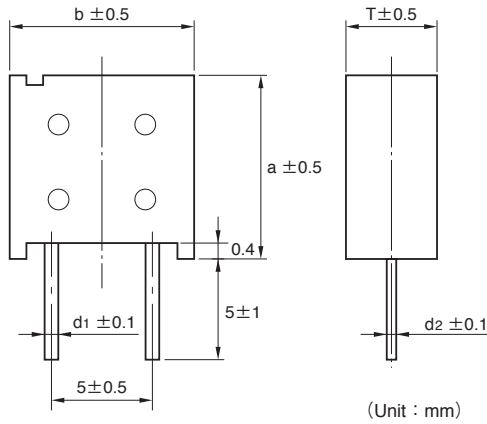


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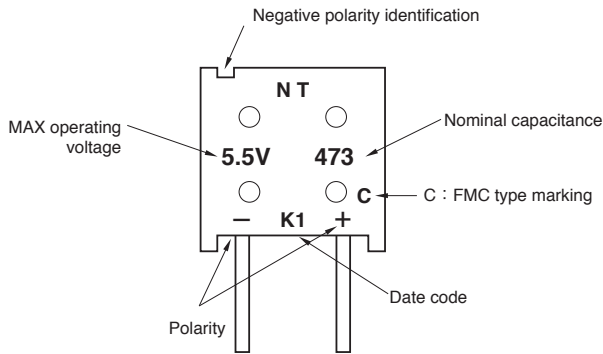
● FMC Type

Chip parts applicable to treatment in bond hardening furnace ($160 \pm 5^\circ\text{C}$ for 120 ± 10 seconds)

Dimensions



Markings



Specifications

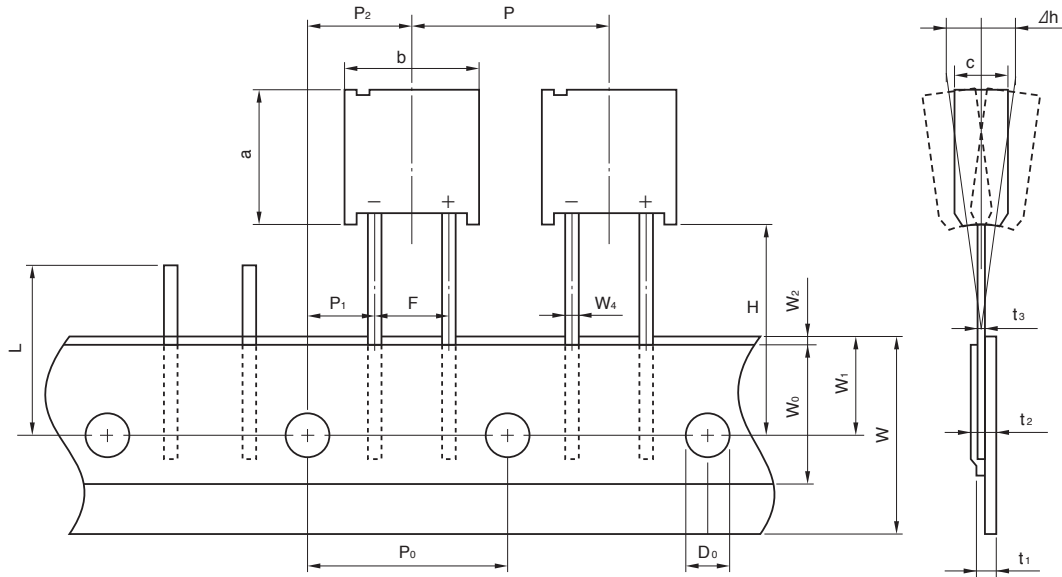
| Part Number | | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | a (mm) | b (mm) | T (mm) | d ₁ (mm) | d ₂ (mm) | Weight (g) |
|-------------|------------------|-----------------------------|---------------------|---------------------|---------------------------------|-----------------------------|-------------------------------------|--------|--------|--------|---------------------|---------------------|------------|
| Bulk | Ammo pack | | Charge system(F) | Discharge system(F) | | | | | | | | | |
| FMC0H473ZF | FMC0H473ZFTP () | 5.5 | 0.047 | 0.06 | 100 | 0.071 | 4.2 | 11.5 | 10.5 | 5.0 | 0.5 | 0.4 | 1.3 |
| FMC0H104ZF | FMC0H104ZFTP () | 5.5 | 0.10 | 0.13 | 50 | 0.15 | 4.2 | 11.5 | 10.5 | 6.5 | 0.5 | 0.4 | 1.6 |
| FMC0H334ZF | FMC0H334ZFTP () | 5.5 | - | 0.33 | 25 | 0.50 | 4.2 | 15.0 | 14.0 | 9.0 | 0.6 | 0.6 | 3.5 |

To complete the part number, insert lead length (16mm or 18mm) in to the "()"



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Taping Specification [except FMC0H334ZFTP()]



(Unit : mm)

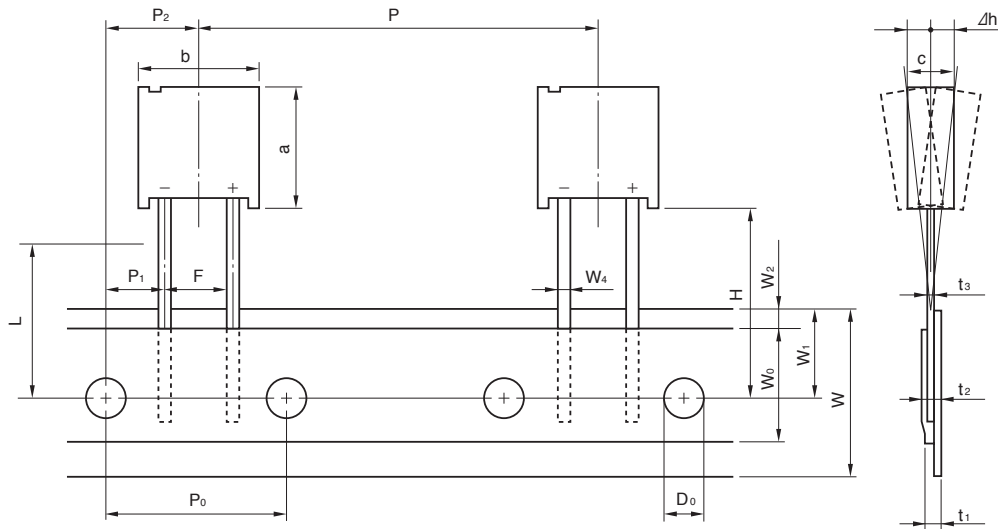
| Item | Symbol | Value | Tolerance | Remarks |
|-----------------------------------|------------|------------|--------------|---|
| Component Height | a | 11.5 | ± 0.5 | |
| Component Width | b | 10.5 | ± 0.5 | |
| Component Thickness | c | — | ± 0.5 | 5.5 V type : 5.0/0.010F to 0.047F, 6.5/0.047F 3.5 V type : 5.0/0.047F to 0.10F, 6.5/0.22F FME type : 5.0/0.022F to 0.047F FML type : 5.0/0.033F 6.5 V type : 6.5/0.047F, 0.10F FMR type : 6.5/0.047F FMC type : 5.0/0.047F, 6.5/0.10F |
| Lead-wire Width | W_4 | 0.5 | ± 0.1 | |
| Lead-wire Thickness | t_3 | 0.4 | ± 0.1 | |
| Pitch between Component | P | 12.7 | ± 1.0 | |
| Sprocket Hole Pitch | P_0 | 12.7 | ± 0.3 | |
| Sprocket Hole to Lead | P_1 | 3.85 | ± 0.7 | |
| ∕ | P_2 | 6.35 | ± 1.3 | |
| Lead Spacing | F | 5.0 | ± 0.5 | |
| Component Alignment | Δh | 2.0 Max. | — | Including tilting caused by bending lead wire. |
| Tape Width | W | 18.0 | +1.0 -0.5 | |
| Hold-down tape Width | W_0 | 12.5 Min. | — | |
| Sprocket Hole Position | W_1 | 9.0 | ± 0.5 | |
| Hold-down Tape Position | W_2 | 3.0 Max. | — | No protrusion of tape. |
| Component's Bottom Line Position | H | 16.0 | ± 0.5 | |
| ∕ | | 18.0 | ± 0.5 | |
| Sprocket Hole Diameter | D_0 | $\phi 4.0$ | ± 0.2 | |
| Total tape Thickness | t_1 | 0.7 | ± 0.2 | |
| ∕ | t_2 | 1.5 Max. | — | |
| Defect Component Cut-off Position | L | 11.0 Max. | — | |

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Taping Specification [except FMC0H334ZFTP ()]



(Unit : mm)

| Item | Symbol | Value | Tolerance | Remarks |
|-----------------------------------|----------------|-----------|--------------|---|
| Component Height | a | 15.0 | ±0.5 | |
| Component Width | b | 14.0 | ±0.5 | |
| Component Thickness | c | 9.0 | ±0.5 | |
| Lead-wire Width | W ₄ | 0.6 | ±0.1 | |
| Lead-wire Thickness | t ₃ | 0.6 | ±0.1 | |
| Pitch between Component | P | 25.4 | ±1.0 | |
| Sprocket Hole Pitch | P ₀ | 12.7 | ±0.3 | |
| Sprocket Hole to Lead | P ₁ | 3.85 | ±0.7 | |
| Lead Spacing | F | 5.0 | ±0.5 | |
| Component Alignment | Δh | 2.0 Max. | — | Including tilting caused by bending lead wire |
| Tape Width | W | 18.0 | +1.0 -0.5 | |
| Hold-down tape Width | W ₀ | 12.5 Min. | — | |
| Sprocket Hole Position | W ₁ | 9.0 | ±0.5 | |
| Hold-down Tape Position | W ₂ | 3.0 Max. | — | No protrusion of tape |
| Component's Bottom Line Position | H | 16.0 | ±0.5 | |
| | | 18.0 | ±0.5 | |
| Sprocket Hole Diameter | D ₀ | φ4.0 | ±0.2 | |
| Total tape Thickness | t ₁ | 0.67 | ±0.2 | |
| | t ₂ | 1.7 Max. | — | |
| Defect Component Cut-off Position | L | 11.0 Max. | — | |



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Specifications

| Series name | | 5.5V type, 3.5V type, 6.5V type FMC, FML type | FME type | Test conditions (conforming to JIS C 5101-1) |
|--|----------------------------|--|--|---|
| Category temperature range | | -25 °C to +70 °C | -25 °C to +70 °C | |
| MAX operating voltage | | 5.5Vdc, 3.5Vdc, 6.5Vdc | 5.5Vdc | |
| Capacitance | | 5.5V : 0.010F to 0.33F 3.5V : 0.047F to 0.22F 6.5V : 0.047 | 0.22F, 0.047F | Refer to "Measurement Conditions" |
| Capacitance allowance | | +80 %, -20 % | +80 %, -20 % | Refer to "Measurement Conditions" |
| ESR | | Refer to standard ratings | Refer to standard ratings | Measured at 1kHz, 10mA ; See also "Measurement Conditions" |
| Current (30-minutes value) | | Refer to standard ratings | Refer to standard ratings | Refer to "Measurement Conditions" |
| Surge | Capacitance | More than 90% of initial ratings | More than 90% of initial ratings | Conforms to 4.26 Surge voltage : 4.0V (3.5V type) : 6.3V (5.5V type) : 7.4V (6.5V type) Charge : 30 sec. Discharge : 9min 30sec. Number of cycles : 1000 Series resistance : 0.010F 1500 Ω : 0.022F 560 Ω : 0.043F, 0.047F 300 Ω : 0.068F 240 Ω : 0.10F 150 Ω : 0.22F 56 Ω : 0.33F 51 Ω Discharge resistance : 0 Ω Temperature : 70 ± 2 °C |
| | ESR | Not to exceed 120% of initial ratings | Not to exceed 120% of initial ratings | |
| | Current (30 minutes value) | Not to exceed 120% of initial ratings | Not to exceed 120% of initial ratings | |
| | Appearance | No obvious abnormality | No obvious abnormality | |
| Characteristics in different temperature | Capacitance | Phase 2 50% or higher than initial value | Phase 2 50% or higher than initial value | Conforms to 4.29 Phase1 : +25 ± 2 °C Phase2 : -25 ± 2 °C Phase4 : +25 ± 2 °C Phase5 : +70 ± 2 °C Phase6 : +25 ± 2 °C |
| | ESR | 400% or less than initial value | 400% or less than initial value | |
| | Capacitance | Phase 3 | Phase 3 | |
| | ESR | | | |
| | Capacitance | Phase 5 200% or less than initial value | Phase 5 200% or less than initial value | |
| | ESR | Satisfy initial ratings | Satisfy initial ratings | |
| | Current (30 minutes value) | 1.5CV (mA) or below | 1.5CV (mA) or below | |
| | Capacitance | Within ±20% of initial value | Within ±20% of initial value | |
| Lead strength (tensile) | ESR | Satisfy initial ratings | Satisfy initial ratings | Conforms to 4.13.1 |
| | Current (30 minutes value) | Satisfy initial ratings | Satisfy initial ratings | |
| Vibration resistance | ESR | Satisfy initial ratings | Satisfy initial ratings | Conforms to 4.17 Frequency : 10 to 55 Hz Testing time : 6 hours |
| | Current (30 minutes value) | Satisfy initial ratings | Satisfy initial ratings | |
| Appearance | | No obvious abnormality | No obvious abnormality | |
| Solderability | | Over 3/4 of the terminal should be covered by the new solder | Over 3/4 of the terminal should be covered by the new solder | Conforms to 4.15 Solder temp : 245 ± 5 °C Dipping time : 5 ± 0.5 sec. 1.6mm from the bottom should be dipped. |
| Solder heat resistance | Capacitance | Satisfy initial ratings | Satisfy initial ratings | Conforms to 4.14 Solder temp : 260 ± 10 °C Dipping time : 10 ± 1 sec. 1.6mm from the bottom should be dipped. |
| | ESR | | | |
| | Current (30 minutes value) | | | |
| | Appearance | | | |
| Temperature cycle | Capacitance | Satisfy initial ratings | Satisfy initial ratings | Conforms to 4.16 Temperature condition : -25 °C → Room temperature → +70 °C → Room temperature Number of cycles : 5 Cycles |
| | ESR | | | |
| | Current (30 minutes value) | | | |
| | Appearance | | | |
| High temp. and high humidity resistance | Capacitance | Within ±20% of initial value | Within ±20% of initial value | Conforms to 4.22 Temperature : 40 ± 2 °C Relative humidity : 90 to 95 % RH Testing time : 240 ± 8 hours |
| | ESR | Not to exceed 120% of initial ratings | Not to exceed 120% of initial ratings | |
| | Current (30 minutes value) | Not to exceed 120% of initial ratings | Not to exceed 120% of initial ratings | |
| | Appearance | No obvious abnormality | No obvious abnormality | |
| High temperature load | Capacitance | Within ±30% of initial value | Within ±30% of initial value | Conforms to 4.23 Temperature : 70 ± 2 °C Voltage applied : MAX operating voltage Series protection resistance : 0 Ω Testing time : 1000 ^h Hours |
| | ESR | Below 200% of initial ratings | Below 200% of initial ratings | |
| | Current (30 minutes value) | Below 200% of initial ratings | Below 200% of initial ratings | |
| | Appearance | No obvious abnormality | No obvious abnormality | |
| Self discharge characteristics (voltage holding characteristics) | | 5.5V type: Voltage between terminal leads higher than 4.2V 3.5V type: Not specified 6.5V type: Not specified | | Charging condition : Voltage applied : 5.0Vdc (Terminal at the case's side be negative) Series resistance : 0 Ω Charging time : 24 hours Storage : Let stand for 24 hours in condition described below with terminals opened. Ambient temperature : Lower than 25 °C Relative humidity : Lower than 70%RH |

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Specifications

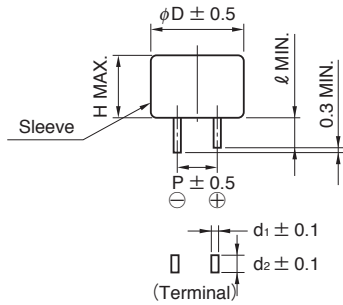
| Series name | | FMR type | | Test conditions (conforming to JIS C 5101-1) |
|--|--|--|----------------------------------|--|
| Item | | | | |
| Category temperature range | | -40 °C to +85 °C | | |
| MAX operating voltage | | 5.5Vdc, 3.5Vdc | | |
| Capacitance | | 0.047F, 0.10F | | Refer to "Measurement Conditions" |
| Capacitance allowance | | +80 %, -20 % | | Refer to "Measurement Conditions" |
| ESR | | Refer to standard ratings | | Measured at 1kHz, 10mA ; See also "Measurement Conditions" |
| Current (30-minutes value) | | Refer to standard ratings | | Refer to "Measurement Conditions" |
| Surge | Capacitance | More than 90% of initial ratings | | Conforms to 4.26 Surge voltage : 6.3V Charge : 30 sec. Discharge : 9min 30sec. Number of cycles : 1000 Series resistance : 300Ω Discharge resistance : 0Ω Temperature : 85±2 °C |
| | ESR | Not to exceed 120% of initial ratings | | |
| | Current (30 minutes value) | Not to exceed 120% of initial ratings | | |
| | Appearance | No obvious abnormality | | |
| Characteristics in different temperature | Capacitance | Phase 2 | 50% or higher than initial value | Conforms to 4.29 Phase1 : +25±2 °C Phase2 : -25±2 °C Phase3 : -40±2 °C Phase4 : +25±2 °C Phase5 : +70±2 °C Phase6 : +25±2 °C |
| | ESR | | 400% or less than initial value | |
| | Capacitance | Phase 3 | 30% or higher than initial value | |
| | ESR | | Below 700% of the initial value | |
| | Capacitance | Phase 5 | 200% or less than initial value | |
| | ESR | | Satisfy initial ratings | |
| | Current (30 minutes value) | | 1.5CV (mA) or below | |
| | Capacitance | Phase 6 | Within ±20% of initial value | |
| ESR | Satisfy initial ratings | | | |
| Current (30 minutes value) | | Satisfy initial ratings | | |
| Lead strength (tensile) | | No terminal damage | | Conforms to 4.13.1 |
| Vibration resistance | Capacitance | Satisfy initial ratings | | Conforms to 4.17 Frequency : 10 to 55 Hz Testing time : 6 hours |
| | ESR | | | |
| | Current (30 minutes value) | | | |
| | Appearance | No obvious abnormality | | |
| Solderability | | Over 3/4 of the terminal should be covered by the new solder | | Conforms to 4.15 Solder temp : 245±5 °C Dipping time : 5±0.5 sec. 1.6mm from the bottom should be dipped. |
| Solder heat resistance | Capacitance | Satisfy initial ratings | | Conforms to 4.14 Solder temp : 260±10 °C Dipping time : 10±1 sec. 1.6mm from the bottom should be dipped. |
| | ESR | | | |
| | Current (30 minutes value) | | | |
| | Appearance | No obvious abnormality | | |
| Temperature cycle | Capacitance | Satisfy initial ratings | | Conforms to 4.16 Temperature condition : -40 °C →Room temperature→ +85 °C →Room temperature Number of cycles : 5 Cycles |
| | ESR | | | |
| | Current (30 minutes value) | | | |
| | Appearance | No obvious abnormality | | |
| High temp. and high humidity resistance | Capacitance | Within ±20% of initial value | | Conforms to 4.22 Temperature : 40±2 °C Relative humidity : 90 to 95 %RH Testing time : 240±8 hours |
| | ESR | Not to exceed 120% of initial ratings | | |
| | Current (30 minutes value) | Not to exceed 120% of initial ratings | | |
| | Appearance | No obvious abnormality | | |
| High temperature load | Capacitance | Within ±30% of initial value | | Conforms to 4.23 Temperature : 85±2 °C Voltage applied : MAX operating voltage Series protection resistance : 0 Ω Testing time : 1000*#Hours |
| | ESR | Below 200% of initial ratings | | |
| | Current (30 minutes value) | Below 200% of initial ratings | | |
| | Appearance | No obvious abnormality | | |
| Self discharge characteristics (voltage holding characteristics) | 5.5V type: Voltage between terminal leads higher than 4.2V 3.5V type: Not specified | | Charging condition | Voltage applied : 5.0Vdc (Terminal at the case's side be negative) Series resistance : 0 Ω Charging time : 24 hours |
| | | | Storage | Let stand for 24 hours in condition described below with terminals opened. Ambient temperature : Lower than 25 °C Relative humidity : Lower than 70%RH |



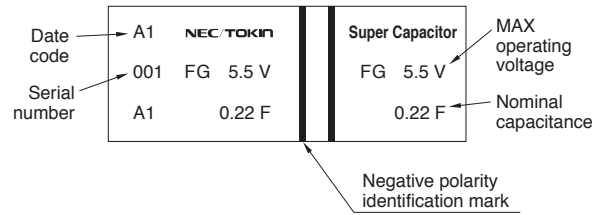
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6.3 FG Series

Dimensions



Markings on sleeve



● FG Type

Specifications

| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|---------------------------------|-----------------------------|-------------------------------------|---------------------|------|-------|-----|-------|-------|------------|
| | | Charge system (F) | Discharge system (F) | | | | ϕD | H | P | l | d_1 | d_2 | |
| FG0H103ZF | 5.5 | 0.010 | 0.013 | 300 | 0.015 | 4.2 | 11.0 | 5.5 | 5.08 | 2.7 | 0.2 | 1.2 | 0.9 |
| FG0H223ZF | 5.5 | 0.022 | 0.028 | 200 | 0.033 | 4.2 | 11.0 | 5.5 | 5.08 | 2.7 | 0.2 | 1.2 | 1.0 |
| FG0H473ZF | 5.5 | 0.047 | 0.060 | 200 | 0.071 | 4.2 | 11.0 | 5.5 | 5.08 | 2.7 | 0.2 | 1.2 | 1.0 |
| FG0H104ZF | 5.5 | 0.10 | 0.13 | 100 | 0.15 | 4.2 | 11.0 | 6.5 | 5.08 | 2.7 | 0.2 | 1.2 | 1.3 |
| FG0H224ZF | 5.5 | 0.22 | 0.28 | 100 | 0.33 | 4.2 | 13.0 | 9.0 | 5.08 | 2.2 | 0.4 | 1.2 | 2.5 |
| FG0H474ZF | 5.5 | 0.47 | 0.60 | 120 | 0.71 | 4.2 | 14.5 | 18.0 | 5.08 | 2.4 | 0.4 | 1.2 | 5.1 |
| FG0H105ZF | 5.5 | 1.0 | 1.3 | 65 | 1.5 | 4.2 | 16.5 | 19.0 | 5.08 | 2.7 | 0.4 | 1.2 | 7.0 |
| FG0H225ZF | 5.5 | 2.2 | 2.8 | 35 | 3.3 | 4.2 | 21.5 | 19.0 | 7.62 | 3.0 | 0.6 | 1.2 | 12.1 |
| FG0H475ZF | 5.5 | 4.7 | 6.0 | 35 | 7.1 | 4.2 | 28.5 | 22.0 | 10.16 | 6.1 | 0.6 | 1.4 | 27.3 |
| FG0V155ZF | 3.5 | 1.5 | 2.2 | 65 | 1.5 | — | 16.5 | 14.0 | 5.08 | 3.1 | 0.4 | 1.2 | 5.2 |

● FGH Type

Specifications

| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|---------------------------------|-----------------------------|-------------------------------------|---------------------|-----|------|-----|-------|-------|------------|
| | | Charge system (F) | Discharge system (F) | | | | ϕD | H | P | l | d_1 | d_2 | |
| FGH0H104ZF | 5.5 | — | 0.10 | 100 | 0.15 | 4.2 | 11.0 | 5.5 | 5.08 | 2.7 | 0.2 | 1.2 | 1.0 |
| FGH0H224ZF | 5.5 | — | 0.22 | 100 | 0.33 | 4.2 | 11.0 | 7.0 | 5.08 | 2.7 | 0.2 | 1.2 | 1.3 |
| FGH0H474ZF | 5.5 | — | 0.47 | 65 | 0.71 | 4.2 | 16.5 | 8.0 | 5.08 | 2.7 | 0.4 | 1.2 | 4.1 |
| FGH0V105ZF | 5.5 | — | 1.0 | 35 | 1.5 | 4.2 | 21.5 | 9.5 | 7.62 | 3.0 | 0.6 | 1.2 | 7.2 |

● FGR Type

Specifications

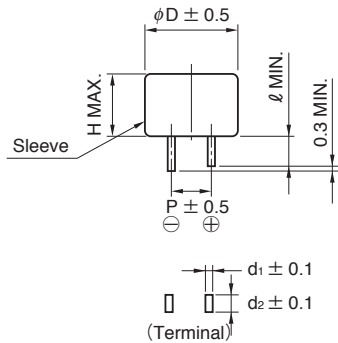
| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|---------------------------------|-----------------------------|-------------------------------------|---------------------|------|------|-----|-------|-------|------------|
| | | Charge system (F) | Discharge system (F) | | | | ϕD | H | P | l | d_1 | d_2 | |
| FGR0H474ZF | 5.5 | 0.47 | 0.60 | 120 | 0.71 | 4.2 | 14.5 | 18.0 | 5.08 | 2.4 | 0.4 | 1.2 | 5.1 |
| FGR0H105ZF | 5.5 | 1.0 | 1.3 | 65 | 1.5 | 4.2 | 16.5 | 19.0 | 5.08 | 2.7 | 0.4 | 1.2 | 7.0 |
| FGR0H225ZF | 5.5 | 2.2 | 2.8 | 35 | 3.3 | 4.2 | 21.5 | 19.0 | 7.62 | 3.0 | 0.6 | 1.2 | 12.1 |



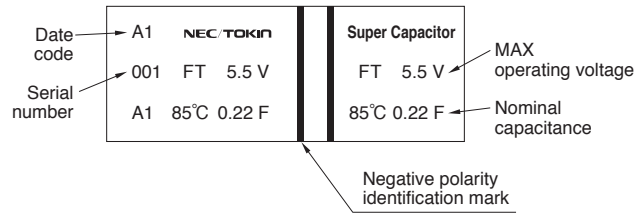
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6.4 FT Series

Dimensions



Markings on sleeve



Specifications

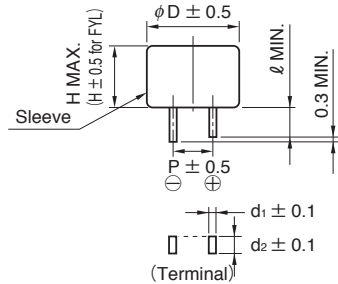
| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|---------------------------------|-----------------------------|---------------------|------|-------|-------|-------|-----|------------|
| | | Charge system (F) | Discharge system (F) | | | ϕD | H | P | d_1 | d_2 | l | |
| FT0H104ZF | 5.5 | 0.10 | 0.14 | 16 | 0.15 | 11.5 | 8.5 | 5.08 | 0.4 | 1.2 | 2.7 | 1.6 |
| FT0H224ZF | 5.5 | 0.22 | 0.28 | 10 | 0.33 | 14.5 | 12.0 | 5.08 | 0.4 | 1.2 | 2.2 | 4.1 |
| FT0H474ZF | 5.5 | 0.47 | 0.60 | 6.5 | 0.71 | 16.5 | 13.0 | 5.08 | 0.4 | 1.2 | 2.7 | 5.3 |
| FT0H105ZF | 5.5 | 1.0 | 1.3 | 3.5 | 1.5 | 21.5 | 13.0 | 7.62 | 0.6 | 1.2 | 3.0 | 10.0 |
| FT0H225ZF | 5.5 | 2.2 | 2.8 | 1.8 | 3.3 | 28.5 | 14.0 | 10.16 | 0.6 | 1.4 | 6.1 | 18.0 |
| FT0H335ZF | 5.5 | 3.3 | 4.2 | 1.0 | 5.0 | 36.5 | 15.0 | 15.00 | 0.6 | 1.7 | 6.1 | 38.0 |
| FT0H565ZF | 5.5 | 5.6 | 7.2 | 0.6 | 8.4 | 44.5 | 17.0 | 20.00 | 1.0 | 1.4 | 6.1 | 72.0 |



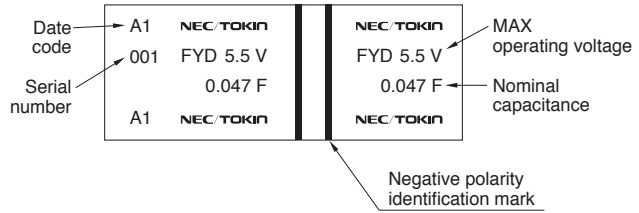
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6.5 FY Series

Dimensions



Markings on sleeve



●FYD Type

Specifications

| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|------------------------|-----------------------------|-------------------------------------|---------------------|------|-------|-----|----------------|----------------|------------|
| | | Charge system (F) | Discharge system (F) | | | | φD | H | P | ℓ | d ₁ | d ₂ | |
| FYD0H223ZF | 5.5 | 0.022 | 0.033 | 220 | 0.033 | 4.2 | 11.5 | 8.5 | 5.08 | 2.7 | 0.4 | 1.2 | 1.6 |
| FYD0H473ZF | 5.5 | 0.047 | 0.070 | 220 | 0.071 | 4.2 | 11.5 | 8.5 | 5.08 | 2.7 | 0.4 | 1.2 | 1.7 |
| FYD0H104ZF | 5.5 | 0.10 | 0.14 | 100 | 0.15 | 4.2 | 13.0 | 8.5 | 5.08 | 2.2 | 0.4 | 1.2 | 2.4 |
| FYD0H224ZF | 5.5 | 0.22 | 0.35 | 120 | 0.33 | 4.2 | 14.5 | 15.0 | 5.08 | 2.4 | 0.4 | 1.2 | 4.3 |
| FYD0H474ZF | 5.5 | 0.47 | 0.75 | 65 | 0.71 | 4.2 | 16.5 | 15.0 | 5.08 | 2.7 | 0.4 | 1.2 | 6.0 |
| FYD0H105ZF | 5.5 | 1.0 | 1.6 | 35 | 1.5 | 4.2 | 21.5 | 16.0 | 7.62 | 3.0 | 0.6 | 1.2 | 11.0 |
| FYD0H145ZF | 5.5 | 1.4 | 2.1 | 45 | 2.1 | 4.2 | 21.5 | 19.0 | 7.62 | 3.0 | 0.6 | 1.2 | 12.0 |
| FYD0H225ZF | 5.5 | 2.2 | 3.3 | 35 | 3.3 | 4.2 | 28.5 | 22.0 | 10.16 | 6.1 | 0.6 | 1.4 | 22.9 |

●FYH Type

Specifications

| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|------------------------|-----------------------------|-------------------------------------|---------------------|------|-------|-----|----------------|----------------|------------|
| | | Charge system (F) | Discharge system (F) | | | | φD | H | P | ℓ | d ₁ | d ₂ | |
| FYH0H223ZF | 5.5 | 0.022 | 0.033 | 200 | 0.033 | 4.2 | 11.5 | 7.0 | 5.08 | 2.7 | 0.4 | 1.2 | 1.5 |
| FYH0H473ZF | 5.5 | 0.047 | 0.075 | 100 | 0.071 | 4.2 | 13.0 | 7.0 | 5.08 | 2.2 | 0.4 | 1.2 | 2.2 |
| FYH0H104ZF | 5.5 | 0.10 | 0.16 | 50 | 0.15 | 4.2 | 16.5 | 7.5 | 5.08 | 2.7 | 0.4 | 1.2 | 3.4 |
| FYH0H224ZF | 5.5 | 0.22 | 0.30 | 60 | 0.33 | 4.2 | 16.5 | 9.5 | 5.08 | 2.7 | 0.4 | 1.2 | 3.6 |
| FYH0H474ZF | 5.5 | 0.47 | 0.70 | 35 | 0.71 | 4.2 | 21.5 | 10.0 | 7.62 | 3.0 | 0.6 | 1.2 | 7.2 |
| FYH0H105ZF | 5.5 | 1.0 | 1.5 | 20 | 1.5 | 4.2 | 28.5 | 11.0 | 10.16 | 6.1 | 0.6 | 1.4 | 13.9 |

●FGL Type

Specifications

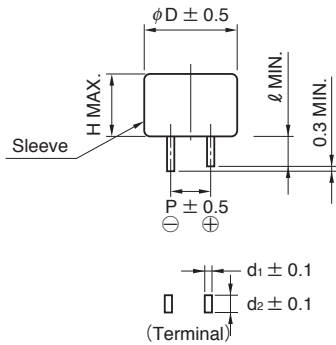
| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|------------------------|-----------------------------|-------------------------------------|---------------------|-----|------|-----|----------------|----------------|------------|
| | | Charge system (F) | Discharge system (F) | | | | φD | H | P | ℓ | d ₁ | d ₂ | |
| FYL0H103ZF | 5.5 | 0.01 | 0.013 | 300 | 0.015 | 4.2 | 11.0 | 5.0 | 5.08 | 2.7 | 0.2 | 1.2 | 0.9 |
| FYL0H223ZF | 5.5 | 0.022 | 0.028 | 200 | 0.033 | 4.2 | 11.0 | 5.0 | 5.08 | 2.7 | 0.2 | 1.2 | 1.0 |
| FYL0H473ZF | 5.5 | 0.047 | 0.061 | 200 | 0.071 | 4.2 | 12.0 | 5.0 | 5.08 | 2.7 | 0.2 | 1.2 | 1.2 |



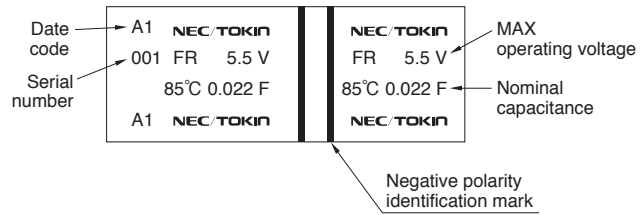
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6.6 FR Series

Dimensions



Markings on sleeve



Specifications

| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Voltage holding characteristics (V) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|---------------------------------|-----------------------------|-------------------------------------|---------------------|------|------|-----|-------|-------|------------|
| | | Charge system (F) | Discharge system (F) | | | | ϕD | H | P | l | d_1 | d_2 | |
| FR0H223ZF | 5.5 | 0.022 | 0.028 | 220 | 0.033 | 4.2 | 11.5 | 14.0 | 5.08 | 2.7 | 0.4 | 1.2 | 2.3 |
| FR0H473ZF | 5.5 | 0.047 | 0.060 | 110 | 0.071 | 4.2 | 14.5 | 14.0 | 5.08 | 2.4 | 0.4 | 1.2 | 3.9 |
| FR0H104ZF | 5.5 | 0.10 | 0.15 | 150 | 0.15 | 4.2 | 14.5 | 15.5 | 5.08 | 2.4 | 0.4 | 1.2 | 4.3 |
| FR0H224ZF | 5.5 | 0.22 | 0.33 | 180 | 0.33 | 4.2 | 14.5 | 21.0 | 5.08 | 2.4 | 0.4 | 1.2 | 5.3 |
| FR0H474ZF | 5.5 | 0.47 | 0.75 | 100 | 0.71 | 4.2 | 16.5 | 21.5 | 5.08 | 2.7 | 0.4 | 1.2 | 7.5 |
| FR0H105ZF | 5.5 | 1.0 | 1.6 | 60 | 1.5 | 4.2 | 21.5 | 22.0 | 7.62 | 3.0 | 0.6 | 1.2 | 13.3 |



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Specifications

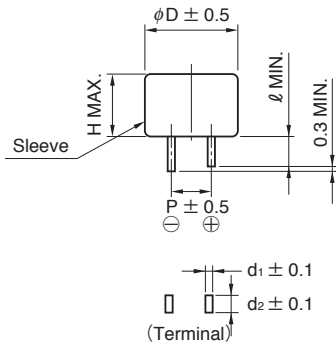
| Series name | | FR type | | Test conditions (conforming to JIS C 5101-1) | |
|--|----------------------------|--|----------------------------------|---|--|
| Item | | | | | |
| Category temperature range | | -40 °C to +85 °C | | | |
| MAX operating voltage | | 5.5Vdc | | | |
| Capacitance | | 0.022F to 1.0F | | Refer to "Measurement Conditions" | |
| Capacitance allowance | | +80 %, -20 % | | Refer to "Measurement Conditions" | |
| ESR | | Refer to standard ratings | | Measured at 1kHz, 10mA ; See also "Measurement Conditions" | |
| Current (30-minutes value) | | Refer to standard ratings | | Refer to "Measurement Conditions" | |
| Surge | Capacitance | More than 90% of initial ratings | | Conforms to 4.26 | |
| | ESR | Not to exceed 120% of initial ratings | | Surge voltage : 6.3V (5.5V type) | |
| | Current (30 minutes value) | Not to exceed 120% of initial ratings | | Charge : 30 sec. | |
| | Appearance | No obvious abnormality | | Discharge : 9min 30sec. Number of cycles : 1000 Series resistance : 0.022F 560 Ω : 0.047F 300 Ω : 0.068F 240 Ω : 0.10F 150 Ω : 0.22F 56 Ω : 0.47F 30 Ω : 1.0F 15 Ω Discharge resistance : 0 Ω Temperature : 70±2 °C | |
| Characteristics in different temperature | Capacitance | Phase 2 | 50% or higher than initial value | Conforms to 4.29 Phase1 : +25±2 °C Phase2 : -25±2 °C Phase3 : -40±2 °C Phase4 : +25±2 °C Phase5 : +70±2 °C Phase6 : +25±2 °C | |
| | ESR | | 400% or less than initial value | | |
| | Capacitance | Phase 3 | 30% or higher than initial value | | |
| | ESR | | 700% or less than initial value | | |
| | Capacitance | Phase 5 | 200% or less than initial value | | |
| | ESR | | Satisfy initial ratings | | |
| | Current (30 minutes value) | 1.5CV (mA) or below | | | |
| | Capacitance | Phase 6 | Within ±20% of initial value | | |
| | ESR | | Satisfy initial ratings | | |
| Current (30 minutes value) | Satisfy initial ratings | | | | |
| Lead strength (tensile) | | No terminal damage | | Conforms to 4.13.1 | |
| Vibration resistance | Capacitance | Satisfy initial ratings | | Conforms to 4.17 Frequency : 10 to 55 Hz Testing time : 6 hours | |
| | ESR | | | | |
| | Current (30 minutes value) | | | | |
| Appearance | | No obvious abnormality | | | |
| Solderability | | Over 3/4 of the terminal should be covered by the new solder | | Conforms to 4.15 Solder temp : 245±5 °C Dipping time : 5±0.5 sec. 1.6mm from the bottom should be dipped. | |
| Solder heat resistance | Capacitance | Satisfy initial ratings | | Conforms to 4.14 Solder temp : 260±10 °C Dipping time : 10±1 sec. 1.6mm from the bottom should be dipped. | |
| | ESR | | | | |
| | Current (30 minutes value) | | | | |
| Appearance | | No obvious abnormality | | | |
| Temperature cycle | Capacitance | Satisfy initial ratings | | Conforms to 4.16 Temperature condition : -40 °C →Room temperature→ +85 °C →Room temperature Number of cycles : 5 Cycles | |
| | ESR | | | | |
| | Current (30 minutes value) | | | | |
| Appearance | | No obvious abnormality | | | |
| High temp. and high humidity resistance | Capacitance | Within ±20% of initial value | | Conforms to 4.22 Temperature : 40±2 °C Relative humidity : 90 to 95 %RH Testing time : 240±8 hours | |
| | ESR | Not to exceed 120% of initial ratings | | | |
| | Current (30 minutes value) | Not to exceed 120% of initial ratings | | | |
| | Appearance | No obvious abnormality | | | |
| High temperature load | Capacitance | Within ±30% of initial value | | Conforms to 4.23 Temperature : 85±2 °C Voltage applied : MAX operating voltage Series protection resistance : 0 Ω Testing time : 1000 *%Hours | |
| | ESR | Below 200% of initial ratings | | | |
| | Current (30 minutes value) | Below 200% of initial ratings | | | |
| | Appearance | No obvious abnormality | | | |
| Self discharge characteristics (voltage holding characteristics) | | Voltage between terminal leads higher than 4.2V | | Charging condition | Voltage applied : 5.0Vdc (Terminal at the case's side be negative) Series resistance : 0 Ω Charging time : 24 hours |
| | | | | Storage | Let stand for 24 hours in condition described below with terminals opened. Ambient temperature : Lower than 25 °C Relative humidity : Lower than 70%RH |



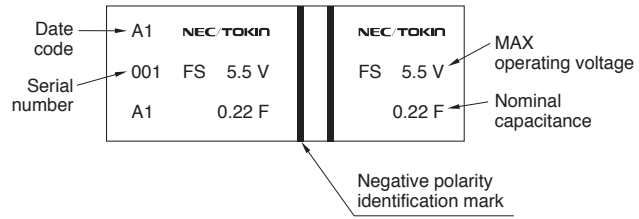
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6.7 FS Series

Dimensions



Markings on sleeve



Specifications

| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|---------------------------------|-----------------------------|---------------------|------|-------|-----|-------|-------|------------|
| | | Charge system (F) | Discharge system (F) | | | ϕD | H | P | l | d_1 | d_2 | |
| FS0H223ZF | 5.5 | 0.022 | 0.033 | 60.0 | 0.033 | 11.5 | 8.5 | 5.08 | 2.7 | 0.4 | 1.2 | 1.6 |
| FS0H473ZF | 5.5 | 0.047 | 0.072 | 40.0 | 0.071 | 13.0 | 8.5 | 5.08 | 2.2 | 0.4 | 1.2 | 2.6 |
| FS0H104ZF | 5.5 | 0.10 | 0.15 | 25.0 | 0.15 | 16.5 | 8.5 | 5.08 | 2.7 | 0.4 | 1.2 | 4.1 |
| FS0H224ZF | 5.5 | 0.22 | 0.33 | 25.0 | 0.33 | 16.5 | 13.0 | 5.08 | 2.7 | 0.4 | 1.2 | 5.3 |
| FS0H474ZF | 5.5 | 0.47 | 0.75 | 13.0 | 0.71 | 21.5 | 13.0 | 7.62 | 3.0 | 0.6 | 1.2 | 10 |
| FS0H105ZF | 5.5 | 1.0 | 1.3 | 7.0 | 1.5 | 28.5 | 14.0 | 10.16 | 6.1 | 0.6 | 1.4 | 18 |
| FS1A474ZF | 11.0 | 0.47 | 0.60 | 7.0 | 1.41 | 28.5 | 25.5 | 10.16 | 6.1 | 0.6 | 1.4 | 32 |
| FS1A105ZF | 11.0 | 1.0 | 1.3 | 7.0 | 3.0 | 28.5 | 31.5 | 10.16 | 6.1 | 0.6 | 1.4 | 35 |
| FS1B105ZF | 12.0 | 1.0 | 1.3 | 7.5 | 3.6 | 28.5 | 38.0 | 10.16 | 6.1 | 0.6 | 1.4 | 40 |
| FS1B505ZF | 12.0 | 5.0 | 6.5 | 4.0 | 18.0 | 44.8 | 60.0 | 20.00 | 9.5 | 1.0 | 1.4 | 160 |

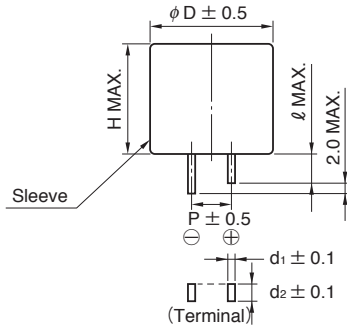


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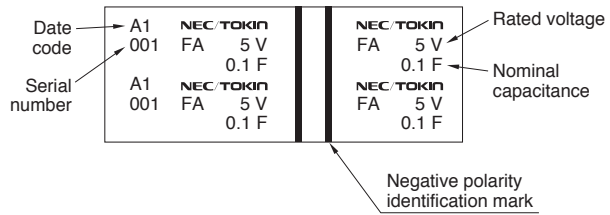
6.8 FA Series, FE Series

● FA Series

Dimensions



Markings on sleeve

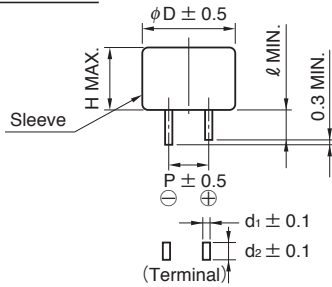


Specifications

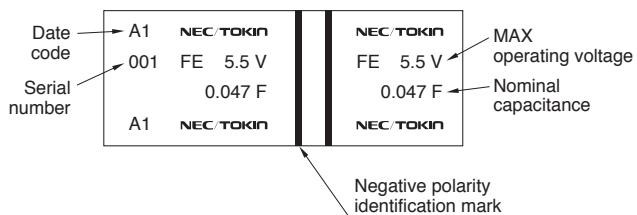
| Part Number | MAX operating voltage (Vdc) | Rated voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|---------------------|----------------------|---------------------------------|-----------------------------|---------------------|------|------|--------|-------|-------|------------|
| | | | Charge system (F) | Discharge system (F) | | | ϕD | H | P | ℓ | d_1 | d_2 | |
| FA0H473ZF | 5.5 | 5 | 0.047 | 0.075 | 20.0 | 0.071 | 16.0 | 15.5 | 5.1 | 5.0 | 0.4 | 1.2 | 6.2 |
| FA0H104ZF | 5.5 | 5 | 0.10 | 0.16 | 8.0 | 0.15 | 21.5 | 15.5 | 7.6 | 5.5 | 0.6 | 1.2 | 12 |
| FA0H224ZF | 5.5 | 5 | 0.22 | 0.35 | 5.0 | 0.33 | 28.5 | 16.5 | 10.2 | 9.5 | 0.6 | 1.4 | 25 |
| FA0H474ZF | 5.5 | 5 | 0.47 | 0.75 | 3.5 | 0.71 | 36.5 | 16.5 | 15.0 | 9.5 | 0.6 | 1.7 | 42 |
| FA0H105ZF | 5.5 | 5 | 1.0 | 1.6 | 2.5 | 1.5 | 44.5 | 18.5 | 20.0 | 9.5 | 1.0 | 1.4 | 65 |
| FA1A223ZF | 11.0 | 10 | 0.022 | 0.035 | 20.0 | 0.066 | 16.0 | 25.0 | 5.1 | 5.0 | 0.4 | 1.2 | 7.5 |
| FA1A104ZF | 11.0 | 10 | 0.10 | 0.16 | 8.0 | 0.30 | 28.5 | 25.5 | 10.2 | 9.5 | 0.6 | 1.4 | 32 |
| FA1A224ZF | 11.0 | 10 | 0.22 | 0.35 | 6.0 | 0.66 | 36.5 | 27.5 | 15.0 | 9.5 | 1.0 | 1.4 | 55 |
| FA1A474ZF | 11.0 | 10 | 0.47 | 0.75 | 4.0 | 1.41 | 44.5 | 28.5 | 20.0 | 9.5 | 1.0 | 1.4 | 83 |

● FE Series

Dimensions



Markings on sleeve



Specifications

| Part Number | MAX operating voltage (Vdc) | Nominal capacitance | | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|---------------------|----------------------|---------------------------------|-----------------------------|---------------------|------|------|--------|-------|-------|------------|
| | | Charge system (F) | Discharge system (F) | | | ϕD | H | P | ℓ | d_1 | d_2 | |
| FE0H473ZF | 5.5 | 0.047 | 0.075 | 14.0 | 0.071 | 14.5 | 14.0 | 5.1 | 2.2 | 0.4 | 1.2 | 3.9 |
| FE0H104ZF | 5.5 | 0.10 | 0.16 | 6.5 | 0.15 | 16.5 | 14.0 | 5.1 | 2.7 | 0.4 | 1.2 | 5 |
| FE0H224ZF | 5.5 | 0.22 | 0.35 | 3.5 | 0.33 | 21.5 | 15.5 | 7.6 | 3.0 | 0.6 | 1.2 | 9.5 |
| FE0H474ZF | 5.5 | 0.47 | 0.75 | 1.8 | 0.71 | 28.5 | 16.5 | 10.2 | 6.1 | 0.6 | 1.4 | 16 |
| FE0H105ZF | 5.5 | 1.0 | 1.4 | 1.0 | 1.5 | 36.5 | 18.5 | 15.0 | 6.1 | 0.6 | 1.7 | 38 |
| FE0H155ZF | 5.5 | 1.5 | 2.1 | 0.6 | 2.3 | 44.5 | 18.5 | 20.0 | 6.1 | 1.0 | 1.4 | 72 |



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Specifications

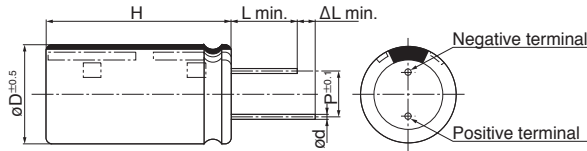
| Series name | | FA | | FE | | Test conditions (conforming to JIS C 5101-1) |
|--|----------------------------|--|----------------------------------|--|----------------------------------|--|
| Item | | | | | | |
| Category temperature range | | -25°C to +70°C | | -40°C to +70°C | | |
| MAX operating voltage | | 5.5Vdc, 11Vdc | | 5.5Vdc | | |
| Capacitance | | 5.5V : 0.047F to 1.0F 11V : 0.022F to 0.47F | | 0.047F to 1.5F | | Refer to "Measurement Conditions" |
| Capacitance allowance | | +80%, -20% | | +80%, -20% | | Refer to "Measurement Conditions" |
| ESR | | Refer to standard ratings | | Refer to standard ratings | | Measured at 1kHz, 10mA; See also "Measurement Conditions" |
| Current (30-minutes value) | | Refer to standard ratings | | Refer to standard ratings | | Refer to "Measurement Conditions" |
| Surge | Capacitance | / | | More than 90% of initial ratings | | Conforms to 4.26 Surge voltage : 6.3V (5.5V type) : 12.6V (11V type) Charge : 30 sec. Discharge : 9min 30sec. Number of cycles : 1000 Series resistance : 0.047F 300Ω : 0.10F 150Ω : 0.22F 56Ω : 0.47F 30Ω : 1.0F, 1.5F 15Ω Discharge resistance : 0Ω Temperature : 70±2°C |
| | ESR | | | Not to exceed 120% of initial ratings | | |
| | Current (30 minutes value) | | | Not to exceed 120% of initial ratings | | |
| | Appearance | | | No obvious abnormality | | |
| Characteristics in different temperature | Capacitance | Phase 2 | 70% or higher than initial value | Phase 2 | | Conforms to 4.29 Phase1 : +25±2°C Phase2 : -25±2°C Phase3 : -40±2°C (FE type) Phase4 : +25±2°C Phase5 : +70±2°C Phase6 : +25±2°C |
| | ESR | | 300% or less than initial value | | | |
| | Capacitance | Phase 3 | | Phase 3 | 40% or higher than initial value | |
| | ESR | | | | 400% or less than initial value | |
| | Capacitance | Phase 5 | 150% or less than initial value | Phase 5 | 200% or less than initial value | |
| | ESR | | Satisfy initial ratings | | Satisfy initial ratings | |
| | Current (30 minutes value) | | 1.5CV (mA) or below | | 1.5CV (mA) or below | |
| | Capacitance | Phase 6 | Within ±20% of initial value | Phase 6 | Within ±20% of initial value | |
| ESR | | Satisfy initial ratings | | Satisfy initial ratings | | |
| Current (30 minutes value) | | Satisfy initial ratings | | Satisfy initial ratings | | |
| Lead strength (tensile) | | No terminal damage | | No terminal damage | | Conforms to 4.13.1 |
| Vibration resistance | Capacitance | Satisfy initial ratings | | Satisfy initial ratings | | Conforms to 4.17 Frequency : 10 to 55 Hz Testing time : 6 hours |
| | ESR | | | | | |
| | Current (30 minutes value) | | | | | |
| | Appearance | | | | | |
| Solderability | | Over 3/4 of the terminal should be covered by the new solder | | Over 3/4 of the terminal should be covered by the new solder | | Conforms to 4.15 Solder temp : 245±5°C Dipping time : 5±0.5 sec. 1.6mm from the bottom should be dipped. |
| Solder heat resistance | Capacitance | Satisfy initial ratings | | Satisfy initial ratings | | Conforms to 4.14 Solder temp : 260±10°C Dipping time : 10±1 sec. 1.6mm from the bottom should be dipped. |
| | ESR | | | | | |
| | Current (30 minutes value) | | | | | |
| | Appearance | | | | | |
| Temperature cycle | Capacitance | Satisfy initial ratings | | Satisfy initial ratings | | Conforms to 4.16 Temperature condition : -25°C (-40°C for FE type)→ Room temperature→ +70°C →Room temperature Number of cycles : 5 Cycles |
| | ESR | | | | | |
| | Current (30 minutes value) | | | | | |
| | Appearance | | | | | |
| High temp. and high humidity resistance | Capacitance | Over 90% of initial value | | Within ±20% of initial value | | Conforms to 4.22 Temperature : 40±2°C Relative humidity : 90 to 95 %RH Testing time : 240±8 hours |
| | ESR | Not to exceed 120% of initial ratings | | Not to exceed 120% of initial ratings | | |
| | Current (30 minutes value) | Not to exceed 120% of initial ratings | | Not to exceed 120% of initial ratings | | |
| | Appearance | No obvious abnormality | | No obvious abnormality | | |
| High temperature load | Capacitance | Over 85% of initial value | | Within ±30% of initial value | | Conforms to 4.23 Temperature : 70±2°C Voltage applied : MAX operating voltage Series protection resistance : 0Ω Testing time : 1000 ^h Hours |
| | ESR | Below 120% of initial ratings | | Below 200% of initial ratings | | |
| | Current (30 minutes value) | Below 200% of initial ratings | | Below 200% of initial ratings | | |
| | Appearance | No obvious abnormality | | No obvious abnormality | | |



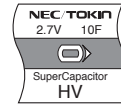
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6.9 HV Series (High capacitance Type)

Dimensions



Markings on sleeve



Specifications

| Part Number | MAX operating voltage (Vdc) | Nominal capacitance (F) | MAX ESR (at 1 kHz) (Ω) | MAX current at 30 min. (mA) | Dimension (unit:mm) | | | | | | Weight (g) |
|-------------|-----------------------------|-------------------------|------------------------|-----------------------------|---------------------|------|------|-----|------|-----|------------|
| | | | | | φ D | H | P | φ d | L | Δ L | |
| HVS0E106NF | 2.7 | 10 | 100 | 8 | 10.0 | 35±2 | 5.0 | 0.6 | 15.0 | 5.0 | 4.5 |
| HVS0E226NF | 2.7 | 22 | 100 | 18 | 12.5 | 35±2 | 5.0 | 0.6 | 15.0 | 5.0 | 6.5 |
| HVS0E506NF | 2.7 | 50 | 30 | 40 | 18.0 | 40±5 | 7.5 | 0.8 | 15.0 | 5.0 | 14.0 |
| HVS0E107NF | 2.7 | 100 | 30 | 81 | 22.0 | 50±5 | 10.2 | 1.0 | 15.0 | 5.0 | 24.0 |

Specifications

| Item | Specifications | Test conditions (conforming to JIS C 5101-1) |
|--|--|---|
| Category temperature range | -25°C to +60°C (50F, 100F), -25°C to +70°C (10F, 22F) | |
| MAX operating voltage | 2.7Vdc | |
| Capacitance | 10F, 20F, 50F, 100F | Refer to "Measurement Conditions" |
| Capacitance allowance | ±30% | Refer to "Measurement Conditions" |
| ESR | Refer to standard ratings | Measured at 1kHz, 10mA; See also "Measurement Conditions" |
| Current (30-minutes value) | Refer to standard ratings | Refer to "Measurement Conditions" |
| Characteristics in different temperature | Capacitance | Conforms to 4.29 Phase2 : Category MAX temp. Phase4 : Category MIN temp. Phase5 : 20°C |
| | ESR | |
| | Capacitance | |
| | ESR | |
| | Current (30 minutes value) | |
| | Capacitance | |
| | ESR | |
| Lead strength (tensile) | No terminal damage | Conforms to 4.13.1 |
| Vibration resistance | Capacitance | Conforms to 4.17 Frequency : 10 to 55 Hz Testing time : 6 hours |
| | ESR | |
| | Current (30 minutes value) | |
| | Appearance | |
| Solderability | Over 3/4 of the terminal should be covered by the new solder | Conforms to 4.15 Solder temp : 245±5°C Dipping time : 5±0.5 sec. 1.6mm from the bottom should be dipped. |
| Solder heat resistance | Capacitance | Conforms to 4.14 Solder temp : 260±10°C Dipping time : 10±1 sec. 1.6mm from the bottom should be dipped. |
| | ESR | |
| | Current (30 minutes value) | |
| | Appearance | |
| Temperature cycle | Capacitance | Conforms to 4.16 Temperature condition : -25°C → Room temperature → +70°C (10F, 22F), +60°C (50F, 100F) → Room temperature Number of cycles : 5 Cycles |
| | ESR | |
| | Current (30 minutes value) | |
| | Appearance | |
| High temp. and high humidity resistance | Capacitance | Conforms to 4.22 Temperature : 40±2°C (50F, 100F) Relative humidity : 90 to 95 %RH Testing time : 240±8 hours |
| | ESR | |
| | Current (30 minutes value) | |
| | Appearance | |
| High temperature load | Capacitance | Conforms to 4.23 Temperature : +70°C (10F, 22F), +60°C (50F, 100F) Voltage applied : MAX operating voltage Series protection resistance : 0Ω Testing time : 1000±#Hours |
| | ESR | |
| | Current (30 minutes value) | |
| | Appearance | |

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6.10 HP • ED/L Series (Thin Type)

● HP, ED/L Series

Features

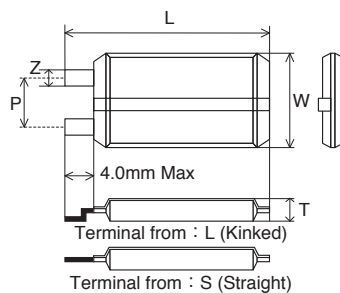
- Minimized the footprint by improving packaging and cell construction method.
- Low ESR
- High speed charging/discharging enabled. Capable of high current discharge in the order of amperes (A).
- Excellent low temperature characteristics. (Can be used at -25°C)
- Thin shape makes it suitable for mobile equipments.
- Environmentally safe as it contains no hazardous substances such as heavy metals.

Applications

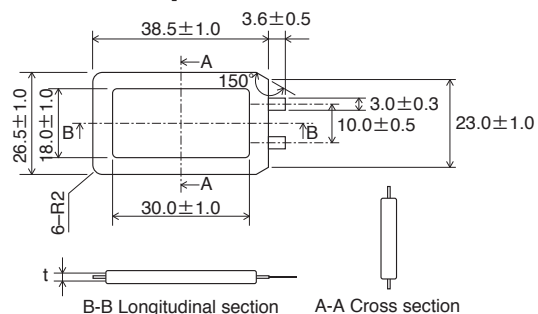
- Peak current assist for mobile equipments.
- Smoothing capacitor for power source.

Dimensions

[HP series]



[EDL 223Z7R0-1]

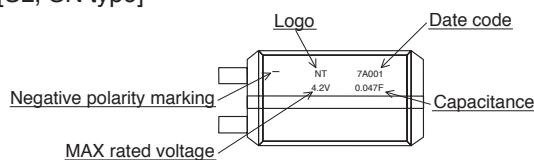


t dimension : $t = 3.4 \pm 0.5\text{mm}$

(Unit : mm)

Markings

[SL, SN type]



Specifications

| Part Number | MAX operating voltage (Vdc) | Nominal capacitance (F) | MAX ESR (at 1 kHz) (Ω) | Size code | L MAX. (mm) | W MAX. (mm) | T MAX. (mm) | Z (mm) | P (mm) |
|---------------|-----------------------------|-------------------------|---------------------------------|------------------------|-------------|-------------|-------------|--------|---------------|
| HPSL0G223Z() | 4.2 | 0.022 | 300 | SL | 34 | 14 | 2.3 | 2.5 | 7.5 ± 0.5 |
| HPSN0G473Z() | 4.2 | 0.047 | 200 | SN | 42.5 | 17 | 2.3 | 3.0 | 10 ± 0.5 |
| EDL223Z7R0-1 | 7.8 | 0.022 | 300 | Refer to above drawing | | | | | |

() Lend from : L (Kinked) or S (Straight)



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7. Packing

1. FM Series

(1) Bulk

- Packing method : Pack in vinyl bags then pack them into cardboard boxes.
- Standard packing quantity : 1000pcs (100pcs / vinyl bag × 10)
 However : FM0H104ZF-L1 and FM0H224ZF-L1=800pcs, FMC0H334ZF=400pcs, FMC0H334ZF-L1=300pcs

(2) Taping

- Packing method : Ammo pack
- Standard packing quantity : 1000pcs However, FMC0H334ZFTP() = 400pcs

2. FC Series

| Part name | Packing unit |
|-----------------|------------------|
| FCS0H473ZFTBR24 | 1000 PCS. / reel |
| FCS0H104ZFTBR24 | 1000 PCS. / reel |
| FC0H224ZFTBR24 | 500 PCS. / reel |
| FC0H474ZFTBR32 | 200 PCS. / reel |
| FC0H105ZFTBR44 | 150 PCS. / reel |
| FC0V104ZFTBR24 | 1000 PCS. / reel |
| FC0V224ZFTBR24 | 1000 PCS. / reel |
| FC0V474ZFTBR24 | 500 PCS. / reel |
| FCH0V683ZFTBR16 | 1500 PCS. / reel |
| FCH0H433ZFTBR16 | 1500 PCS. / reel |

3. FG, FT, FS, FR, FY, FA Series

(1) Bulk (Small type)

- Packing method : Pack in vinyl bags then pack them into cardboard boxes.
- Standard packing quantity: see chart below.

(Unit : Pises)

| Series name Capacitance | FA | | FE | FS | | FY | | | FR | FG | FT |
|----------------------------|-----------|----------|-----|-----------|--------------------|------|------|------|-----|------|------|
| | 5.5V type | 11V type | | 5.5V type | 11V type, 12V type | FYD | FYH | FYL | | | |
| 0.010F | — | — | — | — | — | — | — | 2000 | — | 2000 | — |
| 0.022F | — | 240 | — | 1000 | — | 1000 | 1600 | 2000 | 800 | 2000 | — |
| 0.047F | 400 | — | 400 | 800 | — | 1000 | 800 | 1600 | 400 | 2000 | — |
| 0.10F | — | — | 400 | 600 | — | 800 | 600 | — | 400 | 1600 | 1000 |
| 0.22F | — | — | — | 400 | — | 400 | 500 | — | 300 | 800 | 400 |
| 0.47F | — | — | — | — | — | 240 | — | — | 240 | 300 | 400 |
| 1.0F | — | — | — | — | — | — | — | — | — | 240 | — |

(2) Bulk (large type)

- Packing method: Pin the terminal onto a conductive mat; then pack it into individual cardboard box with insulation material.
- Standard packing quantity: see chart below.

(Unit : Pises)

| Series name Capacitance | FA | | FE | FS | | FY | | | FR | FG | FT |
|----------------------------|-----------|----------|----|-----------|--------------------|-----|-----|-----|----|-----|----|
| | 5.5V type | 11V type | | 5.5V type | 11V type, 12V type | FYD | FYH | FYL | | | |
| 0.10F | 90 | 50 | — | — | — | — | — | — | — | — | — |
| 0.22F | 50 | 30 | 90 | — | — | — | — | — | — | — | — |
| 0.47F | 30 | 20 | 50 | 90 | 50 | — | 90 | — | — | — | — |
| 1.0F | 20 | — | 30 | 50 | 50 | 90 | 50 | — | 90 | — | 90 |
| 1.4F | — | — | — | — | — | 90 | — | — | — | — | — |
| 1.5F | — | — | 20 | — | — | — | — | — | — | 160 | — |
| 2.2F | — | — | — | — | — | 50 | — | — | — | 90 | 50 |
| 3.3F | — | — | — | — | — | — | — | — | — | — | 30 |
| 4.7F | — | — | — | — | — | — | — | — | — | 50 | — |
| 5.0F | — | — | — | — | 20 | — | — | — | — | — | — |
| 5.6F | — | — | — | — | — | — | — | — | — | — | 20 |

4. Winded type (HV Series)

- Packing method : Pack in vinyl bags then pack them into cardboard boxes.
- Standard packing quantity : 320pcs (10F), 224pcs (22F), 120pcs (50F), 80pcs (100F)

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8. List of Plating Type and Sleeve Type

By changing the solder plating from leaded solder to lead-free solder, and the outer tube material of can-cased conventional SuperCapacitor from polyvinyl chloride to Polyethylene Terephthalate (PET), our new SuperCapacitor has now become even more friendlier to the environment.

- a. Iron + copper base + lead-free solder plating (Sn-1Cu)
- b. SUS nickel base + copper base + reflow lead-free solder plating (100% Sn, reflow processed)
- c. Copper + nickel base + lead-free solder plating (100% Sn)
- d. Iron + copper base + lead-free solder plating (100% Sn)

| Series | Part Number | Plating | Sleeve |
|-----------------|-------------------|--------------|--------------|
| FA | All FA Series | a | PET (Blue) |
| FE | All FE Series | a | PET (Blue) |
| FS | All FS Series | a | PET (Blue) |
| FR | All FR Series | a | PET (Blue) |
| FT | All FT Series | a | PET (Blue) |
| FY | All FYD type | a | PET (Blue) |
| | All FYH type | a | PET (Blue) |
| | FYL0H473ZF | a | PET (Blue) |
| | FYL0H223ZF | b | PET (Blue) |
| FG | FYL0H103ZF | b | PET (Blue) |
| | FG0H103ZF | b | PET (Blue) |
| | FG0H223ZF | b | PET (Blue) |
| | FG0H473ZF | b | PET (Blue) |
| | FG0H104ZF | b | PET (Blue) |
| | FG0H224ZF | a | PET (Blue) |
| | FG0H474ZF | a | PET (Blue) |
| | FG0H105ZF | a | PET (Blue) |
| | FG0H225ZF | a | PET (Blue) |
| | FG0H475ZF | a | PET (Blue) |
| | FGH0H104ZF | b | PET (Blue) |
| | FGH0H224ZF | b | PET (Blue) |
| FGH0H474ZF | a | PET (Blue) | |
| FGH0H105ZF | a | PET (Blue) | |
| FM | All FM Series | a | No tube used |
| FC | FC0H473ZFTBR24 | b | No tube used |
| | FC0H104ZFTBR24 | b | No tube used |
| | FC0H224ZFTBR24 | b | No tube used |
| | FC0H474ZFTBR32-SS | a | No tube used |
| | FC0H105ZFTBR44-SS | a | No tube used |
| | FC0V104ZFTBR24 | b | No tube used |
| | FC0V224ZFTBR24 | b | No tube used |
| | FC0V474ZFTBR24 | b | No tube used |
| FCH0V683ZFTBR16 | b | No tube used | |
| HP | All HP Series | c | No tube used |
| ED/L | All ED/L Series | c | No tube used |
| HV | All HV Series | d | PET (Blue) |

Recommended Pb-free solder : Sn / 3.5Ag / 0.75Cu

Sn / 3.0Ag / 0.5Cu

Sn / 0.7Cu

Sn / 2.5Ag / 1.0Bi / 0.5Cu



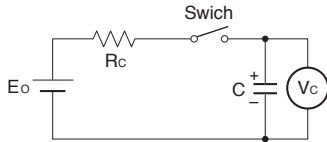
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9. Measurement Conditions

(1) Capacitance (Charge System)

Capacitance is calculated from expression (9) by measuring the charge time constant (τ) of the capacitor (C). Prior to measurement, short between both pins of the capacitor for 30 minutes or more to let it discharge. In addition, follow the indication of the product when determining the polarity of the capacitor during charging.

$$\text{Capacitance: } C = \frac{\tau}{R_c} \text{ (F)} \quad (9)$$



- E₀: 3.0 (V) ... Product with maximum operating voltage 3.5 V
- 5.0 (V) ... Product with maximum operating voltage 5.5 V
- 6.0 (V) ... Product with maximum operating voltage 6.5 V
- 10.0 (V) ... Product with maximum operating voltage 11 V
- 12.0 (V) ... Product with maximum operating voltage 12 V

τ : Time from start of charging until V_c becomes 0.632E₀ (V) (sec)

R_c: See table below (Ω).

| | FA | FE | FS | FY | | | FR | FM, FME FMR, FML | FMC | FG | FGH | FT | FC |
|--------|--------|--------|--------|--------|--------|--------|--------|-----------------------------|-----------|--------|-----------|-------|-----------|
| | | | | FYD | FYH | FYL | | | | | | | |
| 0.010F | - | - | - | - | - | 5000 Ω | - | 5000 Ω | - | 5000 Ω | - | - | - |
| 0.022F | 1000 Ω | - | 1000 Ω | 2000 Ω | 2000 Ω | 2000 Ω | 2000 Ω | 2000 Ω | - | 2000 Ω | - | - | Discharge |
| 0.047F | 1000 Ω | 1000 Ω | 1000 Ω | 2000 Ω | 1000 Ω | 2000 Ω | 1000 Ω | 2000 Ω | 1000 Ω | 2000 Ω | - | - | - |
| 0.10F | 510 Ω | 510 Ω | 510 Ω | 1000 Ω | 510 Ω | - | 1000 Ω | 1000 Ω | 1000 Ω | 1000 Ω | Discharge | 510 Ω | Discharge |
| 0.22F | 200 Ω | 200 Ω | 200 Ω | 510 Ω | 510 Ω | - | 510 Ω | OH: Discharge 0V: 1000 Ω | - | 1000 Ω | Discharge | 200 Ω | Discharge |
| 0.33F | - | - | - | - | - | - | - | - | Discharge | - | - | - | - |
| 0.47F | 100 Ω | 100 Ω | 100 Ω | 200 Ω | 200 Ω | - | 200 Ω | - | - | 1000 Ω | Discharge | 100 Ω | Discharge |
| 1.0F | 51 Ω | 51 Ω | 100 Ω | 100 Ω | 100 Ω | - | 100 Ω | - | - | 510 Ω | Discharge | 100 Ω | Discharge |
| 1.4F | - | - | - | 200 Ω | - | - | - | - | - | - | - | - | - |
| 1.5F | - | 51 Ω | - | - | - | - | - | - | - | 510 Ω | - | - | - |
| 2.2F | - | - | - | 100 Ω | - | - | - | - | - | 200 Ω | - | 51 Ω | - |
| 3.3F | - | - | - | - | - | - | - | - | - | - | - | 51 Ω | - |
| 4.7F | - | - | - | - | - | - | - | - | - | 100 Ω | - | - | - |
| 5.0F | - | - | 100 Ω | - | - | - | - | - | - | - | - | - | - |
| 5.6F | - | - | - | - | - | - | - | - | - | - | - | 20 Ω | - |

*Capacitance values according to the constant current discharge method.

Table 3 Capacitance measurement

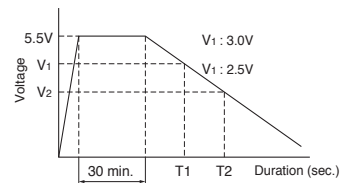
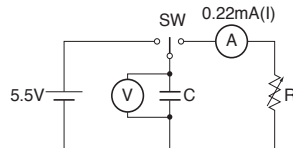
Capacitance (Discharge System)

In the diagram below, charging is performed for a duration of 30 minutes, once the voltage of the condenser terminal reaches 5.5 V.

Then, use a constant current load device and measure the time for the terminal voltage to drop from 3.0 to 2.5 V upon discharge at 0.22 mA for 0.22 F, for example, and calculate the static capacitance according to the equation shown below.

Note: The current value is 1 mA discharged per 1F.

$$\text{Capacitance : } C = \frac{I \times (T_2 - T_1)}{V_1 - V_2} \text{ (F)}$$



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10. Notes on Using Super Capacitor (Electric Double-Layer Capacitor)

1. Circuitry design

1.1 Useful life

The electrical double layered capacitor (super capacitor) uses electrolyte and is sealed with rubber etc. Water in the electrolyte can evaporate in use over long periods at high temperatures, thus reducing electrostatic capacity which in turn will create greater internal resistance. The characteristics of the super capacitor can vary greatly depending on the environment it is used in. Therefore, controlling the usage environment will ensure prolonged life of the part.

Basic breakdown mode is an open mode due to increased internal resistance.

1.2 Fail rate in the field

Based on field data, the fail rate is calculated at approx. 0.006Fit. We estimate that unreported failures are ten times this amount. Therefore, we assume that the fail rate is below 0.06Fit.

1.3 Voltage application when maximum usable voltage is exceeded

Performance may be compromised, and in some cases leakage or damage may occur if applied voltage exceeds maximum working voltage.

1.4 Use of capacitor as a smoothing capacitor (ripple absorption) in electrical circuits

As super capacitors contain a high level of internal resistance, they are not recommended for use as electrical smoothing capacitors in electrical circuits.

Performance may be compromised, and in some cases leakage or damage may occur if a super capacitor is used in ripple absorption.

1.5 Series connections

As applied voltage balance to each super capacitor is lost when used in series connection, excess voltage may be applied to some super capacitors, which will not only negatively affect its performance but may also cause leakage and/or damage.

Allow ample margin for maximum voltage or attach a circuit for applying equal voltage to each super capacitor (partial pressure resistor/voltage divider) when using super capacitors in series connection.

Also, arrange super capacitors so that the temperature between each capacitor will not vary.

1.6 Outer sleeve insulation

The outer sleeve wrapped around the super capacitor indicates that it is sealed, however the outer sleeve is not guaranteed for insulation purposes. Therefore, it cannot be used where insulation is necessary.

1.7 Polar characteristics

The super capacitor is manufactured so that the terminal on the outer case is negative (-). Align the (-) symbol during use. Even though discharging has been carried out prior to shipping, any residual electrical charge may negatively affect other parts.

1.8 Use next to heat emitters

Useful life of the super capacitor will be significantly affected if used near heat emitting items (coils, power transistors, and posistors etc) where the super capacitor itself may become heated.

1.9 Usage environment

This device cannot be used in any acidic, alkaline or similar type of environment.



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1.10 Super capacitors fitted with pressure valves

HV series super capacitors are fitted with pressure valves. Make an opening in the top of the pressure valve to avoid any damage to the super capacitor when the pressure valve is in use. Allow at least a 2mm opening for models with a diameter of ϕ 18mm or less, and at least a 3mm opening for models with a diameter of ϕ 22mm.

2. Mounting

2.1 Mounting onto a reflow furnace

Except for the FC series, it is not possible to mount this capacitor onto an IR / VPS reflow furnace. Do not immerse the capacitor into a soldering dip tank.

2.2 Flow soldering conditions

Keep solder under 260 °C and soldering time to within 10 seconds when using the flow automatic soldering method. (Except for the FC, HV and the HP/EDL series)

2.3 Installation using a soldering iron

Care must be taken to prevent the soldering iron from touching other parts when soldering. Keep the tip of the soldering iron under 400 °C and soldering time to within 3 seconds. For the HP/EDL series, the tip of the soldering iron must be kept at below 320 °C and soldering time to within 3 seconds. Always make sure that the temperature of the tip is controlled. Internal capacitor resistance is likely to increase if the terminals are overheated.

2.4 Lead terminal processing

Do not attempt to bend or polish the capacitor terminals with sand paper etc. Soldering may not be possible if the metallic plating is removed from the top of the terminals.

2.5 Cleaning, Coating, and Potting

Except for the FM series, cleaning, coating, and potting must not be carried out. Consult us if this type of procedure is necessary.

Terminals should be dried at less than the maximum operating temperature after cleaning.

3. Storage

3.1 Temperature and Humidity

Make sure that the super capacitor is stored according to the following conditions: Temp.: 5~35 °C (Standard 25), Humidity: 20~70% (Standard: 50%). Do not allow the build up of condensation through sudden temperature change.

3.2 Environment conditions

Make sure that there are no corrosive gasses like sulfur dioxide as penetration of the lead terminals is possible.

Always store this item in an area with low dust and dirt levels.

Make sure that the packaging will not be deformed through heavy loading, movement and/or knocks.

Keep out of direct sunlight, and away from radiation, static electricity, and magnetic fields.

3.3 Maximum storage period

This item may be stored up to one year from the date of delivery if stored at the conditions stated above.

This product should be safe to use even after being stored for over a 1 year period. However, depending on the storage conditions, we recommend that the soldering is checked.

4. Dismantling

There is a small amount of electrolyte stored within the capacitor. Do not attempt to dismantle as direct skin contact with the electrolyte will cause burning.

This product should be treated as industrial waste and not be disposed of by fire.



When using our products, the following precautions should be taken.

- (1) Safety designing of an apparatus or a system allowing for failures of electronic components used in the system

In general, failures will occur in electronic components at a certain probability. NEC TOKIN makes every effort to improve the quality and reliability of electronic component products. However, it is impossible to completely eliminate the probability of failures. Therefore, when using NEC TOKIN's electronic component products, systems should be carefully designed to ensure redundancy in the event of an accident which would result in injury or death, fire, or social damage, to ensure the prevention of the spread of fire, and the prevention of faulty operation. (Please refer to pre-cautions to be taken when using SuperCapacitor capacitors for the details of failures.)

- (2) Quality level of various kinds of parts, and equipment in which the parts can be utilized
Electronic components have a standard quality level unless otherwise specified.

NEC TOKIN classifies the level of quality of electronic component products into three levels, in order from a lower level, a standard quality level, a special quality level, and a custom quality level in which a customer individually specifies a quality assurance program. Each of the quality levels has recommended applications.

If a user wants to use the electronic parts having a standard quality level in applications other than the applications specified for the standard quality level, they should always consult a member of our company's sales staff before using the electronic parts.

| | |
|-------------------------|--|
| Standard quality level: | Computers, office automation equipment, communications equipment, measuring instruments, AV equipment, household electrical appliances, machine tools, personal equipment, industrial robots |
| Special quality level: | Transportation equipment (automobiles, railways, shipping, or the like), traffic signals, disaster prevention/crime prevention systems, safety devices, and medical equipment which is not directly intended for life-support purposes |
| Custom quality level: | Equipment for airplanes, aerospace equipment, nuclear power control systems, and medical equipment, apparatus or systems for life-support purposes |

Unless otherwise shown, the quality level of NEC TOKIN's electronic component products included in documents such as catalogues, data sheets or data books is the standard quality level.

- (3) This manual is subject to change without notice.

The contents of this manual are based on data which is correct as of March 2010, and they may be changed without notice. If our products are used for mass-production design, please consult with a member of our company's sales staff by way of precaution.

- (4) Reprinting and copying of this manual without prior written permission from NEC TOKIN Corporation are not permitted.

- (5) Industrial property problems

In the event any problems associated with industrial property of a third party arising as a result of the use of our products, NEC TOKIN assumes no responsibility for problems other than problems directly associated with the constitution and manufacturing method of the products.

- (6) Should any of these products come under the category of strategic goods or services (according to Japan's foreign trade and foreign exchange regulations), the sender must obtain an export license from the Japanese Government before said products can be exported outside Japan.



- All specifications in this catalog and production status of products are subject to change without notice. Prior to the purchase, please contact NEC TOKIN for updated product data.
- Please request for a specification sheet for detailed product data prior to the purchase.
- Before using the product in this catalog, please read "Precautions" and other safety precautions listed in the printed version catalog.