Devices thru Material Innovation

NEC/TOKIN

Vol.01

Super Capacitors

# Super Capacitors

## FOR CORRECT USE OF SUPER CAPACITORS

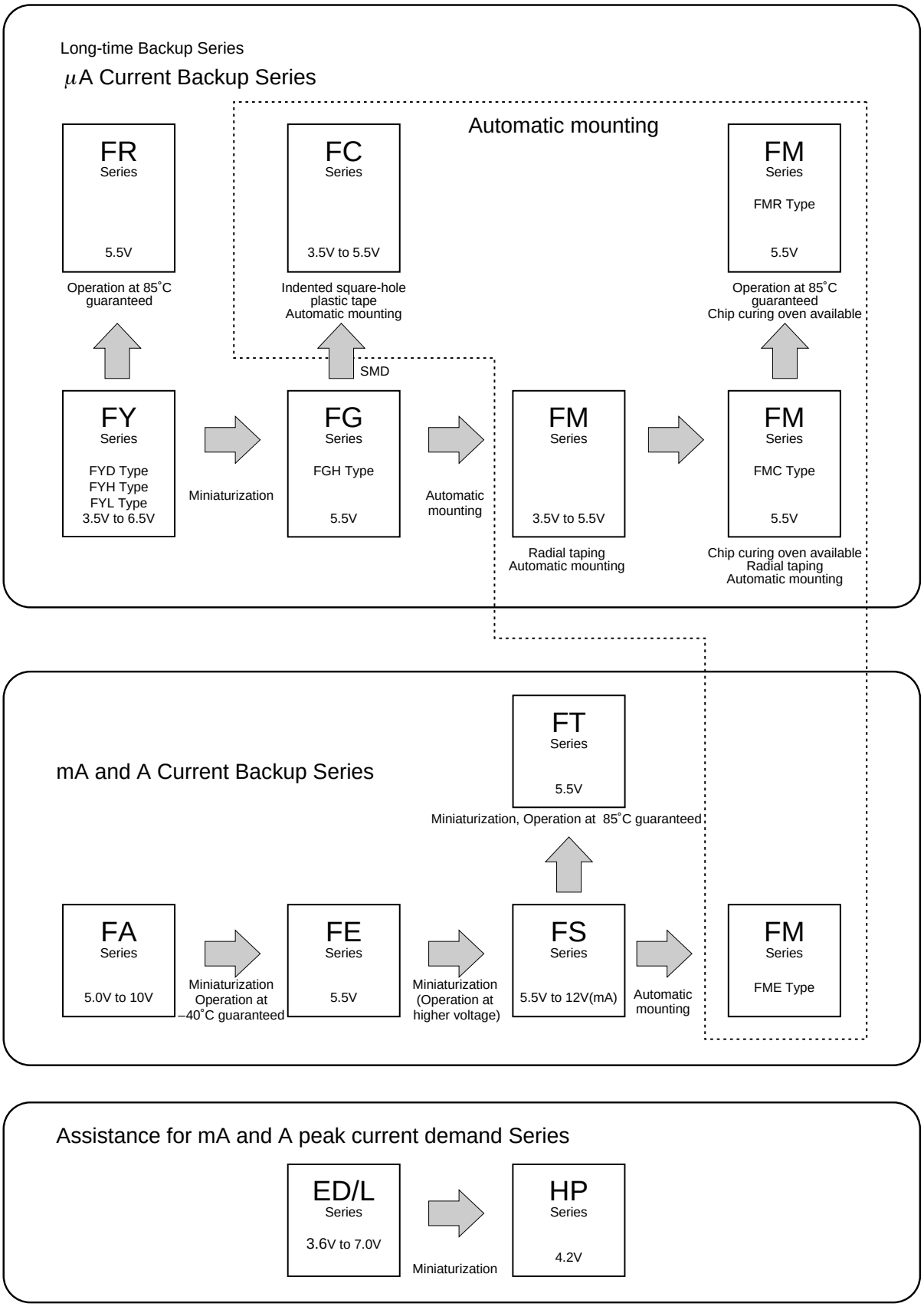
1. Please confirm the operating conditions and the specifications of the Super Capacitors befor using them.
2. The electrolyte of these Super Caapacitors is sealed with material such as rubber. When you use the capacitors for a long time at high temperature, the moisture of the eleotrolyte evaporates 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.

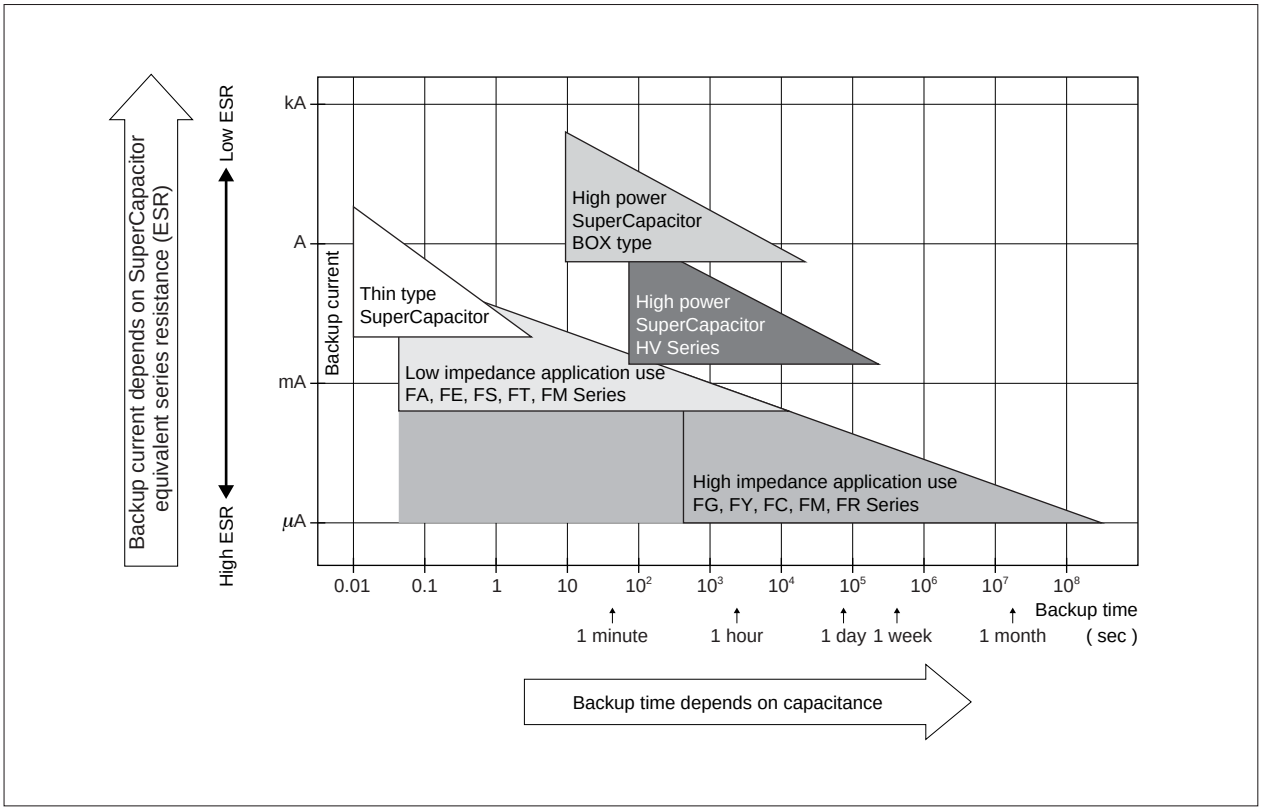
| ISO 9001<br>QS 9000 | ISO 14001 |
|---|---|
| JQA | JQA |
| JQA-0366 | JQA-E-90094 |

# CONTENTS

# Organization of Super Capacitor Series



# Performance For Selection



# Description

The Super Capacitor is the most outstanding capacitor concept to appear in the past decade. The large capacitance, slow rate of discharge and small package make it useful as a non-battery reserve power source that can provide currents (1-100 mA) and protect microcomputers from power shutdowns lasting several seconds.

It is also useful for maintaining the contents of low dissipation volatile memories (i.e. CMOS) for several months. (For more detailed applications, refer to the table shown below.)

The operating principle of the Super Capacitor is based on an electric double layer appearing at the interface between activated carbon particles and sulfuric acid solution as electrolyte. The two electrodes are separated by an ionically conducting but electrically insulating porous membrane.

Conductive rubber membranes contain the electrode and electrolyte material and make contact to the cell. Several cells are stacked in series to achieve the 5.5 V and 11 V rated voltages.

Since the Super Capacitor exhibit relatively high ESR, it is not recommended for ripple absorption in DC power supply applications.

In some manufacturing operations it has been polarized with the following voltage direction.

Shorter lead: Positive

Longer lead (connected to case): N egative

Therefore, the use of the Super Capacitor in that direction is recommended in actual usage.

# Typical Applications

The following table shows typical applications categorized by the functions and the magnitude of back-up current required.

| FUNCTIONS | BACKUP CURRENT | APPLICATIONS | EQUIPMENT | ADEOUATE SERIES |
|---|---|---|---|---|
| Assistance for peak current demand | UP to 1A | Use for rapid charging and discharging in order of Amperes (A)<br>Actuator applications (Large current in a short period) | For Mobile systemes<br>Wireless card, Digital still camera, Personal digital assistance | HP Series<br>ED/L Series |
| Large current supply | Up to 1 A | Actuator applications (Large current in a short period) | Actuators<br>Relay/Solenoid starter<br>Igniters | FA and FE series |
| | | Primary power supply for LED displays, toys, electric buzzers, etc. | Handheld toys<br>Displays, Smoke detectors, Alarm devices, Emergency display | |
| Medium capacity power supply | Up to 50 mA | Secondary power source for undesirable voltage drops | Car radio back-up at the engine start, etc. | FT series<br>FS series<br>3.5 V•6.5 V series (FSH)<br>FME type |
| | | Motor Start | VCR, Video disk<br>Record player | |
| Power backup for primary power outages | Less than 500 $\mu$A | CMOS Microcomputers | Phones (Memory dial, Auto-answering)<br>Electric cash registers<br>Electric typewriters<br>Computer terminals<br>Automatic measuring instruments, etc. | FC series<br>FY series<br>FYD Type<br>FYH Type<br>FYL Type<br>3.5 V•6.5 V Series (FYD)<br>FM series<br>FG series |
| | | CMOS RAMs<br>ICs for Clocks | Digital tuning audio system<br>(LW-MW-FM Radio, Car Radio, Stereo, etc.)<br>Programmable consumer electronic products<br>(VCR, Microwave overun, Games, etc.) | |
| | | • CMOS RAMs<br>ICs for Clocks<br>• High operating temperature (85°C) | Measuring instruments<br>Automatic control<br>Communications<br>Car | FR series |
| Other Applications<br>Programmable Thermostat, Copiers, Vending Machines, Automatic Electricity Counters, Traffic Signals, Taxi Meters, Fuel Management Systems, Process Monitoring or Control, Satellite Communications, Portable "Battery" Operated Equipment, Fare Collection System, POS Terminals, Mail Sorters, Scale, Flow Metering, Eiectronic Slot Machines, Water Heat Controllers. | | | | |

# Super Capacitor Thin Type HP Series

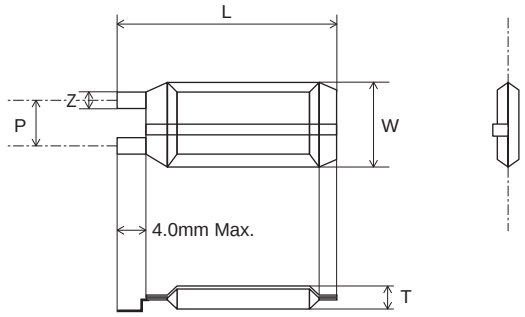
## Features

- More smaller square size than conventional ED/L series
- Low ESR
- Capable of current discharge in the order of amperes (A)
- Excellent low temperature features (can be used at -25˚C)
- Thin (t:2.3mm, refer to dimensions)
- Environmentally safe

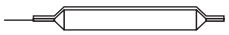
## Applications

- Assistance for peak current demand of mobile systems
- Smoothing voltage fluctuation as a smoothing capacitor in circuit with large current fluctuation

## Dimensions

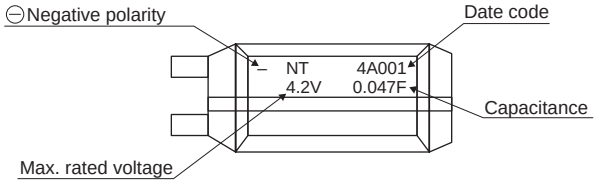



Lead form : L (kink forming type)



Lead form : S (straight forming type)

## Markings




| Size code | L Max. (mm) | W Max. (mm) | T Max. (mm) | Z (mm) | P (mm) |
|---|---|---|---|---|---|
| SK | 29.5 | 12 | 2.3 | 2 | 5.0±0.5 |
| SL | 34 | 14 | 2.3 | 2.5 | 7.5±0.5 |
| SN | 42.5 | 17 | 2.3 | 3 | 10±0.5 |

## Part Number System

**HP S N 0G 473 Z L**

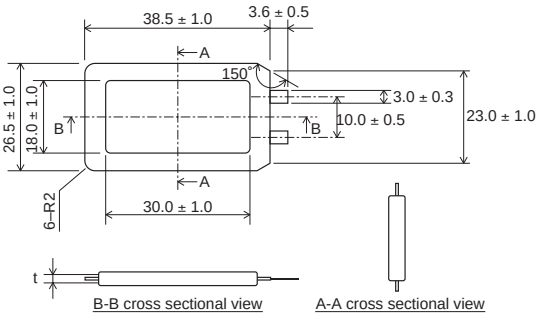
- L — Lead form
  L: kink forming, S: straight forming
- Z — Capacitance tolerance
  From +80% to –20%
- 473 — Capacitance ( $\mu$F)
  First two digits represent significant figure. Third digit specifies number of zeroes to follow microfarad code.
- 0G — Maximum rated voltage
  0G: 4.2V
- SN — Size code
- HP — Series Name
  HP: HP series

## Standard Rating

| Part Number | Max. Rated Voltage (Vdc) | Nominal Capacitance (F) | Max. ESR (at 1kHz) (Ω) |
|---|---|---|---|
| HPSN0G473ZL | 4.2 | 0.047 | 200 |
| HPSL0G223ZL | 4.2 | 0.022 | 250 |
| HPSK0G103ZL | 4.2 | 0.01 | 350 |

# Super Capacitor Thin Type ED/L Series

## Dimensions




t Dimensions : EDL473Z3R6-1 t = 2.0 ± 0.5mm
EDL223Z7R0-1 t = 3.4 ± 0.5mm

## Part Number System

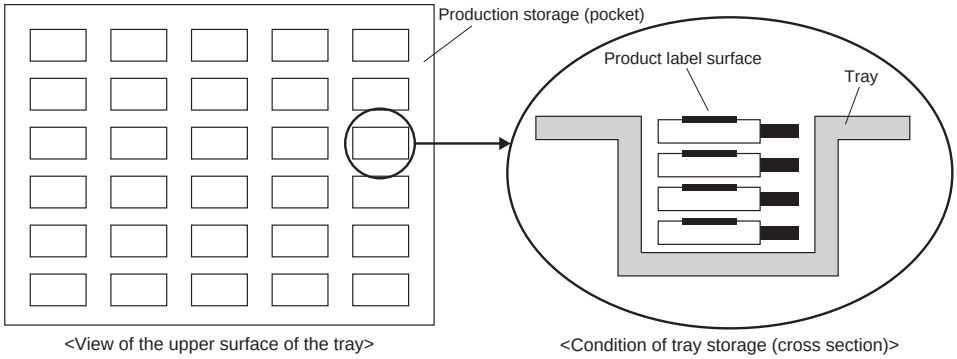
**EDL 473 Z 3R6 - 1**

- Range of temperature for use
  1: -25˚C to 70˚C
- Rated voltage (example) 3R6: 3.6V
- Capacitance tolerance
  Z: +80%, –20%
- Capacitance ($\mu$F)
  First two digits represent significant figures. Third digit specifies number of zeros to follow microfarad code.
- Series Name

## Standard Rating

| Part Number | Rated Voltage (Vdc) | Maximum Rated Voltage (Vdc) | Nominal Capacitance (F) | ESR (mΩ) |
|---|---|---|---|---|
| EDL473Z3R6-1 | 3.6 | 4.2 | 0.047 | 200 or less |
| EDL223Z7R0-1 | 7.0 | 7.8 | 0.022 | 300 or less |

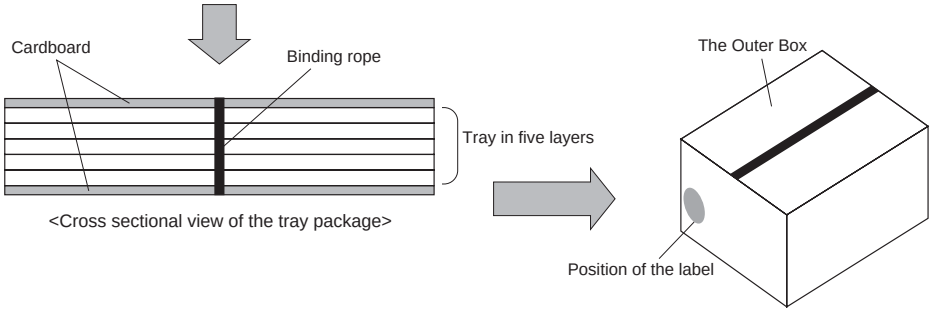
# Packaging




<View of the upper surface of the tray>

<Condition of tray storage (cross section)>

Number of units in the package
HPSN0G473ZL: 750 units/box
HPSL0G223ZL: 750 units/box
HPSK0G103ZL: 750 units/box
EDL473Z3R6-1: 750 units/box
EDL223Z7R0-1: 600 units/box




<Cross sectional view of the tray package>

<Condition of the packaging>

# Specifications HP Series

<table>
<tr><th>Item</th><th colspan="3">Specification</th><th>Test Condition (Refer to EIAJ RC-2377)</th></tr>
<tr><td>Operating Temperature Range</td><td colspan="3">–25°C to +70˚C</td><td></td></tr>
<tr><td>Maximum Rated Voltage (V.dc)</td><td colspan="3">Refer to standard ratings</td><td></td></tr>
<tr><td>Capacitance</td><td colspan="3">Refer to standard ratings</td><td rowspan="2">Impedance method (at 1Hz)</td></tr>
<tr><td>Capacitance Allowance</td><td colspan="3">+80%, –20%</td></tr>
<tr><td>ESR</td><td colspan="3">Refer to standard ratings</td><td>Impedance method (at 1kHz)</td></tr>
<tr><td>DC Leakage Current</td><td colspan="3">5mA or less</td><td>Rated Voltage, Rs=0.1Ω, 5minute</td></tr>
<tr><td>Lead Strength (Tensile)</td><td colspan="3">No loosening nor permanent damage of the leads</td><td>Refer to "JIS C 5101-14.13"</td></tr>
<tr><td rowspan="4">Surge Voltage</td><td>Capacitance</td><td>Initial requirement</td><td rowspan="4">Temp: 70±2˚C<br>Voltage: 4.7V<br>Charge: 30 sec.<br>Discharge: 330 sec. 1000 cycles.</td></tr>
<tr><td>ESR</td><td>Shall not exceed 120% of initial requirements</td></tr>
<tr><td>LC</td><td>Initial requirement</td></tr>
<tr><td>Visual</td><td>There shall be no evidence of mechanical damage</td></tr>
<tr><td rowspan="4">Vibration Resistance</td><td>Capacitance</td><td rowspan="3">Initial requirement</td><td rowspan="4">Frequency: 10 to 55 Hz<br>Amplitude of vibration: 0.75mm<br>2 hr each in three directions</td></tr>
<tr><td>ESR</td></tr>
<tr><td>LC</td></tr>
<tr><td>Visual</td><td>There shall be no evidence of mechanical damage</td></tr>
<tr><td rowspan="4">Soldering Heat Resistance</td><td>Capacitance</td><td rowspan="3">Initial requirement</td><td rowspan="3">Using soldering iron<br>Iron temperature 320˚C Max, Time 3 sec. Max.<br>Iron power 30 W Max.</td></tr>
<tr><td>ESR</td></tr>
<tr><td>LC</td></tr>
<tr><td>Visual</td><td>There shall be no evidence of mechanical damage</td><td>(Attach at a point 2mm from the tip of the terminal)</td></tr>
<tr><td colspan="2">Solderbility</td><td colspan="2">Over 75% of the terminal surface shall be covered by a continuous new solder coating after immersion</td><td>Refer to JIS C 5101-14.15<br>Solder temp.: 230±5˚C<br>Immersion time: 5±0.5 sec.<br>Solder immersion: 1.5mm</td></tr>
<tr><td rowspan="9">Temperature Variation of Characteristics</td><td rowspan="3">Step 2</td><td>Capacitance</td><td>Shall be exceed 50% of initial requirement</td><td rowspan="9">Measurements shall be made at each of the temperatures specified above after the capacitor has reached thermal stability<br>Step 1: +20±2˚C<br>Step 2: –25±3˚C<br>Step 3: +20±2˚C<br>Step 4: +70±2˚C<br>Step 5: +20±2˚C<br>*) Thermal stability<br>The condition of thermal stability is judged to be reached when two readings of ESR taken at an interval of not less than 5 min do not differ by an amount greater than which can be attributed to the measuring apparatus.</td></tr>
<tr><td>ESR</td><td>Shall not be exceed 500% of initial requirement</td></tr>
<tr><td>LC</td><td>Initial requirement</td></tr>
<tr><td rowspan="3">Step 4</td><td>Capacitance</td><td>Shall not be exceed 200% of initial requirement</td></tr>
<tr><td>ESR</td><td rowspan="2">Initial requirement</td></tr>
<tr><td>LC</td></tr>
<tr><td rowspan="3">Step 5</td><td>Capacitance</td><td rowspan="3">Initial requirement</td></tr>
<tr><td>ESR</td></tr>
<tr><td>LC</td></tr>
<tr><td colspan="2" rowspan="4">Humidity Resistance</td><td>Capacitance</td><td>Within ±30% of initial requirement</td><td rowspan="4">Refer to JIS C 5101-14.22<br>Temperature: 40±2˚C, Moisture: 90 to 95% R.H.<br>Duration: 500(–0 to +24)hr,<br>The specimen shall then remain under standard atmospheric condition for recovery for a period adequate for the attainment of temperature stability, with 12 to 24hr.</td></tr>
<tr><td>ESR</td><td>Shall not exceed 300% of initial requirement</td></tr>
<tr><td>LC</td><td>Initial requirement</td></tr>
<tr><td>Visual</td><td>There shall be no evidence of mechanical damage</td></tr>
<tr><td colspan="2" rowspan="4">High Temperature Load</td><td>Capacitance</td><td>Within ±30% of initial requirement</td><td rowspan="4">Refer to JIS C 5101-14.23<br>Temperature: 70±2˚C, Duration: 1000 (–0 to +48) hr,<br>Rated voltage applied<br>The specimen shall then remain under standard atmospheric condition for recovery for a period adequate for the attainment of temperature stability, with 12 to 24hr.</td></tr>
<tr><td>ESR</td><td>Shall not exceed 300% of initial requirements</td></tr>
<tr><td>LC</td><td>Initial requirement</td></tr>
<tr><td>Visual</td><td>There shall be no evidence of mechanical damage</td></tr>
<tr><td colspan="2" rowspan="4">Temperature Cycle</td><td>Capacitance</td><td rowspan="3">Initial requirement</td><td rowspan="4">Refer to JIS C 5101-14.16<br>Temperature: –25 to 70˚C<br>
<table>
<tr><th>Step</th><th>Temp.</th><th>Time</th></tr>
<tr><td>1</td><td>–25˚C</td><td>30±3 min.</td></tr>
<tr><td>2</td><td>Room Temp.</td><td>3min. Max.</td></tr>
<tr><td>3</td><td>+70˚C</td><td>30±3 min.</td></tr>
<tr><td>4</td><td>Room Temp.</td><td>3min. Max.</td></tr>
</table>
</td></tr>
<tr><td>ESR</td></tr>
<tr><td>LC</td></tr>
<tr><td>Visual</td><td>There shall be no evidence of mechanical damage</td></tr>
</table>

# Specifications ED/L Series

| Item | | Specification | | Test Condition (Refer to EIAJ RC-2377) |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70˚C | | |
| Maximum Rated Voltage (V.dc) | | Refer to standard ratings | | |
| Rated Voltage (V.dc) | | Refer to standard ratings | | |
| Capacitance | | Refer to standard ratings | | Impedance method (at 1Hz) |
| Capacitance Allowance | | +80%, –20% | | |
| ESR | | Refer to standard ratings | | Impedance method (at 1kHz) |
| DC Leakage Current | | 5mA or less | | Rated Voltage, Rs=0.1Ω, 5minute |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Refer to "JIS C 5101-14.13" |
| Surge Voltage | | Capacitance | Initial requirement | Temp: 70±2˚C<br>Voltage: EDL473Z3R6-1: 4.4V<br>EDL223Z7R0-1: 7.8V<br>Charge: 30 sec.<br>Discharge: 330 sec. 1000 cycles. |
| | | ESR | Shall not exceed 120% of initial requirements | |
| | | LC | Initial requirement | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Vibration Resistance | | Capacitance | Initial requirement | Frequency: 10 to 55 Hz<br>Amplitude of vibration: 0.75mm<br>2 hr each in three directions |
| | | ESR | | |
| | | LC | | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Soldering Heat Resistance | | Capacitance | Initial requirement | Using soldering iron<br>Iron temperature 320˚C Max, Time 3 sec. Max.<br>Iron power 30 W Max.<br>(Attach at a point 2mm from the tip of the terminal) |
| | | ESR | | |
| | | LC | | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Solderbility | | Over 75% of the terminal surface shall be covered by a continuous new solder coating after immersion | | Refer to JIS C 5101-14.15<br>Solder temp.: 230±5˚C<br>Immersion time: 5±0.5 sec.<br>Solder immersion: 1.5mm |
| Temperature Variation of Characteristics | Step 2 | Capacitance | Shall be exceed 50% of initial requirement | Measurements shall be made at each of the temperatures specified above after the capacitor has reached thermal stability<br>Step 1: +20±2˚C<br>Step 2: –25±3˚C<br>Step 3: +20±2˚C<br>Step 4: +70±2˚C<br>Step 5: +20±2˚C<br>*) Thermal stability<br>The condition of thermal stability is judged to be reached when two readings of ESR taken at an interval of not less than 5 min do not differ by an amount greater than which can be attributed to the measuring apparatus. |
| | | ESR | Shall not be exceed 500% of initial requirement | |
| | | LC | Initial requirement | |
| | Step 4 | Capacitance | Shall not be exceed 200% of initial requirement | |
| | | ESR | Initial requirement | |
| | | LC | | |
| | Step 5 | Capacitance | Initial requirement | |
| | | ESR | | |
| | | LC | | |
| Humidity Resistance | | Capacitance | Within ±30% of initial requirement | Refer to JIS C 5101-14.22<br>Temperature: 40±2˚C, Moisture: 90 to 95% R.H.<br>Duration: 500(–0 to +24)hr,<br>The specimen shall then remain under standard atmospheric condition for recovery for a period adequate for the attainment of temperature stability, with 12 to 24hr. |
| | | ESR | Shall not exceed 300% of initial requirement | |
| | | LC | Initial requirement | |
| | | Visual | There shall be no evidence of mechanical damage | |
| High Temperature Load | | Capacitance | Within ±30% of initial requirement | Refer to JIS C 5101-14.23<br>Temperature: 70±2˚C, Duration: 1000 (–0 to +48) hr,<br>Rated voltage applied<br>The specimen shall then remain under standard atmospheric condition for recovery for a period adequate for the attainment of temperature stability, with 12 to 24hr. |
| | | ESR | Shall not exceed 300% of initial requirement | |
| | | LC | Initial requirement | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Temperature Cycle | | Capacitance | Initial requirement | Refer to JIS C 5101-14.16<br>Temperature: –25 to 70˚C<br>Step / Temp. / Time<br>1 / –25˚C / 30±3 min.<br>2 / Room Temp. / 3min. Max.<br>3 / +70˚C / 30±3 min.<br>4 / Room Temp. / 3min. Max. |
| | | ESR | | |
| | | LC | | |
| | | Visual | There shall be no evidence of mechanical damage | |

# FC Series

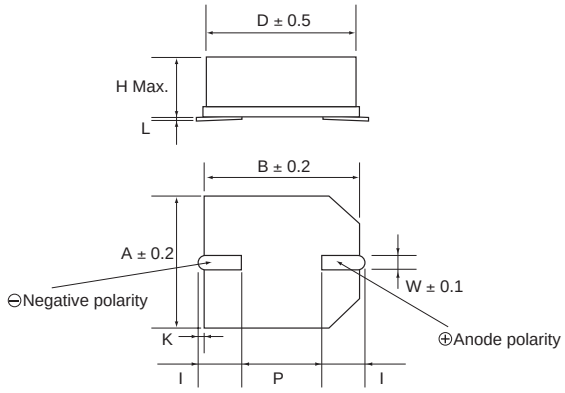
## Features

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

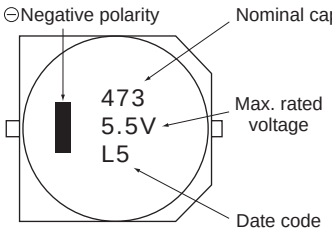
## Applications

- Subsidiary power supply.
  Buck up power supply line.
  Memory backup during battery exchange.

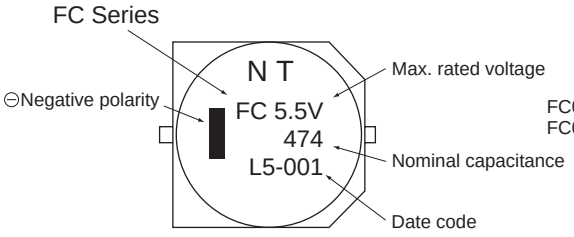
## Dimensions




## Markings




FC0H473ZTBR24
FC0H104ZTBR24
FC0H224ZTBR24
FC0V104ZTBR24
FC0V224ZTBR24
FC0V474ZTBR24




FC0H474ZTBR32
FC0H105ZTBR44

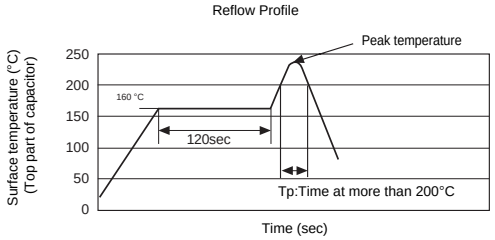
## Standard Rating

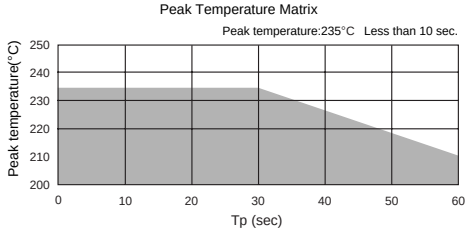
| Part Number | Max. Rated Voltage (Vdc) | Nominal Capacitance Discharge system (F) | Max. ESR (at 1kHz) (Ω) | Max. current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) | Dimension (Unit:mm) | | | | | | | | | Weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | D | H | A | B | I | W | P | K | L | |
| FC0H473ZTBR24 | 5.5 | 0.047 | 50 | 0.071 | 4.2 | 10.5 | 5.5 | 10.8 | 10.8 | 3.6±0.5 | 1.2 | 5.0 | 0.7±0.2 | $0^{+0.3}_{-0.1}$ | 1.0 |
| FC0H104ZTBR24 | 5.5 | 0.10 | 25 | 0.15 | 4.2 | 10.5 | 5.5 | 10.8 | 10.8 | 3.6±0.5 | 1.2 | 5.0 | 0.7±0.2 | $0^{+0.3}_{-0.1}$ | 1.0 |
| FC0H224ZTBR24 | 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±0.2 | $0^{+0.3}_{-0.1}$ | 1.4 |
| FC0H474ZTBR32 | 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±0.35 | $0^{+0.5}_{-0.1}$ | 4.0 |
| FC0H105ZTBR44 | 5.5 | 1.00 | 7 | 1.50 | 4.2 | 21.0 | 10.5 | 21.6 | 21.6 | 7.0±1.0 | 1.4 | 10.0 | 1.2±0.35 | $0^{+0.5}_{-0.1}$ | 6.7 |
| FC0V104ZTBR24 | 3.5 | 0.10 | 50 | 0.090 | – | 10.5 | 5.5 | 10.8 | 10.8 | 3.6±0.5 | 1.2 | 5.0 | 0.7±0.2 | $0^{+0.3}_{-0.1}$ | 1.0 |
| FC0V224ZTBR24 | 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±0.2 | $0^{+0.3}_{-0.1}$ | 1.0 |
| FC0V474ZTBR24 | 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±0.2 | $0^{+0.3}_{-0.1}$ | 1.4 |

## Precautions for use

- This capacitor is exclusive use of reflow soldering. It's designed for thermal conduction system such as infrared ray (IR) or heat blow.
  For applying other methods, Please consult with us first.
- Graph attheleft,"Reflow Condition" indicares the surface temperature at the top of capacitor.

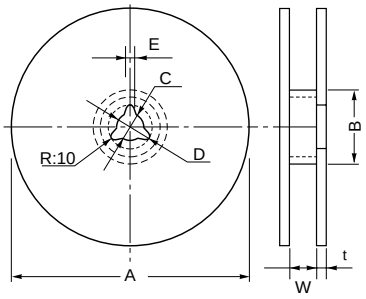
- Reflow Condition



# Tape and Reel Dimensions

[Reel Dimensions]

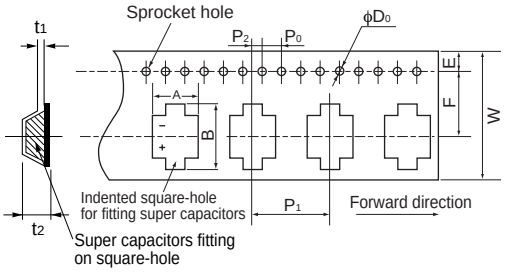



(mm)

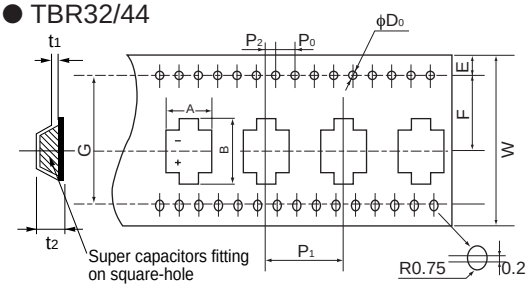
| Mark | TBR24 | | TBR32 | TBR44 |
|---|---|---|---|---|
| A | 380±2 | | 330±2 | 370±2 |
| B | Product height 5.5mm | 80±1 | 100±1 | 100±1 |
| | Product height 8.5mm | 100±1 | | |
| C | 13±0.5 | | 13±0.5 | 13±0.5 |
| D | 21±0.8 | | 21±0.8 | 23±0.8 |
| E | 2±0.5 | | 2±0.5 | 2±0.5 |
| W | 25.5±0.5 | | 33.5±0.5 | 45.5±0.5 |
| t | Product height 5.5mm | 3.0 | 2.8 | 2.8 |
| | Product height 8.5mm | 2.8 | | |

Dimensions of indented [square-hole plastic tape]

● TBR24




● TBR32/44




(mm)

| Mark | TBR24 | | TBR32 | TBR44 |
|---|---|---|---|---|
| W | 24.0 | | 32.0 | 44.0 |
| A | 11.4 | | 18.0 | 23.0 |
| B | 13.0 | | 20.0 | 25.0 |
| $P_0$ | 4.0 | | 4.0 | 4.0 |
| $P_1$ | 16.0 | | 24.0 | 32.0 |
| $P_2$ | 2.0 | | 2.0 | 2.0 |
| F | 11.5 | | 14.2 | 20.2 |
| $\phi D_0$ | 1.55 | | 1.55 | 1.55 |
| $t_1$ | 0.4 | | 0.5 | 0.5 |
| E | 1.75 | | 1.75 | 1.75 |
| $t_2$ | Product height 5.5mm | 6.0 | 10.0 | 12.0 |
| | Product height 8.5mm | 8.4 | | |
| G | – | | 28.4 | 40.4 |

Number of pachaged Super capacitors

| Part Number | Packaging |
|---|---|
| FC0H473ZTBR24 | 1000pcs./reel |
| FC0H104ZTBR24 | 1000pcs./reel |
| FC0H224ZTBR24 | 500pcs./reel |
| FC0H474ZTBR32 | 200pcs./reel |
| FC0H105ZTBR44 | 150pcs./reel |
| FC0V104ZTBR24 | 1000pcs./reel |
| FC0V224ZTBR24 | 1000pcs./reel |
| FC0V474ZTBR24 | 500pcs./reel |

# Specifications 5.5V Type

| Item | | Standard | | Test Conditions conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70˚C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | 0.047 to 1.0F | | See characteristics measuring method. |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| *Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 6.3 V(5.5V products)<br>Temperature: 70 ± 2˚C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Charge resistance: 0.047F 300 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| *Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| *Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| *Soldering Heat Resistance | | Capacitance | Satisty initial standard value | |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious able abnormality | |
| *Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| *Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| *High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| *Voltage Holding Characteristics (Self Dischage ) | | Voltage between terminal leads higher than 4.2 V | | Charging condition: Voltage applied: 5.0 VDC<br>Series resistance: 0 Ω<br>Charging time: 24hours |
| | | | | Storage: Time: 24hours<br>Temperature:Lower than 25°C |

* The characteristics above must be satisfied for asterisked items after the end of reflow soldering (according to the reflow condition shown on page ).

# Specifications 3.5V Type

| Item | | Standard | | Test Conditions conforming to JIS C 5012-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 3.5 VDC | | |
| Nominal Capacitance Range | | 0.10 to 0.47F | | See characteristics measuring method. |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| *Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 4.0 V(3.5V products)<br>Temperature: 70 ± 2°C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Charge resistance : 0.10F 150 Ω<br>: 0.22F 56 Ω<br>: 0.47F 30 Ω<br>: 1.0F 15 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| *Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| *Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| *Soldering Heat Resistance | | Capacitance | Satisty initial standard value | |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious able abnormality | |
| *Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| *Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| *High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 3.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000\ ^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

* The characteristics above must be satisfied for asterisked items after the end of reflow soldering (according to the reflow condition shown on page ).

# FT Series

The FT series Super Capacitors are ideal as short-time (30 minutes max.) backup devices in small and lightweight systems. 5.5 VDC (0.10 F to 5.6 F)

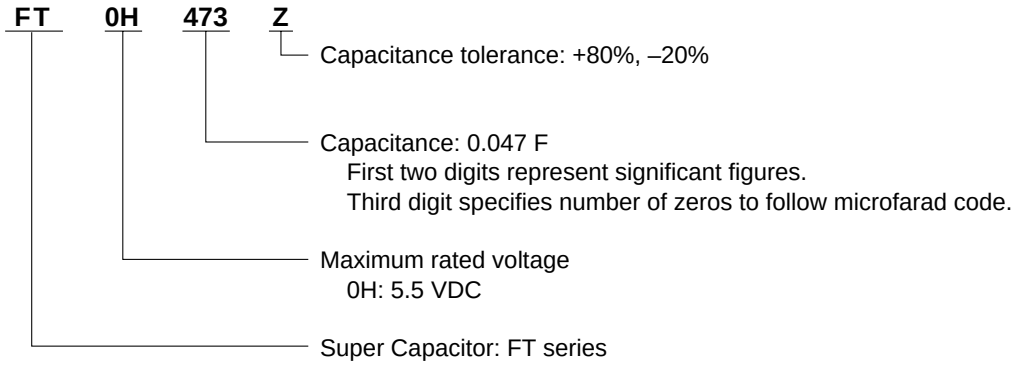
## Features

- Ideal for supplying current of several hundred $\mu$A to several mA for short time

## Applications

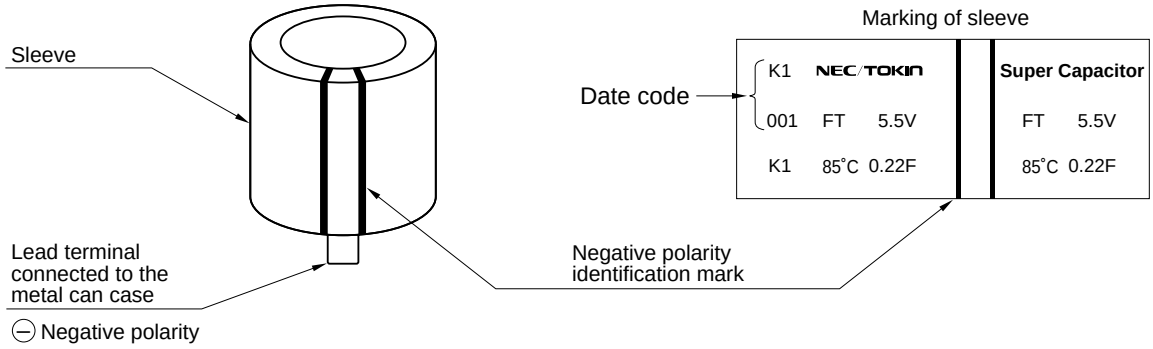
- Backup source for microcomputers and buffer for momentary high-current loads (for example, motors)

## Part Number System

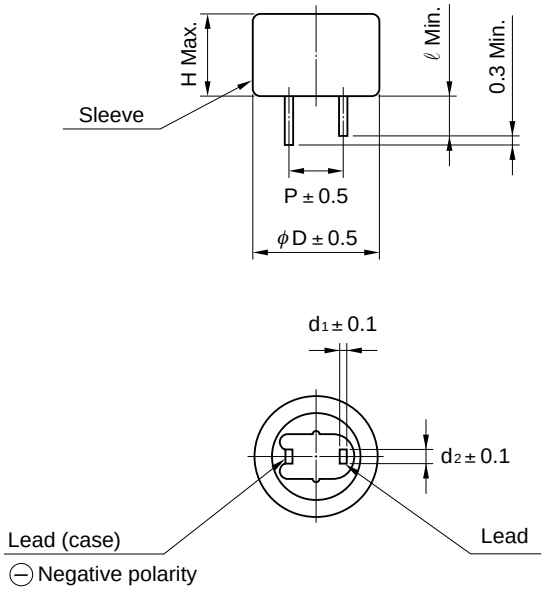


# Markings

Markings are made with black ink on the green sleeve.




# Dimensions and Standard Ratings




| Part No. | Dimensions mm (inch) | | | | | | Weight (g) (oz) |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | ℓ | |
| FT0H104Z | 11.5 (0.453) | 8.5 (0.335) | 5.08 (0.2) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.6 (0.057) |
| FT0H224Z | 14.5 (0.57) | 12.0 (0.47) | 5.08 (0.2) | 0.4 (0.016) | 1.2 (0.047) | 2.2 (0.087) | 4.1 (0.145) |
| FT0H474Z | 16.5 (0.65) | 13.0 (0.512) | 5.08 (0.2) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 5.3 (0.187) |
| FT0H105Z | 21.5 (0.85) | 13.0 (0.512) | 7.62 (0.3) | 0.6 (0.024) | 1.2 (0.047) | 3.0 (0.118) | 10.0 (0.353) |
| FT0H225Z | 28.5 (1.12) | 14.0 (0.55) | 10.16 (0.4) | 0.6 (0.024) | 1.4 (0.055) | 6.1 (0.240) | 18.0 (0.635) |
| FT0H335Z | 36.5 (1.44) | 15.0 (0.588) | 15.00 (0.59) | 0.6 (0.024) | 1.7 (0.067) | 6.1 (0.240) | 38.0 (1.34) |
| FT0H565Z | 44.5 (1.75) | 17.0 (0.67) | 20.00 (0.79) | 1.0 (0.039) | 1.4 (0.055) | 6.1 (0.240) | 72.0 (2.54) |

**Note:** Weight is typical.

| Part Number | Max. Rated Voltage ( V ) | Nominal Capacitance Charge System ( F ) | Discharge System ( F ) | Max. ESR (at 1 kHz) ( Ω ) | Max. Current at 30 minutes ( mA ) |
|---|---|---|---|---|---|
| FT0H104Z | 5.5 | 0.10 | 0.14 | less than 16 | less than 0.15 |
| FT0H224Z | 5.5 | 0.22 | 0.28 | less than 10 | less than 0.33 |
| FT0H474Z | 5.5 | 0.47 | 0.60 | less than 6.5 | less than 0.71 |
| FT0H105Z | 5.5 | 1.0 | 1.3 | less than 3.5 | less than 1.5 |
| FT0H225Z | 5.5 | 2.2 | 2.8 | less than 1.8 | less than 3.3 |
| FT0H335Z | 5.5 | 3.3 | 4.2 | less than 1.0 | less than 5.0 |
| FT0H565Z | 5.5 | 5.6 | 7.2 | less than 0.6 | less than 8.4 |

# Specifications

| Item | | Specification | | Test Conditions conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –40˚C to +85˚C | | |
| Maximum Operating Voltage | | 5.5 Vdc | | |
| Nominal Capacitance Range | | 0.1 to 5.6 F (Refer to standard ratings) | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minute value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | At 85˚C Surge voltage 6.3 V<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>1000 cycles<br>Charge resistance:<br>0.10 F 150 Ω<br>0.22 F 56 Ω<br>0.47 F 30 Ω<br>1.0 F 15 Ω<br>2.2 F 10 Ω<br>3.3 F 10 Ω<br>5.6 F 10 Ω<br>Discharge resistance:<br>Not applicable (0 Ω) |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | More than 50 % of initial value | Conforms to 7.12<br>Phase 1: +25 ±2˚C<br>Phase 2: –25 ±2˚C<br>Phase 3: –40 ±2˚C<br>Phase 4: +25 ±2˚C<br>Phase 5: +85 ±2˚C<br>Phase 6: +25 ±2˚C |
| | | Equivalent Series Resistance | Not to exceed 3 times initial value | |
| | Phase 3 | Capacitance | More than 30 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed 7 times initial value | |
| | Phase 5 | Capacitance | Not to exceed 150 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed 1.5 CV (mA) | |
| | Phase 6 | ΔC/C | Within ±20 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2(1)<br>0.022 to 0.47 F: 1 kg, 10 sec.<br>1 F: 2.5 kg, 10 sec. |
| Vibration Resistance | | Capacitance | Meet initial requirement | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>230 ±5˚C<br>5 ±0.5 sec. 1.6 mm from body |
| Soldering Heat Resistance | | Capacitance | Meet initial requirement | Conforms to 8.5<br>260 ±10˚C, 10 ±1 sec.<br>Immersion depth:<br>1.6 mm from body |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Temperature Cycle | | Capacitance | Meet initial requirement | Conforms to 9.3<br>Temperatuve condition:<br>–40˚C → Normal temperature<br>→ +85˚C→ Normal temperature<br>Number of cycles : 5 cycles |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>40 ±2˚C, 90 to 95% RH<br>240 ± 8 hours |
| | | Equivalent Series Resistance | Not to exceed120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed120 % of initial requirement | |
| High Temperature Load | | Capacitance change | Within ±30% of initial value | Conforms to 9.10<br>Temperature: 85 ± 2˚C<br>Series resistance: 0 Ω<br>Applied voltage: 5.5 VDC<br>Time of test: $1000^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Not to exceed 200% of initial requirement | |
| | | Current at 30 minutes | Not to exceed 200% of initial requirement | |

# FG Series

The FG series includes small-size electric double-layer capacitors with excellent voltage holding characteristics. The FG series are ideal as long-time backup devices for minute-current loads in small and lightweight systems.

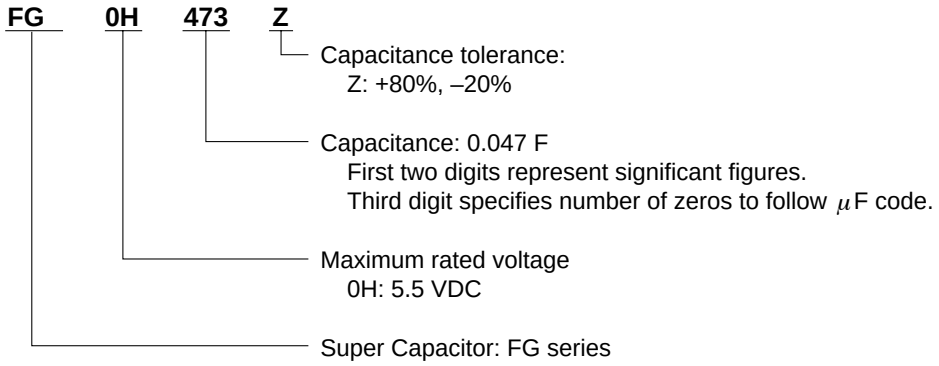
## Features

- The volume of the products is approx. 1/2 that of the FYD type products. (0.22F~2.2F)
- Added 4.7F/5.5V to series.
- Miniaturized 0.047F/5.5V and 0.10F/5.5V

## Applications

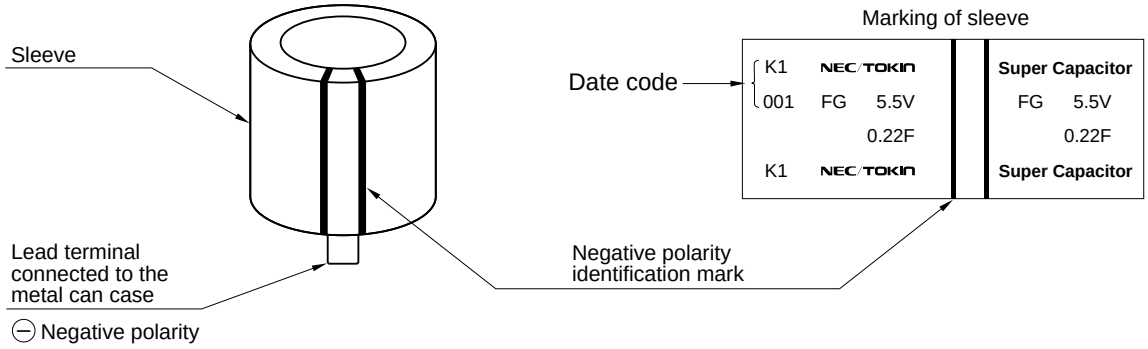
- Backup of CMOS microprocessors, static RAMs, DTSs (digital tuning systems)
- Memory backup of remote controllers and handy cassette player during battery exchange

## Part Number System

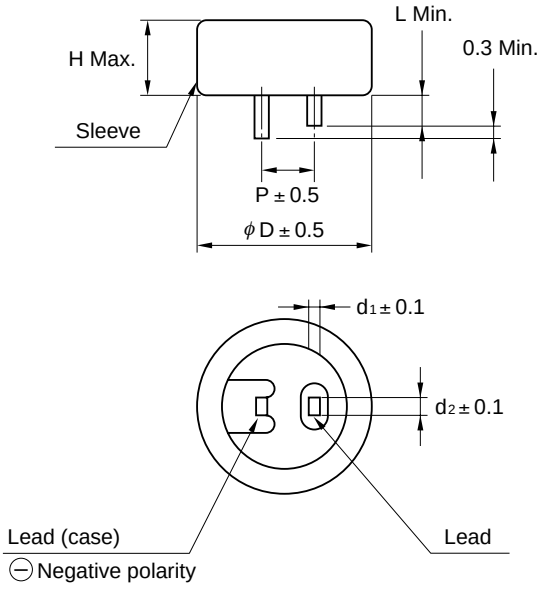


## Markings

Markings are made with black ink on the green sleeve.




## Dimensions and Standard Ratings




| Part No. | Dimensions mm (inch) | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g (oz) |
| FG0H103Z | 11.0 (0.43) | 5.5 (0.215) | 5.08 (0.200) | 0.2 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 0.9 (0.032) |
| FG0H223Z | 11.0 (0.43) | 5.5 (0.215) | 5.08 (0.200) | 0.2 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.0 (0.035) |
| FG0H473Z | 11.0 (0.43) | 5.5 (0.215) | 5.08 (0.200) | 0.2 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.0 (0.035) |
| FG0H104Z | 11.0 (0.43) | 6.5 (0.256) | 5.08 (0.200) | 0.2 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.3 (0.046) |
| FG0H224Z | 13.0 (0.512) | 9.0 (0.355) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.2 (0.087) | 2.5 (0.088) |
| FG0H474Z | 14.5 (0.571) | 18.0 (0.709) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.4 (0.095) | 5.1 (0.180) |
| FG0H105Z | 16.5 (0.65) | 19.0 (0.749) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 7.0 (0.247) |
| FG0H225Z | 21.5 (0.85) | 19.0 (0.749) | 7.62 (0.300) | 0.6 (0.024) | 1.2 (0.047) | 3.0 (0.118) | 12.1 (0.427) |
| FG0H475Z | 28.5 (1.122) | 22.0 (0.867) | 10.16 (0.400) | 0.6 (0.024) | 1.4 (0.055) | 6.1 (0.240) | 27.3 (0.964) |

**Note:** Weight is typical.

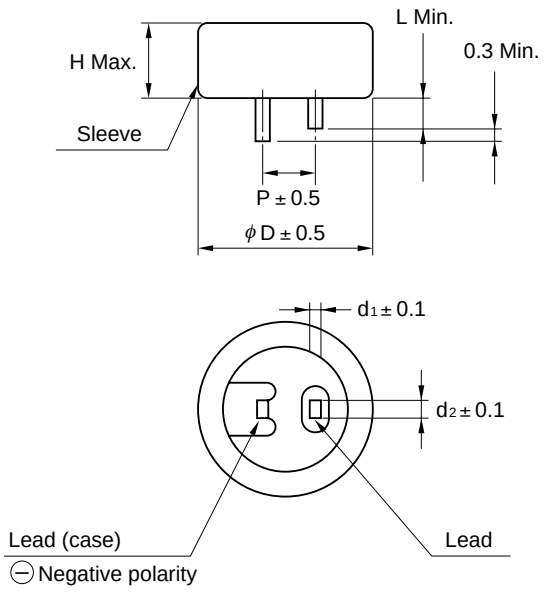
| Part Number | Max. Rated Voltage (V) | Nominal Capacitance Charge System (F) | Nominal Capacitance Discharge System (F) | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min.(V) |
|---|---|---|---|---|---|---|
| FG0H103Z | 5.5 | 0.01 | 0.013 | 300 | 0.015 | 4.2 |
| FG0H223Z | 5.5 | 0.022 | 0.028 | 200 | 0.033 | 4.2 |
| FG0H473Z | 5.5 | 0.047 | 0.060 | 200 | 0.071 | 4.2 |
| FG0H104Z | 5.5 | 0.10 | 0.13 | 100 | 0.15 | 4.2 |
| FG0H224Z | 5.5 | 0.22 | 0.28 | 100 | 0.33 | 4.2 |
| FG0H474Z | 5.5 | 0.47 | 0.60 | 120 | 0.71 | 4.2 |
| FG0H105Z | 5.5 | 1.0 | 1.3 | 65 | 1.5 | 4.2 |
| FG0H225Z | 5.5 | 2.2 | 2.8 | 35 | 3.3 | 4.2 |
| FG0H475Z | 5.5 | 4.7 | 6.0 | 35 | 7.1 | 4.2 |

# Specifications

| Items | | Standard | | Test Conditions Conforming to JIS C 5102-1994 | |
|---|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to +70˚C | | | |
| Maximum Operating Voltage. | | 5.5 Vdc | | | |
| Nominal Capacitance Range | | 0.010 to 4.7 F | | See characteristics measuring method | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring method | |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method | |
| Current (30-minute value) | | See standard list | | See characteristics measuring method | |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge voltage: 6.3V<br>Temperature: 70±2˚C<br>Charge: 30 sec.<br>Discharge: 9 min 30 sec.<br>Number of cycles: 1000 cycles<br>Series resistance:<br>0.010F: 1500 Ω 0.47F: 30 Ω<br>0.022F: 560 Ω 1.0F: 15 Ω<br>0.047F: 300 Ω 2.2F: 10 Ω<br>0.10F: 150 Ω 4.7F: 10 Ω<br>0.22F: 56 Ω<br>Discharge resistance: 0 Ω | |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | | |
| | | Current at 30 min. | Not to exceed 120% of initial requirement | | |
| | | Appearance | No obvious abnormality | | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ±2˚C<br>Phase 2: –25 ±2˚C<br>Phase 3: –40 ±2˚C<br>Phase 4: +25 ±2˚C<br>Phase 5: +70 ±2˚C<br>Phase 6: +25 ±2˚C | |
| | | Equivalent series resistance | 4 or less times initial value | | |
| | Phase 5 | Capacitance | 200% or below of initial value | | |
| | | Equivalent series resistance | Satisfy initial standard value | | |
| | | Current at 30 min. | 1.5 CV (mA) or below | | |
| | Phase 6 | Capacitance | Within ±20% of initial value | | |
| | | Equivalent series resistance | Satisfy initial standard value | | |
| | | Current at 30 min. | Satisfy initial standard value | | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1) | |
| Vibration Resistance | | Capacitance | Meet initial standard value | Conforms to 8.2.3 (1)<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours | |
| | | Equivalent series resistance | | | |
| | | Current at 30 min. | | | |
| | | Appearance | No obvious abnormality | | |
| Solderability | | 3 / 4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 230±5˚C<br>Dipping duration: 5±0.5 sec.<br>Should be dipped up to 1.6mm from the lower end of the capacitor | |
| Soldering Heat Resistance | | Capacitance | Should satisfy initial standard value | Conforms to 8.5<br>Solder temperature: 260±10˚C<br>Dipping duration: 10±1 sec.<br>Should be dipped up to 1.6mm from the lower end of the capacitor | |
| | | Equivalent series resistance | | | |
| | | Current at 30 min. | | | |
| | | Appearance | No obvious abnormality | | |
| Temperature Cycle | | Capacitance | Satisfy initial standard value | Conforms to 9.3<br>Temperature: –25˚C → normal temperature → +70˚C → normal temperature<br>Number of cycles: 5 cycles | |
| | | Equivalent series resistance | | | |
| | | Current at 30 min. | | | |
| | | Appearance | No obvious abnormality | | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40±2˚C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ±8hours | |
| | | Equivalent series resistance | 1.2 or less times initial standard value | | |
| | | Current at 30 min. | 1.2 or less times initial standard value | | |
| | | Appearance | No obvious abnormality | | |
| High Temperature Load | | Capacitance | Within ±30% of initial value | Conforms to 9.10<br>Temperature: 70±2˚C<br>Voltage applied: 5.5Vdc<br>Series protection resistance: 0Ω<br>Test duration: $1000^{+48}_{0}$ hours | |
| | | Equivalent series resistance | Twice or less times initial standard value | | |
| | | Current at 30 min. | Twice or less times initial standard value | | |
| | | Appearance | No obvious abnormality | | |
| Voltage Holding Characteristics (Self Discharge) | | Voltage between terminal leads higher than 4.2V | | Charging Condition | Voltage applied: 5.0VDC (with case side terminal negative)<br>Series resistance: 0Ω<br>Charging time: 24 hours |
| | | | | Storage | Time: 24 hours<br>Temperature: Lower than 25˚C<br>Humidity: Lower than 70%RH |

● **FGH Type**

## Dimensions and Standard Ratings




| Part No. | Dimensions mm | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g |
| FGH0H104Z | 11.0 | 5.5 | 5.08 | 0.2 | 1.2 | 2.7 | 1.0 |
| FGH0H224Z | 11.0 | 7.0 | 5.08 | 0.2 | 1.2 | 2.7 | 1.3 |
| FGH0H474Z | 16.5 | 8.0 | 5.08 | 0.4 | 1.2 | 2.7 | 4.1 |
| FGH0H105Z | 21.5 | 9.5 | 7.62 | 0.6 | 1.2 | 3.0 | 7.2 |

**Note:** Weight is typical.

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min.(V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FGH0H104Z | 5.5 | – | 0.10 | 100 | 0.15 | 4.2 |
| FGH0H224Z | 5.5 | – | 0.22 | 100 | 0.33 | 4.2 |
| FGH0H474Z | 5.5 | – | 0.47 | 65 | 0.71 | 4.2 |
| FGH0H105Z | 5.5 | – | 1.0 | 35 | 1.5 | 4.2 |

# Specifications FGH Type

| Items | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to +70˚C | | |
| Maximum Operating Voltage. | | 5.5 Vdc | | |
| Nominal Capacitance Range | | 0.10 to 1.0 F | | See characteristics measuring method |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring method |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method |
| Current (30-minute value) | | See standard list | | See characteristics measuring method |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge voltage: 6.3V<br>Temperature: 70±2˚C<br>Charge: 30 sec.<br>Discharge: 9 min 30 sec.<br>Number of cycles: 1000 cycles<br>Series resistance:<br>0.10F: 150 Ω<br>0.22F: 56 Ω<br>0.47F: 30 Ω<br>1.0F: 15 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of inital requirement | |
| | | Current at 30 min. | Not to exceed 120% of inital requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ±2˚C<br>Phase 2: –25 ±2˚C<br>Phase 3: –40 ±2˚C<br>Phase 4: +25 ±2˚C<br>Phase 5: +70 ±2˚C<br>Phase 6: +25 ±2˚C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current at 30 min. | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current at 30 min. | Satisfy initial standard value | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1) |
| Vibration Resistance | | Capacitance | Meet initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current at 30 min. | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3 / 4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 230±5˚C<br>Dipping duration: 5±0.5 sec.<br>Should be dipped up to 1.6mm from the lower end of the capacitor |
| Solder Heat Resistance | | Capacitance | Should satisfy initial standard value | Conforms to 8.5<br>Solder temperature: 260±10˚C<br>Dipping duration: 10±1 sec.<br>Should be dipped up to 1.6mm from the lower end of the capacitor |
| | | Equivalent series resistance | | |
| | | Current at 30 min. | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisfy initial standard value | Conforms to 9.3<br>Temperature: –25˚C → normal temperature → +70˚C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current at 30 min. | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40±2˚C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ±8hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current at 30 min. | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within ±30% of initial value | Conforms to 9.10<br>Temperature: 70±2˚C<br>Voltage applied: 5.5Vdc<br>Series protection resistance: 0Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current at 30 min. | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Discharge) | | Voltage between terminal leads higher than 4.2V | | Charging Condition: Voltage applied: 5.0VDC (with case side terminal negative)<br>Series resistance: 0Ω<br>Charging time: 24 hours |
| | | | | Storage: Time: 24 hours<br>Temperature: Lower than 25˚C<br>Humidity: Lower than 70%RH |

# FM Series for Automatic Assembly

The FM series includes small, resin-molded electric double-layer capacitors suitable for automatic assembly. These capacitors are ideal as long-time backup devices for minute-current loads in VCRs, audio systems, cordless telephones, and compact electronic systems. (FME types are backup devices adaptable to current consumption mA level.)

## Features

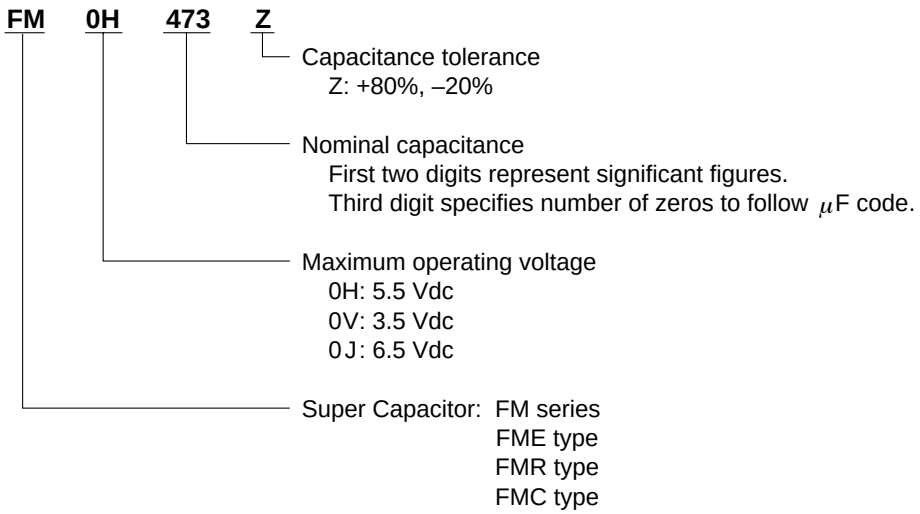
- High adaptability to automatic assembly
- Can be cleaned
- Excellent voltage holding characteristics ideal for long-time supply of 1 $\mu$A to several hundred $\mu$A (Except 3.5 V type, FME type)
- Space saving

## Applications

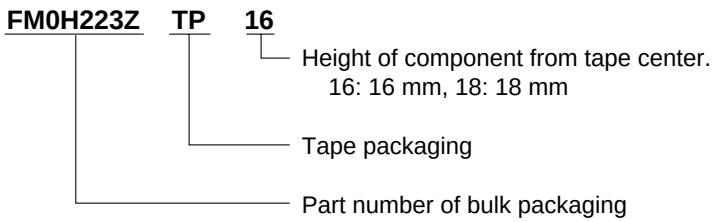
Backup of CMOS microcomputers, static RAMs, and DTSs

## Part Number System

• Bulk



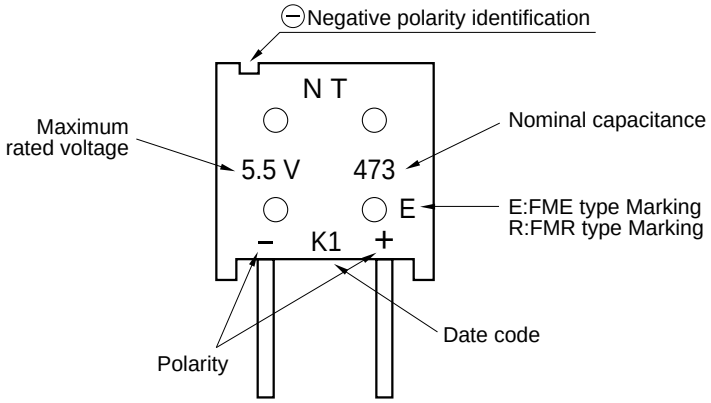

• Tape (Ammo Pack)



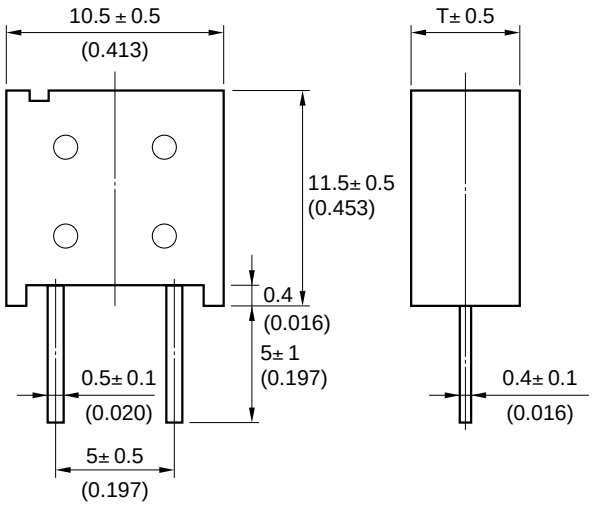

## Number of Packed Capacitors

Tape: 1000 pcs./box

## Markings




## Dimensions And Standard Ratings




Unit: mm
(inch)

### ● 5.5 V Type

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) | T mm (inch) | Weight g (oz) |
|---|---|---|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System (F) | Discharge System (F) | | | | | |
| FM0H103Z | FM0H103ZTP ( ) | 5.5 | 0.01 | 0.014 | 300 | 0.015 | 4.2 | 5.0 (0.197) | 1.3 (0.046) |
| FM0H223Z | FM0H223ZTP ( ) | 5.5 | 0.022 | 0.028 | 200 | 0.033 | 4.2 | 5.0 (0.197) | 1.3 (0.046) |
| FM0H473Z | FM0H473ZTP ( ) | 5.5 | 0.047 | 0.06 | 200 | 0.071 | 4.2 | 5.0 (0.197) | 1.3 (0.046) |
| FM0H104Z | FM0H104ZTP ( ) | 5.5 | 0.10 | 0.13 | 100 | 0.15 | 4.2 | 6.5 (0.256) | 1.6 (0.056) |
| FM0H224Z | FM0H224ZTP ( ) | 5.5 | – | 0.22 | 100 | 0.33 | 4.2 | 6.5 (0.256) | 1.6 (0.056) |

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

## ● 3.5 V Type

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | T mm (inch) | Weight g (oz) |
|---|---|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System (F) | Discharge System (F) | | | | |
| FM0V473Z | FM0V473ZTP ( ) | 3.5 | 0.047 | 0.06 | 200 | 0.042 | 5.0 (0.197) | 1.3 (0.046) |
| FM0V104Z | FM0V104ZTP ( ) | 3.5 | 0.10 | 0.13 | 100 | 0.090 | 5.0 (0.197) | 1.3 (0.046) |
| FM0V224Z | FM0V224ZTP ( ) | 3.5 | 0.22 | 0.30 | 100 | 0.20 | 6.5 (0.256) | 1.6 (0.056) |

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

## ● FME Type ( Backup Large Current , mA Order )

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | T mm (inch) | Weight g (oz) |
|---|---|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System (F) | Discharge System (F) | | | | |
| FME0H223Z | FME0H223ZTP ( ) | 5.5 | 0.022 | 0.028 | 40 | 0.033 | 5.0 (0.197) | 1.3 (0.046) |
| FME0H473Z | FME0H473ZTP ( ) | 5.5 | 0.047 | 0.06 | 20 | 0.071 | 5.0 (0.197) | 1.3 (0.046) |

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

## ● FMR Type ( Extended Operating Temperature range )

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min.(V) | T mm (inch) | Weight g (oz) |
|---|---|---|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System (F) | Discharge System (F) | | | | | |
| FMR0H473Z | FMR0H473ZTP ( ) | 5.5 | 0.047 | 0.062 | 200 | 0.071 | 4.2 | 6.5 | 1.6 |

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

## ● FM 6.5V Type

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | T mm (inch) | Weight g (oz) |
|---|---|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System (F) | Discharge System (F) | | | | |
| FM0J473Z | FM0J473ZTP ( ) | 6.5 | 0.047 | 0.062 | 200 | 0.085 | 6.5 | 1.6 |

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

# Specifications 5.5 V Type

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 6.3 V<br>Temperature: 70 ± 2°C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.01F: 1500 Ω 0.22F: 56 Ω<br>0.022 F: 560 Ω<br>0.047 F: 300 Ω<br>0.10 F: 150 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality. | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10sec. |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 230 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Discharge ) | | Voltage between terminal leads higher than 4.2 V | | Charging condition: Voltage applied: 5.0 VDC<br>Series resistance: 0 Ω<br>Charging time: 24hours |
| | | | | Storage: Time: 24hours<br>Temperature:Lower than 25°C<br>Humidity:Lower than 70%RH |

# Specifications 3.5 V Type

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 3.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge voltage: 4.0 V<br>Temperature: 70 ± 2°C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.047 F: 300 Ω<br>0.10 F: 150 Ω<br>0.22 F: 56 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10 sec |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No considerable abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 230 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from for the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from for the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 3.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

# Specifications FME Type

| Item | | Standard | | Test Conditions Conforming JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 7.4 V<br>Temperature: 70 ± 2°C<br>Chargs: 30 sec.<br>Dischargs: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.022 F: 560 Ω<br>0.047 F: 300 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 3 or less times initial value | |
| | Phase 5 | Capacitance | 150% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10 sec |
| Vibration Resistance | | Capacitance | Should satisty initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | There should be no considerable abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 230 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000\ ^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

# Specifications FMR Type

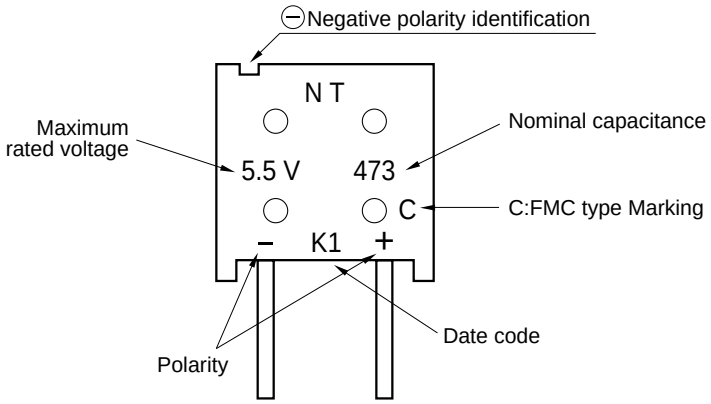
| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –40°C to +85°C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 6.3 V<br>Temperature: 85 ± 2°C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.047 F: 300 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +85 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 3 | Capacitance | 30% or higher initial value | |
| | | Equivalent series resistance | 7 or less times initial value | |
| | Phase 5 | Capacitance | 200% or higher initial value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial standard value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current (30-minute value) | Satisfy initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10sec. |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder. | | Conforms to 8.4<br>Solder temperature: 230 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–40°C → normal temperature<br>→ +85°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 85 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000\ ^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Discharge ) | | Voltage between terminal leads higher than 4.2 V | | Charging condition: Voltage applied: 5.0 VDC<br>Series resistance: 0 Ω<br>Charging time: 24hours |
| | | | | Storage: Time: 24hours<br>Temperature:Lower than 25°C<br>Humidity:Lower than 70%RH |

# Specifications FM 6.5V Type

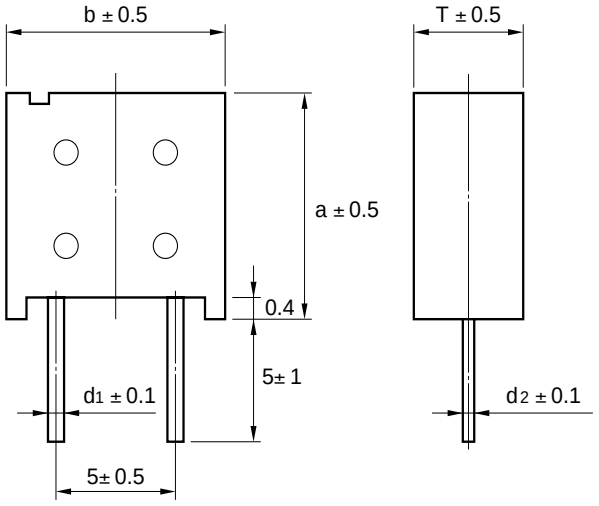
| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 6.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 7.4 V<br>Temperature: 70 ± 2°C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.047 F: 300 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10sec. |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 230 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 6.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

● **FMC Type**

## Markings




## Dimensions And Standard Ratings




Unit: mm

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance Charge System ( F ) | Discharge System ( F ) | Max. ESR (at 1 kHz) ( Ω ) | Max. Current at 30 minutes ( mA ) | Voltage Holding Characteristic Min. ( V ) | a (mm) | b (mm) | T (mm) | $d_1$ (mm) | $d_2$ (mm) | Weight ( g ) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ammo pack | | | | | | | | | | | | |
| FMC0H473Z | FMC0H473ZTP( ) | 5.5 | 0.047 | 0.062 | less than 100 | less than 0.071 | more than 4.2V | 11.5 | 10.5 | 5.0 | 0.5 | 0.4 | 1.3 |
| FMC0H104Z | FMC0H104ZTP( ) | 5.5 | 0.10 | 0.13 | less than 50 | less than 0.15 | more than 4.2V | 11.5 | 10.5 | 6.5 | 0.5 | 0.4 | 1.6 |
| FMC0H334Z | FMC0H334ZTP( ) | 5.5 | – | 0.33 | less than 25 | less than 0.50 | more than 4.2V | 15.0 | 14.0 | 9.0 | 0.6 | 0.6 | 3.5 |

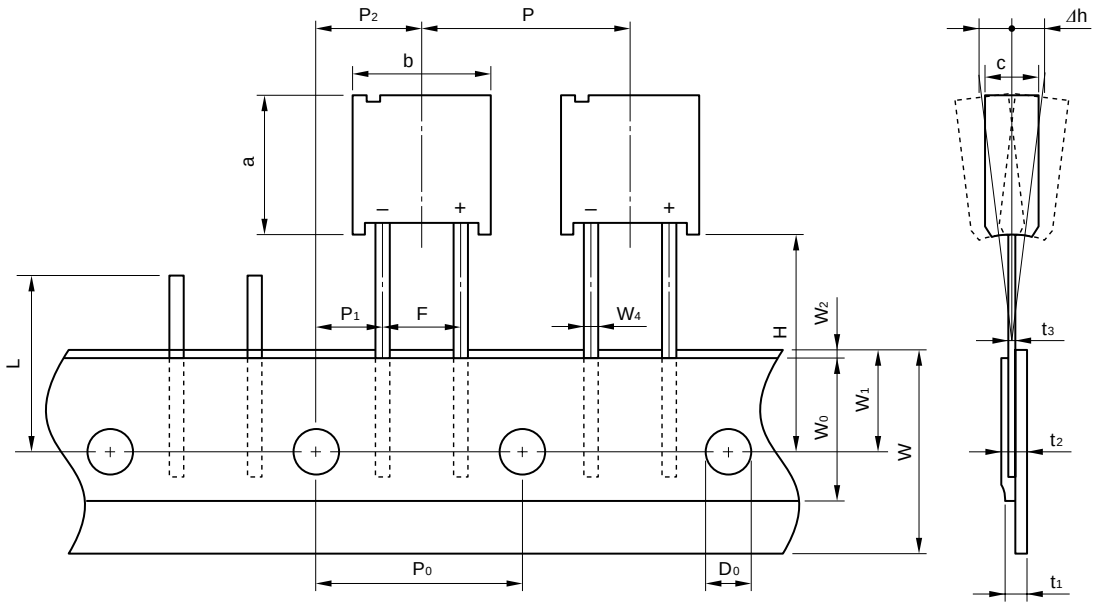
Chip parts applicable to treatment in bond hardening furnace (160 ± 5°C for 120 ±10 seconds)

Note: To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34 or 35.)

# Specifications FMC Type

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70˚C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | 0.047F , 0.10F , 0.33F | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 6.3 V<br>Temperature: 70 ± 2°C<br>Chargs: 30 sec.<br>Dischargs: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.047 F: 300 Ω<br>0.1 F: 150 Ω<br>0.33 F: 51 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality. | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tenile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10 sec |
| Vibration Resistance | | Capacitance | Should satisty initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | There should be no considerable abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 230 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Dischage) | | Voltage between terminal leads higher then 4.2V | | Charging condition: Voltage applied: 5.0 VDC<br>Series resistance: 0 Ω<br>Charging time: 24hours |
| | | | | Storage: Time: 24hours<br>Temperature:Lower than 25°C<br>Humidity:Lower than 70%RH |

# Taping Specification (Ammo pack) (except FMC0H334ZTP( ))



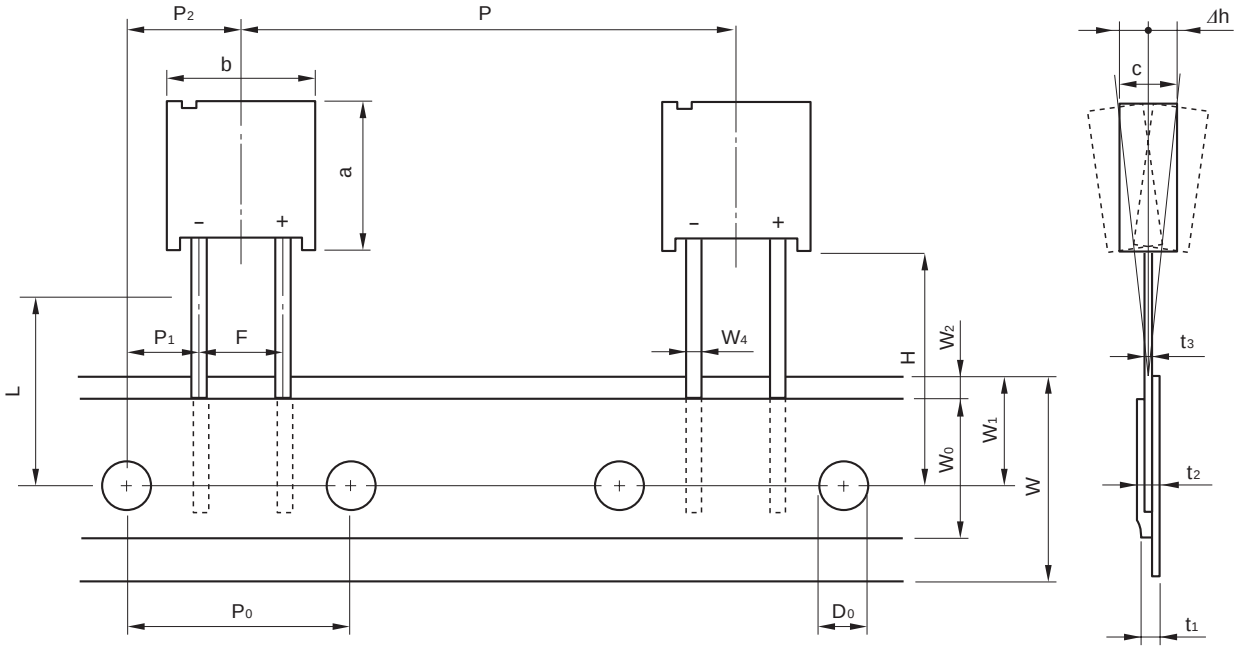

Unit : mm

| 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: 5.0/0.010 F~0.047 F, 6.5/0.10 F~0.22 F<br>3.5 V Type: 5.0/0.047 F~0.10 F, 6.5/0.22 F<br>FME Type: 5.0/0.022 F~0.047 F<br>6.5 Type: 6.5/0.022 F<br>FMR Type: 6.5/0.047 F<br>FMC Type: 5.0/0.047 F, 6.5/0.10 F |
| Lead-wire Width | $W_4$ | 0.5 | ±0.1 | |
| Lead-wire Thickness $t_3$ | $t_3$ | 0.4 | ±0.1 | |
| Pitch of Component | P | 12.7 | ±1.0 | |
| Sprocket Pitch | $P_0$ | 12.7 | ±0.3 | |
| Sprocket Hole Center to Lead | $P_1$ | 3.85 | ±0.7 | |
| Sprocket Hole to Component Center | $P_2$ | 6.35 | ±1.3 | |
| Lead Spacing | F | 5.0 | ±0.5 | |
| Component Alignment | $\Delta$h | 2.0 Max. | – | Including tiltiing caused by bending of 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 |
| Height of Component from Tape Center | 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. | – | |
| Length of Shipped Lead | L | 11.0 Max. | – | |

# Packing Quantity

1000 pcs. / box

# Taping Specifications [FMC0H334ZTP( )]



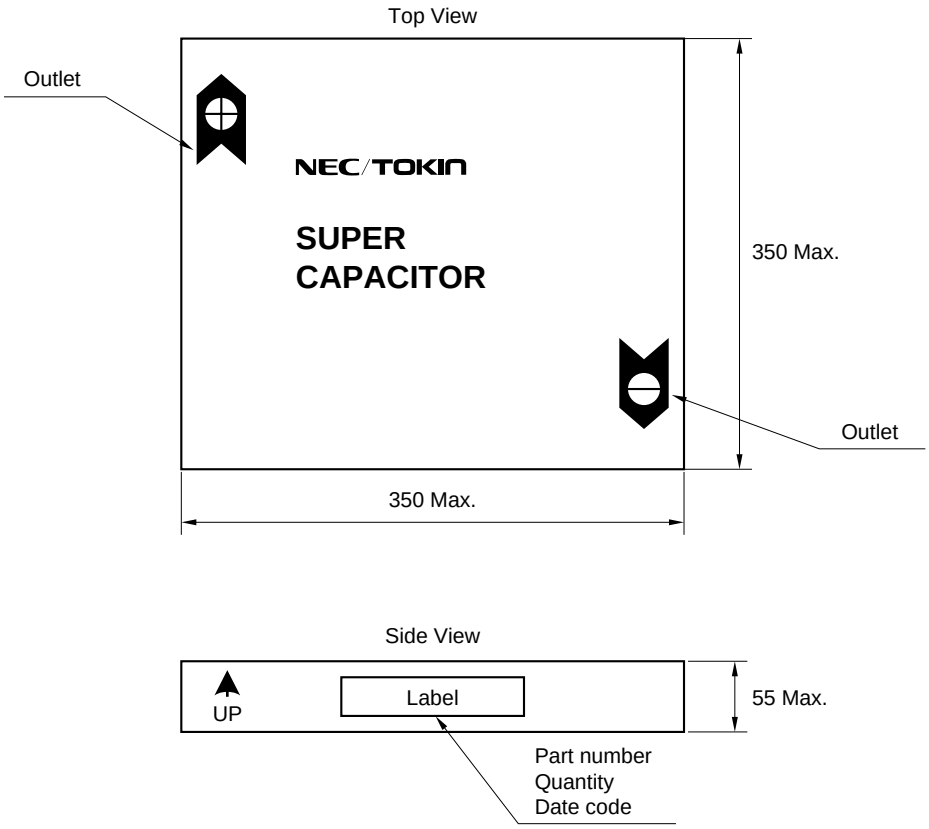

Unit : mm

| 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 of Component | P | 25.4 | ±1.0 | |
| Sprocket Pitch | $P_0$ | 12.7 | ±0.3 | |
| Sprocket Hole Center to Lead | $P_1$ | 3.85 | ±0.7 | |
| Sprocket Hole to Component Center | $P_2$ | 6.35 | ±1.3 | |
| Lead Spacing | F | 5.0 | ±0.5 | |
| Component Alignment | $\Delta$ h | 2.0 Max. | – | Including tiltiing caused by bending of 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 |
| Height of Component from Tape Center | H | 16.0 | ±0.5 | |
| | | 18.0 | ±0.5 | |
| Sprocket Hole Diameter | $D_0$ | $\phi$4.0 | ±0.2 | |
| Total tape thickness | $t_1$ | 0.67 | ±0.2 | |
| | $t_2$ | 1.7 Max. | – | |
| Length of Shipped Lead | L | 11.0 Max. | – | |

# Packing Quantity

400 pcs. / box

## Packing dimensions




## Marking of Box

Marking shows the following items.

(a) Terminal direction
(b) Part number
(c) Quantity
(d) Date code
(e) Company logo

## Packing Quantity :

1000 pcs. / box (Except FMC0H334ZTP( ))
400 pcs. / box (FMC0H334ZTP( ))

# FA Series for Large Backup Current Capacitors

The FA series is suitable for supplying a large current in a short time.
These capacitors are ideal for momentarily backing up a high-current, short-time load in an electronic system (in the event of momentary power failure).

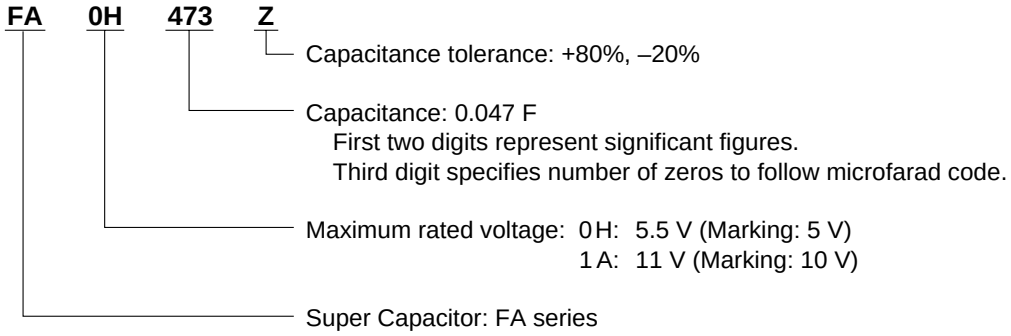
## Features

- Extremely low equivalent series resistance (ESR) ideal for supplying backup current of 10 mA to 1 A for a short time
- High breakdown voltage (maximum operating voltage: 11 V) that can drive microcomputers and actuators

## Applications

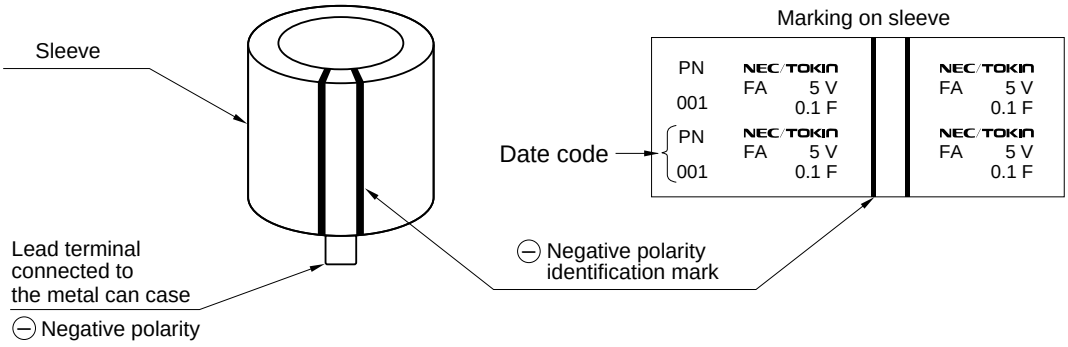
Momentary backup of microcomputers and DRAMs and auxiliary power supply of mechanical systems (motors, relays, electromagnetic valves)

## Part Number System

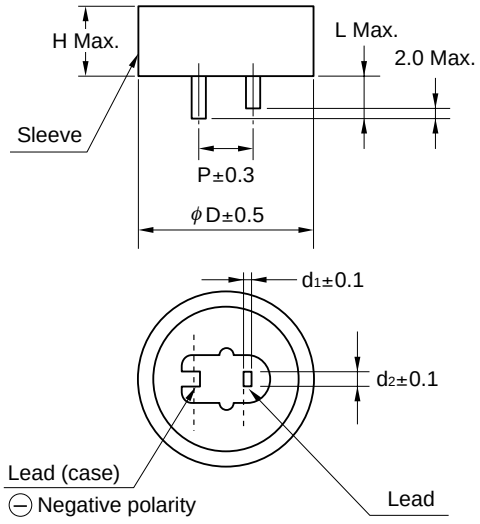


## Markings

Markings are made with black ink on the green sleeve.




## Dimensions and Standard Ratings




| Part No. | Dimensions mm (inch) | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g (oz) |
| FA0H473Z | 16.0 (0.630) | 15.5 (0.610) | 5.1 (0.2) | 0.4 (0.016) | 1.2 (0.047) | 5.0 (0.197) | 6.2 (0.219) |
| FA0H104Z | 21.5 (0.846) | 15.5 (0.610) | 7.6 (0.3) | 0.6 (0.024) | 1.2 (0.047) | 5.5 (0.217) | 12 (0.423) |
| FA0H224Z | 28.5 (1.122) | 16.5 (0.650) | 10.2 (0.4) | 0.6 (0.024) | 1.4 (0.055) | 9.5 (0.374) | 25 (0.882) |
| FA0H474Z | 36.5 (1.437) | 16.5 (0.650) | 15 (0.591) | 0.6 (0.024) | 1.7 (0.067) | 9.5 (0.374) | 42 (1.482) |
| FA0H105Z | 44.5 (1.752) | 18.5 (0.728) | 20 (0.787) | 1.0 (0.039) | 1.4 (0.055) | 9.5 (0.374) | 65 (2.293) |
| FA1A223Z | 16.0 (0.630) | 25.0 (0.984) | 5.1 (0.2) | 0.4 (0.016) | 1.2 (0.047) | 5.0 (0.197) | 7.5 (0.265) |
| FA1A104Z | 28.5 (1.122) | 25.5 (1.004) | 10.2 (0.4) | 0.6 (0.024) | 1.4 (0.055) | 9.5 (0.374) | 32 (1.129) |
| FA1A224Z | 36.5 (1.437) | 27.5 (1.083) | 15 (0.591) | 1.0 (0.039) | 1.4 (0.055) | 9.5 (0.374) | 55 (1.940) |
| FA1A474Z | 44.5 (1.752) | 28.5 (1.122) | 20 (0.787) | 1.0 (0.039) | 1.4 (0.055) | 9.5 (0.374) | 83 (2.928) |

**Note:** Weight values are typical.

| Part Number | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. Current at 30 minutes (mA) | Max. ESR (at 1 kHz) (Ω) |
|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | |
| FA0H473Z | 5.5 | 0.047 | 0.075 | 0.071 | 20 |
| FA0H104Z | 5.5 | 0.1 | 0.16 | 0.15 | 8 |
| FA0H224Z | 5.5 | 0.22 | 0.35 | 0.33 | 5 |
| FA0H474Z | 5.5 | 0.47 | 0.75 | 0.71 | 3.5 |
| FA0H105Z | 5.5 | 1.0 | 1.6 | 1.5 | 2.5 |
| FA1A223Z | 11 | 0.022 | 0.035 | 0.066 | 20 |
| FA1A104Z | 11 | 0.1 | 0.16 | 0.30 | 8 |
| FA1A224Z | 11 | 0.22 | 0.35 | 0.66 | 6 |
| FA1A474Z | 11 | 0.47 | 0.75 | 1.41 | 4 |

# Specifications

| Item | | Specification | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to 70˚C | | |
| Maximun Rated Voltage | | 5.5 VDC, 11.0 VDC | | |
| Nominal Capacitance Range | | 0.047 to 1.0 F (Refer to standard ratings) | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minute value) | | See standard list | | See characteristics measuring conditions |
| Temperature Variation of Characteristics | At min. temp. (–25˚C Step 2) | Capacitance | More than 70 % of initial value | Conforms to 7.14<br>Phase 1 : +25±2.0˚C<br>Phase 2 : –25±2.0˚C<br>Phase 3 : +25±2.0˚C<br>Phase 4 : +70±2.0˚C<br>Phase 5 : +25±2.0˚C |
| | | Equivalent Series Resistance | Not to exceed 3 times initial value | |
| | At max. temp. (+70˚C Step 4) | Capacitance | Not to exceed 150 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed 1.5 CV (mA) | |
| | At room temp. (+25˚C Step 5) | Capacitance | Not to change more than ±20 % from initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed initial requirement | |
| Lead Strength (Tensile) | | No loosening or permanent damage of the leads | | Conforms to 8.1.2 (1)<br>5.5 VDC: 0.047 F to 0.22 F: 1 kg 10 sec; 0.47 F to 1.0 F: 2.5 kg 10 sec<br>11 VDC: 0.022 F to 0.1 F: 1 kg 10 sec; 0.22 F to 0.47 F: 2.5 kg 10 sec |
| Vibration Resistance | | Capacitance | Meet initial requirement | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>230 ± 5˚C, 5 ± 0.5 sec.<br>Immersion depth:<br>2.5 mm from body |
| Soldering Heat Resistance | | Capacitance | Meet initial requirement | Conforms to 8.5<br>260 ±10˚C, 10 ±1 sec.<br>Immersion depth:<br>2.5 mm from body |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Temperature Cycle | | Capacitance | Meet initial requirement | Conforms to 9.3<br>Temperature conitiom:<br>–25˚C → normal temperature<br>→+70˚C normal temperature<br>Number of cycles : 5 cycles |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Humidity Resistance | | Capacitance | More than 90 % of initial requirement | Conforms to 9.5<br>40 ± 2˚C, 90 to 95 % RH<br>240 ± 8 hours |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| High Temperature Load | | Capacitance | More than 85 % of initial requirement | Conforms to 9.10<br>70 ± 2˚C<br>5.5 V applied for 5 V type<br>11 V applied for 10 V type<br>1 000 $^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 200 % of initial requirement | |

# FE Series for Large Backup Current Capacitors

The FE series offers small, high-capacitance electric double-layer capacitors suitable for supplying a large current in a short time.
These capacitors are ideal for momentarily backing up a large-current, short-time load in an electronic system (in the event of momentary power failure)

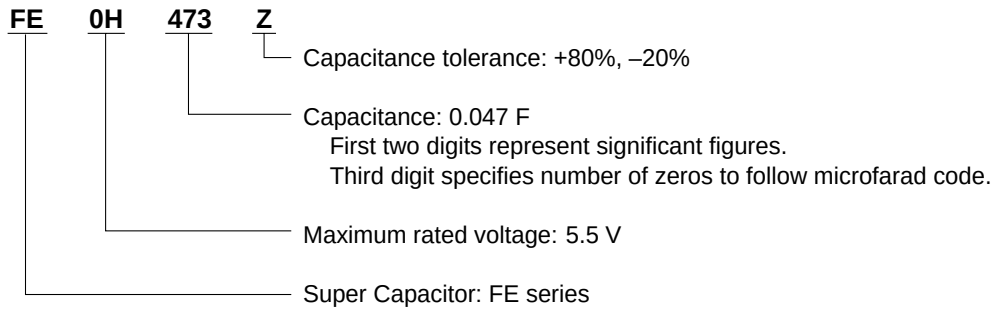
## Features

- Extremely low equivalent series resistance (ESR), ideal for supplying several 10 mA to 1 A for short periods of time (about 1/2 the CV value when compared to the ESR of FA series)
- Small (about 1/4 in volume of aluminum electrolytic capacitor and 3/5 of FA series at same CV value)
- Product variety, including low-capacitance and high-capacitance models (0.047 F to 1.5 F)

## Applications

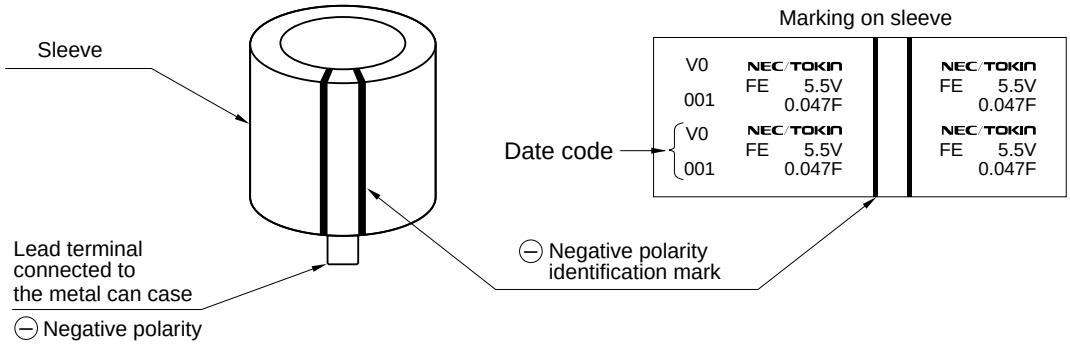
Momentary backup sources for microcomputers, SRAMs, and DRAMs, and auxiliary power source for mechanical systems (motors, relays, electromagnetic valves).

## Part Number System

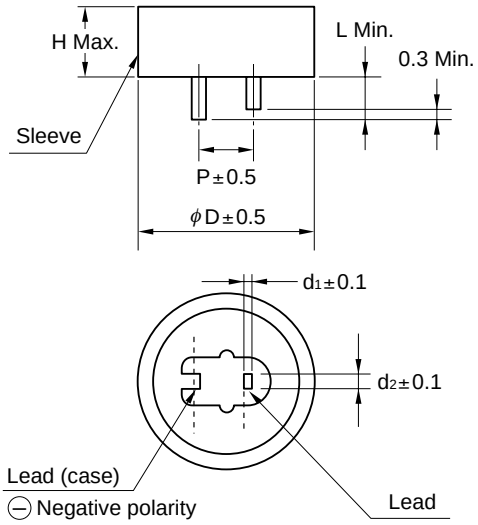


## Markings

Markings are made with black ink on the green sleeve.




## Dimensions And Standard Ratings




| Part No. | Dimensions mm (inch) | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g (oz) |
| FE0H473Z | 14.5 (0.57) | 14.0 (0.55) | 5.1 (0.2) | 0.4 (0.016) | 1.2 (0.047) | 2.2 (0.087) | 3.9 (0.138) |
| FE0H104Z | 16.5 (0.65) | 14.0 (0.55) | 5.1 (0.2) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 5 (0.177) |
| FE0H224Z | 21.5 (0.85) | 15.5 (0.61) | 7.6 (0.3) | 0.6 (0.024) | 1.2 (0.047) | 3.0 (0.118) | 9.5 (0.336) |
| FE0H474Z | 28.5 (1.12) | 16.5 (0.65) | 10.2 (0.4) | 0.6 (0.024) | 1.4 (0.055) | 6.1 (0.240) | 16 (0.565) |
| FE0H105Z | 36.5 (1.44) | 18.5 (0.73) | 15.0 (0.59) | 0.6 (0.024) | 1.7 (0.067) | 6.1 (0.240) | 38 (1.343) |
| FE0H155Z | 44.5 (1.75) | 18.5 (0.73) | 20.0 (0.79) | 1.0 (0.039) | 1.4 (0.055) | 6.1 (0.240) | 72 (2.544) |

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance Charge System (F) | Discharge System (F) | Max. Current at 30 minutes (mA) | Max. ESR (at 1 kHz) (Ω) |
|---|---|---|---|---|---|
| FE0H473Z | 5.5 | 0.047 | 0.075 | 0.071 | 14.0 |
| FE0H104Z | 5.5 | 0.10 | 0.16 | 0.15 | 6.5 |
| FE0H224Z | 5.5 | 0.22 | 0.35 | 0.33 | 3.5 |
| FE0H474Z | 5.5 | 0.47 | 0.75 | 0.71 | 1.8 |
| FE0H105Z | 5.5 | 1.0 | 1.4 | 1.5 | 1.0 |
| FE0H155Z | 5.5 | 1.5 | 2.1 | 2.3 | 0.6 |

# Specifications

| Item | | Specification | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –40˚C to 70˚C | | |
| Maximun Rated Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | 0.047 to 1.5 F (Refer to standard ratings) | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minute value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | Conforms to 7.14<br>At 70˚C<br>Surge voltage 6.3 V<br>Temperature : 70±2˚C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>1 000 cycles<br>Charge resistance :<br>0.047 F 300 Ω<br>0.10 F 150 Ω<br>0.22 F 56 Ω<br>0.47 F 30 Ω<br>1.0, 1.5 F 15 Ω<br>Discharge resistance:<br>Not applicable (0 Ω) |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| Temperature Variation of Characteristics | Phase 3 | Capacitance | More than 40 % of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2˚C<br>Phase 2: –25 ± 2˚C<br>Phase 3: –40 ± 2˚C<br>Phase 4: +25 ± 2˚C<br>Phase 5: +70 ± 2˚C<br>Phase 6: +25 ± 2˚C |
| | | Equivalent Series Resistance | Not to exceed 4 times initial value | |
| | Phase 5 | Capacitance | Not to exceed 200 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed 1.5 CV (mA) | |
| | Phase 6 | Capacitance | Within ±20 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>0.047 to 0.47 F: 1 kg, 10 sec.<br>1 F, 1.5 F : 2.5 kg, 10 sec. |
| Vibration Resistance | | Capacitance | Meet initial requirement | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>230 ±5˚C Immersion depth:<br>5 ±0.5 sec. 1.6 mm from body |
| Soldering Heat Resistance | | Capacitance | Meet initial requirement | Conforms to 8.5<br>260 ±10˚C, 10 ±1 sec.<br>Immersion depth :<br>1.6 mm from body |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Temperature Cycle | | Capacitance | Shall meet initial requirement | Conforms to 9.3<br>Temperature condition:<br>–40˚C → normal temperture<br>→ +70˚C → normal temperture<br>Number of cycles : 5 cycles |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Humidity Resistance | | Capacitance change | Within ±20 % of initial value | Conforms to 9.5<br>40 ± 2˚C, 90 to 95 % RH<br>240 hours<br>240 ± 8 hours |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| High Temperature Load | | Capacitance change | Within ±30 % of initial value | Conforms to 9.10<br>70 ± 2˚C<br>5.5 V applied<br>1 000 $^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Not to exceed 300 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 200 % of initial requirement | |

# FS Series

The FS series Super Capacitors are ideal as short-time (30 minutes max.) backup devices in small and lightweight systems. 5.5 VDC (0.022 F to 1.0 F), 11 VDC (0.47 F and 1.0 F only) and 12 VDC (1.0 F and 5.0 F only)

## Features

- Ideal for supplying current of several hundred $\mu$A to several mA for short time

## Applications

- Backup source for microcomputers and buffer for momentary high-current loads (for example, motors)

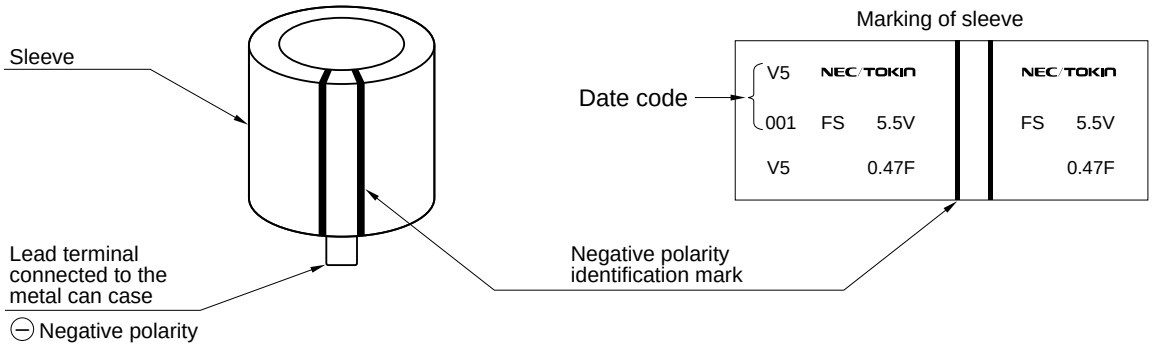
## Part Number System

**FS 0H 473 Z**

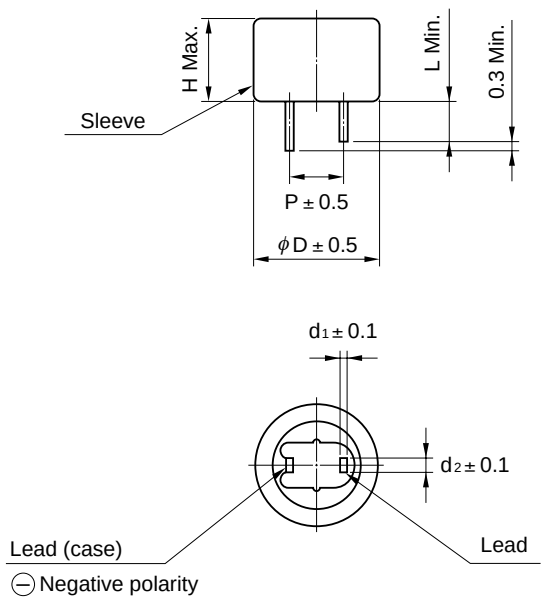
- **Z**: Capacitance tolerance: +80%, –20%
- **473**: Capacitance: 0.047 F
  First two digits represent significant figures.
  Third digit specifies number of zeros to follow microfarad code.
- **0H**: Maximum rated voltage:
  0 H: 5.5 VDC
  1 A: 11 VDC
  1 B: 12 VDC
- **FS**: Super Capacitor: FS series

## Markings

Markings are made with black ink on the green sleeve.




## Dimensions and Standard Ratings




| Part No. | Dimensions mm (inch) | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g (oz) |
| FS0H223Z | 11.5 (0.453) | 8.5 (0.335) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.6 (0.057) |
| FS0H473Z | 13.0 (0.512) | 8.5 (0.335) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.2 (0.087) | 2.6 (0.092) |
| FS0H104Z | 16.5 (0.650) | 8.5 (0.335) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 4.1 (0.145) |
| FS0H224Z | 16.5 (0.650) | 13.0 (0.512) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 5.3 (0.187) |
| FS0H474Z | 21.5 (0.846) | 13.0 (0.512) | 7.62 (0.300) | 0.6 (0.024) | 1.2 (0.047) | 3.0 (0.118) | 10 (0.353) |
| FS0H105Z | 28.5 (1.122) | 14.0 (0.551) | 10.16 (0.400) | 0.6 (0.024) | 1.4 (0.055) | 6.1 (0.240) | 18 (0.635) |
| FS1A474Z | 28.5 (1.122) | 25.5 (1.004) | 10.16 (0.400) | 0.6 (0.024) | 1.4 (0.055) | 6.1 (0.240) | 32.0 (1.129) |
| FS1A105Z | 28.5 (1.122) | 31.5 (1.240) | 10.16 (0.400) | 0.6 (0.024) | 1.4 (0.055) | 6.1 (0.240) | 35.0 (1.235) |
| FS1B105Z | 28.5 (1.122) | 38.0 (1.496) | 10.16 (0.400) | 0.6 (0.024) | 1.4 (0.055) | 6.1 (0.240) | 40 (1.411) |
| FS1B505Z | 44.8 (1.764) | 60.0 (2.361) | 20.0 (0.787) | 1.0 (0.040) | 1.4 (0.055) | 9.5 (0.240) | 160 (5.644) |

**Note:** Weight is typical.

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (at 1 kHz) (mA) |
|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | |
| FS0H223Z | 5.5 | 0.022 | 0.033 | 60 | 0.033 |
| FS0H473Z | 5.5 | 0.047 | 0.072 | 40 | 0.071 |
| FS0H104Z | 5.5 | 0.10 | 0.15 | 25 | 0.15 |
| FS0H224Z | 5.5 | 0.22 | 0.33 | 25 | 0.33 |
| FS0H474Z | 5.5 | 0.47 | 0.75 | 13 | 0.71 |
| FS0H105Z | 5.5 | 1.0 | 1.3 | 7 | 1.5 |
| FS1A474Z | 11.0 | 0.47 | 0.60 | 7 | 1.41 |
| FS1A105Z | 11.0 | 1.0 | 1.3 | 7 | 3.0 |
| FS1B105Z | 12.0 | 1.0 | 1.3 | 7.5 | 3.6 |
| FS1B505Z | 12.0 | 5.0 | 6.5 | 4.0 | 18.0 |

# Specifications

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 5.5 VDC, 11 VDC, 12 VDC | | |
| Nominal Capacitance Range | | 0.022 to 1.0 F (5.5 V products), 0.47 F to 1.0 F (11 V products), 1.0 F to 5.0 F (12 V products) | | See characteristics measuring method. |
| Capacitance Allowance | | +80%, –20% | | |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge voltage: 6.3 V (5.5 V products)<br>12.6 V (11 V products)<br>13.6 V (12 V products)<br>Temperature: 70 ± 2°C<br>Chargs: 30 seconds<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.022 F 560 Ω<br>0.047 F 300 Ω<br>0.1 F 150 Ω<br>0.22 F 56 Ω<br>0.47 F 30 Ω<br>1 F 15 Ω<br>5 F 10 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 3 or less times initial value | |
| | Phase 5 | Capacitance | 150% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ± 20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>5.5 VDC: 0.022 F to 0.22 F: 1 kg 10 sec; 0.47 F to 1.0 F: 2.5 kg 10 sec<br>11 VDC: 2.5 kg 10 sec<br>12 VDC: 2.5 kg 10 sec |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 230 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Should be dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | 90% or higher of initial standard value (5.5 V products)<br>Within 20% of initial value (11 V, 12 V products) | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | 85% or higher of initial standard value (5.5 V products)<br>Within ±30% of initial value (11 V, 12 V products) | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: Maximum operating voltage<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

# FR Series Wide Temperature Range Capacitor [–40˚C to +85˚C]

The FR series Super Capacitors are small-size electric double-layer capacitors that can operate in a temperature range as wide as –40˚C to +85˚C.
These capacitors are ideal as long-time backup devices for minute current loads in industrial equipment such as measuring instruments, control equipment, and communications equipment.

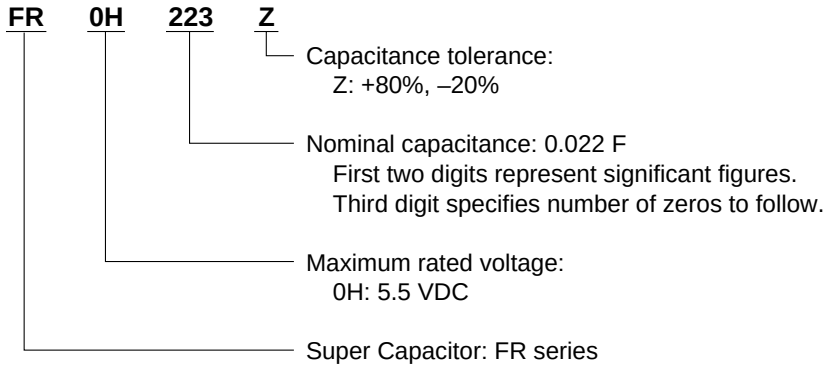
## Features

- Wide operating temperature range: –40˚C to +85˚C
- High reliability (Ioad life of 85˚C, 5.5 V, 1000 hours guaranteed)
- Excellent voltage holding characteristics ideal for long-time current supply of 1 $\mu$A to several hundred $\mu$A

## Applications

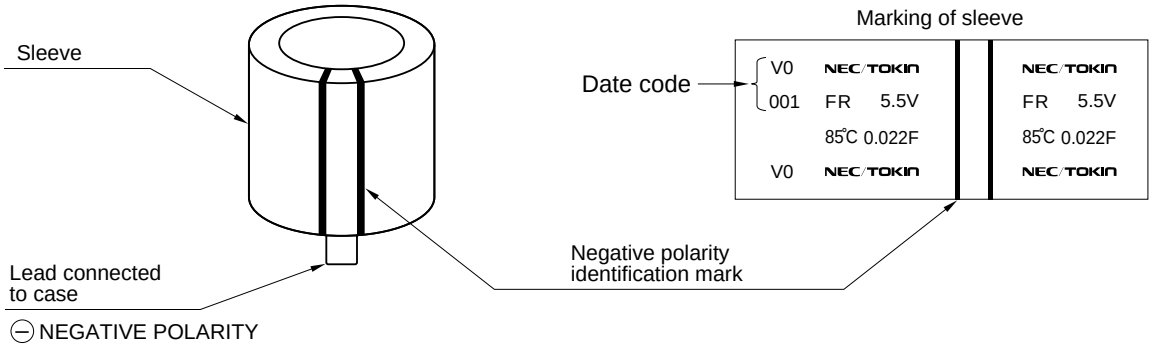
Backup of CMOS microcomputers, static RAMs, and DTSs (digital tuning systems)

## Part Number System

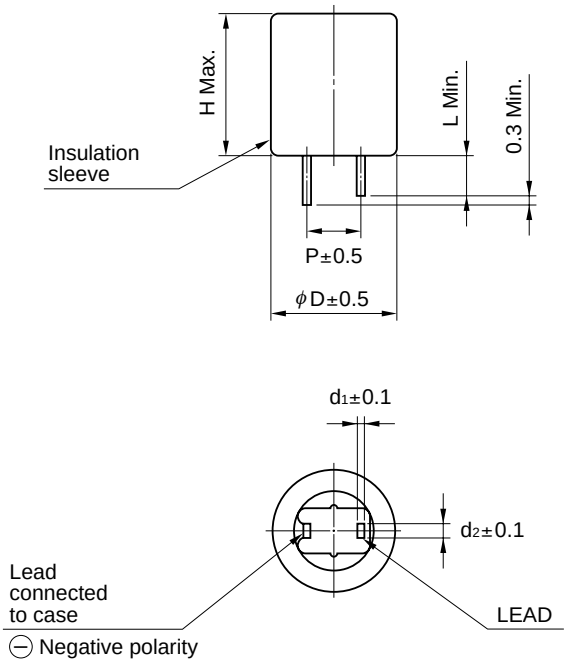


## Markings

Markings are made with black ink on the green sleeve.




## Dimensions and Standard Ratings




| Part No. | Dimensions mm (inch) | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g (oz) |
| FR0H223Z | 11.5 (0.453) | 14.0 (0.551) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 2.3 (0.081) |
| FR0H473Z | 14.5 (0.571) | 14.0 (0.551) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.4 (0.095) | 3.9 (0.138) |
| FR0H104Z | 14.5 (0.571) | 15.5 (0.610) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.4 (0.095) | 4.3 (0.152) |
| FR0H224Z | 14.5 (0.571) | 21.0 (0.827) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.4 (0.095) | 5.3 (0.187) |
| FR0H474Z | 16.5 (0.650) | 21.5 (0.846) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 7.5 (0.265) |
| FR0H105Z | 21.5 (0.850) | 22.0 (0.866) | 7.62 (0.300) | 0.6 (0.024) | 1.2 (0.047) | 3.0 (0.118) | 13.3 (0.470) |

**Note:** Weight is typical.

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FR0H223Z | 5.5 | 0.022 | 0.028 | 220 | 0.033 | 4.2 |
| FR0H473Z | 5.5 | 0.047 | 0.060 | 110 | 0.071 | 4.2 |
| FR0H104Z | 5.5 | 0.10 | 0.15 | 150 | 0.15 | 4.2 |
| FR0H224Z | 5.5 | 0.22 | 0.33 | 180 | 0.33 | 4.2 |
| FR0H474Z | 5.5 | 0.47 | 0.75 | 100 | 0.71 | 4.2 |
| FR0H105Z | 5.5 | 1.0 | 1.6 | 60 | 1.5 | 4.2 |

# Specifications

| Item | | Specification | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –40˚C to +85˚C | | |
| Maximun Working Voltage | | 5.5 Vdc | | |
| Nominal Capacitance Range | | 0.022 to 1.0 F (Refer to standard ratings) | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minute Value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | Conform to 7.14<br>Surge voltage 6.3 V<br>Temperature : 85± 2˚C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>1 000 cycles<br>Charge resistance:<br>0.022 F 560 Ω<br>0.047 F 300 Ω<br>0.10 F 150 Ω<br>0.22 F 56 Ω<br>0.47 F 30 Ω<br>1.0 F 15 Ω<br>Discharge resistance:<br>Not applicable (0 Ω) |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | More than 50 % of initial value | Conform to 7.12<br>Phase 1: +25±2˚C<br>Phase 2: –25±2˚C<br>Phase 3: –40±2˚C<br>Phase 4: +25±2˚C<br>Phase 5: +85±2˚C<br>Phase 6: +25±2˚C |
| | | Equivalent Series Resistance | Not to exceed 4 times initial value | |
| | Phase 3 | Capacitance | More than 30 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed 7 times initial value | |
| | Phase 5 | Capacitance | Not to exceed 200 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed 1.5 CV (mA) | |
| | Phase 6 | Capacitance | Within ±20 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conform to 8.1.2 (1)<br>0.022 to 0.47 F: 1 kg, 10 sec.<br>1 F: 2.5 kg, 10 sec. |
| Vibration Resietance | | Capacitance | Meet initial requirement | Conform to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Solderability | | 3/4 or more of the pin surface shoud be covered with new solder | | Conform to 8.4<br>230 ± 5˚C<br>5 ± 0.5 sec. 1.6 mm from body |
| Soldering Heat Resistance | | Capacitance | Meet initial requirement | Conform to 8.5<br>260 ±10˚C, 10 ±1 sec.<br>Immersion depth:<br>1.6 mm from body |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Temperature Cycle | | Capacitance | Meet initial requirement | Conform to 9.3<br>Temperature condition:<br>–40°C → normal temperature<br>→ +85°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Humidity Resistance | | Capacitance | Within ± 20% of initial value | Conform to 9.5<br>40 ± 2˚C, 90 to 95% RH<br>240 ± 8 hours |
| | | Equivalent Series Resistance | Not to exceed120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed120 % of initial requirement | |

<table>
<tr><th>Item</th><th colspan="2">Specification</th><th colspan="3">Test Conditions<br>Conforming to JIS C 5102-1994</th></tr>
<tr><td rowspan="3">High Temperature Load</td><td>Capacitance change</td><td>Within ±30% of initial value</td><td colspan="3" rowspan="3">Conforms to 9.10<br>Temperature: 85 ± 2°C<br>Series resistance: 0 Ω<br>Applied voltage: 5.5 VDC<br>Time of test: 1000 $^{+48}_{-0}$ hours</td></tr>
<tr><td>Equivalent Series Resistance</td><td>Not to exceed 200% of initial requirement</td></tr>
<tr><td>Current at 30 minutes</td><td>Not to exceed 200% of initial requirement</td></tr>
<tr><td rowspan="2">Voltage Holding Characteristics</td><td colspan="2" rowspan="2">Voltage between terminal leads higher than 4.2V</td><td>Charging</td><td>(1) Applied Voltage: 5.0 V<br>(2) Series Resistance: 0 Ω<br>(3) Charging time: 24 h</td></tr>
<tr><td>Storege</td><td>(1) Load: Nothing<br>(2) Temp.: Less than 25°C<br>(3) Humidity: Less than 70% RH<br>(4) Storage time: 24 h</td></tr>
</table>

# 3.5 V, 6.5 V Rated Voltage Series FSH Type, FYD Type

These 3.5 V and, 6.5 V rated voltage are suitable for use in portable or battery-driven equipment.
These capacitors are especially ideal as backup devices for cameras, remote controllers, headphone and stereos.

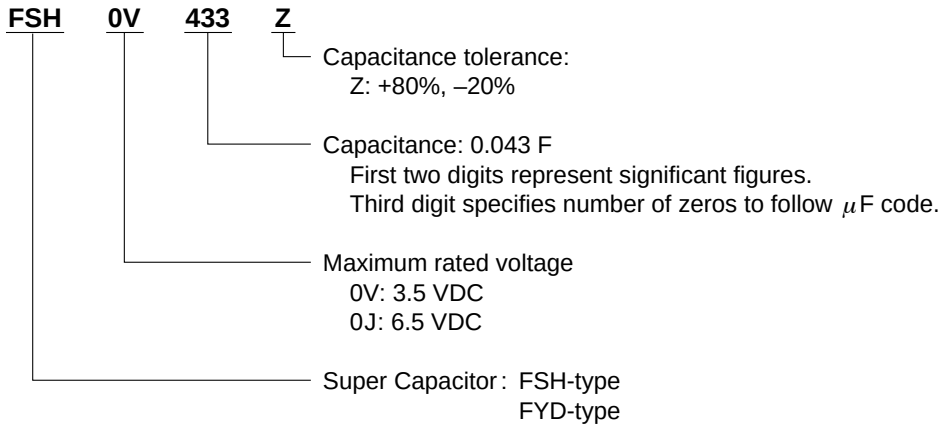
## Features

- The FSH-type is ideal for supplying several hundred $\mu$A to several mA for a short time. The FYD type is ideal for backup of 1 $\mu$A to several hundred $\mu$A for a long time.
- Smaller than existing series (25% less than FS series in C•V per volume)

## Applications

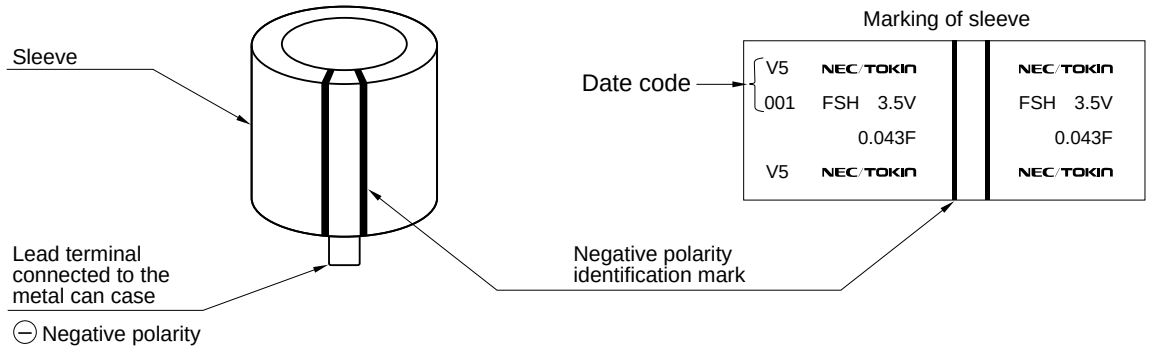
- Secondary backup power supply for cameras to charge an electronic flash (FSH type)
- Secondary backup power supply for motors (FSH-type)
- Backup of CMOS microprocessors, SRAMs, DTS ICs to charge the battery

## Part Number System

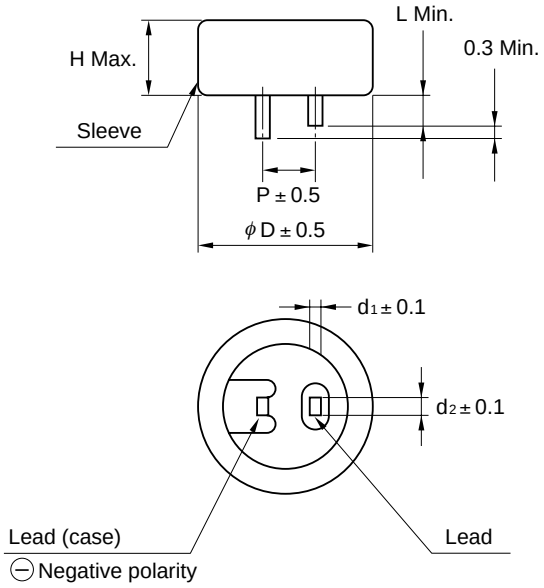


## Markings

Markings are made with black ink on the green sleeve.




## Dimensions and Standard Ratings




| Part No. | Dimensions mm (inch) | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g (oz) |
| FSH0V433Z | 11.0 (0.413) | 5.2 (0.205) | 5.08 (0.2) | 0.2 (0.008) | 1.2 (0.047) | 2.7 (0.106) | 1.0 (0.035) |
| FYD0V563Z | 11.0 (0.413) | 5.2 (0.205) | 5.08 (0.2) | 0.2 (0.008) | 1.2 (0.047) | 2.7 (0.106) | 1.0 (0.035) |
| FSH0J223Z | 11.5 (0.453) | 8.5 (0.355) | 5.08 (0.2) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.7 (0.060) |
| FYD0J273Z | 11.5 (0.453) | 8.5 (0.355) | 5.08 (0.2) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.6 (0.056) |

**Note:** The weight values are typical.

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance ChargeSystem (F) | Nominal Capacitance DischargeSystem (F) | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) |
|---|---|---|---|---|---|
| FSH0V433Z | 3.5 | 0.043 | 0.055 | 50 | 0.039 |
| FYD0V563Z | 3.5 | 0.056 | 0.070 | 150 | 0.050 |
| FSH0J223Z | 6.5 | 0.022 | 0.033 | 60 | 0.040 |
| FYD0J273Z | 6.5 | 0.027 | 0.040 | 200 | 0.049 |

# Specifications

| Items | | Specifications | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to +70˚C | | |
| Maximum Rated Voltage | | 3.5 VDC, 6.5 VDC | | |
| Nominal Capacitance Range | | See standard ratings | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minutes value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | Conforms to 7.14<br>Surge voltage:<br>4.0 V (3.5 VDC), 7.4 V (6.5 VDC)<br>rated part rated part<br>Temperature: 70±2˚C<br>Charging for 30 seconds<br>Discharging for 9 min 30 sec.<br>Number of cycles: 1 000 cycles<br>Charge resistance:<br>0.022 F 560 Ω<br>0.027 F 560 Ω<br>0.043 F 300 Ω<br>0.056 F 240 Ω<br>No discharge resistance |
| | | Equivalent Series Resistance | Less than 200% of initial requirement | |
| | | Current 30 minutes | Less than 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | More than 50 % of initial value | Conforms to 7.12<br>Phase 1: +25 ±2˚C<br>Phase 2: –25 ±2˚C<br>Phase 3: –40 ±2˚C<br>Phase 4: +25 ±2˚C<br>Phase 5: +70 ±2˚C<br>Phase 6: +25 ±2˚C |
| | | Equivalent Series Resistance | Less than 400% of initial value | |
| | Phase 5 | Capacitance | Less than 200% of initial value | |
| | | Equivalent Series Resistance | Initial requirement | |
| | | Current 30 minutes | Less than 1.5 CV (mA) | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent Series Resistance | Initial requirement | |
| | | Current 30 minutes | Initial requirement | |
| Vibration Resistance | | Capacitance | Shall meet initial requirements | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Time of test: 6 hours |
| | | Equivalent Series Resistance | | |
| | | Current 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/ 4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Temperature of solder: 230 ± 5˚C<br>Time of immersion: 5 ± 0.5 seconds<br>To immerse capacitors up to 1.6 mm from the bottom |
| Soldering Heat Resistance | | Capacitance | Shall meet initial requirements | Conforms to 8.5<br>Temperature of solder: 260 ± 10˚C<br>Time of immersion: 10 ± 1 seconds<br>To immerse capacitors up to 1.6 mm from the bottom |
| | | Equivalent Series Resistance | | |
| | | Current 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Shall meet initial requirements | Conforms to 9.3<br>Temperature condition:<br>–25˚C → normal temperature<br>→ +70˚C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent Series Resistance | | |
| | | Current 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2˚C<br>Humidity: 90 to 95% RH<br>Time of test: 240 ± 8 hours |
| | | Equivalent Series Resistance | Less than 200% of initial requirement | |
| | | Current 30 minutes | Less than 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within ±30% of initial requirement | Conforms to 9.10<br>Temperature: 70 ± 2˚C<br>Series resistance: 0 Ω<br>Applied voltage: 3.5 VDC, 6.5 VDC<br>Time of test: 1000 $^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Less than 300% of initial requirement | |
| | | Current 30 minutes | Less than 200% of initial requirement | |
| | | Appearance | No obvious abnormality | |

# FY Series

FYD TYPE: SMALL DIAMETER, EXCELLENT VOLTAGE HOLDING CHARACTERISTICS
FYH, and FYL TYPE: LOW PROFILE, EXCELLENT VOLTAGE HOLDING CHARACTERISTICS

The FY series includes small-size electric double-layer capacitors with excellent voltage holding characteristics. The FYD type occupies only a small area on a printed circuit board, and the FYH and FYL types feature a low profile in height, so that they can be used in various systems.
These capacitors are ideal as long-time backup devices for minute-current loads in small and lightweight systems.

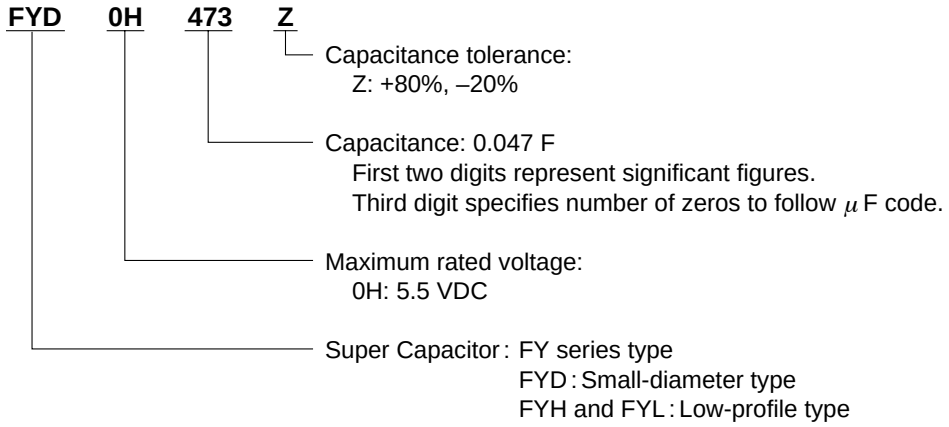
## Features

- Product variety makes the FYD, FYH, and FYL types suitable for use in many types of application systems.
- Excellent voltage holding characteristics ideal for backup of 1 $\mu$A to several hundred $\mu$A.
- Smaller than other Super Capacitors (25% less than FS series in volume)
- Capacitance ranges from low to high (0.01 F to 2.2 F).

## Applications

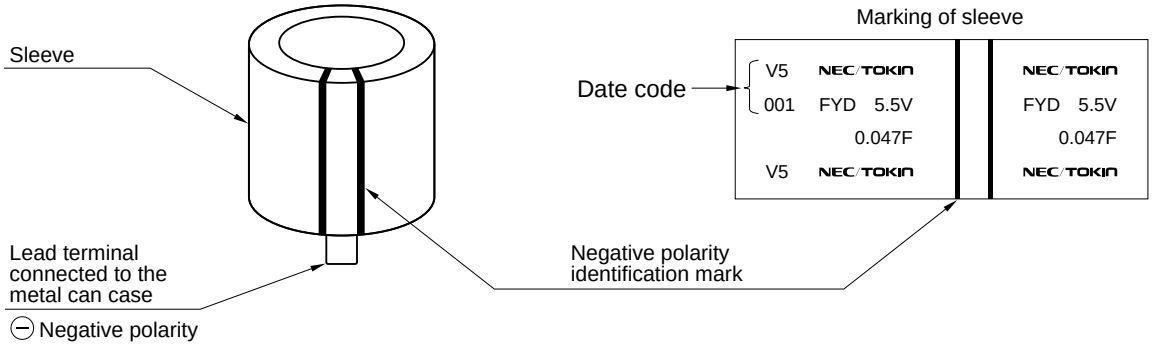
- Backup of CMOS microcomputers, static RAMs, DTSs (digital tuning systems)
- Memory backup of remote controllers and handy cassette player during battery exchange

## Part Number System



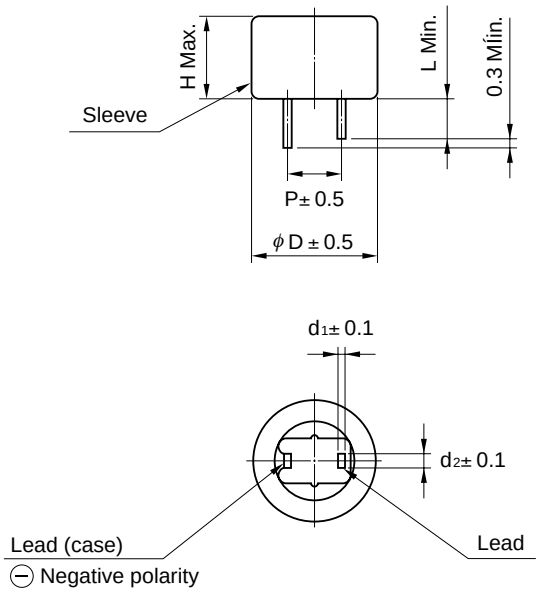
# Markings

Markings are made with black ink on the green sleeve.




# Dimensions and Standard Ratings

## ● FYD-Type

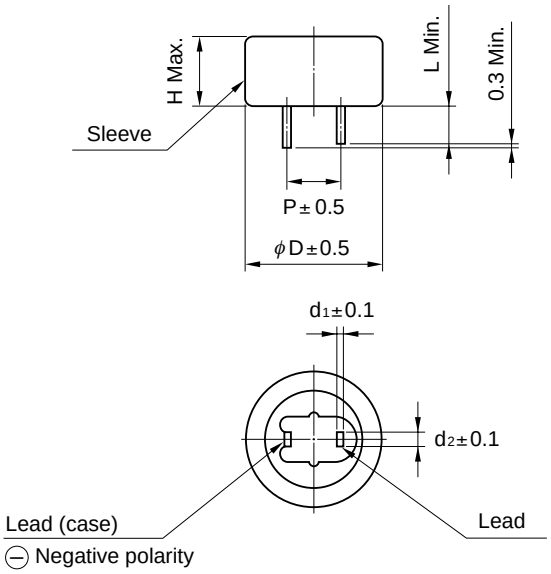



| Part No. | Dimensions mm (inch) | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g (oz) |
| FYD0H223Z | 11.5 (0.453) | 8.5 (0.335) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.6 (0.056) |
| FYD0H473Z | 11.5 (0.453) | 8.5 (0.335) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.7 (0.058) |
| FYD0H104Z | 13.0 (0.512) | 8.5 (0.335) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.2 (0.087) | 2.4 (0.085) |
| FYD0H224Z | 14.5 (0.571) | 15.0 (0.591) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.4 (0.095) | 4.3 (0.152) |
| FYD0H474Z | 16.5 (0.65) | 15.0 (0.591) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 6.0 (0.212) |
| FYD0H105Z | 21.5 (0.85) | 16.0 (0.629) | 7.62 (0.300) | 0.6 (0.024) | 1.2 (0.047) | 3.0 (0.118) | 11.0 (0.338) |
| FYD0H145Z | 21.5 (0.85) | 19.0 (0.748) | 7.62 (0.300) | 0.6 (0.024) | 1.2 (0.047) | 3.0 (0.118) | 12.0 (0.424) |
| FYD0H225Z | 28.5 (1.122) | 22.0 (0.866) | 10.16 (0.400) | 0.6 (0.024) | 1.4 (0.055) | 6.1 (0.240) | 22.9 (0.809) |

**Note:** Weight is typical.

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FYD0H223Z | 5.5 | 0.022 | 0.033 | 220 | 0.033 | 4.2 |
| FYD0H473Z | 5.5 | 0.047 | 0.070 | 220 | 0.071 | 4.2 |
| FYD0H104Z | 5.5 | 0.10 | 0.14 | 100 | 0.15 | 4.2 |
| FYD0H224Z | 5.5 | 0.22 | 0.35 | 120 | 0.33 | 4.2 |
| FYD0H474Z | 5.5 | 0.47 | 0.75 | 65 | 0.71 | 4.2 |
| FYD0H105Z | 5.5 | 1.0 | 1.6 | 35 | 1.5 | 4.2 |
| FYD0H145Z | 5.5 | 1.4 | 2.1 | 45 | 2.1 | 4.2 |
| FYD0H225Z | 5.5 | 2.2 | 3.3 | 35 | 3.3 | 4.2 |

## ● FYH-Type

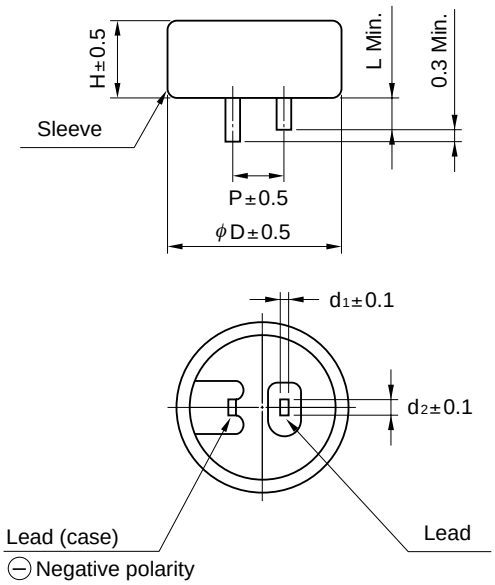



| Part No. | Dimensions mm (inch) | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g (oz) |
| FYH0H223Z | 11.5 (0.453) | 7.0 (0.276) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.5 (0.053) |
| FYH0H473Z | 13.0 (0.512) | 7.0 (0.276) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.2 (0.087) | 2.2 (0.078) |
| FYH0H104Z | 16.5 (0.65) | 7.5 (0.295) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 3.4 (0.120) |
| FYH0H224Z | 16.5 (0.65) | 9.5 (0.374) | 5.08 (0.200) | 0.4 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 3.6 (0.127) |
| FYH0H474Z | 21.5 (0.85) | 10.0 (0.394) | 7.62 (0.300) | 0.6 (0.024) | 1.2 (0.047) | 3.0 (0.118) | 7.2 (0.255) |
| FYH0H105Z | 28.5 (1.122) | 11.0 (0.433) | 10.16 (0.400) | 0.6 (0.024) | 1.4 (0.055) | 6.1 (0.240) | 13.9 (0.491) |

**Note:** Weight is typical.

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FYH0H223Z | 5.5 | 0.022 | 0.033 | 200 | 0.033 | 4.2 |
| FYH0H473Z | 5.5 | 0.047 | 0.075 | 100 | 0.071 | 4.2 |
| FYH0H104Z | 5.5 | 0.10 | 0.16 | 50 | 0.15 | 4.2 |
| FYH0H224Z | 5.5 | 0.22 | 0.30 | 60 | 0.33 | 4.2 |
| FYH0H474Z | 5.5 | 0.47 | 0.70 | 35 | 0.71 | 4.2 |
| FYH0H105Z | 5.5 | 1.0 | 0.50 | 20 | 1.5 | 4.2 |

## ● FYL-Type




| Part No. | Dimensions mm (inch) | | | | | | Weight |
|---|---|---|---|---|---|---|---|
| | D | H | P | $d_1$ | $d_2$ | L | g (oz) |
| FYL0H103Z | 11.0 (0.43) | 5.0 (0.197) | 5.08 (0.200) | 0.2 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 0.9 (0.032) |
| FYL0H223Z | 11.0 (0.43) | 5.0 (0.197) | 5.08 (0.200) | 0.2 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.0 (0.035) |
| FYL0H473Z | 12.0 (0.47) | 5.0 (0.197) | 5.08 (0.200) | 0.2 (0.016) | 1.2 (0.047) | 2.7 (0.106) | 1.2 (0.042) |

**Note:** Weight is typical.

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FYL0H103Z | 5.5 | 0.010 | 0.013 | 300 | 0.015 | 4.2 |
| FYL0H223Z | 5.5 | 0.022 | 0.028 | 200 | 0.033 | 4.2 |
| FYL0H473Z | 5.5 | 0.047 | 0.061 | 200 | 0.071 | 4.2 |

# Specifications

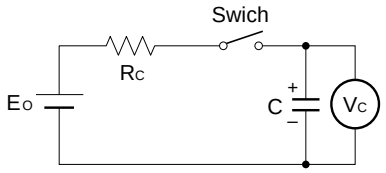
| Items | | Specifications | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to +70˚C | | |
| Maximum Operating Voltage | | 5.5 Vdc | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minutes Value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | Conforms to 7.14<br>Surge voltage: 6.3 V<br>Temperature: 70 ± 2˚C<br>Charging for 30 seconds<br>Discharging for 9 min. 30 sec.<br>Number of cycles 1 000 cycles<br>Charge resistance :<br>0.01 F 1500 Ω 0.47 F 30 Ω<br>0.022 F 560 Ω 1.0 F 15 Ω<br>0.047 F 300 Ω 1.4 F 15 Ω<br>0.10 F 150 Ω 2.2 F 10 Ω<br>0.22 F 56 Ω<br>No discharge resistance |
| | | Equivalent Series Resistance | Less than 120% of initial requirement | |
| | | Current at 30 minutes | Less than 120% of initial requirement | |
| | | Appearance | No significant change | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | More than 50 % of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2˚C<br>Phase 2: –25 ± 2˚C<br>Phase 3: –40 ± 2˚C<br>Phase 4: +25 ± 2˚C<br>Phase 5: +70 ± 2˚C<br>Phase 6: +25 ± 2˚C |
| | | Equivalent Series Resistance | Less than 400% of initial value | |
| | Phase 5 | Capacitance | Less than 200% of initial value | |
| | | Equivalent Series Resistance | Initial requirement | |
| | | Current at 30 minutes | Less than 1.5 CV (mA) | |
| | Phase 6 | Capacitance | Within ± 20% of initial value | |
| | | Equivalent Series Resistance | Initial requirement | |
| | | Current at 30 minutes | Initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>FYD0H105Z<br>FYD0H145Z<br>FYD0H225Z<br>FYH0H474Z<br>FYH0H105Z<br>: 2.5 kg-f 10 ± 1 sec.<br>Others: 1.0 kg-f 10 ± 1 sec. |
| Vibration Resistance | | Capacitance | Meet initial requirements | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Time of test: 6 hours |
| | | Equivalent Series Resistance | | |
| | | Current at 30 minutes | | |
| | | Appearance | No significant change | |
| Solderability | | 3/4 or more of the pin of surface should be covered with the solder | | Conforms to 8.4<br>Temperature of solder: 230 ± 5˚C<br>Time of immersion: 5 ± 0.5 second<br>To immerse capacitors up to 1.6 mm from the bottom |
| Soldering Heat Resistance | | Capacitance | Meet initial requirements | Conforms to 8.5<br>Temperature of solder: 260 ± 10˚C<br>Time of immersion: 10 ± 1 seconds<br>To immerse capacitors up to 1.6 mm from the bottom |
| | | Equivalent Series Resistance | | |
| | | Current at 30 minutes | | |
| | | Appearance | No significant change | |
| Temperature Cycle | | Capacitance | Shall meet initial requirements | Conforms to 9.3<br>Temperature condition:<br>–25˚C → normal temperature<br>→ +70˚C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent Series Resistance | | |
| | | Current at 30 minutes | | |
| | | Visual appearance | No significant change | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2˚C<br>Humidity: 90 to 95% RH<br>Time of test: 240 ± 8 hours |
| | | Equivalent Series Resistance | Less than 120% of initial requirement | |
| | | Current at 30 minutes | Less than 120% of initial requirement | |
| | | Appearance | No significant change | |
| High Temperature Load | | Capacitance | Within ±30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2˚C<br>Series resistance: 0 Ω<br>Applied voltage: 5.5 VDC<br>Time of test: 1000 $^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Less than 200% of initial requirement | |
| | | Current at 30 minutes | Less than 200% of initial requirement | |
| | | Appearance | No significant change | |
| Voltage Holding Characteristics (Self Discharge) | | Voltage between terminal leads higher than 4.2 V. | | Charging condition: Applied voltage: 5.0 VDC<br>Series resistance: 0 Ω<br>Curging time: 24 hours<br>Storage: Load: Nothing<br>Temperature: Lower than 25˚C<br>Humidity: Lower than 70% RH<br>Time: 24 hours |

# 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.

$$\text{Capacitance: } C = \frac{\tau}{R_C}\ (F) \qquad (9)$$




$E_O$: 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 Vc becomes $0.632E_0$ (V) (sec)

$R_C$: See table below (Ω).

| Series Name / Capacitance | FA | FE | FS | FY | | | FR | 3.5 V, 6.5 V Operation Series | FM FME FMR | FMC | FG | FGH | FT | FC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | FYD | FYH | FYL | | | | | | | | |
| 0.010F | – | – | – | – | – | 5000 Ω | – | 0.022 F to | 5000 Ω | – | 5000 Ω | – | – | – |
| 0.022F | 1000 Ω | – | 1000 Ω | 2000 Ω | 2000 Ω | 2000 Ω | 2000 Ω | 0.056 F | 2000 Ω | – | 2000 Ω | – | – | Discharge |
| 0.047F | 1000 Ω | 1000 Ω | 1000 Ω | 2000 Ω | 1000 Ω | 2000 Ω | 1000 Ω | 2000 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 | – | 510 Ω | 510 Ω | – | 510 Ω | – | Discharge | – | 1000 Ω | Discharge | 200 Ω | Discharge |
| 0.33F | – | – | – | – | – | – | – | – | Discharge | 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 | – | – | – | – | – | – | – | – | – | – | – | – |
| 2.2F | – | – | – | 100 Ω | – | – | – | – | – | – | 200 Ω | – | 51 Ω | – |
| 3.3F | – | – | – | – | – | – | – | – | – | – | – | – | 51 Ω | – |
| 4.7F | – | – | – | 51 Ω | – | – | – | – | – | – | 100 Ω | – | – | – |
| 5.0F | – | – | 100 Ω | – | – | – | – | – | – | – | – | – | – | – |
| 5.6F | – | – | – | – | – | – | – | – | – | – | – | – | 20 Ω | – |

*Capacitance values according to the constant current discharge method.

**Table 3 Capacitance measurement**

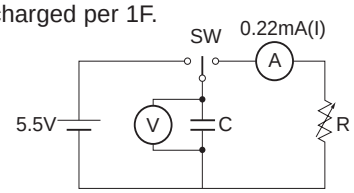
**Capacitance ( Discharge System )**

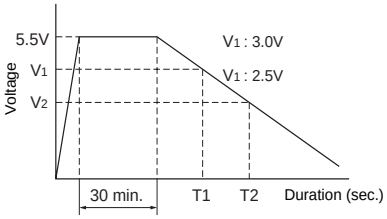
In the diagram below, charging is performed for a duration of 30 minutes, once the voltage of the condensor terminal reaches 5.5 V.

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.

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



**∗Difference owing to method of measuring capacitance**

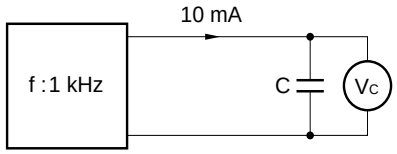
Measurement of the capacitance values by Super capacitors accords to the constant resistance charge method. If measured according to competitors' constant current, discharge and charge measurement methods, the specified current values are smaller than those specified by us and therefore they are apparently 1.3 to 1.5 times the capacitance values measured by our measurement method. Therefore, the backup capability of the same rated product as those of competitiors is 1.3 to 1.5 times that of competitors.

This catalog describes the constant resistance charge method and the constant current discharge method.

### (2) Equivalent series resistance (ESR)

ESR is calculated from expression (10) by using a 1 kHz oscillator, applying an AC current of 10 mA and measuring the voltage (Vc) between both ends of the capaoitor.

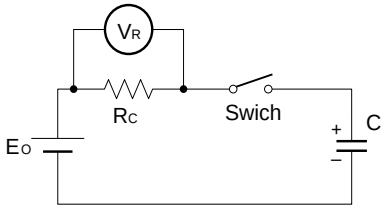
$$\text{Equivalent series resistance : ESR} = \frac{Vc}{10^{-2}}\ (\Omega) \qquad (10)$$




### (3) Current (30-minute value)

The current value is calculated from expression (11) by applying a voltage to the capacitor (C), and measuring the voltage ($V_R$) between both ends of the series resistor ($R_C$) 30 minutes later. Prior to measurement, short between both pins of the capacitor for 30 minutes or more to let it discharge. Follow the indication of the product when determining the polarity of the capacitor during charging.

$$\text{Current : I} = \frac{V_R}{R_C} \times 10^3\ (\text{mA}) \qquad (11)$$




$E_O$: Conforms to $E_O$ of capacitance measuring condition.
$R_C$: 0.01 to 0.056 F: 1 kΩ
0.1 to 0.47 F: 100 Ω
1 to 2.2 F: 10 Ω
FS Series 11 VDC, 12 Vdc products
0.47 F to 1.0 F: 100 Ω
5.0 F: 10 Ω
FG Series
1.0 F to 4.7 F: 100Ω
FT Series
1.0 F to 5.6 F: 10Ω

### (4) Self-discharge characteristlic (except HP, ED/L, FA, FE, FS series, and 3.5 V and 6.5 V product)

The self-discharge characteristic is measured by charging a voltage of 5.0 VDC (charge protection resistance: 0 Ω) according to the capacitor polarity for 24 hours, then releasing between the pins for 24 hours and measuring the pin-to-pin voltage.

This test should be carried out in an environment with an ambient temperature of 25°C or below and relative humidity of 70% RH or below.

# Notes on Using the Super Capacitor (Electric Double-Layer Capacitor)

This capacitor uses an electrolyte and a rubber-sealed structure. Using it at a high temperature for many hours may cause water content in the electrolyte to evaporate and increase equivalent series resistance.
The basic failure mode is an open mode caused by an increase of equivalent series resistance.

## Failure rate

The failure rate calculated based on the field data is approximately 0.006 Fit.

## Circuitry

a. Ensure that the maximum operating voltage and other rated values are selected reliably.
   Application of a voltage exceeding the maximum operating voltage may not only deteriorate performance but also damage the case, etc.
b. Since the equivalent series resistance (ESR) of the capacitor is relatively high, do not use it in a smoothing circuit such as a power supply circuit.
c. For reasons related to the marking display lamp, a outer tube is used for the capacitor, but its isolation is not guaranteed. Contact with adjacent components may cause leakage.
d. In the manufacturing process, the capacitor is processed with the pin on the case side designated as the (–) side. Note this (–) symbol when using the capacitor.
   A discharge may occur during shipment, but some residual potential may have an adverse effect on other components.
e. Use of a SuperCapacitor in the vicinity of a heating element (coil, power transistor, posistor, etc.) may heat the capacitor itself and considerably shorten its service life.
f. Avoid exposure to acidic or alkaliue liquids.

## Mounting

a. This capacitor cannot be mounted with a reflow furnace such as IR and VPS. Avoid dipping the capacitor in a solder dip bath.
b. When using flow automatic soldering, ensure that the soldering temperature is 260˚C or below and soldering duration at one point does not exceed 10 sec.
c. For soldering with a soldering rod, select a soldering rod with a capacity of approximately 30 W and ensure that the temperature at the rod tip does not exceed 350˚C and that the soldering duration does not exceed 5 sec. The rod temperature should be controlled reliably. Heating pins excessively may increase the equivalent series resistance (ESR) of the capacitor.
d. Do not deform or file capacitor pins.
   Doing so may cause solder plating on the pin to fall off and prevent solder from sticking.
e. Avoid mechanical impacts such as dropping on the floor and touching with a hard blade, to prevent renting sleeves and pin wave.

## Cleaning

a. Basically do not wash capacitors except the FM series. When washing is unavoidable, use a washing resistant product.
b. Drying after washing should be performed within the maximum operating temperature range.

## Storage

a. Store the product in an environment with a normal temperature and normal humidity without condensation.
b. Avoid exposing the product in direct sunlight for many hours. (Doing so may cause deterioration or discoloration of the outer tube.)
c. Avoid storage in an acidic or alkaline atmosphere.

## Taking the capacitors apart

a. The capacitors contains a trace of dilute sulfuric acid. Contact with hands, etc., may be harmful, so do not disassemble them.
b. Do not use incineration for disposal. Instead, dispose of them as industrial waste.

# Environmental Impact Reduced Products

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 Terephathatate (PET), our new SuperCapacitor has now became even more friendlier to the environment.

## Types of plating and outer tube

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

| Series | Part Number | Plating | Outer Tube |
|---|---|---|---|
| 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) |
| | FYL0H103ZF | b | PET (Blue) |
| FG | FG0H103ZF | b | PET (Blue) |
| | FG0H223ZF | b | PET (Blue) |
| | FG0H104ZF | b | PET (Blue) |
| | FG0H473ZF | b | 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 | a | No tube used |
| | FC0H105ZFTBR44 | a | No tube used |
| | FC0V104ZFTBR24 | b | No tube used |
| | FC0V224ZFTBR24 | b | No tube used |
| | FC0V474ZFTBR24 | b | No tube used |
| HP | All HP Series | c | No tube used |
| ED/L | All ED/L Series | c | No tube used |
| Others | FSH0H473ZF | b | PET (Blue) |
| | FSH0V433ZF | b | PET (Blue) |
| | FYD0V563ZF | b | PET (Blue) |
| | FSH0J223ZF | a | PET (Blue) |
| | FYD0J273ZF | a | 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

## FC Series

| Prot Number | Max. Rated Voltage (Vdc) | Nominal Capacitance Discharge sytem (F) | Max. ESR (at 1kHz) (Ω) | Max. current at 30 minutes (mA) | Min. Voltage Holding Characteristic (V) |
|---|---|---|---|---|---|
| FC0H473ZFTBR24 | 5.5 | 0.047 | lesss than 50 | lesss than 0.071 | more than 4.2 |
| FC0H104ZFTBR24 | 5.5 | 0.10 | lesss than 25 | lesss than 0.15 | more than 4.2 |
| FC0H224ZFTBR24 | 5.5 | 0.22 | lesss than 25 | lesss than 0.33 | more than 4.2 |
| FC0H474ZFTBR32 | 5.5 | 0.47 | lesss than 13 | lesss than 0.71 | more than 4.2 |
| FC0H105ZFTBR44 | 5.5 | 1.00 | lesss than 7 | lesss than 1.50 | more than 4.2 |
| FC0V104ZFTBR24 | 3.5 | 0.10 | lesss than 50 | lesss than 0.090 | – |
| FC0V224ZFTBR24 | 3.5 | 0.22 | lesss than 25 | lesss than 0.20 | – |
| FC0V474ZFTBR24 | 3.5 | 0.47 | lesss than 25 | lesss than 0.42 | – |

Same shape as
FC Series (See page 12.)

## FT Series

| Part Number | Max. Rated Voltage ( V ) | Nominal Capacitance | | Max. ESR (at 1 kHz) ( Ω ) | Max. Current at 30 minutes ( mA ) |
|---|---|---|---|---|---|
| | | Charge System ( F ) | Discharge System ( F ) | | |
| FT0H104ZF | 5.5 | 0.10 | 0.14 | less than 16 | less than 0.15 |
| FT0H224ZF | 5.5 | 0.22 | 0.28 | less than 10 | less than 0.33 |
| FT0H474ZF | 5.5 | 0.47 | 0.60 | less than 6.5 | less than 0.71 |
| FT0H105ZF | 5.5 | 1.0 | 1.3 | less than 3.5 | less than 1.5 |
| FT0H225ZF | 5.5 | 2.2 | 2.8 | less than 1.8 | less than 3.3 |
| FT0H335ZF | 5.5 | 3.3 | 4.2 | less than 1.0 | less than 5.0 |
| FT0H565ZF | 5.5 | 5.6 | 7.2 | less than 0.6 | less than 8.4 |

Same shape as
FT Series
(See page 17.)

## FG Series

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min.(V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FG0H103ZF | 5.5 | 0.01 | 0.013 | 300 | 0.015 | 4.2 |
| FG0H223ZF | 5.5 | 0.022 | 0.028 | 200 | 0.033 | 4.2 |
| FG0H473ZF | 5.5 | 0.047 | 0.060 | 200 | 0.071 | 4.2 |
| FG0H104ZF | 5.5 | 0.10 | 0.13 | 100 | 0.15 | 4.2 |
| FG0H224ZF | 5.5 | 0.22 | 0.28 | 100 | 0.33 | 4.2 |
| FG0H474ZF | 5.5 | 0.47 | 0.60 | 120 | 0.71 | 4.2 |
| FG0H105ZF | 5.5 | 1.0 | 1.3 | 65 | 1.5 | 4.2 |
| FG0H225ZF | 5.5 | 2.2 | 2.8 | 35 | 3.3 | 4.2 |
| FG0H475ZF | 5.5 | 4.7 | 6.0 | 35 | 7.1 | 4.2 |

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min.(V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FGH0H104ZF | 5.5 | – | 0.10 | 100 | 0.15 | 4.2 |
| FGH0H224ZF | 5.5 | – | 0.22 | 100 | 0.33 | 4.2 |
| FGH0H474ZF | 5.5 | – | 0.47 | 65 | 0.71 | 4.2 |
| FGH0H105ZF | 5.5 | – | 1.0 | 35 | 1.5 | 4.2 |

Same shape as
FG Series
(See page 20., 22.)

# FM Series

## ● 5.5 V Type

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) |
|---|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System ( F ) | Discharge System ( F ) | | | |
| FM0H103ZF | FM0H103ZFTP ( ) | 5.5 | 0.01 | 0.014 | 300 | 0.015 | 4.2 |
| FM0H223ZF | FM0H223ZFTP ( ) | 5.5 | 0.022 | 0.028 | 200 | 0.033 | 4.2 |
| FM0H473ZF | FM0H473ZFTP ( ) | 5.5 | 0.047 | 0.06 | 200 | 0.071 | 4.2 |
| FM0H104ZF | FM0H104ZFTP ( ) | 5.5 | 0.10 | 0.13 | 100 | 0.15 | 4.2 |
| FM0H224ZF | FM0H224ZFTP ( ) | 5.5 | – | 0.22 | 100 | 0.33 | 4.2 |

Same shape as FM Series 5.5V Type (See page 25.)

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

## ● 3.5 V Type

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) |
|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System (F) | Discharge System (F) | | |
| FM0V473ZF | FM0V473ZFTP ( ) | 3.5 | 0.047 | 0.06 | 200 | 0.042 |
| FM0V104ZF | FM0V104ZFTP ( ) | 3.5 | 0.10 | 0.13 | 100 | 0.090 |
| FM0V224ZF | FM0V224ZFTP ( ) | 3.5 | 0.22 | 0.30 | 100 | 0.20 |

Same shape as FM Series 3.5V Type (See page 26.)

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

## ● FME Type ( Backup Large Current , mA Order )

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) |
|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System (F) | Discharge System (F) | | |
| FME0H223ZF | FME0H223ZFTP ( ) | 5.5 | 0.022 | 0.028 | 40 | 0.033 |
| FME0H473ZF | FME0H473ZFTP ( ) | 5.5 | 0.047 | 0.06 | 20 | 0.071 |

Same shape as FM Series FME Type (See page 26.)

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

## ● FMR Type ( Extended Operating Temperature range )

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min.(V) |
|---|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System (F) | Discharge System (F) | | | |
| FMR0H473ZF | FMR0H473ZFTP ( ) | 5.5 | 0.047 | 0.062 | 200 | 0.071 | 4.2 |

Same shape as FM Series FMR Type (See page 26.)

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

## ● FM 6.5V Type

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) |
|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System (F) | Discharge System (F) | | |
| FM0J473ZF | FM0J473ZFTP ( ) | 6.5 | 0.047 | 0.062 | 200 | 0.085 |

Same shape as FM Series 6.5V Type (See page 26.)

**Note:** To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34.)

## ● FMC Type

| Part Number | | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. ESR (at 1 kHz) ( Ω ) | Max. Current at 30 minutes ( mA ) | Voltage Holding Characteristic Min. ( V ) |
|---|---|---|---|---|---|---|---|
| | Ammo pack | | Charge System ( F ) | Discharge System ( F ) | | | |
| FMC0H473ZF | FMC0H473ZFTP( ) | 5.5 | 0.047 | 0.062 | less than 100 | less than 0.071 | more than 4.2V |
| FMC0H104ZF | FMC0H104ZFTP( ) | 5.5 | 0.10 | 0.13 | less than 50 | less than 0.15 | more than 4.2V |
| FMC0H334ZF | FMC0H334ZFTP( ) | 5.5 | – | 0.33 | less than 30 | less than 0.50 | more than 4.2V |

Same shape as FM Series FMC Type (See page 32.)

Chip parts applicable to treatment in bond hardening furnace (160 ± 5°C for 120 ±10 seconds)

Note: To complete part number, insert lead length H. (16 or 18 mm: Refer to Taping Specification on page 34 or 35.)

# FA Series

| Part Number | Max. Rated Voltage (VDC) | Nominal Capacitance | | Max. Current at 30 minutes (mA) | Max. ESR (at 1 kHz) (Ω) |
|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | |
| FA0H473ZF | 5.5 | 0.047 | 0.075 | 0.071 | 20 |
| FA0H104ZF | 5.5 | 0.1 | 0.16 | 0.15 | 8 |
| FA0H224ZF | 5.5 | 0.22 | 0.35 | 0.33 | 5 |
| FA0H474ZF | 5.5 | 0.47 | 0.75 | 0.71 | 3.5 |
| FA0H105ZF | 5.5 | 1.0 | 1.6 | 1.5 | 2.5 |
| FA1A223ZF | 11 | 0.022 | 0.035 | 0.066 | 20 |
| FA1A104ZF | 11 | 0.1 | 0.16 | 0.30 | 8 |
| FA1A224ZF | 11 | 0.22 | 0.35 | 0.66 | 6 |
| FA1A474ZF | 11 | 0.47 | 0.75 | 1.41 | 4 |

Same shape as FA Series (See page 38.)

# FE Series

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. Current at 30 minutes (mA) | Max. ESR (at 1 kHz) (Ω) |
|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | |
| FE0H473ZF | 5.5 | 0.047 | 0.075 | 0.071 | 14.0 |
| FE0H104ZF | 5.5 | 0.10 | 0.16 | 0.15 | 6.5 |
| FE0H224ZF | 5.5 | 0.22 | 0.35 | 0.33 | 3.5 |
| FE0H474ZF | 5.5 | 0.47 | 0.75 | 0.71 | 1.8 |
| FE0H105ZF | 5.5 | 1.0 | 1.4 | 1.5 | 1.0 |
| FE0H155ZF | 5.5 | 1.5 | 2.1 | 2.3 | 0.6 |

Same shape as FE Series (See page 41.)

## FS Series

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (at 1 kHz) (mA) |
|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | |
| FS0H223ZF | 5.5 | 0.022 | 0.033 | 60 | 0.033 |
| FS0H473ZF | 5.5 | 0.047 | 0.072 | 40 | 0.071 |
| FS0H104ZF | 5.5 | 0.10 | 0.15 | 25 | 0.15 |
| FS0H224ZF | 5.5 | 0.22 | 0.33 | 25 | 0.33 |
| FS0H474ZF | 5.5 | 0.47 | 0.75 | 13 | 0.71 |
| FS0H105ZF | 5.5 | 1.0 | 1.3 | 7 | 1.5 |
| FS1A474ZF | 11.0 | 0.47 | 0.60 | 7 | 1.41 |
| FS1A105ZF | 11.0 | 1.0 | 1.3 | 7 | 3.0 |
| FS1B105ZF | 12.0 | 1.0 | 1.3 | 7.5 | 3.6 |
| FS1B505ZF | 12.0 | 5.0 | 6.5 | 4.0 | 18.0 |

Same shape as FS Series (See page 44.)

## FR Series

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FR0H223ZF | 5.5 | 0.022 | 0.028 | 220 | 0.033 | 4.2 |
| FR0H473ZF | 5.5 | 0.047 | 0.060 | 110 | 0.071 | 4.2 |
| FR0H104ZF | 5.5 | 0.10 | 0.15 | 150 | 0.15 | 4.2 |
| FR0H224ZF | 5.5 | 0.22 | 0.33 | 180 | 0.33 | 4.2 |
| FR0H474ZF | 5.5 | 0.47 | 0.75 | 100 | 0.71 | 4.2 |
| FR0H105ZF | 5.5 | 1.0 | 1.6 | 60 | 1.5 | 4.2 |

Same shape as FR Series (See page 47.)

## 3.5 V, 6.5 V Rated Voltage Series

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) |
|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | |
| FSH0V433ZF | 3.5 | 0.043 | 0.055 | 50 | 0.039 |
| FYD0V563ZF | 3.5 | 0.056 | 0.070 | 150 | 0.050 |
| FSH0J223ZF | 6.5 | 0.022 | 0.033 | 60 | 0.040 |
| FYD0J273ZF | 6.5 | 0.027 | 0.040 | 200 | 0.049 |

Same shape as 3.5V, 6.5V Rated Voltage Series (See page 51.)

# FY Series

## ● FYD-Type

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FYD0H223ZF | 5.5 | 0.022 | 0.033 | 220 | 0.033 | 4.2 |
| FYD0H473ZF | 5.5 | 0.047 | 0.070 | 220 | 0.071 | 4.2 |
| FYD0H104ZF | 5.5 | 0.10 | 0.14 | 100 | 0.15 | 4.2 |
| FYD0H224ZF | 5.5 | 0.22 | 0.35 | 120 | 0.33 | 4.2 |
| FYD0H474ZF | 5.5 | 0.47 | 0.75 | 65 | 0.71 | 4.2 |
| FYD0H105ZF | 5.5 | 1.0 | 1.6 | 35 | 1.5 | 4.2 |
| FYD0H145ZF | 5.5 | 1.4 | 2.1 | 45 | 2.1 | 4.2 |
| FYD0H225ZF | 5.5 | 2.2 | 3.3 | 35 | 3.3 | 4.2 |

Same shape as FY Series FYD Type (See page 54.)

## ● FYH-Type

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FYH0H223ZF | 5.5 | 0.022 | 0.033 | 200 | 0.033 | 4.2 |
| FYH0H473ZF | 5.5 | 0.047 | 0.075 | 100 | 0.071 | 4.2 |
| FYH0H104ZF | 5.5 | 0.10 | 0.16 | 50 | 0.15 | 4.2 |
| FYH0H224ZF | 5.5 | 0.22 | 0.30 | 60 | 0.33 | 4.2 |
| FYH0H474ZF | 5.5 | 0.47 | 0.70 | 35 | 0.71 | 4.2 |
| FYH0H105ZF | 5.5 | 1.0 | 0.50 | 20 | 1.5 | 4.2 |

Same shape as FY Series FYH Type (See page 55.)

## ● FYL-Type

| Part Number | Max. Rated Voltage (V) | Nominal Capacitance | | Max. ESR (at 1 kHz) (Ω) | Max. Current at 30 minutes (mA) | Voltage Holding Characteristic Min. (V) |
|---|---|---|---|---|---|---|
| | | Charge System (F) | Discharge System (F) | | | |
| FYL0H103ZF | 5.5 | 0.010 | 0.013 | 300 | 0.015 | 4.2 |
| FYL0H223ZF | 5.5 | 0.022 | 0.028 | 200 | 0.033 | 4.2 |
| FYL0H473ZF | 5.5 | 0.047 | 0.061 | 200 | 0.071 | 4.2 |

Same shape as FY Series FYL Type (See page 56.)

## HP Series

| Part Number | Max. Rated Voltage (Vdc) | Norminal Capacitance (F) | Max. ESR (at 1kHz) (mΩ) |
|---|---|---|---|
| HPSN0G473ZL | 4.2 | 0.047 | 200 |
| HPSN0G223ZL | 4.2 | 0.022 | 250 |
| HPSN0G103ZL | 4.2 | 0.01 | 350 |

Same shape as HP Series (See page 8.)

## ED/L Series

| Part Number | Max. Rated Voltage (Vdc) | Max. Rated Voltage (Vdc) | Norminal Capacitance (F) | Max. ESR (at 1kHz) (mΩ) |
|---|---|---|---|---|
| EDL473Z3R6-1 | 3.6 | 4.2 | 0.047 | 200 or less |
| EDL223Z7R0-1 | 7.0 | 7.8 | 0.022 | 300 or less |

Same shape as ED/L Series (See page 9.)

# Environmental Impact Reduced Products Specifications

## FC Series 5.5V Type

| Item | | Standard | | Test Conditions conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70˚C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | 0.047 to 1.0F | | See characteristics measuring method. |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| *Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 6.3 V(5.5V products)<br>Temperature: 70 ± 2˚C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Charge resistance: 0.047F 300 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| *Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| *Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| *Soldering Heat Resistance | | Capacitance | Satisty initial standard value | |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| *Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| *Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| *High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| *Voltage Holding Characteristics (Self Dischage ) | | Voltage between terminal leads higher than 4.2 V | | Charging condition: Voltage applied: 5.0 VDC<br>Series resistance: 0 Ω<br>Charging time: 24hours |
| | | | | Storage: Time: 24hours<br>Temperature:Lower than 25°C |

* The characteristics above must be satisfied for asterisked items after the end of reflow soldering (according to the reflow condition shown on page ).

# FC Series 3.5V Type

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 3.5 VDC | | |
| Nominal Capacitance Range | | 0.10 to 0.47F | | See characteristics measuring method. |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| * Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 4.0 V(3.5V products)<br>Temperature: 70 ± 2°C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Charge resistance : 0.10F 150 Ω<br>: 0.22F 56 Ω<br>: 0.47F 30 Ω<br>: 1.0F 15 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| * Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| * Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| * Soldering Heat Resistance | | Capacitance | Satisty initial standard value | |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| * Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| * Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| * High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 3.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

* The characteristics above must be satisfied for asterisked items after the end of reflow soldering (according to the reflow condition shown on page ).

# FT Series

| Item | | Specification | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –40˚C to +85˚C | | |
| Maximum Operating Voltage | | 5.5 Vdc | | |
| Nominal Capacitance Range | | 0.1 to 5.6 F (Refer to standard ratings) | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minute value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | Conforms to 7.14<br>At 85˚C Surge voltage 6.3 V<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>1000 cycles<br>Charge resistance:<br>0.10 F 150 Ω<br>0.22 F 56 Ω<br>0.47 F 30 Ω<br>1.0 F 15 Ω<br>2.2 F 10 Ω<br>3.3 F 10 Ω<br>5.6 F 10 Ω<br>Discharge resistance:<br>Not applicable (0 Ω) |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | More than 50 % of initial value | Conforms to 7.12<br>Phase 1: +25 ±2˚C<br>Phase 2: –25 ±2˚C<br>Phase 3: –40 ±2˚C<br>Phase 4: +25 ±2˚C<br>Phase 5: +85 ±2˚C<br>Phase 6: +25 ±2˚C |
| | | Equivalent Series Resistance | Not to exceed 3 times initial value | |
| | Phase 3 | Capacitance | More than 30 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed 7 times initial value | |
| | Phase 5 | Capacitance | Not to exceed 150 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed 1.5 CV (mA) | |
| | Phase 6 | ΔC/C | Within ±20 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2(1)<br>0.022 to 0.47 F: 1 kg, 10 sec.<br>1 F: 2.5 kg, 10 sec. |
| Vibration Resistance | | Capacitance | Meet initial requirement | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>245 ±5˚C<br>5 ±0.5 sec. 1.6 mm from body |
| Soldering Heat Resistance | | Capacitance | Meet initial requirement | Conforms to 8.5<br>260 ±10˚C, 10 ±1 sec.<br>Immersion depth:<br>1.6 mm from body |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Temperature Cycle | | Capacitance | Meet initial requirement | Conforms to 9.3<br>Temperatuve condition:<br>–40˚C → Normai temperature<br>→ +85˚C→ Normai temperature<br>Number of cycles : 5 cycles |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>40 ±2˚C, 90 to 95% RH<br>240 ± 8 hours |
| | | Equivalent Series Resistance | Not to exceed120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed120 % of initial requirement | |
| High temperature Load | | Capacitance change | Within ±30% of initial value | Conforms to 9.10<br>Temperature: 85 ± 2˚C<br>Series resistance: 0 Ω<br>Applied voltage: 5.5 VDC<br>Time of test: $1000^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Not to exceed 200% of initial requirement | |
| | | Current at 30 minutes | Not to exceed 200% of initial requirement | |

# FG Series

| Items | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to +70˚C | | |
| Maximum Operating Voltage. | | 5.5 Vdc | | |
| Nominal Capacitance Range | | 0.010 to 4.7 F | | See characteristics measuring method |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring method |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method |
| Current (30-minute value) | | See standard list | | See characteristics measuring method |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge voltage: 6.3V<br>Temperature: 70±2˚C<br>Charge: 30 sec.<br>Discharge: 9 min 30 sec.<br>Number of cycles: 1000 cycles<br>Series resistance:<br>0.010F: 1500 Ω 0.47F: 30 Ω<br>0.022F: 560 Ω 1.0F: 15 Ω<br>0.047F: 300 Ω 2.2F: 10 Ω<br>0.10F: 150 Ω 4.7F: 10 Ω<br>0.22F: 56 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current at 30 min. | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ±2˚C<br>Phase 2: –25 ±2˚C<br>Phase 3: –40 ±2˚C<br>Phase 4: +25 ±2˚C<br>Phase 5: +70 ±2˚C<br>Phase 6: +25 ±2˚C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current at 30 min. | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current at 30 min. | Satisfy initial standard value | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1) |
| Vibration Resistance | | Capacitance | Meet initial standard value | Conforms to 8.2.3 (1)<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current at 30 min. | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3 / 4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 245±5˚C<br>Dipping duration: 5±0.5 sec.<br>Should be dipped up to 1.6mm from the lower end of the capacitor |
| Soldering Heat Resistance | | Capacitance | Should satisfy initial standard value | Conforms to 8.5<br>Solder temperature: 260±10˚C<br>Dipping duration: 10±1 sec.<br>Should be dipped up to 1.6mm from the lower end of the capacitor |
| | | Equivalent series resistance | | |
| | | Current at 30 min. | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisfy initial standard value | Conforms to 9.3<br>Temperature: –25˚C → normal temperature → +70˚C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current at 30 min. | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40±2˚C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ±8hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current at 30 min. | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within ±30% of initial value | Conforms to 9.10<br>Temperature: 70±2˚C<br>Voltage applied: 5.5Vdc<br>Series protection resistance: 0Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current at 30 min. | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Discharge) | | Voltage between terminal leads higher than 4.2V | | Charging Condition: Voltage applied: 5.0VDC (with case side terminal negative)<br>Series resistance: 0Ω<br>Charging time: 24 hours |
| | | | | Storage: Time: 24 hours<br>Temperature: Lower than 25˚C<br>Humidity: Lower than 70%RH |

# FG Series FGH Type

| Items | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to +70˚C | | |
| Maximum Operating Voltage. | | 5.5 Vdc | | |
| Nominal Capacitance Range | | 0.10 to 1.0 F | | See characteristics measuring method |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring method |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method |
| Current (30-minute value) | | See standard list | | See characteristics measuring method |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge voltage: 6.3V<br>Temperature: 70±2˚C<br>Charge: 30 sec.<br>Discharge: 9 min 30 sec.<br>Number of cycles: 1000 cycles<br>Series resistance:<br>0.010F: 1500 Ω 0.47F: 30 Ω<br>0.022F: 560 Ω 1.0F: 15 Ω<br>0.047F: 300 Ω 2.2F: 10 Ω<br>0.10F: 150 Ω 4.7F: 10 Ω<br>0.22F: 56 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of inital requirement | |
| | | Current at 30 min. | Not to exceed 120% of inital requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ±2˚C<br>Phase 2: –25 ±2˚C<br>Phase 3: –40 ±2˚C<br>Phase 4: +25 ±2˚C<br>Phase 5: +70 ±2˚C<br>Phase 6: +25 ±2˚C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current at 30 min. | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current at 30 min. | Satisfy initial standard value | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1) |
| Vibration Resistance | | Capacitance | Meet initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current at 30 min. | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3 / 4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 245±5˚C<br>Dipping duration: 5±0.5 sec.<br>Should be dipped up to 1.6mm from the lower end of the capacitor |
| Solder Heat Resistance | | Capacitance | Should satisfy initial standard value | Conforms to 8.5<br>Solder temperature: 260±10˚C<br>Dipping duration: 10±1 sec.<br>Should be dipped up to 1.6mm from the lower end of the capacitor |
| | | Equivalent series resistance | | |
| | | Current at 30 min. | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisfy initial standard value | Conforms to 9.3<br>Temperature: –25˚C → normal temperature → +70˚C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current at 30 min. | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40±2˚C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ±8hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current at 30 min. | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within ±30% of initial value | Conforms to 9.10<br>Temperature: 70±2˚C<br>Voltage applied: 5.5Vdc<br>Series protection resistance: 0Ω<br>Test duration: $1000^{+48}_{-0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current at 30 min. | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Discharge) | | Voltage between terminal leads higher than 4.2V | | Charging Condition: Voltage applied: 5.0VDC (with case side terminal negative) Series resistance: 0Ω Charging time: 24 hours<br>Storage: Time: 24 hours Temperature: Lower than 25˚C Humidity: Lower than 70%RH |

# FM Series 5.5V Type

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 6.3 V<br>Temperature: 70 ± 2°C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.01F: 1500 Ω 0.22F: 56 Ω<br>0.022 F: 560 Ω<br>0.047 F: 300 Ω<br>0.10 F: 150 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality. | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10sec. |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 245 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Discharge ) | | Voltage between terminal leads higher than 4.2 V | | Charging condition: Voltage applied: 5.0 VDC<br>Series resistance: 0 Ω<br>Charging time: 24hours |
| | | | | Storage: Time: 24hours<br>Temperature:Lower than 25°C<br>Humidity:Lower than 70%RH |

# FM Series 3.5V Type

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 3.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge voltage: 4.0 V<br>Temperature: 70 ± 2°C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.047 F: 300 Ω<br>0.10 F: 150 Ω<br>0.22 F: 56 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10 sec |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No considerable abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 245 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from for the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from for the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 3.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

# FM Series FME Type

| Item | | Standard | | Test Conditions Conforming JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 7.4 V<br>Temperature: 70 ± 2°C<br>Chargs: 30 sec.<br>Dischargs: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.022 F: 560 Ω<br>0.047 F: 300 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 3 or less times initial value | |
| | Phase 5 | Capacitance | 150% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10 sec |
| Vibration Resistance | | Capacitance | Should satisty initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | There should be no considerable abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 245 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

# FM Series FMR Type

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –40°C to +85˚C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 6.3 V<br>Temperature: 85 ± 2˚C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.047 F: 300 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +85 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 3 | Capacitance | 30% or higher initial value | |
| | | Equivalent series resistance | 7 or less times initial value | |
| | Phase 5 | Capacitance | 200% or higher initial value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial standard value | |
| | | Equivalent series resistance | Satisfy initial standard value | |
| | | Current (30-minute value) | Satisfy initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10sec. |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder. | | Conforms to 8.4<br>Solder temperature: 245 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–40°C → normal temperature<br>→ +85°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 85 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Discharge ) | | Voltage between terminal leads higher than 4.2 V | | Charging condition: Voltage applied: 5.0 VDC<br>Series resistance: 0 Ω<br>Charging time: 24hours |
| | | | | Storage: Time: 24hours<br>Temperature:Lower than 25°C<br>Humidity:Lower than 70%RH |

# FM Series FM 6.5V Type

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 6.5 VDC | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 7.4 V<br>Temperature: 70 ± 2°C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.047 F: 300 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10sec. |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency : 10 to 55 Hz<br>Test duration : 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 245 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soidering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obuious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 6.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

# FM Series FMC Type

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | 0.047F , 0.10F , 0.33F | | |
| Capacitance Allowance | | +80%, –20% | | See characteristics measuring method. |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge Voltage: 6.3 V<br>Temperature: 70 ± 2°C<br>Chargs: 30 sec.<br>Dischargs: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.047 F: 300 Ω<br>0.1 F: 150 Ω<br>0.33 F: 51 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality. | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 4 or less times initial value | |
| | Phase 5 | Capacitance | 200% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tenile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>1 kg 10 sec |
| Vibration Resistance | | Capacitance | Should satisty initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | There should be no considerable abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 245 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: 5.5 Vdc<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Dischage) | | Voltage between terminal leads higher then 4.2V | | Charging condition: Voltage applied: 5.0 VDC<br>Series resistance: 0 Ω<br>Charging time: 24hours |
| | | | | Storage: Time: 24hours<br>Temperature:Lower than 25°C<br>Humidity:Lower than 70%RH |

# FA Series

| Item | | Specification | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to 70˚C | | |
| Maximun Rated Voltage | | 5.5 VDC, 11.0 VDC | | |
| Nominal Capacitance Range | | 0.047 to 1.0 F (Refer to standard ratings) | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minute value) | | See standard list | | See characteristics measuring conditions |
| Temperature Variation of Characteristics | At min. temp. (–25˚C Step 2) | Capacitance | More than 70 % of initial value | Conforms to 7.14<br>Phase 1 : +25±2.0˚C<br>Phase 2 : –25±2.0˚C<br>Phase 3 : +25±2.0˚C<br>Phase 4 : +70±2.0˚C<br>Phase 5 : +25±2.0˚C |
| | | Equivalent Series Resistance | Not to exceed 3 times initial value | |
| | At max. temp. (+70˚C Step 4) | Capacitance | Not to exceed 150 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed 1.5 CV (mA) | |
| | At room temp. (+25˚C Step 5) | Capacitance | Not to change more than ±20 % from initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>5.5 VDC: 0.047 F to 0.22 F: 1 kg 10 sec; 0.47 F to 1.0 F: 2.5 kg 10 sec<br>11 VDC: 0.022 F to 0.1 F: 1 kg 10 sec; 0.22 F to 0.47 F: 2.5 kg 10 sec |
| Vibration Resistance | | Capacitance | Meet initial requirement | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>245 ±5˚C, 5 ±0.5 sec.<br>Immersion depth:<br>2.5 mm from body |
| Soldering Heat Resistance | | Capacitance | Meet initial requirement | Conforms to 8.5<br>260 ±10˚C, 10 ±1 sec.<br>Immersion depth:<br>2.5 mm from body |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Temperature Cycle | | Capacitance | Meet initial requirement | Conforms to 9.3<br>Temperature conitiom:<br>–25˚C → normal temperature<br>→+70˚C normal temperature<br>Number of cycles : 5 cycles |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Humidity Resistance | | Capacitance | More than 90 % of initial requirement | Conforms to 9.5<br>40 ±2˚C, 90 to 95 % RH<br>240 ± 8 hours |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| High Temperature Load | | Capacitance | More than 85 % of initial requirement | Conforms to 9.10<br>70 ±2˚C<br>5.5 V applied for 5 V type<br>11 V applied for 10 V type<br>1 000 $^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 200 % of initial requirement | |

# FE Series

| Item | | Specification | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –40˚C to 70˚C | | |
| Maximun Rated Voltage | | 5.5 VDC | | |
| Nominal Capacitance Range | | 0.047 to 1.5 F (Refer to standard ratings) | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minute value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | Conforms to 7.14<br>At 70˚C<br>Surge voltage 6.3 V<br>Temperature : 70±2˚C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>1 000 cycles<br>Charge resistance :<br>0.047 F 300 Ω<br>0.10 F 150 Ω<br>0.22 F 56 Ω<br>0.47 F 30 Ω<br>1.0, 1.5 F 15 Ω<br>Discharge resistance:<br>Not applicable (0 Ω) |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| Temperature Variation of Characteristics | Phase 3 | Capacitance | More than 40 % of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2˚C<br>Phase 2: –25 ± 2˚C<br>Phase 3: –40 ± 2˚C<br>Phase 4: +25 ± 2˚C<br>Phase 5: +70 ± 2˚C<br>Phase 6: +25 ± 2˚C |
| | | Equivalent Series Resistance | Not to exceed 4 times initial value | |
| | Phase 5 | Capacitance | Not to exceed 200 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed 1.5 CV (mA) | |
| | Phase 6 | Capacitance | Within ±20 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>0.047 to 0.47 F: 1 kg, 10 sec.<br>1 F, 1.5 F : 2.5 kg, 10 sec. |
| Vibration Resistance | | Capacitance | Meet initial requirement | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>245 ±5˚C Immersion depth:<br>5 ±0.5 sec. 1.6 mm from body |
| Soldering Heat Resistance | | Capacitance | Meet initial requirement | Conforms to 8.5<br>260 ±10˚C, 10 ±1 sec.<br>Immersion depth :<br>1.6 mm from body |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Temperature Cycle | | Capacitance | Shall meet initial requirement | Conforms to 9.3<br>Temperature condition:<br>–40˚C → normal temperture<br>→ +70˚C → normal temperture<br>Number of cycles : 5 cycles |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Humidity Resistance | | Capacitance change | Within ±20 % of initial value | Conforms to 9.5<br>40 ± 2˚C, 90 to 95 % RH<br>240 hours<br>240 ± 8 hours |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| High Temperature Load | | Capacitance change | Within ±30 % of initial value | Conforms to 9.10<br>70 ± 2˚C<br>5.5 V applied<br>1 000 $^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Not to exceed 300 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 200 % of initial requirement | |

# FS Series

| Item | | Standard | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70°C | | |
| Maximum Operating Voltage | | 5.5 VDC, 11 VDC, 12 VDC | | |
| Nominal Capacitance Range | | 0.022 to 1.0 F (5.5 V products), 0.47 F to 1.0 F (11 V products), 1.0 F to 5.0 F (12 V products) | | See characteristics measuring method. |
| Capacitance Allowance | | +80%, –20% | | |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring method. |
| Current (30-minutes value) | | See standard list | | See characteristics measuring method. |
| Surge Voltage | | Capacitance | More than 90% of initial requirement | Conforms to 7.14<br>Surge voltage: 6.3 V (5.5 V products)<br>12.6 V (11 V products)<br>13.6 V (12 V products)<br>Temperature: 70 ± 2°C<br>Chargs: 30 seconds<br>Discharge: 9 min. 30 sec.<br>Number of cycles 1000 cycles.<br>Series resistance:<br>0.022 F 560 Ω<br>0.047 F 300 Ω<br>0.1 F 150 Ω<br>0.22 F 56 Ω<br>0.47 F 30 Ω<br>1 F 15 Ω<br>5 F 10 Ω<br>Discharge resistance: 0 Ω |
| | | Equivalent series resistance | Not to exceed 120% of initial requirement | |
| | | Current (30-minute value) | Not to exceed 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | 50% or higher of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2°C<br>Phase 2: –25 ± 2°C<br>Phase 3: –40 ± 2°C<br>Phase 4: +25 ± 2°C<br>Phase 5: +70 ± 2°C<br>Phase 6: +25 ± 2°C |
| | | Equivalent series resistance | 3 or less times initial value | |
| | Phase 5 | Capacitance | 150% or below of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | 1.5 CV (mA) or below | |
| | Phase 6 | Capacitance | Within ± 20% of initial value | |
| | | Equivalent series resistance | Satisty initial standard value | |
| | | Current (30-minute value) | Satisty initial standard value | |
| Lead Strengh (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>5.5 VDC: 0.022 F to 0.22 F: 1 kg 10 sec; 0.47 F to 1.0 F: 2.5 kg 10 sec<br>11 VDC: 2.5 kg 10 sec<br>12 VDC: 2.5 kg 10 sec |
| Vibration Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 245 ± 5°C<br>Dipping duration: 5 ± 0.5 sec.<br>Should be dipped up to 1.6 mm from the lower end of the capacitor. |
| Soldering Heat Resistance | | Capacitance | Satisty initial standard value | Conforms to 8.5<br>Solder temperature: 260 ± 10°C<br>Dipping duration: 10 ± 1 sec.<br>Dipped up to 1.6 mm from the lower end of the capacitor. |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Satisty initial standard value | Conforms to 9.3<br>Temperature condition:<br>–25°C → normal temperature<br>→ +70°C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent series resistance | | |
| | | Current (30-minute value) | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | 90% or higher of initial standard value (5.5 V products)<br>Within 20% of initial value (11 V, 12 V products) | Conforms to 9.5<br>Temperature: 40 ± 2°C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240 ± 8 hours |
| | | Equivalent series resistance | 1.2 or less times initial standard value | |
| | | Current (30-minute value) | 1.2 or less times initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | 85% or higher of initial standard value (5.5 V products)<br>Within ±30% of initial value (11 V, 12 V products) | Conforms to 9.10<br>Temperature: 70 ± 2°C<br>Voltage applied: Maximum operating voltage<br>Series protection resistance: 0 Ω<br>Test duration: $1000^{+48}_{0}$ hours |
| | | Equivalent series resistance | Twice or less times initial standard value | |
| | | Current (30-minute value) | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

# FR Series

| Item | | Specification | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –40˚C to +85˚C | | |
| Maximun Working Voltage | | 5.5 Vdc | | |
| Nominal Capacitance Range | | 0.022 to 1.0 F (Refer to standard ratings) | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minute Value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | Conform to 7.14<br>Surge voltage 6.3 V<br>Temperature : 85± 2˚C<br>Charge: 30 sec.<br>Discharge: 9 min. 30 sec.<br>1 000 cycles<br>Charge resistance:<br>0.022 F 560 Ω<br>0.047 F 300 Ω<br>0.10 F 150 Ω<br>0.22 F 56 Ω<br>0.47 F 30 Ω<br>1.0 F 15 Ω<br>Discharge resistance:<br>Not applicable (0 Ω) |
| | | Equivalent Series Resistance | Not to exceed 120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed 120 % of initial requirement | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | More than 50 % of initial value | Conform to 7.12<br>Phase 1: +25 ±2˚C<br>Phase 2: –25 ±2˚C<br>Phase 3: –40 ±2˚C<br>Phase 4: +25 ±2˚C<br>Phase 5: +85 ±2˚C<br>Phase 6: +25 ±2˚C |
| | | Equivalent Series Resistance | Not to exceed 4 times initial value | |
| | Phase 3 | Capacitance | More than 30 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed 7 times initial value | |
| | Phase 5 | Capacitance | Not to exceed 200 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed 1.5 CV (mA) | |
| | Phase 6 | Capacitance | Within ±20 % of initial value | |
| | | Equivalent Series Resistance | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conform to 8.1.2 (1)<br>0.022 to 0.47 F: 1 kg, 10 sec.<br>1 F: 2.5 kg, 10 sec. |
| Vibration Resietance | | Capacitance | Meet initial requirement | Conform to 8.2.3<br>Frequency: 10 to 55 Hz<br>Test duration: 6 hours |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Solderability | | 3/4 or more of the pin surface shoud be covered with new solder | | Conform to 8.4<br>245 ±5˚C<br>5 ±0.5 sec. 1.6 mm from body |
| Soldering Heat Resistance | | Capacitance | Meet initial requirement | Conform to 8.5<br>260 ±10˚C, 10 ±1 sec.<br>Immersion depth:<br>1.6 mm from body |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Temperature Cycle | | Capacitance | Meet initial requirement | Conform to 9.3<br>Temperature condition:<br>–40˚C → normal temperature<br>→ +85˚C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent Series Resistance | Meet initial requirement | |
| | | Current at 30 minutes | Meet initial requirement | |
| Humidity Resistance | | Capacitance | Within ± 20% of initial value | Conform to 9.5<br>40 ± 2˚C, 90 to 95% RH<br>240 ± 8 hours |
| | | Equivalent Series Resistance | Not to exceed120 % of initial requirement | |
| | | Current at 30 minutes | Not to exceed120 % of initial requirement | |

| Item | Specification | | Test Conditions Conforming to JIS C 5102-1994 | |
|---|---|---|---|---|
| High Temperature Load | Capacitance change | Within ±30% of initial value | Conforms to 9.10<br>Temperature: 85 ± 2°C<br>Series resistance: 0 Ω<br>Applied voltage: 5.5 VDC<br>Time of test: 1000 $^{+48}_{-0}$ hours | |
| | Equivalent Series Resistance | Not to exceed 200% of initial requirement | | |
| | Current at 30 minutes | Not to exceed 200% of initial requirement | | |
| Voltage Holding Characteristics | Voltage between terminal leads higher than 4.2V | | Charging | (1) Applied Voltage: 5.0 V<br>(2) Series Resistance: 0 Ω<br>(3) Charging time: 24 h |
| | | | Storege | (1) Load: Nothing<br>(2) Temp.: Less than 25°C<br>(3) Humidity: Less than 70% RH<br>(4) Storage time: 24 h |

# 3.5V, 6.5V Rated Voltage Series

| Items | | Specifications | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to +70˚C | | |
| Maximum Rated Voltage | | 3.5 VDC, 6.5 VDC | | |
| Nominal Capacitance Range | | See standard ratings | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minutes value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | Conforms to 7.14<br>Surge voltage:<br>4.0 V (3.5 VDC), 7.4 V (6.5 VDC)<br>rated part rated part<br>Temperature: 70±2˚C<br>Charging for 30 seconds<br>Discharging for 9 min 30 sec.<br>Number of cycles: 1 000 cycles<br>Charge resistance:<br>0.022 F 560 Ω<br>0.027 F 560 Ω<br>0.043 F 300 Ω<br>0.056 F 240 Ω<br>No discharge resistance |
| | | Equivalent Series Resistance | Less than 200% of initial requirement | |
| | | Current 30 minutes | Less than 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | More than 50 % of initial value | Conforms to 7.12<br>Phase 1: +25 ±2˚C<br>Phase 2: –25 ±2˚C<br>Phase 3: –40 ±2˚C<br>Phase 4: +25 ±2˚C<br>Phase 5: +70 ±2˚C<br>Phase 6: +25 ±2˚C |
| | | Equivalent Series Resistance | Less than 400% of initial value | |
| | Phase 5 | Capacitance | Less than 200% of initial value | |
| | | Equivalent Series Resistance | Initial requirement | |
| | | Current 30 minutes | Less than 1.5 CV (mA) | |
| | Phase 6 | Capacitance | Within ±20% of initial value | |
| | | Equivalent Series Resistance | Initial requirement | |
| | | Current 30 minutes | Initial requirement | |
| Vibration Resistance | | Capacitance | Shall meet initial requirements | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Time of test: 6 hours |
| | | Equivalent Series Resistance | | |
| | | Current 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/ 4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Temperature of solder: 245 ±5˚C<br>Time of immersion: 5 ±0.5 seconds<br>To immerse capacitors up to 1.6 mm from the bottom |
| Soldering Heat Resistance | | Capacitance | Shall meet initial requirements | Conforms to 8.5<br>Temperature of solder: 260 ±10˚C<br>Time of immersion: 10 ±1 seconds<br>To immerse capacitors up to 1.6 mm from the bottom |
| | | Equivalent Series Resistance | | |
| | | Current 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Shall meet initial requirements | Conforms to 9.3<br>Temperature condition:<br>–25˚C → normal temperature<br>→ +70˚C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent Series Resistance | | |
| | | Current 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms to 9.5<br>Temperature: 40 ±2˚C<br>Humidity: 90 to 95% RH<br>Time of test: 240 ± 8 hours |
| | | Equivalent Series Resistance | Less than 200% of initial requirement | |
| | | Current 30 minutes | Less than 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within ±30% of initial requirement | Conforms to 9.10<br>Temperature: 70 ±2˚C<br>Series resistance: 0 Ω<br>Applied voltage: 3.5 VDC, 6.5 VDC<br>Time of test: 1000 $^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Less than 300% of initial requirement | |
| | | Current 30 minutes | Less than 200% of initial requirement | |
| | | Appearance | No obvious abnormality | |

# FY Series

| Items | | Specifications | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to +70˚C | | |
| Maximum Operating Voltage | | 5.5 Vdc | | |
| Nominal Capacitance Range | | See standard list | | |
| Capacitance Allowance | | +80 %, –20 % | | See characteristics measuring conditions |
| Equivalent Series Resistance | | See standard list | | See characteristics measuring conditions |
| Current (30-minutes Value) | | See standard list | | See characteristics measuring conditions |
| Surge Voltage | | Capacitance | More than 90 % of initial requirement | Conforms to 7.14<br>Surge voltage: 6.3 V<br>Temperature: 70 ± 2˚C<br>Charging for 30 seconds<br>Discharging for 9 min. 30 sec.<br>Number of cycles 1 000 cycles<br>Charge resistance :<br>0.01 F 1500 Ω 0.47 F 30 Ω<br>0.022 F 560 Ω 1.0 F 15 Ω<br>0.047 F 300 Ω 1.4 F 15 Ω<br>0.10 F 150 Ω 2.2 F 10 Ω<br>0.22 F 56 Ω<br>No discharge resistance |
| | | Equivalent Series Resistance | Less than 120% of initial requirement | |
| | | Current at 30 minutes | Less than 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Temperature Variation of Characteristics | Phase 2 | Capacitance | More than 50 % of initial value | Conforms to 7.12<br>Phase 1: +25 ± 2˚C<br>Phase 2: –25 ± 2˚C<br>Phase 3: –40 ± 2˚C<br>Phase 4: +25 ± 2˚C<br>Phase 5: +70 ± 2˚C<br>Phase 6: +25 ± 2˚C |
| | | Equivalent Series Resistance | Less than 400% of initial value | |
| | Phase 5 | Capacitance | Less than 200% of initial value | |
| | | Equivalent Series Resistance | Initial requirement | |
| | | Current at 30 minutes | Less than 1.5 CV (mA) | |
| | Phase 6 | Capacitance | Within ± 20% of initial value | |
| | | Equivalent Series Resistance | Initial requirement | |
| | | Current at 30 minutes | Initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1)<br>FYD0H105Z<br>FYD0H145Z<br>FYD0H225Z } : 2.5 kg-f 10 ± 1 sec.<br>FYH0H474Z<br>FYH0H105Z<br>Others: 1.0 kg-f 10 ± 1 sec. |
| Vibration Resistance | | Capacitance | Meet initial requirements | Conforms to 8.2.3<br>Frequency: 10 to 55 Hz<br>Time of test: 6 hours |
| | | Equivalent Series Resistance | | |
| | | Current at 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Solderability | | 3/4 or more of the pin of surface should be covered with the solder | | Conforms to 8.4<br>Temperature of solder: 245 ± 5˚C<br>Time of immersion: 5 ± 0.5 second<br>To immerse capacitors up to 1.6 mm from the bottom |
| Soldering Heat Resistance | | Capacitance | Meet initial requirements | Conforms to 8.5<br>Temperature of solder: 260 ± 10˚C<br>Time of immersion: 10 ± 1 seconds<br>To immerse capacitors up to 1.6 mm from the bottom |
| | | Equivalent Series Resistance | | |
| | | Current at 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Shall meet initial requirements | Conforms to 9.3<br>Temperature condition:<br>–25˚C → normal temperature<br>→ +70˚C → normal temperature<br>Number of cycles: 5 cycles |
| | | Equivalent Series Resistance | | |
| | | Current at 30 minutes | | |
| | | Visual appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ± 20% of initial value | Conforms to 9.5<br>Temperature: 40 ± 2˚C<br>Humidity: 90 to 95% RH<br>Time of test: 240 ± 8 hours |
| | | Equivalent Series Resistance | Less than 120% of initial requirement | |
| | | Current at 30 minutes | Less than 120% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load | | Capacitance | Within ± 30% of initial value | Conforms to 9.10<br>Temperature: 70 ± 2˚C<br>Series resistance: 0 Ω<br>Applied voltage: 5.5 VDC<br>Time of test: 1000 $^{+48}_{-0}$ hours |
| | | Equivalent Series Resistance | Less than 200% of initial requirement | |
| | | Current at 30 minutes | Less than 200% of initial requirement | |
| | | Appearance | No obvious abnormality | |
| Voltage Holding Characteristics (Self Discharge) | | Voltage between terminal leads higher than 4.2 V. | | Charging condition: Applied voltage: 5.0 VDC<br>Series resistance: 0 Ω<br>Curging time: 24 hours |
| | | | | Storage: Load: Nothing<br>Temperature: Lower than 25˚C<br>Humidity: Lower than 70% RH<br>Time: 24 hours |

# HP Series

| Item | | Specification | | Test Condition (Refer to EIAJ RC-2377) |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70˚C | | |
| Maximum Rated Voltage (V.dc) | | Refer to standard ratings | | |
| Capacitance | | Refer to standard ratings | | Impedance method (at 1Hz) |
| Capacitance Allowance | | +80%, –20% | | |
| ESR | | Refer to standard ratings | | Impedance method (at 1kHz) |
| DC Leakage Current | | 5mA or less | | Rated Voltage, Rs=0.1Ω, 5minute |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Refer to "JIS C 5101-14.13" |
| Surge Voltage | | Capacitance | Initial requirement | Temp: 70±2˚C<br>Voltage: 4.7V<br>Charge: 30 sec.<br>Discharge: 330 sec. 1000 cycles. |
| | | ESR | Shall not exceed 120% of initial requirements | |
| | | LC | Initial requirement | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Vibration Resistance | | Capacitance | Initial requirement | Frequency: 10 to 55 Hz<br>Amplitude of vibration: 0.75mm<br>2 hr each in three directions |
| | | ESR | | |
| | | LC | | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Soldering Heat Resistance | | Capacitance | Initial requirement | Using soldering iron<br>Iron temperature 320˚C Max, Time 3 sec. Max.<br>Iron power 30 W Max.<br>(Attach at a point 2mm from the tip of the terminal) |
| | | ESR | | |
| | | LC | | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Solderbility | | Over 75% of the terminal surface shall be covered by a continuous new solder coating after immersion | | Refer to JIS C 5101-14.15<br>Solder temp.: 230±5˚C<br>Immersion time: 5±0.5 sec.<br>Solder immersion: 1.5mm |
| Temperature Variation of Characteristics | Step 2 | Capacitance | Shall be exceed 50% of initial requirement | Measurements shall be made at each of the temperatures specified above after the capacitor has reached thermal stability<br>Step 1: +20±2˚C<br>Step 2: –25±3˚C<br>Step 3: +20±2˚C<br>Step 4: +70±2˚C<br>Step 5: +20±2˚C<br>*) Thermal stability<br>The condition of thermal stability is judged to be reached when two readings of ESR taken at an interval of not less than 5 min do not differ by an amount greater than which can be attributed to the measuring apparatus. |
| | | ESR | Shall not be exceed 500% of initial requirement | |
| | | LC | Initial requirement | |
| | Step 4 | Capacitance | Shall not be exceed 200% of initial requirement | |
| | | ESR | Initial requirement | |
| | | LC | | |
| | Step 5 | Capacitance | Initial requirement | |
| | | ESR | | |
| | | LC | | |
| Humidity Resistance | | Capacitance | Within ±30% of initial requirement | Refer to JIS C 5101-14.22<br>Temperature: 40±2˚C, Moisture: 90 to 95% R.H.<br>Duration: 500(–0 to +24)hr,<br>The specimen shall then remain under standard atmospheric condition for recovery for a period adequate for the attainment of temperature stability, with 12 to 24hr. |
| | | ESR | Shall not exceed 300% of initial requirement | |
| | | LC | Initial requirement | |
| | | Visual | There shall be no evidence of mechanical damage | |
| High Temperature | | Capacitance | Within ±30% of initial requirement | Refer to JIS C 5101-14.23<br>Temperature: 70±2˚C, Duration: 1000 (–0 to +48) hr,<br>Rated voltage applied<br>The specimen shall then remain under standard atmospheric condition for recovery for a period adequate for the attainment of temperature stability, with 12 to 24hr. |
| | | ESR | Shall not exceed 300% of initial requirements | |
| | | LC | Initial requirement | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Temperature Cycle | | Capacitance | Initial requirement | Refer to JIS C 5101-14.16<br>Temperature: –25 to 70˚C |
| | | ESR | | |
| | | LC | | |
| | | Visual | There shall be no evidence of mechanical damage | |

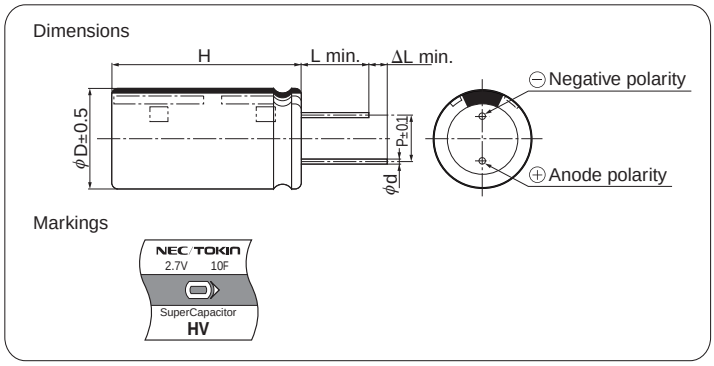
| Step | Temp. | Time |
|---|---|---|
| 1 | –25˚C | 30±3 min. |
| 2 | Room Temp. | 3min. Max. |
| 3 | +70˚C | 30±3 min. |
| 4 | Room Temp. | 3min. Max. |

# ED/L Series

| Item | | Specification | | Test Condition (Refer to EIAJ RC-2377) |
|---|---|---|---|---|
| Operating Temperature Range | | –25°C to +70˚C | | |
| Maximum Rated Voltage (V.dc) | | Refer to standard ratings | | |
| Rated Voltage (V.dc) | | Refer to standard ratings | | |
| Capacitance | | Refer to standard ratings | | Impedance method (at 1Hz) |
| Capacitance Allowance | | +80%, –20% | | |
| ESR | | Refer to standard ratings | | Impedance method (at 1kHz) |
| DC Leakage Current | | 5mA or less | | Rated Voltage, Rs=0.1Ω, 5minute |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Refer to "JIS C 5101-14.13" |
| Surge Voltage | | Capacitance | Initial requirement | Temp: 70±2˚C<br>Voltage: EDL473Z3R6-1: 4.4V<br>EDL223Z7R0-1: 7.8V<br>Charge: 30 sec.<br>Discharge: 330 sec. 1000 cycles. |
| | | ESR | Shall not exceed 120% of initial requirements | |
| | | LC | Initial requirement | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Vibration Resistance | | Capacitance | Initial requirement | Frequency: 10 to 55 Hz<br>Amplitude of vibration: 0.75mm<br>2 hr each in three directions |
| | | ESR | | |
| | | LC | | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Soldering Heat Resistance | | Capacitance | Initial requirement | Using soldering iron<br>Iron temperature 320˚C Max, Time 3 sec. Max.<br>Iron power 30 W Max.<br>(Attach at a point 2mm from the tip of the terminal) |
| | | ESR | | |
| | | LC | | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Solderbility | | Over 75% of the terminal surface shall be covered by a continuous new solder coating after immersion | | Refer to JIS C 5101-14.15<br>Solder temp.: 230±5˚C<br>Immersion time: 5±0.5 sec.<br>Solder immersion: 1.5mm |
| Temperature Variation of Characteristics | Step 2 | Capacitance | Shall be exceed 50% of initial requirement | Measurements shall be made at each of the temperatures specified above after the capacitor has reached thermal stability<br>Step 1: +20±2˚C<br>Step 2: –25±3˚C<br>Step 3: +20±2˚C<br>Step 4: +70±2˚C<br>Step 5: +20±2˚C<br>*) Thermal stability<br>The condition of thermal stability is judged to be reached when two readings of ESR taken at an interval of not less than 5 min do not differ by an amount greater than which can be attributed to the measuring apparatus. |
| | | ESR | Shall not be exceed 500% of initial requirement | |
| | | LC | Initial requirement | |
| | Step 4 | Capacitance | Shall not be exceed 200% of initial requirement | |
| | | ESR | Initial requirement | |
| | | LC | | |
| | Step 5 | Capacitance | Initial requirement | |
| | | ESR | | |
| | | LC | | |
| Humidity Resistance | | Capacitance | Within ±30% of initial requirement | Refer to JIS C 5101-14.22<br>Temperature: 40±2˚C, Moisture: 90 to 95% R.H.<br>Duration: 500(–0 to +24)hr,<br>The specimen shall then remain under standard atmospheric condition for recovery for a period adequate for the attainment of temperature stability, with 12 to 24hr. |
| | | ESR | Shall not exceed 300% of initial requirement | |
| | | LC | Initial requirement | |
| | | Visual | There shall be no evidence of mechanical damage | |
| High Temperature | | Capacitance | Within ±30% of initial requirement | Refer to JIS C 5101-14.23<br>Temperature: 70±2˚C, Duration: 1000 (–0 to +48) hr,<br>Rated voltage applied<br>The specimen shall then remain under standard atmospheric condition for recovery for a period adequate for the attainment of temperature stability, with 12 to 24hr. |
| | | ESR | Shall not exceed 300% of initial requirements | |
| | | LC | Initial requirement | |
| | | Visual | There shall be no evidence of mechanical damage | |
| Temperature Cycle | | Capacitance | Initial requirement | Refer to JIS C 5101-14.16<br>Temperature: –25 to 70˚C |
| | | ESR | | |
| | | LC | | |
| | | Visual | There shall be no evidence of mechanical damage | |

| Step | Temp. | Time |
|---|---|---|
| 1 | –25˚C | 30±3 min. |
| 2 | Room Temp. | 3min. Max. |
| 3 | +70˚C | 30±3 min. |
| 4 | Room Temp. | 3min. Max. |

# Super Capacitor HV Series




## Standard Rating

| Part No. | Max. Rated Voltage (Vdc) | Nominal Capacitance (F) | Max. ESR (at 1 kHz) (mΩ) | Max. Current at 30 minutes (mA) | Dimensions (Unit: mm) | | | | | | Weight (g) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ∅D | H | P | ∅d | l | ΔL | |
| HV0E106N | 2.7 | 10 | 500 | 8 | 10.0 | 35±2 | 5.0 | 0.6 | 15.0 | 5.0 | 4.5 |
| HV0E226N | 2.7 | 22 | 500 | 18 | 12.5 | 35±2 | 5.0 | 0.6 | 15.0 | 5.0 | 6.5 |
| HV0E506N | 2.7 | 50 | 100 | 40 | 18.0 | 40±5 | 7.5 | 0.8 | 15.0 | 5.0 | 14.0 |
| HV0E107N | 2.7 | 100 | 100 | 80 | 22.0 | 50±5 | 10.2 | 1.0 | 18.0 | 7.0 | 24.0 |

## Specifications

| Item | | Specification | | Test Conditions Conforming to JIS C 5102-1994 |
|---|---|---|---|---|
| Operating Temperature Range | | –25˚C to +60˚C | | |
| Maximum Operating Voltage | | 2.7 Vdc | | |
| Nominal Capacitance Range | | 10F to 100F | | |
| Capacitance Allowance | | ±30% | | |
| Equivalent Series Resistance (ESR) | | See Standard list | | |
| Current at 30 minutes | | See Standard list | | |
| Tempere Variation of Characteristics | Phase 2 | Capacitance | More than 50% of initial value | Conforms to 7.12<br>Phase2: –25±2˚C<br>Phase4: +60±2˚C<br>Phase5: +25±2˚C |
| | | ESR | Not to exceed 4 times initial value | |
| | Phase 4 | Capacitance | Not to exceed 150% of initial value | |
| | | ESR | Not to exceed initial requirement | |
| | | Current at 30minutes | Not to exceed 1.5CV(mA) | |
| | Phase 5 | ΔC/C | Within ±20% of initial value | |
| | | ESR | Not to exceed initial requirement | |
| | | Current at 30 minutes | Not to exceed initial requirement | |
| Lead Strength (Tensile) | | No loosening nor permanent damage of the leads | | Conforms to 8.1.2 (1) |
| Vibration Resistance | | Caoacitance | Meet initial standard value | Conforms to 8.2.3 (1)<br>Frequency: 10 to 55Hz<br>Test duration: 6 hours |
| | | ESR | | |
| | | Current at 30 minutes | | |
| | | Appearance | Noobvious abnormality | |
| Solderability | | 3/4 or more of the pin surface should be covered with new solder | | Conforms to 8.4<br>Solder temperature: 230±5˚C<br>Dipping duration: 5±0.5sec.<br>Shold be dipped up to 1.6mm from the lower end of the capacitor |
| Soldering Heat Resistance | | Capacitance | Should satisfy initial standard value | Conforms to 8.5<br>Solder temperature: 260±10˚C<br>Dipping duration: 10±1sec.<br>Shold be dipped up to 1.6mm from the lower end of the capacitor |
| | | ESR | | |
| | | Current at 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Temperature Cycle | | Capacitance | Meet initial standard value | Conforms to 9.3<br>Temperature: –25˚C→R.T.→+60˚C→R.T.<br>Number of cycles: 5 cycles |
| | | ESR | | |
| | | Current at 30 minutes | | |
| | | Appearance | No obvious abnormality | |
| Humidity Resistance | | Capacitance | Within ±20% of initial value | Conforms 9.5<br>Temperature: 40±2˚C<br>Relative humidity: 90 to 95% RH<br>Test duration: 240±8hours |
| | | ESR | 1.2 or less time initial standard value | |
| | | Current at 30 minutes | 1.2 or less time initial standard value | |
| | | Appearance | No obvious abnormality | |
| High Temperature Load Life | | Capacitance | Within ±30% of initial value | Conforms 9.10<br>Temperature: 60±2˚C<br>Voltage applied: 2.7Vdc<br>Test duration: $1000^{+48}_{0}$ hours<br>Series protection resistance: 0Ω |
| | | ESR | Twice or less times initial standard value | |
| | | Current at 30 minutes | Twice or less times initial standard value | |
| | | Appearance | No obvious abnormality | |

## 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 September 2004, and they may be changed without notice. If our products are used for mass-production design, please cousult 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.

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