

# Ceramic Trimmer Capacitors



**muRata**

*Innovator  
in Electronics*

Murata  
Manufacturing Co., Ltd.

Cat.No.T13E-9

# CONTENTS

|                                                     |    |
|-----------------------------------------------------|----|
| <b>Part Numbering</b>                               | 2  |
| <b>Selection Guide of Ceramic Trimmer Capacitor</b> | 3  |
| <b>1 TZR1 Series</b>                                | 4  |
| <b>2 TZS2 Series</b>                                | 8  |
| <b>3 TZY2 Series</b>                                | 12 |
| <b>4 TZV2 Series</b>                                | 16 |
| <b>5 TZC3 Series</b>                                | 20 |
| <b>6 TZW4 Series</b>                                | 25 |
| <b>7 TZB4 Series</b>                                | 29 |
| <b>8 TZ03 Series</b>                                | 35 |
| <b>Packaging</b>                                    | 42 |
| <b>Recommended Adjustment Tools</b>                 | 45 |
| <b>Qualified Standards</b>                          | 47 |

## ● Part Numbering

### Ceramic Trimmer Capacitors

|               |           |           |          |            |          |            |            |
|---------------|-----------|-----------|----------|------------|----------|------------|------------|
| (Part Number) | <b>TZ</b> | <b>Y2</b> | <b>R</b> | <b>200</b> | <b>A</b> | <b>001</b> | <b>R00</b> |
|               | ①         | ②         | ③        | ④          | ⑤        | ⑥          | ⑦          |

#### ① Product ID

| Product ID |                    |
|------------|--------------------|
| <b>TZ</b>  | Trimmer Capacitors |

#### ② Series/Terminal

| Code      | Series/Terminal                   |
|-----------|-----------------------------------|
| <b>03</b> | 6mm Size Lead Type                |
| <b>B4</b> | 4mm Size SMD/Lead Type            |
| <b>W4</b> | 4mm Size SMD Type                 |
| <b>C3</b> | 3mm Size SMD Type                 |
| <b>S2</b> | 2mm Size SMD Type (Height 1.0mm)  |
| <b>Y2</b> | 2mm Size SMD Type (Height 1.25mm) |
| <b>V2</b> | 2mm Size SMD Type (Height 1.45mm) |
| <b>R1</b> | 1mm Size SMD Type (Height 0.90mm) |

#### ③ Temperature Characteristics

| Code     | Temperature Characteristics |
|----------|-----------------------------|
| <b>Z</b> | NP0 ppm/°C                  |
| <b>S</b> | N150ppm/°C                  |
| <b>N</b> | N200ppm/°C                  |
| <b>T</b> | N450ppm/°C                  |
| <b>R</b> | N750ppm/°C                  |
| <b>K</b> | N1000ppm/°C                 |
| <b>P</b> | N1200ppm/°C                 |

Please refer to ratings for tolerance of temperature characteristics.

#### ④ Maximum Capacitance

Expressed by three figures. The unit is pico-farad(pF). The first and second figures are significant digits, and the third figure expresses the number of zeros which follow the two numbers. If there is a decimal point, it is expressed by the capital letter "R". In this case, all figures are significant digits.

#### ⑤ Terminal Shape

| Code     | Terminal Shape                                                                      |
|----------|-------------------------------------------------------------------------------------|
| <b>A</b> | Top Adjustment; <b>TZR1,TZS2,TZY2,TZV2,TZC3,TZW4,TZB4</b> (SMD Type)                |
| <b>B</b> | Top Adjustment; <b>TZB4</b> (SMD Type),<br>Rear Adjustment; <b>TZ03</b> (Lead Type) |
| <b>C</b> | Top Adjustment; <b>TZB4</b> (Lead Type)                                             |
| <b>D</b> | Rear Adjustment; <b>TZB4</b> (Lead Type)                                            |
| <b>E</b> | Top Adjustment; <b>TZ03</b> (Lead Type),<br>Rear Adjustment; <b>TZB4</b> (SMD Type) |
| <b>F</b> | Top Adjustment; <b>TZ03</b> (Lead Type)                                             |
| <b>N</b> | Rear Adjustment; <b>TZ03</b> (Lead Type)                                            |
| <b>T</b> | Top Adjustment; <b>TZ03</b> (Taping Type)                                           |
| <b>Y</b> | Side Adjustment; <b>TZ03</b> (Lead Type)                                            |

Please refer to dimensions for terminals in detail.

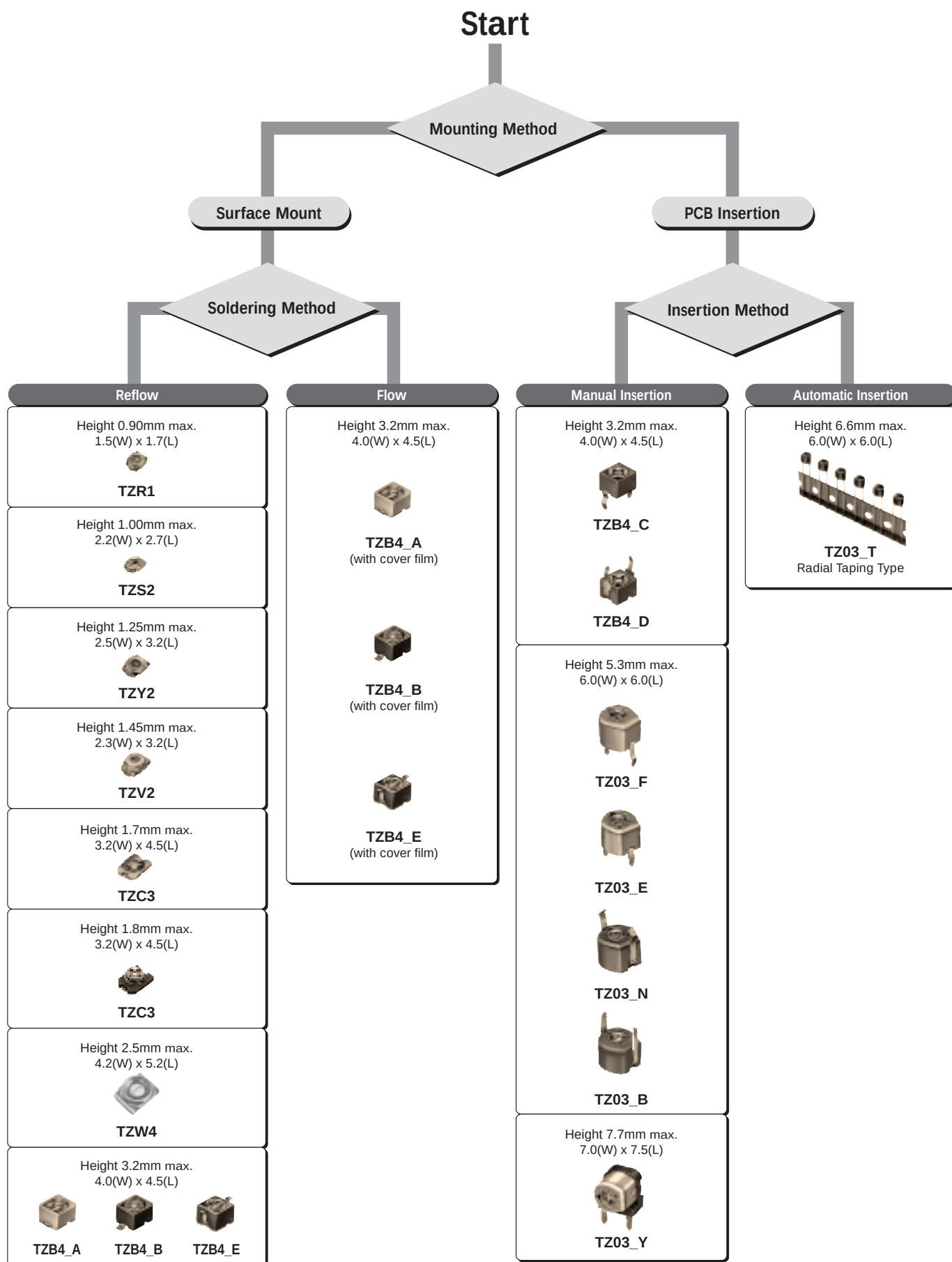
#### ⑥ Individual Specification

| Code       | Individual Specifications                   |
|------------|---------------------------------------------|
| <b>001</b> | <b>TZR1,TZS2,TZY2,TZW4</b> Standard Type    |
| <b>110</b> | <b>TZV2,TZC3</b> (Minus Slot) Standard Type |
| <b>169</b> | <b>TZ03</b> Standard Type                   |
| <b>310</b> | <b>TZC3</b> (Plus Slot) Standard Type       |
| <b>A10</b> | <b>TZB4</b> No-cover Film Standard Type     |
| <b>B10</b> | <b>TZB4</b> with Cover Film Standard Type   |

#### ⑦ Packaging

| Code       | Packaging                 |
|------------|---------------------------|
| <b>A00</b> | Ammo Pack (Radial Taping) |
| <b>B00</b> | Bulk                      |
| <b>M00</b> | Magazine                  |
| <b>R00</b> | Reel (Taping ø180mm)      |
| <b>R01</b> | Reel (Taping ø330mm)      |

## Selection Guide of Ceramic Trimmer Capacitor



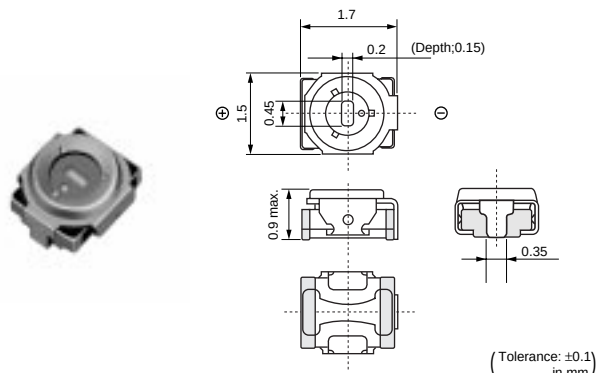
# Ceramic Trimmer Capacitors



## TZR1 Series

### ■ Features

1. Ultra-small and thin with external dimensions of 1.5(W)x1.7(L)x0.85(H)mm (80% less in volume than the current product).
2. Unique construction with no plastic material provides superior soldering heat resistance to maintain excellent characteristic performance after reflow soldering.
3. Suitable for high frequency circuit due to high self resonant frequency (6.2GHz of TZR1Z010 at 1.0pF setting)



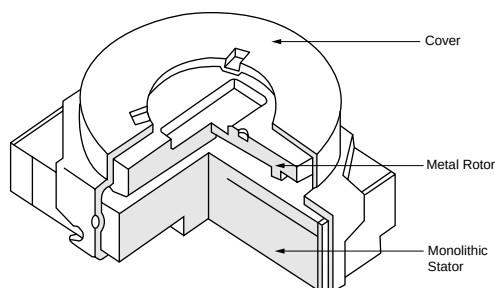
### ■ Applications

1. "Bluetooth"
2. Crystal oscillators
3. Crystal filters
4. Hand radios
5. Miniature tuner packs (FM Radio, TV)
6. Remote keyless entry systems
7. Pagers

| Part Number  | Cmin. (max.) (pF) | Cmax. (pF)   | TC             | Q                        | Rated Voltage | Withstanding Voltage |
|--------------|-------------------|--------------|----------------|--------------------------|---------------|----------------------|
| TZR1Z010A001 | 0.55              | 1.0 +100/-0% | NP0±300ppm/°C  | 200min. at 200MHz, Cmax. | 25Vdc         | 55Vdc                |
| TZR1Z1R5A001 | 0.7               | 1.5 +100/-0% | NP0±300ppm/°C  | 200min. at 200MHz, Cmax. | 25Vdc         | 55Vdc                |
| TZR1Z040A001 | 1.5               | 4.0 +100/-0% | NP0±500ppm/°C  | 300min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |
| TZR1R080A001 | 3.0               | 8.0 +100/-0% | N750±500ppm/°C | 300min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |

Insulation Resistance : 10000M ohm Torque : 0.1 to 1.0mNm Operating Temperature Range : -25 to +85°C

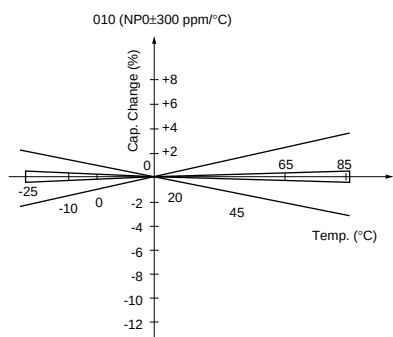
### ■ Construction



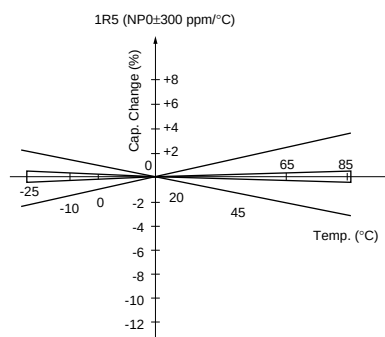
## ■ Temperature Characteristics

1

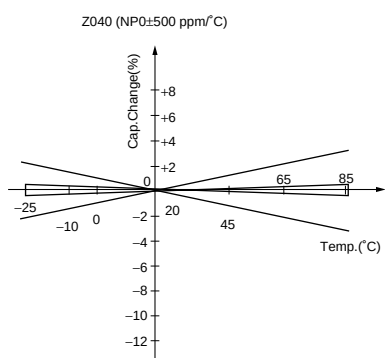
TZR1Z010



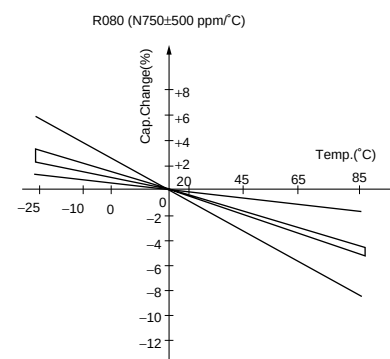
TZR1Z1R5



TZR1Z040

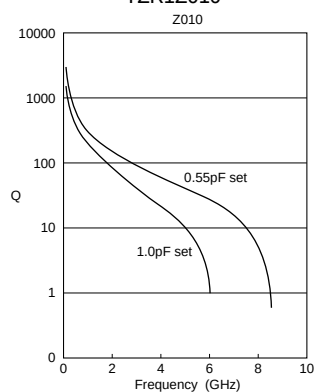


TZR1R080

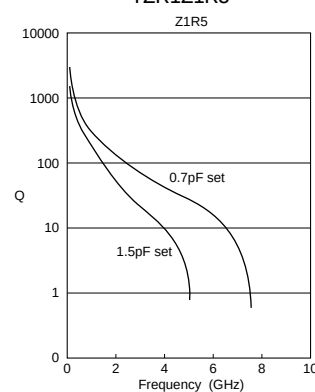


## ■ Frequency Characteristics

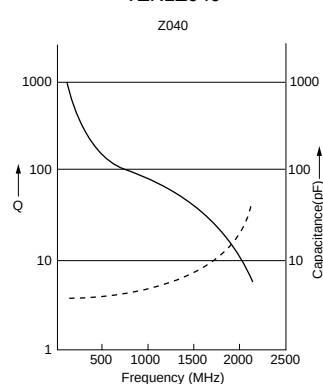
TZR1Z010



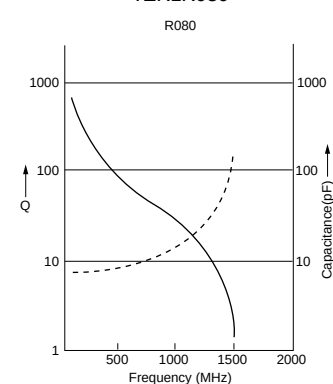
TZR1Z1R5



TZR1Z040



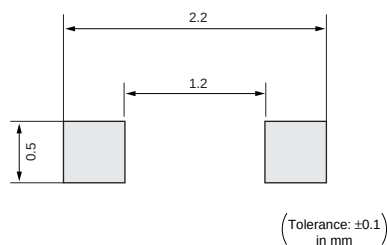
TZR1R080



Continued on the following page. ➤

Continued from the preceding page.

## ■ Land Pattern



## ■ Notice (Storage and operating condition)

- Do not use the trimmer capacitor under atmosphere of RTV silicone rubber (Room Temperature Vulcanizing Silicone Rubber) except Acetone liberating silicone sealant.
- Before using trimmer capacitor, please store under the condition of -10 to +40 degree C and 30 to 85%RH.
- Do not store in or near corrosive gasses.
- Use within 6 months of delivery.
- Do not store under direct sunlight.
- Do not use the trimmer capacitor under the conditions listed below.

## ■ Notice (Soldering and mounting)

### 1. Soldering

- TZR1 series can be soldered by reflow soldering method and soldering iron. Do not use flow soldering method (dipping).

#### (2) Standard soldering condition

- Reflow soldering: Refer to the standard temperature profile.

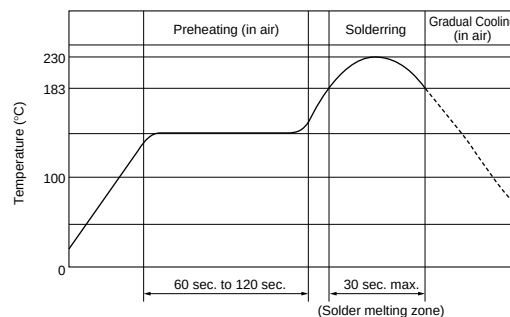
#### (b) Soldering iron:

- > Temperature of tip 260 $\pm$ 10 degree C
- > Soldering time 3 sec. max.
- > Diameter 0.5mm max.
- > Wattage of iron 20W max.

Before using other soldering conditions than those listed above, please consult with Murata factory representative prior to using. If the soldering conditions are not suitable, e.g., excessive time and/or excessive temperature, the trimmer capacitor may deviate from the specified characteristics.

- The amount of solder is critical.
- The thickness of solder paste should be printed from 100 micro m to 150 micro m and the dimension of land pattern should be Murata's standard land pattern used at reflow soldering. Insufficient amounts of solder can lead to insufficient soldering strength on PCB. Excessive amounts of solder may cause bridging between the terminals or contact failure due to

## ■ Temperature Profile



- Corrosive gasses atmosphere (ex. Chlorine gas, Hydrogen sulfide gas, Ammonia gas, Sulfuric acid gas, Nitric oxide gas, etc.)
- In liquid (ex. water, oil, medical liquid, organic solvent, etc.)
- Dusty / dirty atmosphere
- Direct sunlight
- Static voltage nor electric/magnetic fields
- Direct sea breeze
- Other variations of the above

flux wicking up.

- When using soldering iron, the diameter of the string solder shall be less than 0.5mm. The string solder shall be applied to the lower part of the terminal only. Do not apply flux except to the terminals. Excessive amounts of solder and/or applying solder to the upper part of the terminal may cause fixed metal rotor or the contact failure due to flux invasion into the movable part and/or the contact point. The soldering iron should not come in contact with the monolithic stator of the trimmer capacitor. If such contact does occur, the trimmer capacitor may be damaged.
- Our recommended chlorine content of solder is as follows.
  - Solder paste: 0.2wt% max.
  - String solder: 0.5wt% max.
- Do not use water-soluble flux (for water cleaning). To prevent the deterioration of trimmer capacitor characteristics, apply flux only to terminals.

### 2. Mounting

- Do not apply excessive force (preferable 5.0N (Ref.; 500gf) max.), when the trimmer capacitor is mounted on the PCB.
- Do not warp and/or bend PCB to prevent trimmer capacitor from breaking.

Continued on the following page.

 Continued from the preceding page.

- (3) Use the suitable dimension of the pick-up nozzle.  
(1.1-1.2mm external diameter and 0.8-0.9mm bore diameter.)

3. Cleaning

Can not be cleaned because of open construction.

4. Other

Note the polarity of the trimmer capacitor to minimize influence by stray capacitance.  
(Refer to the dimensions concerning the polarity.)

■ Notice (Handling)

1. Use suitable screwdrivers that fit comfortably in driver slot.

\*Recommended screwdriver for manual adjustment  
MURATA: KMDR160

2. When adjusting with a screwdriver, do not apply excessive force (preferable 0.5N (Ref; 50gf) max.) to minimize capacitance drift. If excessive force

is applied to the screwdriver slot, it may cause deformation of the products.

3. Do not apply adhesive, lock paints, or any other substances to the trimmer capacitor to secure the rotor position. They may cause corrosion or electrical contact problems.

■ Notice (Other)

Before using trimmer capacitor, please test after assembly in your particular mass production system.

# Ceramic Trimmer Capacitors

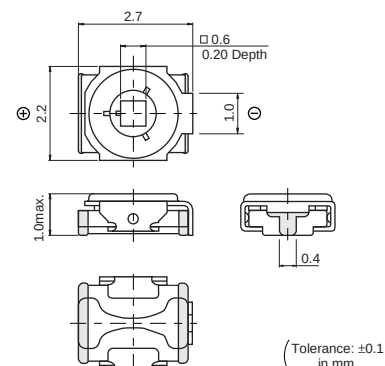


## TZS2 Series

2

### ■ Features

1. Ultra-small and thin type with external dimensions of 2.2(W)x2.7(L)x0.95(H)mm (30% less in volume from the current product).
2. Unique construction with no plastic material provides superior soldering heat resistance to maintain excellent characteristic performance after reflow soldering.
3. Pierced square hole allows for high resistance to tuning force and in-process automatic adjustment.



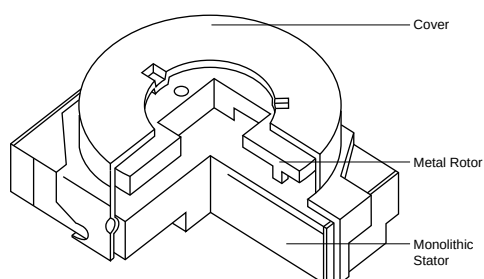
### ■ Applications

1. Crystal oscillators
2. Crystal filters
3. Hand radios
4. Cordless telephones
5. Cellular telephones
6. Tuner packs
7. Pagers
8. Remote keyless entry systems
9. PHS
10. Radar detectors
11. W-LAN
12. Compact radios
13. Headphone stereos

| Part Number  | Cmin. (max.) (pF) | Cmax. (pF)    | TC             | Q                      | Rated Voltage | Withstanding Voltage |
|--------------|-------------------|---------------|----------------|------------------------|---------------|----------------------|
| TZS2Z060A001 | 3.0               | 6.0 +100/-0%  | NP0±300ppm/°C  | 500min. at 1MHz, Cmax. | 25Vdc         | 55Vdc                |
| TZS2Z100A001 | 3.5               | 10.0 +100/-0% | NP0±300ppm/°C  | 500min. at 1MHz, Cmax. | 25Vdc         | 55Vdc                |
| TZS2R200A001 | 7.0               | 20.0 +100/-0% | N750±500ppm/°C | 500min. at 1MHz, Cmax. | 25Vdc         | 55Vdc                |

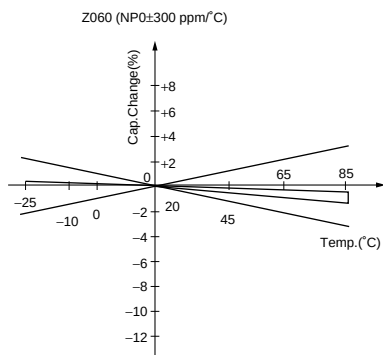
Insulation Resistance : 10000M ohm    Torque : 0.5 to 5.0mNm    Operating Temperature Range : -25 to +85°C

### ■ Construction

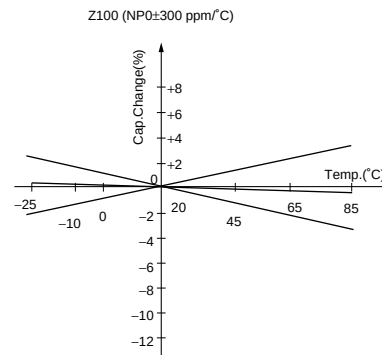


## ■ Temperature Characteristics

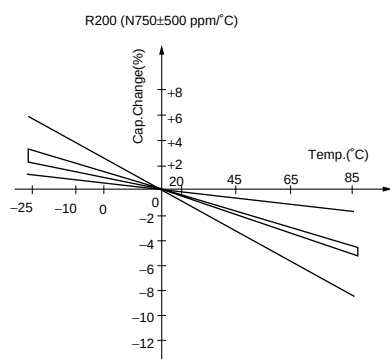
TZS2Z060



TZS2Z100

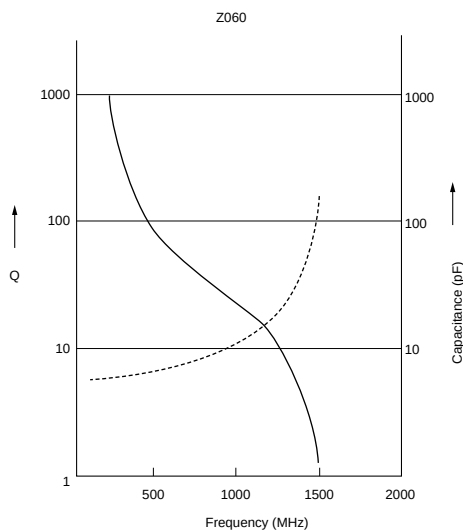


TZS2R200

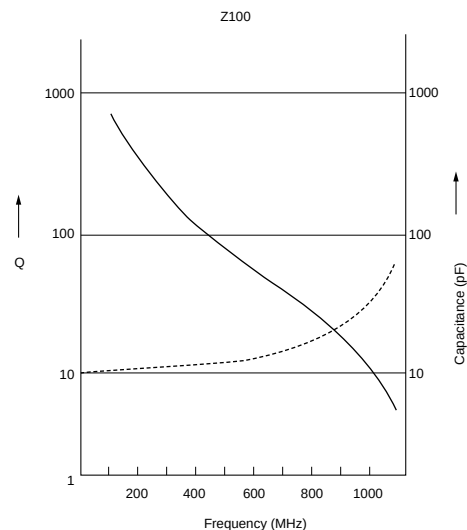


## ■ Frequency Characteristics

TZS2Z060



TZS2Z100



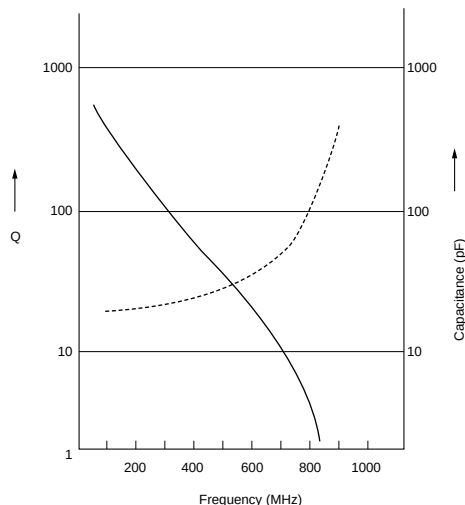
Continued on the following page.

Continued from the preceding page.

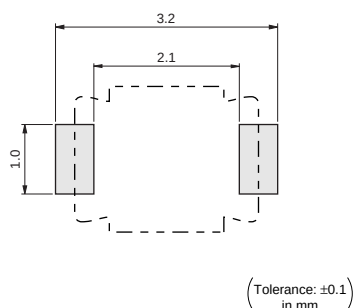
## Frequency Characteristics

TZS2R200

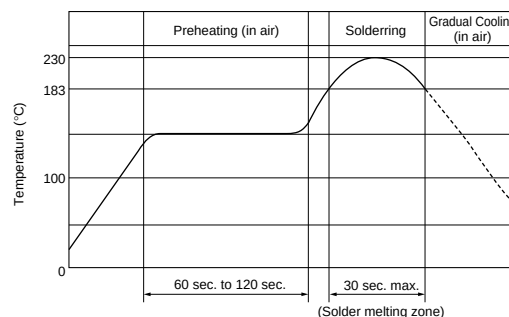
R200



## Land Pattern



## Temperature Profile



## Notice (Storage and operating condition)

- Do not use the trimmer capacitor under atmosphere of RTV silicone rubber (Room Temperature Vulcanizing Silicone Rubber) except Acetone liberating silicone sealant.
- Before using trimmer capacitor, please store under the condition of -10 to +40 degree C and 30 to 85%RH.
- Do not store in or near corrosive gasses.
- Use within 6 months of delivery.
- Do not store under direct sunlight.
- Do not use the trimmer capacitor under the conditions listed below.

- Corrosive gasses atmosphere (ex. Chlorine gas, Hydrogen sulfide gas, Ammonia gas, Sulfuric acid gas, Nitric oxide gas, etc.)
- In liquid (ex. water, oil, medical liquid, organic solvent, etc.)
- Dusty / dirty atmosphere
- Direct sunlight
- Static voltage nor electric/magnetic fields
- Direct sea breeze
- Other variations of the above

## Notice (Soldering and mounting)

- Soldering
  - TZS2 series can be soldered by reflow soldering method and soldering iron. Do not use flow soldering method (dipping).
  - Standard soldering condition
    - Reflow soldering: Refer to the standard temperature profile.
    - Soldering iron:

- > Temperature of tip 260±10 degree C
- > Soldering time 3 sec. max.
- > Diameter 1.0mm max.
- > Wattage of iron 20W max.

Before using other soldering conditions than those listed above, please consult with Murata factory representative prior to using. If the soldering conditions are not suitable, e.g.,

Continued on the following page. ➤

Continued from the preceding page.

excessive time and/or excessive temperature, the trimmer capacitor may deviate from the specified characteristics.

(3) The amount of solder is critical.

(4) The thickness of solder paste should be printed from 100 micro m to 150 micro m and the dimension of land pattern should be Murata's standard land pattern used at reflow soldering.

Insufficient amounts of solder can lead to insufficient soldering strength on PCB.

Excessive amounts of solder may cause bridging between the terminals or contact failure due to flux wicking up.

(5) When using soldering iron, the diameter of the string solder shall be less than 0.5mm. The string solder shall be applied to the lower part of the terminal only. Do not apply flux except to the terminals. Excessive amounts of solder and/or applying solder to the upper part of the terminal may cause fixed metal rotor or contact failure due to flux invasion into the movable part and/or the contact point. The soldering iron should not come in contact with the monolithic stator of the trimmer capacitor. If such contact does occur, the trimmer

capacitor may be damaged.

(6) Our recommended chlorine content of solder is as follows.

(a) Solder paste: 0.2wt% max.

(b) String solder: 0.5wt% max.

(7) Do not use water-soluble flux (for water cleaning). To prevent the deterioration of trimmer capacitor characteristics, apply flux only to terminals.

## 2. Mounting

(1) Do not apply excessive force (preferable 5.0N (Ref.; 500gf) max.), when the trimmer capacitor is mounted on the PCB.

(2) Do not warp and/or bend PCB to prevent trimmer capacitor from breakage.

(3) Use the suitable dimension of the pick-up nozzle (1.8mm external diameter and 1.3mm bore diameter).

## 3. Cleaning

Cannot be cleaned because of open construction.

## 4. Other

Note the polarity of the trimmer capacitor to minimize influence by stray capacitance.

(Refer to the dimensions concerning the polarity.)

## ■ Notice (Handling)

1. Use suitable screwdrivers that fit comfortably in driver slot.

(1) Recommended screwdriver for manual adjustment  
MURATA: KMDR050

(2) Recommended screwdriver bit for automatic adjustment  
MURATA: KMBT050

2. When adjusting with a screwdriver, do not apply

excessive force (preferable 1.0N (Ref; 100gf) max.) to minimize capacitance drift. If excessive force is applied to the screwdriver slot, it may cause deformation of the products.

3. Do not apply adhesive, lock paints, or any other substances to the trimmer capacitor to secure the rotor position. They may cause corrosion or electrical contact problems.

## ■ Notice (Other)

Before using trimmer capacitor, please test after assembly in your particular mass production system.

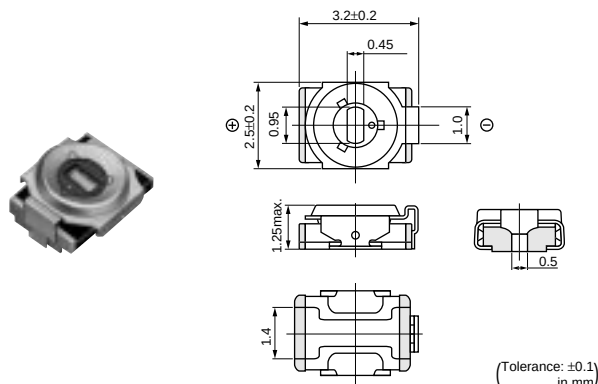
# Ceramic Trimmer Capacitors

**muRata**

## TZY2 Series

### ■ Features

1. Small and thin size with external dimensions of 2.5(W)x3.2(L)x1.25max.(H)mm
2. New shape of cover can improve the flux invasion compared with current products.
3. Improvement of the adhesion between rotor and stator leads to superior stability.
4. Unique construction with no plastic material provides superior soldering heat resistance to maintain excellent characteristic performance after reflow soldering.
5. Suitable for high frequency circuit due to high self resonant frequency (4.8GHz of TZY2Z010 at 1.0pF setting)



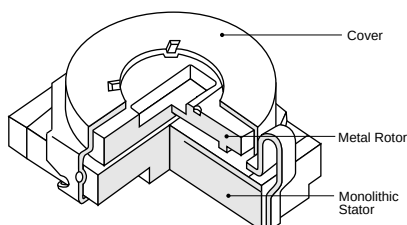
### ■ Applications

1. Crystal oscillators
2. Crystal filters
3. Pagers
4. Cordless telephones
5. PHS
6. Hand radios
7. Cellular telephones
8. Watches
9. Remote keyless entry systems
10. W-LAN
11. Radar detectors
12. Compact radios
13. DVD
14. Burglarproof devices
15. Headphone stereos

| Part Number  | Cmin. (max.) (pF) | Cmax. (pF)    | TC              | Q                        | Rated Voltage | Withstanding Voltage |
|--------------|-------------------|---------------|-----------------|--------------------------|---------------|----------------------|
| TZY2Z010A001 | 0.5               | 1.0 +100/-0%  | NP0±300ppm/°C   | 200min. at 200MHz, Cmax. | 25Vdc         | 55Vdc                |
| TZY2Z2R5A001 | 0.65              | 2.5 +100/-0%  | NP0±300ppm/°C   | 200min. at 200MHz, Cmax. | 25Vdc         | 55Vdc                |
| TZY2Z030A001 | 1.5               | 3.0 +100/-0%  | NP0±300ppm/°C   | 300min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |
| TZY2Z060A001 | 2.5               | 6.0 +100/-0%  | NP0±300ppm/°C   | 500min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |
| TZY2Z100A001 | 3.0               | 10.0 +100/-0% | NP0±300ppm/°C   | 500min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |
| TZY2R200A001 | 4.5               | 20.0 +100/-0% | N750±500ppm/°C  | 500min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |
| TZY2R250A001 | 5.5               | 25.0 +100/-0% | N750±500ppm/°C  | 300min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |
| TZY2K450A001 | 8.0               | 45.0 +100/-0% | N1000±500ppm/°C | 300min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |

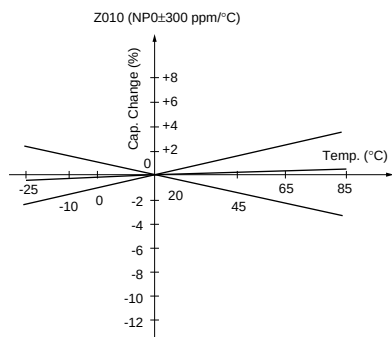
Insulation Resistance : 10000M ohm    Torque : 0.5 to 5.0mNm    Operating Temperature Range : -25 to +85°C

### ■ Construction

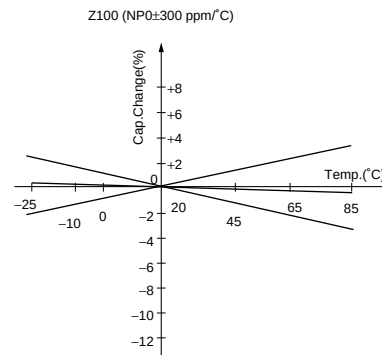


## ■ Temperature Characteristics

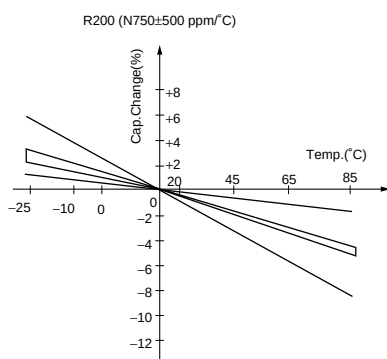
TZY2Z010



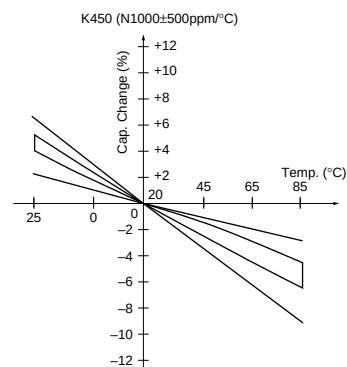
TZY2Z100



TZY2R200

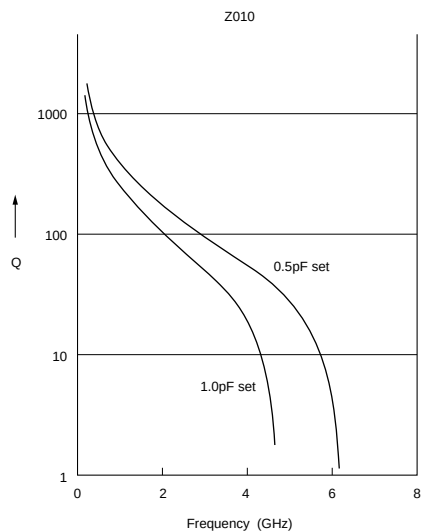


TZY2K450

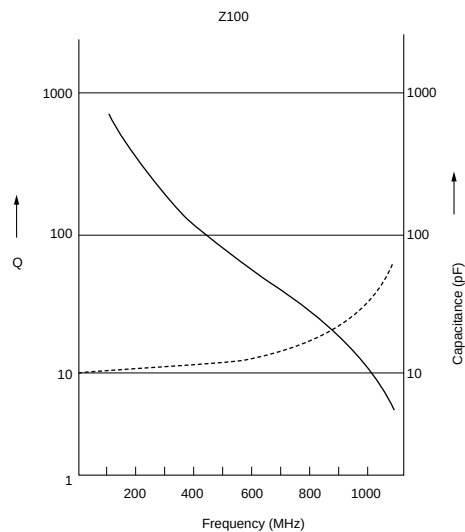


## ■ Frequency Characteristics

TZY2Z010



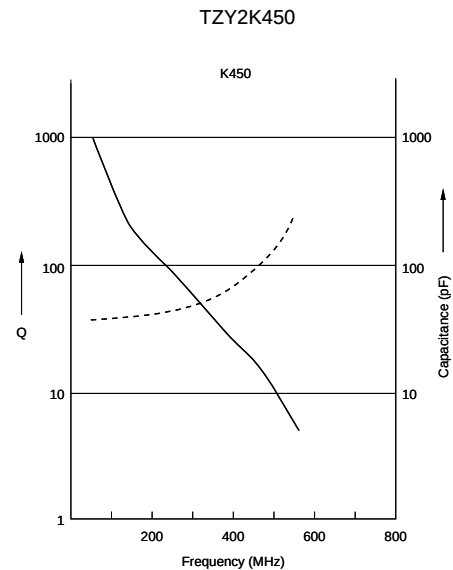
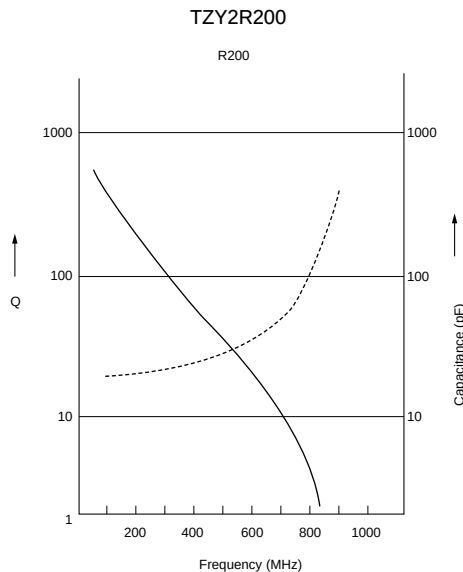
TZY2Z100



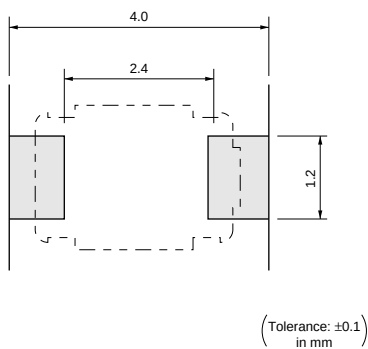
Continued on the following page. ↗

Continued from the preceding page.

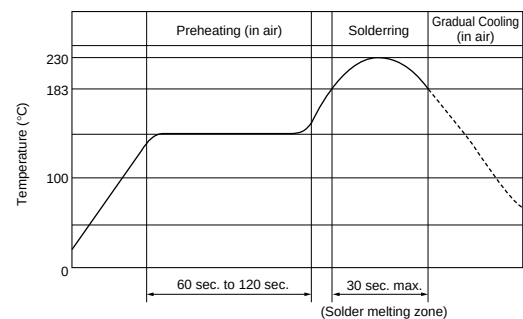
## Frequency Characteristics



## Land Pattern



## Temperature Profile



## Notice (Storage and operating condition)

- Do not use the trimmer capacitor under atmosphere of RTV silicone rubber (Room Temperature Vulcanizing Silicone Rubber) except Acetone liberating silicone sealant.
- Before using trimmer capacitor, please store under the condition of -10 to +40 degree C and 30 to 85%RH.
- Do not store in or near corrosive gasses.
- Use within 6 months of delivery.
- Do not store under direct sunlight.
- Do not use the trimmer capacitor under the conditions listed below.

- Corrosive gasses atmosphere (ex. Chlorine gas, Hydrogen sulfide gas, Ammonia gas, Sulfuric acid gas, Nitric oxide gas, etc.)
- In liquid (ex. water, oil, medical liquid, organic solvent, etc.)
- Dusty / dirty atmosphere
- Direct sunlight
- Static voltage nor electric/magnetic fields
- Direct sea breeze
- Other variations of the above

## Notice (Soldering and mounting)

- Soldering
  - TZY2 series can be soldered by reflow soldering method and soldering iron. Do not use flow soldering method (dipping).
  - Standard soldering condition
    - Reflow soldering: Refer to the standard temperature profile.
    - Soldering iron:

- > Temperature of tip 260 $\pm$ 10 degree C
- > Soldering time 3 sec. max.
- > Diameter 1mm max.
- > Wattage of iron 20W max.

Before using other soldering conditions than those listed above, please consult with Murata factory representative prior to using. If the soldering conditions are not suitable, e.g.,

Continued on the following page.

Continued from the preceding page.

excessive time and/or excessive temperature, the trimmer capacitor may deviate from the specified characteristics.

- (3) The amount of solder is critical.
- (4) The thickness of solder paste should be printed from 120 micro m to 170 micro m and the dimension of land pattern should be Murata's standard land pattern used at reflow soldering.  
Insufficient amounts of solder can lead to insufficient soldering strength on PCB.  
Excessive amounts of solder may cause bridging between the terminals or contact failure due to flux wicking up.
- (5) When using soldering iron, the diameter of the string solder shall be less than 0.5mm. The string solder shall be applied to the lower part of the terminal only. Do not apply flux except to the terminals. Excessive amounts of solder and/or applying solder to the upper part of the terminal may cause fixed metal rotor or contact failure due to flux invasion into the movable part and/or the contact point. The soldering iron should not come in contact with the monolithic stator of the trimmer capacitor. If such contact does occur, the trimmer

capacitor may be damaged.

- (6) Our recommended chlorine content of solder is as follows.
  - (a) Solder paste: 0.2wt% max.
  - (b) String solder: 0.5wt% max.
- (7) Do not use water-soluble flux (for water cleaning). To prevent the deterioration of trimmer capacitor characteristics, apply flux only to terminals.

## 2. Mounting

- (1) Do not apply excessive force (preferable 5.0N (Ref.; 500gf) max.), when the trimmer capacitor is mounted on the PCB.
- (2) Do not warp and/or bend PCB to prevent trimmer capacitor from breakage.
- (3) Use the suitable dimension of the pick-up nozzle (1.8mm external diameter and 1.3mm bore diameter).

## 3. Cleaning

Cannot be cleaned because of open construction.

## 4. Other

Note the polarity of the trimmer capacitor to minimize influence by stray capacitance.  
(Refer to the dimensions concerning the polarity.)

## ■ Notice (Handling)

- 1. Use suitable screwdrivers that fit comfortably in driver slot.
  - (1) Recommended screwdriver for manual adjustment  
ENGINEER INC.: DA-89  
(Murata P/N is KMDR060)
  - (2) Recommended screwdriver bit for automatic adjustment  
MURATA: KMBT060
- 2. When adjusting with a screwdriver, do not apply

excessive force (preferable 1.0N (Ref; 100gf) max.) to minimize capacitance drift. If excessive force is applied to the screwdriver slot, it may cause deformation of the products.

- 3. Do not apply adhesive, lock paints, or any other substances to the trimmer capacitor to secure the rotor position. They may cause corrosion or electrical contact problems.

## ■ Notice (Other)

Before using trimmer capacitor, please test after assembly in your particular mass production system.

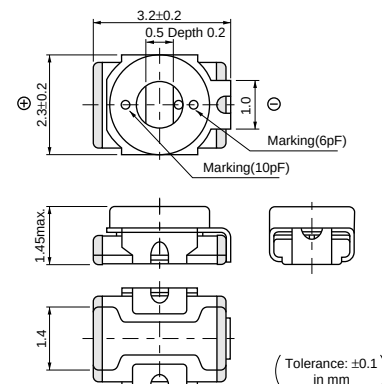
# Ceramic Trimmer Capacitors

**muRata**

## TZV2 Series

### ■ Features

1. Small size with external dimensions of 2.3(W)x3.2(L)x1.45max.(H)mm
2. Unique construction with no plastic material provides superior soldering heat resistance to maintain excellent characteristic performance after reflow soldering.
3. Designed for automatic placement in surface mount applications.
4. Funnel shaped metal case enables in-process automatic adjustment.



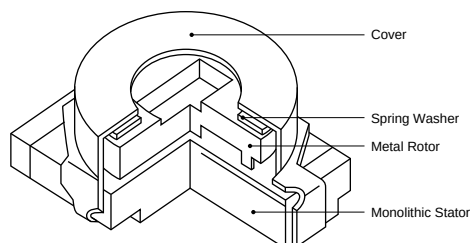
### ■ Applications

1. Crystal oscillator
2. Crystal filters
3. Hand radios
4. Cordless telephones
5. Cellular telephones
6. Tuner packs
7. Pagers
8. Remote keyless entry systems
9. PHS
10. Radar detectors
11. W-LAN
12. Compact radios
13. Headphone stereos
14. DVD
15. Burglarproof devices

| Part Number  | Cmin. (max.) (pF) | Cmax. (pF)    | TC             | Q                        | Rated Voltage | Withstanding Voltage |
|--------------|-------------------|---------------|----------------|--------------------------|---------------|----------------------|
| TZV2Z2R5A110 | 0.65              | 2.5 +100/-0%  | NP0±300ppm/°C  | 200min. at 200MHz, Cmax. | 25Vdc         | 55Vdc                |
| TZV2Z030A110 | 1.5               | 3.0 +100/-0%  | NP0±300ppm/°C  | 300min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |
| TZV2Z060A110 | 2.5               | 6.0 +100/-0%  | NP0±300ppm/°C  | 500min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |
| TZV2Z100A110 | 3.0               | 10.0 +100/-0% | NP0±300ppm/°C  | 500min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |
| TZV2R200A110 | 4.5               | 20.0 +100/-0% | N750±500ppm/°C | 500min. at 1MHz, Cmax.   | 25Vdc         | 55Vdc                |

Insulation Resistance : 10000M ohm    Torque : 1.0 to 10.0mNm    Operating Temperature Range : -25 to +85°C

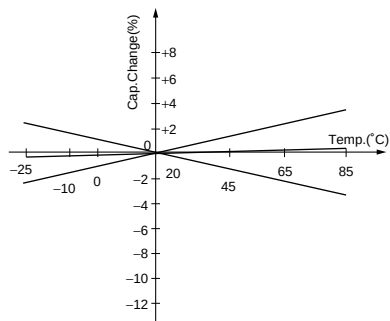
### ■ Construction



## ■ Temperature Characteristics

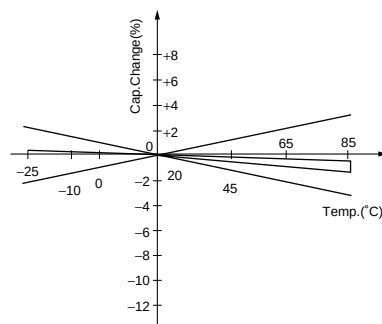
TZV2Z2R5

Z2R5 (NP0±300 ppm/°C)



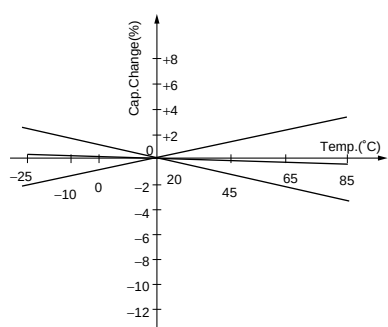
TZV2Z060

Z060 (NP0±300 ppm/°C)



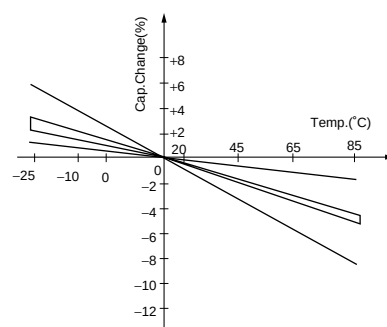
TZV2Z100

Z100 (NP0±300 ppm/°C)



TZV2R200

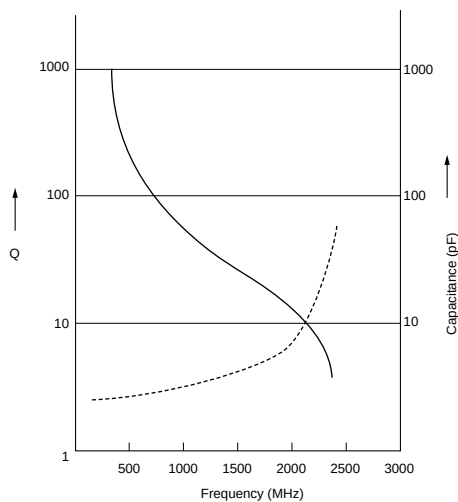
R200 (N750±500 ppm/°C)



## ■ Frequency Characteristics

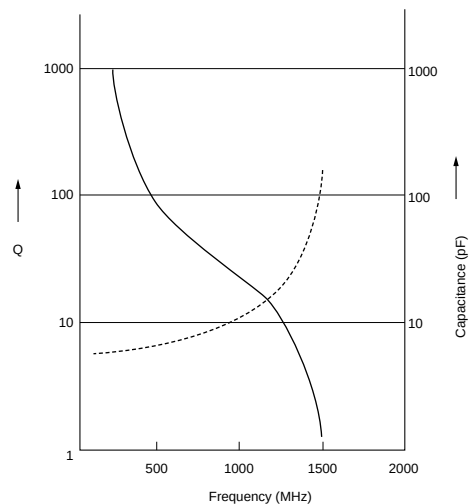
TZV2Z2R5

Z2R5



TZV2Z060

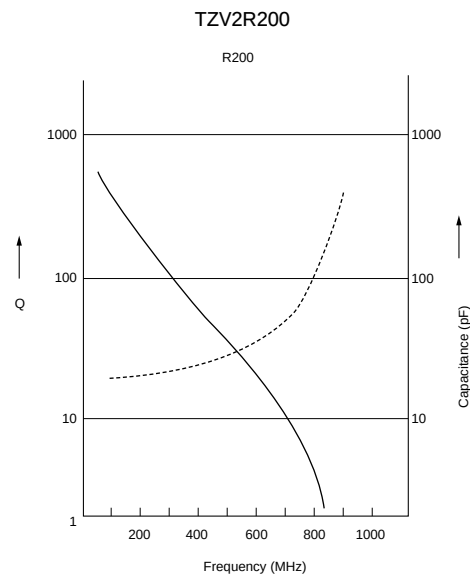
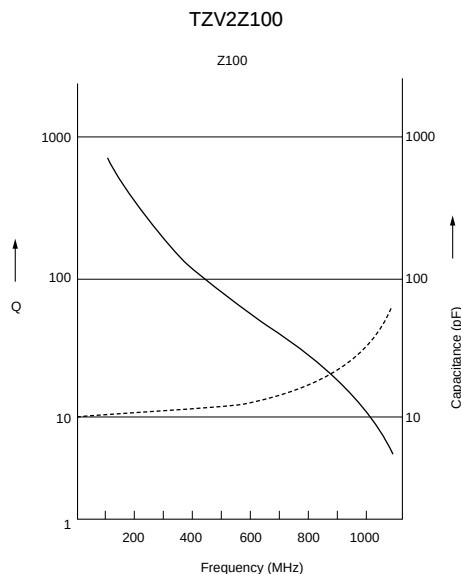
Z060



Continued on the following page.

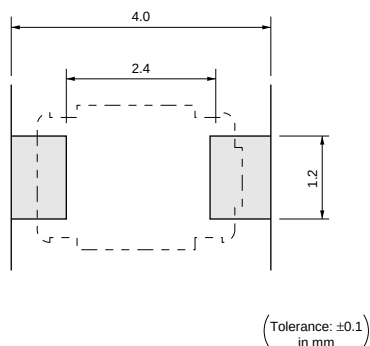
Continued from the preceding page.

## Frequency Characteristics

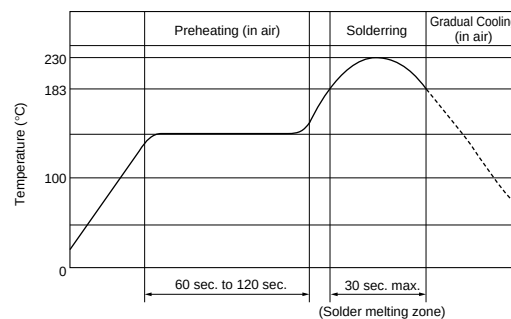


4

## Land Pattern



## Temperature Profile



## Notice (Storage and operating condition)

- Do not use the trimmer capacitor under atmosphere of RTV silicone rubber (Room Temperature Vulcanizing Silicone Rubber) except Acetone liberating silicone sealant.
- Before using trimmer capacitor, please store under the condition of -10 to +40 degree C and 30 to 85%RH.
- Do not store in or near corrosive gasses.
- Use within 6 months of delivery.
- Do not store under direct sunlight.
- Do not use the trimmer capacitor under the conditions listed below.

- Corrosive gasses atmosphere (ex. Chlorine gas, Hydrogen sulfide gas, Ammonia gas, Sulfuric acid gas, Nitric oxide gas, etc.)
- In liquid (ex. water, oil, medical liquid, organic solvent, etc.)
- Dusty / dirty atmosphere
- Direct sunlight
- Static voltage nor electric/magnetic fields
- Direct sea breeze
- Other variations of the above

## Notice (Soldering and mounting)

- Soldering
  - TZV2 series can be soldered by reflow soldering method and soldering iron. Do not use flow soldering method (dipping).
  - Standard soldering condition
    - Reflow soldering: Refer to the standard temperature profile.
    - Soldering iron:

- >Temperature of tip 260±10 degree C
- >Soldering time 3 sec. max.
- >Diameter 1mm max.
- >Wattage of iron 20W max.

Before using other soldering conditions than those listed above, please consult with Murata factory representative prior to using. If the soldering conditions are not suitable, e.g.,

Continued on the following page. ➤

Continued from the preceding page.

excessive time and/or excessive temperature, the trimmer capacitor may deviate from the specified characteristics.

- (3) The amount of solder is critical.
- (4) The thickness of solder paste should be printed from 120 micro m to 170 micro m and the dimension of land pattern should be Murata's standard land pattern used at reflow soldering.  
Insufficient amounts of solder can lead to insufficient soldering strength on PCB.  
Excessive amounts of solder may cause the bridging between the terminals or the contact failure due to flux wicking up.
- (5) When using soldering iron, the diameter of the string solder shall be less than 0.5mm. The string solder shall be applied to the lower part of the terminal only. Do not apply flux except to the terminals. Excessive amounts of solder and/or applying solder to the upper part of the terminal may cause fixed metal rotor or contact failure due to flux invasion into the movable part and/or the contact point. The soldering iron should not come in contact with the monolithic stator of the trimmer capacitor. If such contact does occur, the trimmer

capacitor may be damaged.

- (6) Our recommended chlorine content of solder is as follows.
  - (a) Solder paste: 0.2wt% max.
  - (b) String solder: 0.5wt% max.
- (7) Do not use water-soluble flux (for water cleaning). To prevent the deterioration of trimmer capacitor characteristics, apply flux only to terminals.

## 2. Mounting

- (1) Do not apply excessive force (preferable 5.0N (Ref.; 500gf) max.), when the trimmer capacitor is mounted on the PCB.
- (2) Do not warp and/or bend PCB to prevent trimmer capacitor from breakage.
- (3) Use the suitable dimension of the pick-up nozzle (1.8mm external diameter and 1.3mm bore diameter).

## 3. Cleaning

Cannot be cleaned because of open construction.

## 4. Other

Note the polarity of the trimmer capacitor to minimize influence by stray capacitance.  
(Refer to the dimensions concerning the polarity.)

## ■ Notice (Handling)

1. Use suitable screwdrivers that fit comfortably in driver slot.
  - (1) Recommended screwdriver for manual adjustment  
VESSEL: No.9000-0.9x30  
(Murata P/N : KMDR020)
  - (2) Recommended screwdriver bit for automatic adjustment  
MURATA: KMBT020
2. When adjusting with a screwdriver, do not apply

excessive force (preferable 1.0N (Ref; 100gf) max.) to minimize capacitance drift. If excessive force is applied to the screwdriver slot, it may cause deformation of the products.

3. Do not apply adhesive, lock paints, or any other substances to the trimmer capacitor to secure the rotor position. They may cause corrosion or electrical contact problems.

## ■ Notice (Other)

Before using trimmer capacitor, please test after assembly in your particular mass production system.

# Ceramic Trimmer Capacitors

**muRata**

## TZC3 Series

### ■ Features

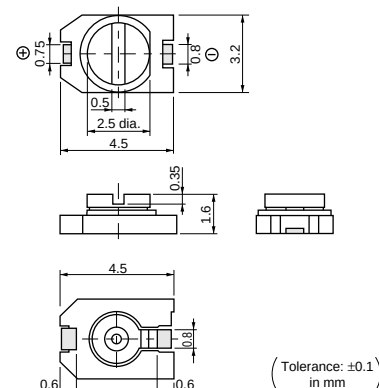
1. Small size with external dimension of 3.2(W)x4.5(L)x1.6(H)mm (Cross slot type: 1.7(H)mm)
2. Color coded stator permits easy identification of capacitance and reduces mounting errors.
3. Can be adjusted with conventional adjustment tools having a thickness of 0.5mm.
4. Available for cross slot type to provide better adjustability.
5. Providing mechanism to prevent air leak offers better mountability with automatic mounter.  
(Cross slot type)
6. Designed for automatic placement in surface mount applications.
7. Heat resistant resin withstands reflow soldering temperatures.

### ■ Applications

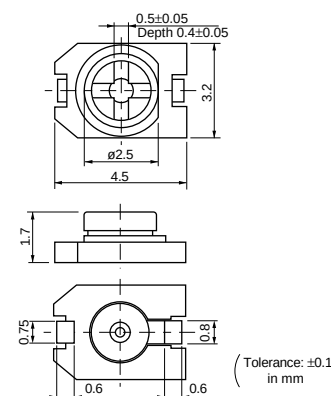
1. Compact radios
2. Headphone stereos
3. Pagers
4. Portable radio equipments
5. Hybrid ICs
6. Cellular telephones
7. Cordless telephones
8. Remote keyless entry systems



Standard Type



Cross Slot Type



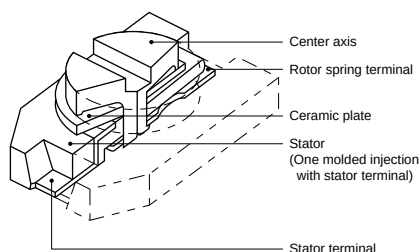
| Part Number          | Cmin. (max.) (pF) | Cmax. (pF)   | TC              | Q                      | Rated Voltage | Withstanding Voltage | Stator/Case Color |
|----------------------|-------------------|--------------|-----------------|------------------------|---------------|----------------------|-------------------|
| <b>TZC3Z030A</b> □□□ | 1.4               | 3.0 +50/-0%  | NP0±300ppm/°C   | 300min. at 1MHz, Cmax. | 100Vdc        | 220Vdc               | Brown             |
| <b>TZC3Z060A</b> □□□ | 2.0               | 6.0 +50/-0%  | NP0±300ppm/°C   | 500min. at 1MHz, Cmax. | 100Vdc        | 220Vdc               | Blue              |
| <b>TZC3R100A</b> □□□ | 3.0               | 10.0 +50/-0% | N750±300ppm/°C  | 500min. at 1MHz, Cmax. | 100Vdc        | 220Vdc               | White             |
| <b>TZC3P200A</b> □□□ | 5.0               | 20.0 +50/-0% | N1200±500ppm/°C | 300min. at 1MHz, Cmax. | 100Vdc        | 220Vdc               | Red               |
| <b>TZC3P300A</b> □□□ | 6.5               | 30.0 +50/-0% | N1200±500ppm/°C | 300min. at 1MHz, Cmax. | 100Vdc        | 220Vdc               | Green             |

Insulation Resistance : 10000M ohm Torque : 1.5 to 10.0mNm Operating Temperature Range : -25 to +85°C

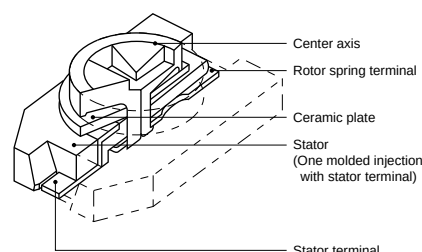
The last three digits show the slot type. 110: standard (minus) type, 310 : cross slot type.

### ■ Construction

Standard Type



Cross Slot Type

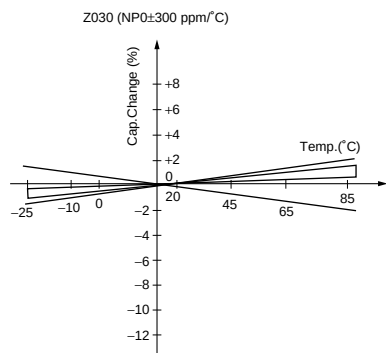


Continued on the following page.

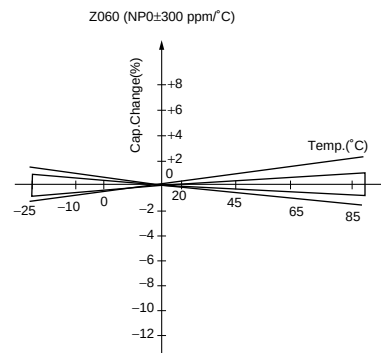
Continued from the preceding page.

## Temperature Characteristics

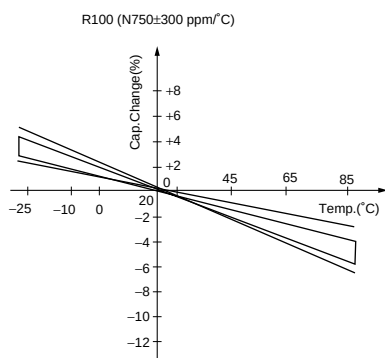
TZC3Z030



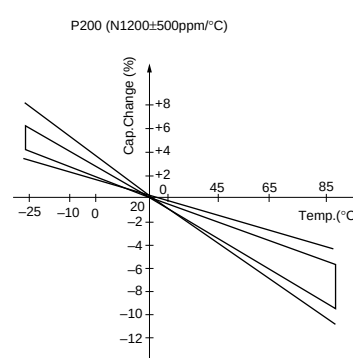
TZC3Z060



TZC3R100

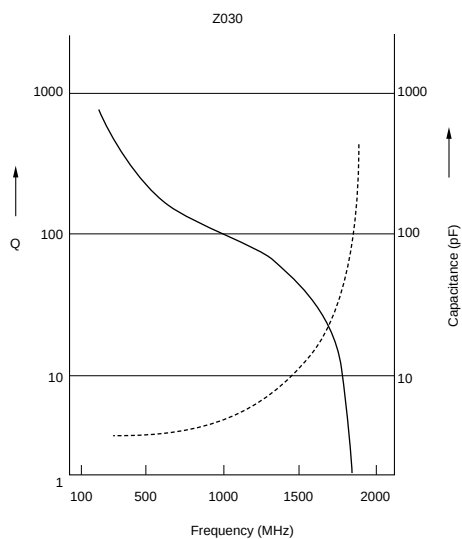


TZC3P200

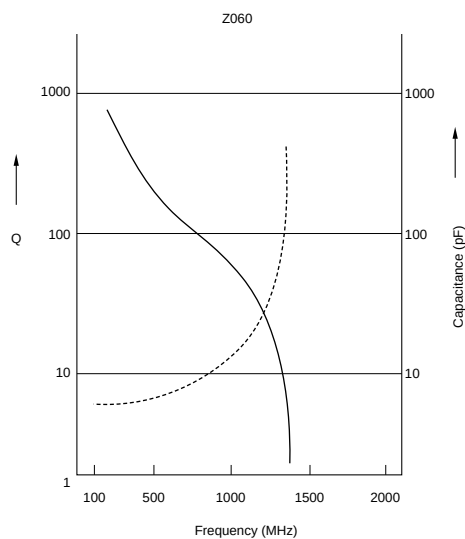


## Frequency Characteristics

TZC3Z030



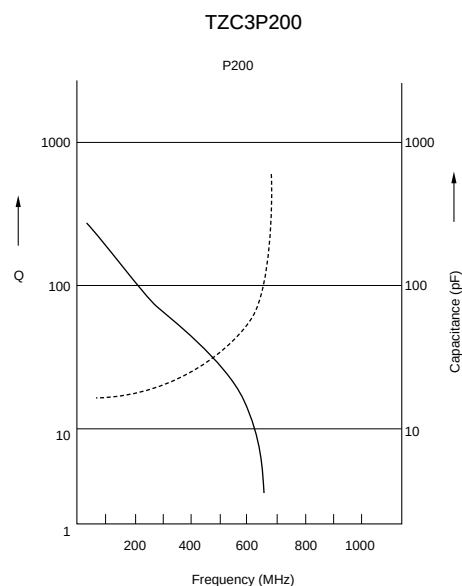
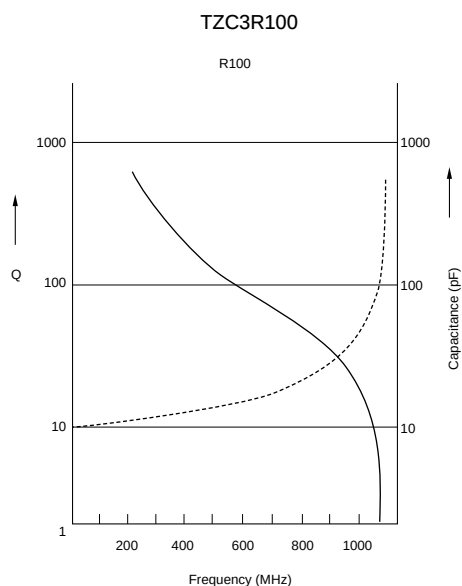
TZC3Z060



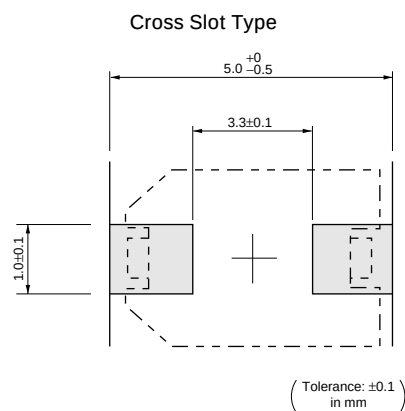
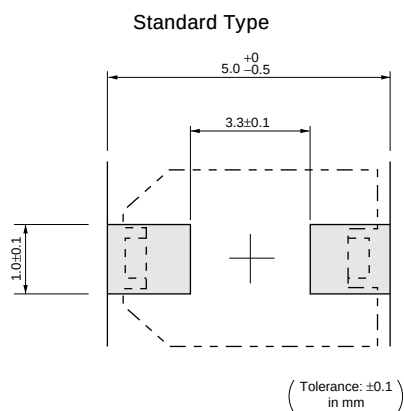
Continued on the following page. ↗

Continued from the preceding page.

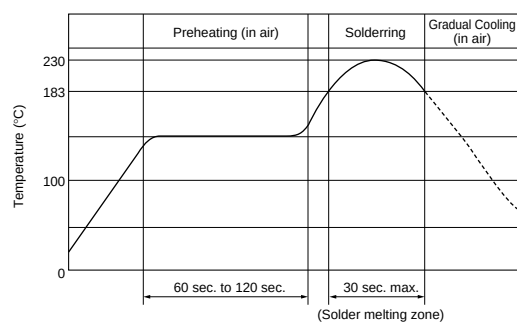
## Frequency Characteristics



## Land Pattern



## Temperature Profile



## ■ Notice (Storage and operating condition)

1. Do not use the trimmer capacitor under atmosphere of RTV silicone rubber (Room Temperature Vulcanizing Silicone Rubber) except Acetone liberating silicone sealant.
2. Before using trimmer capacitor, please store under the condition of -10 to +40 degree C and 30 to 85%RH.
3. Do not store in or near corrosive gasses.
4. Use within 6 months of delivery.
5. Do not store under direct sunlight.
6. Do not use the trimmer capacitor under the conditions listed below.

- (1) Corrosive gasses atmosphere  
(ex. Chlorine gas, Hydrogen sulfide gas, Ammonia gas, Sulfuric acid gas, Nitric oxide gas, etc.)
- (2) In liquid (ex. water, oil, medical liquid, organic solvent, etc.)
- (3) Dusty / dirty atmosphere
- (4) Direct sunlight
- (5) Static voltage nor electric/magnetic fields
- (6) Direct sea breeze
- (7) Other variations of the above

## ■ Notice (Soldering and mounting)

### 1. Soldering

- (1) TZC3 series can be soldered by reflow soldering method and soldering iron. Do not use flow soldering method (dipping).

#### (2) Standard soldering condition

- (a) Reflow soldering: Refer to the standard temperature profile.

#### (b) Soldering iron:

- > Temperature of tip 260±10 degree C
- > Soldering time 3 sec. max.
- > Diameter 1mm max.
- > Wattage of iron 20W max.

Before using other soldering conditions than those listed above, please consult with Murata factory representative prior to using. If the soldering conditions are not suitable, e.g., excessive time and/or excessive temperature, the trimmer capacitor may deviate from the specified characteristics.

- (3) The amount of solder is critical.
- (4) The thickness of solder paste should be printed from 150 micro m to 200 micro m and the dimension of land pattern should be Murata's standard land pattern used at reflow soldering.  
Insufficient amounts of solder can lead to insufficient soldering strength on PCB.  
Excessive amounts of solder may cause bridging between the terminals or contact failure due to flux wicking up.
- (5) When using soldering iron, the diameter of the string solder shall be less than 0.5mm. The string solder shall be applied to the lower part of the terminal only. Do not apply flux except to the terminals. Excessive amounts of solder and/or applying solder to the upper part

of the terminal may cause fixed metal rotor or contact failure due to flux invasion into the movable part and/or the contact point. The soldering iron should not come in contact with the stator of the trimmer capacitor. If such contact does occur, the trimmer capacitor may be damaged.

- (6) Our recommended chlorine content of solder is as follows.

- (a) Solder paste: 0.2wt% max.
- (b) String solder: 0.5wt% max.

- (7) Do not use water-soluble flux (for water cleaning). To prevent the deterioration of trimmer capacitor characteristics, apply flux only to terminals.
- (8) When soldering the TZC3 series, the solder should not flow into the staking part of the substrate. If such flow does occur, driver slot rotation will be damaged.

### 2. Mounting

- (1) Do not apply excessive force (preferable 5.0N (Ref.; 500gf) max.), when the trimmer capacitor is mounted on the PCB.
- (2) Do not warp and/or bend PCB to prevent trimmer capacitor from breakage.
- (3) Use the suitable dimension of the pick-up nozzle (2.5mm external diameter and 1.5mm bore diameter).

### 3. Cleaning

Cannot be cleaned because of open construction.

### 4. Other

Note the polarity of the trimmer capacitor to minimize influence by stray capacitance.  
(Refer to the dimensions concerning the polarity.)

## ■ Notice (Handling)

1. Use suitable screwdrivers that fit comfortably in driver slot.
  - (1) Recommended screwdriver for manual adjustment  
Standard type --> MURATA: KMDR010  
Cross slot type --> TORAY: SA-1825  
(Murata P/N is KMDR040)
  - (2) Recommended screwdriver bit for automatic adjustment  
Standard type --> MURATA: KMBT010  
Cross slot type --> TORAY: JB-1825
- (Murata P/N is KMBT040)
2. When adjusting with a screwdriver, do not apply excessive force (preferable 1.0N (Ref; 100gf) max.) to minimize capacitance drift. If excessive force is applied to the screwdriver slot, it may cause deformation of the products.
3. Do not apply adhesive, lock paints, or any other substances to the trimmer capacitor to secure the rotor position. They may cause corrosion or electrical contact problems.

## ■ Notice (Other)

Before using trimmer capacitor, please test after assembly in your particular mass production system.

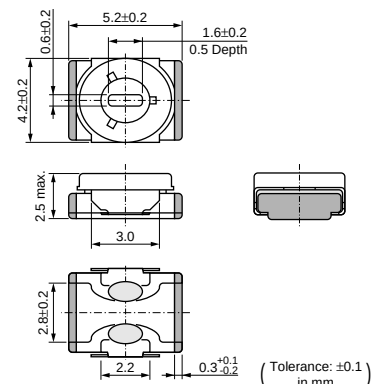
# Ceramic Trimmer Capacitors



## TZW4 Series

### ■ Features

1. To meet high power application due to withstanding voltage 550Vdc.
2. Extremely high self resonant frequency.  
(More than 3GHz at 1.5pF setting)
3. Typical application: Impedance matching for Cellular Base Station.
4. High Q value in more than VHF,UHF and Micro wave band.  
(More than 200 in 500MHz, C max.)
5. Available for pick and place machine. Possible thinner design due to 2.5mm low profile.
6. Non electrical contact construction  
(rotor as middle electrode) provides high reliability.
7. Compact size due to 4.2(W)x5.2(L)x2.5max.(H)mm.



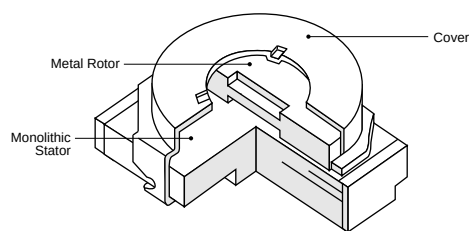
### ■ Applications

1. Transmitting power amplifier for Cellular Base Station
2. Transmitting amplifier for PHS Base Station
3. High frequency electric circuit
4. High power radio transmission
5. Transponder amplifier for cable TV

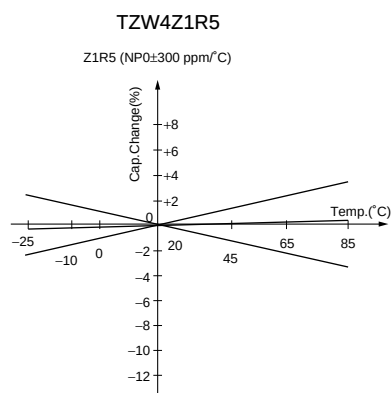
| Part Number         | Cmin. (max.) (pF) | Cmax. (pF)   | TC            | Q                        | Rated Voltage | Withstanding Voltage |
|---------------------|-------------------|--------------|---------------|--------------------------|---------------|----------------------|
| <b>TZW4Z1R5A001</b> | 0.4               | 1.5 +100/-0% | NP0±300ppm/°C | 200min. at 500MHz, Cmax. | 250Vdc        | 550Vdc               |

Insulation Resistance : 10000M ohm    Torque : 2.0 to 10.0mNm    Operating Temperature Range : -55 to +125°C

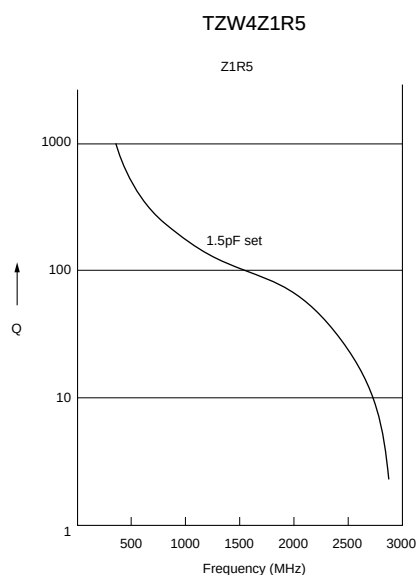
### ■ Construction



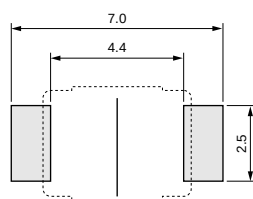
## ■ Temperature Characteristics



## ■ Frequency Characteristics

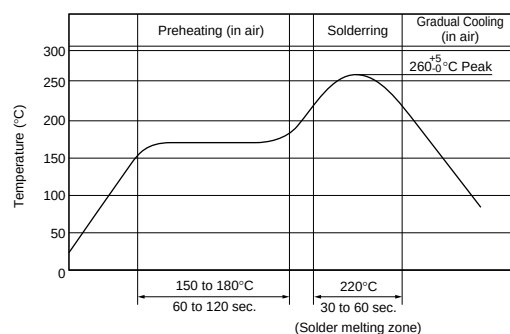


## ■ Land Pattern



(Tolerance: ±0.1  
in mm)

## ■ Temperature Profile



## ■ Notice (Storage and operating condition)

1. Do not use the trimmer capacitor under atmosphere of RTV silicone rubber (Room Temperature Vulcanizing Silicone Rubber) except Acetone liberating silicone sealant.
2. Before using trimmer capacitor, please store under the condition of -10 to +40 C. and 30 to 85%RH.
3. Do not store in or near corrosive gasses.
4. Use within 6 months of delivery.
5. Open the package just before using.
6. Do not store under direct sunlight.
7. Do not use the trimmer capacitor under the conditions listed below.

- (1) Corrosive gasses atmosphere  
(Ex. Chlorine gas, Hydrogen sulfide gas, Ammonia gas, Sulfuric acid gas, Nitric oxide gas, etc.)
- (2) In liquid (Ex. water, oil, medical liquid, organic solvent, etc.)
- (3) Dusty / dirty atmosphere
- (4) Direct sunlight
- (5) Static voltage nor electric/magnetic fields
- (6) Direct sea breeze
- (7) Other variations of the above

## ■ Notice (Soldering and mounting)

### 1. Soldering

- (1) TZW4 series can be soldered by reflow soldering method and soldering iron. Do not use flow soldering method (dipping).
- (2) Standard soldering condition
  - (a) Reflow soldering: Refer to the standard temperature profile.
  - (b) Soldering iron:
    - > Temperature of tip 390±10 degree C
    - > Soldering time 5 sec. max.
    - > Diameter 1.0mm max.
    - > Wattage of iron 30W max.

Before using other soldering conditions than those listed above, please consult with Murata factory representative prior to using. If the soldering conditions are not suitable, e.g., excessive time and/or excessive temperature, the trimmer capacitor may deviate from the specified characteristics.

- (3) The amount of solder is critical.
- (4) The thickness of solder paste should be printed from 150 micro m to 200 micro m and the dimension of land pattern should be Murata's standard land pattern used at reflow soldering.  
Insufficient amounts of solder can lead to insufficient soldering strength on PCB.  
Excessive amounts of solder may cause bridging between the terminals or contact failure due to flux wicking up.
- (5) When using soldering iron, the diameter of the string solder shall be less than 0.5mm. The

string solder shall be applied to the lower part of the terminal only. Do not apply flux except to the terminals. Excessive amounts of solder and/or applying solder to the upper part of the terminal may cause fixed metal rotor or the contact failure due to flux invasion into the movable part and/or the contact point. The soldering iron should not come in contact with the monolithic stator of the trimmer capacitor. If such contact does occur, the trimmer capacitor may be damaged.

- (6) Our recommended chlorine content of solder is as follows.
  - (a) Solder paste: 0.2wt% max.
  - (b) String solder: 0.5wt% max.
- (7) Do not use water-soluble flux (for water cleaning). To prevent the deterioration of trimmer capacitor characteristics, apply flux only to terminals.

### 2. Mounting

- (1) Do not apply excessive force (preferable 5.0N (Ref.; 500gf) max.), when the trimmer capacitor is mounted on the PCB.
- (2) Do not warp and/or bend PCB to prevent trimmer capacitor from breaking.
- (3) Use the suitable dimension of the pick-up nozzle. (1.8mm external diameter and 1.1mm bore diameter.)

### 3. Cleaning

Can not be cleaned because of open construction.

## ■ Notice (Handling)

1. Use suitable screwdrivers that fit comfortably in driver slot.  
-Recommended screwdriver for manual adjustment  
VESSEL : NO.9000 -1.3x30  
(Murata P/N is KMDR130)
2. When adjusting with a screwdriver, do not apply excessive force(preferable 1.0N(Ref; 100gf) max.)

to minimize capacitance drift. If excessive force applied to the screwdriver slot, it may cause deformation of the products.

3. Do not apply adhesive, lock paints, or any other substances to the trimmer capacitor to secure the rotor position. They may cause corrosion or electrical contact problems.

## ■ Notice (Other)

Before using trimmer capacitor, please test after assembly in your particular mass production system.

# Ceramic Trimmer Capacitors

**muRata**

## TZB4 Series

### ■ Features

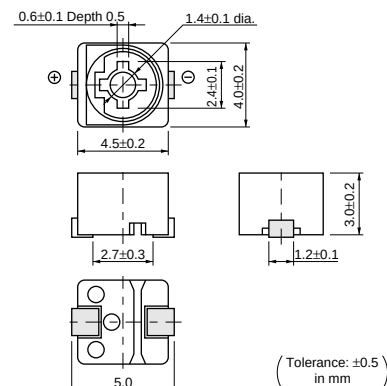
1. Miniature rectangular shape:  
4.0(W)x4.5(L)x3.0(H)mm
2. Color coded case facilitates identification of capacitance range.
3. Designed for automatic placement in surface mount applications.
4. Designed to withstand flux baths and solder baths (with cover film type)
5. Can be temporarily attached to PCB with adhesives (Terminal style A and B)
6. Can be reflow and flow (with cover film type) soldering method
7. Stable characteristics over a wide frequency range (Resonant frequency: 1000MHz min. / 6pF)

### ■ Applications

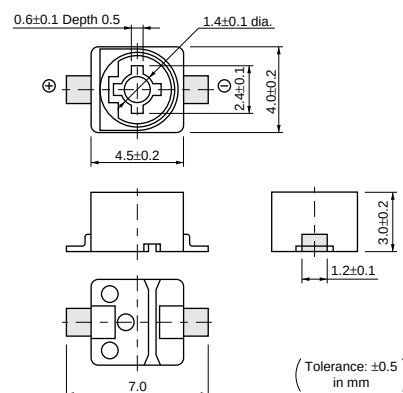
- |                                 |                         |
|---------------------------------|-------------------------|
| 1. Car audio systems            | 2. Cordless telephones  |
| 3. Hybrid ICs                   | 4. Pagers               |
| 5. Remote keyless entry systems |                         |
| 6. Tuner packs                  | 7. Surveillance cameras |
| 8. DVD                          | 9. Burglarproof devices |



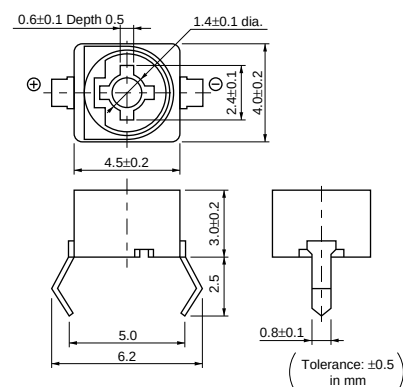
A Type



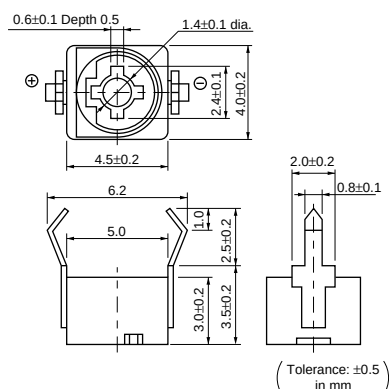
B Type



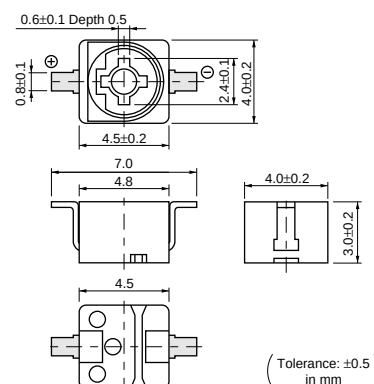
C Type



D Type



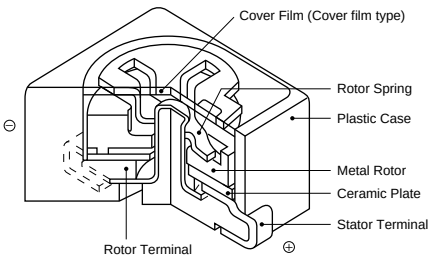
E Type



| Part Number  | Cmin. (max.)<br>(pF) | Cmax.<br>(pF) | TC              | Q                      | Rated<br>Voltage | Withstanding<br>Voltage | Stator/Case Color |
|--------------|----------------------|---------------|-----------------|------------------------|------------------|-------------------------|-------------------|
| TZB4Z030□□10 | 1.4                  | 3.0 +50/-0%   | NP0±200ppm/°C   | 300min. at 1MHz, Cmax  | 100Vdc           | 220Vdc                  | Brown             |
| TZB4Z060□□10 | 2.0                  | 6.0 +50/-0%   | NP0±200ppm/°C   | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Blue              |
| TZB4Z100□□10 | 3.0                  | 10.0 +50/-0%  | NP0±300ppm/°C   | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | White             |
| TZB4R200□□10 | 4.5                  | 20.0 +50/-0%  | N750±300ppm/°C  | 500min. at 1MHz, Cmax  | 100Vdc           | 220Vdc                  | Red               |
| TZB4P300□□10 | 6.5                  | 30.0 +50/-0%  | N1200±500ppm/°C | 300min. at 1MHz, Cmax  | 100Vdc           | 220Vdc                  | Green             |
| TZB4P400□□10 | 8.5                  | 40.0 +50/-0%  | N1200±500ppm/°C | 300min. at 1MHz, Cmax  | 100Vdc           | 220Vdc                  | Yellow            |
| TZB4Z250□□10 | 4.0                  | 25.0 +100/-0% | NP0±300ppm/°C   | 300min. at 1MHz, Cmax. | 50Vdc            | 110Vdc                  | Black+Marking     |
| TZB4R500□□10 | 7.0                  | 50.0 +100/-0% | N750±300ppm/°C  | 300min. at 1MHz, Cmax  | 50Vdc            | 110Vdc                  | Black+Marking     |

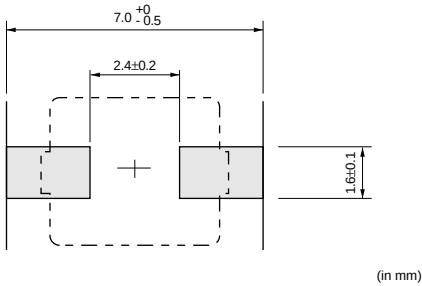
Insulation Resistance : 10000M ohm    Torque : 1.5 to 10.0mNm    Operating Temperature Range : -25 to +85°C  
First blank: Terminal Type    Second blank: Cover film codes (A: not provided, B: provided)

Construction

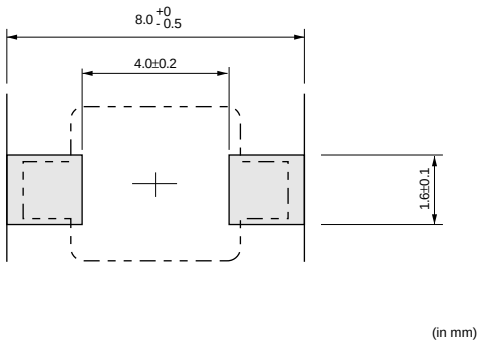


Land Pattern/Mounting Holes

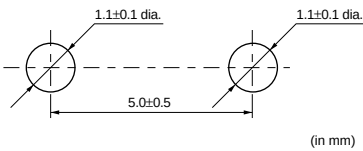
A Type



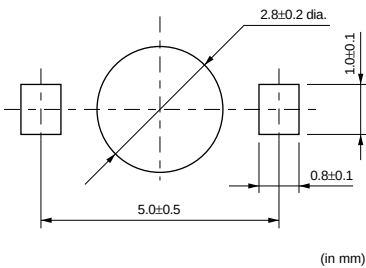
B Type



C Type



D Type

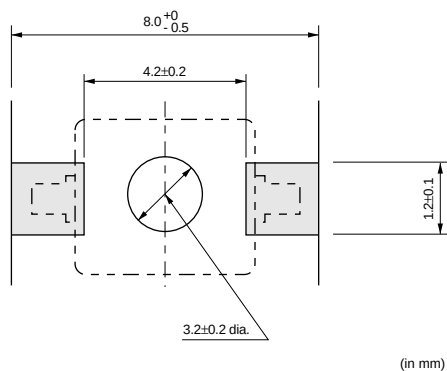


Continued on the following page. ↗

Continued from the preceding page.

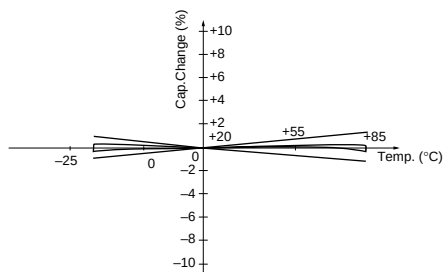
## Land Pattern/Mounting Holes

E Type

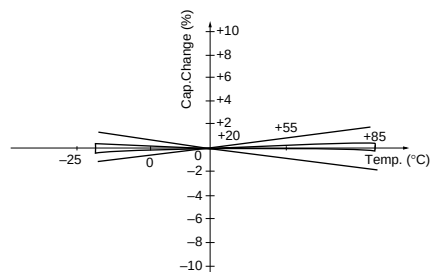


## Temperature Characteristics

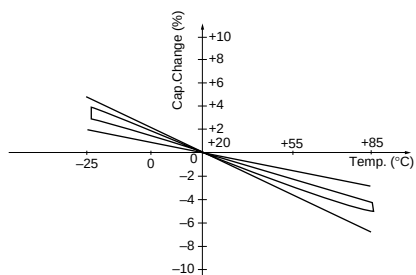
Z060 (NP0 $\pm$ 200ppm/ $^{\circ}$ C)



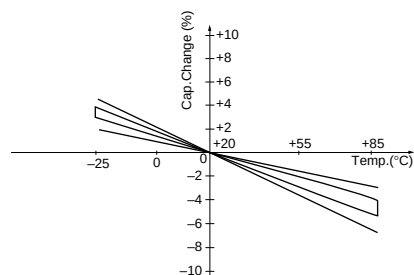
Z100 (NP0 $\pm$ 300ppm/ $^{\circ}$ C)



R200 (N750 $\pm$ 300ppm/ $^{\circ}$ C)



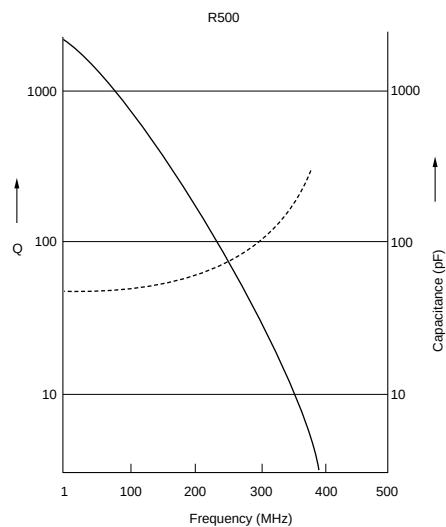
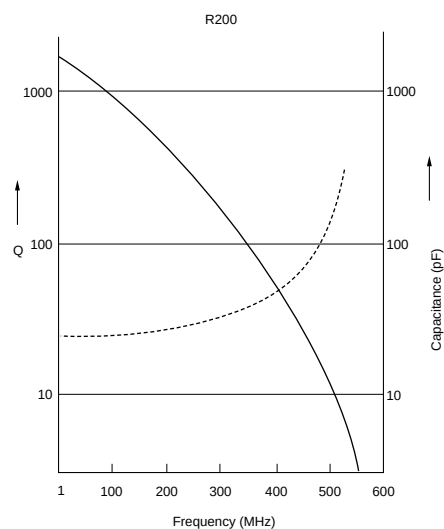
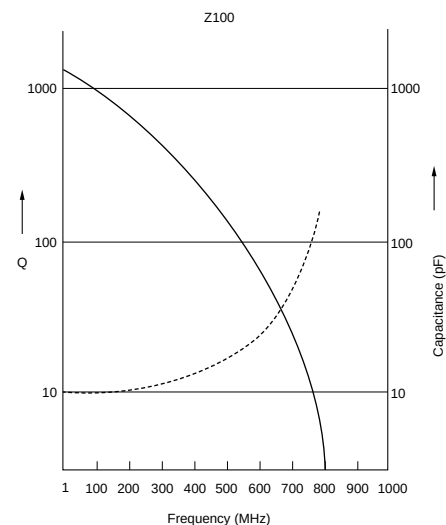
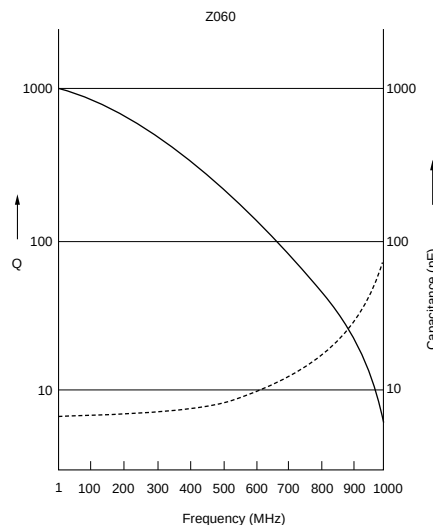
R500 (N750 $\pm$ 200ppm/ $^{\circ}$ C)



Continued on the following page.

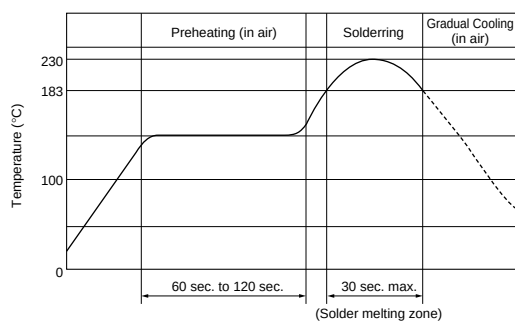
Continued from the preceding page.

## Frequency Characteristics

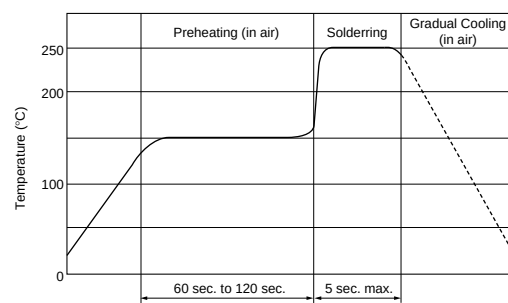


## Temperature Profile

Reflow



Flow



## ■ Notice (Storage and operating condition)

1. Do not use the trimmer capacitor under atmosphere of RTV silicone rubber (Room Temperature Vulcanizing Silicone Rubber) except Acetone liberating silicone sealant.
2. Before using trimmer capacitor, please store under the condition of -10 to +40 degree C and 30 to 85%RH.
3. Do not store in or near corrosive gasses.
4. Use within 6 months of delivery.
5. Do not store under direct sunlight.
6. Do not use the trimmer capacitor under the conditions listed below.

- (1) Corrosive gasses atmosphere  
(ex. Chlorine gas, Hydrogen sulfide gas, Ammonia gas, Sulfuric acid gas, Nitric oxide gas, etc.)
- (2) In liquid (ex. water, oil, medical liquid, organic solvent, etc.)
- (3) Dusty / dirty atmosphere
- (4) Direct sunlight
- (5) Static voltage nor electric/magnetic fields
- (6) Direct sea breeze
- (7) Other variations of the above

## ■ Notice (Soldering and mounting)

### 1. Soldering

- (1) Can be soldered by reflow soldering method, flow soldering method, and soldering iron.

#### (2) Standard soldering condition

- (a) Reflow soldering: Refer to the standard temperature profile.

\*Available for terminal shape A, B, and E.

- (b) Flow soldering: Refer to the standard temperature profile.

> Immerse the body in solder bath

- Available for cover film type

> Only immerse the terminal in solder bath

- Available for terminal shape C and D.

#### (c) Soldering iron:

> Temperature of tip 260±10 degree C

> Soldering time 3 sec. max.

> Diameter 3mm max.

> Wattage of iron 30W max.

Before using other soldering conditions than those listed above, please consult with Murata factory representative prior to using. If the soldering conditions are not suitable, e.g., excessive time and/or excessive temperature, the trimmer capacitor may deviate from the specified characteristics.

- (3) The amount of solder is critical.
- (4) The thickness of solder paste should be printed from 150 micro m to 200 micro m and the dimension of land pattern should be Murata's standard land pattern used at reflow soldering. Insufficient amounts of solder can lead to insufficient soldering strength on PCB. Excessive amounts of solder may cause bridging between the terminals or contact failure due to flux wicking up.
- (5) When using soldering iron, the string solder shall be applied to the lower part of the terminal only. Do not apply flux except to the terminals. Excessive amounts of solder and/or applying solder to the upper part of the terminal may cause fixed rotor or contact failure due to flux invasion into the movable part and/or the contact point. The soldering iron should not come in contact with the plastic case of the

trimmer capacitor. If such contact does occur, the trimmer capacitor may be damaged.

- (6) Our recommendable chlorine content of solder is as follows.

(a) Solder paste: 0.2wt% max.

(b) String solder: 0.5wt% max.

- (7) Do not use water-soluble flux (for water cleaning). To prevent the deterioration of trimmer capacitor characteristics, apply flux only to terminals.

### 2. Mounting

- (1) Do not apply excessive force (preferable 5.0N (Ref.; 500gf) max.), when the trimmer capacitor is mounted on the PCB.
- (2) Do not warp and/or bend PCB to prevent trimmer capacitor from breakage.
- (3) Use the suitable PCB holes which are the same pitch as the terminal of the trimmer capacitor. If it would not fit with the terminal, the excessive stress would be applied to the terminal and the trimmer capacitor may deviate from the specified characteristics (Terminal shape C and D).
- (4) Do not apply bending stress more than 10.0N (Ref.; 1kgf) after the trimmer capacitor has been mounted on the PCB (Terminal shape C and D).
- (5) Mount trimmer capacitor in contact with PCB (Terminal shape C and D).
- (6) In case of bending the terminals, do not apply excessive force to the body of the product and prevent the terminal fixing part from damaging.
- (7) Use the suitable dimension of the pick-up nozzle.
  - > Without cover film type
    - External dimensions of 4.5x4.0mm and 2.5mm bore diameter.
  - > With cover film type
    - 4.0mm external diameter and 2.0mm bore diameter.

### 3. Cleaning [with cover film type]

- (1) Isopropyl alcohol and Ethyl alcohol are available material for cleaning. Water group material like Pinealpha, Cleanthru can not be used. For other materials, please consult with

Continued on the following page. 

☐ Continued from the preceding page.

Murata factory representative prior to using.

- (2) The total cleaning time by dipping, vapor and ultra-sonic method shall be less than 2 minutes.

For ultra-sonic cleaning, the available condition is as follows.

- > Cleaning time: 1 min. max.
- > Power: 20W/liter max.
- > Frequency: 20 - 60kHz
- > Temperature: Ambient temperature

Due to the ultra-sonic cleaning equipment's peculiar self resonance point and the cleaning

compatibility usually depends on the jig construction and/or the cleaning condition such as the depth of immersion, please check the cleaning equipment to determine the suitable conditions. If the trimmer capacitor is cleaned by other conditions, the trimmer capacitor may deviate from the specified characteristics.

4. Other

Note the polarity of the trimmer capacitor to minimize influence by stray capacitance. (Refer to the dimensions concerning the polarity.)

■ Notice (Handling)

1. Use suitable screwdrivers that fit comfortably in driver slot.

(1) Recommended screwdriver for manual adjustment  
MURATA: KMDR010

(2) Recommended screwdriver bit for automatic adjustment  
MURATA: KMBT010

2. When adjusting with a screwdriver, do not apply excessive force (preferable 1.0N (Ref; 100gf) max.) to minimize capacitance drift. If excessive force is applied to the screwdriver slot, it may cause deformation of the products.

3. Do not apply adhesive, lock paints, or any other substances to the trimmer capacitor to secure the rotor position. They may cause corrosion or electrical contact problems.

4. Do not break the cover film before the completion of PCB mounting, soldering, and cleaning.

5. Do not clean the trimmer capacitor after the cover film has been broken.

6. To break the cover film, first turn the screwdriver more than 45 deg., then set the capacitance value. (Only inserting the screwdriver cannot break the cover film.)

■ Notice (Other)

Before using trimmer capacitor, please test after assembly in your particular mass production system.

# Ceramic Trimmer Capacitors

**muRata**

## TZ03 Series

### ■ Features

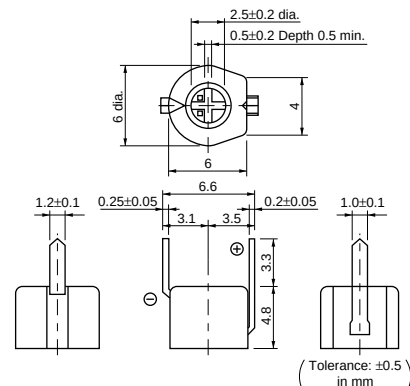
1. Color coded case facilitates identification of capacitance range.
2. Sealed construction prevents the penetration of flux and dust.
3. Available in three adjustment styles: Top/Rear/Side.
4. Available in both tape and reel and magazine packaging for automatic insertion.
5. + (Cross-shaped) slot enables automatic adjustment.

### ■ Applications

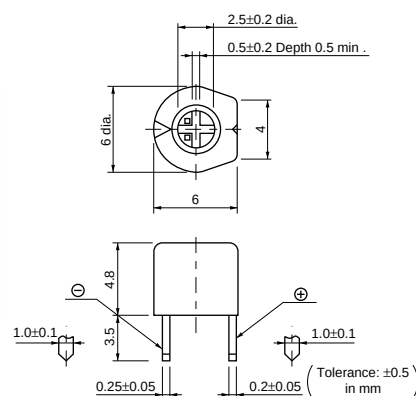
1. Car audio systems
2. Car clocks
3. Stereos
4. Radio cassette tape recorders
5. Cordless telephones
6. Video games
7. Compact radio equipments
8. Remote keyless entry systems
9. Burglarproof devices



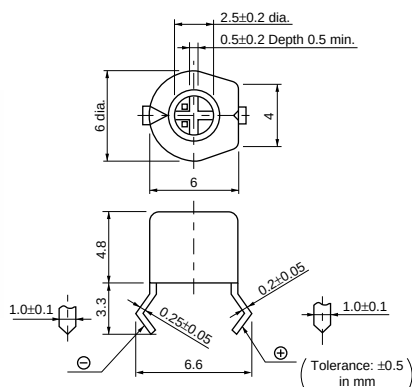
B Type



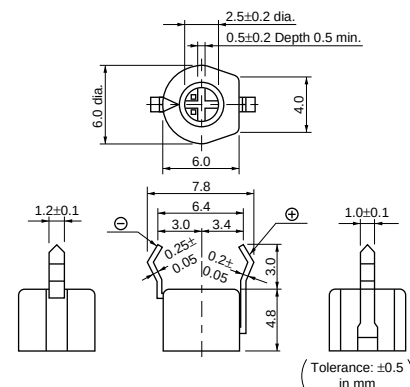
E Type



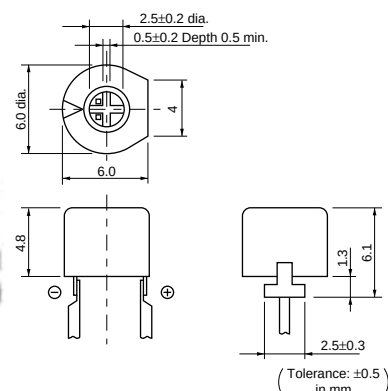
F Type



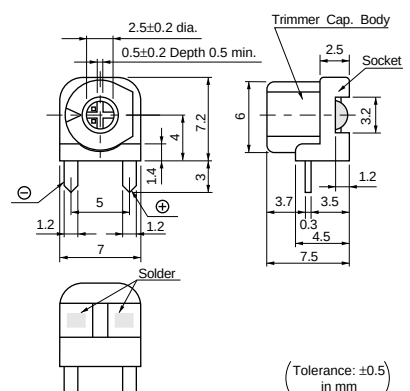
N Type



T Type



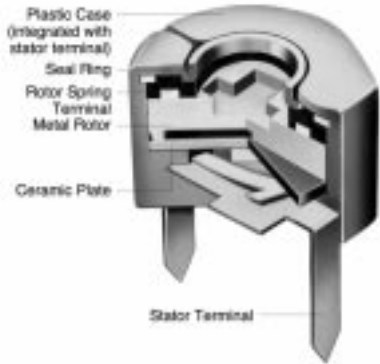
Y Type



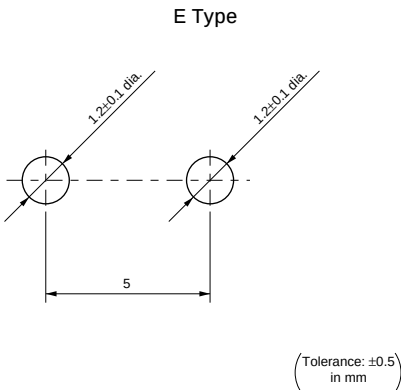
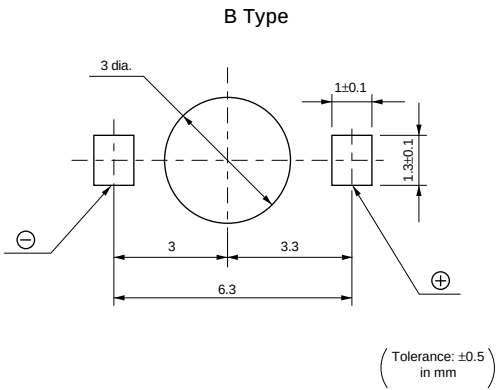
| Part Number  | Cmin. (max.)<br>(pF) | Cmax.<br>(pF)  | TC              | Q                      | Rated<br>Voltage | Withstanding<br>Voltage | Stator/Case Color |
|--------------|----------------------|----------------|-----------------|------------------------|------------------|-------------------------|-------------------|
| TZ03Z2R3□169 | 1.25                 | 2.3 +50/-0%    | NP0±200ppm/°C   | 300min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Black             |
| TZ03Z050□169 | 1.5                  | 5.0 +50/-0%    | NP0±200ppm/°C   | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Blue              |
| TZ03Z070□169 | 2.0                  | 7.0 +50/-0%    | NP0±200ppm/°C   | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Blue              |
| TZ03N100□169 | 2.1                  | 10.0 +50/-0%   | N200±200ppm/°C  | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | White             |
| TZ03Z100□169 | 2.7                  | 10.0 +50/-0%   | NP0±200ppm/°C   | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Blue              |
| TZ03T110□169 | 3.0                  | 11.0 +50/-0%   | N450±300ppm/°C  | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | White             |
| TZ03R200□169 | 4.2                  | 20.0 +50/-0%   | N750±300ppm/°C  | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Red               |
| TZ03T200□169 | 4.2                  | 20.0 +50/-0%   | N450±300ppm/°C  | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Pink              |
| TZ03R300□169 | 5.2                  | 30.0 +50/-0%   | N750±300ppm/°C  | 500min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Green             |
| TZ03P450□169 | 6.8                  | 45.0 +50/-0%   | N1200±500ppm/°C | 300min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Yellow            |
| TZ03P600□169 | 9.8                  | 60.0 +50/-0%   | N1200±500ppm/°C | 300min. at 1MHz, Cmax. | 100Vdc           | 220Vdc                  | Brown             |
| TZ03Z500□169 | 6.0                  | 50.0 +100/-0%  | NP0±300ppm/°C   | 300min. at 1MHz, Cmax. | 50Vdc            | 110Vdc                  | Orange            |
| TZ03R900□169 | 9.0                  | 90.0 +100/-0%  | N750±300ppm/°C  | 300min. at 1MHz, Cmax. | 50Vdc            | 110Vdc                  | Black+Dot         |
| TZ03R121□169 | 10.0                 | 120.0 +100/-0% | N750±300ppm/°C  | 300min. at 1MHz, Cmax. | 50Vdc            | 110Vdc                  | Black             |

Insulation Resistance : 10000M ohm    Torque : 2.0 to 15.0mNm    Operating Temperature Range : -25 to +85°C  
A blank column is filled with terminal type codes.

Construction



Mounting Holes

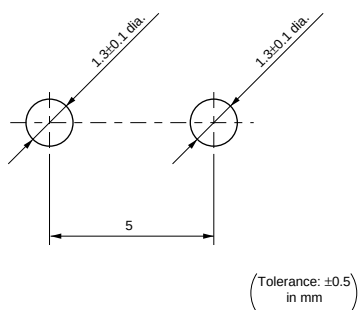


Continued on the following page. ↗

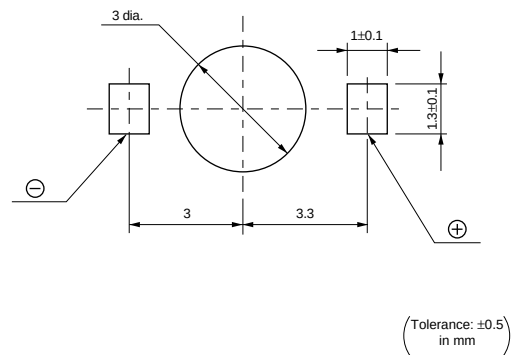
Continued from the preceding page.

## ■ Mounting Holes

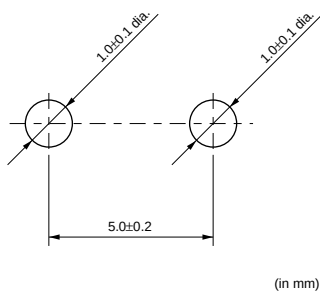
F Type



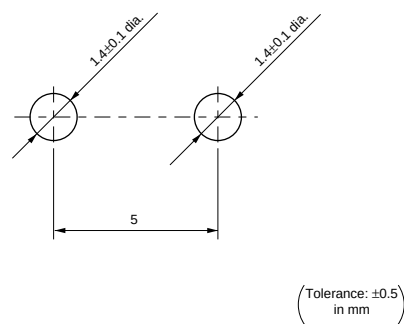
N Type



T Type

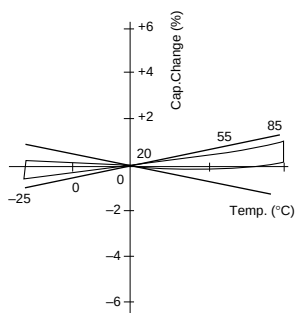


Y Type

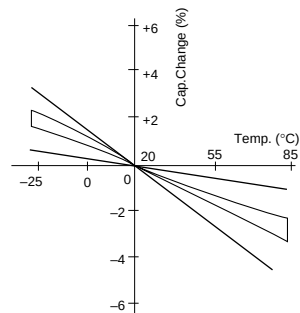


## ■ Temperature Characteristics

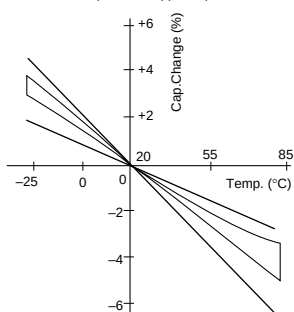
Z070 (NP0 $\pm 200$ ppm/ $^{\circ}$ C)



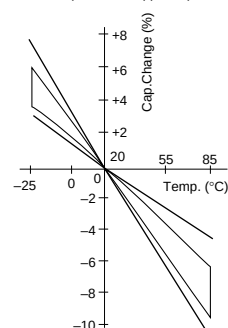
T110 (N450 $\pm 300$ ppm/ $^{\circ}$ C)



R200 (N750 $\pm 300$ ppm/ $^{\circ}$ C)



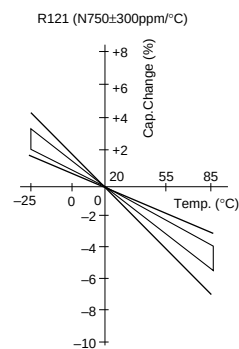
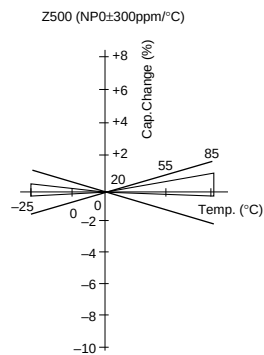
P600 (N1200 $\pm 500$ ppm/ $^{\circ}$ C)



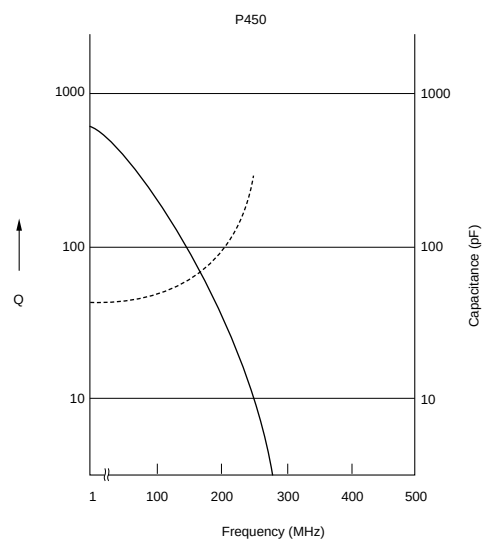
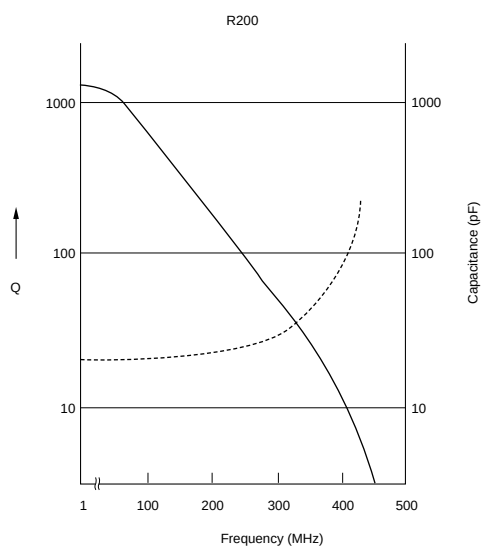
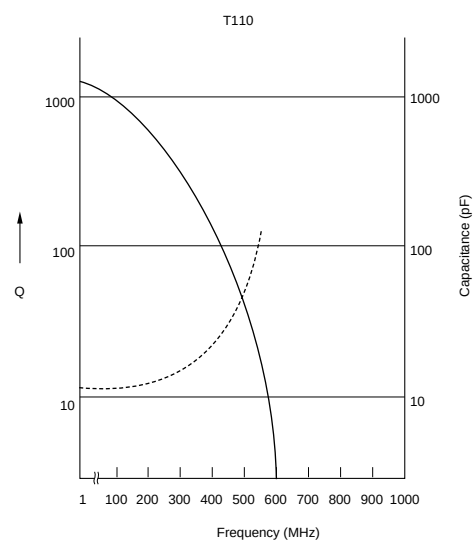
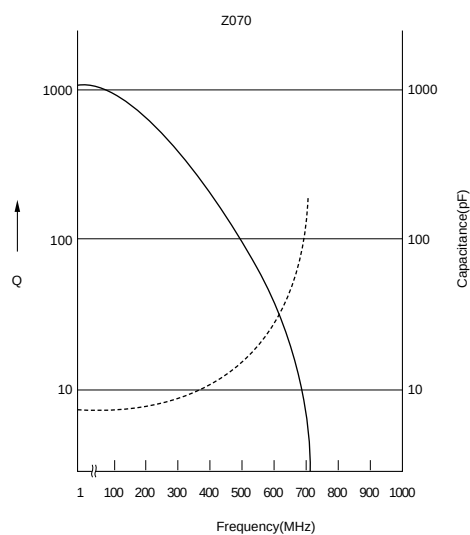
Continued on the following page.

Continued from the preceding page.

## Temperature Characteristics



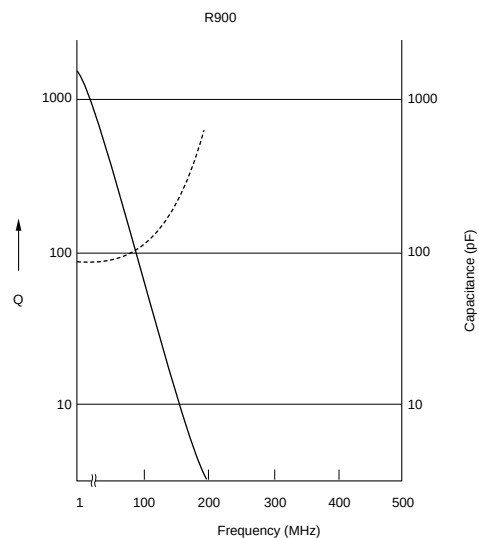
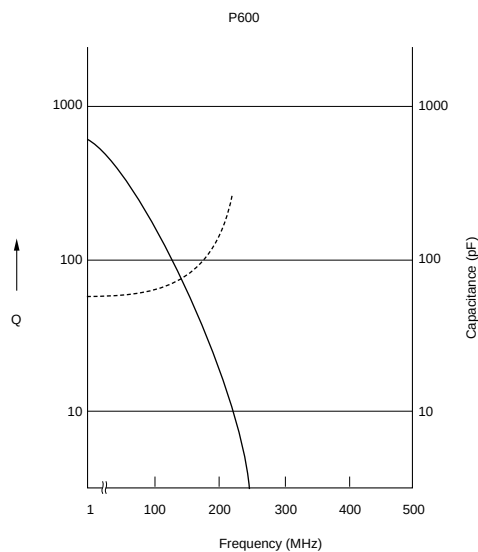
## Frequency Characteristics



Continued on the following page. ➤

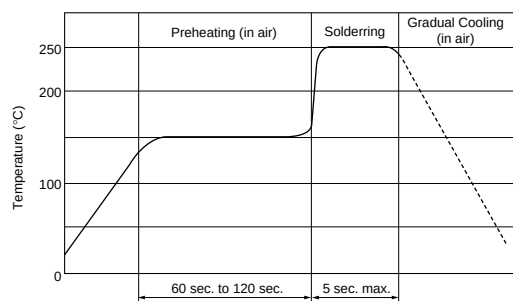
Continued from the preceding page.

## Frequency Characteristics



## Temperature Profile

Flow



## ■ Notice (Storage and operating condition)

1. Do not use the trimmer capacitor under atmosphere of RTV silicone rubber (Room Temperature Vulcanizing Silicone Rubber) except Acetone liberating silicone sealant.
2. Before using trimmer capacitor, please store under the condition of -10 to +40 degree C and 30 to 85%RH.
3. Do not store in or near corrosive gasses.
4. Use within 6 months of delivery.
5. Open the package just before using.
6. Prior to storing previously opened packages, the packaging should be heat-sealed. Avoid using rubber bands for repackaging.
7. Do not store under direct sunlight.

## ■ Notice (Soldering and mounting)

### 1. Soldering

- (1) TZ03 series can be soldered by flow soldering method and soldering iron. Do not use reflow soldering method.

#### (2) Standard soldering condition

- (a) Flow soldering: Refer to the standard temperature profile.

#### (b) Soldering iron:

- > Temperature of tip 260±10 degree C
- > Soldering time 3 sec. max.
- > Diameter 3mm max.
- > Wattage of iron 30W max.

Before using other soldering conditions than those listed above, please consult with Murata factory representative prior to using. If the soldering conditions are not suitable, e.g., excessive time and/or excessive temperature, the trimmer capacitor may deviate from the specified characteristics.

- (3) The dimension of mounting hole should be Murata's standard mounting hole used at flow soldering. The amount of solder is critical. Insufficient amounts of solder can lead to insufficient soldering strength on PCB. Excessive amounts of solder may cause bridging between the terminals or contact failure due to flux wicking up.
- (4) When using soldering iron, the string solder shall be applied to the lower part of the terminal only. Do not apply flux except to the terminals. Excessive amounts of solder and/or applying solder to the upper part of the terminal may cause fixed rotor or the contact failure due to flux invasion into the movable part and/or the contact point. The soldering iron should not come in contact with the plastic case of the trimmer capacitor. If such contact does occur, the trimmer capacitor may be damaged.
- (5) Our recommendable chlorine content of string solder is 0.5wt% max.
- (6) Do not use water-soluble flux (for water cleaning). To prevent the deterioration of trimmer

8. Do not use the trimmer capacitor under the conditions listed below.

- (1) Corrosive gasses atmosphere  
(ex. Chlorine gas, Hydrogen sulfide gas, Ammonia gas, Sulfuric acid gas, Nitric oxide gas, etc.)
- (2) In liquid (ex. water, oil, medical liquid, organic solvent, etc.)
- (3) Dusty / dirty atmosphere
- (4) Direct sunlight
- (5) Static voltage nor electric/magnetic fields
- (6) Direct sea breeze
- (7) Other variations of the above

capacitor characteristics, apply flux only to terminals.

### 2. Mounting

- (1) Do not apply excessive force (preferable 5.0N (Ref.; 500gf) max.), when the trimmer capacitor is mounted on the PCB.
- (2) Use the suitable PCB holes which are the same pitch as the terminal of the trimmer capacitor. If it would not fit with the terminal, the excessive stress would be applied to the terminal and the trimmer capacitor may deviate from the specified characteristics.
- (3) Do not apply bending stress more than 10.0N (Ref.; 1kgf) after the trimmer capacitor has been mounted on the PCB.
- (4) Mount trimmer capacitor in contact with PCB.
- (5) In case of bending the terminals, do not apply excessive force to the body of the product and prevent the terminal fixing part from damaging.

### 3. Cleaning

- (1) Isopropyl alcohol and Ethyl alcohol are available material for cleaning. Water group materials like Pinealpha, Cleanthru cannot be used. For other materials, please consult with Murata factory representative prior to using.
- (2) The total cleaning time by dipping, vapor and ultra-sonic method shall be less than 2 minutes. For ultra-sonic cleaning, the available condition is as follows.
  - > Cleaning time: 30 sec. max.
  - > Power: 20W/liter max.
  - > Frequency: 20 - 60kHz
  - > Temperature: Ambient temperature

Due to the ultra-sonic cleaning equipment's peculiar self resonance point and the cleaning compatibility usually depends on the jig construction and/or the cleaning condition such as the depth of immersion, please check the cleaning equipment to determine the suitable conditions. If the trimmer capacitor is cleaned by other conditions, the trimmer capacitor may

Continued on the following page. 

 Continued from the preceding page.

deviate from the specified characteristics.

4. Other

Note the polarity of the trimmer capacitor to

minimize influence by stray capacitance.

(Refer to the dimensions concerning the polarity.)

■ **Notice (Handling)**

1. Use suitable screwdrivers that fit comfortably in driver slot.

(1) Recommended screwdriver for manual adjustment

MURATA: KMDR010

(2) Recommended screwdriver bit for automatic adjustment

MURATA: KMBT010

2. When adjusting with a screwdriver, do not apply

excessive force (preferable 1.0N (Ref; 100gf) max.)

to minimize capacitance drift. If excessive force is applied to the screwdriver slot, it may cause deformation of the products.

3. Do not apply adhesive, lock paints, or any other substances to the trimmer capacitor to secure the rotor position. They may cause corrosion or electrical contact problems.

■ **Notice (Other)**

Before using trimmer capacitor, please test after assembly in your particular mass production system.

## Packaging

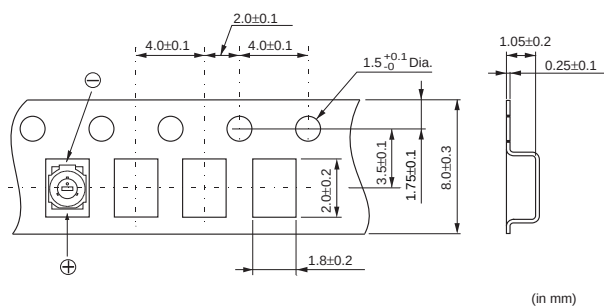
### ■ Minimum Quantity

| Part Number | Minimum Quantity (pcs.) |             |           |          |       |
|-------------|-------------------------|-------------|-----------|----------|-------|
|             | φ180mm Reel             | φ330mm Reel | Ammo Pack | Magazine | Bulk  |
| TZR1        | 3000                    | 10000       | -         | -        | 500   |
| TZS2        | 3000                    | 10000       | -         | -        | 500   |
| TZY2        | 2000                    | 10000       | -         | -        | 500   |
| TZV2        | 2000                    | 8000        | -         | -        | 500   |
| TZC3        | 1000                    | 4000        | -         | -        | 500   |
| TZW4        | 500                     | -           | -         | -        | 100   |
| TZB4        | 500                     | 2500        | -         | -        | 500   |
| TZ03        | -                       | -           | 1000      | 80       | 1000* |

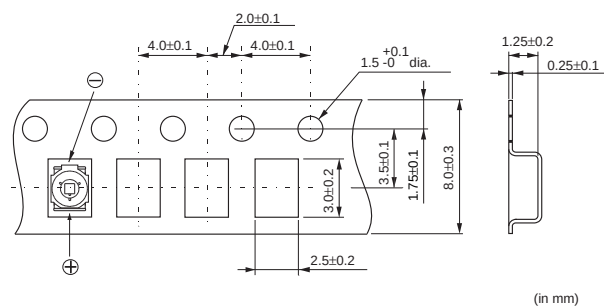
\*Y terminal type is supplied on the 500pcs./bulk basis.

### ■ Dimension of Tape

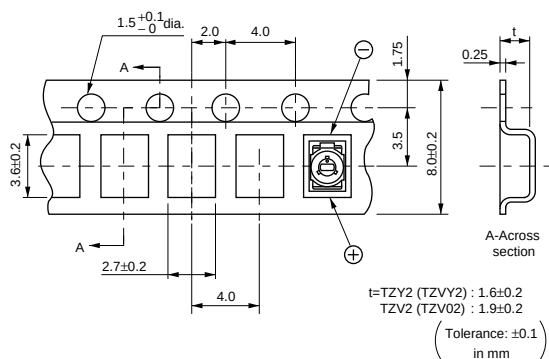
TZR1 Series



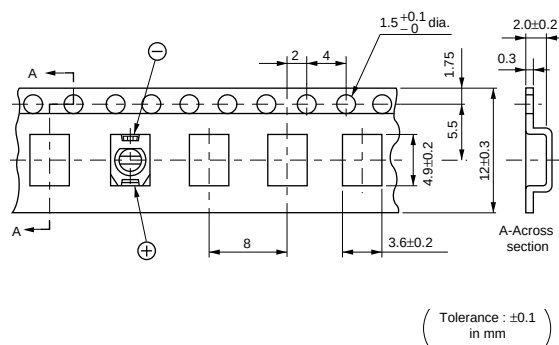
TZS2 Series



TZY2/TZV2 Series



TZC3 Series



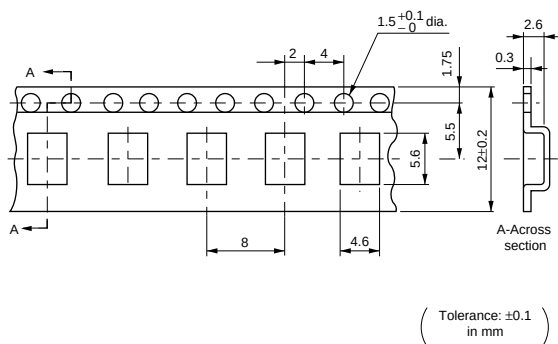
Continued on the following page. ➤

## Packaging

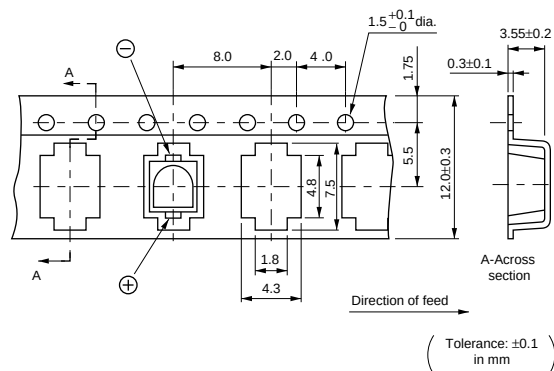
Continued from the preceding page.

### Dimension of Tape

TZW4 Series

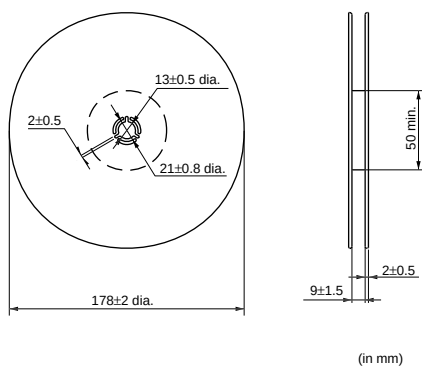


TZB4 Series

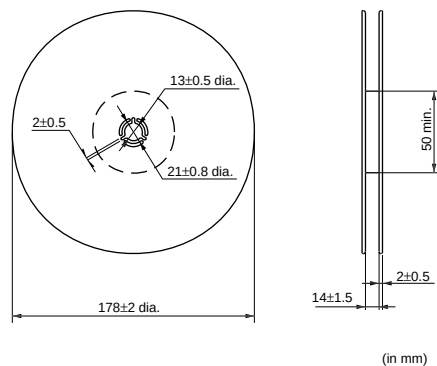


### Dimension of dia. 178mm Reel

TZR1/TZS2/TZY2/TZV2 Series

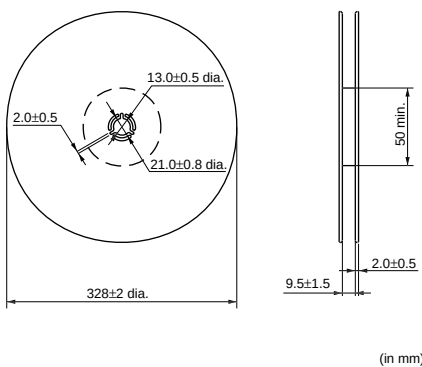


TZC3/TZW4/TZB4 Series

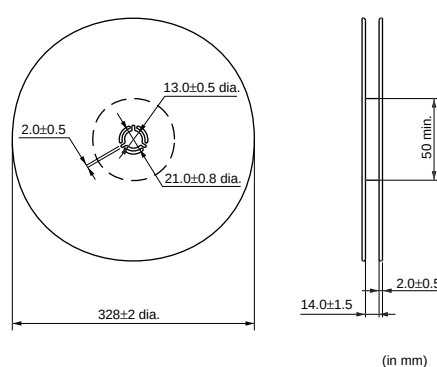


### Dimension of dia. 330mm Reel

TZR1/TZS2/TZY2/TZV2 Series



TZC3/TZB4 Series

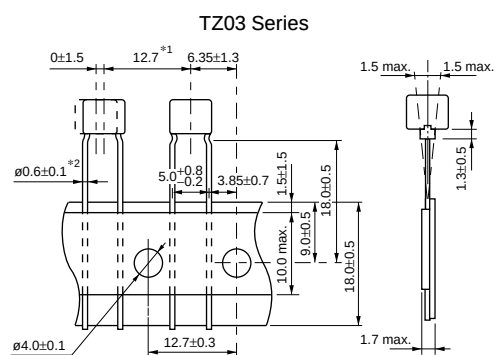


Continued on the following page. ↗

## Packaging

Continued from the preceding page.

### Dimension of Tape



\*1 : Tolerance varies with  $\Delta S$ .  
\*2 : Except 1mm from the stand-off position.

(in mm)

### Ammo Pack



TZ03 Series

## Recommended Adjustment Tools

Please use the following recommended screwdriver.

You can order this driver with part number below.

Though you can also adjust the capacitance value by commercial products, please use one which has the same head size as the driver below.

### ■ For Manual Adjustutment

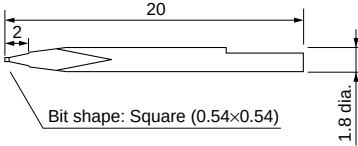
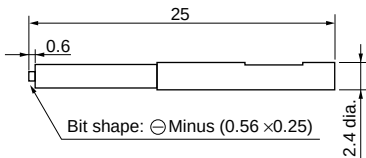
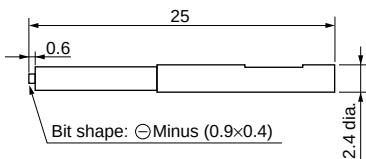
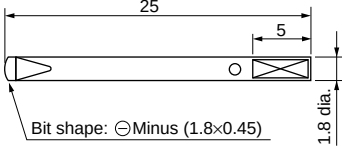
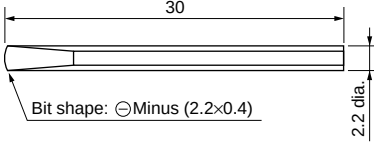
| Series                          | MURATA Model Number | Manufacturers Model Number        | Shape          |
|---------------------------------|---------------------|-----------------------------------|----------------|
| TZR1                            | KMDR160             | MURATA MFG.<br>KMDR160            | <p>(in mm)</p> |
| TZS2                            | KMDR050             | MURATA MFG.<br>KMDR050            | <p>(in mm)</p> |
| TZY2                            | KMDR060             | ENGINEER INC.<br>DA-89            | <p>(in mm)</p> |
| TZV2                            | KMDR020             | VESSEL MFG.<br>NO.9000-0.9×30     | <p>(in mm)</p> |
| TZC3 Cross Slot Type            | KMDR040             | TORAY INDUSTRIES, INC.<br>SA-1825 | <p>(in mm)</p> |
| TZC3 Standard Type (Minus Slot) | KMDR010             | MURATA MFG.<br>KMDR010            | <p>(in mm)</p> |
| TZW4                            | KMDR130             | VESSEL MFG.<br>NO.9000-1.3×30     | <p>(in mm)</p> |
| TZB4<br>TZ03                    | KMDR010             | MURATA MFG.<br>KMDR010            | <p>(in mm)</p> |

Continued on the following page.

## Recommended Adjustment Tools

Continued from the preceding page.

### ■ For Automatic Adjustment

| Series                                          | MURATA Model Number | Manufacturers Model Number        | Shape                                                                                                                                  |
|-------------------------------------------------|---------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| TZS2                                            | KMBT050             | MURATA MFG.<br>KMBT050            |  <p>Bit shape: Square (0.54×0.54)</p> <p>(in mm)</p> |
| TZY2                                            | KMBT060             | MURATA MFG.<br>KMBT060            |  <p>Bit shape: ⊖Minus (0.56×0.25)</p> <p>(in mm)</p> |
| TZV2                                            | KMBT020             | MURATA MFG.<br>KMBT020            |  <p>Bit shape: ⊖Minus (0.9×0.4)</p> <p>(in mm)</p>   |
| TZC3 Cross Slot Type                            | KMBT040             | TORAY INDUSTRIES, INC.<br>JB-1825 |  <p>Bit shape: ⊖Minus (1.8×0.45)</p> <p>(in mm)</p> |
| TZC3 Standard Type (Minus Slot)<br>TZB4<br>TZ03 | KMBT010             | MURATA MFG.<br>KMBT010            |  <p>Bit shape: ⊖Minus (2.2×0.4)</p> <p>(in mm)</p> |

## Qualified Standards

The products listed herein have been produced by the QS9000 and ISO9001 certified factory

| MURATA FACTORY              | Qualified Date  | Standard                       | Qualified Number |
|-----------------------------|-----------------|--------------------------------|------------------|
| Sabae Murata Mfg. Co., Ltd. | August 14, 1997 | UNDERWRITERS LABORATORIES INC. | A5704            |

\* No ODCs (Ozone Depleting Chemicals) are used on Murata's all trimmer potentiometers

\* TRIMCAP® is a registered trademark of Murata Mfg. Co., Ltd.

 **Note:**

1. Export Control  
〈For customers outside Japan〉  
Murata products should not be used or sold for use in the development, production, stockpiling or utilization of any conventional weapons or mass-destructive weapons (nuclear weapons, chemical or biological weapons, or missiles), or any other weapons.  
〈For customers in Japan〉  
For products which are controlled items subject to the "Foreign Exchange and Foreign Trade Law" of Japan, the export license specified by the law is required for export.
2. Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage to a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.
  - ① Aircraft equipment                      ② Aerospace equipment
  - ③ Undersea equipment                      ④ Power plant equipment
  - ⑤ Medical equipment                      ⑥ Transportation equipment (vehicles, trains, ships, etc.)
  - ⑦ Traffic signal equipment                      ⑧ Disaster prevention / crime prevention equipment
  - ⑨ Data-processing equipment                      ⑩ Application of similar complexity and/or reliability requirements to the applications listed in the above
3. Product specifications in this catalog are as of April 2004. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.
4. Please read rating and  **CAUTION** (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.
5. This catalog has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.
6. Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.
7. No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.