FUJITSU SEMICONDUCTOR
DATA SHEET

DS07-20101-7E

*Resonator*

# Piezoelectric Resonator

# FAR Family (C1, C3, C4 series)

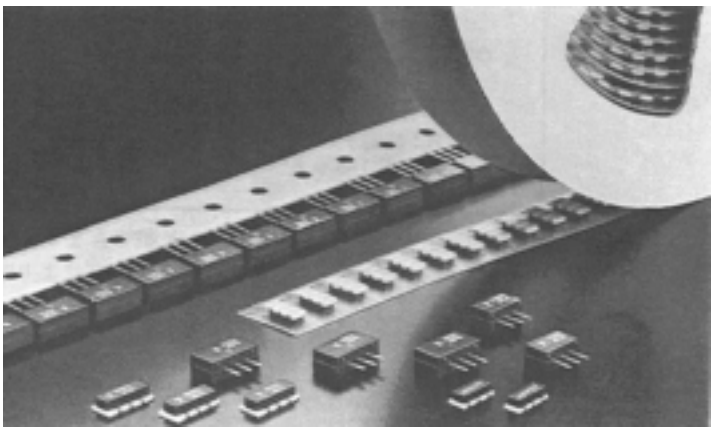
## ■ DESCRIPTION

Fujitsu resonators (C1, C3, C4 series) feature originally developed single crystals with a high electromechanical coupling coefficient ($LiTaO_3$: lithium tantalate, $LiNbO_3$: lithium niobate), the result is compact packaging. Three series are available: the C3 and C4 series with built-in capacitors for high integration, for exclusive use in microcomputer clocks; and the C1 series for high precision. All series include the CHIP type device for surface-mount and the SIP type device for general PC boards.

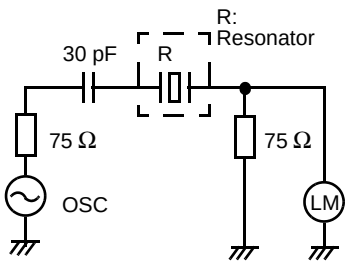
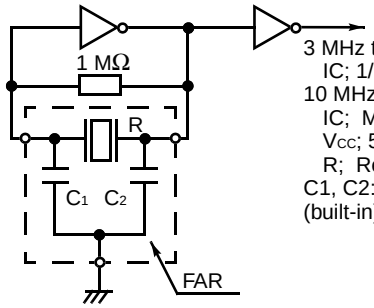
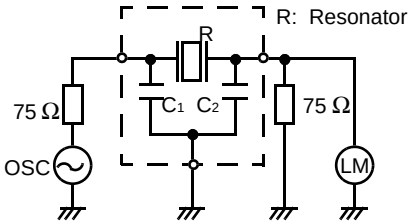
## ■ FEATURES

- Surface-mount technology can be applied to the CHIP type to increase packaging density. The SIP type is only half the height of conventional quartz crystal resonators, and can be easily mounted on general PC boards.
- The C3 and C4 series have been developed for exclusive use in microcomputer clocks. They have built-in capacitors, and the number of components has been reduced to one-third of that of conventional circuits.
- Both the SIP and CHIP types can be shipped in taped packages for automatic mounting.
- The resonators have superior shock and vibration resistance, preventing damage during automatic insertion process.

## ■ PACKAGE



## ■ STANDARD CHARACTERISTICS

| Parameter \ Series | C1 series | C3 series | C4 series |
|---|---|---|---|
| Material | Lithium Tantalate ($LiTaO_3$) | | Lithium Niobate ($LiNbO_3$) |
| Frequency | 3.58 to 16 MHz | | 3 to 16 MHz |
| Standard frequency | See "■ Standard frequency." | | |
| Initial frequency tolerance | ±0.05% (G)<br>±0.1% (J)<br>±0.3% (K)<br>±0.5% (M) | ±0.1% (J)<br>±0.3% (K)<br>±0.5% (M) | ±0.5% (M)<br>±0.3% (K)<br>±1% (L) |
| Temperature characteristics (–20 to 60°C) | ±0.02% | ±0.05% | ±0.5% |
| Capacity of built-in capacitor | — | 20±8 pF (standard)* | |
| Aging stability | Within ±0.1% | | |
| Operating temperature | –30 to 85°C | | |
| Storage temperature | –40 to 100°C | | |
| Standard measuring circuit | (Resonant frequency and serial resonant resistance)<br>  <br> | (Oscillation frequency)<br>  <br><br>3 MHz to 10 MHz max.<br>IC; 1/6MB84069B x 2<br>10 MHz to 16 MHz<br>IC; MC74HC04<br>$V_{CC}$; 5 VDC<br>R; Resonator<br>C1, C2: Loading capacitors (built-in)<br>(Serial resonant resistance)<br>  <br> | |

*: The capacity of the built-in capacitor is 20±8 pF by standard.
10±4 pF and 30±8 pF types are also available. However, the characteristics of 10±4 pF and 30±8 pF types are specified by Fujitsu, considering matching data with applied IC (mainly microcomputer).

## ■ STANDARD FREQUENCY

| Standard frequency (kHz) | C1/C3 series | | C4 series | |
|---|---|---|---|---|
| | Package size | Resonant resistance | Package size | Resonant resistance |
| 3,580<br>4,000<br>4,194<br>4,915 | A<br>A<br>A<br>A | 300 Ω max.<br>(00) | A<br>A<br>A<br>A | 150 Ω max.<br>(01) |
| 6,000<br>6,144<br>7,373<br>8,000<br>10,000<br>11,000<br>11,059<br>12,000<br>14,746<br>16.000 | B<br>B<br>B<br>B<br>B<br>B<br>B<br>B<br>B<br>B | 150 Ω max.<br>(01) | B<br>B<br>B<br>B<br>B<br>B<br>B<br>B<br>B<br>B | 75 Ω max.<br>(02) |

- **Package sizes and resonant resistance**
  There are two package sizes according to frequency:

| Frequency | Package size |
|---|---|
| 3 to 5.99 MHz | A |
| 6 to 16 MHz | B |

For resonant resistance, standard values are specified according to frequency:

| Frequency | Standard resonant resistance | |
|---|---|---|
| | C1/C3 series | C4 series |
| 3 to 3.57 MHz | — | 300 Ω max.<br>(00) |
| 3.58 to 5.99 MHz | 300 Ω max.<br>(00) | 150 Ω max.<br>(01) |
| 6 to 16 MHz | 150 Ω max.<br>(01) | 75 Ω max.<br>(02) |

**Note:** For resonant resistance other than the standard values, they are specified by Fujitsu considering matching data with applied IC (mainly micro computer).

## ■ NOTES ON USE

- Handle carefully.
- Solder under the following conditions.
  CHIP type: 5 seconds max. at 230°C (PCB)
  SIP type: 10 seconds max. at 260°C
  Do not apply extreme heat to the resonator. Recommended preheating for the CHIP type is 150°C for one minute.
- Avoid extreme fluctuations in temperature during use.
- There is no specific direction in resonator mounting.
- Additional information is available separately, if required, for designing microcomputer oscillation circuits.
- CHIP type is for reflow solder, not for flow solder.

## ■ PART NUMBERING SYSTEM

FAR – □□ □ □ – □□□□□ – □ □ □ – □

(1) (2) (3) (4) (5) (6) (7) (8)

(1) Series

| Series | Single crystal | Capacitor |
|---|---|---|
| C1 | $LiTaO_3$ | — |
| C3 | $LiTaO_3$ | With built-in capacitors |
| C4 | $LiNbO_3$ | With built-in capacitors |

(2) Package type

| Specification | Type |
|---|---|
| C | CHIP |
| S | SIP |

(3) Package size
See Table 1 in "■ Dimensions."

| Specification | Size |
|---|---|
| A | Large |
| B | Small |

(4) Frequency (kHz)

| Frequency | Designation | Frequency | Designation | Frequency | Designation | Frequency | Designation |
|---|---|---|---|---|---|---|---|
| 3,580 kHz | 03580 | 6,000 kHz | 06000 | 10,000 kHz | 10000 | 14,746 kHz | 14746 |
| 4,000 kHz | 04000 | 6,144 kHz | 06144 | 11,000 kHz | 11000 | 16,000 kHz | 16000 |
| 4,194 kHz | 04194 | 7,373 kHz | 07373 | 11,059 kHz | 11059 | | |
| 4,195 kHz | 04915 | 8,000 kHz | 08000 | 12,000 kHz | 12000 | | |

(5) Initial tolerance of frequency
See "■ Standard Frequency."

| Specification | Tolerance | C1 series | C3 series | C4 series |
|---|---|---|---|---|
| G | ±0.05% | available | — | — |
| J | ±0.1% | available | available | — |
| K | ±0.3% | available | available | available |
| M | ±0.5% | avaialble | available | available |
| L | ±1% | — | — | available |

(6) Capacity of built-in capacitor

| Specification | Capacitance |
|---|---|
| 0 | 20±8 pF |
| 1 | 10±4 pF |
| 2 | 30±8 pF |

**Note:** For C1 series, only “0” is available.

(7) Resonant resistance

| Specification | Resonant resistance |
|---|---|
| 0 | 300 Ω max. |
| 1 | 150 Ω max. |
| 2 | 75 Ω max. |

(8) User-specific Special Symbols

| Specification | Description |
|---|---|
| Name | No specification, no taping specification |
| — | No specification, with taping specification |
| A to Z | Serial number for custom design |

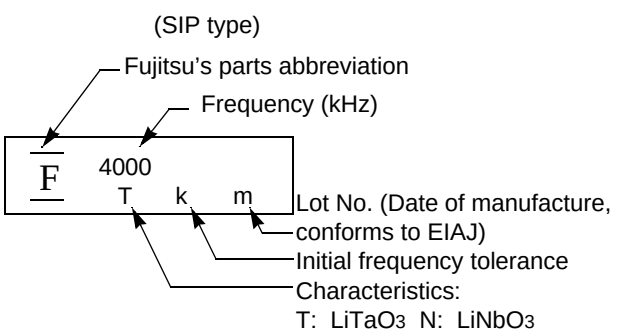
(9)Taping specification
• SIP type

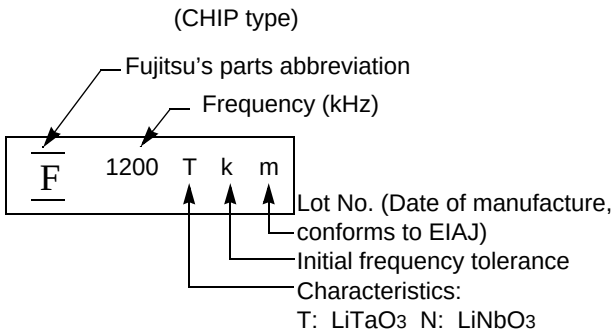
| Specification | Description |
|---|---|
| –T | Reel pack |
| –U | Ammo pack |

• CHIP type

| Specification | Description |
|---|---|
| –R | 16 mm carrier pack |

## ■ MARKING




The stamp color varies with the capacity of the capacitor.

| Capacitance | Marking clolr |
|---|---|
| 10 pF | Yellow |
| 20 pF | White |
| 30 pF | Gray |

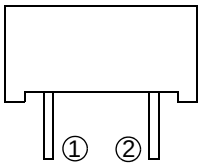
Data code (EIAJ standard) is specified as follows in a four-year cycle.

| Year | Month | Symbol | Year | Month | Symbol | Year | Month | Symbol | Year | Month | Symbol |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | A | | 1 | N | | 1 | a | | 1 | n |
| | 2 | B | | 2 | P | | 2 | b | | 2 | p |
| | 3 | C | | 3 | Q | | 3 | c | | 3 | q |
| | 4 | D | | 4 | R | | 4 | d | | 4 | r |
| 1977 | 5 | E | 1978 | 5 | E | 1979 | 5 | e | 1980 | 5 | s |
| 1981 | 6 | F | 1982 | 6 | T | 1983 | 6 | f | 1984 | 6 | t |
| 1985 | 7 | G | 1986 | 7 | U | 1987 | 7 | g | 1988 | 7 | u |
| 1989 | 8 | H | 1990 | 8 | V | 1991 | 8 | h | 1992 | 8 | v |
| 1993 | 9 | J | 1994 | 9 | W | 1995 | 9 | j | 1996 | 9 | w |
| | 10 | K | | 10 | X | | 10 | k | | 10 | x |
| | 11 | L | | 11 | Y | | 11 | l | | 11 | y |
| | 12 | M | | 12 | Z | | 12 | m | | 12 | z |

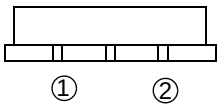
## ■ PIN ASSIGNMENT

- C1 series

SIP type



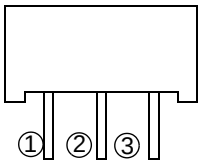

CHIP type



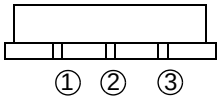

(Equivalent circuit)


- C3 and C4 series

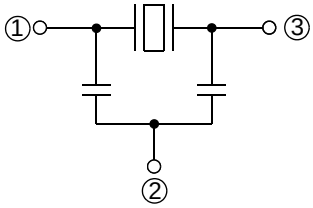
SIP type




CHIP type




(Equivalent circuit)



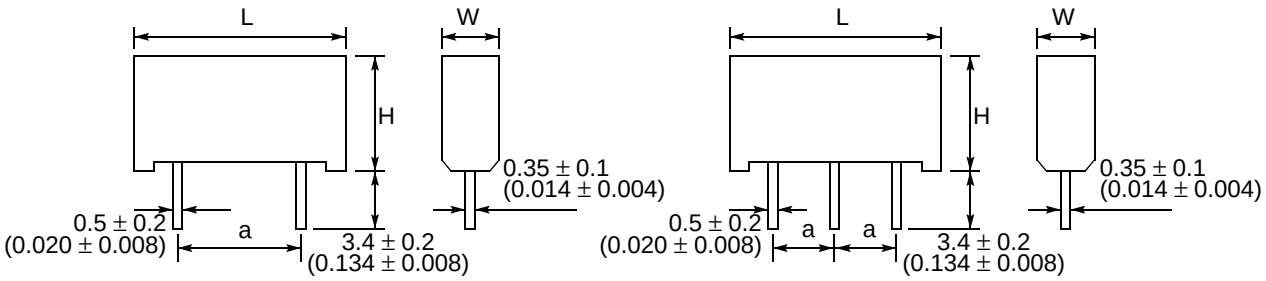
## ■ DIMENSIONS

**Table 1 Package size**

Unit: mm (in.)

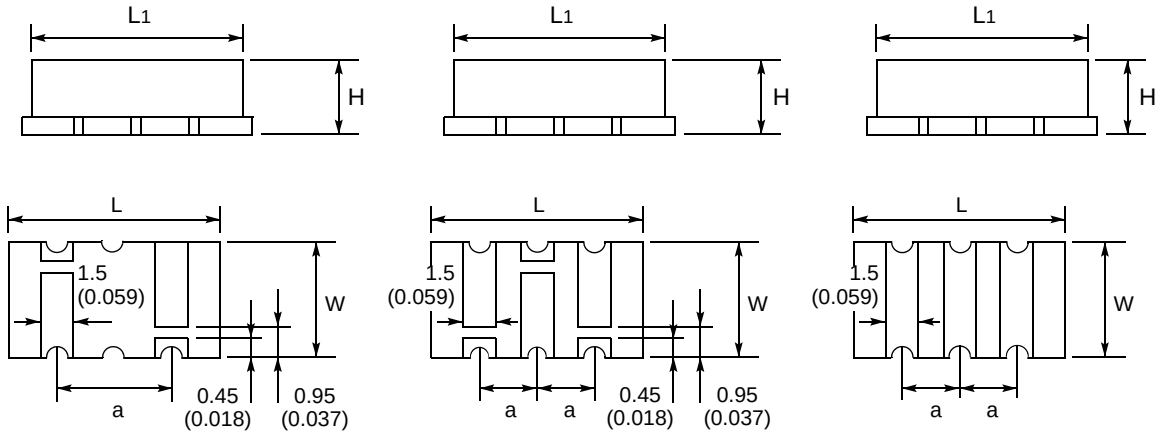
| Type | | L | $L_1$ | W | H | a | |
|---|---|---|---|---|---|---|---|
| | | | | | | Two terminal | Three terminal |
| SIP type | A | 11.0 ± 0.2 (0.433 ± 0.008) | — | 4.3 ± 0.2 (0.169 ± 0.008) | 6.3 ± 0.2 (0.248 ± 0.008) | 5.08 ± 0.2 (0.200 ± 0.008) | 2.54 ± 0.2 (0.100 ± 0.008) |
| | B | 9.0 ± 0.2 (0.354 ± 0.008) | — | 4.3 ± 0.2 (0.169 ± 0.008) | 5.3 ± 0.2 (0.209 ± 0.008) | | |
| CHIP type | A | 10.0 ± 0.5 (0.394 ± 0.020) | 9.4 ± 0.2 (0.370 ± 0.008) | 4.5 ± 0.5 (0.177 ± 0.020) | 2.5 ± 0.3 (0.098 ± 0.012) | | |
| | B | 8.0 ± 0.5 (0.315 ± 0.020) | 7.4 ± 0.2 (0.291 ± 0.008) | 3.2 ± 0.5 (0.126 ± 0.020) | 2.5 ± 0.3 (0.098 ± 0.012) | | |

SIP type




C1 series　　C3 and C4 series

CHIP type

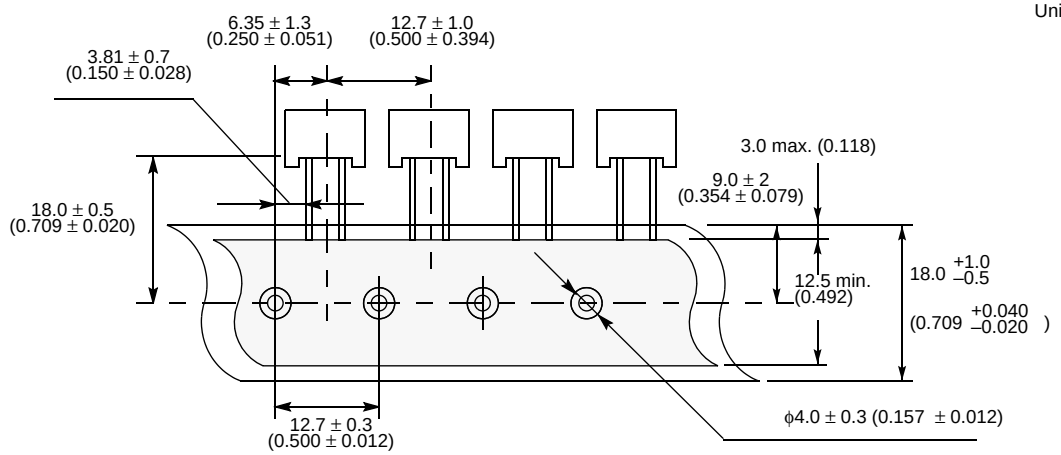



C1 series　　C3 series　　C4 series

## ■ TAPING FORM AND DIMENSIONS

- SIP type

Unit: mm (in.)

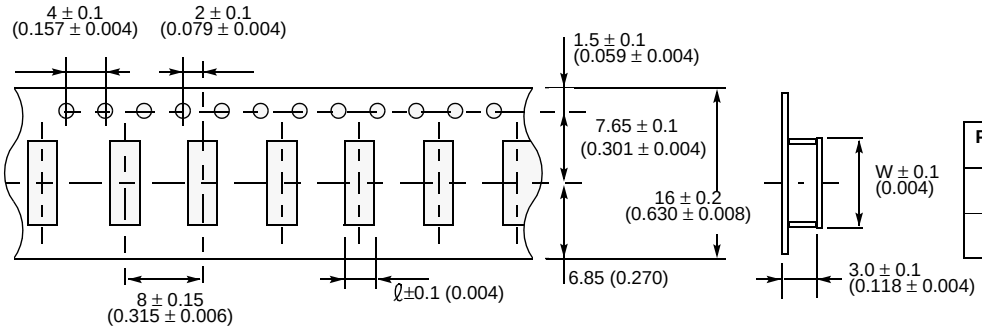



| Designation | Pack form | Pack quantity (pcs) | |
|---|---|---|---|
| | | Package size A | Package size B |
| T | Reel pack | 1000 | 1000 |
| U | Ammo pack | 1500 | 1500 |

Note: 1. In reel packs, the tolerance of the cumulative feed hole pitch (20 pitches) is ±1.3 (0.051) or less.
2. In ammo packs, there must be perforations every 25 pitches.

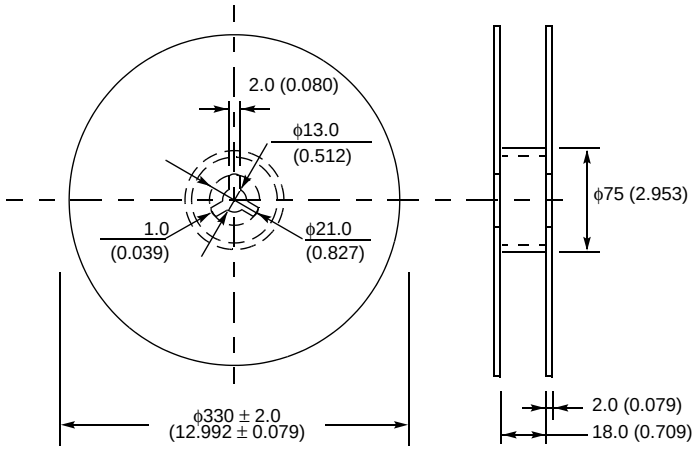
- CHIP type

Unit: mm (in.)




| Package size | ℓ | W |
|---|---|---|
| A | 4.9 (0.193) | 10.4 (0.409) |
| B | 3.6 (0.142) | 8.4 (0.331) |

Reel form

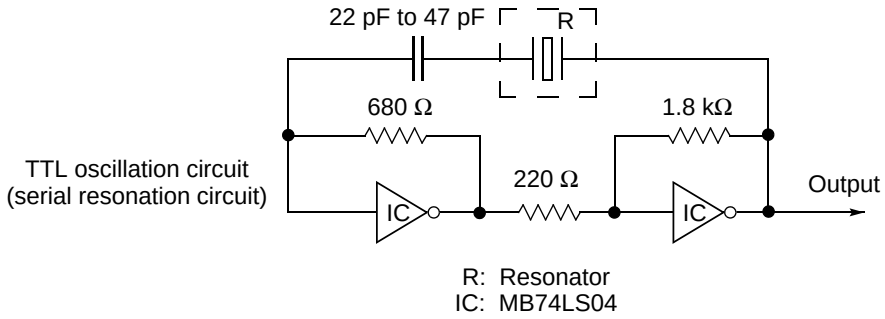



• Pack quantity

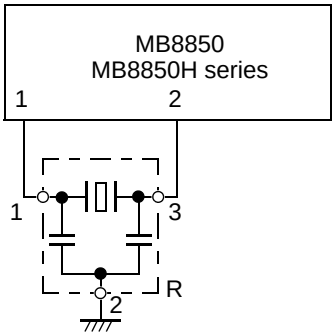
| Package size | Pack quantity |
|---|---|
| A | 3,000 pcs |
| B | 3,400 pcs |

## ■ APPLICATION EXAMPLES

- C1 series




- C3, C4 series




## ■ RELIABILITY

| Parameter | Test conditions | Requirements |
|---|---|---|
| Shock | MIL-STD-883B, 2002, condtion C (3000G) | Frequency fluctuation: within ±0.1% |
| Vibration | MIL-STD-202E, 201A (1.5 mm <0.059> at 10 Hz to 55 Hz for 2 hours) | Frequency fluctuation: within ±0.1% |
| Drop | 5 times drop from 1 m (39.370 in.) height to wooden board. | Frequency fluctuation: within ±0.1% |
| Sealing | Immersion in water at 85°C | No bubbles observed |
| Heat resistance | MIL-STD-202E, 210A condition B (260°C • 5 sec.) | Frequency fluctuation: within ±0.1% |
| Temperature cycling | MIL-STD-883B, 1010, condition A (–35 to 85°C, 10 cycle) | Frequency fluctuation: within ±0.1% |
| High-temperature loading test | MIL-STD-883B, 1008, condition B 1000 h (100°C • 1000 hours) | Frequency fluctuation: within ±0.1% |
| High-temperature humidity test | MIL-STD-202E, 103A, condition B (96 hours at 60°C, 90% to 95% RH, 12 VDC) | Frequency fluctuation: within ±0.1% |

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