

RECIPIENT

## SPECIFICATIONS

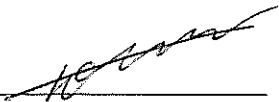
**MODEL :** FC-135

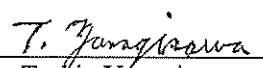
**SPEC. No. :** Q07-060-3A

**DATE:** Jul. 5. 2007

**EPSON TOYOCOM CORPORATION**  
**QZ Business Unit**

**8548 Naka-minowa**  
**Minowa-machi Kamiina-gun**  
**Nagano-ken**  
**399-4696 Japan**

**CHECKED**  / General Manager of Quality Assurance  
Jun Watanuki

**PREPARED**  / Assistant Manager of Quality Assurance  
Toshio Yanagisawa

# SPECIFICATIONS

## 1. Application

This document is applicable to the crystal unit that are delivered to MITEC from Epson Toyocom Corp.

This Product supplied (and any technical information furnished, if any) by Epson Toyocom Corporation shall not be used for the development and manufacture of weapon of mass destruction or for other military purposes. Making available such products and technology to any third party who may use such products or technologies for the said purposes are also prohibited.

This product listed here is designed as components or parts for electronics equipment in general consumer use. We do not expect that any of these products would be incorporated or otherwise used as a component or part for the equipment, which requires an extra high reliability, such as satellite, rocket and other space systems, and medical equipment, the functional purpose of which is to keep life.

## 2. Model

The model is FC-135.

## 3. Packing

It is subject to the packing standard of Epson Toyocom Corp.

## 4. Warranty

Defective parts which originate with us are replaced free of charge in the case of defects being found with 12 months after delivery.

## 5. Amendment and/or termination

Amendment and/or termination of this specification is subject to the agreement between the two parties.

## 6. Contents

Item No.	Item	Page
[ 1 ]	Absolute maximum ratings	2
[ 2 ]	Operating range	2
[ 3 ]	Static characteristics	2
[ 4 ]	Environmental and Mechanical characteristics	3 to 4
[ 5 ]	Dimensions and Marking layout	5 to 6
[ 6 ]	Notes	7

[ 1 ] Absolute maximum ratings

Item	Symbol	Rating value
Storage temperature	TSTG	-55°C to +125°C
Maximum drive level	DL	1.0 μW

[ 2 ] Operating range

Item	Symbol	Value		
		Min.	Typ.	Max.
Operating temperature range	TOPR	-40°C		+85°C
Drive level	DL	0.01 μW	0.1 μW	0.5μW
Vibration mode		Fundamental		

[ 3 ] Static characteristics

Item	Symbol	Value	Note
Frequency	f <sub>i</sub>	32.768 kHz	
Frequency tolerance	Δ f/f	± 20 ×10 <sup>-6</sup>	CL = 7 pF Ta = +25± 3°C, Drive level : 0.1 μW Not include aging
Series resistance	R <sub>1</sub>	70 kΩ Max.	CI meter : Saunders 140B Drive level : 0.5 μW
Motional capacitance	C <sub>1</sub>	Typ. 3.4 fF	
Shunt capacitance	C <sub>0</sub>	Typ. 1.2 pF	
Turnover temperature	θT	+25 ± 5 °C	Values are calculated by the frequencies at +10, +25, +40°C with C-MOS circuit.
Temperature coefficient	a	-4.0 × 10 <sup>-8</sup> /°C <sup>2</sup> Max.	
Isolation resistance	IR	500 MΩ Min.	DC 100V, 60 seconds Between terminal #1 and terminal #2
Aging	fa	± 3 ×10 <sup>-6</sup> /year	Ta = +25 °C ± 3 °C Drive level : 0.1 μW

#### [ 4 ] Environmental and Mechanical characteristics

No.	Items	Value	Conditions
1	Shock resistance	*3 $\Delta$ f/f : $\pm 8 \times 10^{-6}$	100g dummy(SEIKO EPSON Standard), Natural drop from 1500 mm height on to the concrete. 3 directions $\times$ 10 times *2
2	Vibration resistance	*3 $\Delta$ f/f : $\pm 3 \times 10^{-6}$	10 Hz to 55 Hz amplitude 0.75 mm 55 Hz to 500 Hz acceleration 98 m/s <sup>2</sup> 10 Hz $\rightarrow$ 500 Hz $\rightarrow$ 10 Hz 15 min./cycle 6 h (2 hours , 3 directions) *2
3	Soldering heat resistance	$\Delta$ f/f : $\pm 5 \times 10^{-6}$	For convention reflow soldering furnace (2 times)
4	High temperature storage	*3 $\Delta$ f/f : $\pm 10 \times 10^{-6}$	+125 °C $\times$ 1000 h *1
		*3 $\Delta$ f/f : $\pm 7 \times 10^{-6}$	+85°C $\times$ 1000 h *1
5	Low temperature storage	*3 $\Delta$ f/f : $\pm 10 \times 10^{-6}$	-55 °C $\times$ 1000 h *1
6	High temperature and humidity	*3 $\Delta$ f/f : $\pm 10 \times 10^{-6}$	+85°C $\times$ 85%RH $\times$ 1000 h *1
7	Temperature cycle	*3 $\Delta$ f/f : $\pm 10 \times 10^{-6}$	-55 °C $\leftrightarrow$ +125°C 30 minutes at each temperature $\times$ 100 cycles *1
8	Sealing	*3 $1 \times 10^{-8}$ hPa $\cdot$ l / s Max.	For He leak detector
9	Shear	No peeling-off at a soldered part	20 N press for 10 $\pm$ 1 s. Ref. IEC 60068-2-21
10	Pull - off	No peeling-off at a soldered part	20 N press for 10 $\pm$ 1 s. Ref. IEC 60068-2-21
11	Substrate bending	No peeling-off at a soldered part	Bend width reaches 3 mm and hold for 5 s $\pm$ 1 s $\times$ 1 time Ref. IEC 60068-2-21
12	Solvent resistance	The marking shall be legible	Ref. JIS C 0052 or IEC 60068-2-45

#### < Notes >

- \*1 Each test done independently.
- \*2 Measuring 2 h to 24 h later leaving in room temperature after each test. Drive level : 0.5  $\mu$ W
- \*3 Pre conditionings( Treat the Reflow 2 times with the following profile) **Initial value shall be after 24 h at room temperature.**

Shift of series resistance at before and after the test should be less than  $\pm 20$  % or less than  $\pm 15$ k $\Omega$ .

In case high temperature storage(+125°C  $\times$  1 000 h), Soldering heat resistance, shift of series resistance at before and after the test should be less than  $\pm 30$  % or  $\pm 20$  k $\Omega$ .

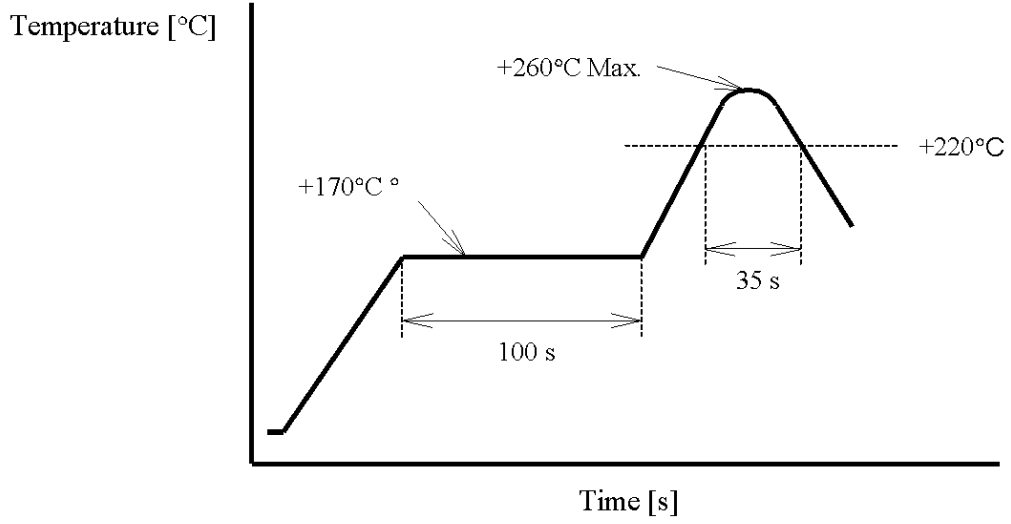
◆ Air reflow

Pre heating temperature: +170 [°C]

Pre heating time: 100 [s]

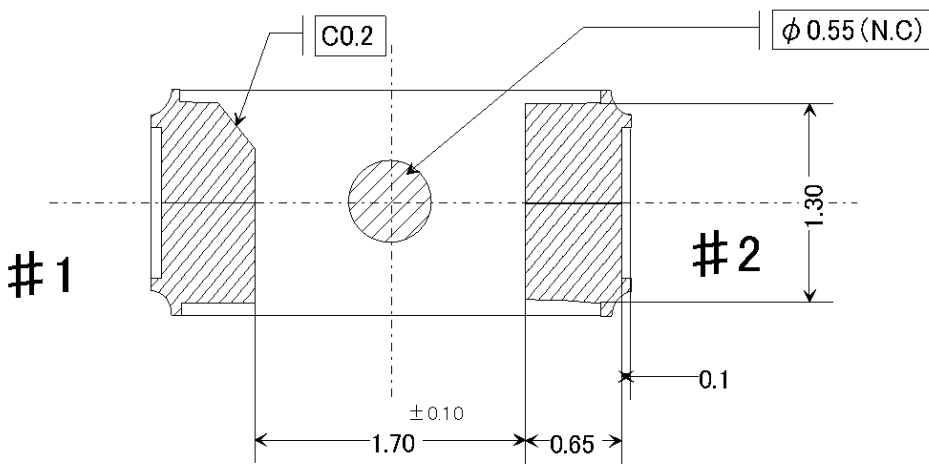
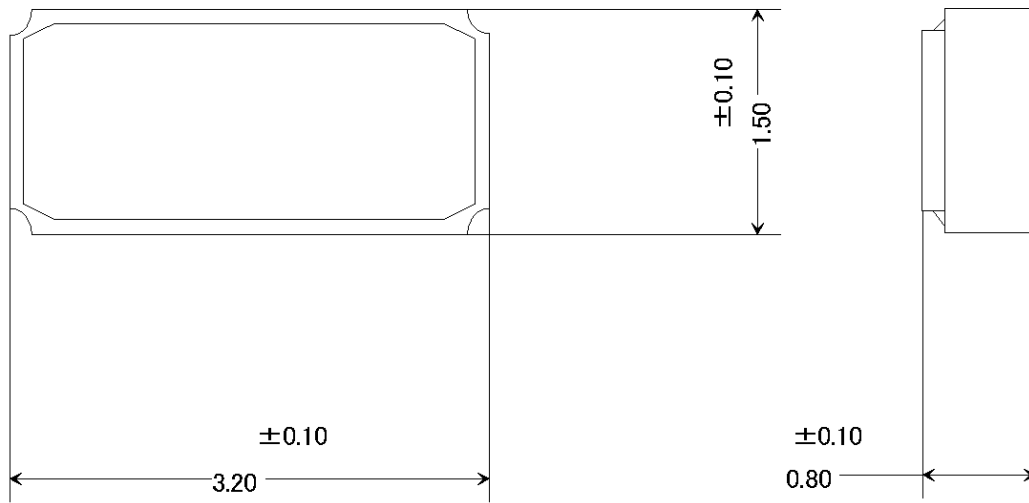
Heating temperature : +220 [°C]

Heating time : 30 [s]



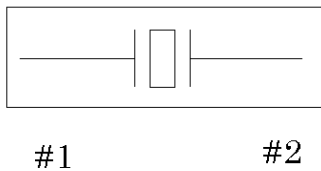
# [ 5 ] Dimensions and Marking layout

## 1. Dimensions



Package : Ceramic( $Al_2O_3$ )  
 Terminal Au plate : 0.5  $\mu$ m Min.  
 Lid : Glass

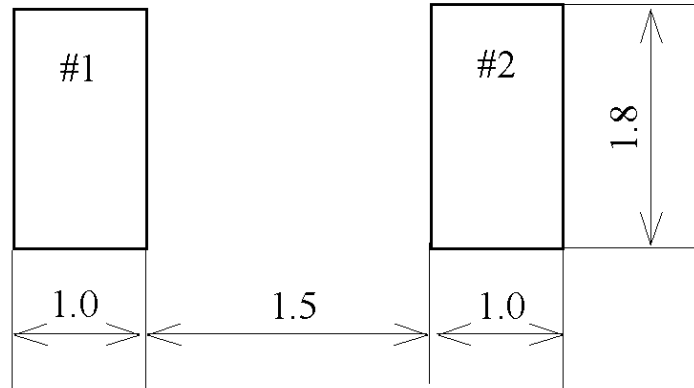
## 2. Internal Connection



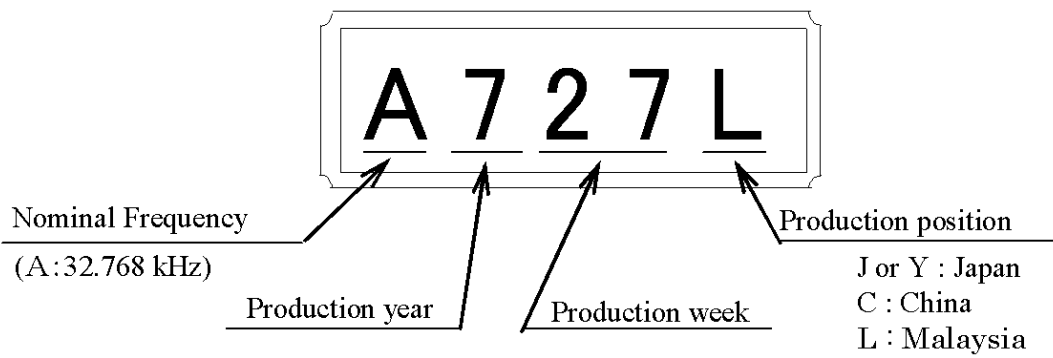
Type	FC-135	Terminal treatment	Au plating	Unit	1 = 1 mm
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3. Recommended soldering pattern

Unit : 1 = 1 mm



4. Marking layout



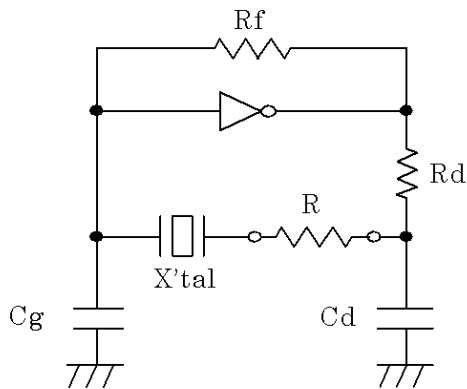
\* The above marking layout shows only marking contents and their approximate position and it is not for font, size and exact position.

Type	FC-135	Unit	1=1 mm
------	--------	------	--------

## [ 6 ] Notes

1. Max two (2) times reflow is allowed. Once miss soldering is happened, hand work soldering by soldering iron is recommended. (+350°C × within 5 s)
2. Patterning should be followed by our recommended one.
3. Applying excessive excitation force to the crystal unit may cause deterioration damage.
4. Unless adequate negative resistance is allocated in the oscillation circuit, start up time of oscillation may be increased, or no oscillation may occur.

How to check the negative resistance.



- (1) Connect the resistance (R) to the circuit in series with the crystal unit.
- (2) Adjust R so that oscillation can start (or stop).
- (3) Measure R when oscillation just start (or stop) in above (2).
- (4) Get the negative resistance  
 $-R = R + CI$  value.
- (5) Recommended -R  
 $|-R| > CI \times (5 \sim 10)$

5. The shortest patterning line on board is recommendable.  
Too long line on board may cause of abnormal oscillation.
6. To avoid mull function, no pattern under or near the crystal is allowed.  
Solder paste should be more than 150  $\mu m$  thickness.
7. This device must be stored at the normal temperature and humidity conditions before mounting on a board.
8. Too much exciting shock or vibration may cause deterioration on damage.  
Depending on the condition such as a shock in assembly machinery, the products may be damaged.  
Please check your condition in advance to maintain shock level to be smallest.
9. Depending on the conditions, ultrasonic cleaning may cause resonant damage of the internal crystal unit. Since we are unable to determine the conditions (type of cleaning unit, power, time, conditions inside the bath, etc.) to be used in your company, we cannot guarantee the safety of this unit when it is cleaned in an ultrasonic cleaner.
10. Ink marking may be damaged by some kind of solvent, please take precautions when choosing solvent by your selves.
11. Please refer to packing specification regarding how to storage the products in the pack.



# TAPING SPECIFICATION

## 1. APPLICATION

This document is applicable to FC-135.

## 2. CONTENTS

Item No.	Item	Page
[ 1 ]	Taping specification	1 to 2
[ 2 ]	Inner carton	3
[ 3 ]	Shipping carton	
[ 4 ]	Marking	4
[ 5 ]	Quantity	
[ 6 ]	Storage environment	
[ 7 ]	Handling	

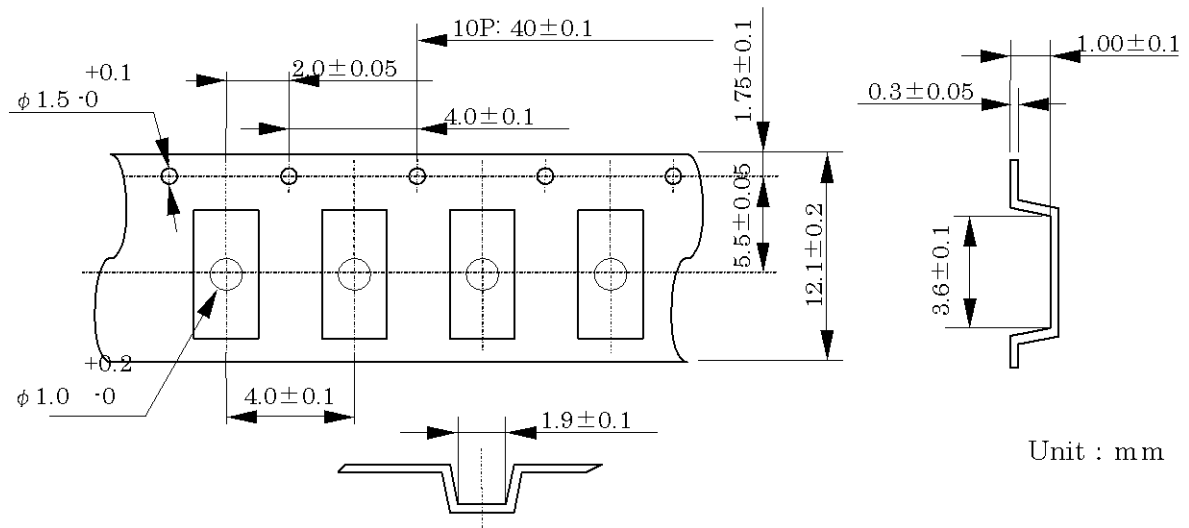
[ 1 ] Taping specification

Subject to EIA-481 , EIAJ EDX7602 , IEC 60286 , and JIS C0806.

(1) Tape dimensions TE1204L

Material of the Carrier Tape : PS

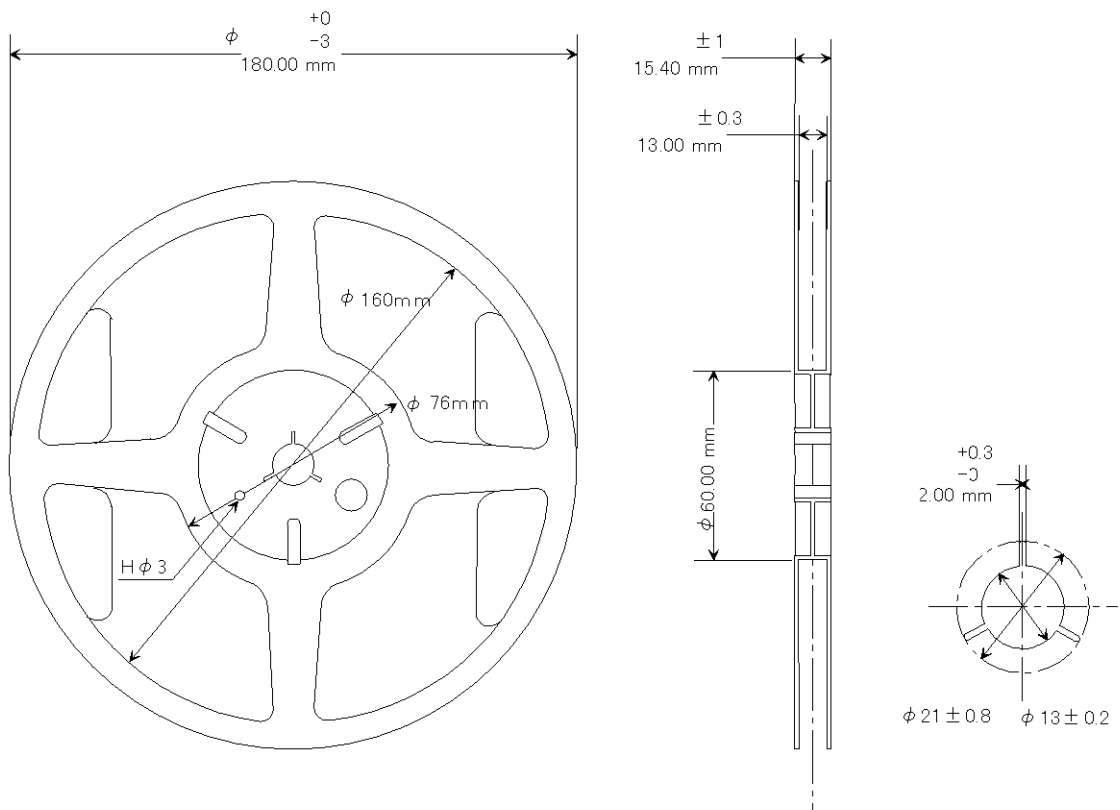
Material of the Top Tape : PET+PE



Unit : mm

(2) Reel dimensions EIAJRRM  $\phi 180$

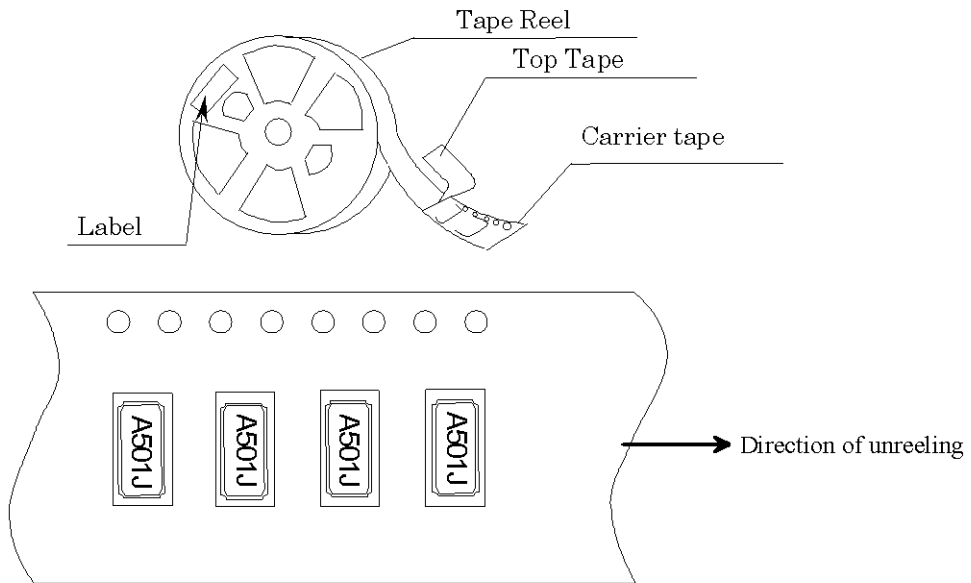
Material of the Reel : PS



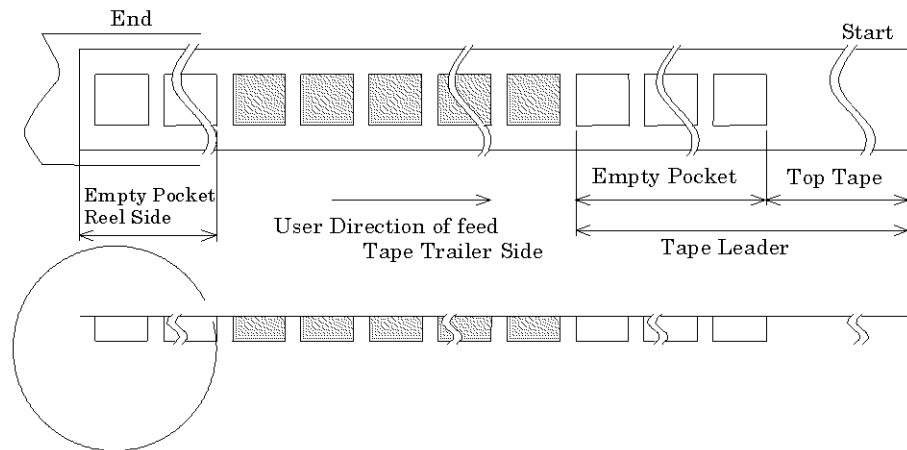
Form and Size of reel window shows are one of the example

(3) Packing

(a) Tape & Reel



(b) Start & End Point



(c) Peel force of the cover tape

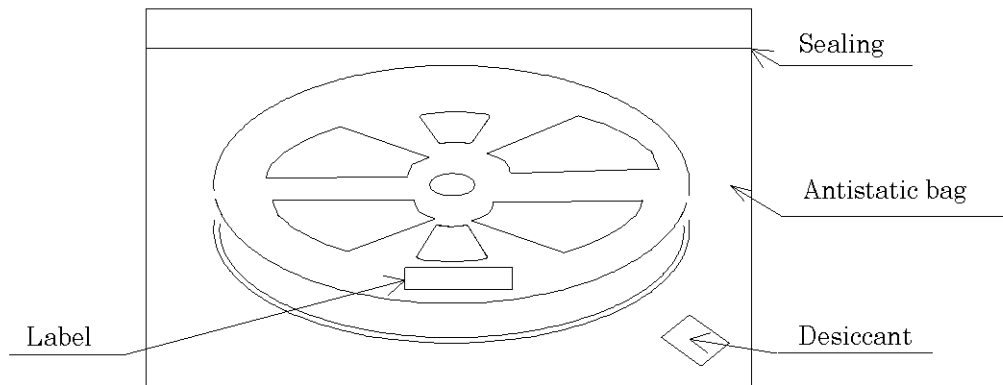
(1) angle : cover tape during peel off and the direction of unreeling shall be 165° to 180°.

(2) peel speed : 5 mm/s.

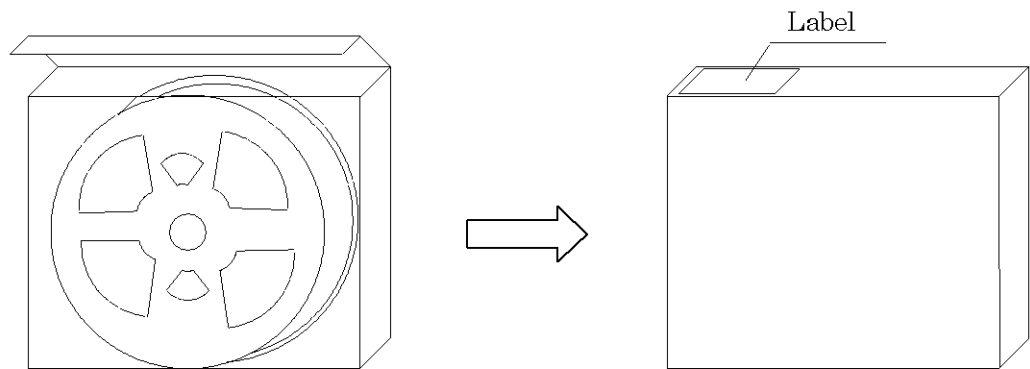
Item		Empty Space
Tape Leader	Top Tape	Min. 1 000 mm
	Carrier Tape	Min. 20 pockets
Tape Trailer	Top Tape	Min. 0 mm
	Carrier Tape	Min. 20 pockets

## [ 2 ] Inner Carton

### a) Packing to antistatic bag

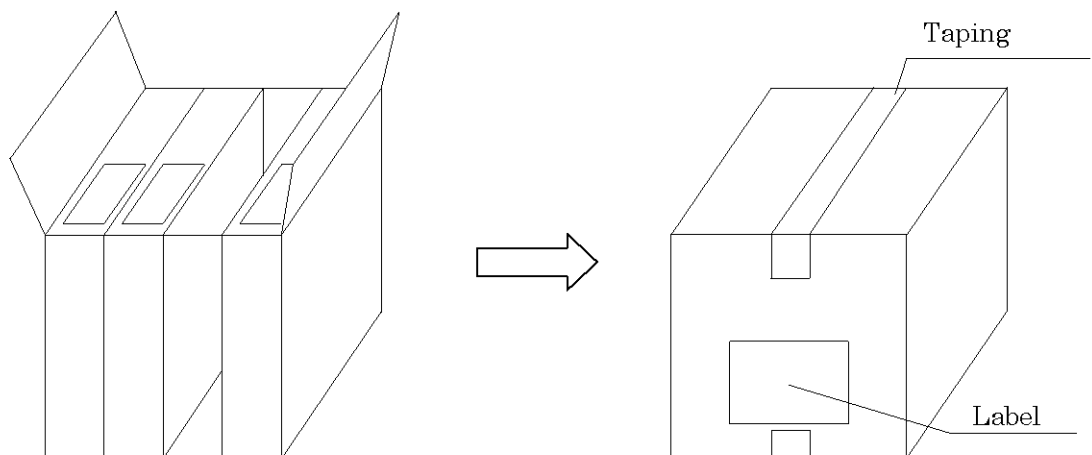


### b) Packing to innercarton



## [ 3 ] Shipping Carton

- Put inner boxes into an outer box.
- If there are room in the outer box, material is put in a shock absorbing together.



#### [ 4 ] Marking

- (1) Reel marking
  - Reel marking shall consist of :
    - 1) Parts name
    - 2) Quantity
    - 3) Manufacturing Date or symbol
    - 4) Manufacturer's Date or symbol
    - 5) Others (if necessary)
- (2) Inner carton marking
  - Same as Reel marking.
- (3) Shipping carton marking
  - Shipping carton marking shall consist of :
    - 1) Parts name
    - 2) Quantity

#### [ 5 ] Quantity

- 3 000 pcs./reel

#### [ 6 ] Storage environment

- (1) To storage the reel at +15 °C to +35 °C, 25 %RH to 85 %RH of Humidity.
- (2) To open the packing just before using.
- (3) Not to expose the sun.
- (4) Not to storage with some erosive chemicals.
- (5) Nothing is allowed to put on the reel or carton to prevent mechanical damage.

#### [ 7 ] Handling

To handle with care to prevent the damage of tape, reel and products.

# PROCESS QUALITY CONTROL

FC-135  
No.C-0102-ASE-2

2006/9/8  
EPSON TOYOCOM CORP.  
INA PLANT QZ BU

PREPARED	CHECKED	APPROVED
<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>

Manufacturing process chart	No.	Section In Charge	Standards	Inspection Control Item	Inspection Methods	Instruments	Record
	1	Inspection Section (INA Plant QA)	Purchasing Specification Incoming Inspection Standard	Appearance Dimension	Sampling Sampling	Visual Inspection Tool Microscope	In-coming Inspection Data Sheet
	2	CHINA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
	3	CHINA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
	4	CHINA Plant	Manufacturing Instruction Sheet	Appearance Height Measure	100% Inspection Sampling	Microscope Inspection Jig	Process Data Sheet
	5	CHINA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
	6	CHINA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
	7	CHINA Plant	Manufacturing Instruction Sheet	Frequency	100% Inspection	Frequency Adjust- ment Machine	Data Sheet
	8	CHINA Plant	Manufacturing Instruction Sheet	Appearance Marking Strength	100% Inspection Sampling	Microscope Rubbing Test	Process Data Sheet Data Sheet
	9	CHINA Plant	Manufacturing Instruction Sheet	Frequency Crystal Impedance Appearance	100% Inspection 100% Inspection 100% Inspection	Characteristics In- spection Machine Microscope	Process Data Sheet
	10	CHINA Plant	Specification Outgoing Inspection Standard	Electrical Characteristics Appearance Dimension	Sampling Sampling Sampling	Measuring Equipment Microscope Tool Microscope	Outgoing Inspection Data Sheet
	11	CHINA Plant	Packing Instruction Daily Shipping List	Customers Type Quantity	---	---	Shipment List

# PROCESS QUALITY CONTROL

FC-135  
No.C-0102-AAE-2

2006/9/20  
EPSON TOYOCOM CORP.  
INA PLANT QZ BU

PREPARED	CHECKED	APPROVED
<i>Y. Yoshida</i>	<i>Y. Hara</i>	<i>A. Hirayama</i>

Manufacturing process chart	No.	Section In Charge	Standards	Inspection Control Item	Inspection Methods	Instruments	Record
<pre> graph TD     Start(( )) --&gt; 1{1}     1 --&gt; 2((2))     1 --&gt; Base[Base]     1 --&gt; Lid[Lid]     2 --&gt; 3((3))     3 --&gt; 4((4))     4 --&gt; 5((5))     5 --&gt; 6((6))     6 --&gt; 7((7))     7 --&gt; 8((8))     8 --&gt; 9((9))     9 --&gt; 10{10}     10 --&gt; 11((11))     11 --&gt; Shipping[Shipping]                     </pre>	1	Inspection Section (INA Plant QA)	Purchasing Specification Incoming Inspection Standard	Appearance Dimension	Sampling Sampling	Visual Inspection Tool Microscope	In-coming Inspection Data Sheet
	2	AKITA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
	3	AKITA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
	4	AKITA Plant	Manufacturing Instruction Sheet	Appearance Height Measure	100% Inspection Sampling	Microscope Inspection Jig	Process Data Sheet Process Data Sheet
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	11	AKITA Plant	Packing Instruction Daily Shipping List	Customers Type Quantity	--- --- ---	--- --- ---	Shipment List

# PROCESS QUALITY CONTROL

FC-135  
No.C-0102-AIE-2

2006/9/20  
EPSON TOYOCOM CORP.  
INA PLANT QZ BU

PREPARED	CHECKED	APPROVED
<i>Hiroshi</i>	<i>Shoji</i>	<i>A. Hirasawa</i>

Manufacturing process chart	No.	Section In Charge	Standards	Inspection Control Item	Inspection Methods	Instruments	Record
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# PROCESS QUALITY CONTROL

FC-135  
No.C-0102-AEE-2

2006/9/8  
EPSON TOYOCOM CORP.  
INA PLANT QZ BU

PREPARED	CHECKED	APPROVED
<i>J. Aritasida</i>	<i>[Signature]</i>	<i>A. Sireman</i>

Manufacturing process chart	No.	Section In Charge	Standards	Inspection Control Item	Inspection Methods	Instruments	Record
	1	Inspection Section (INA Plant QA)	Purchasing Specification Incoming Inspection Standard	Appearance Dimension	Sampling Sampling	Visual Inspection Tool Microscope	In-coming Inspection Data Sheet
	2	MALAYSIA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
	3	MALAYSIA Plant	Manufacturing Instruction Sheet	Appearance	100% Inspection	Microscope	Process Data Sheet
	4	MALAYSIA Plant	Manufacturing Instruction Sheet	Appearance Height Measure	100% Inspection Sampling	Microscope Inspection Jig	Process Data Sheet Process Data Sheet
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	11	MALAYSIA Plant	Packing Instruction Daily Shipping List	Customers Type Quantity	--- --- ---	--- --- ---	Shipment List

## RELIABILITY TEST DATA

### Product Name : FC-135

The Company evaluation condition

We evaluate environmental and mechanical characteristics by the following test condition .

**F-C-0102-03-001E**


No.	ITEM	TEST CONDITIONS	VALUE *1 *2		TEST	FAIL
			$\Delta f / f$ [ $1 \times 10^{-6}$ ]		Qty [ n ]	Qty [ n ]
1	Shock	100 g dummy (SEIKO EPSON Standard) drop from 1 500 mm height on to the concrete 3 directions 10 times	*3	$\pm 8$	22	0
2	Vibration	10 Hz to 55 Hz amplitude 0.75 mm 55 Hz to 500 Hz acceleration 98 m/s <sup>2</sup> 10 Hz → 500 Hz → 10 Hz 15 min / cycle 6 h ( 2 h × 3 directions )	*3	$\pm 3$	22	0
3	Resistance to soldering heat	For convention reflow soldering furnace (2 times) 260°C Max.		$\pm 5$	22	0
4	High temperature storage	a) +125°C × 1 000 h	*3	a) $\pm 20$	a) 22	a) 0
		b) +85 °C × 1 000 h	*3	b) $\pm 7$	b) 22	b) 0
5	Low temperature storage	-55 °C × 1 000 h	*3	$\pm 10$	22	0
6	Temperature humidity storage	+85 °C × 85 %RH × 1 000 h	*3	$\pm 10$	22	0
7	Temperature cycle	-55 °C ⇔ +125 °C 30 min at each temp. 100 cycles	*3	$\pm 10$	22	0
8	Sealing	For He leak detector		$1 \times 10^{-8}$ hPa · l / s Max.	11	0
9	Shear	20 N press for 10 s ± 1 s Ref. IEC 60068-2-21		No peeling - off at a solder part	11	0
10	Pull - off	20 N press for 10 s ± 1 s Ref. IEC 60068-2-21		No peeling - off at a solder part	11	0
11	Substrate bending	Bend width reaches 3 mm and hold for 5 s ± 1 s × 1 time Ref. IEC 60068-2-21		No peeling - off at a solder part	11	0
12	Solvent resistance	Ref. JIS C 0052 or IEC 60068-2-45		The marking shall be legible	11	0

#### Notes

- \*1 Each test done independently.
- \*2 Measuring 2 h to 24 h later leaving in room temperature after each test. DL : 0.5 μW
- \*3 Pre conditionings Initial value shall be after 24 h at room temperature.
- Shift series resistance at before above tests should be less than  $\pm 20$  % or less than  $\pm 15$  kΩ.  
In case Resistance to solder heat and High temperature storage (+125 °C × 1 000 h) shift series resistance at before above tests should be less than  $\pm 30$  % or less than  $\pm 20$  kΩ.

QZ Business Unit

Qualification Data

Signature 

**Product Name : FC-135**

$\Delta f/f$

**F-C-0102-03-002E**

