

RECIPIENT

SPECIFICATIONS

PRODUCT

No.: Q13FC1350000400


MODEL : FC-135


SPEC. No. : _____

DATE: May. 19. 2015

SEIKO EPSON CORPORATION

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

CHECKED  / TD·CS Quality Assurance Department Manager
Yasushi Hiraizumi

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SPECIFICATIONS

1. Application

- 1) This document is applicable to the crystal unit that are delivered to from Seiko Epson Corp.
- 2) RoHS compliant
FC-135 contains lead in Low melting type solder which is exempted in RoHS directive.
- 3) This Product supplied (and any technical information furnished, if any) by Seiko Epson 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.
- 4) 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 systems, and medical equipment, the functional purpose of which is to keep extra high reliability, such as satellite, rocket and other space life.

2. Product No. / Model

The product No. of this crystal unit is Q13FC1350000400.
The model is FC-135.

3. Packing

It is subject to the packing standard of Seiko Epson 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

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[1] Absolute maximum ratings

No.	Item	Symbol	Rating value			Unit	Note
			Min.	Typ.	Max.		
1	Storage temperature range	T _{stg}	- 55		+ 125	°C	Suppose to be within CI STD at + 25 °C + 3 °C.
2	Maximum level of drive	GL		0.5		μW	

Level <1.0uW is also acceptable.

[2] Operating range

No.	Item	Symbol	Rating value			Unit	Note
			Min.	Typ.	Max.		
1	Operating temperature range	T _{use}	- 40		+ 105	°C	
2	Level of drive	DL	0.01	0.1	0.5	μW	
3	Vibration mode		Fundamental				

**Use CL=12.5pF
: external capacitor=20pF;
Use CL=9pF
: external capacitor=12pF**

[3] Static characteristics

No.	Item		Symbol	Value	Unit	Conditions
1	Nominal Frequency		f _{nom}	32.768	kHz	
2	Frequency tolerance		f _{tol}	± 20	× 10 ⁻⁶	CL = 12.5 pF Ta = + 25 ± 3 °C Level of drive : 0.1 μW Not include aging
3	Motional resistance		R1	70 Max.	kΩ	CI meter : Saunders 140B Level of drive : 0.5 μW
4	Motional capacitance		C1	3.4 Typ.	fF	
5	Shunt capacitance		C0	1.2 Typ.	pF	
6	Frequency temperature characteristics	Turnover temperature	Ti	+ 25 ± 5	°C	Values are calculated by The frequencies at + 10, + 25, + 40 °C with C-MOS circuit.
		Parabolic coefficient	B	- 0.04 Max.	× 10 ⁻⁶ / °C ²	
7	Isolation resistance		IR	500 Min.	MΩ	DC 100 V ± 15, 60 seconds Between terminal # 1 and terminal # 2
8	Frequency Aging		f _{age}	± 3	× 10 ⁻⁶ /year	Ta = + 25 °C ± 3 °C Level of drive : 0.1 μW

[4] Environmental and Mechanical characteristics

No.	Items	Value	Conditions
1	Shock resistance	$*3\Delta f/f : \pm 8 \times 10^{-6}$	100 g dummy(EPSON TOYOCOM Standard), Natural drop from 1 500 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^2 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 1 000 h *1
		$*3\Delta f/f : \pm 7 \times 10^{-6}$	+ 85 °C \times 1 000 h *1
5	Low temperature storage	$*3\Delta f/f : \pm 10 \times 10^{-6}$	- 55 °C \times 1 000 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 $1 \times 10^{-8} \text{ hPa} \cdot \text{l} / \text{s}$ Max.	For He leak detector
9	Shear	No peeling-off at a soldered part	20 N press for $10 \pm 1 \text{ s}$. Ref. IEC 60068-2-21
10	Pull - off	No peeling-off at a soldered part	20 N press for $10 \pm 1 \text{ s}$. Ref. IEC 60068-2-21
11	Substrate bending	No peeling-off at a soldered part	Bend width reaches 3 mm and hold for $5 \text{ s} \pm 1 \text{ s} \times 1 \text{ time}$ 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 : $0.5 \mu\text{W}$
- *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 $\pm 15 \text{ k}\Omega$.

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 $\pm 20 \text{ k}\Omega$.

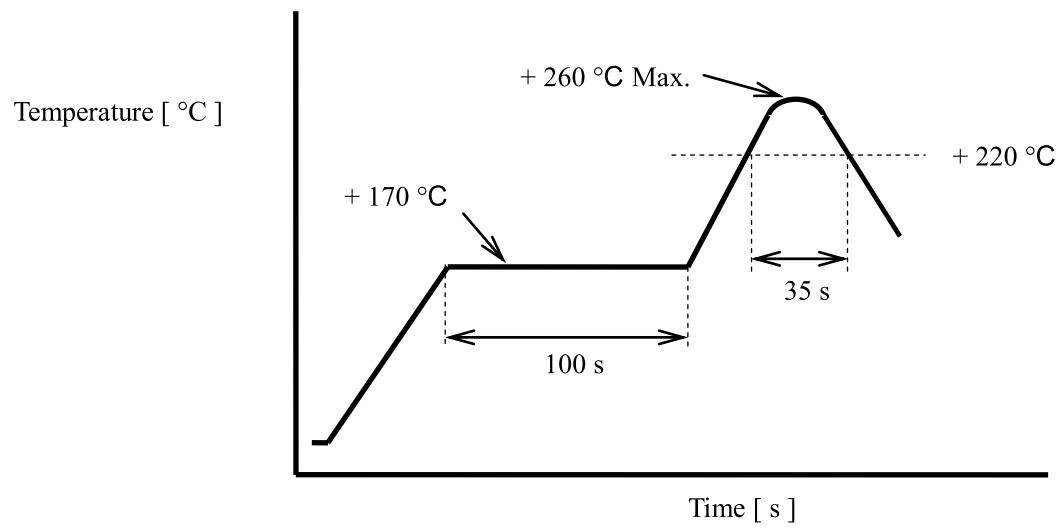
◆ Conditions of hot air convection reflow

Pre heating temperature : + 170 °C

Heating temperature : + 220 °C

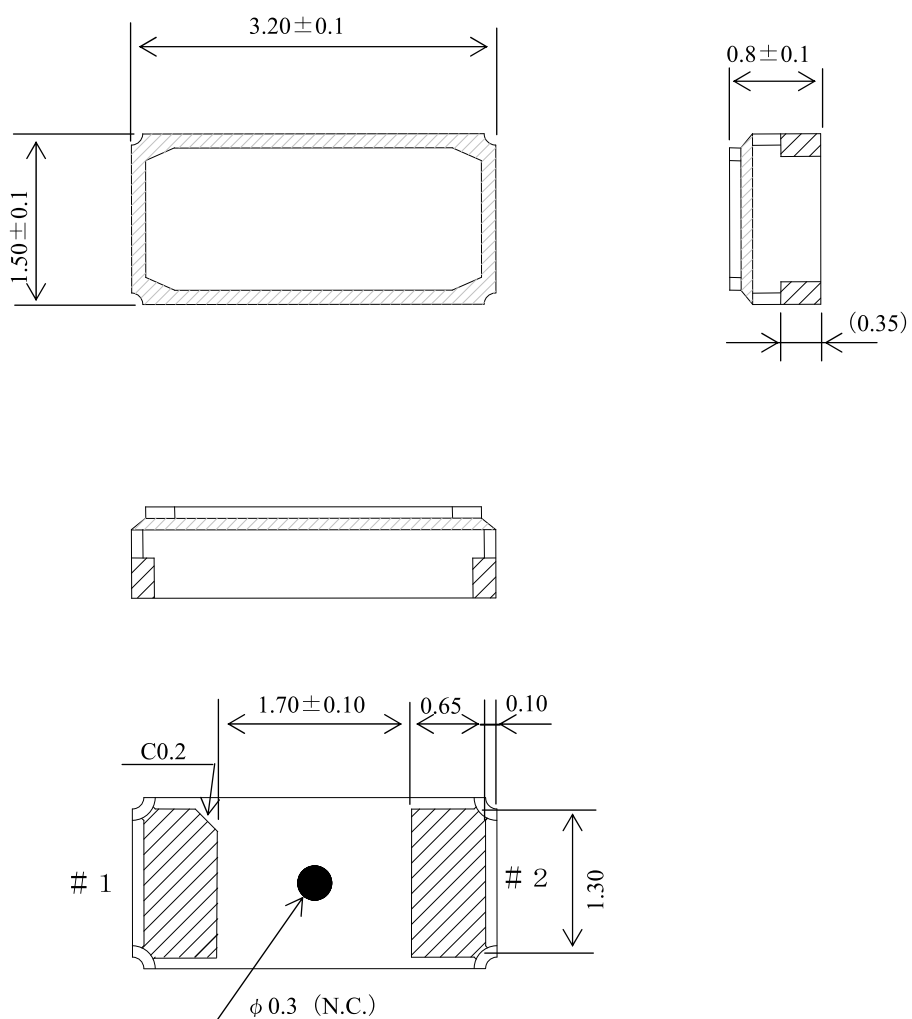
Pre heating time : 100 s

Heating time : 35 s

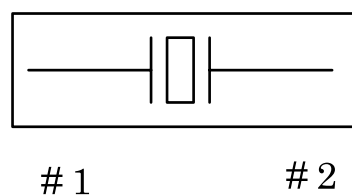


[5] Dimensions and Marking layout

1. Dimensions



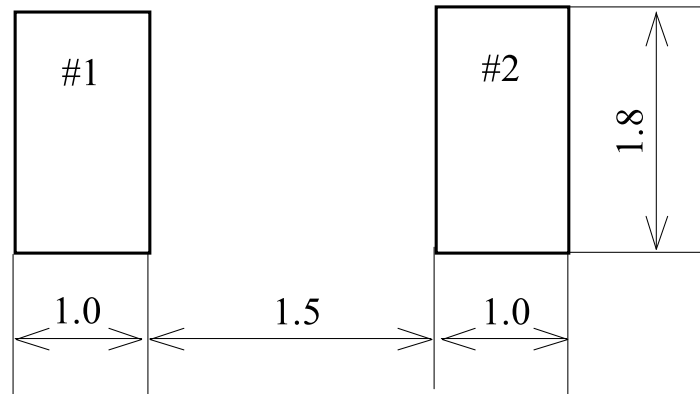
2. Internal Connection



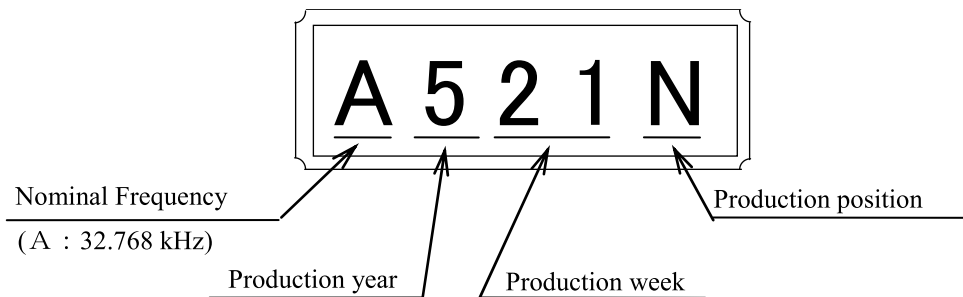
Type	FC-135	Terminal treatment	Au plating	Unit	1 = 1 mm
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3. Recommended soldering pattern

Unit : 1 = 1 mm



4. Marking layout



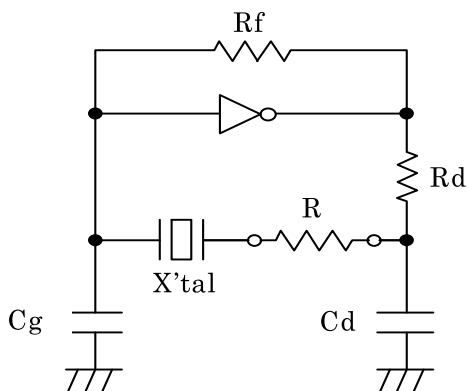
* The above marking layout shows only marking contents and their approximate position and it is not for font, size and exact position.

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.
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

テープ梱包基準書

1. APPLICATION 適用範囲

This document is applicable to FC-135 series.

本基準書は、FC-135 シリーズのテーピング梱包について規定する。

2. CONTENTS 目次

Item No.	Item	Page
[1]	Taping specification テーピング仕様	1 to 2
[2]	Inner sleeve 袋への収納	3
[3]	Shipping carton 外装箱への収納	
[4]	Marking 表示	4
[5]	Quantity 収納数量	
[6]	Storage environment 保管環境	
[7]	Handling リール取扱い	

[1] Taping specification テーピング仕様

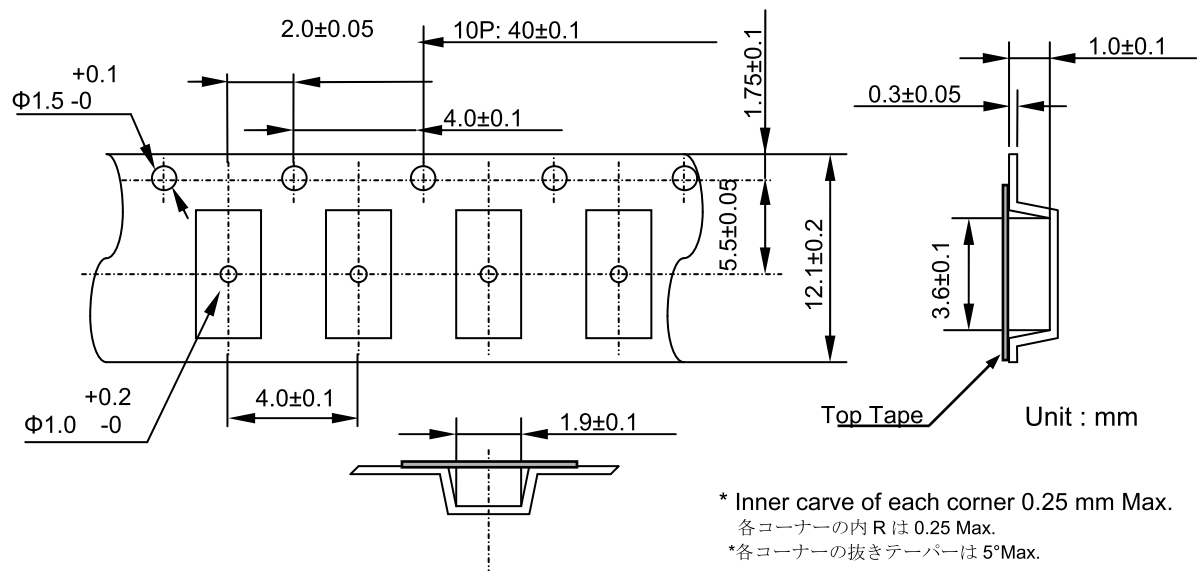
Subject to EIA-481 , IEC 60286.

「EIA-481」「IEC 60286」に準拠する。

(1) Tape dimensions TE1204L

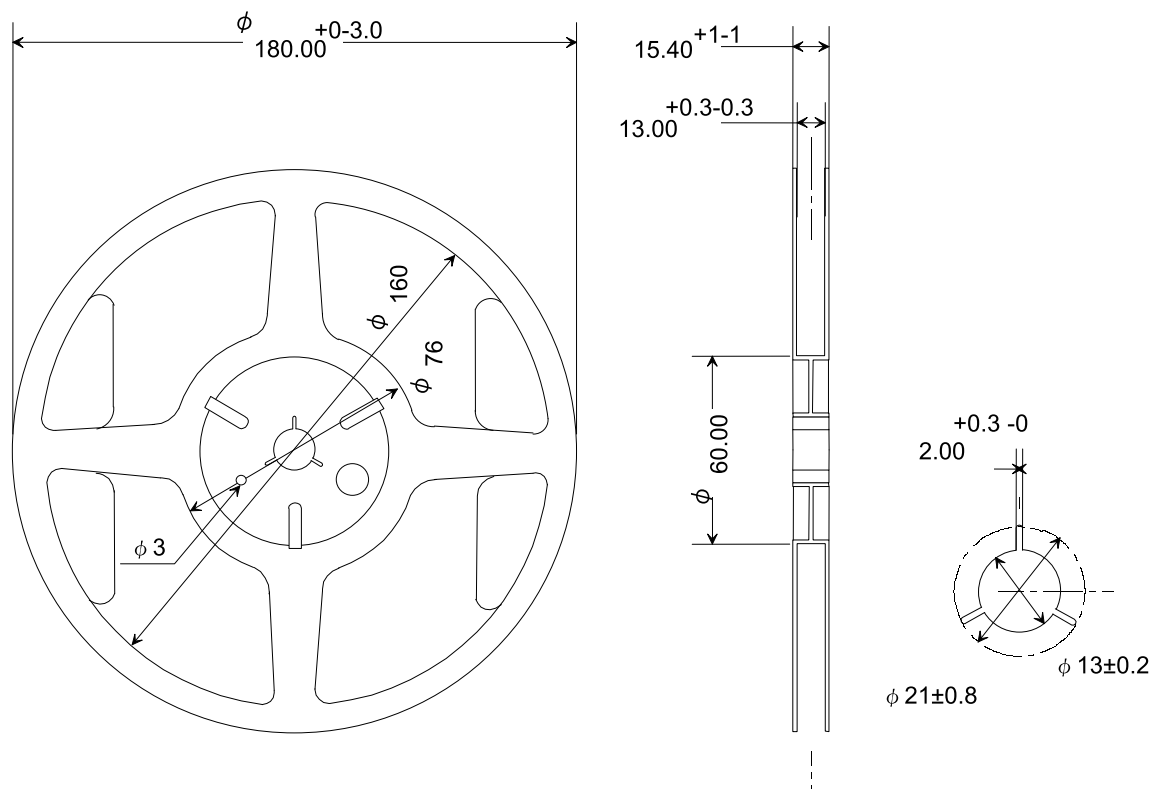
Material of the Carrier Tape キャリアテープ材質: PS (Electrically conductive)

Material of the Top Tape トップテープ材質 : PET+PE



(2) Reel dimensions : EIAJRRM $\Phi 180$ mm Tape Wide 12 mm

Material of the Reel リール材質: PS

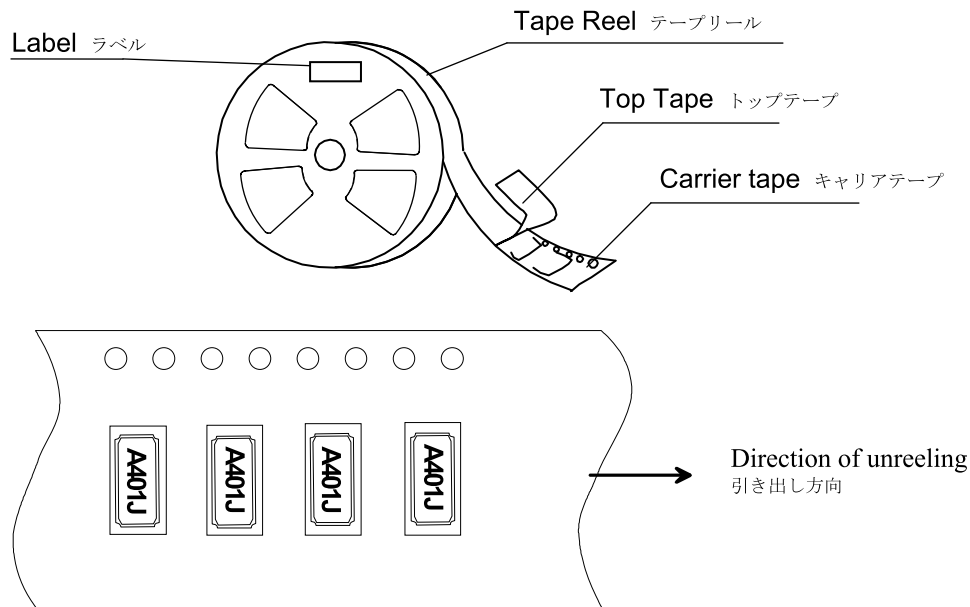


Form and Size of reel window shows are one of the example

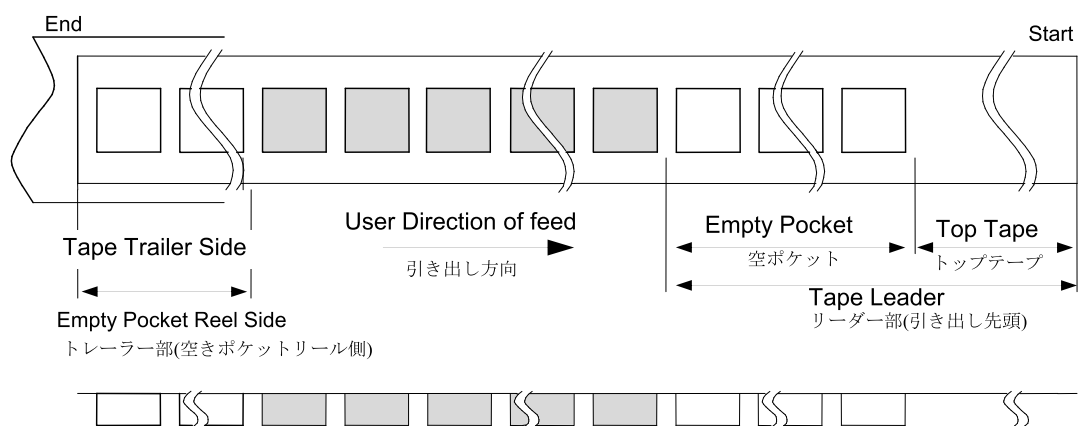
リールの窓の形状は代表例を掲載。

(3) Packing 收納形態

(a) Tape & Reel デバイス収納方法



(b) Start & End Point 引き出し先頭側及びリール側の処理



Item		Empty Space 空きスペース	Note 備考
Tape Leader (引き出し先頭側)	Top Tape	Min. 1 000 mm	Feeding in the Top tape, the tip is fixed with tape. トップテープ単独で繰り出し、先端はテープにより固定。 Winding method is a diagram of the above リールへの巻き取り方法は、上図の通り。
	Carrier Tape	Min. 80 mm	
Tape Trailer (リール側)	Top Tape	Min. 0 mm	Tip is fixed to the reel. 先端はリールに固定。
	Carrier Tape	Min. 80 mm	

(4) Peel force of the cover tape トップテープの剥離強度

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

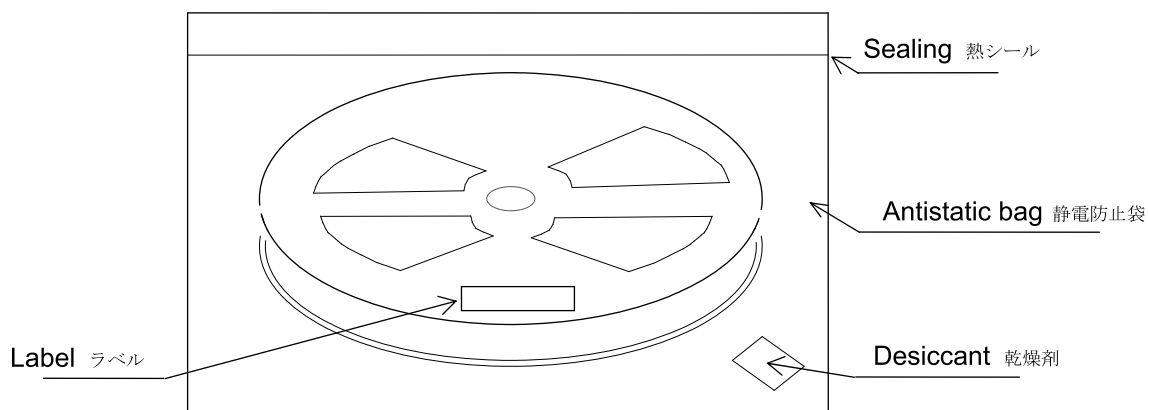
剥離角度:テープの接着面に対し 165~180 度とする。

(b) peel speed : 300 mm/min

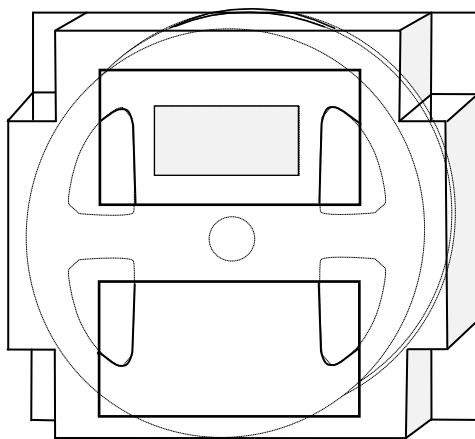
剥離速度: 300 mm/min とする。

[2] Inner sleeve

a) Packing to antistatic bag 袋への収納

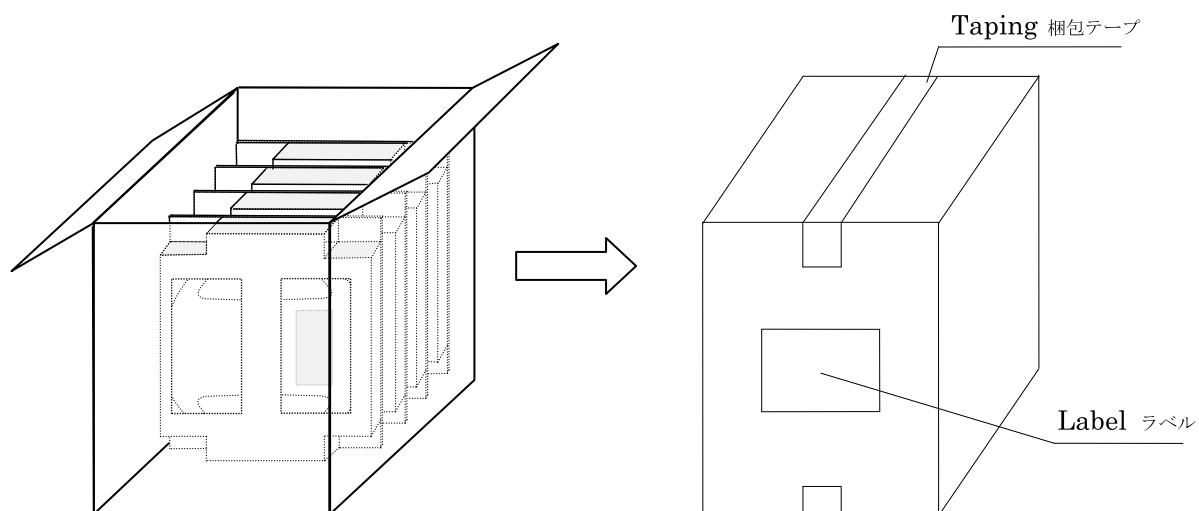


b) Packing to inner sleeve スリーブへの収納



[3] Shipping Carton 外装箱への収納

- Put inner sleeve into an outer box.
外装箱の中へ、スリーブを収納する。
- If there are room in the outer box, material is put in a shock absorbing together.
空間ができた時は、クッション材を入れる。



[4] Marking 表示

(1) Reel marking リールへの表示

• Reel marking shall consist of

下記内容をリール表面に表示できるラベルを貼る。:

- 1) Parts name 製品名称
- 2) Quantity 製品数量
- 3) Manufacturing Date or symbol 製品の製造年月又はこれを示す記号
- 4) Manufacturer's Date or symbol 製品の製造業者又はその略号
- 5) Others (if necessary) その他必要事項

(2) Shipping carton marking 外装箱への表示

• Shipping carton marking shall consist of :

下記内容を外装箱表面に表示できるラベルを貼る。:

- 1) Parts name 製品名称
- 2) Quantity 製品数量

[5] Quantity 収納数量

• 3 000 pcs./reel (Standard)

However it is not the limit, in case that the order quantity does not fill with 3000 pieces.

Packing quantity is defined by 14th and 15th digit of product number.

但し、注文数量が 3 000 pcs に満たない場合は、その限りではない。

収納数量は、製品型番の 14 桁、15 桁による。

14th and 15th digit of product number. 製品型番の 14 桁、15 桁	Quantity
00	3 000 pcs
01	Vinyl Bag(Bulk)
11	Any Quantity
12	250 pcs
13	250 pcs
14	1 000 pcs
15	2 000 pcs

[6] Storage environment 保管環境

(1) Before open the packing, we recommend to keep less than +30 °C and 85 %RH of Humidity, and to use it less than 6 months after delivery.

開梱前の製品は、温度 +30 °C、湿度 85 %RH 以下での保管をして下さい。

貴社納入後、袋未開封で 6 ヶ月以内の実装を推奨します。

(2) We recommend to open Package in immediately before use. After open Package, We recommend to keeps less than 6 month. No need dry air before soldering work if it is less than temperature +30 °C, 85 humidity %RH.

使用直前まで開梱せず、袋開封後は 6 ヶ月以内の実装を推奨します。

温度 +30 °C、湿度 85 %RH 以下では、はんだ付け作業前に乾燥不要です。

(3) Not to storage with some erosive chemicals.

化学薬品類との同居を避ける。

(4) Nothing is allowed to put on the reel or carton to prevent mechanical damage

内・外装箱がゆがまないようまた、外圧がかからないように保管して下さい。

[7] Handling リール取扱い

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

リールの取扱いについては、中のテープ・製品を変形させないようにして下さい。

PROCESS QUALITY CONTROL

FC-135

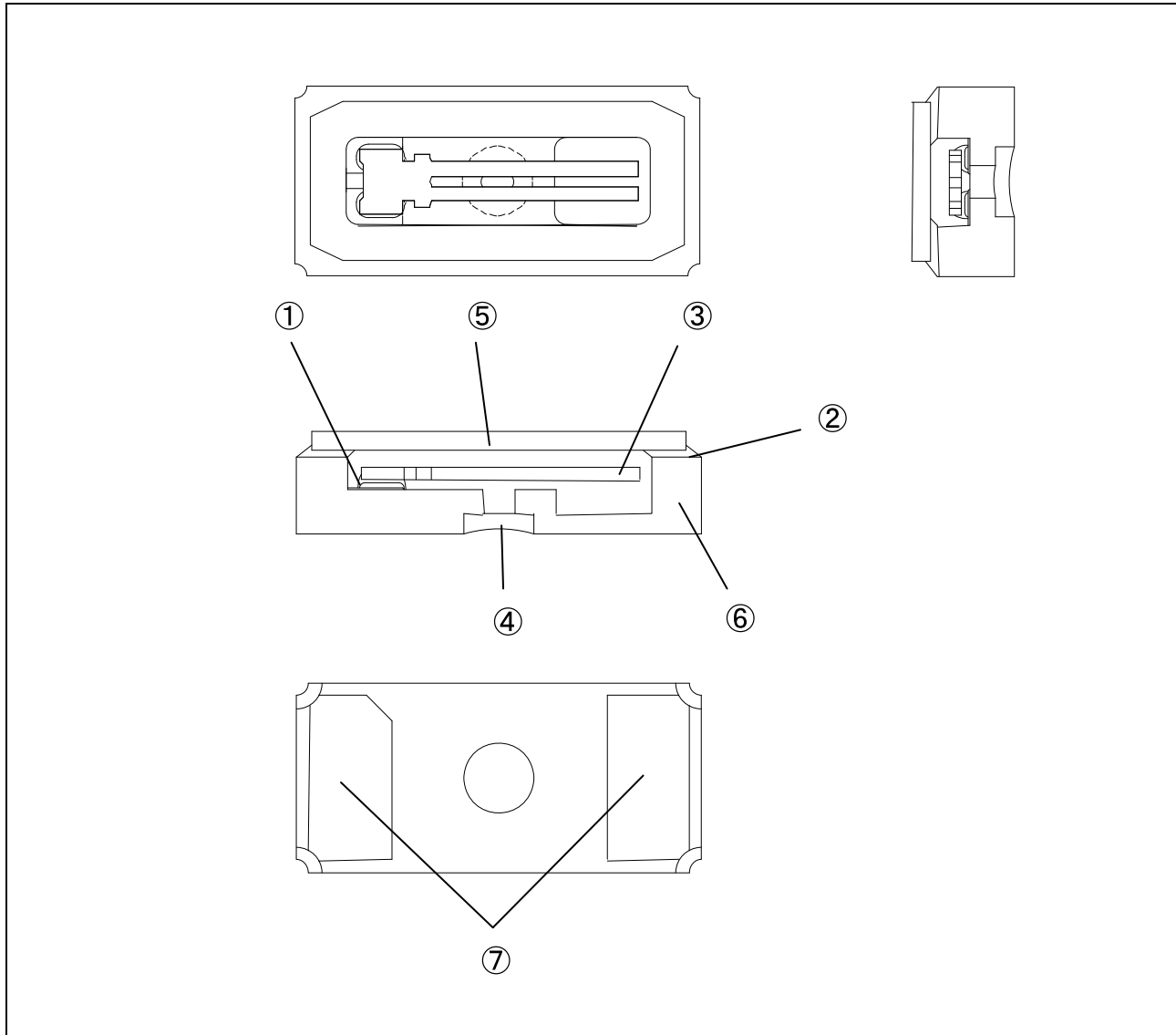
No.C-0102-AGE-1

2015.03.10

FC135_Q_0001

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

Structure Diagram 構造図		
Model 型式	FC-135	
Document No. 管理No.	-	FC135_D_0001



⑦	Terminal 端子 (外部電極)	
⑥	Package パッケージ	
⑤	Lid キャップ	
④	Sealing 封止材	
③	Crystal chip 水晶片	
②	Sealing 封止材	
①	Crystal Adhesive 水晶接着	
No.	Name of Part 部品名	

RELIABILITY TEST DATA

Product Name : FC-135

The Company evaluation condition

We evaluate environmental and mechanical characteristics by the following test condition . No. F-C-0102-04-007EMH

No.	ITEM	TEST CONDITIONS	VALUE *1 *2		TEST	FAIL
			$\Delta f / f$ [1×10^{-6}]		Qty [n]	Qty [n]
1	Shock	100 g dummy (Epson Toyocom Standard) drop from 1 500 mm height on to the concrete 3 directions 10 times	*3	± 8	22	0
2	Vibration	10 Hz to 55 Hz amplitude 0.75 mm 55 Hz to 500 Hz acceleration 98 m/s ² 10 Hz → 500 Hz → 10 Hz 15 min / cycle 6 h (2 h × 3 directions)	*3	± 3	22	0
3	Resistance to soldering heat	For air reflow soldering furnace (2 times)		± 5	22	0
4	High temperature storage	a) +125℃ × 1 000 h b) +85 ℃ × 1 000 h	*3 *3	a) ± 10 b) ± 7	a) 22 b) 22	a) 0 b) 0
5	Low temperature storage	-55 ℃ × 1 000 h	*3	± 10	22	0
6	Temperature humidity storage	+85 ℃ × 85 %RH × 1 000 h	*3	± 10	22	0
7	Temperature cycle	-55 ℃ ⇔ +125 ℃ 30 min at each temp. 100 cycles	*3	± 10	22	0
8	Sealing	For He leak detector	*3	1×10^{-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 : $0.5 \mu\text{W}$

*3 Pre conditionings 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 $\pm 15 \text{ k}\Omega$.

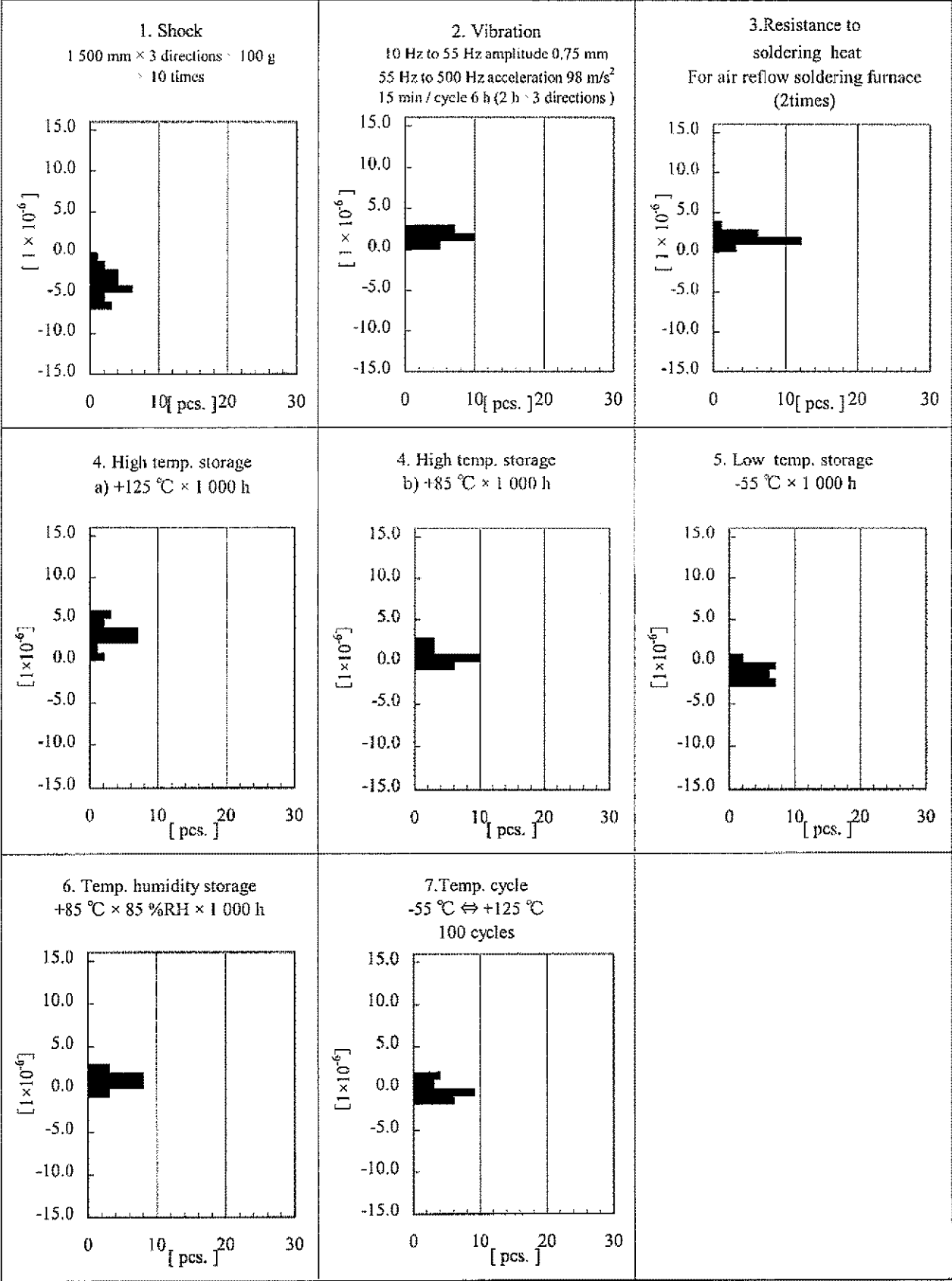
In case high temperature storage($+125^\circ\text{C} \times 1\,000 \text{ h}$), Soldering heat resistance, shift of series resistance at before and after the test should be less than $\pm 30\%$ or $\pm 20 \text{ k}\Omega$.

Qualification Data

Product Name : FC-135

$\Delta f/f$

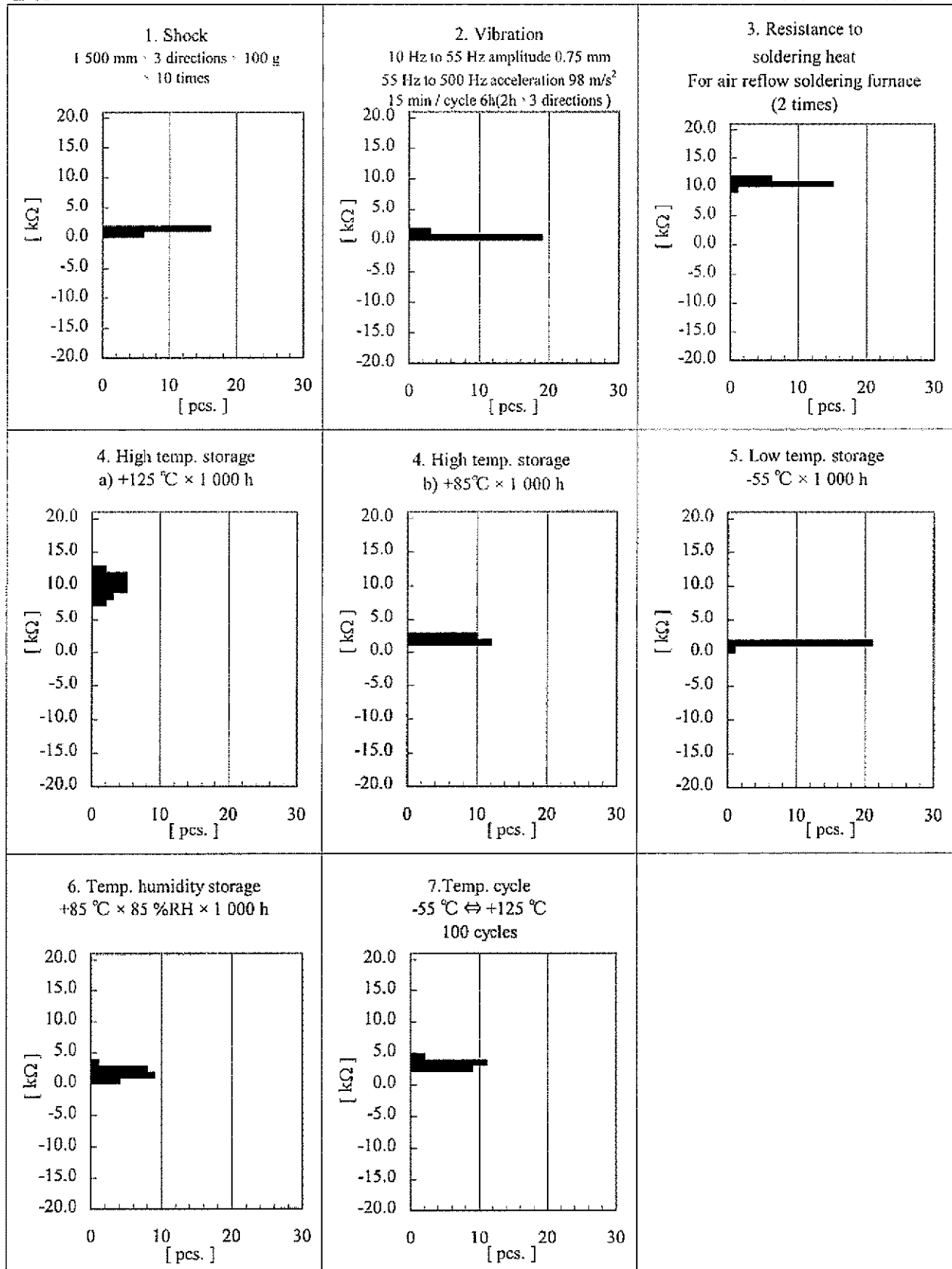
No. F-C-0102-04-008EMH



Product Name : FC-135

Δ CI

No. F-C-0102-04-009EMH



Certificate of Compliance

We certify that the product listed below is in compliance with the Directive 2011/65/EU and (EU)2015/863 of the European Parliament, and of the Council on the restriction of the use of certain hazardous substances in electrical and electronics equipment. (1 July 2011, RoHS Directive)

Product model	Exemption
FC-135	This product contains Lead (Pb) exempted under Exemption No. 7(c)-I .

The restricted substances referred to in the RoHS Directives (EU) 2015/863 are as listed below.

Substance	Maximum concentration values tolerated by weight in homogeneous materials.
Lead (Pb)	0.1% (1000 ppm)
Mercury (Hg)	0.1% (1000 ppm)
Cadmium (Cd)	0.01% (100 ppm)
Hexavalent chromium (Cr 6+)	0.1% (1000 ppm)
Polybrominated biphenyls (PBB)	0.1% (1000 ppm)
Polybrominated diphenyl ethers (PBDE)	0.1% (1000 ppm)
Bis(2-ethylhexyl) phthalate (DEHP)	0.1% (1000 ppm)
Butyl benzyl phthalate (BBP)	0.1% (1000 ppm)
Dibutyl phthalate (DBP)	0.1% (1000 ppm)
Diisobutyl phthalate (DIBP)	0.1% (1000 ppm)

Company name: SEIKO EPSON CORPORATION

Company Address: 8548 Nakaminowa, Minowa-machi, Kamiina-gun,
Nagano-ken, 399-4696 JAPAN

Signature: 大橋 浩朗

Name(Title): Hiroaki Ohashi
(General Manager / TD CS Quality Assurance Department)

Issue Date: May 6, 2019

Information on substances of Very High Concern in our products

In the following product, the content of the Substances of Very High Concern (SVHC) included on the candidate list according to articles 59 (1,10) of EC Regulation Number 1907/2006 ("REACH") is as follows.

Product model	Candidate List Effective Date	Number of SVHC
FC-135	June 25, 2020	209

This product contains SVHC in a concentration above 0.1% weight by weight.

Substance Name	CAS No.
Lead titanium trioxide	12060-00-3

Company name: SEIKO EPSON CORPORATION

Company Address: 8548 Nakaminowa, Minowa-machi, Kamiina-gun,
Nagano-ken, 399-4696 JAPAN

Signature:

大橋 浩朗

Name(Title):

Hiroaki Ohashi
(General Manager/ TD CS Quality Assurance Department)

Issue Date:

July 2, 2020