

**Chip EMIFIL LC Combined Type for Large Current  
for Consumer equipment & Industrial equipment  
NFE31PT□□□1E9□ REFERENCE SPECIFICATION**

**1. Scope**

This reference specification applies to Chip EMIFIL LC Combined Type for Large Current NFE31P Series.

**1.1 Specific applications:**

- Power equipment: Products that can be used in power equipment such as renewable energy equipment, energy storage equipment and EV charging equipment and whose functions are not directly related to the protection of human life and property.
- Industrial equipment: Products that can be used in industrial equipment such as base stations, manufacturing equipment, industrial robotics equipment, and measurement equipment, and whose functions do not directly relate to the protection of human life and property.
- Medical equipment (GHTF Class C) \*Except for implant/surgery/auto injector: Products that can be used for medical equipment of Class C of the international classification class GHTF and whose malfunction is considered to pose a relatively high risk to the human body.
- Medical equipment (GHTF Class A and B): Products that can be used for medical equipment regulated by Class A and Class B of the international classification class GHTF and whose functions do not directly relate to the protection of human life and property.
- Consumer equipment: Products that can be used in consumer equipment such as home appliances, audio/visual equipment, communication equipment, information equipment, office equipment, and household robotics, and whose functions are not directly related to the protection of human life and property.

**1.2 Unsuitable application:**

Applications listed in "Limitation of applications" in this reference specification.

WE DISCLAIM ANY LOSS AND DAMAGES ARISING FROM OR IN CONNECTION WITH THE PRODUCTS INCLUDING BUT NOT LIMITED TO THE CASE SUCH LOSS AND DAMAGES CAUSED BY THE UNEXPECTED ACCIDENT, IN EVENT THAT THE PRODUCT IS APPLIED FOR THE PURPOSE WHICH IS SPECIFIED ABOVE AS THE UNSUITABLE APPLICATION FOR THE PRODUCT.

**2. Part Numbering**

NF	E	31	PT	220	R	1E	9	L
Product ID	Structure	Dimension (L × W)	Features	Capacitance	Characteristics	Rated Voltage	Electrode	Packaging Code
								(L: Taping / B: Bulk)

**3. Rating**

Customer Part Number	Murata Part Number	Capacitance	Rated Voltage	Withstanding Voltage	Rated Current	Insulation Resistance
	NFE31PT220R1E9L NFE31PT220R1E9B	22pF ± 30%	25 V (DC)	62.5 V (DC)	6 A (DC)	1000 MΩ min.
	NFE31PT470C1E9L NFE31PT470C1E9B	47pF ± $\begin{smallmatrix} 50 \\ 20 \end{smallmatrix}$ %				
	NFE31PT101C1E9L NFE31PT101C1E9B	100pF ± $\begin{smallmatrix} 80 \\ 20 \end{smallmatrix}$ %				
	NFE31PT221D1E9L NFE31PT221D1E9B	220pF ± $\begin{smallmatrix} 50 \\ 20 \end{smallmatrix}$ %				
	NFE31PT471F1E9L NFE31PT471F1E9B	470pF ± $\begin{smallmatrix} 50 \\ 20 \end{smallmatrix}$ %				
	NFE31PT152Z1E9L NFE31PT152Z1E9B	1500pF ± $\begin{smallmatrix} 50 \\ 20 \end{smallmatrix}$ %				
	NFE31PT222Z1E9L NFE31PT222Z1E9B	2200pF ± 50%				

• Operating Temperature: - 40 °C to + 85 °C

• Storage Temperature: - 55 °C to + 125 °C

### 4. Standard Testing Condition

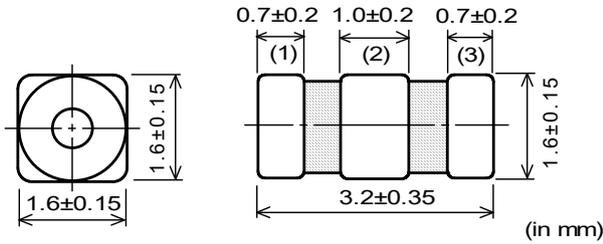
<Unless otherwise specified>

Temperature: Ordinary Temp. 15 °C to 35 °C  
 Humidity: Ordinary Humidity 25 %(RH) to 85 %(RH)

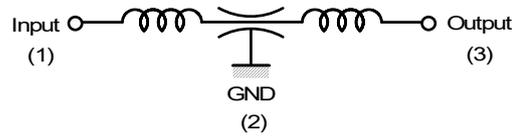
<In case of doubt>

Temperature: 20 °C ± 2 °C  
 Humidity: 60 %(RH) to 70 %(RH)  
 Atmospheric pressure: 86kPa to 106kPa

### 5. Style and Dimensions



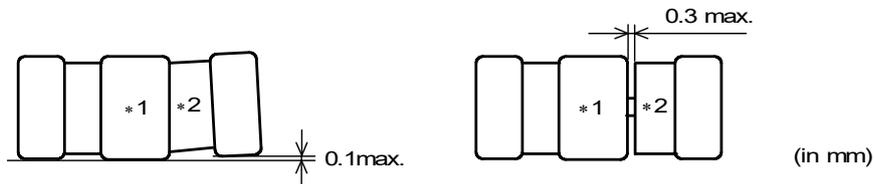
#### ■ Equivalent Circuit



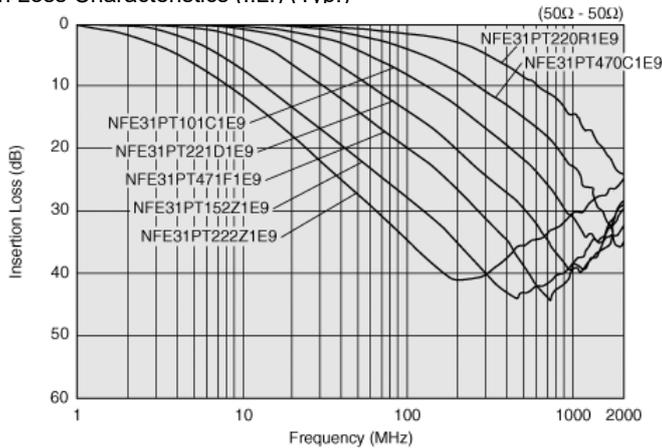
\*(1),(3):No Polarity

■ Unit Mass (Typical value)  
0.034g

Note : Gap and bend between ceramic capacitor(\*1) and ferrite bead(\*2) may come out as illustrated below, however, these are not affect the performance, mounting and reliability of the products.



#### ■ Insertion Loss Characteristics (I.L.) (Typ.)



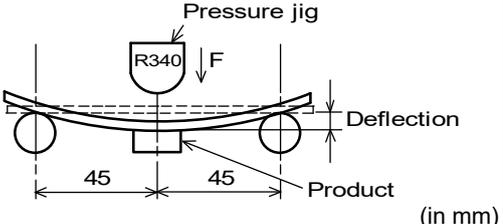
### 6. Marking

No marking

### 7. Electrical Performance

No.	Item	Specification	Test Method									
7.1	Capacitance	Meet item 3.	Table 1									
			<table border="1"> <thead> <tr> <th>Capacitance</th> <th>Voltage</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td>22 (pF)</td> <td>1 to 5 V(rms)</td> <td>1MHz ± 10%</td> </tr> <tr> <td>47,100,220,470 1500 (pF)</td> <td>1±0.2 V(rms)</td> <td>1kHz ± 10%</td> </tr> <tr> <td>2200 (pF)</td> <td>0.1 V(rms) max.</td> <td>1kHz ± 10%</td> </tr> </tbody> </table>	Capacitance	Voltage	Frequency	22 (pF)	1 to 5 V(rms)	1MHz ± 10%	47,100,220,470 1500 (pF)	1±0.2 V(rms)	1kHz ± 10%
Capacitance	Voltage	Frequency										
22 (pF)	1 to 5 V(rms)	1MHz ± 10%										
47,100,220,470 1500 (pF)	1±0.2 V(rms)	1kHz ± 10%										
2200 (pF)	0.1 V(rms) max.	1kHz ± 10%										
7.2	Insulation Resistance(I.R.)		Voltage : 25 V(DC) Time : 60±5 seconds									
7.3	Withstanding Voltage	Products shall not be damaged.	Test Voltage : 62.5 V(DC) Testing Time : 1 to 5 seconds Limit the charging current: 10mA max.									

## 8. Mechanical Performance

No.	Item	Specification	Test Method														
8.1	Appearance and Dimensions	Meet item 5.	Visual Inspection and measured with Slide Calipers, etc.														
8.2	Solderability	The electrodes shall be at least 75% covered with new solder coating.	Flux : Ethanol solution of rosin, 25(wt)% Pre-heat : 150 ± 10 °C, 60 ~ 90 s Solder : Sn-3.0Ag-0.5Cu Solder Temperature : 240 ± 3 °C Immersion Time : 3 ± 1 s Immersion and emersion rates : 25mm / s														
8.3	Resistance to soldering heat	Meet Table 2. <u>Table 2</u> <table border="1"> <thead> <tr> <th>Appearance</th> <th colspan="2">No damaged</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Cap. Change</td> <td>22,47,100 220 (pF)</td> <td>within ±15%</td> </tr> <tr> <td>470,1500 2200 (pF)</td> <td>within ±30%</td> </tr> <tr> <td>I.R.</td> <td colspan="2">meet item 3</td> </tr> <tr> <td>Withstanding Voltage</td> <td colspan="2">No damaged</td> </tr> </tbody> </table>	Appearance	No damaged		Cap. Change	22,47,100 220 (pF)	within ±15%	470,1500 2200 (pF)	within ±30%	I.R.	meet item 3		Withstanding Voltage	No damaged		Flux : Ethanol solution of rosin, 25(wt)% Pre-heat : 150 ± 10 °C, 60 ~ 90 s Solder : Sn-3.0Ag-0.5Cu Solder Temperature : 270 ± 5 °C (for NFE31PT152Z1E9□ : 250±5°C) Immersion Time : 10 ± 1 s Immersion and emersion rates : 25mm / s Then measured after exposure the room condition for 4 to 48 hours.
Appearance	No damaged																
Cap. Change	22,47,100 220 (pF)	within ±15%															
	470,1500 2200 (pF)	within ±30%															
I.R.	meet item 3																
Withstanding Voltage	No damaged																
8.4	Bending Strength	Meet Table 3. <u>Table 3</u> <table border="1"> <thead> <tr> <th>Appearance</th> <th colspan="2">No damaged</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Cap. Change</td> <td>22,47,100 220 (pF)</td> <td>within ±15%</td> </tr> <tr> <td>470,1500 2200 (pF)</td> <td>within ±30%</td> </tr> </tbody> </table>	Appearance	No damaged		Cap. Change	22,47,100 220 (pF)	within ±15%	470,1500 2200 (pF)	within ±30%	It shall be soldered on the paper-phenol substrate. (t=1.6mm)  Deflection : 3 mm Keeping Time : 30 seconds						
Appearance	No damaged																
Cap. Change	22,47,100 220 (pF)	within ±15%															
	470,1500 2200 (pF)	within ±30%															

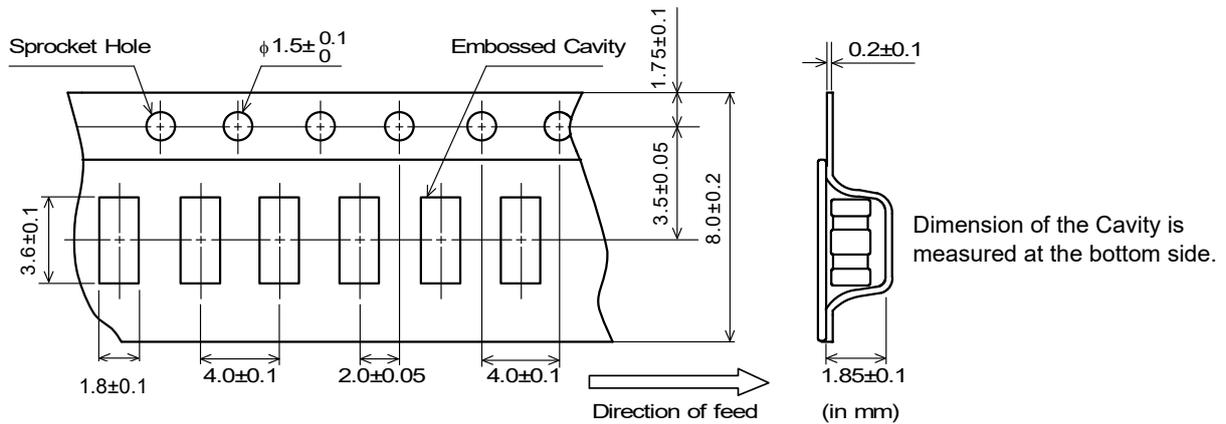
## 9. Environment Performance (It shall be soldered on the substrate.)

No.	Item	Specification	Test Method														
9.1	Humidity	Meet Table 4. <u>Table 4</u> <table border="1"> <thead> <tr> <th>Appearance</th> <th colspan="2">No damaged</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Cap. Change</td> <td>22,47,100 220 (pF)</td> <td>within ±15%</td> </tr> <tr> <td>470,1500 2200 (pF)</td> <td>within ±30%</td> </tr> <tr> <td>I.R.</td> <td colspan="2">100 MΩ min.</td> </tr> <tr> <td>Withstanding Voltage</td> <td colspan="2">No damaged</td> </tr> </tbody> </table>	Appearance	No damaged		Cap. Change	22,47,100 220 (pF)	within ±15%	470,1500 2200 (pF)	within ±30%	I.R.	100 MΩ min.		Withstanding Voltage	No damaged		Temperature : 40 ± 2 °C Humidity : 90 to 95 %(RH) Time : 500 h (+ 24h , - 0h) Then measured after exposure in the room condition for 4 to 48 hours.
Appearance	No damaged																
Cap. Change	22,47,100 220 (pF)	within ±15%															
	470,1500 2200 (pF)	within ±30%															
I.R.	100 MΩ min.																
Withstanding Voltage	No damaged																
9.2	Heat Life	<table border="1"> <thead> <tr> <th>Appearance</th> <th colspan="2">No damaged</th> </tr> </thead> <tbody> <tr> <td rowspan="2">Cap. Change</td> <td>22,47,100 220 (pF)</td> <td>within ±15%</td> </tr> <tr> <td>470,1500 2200 (pF)</td> <td>within ±30%</td> </tr> <tr> <td>I.R.</td> <td colspan="2">100 MΩ min.</td> </tr> <tr> <td>Withstanding Voltage</td> <td colspan="2">No damaged</td> </tr> </tbody> </table>	Appearance	No damaged		Cap. Change	22,47,100 220 (pF)	within ±15%	470,1500 2200 (pF)	within ±30%	I.R.	100 MΩ min.		Withstanding Voltage	No damaged		Temperature : 85 ± 2 °C Test Voltage : 22,47,100,220(pF) : Rated Voltage × 200 % 470,1500,2200(pF) : Rated Voltage × 150 % Time : 1000 h (+ 48h , - 0h) Then measured after exposure in the room condition for 4 to 48 hours.
Appearance	No damaged																
Cap. Change	22,47,100 220 (pF)	within ±15%															
	470,1500 2200 (pF)	within ±30%															
I.R.	100 MΩ min.																
Withstanding Voltage	No damaged																

No.	Item	Specification	Test Method
9.3	Temperature Cycling	Meet Table 2.	1 Cycle 1 step: -55 °C (+ 0°C , - 3°C) / 30 ± 3 min 2 step: Room Temperature / within 5 min 3 step: +125 °C (+ 3°C , - 0°C) / 30 ± 3 min 4 step: Room Temperature / within 5 min Total of 10 cycles Then measured after exposure in the room condition for 4 to 48 hours.

**10. Specification of Packaging**

10.1. Appearance and Dimensions (8mm-wide plastic tape)



10.2. Specification of Taping

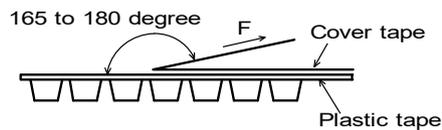
- (1) Packing quantity (standard quantity)  
2000 pcs. / reel
- (2) Packing Method  
Products shall be packaged in the cavity of the plastic tape and sealed with cover tape.
- (3) Sprocket Hole  
The sprocket holes are to the right as the tape is pulled toward the user.
- (4) Spliced point  
The cover tape have no spliced point.
- (5) Missing components number  
Missing components number within 0.1% of the number per reel or 1 pc., whichever is greater, and are not continuous. The specified quantity per reel is kept.

10.3. Pull Strength of Plastic Tape and Cover Tape

Plastic tape	5N min.
Cover tape	10N min.

10.4. Peeling off force of cover tape

- 0.2N to 0.7N (minimum value is typical)
- \* Speed of Peeling off : 300 mm / min



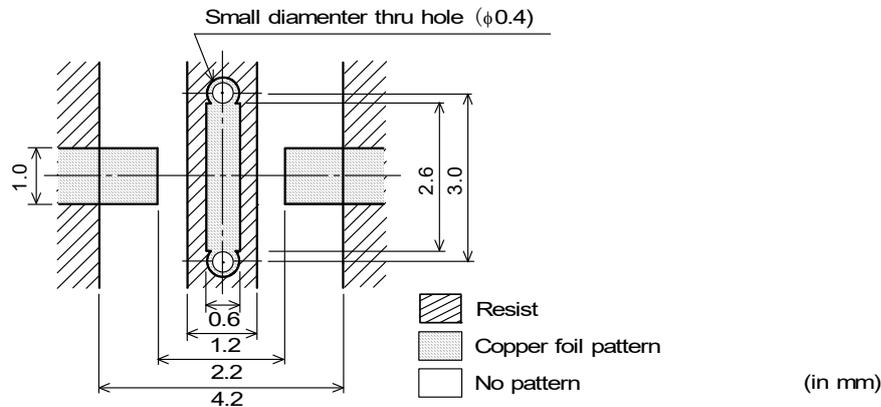


**11. Standard Land Dimensions**

The chip EMI filter suppresses noise by conducting the high-frequency noise element to ground. Therefore, to get enough noise reduction, feed through holes which is connected to ground-plane should be arranged according to figure to reinforce the ground-pattern.

(Standard land dimensions for reflow)

-Side on which chips are mounted

**12. ⚠ Caution****12.1 Limitation of applications**

The products listed in the reference specification (hereinafter the product(s) is called as the "Product(s)") are designed and manufactured for applications specified in the reference specification (hereinafter called as the "Specific Application").

We shall not warrant anything in connection with the Products including fitness, performance, adequateness, safety, or quality, in the case of applications listed in from (1) to (11) written at the end of this precautions, which may generally require high performance, function, quality, management of production or safety. Therefore, the Product shall be applied in compliance with the specific application.

WE DISCLAIM ANY LOSS AND DAMAGES ARISING FROM OR IN CONNECTION WITH THE PRODUCTS INCLUDING BUT NOT LIMITED TO THE CASE SUCH LOSS AND DAMAGES CAUSED BY THE UNEXPECTED ACCIDENT, IN EVENT THAT (i) THE PRODUCT IS APPLIED FOR THE PURPOSE WHICH IS NOT SPECIFIED AS THE SPECIFIC APPLICATION FOR THE PRODUCT, AND/OR (ii) THE PRODUCT IS APPLIED FOR ANY FOLLOWING APPLICATION PURPOSES FROM (1) TO (11) (EXCEPT THAT SUCH APPLICATION PURPOSE IS UNAMBIGUOUSLY SPECIFIED AS SPECIFIC APPLICATION FOR THE PRODUCT IN OUR CATALOG SPECIFICATION FORMS, DATASHEETS, OR OTHER DOCUMENTS OFFICIALLY ISSUED BY US\*).

- (1) Aircraft equipment
- (2) Aerospace equipment
- (3) Undersea equipment
- (4) Power plant control equipment
- (5) Medical equipment
- (6) Transportation equipment
- (7) Traffic control equipment
- (8) Disaster prevention/security equipment
- (9) Industrial data-processing equipment
- (10) Combustion/explosion control equipment
- (11) Equipment with complexity and/or required reliability equivalent to the applications listed in the above.

For exploring information of the Products which will be compatible with the particular purpose other than those specified in the reference specification, please contact our sales offices, distribution agents, or trading companies with which you make a deal, or via our web contact form.

Contact form: <https://www.murata.com/contactform>

\* We may design and manufacture particular Products for applications listed in (1) to (11). Provided that, in such case we shall unambiguously specify such Specific Application in the reference specification without any exception. Therefore, any other documents and/or performances, whether exist or non-exist, shall not be deemed as the evidence to imply that we accept the applications listed in (1) to (11).

12.2. Corrosive gas

Please refrain from use since contact with environments with corrosive gases (sulfur gas [hydrogen sulfide, sulfur dioxide, etc.], chlorine, ammonia, etc.) or oils (cutting oil, silicone oil, etc.) that have come into contact with the previously stated corrosive gas environment will result in deterioration of product quality or an open from deterioration due to corrosion of product electrode, etc. We will not bear any responsibility for use under these environments.

13. Notice

- Products can only be soldered with reflow.
- If it were soldered with flow, cracks might be caused in the ceramic body.
- This product is designed for solder mounting.
- Please consult us in advance for applying other mounting method such as conductive adhesive.

13.1. Flux and Solder

Flux	Use rosin-based flux, Do not use highly acidic flux (with chlorine content exceeding 0.2(wt)%). Do not use water-soluble flux.
Solder	Use Sn-3.0Ag-0.5Cu solder

13.2. Note for Assembling

< Thermal Shock >

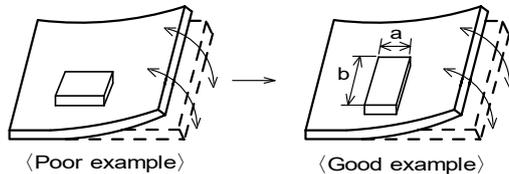
Pre-heating should be in such a way that the temperature difference between solder and products surface is limited to 100 °C max. Also cooling into solvent after soldering should be in such a way that the temperature difference is limited to 100°C max.

13.3. Attention Regarding P.C.B. Bending

The following shall be considered when designing P.C.B.'s and laying out products.

- (1) P.C.B. shall be designed so that products are not subject to the mechanical stress for board warpage.

[Products direction]



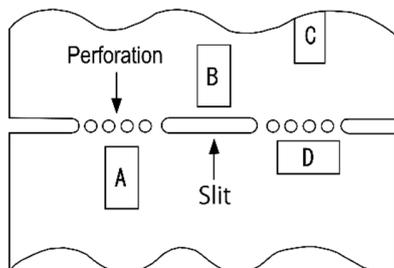
Products shall be located in the sideways direction (Length:a<b) to the mechanical stress.

- (2) Components location on P.C.B. separation.

It is effective to implement the following measures, to reduce stress in separating the board.

It is best to implement all of the following three measures; however, implement as many measures as possible to reduce stress.

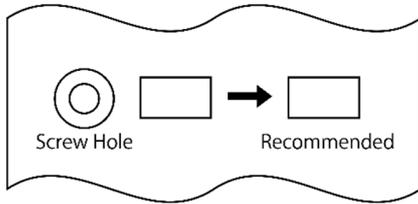
Contents of Measures	Stress Level
(1) Turn the mounting direction of the component parallel to the board separation surface.	A > D *1
(2) Add slits in the board separation part.	A > B
(3) Keep the mounting position of the component away from the board separation surface.	A > C



\*1 A > D is valid when stress is added vertically to the perforation as with Hand Separation. If a Cutting Disc is used, stress will be diagonal to the PCB, therefore A > D is invalid.

(3) Mounting Components Near Screw Holes

When a component is mounted near a screw hole, it may be affected by the board deflection that occurs during the tightening of the screw. Mount the component in a position as far away from the screw holes as possible.

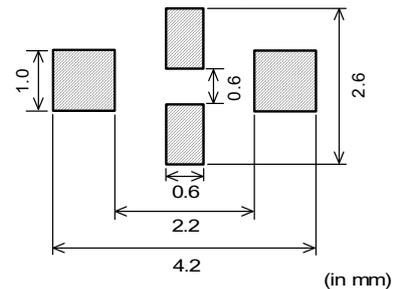


13.4. Reflow Soldering

• Standard printing pattern of solder paste.

(1) Solder paste printing for reflow

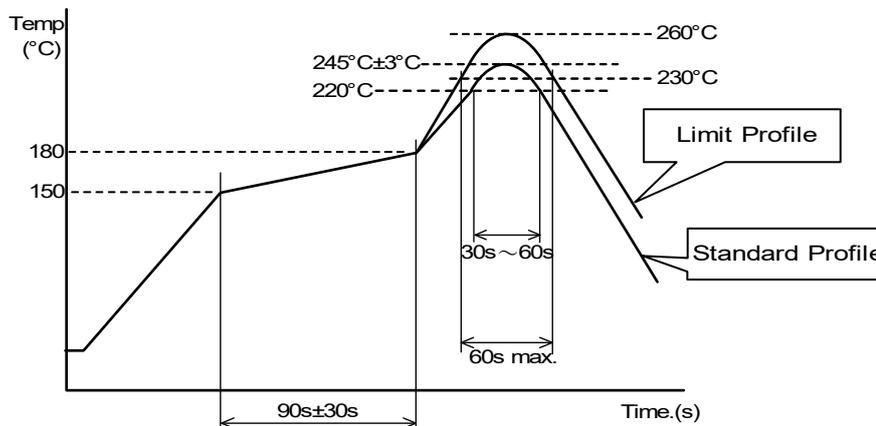
- Standard thickness of the solder paste should be 150µm to 200µm.
- Use the solder cream printing pattern of the right pattern.
- For the resist and copper foil pattern, use standard land dimensions.



(2) Soldering Conditions

Standard soldering profile and the limit soldering profile is as follows.

The excessive soldering conditions may cause leaching of the electrode and/or resulting in the deterioration of product quality.



	Standard Profile	Limit Profile
Pre-heating	150°C ~ 180°C , 90s ± 30s	
Heating	above 220°C , 30s ~ 60s	above 230°C , 60s max.
Peak temperature	245°C ± 3°C	260°C , 10s
Cycle of reflow	2 times	2 times

13.5. Reworking with Soldering iron

The following conditions shall be strictly followed when using a soldering iron.

- Pre-heating: 150°C, 1 min
- Soldering iron output: 30W max.
- Tip temperature/ Soldering time: 350°C max. / 3(+1,-0) s (NFE31PT152Z1E9: 280 °C max. / 10 s max. )
- Tip diameter: φ3mm max.
- Times: 2times max.

Note: Do not directly touch the products with the tip of the soldering iron in order to prevent the crack on the ceramic material due to the thermal shock.

**13.6. Cleaning Conditions**

Products shall be cleaned on the following conditions.

- (1) Cleaning temperature shall be limited to 60 °C max. (40° C max. for IPA.)
- (2) Ultrasonic cleaning shall comply with the following conditions, with avoiding the resonance phenomenon at the mounted products and P.C.B.  
Power: 20W / l max.      Frequency: 28kHz to 40kHz      Time: 5 minutes max.
- (3) Cleaner
  1. Cleaner
    - Isopropyl alcohol (IPA)
  2. Aqueous agent
    - PINE ALPHA ST-100S
- (4) There shall be no residual flux and residual cleaner after cleaning.  
In the case of using aqueous agent, products shall be dried completely after rinse with de-ionized water in order to remove the cleaner.
- (5) Other cleaning  
Please contact us.

**13.7. Operating Environment**

Do not use this product under the following environmental conditions, on deterioration of the performance, such as insulation resistance may result from the use.

- (1) in the corrodible atmosphere (acidic gases, alkaline gases, chlorine, sulfur gases, organic gases and etc.)
- (2) in the atmosphere where liquid such as organic solvent, may splash on the products.

**13.8. Resin coating**

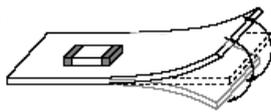
It may affect on the product's performance when using resin for coating / molding products. So please pay your careful attention in selecting resin. In prior to use, please make the reliability evaluation with the product mounted in your application set.

**13.9. Handling of a substrate**

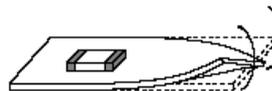
After mounting products on a substrate, do not apply any stress to the product caused by bending or twisting to the substrate when cropping the substrate, inserting and removing a connector from the substrate or tightening screw to the substrate.

Excessive mechanical stress may cause cracking in the product.

Bending



Twisting

**13.10. Storage condition****(1) Storage period**

Use the products within 12 months after delivered.

Solderability should be checked if this period is exceeded.

**(2) Storage environment condition**

- Products should be storage in the warehouse on the following conditions.

Temperature : -10 °C to +40 °C

Humidity : 15% to 85% relative humidity      No rapid change on temperature and humidity

- Don't keep products in corrosive gases such as sulfur, chlorine gas or acid, or it may cause oxidization of electrode, resulting in poor solderability.
- Products should be stored on the palette for the prevention of the influence from humidity, dust and so on.
- Products should be stored in the warehouse without heat shock, vibration, direct sunlight and so on.
- Avoid storing the product by itself bare (i.e.exposed directly to air).

**(3) Delivery**

Care should be taken when transporting or handling product to avoid excessive vibration or mechanical shock.

**14.  Notes**

- (1) Please make sure that your product has been evaluated in view of your specifications with our product being mounted to your product.
- (2) You are requested not to use our product deviating from the reference specifications.
- (3) The contents of this reference specification are subject to change without advance notice. Please approve our product specifications or transact the approval sheet for product specifications before ordering.