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Reference Only

Spec No. JELF243C-9101C-01

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CHIP COIL (CHIP INDUCTORS) LQP03TN□□□□Z2D
Murata Standard Reference Specification 【AEC-Q200】

1.Scope

This reference specification applies to Chip coil (Chip Inductors) LQP03TN_Z2 Series for automotive Electronics based on AEC-Q200 except for Power train and Safety.

2.Part Numbering

(ex) LQ P 03 T N 68N J Z 2 D
 Product ID Structure Dimension Applications Category Inductance Tolerance Features Electrode Packaging
 (L × W) and Characteristics D:Taping

3.Rating

- Operating Temperature Range. -55°C to +125°C
 (Ambient temperature: Rated current can be handled in this temperature range.)
- Storage Temperature Range. -55°C to +125°C

Customer Part Number	MURATA Part Number	Inductance		Q (min)	DC Resistance (Ωmax)	Self Resonant Frequency (MHz)		Rated Current (mA)	ESD Rank 1C: 1kV
		(nH)	Tolerance			Min.	*Typ.		
	LQP03TN0N6BZ2D	0.6			0.07	20000		850	
	LQP03TN0N6CZ2D								
	LQP03TN0N7BZ2D	0.7			0.08			800	
	LQP03TN0N7CZ2D								
	LQP03TN0N8BZ2D	0.8				18000			
	LQP03TN0N8CZ2D								
	LQP03TN0N9BZ2D	0.9					20000		
	LQP03TN0N9CZ2D								
	LQP03TN1N0BZ2D	1.0			0.10			750	
	LQP03TN1N0CZ2D								
	LQP03TN1N1BZ2D	1.1				17000			
	LQP03TN1N1CZ2D								
	LQP03TN1N2BZ2D	1.2							
	LQP03TN1N2CZ2D								
	LQP03TN1N3BZ2D	1.3							
	LQP03TN1N3CZ2D								
	LQP03TN1N4BZ2D	1.4				16000	19600		
	LQP03TN1N4CZ2D								
	LQP03TN1N5BZ2D	1.5	B:±0.1nH C:±0.2nH	14			17900		
	LQP03TN1N5CZ2D								
	LQP03TN1N6BZ2D	1.6			0.15	15000	20000		
	LQP03TN1N6CZ2D								
	LQP03TN1N7BZ2D	1.7					19100	600	
	LQP03TN1N7CZ2D								
	LQP03TN1N8BZ2D	1.8					17700		
	LQP03TN1N8CZ2D								
	LQP03TN1N9BZ2D	1.9					15100		
	LQP03TN1N9CZ2D								
	LQP03TN2N0BZ2D	2.0				12500	14800		
	LQP03TN2N0CZ2D								
	LQP03TN2N1BZ2D	2.1					13900		
	LQP03TN2N1CZ2D								
	LQP03TN2N2BZ2D	2.2				11000	13400		
	LQP03TN2N2CZ2D								
	LQP03TN2N3BZ2D	2.3					12900	500	
	LQP03TN2N3CZ2D								
	LQP03TN2N4BZ2D	2.4					12200		
	LQP03TN2N4CZ2D								

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Customer Part Number	MURATA Part Number	Inductance		Q (min)	DC Resistance (Ω max)	Self Resonant Frequency (MHz)		Rated Current (mA)	ESD Rank 1C: 1kV			
		(nH)	Tolerance			Min.	*Typ.					
	LQP03TN2N5BZ2D	2.5	B:±0.1nH C:±0.2nH	14	0.20	10000	12200	500	1C			
	LQP03TN2N5CZ2D											
	LQP03TN2N6BZ2D											
	LQP03TN2N6CZ2D	2.6								10000	13300	
	LQP03TN2N7BZ2D											
	LQP03TN2N7CZ2D	2.7								9500	13000	
	LQP03TN2N8BZ2D											
	LQP03TN2N8CZ2D	2.8								8000	11800	
	LQP03TN2N9BZ2D											
	LQP03TN2N9CZ2D	2.9								7000	12400	
	LQP03TN3N0BZ2D											
	LQP03TN3N0CZ2D	3.0			6000	11900						
	LQP03TN3N1BZ2D											
	LQP03TN3N1CZ2D	3.1			5300	11300						
	LQP03TN3N2BZ2D											
	LQP03TN3N2CZ2D	3.2			4000	10600						
	LQP03TN3N3BZ2D											
	LQP03TN3N3CZ2D	3.3			3000	10900						
	LQP03TN3N4BZ2D											
	LQP03TN3N4CZ2D	3.4			2000	9400						
	LQP03TN3N5BZ2D											
	LQP03TN3N5CZ2D	3.5			1500	9600						
	LQP03TN3N6BZ2D											
	LQP03TN3N6CZ2D	3.6			1000	9500						
	LQP03TN3N7BZ2D											
	LQP03TN3N7CZ2D	3.7			800	8200						
	LQP03TN3N8BZ2D											
	LQP03TN3N8CZ2D	3.8			600	8100						
	LQP03TN3N9BZ2D											
	LQP03TN3N9CZ2D	3.9			500	7900						
	LQP03TN4N0BZ2D											
	LQP03TN4N0CZ2D	4.0			400	8600						
	LQP03TN4N1BZ2D											
	LQP03TN4N1CZ2D	4.1			300	8400						
	LQP03TN4N2BZ2D											
	LQP03TN4N2CZ2D	4.2			200	8600						
	LQP03TN4N3HZ2D											
	LQP03TN4N3JZ2D	4.3			150	9800						
	LQP03TN4N7HZ2D											
	LQP03TN4N7JZ2D	4.7			100	4400						
	LQP03TN5N1HZ2D											
	LQP03TN5N1JZ2D	5.1			70	4200						
	LQP03TN5N6HZ2D											
	LQP03TN5N6JZ2D	5.6			50	8000						
	LQP03TN6N2HZ2D											
	LQP03TN6N2JZ2D	6.2			30	7900						
	LQP03TN6N8HZ2D											
	LQP03TN6N8JZ2D	6.8			20	3900						
	LQP03TN7N5HZ2D											
	LQP03TN7N5JZ2D	7.5			15	3700						
	LQP03TN8N2HZ2D											
	LQP03TN8N2JZ2D	8.2			10	3600						
	LQP03TN9N1HZ2D											
	LQP03TN9N1JZ2D	9.1			5	3300	5900	250				

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Customer Part Number	MURATA Part Number	Inductance		Q (min)	DC Resistance (Ω max)	Self Resonant Frequency (MHz)		Rated Current (mA)	ESD Rank 1C: 1kV
		(nH)	Tolerance			Min.	*Typ.		
	LQP03TN10NHZ2D	10	H:±3% J:±5%	14	0.70	3200	5800	250	1C
	LQP03TN10NJZ2D								
	LQP03TN11NHZ2D	11	H:±3% J:±5%	12	0.80	2900	5400	200	
	LQP03TN11NJZ2D								
	LQP03TN12NHZ2D	12	H:±3% J:±5%	9	0.70	2600	4300	150	
	LQP03TN12NJZ2D								
	LQP03TN13NHZ2D	13	H:±3% J:±5%	12	0.80	2200	3600	140	
	LQP03TN13NJZ2D								
	LQP03TN15NHZ2D	15	H:±3% J:±5%	12	0.70	2000	3800	120	
	LQP03TN15NJZ2D								
	LQP03TN16NHZ2D	16	H:±3% J:±5%	9	0.95	1700	3700	100	
	LQP03TN16NJZ2D								
	LQP03TN18NHZ2D	18	H:±3% J:±5%	12	0.80	1500	3400	100	
	LQP03TN18NJZ2D								
	LQP03TN20NHZ2D	20	H:±3% J:±5%	9	2.30	1300	3600	100	
	LQP03TN20NJZ2D								
	LQP03TN22NHZ2D	22	H:±3% J:±5%	12	1.90	1200	3300	100	
	LQP03TN22NJZ2D								
	LQP03TN24NHZ2D	24	H:±3% J:±5%	9	2.30	1000	3200	80	
	LQP03TN24NJZ2D								
	LQP03TN27NHZ2D	27	H:±3% J:±5%	12	2.30	900	2900	80	
	LQP03TN27NJZ2D								
	LQP03TN30NHZ2D	30	H:±3% J:±5%	9	2.95	1700	2700	100	
	LQP03TN30NJZ2D								
	LQP03TN33NHZ2D	33	H:±3% J:±5%	12	2.95	1500	2600	100	
	LQP03TN33NJZ2D								
	LQP03TN36NHZ2D	36	H:±3% J:±5%	9	3.00	1300	2400	100	
	LQP03TN36NJZ2D								
	LQP03TN39NHZ2D	39	H:±3% J:±5%	12	3.00	1200	2200	100	
	LQP03TN39NJZ2D								
	LQP03TN43NHZ2D	43	H:±3% J:±5%	9	3.60	1000	2000	100	
	LQP03TN43NJZ2D								
	LQP03TN47NHZ2D	47	H:±3% J:±5%	12	3.60	900	1400	80	
	LQP03TN47NJZ2D								
	LQP03TN51NHZ2D	51	H:±3% J:±5%	9	3.90	1200	2000	100	
	LQP03TN51NJZ2D								
	LQP03TN56NHZ2D	56	H:±3% J:±5%	12	3.90	1100	1800	80	
	LQP03TN56NJZ2D								
	LQP03TN62NHZ2D	62	H:±3% J:±5%	9	8	1000	1500	80	
	LQP03TN62NJZ2D								
	LQP03TN68NHZ2D	68	H:±3% J:±5%	12	8	1000	1400	80	
	LQP03TN68NJZ2D								
	LQP03TN75NJZ2D	75	H:±3% J:±5%	9	10	900	1300	80	
	LQP03TN75NHZ2D								
	LQP03TN82NHZ2D	82	H:±3% J:±5%	12	10	800	1100	80	
	LQP03TN82NJZ2D								
	LQP03TN91NHZ2D	91	H:±3% J:±5%	9	10	900	1300	80	
	LQP03TN91NJZ2D								
	LQP03TNR10HZ2D	100	H:±3% J:±5%	12	12	800	1100	80	
	LQP03TNR10JZ2D								
	LQP03TNR11HZ2D	110	H:±3% J:±5%	9	12	800	1100	80	
	LQP03TNR11JZ2D								
	LQP03TNR12HZ2D	120	H:±3% J:±5%	12	12	800	1100	80	
	LQP03TNR12JZ2D								

* Typical value is actual performance.

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4. Testing Conditions

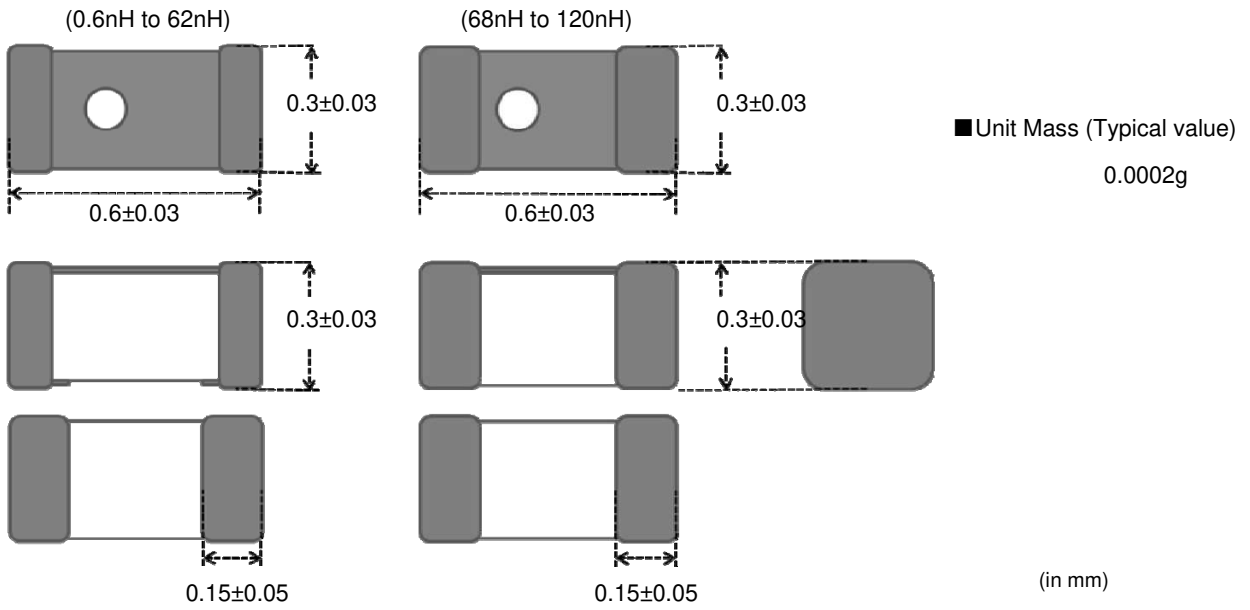
《Unless otherwise specified》

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

《In case of doubt》

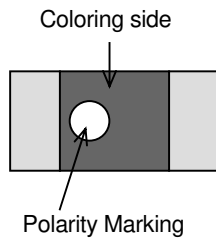
Temperature : 20°C ± 2°C
Humidity : 60%(RH) to 70 %(RH)
Atmospheric Pressure : 86kPa to 106 kPa

5. Appearance and Dimensions



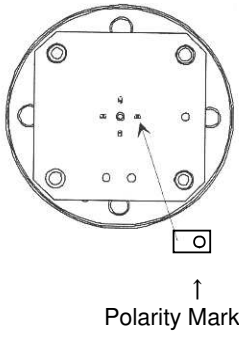
6. Marking

Polarity Marking :white



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7.Electrical Performance

No.	Item	Specification	Test Method
7.1	Inductance	Inductance shall meet item 3.	<p>Measuring Equipment: KEYSIGHT E4991A or equivalent</p> <p>Measuring Frequency: (0.6nH~30nH) 500MHz (33nH~120nH) 300MHz</p> <p>Measuring Condition: Test signal level / about 0dBm Electrical length / 10mm Weight / about 1N to 5N</p> <p>Measuring Fixture: KEYSIGHT 16197A Position coil under test as shown in below and contact coil with each terminal by adding weight. Coloring side should be a topside, and should be in the direction of the fixture for position of chip coil.</p>
7.2	Q	Q shall meet item 3.	<div style="text-align: center;">  <p>↑ Polarity Marking</p> </div> <p>Measuring Method:See P.12 <Electrical Performance:Measuring Method of Inductance/Q></p>
7.3	DC Resistance	DC Resistance shall meet item 3.	Measuring Equipment:Digital multi meter
7.4	Self Resonant Frequency(S.R.F)	S.R.F shall meet item 3.	Measuring Equipment: KEYSIGHT N5230A or equivalent
7.5	Rated Current	Self temperature rise shall be limited to 25°C max.	The rated current is applied.

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8.Q200 Requirement

8.1.Performance (based on Table 5 for Magnetics(Inductors / Transformer)

AEC-Q200 Rev.D issued June 1. 2010

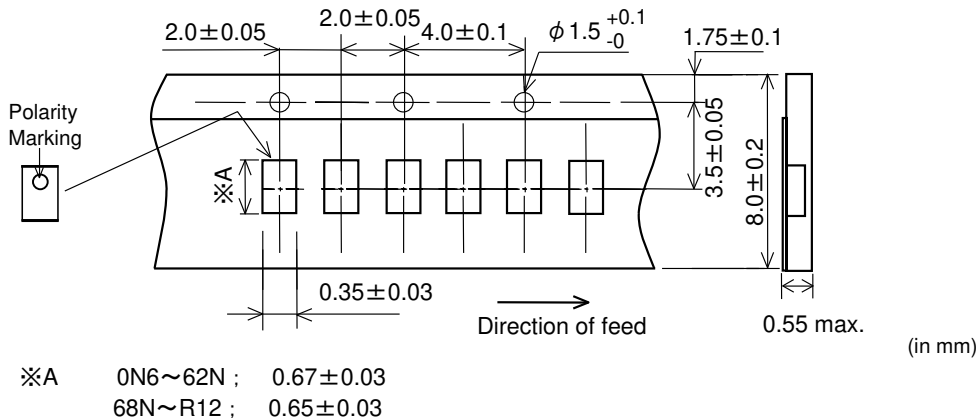
AEC-Q200			Murata Specification / Deviation	
No	Stress	Test Method		
3	High Temperature Exposure	1000hours at 125 deg C Set for 24hours at room temperature, then measured.	Meet Table A after testing.	
			Table A	
			Appearance	No damage
			Inductance 0.6nH~30nH (at 500MHz) 33nH~120nH (at 300MHz)	Within ±10%
			Substrate ; 6-layers FR-4	
4	Temperature Cycling	1000cycles -40 deg C to +125 deg C Set for 24hours at room temperature,then measured.	Meet Table A after testing. Substrate ; 6-layers FR-4	
7	Biased Humidity	1000hours at 85 deg C, 85%RH unpowered.	Meet Table A after testing. Substrate ; 6-layers FR-4	
8	Operational Life	Apply 125 deg C 1000hours Set for 24hours at room temperature, then measured	Meet Table A after testing. Substrate ; 6-layers FR-4	
9	External Visual	Visual inspection	No abnormalities	
10	Physical Dimension	Meet ITEM 4 (Style and Dimensions)	No defects	
12	Resistance to Solvents	Per MIL-STD-202 Method 215	Not Applicable	
13	Mechanical Shock	Per MIL-STD-202 Method 213 Condition F: 1500g's(14.7N)/0.5ms/Half sine	Meet Table A after testing.	
			Substrate ; 6-layers FR-4	
14	Vibration	5g's(0.049N) for 20 minutes, 12cycles each of 3 orientations Test from 10-2000Hz.	Meet Table A after testing.	
			Substrate ; 6-layers FR-4	

Reference Only

AEC-Q200			Murata Specification / Deviation				
No	Stress	Test Method					
15	Resistance to Soldering Heat	No-heating Solder temperature 260C +/- 5 deg C Immersion time 10s	Meet Table A after testing. Pre-heating 150C +/- 10 deg C, 60s to 90s				
17	ESD	Per AEC-Q200-002	ESD Rank: 1C (1KV~2KV) Substrate ; 6-layers FR-4				
18	Solderbility	Per J-STD-002	Method b : Not Applicable Pre-heating 150C +/- 10 deg C, 60s to 90s 90% of the terminations is to be soldered.				
19	Electrical Characterization	Measured : Inductance	No defects				
20	Flammability	Per UL-94	Not Applicable				
21	Board Flex	Epoxy-PCB(1.6mm_thickness) Deflection 2mm(min) Holding time 60s	Meet Table B after testing. Murata deviation request: Substrate ; Substrate ; FR-4(0.8mm_thickness) Holding time 30s Table B <table border="1" style="margin-left: auto; margin-right: auto; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Appearance</td> <td style="padding: 2px;">No damage</td> </tr> <tr> <td style="padding: 2px;">DC resistance</td> <td style="padding: 2px;">Within ±10%</td> </tr> </table>	Appearance	No damage	DC resistance	Within ±10%
Appearance	No damage						
DC resistance	Within ±10%						
22	Terminal Strength	Per AEC-Q200-006 A force of 17.7N for 60s	Murata Deviation Request: 2N/5s No defect Substrate ; Substrate ; 6-layers FR-4				

9.Specification of Packaging

9.1 Appearance and Dimensions of paper tape (8mm-wide)



Reference Only

9.2 Specification of Taping

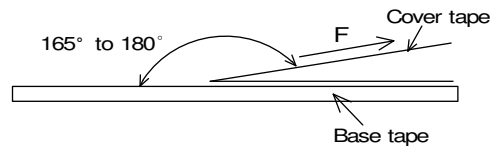
- (1) Packing quantity (standard quantity)
15,000 pcs. / reel
- (2) Packing Method
Products shall be packed in the cavity of the base tape and sealed by cover tape.
- (3) Sprocket hole
The sprocket holes are to the right as the tape is pulled toward the user.
- (4) Spliced point
Base tape and Cover tape has 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.

9.3 Pull Strength

Cover tape	5N min
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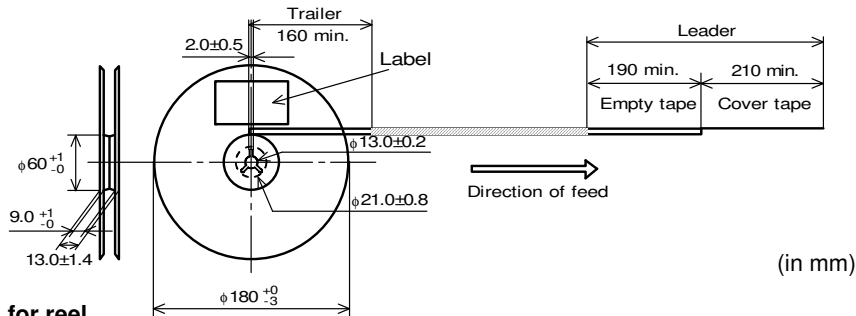
9.4 Peeling off force of cover tape

Speed of Peeling off	300mm/min
Peeling off force	0.1N to 0.6N (minimum value is typical)



9.5 Dimensions of Leader-tape, Trailer and Reel

There shall be leader-tape (top tape and empty tape) and trailer-tape (empty tape) as follows.



9.6 Marking for reel

Customer part number, MURATA part number, Inspection number(*1) , RoHS Marking (*2), Quantity etc ...

*1) <Expression of Inspection No.>

□□
OOOO
XXX
 (1) (2) (3)

(1) Factory Code

(2) Date

First digit : Year / Last digit of year

Second digit : Month / Jan. to Sep. → 1 to 9, Oct. to Dec. → O,N,D

Third, Fourth digit : Day

(3) Serial No.

*2) <Expression of RoHS Marking>

ROHS - Y (Δ)
 (1) (2)

(1) RoHS regulation conformity parts.

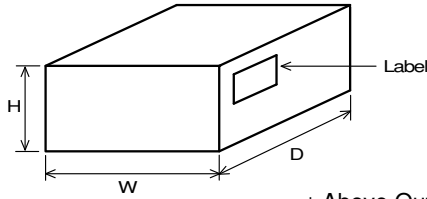
(2) MURATA classification number

9.7 Marking for Outside package (corrugated paper box)

Customer name, Purchasing order number, Customer part number, MURATA part number, RoHS Marking (*2) ,Quantity, etc ...

Reference Only

9.8 Specification of Outer Case



Outer Case Dimensions (mm)			Standard Reel Quantity in Outer Case (Reel)
W	D	H	
186	186	93	5

* Above Outer Case size is typical. It depends on a quantity of an order.

10. ⚠ Caution

Limitation of Applications

Please contact us before using our products for the applications listed below which require especially high reliability for the prevention of defects which might directly cause damage to the third party's life, body or property.

- | | |
|-----------------------------------|--|
| (1) Aircraft equipment | (6) Transportation equipment (trains, ships, etc.) |
| (2) Aerospace equipment | (7) Traffic signal equipment |
| (3) Undersea equipment | (8) Disaster prevention / crime prevention equipment |
| (4) Power plant control equipment | (9) Data-processing equipment |
| (5) Medical equipment | (10) Applications of similar complexity and / or reliability requirements to the applications listed in the above. |

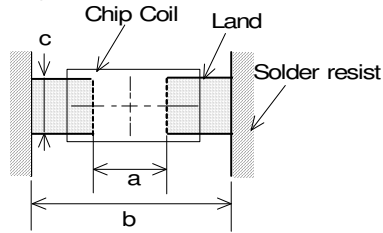
11. Notice

Products can only be soldered with reflow.

This product is designed for solder mounting.

Please consult us in advance for applying other mounting method such as conductive adhesive.

11.1 Land pattern designing



a	0.2~0.3
b	0.8~0.9
c	0.2~0.3

(in mm)

11.2 Flux, Solder

- Use rosin-based flux.
Don't use highly acidic flux with halide content exceeding 0.2(wt)% (chlorine conversion value).
Don't use water-soluble flux.
- Use Sn-3.0Ag-0.5Cu solder.
- Standard thickness of solder paste :60 μm~100 μm.

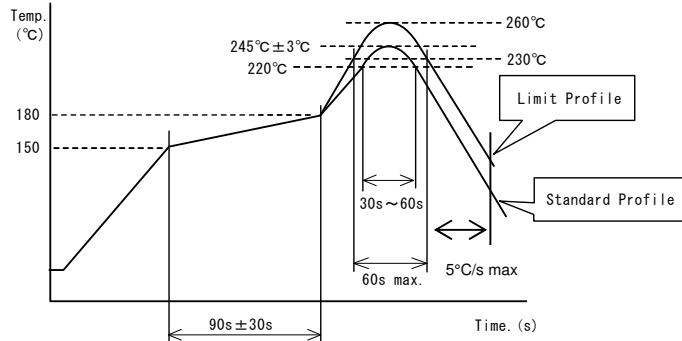
11.3 Reflow soldering conditions

- Pre-heating should be in such a way that the temperature difference between solder and product surface is limited to 150°C max.

Insufficient pre-heating may cause cracks on the product, resulting in the deterioration of products quality.

- Standard soldering profile and the limit soldering profile is as follows.
The excessive limit soldering conditions may cause leaching of the electrode and / or resulting in the deterioration of product quality.

• Reflow soldering profile



	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
Cooling rate	5°C/s max	

11.4 Reworking with soldering iron

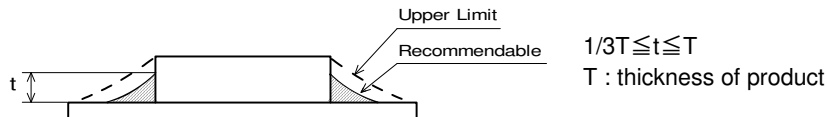
The following conditions must be strictly followed when using a soldering iron.

Pre-heating	150°C, 1 min
Tip temperature	350°C max.
Soldering iron output	80W max.
Tip diameter	φ8mm max.
Soldering time	3(+1, -0)s
Time	2 times

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

11.5 Solder Volume

• Solder shall be used not to be exceeded the upper limits as shown below.



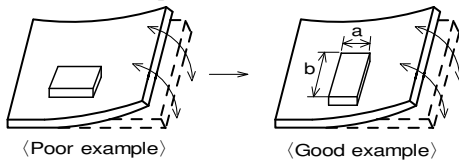
Accordingly increasing the solder volume, the mechanical stress to Chip is also increased. Exceeding solder volume may cause the failure of mechanical or electrical performance.

11.6 Attention regarding P.C.B. bending

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

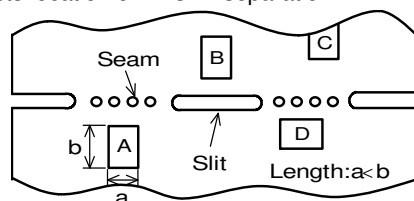
- (1) P.C.B. shall be designed so that products are not subject to the mechanical stress due to warping the board.

[Products direction]



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

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



Products (A,B,C,D) shall be located carefully so that products are not subject to the mechanical stress due to warping the board. Because they may be subjected the mechanical stress in order of $A > C > B \cong D$.

11.7 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 : 20 W / l max. Frequency : 28kHz to 40kHz Time : 5 min max.
- (3) Cleaner
 1. Alcohol type 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.

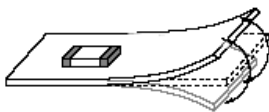
11.8 Resin coating

When products are coated with resin, please contact us in advance.

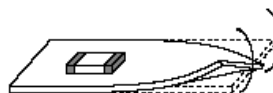
11.9 Handling of a substrate

- (1) There is a possibility of chip cracking caused by PCB expansion/contraction with heat, because stress on a chip is different depending on PCB material and structure.
When the thermal expansion coefficient greatly differs between the board used for mounting and the chip, it will cause cracking of the chip due to the thermal expansion and contraction.
The chip is assumed to be mounted on the PCB of glass-epoxy material, and we don't test with other PCB material which has different thermal expansion coefficient from Glass-epoxy.
When other PCB materials are considered, please be sure to evaluate by yourself.
- (2) 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.
In case of the mounting on flexible PCB, there is a possibility of chip cracking caused by mechanical stress even from small bending or twisting.
When the flexible PCB is considered, please be sure to evaluate by yourself.

Bending



Twisting



Substrate restriction

- Don't mount on FPC (Flexible printed circuits)
- When components are mounted on substrate of under 6-layers, please contact us in advance.
To mount components on FPC or substrate of under 6-layers may cause of cracking issue by stress.

11.10 Storage and Handling Requirements

(1) Storage period

Use the products within 12 months after delivered.
Solderability should be checked if this period is exceeded.

(2) Storage conditions

- Products should be stored in the warehouse on the following conditions.
 Temperature : -10°C ~ 40°C
 Humidity : 15% to 85% relative humidity No rapid change on temperature and humidity.
- Products should not be stored on bulk packaging condition to prevent the chipping of the core and the breaking of winding wire caused by the collision between the products.
- 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.

(3) Handling Condition

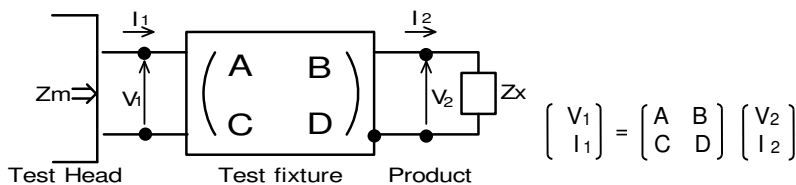
Care should be taken when transporting or handling product to avoid excessive vibration or mechanical shock.

12. ⚠ Note

- (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.

<Electrical Performance:Measuring Method of Inductance/Q>

(1) Residual elements and stray elements of test fixture can be described by F-parameter shown in following.



(2) The impedance of chip coil Z_x and measured value Z_m can be described by input/output current/voltage.

$$Z_m = \frac{V_1}{I_1} \quad , \quad Z_x = \frac{V_2}{I_2}$$

(3) Thus, the relation between Z_x and Z_m is following;

$$Z_x = \alpha \frac{Z_m - \beta}{1 - Z_m \Gamma} \quad \text{where, } \alpha = D / A = 1$$

$$\beta = B / D = Z_{sm} - (1 - Y_{om} Z_{sm}) Z_{ss}$$

$$\Gamma = C / A = Y_{om}$$

$\left[\begin{array}{l} Z_{sm}: \text{measured impedance of short chip} \\ Z_{ss}: \text{residual impedance of short chip (0.480nH)} \\ Y_{om}: \text{measured admittance when opening the fixture} \end{array} \right]$

(4) L_x and Q_x shall be calculated with the following equation.

$$L_x = \frac{\text{Im}(Z_x)}{2\pi f} \quad , \quad Q_x = \frac{\text{Im}(Z_x)}{\text{Re}(Z_x)}$$

L_x :Inductance of chip coil
 Q_x :Q of chip coil
 f :Measuring frequency