



## PRODUCT SPECIFICATION SHEET



|                   |                               |         |    |
|-------------------|-------------------------------|---------|----|
| Customer          |                               |         |    |
| Customer P/N      |                               |         |    |
| Product Type      | Temperature Sensing Crystal   |         |    |
| Part Number       | 2Z19200001                    | Version | S1 |
| Part Description  | SMD TSX 2.5 x 2.0 (TH + Xtal) |         |    |
| Nominal Frequency | 19.200000MHz                  |         |    |

|          |           |
|----------|-----------|
| Prepared | Li Xiang  |
| Reviewed | Kuro Peng |
| Approved | Xing Yue  |
| Date     | 2022-6-2  |

Customer's Approval & Date :

### 广东惠伦晶体科技股份有限公司

中国广东省东莞市黄江镇东环路鸡啼岗段68号  
68 Donghuan Road, Jitigang Village, Huangjiang,

Dongguan, Guangdong Province, P. R. China



WEB : <http://www.dgylec.com/>

TEL : +86 ( 0 ) 769 - 38879888

FAX : +86 ( 0 ) 769 - 38879889

EMAIL : [yl@dgylec.com](mailto:yl@dgylec.com)



Moisture Sensitivity Level 1

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## 2. Electrical Specifications

### 2.1 Specifications for operation condition and electrical characteristics

| #  | Parameter                                                | Min.        | Typ. | Max. | Unit                                               | Remark                                                                          |
|----|----------------------------------------------------------|-------------|------|------|----------------------------------------------------|---------------------------------------------------------------------------------|
| 1  | Nominal frequency                                        | 19.200000   |      |      | MHz                                                |                                                                                 |
| 2  | Crystal cut type                                         | AT-cut      |      |      | -                                                  |                                                                                 |
| 3  | Mode of vibration                                        | Fundamental |      |      | -                                                  |                                                                                 |
| 4  | Load capacitance ( $C_L$ )                               | -           | 7.0  | -    | pF                                                 | Note 1.                                                                         |
| 5  | Drive level                                              | 10          | -    | 100  | $\mu$ W                                            |                                                                                 |
| 6  | Operating temperature range                              | -30         | -    | +105 | $^{\circ}$ C                                       |                                                                                 |
| 7  | Storage temperature range                                | -40         | -    | +105 | $^{\circ}$ C                                       |                                                                                 |
| 8  | Initial frequency tolerance                              | -10         | -    | +10  | ppm                                                | At $30\pm 3^{\circ}$                                                            |
| 9  | Frequency drift after reflow                             | -2.0        | -    | +2.0 | ppm                                                | After two times of reflow<br>(0.5Hr freq. driftsubstruct<br>168Hr freq.)        |
| 10 | Tolerance over temperature<br>(reference $30^{\circ}$ C) | -12         | -    | 12   | ppm                                                | Within $-30^{\circ}$ C to $+85^{\circ}$ C.<br>Above $+85^{\circ}$ C see Note 2. |
| 11 | Frequency aging                                          | -0.7        | -    | +0.7 | ppm/yr                                             |                                                                                 |
| 12 | Equivalent series resistance (ESR)                       | -           | -    | 70   | $\Omega$                                           | Note 3.                                                                         |
| 13 | Insulation resistance                                    | 500         | -    | -    | M $\Omega$                                         | at DC 100V                                                                      |
| 14 | Quality factor (Q)                                       | 75,000      | -    | -    | -                                                  | Note 4.                                                                         |
| 15 | Spurious mode series resistance                          | 1100        | -    | -    | $\Omega$                                           | Within $\pm 500$ KHz offset.                                                    |
| 16 | Shunt Capaitance ( $C_0$ )                               | 0.3         | -    | 1.3  | pF                                                 |                                                                                 |
| 17 | Motional Capacitance ( $C_1$ )                           | 1.8         | -    | 3.1  | fF                                                 |                                                                                 |
| 18 | First-order curve fitting parameter( $C_1$ )             | -0.4        | 0    | -0.1 | ppm/ $^{\circ}$ C                                  | Note 5.                                                                         |
| 19 | Second-order curve fitting parameter<br>( $C_2$ )        | -4.5        | 0    | +4.5 | $\times 10^{-4}$<br>ppm/ $^{\circ}$ C <sup>2</sup> | Note 5.                                                                         |
| 20 | Third-order curve fitting parameter ( $C_4$ )            | 8.5         | 10   | 11.5 | $\times 10^{-5}$<br>ppm/ $^{\circ}$ C <sup>3</sup> | Note 5.                                                                         |

Note 1 The load capacitance is measured according to IEC Standard #60444-7.

Note 2 Above  $85^{\circ}$ C, the frequency tolerance over temperature is bound by the third order coefficient range.

Note 3 The ESR max is specified at max drive level minimum Q, drives a smaller ESR; that is, design the crystal to the minimum Q.

Note 4 The minimum Q value calculated from ESR and L is smaller than this specification.

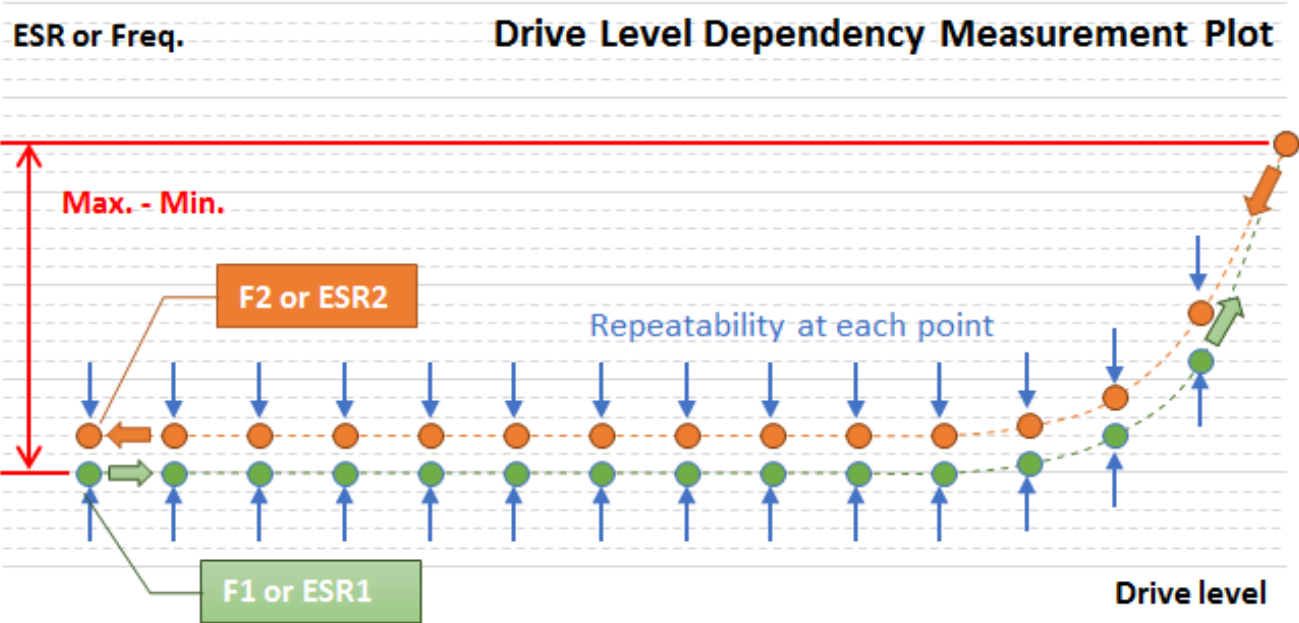
Note 5 The curve fitting parameter is obtained from the QTI crystal curve fitting algorithm, using the temperature inflection point  $t_0 = 30^{\circ}$ C.

2. Electrical Specifications (Cont.)

2.2 Specifications for crystal drive level dependency (DLD)

| # | Parameter                         | Min. | Typ. | Max. | Unit | Remarks                                       |
|---|-----------------------------------|------|------|------|------|-----------------------------------------------|
| 1 | Drive level measurement condition | 0.01 | -    | 100  | μW   | Drive level from 0.01 μW to 100 μW to 0.01 μW |
| 2 | DLD Frequency (Maximum - Minimum) | -    | -    | 3.0  | ppm  | Define as FDLD.<br>Note 6.                    |
| 3 | DLD Frequency (Repeatability)     | -    | -    | 0.7  | ppm  | Define as FDLDH.<br>Note 7.                   |
| 4 | DLD ESR (Maximum - Minimum)       | -    | -    | 20.0 | %    | Define as DLD2.<br>Note 6.                    |
| 5 | DLD ESR (Repeatability)           | -    | -    | 10.0 | %    | Define as DLDH2.<br>Note 7~9.                 |

- Note 6
- Maximum - minimum: Difference between the maximum and minimum in a two-way measurement.
- Note 7
- Repeatability of the two-way measurement is defined in the above Drive level measurement condition.
- Note 8
- ESR1: This is the first measurement on each drive level.
- Note 9
- ESR2: This is the second measurement on each drive level.



## 2. Electrical Specifications (Cont.)

### 2.3 Specifications for GPS quality

| # | Parameter                                   | Min.            | Typ. | Max. | Unit      | Remarks                                             |
|---|---------------------------------------------|-----------------|------|------|-----------|-----------------------------------------------------|
| 1 | Full Cycle Frequency stability slope        | -50             | -    | +50  | ppb/°C    | Note 11.                                            |
| 2 | 5°C Small Cycle Frequency stability slope 1 | -50             | -    | +50  | ppb/°C    |                                                     |
| 3 | 5°C Small Cycle Frequency stability slope 2 | 100 (magnitude) |      |      | ppb pk-pk | Average measured peak-to-peak frequency difference. |
| 4 | ESD                                         | HBM > 2000V     |      |      | -         | JESD22-A114-B                                       |
| 5 | MSL                                         | Level 1         |      |      | -         | IPC/JEDEC J-STD-033C                                |

Note 10 Temp. range:-30 to 85°C for each 1°C, Temp. rate: ~1.0°C/min  
 Test flow: 25°C(1)->-30°C->85°C->25°C(2), (25°C(1) freq. drift subtract 25°C(2) freq. drift)

Note 11 Test condition: Continuous temperature rate change of ~ 1.0°C/min  
 Measure FT points every 1°C, heating up from -30 to 85°C, subtract a fifth-order polynomial best fit, and then calculate the slope of the residual.

## 2. Electrical Specifications (Cont.)

### 2.4 NTC thermistor specification table

| # | Parameter                   | Min. | Typ.  | Max. | Unit | Remarks        |
|---|-----------------------------|------|-------|------|------|----------------|
| 1 | Operating temperature range | -30  | -     | +105 | °C   |                |
| 2 | Storage temperature range   | -40  | -     | +105 | °C   |                |
| 3 | Resistance                  | -    | 100   | -    | kΩ   | At 25°C*       |
| 4 | B-constant                  | -    | 4,250 | -    | K    | At 25°C - 50°C |
| 5 | Tolerance                   | -    | -     | 1    | %    |                |

\*In order to get the precise resistance value of the thermistor, the temperature control will be very important during testing since the resistance value will change ~4% per 1°C temperature difference.

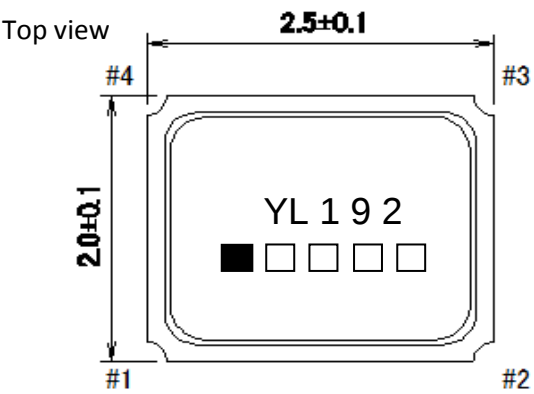
Please check the following Murata website for detail explanation.

<https://www.murata.com/en-us/support/faqs/products/thermistor/ntc/pct/0001>

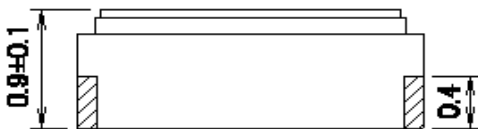
3. Product Design

3.1 Package dimensions and pad functions (Unit : mm)

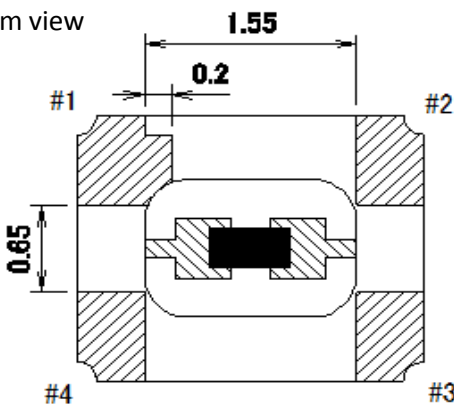
3.2 Pad connection diagram and function



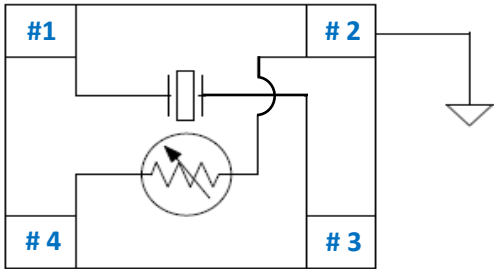
Lateral view



Bottom view

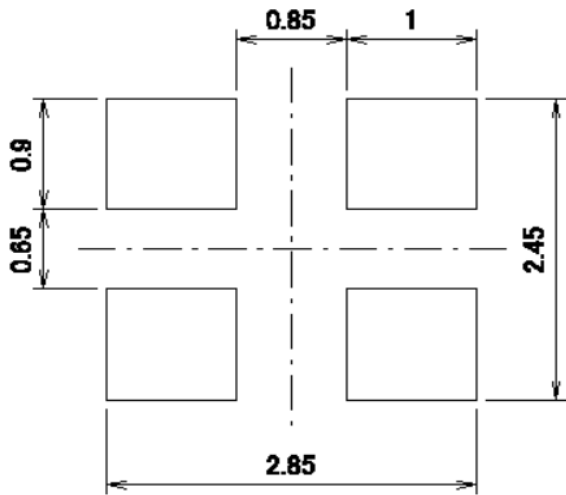


Bottom view



| Pad | Function                             |
|-----|--------------------------------------|
| 1   | Xtal in                              |
| 2   | Thermistor out, connecting to ground |
| 3   | Xtal out                             |
| 4   | Thermistor in                        |

3.3 Recommended land pattern (Unit : mm)



3. Product Design (Cont.)

3.4 Marking definition

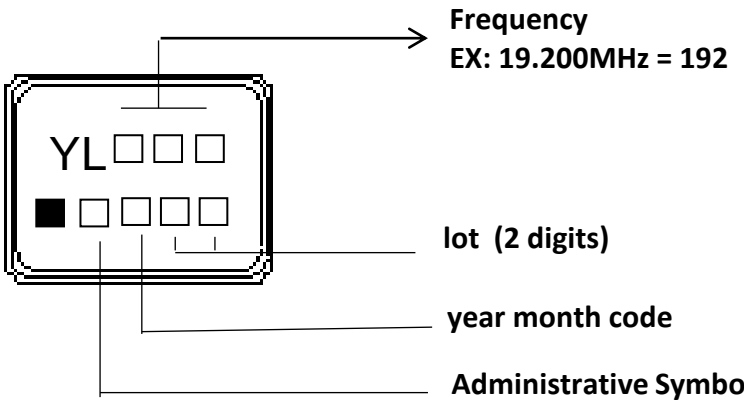
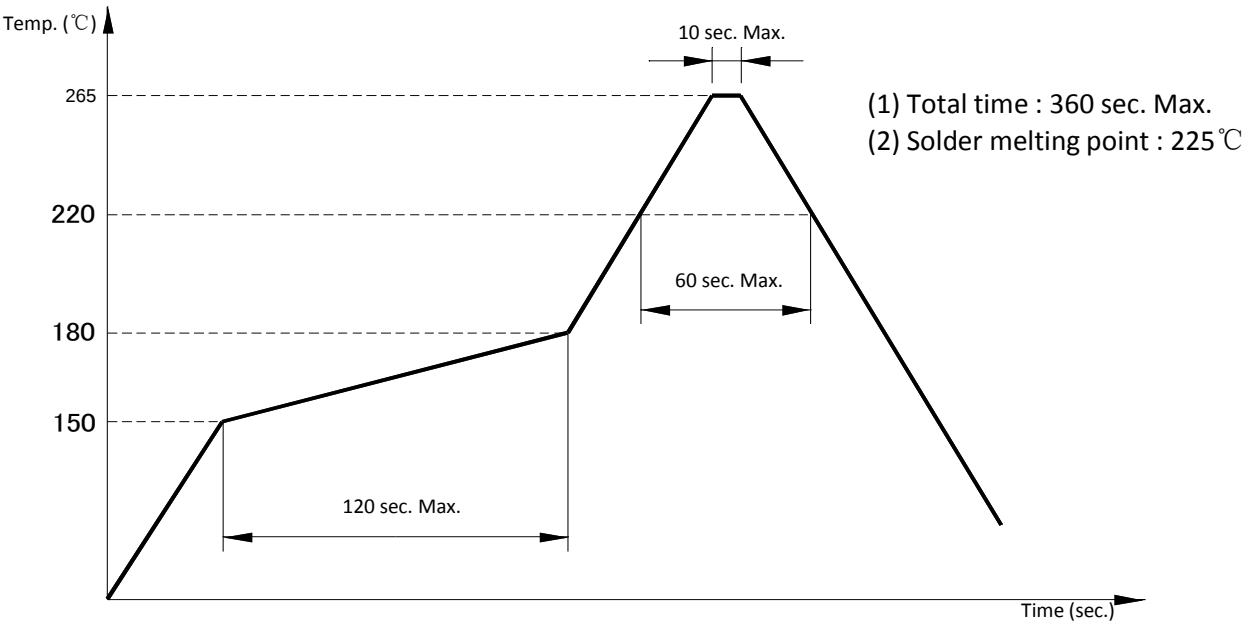


Table of Year and Month code

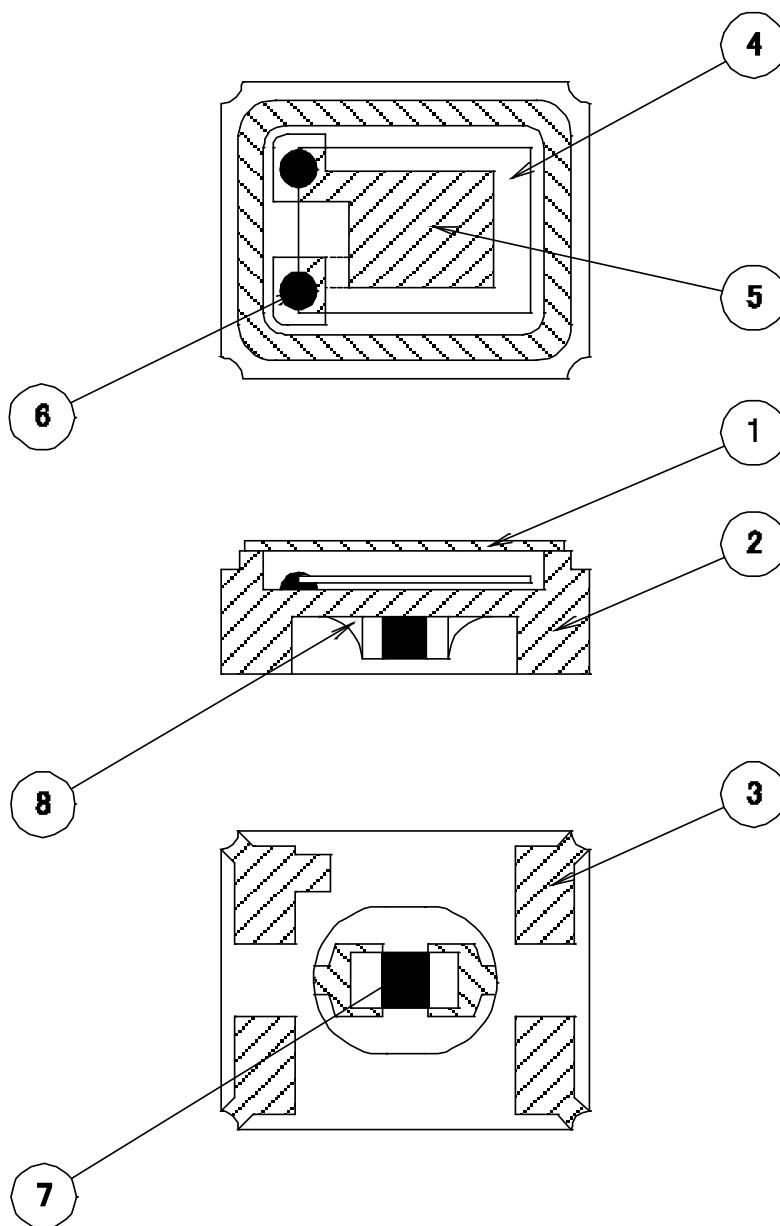
| Month<br>Year |      | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
|---------------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 2021          | 2025 | A   | B   | C   | D   | E   | F   | G   | H   | J   | K   | L   | M   |
| 2022          | 2026 | N   | P   | Q   | R   | S   | T   | U   | V   | W   | X   | Y   | Z   |
| 2023          | 2027 | a   | b   | c   | d   | e   | f   | g   | h   | j   | k   | l   | m   |
| 2024          | 2028 | n   | p   | q   | r   | s   | t   | u   | v   | w   | x   | y   | z   |

3.5 Recommended reflow profile



### 3. Product Design (Cont.)

#### 3.6 Structure illustration



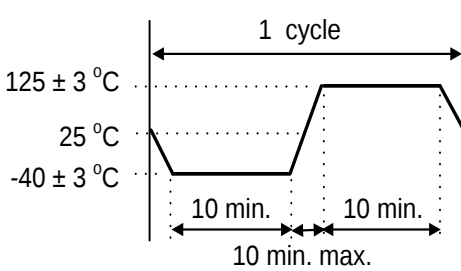
| # | Components          | Materials                                                  | QTY | Finish/Specifications                           |
|---|---------------------|------------------------------------------------------------|-----|-------------------------------------------------|
| 1 | Cap (Lid)           | Kovar (Fe + Co + Ni)                                       | 1   | Ni plating                                      |
| 2 | Base (Package)      | Ceramic ( $\text{Al}_2\text{O}_3$ ) + Kovar (Fe + Co + Ni) | 1   | Alumina ceramics                                |
| 3 | Pad (Package)       | Ni + Au                                                    | 4   | Tungsten metalization + Ni plating + Au plating |
| 4 | Crystal blank       | $\text{SiO}_2$                                             | 1   | -                                               |
| 5 | Electrode           | Cr + Nobel material                                        | 2   |                                                 |
| 6 | Conductive adhesive | Ag                                                         | 2   | Silicone resin                                  |
| 7 | Thermistor          | Alumina Ceramics ( $\text{Al}_2\text{O}_3$ ), Ni + Ag+ Sn  | 1   | -                                               |
| 8 | Solder              | Sn + Ag + Cu                                               | 2   | -                                               |

#### 4. Reliability Assurance

##### 4.1 Mechanical endurance

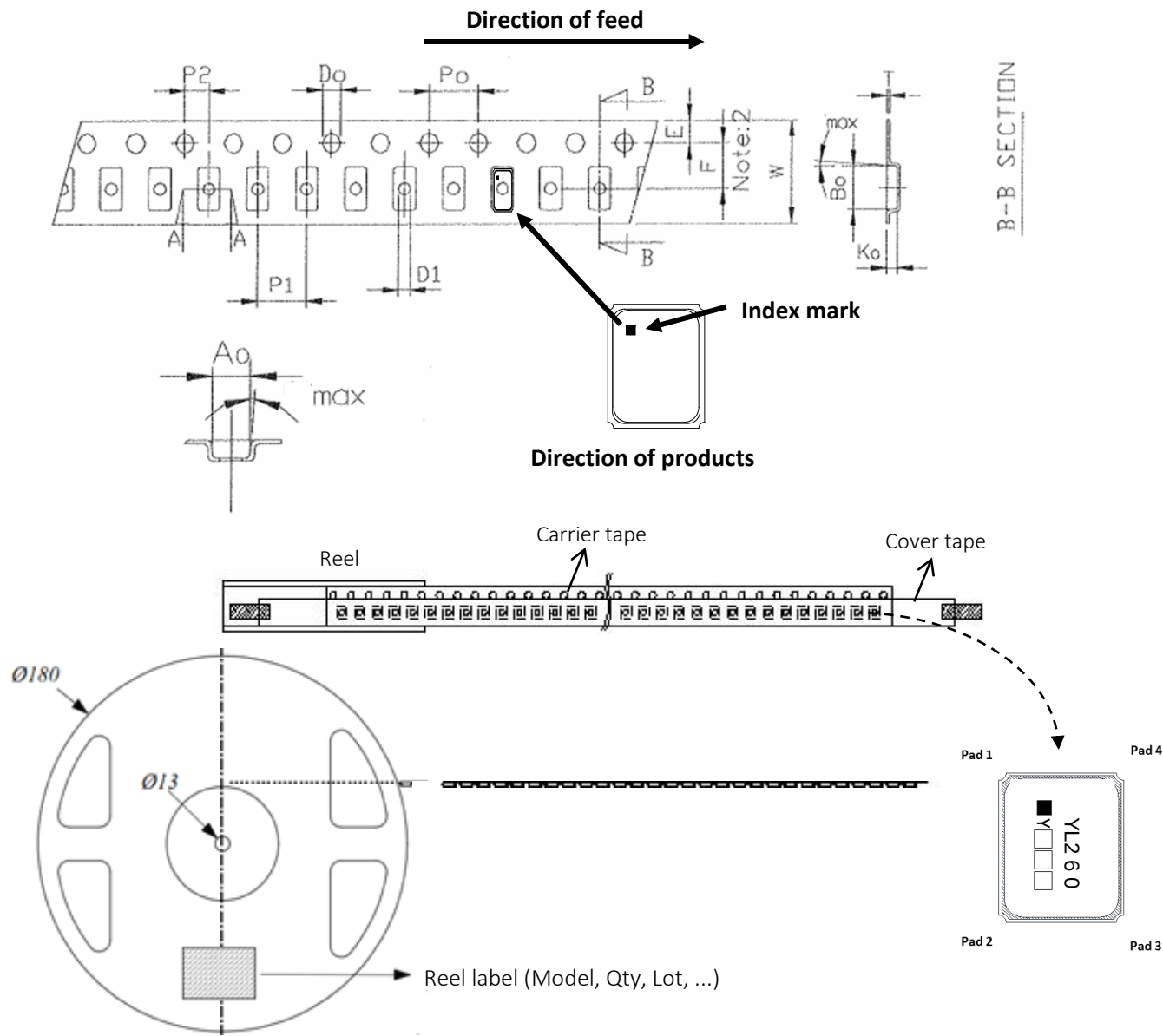
| # | Item                         | Test Condition                                                                                                                                             | Reference                                                                           |
|---|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1 | Drop test                    | 150 cm height, fall freely onto stainless plate, 3 times.                                                                                                  | JIS C6701                                                                           |
| 2 | Shock test                   | 150 g weight, 150 cm height onto concrete floor.<br>Each direction ( $\pm x$ , $\pm y$ , $\pm z$ ) for 3 cycles.                                           | IEC-68-02-27                                                                        |
| 3 | Mechanical shock             | Half sine wave 1000 G. Three mutually perpendicular axes, each axis for 3 times. Duration time 1.0ms.                                                      | MIL-STD-202F                                                                        |
| 4 | Vibration                    | Frequency range : 10 ~ 55 Hz<br>Amplitude : 1.52 mm<br>Pendicular axes each test time : 2 hours (x,y,z Axis)<br>Total test time 6 hours                    | MIL-STD-883E                                                                        |
| 5 | Gross Leak                   | Standard sample for automatic gross leak detector.<br>Test pressure: 2kg /cm <sup>2</sup> .                                                                | MIL-STD-883E                                                                        |
| 6 | Fine Leak                    | Helium bombing 4.5 kgf/cm <sup>2</sup> for 2 hours.                                                                                                        | MIL-STD-883E                                                                        |
| 7 | Solderability                | Temperature : 260°C $\pm$ 5°C<br>Immersing depth : 0.5 mm minimum<br>Immersion time : 5 $\pm$ 1 seconds<br>Flux : Rosin resin methyl alcohol solvent (1:4) | GB/T 2424.17-2008 / IEC 60068-2-44:1995;<br>GB/T 2423.28-2005 / IEC 60068-2-20:1979 |
| 8 | Resistance To Soldering Heat | Pre-heat temperature 125°C<br>Pre-heat time 60 ~ 120 sec.<br>Test temperature 260 $\pm$ 5°C<br>Test time 5 $\pm$ 1 sec.                                    | MIL-STD-202F                                                                        |

##### 4.2 Environmental endurance

| # | Item                        | Test Condition                                                                                                                              | Reference    |
|---|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1 | High temperature storage    | Temperature : +125°C $\pm$ 3°C<br>Duration : 500 $\pm$ 12 hours                                                                             | MIL-STD-883E |
| 2 | Low temperature storage     | Temperature : -40°C $\pm$ 3°C<br>Duration : 500 $\pm$ 12 hours                                                                              | MIL-STD-883E |
| 3 | Thermal shock (Air to Air)  | Total 100 cycles of the following temperature cycle<br> | MIL-STD-883E |
| 4 | High temperature & humidity | Temperature : 85°C $\pm$ 3°C<br>Humidity : RH 85%<br>Duration : 500 hours                                                                   | JIS C5023    |

5. Taping and Packing

5.1 Tape and reel (EIA-481-2)



| Package Type   | Dimension (Unit : mm) |                |                |                |                |          |          |
|----------------|-----------------------|----------------|----------------|----------------|----------------|----------|----------|
|                | A <sub>0</sub>        | B <sub>0</sub> | K <sub>0</sub> | T              | W              | E        | F        |
| 2520 TSX (8mm) | 2.25±0.1              | 2.70±0.1       | 1.45±0.1       | 0.25±0.05      | 8.00±0.3       | 1.75±0.2 | 3.50±0.1 |
|                | P1                    | P2             | D1             | D <sub>0</sub> | P <sub>0</sub> |          |          |
|                | 4.00±0.1              | 2.00±0.1       | 1.00±0.1       | 1.55±0.05      | 4.00±0.1       |          |          |

Standard Reel Quantity is 3000 pcs per reel.

The inspection standard of tape tension

| Item         |            | Defect                                          | Method            |
|--------------|------------|-------------------------------------------------|-------------------|
| Appearance   | All        | 1. The tape is not coincidence<br>2. The bubble | Visual inspection |
| Tape tension | 2520 - 8mm | Overstep 55±6g (49 to 61g)                      | Pull test         |

## 5. Taping and Packing (Cont.)

### 5.2 Packing standard

Out-going packing instruction

| Reel packing                                                                                                                                     | Inner packing                                                                                  | Carton                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Name : Reel<br>Standard : Diameter 18cm<br>Material : Plastics<br>Name : Anti-static shielding bag<br>Standard : 205×250mm<br>Material : APET/CP | Name : Bubble wrap<br>Standard : 430×330×(t)20mm<br>Material : HDPE<br>Quantity : Max.15 reels | Name : Carton<br>Standard : 400×400×(H)280mm<br>Material : AB corrugated paper<br>Quantity : 4 bags |
|                                                                  |               |                 |

The label information

| Label | Label Drawing                                                                       | Name of Article        | Spec.                                                                                                                                          | Label size | Printing |
|-------|-------------------------------------------------------------------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------|----------|
| L1    |  | 条码标签<br>Bar Code Label | 1.Customer P/N<br>2.Manufacturer P/N<br>3.Q'ty<br>4.Vendor Code<br>5.Lot No<br>6.Date Code<br>7.Manufacturer<br>8.Country of Origin            | 70×50mm    | White    |
| L2    |  | 条码标签<br>Bar Code Label | 1.PO NO<br>2.Customer P/N<br>3.Manufacturer P/N<br>4.Q'ty<br>5.Vendor Code<br>6.Lot No<br>7.Date Code<br>8.Manufacturer<br>9.Country of Origin | 100×75mm   | White    |
| L2    |  | 条码标签<br>Bar Code Label | 1.Date Code<br>2.Q'ty                                                                                                                          | 100×75mm   | White    |

Remark: Specifications on the label is for default templates purpose and may change with different product.

If any specified requirements for labels packaging is needed, please provide the instruction information.

## 6. Specification of the Environment-related Substances

| #  | Range                                                                                                                          | Max. concentration (ppm; mg/kg)     |                                                   |
|----|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---------------------------------------------------|
|    | Banned Substances                                                                                                              | Product                             | Packing                                           |
| 1  | 镉及镉化合物<br>Cadmium and cadmium compounds                                                                                        | 100                                 | 100                                               |
| 2  | 铅及铅化合物<br>Lead and lead compounds                                                                                              | 1000                                | 100                                               |
| 3  | 汞及汞化合物<br>Mercury and mercury compounds                                                                                        | 1000                                | 100                                               |
| 4  | 六价铬化合物<br>Hexavalent-Chromium VI (Cr <sup>+6</sup> )                                                                           | 1000                                | 100                                               |
| 5  | 聚溴联苯 PBB<br>Polybrominated biphenyls                                                                                           | 1000                                | N/A                                               |
| 6  | 聚溴二苯醚 PBDE<br>Polybrominated diphenyl ethers                                                                                   | 1000                                | N/A                                               |
| 7  | 邻苯二甲酸二(2-乙基己基)酯 DEHP<br>Di (2-ethylhexyl) phthalate                                                                            | 1000                                | N/A                                               |
| 8  | 邻苯二甲酸丁苄酯 BBP<br>Butyl Benzyl Phthalate                                                                                         | 1000                                | N/A                                               |
| 9  | 邻苯二甲酸二丁酯 DBP<br>Dibutyl Phthalate                                                                                              | 1000                                | N/A                                               |
| 10 | 邻苯二甲酸二异丁酯 DIBP<br>Diisobutyl Phthalate                                                                                         | 1000                                | N/A                                               |
| 11 | 氟(F)、氯(Cl)、溴(Br)、碘(I)<br>Fluorine, Chlorine, Bromine, Iodine                                                                   | 900、900、900、900<br>注：Br + Cl < 1000 | N/A                                               |
| 12 | 包装材料中重金属(汞、镉、六价铬、铅、PBB、PBDE)之总量<br>Heavy metals (mercury, cadmium, lead, Cr <sup>+6</sup> , PBB and PBDE) in packing materials | N/A                                 | 100<br>铅(Pb) + 镉(Cd) + 汞(Hg) + 六价铬(Cr+6) < 100ppm |
| 13 | 高度关注物质<br>SVHC-Substances of Very High Concern                                                                                 | 1000                                | N/A                                               |