RN.2 Technologies

Datasheet

Delay Line 2

Rev. 1.0

Revision History

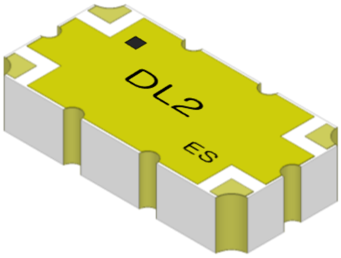
Rev	Release Date	Description	Author
1.0	2020-04-08	• Initial release	G.H.Baek

Contents

Delay Line
with High-Power Capacity and Stable Performance based on RN2 Technologies LTCC Multilayer Technology

1. KEY FEATURES

- Frequency range 300 – 2700 MHz
- Excellent high-power capacity up to average 80 watts
- Excellent stable performance at different temperatures
- Low insertion loss Max 2.2 dB high conductivity metal conductor (Ag), and gold (Au) plating
- Small size (10.16 x 5.08 mm) SMD package
- RoHS compliance (Pb-Free)



2. APPLICATIONS

- Applications using GSM, UMTS, and LTE
- RF amplifiers
- Communications equipment

3. GENERAL DESCRIPTIONS

The DL2 is a Delay Line with high-power capacity and stable performance in different temperatures. The LTCC, high conductivity metal conductor (Ag), and gold (Au) plating enable the DL2 to minimize insertion loss and improve durability for thermal stabilization and electricity.

DL2 is best application solution for GSM, UMTS, and LTE and communications equipment, requiring low insertion loss and high power.

DL2 supports CW up to average 80 W. It's package type is SMD type product enabling Pb-Free solder and meets RoHS-6.

4. ELECTRICAL SPECIFICATIONS

Frequency (MHz)	Return Loss Min.(dB)	Insertion Loss Max.(dB)	Group Delay (nS)	Power Capacity (Watts)
300 – 1500	20	1.8	2.00 ± 0.20	80
1500 – 2700	14	2.2	2.00 ± 0.20	80

NOTE: These electrical specifications are measured by using a RN2 Technologies test board.
Specifications subject to change without notice.
For reliability test data, please contact RN2 Technologies sales team.

5. PORT CONFIGURATIONS

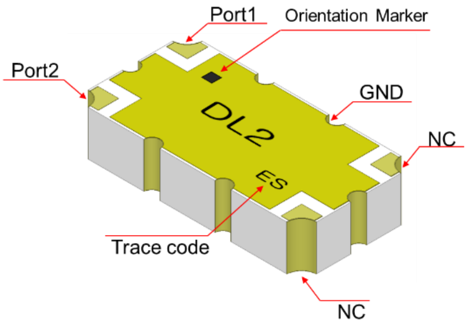


Figure 1. Top View

DL2 port configurations depending on how input signals are split. The Case 1 and Case 2 configurations mean that one input signal is split into two output signals. When port 1 is defined, the other ports are defined automatically.

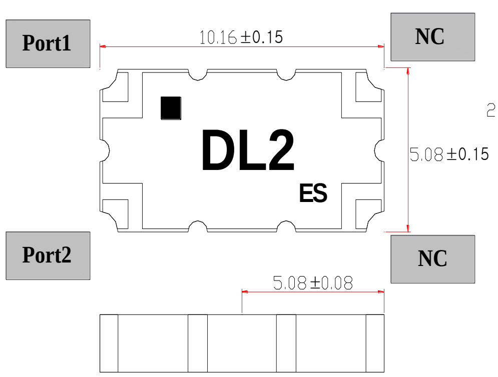
Table 1. DL2 Port Configurations

Configuration	Port 1	Port 2	N.C	N.C
Case 1.	Input	Output	N.C	N.C
Case 2.	Output	Input	N.C	N.C

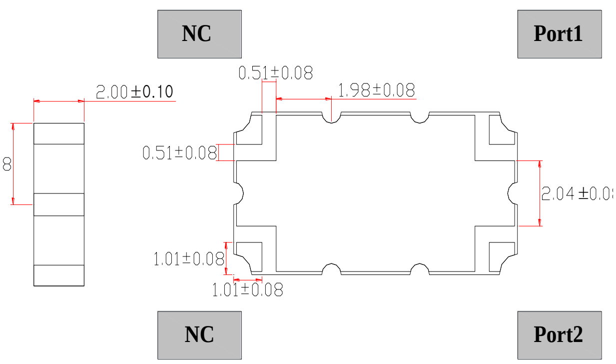
***NOTE**: 0˚ is an actual phase or amplitude of the frequency specified at all ports.

6. OUT DIMENSION

Top View



Bottom View



- Unit: mm
- Weight: 0.26 grams
- Camber specifications: Less than ±0.08 mm

7. POWER DERATING CURVE

The maximum allowable average power (Maximum input power, CW) of the DL2 depending on base PCB temperature changes. The maximum allowable average power of the DL2 is limited by the following power derating curve.

The DL2 factors that determine the power derating curve are as follows:

- Internal circuit
- Thickness
- Thermal conductivity of materials
- Insertion loss
- Operating temperature
- Mounting interface temperature between the DL2 and the base PCB

The maximum operating temperature of the DL2 is 125 °C. Therefore, when the base PCB temperature is over 125 °C, the DL2 operates stably by decreasing its durable average input power. When the base PCB temperature reaches 200 °C, the maximum allowable average power decreases to 0 watt.

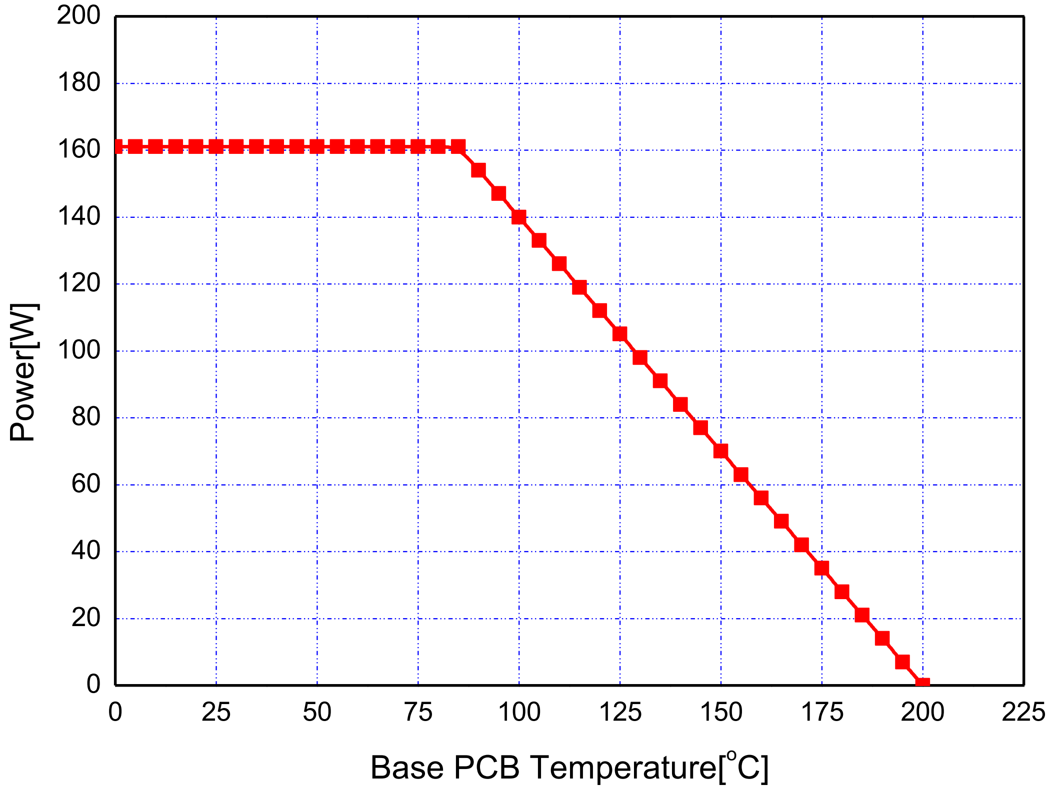


Figure 2. Power Derating Curve

8. RF PERFORMANCE CURVES: Return Loss and Insertion Loss (-55 ºC, 25 ºC, and 125 ºC)

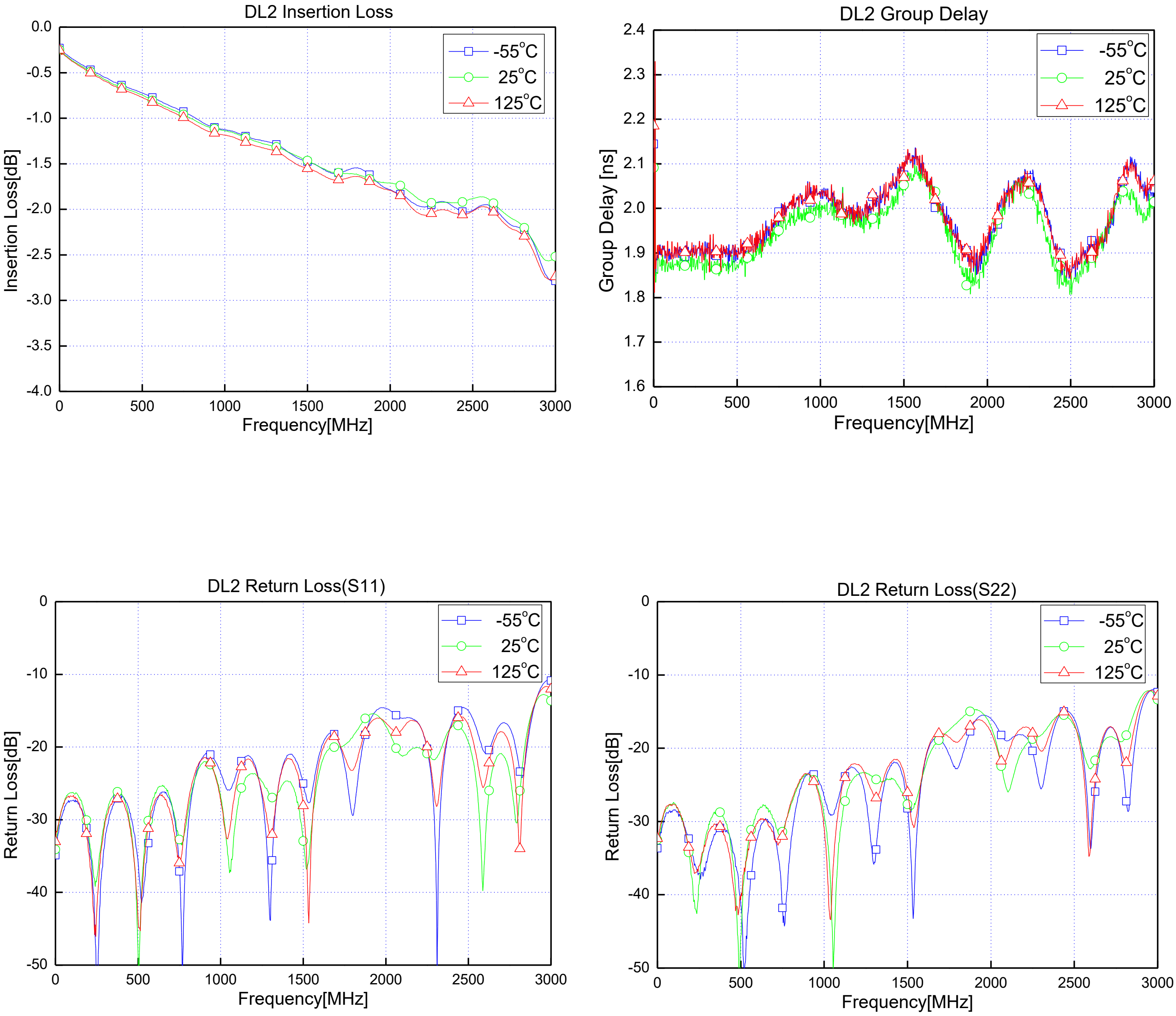


Figure 3. Test Plots of Insertion Loss, Group Delay and Return Loss (-55 ºC, 25 ºC, and 125 ºC)

9. RF TEST METHODS

To ensure S-Parameters reliability, we follow our internal test procedures by using the RN2 Technologies bare test board, RN2 Technologies test board, and test fixture connected with VNA (Vector Network Analyzer). In addition, we use the Automatic Port Extensions (APE) function of the Vector network analyzer to obtain accurate S-Parameters.

9.1 RF TEST PROCEDURES

To test the DL2 RF performance, we perform the following steps:

1. Preparing the Test Equipment
2. Performing the APE Function of the VNA
3. Measuring the S-parameters (Insertion Loss, Group delay, and Return Loss)

STEP 1: Preparing the Test Equipment

The following test equipment is prepared to test the DL2 RF performance.

- RN2 Technologies bare test board
- RN2 Technologies test board
- Vector network analyzer
- Test fixture

NOTE: See *'RN2 Technologies TEST BOARD LAYOUT'* for the RN2 Technologies test board details.

STEP 2: Performing the Automatic Port Extensions (APE) Function of the Vector Network Analyzer

The APE function is used with the RN2 Technologies bare test board to correctly check the DL 2 RF performance. This reduces or eliminates both electrical delay and insertion loss of the test fixture.

The detailed steps are as follows:

1. Place the RN2 Technologies bare test board on the test fixture.
2. Click the **Cal** button of the VNA to calibrate it.
3. Connect the four ports of the test fixture into the two ports of the VNA.
4. Click the **Port Extensions** button of the VNA to measure the data of the RN2 Technologies bare test board.

NOTE: See *'AUTOMATIC PORT EXTENSIONS FUNCTION'* for more details.

STEP 3: Measuring the S-Parameters (insertion Loss, Group delay, and Return Loss)
After performing the APE function, the DL2 S-Parameters are measured through the following steps:

1. Place the RN2 test board on the text fixture.
2. Apply pressure to the text fixture using a pneumatic piston.
3. Connect the two ports of the test fixture into the two ports of the Vector network analyzer.
4. Set port1 as Case 1 configuration in *'Table 1. DL2 Port Configurations'*.
5. Calibrate the Vector network analyzer.
6. Measure the insertion Loss and Group delay value from port 1 to port 2 (S21).
7. Measure the return loss value from port 1 to port 1 respectively (S11).

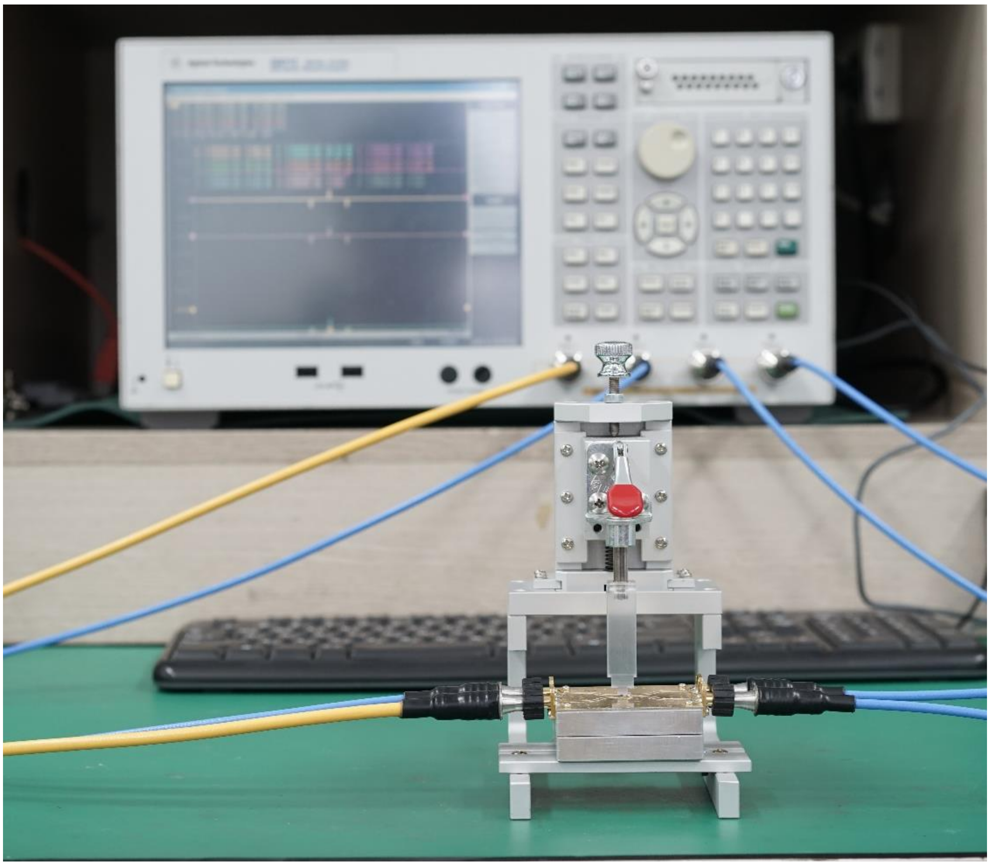


Figure 4. Test Setting to Measure the DL2 S-Parameters

STEP 4: Obtaining the Characteristic Parameters (insertion Loss, Group delay, and Return Loss)
The S-Parameters are calculated by using the formula in ***Table 2*** to obtain the characteristic parameters, such as insertion Loss, Group delay, and Return Loss.

Table 2. Mathematical Formula for the DL2 S-Parameters

Parameter	S-Parameter	Power Method
Insertion Loss	S21	
Return Loss	S11 S22	$10 \cdot \log\left(\frac{P_{in}}{P_{back}}\right)$

NOTE
- P_{in} : Power of Input Port
- P_{back} : Return Power of Input Port

9.2 RN2 Technologies TEST BOARD LAYOUT

Figure 5 shows the RN2 Technologies test board layout used for testing the DL2 RF performance. The RN2 Technologies test board is based on the Taconic RF35 board with the dielectric constant of 3.5, board thickness of 0.8 mm, and copper of 1 Oz.

We recommend that you use the same material and design layout, as shown in ***Figure 5***, to meet the specifications in this datasheet. However, if you use different materials, you must follow the basic guidelines. See *'RECOMMENDED PCB LAYOUT AND SOLDER MASK PATTERN'* for more details.

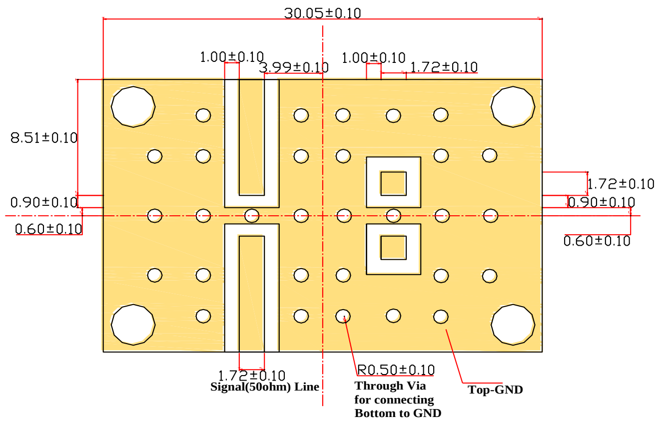


Figure 5. RN2 Technologies Test Board Layout

9.3 AUTOMATIC PORT EXTENSIONS (APE) FUNCTION

To accurately measure the DL2 S-Parameters, we use the Automatic Port Extensions (APE) function of the VNA. The APE function is used for reducing or eliminating both electrical delay and insertion loss of test fixtures. It provides a convenient, automated way to calculate the insertion loss and electrical delay terms by a simple measurement of an open or short circuit, which is easy to do in test fixtures.

We consider the transmission lines of the RN2 Technologies bare test board as extensions of the coaxial test cables that are between the Vector network analyzer and the DL2. With the APE function, we extend the coaxial test ports so that our calibration plane is right at the terminals of the DL2, and not at the connectors of the RN2 Technologies bare test board.

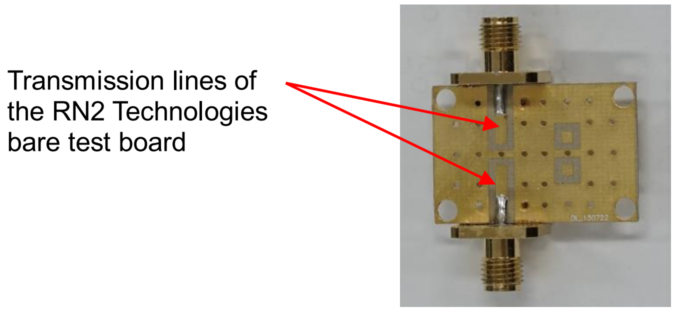


Figure 6. Performing the APE Function Test

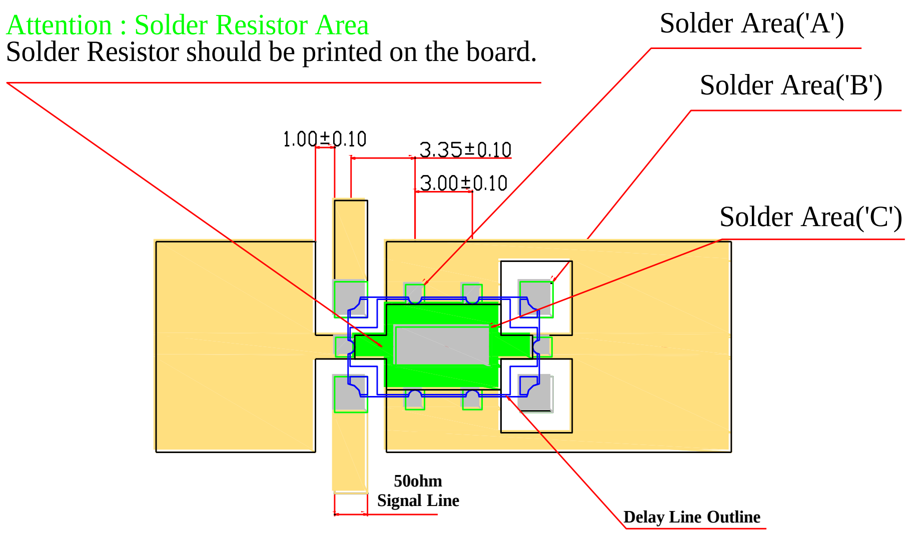
10. RECOMMENDED PCB LAND PATTERN

Figure 7 shows the recommended PCB layout and solder mask pattern to meet the specifications in this datasheet. When you use different materials other than the RN2 Technologies test board, you must follow the basic guidelines and calculate the 50 ohm impedance line width using a different PCB stack information.

Basic Guidelines

- Place GND more than 30% of the DL2 GND dimension regardless of a via size.
- Appropriately increase via sizes and numbers to allow low impedance ground connection and good thermal conductivity.
- Align the DL2ground plane with the solder to have good connection to ground.
- Fill the via holes under the DL2with the solder for thermal emission.

NOTE: Contact the RN2 Technologies sales team for more detailed PCB layout and solder mask pattern information.



NOTE

- Test Solder Cream: SAC-305 (Alpha Metal)
- Pb-Free Solder Alloy: Sn/Ag/Cu Ratio of 96.5/3.0/0.5
- Solder Area ('A') Dimension: 1.00 mm by 1.00 mm
- Solder Area ('B') Dimension: 1.72 mm by 1.80 mm
- Solder Area ('C') Dimension: 5.00 mm by 2.00 mm

Figure 7. Recommended PCB Layout and Solder Mask Pattern

11. SOLDERING PROCESS

The DL2 soldering steps are as follows:

1. Cleaning the PCB
2. Applying solder paste to the PCB
3. Placing the DL2 on the PCB
4. Reflowing the DL2 to the PCB
5. Cleaning and inspecting the soldered PCB with the DL2

STEP 1: Cleaning the PCB
Carefully clean the PCB surface where the DL2 is soldered.
Particles must not be placed on the PCB surface where the DL2is soldered.

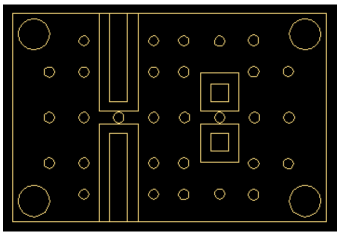


Figure 8. Cleaning the PCB Surface Where the DL2is Soldered

STEP 2: Applying the Solder Paste to the PCB
Apply the solder paste to the 11points on the PCB surface.
It enables good thermal conductivity because the DL2 is firmly attached to the PCB surface without air.

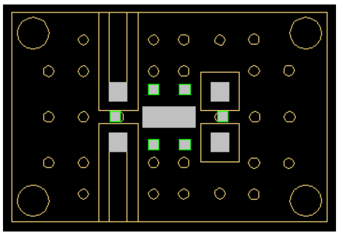


Figure 9. Applying the Solder Paste to the 11Points on the PCB Surface

STEP 3: Placing the DL2 on the PCB
Correctly place the DL2 on the 11points of the PCB surface.
Applying the solder paste to the 11points helps you firmly attach the DL2 to the PCB surface.

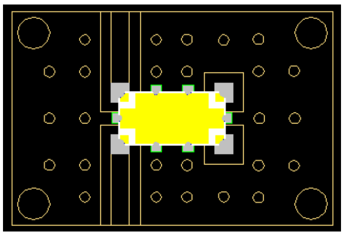


Figure 10. Placing the DL2on the 11Points of the PCB Surface

STEP 4: Reflowing the DL2 to the PCB
We recommend both manual soldering and PCB surface pre-heating methods when reflowing the DL2 to the PCB surface. Be careful NOT to touch the iron tip to the DL2 when you use the manual soldering method.
See *‘REFLOW PROFILE’* for more details.

12. REFLOW PROFILE

Figure 12 shows the thermal reflow profile of the SAC-305 (Alpha metal), which is a test solder cream we used.

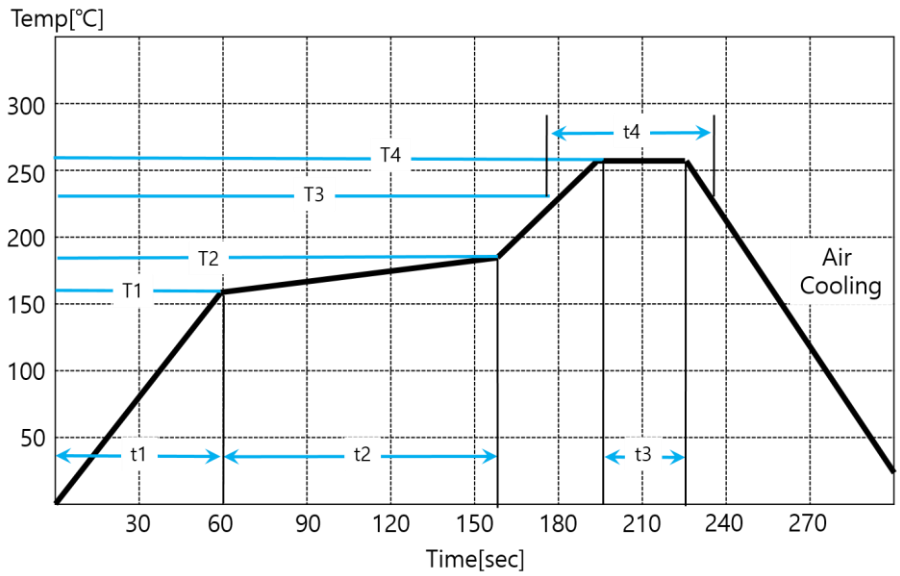
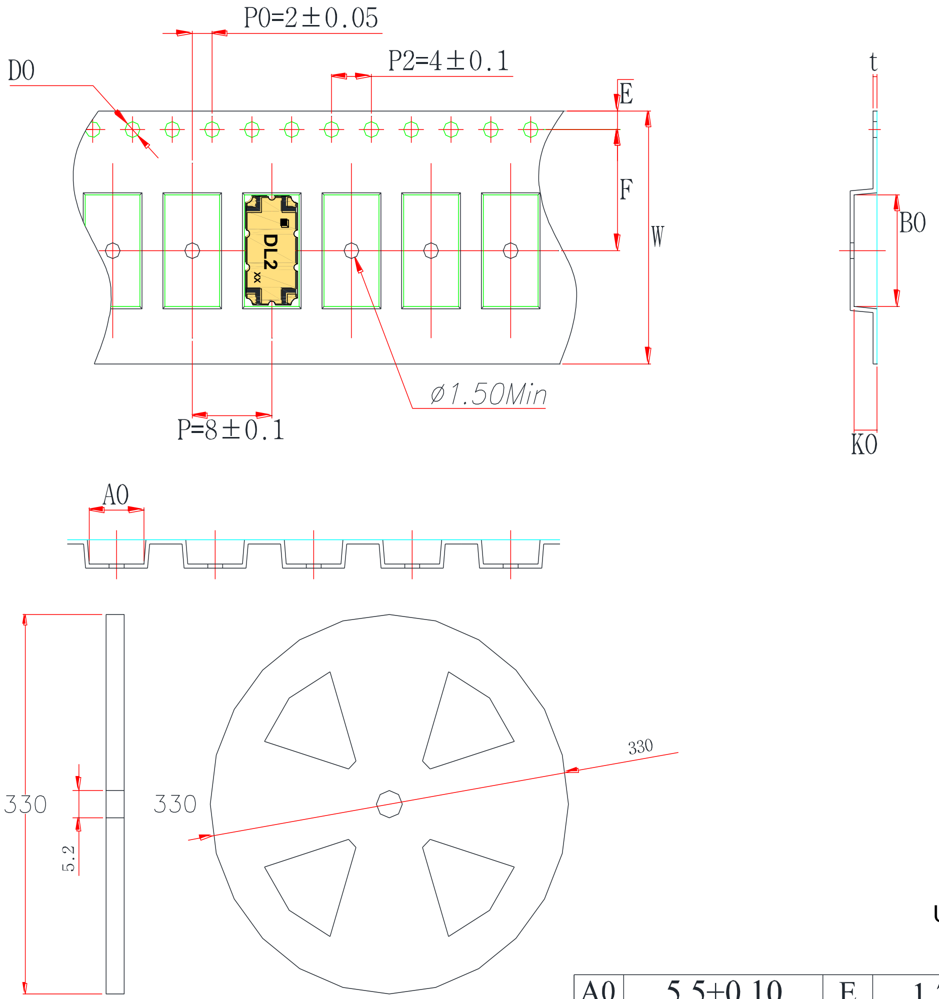


Figure 11. Thermal Reflow Profile

	Ramp Up	Pre-Heating	Peak	Soaking
Temperature(℃)	T1:160±5	T2:180±5	T4:260±5	T3:230±5
Time(sec)	t1:60±5	t2:100±15	t3:30±5	t4:60±10

13. PACKAGING AND ORDERING INFORMATION



Units : mm

A0	5.5±0.10	E	1.75±0.10
B0	10.6±0.10	F	11.50±0.10
D0	1.55±0.05	t	0.40±0.05
K0	2.30±0.10	w	24.0±0.30

Starndard Packaging Quantity : 3,000 PCS / Reel

14. HANDLING GUIDE

PLEASE READ THIS NOTICE BEFORE USING OUR LTCC Delay line.

I. Be careful when transporting

- Ensure proper transportation as excessive stress or shock may damage LTCC Delay lines due to the nature of ceramics structure.
- LTCC Delay lines cracked or damaged on terminals may have their property changed.

II. Be careful during storage

- Store LTCC Delay lines in the temperature of -55 ℃ to +125 ℃.
- Keep the humidity at 45 % to 75 % around LTCC Delay lines.
- Prevent corrosive gas (Cl_2, NH_3, SO_X, NO_X, etc.) from contacting LTCC Delay lines.
- It is recommended to use LTCC Delay lines within 6 months of receipt. If the period exceeds 6 months, solderability may need to be verified.

III. Be careful when soldering

- Solder all the ground terminals, IN and OUT pad of LTCC Delay lines on the ground plane of the PCB.
- LTCC Delay lines may be cracked or broken by uneven forces from a claw or suction device.
- Mechanical stress by any other devices may damage LTCC Delay lines when positioning them on PCB.
- Do not use dropped LTCC Delay lines.
- Ensure that any soldering is carried out by the condition of specification sheet.
- Do not re-use LTCC Delay lines which are de-soldered from PCB.

15. LEGAL INFORMATION

Information in this document is believed to be accurate and reliable. However, RN2 Technologies does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. RN2 Technologies does not take any responsibility for the content in this document if provided by an information source outside of RN2 Technologies.

RN2 Technologies reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without notice. This document supersedes and replaces all information supplied prior to the publication hereof.

RN2 Technologies products are not authorized for use in safety-critical applications (such as life support) where a failure of the RN2 Technologies products would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of RN2 Technologies products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by RN2 Technologies. Further, Buyers must fully indemnify RN2 Technologies and its representatives against any damages arising out of the use of RN2 Technologies products in such safety-critical applications.

RN2 Technologies does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products. Customer is responsible for doing all necessary testing for the customer's applications or products using RN2 Technologies products in order to avoid a default of the applications and the products. RN2 Technologies does not accept any liability in this respect.

RN2 Technologies

HTTP://WWW.RN2.CO.KR