RN.2 Technologies

Datasheet

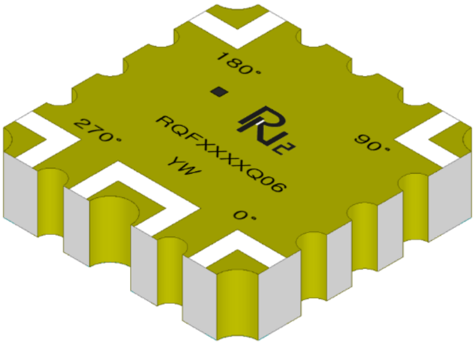
RQF1600Q06

Rev. 1.2

Contents

4-Phase Antenna Feeder
with High-Power Capacity and Stable Performance based on RN2 LTCC Multilayer Technology

1. KEY FEATURES
- Frequency range 1520 – 1660 MHz
- 4-Phased Antenna Feeder, 6dB (0˚, 90˚, 180˚, 270˚)
- Excellent stable performance at different temperatures
- Low insertion loss Max. 0.5 dB, high conductivity metal conductor (Ag), and gold (Au) plating
- Small size (8.00 x 8.00 mm) SMD package
- RoHS compliance (Pb-Free)



2. APPLICATIONS
- Applications using GNSS
- RF amplifiers
- Communications equipment

3. GENERAL DESCRIPTIONS
RQF1600Q06 is a 4-Phase antenna feeder with stable performance in different temperatures. The LTCC (Low Temperature Co-fired Ceramic), high conductivity metal conductor (Ag), and gold (Au) plating enable the RQF1600Q06 to minimize insertion loss and improve durability for thermal stabilization and electricity.

RQF1600Q06 is suited for applications using GNSS and communications equipment, requiring low insertion loss and high power.

RQF1600Q06 is a SMD type product enabling Pb-Free solder and meets RoHS-6.

4. ELECTRICAL SPECIFICATIONS

Frequency (MHz)	Amplitude Balance Max.(dB)	Insertion Loss Max.(dB)	Return Loss Min.(dB)
1520-1660	± 0.5	0.5	17.7
Isolation Min.(dB)	**Phase Balance (degree)**	**Characteristic Imp. (ohm)**	**Operating Temp. (℃)**
20	90 ± 5.0	50	-55 ~ 125

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

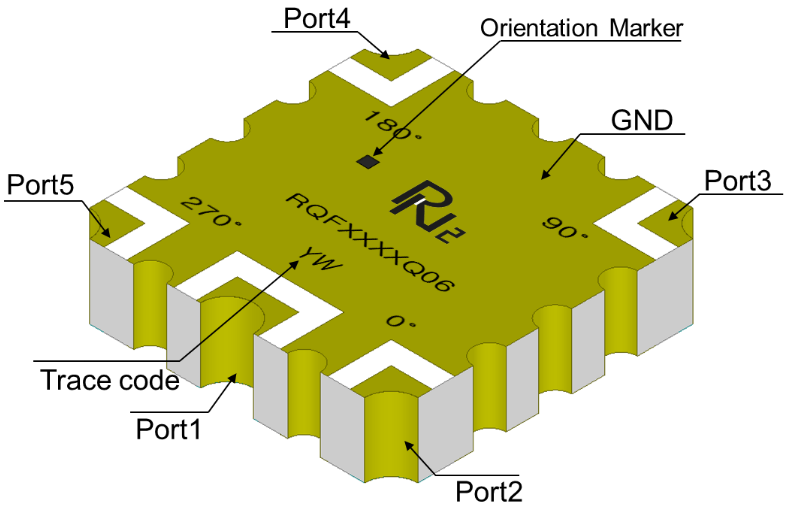


Figure 1. Top View

RQF1600Q06 port configurations depending on how input signals are split. The Case 1 and Case 2 configurations mean that one input signal is split into four output signals. When port 1 is defined, the other ports are defined automatically.

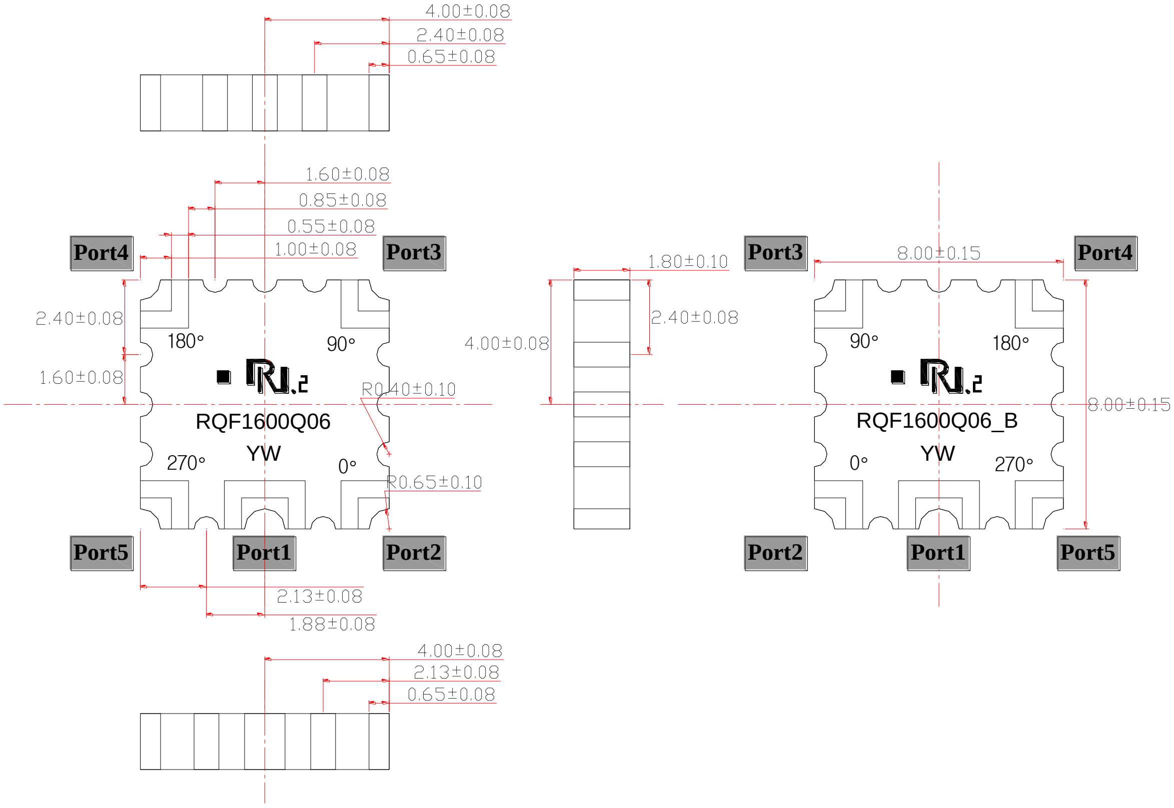
Table 1. RQF1600Q06 Port Configurations

Configuration	Port 1	Port 2	Port 3	Port 4	Port 5
Case 1.	Input	Output1 -6 dB, *0˚	Output2 -6 dB, -90˚	Output3 -6 dB, -180˚	Output4 -6 dB, -270˚
Case 2.	Input	Output4 -6 dB, -270˚	Output3 -6 dB, -180˚	Output2 -6 dB, -90˚	Output1 -6 dB, *0˚

***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 : 0.30 grams
- Camber specifications: Less than 0.08 mm

7. RF Characteristics: Return Loss (at -55 ºC, 25 ºC and 125 ºC)

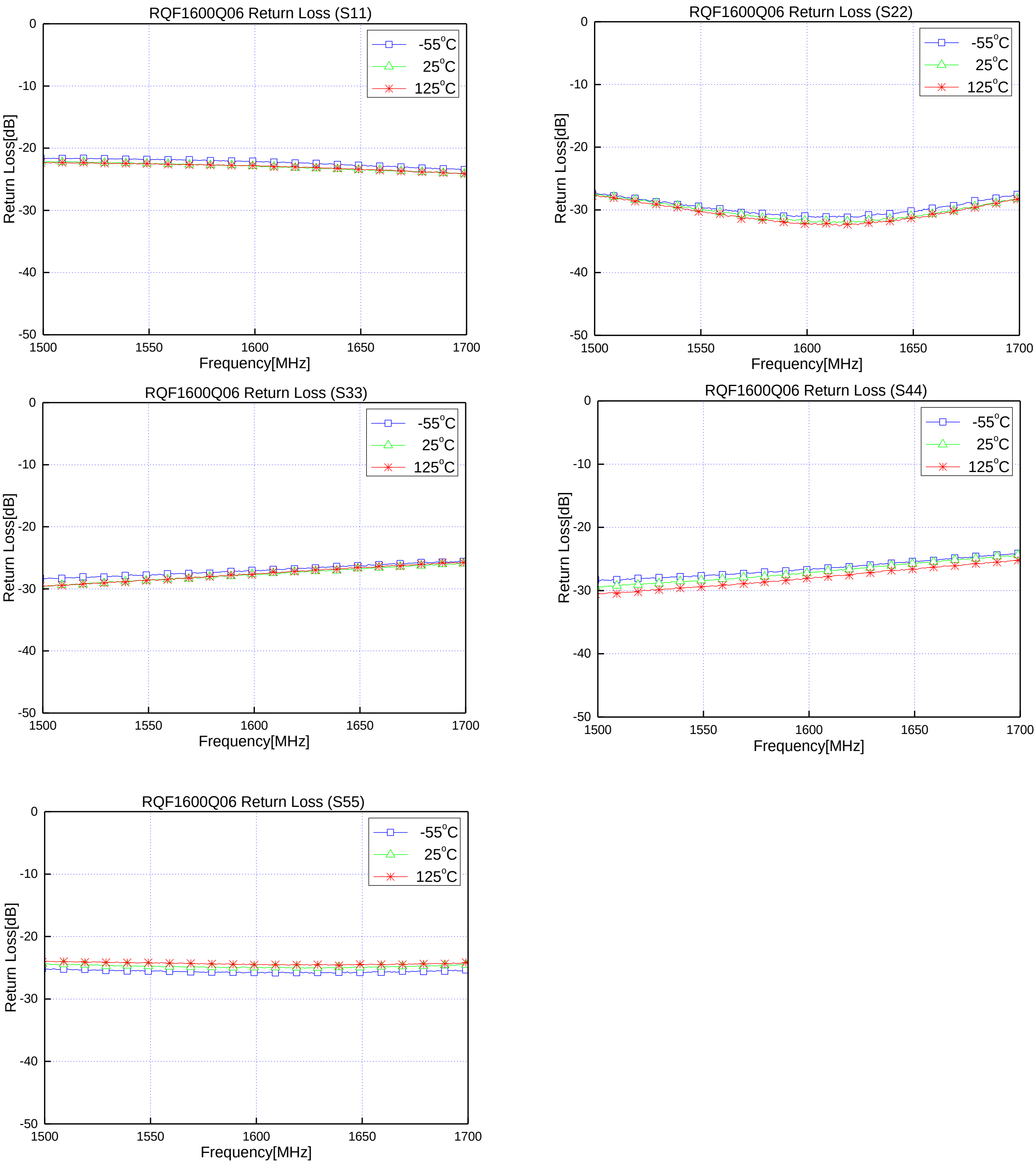


Figure 2. Test Plots of Return Loss (at -55 ºC, 25 ºC and 125 ºC)

8. RF Characteristics: Insertion Loss, Amplitude balance and Phase balance (at -55 ºC, 25 ºC and 125 ºC)

These test plots result from the Case 1 configuration in *'Table 1. RQF1600Q06 Port Configurations'*. See *'PORT CONFIGURATIONS'* for more details.

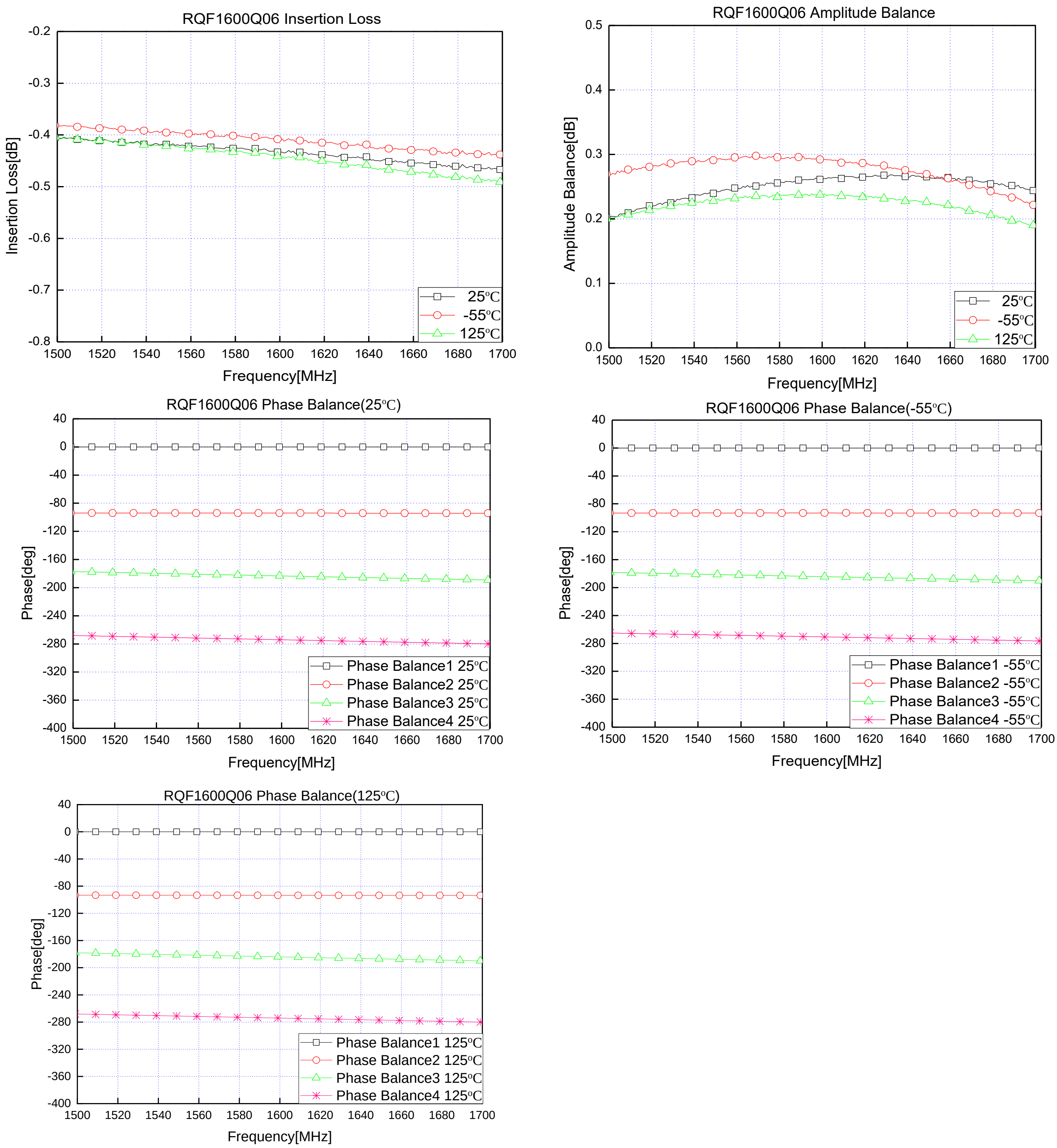


Figure 3. Test Plots of Insertion Loss, Amplitude balance and Phase balance (at -55 ºC, 25 ºC and 125 ºC)

9. RF Characteristics: Isolation (at -55 ºC, 25 ºC and 125 ºC)

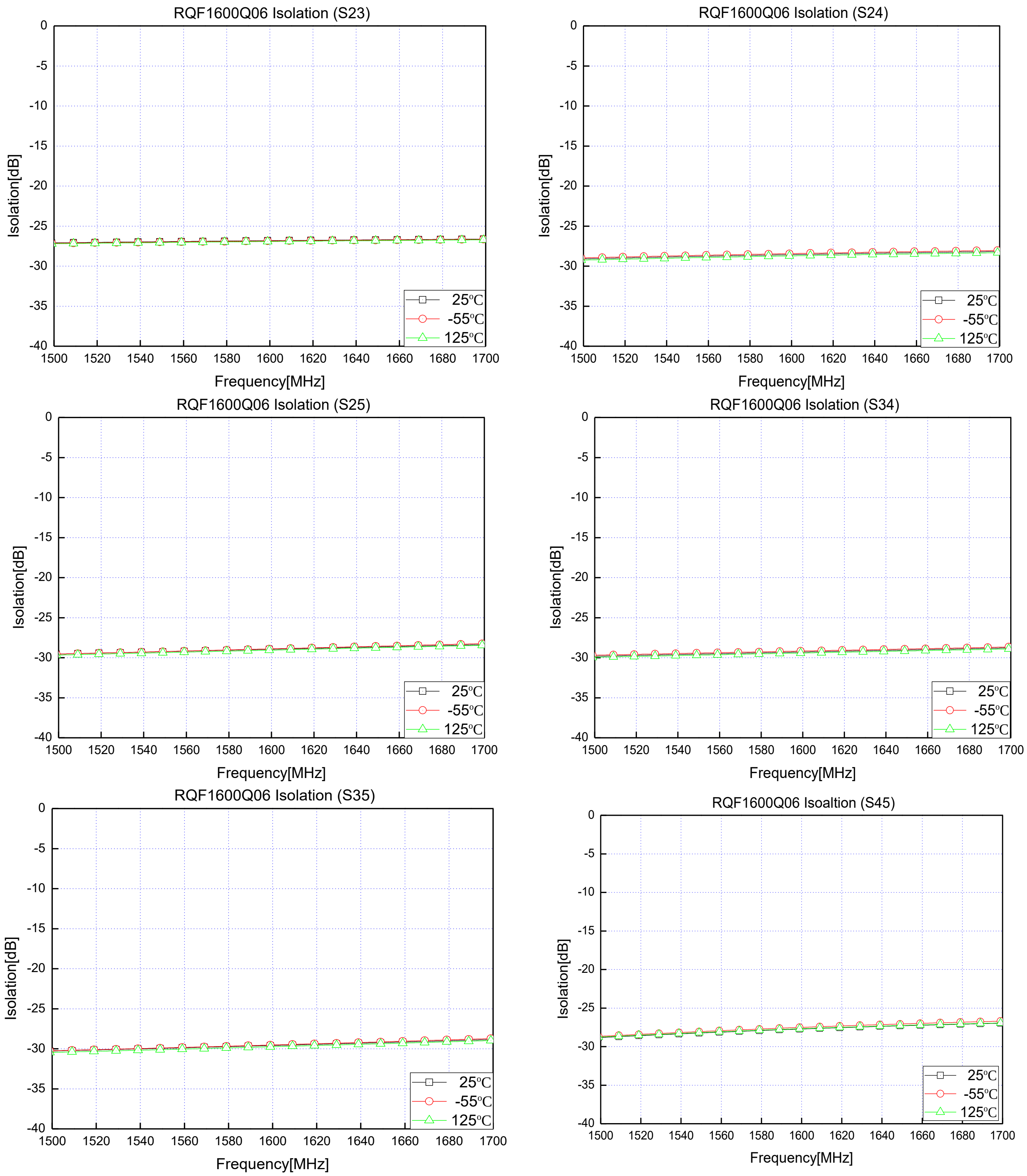


Figure 4. Test Plots of Isolation (at -55 ºC, 25 ºC and 125 ºC)

10. RF TEST METHODS

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

10.1 RF TEST PROCEDURES

To test the RQF1600Q06 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 (Transmission Loss, Isolation and Return Loss)
4. Obtaining the Characteristic Parameters (Amplitude Balance, Isolation, Insertion Loss, Return Loss and Phase Balance)

STEP 1: Preparing the Test Equipment
The following test equipment is prepared to test the RQF1600Q06 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: APE Function of the VNA
The APE function is used with the RN2 Technologies bare test board to correctly check the RQF1600Q06 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 five ports of the test fixture into the five 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 (Transmission Loss, Isolation and Return Loss)
After performing the APE function, the RQF1600Q06 S-Parameters are measured through the following steps:

1. Place the RN2 Technologies test board on the test fixture.
2. Apply pressure to the test fixture using a pneumatic piston.
3. Connect the five ports of the test fixture into the five ports of the VNA.
4. Set port1 as Case 1 configuration in *'Table 1. RQF1600Q06 Port Configurations'*.
5. Calibrate the VNA.
6. Measure the transmission loss value from port 1 to port 2, 3, 4, 5 (S21, S31, S41, S51).
7. Measure the isolation value (S23, S24, S25, S34, S35, S45).
8. Measure the return loss value from port 1 to port 1, port 2 to port 2, port 3 to port 3, port 4 to port 4 and port 5 to port 5 respectively (S11, S22, S33, S44 and S55).

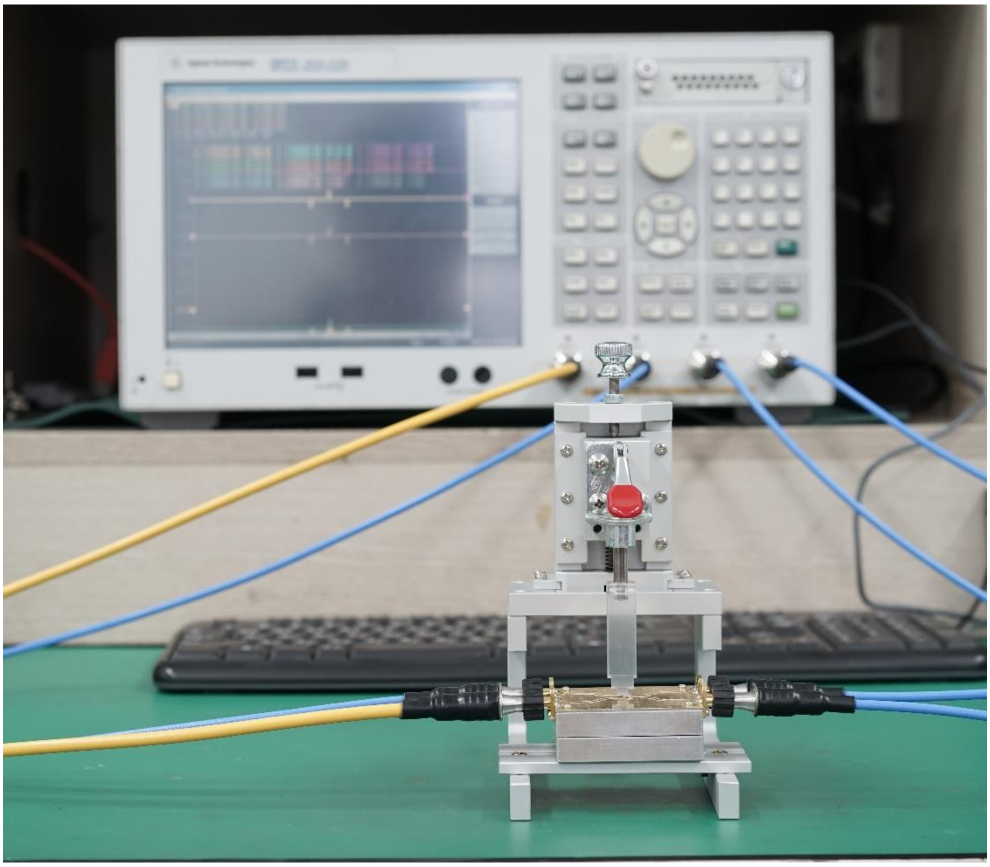


Figure 5. Test Setting to Measure the RQF1600Q06 S-Parameters

STEP 4: Obtaining the Characteristic Parameters (Amplitude Balance, Isolation, Insertion Loss, Return Loss and Phase Balance)

The S-Parameters are calculated by using the formula in ***Table 2*** to obtain the characteristic parameters, such as amplitude balance, isolation, insertion loss, return loss and phase balance.

Table 2. Mathematical Formula for the RQF1600Q06 S-Parameters

Parameter	S-Parameter	Power Method
Output1	S21	$10 \cdot \log\left(\frac{P_{Out1}}{P_{in}}\right)$
Output2	S31	$10 \cdot \log\left(\frac{P_{out2}}{P_{in}}\right)$
Output3	S41	$10 \cdot \log\left(\frac{P_{out3}}{P_{in}}\right)$
Output4	S51	$10 \cdot \log\left(\frac{P_{out4}}{P_{in}}\right)$
Insertion Loss	-	$10 \cdot \log\left(\frac{P_{in}}{P_{Out1}+P_{Out2}+P_{Out3}+P_{Out4}}\right)$
Amplitude Balance	-	$10 \cdot \log\left(P_{(Out1\sim Out4)} \Big/ \frac{P_{Out1}+P_{Out2}+P_{Out3}+P_{Out4}}{2}\right)$
Isolation1	S23	$10 \cdot \log\left(\frac{P_{Out3}}{P_{out2}}\right)$
Isolation2	S24	$10 \cdot \log\left(\frac{P_{Out4}}{P_{out2}}\right)$
Isolation3	S25	$10 \cdot \log\left(\frac{P_{Out5}}{P_{out2}}\right)$
Isolation4	S34	$10 \cdot \log\left(\frac{P_{Out4}}{P_{out3}}\right)$
Isolation5	S35	$10 \cdot \log\left(\frac{P_{Out5}}{P_{out3}}\right)$
Isolation6	S45	$10 \cdot \log\left(\frac{P_{Out5}}{P_{out4}}\right)$
Phase Balance1(0˚)	$Phase_{(S21)}$	-
Phase Balance2(-90˚)	$Phase_{(S31)}$ - $Phase_{(S21)}$	-
Phase Balance3(-180˚)	$Phase_{(S41)}$ - $Phase_{(S21)}$	-
Phase Balance4(-270˚)	$Phase_{(S51)}$ - $Phase_{(S21)}$	-

NOTE

- P_{in} : Power of Input Port1
- $P_{out\,1}$: Power of Output Port2 / $P_{out\,2}$: Power of Output Port3 / $P_{out\,3}$: Power of Output Port4 / $P_{out\,4}$: Power of Output Port5

10.2 RN2 Technologies TEST BOARD LAYOUT

Figure 6 shows the RN2 Technologies test board layout used for testing the RQF1600Q06 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 6***, 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.

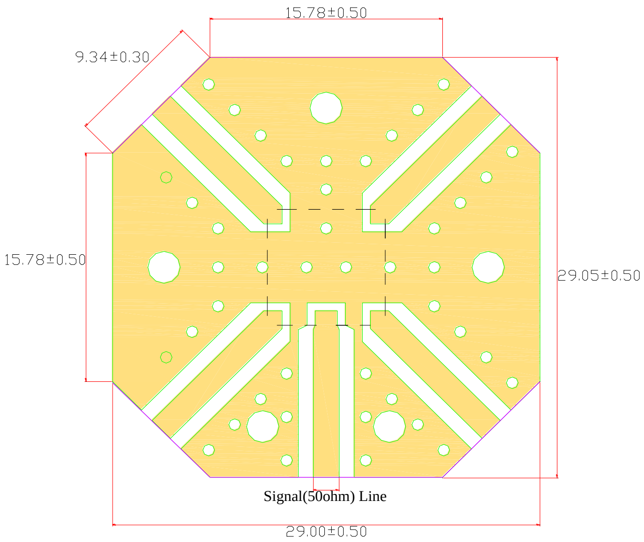


Figure 6. RN2 Technologies Test Board Layout

10.3 AUTOMATIC PORT EXTENSIONS (APE) FUNCTION

To accurately measure the RQF1600Q06 S-Parameters, we use the 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 VNA and the RQF1600Q06. With the APE function, we extend the coaxial test ports so that our calibration plane is right at the terminals of the RQF1600Q06, and not at the connectors of the RN2 Technologies bare test board.

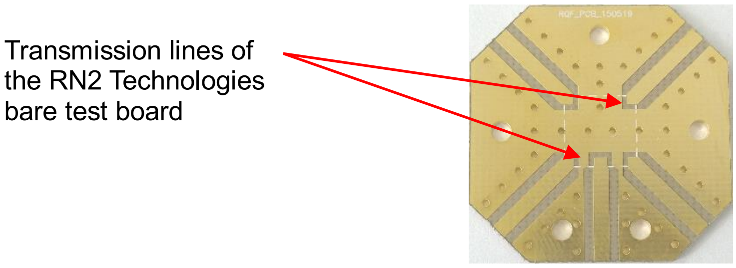


Figure 7. Performing the APE Function Test

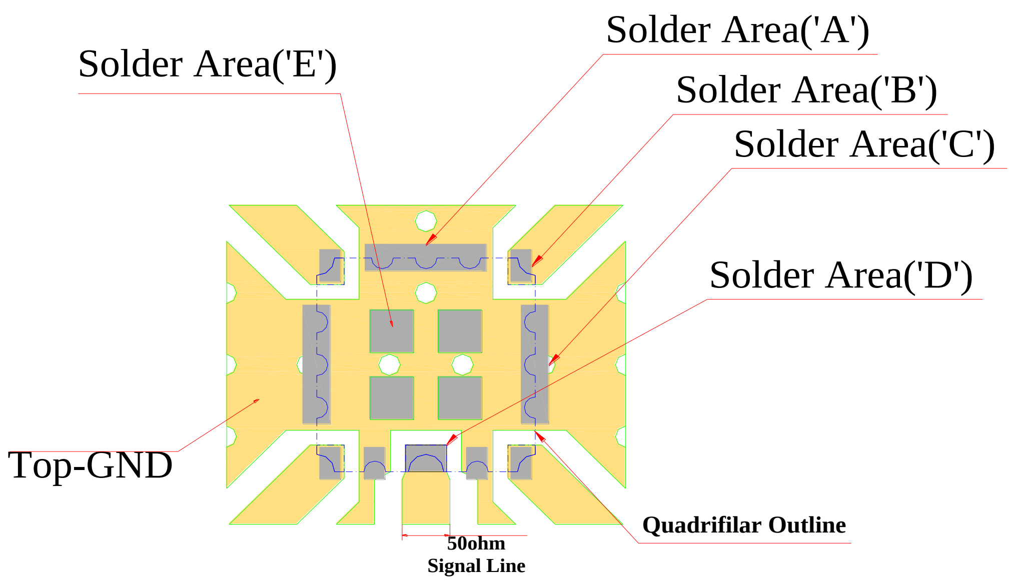
11. RECOMMENDED PCB LAND PATTERN

Figure 8 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 RQF1600Q06 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 RQF1600Q06 ground plane with the solder to have good connection to ground.
- Fill the via holes under the RQF1600Q06 with 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 X 4.50
- Solder Area ('B') Dimension: 1.20 X 0.76
- Solder Area ('C') Dimension: 4.50 X 1.00
- Solder Area ('D') Dimension: 1.00 X 1.00
- Solder Area ('E') Dimension: 1.60 X 1.60
- Unit: mm

Figure 8. Recommended PCB Layout and Solder Mask Pattern

12. SOLDERING PROCESS

The RQF1600Q06 soldering steps are as follows:

1. Cleaning the PCB
2. Applying solder paste to the PCB
3. Placing the RQF1600Q06 on the PCB
4. Reflowing the RQF1600Q06 to the PCB
5. Cleaning and inspecting the soldered PCB with the RQF1600Q06

STEP 1: Cleaning the PCB
Carefully clean the PCB surface where the RQF1600Q06 is soldered.
Particles must not be placed on the PCB surface where the RQF1600Q06 is soldered.

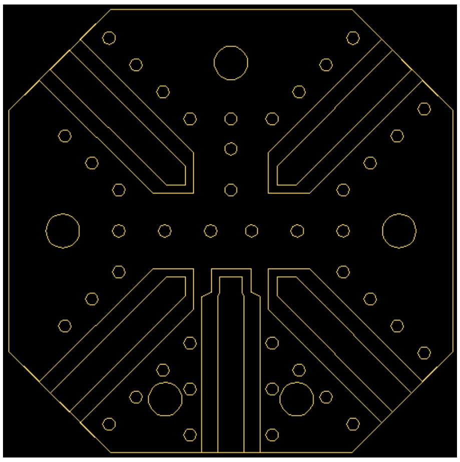


Figure 9. Cleaning the PCB Surface Where the RQF1600Q06 is Soldered

STEP 2: Applying the Solder Paste to the PCB
Apply the solder paste to the 14 points on the PCB surface.
It enables good thermal conductivity because the RQF1600Q06 is firmly attached to the PCB surface without air.

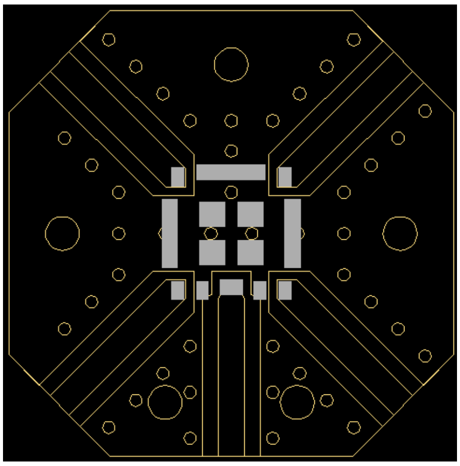


Figure 10. Applying the Solder Paste to the 14 points on the PCB Surface

STEP 3: Placing the RQF1600Q06 on the PCB
Correctly place the RQF1600Q06 on the 14 points of the PCB surface.
Applying the solder paste to the 14 points helps you firmly attach the RQF1600Q06 to the PCB surface.

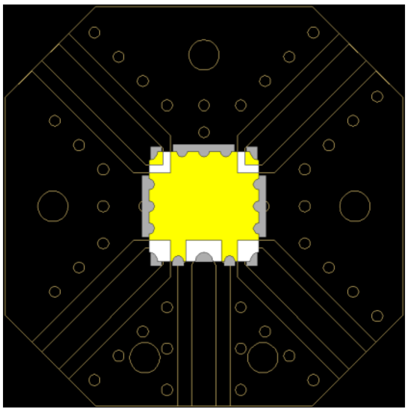


Figure 11. Placing the RQF1600Q06 on the 14 points of the PCB Surface

STEP 4: Reflowing the RQF1600Q06 to the PCB
We recommend both manual soldering and PCB surface pre-heating methods when reflowing the RQF1600Q06 to the PCB surface. Be careful NOT to touch the iron tip to the RQF1600Q06 when you use the manual soldering method.
See *'REFLOW PROFILE'* for more details.

13. REFLOW PROFILE

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

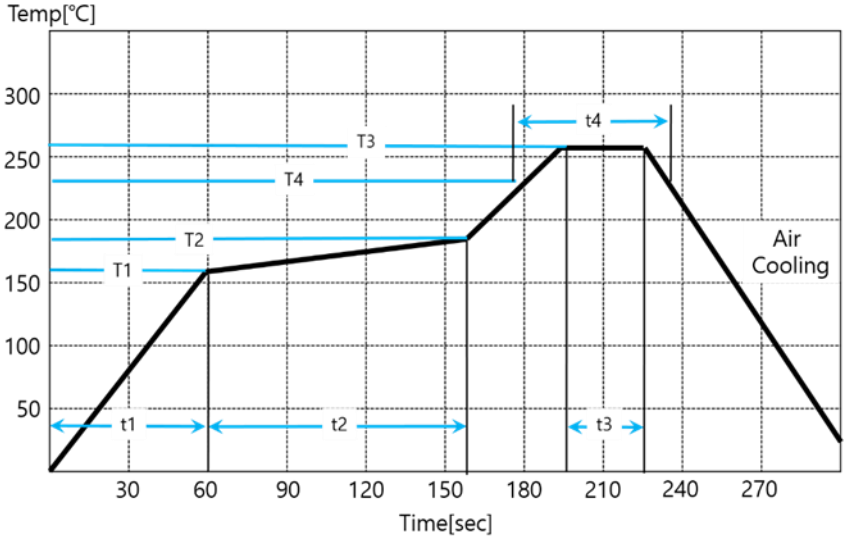
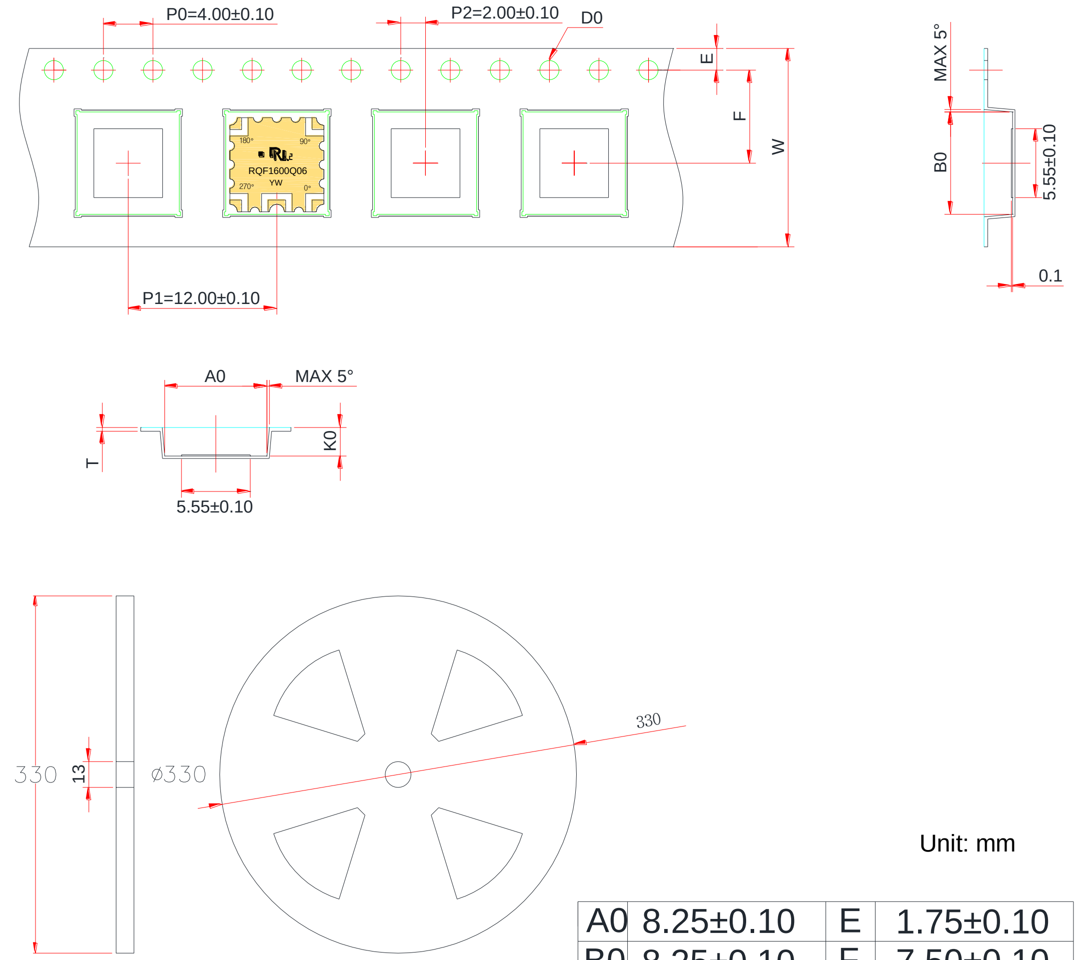


Figure 12. Thermal Reflow Profile

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

14. PACKAGING AND ORDERING INFORMATION



A0	8.25±0.10	E	1.75±0.10
B0	8.25±0.10	F	7.50±0.10
K0	2.30±0.10	T	0.30±0.05
D0	1.55±0.05	W	16.00±0.30

Standard Packaging Quantity : 2,500 PCS / Reel

15. HANDLING GUIDE

PLEASE READ THIS NOTICE BEFORE USING OUR LTCC QUADRIFILARS.

I. Be careful when transporting

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

II. Be careful during storage

- Store LTCC quadrifilars less than temperature +30°C.
- Keep the humidity at 45 % to 75 % around LTCC quadrifilars.
- Prevent corrosive gas (Cl_2, NH_3, SO_X, NO_X, etc.) from contacting LTCC quadrifilars.
- It is recommended to use LTCC quadrifilars 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 quadrifilars on the ground plane of the PCB.
- LTCC quadrifilars may be cracked or broken by uneven forces from a claw or suction device.
- Mechanical stress by any other devices may damage LTCC quadrifilars when positioning them on PCB.
- Do not use dropped LTCC quadrifilars.
- Ensure that any soldering is carried out by the condition of specification sheet.
- Do not re-use LTCC quadrifilars which are de-soldered from PCB.

16. 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