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RQFN PROTOTYPE ASSEMBLY PROCESS USING M400 ISOTHERMAL SYSTEM (ITS)

REVISION HISTORY

Revision	Description	ECR Number	Date	Owner
A	Initial Release	ECR 202007-01	December 17, 2020	WS

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1.0 OBJECTIVE

This document is intended to guide customers on the assembly of RJR's Air Cavity Plastic packages for prototyping using the M400 isothermal sealing system (ITS).

2.0 RQFN PACKAGE PLATFORM

2.1 RQFN (Air-cavity Quad Flat No-leads) is an air-cavity package consisting of a substrate (10 mil thick Cu-leadframe molded with RJR's proprietary material and LCP lid sealed together with RJR's B-stage epoxy).

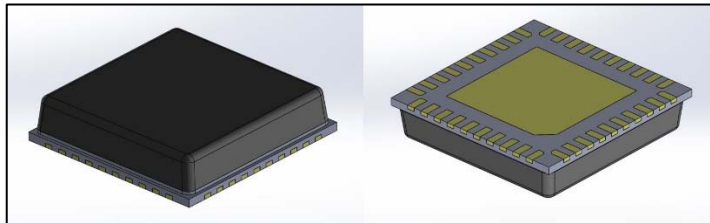


Figure 1: Example RQFN Package

Semiconductor chips are attached directly to the die pad for good grounding and better thermal management. Connecting wires (Au or Al) are used for chip-to-chip and chip-to-terminal connection. The package is then sealed with lid or cap.

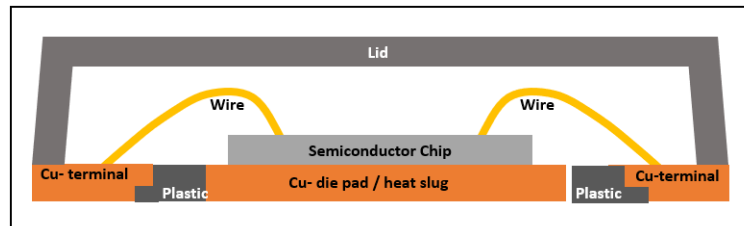


Figure 2: Cross-section Illustration of a Product Housed in RQFN Package

2.2 RJR's RQFN Material Presentation

2.2.1 Substrates

- 1) The RQFN substrate is composed of a 10mil-thick NiPdAu-plated Cu-leadframe molded with RJR's proprietary material. It is supplied in single format for prototyping purposes.

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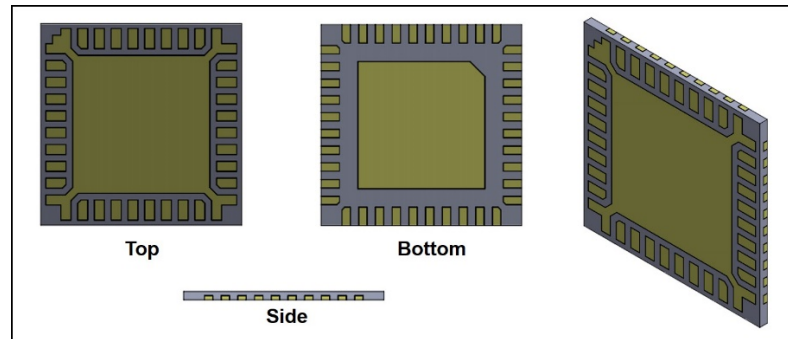


Figure 3: Sample Single RQFN Substrate

2.2.2 Lids

- 1) The RQFN lid is an LCP-based cap with a pre-applied B-stage epoxy. It is supplied in single format.

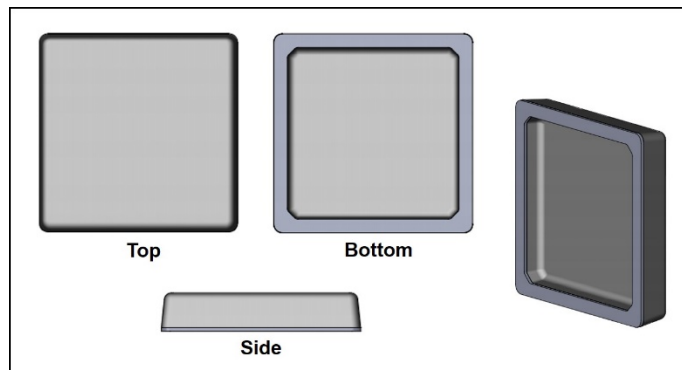


Figure 4: Sample Single RQFN Lid

3.0 M400 MACHINE DESCRIPTION:

Machine: The M400 isothermal sealing system is custom designed by RJR to guarantee the seal integrity of the ACP package.

- Physical dimensions:
 - Length: 33inches (838.2mm)
 - Width: 17.73inches (450.48mm)
 - Height: 19.23inches (488.67)
 - Weight: 60lbs (27.3 kg)

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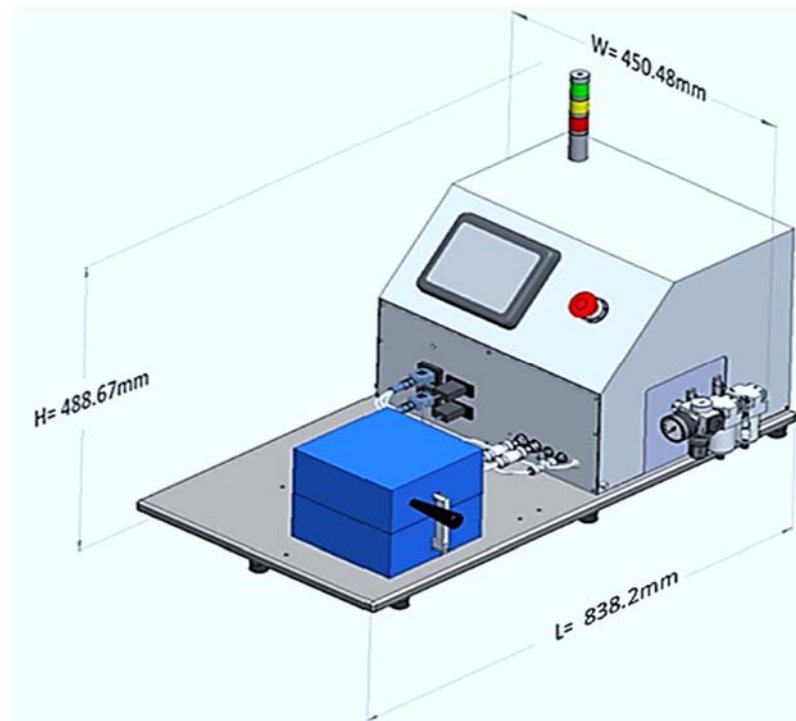


Figure 5: M400 Machine Dimensions

- Machine Facilitation:
 - Power Supply: user Selected 115/230VAC, 15A, single phase
 - System Compressed Air Pressure: 40-80 PSI (2.76-5.5 Bar)
 - Vacuum pressure: minimum 9.82 psi (0.68 bar)

- Machine Tool-up:
 - The sealing plates included with the Model 400 are custom designed for RQFN packages.

 - The RQFN prototype sealing plates have 40 cavities each for substrates and lids, composed of 8 rows for each package size: 4x4, 5x5, 6x6, 7x7, and 8x8.

4.0 PACKAGE PROTOTYPE ASSEMBLY INSTRUCTIONS

4.1 Machine Setup

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4.1.1 The setup of the machine can be checked in the ITS 400 User Manual.

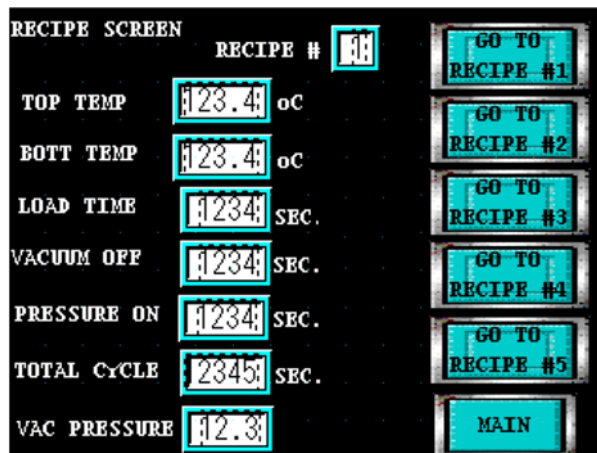


ITS400 User Manual
Upgrade June 17 20

4.1.2 A sealing plate is used in the RJR Model 400 Isothermal sealing system, which has to be properly installed, according to the operating manual (see ITS400 User manual). For RQFN, the prototype plates will support 5 package sizes ranging from 4x4 to 8x8 sizes.

4.1.3 The next step is to either (1) download the program; or (2) select the program (if preloaded); then turn on the unit and you are ready to assemble parts after a half an hour of warm-up time to reach the proper operating temperature. In the case that the machine program will be provided during on-site process dial-in and training by an RJR Engineer, then wait for the RJR personnel to initially set up the unit.

4.1.4 RQFN substrate to lid process needs to be sealed on the sealing step to be processed, which can be confirmed on the touch screen as follows:



4.2 Sealing Plate Setup

4.2.1 The RQFN assembly using the prototype plate, you would populate the size(s) to be used and tape off the empty cavities, otherwise, the vacuum channels of unused cavities will leak and the parts that need to be held by vacuum will fall out. Thermal tape should be used to cover the unused cavities for the sealing process to work properly.

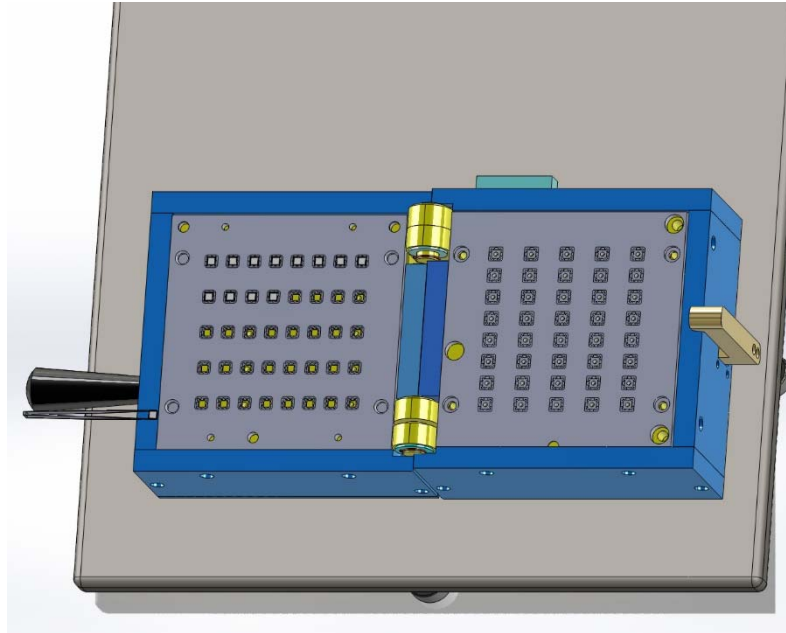
4.3 Sealing Processes

4.3.1 RQFN Substrate to Lid Attach

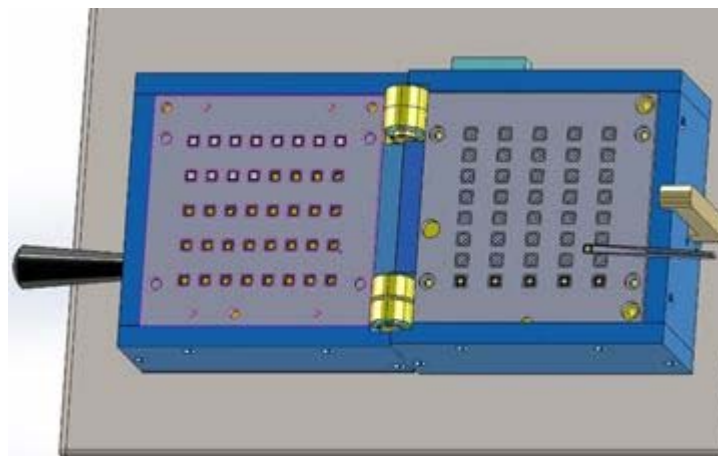
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- 1) Open the top clamshell of the M400 machine.
- 2) Using plastic tweezers, carefully place the coupon substrate with pre-bonded dies and wirebonds on the coupon substrate cavity in the bottom sealing plate of the M400 sealing plates.



- 3) Using a plastic tweezers, place the lids in the lids-cavity slot in the top sealing plate with epoxy side facing out in the M400 sealing plates.



- 4) Press "**LOAD**" button in the HMI and wait for 1 minute (as pre-heating of the materials).

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- 5) When the “**LOAD**” time is completed, the operator will hear the buzzer, signaling it is time to close the clamshell.
- 6) When the clamshell is closed, press “**START**”.
- 7) After pressing “**START**”, sealing cycle starts and ends in 12 minutes. After 12 minutes the, clamshell lock is released and “Total Cycle Complete Press “**Enter**” to Continue” appears in HMI.



- 8) After pressing “**ENTER**”, then the top clamp can be opened.
 - The operator can now remove the sealed ACP package from the sealing plates. Use plastic tweezers to unload and place the unit on a clean metal surface to cool down.

Notes:

- Since the units are functional, make sure that the M400 machine and cooling plates are properly grounded to avoid ESD.
- Close the M400 clamshell when not in use.
- The sealing plates temperature is 160°C.

5.0 POST CURING

- 5.1 After the sealing process in the M400, the units must be post cured on a batch oven at a temperature of 180°C ±5°C for 1 hour.

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Figure 6: Batch Curing Oven

6.0 BUBBLE LEAK TEST

6.1 To test sealing integrity the RQFN package is subjected to gross leak test. RJR recommends following MIL-STD-202G (see MIL-STD-202G document). In general, the assembled ACP package is submerged in an indicator fluid tank at temperature of 125°C for at least 30sec. The fluid typically used is Fluorinert® Liquid (FC-40).



Figure 7: Trio-Tech Bubble Leak Tank

7.0 DISCLAIMER

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