

A Study of Universal Bond Testers

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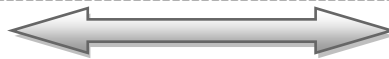
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Abstract

Universal bond testers are the devices that aid the operators in testing the die to withstand a force on its wire and ball bonds. Advanced bond test systems today are high precision universal systems that can perform pull and shear type tests. Royce -550,552 and 580 are being used by SPEL Semiconductor Ltd. for carrying out wire pull and ball shear tests. Of these, Royce-580 is the most advanced version which updates the test logs instantly into the computer. This decreases the need of man power to enter the test values. Several new features of the more advanced universal bond testers have been discussed. The paper also contains a brief analysis on different universal bond testers present till date and the new versions being upgraded.

Keywords : CAR, ERP, ED, QC, Statistical process.

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I. INTRODUCTION

SPC:Statistical process control is a method of quality control which uses methods based on statistics and is applied to monitor and control the process. Monitoring and controlling the process ensures the operator to work at his full potential. The process can make as much conforming product as possible with a minimum of waste and be applied to any process where the 'conforming product' output can be measured. Statistical process control is an analytical decision making tool which allows us to see whether a process is working correctly or not. There is a document by name WIP-SPC-001 where all the relevant information regarding the known procedures and specifications shall be followed by the ED personnel. For plotting charts, it considers both the engineering as well as manufacturing functions and there will be a measure of relationship between specification limits and capability. It is a combination of people, procedures, methods, machines, materials environment for specific work activities to produce a given product or service. All SPC data collection, charting, plotting and interpretation must be made in real time. When a particular lot is out of control limit, the CAR alert will be generated automatically. The ED & QC personnel will close the raised CAR by taking necessary action on the deviated lots & ensure it is entered in the system. Once the CAR gets closed, the lot will be released from the ERP system & the entries can be made for the particular lot.

1.1 Wire Pull Testing (WPT): It is one of the most available forms of performing tests on the wire bond strength and quality. It consists of a small hook kind of thing for applying an upward force under the wire to be tested, by pulling the wire away from the die. Wire pull testing requires special equipment usually called wire pull testers or bond testers. A mechanism for applying the upward pulling force on the wire using a needle like tool known as 'pull hook', a calibrated instrument for measuring the force at which the wire eventually breaks. The breaking force is expressed in terms of grams-force (gf). Attach one end to a bond pad on the die and the other end to the bonding finger of the package. The pull hook is usually positioned at the highest point along the loop of the bonded wire, and the pulling force is generally applied perpendicular to the die surface (vertically if the die surface is horizontal). The wire pull tester measures the pulling force at which the wire or bond fails. Royce 550, Royce 552 and also Royce 580 are the test machines with a speed 0.004 – 0.005 inch/sec.

1.2 Bond shear testing (BST): This is a destructive test conducted to determine the ability of Ball Grid array solder balls to withstand the mechanical shear forces. This test complements the wire pull test. This is because of the existence of failure mechanisms in the bond exhibits a high bond shear strength but offers very little resistance to wire pull stresses. A bond shear tester consisting of a sample holder, a shearing arm with a chisel-shaped tool at the end, and an instrument for measuring the shear strength of the bond. Initially, the shearing tool is positioned beside the ball bond to be tested. The shearing arm then moves the tool horizontally against the ball, in effect pushing the ball off its bond pad. The force needed to shear a ball off its pad, known as the bond shear force, is then measured by the ball shear tester.

The shear force reading of a ball bond must be related with its ball diameter for proper assessment of its ball shear strength. Similarly the shear force reading of wedge bond must be related with the tensile strength of wire for proper assessment of its wedge shear strength.

Bond shear failure modes include the following:

- [1] Bond lifting;
- [2] Bond shearing;
- [3] Crate ring;

Misplacement of the shearing tool produces invalid bond shear failures. Those shear force readings must be excluded from the analysis.

II. UNIVERSAL BOND TESTERS

We hear a lot about the bond pull and shear tests in today's technology press. So the crucial testing mechanisms in the industry are met using the universal bond testers. This high-end instrument is advanced, versatile and powerful enough to meet your complete bond testing needs. The range and resolution of the shear force in Royce 580 can be varied according to the specifications.

I/P and O/P ports of Royce 580

RS-232 port (9 pin male)

Sure PC port (9 pin male)

Tool controller

Stage controller

Camera power (0.4 A, 12V DC)

Printer setup

Main power (3A 240V ~ ; 6A 100V ~; 50-60 Hz)



Fig.1 I/P and O/P ports of Royce 580

Another lateral side of the machine has 4 connections. They are used to interface:

- [1] keyboard
- [2] foot switch
- [3] supply air (60-80 PSI)
- [4] supply vacuum (20 in HG)

The Royce 580 system at the FOL has three modules of which 2 are shear modules used to carry on ball shear test and 1 is wire pull module used to perform the wire bondings. The following is the statistics menu in the Royce 550 instrument used for performing the tests:

- [1] 1.output report
- [2] 2.output data
- [3] 3.output histogram
- [4] 4.non-destruct and void tests
- [5] 5.valid tests and
- [6] 6.test starts

The other systems used are Royce 550 and 552, which are of old technology, which does not support interfacing with the computer at present.

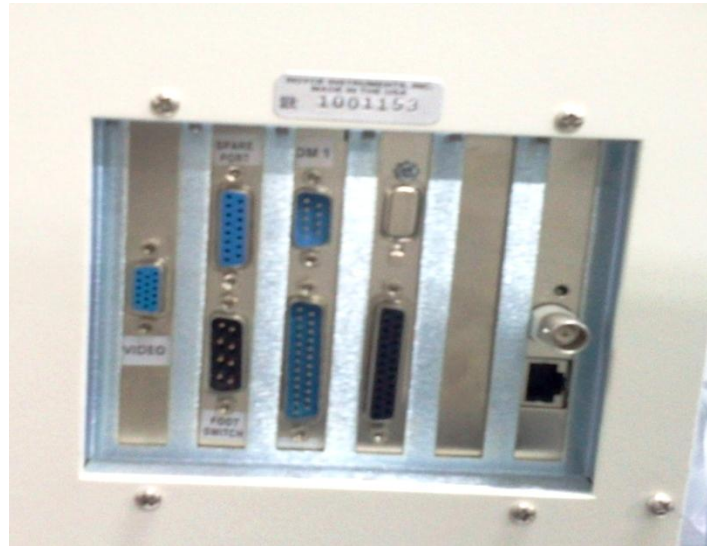


Fig.2 I/P and O/P ports of Royce 552 instrument.

The following is a table showing the minimum no. of samples on which the tests are performed:

Packages	WP & crater test	Bond shear test	Total units
LMP	2	1	3
Matrix QSOP	2	2	4
Matrix 8tssop	2	2	4
Matrix 56& 64 TSSOP	2	1	3
20 SOIC & 48 TSSOP	1	1	2

Table.1

Force measurement The pull and shear tests are mechanically different. The nature of these processes dictates that resolution and accuracy of the testing systems is key.

Test module for	Max force	Accuracy (+ or -)	Resolution
Pull	100g	0.15g	0.01g
Pull	1kg	1.5g	0.1g
Pull	10kg	10.0g	1.0g
Shear	250g	0.38g	0.025g
Shear	5kg	7.5g	0.5g
Shear	100kg	100g	10.0g

Table2. Accuracy and resolution requirements for various pull and shear tests.

In a casualness of system applications, accuracy and resolution in pull and shear testing often lost their importance. Resolution is the smallest increment an instrument can show. Accuracy is the distance between the two concentric circles a distance from the center. Precision is the tightness of the cluster of accuracy measurements. It is important to precisely identify the force peak that corresponds to bond failure. For accurate bond testing, different segments of the force range to be tested are best accommodated with separate modules, rather than electronic range witching that magnifies noise along with the range.

III. COMPARISON OF ROYCE-550,552,580 BOND TESTERS

The following is a table showing the present network feasibility of the Royce modules:

Property	Royce 550	Royce 552	Royce 580
PC interface	No	No	Yes
N/w feasibility	No	Yes	Yes
Flat file generation	Yes	Yes	Yes
Data through floppy	Yes	Yes	Yes

Table.3

Features Common to the Royce 550 and 580

In addition, the Royce 552 includes a number of important features that are also standard on the Royce 580:

- **Interchangeable test modules and tooling.** Most of the test modules and tools are quickly interchangeable between the Royce 552 and Royce 580. All test modules have four software-selectable sub ranges down to 1/10 of full scale, to maximize the versatility of the instrument.
- **Robust test module design.** Royce's robust design minimizes down time and the need for module repairs, while improving the user experience.
- **Ergonomic design.** The Royce 552 and 580 have been designed to support operator comfort over long shifts.

IV. CONCLUSION

Linking of Royce module to the system to update the information of wire pull test, ball shear test, die shear test values directly into the ERP. If we update the information automatically there will be no delay in production as well as we can get to know the information regarding rejections, etc. The advanced versions of the Royce 600 series are also available which offer even more services. As packaging and technology roadmaps weave their way toward ever more complex inter-connects, more advanced bond test systems must and will continue to evolve to meet this challenge.

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