

Optima II 7250™ Optical Process Test (OPT) System

In-process test & measurement of SMD component placement performance



OPTICAL PROCESS TEST

- *In-process measurement and defect detection for Wireless, RF, and NPI applications*
- *Ideal measurement vehicle for PCBA manufacturers implementing 6-sigma SMD practices*
- *Built-in compensation for normal PCBA and process variation during program and runtime*
- *Internal SMD process knowledge displaces user judgment and skill requirements*
- *Eliminates nonstop user program tweaking to maintain stability and coverage over time*
- *Production-ready programs developed with as few as one PCB sample*
- *Complete production ready program in hours*
- *Less than 20 ppm false flag/false accept rates readily achievable*
- *In-process measurement of component placement function and performance*



Introducing the Optima II 7250™ Optical Process Test (OPT) System from Landrex, representing groundbreaking developments in PCBA vision technology, and an exciting alternative to earlier-generation machine vision systems. The Optima II 7250 OPT System uses patented image analysis technology to perform PCBA tests for SMD component placement defects in a single pass, while also providing in-line monitoring capability for placement process conditions. The Optima II 7250 OPT patented image analysis technology replaces user judgment and skill with built-in knowledge of SMD process and variation compensation. This simplifies programming and runtime, while eliminating continuous tweaking of programs over time. Optima OPT programs can be written and debugged rapidly because variation is compensated for and actively managed, not left to lengthy program modification throughout production. The novel hardware design of the Optima II 7250 OPT System uses broad spectrum light and a single color camera. This eliminates the complex lighting and control common to other machine vision alternatives, simpli-

fying system operation and assuring reliable, repeatable results. As a result, Optima II 7250 can deliver gauge repeatability and reproducibility (GR&R) metrics suitable for 0402 and 0201 sized components, on real boards, with real parts, in real conditions, making it the ideal choice where real-time closed-loop operation mandates repeatable, accurate measurement of process information in spite of process variation.

VARIATION SMART

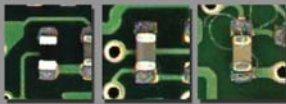
Appearance variation is a major cause of alternative machine vision systems' long programming, trial-and-error based debug, nonstop modification and elevated false flag rates. Because variation and defects represent changes from expected conditions, they cause inspections to fail. Yet, some types of variation are a normal occurrence in manufacturing and must be accommodated. Parts vary, boards vary, people, and processes can all vary. However, while normal variation must be expected and tolerated in a process, abnormal process variance and defects must not be. That's why we developed the Optima II 7250 OPT System. The Optima II 7250 OPT System features revolutionary Configural Recognition™ Image Analysis and VARI-Smart™ Image Compensation Technology that builds process knowledge and variation awareness into the image analysis phase. These technologies enable the Optima II 7250 OPT System to automatically compensate for normal variations in PCBA manufacturing processes from part color and shape, board color, placement, and construction variances during testing. This eliminates the need for the programmer to incorporate these considerations during programming, debug and runtime. Compensation for variation effects during programming and debug phases enables OPT program development cycle-times to be significantly shorter than trial and error based alternatives, and dramatically improve false flags and escapes rates. The Optima II 7250 System's VARI-Smart technology allows experienced users to complete production-ready programs in as little time as one hour, with as few as one sample board. Optima II 7250 OPT System programs operate



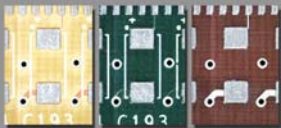
without requiring changes or tweaking despite normal variances in board color, part color, part shape, or standard part substitution. Unlike alternative statistical appearance methods that require large board volumes to establish normal variation levels, VARI-Smart Technology uses internal standards and first article tested data. Existing statistical methods require large quantities of good & bad PCB samples that must be reviewed using consistent standards and user judgment. VARI-Smart Technology is different. It's built into the Optima II 7250 OPT programming paradigm, and operates from the onset of production, compensating for normal variation on-the-fly.



Parts color variation



Tin end cap luminance variation



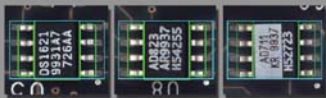
Board color variation



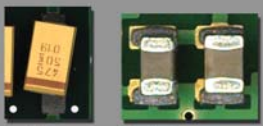
Pad colors & paste configuration variation



Fiducial variation



Part marking/labeling variation



Gold board X, Y, θ variation

Part size variation

Normal process variation is automatically compensated for by the Optima II 7250 Optical Process Test (OPT) System.

Where local standards mandate differing degrees of "normal" variation, VARI-Smart Technology provides advanced tools to adjust parameters rapidly, validating the resulting operational differences, and allowing the reversal of any changes made.

FLEXIBILITY

The Optima II 7250 OPT System delivers comprehensive coverage for customers requiring high-flexibility, non-contact test solutions, even in medium/high mix or medium/low volume lines. Configural recognition allows the Optima II 7250 OPT System to generate effective test programs even where board volumes are modest. VARI-Smart Technology allows Optima II 7250 OPT Systems to compensate for normal variation immediately, providing coverage for rapid changeover lines and con-signed lot manufacturing. Even in very low volume applications such as new product introduction (NPI)

Optical Process Test:

The Optima OPT System ushers in a new type of machine vision technology. It uses completely different science to collect and analyze image data. The Optima II 7250 OPT System does not use adjustable lighting, imaging or source conditions to image the PCB. Instead, the Optima OPT System collects, ordinary color image, making the image capture process extremely quick and simple. The balance of the optical test then uses the Optima II 7250 System's sophisticated image analysis and recognition technology on this stored image to properly test placed objects on the PCBA.

Optima OPT System is based on Configural Recognition: intelligent object and scene localization, test, and diagnostic methods commercialized by Imagen, Inc. These patented techniques use built-in process knowledge of what's being tested, and take a "holistic" approach into the localization and test process. Diagnostics then use both individual assessments of regions of the object, as well as the spatial relationships of these regions to determine the overall test conclusion

for appropriate fault classes, making it a viable alternative to deliver volume process coverage for wireless, mobile phone, and RF applications.

The Optima II 7250 System delivers on the promise of machine vision, providing true non-contact testing with rapid programming, vast reductions in false flag rates, and the elimination of non-stop program maintenance required to resolve them. It solves the most basic problem inherent in alternative machine vision systems by compensating for normal, every-day variations, while still providing user flexibility in its deployment and use.

PROCESS TEST PERFORMANCE

Most manufacturing test systems are defect oriented, focused at hard defects in product. Optima II 7250 OPT Systems provide product defect coverage, but are also designed for users who require real-time manufacturing and process control data. They measure process variable data to provide users with real-time feedback of what's happening in the process - before hard defects occur.

Generally, it's recognized that any measurement system must maintain a figure of merit 10 times that of which it's trying to measure. For measurement repeatability of small geometry parts, this represents a significant challenge. 50 percent off-pad rules for 0201 devices therefore mandate a measurement repeatability of 0.5 mils to reliably gauge the 5 mil offset that results (see example box). Optima II 7250 OPT Systems are designed to deliver measurement repeatability of better than 0.133 mil/3.3 microns, more than sufficient for today and tomorrow's small geometry components. Optima OPT Systems are capable of reliably measuring process variable data on components as small as 0201 discretes and 16 mil pitch devices, ideal for an

facilities, the Optima II 7250 OPT System's flexibility delivers rapid production-ready programs. With rapid test generation, NPI facilities can shorten overall board manufacturing cycle-times, reduce time to first article validation, and improve outgoing prototype product quality. In high-volume applications where in-circuit test (ICT) is not possible or not economical, the Optima II 7250 OPT System delivers equally reliable process test results

advanced manufacturer's implementing advanced 6-sigma processes. More impressively, the Optima II 7250 OPT System delivers this performance capability with real components, real boards, and with real manufacturing variances present, not just in laboratory conditions. SPC and measurement packages allow variable data measured by the Optima II 7250 System to be reviewed for failure paretos and specific fault types, generating advisory reports to pinpoint setup and offset problems that left unchecked, result in component defects down the line.

Highlighted System Features Include:

■ **One-hour, One-Board Programming:**

The software tools of the Optima II 7250 OPT System understand normal process variation, and do not require massive board volumes or long production runs to establish the normal variation present. Using a single board as its reference, experienced engineers can develop a production-ready test program for a board in as little as one hour. The result is unified testing across an entire production run from board one onward.

■ **Complete Normal Variation**

Tolerance: The Optima II 7250 OPT System incorporates the awareness and acceptance of common and normal variations in the PCB being tested. Vendor, line, part, and board variations are accommodated without program change or down time. Program changes are not necessary to correct for variations in components and PCB.

■ **Elimination of Constant Modification and Tuning In**

Volume: Built-in variation tolerance in the Optima OPT System allows new products to move quickly from program debug to production. Perpetual volume modification or fine-tuning is not needed, allowing precise test margins, not their variations, to validate the objects under test. The result: a uniform and consistent test program.

■ **OCV Capability:** Optical character verification (OCV) enables the Optima II 7250 OPT System to validate part markings to accurately accept or reject parts based on part markings.

■ **NPI Compatible, for "Any-Volume Capable"**

Operation: Because the Optima II 7250 OPT System works in any volume/mix requirement, new product introduction (NPI) and product introduction centers (PIC) will find the Optima II 7250 System ideal for testing versions of new designs. The Optima OPT System does not require the testing of large volumes of boards to stabilize processes before it can be put into use. The Optima II 7250 System is capable of delivering coverage in an NPI environment after viewing only one board, shortening machine setup times and increasing delivered quality.

■ **20 ppm False Flag Rate:** With the elimination of false flags due to variations, false flag rates under 20 ppm can be readily achieved with the Optima OPT System's standard

System Features:

While highly sophisticated, the Optima OPT System is also very simple to operate making it the ideal choice for a wide array of electronics manufacturing environments. The skill levels required to program and operate the Optima II 7250 System are reduced as compared to other test and inspection alternatives, which allows expensive engineering talent to be redeployed elsewhere.

parts library, eliminating unnecessary rework and review operations common to less reliable systems.

■ **Gauge Repeatability and Reproducibility (GR&R):** The Optima II 7250 OPT System is capable of testing for positional compliance to a GR&R of 10%, for small geometry components outside of a "perfect" lab environment, on real boards, in real production situations.

■ **Closed-Loop Operation:** The Optima II 7250 System's combination of extraordinary GR&R performance and low false flag rates make it a preferred choice for providing accurate variable data to pick-and-place or chip-shoot equipment operating in closed-loop modes.

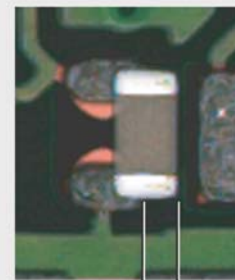
■ **SPC Data:** The Optima II 7250 System is equipped with a statistical process control software package which allows positional(i.e. variable) data to be collected, aggregated and analyzed to examine process variation by reference designator, package type, placement feeder, geographical area of the board, and more.

■ **0201 Capable:** The Optima II 7250 System can reliably test 0201 components today, for tomorrow's wireless and high-end personal electronic devices.

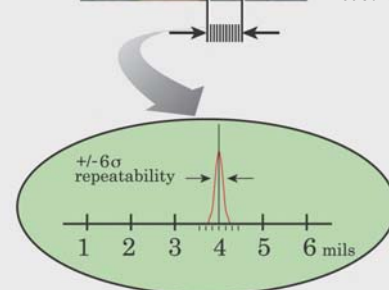
■ **Program Transportability:** The reliability of the Optima II 7250 System allows for test programs to be deployed across any number of multiple systems without the need for additional debugging or tweaking.

Repeatable in-process measurement of SMD line performance finds process error conditions in real time, avoiding later problems.

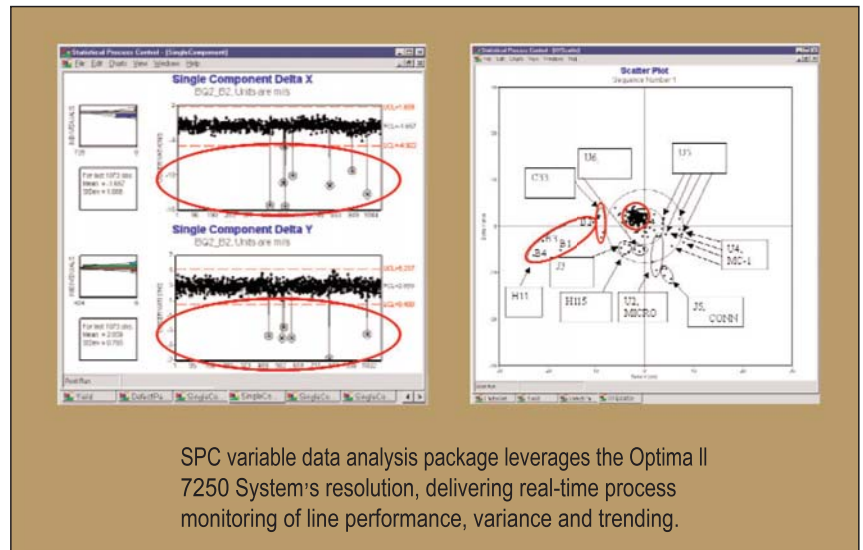
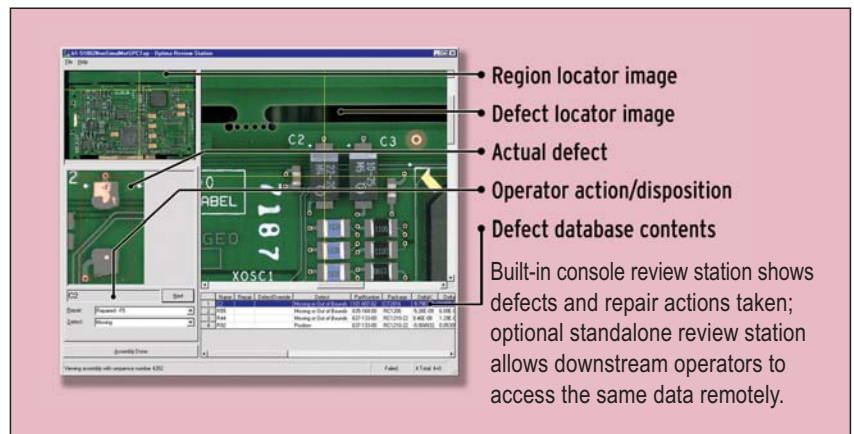
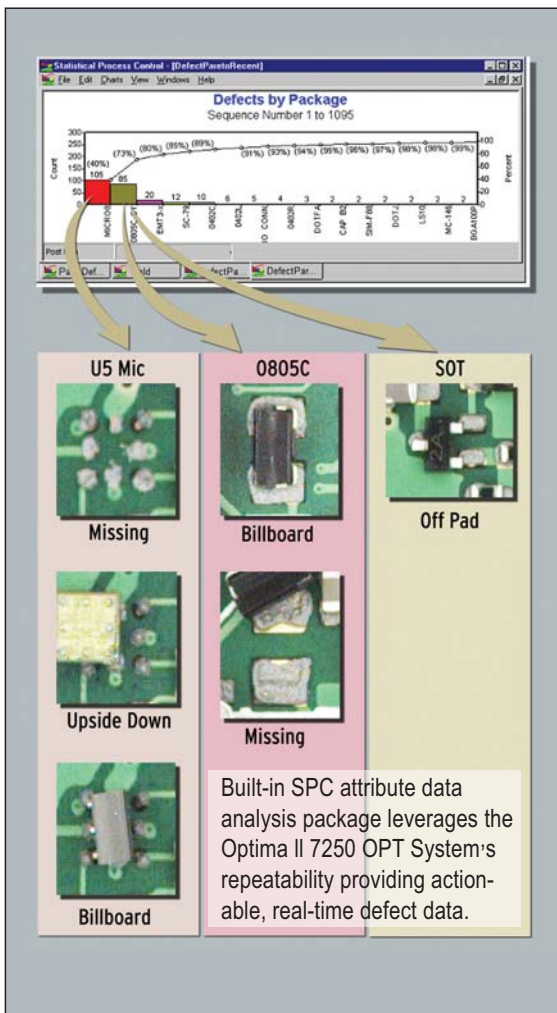
Results: High-repeatability, high-resolution SMD measurements of manufacturing process metrics.



The minimum measurement resolution required is one tenth of the smallest dimension being measured.



Process measurement repeatability is key to reliable process data. Optima OPT is the ideal SMD process measurement platform for Six-Sigma focused manufacturers.



Specifications

Test technology

- Configural Recognition image analysis technology for comprehensive, repeatable, production-ready tests
- VARI-Smart image compensation technology automatically compensates for variation
- Built-in process knowledge for rapid program development
- Awareness of key features for more reliable image analysis, more repeatable tests
- Fast, robust optical character recognition (OCV/OCR) capability. Automatic adjustment for common geometric and image variations

Component placement tests

- Presence/absence
- X/Y offset
- Rotational offset
- Wrong component
- Component orientation
- Damaged component

Measurement accuracy

- X & Y axis: +/- 0.0001" (0.0025 mm)

Measurement repeatability

- X & Y axis: +/- 0.133 mil" / (3.3μ) @ 1 sigma
- +/- 0.4 mil" / (10μ) @ 3 sigma
- +/- 0.8 mil" / (20μ) @ 6 sigma

Inspectable parts

- All discrete parts to 0201
- All SMD IC packages types

Field of view (FOV)

- 1.3" x 1.3" (33 mm x 33 mm)



Optical resolution

- 0.00129" (0.033 mm) pixel size

Inspectable area

- Minimum: 2" W x 2" L (50 mm x 50 mm)
- Maximum: 18" x 20" (457 mm x 510 mm)

Top-side/bottom-side clearance

- 1.5" (38 mm)

Facility and Factory Integration

Power requirement

- 100/110/120V, single-phase, 50/60Hz, 20A
- 200/210/220/230/240V, single-phase, 50/60Hz, 10A

Size

- 39.37" W x 62.6" H x 49.49" D
- (100 cm x 159 cm x 125.7 cm)

Weight

- 2500 lb (1134 kg)

Conveyor system

- Fixed front rail
- Integrated conveyor
- Optional auto-adjust conveyor
- Pass-through mode allows independent conveyor operation
- SMIEMA compliant
- Panel thickness:
 - Minimum: 0.01" (0.250 mm)
 - Maximum: 0.25" (6.4 mm)
- Maximum panel mass: 6.6 lb (3 kg)
- Board edge clearance: a minimum of 3mm or .118" of clear board space is needed.

Computer system

- Dual Intel Pentium III 1.4 GHz processors
- 2 gigabytes of CPU memory
- Fixed 18 gigabyte SCSI disk drive
- Removable 40 gigabyte IDE disk drive
- CDR
- 10/100 networking

Operating system

- Windows XP
- Microsoft Windows networking ease factory integration
- Microsoft Windows security for shop control & security

Software system

- Optima II 7250 System Production Operation software
- Optima II 7250 System Program Development software
- Optima II 7250 System Self-Test Procedure (Checker)
- Optima II 7250 System Component Package Library
- On-line Help for all system functions

Programming

- CAD data import
- Fully-automated programming process
- Landrex and user-defined library support
- Multi-board panel support

Result data management and reporting

- Data-Logging database records all attribute and variable data
- Used to create a variety of management reports including yield, Pareto, p-charts, u-charts

*Technology developed and licensed from Teradyne, Inc.

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