

Quality Assurance

The Management of Supertex, Inc. is committed to the continued enhancement of product excellence and service through the dynamics of its Reliability and Quality Assurance System, through the integrity of its people, and through the many professional disciplines engaged in new product development and process innovation.

It is the chartered responsibility of the Reliability and Quality Assurance Director to oversee and ensure enforcement of Supertex's Quality System. A timely review is undertaken to ensure continued development of a Quality System that maintains a competitive stance with the marketplace and meets customer requirements.

Primary Job Charter of the QA & R Departments

In-Process QC – The primary responsibilities of the Quality Control Department are to establish and maintain effective controls for monitoring manufacturing processes and equipment; to provide real time feedback of information concerning the state-of-control; and to initiate statistically valid techniques to further improve quality and reliability levels. This concept is used extensively in, but not limited to, the following major Quality Control functions:

- ▶ *Incoming Raw Materials*
- ▶ *In-process Wafer Fabrication*
- ▶ *In-process Assembly*

Quality Assurance (Standard and Hi-Reliability) – The primary responsibilities of the Quality Assurance Department are to assure that the delivered product meets workmanship standards imposed for standard or hi-reliability products and/or special customer requirements. This is accomplished through a program of process controls and gate inspections designed so that all devices are properly tested and sampled prior to shipment. Real time feedback, concerning control/inspection data, keeps all relevant personnel fully informed on the quality level of product going through final test operations. Major Quality Assurance functions include:

- ▶ *Incoming Contract Subassemblies*
- ▶ *Outgoing Wafer Visual Inspection*
- ▶ *Plant Clearance*

Reliability – The primary responsibility of the reliability function is to assure that a high and consistent level of product reliability is continually being produced. The Reliability Department establishes, defines and maintains evaluation programs to determine process/product reliability. Major reliability activities include:

- ▶ *Failure Analysis*
- ▶ *Hi-Reliability Program*
- ▶ *Process/Product Qualification*
- ▶ *New Product Design Evaluations*
- ▶ *Reliability Assurance Monitors*

Document Control – The primary responsibilities of the Document Control department are to translate and format internal operating procedures and customer requirements into a system of regulatory written instructions. Document Control functions to ensure documentation integrity by establishing and maintaining procedures for:

- ▶ *Initiating, revising, approving, distributing, recalling, and archiving documents.*

Organization

The Director of Quality Assurance/Quality Control reports directly to executive staff level of Management.

Reliability Assurance Management maintains a dual level of reporting; with direct report to the R & QA Manager for R & QA program coordination and by dotted line to the Product Vice President respective of product service for Reliability Assurance support.

It is the responsibility of the R & QA Director to administer the planning, organization, execution, surveillance, appraisal, corrective action and documentation of Quality Programs. The character, responsibility and authority vested with the R & QA Director will establish the means to attain the necessary quality and reliability objectives in all aspects of manufacturing within the accorded guidelines of this manual.

Quality programs administered by the R & QA Department support the following functions:

Operator Training – Supertex maintains a System of Operator Training and Qualification specific to the nature and complexity of each manufacturing operation, inspection, or test requirement. The basic training approach used by Supertex is supervised on-the-job training assisted by experienced/qualified personnel to provide a "buddy system" of training.

Training is typically performed with the same equipment and tools used in the normal manufacturing environment. The use of training aids, such as films, photographs and demonstrations of equipment and tools, is typical.

Each department manager is responsible for the training and evaluation of the workmanship performance to manufacturing norms.

The R & QA department maintains a system of audits/monitors for evaluating operator's adherence to specification and quality of workmanship.

Raw Material Procurement and Qualification – Supertex maintains a system that ensures economical control and conformance to detailed technical and quality requirements of purchased materials (direct and critical indirect). Material procurement is performed through regulated specifications and drawings. R & QA functions within this system by providing the following services:

- ▶ *Documented instructions for material evaluation, procedures, flow, workmanship standards, test methods and statistical sampling.*
- ▶ *Incoming inspection of raw materials.*
- ▶ *Identification and segregation of qualified and non-conforming material.*
- ▶ *Vendor qualification and ongoing vendor performance appraisal.*
- ▶ *Feedback of inspection results and informing suppliers of new design changes on raw materials.*
- ▶ *Formal review for disposition of nonconforming materials.*

Equipment Calibration – Supertex maintains a Calibration System that ensures measurement accuracy of equipment used to determine product workmanship and acceptability.

The Calibration System conforms to ANSI/NCSL Z540-1. Major provisions of the R & QA program are described as follows:

- ▶ *Qualification of external calibration services.*
- ▶ *Traceability of references to National Institution of Standards and Technology. Identifications of measurement and test equipment (electrical, mechanical, and optical) for type and frequency of calibration.*
- ▶ *Document file certifying equipment calibration and recall history.*
- ▶ *Management report on recall status.*
- ▶ *R & QA audits of equipment calibration (date stickers and recall designation).*

Manufacturing Flow, Inspection, and Test Points – Supertex maintains Flow Charts that describe the sequential steps of semiconductor processing and associated documentation for Wafer Fabrication. Flow charts are prepared for each product family and associated manufacturing technology.

Flow charts that delineate Fabrication processing are regarded as proprietary and are not available for external dissemination without prior approvals from the foundry customer.

Flow charts for Customer Hi-Reliability Products are documented by a detailed lot traveler which defines all sequential operations, manufacturing inspection points, Customer Source Inspection points, and Quality Assurance product sample acceptance points.

In-Process Quality Control – Quality Control is a system of measurement and surveillance. The System is comprised of visual, dimensional, structural, and electrical characterization of material from incoming receipt of raw goods to outgoing finished product. Information obtained provides management with an overview on the state-of-the-process by specifically quantifying position of product yield, quality, and reliability.

Major elements found in Supertex's Quality Control Program are summarized by, but not limited to, the following:

- ▶ *Environmental monitors (Airborne Particle counts, % RH and temperature).*
- ▶ *Routine Scanning Electron Micrography (SEM) of semiconductor devices.*
- ▶ *Specification compliance audits.*
- ▶ *Random monitor of wafers in-process.*
- ▶ *Electrostatic discharge prevention/monitor.*
- ▶ *Product lot sample qualification at critical manufacturing points.*
- ▶ *Wafer/die electrical sort monitor.*
- ▶ *Quality performance/trend data reporting.*
- ▶ *Return material analysis reporting.*
- ▶ *Monitoring of storage, handling, packaging, and identification of raw materials, of work-in-process, and of finished product.*

Product Assurance Inspection – Supertex maintains a system of Product Qualification through inspection and test of finished product prior to customer shipment.

The Quality Assurance department provides inspection based on statistical sampling to ensure that outgoing product quality meets internal workmanship standards and customer procurement requirements.

The following process controls, inspections, tests, and documentation requirements are assured prior to submission of product to Customer Source Inspection and final Outgoing Plant Clearance:

- ▶ *Test equipment correlation and qualification.*
- ▶ *Monitor manufacturing test operations.*
- ▶ *Ensure conformance of product lots to detailed customer test requirements (electrical, external visual, mechanical).*
- ▶ *Assure proper and complete documentation for each product lot, both in-process and at-plant clearance.*

Reliability Assurance – At Supertex, the Reliability Concept is introduced at the design phase of all new Supertex standard products. The factors that may affect product reliability are: compatibility of fabrication process, circuit layout and characteristics, assembly process, package materials, and application. Hence, Reliability Engineering is involved in evaluating all critical factors of reliability, starting with the design and first prototype functional circuit. From analysis, modification

of design, wafer fabrication, and assembly, process changes can be implemented to enhance the reliability of the product. Approval is given for the release of new product to manufacturing only after the reliability of the product is established as acceptable within standard norms. Upon agreement, Supertex can provide reliability services to the Foundry customers.

Qualification Program of New Products and Processes

- ▶ *Procedures for qualification of new product designs require reliability participation and approval in design reviews, documentation, characterization, and reliability stress studies.*
- ▶ *New package qualification is approved and released for production by reliability after prescribed environmental tests have been successfully completed.*
- ▶ *Qualification of a new product is granted only after Quality and reliability have completed evaluation of process control studies. Significant modifications to existing processes are treated as new processes for the purpose of qualification.*
- ▶ *Proper documentation of all changes to process steps and procedure, and of any new or improved designs or material, is assured by Reliability's approval.*

Failure Analysis

- ▶ *It is the policy of Supertex to perform analysis of defective product and utilize the resulting findings to improve product yield and integrity.*
- ▶ *Reliability Engineering also performs failure analysis in mode and the mechanism of all failures (both from routine reliability tests and customer returns).*

Failure Analysis Support Activities include:

- ▶ *Qualification of existing products for new applications.*
- ▶ *Customer Qualifications. Reliability is responsible for review and acceptance of all customer requirements. When qualification programs or special testing is required, Reliability designs and implements appropriate test plans and coordinates with customer.*
- ▶ *Failure analysis, in support of In-Process Quality Control monitors, is handled by Reliability through Failure Report Requests. This support includes such services as visual inspection, metalography, thickness measurements, selective etching, and die probing.*
- ▶ *Customer's requests for failure analysis are filled by Reliability, which coordinates all replies to customers and approves all correspondence outside the Company.*

- ▶ *Where Reliability has determined that corrective action is necessary prior to the release of product for shipment, or to proceed further in production processing, a Corrective Action Request is generated by Reliability. No shipment may occur if the integrity of product reliability would be jeopardized.*

Reliability Monitor Programs

Device and Package Reliability Monitor Programs are effected for all packages using a variety of device types to maximize data usefulness and to evaluate cost effectiveness of equipment.

Accelerated Stress Monitor Programs are conducted to obtain timely feedback for process evaluations, as well as for ultimate device capability studies.

Packages are evaluated using all applicable methods of MIL-STD-883; Class B, or MIL-STD-750, as appropriate. Data are reported, as specified, in detailed procedures for each package-chip combination. Package Monitor programs include, but are not limited to, the following general tests, using the appropriate conditions specified in MIL-STD-883, Class B, Method 5005:

Condition	Method
Operating Life (HTRB)	1005
Steam Pressure (molded packages)	N/A
Temperature Cycling	1010
Package Hermeticity 1014	
Intermittent Opens (molded package)	N/A
Salt Atmosphere (Initial Qual, only)	1009
Constant Acceleration	2001
Mechanical Shock (Initial Qual, only)	2002
Solderability	2003
Lead Integrity	2004
Vibration (Initial Qual, only)	2007
Biased Temperature Humidity (molded packages)	N/A

Reporting and Publication of Data

Qualification test reports are prepared and distributed by Reliability for all certified products and processes which have been formally qualified and released for manufacturing.

Reliability is responsible for assisting the Marketing department in the preparation of publications for distribution to field sales locations and to customers.

Presently, the in-house Reliability Assurance testing is supplemented by testing done at outside Test Laboratories that have been approved by DESC for performing MIL-STD testing.

In addition, Reliability Assurance maintains a routine monitor of commercial grade finished product to evaluate reliability attributes against internally published norms. Products and packages are deliberately selected to represent typical characteristics and conditions of manufacturing – with the following considerations given:

- ▶ Design complexity and fabrication processing technology.
- ▶ Package type/assembly construction and materials.
- ▶ Assembly plant location.

Supertex reliability data for standard product is published for internal use. Specific reliability information is made available to customers upon request.

Plant Clearance Inspection – Supertex maintains a Final Outgoing Inspection to ensure that all conditions of processing have been satisfied and that support documentation, as specified by contract, is maintained for each shipped lot.

Provisions for the control of shipped product during the Outgoing Plant Clearance Final Acceptance Program are structured to ensure product workmanship guarantees are met.

Summary

Supertex maintains R & QA Programs at critical operations to assure that products are manufactured under a documented and controlled system for consistency in workmanship standards (fit, form, function, and reliability).

The following Standards and Specifications have been integrated into Supertex's manufacturing operations and process control programs:

ISO 9001	International Standard, Quality Management and Quality System.
FED-STD-209	Clean Room and Work Station Requirements, Controlled Environments.
DOD-HDBK-263	Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts, Assemblies and Equipment
DOD-STD-1686	Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment.
MIL-PRF-38535	General Specification for Microcircuits.
MIL-Q-9858	Quality Program Requirements.
MIL-I-45208	Inspection Systems.
MIL-PRF-19500	General Specification for Semiconductor Devices.
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-750	Test Methods for Semiconductor Devices.
MIL-STD-883	Test Method and Procedures for Microelectronics.
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts.
MIL-STD-45662	Calibration System Requirements.
Special Customer Specifications	

Supertex inc. does not recommend the use of its products in life support applications, and will not knowingly sell them for use in such applications unless it receives an adequate "product liability indemnification insurance agreement." **Supertex inc.** does not assume responsibility for use of devices described, and limits its liability to the replacement of the devices determined defective due to workmanship. No responsibility is assumed for possible omissions and inaccuracies. Circuitry and specifications are subject to change without notice. For the latest product specifications refer to the **Supertex inc.** (website: <http://www.supertex.com>)