CHAPTER 2
QUALITY SYSTEM

2.1 COMPANY-WIDE COORDINATION

"*Solving a problem may be easier than you think. You just need a systematic approach*."
Dr. W. Edwards Deming

The Quality System is represented by the organizational structure, responsibilities, procedures, processes and resources for implementing quality management.

SGS-THOMSON performs regular quality operation reviews (Quality Council meetings). These aim to promote company-wide coordination of all quality activities in order to achieve the stated quality goals.

2.2 QUALITY MANUAL

The SGS-THOMSON Quality System is fully and systematically documented to ensure a common understanding of all quality activities. At the heart of the system is the Quality Manual which describes the quality management system and which is used as a permanent reference in the implementation and maintenance of the system.

The Quality Manual follows the ISO 9000/ EN29000 scheme. Various levels relate to:

- Corporate Quality Manual
- Group Quality Manuals
- Plant Quality Manuals
- Specialized Manuals & Specifications.

2.3 QUALITY AUDIT

"A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives"
ISO 8402

Quality Audits are used as standard practice to measure progress, anticipate quality problems, ensure that all quality procedures are being carried out and measure compliance of operations with local specifications as a gauge of manufacturing discipline and engineering integrity. The main types of audits are :

- System audit
- Line /Process/Product audit

These are shown in more detail in the table below.

External organizations which have performed independent audits in SGS-THOMSON include:

AIAG - Automotive Industry Action Group (USA)
AEIS - Association of Electronic Industries (Singapore)
DESC - Defense Electronic Supply Center (USA)
ESA - European Space Agency
IMQ - Instituto del Marchio di Qualità (Italy)
Lloyds - Lloyds Register Quality Assurance (UK)
SNQ - Service Nationale de la Qualité (France)
UL - Underwriters Laboratories (USA)

TYPE OF AUDIT	PURPOSE	BASE	FREQ.	AUDITOR
Quality System Audit	Assessment of quality system's effectiveness by determining whether the necessary elements exist. Assessing the employee's level of knowledge. Reviewing the practical application of individual elements of the quality system.	Quality manual, organization, responsibilities and procedures Specifications and work instructions, Corporate SOPs, manual, specifications, ISO 9000 / QS 9000 , Internal Audits Documentation management, training, Inspection records, directives, checklists Contract review & design control Quality reports,	Yearly	Corp Q&R
Line/ Process/ Product Audit	Assessment of the effectiveness of process quality elements. Assesment of compliance to specifications and work instructions. Review of implementation of corrective actions.	Management and Quality System, Material procurement, Traceability Process Control (SPC, FMEA, DOE, TOPS) Test, Inspection, Maintenance and Calibration Control of Non-conforming product, Corrective and Preventive actions, Change control and Informing customers Handling, packing, preservation and delivery,	Every Six Months	Group/Plant QA

Our customers and external organizations also perform independent audits on parts of the company and we perform audits on our suppliers. The results of these audits are systematically used to originate and/or update improvement plans.

2.4 COST OF NON QUALITY (CONQ)

The CONQ technique (measure of costs specifically associated with the achievement or non- achievement of product or service quality) is a "tool" for quality management in its pursuit of quality improvement and profit contributions.

The CONQ data is collected according to the world wide standard approach (splitting them into prevention, appraisal, internal and external failures). However we consider "prevention costs" not as a cost but as an investment that allows us to reduce real costs associated with Appraisal and Failures.

This approach encourages prevention whereas the traditional definition, to consider it as a cost, runs the risk of discouraging it. SGS-THOMSON has implemented its own estimation method linked to billings and which takes into account yield loss, inspection costs, customer returns, etc.

The strategies used in improving CONQ are:

- directly attack failure costs driving them towards zero
- invest in prevention activities that guarantee improvements
- reduce appraisal costs according to results achieved
- compare current system results with past performance.

The whole of the CONQ system is based on the premise that:

- each failure has a root cause
- causes are preventable
- prevention is always cheaper.

Our CONQ system measures the difference between the actual cost of running our business and what a theoretically perfect one would cost. We then try to reduce that difference by first analyzing effects and then removing root causes forever.

Essentially CONQ reflects real costs or lost opportunities to the Company and so, improved CONQ is intrinsically reflected in improved service and product quality performance. As a result, improved CONQ can have a positive effect on tangible parameters, like sales and market share.

2.5 QUALITY IN MARKETING

"The service commitment must be renewed every day. The quality of service in any organization will tend to regress to mediocrity unless it is actively and consciously managed."
Karl Albrecht

Customer quality support ensures that a system is maintained for soliciting and analyzing customers' suggestions for product improvements. Support provided to customers includes failure analysis on products as needed and assessment of trends in reliability.

Provision is made for product alerts and customer notification of potential product reliability problems. It is the responsibility of sales to ensure that all customer orders are entered correctly, and that all referenced issues (i.e. customer specifications, agreements, or special requirements) are properly coordinated before entry of the order.

Coordinated contract reviews lead to well prepared high quality products meeting the expectations of our customers.

The sales personnel, including marketing support, maintain on-going communications with the customer and coordinate customer communications with manufacturing, product groups, quality, and all other company functions.

"Quality is what the customer says it is."
Tom Peters

Manufacturing and reliability must be considered at the design level in order to manufacture reliable products meeting customers' expectations.

New product development plans adopt the Quality Function Deployment (QFD) methodology as a basic tool to understand customers' requirements. This formally translates the customers' needs into technical requirements as product specifications, process operations and manufacturing process controls, that represent the key points for the product finalization.

In SGS-THOMSON, a corporate procedure defines the product maturity, specifying three maturity levels with rules from one level to the next. They are: design, engineering and production. In addition there are various sub levels. This procedure governs the entire life cycle of a product from new product proposal to its obsolescence. It also determines when and how, engineering samples can be released at sub-maturity levels in a controlled manner by defining "for application study only" or "not yet fully qualified" on the customer documentation.

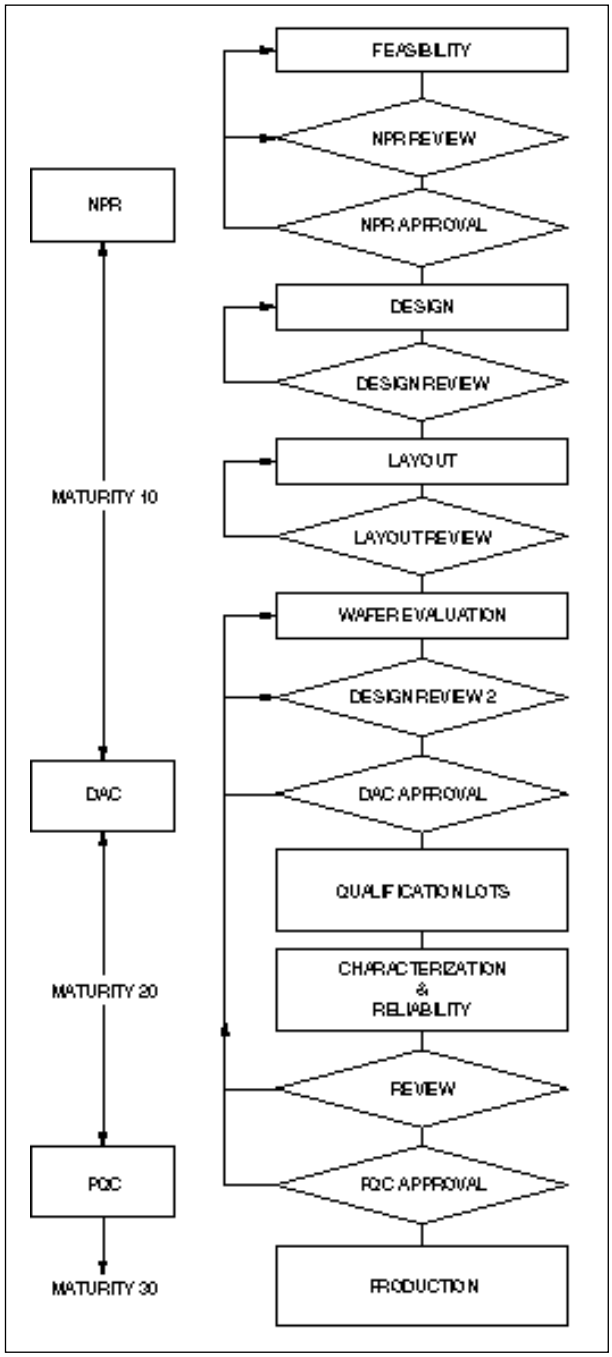
Each new product begins from the preparation of a target specification and a document called a New Product Request (NPR), which contains business and technical details. The purpose of this first control is to evaluate the potential of the product and determine if there is sufficient justification to allocate design resources.

Once the NPR is approved the designers can start work. Designers work to clearly defined design rules which incorporate robust design principles. When the design is complete and the first working samples are available they are evaluated to make sure that the design is acceptable for the next phase, Engineering.

The results of these tests are included in the next key document, the Design Approval Certificate (DAC). The approval of the DAC commits the company to a major investment so it is essential to ensure that the product is ready to proceed.

While a product is in design and characterization (maturity 10 & 20), samples may be given to customers with the documentation indicating "engineering samples for application study only and at the customers' risk" under the responsibility of the Division Manager.

New product is prepared for qualification through product characterization and reliability testing. A Product Qualification Certificate (PQC) which permits the new product to proceed to manufacturing must be approved by Group Management.



Product design qualification flow

2.7 QUALITY IN PROCUREMENT

SGS-THOMSON's worldwide suppliers are an integral part of the high-technology research, development and manufacturing process.

We are confident that consistent supply and continuous improvement of suppliers' performance are mandatory to ensure our continuous improvement and consequently to meet our commitments to customers.

Based on these principles, material suppliers are selected according to specific business, quality and service criteria. The quality approach with material suppliers is described in the flow diagram opposite.

Supplier Materials Management

- Selection of strategic suppliers
- Business agreement
- Negotiation of price, delivery and payment terms

Supplier Quality Management

- Audit control
- Qualification follow-up
- Qualification list co-ordination
- Certification Program
- Performance measurement co-ordination
- Long term targets

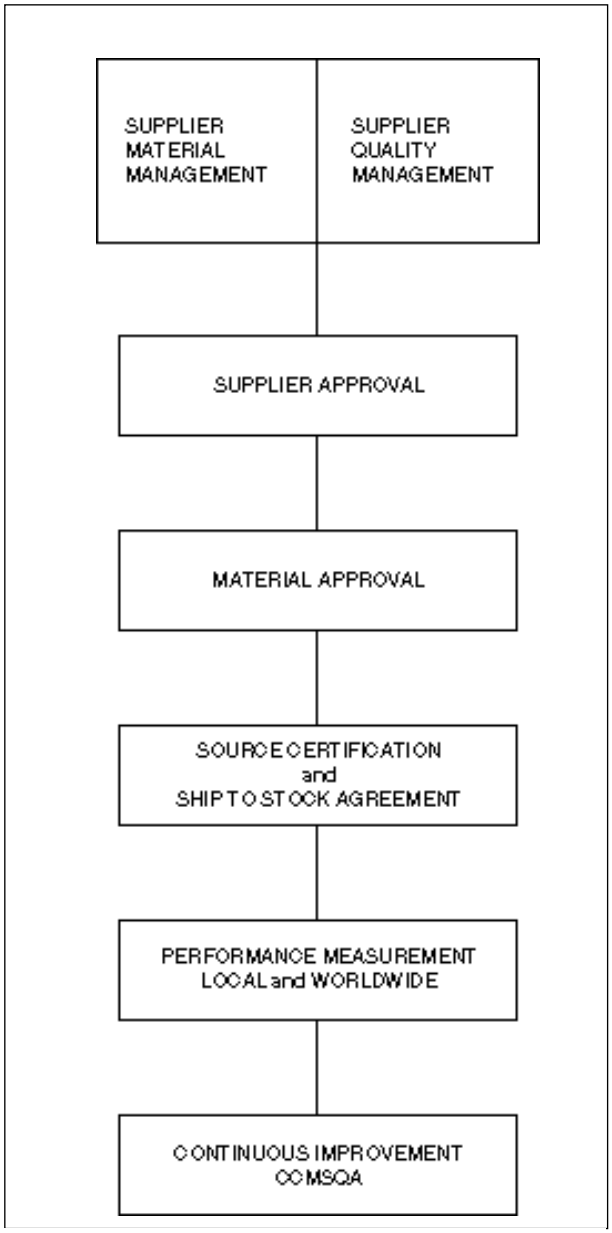
Supplier Approval: includes completion of a questionnaire based on International Standards and an assessment of the adequacy of the suppliers' organization in achieving Total Customer Satisfaction. All material suppliers must be certified or in the process of being certified to ISO 9000.

Material Qualification: after successful business discussions and audit results, the material is analyzed, then submitted to qualification testing and in-line use-tests.

Source Certification and Ship to Stock: when the level of performance is sufficient, each SGS-THOMSON plant can decide to certify its sources, (one source = one part number from one supplier plant). On completion a Ship to Stock agreement is signed.

Performance Measurement: after material qualification, all supplier performance is followed at plant level by the Supplier TQM teams in terms of quality, delivery and service, yielding a supplier's report card and all the results are consolidated at corporate level.

Continuous Improvement: all strategic suppliers with significant business, are requested to enter into a continuous improvement program with SGS-THOMSON. This program is periodically reviewed using the Corporate Certified Materials Supplier Quality Assessment (CCMSQA).



SGS-THOMSON - supplier relationship

2.8 QUALITY IN PRODUCTION

All products manufactured for sale are built using qualified materials, processes, certified operators and released specifications.

Preparation is made for the selection and scheduling of raw materials in coordination with the Purchasing Department. Before going into production, materials and parts have to conform to approved specifications. In addition they must be correctly stored, segregated, handled and protected to maintain their characteristics.

Analysis of the wafer fabrication site, assembly site and test site capabilities is done as part of the manufacturing planning process. An analysis of process capability is done, as well as cost analysis and process cycle time studies.

A process shall be statistically stable and capable of meeting relevant specifications before it is certified to build saleable products. Inspections are performed throughout the production flow, partly to prevent defective units from passing on to the next production stage, but also to collect data for process control.

Specifications and procurement of manufacturing, test and inspection equipment are accomplished, as needed, and consideration is given to the availability, usability, capability and maintainability of current manufacturing equipment.

SGS-THOMSON uses statistical process control techniques supported by a computer system for data collection and analysis (CAM). Results from measurements and inspections after important process steps are continuously recorded and fed back in the production line to control and improve the quality of our manufacturing processes and thus build in quality during production.

To keep the complex manufacturing processes under control we apply also strict rules for quality control of the environment and the production media in our manufacturing plants.

Re-work is prohibited unless specifically allowed by the process specifications. Only qualified and documented re-work procedures are used. e.g. Photoresist.

A Total Productive Maintenance (TPM) program is the foundation to achieving capacity optimization, cycle time, yield and low variability in manufacturing.

The ultimate goal of TPM is to achieve, by using statistical tools, accurate maintenance schedules with no unscheduled repairs or maintenance required. When this is achieved, the level of preventive or scheduled maintenance can be optimized.

People are trained to wear their clean room protection gear correctly at all times, as well as how to handle wafers, minimizing contamination and breakage.

Statistical tools are applied in facilities to ensure that, the environment is controlled, the air flow is monitored, the vents are working at proper rate and the HEPA filters are operating efficiently.

Last, but not least, a great deal of attention is paid to automation which, more than a productivity improvement tool, is a major contributor to quality and yield (fewer operator errors, less contamination).

The manufacturing process flows are detailed in section 3, charts 3.8 and 3.9

2.9 TRACEABILITY

The ability to access historical records of a manufacturing process is necessary for identifying causes and corrective actions for problems, and in support of continuous process improvements. This is commonly referred to as “traceability”. It could be defined as both the ability to trace any individual product sample back to the time, place and condition of its manufacture, as well as the ability to trace the present whereabouts of all product samples produced at a given time, place and condition of manufacture.

Traceability requires the presence of structured manufacturing and quality systems, and very disciplined procedures for recording and archiving the activities and results of manufacture. In addition, a traceability procedure must provide a “key” to unlock the pathway into the archived manufacturing records.

SGS-THOMSON has established procedures which provide excellent traceability for all of its products.

At the foundation of this capability is the computerized manufacturing tracking and data collection system, and the computerized specification system (Document Control System) which documents and controls changes to manufacturing processes. DCS provides world-wide electronic access to the specifications at manufacturing sites. Each manufacturing site maintains archives of all processing activities and data for a minimum of five years.

To access the traceability system, SGS-THOMSON marks its products with a topside trace code, where space allows, which is the "key" to the archived manufacturing records.

A trace code, in addition to guiding access to all archived manufacturing records, provides immediate information in the format shown below.

Wafer fab Site	Assy site	Test site	Wafer lot number.		Date code of assemby lot			
Z	9	D	A	A	(9)	6	1	4

Traceability Code

With this trace code marked on each part, when space permits, the locations of wafer fabrication, assembly and testing are determined. Also the unique final test and inspection sequence number and the manufacturing time period are identified. This trace code can be easily used to support investigation of manufacturing issues.

2.10 CONTROL OF MEASURING AND TEST EQUIPMENT (CALIBRATION)

"Calibration is the set of operations which establish, under specific conditions, the relationship between values indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values of a quantity realized by a reference standard."

ISO 10012

No matter how good a piece of measuring equipment is, its results will always be subject to some error. This is due to the ability of the instrument to resolve small changes, its repeatability, its closeness to an accepted standard and the accuracy of the standard employed. All these factors together form the uncertainty of the measurement. Determining and, where appropriate, reducing this uncertainty, is called calibration.

The calibration system within SGS-THOMSON is designed to meet the requirements of international standards such as ISO 10012. This ensures that critical measurements are traceable, via an unbroken chain of comparisons, to recognized national standards.

A schedule of internal audits, vendor (external calibration agency) audits and of course customer audits, ensure the probity of the calibration system.

Skilled engineers, high quality standards and computerized calibration scheduling and recall systems are utilized to maintain the integrity of all measurements critical to the performance and reliability of the product.

2.11 NON CONFORMITY
(Control of non-conforming products)

Products which don't fall within SGS-THOMSON's and/or Customer's specification limits must be considered as non acceptable and therefore not released for customer utilization.

Only in certain very limited and exceptional cases and with the customers prior written agreement, can these products be released.

This can happen in case of minor deviations when:

- the product is not in specification internally, but meets the requirements for the customers specific application
- it is impossible or extremely difficult to perform a selection of the product within the time frame required by the customer

This applies for shipments forwarded directly to the individual customer only. No derogation is allowed for distributors.
Any release of these products is subject to the Q&R managers approval.

2.12 TEAM ORIENTED METHODS FOR PROBLEM SOLVING

Fact-based problem solving processes are used in resolving customer related and internal process & product problems. Most models share many common elements, but the number of steps may vary.

At SGS-THOMSON two methodologies are used:

- improvement teams for common cause problems. The teams analyze the existing level of performance and study methods to make a step function improvement.

- formalized Team Oriented Problem Solving (TOPS) for sporadic or special cause problems, to analyze the root cause of the problem and effect preventive action.

The nine steps in the TOPS problem solving process are:

1) select a team of people with the appropriate product/process knowledge
2) describe the problem in detail
3) implement and verify short term containment actions to isolate the problem from the customer
4) define root causes of the problem and all possible corrective actions
5) verify corrective actions that prevent the problem and do not create additional side effects
6) implement permanent actions identified
7) prevent recurrence by modifying systems, practices and procedures when necessary
8) congratulate the team
9) disseminate the information to every other site that could experience a similar problem for local preventive action.

2.13 TRAINING

"The need for training of personnel should be identified and a method for providing that training should be established. Consideration should be given to providing training to all levels of personnel within the organization"
ISO 9004

Achieving excellence demands that every person at every level in the company is trained to do his/her job to the best of his/her ability. For this reason SGS-THOMSON invests significantly in training and education.

Management
Top management realizes the importance of encouraging training and participate fully in training programs.

Technical Personnel
All technicians need to constantly adapt to new skills and techniques and are trained in elements such as statistics, process capability studies, data collection and analysis, problem identification, problem analysis, problem solving, preventive/improvement action and team work. In this way all technicians contribute to the enhancement and success of the quality system.

Operator Training and Certification
All operators are fully trained to ensure peak performance. Operators are formally certified and must be recertified at least every 18 months. This follows a common corporate policy which is designed to ensure excellence by training newly hired staff as well as re-training.
Internal goals are set to have experienced operators trained on more than one work station.

2.14 DOCUMENTATION

Standard Operating Procedures (SOP)
SOPs define the ways in which corporate policies and objective are implemented. These procedures in conjunction with Quality Manuals, provide comprehensive, practical and unequivocal rules to all users.

Group, division, plant or site procedures must be issued in conformance with corporate policies in the company document control system.

Document Control
The SGS-THOMSON documents are managed in a computerized control system. The Document Control System (DCS) is in the evolving stage to the Advanced Document Control System (ADCS).

Access to the system is facilitated by SGS-THOMSON's private network ST-NET, which links all the sites to the global computer network available within the company.

Electronic mail plays a vital role in alerting the approvers that their approval is required and it also informs the users of the release of a new issue or revised document.

The system provides a means of efficiently issuing, updating and approving specifications to all sites assuring real time availability of the current release at point of use. Once released, the document can be viewed and/or printed world-wide by any sites possessing the security authorization.

The traceability of the history and approval cycle is maintained on the system, permitting the rapid retrieval of changes made to a given revision of the document.

The system guarantees the necessary securities, according to the user level, for reading, printing, modifying or approving the document.

SGS-THOMSON INTERNAL SPECIFICATIONS	ACTIVITIES			MAIN REFERENCE STANDARDS USED FOR Q&R SPECIFICATIONS													
	PROCUREMENT	PRODUCTION	TESTING&FINISHING	CECC 50000	CECC 900000	EIA	FED DTD 209	IEC 68	IEC 147	MIL STD 105	MIL STD 202	MIL STD 750	MIL STD 883	MIL S 18500	MIL M 38510	SEMI STD	UL
MATERIAL SPECIFICATIONS	●									●						●	
PROCESS SPECIFICATIONS		●															
QUALITY IN PROCESS SPECIFICATIONS (MONITORING)		●					●						●		●	●	
QUALITY ACCEPTANCE SPECIFICATIONS (GATE)		●		●	●					●		●	●		●	●	
FINAL ELECTRICAL SPECIFICATIONS			●							●							
GENERAL RELIABILITY SPECIFICATIONS			●							●			●		●		●
RELIABILITY TEST METHOD SPECIFICATIONS			●	●	●			●	●	●	●	●	●	●			●
PACKING SHIPMENT SPECIFICATIONS		●				●										●	
ENVIRONMENTAL SPECIFICATIONS		●	●				●										

SGS-THOMSON internal specifiactions versus main international Quality and Reliability standards