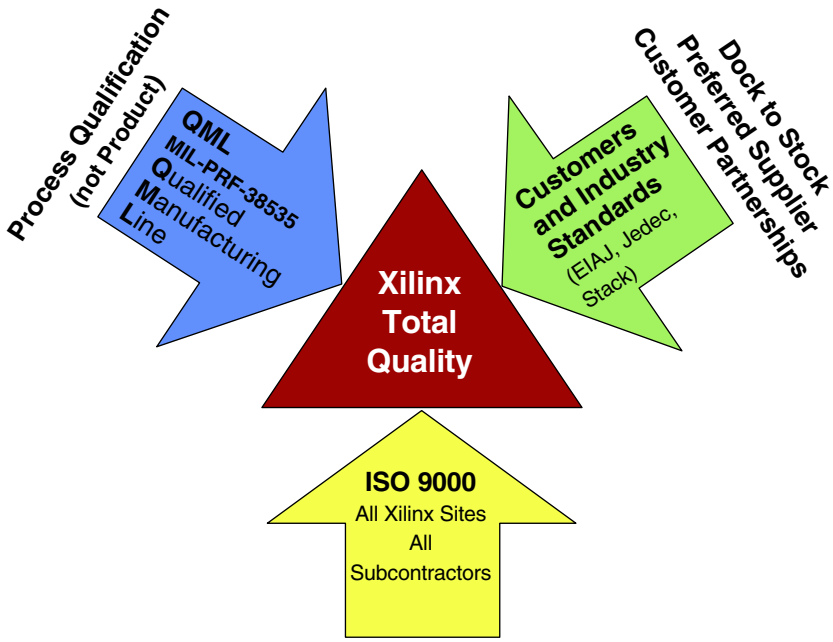
June 15, 2000 (v1.0)

QPRO High-Reliability QML Products Quality and Reliability Program

Quality Systems Compliance:

The quality level of all Xilinx products are assured by strict compliance to several world wide standards. These standards include QML, ISO9000 (9001 and 9002), STACK, PURE, Siemen's 72500, and others (see Table 1 on page 2). All Xilinx products are manufactured in compliance with the rigorous quality requirements of these standards. This includes all of our commercial grades, our QML product lines and our MIL-M-38510 full "B-grade" Military and "T-grade" Radiation Tolerant product lines. However, not all product lines are screened to the screening requirements of MIL-M-38510. While all products are manufactured on QML certified lines and are capable of passing the screening levels of MIL-M-38510, only those products designated as compliant to these screening levels are so tested. A comparison of the various flows available from Xilinx is detailed in Table 2.



QML Background

In 1994, Dr. William Perry issued a mandate that became known as the "Perry Initiative". It directed all contractors involved in the design and/or upgrade of military equipment(s) to utilize performance standards to define (hopefully) Commercial Off the Shelf (COTs) parts for use in these military systems. After this directive, it became mandatory for a manufacturer to utilize performance standards to define parts to be used in military systems, and it took a waiver from the government for the manufacturer to specify and/or utilize MIL-Spec parts. This was done to (hopefully) remove unnecessary costs from defense procurements. Like all generalizations, this one had its exceptions.

Fortunately, the defense industry with the aid of DSCC (then known as the Defense Electronics Supply Center, DESC) was already moving in this direction. In early 1995, the government formally recognized the QML concept in its issuance of MIL-PRF-38535. This directive went beyond the MIL-SPEC status of parts and gave manufacturers a cost effective way to provide military customers with the quality and reliability levels they needed, while meeting the "performance-based" requirements of the Perry Initiative. This methodology was the

establishment of QML (Qualified Manufacturing Lines) originally audited and overseen by DSCC but eventually governed by the TRB (Technical Review Board) of the certifying manufacturer.

Table 1: **Quality Standards**

Standard	Description
QML	A standard for the Qualification of Manufacturing Lines, instituted by DSCC as part of MIL-PRF-38535. Full compliance certified at Xilinx by DSCC in November, 1997.
ISO9000	An international standard for implementation of Quality systems. ISO9001 is the standard which includes design, manufacturing and testing. Xilinx compliance was registered to ISO9001 by an independent auditor in November, 1997.
STACK	A consortium of international electronic manufacturers who share pre-competitive data and establish standards for qualification and reliability assessment. Xilinx was audited and found compliant to STACK 0001 in June, 1994.
PURE	An association of European equipment makers concerned with quality and reliability. PURE members are committed to the use of plastic components in rugged environments. Their actions are supported by the French and Swedish Ministries of Defense. Xilinx was audited and found compliant to PURE requirements in March, 1997.
72500	Siemen's 72500 is an international reliability and qualification specification that is imposed on all suppliers of high-reliability products by Siemens. Xilinx was found to be compliant to Siemens 72500 in 1994.

Screening-In Quality

The Qualified Parts List was the government's original attempt to establish a supply of integrated circuit products with assured quality and reliability levels. This concept establish a "cookbook" of screening tests (defined by then MIL-STD-883) to which each and every part had to be subjected. While the standardization of these flows led to a supply of products (from various manufacturers) capable of meeting the government's quality and reliability requirements, the tracking and screening (and the fallout of product through the screening process) led to high costs of manufacturing, and hence to high procurement costs. Indeed, the paperwork or documentation costs of product often exceeded the costs of manufacture of the devices themselves. But the primary limitation of this methodology was that it required the "screening-in" of reliability through a rigid set of tests that every manufacturer of every part had to implement for every lot. The method made no allowances for design similarity, design process control, SPC, wafer scale reliability monitoring, or other equivalent (or superior) methodologies to be substituted for the screening.

Best Commercial Practices

While the QPL system worked well for years, it suffered from stagnation. It did not allow the implementation of advances in technology or advances in methodology (like some of those cited above). Thus, while the commercial semiconductor industry made great strides in the quality and reliability (and yield) of its products (and hence the cost), the military establishment was chained to the "screening-in" methodology. That changed in 1995 when DSCC published the QML concepts. The major change between the two systems is that the QPL system was stagnant and strictly prescribed, while the QML system was flexible and allowed the incorporation of those "best commercial practices" that improve component quality and reliability while decreasing costs. Finally, it was possible to establish the "performance based" standards mandated by Dr. Perry and gain the flexibility and process improvements that came from the incorporation of "best commercial practices" while assuring the military needs for

quality and reliability. In 1998 the DOD allowed the approval of off-shore wafer fabs (off shore assembly had been available for several years) as sourceing for QPL and QML devices, extending the number and availability of more total system solutions to those customers who elect QML certified products.

Current Status

Xilinx was audited by DSCC in November 1997, was found to be in full compliance with the requirements of MIL-M-38535 and was granted full status as a QML supplier. In 1998 and 1999 DSCC was invited by Xilinx to participate in the Xilinx annual audits of our hermetic assembly supplier and two of our wafer fabrication suppliers, and in all three instances DSSC and Xilinx confirmed full compliance of these suppliers to the requirements of the QML program. Future supplier management and the audit conformance demonstration of additional suppliers was left to the control of the Xilinx Technical Review Board. In February, 2000 DSCC again visited Xilinx and reviewed our conduct of the QML program and the performance of our Technical Review Board. At that time Xilinx proposed “class T” flow was reviewed and Xilinx was approved to manufacture and certify “class T” products for the radiation hardened communities (both commercial and military).

What QML Means Today

From a customer’s stand point, QML means that the supplier has the ability to rapidly convert to newer, superior technologies. Reduced screening tests mean reduced lead times and lower manufacturing costs. Designing-in and manufacturing-in reliability means that product is not handled unnecessarily during the screening steps. Rather, process design, control and SPC are strictly monitored by the manufacturer’s Technical Review Board. This, combined with robust reliability monitoring programs and sound technical assessments, ensures that product manufactured under the QML flows meet or exceed the reliability and quality of product manufactured utilizing screening. Indeed today, per directives from DSCC and from Dr. Perry, QML products represent the preferred procurement methodology for high reliability integrated circuits for use in military systems.

It should be noted that the incorporation of QML manufacturing flows does not throw out the baby with the bath water. Xilinx QML products still retain the special services military customers require. These includes configuration control, device traceability, standard supplier certification and obsolescence control. Indeed, QML products represent the most cost effective methodology to meet the quality and reliability requirements of military equipment manufacturers.

ISO9000

All aspects of the Quality Assurance Program at Xilinx have been designed to eliminate the root cause of defects by prevention, rather than to try to remove defects through inspection. This is the heart of the ISO9000 philosophy, and is in concert with the QML programs referenced above. A quality management system is in place at Xilinx which is in full compliance with the requirements of ISO9001. Xilinx has been audited and found in full compliance to ISO9001:1994 by an independent auditor and was registered in November 1997. Xilinx registration covers “the design, manufacturing and testing of programmable logic devices”. Xilinx was the first “fabless” semiconductor company to be registered as a “manufacturer of semiconductor products”, due to the engineering support, the process control and partner relationships we exhibited with our wafer fabrication suppliers.

Those aspects of ISO conformance which are in place at Xilinx include the following 16 points:

1. **Management Review:** a comprehensive system of management attention to and direction of all aspects of company performance with directly affects customers. This policy is implemented and understood at all levels of the organization.
2. **Quality Systems:** are in place to ensure that all Xilinx products conform to customer specifications. These systems facilitate, measure and foster the continuous improvement process.

3. **Contract Review:** is conducted to ensure that each contract adequately defines and documents customer requirements, and that compliance is assured or differences negotiated and agreed.
4. **Document Control:** procedures are established and maintained to control all documents and data that relate to the performance of Xilinx business and processing requirements. All access to these documents is electronically assured to be the latest revision and properly controlled.
5. **Purchasing**: procedures are in place to ensure that all purchased products and materials conform to specified requirements. Special attention is paid to the performance of our subcontractors, all of whom are ISO9000 registered.
6. **Product Identification and Traceability:** is maintained throughout the manufacturing process, and is uniquely identified through product markings.
7. **Process Control:** is assured by identifying and planning those processes which directly affect the quality of our products, whether performed by Xilinx or by our subcontractors. All Xilinx subcontractors are ISO9000 registered.
8. **Inspection and Test**: is performed to ensure that incoming product is verified (both by Xilinx and our Subcontractors) to be compliant with requirements.
9. **Inspection, Measuring and Test Equipment**: is calibrated in conformance with ANSI/NCSL Z540-I-1994 (and former MIL-REF-45662) and maintained to ensure consistent verification of specification compliance.
10. **Inspection and Test Status**: products are uniquely identified throughout the manufacturing process, both at Xilinx and at our qualified subcontractors. Control of Non-Conforming Product is assured through disposition procedures which are defined to prevent the shipment of non-conforming product.
11. **Corrective Action**: processes are documented and implemented to prevent the recurrence of product non-conformance. Root cause elimination through corrective action is the main focus of ISO9000.
12. **Handling, Storage, Packaging and Delivery:** procedures are defined and implemented to prevent damage or deterioration of product once manufacturing is complete.
13. **Quality Records**: procedures are established and maintained for the collection, indexing, filing, and storage of quality records.
14. **Internal Quality Audits**: are carried out to verify that quality activities comply with the documented requirements and further, to determine their effectiveness. These audits are regularly supplemented by our independent auditors, by our customers, and by DSCC.
15. **Training:** procedures have been established and are implemented to identify the training needs of all personnel whose performance affects the quality and reliability of our products. Personnel performing such activities are qualified based on appropriate training, education and/or experience.
16. **Statistical Techniques:** are in place at Xilinx and at our subcontractors for verifying the acceptability of process capabilities and product characteristics.

Manufacturing Flows

All Xilinx Military classes have the following items under formal control:

- Wafer Scale Reliability Data
- Full Temperature Characterization
- Maverick Lot Elimination
- TRB Review (Monthly)
- Periodic Reliability Monitor
- "QCI Coverage (groups B,C,D)"

Table 2: **Manufacturing Flow Tests**

Test	Methodology	Class T	Class Q	Class N	M-grade
Specification Control	Documentation	SMD	SMD	SMD	Data Sheet
Mask Control	per Internal Controlled Documents	Yes	Yes	Yes	No
QML Qualified Wafer Fab	per MIL Prf 38535	Yes	Yes	Yes	Yes
Wafer Lot Acceptance	per Internal Parametric Specifications	Yes	Yes	Yes	Yes
Lot Radiation Hardness Assurance	per Method 1019 / per wafer fab lot	Yes	No	No	No
QML Qualified Assembly	per MIL Prf 38535	Yes	Yes	Yes	Varies
Destructive Bond Pull	per Method 2011, sample, SPC	Yes	Yes	Yes	Yes
Internal Visual	per Method 2010B / 100%	Yes	Yes	Sample only	Sample only
Temperature Cycling	per Method 1010 / 100%	Yes	Yes	No	No
Constant Acceleration	per Method 2001 / 100%	Yes	Yes	N/A	No
Fine/Gross Leak	per Method 1014 / 100%	Yes	Yes	N/A	Yes (ceramic only)
Radiographic Inspection	per Method 2012, sample, SPC	Yes	Yes	Yes	Yes
Interim (Pre Burn-In) Electrical Parameters	Per SMD or Data Sheet	Yes	Yes	N/A	N/A
Burn-In	per Method 1015, Condition B / 100%	Yes	Yes	No	No
Post Burn-In Electrical	per SMD or Data Sheet	Yes	Yes	N/A	N/A
Percent Defective Allowable (PDA) Calculation	per SMD or Data Sheet	Yes	Yes	N/A	N/A
Final Electrical Test	per SMD or Data Sheet / 3 temps	Yes	Yes	Class temp only	Class temp only
Group A sample, 0/116 every lot	per SMD or Data Sheet / 3 temps	Yes	Yes	Class temp only	Class temp only
External Visual	per Method 2009 /100%	Yes	Yes	Plastic equivalent	Commercial

Please note that, as a QML supplier, Xilinx reserves the right to substitute alternate control methodologies (which assure equivalent quality and reliability) for some of the screening elements of the class B flow on a part by part basis. Any such decisions are approved by the Xilinx Technical Review Board and communicated to DSCC (along with technical justification) on a quarterly basis.

For more information, refer to Xilinx Quality and Reliability web site:

http://www.xilinx.com/products/qa_data/index.htm

Revision History

The following table shows the revision history for this document.

Date	Version	Revision
06/15/00	1.0	Initial Xilinx release.