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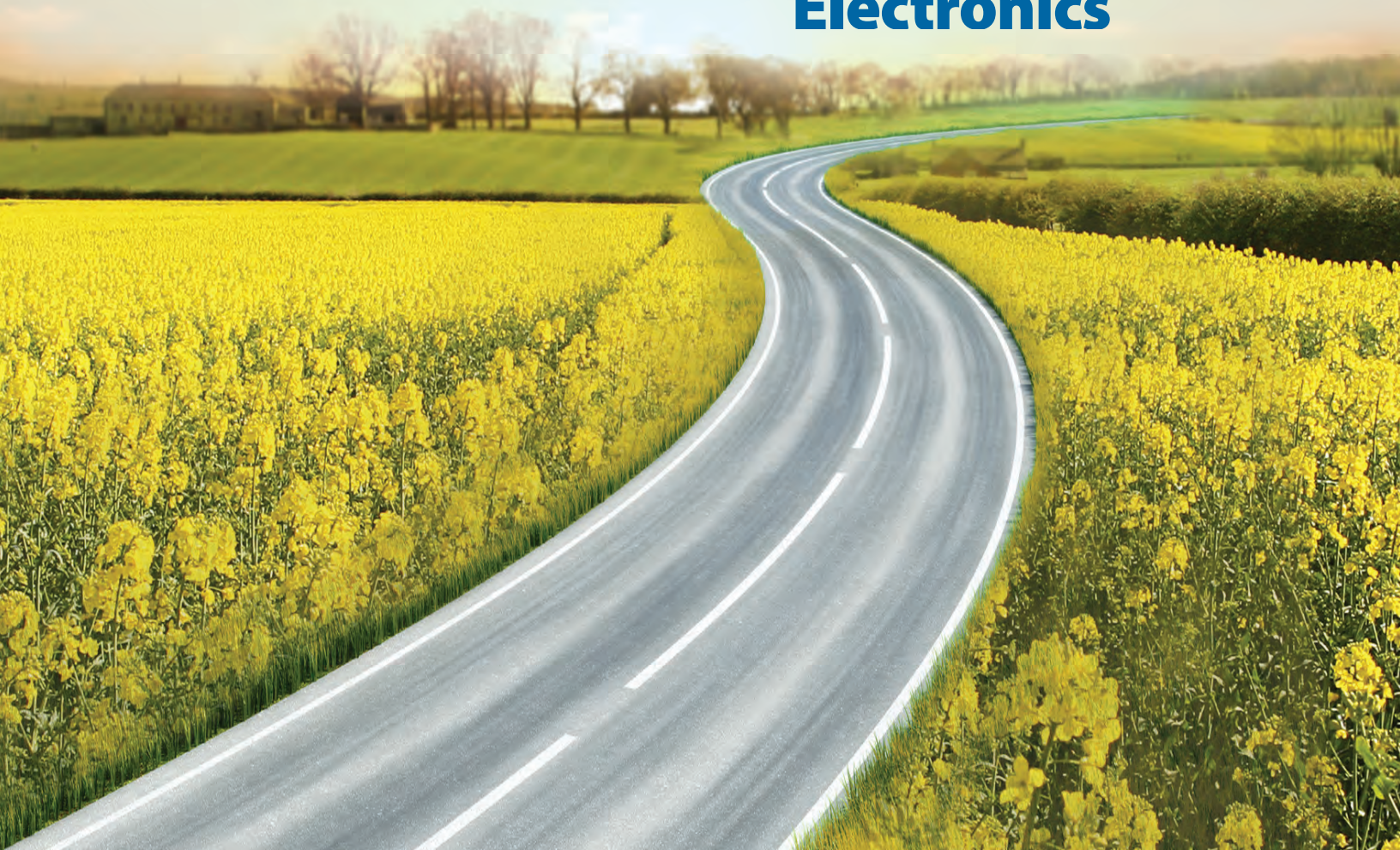
Altera's Automotive Quality Program

Building Higher Quality Automotive Electronics



Altera Commitment to Quality

When it comes to product quality, we believe our track record speaks for itself. As a leading supplier of programmable logic to the automotive industry for the past two decades, Altera has shipped tens of millions of devices to our customers. In each and every case we have met or exceeded our customers' quality goals.

That doesn't happen by accident. It takes effort and careful planning. Fortunately, here at Altera, we have a long legacy in world-class quality through our corporate DRIVE quality assurance program. Running through our entire organization, DRIVE ensures every employee—from top management on down—has a crucial role to play in product quality. At the heart of this program's mission is meeting rigorous requirements, delivering defect-free products and services on time, and continuous improvement.

That same culture lies at the heart of the automotive quality assurance program we describe in this brochure. As a cornerstone of that quality effort, we pursue a zero-defect strategy that has successfully driven return-defect-rates down to < 1 defect per million. That achievement illustrates the effort we make in every step of production, from design and wafer fabrication through assembly and test.

One key factor in our success has been our long-term, sustained relationships with our fabrication, assembly and test partners. Few semiconductor companies can match the length and depth of our relationships with our suppliers. The day-to-day interaction over decades gives us unparalleled opportunities to work closely together to constantly improve our process and our communication. Ultimately, that long history together pays dividends in outstanding product quality.

This world-class quality effort is important because we plan to be in the automotive industry for a long time. New advances in driver assistance systems, infotainment, electric vehicle drivetrains and intelligent safety features offer exciting new applications for FPGA technology in automobiles. Along with the high quality standards our customers have come to expect, our FPGA products deliver the low power and small footprint automotive designers need, along with the design flexibility and shorter development cycles today's competitive auto markets demand.

William Mazotti

VP, Reliability and Quality Assurance

Building Higher Quality Automotive Electronics

Altera's Automotive Quality Program

With more than 40 million PLDs shipped to automotive customers since 2003, Altera has played a leading role in the rapid growth of digital electronics in automobiles. Key to Altera's success has been a robust and comprehensive automotive IC quality program. Quality at Altera is not viewed as simply a single task in the manufacturing process, but a holistic discipline that runs through every group in the company.

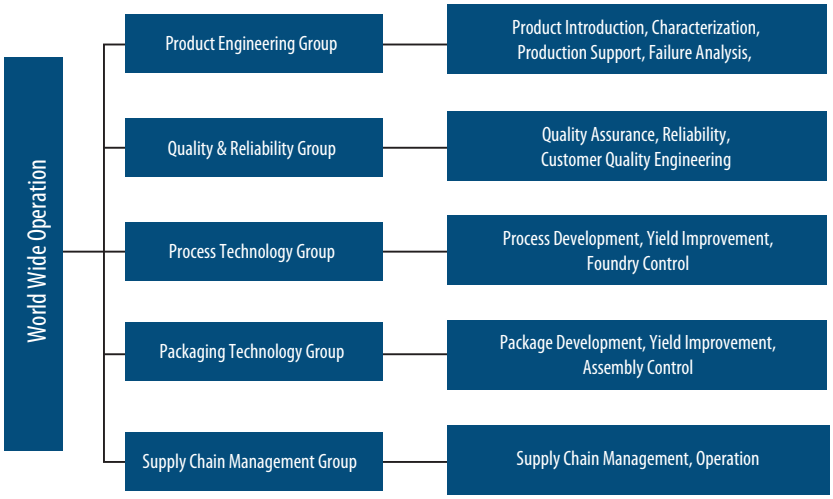
This corporate-wide commitment to quality is vividly illustrated in Altera's DRIVE program. As part of our corporate mission to be the preferred fabless supplier of FPGAs, SoCs, CPLDs and Power SoCs and supporting software tools and IP, we have built a corporate culture that strives to optimize risk management, achieve defect-free performance, verify the effectiveness of its quality programs, and continuously improve on those processes.

DRIVE Quality in Everything We Do to Ensure the Customer's Total Experience

D	Deliver defect-free products and services on time
R	Requirements are met at all times for internal and external customers
I	Improve continuously
V	Verify effectiveness
E	Every Altera employee is responsible!

Achieving these high quality results is the responsibility of all of Altera's employees, managers, and directors. To reach these goals, each employee is committed to producing quality work, conforming to all quality procedures, monitoring the performance of all business processes against current quality goals, and driving and implementing quality improvements.

Role and Responsibility of World-Wide Operation Organization



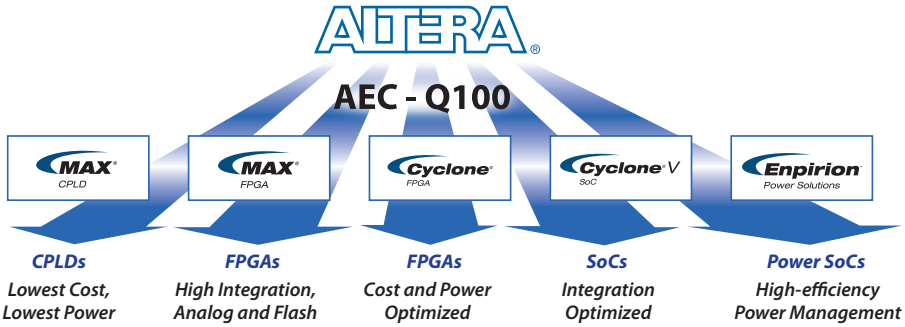
Product Conception

Altera's holistic approach to automotive product quality begins at the earliest stages of each new product design. Every new development project, including silicon and software, begins with a product planning process (PPP). New product concepts must progress through a series of quality gates from pre-vetting and discovery to concept, product and plan.

The process next enters the New Product Execution (NPE) phase. Here, each new product must pass a mid-point and final review to ensure it has met pre-defined quality objectives. Silicon must receive approval at tapeout, initial ES, general ES, initial production and final production stages. Similar quality gates control the release of software design tools and IP.

Product Quality and Reliability

Altera Automotive Grade Portfolio



Beyond AEC-Q100

Altera's Automotive Qualification Program conforms to AEC-Q100, the industry standard developed by automotive manufacturers and suppliers. Altera is an active member of the Automotive Electronic Council (AEC) and representatives from Altera have chaired subcommittees that define test criteria. While all of Altera's automotive products are "A" grade qualified to AEC-Q100 requirements, we go well beyond AEC-Q100 requirements by exceeding required test time by a factor of two to ensure our products achieve the highest quality levels.

Altera Reliability Monitoring

Stress Test	ABV	Reference Standard	AEC-Q100 Grade 2 Requirements	Altera Reliability Monitoring
Unbiased HAST	UHST	JEDEC JESD22-A102, A118 or A101	130C/85% for 96h, or 110C/85% for 264h	130C/85% up to 192h
Temperature-Humidity-Bias	THB	JEDEC JESD22-A101 or A110	85C/85% for 1000h	85C/85% up to 2000h
Temp Cycle	TC	JEDEC JESD22-A104	-55C to +125C for 1000cyc	-55C to +125C for 1000cyc
High temp storage	HTSL	JEDEC JESD22-A103	Ta 125C for 1000h	Ta 150C up to 2000h
High Temp Operating Life	HTOL	JEDEC JESD22-A108	Ta 105C for 1000h	Tj 125C up to 2000h (1.2xVcc)

For more details, please visit Altera reliability report link: **http://www.altera.com/literature/rr/rr.pdf**

As part of the AEC-Q100 qualification, Altera provides a Production Part Approval Process (PPAP) document package that includes AEC-Q100 qualification results including baseline product details including die, package, wafer fabrication process, package assembly process and constituent materials.

Zero-defect strategy

The core of Altera's ongoing continuous improvement process is its Zero-defect strategy. Altera and its manufacturing partners work closely together to drive down defects by continually implementing manufacturing process improvements and enhancements. Altera's current customer return defect rate for automotive products is under 1 dpm (defect per million) and our corporate level zero defect roadmap will take us to even lower defect rates. The following factors play a key role in the success of our comprehensive Zero-defect program:

Design for Test (DFT) and Design for Manufacturing (DFM)

- An extremely robust DFT and testing methodology – capable of achieving > 99% test coverage – builds quality into the design one of the industry's largest die.
- Repeatedly reprograming arrays exhaustively tests logic resources. While conventional ASIC test coverage reaches about 90%, Altera can exceed 99% by using FPGA reprogrammability and extensive DFT capabilities to gain access to all more nodes.

Wafer Level Defect Density Reduction

- Due to the structured design of FPGAs, TMSC uses them as a vehicle to improve defect density. This allows us to consistently meet defect density targets on the industry's most aggressive process technologies.

Assembly Yield Improvement

- Altera maximizes assembly yield through long-term strategic supplier relationships and rigorous manufacturing control.

Outlier Detection

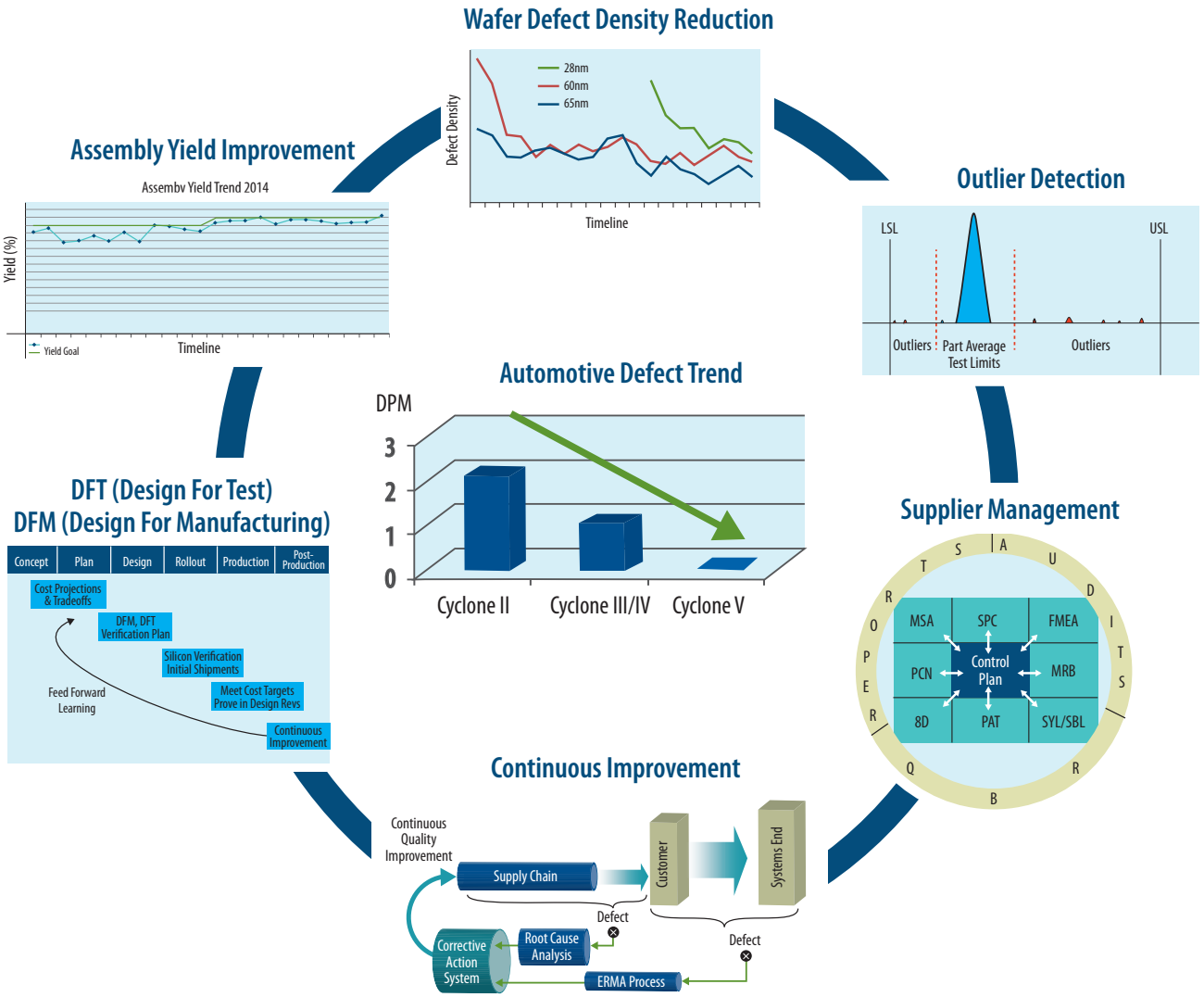
- Altera employs extensive expertise to identify outliers and prevent them from reaching customers.
- Numerous methodologies – including Statistical Yield Limit (SYL), Part Average Testing (PAT) and High Voltage Stress Test (HVST) – catch infant mortality defects which may escape production test.

Rigorous Supplier Management

- A real-time Automated Lot Monitoring System controls quality and yield, and communicates data constantly across every layer of organization with our suppliers. Frequent audits ensure changes to the process do not impact quality.

Continuous Improvement

- Altera's Quality Office manages ongoing continuous improvement efforts using key performance indicators (KPIs). Data on quality issues is constantly applied to next generation product development.



Supplier Management

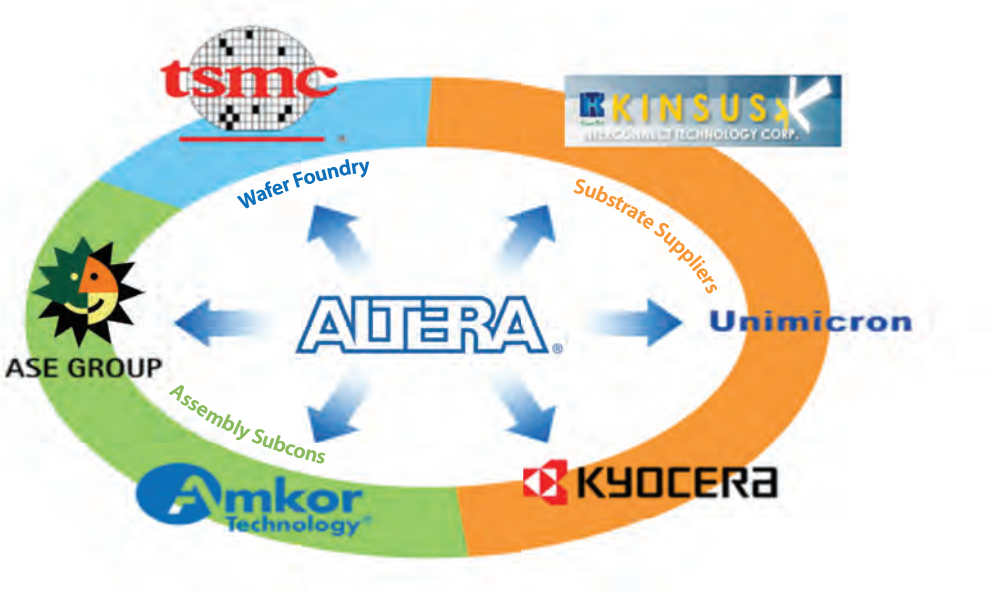
TS 16949-certified Manufacturing

To ensure the highest quality levels, Altera has adopted a TS 16949-certified manufacturing flow that starts with the TSMC fab and passes through our package assembly sites, test sites, and programming sites. Each production phase in this flow has also adopted a zero-defect philosophy with rigorous procedures at each phase of development.

Partner Participation

Long-term strategic partnerships play a pivotal role in the automotive industry with its long product lifecycles and stringent quality standards. One of the unique benefits Altera brings to the automotive industry is its rich history of close, sustained relationships with its suppliers. Altera has maintained highly productive strategic relationships with its foundry, TMSC, and its assembly and test vendors, ASE Group and Amkor, for over 20 years.

Altera's Supply Chain Sources for PLD Products*

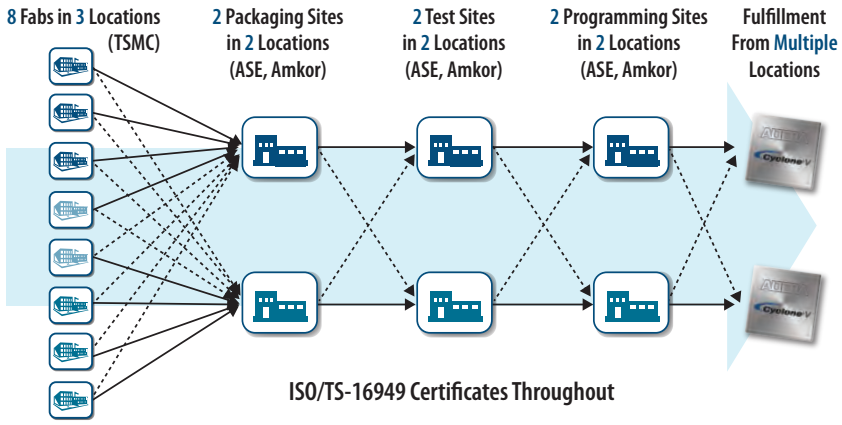


*Enpirion Power SoC is also offered through robust supply chain sources, contact Altera for details

Business Continuity Plan (BCP)

Altera's BCP provides the documented policies and procedures needed to effectively respond to disasters of varying levels of severity. The program manages multiple levels of response from a site-level crisis to company-wide recovery of all mission-critical business functions.

To ensure rapid recovery from disruptions to the manufacturing process, Altera partners with its vendors to ensure its entire supply chain is multi-sourced. As an example, Altera produces the same product at two different TMSC sites in distinct locations. That same duplication strategy is employed across the entire manufacturing line including product assembly, testing and programming.



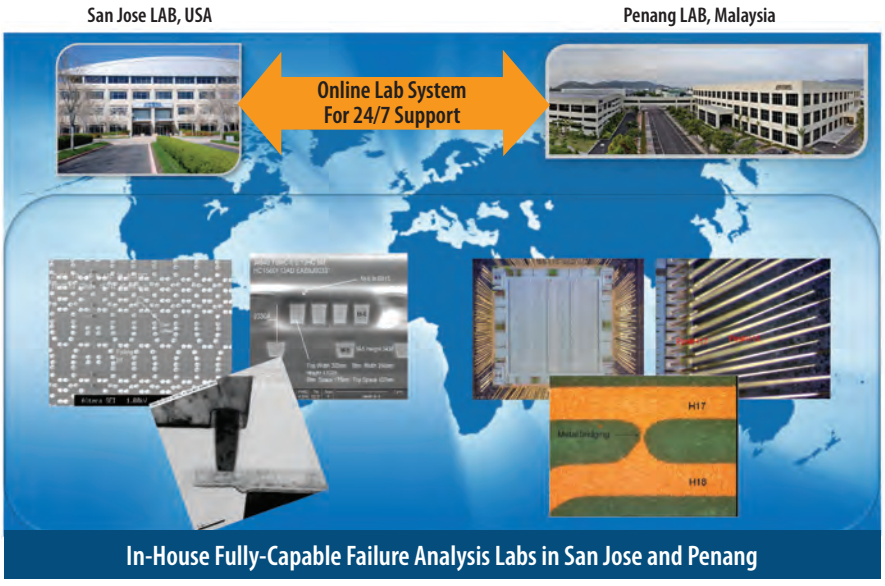
Product Life Cycle Support

To ensure product availability over time and comply with the automotive industry's minimum 10-year product lifecycle, Altera has adopted an average product lifecycle of 15 years. Some of the company's products offer lifetimes in excess of 20 years. When a product change is required, Altera takes exceptional care to provide special product change notifications so that customers can manage the rollout of new products with minimal disruption.

Comprehensive Technical Support

Rapid failure analysis is another crucial aspect of Altera's automotive quality program. The company offers 24/7 technical support for all its products. As part of that program, Altera conducts a comprehensive ERMA process on all products experiencing performance issues.

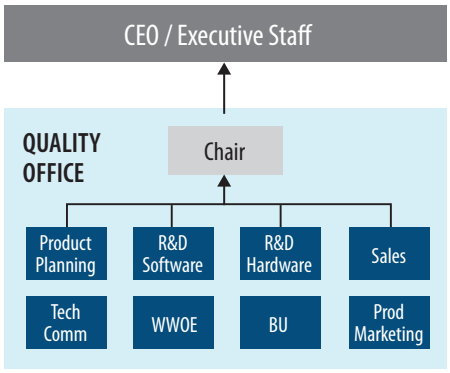
To ensure 24/7 technical support, Altera maintains two state-of-the-art laboratories in San Jose (USA) and Penang (Malaysia). By having failure analysis equipment accessible in two locations, engineers can test a potentially defective device quickly. This unique approach results in a faster response to customer requests and quicker issue resolution.



Feed Forward & Continuous Improvement

The key to the long term success of any quality program is the application of continuous improvement principles. Altera's Automotive Quality Program inculcates that philosophy by driving the continuous improvement approach from top management down through the entire organization.

The Quality Office monitors Key Performance Indicators (KPI) and manages ongoing continuous improvement efforts. This group, meeting each month, reinforces internal awareness of the importance of quality efforts and continuous improvement activities. It also ensures that information on quality issues is passed to next generation product development.



For More Information

Altera's Automotive Products Page
https://www.altera.com/solutions/industry/automotive/overview.html

Altera's Automotive Brochure
http://www.altera.com/literature/br/br-automotive_broch-1005.pdf

Altera's Automotive Grade Device Handbook
http://www.altera.com/literature/hb/auto/automotive_handbook.pdf

Altera's Reliability Report
http://www.altera.com/literature/rr/rr.pdf

Altera's Corporate Social Responsibility
http://www.altera.com/support/reliability/environmental/rel-environmental.html

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