Hybrid QML Update

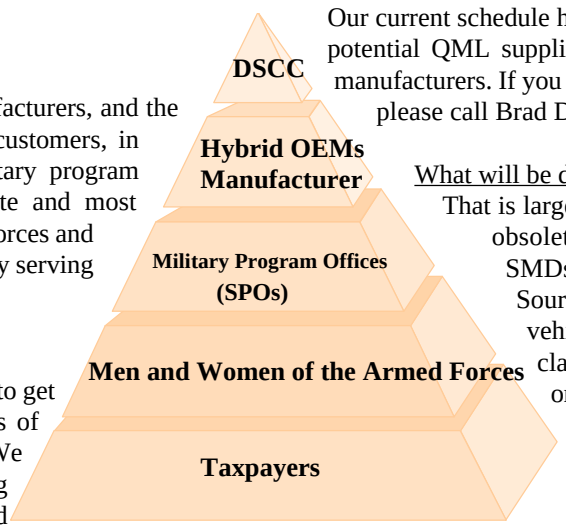
Issue 10 **November 2000**

Getting To Know You

Jonnie Schneider
DSCC-VQH

The number one pillar of the Defense Logistics Agency's (DLA) Strategic plan is CUSTOMER KNOWLEDGE AND FOCUS. Getting to know our customers is our number one focus.

Who are our customers?
Our customers include two direct groups, the hybrid manufacturers, and the equipment manufacturers who buy hybrids. The direct customers, in turn share with us common customers. These are military program offices, who procure the military systems. Our ultimate and most important customers are the men and women of the armed forces and the taxpayers. We can best satisfy our ultimate customers by serving our direct customers.



How are we getting to know our direct customers?
We began with our "post card survey". We sent post cards to get updated information about our customers including points of contact, mailing, and interest in a face-to-face meeting. We have used the results of this survey to update our mailing lists and to make plans for some visits. If you have not filled out a card, go to our web site at www.dscccols.com/offices/sourcing_and_qualification or call Brad Deslich at 614-692-0593.

With corrected mailing and contact lists, we can get information into the right hands quickly. Through the Customer Focus visits we hope and to learn what changes we need to make to our services (to share with customers what services we offer).

Whom will we be visiting?
We know how valuable your time is, so we are customizing our visits according to your needs. We envision four different kinds of Customer Focus Vsits.

Original Equipment Manufacturer (OEM) Visits:
We will send you a survey in advance asking you about your procurement policies and problems and about your experience with our services/programs and any suggested changes. During the visit we hope you will gather your component engineers and other individuals involved in the selection of components and accompanying requirements, and those involved in source selection. We will have a brief presentation that will inform you about any services for which you requested information. Then we want to dive into your survey responses, so it's important that you give the survey some real thought before completing it. We wish to get your perspective on what we can do to better meet your needs. We anticipate this type of meeting to be under two hours but well worth your.

Hybrid Manufacturer Visits:
This type of visit applies to manufacturers, whose product types are covered by MIL-PRF-38534 but who are not currently QML-38534 suppliers. During these visits, we would like to speak to management and department managers about the QML program. We will present the advantages of supplying to MIL-PRF-38534, the expectations we have of a MIL-PRF-38534 supplier, and the process to become listed on our QML. The presentation will be followed by a discussion to answer your questions and concerns about the program. We anticipate this meeting to be under two hours. If invited, we will tour the facility and/or review some of your procedures, methods and systems and provide feedback on your readiness for a QML audit.

Multi-Company Visits:
This type of visit is similar to ones we have made before. A company offers to host a session and any companies who wish to send representatives may do so. We will pre-register the guests and send out the surveys in advance. These meetings will be conducted very much like the OEM visits. However, we may have a more varied list of issues to discuss.

Special Visits:
These visits apply to OEMs and existing QML suppliers who have special topics to discuss or issues to resolve. Some QML supplier examples may include educating new staff on the QML program, working through major changes such as initiation of a Technology Review Board, or a conference with customers involved. Some OEM examples might include working with DSCC regarding part failures, DMS issues, or help in getting Standard Microcircuit Drawings written to cover their parts.

When will we be in your area?

"Through the customer visits we hope to learn what changes we need to make to our services and to share with customers what services we offer."

Our current schedule has us in the states shown below and includes contacts with 15 potential QML suppliers, 18 existing QML suppliers, and 13 original equipment manufacturers. If you would like to participate and have not already been scheduled, please call Brad Deslich 614-692-0593.

What will be discussed at these visits?
That is largely up to you. Some suggestions include: Finding sources for obsolete parts…Determining availability of devices … Having SMDs written for parts you need…Deciding when to use SMDs vs. Source Control Drawings (SCDs)… Use of various procurement vehicles to purchase QML products… Choosing the appropriate class level for your application… Participating in DSCC audits or making use of audit reports to monitor suppliers.

We are conserving our travel funds by grouping the visits or making the visits in conjunction with our audits. Other visits will be scheduled as needed.

Customer Focus Visits

Destination	Date
Indiana	October 2000
New York (Long Island)	TBD
Massachusetts	TBD
New Jersey	TBD
Los Angeles, CA	November 2000
Silicon Valley, CA	November 2000
Nevada	January 2001
Texas	January 2001
Arizona	January 2001
Arizona	February 2001
Alabama	February 2001
Kentucky	February 2001
Massachusetts	April 2001
Florida	April 2001
Washington	April 2001
Colorado	May 2001
Iowa	September 2001

Inside This Issue…

This Hybrid QML Update is an unofficial publication produced by DSCC-VQH to keep users and manufacturers informed on issues concerning Hybrid and MCM microcircuits. The articles contained herein are for information only and do not represent official Defense Logistics Agency (DLA) policy. We invite comments and feedback concerning the topics presented in this issue and suggested topics and articles for future issues. Contact us at DSCC-VQH, PO Box 3990, Columbus, OH 43216-5000, or http://www.dscccols.com/offices/sourcing_and_qualification, or 614-692-0663.

What's Wrong with This Hybrid?...

Visual Inspection and Defect Recognition

Commentary by Tom Green
National Training Center for Microelectronics (NTCμ)

Over the years there has been much "to do" over the visual inspection criteria contained in MIL-STD-883 TM 2017, TM 2010, TM 2032 and TM 2009. In essence, these were consensus specs developed over time in a politically charged environment and intended to cover a broad range of emerging technologies. An impossible task! As a young Lieutenant, I was assigned to Rome Air Development Center (RADC). We had the responsibility to referee the mil spec visual criteria. We were constantly fielding calls from industry asking for clarification and interpretation of the spec - always going back and forth on the limits and the wording. We often had to "give-in" to accommodate new technologies and company specific concerns. I could never understand the confusion. It seemed so straightforward. Of course, at that point in my career I never actually built a hybrid, but the interpretation of the words always seemed to cause confusion.

A few years later I jumped ship and went into industry, where I worked as a process engineer and had to actually live to the mil spec visual criteria. I remember a time QA tried to measure ball bond squash out with a caliper to verify conformance to the 1.5X to 5X squash factor. In industry, cost, schedule, and ultimately the customer drive the process, so exceptions to the visual specs were commonplace. How much time was spent on cracked glass seals? In many cases we lost sight of the material and process concerns and the customer end use environment, and instead focused on the words in a spec. There were many occasions when QA, Engineering, Production would meet to argue the spec and everyone left thinking he/she was right. There were so many ways to interpret the language.

After seven years of trying to build hybrids I jumped from industry to academia. The saying is true; "you never really learn something until you've taught it!" Now I find myself teaching others about visual inspection and defect recognition. It's my opinion the information contained in above referenced mil specs is an excellent source for lessons learned over the years, but should never be used as an on the floor working document. It all sounds good on paper and there is a lot of good information in the specs, but practically speaking it's very difficult to relate the words to what is seen under the scope.

I have found that operators need to see what good workmanship looks like to then determine what is wrong. But trying to relate an anomaly to the military visual inspection language is a challenge. Real-life failures are needed to train inspectors. Pictures are the next best things.

I have made finding the pictures my quest. With input from many sources, the primary being Lockheed Sanders, we have published a workmanship standard with over 200 full color photos that illustrate the military visual criteria.

If you have pictures or hardware you would like to provide for training purposes and for updates to the standard, contact me at (610) 861-5486.

For additional information about the book and upcoming schedule of classes regarding defect recognition, you can visit our website at www.northampton.edu/ntc , or call (610) 861-5486 and ask for Shelly.

Disclaimer: Publication of this article in the Hybrid QML Update does not constitute DSCC endorsement of NTCu products or services.

Capacitor Survey

Brad Deslich
DSCC-VQH

Capacitors of many types and sizes are used in building hybrid microcircuits. Common types include tantalum chip, used in thin and thick film and surface mount applications, and ceramic chip also used in thin and thick film applications. DSCC manages a Qualified Parts List (QPL) which covers many of these types of capacitors. In addition, some of the capacitor types meet reliability levels that allow them to be classified as established reliability (ER) components. Use of capacitors procured under the ER program permits reduced vendor evaluation, reduced incoming inspection, and greater reliability.

Some concerns regarding the method hybrid manufacturers use to select and evaluate capacitors have been raised at meetings with customers and manufacturers of hybrid microcircuits. Manufacturers have shared experiences with unavailability of certain types of capacitors as well as assembly, testing, and field failures related to capacitors. As such, DSCC-VQH initiated a survey in November 1999 to find out what types of problems manufacturers are experiencing with purchasing and using capacitors. The survey also queried industry use of the established reliability series of capacitor specifications.

Nearly forty survey responses were received. The results were sorted and compiled into a report. Unavailability of several capacitor types was identified. In addition, several examples of field failures, as well as incoming inspection and screening/life test failures were provided. This information was fed into the work being done by JEDEC Task Group 144-599 on capacitors. It will also be looked at independently by DSCC to determine if specification changes are necessary. As a follow-up, a second survey will be sent out to discover how manufacturers detect and prevent capacitor failures, in particular the failures uncovered by the first survey. Further information will be published when the final analysis is complete.

Program Status

- Certified Manufacturers: 46
- Certified Class H Manufacturers: 46
- Certified Class K Manufacturers: 10
  (Aeroflex, Cougar, Crane Interpoint, DDC, EMS, Hytek, Micropac, M.S. Kennedy, Omnirel, Qbit,)
- Number of TRB approved manufacturers: 10
  (Analog Devices, Austin Semiconductor, Boeing, Cougar, DDC, Lockheed Martin - FL, Lockheed Martin - IN, REMEC, Northrop)

Call For Newsletter Articles

We welcome input from the industry that could be included in future editions of the Hybrid QML Update. If your organization has any activities that are of interest to the hybrid/MCM community, we encourage you to submit material on each subject and extend our thanks to those who have contributed. Please send your articles to your DSCC-VQH contact or Jackie Cunningham at 614-692-0584 or Brad Deslich at 614-692-0593.

Company Profiles

The Aerospace Corp

The Aerospace Corporation's Role in QML

Larry Harzstark
Engineering Specialist

The Aerospace Corporation is a private, nonprofit corporation created in 1960 under the laws of the state of California. The purposes of the corporation are exclusively scientific: to provide research, development, and advisory services. Aerospace operates a Federally Funded Research and Development Center (FFRDC) sponsored by the Department of Defense, providing the specific skills, specialized facilities, and continuity of effort required for programs that often take decades to complete. This end-to-end involvement minimizes development risks, reduces costs, and assures a high probability of mission success.

Although The Aerospace Corporation provides technical support to a variety of space-related programs, the primary customers are the Space and Missile Systems Center (SMC) of Air Force Materiel Command and the National Reconnaissance Office (NRO).

One specific task The Aerospace Corporation performs in support of SMC is to provide the technical experts (hybrid, monolithic, semiconductor and passive component specialists) to accompany the Defense Supply Center Columbus (DSCC) in the performance of QML audits of space level suppliers. Aerospace personnel participate in the audits in order to lend technical expertise and to obtain an understanding of a supplier's capabilities to comply with space level requirements.

The technical specialists are all college degreed (many with advanced degrees) and possess a significant number of years of experience in industry and working closely with suppliers and users in the application of components for space utilization.

In order for the hybrid manufacturers to gain familiarity with Aerospace personnel that may be involved in the hybrid audits, a few of the specialists and their qualifications are identified:
Mel Cohen – Discrete Semiconductor Specialist: Bachelor of Science in Electrical Engineering with over 30 years of experience in the component engineering field. Job positions have included working for major contractors (Litton and Hughes) and integrated circuit manufacturer (Signetics).
Larry Harzstark – Hybrid and Microcircuit Specialist: Bachelor and Master of Science in Electrical Engineering with over 30 years of experience in the component engineering field. Job positions have included working for a major contractor (Northrop Grumman) and integrated circuit manufacturer (Signetics).

Agilent Technologies

Agilent's move to Singapore PTE. LTD.

Agilent Technologies, formerly Hewlett-Packard of San Jose, CA., underwent a major transition. The Optical Communication Division, which controls the QML Hybrid-Line moved to Singapore. The move started in mid 1999. The Administrative staff, Design Engineering, Element Evaluation and Accept to Ship were to remain in San Jose, CA., while the Assembly, Tests and Seal moved to Singapore. Incidentally, the San Jose office has been moved to Santa Clara, CA. The major transition involved two processes taking place simultaneously: 1) San Jose facility continued production till the end of October 1999, while shipping product till the end of December 1999, 2) Agilent Technologies moved the assembly and test equipment to the Singapore facility, while also training new operators, supervisors, engineers, technicians and other personnel to the various military standards (i.e. MIL-STD-883, MIL-PRF-38534, etc.), approved baseline procedures, internal procedures and source control drawings (SCDs).

Agilent Technologies decided early in the transition, that it was in their best interest, to only pursue Class H Certification prior to Class K at the Singapore facility. Both Class K and H Certifications had been obtained at the San Jose facility. Agilent Technologies was granted Class H Certification in March of 2000. Presently, Agilent Technologies is pursuing Class K Certification.

Benchmarking Automotive and Military Procurement Practices

Jonnie Schneider DSCC-VQH
Comments provided by Darrell Hill, Chief DSCC-VQ

In the spirit of adopting "best commercial practices", we have looked at the automotive industries' procurement practices for the purchase of hybrid microcircuits and compared them to our QML/military method. Information on automotive practices, used in this paper, comes primarily from two sources (a QS9000 Course and a visit to the Automotive Materials Group of a large automotive manufacturer.) We are able to identify the similarities and differences in procurement needs and procurement approaches.

Procurement Needs:

Automotive companies use relatively few variations of high-density packaged microcircuits in each car. Approximately five per car were discussed at one automotive manufacturer. The automotive company usually builds a large quantity of cars, so the quantity of each part number is large. These cars are typically sold with a three-year warranty. The environmental thermal cycling conditions that some automotive hybrids may see include –40 degrees C to 250 degrees C.

The military uses a huge variety of high-density packaged microcircuits in many different systems. However, the quantity of each part number is relatively small. Therefore the quantity of each part number is small. Many military systems are required to operate twenty years. Operating conditions for some hybrids may be –55 degrees C to 125 degrees C.

Procurement Approaches:

The automotive procurement system has four focuses:

- First, all suppliers must conform to QS9000. QS9001 is a document that combines ISO 9000 quality system requirements with five automotive consensus documents (Statistical Process Control, Measurement System Analysis, Production Part Approval Process, Failure Mode and Effects Analysis, Advanced Product Quality Panning and Control, Problem Resolution and Reporting), additional quality system requirements, and an appendix of additional requirements specific to each automobile manufacturer. QS9000 and the documents referenced therein are very prescriptive giving instructions down to the forms to be used for customer returns. The supplier must undergo a certification audit by a recognized QS9000 registrar as well as maintenance audits performed on a standard schedule.
- Second, prior to approving a part, the automotive manufacturer tests hundreds of samples to destruction to identify failure mechanisms and to determine reliability and builds some assembly units to ensure that the product is compatible with the next level of assembly.
- Third, the automotive customer audits each supplier to establish a relationship, evaluate the supplier's capabilities relative to the technology (which is not covered in a QS9000 audit), and approve the supplier's test facilities (also not covered in a QS9000 audit.) Also during this audit, the automobile manufacturer verifies that the product is baselined correctly in the Production Part Approval Process (PPAP).
- Fourth, once the product baseline (equipment, process, materials, test, etc.) has been defined in the PPAP, tested, and approved all changes require customer approval before deliverable hardware can be produced. Note: Product testing is determined by the supplier and will normally not include 100% electrical at multiple temperatures.

With this front-loaded approach, automotive manufacturers have confidence in the parts and the suppliers. The hybrid procurement documents require that the supplier meet a parts per million defect limit (ppm), and severe financial penalties are assessed to the supplier for defective products that hold up production. The methods used to establish the ppm performance are based on various production checks and whatever warranty feedback the automobile manufacturer receives.

The QML approach is not the mandated military procurement system. In fact, no standard procurement system is required. *Comment "This results in a fragmented military market which makes it very difficult to even get the manufacturer's attention."* However, for the sake of this comparison, we will address how the hybrid QML process relates, when imposed. Note: The hybrid QML (MIL-PRF-38534) has been recognized as a model acquisition reform tool. *Comment "At this point I want to address a statement which is often touted: 'DOD can just buy parts off the automotive lines.' There are a couple problems with this statement. First, there is virtually no similarity in the products being bought by the military and the automotive industries. Second, a manufacturer wouldn't give a military customer the time of day because the quantities are so small."*

- The supplier must comply with MIL-PRF-38534. *Comment "MIL-PRF-38534 provides the same assurance as the QS9001, but is more flexible."* This document identifies issues to be addressed relative to a quality system. Additionally, it contains hybrid specific standard design guidelines, testing, and qualification testing. Any requirements of this document can be met by addressing the performance requirement or concern the requirement was designed to address. The supplier must undergo a certification audit by the qualifying activity (DSCC) and is subject to maintenance audits, which are performed based on the manufacturer's performance and stability. This audit addresses the quality system, product quality and reliability, technology and compliance with the specified test requirements.
- The supplier performs a series of qualification tests on a small sample of units, which represent the processes, materials, and technology used in construction, as well

(Continued on page 4)

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as the part design. Additional parts, which differ in design, but use the same construction, require a small sample to be life tested. Customers normally buy a few pieces to use in 'compatibility testing" (i.e., verify it works in the application.)

- When Standard Microcircuit Drawing (SMD) parts are purchased, the user simply orders the parts in accordance with the SMD. For custom hybrids the customer must provide a product description and list the performance requirements. The customer very often chooses to approve the electrical test program.
- Change control after qualification is managed for both the customer and the qualifying activity (DSCC). Any change that effects form, fit or function of a specific product is provided to the customer and for SMDs, DSCC. Changes or additional qualified materials and processes require DSCC approval or the approval of a DSCC-approved Company Technology Review Board (TRB). Additionally major changes to the support areas (e.g., calibration, training, and equipment maintenance) and organization changes also require DSCC notification. DSCC reviews all major changes and supporting data.
- Much of the front-end work in this structure is performed between DSCC and the manufacturer on a process, material and technology basis. This reduces the amount of front-end work which, would otherwise be repeated by every customer, for every part and supplier. Five quality levels are offered in MIL-PRF-38534 that address the various applications and (environments, reliability levels) required by the military. These Class Levels range from Class D where the manufacturer determines the level of testing, to Class K (space) which requires acceptance testing for each lot of components, environmental and electrical screening, and periodic destructive testing. These levels allow the military to reduce cost, and lead time for the less harsh environments and/or less critical applications.

Analysis:

Similarity in the Procurement Systems:

Each of the procurement methods discussed includes partnering with the supplier, up-front testing to prove out product, processes, materials and technology, and an attempt to reduce redundant activities (i.e., Quality System Audits.)

Differences:

- The difference in the end applications of weapon platforms vs. automotive, however, dictate some differences in the approach. Since the military buys so many different parts in small quantities, the cost and time of testing hundreds of each part as an up-front qualification is prohibitive. On the other side, since a small number of each part is bought, the cost of individual parts is greater since even the smaller number of parts and testing to qualify cannot be amortized over as large a number of parts. Most hybrids, used in military applications, will receive 100% (screening) testing by the hybrid supplier to assure performance. This also becomes a cost driver. In addition the government does not receive quantity discounts that are often given to large automotive accounts.
- Another difference between the two programs is the level of detailed requirements dictated by the documents. MIL-PRF-38534 is a performance document which offers guidelines on design, for example that the automotive system does not. However, the system requirements for automotive are very prescriptive. The difference here also reflects back to the need. Automotive customers still buy enough of each product to be able to place demands on the suppliers. How long this will be true with the entire automotive industry being less than 5 percent of microcircuit sales is not clear. The QML on the other hand is taking the approach of listing the issues of concern and then being open to approving various methods of addressing them. This approach burdens the suppliers less with requirements, and paper work etc.
- Another fundamental difference is in standardization. The military benefits from part standardization through SMDs because of the small quantities that will be procured across a number of military applications. Part numbers are defined for each customer for automotive. Automotive benefits from standardization of the procurement system by dictating stringent parts lists, baselining and up-front testing qualifications etc. On the other hand the military makes a point of not mandating any standard. QML and SMDs however, make up a standard system that is available to all military offices and contractors to use when they deem it appropriate. In other words, the government has given much more flexibility to their equipment contractors to use what they deem appropriate.

Conclusion:

When the phrase "commercial practices" is used, it is important to recognize that there is no such thing. The commercial world is broken out by market segment. Some of these include automotive, telecommunications, medical, consumer product, industrial products, etc. There is no standard procurement system used in common with all these segments. To determine "best practices", the military program offices and their subcontractor must look at their needs and application requirements compared to the needs of that market sector, and then evaluate the appropriateness of that market segment's procurement system. Best practices may be a combination of practices from several different market segments with traditional military procurement tools, such as specifications. *Comment "However, the program must keep in mind that their small quantities needed makes a standard program like QML and SMD imperative. Plus there is another area often overlooked: Twenty-year logistical supportability of the system!!"*

A big problem with each contractor seeking out different procurement practices for each system is the expense of efforts being duplicated and a lack of sharing lessons learned. While the automotive industry receives a great benefit by using one part/supplier management system, the military is not able to experience the full benefit of its standard system, QML. QML-38534 is designed with the flexibility to meet acquisition reform through the multiple quality levels and the "performance specification" approach. One combination of "best practices" the military and OEMs can choose from the automotive market sector is to standardize most high-density microcircuit packaging procurements, in this case using the military performance specification MIL-PRF-38534.

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