

## ***A Guide To Using AEC-Q Components In Mil/Aero Applications***

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One of the proximate issues in the components market is that the line between automotive and military and/or aerospace (mil/aero) electronics has increasingly blurred. The components, semiconductors and all other parts used for these two distinct markets are defined by rigorous qualification standards to ensure consistent performance under extreme conditions. This article focuses on semiconductors, however the same principles apply to passive–electromechanical parts as well. If you can qualify a component for use in an automotive electronics application, it's likely it can be used in various mil/aero applications.

Two of the most recognized frameworks are MIL-STD (military standards) for defense and aerospace systems and the AEC's (Automotive Electronics Council's) AEC-Q standards for automotive applications. While applications engineers designing for these two markets share a common goal of achieving uncompromising reliability, they must also navigate the differences in documentation, qualification philosophies and cost structures.

This article shows how, why, and when mil/aero engineers can use automotive-qualified components in their designs. This approach helps them pass system-level military qualifications while providing critical competitive advantages. It also applies to other high-reliability applications, including telecom, datacom, railway, downhole drilling, avionics, utility, medical and industrial

This discussion is informed by the author's long-time experience in the electronics industry. It argues the when, where and why AEC-Q-qualified automotive components are often a good option, or even the best choice, for use in military/aerospace applications and when they are not. The article contrasts and compares the differences and the convergence points of the two by presenting demonstrable evidence and backup data.

### ***Why Military And Aerospace Engineers Are Looking At AEC-Q***

Historically, weapons systems were developed over decades. In my experience, for instance, I saw multiple generations of FAEs working with engineers on the MARK48 torpedo, which is probably still being worked on today. The investment in this system alone must be upwards of hundreds of millions of dollars per year.

Today we see common off-the-shelf materials being used to develop technically sophisticated highly effective weapons, especially air- and sea-based UAVs, drones, autonomous vehicles like boats and more. These systems are being designed and built, iterated and improved quickly, in real time, and at low cost and very impressive ROI. This means that if someone can adapt faster, cheaper and better systems, they are likely to win.

This reality is causing militaries around the world to rethink development methodologies and ways to not be outpaced and surprised by innovative adversaries. Thus, they must do things differently and rethink approaches.

Rapid advances in semiconductor manufacturing, coupled with the high costs, technology aging, and long lead times of traditional military-grade components, have forced defense and aerospace engineers to explore alternative approaches. As a consequence, they are turning to AEC-Q-qualified semiconductors, originally developed for the automotive industry, as a viable option for many non-critical mil/aero applications.

### ***Applying The OODA Loop Concept To Mil/Aero Technology***

In the world of defense and aerospace, a driving technology trend is the race to develop and deploy highly reliable and cost-effective applications faster than the adversary. This goal can be seen as the technology-based equivalent of the "observe, orient, decide and act" OODA loop military strategy created by Colonel John Boyd in the mid-1950s (see the figure). This was developed for the military and tactical use so it fitting we use it here in this article. If you can cycle through this loop faster than your adversary, you will gain an advantage.

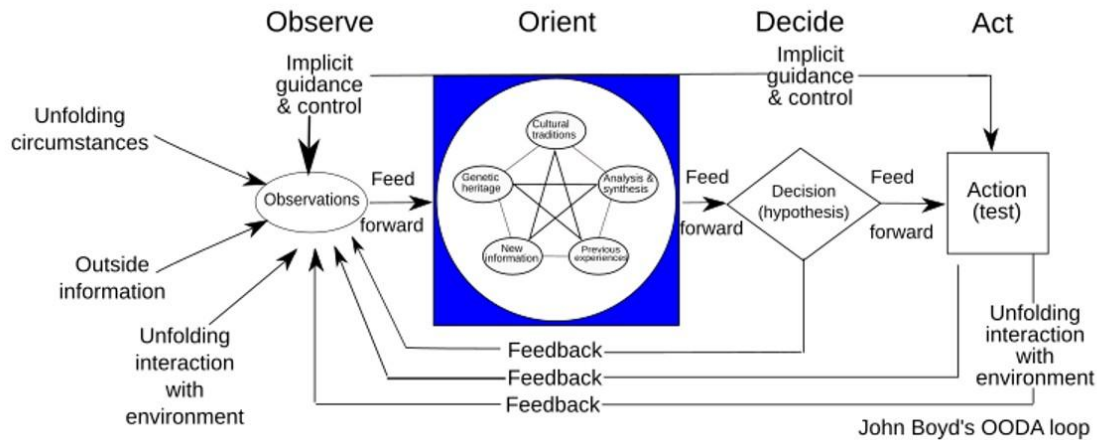


Figure. Diagram illustrating the OODA loop concept that can be applied to mil/aero technology trends. (Courtesy of Wikipedia.<sup>[1]</sup>)

The concept can be applied to the development and sale of advanced technologies in the mil/aero market as follows: if you can respond to an engineer’s request faster than the competitor (adversary) by acquiring samples and data faster than they do, you will win. The cost, response speed and timing are competitive “weapons” that stand in for Boyd’s OODA loop concept of observing, orienting, deciding and acting.

At the time of this writing, for example, in Ukraine we see a very low-cost drone system, which was very quickly innovated and deployed, destroying a high-value parked aircraft, showing excellent ROI on the development of that system. The Ukrainians go to whatever their version of Radio Shack is and create a 2K dollar device that wipes out a 400-million-dollar enemy asset, and they can iterate it quickly if a countermeasure is found. They are on to the next low-cost system quickly to try and test it out. This is making people notice.

Applying a common-sense, OODA loop concept to component technology sales is especially relevant when everyone comprising competitive companies/contractors is chasing the same bid or contract. It is far easier to get real-time inventory on AEC-rated parts than to find specialized rad-hard or unscreened parts.

Using AEC-Q alternatives can help designers to estimate the upfront costs and lead to better planning since time is of the essence. Thus, if the weapons systems manufacturer can close the OODA loop faster than their opponent an advantage will be achieved. This model can be used to your advantage in many areas of life and business.

### **The Changing Landscape Of The High-Reliability Electronics Market**

How can the mil/aero industry respond faster to gain this competitive advantage? Unlike automotive, commercial/industrial, computing and datacom-telecom-networking and other markets, the cost associated with developing specific components intended just for the mil/aero sector cannot be amortized across many customers. Moreover, electronics markets—other than perhaps medical—move faster than the mil/aero market. Automotive, medical and industrial markets share more in common with mil/aero than consumer and computing do. This is where AEC-Q parts come in.

Like the mil/aero market the automotive electronics industry needs advanced technologies, but ones that are also extremely reliable, with supply chain resiliency and long-term assurance of supply. These are often contractually obligated and not negotiable. The differences are the high volumes found in the automotive sector and frankly the money associated with the automotive electronics industry makes it attractive to be in. As in many things in our industry, getting things done relies on money and sometimes egos come into play in hanging onto the past. I will cover that shortly.

For decades, military-grade (MIL) components defined the gold standard for reliability. Each part was tested to rigorous military standards, such as MIL-STD-883, MIL-PRF-38535, MIL-STD-202, and the QPL program, ensuring survivability in extreme conditions of shock, radiation, wide temperature ranges, and long lifetimes. Today, however, modern defense programs face new pressures:

- Rapid obsolescence of electronic components, including semiconductors, because the commercial market changes quickly and it “follows the money.”
- Budget constraints and the drive toward cost-effective procurement.
- Demand for higher performance and integration, especially in advanced computing, AI, and radar systems (along with COTS concerns). When a mil/aero customer calls with a list of demands it’s often more attractive for a supplier to say no and send them on their way. “Won’t and don’t, sorry the volumes are too low and your needy list too large. We don’t have the resources.”
- Meeting size, weight and power consumption (SWAP) goals and requirements.
- Today’s necessity of speed of response (OODA loop). Historically, the mil/aero “military industrial complex” is not “wired” for speed. In decades past that might have worked but the world is changing.

Traditionally, a drone system, power supply, radar or missile system could take decades to develop and deploy. Acquiring the right mil/aero components was the first major obstacle.

For example, when working for a defense contractor early in my career, a team I was working on was tasked with designing advanced technology that had to meet our customers’ high expectations. Initially, we consulted the list of QPL parts, as instructed. However, we found that not only would the parts count be enormous (potentially decreasing reliability), but also that the available parts on the QPL list used very old technology. Using old technology would have resulted in the parts count going higher to compensate for the ancient lack of functional integration, meaning reliability would have gone down (on paper anyway).

This also meant cost, power efficiency, size, weight and ability to design anything new were out of the question. We persuaded management and our customer to use 883 “good enough” instead of QPL parts, which were old, heavy, large, out of date and expensive.

Sometimes those in today’s mil/aero applications sector believe they should receive special consideration from components suppliers; yet, with such low volumes, it can be difficult for them to get the support they expect. Also, they can assume their components will simply be an extension of COTS since there are very few semiconductor suppliers who focus exclusively on mil/aero parts.

You can build your own semiconductors and components, yet with fabs reaching toward the stratosphere on cost—multiple billions of dollars each—how will those parts coming out of your fab 1) keep up with technology and 2) amortize those costs against volumes?

Alternatively, you can design your own semiconductors and have an external fab make them for you. Yet you still need volumes to drive down costs *and* don’t tell them you need anything too special or expect to be dropped as a customer. In other words, you can likely ask for AEC-Q qualification but nothing more. There are just not that many ways around this problem in today’s electronics industry.

In the current realm of mil/aerospace, using AEC-Q automotive components offers a competitive advantage. When my “adversary” is bogged down in bureaucracy—or is forced to use a JAN-QPL part of inferior technology that increases the application’s SWaP—I can gain an advantage by having current automotive-qualified parts that are technologically superior. With this approach, I can quickly create a cost-effective, lightweight and reliable application, while competitors jokingly complain that the weight of their paperwork exceeds the product’s.

## **AEC-Q Vs. COTS**

The automotive sector, driven by the rise of electric and autonomous vehicles, has evolved its own reliability standard: the Automotive Electronics Council (AEC) specifications. Parts that meet AEC-Q100 (for ICs) or AEC-Q101 (for discrete devices) undergo extensive qualification for thermal cycling, vibration, humidity, HALT, HAST, HTRB, HTOL, ESD and electrical overstress, which are many of the same stresses found in aerospace environments.

While AEC-Q100 and MIL-STD-883 share many test categories, such as thermal cycling, ESD, and vibration, their intent and rigor differ. MIL standards emphasize absolute reliability, hermeticity, and traceability under the harshest conditions. AEC-Q focuses on statistical robustness and cost-effective reliability for long-term automotive use.

The philosophy is different also. Since AEC-Q is newer it incorporates decades of learnings in how to achieve these goals in high volumes and zero defects with high reliability by making sure processes are tightly controlled and well understood. MIL STDs are often stuck decades behind and the approach is one of let's test this part to death to make sure it's not a bad escape from the system, and that it's reliable. This means more handling, which we will get into in a bit.

For many non-space-flight-critical applications, including ship, mobile or fixed ground-based military systems, drones, autonomous vehicles and more, AEC-Q parts can meet performance requirements when combined with additional screening, derating and, of course, system-level qualification. In this way, it can be easy to use AEC-Q devices in mil/aero systems, especially if the system must meet current technological relevance and SWAP goals.

This approach is also advantageous where there is a need to speed innovation and cycling product adaptations and advancements. In addition, using AEC-Q parts can make a huge difference simply by eliminating paperwork and costs.

In my recent past I have been involved in qualifying AEC-Q parts at every defense contractor name I can think of. It would be hard to come up with one that I have not heard from. Even rocket guidance systems and flight computers. In all these instances, there were zero issues in qualifying AEC-Q parts. In terms of paperwork, usually, the customer required a PPAP, an AEC-Q Reliability – Qualification report (often in the PPAP) and an MTBF-FIT report.

For space, radiation-exposed, or man-rated space and safety-critical flight applications, MIL-qualified or radiation-hardened components remain the required choice. Often these requirements can be met with up screening at a lab that provides such services. Tables 1 and 2 provide a clear comparison of the major qualification and screening requirements of MIL-STD-883 (for microelectronics) vs. AEC-Q100 (for automotive integrated circuits). As shown, some MIL standards are clearly outdated.

Table 1. Comparison of MIL-STD-883 and AEC-Q100 qualification and testing standards—high level differences.

Category	MIL-STD-883 (military) (often +125°C or +150°C)	AEC-Q100 (automotive)	Key difference/notes
Governing body	U.S. Department of Defense (Defense Logistics Agency, JEDEC support)	Automotive Electronics Council (AEC)	MIL is government- regulated; AEC-Q is industry self-regulated.
Primary purpose	Qualification and screening of microcircuits for military and aerospace use	Qualification of integrated circuits for automotive environments	Both ensure high reliability under stress but focus on different end-use conditions.
Qualification approach	Lot-by-lot and device family qualification per QML (Qualified Manufacturers List)	Device family qualification by manufacturer self- certification	AEC-Q relies on process capability and statistical confidence, not government oversight.
Operating temperature range	-55°C to +125°C (typical), up to +175°C for extended temperature grades	-40°C to +150°C (Grade 0), -40°C to +125°C (Grade 1), etc.	MIL supports wider temperature extremes; AEC-Q covers most automotive ranges.
Package type	Hermetic (ceramic or metal)	Plastic molded (non- hermetic)	Hermiticity is required for MIL; AEC-Q accepts non- hermetic.

Table 2. Comparison of MIL-STD-883 and AEC-Q100 qualification and testing standards—test requirements.

Category	MIL-STD-883 (military) (often +125°C or +150°C)	AEC-Q100 (automotive)	Key difference/notes
Thermal cycling/temperature cycle	Method 1010: typically, 500 cycles, -65°C to +150°C	Test A4: 500 to 1000 cycles, -40°C to +125°C or +150°C	Similar intent, slightly different ranges and ramp rates.
High-temperature operating life (HTOL)	Method 1005: 1000 hr at maximum rated temperature	Test A1: 1000 hr at operating max temperature (125-150°C)	Nearly identical stress concept: MIL may require more detailed failure analysis.
Burn-in (dynamic or static)	Method 1015: 160 hr min at 125°C or 240 hr at 125°C	Optional: not always required under AEC-Q100	MIL mandates 100% device screening; AEC-Q relies on statistical sampling (you can't burn in quality).
Moisture resistance/humidity testing	Method 1004/1008/1009	Test A6 (biased HAST) and A110 (unbiased HAST)	AEC-Q uses HAST; MIL uses longer-duration steady-state tests.
ESD/latchup	Method 3015 (ESD) and Method 1020 (latchup)	Test A5 (ESD) and A7 (latchup)	Similar, AEC-Q aligns with JEDEC JS-001/002 standards
Vibration/shock	Method 2006/2007: 20 g to 1500 g	Test AB (mechanical shock)/A9 (vibration)	Both simulate handling and system shock; MIL requires more severe profiles.
Radiation effects	Method 1019 (ionizing), 1020 (total dose)	Not specified	MIL includes radiation testing for space/nuclear; AEC-Q does not require it.
Wire bond pull/shear/die attach	Methods 2011, 2019, 2030	Included indirectly in assembly qualification (Test A3)	MIL specifies detailed mechanical bond integrity tests.
Failure rate and reliability data	Statistical analysis per Method 5005; failure rate levels (e.g., Level B, S)	Statistical process control; AEC-Q Grade 0-3 lifetime goals	MIL defines explicit failure rate levels; AEC-Q focuses on process stability.
Traceability/lot control	Full lot traceability. Serialized components, controlled changes	Manufacturer-controlled traceability, PPAP documentation	MIL has government-controlled traceability; AEC-Q relies on supplier documentation.
Certification and listing	Must appear on Qualified Manufacturers List (QML/QPL)	No central listing; self-qualified per AEC guidelines	MIL is third-party certified; AEC-Q is self-certification.
Cost/availability	High cost, low volume, long lead times	Lower cost, high volume, wide commercial availability	AEC-Q wins on cost and availability but with less environmental rigor.
Lifecycle expectation	20 to 30 years typical (defense programs)	10 to 15 years typical (automotive platforms)	Automotive lifecycle is shorter; obsolescence planning is critical for defense use.

### The Benefits Of AEC-Q Devices

#### Availability And Cost Efficiency

Military-grade components often have limited production runs and long lead times. In contrast, AEC-Q parts benefit from high-volume automotive production, which helps ensure lower unit costs and stable long-term supply chains. Moreover, automotive customers require longevity of parts for 10-years-plus and sometimes longer. These are contractually obligated to massive automotive customers and will not be violated. Additionally supply chain resiliency, COO and other proximate shared concerns are also requirements.

The mil/aero market shares much in common with the automotive and industrial markets which have a big stick to drive supplier behavior that the mil/aero customers do not. Typically, medical electronics do not either, so the medical electronics market can ride on the automotive coattails as well.

### **Comparable Environmental Robustness**

Automotive environments—under the hood or in EV powertrains—expose electronics to -55°C to +175°C, vibration, and combined temperature-humidity and transient electrical noise. These extreme conditions are comparable to those faced in many aerospace and defense platforms (excluding space or nuclear applications).

Additionally, the automotive AEC-Q requirements have been built on decades of mil/aero experience and standards and then gone farther. For example, the use case of automotive parts often requires more qualification on thermal shock from -55°C to +175°C than any other market because that is often the use case.

Other markets have accepted automotive standards rather than reinventing the wheel. Additionally, product- and system-level qualification is more acceptable than in the past. In other words, if your product is a military power supply potted in MIL STD potting compound, if you can meet the testing and customer requirements nobody is going to care if you have used AEC-Q parts inside or not.

Conversely, if you can't pass testing, then you might get "help". However this is more a factor of quality of design and manufacturing than it is component selection. It's been my experience that you can't take a bad design and improve it with higher-reliability parts, but you can take a good design and improve it with better-quality parts.

### **Technology Currency**

Automotive manufacturers continuously innovate to meet demands for ADAS, radar, EVs, HEVs, drive train components, autonomous control and soon, AI. AEC-Q semiconductors often offer newer process nodes, higher integration, and lower power consumption, along with recent technology compared with legacy MIL parts. Moreover, adjacent markets like networking, down-hole instrumentation, avionics, railway, energy, utility, metering and control, industrial electronics and even medical are embracing AEC-Q parts with established reliability.

Attractive attributes for non-automotive applications are response speed and cycle time, which are orders of magnitude faster than with military-specific or QPL parts. (I challenge designers to find the time to locate QPL parts on the list while also doing their "real" job.)

### **Established Quality Systems**

AEC-Q qualification is performed under IATF 16949 and ISO 9001 quality systems. While not military certifications, they provide structured control over design, process and change management. In fact, due to the higher volumes and risk of recalls for automotive customers, the goal is zero defects.

The allowable limits for AQL in the military component market would be a disaster for an automotive part because the volumes and contractual liability in automotive mean quality and reliability must be maintained, or else substantial contractual liabilities are invoked. Automotive customers often audit their suppliers and provide score cards with pass/fail criteria and monitoring of SPC and CPK data. As in many things in life, money and in this case, volumes, drive things.

When automotive companies provide feedback to a component supplier, they can expect to see designs implemented almost instantly since, as customers, they represent large revenues. And if issues occur, large automotive OEMs demand that an 8D report be processed quickly—like hours.

In contrast, when a 100-piece-a-year mil/aero customer gives feedback, the supplier will provide polite responses, but nothing will be done. In other words, it is helpful to have those with a "big stick" driving technology improvement. Typically, military customers do not have the time or resources to audit electronic component suppliers. However, they don't need to since top-tier automotive companies are already providing this oversight process.

## AEC-Q Component Suitability In Mil/Aero Applications

AEC-Q devices can be appropriate for many non-flight-critical or non-spaceborne, defense and aerospace functions. Typical examples include:

- Ground-based radar and communications systems
- Vehicle-mounted control electronics (military ground vehicles, UAVs)
- Power management and power conversion systems
- Test and training equipment
- Mission computing, vision systems, and AI processors
- Newer and more compact designs

AEC-Q parts generally may *not* be suitable for:

- Radiation-exposed environments (e.g., space). More on this below.
- Safety-critical and manned flight control or weapons guidance where single-event failures are catastrophic. (Having said that, I have worked with customers using AEC-Q semiconductors in rocket engine control and guidance systems and more, so this restriction might no longer be true.)
- Applications that require hermetic packaging or extended life beyond typical automotive design cycles; although, modern plastic-packaged parts often test better than ceramic or other historical packaged semiconductor devices. In these cases, MIL-PRF/QML-qualified or radiation-hardened devices remain mandatory.

With regard to the last item, due to demanding markets, plastic molding compounds and material science have made tremendous strides and in high shock and vibration applications (think firing artillery shells with embedded electronics out of a launcher). Wire bonds in hermetic packages can break if not supported whereas plastic parts can survive high Gs and shock easier than hermetic parts. Yes, we have worked on this with AEC-Q parts.

About rad hardness, I was sometimes able to use an AEC-Q part alternative. When customers asked for rad-hardness data, I would send them parts to test at Texas A&M (or other location) and asked them to send me back the results. No one ever refused this approach, even for rocket-guidance computer systems. Unless they wanted to recreate the Univac computer from discrete NAND gates, 2N2222 transistors and 741 op amps, I knew they wouldn't find what they needed on any military QPL component list.

### **Engineering Considerations For AEC-Q Integration**

When adopting AEC-Q semiconductors for military or aerospace use, engineers should consider the following:

#### **Derating And Margin Analysis**

Operate components below their rated maximums—voltage, current, and temperature—to improve reliability and align with military derating guidelines (MIL-HDBK-1547). Running the parts cooler greatly increases reliability. High reliability parts can't compensate for bad design. Design well is goal #1.

Early in my career, I learned that a high-reliability design can be improved by using good parts, but even the best parts will not compensate for marginal designs. You cannot test-in reliability, but you can design-in great reliability. AEC-Q parts have a proven track record in high volumes, so excellent upfront design work will result in years of service over time even under temperature extremes.

Although somewhat dated, most engineers follow the minimum standard for aerospace applications set by NASA's EEE-INST-002 (see reference 2), defined in 2003. This standard provides exact guidelines on unique specifications for each type of product that could be on a PCB. Often, AEC-Q satisfies or surpasses the requirements in the different categories. Worst-case analysis and conservative component derating will almost always ensure long life in the intended applications. Good design, especially in switching power applications will give better results than trying to upgrade parts for a marginal design.

Using AEC-Q parts can help save costs and delays in the front-end procedures. Most companies follow AS9100D and have certain gating milestones, such as preliminary design review (PDR) and critical design review (CDR). During the PDR phase, AEC-Q parts could extend some relief in the process. Moving forward into CDR, engineers can plan for and lock in the items listed below. Designers can simply pull out the standard documentation such as PPAPs and such to tick the boxes on component reliability.

The lead engineer should be involved, as needed, in peer design reviews, such as mechanical design/analyses, hardware analyses, schematic, PCB layout, software, firmware/FPGA-ware, and IPL.

In preparation for CDR, the lead engineer should complete or assist with tasks as required. Various additional tasks may be needed, including:

- Ensuring all TBRs/TBDs are resolved from customer documents
- Completing design analyses (working with designers) on:
  - Derating/parts stress
  - Worst-case analysis
  - FMEA/FMECA
- Conducting power analysis (board and box level) for:
  - Radiation
  - Reliability
  - Structural
  - Thermal

## Extended Testing

Engineers may need to perform the following additional screening beyond AEC-Q qualification: thermal cycling, vibration, burn-in, and high-temperature operating life (HTOL). Up-screening can be performed by an outside lab. Do keep in mind that this additional handling is required before inserting it into the PCB pins ESD testing, and improper handling in and out of the test equipment can introduce problems.

For example, a defense contractor I worked for years ago had an area for incoming inspection where they tested every part that came in. We had 6.5-digit DMM, which was then very large and expensive at that time.

One day, I saw a technician unpacking and testing 1% military RN55 resistors. I asked him how many bad resistors he'd found, and he replied that he had never found one. He mentioned, however, that occasionally the different resistors wound up in the wrong bins. So, rather than following "the process," we would have been better off not touching the parts in the first place. This is an example of dumb stuff that "we have to keep doing".

## Lot Traceability And Change Control

Unlike MIL parts, AEC-Q devices are self-qualified by the manufacturer and are not listed on a government Qualified Manufacturers List (QML). Engineers must ensure traceability and configuration control, especially if parts are procured through commercial channels. In my experience, AEC-Q electronic components are highly traceable. That's because end customers demand it and, of course, they have greater volumes, so they get what they want. Moreover, it's a requirement of AEC-Q and contracts.

## Packaging And Environmental Protection

AEC-Q parts are often plastic encapsulated, which may not provide sufficient moisture or outgassing protection in aerospace conditions. Hermetic sealing or conformal coating may be required. In many cases, military and aerospace components are potted in some type of approved compound, and if that material changes shape, plastic components are more resistant to exothermic pressures than are the "hermetic" parts.

Often, the plastic parts are passing the same tests or even more stringent tests than the older ceramic and metal packages were subjected to. In some cases, we are still living with legacy beliefs in component reliability that have come and gone.

## Lifecycle Management

Because automotive design cycles are typically 10 years or more, some AEC-Q devices may become obsolete

sooner than military systems designed for 20-plus years of service. Proactive lifecycle planning and last-time-buy strategies are essential. Since the other requirement for automotive parts is generous lifetime buy offerings and a long period to procure last time buys, this support for long product life should be no problem. It's certainly better than commercial or consumer parts which are on six months to one-year lifecycles and can go EOL without much warning.

Yet in most cases with limited quantities of mil/aero parts, components for automotive are around for 10 years or more. This is especially true in the discrete small-signal and power semiconductor areas. In many instances, upgraded alternatives will be offered that are drop-in replacements.

### **Using Hybrid Qualification Strategies**

Many defense contractors now adopt hybrid qualification approaches: using AEC-Q devices where possible but validating them through additional in-house testing or outside up-screening to achieve "MIL-equivalent reliability." Other times, simply validating through screening as an assembly to pass end-system testing is acceptable.

Some organizations have even created internal "enhanced AEC-Q" or "military-automotive" standards by adding temperature extension, vibration testing, and radiation screening, as needed. This approach helps balance cost, availability and reliability while maintaining mission assurance. This is more often the case with sub-assemblies rather than semiconductors. It's better to start with an AEC-Q part and up screen than a part targeted for a flat panel TV and up screen from there.

AEC-Q semiconductors are not affected by shock and vibration, especially plastic-packaged devices. Also, end-system testing and validation are more acceptable today than they were in the past.

### **Other Supply Chain Issues**

Although it might not be as big a topic of discussion lately, supply chain resiliency continues to be a concern. Covid and various wars raised supply chain issues and many what-if questions. Additionally, many U.S. customers simply do not want China-made COO parts—so companies are seeking sources in other countries.

Again, the automotive customers can bang this drum with a much bigger stick than the mil/aero market and everyone can benefit from this. Some of the automotive customers have entire teams appointed by the CEO to work on supply chain areas so you don't have to. In fact, if you have concerns, talk to your suppliers. You will likely find that if the mil/aero market has a legitimate concern, it's already being addressed for another customer segment.

Naturally, there are always exceptions, however getting off the mainstream component revenue stream always has consequences. Sometimes, money and ego are driving such decisions. If someone insists on special requirements for some low-volume specialty thing(s), they may be truly necessary. Or they may be engaging in "empire building."

For example, a designer might say, "I have to have this hermetic, gold-plated, shiny custom expensive device." Maybe that's true, maybe not. Or perhaps, they just want to maintain control of the design, so they're the only one who knows how it works, and the company must keep them around.

Never discount empire building as a motivation for not being able to accept industry standards. I have seen many examples of this over the decades in needing special ESD standards and other requirements where "we can't accept \_\_\_\_\_ because we need \_\_\_\_\_". Ninety percent of the time, it's empire building versus not being able to accept an industry standard. This often costs organizations dearly and needlessly.

### **Conclusion**

The use of AEC-Q semiconductors in military and aerospace systems represents a pragmatic shift toward leveraging the massive reliability investments proven out in the volumes of the automotive industry. While AEC-Q components may not fully replace MIL-grade or space-qualified parts, they can play a vital role in creating cost-sensitive, technologically similar and rapidly adaptive defense applications. This is especially true where SWAP—size, weight and power—goals can be met by using current-technology parts rather than outdated, conventional devices.

By combining robust design practices, extended qualification testing, and disciplined configuration control, engineers can confidently integrate AEC-Q devices into non-mission-critical mil/aero systems, thereby achieving a balance between system performance, speed, viability, reliability and affordability.

In summary the historical MIL STD approach is to up-screen components to weed out the bad ones where 0.1% AQL was tolerable. In contrast, in the automotive component world, you qualify the part and processes and implement a "copy exact" mentality to change nothing so you can trust the part meets specification and you will never find a bad part versus screening-in quality.

In other words, you insure zero-defect part quality by design. With high-quality designs this results in a more modern and better approach. Then, if more testing is needed, you can always have AEC-Q parts up screened and further tested. Just make sure that in up screening and testing you are not inducing failures you would otherwise not have.

With the continued growth in automotive technology, we can expect to be successfully borrowing more from the AEC-Q program for many other applications including the mil/aero market.

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### About The Author



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