Rethinking "Automotive": How to Specify Components for Tomorrow's Mobility

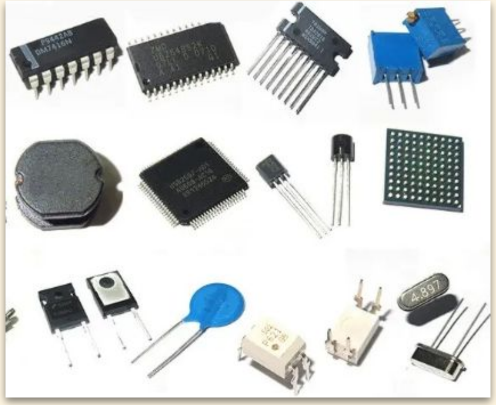
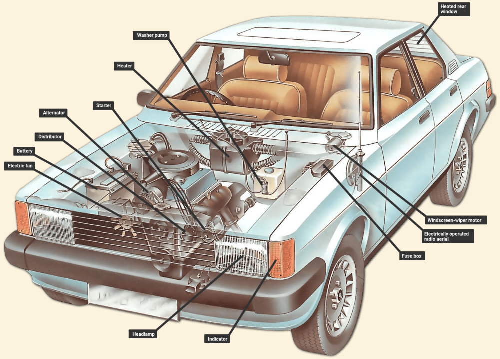
European Automotive Electronics Reliability Workshop

F.GOUYOU - Oct 2025

SMART TECHNOLOGY FOR SMARTER MOBILITY

Electronics in the cars...

When AEC-Q specifications were first published (1994)...

The electronics shows	The electronic parts	Basic electronics
		

… to electronic cars …

In the last 2 decades

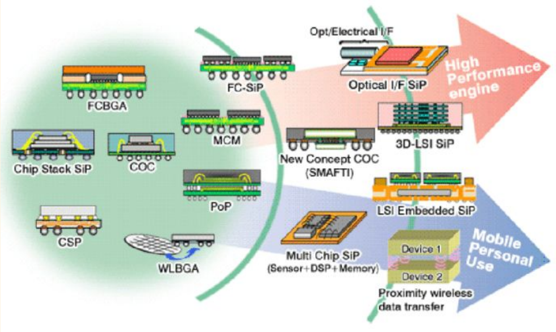
The electronics shows

The electronic parts

Electronic equipments everywhere

… to EV and mobility

Nowadays

Mobility shows	Advanced packaging	EVs and Smart cities
		

Electronics Everywhere — Inside and Outside the Car

Charging & Energy Interfaces

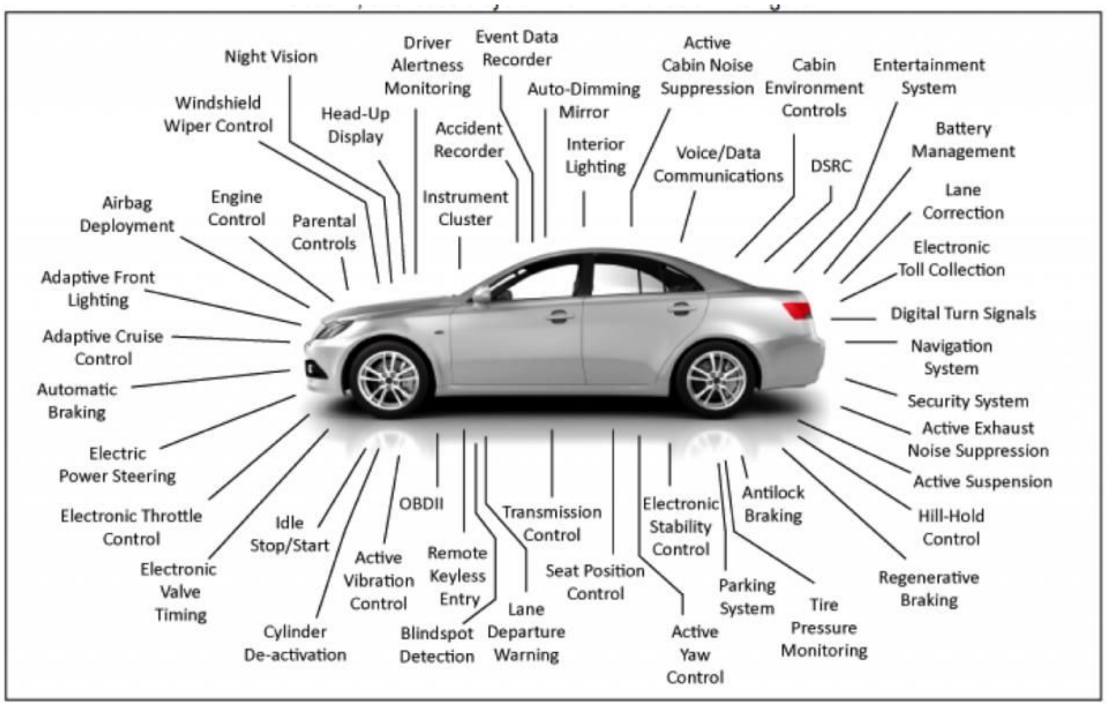
- **EV chargers (AC / DC fast chargers) :** wallboxes, public charging stations.
- **Charge connectors & cables** Type 2, CCS, CHAdeMO, etc.
- **Vehicle-to-Grid or -to-Home (V2G/V2H) converters** : bidirectional power interfaces.

Access & Security Systems

- **Key fobs / remote keyless entry (RKE)** devices.
- **Smart keys / proximity keys** : communicate via LF (125 kHz) and UHF (433 MHz / 868 MHz).
- **Digital keys on smartphones** (BLE, NFC, UWB).
- **Immobilizer antennas** (sometimes integrated in external modules like door handles).

Service & Diagnostic Equipment

- **OBD service tools and diagnostic dongles** (plugged in externally).
- **Remote diagnostic or fleet management devices** connected temporarily or permanently outside the vehicle.



Connectivity & communication

- **Telematics units or antennas integrated into roof modules or shark fins** (sometimes physically external).
- **Vehicle-to-Infrastructure (V2X) roadside units (RSU)** : placed along roads or in smart parking systems.
- **External Wi-Fi / LTE gateways** used by fleet operators.

Environment Monitoring & Infrastructure

- **Parking sensors or smart parking infrastructure** (ground sensors, parking meters)
- **Traffic and ADAS infrastructure** (radar reflectors, cameras, beacons supporting autonomous functions).

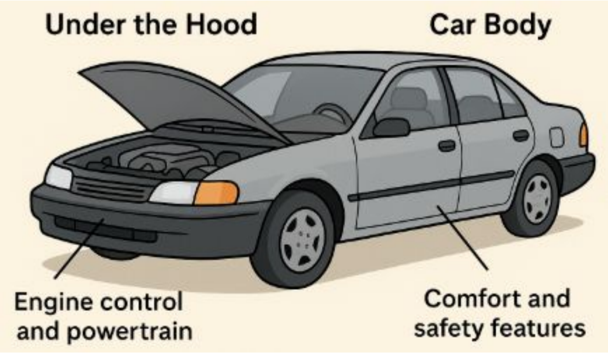
Accessories & Add-ons

- **Tire Pressure Monitoring System (TPMS)** sensors (technically *outside* the cabin, inside wheel assemblies).
- **Trailer control units / towing modules**.
- **External lighting units** (smart headlights, taillights, exterior cameras).
- **Roof boxes, auxiliary lights, or solar roofs** with embedded electronics.

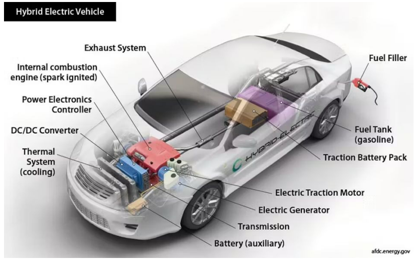
Diversification of Electronic Platforms Over Decades

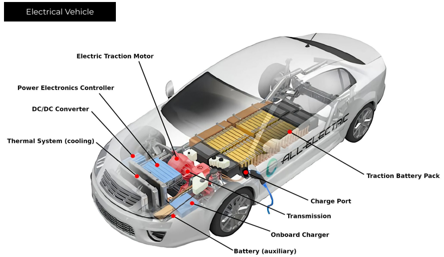
Changes in the compartments / platforms

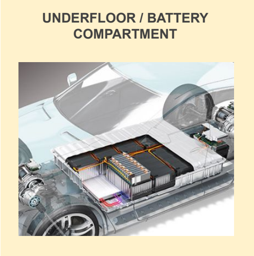
In the past, electronics were mainly confined to 2 platforms (engine bay, cabin)

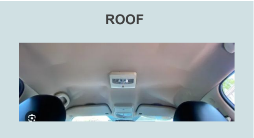


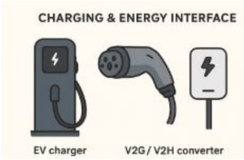
Today, vehicle evolution extends them to new areas :

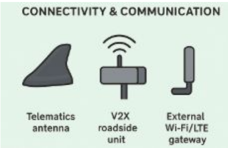


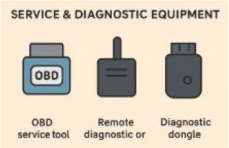












Applications moving to EV

BEV's in 2025

	Market Share	Volumes
China	29.7%	~ 10.5 – 11.5 millions
Europe	20.4%	~ 2.5 millions
United States	11.2%	~ 1.0 million
India	7.5%	~ 0.6 – 0.9 million
Global	16.7	~ 14 – 15 millions

Applications moving to EV

Changes in the stress factors

Typical validation plan for powertrain/inverter ECUs

	ICE VEHICLES (AEC-Q100 Gr. 0/1)	EV VEHICLES (LV124 / ISO 1675-4)
Operating Temperature range	-40 to +125°C (gr. 1) +150°C (gr. 0)	-40 to +105°C
Thermal Cycling tests	Rapid cycles -40 to +150°C 1000 cycles	Moderate ramp rate cycles -40 to +105°C
Power cycling / Active stresses	Engine starts and ignition cycles	Continuous load operation, regenerative braking, DC fast charges
Humidity / condensation tests	85°C/85% RH (1000h) non-condensing	60°C / 95% RH (1000h) + condensation cycles
Electrical stresses	12V, load dump, jump start	12V / 48V & HV (400-800V)
Mechanical / vibrations	High vibrations and shocks	Lower vibration (motor mount-damped) but higher frequencies

More use cases

RANGES	Passenger cars								
	Engine bay			Underfloor / Battery Compartment		Cabin / dashboard		Roof	Exterior
	ICE	MHEV	EV	ICE	EV	ICE	EV	ICE / EV	ICE / EV
Typical use cases or functions	- Combustion engine - Alternator - Radiator - HVAC	Combustion engine with equipments + Electrical motors	- Inverter - DC-DC converter - Charger - HVAC - Front motor	- Fuel lines - Exhaust - Transmission tunnel	- HV battery pack - Cooling system - BMS	- Instrument cluster - HVAC - Airbags/ECUs	- Infotainment - ADAS/ECUs - Displays	- Antennas / Telematic unit - Sensors - Cameras	- GPS, - LiDAR, RADAR, - Cameras
Ambient Temperature Range	-40°C to 90-110°C	-40°C to +110 °C (near IBSG/Inverter)	-40°C to 75°C (85-90°C under load)	-40°C to 60°C (>80°C near the exhaust)	-40°C to +45°C (+60°C during fast charge/heavy use)	-40°C to +75°C	-40°C to +75°C	-40 to +100°C (parking conditions at sun) (70°C for dark surfaces exposed to direct sun)	
Reference standards	AEC-Q100 Gr. 1: –40°C to +125°C		LV124 or ISO 16750-4	AEC-Q100 Gr.2: –40°C to +105°C	LV124 or ISO 16750-4	AEC-Q100 Gr.2: –40°C to +105°C	LV124 or ISO 16750-4	AEC-Q100 Gr.2: –40°C to +105°C	
Service Life Time	15 years 240,000 km	10 to 15 years for ICE 7 to 10 years for 48V products	15 years 300,000 km (warranty) 500,000km (lifetime)	15 years 240,000 km	8 to 12 years 160,000 to 240,000 km	15 years	16 years	15 years	15 years
Operating hours	4000 to 6000h (engines) 1000 to 2000h (alternator)	ICE: 4000 to 6000h BSG: 2000 to 3000h DC-DC: 1000 to 2000h	8,000h (service lifetime) 20,000 to 30,000h (charging/OBC)	4000 to 6000h	2000 to 3000h (battery discharge) 500 to 1000h (charging)	6000 to 10000h	6000 to 10000h (displays) up to 160000 (ECUs) depends on operating modes	4000 to 10000h	4000 to 10000h
Vibration Range	Low-frequency dominant 20 to 200Hz (combustion pulses, engine mounts)	20Hz to 1kHz (ICE range) plus 10 to 15kHz (electric)	High-frequency dominant 10Hz to 15kHz	200 to 1kHz (transmission, drivetrain)		20 to 250Hz	40 to 600Hz	30Hz to 1kHz	100Hz to 2kHz
Acceleration	2.5 to 7.0 m/s^2	2.5 to 12.0 m/s^2	3.9 to 12.0 m/s^2	2.5 to 7.0 m/s^2	3.9 to 12.0 m/s^2	2.5 to 7.0 m/s^2	3.9 to 12.0 m/s^2	2.5 to 7.0 m/s^2	2.5 to 7.0 m/s^2
Humidity Range	10% to 95% RH	10% to 95% RH	10% to 95% RH	10% to 95%	5% to 95%	10% to 90%	10% to 90%	10% to 90%	5% to 100%
Electrical stress	12V, load dump up to +174V	12V and HV (48-100V)	12V, 48V, and HV (400-800V)	12V, load dump up to +174V	12V, 48V, and HV (400-800V)	12V, load dump up to +174V	12V, 48V, and HV (400-800V)		

Labels (grades) commonly found

RANGES	Consumer	Industrial	Avionic	Military	Aerospace
Typical use cases or functions	Smartphones, laptops, TVs, home appliances.	Industrial equipments, automation, robotics, energy management.	Aircraft control systems, flight computers, navigation.	Radar systems, communication equipment, missile guidance, tanks.	Satellites, spacecraft, deep-space probes, orbital vehicles.
Ambient Temperature Range	0 to +70°C	-40°C to 85°C	-55°C to 125°C	-55°C to 125°C	-150°C to 150°C
Reference standards			Certified under DO-254 (HW) and DO-178C (SW).	Built to MIL-STD specs.	
Service Life Time	3 to 5 years	7 to 15 years	20 to 30 years	Minutes to 30 years	10-25+ years
Operating hours	1,000 to 10,000	20,000 to 50,000	50000 to 100000	20000 to 80000h	50000 to 150000h
Vibration Range	0Hz to 500Hz	0Hz to 1000Hz	0Hz to 2000Hz	0Hz to 2000Hz	0Hz to 2000Hz
Acceleration	$30ms^{-1}$	$50ms^{-1}$	$1000ms^{-1}$	$1000ms^{-1}$	$1000ms^{-1}$
Humidity Range	0% to 90%	Application def.	0% to 100%	0% to 100%	0% to 100%
Ionizing Radiation	Insignificant	Low to high	Medium	High	High
ESD Robustness (HBM)	Up to 3kV	Up to 10kV	Up to 25kV	Up to 25kV	Up to 25kV
PCBA ppm Targets	< 1000	< 500	0.1 to 10	0.1 to 10	0.1 to 10
Device, component & SIP FIT targets	< 100	< 100	< 1	< 1	< 1

Grade comparison

For Integrated Circuits (collected from diverse companies)

	Grade	C	I	A
Quality & Reliability	Qualification Test Plan	No	AEC-Q100	AEC-Q100
	Quality System	ISO9001		IATF16949
	Operating Temperature	0 to 70°C	-40 to 85 °C	-40 to 125 °C
	DPM		<50	Zero Defect Methodology
	Failure Analysis flow	Upon agreement	Standard	Priority
Foundry	Automotive Process Flow	No	No	On demand
	WAT SPL Monitoring	No	No	Yes
Probe	EWS (die sort)	No or sampled	Yes	Yes
	GDBC Detection	No	No	Optional
	Dynamic PAT	No	No	Yes
Assembly	Enhanced optical inspections	No	No	Yes
	Certified equipment and operators	No	No	Yes
Test	Test conditions	100% RT	100% RT or HT	100% RT or HT
	HSOV (when applicable)	No	Yes	Yes
	SBL, SYA	No	Yes	Yes
Documentation	Part Production Approval Process (PPAP)	No	No	Yes
	Material declaration (MDS)	IEC 62474 / IPC-175x	IEC 62474 / IPC-175x	IMDS / CAMDS

Main differences between grades : Process control and Services
Design and reliability are intrinsically the same.

DPM comparison

Year	Grade	Volume	Failures	EOS	DPM incl EOS	DPM w/out EOS
2018	A-grade	1,012,088	3	3	2.96	0.00
2018	I-grade	47,868,037	78	66	1.63	0.25
2019	A-grade	3,525,704	3	3	0.85	0.00
2019	I-grade	48,692,384	58	54	1.19	0.08
2020	A-grade	6,781,002	10	10	1.47	0.00
2020	I-grade	63,582,279	69	64	1.09	0.08

Reference : Skyworks Si86xx digital isolators

- ➢ In some years, A-grade DPM may appear higher because automotive customers are more diligent in returning suspected defective parts for F/A.
- ➢ PPM rates are similar for I and A grades ; reliability is good.
- ➢ Few isolated I-grade failures likely due to lighter testing.

Component and assembly technologies evolve

Type of substrate	Placement / Attachment method	Technology principle	Main stresses during process	Typical applications
Rigid PCB (FR4)	Reflow soldering (SMT)	Solder paste reflowed in oven	Thermal (220–260 °C)	Standard ICs, passives, connectors
	Wave / Selective soldering	Molten solder bath or localized flow	Thermal + Mechanical (vibration, flow)	THT, mixed-assembly boards
	Conductive adhesive bonding	Epoxy with conductive fillers	Chemical curing (low thermal)	Temperature-sensitive parts
HDI / Rigid-Flex PCB	Vapor phase reflow	Controlled condensation heating	Thermal (uniform)	Dense assemblies, fine-pitch BGAs
	Laser soldering	Local heat input by laser	Localized thermal + Optical	Optical / high-precision modules
	Silver sintering	Pressure + temperature bonding with Ag paste	Thermal + Compression / Pressure	Power MOSFETs, LEDs, IGBTs
	Epoxy underfill + reflow	Mechanical reinforcement post-reflow	Thermal + Chemical curing	Flip-chip or CSP packages
Ceramic / LTCC / HTCC	Wire bonding (Au, Cu, Al)	Ultrasonic or thermo-compression bonding	Mechanical (ultrasonic force) + Mild th	Power modules, sensors
	Flip-chip solder bumps	Direct die attach with solder interconnects	Thermal + Mechanical (CTE mismatch	ASICs, RF chips
	Direct Copper Bonding (DCB)	Cu–ceramic joining by high-T process	High thermal + Thermal stress (CTE m	High-power substrates
Organic / Silicon Interposers	Thermo-compression bonding	Pressure + heat for fine-pitch dies	Thermal + Compression pressure	2.5D, 3D packages
	Micro-bump / Cu pillar bonding	Fine-pitch bump interconnects	Thermal + Compression	WLP, SiP, HBM memory stacks
	Embedded die / component	Die laminated into PCB stack-up	Mechanical (lamination) + Thermal	Compact power or sensor modules
Flexible / Film Substrates	ACF / ACA bonding	Anisotropic conductive film adhesive	Low thermal + Compression	Displays, camera modules, FPCs
	Low-temp solder / adhesive attach	<150°C reflow for polymer substrates	Low thermal	Wearables, flexible sensors
	Laser Direct Structuring (LDS)	3D circuit on molded plastic	Optical + localized thermal	Antenna modules, 3D-MID parts
	Printed electronics	Additive conductive ink printing	Chemical drying / curing	Smart labels, sensors, IoT tags
Wafer / Die-Level (SiP, FOWLP)	TSV stacking	Through-silicon vias for vertical links	Mechanical (thinning) + Thermal	3D memory, logic stacks
	Fan-Out Packaging (FOWLP, eWLB)	Redistribution layer + molded carrier	Mechanical (molding) + Thermal	Mobile SoC, RF front-end
	Hybrid Cu–Cu bonding	Direct metallic interconnect	Compression + Moderate thermal	Advanced SoC integration
High-Power Substrates (DCB, AMB, Si_3N_4)	Pressure-assisted Ag sintering	High reliability, void-free attach	High compression + Thermal	Automotive inverter, LED, power control
	Transient Liquid Phase Bonding (TLPB)	Solid-state diffusion bonding	High thermal + Compression	Harsh environment power modules
	Cu clip / ribbon bonding	Low-inductance replacement for wires	Mechanical (stamping / bonding)	Power MOSFETs, SiC modules
	Direct die attach to heat spreader	Die placed directly on Cu / Al base	Compression + Thermal	High-dissipation devices

Type of stress

- Thermal (high)
- Thermal (moderate)
- Thermal (low)
- Chemical reaction
- Mechanical (compression)
- Mechanical (others)
- Light induced (UV, LASER)

Assembly process stressors moving from high-temp to TC or sintering => PC (Pre-conditioning) to extend to new assembly technologies

RELIABILITY ASPECTS

As specified in AEC-Q100

Loading	Example Mission Profile Input	Stress Test	Stress Conditions	Acceleration Model (all temperatures in K, not in °C)	Model Parameters	Calculated Test Duration	Q100 Test Duration
Operation	t_u = 12,000 hr (average operating use time over 15 yr) T_u = 87°C (average junction temperature in use environment)	High Temperature Operating Life (HTOL)	T_t = 125°C (junction temperature in test environment)	Arrhenius $A_f = \exp\left[\frac{E_a}{k_B}\bullet\left(\frac{1}{T_u}-\frac{1}{T_t}\right)\right]$ Also applicable for High Temperature Storage Life (HTSL) and NVM Endurance, Data Retention Bake, & Operational Life (EDR)	E_a = 0.7 eV (activation energy; 0.7 eV is a typical value, actual values depend on failure mechanism and range from -0.2 to 1.4 eV) k_B = 8.61733 x 10^{-5} eV/K (Boltzmann's Constant)	t_t = 1393 hr (test time) $t_t = \frac{t_u}{A_f}$	1000 hr
Thermo-mechanical	n_u = 54,750 cls (number of engine on/off cycles over 15 yr of use) ΔT_u =76°C (average thermal cycle temperature change in use environment)	Temperature Cycling (TC)	ΔT_t = 205°C (thermal cycle temperature change in test environment: -55°C to +150°C)	Coffin Manson $A_f = \left(\frac{\Delta T_t}{\Delta T_u}\right)^m$ Also applicable for Power Temperature Cycle (PTC)	m = 4 (Coffin Manson exponent; 4 is to be used for cracks in hard metal alloys, actual values depend on failure mechanisms and range from 1 for ductile to 9 for brittle materials)	n_t =1034 cls (number of cycles in test) $n_t = \frac{n_u}{A_f}$	1000 cls
Humidity (Option 1)	t_u = 131,400 hr (average on/off time over 15 yr of use) RH_u = 74% (average relative humidity in use environment) T_u = 32°C (average temperature in use environment: 9% @ 87°C - time on and 91% @ 27°C - time off)	Temperature Humidity Bias (THB)	RH_t = 85% (relative humidity in test environment) T_t = 85°C (ambient temperature in test environment)	Hallberg-Peck $A_f = \left(\frac{RH_t}{RH_u}\right)^p \bullet \exp\left[\frac{E_a}{k_B}\bullet\left(\frac{1}{T_u}-\frac{1}{T_t}\right)\right]$ Also applicable for Highly Accelerated Steam Test (HAST) and Unbiased Humidity Steam Test (UHST). See Notes.	p = 3 (Peck exponent, 3 is to be used for bond pad corrosion) E_a = 0.8 eV (activation energy; 0.8 eV is to be used for bond pad corrosion) k_B = 8.61733 x 10^{-5} eV/K (Boltzmann's Constant)	T_t = 960 hr $t_t = \frac{t_u}{A_f}$	1000 hr

Test plans must be adapted to new mission profiles coming from new use cases.

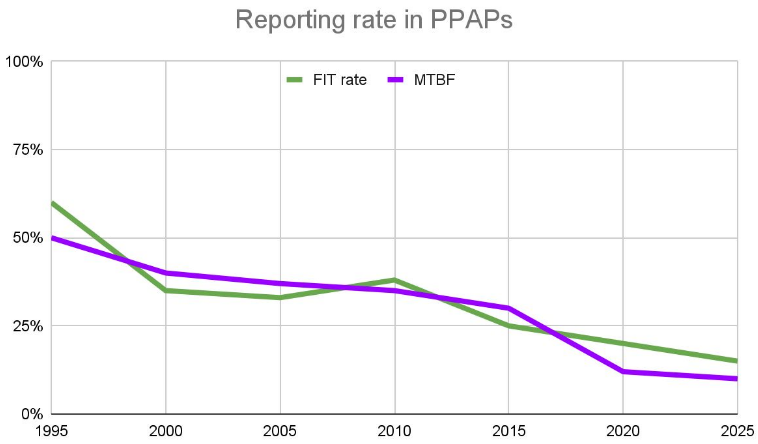
Reliability data

Declarations in PPAPs

AEC-Q reports (tests to pass) have taken over…

Test number: [illegible]	PRODUCT QUALIFICATION TEST REPORT											
	Product series / part number: [illegible]								Product type: Single Ended			
	Base standard: AEC-Q200 rev. D								Rated capacitance: 3900µF ± 20 %			
	Climatic category: 40/135/56								Rated voltage: 35V			
	Lot traceability: 905875176								Result: APPROVED			
Test Group	**Number of specimen**	**Test condition**	**ΔC/C**		**Dissipation factor (tan δ)**		**Equivalent Series Resistance (ESR)**				**Leakage current (LC)**	
			%		*		m Ω				μ A	
			f =	120Hz	f =	120Hz	f =	120Hz	f =	100kHz	35 Vdc, 1min	
1	419	**Pre Stress Electrical Test** For ΔC/C it was considered ΔC/Cr.	max ▶	-10,74	max ▶	0,106	max ▶	39,23	max ▶	26,29	max ▶	145,90
			ave ▶	-7,19	ave ▶	0,093	ave ▶	34,19	ave ▶	21,15	ave ▶	86,48
			min ▶	-3,71	min ▶	0,086	min ▶	30,96	min ▶	19,27	min ▶	60,52
			max.:	±20	max.:	0,160	max.:	*	max.:	27,00	max.:	4095
3	77	**High temperature exposure** MIL-STD-202, method 108: Test temperature: 135°C Test duration: 1000h Unpowered.	max ▶	-6,46	max ▶	0,092	max ▶	35,48	max ▶	24,90	max ▶	154,73
			ave ▶	-6,03	ave ▶	0,089	ave ▶	34,50	ave ▶	23,93	ave ▶	139,33
			min ▶	-5,19	min ▶	0,087	min ▶	33,66	min ▶	23,06	min ▶	127,42
			max.:	±20	max.:	0,320	max.:	*	max.:	*	max.:	4095
4	77	**Temperature cycling** JESD22, method JA-104: Maximum temperature: 150°C Minimum temperature: -40°C Dwell time at each temperature: 30min Test duration: 1000 cycles	max ▶	-6,35	max ▶	0,088	max ▶	33,78	max ▶	22,72	max ▶	265,33
			ave ▶	-5,59	ave ▶	0,086	ave ▶	33,02	ave ▶	22,13	ave ▶	231,16
			min ▶	-4,83	min ▶	0,084	min ▶	32,35	min ▶	21,37	min ▶	190,09
			max.:	± 15	max.:	0,192	max.:	*	max.:	*	max.:	*
7	77	**Biased humidity** MIL-STD-202, method 103: Test temperature: 85°C Relative Humidity: 85% Test duration: 1000h Test voltage: 35V	max ▶	-4,11	max ▶	0,099	max ▶	37,46	max ▶	22,92	max ▶	143,61
			ave ▶	-3,20	ave ▶	0,091	ave ▶	34,71	ave ▶	21,10	ave ▶	96,82
			min ▶	-2,63	min ▶	0,086	min ▶	32,57	min ▶	20,52	min ▶	72,32
			max.:	± 15	max.:	0,160	max.:	*	max.:	*	max.:	4095

…while reliability data (FIT rate, MTBF) no longer reported.



Reduced visibility on product robustness.

Reliability data

Detailed AEC gr. D reliability data are rarely shared.

Die technology			FEOL			
Technology name	Foundry service	Fab name	Gate Oxide Integrity (GOI)	Time Dependant Dielectric Breakdown (TDDB)	Hot Carrier Stress (HCS) Hot Carrier Injection (HCI)	Negative Bias Temperature Instability (NBTI)
0.11um e-flash ULL 1.5V3.3VHV	[redacted]	[redacted]	Da<5cm²(for bulk); Dp&Df<5E-4/cm	T(0.01%)>10yrs @1.1Vop @ 125°C with chip area 10mm²	DC T0.1% >= 0.2 years @ 1.1Vop & RT	DC T0.1% >= 10 years @ 1.1Vdd & 125°C
BCD 0.13um	[redacted]	[redacted]	Lifetime > 3 yrs DC, Vddmax LV (1.65V), MV(6.0V) @ T=150C, 1ppm, Ause=10mm²	Lifetime>DC 3yrs @ 5.5V, Tuse, 1ppm, Ause=5mm²	Lifetime > 3 yrs AC with duty 2% Vddmax LV (1.65V), MV(6.0V) ∆Ids/Ids=10% @ Tworst, 1ppm	Lifetime > 3 yrs AC with duty 50% Vddmax LV (1.65V), MV(6.0V) ∆Vth=5% of Vddmax @ T=150C, 1ppm
BCD 0.13um (151aBD13SA)	[redacted]	[redacted]	Lifetime > 3 yrs DC, Vddmax LV (1.65V), MV(5.5V) @ T=125C, 10 ppm, Ause=10mm²	Lifetime > 3 yrs DC, Vddmax LV (1.65V), MV(5.5V), MIM 2fF (5.5V) / 1.5fF (8.8V), MIM 1fF (15.4V) @ T=125C, 10 ppm, Ause=10mm²	Lifetime > 0.06 yrs DC Vddmax LV (1.65V), MV(5.5V) ∆Idsat=10% @ RT (25'C), 10 ppm	Lifetime > 1.5 yrs DC Vddmax LV (1.65V), MV(5.5V) ∆∆Idsat=10% @125'C, 10 ppm
CMOS 0.35um	[redacted]	[redacted]	BVD>8V Results: pass	(0.1%) @1.1Vcc & 80°C ≥10 yrs Results: Pass	AC (0.1%) @1.1Vcc & -55°C ≥10 yrs Results: Pass	
CMOS 0.11um	[redacted]	[redacted]	life time > 11 yrs @ 3.5V, 95C, 0.05ppm, 90%CL, 1 mm^2	life time > 11 yrs @ 3.5V, 95C, 0.05ppm, 90%CL, 1 mm^2	Life time > 15.5 yers @ L=0.318um, 0.05ppm, 90%CL	life time > 3.9 yrs @ 150C, 0.05ppm, 90%CL
NORD90 (90 nm Nor Flash)	[redacted]	[redacted]	A mode Density: Da<5 cm2(for bulk);Dp&Df<5E-4cm-1(for Edge) B mode Density: Da<1 cm2(for bulk);Dp&Df<1E-4cm-1(for Edge) Failure criteria: 1.5V Initial Fail (A-mode): Vbd≤1.5V 1.5V Reliability Fail (B-mode): 1.5V<Vbd<3.45V 3.3V Initial Fail (A-mode): Vbd≤3.3V 3.3V Reliability Fail (B-mode): 3.3V<Vbd<7.59V 5V Initial Fail (A-mode): Vbd≤5V 5V Reliability Fail (B-mode): 5V<Vbd<11.5V	T0.01%≥10yrs @ 1.1Vop @ 125°C, with chip area 10mm2 Failure criteria: It>10×It0	DC T0.1% ≥ 0.2 yrs@1.1Vdd,RT Failure criteria: 10% Idsat forward degradation	DC T0.1% ≥ 10 yrs@1.1Vdd,125°C Failure criteria: 10% Idsat forward degradation

When available, acceptance criteria often misalign with automotive lifetime targets

AEC D reliability data rarely shared.
Criteria often miss automotive lifetimes.

Conclusion

- **Revisit qualification models** ⇒ evolving technologies, new stresses
- **Diversify Mission Profiles** ⇒ by platform, not one-size-fits-all
- **Be cautious with supplier labels** ⇒ potential misinterpretation
- **Include new stress factors** ⇒ environment + process
- **Back to fundamentals** ⇒ mission-driven tests, reliability metrics (FIT / MTBF), not outdated "test-to-pass" plans

This will help avoiding under- or over-specification and ensure our requirements remain both relevant and robust.

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