

OBJECTIVE:

Assess the contribution of each Use Condition, and combinations thereof, to enable measurement of realistic mechanisms for input into Monte Carlo simulations → Accurate prediction, Consistent reporting

OUTPUT

Define what constitutes failure

Identify key parameter(s) controlling life times

Determine acceleration/extrapolation mechanisms

Develop methodology for experimental tests

Enlist experimental and numerical contributors

- **Result of meeting on August 3 and 4**
 - **Gap 0.01 Lifetime prediction**
 - **Action: Establish sub-team for life prediction methodology development**
- **First teleconference on September 26th**
- **Members:**
 - **MSEI: Scott and Jerry**
 - **Med-EI: Peter, Dominik, and Martin**
 - **Boston Scientific (Guidant): Francis, Tony (, and Lou)**
 - **Advanced Bionics: Les Halberg**
 - **NIST: Liz**
 - **(Intel: Celeste)**

COMPONENTS

- Tantalum Capacitors
- SRAM
- MLCCs
- Bare dice
- Chip resistors
- Paste resistors

SUBSTRATES

- Flexible circuit boards
- Ceramic
- FR4

OTHER TECHNOLOGIES

- Bonding
- BGA packaging
- CSP packaging
- Substrate-integrated resistors
- Kovar tabs

1.01	Thermal	Operating life	Temperature range of operation
1.02	Mechanical	Ultrasonic Energy	Diagnostic levels of ultrasound, therapeutic, sonogram
1.03	Mechanical	Vibration	Normal conditions of use
1.04	Mechanical	Shock	g forces
1.05	Mechanical	Impact	Head trauma, eg
1.06	Mechanical	cyclic loading	rib, body flexure, breathing, muscle contraction, BP, etc
1.07	Mechanical	Atmospheric Pressure	Hyperbaric treatment, deep sea diving
1.08	Electrical	Electrical	Design specific
1.09	Electrical	strong field	defibrillation, internal and external, ESD
1.10	Electrical	RF	Security Devices immunity
1.11	Environment	Operating life	Internal gas composition/ chemical composition
1.12	Environment	particulate radiation, external & internal sources	alpha, neutron, beta
1.13	Environment	ionizing Radiation, external sources	Diagnostic levels of x-ray exposure, therapeutic radiation, gamma
1.14	Environment	non-ionizing Radiation	infrared, ultra wide-band
1.15	Environment	electro-magnetic medical imaging	Diagnostic levels of MRI exposure, PET, CT, etc
1.16	Environment	corrosion	header, proximity of hi and lo voltage areas
1.17	Biocompatibility	Biocompatibility	Insure human-to-machine interface maintains safety and efficacy
2.01	Thermal	Operating life	Temperature range of operation
2.01	Thermal	Temperature (transit)	Transit conditions
2.02	Thermal	Storage (Sterile packaged device)	Storage
2.03	Mechanical	Vibration	transit
2.04	Mechanical	Shock	Mishandling during transit
2.05	Mechanical	Impact	Mishandling during transit

2.06	Mechanical	cyclic loading	
2.07	Mechanical	Drop test w/o pkg	Mishandling during the implant procedure
2.08	Mechanical	Atmospheric Pressure	Transit and normal use conditions
2.09	Electrical	strong field	ESD
2.10	Electrical	RF	Security Devices immunity
2.11	Environment	particulate radiation, external & internal sources	alpha, neutron, beta
2.12	Environment	ionizing Radiation	Inspection and security x-ray exposure, gamma
2.13	Environment	corrosion	during storage (2 yr for CI)
3.03	Mechanical		Load profile
3.04	Mechanical	Physical dimensions	material properties
3.05	Mechanical	Bow & twist	material properties
3.06	Mechanical	Shear	material properties
1.10	Biocompatibility	Biocompatibility	Insure human-to-machine interface maintains safety and efficacy
3.08	Environment	Moisture resistance	
4.01	Thermal	Storage	Temperature
4.02	Environment		Environment
4.03	Physical	Voids / Streaks	Shorts, Low IR, breakdown Voltage
4.04		Delaminations	IR failures, VBD failures, Reliability Thermal shock,
4.05		Chips, Broken Caps	Visual defects, Low IR
4.06	Electrical	Capacitance / DF	Deteriorated circuit function
4.07		Insulation Resistance	Varies from no effect to circuit failure based on IR loss level.
4.08		DWV	Circuit failure

- **Design test coupon**
- **Pare down Use Condition, if possible**
- **Sort Use Conditions into groups of 4 to 5 in order to be able to separate out the effects of each**
- **Characterize failure modes so that we can recognize the failures of interest**

- **Step 1: Develop a screening test platform that will eliminate the suspect Use Conditions that do *not* contribute to the recognized failure modes.**
- **Step 2: Investigate means of accelerating the pertinent Use Conditions to obtain the recognized failure modes.**
- **Step 3: Develop a standard testing platform that includes the appropriate Use Conditions and acceleration modes.**
- **Step 4: Transfer the test platform to the manufacturers and conduct round-robin testing to assure that standard test protocols are clearly defined and articulated.**