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ELECTRONICS & APPLICATIONS
14 T/M 16 MEI 2019 JAARBEURS UTRECHT

Reliability en Compliancy in elektronica developments

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Variass is the EMS and system supplier in high technology solutions for tomorrow's markets: industry, medical, defense and security.

Accelerators in optimizing development and production

What we do

Veendam
Electronic
Manufacturing
Services (EMS)

Drachten
High Tech
System Supplier,
Development Support

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Contents

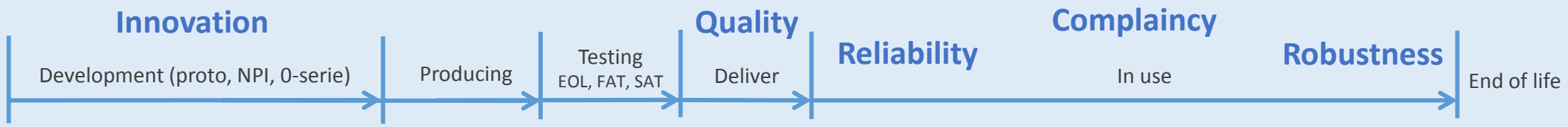
Reliability en Compliance in elektronica developments

- Definities
- Waarom?
- Wanneer?
- Hoe?
- Samenvating

Definitions

- ✓ **Quality** (kwaliteit) = De productprestaties in relatie tot de functionele eisen direct na levering.
- ✓ **Reliability** (betrouwbaarheid) = Het vermogen van een systeem om consequent de bedoelde functie uit te voeren zonder verslechtering of uitval. Kwaliteit na verloop van tijd.
- ✓ **Robustness** (robuustheid) = Het vermogen van een systeem om te blijven functioneren onder de aanwezigheid van ongeldige inputs of stressvolle omgevingscondities.
- ✓ **Compliancy** (overeenstemming) = Overeenstemming met de geldende wet- en regelgeving.
  CE: veiligheid in het gebruik van de producten verhogen, borgen en hiermee vrije handel.
  Compliancy: verplichte Reliability en Robustness voor veiligheid.
- ✓ **Innovation** (Innovatie) = De ontwikkeling en succesvolle invoering van nieuwe of verbeterde goederen en diensten.

Product life cyclus:



Why is Reliability and Compliancy important

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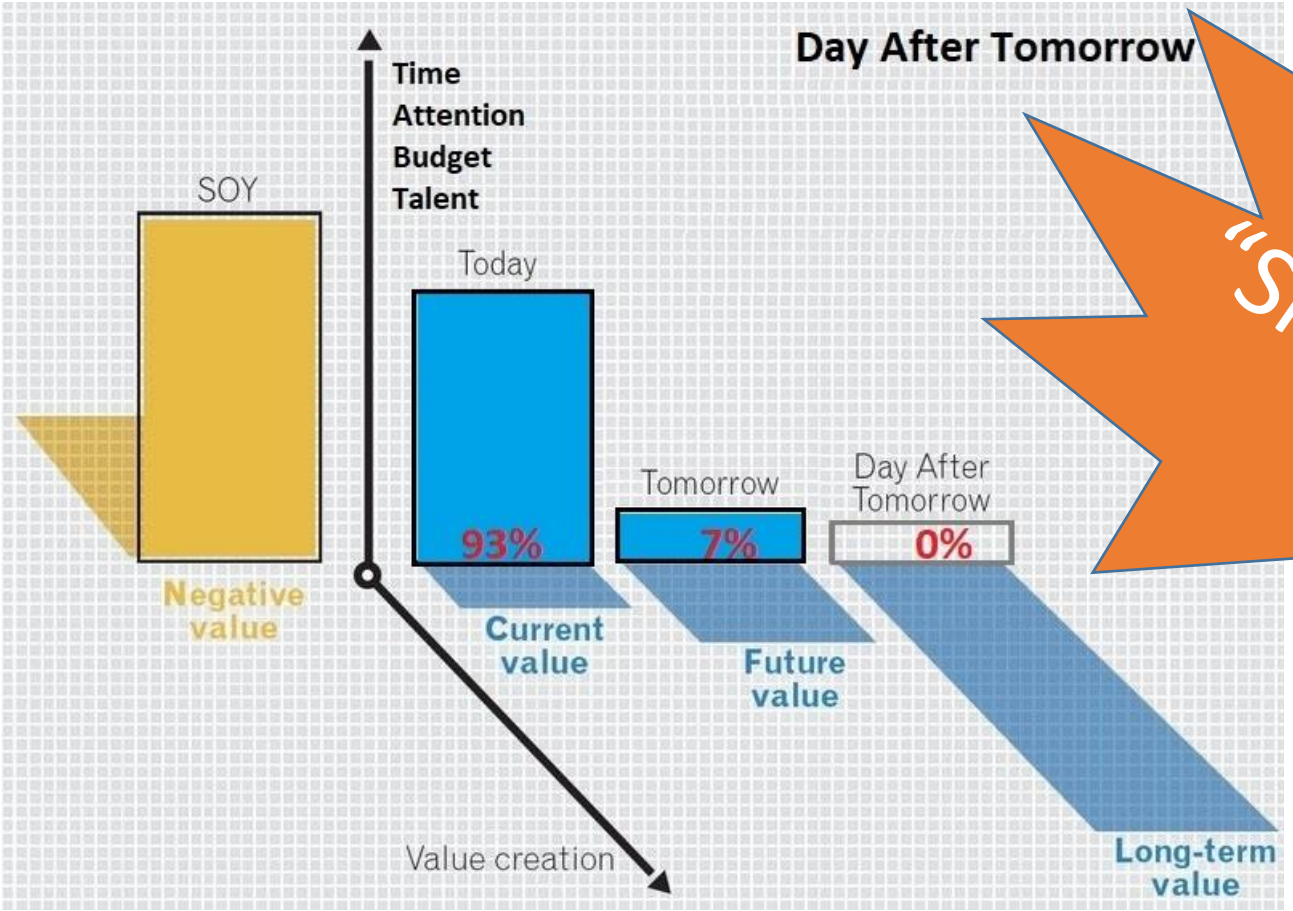
Hoeveel tijd besteedt u aan waarde creatie (innovatie) voor de dag na morgen?



Avoid "Shit Of Yesterday".

Bron: bnox.be & P. Hinsen, 2017, The day after tomorrow

Waarom is Reliability and Compliancy belangrijk

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- ✓ Avoid “Shit of Yesterday”
  - ✓ Product compliance problemen 0-series
  - ✓ Problemen tijdens NVWA check
  - ✓ Uitval in het veld
  - ✓ Imago schade en claims
  - ✓ Hoge kosten voor service en reparatie
  - ✓ Zwakheden worden gevonden
- ✓ Keep you focussed at innovation
  - ✓ Nieuwe business modellen
  - ✓ EMC, product safety test lab
  - ✓ Service & reparatie
  - ✓ Product upgrade
  - ✓ Spare parts
  - ✓ Product kosten reductie

Wanneer? Reliability and Compliancy

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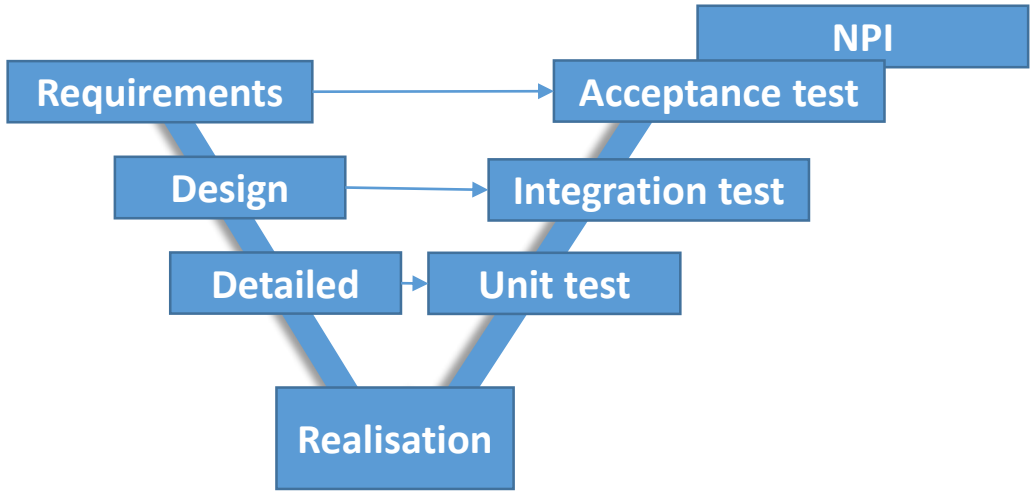
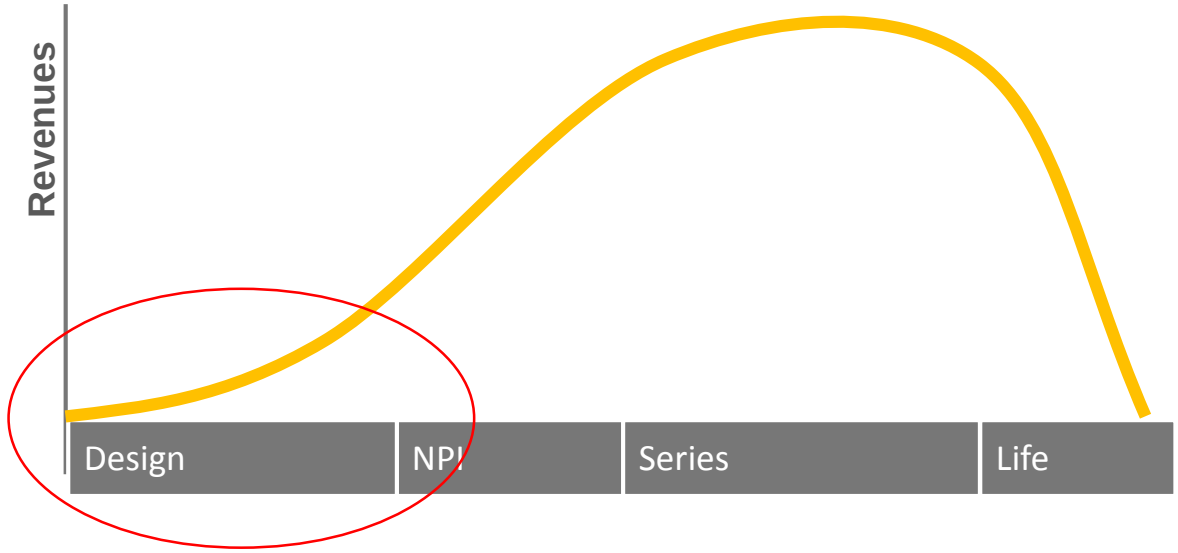




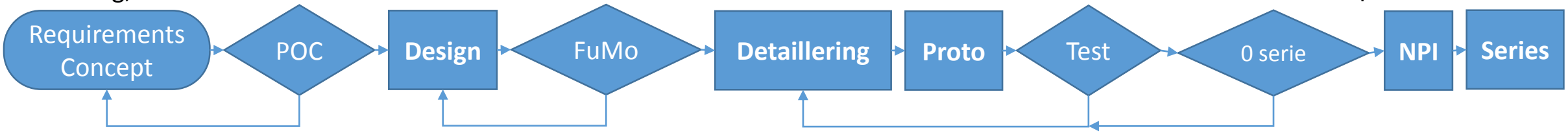
Directives (richtlijn)
temp., vocht,trilling ,
vervuiling, etc.

Standards (norm)
architectuur, behuizing
inter-connecties, etc.

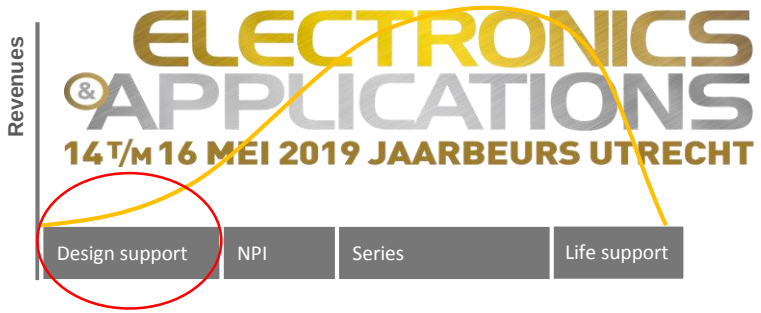
voorbereiden compliancy
onderdelen selectie,
toleranties, dimensioneren

Verification
QS compliancy
HALT, ALT

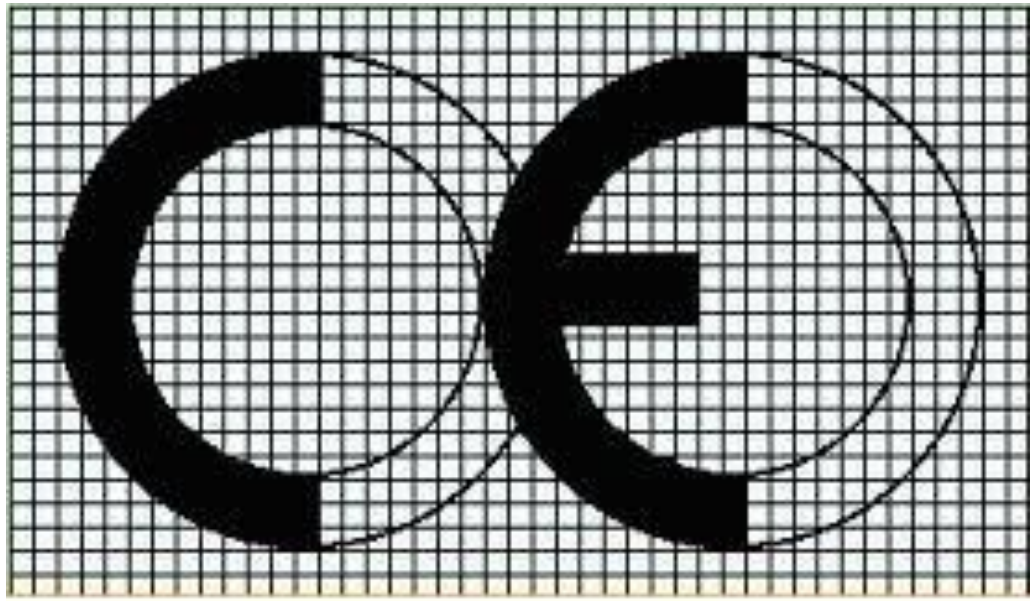
Validation
compliance directive check
Klant acceptatie



Hoe? Compliancy (CE)



1. Bepaal de van toepassingzijnde Directives (richtlijn) uit productgroepenlijst (27).
   EMC, LVD, MDD, RED, MD, etc.
   https://ec.europa.eu/growth/single-market/ce-marking/manufacturers_nl
2. Bepaal de te gebruiken harmonised Standards (norm)
   EN 60601, EN 61010, EN 50065, EN 55011, EN 61000, etc.
   https://ec.europa.eu/growth/single-market/european-standards/harmonised-standards_nl
3. Competent body / Notified body (NoBo) / self-declaration
4. Uitvoeren testen zoals beschreven in Standards (norm)
5. Aanleggen en bijhouden technisch documentatie (PDM)
6. Stel op Declaration of Conformity en plaatst CE markering (vermoeden van overeenstemming)



Hoe? Predicted Reliability

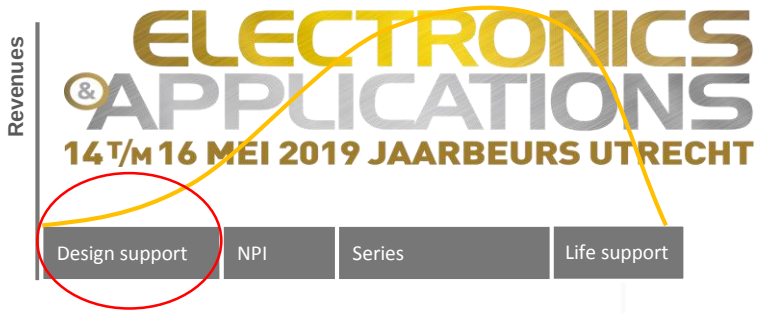
Predicted Reliability:

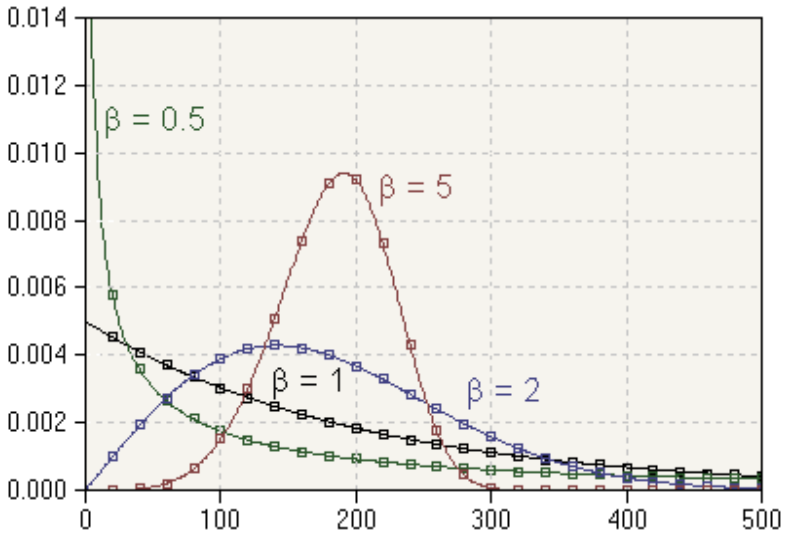
1. Physics of Failure (PoF, “Hoe dingen stuk gaan”)
   - Voorgaande producten, QA database, Weibull-verdeling
2. Data sheets
   - MTBF, FIT, berekeningen , simulaties en metingen
3. Reliability Standards (empirical models)
   - IPC-A 6x0, MIL, SR-332
4. Testen
   - HALT, ALT, MEOST

Hoe? Physics of Failure

- ✓ Registreren van product uitval en problemen
  - ✓ Serie nummer (traceability)
  - ✓ Wanneer
  - ✓ Hoelang
  - ✓ Interval
  - ✓ Gedrag
  - ✓ Omgevingsomstandigheden
  - ✓ Vroegtijdige waarschuwingen
  - ✓ Etc.
- ✓ Data analyseren
  - ✓ Weibull Distribution

Hoe? Weibull Distribution





Statistical distribution (CDF)

$$F(t) = 1 - e^{-\left[t/\eta\right]^{\beta}}$$

F(t) = Failure Percentage
β = Shape Parameter
η = Characteristic Live

β = Shape parameter

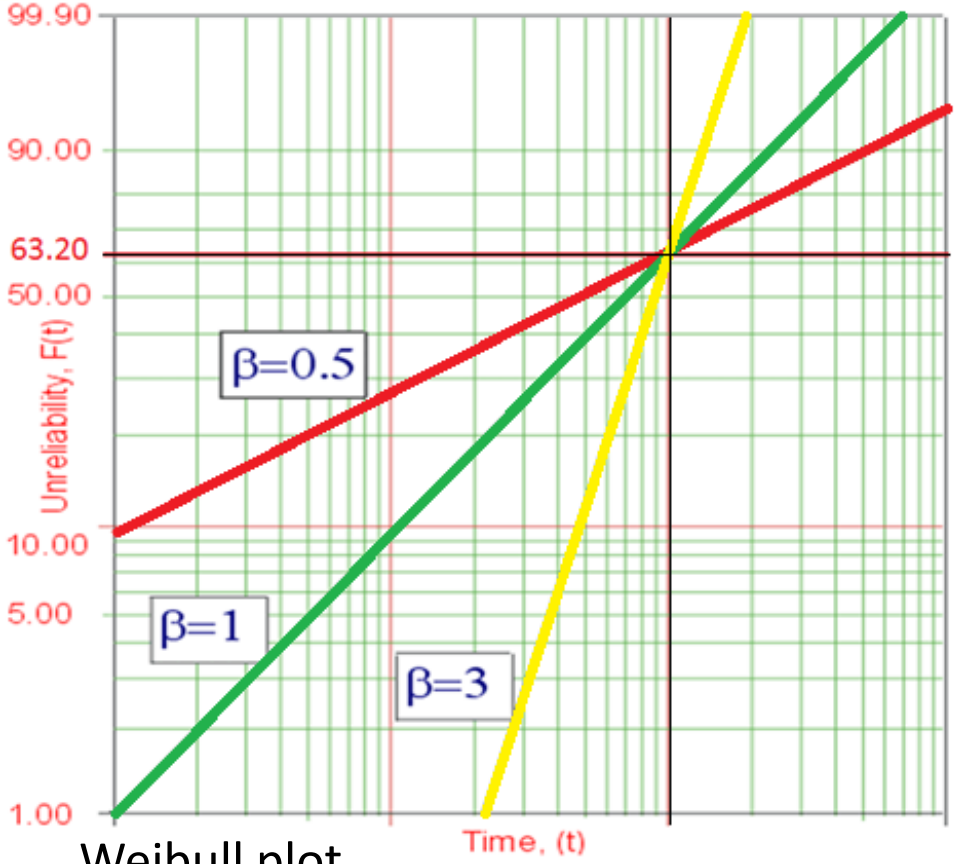
Beta <1: Infant Mortality

Beta=1: random failure

Beta 1…4: Early Wear out

Beta>4: age rapid wear out

@ β=1, η=t
F = 1 – 0,368
Failure = 63,2%
R = 1 - F
Reliability = 36,8%



Weibull plot

Hoe? Data sheets

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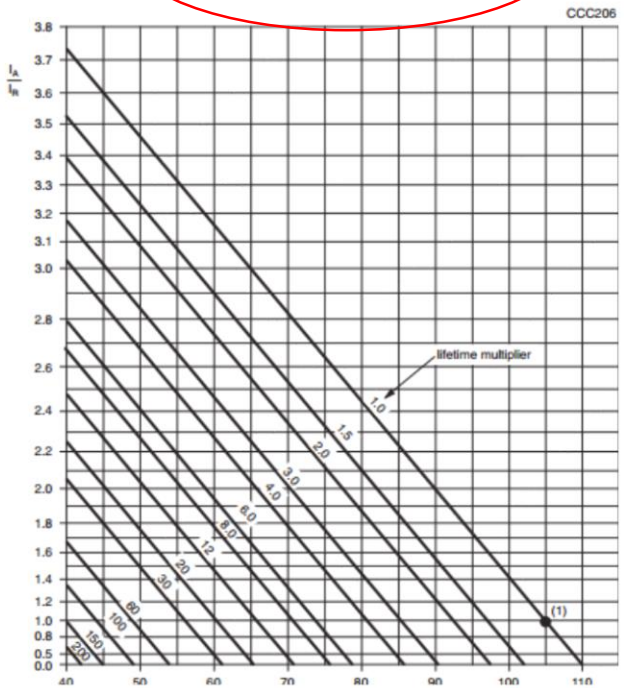
www.vishay.com
153 CRV
Vishay BCcomponents

RIPPLE CURRENT AND USEFUL LIFE

Table 5

ENDURANCE TEST DURATION AND USEFUL LIFE			
NOMINAL CASE SIZE Ø D x L (mm)	ENDURANCE AT 105 °C (h)	USEFUL LIFE AT 105 °C (h)	USEFUL LIFE AT 40 °C 1.3 x I_R APPLIED (h)
4.0 x 4.0 x 5.3	1000	2000	200 000



I_A = Actual ripple current at 100 Hz or 120 Hz
I_R = Rated ripple current at 100 Hz or 120 Hz at 105 °C
For case codes 0405 to 1010 max. I_A/I_R = 2.4
(1) Useful life at 105 °C and I_R applied:
Case codes 0405 to 0605: 2000 h
Case codes 0807 to 1014: 3000 h

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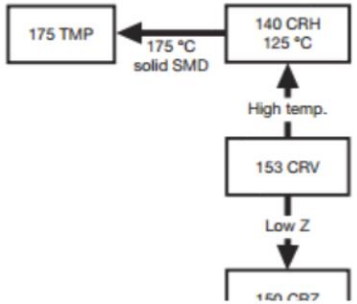
Aluminum Electrolytic Capacitors SMD (Chip) Long Life Vertical



FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version with base plate, vertical construction requiring minimum board space, lead (Pb)-free reflow solderable
- High CV per unit volume
- Long useful life: 2000 h to 3000 h at 105 °C
- Charge and discharge proof, no peak current limitation
- Supplied in blister tape on reel
- ATTENTION: for maximum safe soldering conditions refer to Fig. 4
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

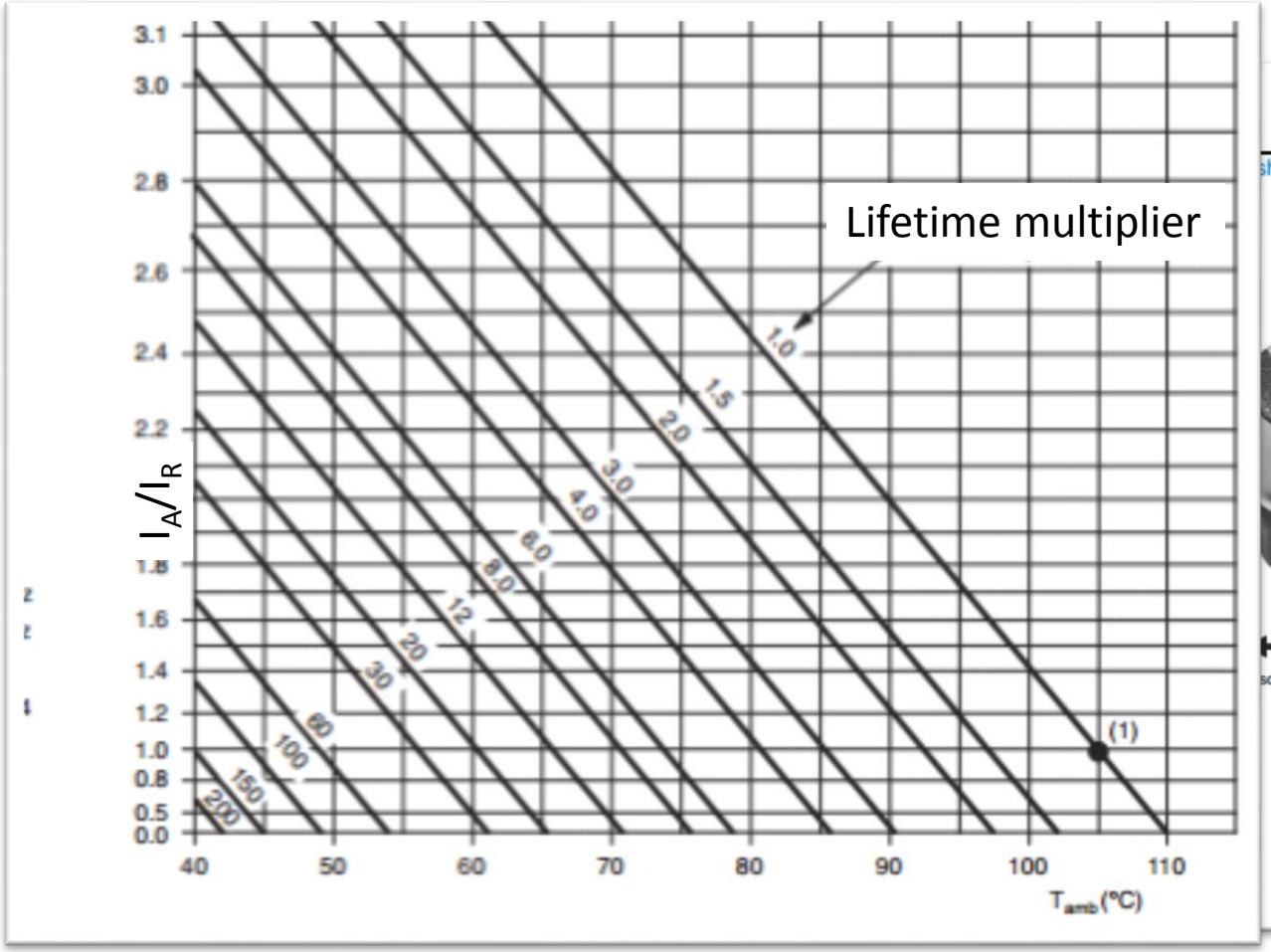
RoHS COMPLIANT

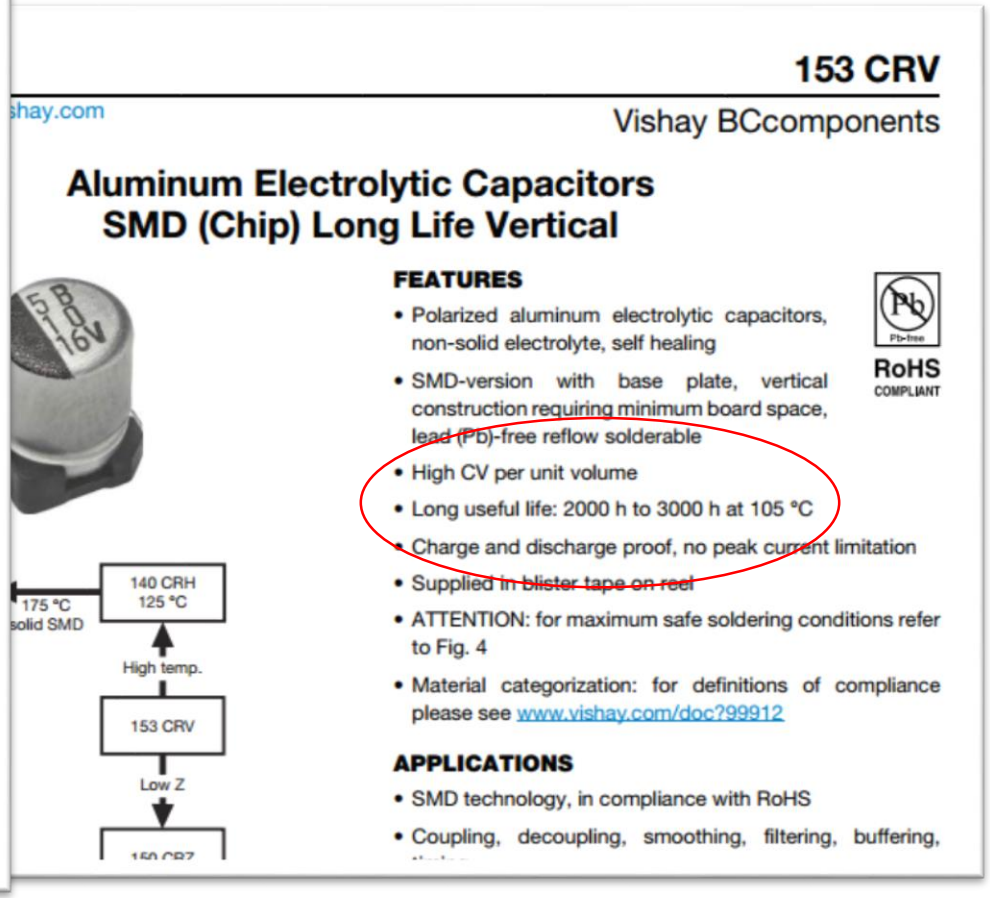
APPLICATIONS

- SMD technology, in compliance with RoHS
- Coupling, decoupling, smoothing, filtering, buffering,

Useful live: 2000h @ 105°C

Hoe? Data sheets





153 CRV

shay.com

Vishay BCcomponents

Aluminum Electrolytic Capacitors
SMD (Chip) Long Life Vertical

FEATURES

- Polarized aluminum electrolytic capacitors, non-solid electrolyte, self healing
- SMD-version with base plate, vertical construction requiring minimum board space, lead (Pb)-free reflow solderable
- High CV per unit volume
- Long useful life: 2000 h to 3000 h at 105 °C
- Charge and discharge proof, no peak current limitation
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- ATTENTION: for maximum safe soldering conditions refer to Fig. 4
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RoHS COMPLIANT

APPLICATIONS

- SMD technology, in compliance with RoHS
- Coupling, decoupling, smoothing, filtering, buffering,

175 °C solid SMD
140 CRH 125 °C
High temp.
153 CRV
Low Z

Useful live: 2000h @ 105°C

Revenues
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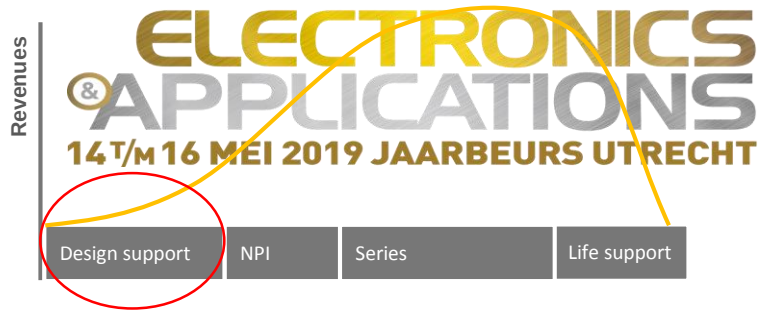
Design support
NPI
Series
Life support

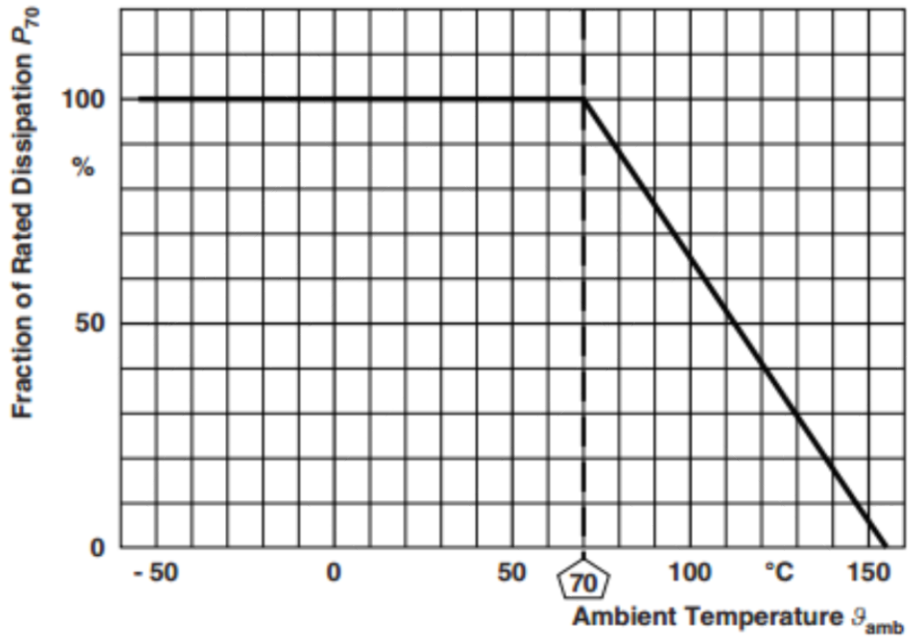
Hoe? Data sheets



VISHAY

Standard Thick Film Chip Resistors

Derating



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D/CRCW e3

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Standard Thick Film Chip Resistors

FEATURES

- Stability $\Delta R/R$ = 1 % for 1000 h at 70 ° C
- 2 mm pitch packaging option for 0603 size
- Pure tin solder contacts on Ni barrier layer provides compatibility with lead (Pb)-free and lead containing soldering processes
- Metal glaze on high quality ceramic
- AEC-Q200 qualified
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT
HALOGEN FREE

STANDARD ELECTRICAL SPECIFICATIONS

MODEL	SIZE	RATED DISSIPATION	LIMITING ELEMENT	TEMPERATURE COEFFICIENT	TOLERANCE	RESISTANCE RANGE	SERIES

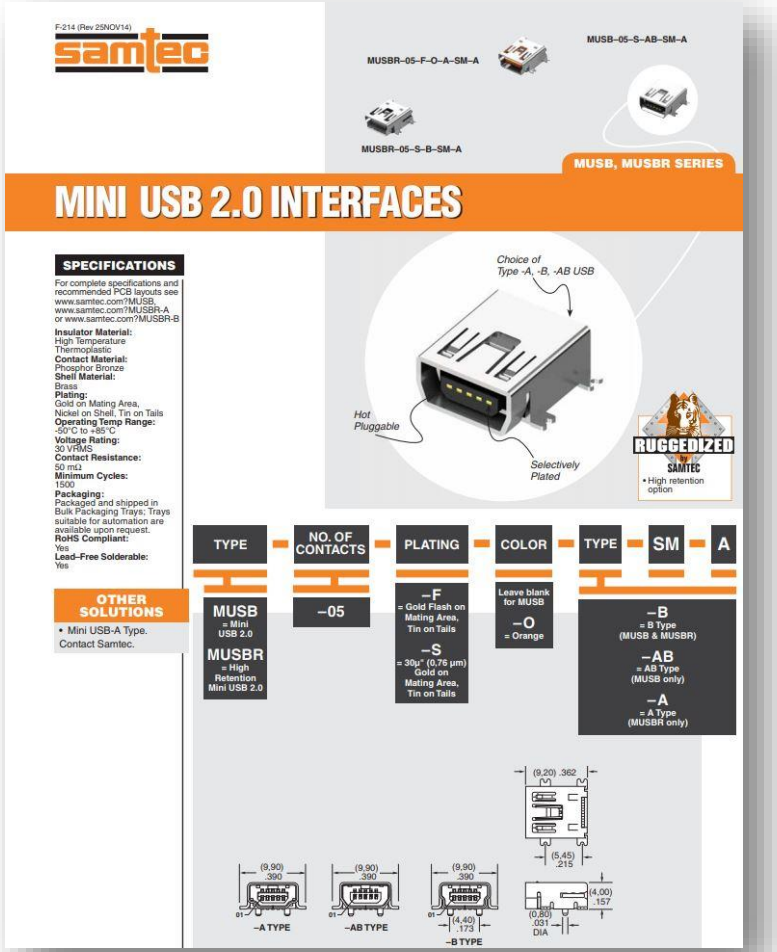
Hoe? Data sheets

SPECIFICATIONS

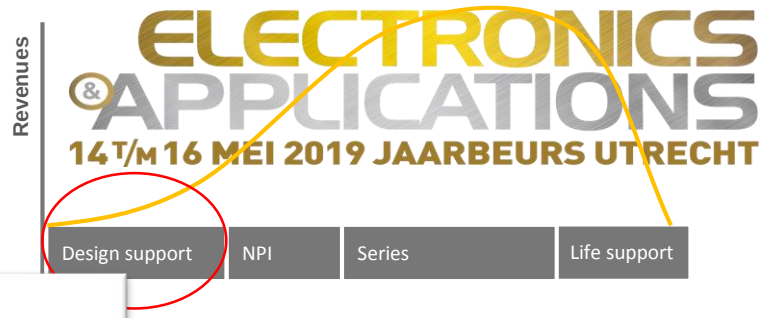
For complete specifications and recommended PCB layouts see www.samtec.com?MUSB, www.samtec.com?MUSBR-A or www.samtec.com?MUSBR-B

Insulator Material:
High Temperature Thermoplastic
Contact Material:
Phosphor Bronze
Shell Material:
Brass
Plating:
Gold on Mating Area, Nickel on Shell, Tin on Tails
Operating Temp Range:
-50°C to +85°C
Voltage Rating:
30 VRMS
Contact Resistance:
50 mΩ
Minimum Cycles:
1500
Packaging:
Packaged and shipped in

Durability = 1500 cycles

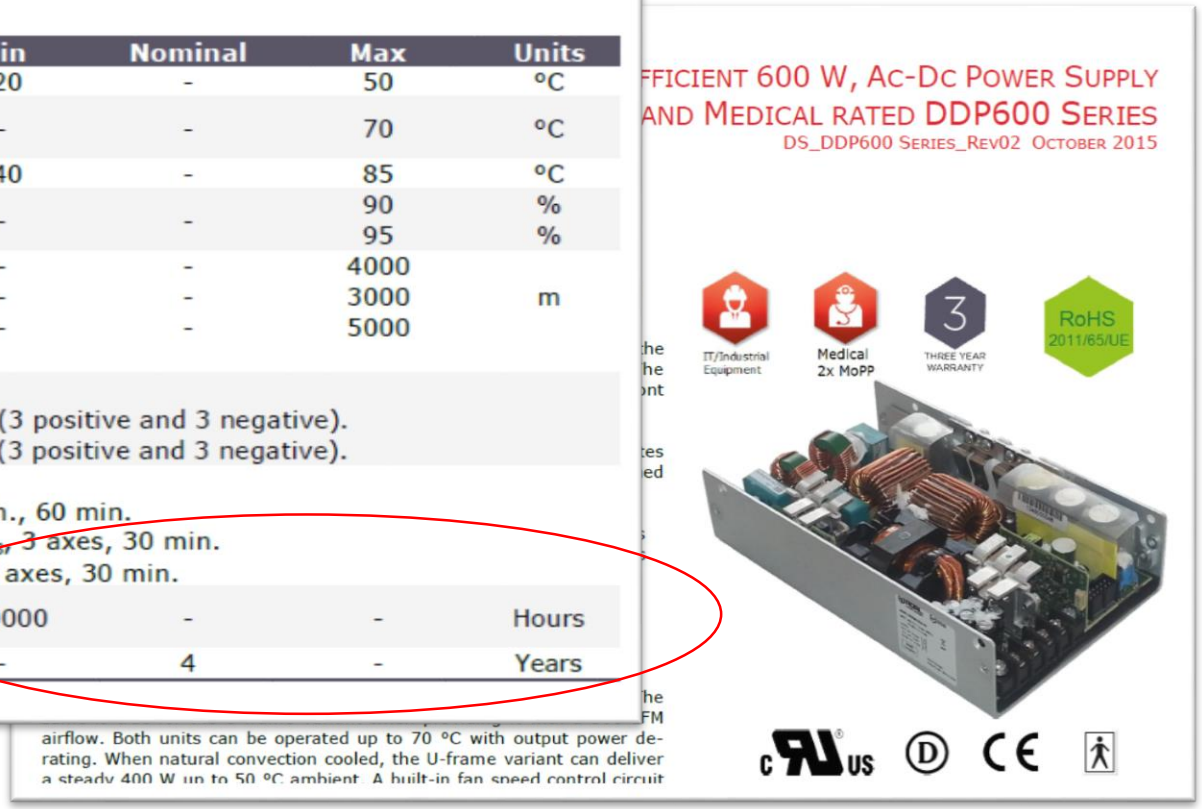


Hoe? Data sheets



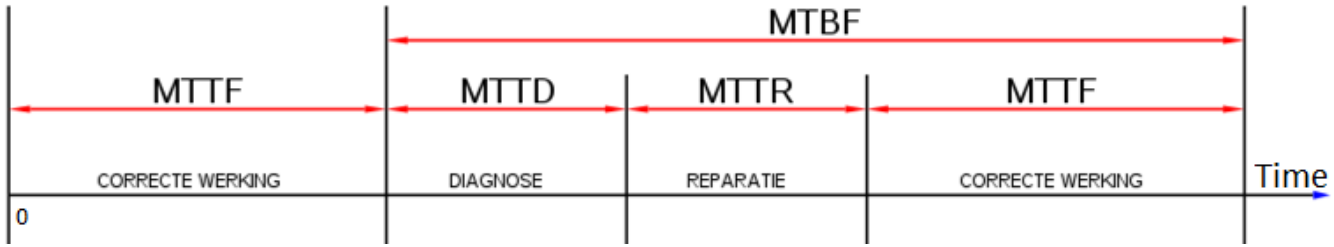
Environmental Specifications

Specification	Test Conditions / Notes	Min	Nominal	Max	Units
Operating Temperature Range	No de-rating up to 50°C	-20	-	50	°C
Operating Temperature Range with De-rating	See de-rating curves and conditions in the Output Specifications section	-	-	70	°C
Storage Temperature		-40	-	85	°C
Humidity	RH, Non-condensing Operating. Non-operating	-	-	90 95	% %
Operating Altitude	MoPP (100 – 250 V_{AC}, 50/60 Hz) MoPP (100 – 277 V_{AC}, 50/60 Hz) MoOP, ITE grade Power de-rating above 1800 m	- - -	- - -	4000 3000 5000	m
Shock	**EN 60068-2-27** Operating: Half sine, 30 g, 18 ms, 3 axes, 6x each (3 positive and 3 negative). Non-Operating: Half sine, 50 g, 11 ms, 3 axes, 6x each (3 positive and 3 negative).				
Vibration	**EN 60068-2-64** Operating: Sine,10 – 500 Hz, 1 g, 3 axes, 1 oct/min., 60 min. Random, 5 – 500 Hz, 0.02 g^2/Hz, 1 g_{RMS}, 3 axes, 30 min. Non-Operating: 5 – 500 Hz, 2.46 g_{RMS} (0.0122 g^2/Hz), 3 axes, 30 min.				
MTBF	Full Load, 40 °C ambient 80% Duty cycle, Telcordia SR-332 Issue 2	300000	-	-	Hours
Useful Life	Worst nominal V_{IN}, 80% load, 40 °C ambient.	-	4	-	Years



MTBF = 300.000h -> 34 Years ?

Hoe? MTBF



MTBF (mean operating time between failures)

$$R(t) = e^{-\lambda t} = e^{\frac{-t}{MTBF}}$$

@ t = MTBF -> Reliability R(t) = 36,8%

Power Unit: R(t) = 36.8% @ 300.000h (34 Years)

R(t) @ 3 Years: R(t) = 92%

Calculation of spare parts

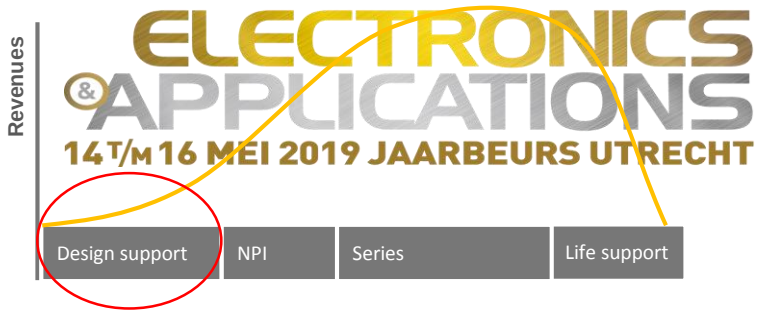
Q = N * (T / MTBF) Q = # of spare units

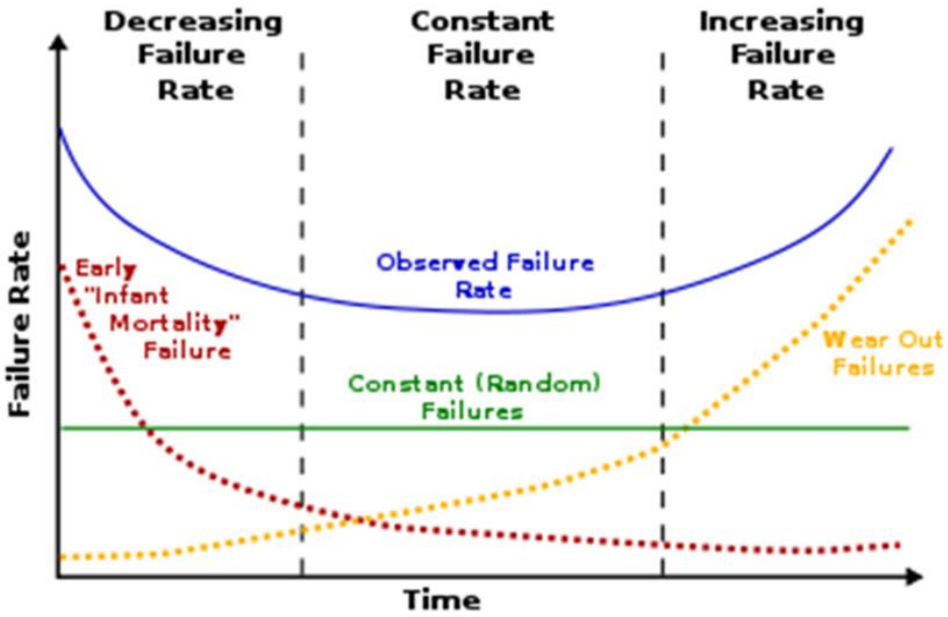
N = # of operating units

T = expected live time

T = 3 Year, N = 100 units

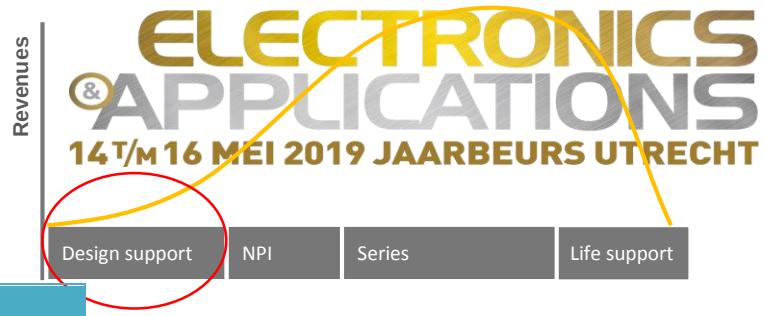
Q = 100 * (26.280 / 300.000) = 9 units



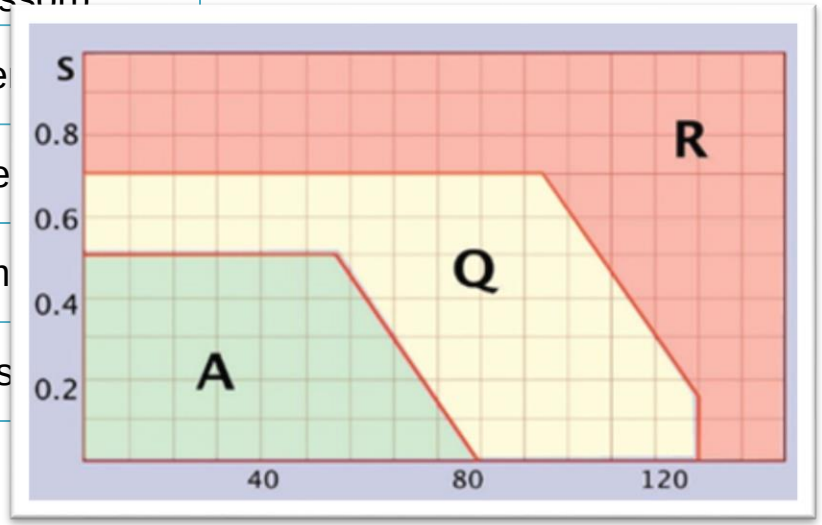


Bathtub curve

Hoe? Reliability Standards



	MIL-HDBK-217	FIDES	SR-332
Origin	US Army	European tech industry	US telecom industry
Publisher	DoD, model is not supported anymore	Fides group (Thales, Eurocopter, Airbus, others)	Telcordia (subsidiary of Ericsson)
Modelling	Components only	Components and process	Compone
Required input	Relatively much	Relatively much	Relative
Supported components	Many components, some are obsolete	Relatively few components	Many com
Quality assessment	Very complex	Complex	Eas



Derating diagram

Reliability software:

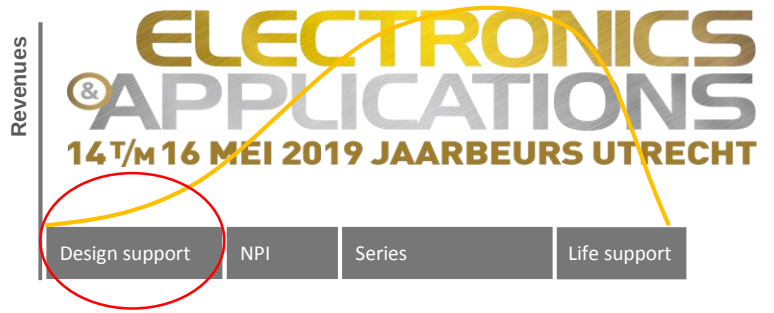
-ReliaSoft

-RAMS (Reliability, Availability, Maintainability and Safety)

Hoe? Reliability Standards

Component name	Description	Number of components at stress fact			Failure rate at stress fact			N*Lamda
		20%	50%	80%	20%	50%	80%	0,000000001
Resistors								
	Metal low pow.	0	19	0	1,5	2	3	38
	Metal high pow		0		8	10	13	0
Fixed Wire	Precision	0	2		3,5	5	8	10
	Power	1	0		8	15	30	8
Variable Wire	Precision		0		320	400	440	0
	Power	0	0		170	210	275	0
Trim	Cermet		0		5	6	7	0
Capacitors								
Elco	Solid		0		45	75	175	0
	Wet Mini		0		25	55	135	0
	Wet Small							
	Wet Large							
X - Y								
Film								
Ceramic								
Semiconductors								
Opto	LED	1			20	35	80	20
	Opto-coupler	1			20	35	80	20
Total failure rate								**1027,69**

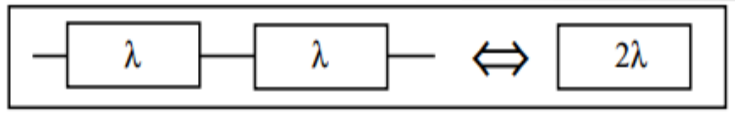
Factor for ambient temperature				**Factor for environment**			
Kt=	0,8 for	15	Kt= 1	K3=	1 for	gnd benign	K3= 3
	1 for	30			3 for	gnd fixed	
	1,2 for	45			9 for	gnd mobile	
	1,5 for	55					
	2 for	70		N*L*Kt*K3=		3083,07	
				M.T.B.F 324352,0257			

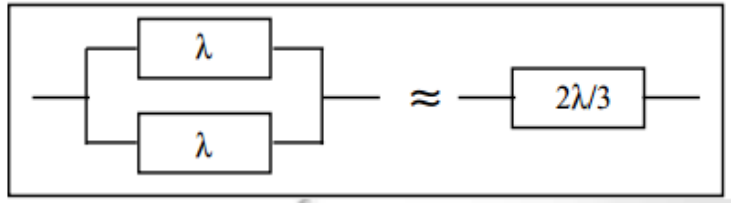


Failure Rate $\lambda = 1 / MTBF$

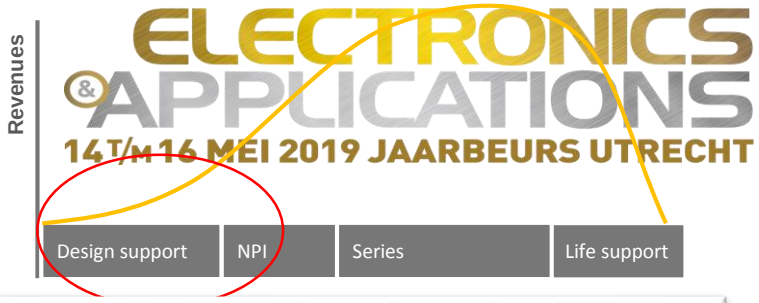
FIT , Failures In Time (10^9h)

$FIT = 10^9 / MTBF$





Hoe? Testen



- Compliancy test (CE mark)
  - Beschreven in standard (Norm)
    EMC, Product veiligheidstesten, etc.
- HALT (Highly Accelerated Life Testing)
  - “smoking out failures”
    Testen op Robustness
    Bepaal product grensen
    Bepaal de zwakheden voor verbetering
- ALT (Accelerated Life Testing)
  - Testen voor Reliability
    Voorspelling levensduur
- MEOST
  (Multiple Environmental Over Stress Testing)
  - Bepaal en demonstreer foutmodes middels combinaties van stressfactoren
  - Geen Standards (normen)

Summary

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Reliability and Compliancy is onderdeel van product developments

- Hou rekening met de verplichte Directives (richtlijnen), en de juiste geharmoniseerde Standards (norm) hiervoor.
- Hou rekening met de beoogde omgeving (temp. vocht, trilling, etc.)
- Hou een QA database bij (service en reparatie)
- Design for eXcellence checks (Variass DfX tool)
  - Lees de datasheets (grensen, levensduur, etc.)
  - Bereken, simuleer en meet (zoek naar onderdelen met (te)veel stress, en kijk naar de grensen binnen tolleranties)
  - Gebruik datasheets en normen voor een levenduur voorspelling
- Test zo snelmogelijk (Compliancy, HALT, ALT)
- Specificeer voorzichtig de product specificaties

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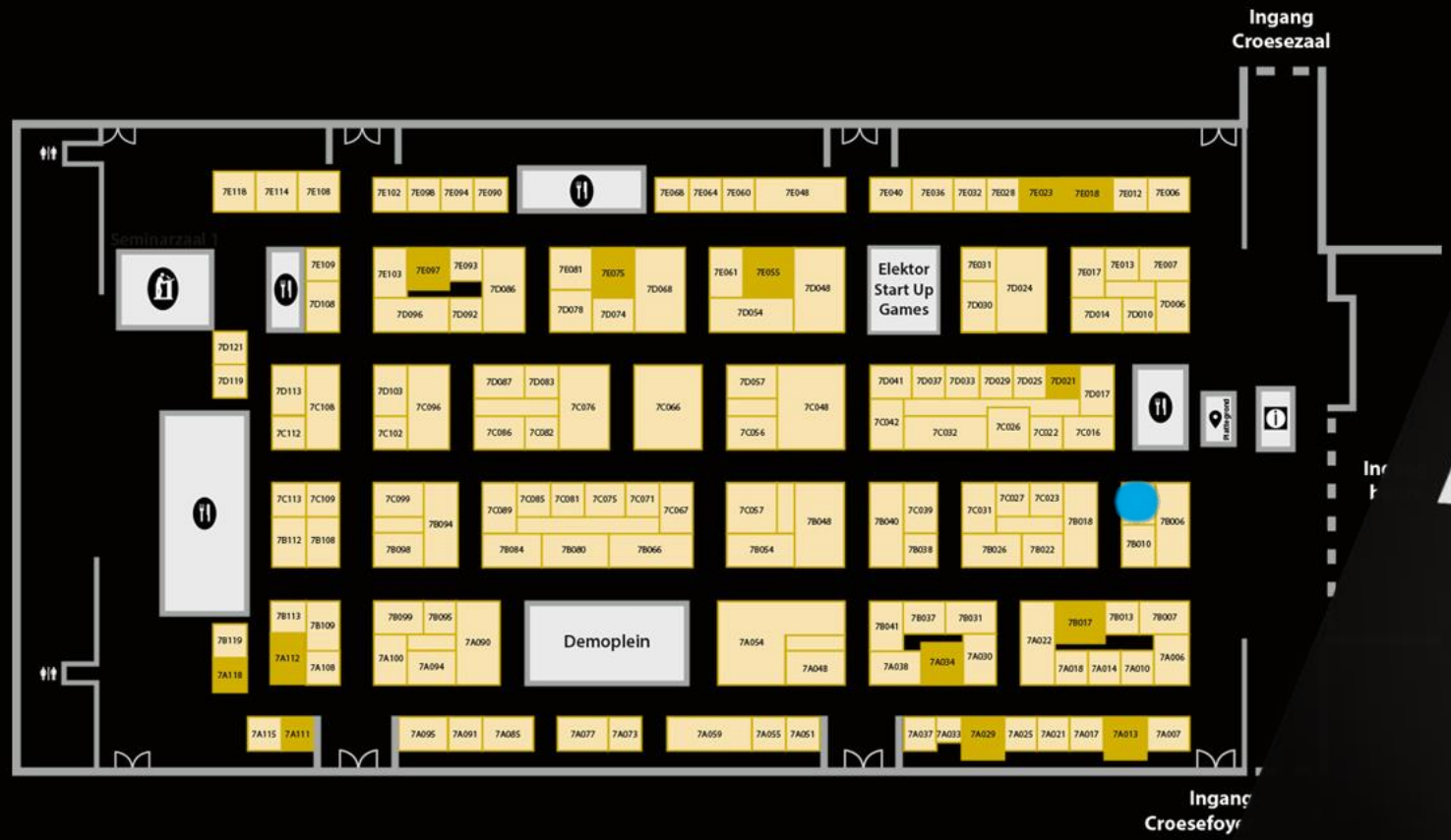

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