MIL-HDFBK-217F
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MILITARY HANDBOOK

RELIABILITY PREDICTION OF ELECTRONIC EQUIPMENT

A short summary of the
base failure rates

1 Einleitung

Dieses Handbuch ist eine Zusammenfassung der Basisfehlerraten des vom Department of Defense in Washington erstellten Handbuchs MIL-HDBK-217F Reliability Prediction of Electronic Equipment [1]. Aufgrund des Alters des Handbuchs sind der semantische Aufbau und strukturelle Elemente vom System nicht korrekt erkannt. Dadurch ist das automatisierte Auslesen des Dokuments erschwert. Diese Zusammenfassung soll durch LaTeX in hoher Qualität geschrieben werden und das ursprüngliche Handbuch zur Ermittlung der Basisfehlerraten handlicher gestalten.

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2 Bauteile

Die Darstellung der Basisfehlerraten ist den Tabellen aus dem MIL-HDBK-217F entnommen [1]. Hierbei werden in diesem Dokument für jedes technische Bauteil eine Seite verwendet. Die Auswahl der Bauteile beruht auf dem Verwendungszweck dieses Dokuments. Hierbei ist es wichtig, dass die Basisfehlerrate eindeutig zugeordnet werden kann und alle Variationen des Oberbegriffs in einer Tabelle zusammengefasst wurden. Andere Bauteile werden zunächst in diesem Dokument nicht berücksichtigt.

2.1 DIODES, LOW FREQUENCY

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	Low Frequency Diodes: General Purpose Analog, Switching, Fast Recovery, Power Rectifier, Transient Suppressor, Current Regulator, Voltage Regulator, Voltage Reference

2.1.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Diode Type/Application	λ_b
General Purpose Analog	0.0038
Switching	0.001
Power Rectifier, Fast Recovery	0.069
Power Rectifier/Schottky Power Diode	0.003
Power Rectifier with High Voltage Stacks	0.005/Junction
Transient Suppressor/Varistor	0.0013
Current Regulator	0.0034
Voltage Regulator and Voltage Reference (Avalanche and Zener)	0.002

Tabelle 2.1: Base Failure Rate λ_b of diodes, low frequency

Quelle

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2.2 DIODES, HIGH FREQUENCY (MICROWAVE, RF)

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	SI IMPATT, Bulk Effect, Gunn, Tunnel, Back, Mixer, Detector, PIN, Schottky, Varactor, Step Recovery

2.2.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Diode Type	λ_b
Si IMPATT ($\leq$ 35 GHz)	0.22
Gunn/Bulk Effect	0.18
Tunnel and Back (Including Mixers, Detectors)	0.0023
PIN	0.0081
Schottky Barrier (Including Detectors) and Point Contact (200 MHz $\leq$ Frequency $\leq$ 35 GHz)	0.027
Varactor and Step Recovery	0.0025

Tabelle 2.2: Base Failure Rate λ_b of diodes, high frequency

Quelle

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2.3 TRANSISTORS, LOW FREQUENCY, BIPOLAR

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	NPN (Frequency $<$ 200 MHz) PNP (Frequency $<$ 200MHz)

2.3.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Type	λ_b
NPN and PNP	0.00074

Tabelle 2.3: Base Failure Rate λ_b of transistors, low frequency, bipolar

Quelle

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2.4 TRANSISTORS, LOW FREQUENCY, SI FET

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	N-Channel and P-Channel Si FET (Frequency $\leq$ 400 MHz)

2.4.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Transistor Type	λ_b
MOSFET	0.012
JFET	0.0045

Tabelle 2.4: Base Failure Rate λ_b of transistors, low frequency, si fet

Quelle

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2.5 TRANSISTORS, UNIJUNCTION

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	Unijunction Transistors

2.5.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Type	λ_b
All Unijunctions	0.0083

Tabelle 2.5: Base Failure Rate λ_b of transistors, low frequency, si fet

Quelle

MIL-HDBK-217F, Seite 55, Abschnitt 6-9

2.6 TRANSISTORS, LOW NOISE, HIGH FREQUENCY, BIPOLAR

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	bipolar, Microwave RF Transistor (Frequency $>$ 200 MHz, Power $<$ 1 W)

2.6.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Type	λ_b
All Types	0.18

Tabelle 2.6: Base Failure Rate λ_b of transistors, low noise, high frequency, bipolar

Quelle

MIL-HDBK-217F, Seite 56, Abschnitt 6-10

2.7 TRANSISTORS, HIGH POWER, HIGH FREQUENCY, BIPOLAR

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	Power, Microwave, RF Bipolar Transistors (Average Power $\leq$ 1 W)

2.7.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Frequency	**Output Power (Watts)**									
(GHz)	1.0	5.0	10	50	100	200	300	400	500	600
$\leq$ 0.5	0.038	0.039	0.04	0.05	0.067	0.12	0.2	0.36	0.62	1.1
1	0.046	0.047	0.048	0.06	0.08	0.14	0.24	0.42	0.74	1.3
2	0.065	0.067	0.069	0.086	0.11	0.2	0.35			
3	0.093	0.095	0.098	0.12	0.16	0.28				
4	0.13	0.14	0.14	0.17	0.23					
5	0.19	0.19	0.2	0.25						

Tabelle 2.7: Base Failure Rate λ_b of transistors, high power, high frequency, bipolar

Quelle

MIL-HDBK-217F, Seite 58, Abschnitt 6-12

2.8 TRANSISTORS, HIGH FREQUENCY, GaAs FET

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	GaAs Low Noise, Driver and Power FETs ($\geq$ 1GHz)

2.8.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Operating	**Average Output Power (Watts)**						
Frequency (GHz)	$<$0.1	0.1	0.5	1	2	4	6
1	0.052	–	–	–	–	–	–
4	0.052	0.054	0.066	0.084	0.14	0.36	0.96
5	0.052	0.083	0.1	0.13	0.21	0.56	1.5
6	0.052	0.13	0.16	0.2	0.32	0.85	2.3
7	0.52	0.2	0.24	0.3	0.5	1.3	3.5
8	0.052	0.3	0.37	0.47	0.76	2.0	–
9	0.052	0.46	0.56	0.72	1.2	–	–
10	0.052	0.71	0.87	1.1	1.8	–	–

Tabelle 2.8: Base Failure Rate λ_b of transistors, high frequency, GaAs FET

Quelle

MIL-HDBK-217F, Seite 60, Abschnitt 6-14

2.9 TRANSISTORS, HIGH FREQUENCY, SI FET

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	Si FETs (Avg. Power $<$ 300 mW, Freq. $>$ 400 MHz)

2.9.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Transistor Type	λ_b
MOSFET	0.06
JFET	0.023

Tabelle 2.9: Base Failure Rate λ_b of transistors, high frequency, si fet

Quelle

MIL-HDBK-217F, Seite 62, Abschnitt 6-16

2.10 THYRISTORS AND SCRS

SPECIFICATION	DESCRIPTION
MIL-S-19500	Thyristors SCRs, Triacs

2.10.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Device Type	λ_b
All Types	0.0022

Tabelle 2.10: Base Failure Rate λ_b of thyristors and scrs

Quelle

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2.11 OPTOELECTRONICS, DETECTORS, ISOLATORS, EMITTERS

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	Photodetectors, Opto-isolators, Emitters

2.11.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Photodetectors	λ_b
Photo-Transistor	0.0055
Photo-Diode	0.004

Tabelle 2.11: Base Failure Rate λ_b of Photodetectors

Opto-Isolators	λ_b
Photodiode Output, Single Device	0.0025
Phototransistor Output, Single Device	0.013
Photodarlington Output, Single Device	0.013
Light Sensitive resistor, Single Device	0.0064
Photodiode Output, Dual Device	0.0033
Phototransistor Output, Dual Device	0.017
Photodarlington Output, Dual Device	0.017
Light Sensitive Resistor, Dual Device	0.0086

Tabelle 2.12: Base Failure Rate λ_b of Opto-Isolators

Emitters	λ_b
Infrared Light Emitting Diode (IRLD)	0.0013
Light Emitting Diode (LED)	0.00023

Tabelle 2.13: Base Failure Rate λ_b of Emitters

Quelle

MIL-HDBK-217F, Seite 65, Abschnitt 6-19

2.12 OPTOELECTRONICS, ALPHANUMERIC DISPLAYS

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	Alphanumeric Display

2.12.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Number of Characters	λ_b **Segment Display**	λ_b **Diode Array Display**
1	0.00043	0.00026
1 w/Logic Chip	0.00047	0.0003
2	0.00086	0.00043
2 w/Logic Chip	0.0009	0.00047
3	0.0013	0.0006
3 w/Logic Chip	0.0013	0.00064
4	0.0017	0.00077
4 w/Logic Chip	0.0018	0.00081
5	0.0022	0.00094
6	0.0026	0.0011
7	0.003	0.0013
8	0.0034	0.0015
9	0.0039	0.0016
10	0.0043	0.0018
11	0.0047	0.002
12	0.0052	0.0021
13	0.0056	0.0023
14	0.006	0.0025
15	0.0065	0.0026

Tabelle 2.14: Base Failure Rate λ_b of optoelectronics, alphanumeric displays

Quelle

MIL-HDBK-217F, Seite 66, Abschnitt 6-20

2.13 OPTOELECTRONICS, LASER DIODE

SPECIFICATION	**DESCRIPTION**
MIL-S-19500	Laser Diodes with Optical Flux Densities < 3 MW/cm^2 and Forward Current < 25 amps

2.13.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Laser Diode Type	λ_b
GaAs/Al GaAs	3.23
In GaAs/In GaAsP	5.65

Tabelle 2.15: Base Failure Rate λ_b of optoelectronics, laser diode

Quelle

MIL-HDBK-217F, Seite 67, Abschnitt 6-21

2.14 DISCRETE SEMICONDUCTORS, EXAMPLE

SPECIFICATION	DESCRIPTION
NA	NA

2.14.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

$$\lambda_b = 0.00074 \text{ Failures}/10^6 \text{ hours}$$

Quelle

MIL-HDBK-217F, Seite 71, Abschnitt 6-25

2.15 TUBES, ALL TYPES EXCEPT TWT AND MAGNETRON

DESCRIPTION
All Types Except Traveling Wave Tubes and Magnetrons.
Includes Receivers, CRT, Thyratron, Crossed Field Amplifier, Pulsed Gridded, Transmitting, Vidicons, Twystron

2.15.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Tube Type	λ_b
Receiver	
Triode, Tetrode, Pentode	5
Power Rectifier	10
CRT	9.6
Thyratron	50
Crossed Field Amplifier	
QK681	260
SFD261	150
Pulsed Gridded	
2041	140
6952	390
7835	140
Transmitting	
Triode, Peak Pwr. $\leq$ 200 KW, Avg. Pwr. $\leq$ 2KW, Freq. $\leq$ 200 MHz	75
Tetrode & Pentode, Peak Pwr. $\leq$ 200 KW, Avg. Power $\leq$ 2KW, Freq. $\leq$ 200 KW	100
If any of the above limits exceeded	250
Vidicon	
Antimony Trisulfide (Sb_2S_3) Photoconductive Material	51
Silicon Diode Array Photoconductive	48
Twystron	
VA144	850
VA145E	450
VA145H	490
VA913A	230
Klystron, Pulsed*	
4KMP10000LF	43
8568	230
L3035	66
L3250	69
L3403	93
SAC42A	100
VA842	18
Z5010A	150
ZM3038A	190
* If the pulsed Klystron of interest is not listed above, use the Alternate Pulsed Kystron λ_b Table on the following page.	

Tabelle 2.16: Base Failure Rate λ_b of tubes, all types except twt and magnetron Part 1

Tube Type	λ_b
Klystron, Low Power, (e.g. Local Oscilator)	30
Klystron, Continous wave*	
3K3000LQ	9
3K50000LF	54
3K210000LQ	150
3KM300LA	64
3KM3000LA	19
3KM50000PA	110
3KM50000PA1	120
3KM50000PA2	150
4K3CC	610
4K3SK	29
4K50000LQ	30
4KM50LB	28
4KM50LC	15
4KM50SJ	38
4KM50SK	37
4KM3000LR	140
4KM50000LQ	79
4KM50000LR	57
4KM170000LA	15
8824	130
8825	120
8826	280
VA800E	70
VA853	220
VA856B	65
VA888E	230
* If the CW Klystron of interest is not listed above, use the Alternate CW Klystron $lambda_b$ Table on the following page.	

Tabelle 2.17: Base Failure Rate λ_b of tubes, all types except twt and magnetron Part 2

Quelle

MIL-HDBK-217F, Seite 72, Abschnitt 7-1

2.16 TUBES, PULSED KLYSTRON, CW KLYSTRON

SPECIFICATION MIL-S-19500

DESCRIPTION Pulsed Klystron , CW Klystron

2.16.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

P(MW)	**F(GHz)**							
	.2	0.4	0.6	0.8	1	2	4	6
0.01	16	16	16	16	16	16	16	16
0.3	16	16	17	17	17	18	20	21
0.8	16	17	17	18	18	21	25	30
1	17	17	18	18	19	22	28	34
3	18	20	21	23	25	34	51	–
5	19	22	25	28	31	45	75	–
8	21	25	30	35	40	63	110	–
10	22	28	34	40	45	75	–	–
25	31	45	60	75	90	160	–	–

Tabelle 2.18: Base Failure Rate λ_b of tubes pulsed Klystron

P(KW)	**F(MHz)**							
	300	500	800	1000	2000	4000	6000	8000
0.1	30	31	33	34	38	47	57	66
1	31	32	33	34	39	48	57	66
3	32	33	34	35	40	49	58	–
5	33	34	35	36	41	50	–	–
8	34	35	37	38	42	–	–	–
10	35	36	38	39	43	–	–	–
30	45	46	48	49	–	–	–	–
50	55	56	58	59	–	–	–	–
80	70	71	73	–	–	–	–	–
100	80	81	–	–	–	–	–	–

Tabelle 2.19: Base Failure Rate λ_b of tubes CW Klystron

Quelle

MIL-HDBK-217F, Seite 73, Abschnitt 7-2

2.17 TUBES TRAVELING WAVE

DESCRIPTION
Traveling Wave Tubes

2.17.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Power(W)	**F(MHz)**								
	0.1	1	2	4	6	8	10	14	18
100	11	12	13	16	20	24	29	42	61
500	11	12	13	16	20	24	29	42	62
1000	11	12	14	16	20	24	29	43	62
3000	12	13	14	17	21	25	30	44	65
5000	12	13	15	18	22	26	32	46	68
8000	13	14	16	19	23	28	33	49	72
10000	14	15	16	20	24	29	35	51	75
15000	15	16	18	22	26	32	39	56	83
20000	17	18	20	24	29	35	43	62	91
30000	20	22	24	29	36	43	52	76	110
40000	25	27	30	36	43	53	64	93	140

Tabelle 2.20: Base Failure Rate λ_b of tubes traveling wave

Quelle

MIL-HDBK-217F, Seite 74, Abschnitt 7-3

2.18 TUBES, MAGNETRON

SPECIFICATION	DESCRIPTION
MIL-S-19500	Magnetrons, Pulsed and Continuous Wave (CW)

2.18.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

P(MW)	Frequency(GHz)													
	0.1	0.5	1	5	10	20	30	40	50	60	70	80	90	100
0.01	1.4	4.6	7.6	24	41	67	91	110	130	150	170	190	200	220
0.05	1.9	6.3	10	34	56	93	120	150	180	210	230	260	280	300
0.1	2.2	7.2	12	39	64	110	140	180	210	240	270	290	320	350
0.3	2.8	9	15	48	80	130	180	220	260	300	330	370	400	430
0.5	3.1	10	17	54	89	150	200	240	290	330	370	410	440	480
1	3.5	11	19	62	100	170	230	280	330	380	420	470	510	550
3	4.4	14	24	77	130	210	280	350	410	470	530	580	630	680
5	4.9	16	26	85	140	230	310	390	460	520	580	640	700	760

Tabelle 2.21: Base Failure Rate λ_b of tubes magnetron

Quelle

MIL-HDBK-217F, Seite 75, Abschnitt 7-4

2.19 RESISTORS, FIXED, COMPOSITION

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-39008	RCR	Resistors, Fixed, Composition (insulated, Established Reliability)
MIL-R-11	RC	Resistors, Fixed, Composition (insulated)

2.19.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.00007	0.0001	0.00015	0.0002	0.00028
10	0.00011	0.00015	0.00021	0.0003	0.00043
20	0.00015	0.00022	0.00031	0.00045	0.00064
30	0.00022	0.00031	0.00046	0.00066	0.00096
40	0.00031	0.00045	0.00067	0.00098	0.0014
50	0.00044	0.00066	0.00098	0.0014	0.0021
60	0.00063	0.00095	0.0014	0.0021	0.0032
70	0.0009	0.0014	0.0021	0.0032	0.0048
80	0.0013	0.002	0.0031	0.0047	–
90	0.0018	0.0029	0.0045	–	–
100	0.0026	0.0041	0.0065	–	–
110	0.0038	0.006	–	–	–
120	0.0054	–	–	–	–

Tabelle 2.22: Base Failure Rate λ_b of resistors fixed composition

Quelle

MIL-HDBK-217F, Seite 83, Abschnitt 9-2

2.20 RESISTORS, FIXED, FILM

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-39017	RLR	Fixed, Film, Insulated, Established Reliability
MIL-R-22684	RL	Fixed, Film, Insulated
MIL-R-55182	RN (R, C, or N)	Fixed, Film, Established Reliability
MIL-R-10509	RN	Fixed, Film, High Stability

2.20.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.00059	0.00073	0.00089	0.0011	0.0013
10	0.00063	0.00078	0.00096	0.0012	0.0014
20	0.00067	0.00084	0.001	0.0013	0.0016
30	0.00072	0.0009	0.0011	0.0014	0.0018
40	0.00078	0.00098	0.0012	0.0016	0.0019
50	0.00084	0.0011	0.0014	0.0017	0.0022
60	0.00092	0.0012	0.0015	0.0019	0.0024
70	0.001	0.0013	0.0017	0.0021	0.0027
80	0.0011	0.0014	0.0018	0.0024	–
90	0.0012	0.0016	0.0021	0.0027	–
100	0.0013	0.0018	0.0023	–	–
110	0.0015	0.002	0.0026	–	–
120	0.0017	0.0023	–	–	–
130	0.0019	–	–	–	–
140	0.0022	–	–	–	–

Tabelle 2.23: Base Failure Rate λ_b of resistors fixed film (MIL-R-22684 and MIL-R-39017)

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.00061	0.00074	0.00091	0.0011	0.0014
10	0.00067	0.00082	0.001	0.0012	0.0015
20	0.00073	0.00091	0.0011	0.0014	0.0017
30	0.0008	0.001	0.0013	0.0016	0.0019
40	0.00088	0.0011	0.0014	0.0017	0.0022
50	0.00096	0.0012	0.0015	0.002	0.0025
60	0.0011	0.0013	0.0017	0.0022	0.0028
70	0.0012	0.0015	0.0019	0.0025	0.0032
80	0.0013	0.0016	0.0021	0.0028	0.0036
90	0.0014	0.0018	0.0024	0.0031	0.004
100	0.0015	0.002	0.0026	0.0035	0.0045
110	0.0017	0.0022	0.0029	0.0039	0.0051
120	0.0018	0.0024	0.0033	0.0043	0.0058
130	0.002	0.0027	0.0036	0.0049	0.0065
140	0.0022	0.003	0.004	0.0054	–
150	0.0024	0.0033	0.0045	–	–
160	0.0026	0.0036	–	–	–
170	0.0029	–	–	–	–

Tabelle 2.24: Base Failure Rate λ_b of resistors fixed film (MIL-R-10509 and MIL-R-55182)

Quelle

MIL-HDBK-217F, Seite 84, Abschnitt 9-3

2.21 RESISTORS, FIXED, FILM, POWER

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-11804	RD	Fixed, Film, Power Type

2.21.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.0089	0.0098	0.011	0.013	0.015
10	0.009	0.01	0.011	0.013	0.015
20	0.0092	0.01	0.012	0.014	0.016
30	0.0094	0.01	0.012	0.014	0.017
40	0.0096	0.011	0.012	0.015	0.017
50	0.0098	0.011	0.013	0.015	–
60	0.01	0.011	0.013	0.016	–
70	0.01	0.012	0.014	0.016	–
80	0.01	0.012	0.014	0.017	–
90	0.011	0.012	0.015	–	–
100	0.011	0.013	0.015	–	–
110	0.011	0.013	0.016	–	–
120	0.012	0.014	0.016	–	–
130	0.012	0.014	0.017	–	–
140	0.012	0.014	–	–	–
150	0.013	0.015	–	–	–
160	0.013	0.016	–	–	–
170	0.014	0.016	–	–	–
180	0.014	–	–	–	–
190	0.015	–	–	–	–
200	0.015	–	–	–	–
210	0.016	–	–	–	–

Tabelle 2.25: Base Failure Rate λ_b of resistors, fixed, film, power

Quelle

MIL-HDBK-217F, Seite 86, Abschnitt 9-5

2.22 RESISTORS, FIXED, WIREWOUND

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-39005	RBR	Fixed, Wirewound, Accurate, Established Reliability
MIL-R-93	RB	Fixed, Wirewound, Accurate

2.22.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.0033	0.0037	0.0045	0.0057	0.0075
10	0.0033	0.0038	0.0047	0.0059	0.0079
20	0.0034	0.0039	0.0048	0.0062	0.0084
30	0.0034	0.004	0.005	0.0066	0.009
40	0.0035	0.0042	0.0052	0.007	0.0097
50	0.0037	0.0043	0.0055	0.0075	0.011
60	0.0038	0.0046	0.0059	0.0081	0.012
70	0.0041	0.0049	0.0064	0.0089	0.013
80	0.0044	0.0053	0.007	0.0099	0.015
90	0.0048	0.0059	0.0079	0.011	0.017
100	0.0055	0.0068	0.0092	0.013	0.02
110	0.0065	0.008	0.011	0.016	0.025
120	0.0079	0.0099	0.014	0.021	0.033
130	0.01	0.013	0.018	0.028	–
140	0.014	–	–	–	–

Tabelle 2.26: Base Failure Rate λ_b of resistors, fixed, wirewound

Quelle

MIL-HDBK-217F, Seite 88, Abschnitt 9-7

2.23 RESISTORS, FIXED, WIREWOUND, POWER

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-39007	RWR	Fixed, Wirewound, Power Type, Established Reliability
MIL-R-26	RW	Fixed, Wirewound, Power Type

2.23.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.0042	0.0062	0.0093	0.014	0.021
10	0.0045	0.0068	0.01	0.016	0.024
20	0.0048	0.0074	0.011	0.017	0.027
30	0.0052	0.0081	0.013	0.02	0.031
40	0.0056	0.0089	0.014	0.022	0.035
50	0.0061	0.0097	0.016	0.025	0.04
60	0.0066	0.011	0.017	0.028	–
70	0.0072	0.012	0.02	0.032	–
80	0.0078	0.013	0.022	0.037	–
90	0.0085	0.014	0.025	0.042	–
100	0.0093	0.016	0.028	0.048	–
110	0.01	0.018	0.031	0.055	–
120	0.011	0.02	0.036	0.063	–
130	0.012	0.022	0.04	–	–
140	0.014	0.025	0.046	–	–
150	0.015	0.028	0.052	–	–
160	0.017	0.032	0.06	–	–
170	0.019	0.036	0.068	–	–
180	0.021	0.04	0.078	–	–
190	0.023	0.046	–	–	–
200	0.026	0.052	–	–	–
210	0.029	0.059	–	–	–
220	0.033	0.068	–	–	–
230	0.037	0.077	–	–	–
240	0.042	0.088	–	–	–
250	0.047	0.01	–	–	–
260	0.054	–	–	–	–
270	0.061	–	–	–	–
280	0.06	–	–	–	–
290	0.079	–	–	–	–
300	0.091	–	–	–	–
310	0.01	–	–	–	–

Tabelle 2.27: Base Failure Rate λ_b of resistors, fixed, wirewound, power

Quelle

MIL-HDBK-217F, Seite 89, Abschnitt 9-8

2.24 RESISTORS, FIXED, WIREWOUND, POWER, CHASSIS MOUNTED

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-39009	RER	Fixed, Wirewound, Power Type, Chassis Mounted,
MIL-R-18546	RE	Established Reliability
		Fixed, Wirewound, Power Type, Chassis Mounted

2.24.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.0021	0.0032	0.0049	0.0076	0.012
10	0.0023	0.0036	0.0056	0.0087	0.014
20	0.0025	0.004	0.0064	0.01	0.016
30	0.0028	0.0045	0.0072	0.012	0.019
40	0.0031	0.005	0.0082	0.013	0.022
50	0.0034	0.0056	0.0093	0.016	0.026
60	0.0037	0.0063	0.011	0.018	–
70	0.0041	0.007	0.012	0.021	–
80	0.0045	0.0079	0.014	0.024	–
90	0.005	0.0088	0.016	0.028	–
100	0.0055	0.0098	0.018	0.032	–
110	0.006	0.011	0.02	–	–
120	0.0066	0.012	0.023	–	–
130	0.0073	0.014	0.026	–	–
140	0.0081	0.015	0.03	–	–
150	0.0089	0.017	0.034	–	–
160	0.0098	0.019	–	–	–
170	0.011	0.022	–	–	–
180	0.012	0.024	–	–	–
190	0.013	0.027	–	–	–
200	0.014	0.03	–	–	–
210	0.016	–	–	–	–
220	0.017	–	–	–	–
230	0.019	–	–	–	–
240	0.021	–	–	–	–
250	0.023	–	–	–	–

Tabelle 2.28: Base Failure Rate λ_b of resistors, fixed, wirewound, power, chassis mounted

Quelle

MIL-HDBK-217F, Seite 91, Abschnitt 9-10

2.25 RESISTORS, THERMISTOR

SPECIFICATION	STYLE	DESCRIPTION
MIL-T-23648	RTH	Thermally Sensitive Resistor, Insulated, Bead, Disk and Rod Types

2.25.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Type	λ_b
Bead (Styles 24, 26, 28, 30, 32, 34, 36, 38, 40)	0.021
Disk (Styles 6, 8, 10)	0.065
Rod (Styles 12, 14, 16, 18, 20, 22, 42)	0.105

Tabelle 2.29: Base Failure Rate λ_b of resistors thermistor

Quelle

MIL-HDBK-217F, Seite 93, Abschnitt 9-12

2.26 RESISTORS, VARIABLE, WIREWOUND

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-39015	RTR	Variable, Wirewound, Lead Screw Actuated,
MIL-R-27208	RT	Established Reliability Variable, Wirewound, Lead Screw Actuated

2.26.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.0089	0.011	0.013	0.016	0.02
10	0.0094	0.012	0.014	0.017	0.021
20	0.01	0.012	0.015	0.019	0.024
30	0.011	0.013	0.017	0.021	0.026
40	0.012	0.015	0.018	0.023	0.029
50	0.013	0.016	0.02	0.026	0.033
60	0.014	0.018	0.023	0.029	0.037
70	0.016	0.02	0.026	0.033	0.043
80	0.018	0.023	0.03	0.039	0.05
90	0.021	0.027	0.035	0.046	0.06
100	0.024	0.032	0.042	0.055	–
110	0.029	0.038	0.051	–	–
120	0.035	0.047	–	–	–
130	0.044	0.059	–	–	–
140	0.056	–	–	–	–

Tabelle 2.30: Base Failure Rate λ_b of resistors, variable, wirewound

Quelle

MIL-HDBK-217F, Seite 94, Abschnitt 9-13

2.27 RESISTORS, VARIABLE, WIREWOUND, PRECISION

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-12934	RR	Variable, Wirewound, Precision

2.27.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.1	0.11	0.12	0.13	0.14
10	0.11	0.12	0.13	0.14	0.15
20	0.12	0.13	0.14	0.16	0.17
30	0.13	0.14	0.16	0.17	0.19
40	0.14	0.15	0.17	0.2	0.22
50	0.15	0.17	0.2	0.22	0.26
60	0.17	0.19	0.22	0.26	0.3
70	0.19	0.22	0.26	0.3	0.36
80	0.21	0.25	0.3	0.36	0.43
90	0.24	0.3	0.36	0.44	0.54
100	0.28	0.35	0.44	0.54	–
110	0.33	0.42	0.54	–	–
120	0.4	0.52	–	–	–
130	0.49	0.65	–	–	–
140	0.6	–	–	–	–

Tabelle 2.31: Base Failure Rate λ_b of resistors, variable, wirewound, precision

Quelle

MIL-HDBK-217F, Seite 96, Abschnitt 9-15

2.28 RESISTORS, VARIABLE, WIREWOUND, SEMIPRECISION

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-19	RA	Variable, Wirewound, Semiprecision (Low Operating
MIL-R-39002	RK	Temperature)
		Variable, Wirewound, Semiprecision

2.28.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.055	0.063	0.072	0.083	0.095
10	0.058	0.069	0.081	0.095	0.11
20	0.063	0.076	0.092	0.11	0.13
30	0.069	0.086	0.11	0.13	0.17
40	0.076	0.098	0.13	0.16	0.21
50	0.085	0.11	0.15	0.2	0.27
60	0.096	0.13	0.19	0.26	0.37
70	0.11	0.16	0.24	0.35	0.52
80	0.13	0.2	0.31	0.48	0.75
90	0.16	0.26	0.42	0.69	1.1
100	0.19	0.34	0.59	1	–
110	0.24	0.45	0.85	–	–
120	0.31	–	–	–	–
130	0.42	–	–	–	–

Tabelle 2.32: Base Failure Rate λ_b of resistors, variable, wirewound, semiprecision

Quelle

MIL-HDBK-217F, Seite 98, Abschnitt 9-17

2.29 RESISTORS, VARIABLE, WIREWOUND, POWER

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-22	RP	Variable, Wirewound, Power Type

2.29.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.064	0.074	0.084	0.097	0.11
10	0.067	0.078	0.091	0.11	0.12
20	0.071	0.084	0.099	0.12	0.14
30	0.076	0.091	0.11	0.13	0.16
40	0.081	0.099	0.12	0.15	–
50	0.087	0.11	0.14	0.17	–
60	0.095	0.12	0.15	–	–
70	0.1	0.14	0.18	–	–
80	0.12	0.15	–	–	–
90	0.13	0.18	–	–	–
100	0.15	–	–	–	–
110	0.17	–	–	–	–
120	0.2	–	–	–	–

Tabelle 2.33: Base Failure Rate λ_b of resistors, variable, wirewound, power

Quelle

MIL-HDBK-217F, Seite 100, Abschnitt 9-19

2.30 RESISTORS, VARIABLE, NONWIREWOUND

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-22097	RJ	Variable, Nonwirewound (Adjustment Types)
MIL-R-39035	RJR	Variable, Nonwirewound (Adjustment Types), Established Reliability

2.30.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.021	0.023	0.024	0.026	0.28
10	0.021	0.023	0.025	0.027	0.03
20	0.022	0.024	0.026	0.029	0.031
30	0.023	0.025	0.028	0.03	0.033
40	0.024	0.026	0.029	0.032	0.036
50	0.025	0.028	0.031	0.035	0.039
60	0.026	0.03	0.033	0.038	0.043
70	0.028	0.032	0.036	0.042	0.047
80	0.03	0.035	0.04	0.046	0.053
90	0.034	0.039	0.045	0.053	0.061
100	0.038	0.044	0.052	0.061	–
110	0.043	0.051	0.06	–	–
120	0.05	0.06	–	–	–
130	0.06	0.073	–	–	–
140	0.074	–	–	–	–

Tabelle 2.34: Base Failure Rate λ_b of resistors, variable, nonwirewound

Quelle

MIL-HDBK-217F, Seite 102, Abschnitt 9-21

2.31 RESISTORS, VARIABLE, COMPOSITION

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-94	RV	Variable, Composition, Low Precision

2.31.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.027	0.03	0.032	0.035	0.038
10	0.028	0.031	0.034	0.038	0.042
20	0.029	0.033	0.037	0.042	0.048
30	0.031	0.036	0.041	0.048	0.056
40	0.033	0.039	0.047	0.056	0.067
50	0.036	0.044	0.054	0.067	0.082
60	0.039	0.05	0.065	0.083	0.11
70	0.045	0.06	0.08	0.11	0.14
80	0.053	0.074	0.1	0.15	–
90	0.065	0.096	0.14	–	–
100	0.084	0.13	–	–	–
110	0.11	–	–	–	–

Tabelle 2.35: Base Failure Rate λ_b of resistors, variable, composition

Quelle

MIL-HDBK-217F, Seite 104, Abschnitt 9-23

2.32 RESISTORS, VARIABLE, NONWIREWOUND, FILM AND PRECISION

SPECIFICATION	STYLE	DESCRIPTION
MIL-R-39023	RQ	Variable, Nonwirewound, Film, Precision
MIL-R-23285	RVC	Variable, Nonwirewound, Film

2.32.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.023	0.024	0.026	0.028	0.031
10	0.024	0.026	0.029	0.031	0.034
20	0.026	0.029	0.032	0.035	0.039
30	0.028	0.032	0.036	0.04	0.045
40	0.032	0.036	0.041	0.047	0.053
50	0.037	0.042	0.049	0.057	0.065
60	0.044	0.051	0.06	0.07	0.083
70	0.053	0.064	0.076	0.091	0.11
80	0.068	0.083	0.1	0.12	–
90	0.092	0.11	0.14	–	–
100	0.13	0.17	–	–	–
110	0.2	–	–	–	–

Tabelle 2.36: Base Failure Rate λ_b of resistors, variable, nonwirewound, film and precision (RQ Style Only)

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.028	0.031	0.033	0.036	0.039
10	0.029	0.032	0.035	0.038	0.042
20	0.03	0.033	0.037	0.041	0.046
30	0.031	0.035	0.04	0.045	0.051
40	0.032	0.037	0.043	0.05	0.058
50	0.034	0.04	0.047	0.056	0.066
60	0.036	0.044	0.053	0.064	0.078
70	0.039	0.049	0.06	0.075	0.093
80	0.043	0.055	0.07	0.09	0.11
90	0.048	0.063	0.083	0.11	0.15
100	0.055	0.075	0.1	0.014	0.019
110	0.064	0.091	0.13	0.18	0.26
120	0.077	0.11	0.17	0.25	0.37
130	0.096	0.15	0.23	0.36	0.55
140	0.12	0.2	0.33	0.53	–
150	0.17	0.29	0.5	–	–
160	0.24	0.44	–	–	–
170	0.37	–	–	–	–

Tabelle 2.37: Base Failure Rate λ_b of resistors, variable, nonwirewound, film and precision (RVC Style Only)

Quelle

MIL-HDBK-217F, Seite 106, Abschnitt 9-25

2.33 CAPACITORS, FIXED, SUPER-METALLIZED PLASTIC

SPECIFICATION	STYLE	DESCRIPTION
MIL-C-83421	CRH	Super-Metallized Plastic, Est. Rel.

2.33.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.00055	0.00068	0.0022	0.0096	0.032
10	0.00055	0.00068	0.0022	0.0096	0.032
20	0.00056	0.00069	0.0023	0.0097	0.033
30	0.00056	0.00069	0.0023	0.0098	0.033
40	0.00057	0.0007	0.0023	0.0099	0.033
50	0.00058	0.00072	0.0024	0.01	0.034
60	0.00061	0.00075	0.0025	0.011	0.036
70	0.00065	0.00081	0.0026	0.011	0.38
80	0.00073	0.00091	0.003	0.013	0.043
90	0.00089	0.0011	0.0036	0.015	0.052
100	0.0012	0.0015	0.0049	0.021	0.07
110	0.0019	0.0024	0.0078	0.033	0.11
120	0.004	0.005	0.016	0.07	0.24

Tabelle 2.38: Base Failure Rate λ_b of capacitors, fixed, super-metallized plastic

Quelle

MIL-HDBK-217F, Seite 121, Abschnitt 10-11

2.34 CAPACITORS, FIXED, ELECTROLYTIC (DRY), ALUMINIUM

SPECIFICATION	STYLE	DESCRIPTION
MIL-C-62	CE	Aluminium, Dry Electrolyte, Polarized

2.34.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.0064	0.0074	0.011	0.02	0.034
10	0.0078	0.009	0.014	0.024	0.042
20	0.0099	0.011	0.017	0.03	0.053
30	0.013	0.015	0.023	0.04	0.07
40	0.018	0.021	0.031	0.055	0.096
50	0.026	0.03	0.046	0.08	0.14
60	0.041	0.047	0.071	0.12	0.22
70	0.068	0.078	0.12	0.21	0.36
80	0.12	0.14	0.21	0.37	0.65

Tabelle 2.39: Base Failure Rate λ_b of capacitors, fixed, electrolyte (dry), aluminium

Quelle

MIL-HDBK-217F, Seite 136, Abschnitt 10-26

2.35 CAPACITORS, VARIABLE, AIR TRIMMER

SPECIFICATION	STYLE	DESCRIPTION
MIL-C-92	CT	Variable, Air Trimmer

2.35.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_A(°C)	Stress				
	0.1	0.3	0.5	0.7	0.9
0	0.0074	0.013	0.032	0.076	0.15
10	0.01	0.017	0.044	0.1	0.21
20	0.014	0.023	0.059	0.14	0.28
30	0.018	0.031	0.08	0.19	0.38
40	0.025	0.042	0.11	0.26	0.52
50	0.034	0.057	0.15	0.35	0.7
60	0.046	0.078	0.2	0.47	0.94
70	0.062	0.1	0.27	0.63	1.3
80	0.083	0.14	0.36	0.85	1.7

Tabelle 2.40: Base Failure Rate λ_b of capacitors, variable, air trimmer

Quelle

MIL-HDBK-217F, Seite 139, Abschnitt 10-29

2.36 INDUCTIVE DEVICES, TRANSFORMERS

SPECIFICATION	STYLE	DESCRIPTION
MIL-T-27	TF	Audio, Power and High Power Pulse
MIL-T-21038	TP	Low Power Pulse
MIL-T-55631	-	IF, RF and Discriminator

2.36.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_{HS}(°C)	Maximum Rated Operating Temperature (°C)					
	85^1	105^2	130^3	155^4	170^5	$> 170^6$
30	0.0024	0.0023	0.0022	0.0021	0.0018	0.0016
35	0.0026	0.0023	0.0023	0.0022	0.0018	0.0016
40	0.0028	0.0024	0.0024	0.0022	0.0019	0.0016
45	0.0032	0.0025	0.0025	0.0022	0.0019	0.0016
50	0.0038	0.0027	0.0026	0.0023	0.002	0.0017
55	0.0047	0.0029	0.0027	0.0023	0.0021	0.0017
60	0.006	0.0032	0.0029	0.0023	0.0021	0.0017
65	0.0083	0.0035	0.003	0.0024	0.0021	0.0017
70	0.012	0.004	0.0033	0.0025	0.0022	0.0017
75	0.02	0.0047	0.0035	0.0026	0.0023	0.0017
80	0.036	0.0057	0.0039	0.0027	0.0024	0.0017
85	0.075	0.0071	0.0043	0.0028	0.0024	0.0017
90	–	0.0093	0.0048	0.0029	0.0025	0.0018
95	–	0.013	0.0054	0.0031	0.0026	0.0018
100	–	0.0019	0.0062	0.0033	0.0027	0.0018
105	–	0.03	0.0072	0.0035	0.0028	0.0018
110	–	–	0.0085	0.0038	0.003	0.0019
115	–	–	0.01	0.0042	0.0031	0.0019
120	–	–	0.013	0.0046	0.0032	0.0019
125	–	–	0.016	0.0052	0.0034	0.002
130	–	–	0.02	0.0059	0.0036	0.002
135	–	–	–	0.0068	0.0038	0.0021
140	–	–	–	0.0079	0.004	0.0021
145	–	–	–	0.0095	0.0042	0.0022
150	–	–	–	0.011	0.0044	0.0023
155	–	–	–	0.014	0.0047	0.0024
160	–	–	–	–	0.005	0.0025
165	–	–	–	–	0.0053	0.0026
170	–	–	–	–	0.0056	0.0027
175	–	–	–	–	–	0.0029
180	–	–	–	–	–	0.003
185	–	–	–	–	–	0.0032

Tabelle 2.41: Base Failure Rate λ_b of inductive devices, transformers

Quelle

MIL-HDBK-217F, Seite 143, Abschnitt 11-1

2.37 INDUCTIVE DEVICES, COILS

SPECIFICATION	STYLE	DESCRIPTION
MIL-C-15305	-	Fixed and Variable, RF
MIL-C-39010	-	Molded, RF, Est. Rel.

2.37.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_{HS}(°C)	Maximum Operating Temperature (°C)			
	85^1	105^2	125^3	150^4
30	0.00044	0.00043	0.00039	0.00037
35	0.00048	0.00044	0.0004	0.00037
40	0.00053	0.00046	0.00042	0.00037
45	0.0006	0.00048	0.00043	0.00038
50	0.00071	0.00051	0.00045	0.00038
55	0.00087	0.00055	0.00048	0.00039
60	0.0011	0.0006	0.00051	0.0004
65	0.0015	0.00067	0.00054	0.00041
70	0.0023	0.00076	0.00058	0.00042
75	0.0037	0.00089	0.00063	0.00043
80	0.0067	0.0011	0.00069	0.00044
85	0.014	0.0013	0.00076	0.00046
90	–	0.0018	0.00085	0.00047
95	–	0.0024	0.00096	0.0005
100	–	0.0036	0.0011	0.00052
105	–	0.0057	0.0013	0.00055
110	–	–	0.0015	0.00059
115	–	–	0.0018	0.00063
120	–	–	0.0022	0.00068
125	–	–	0.0028	0.00075
130	–	–	–	0.00083
135	–	–	–	0.00093
140	–	–	–	0.0011
145	–	–	–	0.0012
150	–	–	–	0.0014

Tabelle 2.42: Base Failure Rate λ_b of inductive devices, coils

Quelle

MIL-HDBK-217F, Seite 145, Abschnitt 11-3

2.38 ROTATING DEVICES, SYNCHROS AND RESOLVERS

SPECIFICATION	DESCRIPTION
-	Rotating Synchros and Resolvers

2.38.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_F(°C)	λ_b
30	0.0083
35	0.0088
40	0.0095
45	0.01
50	0.011
55	0.013
60	0.014
65	0.016
70	0.019
75	0.022
80	0.027
85	0.032
90	0.041
95	0.041
100	0.069
105	0.094
110	0.13
115	0.19
120	0.29
125	0.45
130	0.74
135	1.3

Tabelle 2.43: Base Failure Rate λ_b of rotating devices, synchros and resolvers

Quelle

MIL-HDBK-217F, Seite 150, Abschnitt 12-3

2.39 ROTATING DEVICES, ELAPSED TIME METERS

SPECIFICATION	DESCRIPTION
-	Elapsed Time Meters

2.39.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Type	λ_b
A.C.	20
Inverter Driven	30
Commutator D.C.	80

Tabelle 2.44: Base Failure Rate λ_b of rotating devices, elapsed time meters

Quelle

MIL-HDBK-217F, Seite 151, Abschnitt 12-4

2.40 RELAYS, MECHANICAL

SPECIFICATION
MIL-R-5757
MIL-R-6106
MIL-R-19523
MIL-R-39016
MIL-R-19648
MIL-R-83725
MIL-R-83726 (Except Class C, Solid State Type)

DESCRIPTION
Mechanical Relay

2.40.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_{HS}(°C)	Rated Temperature (°C)	
	85^1	125^2
25	0.006	0.0059
30	0.0061	0.006
35	0.0063	0.0061
40	0.0065	0.0062
45	0.0068	0.0064
50	0.0072	0.0066
55	0.0077	0.0068
60	0.0084	0.0071
65	0.0094	0.0074
70	0.011	0.0079
75	0.013	0.0083
80	0.016	0.0089
85	0.02	0.0097
90	–	0.011
95	–	0.012
100	–	0.013
105	–	0.015
110	–	0.018
115	–	0.021
120	–	0.025
125	–	0.031

Tabelle 2.45: Base Failure Rate λ_b of relays mechanical

Quelle

MIL-HDBK-217F, Seite 153, Abschnitt 13-1

2.41 RELAYS, SOLID STATE AND TIME DELAY

SPECIFICATION	DESCRIPTION
MIL-R-28750	Relay, Solid State
MIL-R-83726	Relay, Time Delay, Hybrid and Solid State

2.41.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Relay Type	λ_b
Solid State	0.4
Solid State Time Delay	0.5
Hybrid	0.5

Tabelle 2.46: Base Failure Rate λ_b of relays, solid state and time delay

Quelle

MIL-HDBK-217F, Seite 155, Abschnitt 13-3

2.42 SWITCHES, TOGGLE OR PUSHBUTTON

SPECIFICATION	DESCRIPTION
MIL-S-3950	Snap-action, Toggle or Pushbutton,
MIL-S-8805	Single Body
MIL-S-8834	
MIL-S-22885	
MIL-S-83731	

2.42.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Relay Type	**MIL-SPEC** λ_b	**Lower Quality** λ_b
Snap-action	0.00045	0.034
Non-snap Action	0.0027	0.04

Tabelle 2.47: Base Failure Rate λ_b of relays, solid state and time delay

Quelle

MIL-HDBK-217F, Seite 156, Abschnitt 14-1

2.43 SWITCHES, BASIC SENSITIVE

SPECIFICATION	DESCRIPTION
MIL-S-8805	Basic Sensitive

2.43.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Description	MIL-SPEC	Lower Quality
λ_{bE}	0.1	0.1
λ_{bC}	0.00045	0.23
λ_{b0}	0.0009	0.63

Tabelle 2.48: Base Failure Rate λ_b of switches, basic sensitive

Quelle

MIL-HDBK-217F, Seite 157, Abschnitt 14-2

2.44 SWITCHES, ROTARY

SPECIFICATION	DESCRIPTION
MIL-S-3786	Rotary, Ceramic or Glass Water, Silver Alloy Contacts

2.44.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Description	MIL-SPEC	Lower Quality
λ_{bE}	0.0067	0.1
λ_{bF}	0.00003	0.02
λ_{bG}	0.00003	0.06

Tabelle 2.49: Base Failure Rate λ_b of switches, rotary

Quelle

MIL-HDBK-217F, Seite 158, Abschnitt 14-3

2.45 SWITCHES, THUMBWHEEL

SPECIFICATION	DESCRIPTION
MIL-S-22710	Switches, Rotary (Printed Circuit) (Thumbwheel, In- and Push-
Line	button)

2.45.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Description	MIL-SPEC	Lower Quality
λ_{b1}	0.0067	0.086
λ_{b2}	0.062	0.089

Tabelle 2.50: Base Failure Rate λ_b of switches, thumbwheel

Quelle

MIL-HDBK-217F, Seite 159, Abschnitt 14-4

2.46 SWITCHES, CIRCUIT BREAKERS

SPECIFICATION	DESCRIPTION
MIL-C-55629	Circuit Breakers, Magnetic, Unsealed, Trip-Free
MIL-C-83383	Circuit Breakers, Remote Control, Thermal, Trip-Free
MIL-C-39019	Circuit Breakers, Magnetic, Low Power, Sealed, Trip-Free Service
W-C-375	Circuit Breakers, Molded Case, Branch Circuit and Service

2.46.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Description	λ_b
Magnetic	0.02
Thermal	0.038
Thermal-Magnetic	0.038

Tabelle 2.51: Base Failure Rate λ_b of switches, circuit breakers

Quelle

MIL-HDBK-217F, Seite 160, Abschnitt 14-5

2.47 CONNECTORS, PRINTED CIRCUIT BOARD

SPECIFICATION	DESCRIPTION
MIL-C-21097	One-Piece Connector
MIL-C-55302	Two-Piece Connector

2.47.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

T_O(°C)	λ_b
0	0.00012
10	0.00017
20	0.00022
30	0.00028
40	0.00037
50	0.00047
60	0.00059
70	0.00075
80	0.00093
90	0.0012
100	0.0015
110	0.0018
120	0.0022
130	0.0028
140	0.0035
150	0.0044
160	0.0055
170	0.0069
180	0.0088
190	0.011
200	0.015

Tabelle 2.52: Base Failure Rate λ_b of connectors, printed circuit board

Quelle

MIL-HDBK-217F, Seite 164, Abschnitt 15-4

2.48 CONNECTORS, INTEGRATED CIRCUIT SOCKETS

SPECIFICATION	DESCRIPTION
MIL-S-83734	IC Sockets, Plug-in

2.48.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Type	λ_b
All MIL-S-83734	0.00042

Tabelle 2.53: Base Failure Rate λ_b of connectors, integrated circuit sockets

Quelle

MIL-HDBK-217F, Seite 166, Abschnitt 15-6

2.49 INTERCONNECTION ASSEMBLIES WITH PLATED THROUGH HOLES

SPECIFICATION	DESCRIPTION
-	Circuit Boards, Printed (PCBs) and Discrete Wiring

2.49.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Technology	λ_b
Printed Wiring Assembly/Printed Circuit Boards with PTHs	0.000041
Discrete Wiring with Electroless Deposited PTH ($\leq$ Levels of Circuitry)	0.00026

Tabelle 2.54: Base Failure Rate λ_b of interconnection assemblies with plated through holes

Quelle

MIL-HDBK-217F, Seite 167, Abschnitt 16-1

2.50 CONNECTIONS

SPECIFICATION	DESCRIPTION
-	Connections Used on All Assemblies Except Those Using Plated Through Holes (PTH)

2.50.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Connection Type	λ_b
Hand Solder, w/o Wrapping	0.0026
Hand Solder, w/Wrapping	0.00014
Crimp	0.00026
Weld	0.00005
Solderless Wrap	0.0000035
Clip Termination	0.00012
Reflow Solder	0.000069

Tabelle 2.55: Base Failure Rate λ_b of connections

Quelle

MIL-HDBK-217F, Seite 168, Abschnitt 17-1

2.51 METERS, PANEL

SPECIFICATION	DESCRIPTION
MIL-M-10304	Meter, Electrical Indicating, Panel Type, Ruggedized

2.51.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Type	λ_b
All	0.09

Tabelle 2.56: Base Failure Rate λ_b of meters, panel

Quelle

MIL-HDBK-217F, Seite 169, Abschnitt 18-1

2.52 QUARTZ CRYSTALS

SPECIFICATION	DESCRIPTION
MIL-C-3098	Crystal Units, Quartz

2.52.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Frequency, f(MHz)	λ_b
0.5	0.011
1	0.013
5	0.019
10	0.022
15	0.024
20	0.026
25	0.027
30	0.028
35	0.029
40	0.03
45	0.031
50	0.032
55	0.033
60	0.033
65	0.034
70	0.035
75	0.035
80	0.036
85	0.036
90	0.037
95	0.037
100	0.037
105	0.038

Tabelle 2.57: Base Failure Rate λ_b of quartz crystals

Quelle

MIL-HDBK-217F, Seite 170, Abschnitt 19-1

2.53 LAMPS

SPECIFICATION	DESCRIPTION
MIL-L-6363	Lamps, Incandescent, Aviation Service
W-L-111	Lamps, Incandescent, Miniature, Tungsten-Filament

2.53.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Rated Voltage, V_r(Volts)	λ_b
5	0.59
6	0.75
12	1.8
14	2.2
24	4.5
28	5.4
37.5	7.9

Tabelle 2.58: Base Failure Rate λ_b of lamps

Quelle

MIL-HDBK-217F, Seite 171, Abschnitt 20-1

2.54 ELECTRONIC FILTERS, NON-TUNABLE

SPECIFICATION	DESCRIPTION
MIL-F-15733	Filters, Radio Frequency Interference
MIL-F-18327	Filters, High Pass, Low Pass, Band Pass, Band Suppression, and Dual Functioning (Non-tunable)

2.54.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Type	λ_b
MIL-F-15733, Ceramic-Ferrite Construction (Styles FL 10-16, 22, 24, 30-32, 34, 35, 38, 41-43, 45, 47-50, 61-65, 70, 81-93, 95, 96)	0.022
MIL-F-15733, Discrete LC Components, (Styles FL 37, 53, 74)	0.12
MIL-F-18327, Discrete LC Components (Composition 1)	0.12
MIL-F-18327, Discrete LC and Crystal Components (Composition 2)	0.27

Tabelle 2.59: Base Failure Rate λ_b of electronic filters, non-tunable

Quelle

MIL-HDBK-217F, Seite 172, Abschnitt 21-1

2.55 FUSES

SPECIFICATION	DESCRIPTION
W-F-1726	Fuse, Cartridge Class H
W-F-1814	Fuse, Cartridge, High Interrupting Capactiy
MIL-F-5372	Fuse, Current Limiter Type, Aircraft
ML-F-23419	Fuse, Instrument Type
MIL-F-15160	Fuse, Instrument, Power and Telephone (Nonindicating), Style F01

2.55.1 Base Failure Rate λ_b

The measurement of the base failure rate λ_b is given in failures per 10^6 hours.

Type	λ_b
W-F-1726, W-F-1814, MIL-F-5372, MIL-F-23419, ML-F-15160	0.01

Tabelle 2.60: Base Failure Rate λ_b of fuses

Quelle

MIL-HDBK-217F, Seite 173, Abschnitt 22-1

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