P R
B X

POWERBOX Medline
OFM100 Series
Technical Note MTBF

MTBF (Mean time between failure)

A statistical figure that gives the number of units that will fail over time for a population of system or components. It is statistics and calculated based on the number and type of components and individual stress of the components in the designed system/component.

MTBF Example 1:

Power supply with calculated MTBF of 200.000 hours.
One year is 8760 hours
You deliver 1000 units to a customer and all of them are powered up day one. After one year the power supplies have a total operating time of 1000 units x 8760h = 8760000 hours.
In theory the number of units that will fail during one year is 8760000/200000 = 43,8 units
An alternative MTBF is so called field based MTBF. It is when the above calculation is made in reverse.

Field based MTBF Example 2:

If 2000 power supplies operates during one year they have a total operating time of 2000 x 8760 = 17520000 hours. If then 25 are reported to fail the field based MTBF is 17520000/25 =700800 hours

Lifetime

A lifetime prediction defines the time until one single unit is worn-out. As the weakest components in power supplies in most cases are the capacitors it is a common rule to base lifetime predictions on the weakest capacitor that runs at the highest temperature and that has an important role in the function of the power supply.

Lifetime example 1:

Capacitor A1 is defined as the most important capacitor in this power supply. It operates at an average temperature of 75 degrees C. Capacitor A1 is specified to a lifetime of 8000 hours at 105 degrees C. A common rule is that every 10 degrees decrease in temperature makes the lifetime double or vise versa.
Calculation from 105 degrees C to 75 makes three 10 degrees steps. 8000 at 105 degrees is equal to 16000 hours at 95 degrees, 32000 hours at 85 degrees, and 64000 hours at 75 degrees.
In this example the lifetime of the complete power supply is equal to the lifetime of capacitor A1, which is 64 000 hours or 7,3 years.
It is common that MTBF figures are about 10 times as many hours compared to the estimated lifetime.

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	0	0	2	8,6	14,4	36,5	73
	Wet Large			2	12,9	21,9	54	108
X - Y				1	0,6	2	4	4
Film				0	0,5	0,9	7,5	0
Ceramic		0	5	0	0,6	2,5	9	12,5
Semiconductors								
Diodes		0	5	1	3	6	17	47
Transistors		0		9	1,3	2,5	9	81
Rectifiers		0	0	1	20	35	80	80
Triacs/Thyristors			0		15	25	60	0
Power Mos/IGBT		1			0,13			0,13

Component name	Description	Number of components at stress fact			Failure rate at stress fact			N*Lamda
		20%	50%	80%	20%	50%	80%	0,000000001
IC								
Linear	Bipolar Small	0		1	6	12	18	18
	Bipolar Medium				20	40	60	0
	Bipolar Large		0		35	70	100	0
	MOS Small		0		12	25	35	0
	MOS Medium		1	1	45	85	125	210
	MOS Large		0		75	150	225	0
Digital	Bipolar Small		0		5	10	15	0
	Bipolar Medium		0		15	30	45	0
	Bipolar Large		0		30	55	80	0
	MOS Small		0		8	15	25	0
	MOS Medium		0		18	35	50	0
	MOS Large		0		25	55	80	0
General								
Coils	Fixed	0	1	1	0,3	0,5	1	1,5
	Variable		0		0,6	1	2	0
Transformer	High power pulse		1		50	60	120	60
	Low power pulse		0		8	10	20	0
Relays	Reed		0		7	10	20	0
	Inductive		0		20	30	55	0
Switches	Push		0		20	30	55	0
	Micro Contact		0		280	400	720	0
	Rotary Contact		0		85	120	210	0
Connectors	Panel		0		1	1	1	0
	Power		1		24	24	24	24
	Coaxial		0		15	15	15	0
	Pcb		2		2	2	2	4
Connections	Hand.sold.		4		3	3	3	12
	Mach.sold.		201		0,29	0,5	0,5	100,5
	Wire		0		0,003	0,003	0,003	0
	Crimp		0		0,3	0,3	0,3	0
Crystal	Quartz		0		200	200	200	0
Fuse	1			100	100	100	100	
Lamps	Gas				200	200	200	0
	Filament				1000	1000	1000	0
PCB	Plat.through/dm2	1			0,06	0,06	0,06	0,06
Meters					10000	10000	10000	0
Opto	LED	0			20	35	80	0
	Opto-coupler	1			20	35	80	20
Total failure rate								**1011,69**

Factor for ambient temperature

Kt=	0,8 for	15	Kt=	1
	1 for	30		
	1,2 for	45		
	1,5 for	55		
	2 for	70		

Factor for environment

K3=	1 for	gnd benign	K3=	3
	3 for	gnd fixed		
	9 for	gnd mobile		

N*L*Kt*K3= 3035,07

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