MTBF PREDICTION REPORT

PRODUCT: R500/M33T

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Reliability Prediction of R500/M33T

Abstracts

The following report follows the Bellcore TR-332 (issue 6, Dec. 1997) which describes what are termed permanent or hard component failures and intermittent component failures confirmed or conformable by failure analysis. That is, the data gathered for TR-332 only counts confirmed physical failures. The failure rates described are only for confirmed or conformable failure mechanisms such as dielectric breakdown, electromigration, ionic contamination, corrosion, etc. The predictions are based solely on the method I, "Parts Count", procedure.

Model: R500/M33T

Component	FITs	Qty	Duty Cycle @ Power On	FITs with Duty Cycle Factor	Note	Data From
Main Board	6070.46	1	100%	6070.46	*1	Wistron
512 DRAM	833.333	1	100%	833.333		Apacer
200W PSU	9708.737	1	80%	11111.111		Zippy
HDD	1000	2	80%	1600		Seagate
CDROM	8443.0935	1	10%	844.30935		MKE
FDD	10131.712	1	10%	1013.1712		Panasonic
FAN	10131.712	2	80%	16210.739		Delta
Total FITs				37683.123		
MTBF (Hours)				26537.078		

Note: **At 30 degree C Prediction**

*1: The FIT values of all parts of motherboard are on the next page.

2 FIT: Failures-in-time; a "steady-state" failure rate. "Steady-state" is that phase of the product's operating life during which the failure rate is constant. Herein the steady-state phase is assumed preceded by an infant mortality phase characterized by a decreasing failure rate.

3 All the failure rates in this report are expressed as *failures per 10^9 operating hours* denoted as FITs.

4 Troubles caused by transient faults, software problems, procedural errors, or unexpected operating environments can have a significant impact on system level reliability. Therefore, this report could only be used to predict system hardware failures.

5 The system is modeled as a "serial system" of all components. i.e. the failure of any component will cause a failure of the system.

6 MTBF = 10^9 / FITs (hours)

The MTBF of R500/M33T Main Board

Device type	Number	F.R.	PI_Q	PI_T	PI_S	FITs subtotal
Battery Lithium	1	150	1	0.9	1	135
Bead	10	4	1	0.6	1	24
Buzzer; inductive audio	1	7	1	0.8	1	5.6
CMOS digital IC (501~1000gates)	29	18	1	0.6	1	313.2
Capacitors discrete fixed aluminum 400-12000uF	23	25	1	0.6	1	345
Capacitors discrete fixed aluminum <400uF	48	15	1	0.6	1	432
Capacitors discrete fixed ceramic	984	1	1	0.9	1	885.6
Connector Socket(Pins)	913	0.2	1	0.6	1	109.56
Connector multi-pin(Pins)	1425	0.2	1	0.6	1	171
Crystal oscillator	3	60	1	0.9	1	162
DRAM 16KBits	2	20	1	0.5	1	20
Digital IC CMOS 30001~50000 gates	15	27	1	0.6	1	243
Diode Si general purpose 1-20Amp	18	6	1	0.8	1	86.4
Diode Si general purpose >20Amp	8	9	1	0.8	1	57.6
FET Si switch	24	20	1	0.8	1	384
Fan assembly + motor	3	150	1	0.9	1	405
Fuse or battery holder	1	5	1	0.6	1	3
Inductive transformer pulse high level	7	19	1	0.8	1	106.4
Inductor	32	7	1	0.8	1	179.2
Inductor radio frequency fixed	2	0.5	1	0.8	1	0.8
LED	21	3	1	0.4	1	25.2
Linear IC (261~360 transistors)	20	62	1	0.5	1	620
Linear IC (33~90 transistors)	6	33	1	0.5	1	99
PGA 370 Socket	2	74	1	0.6	1	88.8
Quartz crystal	6	25	1	0.9	1	135
ROM/EEPROM 1024KBits	1	71	1	0.4	1	28.4
ROM/EEPROM 128KBits	1	43	1	0.4	1	17.2
ROM/EEPROM 2KBits	2	17	1	0.5	1	17
ROM/EEPROM 4096KBits	1	99	1	0.4	1	39.6
ROM/EEPROM 4KBits	1	19	1	0.5	1	9.5
Resistor Accurate film <1Mohm	73	0.5	1	0.8	1	29.2
Resistor Accurate film >1Mohm	4	3	1	0.8	1	9.6
Resistor film <1Mohm	545	0.5	1	0.8	1	218

Resistor film >1Mohm	8	3	1	0.8	1	19.2
Resistor networks discrete	440	1	1	0.7	1	308
SRAM 256KBits	1	73	1	0.6	1	43.8
Switches toggle or pushbutton	10	10	1	0.6	1	60
TTL digital IC (501~1000gates)	8	33	1	0.7	1	184.8
Transistor NPN/PNP Si 0.6~6.0W	3	6	1	0.8	1	14.4
Transistor NPN/PNP Si <=0.6W	9	4	1	0.8	1	28.8
USB connector	1	11	1	0.6	1	6.6
π_E	1.0 (Ground, Fixed, Controlled)					
FITs	6070.46					
MTBF(hours)	189720.92					

Note:

1. The above calculations are based on the Bellcore case 1 of method I. (Assumed component operating temperature is 30°C and electrical stress is 50%)

2. GFR means generic steady state failure rates in FITs. These GFR numbers are obtained from Table A. Device Failure Rates of BellCore TR-332, which is based on data provided by several suppliers.

3. Device's "FITs subtotal" is calculated by the product of device quantity, GFR, π_Q, π_T, and π_S

4. FITs is calculated by the product of π_E and the summation of FITs subtotal of all devices.

5. π_T means the temperature factor and is equal to 1 if the operating temperature is 40°C

6. π_S means the stress factor and is equal to 1 if the electrical stress is 50%

7. π_Q means the quality factor, if it is in

(1) Quality level I, then $\pi_Q = 3.0$; components without thorough device qualification or lot-to lot controls

(2) Quality level II, then $\pi_Q = 1.0$; AQL/DPM lot controlled; devices and device manufacturer must be qualified and identified on approved parts/manufacturer's list; lot-to-lot control

(3) Quality level III, then $\pi_Q = 0.9$; re-qualified periodically; lot-to-lot controls must include early life reliability control of 100% screen; the percent defective allowed shall not exceed 2% while burn-in screen is used; ongoing, continuous reliability improvement program must be implement

8. π_E: Environmental conditions and multiplying factors

$\pi_E = 1.0$ if the operating environment is grounded, fixed and controlled

$\pi_E = 2.0$ if the operating environment is grounded, fixed and uncontrolled

$\pi_E = 6.0$ if the operating environment is grounded and mobile.

Note: Although notebook PC is portable or mobile, but while operating, fixed environment is supposed.