TAIT Technical Support

TECHNICAL NOTE

TECHNICAL NOTE TN-989d

MTBF Figures for Tait Products

17 October 2006

Applicability

This Technical Notes applies to the following product types that have had MTBF figures calculated for them:
- T700, T2000, TM8000 and TM9100 Mobiles
- T3000, Tait Orca 'E' Series, Tait Orca 5000 and TP9100 Handportables
- T800, TB7100, TB8000 and TB9100 Infrastructure Modules
- TaitNet Network Equipment

1.   Introduction

What is MTBF?

Literally means "Mean Time Between Failure". Defined as the average time (usually expressed in hours) that a component works without failure. It is calculated by dividing the total number of failures into the total number of operating hours observed. The term can also mean the length of time a user may reasonably expect a device or system to work before an incapacitating fault occurs.

The Calculation Method.

The MTBF figures for the offered radio equipment, both fixed and mobile are calculated according to the British Telecom "Handbook of Reliability Data for Components used in Telecommunications Systems" Iss.4 (HRD4).

The **temperature weighting factor**, πt, is used as specified in the above reference.

The **quality factor**, πq, is derived assuming a Quality Level 1, i.e. components manufactured and tested in accordance with generally accepted commercial practices; with no tests, inspection or screening beyond the component manufacturers normal quality control practices.

The **application environment factor**, πe, is assumed to be either ground benign ($\pi e = 1$), ground fixed ($\pi e = 1.5$) or mobile ($\pi e = 4$ or 8) depending on the intended use of the equipment.

Central control equipment is often situated in an environmentally friendly equipment room, which may often be air- conditioned and an application environment factor of 1 is appropriate.

Radio equipment may be installed on sites with various environmental conditions, a factor of either 1 or 1.5 may be appropriate.

Please note that all MTBF figures are intended as a guide only and that the actual performance of the equipment experienced in practice will differ from this due to a number of factors that are not accounted for in the prediction method.

The prediction method does not include any factor to account for the duty cycle under which the equipment is operated. The figures given assume the transmitters are operated at their maximum rated RF output power at their maximum duty cycle.

The prediction method also does not take into account the "soak testing" that takes place on completed systems before delivery.

NOTE   **This document is the culmination of all MTBF figures that have been used in tender responses by the CSO's and Tait Sales Teams over the last several years.**

2.   Tait Mobile Radio MTBF

T500 and T700   No known figures currently exist for these products

T2000

TYPE	Total Failure Rate (FITS) Failure in 10^9 Hours	MTBF (Hrs) in Ground Benign Controlled Environment Πe = 1 (Application Environment)	MTBF (Hrs) Ground Fixed Uncontrolled Environment Πe = 8 (Application Environment)
T2010-nnn-nnn	16,500 hrs	40,000 hrs (Tle = 1.5)	7,500 hrs
T2015-nnn-nnn	16,500 hrs	40,000 hrs (Tle = 1.5)	7,500 hrs
T2020-nnn-nnn	16,500 hrs	40,000 hrs (Tle = 1.5)	7,500 hrs
T2030-nnn-nnn	16,500 hrs	40,000 hrs (Tle = 1.5)	7,500 hrs
T2035-nnn-nnn			
T2040-nnn-nnn	20,300 hrs	32,500 hrs (Tle = 1.5)	6,100 hrs

TM8000 Series

TYPE	Total Failure Rate (FITS) Failure in 10^9 Hours	MTBF (Hrs) in Ground Stationary, Weather protected & Temperature Controlled. Πe = 1 (Application Environment)	MTBF (Hrs) Ground Mobile, protected installations Πe = 4 (Application Environment)	MTBF (Hrs) Ground Mobile (perHRD4) Πe = 8 (Application Environment)
TM8105	11565 hrs	86,465 hrs	21,616 hrs	10,808 hrs
TM8110	14348 hrs	69,696 hrs	17,424 hrs	8,712 hrs
TM8115	14348 hrs	69,696 hrs	17,424 hrs	8,712 hrs
TM8252	11481 hrs	87,101 hrs	21,775 hrs	10,888 hrs
TM8255	21718 hrs	46,044 hrs	11,511 hrs	5,755 hrs

TM8200 NOTE: Note that the control head contributes significantly to the reduced MTBF figure due to its relative complexity, and in particular that of the LCD. Using this data, the LCD contributes to around half of the expected total head failures. Please note that failure of an LCD pixel does not constitute a failure of the product to operate as a two-way radio.

TEL therefore urge extreme caution in releasing these numbers.

TM9000 Series
APCO Mobile

TYPE	Total Failure Rate (FITS) Failure in 10^9 Hours	MTBF (Hrs) in Ground Stationary, Weather protected & Temperature Controlled. Πe = 1 (Application Environment)	MTBF (Hrs) Ground Mobile, protected installations Πe = 4 (Application Environment)	MTBF (Hrs) Ground Mobile (perHRD4) Πe = 8 (Application Environment)
TM9155	21718 hrs	46,044 hrs	11,511 hrs	5,755 hrs

Note: The heated LCD has not been accounted for in these calculations.

3.   Tait Infrastructure Product MTBF

TYPE	Total Failure Rate (FITS) Failure in 10^9 Hours	MTBF (Hrs) in Ground Benign Controlled Environment Πe = 1(Application Environment)	MTBF (Hrs) Ground Fixed Uncontrolled Environment Πe = 1.5 (Application Environment)
T825-nn-nnnn	9,450	105,800	70,500
T826-nn-nnnn	9,750	102,500	68,300
T827-nn-nnnn	9,400	106,300	70,900
T828-nn-nnnn	3,300	303,000	202,000
T835-nn-nnnn	9,450	105,800	70,500
T836-nn-nnnn	9,750	102,500	68,300
T837-nn-nnnn	9,400	106,300	70,900
T838-nn-nnnn	4,510	221,700	147,800
T839-nn-nnnn	6,400	156,200	104,100
T855-nn-nnnn	9,450	105,800	70,500
T856-nn-nnnn	9,750	102,500	68,300
T857-nn-nnnn	9,400	106,300	70,900
T858-nn-nnnn	3,900	256,400	171,000
T859-nn-nnnn	5,510	181,400	120,900
T807-10-0000	4,600	217,000	145,000
T800-23-0011			
T801-00	6,900	144,900	96,600
T801-1n	6,900	144,900	96,600
T805-01	12,000	83,300	55,500
T805-02	12,000	83,300	55,500
T805-03	12,000	83,300	55,500
T805-04	4,900	204,000	136,000
T805-06	12,000	83,300	55,500
T803-00-0000	5220	190,000	126,600
TA087-02-0000	5,221	191,500	127,000
TA136-02-0000	5,050	198,000	132,000
TA703-01-000n	8,500	117,000	78,000

T800 MTBF (cont)   Third party products

TYPE	Total Failure Rate (FITS) Failure in 10^9 Hours	MTBF (Hrs) in Ground Benign Controlled Environment Πe = 1(Application Environment)	MTBF (Hrs) Ground Fixed Uncontrolled Environment Πe = 1.5 (Application Environment)
DC/DC Converter PV12i (24/12V)			162 Years (HRD4)
DC/DC Converter PV24i (24/12V)			162 Years (HRD4)
HC100			157,700 (manufacturers est)
HC250			78,900 (manufacturers est)
OCXO (HCD660SC)		1,000,000(Calc MIL 217C iss E	
TS4013	11,000		91,000 (Πe = 8)
TS4014	10,976		91,000 (Πe = 8)
TS5042	9,896		101,000 (Tle = 8)
TS5043	10,256		97,500 (Tle = 8)

Please Note:

- The above figures for T800 equipment were calculated for the VHF T830 series. They are also considered to be applicable to the VHF T820 and UHF T850 series as the component counts and component types are essentially the same
- The figures exclude the cooling fans. The fans used on the 100W power amplifiers are quoted by the supplier as having MTBF 70,000 hours at 40degC . The fan used in the T808 is also quoted by its supplier at the same figure.

TB8000 Series

The following data has been calculated from units running in the field.

The complete system (rack) has an MTBF of **>= 50000 hours**.

Individual modules have the following MTBF:
Reciter: **120,000 hours**.
PA: **225,000 hours**.
PMU: **135,000 hours**.

TB7100 Series

The TB7100 series of base station has been given an estimated MTBF value of **>20,000 hours**. Field failure data analysed to date has shown the performance is much greater than this.

4.   Tait Hand Portable Radio MTBF

T3000 Series

TYPE	Total Failure Rate (FITS) Failure in 10^9 Hours	MTBF (Hrs) in Ground Benign Controlled Environment Πe = 1(Application Environment)	MTBF (Hrs) Ground Fixed Uncontrolled Environment Πe = 8 (Application Environment)
T3010-XXXX-XXX	14,400		8700

Tait Orca 'E' Series

TYPE	Total Failure Rate (FITS) Failure in 10^9 Hours	MTBF (Hrs) in Ground Benign Controlled Environment Πe = 1(Application Environment)	MTBF (Hrs) Ground Fixed Uncontrolled Environment Πe = 2.5 (Application Environment)
TOP-H2110 (PCB rev 1)	95850		10433

Tait Orca 5000 Series

TYPE	Total Failure Rate (FITS) Failure in 10^9 Hours	MTBF (Hrs) in Ground Benign Controlled Environment Πe = 1	MTBF (Hrs) Ground Fixed Uncontrolled Environment Πe = 2.5
TOP-H2610-T0 (PCB rev 13)	57104		17512

TP9100 APCO Portables

TYPE	Total Failure Rate (FITS) Failure in 10^9 Hours	MTBF (Hrs) Stationary use at weather protected and temperature controlled locations Πe = 1	MTBF (Hrs) Portable and non-stationary use at temperature controlled locations Πe = 2	MTBF (Hrs) Portable and non-stationary use at partly weather and non weather protected locations Πe = 2.5
TP9155 (4 key)	18639	53651	26825	21460
TP9155 (4 key) Up to 15% LCD Pixel Failure[1]	17482	57202	28601	22881
TP9155 (4 key) Full LCD failure[2]	10925	91533	45767	36613
TP9160 (16 key)	19839	50406	25203	20162
TP9160 (16 key) Up to 15% LCD Pixel Failure	18682	53527	26764	21411
TP9160 (16 key) Full LCD failure	12125	82474	41237	23990

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[1] The HRD5 method counts each of the 5952 LCD pixels as potential failure candidates. A few pixel failures are not deemed critical to the radio operation so a "derated" figure is supplied to indicate the MTBF when up to 15% of pixel failures are allowed

[2] LCD module excluded from calculations to illustrate its effect on MTBF

5.   Tait Network Product MTBF

Liberty Trunked System Components

Model Number *(where applicable)*	MTBF (Hrs)
Channel Management Module (CMM)	Greater than 25,000
Site Management Module (SMM)	Greater than 25,000
Network Management Module (NMM)	Greater than 25,000
2W PSTN Card	Greater than 25,000

T1541 Trunked System Components

Model Number *(where applicable)*	MTBF (Hrs)
T1511-00 Channel Control Module (CCM)	Greater than 25,000
T1520-40 Site Control Unit (SCU)	Greater than 25,000
T1556-02 Modem inter site	Greater than 25,000
T1541-00 Node Computer	Greater than 25,000
T1561-15 Embedded Controller Card	Greater than 25,000
T1561-02 Audio I/O	Greater than 25,000
T1561-03 PSTN 2 wire E&M DTMF	Greater than 25,000
T1561-08 PSTN 4 wire E&M	Greater than 25,000
Channel Management Module (CCM)	Greater than 25,000
Site Management Module (SSM)	Greater than 25,000
Network Management Module (NMM)	Greater than 25,000

Please Note: These figures are based on actual field testing in various environments. Burn-in procedures are carried out on each module at the production stage and again as part of the pre-delivery testing.

Compliance Issues	MTBF figures are a subjective value sometimes required by RFP's / Tenders. They do not tie into governmental compliances or regulations.
CSO Instruction	Please use this document to respond to all tender responses requiring MTBF information. If you find the information lacking in anyway, please contact the author.

6. Issuing Authority

Name and Position of Issuing Officer	Barry Crates Technical Support Team Leader
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Document History

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Added TM8200 Information	2 April 2005	BLC
Added TP9100 and TM9100 information	14 June 2005	BLC
Added TB7100	28 July 2006	PH
Updated TB8100 MTBF	17 October 2006	JN