GET- 30105

MTF for NEC's Microwave Transistors

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1. Fig. 1 shows the relationship between life and junction temperature deducted from the results of the life tests.

From the data of Fig.1 , the following value can be expected as the life of the device under the same temperature as actual operating conditions(Tj=120℃).

The life(MTF) when 50 % of the parent body is faulty.

10^{10} hours.

The life when 0.3 % of the parent body is faulty.

10^{9} hours.

(The 3σ variation of like taken into condideration)

From the above results, it is clear that there is absolulely no problem exisiting concerning the life, in regards to thermal stress, of NEC microwave transistors.

2. On the other hand, devices which are operated at some current densities, have electro-migration of the electrodes as a prominent factor determining the device reliability.

The life of a metal film due to electro-migration is as follows:

$$MTF = 2.04 \times 10^{18} \frac{A \cdot \exp(0.61/KT)}{J^2}$$

Where

A : Cross Section of the metal film (cm^2)

K : Boltjman' s constant

T : Temperature of metal film (k)

J : Current density of metal film (A/cm^2)

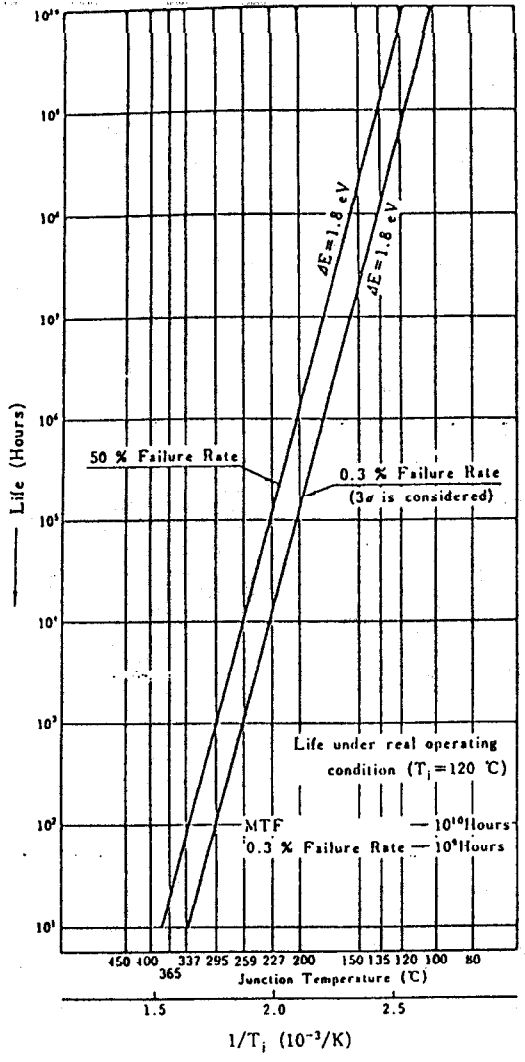
The above equation shows that the life of metal film due to electromigration is inversely proportional to the square of the current density and the temperature of the metal film.

MTF for gold film in NEC' s microware transistor as a function of current density, junction temperature and cross sectional dimensions are shown in Fig. 2.

From the above equation, MTF of each devices are calculated.

The results are shown Table. 1.

AS can be seen from the above calculations, under actual operating condititions NEC microwave transistors have a MTF of over 10^6 hours, as designed.


Life (Hours)
ΔE=1.8 eV
ΔE=1.8 eV
50 % Failure Rate
0.3 % Failure Rate
(3σ is considered)
Life under real operating condition (T_j=120 ℃)
MTF — 10^10 Hours
0.3 % Failure Rate — 10^8 Hours
450 400 365 337 295 259 227 200 150 135 120 100 80
Junction Temperature (℃)
1.5 2.0 2.5
1/T_j (10^-3/K)

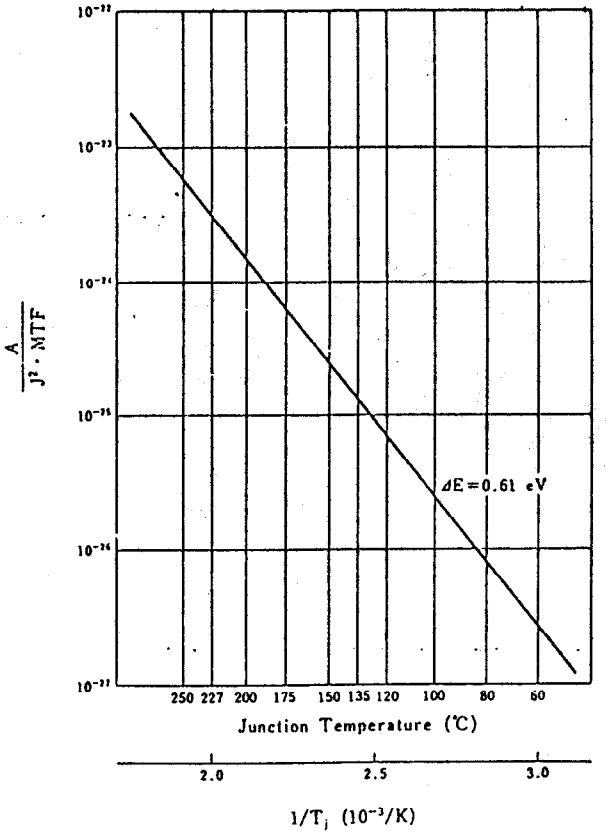

A / J^2 · MTF
ΔE=0.61 eV
250 227 200 175 150 135 120 100 80 60
Junction Temperature (℃)
2.0 2.5 3.0
1/T_j (10^-3/K)

Table. 1

	MTF (hours)
NE 02135	9.3×10^7
NE 33387	4.6×10^7
NE 41635	2.5×10^6
NE T3440B	1.4×10^7
NEX Z30165	3.5×10^6