

# 附 錄 一

## 各類電子零件之基本失效率對照表



**Table 7-1. Device Failure Rates (Sheet 1 of 16)**

Classes of Microprocessors and Their Relative Complexities					
Microprocessor		Internal Bus Width		Complexity	
Class A	(4004)		4-Bit	2,300	Transistors
Class B	(8085)				
Class C	(8086)			29,000	Transistors
Class D	(8088)		16-Bit	29,000	Transistors
Class 1	(80186)				
Class 2	(80286)		16-Bit	134,000	Transistors
Class 3	(80386)		32-Bit	275,000	Transistors
Class 4	(80486)		32-Bit	1.2 Million	Transistors
Class 5	(Pentium)		32-Bit	3.1 Million	Transistors
Class 6					
Class 7					

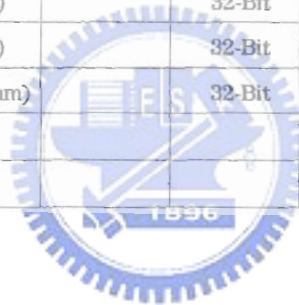


Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 2 of 16)

DEVICE TYPE	BIPOLAR		NMOS		CMOS		
	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tb1 7-7)	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tb1 7-7)	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tb1 7-7)	
<b>INTEGRATED CIRCUIT DIGITAL</b>							
Range	Nominal						
1-20 GATES <sup>c</sup>	15	<b>21</b>	<b>6</b>	<b>27</b>	<b>8</b>	<b>10</b>	8
21-50	40	<b>22</b>	<b>6</b>	<b>29</b>	<b>8</b>	<b>10</b>	8
51-100	80	<b>23</b>	<b>6</b>	<b>30</b>	<b>8</b>	<b>10</b>	8
101-500	400	<b>29</b>	<b>6</b>	<b>39</b>	<b>8</b>	<b>11</b>	8
501-1000	800	<b>33</b>	<b>6</b>	<b>45</b>	<b>8</b>	<b>12</b>	8
1001-2000	1600	<b>39</b>	<b>6</b>	<b>52</b>	<b>8</b>	<b>13</b>	8
2001-3000	2500	<b>42</b>	<b>6</b>	<b>58</b>	<b>8</b>	<b>14</b>	8
3001-5000	4000	<b>47</b>	<b>6</b>	<b>65</b>	<b>8</b>	<b>14</b>	8
5001-7500	6500	<b>52</b>	<b>6</b>	<b>73</b>	<b>8</b>	<b>15</b>	8
7501-10000	9000	<b>56</b>	<b>6</b>	<b>79</b>	<b>8</b>	<b>16</b>	8
10001-15000	13000	<b>61</b>	<b>6</b>	<b>86</b>	<b>8</b>	<b>16</b>	8
15001-20000	18000	<b>65</b>	<b>6</b>	<b>93</b>	<b>8</b>	<b>17</b>	8
20001-30000	25000	<b>70</b>	<b>6</b>	<b>100</b>	<b>8</b>	<b>17</b>	8
30001-50000	40000	<b>77</b>	<b>6</b>	<b>110</b>	<b>8</b>	<b>18</b>	8
<b>MICROPROCESSORS<sup>d</sup></b>							
Range	Nominal						
1-20 GATES <sup>c</sup>	15	<b>10</b>	<b>6</b>	<b>31</b>	<b>8</b>	<b>10</b>	8
21-50	40	<b>11</b>	<b>6</b>	<b>33</b>	<b>8</b>	<b>10</b>	8
51-100	80	<b>11</b>	<b>6</b>	<b>35</b>	<b>8</b>	<b>10</b>	8
101-500	400	<b>14</b>	<b>6</b>	<b>50</b>	<b>8</b>	<b>11</b>	8
501-1000	800	<b>16</b>	<b>6</b>	<b>60</b>	<b>8</b>	<b>12</b>	8
1001-2000	1600	<b>19</b>	<b>6</b>	<b>75</b>	<b>8</b>	<b>13</b>	8
2001-3000	2500	<b>21</b>	<b>6</b>	<b>86</b>	<b>8</b>	<b>14</b>	8
3001-5000	4000	<b>24</b>	<b>6</b>	<b>100</b>	<b>8</b>	<b>14</b>	8
5001-7500	6500	<b>26</b>	<b>6</b>	<b>117</b>	<b>8</b>	<b>15</b>	8
7501-10000	9000	<b>28</b>	<b>6</b>	<b>130</b>	<b>8</b>	<b>16</b>	8
10001-15000	13000	<b>31</b>	<b>6</b>	<b>147</b>	<b>8</b>	<b>16</b>	8
15001-20000	18000	<b>33</b>	<b>6</b>	<b>164</b>	<b>8</b>	<b>17</b>	8
20001-30000	25000	<b>36</b>	<b>6</b>	<b>183</b>	<b>8</b>	<b>17</b>	8
30001-50000	40000	<b>40</b>	<b>6</b>	<b>213</b>	<b>8</b>	<b>18</b>	8

- Table values that are changed for this issue are in **boldface**. Note that all **Integrated Circuit failure rates** in Table 7-1 are reported at Quality Level II and separate Quality Factors are to be applied to distinguish hermetic and non-hermetic (see Table 7-4). The base failure rates given in Table 7-1 apply to both conventional (through-hole) and surface mount technology (see Section 6.6).
- Failures in  $10^9$  hours.
- The number of **gates is equal to the number of logical gates on the device schematic**.
- It includes **associated peripheral circuits**.

**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 3 of 16)**

DEVICE TYPE		FAILURE RATE <sup>b</sup> (Tbl 7-7)	
<b>INTEGRATED CIRCUITS ANALOG</b>			
<b>Range</b>	<b>Nominal</b>		
1-32 Transistors	20 Transistors	19	9
<b>33-90</b>	<b>70</b>	<b>33</b>	9
91-170	150	46	9
<b>171-260</b>	<b>200</b>	<b>52</b>	9
261-360	300	62	9
361-470	450	74	9
471-590	550	81	9
591-720	700	90	9
721-860	800	95	9
<b>HYBRID MICROCIRCUIT</b>		See Table 7-2	

- a. Table values that are changed for this issue are in **boldface**. Note that all Integrated Circuit failure rates in Table 7-1 are reported at Quality Level II (see Table 7-4). The base failure rates given in Table 7-1 apply to both conventional (through-hole) and surface mount technology (see Section 6.6).
- b. Failures in  $10^9$  hours.

**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 4 of 16)**

DEVICE TYPE	BIPOLAR		NMOS		CMOS		
	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	
<b>RANDOM ACCESS MEMORY</b>	<b>STATIC</b>		<b>STATIC</b>		<b>STATIC</b>		
<b>Range</b>	<b>Nominal</b>						
1-320 BITS	256 BITS	<b>19</b>	<b>7</b>	<b>15</b>	<b>9</b>	<b>12</b>	<b>9</b>
321-576	512 BITS	<b>22</b>	<b>7</b>	<b>17</b>	<b>9</b>	<b>13</b>	<b>9</b>
577-1120	1K <sup>c</sup>	<b>27</b>	<b>7</b>	<b>20</b>	<b>9</b>	<b>15</b>	<b>9</b>
1121-2240	2K	<b>34</b>	<b>7</b>	<b>24</b>	<b>9</b>	<b>17</b>	<b>9</b>
2241-5000	4K	<b>43</b>	<b>6</b>	<b>30</b>	<b>9</b>	<b>19</b>	<b>9</b>
5001-11000	8K	<b>55</b>	<b>6</b>	<b>37</b>	<b>9</b>	<b>22</b>	<b>9</b>
11001-17000	16K	<b>71</b>	<b>6</b>	<b>45</b>	<b>9</b>	<b>25</b>	<b>9</b>
17001-38000	32K	<b>92</b>	<b>6</b>	<b>57</b>	<b>9</b>	<b>29</b>	<b>9</b>
38001-74000	64K	<b>119</b>	<b>6</b>	<b>71</b>	<b>8</b>	<b>34</b>	<b>8</b>
74001-150,000	128K	<b>155</b>	<b>6</b>	<b>88</b>	<b>8</b>	<b>39</b>	<b>8</b>
150,001-300,000	256K	<b>201</b>	<b>6</b>	<b>110</b>	<b>8</b>	<b>45</b>	<b>8</b>
300,001-600,000	512K	<b>261</b>	<b>6</b>	<b>138</b>	<b>8</b>	<b>52</b>	<b>8</b>
600,001-1,200,000	1024K	<b>339</b>	<b>6</b>	<b>172</b>	<b>8</b>	<b>60</b>	<b>8</b>
1,200,001-2,400,000	2048K	<b>441</b>	<b>6</b>	<b>215</b>	<b>8</b>	<b>69</b>	<b>8</b>
2,400,001-4,800,000	4096K	<b>573</b>	<b>6</b>	<b>268</b>	<b>8</b>	<b>80</b>	<b>8</b>
4,800,001-9,600,000	8192K					<b>93</b>	<b>8</b>
9,600,001-19,200,000	16383K					<b>107</b>	<b>8</b>
<b>Range</b>	<b>Nominal</b>	<b>DYNAMIC</b>		<b>DYNAMIC</b>			
1-320 BITS	256 BITS			<b>14</b>	<b>9</b>	<b>14</b>	<b>9</b>
321-576	512 BITS			<b>14</b>	<b>9</b>	<b>14</b>	<b>9</b>
577-1120	1K			<b>15</b>	<b>9</b>	<b>15</b>	<b>9</b>
1121-2240	2K			<b>16</b>	<b>9</b>	<b>16</b>	<b>9</b>
2241-5000	4K			<b>17</b>	<b>9</b>	<b>17</b>	<b>9</b>
5001-11000	8K			<b>19</b>	<b>9</b>	<b>19</b>	<b>9</b>
1101-17000	16K			<b>20</b>	<b>9</b>	<b>20</b>	<b>9</b>
17001-38000	32K			<b>22</b>	<b>9</b>	<b>22</b>	<b>9</b>
38001-74000	64K			<b>23</b>	<b>8</b>	<b>23</b>	<b>8</b>
74001-150,000	128K			<b>25</b>	<b>8</b>	<b>25</b>	<b>8</b>
150,001-300,000	256K			<b>27</b>	<b>8</b>	<b>27</b>	<b>8</b>
300,001-600,000	512K			<b>30</b>	<b>8</b>	<b>30</b>	<b>8</b>
600,001-1,200,000	1024K			<b>32</b>	<b>8</b>	<b>32</b>	<b>8</b>
1,200,001-2,400,000	2048K			<b>34</b>	<b>8</b>	<b>34</b>	<b>8</b>
2,400,001-4,800,000	4096K			<b>37</b>	<b>8</b>	<b>37</b>	<b>8</b>
4,800,001-9,600,000	8192K			<b>40</b>	<b>8</b>	<b>40</b>	<b>8</b>
9,600,001-19,200,000	16383K			<b>43</b>	<b>8</b>	<b>43</b>	<b>8</b>
19,200,001-38,400,000	32768K			<b>47</b>	<b>8</b>	<b>47</b>	<b>8</b>

- a. Table values that are changed for this issue are in **boldface**. Note that all Integrated Circuit failure rates in Table 7-1 are reported at Quality Level II and separate Quality Factors are to be applied to distinguish hermetic and non-hermetic (see Table 7-4).
- b. Failures in 10<sup>9</sup> hours.
- c. K equals 1024 BITS.

**Table 7-1. Device Failure Rates (Sheet 5 of 16 )**

<b>GATE ARRAYS, PROGRAM ARRAY LOGIC (PAL)</b>
<ol style="list-style-type: none"><li>1. Determine the number of gates being used for the digital portion of the circuit.</li><li>2. Determine the number of transistors being used for the analog portion of the circuit (if any).</li><li>3. Look up the base failure rates for a digital IC and linear device using the number of gates and transistors determined in Steps 1 and 2.</li><li>4. Sum the failure rates determined in Step 3.</li></ol>
Temperature stress curve: the curve listed for a digital IC with the number of gates determined in Step 1.





Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 6 of 16)

DEVICE TYPE	BIPOLAR		NMOS		CMOS	
	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)
<b>ROMS, PROMS, EPROMS<sup>c</sup></b>						
<b>Range</b>	<b>Nominal</b>					
1-320 BITS	256 BITS	<b>5</b>	<b>6</b>	<b>10</b>	<b>9</b>	<b>9</b>
321-576	512 BITS	<b>6</b>	<b>6</b>	<b>11</b>	<b>9</b>	<b>10</b>
577-1120	1K <sup>d</sup>	<b>7</b>	<b>6</b>	<b>12</b>	<b>9</b>	<b>11</b>
1121-2240	2K	<b>10</b>	<b>6</b>	<b>14</b>	<b>9</b>	<b>12</b>
2241-5000	4K	<b>15</b>	<b>6</b>	<b>16</b>	<b>9</b>	<b>15</b>
5001-11000	8K	<b>24</b>	<b>6</b>	<b>19</b>	<b>9</b>	<b>17</b>
11001-17000	16K	<b>41</b>	<b>6</b>	<b>23</b>	<b>9</b>	<b>20</b>
17001-38000	32K	<b>69</b>	<b>6</b>	<b>27</b>	<b>9</b>	<b>23</b>
38001-74000	64K	<b>119</b>	<b>6</b>	<b>32</b>	<b>10</b>	<b>28</b>
74001-150,000	128K	<b>207</b>	<b>6</b>	<b>38</b>	<b>10</b>	<b>33</b>
150,001-300,000	256K	<b>360</b>	<b>6</b>	<b>45</b>	<b>10</b>	<b>38</b>
300,001-600,000	512K	<b>628</b>	<b>6</b>	<b>53</b>	<b>10</b>	<b>45</b>
600,001-1,200,000	1024K	<b>1096</b>	<b>6</b>	<b>63</b>	<b>10</b>	<b>53</b>
1,200,001-2,400,000	2048K	<b>1912</b>	<b>6</b>	<b>75</b>	<b>10</b>	<b>63</b>
2,400,001-4,800,000	4096K	<b>3388</b>	<b>6</b>	<b>89</b>	<b>10</b>	<b>74</b>
4,800,001-9,600,000	8192K					<b>87</b>
9,600,001-19,200,000	16383K					<b>103</b>

- a. Table values that are changed for this issue are in boldface. Note that all Integrated Circuit failure rates in Table 7-1 are reported at Quality Level II and separate Quality Factors are to be applied to distinguish hermetic and non-hermetic (see Table 7-4).
- b. Failures in 10<sup>9</sup> hours.
- c. Includes electrically erasable 11-1nd flash versions.
- d. K equals 1024 BITS.

**Table 7-1. Device Failure Rates (Sheet 7 of 16)**

Device Type	Model
<b>Digital IC</b>	
Bipolar	$\lambda = 7.45 (G + 100)^{0.221}$
NMOS	$\lambda = 8.56 (G + 100)^{0.243}$
CMOS	$\lambda = \mathbf{5.97} (G + 100)^{0.105}$
<b>Microprocessors*</b>	
Bipolar	$\lambda = 3.33 (G + 100)^{0.235}$
NMOS	$\lambda = \mathbf{6.32} (G + 100)^{0.332}$
CMOS	$\lambda = \mathbf{5.97} (G + 100)^{0.105}$
<b>Static RAM</b>	
Bipolar	$\lambda = 24.68 (B + 0.25)^{0.378}$
NMOS	$\lambda = 18.58 (B + 0.25)^{0.321}$
CMOS	$\lambda = \mathbf{14.00} (B + 0.25)^{0.210}$
<b>Dynamic RAM</b>	
NMOS	$\lambda = 14.79 (B + 0.25)^{0.111}$
CMOS	$\lambda = 14.79 (B + 0.25)^{0.111}$
<b>ROM/PROM/EPROM</b>	
Bipolar	$\lambda = 4.16 (B + 1)^{0.804}$
NMOS	$\lambda = \mathbf{11.35} (B + 0.25)^{0.248}$
CMOS	$\lambda = \mathbf{10.31} (B + 0.25)^{0.237}$
<b>Analog IC</b>	
	$\lambda = 5.03 (T)^{0.440}$
where	$\lambda$ = failure rate in FITS G = number of gates B = number of kilobits T = number of transistors
* The failure rate of a microcontroller is estimated by summing up the failure of the microprocessor and the Random Access Memory (RAM) it contends.	



**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 8 of 16)**

DEVICE TYPE	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	NOTES
<b>OPTO-ELECTRONIC DEVICES</b>			
<b>FIBER OPTIC LASER MODULE</b>			
Uncontrolled Environments	<b>1500</b>	7	See Note A below
Controlled Environments	<b>1000</b>	7	See Note A below
<b>FIBER OPTIC LED MODULE</b>			
Uncontrolled Environments	<b>1100</b>	8	See Note A below
Controlled Environments	<b>240</b>	8	See Note A below
<b>FIBER OPTIC DETECTOR MODULE</b>			
Uncontrolled Environments	<b>1400</b>	10	See Note A below
Controlled Environments	<b>500</b>	10	See Note A below
<b>FIBER OPTIC COUPLER/SPLITTER</b>			
Uncontrolled Environments	<b>725</b>	5	See Note A below
Controlled Environments	<b>180</b>	5	See Note A below
<b>WDM (Passive)</b>			
Uncontrolled Environments	<b>1500</b>	5	See Note A below
Controlled Environments	<b>550</b>	5	See Note A below
OPTICAL ISOLATOR	<b>110</b>	10	See Note A below
OPTICAL FILTER	<b>1500</b>	5	See Note A below
<b>OTHER OPTICAL DEVICES</b>			
Single LED/LCD Display	<b>3</b>	10	
Phototransistor	<b>60</b>	10	
Photodiode	<b>15</b>	10	
<b>SINGLE ISOLATORS</b>			
Photodiode Detector	<b>10</b>	10	
Phototransistor Detector	<b>15</b>	10	
Light Sensitive Resistor	<b>20</b>	10	

**Note A:** In this document, a module is defined as a small packaged assembly that includes a laser diode/LED/detector and easy means for electrical connections and optical couplings. Only Quality Level III fiber-optic devices should be used for major network products. Only hermetic fiber-optic devices should be used for the laser modules, LED modules, and detector modules in major network products. The impact of Quality Level III is already incorporated in these failure rates. The environmental factor  $\pi_E=2.0$  should be used for the uncontrolled environments. Non-hermetic or lower quality parts are expected to have much higher failure rates than those predicted by using Table 7-4 device quality factors. If the module contains other electronic devices or hybrids (such as laser drive in the laser module and amplifiers in the detector module), additional failure rates should be added to the failure rates given here. Also, significant differences in failure rates of these devices are expected among different suppliers. Telcordia recommends that field data and/or laboratory data be used to support reliability predictions for these devices, and that additional questions be directed to the Physical Protection and Network Hardware Department in Telcordia.

- a. Table values in **boldface** are new or revised in this issue of the RPP.
- b. Failures in  $10^9$  hours.

**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 9 of 16)**

DEVICE TYPE	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	NOTES
<b>DUAL ISOLATORS</b>			
Photodiode Detector	20	<b>10</b>	
Phototransistor Detector	30	<b>10</b>	
Light Sensitive Resistor	40	<b>10</b>	
<b>ALPHA-NUMERIC DISPLAYS</b>			
1 Character	20	<b>10</b>	
1 Character w/Logic Chip	30	<b>10</b>	
2 Character	30	<b>10</b>	
2 Character w/Logic Chip	40	<b>10</b>	
3 Character	40	<b>10</b>	
3 Character w/Logic Chip	50	<b>10</b>	
4 Character	45	<b>10</b>	
5 Character	50	<b>10</b>	
6 Character	50	<b>10</b>	
7 Character	55	<b>10</b>	
8 Character	60	<b>10</b>	
9 Character	65	<b>10</b>	
10 Character	70	<b>10</b>	

- a. Table values in boldface are new or revised in this issue of the RPP.  
b. Failures in 10<sup>9</sup> hours.

Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 10 of 16)

DEVICE TYPE	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	ELEC STRESS (Tbl 7-6)	NOTES
<b>TRANSISTORS</b>				
<b>SILICON</b>				
<b>NPN</b>				
≤ 0.6 W	4	4	E,E <sup>c</sup>	
0.6-6.0 W	6	4	E,E <sup>c</sup>	
> 6.0 W	10	4	E,E <sup>c</sup>	
<b>PNP</b>				
≤ 0.6 W	4	4	E,E <sup>c</sup>	
0.6-6.0 W	6	4	E,E <sup>c</sup>	
> 6.0 W	10	4	E,E <sup>c</sup>	
<b>GERMANIUM</b>				
<b>NPN</b>				
≤ 0.6 W	60	4	E,E <sup>c</sup>	
0.6-6.0 W	90	4	E,E <sup>c</sup>	
> 6.0 W	150	4	E,E <sup>c</sup>	
<b>PNP</b>				
≤ 0.6 W	20	4	E	
0.6-6.0 W	30	4	E	
> 6.0 W	55	4	E	
<b>FIELD EFFECT</b>				
<b>Silicon</b>				
Linear	40	4	E	
Switch	20	4	E	
High Frequency	170	4	E	
<b>GaAs</b>				
Low Noise (≤ 100 mW)	100	4	E	
Driver (≤ 100 mW)	700	4	E	
<b>UNIJUNCTION</b>	<b>180</b>	4	E	
<b>MICROWAVE</b>				
Pulse Amplifier	1100	7	E	
Continuous Wave	2200	7	E	

- a. Table values in boldface are new or revised in this issue of the RPP.
- b. Failures in 10<sup>9</sup> hours.
- c. First curve is (P operate/P rated). Second curve is (V<sub>ceo</sub> operate/V<sub>ceo</sub> rated). When two stress curves apply, take the product of the two stress factors. For example, if a Silicon Transistor (NPN, 0.6-6.0W) is operated at P = 40% and V = 60%, the electric stress is 0.8 X 1.3 = 1.04.

**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 11 of 16)**

DEVICE TYPE	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	ELEC STRESS (Tbl 7-6)	NOTES
<b>DIODES</b>				
SILICON				
General Purpose				
< 1 AMP	<b>3</b>	4	<b>F,K<sup>c</sup></b>	
1 - 20 AMP	<b>6</b>	4	<b>F,K<sup>c</sup></b>	
> 20 AMP	<b>9</b>	4	<b>F,K<sup>c</sup></b>	
Microwave Detector	100	3	F	
Microwave Mixer	150	3	F	
GERMANIUM				
General Purpose				
< 1 AMP	<b>12</b>	8	<b>F,K<sup>c</sup></b>	
1 - 20 AMP	<b>30</b>	8	<b>F,K<sup>c</sup></b>	
> 20 AMP	<b>120</b>	8	<b>F,K<sup>c</sup></b>	
Microwave Detector	270	8	F	
Microwave Mixer	500	8	F	
VOLTAGE REGULATOR				
≤ 0.5 W	3	3	E	
0.6-1.5 W	6	3	E	
> 1.5 W	9	3	E	
THYRISTOR				
≤ 1 AMP	12	4	F	
> 1 AMP	25	4	F	
VARACTOR, STEP RECOVERY, TUNNEL				
	20	3	H	
VARISTOR, SILICON CARBIDE				
	10	3	C	
VARISTOR, METAL OXIDE				
	10	3	C	

- a. Table values in **boldface** are new or revised in this issue of the RPP.
- b. Failures in  $10^9$  hours.
- c. First curve is  $(I_{operate}/I_{rated})$ . Second curve is  $(V_r_{operate}/V_r_{rated})$ . When two stress curves apply, take the product of the two stress factors.

**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 12 of 16)**

DEVICE TYPE	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	ELEC STRESS (Tbl 7-6)	NOTES
<b>THERMISTOR</b>				
Bead	<b>4</b>	<b>7</b>		
Disk	<b>10</b>	<b>7</b>		
Rod	<b>15</b>	<b>7</b>		
Polymetric Positive Temp. Coefficient (PPTC) Device	<b>10</b>			
<b>RESISTORS, FIXED (including SMT)</b>				
<b>COMPOSITION</b>				
≤ 1 MEGOHM	<b>1</b>	<b>6</b>	<b>D</b>	
> 1 MEGOHM	<b>4</b>	<b>4</b>	<b>D</b>	
<b>FILM (Carbon, Oxide, Metal)</b>				
≤ 1 MEGOHM	<b>0.5</b>	<b>3</b>	<b>C</b>	
> 1 MEGOHM	<b>3</b>	<b>3</b>	<b>C</b>	
<b>FILM, POWER (&gt; 1W)<sup>c</sup></b>				
≤ 1 MEGOHM	<b>3</b>	<b>1</b>	<b>A</b>	
> 1 MEGOHM	<b>7</b>	<b>1</b>	<b>A</b>	
<b>WIREWOUND, ACCURATE</b>				
≤ 1 MEGOHM	<b>16</b>	<b>2</b>	<b>C</b>	
> 1 MEGOHM	<b>41</b>	<b>2</b>	<b>C</b>	
<b>WIREWOUND, POWER, LEAD MOUNTED</b>				
	<b>10</b>	<b>3</b>	<b>D</b>	
<b>WIREWOUND, POWER, CHASSIS MOUNTED</b>				
	<b>10</b>	<b>3</b>	<b>D</b>	

- a. Table values in **boldface** are new or revised in this issue of the RPP.
- b. Failures in 10<sup>9</sup> hours.
- c. This includes the failure rates for chip (Surface Mount Technology) that were listed separately in TR-NWT-000332, Issue 3, September 1990.



**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 13 of 16)**

DEVICE TYPE	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	ELEC STRESS (Tbl 7-6)	NOTES
<b>RESISTORS, VARIABLE</b>				
<b>NON-WIREWOUND</b>				
Film				
≤ 200K OHM	25	3	B	
> 200K OHM	40	3	B	
Low Precision, Carbon				
≤ 200K OHM	35	4	B	
> 200K OHM	50	4	B	
Precision				
≤ 200K OHM	25	4	A	
> 200K OHM	40	4	A	
Trimmer				
≤ 200K OHM	25	2	A	
> 200K OHM	40	2	A	
<b>WIREWOUND</b>				
High Power				
≤ 5K OHM	170	3	B	
> 5K OHM	240	3	B	
Leadscrew	25	3	C	
Precision				
≤ 100K OHM	200	3	A	
> 100K OHM	350	3	A	
Semi-Precision				
≤ 5K OHM	85	4	C	
> 5K OHM	120	4	C	
<b>RESISTORS, NETWORKS, DISCRETE ELEMENTS</b>	<b>1</b>	<b>6</b>		<b>Per Resistor</b>
<b>RESISTORS, NETWORKS, THICK OR THIN FILM</b>	<b>0.5</b>	<b>6</b>		<b>Per Resistor</b>

a. Table values in boldface are new or revised in this issue of the RPP.

b. Failures in 10<sup>9</sup> hours.



**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 14 of 16)**

DEVICE TYPE	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	ELEC STRESS (Tbl 7-6)	NOTES
<b>CAPACITORS, DISCRETE</b>				
<b>FIXED</b>				
Paper	10	2	J	
Paper/Plastic	10	2	J	
Plastic	1	3	J	
Mica	1	7	G	
Glass	1	7	G	
Ceramic <sup>c</sup>	1	1	H	
Tantalum, Solid, Hermetic <sup>c</sup>	1	3	J	
Tantalum, Solid, Non-Hermetic	5	3	J	
Tantalum, Nonsolid	7	3	G	
Aluminum, Axial Lead				
< 400 µf	15	7	E	
400 µf-12000 µf	25	7	E	
> 12000 µf	40	7	E	
Aluminum, Chassis Mounted				
< 400 µf	40	7	E	
400-12000 µf	75	7	E	
> 12000 µf	105	7	E	
<b>VARIABLE</b>				
Air, Trimmer	10	5	H	
Ceramic	8	3	J	
Piston, Glass	3	5	H	
Vacuum	25	2	I	
<b>CAPACITOR NETWORK</b>				<b>Sum Individual Capacitor Failure Rate</b>

- a. Table values in **boldface** are new or revised in this issue of the RPP.
- b. b.Failures in 10<sup>9</sup> hours.
- c. This includes the failure rates for chip (Surface Mount Technology) that was listed separately in TR-NWT-000332, Issue 3, September 1990.

**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 15 of 16)**

DEVICE TYPE	FAILURE RATE <sup>b</sup>	TEMP STRESS (Tbl 7-7)	ELEC STRESS (Tbl 7-6)	NOTES
<b>INDUCTIVE DEVICES</b>				
<b>TRANSFORMER</b>				
Pulse Low Level	4	3		
Pulse High Level	19	3		
Audio	7	3		
Power (> 1W)	19	3		
Radio Frequency	30	3		
<b>COIL</b>				
Load Coil	7	3		
Power Filter	19	3		
Radio Frequency, Fixed	0.5	3		
Radio Frequency, Variable	1	3		
<b>CONNECTORS</b>				
General Purpose, Power	5	7		Per Pin
Coaxial, Electric	0.5	7		
Coaxial, Optical	100	7		Per Pin
Multi-Pin	0.2	7		Per Pin
Printed Board, Edge	0.2	7		Per Pin
Ribbon Cable	0.2	7		Per Pin
IC Socket	0.2	7		Per Pin
<b>SWITCHES<sup>c</sup></b>				
Toggle or Pushbutton	10	7	C	Add 5 per Contact Pair
Rocker or Slide	10	7	C	Add 5 per Contact Pair
Rotary	15	7	C	Add 5 per Contact Pair
<b>RELAYS</b>				
General Purpose	70	3	C	
Contactors	270	3	C	
Latching	70	3	C	
Reed	50	3	C	
Thermal, Bimetal	50	3	C	
Mercury	50	3	C	
Solid State	25	3	C	
<b>ROTATING DEVICES<sup>d</sup></b>				
Blower Assembly	2000			
Blower Motor	500			
Fan Assembly < 6" Diameter	100			
Fan Motor < 1/3 HP	50			

- Table values in boldface are new or revised in this issue of the RPP.
- Failures in 10<sup>9</sup> hours.
- The number of contact pairs equals  $n \times m$ , where  $n$  equals the number of poles and  $m$  equals the number of throws. For example, a single pole double throw (SPDT) switch has  $1 \times 2 = 2$  contact pairs.
- These are limited life components. The steady-state rates given here apply during the useful life before unacceptable wearout.

**Table 7-1. Device Failure Rates<sup>a</sup> (Sheet 16 of 16)**

DEVICE TYPE	FAILURE RATE <sup>b</sup>	NOTES
<b>MISCELLANEOUS DEVICES</b>		
GYROSCOPE <sup>c</sup>	<b>50,000</b>	
VIBRATOR		
60 Hertz	15,000	
120 Hertz	20,000	
400 Hertz	40,000	
CERAMIC RESONATOR	25	
QUARTZ CRYSTAL	25	
CRYSTAL OSCILLATOR <sup>d</sup>		
Quartz Controlled	60	
Voltage Controlled	60	
CIRCUIT BREAKER		
Protection-Only Application (per pole)	170	per pole
Power On/Off Application (per pole)	1700	per pole
FUSE		
≤ 30A	0.5	
> 30A	1	
LAMP		
Neon	200	
Incandescent		
5V DC	1400	
12V DC	4200	
48V DC	4300	
METER	300	
HEATER (Crystal Oven) <sup>c</sup>	1000	
<b>MICROWAVE ELEMENTS</b>		
Coaxial and Waveguide		
Load	15	
Attenuator		
Fixed	10	
Variable	10	
Fixed Elements		
Directional Couplers	10	
Fixed Stubs	10	
Cavities	10	
Variable Elements		
Tuned Stubs	100	
Tuned Cavities	100	
Ferrite Devices (Transmit)	200	
Ferrite Devices (Receive)	100	
THERMO-ELECTRIC COOLER (< 2W)	500	
DELAY LINES	100	
<b>BATTERY</b>		
Nickel Cadmium	100	
Lithium	150	



- a. Table values in boldface are new or revised in this issue of the RPP.
- b. Failures in 10<sup>9</sup> hours.
- c. Originally derived from MIL-HDBK-271B, Table 2.13-1, revised September 1976.
- d. Crystal oscillators are temperature compensated.

## 附 錄 二

### 新產品開發客戶需求要項調查資料

附錄 2-1：新產品設計開發客戶需求要項調查表

附錄 2-2：新產品開發客戶需求要項調查評分統計



## 附錄 2-1：新產品設計開發客戶需求要項調查表

各位計畫負責人您好：

為了改善產品設計開發流程與找出您負責產品之設計開發重點工作項目，請您以過去與該產品客戶接觸的經驗與瞭解客戶需求的程度，以客戶的立場協助回答下列幾項問題，請分別從正向(如果我們能作到)與反向(如果我們未作到)的角度來評估客戶可能的滿意與不滿意的程度。

本調查主要目的是要嘗試找出客戶最重視的品質要項，調查資料純作為分析研究之用，不會影響各計畫目前作業程序的變更，煩請忠實反映與評分。

填表過程中如有不瞭解處與任何問題，請洽品保部余信超 ext:2073。

品保部 可靠度中心 敬上

Apr. 12, 2004

客戶需求要項	如果我們能作到					如果我們無法作到				
	非常滿意	很滿意	滿意	還好	普通	非常不滿意	很不滿意	不滿意	稍有不滿	普通
快速回映客戶的要求	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
符合產品性能規格要求	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
產品符合 CE, UL, FCC, ... 認證要求	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
開發低成本產品	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
產品開發時程能符合客戶要求	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
產品品質與可靠度符合要求	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
產品符合 RoHS 與 WEEE 環保要求	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
能協助客戶解決系統整合界面問題	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## 附錄2-2:新產品開發客戶需求要項調查評分統計

	A	B	C	D	E	F	G	平均	品質要素
正向(1)	3	2	2	2	2	2	3	2.3	當然品質
反向(1)	-5	-4	-4	-3	-4	-3	-5	-4.0	
正向(2)	3	3	2	3	2	2	2	2.4	
反向(2)	-5	-5	-5	-4	-5	-4	-5	-4.7	
正向(3)	2	2	3	1	2	2	1	1.9	
反向(3)	-5	-5	-5	-5	-5	-4	-5	-4.9	
正向(4)	3	3	4	4	3	4	4	3.6	一元品質
反向(4)	-3	-2	-3	-3	-2	-3	-3	-2.7	
正向(5)	5	5	5	4	5	5	4	4.7	
反向(5)	-5	-4	-4	-4	-5	-5	-4	-4.4	
正向(6)	5	4	5	4	5	5	5	4.7	
反向(6)	-5	-5	-5	-4	-5	-5	-5	-4.9	
正向(7)	5	5	4	4	5	5	5	4.7	魅力品質
反向(7)	-3	-2	-2	-1	-2	-2	-3	-2.1	
正向(8)	5	5	4	4	5	5	5	4.7	
反向(8)	-3	-2	-1	-1	-2	-2	-2	-1.9	

附註：正向(1) 如果我們能快速回映客戶的要求，客戶會滿意的程度  
 反向(1) 如果我們不能快速回映客戶的要求，客戶會不滿的程度  
 正向(2) 如果我們能符合產品性能規格要求，客戶會滿意的程度  
 反向(2) 如果我們不能符合產品性能規格要求，客戶會不滿的程度  
 正向(3) 如果產品能符合CE,UL,FCC,...認證要求,客戶會滿意的程度  
 反向(3) 如果產品不能符合CE,UL,FCC,...認證要求,客戶會不滿的程度  
 正向(4) 如果我們能開發低成本產品，客戶會滿意的程度  
 反向(4) 如果我們不能開發低成本產品，客戶會不滿的程度  
 正向(5) 如果產品開發時程能符合客戶要求，客戶會滿意的程度  
 反向(5) 如果產品開發時程不能符合客戶要求，客戶會不滿的程度  
 正向(6) 如果產品品質與可靠度能符合客戶要求，客戶會滿意的程度  
 反向(6) 如果產品品質與可靠度不能符合客戶要求，客戶會不滿的程度  
 正向(7) 如果產品能符合RoHS與WEEE環保要求,客戶會滿意的程度  
 反向(7) 如果產品不能符合RoHS與WEEE環保要求,客戶會不滿的程度  
 正向(8) 如果我們能協助客戶解決系統整合界面的問題，客戶會滿意的程度  
 反向(8) 如果我們不能協助客戶解決系統整合界面的問題，客戶會不滿的程度  
 代號A~G是指受調查的7位產品負責人



# 附 錄 三

## BUC 產品失效率分析報告

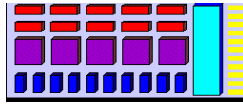
附錄 3-1：BUC 產品原型之失效率與 MTBF 分析結果

附錄 3-2：BUC 產品最終設計之失效率與 MTBF 分析結果



附錄3-1:BUC產品原型之失效率與MTBF分析結果

**Part Number** SK102  
**Reference Des**  
**Date** Jun 8, 2004  
**Environment** GF, GU - Ground Fixed,  
**Temperature** 30.00



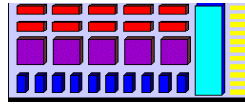
**Description** BUC  
**File Name** SK102-B.RPJ  
**Time** 3:40 PM  
**Failure Rate** 12,847.935805  
**MTBF** 77,834

Assembly Name	Part Number	Ref Des	Qty	Failure Rate	MTBF
BUC	SK102		1.00	12,847.935805	77,834



**Standard Reliability Prediction Report**

**Part Number** SK102  
**Reference Des**  
**Date** Jun 8, 2004  
**Environment** GF, GU - Ground Fixed,  
**Temperature** 30.00

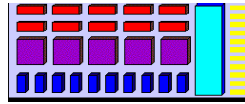


**Description** BUC  
**File Name** SK102-B.RPJ  
**Time** 3:40 PM  
**Failure Rate** 12,847.935805  
**MTBF** 77,834

Part Number	Category	Description	Failure Rate, Unit	Quantity	Failure Rate
1120-0012	Semiconductor	(ET)Transistor, GaAsFET,Out(4)-K-In(2)	949.069851	6.00	5,694.419107
1033-0008	Semiconductor	(E)TX BJT SBFP420M MCPH4NPN 25GHz	2,306.490539	2.00	4,612.981077
1030-0017	Semiconductor	(ET)Transistor, SwitchingMOSFET, 14A, 30V, .008R	696.370924	1.00	696.370924
1033-0032	Semiconductor	(ET)Transistor,Lo-PhaseNoise	491.947631	1.00	491.947631
1403-0002	Integrated Circuit	(ET)IC, Mixer,Fund.,DblBal., 9-15GHz	163.872379	1.00	163.872379
0451-0001	Capacitor	(T) Cap,AlumPolymer, 120uF-20%-10V Lo ESR .04ohm	65.954054	2.00	131.908108
1403-0003	Integrated Circuit	(ET)IC, Synth, PLL 6.5GHz	124.079795	1.00	124.079795
1032-0003	Semiconductor	(ET)Transistor, PNPBiPolar	9.169152	12.00	110.029819
1403-0001	Integrated Circuit	(ETH2A)IC,Microcontroller,OTP	82.682112	1.00	82.682112
0404-0034	Capacitor	(T) Cap,Cer,22uF-80%-10V Y5V 1210	5.422810	13.00	70.496535
1434-0240	Integrated Circuit	(E3)IC OP AMP LT1112S8SOIC 8P	67.378494	1.00	67.378494
0404-1442	Capacitor	(T)C CP X7R 1uF +/-10% 1 0V 0603	5.422810	11.00	59.650914
1437-0282	Integrated Circuit	(E3N)MMIC KU AMP FMM5059VF 7V VF 6P	55.434288	1.00	55.434288
1032-0002	Semiconductor	(ET)Transistor, NPNBiPolar	9.169504	6.00	55.017025
0404-0032	Capacitor	(T) Cap,Cer, 4.7uF-80%-50V Y5V 1210	2.027116	22.00	44.596557
1437-0002	Integrated Circuit	(ET)MMIC, Variable GainAmplifier, Dot is Pin 1	39.630020	1.00	39.630020
1282-0001	Semiconductor	(ET)Diode, VaractorHyperabrupt	33.679960	1.00	33.679960
0632-0006	Semiconductor	(E) IC, VoltageRegulator, Linear,3.0V	15.623160	2.00	31.246319
0404-0015	Capacitor	(T)CAP,Cer,.10uF-10%-16V X7R 0603	1.792505	16.00	28.680083
0200-0001	Resistor	(T)RES,0.0 ohm- 0603	1.268739	12.00	15.224869
0630-0004	Semiconductor	(EH3)IC Voltage Regulator Switching Moisture Sen	13.362076	1.00	13.362076
0200-0004	Resistor	(T)RES,10 ohm-1%-1W0603	1.268739	8.00	10.149913
0200-0048	Resistor	(T)R CP 0.1W 2.49K 1% 0603	0.699946	14.00	9.799242
0404-1261	Capacitor	(T)C CP X7R 0.01uF 10% 50V 0603	0.503027	16.00	8.048431
1264-0001	Semiconductor	(ET)Diode, SchottkyRectifier 5.5A, 40V	7.861839	1.00	7.861839
0630-0002	Semiconductor	(E)IC, Voltage Regulator , Linear, 5.0 V	7.695375	1.00	7.695375
0630-0025	Semiconductor	(E)DC/DC REG 1A -1.2/-37 V SOT-223 LM337IMP	7.234023	1.00	7.234023
0200-0023	Resistor	(T)R CP 0.1W 270 5% 0603	1.444876	5.00	7.224380
0200-0033	Resistor	(T)RES,10 Kohm-1%-1W0603	1.030479	7.00	7.213352
HN9002487-0137	Semiconductor	(E3T)DIODE , SWITCHING200mA	7.182125	1.00	7.182125
0207-0174	Semiconductor	(T)TVS 3000W 28V SMDJ28A	6.878596	1.00	6.878596
0200-0027	Resistor	(T)RES,1500 ohm-1%-.06W0402	0.676261	10.00	6.762608
1200-0004	Semiconductor	(ET)Diode, Zener, 15V	6.327992	1.00	6.327992
0200-0030	Resistor	(T)RES,4990ohm-1%-1W0603	0.725440	8.00	5.803523
0201-0013	Resistor	(T) Res, 200 ohm-1%-1W 0603	1.444876	4.00	5.779504
0200-0026	Resistor	(T)RES,1000ohm-1%-1W0603	0.663201	8.00	5.305612
1200-0006	Semiconductor	(ET)Diode, Zener, 8.2V	5.049974	1.00	5.049974
0404-1360	Capacitor	(T)C CP NPO 1pF +/- 0.25pF 50V 0402	0.356468	14.00	4.990548
0404-1308	Capacitor	(T) C CP COG 5.6pF +/-0.25pF 50V 0603	0.377528	12.00	4.530331
0202-1089	Resistor	(T)R CP 0.1W 300 +/-1% 0 402	0.676261	6.00	4.057565
0200-0010	Resistor	(T)RES,51.1 ohm-1%-1W0603	0.965628	4.00	3.862513
0202-0001	Resistor	(T)RES 0 1/16W TKF 5% 0402	1.268739	3.00	3.806217
0201-0522	Resistor	(T)R CP 1/10W 5.6K 5% 0603	0.697693	5.00	3.488464
0200-0014	Resistor	(T)RES,121ohm-1%-1W0603	0.679787	5.00	3.398933
0404-1325	Capacitor	(T) C CP X7R 0.01uF 10% 25V 0402	0.511345	6.00	3.068067
0201-0516	Resistor	(T)R CP 0.1W 240 5% 0603	1.444876	2.00	2.889752
0201-0491	Resistor	(T)R CP 0.1W 180 5% 0603	1.444876	2.00	2.889752
0200-0006	Resistor	(T)RES,20 ohm-1%-1W0603	0.662771	4.00	2.651082
0200-0049	Resistor	(T)R CP 0.1W 20K 1% 0603	0.826152	3.00	2.478456
0404-1419	Capacitor	(T) C CP, NPO, 1000pF,10%,50V,0402	0.494845	5.00	2.474223
1200-0007	Semiconductor	(E3T)D ZNR MMBZ5225B SOT-23 3.0V	2.394042	1.00	2.394042
1206-0101	Semiconductor	(ET)D MMBD7000LT1 SOT-23 100V	2.365485	1.00	2.365485
2651-0008	Inductor	(T) Inductor, 4.7nH+/-2nH, 0603	0.755902	3.00	2.267707
2651-0018	Inductor	(T) Inductor, 10nH-5%, Ceramic 0603	0.755902	3.00	2.267707
0200-0013	Resistor	(T)RES,100ohm-1%-1W0603	0.744549	3.00	2.233647

**Standard Reliability Prediction Report**

**Part Number** SK102  
**Reference Des**  
**Date** Jun 8, 2005  
**Environment** GF, GU - Ground Fixed,  
**Temperature** 30.00

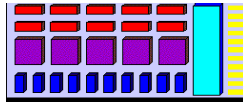


**Description** BUC  
**File Name** SK102-B.RPJ  
**Time** 3:40 PM  
**Failure Rate** 12,847.935805  
**MTBF** 77,834

Part Number	Category	Description	Failure Rate, Unit	Quantity	Failure Rate
0404-0004	Capacitor	(T)CAP,Cer,1.2pF+/-0.25pNPO 0402	2.165147	1.00	2.165147
0404-1521	Capacitor	(T)C CP X7R 3.9pF +/- 0.25pF 50V 0402	2.165147	1.00	2.165147
0404-1358	Capacitor	(T)C CP COG 5pF ±0.25pF 50V 0402	2.165147	1.00	2.165147
0201-1147	Resistor	(T)R CP 1/10W 17.8 1% 0402	0.676261	3.00	2.028782
0404-1308	Capacitor	(T) C CP COG 5.6pF +/-0.25pF 50V 0603	2.027116	1.00	2.027116
0404-1217	Capacitor	(T)C CP NPO 18pF 5% 50V 0603	2.027116	1.00	2.027116
0404-0397	Capacitor	(T)C CP X7R 0.1uF 20% 50V 0805	1.994689	1.00	1.994689
0404-1325	Capacitor	(T) C CP X7R 0.01uF 10% 25V 0402	0.907818	2.00	1.815635
2651-0003	Inductor	(T)Inductor, 47nH ±5%,603	0.755902	2.00	1.511805
2651-0021	Inductor	(T) Inductor, 150nH ±10%, 0603	0.755902	2.00	1.511805
0200-0019	Resistor	(T)RES,332ohm-1%-1W0603	0.688681	2.00	1.377363
0201-1128	Resistor	(T)R CP 1/10W 3.9K 1% 0603	0.679787	2.00	1.359573
0201-1145	Resistor	(T)R CP 1/10W 12.1ohm 1% 40*20	0.676261	2.00	1.352522
0202-1069	Resistor	(T)R CP 1/10W 180 1% 0402	0.676261	2.00	1.352522
0200-0022	Resistor	(T)RES,499ohm-1%-1W0603	0.671007	2.00	1.342013
0404-1385	Capacitor	(T) C CP COG 10PF +/- 5% 50V 0402	0.328404	4.00	1.313615
0404-1217	Capacitor	(T)C CP NPO 18pF 5% 50V 0603	0.328404	4.00	1.313615
0404-1260	Capacitor	(T)C CP COG 1.5pF +/-0.25pF 50V 0603	0.651283	2.00	1.302565
0201-1201	Resistor	(T)R CP 1/10W 10K +/-5% 0402	1.268739	1.00	1.268739
0202-1083	Resistor	(T)R CP 0.1W 1.2K +/-1% 0402	1.268739	1.00	1.268739
0202-1066	Resistor	(T)R CP 1/10W 27K +-5% 0 402	1.268739	1.00	1.268739
0200-0034	Resistor	(T)RES,15.8Kohm-1%-1W0603	1.268739	1.00	1.268739
0404-1261	Capacitor	(T)C CP X7R 0.01uF 10% 50V 0603	1.105269	1.00	1.105269
0201-1075	Resistor	(T)R CP 1/10W 680 5% 0603	0.815482	1.00	0.815482
2651-0419	Inductor	(T)L CP 2.2uH +/-20% SSL0402T-2R2M-S	0.801201	1.00	0.801201
2651-0016	Inductor	(T) Inductor, 33uH, Power, 20%, 3.0Amp	0.801201	1.00	0.801201
2651-0014	Inductor	(T) Inductor, 22uH,Power, 20%, 2.6A @60C	0.770810	1.00	0.770810
0404-1423	Capacitor	(T)C CP NPO 2.2pF +/-0.25pF 50V 0402	0.379079	2.00	0.758157
2651-0392	Inductor	(T)L CP 3.9nH +/-0.1nH 0402	0.755902	1.00	0.755902
2651-0393	Inductor	(T)L CP 4.7nH +/-0.1nH 0402	0.755902	1.00	0.755902
2651-0391	Inductor	(T)L CP 3.3nH +/-0.1nH 0402	0.755902	1.00	0.755902
2651-0022	Inductor	(T) Inductor, 2.2uH ±10%, 0603	0.755902	1.00	0.755902
2651-0023	Inductor	(T)L CP 8.2nH +/-0.2 nH0603	0.755902	1.00	0.755902
2651-0012	Inductor	(T) Inductor, 10uH-5%,SRF 60, Q 28, RDC 3.4 oh	0.755902	1.00	0.755902
0201-0494	Resistor	(T)R CP 1/10W 390 5% 0603	0.744549	1.00	0.744549
0201-1216	Resistor	(T)R CP 1/10W 68.1 1% 0402	0.718869	1.00	0.718869
0200-0025	Resistor	(T)RES,825ohm-1%-1W0603	0.699946	1.00	0.699946
0201-1180	Resistor	(T) R CP 1/10W 3.9K +/- 5% 0402	0.690474	1.00	0.690474
0201-1111	Resistor	(T)R CP 1/10W 4.3K 5%0603	0.688681	1.00	0.688681
0201-0860	Resistor	(TE)R CP 1W 0.1 1% 3264	0.685110	1.00	0.685110
0200-0029	Resistor	(T)R CP 1/10W 2.4K +/-1% 0603	0.679787	1.00	0.679787
0202-1070	Resistor	(T)R CP 1/10W 30 1% 0402	0.676261	1.00	0.676261
0200-0023	Resistor	(T)RES,562ohm-1%-1W0603	0.671007	1.00	0.671007
0201-0002	Resistor	(T)Res, Trim, 500 , 3mm, Sealed	0.671007	1.00	0.671007
0200-0003	Resistor	(T)Res,2.43 ohm-1%-1W0603	0.664064	1.00	0.664064
0201-0015	Resistor	(T) Res, 33.2 Kohm-1%-1W 0603	0.662512	1.00	0.662512
0404-0719	Capacitor	(T) C CP NPO 470pF 5% 50V 0603	0.317807	2.00	0.635614
0404-1431	Capacitor	(T)C CP NPO 0.5pF 0.25pF 25V 0402	0.455886	1.00	0.455886
0404-1439	Capacitor	(T)C CP NPO 22pF +/-5% 50V 0402	0.342148	1.00	0.342148
0404-1457	Capacitor	(T)C CP NPO 680pF 5% 50V 0603	0.342148	1.00	0.342148

附錄3-2:BUC產品最終設計之失效率與MTBF分析結果

**Part Number** SK102  
**Reference Des**  
**Date** July 16, 2004  
**Environment** GF, GU - Ground Fixed,  
**Temperature** 30.00



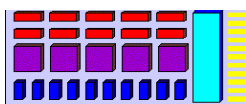
**Description** BUC  
**File Name** SK102-F.RPJ  
**Time** 5:25 PM  
**Failure Rate** 1,801.003062  
**MTBF** 555,246

Assembly Name	Part Number	Ref Des	Qty	Failure Rate	MTBF
BUC	SK102		1.00	1,801.003062	555,246



**Standard Reliability Prediction Report**

**Part Number** SK102  
**Reference Des**  
**Date** July 16, 2004  
**Environment** GF, GU - Ground Fixed,  
**Temperature** 30.00



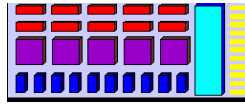
**Description** BUC  
**File Name** SK102-F.RPJ  
**Time** 5:25 PM  
**Failure Rate** 1,801.003062  
**MTBF** 555,246

Part Number	Category	Description	Failure Rate, Unit	Quantity	Failure Rate
1124-0040	Semiconductor	(ET)Transistor, GaAsFET,Out(4)-K-In(2)	128.716716	6.00	772.300296
1403-0002	Integrated Circuit	(ET)IC, Mixer,Fund.,DblBal., 9-15GHz	136.794331	1.00	136.794331
1403-0003	Integrated Circuit	(ET)IC, Synth, PLL 6.5GHz	107.317564	1.00	107.317564
1032-0003	Semiconductor	(ET)Transistor, PNPBiPolar	8.541111	12.00	102.493330
1403-0001	Integrated Circuit	(ETH2A)IC,Microcontroller,OTP	82.682112	1.00	82.682112
1434-0240	Integrated Circuit	(E3)IC OP AMP LT1112S8SOIC 8P	67.378494	1.00	67.378494
0451-0001	Capacitor	(T) Cap,AlumPolymer, 120uF-20%-10V Lo ESR .04ohm	62.839310	1.00	62.839310
1437-0282	Integrated Circuit	(E3N)MMIC KU AMP FMM5059VF 7V VF 6P	55.434288	1.00	55.434288
1032-0002	Semiconductor	(ET)Transistor, NPNBiPolar	8.541439	6.00	51.248636
1437-0002	Integrated Circuit	(ET)MMIC, Variable GainAmplifier, Dot is Pin 1	39.630020	1.00	39.630020
1282-0001	Semiconductor	(ET)Diode, VaractorHyperabrupt	33.679960	1.00	33.679960
1032-0026	Semiconductor	(TE)TX BJT SBFP420M MCPH4NPN 25GHz	11.342341	2.00	22.684683
1032-0004	Semiconductor	(ET)Transistor, SwitchingMOSFET, 14A, 30V, .008R	17.412366	1.00	17.412366
0200-0001	Resistor	(T)RES,0.0 ohm- 0603	1.268739	12.00	15.224869
0630-0004	Semiconductor	(EH3)IC Voltage Regulator Switching Moisture Sen	13.362076	1.00	13.362076
0200-0004	Resistor	(T)RES,10 ohm-1%-1W0603	1.268739	8.00	10.149913
0200-0048	Resistor	(T)R CP 0.1W 2.49K 1% 0603	0.679787	14.00	9.517012
1264-0001	Semiconductor	(ET)Diode, SchottkyRectifier 5.5A, 40V	7.861839	1.00	7.861839
0630-0025	Semiconductor	(E)DC/DC REG 1A -1.2/-37 V SOT-223 LM337IMP	7.662937	1.00	7.662937
0200-0023	Resistor	(T)R CP 0.1W 270 5% 0603	1.444876	5.00	7.224380
0200-0033	Resistor	(T)RES,10 Kohm-1%-1W0603	1.030479	7.00	7.213352
HN9002487-0137	Semiconductor	(E3T)DIODE , SWITCHING200mA	7.182125	1.00	7.182125
0207-0174	Semiconductor	(T)TVS 3000W 28V SMDJ28A	6.878596	1.00	6.878596
0200-0027	Resistor	(T)RES,1500 ohm-1%-06W0402	0.676261	10.00	6.762608
1200-0004	Semiconductor	(ET)Diode, Zener, 15V	6.327992	1.00	6.327992
0200-0030	Resistor	(T)RES,4990ohm-1%-1W0603	0.725440	8.00	5.803523
0201-0013	Resistor	(T) Res, 200 ohm-1%-1W 0603	1.444876	4.00	5.779504
0632-0006	Semiconductor	(E) IC, VoltageRegulator, Linear,3.0V	2.783216	2.00	5.566433
0404-0034	Capacitor	(T) Cap,Cer,22uF-80%-10V Y5V 1210	5.336064	1.00	5.336064
0404-1442	Capacitor	(T)C CP X7R 1uF +/-10% 1 0V 0603	5.336064	1.00	5.336064
0200-0026	Resistor	(T)RES,1000ohm-1%-1W0603	0.663201	8.00	5.305612
1200-0006	Semiconductor	(ET)Diode, Zener, 8.2V	5.049974	1.00	5.049974
1032-0001	Semiconductor	(ET)Transistor,Lo-PhaseNoise	4.459081	1.00	4.459081
0202-1089	Resistor	(T)R CP 0.1W 300 +/-1% 0 402	0.676261	6.00	4.057565
0200-0010	Resistor	(T)RES,51.1 ohm-1%-1W0603	0.965628	4.00	3.862513
0202-0001	Resistor	(T)RES 0 1/16W TKF 5% 0402	1.268739	3.00	3.806217
0201-0522	Resistor	(T)R CP 1/10W 5.6K 5% 0603	0.697693	5.00	3.488464
0200-0014	Resistor	(T)RES,121ohm-1%-1W0603	0.679787	5.00	3.398933
0630-0002	Semiconductor	(E)IC, Voltage Regulator , Linear, 5.0 V	3.108086	1.00	3.108086
0201-0516	Resistor	(T)R CP 0.1W 240 5% 0603	1.444876	2.00	2.889752
0201-0491	Resistor	(T)R CP 0.1W 180 5% 0603	1.444876	2.00	2.889752
0200-0006	Resistor	(T)RES,20 ohm-1%-1W0603	0.662771	4.00	2.651082
0200-0049	Resistor	(T)R CP 0.1W 20K 1% 0603	0.826152	3.00	2.478456
1200-0007	Semiconductor	(E3T)D ZNR MMBZ5225B SOT-23 3.0V	2.394042	1.00	2.394042
1206-0101	Semiconductor	(ET)D MMBD7000LT1 SOT-23 100V	2.365485	1.00	2.365485
2651-0018	Inductor	(T) Inductor, 10nH-5%, Ceramic 0603	0.755902	3.00	2.267707
2651-0008	Inductor	(T) Inductor, 4.7nH+/-2nH, 0603	0.755902	3.00	2.267707
0200-0013	Resistor	(T)RES,100ohm-1%-1W0603	0.744549	3.00	2.233647
0404-1521	Capacitor	(T)C CP X7R 3.9pF +/- 0.25pF 50V 0402	2.165147	1.00	2.165147
0404-1358	Capacitor	(T)C CP COG 5pF ±0.25pF 50V 0402	2.165147	1.00	2.165147
0404-0004	Capacitor	(T)CAP,Cer,1.2pF+/-0.25pNPO 0402	2.165147	1.00	2.165147
0201-1147	Resistor	(T)R CP 1/10W 17.8 1% 0402	0.676261	3.00	2.028782
0404-1217	Capacitor	(T)C CP NPO 18pF 5% 50V 0603	1.994689	1.00	1.994689
0404-1308	Capacitor	(T) C CP COG 5.6pF +/-0.25pF 50V 0603	1.994689	1.00	1.994689
0404-0032	Capacitor	(T) Cap,Cer, 4.7uF-80%-50V Y5V 1210	1.994689	1.00	1.994689



**Standard Reliability Prediction Report**

**Part Number** SK102  
**Reference Des**  
**Date** July 16, 2004  
**Environment** GF, GU - Ground Fixed,  
**Temperature** 30.00



**Description** BUC  
**File Name** SK102-F.RPJ  
**Time** 5:25 PM  
**Failure Rate** 1,801.003062  
**MTBF** 555,246

Part Number	Category	Description	Failure Rate, Unit	Quantity	Failure Rate
0404-0397	Capacitor	(T)C CP X7R 0.1uF 20% 50V 0805	1.994689	1.00	1.994689
0404-0015	Capacitor	(T)CAP,Cer.,.10uF-10%-16V X7R 0603	1.763831	1.00	1.763831
0200-0022	Resistor	(T)RES,499ohm-1%-.1W0603	0.774160	2.00	1.548320
2651-0003	Inductor	(T)Inductor, 47nH ±5%,603	0.755902	2.00	1.511805
2651-0021	Inductor	(T) Inductor, 150nH ±10%, 0603	0.755902	2.00	1.511805
0200-0019	Resistor	(T)RES,332ohm-1%-.1W0603	0.688681	2.00	1.377363
0201-1128	Resistor	(T)R CP 1/10W 3.9K 1% 0603	0.679787	2.00	1.359573
0201-1145	Resistor	(T)R CP 1/10W 12.1ohm 1% 40*20	0.676261	2.00	1.352522
0202-1069	Resistor	(T)R CP 1/10W 180 1% 0402	0.676261	2.00	1.352522
0202-1083	Resistor	(T)R CP 0.1W 1.2K +/-1% 0402	1.268739	1.00	1.268739
0200-0034	Resistor	(T)RES,15.8Kohm-1%-.1W0603	1.268739	1.00	1.268739
0202-1066	Resistor	(T)R CP 1/10W 27K +-5% 0 402	1.268739	1.00	1.268739
0201-1201	Resistor	(T)R CP 1/10W 10K +/-5% 0402	1.268739	1.00	1.268739
0404-1261	Capacitor	(T)C CP X7R 0.01uF 10% 50V 0603	1.105269	1.00	1.105269
0201-0860	Resistor	(TE)R CP 1W 0.1 1% 3264	0.923877	1.00	0.923877
0404-1325	Capacitor	(T) C CP X7R 0.01uF 10% 25V 0402	0.907818	1.00	0.907818
0201-1075	Resistor	(T)R CP 1/10W 680 5% 0603	0.815482	1.00	0.815482
2651-0016	Inductor	(T) Inductor, 33uH, Power, 20%, 3.0Amp	0.801201	1.00	0.801201
2651-0419	Inductor	(T)L CP 2.2uH +/-20% SSL0402T-2R2M-S	0.801201	1.00	0.801201
2651-0014	Inductor	(T) Inductor, 22uH,Power, 20%, 2.6A @60C	0.770810	1.00	0.770810
2651-0022	Inductor	(T) Inductor, 2.2uH ±10%, 0603	0.755902	1.00	0.755902
2651-0023	Inductor	(T)L CP 8.2nH +/-0.2 nH0603	0.755902	1.00	0.755902
2651-0012	Inductor	(T) Inductor, 10uH-5%,SRF 60, Q 28, RDC 3.4 oh	0.755902	1.00	0.755902
2651-0392	Inductor	(T)L CP 3.9nH +/-0.1nH 0402	0.755902	1.00	0.755902
2651-0391	Inductor	(T)L CP 3.3nH +/-0.1nH 0402	0.755902	1.00	0.755902
2651-0393	Inductor	(T)L CP 4.7nH +/-0.1nH 0402	0.755902	1.00	0.755902
0201-0494	Resistor	(T)R CP 1/10W 390 5% 0603	0.744549	1.00	0.744549
0201-1216	Resistor	(T)R CP 1/10W 68.1 1% 0402	0.718869	1.00	0.718869
0201-1180	Resistor	(T) R CP 1/10W 3.9K +/- 5% 0402	0.690474	1.00	0.690474
0201-1111	Resistor	(T)R CP 1/10W 4.3K 5%0603	0.688681	1.00	0.688681
0200-0025	Resistor	(T)RES,825ohm-1%-.1W0603	0.679787	1.00	0.679787
0200-0029	Resistor	(T)R CP 1/10W 2.4K +/-1% 0603	0.679787	1.00	0.679787
0202-1070	Resistor	(T)R CP 1/10W 30 1% 0402	0.676261	1.00	0.676261
0200-0023	Resistor	(T)RES,562ohm-1%-.1W0603	0.671007	1.00	0.671007
0200-0003	Resistor	(T)Res,2.43 ohm-1%-.1W0603	0.664064	1.00	0.664064
0201-0002	Resistor	(T)Res, Trim, 500 , 3mm, Sealed	0.663201	1.00	0.663201
0201-0015	Resistor	(T) Res, 33.2 Kohm-1%-.1W 0603	0.662512	1.00	0.662512
0404-1260	Capacitor	(T)C CP COG 1.5pF +/-0.25pF 50V 0603	0.651283	1.00	0.651283
0404-1325	Capacitor	(T) C CP X7R 0.01uF 10% 25V 0402	0.511345	1.00	0.511345
0404-1261	Capacitor	(T)C CP X7R 0.01uF 10% 50V 0603	0.503027	1.00	0.503027
0404-1419	Capacitor	(T) C CP, NPO, 1000pF,10%,50V,0402	0.494845	1.00	0.494845
0404-1431	Capacitor	(T)C CP NPO 0.5pF 0.25pF 25V 0402	0.455886	1.00	0.455886
0404-1423	Capacitor	(T)C CP NPO 2.2pF +/-0.25pF 50V 0402	0.379079	1.00	0.379079
0404-1308	Capacitor	(T) C CP COG 5.6pF +/-0.25pF 50V 0603	0.377528	1.00	0.377528
0404-1360	Capacitor	(T)C CP NPO 1pF +/- 0.25pF 50V 0402	0.356468	1.00	0.356468
0404-1457	Capacitor	(T)C CP NPO 680pF 5% 50V 0603	0.342148	1.00	0.342148
0404-1439	Capacitor	(T)C CP NPO 22pF +/-5% 50V 0402	0.342148	1.00	0.342148
0404-1217	Capacitor	(T)C CP NPO 18pF 5% 50V 0603	0.328404	1.00	0.328404
0404-1385	Capacitor	(T) C CP COG 10PF +/- 5% 50V 0402	0.328404	1.00	0.328404
0404-0719	Capacitor	(T) C CP NPO 470pF 5% 50V 0603	0.317807	1.00	0.317807

# 附 錄 四

## BUC 產品環境可靠度試驗規格

附錄 4-1：BUC 產品環境試驗流程

附錄 4-2：BUC 產品環境應力篩選測試規格

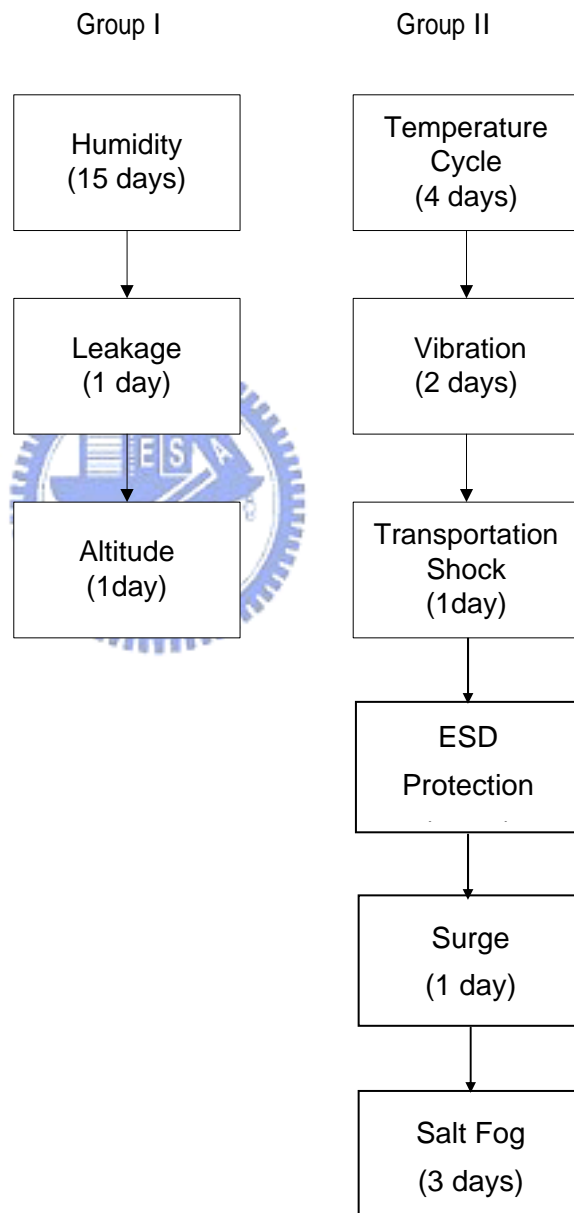
附錄 4-3：BUC 產品環境鑑定試驗規格

附錄 4-4：BUC 產品加速壽命試驗規格

附錄 4-5：BUC 產品環境試驗照片

## 附錄 4-1：BUC 產品環境試驗流程

### EQT Flow Chart for BUC



## 附錄4-2：BUC產品環境應力篩選測試規格

### ESS SPECIFICATIONS for BUC

#### 1. Temperature Cycling (ESS-TC)

- Temp. Range 1:  $-55^{\circ}\text{C}$  ~  $+85^{\circ}\text{C}$ , Non-operation
- Hi/Lo Dwell Time: 1 hr
- Cycle No.: 10 cycles
- Temp. Change Rate:  $10^{\circ}\text{C}/\text{min}$ .
- Function Test: before, & after
- Temp. Profile: see Figure A1.

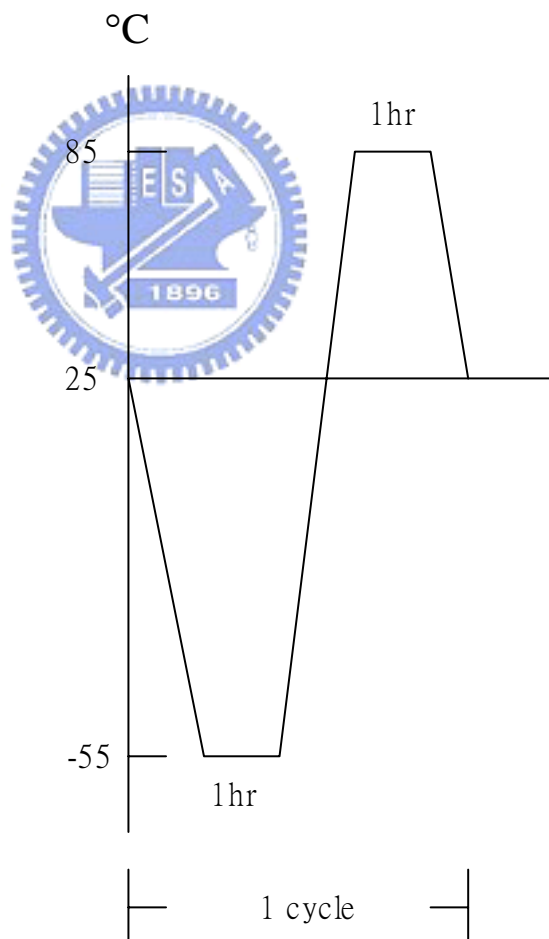


Figure A1. ESS-TC Profile

## 2. Random Vibration (ESS-RV)

- Vibration Level: 3.0Grms
- Duration: 10 min./axis, 3 axes, non-operation
- Function Test: before, & after
- Vibration Profile: see Figure A2.

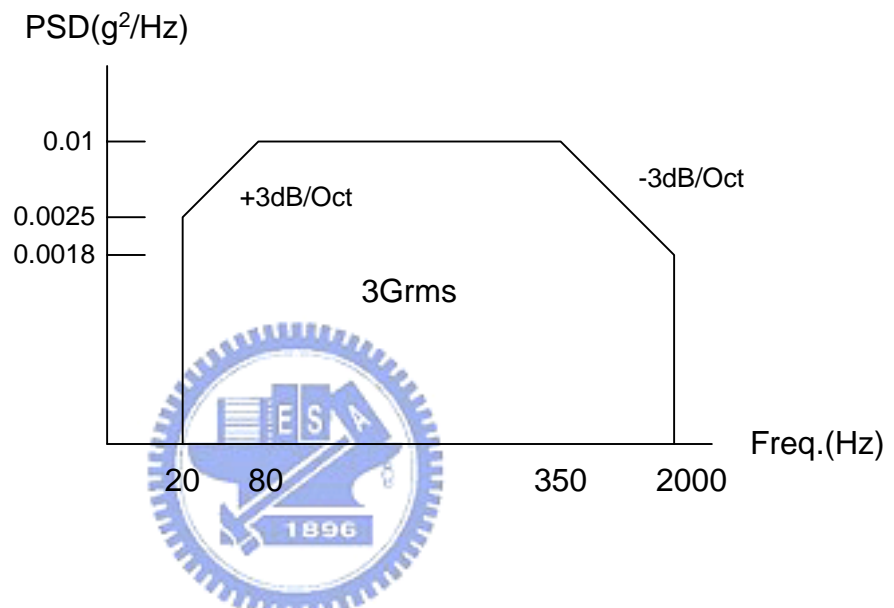


Figure A2. ESS-RV Profile

## 附錄4-3：BUC產品環境鑑定試驗規格

### EQT SPECIFICATIONS for BUC

#### 1. Temperature Cycling (EQT-TC)

- Temp. Range :  $-55^{\circ}\text{C}$  ~  $+85^{\circ}\text{C}$ , Non-operation
- Temp. Range :  $-40^{\circ}\text{C}$  ~  $+60^{\circ}\text{C}$ , Operation
- Humidity: Maximum 50% @RH
- Hi/Lo Dwell Time: 2 hrs
- Duration 1: 1st~9th cycle, Non-operation
- Duration 2: 10th cycle, Operation
- Total Cycle No.: 10 cycles
- Temp. Change Rate:  $10^{\circ}\text{C}/\text{min}$ .
- Function Test: before, during & after



#### 2. Humidity (EQT-HM)

- Humidity:  $93 \pm 2/3$  %R.H.
- Temperature:  $+40^{\circ}\text{C}$
- Duration: 10 days for Non-operation; 4 days for Operation with function test.
- Function Test: before, during & after



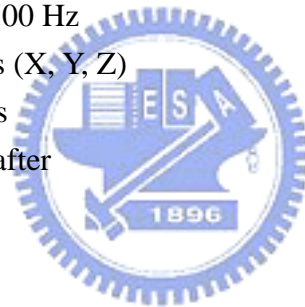
### 3. Vibration (EQT-VB)

#### 3-1 Vibration (according to Bellcore GR-63 4.4.3 Office Vibration)

- Frequency Range: 5 ~ 100 Hz, Operating
- Sweep Rate: 0.1 oct/min
- Acceleration: 1 m/s<sup>2</sup>
- Axes of Vibration: 3 axes
- Function Test: before, during & after

#### 3-2 Transportation Vibration (according to IEC 60068-2-64 Method Fh: Vibration)

- Acceleration Spectral Density: 1 m<sup>2</sup>/s<sup>3</sup>; -3 dB/oct
- Frequency Range: 5 ~ 20 Hz
- Frequency Range: 20 ~ 500 Hz
- Axes of Vibration: 3 axes (X, Y, Z)
- Duration: 30 min per axis
- Function Test: before & after



#### 4. Transportation Shock (EQT-TS) (according to ISTA Procedure 1A)

- Drop height: 61 cm
- Number of Shocks: 10 (1 corner, 3 edges, 6 faces) shocks.
- Function Test: before & after
- The container shall be without severe broken to cause product damage after test.

#### 5. Leakage (Immersion) (EQT-LK)

- Water Temp.:  $18 \pm 10$  °C
- Specimen Temp.:  $27 \pm 2$  °C above water temp.
- Depth of Immersion: 1 m
- Duration: 2 hrs
- Penetration Inspection: before & after.
- Function Test: before & after



## 6. Altitude (EQT-AL)

- Altitude: 4,500 m (Operating); 12,000 m (Non-operating)
- Altitude Change Rate:  $\leq 650$  m/min
- Temperature Change Rate:  $10$  °C/min.
- Dwell Time: 2hrs(Non-operation) & 3hrs(Operation), including 1 hr for functional test
- Function Test: before, during & after

## 7. Salt Fog (EQT-SF) (according to ASTM B117-97)

- Salt Solution: 5% by weight; pH=6.5~7.2 at  $35^{\circ}\text{C}$
- Chamber Temp. :  $35 +1.1/-1.7$  °C
- Exposure Period: 72 hrs
- Function Test: before & after
- Cosmetic Inspection: before & after



## 8. Surge (EQT-SG)

- Surge Waveform:  $1.2/50\mu\text{s} - 8/20\mu\text{s}$  (according to IEC 61000-4-5)
- Resistance of Generator:  $2\Omega$
- Test Level:  $\pm 4\text{kV}$  transient surge on shielding of coaxial cable and UUT should be grounded. See test configuration below.
- Number of test: 5 positive; 5 negative, total 10 surges.
- Time interval between surges: 60 seconds.
- Function Test: before & after

## 9. ESD Protection (EQT-ESD)

- Capacitor Source: 150 pF $\pm$ 10%
- Discharge Resistance: 330 ohms $\pm$ 5%
- Contact Discharge: +/-2; +/-4; +/- 8kV.
- Air Discharge: +/-2; +/-4; +/- 8; +/-15kV.
- Test point: Enclosure, connectors that can be touched during normal operation.
- Number of Discharge: 10 times for each test point.
- Test criteria: The specimen shall be without malfunction and failures during test.



## 附錄4-4：BUC產品加速壽命試驗規格

### ALT SPECIFICATIONS for BUC

#### 1. Accelerated Life Test (ALT)

MTBF = 180,000 hours = 5,555.0 FIT

1 FIT = 1 failure /  $1 \times 10^9$  hours

Samples size = 10 units

Defect # = 0

Test temperature = 70

Test time = 480 hours = 20 days



## 附錄 4-5：BUC 產品環境試驗照片



BUC 產品



振動試驗



溫度循環試驗



水密(浸水)試驗