



ATMEL CORPORATION

Tel:(408)441-0311

Fax:(408)436-4200

AT-27C1024 CMOS EPROM RELIABILITY DATA

-125°C OPERATING LIFE TEST

-200°C DATA RETENTION BAKE

-PROGRAM AND ERASE

-125°C OPERATING LIFE TEST (PLASTIC)

-150°C RETENTION BAKE (PLASTIC)

-15 PSIG PRESSURE POT

-85°C/85% RELATIVE HUMIDITY OPERATING LIFE TEST

* This report was generated from AT-27C1024 reliability testing. This data is applicable to the following device types due to same technology grouping as defined in MIL-M-38535 Appendix A:

AT-27C010

JANUARY 2005

2325 Orchard Parkway San Jose CA. 95131

AT-27C1024

125°C DYNAMIC OPERATING LIFE TEST

| <u>LOT NUMBER</u> | <u>DATE CODE</u> | <u>SAMPLE SIZE</u> | <u>TOTAL CKT-HRS (K)</u> | <u>NUMBER OF FAILURES</u> |
|-----------------------|----------------------|------------------------|------------------------------|-------------------------------|
| 81380 | 8C8840 | 77 | 77.0 | 0 |
| 83649 | 8C8847 | 76 | 76.0 | 0 |
| 83650 | 8C8848 | 100 | 100.0 | 0 |
| 00273 | 0B9029 | 77 | 77.0 | 0 |
| 00274 | 0B9029 | 77 | 77.0 | 0 |
| 133147-18 | 1D9147 | 74 | 222.0 | 0 |
| 232699-2 | 2C9239 | 78 | 78.0 | 0 |
| 232447 | 2C9237 | 76 | 76.0 | 0 |
| 234055 | 2D9307 | 62 | 62.0 | 0 |
| 3B0202 | 3B9323 | 80 | 80.0 | 0 |
| 3B0974C | 3B9332 | 80 | 80.0 | 0 |
| 3B0905 | 3B9331 | 78 | 78.0 | 0 |
| 3B0201A | 3B9339 | 53 | 53.0 | 0 |
| 4B1821 | 4B9433 | 96 | 96.0 | 0 |
| 4C2399 | 4C9447 | 92 | 92.0 | 0 |
| 4D2847 | 4D9509 | 54 | 54.0 | 0 |
| 6E1324 | 6E9616 | 81 | 81.0 | 0 |
| 0A2578 | 0A0015 | 100 | 100.0 | 0 |

FAILURE RATETOTAL DEVICE HOURS

1,638,000 DEVICE HOURS

BEST ESTIMATE $\lambda = 0.045\%$ PER 1,000 HOURS50°C AMBIENT

EXTRAPOLATION TO 50°C VIA
ARRHENNIUS EQUATION AND
ACTIVATION ENERGY OF 0.5eV
 $\lambda = 0.0015\%$ PER 1,000 HOURS (15
FITS)

CONFIDENCE ESTIMATE

λ 60 = 0.002% PER 1,000 HOURS
60% CONFIDENCE (20 FITS)
 λ 90 = 0.0051% PER 1,000 HOURS
90% CONFIDENCE (51 FITS)

AT-27C1024

200°C RETENTION BAKE

| <u>LOT NUMBER</u> | <u>DATE CODE</u> | <u>SAMPLE SIZE</u> | <u>HOURS TO FAILURE</u> | | |
|-----------------------|----------------------|------------------------|-------------------------|------------|------------|
| | | | <u>24</u> | <u>168</u> | <u>500</u> |
| <u>1000</u> | | | | | |
| 00274 | OB9029 | 77 | 0 | 0 | 0 |
| 0 | | | | | |
| 133147-18 | 1D9147 | 78 | 0 | 0 | 0 |
| 0 | | | | | |
| 3B0974C | 3B9332 | 79 | 0 | 0 | 0 |
| 0 | | | | | |
| 3B0905 | 3B9331 | 77 | 0 | 0 | 0 |
| 0 | | | | | |
| 4B1821 | 4B9433 | 80 | 0 | 0 | 0 |
| 0 | | | | | |

FAILURE RATETOTAL DEVICE HOURS

391,000 DEVICE HOURS

BEST ESTIMATE $\lambda = 0.2\%$ PER 1,000 HOURS50°C AMBIENT

EXTRAPOLATION TO 50°C VIA
ARRHENNIUS EQUATION AND
ACTIVATION ENERGY OF 0.5eV
 $\lambda = 0.001\%$ PER 1,000 HOURS (6 FITS)

CONFIDENCE ESTIMATE

λ 60 = 0.001% PER 1,000 HOURS
60% CONFIDENCE (8 FITS)
 λ 90 = 0.002% PER 1,000 HOURS
90% CONFIDENCE (21 FITS)

AT-27C1024

PROGRAM/ERASE CYCLE

| <u>LOT</u> <u>NUMBER</u> | <u>DATE</u> <u>CODE</u> | <u>SAMPLE</u> <u>SIZE</u> | <u>NUMBER</u> <u>10</u> | <u>OF</u> <u>20</u> | <u>FAILURES</u> <u>30</u> | <u>AT</u> <u>40</u> | <u>CYCLE</u> <u>50</u> |
|-----------------------------|----------------------------|------------------------------|----------------------------|------------------------|------------------------------|------------------------|---------------------------|
| 232699-2 | 2C9239 | 79 | 0 | 0 | 0 | 0 | 0 |
| 232447 | 2C9237 | 79 | 0 | 0 | 0 | 0 | 0 |
| 3B0905 | 3B9331 | 83 | 0 | 0 | 0 | 0 | 0 |

AT-27C1024

PLASTIC PACKAGE

125°C DYNAMIC OPERATING LIFE TEST

| <u>LOT NUMBER</u> | <u>DATE CODE</u> | <u>SAMPLE SIZE</u> | <u>TOTAL CKT-HRS (K)</u> | <u>NUMBER OF FAILURES</u> |
|-----------------------|----------------------|------------------------|------------------------------|-------------------------------|
| 133147-7 | 1D9145 | 77 | 77.0 | 0 |
| 3B0202B3 | 3B9321 | 78 | 78.0 | 0 |
| 3B0974C | 3B9332 | 79 | 79.0 | 0 |
| 3C0079C | 3C9338 | 45 | 45.0 | 0 |
| 3D1279 | 3D9404 | 77 | 77.0 | 0 |
| 4B1821BA2 | 4B9433 | 77 | 77.0 | 0 |
| 4C0164AA1 | 4C9439 | 80 | 80.0 | 0 |
| 4C0164A | 4C9440 | 77 | 77.0 | 0 |
| 4C1383 | 4C9444 | 161 | 161.0 | 0 |
| 5B2180 | 4D9452 | 160 | 160.0 | 0 |
| 5B0583 | 4D9511 | 159 | 159.0 | 0 |
| 5B1475 | 4D9515 | 78 | 78.0 | 0 |
| 5C2591 | 4D9515 | 78 | 78.0 | 0 |
| 5C1162 | 4D9515 | 78 | 78.0 | 0 |
| 4D0481 | 4D9515 | 78 | 78.0 | 0 |
| 4D0481 | 4D9515 | 78 | 78.0 | 0 |
| 4D0481 | 4D9515 | 78 | 78.0 | 0 |
| 4D0481 | 4D9515 | 78 | 78.0 | 0 |
| 4D0481 | 4D9515 | 78 | 78.0 | 0 |
| 4D0481 | 4D9515 | 78 | 78.0 | 0 |
| 4D0481 | 4D9515 | 78 | 78.0 | 0 |
| 5B2180 | 5B9534 | 78 | 78.0 | 0 |
| 5B0583 | 5B9524 | 160 | 160.0 | 0 |
| 5B1475 | 5B9529 | 80 | 80.0 | 0 |
| 5C2591 | 5C9547 | 50 | 50.0 | 0 |
| 5C1162 | 5C9542 | 79 | 79.0 | 0 |
| 5C2586 | 5C9547 | 80 | 80.0 | 0 |
| 5C2831 | 5C9549 | 160 | 160.0 | 0 |
| 4D2847 | 4D9509 | 54 | 54.0 | 0 |
| 9B1095 | 9B9927 | 250 | 250.0 | 0 |
| 0H4002-1 | 0H0052 | 250 | 250.0 | 0 |
| 1A0319 | 1A0112 | 250 | 250.0 | 0 |
| 1B0498 | 1B0124 | 100 | 100.0 | 0 |
| 1B2127-2 | 1B0124 | 100 | 100.0 | 0 |
| 2G4787 | 2G0232 | 250 | 250.0 | 0 |

FAILURE RATETOTAL DEVICE HOURS

3,089,000 DEVICE HOURS

BEST ESTIMATE $\lambda = 0.02\%$ PER 1,000 HOURS50°C AMBIENT

EXTRAPOLATION TO 50°C VIA
ARRHENNIUS EQUATION AND
ACTIVATION ENERGY OF 0.5eV
 $\lambda = 0.0007\%$ PER 1,000 HOURS (8
FITS)

CONFIDENCE ESTIMATE

λ 60 = 0.001% PER 1,000 HOURS
60% CONFIDENCE (10 FITS)
 λ 90 = 0.002% PER 1,000 HOURS
90% CONFIDENCE (25 FITS)

AT-27C1024

PLASTIC PACKAGE

150°C RETENTION BAKE

| <u>LOT NUMBER</u> | <u>DATE CODE</u> | <u>SAMPLE SIZE</u> | <u>HOURS TO FAILURE</u> | | |
|-----------------------|----------------------|------------------------|-------------------------|------------|--------------|
| | | | <u>168</u> | <u>500</u> | <u>1,000</u> |
| 233684 | 2D9250 | 141 | 0 | 0 | 0 |
| 3B0202B3 | 3B9321 | 80 | 0 | 0 | 0 |
| 3B0974C | 3B9332 | 80 | 0 | 0 | 0 |
| 3D1279 | 3D9404 | 77 | 0 | 0 | 0 |
| 4A1162 | 4B9429 | 77 | 0 | 0 | 0 |
| 4B0634 | 4B9429 | 77 | 0 | 0 | 0 |
| 4C0164AA | 4C9439 | 80 | 0 | 0 | 0 |
| 4C0164A | 4C9440 | 77 | 0 | 0 | 0 |
| 4B2530 | 4B9441 | 119 | 0 | 0 | 0 |
| 4C1383 | 4C9441 | 340 | 0 | 0 | 0 |
| 4D0481 | 4D9452 | 154 | 0 | 0 | 0 |
| 4D0482 | 4D9503 | 80 | 0 | 0 | 0 |
| 4D0481 | 4D9515 | 77 | 0 | 0 | 0 |
| 5B0983 | 5B9534 | 158 | 0 | 0 | 0 |
| 5B2180 | 5B9534 | 45 | 0 | 0 | 0 |
| 5C1162 | 5C9542 | 63 | 0 | 0 | 0 |
| 5C2591 | 5C9547 | 55 | 0 | 0 | 0 |
| 5C2586 | 5C9547 | 98 | 0 | 0 | 0 |
| 5C2831 | 5C9549 | 235 | 0 | 0 | 0 |
| 8B3048-1A | 8B9833 | 50 | 0 | 0 | 0 |
| 8J2321 | 8J9909 | 500 | 0 | 0 | 0 |
| 9A1263A | 9A9916 | 49 | 0 | 0 | 0 |
| 9B1095 | 9B9927 | 250 | 0 | 0 | 0 |
| 0A2578 | 0A0015 | 50 | 0 | 0 | 0 |
| 0H4002-1 | 0H0052 | 250 | 0 | 0 | 0 |
| 1A0319 | 1A0112 | 252 | 0 | 0 | 0 |
| 1B0498 | 1B0124 | 50 | 0 | 0 | 0 |
| 1B2127-2 | 1B0124 | 50 | 0 | 0 | 0 |
| 1J0397 | 1J0203 | 250 | 0 | 0 | 0 |
| 3H3902-2 | 3H0345 | 500 | 0 | 0 | 0 |
| 4H1861 | 4H0439 | 500 | 0 | 0 | 0 |

FAILURE RATETOTAL DEVICE HOURS

4,864,000 DEVICE HOURS

BEST ESTIMATE $\lambda = 0.02\%$ PER 1,000 HOURS50°C AMBIENT

EXTRAPOLATION TO 50°C VIA
ARRHENNIUS EQUATION AND
ACTIVATION ENERGY OF 0.5eV
 $\lambda = 0.002\%$ PER 1,000 HOURS (2 FITS)

CONFIDENCE ESTIMATE

λ 60 = 0.0003% PER 1,000 HOURS
60% CONFIDENCE (3 FITS)
 λ 90 = 0.0007% PER 1,000 HOURS
90% CONFIDENCE (7 FITS)

AT-27C1024

PLASTIC PACKAGE

PRESSURE POT TEST

| <u>DATE</u> <u>CODE</u> (96) | <u>PACKAGE</u> <u>TYPE</u> | <u>SAMPLE</u> <u>SIZE</u> | <u>(24)</u> | <u>NUMBER</u> <u>(48)</u> | <u>OF FAILURE</u> <u>(72)</u> | | |
|------------------------------------|-------------------------------|------------------------------|-------------|------------------------------|----------------------------------|---|---|
| 0 2D9246 | 44 PLCC | 43 | 0 | 0 | 0 | | |
| 0 3B9321 | 44 PLCC | 122 | 0 | 0 | 0 | | |
| 0 4B9429 | 40 TSOP | 90 | 0 | 0 | 0 | | |
| 0 4B9433 | 44 PLCC | 45 | 0 | 0 | 0 | | |
| 0 4C9438 | 44 PLCC | 45 | 0 | 0 | 0 | | |
| 0 4C9440 | 40 TSOP | 45 | 0 | 0 | 0 | | |
| 0 4D9452 | 40 TSOP | 231 | 0 | 0 | 0 | | |
| 0 4D9503 | 40 VSOP | 44 | 0 | 0 | 0 | | |
| 0 4D9511 | 44 PLCC | 157 | 0 | 0 | 0 | | |
| 0 4D9515 | 40 TSOP | 45 | 0 | 0 | 0 | | |
| 0 5C9542 | 44 PLCC | 90 | 0 | 0 | 0 | | |
| 0 5C9547 | 44 PLCC | 167 | 0 | 0 | 0 | | |
| 8B9833 | 44 PLCC | 34 | 0 | 0 | 0 | 0 | 0 |
| 9A9916 | 44 PLCC | 50 | 0 | 0 | 0 | 0 | 0 |
| 9B9927 | 40 VSOP | 100 | 0 | 0 | 0 | 0 | 0 |
| 0A0015 | 44 PLCC | 50 | 0 | 0 | 0 | 0 | 0 |
| 1A0112 | 40 VSOP | 76 | 0 | 0 | 0 | 0 | 0 |
| 1B0124 | 44 PLCC | 50 | 0 | 0 | 0 | 0 | 0 |
| 1B0124 | 40 PDIP | 50 | 0 | 0 | 0 | 0 | 0 |
| 2G0232 | 40 PDIP | 100 | 0 | 0 | 0 | 0 | 0 |
| 3H0345 | 40 PDIP | 100 | 0 | 0 | 0 | 0 | 0 |
| 4H0439 | 44 PLCC | 100 | 0 | 0 | 0 | 0 | 0 |

AT-27C1024

PLASTIC PACKAGE

85°C/85% RELATIVE HUMIDITY OPERATING LIFE TEST

| <u>LOT FAILURES NUMBER HOURS</u> | <u>DATE</u> | <u>PACKAGE</u> | <u>SAMPLE</u> | <u>NUMBER OF</u> | |
|--|-------------|----------------|---------------|------------------|------------------|
| | <u>CODE</u> | <u>TYPE</u> | <u>SIZE</u> | <u>AT</u> | <u>INDICATED</u> |
| (1000) | | | | (168) | (500) |
| 3D1279 0 | 3D9404 | 40 PDIP | 77 | 0 | 0 |
| 4D0481 0 | 4D9452 | 40 PDIP | 50 | 0 | 0 |
| 4D0481-1 0 | 4D9452 | 40 TSOP | 28 | 0 | 0 |
| 5C1162 0 | 5C9542 | 44 PLCC | 45 | 0 | 0 |
| 5C2586 0 | 5C9547 | 40 PDIP | 45 | 0 | 0 |
| 5C2591 0 | 5C9547 | 44 PLCC | 45 | 0 | 0 |

Date: Sept. 28, 1994
Subject: AT27C1024 (18705A Stepping) ESD
From: C. Lionbarger, G. Korsh
To: E. Hui, M. Wong, LY. Lee
From: T. Pearce, H. Nguyen

Packaged units of the AT27C1024 (18705A stepping) from lot 4B1821 were tested for Electro-Static Discharge immunity. Testing was performed on an IMCS ESD discharge tester, which was set up per Mil-std-883, method 3015 (100pF capacitor discharged through a 1.5K ohm resistor). Individual pins on units were step-stress tested in 500V increments. Three consecutive high voltage pulses with six seconds cool down period between pulses were used at each voltage setting. The leakage current on each pin was measured before and after each high voltage pulse train. The leakage current noise level was below 1nA and the failure criteria at 1.5V was 1uA or 0.2uA increase due to a single voltage pulse sequence. This procedure is implemented with VSS grounded and VCC floating, and vice versa.

The results are shown in Table 1. They indicate that the AT27C1024 (18705A) has excellent input and output protection structures. The inputs pass +/- 5000V and the outputs pass +/- 4000V.

Table 1. AT27C1024 (18705A) ESD Voltage Protection by pin

| <u>Pin</u> | <u>Function</u> | <u>+V</u> | <u>-V</u> |
|------------|-----------------|-----------|-----------|
| 1 | VPP | >6000 | >6000 |
| 2 | CE | >6000 | >6000 |
| 3 | D15 | >6000 | >6000 |
| 4 | D14 | >6000 | >6000 |
| 5 | D13 | >6000 | >6000 |
| 6 | D12 | >6000 | >6000 |
| 7 | D11 | >6000 | >6000 |
| 8 | D10 | >6000 | >6000 |
| 9 | D9 | >6000 | >6000 |
| 10 | D8 | >6000 | >6000 |
| 12 | D7 | >6000 | >6000 |
| 13 | D6 | >6000 | >6000 |
| 14 | D5 | >6000 | >6000 |
| 15 | D4 | >6000 | >6000 |
| 16 | D3 | 5000 | 5000 |
| 17 | D2 | 4500 | 4500 |
| 18 | D1 | >6000 | >6000 |
| 19 | D0 | >6000 | >6000 |
| 20 | OE | >6000 | >6000 |
| 21 | A0 | 5500 | 5500 |
| 22 | A1 | 5500 | 5500 |
| 23 | A2 | >6000 | >6000 |
| 24 | A3 | >6000 | >6000 |
| 25 | A4 | >6000 | >6000 |
| 26 | A5 | >6000 | >6000 |
| 27 | A6 | >6000 | >6000 |
| 28 | A7 | 5500 | 5500 |
| 29 | A8 | >6000 | >6000 |
| 31 | A9 | 5500 | 5500 |
| 32 | A10 | 5500 | 5500 |
| 33 | A11 | 5500 | 5500 |
| 34 | A12 | >6000 | >6000 |
| 35 | A13 | >6000 | >6000 |
| 36 | A14 | >6000 | >6000 |
| 37 | A15 | >6000 | >6000 |
| 39 | PGM | >6000 | >6000 |

Date: October 13, 1994
Subject: AT27C1024 (18705A Stepping) Latchup Characterization
From: David Nemeth
To: L.Y. Lee, M. Lai, M. Wong
cc: G. Korsh, Larry Sun

Packaged units of AT27C1024 (18705A stepping) from lot 4B1821-2 were tested for latchup. A curve tracer was used to force current into each pin, and the voltage for latchup or $I=600\text{mA}$ was observed. The current into Vcc was monitored by a separate current meter, and Vcc had a 9 ohm resistor to ground at the power supply to allow the pin to source current.

The result are given in table 1. No latchup was observed for any pin at Vcc = 5V for currents up to 600mA. No latchup occurs for output voltages up 2V., or up to 14V on the output pins.

Table 1. AT27C1024 Latchup Trigger Current and Voltage at 5V
 Lot # 4B1821-2 (18705A stepping)

| Pin | Function | +I (mA) | +V (V) | -I(mA) | -V (V) |
|-----|----------|---------|--------|--------|--------|
| 1 | Vpp | | | >600 | 3.35 |
| 2 | CE | | | >600 | 4.25 |
| 3 | O15 | >600 | 9.4 | >600 | 3.25 |
| 4 | O14 | >600 | 9.4 | >600 | 3.45 |
| 5 | O13 | >600 | 9.7 | >600 | 3.5 |
| 6 | O12 | >600 | 9.65 | >600 | 3.7 |
| 7 | O11 | >600 | 10 | >600 | 3.8 |
| 8 | O10 | >600 | 10 | >600 | 3.6 |
| 9 | O9 | >600 | 10.4 | >600 | 3.6 |
| 10 | O8 | >600 | 10.4 | >600 | 3.6 |
| 11 | GND | | | | |
| 12 | O7 | >600 | 10.8 | >600 | 3.5 |
| 13 | O6 | >600 | 10.9 | >600 | 3.5 |
| 14 | O5 | >600 | 11.1 | >600 | 3.45 |
| 15 | O4 | >600 | 11.2 | >600 | 3.55 |
| 16 | O3 | >600 | 11.6 | >600 | 3.4 |
| 17 | O2 | >600 | 11.7 | >600 | 3.2 |
| 18 | O1 | >600 | 12 | >600 | 3.1 |
| 19 | O0 | >600 | 12 | >600 | 2.85 |
| 20 | GND | | | >600 | 4 |
| 21 | A0 | | | >600 | 4 |
| 22 | A1 | | | >600 | 3.9 |
| 23 | A2 | | | >600 | 3.9 |
| 24 | A3 | | | >600 | 3.8 |
| 25 | A4 | | | >600 | 3.8 |
| 26 | A5 | | | >600 | 3.65 |
| 27 | A6 | | | >600 | 3.6 |
| 28 | A7 | | | >600 | 3.5 |
| 29 | A8 | | | >600 | 3.4 |
| 30 | GND | | | | |
| 31 | A9 | | | >600 | 3.4 |
| 32 | A10 | | | >600 | 3.5 |
| 33 | A11 | | | >600 | 3.6 |
| 34 | A12 | | | >600 | 3.8 |
| 35 | A13 | | | >600 | 3.8 |
| 36 | A14 | | | >600 | 3.8 |
| 37 | A15 | | | >600 | 3.8 |
| 38 | N.C. | | | | |
| 39 | PGM | | | >600 | 3.8 |