DALLAS
SEMICONDUCTOR

DS19xx iButton Reliability Report

This report has been prepared by:

Dallas Semiconductor
Quality Assurance Department
Original Report: 10/06/93
1st Addendum: 6/10/96

Touch Memory Reliability Report
October 6, 1993

Addendum

6/10/96 Change Appendix IV to include additional Reliability Monitor Products.
Appendix IV.
Reliability Monitor Results

6/10/96 Add Appendix VII
Appendix VII
Additional Product Reliability Projections

1.0. Introduction: Goals of Reliability Program

Dallas Semiconductor's DS19xx Touch Memory reliability program is designed to evaluate the environmental stress factors that may affect the use of the DS19xx in customer applications. Most tests attempt to reflect environmental abuse that might occur in applications such as medical, industrial, and human handling. In some devices (DS1990A, DS198X) only a silicon integrated circuit is contained within the MicroCan. In other devices (DS1494/DS1991/DS1992/DS1993/DS1994) a lithium energy source is combined with the integrated circuit and sealed inside of the MicroCan enclosure. The DS1494/DS1994 also has a quartz crystal inside to support the timekeeping functions. Therefore, separate reliability studies have been conducted on the assembled Touch Memory devices, the integrated circuits, and the lithium energy source. The qualification goals for each process are as follows:

(1) Packaged DS19xx device qualification
- Storage life, +85 deg C, 1000 hrs
- Moisture soak, 60 deg C at 90% R.H., 1000 hrs
- Temperature cycling, -40 to +85 deg C, 1,000 repetitions
- Mechanical shock, Mil-Std-883C, Method 2002
- Mechanical vibration, Mil-Std-883C, Method 2005
- Salt atmosphere exposure, Mil-Std-883C, Method 1009
- Grommet integrity
- Environmental studies (handling use, outdoor exposure, water immersion)

(2) DS19xx die qualification
- Burn-in, +125 deg C, 7.0 volt bias, 1000 hours, dynamic excitation
- Storage life, +85 deg C, 1000 hrs
- Moisture soak, 70 deg C at 90% R.H., 1000 hrs
- Temperature cycling, -40 to +85 deg C, 1000 repetitions

(3) Battery cell qualification
- Storage life
- Seal integrity
- Moisture resistance
- Capacity
- Safety
- Performance
- Incoming Q.C.

This report will tend to use the DS1994L-F50 which uses the BR1225 lithium cell and a 32Khz crystal as a vehicle to determine reliability results related to devices that contain a lithium energy source. Other devices that contain a lithium cell will be a subset of the DS1994L-F50. The DS1990-F30 will tend to be the vehicle to determine reliability results related to devices that are entirely passively powered (parasite-powered).

2.0. DS19xx Touch Memory Family Characteristics

A Touch Memory is a ruggedized data carrier that can be used in many diverse applications such as access control, work-in-progress, field maintenance tracking, event logging and security. Because of this diversity of use, the DS19xx Touch Memory has been constructed to be highly durable, resisting a variety of environmental effects such as moisture, temperature, shock, vibration, and corrosion.

2.1. Physical Construction

A Touch Memory is an electronic circuit housed in a stainless steel enclosure called a MicroCan which resembles a typical coin-cell battery in appearance. The material thickness is 0.254mm (10 mil). The two conductive surfaces of the MicroCan are separated by a polypropylene grommet which serves as an electrical insulator. Inside, the substrate on which the integrated circuit (IC) is mounted makes contact to one surface of the MicroCan by touching it directly, the other MicroCan surface is connected by a spring bias to contact points on the substrate. Normal IC wire-bonding techniques connect the bond pads of the IC to the substrate. A second spring bias is present in devices that contain a lithium energy source, where this second spring serves to connect the positive voltage of the battery to the substrate. The details of this construction are illustrated on the next page.

2.2.1. Type 305 Stainless Steel

Composition:		Physical Constants:	
Carbon	0.12% max	Specific Gravity	8.03
Manganese	2.00% max	Density (lb/in^3)	0.29
Phosphorus	0.045% max	Coeff. of Therm. Expan.	
Sulfur	0.03% max	($cm/cm/^oC \times 10^{-6}$)	19.0
Silicon	1.00% max	Electrical Res. (microhm-cm)	75.6
Chromium	17.00/19.00%		
Nickel	10.50/13.00%		

Type 305 stainless steel is used in all of the standard (non-magnetic stainless) Touch Memory products. Type 305 stainless steel is used extensively for parts produced by deep drawing. Its nonmagnetic properties recommend it for electrical instruments, and its high corrosion resistance makes it ideal for use in textile and chemical processing equipment. It resists nitric acid well and sulfuric acid solutions moderately well. It is satisfactory for use with a wide variety of organic and inorganic chemicals, foodstuffs, and sterilizing solutions.

2.2.2. Type 430F Stainless Steel

Composition:		Physical Constants:	
Carbon	0.12% max	Specific Gravity	7.75

Manganese	1.25% max	Density (lb/in^3)	0.28
Phosphorus	0.06% max	Coeff. of Therm. Expan. (cm/cm/^{o}C x 10^{-6})	11.9
Sulfur or Selenium	0.15% min	Electrical Res. (microhm-cm)	60
Silicon	1.00% max		
Chromium	14.00/18.00%		
Molybdenum	0.60%		

Type 430F stainless is used in all of the "magnetic" stainless steel Touch Memory product options. They are specified by the suffix "M" in the product identifier. (For example, a DS1994L-F50 is type 305 "non-magnetic" stainless steel and a DS1994L-F5M is type 430F "magnetic" stainless steel. These two products are identical except for the composition of the stainless steel MicroCan.) The type 430F stainless steel composition was chosen to permit the magnetic attraction of Touch Memories in applications where a magnetic probe or holder is desirable. The other properties of type 430F stainless steel are similar to type 305 described above.

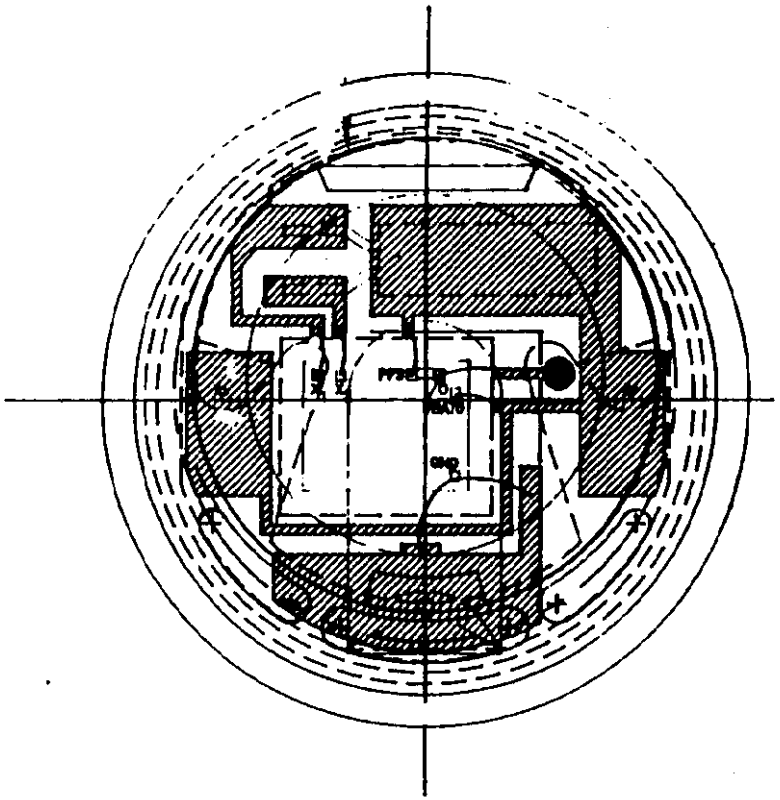
2.3. Polypropylene Grommet

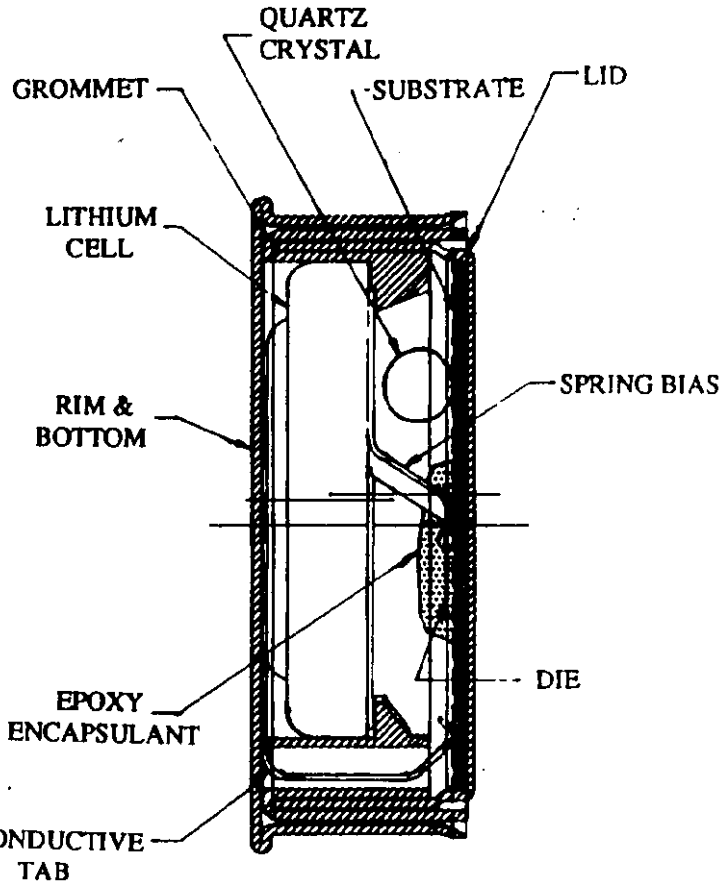
The insulating grommet is molded from a polypropylene homoplymer resin that has a carbon black additive to inhibit breakdown due to ultraviolet light. The material was chosen for its high resistance to solvents, chemicals, and environmental stress-cracking. It also has a high degree of stiffness and good heat-age life. It is typically used in automotive products, housewares, and general molding items. It also meets all of the FDA criteria for safe use in components intended for food-contact use, including cookware.

Typical properties:

Water absorption after 24 hours: 0.02%	(ASTM Method D 570)
Environmental stress-cracking: >500 hrs, no failures	(ASTM Method D 1693)

DS1994L-F50





COMPONENT ASSEMBLY, DS1994-TOUCH DEVICE

90-19940-000

3.0. DS19xx Temperature Stress

3.1.1. Storage life - Parasite-powered devices

Description of test: Exposure of the DS1990-R30 to a +85°C environment with no electrical bias on the devices. The DS1990-R30 is representative of the type of Touch Memory that is powered entirely from the reader.

Duration of test: 1000 hours

Sample size: 225

Results: No failures. Operation was unaffected and ROM data was retrieved with no errors. See Appendix I for details.

3.1.2. Storage life - Lithium-powered devices

Description of test: Exposure of the DS1994L-F50 to a +85°C environment with no electrical bias on the devices. The DS1994L-F50 is representative of the type of Touch Memory that is powered partially from the reader and partially from an internal lithium supply.

Duration of test: 1000 hours

Sample size: 224 devices total chosen from two different lots of material.

Results: No failures. Operation was unaffected and data test pattern was retrieved with no errors. See Appendix II for details. (Note: The product qualification process requires that devices pass 1000 hours of +85°C stress without failure. The stress test was continued out to 2000 hours with no failures recorded.)

3.2.1. Temperature cycling - Parasite-powered devices

Description of test: Temperature cycling of the DS1990-F30 from -40°C to +85°C with no electrical bias on the devices. A cycle consists of a dwell of approximately ten minutes at each temperature extreme with a fifteen minute transition time between the extremes. The DS1990-F30, DS1990-R30 and DS1990A-F50 are representative of the type of Touch Memory that is powered entirely from the reader.

Duration of test: Group A: 2000 cycles
Group B: 2000 cycles

Group C: 1000 cycles

Sample size: Group A: 75 DS1990-F30
Group B: 75 DS1990-R30
Group C: 150 DS1990-R30

Results: No failures. Operation was unaffected and ROM data was retrieved with no errors. See Appendix I for details. (Note: The product qualification process requires that devices pass 1000 hours of temperature cycling stress without failure. The stress test was continued out to 2000 hours for Group A and Group B with no failures recorded.)

3.2.2. Temperature cycling - Lithium-powered devices

Description of test: Temperature cycling of the DS1994L-F50 and the DS1994L-F5M from -40°C to +85°C with no electrical bias on the devices. A cycle consists of a dwell of approximately ten minutes at each temperature extreme with a fifteen minute transition time between the extremes. The DS1994L-F50 and DS1994L-F5M are representative of the type of Touch Memory that is powered partially from the reader and partially from an internal lithium supply.

Duration of test: 1000 cycles

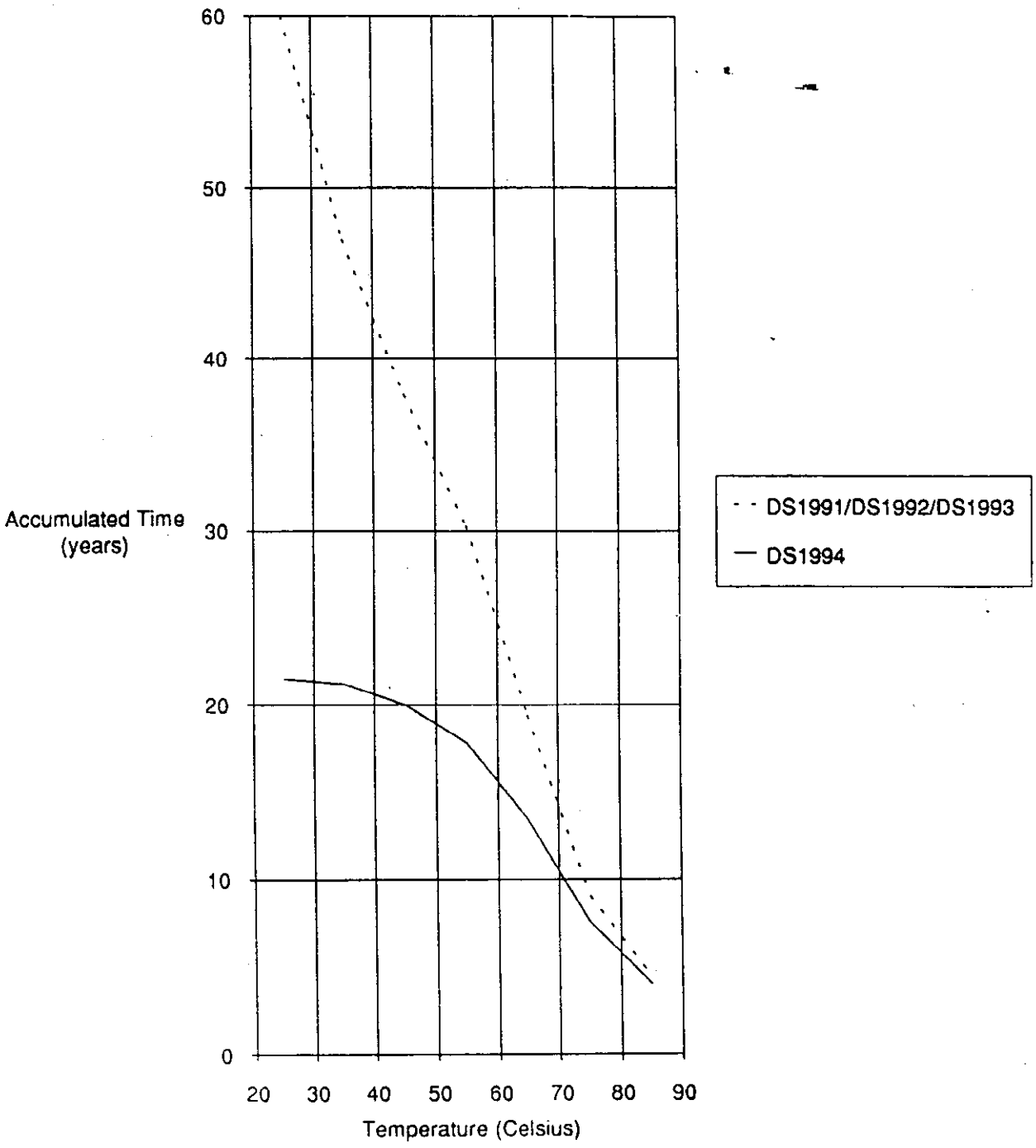
Sample size: 328 devices total chosen from four different lots of material.

Results: No failures. Operation was unaffected and data test pattern was retrieved with no errors. See Appendix II for details.

3.3. Temperature affect on predicted product lifetime

The integrated circuit within each Touch Memory has greater leakage current at elevated temperatures and therefore demands more energy from the lithium supply. This results in a reduced lifetime for the device. The graph shows the relationship between temperature and lifetime. There are two general classes of lithium-powered devices, those with an oscillator used for timekeeping (DS1994) and those that do not have an oscillator (DS1991/DS1992/DS1993).

Predicted Lifetime for Touch Memories using BR1225 Lithium Cell



4.0. DS19xx Moisture/Humidity Stress

4.1.1. Moisture soak - Parasite-powered devices

Description of test: Exposure of the DS1990-F30 to a 60°C/90% relative humidity environment and the DS1990-R30 to a 70°C/90% relative humidity environment with no electrical bias.

Duration of test: Group A: 960 hours
Group B: 480 hours

Sample size: Group A: 75 DS1990-F30
Group B: 225 DS1990-R30

Results: No failures. Operation was unaffected and ROM data was retrieved with no errors. See Appendix I for details.

4.1.2. Moisture soak - Lithium-powered devices

Description of test: Exposure of the DS1994L-F50 and DS1994L-F5M to a 60°C/90% relative humidity environment with no electrical bias.

Duration of test: 960 hours

Sample size: 360 devices total chosen from four different lots of material.

Results: No failures. Operation was unaffected and data test pattern was retrieved with no errors. See Appendix I for details.

4.2. Salt atmosphere exposure

Description of test: Exposure of the DS1994L-F50 and DS1994L-F5M to a salt spray according to Mil-Std-883C, Method 1009, Cond. C. with no electrical bias. Five units of DS1994L-F50 (type 305 stainless) and five units of DS1994L-F5M (type 430 stainless) were used in the testing.

Duration of test: 96 hours

Sample size: 10 devices

Results: No failures. Operation was unaffected and data test pattern was retrieved with no errors.

Readpoint: 24 hours

- DS1994L-F5M: All 5 have slight rusting at grommet sight, with an average of 75% of grommet circumference affected. Two have a rust stream across the device.
  DS1994L-F50: 2 of 5 devices have slight rusting, appears to have migrated from DS1994L-F5M devices that were in close proximity.

Readpoint: 48 hours

DS1994L-F5M: All 5 have medium to heavy rusting at grommet sight. All 5 have rust that runs across the device.
DS1994L-F50: 4 of 5 devices have slight rusting on 50% of the grommet area.

Readpoint: 96 hours

DS1994L-F5M: All 5 have heavy rusting at grommet sight, 100% of the circumference affected on 3 devices, 75% on the others. Also heavy rust running across the top and down the sides of the MicroCan.
DS1994L-F50: 4 of 5 devices have slight rusting on 50% of the grommet area.

4.3. Immersion in saline water

Description of test: Immersion of DS1991L-F5 devices in saturated saline solution, then wiped dry before reading with DS9092GT probe.

Duration of test: 24 hour immersion

Sample size: 10 devices

Results: No failures. Operation was unaffected and data test pattern was retrieved with no errors. Slight loss of brightness noted on some devices.

5.0. DS19xx Physical Stress

5.1.1. Mechanical Shock - Parasite-powered devices

Description of test: Mechanical shock testing performed on the DS1990-F30 and DS1990A-F50 using Mil-Std-883C, Method 2002.3, Condition A. in all three axes at 500g's.

Duration of test: 18 cycles

Sample size: 15 DS1990-F30
15 DS1990A-F50

Results: No failures. Operation was unaffected and ROM data was retrieved with no errors and the physical appearance was unchanged. See Appendix I for details. (A mechanical shock of 500g's is roughly equivalent to a drop onto a hard surface from a height of 1.5m (5ft).

5.1.2. Mechanical Shock - Lithium-powered devices

Description of test: Mechanical shock testing performed on the DS1991L-F50 using Mil-Std-883C, Method 2002.3, Condition A. in all three axes. Group A received 500g's, Group B received 1500g's, Group C received 3000 g's.

Duration of test: 18 cycles

Sample size: 90 devices total chosen from three different lots of material. Group A: 70 pieces; Group B: 10 pieces; Group C: 10 pieces

Results: No failures. Operation was unaffected and data test pattern was retrieved with no errors and the physical appearance was unchanged. See Appendix II for details. (A mechanical shock of 500g's is roughly equivalent to a drop onto a hard surface from a height of 1.5m (5ft), and a shock of 3000 g's is roughly equivalent to a drop from a height of two stories.)

5.2.2. Vibration - Parasite-powered devices

Description of test: Vibration testing performed on the DS1990-F30 and DS1990A-F50 using Mil-Std-883C, Method 2005, Condition A. Testing was performed in all three axes, with the frequency varied from 10Hz to 55Hz and amplitude of 3mm (0.12 in).

Duration of test: 96 hours

Sample size: 33 DS1990-F30
33 DS1990A-F50

Results: No failures. Operation was unaffected and ROM data was retrieved with no errors and the physical appearance was unchanged. See Appendix I for details.

5.2.2. Vibration - Lithium-powered devices

Description of test: Vibration testing performed on the DS1991L-F50 and DS1994L-F5M using Mil-Std-883C, Method 2005, Condition A. Testing was performed in all three axes, with the frequency varied from 10Hz to 55Hz and amplitude of 3mm (0.12 in).

Duration of test: 96 hours

Sample size: 33 DS1991L-F50
33 DS1994L-F5M

Results: No failures. Operation was unaffected and data test pattern was retrieved with no errors and the physical appearance was unchanged. See Appendix II for details.

5.3. Crush Test

Description of test: DS1991L-F50 subjected to direct weight of 114kg (25 lb) placed on lid of can, evenly distributed.

Duration of test: 30 seconds

Sample size: 10 devices

Results: No visible can damage. Data test pattern retrieved with no errors.

5.4. Contact Durability

Description of test: A DS1991L-F50 was mounted on a pneumatic piston that inserted the device into a rigidly affixed DS9092 probe that was connected to a PC thru a DS9097 Serial Port Adapter. The DS1991L-F50 was read on each insertion. The insertion force was estimated to be a maximum of 67N.

Duration of test: 1 million insertions

Sample size: 1 device

Results: Operation of Touch Memory and probe was unaffected and data test pattern was retrieved with no errors. Some minor denting and deformation of the DS1991L-F50 was observed. Significant wear occurred on the ground contact ring and the center contact of the DS9092 Touch Probe but it was not worn completely through and was still functional.

5.5. Tensile Attachment Strength

This test characterizes the strength of the DS9096P self-stick pads as an attachment method. Tensile strength measures the resistance of the tape to being pulled off in a direction perpendicular to the mounting surface plane. The tape pad vendor has indicated that this parameter will exceed 100 psi tensile pull strength.

5.6. Solderability

Do not solder directly to the surfaces of the MicroCan. The stainless steel is not solderable. Dallas Semiconductor supplies printed circuit board mounting clips (DS9094F) and snaps (DS9098) so that direct soldering can be avoided.

6.0. Environmental/Handling Stress

In order to evaluate the performance of the Touch Memory devices in typical real-world applications, additional testing was performed beyond the standard temperature and moisture acceleration studies. These tests provide quantitative data to drive ongoing improvements in the overall design.

6.1. Outdoor Daily Exposure

This test is designed to expose the DS19xx Touch Memory devices to an outdoor environment which presents a variety of typical stresses such as temperature (-10°C to 40°C), humidity, rain, dust, UV irradiation, and air pollution.

Description of test:	Devices programmed with test pattern and placed on roof with direct sunlight exposure.
Duration of test:	Ongoing - Start date June 1991.
Sample size:	75 DS1991L-F5's.
Readpoints:	Every 168 hours.
Results:	Failure Type: One unit developed a cracked grommet after 99 weeks (16,632 hours) which allowed moisture to penetrate and short the Data contact to Ground. Corrective Action: Grommet design on the failed unit was of the original polyethylene type. Grommet material was changed to polypropylene with additives to enhance UV resistance. All units produced after March 1, 1993 have polypropylene grommets. Remaining 74 units are still under test and have reached 121 weeks (20,328 hours) with no additional failures, data test pattern was retrieved with no errors. Physical appearance shows some deterioration of the grommets where the exposed polyethylene material is powderized. Test will be on-going indefinitely.

6.2. Handling Use

This test is designed to expose the DS19xx Touch Memory devices to typical daily human handling as part of an access control system at Dallas Semiconductor. All Dallas Semiconductor employees now use the DS1994L-F50 device attached to their photo-ID badge as a means of entering all secured doors. Each time they enter a door, the system reads the 64-bit lasered ROM to grant access as well as performing a data integrity test on the contents of the device. This information is automatically recorded by the system and is monitored by the MIS department at Dallas to identify failed Touch Memory devices. The ID badges are subjected to a wide range of conditions, including coming in contact with a variety of clothing materials, being left on automobile dashboards in direct sunlight, getting placed into a pocket or purse, and occasionally going through a clothes washer. The results of this on-going test are summarized below.

Description of test: Devices in Group A are DS1994L-F50 programmed with a test pattern and real-time clock running. Each time an employee enters a secured door the data pattern is tested and timekeeping accuracy is checked. A second group of employees carries badges with two Touch Memories affixed, one DS1994L-F50 (Group B) and one DS1991L-F50 (Group C). Badges that are in Group B and Group C are checked for data integrity of the test pattern. In addition, the ability to write data correctly in a dynamic environment is tested by writing 32 bytes of new information to the badge each time a secured door is entered and then reading back and confirming the new information. Group B is also checked for timekeeping accuracy. Total number of transactions to date is 504,198.

Sample size: Group A: 900 DS1994L-F50 mounted on photo ID badges
Group B: 100 DS1994L-F50 mounted on photo ID badges
Group C: 100 DS1991L-F50 mounted on photo ID badges

Readpoints: Each time a secured door is entered (2-8 times a day)

Results: Group A: 436,628 transactions completed in 10 months. (Read of data plus clock accuracy.)
No data errors during transactions. No clock accuracy errors.

17 devices returned:

Failure type: Unable to communicate with 15 units due to an early version of the silicon chip contained in the DS1994L-F50 that would prevent access to the device if subjected to certain ESD conditions. A procedure was developed to externally reverse this condition in the chip and confirm that the data and timekeeping registers were not corrupted.

Corrective Action: Silicon chip was modified and this failure mode has not been observed with current version of the DS1994L-F50. All units produced after March 1, 1993 have this version of the silicon chip.

Failure type: One unit developed an internal short.
Corrective Action: Failure appears to be random. No design changes made.

Failure type: One unit failed due to moisture penetration as a result of being put thru a clothes washing machine. Unit became functional again after a period of several days.
Corrective Action: No design changes made.

Group B: 36,552 transactions completed in 14 months. (Read and write of data plus clock accuracy.)
No data errors during transactions. Two clock accuracy errors.

3 devices returned:

Failure type: One unit failed due to a mechanical stress placed on the device when pressed into an employee badge causing intermittent operation.
Corrective Action: Press fit procedure reviewed. No design changes made.

Failure type: Two units experienced timekeeping errors believed to be caused by an ESD event causing a 6 hour error in one case and an 18 hour error in the other. Data test pattern was retrieved with no errors.
Corrective Action: Timekeeping oscillator is high impedance and under certain conditions will be subjected to disturbances. No design changes made.

Group C: 31,018 transactions completed in 14 months. (Read and write of data .)
No data errors during transactions.

1 device returned:

Failure type: One unit initially would not allow entry. Device was believed to have been programmed incorrectly from the start of the test, but was inadvertently reprogrammed before the cause could be investigated.

Corrective Action: Device was placed back into study after proper initialization and has not exhibited any problems.

6.3. Electrostatic Discharge (ESD)

Description of test: Testing done with an IMCS 5000 ESD tester using Mil-Std-883C Method 3015.7 (Human Body Model: 100pf thru 1500 ohms).

Duration of test: 3 pulses of +10KV, 3 pulses of -10KV

Sample size: Total of 9 DS1991L-F50 chosen from three separate lots.
Total of 9 DS1994L-F50 chosen from three separate lots.
Total of 9 DS1990A-F30 chosen from three separate lots.

Results: No failures. Operation was unaffected and data test pattern was retrieved with no errors.

6.4. Effects of Magnetic Fields

Description of test: Devices were magnetically attracted and held to a large permanent magnet for the duration of the test, except during the reading of the stored and data and the timekeeping registers. The testing occurred at room temperature. The magnet was capable of completely erasing a 5.25", 1.2M floppy disk when passed within a few millimeters of the disk for approximately 30 seconds. After being subjected to the magnet, the floppy disk was unrecognizable to a PC, including any formatting information.

Duration of test: 168 hours

Sample size: 25 DS1994L-F5M

Results: No failures. Operation was unaffected and data test pattern including timekeeping information was retrieved with no errors.

6.5. Intrinsically Safe Certification

Description of test: UL #913 - Intrinsically Safe Apparatus.
Testing done by MET Labs/NRTL, Project Number: SAF128
Listing Number: DAL0913

Products evaluated: DS1990, DS1991, DS1992, DS1993, DS1994

Results: Above products are designed to allow for storage and retrieval of information by touching the MicroCan surfaces with a wand interface and computer approved under the entity concept and

meeting the electrical ratings marked on the products (see below for a sample marking). The above products have been approved under the entity concept for use in Class I, Division I, Groups A,B,C, and D Locations. See Appendix III for details. For the complete listing report contact Dallas Semiconductor.

Sample marking required for Intrinsically Safe Applications:

Vmax = 15 V	Li = 18 µH
Imax = 10 mA	Ci = 0.2 nF

7.0. IC Qualification Data

7.1.1. High Voltage Accelerated Life Stress - Parasite-powered devices

Description of test: Device is exposed to a +125°C environment and is operated with Vcc = 7.0 volts. The parts are exercised continuously during testing. The DS914 and DS915 are representative of the type of integrated circuit used in a Touch Memory that is powered entirely from the reader.

Duration of test: Group A: 48 hours; Group B: 96 hours; Group C: 1000 hours; Group D: 504 hours; Group E: 72 hours; Group F:1072 hours

Sample size:

DS914 A1:	Group A: 1394; Group B: 898; Group C: 444
DS914 A2:	Group D: 196
DS915 A2:	Group E: 490; Group F: 77

Results: One device failure in approximately 290 million equivalent device hours at 55°C. When combined with the Operating Voltage Accelerated Stress data the resulting failure rating is 7 Fits. See Appendix I for details.

7.1.2. High Voltage Accelerated Life Stress - Lithium-powered devices

Description of test: Device is exposed to a +125°C environment and is operated with Vcc = 7.0 volts. The parts are exercised continuously during testing. The DS2404 is representative of the type of integrated circuit used in a Touch Memory that is powered partially from the reader and partially from an internal lithium supply.

Duration of test: Group A: 48 hours; Group B: 1000 hours

Sample size: Group A: 784; Group B: 154

Results: Three device failures in approximately 65 million equivalent device hours at 55°C. When combined with the Operating Voltage Accelerated Stress data the resulting failure rating is 51 Fits. See Appendix II for details.

7.2.1. Operating Voltage Accelerated Life Stress - Parasite-powered devices

Description of test: Device is exposed to a +125°C environment and is operated with Vcc = 5.0 volts. The parts are exercised continuously during testing. The DS914 is representative of the type of integrated

circuit used in a Touch Memory that is powered entirely from the reader.

Duration of test: 1000 hours

Sample size: 444

Results: No device failures in approximately 33 million equivalent device hours at 55°C. When combined with the High Voltage Accelerated Stress data the resulting failure rating is 7 Fits. See Appendix I for details.

7.2.2. Operating Voltage Accelerated Life Stress - Lithium-powered devices

Description of test: Device is exposed to a +125°C environment and is operated with Vcc = 5.0 volts. The parts are exercised continuously during testing. The DS2404 is representative of the type of integrated circuit used in a Touch Memory that is powered partially from the reader and partially from an internal lithium supply.

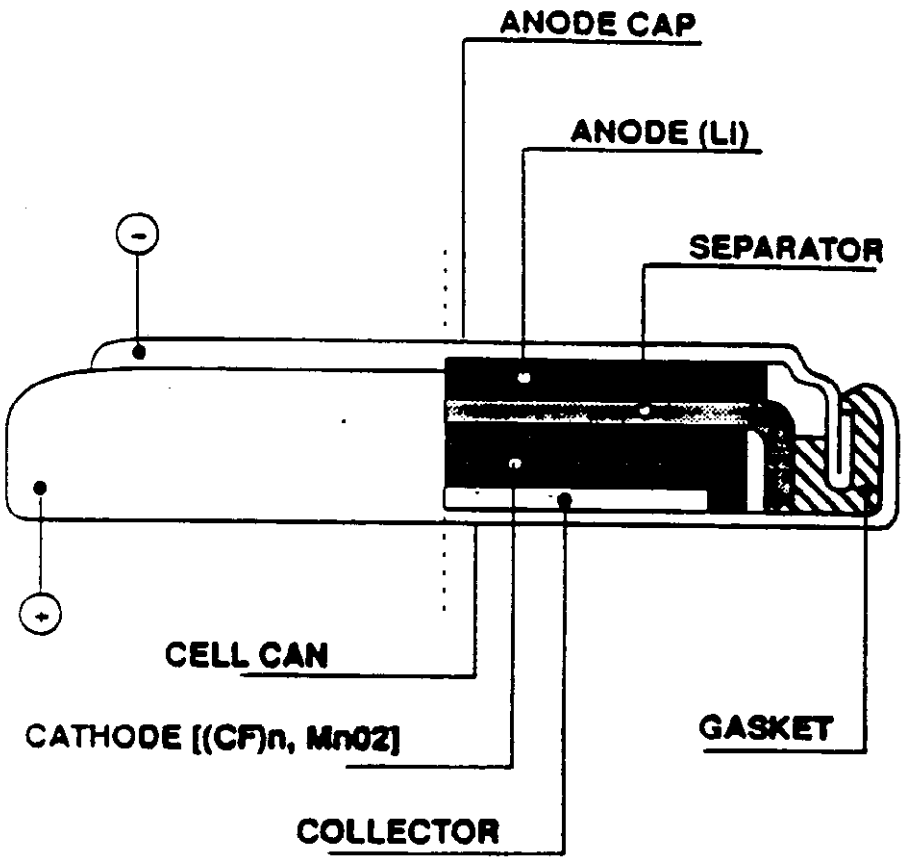
Duration of test: 1000 hours

Sample size: 234

Results: No device failures in approximately 18 million equivalent device hours at 55°C. When combined with the High Voltage Accelerated Stress data the resulting failure rating is 51 Fits. See Appendix II for details.

8.0 BR1225 Lithium Cell

8.1. Cell cross-section



TYPICAL CROSS-SECTION OF A LITHIUM COIN CELL

8.2. Cell qualification methods and procedures

The BR1225 used in all DS19xx devices that are lithium-powered has undergone an extensive qualification process at Dallas Semiconductor. The methods and procedures used to evaluate and qualify a cell are described below.

8.2.1. Storage Life

Purpose: Estimate the cell lifetime due to electrolyte evaporation as a function of time.

Method: Expose samples from at least three separate production lots to a minimum of three accelerated temperatures. The temperatures will be selected to accelerate electrolyte evaporation, yet not exceed absolute material or component limitations. This test is done on bare, untabbed cells, and the data consists of open circuit voltage and closed circuit voltage readings at various time intervals. The test is extended until at least 50% of each sample has reached a predetermined failing voltage level. This data is fitted into a log-normal distribution, and the values of $T_{1\%}$, $T_{50\%}$, and sigma are recorded. The data from each temperature exposure is analyzed for lot-to-lot variations, and, if insignificant, the combined data for each temperature is used to determine the Arrehenius activation energy for the cell system. This allows the lifetime prediction for the "use condition" to be determined.

8.2.2. Seal Integrity

Purpose: Evaluate the seal integrity over an accelerated range of temperature extremes.

Method: Expose samples from at least three separate production lots to a minimum of two accelerated temperature cycle conditions. Record open-circuit voltage (OCV) and closed-circuit voltage (CCV) for all cells at each readpoint, as well as magnified visual observations on a sample from each lot. Visual data is recorded for presence and location of salt formations, corrosion, the presence of liquid electrolyte, seal color and appearance, and cell deformation. Voltage distributions versus cycles is recorded, and used to establish performance baselines that will be compared to DS19xx devices undergoing the identical stress conditions.

8.2.3. Moisture Resistance

Purpose: Evaluate the cell performance with respect to a high humidity environment.

Method: Expose samples from at least three separate production lots to a single,

non-condensing, accelerated temperature/humidity storage condition. The temperature is chosen to be within the rated operating range for the cell. Record OCV and CCV values for all cells at each readpoint, as well as magnified visual observations on a sample from each lot. Visual data is recorded for presence and location of salt formations, corrosion, seal color and appearance, and cell deformation. Voltage distributions versus time are recorded, and used to establish the effects of moisture resistance when compared to predicted nominal performance baselines that were established in the temperature-only storage life tests. Bare cell moisture resistance data will be compared to DS19xx devices undergoing the identical stress conditions.

8.2.4. Capacity

Purpose: Determine the statistical distributions of useable capacity within a lot, and lot-to-lot.

Method: Discharge a sample of cells from each of three production lots into the maximum rated load for the cell type to a predetermined cut-off voltage. Record the data for the maximum, minimum, and average capacity, as well as the standard deviation for each lot. Compare this same data for all three lots for significant variations. Open a sample from each discharged sample, and record cathode thickness, separator and anode appearance, and presence of remaining electrolyte.

8.2.5. Safety

Purpose: Determine the safety aspects regarding the cell being qualified.

Method: Require the cell manufacturer to provide documented test results, independent laboratory data, material safety data sheets, and any other objective evidence that the cell under consideration has been tested for the effects of:

External corrosion caused by leaking cells;
Toxicity of the cell components;
Heat rise or explosion due to shorting;
Safe operating exposure limits to solder heat;
Short and long term effects of various reverse charging currents;
Recommended and non-recommended methods of disposal.

8.2.6. Performance

Purpose: Determine the suitability-for-use of the cell with respect to existing or planned assembly methods and product applications.

Method: Evaluate cell performance in the final product by collecting data in the following areas:

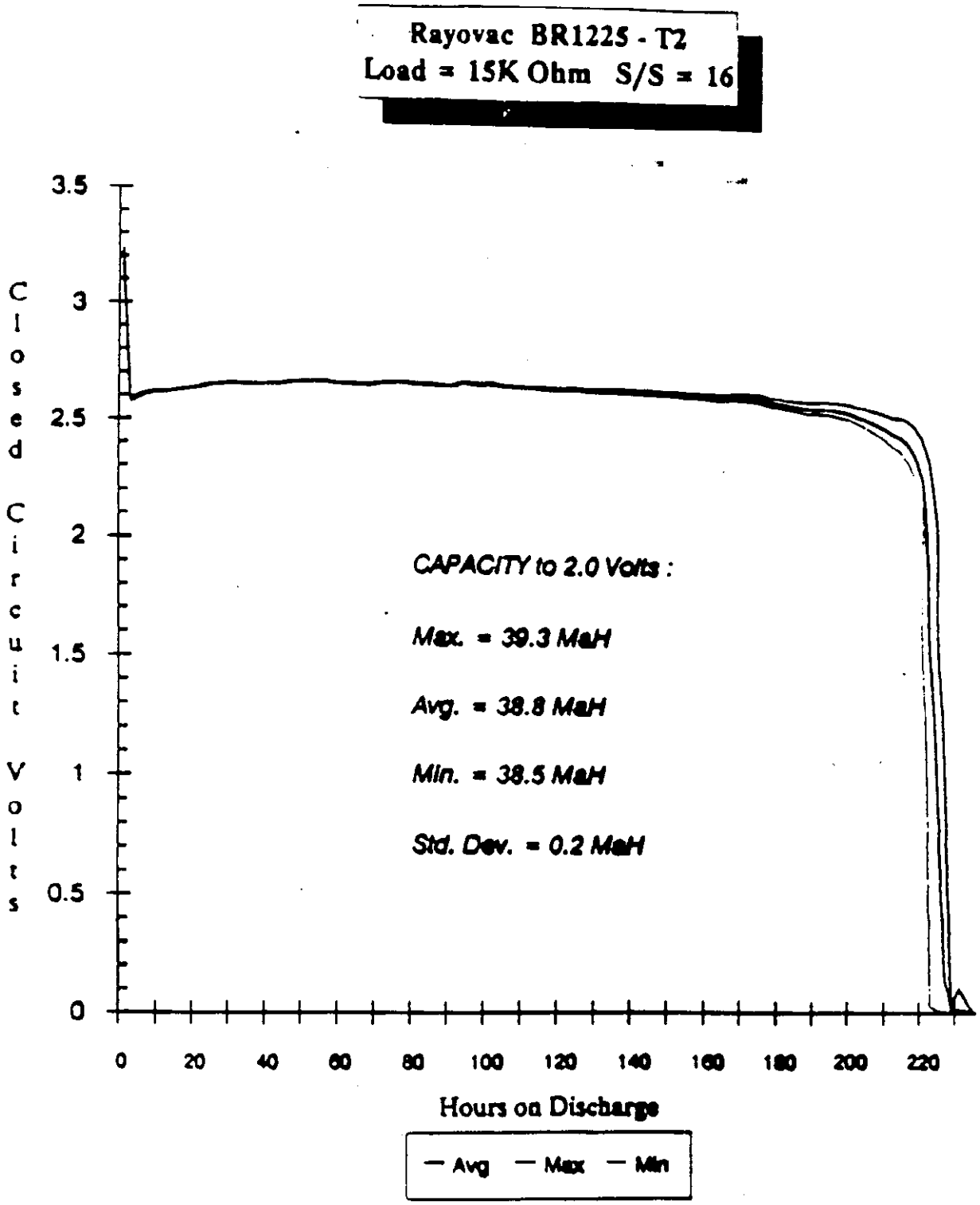
Open circuit voltage stability ove the temperature extremes encountered in manufacturing as well as the data sheet temperature ranges;
Perform data retention tests at high and low temperature extremes to observe any presence of a "wake-up" phenomena;
Determine the compatibility with the MicroCan package by performing storage life, temperature cycle, and temperature/humidity tests on the final product, and compare visual and electrical results to those obtained on bare cells;
Evaluate the tab welding process for tab pull strength, as well as any residual damage to the cell electrodes by evaluating the long term OCV characteristics under ambient storage conditions.

8.2.7. Quality Specification

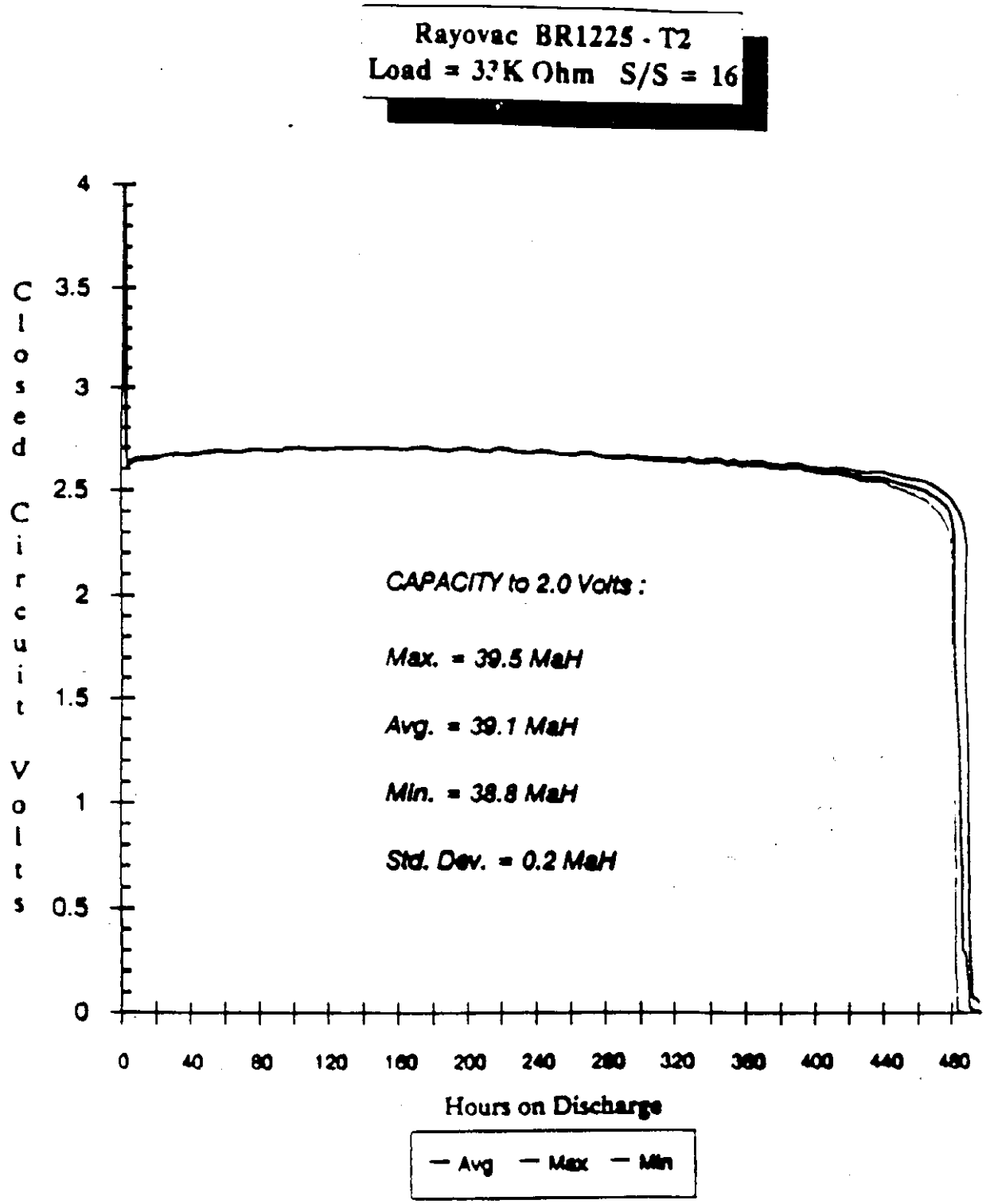
Purpose: Determine a mutually agreeable quality specification that can be applied to incoming material for the purposes of lot acceptance testing, and define the requirements for a qualified supplier.

Method: Acceptance testing shall be based on correlation of electrical parameters between the cell vendor and the IQC department. This correlation will include open circuit voltage, closed circuit voltage, and capacity distributions. Lots submitted for correlation will have the mean values, as well as the distribution of these parameters identified based on data taken by the supplier. This data will be correlated and verified by testing of samples from these same lots. Once correlation is established, future shipments will be accepted on lot statistics supplied by the vendor, and verified with sampling at the IQC step. In addition, this mutually agreed specification will require a period of prior notification of any major changes, and will detail the requalification responsibility incurred as a result of the major changes.

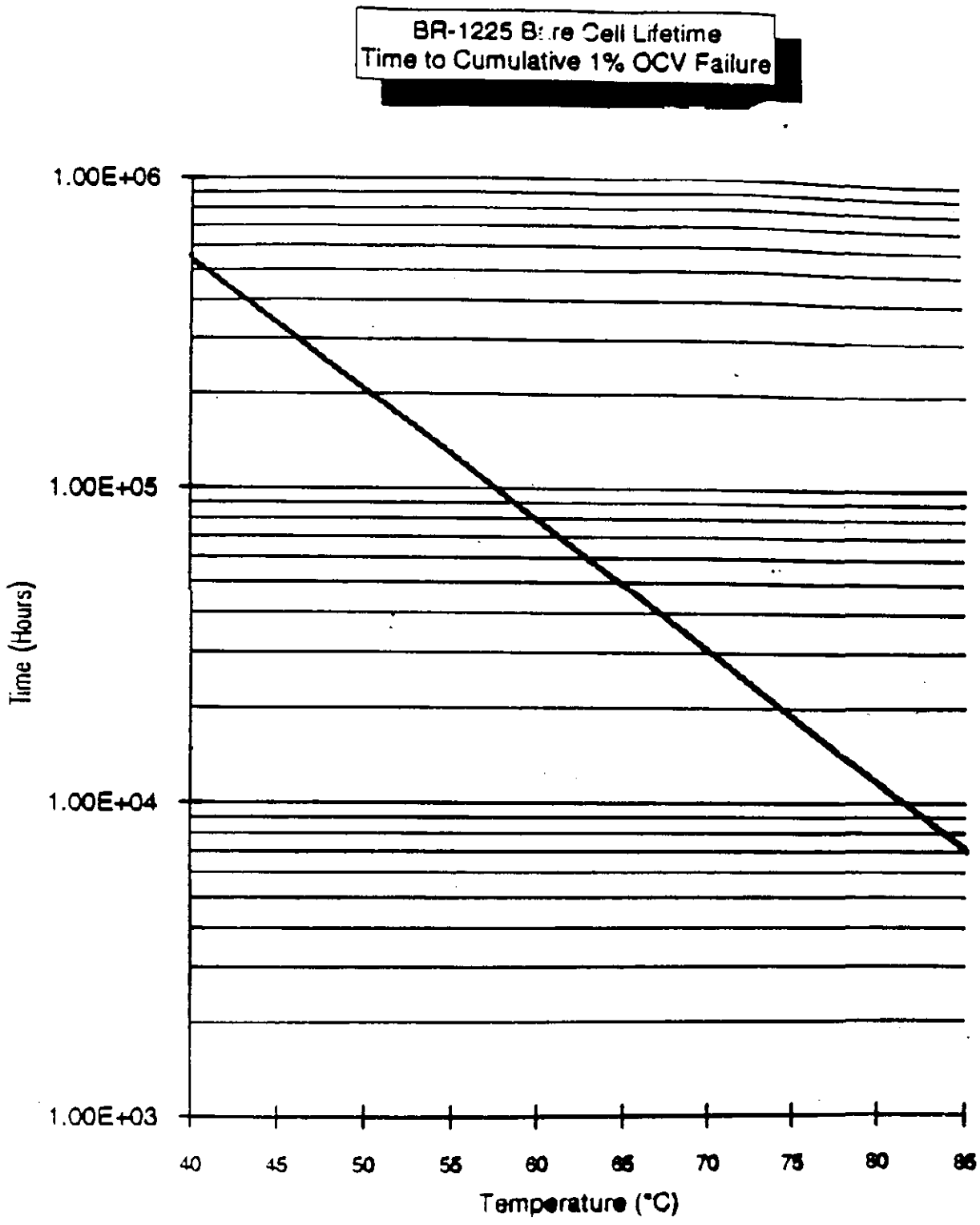
8.3.1 Discharge test - 15K ohm load



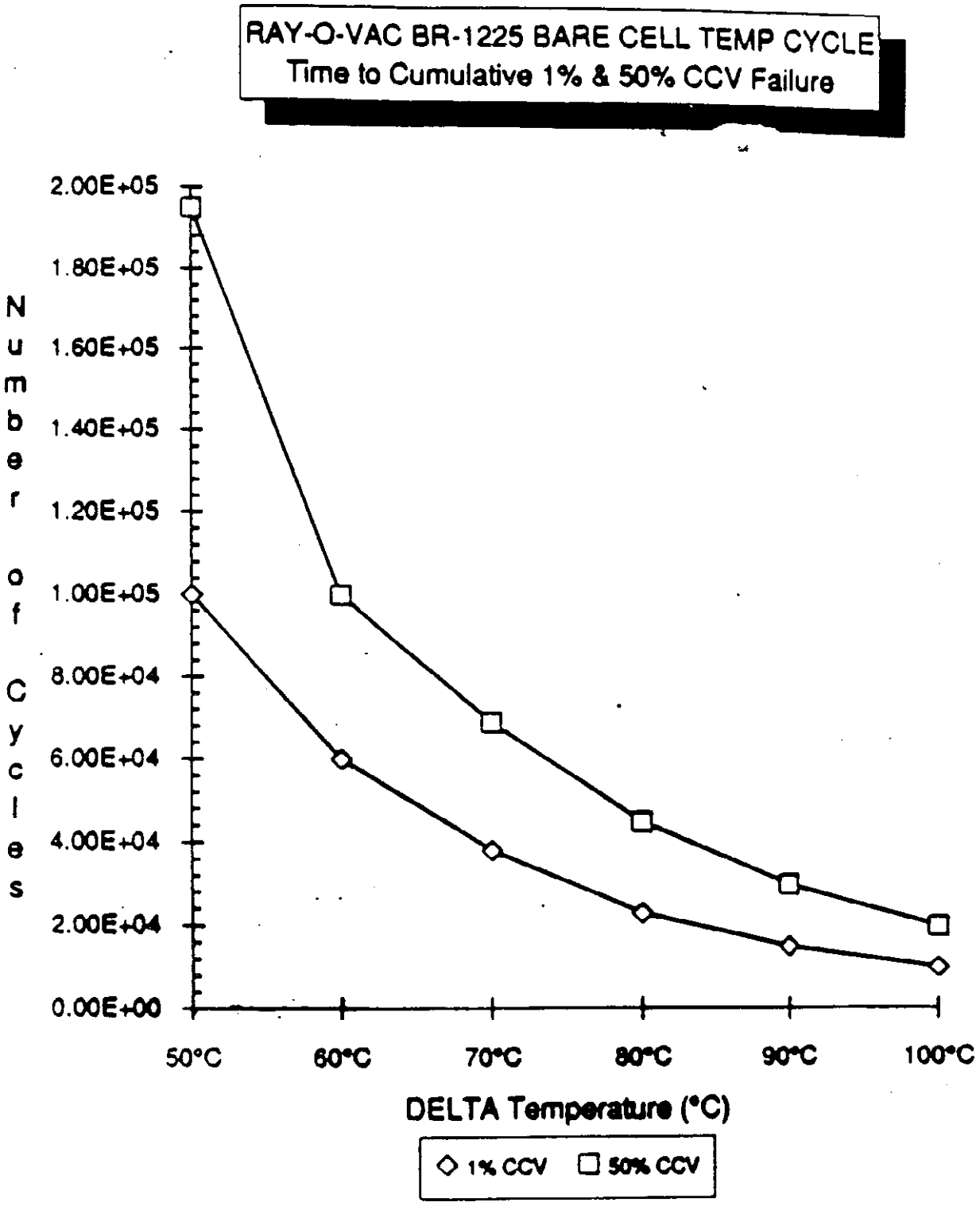
8.3.2 Discharge test - 33K ohm load



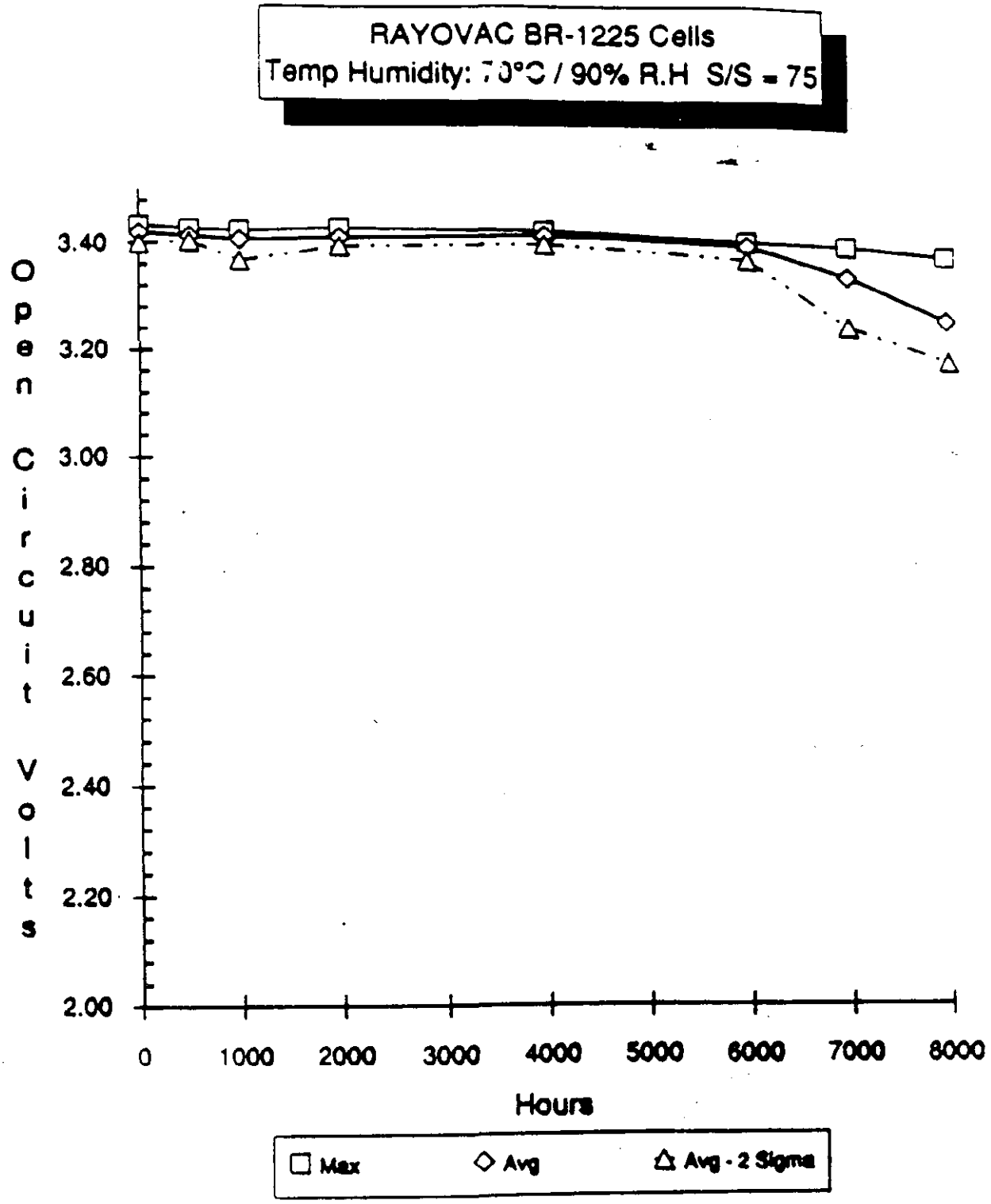
8.4. High temperature storage stress



8.5. Temperature cycling stress



8.6. Temperature/humidity stress



8.7. Safety issues

Manufacturer supplied data covering a wide range of mechanical and electrical tests is available upon request from Dallas Semiconductor. A summary of the tests are listed below. No adverse effects were noted after any of the tests.

8.7.1. Mechanical Vibration - Method 204C, Mil-Std-202E; 0.06" double amplitude from 10 to 56Hz, and 10g peak from 57 to 500Hz. Vibration frequency was varied logarithmically from 10 to 500Hz and back to 10Hz over a 15 minute period.

8.7.2. Mechanical Shock - 150g peak acceleration for 5 ms

8.7.3. Reduced Pressure (High Altitude) - 10 days at 3mm Hg (equal to altitude of 37km or 122,00ft)

8.7.4. Drop Test - Five drops onto concrete from a height of 102cm (40").

8.7.5. High Temperature Storage - 70°C for 90 days

8.7.6. Hot Plate Test - Temperature raised 5°C/minute up to 180°C without rupture, ignition, or explosion.

8.7.7 Thermal Shock - +60°C for one hour followed by -10°C for one hour; repeated 60 times. Transition from one temperature extreme to the other is immediate.

8.7.8. Thermal Cycle - +60°C for one hour, transition linearly for one hour to -10°C,dwell at -10°C for one hour, transition linearly for one hour back to +60°C; repeated 120 times.

8.7.9. Drilling - Drilled diametrically with an electric drill with drill diameter 4 mm. Temperature rose due to short circuit but no rupture, ignition, or explosion occurred.

8.7.10. Crush Test - Cells were crushed to half size diametrically with a hammer. Temperature rose due to short circuit but no rupture, ignition, or explosion occurred.

8.7.11. Burning Test - Cells subjected to 1000°C flame from gas burner. Cells vented out and caught fire within 3 minutes, no explosion occurred.

8.7.12. Immersion Test - Immersion in water and 5% salt water solution did not cause ignition.

8.7.13. Salt Water Spray - Sprayed with 5% salt water solution and left for 8 hours. Rust was produced but no cell leakage.

8.7.14. Short Circuit - Temperature rise was noted but no leakage or change in cell appearance.

8.7.15. Charge Test - No leakage, rupture, or explosion occurred when cell was charged to 3% of the nominal capacity with 4μA of current.

8.7.16. Transportation Regulations - Cells are authorized for all modes of transportation provided that they are packaged in strong outside containers or boxes and are separated to prevent shorting, or installed in electronic devices. Exact wording of the U.S. Department of Transportation regulation can be found in Title 49, Code of Federal Regulations (49 CFR 173.206(f)).

8.7.17. Disposal Regulations - Disposal of large quantities of lithium batteries should be performed by permitted, professional disposal firms knowledgeable in federal, state, and local hazardous materials and hazardous waste transportation and disposal requirements. The cells should never be incinerated or exposed to fire.

9.0. Reliability Monitoring Program

The Quality and Reliability department at Dallas Semiconductor performs a comprehensive set of tests at the point of product introduction to insure that all products meet a defined set of qualification standards. There is also an ongoing program to monitor the manufacturing processes which assures the customer that subsequent production lots meet the same high standards as those originally examined. This monitoring is accomplished by the Quality and Reliability department acting as an actual customer and placing a purchase order through a customer service representative. This guarantees that the units shipped from the stock room are randomly selected for the evaluation. The evaluation consists of three groups of 30 units each subjected to the set of tests as the original qualification. There are additional x-ray and dimensional checks done to insure that the assembly processes are still within specification. The results of the June 1993 monitor using the DS1992L-F50 as the test vehicle show no failures. The details can be found in Appendix IV.

Appendix I.
Notice of Qualification/Reliability Projection - DS1990A-F30/F50 and Related

DALLAS
SEMICONDUCTOR

NOTICE OF QUALIFICATION

Date: 7/22/93

Product Type: DS1990A F30/50 Rev A1

Product Description: Touch Serial No.

Design Type: AutoID w/one wire port

Component Parts: DS915 IC, PC Board

Assembly Process Description: Dallas Semiconductor, Short (F30) & Tall (F50) Can

Package Type: Anode/Cathode Stainless Steel Flange Can w/Polypropylene Grommet

Reliability Process Flow: Module Products Flow

Reliability Failure rate (Fits): 26 Fits

Reliability File Nos: Q-8800, Q-9318

The above product has successfully completed qualification on this date and meets Dallas Semiconductor requirement, 05-00605-000, for Fully Qualified Production Product.

Kim Windell
Reliability Engr. Manager

Product Engr. Manager

Test Engr. Manager

Director of Manufacturing

Director of Assembly Engr.

Director of Quality

RELIABILITY PROJECTION
DS1990A F30/50
TOUCH SERIAL NO.

Assembly Technology: Metal Can **Sub Components: DS915 Touch Memory Chip, PC Board**

Location: Dallas **Package Style: Anode/Cathode Short (F30) & Tail (F50) Can w/Flange & Polypropylene Grommet**

No. Pins: 0

Summary Data with Chi-Squared Distribution Assumed for IC's and Ea & B as noted below
Stress Ambient Temperature & Voltage to
Field Ambient Temperature & Voltage

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C	No. of Rejects	Failure Rate & Fail Mech.
DS914 A1	125°C, 7.0 V, Dyn.	48	1394	2.33E+07	1	F1
Touch Mem Chip		96	898	1.50E+07	0	
D/C 9045, 9049, 9107		1000	444	1.47E+06	0	
	125°C, 5.5 V, Dyn	1000	444	3.27E+07	0	
DS914 A2	125°C, 7.0 V, Dyn.	504	198	3.43E+07	0	
D/C 9143						
DS915 A2	125°C, 7.0 V, Dyn.	72	490	1.23E+07	0	
D/C 9306		1072	77	2.68E+07	0	
Subtotals				**2.9E+08**	**1**	**7 Fits**
Prnt'd Crkt Board	per MIL-HDBK-217D	2 clip terminals + Chip on PC board				
Subtotals						**19**
				Total		**26 Fits**

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1990 F30	Moisture Soak	960 hr	75	n/a	0	
D/C 9304	60°C/90% R.H. No bias			**Total**	**0**	**0.0%**
DS1990 F30	Temperature Cycle	2000 -	150	n/a	0	
D/C 9304	-40°C to +85°C, No bias			**Total**	**0**	**0.0%**
DS1990A F50						
D/C 9317	Mechanical Shock	Gp A: 16-/axis	30	n/a	0	
	Mil-Std-883C	500g's		**Total**	**0**	**0.0%**
	Method 2002					
	x1, x2, y1, y2, z1, z2					
	Vibration	Cond. A	66	n/a	0	
	Mil-Std-883C	10 to 55 Hz		**Total**	**0**	**0.0%**
	Method 2005	2x.06" /axis				
R1990 R30	Storage Life	1khr	225	n/a	0	
D/C 9106	85°C, No Bias			**Total**	**0**	**0.0%**
	Temperature Cycle	1000 -	150	n/a	0	
	-40°C to +85°C, No bias			**Total**	**0**	**0.0%**
	Moisture Soak	480 hr	225	n/a	0	
	70°C/90% R.H. No bias			**Total**	**0**	**0.0%**

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: Read type id	None	Not Analyzed	0.7	0.43

KW, 8/16/93

Appendix II.
Notice of Qualification/Reliability Projection - DS1994L-F50 and Related

DALLAS
SEMICONDUCTOR

NOTICE OF QUALIFICATION

Date: 6/7/93

Product Type: DS1994 LF50, DS1994 LM50 Rev B5

Product Description: Touch Serial w/Time

Design Type: AutoID w/one wire port

Component Parts: DS2404 IC, BR1225 Battery, Crystal, PC Board

Assembly Process Description: Dallas Semiconductor, Tail-Can

Package Type: Anode/Cathode Stainless Steel Tail Flange Can w/Polypropylene Grommet

Reliability Process Flow: Module Products Flow

Reliability Failure rate (Fits): 160 Fits

Reliability File Nos: Q-7613, Q-8120, Q-8138, S-8287, S-8233

The above product has successfully completed qualification on this date and meets Dallas Semiconductor requirement, 05-00605-000, for Fully Qualified Production Product.

Reliability Engr. Manager	*Product Engr. Manager*	*Test Engr. Manager*
Director of Manufacturing	*Director of Assembly Engr.*	*Director of Quality*

RELIABILITY PROJECTION
DS1994LF50 / LM50
TOUCH MEMORY W/TIME

Device Types: DS1994LF50 Rev B5, DS1994LM50 Rev B5

Assembly Technology: Metal Can

Sub Components: DS2404 1/3 Wire EconoRAM, PC Board, BR1225 Battery, Crystal

Location: Dallas **Package Style:** Anode/Cathode Tall Flange Can

Summary Data with Chi-Squared Distribution Assumed @ 60%CF and Ea, B as assigned below
Stress Ambient Temperature and Voltage to
Field Ambient Temperature and Voltage

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 3.0V	No. of Rejects	Failure Rate & Fail Mech.
DS2404B4	125°C, Dyn. 7.0V	48	784	1.33E+07	2	F1
1/3 Wire EconoRAM		1000	154	5.18E+07	1	P2
	125°C, Dyn. 5.5V	1000	234	1.76E+07	0	
			Subtotals	8.26E+07	3	51 Fits
BR1225	Storage Life	120000		n/a	1%	
Battery	55°C		Subtotals		1%	80
Seiko	estimate	n/a	n/a	n/a	n/a	
Crystal			Subtotals			10
Prnt'd Crkt Board	per HDBK 217D	2 clip terminals + Chip on PC board				
			Subtotals			19
Total						160 Fits

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1994LF50	Temperature Cycle	1000 ~	328	n/a	0	
DS1994LM50	-40°C to +85°C, No bias			Total	0	0.0%
D/C 9231, 9238, 9242, 9240						
	Moisture Soak	960 hr	360	n/a	0	
	60°C/90% R.H. No bias			Total	0	0.0%
DS1994LF50	Storage Life	2000 hr	224	n/a	0	
D/C 9207, 9208	85°C, No Bias			Total	0	0.0%
DS1991LF50	Mechanical Shock	Gp A: 18-/axis	70	n/a	0	
D/C 9123, 9131, 9136	Mil-Std-883C	500g's		Total	0	0.0%
	Method 2002					
	x1, x2, y1, y2, z1, z2	Gp B: 18-/axis	10	n/a	0	
		1500g's		Total	0	0.0%
		Gp C: 18-/axis	10	n/a	0	
		3000g's		Total	0	0.0%
DS1991LF50	Vibration	Cond. A	66	n/a	0	
DS1994LM50	Mil-Std-883C	10 to 55 Hz		Total	0	0.0%
D/C 9211, 9240	Method 2006	2x.06" /axis				
DS1994LF50	Salt Atmosphere	Cond C	10	n/a	0	
DS1994LM50	Mil-Std-883	96 hr		Total	0	0.0%
D/C 9240, 9242	Method 1009					

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: VccLeak /Comp	92-0104	pch gate oxide defect	0.3	1
F2: VccLeak /Comp/True	In Analysis		0.3	1

KW, 6/7/93

Appendix III.
MET Laboratories, Inc. - Intrinsically Safe Listing

LISTING No: DAL0913
MET PROJECT No: SAF128

DALLAS SEMICONDUCTOR
FEBRUARY 1, 1993

PRODUCT COVERED:

Touch Memories

MODELS:

DS1994, DS1993, DS1992, DS1991, DS1990

ELECTRICAL RATINGS:

V_{MAX} = 15 V L_i = 18 µH
I_{MAX} = 10 mA C_i = 0.2 nF

MANUFACTURED BY:

DALLAS SEMICONDUCTOR
4401 S. Beltwood Pkwy
Dallas, TX 75244-3292

PRODUCT DESCRIPTION:

The products covered by this report are designed to allow for storage and retrieval of information by touching the product's enclosure with a wand interface and computer approved under the entity concept and meeting the electrical ratings marked on the products. The products have been approved under the entity concept for use in **CLASS I, DIVISION I, GROUPS A, B, C, and D LOCATIONS.**

PREPARED BY:
MET LABORATORIES, INCORPORATED
914 W. PATAPSCO AVENUE
BALTIMORE, MARYLAND 21230
PHONE (410) 354-3300 / FACSIMILE (410) 354-3313

Appendix IV.
Reliability Monitoring Results - attached

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY FACILITY	AFER LOT NO.	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Jun-93	9311 B5	DALLAS	N/A	27640	1.2 µ Ox/Ni Pas	CAN

STRESS/JOB NO. — **READPOINT (Sample Size/No. of Fails)**

Hi Temp Storage	0 Hr	336 Hr	1KHr	Elect. Test	Cum %/FA Status
70°C, No Bias	90/0	30/0	30/0	30/0	0.0%
P-9487	Write Data	Read Data	Read Data	Full Elect	
Temp Cycle		100 ~	500 ~	1000 ~	Cum %/FA Status
0°C to +70°C		30/0	30/0	30/0	0.0%
P-9489					
Moisture Soak		192 Hr	576 Hr	960 Hr	Cum %/FA Status
60°C/90% RH		30/0	30/0	30/0	0.0%
P-9488					
Package Integrity			X-Ray	Phys.	
P-9481			Views	Dimen.	FA Status
			5/0	5/0	N/A

Failure Mode **FA#** **Failure Mechanism**

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY FACILITY	AFER LOT NO.	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Aug-93	9316 B5	DALLAS	N/A	240862AB	1.2 µ Ox/Ni Pas	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-9833, P-9850	0 Hr 90/1 F1 Write Data	336 Hr 29/0 Read Data	1KHr 29/0 Read Data	Elect. Test 29/0 Full Elect	Cum %/FA Status 0.0%
Temp Cycle 0°C to +70°C P-9852		100 ~ 30/0	500 ~ 30/0	1000 ~ 30/0	Cum %/FA Status 0.0%
Moisture Soak 60°C/90% RH P-9851		192 Hr 30/0	576 Hr 30/0	960 Hr 30/0	Cum %/FA Status 0.0%
Package Integrity P-9834			X-Ray Views 6/0	Phys. Dimen. 6/0	FA Status N/A

Failure Mode	FA#	Failure Mechanism
F1: Fail Bat Volt @ Write	Engr Eval	In Process

RELIABILITY MONITOR

PRODUCT	MONITOR DATE ~	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Oct-93	9318 B5	DALLAS	DS251255AB	1.2 µ Ox/Ni Pass.	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P10243, P10280	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum %/FA Status 0.0%
Temp Cycle 0°C to +70°C P10282	100 ~ 30/0 Read Data	500 ~ 30/0 Read Data	1000 ~ 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum %/FA Status 0.0%
Moisture Soak 60°C/90% RH P10281	192 Hr 30/0 Read Data	576 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum %/FA Status 0.0%
Package Integrity P-10244			X-Ray Views 5/0	Phys. Dimen. 6/0	

Failure Mode	FA#	Failure Mechanism

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Dec-93	9343 C1	DALLAS	DS317099AB-05	1.2 µ Ox/Ni Pass.	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-10853, P-10867	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-10869	100 ~ 30/0 Read Data	500 ~ 30/0 Read Data	1000 ~ 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-10868	192 Hr 30/0 Read Data	576 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Package Integrity P-10854			X-Ray Views 6/0	Phys. Dimen. 6/0	

Failure Mode	FA#	Failure Mechanism

RELIABILITY MONITOR

PRODUCT	MONITOR DATE _	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Feb-94	9406 C1	DALLAS	347079AA-25	1.2 µ Ox/Ni Pass.	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-11369	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-11371	100 ~ 30/0 Read Data	500 ~ 30/0 Read Data	1000 ~ 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-11370	192 Hr 30/0 Read Data	576 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Package Integrity P-11342			X-Ray Views 6/0	Phys. Dimen. 6/0	

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Apr-94	9413 C1	DALLAS	401055AA-23	1.2 µ Ox/Ni Pass.	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-11906, P-11929	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-11931	100 ~ 30/0 Read Data	500 ~ 30/0 Read Data	1000 ~ 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-11930	192 Hr 30/0 Read Data	576 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Package Integrity P-11905			X-Ray Views 6/0	Phys. Dimen. 6/0	

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Jun-94	9418 C1	DALLAS	405255AC-01	1.2 µ Ox/Ni Pass.	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-12522, P-12608	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-12610	100 ~ 30/0 Read Data	500 ~ 30/0 Read Data	1000 ~ 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-12609	192 Hr 30/0 Read Data	576 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Package Integrity P-12523			X-Ray Views 6/0	Phys. Dimen. 6/0	

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE ~	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Aug-94	9419 D2	DALLAS	411557AA-23	1.2 µ Ox/Ni Pass.	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-13210, P-13241	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-13243	100 ~ 30/0 Read Data	500 ~ 30/0 Read Data	1000 ~ 30/1 F1 Read Data	Elect. Test 30/0 Full Elect	Cum % 3.3%
Moisture Soak 60°C/90% RH P-13242	192 Hr 30/0 Read Data	576 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Package Integrity P-13211			X-Ray Views 6/0	Phys. Dimen. 6/0	

Failure Mode
F1: 1-RD Checkerbd

RELIABILITY MONITOR

PRODUCT	MONITOR DATE _	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Oct-94	9427 D2	DALLAS	411562AA-23	1.2 µ Ox/Ni Pass.	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-13654, P-13685	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-13687	100 ~ 30/1 F1 Read Data	500 ~ 29/0 Read Data	1000 ~ 29/0 Read Data	Elect. Test 29/0 Full Elect	Cum % 3.3%
Moisture Soak 60°C/90% RH P-13686	192 Hr 30/0 Read Data	576 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Package Integrity P-13655			X-Ray Views 6/0	Phys. Dimen. 6/0	

Failure Mode
F1: 1-RD Checkerbd

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Dec-94	9433 D2	DALLAS	413096AB-09	1.2µ Ox/Ni	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-14342, P-14383	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-14384		300 ~ 30/0 Read Data	1000 ~ 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-14385		288 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Package Integrity P-14343			X-Ray Views 6/0	Phys. Dimen. 6/0	

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Feb-95	9433 D2	DALLAS	413096AC-23	1.2µ Ox/Ni	F5 CAN

STRESS/JOB NO.

READPOINT
(Sample Size/No. of Fails)

Hi Temp Storage 70°C, No Bias P-15017, P-15034	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-15035		300 ~ 30/0 Read Data	1000 ~ 29/1 Read Data	Elect. Test 29/0 F1 Full Elect	Cum % 3.3%
Moisture Soak 60°C/90% RH P-15036		288 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Package Integrity P-15018			X-Ray Views 6/0	Phys. Dimen. 6/0	

Failure Mode
F1: 1-RD Checkerbd F

RELIABILITY MONITOR

PRODUCT	MONITOR DATE ←	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Apr-95	9435 D2	DALLAS	413095AAA24	1.2µ Ox/Ni	F5 CAN

STRESS/JOB NO.

READPOINT
(Sample Size/No. of Fails)

Hi Temp Storage 70°C, No Bias P-15561, P-15563	0 Hr 88/0 Write Data	336 Hr 29/0 Read Data	1KHr 29/0 Read Data	Elect. Test 29/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-15035		300 ~ 29/0 Read Data	1000 ~ 29/0 Read Data	Elect. Test 29/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-15036		288 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE ~	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Jun-95	9437 D2	DALLAS	416242AA-25	1.2µ Ox/Ni	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-15950, P-15956	0 Hr 90/0 Write Data	336 Hr 28/0 Read Data	1KHr 28/0 Read Data	Elect. Test 28/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-15957		300 ~ 29/0 Read Data	1000 ~ 29/0 Read Data	Elect. Test 29/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-15958		288 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Aug-95	9535 E3	DALLAS	425882AA-02	1.2µ Ox/Ni	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-16134, P-16386	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-16387		300 ~ 30/0 Read Data	1000 ~ 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-16388		288 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Dec-95	9523 D2	DALLAS	450117AA-03	1.2µ Ox/Ni	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-16748, P-16891	0 Hr 100/14 F1 Write Data	336 Hr 29/0 Read Data	1KHr 29/0 Read Data	Elect. Test 29/0 Full Elect	Cum % 14.0%
Temp Cycle 0°C to +70°C P-16892		300 ~ 28/0 Read Data	1000 ~ 28/0 Read Data	Elect. Test 28/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-16893		288 Hr 29/0 Read Data	960 Hr 29/0 Read Data	Elect. Test 29/0 Full Elect	Cum % 0.0%

Failure Mode
F1: 14-Low Battery

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS1992L-F50 w/BR1225 Bat	Mar-96	9611 E3	DALLAS	605355AB-04	1.2µ Ox/Ni	F5 CAN

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)				
Hi Temp Storage 70°C, No Bias P-17081, P-17089	0 Hr 90/0 Write Data	336 Hr 30/0 Read Data	1KHr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Temp Cycle 0°C to +70°C P-17090		300 – 30/0 Read Data	1000 – 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%
Moisture Soak 60°C/90% RH P-17091		288 Hr 30/0 Read Data	960 Hr 30/0 Read Data	Elect. Test 30/0 Full Elect	Cum % 0.0%

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Jan-94	9352 A3	CARSEM	DM340436AW	1.2µ OX/NI	TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Burn-in 125°C, 7.0 V. P-11113, P-11178	48 Hr 235/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 31 Fits
*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0				
Temp Cycle -55°C to +125°C P-11180	100 ~ 76/0	500 ~ 76/0	1K ~ 76/0	Cum % 0.0%
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-11179			100 Hr 77/0	Cum % 0.0%

Package Integrity P-11112	X-Ray Views	Phys. Dimen.	Mark. Perm.	Lead Integrity	Solderability P-11111
	6/0	6/0	6/0	24/0	24/0

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Mar-94	9408 A3	CARSEM	DM346021AD	1.2µ OX/NI	TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
	48 Hr	336 Hr	1KHr	*Failure Rate
Burn-in 125°C, 7.0 V. P-11577, P-11630	231/0	77/0	77/0	30 Fits

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev, Voltage Derating B = 1.0

	100 ~	500 ~	1K ~	Cum %
Temp Cycle -55°C to +125°C P-11632	77/0	77/0	77/0	0.0%

	100 Hr	Cum %
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-11631	77/0	0.0%

	X-Ray	Phys.	Mark.	Lead	Solderability
Package Integrity P-11576	Views 6/0	Dimen. 6/0	Perm. 6/0	Integrity 24/0	P-11575 24/0

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE ←	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	May-94	9415 A3	CARSEM	DM347073AT	1.2µ OX/NI	TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Burn-in 125°C, 7.0 V. P-12239, P-12279	48 Hr 240/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 30 Fits

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

Temp Cycle -55°C to +125°C P-12281	100 ~ 77/0	500 ~ 77/0	1K ~ 77/0	Cum % 0.0%
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-12280			100 Hr 77/0	Cum % 0.0%

Package Integrity P-12238	X-Ray Views 6/0	Phys. Dimen. 6/0	Mark. Perm. 6/0	Lead Integrity 24/0	Solderability P-12237 24/0

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Jul-94	9422 A3	CARSEM	DM409424AI	1.2µ OX/NI	TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Infant / High voltage Life 125°C, 7.0 V. P-12761, P-12849	48 Hr 231/1 F1	336 Hr 77/0	1KHr 77/0	*Failure Rate 66 Fits

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

Temp Cycle -55°C to +125°C P-12851	100 ~ 77/0	500 ~ 77/0	1K ~ 77/0	Cum % 0.0%
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-12850			100 Hr 73/0	Cum % 0.0%

Package Integrity P-12760	X-Ray Views 6/0	Phys. Dimen. 6/0	Mark. Perm. 6/0	Lead Integrity 24/0	Solderability P-12759 24/0

Failure Mode

F1: Prefunctional

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Sep-94	9430 A3	CARSEM	DM418322AB	1.2µ OX/NI	03 TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Infant / High voltage Life 125°C, 7.0 V. P-13461, P-13506	48 Hr 240/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 30 Fits
*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0				
Temp Cycle -55°C to +125°C P-13508	100 ~ 77/0	500 ~ 77/0	1K ~ 77/0	Cum % 0.0%
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-13507			100 Hr 77/0	Cum % 0.0%

Package Integrity P-13460	X-Ray Views	Phys. Dimen.	Mark. Perm.	Lead Integrity	Solderability P-13459
	6/0	6/0	6/0	24/0	24/0

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Nov-94	9443 A3	CARSEM	DM429142AI	1.2µ OX/NI	03 TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Infant / High voltage Life 125°C, 7.0 V. P-14042, P-14065	48 Hr 231/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 30 Fits
*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0				
Temp Cycle -55°C to +125°C P-14066		300 ~ 77/0	1K ~ 77/0	Cum % 0.0%
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-14067			100 Hr 77/0	Cum % 0.0%

Package Integrity P-14041	X-Ray Views	Phys. Dimen.	Mark. Perm.	Lead Integrity	Solderability P-14040
	6/0	6/0	6/0	24/0	24/0

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE _	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Jan-95	9449 A3	CARSEM	DM425668AO	1.2µ OX/NI	03 TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Infant / High voltage Life 125°C, 7.0 V. P-14581, P-14686	48 Hr 231/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 30 Fits
*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0				
Temp Cycle -55°C to +125°C P-14687		300 ~ 77/0	1K ~ 77/0	Cum % 0.0%
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-14688			100 Hr 77/0	Cum % 0.0%

Package Integrity P-14580	X-Ray Views	Phys. Dimen.	Mark. Perm.	Lead Integrity	Solderability P-14579
	6/0	6/0	6/0	24/0	24/0

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE ~	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Mar-95	9509 B1	CARSEM	DM438816CA	1.2µ OX/NI	03 TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Infant / High voltage Life 125°C, 7.0 V. P-15313, P-15345	48 Hr 231/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 30 Fits

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

Temp Cycle -55°C to +125°C P-15346	300 ~ 77/0	1K ~ 77/0	Cum % 0.0%
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-15347		100 Hr 77/0	Cum % 0.0%

Package Integrity P-15312	X-Ray Views	Phys. Dimen.	Mark. Perm.	Lead Integrity	Solderability P-15311 24/0

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	May-95	9518 A3	CARSEM	DM503082AW	1.2µ OX/NI	03 TO-92

STRESS/JOB NO. — **READPOINT (Sample Size/No. of Fails)**

	48 Hr	336 Hr	1KHr	*Failure Rate
Infant / High voltage Life 125°C, 7.0 V. P-15739, P-15788	231/0	77/0	77/0	30 Fits

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

	300 ~	1K ~	Cum %
Temp Cycle -55°C to +125°C P-15789	77/0	77/0	0.0%

	100 Hr	Cum %
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-15790	77/0	0.0%

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE ~	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Jul-95	9526 A3	CARSEM	DM505226AG	1.2µ OX/NI	03 TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Infant / High voltage Life	48 Hr	336 Hr	1KHr	*Failure Rate
125°C, 7.0 V.	231/0	77/0	77/0	30 Fits
P-16045, P-16097				

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

Temp Cycle	300 ~	1K ~	Cum %
-55°C to +125°C	39/0	39/0	0.0%
P-16098			

Biased Moisture (HAST)	100 Hr	Cum %
120°C/85% RH, 5.5 V	77/0	0.0%
P-16099		

Autoclave	96 Hr	Cum %
121°C/100% RH, 2 Atmos	38/1	0.0%
P-16100	F1	

Failure Mode

F1: 1-Prefunct.

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Sep-95	9535 B1	CARSEM	DM525054AF	1.2µ OX/NI	03 TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Infant / High voltage Life 125°C, 7.0 V. P-16365, P-16405	48 Hr 231/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 30 Fits
Temp Cycle -55°C to +125°C P-16406		300 ~ 38/0	1K ~ 38/0	Cum % 0.0%
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-16407			100 Hr 77/0	Cum % 0.0%
Autoclave 121°C/100% RH, 2 Atmos P-16408			96 Hr 38/0	Cum % 0.0%

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE _	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Dec-95	9544 B1	CARSEM	DM525683AH	1.2µ OX/NI	03 TO-92

STRESS/JOB NO. — **READPOINT (Sample Size/No. of Fails)**

	48 Hr	336 Hr	1KHr	*Failure Rate
Infant / High voltage Life 125°C, 7.0 V. P-16740, P-16792	228/3 F1	77/0	77/0	137 Fits

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

	300 ~	1K ~	Cum %
Temp Cycle -55°C to +125°C P-16793	36/0	36/0	0.0%

	100 Hr	Cum %
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-16794	77/0	0.0%

	96 Hr	Cum %
Autoclave 121°C/100% RH, 2 Atmos P-16795	38/0	0.0%

Failure Mode

F1: 3-DQ Resistance

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY FACILITY	ASSEMBLY OT NO	PROCESS TYPE	PACKAGE TYPE
DS2401	Mar-96	9545 B1	CARSEM	DM528323AD	1.2µ OX/NI	03 TO-92

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Infant / High voltage Life 125°C, 7.0 V. P-17076, P-17104	48 Hr 231/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 30 Fits

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

Temp Cycle -55°C to +125°C P-17105	300 ~ 39/0	1K ~ 39/0	Cum % 0.0%
Biased Moisture (HAST) 120°C/85% RH, 5.5 V. P-17106		100 Hr 77/0	Cum % 0.0%
Autoclave 121°C/100% RH, 2 Atmos P-17107		96 Hr 38/0	Cum % 0.0%

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE –	DATE CODE	ASSEMBLY ACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS2502	Nov-94	9439 A6	CARSEM	DM411591AI	1.2µ OX/NI EPROM	08 SOIC 150

STRESS/JOB NO. — **READPOINT (Sample Size/No. of Fails)**

Preconditioning (P/C): HTC Vapor Phase P-14021				Electrical 233/0	Cum % 0.0%
Infant / High Voltage Life 125°C, 7.0 V. P-14097, P-14204	48 Hr 230/1 F1	336 Hr 77/0	1KHr 77/0		*Failure Rate 66 Fits
Temp Cycle -55°C to +125°C P-14205		300 ~ 38/0	1K ~ 38/0		Cum % 0.0%
Biased Moisture 85°C/85% RH, 5.5 V. P-14206		274 Hr 76/0	959 Hr 76/0		Cum % 0.0%
Storage Life 150°C, No bias P-14207		336 Hr 37/0	1KHr 37/0		Cum % 0.0%

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

Package Integrity P-14019	X-Ray Views	Phys. Dimen.	Mark. Perm.	Lead Integrity	Solderability P-14002	Sonoscan, Post P/C P-14096
	6/0	6/0	6/0	24/0	24/0	2/2 F2

Failure Mode

F1: 1-Read Matrix
F2: 2-Delamination

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY ACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS2502	Jan-95	9441 A6	ANAM, K.	DN415200AH	1.2µ OX/NI EPROM	08 SOIC 150

STRESS/JOB NO.

READPOINT
(Sample Size/No. of Fails)

Preconditioning (P/C): HTC Vapor Phase P-14021				Electrical 233/0	Cum % 0.0%
Infant / High Voltage Life 125°C, 7.0 V. P-14710, P-14766	48 Hr 231/0	336 Hr 77/0	1KHr 77/0		*Failure Rate 30 Fits
*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0					
Temp Cycle -55°C to +125°C P-14767		300 ~ 39/0	1K ~ 39/0		Cum % 0.0%
Biased Moisture 85°C/85% RH, 5.5 V. P-14768		274 Hr 77/0	959 Hr 77/0		Cum % 0.0%
Storage Life 150°C, No bias P-14769		336 Hr 36/0	1KHr 36/0		Cum % 0.0%

Package Integrity P-14585	X-Ray Views	Phys. Dimen.	Mark Perm.	Lead Integrity	Solderability P-14584
	6/0	6/0	6/0	24/0	24/0

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY ACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS2502	Mar-95	9507 A6	ANAM, K.	DN434372AIA	1.2µ OX/NI EPROM	08 SOIC 150

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Preconditioning (P/C): HTC Vapor Phase P-15427			Electrical 233/0	Cum % 0.0%
Infant / High Voltage Life 125°C, 7.0 V. P-15484, P-15521	48 Hr 230/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 30 Fits
*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0				
Temp Cycle -55°C to +125°C P-15522		300 ~ 38/0	1K ~ 38/0	Cum % 0.0%
Biased Moisture 85°C/85% RH, 5.5 V. P-15523		274 Hr 64/0	959 Hr 64/0	Cum % 0.0%
Storage Life 150°C, No bias P-15524		336 Hr 38/0	1KHr 38/0	Cum % 0.0%

Package Integrity P-15425	X-Ray Views	Phys. Dimen.	Mark. Perm.	Lead Integrity	Solderability P-15424
					24/0

Failure Mode

-------- Touch Memory Reliability Report --------

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY ACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS2502	May-95	9512 A6	CARSEM	DM436518ACA	1.2µ OX/NI EPROM	08 SOIC 150

STRESS/JOB NO.

READPOINT
(Sample Size/No. of Fails)

Preconditioning (P/C):
HTC Vapor Phase
P-15762

Electrical	Cum %
233/0	0.0%

Infant / High Voltage Life
125°C, 7.0 V.
P-15802, P-15838

48 Hr	336 Hr	1KHr	*Failure Rate
231/0	77/0	77/0	30 Fits

*Chi Squared Method. 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

Temp Cycle
-55°C to +125°C
P-15839

300 ~	1K ~	Cum %
39/0	39/0	0.0%

Biased Moisture
85°C/85% RH, 5.5 V.
P-15840

274 Hr	959 Hr	Cum %

Note: Not performed due to board capacity

Storage Life
150°C, No bias
P-15841

336 Hr	1KHr	Cum %
38/0	38/0	0.0%

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY ACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS2502	Jul-95	9509 A6	CARSEM	DM434371AHA	1.2µ OX/NI EPROM	08 SOIC 150

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Preconditioning (P/C): HTC Vapor Phase P-16030			Electrical 233/0	Cum % 0.0%
Infant / High Voltage Life 125°C, 7.0 V. P-16067, P-16101	48 Hr 231/0	336 Hr 77/0	1KHr 77/0	*Failure Rate 30 Fits
*Chi Squared Method, 60% C L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0				
Temp Cycle -55°C to +125°C P-16102		300 ~ 39/0	1K ~ 39/0	Cum % 0.0%
Biased Moisture 85°C/85% RH, 5.5 V. P-16103		274 Hr 77/0	959 Hr 77/0	Cum % 0.0%
Storage Life 150°C, No bias P-16104		336 Hr 38/0	1KHr 38/0	Cum % 0.0%

Failure Mode

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY ACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS2502	Sep-95	9516 A6	CARSEM	DM440165GAA	1.2µ OX/NI EPROM	08 SOIC 150

STRESS/JOB NO.		READPOINT (Sample Size/No. of Fails)		
Preconditioning (P/C): HTC Vapor Phase P-16363			Electrical 232/0	Cum % 0.0%
Infant / High Voltage Life 125°C, 7.0 V. P-16379, P-16399	48 Hr 230/2 F1,F2	336 Hr 77/0	1KHr 77/0	*Failure Rate 102 Fits
*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0				
Temp Cycle -55°C to +125°C P-16400		300 ~ 39/0	1K ~ 39/0	Cum % 0.0%
Biased Moisture 85°C/85% RH, 5.5 V. P-16401		274 Hr 77/0	959 Hr 77/0	Cum % 0.0%
Storage Life 150°C, No bias P-16402		336 Hr 35/0	1KHr 35/0	Cum % 0.0%

Failure Mode

F1: 1-Iol/Vol
F2: 1-Read Matrix

RELIABILITY MONITOR

PRODUCT	MONITOR DATE ~	DATE CODE	ASSEMBLY ACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS2502	Dec-95	9546 A6	CARSEM	DM534661ANA	1.2µ OX/NI EPROM	08 SOIC 150

STRESS/JOB NO.	READPOINT (Sample Size/No. of Fails)			
Preconditioning (P/C): HTC Vapor Phase P-16744			Electrical 233/0	Cum % 0.0%
Infant / High Voltage Life 125°C, 7.0 V. P-16774, P-16894	48 Hr 231/0	336 Hr 77/0	1KHr 77/1 F1	*Failure Rate 67 Fits
*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0				
Temp Cycle -55°C to +125°C P-16895		300 ~ 39/0	1K ~ 39/0	Cum % 0.0%
Biased Moisture 85°C/85% RH, 5.5 V. P-16896		274 Hr 77/0	959 Hr 77/1 F2	Cum % 1.3%
Storage Life 150°C, No bias P-16897		336 Hr 38/0	1KHr 38/0	Cum % 0.0%

Failure Mode

F1: Read Matrix
F2: DQ Resistance

RELIABILITY MONITOR

PRODUCT	MONITOR DATE	DATE CODE	ASSEMBLY ACILITY	ASSEMBLY LOT NO	PROCESS TYPE	PACKAGE TYPE
DS2502	Mar-96	9546 A6	CARSEM	DM534656ATA	1.2µ OX/NI EPROM	08 SOIC 150

STRESS/JOB NO. — **READPOINT (Sample Size/No. of Fails)**

Preconditioning (P/C): HTC Vapor Phase P-17086			Electrical 229/1 F1	Cum % 0.4%
Infant / High Voltage Life 125°C, 7.0 V. P-17098, P-17138	48 Hr 226/1 F2	336 Hr 70/0	1KHr 70/0	*Failure Rate 72 Fits
Temp Cycle -55°C to +125°C P-17139		300 ~ 38/0	1K ~ 38/0	Cum % 0.0%
Biased Moisture 85°C/85% RH, 5.5 V. P-17140		274 Hr 74/0	959 Hr	Cum %
Storage Life 150°C, No bias P-17141		336 Hr 37/0	1KHr 37/0	Cum % 0.0%

*Chi Squared Method, 60% C. L., 55°C & 5.5V; Temperature Derating: Ea = 0.7 ev; Voltage Derating B = 1.0

Failure Mode

F1: Preset Matrix
F2: DQ Resistance

Appendix V.
Example FIT Rate Calculation

The data presented in the Notice of Qualification provided by the Dallas Semiconductor Quality and Reliability Department expresses the reliability failure rate in FITs. A FIT is a a figure of merit that predicts the statisical likelihood of failure within a certain population of parts over a given period of time. A FIT is equal to 1 failure in 1 billion cumulative device hours. The determination of this figure is usually achieved thru accelerated testing that is then extrapolated back to the actual use conditions. This is necessary to be able to achieve qualification of a product within a reasonable period (i.e. cannot wait for 10 years to determine that 10 year data retention is possible).

An example using the information provided in Appendix I. shows how the number of FITs for a device can predict the number of failures in a given application.

Assumptions:
1) Device type is DS1990A-F30; reliability failure rate is 26 FITs (Appendix I.)
2) Use condition is within datasheet specification
3) Application requires the use of 100,000 units

For 100K units:

26 FITs = 26 failures per 1 billion device hours

26 failures per 1 billion device hours/100K devices = 26 failures per 10K hours

10K hours is approximately 1.2 years

With a FIT rate of 26, out of the original 100K units the cumulative number of failures would be 217 (.2%) over a 10 year period.

Appendix VI.
Maximum Number of Transactions and Lifetime Calculations for Touch Memory

In this section two different lifetime calculations for Touch Memories are presented:

a) maximum possible number of transactions during the service life of 10 years before the available energy is consumed
b) lifetime of the internal energy source if transactions occur such that a device is constantly accessed at the maximum possible rate

For each calculation a typical and a worst case is considered. DS1991/-x- are very similar with respect to energy consumption. The transaction cycle for the DS1991 is 8 bits shorter than for the other devices. Since this is only a minor difference, the values of the DS1992/3 are also used for the DS1991. The DS1994 needs to be considered separately, since the timekeeping circuitry causes a standby current (no communication occurring) which is higher than the standby current of the other devices.

I. Definition of a transaction

One transaction consists of the following steps:

A. Initialization (Reset and Presence)	960µs
B. ROM Function Command (Skip ROM)	488µs (61µs x 8)
C. Memory Function Command (Write Scratch)	488µs (61µs x 8)
D. Target Address (write 16 bits)	976µs (61µs x 16)
E. Data (write 256 bits)	15,616µs (61µs x 256)
F. Initialization (Reset and Presence)	960µs
G. ROM Function Command (Skip ROM)	488µs (61µs x 8)
H. Memory Function Command (Read Scratch)	488µs (61µs x 8)
I. Target Address (read 24 bits)	1464µs (61µs x 24)
J. Data (read 256 bits)	15,616µs (61µs x 256)

Minimum time for one transaction: 37.544 ms.

II. Lithium Cell and Device Data

Capacity of BR1225:

Qbat = 35mAh => 35mAh/(24h/day * 365.25day/yr) = 3.99µAyr

A. Device Data, typical case:

Standby Current	DS1991/2/3:	IBAT1 = 25nA
	DS1994:	IBAT1 = 200nA
Operating Charge:	DS1991/2/3/4	QBAT0 = 100nC/trans

B. Device Data, worst case: (from 1992/3 databook):

Standby Current	DS1991/2/3:	IBAT1 = 200nA
	DS1994:	IBAT1 = 350nA
Operating Charge:	DS1991/2/3/4	QBAT0 = 200nC/trans

III. Expected number of available transactions:

During the Service Life of 10 years the charge consumed in the standby mode is:

QSTB = IBAT1 * 10yr

A. typical case:

DS1991/2/3: QSTB = 25nA * 10yr = 0.25 µAyr
DS1994: QSTB = 200nA * 10yr = 2.00 µAyr

B. worst case:

DS1991/2/3: QSTB = 200nA * 10yr = 2.00 µAyr
DS1994: QSTB = 350nA * 10yr = 3.50 µAyr

With the lithium cell of Qbat = 3.99 µAyr, the charge available for transactions is:

Qavail = Qbat - QSTB

A. typical case:

DS1991/2/3: Qavail = 3.99µAyr - 0.25µAyr = 3.74µAyr
DS1994: Qavail = 3.99µAyr - 2.00µAyr = 1.99uAyr

B. worst case:

DS1991/2/3: Qavail = 3.99µAyr - 2.00µAyr = 1.99µAyr
DS1994: Qavail = 3.99µAyr - 3.50µAyr = 0.49µAyr

Since one year is 31.56 million seconds, 1 µAyr is equivalent to 31.56 Coulombs.

The number of available transactions is:

TRavail = Qavail / QBAT0

A. typical case:

DS1991/2/3: TRavail = 3.74 * 31.56 C / 100nC = 1180 million
DS1994: TRavail = 1.99 * 31.56 C / 100nC = 628 million

B. worst case:

DS1991/2/3: TRavail = 1.99* 31.56 C / 200nC = 314 million
DS1994: TRavail = 0.49* 31.56 C / 200nC = 77.3 million

IV. Expected lifetime when transactions occur at maximum 1-wire rate:

Since one transaction takes minimum 37.544ms the maximum rate of transactions is

TRrate = 1 / 37.544ms = 26.6 transactions / s

The current drained from the lithium cell at the maximum rate of transactions is:

Imaxtr = QBAT0 * TRrate + IBAT1

A. typical case:

DS1991/2/3: Imaxtr = 100nC * 26.6/s + 25nA = 2.685 µA
DS1994: Imaxtr = 100nC * 26.6/s + 200nA =2.860 µA

B. worst case:

DS1991/2/3: Imaxtr = 200nC * 26.6/s + 200nA = 5.520 µA
DS1994: Imaxtr = 200nC * 26.6/s + 350nA = 5.670 µA

With the total charge of the lithium cell being 3.99 µAyr, the calculated lifetime of the device is:

Lifetime = Capacity / Imaxtr

A. typical case:

DS1991/2/3: Lifetime = 3.99 µAyr / 2.685 µA = 1.486 yr
DS1994: Lifetime = 3.99 µAyr / 2.860 µA = 1.395 yr

B. worst case:

DS1991/2/3: Lifetime = 3.99 µAyr / 5.520 µA = 0.723 yr
DS1994: Lifetime = 3.99 µAyr / 5.670 µA = 0.704 yr

During this calculated lifetime the number of transactions is:

NRtr = Lifetime * TRrate

A. typical case:

DS1991/2/3: NRtr = 1.486 yr*31.56 million s/yr* 26.6/s = 1247 million
DS1994: NRtr = 1.395 yr*31.56 million s/yr* 26.6/s = 1171 million

B. worst case:

DS1991/2/3: NRtr = 0.723 yr* 31.56 million s/yr* 26.6/s = 607 million
DS1994: NRtr = 0.704 yr* 31.56 million s/yr* 26.6/s = 591 million

Appendix VII.
Additional Product Reliability Projections - attached

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS1205S

Product Types:	DS1205 REV: B2, B4		
Date Codes:	9122, 9127, 9128		
Process Technology:	Si Gate CMOS	Channel Length: 1.2 µ	Metal Pitch: 3.0µ
Assembly Technology:	Site: ANAM	Package: 16 SOIC	

Summary Data with Chi-Squared Distribution Assumed @ 60%CF and Ea = 0.7 ev, B = 1.0
Stress Ambient Temperature and Voltage to
Field Ambient Temperature and Voltage

Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 5.5V	No. of Rejects	Failure Rate & Fail Mech.
125°C, Dyn. 7.0V	36	1050	1.3E+07	1	F1
	1000	231	7.7E+07	0	
125°C, Dyn. 5.5V	1000	348	2.6E+07	0	
Totals			**1.17E+08**	**1**	**17 Fits**

Package Tests

Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
Temperature Cycle -55°C to +125°C	1000 ~	231	n/a	0	
			Total	**0**	**0.0%**
Temperature Humidity 85°C/85% R H , 5 5V	959 hr	231	F2, F3	2	
			Total	**2**	**0.9%**

Failure Mechanism		Corrective Action
F1	IccStby	Pending, Product Engr Evaluation
F2	Continuity	Pending, Product Engr Evaluation
F3	Functional	Pending, Product Engr Evaluation

——— Touch Memory Reliability Report ———

RELIABILITY PROJECTION
DS1420 F30
TOUCH MEMORY CHIP

Assembly Technology: Metal-Can

Sub Components: DS915 Touch Memory Chip, PC Board

Location: Dallas

Package Style: Anode/Cathode Short (F30) & Can w/Flange & Polypropylene Grommet

No. Pins: 0

Summary Data with Chi-Squared Distribution Assumed for IC's and Ea & B as noted below
Stress Ambient Temperature & Voltage to Field Ambient Temperature & Voltage

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C	No. of Rejects	Failure Rate & Fail Mech.
DS914 A1	125°C, 7.0 V, Dyn.	48	1394	2.33E+07	1	F1
Touch Mem Chip		96	898	1.50E+07	0	
D/C 9045, 9049, 9107		1000	444	1.47E+08	0	
	125°C, 5.5 V, Dyn	1000	444	3.27E+07	0	
DS914 A2	125°C, 7.0 V, Dyn.	504	196	3.43E+07	0	
D/C 9143						
DS915 A2	125°C, 7.0 V, Dyn.	72	490	1.23E+07	0	
D/C 9308		1072	77	2.68E+07	0	
Subtotals				2.9E+08	1	7 Fits
Prnt'd Crkt Board	per MIL-HDBK-217D	2 clip terminals + Chip on PC board				
Subtotals						19
				Total		26 Fits

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1990 F30	Moisture Soak	960 hr	75	n/a	0	
D/C 9304	60°C/90% R.H. No bias			Total	0	0.0%
DS1990 F30	Temperature Cycle	2000 ~	150	n/a	0	
D/C 9304	-40°C to +85°C, No bias			Total	0	0.0%
DS1990A F50						
D/C 9317	Mechanical Shock	Gp A: 18~/axis	30	n/a	0	
	Mil-Std-883C	500g's		Total	0	0.0%
	Method 2002					
	x1, x2, y1, y2, z1, z2					
	Vibration	Cond. A	66	n/a	0	
	Mil-Std-883C	10 to 55 Hz		Total	0	0.0%
	Method 2005	2x.06" /axis				
R1990 R30	Storage Life	1khr	225	n/a	0	
D/C 9108	85°C, No Bias			Total	0	0.0%
	Temperature Cycle	1000 ~	150	n/a	0	
	-40°C to +85°C, No bias			Total	0	0.0%
	Moisture Soak	480 hr	225	n/a	0	
	70°C/90% R.H. No bias			Total	0	0.0%

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: Read type Id	None	Not Analyzed	0.7	0.43

-------- Touch Memory Reliability Report -------

RELIABILITY PROJECTION
DS1425LF5 Rev C1
Touch MultiKey

Device Types: DS1425LF50 Rev C1

Assembly Technology: Metal Can Sub Components: DS1205 MultiKey, PC Board, BR1225 Battery
Location: Dallas Package Style: Anode/Cathode Tall Flange Can

Summary Data with Chi-Squared Distribution Assumed for IC's and Ea = 0.7 ev
Stress Ambient Temperature to Field Ambient Temperature
o Voltage Derating

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C	No. of Rejects	Failure Rate & Fail Mech.
DS1205S Multi Key	125°C, Dyn. 7.0V	36	1050	1.31E+07	1	F1
		1000	231	7.74E+07	0	
	125°C, Dyn. 5.5V	1000	348	2.60E+07	0	
			Subtotals	1.17E+08	1	17 Fits
BR1225 Battery	Storage Life 55°C	120000		n/a	1%	
			Subtotals		1%	80
Prnt'd Crkt Board per MIL-HDBK-217D		2 clip terminals + Chip on PC board				
			Subtotals			19
				Total		116 Fits

Package Tests

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1991F5 Rev C1	Temperature Cycle -40°C to +85°C, No bias	1000 ~	225	n/a	0	
				Total	0	0.0%
	Moisture Soak 70°C/90% R.H. No bias	2000 hr	225	n/a	0	
				Total	0	0.0%
	Storage Life 85°C, No Bias	2000 hr	224	n/a	0	
				Total	0	0.0%
DS1991F5 Rev B1	Mechanical Shock Mil-Std-883C Method 2002 x1, x2, y1, y2, z1, z2	Gp A: 18~/axis 500g's	70	n/a	0	
				Total	0	0.0%
		Gp B: 18~/axis 1500g's	10	n/a	0	
				Total	0	0.0%
		Gp C: 18~/axis 3000g's	10	n/a	0	
				Total	0	0.0%

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: ICC	None	Not Analysed	0.7	0.43

——— Touch Memory Reliability Report ———

RELIABILITY PROJECTION
DS1427LF50 / LM50
Touch 4K X 1 Memory w/Time

Device Types: DS1427LF50 Rev B5, DS1427LM50 Rev B5

Assembly Technology: Metal Can

Sub Components: DS2404 1/3 Wire EconoRAM, PC Board, BR1225 Battery, Crystal
Location: Dallas Package Style: Anode/Cathode Tall Flange Can

Summary Data with Chi-Squared Distribution Assumed @ 60%CF and Ea, B as assigned below
Stress Ambient Temperature and Voltage to
Field Ambient Temperature and Voltage

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 3.0V	No. of Rejects	Failure Rate & Fail Mech.
DS2404B4	125°C, Dyn. 7.0V	48	784	1.33E+07	2	F1
1/3 Wire EconoRAM		1000	154	5.18E+07	1	F2
	125°C, Dyn. 5.5V	1000	234	1.76E+07	0	
			Subtotals	8.26E+07	3	51 Fits
BR1225	Storage Life	120000		n/a	1%	
Battery	55°C		Subtotals		1%	80
Seiko	estimate	n/a	n/a	n/a	n/a	
Crystal			Subtotals			10
Prnt'd Crkt Board	per HDBK 217D	2 clip terminals + Chip on PC board				
			Subtotals			19
Total						160 Fits

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1994LF50	Temperature Cycle	1000 –	328	n/a	0	
DS1994LM50	-40°C to +85°C, No bias			Total	0	0.0%
D/C 9231, 9238, 9242, 9240						
	Moisture Soak	960 hr	360	n/a	0	
	60°C/90% R.H. No bias			Total	0	0.0%
DS1994LF50	Storage Life	2000 hr	224	n/a	0	
D/C 9207, 9208	85°C, No Bias			Total	0	0.0%
DS1991LF50	Mechanical Shock	Gp A: 18–/axis	70	n/a	0	
D/C 9123, 9131, 9136	Mil-Std-883C	500g's		Total	0	0.0%
	Method 2002					
	x1, x2, y1, y2, z1, z2	Gp B: 18–/axis	10	n/a	0	
		1500g's		Total	0	0.0%
		Gp C: 18–/axis	10	n/a	0	
		3000g's		Total	0	0.0%
DS1991LF50	Vibration	Cond. A	66	n/a	0	
DS1994LM50	Mil-Std-883C	10 to 55 Hz		Total	0	0.0%
D/C 9211, 9240	Method 2005	2x.06" /axis				
DS1994LF50	Salt Atmosphere	Cond C	10	n/a	0	
DS1994LM50	Mil-Std-883	96 hr		Total	0	0.0%
D/C 9240, 9242	Method 1009					

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: VccLeak /Comp	92-0104	pch gate oxide defect	0.3	1
F2: VccLeak /Comp/True	In Analysis		0.3	1

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS1494LF50 / LM50
- Touch 4K X 1 Memory w/Time

Device Types: DS1494LF50 Rev B5, DS1494LM50 Rev B5

Assembly Technology: Metal Can

Sub Components: DS2404 1/3 Wire EconoRAM, PC Board, BR1225 Battery, Crystal

Location: Dallas **Package Style:** Anode/Cathode Tall Flange Can

Summary Data with Chi-Squared Distribution Assumed @ 60%CF and Ea, B as assigned below
Stress Ambient Temperature and Voltage to
Field Ambient Temperature and Voltage

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 3.0V	No. of Rejects	Failure Rate & Fail Mech.
DS2404B4	125°C, Dyn 7.0V	48	784	1.33E+07	2	F1
1/3 Wire EconoRAM		1000	154	5.18E+07	1	F2
	125°C, Dyn. 5.5V	1000	234	1.76E+07	0	
			Subtotals	**8.26E+07**	**3**	**51 Fits**
BR1225	Storage Life	120000		n/a	1%	
Battery	55°C		**Subtotals**		**1%**	**80**
Seiko	estimate	n/a	n/a	n/a	n/a	
Crystal			**Subtotals**			**10**
Prnt'd Crkt Board	per HDBK 217D	2 clip terminals + Chip on PC board				
			Subtotals			**19**
Total						**160 Fits**

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1994LF50	Temperature Cycle	1000 ~	328	n/a	0	
DS1994LM50	-40°C to +85°C, No bias			**Total**	**0**	**0.0%**
D/C 9231, 9238, 9242, 9240						
	Moisture Soak	960 hr	360	n/a	0	
	60°C/90% R.H. No bias			**Total**	**0**	**0.0%**
DS1994LF50	Storage Life	2000 hr	224	n/a	0	
D/C 9207, 9208	85°C, No Bias			**Total**	**0**	**0.0%**
DS1991LF50	Mechanical Shock	Gp A: 18~/axis	70	n/a	0	
D/C 9123 9131, 9136	Mil-Std-883C Method 2002	500g's		**Total**	**0**	**0.0%**
	x1 x2, y1, y2, z1, z2	Gp B: 18~/axis	10	n/a	0	
		1500g's		**Total**	**0**	**0.0%**
		Gp C: 18~/axis	10	n/a	0	
		3000g's		**Total**	**0**	**0.0%**
DS1991LF50	Vibration	Cond. A	66	n/a	0	
DS1994LM50	Mil-Std-883C	10 to 55 Hz		**Total**	**0**	**0.0%**
D/C 9211, 9240	Method 2005	2x.06" /axis				
DS1994LF50	Salt Atmosphere	Cond C	10	n/a	0	
DS1994LM50	Mil-Std-883	96 hr		**Total**	**0**	**0.0%**
D/C 9240 9242	Method 1009					

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1 VccLeak /Comp	92-0104	pch gate oxide defect	0.3	1
F2 VccLeak /Comp/True	In Analysis		0.3	1

-------- Touch Memory Reliability Report -------

RELIABILITY PROJECTION
DS1982 F30/50

Device types: DS1982 F30/50

Assembly Technology: Metal Can

Sub Components: DS2502 Touch Memory w/ 1K EPROM Chip, PC Board
Location: Dallas
Package Style: Anode/Cathode Short (F30) & Tall (F50) Can w/Flange & Polypropylene Grommet

Summary Data with Chi-Squared Distribution Assumed
Stress Ambient Temperature and Voltage (125°C, 5.5V, 6.0V or 7.0V)
to Field Ambient Temperature and Voltage (55°C, 5.5V)
Voltage and Temperature Acceleration as noted below

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 5.50 V	No. of Rejects	Failure Rate & Fail Mech.
DS2502 A6	125°C, Static 7.0V	48	692	1.15E+07	0	
D/C 9507, 9509, 9512		1000	231	8.03E+07	0	
Subtotals				**9.2E+07**	**0**	**10 Fits**
Prnt'd Crkt Board	per MIL-HDBK-217D	2 clip terminals + Chip on PC board				
Subtotals						**19**
				Total		**29 Fits**

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1990 F30	Moisture Soak	960 hr	75	n/a	0	
D/C 9304	60°C/90% R.H. No bias			**Total**	**0**	**0.0%**
DS1990 F30	Temperature Cycle	2000 ~	150	n/a	0	
D/C 9304	-40°C to +85°C, No bias			**Total**	**0**	**0.0%**
DS1990A F50						
D/C 9317	Mechanical Shock	Gp A: 18~/axis	30	n/a	0	
	Mil-Std-883C	500g's		**Total**	**0**	**0.0%**
	Method 2002					
	x1, x2, y1, y2, z1, z2					
	Vibration	Cond. A	66	n/a	0	
	Mil-Std-883C	10 to 55 Hz		**Total**	**0**	**0.0%**
	Method 2005	2x.06" /axis				
R1990 R30	Storage Life	1khr	225	n/a	0	
D/C 9108	85°C No Bias			**Total**	**0**	**0.0%**
	Temperature Cycle	1000 ~	150	n/a	0	
	-40°C to +85°C, No bias			**Total**	**0**	**0.0%**
	Moisture Soak	480 hr	225	n/a	0	
	70°C/90% R.H. No bias			**Total**	**0**	**0.0%**

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
None	n/a	n/a	0.7	1

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS1990
TOUCH SERIAL NO.

Device Types: DS1990A

Assembly Technology: Metal Can

Sub Components: DS914 Touch Memory Chip, PC Board
Location: Dallas Package Style: Anode/Cathode Can

Summary Data with Chi-Squared Distribution Assumed for IC's and Ea = 0.7 ev
Stress Ambient Temperature to Field Ambient Temperature
No Voltage Derating

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C	No. of Rejects	Failure Rate & Fail Mech.
DS914	125°C, 7.0 V, Dyn.	48	898	3.34E+06	1	F1
Memory Chip	125°C, 7.0 V, Dyn.	1000	444	3.27E+07	0	
	125°C, 5.5 V, Dyn	1000	444	3.27E+07	0	
Subtotals				6.9E+07	1	9 Fits
Pmt'd Crkt Board	per MIL-HDBK-217D	2 clip terminals + Chip on PC board				
Subtotals						19
				Total		28 Fits

Package Tests

Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
Temperature Cycle	1000 ~	150	n/a	0	
-40°C to +85°C, No bias			Total	0	0.0%
Moisture Soak	480 hr	225	n/a	0	
70°C/90% R.H. No bias			Total	0	0.0%
Storage Life	1khr	225	n/a	0	
85°C, No Bias			Total	0	0.0%

Failure Mechanism		Corrective Action
F1	Read Type Id	None

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS1991LF5 Rev C1
OUCH SERIAL NO.

Device Types: DS1991LF5

Assembly Technology: Metal Can

Sub Components: DS1205 MultiKey, PC Board, BR1225 Battery
Location: Dallas **Package Style:** Anode/Cathode Tall Flange Can

Summary Data with Chi-Squared Distribution Assumed for IC's and Ea = 0.7 ev
Stress Ambient Temperature to Field Ambient Temperature
o Voltage Derating

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C	No. of Rejects	Failure Rate & Fail Mech.
DS1205S	125°C, Dyn. 7.0V	36	1050	1.31E+07	1	F1
Multi Key		1000	231	7.74E+07	0	
	125°C, Dyn. 5.5V	1000	348	2.60E+07	0	
			Subtotals	1.17E+08	1	17 Fits
BR1225	Storage Life	120000		n/a	1%	
Battery	55°C		Subtotals		1%	80
Prnt'd Crkt Board	per MIL-HDBK-217D	2 clip terminals + Chip on PC board				
			Subtotals			19
				Total		116 Fits

Package Tests

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1991F5 Rev C1	Temperature Cycle	1000 ~	225	n/a	0	
	-40°C to +85°C, No bias			Total	0	0.0%
	Moisture Soak	2000 hr	225	n/a	0	
	70°C/90% R.H. No bias			Total	0	0.0%
	Storage Life	2000 hr	224	n/a	0	
	85°C, No Bias			Total	0	0.0%
DS1991F5 Rev B1	Mechanical Shock	Gp A: 18~/axis	70	n/a	0	
	Mil-Std-883C	500g's		Total	0	0.0%
	Method 2002					
	x1, x2, y1, y2, z1, z2	Gp B: 18~/axis	10	n/a	0	
		1500g's		Total	0	0.0%
		Gp C: 18~/axis	10	n/a	0	
		3000g's		Total	0	0.0%

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: ICC	None	Not Analysed	0.7	0.43

-------- Touch Memory Reliability Report -------

RELIABILITY PROJECTION
DS1991S-R30

Device Types: DS1991S-R30

Assembly Technology: Metal Can

Sub Components: DS1205 MultiKey, PC Board, BR1225 Battery
Location: Dallas Package Style: Anode/Cathode Short Can

Summary Data with Chi-Squared Distribution Assumed for IC's and Ea = 0.7 ev
Stress Ambient Temperature to Field Ambient Temperature
o Voltage Derating

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 30°C	No. of Rejects	Failure Rate & Fail Mech.
DS1205S	125°C, Dyn. 7.0V	36	1050	1.89E+07	1	F1
Multi Key		1000	231	1.11E+08	0	
	125°C, Dyn. 5.5V	1000	348	1.68E+08	0	
			Subtotals	**2.98E+08**	**1**	**7 Fits**
AG364	Storage Life	12000		n/a	1%	
Battery	30°C		**Subtotals**		**1%**	**830**
Prnt'd Crkt Board	per MIL-HDBK-217D	2 clip terminals + Chip on FR4 PC board				
			Subtotals			**19**
				Total		**856 Fits**

Package Tests

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1991S-R30	Temperature Cycle	1000 ~	225	n/a	0	
	0°C to +70°C, No bias			Total	0	0.0%
	Moisture Soak	960 hr	225	n/a	0	
	60°C/90% R.H. No bias			Total	0	0.0%
	Storage Life	1000 hr	225	n/a	0	
	85°C, No Bias			Total	0	0.0%
DS1991F5 Rev B1	Mechanical Shock	Gp A: 18~/axis	70	n/a	0	
	Mil-Std-883C	500g's		Total	0	0.0%
	Method 2002					
	x1, x2, y1, y2, z1, z2	Gp B: 18~/axis	10	n/a	0	
		1500g's		Total	0	0.0%
		Gp C: 18~/axis	10	n/a	0	
		3000g's		Total	0	0.0%

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: ICC	None	Not Analysed	0.7	0.43

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS1992/3LF50
TOUCH MEMORY

Device Types: DS1992LF50 Rev C1, DS1993LF50 Rev C1

Assembly Technology: Metal Can

Sub Components: DS2402/3 1/3 Wire EconoRAM, PC Board, BR1225 Battery
Location: Dallas **Package Style:** Anode/Cathode Tall Flange Can

Summary Data with Chi-Squared Distribution Assumed @ 60%CF and Ea, B as assigned below
Stress Ambient Temperature and Voltage to
Field Ambient Temperature and Voltage

Sub Component (Vehicle)	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 3.0V	No. of Rejects	Failure Rate & Fail Mech.
DS2402/3B4 (DS2404	125°C, Dyn. 7.0V	48	784	1.33E+07	2	F1
1/3 Wire EconoRAM		1000	154	5.18E+07	1	F2
	125°C, Dyn. 5.5V	1000	234	1.76E+07	0	
			Subtotal	**8.26E+07**	**3**	**51 Fits**
BR1225	Storage Life	120000		n/a	1%	
Battery	55°C		**Subtotal**		1%	**80**
Prnt'd Crkt Board	per HDBK 217D	2 clip terminals + Chip on PC board				
			Subtotal			**19**
Total						**150 Fits**

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1994LF50	Temperature Cycle	1000 ~	328	n/a	0	
DS1994LM50	-40°C to +85°C, No bias			**Total**	**0**	**0.0%**
D/C 9231, 9238, 9242, 9240						
	Moisture Soak	960 hr	360	n/a	0	
	60°C/90% R.H. No bias			**Total**	**0**	**0.0%**
DS1994LF50	Storage Life	2000 hr	224	n/a	0	
D/C 9207, 9208	85°C, No Bias			**Total**	**0**	**0.0%**
DS1991LF50	Mechanical Shock	Gp A: 18~/axis	70	n/a	0	
D/C 9123, 9131, 9136	Mil-Std-883C Method 2002	500g's		**Total**	**0**	**0.0%**
	x1, x2, y1, y2, z1, z2	Gp B: 18~/axis 1500g's	10	n/a	0	
				Total	**0**	**0.0%**
		Gp C: 18~/axis 3000g's	10	n/a	0	
				Total	**0**	**0.0%**
DS1991LF50	Vibration	Cond. A	66	n/a	0	
DS1994LM50	Mil-Std-883C	10 to 55 Hz		**Total**	**0**	**0.0%**
D/C 9211, 9240	Method 2005	2x.06" /axis				
DS1994LF50	Salt Atmosphere	Cond C	10	n/a	0	
DS1994LM50	Mil-Std-883	96 hr		**Total**	**0**	**0.0%**
D/C 9240, 9242	Method 1009					

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1 VccLeak /Comp	92-0104	pch gate oxide defect	0.3	1
F2 VccLeak /Comp/True	93-0074	pch gate oxide defect	0.3	1

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS1993LF50
TOUCH MEMORY W/TIME

Device Types: DS1993LF50

Assembly Technology: Metal Can **Sub Components: DS2403 1/3 Wire EconoRAM, PC Board, BR1225 Battery**
Location: Dallas **Package Style: .Anode/Cathode Tall Flange Can**

Summary Data with Chi-Squared Distribution Assumed @ 60%CF and Ea, B as assigned below
Stress Ambient Temperature and Voltage to
Field Ambient Temperature and Voltage

Sub Component (Vehicle)	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 3.0V	No. of Rejects	Failure Rate & Fail Mech.
DS2403B4 (DS2404)	125°C, Dyn. 7.0V	48	784	1.33E+07	2	F1
1/3 Wire EconoRAM		1000	154	5.18E+07	1	F2
	125°C, Dyn. 5.5V	1000	234	1.76E+07	0	
			Subtotals	**8.26E+07**	**3**	**51 Fits**
BR1225	Storage Life	120000		n/a	1%	
Battery	55°C		**Subtotals**		**1%**	**80**
Seiko	estimate	n/a	n/a	n/a	n/a	
Crystal			**Subtotals**			**10**
Prnt'd Crkt Board	per HDBK 217D	2 clip terminals + Chip on PC board				
			Subtotals			**19**
Total						160 Fits

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1994LF50	Temperature Cycle	1000 ~	328	n/a	0	
	-40°C to +85°C, No bias			Total	0	0.0%
	Moisture Soak	960 hr	360	n/a	0	
	60°C/90% R.H. No bias			Total	0	0.0%
	Storage Life	2000 hr	224	n/a	0	
	85°C, No Bias			Total	0	0.0%
DS1991LF50	Mechanical Shock	Gp A: 18~/axis	70	n/a	0	
	Mil-Std-883C	500g's		Total	0	0.0%
	Method 2002					
	x1, x2, y1, y2, z1, z2	Gp B: 18~/axis	10	n/a	0	
		1500g's		Total	0	0.0%
		Gp C: 18~/axis	10	n/a	0	
		3000g's		Total	0	0.0%
DS1991LF50	Vibration	Cond. A	66	n/a	0	
DS1994LM50	Mil-Std-883C	10 to 55 Hz		Total	0	0.0%
	Method 2005	2x.06" /axis				
DS1994LF50	Salt Atmosphere	Cond C	10	n/a	0	
DS1994LM50	Mil-Std-883	96 hr		Total	0	0.0%
	Method 1009					

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1 VccLeak /Comp	92-0104	pch gate oxide defect	0.3	1
F2 VccLeak /Comp/True	In Analysis		0.3	1

RELIABILITY PROJECTION
DS1994LF50 / LM50
TOUCH MEMORY W/TIME

Device Types: DS1994LF50 Rev B5, DS1994LM50 Rev B5

Assembly Technology: Metal Can

Sub Components: DS2404 1/3 Wire EconoRAM, PC Board, BR1225 Battery, Crystal

Location: Dallas **Package Style:** Anode/Cathode Tall Flange Can

Summary Data with Chi-Squared Distribution Assumed @ 60%CF and Ea, B as assigned below
Stress Ambient Temperature and Voltage to
Field Ambient Temperature and Voltage

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 3.5V	No. of Rejects	Failure Rate & Fail Mech.
DS2404B4	125°C, Dyn. 7.0V	48	784	1.08E+09	2	F1
1/3 Wire EconoRAM		1000	154	4.43E+09	1	F2
	125°C, Dyn. 5.5V	1000	234	1.75E+08	0	
			Subtotal	**5.69E+09**	**3**	**1 Fits**
BR1225	Storage Life	1E+05		n/a	1%	
Battery	55°C		**Subtotal**		**1%**	**80**
Seiko	estimate	n/a	n/a	n/a	n/a	
Crystal			**Subtotal**			**10**
Prnt'd Crkt Board	per HDBK 217D	2 clip terminals + Chip on PC board				
			Subtotal			**19**
Total						**110 Fits**

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1994LF50	Temperature Cycle	1000 ~	328	n/a	0	
DS1994LM50	-40°C to +85°C, No bias			**Total**	**0**	**0.0%**
D/C 9231, 9238,						
9242, 9240	Moisture Soak	960 hr	360	n/a	0	
	60°C/90% R.H. No bias			**Total**	**0**	**0.0%**
DS1994LF50	Storage Life	2000 hr	224	n/a	0	
D/C 9207, 9208	85°C, No Bias			**Total**	**0**	**0.0%**
DS1991LF50	Mechanical Shock	Gp A: 18	70	n/a	0	
D/C 9123, 9131,	Mil-Std-883C	500g's		**Total**	**0**	**0.0%**
9136	Method 2002					
	x1, x2, y1, y2, z1, z2	Gp B: 18	10	n/a	0	
		1500g's		**Total**	**0**	**0.0%**
		Gp C: 18	10	n/a	0	
		3000g's		**Total**	**0**	**0.0%**
DS1991LF50	Vibration	Cond. A	66	n/a	0	
DS1994LM50	Mil-Std-883C	10 to 55 Hz		**Total**	**0**	**0.0%**
D/C 9211, 9240	Method 2005	2x 06" /axis				
DS1994LF50	Salt Atmosphere	Cond C	10	n/a	0	
DS1994LM50	Mil-Std-883	96 hr		**Total**	**0**	**0.0**

-------- Touch Memory Reliability Report --------

D/C 9240, 9242 Method 1009

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: VccLeak /Comp	92-0104	pch gate oxide defect	0.3	2.4
F2: VccLeak /Comp/True	93-0074	pch gate oxide defect	0.3	2.4

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS1996LF50 / LM50
TOUCH MEMORY W/TIME

Device Types: DS1996LF50 Rev A5

Assembly Technology: Metal Can

Sub Components: DS2464 1 & 3 wire 64K SRAM, PC Board, BR1225 Battery
Location: Dallas **Package Style:** Anode/Cathode Tall Flange Can

Summary Data with Chi-Squared Distribution Assumed @ 60%CF and Ea, B as assigned below
Stress Ambient Temperature and Voltage to
Field Ambient Temperature and Voltage

Sub Component	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 3.0V	No. of Rejects	Failure Rate & Fail Mech.
DS2464 B3	125°C, Static 6.0V	48	298	1.4E+07	5	
D/C 9530		1000	104	9.9E+07	0	
DS2464 A2	125°C, Static 6.0V	48	311	1.4E+07	1	
D/C 9449		1000	103	9.8E+07	1	
DS24S03 A3	125°C, Static 6.0V	48	320	1.5E+07	0	
D/C 9451		1000	114	1.1E+08	1	
			Subtotal	3.5E+08	8	27 Fits
BR1225	Storage Life	120000		n/a	1%	
Battery	55°C		Subtotal		1%	80
Prnt'd Crkt Board	per HDBK 217	2 clip terminals + Chip on PC board				
			Subtotal			19
Total						99 Fits

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS1994LF50	Temperature Cycle	1000 ~	328	n/a	0	
DS1994LM50	-40°C to +85°C, No bias			Total	0	0.0%
D/C 9231, 9238, 9242, 9240						
	Moisture Soak	960 hr	360	n/a	0	
	60°C/90% R.H. No bias			Total	0	0.0%
DS1994LF50	Storage Life	2000 hr	224	n/a	0	
D/C 9207, 9208	85°C, No Bias			Total	0	0.0%
DS1991LF50	Mechanical Shock	Gp A: 18~/axis	70	n/a	0	
D/C 9123, 9131, 9136	Mil-Std-883C	500g's		Total	0	0.0%
	Method 2002					
	x1, x2, y1, y2, z1, z2	Gp B: 18~/axis	10	n/a	0	
		1500g's		Total	0	0.0%
		Gp C: 18~/axis	10	n/a	0	
		3000g's		Total	0	0.0%
DS1991LF50	Vibration	Cond. A	66	n/a	0	
DS1994LM50	Mil-Std-883C	10 to 55 Hz		Total	0	0.0%
D/C 9211, 9240	Method 2005	2x.06" /axis				
DS1994LF50	Salt Atmosphere	Cond C	10	n/a	0	
DS1994LM50	Mil-Std-883	96 hr		Total	0	0.0%
D/C 9240, 9242	Method 1009					

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: IPD-PD=0V	in process	n/a	0.7	1
F2: IIH PD	Engr. Eval.	High Current Condition / EOS. (Test Induced/escape)	n/a	n/a
F3: VREF @ 4V	94-0088	Gate Oxide Defect	0.7	1
F4: 3-IIH PD	94-0118	High Current Condition / EOS. (Test Induced/escape)	n/a	n/a
F5: TERM R1-R10	94-0134	Gate Oxide Defect	0.7	1

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS2400/DS914

Product Types:	DS2400/DS914		
Date Codes:	9045, 9049, 9107		
Process Technology:	Si Gate CMOS	Channel Length: 1.2 µ	Metal Pitch: 3.0 µ
Assembly Technology:	See Below		

Summary Data with Chi-Squared Distribution Assumed: Ea = 0.7 ev & B = 1.0
Stress Ambient Temperature to Field Ambient Temperature
Stress Voltage to Use Voltage

Vehicle	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 5.5 V	No. of Rejects	Failure Rate & Fail Mech.
DS914 A1	125°C, 7.0 V, Dyn.	48	1394	2.33E+07	1	F1
Touch Mem Chip		96	898	3.00E+07	0	
D/C 9045, 9049, 9107		1000	444	1.47E+08	0	
	125°C, 5.5 V, Dyn	1000	444	3.27E+07	0	
DS914 A2	125°C, 7.0 V, Dyn.	504	196	3.43E+07	0	
Touch Mem Chip						
D/C 9143						
Totals				**2.67E+08**	**1**	**8 Fits**

Package Tests
8 PDIP, Anam, K.

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS2400	Temperature Humidity	1000 hr	348	n/a	0	
	85°C/85% R.H., 5.5V			**Total**	**0**	**0.0%**

TO92, 3LD, Carsem

DS2223	Temperature Cycle	1000 ~	166	n/a	0	
	-55°C to +125°C, No bias			**Total**	**0**	**0.0%**
DS2223	HAST	200 hr	153	n/a	0	
	120°C/85% R.H. 5.5 V.			**Total**	**0**	**0.0%**
DS2223	Storage Life	1khr	166	n/a	0	
	150°C, No Bias			**Total**	**0**	**0.0%**

Failure Mechanism		Corrective Action
F1	Read Type Id	None

------- Touch Memory Reliability Report ------

RELIABILITY PROJECTION
DS24S03

Device Type: DS24S03 Rev A3, A4

Process Tech: 0.8µ CMOS
Metal Pitch: 2.0 µ
Die Size: 89 X 97 mil**2
Passivation: 10K Ox / 6K Ni
Metal Type: Al / 0.8% Si / 0.5% Cu
Metal Width: 0.8 µ
Xstr Count: 2180
Channel Length: 0.8 µ
Gate Oxide Thickness: 175 Å

Summary Data with Chi-Squared Distribution Assumed
Stress Ambient Temperature and Voltage (125°C, 5.5V, 6.0V or 7.0V)
to Field Ambient Temperature and Voltage (55°C, 3.5V)
Voltage and Temperature Acceleration as noted below

Vehicle	Stress	Time (hrs)	Sample Size	Equivalent ev. Hrs. @ 55°C, 3.50 V	No. of Rejects	Failure Rate & Fail Mode
DS24S03 A3	125°C, Static 6.0V	48	340	4.3E+07	2	2-F1
D/C 9427		336	115	1.0E+08	1	F2
		1000	114	3.0E+08	0	
DS24S03 A3	125°C, Static 6.0V	48	320	4.0E+07	0	
D/C 9451		336	115	1.0E+08	1	F3
		1000	114	3.0E+08	0	
Totals				9E+08	4	6 Fits

Assy Tech: Sumitomo 6300H Plasti
Assembly Site: Anam, PI
Die Attach: Silverfilled Epoxy
Lead Frame: Cu w/Solder Plate
Package: PDIP
Pad Size: 110 X 140 mil**2
No. Pins: 16

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS24S03 A3	Temperature Cycle	1000 ~	151	n/a	0	
D/C 9427, 945	-55°C to +125°C		Total		0	0.0%
	Temp. Humidity Bias	959 hr	152	n/a	0	
	85°C/85% R.H., 5.5V		Total		0	0.0%
	Autoclave	168 hr	90	n/a	0	
	121°C, 2Atmos, No bias		Total		0	0.0%

Failure Mode	FA #	Failure Mechanism	Ea	B
F1: Batt Leaka	94-0121	Gate Oxide Defect	0.3	2.4
F2: Chkrbrd Tr	94-0120	Gate Oxide Defect	0.3	2.4
F3: Batt Leaka	95-0077	Gate Oxide Defect	0.3	2.4

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS2404 / DS1608

Product Types: DS2404 Rev B4, DS1608 Rev B4

Process Technology: Si gate CMOS
Die Size: 136 X 175 mil

Metallization: Al/1.0% Si/0.5% Cu
Passivation: Nitride

Transistor Count: 45191
Metal Pitch: 3.0µ Channel Length: 1.2 µ

Summary Data with Chi-Squared Distribution Assumed @ 60%CF and Ea, B as assigned below
Stress Ambient Temperature and Voltage to
Field Ambient Temperature and Voltage

Vehicle	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 5.5V	No. of Rejects	Failure Rate & Fail Mech.
DS2404B4	125°C, Dyn. 7.0V	48	1871	3.39E+07	2	F1
D/C 9236, 9244, 9301		500	347	5.92E+07	0	
		1000	231	4.36E+07	1	F2
	125°C, Dyn. 5.5V	1000	348	2.14E+06	0	
DS1608B4	125°C, Dyn. 7.0V	48	1749	2.80E+08	0	
D/C 9301		336	232	2.52E+07	1	F3
Totals				**4.44E+08**	**4**	**12 Fits**

Assembly Tech: Plastic Package Style: SOIC
No. Pins: 16

Assembly Site: ANAM, K
Pad Size: 160 X 200 mil Lead Frame: Cu w/ Solder Plate

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS2404 S	Preconditioning					
D/C 9236, 9244	T/C: -55°C to +125°C	5~	794	n/a	0	
	THB: 85°C/85% R.H.	137 hr				
	HTC Vapor Phase	2X, 220°C		**Total**	0	0.0%
	Temperature Cycle	1000 ~	229	n/a	0	
	-55°C to +125°C			**Total**	0	0.0%
	Autoclave	168 hr	135	n/a	0	
	121°C, 2 At. Unbiased			**Total**	0	0.0%
	Temperature Humidity	959 hr	231	n/a	0	
	85°C/85% R.H., 5.5V			**Total**	0	0.0%

Vehicle	Package Test	X-Ray	Phys Dim.	Mark. Perm.	Solderability	Lead Integrity
DS2404S	Total Samples	10	10	10	48	48
D/C 9236, 9244	Total Fails	0	0	0	0	0

Failure Mode	FA #,s	Failure Mechanism	Ea (ev)	B (1/volt)
F1: VccLeak /Comp	92-0104	pch gate oxide defect	0.30	2.7
F2: VccLeak /Comp/True	93-0074	pch gate oxide defect	0.30	2.7
F3: Parity Hi Vcc	In Analysis	(pch gate oxide defect)	0.30	2.7

------- Touch Memory Reliability Report ------

RELIABILITY PROJECTION
DS2464

Device Type: DS2464 Rev B3

Process Tech: 0.8µ CMOS

Metal Pitch: 2.0 µ
Die Size: 160 X 204 mil**2
Passivation: 10K Ox / 6K Ni

Metal Width: 0.8 µ
Xstr Count: 56200
Channel Length: 0.8 µ

Metal Type: Al / 0.8% Si / 0.5% Cu
Gate Oxide Thickness: 175 Å

Summary Data with Chi-Squared Distribution Assumed
Stress Ambient Temperature and Voltage (125°C, 5.5V, 6.0V or 7.0V)
to Field Ambient Temperature and Voltage (55°C, 5.5V)
Voltage and Temperature Acceleration as noted below

Vehicle	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 3.50 V	No. of Rejects	Failure Rate & Fail Mode
DS2464 B3	125°C, Static 6.0V	48	298	3.7E+07	5	F1, F2, F3, 2-F4
D/C 9530		1000	104	2.7E+08	0	
DS2464 A2	125°C, Static 6.0V	48	311	3.9E+07	1	F5
D/C 9449		1000	103	2.7E+08	1	F6
DS24S03 A3	125°C, Static 6.0V	48	320	4.0E+07	0	
D/C 9451		1000	114	3.0E+08	1	F7
Totals				1E+09	8	10 Fits

Assy Tech: Sumitomo 6300H Plastic

Assembly Site: Hundai / Omedata
Die Attach: Silverfilled Epoxy
Lead Frame: A42 w/Solder Plate

Package: 300 mil PDIP
Pad Size: 225 X 390 mil**2

No. Pins: 24

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS2464 B3	Temperature Cycle	1000 –	154	n/a	0	
D/C 9530	-55°C to +125°C		Total		0	0.0%
DS2464 A2						
D/C 9449	Temp. Humidity Bias	959 hr	153	F7	1	
	85°C/85% R.H., 5.5V		Total		1	0.7%
	Autoclave	168 hr	85	n/a	0	
	121°C, 2Atmos, No bias		Total		0	0.0%

Failure Mode	FA #	Failure Mechanism	Ea	B
F1: Vccleak True	95-0163		0.3	2.4
F2: Checkbd Hi Vc	95-0163		0.3	2.4
F3: Icc Active	95-0163		0.3	2.4
F4: IO Resistance	95-0163		0.3	2.4
F5: VCCLeak True	95-0017	Gate Oxide Defect	0.3	2.4
F6: VCCLeak Com	95-0015	Gate Oxide Defect	0.3	2.4
F7: VCCLeak True	95-0016	Gate Oxide Defect	0.3	2.4
F8: Static	95-0077	Gate Oxide Defect	0.3	2.4

-------- Touch Memory Reliability Report --------

RELIABILITY PROJECTION
DS2505
Preliminary Release

Device Type: DS2505 Rev A3

Proc. Tech.: 0.8µ CMOS

Metal Pitch: 2.2 µ
Die Size: 77 X 114 mil
Passivation: Oxide / OxyNitride

Metal Width: 1.2 µ
Xstr Count: ~6400
Channel Length: 0.8 µ

Metal Type: Al / 1% Si / 0.5% Cu
Gate Oxide Thickness: 175Å

Summary Data with Chi-Squared Distribution Assumed
Stress Ambient Temperature and Voltage (125°C, 5.5V or 7.0V) to
Field Ambient Temperature and Voltage (55°C, 5.5V)
Voltage and Temperature Acceleration as noted below

Vehicle	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C, 5.5 V	No. of Rejects	Failure Rate & Fail Mech.
DS2505 A3	125°C, Dyn. 7.0V	48	347	5.8E+06	0	
D/C 9449		336	116	1.4E+07	0	
		1000	116	2.7E+07	0	
Totals				4.6E+07	0	20 Fits

Vehicle	Stress	Time (hrs)	Sample Size	Equivalent Dev. Hrs. @ 55°C	No. of Rejects	Failure Rate & Fail Mech.
DS2505 A3	150°C, Storage Life	1000	77	2.2E+08	0	
D/C 9449	Data Retention					
Totals				2.2E+08	0	4 Fits

Assembly Technology: Shinetsu 184

Site: Anam, Pl
Lead Frame: C7025 Cu
Die Attach: Ag filled Ablebond 84-1 LMISR4 Epoxy

Package: 170 mil TSSOP
Pad Size: 118 X 165 mil**2

Vehicle	Stress Type	Maximum Stress	Sample Size	Failure Mechanism	No. of Rejects	Percent Rejected
DS2107A A5	Preconditioning					
D/C 9306, 7	T/C: -55°C to +125°C	5~	897		0	
	THB: 85°C/85% R.H.	137 hr			0	
	Vapor Phase Reflow	2X, 230°C		Total	0	0.0%
	Temperature Cycle -55°C to +125°C	1000 ~	230	Total	0	0.0%
	Temperature Humidity 85°C/85% R.H., 5.5V	959 hr	229	n/a Total	0 0	0.0%
	Autoclave 121°C, 2Atmos, No bias	168 hr	132	n/a Total	0 0	0.0%

Vehicle	Package Test:	X-Ray	Phys Dim.	Mrk. Prm.	Solderability	Lead Integrity	Sonoscan
DS2107A A5	Total Samples	15	15	15	72	72	6
D/C 9306, 7	Total Fails	0	0	0	0	0	0