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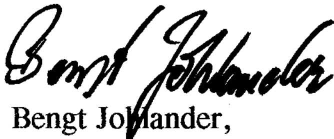
April 4, 1991.

Radiation test report RA 066

Comparative radiation test of Motorola and National Semiconductor AC 240 and AC 244.

The work presented in this report have been funded by the European Space Agency and coordinated by the Radiation Effects and Analysis Techniques Unit at ESTEC.

We believe that both the Motorola and National AC240 and AC244 are liable candidates for space missions with expected total dose exposure of less than 100 Krad from a radiation point.



Bengt Johlander,
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Comparative radiation test of Motorola and National Semiconductor AC 240 and AC 244.

ESA/ESTEC, 2/4-91.

Prepared by:
Bengt Johlander,
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Summary

- *The quiescent current increases more for Motorola than National Semicond. parts.*
- *The tri-state leakage currents increase more for National Semicond. than Motorola parts.*
- *Propagation delay was not affected by irradiation.*

Considering small performance degradation after Co-60 exposure, both Motorola and National Semicond. AC 240 and AC 244 are believed to withstand up to 100 krad total dose exposure in a space environment.

Content:

1. Introduction
2. Aims and objectives
3. The radiation source and dosimetry
4. The biasing circuitry and sample allocation
5. Annealing conditions
6. Time schedule
7. Test results
8. Rood Testhouse test report
9. Rood Testhouse Appendices

1. Introduction.

Fast logic have been identified for use in several future space projects. Due to the unknown radiation performance of these parts, the Radiation Effects and analysis techniques unit, Components Division, was requested to perform a pre-screening radiation test of two functions for the SOHO project.

The work was performed together with a larger pre-screening test for future qualification of fast logic for coordination reasons.

Rood Testhouse was contracted for all electrical testing as well as annealing of all samples. Sample identification and test results can be found in attached report from Rood testhouse, while this section describes radiation source and conditions and includes a discussion on the test results.

2. Aims and objectives.

The aim of the test was to compare similar fast logic functions from two manufacturers under similar and mission representative radiation conditions.
The objective of the work was to build and design biasing circuitry, expose the samples to ionizing radiation and perform subsequent full parametric AC/DC test.

3. The radiation source and dosimetry.

The 1460 Curie Co-60 facility in ESTEC was used for exposing the samples to ionizing radiation (1.25 MeV gamma radiation). The dose rate can be varied by placing the samples at different distance from the Co-60 pellets. The dose rate chosen for all irradiations in this test was 26 rad/min (H2O), which is a lower dose rate than specified by ESA/SCC22900 and also proposed Mil. Std. 883/1019.4. The reasons are:
1. to keep dose rate more applicable to space applications,
2. to allow for a uniform dose for all samples irradiated,
3. practicality, to be able to complete the longest exposure in 16 hours (one night exposure).
The dose was monitored by a Ionex Dosemaster equipped with a 0.6 cc ion probe placed at the same distance from the Co-60 source as the samples. The Ionex Dosemaster is calibrated to +/- 0.5 %.

4. The biasing circuitry and sample allocation.

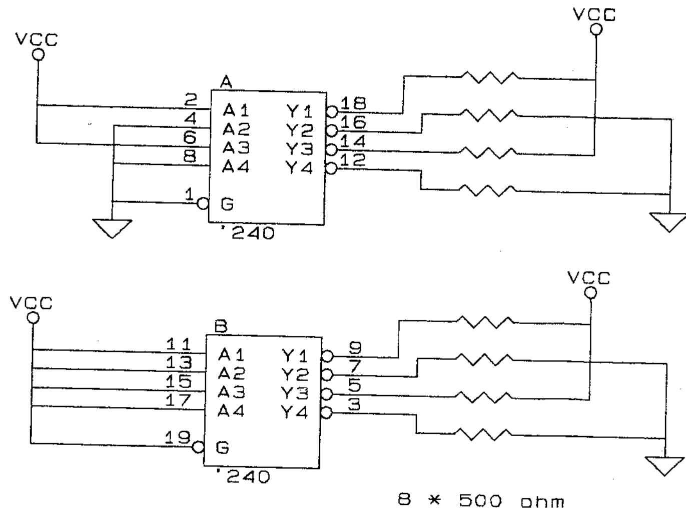
The biasing circuitry is shown in figure 1. The biasing conditions for different samples is shown below in table 1.
Due to an uncertainty of exactly what bias condition should be a worst case, several different conditions was implemented for each package (eight drivers per package).

Table 1, Biasing conditions.

Manufacturer	Function	Sample	Condition	Description
Motorola	AC 240	1	A	Static
Motorola	AC 240	2	A	Static
Motorola	AC 244	1	B	Static
Motorola	AC 244	2	B	Static
National Sem.	AC 240	1	A	Static
National Sem.	AC 240	2	A	Static
National Sem.	AC 244	1	B	Static
National Sem.	AC 244	2	B	Static

5. Annealing conditions.

After a total exposure of all samples to 100 krad, the samples were placed in a oven for 168 hours, 100 degrees Celsius with all pins grounded. All samples were again tested after annealing to check for any reverse annealing phenomena.



Condition A

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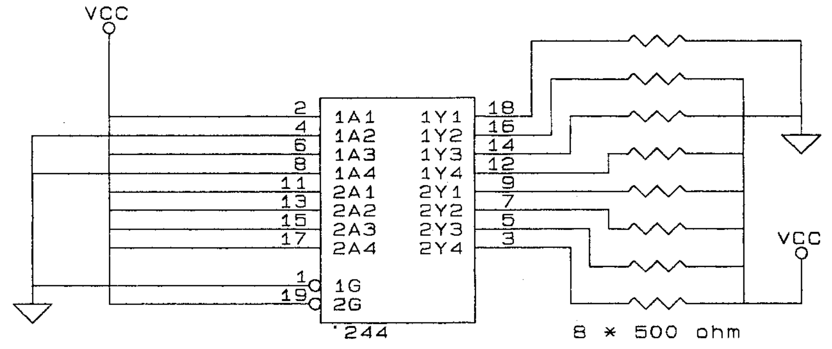

Condition B

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6. Time schedule.

The samples were irradiated during the nights while the transport to Rood Testhouse and electrical characterisation was done daytime. The Co-60 source was controlled by a timer, so a pre-set total dose was reached without attention by any operator.

Day Start time	Activity	Bias
24/2, 19.15	Irr. 0-5 krad	on
24/2, 22.20	5 krad reached	on
25/2, 8.45	Transport & meas.	off
25/2, 19.00	Irr. 5-10 krad	on
25/2, 22.07	10 krad reached	on
26/2, 8.45	Transport & meas.	off
26/2, 17.40	Irr. 5-15 krad	on
26/2, 21.00	15 krad reached	on
27/2, 8.45	Transport & meas.	off
27/2, 17.15	Irr. 15-25 krad	on
27/2, 23.55	25 krad reached	on
28/2, 8.45	Transport & meas.	off
28/2, 17.00	Irr. 25-50 krad	on
1/3, 8.50	Transport & meas	off
2/3, 18.00	Irr. 50-100 krad	on
4/3, 8.50	Transport & meas.	off
5/3, 9.00	Annealing, 100 C.	off
12/3, 9.00	Measurement	off

7. Test results.

Considering the large amount of test data generated from the electrical measurements, only minimum and maximum values of each package are reported in the graphs for readability. As a reminder, each package contains eight drivers with different bias conditions.
The method of plotting only min. and max. values gives a better estimate of what can be expected during most operating conditions. The average is indicated in the graphs as a solid line, while specification limits are drawn as broken lines.
Only worst case measurements are plotted in graphs, e.g. worst case Vcc for Tplz etc. All other measurements conditions for a parameter as listed in Rood T.H. appendix degrade less with irradiation than the plotted.
All raw data is stored on tape in Rood Testhouse for any future requirement of further data analysis.
As can be seen from the graphs, the only failing parameters are Tplz and Iozh for National Semicond. 54AC240DMQB.
The failure of Tplz can be explained as a too tight specification limit rather than a radiation induced failure as no increase of Tplz is seen with increasing total dose.
The Iozh failure is seen at a total accumulated dose at 100 krad and decreases after annealing. This indicates that the evolution of Iozh depends on dose rate. On the other hand, also the Motorola devices show a increase in Iozh, though less than the National devices.
The Motorola Iccl and Icch show a significant increase with total dose, even though they both stay within specification limits.

The physical mechanism for the increase in leakage currents for both National and Motorola devices is probably explained by a slow formation of compensating charge in interface states under the field oxide.
When such states are eventually formed, the current leakage path under the field oxide is switched off (compare to a threshold voltage shift due to negative of positive charge build-up in the gate oxide of a MOSFET, see e.g. Sze: Physics of semiconductor devices). The formation of such states is accelerated by annealing in 100 degrees Celsius. It is assumed that no significant reduction of interface states takes place during one week annealing.

Threshold voltage shift related to the gate oxide is on both technologies low as indicated by small shifts in Vil and Vih.

No large change is observed on any switching time parameter. This indicates that the interface state build-up under the gate oxide is of small importance for the AC performance of these functions.

ROOD TESTHOUSE

Quality and Reliability Investigation Report

of several AC/ACT 240/244 devices

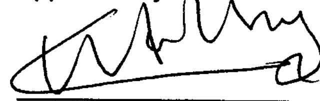
for ESA/ESTEC, Noordwijk, The Netherlands

Heerde, March 15th 1991.

Originated by :

W.J. Kemper
Q&R Investigations Engineer

Approved by :



C.Th.A Revenberg
Q&R Investigations Manager

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Appendices

A Testflows

B Specifications MCT2000

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1 General Information

The following Rood Testhouse numbers can be used for reference:

- Rood Testhouse report number : QRR91004
- Rood Testhouse project number : 052187/03
- Rood Testhouse order number : 91000022/00

This report describes the results of a quality and reliability investigation that was performed for ESA/ESTEC, Noordwijk, The Netherlands. The test procedure and the used test equipment are listed in section 3 and 4. The results of the electrical tests are presented in four tables with the device numbers that failed a specific electrical test and a number of figures of selected parameters.

2 Summary

For this quality and reliability investigation four different AC/ACT 240/244 devices were submitted to several periods of radiation and electrical read outs. The total number of read outs was eight: after 0, 5, 10, 15, 25, 50, 100 kRad and after 168 hours annealing at +100°C. The radiation was performed at ESTEC and the electrical tests were performed at Rood Testhouse on a MCT 2000 tester.

The devices under test were:

- National Semiconductor 54AC240DMQB (2 devices)
- Motorola 74AC240N (2 devices)
- National Semiconductor 74AC244DMQB (2 devices)
- Motorola 74AC244N (2 devices)

The results of the electrical read outs are as follows:

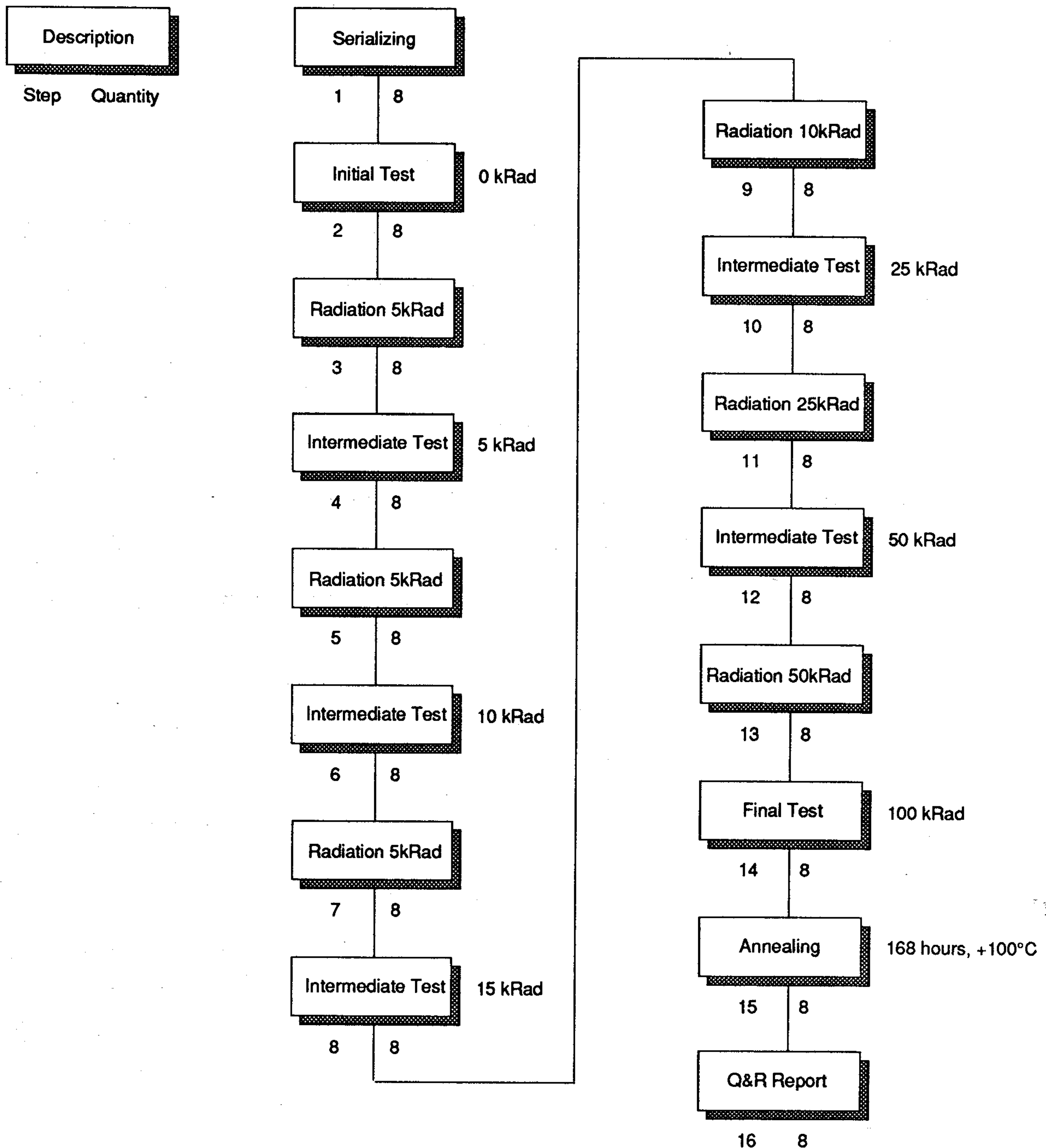
- the only device type that showed failing electrical test results was the National Semiconductor 54AC240DMQB, the failing tests were:
  - Tplz starting at the initial test for both devices (This is caused by a too narrow specification limit)
  - Iozh after 100 kRad for device number 1 (This test was pass again after the annealing)
- the Iccl and Icch currents increased more for the Motorola 74AC240N devices than for the National Semiconductor 54AC240DMQB devices
- the Iccl and Icch currents also increased more for the Motorola 74AC244N devices than for the National Semiconductor 74AC244DMQB devices
- The iozh measurent results of both National Semiconductor types (54AC240DMQB and 74AC244DMQB) showed increasing values during this investigation

Based on the Iccl and Icch measurement results, it can be concluded that the tested Motorola devices are more sensitive for radiation than the National Semiconductor devices although the National Semiconductor devices showed a greater sensitivity at the output leakage current high tests than the Motorola devices.

3 Investigation Procedure

3.1 Procedure Flow

The following procedure diagram illustrates the used procedure for testing.



3.2 Detailed Description

Table 3-1 Detailed Procedure Description

Step No.	Procedure Description	Quantity
1	Serialization of the devices.	8
2	Initial electrical test at ambient.	8
3	Radiation 5kRad at ESTEC.	8
4	Electrical test at ambient.	8
5	Radiation 5 kRad at ESTEC to a sub–total of 10 kRad.	8
6	Electrical test at ambient.	8
7	Radiation 5 kRad at ESTEC to a sub–total of 15 kRad.	8
8	Electrical test at ambient.	8
9	Radiation 10 kRad at ESTEC to a sub–total of 25 kRad.	8
10	Electrical test at ambient.	8
11	Radiation 25 kRad at ESTEC to a sub–total of 50 kRad.	8
12	Electrical test at ambient.	8
13	Radiation 50 kRad at ESTEC to a total of 100 kRad.	8
14	Electrical test at ambient.	8
15	Annealing 168 hours at +100 °C	8
16	Quality and Reliability report	8

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3.3 Specifications

The following specifications were used for the electrical tests:

For the National 54AC240DMQB:
- MIL-M-38510/757, December 1989

For the Motorola 74AC240N:
- Motorola FACT DATA Q3/89 DL138 Rev. 1, +25 °C

For the National 74AC244DMQB:
- National FACT Advanced CMOS Logic Databook 1990, +25 °C

For the Motorola 74AC244N:
- Motorola FACT DATA Q3/89 DL138 Rev. 1, +25 °C

More details about the electrical tests can be found in the testflows (Appendix A).

4 Equipment List

Electrical Test Equipment

- MCT 2000 (For specifications see appendix B)

5 Device Description

The following devices were submitted to this investigation:

- National Semiconductor 54AC240DMQB
- Motorola 74AC240N
- National Semiconductor 74AC244DMQB
- Motorola 74AC244N

The devices under test are octal bus-buffer and line drivers with tri-state outputs. All devices are packaged in a 300 Mil 20-pin dual-in-line case. The National Semiconductor devices have ceramic packages and the Motorola devices have plastic packages.

6 Test Results

Table 6-1 Fail devices National Semiconductor 54AC240DMQB

Test	0kRad	5kRad	10kRad	15kRad	25kRad	50kRad	100kRad	Anneal
Cont	-	-	-	-	-	-	-	-
Iil	-	-	-	-	-	-	-	-
Iih	-	-	-	-	-	-	-	-
Vil	-	-	-	-	-	-	-	-
Vih	-	-	-	-	-	-	-	-
Vol	-	-	-	-	-	-	-	-
Voh	-	-	-	-	-	-	-	-
Iozl	-	-	-	-	-	-	-	-
Iozh	-	-	-	-	-	-	1	-
Iccl	-	-	-	-	-	-	-	-
Icch	-	-	-	-	-	-	-	-
Icc	-	-	-	-	-	-	-	-
Func	-	-	-	-	-	-	-	-
tPLH	-	-	-	-	-	-	-	-
tPHL	-	-	-	-	-	-	-	-
tPLZ	2,3	1,2,3	1,2,3	2,3	1,2,3	1,2,3	1,2,3	1,2
tPZL	-	-	-	-	-	-	-	-
tPHZ	-	-	-	-	-	-	-	-
tPZH	-	-	-	-	-	-	-	-

Table 6-2 Fail devices Motorola 74AC240N

Test	0kRad	5kRad	10kRad	15kRad	25kRad	50kRad	100kRad	Anneal
Cont	-	-	-	-	-	-	-	-
Iil	-	-	-	-	-	-	-	-
Iih	-	-	-	-	-	-	-	-
Vil	-	-	-	-	-	-	-	-
Vih	-	-	-	-	-	-	-	-
Vol	-	-	-	-	-	-	-	-
Voh	-	-	-	-	-	-	-	-
Iozl	-	-	-	-	-	-	-	-
Iozh	-	-	-	-	-	-	-	-
Iccl	-	-	-	-	-	-	-	-
Icch	-	-	-	-	-	-	-	-
Icc	-	-	-	-	-	-	-	-
Func	-	-	-	-	-	-	-	-
tPLH	-	-	-	-	-	-	-	-
tPHL	-	-	-	-	-	-	-	-
tPLZ	-	-	-	-	-	-	-	-
tPZL	-	-	-	-	-	-	-	-
tPHZ	-	-	-	-	-	-	-	-
tPZH	-	-	-	-	-	-	-	-

Figure 6-1 IiI National Semiconductor 54AC240DMQB

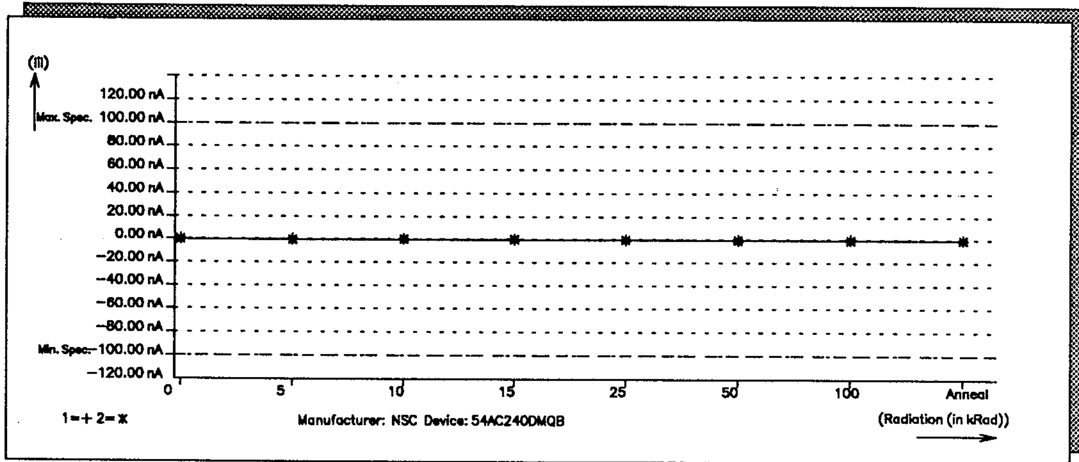


Figure 6-2 IiI Motorola 74AC240AN

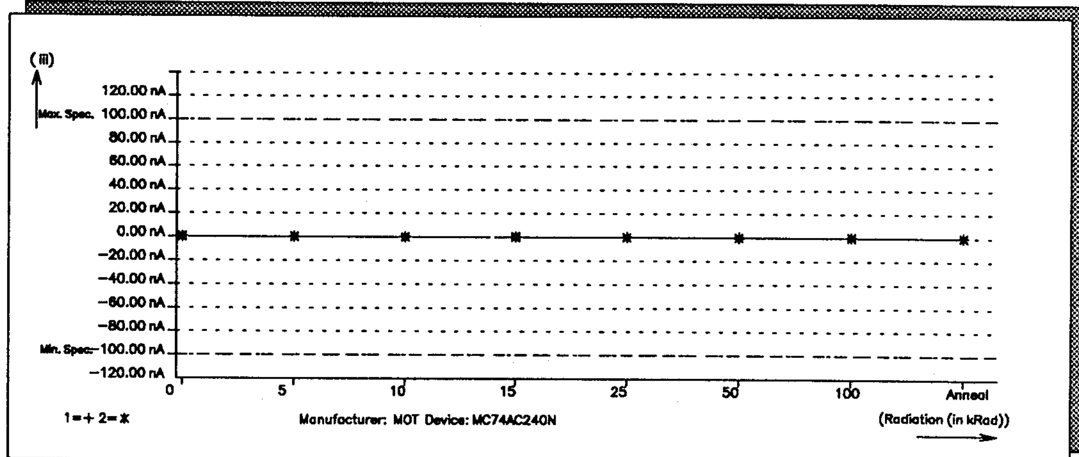


Figure 6-3 Iih National Semiconductor 54AC240DMQB

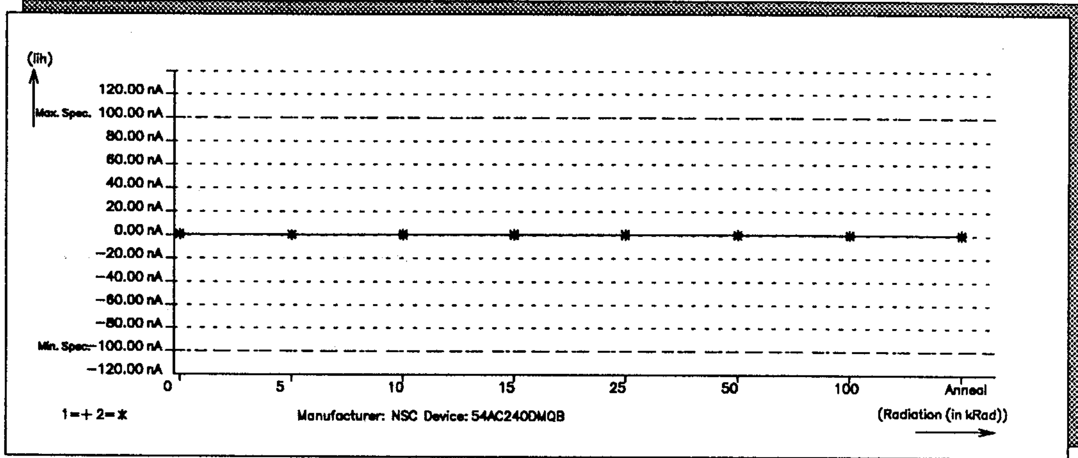


Figure 6-4 Iih Motorola 74AC240N

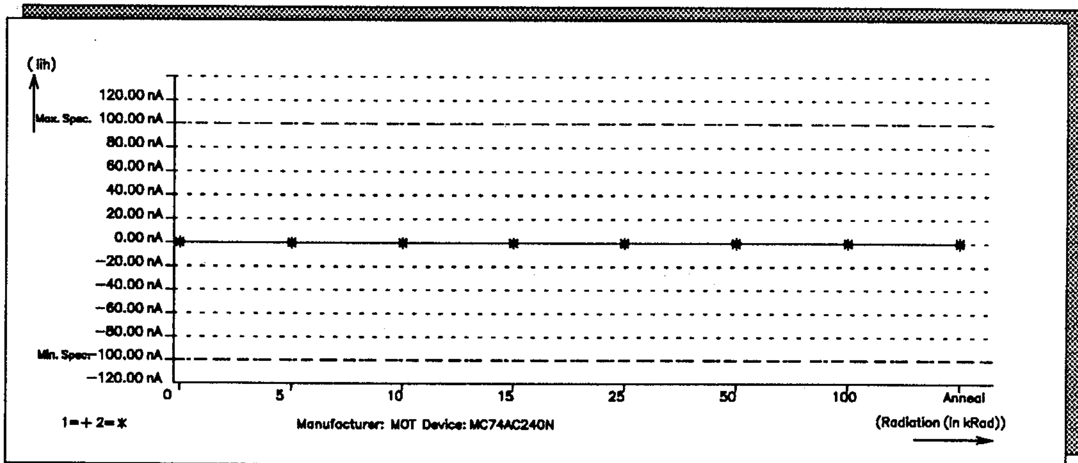


Figure 6-5 Vil National Semiconductor 54AC240DMQB

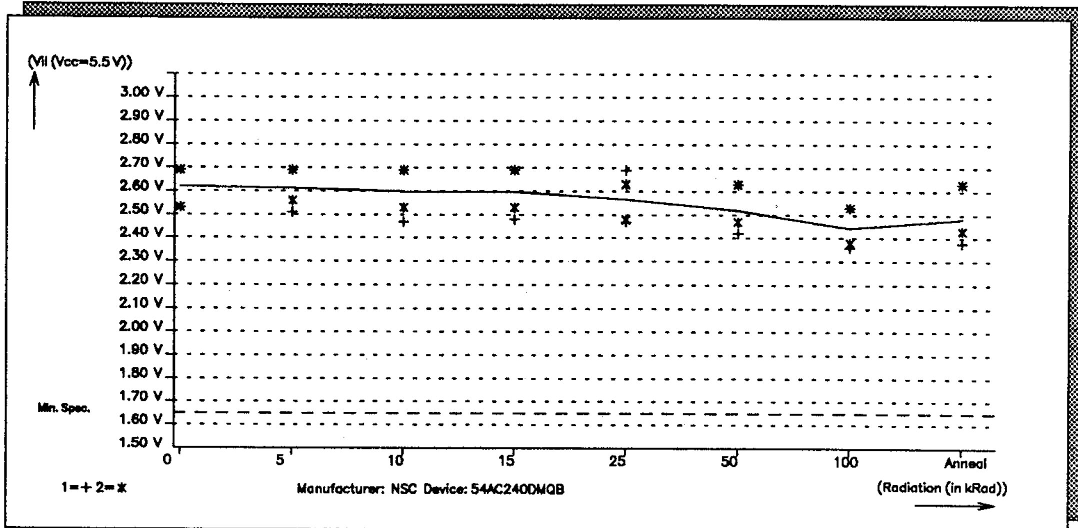
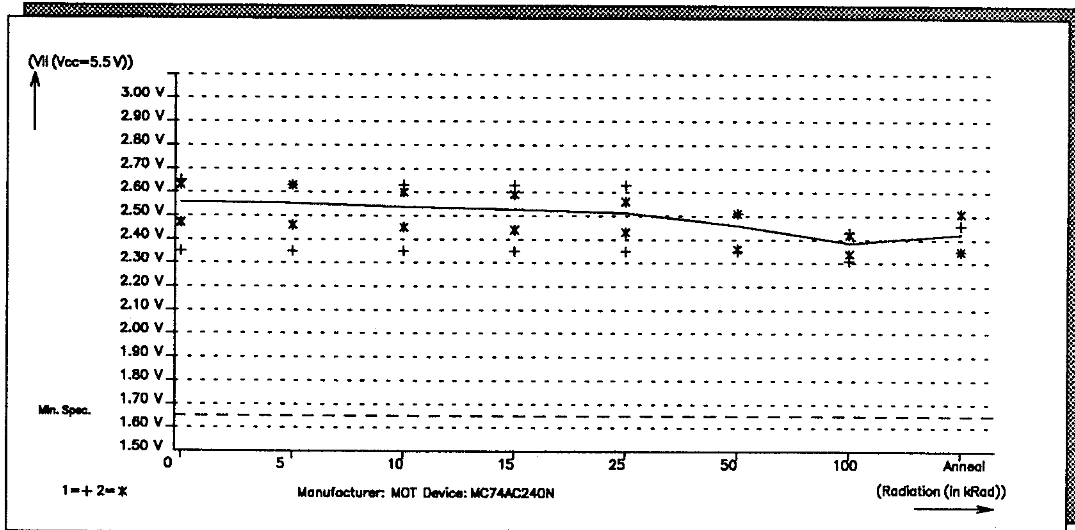


Figure 6-6 Vil Motorola 74AC240N



Note: Only the minimum and maximum values of each device are plotted.

Figure 6-7 Vih National Semiconductor 54AC240DMQB

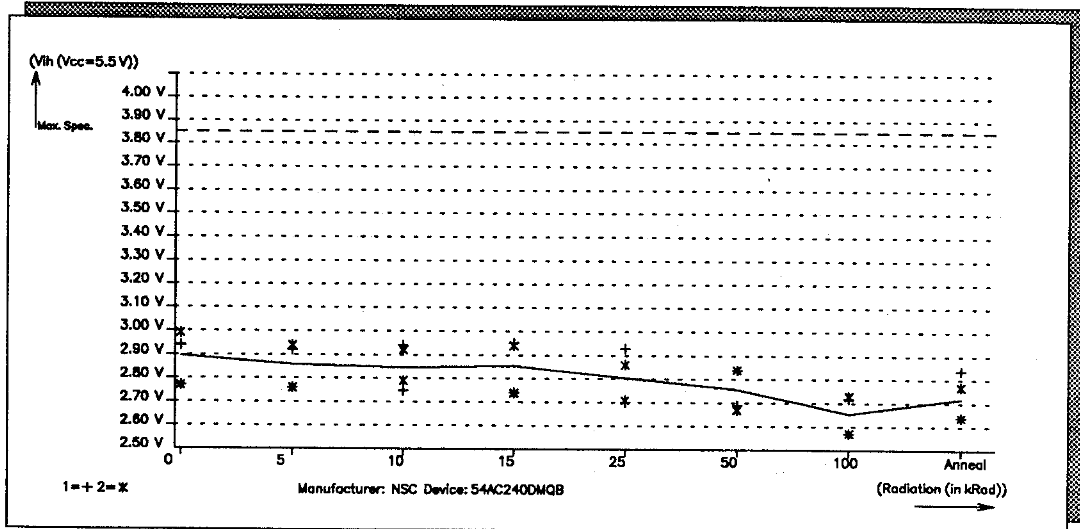


Figure 6-8 Vih Motorola 74AC240N

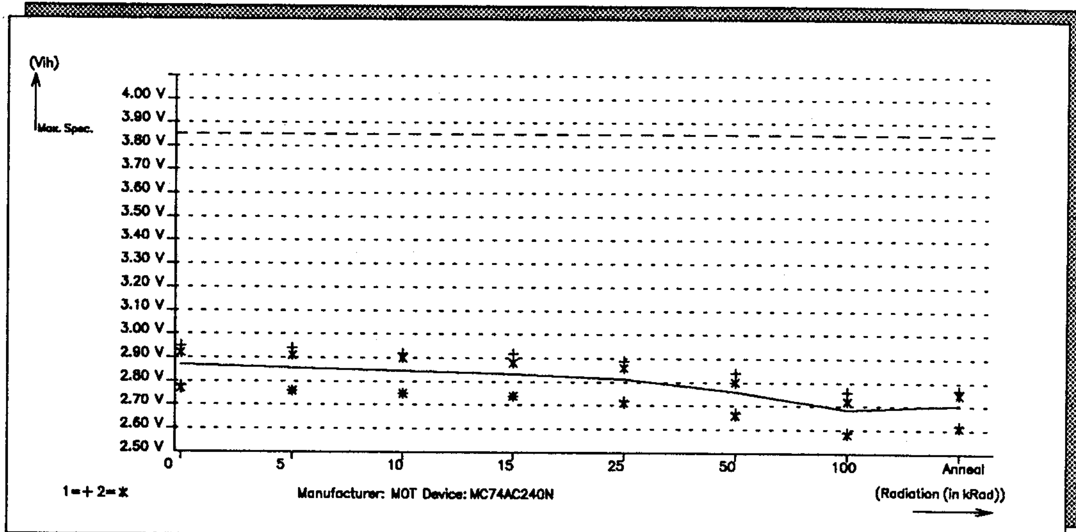


Figure 6-9 Vol National Semiconductor 54AC240DMQB

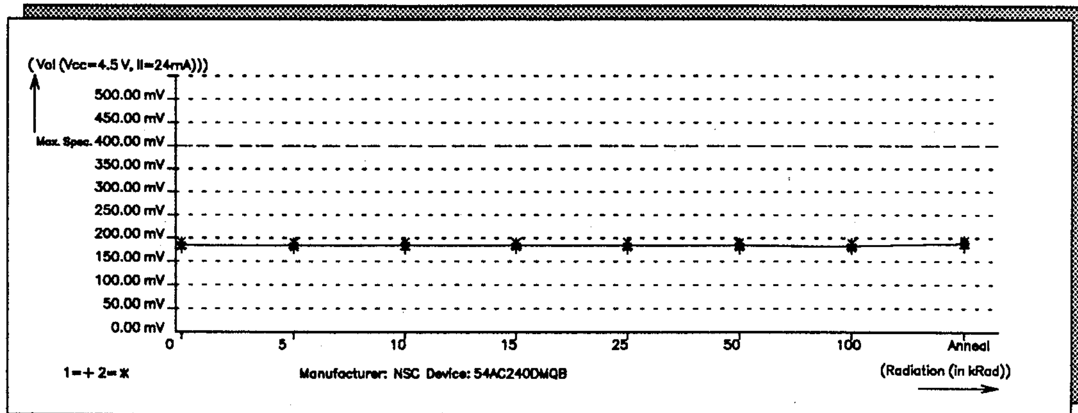


Figure 6-10 Vol Motorola 74AC240N

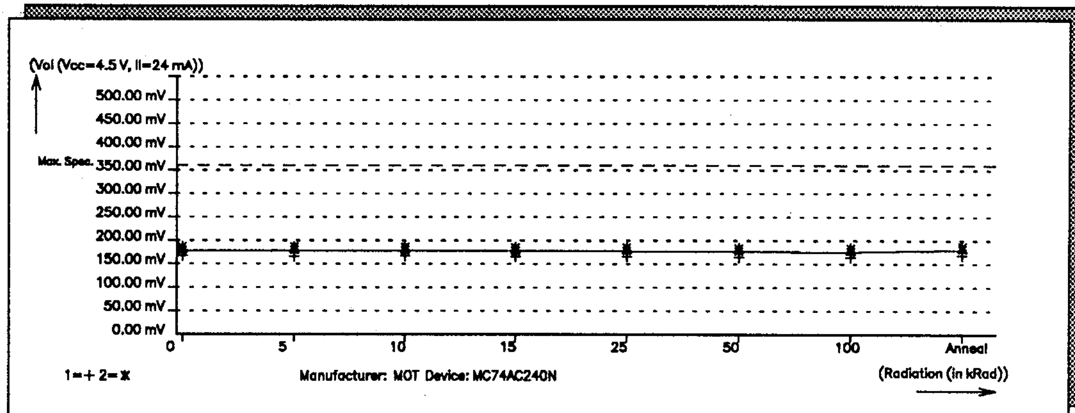


Figure 6-11 Voh National Semiconductor 54AC240DMQB

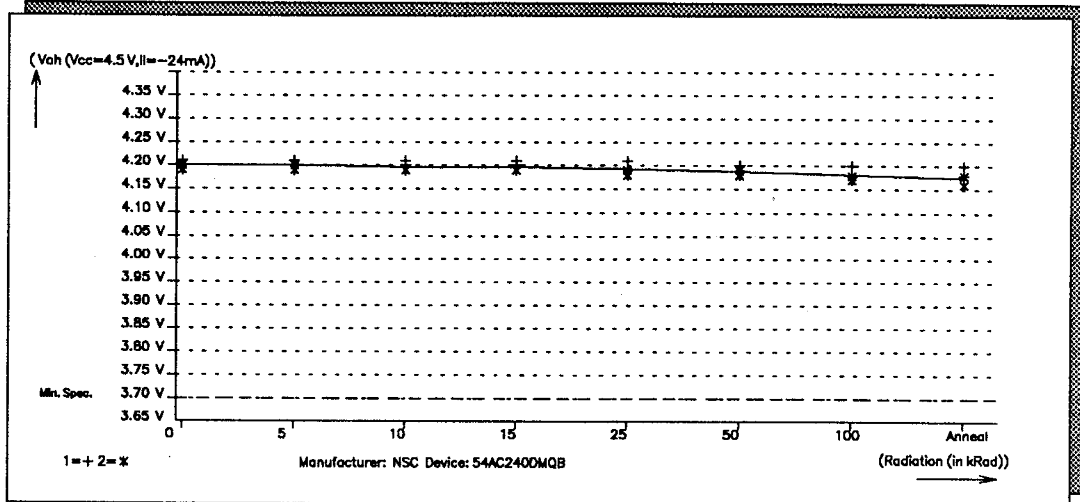


Figure 6-12 Voh Motorola 74AC240N

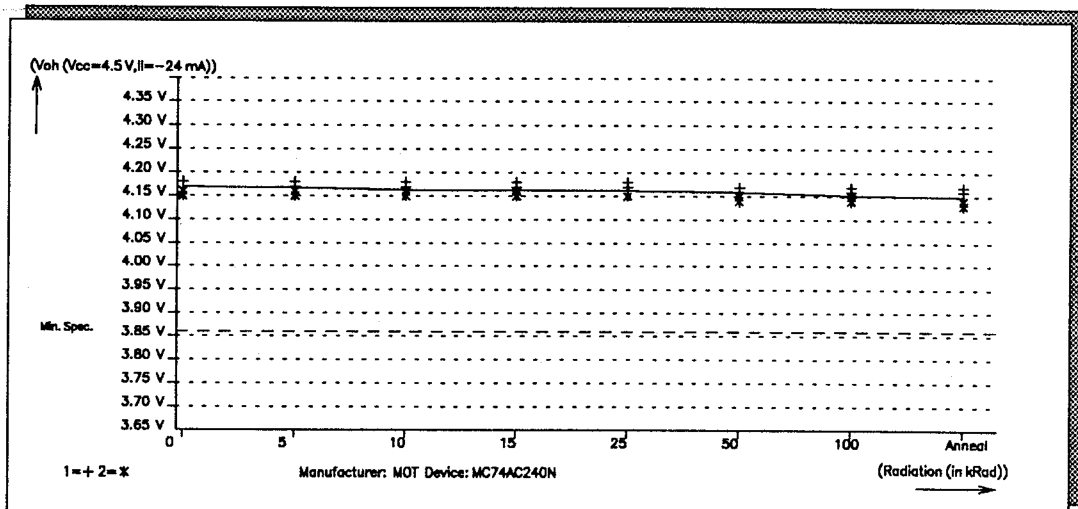


Figure 6-13 Iozl National Semiconductor 54AC240DMQB

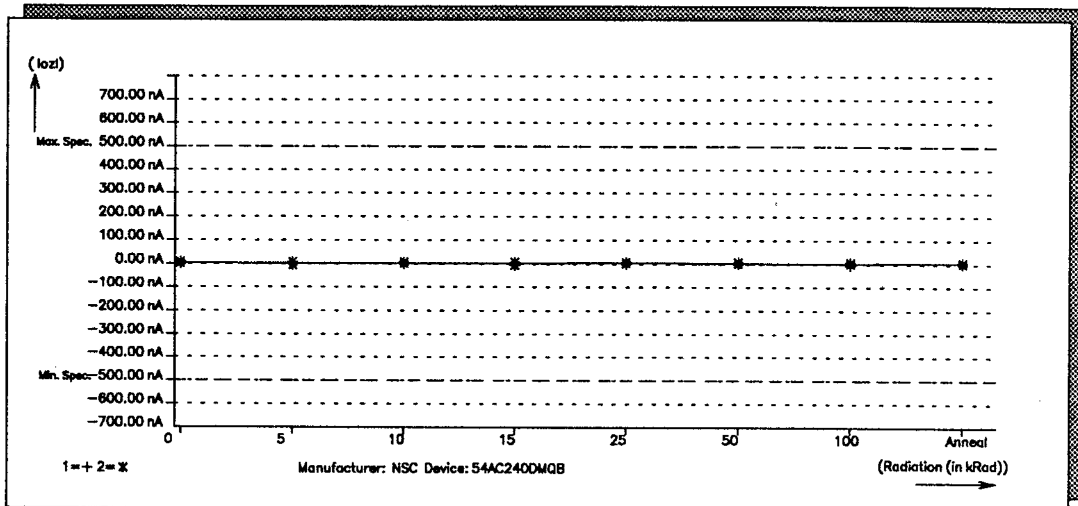


Figure 6-14 Iozl Motorola 74AC240N

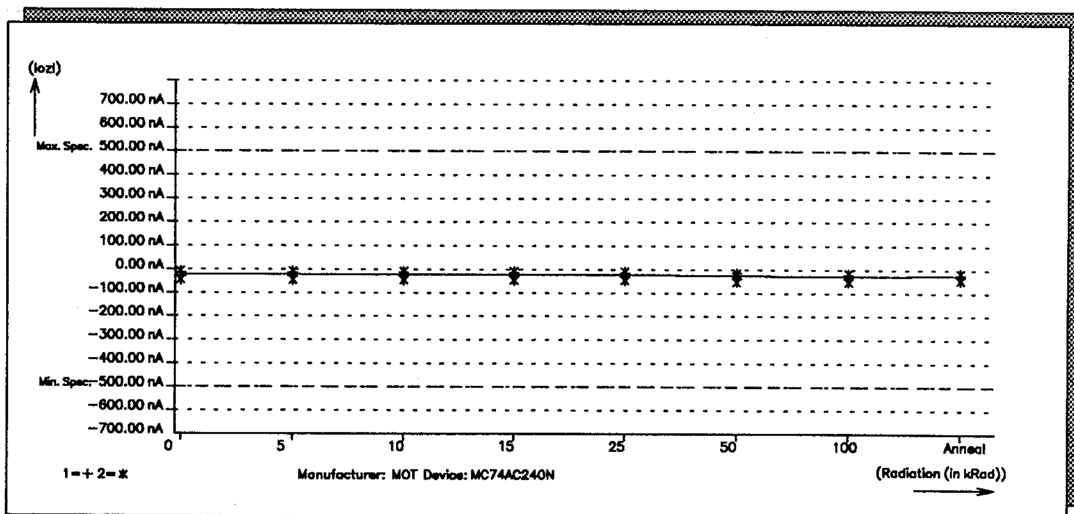


Figure 6-15 Iozh National Semiconductor 54AC240DMQB

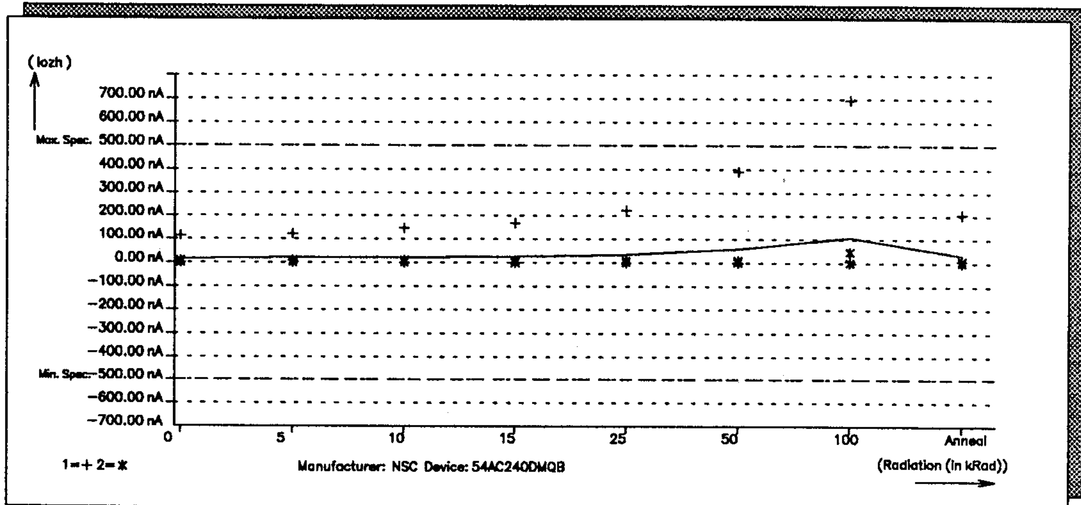


Figure 6-16 Iozh Motorola 74AC240N

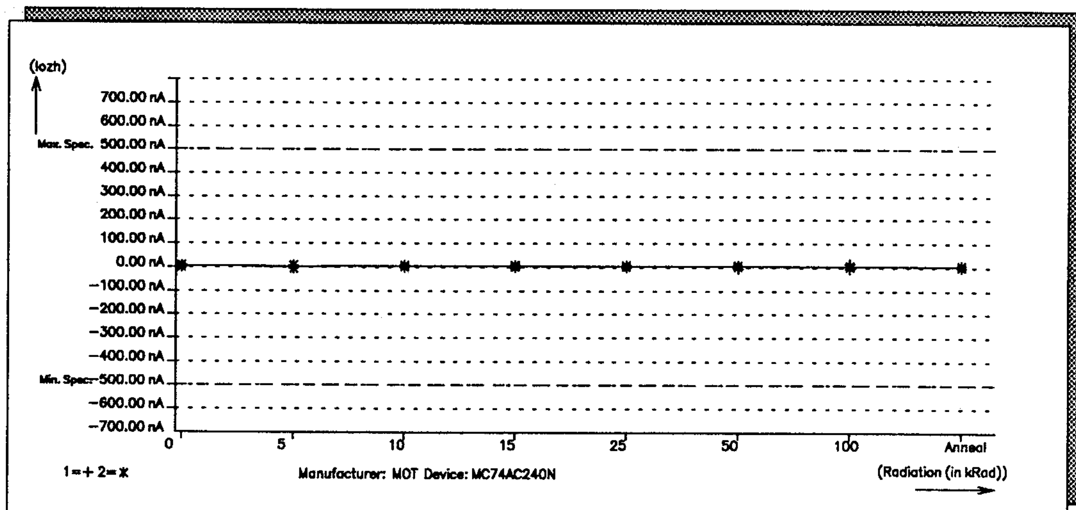


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Figure 6-17 Iccl National Semiconductor 54AC240DMQB

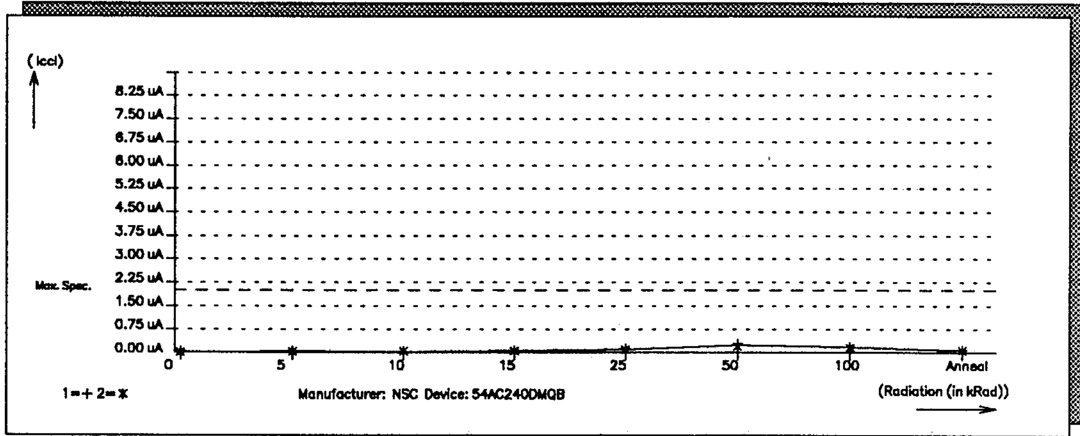

Figure 6-18 Iccl Motorola 74AC240N

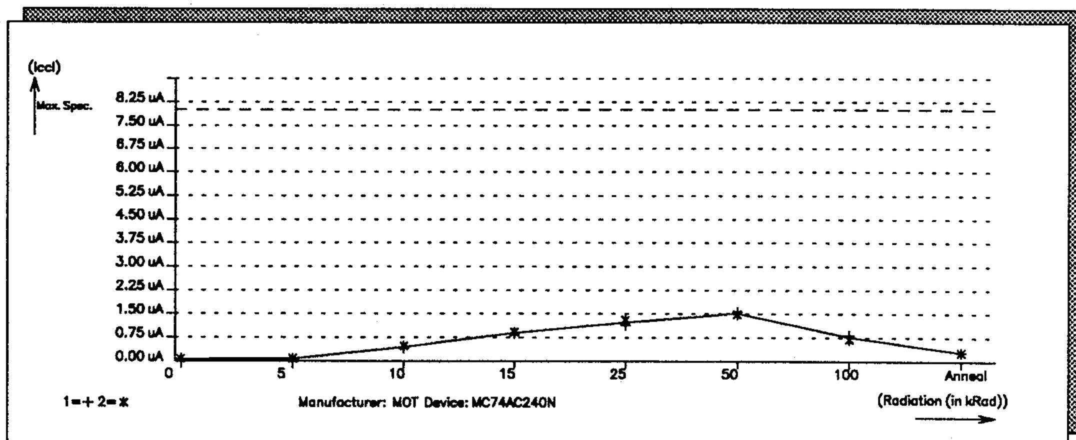

Figure 6-19 Icch National Semiconductor 54AC240DMQB

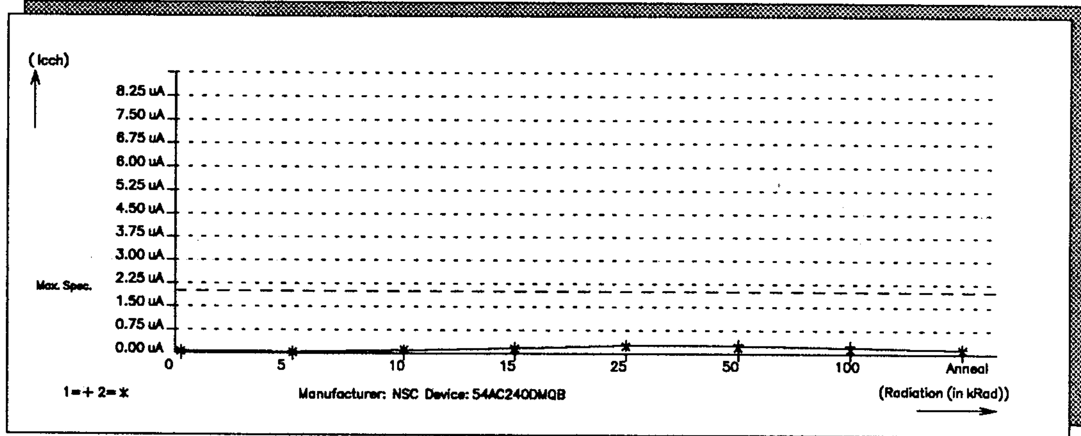

Figure 6-20 Icch Motorola 74AC240N

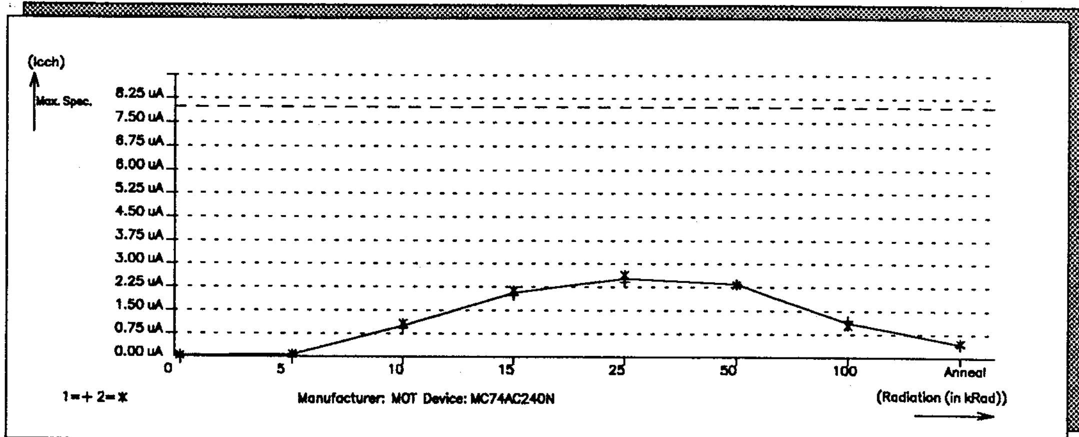

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Figure 6-21 Icc National Semiconductor 54AC240DMQB

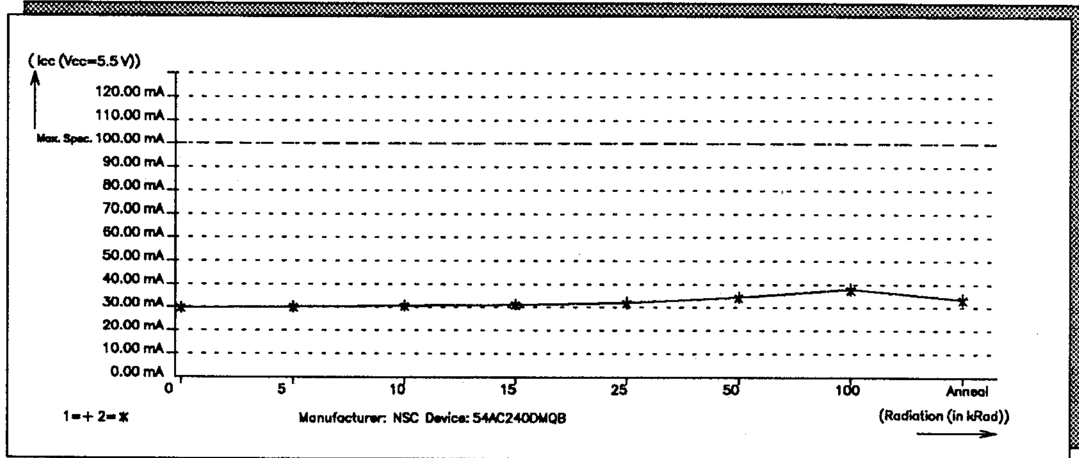

Figure 6-22 Icc Motorola 74AC240N

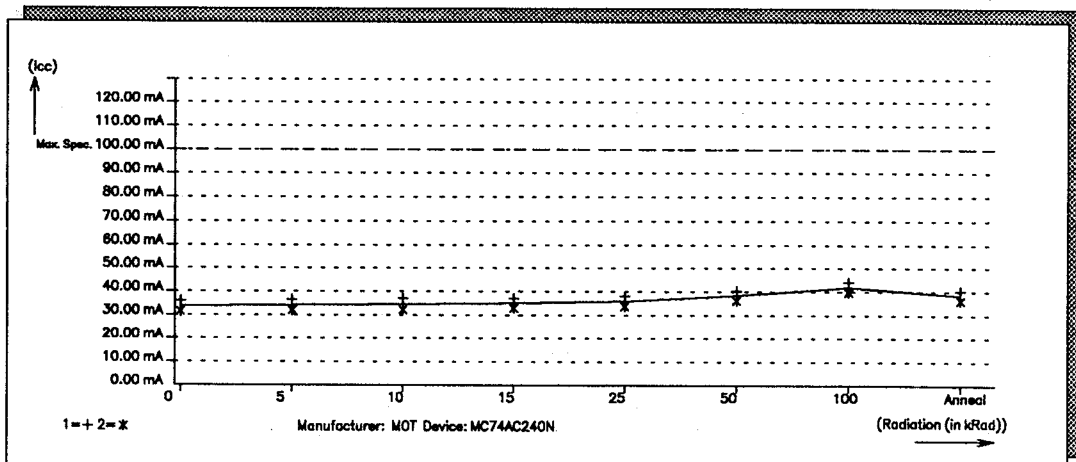

Figure 6-23 Tplh National Semiconductor 54AC240DMQB

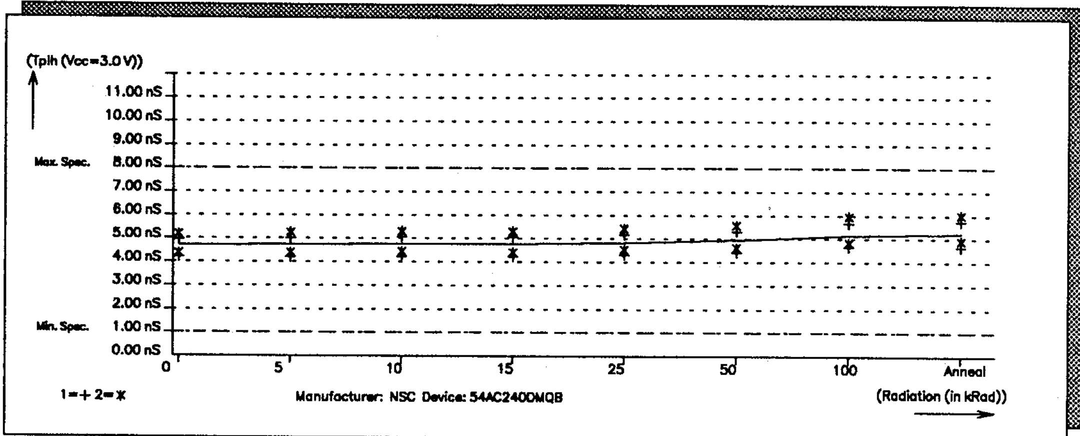

Figure 6-24 Tplh Motorola 74AC240N

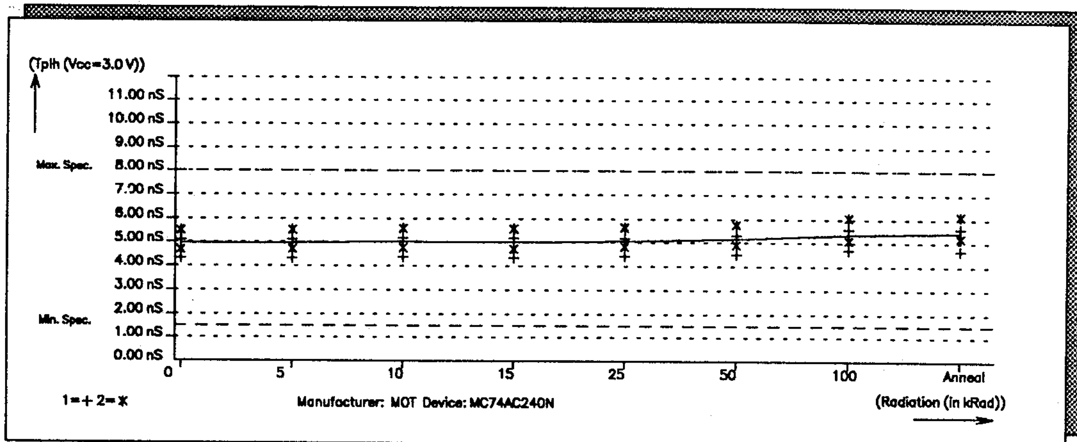

Figure 6-25 Tphl National Semiconductor 54AC240DMQB

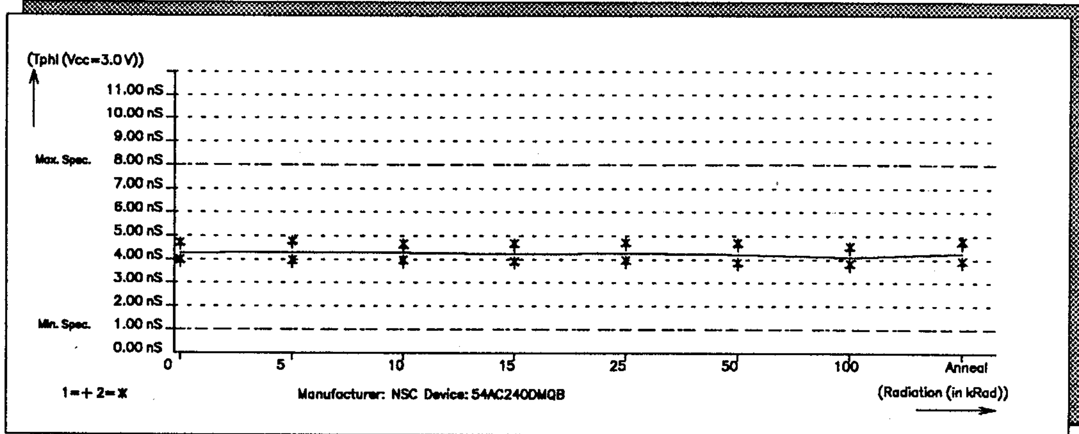

Figure 6-26 Tphl Motorola 74AC240N

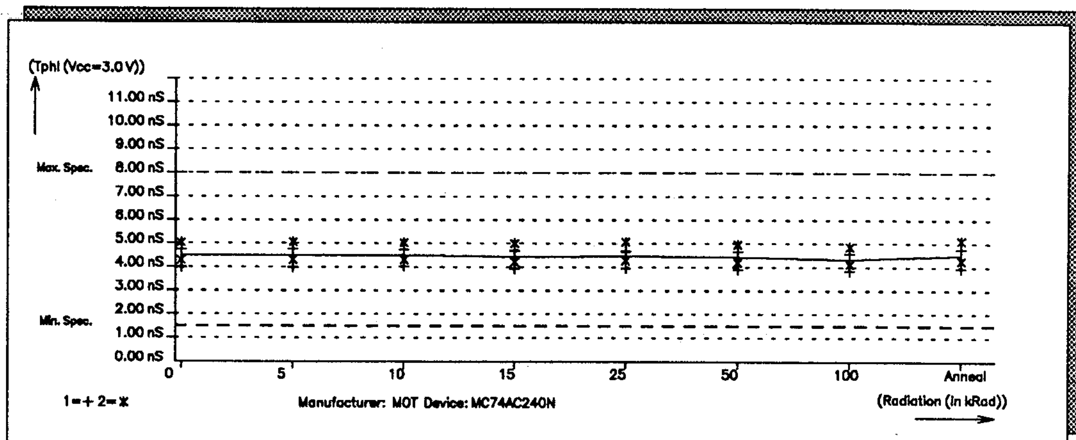

Figure 6-27 Tplz National Semiconductor 54AC240DMQB

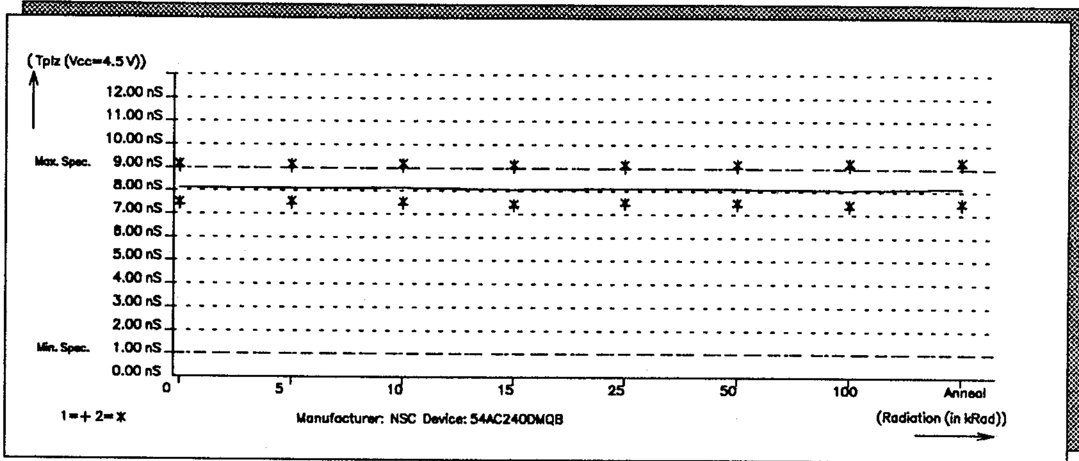

Figure 6-28 Tplz Motorola 74AC240N

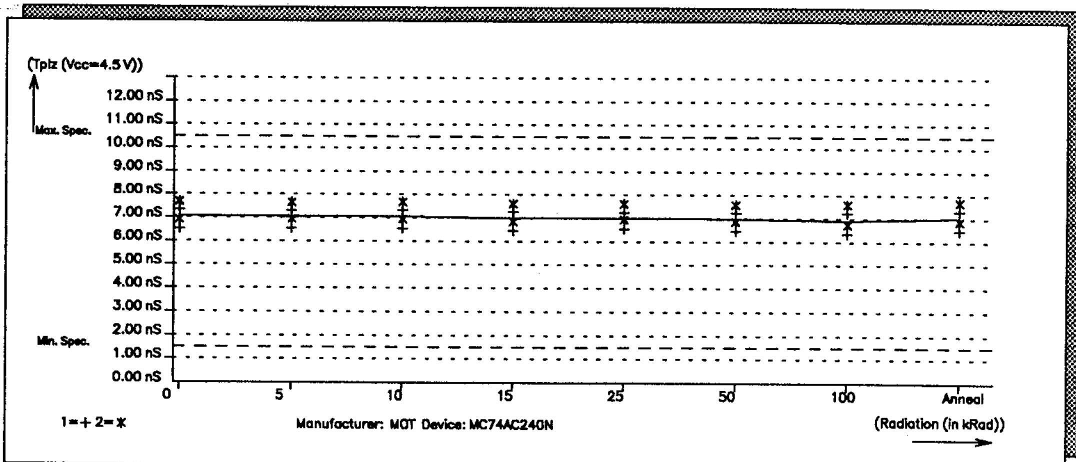

Table 6-3 Fail devices National Semiconductor 74AC244 DMQB

Test	0kRad	5kRad	10kRad	15kRad	25kRad	50kRad	100kRad	Anneal
Cont	-	-	-	-	-	-	-	-
Iil	-	-	-	-	-	-	-	-
Iih	-	-	-	-	-	-	-	-
Vil	-	-	-	-	-	-	-	-
Vih	-	-	-	-	-	-	-	-
Vol	-	-	-	-	-	-	-	-
Voh	-	-	-	-	-	-	-	-
Iozl	-	-	-	-	-	-	-	-
Iozh	-	-	-	-	-	-	-	-
Iccl	-	-	-	-	-	-	-	-
Icch	-	-	-	-	-	-	-	-
Icc	-	-	-	-	-	-	-	-
Func	-	-	-	-	-	-	-	-
tPLH	-	-	-	-	-	-	-	-
tPHL	-	-	-	-	-	-	-	-
tPLZ	-	-	-	-	-	-	-	-
tPZL	-	-	-	-	-	-	-	-
tPHZ	-	-	-	-	-	-	-	-
tPZH	-	-	-	-	-	-	-	-

Table 6-4 Fail devices Motorola 74AC244N

Test	0kRad	5kRad	10kRad	15kRad	25kRad	50kRad	100kRad	Anneal
Cont	-	-	-	-	-	-	-	-
Iil	-	-	-	-	-	-	-	-
Iih	-	-	-	-	-	-	-	-
Vil	-	-	-	-	-	-	-	-
Vih	-	-	-	-	-	-	-	-
Vol	-	-	-	-	-	-	-	-
Voh	-	-	-	-	-	-	-	-
Iozl	-	-	-	-	-	-	-	-
Iozh	-	-	-	-	-	-	-	-
Iccl	-	-	-	-	-	-	-	-
Icch	-	-	-	-	-	-	-	-
Icc	-	-	-	-	-	-	-	-
Func	-	-	-	-	-	-	-	-
tPLH	-	-	-	-	-	-	-	-
tPHL	-	-	-	-	-	-	-	-
tPLZ	-	-	-	-	-	-	-	-
tPZL	-	-	-	-	-	-	-	-
tPHZ	-	-	-	-	-	-	-	-
tPZH	-	-	-	-	-	-	-	-

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Figure 6-29 IIl National Semiconductor 74AC244DMQB

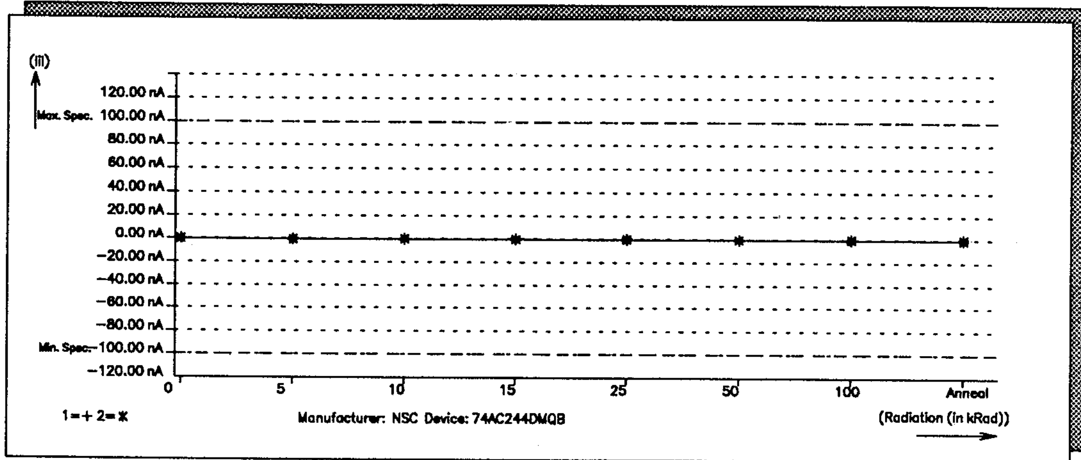

Figure 6-30 IIl Motorola 74AC244AN

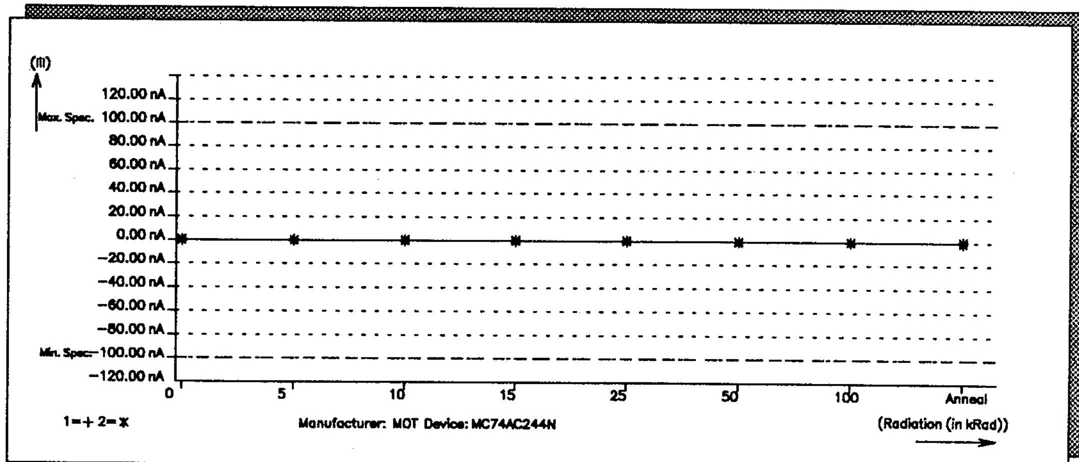

Figure 6-31 Iih National Semiconductor 74AC244DMQB

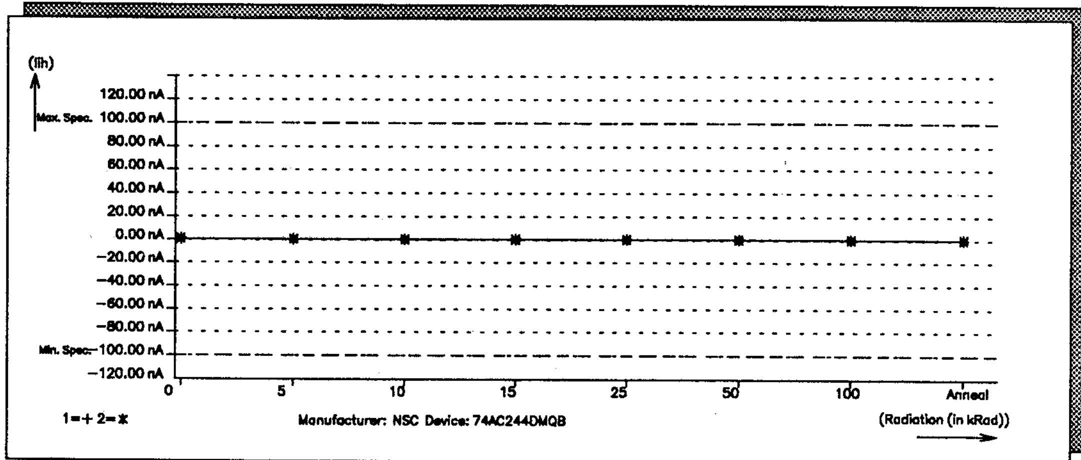

Figure 6-32 Iih Motorola 74AC244N

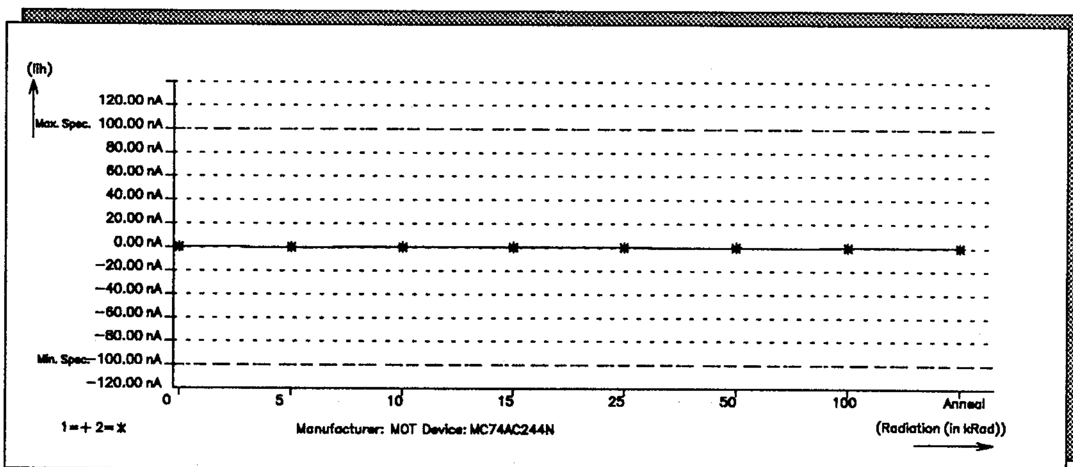

Figure 6-33 Vil National Semiconductor 74AC244DMQB

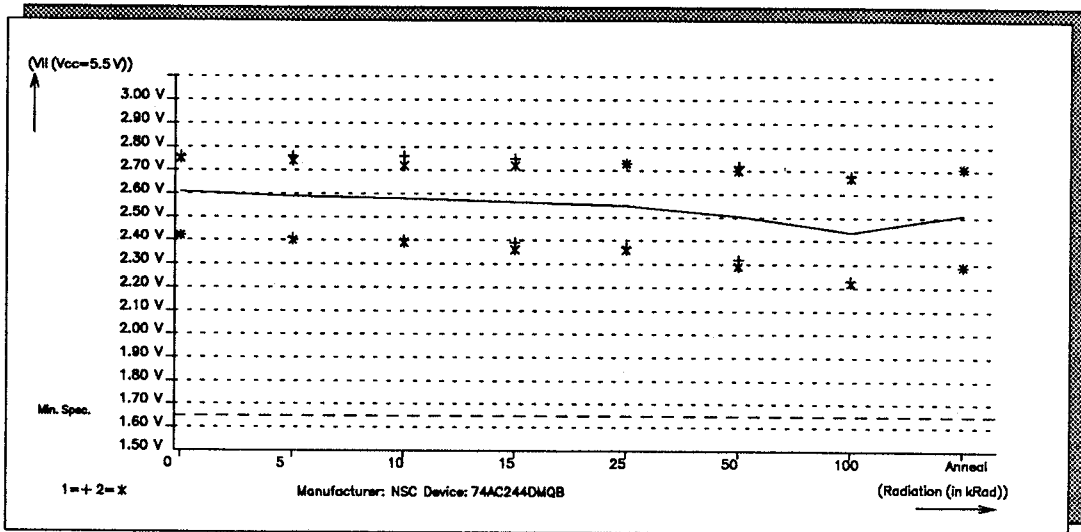

Figure 6-34 Vil Motorola 74AC244N

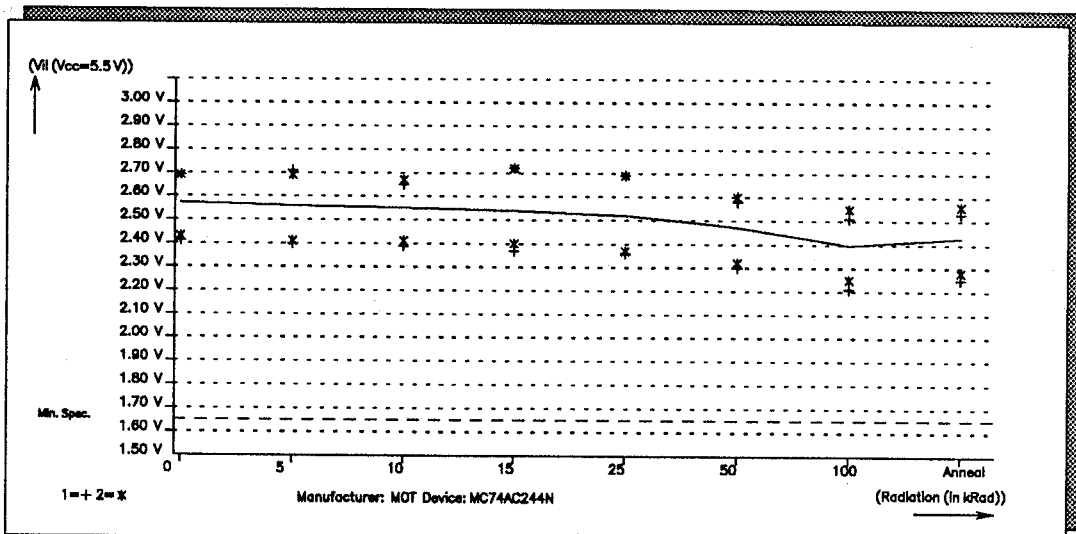

Figure 6-35 Vih National Semiconductor 74AC244DMQB

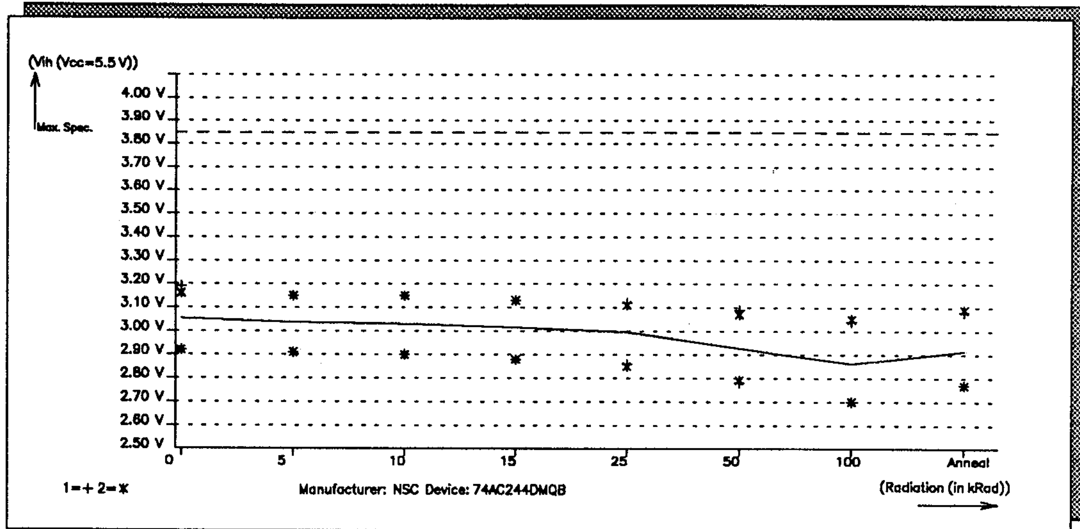

Figure 6-36 Vih Motorola 74AC244N

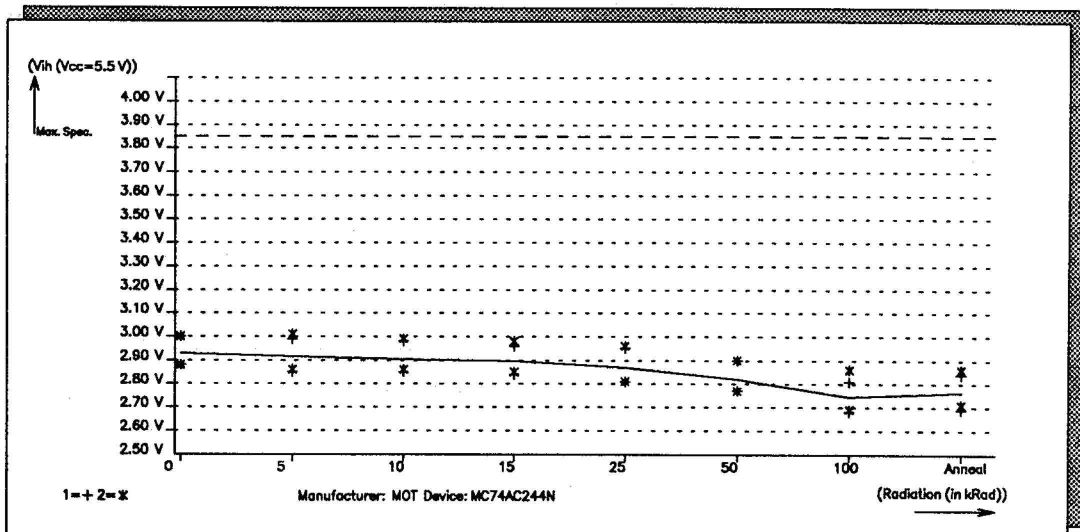

Figure 6-37 Vol National Semiconductor 74AC244DMQB

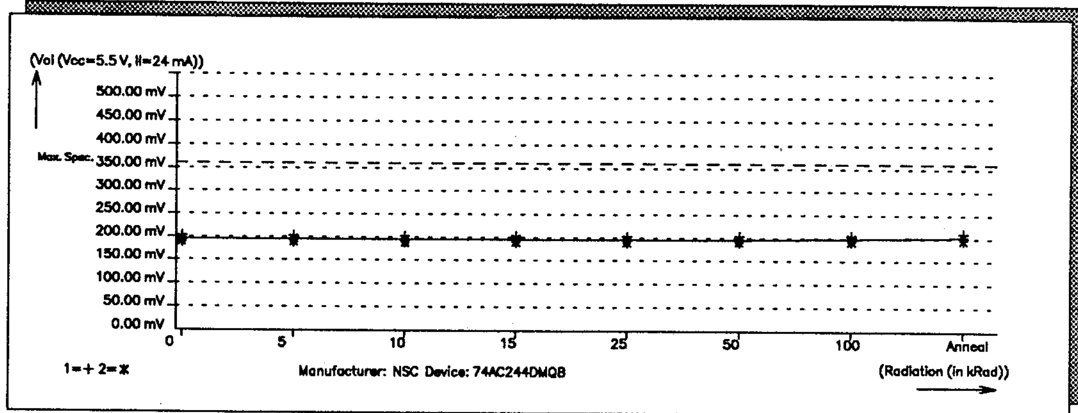

Figure 6-38 Vol Motorola 74AC244N

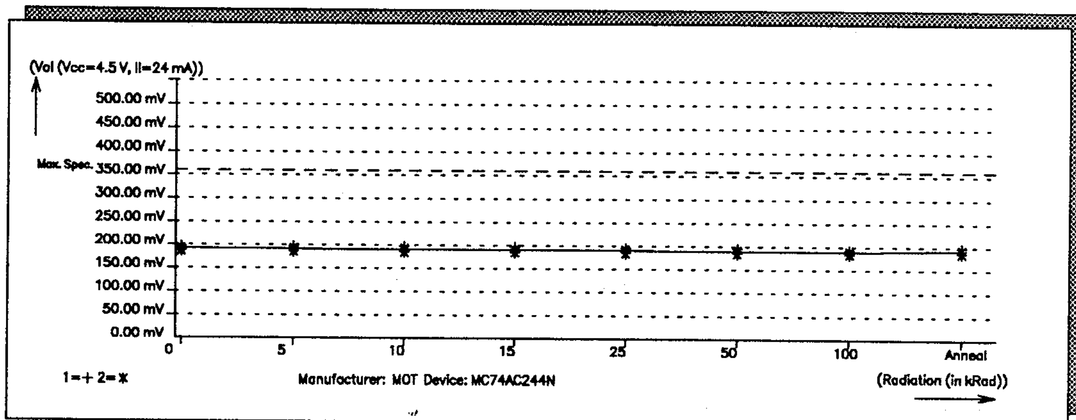

Figure 6-39 Voh National Semiconductor 74AC244DMQB

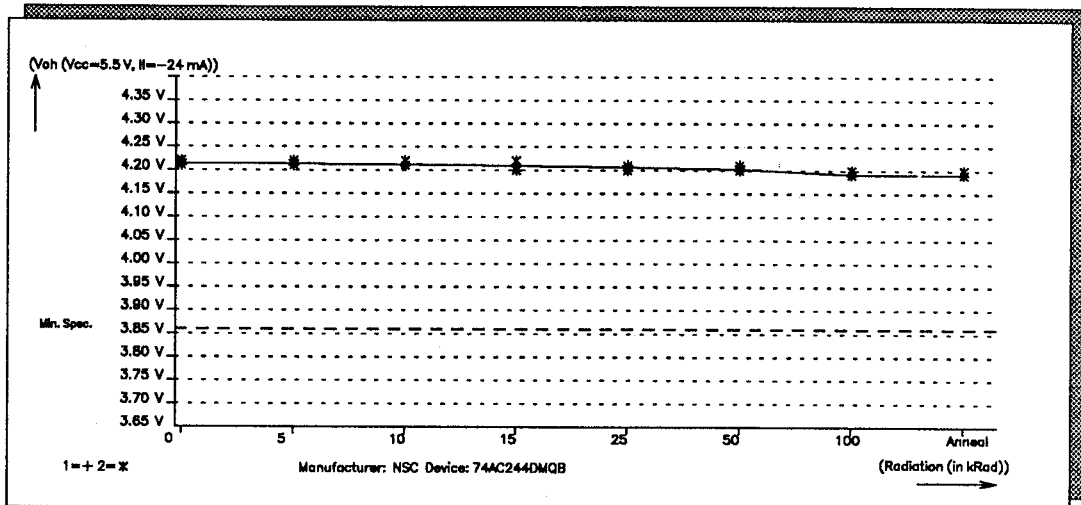

Figure 6-40 Voh Motorola 74AC244N

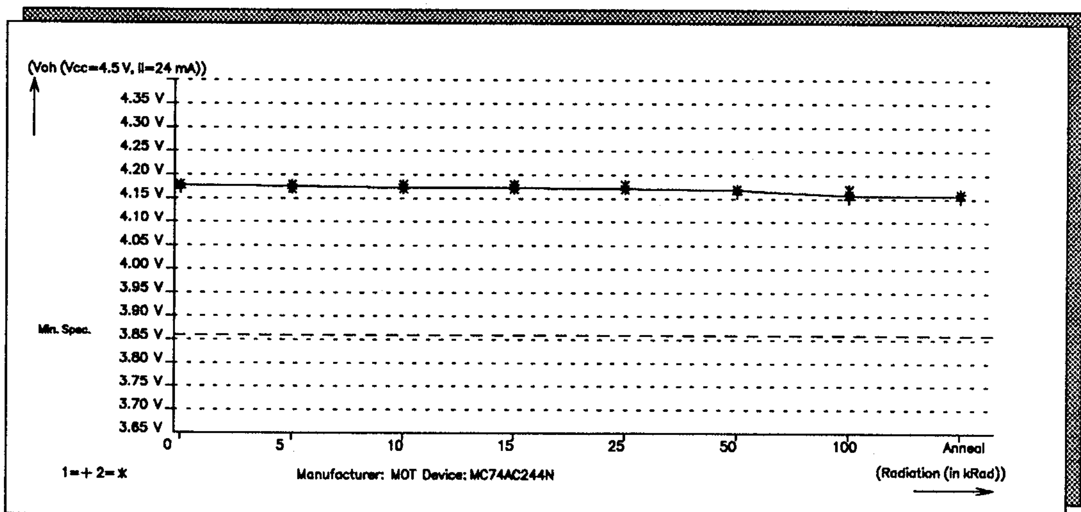

Figure 6-41 Iozl National Semiconductor 74AC244DMQB

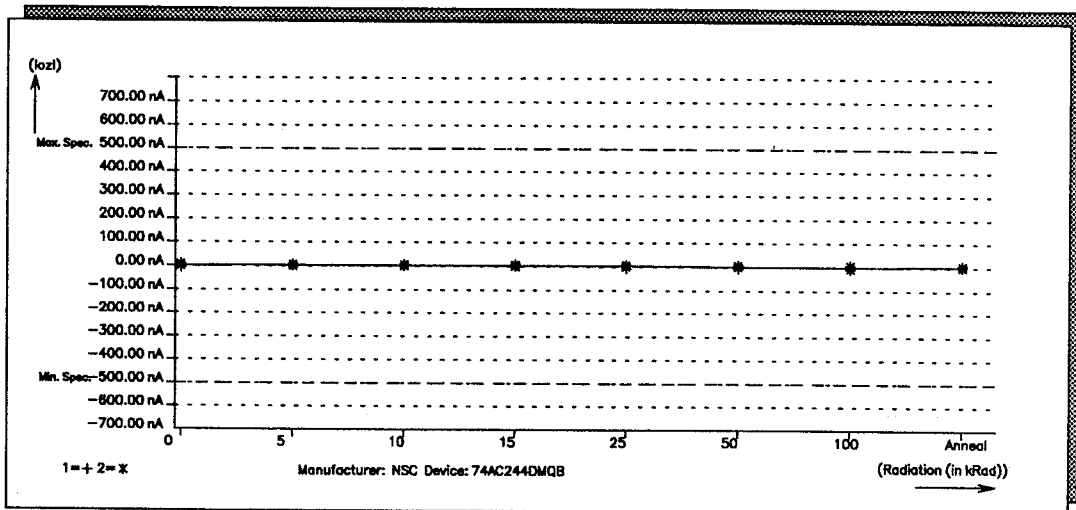

Figure 6-42 Iozl Motorola 74AC244N

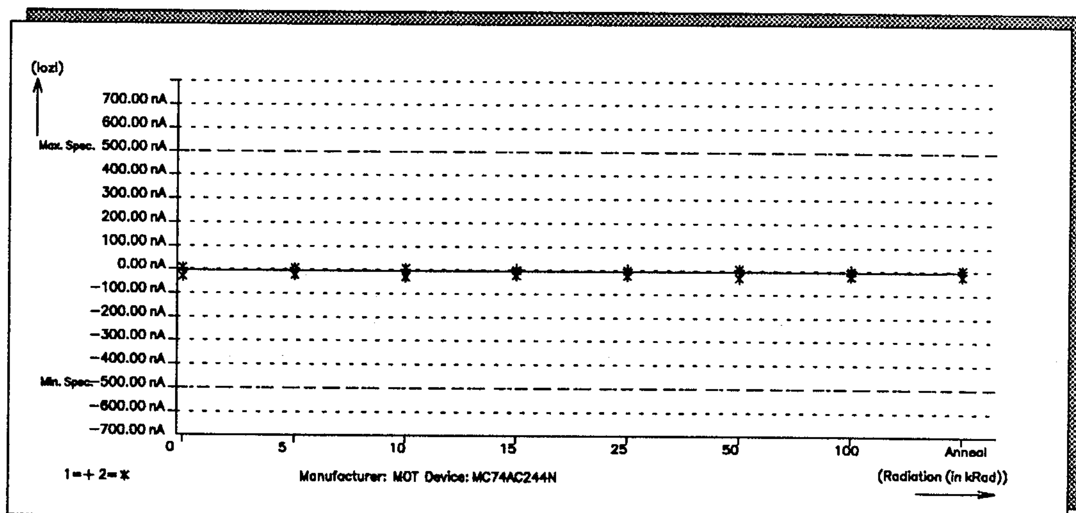

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Figure 6-43 Iozh National Semiconductor 74AC244DMQB

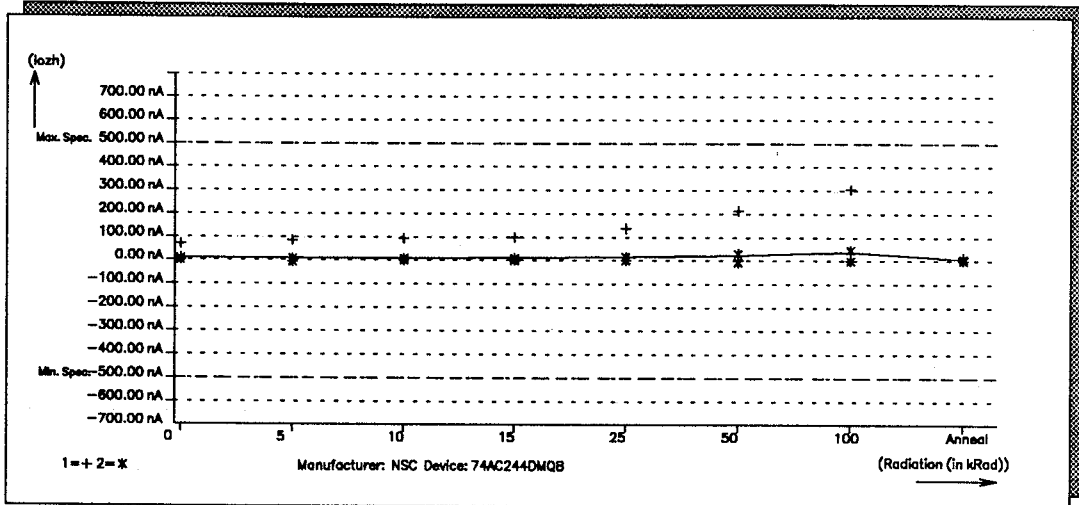

Figure 6-44 Iozh Motorola 74AC244N

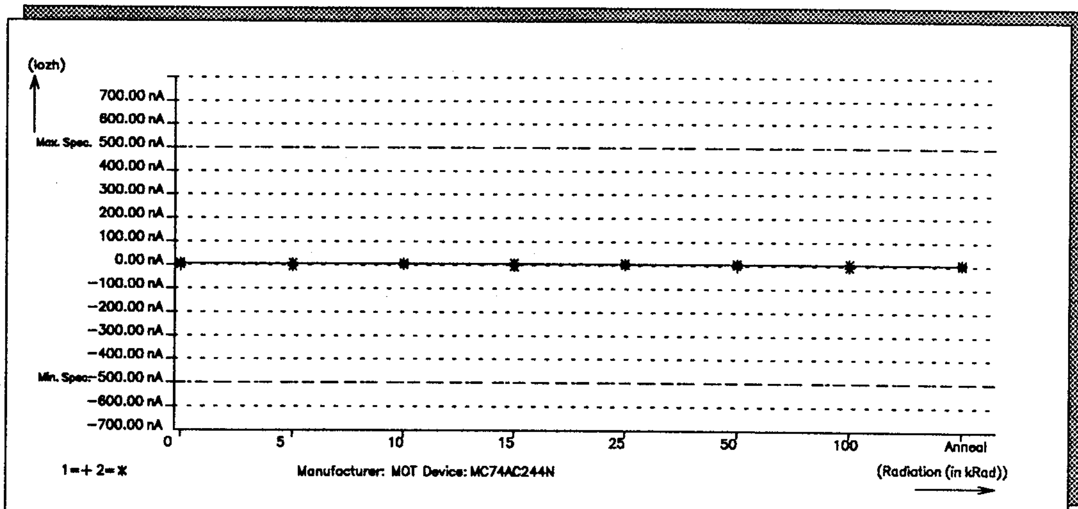

Figure 6-45 Iccl National Semiconductor 74AC244DMQB

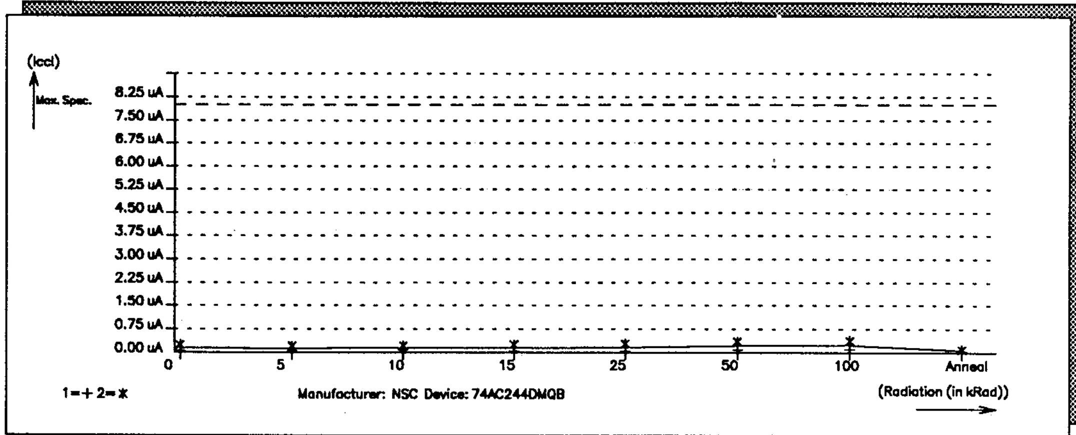

Figure 6-46 Iccl Motorola 74AC244N

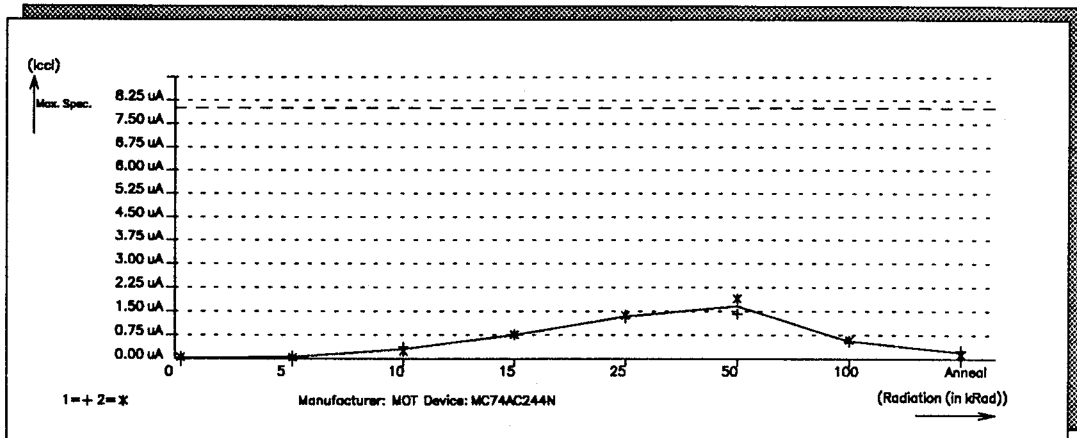

Figure 6-47 Icch National Semiconductor 74AC244DMQB

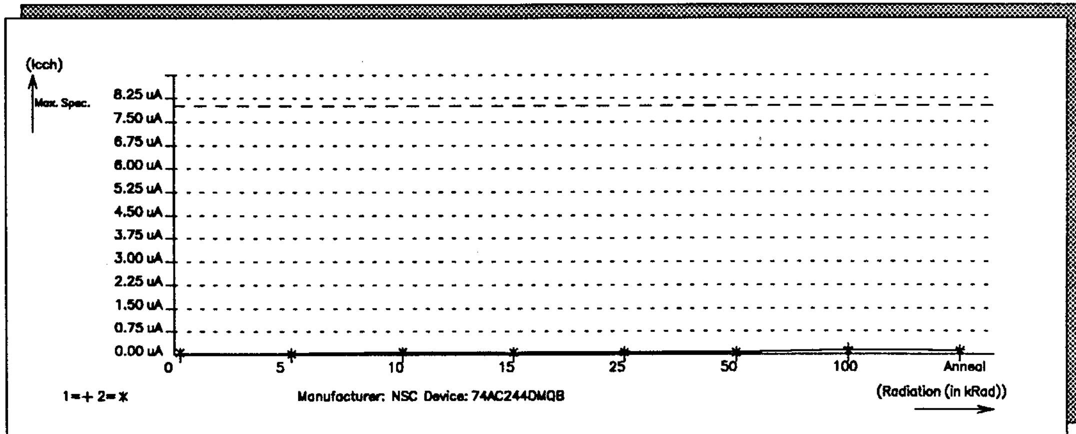

Figure 6-48 Icch Motorola 74AC244N

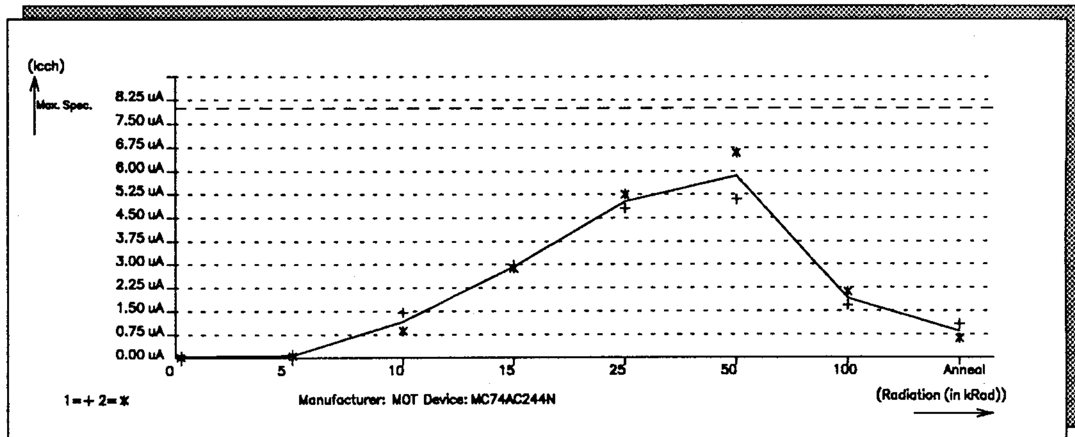

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Figure 6-49 Icc National Semiconductor 74AC244DMQB

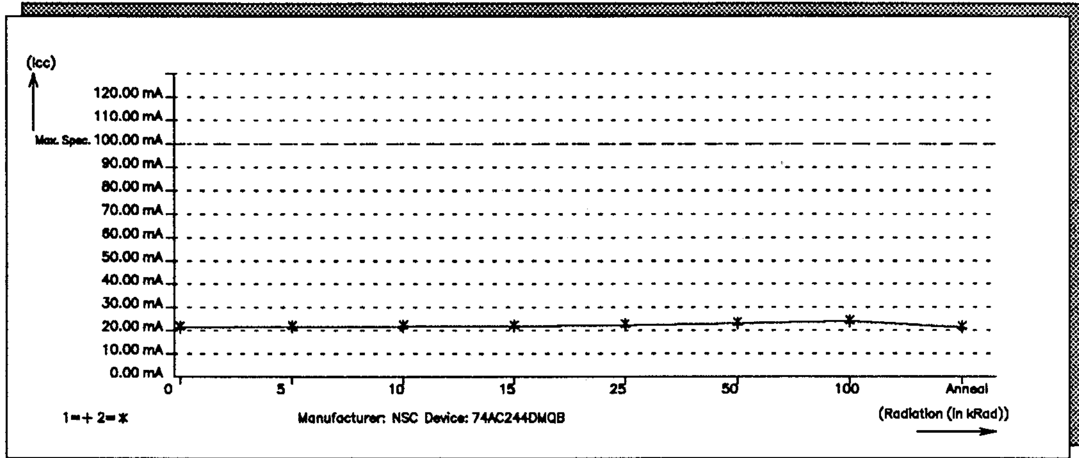


Figure 6-50 Icc Motorola 74AC244N

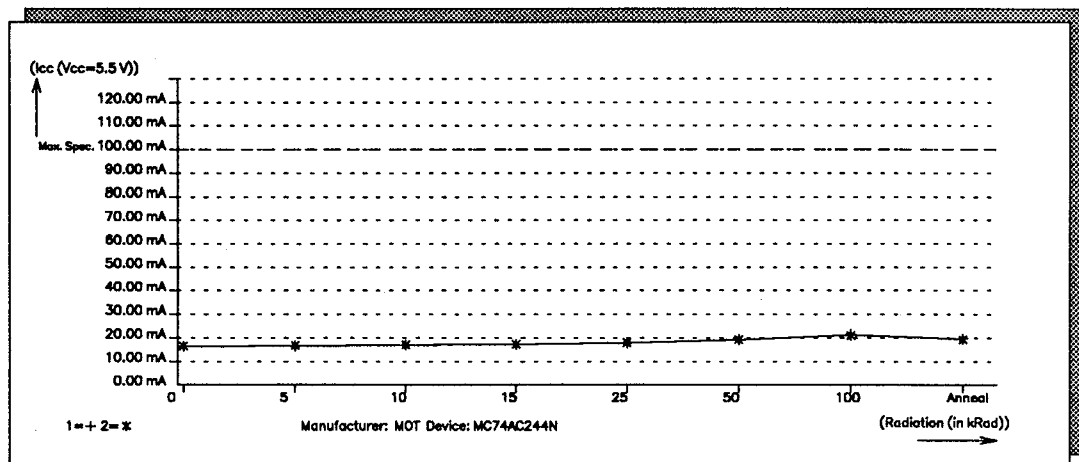


Figure 6-51 Tplh National Semiconductor 74AC244DMQB

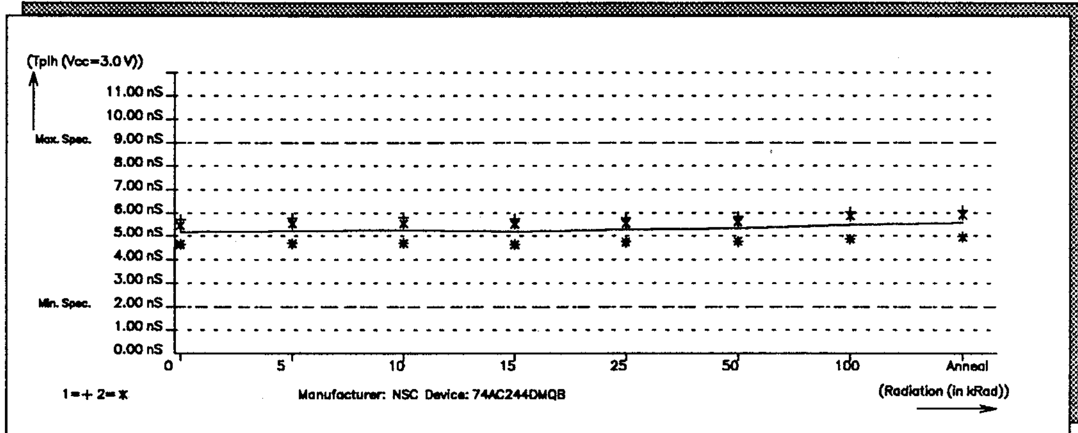


Figure 6-52 Tplh Motorola 74AC244N

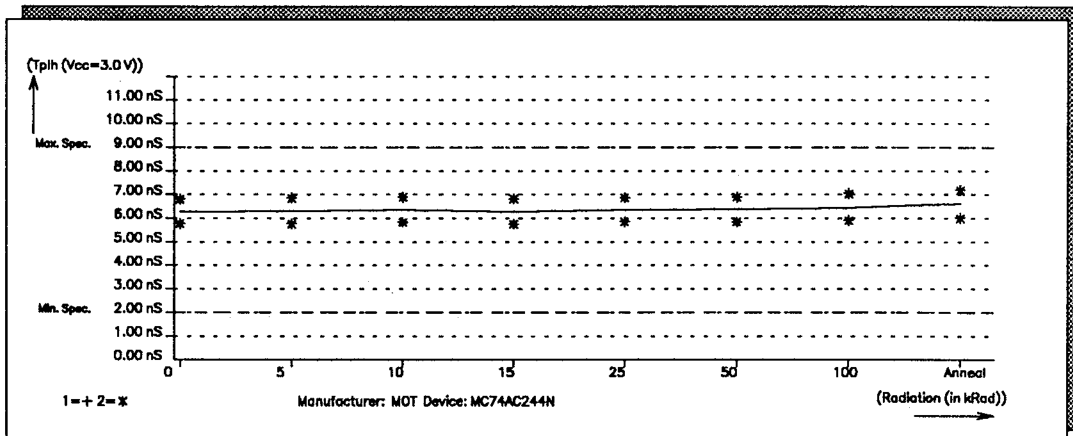


Figure 6-53 Tphl National Semiconductor 74AC244DMQB

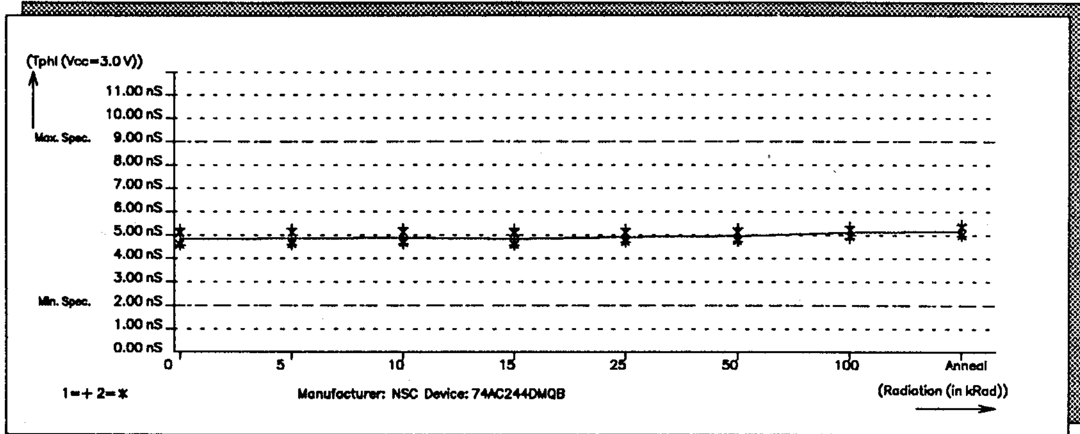


Figure 6-54 Tphl Motorola 74AC244N

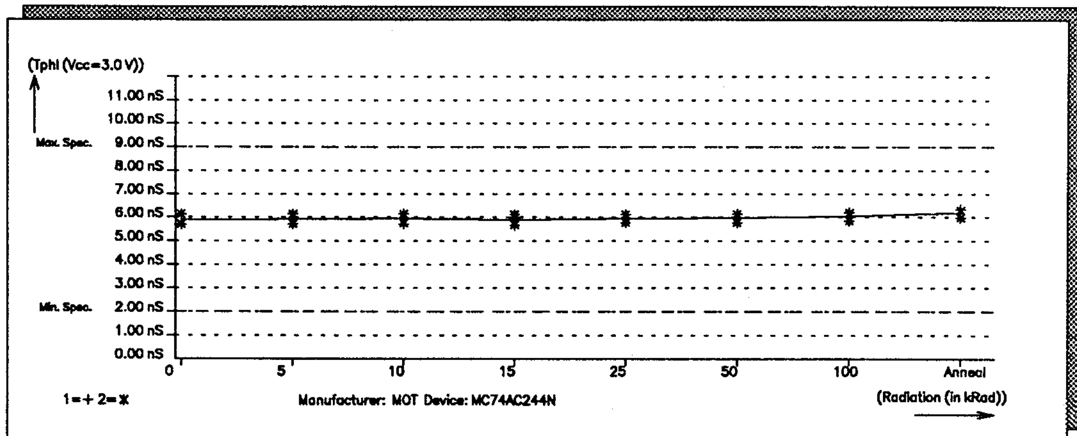


Figure 6-55 Tplz National Semiconductor 74AC244DMQB

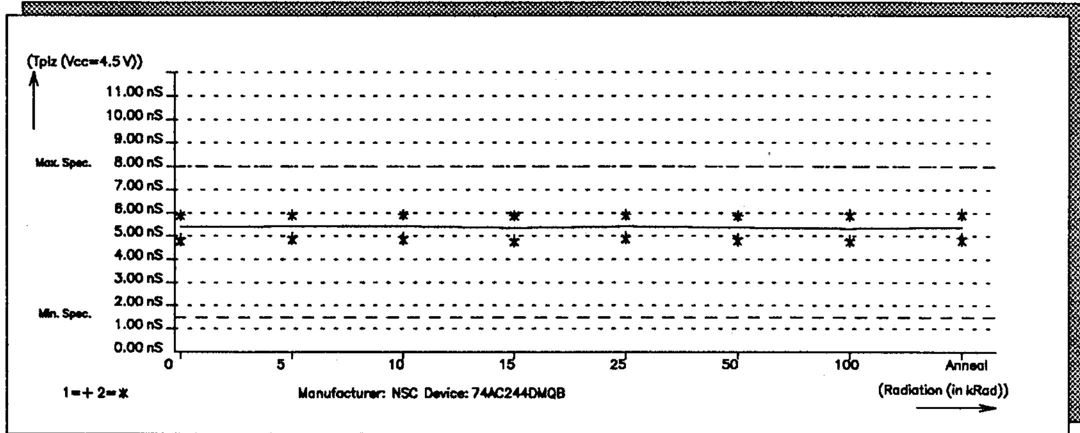
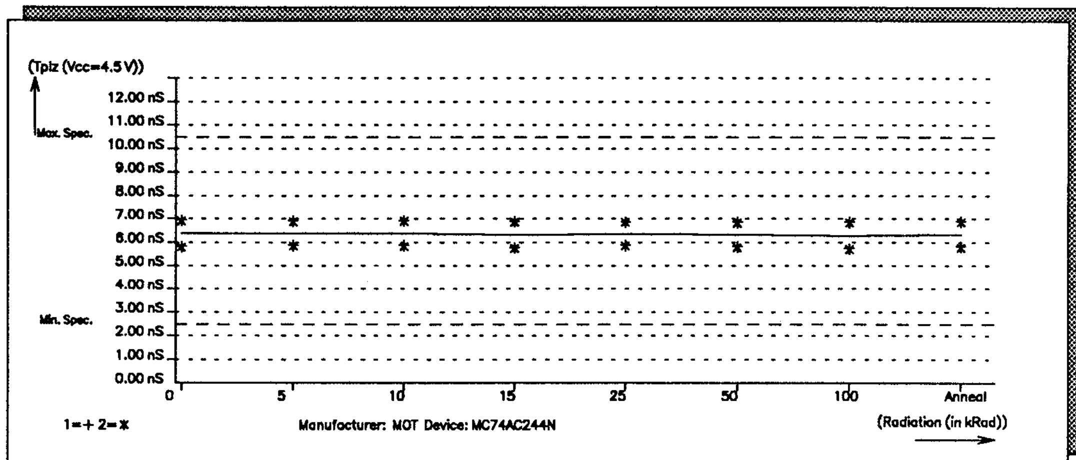


Figure 6-56 Tplz Motorola 74AC244N



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Appendices of the Report QRR 91.004

for ESA/ESTEC, Noordwijk, The Netherlands

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Report Number : QRR 91.004
Date : 91 - 03 - 15

Appendix A - Testflows

TESTFLOW FOR THE

M38510-75703BRX/ESTEC

Manufacturer : National Semiconductor

Octal Buffer/Line Driver With
3-State Outputs

Registration RTH-lab

Registration RTH-sales office

Originated by : H. v. Winkoop

Function : TPS Engineer

Date : 2 February 1991

Reviewed by : G. Schoonhoven

Function : Test Engineer

Date : 2 February 1991

Rood Testhouse B.V., Heerde reserves the right to alter the specifications of a testflow at any time without notifying the customer, unless otherwise agreed.

Device type : M38510-75703BRX/ESTEC at +25'C Degrees C.

Manufacturer : National Semiconductor

Function : Octal Buffer/Line Driver With 3-State Outputs

Testsequence	Rood Testhouse classification
Test 10 - 27 OPENS TEST	Fail Continuity
Test 100 - 109 INPUT CURRENT LOW Test 110 - 119 INPUT CURRENT HIGH Test 120 - 149 INPUT VOLTAGE LOW Test 150 - 179 INPUT VOLTAGE HIGH Test 200 - 257 OUTPUT VOLTAGE LOW Test 260 - 317 OUTPUT VOLTAGE HIGH Test 320 - 327 OUTPUT 3-STATE CURRENT LOW Test 330 - 337 OUTPUT 3-STATE CURRENT HIGH Test 340 QUIESCENT SUPPLY CURRENT WITH OUTPUTS LOW Test 350 QUIESCENT SUPPLY CURRENT WITH OUTPUTS HIGH Test 360 - 380 DYNAMIC SUPPLY CURRENT	Fail Static
Test 400 BASIC FUNCTIONAL TEST Test 401 - 403 FUNCTIONAL TEST CRITICAL INPUT LEVELS Test 500 - 527 PROPAGATION DELAY TIME TPLH Test 530 - 557 PROPAGATION DELAY TIME TPHL Test 560 - 587 PROPAGATION DELAY TIME TPLZ Test 590 - 617 PROPAGATION DELAY TIME TPZL Test 620 - 647 PROPAGATION DELAY TIME TPHZ Test 650 - 677 PROPAGATION DELAY TIME TPZH	Fail Dynamic
All Tests Pass	Pass

The following pages are a description of the tests as performed on the tester. The description is valid for all devices and temperatures as mentioned in this testflow, unless noted otherwise.

Test 10 - 27 OPENS TEST

This is a test to detect a bad contact between the device pins and the tester contacts. A PN junction from any pin to the substrate will clamp the pins terminal voltage to about one diode drop voltage. Vcc and ground are set to 0 Volt. A low current value (Idiode) is drawn out of the device pins. The test fails when the measured voltage level (Vdiode) exceeds the specified maximum voltage limit.

Test 100 - 109 INPUT CURRENT LOW

This measurement is performed on a single input pin or on a group of input pins. The measurement is done on one pin at a time. A voltage level (Vil) equal to the ground level is supplied to the pin that is measured. The power supply voltage (Vcc) is set to the specified value. The test fails when the measured input leakage current (Iil) is less than the specified minimum limit or greater than the specified maximum limit.

Test 110 - 119 INPUT CURRENT HIGH

This measurement is performed on a single input pin or on a group of input pins. The measurement is done on one pin at a time. A voltage level (Vih) equal to the Vcc level is supplied to the pin that is measured. The power supply voltage (Vcc) is set to the specified value. The test fails when the measured input leakage current (Iih) is less than the specified minimum limit or greater than the specified maximum limit.

Test 120 - 149 INPUT VOLTAGE LOW

This measurement is performed on a single input or on a group of inputs. The measurement is done on one pin at a time. The critical input voltage low at which the device still passes functionally is determined with a binary search algorithm. The Vcc voltage level is set to the specified level. The test fails when the measured input low level (Vil) is less than the specified minimum limit.

Test 150 - 179 INPUT VOLTAGE HIGH

This measurement is performed on a single input or on a group of inputs. The measurement is done on one pin at a time. The critical input voltage high at which the device still passes functionally is determined with a binary search algorithm. The Vcc voltage level is set to the specified level. The test fails when the measured input low level (Vil) is greater than the specified maximum limit.

Test 200 - 257 OUTPUT VOLTAGE LOW

This measurement is performed on a single output pin or on a group of output pins. The measurement is done on one pin at a time. A functional pattern is executed to set the pin that is measured to the low state. The output is loaded with the specified load current (Iol). The input pins and the Vcc voltage level are set to the specified values. The test fails when the measured output level (Vol) exceeds the specified maximum limit.

Test 260 - 317 OUTPUT VOLTAGE HIGH

This measurement is performed on a single output pin or on a group of output pins. The measurement is done on one pin at a time. A functional pattern is executed to set the pin that is measured to the high state. The output is loaded with the specified load current (Ioh). The input pins and the Vcc voltage level are set to the specified values. The test fails when the measured output level (Voh) is lower than the specified minimum limit.

Test 320 - 327 OUTPUT 3-STATE CURRENT LOW

This measurement is performed on a single 3-state pin or on a group of 3-state pins. The measurement is done on one pin at a time. A functional pattern is executed to set all pins to be measured to 3-state. A voltage level (Vol) equal to the ground level is supplied to the pin that is measured. The power supply voltage (Vcc) and the input levels (Vil,Vih) are set to the specified values and the remaining 3-state pins are set to this Vcc level. The test fails when the measured 3-state leakage current (Iozl) is less than the specified minimum limit or greater than the specified maximum limit.

Test 330 - 337 OUTPUT 3-STATE CURRENT HIGH

This measurement is performed on a single 3-state pin or on a group of 3-state pins. The measurement is done on one pin at a time. A functional pattern is executed to set all pins to be measured to 3-state. A voltage level (Voh) equal to the Vcc level is supplied to the pin that is measured. The power supply voltage (Vcc) and the input levels (Vil,Vih) are set to the specified values and the remaining 3-state pins are set to ground level. The test fails when the measured 3-state leakage current (Iozh) is less than the specified minimum limit or greater than the specified maximum limit.

Test 340 QUIESCENT SUPPLY CURRENT WITH OUTPUTS LOW

This measurement is performed on the Vcc pin. The inputs of the device are not changing during the power supply current measurement. The input pins are set to Vcc or to ground level. The outputs are set to their logical low level and not loaded. The Vcc voltage level is set to the specified value. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 350 QUIESCENT SUPPLY CURRENT WITH OUTPUTS HIGH

This measurement is performed on the Vcc pin. The inputs of the device are not changing during the power supply current measurement. The input pins are set to Vcc or to ground level. The outputs are set to their logical high level and not loaded. The Vcc voltage level is set to the specified value. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 360 - 380 DYNAMIC SUPPLY CURRENT

This measurement is performed on the Vcc pin. Vcc is set to the specified level. The input pins are set to the according Vil-max and Vih-min voltage levels. The outputs are unloaded. A functional pattern is applied to the device during the measurement. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 400 BASIC FUNCTIONAL TEST

This test checks the function of the device under non critical conditions. The power supply voltage (Vcc) is set to nominal. The input voltage levels are set to the specified non critical voltage levels. The outputs are checked at the specified non critical voltage levels and are loaded with the specified non critical load currents. The test fails when the device fails according to its function.

Test 401 - 403 FUNCTIONAL TEST CRITICAL INPUT LEVELS

This test checks the input voltage levels (Vil,Vih) by means of a functional test. The power supply voltage (Vcc) is set to the specified level. Vil is set to the critical value minus a noise margin. Vih is set to the critical value plus a noise margin. The outputs are checked at the specified non critical levels. The outputs are loaded with the specified non critical load current. The test fails when the device fails according to its function.

Test 500 - 527 PROPAGATION DELAY TIME TPLH

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPLH) is measured for the output transition from low to high, at the specified reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc), the input voltage levels (Vil,Vih) and the output loads (Iol,Ioh) are set to the specified values. The test fails when the propagation delay time exceeds the minimum or maximum value for tPLH.

Test 530 - 557 PROPAGATION DELAY TIME TPHL

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPHL) is measured for the output transition from high to low, at the specified reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc), the input voltage levels (Vil,Vih) and the output loads (Iol,Ioh) are set to the specified values. The test fails when the propagation delay time exceeds the minimum or maximum value for tPHL.

Test 560 - 587 PROPAGATION DELAY TIME TPLZ

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPLZ) is measured for the output transition from low to 3-state at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPLZ.

Test 590 - 617 PROPAGATION DELAY TIME TPZL

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPZL) is measured for the output transition from 3-state to low at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPZL.

Test 620 - 647 PROPAGATION DELAY TIME TPHZ

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPHZ) is measured for the output transition from high to 3-state at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPHZ.

Test 650 - 677 PROPAGATION DELAY TIME TPZH

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPZH) is measured for the output transition from 3-state to high at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPZH.

Table of measured pins (M38510-75703BRX/ESTEC)

The testnumber is incremented for every pin to be measured.

Test	Measured pins (package pin numbers)
10 - 27	1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17 18 19
100 - 109	1 2 4 6 8 19 11 13 15 17
110 - 119	1 2 4 6 8 19 11 13 15 17
120 - 127	2 4 6 8 11 13 15 17
128 - 129	1 19
130 - 137	2 4 6 8 11 13 15 17
138 - 139	1 19
140 - 147	2 4 6 8 11 13 15 17
148 - 149	1 19
150 - 157	2 4 6 8 11 13 15 17
158 - 159	1 19
160 - 167	2 4 6 8 11 13 15 17
168 - 169	1 19
170 - 177	2 4 6 8 11 13 15 17
178 - 179	1 19
200 - 207	18 16 14 12 9 7 5 3
210 - 217	18 16 14 12 9 7 5 3
220 - 227	18 16 14 12 9 7 5 3
230 - 237	18 16 14 12 9 7 5 3
240 - 247	18 16 14 12 9 7 5 3
250 - 257	18 16 14 12 9 7 5 3
260 - 267	18 16 14 12 9 7 5 3
270 - 277	18 16 14 12 9 7 5 3
280 - 287	18 16 14 12 9 7 5 3
290 - 297	18 16 14 12 9 7 5 3
300 - 307	18 16 14 12 9 7 5 3
310 - 317	18 16 14 12 9 7 5 3
320 - 327	18 16 14 12 9 7 5 3
330 - 337	18 16 14 12 9 7 5 3
340	20
350	20
360	20
370	20
380	20

DC Electrical Characteristics (M38510-75703BRX/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
10 - 27	Opens test	Vdiode	Idiode=-100uA		-2.5V
100 - 109	Input Leakage Current Low	Iil	Vcc=5.5V Vil=0mV	-100nA	100nA
110 - 119	Input Leakage Current High	Iih	Vcc=5.5V Vih=5.5V	-100nA	100nA
120 - 127	Input Voltage Low, Binary search	Vil	Vcc=3V	900mV	
128 - 129	Input Voltage Low, Binary search	Vil	Vcc=3V	900mV	
130 - 137	Input Voltage Low, Binary search	Vil	Vcc=4.5V	1.35V	
138 - 139	Input Voltage Low, Binary search	Vil	Vcc=4.5V	1.35V	
140 - 147	Input Voltage Low, Binary search	Vil	Vcc=5.5V	1.65V	
148 - 149	Input Voltage Low, Binary search	Vil	Vcc=5.5V	1.65V	
150 - 157	Input Voltage High, Binary search	Vih	Vcc=3V		2.1V
158 - 159	Input Voltage High, Binary search	Vih	Vcc=3V		2.1V
160 - 167	Input Voltage High, Binary search	Vih	Vcc=4.5V		3.15V
168 - 169	Input Voltage High, Binary search	Vih	Vcc=4.5V		3.15V
170 - 177	Input Voltage High, Binary search	Vih	Vcc=5.5V		3.85V
178 - 179	Input Voltage High, Binary search	Vih	Vcc=5.5V		3.85V
200 - 207	Output Voltage Low Level	Vol	Vcc=3V Iol=50uA Vil=900mV, Vih=2.1V		100mV
210 - 217	Output Voltage Low Level	Vol	Vcc=4.5V Iol=50uA Vil=1.35V, Vih=3.15V		100mV
220 - 227	Output Voltage Low Level	Vol	Vcc=5.5V Iol=50uA Vil=1.65V, Vih=3.85V		100mV
230 - 237	Output Voltage Low Level	Vol	Vcc=3V Iol=12mA Vil=900mV, Vih=2.1V		400mV
240 - 247	Output Voltage Low Level	Vol	Vcc=4.5V Iol=24mA Vil=1.35V, Vih=3.15V		400mV
250 - 257	Output Voltage Low Level	Vol	Vcc=5.5V Iol=24mA Vil=1.65V, Vih=3.85V		400mV

DC Electrical Characteristics (M38510-75703BRX/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
260 - 267	Output Voltage High Level	Voh	Vcc=3V Ioh=-50uA Vil=900mV, Vih=2.1V	2.9V	
270 - 277	Output Voltage High Level	Voh	Vcc=4.5V Ioh=-50uA Vil=1.35V, Vih=3.15V	4.4V	
280 - 287	Output Voltage High Level	Voh	Vcc=5.5V Ioh=-50uA Vil=1.65V, Vih=3.85V	5.4V	
290 - 297	Output Voltage High Level	Voh	Vcc=3V Ioh=-4mA Vil=900mV, Vih=2.1V	2.4V	
300 - 307	Output Voltage High Level	Voh	Vcc=4.5V Ioh=-24mA Vil=1.35V, Vih=3.15V	3.7V	
310 - 317	Output Voltage High Level	Voh	Vcc=5.5V Ioh=-24mA Vil=1.65V, Vih=3.85V	4.7V	
320 - 327	3-state Leakage Current Low	Iozl	Vcc=5.5V Vol=0mV	-500nA	500nA
330 - 337	3-state Leakage Current High	Iozh	Vcc=5.5V Voh=5.5V	-500nA	500nA
340	Quiescent Supply Current	Iccl	Vcc=5.5V		2uA
350	Quiescent Supply Current	Icch	Vcc=5.5V		2uA
360	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=3V		100mA
370	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=4.5V		100mA
380	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=5.5V		100mA

AC and functional Characteristics (M38510-75703BRX/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
400	Basic Functional Test		Vcc=4.5V Vil=0mV, Vih=4.5V Vol=2.25V, Voh=2.25V Iol=0nA, Ioh=0nA	P/F	
401	Functional Test (critical Vil,Vih)		Vcc=4.5V Vil=600mV, Vih=3.7V Vol=2.25V, Voh=2.25V Iol=0nA, Ioh=0nA	P/F	
402	Functional Test (critical Vil,Vih)		Vcc=3V Vil=450mV, Vih=2.5V Vol=1.5V, Voh=1.5V Iol=0nA, Ioh=0nA	P/F	
403	Functional Test (critical Vil,Vih)		Vcc=5.5V Vil=400mV, Vih=4.7V Vol=400mV, Voh=4.7V Iol=12mA, Ioh=-12mA	P/F	
500 - 507	Propagation delay (Dn to On)	tPLH	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	8ns
510 - 517	Propagation delay (Dn to On)	tPLH	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	6.5ns
520 - 527	Propagation delay (Dn to On)	tPLH	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	6.5ns
530 - 537	Propagation delay (Dn to On)	tPHL	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	8ns
540 - 547	Propagation delay (Dn to On)	tPHL	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	6.5ns
550 - 557	Propagation delay (Dn to On)	tPHL	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	6.5ns

Note : P/F means 'test on PASS/FAIL condition'.

AC and functional Characteristics (M38510-75703BRX/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
560 - 567	Propagation delay (OE to On)	tPLZ	Vcc=3V Vil=0mV, Vih=3V Iol=6mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=20% of Vcc	1ns	11.5ns
570 - 577	Propagation delay (OE to On)	tPLZ	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=9mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=20% of Vcc	1ns	9ns
580 - 587	Propagation delay (OE to On)	tPLZ	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=11mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=20% of Vcc	1ns	9ns
590 - 597	Propagation delay (OE to On)	tPZL	Vcc=3V Vil=0mV, Vih=3V Iol=6mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	11.5ns
600 - 607	Propagation delay (OE to On)	tPZL	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=9mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	9ns
610 - 617	Propagation delay (OE to On)	tPZL	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=11mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	9ns
620 - 627	Propagation delay (OE to On)	tPHZ	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-12mA Ref(in)=50% of Vcc Ref(out)=80% of Vcc	1ns	11.5ns
630 - 637	Propagation delay (OE to On)	tPHZ	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-18mA Ref(in)=50% of Vcc Ref(out)=80% of Vcc	1ns	9ns
640 - 647	Propagation delay (OE to On)	tPHZ	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-20mA Ref(in)=50% of Vcc Ref(out)=80% of Vcc	1ns	9ns

AC and functional Characteristics (M38510-75703BRX/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
650 - 657	Propagation delay (OE to On)	tPZH	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-12mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	11.5ns
660 - 667	Propagation delay (OE to On)	tPZH	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-18mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	9ns
670 - 677	Propagation delay (OE to On)	tPZH	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-20mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1ns	9ns

TESTFLOW FOR THE

74AC244DMQB/ESTEC

Manufacturer : National Semiconductor

Octal Buffer/Line Driver With
3-State Outputs

Registration RTH-lab

Registration RTH-sales office

Originated by	: H. v. Winkoop	Function	: TPS Engineer
		Date	: 2 February 1991
Reviewed by	: G. Schoonhoven	Function	: Test Engineer
		Date	: 2 February 1991

Rood Testhouse B.V., Heerde reserves the right to alter the specifications of a testflow at any time without notifying the customer, unless otherwise agreed.

Device type : 74AC244DMQB/ESTEC at +25'C Degrees C.

Manufacturer : National Semiconductor

Function : Octal Buffer/Line Driver With 3-State Outputs

Testsequence	Rood Testhouse classification
Test 10 - 27 OPENS TEST	Fail Continuity
Test 100 - 109 INPUT CURRENT LOW Test 110 - 119 INPUT CURRENT HIGH Test 120 - 149 INPUT VOLTAGE LOW Test 150 - 179 INPUT VOLTAGE HIGH Test 200 - 257 OUTPUT VOLTAGE LOW Test 260 - 317 OUTPUT VOLTAGE HIGH Test 320 - 327 OUTPUT 3-STATE CURRENT LOW Test 330 - 337 OUTPUT 3-STATE CURRENT HIGH Test 340 QUIESCENT SUPPLY CURRENT WITH OUTPUTS LOW Test 350 QUIESCENT SUPPLY CURRENT WITH OUTPUTS HIGH Test 360 - 380 DYNAMIC SUPPLY CURRENT	Fail Static
Test 400 BASIC FUNCTIONAL TEST Test 401 - 403 FUNCTIONAL TEST CRITICAL INPUT LEVELS Test 500 - 527 PROPAGATION DELAY TIME TPLH Test 530 - 557 PROPAGATION DELAY TIME TPHL Test 560 - 587 PROPAGATION DELAY TIME TPLZ Test 590 - 617 PROPAGATION DELAY TIME TPZL Test 620 - 647 PROPAGATION DELAY TIME TPHZ Test 650 - 677 PROPAGATION DELAY TIME TPZH	Fail Dynamic
All Tests Pass	Pass

The following pages are a description of the tests as performed on the tester. The description is valid for all devices and temperatures as mentioned in this testflow, unless noted otherwise.

Test 10 - 27 OPENS TEST

This is a test to detect a bad contact between the device pins and the tester contacts. A PN junction from any pin to the substrate will clamp the pins terminal voltage to about one diode drop voltage. Vcc and ground are set to 0 Volt. A low current value (Idiode) is drawn out of the device pins. The test fails when the measured voltage level (Vdiode) exceeds the specified maximum voltage limit.

Test 100 - 109 INPUT CURRENT LOW

This measurement is performed on a single input pin or on a group of input pins. The measurement is done on one pin at a time. A voltage level (Vil) equal to the ground level is supplied to the pin that is measured. The power supply voltage (Vcc) is set to the specified value. The test fails when the measured input leakage current (Iil) is less than the specified minimum limit or greater than the specified maximum limit.

Test 110 - 119 INPUT CURRENT HIGH

This measurement is performed on a single input pin or on a group of input pins. The measurement is done on one pin at a time. A voltage level (Vih) equal to the Vcc level is supplied to the pin that is measured. The power supply voltage (Vcc) is set to the specified value. The test fails when the measured input leakage current (Iih) is less than the specified minimum limit or greater than the specified maximum limit.

Test 120 - 149 INPUT VOLTAGE LOW

This measurement is performed on a single input or on a group of inputs. The measurement is done on one pin at a time. The critical input voltage low at which the device still passes functionally is determined with a binary search algorithm. The Vcc voltage level is set to the specified level. The test fails when the measured input low level (Vil) is less than the specified minimum limit.

Test 150 - 179 INPUT VOLTAGE HIGH

This measurement is performed on a single input or on a group of inputs. The measurement is done on one pin at a time. The critical input voltage high at which the device still passes functionally is determined with a binary search algorithm. The Vcc voltage level is set to the specified level. The test fails when the measured input low level (Vil) is greater than the specified maximum limit.

Test 200 - 257 OUTPUT VOLTAGE LOW

This measurement is performed on a single output pin or on a group of output pins. The measurement is done on one pin at a time. A functional pattern is executed to set the pin that is measured to the low state. The output is loaded with the specified load current (Iol). The input pins and the Vcc voltage level are set to the specified values. The test fails when the measured output level (Vol) exceeds the specified maximum limit.

Test 260 - 317 OUTPUT VOLTAGE HIGH

This measurement is performed on a single output pin or on a group of output pins. The measurement is done on one pin at a time. A functional pattern is executed to set the pin that is measured to the high state. The output is loaded with the specified load current (Ioh). The input pins and the Vcc voltage level are set to the specified values. The test fails when the measured output level (Voh) is lower than the specified minimum limit.

Test 320 - 327 OUTPUT 3-STATE CURRENT LOW

This measurement is performed on a single 3-state pin or on a group of 3-state pins. The measurement is done on one pin at a time. A functional pattern is executed to set all pins to be measured to 3-state. A voltage level (Vol) equal to the ground level is supplied to the pin that is measured. The power supply voltage (Vcc) and the input levels (Vil,Vih) are set to the specified values and the remaining 3-state pins are set to this Vcc level. The test fails when the measured 3-state leakage current (Iozl) is less than the specified minimum limit or greater than the specified maximum limit.

Test 330 - 337 OUTPUT 3-STATE CURRENT HIGH

This measurement is performed on a single 3-state pin or on a group of 3-state pins. The measurement is done on one pin at a time. A functional pattern is executed to set all pins to be measured to 3-state. A voltage level (Voh) equal to the Vcc level is supplied to the pin that is measured. The power supply voltage (Vcc) and the input levels (Vil,Vih) are set to the specified values and the remaining 3-state pins are set to ground level. The test fails when the measured 3-state leakage current (Iozh) is less than the specified minimum limit or greater than the specified maximum limit.

Test 340 QUIESCENT SUPPLY CURRENT WITH OUTPUTS LOW

This measurement is performed on the Vcc pin. The inputs of the device are not changing during the power supply current measurement. The input pins are set to Vcc or to ground level. The outputs are set to their logical low level and not loaded. The Vcc voltage level is set to the specified value. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 350 QUIESCENT SUPPLY CURRENT WITH OUTPUTS HIGH

This measurement is performed on the Vcc pin. The inputs of the device are not changing during the power supply current measurement. The input pins are set to Vcc or to ground level. The outputs are set to their logical high level and not loaded. The Vcc voltage level is set to the specified value. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 360 - 380 DYNAMIC SUPPLY CURRENT

This measurement is performed on the Vcc pin. Vcc is set to the specified level. The input pins are set to the according Vil-max and Vih-min voltage levels. The outputs are unloaded. A functional pattern is applied to the device during the measurement. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 400 BASIC FUNCTIONAL TEST

This test checks the function of the device under non critical conditions. The power supply voltage (Vcc) is set to nominal. The input voltage levels are set to the specified non critical voltage levels. The outputs are checked at the specified non critical voltage levels and are loaded with the specified non critical load currents. The test fails when the device fails according to its function.

Test 401 - 403 FUNCTIONAL TEST CRITICAL INPUT LEVELS

This test checks the input voltage levels (Vil,Vih) by means of a functional test. The power supply voltage (Vcc) is set to the specified level. Vil is set to the critical value minus a noise margin. Vih is set to the critical value plus a noise margin. The outputs are checked at the specified non critical levels. The outputs are loaded with the specified non critical load current. The test fails when the device fails according to its function.

Test 500 - 527 <u>PROPAGATION DELAY TIME TPLH</u>

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPLH) is measured for the output transition from low to high, at the specified reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc), the input voltage levels (Vil,Vih) and the output loads (Iol,Ioh) are set to the specified values. The test fails when the propagation delay time exceeds the minimum or maximum value for tPLH.

Test 530 - 557 <u>PROPAGATION DELAY TIME TPHL</u>

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPHL) is measured for the output transition from high to low, at the specified reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc), the input voltage levels (Vil,Vih) and the output loads (Iol,Ioh) are set to the specified values. The test fails when the propagation delay time exceeds the minimum or maximum value for tPHL.

Test 560 - 587 <u>PROPAGATION DELAY TIME TPLZ</u>

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPLZ) is measured for the output transition from low to 3-state at the reference voltage levels Ref(in) and Ref(out). The Ref(in) level is set to the specified percentage of Vcc. The Ref(out) level is determined by measuring the output low level voltage (Vol). This is done on a per pin basis. Each pin is tested at a Ref(out) level calculated by the following formula : Ref(out) equals Vol plus the specified voltage (Vdelta). The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPLZ.

Test 590 - 617 <u>PROPAGATION DELAY TIME TPZL</u>

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPZL) is measured for the output transition from 3-state to low at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPZL.

Test 620 - 647 PROPAGATION DELAY TIME TPHZ

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPHZ) is measured for the output transition from high to 3-state at the reference voltage levels Ref(in) and Ref(out). The Ref(in) level is set to the specified percentage of Vcc. The Ref(out) level is determined by measuring the output high level voltage (Voh). This is done on a per pin basis. Each pin is tested at a Ref(out) level calculated by the following formula : Ref(out) equals Voh minus the specified voltage (Vdelta). The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPHZ.

Test 650 - 677 PROPAGATION DELAY TIME TPZH

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPZH) is measured for the output transition from 3-state to high at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPZH.

Table of measured pins (74AC244DMQB/ESTEC)

The testnumber is incremented for every pin to be measured.

Test	Measured pins (package pin numbers)
10 - 27	1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17 18 19
100 - 109	1 2 4 6 8 19 11 13 15 17
110 - 119	1 2 4 6 8 19 11 13 15 17
120 - 127	2 4 6 8 11 13 15 17
128 - 129	1 19
130 - 137	2 4 6 8 11 13 15 17
138 - 139	1 19
140 - 147	2 4 6 8 11 13 15 17
148 - 149	1 19
150 - 157	2 4 6 8 11 13 15 17
158 - 159	1 19
160 - 167	2 4 6 8 11 13 15 17
168 - 169	1 19
170 - 177	2 4 6 8 11 13 15 17
178 - 179	1 19
200 - 207	18 16 14 12 9 7 5 3
210 - 217	18 16 14 12 9 7 5 3
220 - 227	18 16 14 12 9 7 5 3
230 - 237	18 16 14 12 9 7 5 3
240 - 247	18 16 14 12 9 7 5 3
250 - 257	18 16 14 12 9 7 5 3
260 - 267	18 16 14 12 9 7 5 3
270 - 277	18 16 14 12 9 7 5 3
280 - 287	18 16 14 12 9 7 5 3
290 - 297	18 16 14 12 9 7 5 3
300 - 307	18 16 14 12 9 7 5 3
310 - 317	18 16 14 12 9 7 5 3
320 - 327	18 16 14 12 9 7 5 3
330 - 337	18 16 14 12 9 7 5 3
340	20
350	20
360	20
370	20
380	20

DC Electrical Characteristics (74AC244DMQB/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
10 - 27	Opens test	Vdiode	Idiode=-100uA		-2.5V
100 - 109	Input Leakage Current Low	Iil	Vcc=5.5V Vil=0mV	-100nA	100nA
110 - 119	Input Leakage Current High	Iih	Vcc=5.5V Vih=5.5V	-100nA	100nA
120 - 127	Input Voltage Low, Binary search	Vil	Vcc=3V	900mV	
128 - 129	Input Voltage Low, Binary search	Vil	Vcc=3V	900mV	
130 - 137	Input Voltage Low, Binary search	Vil	Vcc=4.5V	1.35V	
138 - 139	Input Voltage Low, Binary search	Vil	Vcc=4.5V	1.35V	
140 - 147	Input Voltage Low, Binary search	Vil	Vcc=5.5V	1.65V	
148 - 149	Input Voltage Low, Binary search	Vil	Vcc=5.5V	1.65V	
150 - 157	Input Voltage High, Binary search	Vih	Vcc=3V		2.1V
158 - 159	Input Voltage High, Binary search	Vih	Vcc=3V		2.1V
160 - 167	Input Voltage High, Binary search	Vih	Vcc=4.5V		3.15V
168 - 169	Input Voltage High, Binary search	Vih	Vcc=4.5V		3.15V
170 - 177	Input Voltage High, Binary search	Vih	Vcc=5.5V		3.85V
178 - 179	Input Voltage High, Binary search	Vih	Vcc=5.5V		3.85V
200 - 207	Output Voltage Low Level	Vol	Vcc=3V Iol=50uA Vil=900mV, Vih=2.1V		100mV
210 - 217	Output Voltage Low Level	Vol	Vcc=4.5V Iol=50uA Vil=1.35V, Vih=3.15V		100mV
220 - 227	Output Voltage Low Level	Vol	Vcc=5.5V Iol=50uA Vil=1.65V, Vih=3.85V		100mV
230 - 237	Output Voltage Low Level	Vol	Vcc=3V Iol=12mA Vil=900mV, Vih=2.1V		360mV
240 - 247	Output Voltage Low Level	Vol	Vcc=4.5V Iol=24mA Vil=1.35V, Vih=3.15V		360mV
250 - 257	Output Voltage Low Level	Vol	Vcc=5.5V Iol=24mA Vil=1.65V, Vih=3.85V		360mV

DC Electrical Characteristics (74AC244DMQB/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
260 - 267	Output Voltage High Level	Voh	Vcc=3V Ioh=-50uA Vil=900mV, Vih=2.1V	2.9V	
270 - 277	Output Voltage High Level	Voh	Vcc=4.5V Ioh=-50uA Vil=1.35V, Vih=3.15V	4.4V	
280 - 287	Output Voltage High Level	Voh	Vcc=5.5V Ioh=-50uA Vil=1.65V, Vih=3.85V	5.4V	
290 - 297	Output Voltage High Level	Voh	Vcc=3V Ioh=-12mA Vil=900mV, Vih=2.1V	2.56V	
300 - 307	Output Voltage High Level	Voh	Vcc=4.5V Ioh=-24mA Vil=1.35V, Vih=3.15V	3.86V	
310 - 317	Output Voltage High Level	Voh	Vcc=5.5V Ioh=-24mA Vil=1.65V, Vih=3.85V	4.86V	
320 - 327	3-state Leakage Current Low	Iozl	Vcc=5.5V Vol=0mV	-500nA	500nA
330 - 337	3-state Leakage Current High	Iozh	Vcc=5.5V Voh=5.5V	-500nA	500nA
340	Quiescent Supply Current	Iccl	Vcc=5.5V		8uA
350	Quiescent Supply Current	Icch	Vcc=5.5V		8uA
360	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=3V		100mA
370	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=4.5V		100mA
380	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=5.5V		100mA

AC and functional Characteristics (74AC244DMQB/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
400	Basic Functional Test		Vcc=4.5V Vil=0mV, Vih=4.5V Vol=2.25V, Voh=2.25V Iol=0nA, Ioh=0nA	P/F	
401	Functional Test (critical Vil,Vih)		Vcc=4.5V Vil=360mV, Vih=3.86V Vol=360mV, Voh=3.86V Iol=12mA, Ioh=-12mA	P/F	
402	Functional Test (critical Vil,Vih)		Vcc=3V Vil=360mV, Vih=2.56V Vol=360mV, Voh=2.56V Iol=6mA, Ioh=-6mA	P/F	
403	Functional Test (critical Vil,Vih)		Vcc=5.5V Vil=360mV, Vih=4.86V Vol=360mV, Voh=4.86V Iol=12mA, Ioh=-12mA	P/F	
500 - 507	Propagation delay (Dn to On)	tPLH	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	9ns
510 - 517	Propagation delay (Dn to On)	tPLH	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns
520 - 527	Propagation delay (Dn to On)	tPLH	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns
530 - 537	Propagation delay (Dn to On)	tPHL	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	9ns
540 - 547	Propagation delay (Dn to On)	tPHL	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns
550 - 557	Propagation delay (Dn to On)	tPHL	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns

Note : P/F means 'test on PASS/FAIL condition'.

AC and functional Characteristics (74AC244DMQB/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
560 - 567	Propagation delay (OE to On)	tPLZ	Vcc=3V Vil=0mV, Vih=3V Iol=6mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=Vol+300mV	2.5ns	10.5ns
570 - 577	Propagation delay (OE to On)	tPLZ	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=9mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=Vol+300mV	2ns	9ns
580 - 587	Propagation delay (OE to On)	tPLZ	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=11mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=Vol+300mV	2ns	9ns
590 - 597	Propagation delay (OE to On)	tPZL	Vcc=3V Vil=0mV, Vih=3V Iol=6mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2.5ns	10ns
600 - 607	Propagation delay (OE to On)	tPZL	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=9mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	8ns
610 - 617	Propagation delay (OE to On)	tPZL	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=11mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	8ns
620 - 627	Propagation delay (OE to On)	tPHZ	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=Voh-300mV	3ns	10ns
630 - 637	Propagation delay (OE to On)	tPHZ	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=Voh-300mV	2.5ns	9ns
640 - 647	Propagation delay (OE to On)	tPHZ	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=Voh-300mV	2.5ns	9ns

AC and functional Characteristics (74AC244DMQB/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
650 - 657	Propagation delay (OE to On)	tPZH	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	10.5ns
660 - 667	Propagation delay (OE to On)	tPZH	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns
670 - 677	Propagation delay (OE to On)	tPZH	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns

TESTFLOW FOR THE

MC74AC240N/ESTEC

Manufacturer : Motorola

Octal Buffer/Line Driver With
3-State Outputs

Registration RTH-lab

Registration RTH-sales office

Originated by : H. v. Winkoop

Function : TPS Engineer

Date : 2 February 1991

Reviewed by : G. Schoonhoven

Function : Test Engineer

Date : 2 February 1991

Rood Testhouse B.V., Heerde reserves the right to alter the specifications of a testflow at any time without notifying the customer, unless otherwise agreed.

Device type : MC74AC240N/ESTEC at +25'C Degrees C.

Manufacturer : Motorola

Function : Octal Buffer/Line Driver With 3-State Outputs

Testsequence	Rood Testhouse classification
Test 10 - 27 OPENS TEST	Fail Continuity
Test 100 - 109 INPUT CURRENT LOW Test 110 - 119 INPUT CURRENT HIGH Test 120 - 149 INPUT VOLTAGE LOW Test 150 - 179 INPUT VOLTAGE HIGH Test 200 - 257 OUTPUT VOLTAGE LOW Test 260 - 317 OUTPUT VOLTAGE HIGH Test 320 - 327 OUTPUT 3-STATE CURRENT LOW Test 330 - 337 OUTPUT 3-STATE CURRENT HIGH Test 340 QUIESCENT SUPPLY CURRENT WITH OUTPUTS LOW Test 350 QUIESCENT SUPPLY CURRENT WITH OUTPUTS HIGH Test 360 - 380 DYNAMIC SUPPLY CURRENT	Fail Static
Test 400 BASIC FUNCTIONAL TEST Test 401 - 403 FUNCTIONAL TEST CRITICAL INPUT LEVELS Test 500 - 527 PROPAGATION DELAY TIME TPLH Test 530 - 557 PROPAGATION DELAY TIME TPHL Test 560 - 587 PROPAGATION DELAY TIME TPLZ Test 590 - 617 PROPAGATION DELAY TIME TPZL Test 620 - 647 PROPAGATION DELAY TIME TPHZ Test 650 - 677 PROPAGATION DELAY TIME TPZH	Fail Dynamic
All Tests Pass	Pass

The following pages are a description of the tests as performed on the tester. The description is valid for all devices and temperatures as mentioned in this testflow, unless noted otherwise.

Test 10 - 27 OPENS TEST

This is a test to detect a bad contact between the device pins and the tester contacts. A PN junction from any pin to the substrate will clamp the pins terminal voltage to about one diode drop voltage. Vcc and ground are set to 0 Volt. A low current value (Idiode) is drawn out of the device pins. The test fails when the measured voltage level (Vdiode) exceeds the specified maximum voltage limit.

Test 100 - 109 INPUT CURRENT LOW

This measurement is performed on a single input pin or on a group of input pins. The measurement is done on one pin at a time. A voltage level (Vil) equal to the ground level is supplied to the pin that is measured. The power supply voltage (Vcc) is set to the specified value. The test fails when the measured input leakage current (Iil) is less than the specified minimum limit or greater than the specified maximum limit.

Test 110 - 119 INPUT CURRENT HIGH

This measurement is performed on a single input pin or on a group of input pins. The measurement is done on one pin at a time. A voltage level (Vih) equal to the Vcc level is supplied to the pin that is measured. The power supply voltage (Vcc) is set to the specified value. The test fails when the measured input leakage current (Iih) is less than the specified minimum limit or greater than the specified maximum limit.

Test 120 - 149 INPUT VOLTAGE LOW

This measurement is performed on a single input or on a group of inputs. The measurement is done on one pin at a time. The critical input voltage low at which the device still passes functionally is determined with a binary search algorithm. The Vcc voltage level is set to the specified level. The test fails when the measured input low level (Vil) is less than the specified minimum limit.

Test 150 - 179 INPUT VOLTAGE HIGH

This measurement is performed on a single input or on a group of inputs. The measurement is done on one pin at a time. The critical input voltage high at which the device still passes functionally is determined with a binary search algorithm. The Vcc voltage level is set to the specified level. The test fails when the measured input low level (Vil) is greater than the specified maximum limit.

Test 200 - 257 OUTPUT VOLTAGE LOW

This measurement is performed on a single output pin or on a group of output pins. The measurement is done on one pin at a time. A functional pattern is executed to set the pin that is measured to the low state. The output is loaded with the specified load current (Iol). The input pins and the Vcc voltage level are set to the specified values. The test fails when the measured output level (Vol) exceeds the specified maximum limit.

Test 260 - 317 OUTPUT VOLTAGE HIGH

This measurement is performed on a single output pin or on a group of output pins. The measurement is done on one pin at a time. A functional pattern is executed to set the pin that is measured to the high state. The output is loaded with the specified load current (Ioh). The input pins and the Vcc voltage level are set to the specified values. The test fails when the measured output level (Voh) is lower than the specified minimum limit.

Test 320 - 327 OUTPUT 3-STATE CURRENT LOW

This measurement is performed on a single 3-state pin or on a group of 3-state pins. The measurement is done on one pin at a time. A functional pattern is executed to set all pins to be measured to 3-state. A voltage level (Vol) equal to the ground level is supplied to the pin that is measured. The power supply voltage (Vcc) and the input levels (Vil,Vih) are set to the specified values and the remaining 3-state pins are set to this Vcc level. The test fails when the measured 3-state leakage current (Iozl) is less than the specified minimum limit or greater than the specified maximum limit.

Test 330 - 337 OUTPUT 3-STATE CURRENT HIGH

This measurement is performed on a single 3-state pin or on a group of 3-state pins. The measurement is done on one pin at a time. A functional pattern is executed to set all pins to be measured to 3-state. A voltage level (Voh) equal to the Vcc level is supplied to the pin that is measured. The power supply voltage (Vcc) and the input levels (Vil,Vih) are set to the specified values and the remaining 3-state pins are set to ground level. The test fails when the measured 3-state leakage current (Iozh) is less than the specified minimum limit or greater than the specified maximum limit.

Test 340 QUIESCENT SUPPLY CURRENT WITH OUTPUTS LOW

This measurement is performed on the Vcc pin. The inputs of the device are not changing during the power supply current measurement. The input pins are set to Vcc or to ground level. The outputs are set to their logical low level and not loaded. The Vcc voltage level is set to the specified value. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 350 QUIESCENT SUPPLY CURRENT WITH OUTPUTS HIGH

This measurement is performed on the Vcc pin. The inputs of the device are not changing during the power supply current measurement. The input pins are set to Vcc or to ground level. The outputs are set to their logical high level and not loaded. The Vcc voltage level is set to the specified value. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 360 - 380 DYNAMIC SUPPLY CURRENT

This measurement is performed on the Vcc pin. Vcc is set to the specified level. The input pins are set to the according Vil-max and Vih-min voltage levels. The outputs are unloaded. A functional pattern is applied to the device during the measurement. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 400 BASIC FUNCTIONAL TEST

This test checks the function of the device under non critical conditions. The power supply voltage (Vcc) is set to nominal. The input voltage levels are set to the specified non critical voltage levels. The outputs are checked at the specified non critical voltage levels and are loaded with the specified non critical load currents. The test fails when the device fails according to its function.

Test 401 - 403 FUNCTIONAL TEST CRITICAL INPUT LEVELS

This test checks the input voltage levels (Vil,Vih) by means of a functional test. The power supply voltage (Vcc) is set to the specified level. Vil is set to the critical value minus a noise margin. Vih is set to the critical value plus a noise margin. The outputs are checked at the specified non critical levels. The outputs are loaded with the specified non critical load current. The test fails when the device fails according to its function.

Test 500 - 527 PROPAGATION DELAY TIME TPLH

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPLH) is measured for the output transition from low to high, at the specified reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc), the input voltage levels (Vil,Vih) and the output loads (Iol,Ioh) are set to the specified values. The test fails when the propagation delay time exceeds the minimum or maximum value for tPLH.

Test 530 - 557 PROPAGATION DELAY TIME TPHL

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPHL) is measured for the output transition from high to low, at the specified reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc), the input voltage levels (Vil,Vih) and the output loads (Iol,Ioh) are set to the specified values. The test fails when the propagation delay time exceeds the minimum or maximum value for tPHL.

Test 560 - 587 PROPAGATION DELAY TIME TPLZ

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPLZ) is measured for the output transition from low to 3-state at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPLZ.

Test 590 - 617 PROPAGATION DELAY TIME TPZL

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPZL) is measured for the output transition from 3-state to low at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPZL.

Test 620 - 647 PROPAGATION DELAY TIME TPHZ

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPHZ) is measured for the output transition from high to 3-state at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPHZ.

Test 650 - 677 PROPAGATION DELAY TIME TPZH

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPZH) is measured for the output transition from 3-state to high at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPZH.

Table of measured pins (MC74AC240N/ESTEC)

The testnumber is incremented for every pin to be measured.

Test	Measured pins (package pin numbers)
10 - 27	1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17 18 19
100 - 109	1 2 4 6 8 19 11 13 15 17
110 - 119	1 2 4 6 8 19 11 13 15 17
120 - 127	2 4 6 8 11 13 15 17
128 - 129	1 19
130 - 137	2 4 6 8 11 13 15 17
138 - 139	1 19
140 - 147	2 4 6 8 11 13 15 17
148 - 149	1 19
150 - 157	2 4 6 8 11 13 15 17
158 - 159	1 19
160 - 167	2 4 6 8 11 13 15 17
168 - 169	1 19
170 - 177	2 4 6 8 11 13 15 17
178 - 179	1 19
200 - 207	18 16 14 12 9 7 5 3
210 - 217	18 16 14 12 9 7 5 3
220 - 227	18 16 14 12 9 7 5 3
230 - 237	18 16 14 12 9 7 5 3
240 - 247	18 16 14 12 9 7 5 3
250 - 257	18 16 14 12 9 7 5 3
260 - 267	18 16 14 12 9 7 5 3
270 - 277	18 16 14 12 9 7 5 3
280 - 287	18 16 14 12 9 7 5 3
290 - 297	18 16 14 12 9 7 5 3
300 - 307	18 16 14 12 9 7 5 3
310 - 317	18 16 14 12 9 7 5 3
320 - 327	18 16 14 12 9 7 5 3
330 - 337	18 16 14 12 9 7 5 3
340	20
350	20
360	20
370	20
380	20

DC Electrical Characteristics (MC74AC240N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
10 - 27	Opens test	Vdiode	Idiode=-100uA		-2.5V
100 - 109	Input Leakage Current Low	Iil	Vcc=5.5V Vil=0mV	-100nA	100nA
110 - 119	Input Leakage Current High	Iih	Vcc=5.5V Vih=5.5V	-100nA	100nA
120 - 127	Input Voltage Low, Binary search	Vil	Vcc=3V	900mV	
128 - 129	Input Voltage Low, Binary search	Vil	Vcc=3V	900mV	
130 - 137	Input Voltage Low, Binary search	Vil	Vcc=4.5V	1.35V	
138 - 139	Input Voltage Low, Binary search	Vil	Vcc=4.5V	1.35V	
140 - 147	Input Voltage Low, Binary search	Vil	Vcc=5.5V	1.65V	
148 - 149	Input Voltage Low, Binary search	Vil	Vcc=5.5V	1.65V	
150 - 157	Input Voltage High, Binary search	Vih	Vcc=3V		2.1V
158 - 159	Input Voltage High, Binary search	Vih	Vcc=3V		2.1V
160 - 167	Input Voltage High, Binary search	Vih	Vcc=4.5V		3.15V
168 - 169	Input Voltage High, Binary search	Vih	Vcc=4.5V		3.15V
170 - 177	Input Voltage High, Binary search	Vih	Vcc=5.5V		3.85V
178 - 179	Input Voltage High, Binary search	Vih	Vcc=5.5V		3.85V
200 - 207	Output Voltage Low Level	Vol	Vcc=3V Iol=50uA Vil=900mV, Vih=2.1V		100mV
210 - 217	Output Voltage Low Level	Vol	Vcc=4.5V Iol=50uA Vil=1.35V, Vih=3.15V		100mV
220 - 227	Output Voltage Low Level	Vol	Vcc=5.5V Iol=50uA Vil=1.65V, Vih=3.85V		100mV
230 - 237	Output Voltage Low Level	Vol	Vcc=3V Iol=12mA Vil=900mV, Vih=2.1V		360mV
240 - 247	Output Voltage Low Level	Vol	Vcc=4.5V Iol=24mA Vil=1.35V, Vih=3.15V		360mV
250 - 257	Output Voltage Low Level	Vol	Vcc=5.5V Iol=24mA Vil=1.65V, Vih=3.85V		360mV

DC Electrical Characteristics (MC74AC240N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
260 - 267	Output Voltage High Level	Voh	Vcc=3V Ioh=-50uA Vil=900mV, Vih=2.1V	2.9V	
270 - 277	Output Voltage High Level	Voh	Vcc=4.5V Ioh=-50uA Vil=1.35V, Vih=3.15V	4.4V	
280 - 287	Output Voltage High Level	Voh	Vcc=5.5V Ioh=-50uA Vil=1.65V, Vih=3.85V	5.4V	
290 - 297	Output Voltage High Level	Voh	Vcc=3V Ioh=-12mA Vil=900mV, Vih=2.1V	2.56V	
300 - 307	Output Voltage High Level	Voh	Vcc=4.5V Ioh=-24mA Vil=1.35V, Vih=3.15V	3.86V	
310 - 317	Output Voltage High Level	Voh	Vcc=5.5V Ioh=-24mA Vil=1.65V, Vih=3.85V	4.86V	
320 - 327	3-state Leakage Current Low	Iozl	Vcc=5.5V Vol=0mV	-500nA	500nA
330 - 337	3-state Leakage Current High	Iozh	Vcc=5.5V Voh=5.5V	-500nA	500nA
340	Quiescent Supply Current	Iccl	Vcc=5.5V		8uA
350	Quiescent Supply Current	Icch	Vcc=5.5V		8uA
360	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=3V		100mA
370	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=4.5V		100mA
380	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=5.5V		100mA

AC and functional Characteristics (MC74AC240N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
400	Basic Functional Test		Vcc=4.5V Vil=0mV, Vih=4.5V Vol=2.25V, Voh=2.25V Iol=0nA, Ioh=0nA	P/F	
401	Functional Test (critical Vil,Vih)		Vcc=4.5V Vil=360mV, Vih=3.86V Vol=360mV, Voh=3.86V Iol=12mA, Ioh=-12mA	P/F	
402	Functional Test (critical Vil,Vih)		Vcc=3V Vil=360mV, Vih=2.56V Vol=360mV, Voh=2.56V Iol=6mA, Ioh=-6mA	P/F	
403	Functional Test (critical Vil,Vih)		Vcc=5.5V Vil=360mV, Vih=4.86V Vol=360mV, Voh=4.86V Iol=12mA, Ioh=-12mA	P/F	
500 - 507	Propagation delay (Dn to On)	tPLH	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	8ns
510 - 517	Propagation delay (Dn to On)	tPLH	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	8ns
520 - 527	Propagation delay (Dn to On)	tPLH	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	6.5ns
530 - 537	Propagation delay (Dn to On)	tPHL	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	8ns
540 - 547	Propagation delay (Dn to On)	tPHL	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	8ns
550 - 557	Propagation delay (Dn to On)	tPHL	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	6ns

Note : P/F means 'test on PASS/FAIL condition'.

AC and functional Characteristics (MC74AC240N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
560 - 567	Propagation delay (OE to On)	tPLZ	Vcc=3V Vil=0mV, Vih=3V Iol=6mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=10% of Vcc	1.5ns	10.5ns
570 - 577	Propagation delay (OE to On)	tPLZ	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=9mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=10% of Vcc	1.5ns	10.5ns
580 - 587	Propagation delay (OE to On)	tPLZ	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=11mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=10% of Vcc	1.5ns	9ns
590 - 597	Propagation delay (OE to On)	tPZL	Vcc=3V Vil=0mV, Vih=3V Iol=6mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	10ns
600 - 607	Propagation delay (OE to On)	tPZL	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=9mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	10ns
610 - 617	Propagation delay (OE to On)	tPZL	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=11mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	8ns
620 - 627	Propagation delay (OE to On)	tPHZ	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=90% of Vcc	1.5ns	10ns
630 - 637	Propagation delay (OE to On)	tPHZ	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=90% of Vcc	1.5ns	10ns
640 - 647	Propagation delay (OE to On)	tPHZ	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=90% of Vcc	1.5ns	9ns

AC and functional Characteristics (MC74AC240N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
650 - 657	Propagation delay (OE to On)	tPZH	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	10.5ns
660 - 667	Propagation delay (OE to On)	tPZH	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	10.5ns
670 - 677	Propagation delay (OE to On)	tPZH	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns

TESTFLOW FOR THE

MC74AC244N/ESTEC

Manufacturer : Motorola

Octal Buffer/Line Driver With
3-State Outputs

Registration RTH-lab

Registration RTH-sales office

Originated by : H. v. Winkoop

Function : TPS Engineer

Date : 2 February 1991

Reviewed by : G. Schoonhoven

Function : Test Engineer

Date : 2 February 1991

Rood Testhouse B.V., Heerde reserves the right to alter the specifications of a testflow at any time without notifying the customer, unless otherwise agreed.

Device type : MC74AC244N/ESTEC at +25'C Degrees C.

Manufacturer : Motorola

Function : Octal Buffer/Line Driver With 3-State Outputs

Testsequence	Rood Testhouse classification
Test 10 - 27 OPENS TEST	Fail Continuity
Test 100 - 109 INPUT CURRENT LOW Test 110 - 119 INPUT CURRENT HIGH Test 120 - 149 INPUT VOLTAGE LOW Test 150 - 179 INPUT VOLTAGE HIGH Test 200 - 257 OUTPUT VOLTAGE LOW Test 260 - 317 OUTPUT VOLTAGE HIGH Test 320 - 327 OUTPUT 3-STATE CURRENT LOW Test 330 - 337 OUTPUT 3-STATE CURRENT HIGH Test 340 QUIESCENT SUPPLY CURRENT WITH OUTPUTS LOW Test 350 QUIESCENT SUPPLY CURRENT WITH OUTPUTS HIGH Test 360 - 380 DYNAMIC SUPPLY CURRENT	Fail Static
Test 400 BASIC FUNCTIONAL TEST Test 401 - 403 FUNCTIONAL TEST CRITICAL INPUT LEVELS Test 500 - 527 PROPAGATION DELAY TIME TPLH Test 530 - 557 PROPAGATION DELAY TIME TPHL Test 560 - 587 PROPAGATION DELAY TIME TPLZ Test 590 - 617 PROPAGATION DELAY TIME TPZL Test 620 - 647 PROPAGATION DELAY TIME TPHZ Test 650 - 677 PROPAGATION DELAY TIME TPZH	Fail Dynamic
All Tests Pass	Pass

The following pages are a description of the tests as performed on the tester. The description is valid for all devices and temperatures as mentioned in this testflow, unless noted otherwise.

Test 10 - 27 OPENS TEST

This is a test to detect a bad contact between the device pins and the tester contacts. A PN junction from any pin to the substrate will clamp the pins terminal voltage to about one diode drop voltage. Vcc and ground are set to 0 Volt. A low current value (Idiode) is drawn out of the device pins. The test fails when the measured voltage level (Vdiode) exceeds the specified maximum voltage limit.

Test 100 - 109 INPUT CURRENT LOW

This measurement is performed on a single input pin or on a group of input pins. The measurement is done on one pin at a time. A voltage level (Vil) equal to the ground level is supplied to the pin that is measured. The power supply voltage (Vcc) is set to the specified value. The test fails when the measured input leakage current (Iil) is less than the specified minimum limit or greater than the specified maximum limit.

Test 110 - 119 INPUT CURRENT HIGH

This measurement is performed on a single input pin or on a group of input pins. The measurement is done on one pin at a time. A voltage level (Vih) equal to the Vcc level is supplied to the pin that is measured. The power supply voltage (Vcc) is set to the specified value. The test fails when the measured input leakage current (Iih) is less than the specified minimum limit or greater than the specified maximum limit.

Test 120 - 149 INPUT VOLTAGE LOW

This measurement is performed on a single input or on a group of inputs. The measurement is done on one pin at a time. The critical input voltage low at which the device still passes functionally is determined with a binary search algorithm. The Vcc voltage level is set to the specified level. The test fails when the measured input low level (Vil) is less than the specified minimum limit.

Test 150 - 179 INPUT VOLTAGE HIGH

This measurement is performed on a single input or on a group of inputs. The measurement is done on one pin at a time. The critical input voltage high at which the device still passes functionally is determined with a binary search algorithm. The Vcc voltage level is set to the specified level. The test fails when the measured input low level (Vil) is greater than the specified maximum limit.

Test 200 - 257 OUTPUT VOLTAGE LOW

This measurement is performed on a single output pin or on a group of output pins. The measurement is done on one pin at a time. A functional pattern is executed to set the pin that is measured to the low state. The output is loaded with the specified load current (Iol). The input pins and the Vcc voltage level are set to the specified values. The test fails when the measured output level (Vol) exceeds the specified maximum limit.

Test 260 - 317 OUTPUT VOLTAGE HIGH

This measurement is performed on a single output pin or on a group of output pins. The measurement is done on one pin at a time. A functional pattern is executed to set the pin that is measured to the high state. The output is loaded with the specified load current (Ioh). The input pins and the Vcc voltage level are set to the specified values. The test fails when the measured output level (Voh) is lower than the specified minimum limit.

Test 320 - 327 OUTPUT 3-STATE CURRENT LOW

This measurement is performed on a single 3-state pin or on a group of 3-state pins. The measurement is done on one pin at a time. A functional pattern is executed to set all pins to be measured to 3-state. A voltage level (Vol) equal to the ground level is supplied to the pin that is measured. The power supply voltage (Vcc) and the input levels (Vil,Vih) are set to the specified values and the remaining 3-state pins are set to this Vcc level. The test fails when the measured 3-state leakage current (Iozl) is less than the specified minimum limit or greater than the specified maximum limit.

Test 330 - 337 OUTPUT 3-STATE CURRENT HIGH

This measurement is performed on a single 3-state pin or on a group of 3-state pins. The measurement is done on one pin at a time. A functional pattern is executed to set all pins to be measured to 3-state. A voltage level (Voh) equal to the Vcc level is supplied to the pin that is measured. The power supply voltage (Vcc) and the input levels (Vil,Vih) are set to the specified values and the remaining 3-state pins are set to ground level. The test fails when the measured 3-state leakage current (Iozh) is less than the specified minimum limit or greater than the specified maximum limit.

Test 340 QUIESCENT SUPPLY CURRENT WITH OUTPUTS LOW

This measurement is performed on the Vcc pin. The inputs of the device are not changing during the power supply current measurement. The input pins are set to Vcc or to ground level. The outputs are set to their logical low level and not loaded. The Vcc voltage level is set to the specified value. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 350 QUIESCENT SUPPLY CURRENT WITH OUTPUTS HIGH

This measurement is performed on the Vcc pin. The inputs of the device are not changing during the power supply current measurement. The input pins are set to Vcc or to ground level. The outputs are set to their logical high level and not loaded. The Vcc voltage level is set to the specified value. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 360 - 380 DYNAMIC SUPPLY CURRENT

This measurement is performed on the Vcc pin. Vcc is set to the specified level. The input pins are set to the according Vil-max and Vih-min voltage levels. The outputs are unloaded. A functional pattern is applied to the device during the measurement. The test fails when the measured power supply current (Icc) exceeds the specified maximum limit.

Test 400 BASIC FUNCTIONAL TEST

This test checks the function of the device under non critical conditions. The power supply voltage (Vcc) is set to nominal. The input voltage levels are set to the specified non critical voltage levels. The outputs are checked at the specified non critical voltage levels and are loaded with the specified non critical load currents. The test fails when the device fails according to its function.

Test 401 - 403 FUNCTIONAL TEST CRITICAL INPUT LEVELS

This test checks the input voltage levels (Vil,Vih) by means of a functional test. The power supply voltage (Vcc) is set to the specified level. Vil is set to the critical value minus a noise margin. Vih is set to the critical value plus a noise margin. The outputs are checked at the specified non critical levels. The outputs are loaded with the specified non critical load current. The test fails when the device fails according to its function.

Test 500 - 527 PROPAGATION DELAY TIME TPLH

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPLH) is measured for the output transition from low to high, at the specified reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc), the input voltage levels (Vil,Vih) and the output loads (Iol,Ioh) are set to the specified values. The test fails when the propagation delay time exceeds the minimum or maximum value for tPLH.

Test 530 - 557 PROPAGATION DELAY TIME TPHL

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPHL) is measured for the output transition from high to low, at the specified reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc), the input voltage levels (Vil,Vih) and the output loads (Iol,Ioh) are set to the specified values. The test fails when the propagation delay time exceeds the minimum or maximum value for tPHL.

Test 560 - 587 PROPAGATION DELAY TIME TPLZ

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPLZ) is measured for the output transition from low to 3-state at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPLZ.

Test 590 - 617 PROPAGATION DELAY TIME TPZL

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPZL) is measured for the output transition from 3-state to low at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPZL.

Test 620 - 647 PROPAGATION DELAY TIME TPHZ

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPHZ) is measured for the output transition from high to 3-state at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPHZ.

Test 650 - 677 PROPAGATION DELAY TIME TPZH

This test measures the propagation delay time between inputs and outputs. The propagation delay (tPZH) is measured for the output transition from 3-state to high at the reference voltage levels Ref(in) and Ref(out). The Ref(in) and Ref(out) levels are set to the specified percentages of Vcc. The power supply voltage (Vcc) is set according to the specifications. The test fails when the propagation delay time exceeds the minimum or maximum value for tPZH.

Table of measured pins (MC74AC244N/ESTEC)

The testnumber is incremented for every pin to be measured.

Test	Measured pins (package pin numbers)
10 - 27	1 2 3 4 5 6 7 8 9 11 12 13 14 15 16 17 18 19
100 - 109	1 2 4 6 8 19 11 13 15 17
110 - 119	1 2 4 6 8 19 11 13 15 17
120 - 127	2 4 6 8 11 13 15 17
128 - 129	1 19
130 - 137	2 4 6 8 11 13 15 17
138 - 139	1 19
140 - 147	2 4 6 8 11 13 15 17
148 - 149	1 19
150 - 157	2 4 6 8 11 13 15 17
158 - 159	1 19
160 - 167	2 4 6 8 11 13 15 17
168 - 169	1 19
170 - 177	2 4 6 8 11 13 15 17
178 - 179	1 19
200 - 207	18 16 14 12 9 7 5 3
210 - 217	18 16 14 12 9 7 5 3
220 - 227	18 16 14 12 9 7 5 3
230 - 237	18 16 14 12 9 7 5 3
240 - 247	18 16 14 12 9 7 5 3
250 - 257	18 16 14 12 9 7 5 3
260 - 267	18 16 14 12 9 7 5 3
270 - 277	18 16 14 12 9 7 5 3
280 - 287	18 16 14 12 9 7 5 3
290 - 297	18 16 14 12 9 7 5 3
300 - 307	18 16 14 12 9 7 5 3
310 - 317	18 16 14 12 9 7 5 3
320 - 327	18 16 14 12 9 7 5 3
330 - 337	18 16 14 12 9 7 5 3
340	20
350	20
360	20
370	20
380	20

DC Electrical Characteristics (MC74AC244N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
10 - 27	Opens test	Vdiode	Idiode=-100uA		-2.5V
100 - 109	Input Leakage Current Low	Iil	Vcc=5.5V Vil=0mV	-100nA	100nA
110 - 119	Input Leakage Current High	Iih	Vcc=5.5V Vih=5.5V	-100nA	100nA
120 - 127	Input Voltage Low, Binary search	Vil	Vcc=3V	900mV	
128 - 129	Input Voltage Low, Binary search	Vil	Vcc=3V	900mV	
130 - 137	Input Voltage Low, Binary search	Vil	Vcc=4.5V	1.35V	
138 - 139	Input Voltage Low, Binary search	Vil	Vcc=4.5V	1.35V	
140 - 147	Input Voltage Low, Binary search	Vil	Vcc=5.5V	1.65V	
148 - 149	Input Voltage Low, Binary search	Vil	Vcc=5.5V	1.65V	
150 - 157	Input Voltage High, Binary search	Vih	Vcc=3V		2.1V
158 - 159	Input Voltage High, Binary search	Vih	Vcc=3V		2.1V
160 - 167	Input Voltage High, Binary search	Vih	Vcc=4.5V		3.15V
168 - 169	Input Voltage High, Binary search	Vih	Vcc=4.5V		3.15V
170 - 177	Input Voltage High, Binary search	Vih	Vcc=5.5V		3.85V
178 - 179	Input Voltage High, Binary search	Vih	Vcc=5.5V		3.85V
200 - 207	Output Voltage Low Level	Vol	Vcc=3V Iol=50uA Vil=900mV, Vih=2.1V		100mV
210 - 217	Output Voltage Low Level	Vol	Vcc=4.5V Iol=50uA Vil=1.35V, Vih=3.15V		100mV
220 - 227	Output Voltage Low Level	Vol	Vcc=5.5V Iol=50uA Vil=1.65V, Vih=3.85V		100mV
230 - 237	Output Voltage Low Level	Vol	Vcc=3V Iol=12mA Vil=900mV, Vih=2.1V		360mV
240 - 247	Output Voltage Low Level	Vol	Vcc=4.5V Iol=24mA Vil=1.35V, Vih=3.15V		360mV
250 - 257	Output Voltage Low Level	Vol	Vcc=5.5V Iol=24mA Vil=1.65V, Vih=3.85V		360mV

DC Electrical Characteristics (MC74AC244N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
260 - 267	Output Voltage High Level	Voh	Vcc=3V Ioh=-50uA Vil=900mV, Vih=2.1V	2.9V	
270 - 277	Output Voltage High Level	Voh	Vcc=4.5V Ioh=-50uA Vil=1.35V, Vih=3.15V	4.4V	
280 - 287	Output Voltage High Level	Voh	Vcc=5.5V Ioh=-50uA Vil=1.65V, Vih=3.85V	5.4V	
290 - 297	Output Voltage High Level	Voh	Vcc=3V Ioh=-12mA Vil=900mV, Vih=2.1V	2.56V	
300 - 307	Output Voltage High Level	Voh	Vcc=4.5V Ioh=-24mA Vil=1.35V, Vih=3.15V	3.86V	
310 - 317	Output Voltage High Level	Voh	Vcc=5.5V Ioh=-24mA Vil=1.65V, Vih=3.85V	4.86V	
320 - 327	3-state Leakage Current Low	Iozl	Vcc=5.5V Vol=0mV	-500nA	500nA
330 - 337	3-state Leakage Current High	Iozh	Vcc=5.5V Voh=5.5V	-500nA	500nA
340	Quiescent Supply Current	Iccl	Vcc=5.5V		8uA
350	Quiescent Supply Current	Icch	Vcc=5.5V		8uA
360	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=3V		100mA
370	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=4.5V		100mA
380	Dynamic Supply Current (Freq. = 10Mhz)	Icc	Vcc=5.5V		100mA

AC and functional Characteristics (MC74AC244N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
400	Basic Functional Test		Vcc=4.5V Vil=0mV, Vih=4.5V Vol=2.25V, Voh=2.25V Iol=0nA, Ioh=0nA	P/F	
401	Functional Test (critical Vil,Vih)		Vcc=4.5V Vil=360mV, Vih=3.86V Vol=360mV, Voh=3.86V Iol=12mA, Ioh=-12mA	P/F	
402	Functional Test (critical Vil,Vih)		Vcc=3V Vil=360mV, Vih=2.56V Vol=360mV, Voh=2.56V Iol=6mA, Ioh=-6mA	P/F	
403	Functional Test (critical Vil,Vih)		Vcc=5.5V Vil=360mV, Vih=4.86V Vol=360mV, Voh=4.86V Iol=12mA, Ioh=-12mA	P/F	
500 - 507	Propagation delay (Dn to On)	tPLH	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	9ns
510 - 517	Propagation delay (Dn to On)	tPLH	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	9ns
520 - 527	Propagation delay (Dn to On)	tPLH	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns
530 - 537	Propagation delay (Dn to On)	tPHL	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	9ns
540 - 547	Propagation delay (Dn to On)	tPHL	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	9ns
550 - 557	Propagation delay (Dn to On)	tPHL	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns

Note : P/F means 'test on PASS/FAIL condition'.

AC and functional Characteristics (MC74AC244N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
560 - 567	Propagation delay (OE to On)	tPLZ	Vcc=3V Vil=0mV, Vih=3V Iol=6mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=10% of Vcc	2.5ns	10.5ns
570 - 577	Propagation delay (OE to On)	tPLZ	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=9mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=10% of Vcc	2.5ns	10.5ns
580 - 587	Propagation delay (OE to On)	tPLZ	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=11mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=10% of Vcc	2ns	9ns
590 - 597	Propagation delay (OE to On)	tPZL	Vcc=3V Vil=0mV, Vih=3V Iol=6mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	10ns
600 - 607	Propagation delay (OE to On)	tPZL	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=9mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	10ns
610 - 617	Propagation delay (OE to On)	tPZL	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=11mA, Ioh=-100uA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	8ns
620 - 627	Propagation delay (OE to On)	tPHZ	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=90% of Vcc	3ns	10ns
630 - 637	Propagation delay (OE to On)	tPHZ	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=90% of Vcc	3ns	10ns
640 - 647	Propagation delay (OE to On)	tPHZ	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=90% of Vcc	2.5ns	9ns

AC and functional Characteristics (MC74AC244N/ESTEC at +25'C Degrees C)

Test	Parameter	Symbol	Testconditions	min	max
650 - 657	Propagation delay (OE to On)	tPZH	Vcc=3V Vil=0mV, Vih=3V Iol=100uA, Ioh=-6mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	10.5ns
660 - 667	Propagation delay (OE to On)	tPZH	Vcc=4.5V Vil=0mV, Vih=4.5V Iol=100uA, Ioh=-9mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	2ns	10.5ns
670 - 677	Propagation delay (OE to On)	tPZH	Vcc=5.5V Vil=0mV, Vih=5.5V Iol=100uA, Ioh=-11mA Ref(in)=50% of Vcc Ref(out)=50% of Vcc	1.5ns	7ns

Appendix B - Specifications MCT2000

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RTH.TE.15

MCT 2000 Specifications

DC Parametric Test Specifications

Voltage Force/Measure

Range	Resolution	Accuracy
±2.5 V	1.221 mV	±0.2% FS
±5 V	2.441 mV	±0.2% FS
±10 V	4.882 mV	±0.2% FS

Current Force/Measure

Range	Resolution	Accuracy
±953.7 nA	465.7 pA	±0.5% FS
±15.26 uA	7.451 nA	±0.2% FS ±0.1% R
±244.1 uA	119.2 nA	±0.2% FS ±0.1% R
±3.906 mA	1.907 uA	±0.2% FS ±0.1% R
±62.50 mA	30.52 uA	±0.2% FS ±0.1% R
±500.0 mA	244.1 uA	±0.3% FS ±0.2% R

Compliance Clamping

Both voltage and current clamps are programmable and symmetrical, i.e., both positive (+) and negative (-) direction of the value selected.

Voltage Clamp

Range	Resolution	Accuracy
±10 V	45 mV	±5% FS

Current Clamps

Range	Resolution	Accuracy
±953.7 nA	3.73 nA	±5% FS
±15.26 uA	59.6 nA	±5% FS
±244.1 uA	953 nA	±5% FS
±3.906 mA	15.3 uA	±5% FS
±62.50 mA	244 uA	±5% FS
±500.0 mA	1.95 mA	±5% FS

AC Parametric Test Specifications

Cycle Time
Programmable from 24.4 KHz to 16 MHz

Measurement System

Range	Resolution	Accuracy
20 nS	7 pS	±1% FS + trigger error
50 nS	18 pS	±1% FS + trigger error
100 nS	50 pS	±1% FS + trigger error
1 uS	500 pS	±1% FS + trigger error

NOTES:

1. Trigger errors = $\frac{+nS/volt}{1000} * 52$
2. TT ± accuracy calculated after bandwidth correction formula:

$$10\% - 90\%\ TT_{DUT} = (MCT\ TT)^2 - (0.35/BW)^2$$

where : MCT TT = 10% - 90%
BW = 150 MHz

Time Generator

Delay	Pulse Width	Resolution	Accuracy
0 - 40 uS	4 nS to 40 uS	5.0 pS	±500 pS

Calibration
Hardware and software auto calibration.

Functional Test Specifications

Cycle Time
Programmable from 40.96 uS (24.4 KHz) to 60 nS (16 MHz) in 20 nS steps.

Pin Memory
4K * 4 on each pin.

Pin Drivers
Two V high and two V low reference levels are available.

Tristate to active time: program value +25 nS
Active to tristate time: program value ±5 nS

RTH.TE.15 (continued)

Voltage

Range	Resolution	Accuracy
-2 V to +6 V	1.2 mV	±26 mV[2] (no load)

Rise/Fall times (10 pF/1 mOhm load)
ECL voltage amplitudes from 0.8 V to 3 V = <2.3 nS
(measured at 20% to 80% points)

TTL	Amplitude	Rise/Fall Time
	0.8 V	<3.0 nS
	3.0 V	<3.0 nS
	5.0 V	<3.5 nS
	8.0 V	<5.0 nS

(measured at 10% to 90% points)

DC drive current ±30 mA over full range of 8V.

Overshoot: <10% of programmed amplitude.

Pin Comparators
Two V high and two V low reference levels are available. Two high speed comparators are located at each pin.

Voltage[2]

Range	Resolution	Accuracy
-2 V to +6 V	1.2 mV	±26 mV[2] (switching level 20 mV overdrive)

Pin Loads
ECL 50 ±5.5 Ohm (sink/source), DC current ±30 mA max.

MOS/TTL Range	Resolution	Accuracy
0 to ±20 mA	5 uA IOH (range:-2 to +6 V)	±0.3% F.R. ±0.2% RD
	20 uA IOL (range:-2 to +5.2 V)	±0.3% F.R. ±0.1% RD

Pulse Placement

Delay	Pulse Width	Resolution	Accuracy
0 - 40 uS	4 nS to 40 uS	5.0 pS	±500 pS

Pulse Skew: ±500 pS
Pulse-to-Pulse Jitter: < ±50 pS

RTH.TE.15 (continued)

Strobe Placement[3]

Delay	Pulse Width	Resolution	Accuracy
0 - 40 uS	Edge Type	5.0 pS	±500 pS

Strobe Skew: ±500 pS
Strobe-to-Strobe Jitter: ±50 pS

[2] Auto calibration guarantees at 1 mS or greater, steady state.
[3] Strobe placement range from 0 nS through cycle time setting less than 15 nS.