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FINAL REPORT
FOR
JANTX 1N649-1

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Prepared
For

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FOREWORD

This report is a summary of the work performed on NASA Contract NAS8-31944. The investigation was conducted for the National Aeronautics and Space Administration, George C. Marshall Space Flight Center, Huntsville, Alabama. The Contracting Officer's Technical Representative was Mr. F. Villella.

The short-term objective of this preliminary study of transistors, diodes, and FETS is to evaluate the reliability of these discrete devices, from different manufacturers, when subjected to power and temperature step stress tests.

The long-term objective is to gain more knowledge of accelerated stress testing for use in future testing of discrete devices, as well as to determine which type of stress should be applied to a particular device or design.

This report is divided as follows: description of tests, figures, tables, and appendix.



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1.0 INTRODUCTION

DCA Reliability Laboratory, under Contract NAS8-31944 for NASA/Marshall Space Flight Center, has compiled data for the purpose of evaluating the effect of power/temperature step stress when applied to a variety of semiconductor devices. This report covers the diode JANTX1N649-1 manufactured by SEMTECH and MICRO SEMICONDUCTOR.

1.1 Sample Distribution

A total of 48 samples from each manufacturer were submitted to the process outlined in Table 1. In addition, two control sample units were maintained for verification of the electrical parametric testing.

2.0 TEST REQUIREMENTS

2.1 Electrical

All test samples were subjected to the electrical tests outlined in Table 2 after completing the prior power/temperature step stress point. These tests were performed using the Fairchild Model 600 High-Speed Computer-Controlled Tester. Additional bench testing was also required on the devices.

2.2 Stress Circuit

The test circuit shown in Figure 1 was used to power all of the test devices during the power/temperature stress conditions. The voltage was set by V_F and the current was varied in order to comply with the specified power rating for the device. At least one of the devices was subjected



to maximum rated power (MRP). All remaining devices were subjected to no less than 90% of MRP. See Figure 1 for load resistance values and voltages.

2.3 Group I - Power Stress

Thirty-two units, 16 from each manufacturer, were submitted to the Power Stress Process. The diodes were stressed in 500-hour steps at 50, 100, 125, 150 and 175 percent of maximum rated power (MRP) for a total of 2500 hours or until 50% or more of the devices in a sample lot failed.* Electrical measurements were performed on all specified electrical parameters after each power step. See Table 1. (*See Notes at end of text.)

2.4 Group II - Temperature Stress I

Thirty-two units, 16 from each manufacturer, were submitted to the Temperature Stress I Process. Group II was subjected to 1600 hours of stress at maximum rated power in increments of 160 hours. The temperature was increased in steps of 25°C, commencing at 75°C and terminating at 300°C, or until 50% or more of the devices failed.* Electrical measurements were performed on all specified electrical parameters after each temperature step. See Table 1.

2.5 Group III - Temperature Stress II

Thirty-two units, 16 from each manufacturer, were submitted to the Temperature Stress II Process. Group III was subjected to 112 hours of stress at maximum rated power in increments of 16 hours. The temperature was increased in steps of 25°C,



commencing at 150°C and terminating at 300°C or until 50% or more of the devices in a sample lot failed.* Electrical measurements were performed on all specified electrical parameters after each temperature step. See Table 1.

3.0 DISCUSSION OF TEST RESULTS

3.1 Group I - Power Stress

3.1.1 Semtech. The Semtech sample lot completed the entire 2500 hours of Group I Testing with one catastrophic failure occurring 250 hours into the 100% MRP step. Serial number 7256 failed due to excessive I_R leakage. Typical characteristics of this lot's performance were:

- 1) The mean value for I_R changed
26.16nA from an initial mean of 26.84nA to
a final mean of 53.00nA.
- 2) The mean value for V_F changed
12.60mV from an initial mean of 943.8mV
to a final mean of 956.4mV.

The control limits for this sample lot remained constant throughout the entire Group I Testing.

3.1.2 Micro Semiconductor. The MSC sample lot completed the entire 2500 hours of Group I Testing with no catastrophic failures. Typical characteristics of this sample lot's performance were:

- 1) The mean value for I_R changed
9.165nA from an initial mean of 2.205nA to
a final mean of 11.37nA.
- 2) The mean value for V_F changed
16.50mV from an initial mean of 968.1mV



to a final mean of 951.6mV.

The control limits for this sample lot remained constant throughout the entire Group I Testing.

3.1.3 Statistical Summary - Group I. Table 4 outlines the results of Group I - Power Stress Process for the two electrical parameters and all measurement points for both Semtech and Micro Semiconductor.

3.2 Group II - Temperature Stress I

3.2.1 Semtech. The Semtech sample lot completed the entire 1600 hours of Group II Testing with three catastrophic failures. The first catastrophic failure occurred 160 hours into the 100°C-temperature step. Serial number 7262 failed due to excessive I_R leakage. The last catastrophic failures occurred 160 hours into the 125°C-temperature step. Serial numbers 7290 and 7291 failed due to excessive I_R leakage, and serial number 7251 was removed as a MIL-S-19500 failure. At 160 hours into the 150°C-temperature step, serial number 7261 was removed as a MIL-S-19500 failure. At 160 hours into the 175°C-temperature step, serial number 7264 was removed as a visual reject due to handling. At 160 hours into the 300°C-temperature step, serial number 7265 was removed from testing as a visual reject due to handling. Typical characteristics of this lot's performance were:

- 1) The mean value for I_R changed 28.22nA from an initial mean of 32.86nA to a final mean of 61.08nA.
- 2) The mean value for V_F changed 4.800mV from an initial mean of 953.4mV to a final



mean of 948.6mV.

The control units for this sample lot remained constant throughout the entire Group II Testing.

3.2.2 Micro Semiconductor. The MSC sample lot completed the entire 1600 hours of Group II Testing with two catastrophic failures. At 160 hours into the 125°C-temperature step, serial number 7333 was missing. The first catastrophic failure occurred 160 hours into the 275°C-temperature step. Serial number 7332 failed the maximum V_F limit. The last failure occurred 160 hours into the 300°C-temperature step. Serial number 7329 failed the maximum I_R and V_F limits. Typical characteristics of this lot's performance were:

- 1) The mean value for V_F changed
362.5mV from an initial mean of 973.5mV
to a final mean of 1.336V.

The control units for this sample lot remained constant throughout the entire Group II Testing.

3.2.3 Statistical Summary - Group II. Table 5 outlines the results of Group II - Temperature Stress I Testing for each of the two electrical parameters and all measurement points for both Semtech and Micro Semiconductor.

3.3 Group III - Temperature Stress II

3.3.1 Semtech. The Semtech sample lot completed the entire 112 hours of Group III Testing with no catastrophic failures. At 16 hours into the 225°C-temperature step, serial number 7272 was removed from testing as a visual reject due to



handling. Typical characteristics of this lot's performance were:

- 1) The mean value for I_R changed 35.47nA from an initial mean of 28.54nA to a final mean of 64.01nA.
- 2) The mean value for V_F changed 2.400mV from an initial mean of 950.1mV to a final mean of 952.5mV.

The control units for this sample lot remained constant throughout the entire Group III Testing.

3.3.2 Micro Semiconductor. The MSC sample lot completed the entire 112 hours of Group III testing with no catastrophic failures. Typical characteristics of this sample lot's performance were:

- 1) The mean value for I_R changed 211.0pA from an initial mean of 1.659nA to a final mean of 1.870nA.
- 2) The mean value for V_F changed 7.100mV from an initial mean of 971.4mV to a final mean of 964.3mV.

The control units for this sample lot remained constant throughout the entire Group III Testing.

3.3.3 Statistical Summary - Group III. Table 6 outlines the results of Group III - Temperature Stress II Testing, for each electrical parameter and all measurement points for both Semtech and Micro Semiconductor.

4.0 FINAL DATA SUMMARY

Table 7 statistically summarizes the change in the mean value from the zero-hour data to the final data. The graphs of Figures 2 and 4 plot the



cumulative percent failures versus the temperature stress level for Group II - Temperature Stress I, and Group III - Temperature Stress II. The graphs of Figures 3 and 5 plot the time step for Group II (160 hours) and Group III (16 hours) versus the temperatures T_1 and T_2 calculated from Figures 2 and 4. Tables 8 and 9 summarize the failures encountered for all three stress groups. The failures are separated into two categories: catastrophic failures in Table 8 and parametric failures in Table 9. The data from Table 8 were used as a source for the graphs in Figures 2 and 4. Figures 2 and 4 were used as a source for the graphs in 3 and 5 respectively. Junction temperature is plotted on an inverse hyperbolic scale.

5.0

CONCLUSIONS

Both the Semtech and the Micro Semiconductor lots did quite well in the tests. Semtech had one catastrophic failure in Group I Testing and three in Group II. MSC had two failures in Group II. Because of the small number of failures, only one Group II diode from each manufacturer was submitted for failure analysis.

The analyzed Semtech diode exhibits surface leakage, which developed due to the migration of impurities at the silicon/glass interface during the severe conditions of the step stress test.

The Micro Semiconductor exhibits leakage due to degradation of the semiconductor junction by migration of mobile impurities under the conditions of the test. Neither diode has evidence of microplasmas or other crystal defects.



A plot showing cumulative failure distribution for Group II was drawn for the Semtech sample lot (Figures 2 and 3) and for the Micro Semiconductor sample lot (Figures 4 and 5), but neither Group III graphs could be drawn because of the absence of catastrophic failures. No activation energies could be calculated due to the absence of Group III failures.

A broken circle around a marked point on the graph indicates a freak failure not calculated as part of the regression line. A solid circle around a marked point indicates an isolated main failure point. The regression line was calculated using the least squares method.

The activation energy was calculated from the formula:

$$E = \left[\ln \left(\frac{t_1}{t_2} \right) \right] \left[\frac{8.63 \times 10^{-5} \text{ eV/}^\circ\text{K}}{\left(\frac{1}{T_1 + 273} \right) - \left(\frac{1}{T_2 + 273} \right)} \right] \text{ eV}$$

Where: t_1 = step of Group II - Temp Stress I = 160 hrs.

t_2 = step of Group III - Temp Stress II = 16 hrs.

T_1 = temperature in $^\circ\text{C}$ of 16% failure for Group II.

T_2 = temperature in $^\circ\text{C}$ of 16% failure for Group III.



JANTX1N649-1

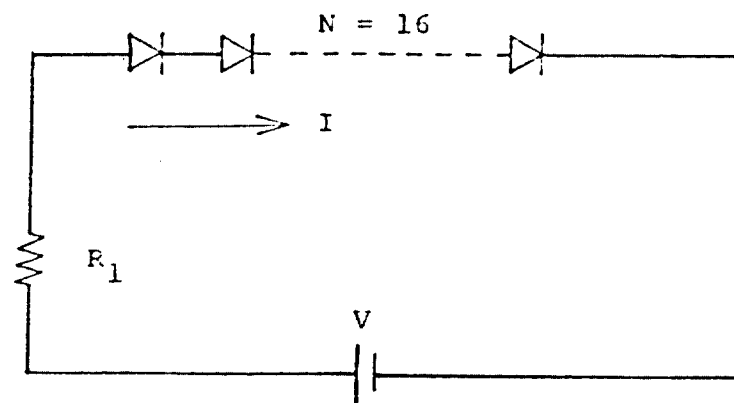
NOTE:

*** Conditions for failure:**

- A) Open or short
- B) Leakage exceeds the maximum limit by 100 times
- C) Other parameters exceed MIL limits by 50% or more.



SWITCHING DIODES



$$R_1 = 1V/I \pm 1\%$$

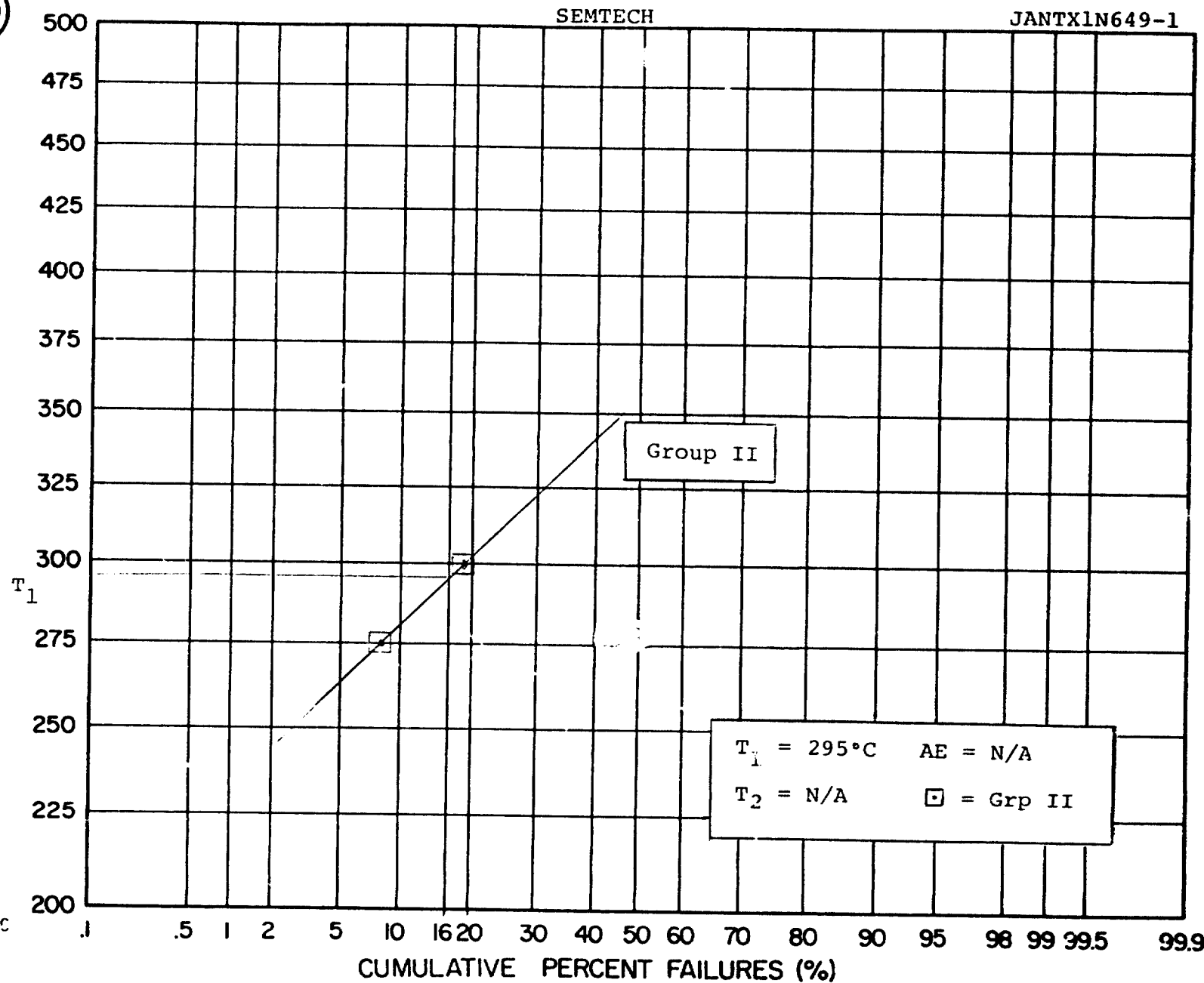
$$P_d = IE$$

FIGURE 1
Power/Temperature Stress Circuit
JANTX1N649-1

JANTX1N649-1

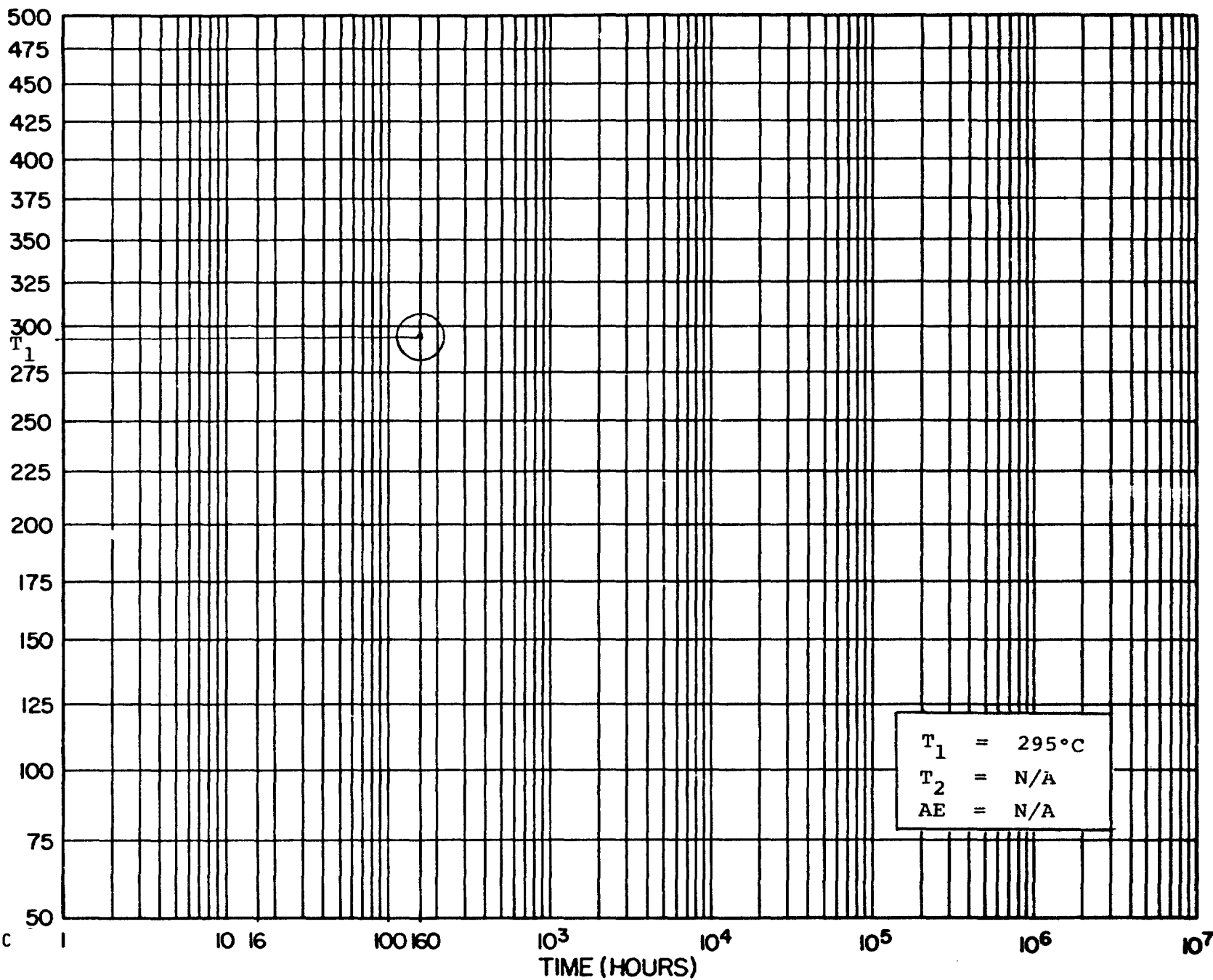


* JUNCTION TEMPERATURE (°C)





* JUNCTION TEMPERATURE (°C)

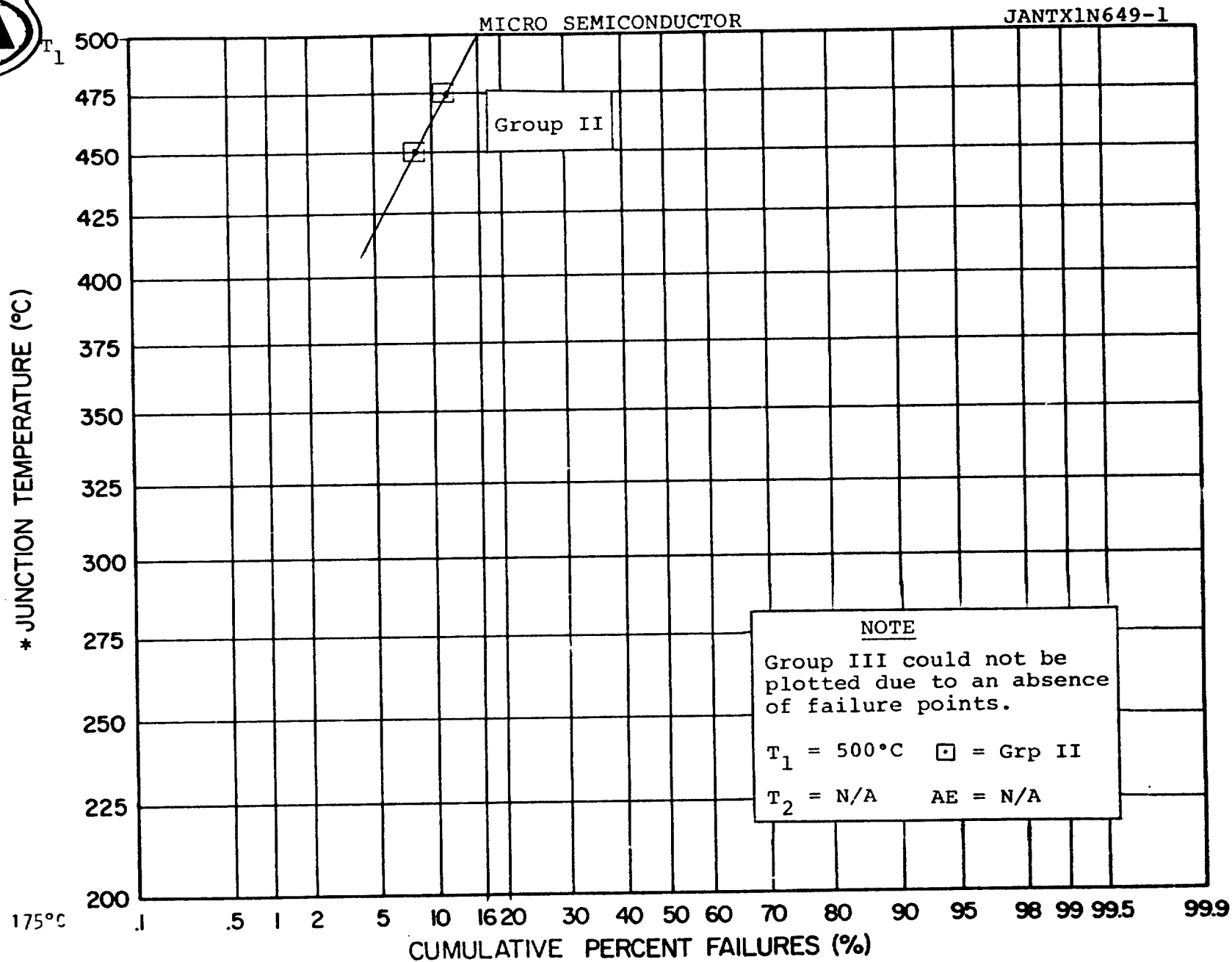


*NOTE

$$T_J \approx T_A + 175^\circ\text{C}$$

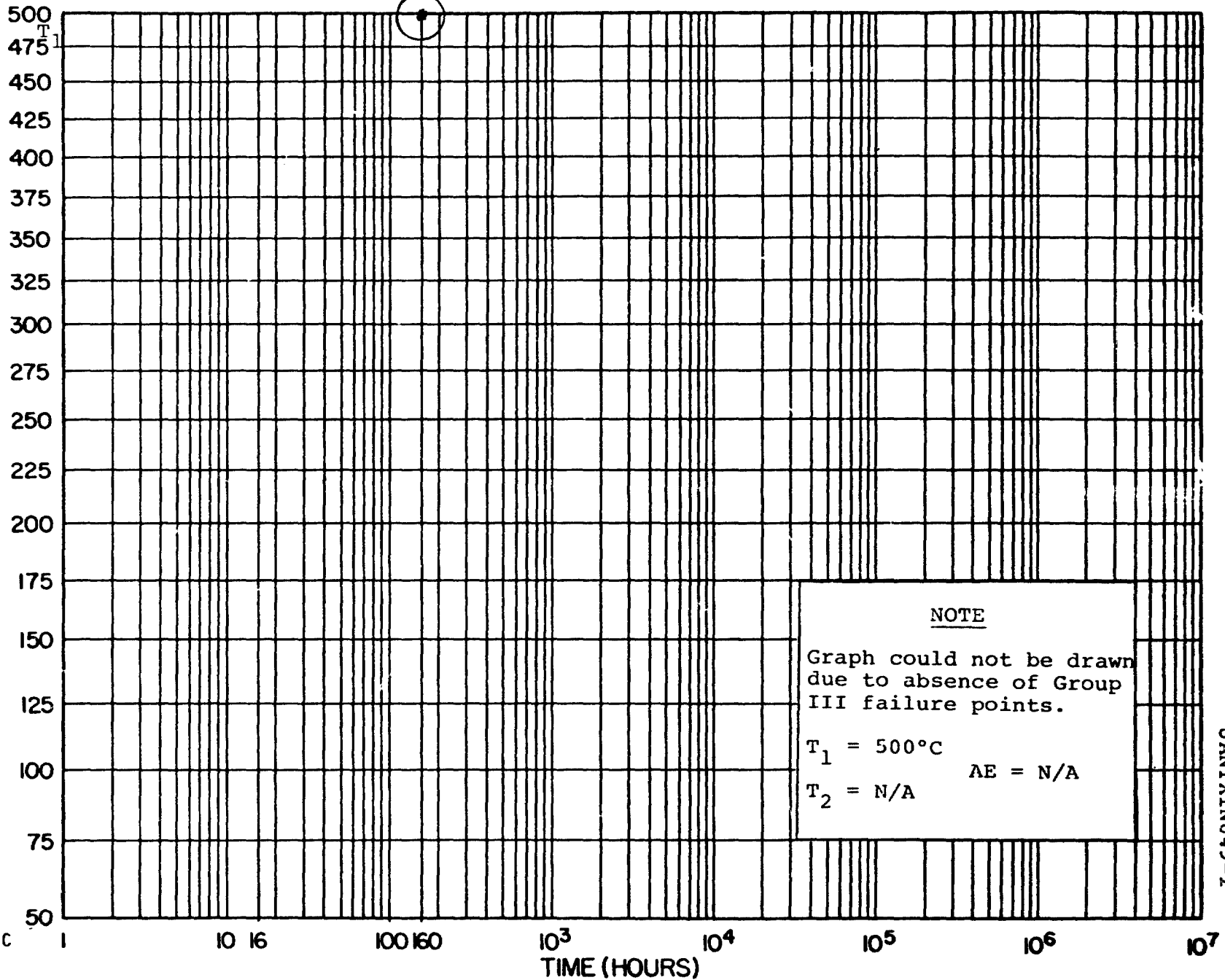
FIGURE 3

Time Steps Versus Junction Temperature, Semtech





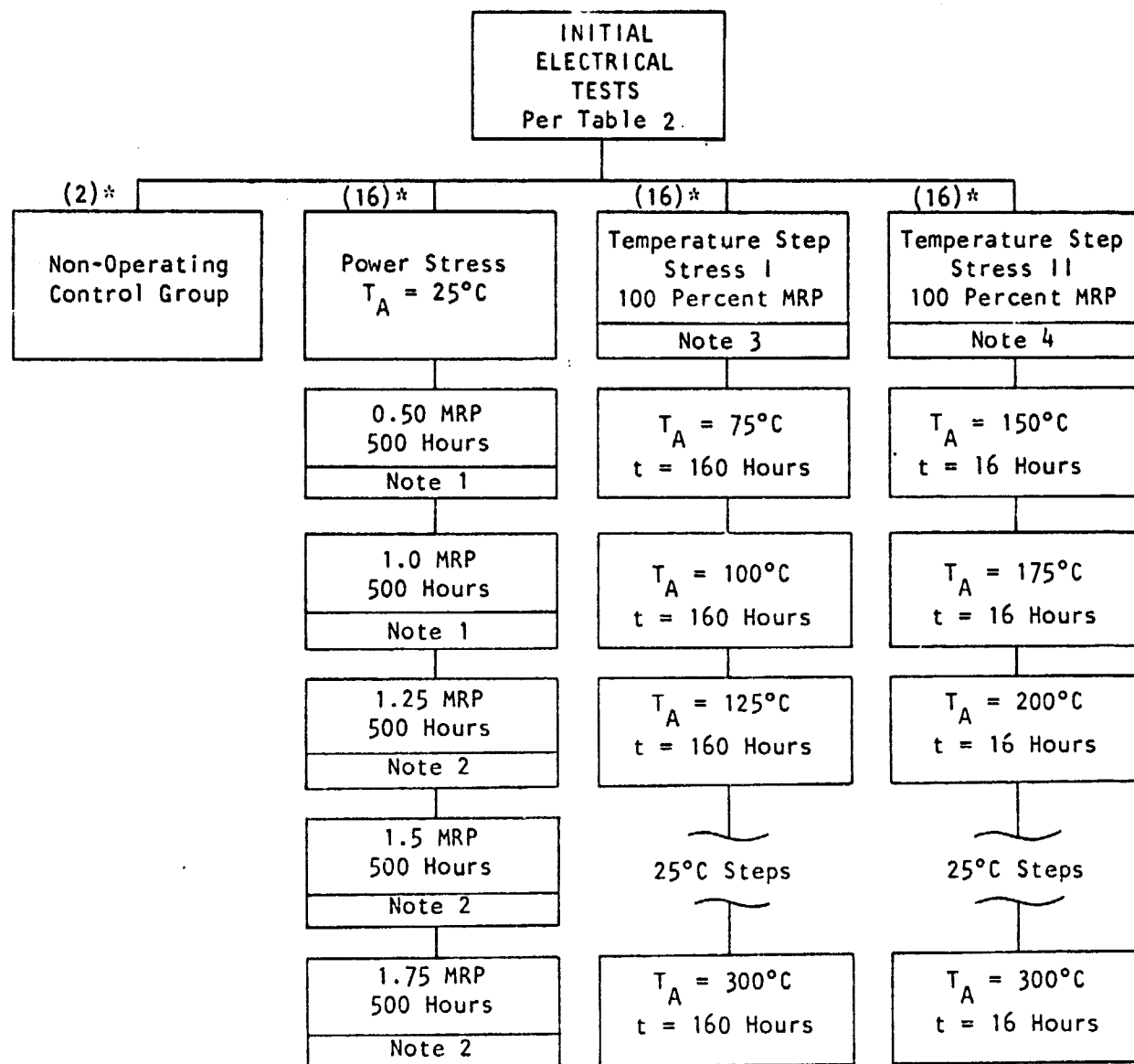
* JUNCTION TEMPERATURE (°C)



*NOTE

$$T_J \approx T_A + 175^\circ\text{C}$$

FIGURE 5
Time Steps Versus Junction Temperature, Micro Semiconductor

TABLE 1
TEST FLOW DIAGRAM

*Quantity per manufacturer (Semtech and Micro Semiconductor)

NOTES:

- 1) Electrical measurements per Table 2 were made at 50, 150, 250 and 500 hours.
- 2) Electrical measurements per Table 2 were made at 10, 25, 50, 150, 250 and 500 hours.
- 3) Electrical measurements per Table 2 were made at the end of each 160 hours.
- 4) Electrical measurements per Table 2 were made at the end of each 16 hours.



JANTX1N649-1

TABLE 2
PARAMETERS AND TEST CONDITIONS

PARAMETER	CONDITIONS	SPEC. LIMIT		CAT. LIMIT		UNITS
		MIN	MAX	MIN	MAX	
I_R	@ $V_R = 600V$	-	.05	-	5	μA
V_F	$I_F = 400mA$ (Pulsed)	-	1.0	-	1.5	V

NOTES:

1/ In addition, any open or short shall be considered catastrophic.

TABLE 3
POWER STRESS BURN-IN CONDITIONS

$V_F = 1V$	
I_F	Percent P_D
.24A	50
.48A	100
.60A	125
.72A	150
.84A	175



NOTE
FOR TABLES
4 THROUGH 7

The minimum/maximum initial and final data generally have an absolute accuracy of $\pm 1\%$ of the reading and $\pm$ one digit except for readings greater than 9.99mA which have an absolute accuracy of $\pm 2\%$ of the reading and $\pm$ one digit. The data also have a resolution for four digits. The standard deviations, means, delta means, and average means are, therefore, valid indicators of trends over time and temperature, excepting the minor statistical computer error of supplying a constant number of significant digits.

TABLE 4
GROUP I - POWER STRESS DATA SUMMARY

Page 1 of 2

PARAMETER	$I_R = .05\mu A(\text{MAX})$		$V_F = 1.0V(\text{MAX})$					
CONDITIONS AND LIMIT	@ $V_R = 600V$		@ $I_F = 400nA(\text{Pulsed})$					
IDENTIFICATION	SEM	MSC	SEM	MSC				
INITIAL DATA								
MIN VALUE	15.60nA	780.0pA	918.0mV	950.0mV				
MAX VALUE	34.20nA	9.350nA	984.0mV	977.0mV				
MEAN	26.84nA	2.205nA	943.8mV	968.1mV				
STD DEV	5.429nA	1.991nA	17.47mV	7.158mV				
INTERIM DATA								
POWER 50 TO 125% Δ MEAN VALUE								
50% POWER								
50 HRS	370.0pA	-123.0pA	-3.200mV	1.600mV				
150 HRS	-2.650nA	-393.0pA	2.000mV	7.100mV				
250 HRS	1.760nA	-43.00pA	-1.900mV	2.200mV				
500 HRS	1.500nA	-145.0pA	-0.700mV	3.700mV				
100% POWER								
550 HRS	-410.0pA	-533.0pA	1.100mV	6.800mV				
650 HRS	201.7nA	-81.00pA	-0.400mV	-51.20mV				
750 HRS	*762.2nA	-451.0pA	1.300mV	7.200mV				
1000 HRS	15.45nA	-462.0pA	2.300mV	5.500mV				
125% POWER								
1010 HRS	16.32nA	-553.0pA	-3.200mV	-124.6mV				
1025 HRS	19.23nA	-441.0pA	0.000mV	3.700mV				
1050 HRS	16.63nA	-419.0pA	5.400mV	-108.8mV				
1150 HRS	16.80nA	-484.0pA	5.500mV	-53.60mV				
1250 HRS	20.04nA	-236.0pA	6.000mV	-0.100mV				
1500 HRS	20.22nA	-440.0pA	-27.40mV	-16.40mV				

(continued on second sheet)



(continued from first sheet)

GROUP I

TABLE 4 (Cont'd)
- POWER STRESS DATA SUMMARY

Page 2 of 2

PARAMETER	$I_R = .05\mu A(\text{MAX})$		$V_F = 1.0V(\text{MAX})$					
CONDITIONS AND LIMITS	@ $V_R = 600V$		@ $I_F = 400nA(\text{Pulsed})$					
IDENTIFICATION	SEM	MSC	SEM	MSC				
INITIAL DATA								
MIN VALUE	15.60nA	780.0pA	918.0mV	950.0mV				
MAX VALUE	34.20nA	9.350nA	984.0mV	977.0mV				
MEAN	26.84nA	2.205nA	943.8mV	968.1mV				
STD DEV	5.429nA	1.991nA	17.47mV	7.158mV				
INTERIM DATA								
POWER 150 TO 175% Δ MEAN VALUE								
150% POWER								
1510 HRS	21.94nA	-482.0pA	6.400mV	8.900mV				
1525 HRS	27.47nA	-301.0pA	3.300mV	-50.50mV				
1550 HRS	29.54nA	-186.0pA	2.600mV	5.100mV				
1650 HRS	24.69nA	-399.0pA	10.30mV	1.200mV				
1750 HRS	22.89nA	-169.0pA	10.60mV	8.200mV				
2000 HRS	23.03nA	737.0pA	10.90mV	3.900mV				
175% POWER								
2010 HRS	24.16nA	240.0pA	9.100mV	4.200mV				
2025 HRS	24.83nA	328.0pA	9.400mV	4.900mV				
2050 HRS	25.89nA	234.0pA	12.30mV	-2.000mV				
2150 HRS	23.83nA	5.422nA	12.90mV	8.700mV				
2250 HRS	20.63nA	3.775nA	20.70mV	6.900mV				
2500 HRS	26.16nA	9.165nA	12.60mV	-16.50mV				
FINAL DATA								
MIN VALUE	24.00nA	530.0pA	931.0mV	608.0mV				
MAX VALUE	83.00nA	35.20nA	979.0mV	985.0mV				
MEAN	53.00nA	11.37nA	956.4mV	951.6mV				
STD DEV	15.28nA	9.555nA	14.50mV	89.12mV				

*NOTE: Catastrophic rejects removed from data after this point.

TABLE 5

GROUP II TEMP STRESS I DATA SUMMARY

PARAMETERS	$I_R = .05\mu A(\text{MAX})$		$V_F = 1.0V(\text{MAX})$					
CONDITIONS AND LIMITS	@ $V_R = 600V$		@ $I_F = 400nA (\text{Pulsed})$					
IDENTIFICATION	SEM	MSC	SEM	MSC				
INITIAL DATA								
MIN VALUE	21.90nA	1.180nA	916.0mV	956.0mV				
MAX VALUE	44.10nA	15.50nA	978.0mV	989.0mV				
MEAN	32.86nA	2.966nA	953.4mV	973.5mV				
STD DEV	6.223nA	3.298nA	16.27mV	9.526mV				
INTERIM DATA (INITIAL TO FINAL)								
Δ MEAN VALUE								
TOTAL HRS TEMP (T_A)								
160 75°C	280.8nA	-1.362nA	0.700mV	-2.000mV				
320 100°C	*975.1nA	-1.429nA	3.000mV	0.900mV				
480 125°C	*77.83nA	-1.459nA	3.600mV	1.000mV				
640 150°C	1.710nA	-35.00pA	4.100mV	4.500mV				
800 175°C	5.860nA	-510.0pA	0.400mV	-3.800mV				
960 200°C	15.46nA	15.17nA	0.300mV	-63.60mV				
1120 225°C	22.67nA	102.9nA	3.400mV	-47.40mV				
1280 250°C	24.10nA	142.3nA	-0.500mV	-9.000mV				
1140 275°C	43.92nA	*2.292μA	-2.500mV	75.50mV				
1600 300°C	28.22nA	*10.21μA	-4.800mV	*362.5mV				
FINAL DATA								
FINAL TEMP (T_A)	300°C	300°C	300°C	300°C				
MIN VALUE	29.50nA	15.80nA	920.0mV	61.00mV				
MAX VALUE	103.0nA	120.0μA	974.0mV	5.920V				
MEAN	61.08nA	10.21μA	948.6mV	1.336V				
STD DEV	25.78nA	29.78μA	14.98mV	1.265V				

* NOTE: Catastrophic reject(s) removed from data after this point.

TABLE 6

GROUP III TEMP STRESS II DATA SUMMARY

PARAMETERS	$I_R = .05\mu A (MAX)$		$V_F = 1.0V (MAX)$					
CONDITIONS AND LIMITS	@ $V_R = 600V$		@ $I_F = 400nA (Pulsed)$					
IDENTIFICATION	SEM	MSC	SEM	MSC				
INITIAL DATA								
MIN VALUE	9.790nA	840.0pA	928.0mV	958.0mV				
MAX VALUE	43.60nA	4.900nA	974.0mV	981.0mV				
MEAN	28.54nA	1.659nA	950.1mV	971.4mV				
STD DEV	8.735nA	914.1pA	12.48mV	6.927mV				
INTERIM DATA (INITIAL TO FINAL)								
Δ MEAN VALUE								
TOTAL HRS TEMP (T_A)								
16 150°C	-620.0pA	35.00pA	4.800mV	4.200mV				
32 175°C	8.700nA	1.663nA	-0.400mV	-2.000mV				
48 200°C	8.870nA	193.0pA	0.300mV	-0.700mV				
64 225°C	18.06nA	-310.0pA	-1.100mV	-1.600mV				
80 250°C	17.49nA	14.00pA	0.100mV	1.900mV				
96 275°C	18.74nA	547.0pA	-0.900mV	-4.000mV				
112 300°C	35.47nA	211.0pA	2.400mV	-7.100mV				
FINAL DATA								
FINAL TEMP (T_A)	300°C	300°C	300°C	300°C				
MIN VALUE	21.20nA	780.0pA	930.0mV	936.0mV				
MAX VALUE	136.0nA	5.530nA	974.0mV	982.0mV				
MEAN	64.01nA	1.870nA	952.5mV	964.3mV				
STD DEV	34.48nA	1.356nA	12.81mV	13.57mV				

* NOTE: Catastrophic reject(s) removed from data after this point.

TABLE 7
FINAL DATA SUMMARY

PARAMETER	SPECIFICATIONS LIMIT		U N I T S	MEAN INT. DATA	AVERAGE Δ IN MEAN VALUE					
	MIN	MAX			POWER STRESS		TEMPERATURE STRESS I		TEMPERATURE STRESS II	
					SEM	MSC	SEM	MSC	SEM	MSC
I _R	-	.05	μA		*+.05324	+.00052	*+.14757	*+1.2758	+.01524	+.00034
V _F	-	1.0	V		+.00415	-.01284	+.00077	*+.03186	+.00074	-.00133

* NOTE: Catastrophic reject(s) removed from data after this point.

TABLE 8 STEP STRESS CATASTROPHIC FAILURE SUMMARY

JAN TX1N649-1

GROUP I POWER STRESS

TEST STEP	MFR A		MFR B	
	QTY.	NOTE	QTY.	NOTE
50% 50 hr.	0	-	0	-
100 hr.	0	-	0	-
100 hr.	0	-	0	-
250 hr.	0	-	0	-
100% 50 hr.	0	-	0	-
100 hr.	0	-	0	-
100 hr.	1	A	0	-
250 hr.	0	-	0	-
125% 10 hr.	0	-	0	-
15 hr.	0	-	0	-
25 hr.	0	-	0	-
100 hr.	0	-	0	-
100 hr.	0	-	0	-
250 hr.	0	-	0	-
150% 10 hr.	0	-	0	-
15 hr.	0	-	0	-
25 hr.	0	-	0	-
100 hr.	0	-	0	-
100 hr.	0	-	0	-
250 hr.	0	-	0	-
175% 10 hr.	0	-	0	-
15 hr.	0	-	0	-
25 hr.	0	-	0	-
100 hr.	0	-	0	-
100 hr.	0	-	0	-
250 hr.	0	-	0	-

GROUP II 160 HR. TEMP. STEPS

TEST STEP (T _A)	MFR A		MFR B	
	QTY.	NOTE	QTY.	NOTE
75°C	0	-	0	-
100°C	1	A	0	-
125°C	2	A	0	-
150°C	0	-	0	-
175°C	0	-	0	-
200°C	0	-	0	-
225°C	0	-	0	-
250°C	0	-	0	-
275°C	0	-	1	B
300°C	0	-	1	C

NOTES: A - $I_R > 5\mu A$
B - $V_F > 1.5V$
C - $I_R > 5\mu A$ and $V_F > 1.5V$

GROUP III 16 HR. TEMP. STEPS

TEST STEP (T _A)	MFR A		MFR B	
	QTY.	NOTE	QTY.	NOTE
150°C	0	-	0	-
175°C	0	-	0	-
200°C	0	-	0	-
225°C	0	-	0	-
250°C	0	-	0	-
275°C	0	-	0	-
300°C	0	-	0	-

MFR "A" - Semtech

MFR "B" - Micro Semiconductor



GROUP I POWER STRESS

TEST STEP	MFR A		MFR B	
	QTY.	NOTE	QTY.	NOTE
50% 50 hr.	0	-	0	-
100 hr.	0	-	0	-
100 hr.	0	-	0	-
250 hr.	0	-	0	-
100% 50 hr.	0	-	0	-
100 hr.	1	A	0	-
100 hr.	0	-	0	-
250 hr.	3	A	0	-
125% 10 hr.	2	A	0	-
15 hr.	1	A	0	-
25 hr.	0	-	0	-
100 hr.	0	-	0	-
100 hr.	0	-	0	-
250 hr.	0	-	0	-
150% 10 hr.	0	-	0	-
15 hr.	2	A	0	-
25 hr.	0	-	0	-
100 hr.	0	-	0	-
250 hr.	0	-	0	-
175% 10 hr.	0	-	0	-
15 hr.	0	-	0	-
25 hr.	0	-	0	-
100 hr.	0	-	0	-
100 hr.	0	-	0	-
250 hr.	1	A	0	-

GROUP II 160 HR. TEMP. STEPS

TEST STEP (T _A)	MFR A		MFR B	
	QTY.	NOTE	QTY.	NOTE
75°C	2	A	0	-
100°C	0	-	0	-
125°C	1	B	1	F
150°C	1	C	0	-
175°C	1	A	0	-
200°C	1	A	3	A
225°C	1	A	3	A
250°C	3	A	1	A
275°C	2	A	4	A
300°C	1	A	0	-

GROUP III 16 HR. TEMP. STEPS

TEST STEP (T _A)	MFR A		MFR B	
	QTY.	NOTE	QTY.	NOTE
150°C	0	-	0	-
175°C	1	A	0	-
200°C	1	A	0	-
225°C	5	A	0	-
250°C	0	-	0	-
275°C	2	A	0	-
300°C	0	-	0	-

MFR "A" - Semtech

MFR "B" - Micro Semiconductor

NOTES: A - I_R limit failure
 B - S/N 7251 removed from testing as MIL-S-19500 failure
 C - S/N 7261 removed from testing as MIL-S-19500 failure
 D - S/N 7264 removed from testing as MIL-S-19500 failure
 E - S/N 7265 removed from testing as MIL-S-19500 failure
 F - S/N 7333 missing from testing
 G - I_R and V_F limit failure
 H - S/N 7272 removed from testing as visual reject due to handling



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APPENDIX

FAILURE ANALYSIS



JANTX1N649-1

FAILURE ANALYSIS

Date 29 December 1978

J/N 2CN242-13B P/N 1N649-1 MFR Semtech

FAILURE VERIFICATION:End point: 5.0 μ A Max. End point: 1.5V Max.

S/N	PIV -volts-	I_R @ 600 V.dc	V_F @ 400mA dc	INITIAL REJ. AT TEST SEQUENCE NO.:	INITIAL REJ. FOR:
7262	730	23 μ A	.96V	07 (125°C 480 Hrs.)	I_R

VISUAL INSPECTION:

There were no visual anomalies on this sample either before or after paint removal (see Figure A-1).

CONCLUSION:

This Semtech diode exhibits surface leakage which developed due to the migration of impurities at the silicon-glass interface under the severe conditions of the step stress test. There is no evidence of microplasmas or other crystal defects.

*^hFE trace present. Cannot meet stated test conditions. (Leaky)
**^hFE trace very leaky.

D=drift H=hysteresis Inv=inversion R=resistive S=soft Uns=unstable



JANTX1N649-1

FAILURE ANALYSIS

Date 29 December 1978

J/N 2CN242-13B P/N 1N649-1 MFR Micro Semiconductor

FAILURE VERIFICATION:End point: End point:
5.0 μ A Max. 1.5V Max.

S/N	PIV -volts-	I_R @ 600 V.dc	V_F @ 400mA dc	INITIAL REJ. AT TEST SEQUENCE NO.:	INITIAL REJ. FOR:
7332	800	160 μ A	5.8V	21 (300°C 1600 Hrs.)	V_F

VISUAL INSPECTION:

There were no visual anomalies on this sample other than discolored external paint (see Figure A-2).

CONCLUSION:

This Micro Semiconductor diode exhibits leakage due to degradation of the semiconductor junction by migration of mobile impurities under the conditions of the step-stress test. There is no evidence of microplasmas or other crystal defects.

*^hFE trace present. Cannot meet stated test conditions. (Leaky)
**^hFE trace very leaky.

D=drift H=hysteresis Inv=inversion R=resistive S=soft Uns=unstable



ORIGINAL PAGE IS
OF POOR QUALITY

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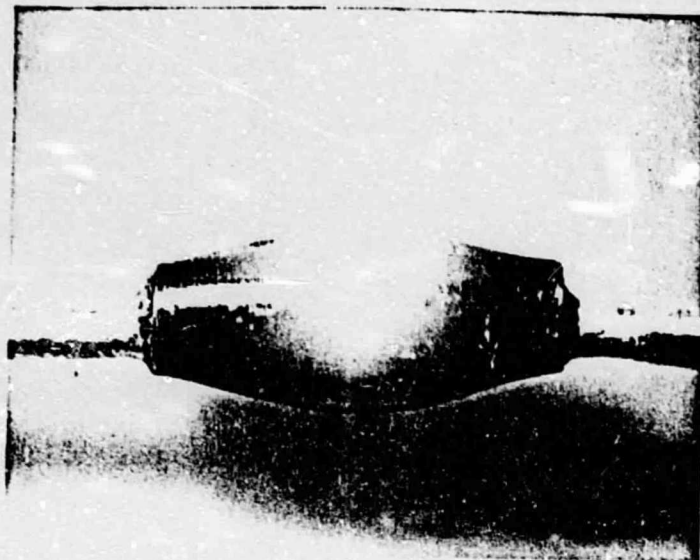


FIGURE A-1
S/N 7262, Semtech, 13X.
Semtech diode after stripping the external paint.

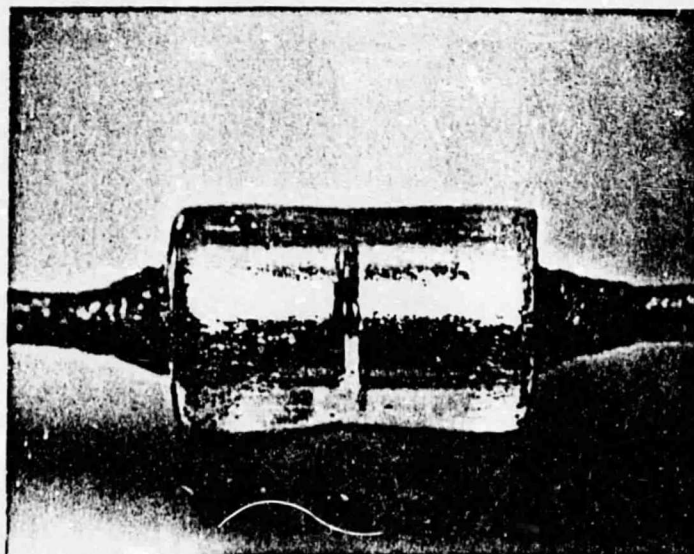


FIGURE A-2
S/N 7332, Micro Semiconductor, 12X.
Micro Semiconductor diode after
stripping the external paint.