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ELECTRICAL CHARACTERIZATION OF THE RCA CPD1822SD RANDOM ACCESS MEMORY

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ELECTRICAL CHARACTERIZATION OF THE RCA CDP1822SD RANDOM ACCESS MEMORY

Volume 1
FINAL REPORT
JUNE 1979

(Text of Report and Appendix A)
Contract Number JPL 954789, Modification 1

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TEST ABSTRACT

Electrical characterization tests were performed on 35 RCA CDP1822SD, 256-by-4-bit, CMOS, random access memories. The tests included three functional tests, AC and DC parametric tests, a series of schmoo plots, rise/fall-time screening, and a data retention test.

All tests were performed on a Tektronix S-3260 automated IC test system. Temperatures were controlled by a Temptronic TP450A thermal airstream unit.

All the functional tests, the data retention test, and the AC and DC parametric tests were performed at ambient temperatures of 25°C, -20°C, -55°C, 85°C, and 125°C. The schmoo plots were performed at ambient temperatures of 25°C, -55°C, and 125°C. The data retention test was performed at 25°C.

Five devices failed one or more functional tests and four of these devices failed to meet the expected limits of a number of AC parametric tests. Some of the schmoo plots indicated a small degree of interaction between parameters.

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1.0 INTRODUCTION

This report documents the electrical characterization tests performed on the RCA CDP1822SD, 256-by-4-bit, CMOS, random access memory. The results of these tests are presented in plots, histograms and statistical analyses of the data. The tests performed include functional tests, AC and DC parametric tests, schmoo plots, a data retention test, and a rise/fall-time screening test. The functional tests were performed on a pass/fail basis to 1) verify that data could be written into and read from each location in the memory array, and 2) assure proper address decoding. The AC parametric tests were performed functionally using standard memory test patterns. The DC parametric tests were all static measurements made by forcing specific conditions on the device and measuring a voltage or current. The schmoo plots were performed to determine if any interdependence of device parameters existed. The data retention test determined if data could be retained in the memory array at reduced supply voltage. The rise/fall-time screening tests were included at the request of JPL. Their purpose was to screen for system use problems associated with slow rise/fall-times on the address lines.

All of the tests were performed on a Tektronix S-3260 automated IC test system. The schmoo plot tests were performed at ambient temperatures of 25°C, -55°C, and 125°C. The functional tests and the AC and DC parametric tests were performed at ambient temperatures of 25°C, -20°C, -55°C, 85°C, and 125°C. Temperature control was provided by a Temptronic TP450A thermal airstream unit under test program control.

2.0 DEVICE DESCRIPTION

The RCA CDP1822SD is a 256-by-4-bit, silicon-on-saphire (SOS), random access memory. The device is organized into 256 4-bit words and packaged in a 22-lead, ceramic, dual-in-line package. Brief descriptions of its operation and of the function of each of its external connections are given in 2.1 and 2.2. See Figures 1 and 2 for terminal assignments and logic diagram.

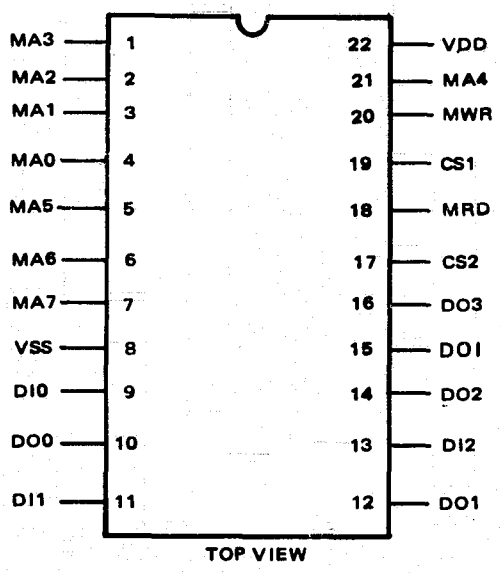


Figure 1. Terminal assignments.

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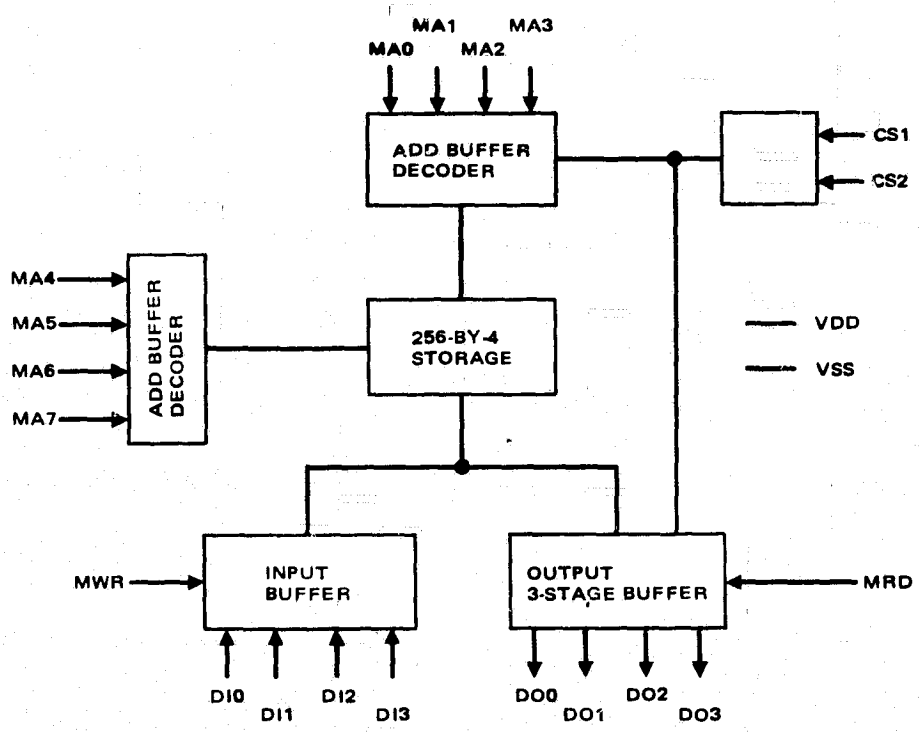


Figure 2. Functional diagram.

2.1 PIN DESCRIPTIONS

2.1.1 Chip Select ($\overline{CS1}$ and CS2) Inputs

The chip select inputs are used to enable or activate the memory. The memory is enabled for read or write only when $\overline{CS1}$ is low (logic "0") and CS2 is high (logic "1"). The memory is disabled for all other combinations of $\overline{CS1}$ and CS2. When the memory is disabled, the memory outputs are in a high-impedance state. Refer to Table 1 for Truth Table.

2.1.2 Write Enable ($\overline{MWR}$) Input

The MWR input controls write/read mode selection. When $\overline{MWR}$ is high (logic "1"), the memory is in a read mode. When $\overline{MWR}$ is low (logic "0"), the memory is in a write mode and the output is in a high-impedance state. Refer to Table 1 for Truth Table.

TABLE 1. TRUTH TABLE

Function	$\overline{MWR}$	$\overline{CS1}$	CS2	$\overline{MRD}$	Data Out (DO)
Read	1	3	1	0	Storage state of addressed cell
Write	0	3	1	1	High impedance
Write	0	0	1	X	New data-in state
Standby	X	1	X	X	High impedance
	X	X	0	X	High impedance
	1	0	1	1	High impedance
Logic "1" = High		Logic "0" = Low			X = Don't care

2.1.3 Address (MA0 through MA7) Inputs

The address inputs select one of 256 possible memory array locations. Data may either be written into or read from the selected location in the memory, provided the memory has been enabled with the chip select inputs. $\overline{MWR}$ must be in the proper logic state to select the desired mode of operation.

2.1.4 Data-In (DI0 through DI3) Inputs

The data input lines are the path through which data is written into the memory array.

2.1.5 Data-Out (DO0 through DO3) Outputs

The data outputs are the lines through which data from the memory array are sampled during a read operation. Positive logic is used (i.e., a logic "1" written into the memory array is recognized as a logic "1" when read from the memory array).

2.1.6 Output Disable ($\overline{MRD}$) Input

The output of the memory is disabled (in a high-impedance state) when $\overline{MRD}$ is high (logic "1").

2.2 DEVICE OPERATION

For the following descriptions, refer to the timing diagrams in Figure 3.

2.2.1 Write Mode

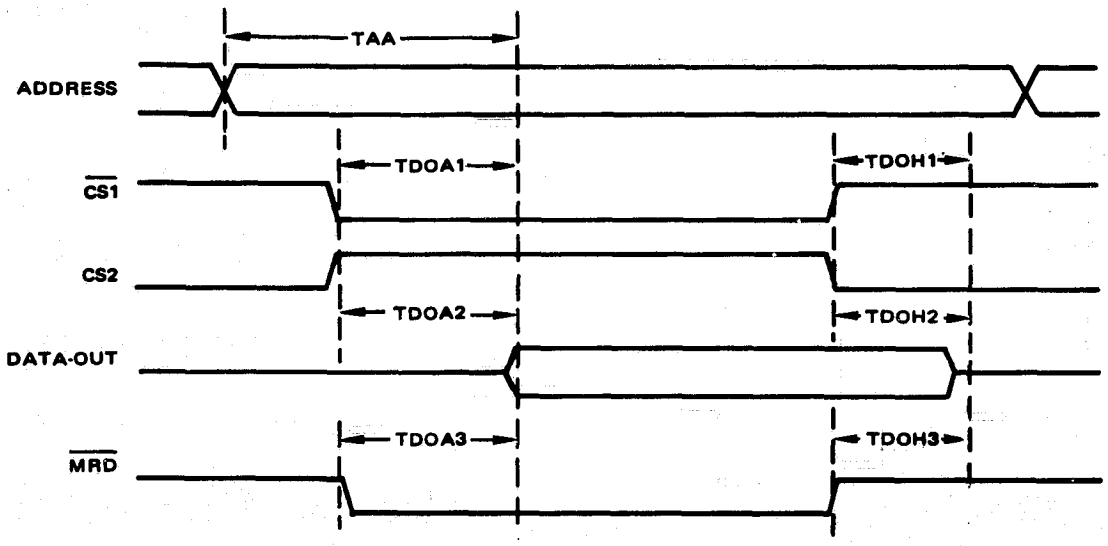
To write data into the memory array $\overline{CS1}$ must be low (logic "0") and CS2 must be high (logic "1"). The address data must be valid for time period TAS* prior to $\overline{MWR}$ high-to-low transition and must remain valid for time period TAH* after $\overline{MWR}$ low-to-high transition. The data inputs must be at the desired level for time period TDS* prior to $\overline{MWR}$ low-to-high transition and remain in the selected state for time period TDH* after $\overline{MWR}$ low-to-high transition. $\overline{MWR}$ must remain low for a minimum of TWP*.

2.2.2 Read Mode

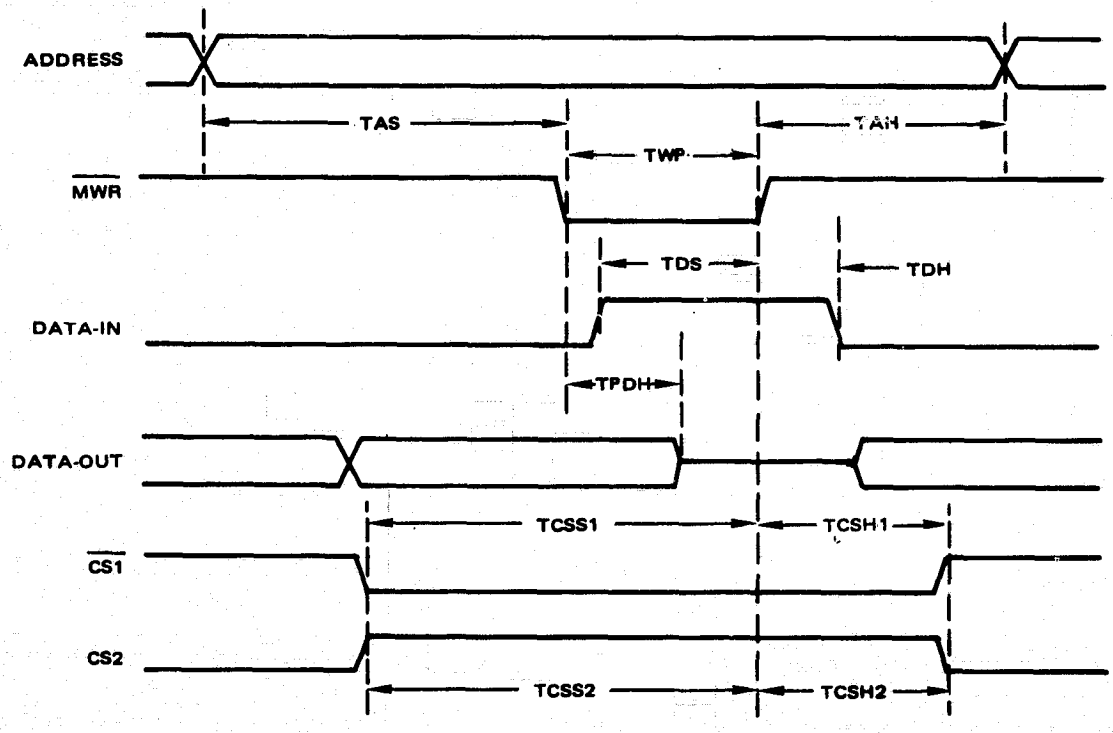
To read data from the memory array, $\overline{CS1}$ and $\overline{MRD}$ must be low (logic "0") and CS2 must be high (logic "1"). $\overline{MWR}$ must be high. The desired memory array position is selected by means of the address lines. Valid data will be available at the output after time interval TAA*.

---

*TAS = address setup time.
TAH = address hold time.
TDS = data setup time.
TDH = data hold time.
TWP = write pulse time.
TAA = address access time.



a. READ CYCLE TIMING



b. WRITE CYCLE TIMING

Figure 3. Timing diagram.

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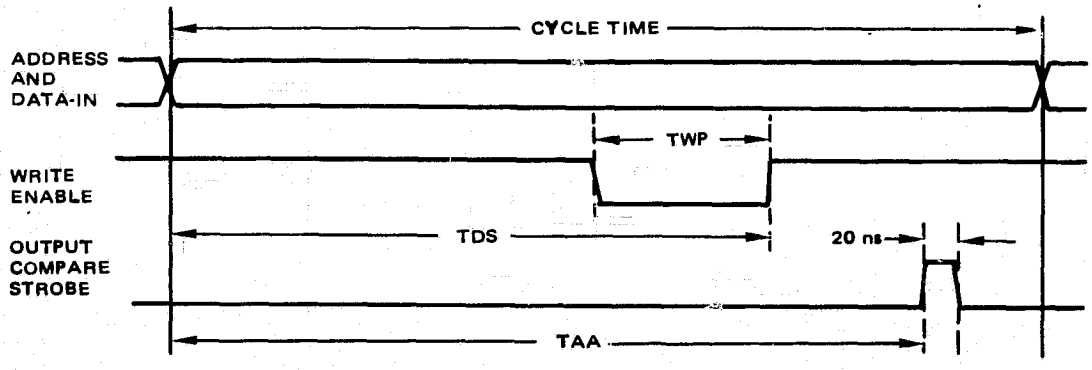


Figure 4. Functional timing diagram

3.0 DESCRIPTION OF TESTS

3.1 FUNCTIONAL TESTS

Three functional tests were performed. The first was a "dead or alive" test with conditions set well within the operating limits for the device. The second and third tests were run under more severe conditions. (Refer to Table 2.) All the functional tests used galpat as the test pattern.

3.2 AC PARAMETRIC TESTS

3.2.1 General Description

All AC parameters were tested functionally using memory test patterns. The parameter of interest was set to a starting value and a functional test was performed to determine whether the memory could function at the programmed value. If the memory failed the functional test, the parameter was incremented by 2, 5, or 8 ns, depending upon the parameter. This

TABLE 2. FUNCTIONAL TEST CONDITIONS

Test No.	Test Conditions								
	VDD	VIL	VIH	Logic "0" Threshold	Logic "1" Threshold	Time	TWP	TDS	TAA
1	10V	0V	9.5V	1V	9V	1 μs	300 ns	700 ns	900 ns
2	10V	1V	9.0V	1V	9V	256 ns	100 ns	200 ns	230 ns
3	5V	0.5V	4.5V	1V	4V	352 ns	200 ns	300 ns	330 ns

Notes: $\overline{CS1}$ and $\overline{MRD}$ = logic "0".
CS2 = logic "1".

process was repeated until the memory passed the test or until the range of values for the parameter was exceeded. The value of the parameter was recorded at the time of the successful completion of the functional test by the memory. If the range of values for the parameter was exceeded without the memory passing the functional test, a 1K default reading was recorded.

All parameters were measured at three sets of test conditions (refer to Table 3). Timing conditions for the individual AC parametric tests are listed in Table 4.

3.2.2 Write Cycle Time (TWC)

The pattern for the TWC test was divided into separate read and write sections so read cycle timing could be set independently from write cycle timing. This allowed enough read cycle time to assure a proper read operation and prevent address access time from affecting TWC data.

Before the start of the TWC test, TWP and TPH were set to the values measured for these parameters plus 10 ns. To measure TWC, the value of TWC was varied over a range starting at (TWP + TDH + 20 ns) or 80 ns (test system minimum cycle time), whichever was greater, to a final value of 450 ns. The value of TWC at the time of successful completion of the functional test was recorded.

TABLE 3. AC – PARAMETRIC TEST CONDITIONS

Test Condition	VDD	Input Voltage Levels		Output Compare Levels	
		VIL	VIH	Logic "0" Threshold	Logic "1" Threshold
1	4.5V	0V	4.4V	1V	3.5V
2	5.0V	0V	4.9V	1V	4.0V
3	5.5V	0V	9.9V	1V	8.0V

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TABLE 4. AC – PARAMETRIC TIMING CONDITIONS

	Timing Conditions					
Parameter	TAS	TAH	TDS	TDH	TWP	Compare Strobe (Measured from Start of Cycle)
TAA	400 ns	300 ns	700 ns	300 ns	300 ns	Varied from 50 ns to 600 ns in 5 ns incr
TAS	Varied from -40 ns to 300 ns in 2 ns incr	250 ns	700 ns	300 ns	300 ns	900 ns
TAH	400 ns	Varied from -20 ns to 200 ns in 2 ns incr	700 ns	300 ns	300 ns	900 ns
TDS	400 ns	300 ns	Varied from -40 ns to 250 ns in 2 ns incr	250 ns	300 ns	900 ns
TDH	400 ns	300 ns	700 ns	Varied from -20 ns to 200 ns in 2 ns incr	300 ns	900 ns
TWP	700 ns minus TWP	300 ns	700 ns	300 ns	Varied from 20 ns to 300 ns in 2 ns incr	900 ns

Notes: Cycle time = 1 μs. CS2 = logic "1".
$\overline{CS1}$ & $\overline{MRD}$ = logic "0". Pattern used = galpat.

(Continued next page)

(Table 4, continued)

Parameter	Timing Conditions					
	TCSS1	TCSS2	TCSH1	TCSH2	Compare Strobe (Measured from Start of Cycle)	Comments
TCSS1	Varied from 0 ns to 550 ns in 2 ns incr	N/A	250 ns	N/A	900 ns	CS2 = logic "1"
TCSS2	N/A	Varied from 0 ns to 550 ns in 2 ns incr	N/A	250 ns	900 ns	$\overline{CS1}$ = logic "0"
TCSH1	700 ns	N/A	Varied from 0 ns to 250 ns in 2 ns incr	N/A	610 ns	CS2 = logic "1"
TCSH2	N/A	700 ns	N/A	Varied from 0 ns to 250 ns in 2 ns incr	610 ns	$\overline{CS1}$ = logic "0"

Notes:
Cycle time = 1 μs.
TAS = 400 ns.
TAH = 300 ns.
TDS = 700 ns.
TDH = 300 ns.
TWP = 300 ns.
Pattern used = galpat.

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(Table 4, continued)

Parameter	Timing Conditions				
	TDOH1	TDOH2	TDOH3	Comments	
TDOH1	Varied from 300 ns to 0 ns in 2 ns incr	N/A	N/A	CS2 = logic "1" $\overline{MRD}$ = logic "0"	TWP = 200 ns TAS = 350 ns TAH = 450 ns TDS = 550 ns TDH = 450 ns Cycle time = 1 μs Pattern = checkerboard
TDOH2	N/A	Varied from 300 ns to 0 ns in 2 ns incr	N/A	$\overline{CS1}$ = logic "0" $\overline{MRD}$ = logic "0"	
TDOH3	N/A	N/A	Varied from 300 ns to 0 ns in 2 ns incr	$\overline{CS1}$ = logic "0" CS2 = logic "1"	

Parameter	Timing Conditions				
	TDOA1	TDOA2	TDOA3	Comments	
TDOA1 (output enable from $\overline{CS1}$)	Varied from 0 ns to 450 ns in 2 ns incr	N/A	N/A	CS2 = logic "1"	TWP = 250 ns TAS = 1 μs TAH = 250 ns TDS = 1.25 μs TDH = 250 ns Cycle time = 1.5 μs Pattern = checkerboard $\overline{MRD}$ = logic "0"
TDOA2 (output enable from CS2)	N/A	Varied from 0 ns to 450 ns in 2 ns incr	N/A	$\overline{CS1}$ = logic "0"	
TDOA3 (output enable from $\overline{MRD}$)	N/A	N/A	Varied from 0 ns to 450 ns in 2 ns incr	$\overline{CS1}$ = logic "0" CS2 = logic "1"	TWP = 300 ns TAS = 400 ns TAH = 300 ns TDS = 700 ns TDH = 300 ns Cycle time = 1 μs Pattern = checkerboard

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(Table 4, concluded)

Parameter	Timing Conditions	
	Read Cycle	Write Cycle
TRC (read cycle time)	TRC varied from 80 ns to 450 ns in 8 ns increments Compare time = TRC minus 20 ns Pattern = diagonal (read only)	Cycle time = 1 μs TAS = 400 ns TAH = 300 ns TDS = 700 ns TDH = 300 ns TWP = 300 ns Pattern = Diagonal (write only)
TWC (write cycle time)	Cycle time = 1 μs Compare time = 900 ns Pattern = diagonal (read only)	TWC varied from 80 ns or (TWP + TDH + 20 ns)* whichever is greater, to 450 ns TWP and TDH set to the measured value for these parameters plus 10 ns Pattern = Diagonal (write only)

*The previously taken values (just prior to this test) of TWP and TDH plus 20 ns.

If the range of values for TWC was exhausted without the functional test being passed, TWC and TDH were incremented by 5 ns and the process was repeated. If after adding 20 ns to TWP and TDH, and after incrementing through the range of values for TWC, the functional test still was not passed, a default value of 1K was recorded for TWC.

3.3 SCHMOO PLOTS

Schmoo plots determine whether interdependence exists between two device parameters. They also provide information on the operating range of the device. Plots were performed on the following parameters:

TWP versus TAS (address setup time)
TWP versus TAH (address hold time)
TWP versus TDS (data setup time)
TWP versus TDH (data hold time).

The following is a description of TWP versus TAS, but it is also a general outline of how the schmoo plot tests were performed. The TWP versus TAS test was performed with the address lines on RZ (return-to-zero) and RZI* (return-to-one) timing. Refer to Table 5 for test conditions. Timing conditions for the individual schmoo plots are lited in Table 6. Both TWP and TAS were set to a starting value below their operating range. TAS was incremented through a range of values until it reached a

TABLE 5. SCHMOO PLOT TEST CONDITIONS

Test Condition	VDD	VIH	VIL	Output Compare Levels	
				Logic "1" Threshold	Logic "0" Threshold
1	5V	4.9V	0V	4V	1V
2	10V	9.9V	0V	8V	1V
Pattern used = skip.					

*RZI = return to zero, invert (equivalent to return-to-one condition).

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TABLE 6. SCHMOO PLOT TIMING CONDITIONS

Test	Timing Conditions					
	TAS	TAH	TAS	TDH	TWP	Compare Strobe (Measured from Start of Cycle)
TWP versus TAS	Varied from -10 ns to 70 ns in 2 ns incr	250 ns	700 ns	300 ns	Varied from 20 ns to 160 ns in 10 ns incr	900 ns
TWP versus TAH	>520 ns	Varied from -30 ns to 10 ns in 2 ns incr	700 ns	300 ns	Varied from 30 ns to 180 ns in 10 ns incr	600 ns
TWP versus TDS	>520 ns	300 ns	Varied from -10 ns to 50 ns in 2 ns incr	250 ns	Varied from 30 ns to 120 ns in 10 ns incr	900 ns
TWP versus TDH	>520 ns	300 ns	700 ns	Varied from -30 ns to 30 ns in 2 ns incr	Varied from 30 ns to 120 ns in 10 ns incr	900 ns

NOTES: Cycle = 1 μs

$\overline{CS1}$ & $\overline{MRD}$ = logic "0".

CS2 = logic "1".

Pattern used = skip.

predetermined stop value. After each increment, a functional test was performed. If the functional test passed, an asterisk was printed on the plot indicating that for those values of TWP and TAS the memory functioned properly. When the stop value for TAS was reached, TWP was incremented and TAS was reset to its starting value. The process described above was repeated until TWP reached its predetermined stop value plus one increment. At this point the test was terminated.

3.4 DATA RETENTION TEST

The data retention test determined if the devices were able to retain data in the memory array at a reduced supply voltage. A checkerboard pattern was written into the memory at a supply voltage of 11.5V. All voltage and timing conditions were well within the operating range for the device. After the write operation, CS2 was switched to a logic zero level, disabling the device. Then the rest of the inputs were also switched to a logic zero level. The supply voltage was reduced to 1.8V. After approximately 2 seconds, the supply voltage was returned to 11.5V, all input voltage conditions were reestablished, and the contents of the memory array were read to verify data integrity.

3.5 RISE- AND FALL-TIME TEST

All samples were screened for susceptibility to functional failures, resulting from slow rise and fall times on the address lines. A galpat pattern was used for this test. Refer to Table 7 for sets of test conditions.

3.6 DC PARAMETRIC TESTS

The following tests were performed in accordance with the test conditions specified in Table 8:

IIL (input low current)
IIH (input high current)
IDN1 and IDN2 (output sink current)
IDP1 and IDP2 (output source current)
VOL1 and VOL2 (output voltage low)
VOH1 and VOH2 (output voltage high)
IC1 to IC4 (quiescent device current)
IOZ1 to IOZ8 (output leakage current)
ILPD (power down device current)

TABLE 7. RISE- AND FALL-TIME TEST CONDITIONS

Test	Condition No. 1	Condition No. 2
VDD	10V	5V
VIH	9.5V	4.5V
VIL	0V	0V
Logic "1" threshold level	9V	4V
Logic "0" threshold level	1V	1V
Cycle time	10 μs	10 μs
TWP	200 ns	200 ns
TDH TAH	50 ns	50 ns
TAS TDS	>1 μs	>1 μs
TR/TF address lines	5 μs	5 μs

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TABLE 8. DC - PARAMETRIC TEST CONDITIONS

Symbol	Note	Terminal Condition (Pins Not Designated are Open)									Meas Term	UNITS
		A(X) X = 0 to 7	DI(Y) Y = 0 to 3	DO(Y) Y = 0 to 3	VSS	CS2	$\overline{MRD}$	$\overline{CS1}$	$\overline{MWR}$	VDD		
		(1) to (7), (21)	(9), (11), (13), (15)	(10), (12), (14), (16)	(8)	(17)	(18)	(19)	(20)	(22)		
VIC1		A(X) = 1 mA			GND					GND	A(X)	V
VIC1			DI(Y) = 1 mA		GND					GND	DI(Y)	V
VIC1					GND	1 mA				GND	17	V
VIC1					GND		1 mA			GND	18	V
VIC1					GND			1 mA		GND	19	V
VIC1					GND				1 mA	GND	20	V
VIC2		A(X) = -1 mA			GND					GND	A(X)	V
VIC2			DI(Y) = -1 mA		GND					GND	DI(Y)	V
VIC2					GND	-1 mA				GND	17	V
VIC2					GND		-1 mA			GND	18	V
VIC2					GND			-1 mA		GND	19	V
VIC2					GND				-1 mA	GND	20	V
IIL		A(X) = 0V	DI(Y) = 10V		GND	10V	10V	10V	10V	11.5V	A(X)	nA
IIL		A(X) = 10V	DI(Y) = 0V		GND	10V	10V	10V	10V	11.5V	DI(Y)	nA
IIL		A(X) = 10V	DI(Y) = 10V		GND	GND	10V	10V	10V	11.5V	17	nA
IIL		A(X) = 10V	DI(Y) = 10V		GND	10V	GND	10V	10V	11.5V	18	nA
IIL		A(X) = 10V	DI(Y) = 10V		GND	10V	10V	GND	10V	11.5V	19	nA
IIL		A(X) = 10V	DI(Y) = 10V		GND	10V	10V	10V	GND	11.5V	20	nA
IIH		A(X) = 11.5V	DI(Y) = 0V		GND	GND	GND	GND	GND	11.5V	A(X)	nA
IIH		A(X) = 0V	DI(Y) = 11.5V		GND	GND	GND	GND	GND	11.5V	DI(Y)	nA
IIH		A(X) = 0V	DI(Y) = 0V		GND	11.5V	GND	GND	GND	11.5V	17	nA
IIH		A(X) = 0V	DI(Y) = 0V		GND	GND	11.5V	GND	GND	11.5V	18	nA
IIH		A(X) = 0V	DI(Y) = 0V		GND	GND	GND	11.5V	GND	11.5V	19	nA
IIH		A(X) = 0V	DI(Y) = 0V		GND	GND	GND	GND	11.5V	11.5V	20	nA
IDN1	(a)	A(X) = 0V	DI(Y) = 0V	DO(Y) = 0.4V	GND	5V	GND	GND	5V	5V	DO(Y)	mA
IDN2	(a)	A(X) = 0V	DI(Y) = 0V	DO(Y) = 0.5V	GND	10V	GND	GND	10V	10V	DO(Y)	mA
IDP1	(b)	A(X) = 0V	DI(V) = 5V	DO(Y) = 4.6V	GND	5V	GND	GND	5V	5V	DO(Y)	mA
IDP2	(b)	A(X) = 0V	DI(Y) = 10V	DO(Y) = 9.5V	GND	10V	GND	GND	10V	10V	DO(Y)	mA

(Concluded next page)

(Table 8, concluded)

Symbol	Note	Terminal Condition (Pins Not Designated are Open)									Meas Term	UNITS
		A(X) X = 0 to 7	DI(Y) Y = 0 to 3	DO(Y) Y = 0 to 3	VSS	CS2	$\overline{MRD}$	$\overline{CS1}$	$\overline{MWR}$	VDD		
		(1) to (7), (21)	(9), (11), (13), (15)	(10), (12), (14), (16)	(8)	(17)	(18)	(19)	(20)	(22)		
VOL1	(a)	A(X) = 5V	DI(Y) = 0.8V	DO(Y) = 2.0 mA	GND	4.5V	GND	GND	5V	5V	DO(Y)	mV
VOL2	(a)	A(X) = 10V	DI(Y) = 0.8V	DO(Y) = 4.0 mA	GND	9.5V	GND	GND	10V	10V	DO(Y)	mV
VOH1	(b)	A(X) = 0V	DI(Y) = 4.5V	DO(Y) = 1.0 mA	GND	4.5V	GND	GND	5V	5V	DO(Y)	V
VOH2	(b)	A(X) = 0V	DI(Y) = 9.5V		GND	9.5V	GND	GND	10V	10V	DO(Y)	V
IL1	(a)	A(X) = 0V	DI(Y) = 0V		GND	10V	GND	GND	10V	11.5V	8	μA
IL2	(a)	A(X) = 10V	DI(Y) = 10V		GND	10V	GND	GND	10V	11.5V	8	μA
IL3	(b)	A(X) = 0V	DI(Y) = 0V		GND	10V	GND	GND	10V	11.5V	8	μA
IL4	(b)	A(X) = 10V	DI(Y) = 10V		GND	10V	GND	GND	10V	11.5V	8	μA
IOZ1	(b)	A(X) = 0V	DI(Y) = 0V	DO(Y) = 11.5V	GND	3.5V	GND	GND	11.5V	11.5V	DO(Y)	μA
IOZ2	(b)	A(X) = 0V	DI(Y) = 0V	DO(Y) = 11.5V	GND	11.5V	8V	GND	11.5V	11.5V	DO(Y)	μA
IOZ3	(b)	A(X) = 0V	DI(Y) = 0V	DO(Y) = 11.5V	GND	11.5V	0V	8V	11.5V	11.5V	DO(Y)	μA
IOZ4	(b)	A(X) = 0V	DI(Y) = 0V	DO(Y) = 11.5V	GND	11.5V	0V	0V	3.5V	11.5V	DO(Y)	μA
IOZ5	(b)	A(X) = 11.5V	DI(Y) = 0V	DO(Y) = 11.5V	GND	3.5V	0V	0V	11.5V	11.5V	DO(Y)	μA
IOZ6	(b)	A(X) = 11.5V	DI(Y) = 0V	DO(Y) = 11.5V	GND	11.5V	8V	0V	11.5V	11.5V	DO(Y)	μA
IOZ7	(b)	A(X) = 11.5V	DI(Y) = 0V	DO(Y) = 11.5V	GND	11.5V	0V	8V	11.5V	11.5V	DO(Y)	μA
IOZ8	(b)	A(X) = 11.5V	DI(Y) = 0V	DO(Y) = 11.5V	GND	11.5V	0V	0V	3.5V	11.5V	DO(Y)	μA
ILPD	(c)										22	μA

(a) Write all zeros in memory.

(b) Write all ones in memory.

(c) Power-down test. Write checkerboard with VDD = 11.5V. Lower VDD to 1.8V. All inputs ≤ VDD. Measure ILPD. Return VDD to 11.5V and read memory (verify contents).

4.0 DATA SUMMARY

The test results are divided into two main groups. The first group includes the functional tests, AC and DC parametric data, and data retention test results. Histograms and statistical data were generated from the AC and DC parametric data (refer to Appendix A). The raw data, which includes results from the first group, is located in Appendix B. The second group includes the schmoo plots, which are located in Appendix C.

4.1 SUMMARY, RAW DATA

Out of 35 samples tested, 5 failed 1 or more of the functional tests (refer to Table 9). Of the five samples that failed functional tests, four also failed to function within the expected operating range for a number of AC parametric tests (refer to Table 10). The expected operating range for the individual AC parameters is listed in Table 11. Some of the data that indicated possible device problems was found on retest to be invalid. The retest data for these devices is summarized in Table 12.

4.2 SUMMARY, SCHMOO PLOTS

Some of the plots indicate interactions between device parameters (consult the data in Appendix C). Lack of interaction between parameters is indicated by a perfectly rectangular plot. The TAS versus TWP plots show no sign of interaction. These plots indicate that for write pulse widths below a certain value, the time interval from the address transition to the write enable high-to-low transition becomes the controlling factor.

TABLE 9. FUNCTIONAL FAILURES

Device Serial Number	Functional Test Number(a)	Test Temperature				
		25°C	20°C	-55°C	85°C	125°C
3	1					
	2					
	3			*		
	4					
18	1					*
	2					*
	3	*	*	*	*	*
	4		*	*	*	*
19	1					
	2					
	3	*	*	*		
	4					
25	1					
	2					
	3					
	4	*	*	*	*	*
32	1					
	2					
	3					
	4	*	*	*	*	*

(a): No. 1 = wide limit functional test (VCC = 10V).
No. 2 = tight limit functional test (VCC = 10V).
No. 3 = tight limit functional test (VCC = 5V).
No. 4 = Data retention test.

* = Failed functional test

TABLE 10. AC – PARAMETRIC TEST SUMMARIES

SN	Temp (°C)	VCC (Volts)	Parameter	Data (ns)	Comments
3	-55	4.5	TDOA1 TDOA2	>450 >450	Exceeded range
			TPDH	≤0	Failed because of slow address-access time
18	25	5.0	TCSS1	>550	
	-20	4.5	TDOA1 TDOA2 TPDH	>450 >450 <0	
	-55	4.5	TAA TAS2 TAH TCSH1 and 2 TDOA1 and 2 TDOH1, 2, and 3 TPDH	>600 >300 >200 >250 >450 <0 <0	
	85	10.0	TPDH	<0	
	125	10.0	All except TAS2	*	
19	-55	4.5	TDOA1 TDOA2	>450 >450	Exceeded range
32	25 -20 -55 85 125	4.5 5.0	TCSS1 and 2 TCSH1 and 2 TDOA1 and 2	≤0	
			TDOH1 and 2	>300	

*Values exceed range. Refer to Table 11 for end-of-range values.

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TABLE 11. AC – PARAMETRIC TEST RANGE

Test	Start of Range (ns)	End of Range (ns)	Increment (ns)
TAA	50	600	5
TDS	-40	250	2
TDH	-20	200	2
TAS1	-40	300	2
TAS2	-40	300	2
TAH	-60	200	2
TWP	20	300	2
TCSS1	0	550	2
TCSS2	0	550	2
TDOA1	0	450	2
TDOA2	0	450	2
TDOA3	0	450	2
TDOH1	300	0	-2
TDOH2	300	0	-2
TDOH3	300	0	-2
TPDH	200	0	-2
TRC	80	450	8
TWC	*	450	8
TCSH1	0	250	2
TCSH2	0	250	2

* = 80 ns or (TWP + TDH + 20 ns).

TABLE 12. RETEST DATA SUMMARY

SN	Temp (°C)	Parameter	Pin	Data		Comments
				Original	Retest	
12	25	V1C1	CS2	4.96V	2.94V	
		V1C2	CS2	-4.95V	-2.93V	
	25 -20 -55	TCSH2	N/A	0 ns	*	at VDD = 4.5V, 5.0V, and 10.0V
15	25	V1C1	CS2	4.96V	2.79V	
		V1C2	CS2	-4.96V	-2.81V	
	85	TDOH1	N/A	0 ns	54 ns	at VDD = 10.0V
16	25 -20 -55 85	V1C1	CS2	≈4.96V	≈2.8V	
		V1C2	CS2	≈4.96V	≈-2.8V	
	25 -20 -55	TCSH2	N/A	0 ns	*	at VDD = 4.5V, 5.0V, and 10.0V
30	25	V1C1	CS2	5.01V	3.03V	
		V1C2	CS2	-4.98V	-3.03V	

* = Data consistent with data for other samples.

5.0 PATTERN DESCRIPTIONS

5.1 GALPAT (Figure 5)

Write a background of zeros into all memory addresses. Write all ones into the first reference word. Read the first background word. Read the reference word. Read the next background word. Read the reference word. Read the next background word, continuing this sequence until all background words have been checked. Write the reference word to zero and write a one into the next reference word. Repeat the process until all words have been used as reference word. Repeat the entire sequence using a background of ones and a test word (for the reference word) of all zeros.

5.2 CHECKERBOARD (Figure 6)

Write alternate (1010) and (0101) into all memory locations while incrementing the address count from memory location zero to memory location 255. Read alternate (1010) and (0101) in all memory locations. Write alternate (0101) and (1010) into all memory locations. Read alternate (0101) and (1010) in all memory locations.

5.3 DIAGONAL WRITE (Figure 7)

For the purposes of this explanation, address lines A0 through A3 are designated as row address lines, and address lines A4 through A7 are designated as column address lines.

Write zeros into all memory locations. Write ones into all memory locations where the row and column address are equal.

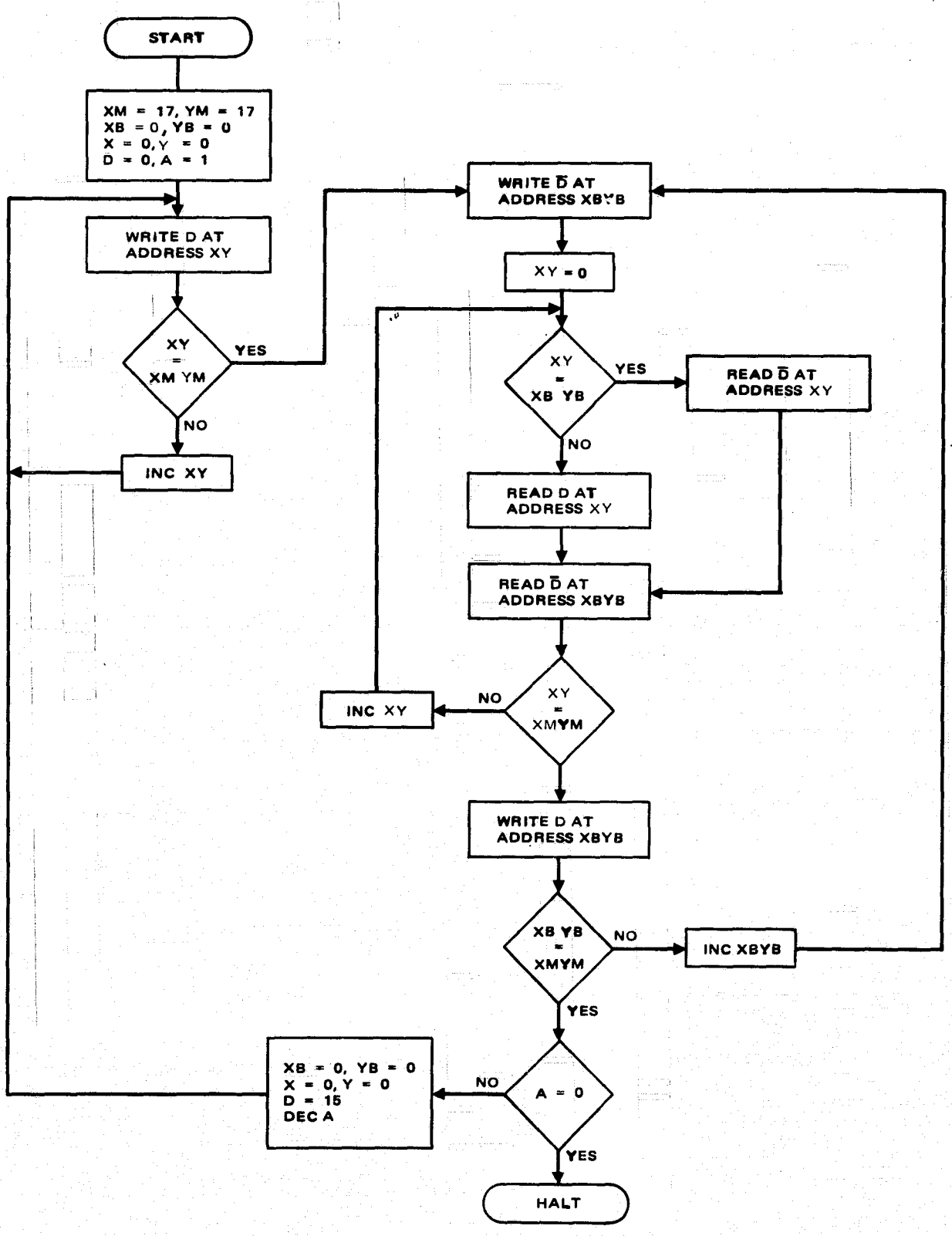


Figure 5. Galpat flow chart

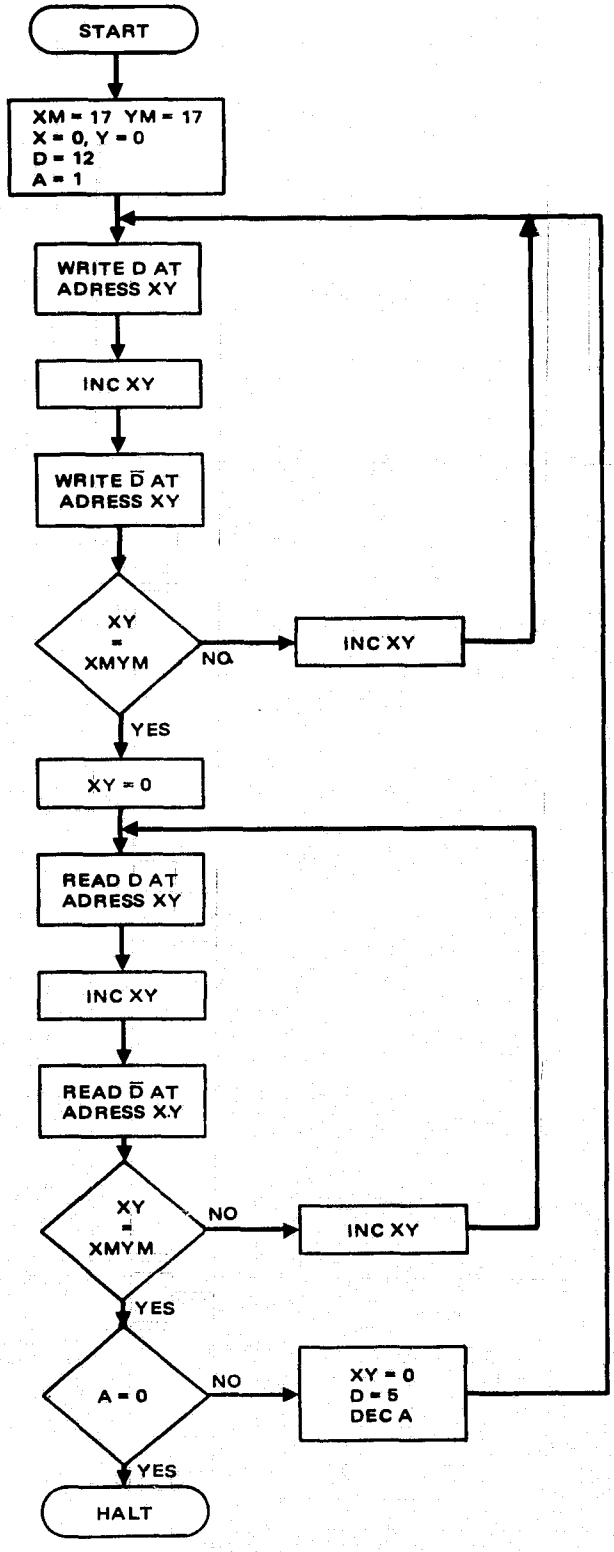


Figure 6. Checkerboard flow chart

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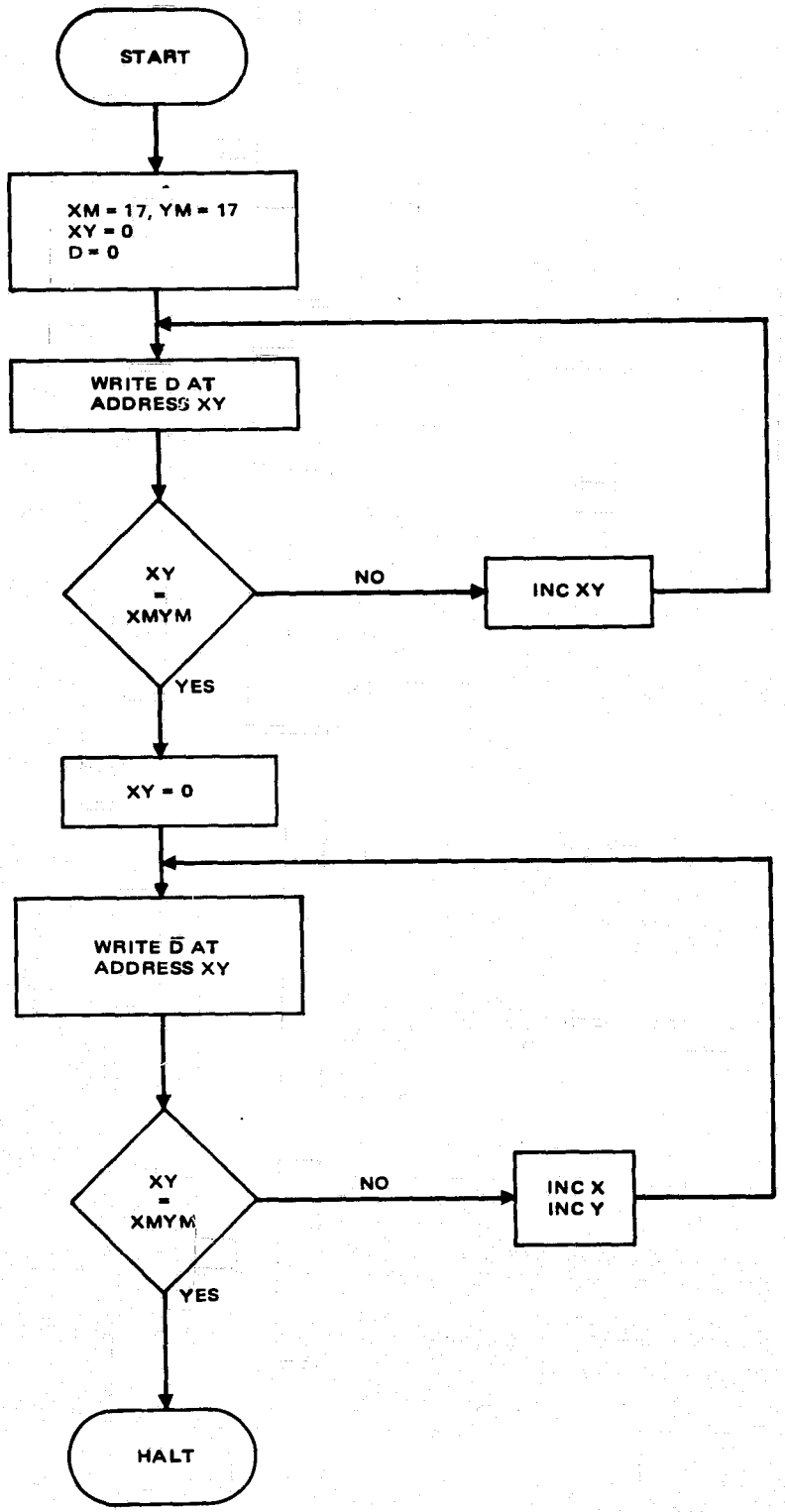


Figure 7. Diagonal write flow chart

5.4 DIAGONAL ROW/COLUMN PING-PONG READ (Figure 8)

Read the first word in the diagonal, which becomes the reference word for the row/column read. Read all the words in the same row as the reference word as follows: Read the reference word. Read the first background word in the row. Read the reference word. Read the next background word in the row. Continue this procedure until all the words in the row have been read. Repeat the above procedure for all the words that share the same column as the reference word. Upon completion of reading the column, select the next word in the diagonal as the reference word and repeat the entire procedure. The above procedure is repeated until every word in the diagonal has been selected for the reference word once.

5.5 MODIFIED CHECKERBOARD (Figure 9)

Write alternate (1010) and (0101) into all memory locations while incrementing the address count from memory locations zero to memory location 255. Increment through the memory a second time, reading the contents of the memory and rewriting the memory at each memory address. The data written into the memory on the second pass is the same as the data written on the first pass.

5.6 SKIP (ROW/COL GALPAT) (Figure 10)

Write a background of zeros. Write all ones into the first reference word. Only background words which share the same row or the same column as the reference word are read. Read the first background word in the row. Read the reference word. Read the next background word in the row, and continue this sequence until all the background words in the row have been checked. Now repeat this process with all the words that share the same column as the reference word. Write the reference word back to zero and write a one into the next reference word. Repeat the process until all words have been used as the reference word. Repeat the entire sequence using a background of ones and a test word (for the reference word) of all zeros.

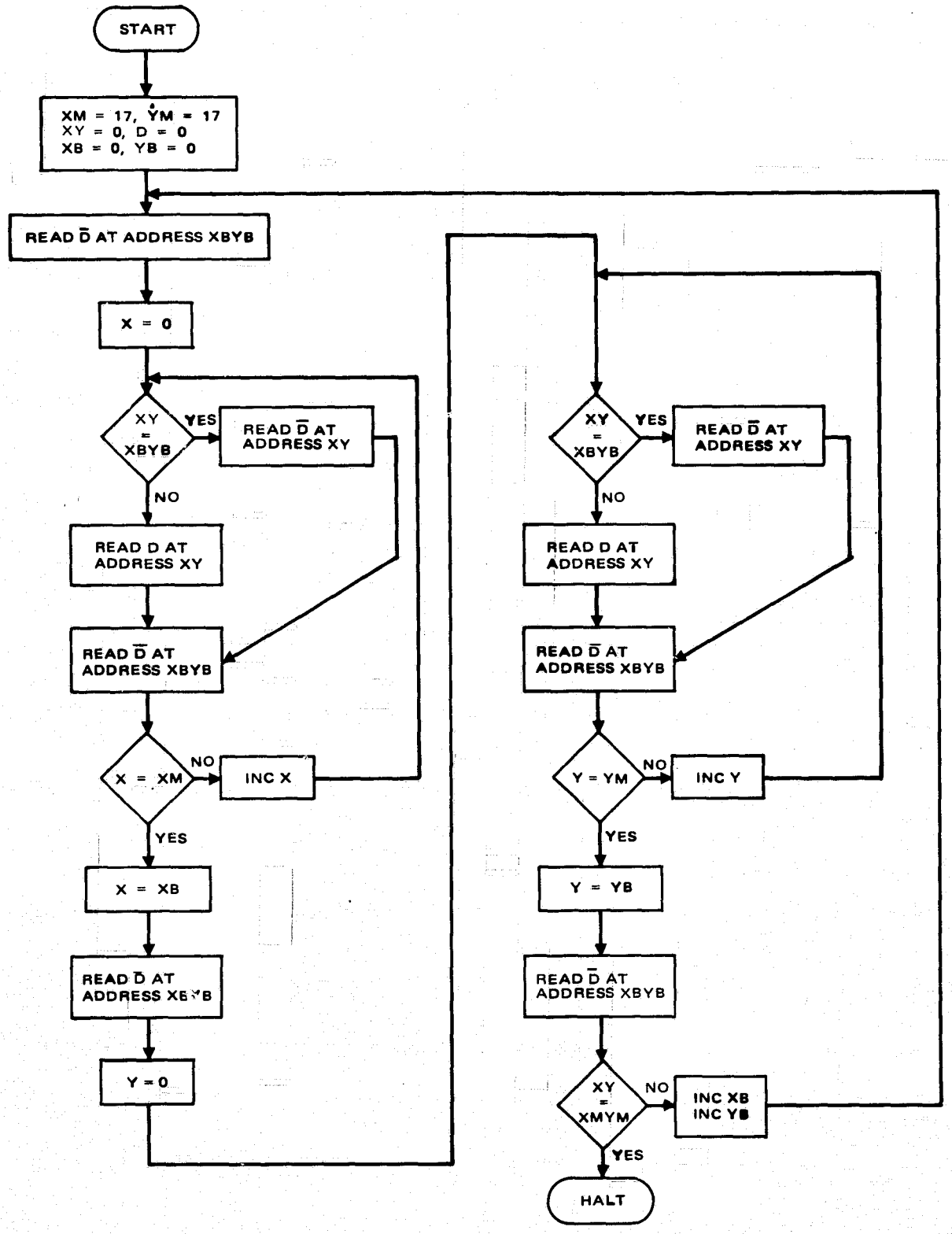
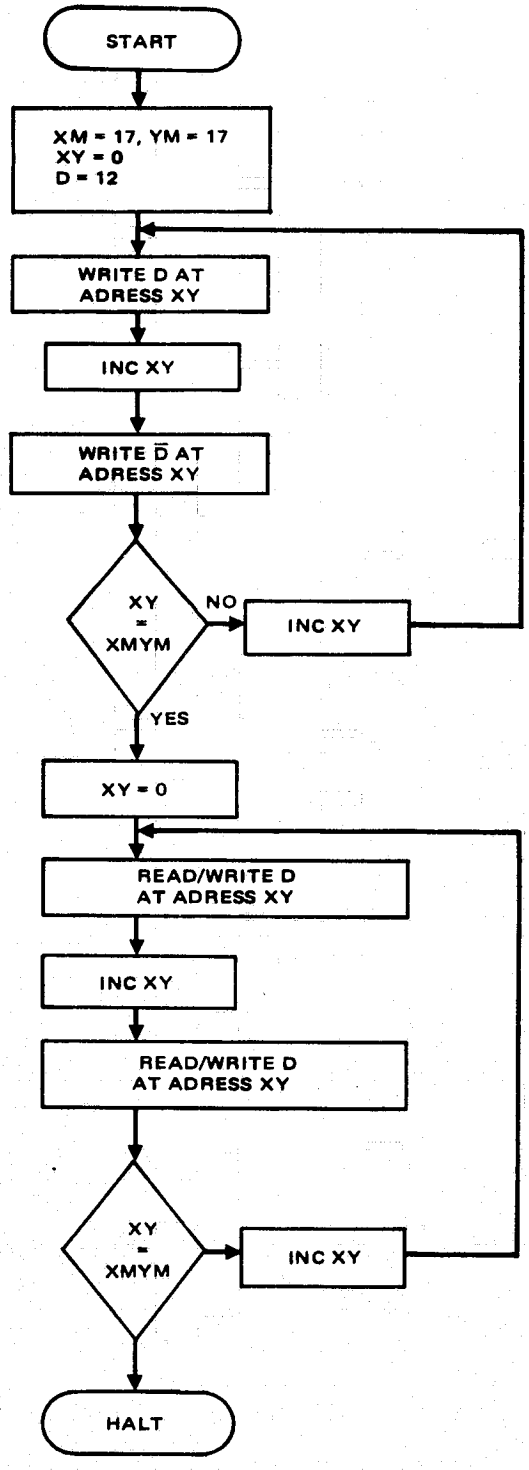


Figure 8. Diagonal row column ping pong read flow chart



NOTE: CHECKERBOARD MODIFIED FOR (TPDH) OUTPUT DISABLE TIME TEST.

Figure 9. Modified checkerboard flow chart

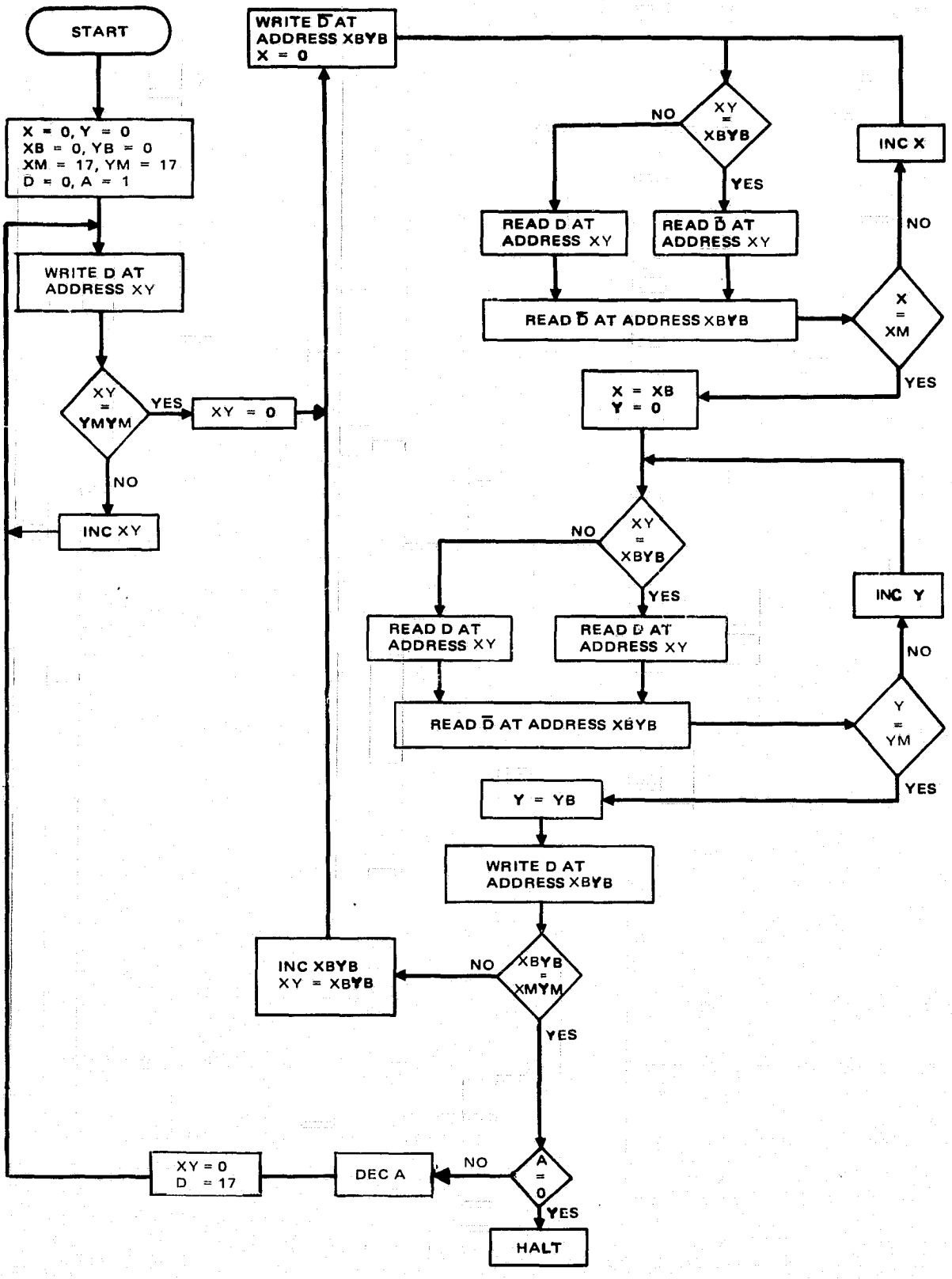
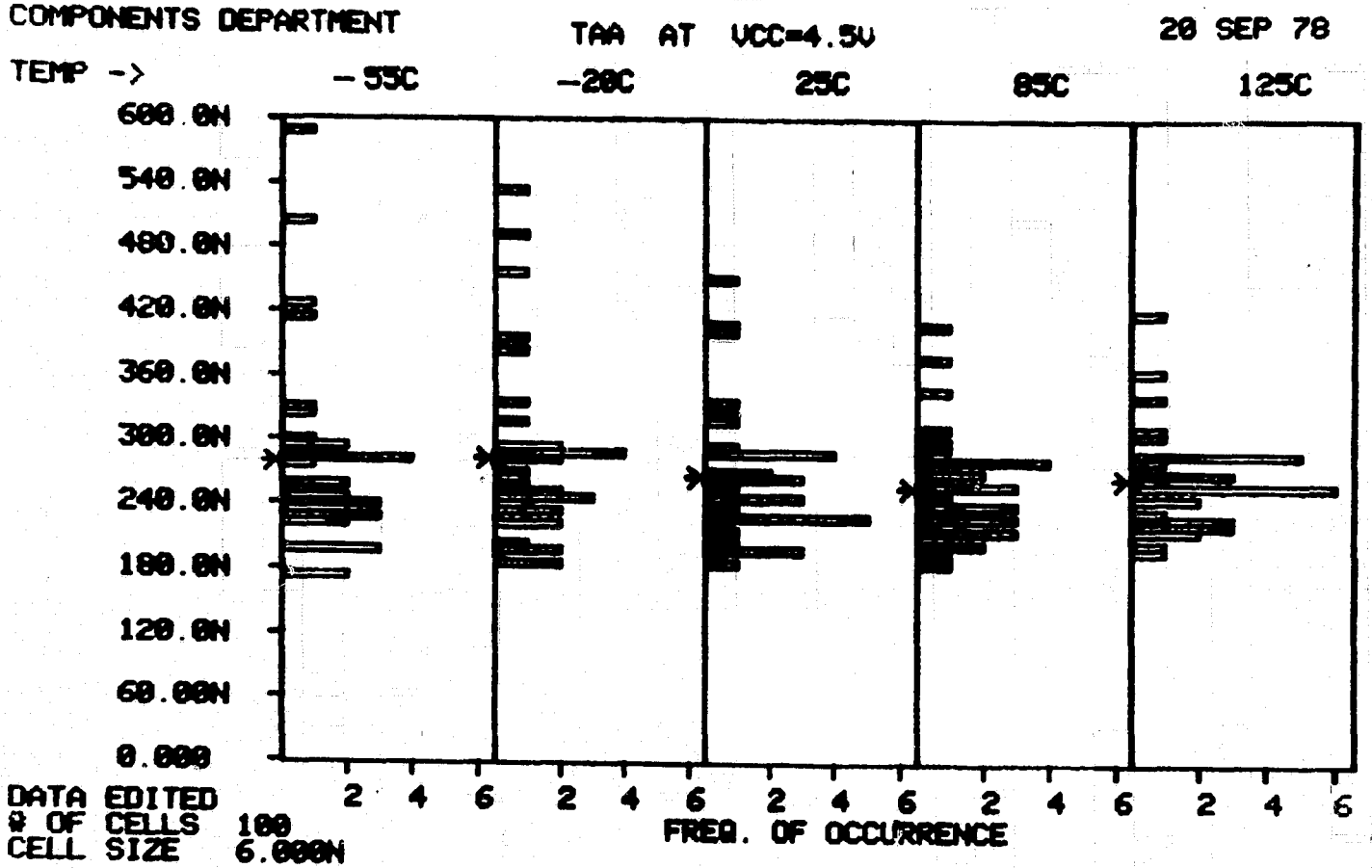


Figure 10. Skip (row/col galpat) flow chart

APPENDIX A

HISTOGRAMS

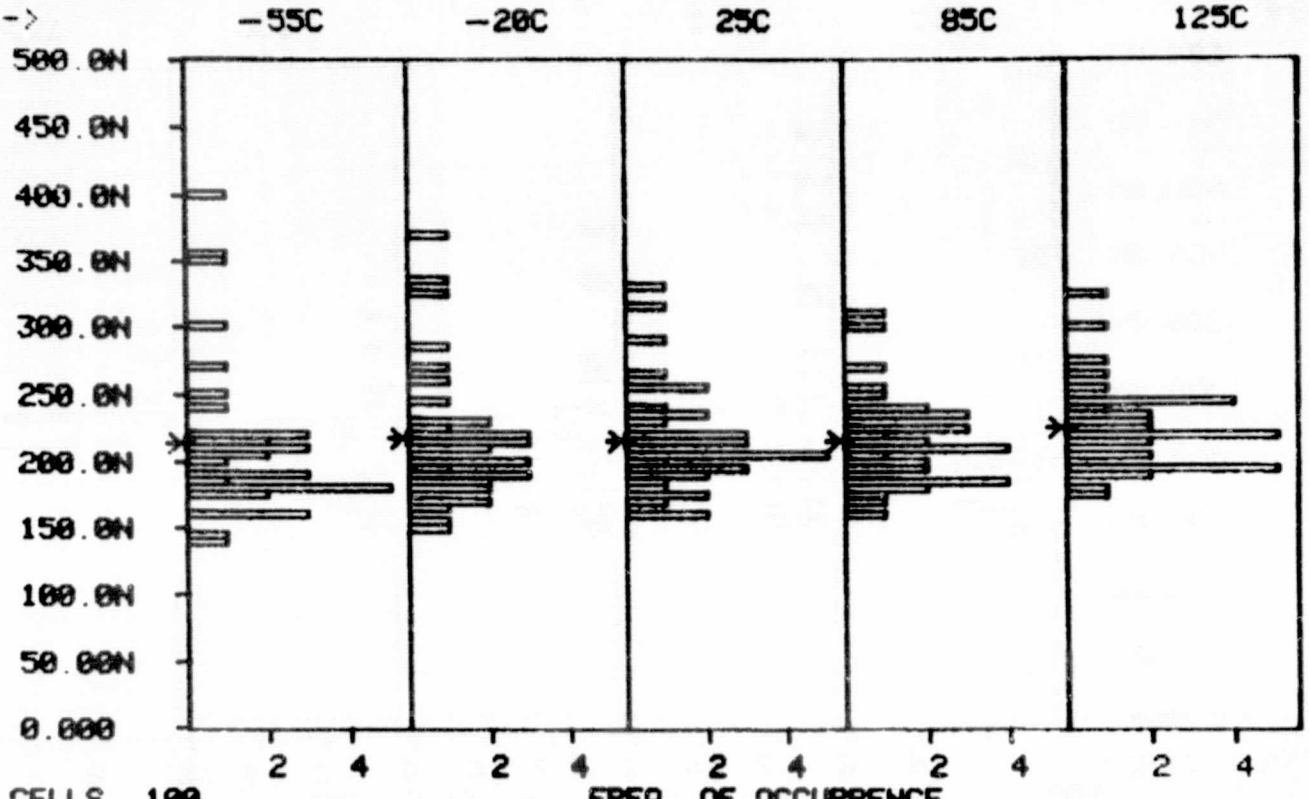


DATA EDITED
OF CELLS 100
CELL SIZE 6.000N

READINGS:	33	34	34	34	34
MAXIMUM:	585.0N	535.0N	450.0N	405.0N	420.0N
MEAN:	278.3N	282.2N	265.4N	256.0N	263.5N
MINIMUM:	175.0N	185.0N	185.0N	185.0N	195.0N
STD.DEV.:	89.60N	83.12N	61.60N	49.86N	46.67N

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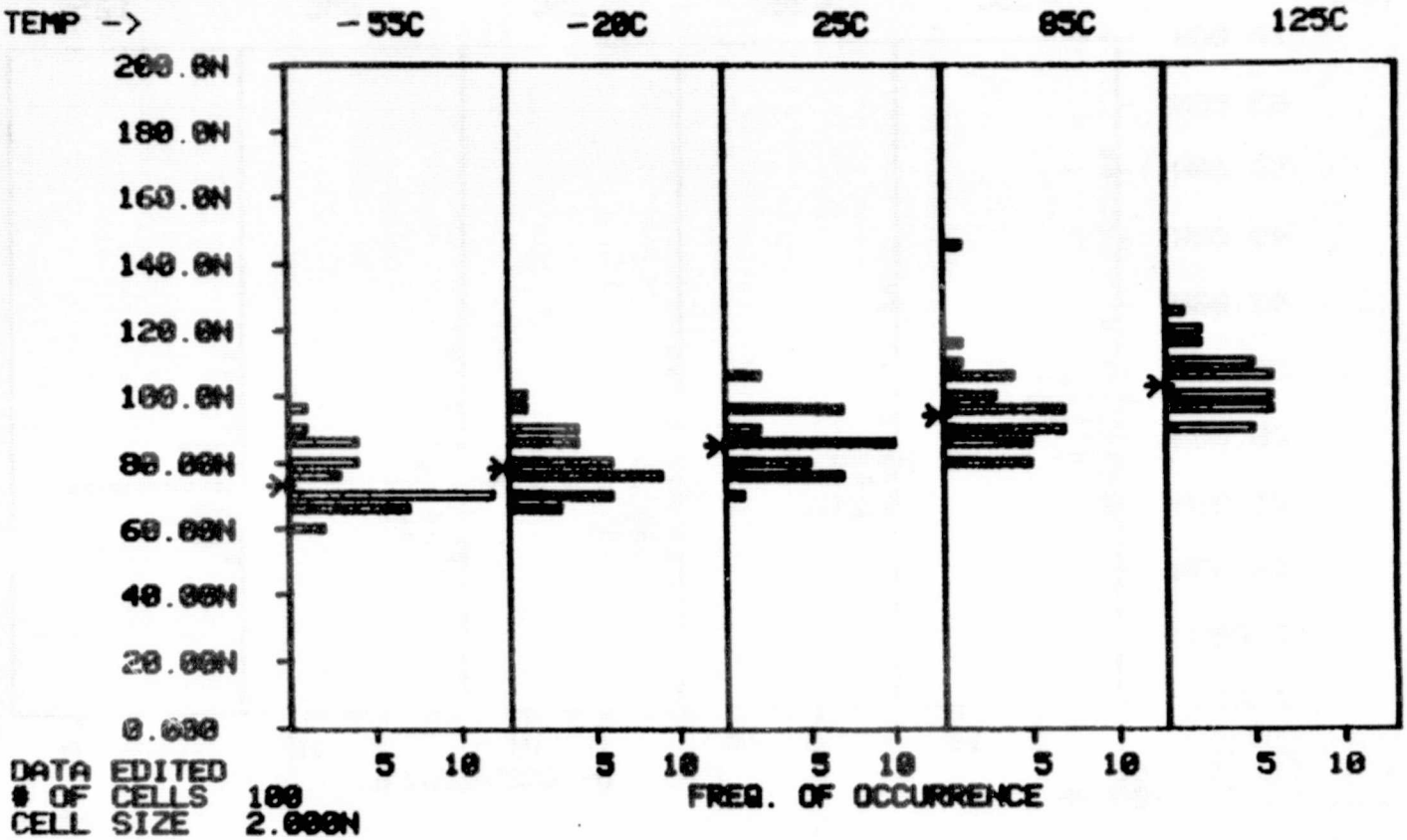
COMPONENTS DEPARTMENT TAA AT VCC=5.0V 20 SEP 78



OF CELLS 100
CELL SIZE 5.000N

READINGS:	34	34	34	34	34
MAXIMUM:	400.0N	370.0N	330.0N	310.0N	325.0N
MEAN:	213.7N	217.8N	216.2N	215.7N	225.6N
MINIMUM:	140.0N	150.0N	160.0N	160.0N	175.0N
STD.DEV.:	59.38N	50.26N	40.00N	34.38N	32.70N

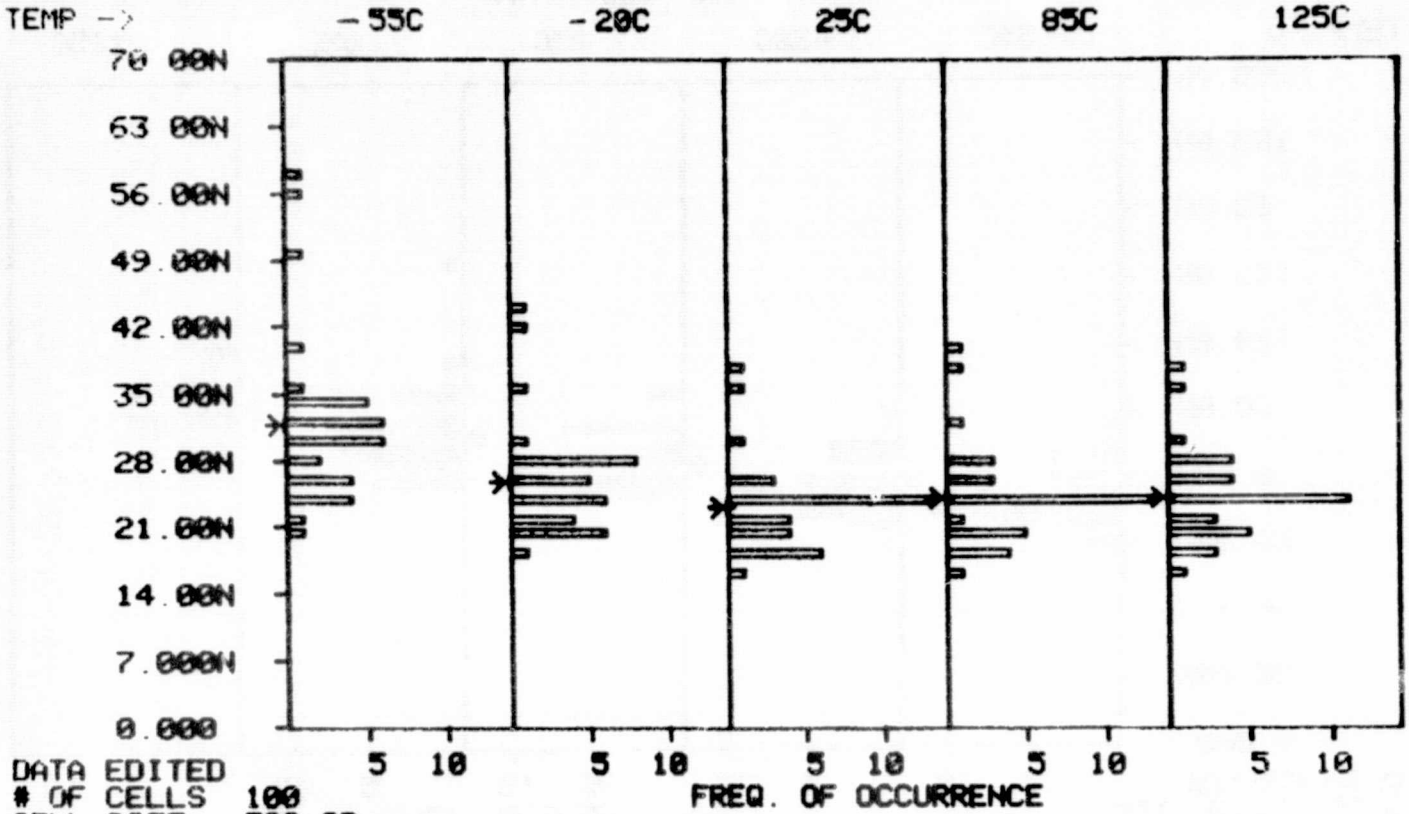
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OF CELLS 100
CELL SIZE 2.000N

READINGS:	34	34	34	34	33
MAXIMUM:	95.00N	100.0N	105.0N	145.0N	125.0N
MEAN:	73.09N	78.38N	85.29N	94.41N	102.9N
MINIMUM:	60.00N	65.00N	70.00N	80.00N	90.00N
STD.DEV.:	8.618N	8.766N	8.871N	12.78N	9.523N

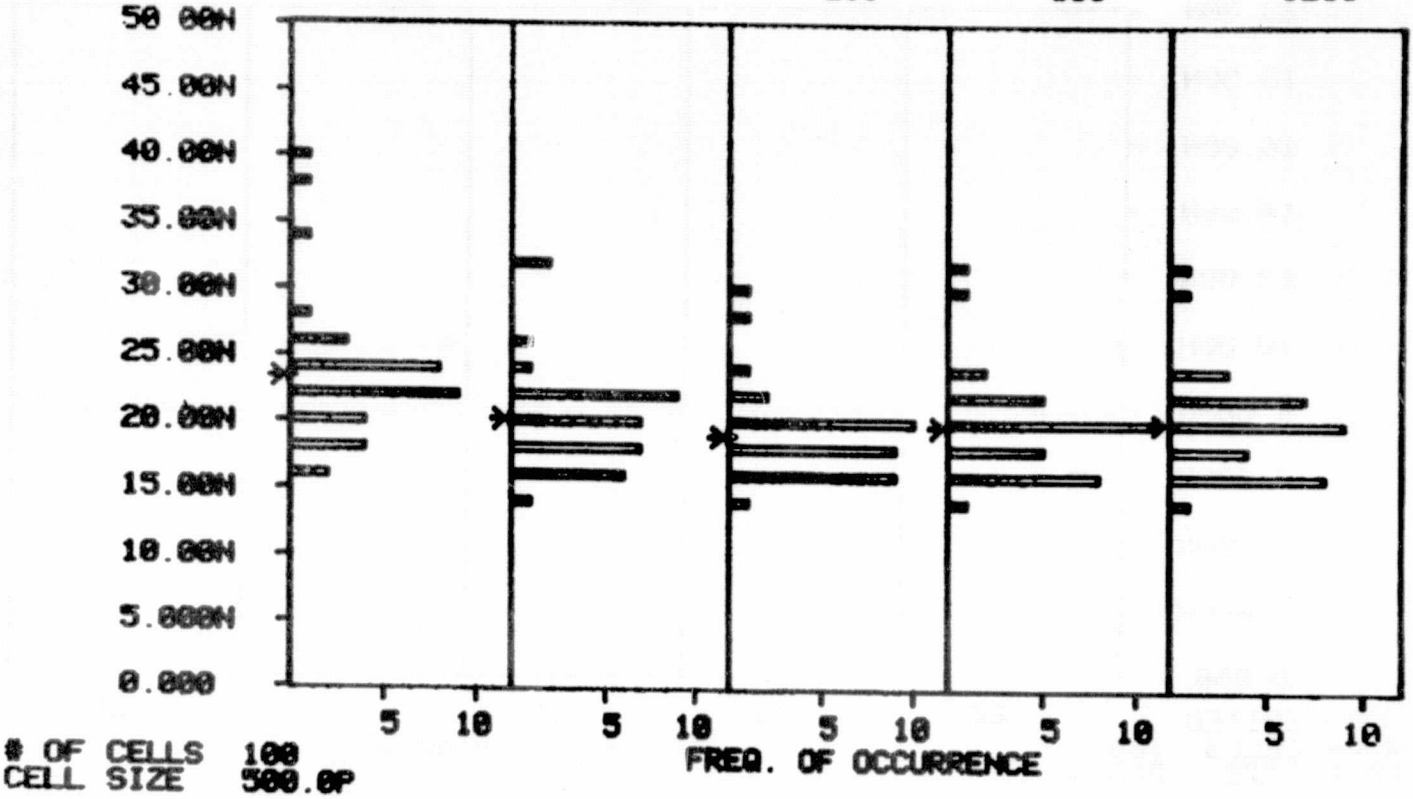
COMPONENTS DEPARTMENT TDS AT VCC=4.5V 20 SEP 78



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CELL SIZE 700.0P

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MEAN:	31.76N	25.76N	23.12N	24.06N	24.12N
MINIMUM:	20.00N	18.00N	16.00N	16.00N	16.00N
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COMPONENTS DEPARTMENT TDS AT VCC=5.0V 20 SEP 78

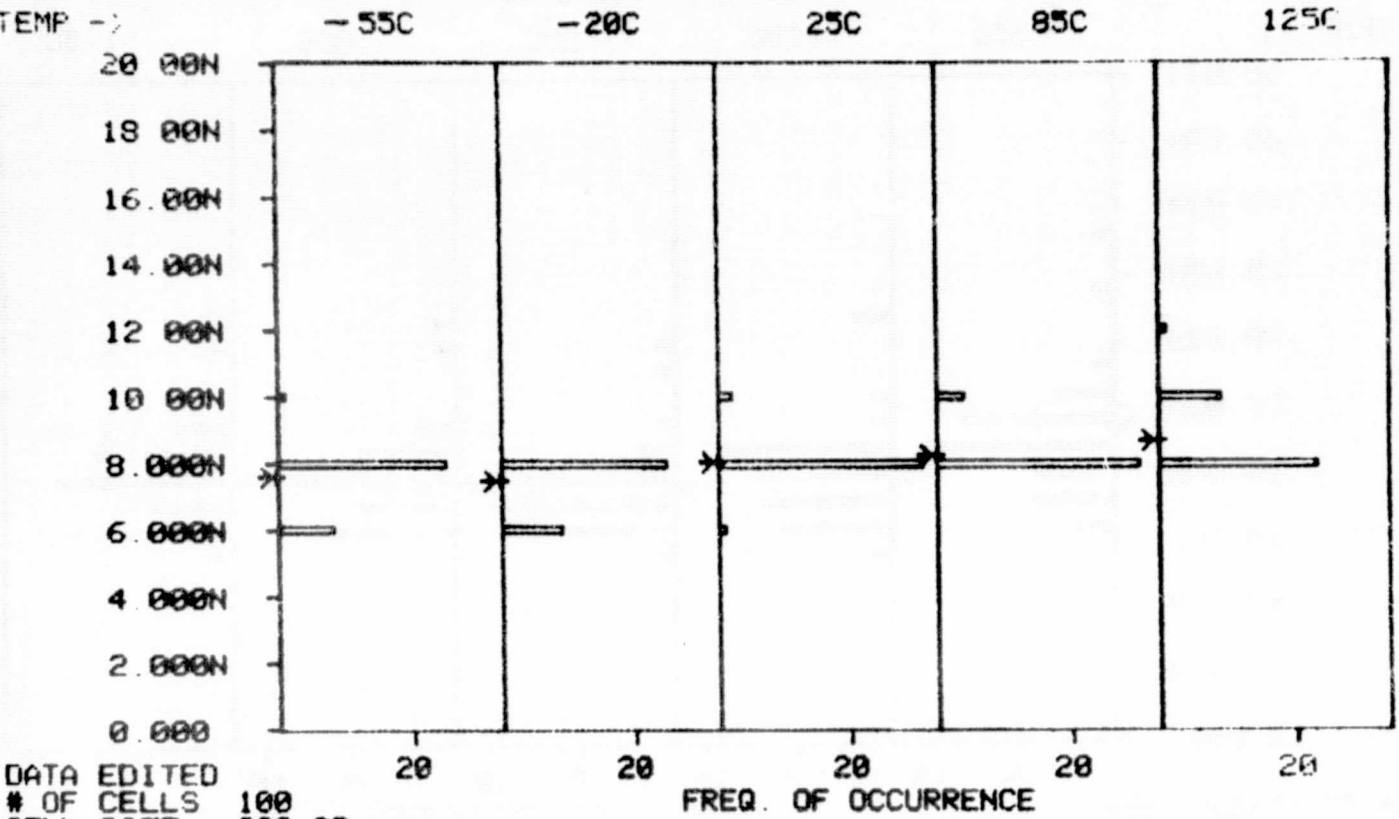


OF CELLS 100
CELL SIZE 500.0P

READINGS:	34	34	34	34	34
MAXIMUM:	40.00N	32.00N	30.00N	32.00N	32.00N
MEAN:	23.29N	20.24N	19.00N	19.76N	20.06N
MINIMUM:	16.00N	14.00N	14.00N	14.00N	14.00N
STD.DEV.:	5.323N	4.023N	3.349N	3.806N	3.892N

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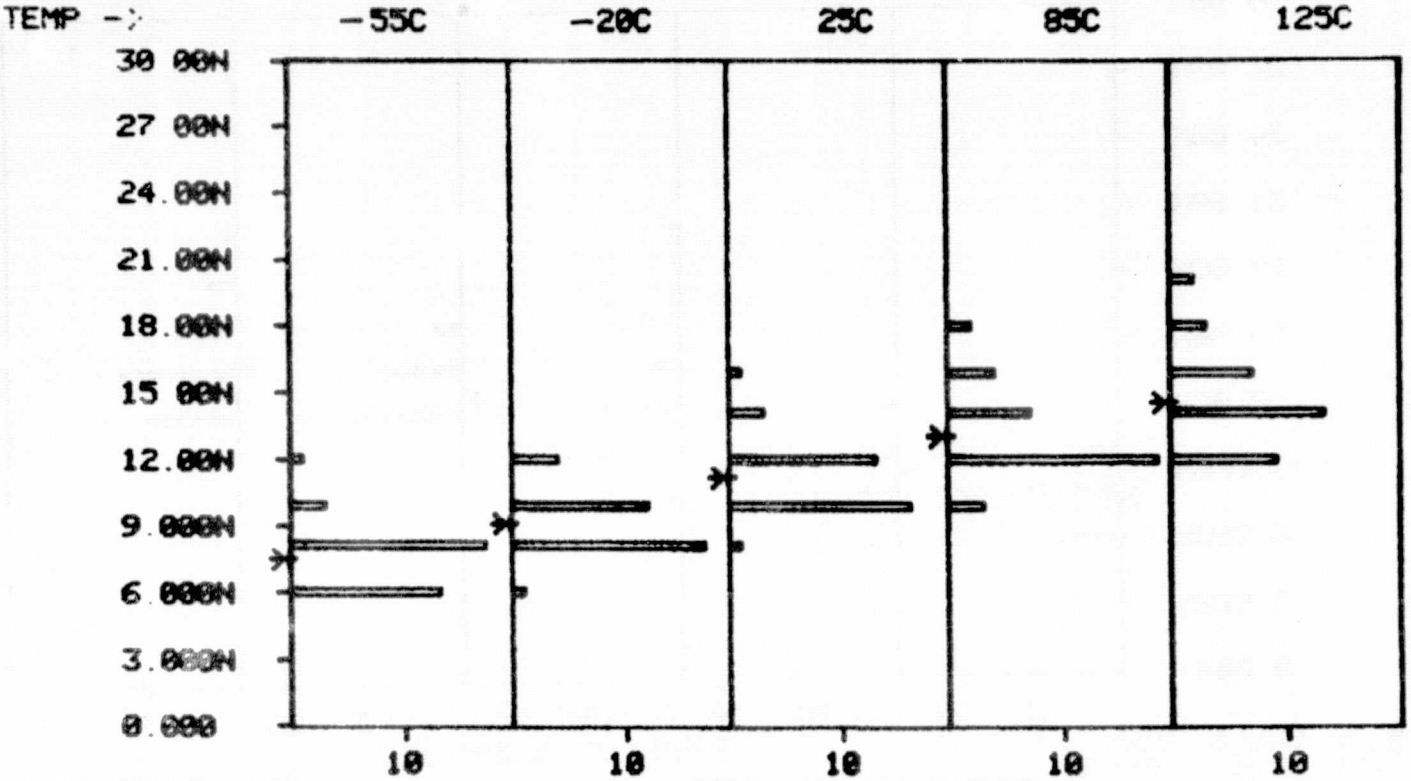
COMPONENTS DEPARTMENT TDS AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 200.0P

READINGS:	34	34	34	34	33
MAXIMUM:	10.00N	8.000N	10.00N	10.00N	12.00N
MEAN:	7.588N	7.471N	8.059N	8.235N	8.667N
MINIMUM:	6.000N	6.000N	6.000N	8.000N	8.000N
STD.DEV	957.3P	895.6P	600.2P	654.1P	1.080N

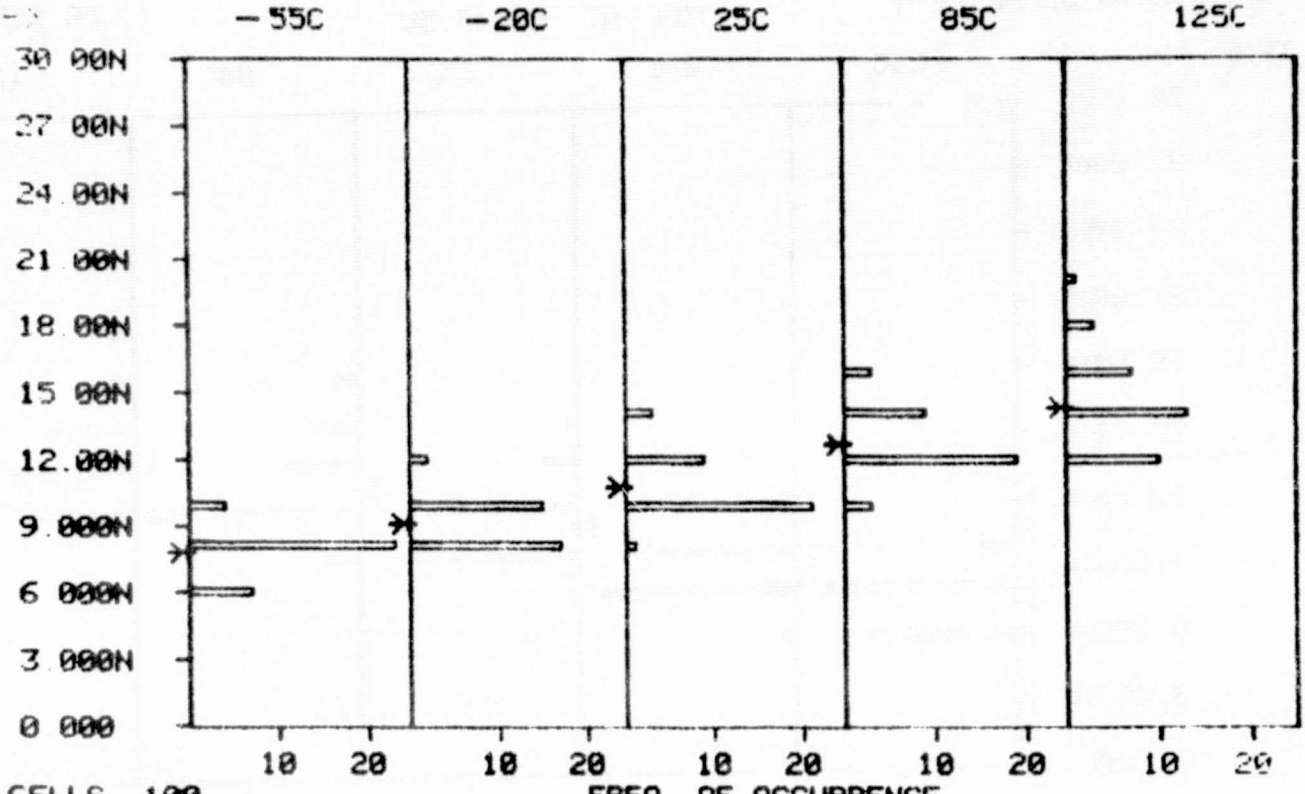
COMPONENTS DEPARTMENT TDH AT VCC=4.5V 20 SEP 78



OF CELLS 100
CELL SIZE 300.0P

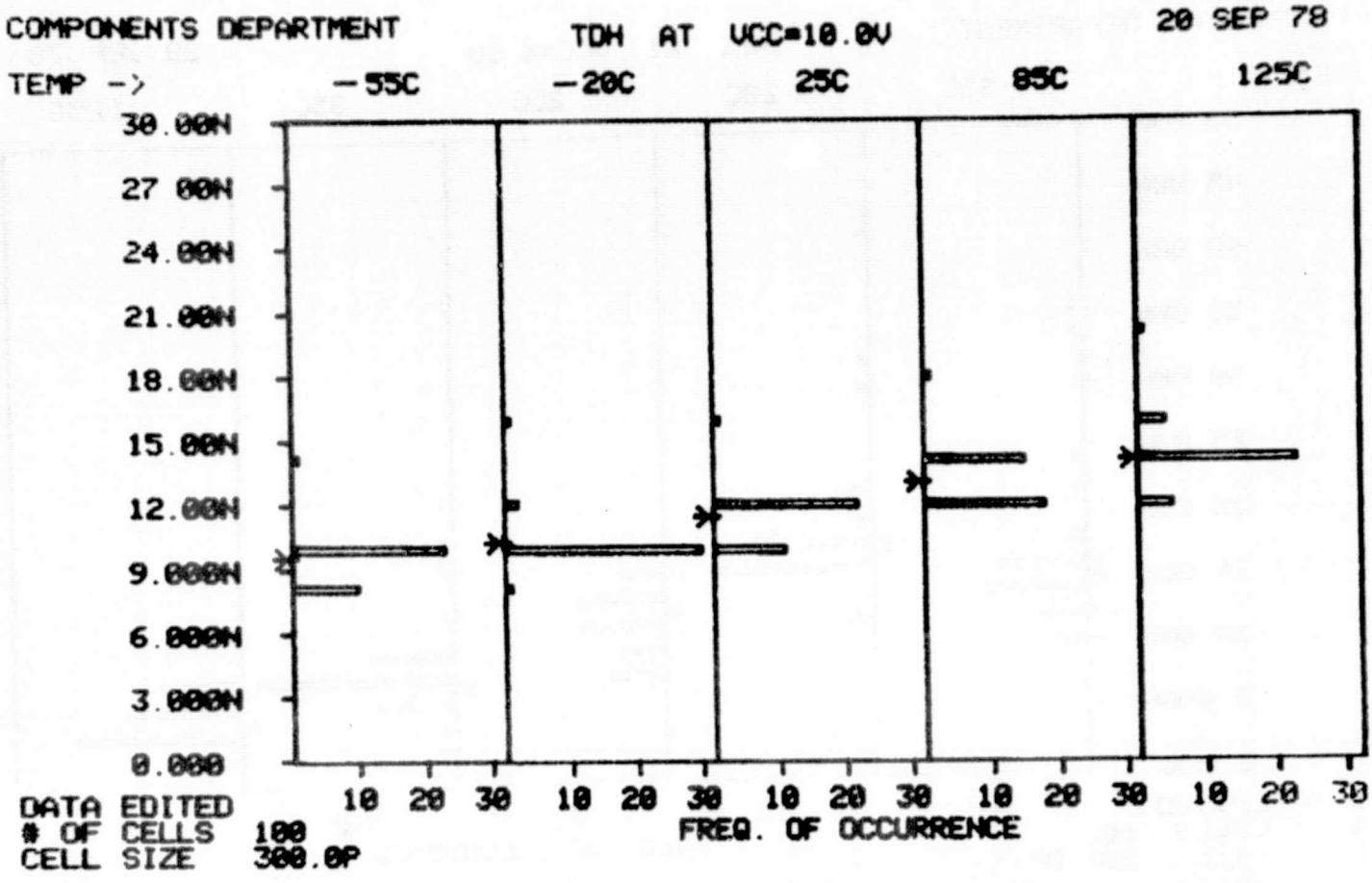
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MAXIMUM:	12.00N	12.00N	16.00N	18.00N	20.00N
MEAN:	7.529N	9.118N	11.24N	13.06N	14.59N
MINIMUM:	6.000N	6.000N	8.000N	10.00N	12.00N
STD DEV.:	1.482N	1.493N	1.634N	2.044N	2.285N

COMPONENTS DEPARTMENT TDH AT VCC=5.0V 20 SEP 78



OF CELLS 100
CELL SIZE 300.0P

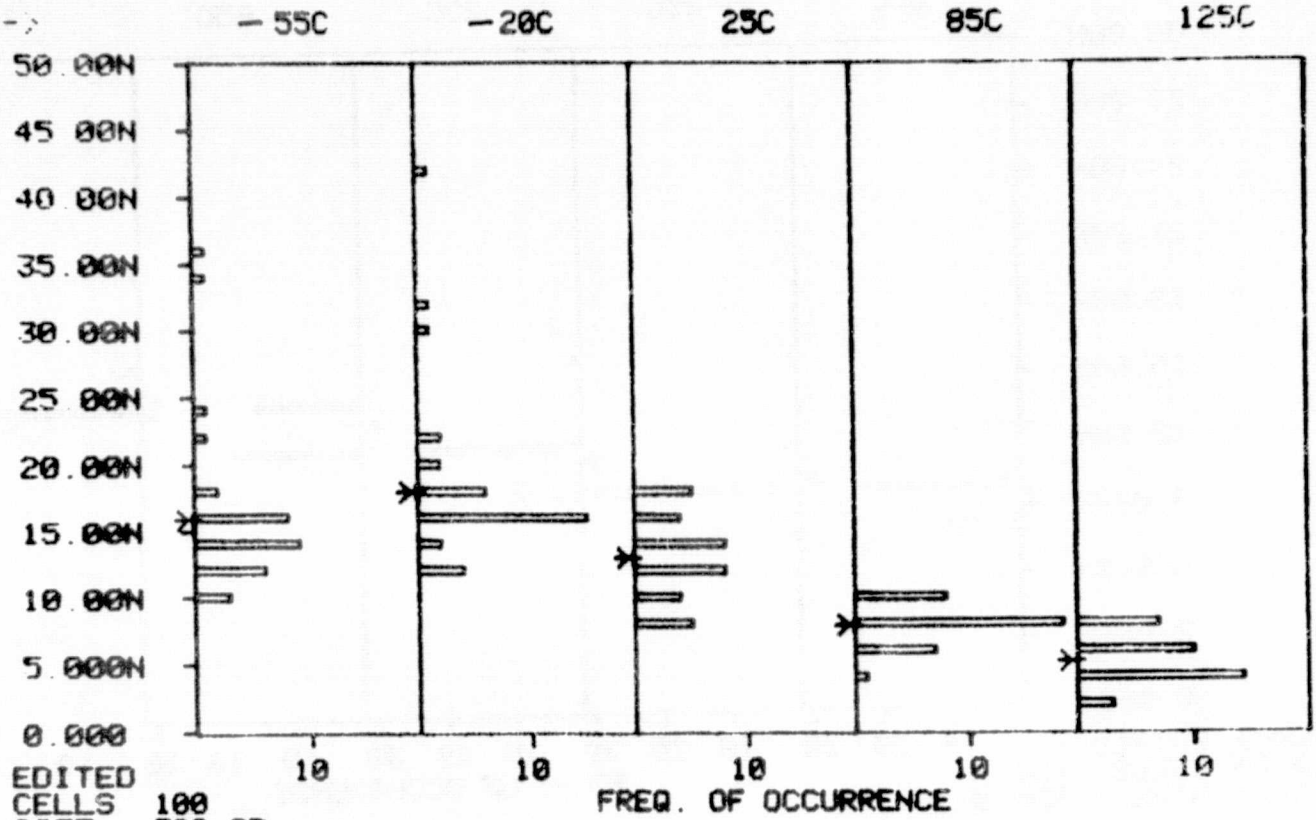
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MINIMUM:	6.000N	8.000N	8.000N	10.00N	12.00N
STD DEV.:	1.141N	1.225N	1.403N	1.548N	2.116N



READINGS:	34	34	34	34	33
MAXIMUM:	14.00N	16.00N	16.00N	18.00N	20.00N
MEAN:	9.529N	10.24N	11.47N	13.06N	14.12N
MINIMUM:	8.000N	8.000N	10.00N	12.00N	12.00N
STD.DEV.:	1.212N	1.182N	1.237N	1.324N	1.495N

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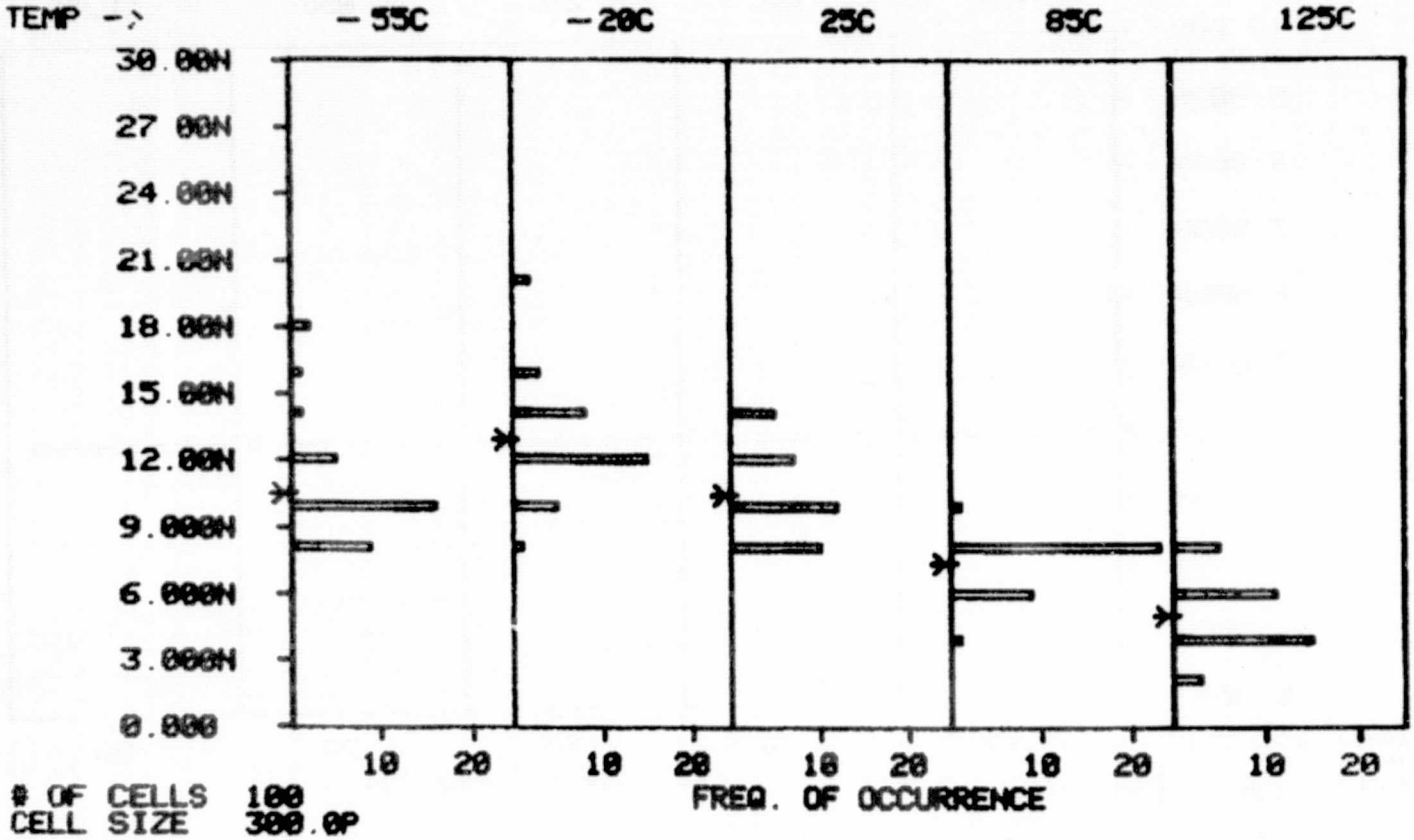
COMPONENTS DEPARTMENT TAS1 AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 500.0P

READINGS:	32	34	34	34	34
MAXIMUM:	36.00N	42.00N	18.00N	10.00N	8.000N
MEAN:	15.88N	18.00N	13.00N	7.941N	5.235N
MINIMUM:	10.00N	12.00N	8.000N	4.000N	2.000N
STD DEV:	5.879N	6.010N	3.200N	1.516N	1.843N

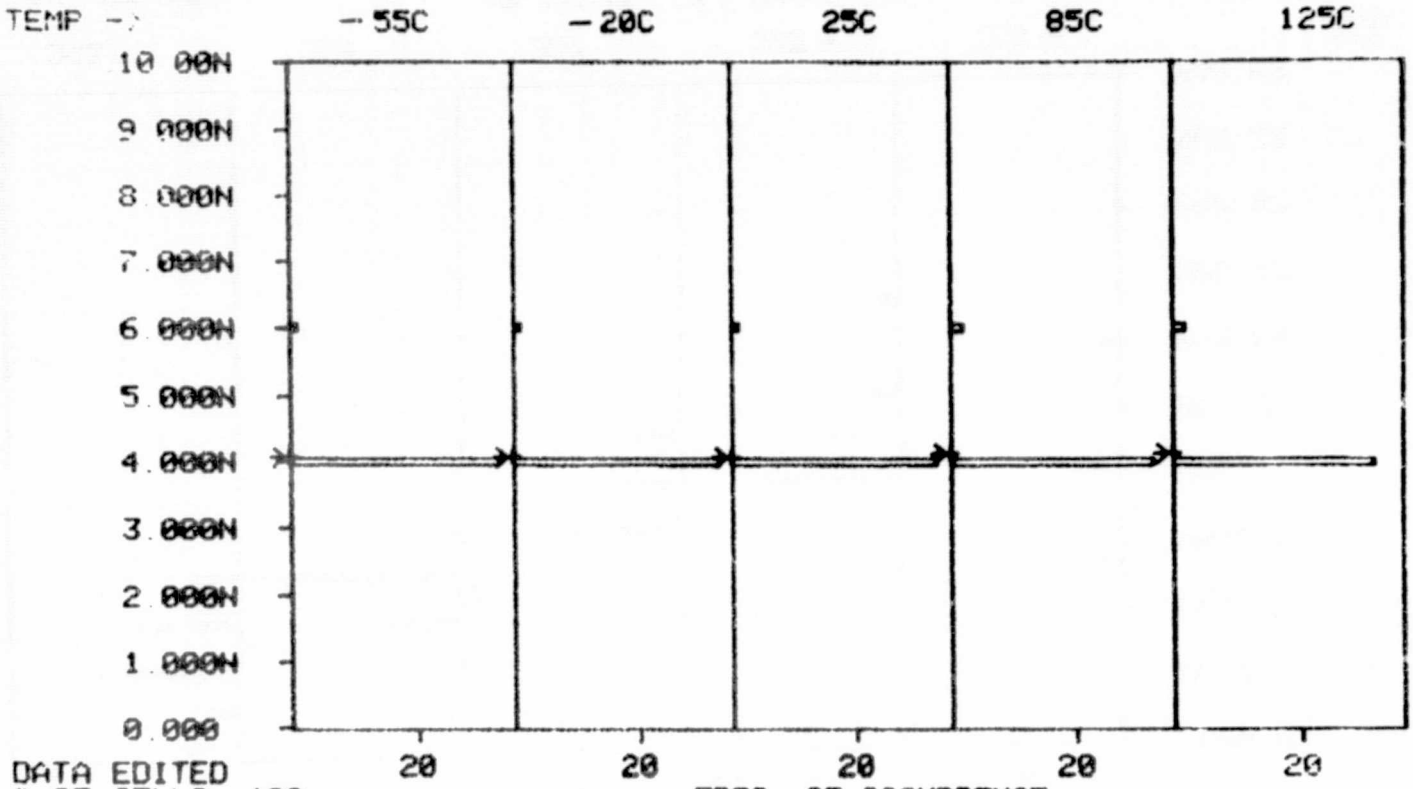
COMPONENTS DEPARTMENT TAS1 AT VCC=5.0V 20 SEP 78



OF CELLS 100
CELL SIZE 300.0P

READINGS:	34	34	34	34	34
MAXIMUM:	18.00N	20.00N	14.00N	10.00N	8.000N
MEAN:	10.53N	12.88N	10.41N	7.412N	5.059N
MINIMUM:	8.000N	8.000N	8.000N	4.000N	2.000N
STD.DEV.:	2.620N	2.567N	2.076N	1.158N	1.722N

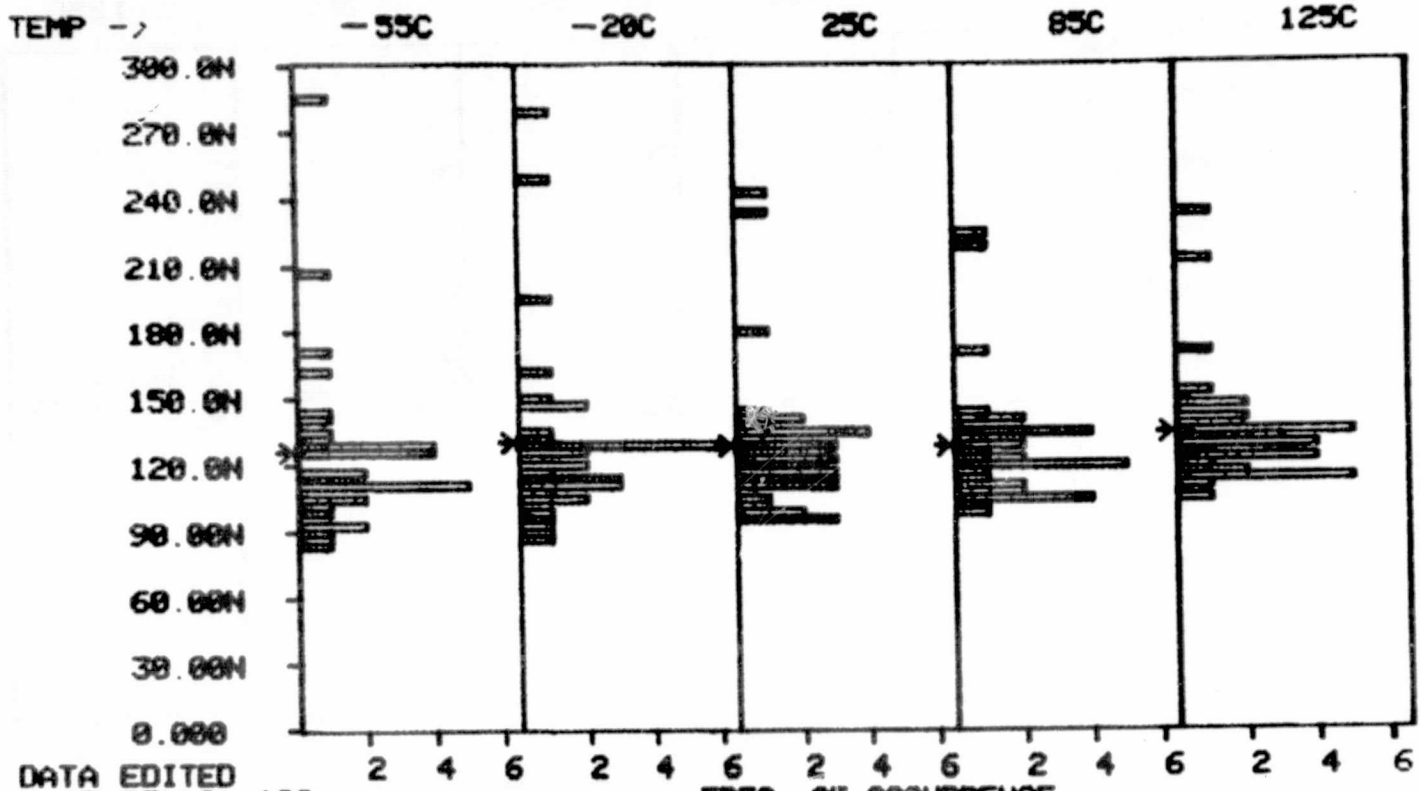
COMPONENTS DEPARTMENT TAS1 AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 100.0P

READINGS	34	34	34	34	33
MAXIMUM	6.000N	6.000N	6.000N	6.000N	6.000N
MEAN	4.059N	4.059N	4.059N	4.118N	4.121N
MINIMUM	4.000N	4.000N	4.000N	4.000N	4.000N
STD.DEV	343.0P	343.0P	343.0P	477.7P	484.6P

COMPONENTS DEPARTMENT TAS2 AT VCC=4.5V 20 SEP 78

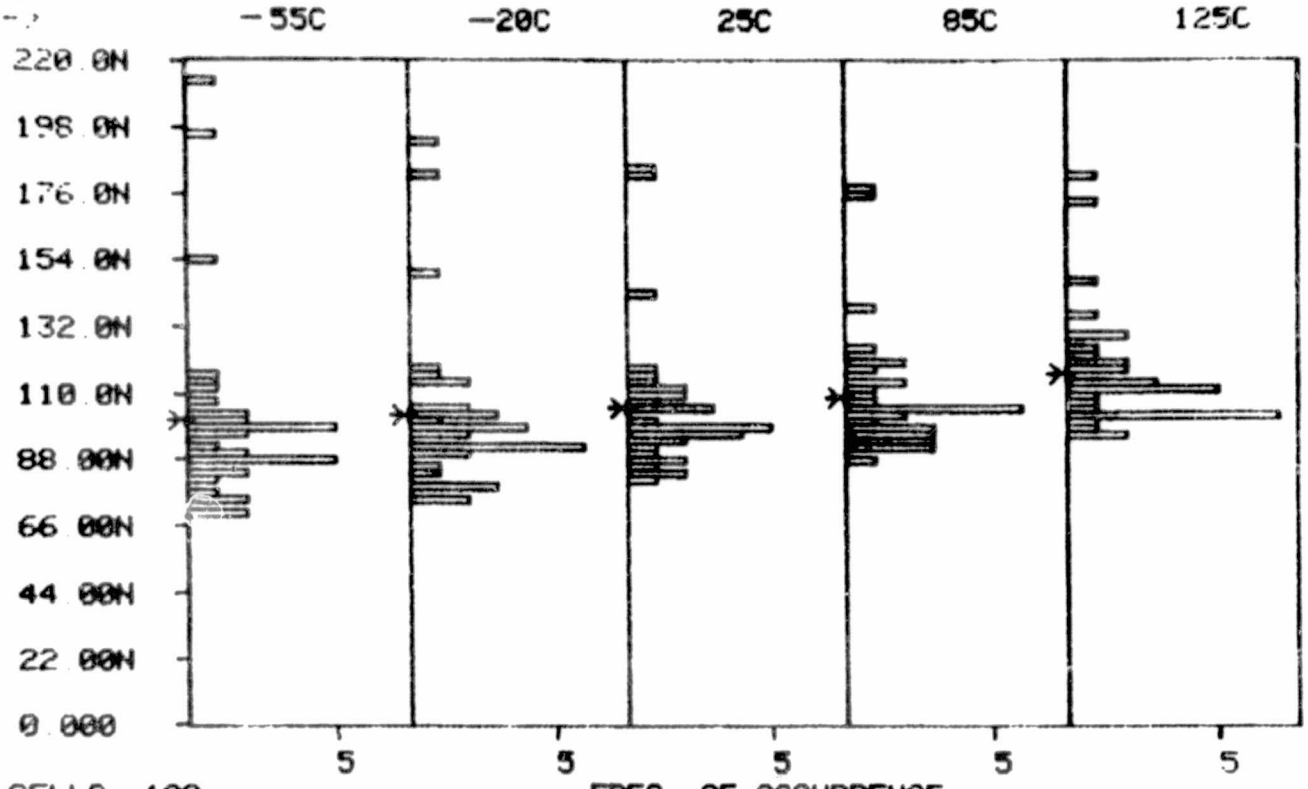


DATA EDITED
OF CELLS 100
CELL SIZE 3.000N

READINGS:	33	34	34	34	34
MAXIMUM:	284.0N	278.0N	242.0N	226.0N	234.0N
MEAN:	126.2N	130.2N	128.2N	128.4N	134.1N
MINIMUM:	84.00N	88.00N	96.00N	98.00N	104.0N
STD.DEV.:	37.82N	40.21N	32.87N	28.12N	26.53N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

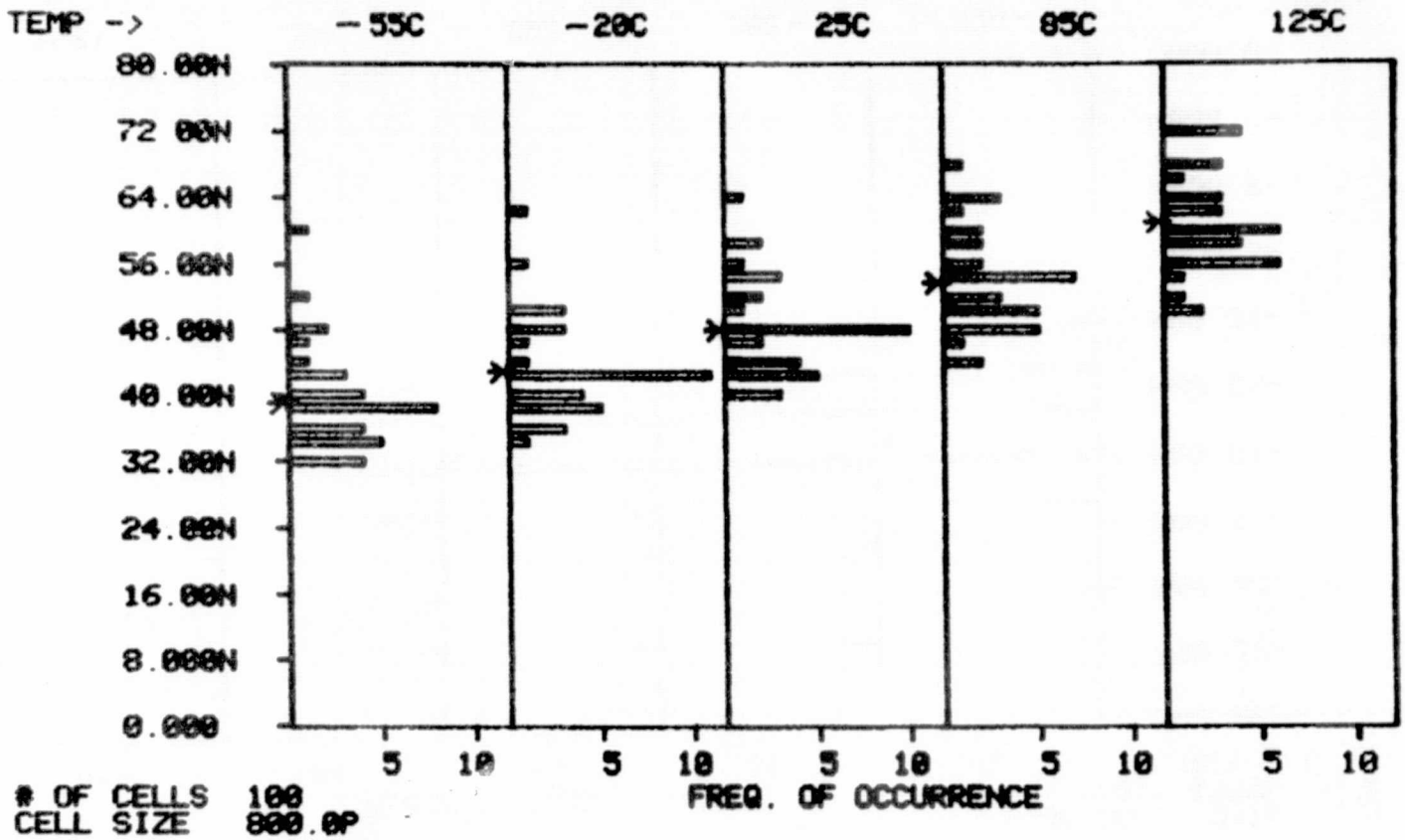
COMPONENTS DEPARTMENT TAS2 AT VCC=5.0V 20 SEP 78



OF CELLS 100
CELL SIZE 2.200N

READINGS:	34	34	34	34	34
MAXIMUM	214.0N	194.0N	184.0N	178.0N	182.0N
MEAN:	101.2N	102.8N	105.5N	109.2N	116.9N
MINIMUM:	70.00N	74.00N	82.00N	88.00N	96.00N
STD DEV	30.83N	26.12N	23.08N	20.40N	19.29N

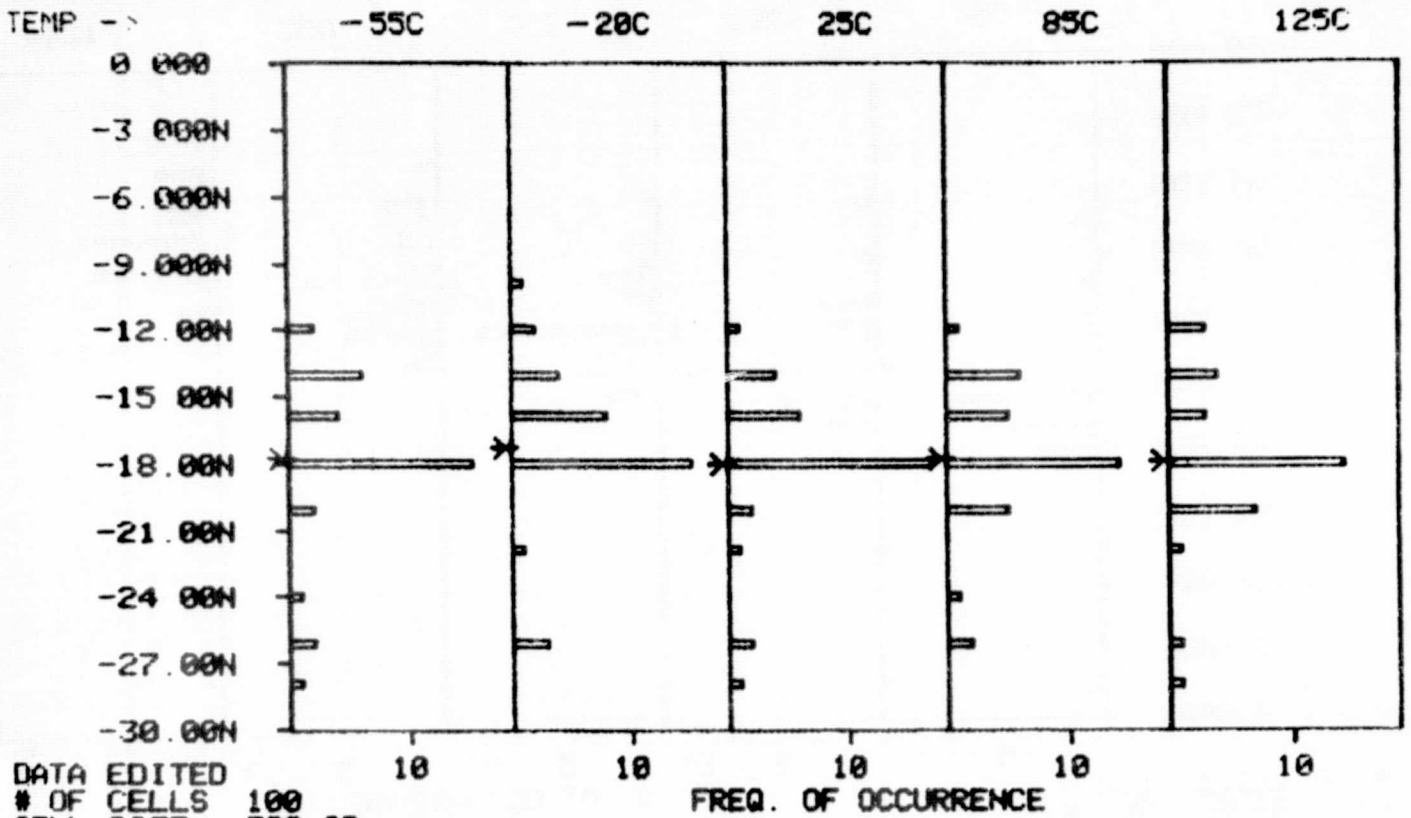
COMPONENTS DEPARTMENT TAS2 AT VCC=10.0V 20 SEP 78



OF CELLS 100
CELL SIZE 800.0P

READINGS:	34	34	34	34	34
MAXIMUM:	60.00N	62.00N	64.00N	68.00N	72.00N
MEAN:	39.12N	42.82N	47.94N	53.76N	60.88N
MINIMUM:	32.00N	34.00N	40.00N	44.00N	50.00N
STD.DEV.:	6.134N	5.931N	5.795N	6.046N	6.153N

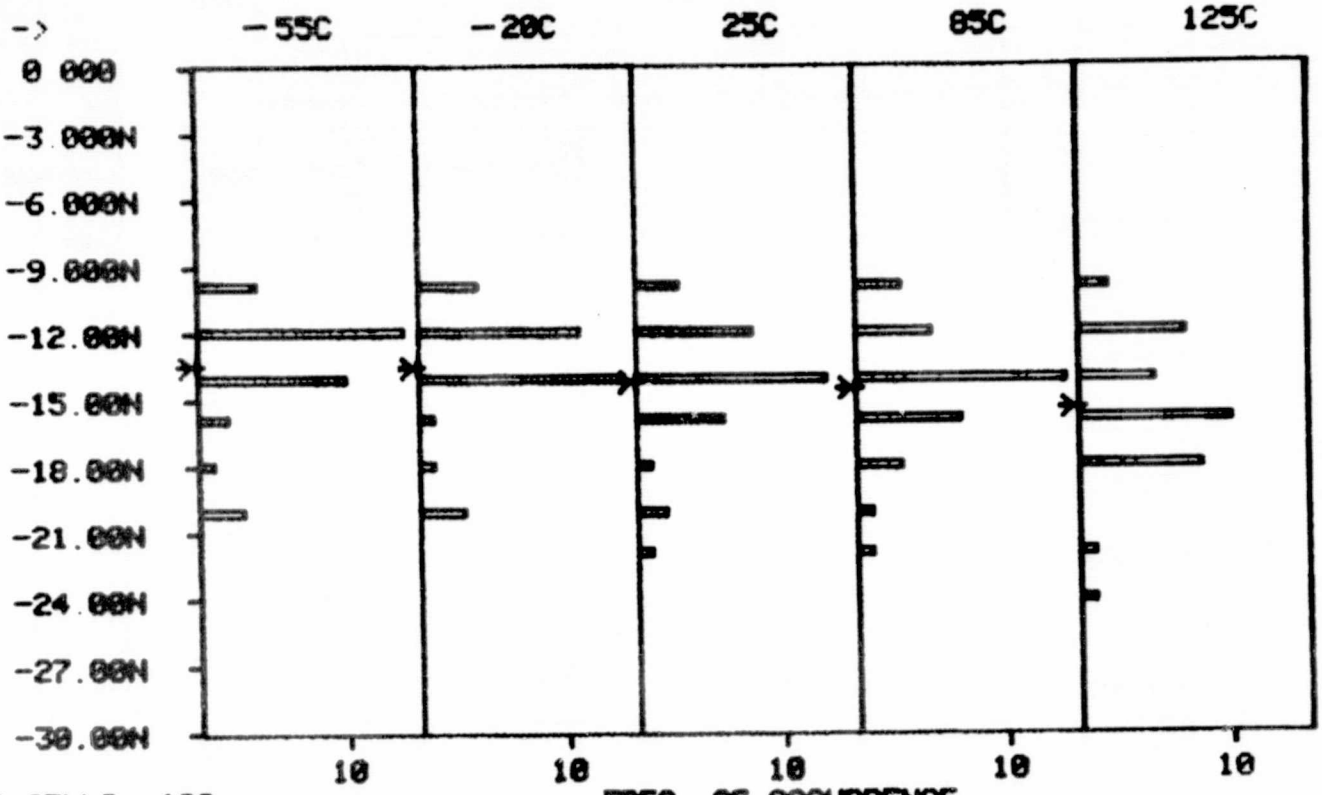
COMPONENTS DEPARTMENT TAH AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 300.0P

READINGS:	33	34	34	34	34
MAXIMUM:	-12.00N	-10.00N	-12.00N	-12.00N	-12.00N
MEAN:	-17.76N	-17.29N	-18.00N	-17.76N	-17.88N
MINIMUM:	-28.00N	-26.00N	-28.00N	-26.00N	-28.00N
STD DEV.:	3.767N	3.580N	3.375N	3.182N	3.444N

COMPONENTS DEPARTMENT TAH AT VCC=5.0V 20 SEP 78

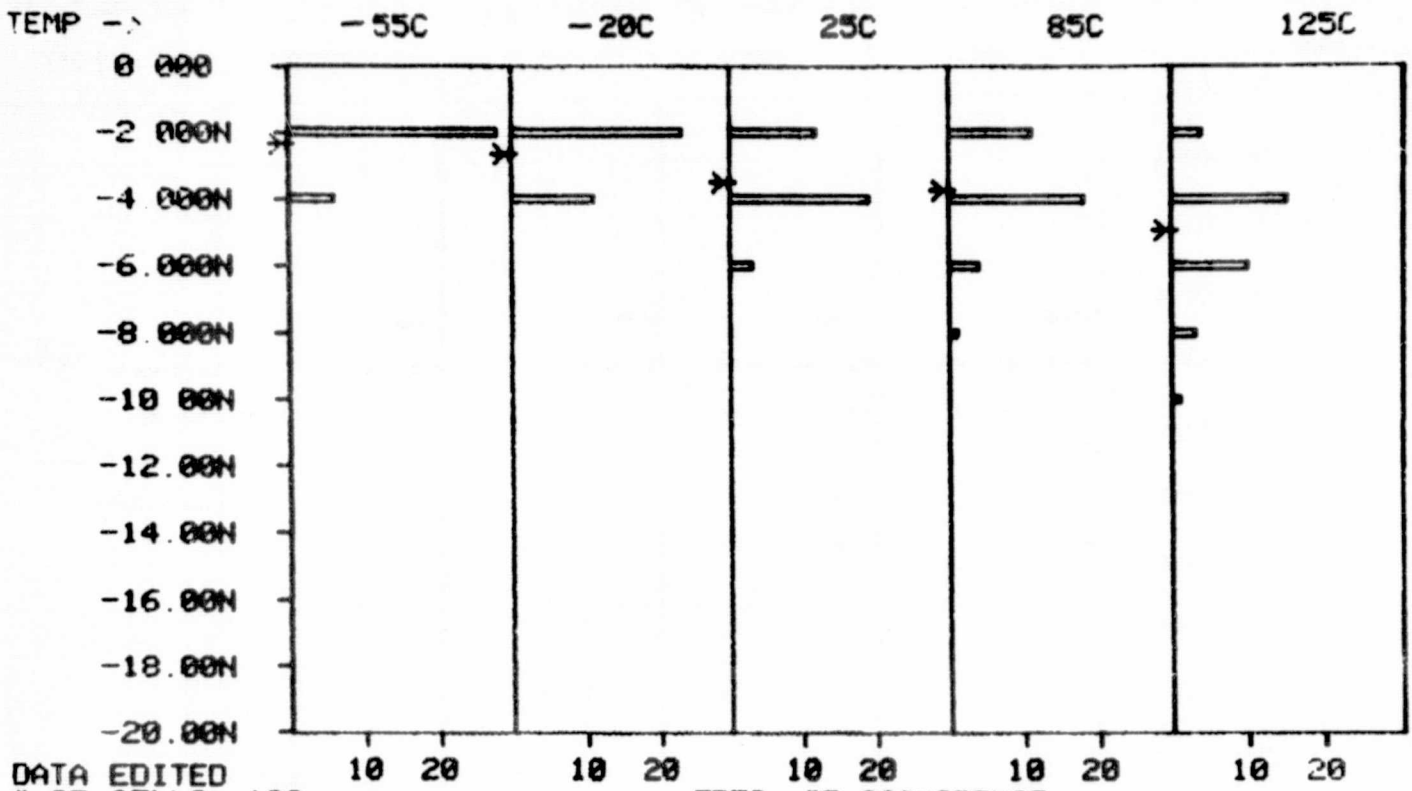


OF CELLS 100
CELL SIZE 300.0P

READINGS:	34	34	34	34	34
MAXIMUM:	-10.00N	-10.00N	-10.00N	-10.00N	-10.00N
MEAN:	-13.47N	-13.59N	-14.24N	-14.53N	-15.41N
MINIMUM:	-20.00N	-20.00N	-22.00N	-22.00N	-24.00N
STD.DEV.:	2.711N	2.641N	2.775N	2.665N	3.135N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

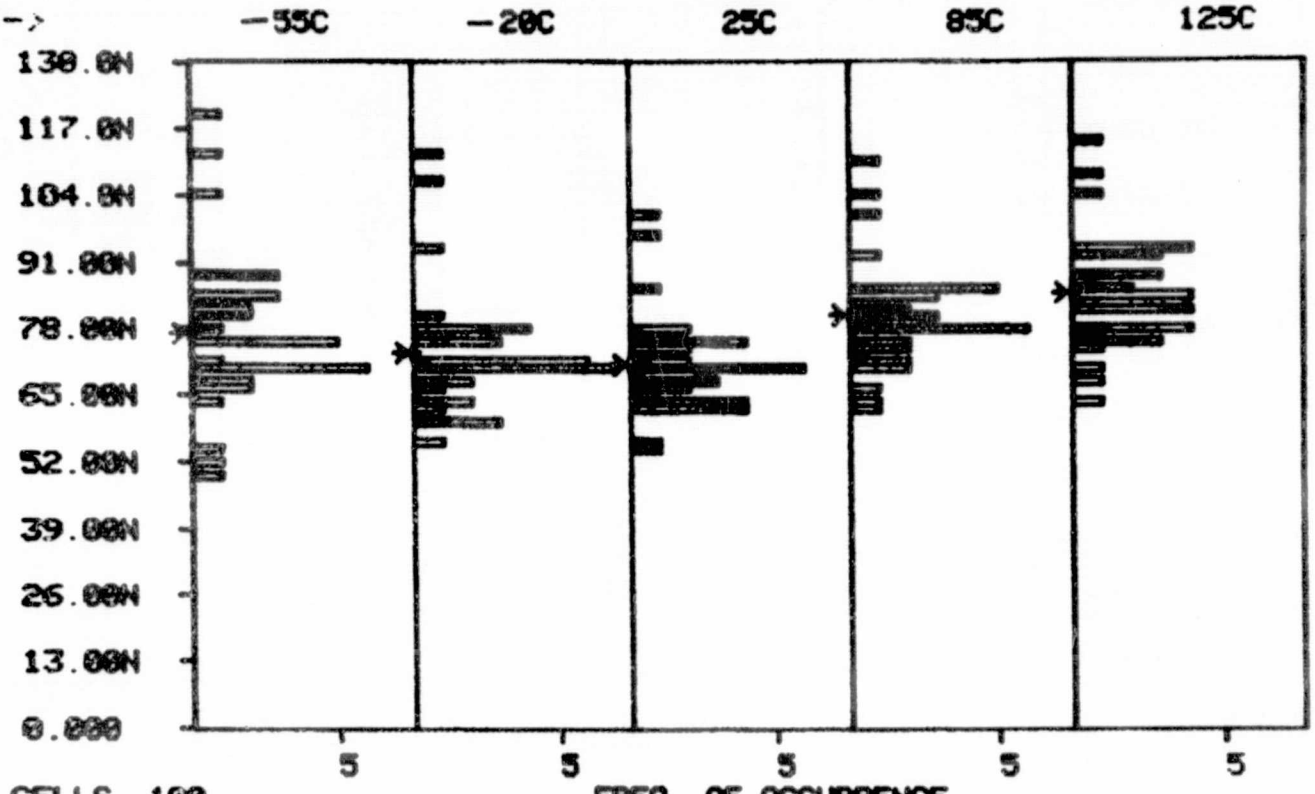
COMPONENTS DEPARTMENT TAH AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 200.0P

READINGS:	34	34	34	34	33
MAXIMUM:	-2.000N	-2.000N	-2.000N	-2.000N	-2.000N
MEAN:	-2.353N	-2.647N	-3.471N	-3.706N	-4.909N
MINIMUM:	-4.000N	-4.000N	-6.000N	-8.000N	-10.00N
STD.DEV.:	773.9P	949.7P	1.237N	1.488N	1.877N

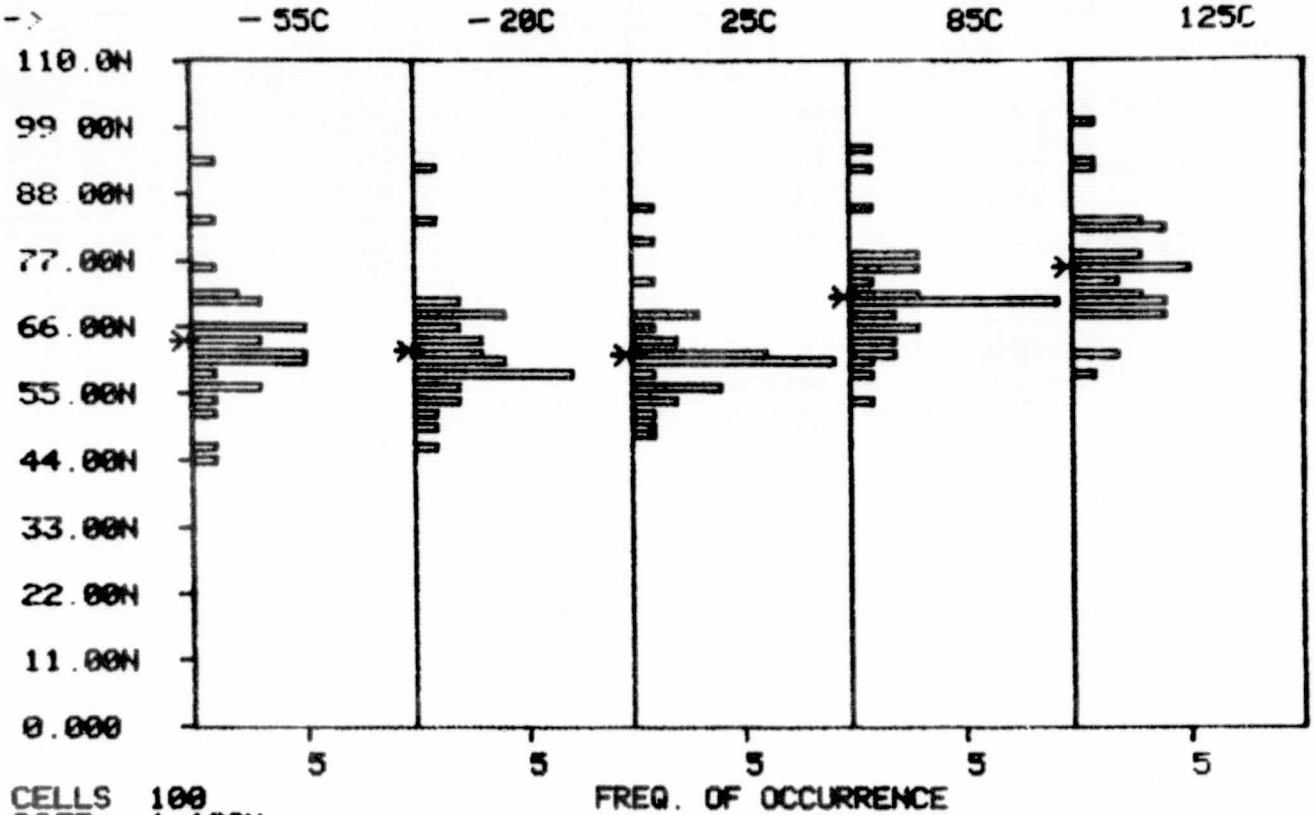
COMPONENTS DEPARTMENT TWP AT VCC=4.5V 20 SEP 78



OF CELLS 100
CELL SIZE 1.300N

READINGS:	34	34	34	34	34
MAXIMUM:	120.0N	112.0N	100.0N	110.0N	114.0N
MEAN:	76.00N	73.00N	70.71N	80.47N	85.12N
MINIMUM:	50.00N	56.00N	54.00N	62.00N	64.00N
STD.DEV.:	14.73N	11.64N	9.571N	10.27N	10.71N

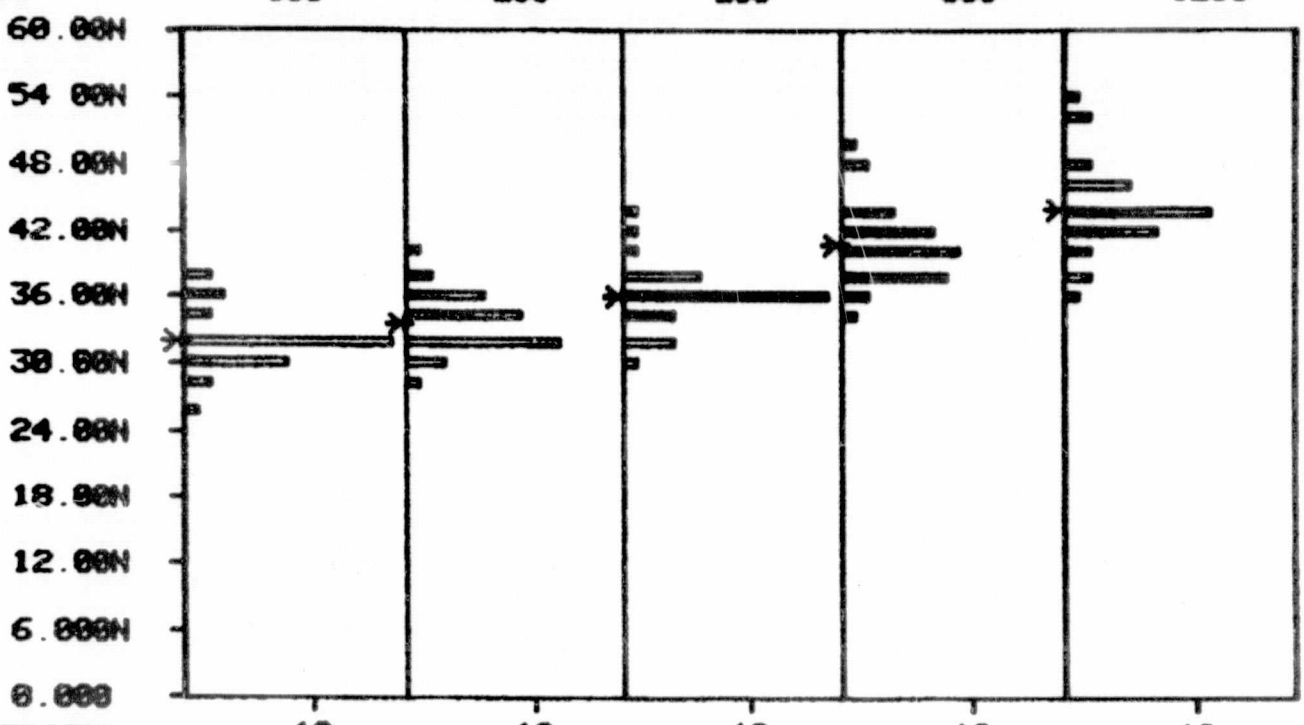
COMPONENTS DEPARTMENT TWP AT VCC=5.0V 20 SEP 78



OF CELLS 100
CELL SIZE 1.100N

READINGS:	34	34	34	34	34
MAXIMUM:	94.00N	92.00N	86.00N	96.00N	100.0N
MEAN:	63.59N	62.12N	61.47N	71.00N	75.82N
MINIMUM:	44.00N	46.00N	48.00N	54.00N	58.00N
STD.DEV.:	9.519N	8.752N	7.648N	8.644N	9.004N

COMPONENTS DEPARTMENT TMP AT VCC=10.0V 20 SEP 78

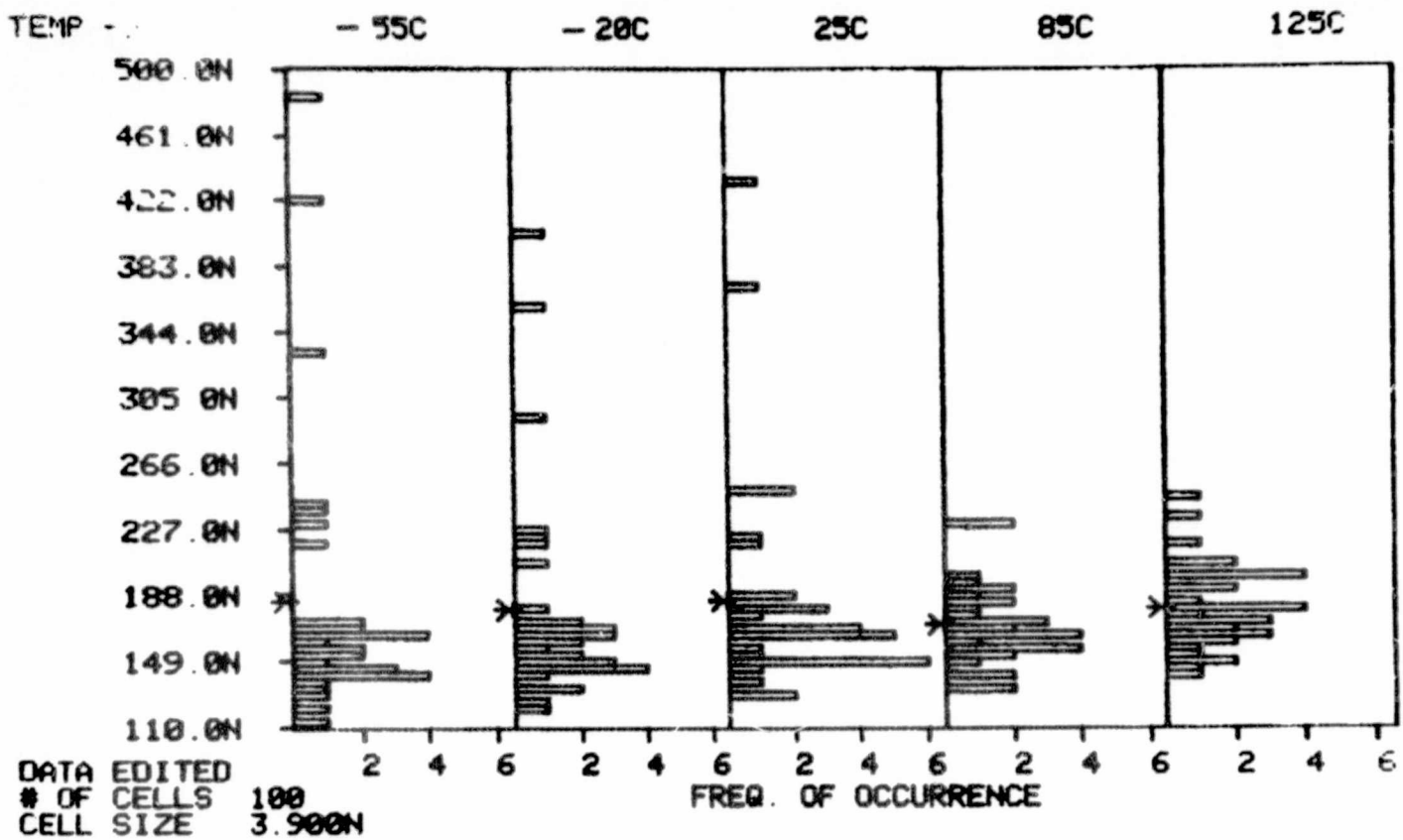


DATA EDITED
OF CELLS 100
CELL SIZE 600.0P

READINGS:	34	34	34	34	33
MAXIMUM:	38.00N	40.00N	44.00N	50.00N	54.00N
MEAN:	31.94N	33.53N	36.00N	40.76N	44.06N
MINIMUM:	26.00N	28.00N	30.00N	34.00N	36.00N
STD.DEV.:	2.628N	2.561N	2.785N	3.482N	3.857N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

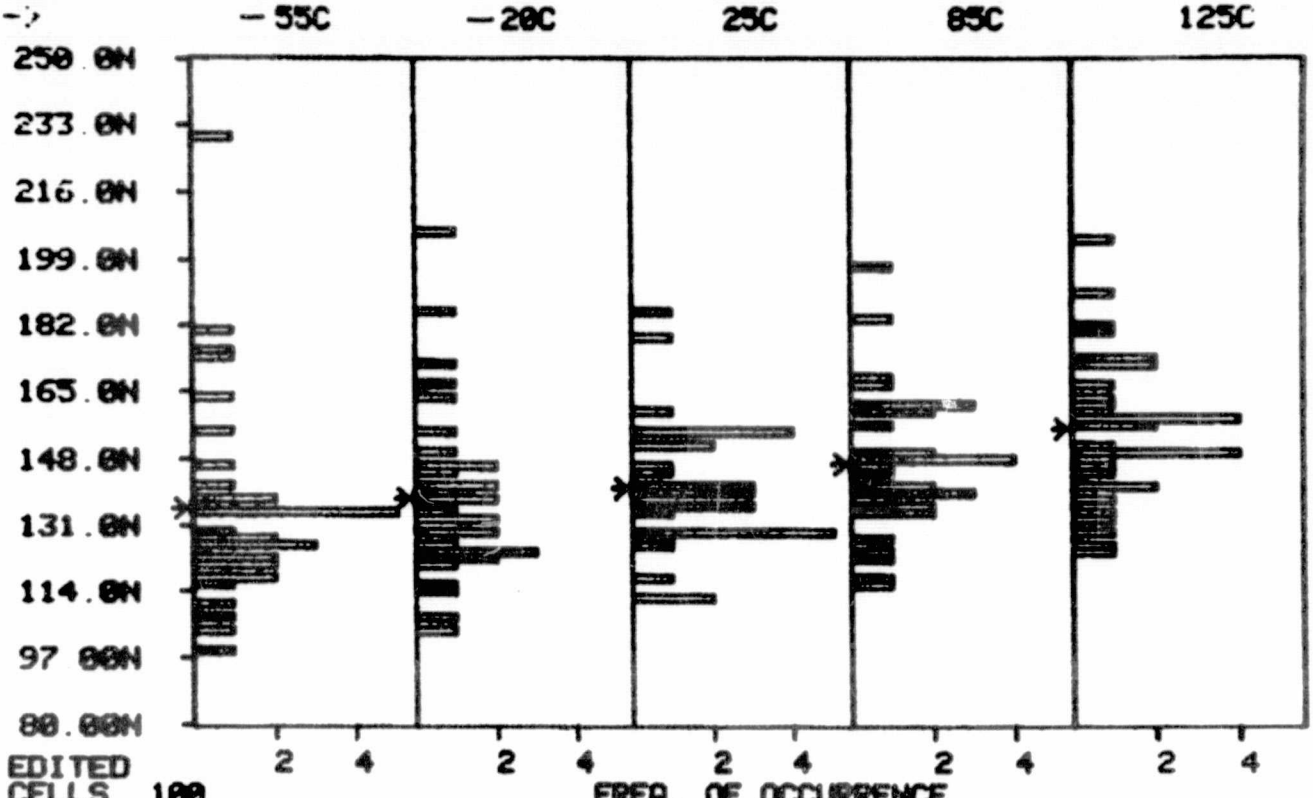
COMPONENTS DEPARTMENT TCSS1 AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 3.900N

READINGS:	33	33	33	32	33
MAXIMUM:	484.0N	402.0N	432.0N	232.0N	246.0N
MEAN:	184.4N	179.6N	184.6N	171.0N	179.9N
MINIMUM:	114.0N	122.0N	128.0N	132.0N	140.0N
STD.DEV :	81.89N	62.47N	63.77N	23.65N	24.90N

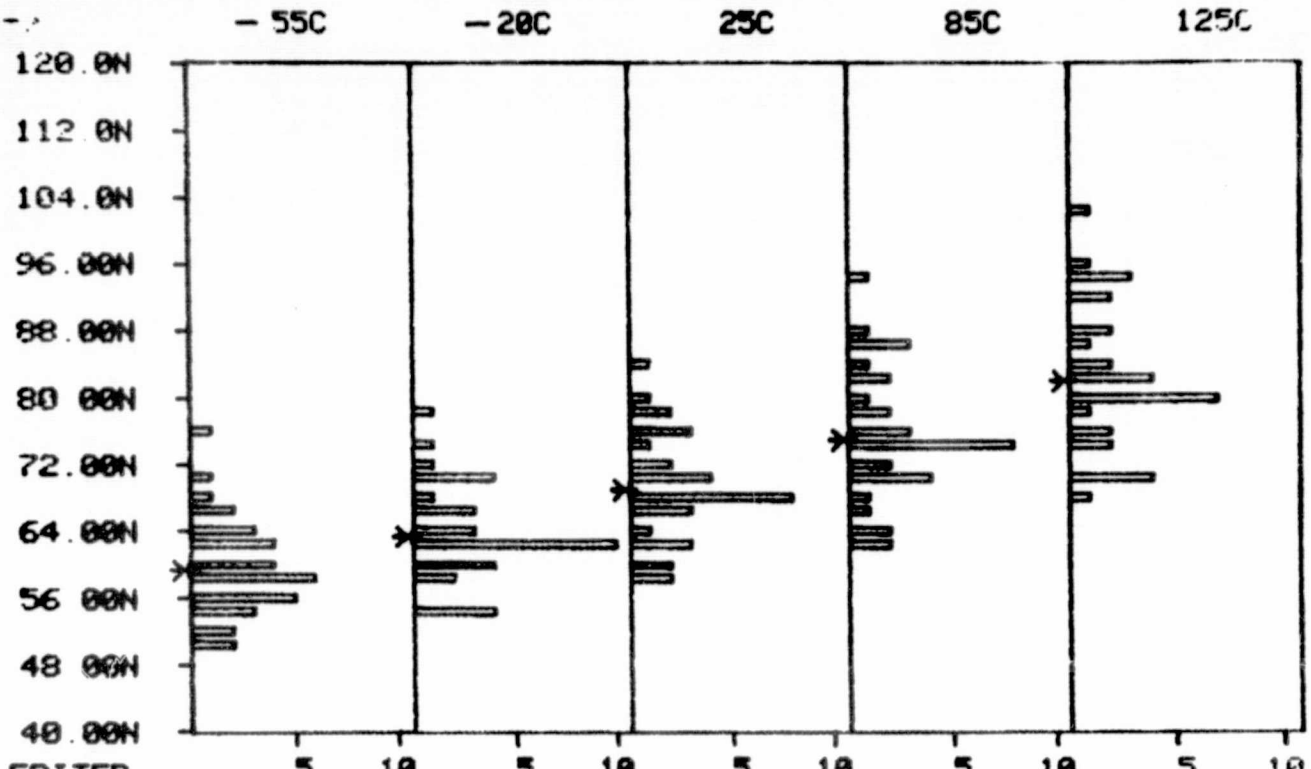
COMPONENTS DEPARTMENT TCSS1 AT VCC=5.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 1.700N

READINGS:	33	33	31	33	33
MAXIMUM:	230.0N	206.0N	186.0N	198.0N	204.0N
MEAN:	135.4N	138.2N	140.9N	147.8N	155.8N
MINIMUM:	98.00N	104.0N	112.0N	116.0N	124.0N
STD.DEV.:	25.87N	21.76N	16.38N	17.74N	18.48N

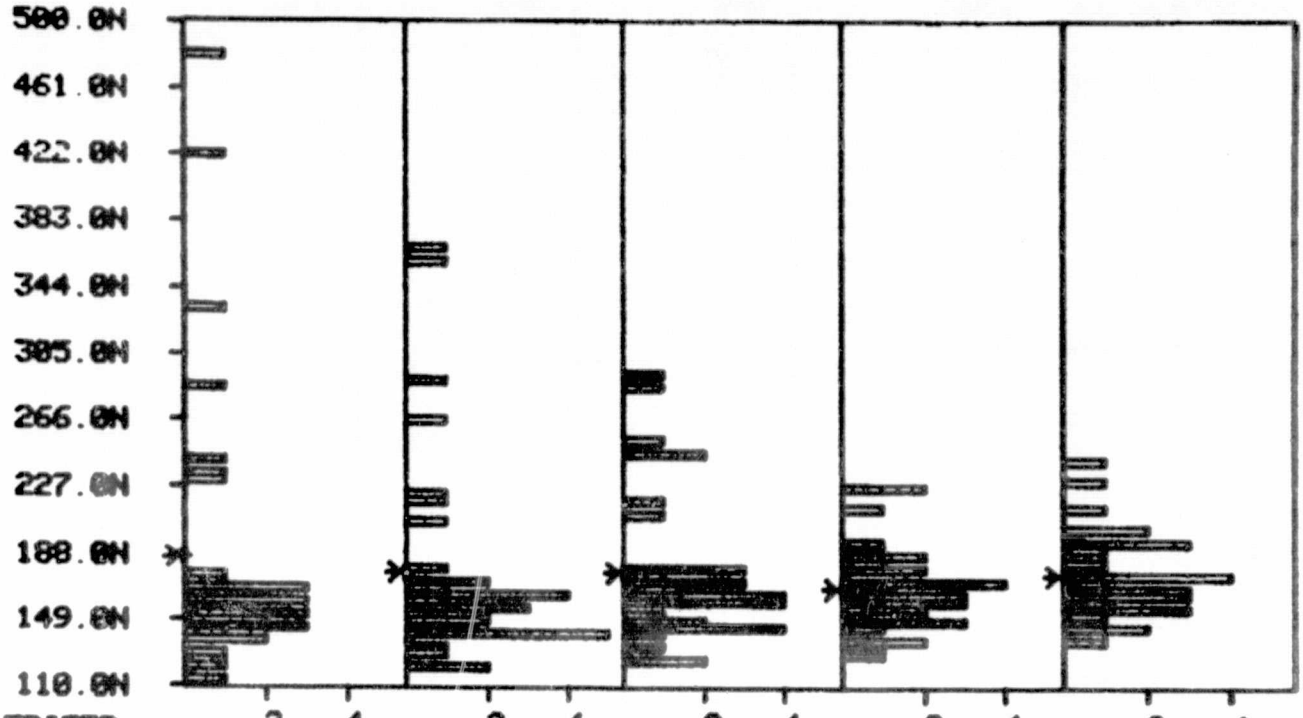
COMPONENTS DEPARTMENT TCSS1 AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 800.0P

READINGS:	34	34	33	34	33
MAXIMUM:	76.00N	78.00N	84.00N	94.00N	102.0N
MEAN:	59.41N	63.35N	68.91N	75.12N	82.06N
MINIMUM:	50.00N	54.00N	58.00N	62.00N	68.00N
STD.DEV.:	5.732N	5.757N	6.406N	7.694N	8.551N

COMPONENTS DEPARTMENT TCS82 AT VCC=4.5V 20 SEP 78

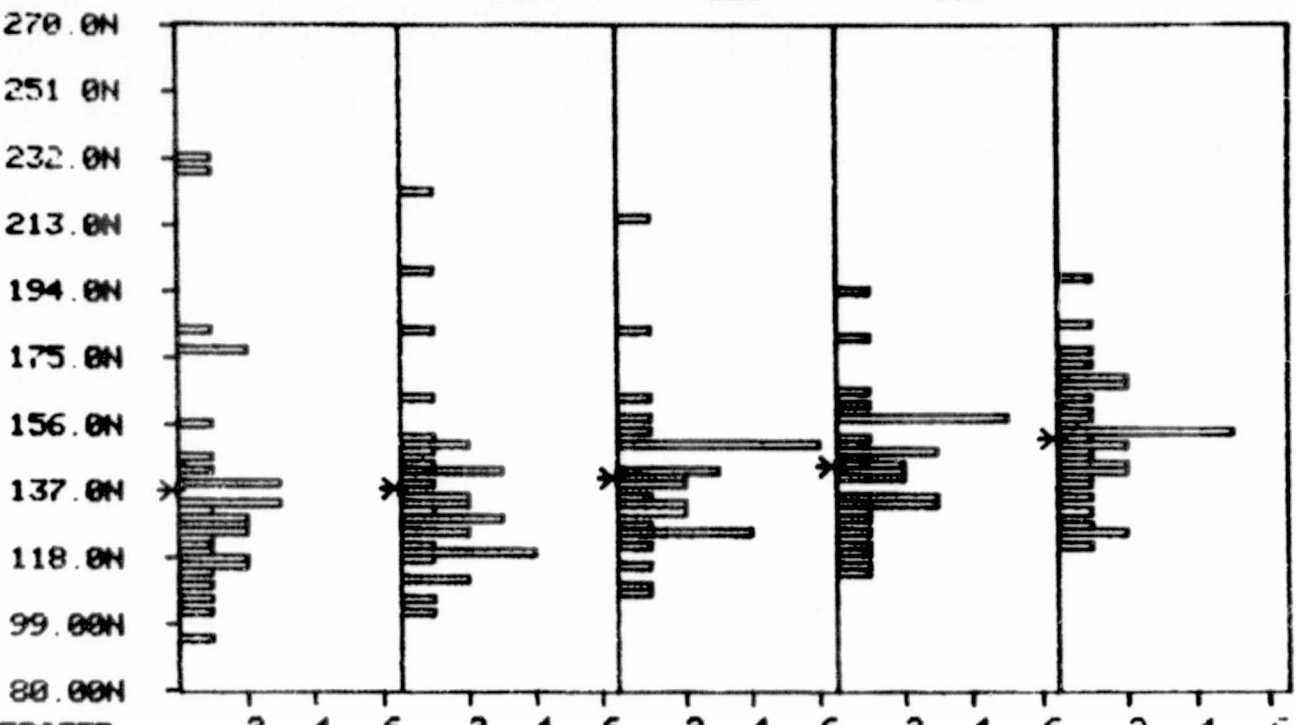


DATA EDITED
OF CELLS 100
CELL SIZE 3.900N

READINGS:	33	33	33	33	33
MAXIMUM:	480.0N	366.0N	294.0N	226.0N	244.0N
MEAN:	186.5N	178.2N	177.7N	168.7N	176.1N
MINIMUM:	114.0N	120.0N	126.0N	130.0N	136.0N
STD.DEV.:	82.96N	60.30N	43.39N	24.05N	24.84N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

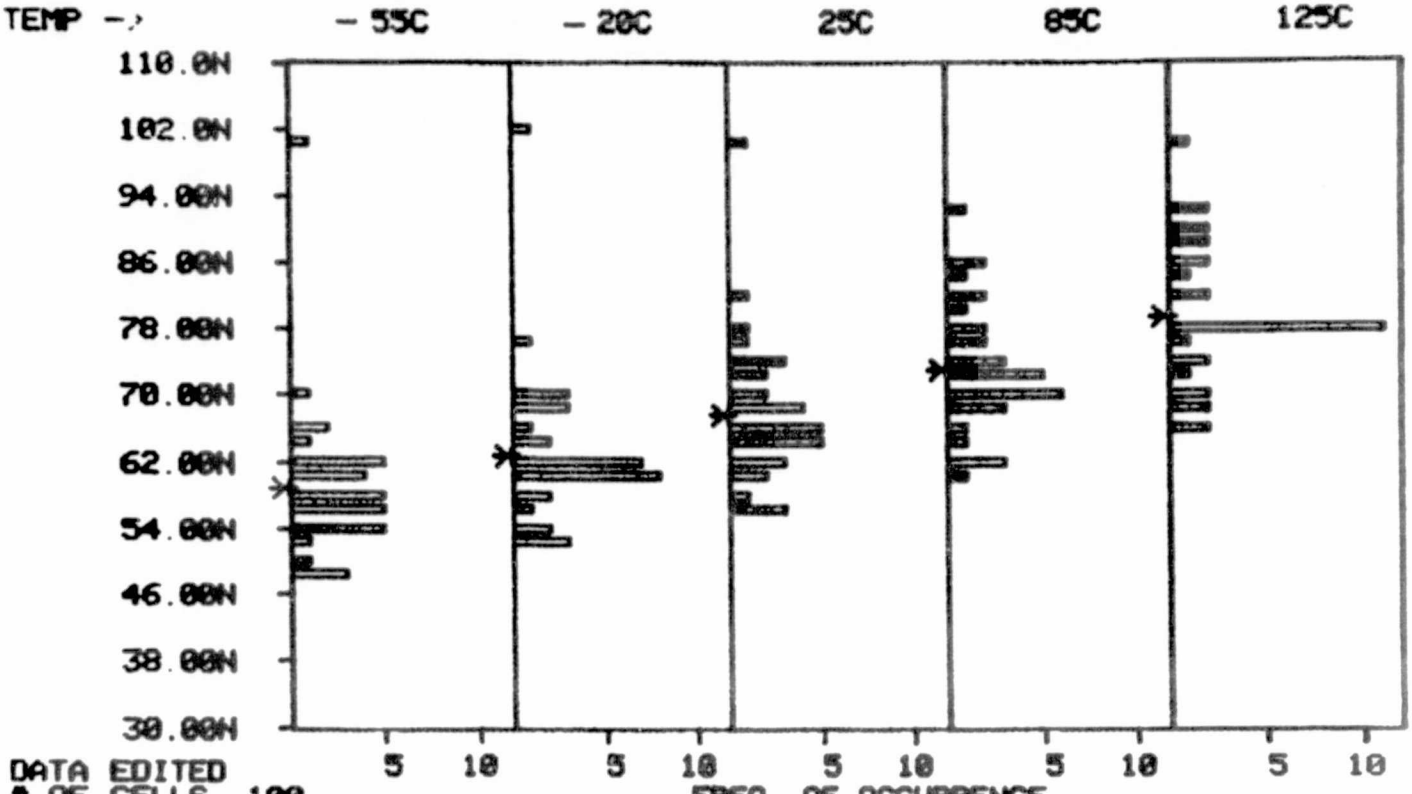
COMPONENTS DEPARTMENT TCSS2 AT VCC=5.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 1.900N

READINGS:	33	33	32	33	33
MAXIMUM:	232.0N	222.0N	214.0N	194.0N	198.0N
MEAN:	136.8N	137.6N	140.9N	144.1N	152.3N
MINIMUM:	96.00N	102.0N	108.0N	114.0N	122.0N
STD.DEV.:	31.03N	25.22N	20.40N	17.36N	17.53N

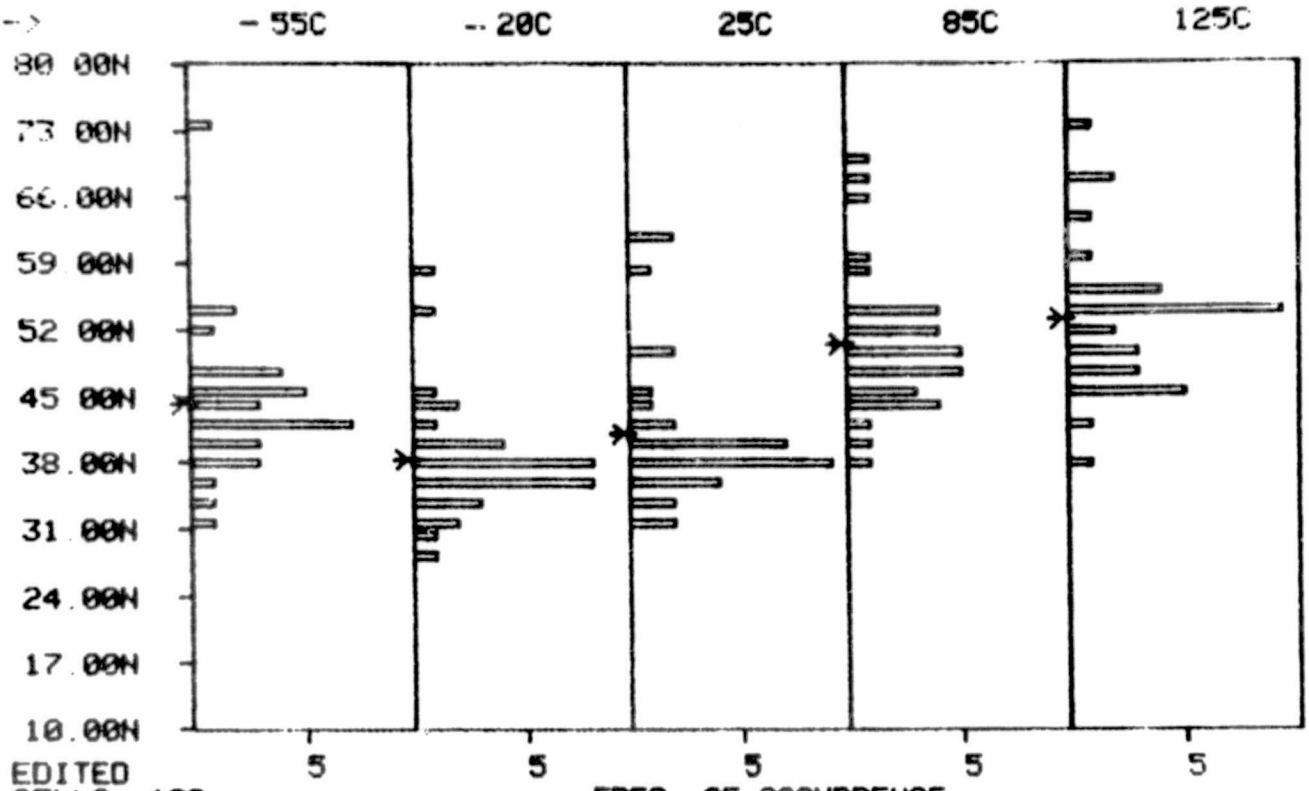
COMPONENTS DEPARTMENT TCSS2 AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 800.0P

READINGS:	34	34	34	34	33
MAXIMUM:	100.0N	102.0N	100.0N	92.00N	100.0N
MEAN:	58.88N	62.82N	67.53N	73.00N	79.45N
MINIMUM:	48.00N	52.00N	56.00N	60.00N	66.00N
STD.DEV.:	8.947N	8.919N	8.515N	7.584N	8.251N

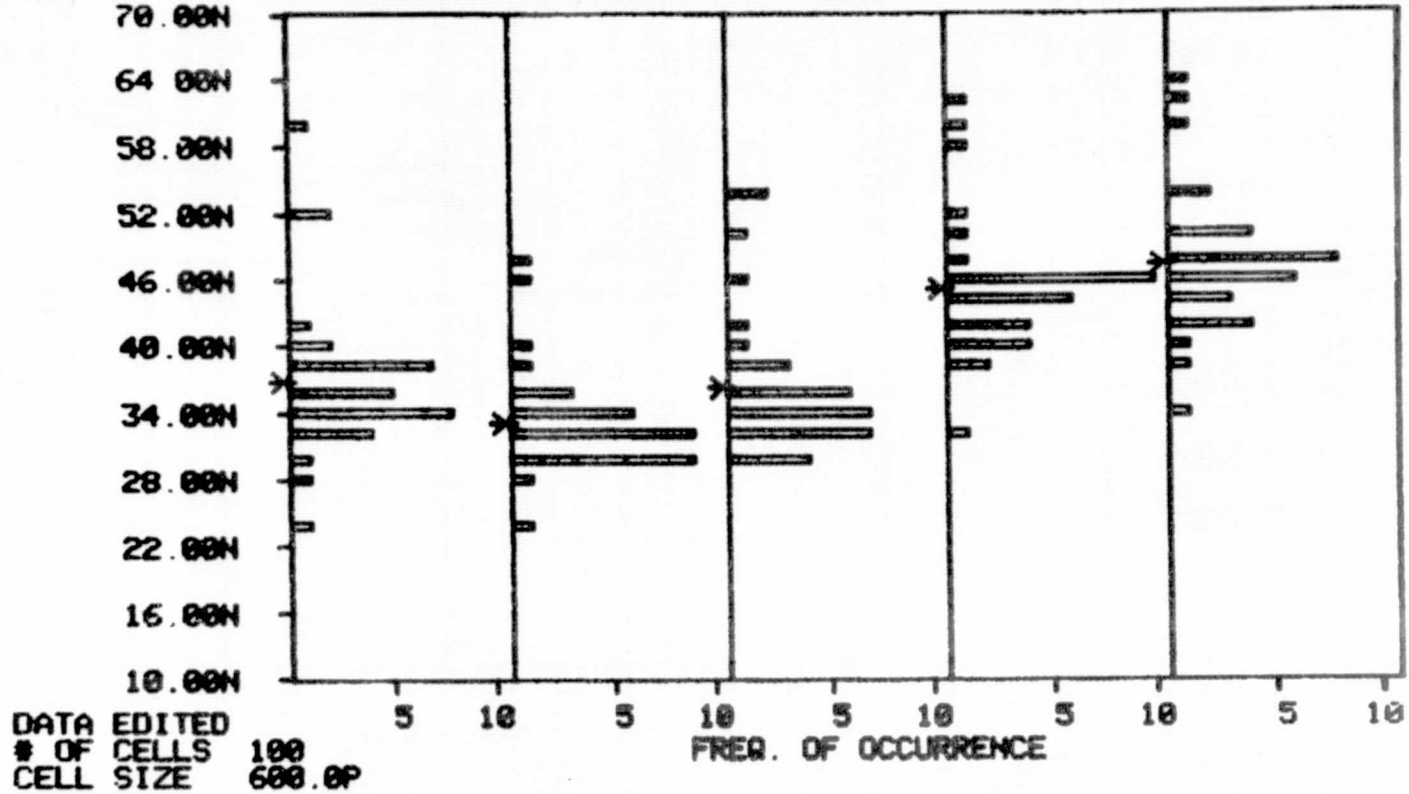
COMPONENTS DEPARTMENT TCSH1 AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 700.0P

READINGS:	32	33	33	33	33
MAXIMUM:	74.00N	58.00N	62.00N	70.00N	74.00N
MEAN:	44.31N	38.30N	41.03N	50.61N	53.09N
MINIMUM:	32.00N	28.00N	32.00N	38.00N	38.00N
STD DEV.:	7.485N	5.961N	7.536N	7.357N	7.502N

COMPONENTS DEPARTMENT TCSH1 AT VCC=5.0V 20 SEP 78

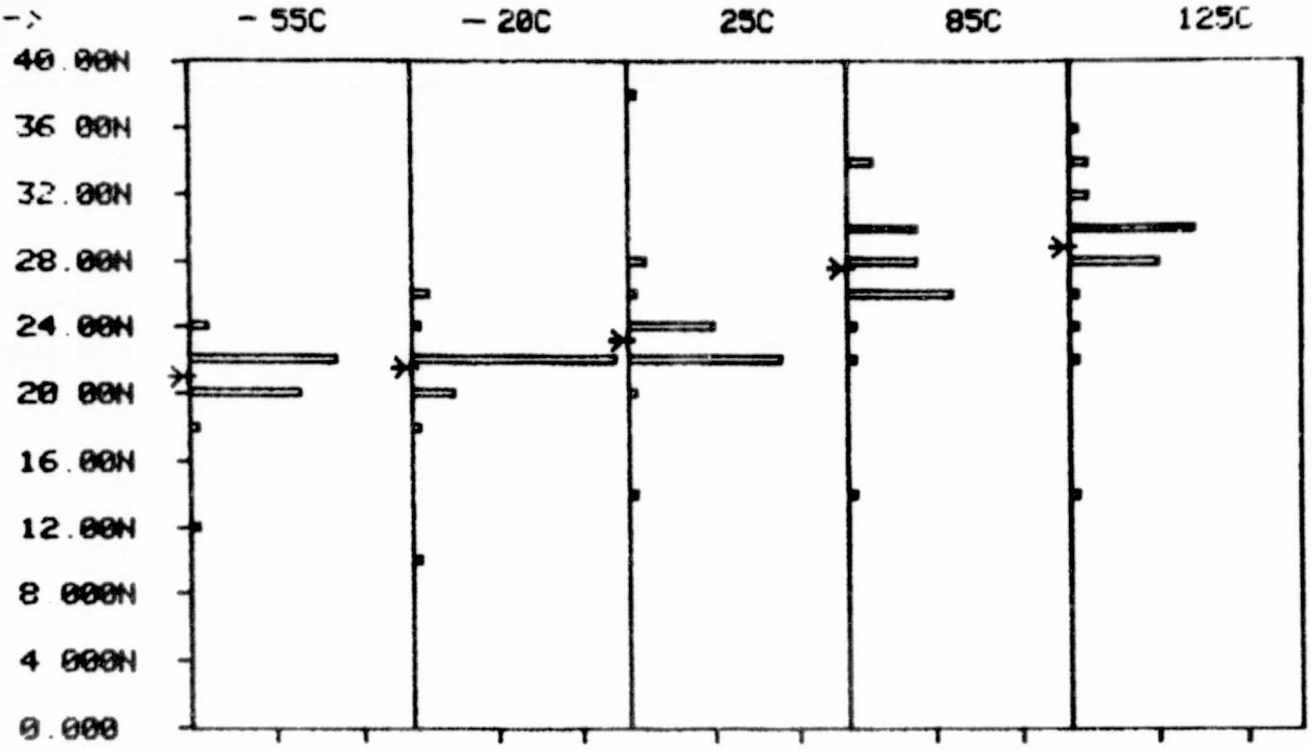


DATA EDITED
OF CELLS 100
CELL SIZE 600.0P

READINGS:	33	33	33	33	33
MAXIMUM:	60.00N	48.00N	54.00N	62.00N	64.00N
MEAN:	36.79N	33.15N	36.30N	45.15N	47.45N
MINIMUM:	24.00N	24.00N	30.00N	32.00N	34.00N
STD.DEV.:	6.855N	4.665N	6.347N	6.084N	6.251N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

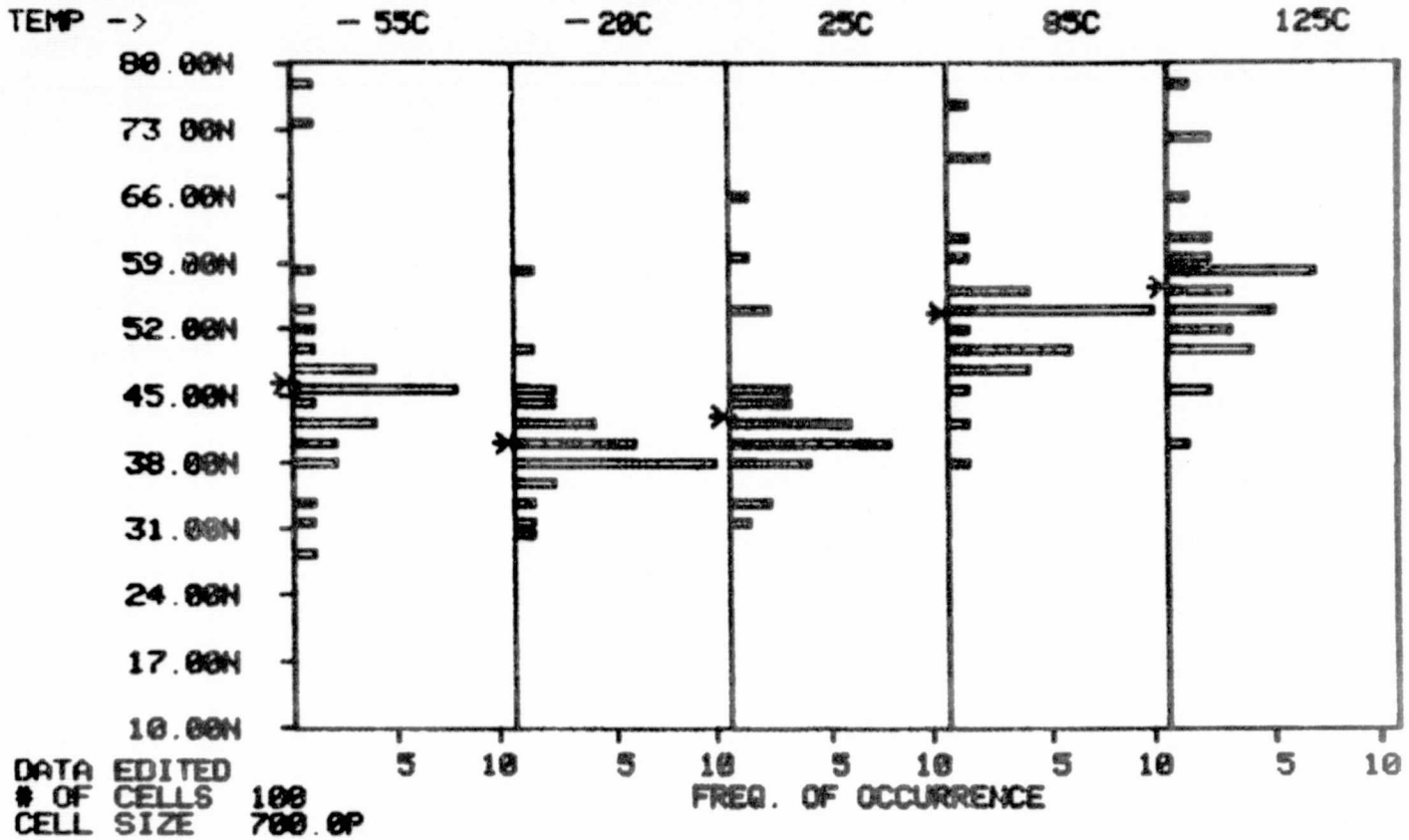
COMPONENTS DEPARTMENT TCSH1 AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 400.0P

READINGS:	34	34	34	34	33
MAXIMUM:	24.00N	26.00N	38.00N	34.00N	36.00N
MEAN:	20.94N	21.53N	23.24N	27.59N	28.91N
MINIMUM:	12.00N	10.00N	14.00N	14.00N	14.00N
STD DEV:	2.044N	2.513N	3.482N	3.611N	3.745N

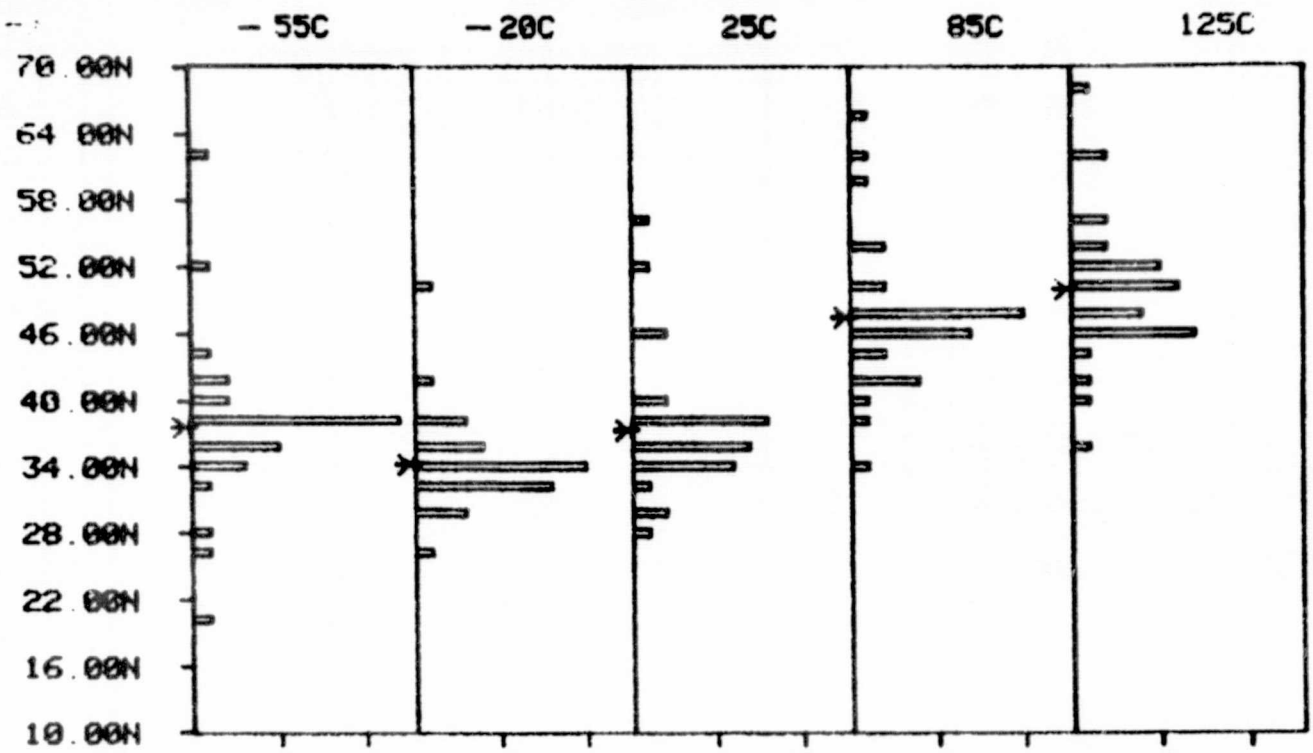
COMPONENTS DEPARTMENT TCSH2 AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 700.0P

READINGS:	30	31	31	33	33
MAXIMUM:	78.00N	58.00N	66.00N	76.00N	78.00N
MEAN:	46.27N	40.13N	42.84N	53.70N	56.48N
MINIMUM:	28.00N	30.00N	32.00N	38.00N	40.00N
STD.DEV.:	10.19N	5.214N	7.189N	7.536N	7.682N

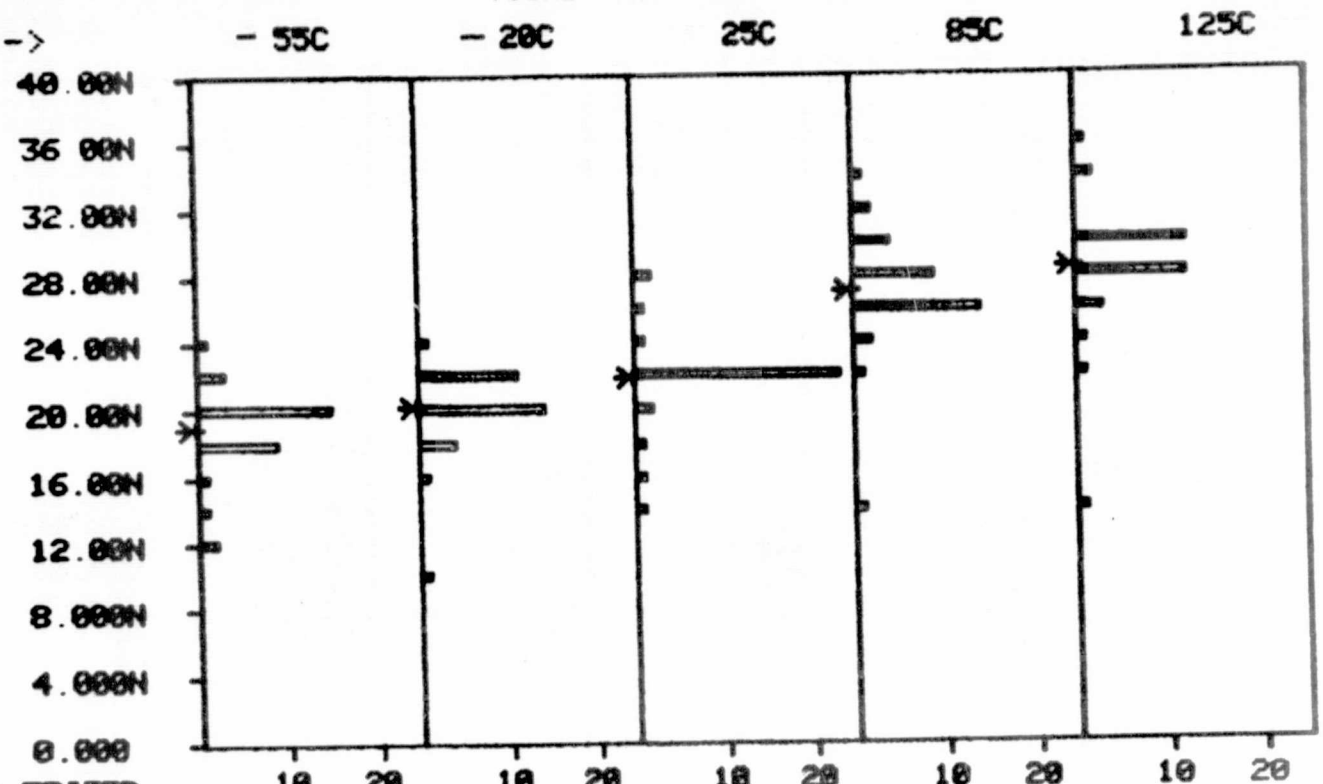
COMPONENTS DEPARTMENT TCSH2 AT VCC=5.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 600.0P

READINGS:	31	31	31	33	33
MAXIMUM:	62.00N	50.00N	56.00N	66.00N	68.00N
MEAN:	37.61N	34.26N	37.42N	47.45N	49.94N
MINIMUM:	20.00N	26.00N	28.00N	34.00N	36.00N
STD.DEV.:	7.107N	4.187N	5.870N	6.369N	6.275N

COMPONENTS DEPARTMENT TCSH2 AT VCC=10.0V 20 SEP 78

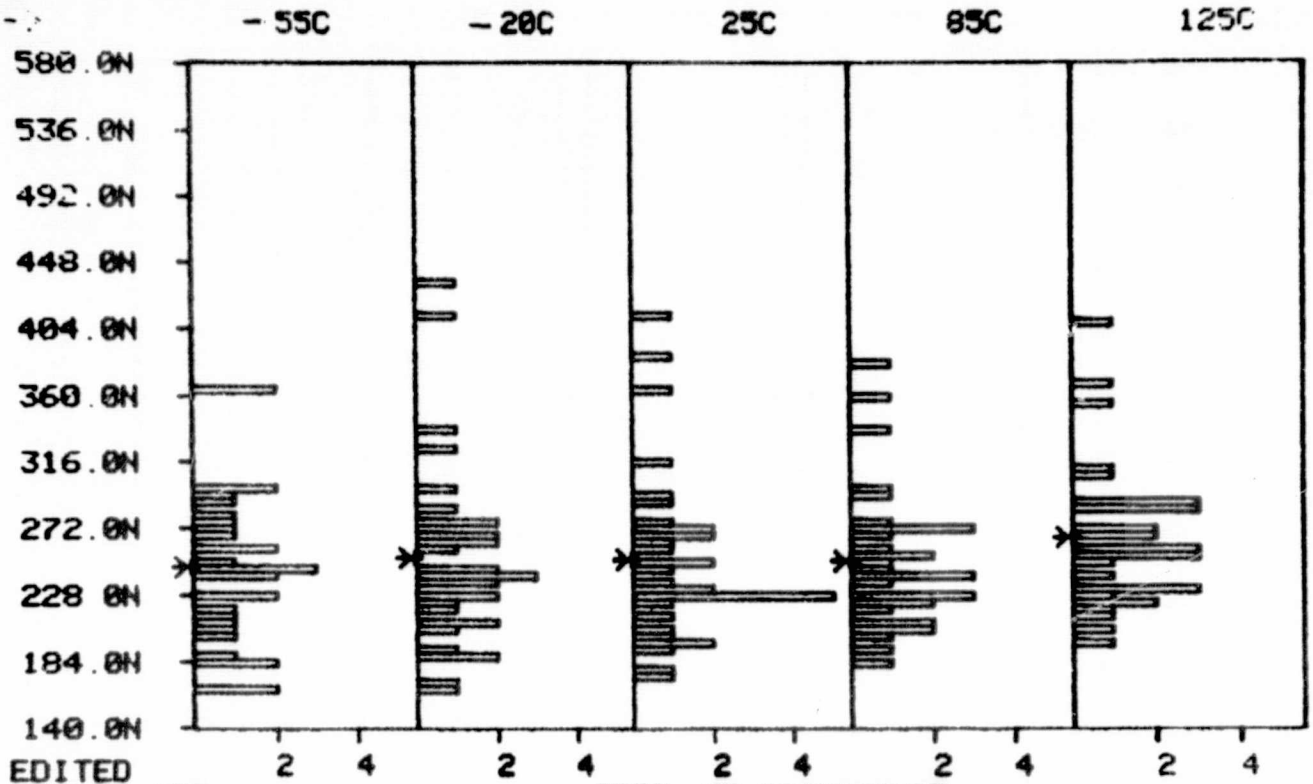


DATA EDITED
OF CELLS 100
CELL SIZE 400.0P

READINGS:	32	32	32	34	33
MAXIMUM:	24.00N	24.00N	28.00N	34.00N	36.00N
MEAN:	18.94N	20.12N	21.88N	27.00N	28.42N
MINIMUM:	12.00N	10.00N	14.00N	14.00N	14.00N
STD.DEV.:	2.590N	2.486N	2.637N	3.348N	3.700N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

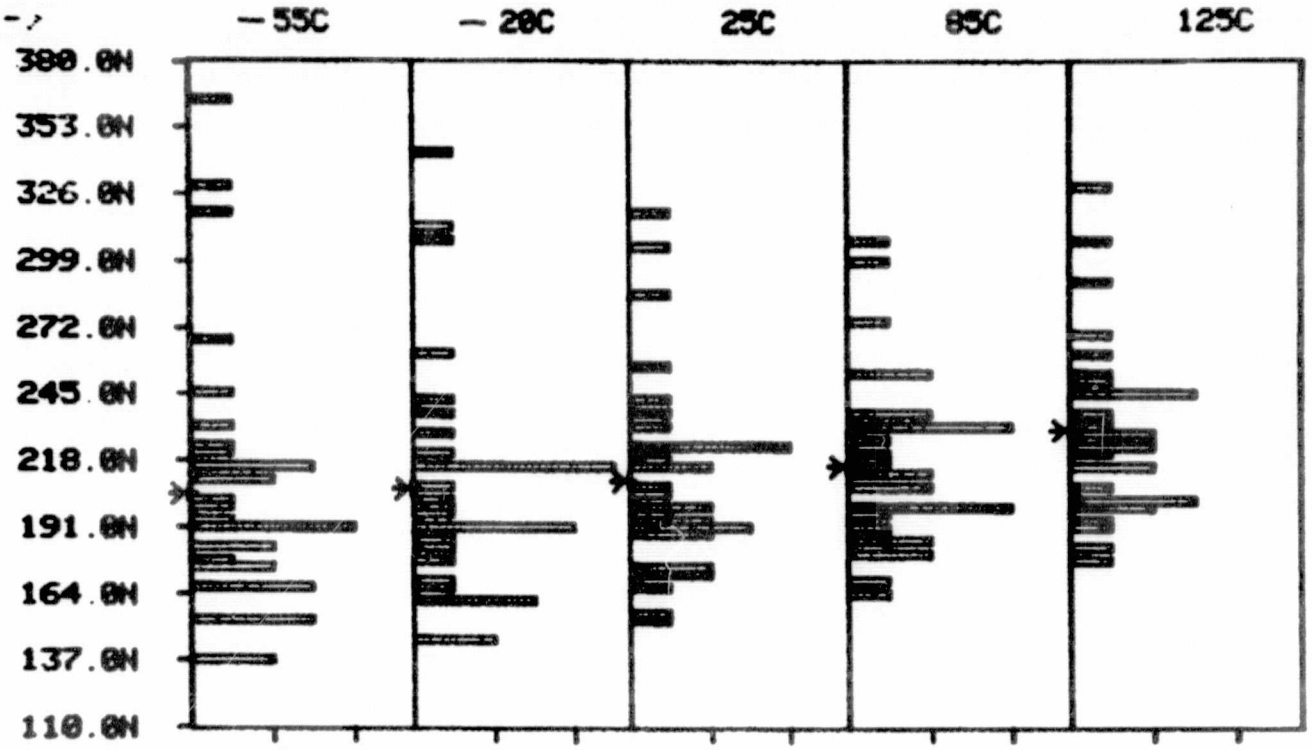
COMPONENTS DEPARTMENT TDOA1 AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 4.400N

READINGS:	30	32	33	32	33
MAXIMUM:	366.0N	434.0N	414.0N	384.0N	408.0N
MEAN:	246.5N	252.3N	252.0N	250.8N	266.2N
MINIMUM:	166.0N	168.0N	176.0N	184.0N	198.0N
STD.DEV :	49.94N	60.18N	55.15N	46.37N	45.72N

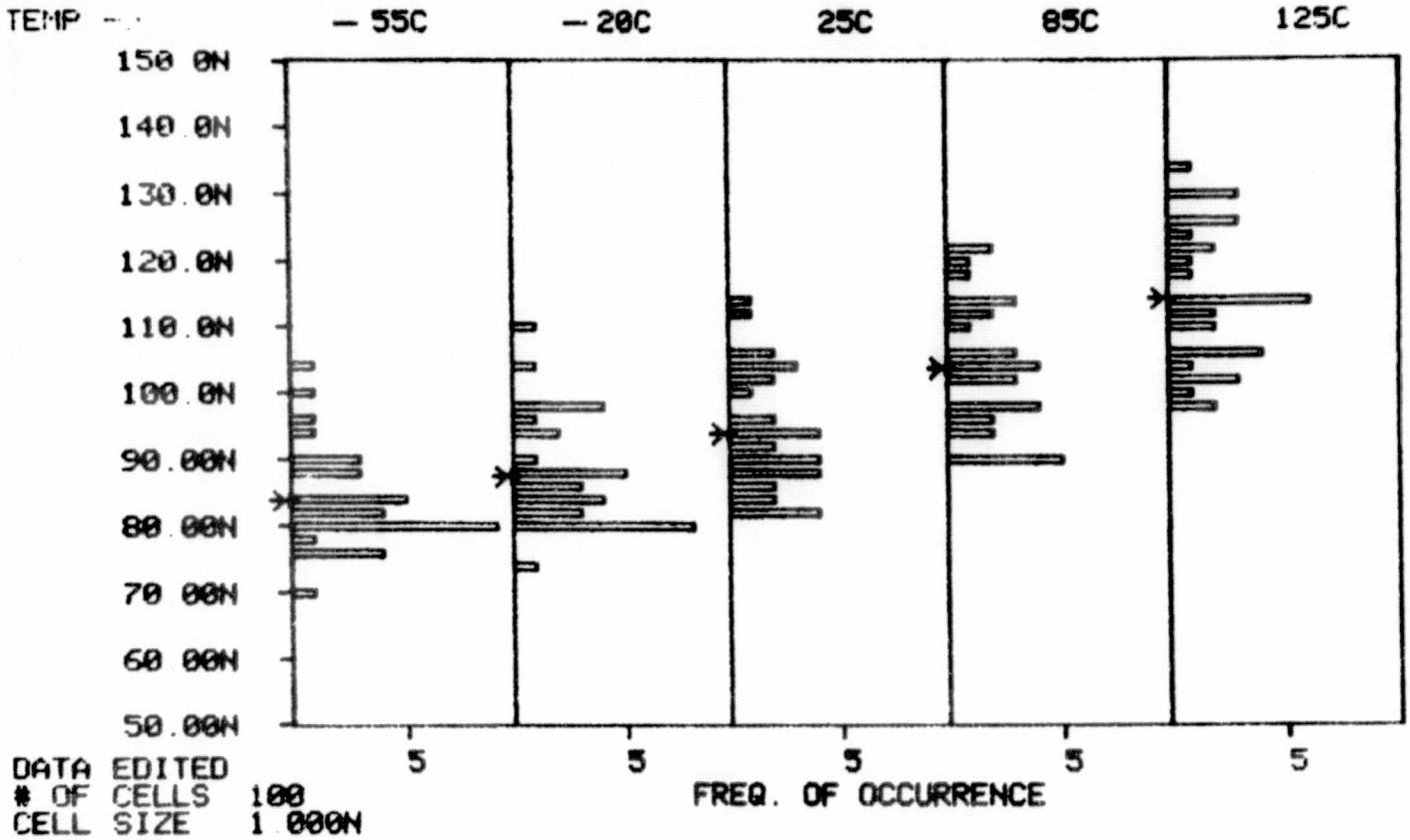
COMPONENTS DEPARTMENT TDOA1 AT VCC=5.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 2.700N

READINGS:	33	33	33	33	33
MAXIMUM:	364.0N	342.0N	318.0N	386.0N	328.0N
MEAN:	204.5N	206.8N	210.0N	215.9N	230.7N
MINIMUM:	136.0N	144.0N	152.0N	164.0N	178.0N
STD.DEV.:	52.00N	45.76N	38.71N	33.75N	33.70N

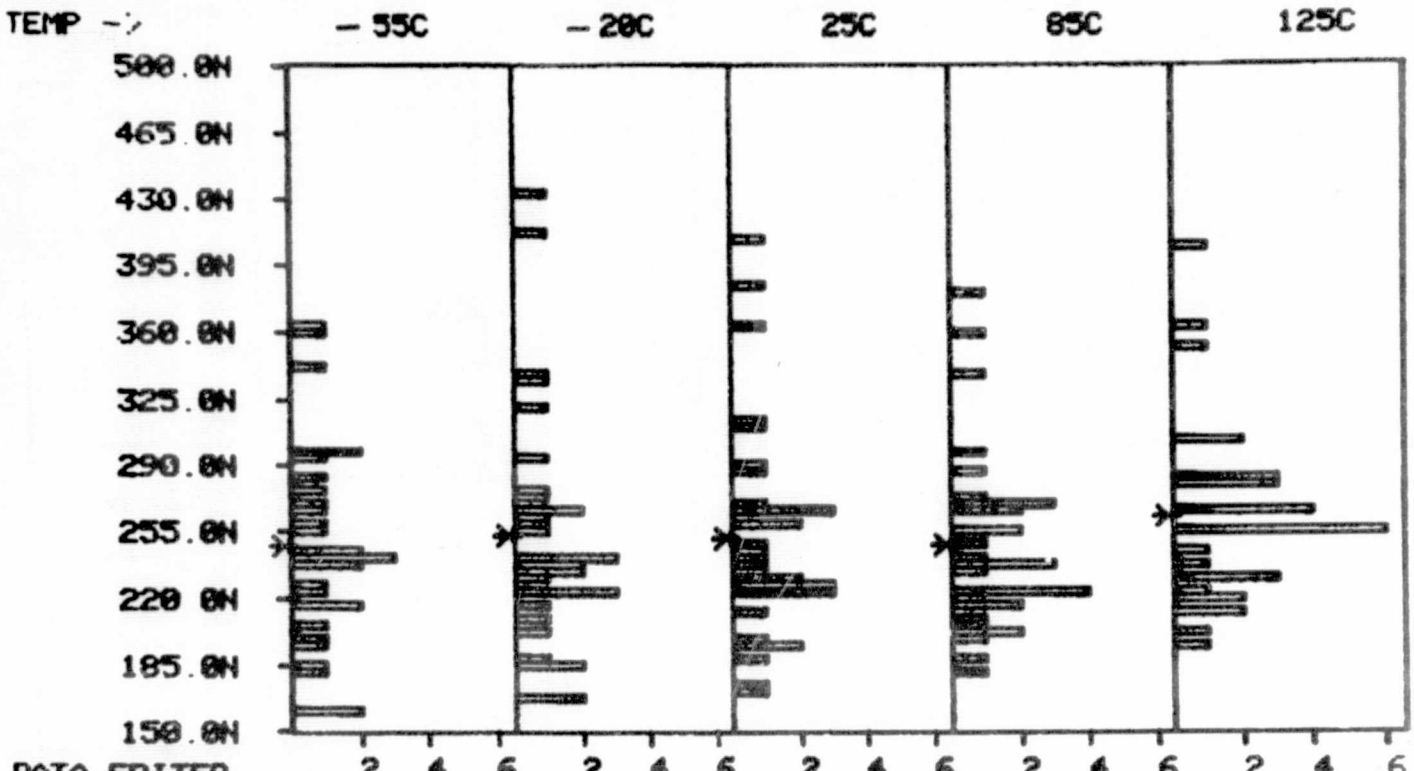
COMPONENTS DEPARTMENT TDOA1 AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 1 000N

READINGS:	34	34	34	33	33
MAXIMUM:	104.0N	110.0N	114.0N	122.0N	134.0N
MEAN:	83.76N	87.47N	93.71N	103.6N	114.1N
MINIMUM:	70.00N	74.00N	82.00N	90.00N	98 00N
STD DEV.:	7.182N	8.096N	8.879N	9.741N	10.33N

COMPONENTS DEPARTMENT TDOA2 AT VCC=4.5V 20 SEP 78

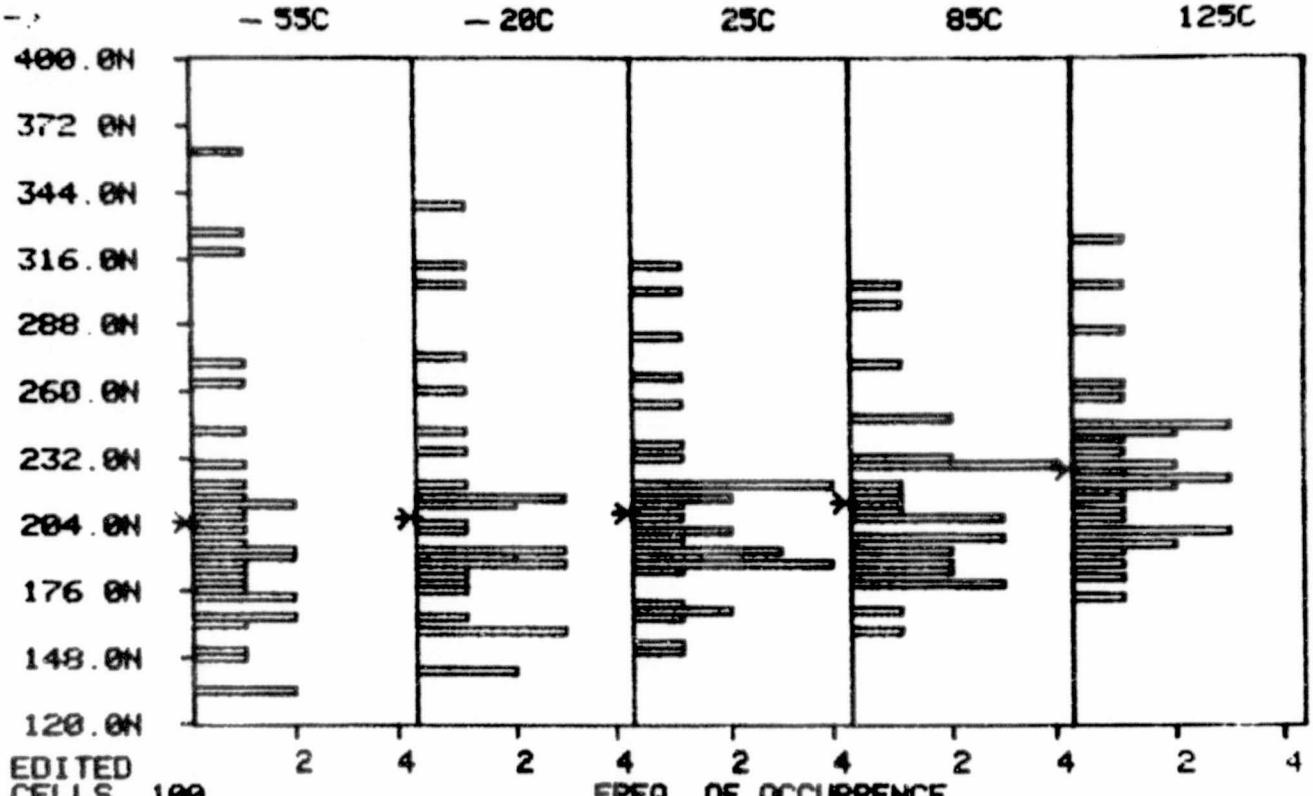


DATA EDITED
OF CELLS 100
CELL SIZE 3.500N

READINGS:	30	32	33	33	33
MAXIMUM:	364.0N	432.0N	410.0N	380.0N	406.0N
MEAN:	247.4N	252.6N	251.6N	248.1N	262.8N
MINIMUM:	162.0N	166.0N	172.0N	180.0N	194.0N
STD.DEV.:	51.68N	61.53N	55.49N	45.80N	45.68N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

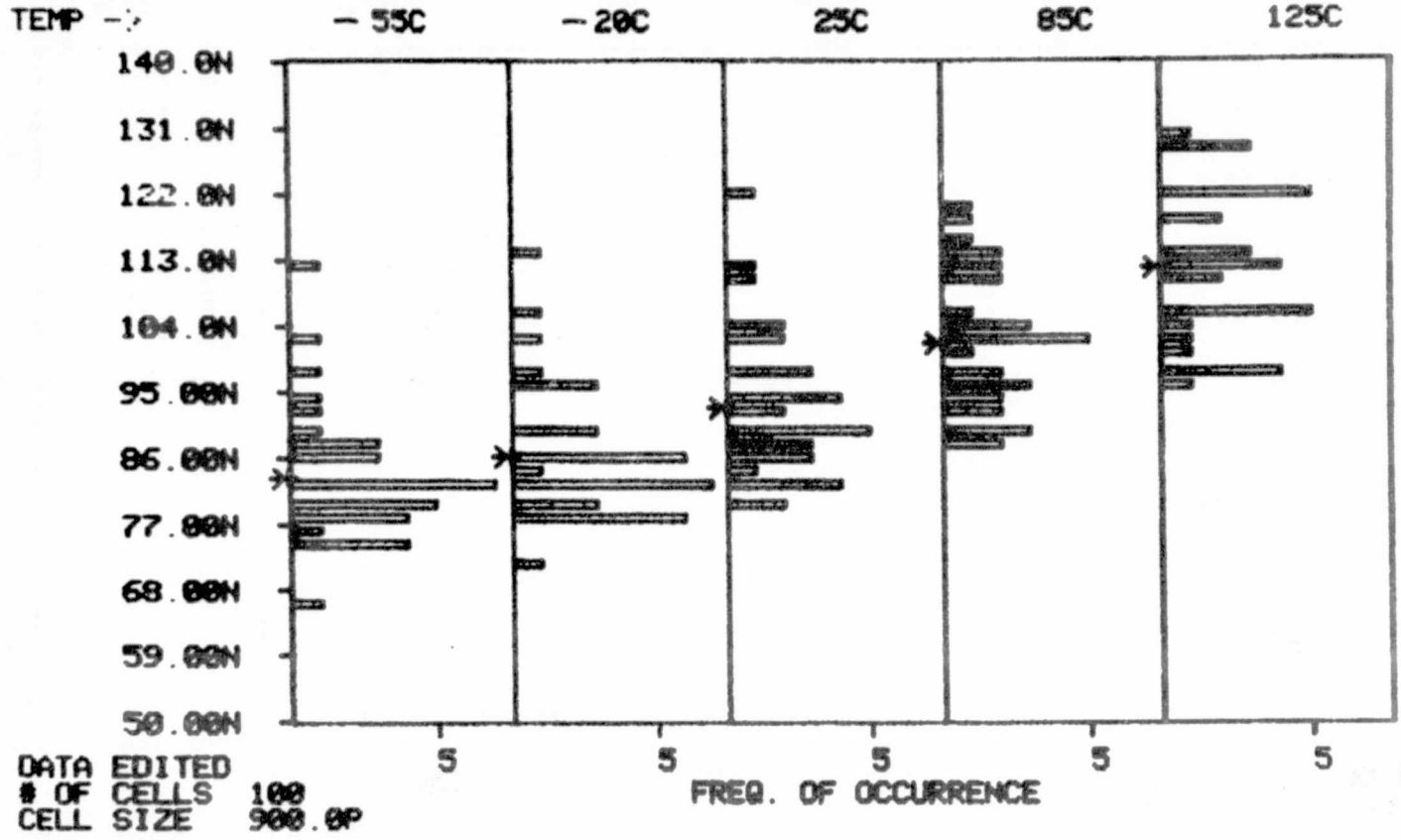
COMPONENTS DEPARTMENT TDOA2 AT VCC=5.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 2.800N

READINGS:	33	33	33	33	33
MAXIMUM:	362.0N	338.0N	314.0N	304.0N	324.0N
MEAN:	205.0N	206.7N	209.2N	213.3N	227.6N
MINIMUM:	134.0N	142.0N	150.0N	160.0N	174.0N
STD.DEV.:	52.87N	46.94N	39.27N	33.59N	33.38N

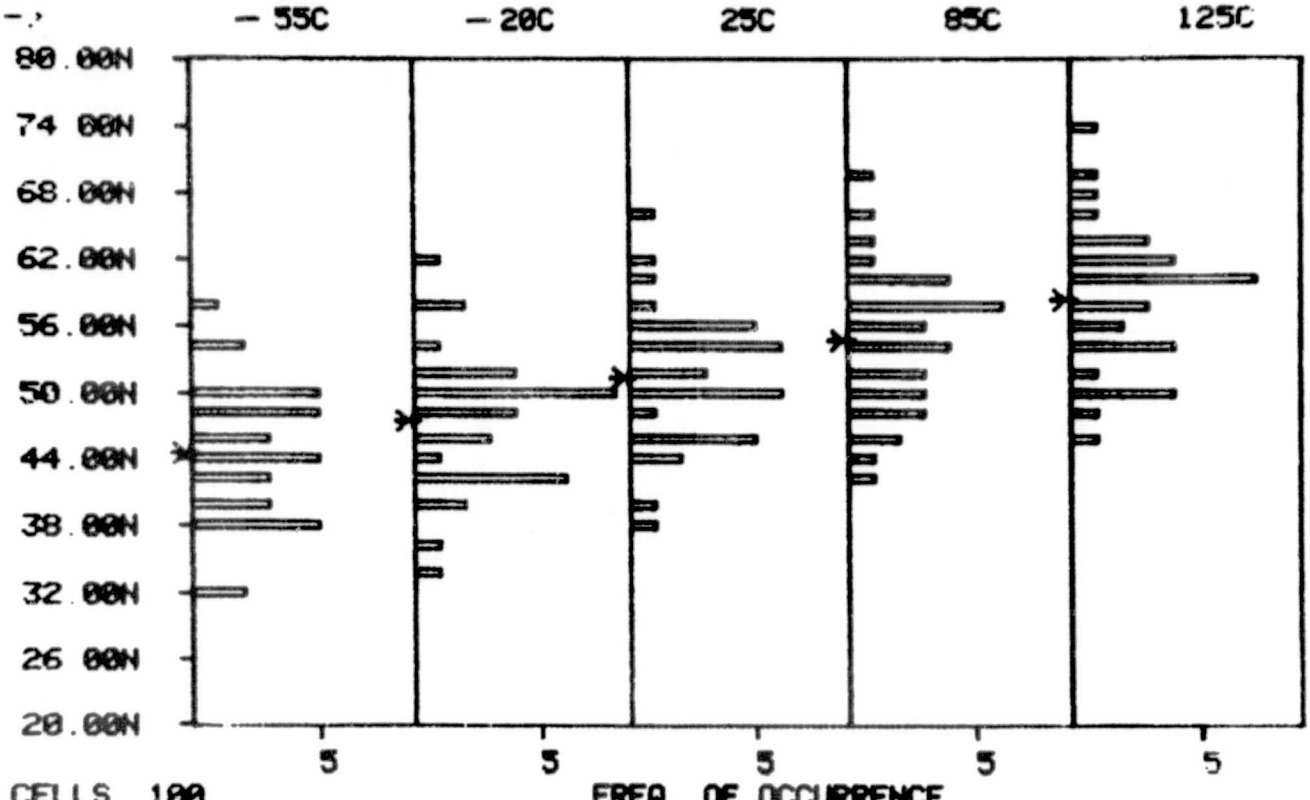
COMPONENTS DEPARTMENT TDOA2 AT VCC=10.0V 20 SEP 78



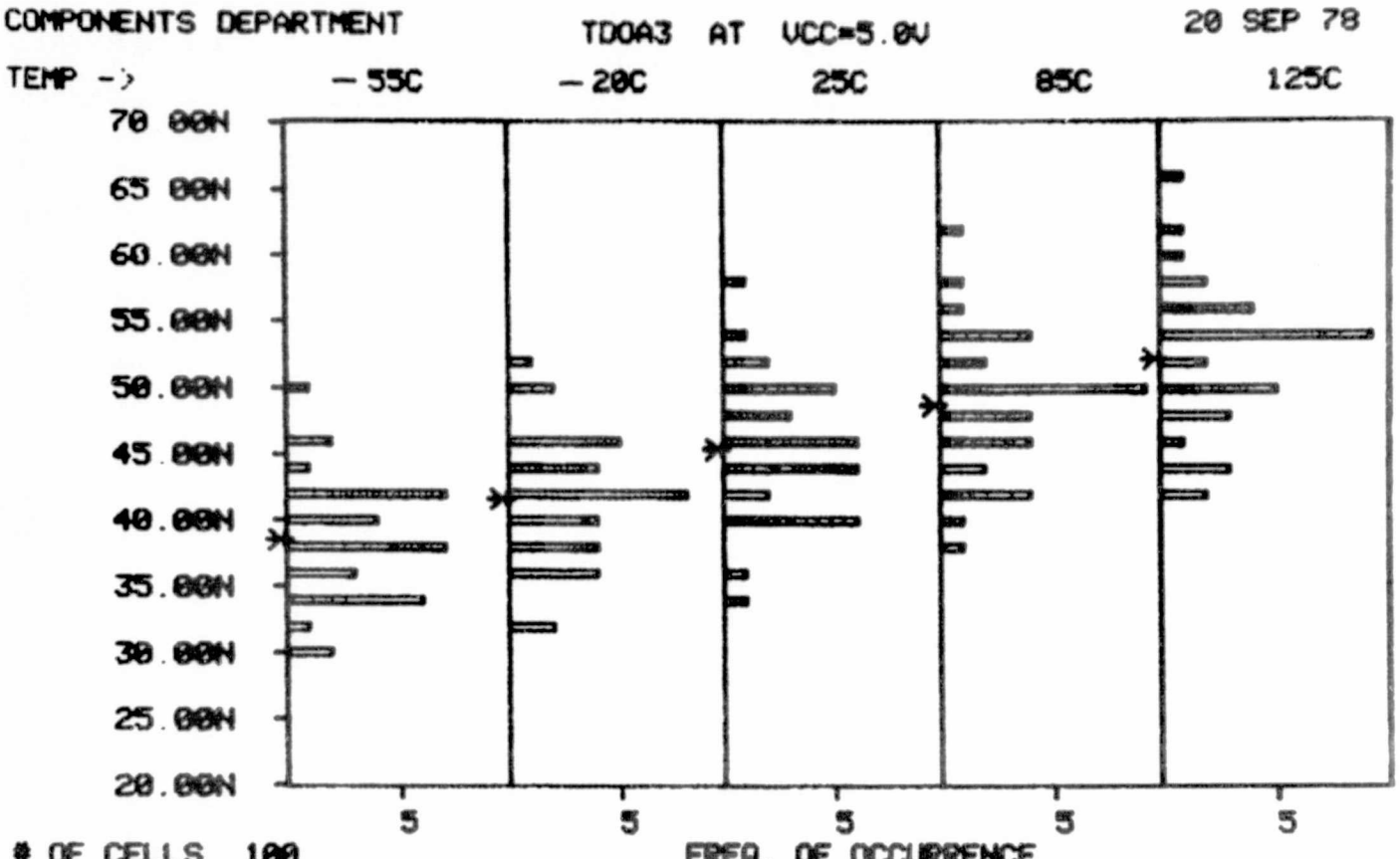
DATA EDITED
OF CELLS 100
CELL SIZE 900.0P

READINGS:	34	34	34	33	33
MAXIMUM:	112.0N	114.0N	122.0N	120.0N	130.0N
MEAN:	83.35N	86.24N	92.76N	101.7N	111.9N
MINIMUM:	66.00N	72.00N	80.00N	88.00N	96.00N
STD.DEV.:	8.859N	9.103N	9.762N	9.208N	10.02N

COMPONENTS DEPARTMENT TDOA3 AT VCC=4.5V 20 SEP 78



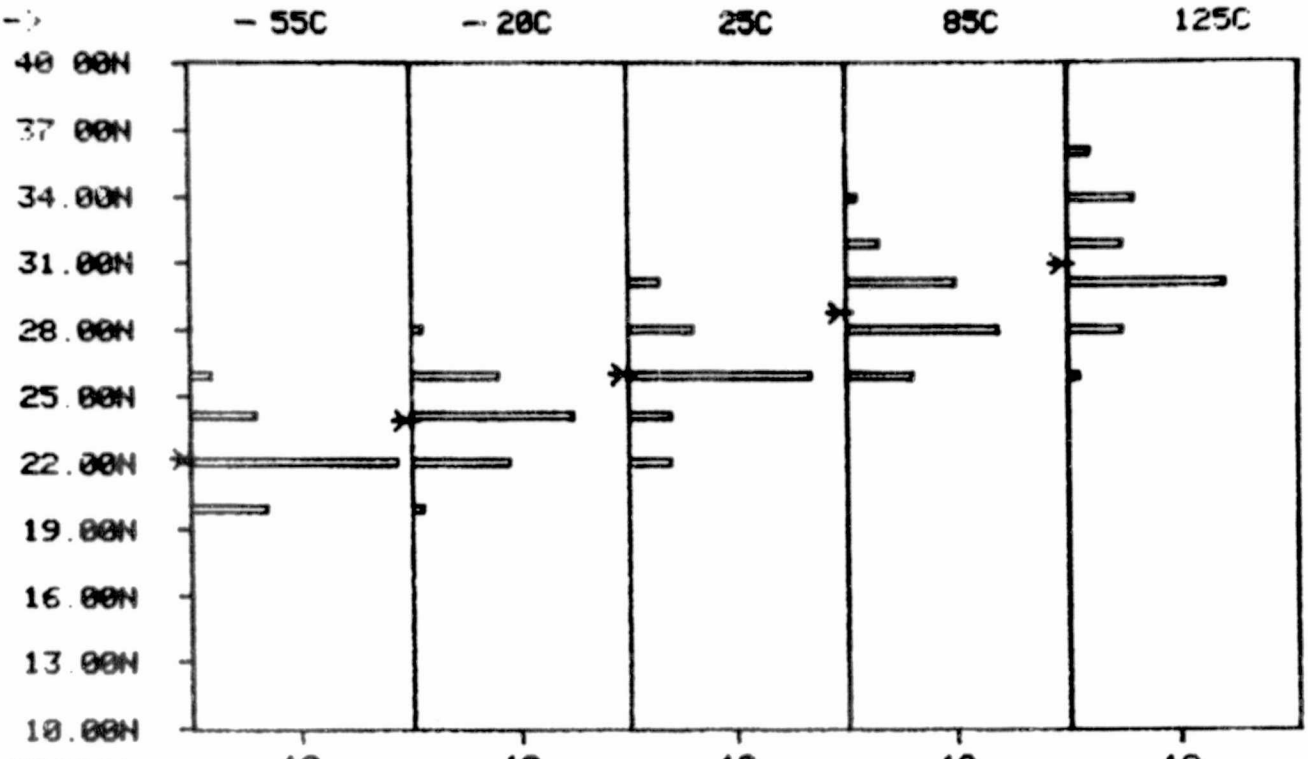
READINGS:	34	34	34	34	34
MAXIMUM:	58.00N	62.00N	66.00N	70.00N	74.00N
MEAN:	44.53N	47.53N	51.47N	54.76N	58.41N
MINIMUM:	32.00N	34.00N	38.00N	42.00N	46.00N
STD.DEV.:	5.996N	6.111N	5.976N	6.363N	6.434N



READINGS:	34	34	34	34	34
MAXIMUM:	50.00N	52.00N	58.00N	62.00N	66.00N
MEAN:	38.53N	41.59N	45.41N	48.71N	52.18N
MINIMUM:	30.00N	32.00N	34.00N	38.00N	42.00N
STD.DEV.:	4.601N	4.743N	5.153N	5.255N	5.579N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

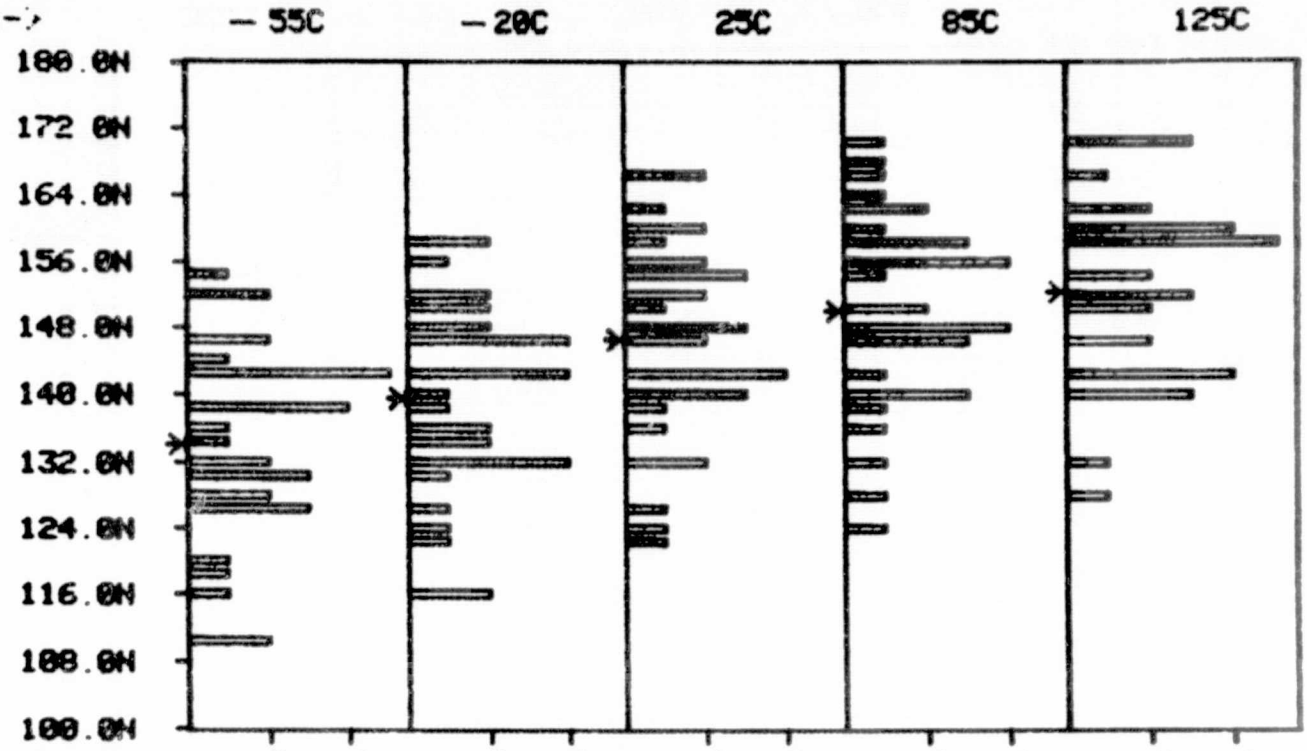
COMPONENTS DEPARTMENT TDQA3 AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 300 0P

READINGS:	34	34	34	34	33
MAXIMUM:	26.00N	28.00N	30.00N	34.00N	36.00N
MEAN:	22.18N	23.94N	26.00N	28.76N	30.97N
MINIMUM:	20.00N	20.00N	22.00N	26.00N	26.00N
STD DEV.:	1.585N	1.740N	2.146N	1.971N	2.456N

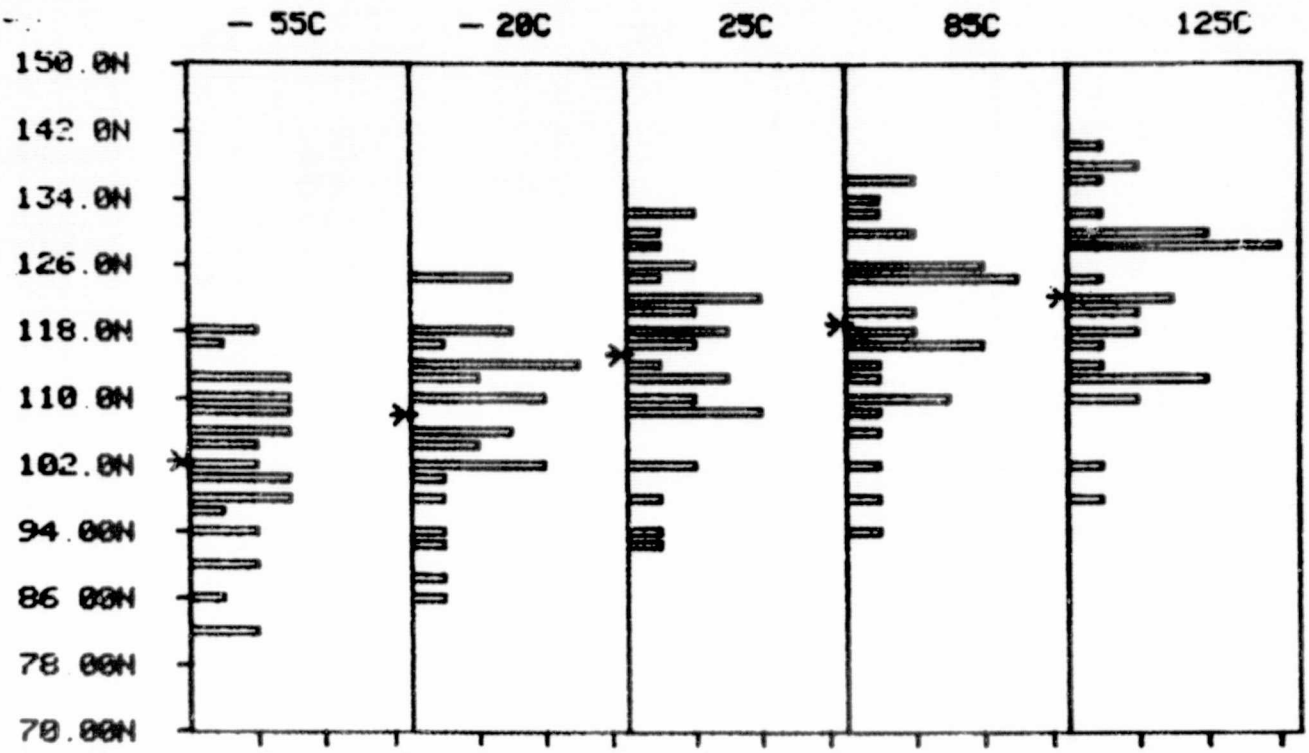
COMPONENTS DEPARTMENT TDOH1 AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 800.0P

READINGS:	32	33	33	33	33
MAXIMUM:	154.0N	158.0N	166.0N	170.0N	170.0N
MEAN:	134.0N	139.5N	146.5N	150.1N	152.5N
MINIMUM:	110.0N	116.0N	122.0N	124.0N	128.0N
STD.DEV.:	11.46N	11.27N	11.54N	11.41N	10.74N

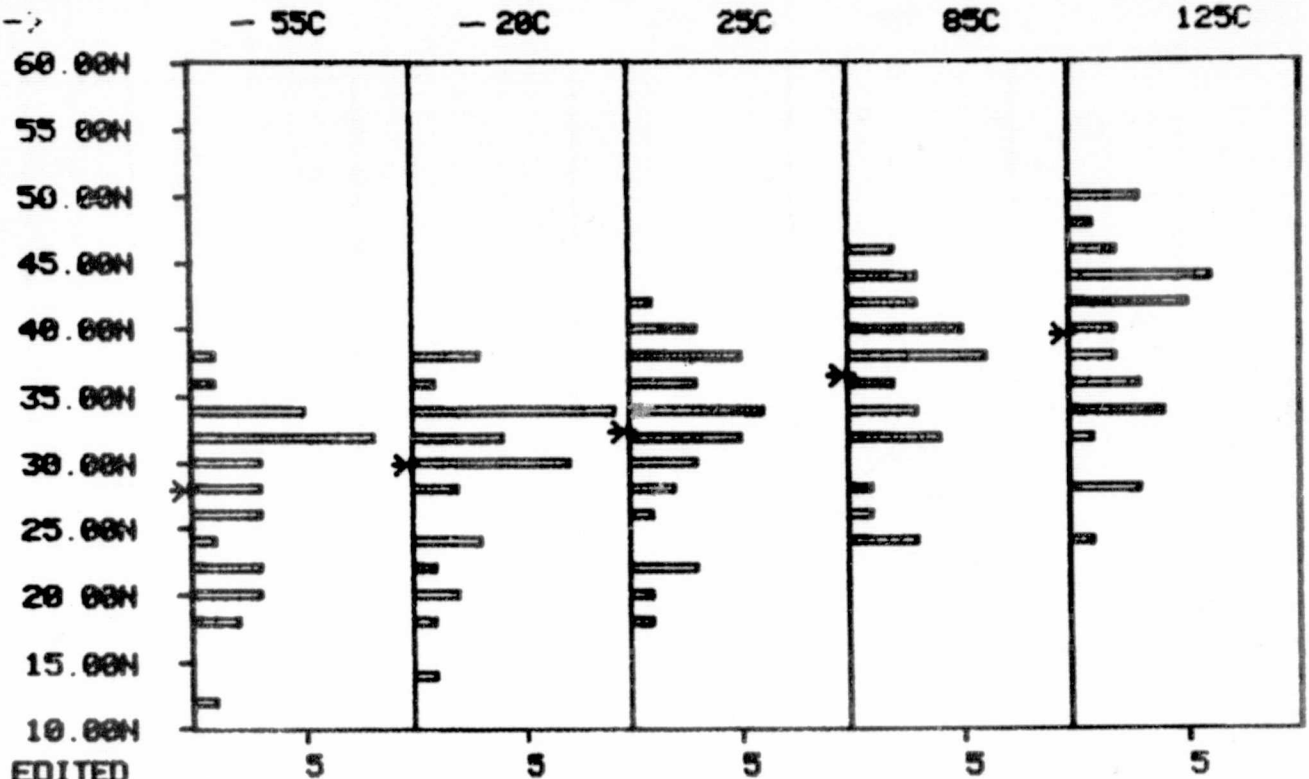
COMPONENTS DEPARTMENT TDOH1 AT VCC=5.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 800.0P

READINGS:	33	33	33	33	33
MAXIMUM:	118.0N	124.0N	132.0N	136.0N	140.0N
MEAN:	102.4N	108.1N	115.2N	119.0N	122.3N
MINIMUM:	82.00N	86.00N	92.00N	94.00N	98.00N
STD DEV.:	9.562N	9.759N	10.37N	10.51N	10.32N

COMPONENTS DEPARTMENT TDOH1 AT VCC=10.0V 20 SEP 78

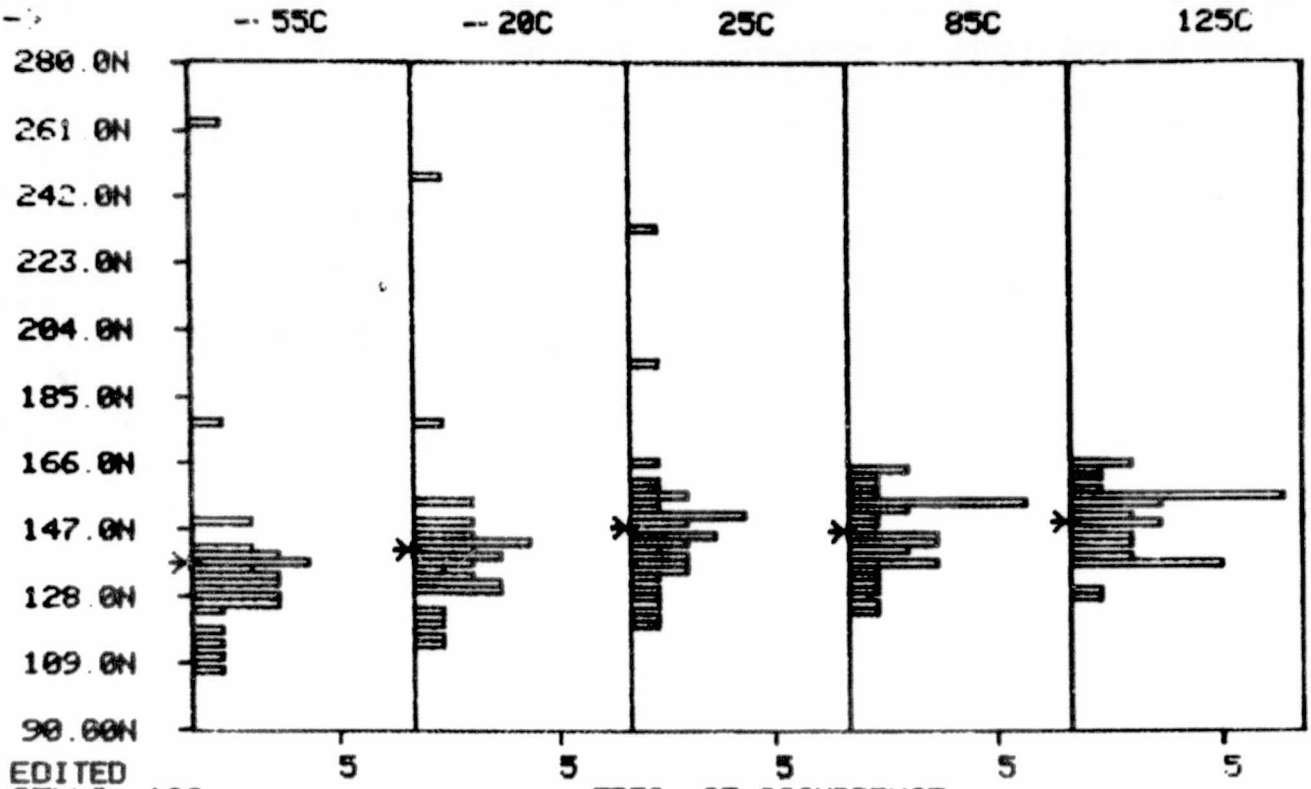


DATA EDITED
OF CELLS 100
CELL SIZE 500.0P

READINGS:	34	34	34	33	33
MAXIMUM:	38.00N	38.00N	42.00N	46.00N	50.00N
MEAN:	27.94N	29.88N	32.35N	36.55N	39.52N
MINIMUM:	12.00N	14.00N	18.00N	24.00N	24.00N
STD.DEV.:	6.198N	5.948N	6.179N	6.291N	6.838N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

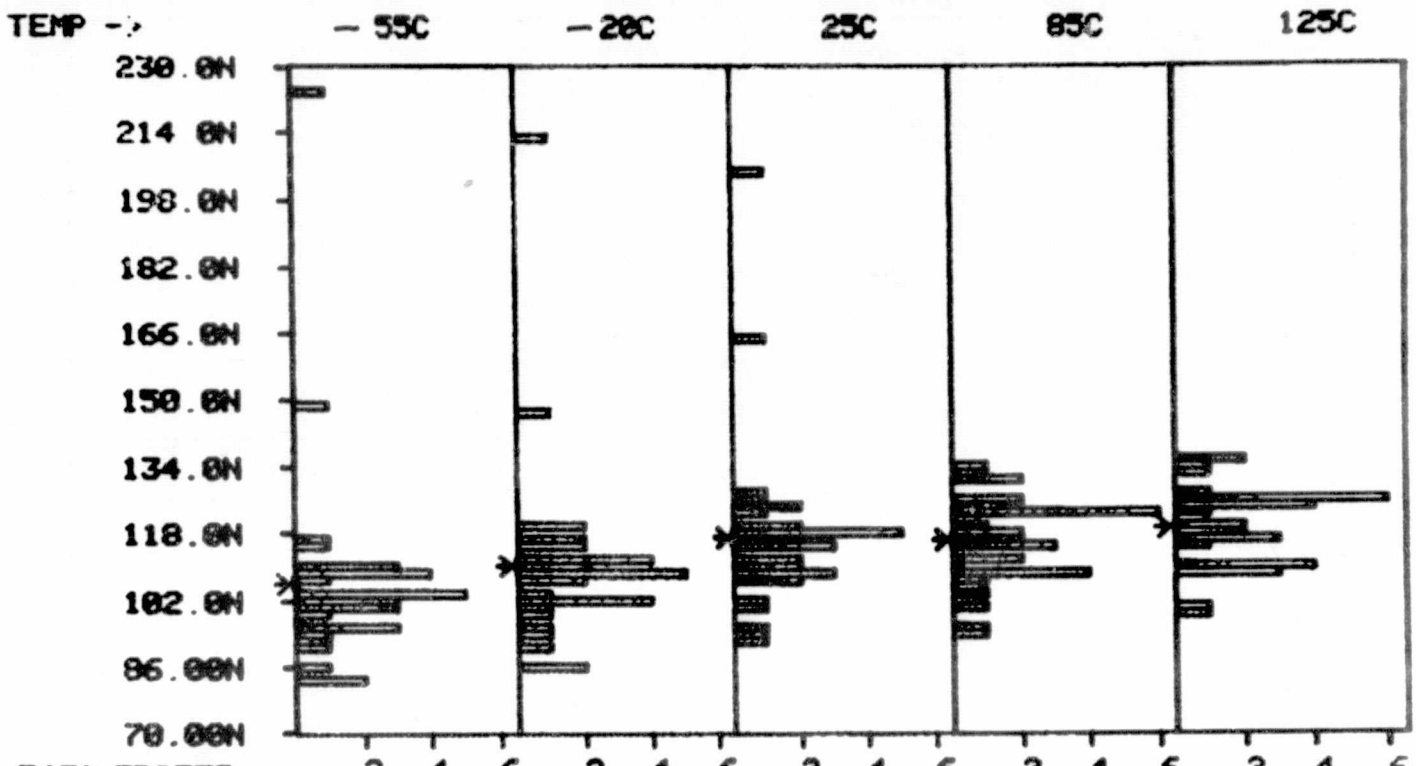
COMPONENTS DEPARTMENT TDOH2 AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 1.900N

READINGS:	32	33	33	33	33
MAXIMUM:	262.0N	248.0N	232.0N	164.0N	166.0N
MEAN:	137.4N	141.3N	147.9N	146.7N	149.2N
MINIMUM:	108.0N	114.0N	120.0N	124.0N	128.0N
STD.DEV.:	26.00N	22.73N	20.54N	10.64N	9.863N

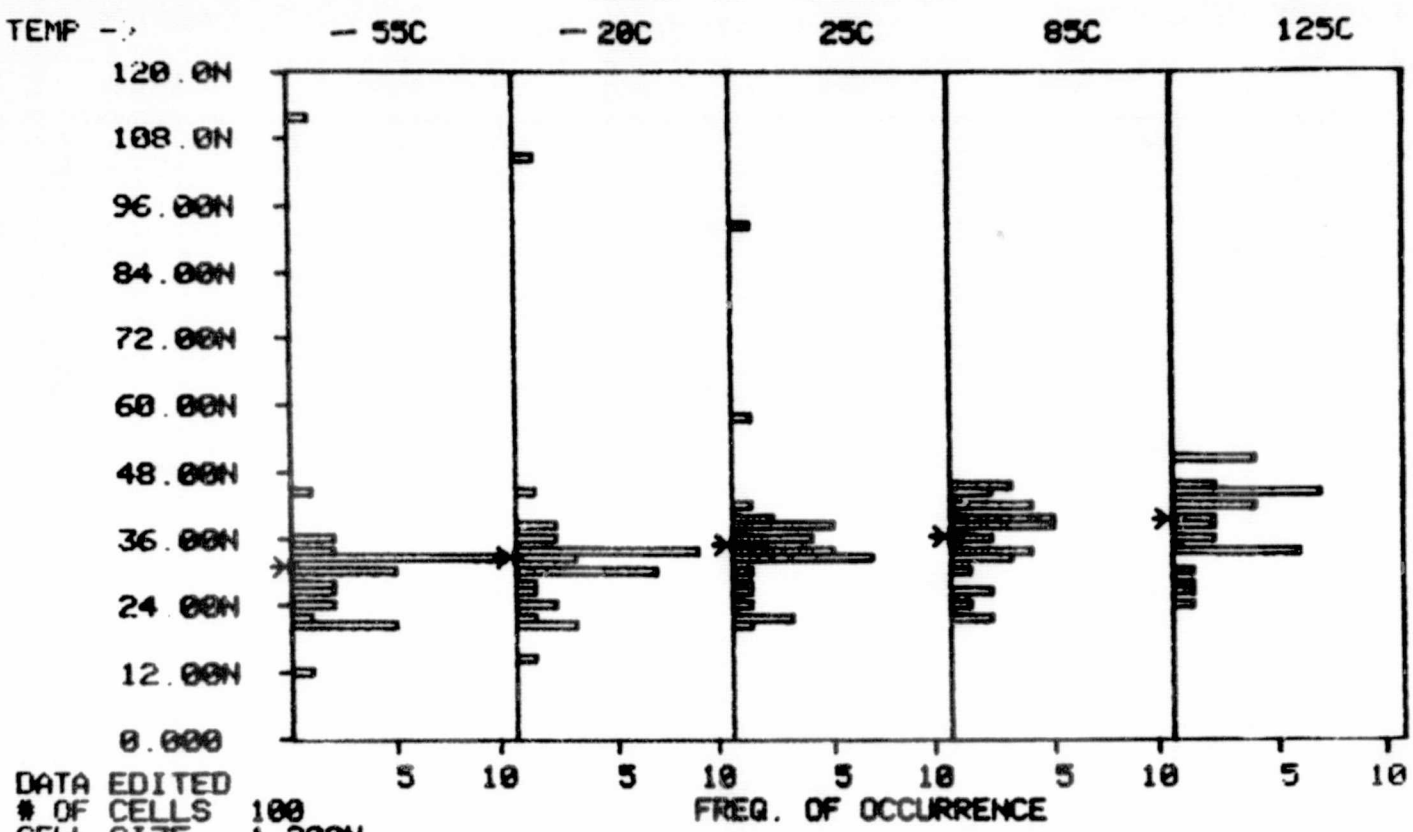
COMPONENTS DEPARTMENT TDOH2 AT VCC=5.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 1.600N

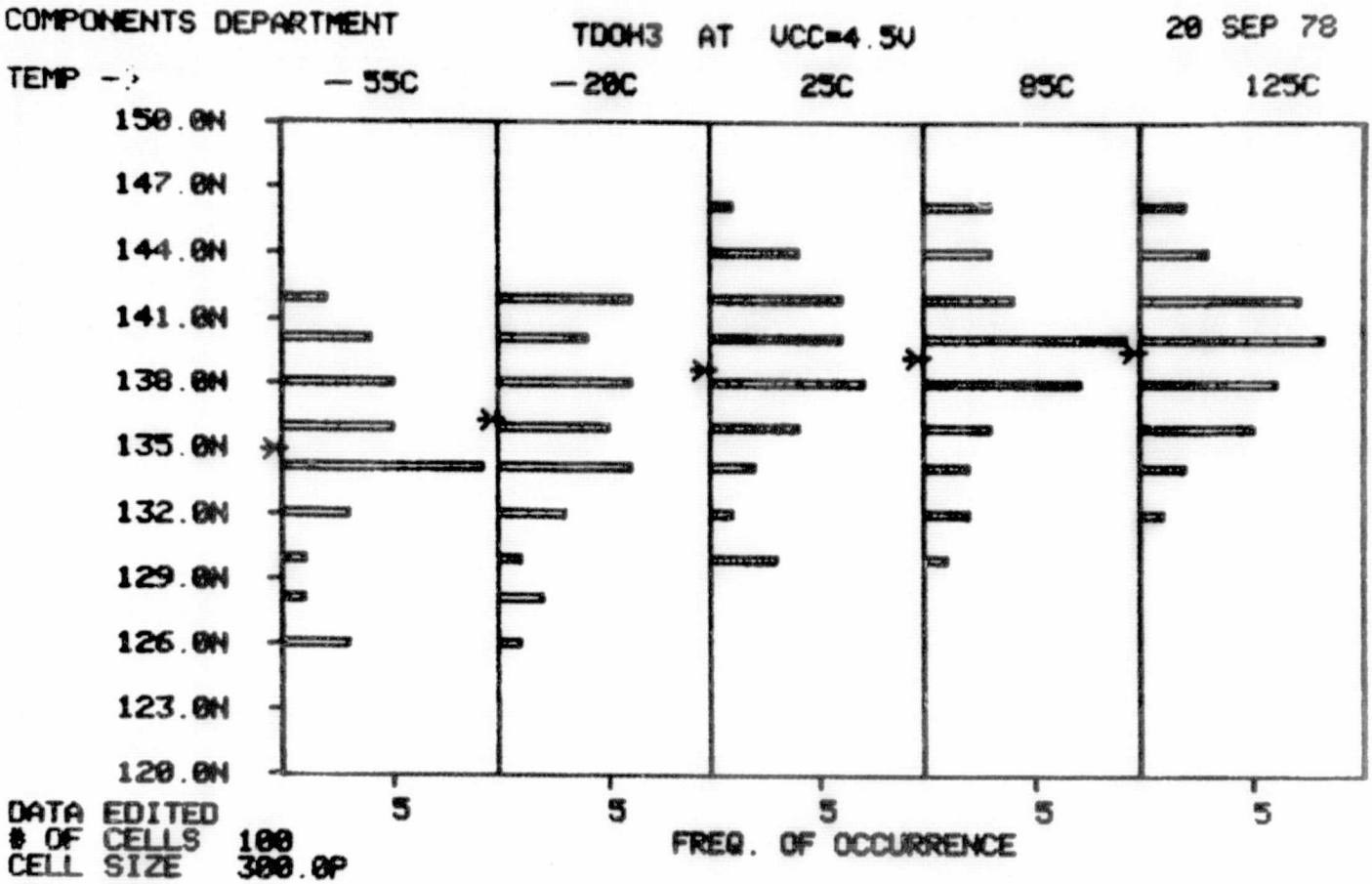
READINGS:	33	33	33	33	33
MAXIMUM:	224.0N	212.0N	204.0N	134.0N	136.0N
MEAN:	106.3N	110.3N	117.0N	116.5N	119.4N
MINIMUM:	82.00N	86.00N	92.00N	94.00N	98.00N
STD.DEV.:	24.11N	21.37N	20.08N	10.03N	9.676N

COMPONENTS DEPARTMENT TDOH2 AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 1.200N

READINGS:	34	34	34	34	33
MAXIMUM:	112.0N	104.0N	92.00N	46.00N	50.00N
MEAN:	31.06N	32.53N	35.12N	36.41N	39.64N
MINIMUM:	12.00N	14.00N	20.00N	22.00N	24.00N
STD.DEV.	15.60N	14.06N	12.31N	6.747N	6.955N

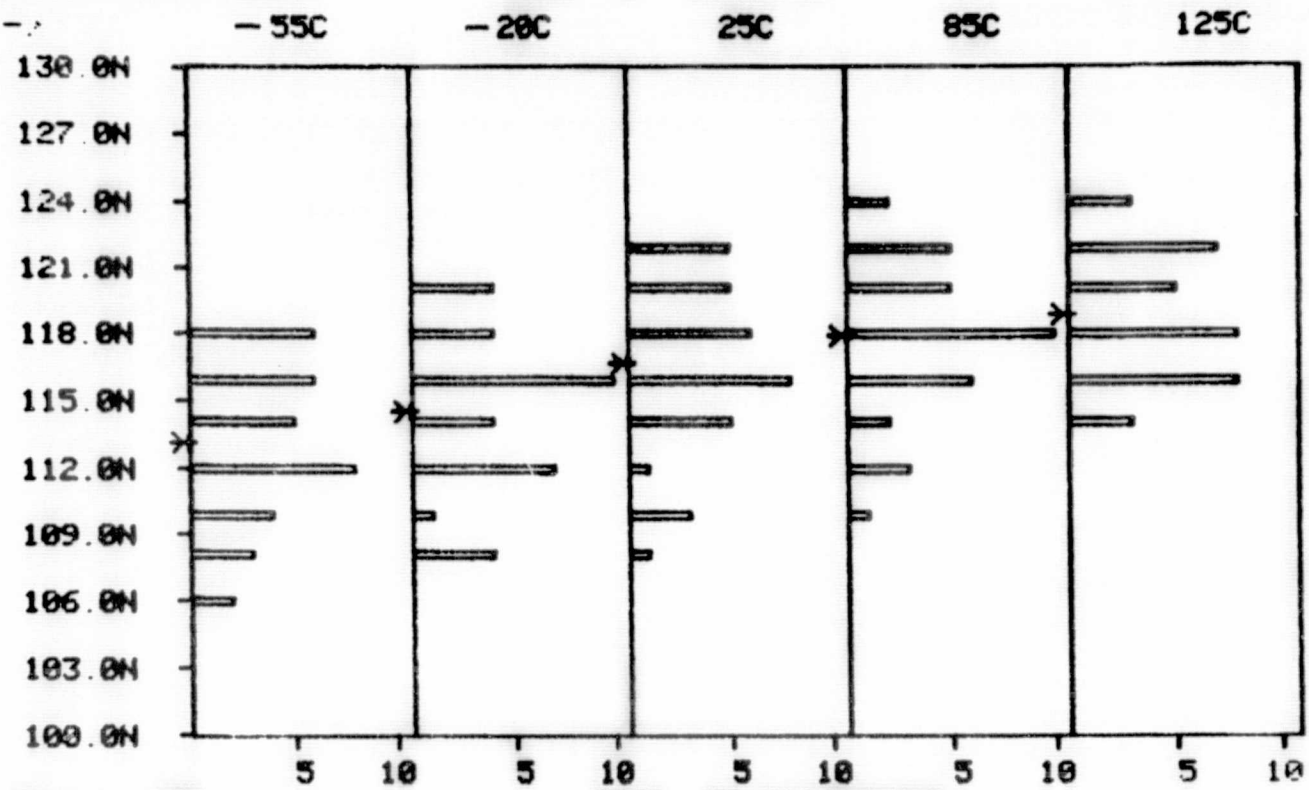


DATA EDITED
OF CELLS 100
CELL SIZE 300.0P

READINGS:	33	34	34	34	34
MAXIMUM:	142.0N	142.0N	146.0N	146.0N	146.0N
MEAN:	134.9N	136.2N	138.6N	139.2N	139.6N
MINIMUM:	126.0N	126.0N	130.0N	130.0N	132.0N
STD.DEV.:	4.332N	4.401N	4.232N	4.008N	3.411N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

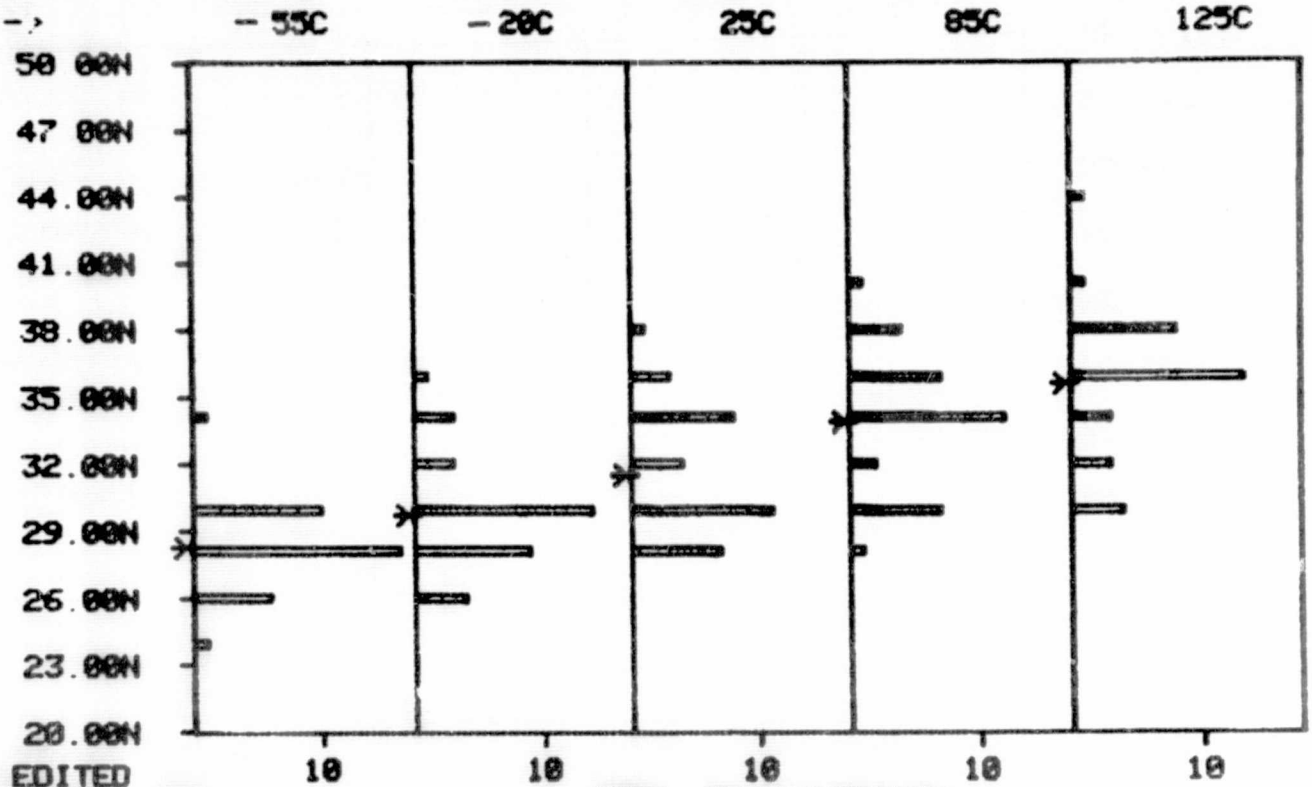
COMPONENTS DEPARTMENT TDOH3 AT VCC=5.0V 20 SEP 78



OF CELLS 100
CELL SIZE 300.0P

READINGS:	34	34	34	34	34
MAXIMUM:	118.0N	120.0N	122.0N	124.0N	124.0N
MEAN:	113.1N	114.5N	116.6N	117.9N	118.8N
MINIMUM:	106.0N	108.0N	108.0N	110.0N	114.0N
STD.DEV.:	3.593N	3.601N	3.810N	3.485N	3.001N

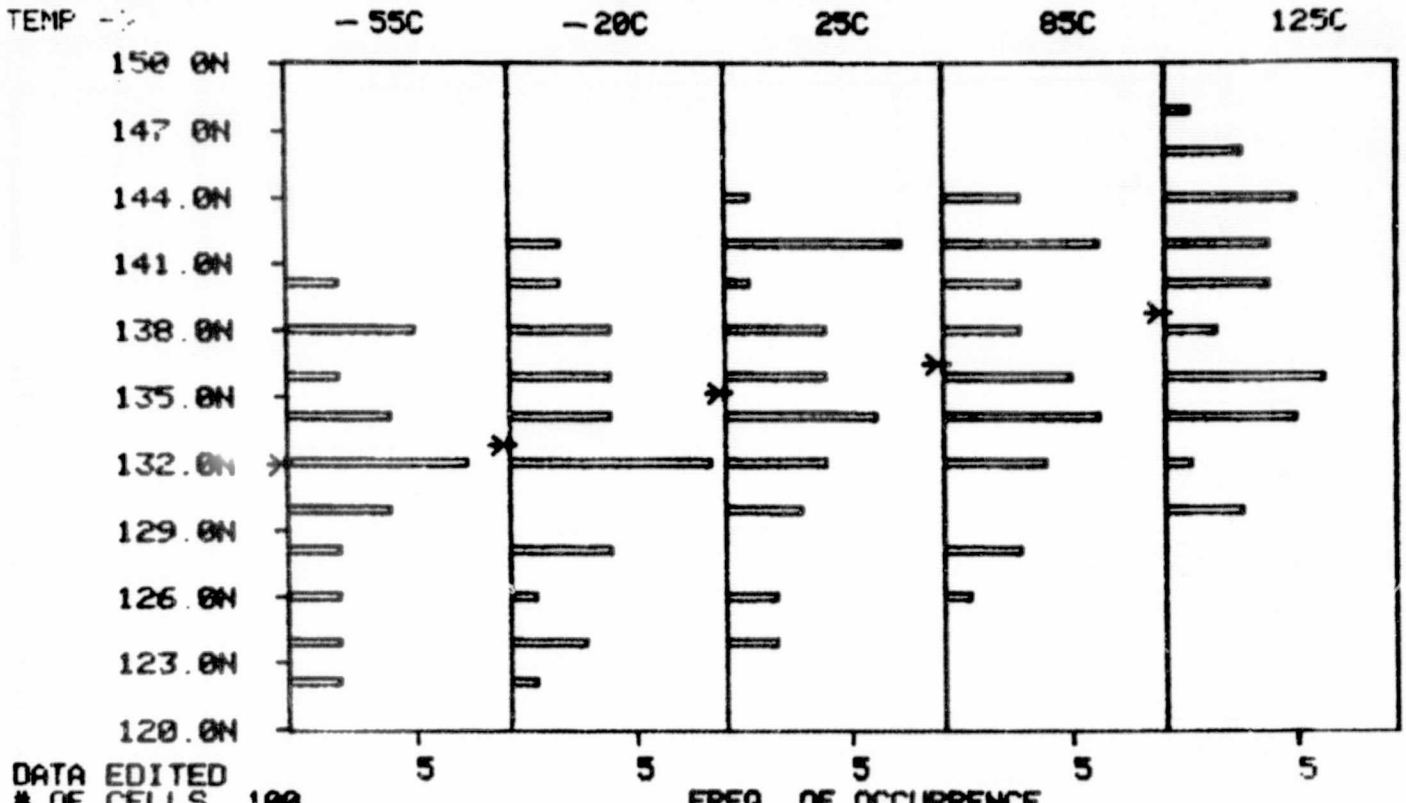
COMPONENTS DEPARTMENT TDOH3 AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 300.0P

READINGS:	34	34	34	34	33
MAXIMUM:	34.00N	36.00N	38.00N	40.00N	44.00N
MEAN:	28.29N	29.71N	31.53N	33.94N	35.58N
MINIMUM:	24.00N	26.00N	28.00N	28.00N	30.00N
STD.DEV.:	1.851N	2.419N	2.831N	2.933N	3.113N

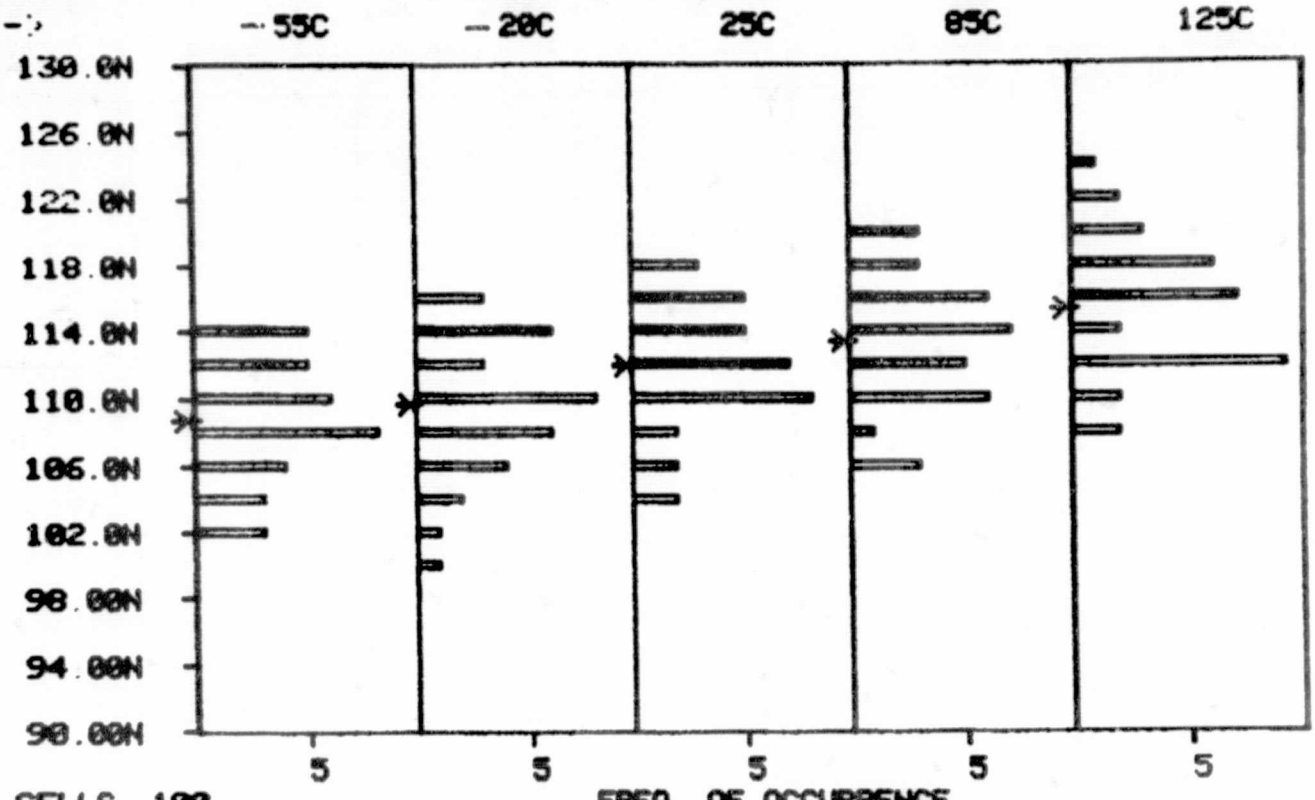
COMPONENTS DEPARTMENT TPDH AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 300.0P

READINGS:	32	33	34	34	34
MAXIMUM:	140.0N	142.0N	144.0N	144.0N	148.0N
MEAN:	131.9N	132.8N	135.2N	136.5N	138.8N
MINIMUM:	122.0N	122.0N	124.0N	126.0N	130.0N
STD.DEV.:	5.096N	5.366N	5.534N	5.051N	5.119N

COMPONENTS DEPARTMENT TPDH AT VCC=5.0V 20 SEP 78

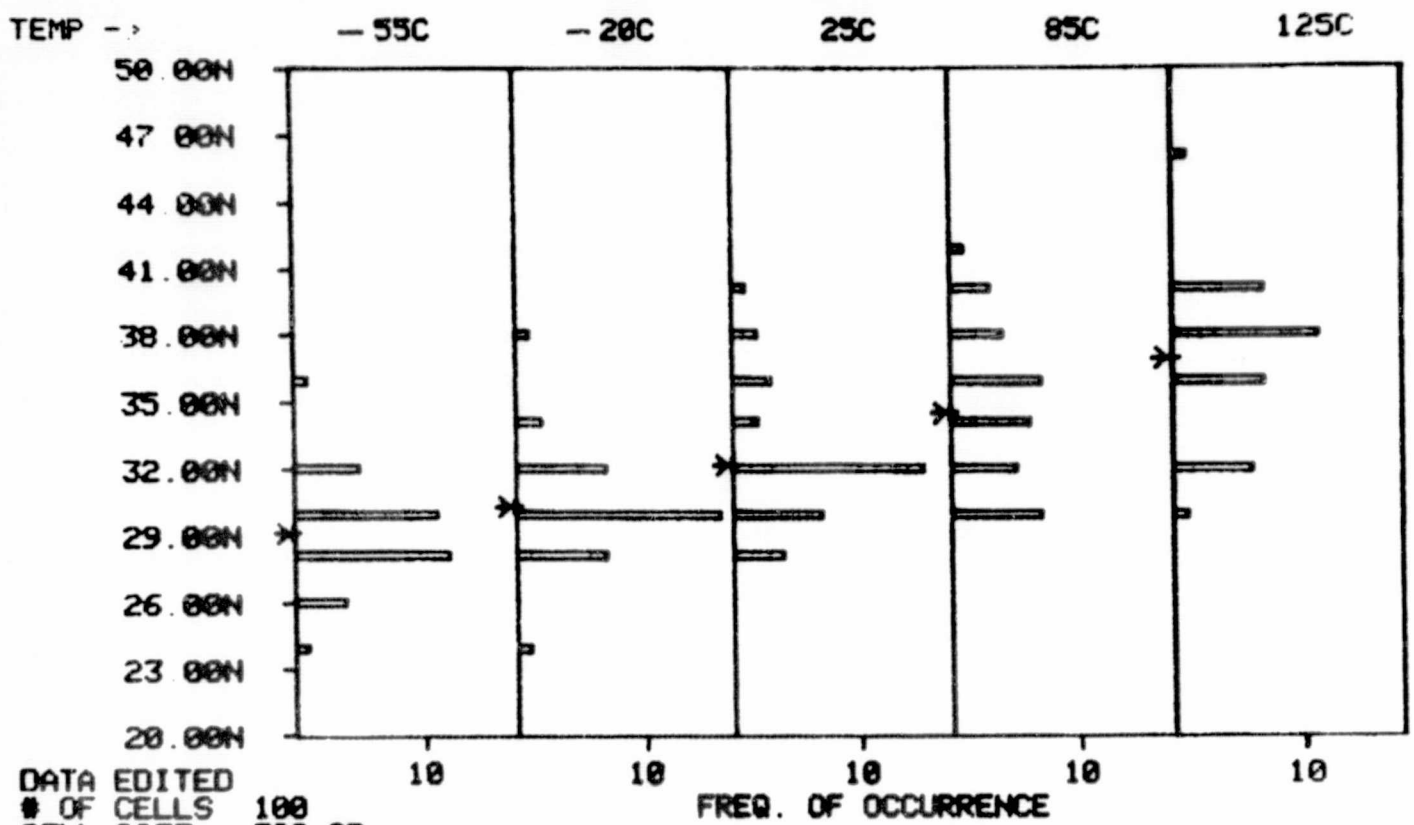


OF CELLS 100
CELL SIZE 400.0P

READINGS:	34	34	34	34	34
MAXIMUM:	114.0N	116.0N	118.0N	120.0N	124.0N
MEAN:	108.7N	109.7N	111.9N	113.4N	115.3N
MINIMUM:	102.0N	100.0N	104.0N	106.0N	108.0N
STD.DEV.:	3.650N	4.033N	3.780N	3.936N	4.060N

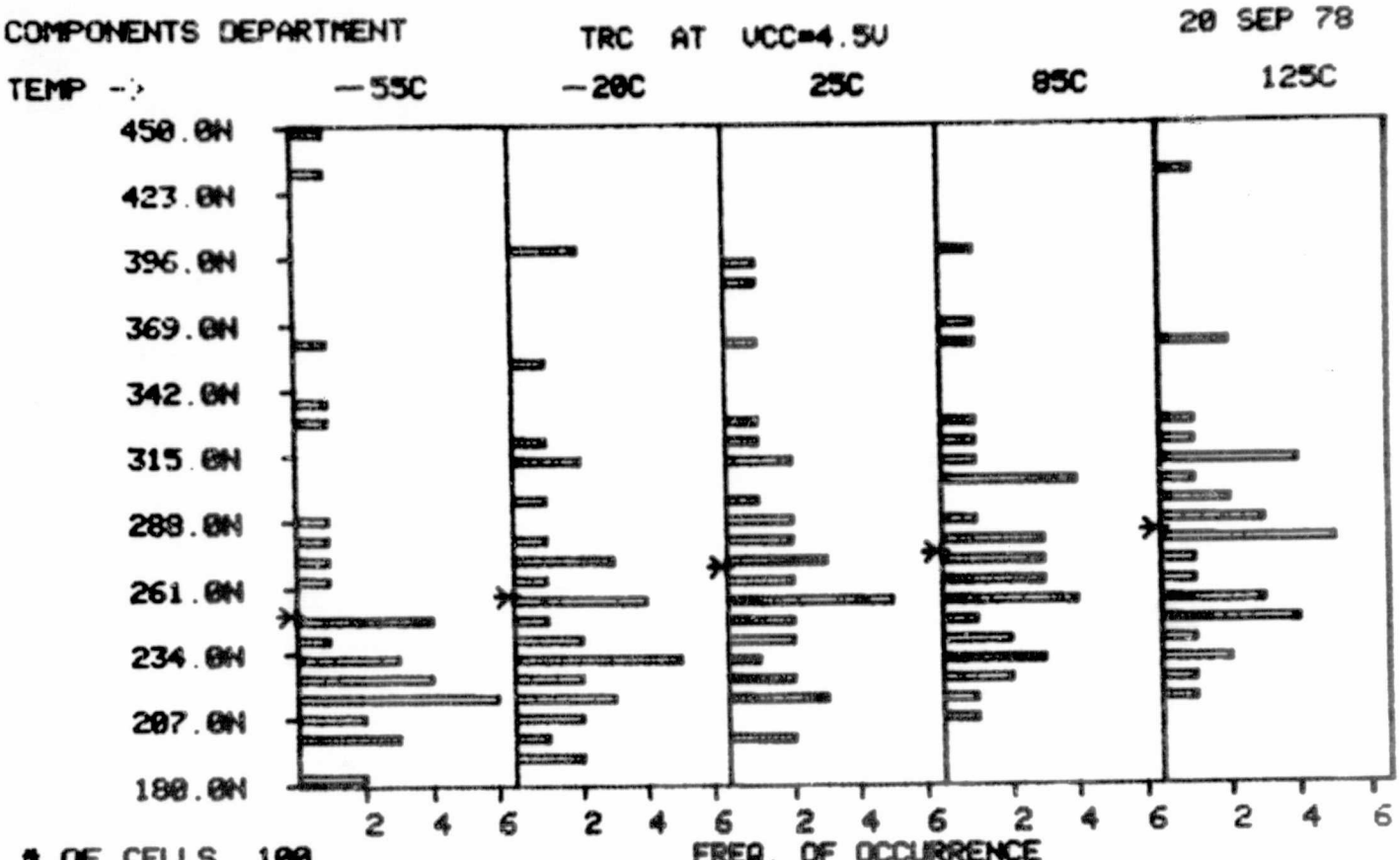
REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

COMPONENTS DEPARTMENT TPDH AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 300.0P

READINGS:	34	34	34	33	33
MAXIMUM:	36.00N	38.00N	40.00N	42.00N	46.00N
MEAN:	29.12N	30.29N	32.18N	34.55N	36.91N
MINIMUM:	24.00N	24.00N	28.00N	30.00N	30.00N
STD.DEV.:	2.320N	2.368N	2.928N	3.474N	3.358N

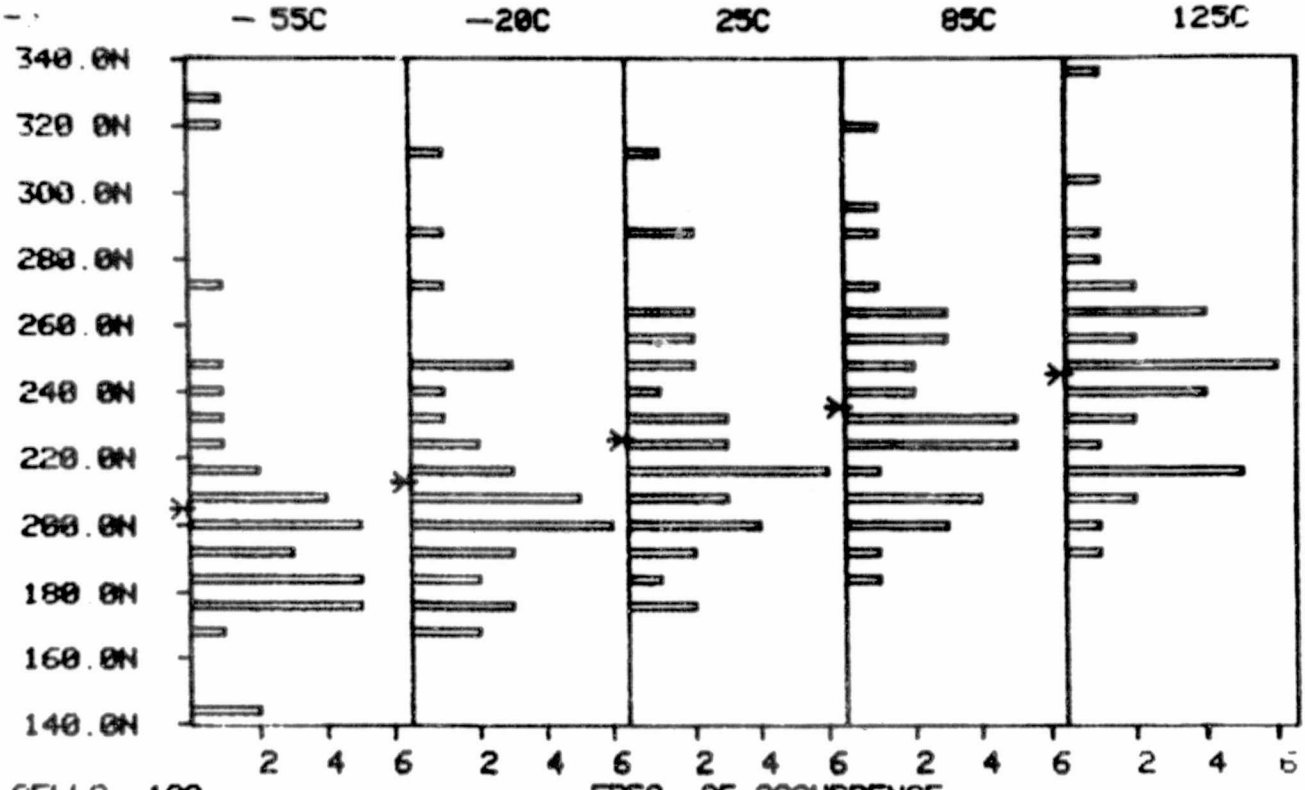


OF CELLS 100
CELL SIZE 2.700N

READINGS:	34	34	34	34	34
MAXIMUM:	448.0N	400.0N	392.0N	400.0N	432.0N
MEAN:	250.4N	257.6N	269.6N	275.3N	283.8N
MINIMUM:	184.0N	192.0N	200.0N	208.0N	216.0N
STD.DEV.:	63.10N	52.28N	47.66N	44.39N	44.14N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

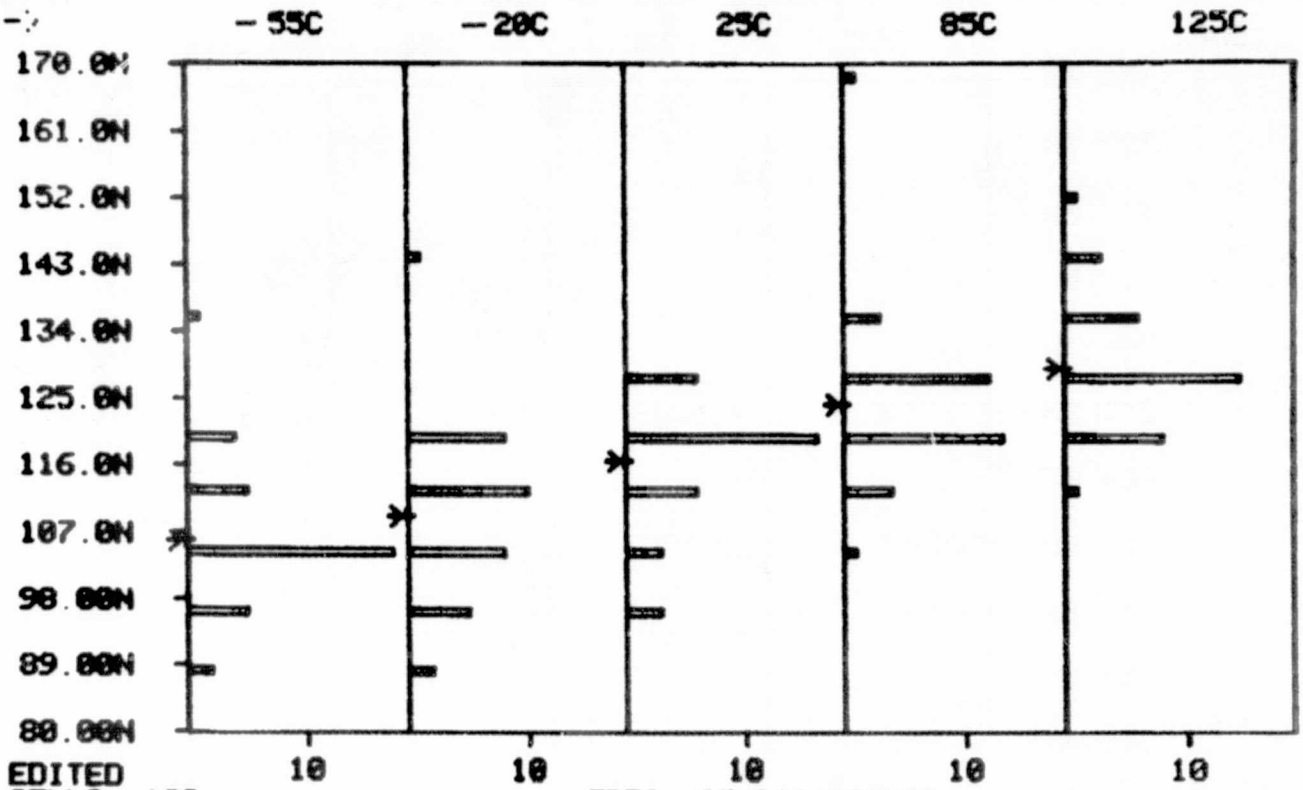
COMPONENTS DEPARTMENT TRC AT VCC=5.0V 20 SEP 78



OF CELLS 100
CELL SIZE 2.000N

READINGS:	34	34	34	34	34
MAXIMUM:	328.0N	312.0N	312.0N	320.0N	336.0N
MEAN:	204.7N	212.7N	225.6N	235.8N	245.4N
MINIMUM:	144.0N	168.0N	176.0N	184.0N	192.0N
STD.DEV :	40.13N	33.14N	32.29N	30.84N	30.49N

COMPONENTS DEPARTMENT TRC AT VCC=10.0V 20 SEP 78

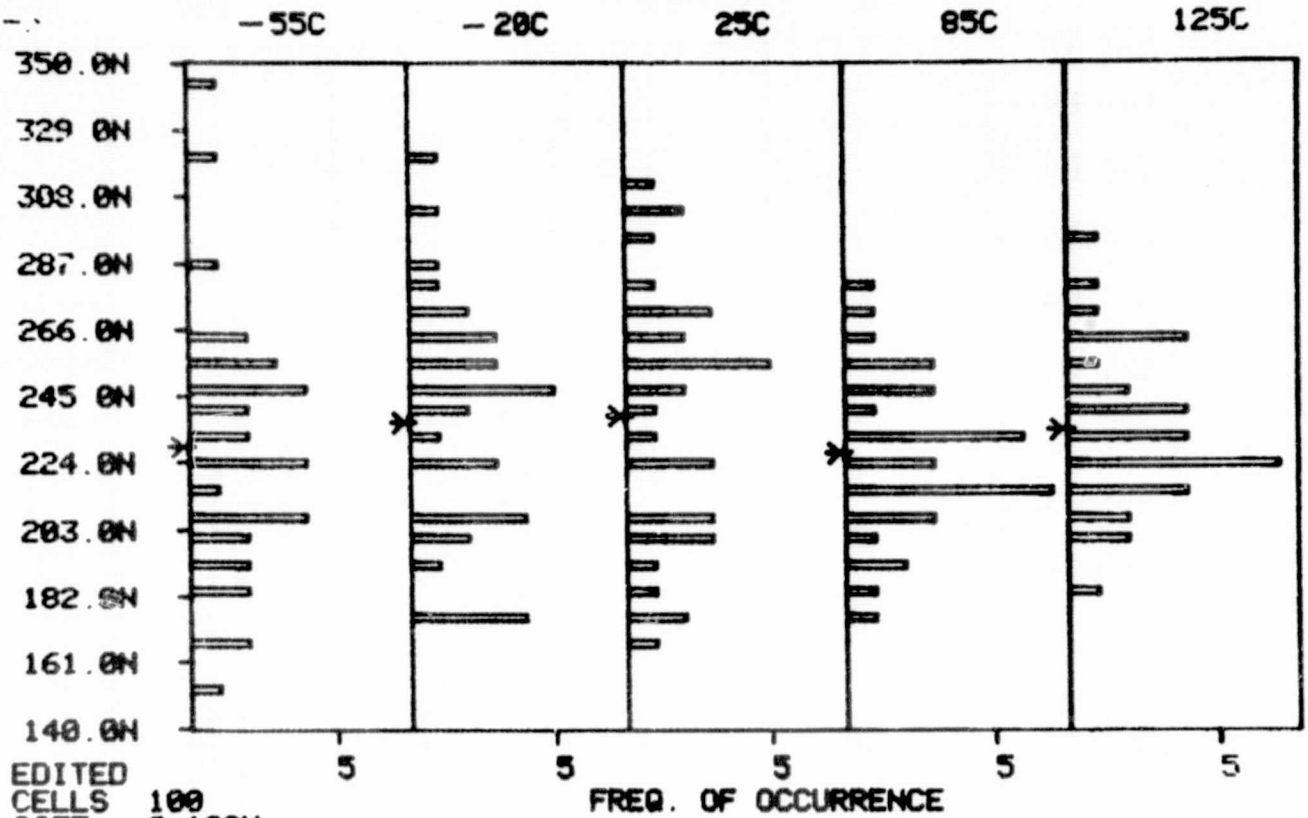


DATA EDITED
OF CELLS 100
CELL SIZE 900.0P

READINGS:	34	34	34	34	33
MAXIMUM:	136.0N	144.0N	128.0N	168.0N	152.0N
MEAN:	105.9N	109.2N	116.5N	124.2N	129.2N
MINIMUM:	88.00N	88.00N	96.00N	104.0N	112.0N
STD.DEV.:	9.661N	11.29N	9.279N	10.65N	8.748N

C-2

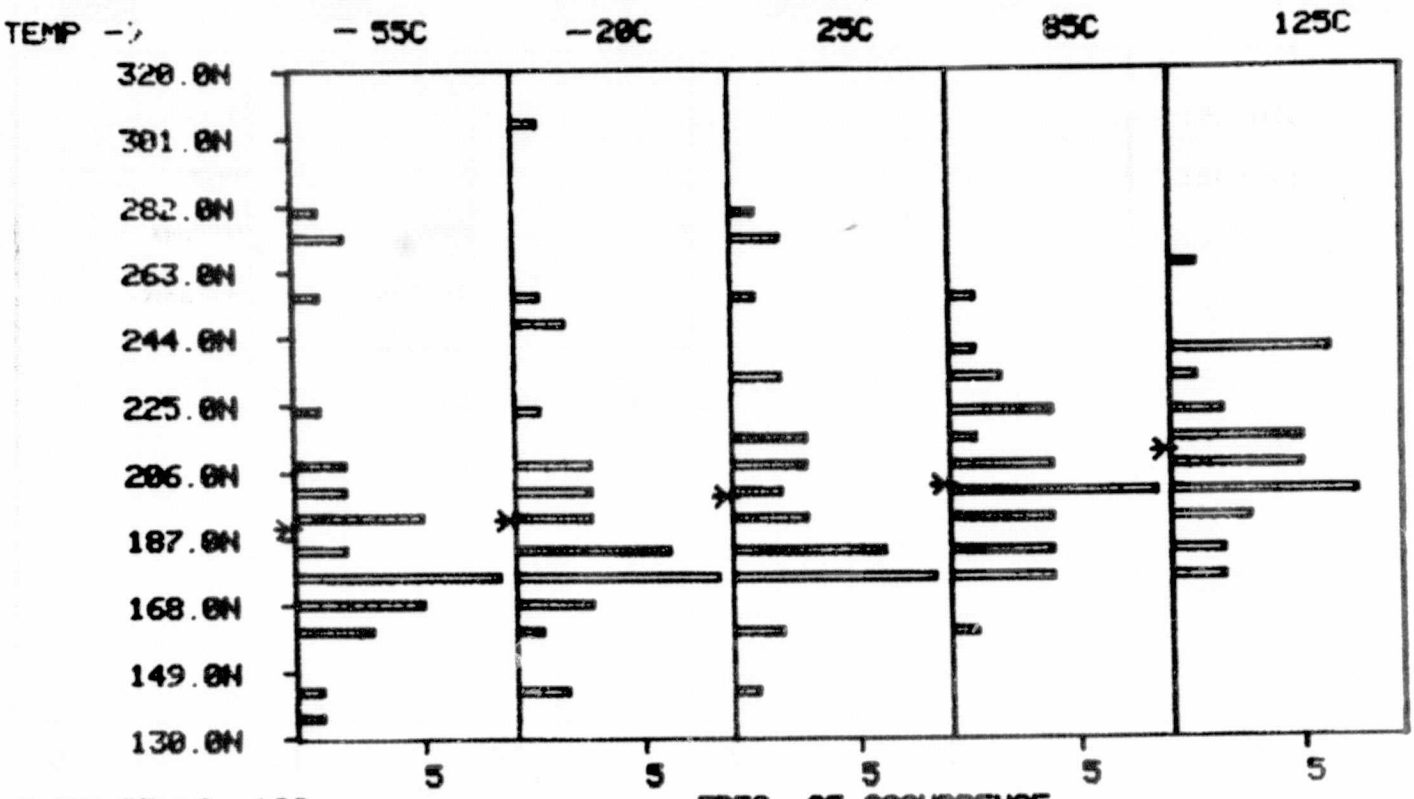
COMPONENTS DEPARTMENT TWC AT VCC=4.5V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 2.100N

READINGS:	34	34	33	34	34
MAXIMUM:	344.0N	320.0N	312.0N	280.0N	296.0N
MEAN:	229.5N	236.7N	238.8N	226.8N	234.6N
MINIMUM:	152.0N	176.0N	168.0N	176.0N	184.0N
STD.DEV.:	40.90N	37.22N	40.01N	24.59N	24.73N

COMPONENTS DEPARTMENT TWC AT VCC=5.0V 20 SEP 78

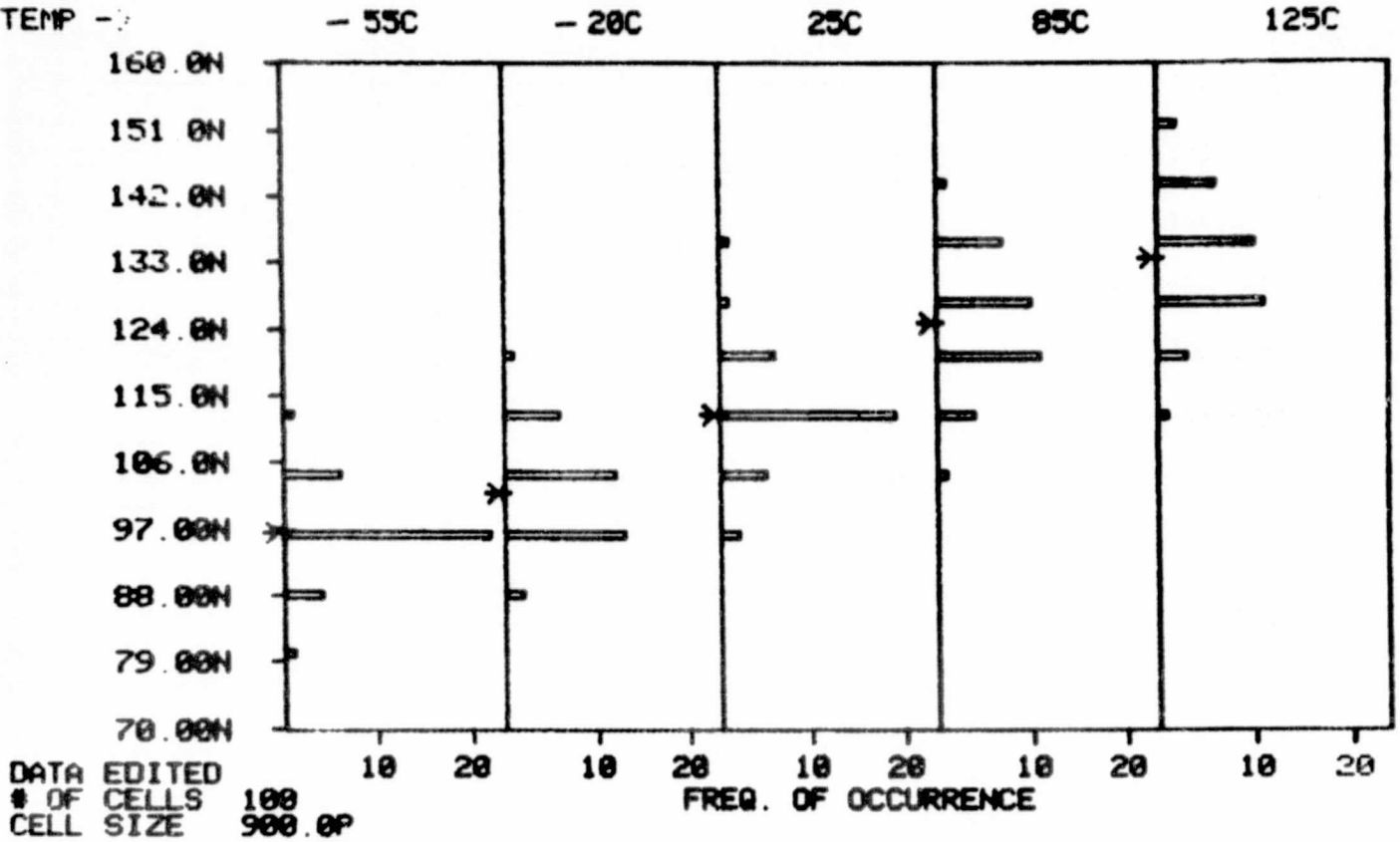


OF CELLS 100
CELL SIZE 1.900N

READINGS:	34	34	34	34	34
MAXIMUM:	280.0N	304.0N	280.0N	256.0N	264.0N
MEAN:	189.9N	192.5N	199.1N	202.1N	211.8N
MINIMUM:	136.0N	144.0N	144.0N	160.0N	176.0N
STD.DEV.:	34.69N	32.42N	32.82N	21.06N	21.05N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

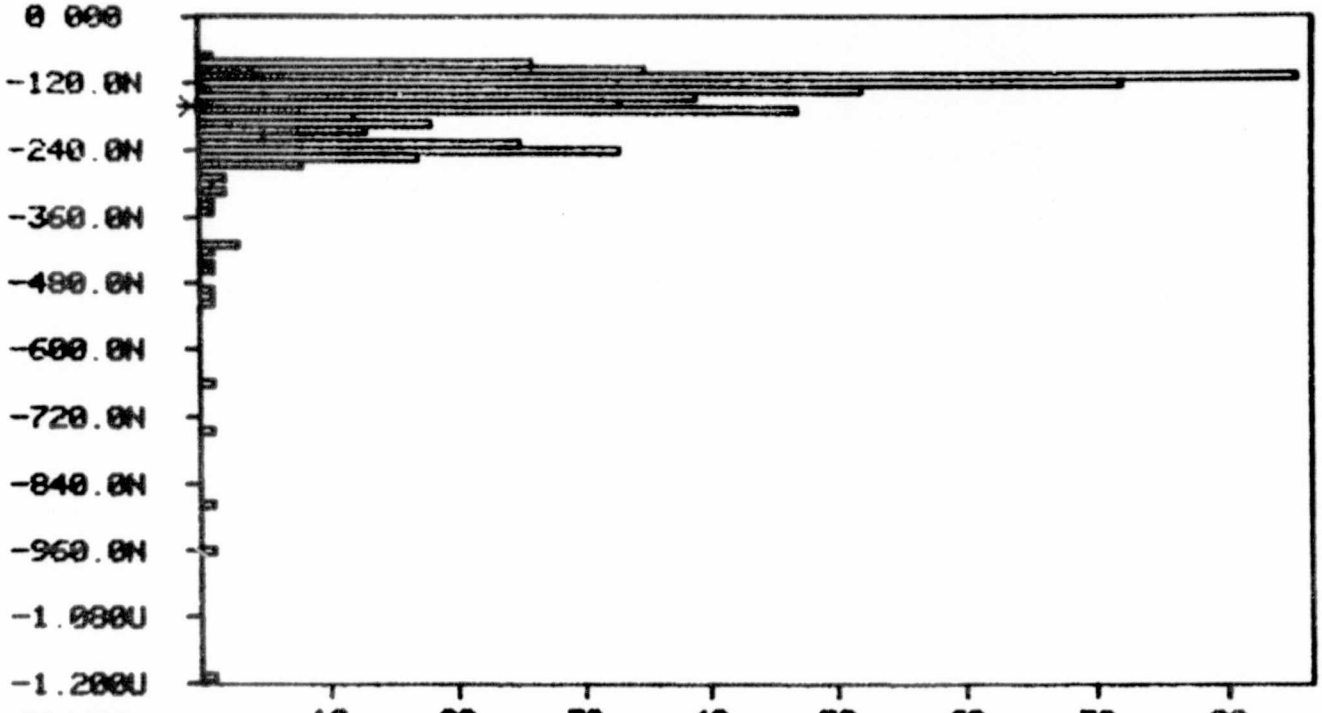
COMPONENTS DEPARTMENT TWC AT VCC=10.0V 20 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 900.0P

READINGS:	34	34	34	34	33
MAXIMUM:	112.0N	120.0N	136.0N	144.0N	152.0N
MEAN:	96.47N	101.9N	112.5N	124.9N	133.6N
MINIMUM:	80.00N	88.00N	96.00N	104.0N	112.0N
STD.DEV.:	5.889N	7.450N	7.864N	9.030N	9.271N

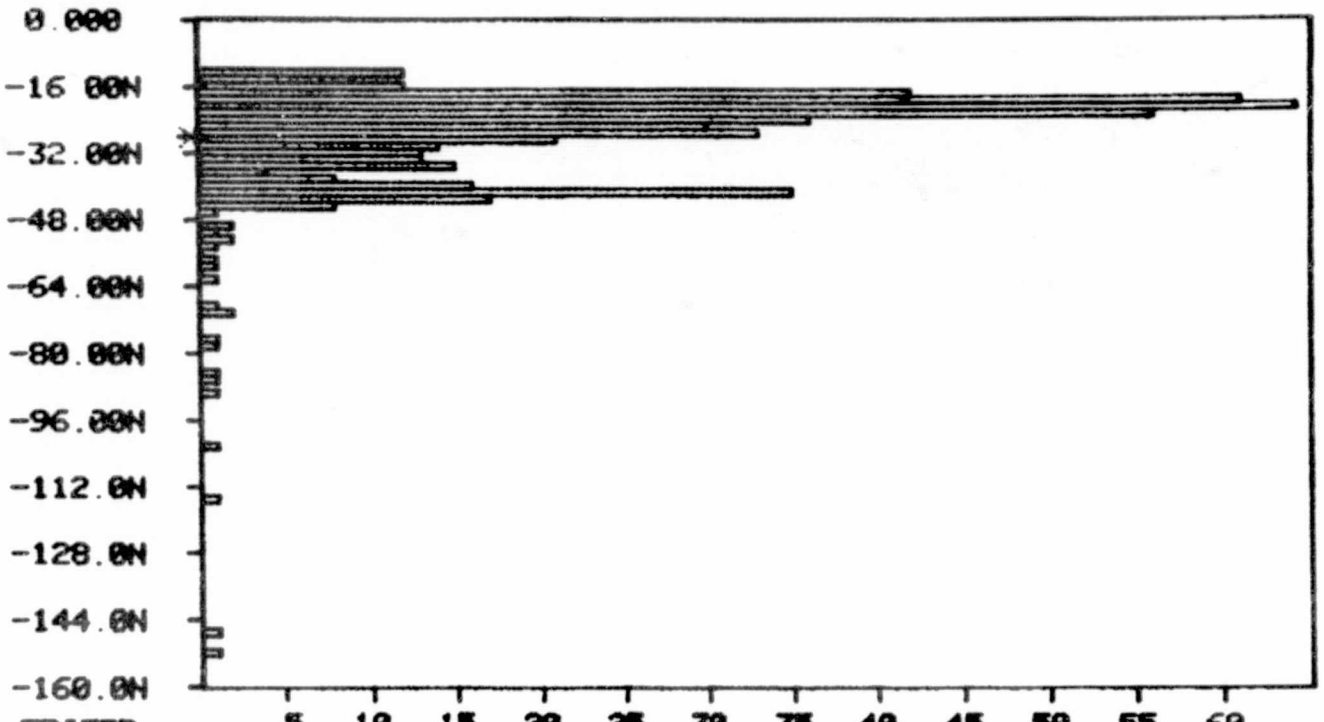
COMPONENTS DEPARTMENT IIL AT TA=125C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 12.00N

READINGS:	543
MAXIMUM:	-77.80N
MEAN:	-164.4N
MINIMUM:	-1.187U
STD.DEV. :	96.85N

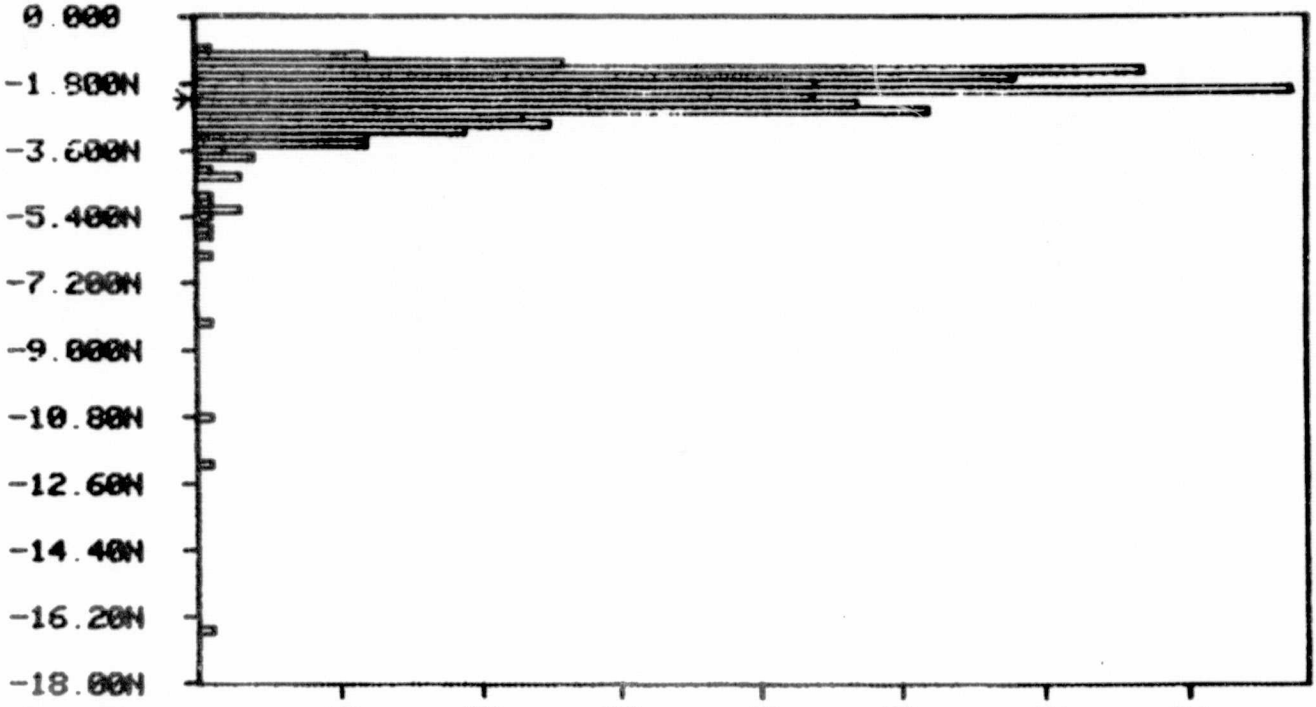
COMPONENTS DEPARTMENT IIL AT TA=85C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 1.600N

READINGS:	541
MAXIMUM:	-12.90N
MEAN:	-28.21N
MINIMUM:	-152.2N
STD.DEV.:	14.19N

COMPONENTS DEPARTMENT IIL AT TA=25C 21 SEP 78

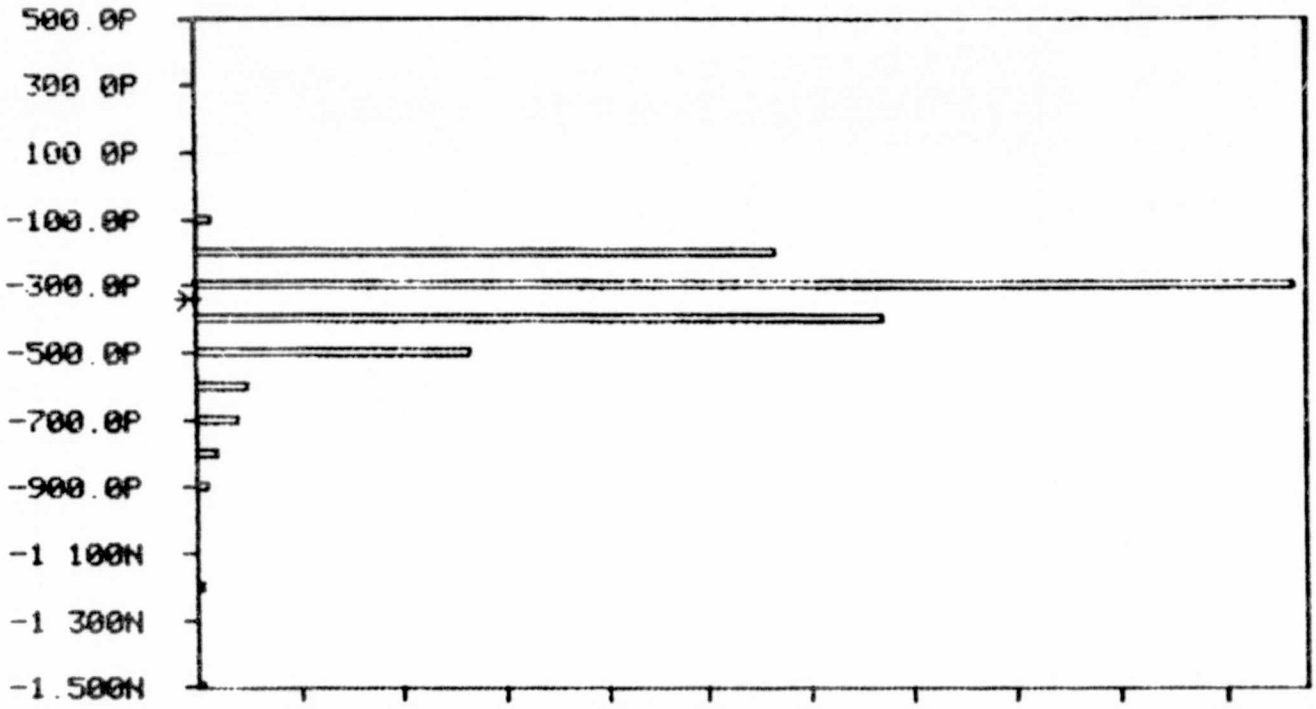


DATA EDITED
OF CELLS 100
CELL SIZE 180.0P

READINGS:	542
MAXIMUM:	-900.0P
MEAN:	-2.237N
MINIMUM:	-16.60N
STD.DEV.:	1.151N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

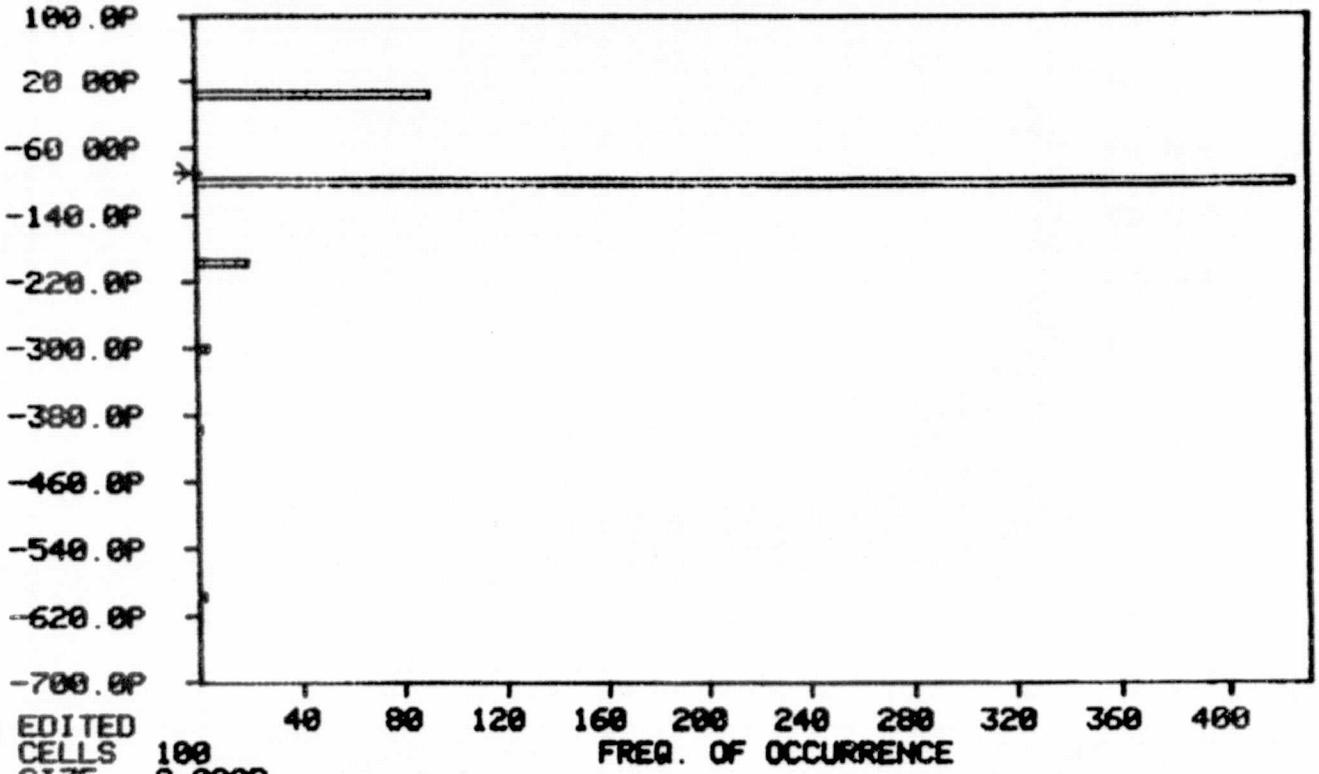
COMPONENTS DEPARTMENT IIL AT TA=-20C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 20.00P

READINGS:	541
MAXIMUM:	-100.0P
MEAN:	-343.6P
MINIMUM:	-1.500N
STD.DEV.:	134.9P

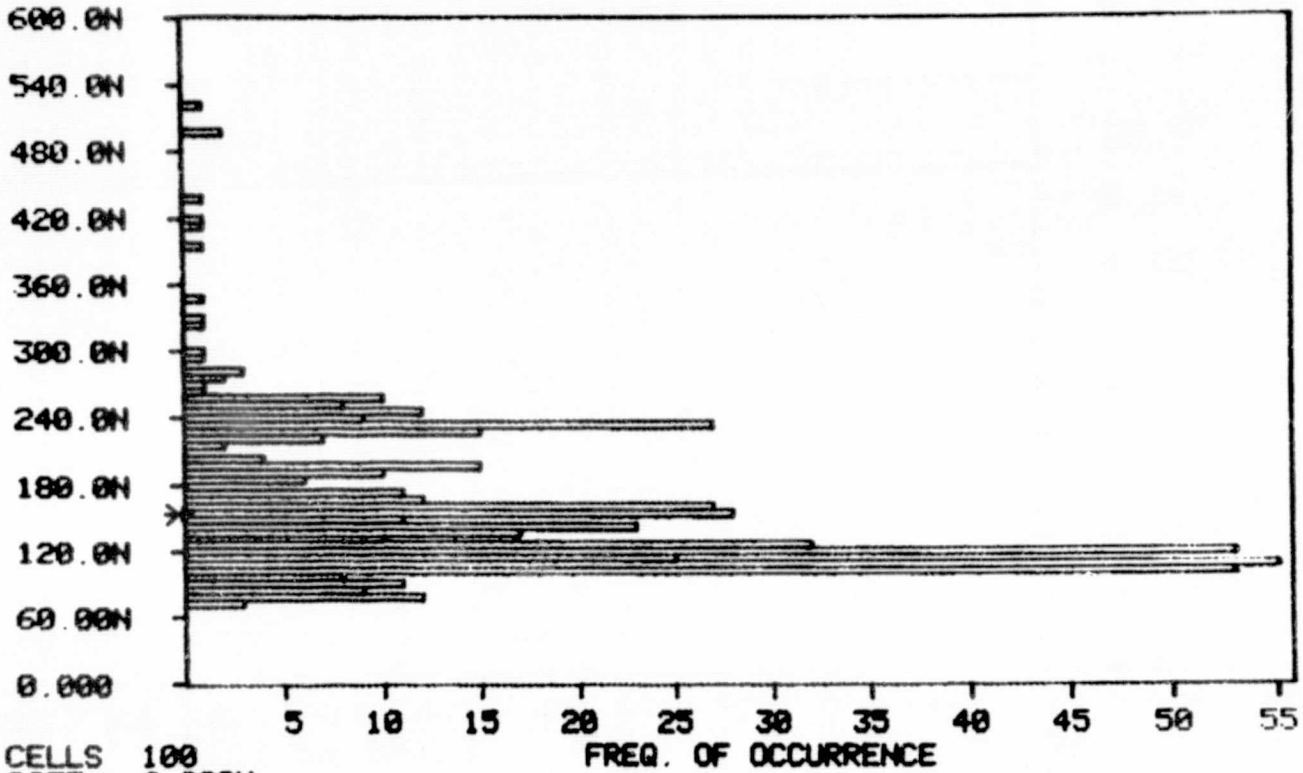
COMPONENTS DEPARTMENT IIL AT TA=-55C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 8.000P

READINGS:	542
MAXIMUM:	0.000
MEAN:	-90.78P
MINIMUM:	-600.0P
STD.DEV.:	57.90P

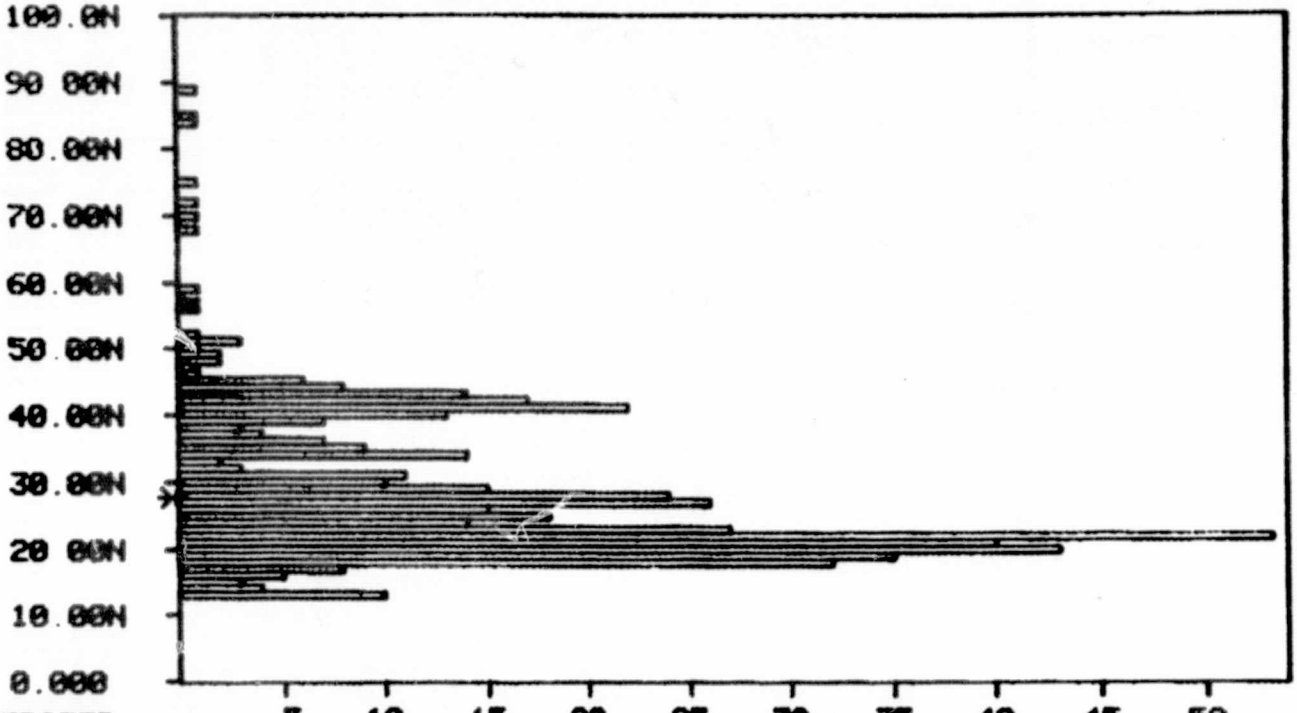
COMPONENTS DEPARTMENT IIH AT TA=125C 21 SEP 78



OF CELLS 100
CELL SIZE 6.000N

READINGS:	544
MAXIMUM:	521.2N
MEAN:	155.2N
MINIMUM:	73.70N
STD.DEV.:	63.74N

COMPONENTS DEPARTMENT IIH AT TA=85C 21 SEP 78

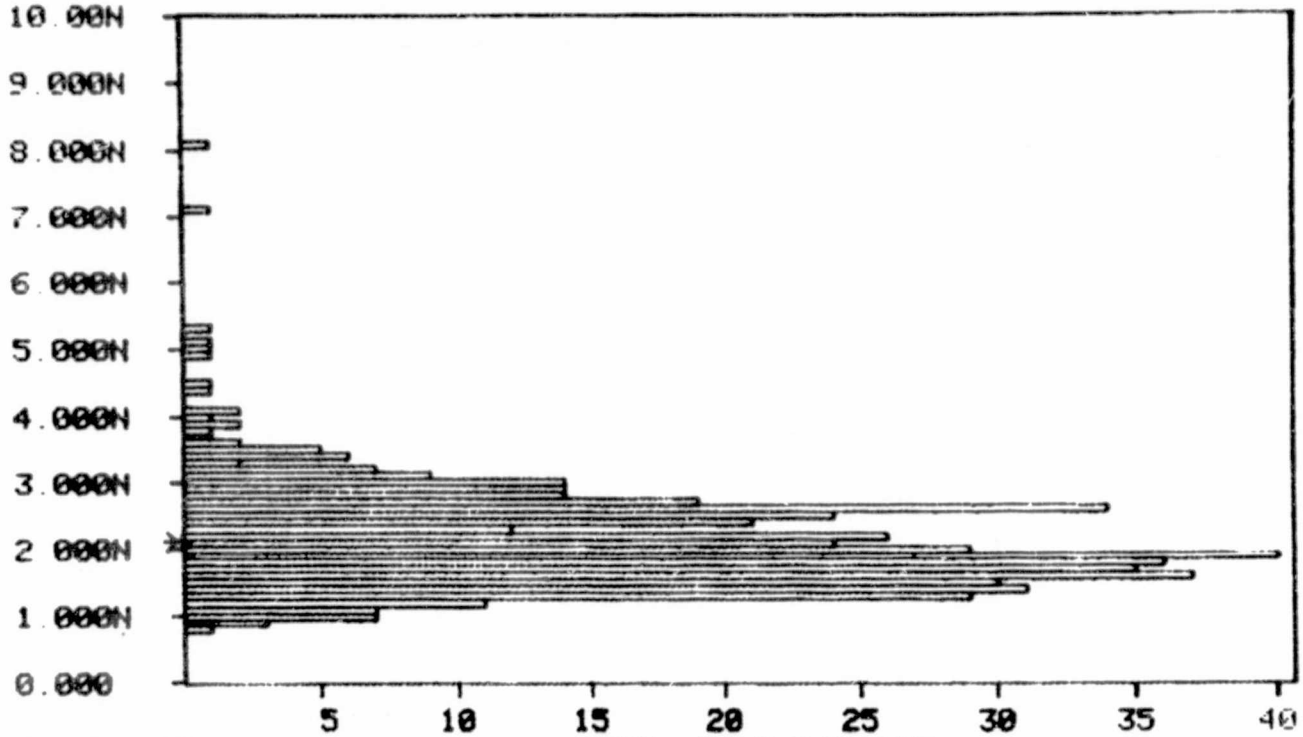


DATA EDITED
OF CELLS 100
CELL SIZE 1.000N

READINGS:	543
MAXIMUM:	89.00N
MEAN:	27.86N
MINIMUM:	12.50N
STD.DEV.:	10.79N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

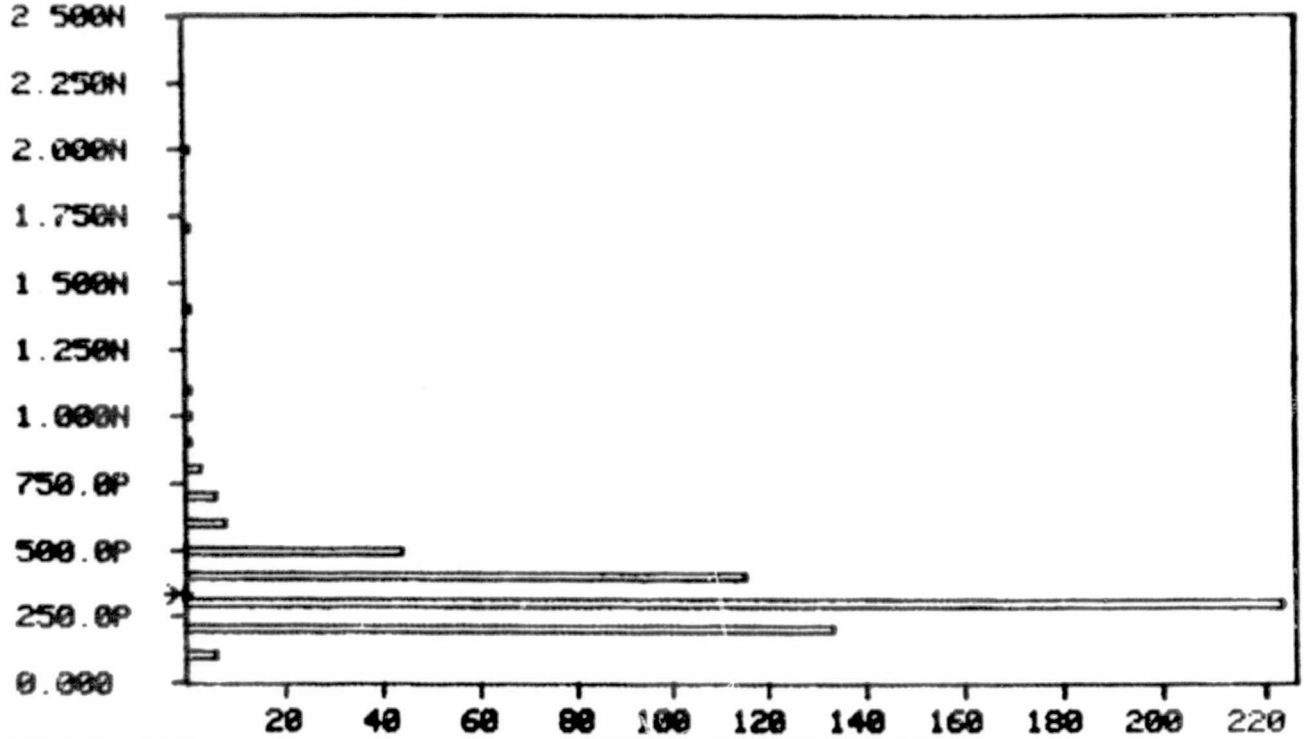
COMPONENTS DEPARTMENT IIH AT TA=25C 21 SEP 78



OF CELLS 100
CELL SIZE 100.0P

READINGS:	544
MAXIMUM:	8.100N
MEAN:	2.125N
MINIMUM:	800.0P
STD.DEV.	767.0P

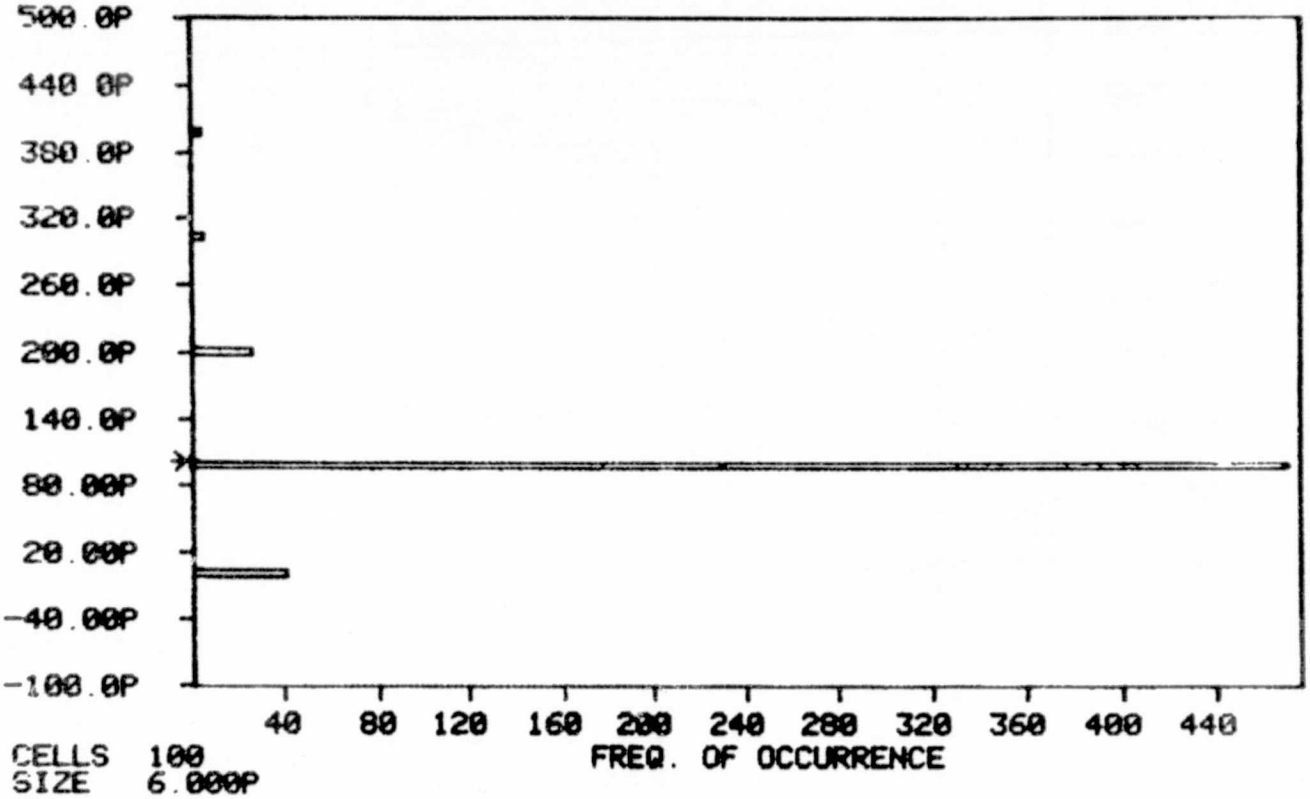
COMPONENTS DEPARTMENT IIH AT TA=-20C 21 SEP 78



OF CELLS 100
CELL SIZE 25.00P

READINGS:	544
MAXIMUM:	2.000N
MEAN:	333.8P
MINIMUM:	100.0P
STD.DEV.:	159.6P

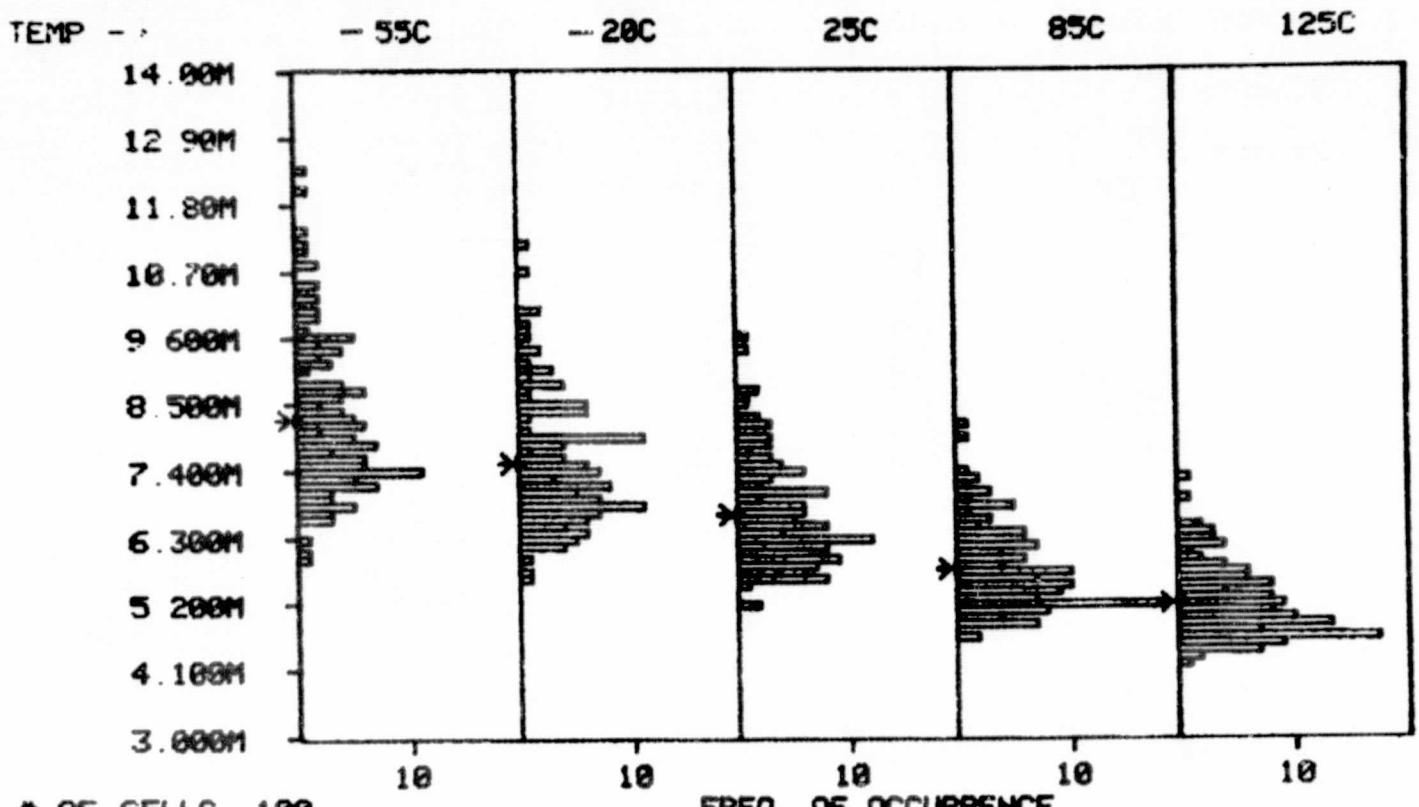
COMPONENTS DEPARTMENT IIH AT TA=-55C 21 SEP 78



OF CELLS 100
CELL SIZE 6.000P

READINGS:	544
MAXIMUM:	400.0P
MEAN:	101.3P
MINIMUM:	0.000
STD.DEV.:	47.58P

COMPONENTS DEPARTMENT IDN1 21 SEP 78

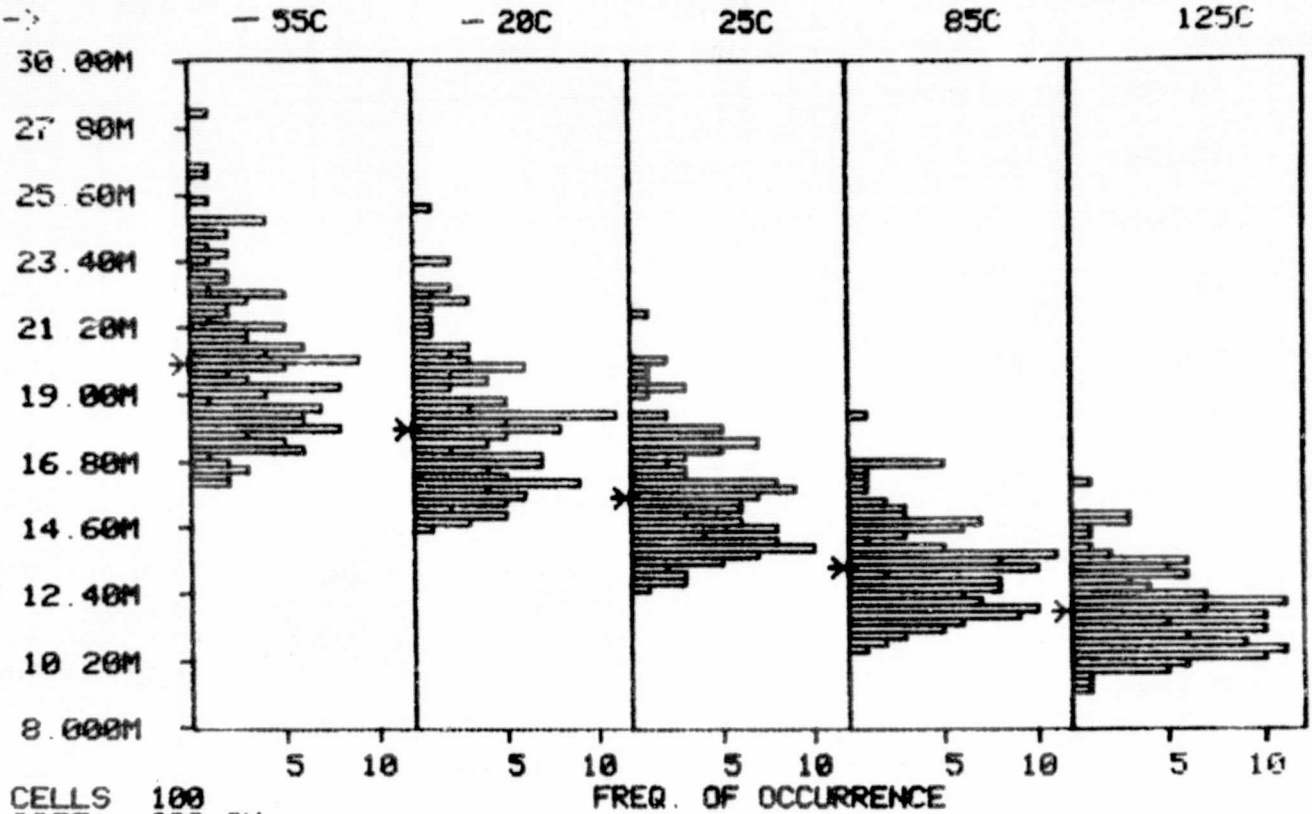


OF CELLS 100
CELL SIZE 110.0U

READINGS:	136	136	136	136	136
MAXIMUM:	12.30M	11.10M	9.650M	8.200M	7.250M
MEAN:	8.243M	7.526M	6.698M	5.783M	5.192M
MINIMUM:	5.950M	5.650M	5.200M	4.650M	4.250M
STD.DEV.:	1.227M	1.040M	862.8U	699.0U	603.7U

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

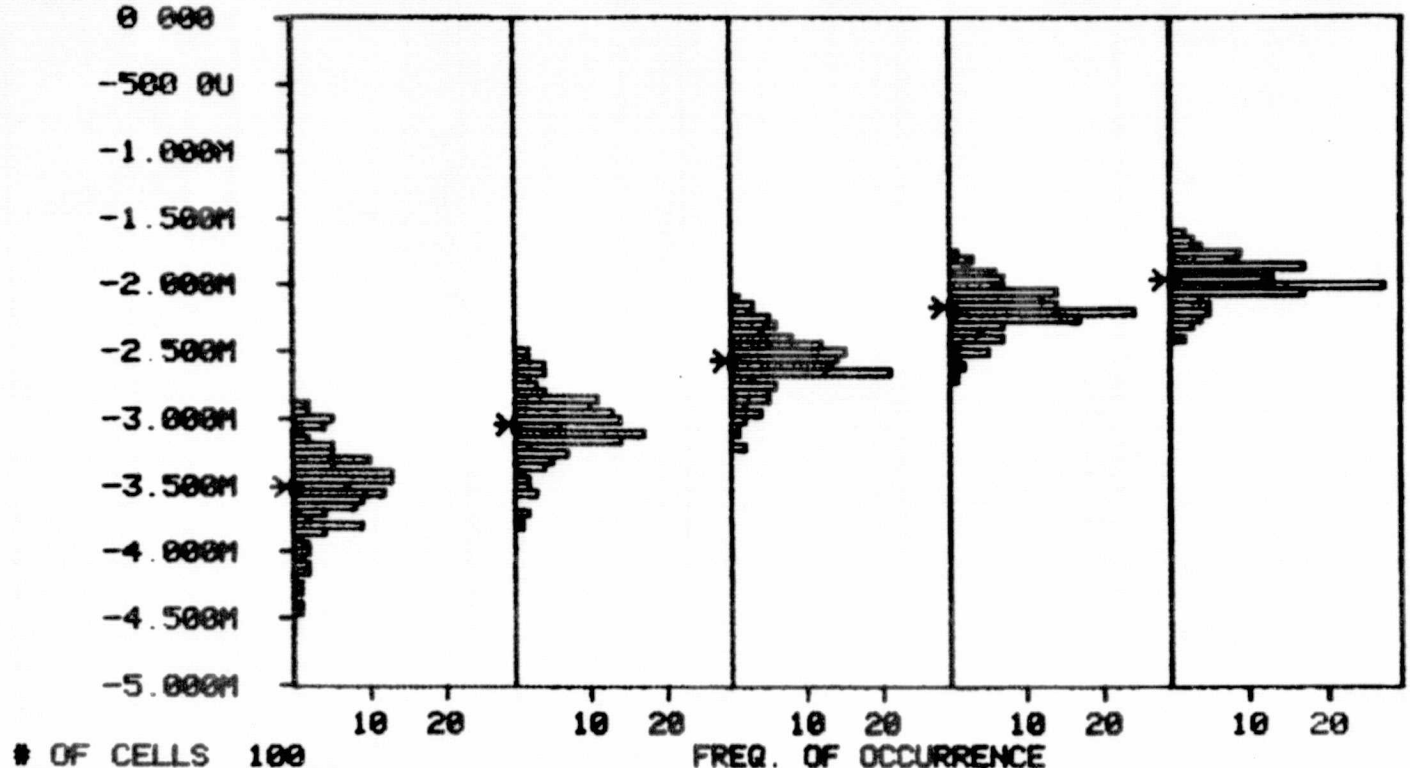
COMPONENTS DEPARTMENT IDN2 21 SEP 78



OF CELLS 100
CELL SIZE 220.0U

READINGS:	136	136	136	136	136
MAXIMUM:	28.25M	25.20M	21.75M	18.30M	16.20M
MEAN:	19.95M	17.92M	15.62M	13.28M	11.83M
MINIMUM:	16.10M	14.65M	12.65M	10.60M	9.350M
STD.DEV :	2.401M	2.115M	1.824M	1.535M	1.357M

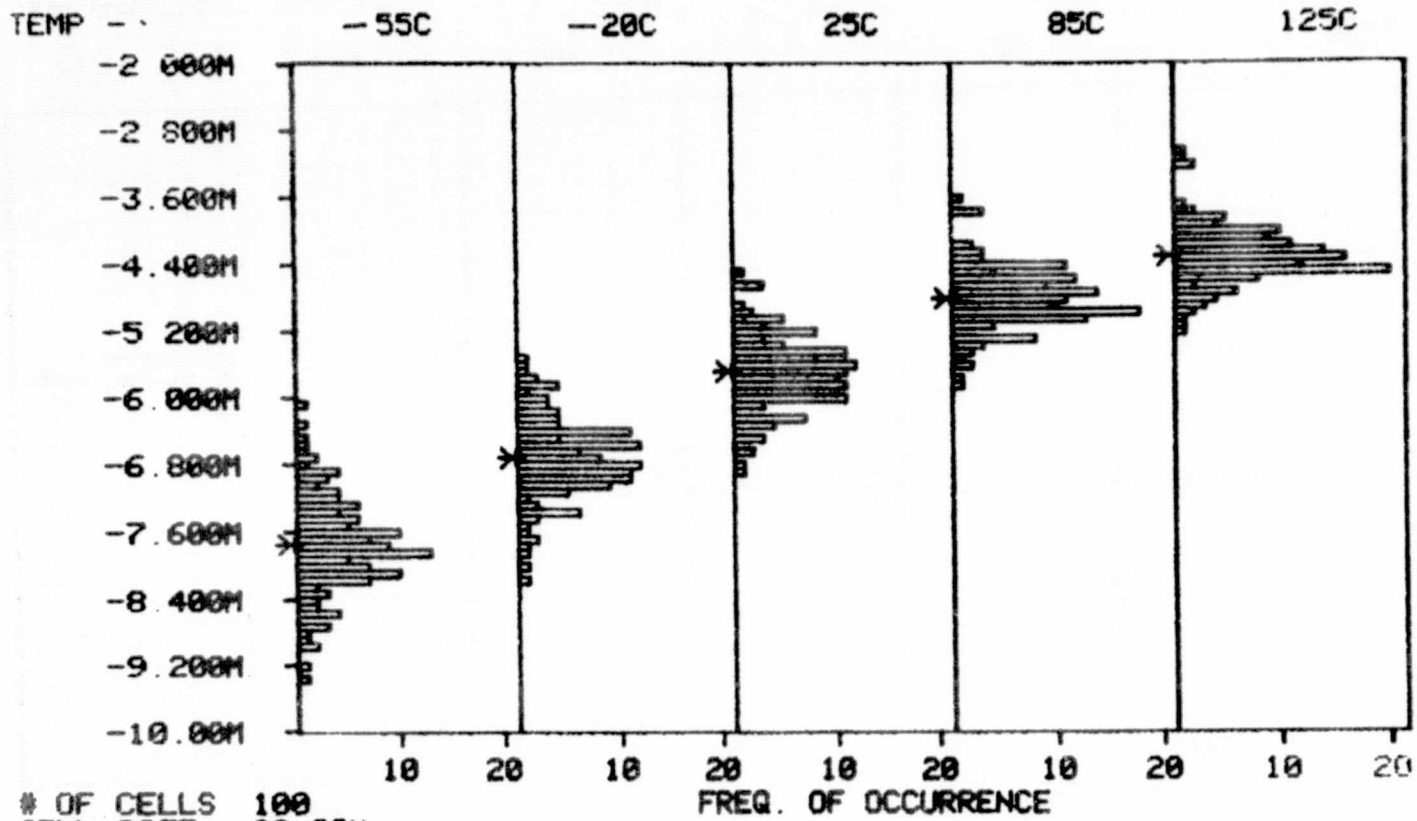
COMPONENTS DEPARTMENT IDP1 21 SEP 78



OF CELLS 100
CELL SIZE 50.00U

READINGS:	136	136	136	136	136
MAXIMUM:	-2.905M	-2.480M	-2.100M	-1.775M	-1.610M
MEAN:	-3.513M	-3.042M	-2.573M	-2.172M	-1.958M
MINIMUM:	-4.440M	-3.810M	-3.215M	-2.690M	-2.405M
STD.DEV.:	307.0U	255.6U	216.2U	180.1U	159.7U

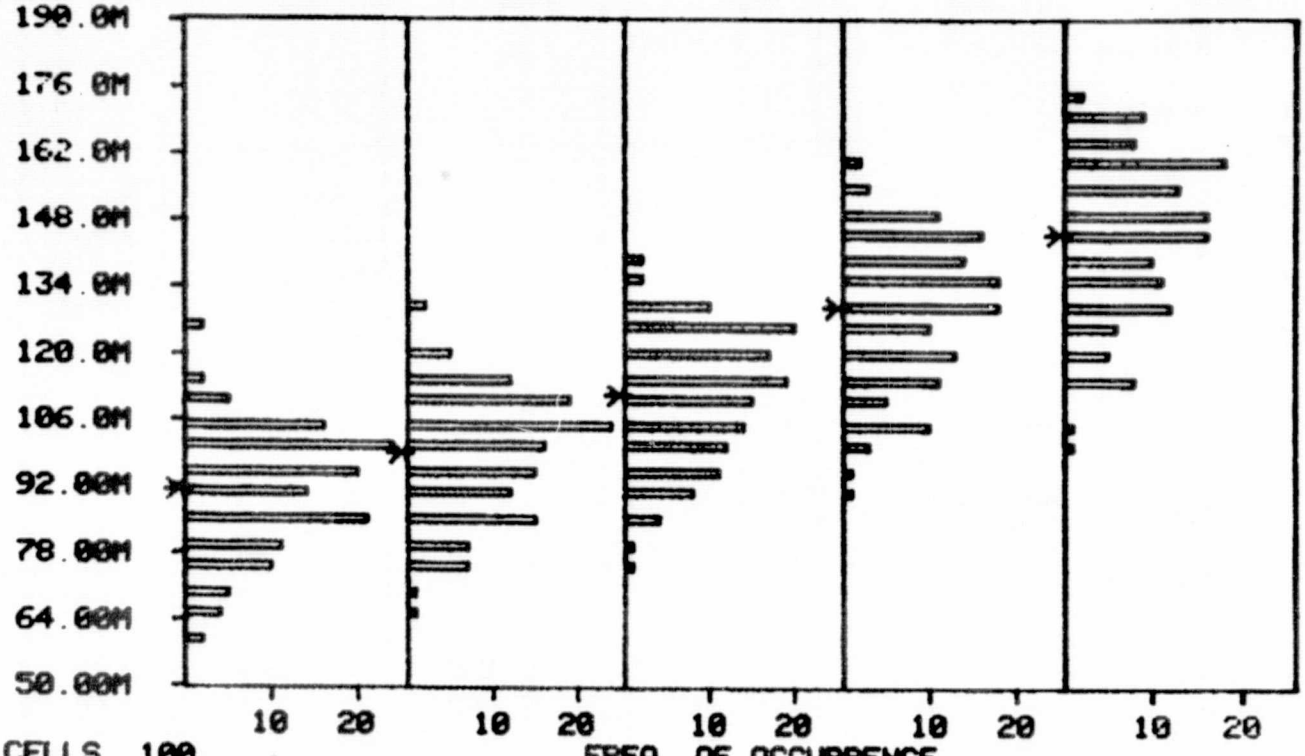
COMPONENTS DEPARTMENT IDP2 21 SEP 78



OF CELLS 100
CELL SIZE 80.00U

READINGS:	136	136	136	136	136
MAXIMUM:	-6.080M	-5.545M	-4.480M	-3.630M	-3.005M
MEAN:	-7.744M	-6.713M	-5.684M	-4.800M	-4.305M
MINIMUM:	-9.400M	-8.155M	-6.915M	-5.825M	-5.220M
STD.DEV. :	583.1U	495.6U	434.5U	376.5U	355.6U

COMPONENTS DEPARTMENT VOL1 21 SEP 78

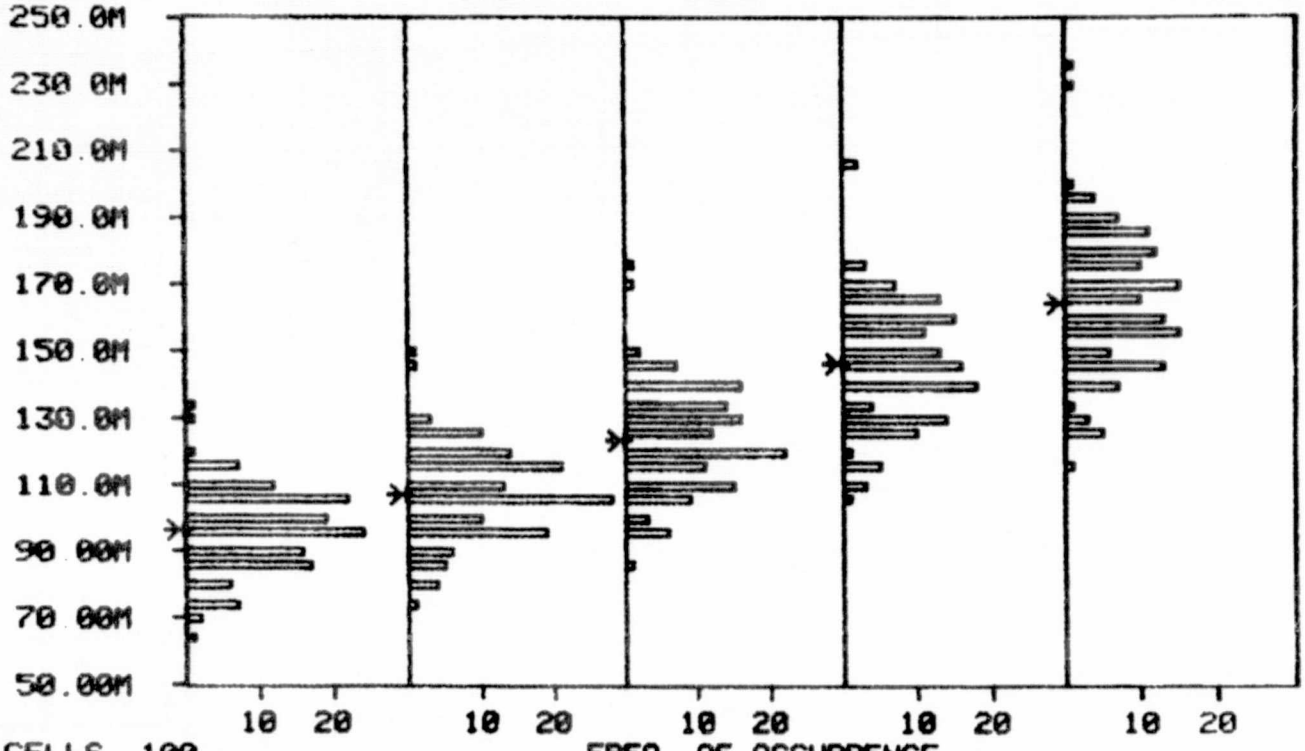


OF CELLS 100
CELL SIZE 1.400M

READINGS:	136	136	136	136	136
MAXIMUM:	125.0M	130.0M	140.0M	160.0M	175.0M
MEAN:	91.29M	98.90M	111.4M	129.7M	145.1M
MINIMUM:	60.00M	65.00M	75.00M	90.00M	100.0M
STD.DEV.:	12.81M	13.08M	13.69M	15.23M	16.50M

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

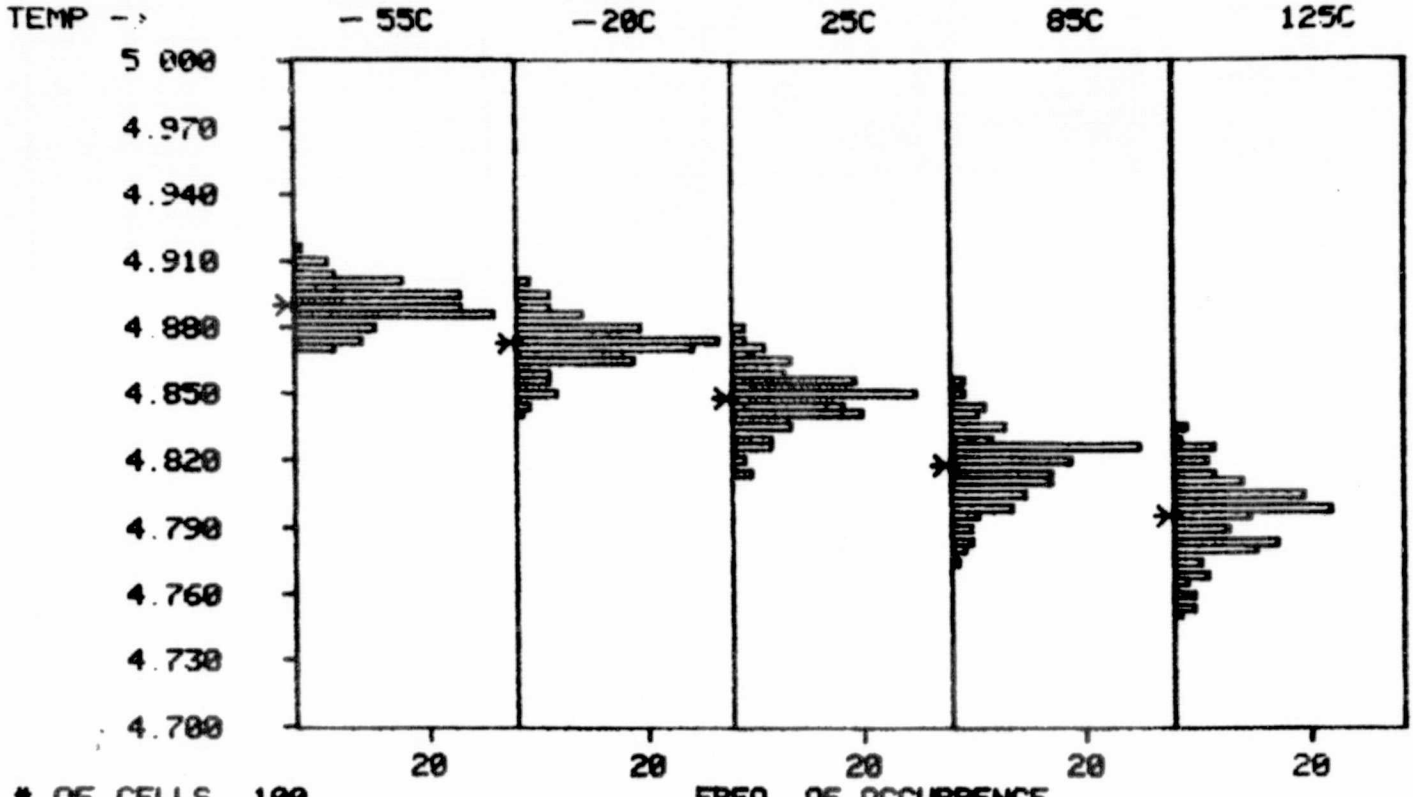
COMPONENTS DEPARTMENT VOL2 21 SEP 78



OF CELLS 100
CELL SIZE 2.000M

READINGS:	136	136	136	136	136
MAXIMUM:	135.0M	150.0M	175.0M	205.0M	235.0M
MEAN:	96.29M	107.1M	123.7M	146.4M	164.4M
MINIMUM:	65.00M	75.00M	85.00M	105.0M	115.0M
STD.DEV.:	12.11M	13.16M	15.21M	17.73M	20.10M

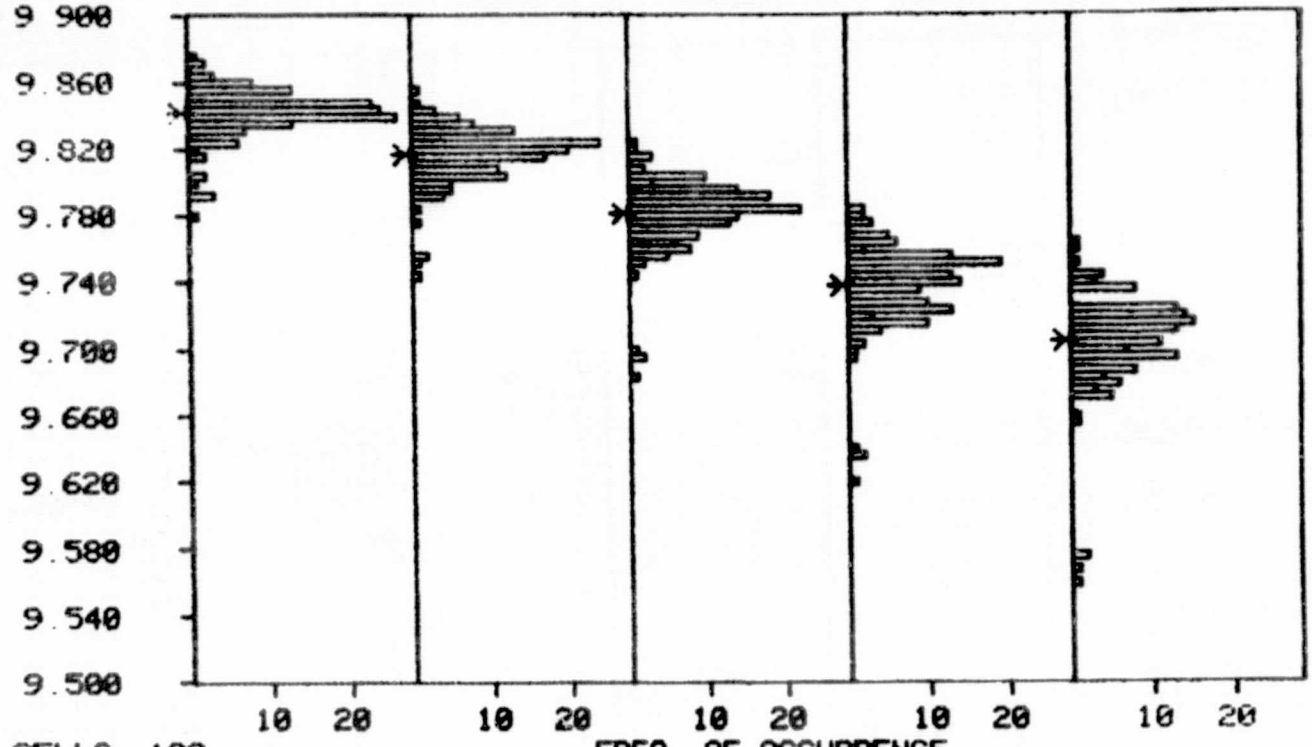
COMPONENTS DEPARTMENT VOH1 21 SEP 78



OF CELLS 100
CELL SIZE 3.000M

READINGS:	136	136	136	136	136
MAXIMUM:	4.915	4.900	4.880	4.855	4.835
MEAN:	4.890	4.873	4.848	4.818	4.796
MINIMUM:	4.870	4.840	4.815	4.775	4.750
STD.DEV.:	8.398M	11.95M	14.30M	15.21M	18.44M

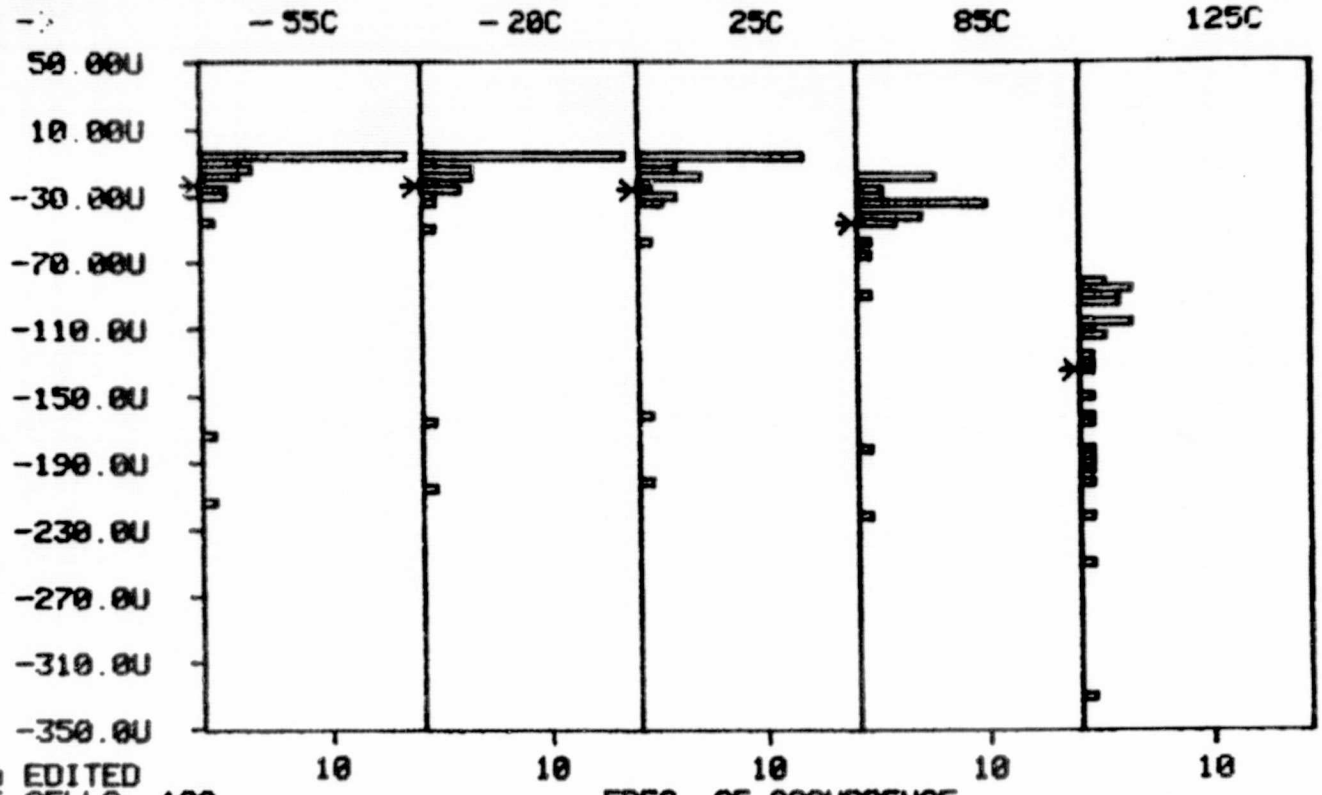
COMPONENTS DEPARTMENT VOH2 21 SEP 78



OF CELLS 100
CELL SIZE 4.000M

READINGS:	136	136	136	136	136
MAXIMUM:	9.875	9.855	9.825	9.785	9.765
MEAN:	9.842	9.817	9.781	9.738	9.705
MINIMUM:	9.780	9.745	9.685	9.620	9.560
STD.DEV.:	15.21M	22.02M	17.22M	27.03M	31.34M

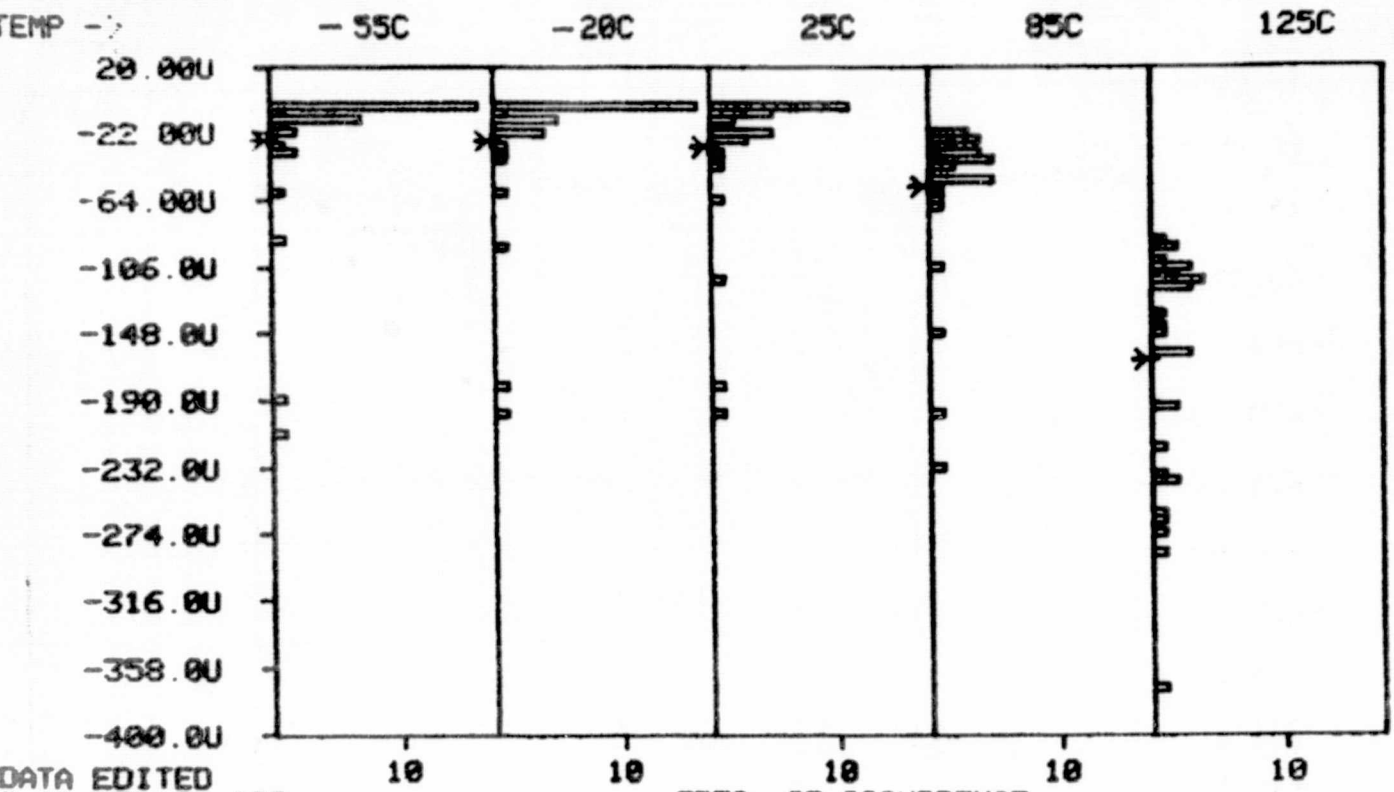
COMPONENTS DEPARTMENT IL1 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 4.000U

READINGS:	33	33	33	33	33
MAXIMUM:	-5.000U	-5.000U	-5.000U	-20.00U	-80.00U
MEAN:	-23.48U	-23.94U	-25.61U	-46.36U	-134.2U
MINIMUM:	-215.0U	-205.0U	-200.0U	-220.0U	-330.0U
STD.DEV.:	45.59U	43.24U	42.07U	42.41U	58.00U

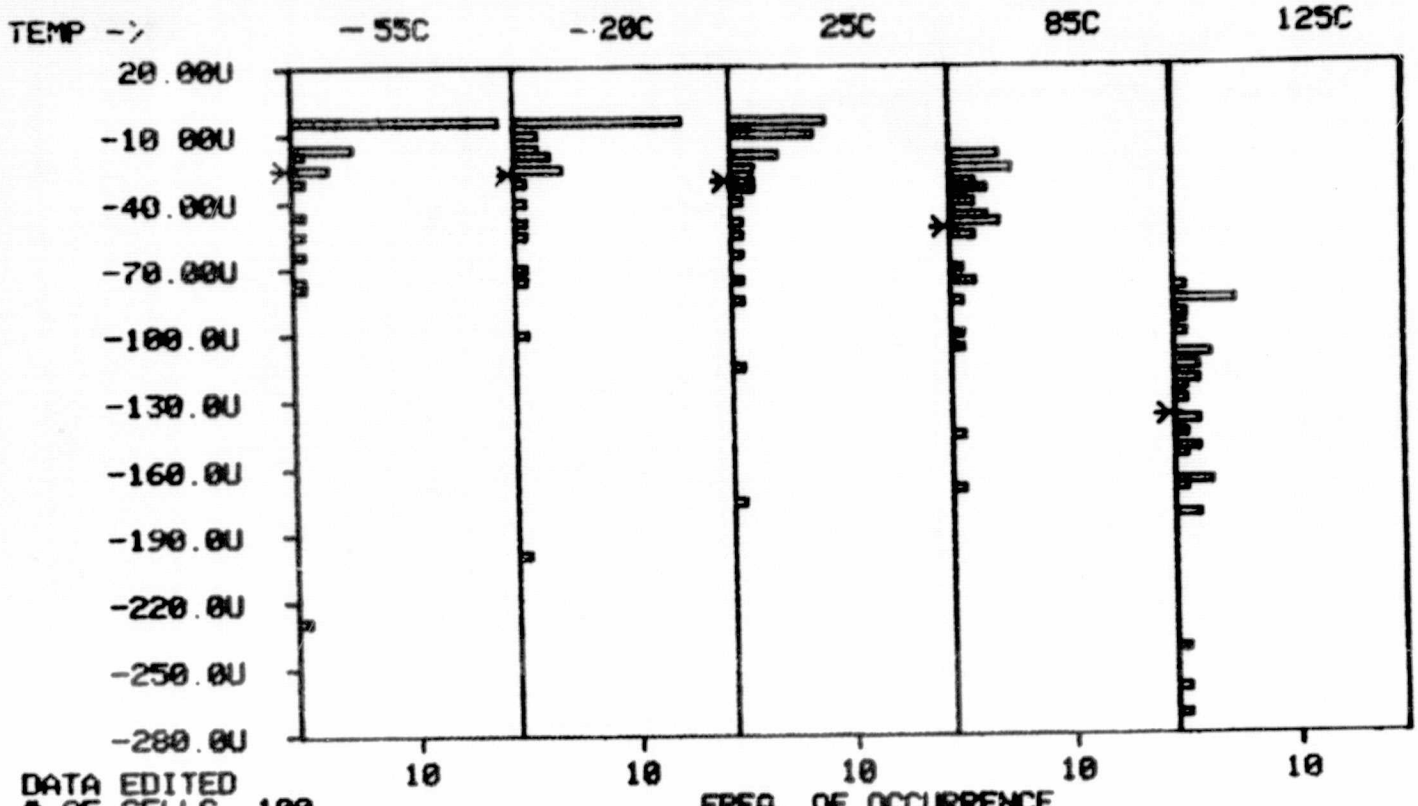
COMPONENTS DEPARTMENT IL2 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 4.200U

READINGS:	33	33	33	33	33
MAXIMUM:	-5.000U	-5.000U	-5.000U	-20.00U	-90.00U
MEAN:	-26.82U	-26.82U	-30.00U	-55.61U	-164.4U
MINIMUM:	-210.0U	-200.0U	-200.0U	-230.0U	-370.0U
STD.DEV.:	48.22U	46.18U	46.80U	48.44U	71.30U

COMPONENTS DEPARTMENT IL3 21 SEP 78

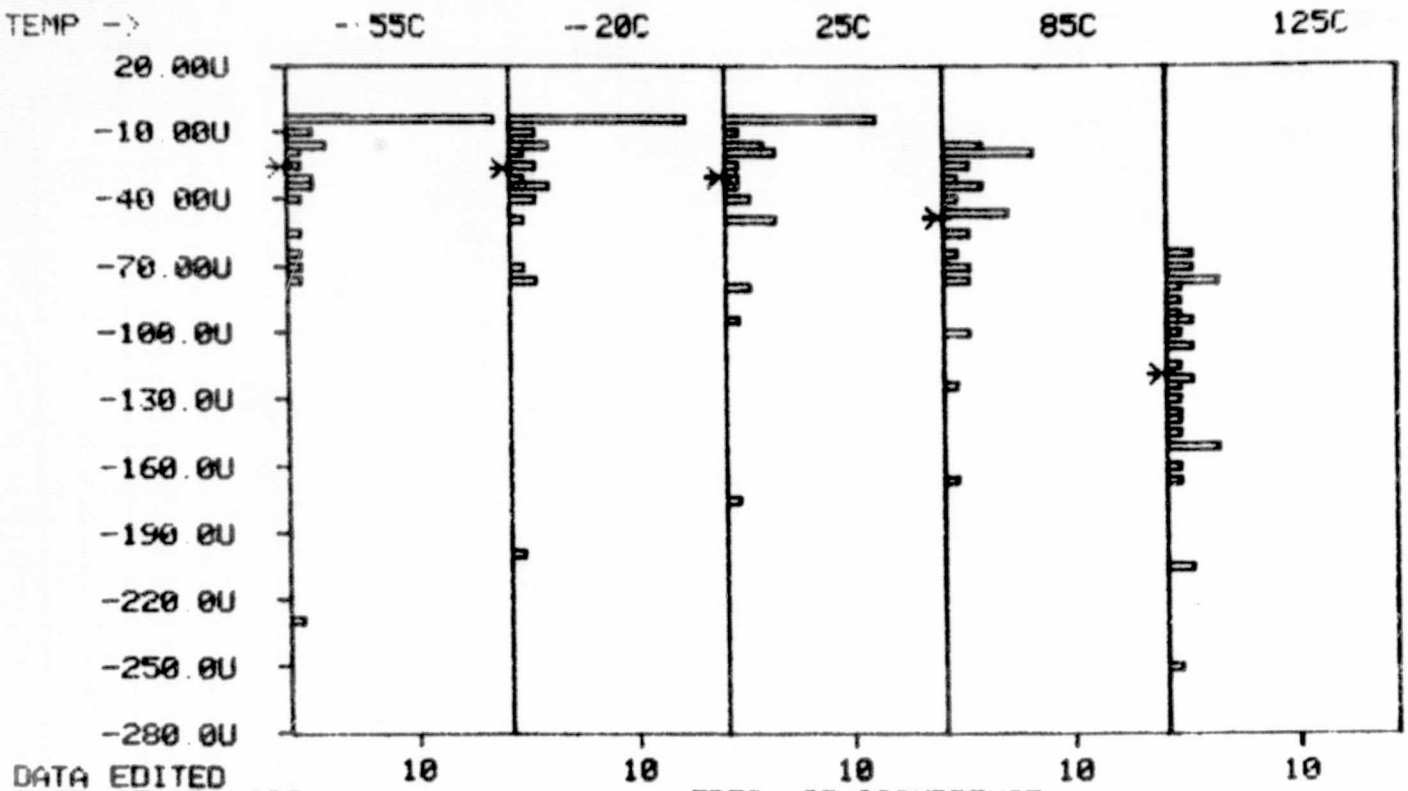


DATA EDITED
OF CELLS 100
CELL SIZE 3.000U

READINGS:	33	33	33	33	33
MAXIMUM:	-5.000U	-5.000U	-5.000U	-20.00U	-80.00U
MEAN:	-25.30U	-27.27U	-31.21U	-52.12U	-137.0U
MINIMUM:	-230.0U	-200.0U	-175.0U	-170.0U	-270.0U
STD.DEV.:	42.50U	39.01U	37.04U	35.44U	49.16U

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

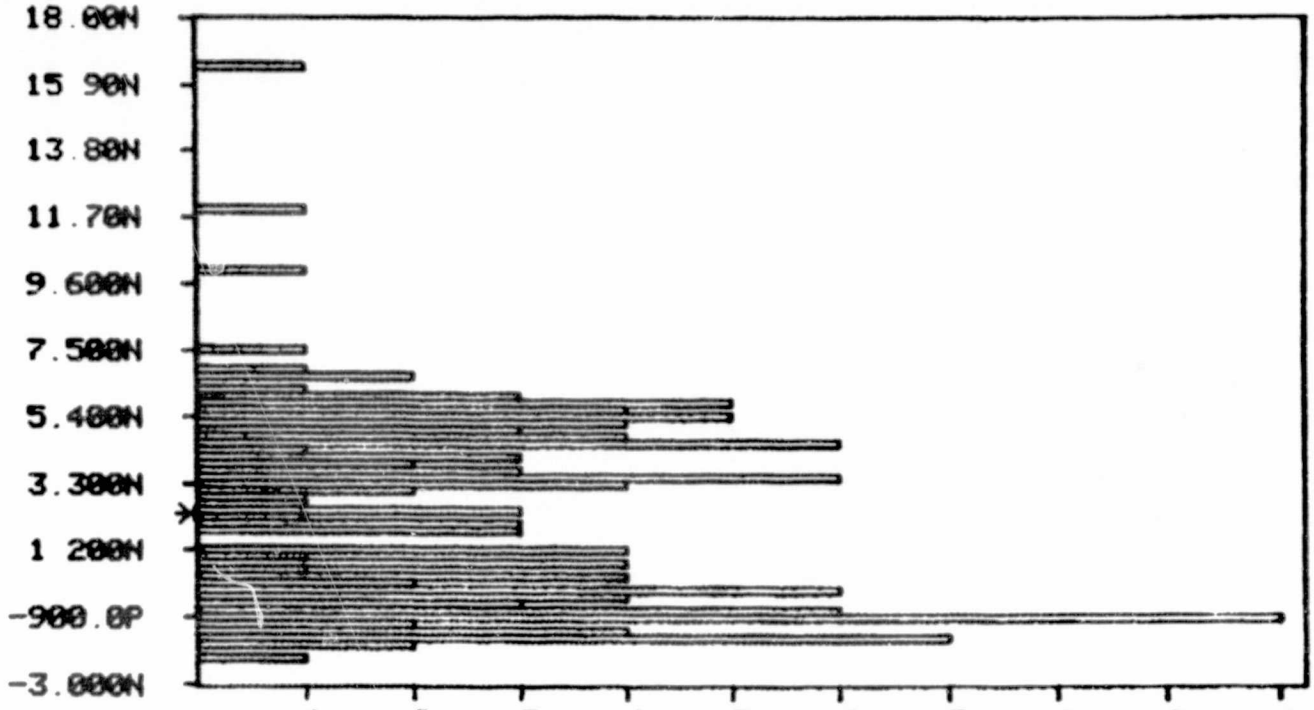
COMPONENTS DEPARTMENT IL4 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 3.000U

READINGS:	33	33	33	33	33
MAXIMUM:	-5.000U	-5.000U	-5.000U	-15.00U	-65.00U
MEAN:	-25.91U	-26.97U	-30.15U	-48.18U	-119.4U
MINIMUM:	-230.0U	-200.0U	-175.0U	-165.0U	-250.0U
STD.DEV.:	42.08U	37.62U	35.83U	34.73U	45.05U

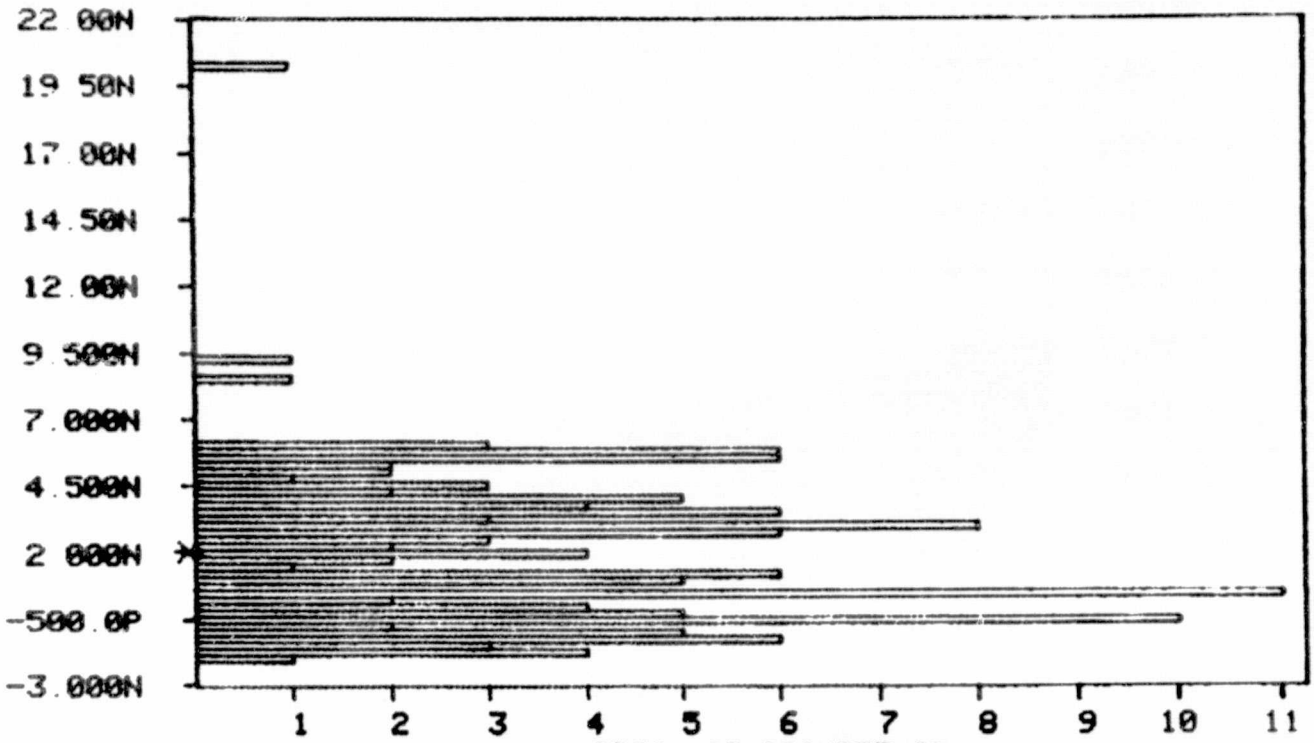
COMPONENTS DEPARTMENT IOZ1 AT TA=-55C 21 SEP 78



OF CELLS 100
CELL SIZE 210.0P

READINGS:	136
MAXIMUM:	16.60N
MEAN:	2.386N
MINIMUM:	-2.200N
STD.DEV.:	3.120N

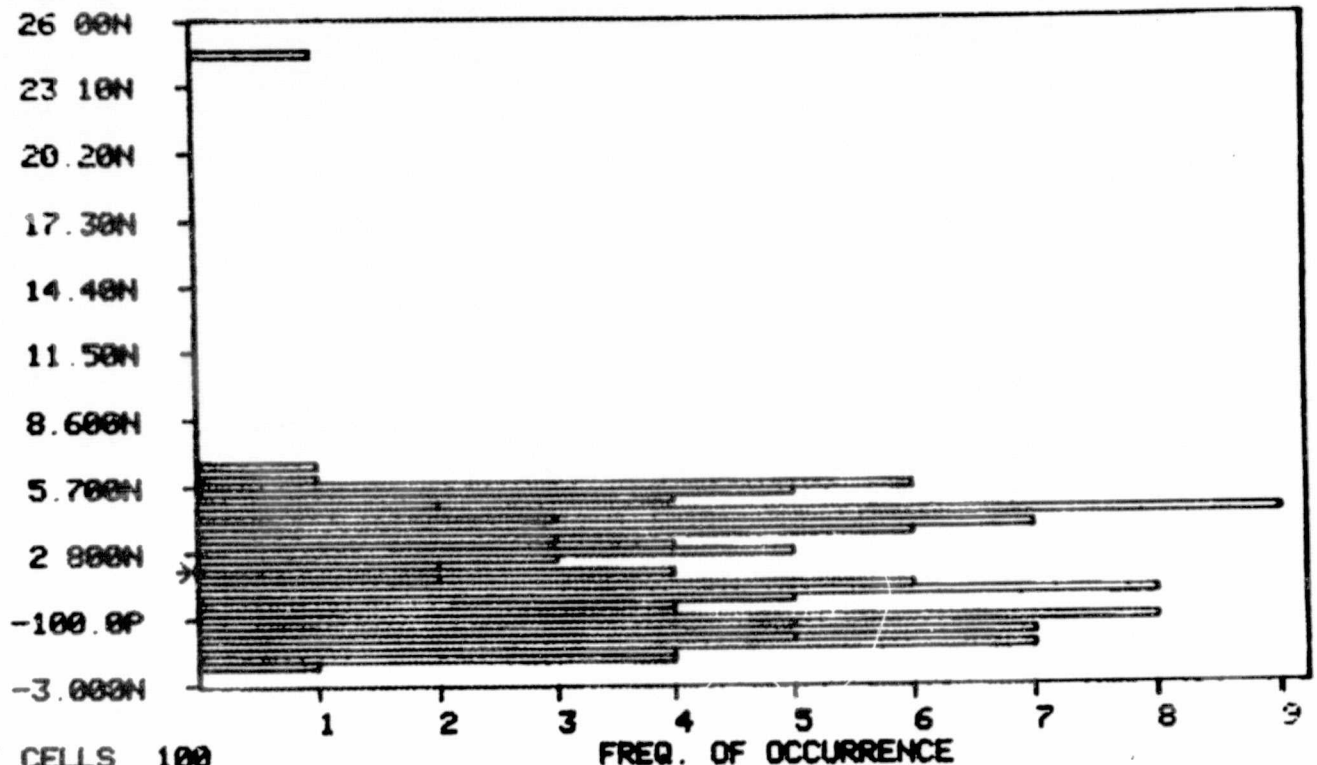
COMPONENTS DEPARTMENT IOZ2 AT TA=-55C 21 SEP 78



OF CELLS 100
CELL SIZE 250.0P

READINGS:	136
MAXIMUM:	20.20N
MEAN:	2.098N
MINIMUM:	-1.900N
STD.DEV :	2.903N

COMPONENTS DEPARTMENT 1023 AT TA=-55C 21 SEP 78

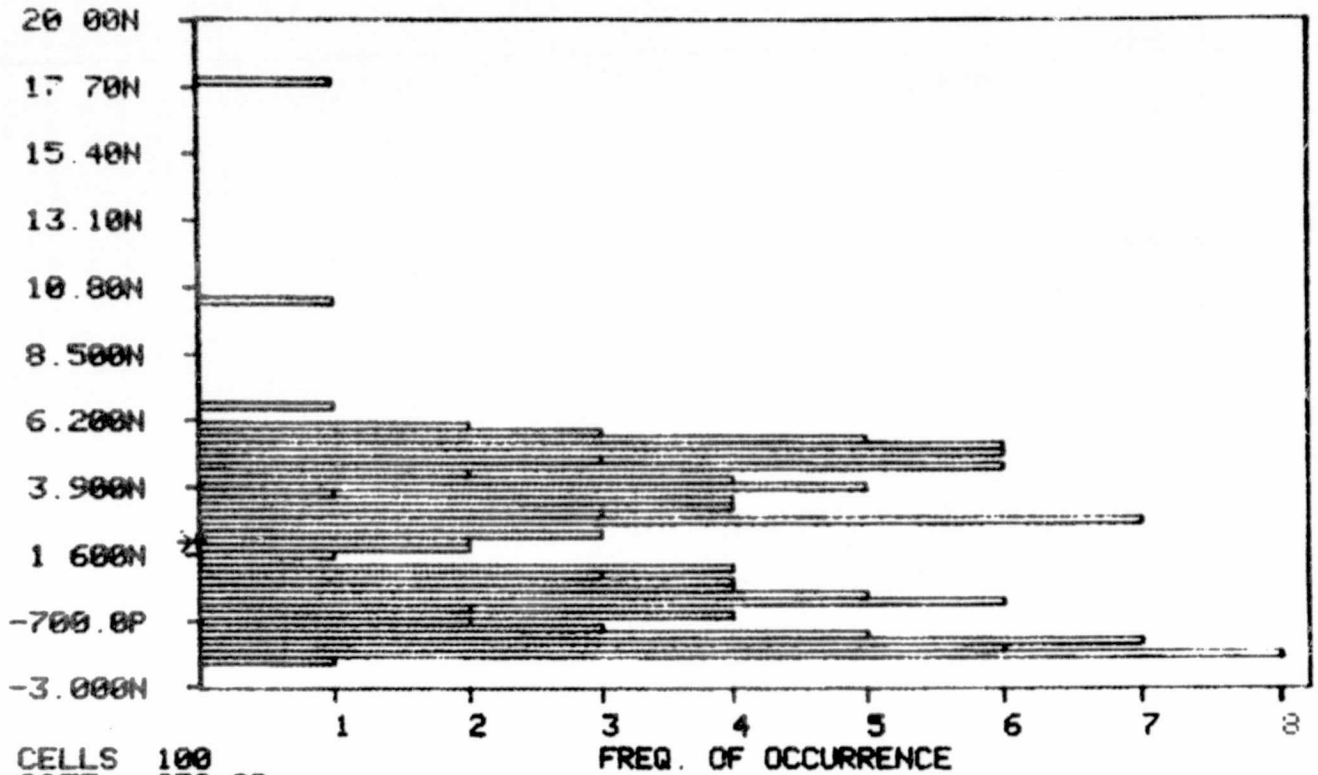


OF CELLS 100
CELL SIZE 290.0P

READINGS:	136
MAXIMUM:	24.60N
MEAN:	2.040N
MINIMUM:	-2.000N
STD.DEV.:	3.067N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

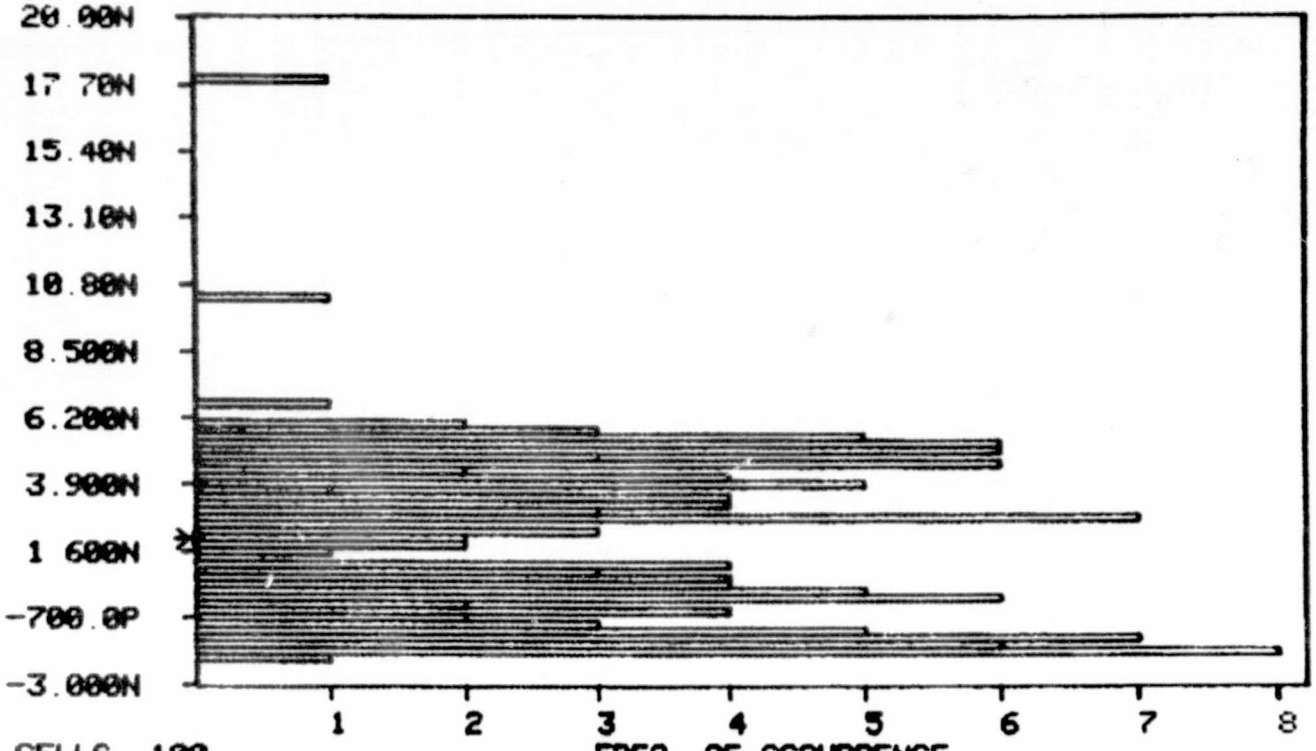
COMPONENTS DEPARTMENT IOZ4 AT TA=-55C 21 SEP 78



OF CELLS 100
CELL SIZE 230.0P

READINGS:	136
MAXIMUM:	18.00N
MEAN:	2.047N
MINIMUM:	-2.000N
STD.DEV :	3.009N

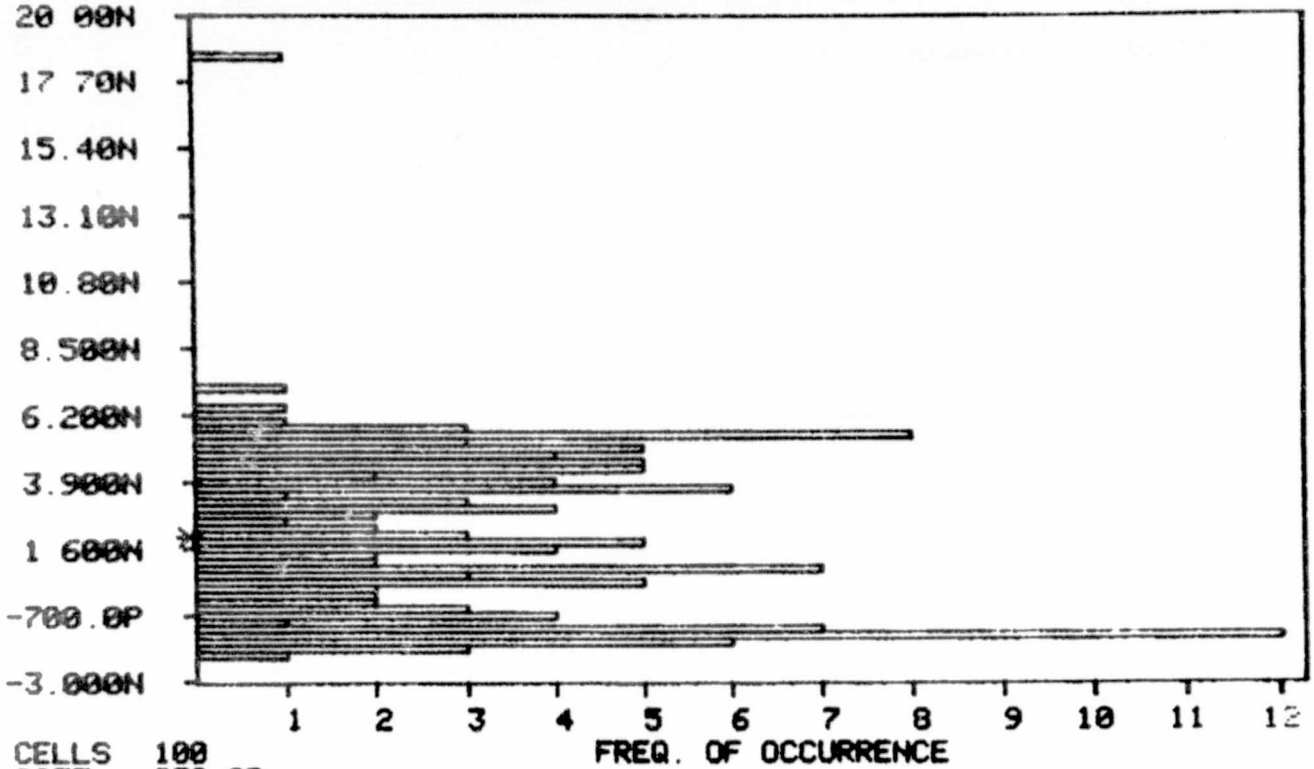
COMPONENTS DEPARTMENT IOZ5 AT TA=-55C 21 SEP 78



OF CELLS 100
CELL SIZE 230.0P

READINGS:	136
MAXIMUM:	18.00N
MEAN:	2.047N
MINIMUM:	-2.000N
STD.DEV.:	3.009N

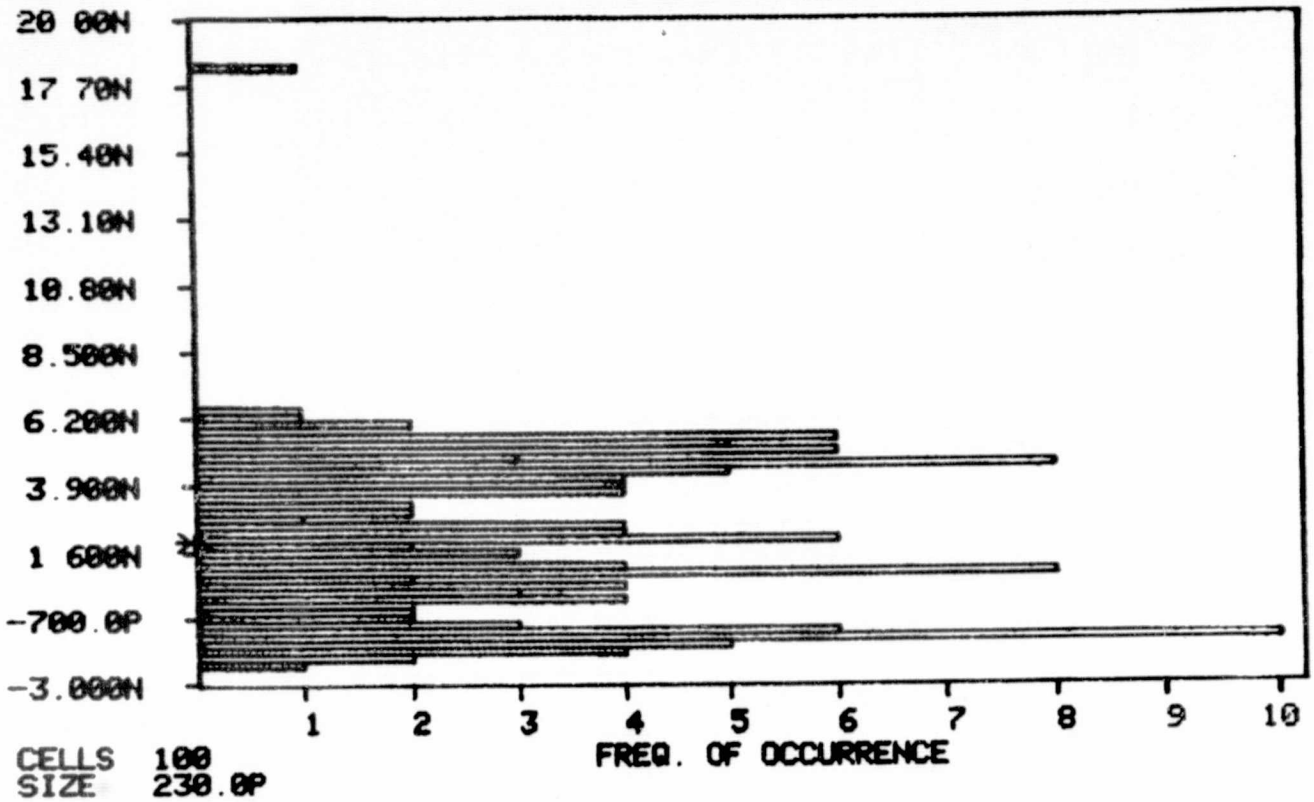
COMPONENTS DEPARTMENT 1026 AT TA=-55C 21 SEP 78



OF CELLS 100
CELL SIZE 230.0P

READINGS:	136
MAXIMUM:	18.70N
MEAN:	2.036N
MINIMUM:	-2.000N
STD.DEV.:	2.945N

COMPONENTS DEPARTMENT 1027 AT TA=-55C 21 SEP 78

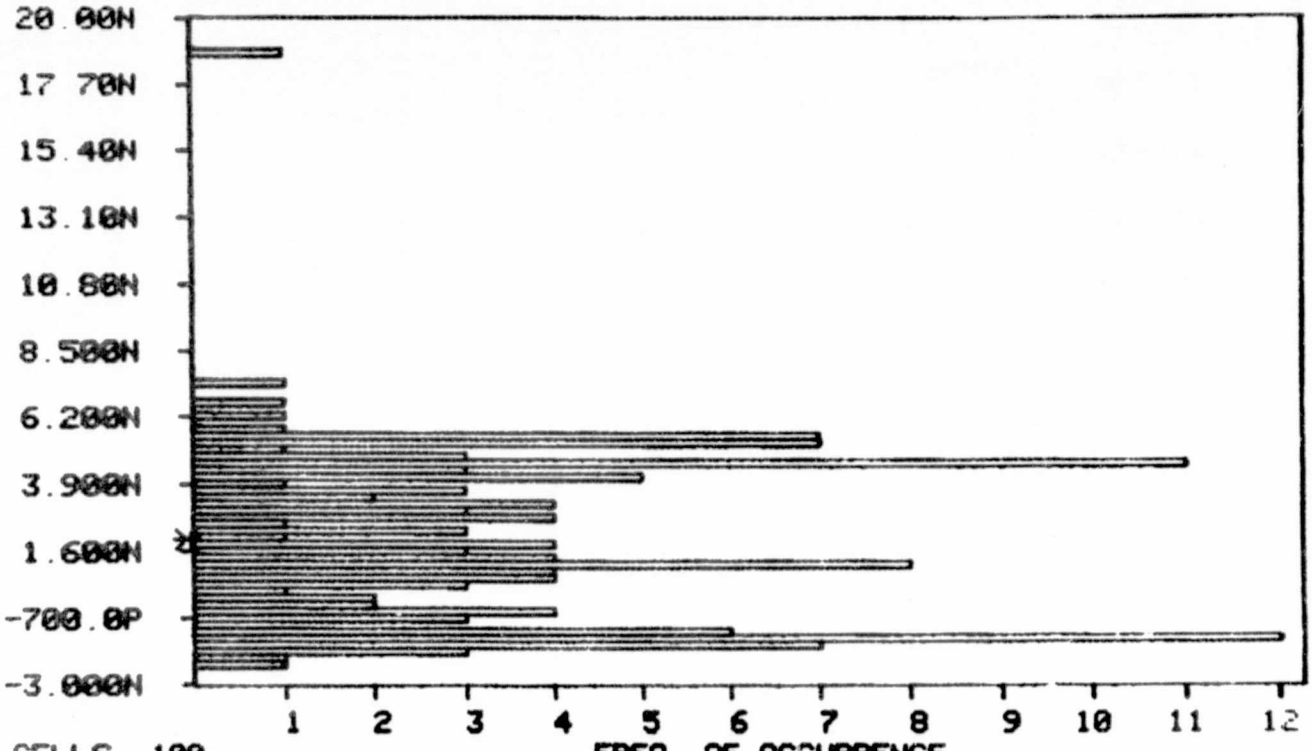


OF CELLS 100
CELL SIZE 230.0P

READINGS:	136
MAXIMUM:	18.50N
MEAN:	2.017N
MINIMUM:	-2.200N
STD.DEV.:	2.911N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

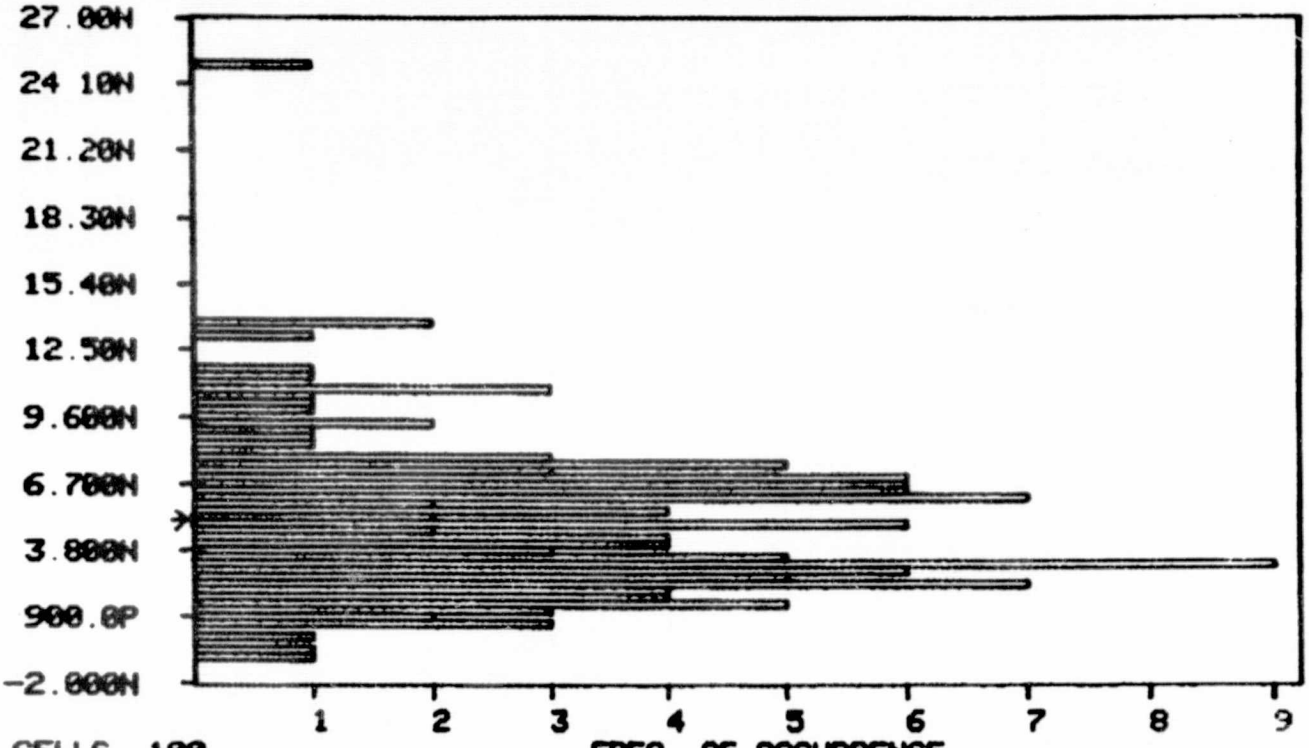
COMPONENTS DEPARTMENT IOZ8 AT TA=-55C 21 SEP 78



OF CELLS 100
CELL SIZE 230.0P

READINGS:	136
MAXIMUM:	18.90N
MEAN:	2.028N
MINIMUM:	-2.300N
STD.DEV.:	2.942N

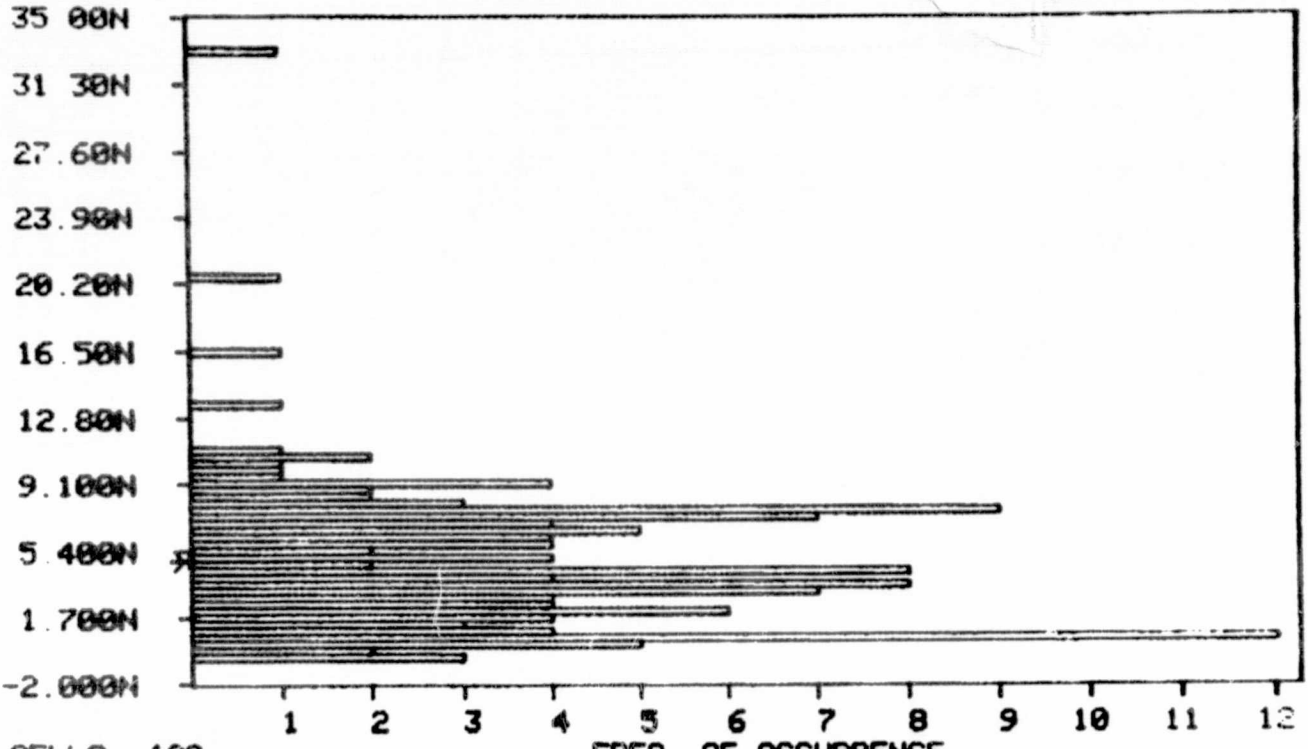
COMPONENTS DEPARTMENT IOZ1 AT TA=-20C 21 SEP 78



OF CELLS 100
CELL SIZE 290.0P

READINGS:	136
MAXIMUM:	25.10N
MEAN:	5.107N
MINIMUM:	-800.0P
STD.DEV.:	3.470N

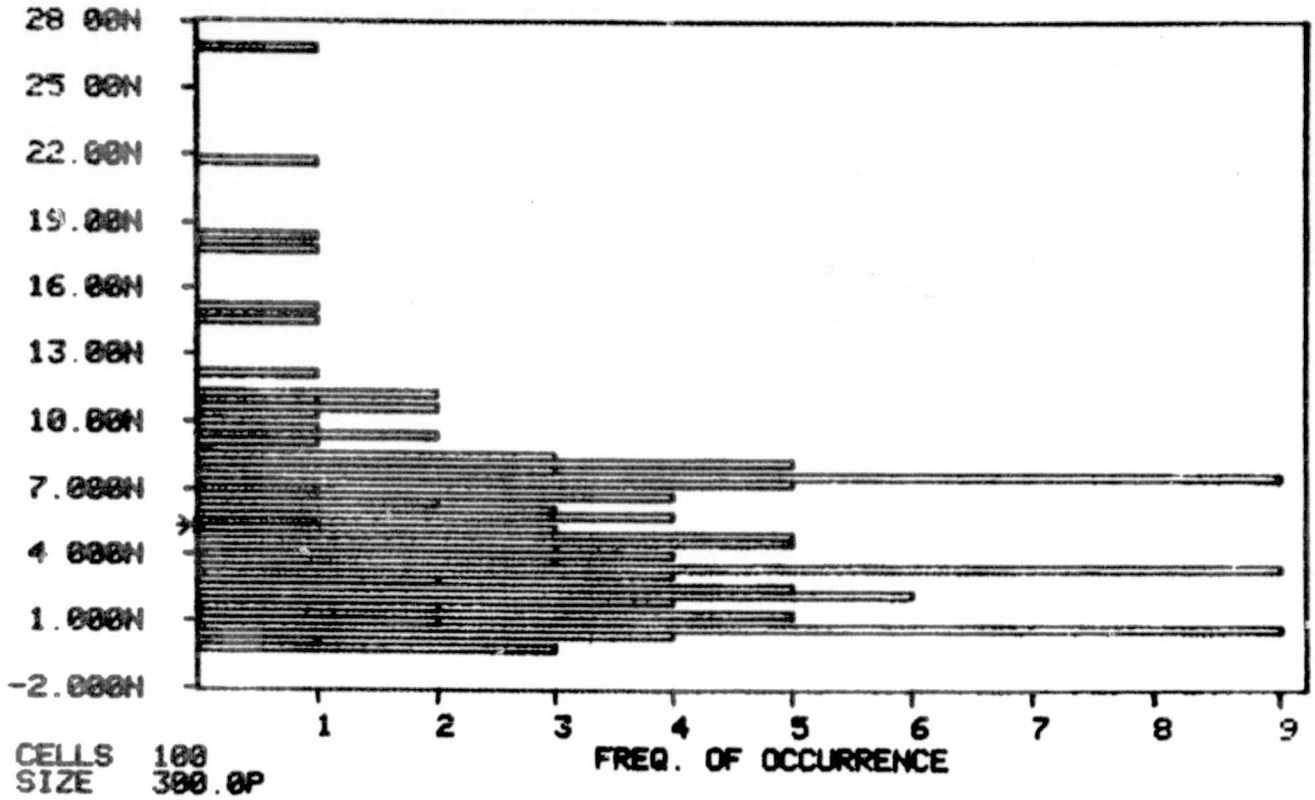
COMPONENTS DEPARTMENT IOZ2 AT TA=-20C 21 SEP 78



OF CELLS 100
CELL SIZE 370.0P

READINGS: 136
MAXIMUM: 33.20N
MEAN: 4.879N
MINIMUM: [illegible]00.0P
STD.DEV.: [illegible]278N

COMPONENTS DEPARTMENT IOZ3 AT TA=-20C 21 SEP 78

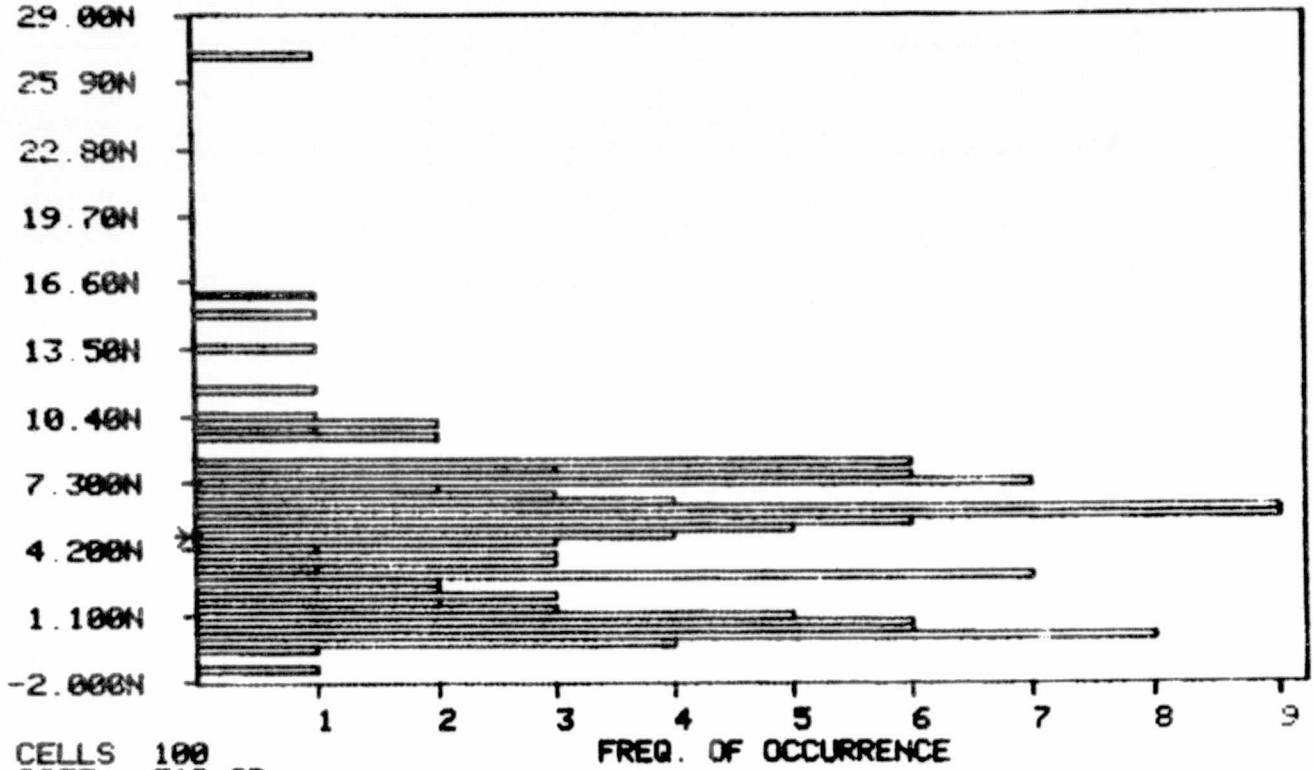


OF CELLS 100
CELL SIZE 300.0P

READINGS:	136
MAXIMUM:	26.90N
MEAN:	5.310N
MINIMUM:	-300.0P
STD.DEV.:	4.296N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

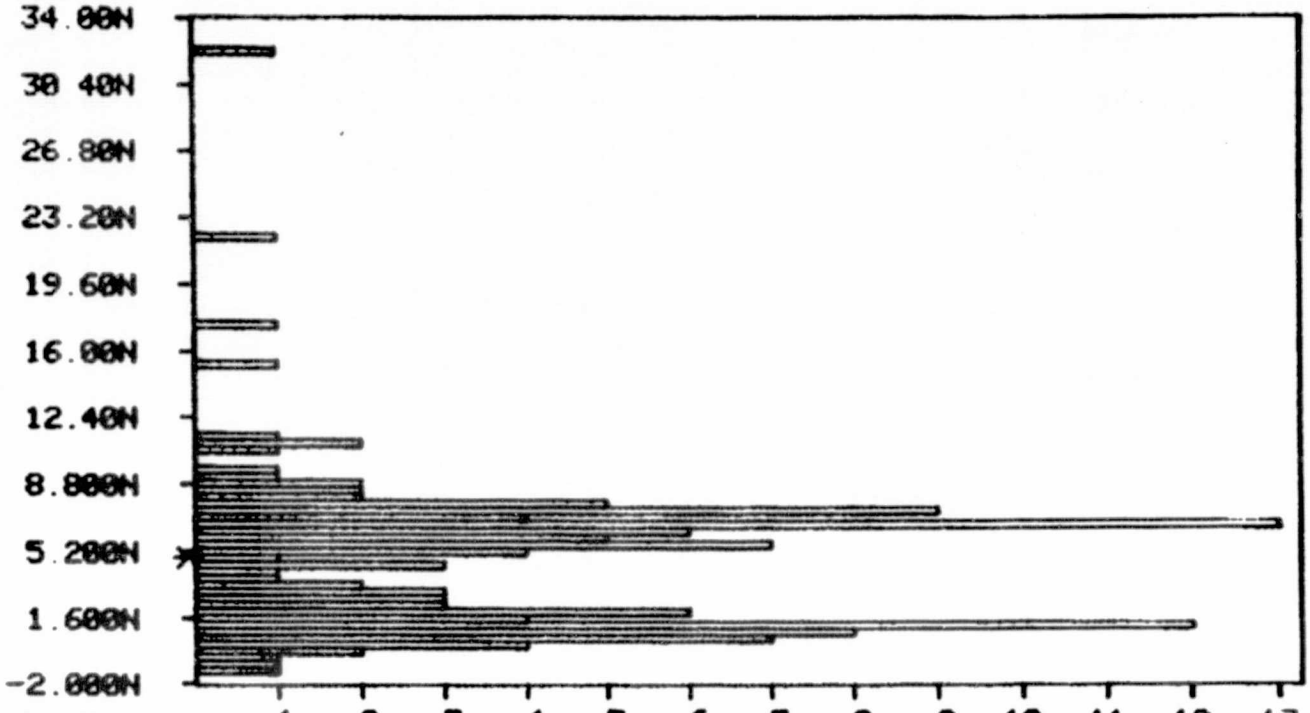
COMPONENTS DEPARTMENT IOZ4 AT TA=-20C 21 SEP 78



OF CELLS 100
CELL SIZE 310.0P

READINGS:	136
MAXIMUM:	27.00N
MEAN:	4.826N
MINIMUM:	-1.500N
STD.DEV.:	3.818N

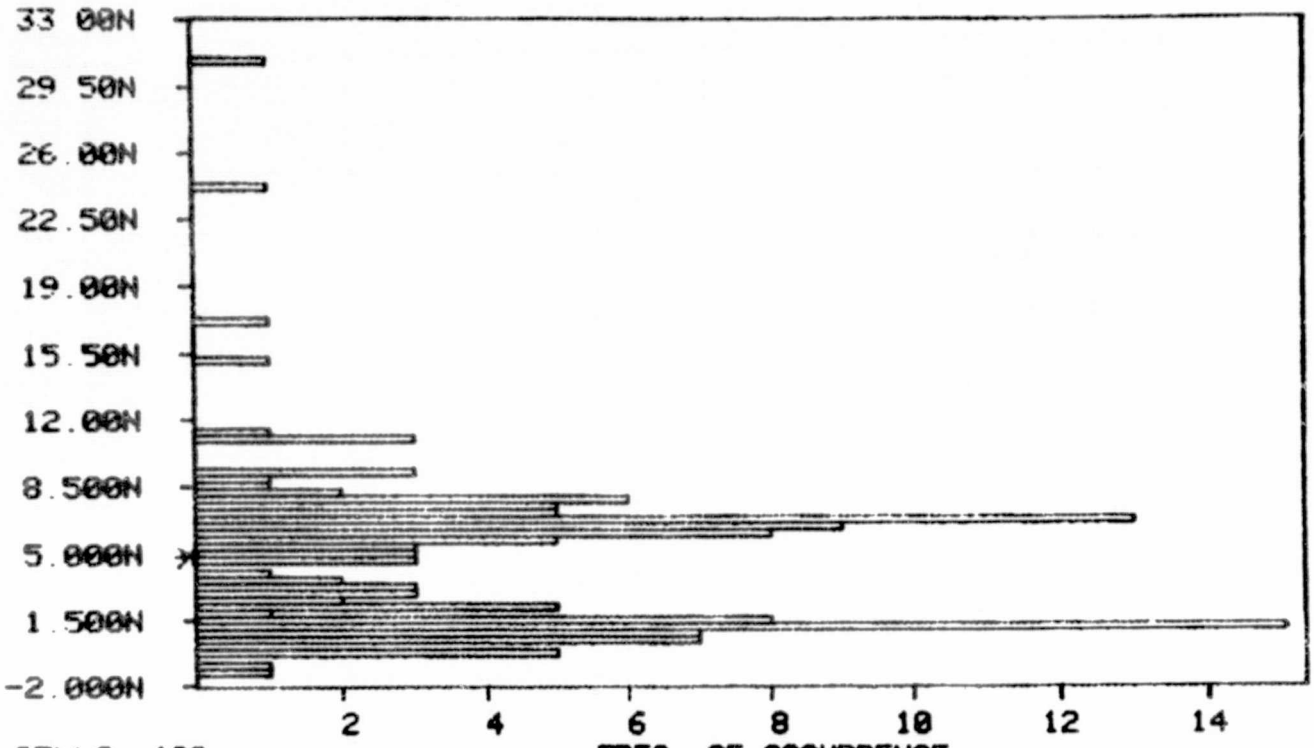
COMPONENTS DEPARTMENT IOZ5 AT TA=-20C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 360.0P

READINGS:	132
MAXIMUM:	32.20N
MEAN:	4.887N
MINIMUM:	-1.400N
STD.DEV.:	4.408N

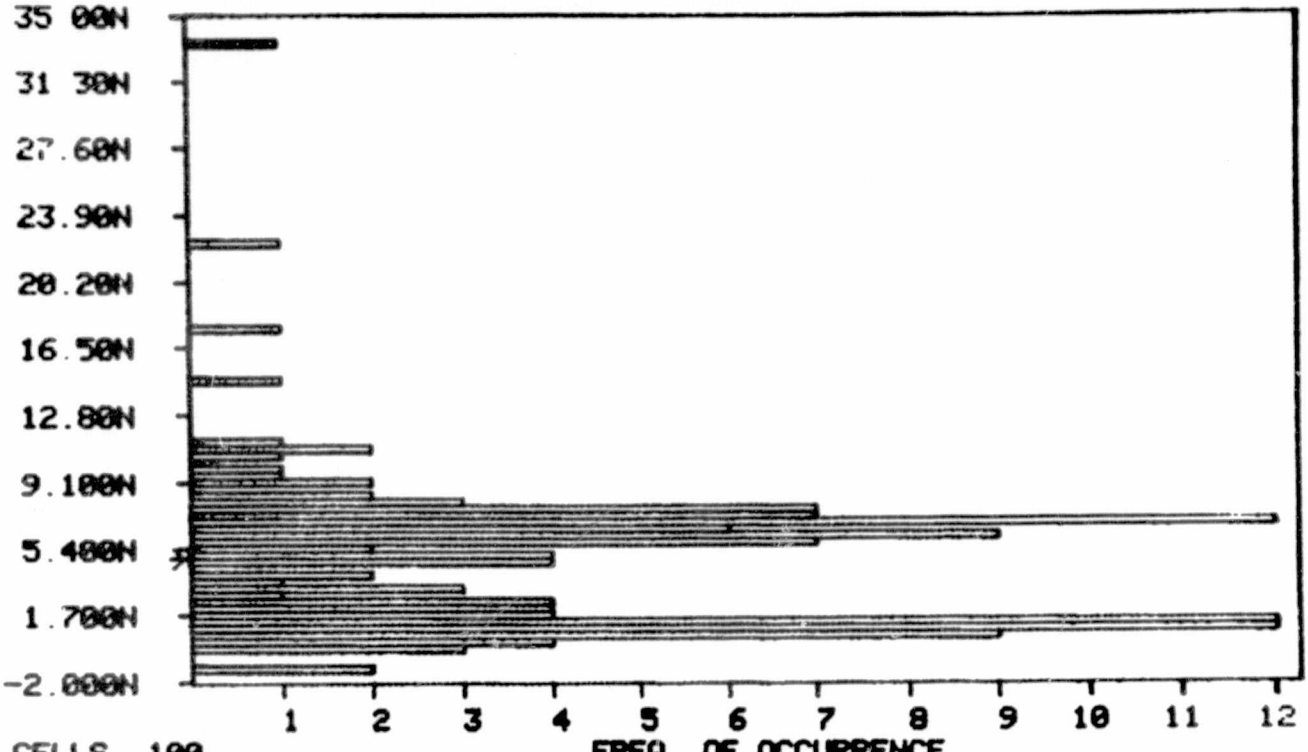
COMPONENTS DEPARTMENT IOZ6 AT TA=-20C 21 SEP 78



OF CELLS 100
CELL SIZE 350.0P

READINGS:	136
MAXIMUM:	31.00N
MEAN:	4.866N
MINIMUM:	-1.200N
STD DEV.:	4.396N

COMPONENTS DEPARTMENT IO27 AT TA=20C 21 SEP 78

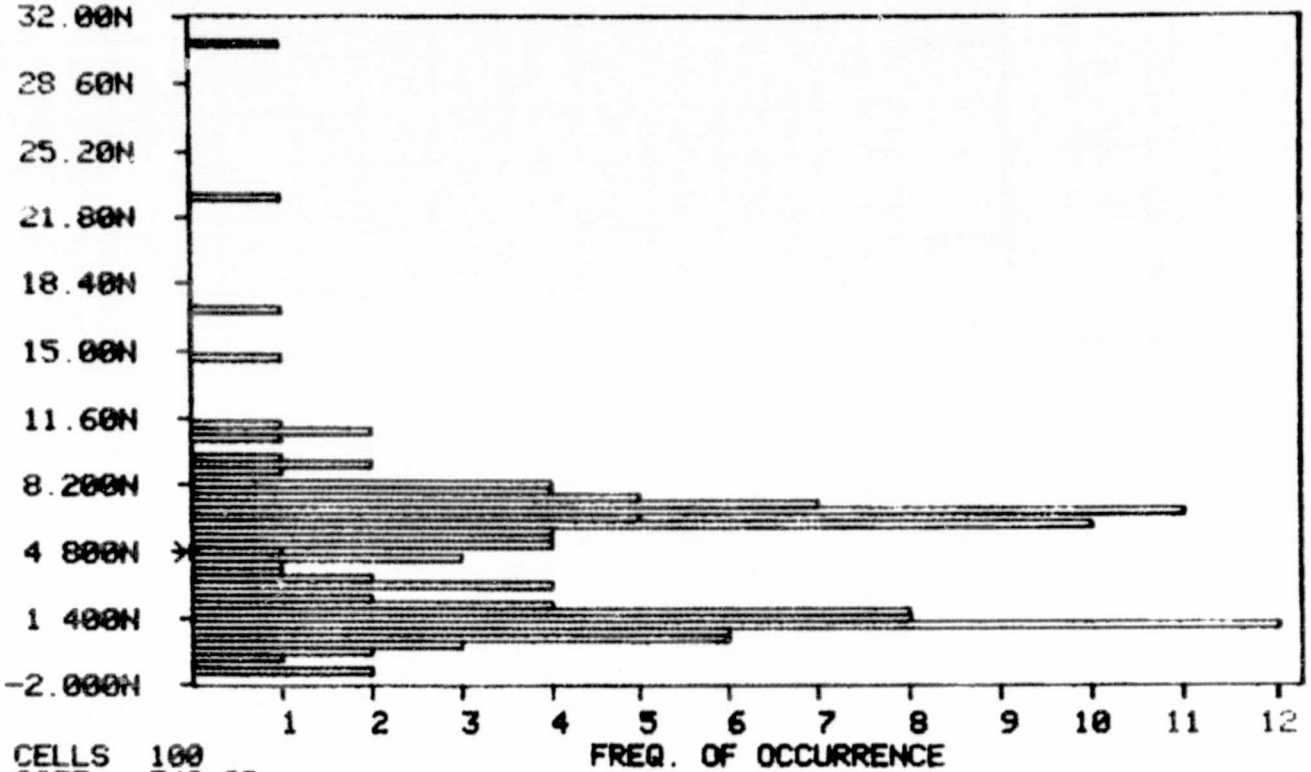


OF CELLS 100
CELL SIZE 370.0P

READINGS:	136
MAXIMUM:	33.40N
MEAN:	4.857N
MINIMUM:	-1.300N
STD.DEV.:	4.468N

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

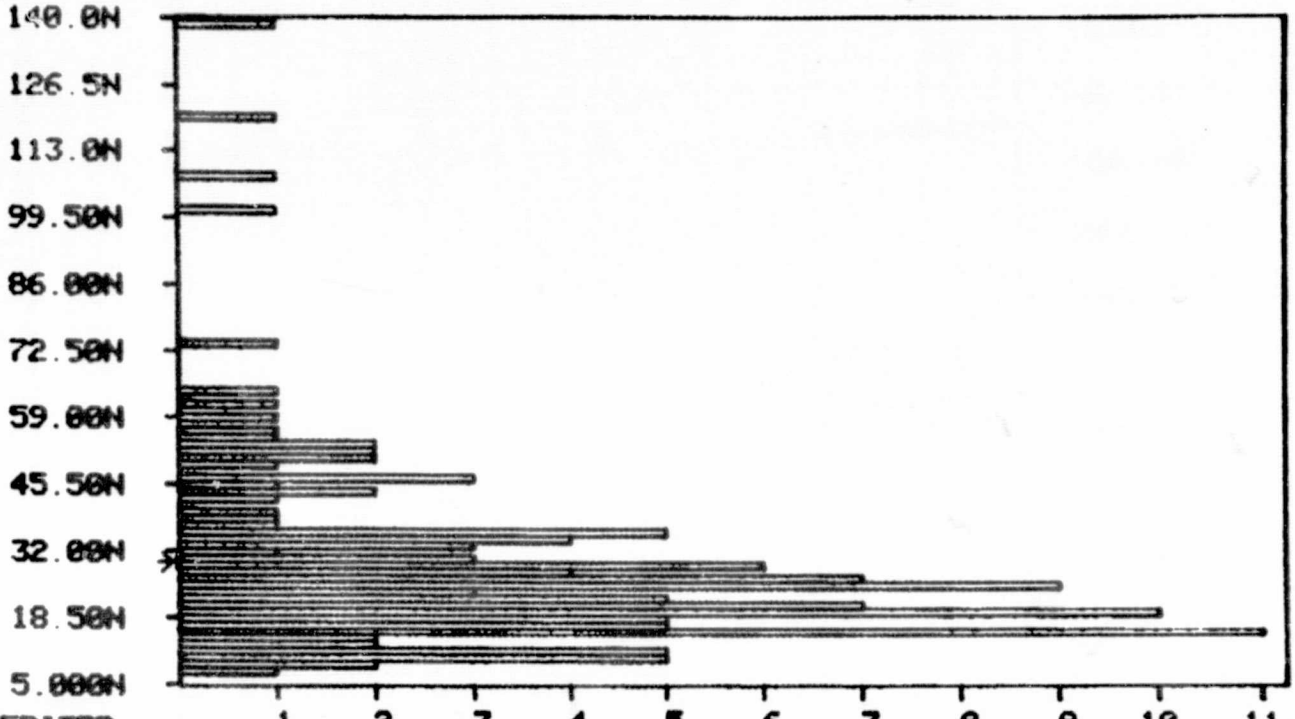
COMPONENTS DEPARTMENT IOZ8 AT TA=-20C 21 SEP 78



OF CELLS 100
CELL SIZE 340.0P

READINGS:	136
MAXIMUM:	30.70N
MEAN:	4.815N
MINIMUM:	-1.400N
STD.DEV.:	4.344N

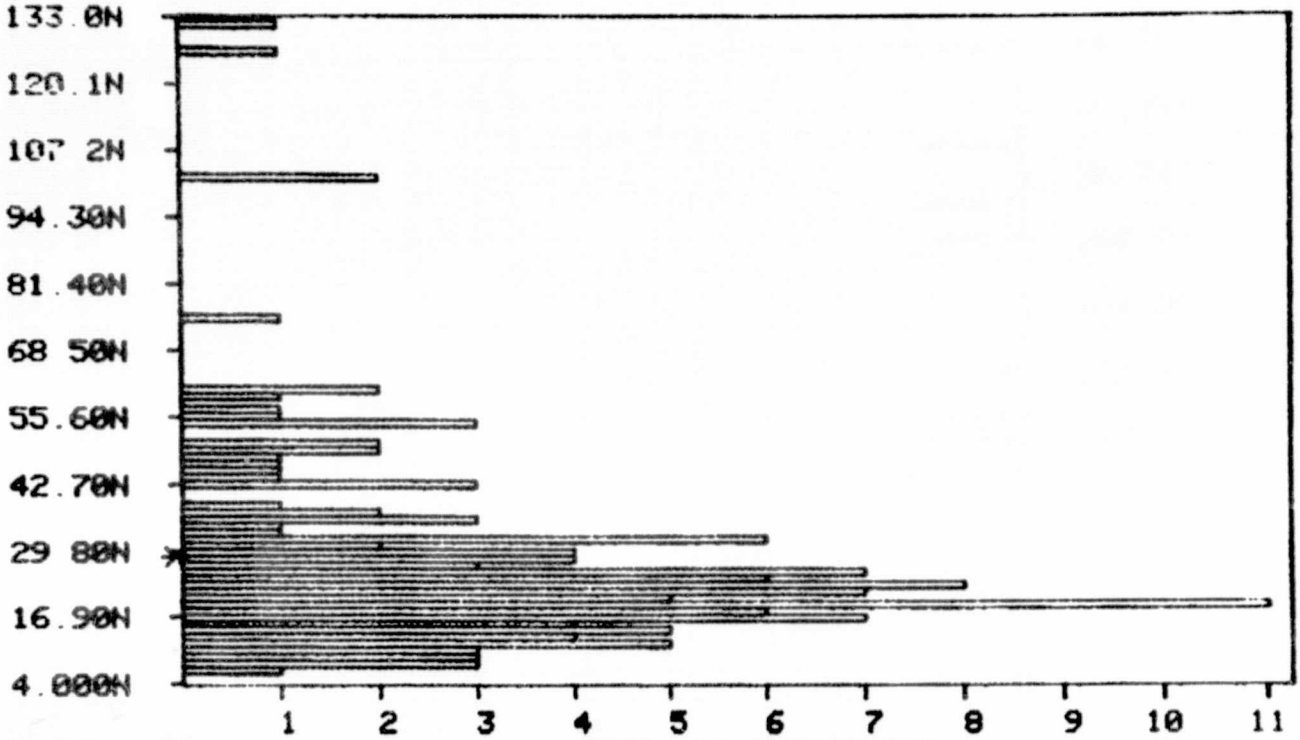
COMPONENTS DEPARTMENT IOZ1 AT TA=25C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 1.350N

READINGS:	132
MAXIMUM:	138.0N
MEAN:	29.90N
MINIMUM:	7.400N
STD.DEV.:	20.42N

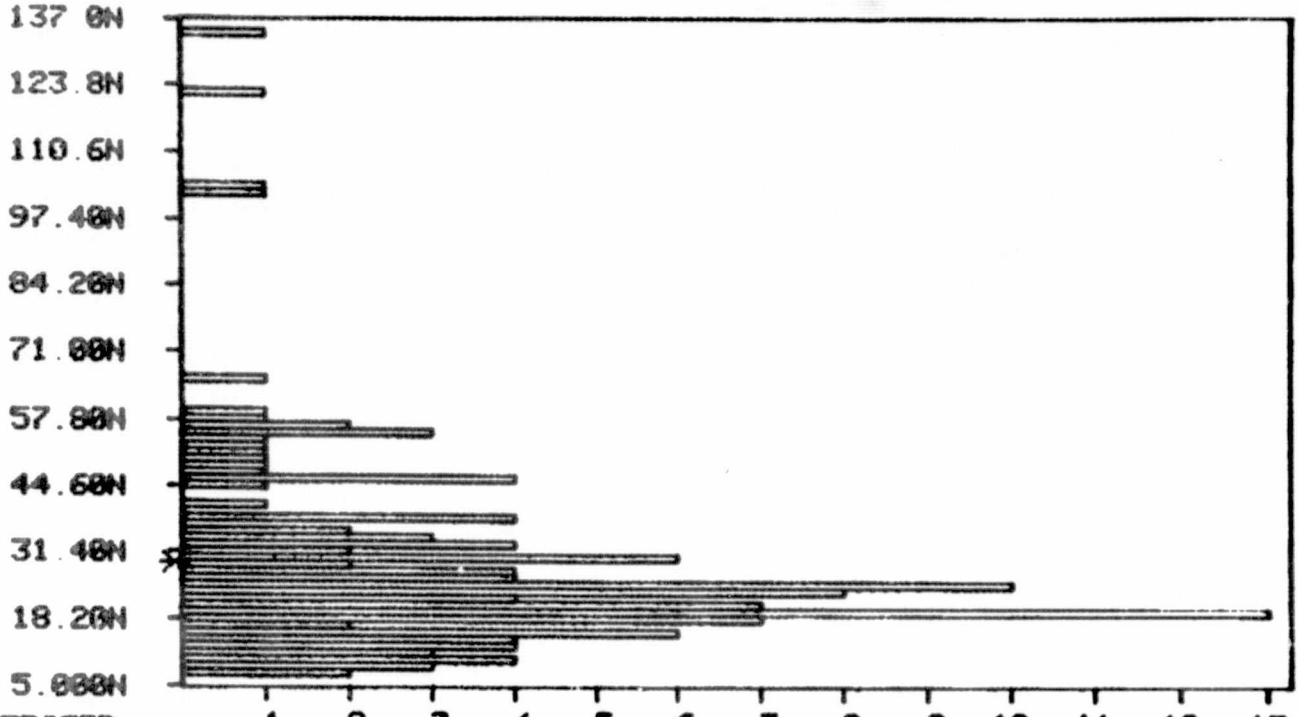
COMPONENTS DEPARTMENT IOZ2 AT TA=25C 21 SEP 78



OF CELLS 100
CELL SIZE 1.290N

READINGS:	136
MAXIMUM:	131.5N
MEAN:	28.84N
MINIMUM:	6.800N
STD DEV.:	20.22N

COMPONENTS DEPARTMENT 1023 AT TA=25C 21 SEP 78

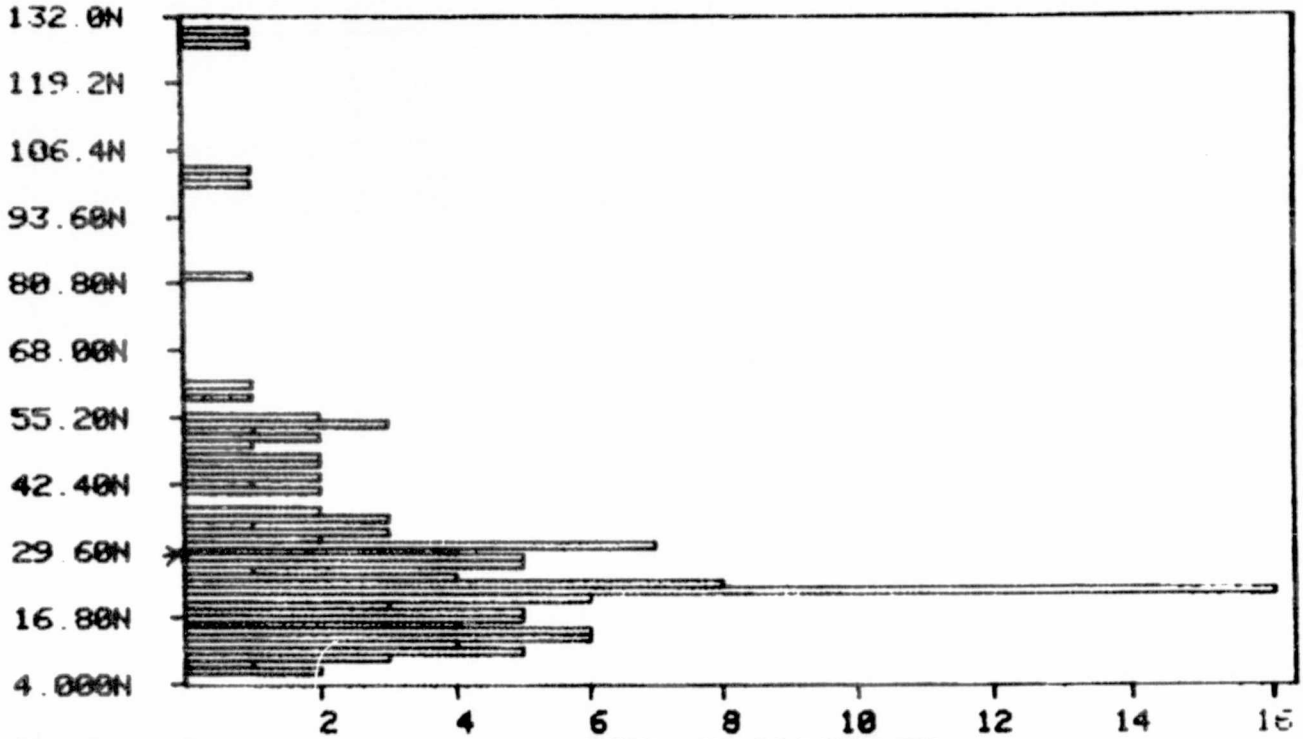


DATA EDITED
OF CELLS 100
CELL SIZE 1.320N

READINGS:	132
MAXIMUM:	135.0N
MEAN:	29.37N
MINIMUM:	7.700N
STD.DEV.:	20.21N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

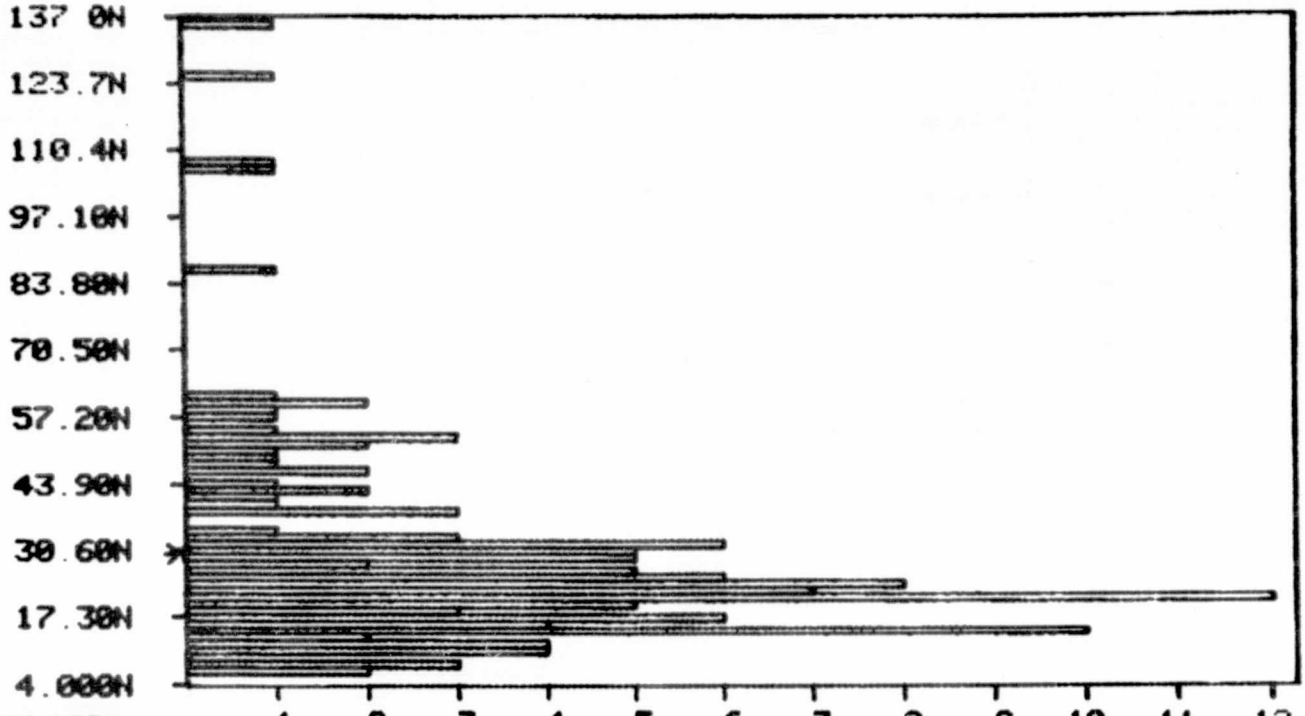
COMPONENTS DEPARTMENT IOZ4 AT TA=25C 21 SEP 78



OF CELLS 100
CELL SIZE 1.280N

READINGS:	136
MAXIMUM:	130.0N
MEAN:	28.86N
MINIMUM:	6.300N
STD.DEV. :	20.28N

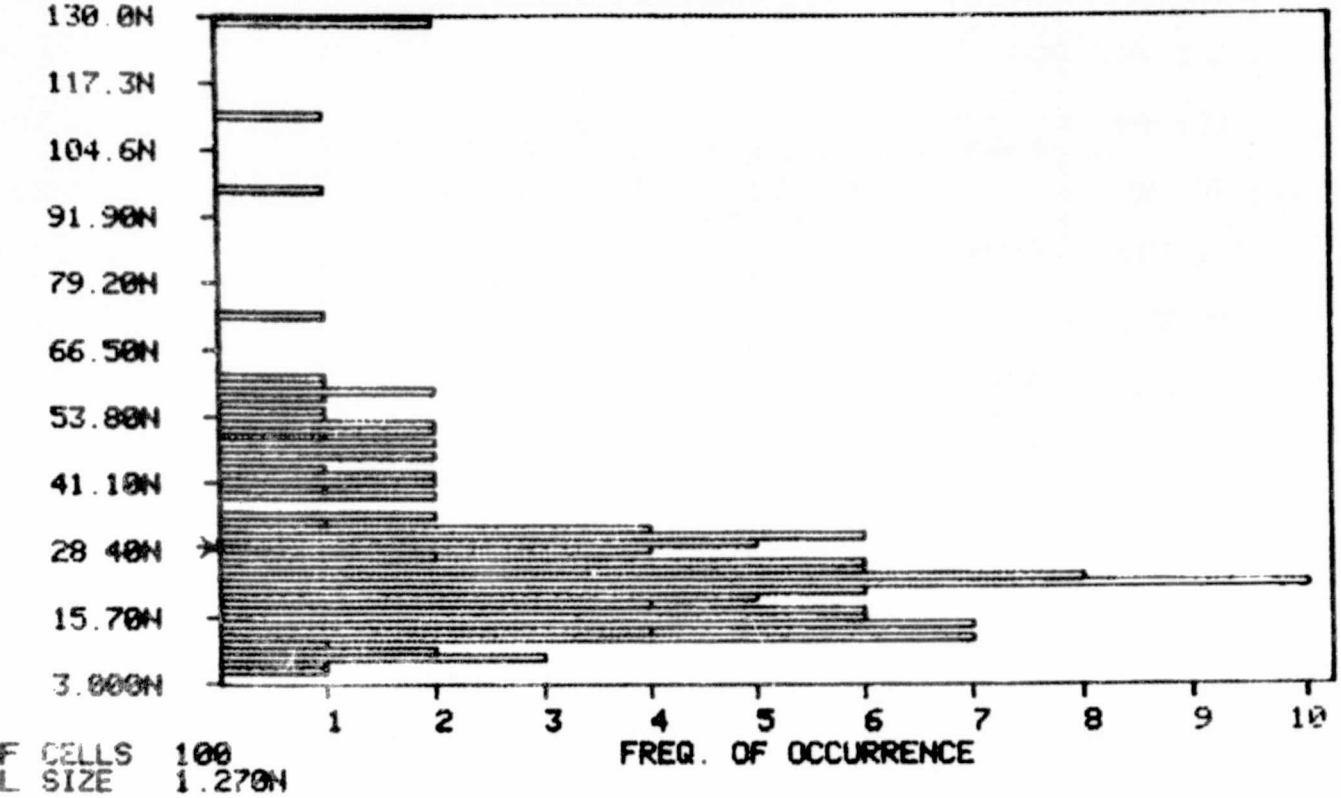
COMPONENTS DEPARTMENT 1025 AT TA=25C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 1.330N

READINGS:	132
MAXIMUM:	135.5N
MEAN:	29.82N
MINIMUM:	6.100N
STD.DEV.:	21.01N

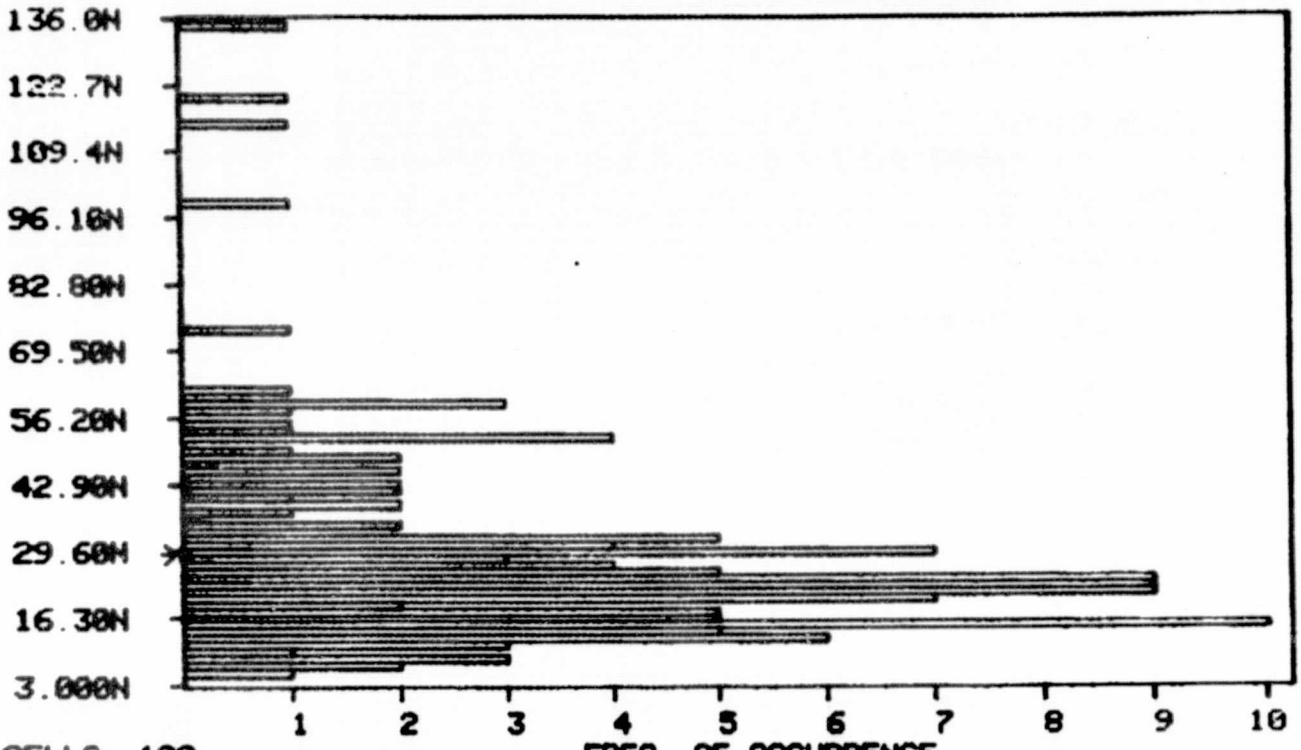
PONENTS DEPARTMENT I026 AT TA=25C 21 SEP 78



F CELLS 100
L SIZE 1.270N

DINGS:	136
IMUM:	128.5N
N:	29.11N
IMUM:	5.700N
.DEV.:	20.40N

COMPONENTS DEPARTMENT 1027 AT TA=25C 21 SEP 78

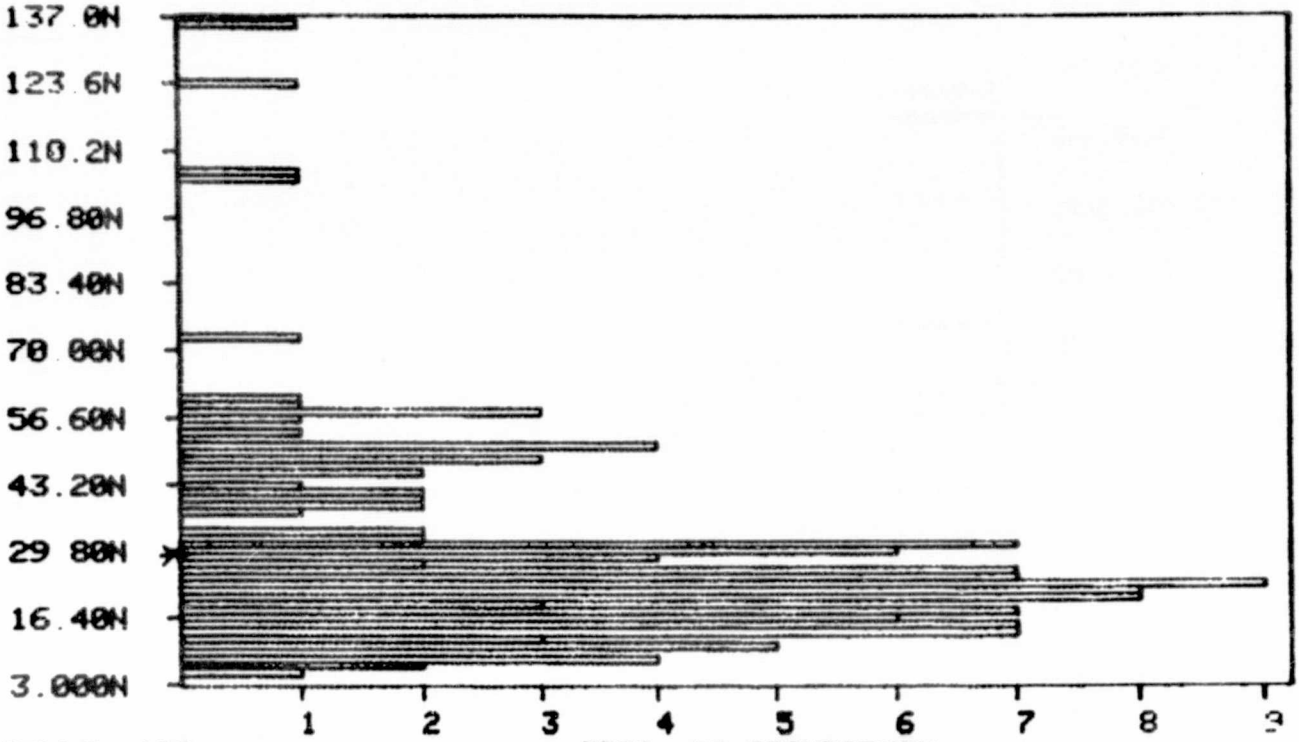


OF CELLS 100
CELL SIZE 1.330N

READINGS:	136
MAXIMUM:	134.5N
MEAN:	29.00N
MINIMUM:	5.900N
STD.DEV.:	20.48N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

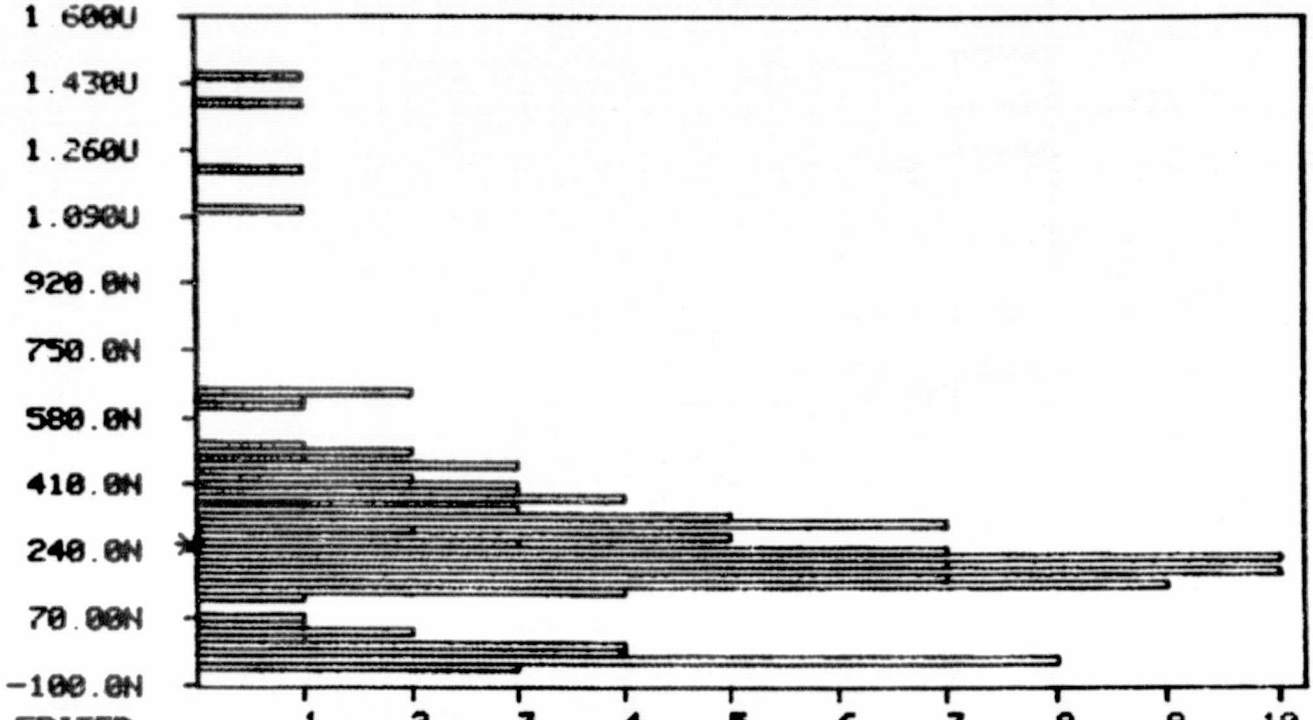
COMPONENTS DEPARTMENT IOZ8 AT TA=25C 21 SEP 78



OF CELLS 100
CELL SIZE 1.340N

READINGS:	136
MAXIMUM:	135.5N
MEAN:	28.91N
MINIMUM:	5.600N
STD.DEV.:	20.55N

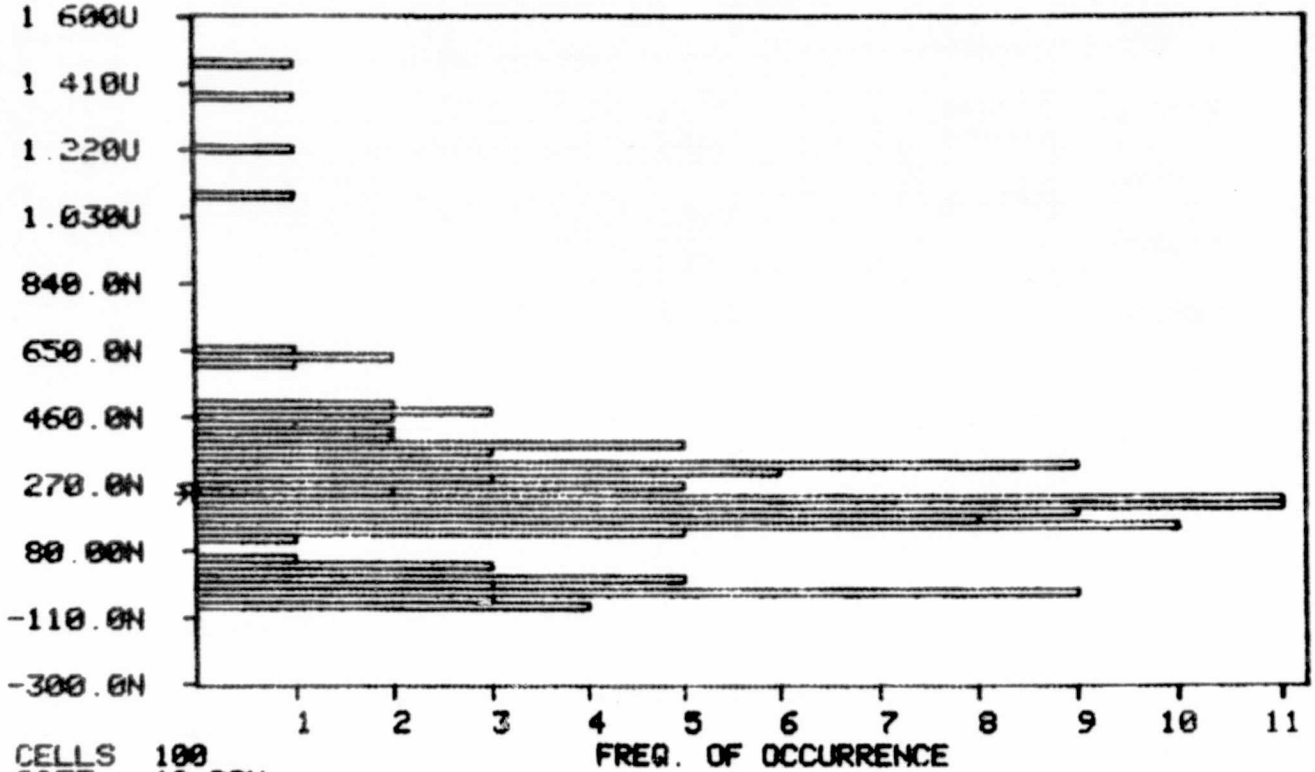
COMPONENTS DEPARTMENT IOZ1 AT TA=85C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 17.00N

READINGS:	132
MAXIMUM:	1.455U
MEAN:	256.9N
MINIMUM:	-48.20N
STD.DEV.:	240.1N

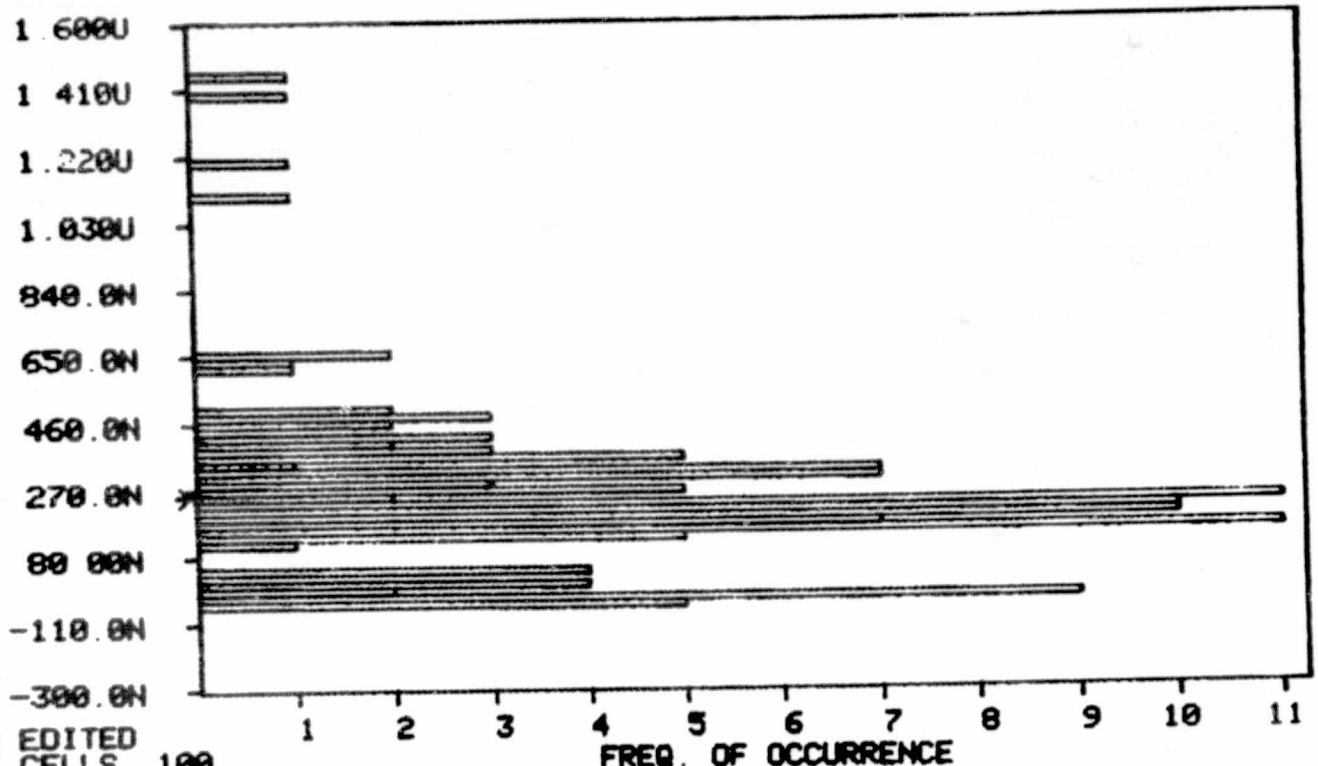
COMPONENTS DEPARTMENT IOZ2 AT TA=85C 21 SEP 78



OF CELLS 100
CELL SIZE 19.00N

READINGS:	136
MAXIMUM:	1.465U
MEAN:	244.9N
MINIMUM:	-78.30N
STD.DEV.:	244.2N

COMPONENTS DEPARTMENT 1023 AT TA=85C 21 SEP 78

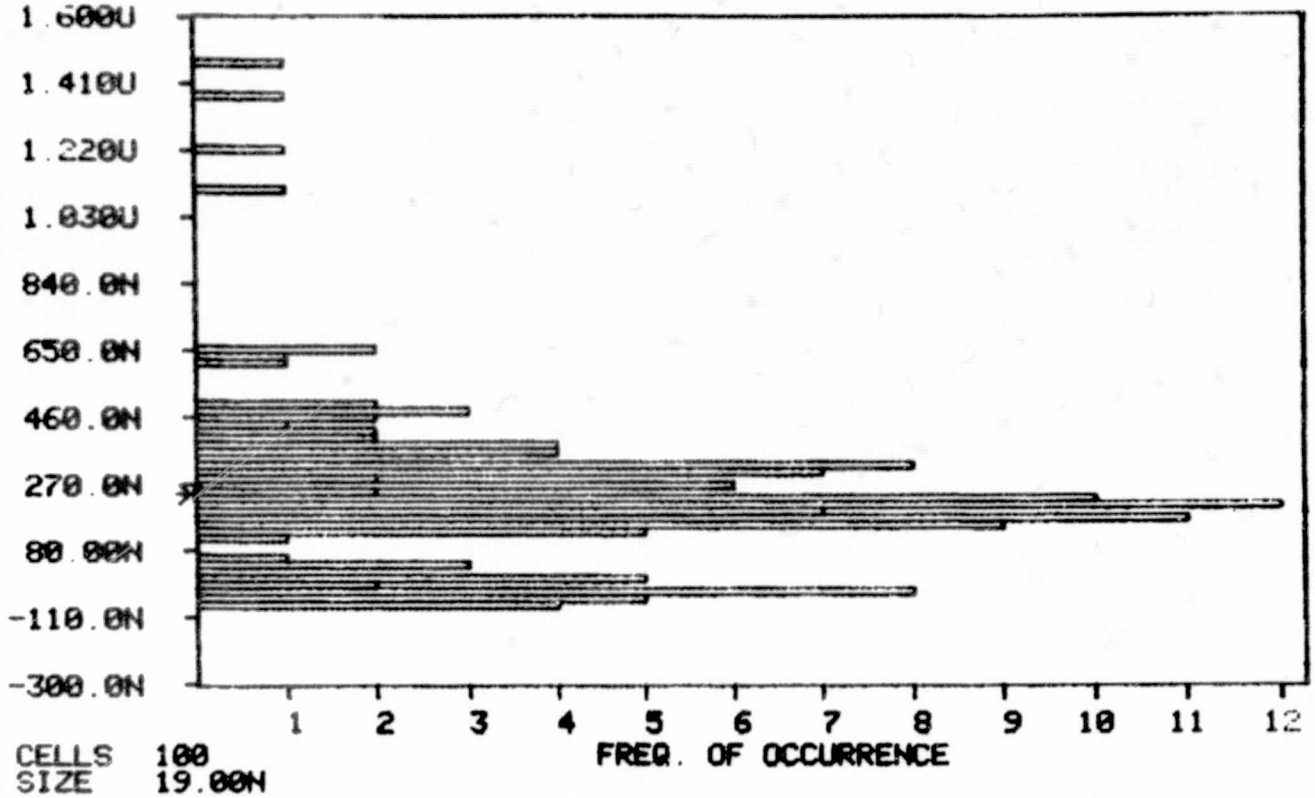


DATA EDITED
OF CELLS 100
CELL SIZE 19.00N

READINGS:	132
MAXIMUM:	1.450U
MEAN:	253.6N
MINIMUM:	-55.70N
STD.DEV.:	242.4N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

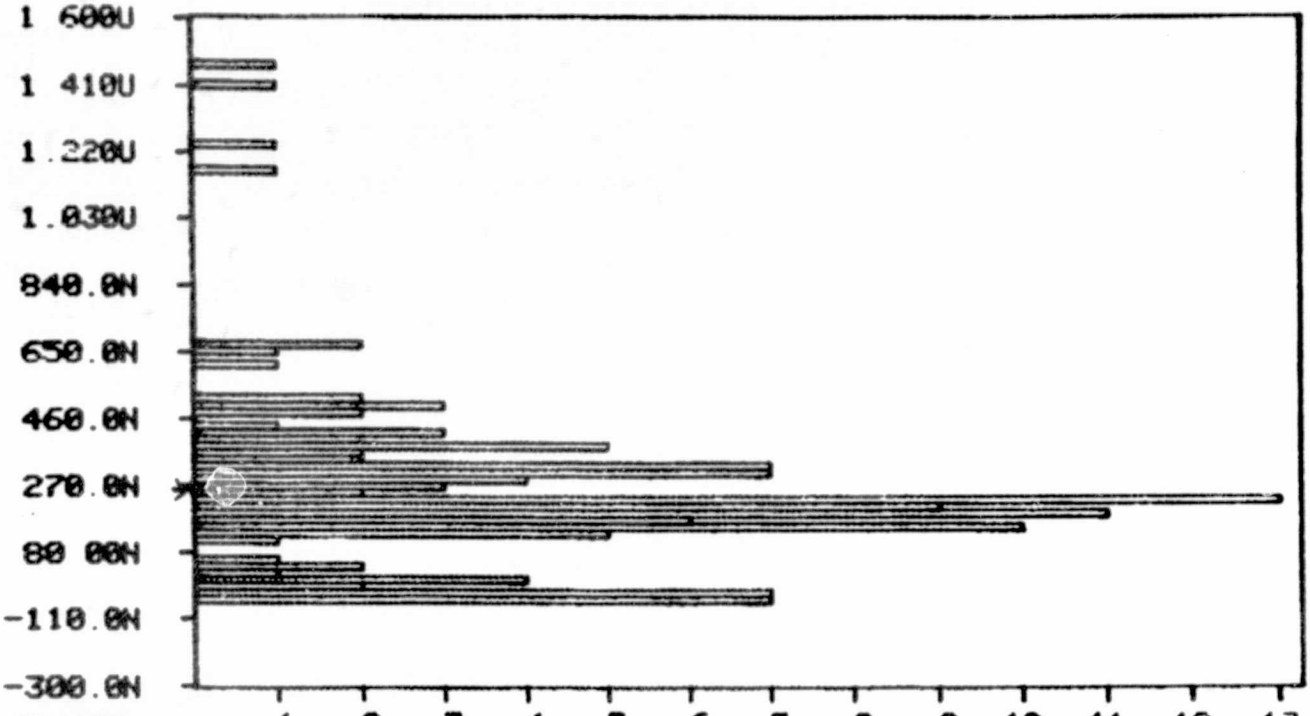
OMPONENTS DEPARTMENT IO24 AT TA=85C 21 SEP 78



OF CELLS 100
ELL SIZE 19.00N

EADINGS:	136
AXIMUM:	1.465U
EAN:	244.0N
INIMUM:	-78.30N
TD.DEV.:	245.8N

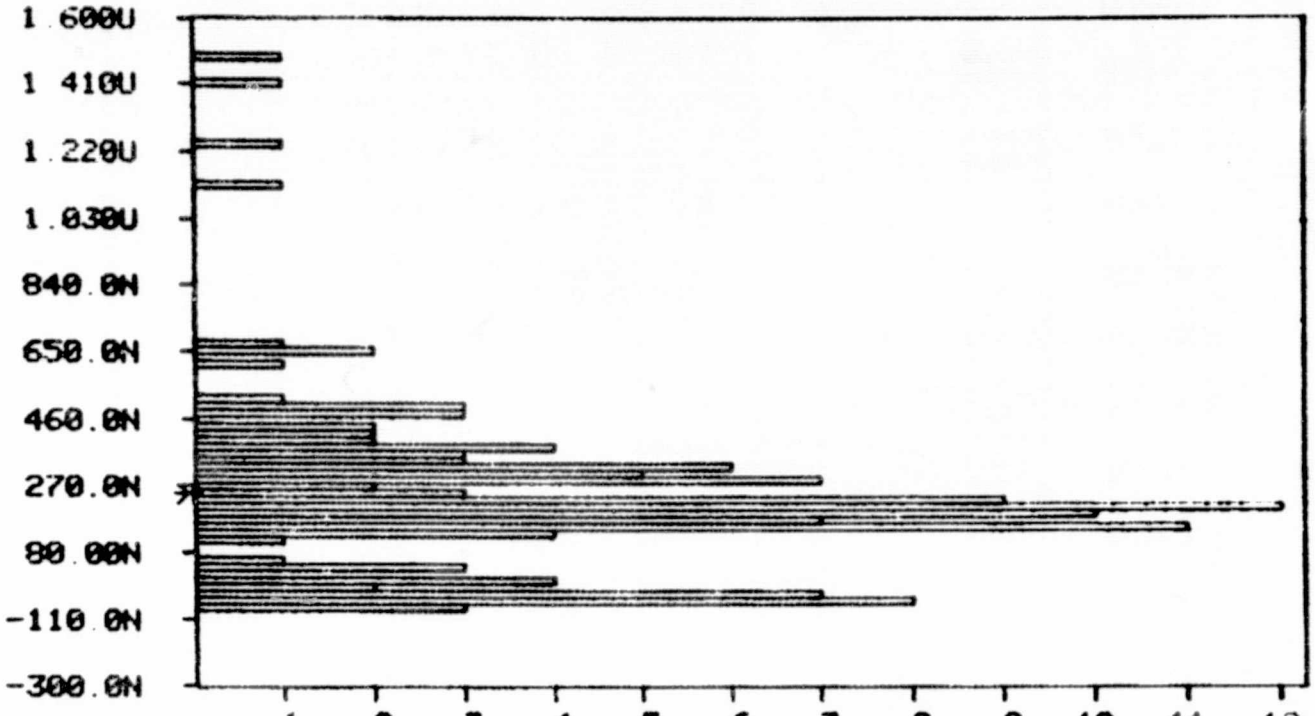
COMPONENTS DEPARTMENT IOZ5 AT TA=85C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 19.00N

READINGS:	132
MAXIMUM:	1.470U
MEAN:	258.2N
MINIMUM:	-58.70N
STD.DEV.:	248.3N

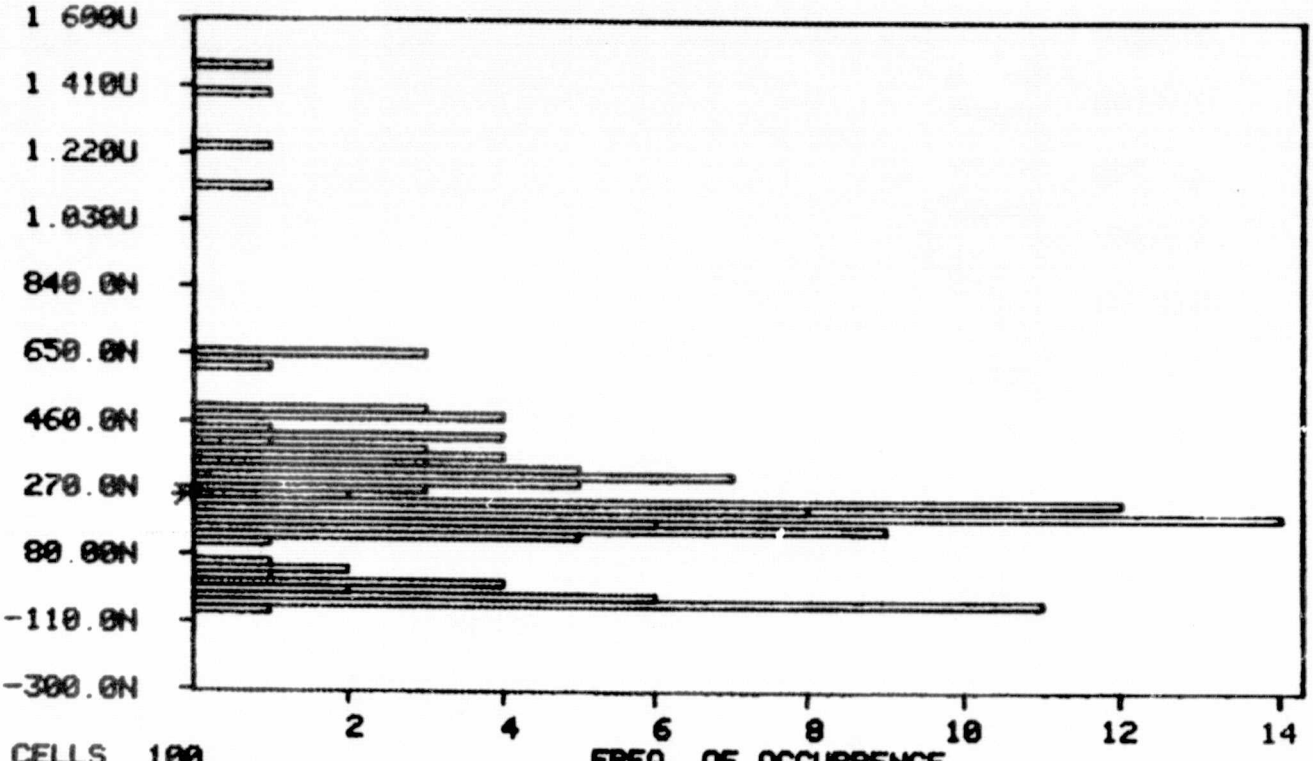
COMPONENTS DEPARTMENT 1026 AT TA=85C 21 SEP 78



OF CELLS 100
CELL SIZE 19.00N

READINGS:	136
MAXIMUM:	1.485U
MEAN:	248.4N
MINIMUM:	-78.00N
STD.DEV.:	250.1N

COMPONENTS DEPARTMENT IOZ7 AT TA=85C 21 SEP 78

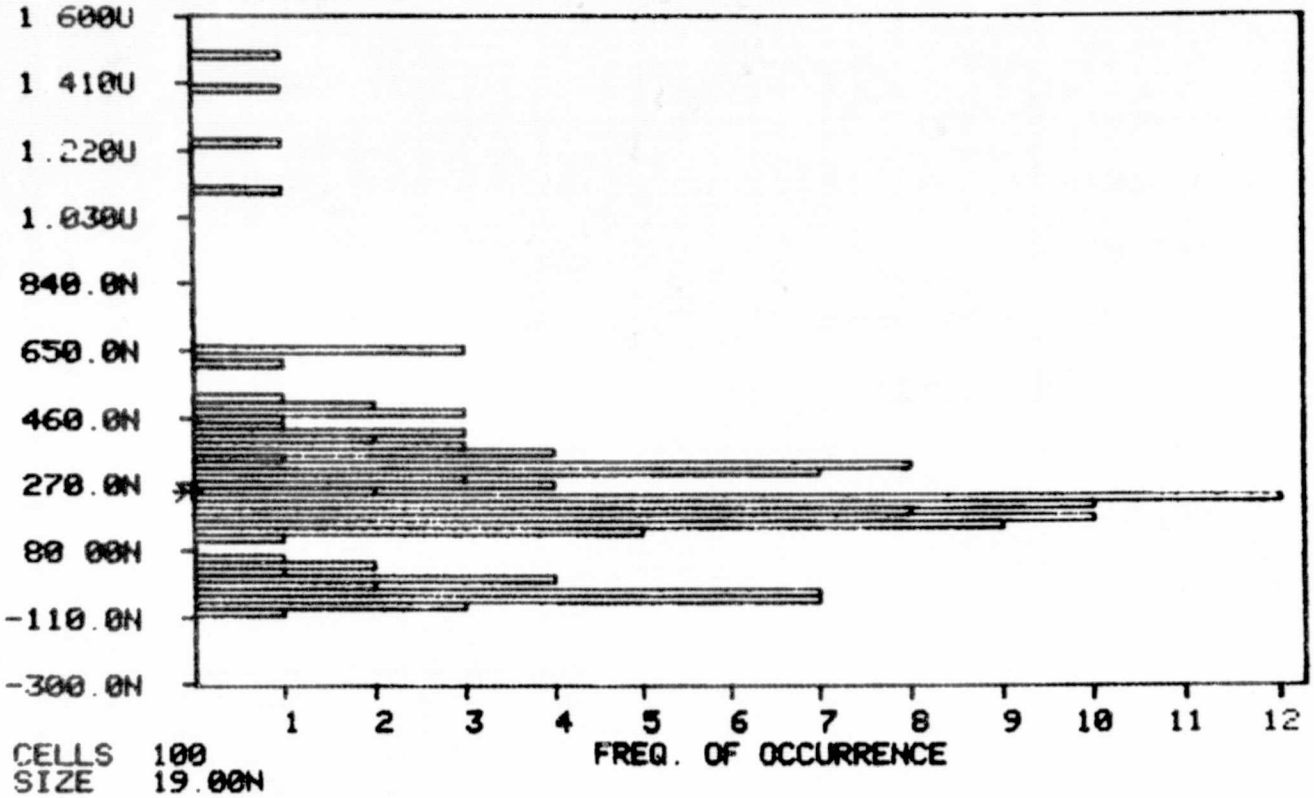


OF CELLS 100
CELL SIZE 19.00N

READINGS:	136
MAXIMUM:	1.475U
MEAN:	247.1N
MINIMUM:	-73.50N
STD.DEV.:	248.3N

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

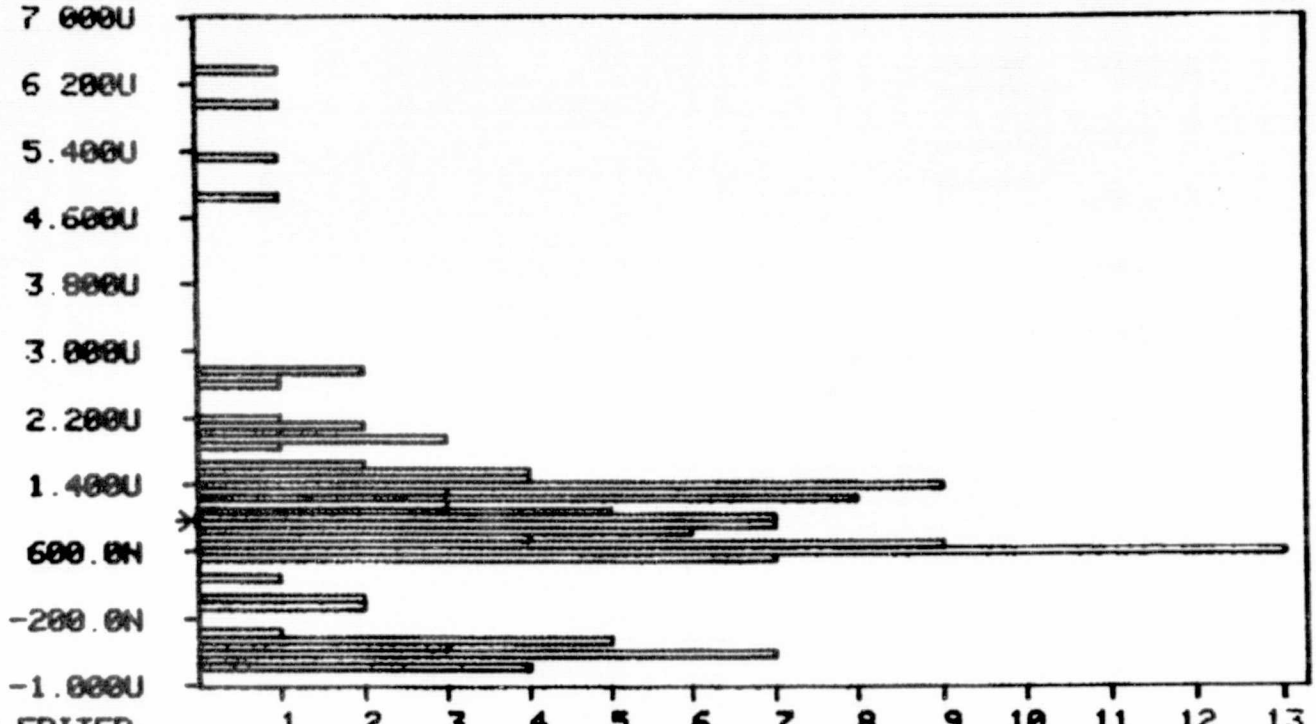
COMPONENTS DEPARTMENT IOZ8 AT TA=85C 21 SEP 78



OF CELLS 100
CELL SIZE 19.00N

READINGS:	136
MAXIMUM:	1.480U
MEAN:	246.5N
MINIMUM:	-81.90N
STD DEV. :	248.7N

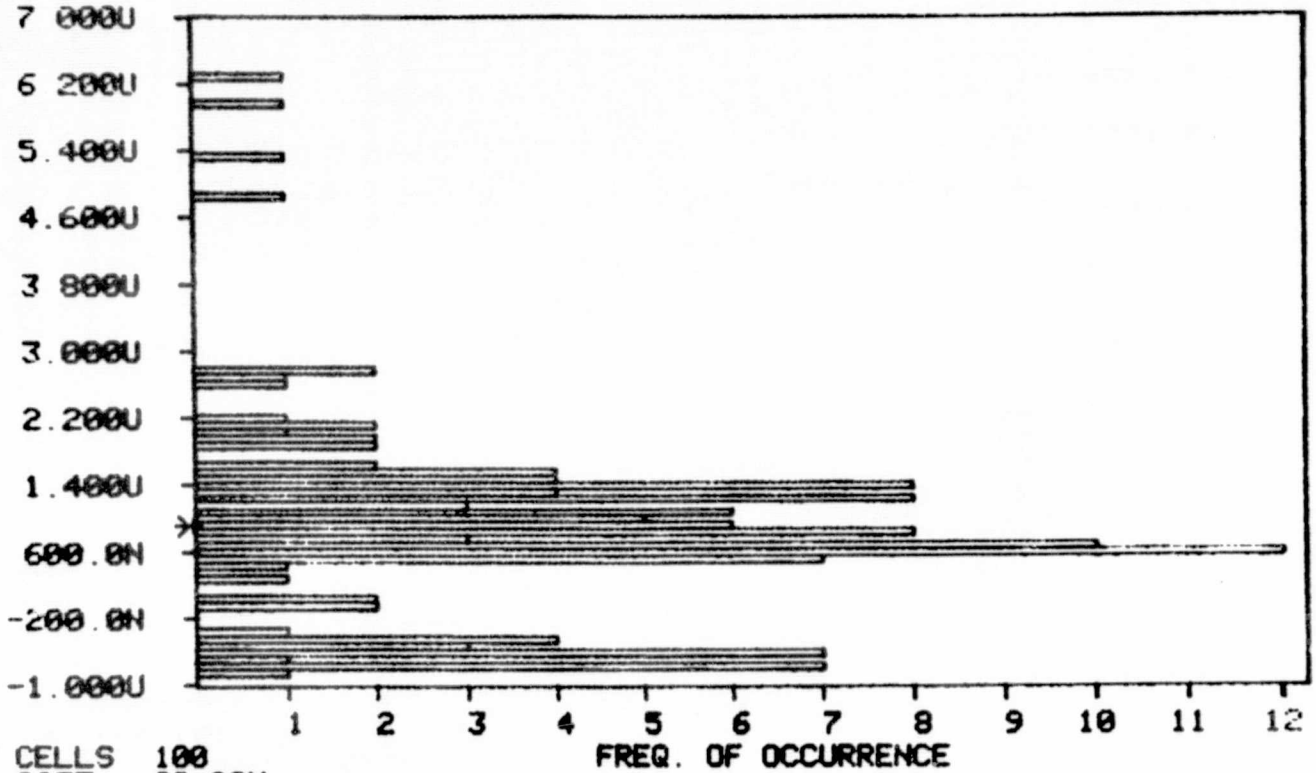
COMPONENTS DEPARTMENT IOZ1 AT TA=125C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 80.00N

READINGS:	132
MAXIMUM:	6.325U
MEAN:	972.4N
MINIMUM:	-761.5N
STD.DEV.:	1.142U

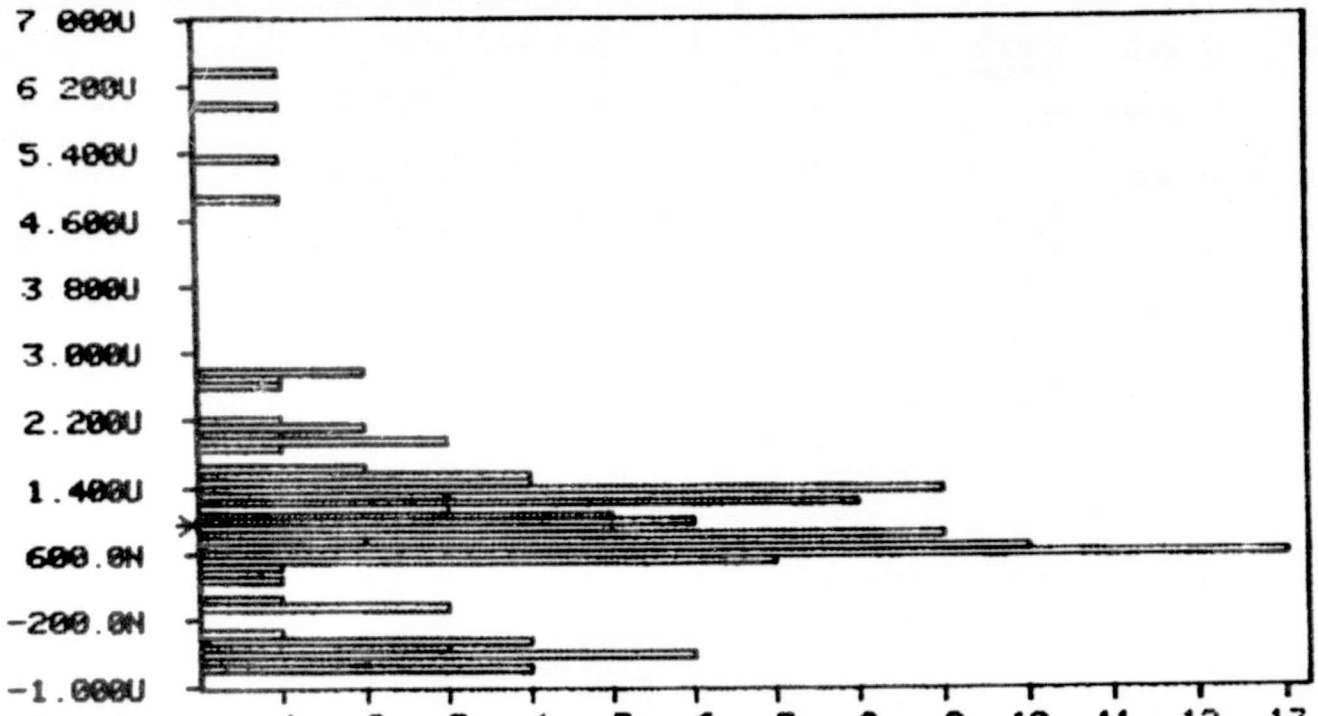
COMPONENTS DEPARTMENT IOZ2 AT TA=125C 21 SEP 78



OF CELLS 100
CELL SIZE 80.00N

READINGS:	136
MAXIMUM:	6.315U
MEAN:	914.0N
MINIMUM:	-813.5N
STD.DEV.:	1.166U

COMPONENTS DEPARTMENT IOZ3 AT TA=125C 21 SEP 78

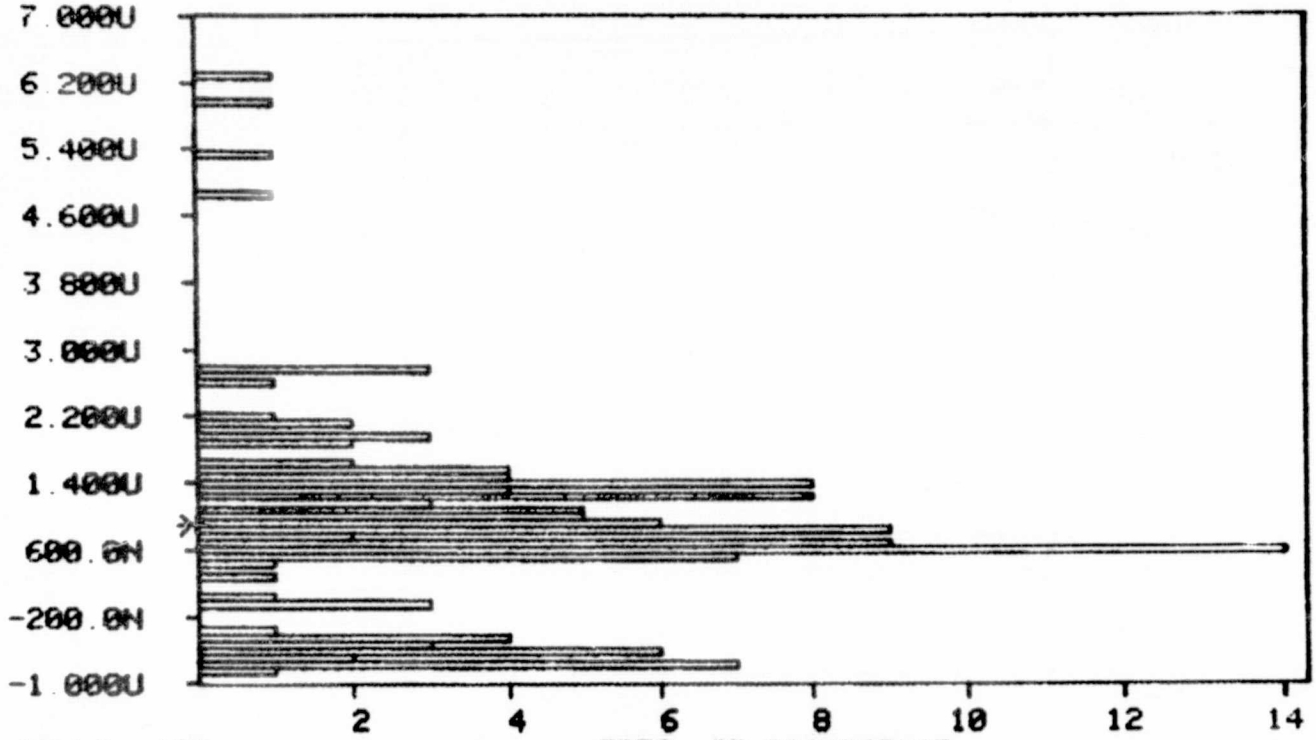


DATA EDITED
OF CELLS 100
CELL SIZE 80.00N

READINGS:	132
MAXIMUM:	6.335U
MEAN:	963.2N
MINIMUM:	-779.0N
STD.DEV.:	1.148U

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

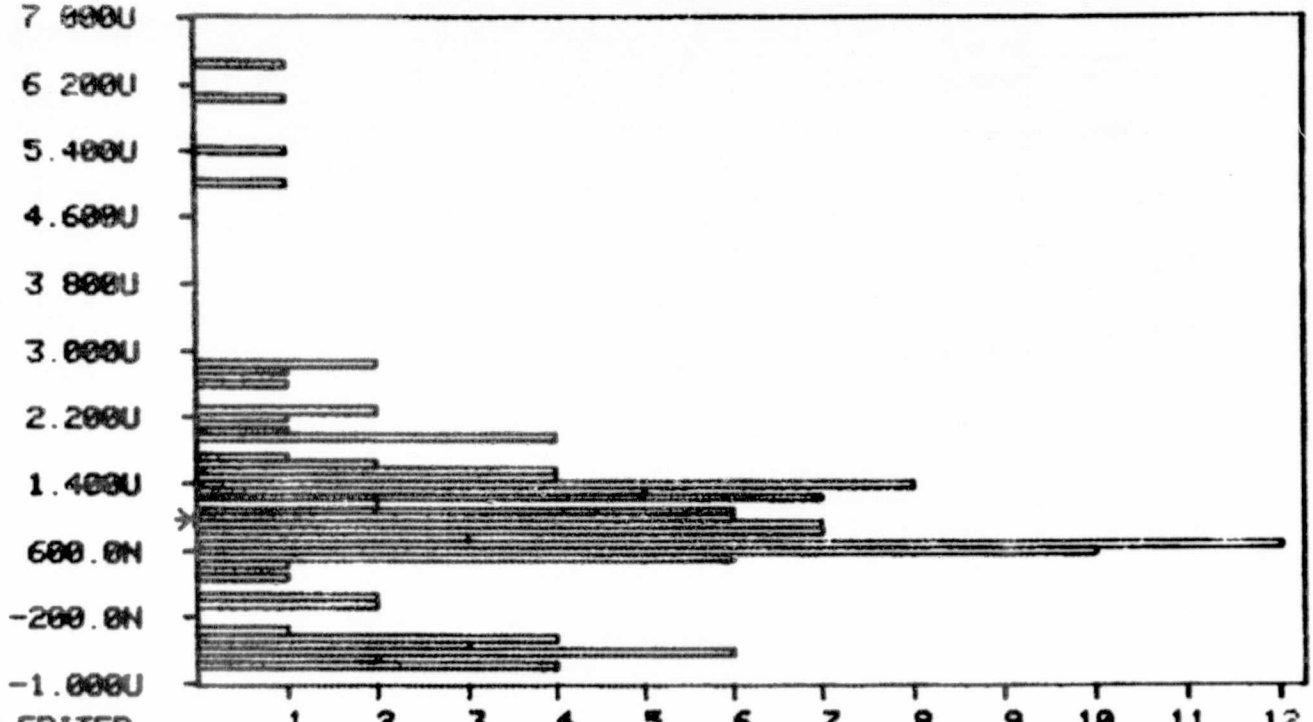
OMPONENTS DEPARTMENT 1024 AT TA=125C 21 SEP 78



OF CELLS 100
CELL SIZE 80.00N

READINGS:	136
MAXIMUM:	6.320U
MEAN:	910.2N
MINIMUM:	-812.5N
STD.DEV.:	1.169U

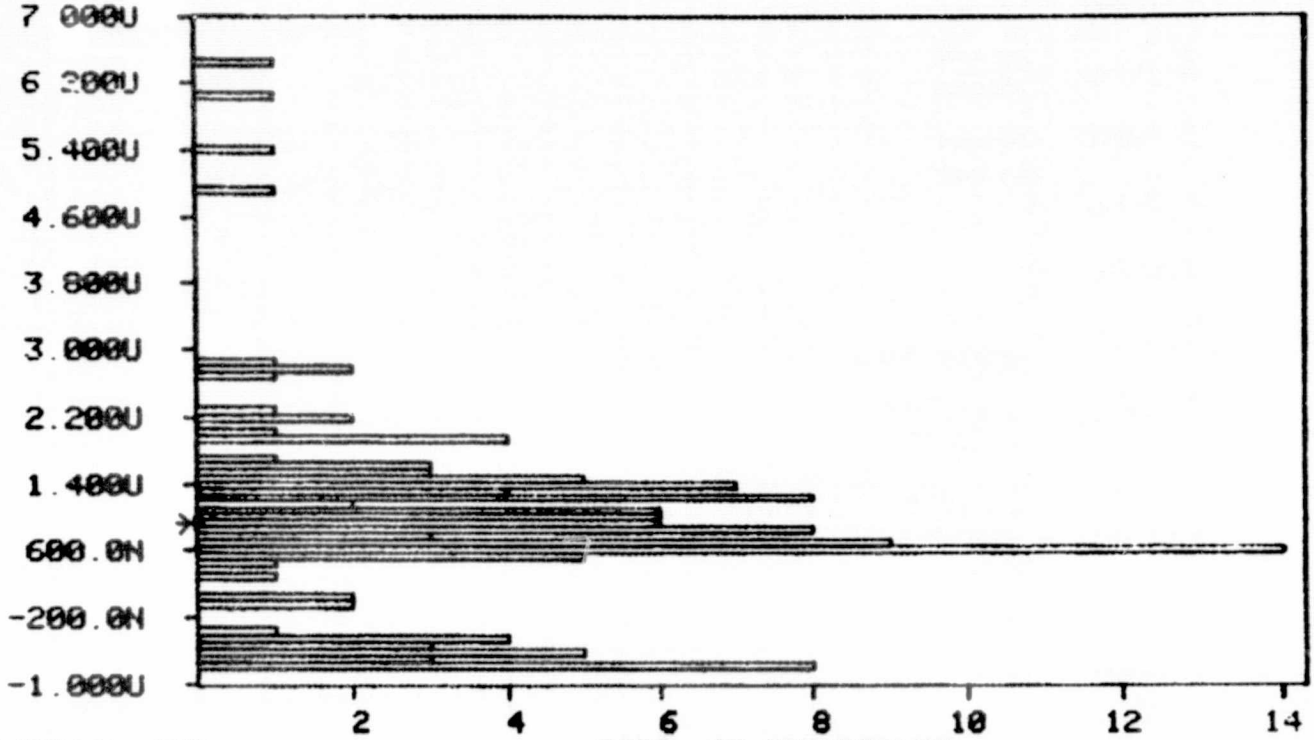
COMPONENTS DEPARTMENT IOZ5 AT TA=125C 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 80.00N

READINGS:	132
MAXIMUM:	6.405U
MEAN:	983.1N
MINIMUM:	-775.0N
STD.DEV.:	1.168U

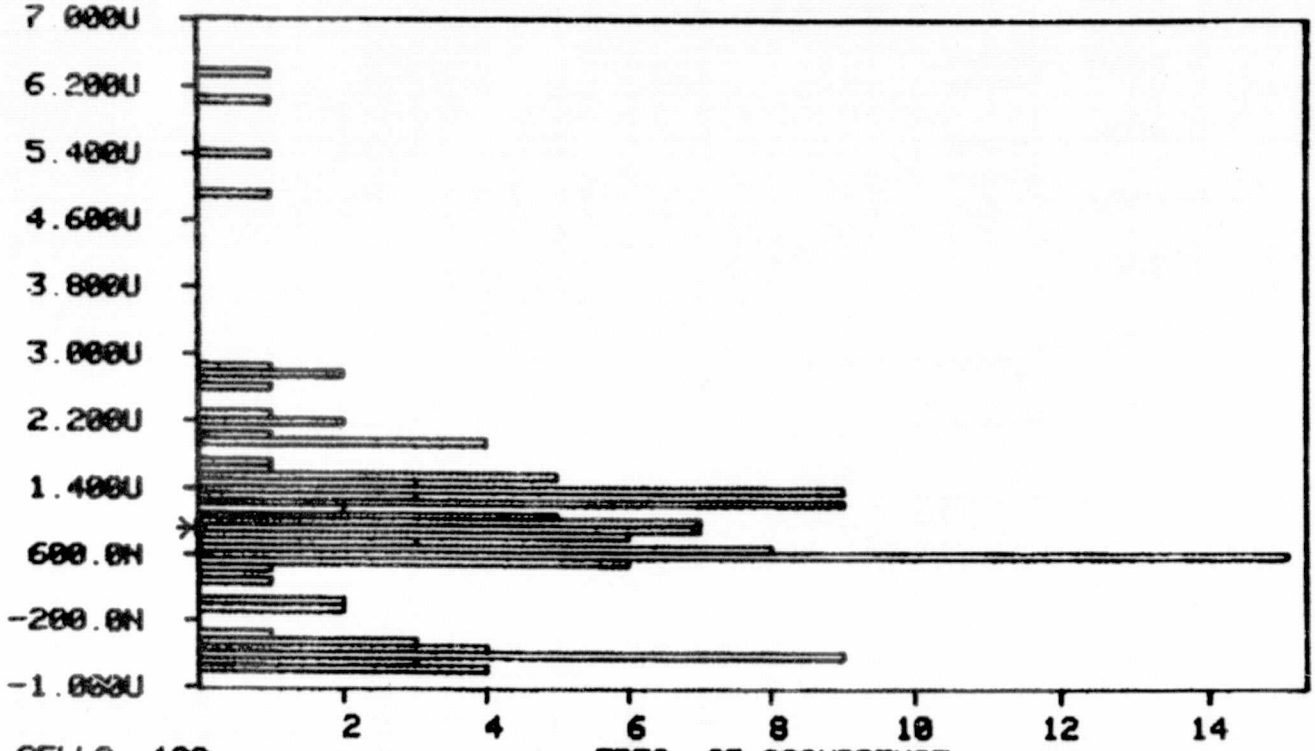
COMPONENTS DEPARTMENT I026 AT TA=125C 21 SEP 78



OF CELLS 100
CELL SIZE 80.00N

READINGS:	136
MAXIMUM:	6.430U
MEAN:	925.7N
MINIMUM:	-797.0N
STD.DEV :	1.185U

COMPONENTS DEPARTMENT 1027 AT TA=125C 21 SEP 78

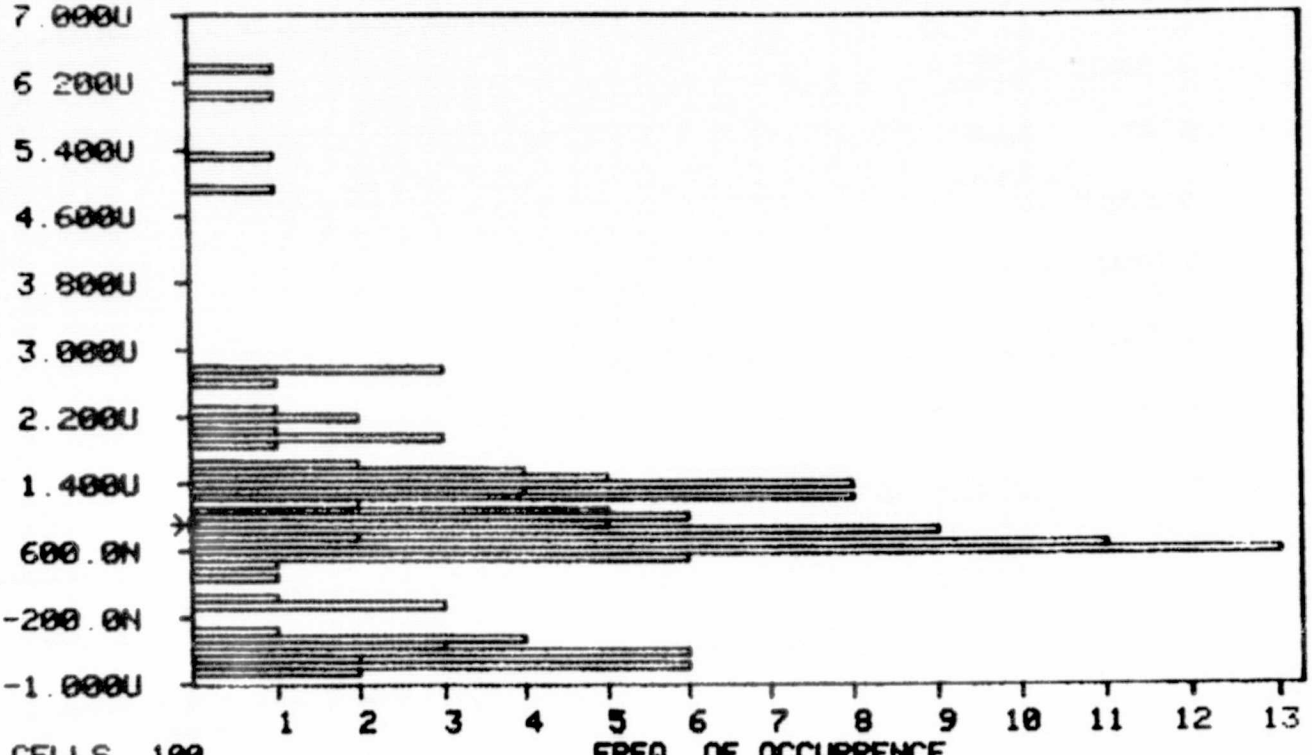


OF CELLS 100
CELL SIZE 80.00N

READINGS:	136
MAXIMUM:	6.395U
MEAN:	926.4N
MINIMUM:	-782.0N
STD.DEV.:	1.174U

REPRODUCIBILITY OF THE
ORIGINAL PAGE IS POOR

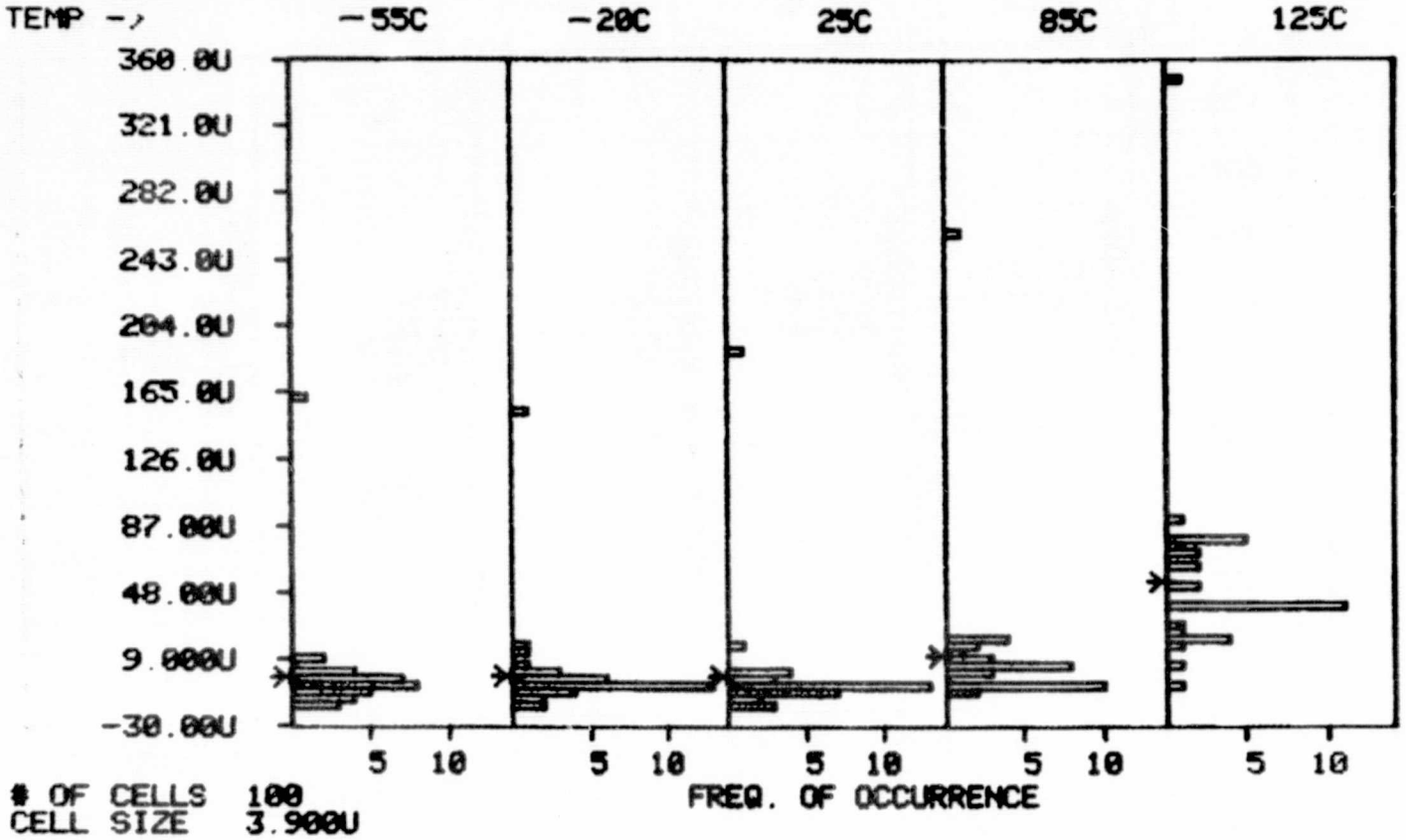
COMPONENTS DEPARTMENT IOZ8 AT TA=125C 21 SEP 78



OF CELLS 100
CELL SIZE 80.00N

READINGS:	136
MAXIMUM:	6.375U
MEAN:	918.8N
MINIMUM:	-804.0N
STD.DEV.:	1.180U

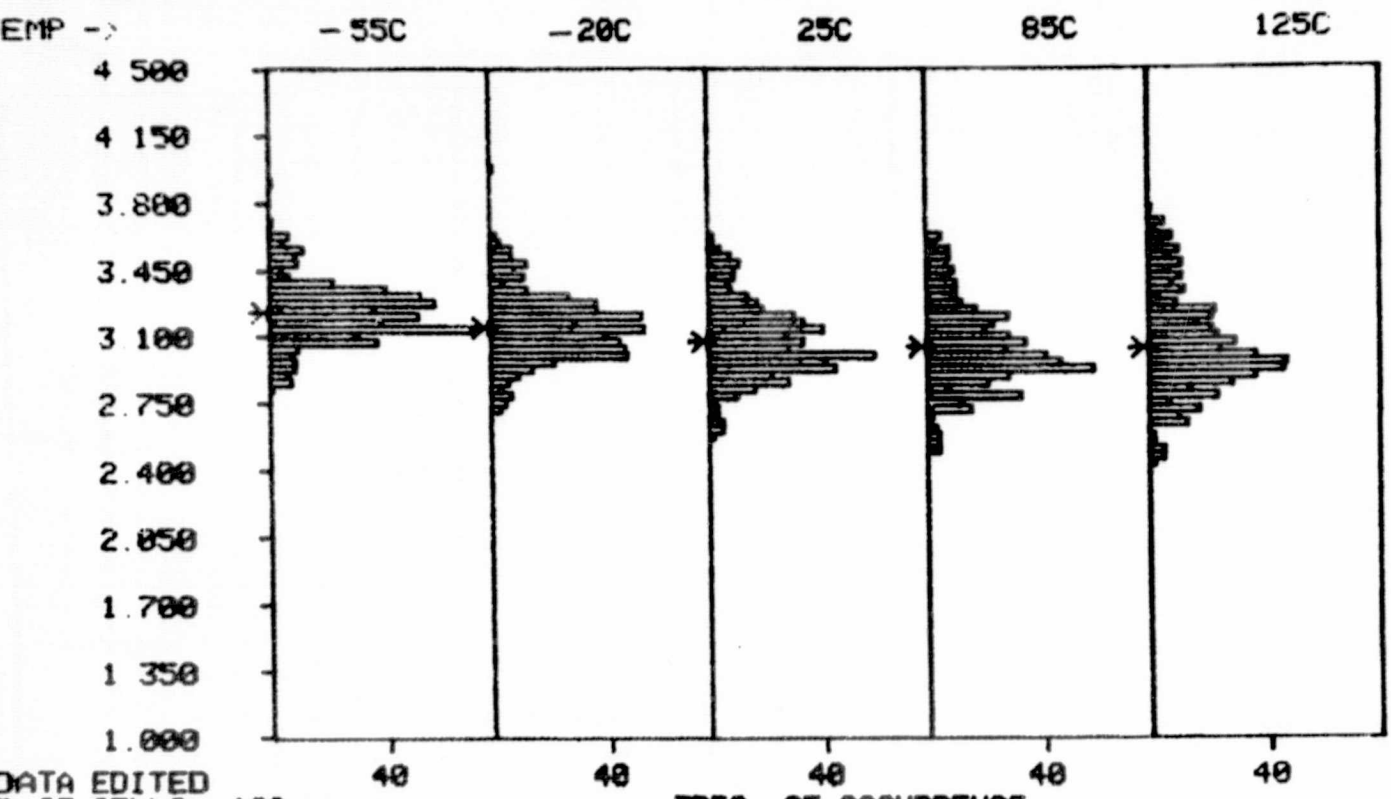
COMPONENTS DEPARTMENT ILDP 21 SEP 78



OF CELLS 100
CELL SIZE 3.900U

READINGS:	34	34	34	34	34
MAXIMUM:	160.0U	155.0U	190.0U	260.0U	350.0U
MEAN:	-1.418U	-11.75N	-523.5N	11.32U	55.15U
MINIMUM:	-20.00U	-20.00U	-20.00U	-10.00U	-5.000U
STD.DEV.:	29.41U	28.29U	34.38U	44.84U	57.49U

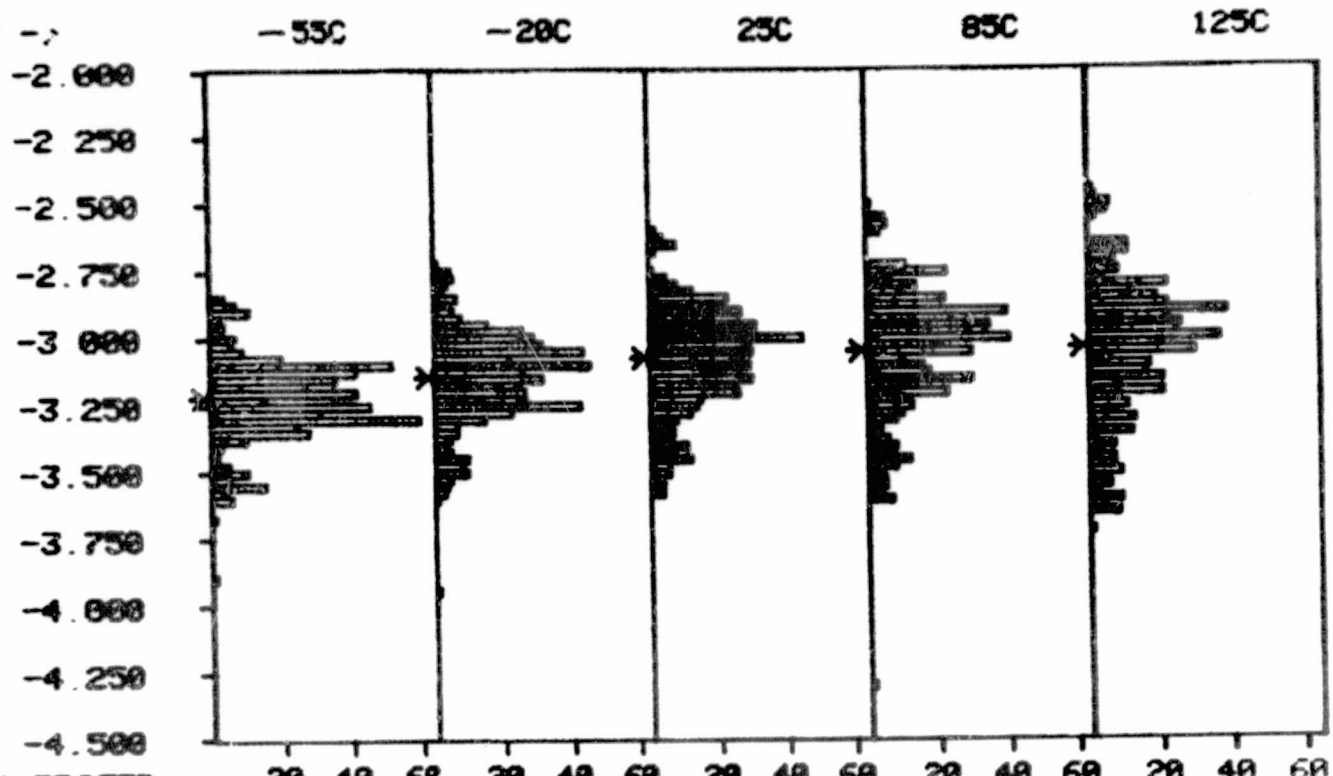
OMPONENTS DEPARTMENT VIC1 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 35.00M

READINGS:	542	542	540	543	544
MAXIMUM:	3.910	3.970	3.610	3.640	3.760
MEAN:	3.225	3.148	3.074	3.045	3.040
MINIMUM:	2.830	2.710	2.580	2.500	2.440
STD.DEV.:	159.8M	174.3M	199.1M	225.7M	259.2M

COMPONENTS DEPARTMENT VIC2 21 SEP 78



DATA EDITED
OF CELLS 100
CELL SIZE 25.00M

READINGS:	542	542	540	544	544
MAXIMUM:	-2.840	-2.730	-2.590	-2.510	-2.460
MEAN:	-3.220	-3.145	-3.075	-3.048	-3.042
MINIMUM:	-3.910	-3.960	-3.570	-4.300	-3.720
STD.DEV.:	154.1M	169.8M	195.2M	228.1M	255.7M

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