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ELECTRICAL CHARACTERIZATION OF STANDARD AND RADIATION-HARDENED RCA CDP1856D

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AEROSPACE GROUPS
HUGHES
HUGHES AIRCRAFT COMPANY
CULVER CITY, CALIFORNIA

ELECTRICAL CHARACTERIZATION OF STANDARD AND RADIATION-HARDENED RCA CDP1856D 4-BIT, CMOS, BUS BUFFER/SEPARATOR

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TEST ABSTRACT

Electrical characterization tests were performed on 25 standard and 15 radiation-hardened RCA CDP1856D, 4-bit, noninverting, bus separators. The tests included functional tests and AC and DC parametric tests at ambient temperatures of -55°C, -20°C, 25°C, 85°C, and 125°C.

All measurements were performed on a Tektronix S-3260 Automated Test System. Temperatures were controlled by a Temptronic TP450A thermal airstream unit.

All 40 devices passed the functional tests and yielded nominal values in the AC and DC parametric tests.

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1.0 INTRODUCTION

This report documents the results of electrical characterization test to determine the electrical performance characteristics of the 25 standard and 15 radiation-hardened RCA CDP1856D, 4-bit, CMOS, bus separators. Electrical characteristics of the devices were measured and recorded under various test conditions. The data was analyzed and tabulated to show the effect of operating conditions on performance and to indicate parameter deviations among devices in each group. Accuracy was given precedence ov test-time efficiency where practical, and tests were designed to measure worst-case performance.

The tests were divided into three categories: functional, AC parametric, and DC parametric. The functional tests were performed on a pass/fail basis to verify that the device under test (DUT) was logically correct. All voltage and timing conditions, except supply voltage, were set to nomina values in order to distinguish between functional failures and statistically unusual devices. The AC parametric tests consisted of propagation delays and transition times. These tests were performed using the "one-shot" measurement system. The DC parametric measurements were static measurements made by forcing specified conditions on the DUT and measuring the resultant voltage or current.

All of these tests were performed on a Tektronix S-3260 Automated Test System. All devices were subjected to the full set of tests at ambient temperatures of -55°C, -20°C, 25°C, 85°C, and 125°C. The temperature environment was provided by a Temptronic TP450A thermal airstream unit.

2.0 DEVICE DESCRIPTION

The RCA CDP1856D is a 4-bit, noninverting bus separator designed for use in the CDP-1800 series microprocessor systems. The device can be directly controlled by the CDP1802 microprocessor without the use of additional components. The CDP1856 uses static silicon-gate CMOS circuitry with a single voltage supply. It is compatible with the CD4000 series and may be used as a general purpose bus buffer or separator. It is supplied in a ceramic, 16-lead, hermetic, dual-in-line package. A brief operational description of the device is given below. Pin connections are shown in Figure 1, and a functional diagram appears in Figure 2.

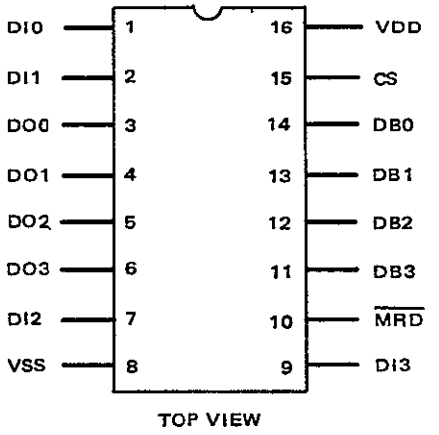


Figure 1. CDP1856D pin connections.

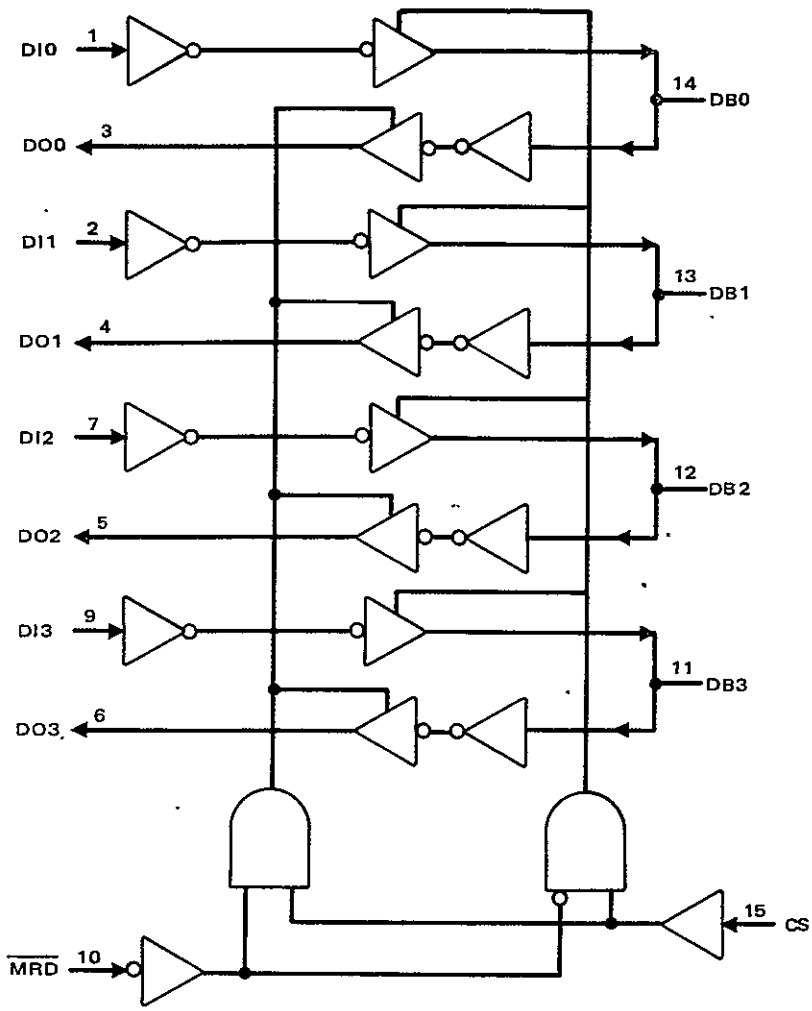


Figure 2. CDP1856D functional diagram.

2.1 PIN DESCRIPTIONS

2.1.1 Chip Select Input (CS)

The chip select input enables (logic "1") or disables (logic "0"), th tristate output drivers.

2.1.2 Memory Read Input (MRD)

The memory read input determines the direction of data flow when the device is enabled.

2.1.3 Data-In Inputs (DI0 to DI3)

The data-in inputs receive input data for transfer to the bus.

2.1.4 Data-Out Outputs (DO0 to DO3)

The data-out outputs transfer output data from the bus tristate drivers

2.1.5 Data Bus (DB0 to DB3)

The data bus provides inputs or outputs, depending on the direction of data flow.

2.2 DEVICE OPERATION

When CS is low (logic "0"), all outputs are disabled. When CS is high (logic "1"), MRD determines the direction of data flow. When MRD = 0, the bus drivers are enabled and data is transferred from the DATA-IN terminals to the bus. When MRD = 1, the bus drivers are disabled and the DATA-OUT drivers are enabled, allowing transfer of data from the bus to the DATA-OUT outputs.

3.0 DESCRIPTION OF TESTS

3.1 FUNCTIONAL TESTS

Functional tests were performed on a pass/fail basis with the pattern given in Table 1 and under the test conditions given in Table 2. (See Figure 3 for timing.) In general, the purpose of the functional tests was to verify that each device performed in accordance with its expected truth table. Performing the tests at both VDD = 3V and VDD = 15V (13V for the radiation-hardened devices) guaranteed that the devices operated over the specified voltage extremes. The lower VDD voltage of 13V for the radiation-hardened devices was used to accommodate the lowered transistor breakdowns common to irradiated CMOS devices.

The functional tests were performed at ambient temperatures of -55°C, -20°C, 25°C, 85°C, and 125°C using a Temptronic TP450A thermal airstream unit to control the device test temperature. All 40 devices passed the functional tests at the specified temperature and voltage extremes.

3.2 AC PARAMETRIC TESTS

AC parametric tests performed on the 1856 included propagation delays and transition times. Propagation delays were measured by a "one-shot" (real time) method, which makes a direct measurement of the time between two transitions. Transition times were measured by measuring the delay to the output under test at two levels (usually the 10-percent and 90-percent points of output swing). The difference between the two delays is the transition time between the two levels. See Figure 4 for propagation delay definitions and Figure 5 for transition time. AC-parametric test conditions are given in Table 3.

TABLE 1. FUNCTIONAL TEST PATTERN

	Name	Pin	Time Slot 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Input	CS	15	0	0	1	1																	1														
	$\overline{MRD}$	10	0	1	1	0																	1														
	DI0	1	1				0	1	0	0	0	1	1	1	0	1	1	0	1	0	0	1															
	DI1	2	1				0	0	1	0	0	1	1	0	1	1	0	1	0	1	0	1															
	DI2	7	1				0	0	0	1	0	1	0	1	1	0	1	1	0	0	1	1															
	DI3	9	1				0	0	0	0	1	0	1	1	1	0	0	0	1	1	1	1															
			Input			Output																	Input														
Bidirectional	DB0	14	0			1	0	1	0	0	0	1	1	1	0	1	1	0	1	0	0	1	1	0	0	0	1	1	1	0	1	1	0	1	0	0	1
	DB1	13	0			1	0	0	1	0	0	1	1	0	1	1	0	1	0	1	0	1	0	1	0	0	1	1	0	1	1	0	1	0	1	0	1
	DB2	12	0			1	0	0	0	1	0	1	0	1	1	0	1	1	0	0	1	1	0	0	1	0	1	0	1	1	0	1	1	0	0	1	1
	DB3	11	0			1	0	0	0	0	1	0	1	1	1	0	0	0	1	1	1	1	0	0	0	1	0	1	1	1	0	0	0	1	1	1	1
Output	DO0	3	X		0	X																	1	0	0	0	1	1	1	0	1	1	0	1	0	0	1
	DO1	4	X		0	X																	0	1	0	0	1	1	0	1	1	0	1	0	1	0	1
	DO2	5	X		0	X																	0	0	1	0	1	0	1	1	0	1	1	0	0	1	1
	DO3	6	X		0	X																	0	0	0	1	0	1	1	1	0	0	0	1	1	1	1
			Leakage Test																																		

X denotes high-impedance state; blank indicates no change from previous state

TABLE 2. FUNCTIONAL TEST CONDITIONS

Parameter	At VDD=3V	At VDD=15V (Standard)	At VDD=13V (Rad-Hard)
Input Driver Level, High (Logic "1")	3V	15V	13V
Input Driver Level, Low (Logic "0")	0V	0V	0V
Output Compare Level, High	1.5V	7.5V	6.5V
Output Compare Level, Low	1.5V	7.5V	6.5V
Cycle Time (Period)	16 µs	16 µs	16 µs
Compare Window:			
Start	15.95 µs	15.95 µs	15.95 µs
Duration	8 ns	8 ns	8 ns

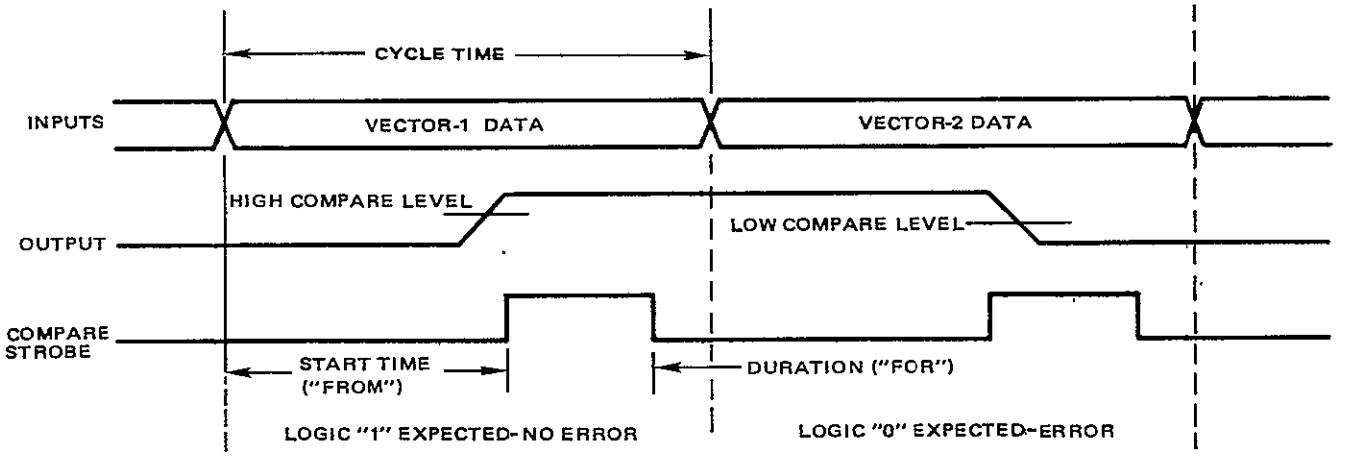


Figure 3. Functional test timing.

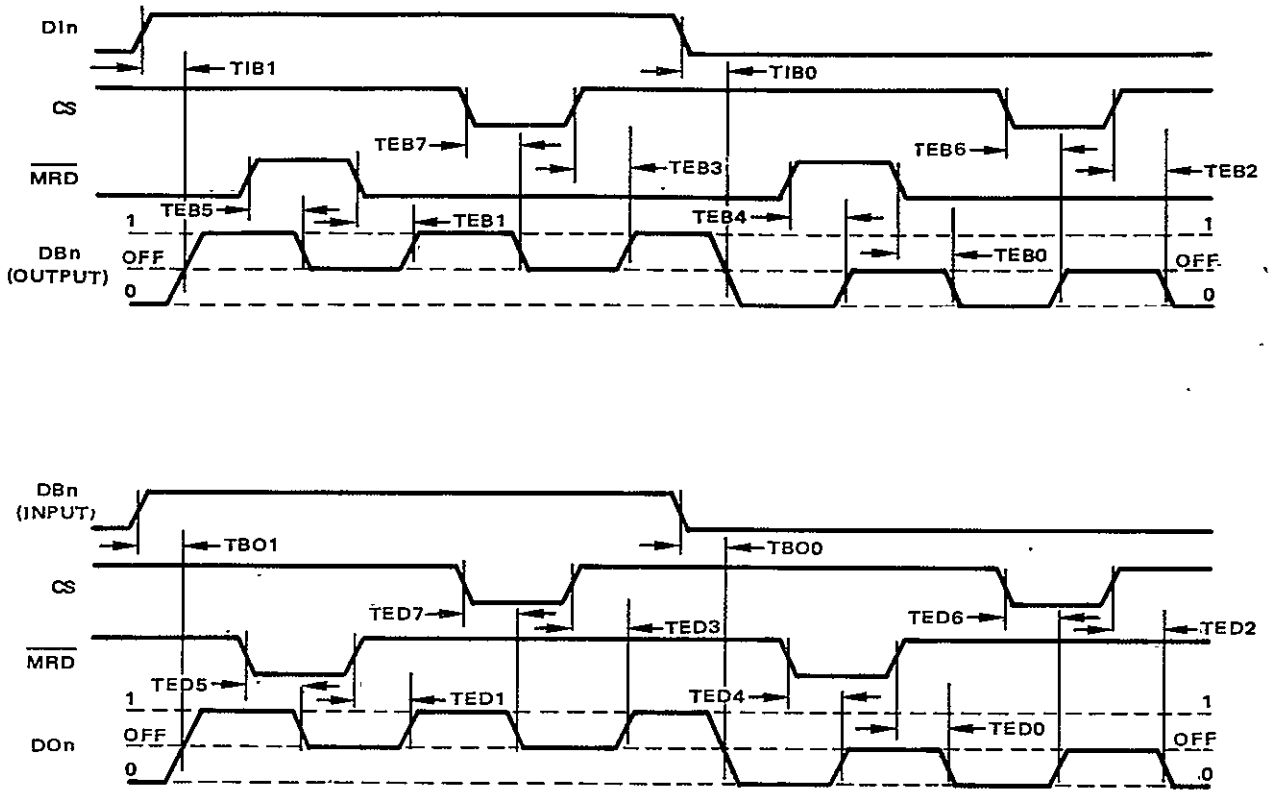


Figure 4. Propagation delay definitions.

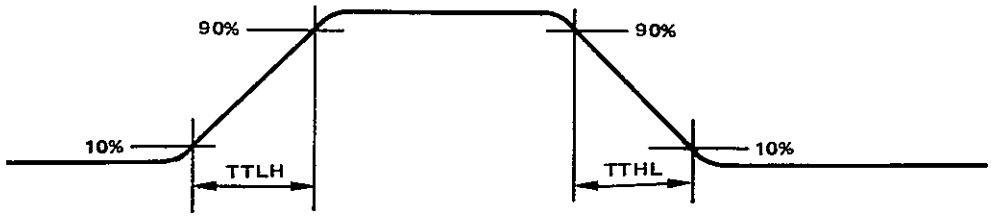


Figure 5. Transition time.

TABLE 3. AC-PARAMETRIC TEST CONDITIONS

Parameter	At VDD=5V	At VDD=10V
Drivers, High	5V	10V
Drivers, Low	0V	0V
Comparators		
Delays to On/Off		
High	3.75V	7.5V
Low	1.25V	2.5V
Other Delays		
High	2.5V	5V
Low	2.5V	5V
Transition Time		
High	4.5V	9V
Low	0.5V	1V
Cycle Time	5 μs	5 μs
Output Loads		
On/Off	Figure 6	Figure 6
Other	Figure 7	Figure 7

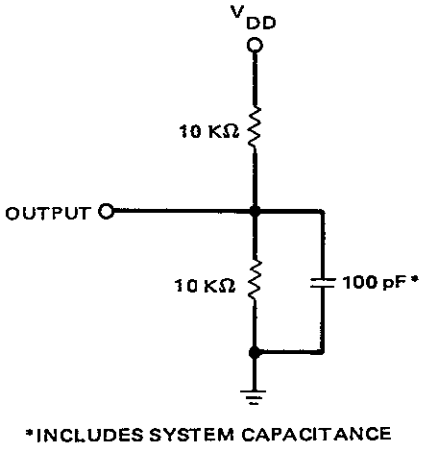


Figure 6. Output load (on/off).

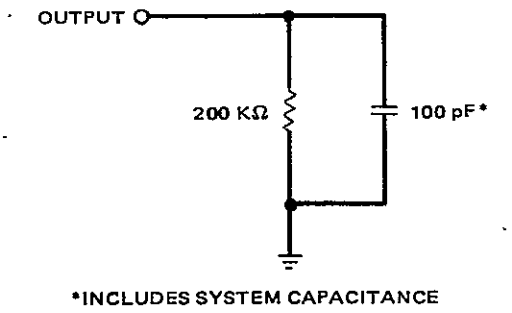


Figure 7. Output Load

The following AC parameters were measured at VDD voltage of 5V and 10V:

	Parameter	Symbol
1.	MRD to DB on, low	TEB0
2.	MRD to DB on, high	TEB1
3.	CS to DB on, low	TEB2
4.	CS to DB on, high	TEB3
5.	MRD to DB off, low	TEB4
6.	MRD to DB off, high	TEB5
7.	CS to DB off, low	TEB6
8.	CS to DB off, high	TEB7
9.	MRD to DO on, low	TED0
10.	MRD to DO on, high	TED1
11.	CS to DO on, low	TED2
12.	CS to DO on, high	TED3
13.	MRD to DO off, low	TED4
14.	MRD to DO off, high	TED5
15.	CS to DO off, low	TED6
16.	CS to DO off, high	TED7
17.	DI to DB, low	TIB0
18.	DI to DB, high	TIB1
19.	DB to DO, low	TBO0
20.	DB to DO, high	TBO1
21.	Transition time low-to-high	TTLH
22.	Transition time high-to-low	TTHL

3.3 DC PARAMETRIC TESTS

Most of the DC parametric tests were performed in a straightforward manner. Input conditions were applied using the drivers as in the functional and AC tests, and the pin under test was forced with a regulated voltage or current supply (depending on the specific parameter). The parameter under test was then measured and recorded.

The exceptions were the VIH (minimum logic "1" input voltage) and VIL (maximum logic "0" input voltage) tests. These were performed by running a functional test pattern while varying the input level under test. In the VIH test, all inputs except the one under test had drive levels of VDD and 0V. Timing conditions were generous. The logic "0" level of the input under test was set at 0V, and the logic "1" level was set to a low enough voltage to ensure that the device would fail to function properly. The functional test was run repeatedly, with the logic "1" level on the input under test raised each time, until the device passed. The voltage at which the device first passed was the minimum logic "1" voltage for the input under test. The VIL test was performed in a similar manner.

Table 4 lists the DC parameters measured. V1H and V1L were measured using the functional test pattern of Table 5. The timing and output comparator conditions were the same as those for the functional tests (Table 2). The input voltages were varied in 0.1-volt increments as shown in Table 5. Each input was tested separately at each voltage.

TABLE 4. DC-PARAMETRIC TESTS

Symbol	Parameter Name	Pin(s)	Voltage or Current Forced	VDD-VSS	Comments[1]
VICP	Input clamp voltage, positive	Each input	1 mA	0V	VDD and VSS grounded.
VICN	Input clamp voltage, negative	Each input	-1 mA	0V	VDD and VSS grounded.
IIH	Input current, high	Each input	15V[2]	15V[2]	0V on other inputs.
IIL	Input current, low	Each input	0V	15V[2]	15V[2] on other inputs.
IOH	Output current, high	Each output	4.6V 4.6V 9.5V 9.0V 10.5V	5V 5V 10V 10V 12V	Output under test is in Logic "1" (high) state.
IOL	Output current, low	Each output	0.4V 0.5V 0.5V 1.0V 1.5V	5V 5V 10V 10V 12V	Output under test is in Logic "0" (low) state.
IOZ1	High-impedance output current	Each output	12V[3] 15V[2]	12V[3] 15V[2]	0V on all data inputs. Outputs disabled.
IOZ2	High-impedance output current	Each output	0V 0V	12V[3] 15V[2]	VDD on all data inputs. Outputs disabled.
ISS	Quiescent supply current	VSS	0V 0V	10V 15V[2]	Inputs forced with functional test pattern at time slots 1, 2, 3, 35, 4, and 5 for 6 tests at each voltage. Logic 1 = VDD, logic 0 = VSS on inputs. Outputs are open.

[1] Bidirectional bus pins are included in both input and output measurements.
[2] 13V for radiation-hardened parts.
[3] 10V for radiation-hardened parts.

TABLE 5. VIH AND VIL TEST CONDITIONS

Parameter	VDD (V)	Varied		Pin Under Test		Other Pins		Compare Levels	
		From (V)	To (V)	VIH (V)	VIL (V)	VIH (V)	VIL (V)	High (V)	Low (V)
VIH	5	0	5	—	0	5	0	2.5	2.5
VIL	5	5	0	5	—	5	0	2.5	2.5
VIH	10	0	10	—	0	10	0	5	5
VIL	10	10	0	10	—	10	0	5	5
VIH	12	0	12	—	0	12	0	6	6
VIL	12	12	0	12	—	12	0	6	6

1.0 INTRODUCTION

This report documents the results of electrical characterization tes to determine the electrical performance characteristics of the 25 standard and 15 radiation-hardened RCA CDP1856D, 4-bit, CMOS, bus separators. Electrical characteristics of the devices were measured and recorded unde various test conditions. The data was analyzed and tabulated to show the effect of operating conditions on performance and to indicate parameter deviations among devices in each group. Accuracy was given precedence o test-time efficiency where practical, and tests were designed to measure worst-case performance.

The tests were divided into three categories: functional, AC param etric, and DC parametric. The functional tests were performed on a pass/ fail basis to verify that the device under test (DUT) was logically correct. All voltage and timing conditions, except supply voltage, were set to nomin values in order to distinguish between functional failures and statistically unusual devices. The AC parametric tests consisted of propagation delays and transition times. These tests were performed using the "one-shot" measurement system. The DC parametric measurements were static measurements made by forcing specified conditions on the DUT and measuring the resultant voltage or current.

~~All of these~~ tests ~~were~~ performed on a Tektronix S-3260 Automated Test System. All devices were subjected to the full set of tests at ambient temperatures of -55°C, -20°C, 25°C, 85°C, and 125°C. The temperature environment was provided by a Temptronic TP450A thermal airstream unit.

4.0 TEST RESUL

4.1 SUMMARY

All of the devices in both groups passed the functional tests and yielded nominal values in the parametric tests.

4.2 DATA TABULATION

For each parameter the data was tabulated by device serial number and temperature. The sign "<*" to the right of a value was used to indicat out-of-range measurements. The minimum, maximum, mean, standard deviation, and median values were listed at the bottom of each temperature column. Out-of-range measurements were excluded from the statistics.

The standard parts were numbered 3 through 27; the radiation-hardened parts were numbered 28 through 42. The statistics for each grou were calculated separately.

In addition to the printed data, histograms of some of the parameter were provided. Each histogram displays data for one or more parameters at all five temperatures, in ascending order (-55°C, -20°C, 25°C, 85°C, 125°C). The histograms illustrate the effect of temperature and the distribution of devices for each parameter. The standard and radiation-hardened parts were plotted separately. Table 6 is a list of the parameter plotted. The histograms are provided in Appendix A.

TABLE 6. LIST OF HISTOGRAMS

Parameters	Conditions	
Propagation Delays	VDD	
TEB0, TEB1, TEB2, TEB3	5V, 10V	
TEB4, TEB6	5V, 10V	
TEB5, TEB7	5V, 10V	
TED0, TED1, TED2, TED3	5V, 10V	
TED4, TED6	5V, 10V	
TED5, TED7	5V, 10V	
TIB0, TIB1	5V, 10V	
TBO0, TBO1	5V, 10V	
TTLH, TTHL	5V, 10V	
DC Parameters	VDD	VO
IOH	5V	4.6V
IOH	10V	9.5V
IOL	5V	0.4V
IOL	10V	0.5V
IOZ	15V*	15V*
IOZ	15V*	0V
ISS	10V	—
ISS	15V	—

*13V for radiation-hardened parts.

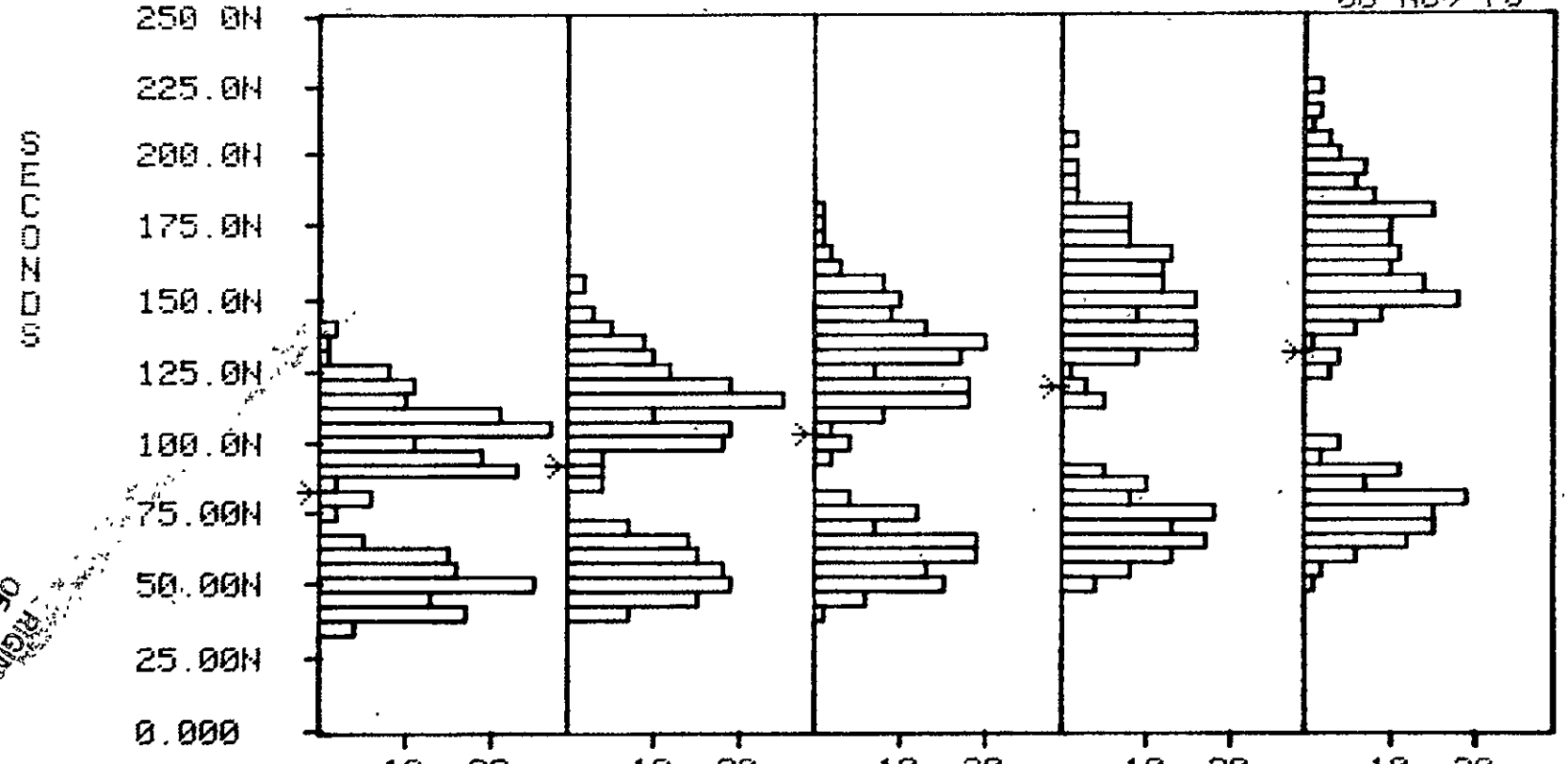
APPENDIX A
HISTOGRAMS

RADIATION-HARDENED DEVICES

S-3260 DATA FOR TEB03A

TEB0,1,2,3 AT 5V

08 NOV 78



DATA EDITED
OF CELLS 50
CELL SIZE 5.000N

READINGS:	239	239	240	240	238
MAXIMUM:	140.0N	156.0N	177.5N	206.0N	225.5N
MEAN:	82.19N	91.00N	102.9N	119.4N	131.3N
MINIMUM:	34.65N	37.70N	41.85N	48.40N	52.30N
STD.DEV.:	28.45N	32.03N	37.12N	43.77N	48.04N

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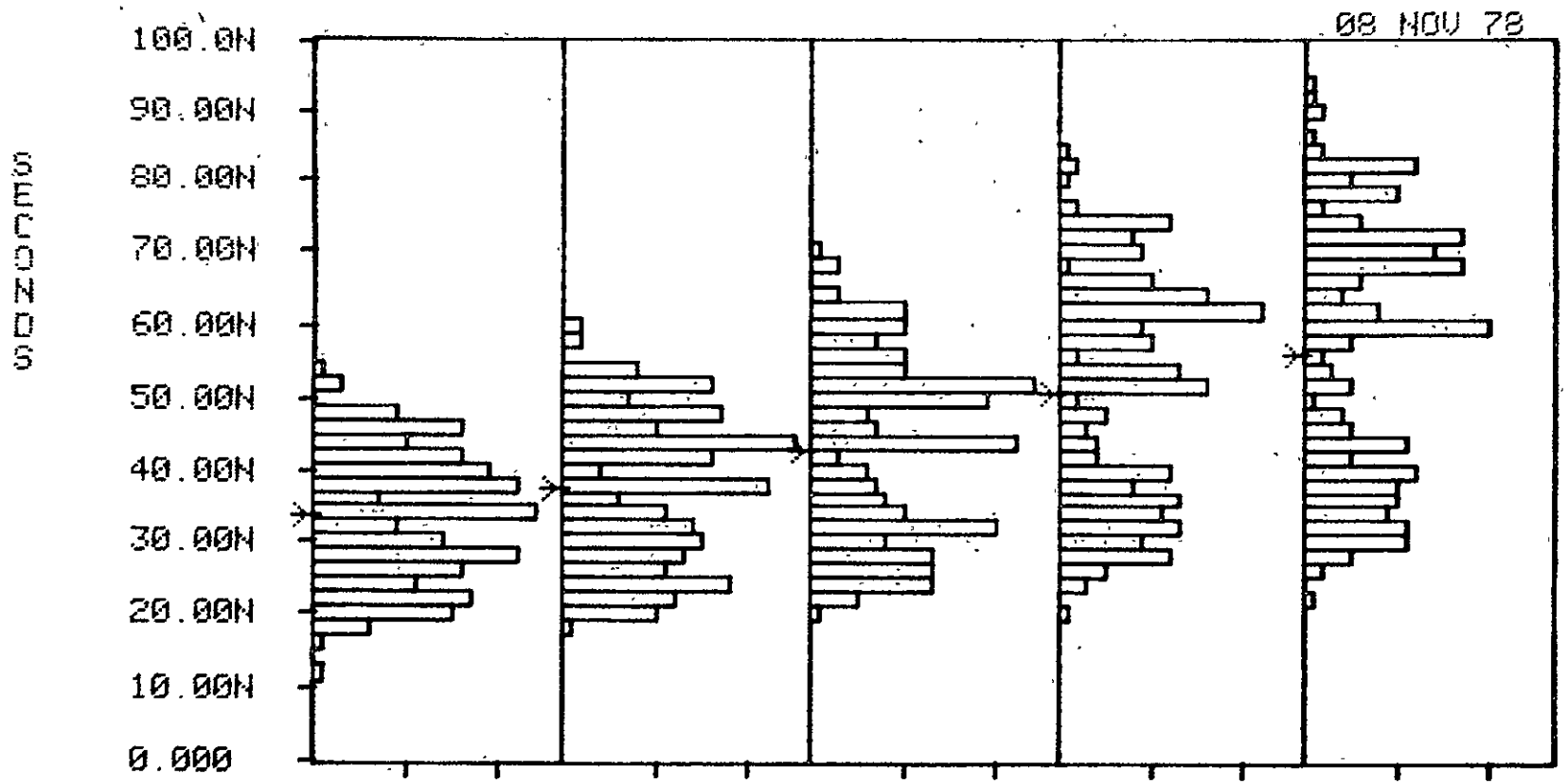
A-1

S-3260 DATA FOR TEB03B

TEB0,1,2,3 AT 10V

08 NOV 78



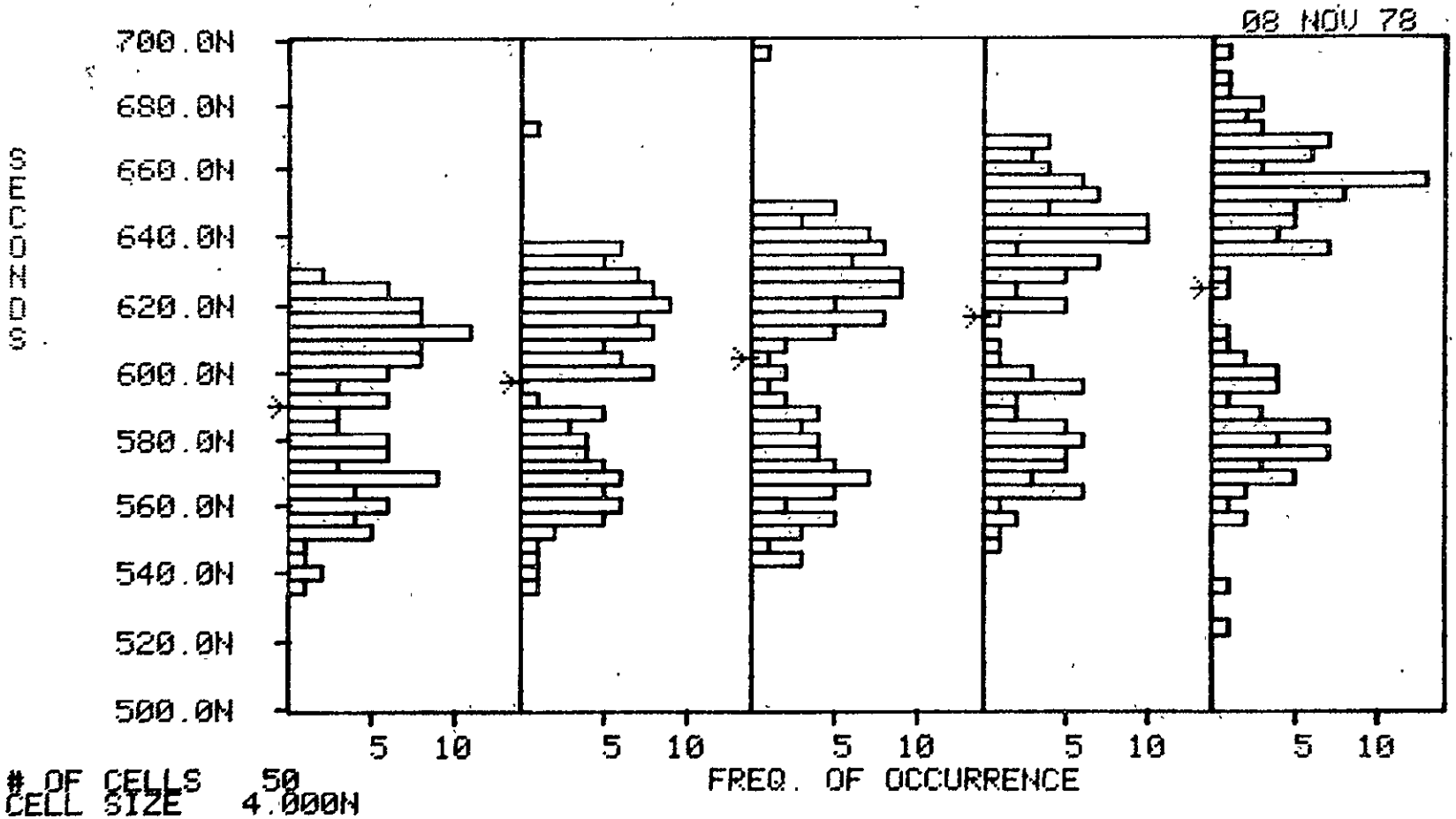
DATA EDITED
OF CELLS 50
CELL SIZE 2.000N

READINGS:	239	240	239	239	240
MAXIMUM	53.10N	60.65N	70.85N	84.70N	94.40N
MEAN:	33.36N	37.23N	42.87N	50.81N	56.27N
MINIMUM	11.95N	18.45N	20.65N	19.70N	22.10N
STD.DEV	8.998N	10.46N	12.56N	15.67N	17.80N

S-3260 DATA FOR TEB46A

TEB4/TEB6 AT 5V

08 NOV 78



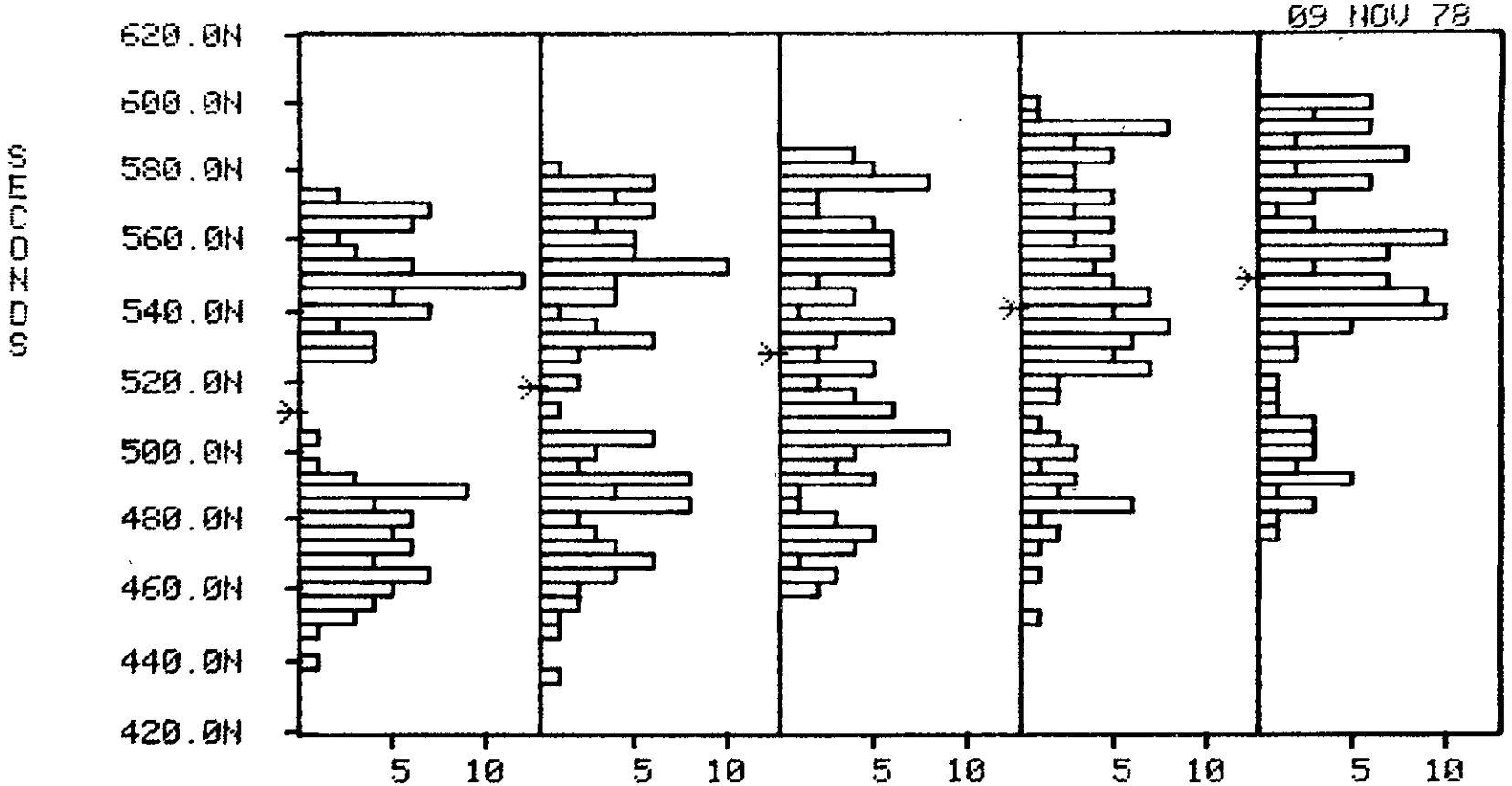
OF CELLS 50
CELL SIZE 4.000N

READINGS:	120	120	120	120	120
MAXIMUM:	629.0N	671.5N	695.5N	668.0N	694.0N
MEAN:	590.1N	597.2N	604.0N	616.3N	624.7N
MINIMUM:	535.5N	536.0N	542.5N	549.0N	523.5N
STD.DEV.:	24.38N	28.06N	32.32N	34.56N	40.82N

S-3260 DATA FOR TEB46B

TEB4/TEB6 AT 10V

09 NOV 78



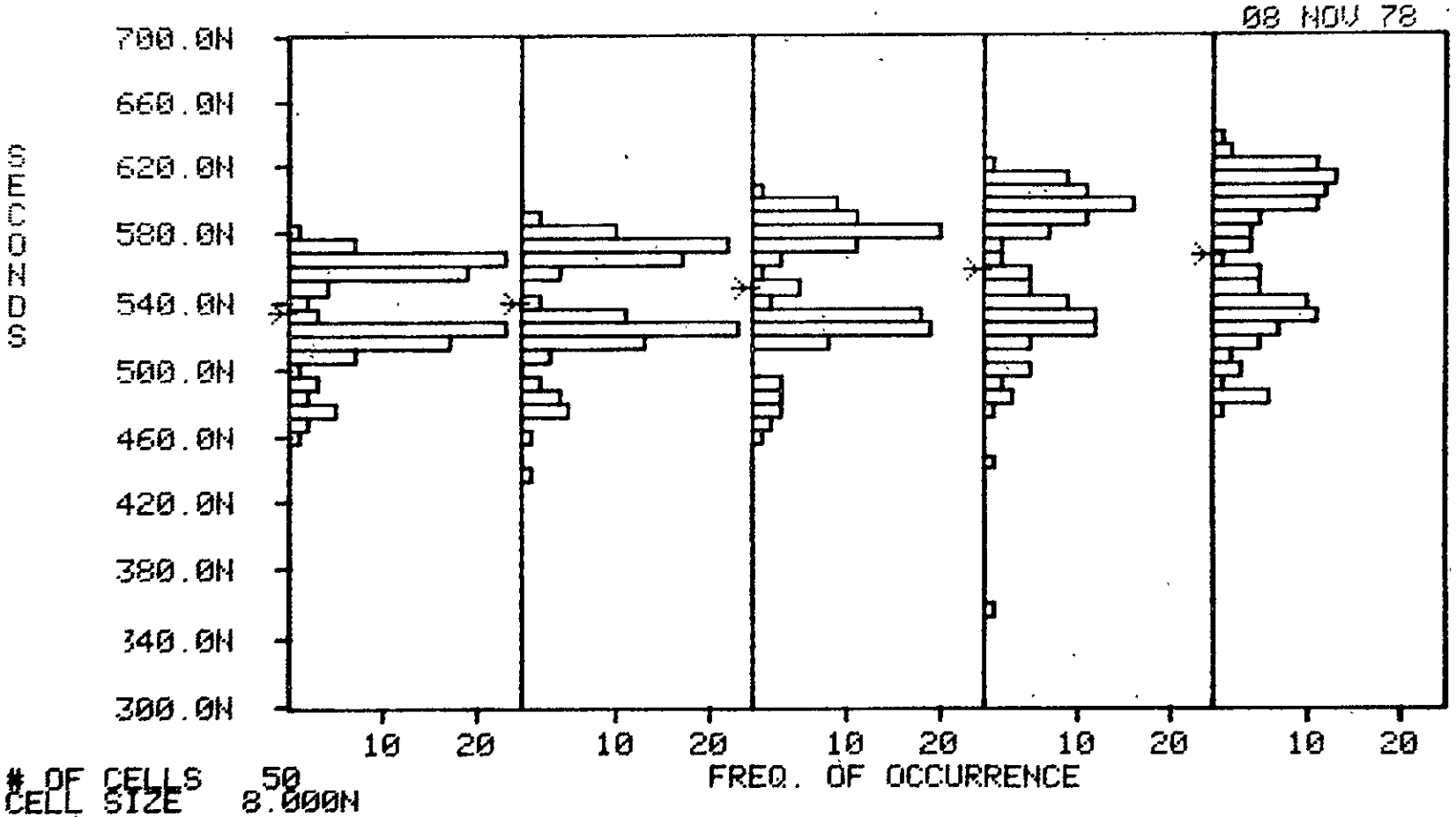
OF CELLS 50
CELL SIZE 4.000N

READINGS:	120	120	120	120	120
MAXIMUM:	571.0N	578.0N	584.5N	599.0N	601.0N
MEAN:	511.1N	518.3N	528.2N	540.9N	548.8N
MINIMUM:	438.0N	435.0N	458.0N	453.0N	477.0N
STD.DEV.:	40.90N	39.98N	36.24N	34.78N	33.12N

S-3260 DATA FOR TEB57A

TEB5/TEB7 AT 5V

08 NOV 78



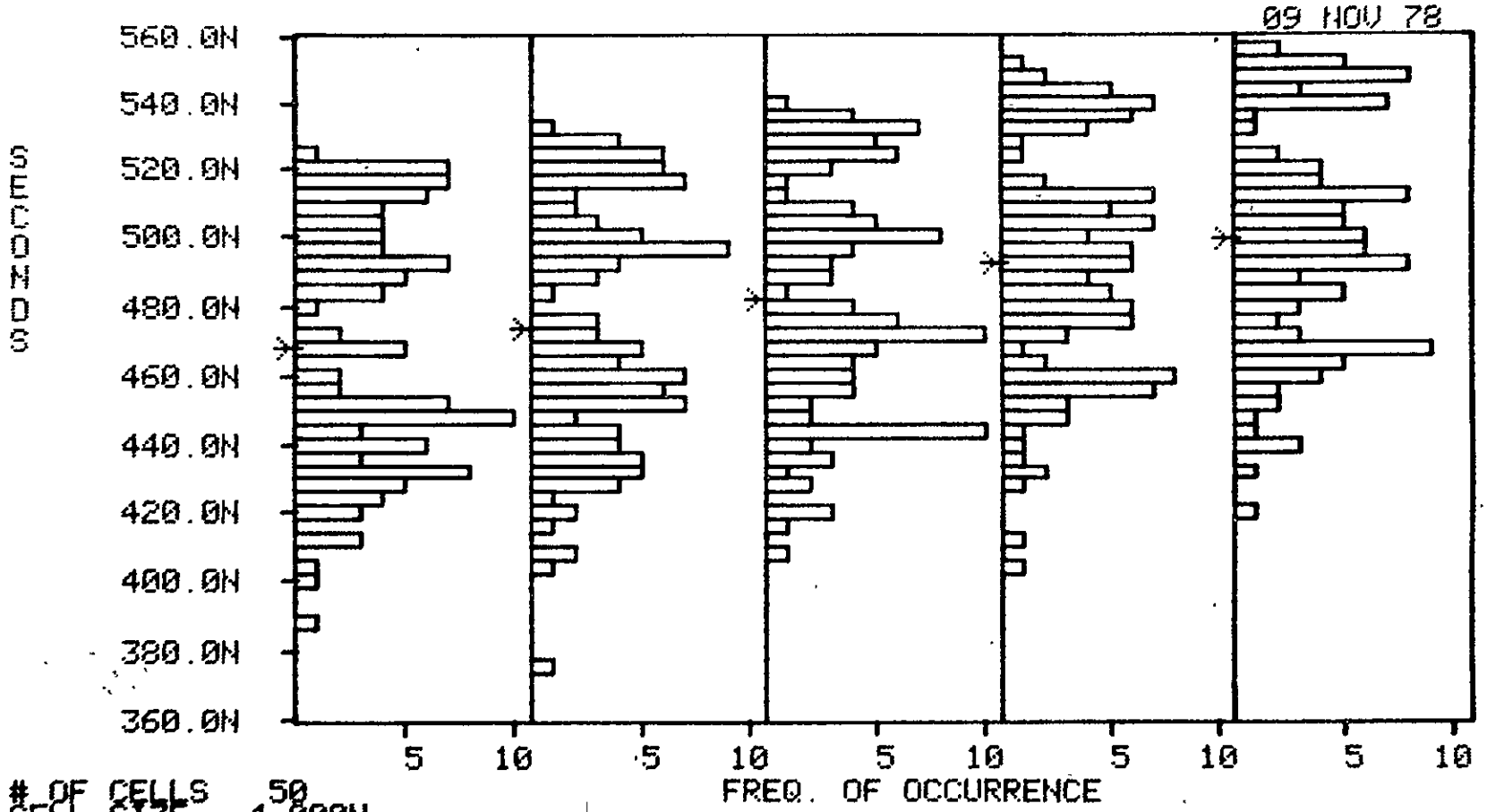
OF CELLS 50
CELL SIZE 8.000N

READINGS:	120	120	120	120	120
MAXIMUM:	576.5N	587.0N	604.5N	618.5N	632.0N
MEAN:	533.7N	539.4N	548.2N	557.7N	566.3N
MINIMUM:	460.5N	435.0N	458.0N	356.0N	476.0N
STD.DEV.:	28.77N	32.28N	35.64N	43.62N	43.24N

S-3260 DATA FOR TEB57B

TEB5/TEB7 AT 10V

09 NOV 78



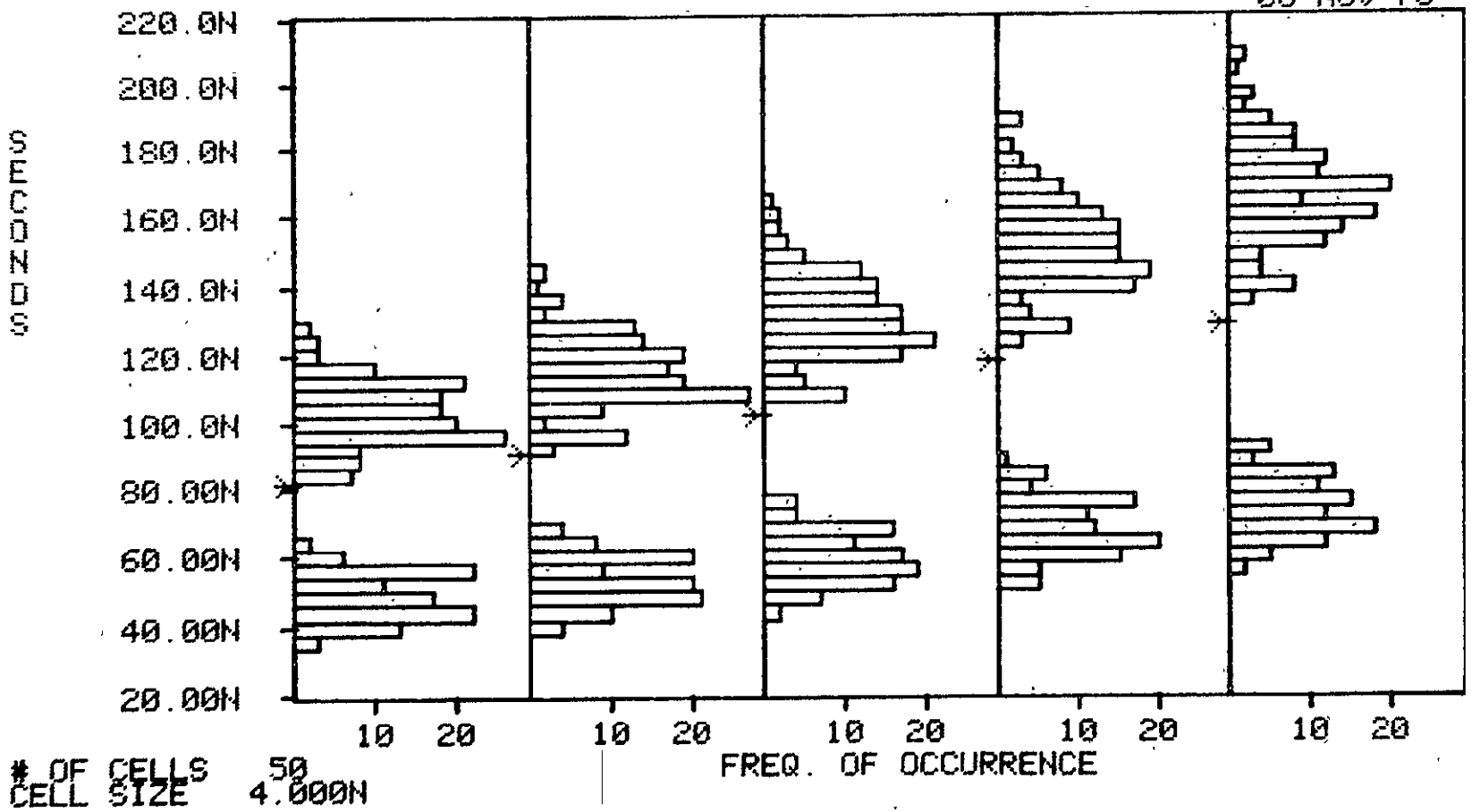
OF CELLS 50
CELL SIZE 4.000N

READINGS:	120	120	120	120	120
MAXIMUM:	524.0N	531.0N	539.0N	550.0N	556.5N
MEAN:	468.0N	473.6N	482.1N	492.1N	499.2N
MINIMUM:	386.0N	374.5N	408.5N	405.5N	419.0N
STD.DEV.:	35.56N	35.37N	33.68N	33.58N	32.54N

S-3260 DATA FOR TED03A

TED0,1,2,3 AT 5U

08 NOV 78



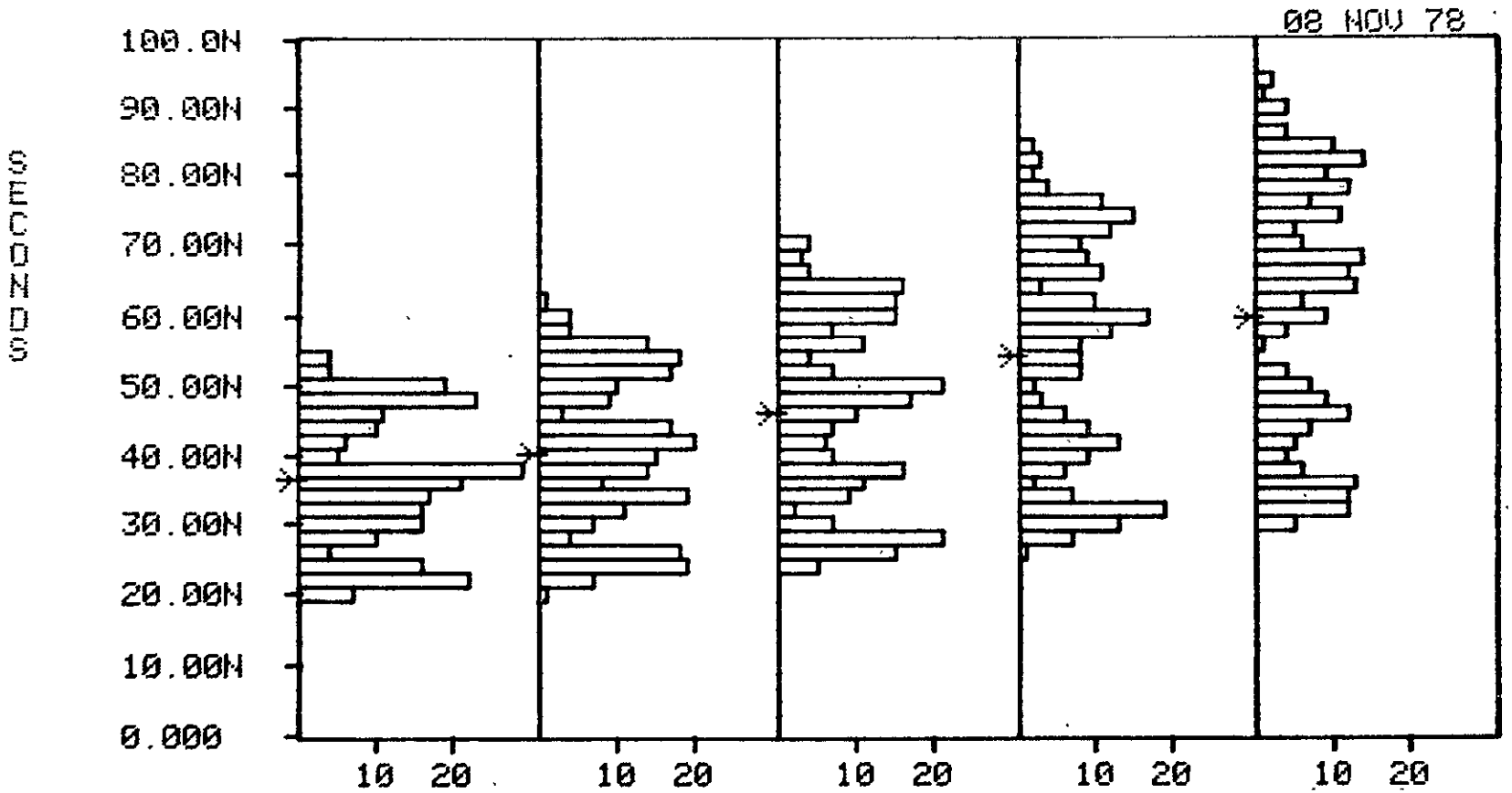
OF CELLS 50
CELL SIZE 4.000N

READINGS:	240	240	240	240	240
MAXIMUM:	128.0N	142.5N	162.0N	188.5N	207.0N
MEAN:	81.25N	89.93N	101.8N	117.9N	128.9N
MINIMUM:	37.35N	40.95N	45.80N	52.00N	56.45N
STD.DEV.:	27.89N	31.38N	36.13N	42.48N	46.83N

S-3260 DATA FOR TED03B

TED0,1,2,3 AT 10V

08 NOV 78



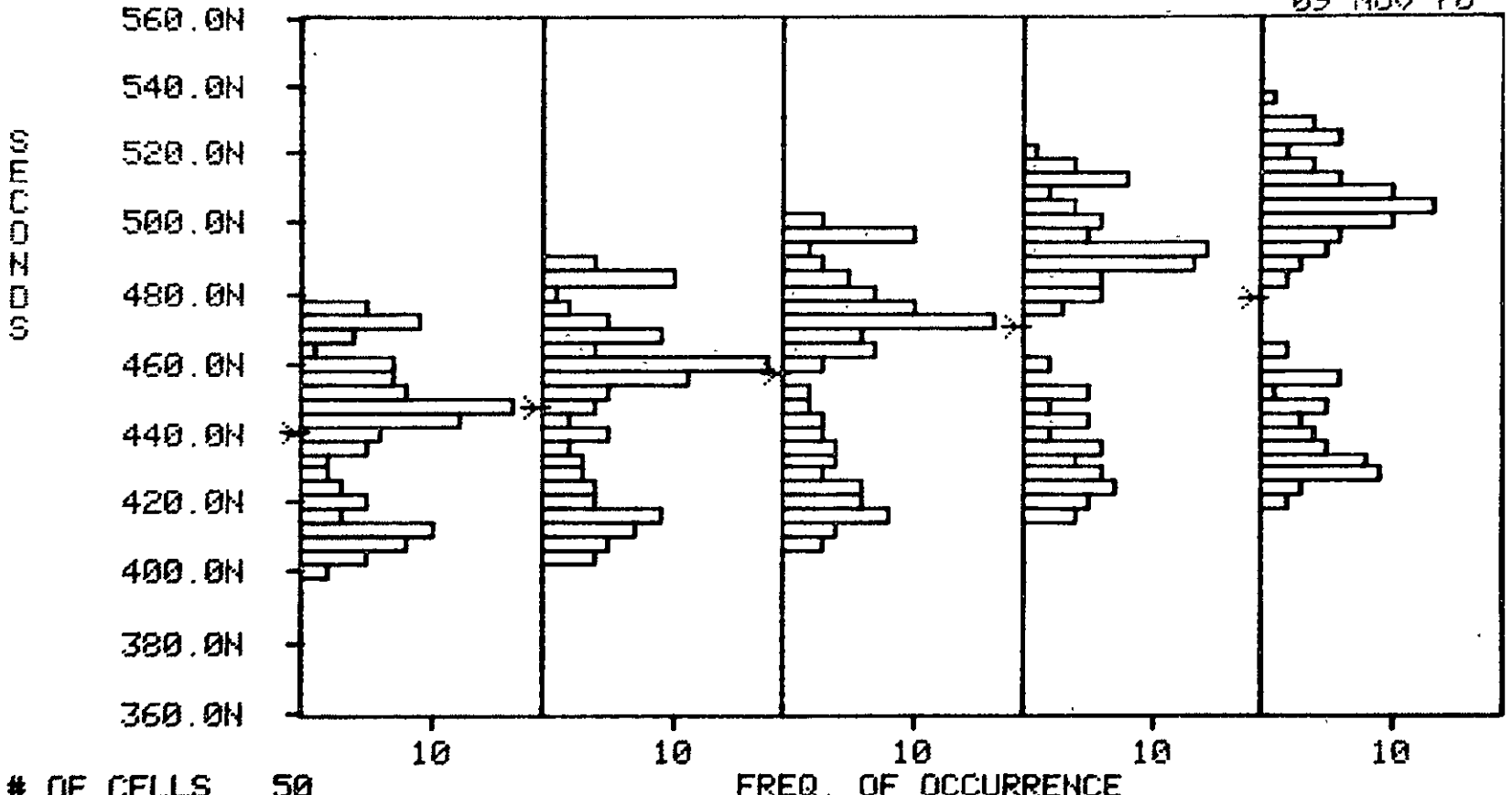
OF CELLS 50
CELL SIZE 2.000N

READINGS:	240	240	240	240	240
MAXIMUM:	54.20N	61.35N	70.90N	83.90N	93.25N
MEAN:	36.22N	40.22N	46.05N	54.11N	59.89N
MINIMUM:	19.20N	20.80N	23.30N	26.85N	29.30N
STD.DEV.:	9.531N	10.99N	13.15N	16.09N	18.11N

S-3260 DATA FOR TED46A

TED4/TED6 AT 5V

09 NOV 78

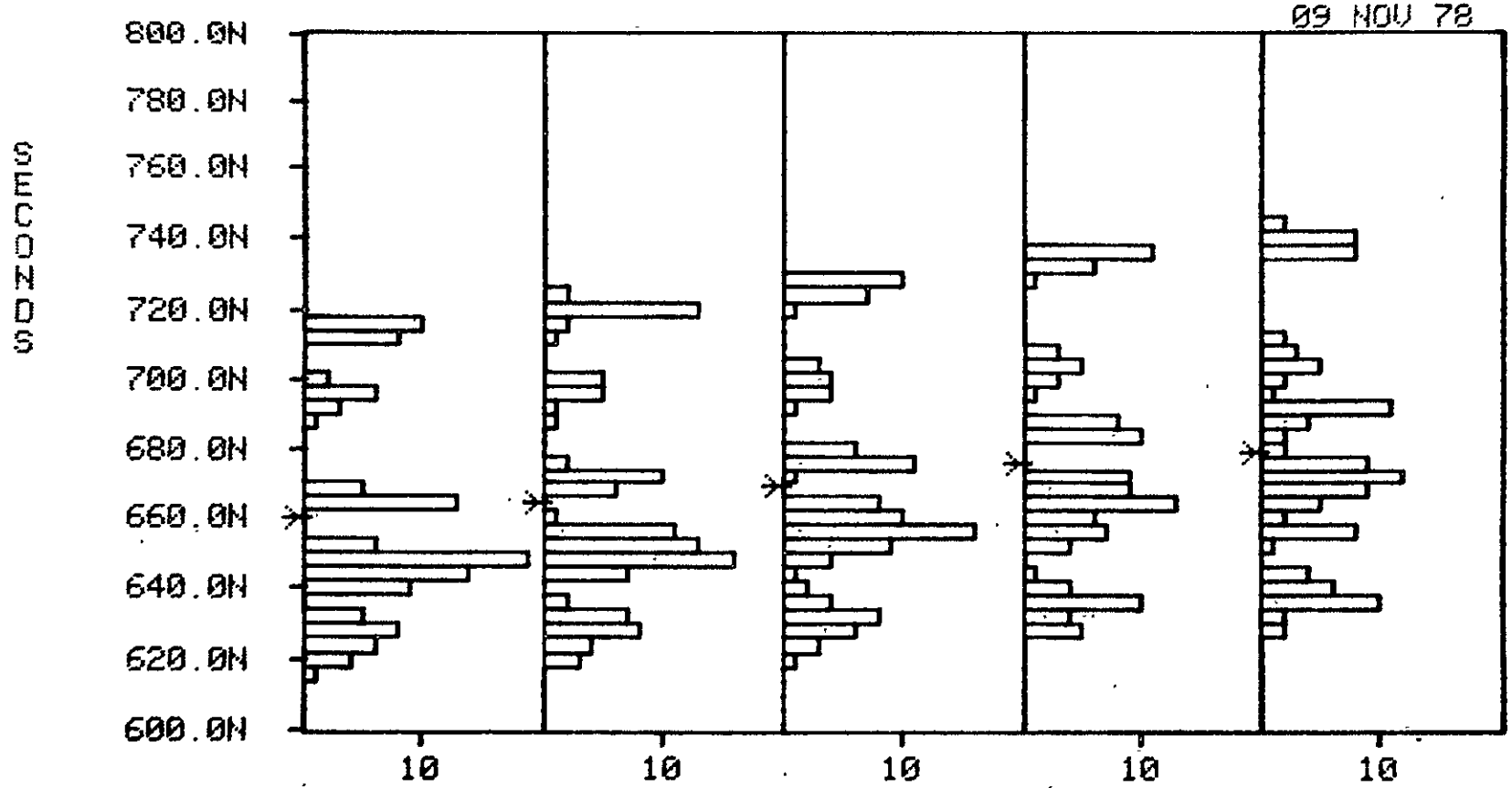


OF CELLS 50
CELL SIZE 4.000N

READINGS:	120	120	120	120	120
MAXIMUM:	477.5N	488.0N	500.5N	519.5N	535.0N
MEAN:	440.3N	447.8N	457.3N	470.4N	479.0N
MINIMUM:	401.0N	403.0N	406.5N	414.5N	419.5N
STD.DEV.:	22.00N	24.87N	28.01N	32.38N	35.47N

S-3260 DATA FOR TED46B TED4/TED6 AT 10V

09 NOV 78



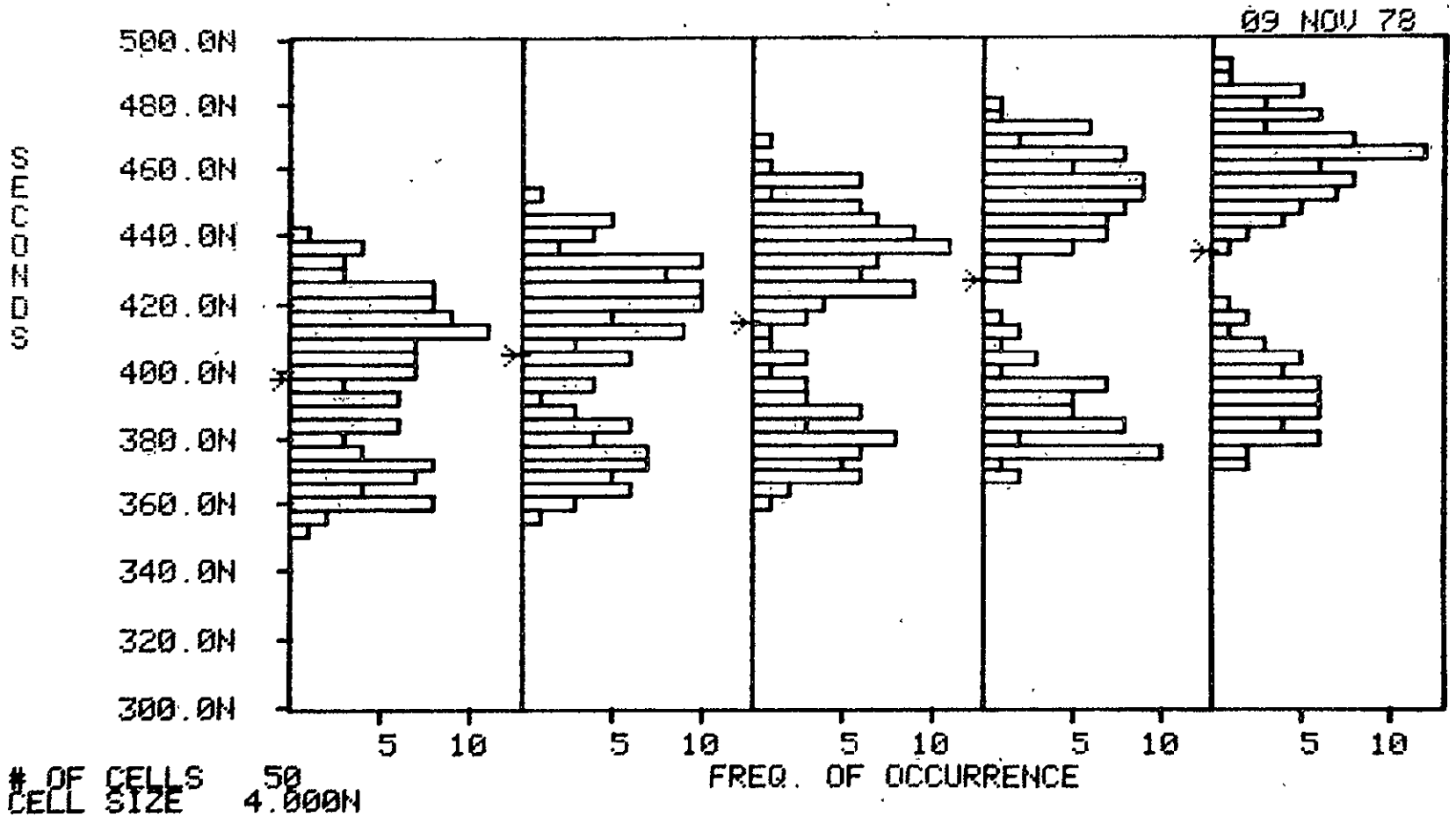
OF CELLS 50
CELL SIZE 4.000N

READINGS:	120	120	120	120	120
MAXIMUM:	716.5N	722.0N	729.0N	736.5N	744.0N
MEAN:	659.7N	663.9N	668.9N	675.3N	679.4N
MINIMUM:	617.0N	618.5N	621.5N	627.0N	628.5N
STD.DEV.:	30.01N	30.55N	31.08N	32.12N	32.59N

S-3260 DATA FOR TED57A

TED5/TED7 AT 5V

09 NOV 78



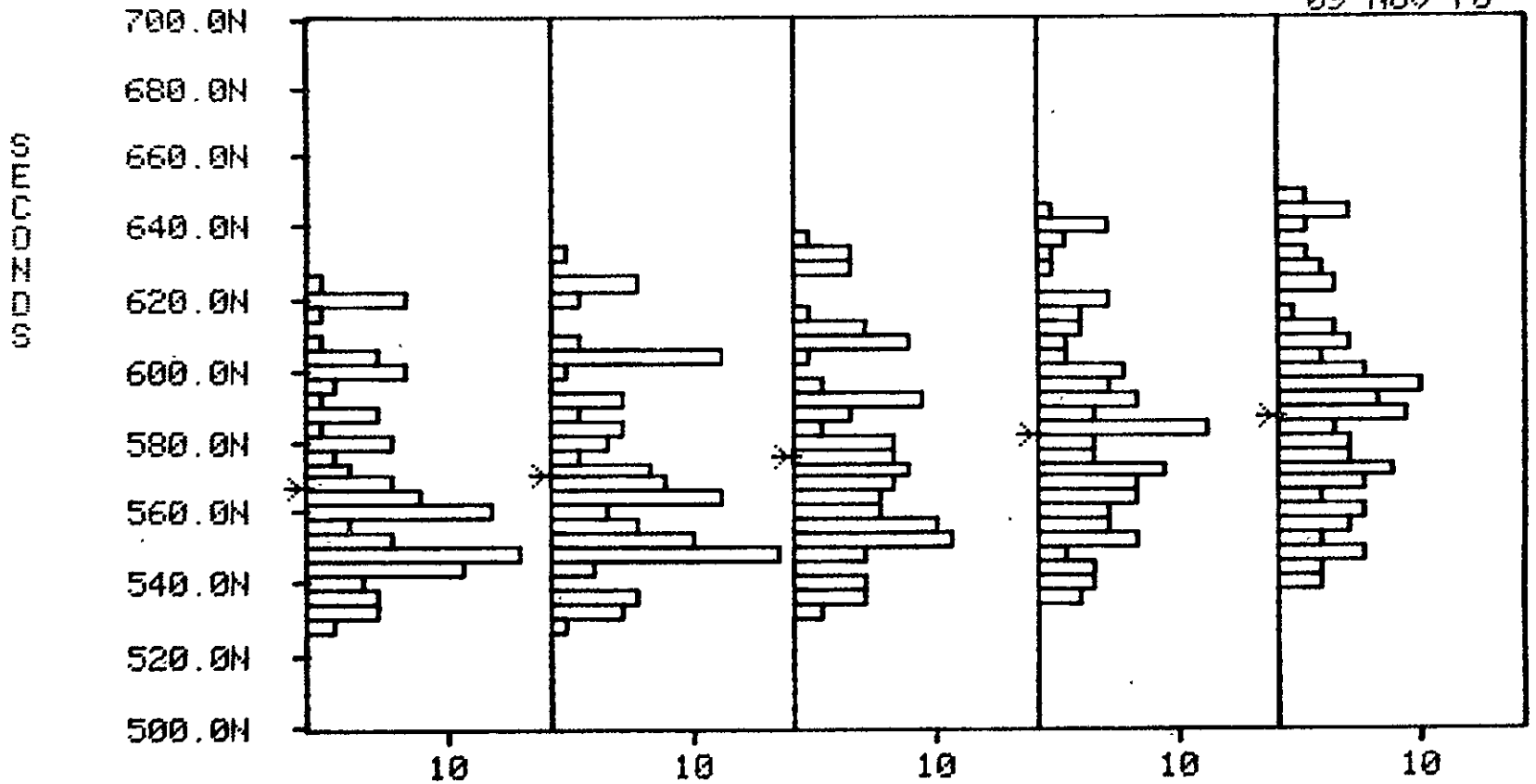
OF CELLS 50
CELL SIZE 4.000N

READINGS:	120	120	120	120	120
MAXIMUM:	441.5N	453.0N	466.5N	481.0N	490.0N
MEAN:	397.6N	404.7N	414.3N	426.6N	434.8N
MINIMUM:	352.5N	356.5N	360.5N	366.0N	370.5N
STD.DEV.:	23.82N	26.16N	29.57N	33.81N	36.38N

S-3260 DATA FOR TED57B

TED5/TED7 AT 10V

09 NOV 78



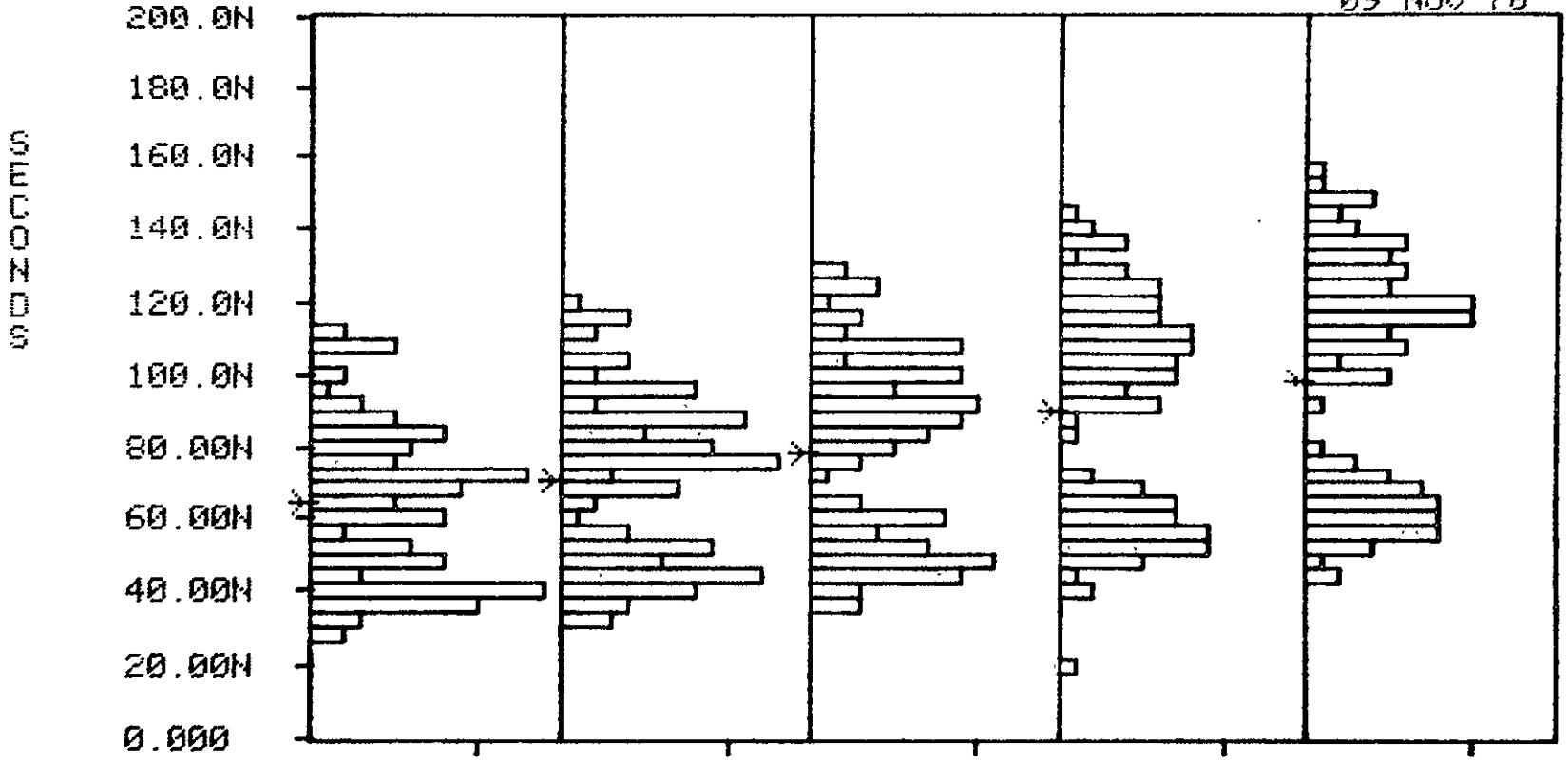
OF CELLS 50
CELL SIZE 4.000N

READINGS:	120	120	120	120	120
MAXIMUM:	625.0N	630.0N	637.0N	644.0N	649.5N
MEAN:	566.5N	570.1N	575.4N	582.2N	587.2N
MINIMUM:	529.0N	529.5N	532.5N	535.5N	538.5N
STD.DEV.:	25.59N	25.92N	26.59N	27.29N	28.11N

S-3260 DATA FOR TIB01A

TIB0.1 AT 5V

09 NOV 78



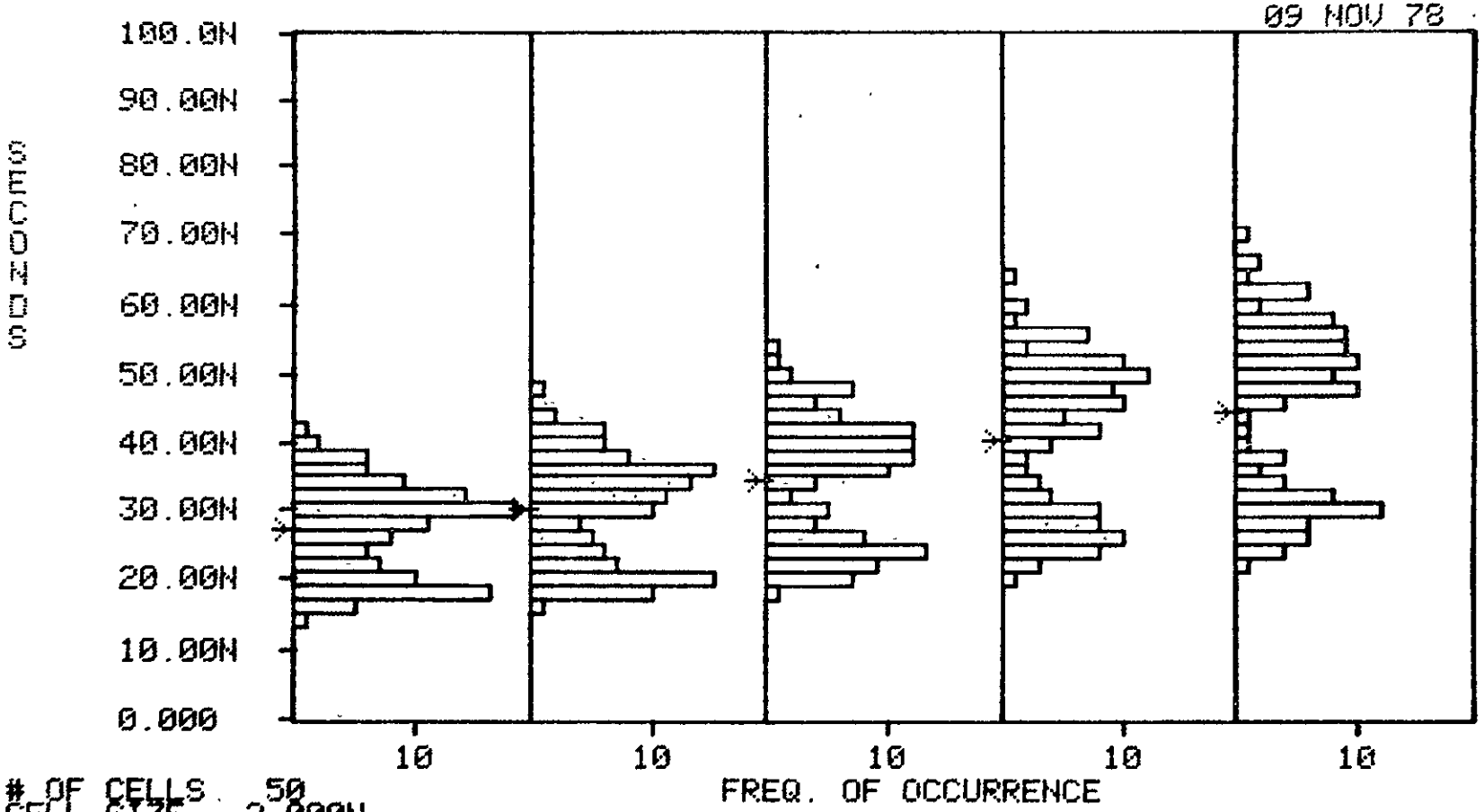
DATA EDITED
OF CELLS 50
CELL SIZE 4.000N

READINGS:	120	120	120	120	119
MAXIMUM:	112.0N	119.0N	129.5N	145.0N	156.0N
MEAN:	63.92N	69.98N	78.56N	89.94N	98.46N
MINIMUM:	28.60N	31.45N	35.45N	20.00N	44.60N
STD.DEV.:	21.76N	23.32N	25.80N	29.98N	31.96N

S-3260 DATA FOR TIB01B

TIB0.1 AT 10V

09 NOV 78



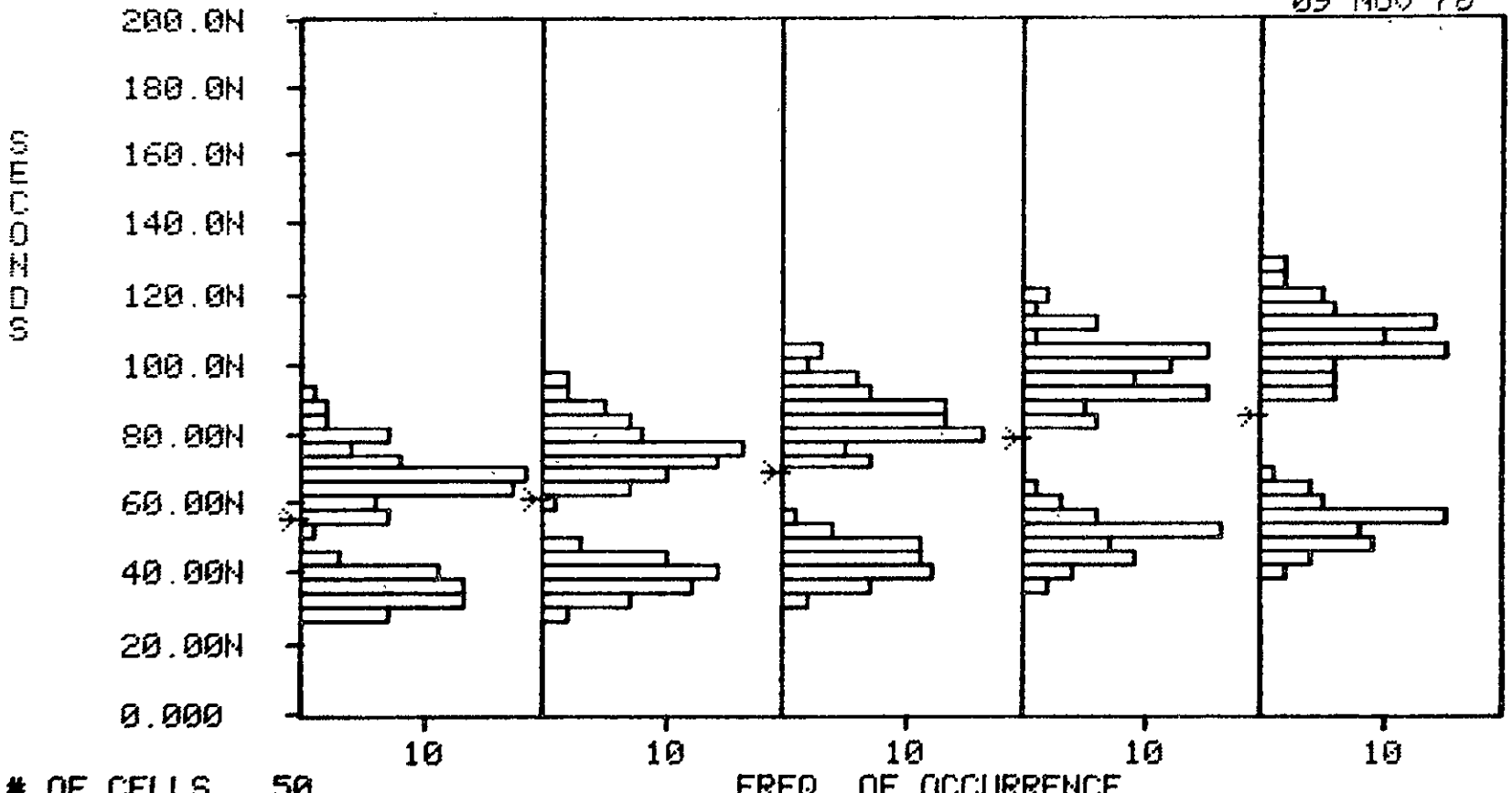
OF CELLS 50
CELL SIZE 2.000N

READINGS:	120	120	120	120	120
MAXIMUM:	41.80N	47.10N	53.80N	63.35N	69.75N
MEAN:	26.96N	29.98N	34.29N	40.36N	44.59N
MINIMUM:	14.95N	16.10N	17.95N	20.40N	22.25N
STD.DEV.:	6.760N	7.791N	9.256N	11.27N	12.59N

S-3260 DATA FOR TB001A

TB00,1 AT 5V

09 NOV 78



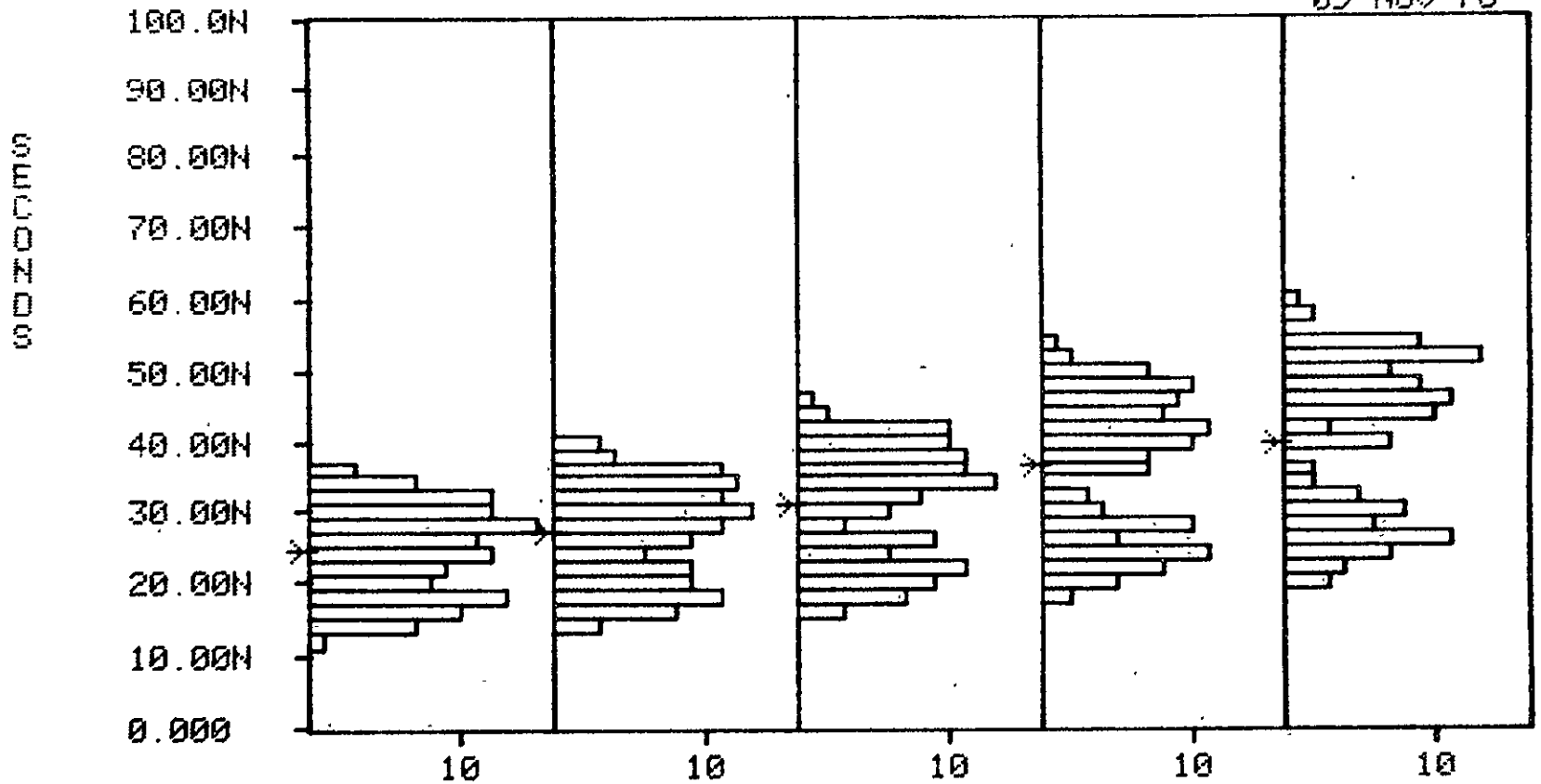
OF CELLS 50
CELL SIZE 4.000N

READINGS:	120	120	120	120	120
MAXIMUM:	90.85N	96.30N	105.5N	118.5N	127.5N
MEAN:	55.40N	60.75N	68.38N	78.69N	85.74N
MINIMUM:	26.25N	28.45N	31.80N	36.65N	39.80N
STD.DEV.:	17.57N	19.40N	21.78N	25.13N	27.56N

S-3260 DATA FOR TB001B

TB00.1 AT 10V

09 NOV 78



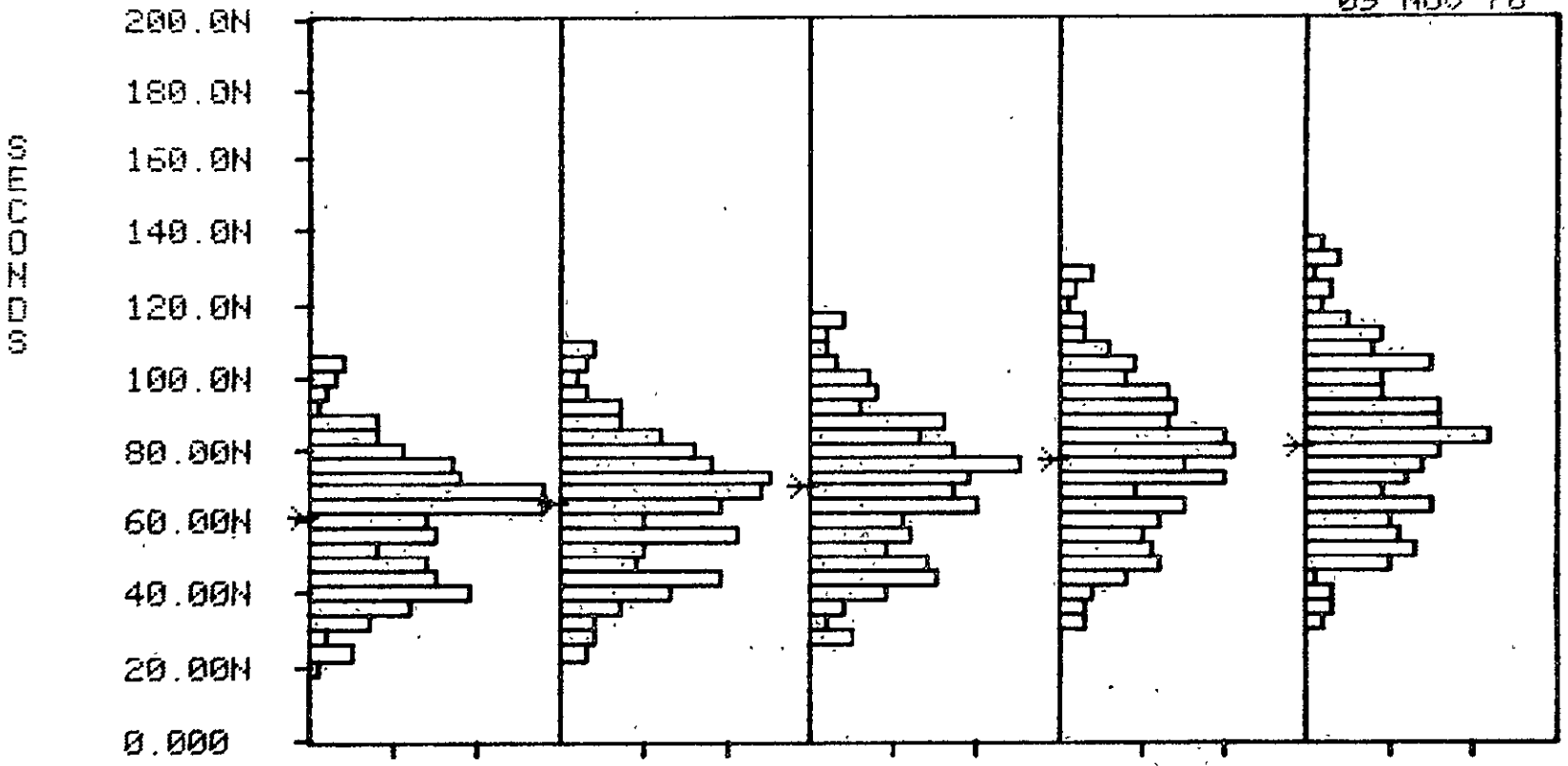
OF CELLS 50
CELL SIZE 2.000N

READINGS:	120	120	120	120	120
MAXIMUM:	35.90N	40.00N	46.05N	53.60N	59.25N
MEAN:	24.46N	27.10N	30.87N	36.10N	39.79N
MINIMUM:	12.70N	13.90N	15.45N	18.00N	19.65N
STD.DEV.:	6.135N	7.035N	8.222N	10.01N	11.18N

S-3260 DATA FOR TTA

TTLH/TTHL AT 5V

09 NOV 78

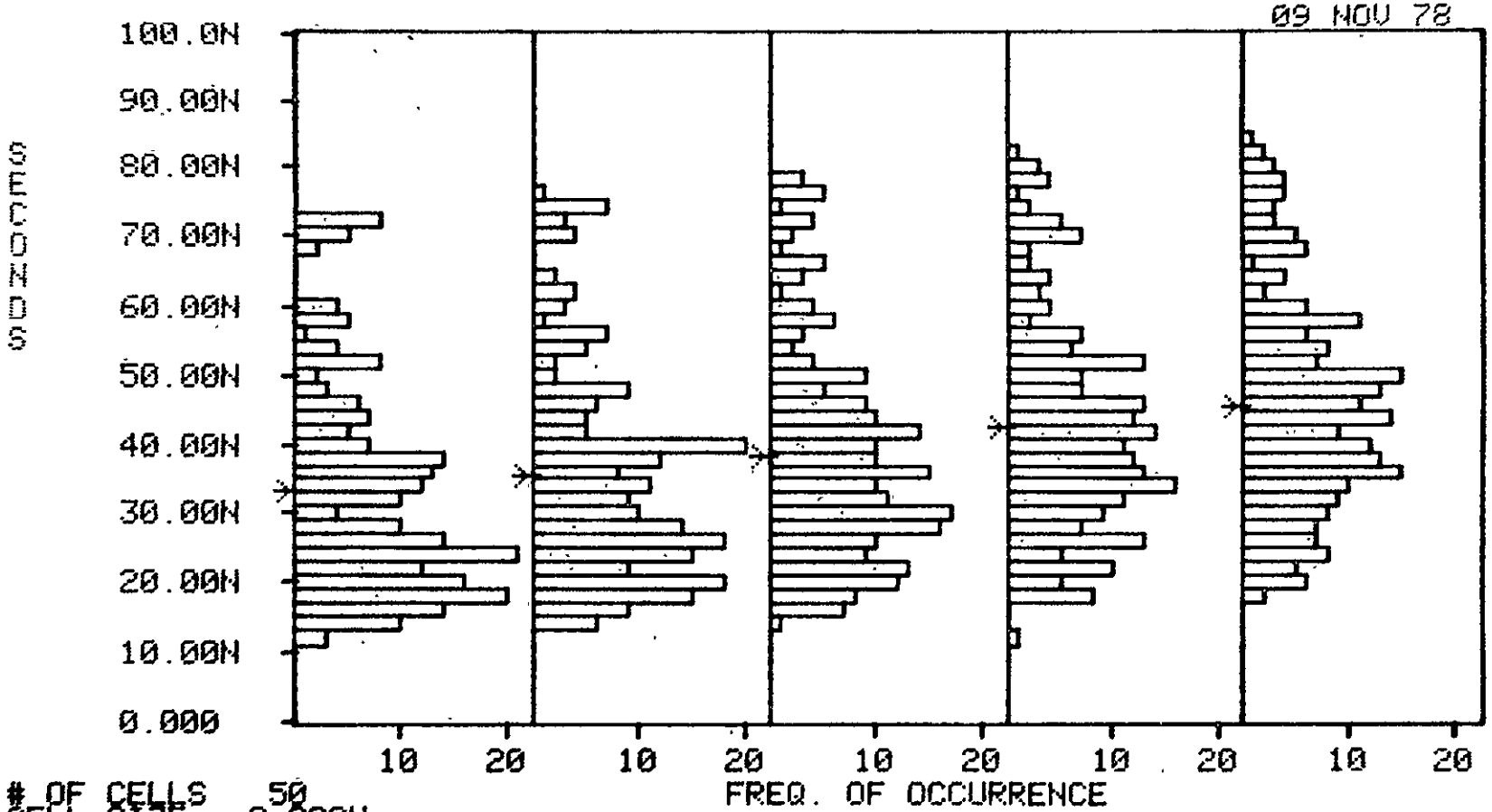


DATA EDITED
OF CELLS 50
CELL SIZE 4.000N

READINGS:	240	240	240	239	240
MAXIMUM:	105.2N	109.9N	117.5N	128.2N	136.3N
MEAN:	60.85N	64.28N	69.27N	76.47N	81.31N
MINIMUM:	21.85N	23.45N	26.60N	30.10N	33.25N
STD.DEV.:	17.88N	18.46N	19.41N	21.08N	22.50N

S-3260 DATA FOR TTB TTLH/TTHL AT 10V

09 NOV 78



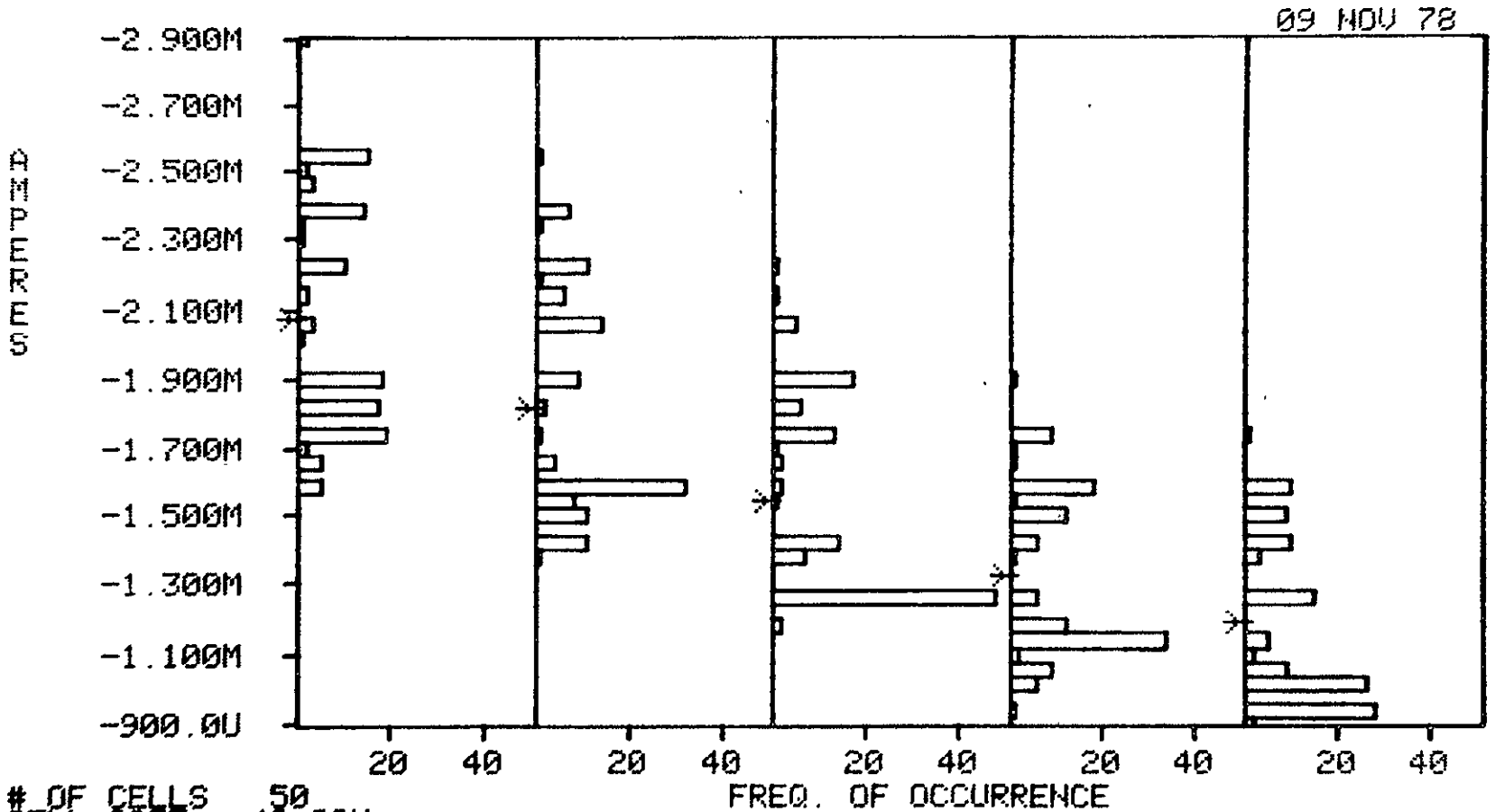
OF CELLS 50
CELL SIZE 2.000N

READINGS:	240	240	240	240	240
MAXIMUM:	72.60N	75.30N	78.90N	81.45N	83.70N
MEAN:	33.06N	35.29N	38.39N	42.59N	45.64N
MINIMUM:	12.55N	13.20N	14.95N	12.20N	18.60N
STD.DEV.:	15.45N	15.54N	15.57N	15.61N	15.51N

S-3260 DATA FOR IOH1

IOH: VDD=5V VO=4.6V

09 NOV 78



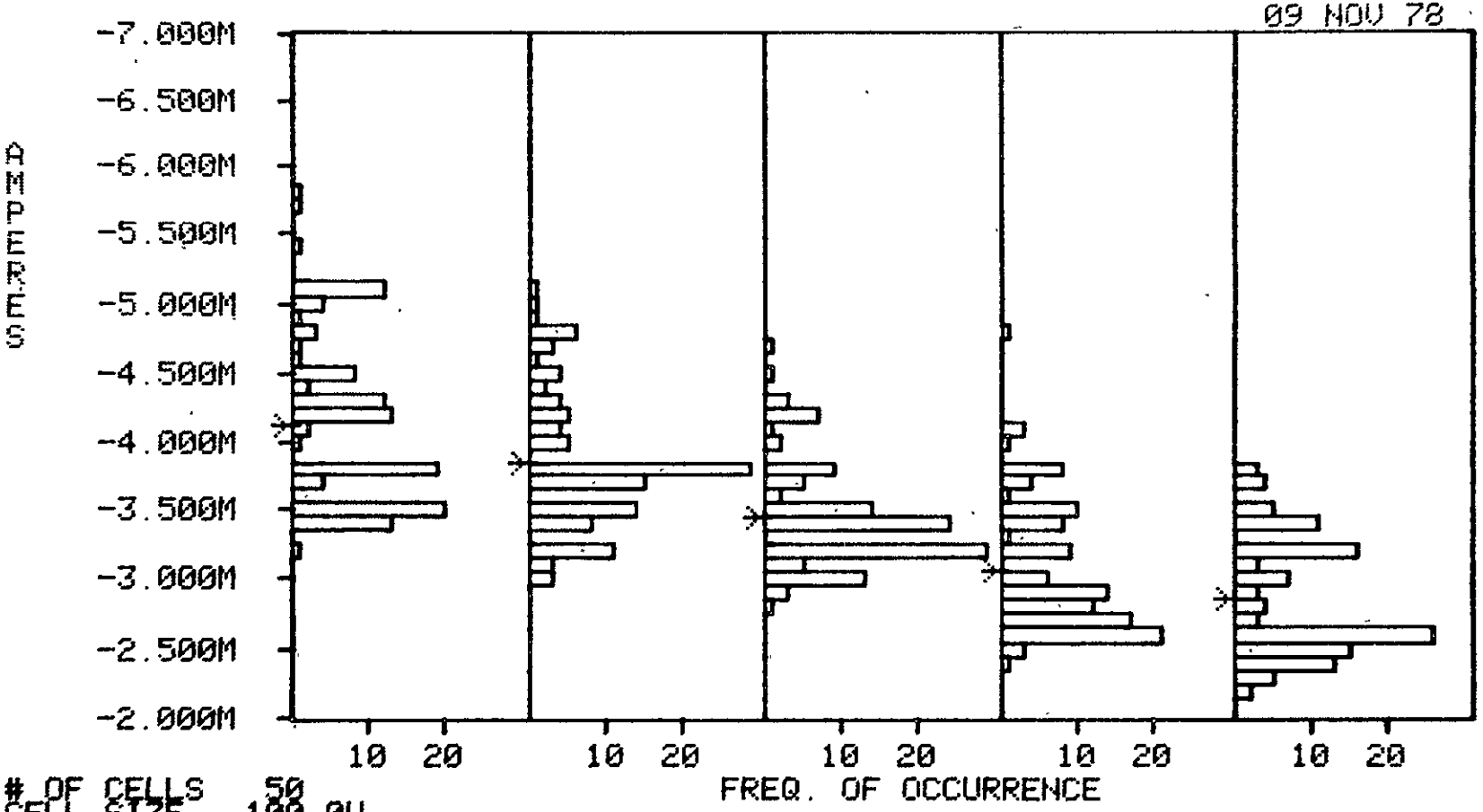
OF CELLS 50
CELL SIZE 40.00U

READINGS:	120	120	120	120	120
MAXIMUM:	-1.600M	-1.400M	-1.200M	-960.0U	-920.0U
MEAN:	-2.074M	-1.814M	-1.540M	-1.324M	-1.187M
MINIMUM:	-2.880M	-2.560M	-2.240M	-1.920M	-1.760M
STD.DEV.:	331.9U	316.8U	287.4U	246.2U	229.2U

S-3260 DATA FOR IOH3

IOH: VDD=10V VO=9.5V

09 NOV 78



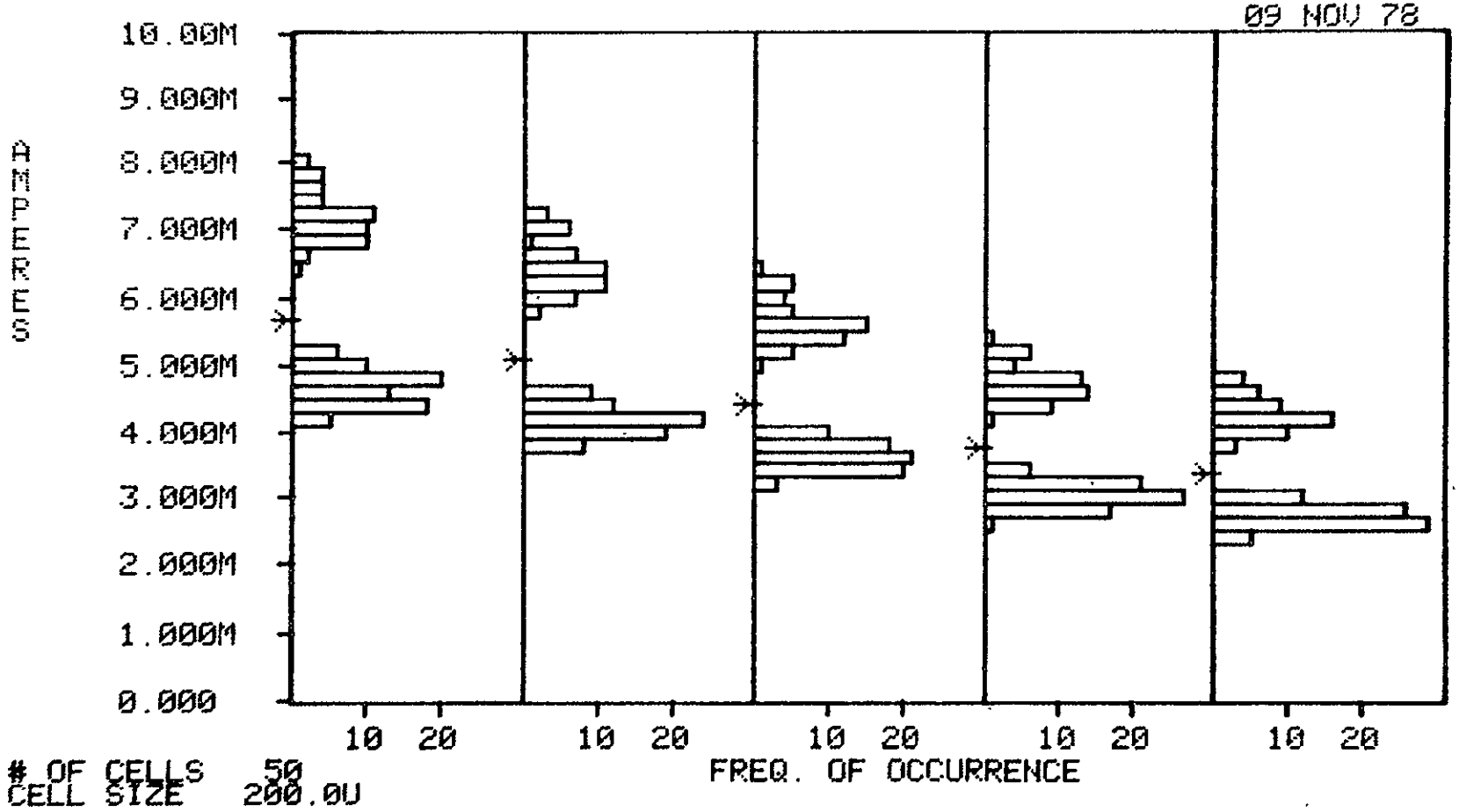
OF CELLS 50
CELL SIZE 100.0U

READINGS:	120	120	120	120	120
MAXIMUM:	-3.200M	-3.040M	-2.800M	-2.400M	-2.200M
MEAN:	-4.124M	-3.831M	-3.443M	-3.052M	-2.848M
MINIMUM:	-5.760M	-5.120M	-4.720M	-4.800M	-3.760M
STD.DEV.:	602.5U	488.0U	382.7U	470.8U	429.9U

S-3260 DATA FOR IOL1

IOL: VDD=5V VO=0.4V

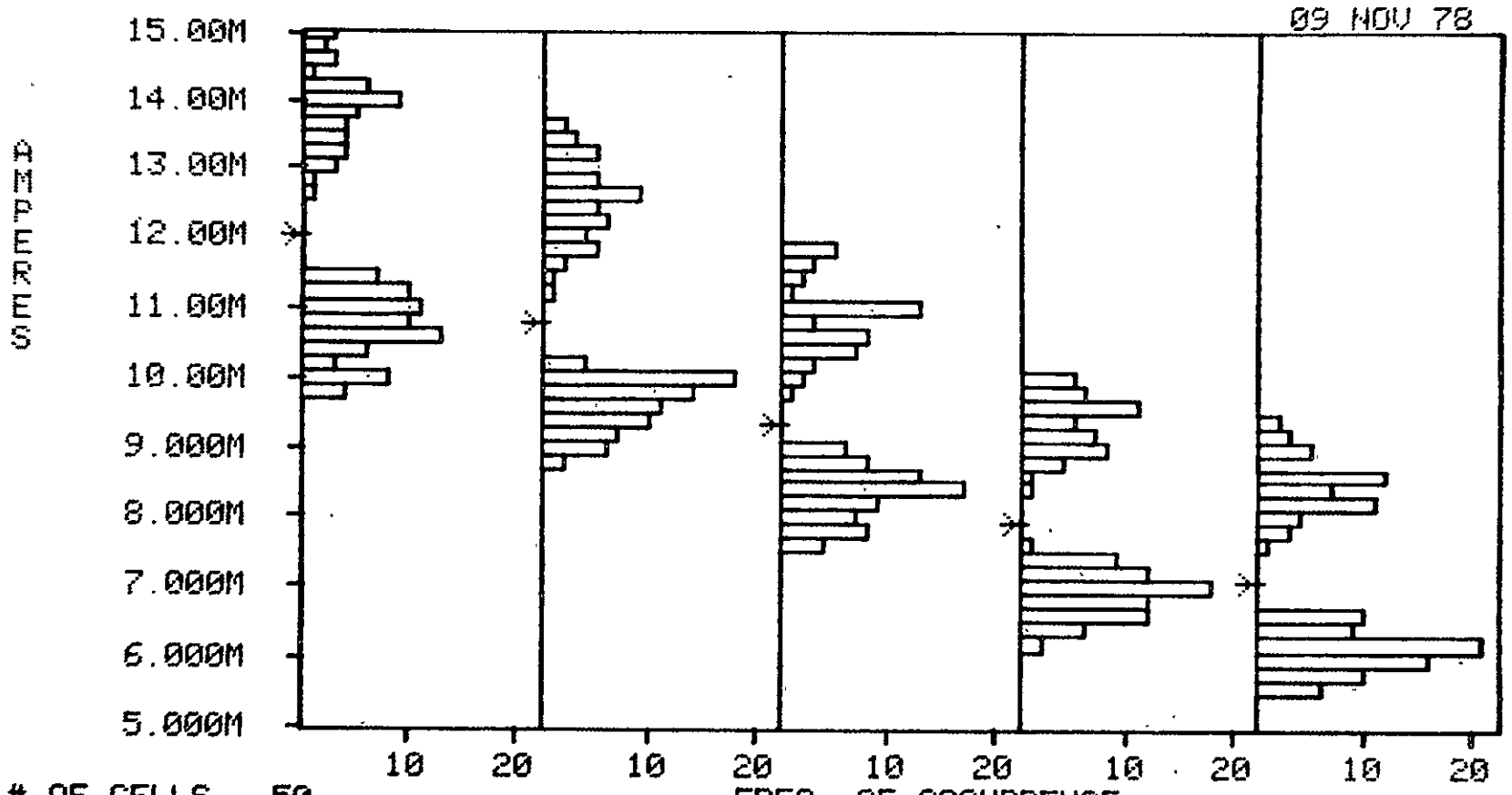
09 NOV 78



OF CELLS 50
CELL SIZE 200.0U

READINGS:	120	120	120	120	120
MAXIMUM:	8.020M	7.280M	6.400M	5.375M	4.630M
MEAN:	5.670M	5.088M	4.425M	3.722M	3.335M
MINIMUM:	4.160M	3.725M	3.215M	2.695M	2.380M
STD.DEV.:	1.257M	1.152M	1.018M	866.7U	786.6U

S-3260 DATA FOR IOL3 IOL: VDD=10V VO=0.5V



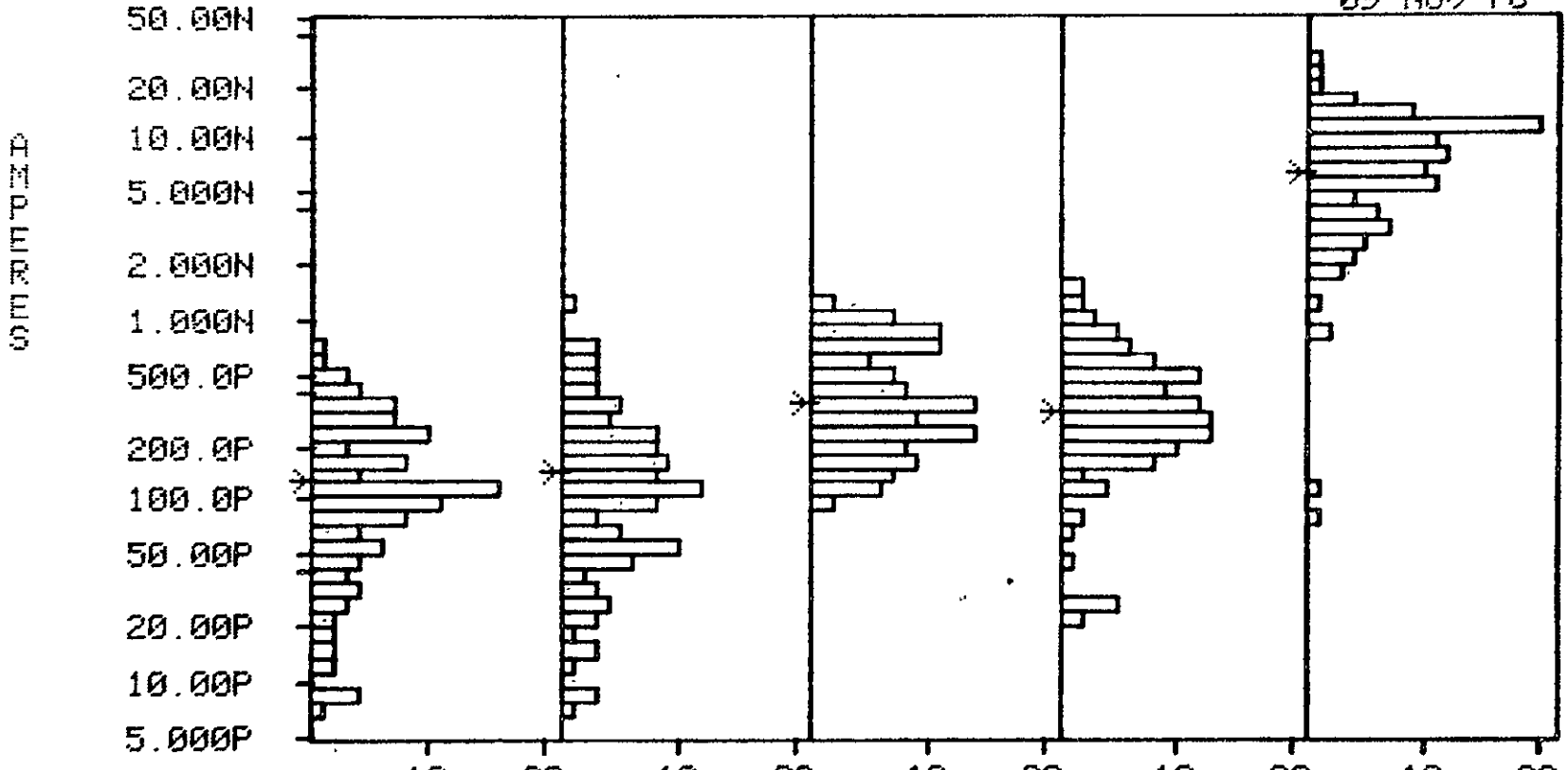
OF CELLS 50
CELL SIZE 200.0U
DATA OUTSIDE= '+'

READINGS:	120	120	120	120	120
MAXIMUM:	15.10M	13.55M	11.85M	10.05M	9.330M
MEAN:	11.99M	10.77M	9.349M	7.906M	7.065M
MINIMUM:	9.750M	8.870M	7.580M	6.280M	5.540M
STD.DEV.:	1.672M	1.463M	1.308M	1.268M	1.207M

S-3260 DATA FOR I021

I02. VDD=13V VO=13V

09 NOV 78



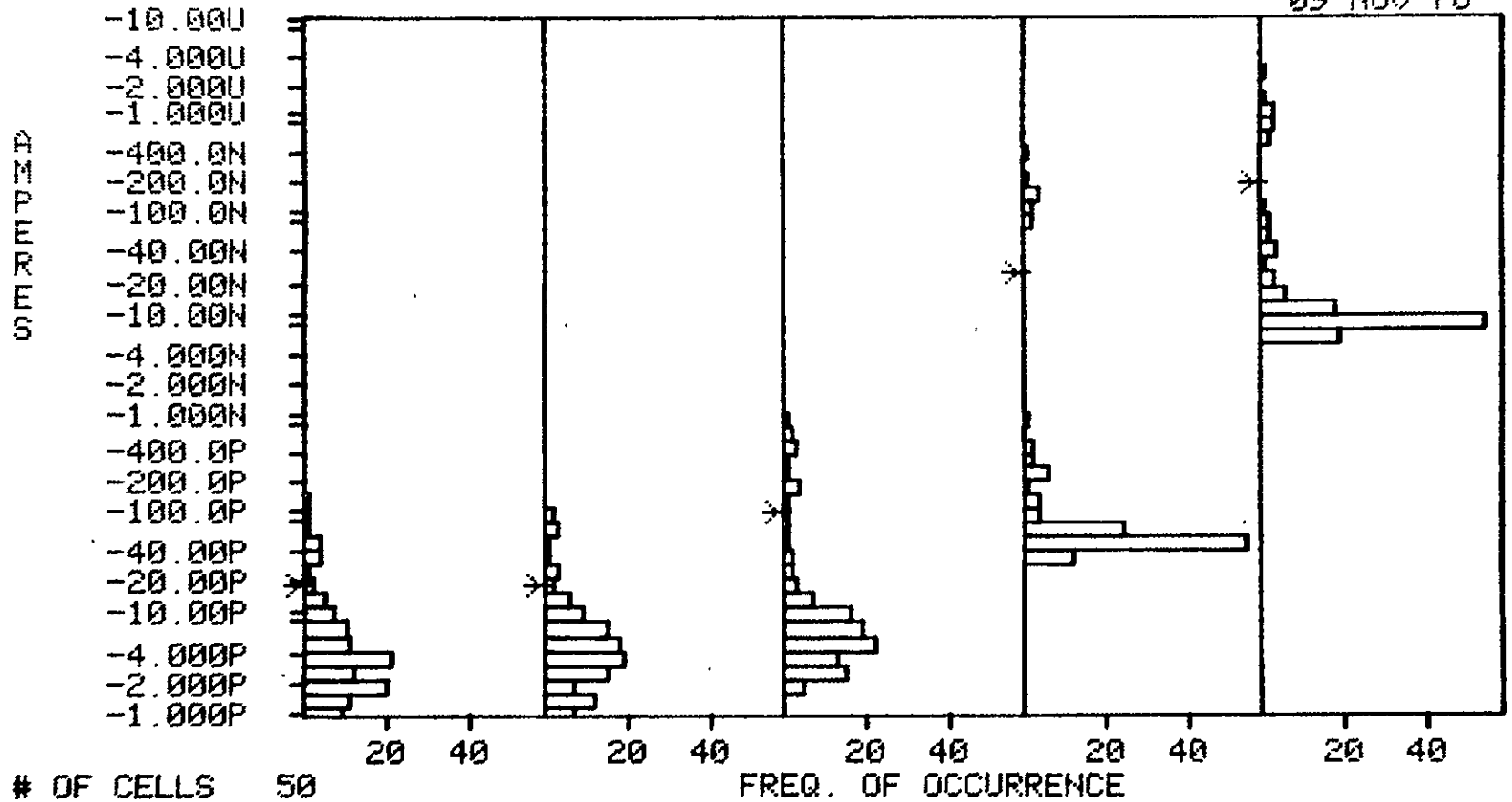
DATA EDITED
OF CELLS 50

READINGS:	120	120	120	120	114
MAXIMUM:	585.0P	986.2P	960.6P	1.229N	21.51N
MEAN:	124.4P	139.1P	351.5P	315.8P	6.334N
MINIMUM:	6.157P	6.337P	72.23P	16.00P	66.67P
STD.DEV.:	111.7P	151.7P	237.9P	239.1P	3.843N

S-3260 DATA FOR IOZ2

IOZ: VDD=13V VO=0V

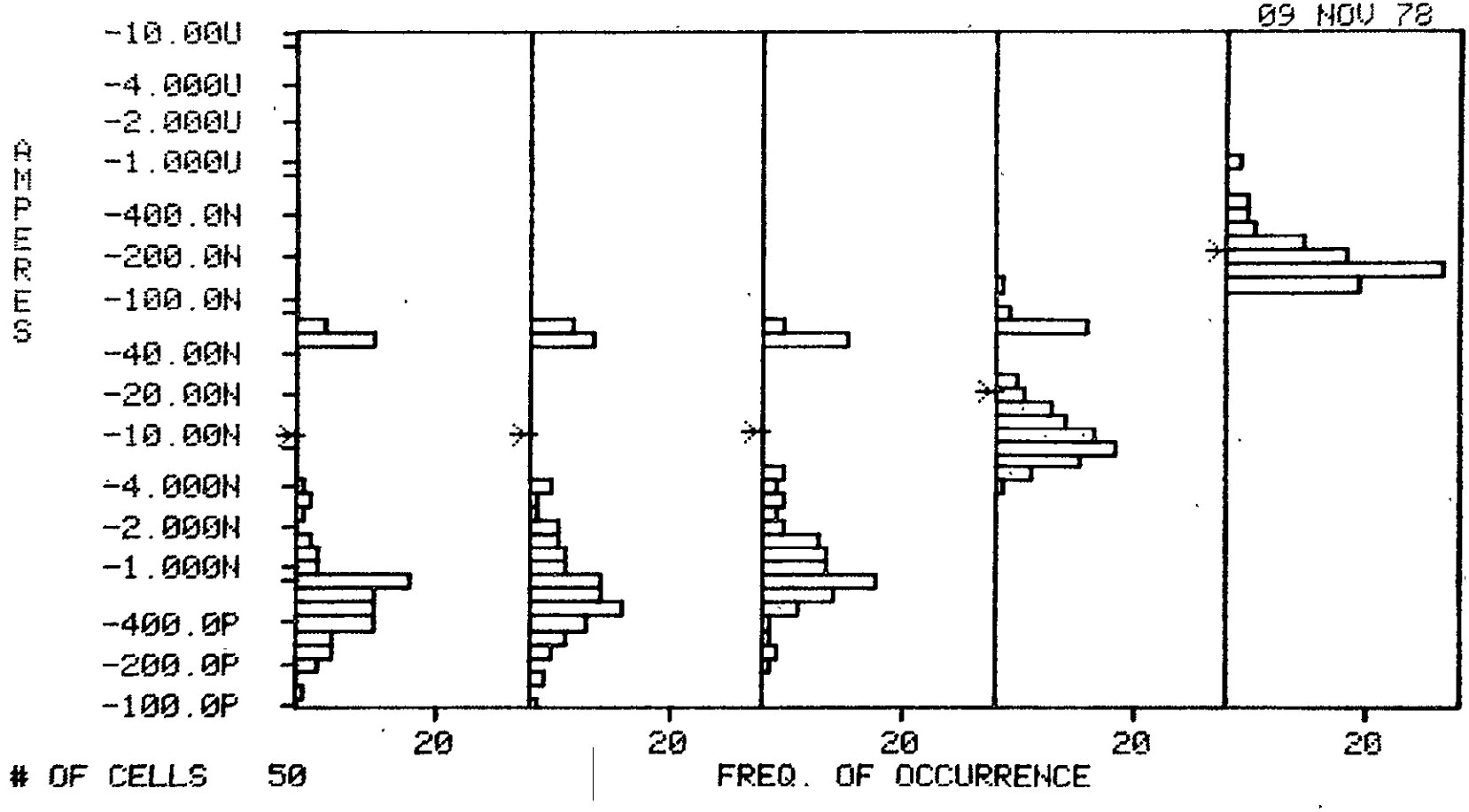
09 NOV 78



READINGS:	120	120	120	120	120
MAXIMUM:	-1.893P	-1.833P	-4.020P	-64.67P	-11.65N
MEAN:	-18.43P	-18.31P	-97.14P	-25.63N	-196.4N
MINIMUM:	-247.0P	-212.7P	-2.024N	-744.5N	-4.690U
STD.DEV.:	34.76P	33.18P	279.0P	97.24N	627.5N

S-3260 DATA FOR ISSA ISS VDD=10V

09 NOV 78

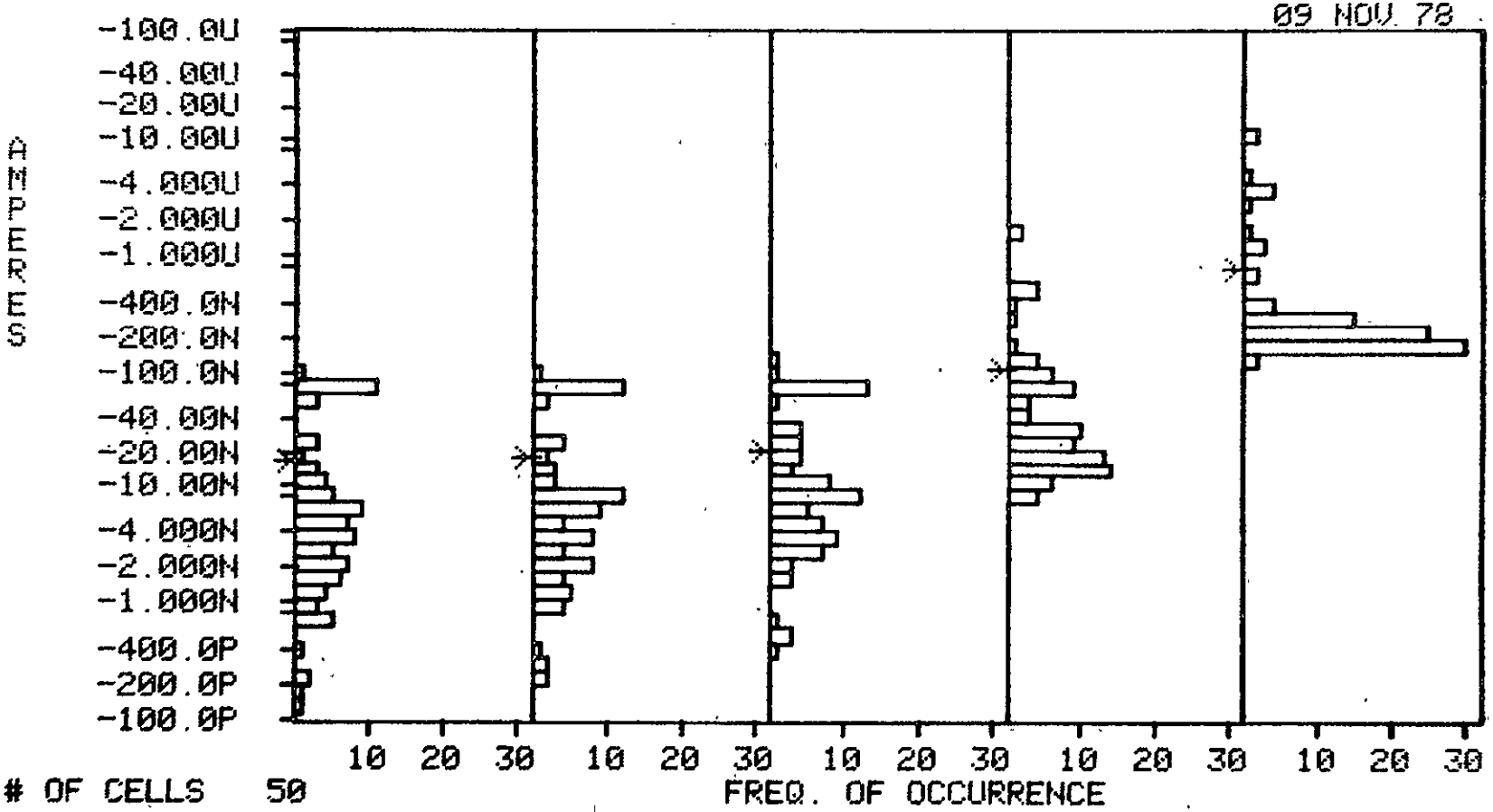


READINGS:	90	90	90	90	90
MAXIMUM:	-137.5P	-100.0P	-225.0P	-4.500N	-117.0N
MEAN:	-9.885N	-10.07N	-10.41N	-20.87N	-218.9N
MINIMUM:	-58.50N	-60.00N	-62.50N	-114.5N	-1.130U
STD.DEV.:	20.55N	20.60N	20.43N	22.90N	157.2N

S-3260 DATA FOR ISSB

ISS: VDD=13V

09 NOV 78

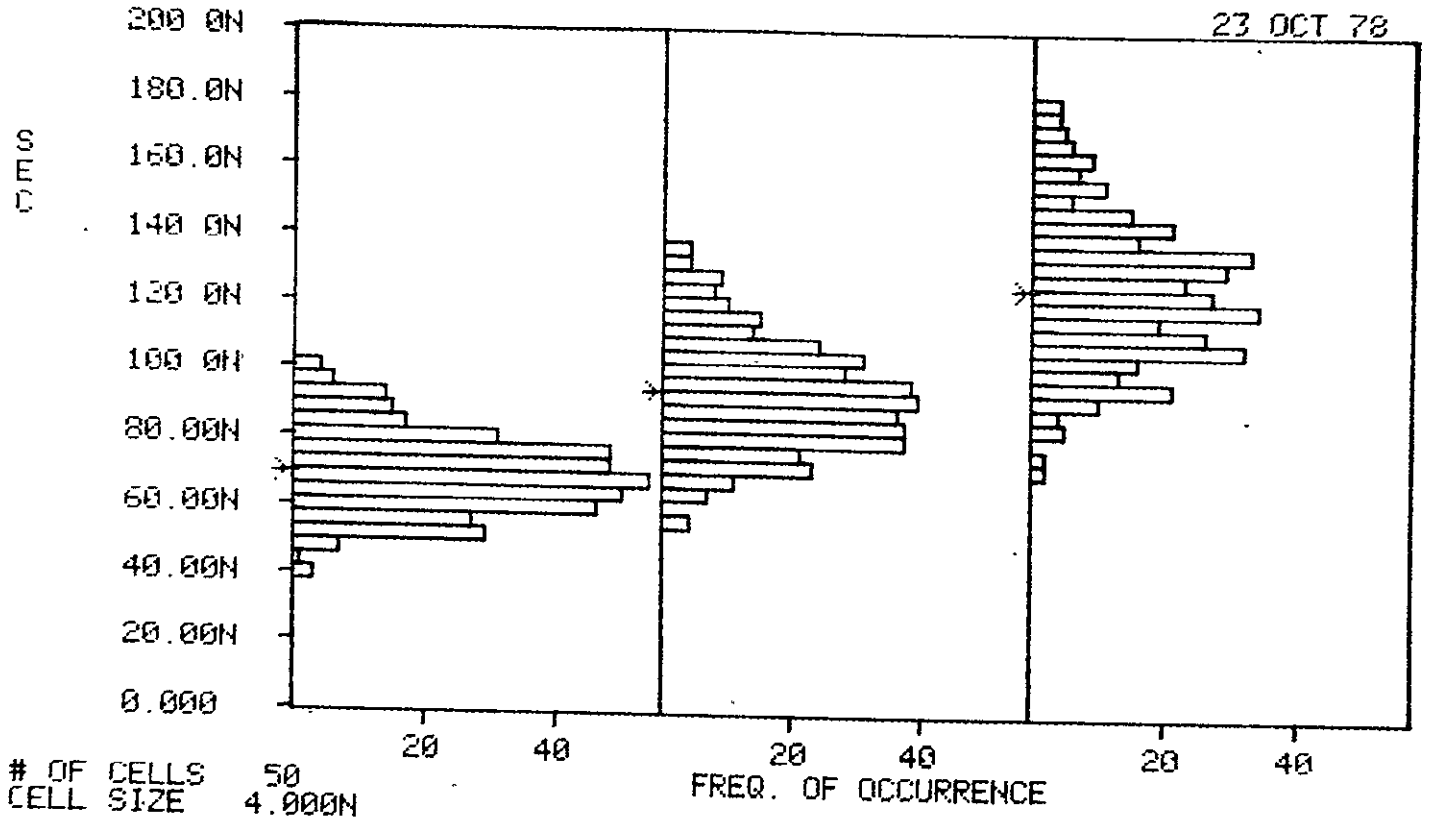


OF CELLS 50

READINGS:	90	90	90	90	90
MAXIMUM:	-125.0P	-212.5P	-387.5P	-7.550N	-146.5N
MEAN:	-16.25N	-17.42N	-21.31N	-109.0N	-771.9N
MINIMUM:	-92.00N	-99.50N	-116.5N	-1.725U	-11.80U
STD.DEV.:	25.38N	25.81N	28.00N	273.3N	1.883U

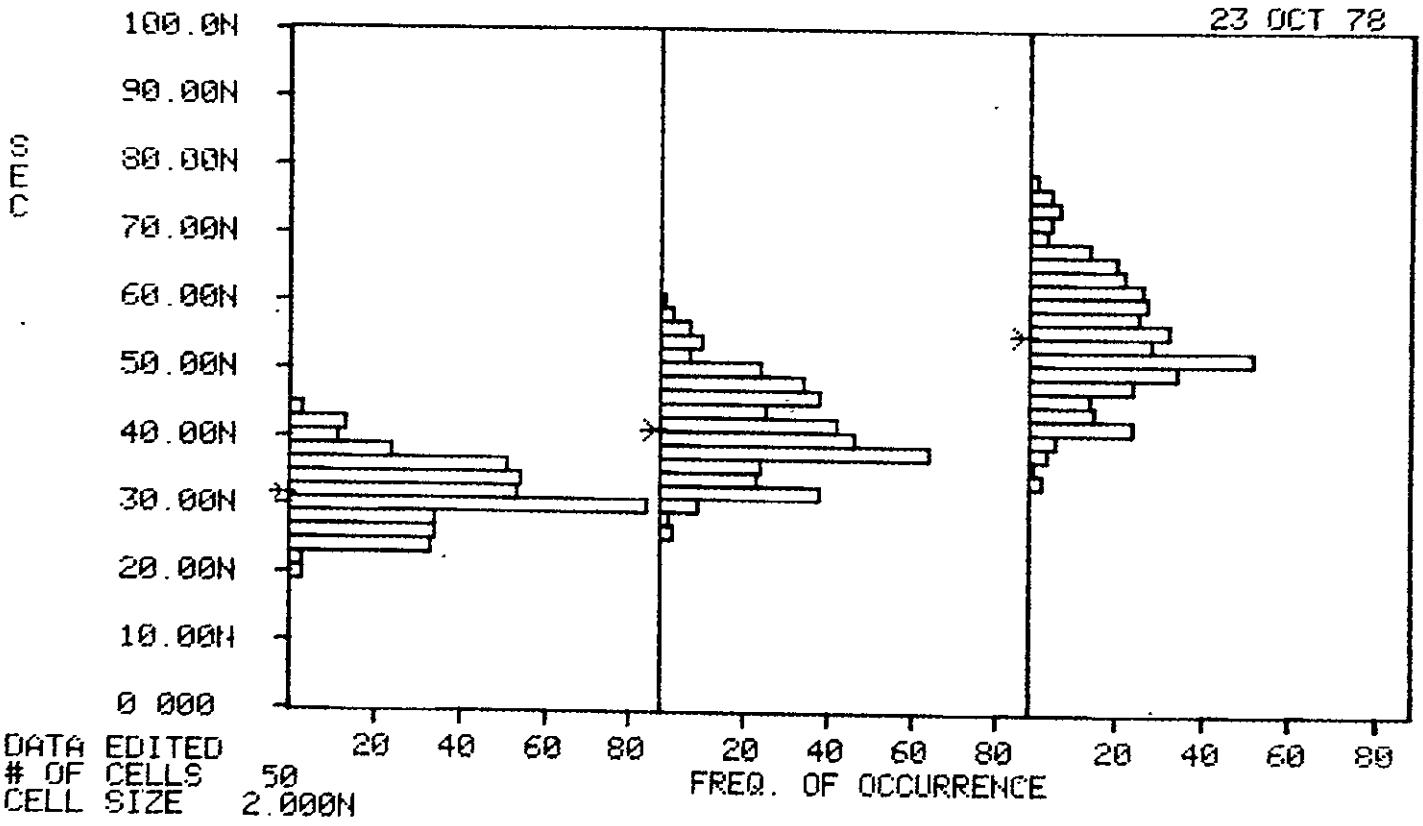
STANDARD DEVICES

S-3260 DATA FOR TEB03H TEB0,1,2,3 AT 5V



READINGS:	400	400	400
MAXIMUM:	99.85N	137.0N	179.5N
MEAN:	69.25N	93.65N	125.3N
MINIMUM:	41.25N	55.15N	73.05N
STD.DEV :	11.66N	16.33N	21.80N

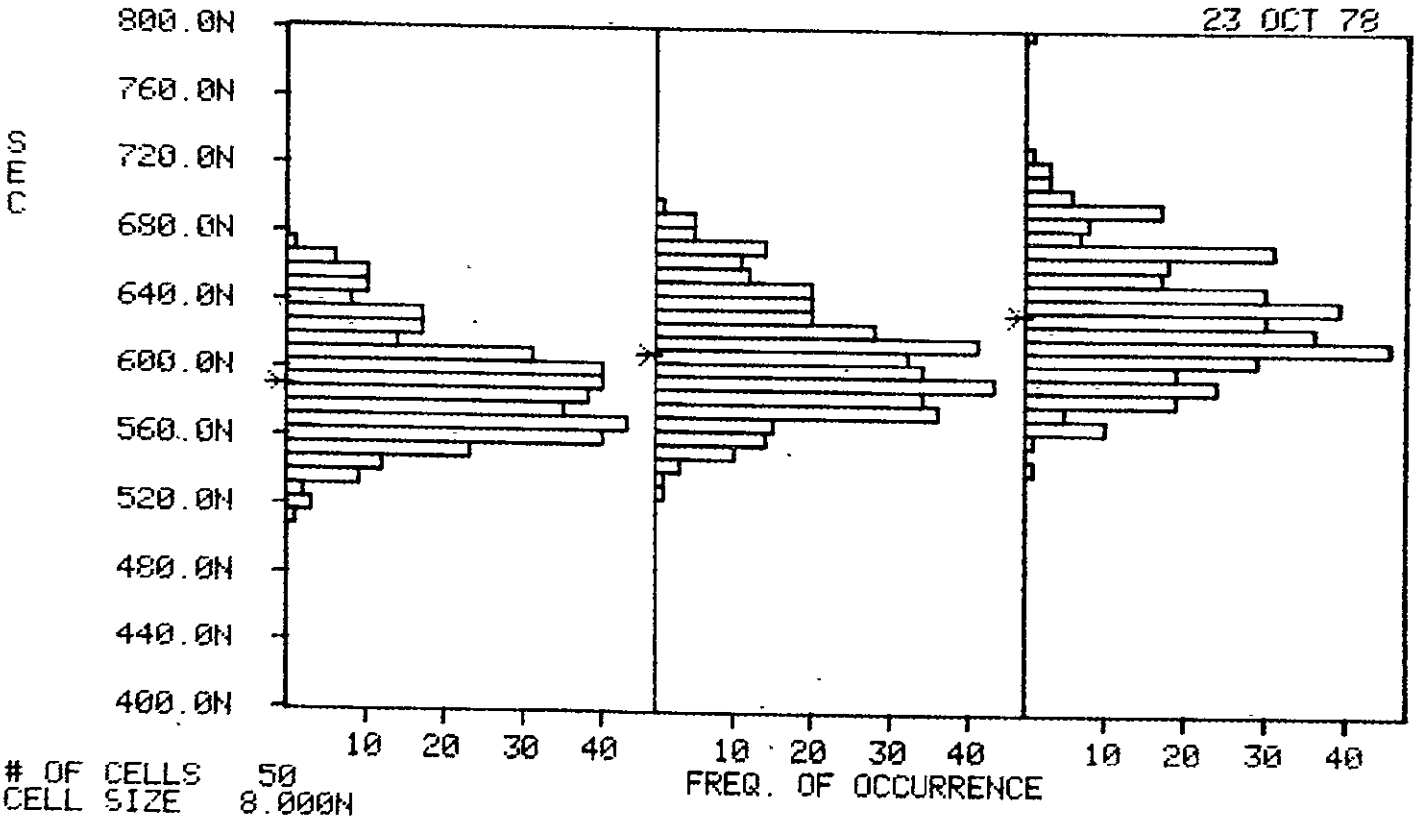
S-3260 DATA FOR TEB03B TEB0,1,2,3 AT 10V



DATA EDITED
OF CELLS 50
CELL SIZE 2.000N

READINGS:	400	400	394
MAXIMUM:	44.35N	59.05N	77.20N
MEAN:	31.63N	41.26N	55.21N
MINIMUM:	20.25N	26.00N	33.95N
STD.DEV.:	4.778N	6.610N	8.795N

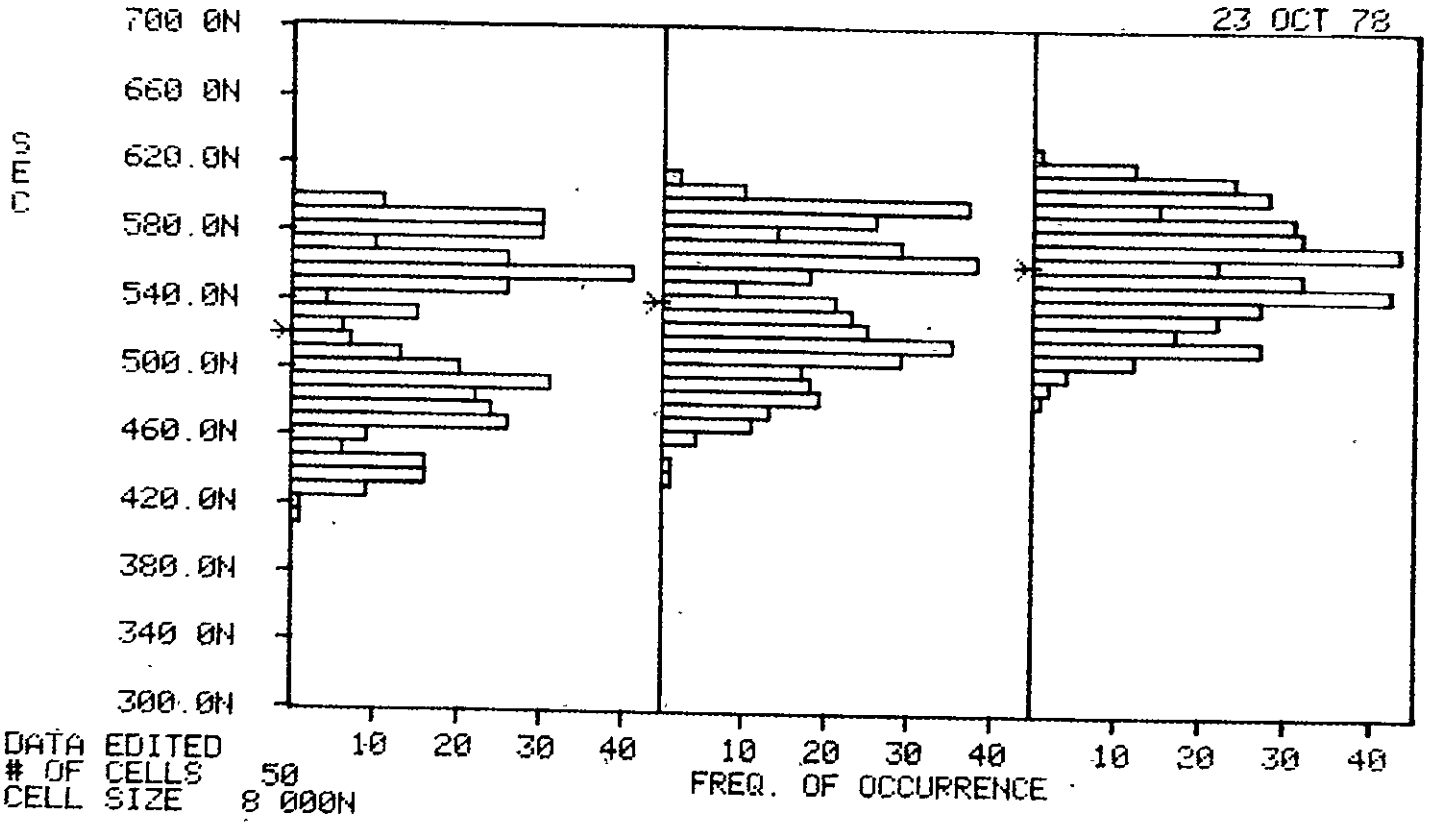
S-3260 DATA FOR TEB47A TEB4,5,6,7 AT 5V



OF CELLS 50
CELL SIZE 8.000N

READINGS:	400	400	400
MAXIMUM:	672.0N	699.5N	796.5N
MEAN:	588.8N	609.0N	633.8N
MINIMUM:	512.0N	527.0N	544.0N
STD.DEV.:	31.23N	33.28N	35.48N

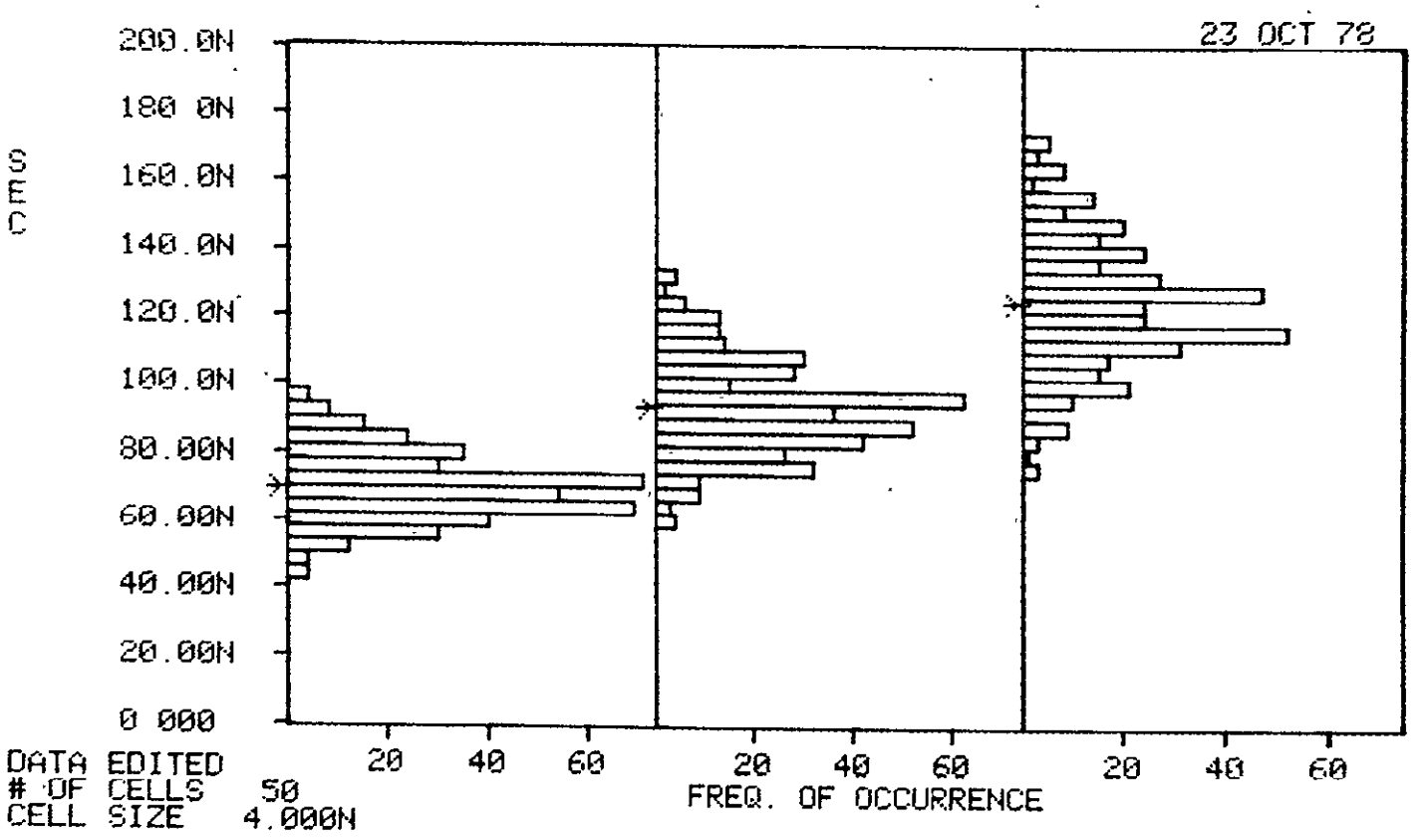
S-3260 DATA FOR TEB47B TEB4,5,6,7 AT 10V



DATA EDITED
OF CELLS 50
CELL SIZE 8 000N

READINGS:	400	400	394
MAXIMUM	597.5N	612.0N	624.0N
MEAN:	518.8N	539.1N	562.8N
MINIMUM	413.5N	435.0N	487.0N
STD.DEV	50.21N	40.34N	31.62N

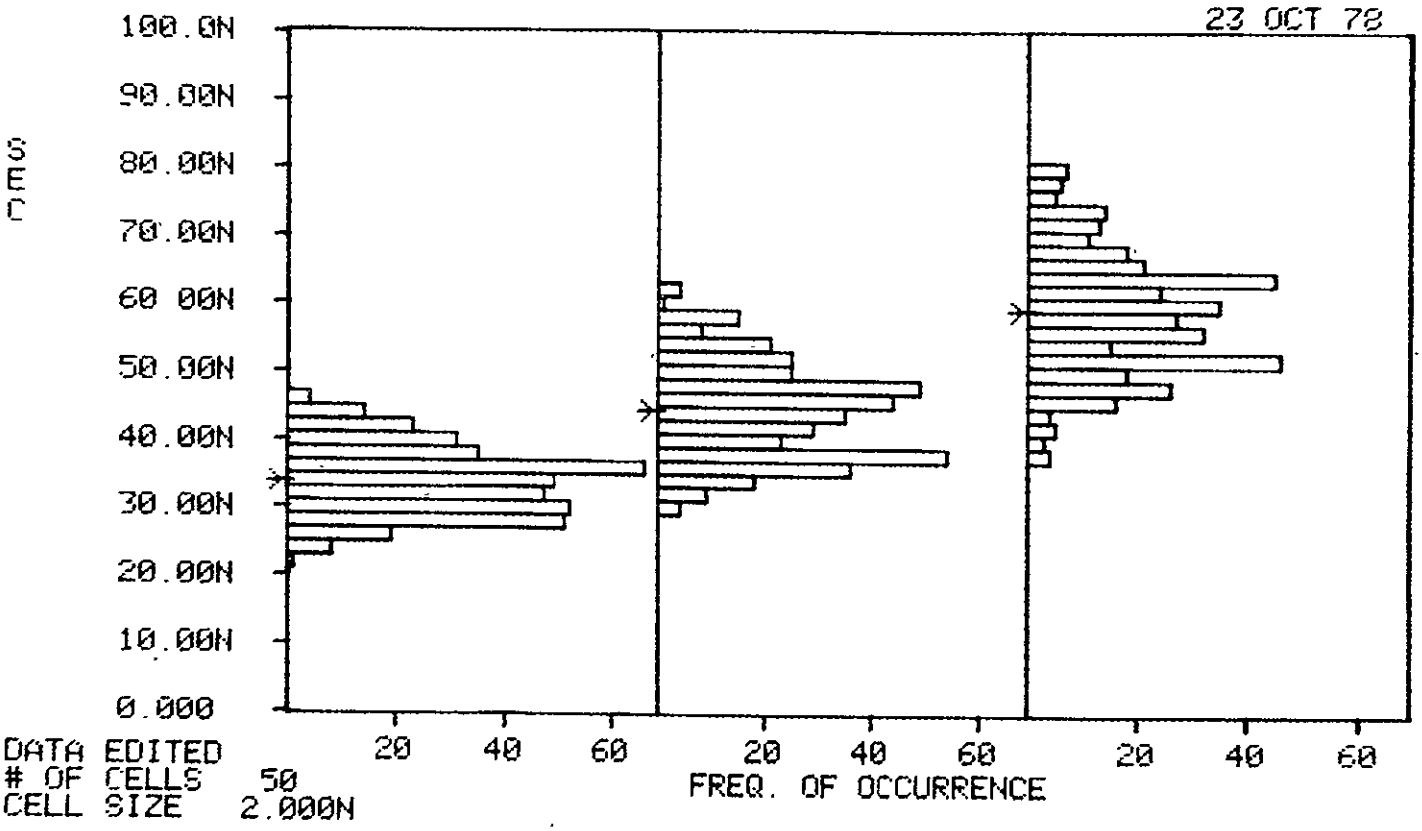
S-3260 DATA FOR TED03A TED0,1,2,3 AT 5V



DATA EDITED
OF CELLS 50
CELL SIZE 4.000N

READINGS:	400	400	398
MAXIMUM:	95.80N	131.0N	170.5N
MEAN:	69.43N	93.31N	124.6N
MINIMUM:	43.45N	58.10N	76.55N
STD.DEV.:	10.16N	14.27N	18.98N

S-3260 DATA FOR TED03B TED0,1,2,3 AT 10V



DATA EDITED
OF CELLS 50
CELL SIZE 2.000N

READINGS:	400	400	395
MAXIMUM:	46.25N	61.75N	80.30N
MEAN:	33.85N	44.31N	59.01N
MINIMUM:	22.70N	29.00N	37.60N
STD.DEV..	5.062N	7.029N	9.076N

S-3260 DATA FOR TED45A

TED4/TED6 AT 5V

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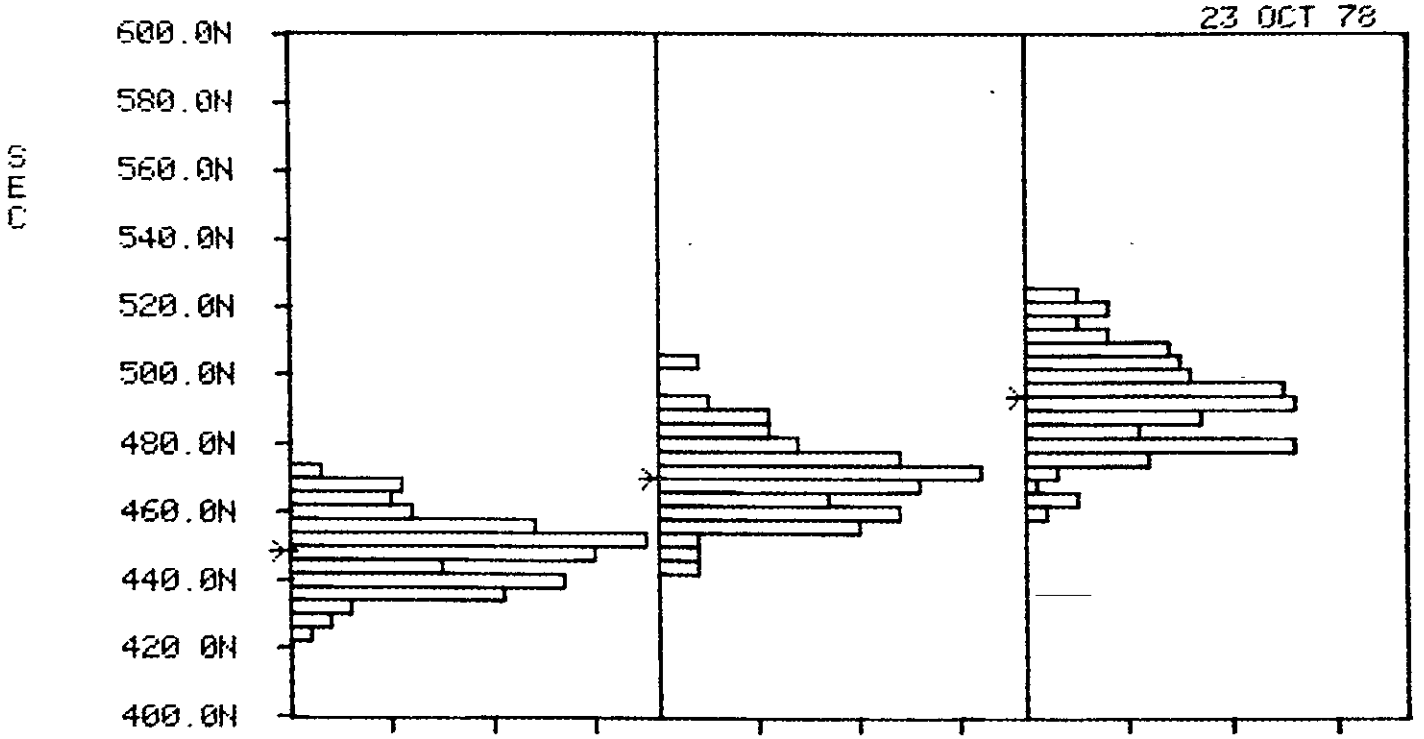
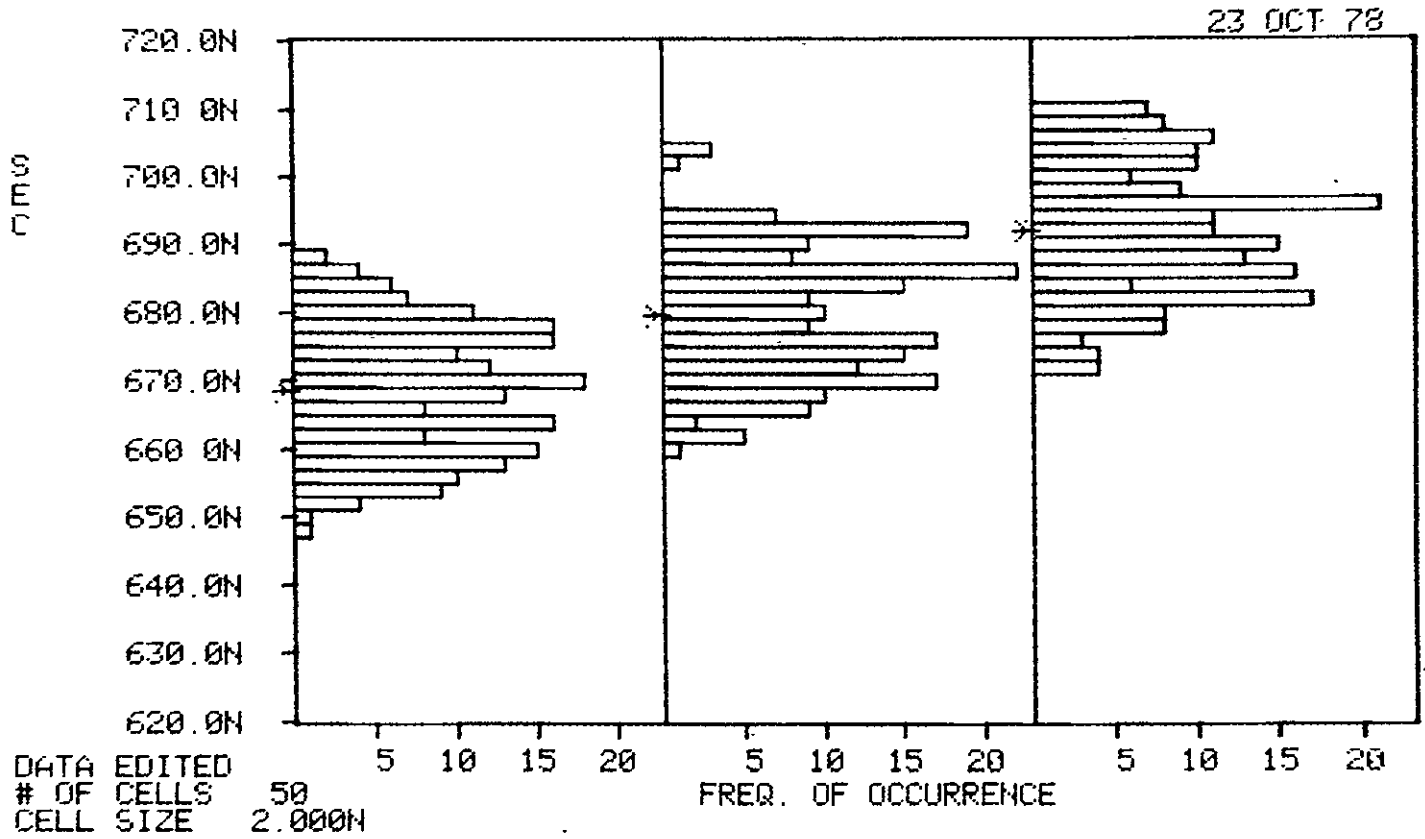


DATA EDITED
OF CELLS 50
CELL SIZE 4 000N

READINGS:	200	200	199
MAXIMUM:	472.0N	504.0N	525.0N
MEAN:	448.5N	469.8N	493.5N
MINIMUM:	422.5N	443.0N	461.0N
STD.DEV.:	10.34N	11.80N	13.96N

S-3260 DATA FOR TED46B

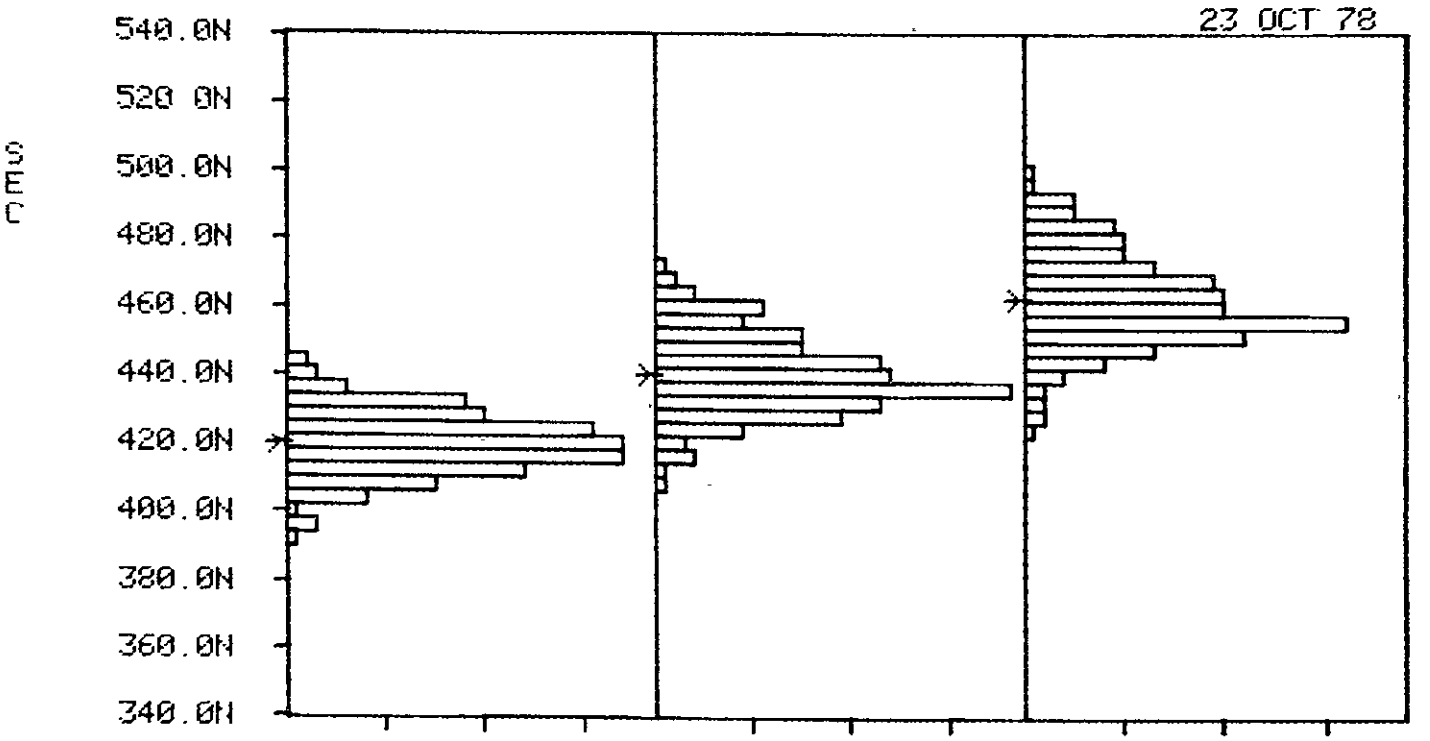
TED4/TED6 AT 10V



DATA EDITED
OF CELLS 50
CELL SIZE 2.000N

READINGS:	200	200	198
MAXIMUM:	688.5N	704.0N	710.5N
MEAN:	668.5N	679.4N	691.9N
MINIMUM:	648.0N	660.5N	671.5N
STD.DEV.	9.355N	9.417N	9.876N

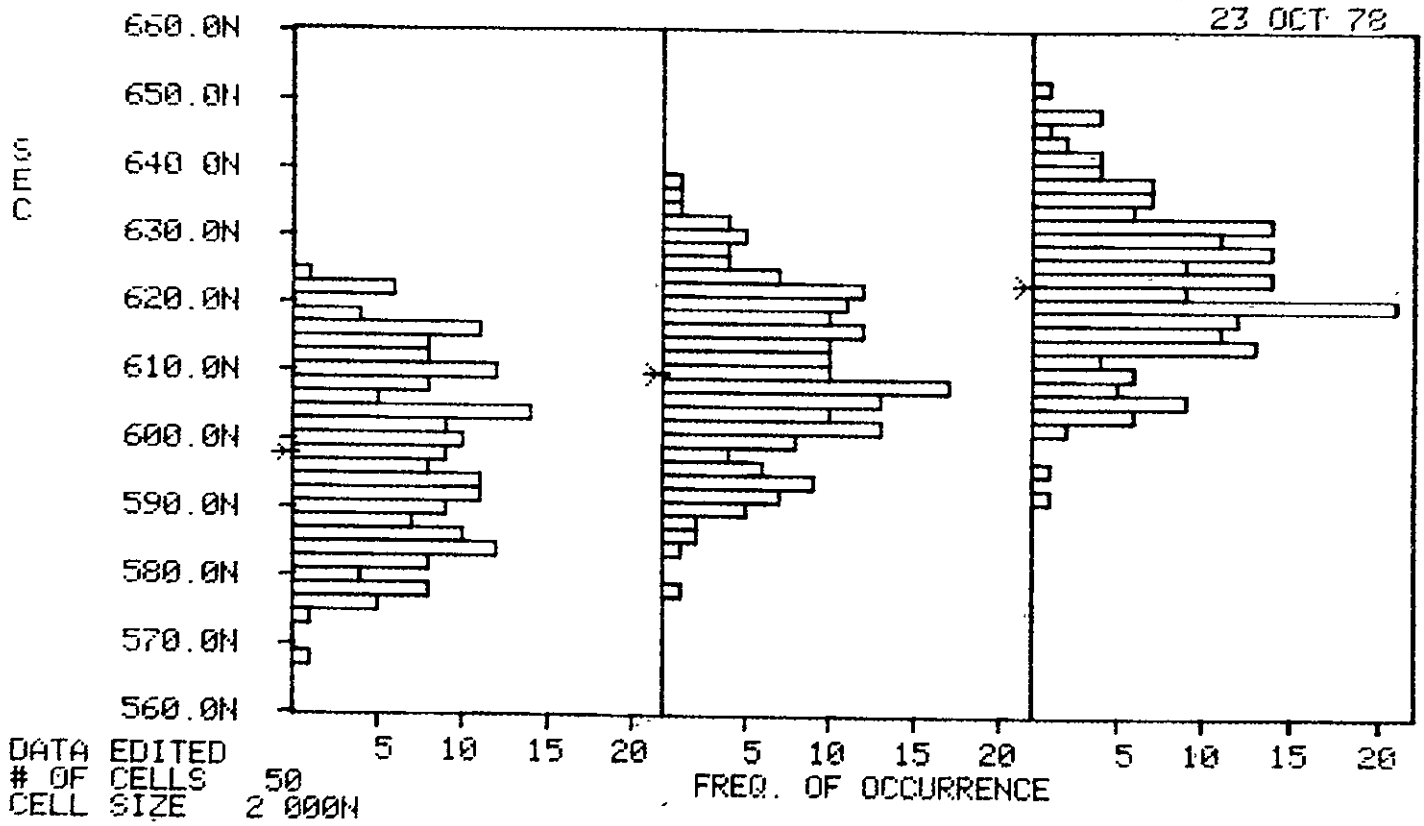
S-3260 DATA FOR TED57A TED5/TED7 AT 5U



DATA EDITED
OF CELLS 50
CELL SIZE 4.000N

READINGS:	200	200	199
MAXIMUM:	443.5N	472.0N	500.5N
MEAN:	419.5N	439.8N	462.2N
MINIMUM:	390.0N	407.0N	423.5N
STD DEV.:	9.348N	11.65N	14.11N

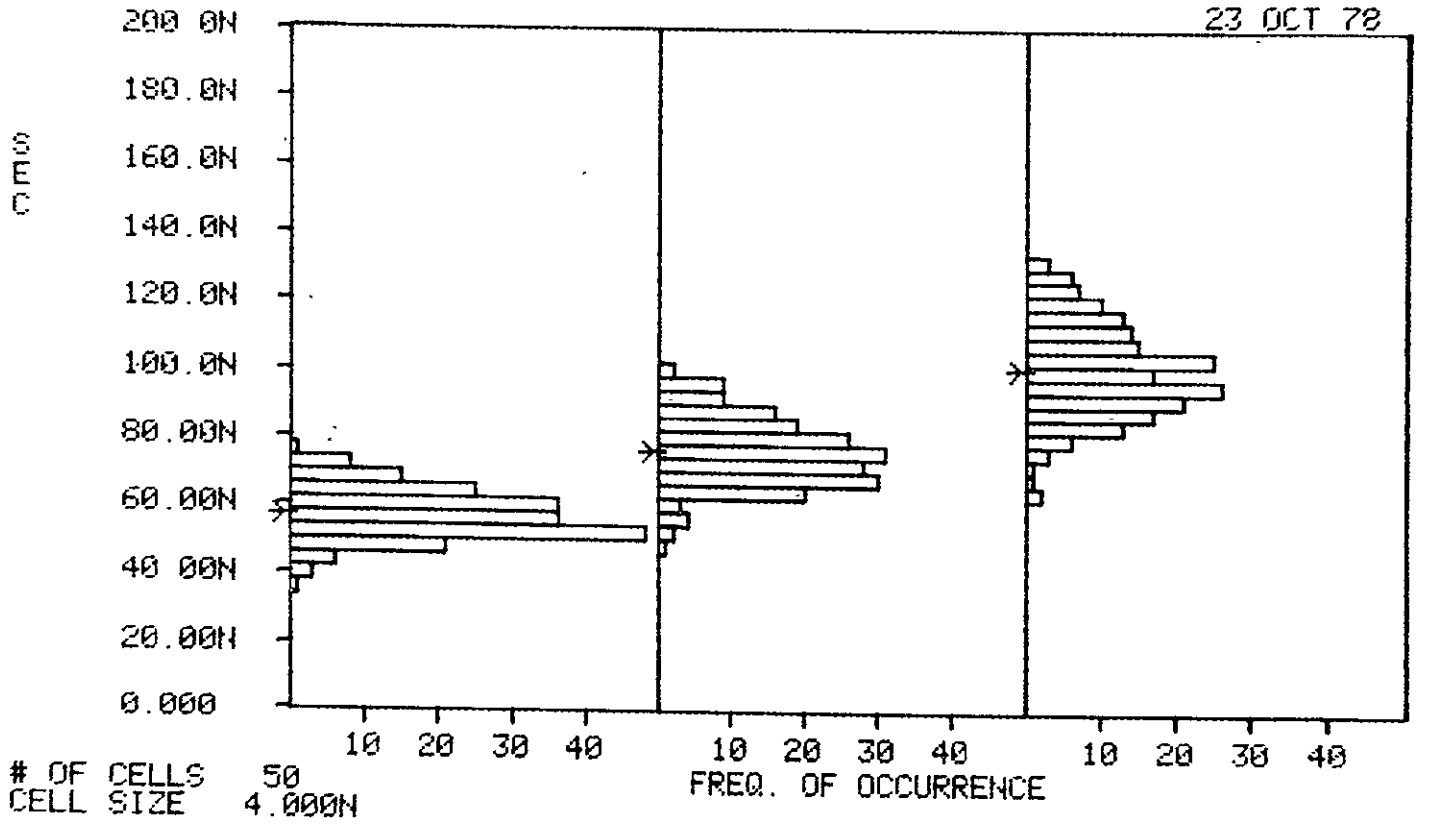
S-3260 DATA FOR TED57B TED5, TED7 AT 10V



DATA EDITED
OF CELLS 50
CELL SIZE 2.000N

READINGS:	200	200	198
MAXIMUM:	624.0N	637.5N	652.5N
MEAN:	597.9N	609.6N	622.8N
MINIMUM:	568.5N	578.0N	591.0N
STD.DEV:	12.76N	11.89N	11.14N

S-3260 DATA FOR TIB01A TIB0/TIB1 AT 5V

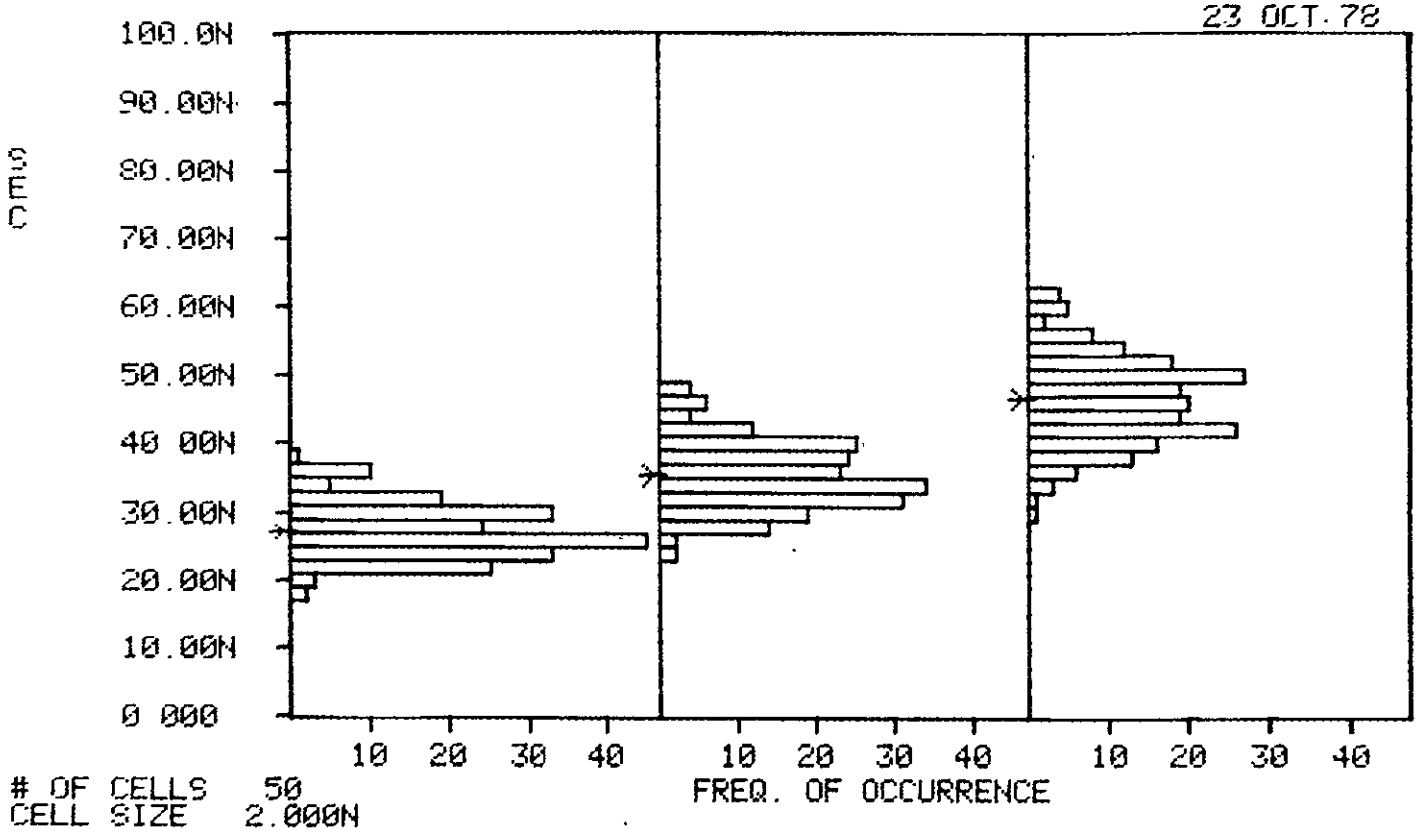


OF CELLS 50
CELL SIZE 4.000N

READINGS:	200	200	200
MAXIMUM:	74.45N	99.80N	131.5N
MEAN:	56.80N	76.19N	101.0N
MINIMUM:	36.85N	49.80N	65.25N
STD.DEV	7.272N	10.10N	13.75N

S-3260 DATA FOR TIB01B

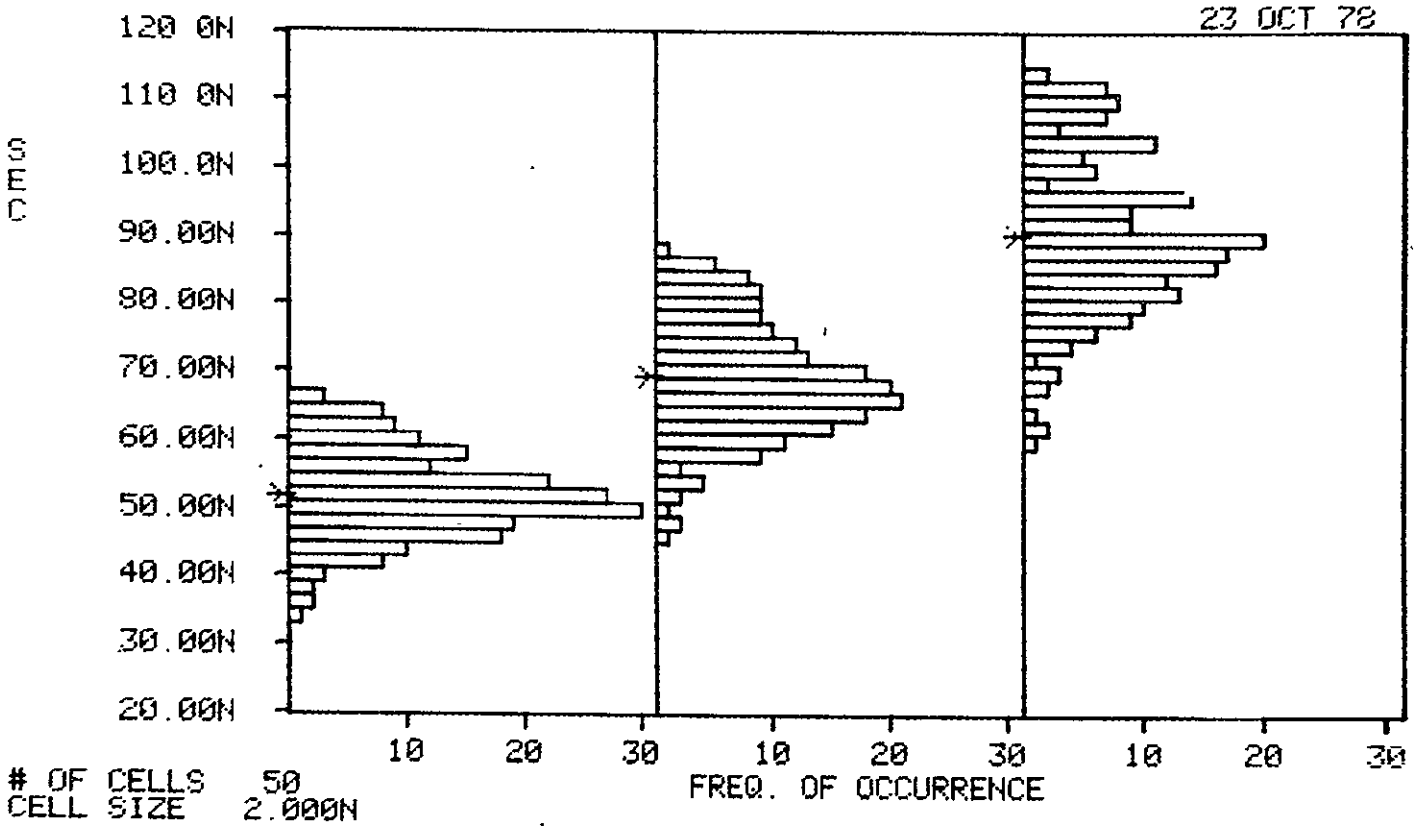
TIB0/TIB1 AT 10V



OF CELLS 50
CELL SIZE 2.000N

READINGS:	200	200	200
MAXIMUM:	37.25N	48.60N	61.80N
MEAN:	27.20N	35.44N	46.53N
MINIMUM:	18.15N	23.40N	30.65N
STD.DEV :	4.019N	5.067N	6.416N

S-3260 DATA FOR TB001A TB00/TB01 AT 5V

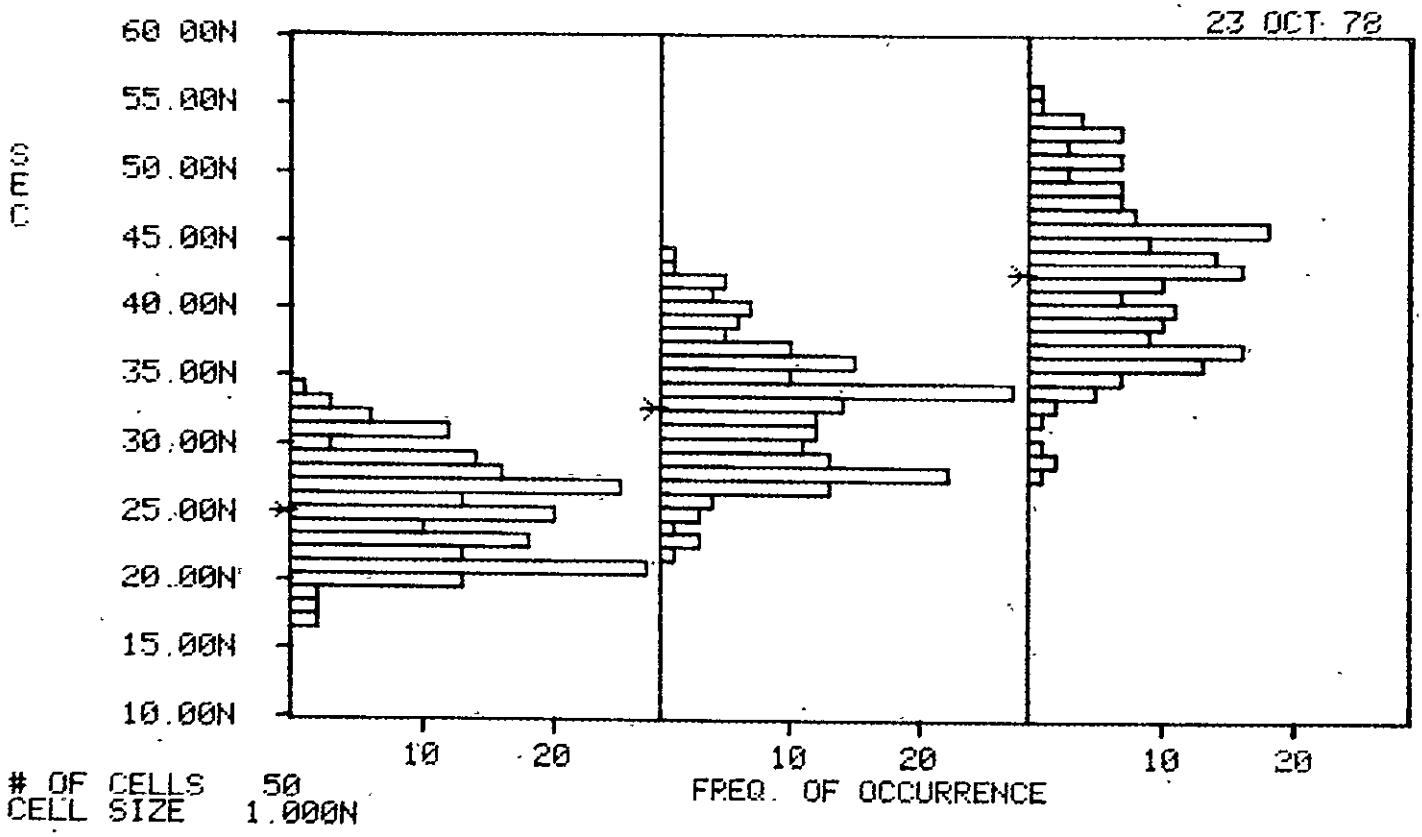


OF CELLS 50
CELL SIZE 2.000N

READINGS:	200	200	200
MAXIMUM:	66.55N	88.55N	113.5N
MEAN:	51.86N	69.14N	90.42N
MINIMUM:	33.85N	45.50N	59.90N
STD.DEV.:	6.462N	8.663N	11.51N

S-3260 DATA FOR TB001B

TB00/TB01 AT 10V



OF CELLS 50
CELL SIZE 1.000N

READINGS:	200	200	200
MAXIMUM:	33.90N	44.05N	56.00N
MEAN:	25.12N	32.63N	42.60N
MINIMUM:	16.65N	21.60N	28.25N
STD.DEV.:	3.744N	4.576N	5.791N

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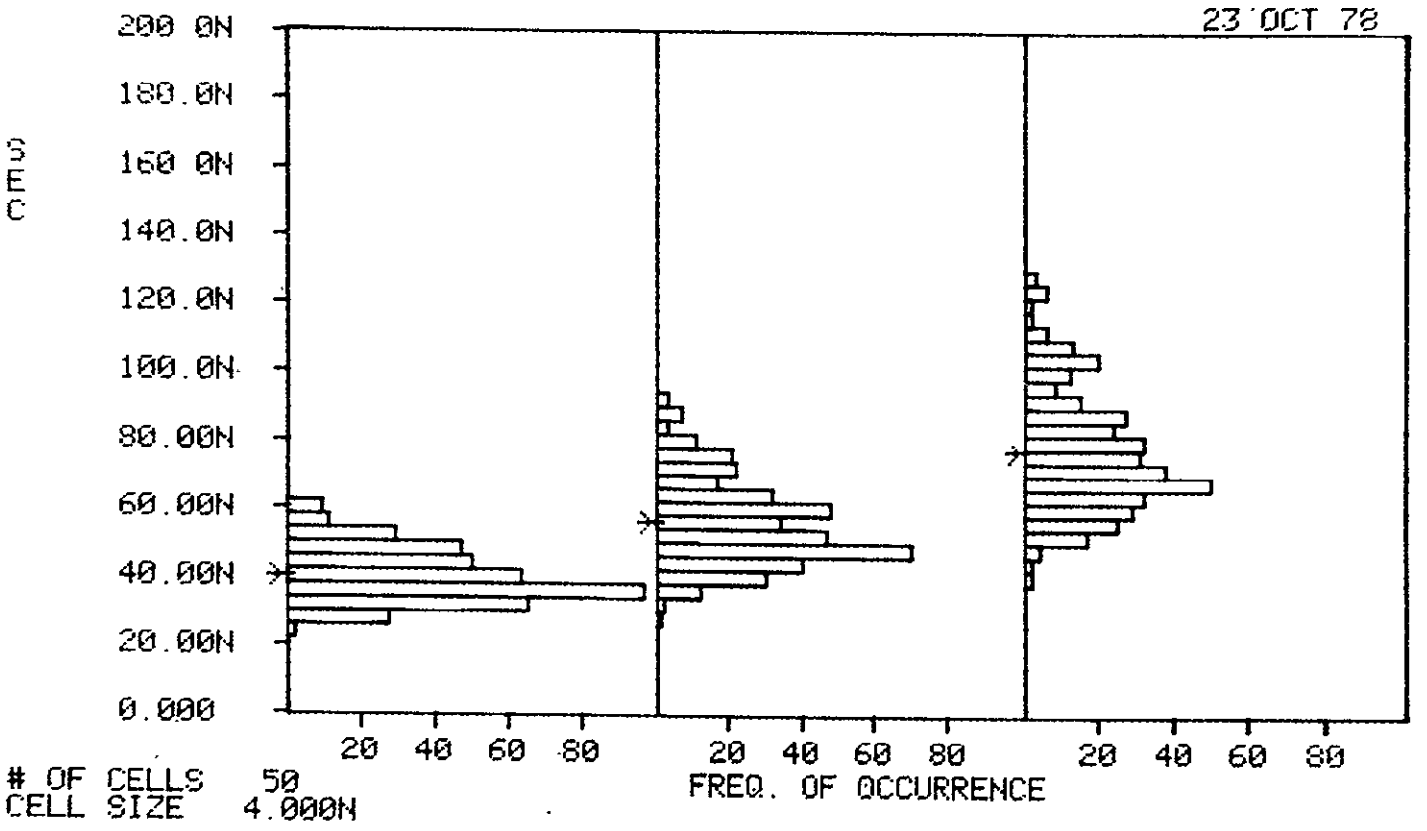
S-3260 DATA FOR TTA

TTLH/TTHL AT 50



OF CELLS 50
CELL SIZE 4.000N

READINGS:	400	400	400
MAXIMUM:	61.80N	93.40N	129.3N
MEAN:	40.04N	56.19N	77.51N
MINIMUM:	22.20N	29.65N	40.10N
STD.DEV	7.760N	12.66N	17.97N

S-3260 DATA FOR TTB

TTLH/TTHL AT 10V

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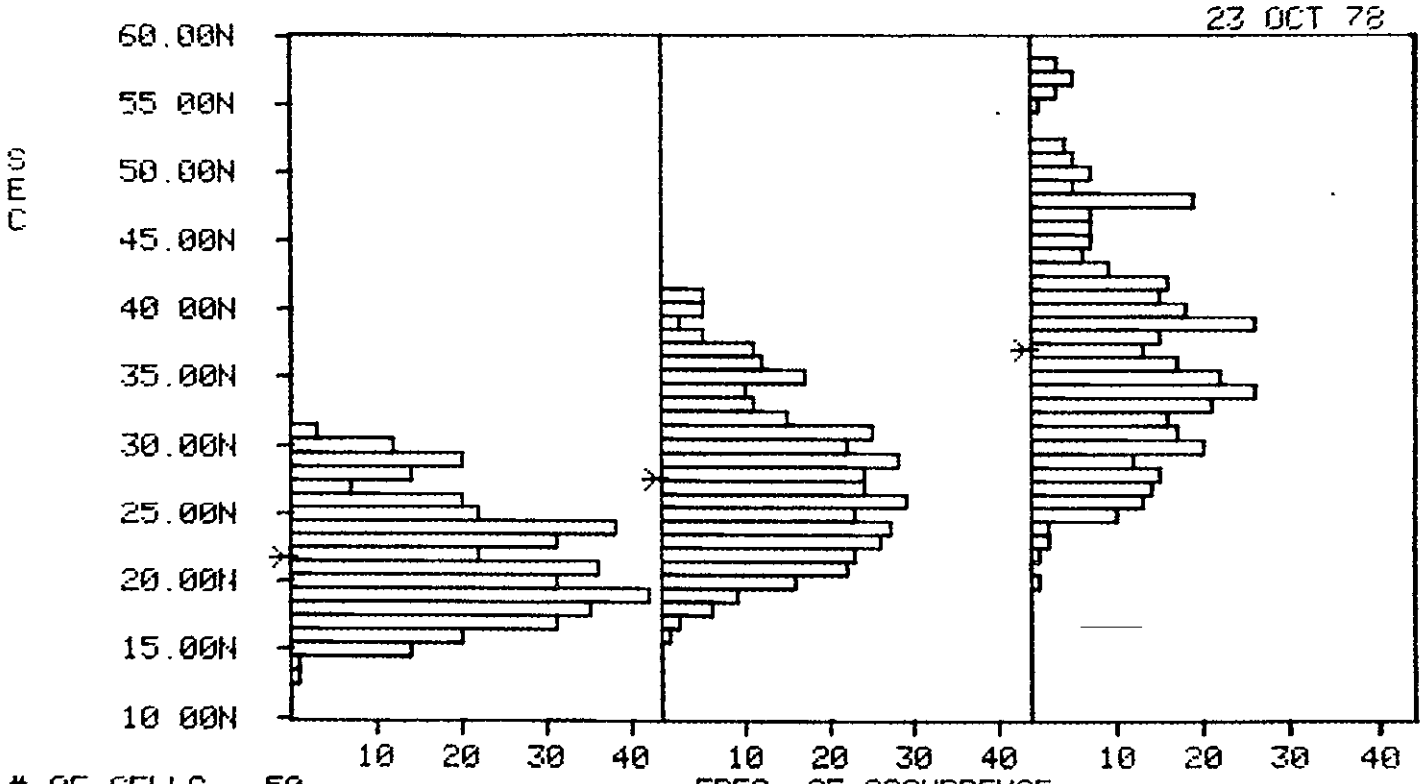
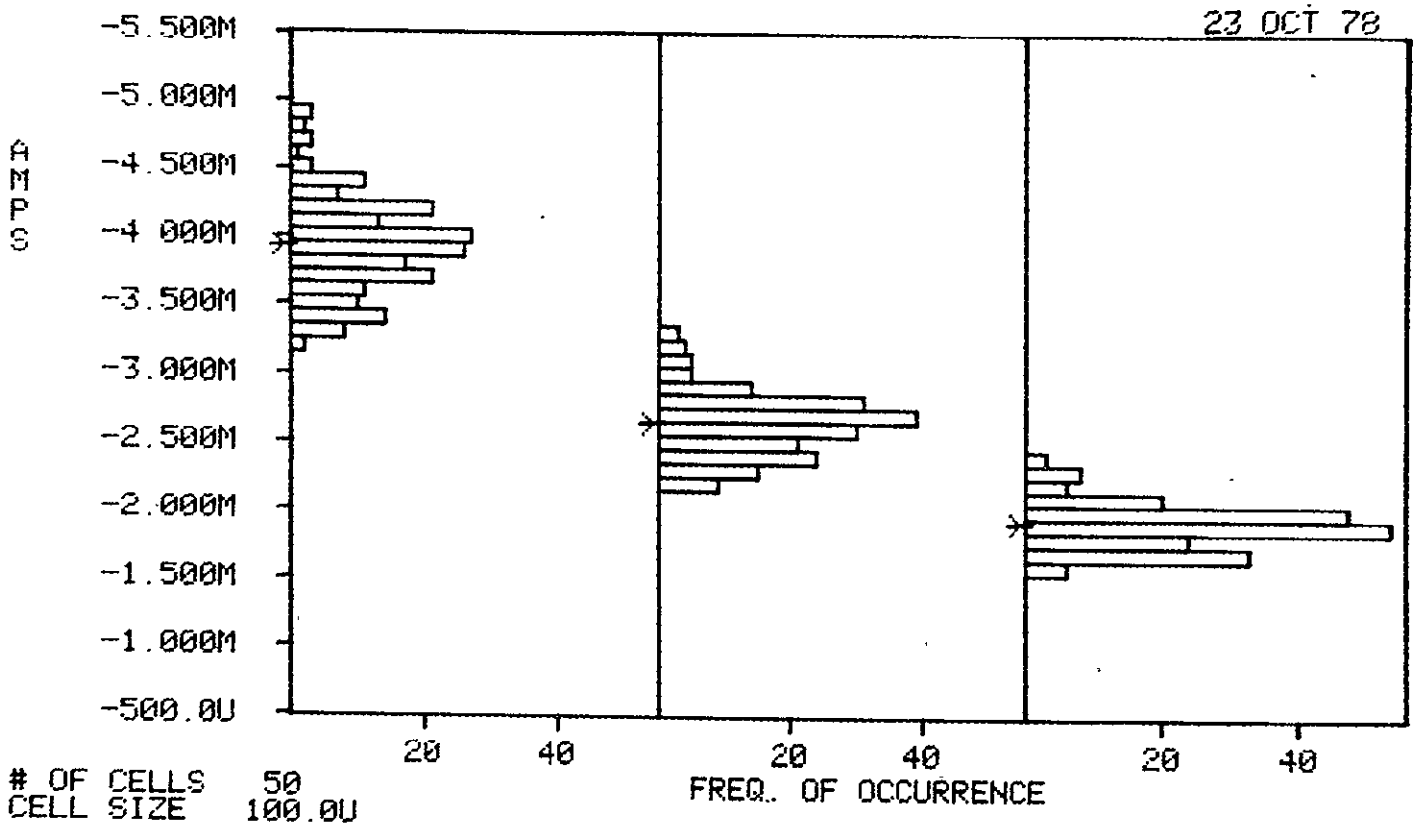


OF CELLS 50
CELL SIZE 1.000N

READINGS:	400	400	400
MAXIMUM:	30.85N	40.90N	57.90N
MEAN:	21.69N	27.60N	37.01N
MINIMUM:	13.20N	16.10N	20.45N
STD.DEV..	4.115N	5.465N	7.823N

S-3260 DATA FOR IOH1 IOH: VDD=5V VOH=4.6V

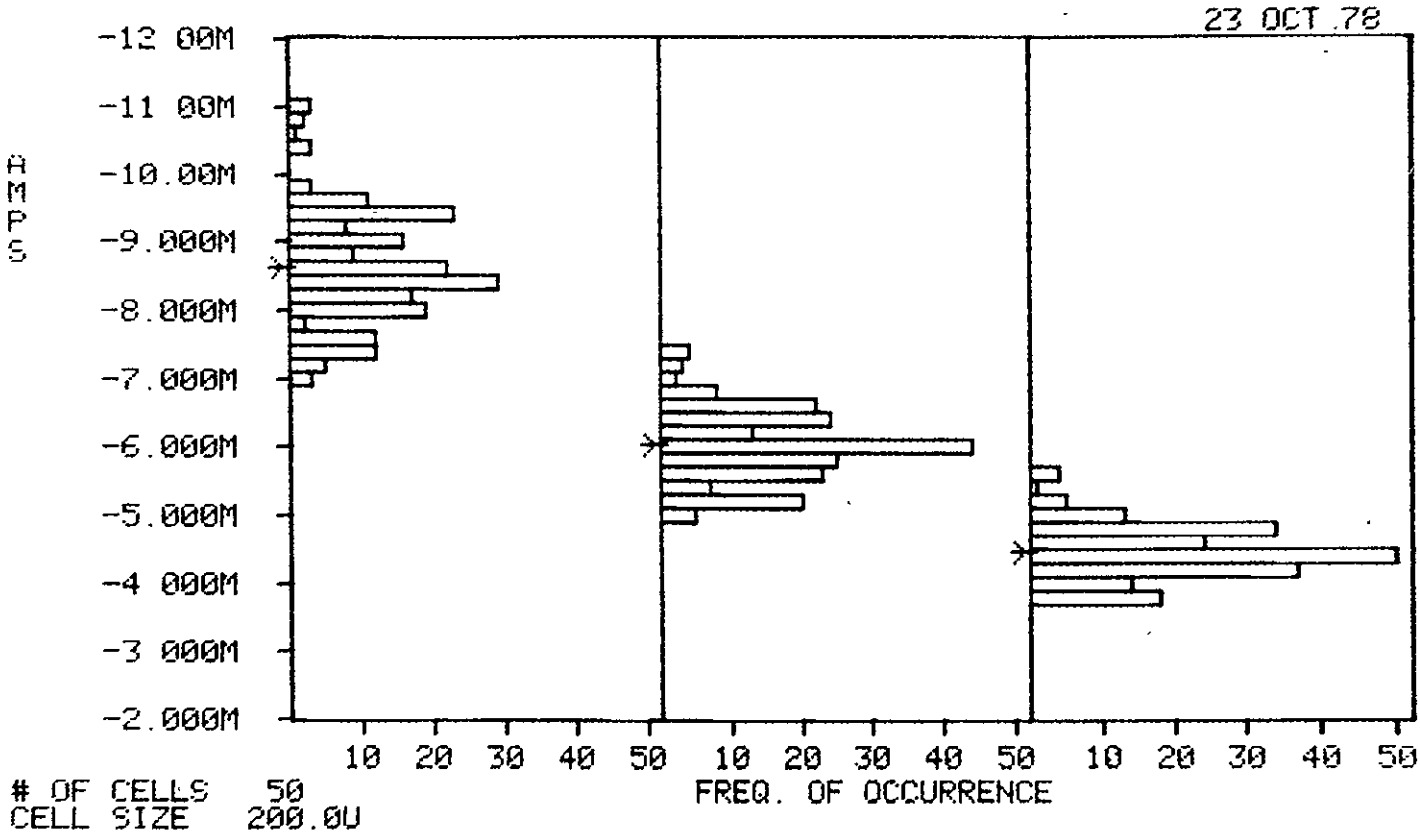


OF CELLS 50
CELL SIZE 100.0U

READINGS:	200	200	200
MAXIMUM:	-3.220M	-2.200M	-1.620M
MEAN:	-3.917M	-2.639M	-1.919M
MINIMUM:	-4.910M	-3.305M	-2.420M
STD DEV :	356.3U	237.2U	168.3U

S-3260 DATA FOR IOH3

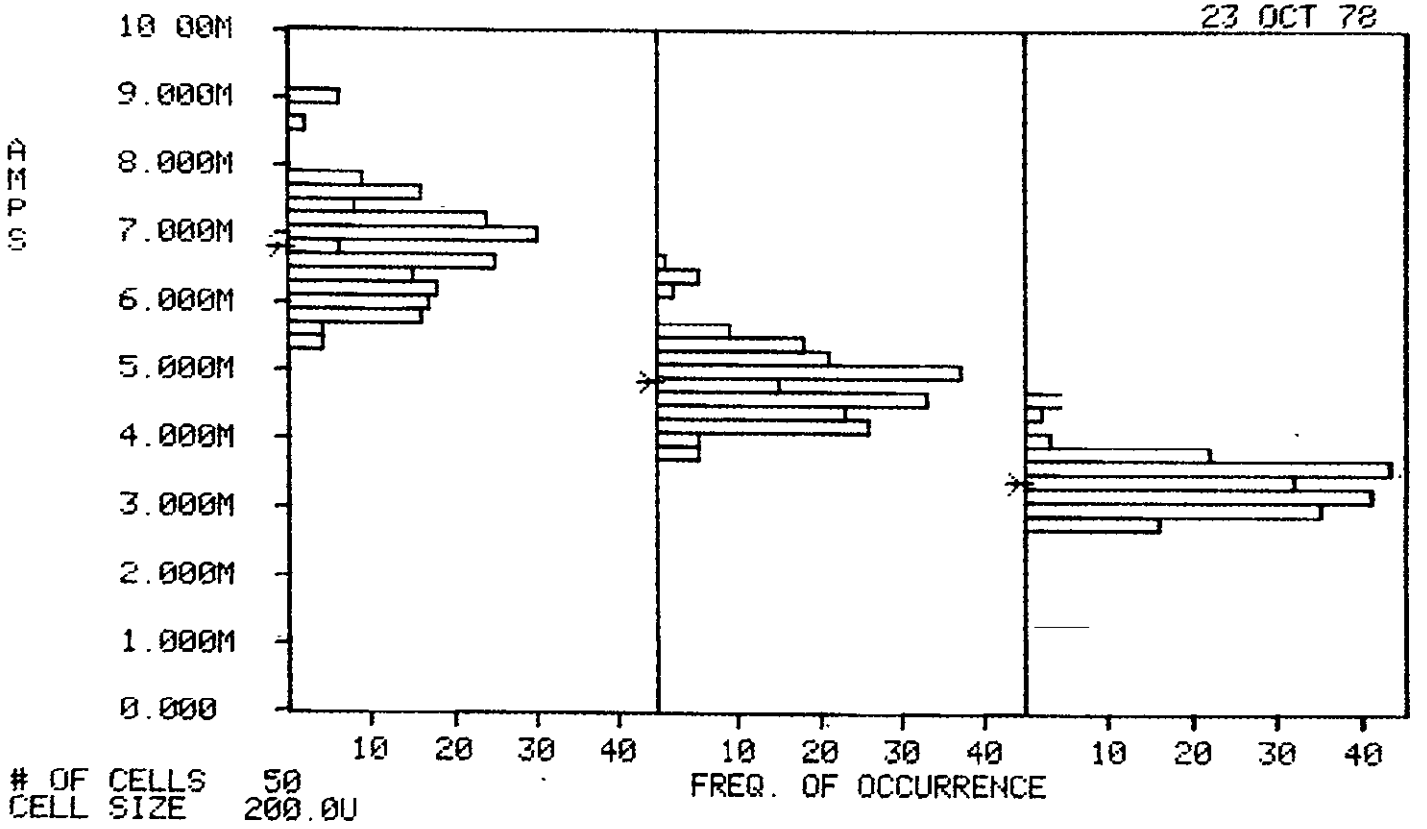
IOH: VDD=10V VOH=9.5V



OF CELLS 50
CELL SIZE 200.0U

READINGS:	200	200	200
MAXIMUM:	-7.050M	-5.000M	-3.745M
MEAN:	-8.601M	-6.021M	-4.460M
MINIMUM:	-11.05M	-7.480M	-5.560M
STD.DEV.:	822.8U	530.1U	379.7U

S-3260 DATA FOR IOL1 IOL: VDD=5V VOL=0.4V

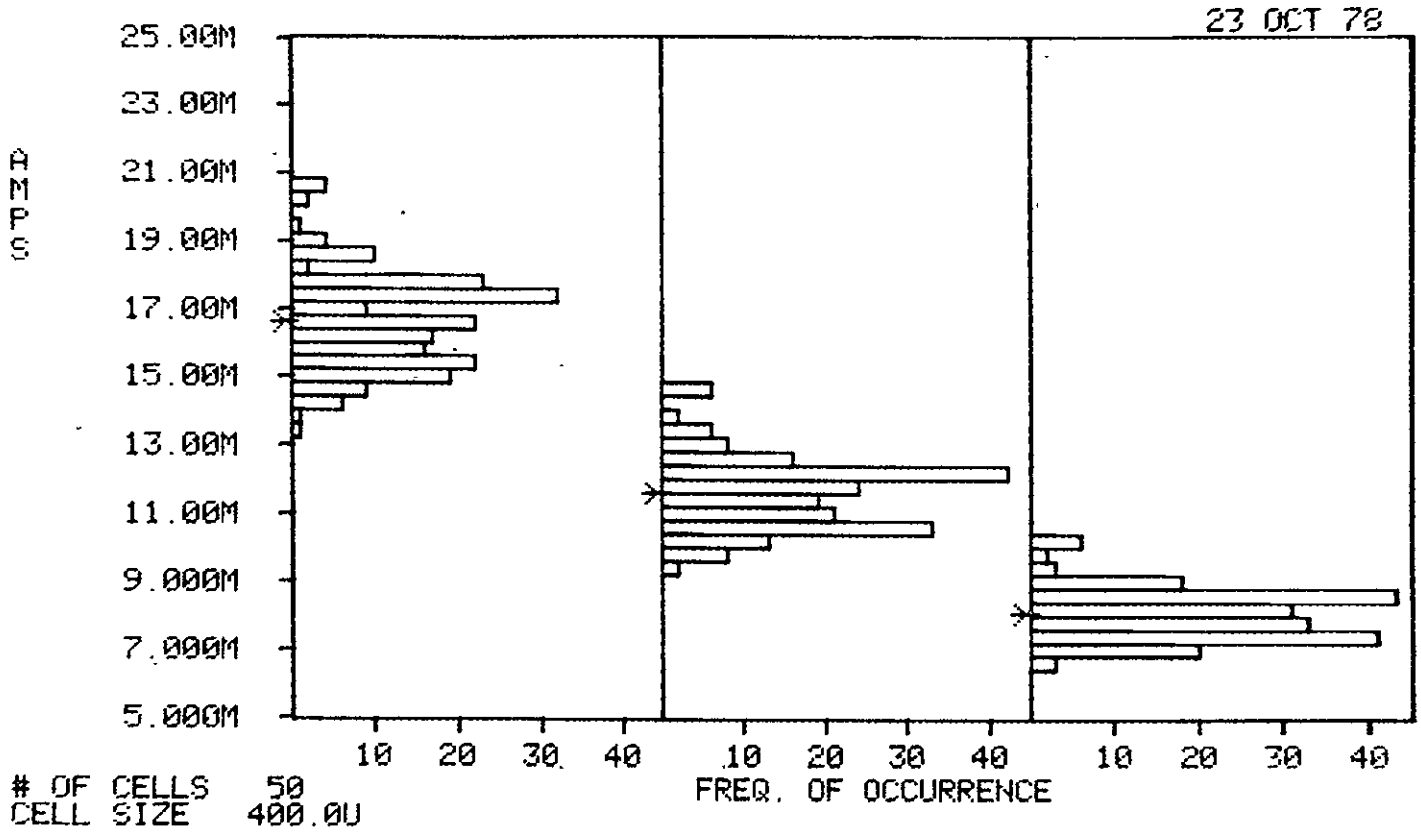


OF CELLS 50
CELL SIZE 200.0U

READINGS:	200	200	200
MAXIMUM:	9.090M	6.505M	4.600M
MEAN:	6.780M	4.831M	3.382M
MINIMUM:	5.310M	3.775M	2.710M
STD DEV.:	750.9U	543.7U	382.5U

S-3260 DATA FOR IOL3

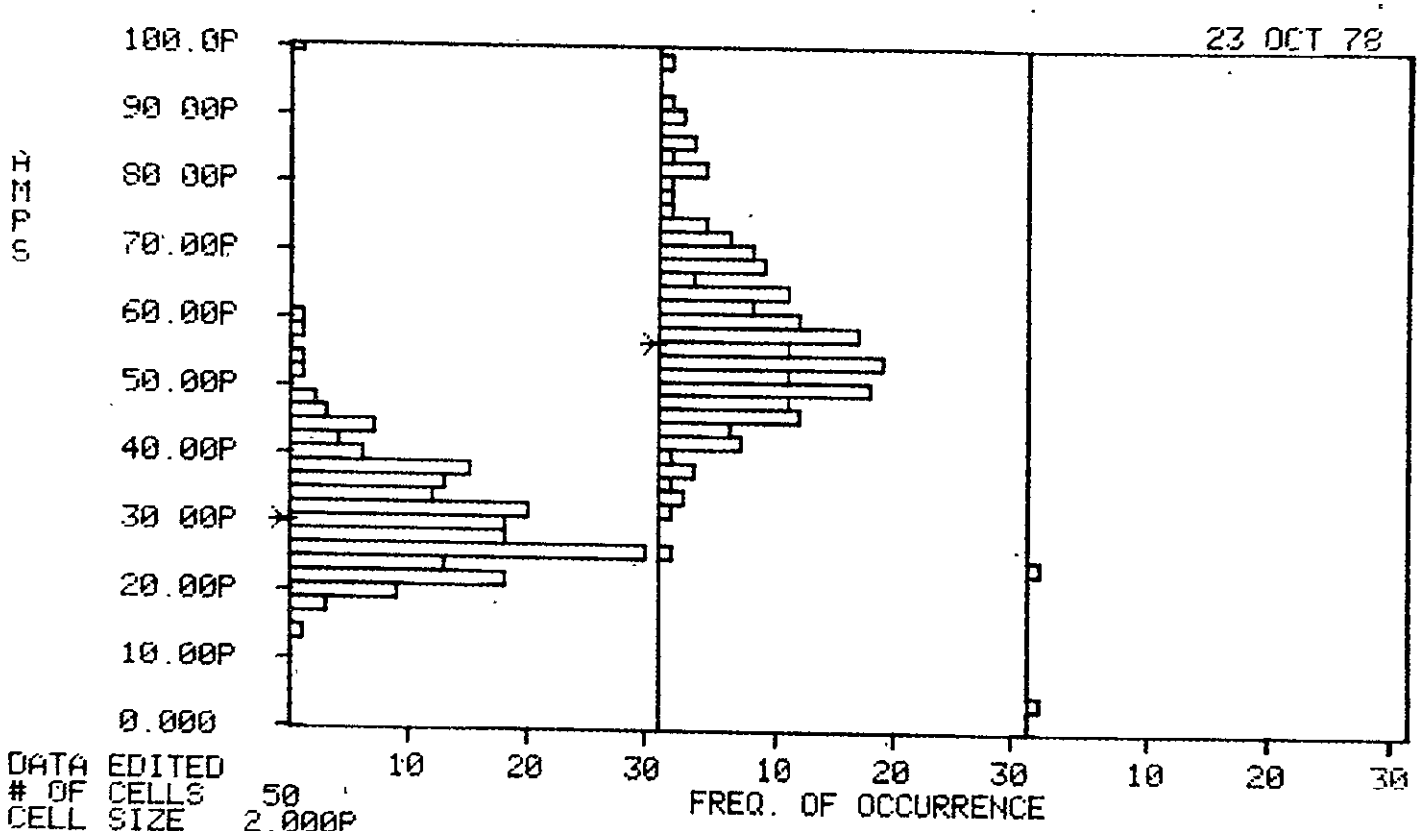
IOL: VDD=10V VOL=0.5V



OF CELLS 50
CELL SIZE 400.0U

READINGS:	200	200	200
MAXIMUM:	20.60M	14.65M	10.30M
MEAN:	16.62M	11.62M	8.074M
MINIMUM:	13.40M	9.410M	6.645M
STD.DEV :	1.435M	1.064M	759.6U

S-3260 DATA FOR IOZ1 IOZ1 VDD=15V VO=15V

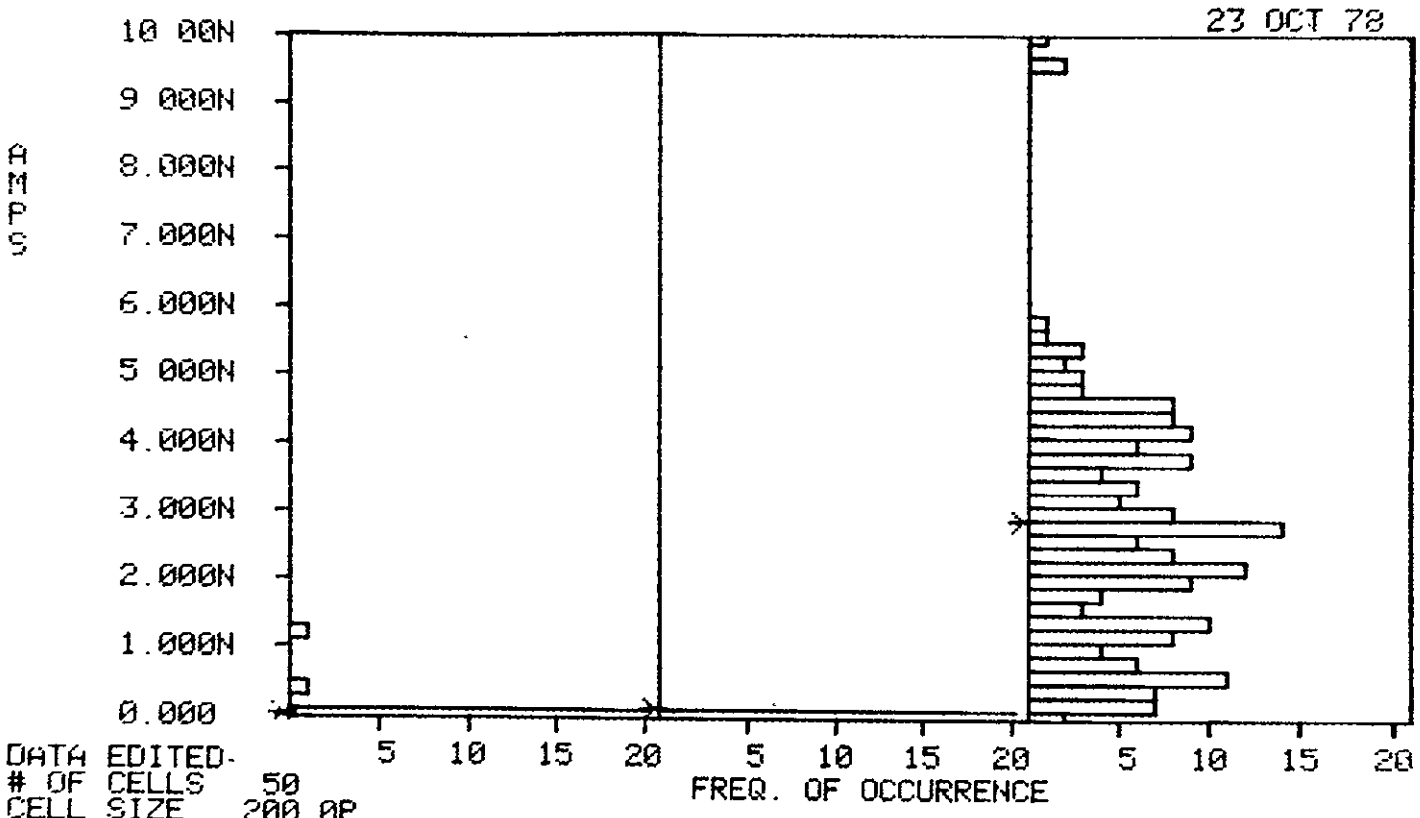


DATA EDITED
OF CELLS 50
CELL SIZE 2.000P
DATA OUTSIDE= '+'

READINGS	197	197	7
MAXIMUM:	98.06P	96.00P	186.7P
MEAN:	30.18P	56.58P	123.9P
MINIMUM:	13.27P	25.87P	3.333P
STD.DEV.:	9.218P	12.15P	77.49P

S-3260 DATA FOR IOZ1

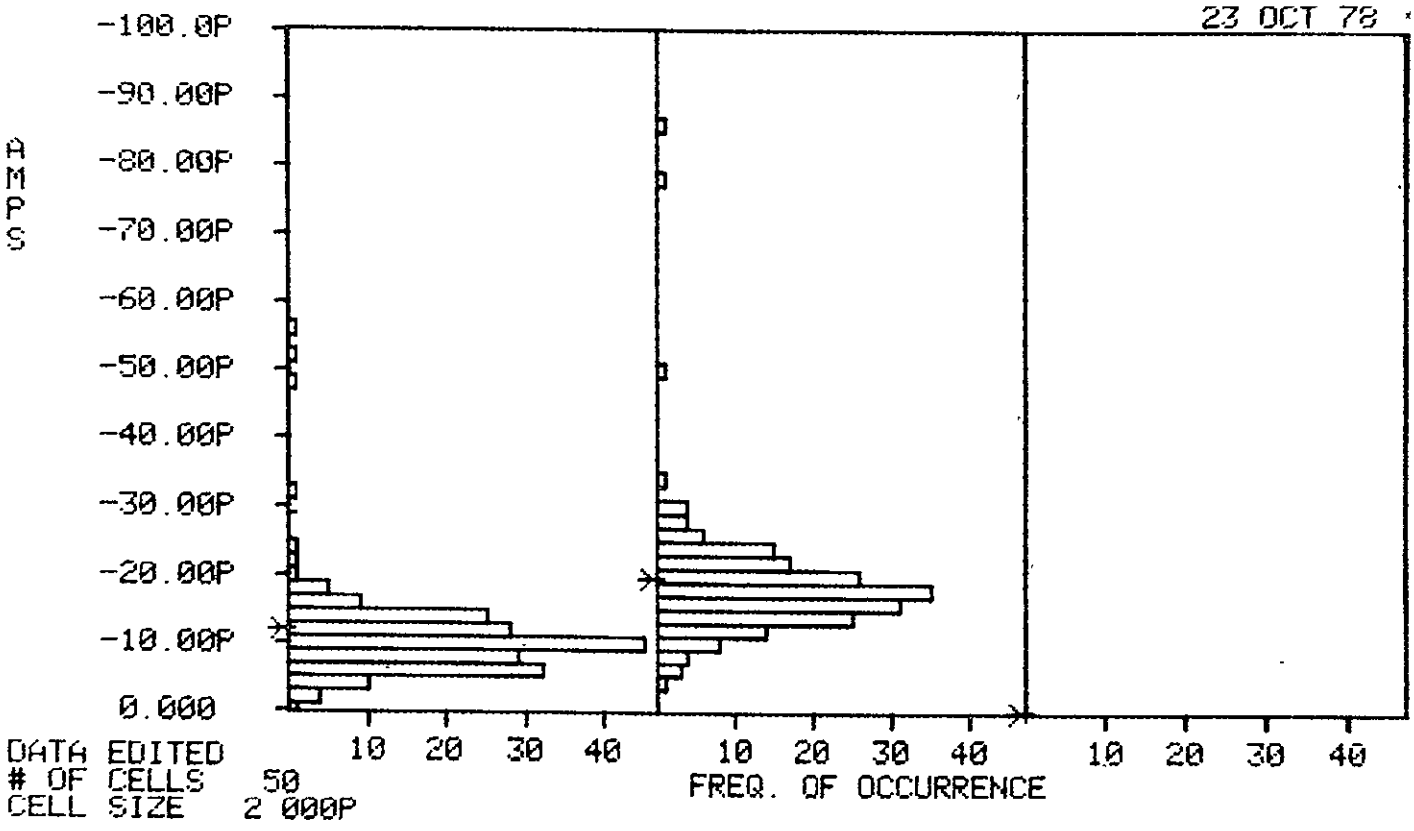
IOZ1: VDD=15V VO=15V



DATA EDITED-
OF CELLS 50
CELL SIZE 200.0P
DATA OUTSIDE= '+'

READINGS:	199	198	194
MAXIMUM	1.241N	10.96N	11.48N
MEAN	37.72P	111.6P	2.872N
MINIMUM	13.27P	25.87P	3.333P
STD.DEV.	88.63P	774.7P	2.060N

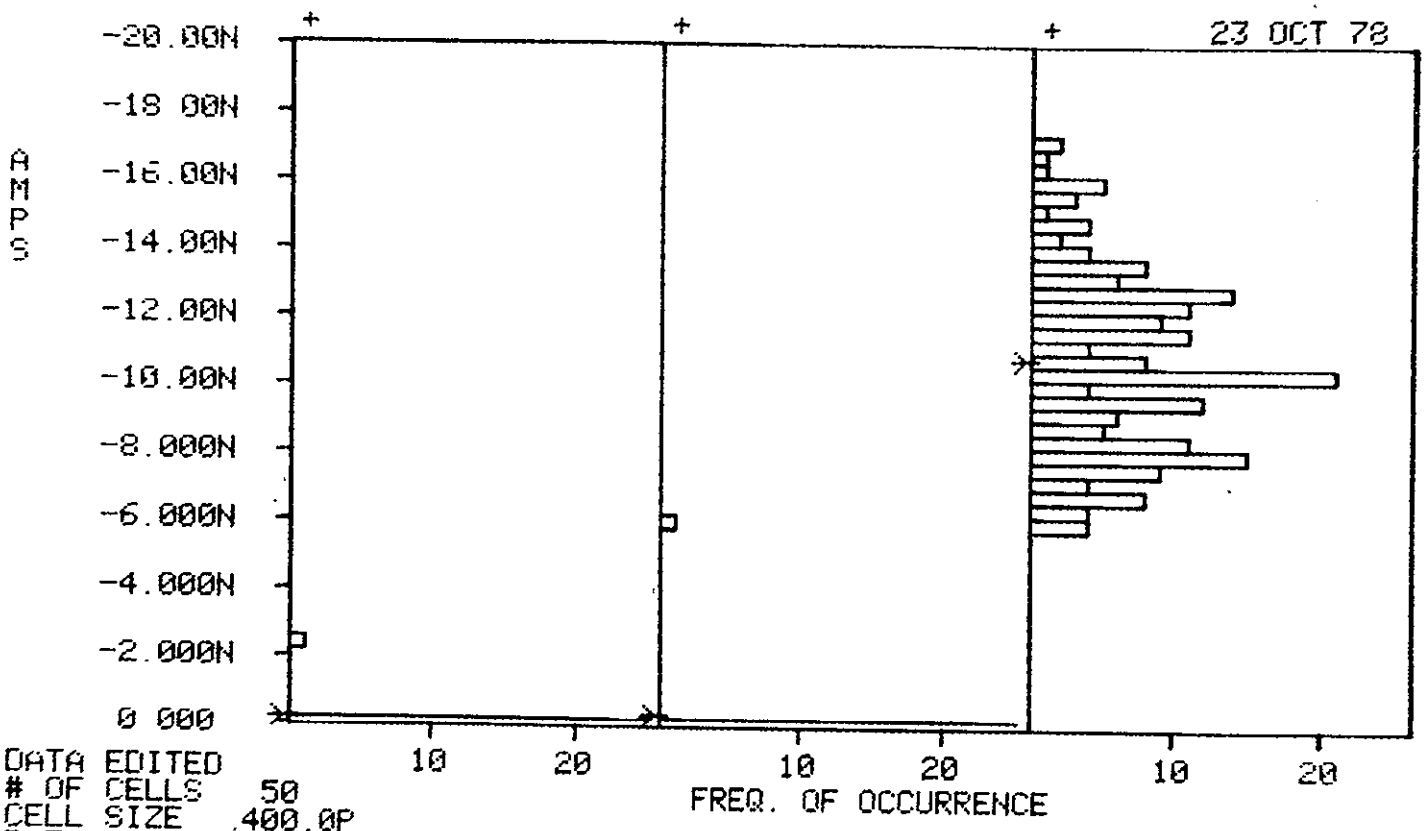
S-3260 DATA FOR IOZ2 IOZ2: VDD=15V VO=0V



DATA EDITED
OF CELLS 50
CELL SIZE 2 000P

READINGS:	197	197	0
MAXIMUM:	-333.3E-15	-4.867P	0.000
MEAN:	-11.92P	-19.65P	0.000
MINIMUM:	-56.84P	-86.38P	0.000
STD.DEV.:	6.867P	8.507P	-----

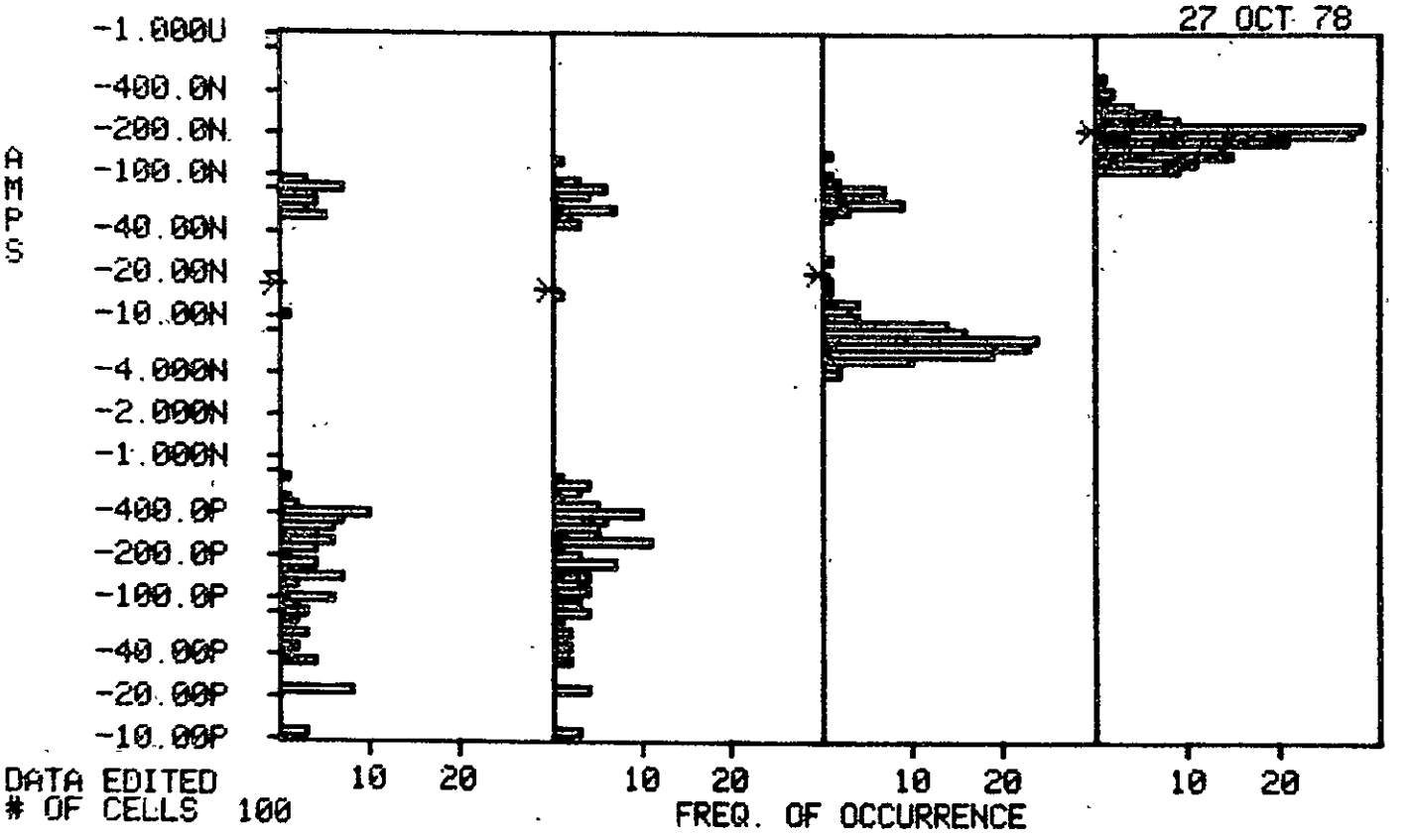
S-3260 DATA FOR IO22 IO22: VDD=15V VO=0V



DATA EDITED
OF CELLS 50
CELL SIZE .400.0P
DATA OUTSIDE= '+'

READINGS:	199	199	198
MAXIMUM	-333.3E-15	-4.867P	-5.893N
MEAN:	-219.3P	-304.4P	-10.80N
MINIMUM	-38.87N	-50.81N	-28.81N
STD.DEV	2.759N	3.622N	2.944N

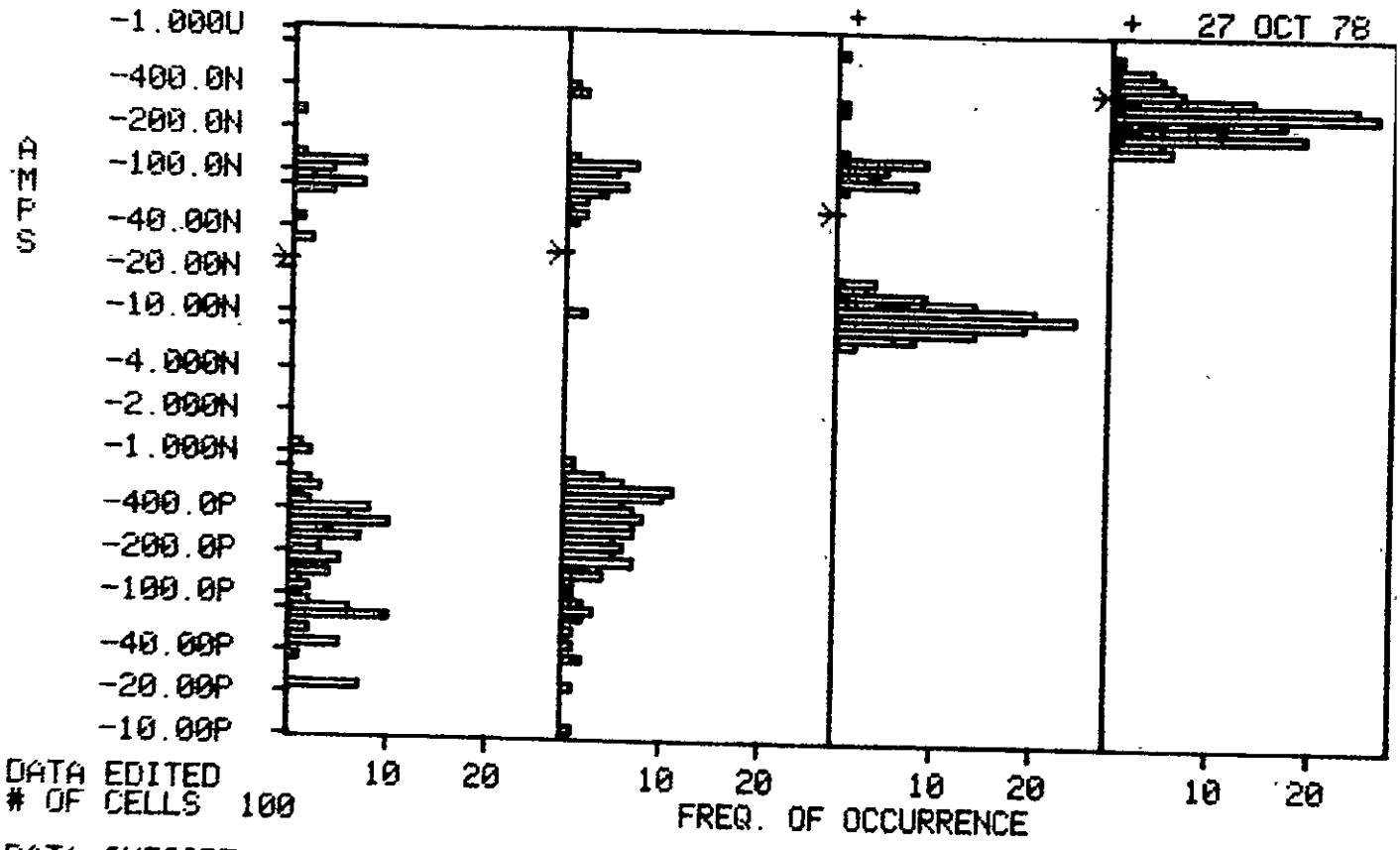
S-3260 DATA FOR ISS10 ISS AT 10V (-55,25,85,125 C)



DATA EDITED
OF CELLS 100

READINGS:	119	129	150	150
MAXIMUM:	0.000	0.000	-4.463N	-120.5N
MEAN:	-16.57N	-15.55N	-20.60N	-214.4N
MINIMUM:	-98.50N	-141.5N	-155.0N	-566.5N
STD DEV	21.63N	21.60N	28.59N	65.47N

S-3260 DATA FOR ISS15 ISS AT 15V (-55,25,85,125 C)



DATA EDITED
OF CELLS 100

DATA OUTSIDE= '+'

READINGS:	130	146	150	150
MAXIMUM:	0.000	-12.50P	-7.050N	-170.0N
MEAN:	-22.94N	-27.14N	-54.59N	-389.5N
MINIMUM:	-273.5N	-455.0N	-1.065U	-3.240U
STD DEV:	46.83N	68.93N	141.4N	395.6N