Lawrence Berkeley National Laboratory

Recent Work

Title

MILLIMICROSECOND DISCRIMINATOR

Permalink

https://escholarship.org/uc/item/9mf0g1bm

Authors

Swift, David F.
Perez-Mendez, Victor.

Publication Date

1959-06-24

eScholarship.org Powered by the California Digital Library
University of California

Loan cy

UCRL 8569 (Rev)

UNIVERSITY OF CALIFORNIA

Ernest O. Lawrence Radiation Laboratory

TWO-WEEK LOAN COPY

This is a Library Circulating Copy which may be borrowed for two weeks. For a personal retention copy, call Tech. Info. Division, Ext. 5545

BERKELEY, CALIFORNIA

DISCLAIMER

This document was prepared as an account of work sponsored by the United States Government. While this document is believed to contain correct information, neither the United States Government nor any agency thereof, nor the Regents of the University of California, nor any of their employees, makes any warranty, express or implied, or assumes any legal responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by its trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof, or the Regents of the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof or the Regents of the University of California.

For internal dist. only

UCRL-8569 (Rev.)

UNIVERSITY OF CALIFORNIA

Lawrence Radiation Laboratory
Berkeley, California

Contract No. W-7405-eng-48

MILLIMICROSECOND DISCRIMINATOR

David F. Swift and Victor Perez-Mendez

June 24, 1959

Printed for the U. S. Atomic Energy Commission

MILLIMICROSECOND DISCRIMINATOR

David F. Swift and Victor Perez-Mendez
Lawrence Radiation Laboratory
University of California
Berkeley, California

June 24, 1959

ABSTRACT

A discriminator circuit for use with millimicrosecond counting equipment is described here. The main characteristics of this unit are its good response to pulses as short as 3 millimicroseconds and the fast recovery time, which is less than 0.1 μsec.

MILLIMICROSECOND DISCRIMINATOR*

David F. Swift and Victor Perez-Mendez

Lawrence Radiation Laboratory

University of California

Berkeley, California

June 24, 1959

I. INTRODUCTION

A discriminator device is necessary in most electronic counting arrangements to determine the voltage level at which pulses are fed to the recording device. Standard discriminator circuits with good stability are in common use for circuits operating in the microsecond region.[1]

For discriminators operating in the millimicrosecond (mμsec) region the requirements are even more exacting. In addition to good stability performance they are often required to have comparatively short resolving times in order to make full use of the "speed" towards which millimicrosecond circuitry is developing.

The discriminator described here was designed with these two requirements in mind. Since the output voltages of "fast" coincidence circuits in current use are of the order of a fraction of a volt, these units have been designed to operate at this input level and to have a resolving time equal to that of the fastest commercially built scalers in common use. This resolving time is approximately 0.1 μsec for the Hewlett-Packard Model-520 prescaler.

---

*Work done under the auspices of the U. S. Atomic Energy Commission.

II. CIRCUIT DESCRIPTION

The main elements of the discriminator are shown in the block diagram, Fig. 1. The complete circuit diagram is seen in Fig. 2. Three units of this kind are assembled on a single rack for compactness. Each unit produces two outputs designated as (1) fast, and (2) slow, which are used to drive the 10-Mc prescalers or the standard microsecond-resolution scalers.

The input stage uses an E180F as a shunt-compensated linear amplifier having a fixed gain of 3.5 with a rise time of 6 mμsec. The terminal input impedance is 125 ohms to provide a match to RG-63/U cable. This circuit is placed before the diode discriminator to give sufficient amplification of input signals to increase discriminator precision and minimize the effects of uncertainty due to the lack of abruptness of the diode break characteristic.

The discriminator stage is a series voltage-comparator circuit using a G111A diode. The reference voltage is obtained from a bleeder network across the minus-105-v bias line. Two potentiometers are provided for varying this voltage, (a) a front-panel control labeled "DISC" and (b) a rear control to initially equalize the discriminator level of all three channels. In order to minimize the effects of pulses feeding through the diode shunt capacitance, an RC neutralizing network is included.

The output from the comparator circuit could be used directly to trigger the EFP60 secondary emission univibrator, but the voltage at this point is of the same order as the inherent instability level of the EFP60. Two cascaded 6485 tubes are used with a combined gain of 60 to provide an amplified signal substantially higher than the threshold level of the univibrator. The instability level of the EFP60 is now a small percentage of the triggering voltage, thus adding to the over-all stability of this unit.

The univibrator stage consists of an EFP60 tube to provide standardized pulses for driving a 10-Mc prescaler. The amplitude and shape of the output pulse are determined by the plate-to-cathode feedback loop.[2] The pulse is initiated by the application of a trigger from the amplifier stage and terminated after one-half the period of the critically damped resonant circuit in the plate. The output is taken from the dynode and should have a terminal impedance of 125 ohms at the input of the prescaler. Dynode voltage is stabilized through use of an OB2. The grid-bias voltage for the EFP60 is sufficient to prevent self-oscillation and also double pulsing from output overload. Diodes placed across the grid and cathode resistors substantially reduce element-voltage change due to high duty cycle. The fast output pulse is shown in Fig. 3(a).

In order for the fast output to drive a conventional slow-speed scaler, a stretching and amplifying circuit is used to give an output pulse with longer duration and greater amplitude. These circuits may be energized by application of B+ voltage from the front-panel switch labeled "FAST-SLOW". The fast output is then applied through an isolating resistor to a diode pulse stretcher in the grid circuit of the slow-output amplifier. The two halves of a 5687 are used in cascade to amplify the stretched pulse to form the slow output shown in Fig. 3(b).

III. PERFORMANCE TESTS

The operating characteristics of this circuit were tested in various ways to determine the following properties:

(a) The long-term stability of the discriminator level.

(b) The discriminator level as a function of the input pulse widths.

(c) The discriminator level as a function of the time interval between two pulses.

The results of these tests are seen in Figs. 4-6. From these graphs it can be seen that the circuit operates reliably for input pulses of approximately 10^{-8} sec and has a resolving time of approximately 1.0×10^{-7} sec. For some applications, the delay time and "jitter" time in the fast pulse must be known. These times were measured at a discrimination level of 0.5 volt; the delay time is 30 mμsec. The jitter time is less than 1.0 mμsec when measured with input pulses 0.1 volt higher than the triggering level, which is 0.5 volt.

IV. ACKNOWLEDGMENTS

We wish to thank Dick Mack, Worrell Deuser, Jacques Mey, C. Norman Winningstad, and George Constantian for their help in the evaluation and testing of this unit.

REFERENCES

[1] W. C. Elmore and M. Sands, Electronics (McGraw-Hill Book Co., Inc., New York, 1949), p. 99.

J. Millman and H. Taub, Pulse and Digital Circuits (McGraw-Hill Book Co., Inc., New York, 1956), p. 458.

[2] I. A. D. Lewis and F. H. Wells, Millimicrosecond Pulse Techniques (McGraw-Hill Book Co., Inc., New York, 1954), p. 232.

LEGENDS

Fig. 1. Block diagram.

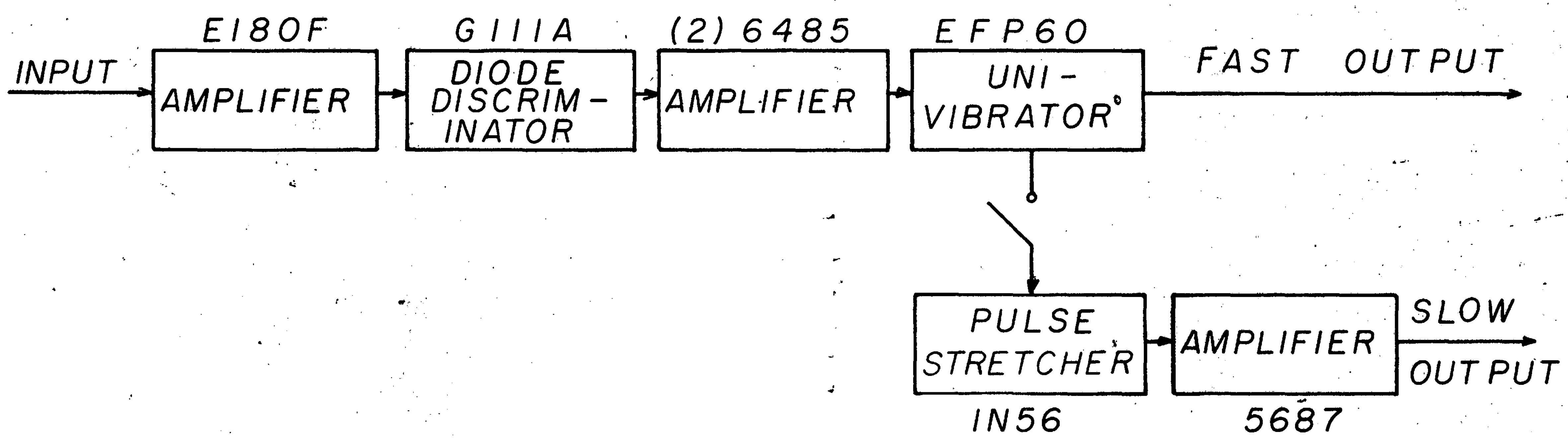
Fig. 2. Circuit diagram.

Fig. 3. (a) Fast output pulse. (b) Slow output pulse.

Fig. 4. Long-term stability of the discriminator level.

Fig. 5. Discriminator level as a function of input pulse widths.

Fig. 6. Discriminator level as a function of the time interval between pulses.



48

Fig. 1
55,070 - 2

eRecordsUsa

eRecordsUsa

eRecordsUsa

eRecordsUsa

eRecordsUsa

eRecordsUsa

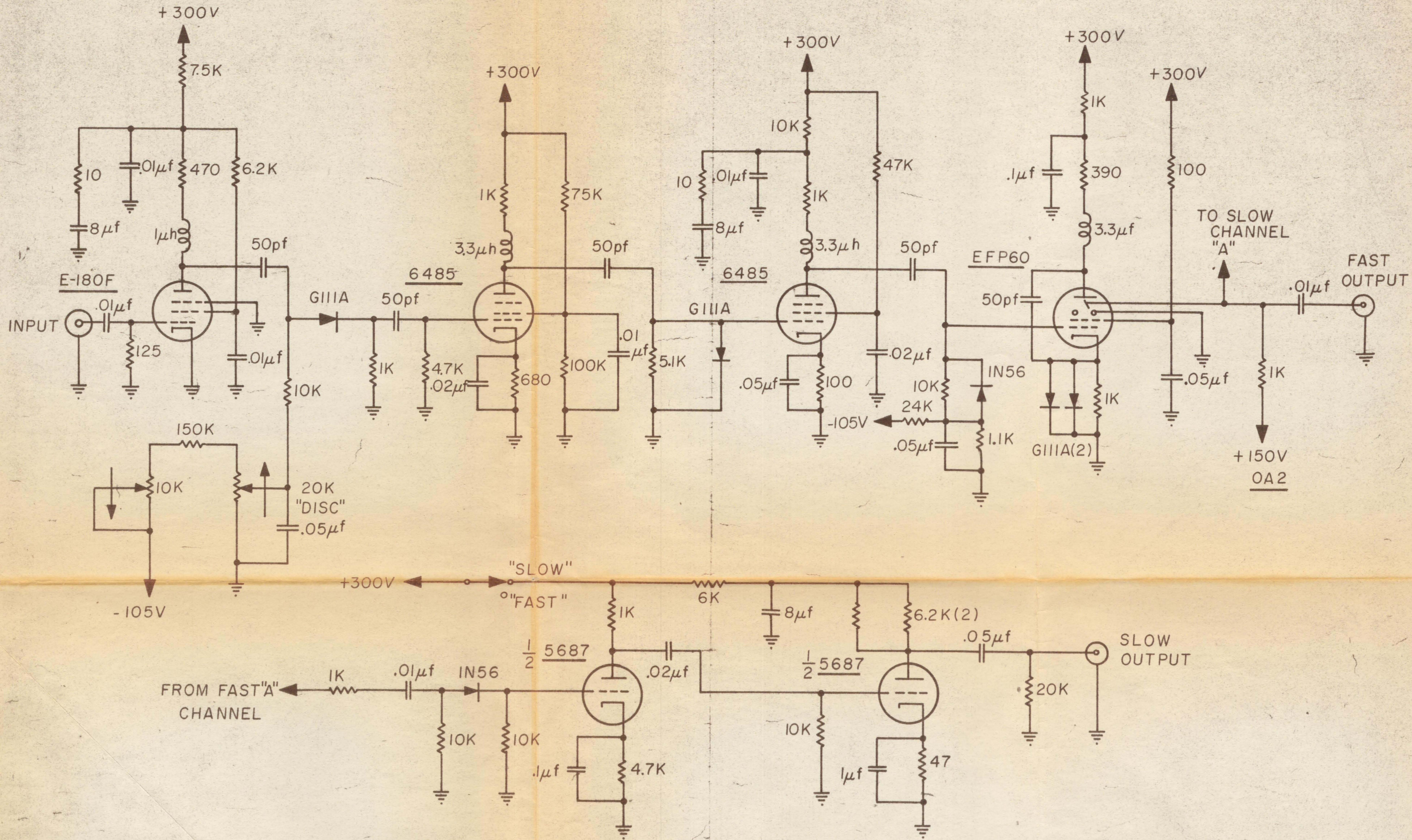

+300V
7.5K
10
.01μf
470
6.2K
8μf
1μh
50pf
E-180F
INPUT
.01μf
125
.01μf
10K
150K
10K
20K
"DISC"
.05μf
-105V
G111A
50pf
1K
4.7K
.02μf
6485
1K
3.3μh
680
75K
100K
.01
μf
5.1K
G111A
10K
10
.01μf
8μf
1K
3.3μh
47K
.02μf
.05μf
100
-105V
24K
.05μf
1.1K
IN56
EFP60
.1μf
390
3.3μf
100
TO SLOW
CHANNEL
"A"
FAST
OUTPUT
.05μf
1K
G111A(2)
+150V
OA2
"SLOW"
"FAST"
6K
8μf
6.2K(2)
.05μf
SLOW
OUTPUT
1/2 5687
.02μf
FROM FAST "A"
CHANNEL
.01μf
IN56
.1μf
4.7K
47
1μf
20K

Fig. 2

55,246-3

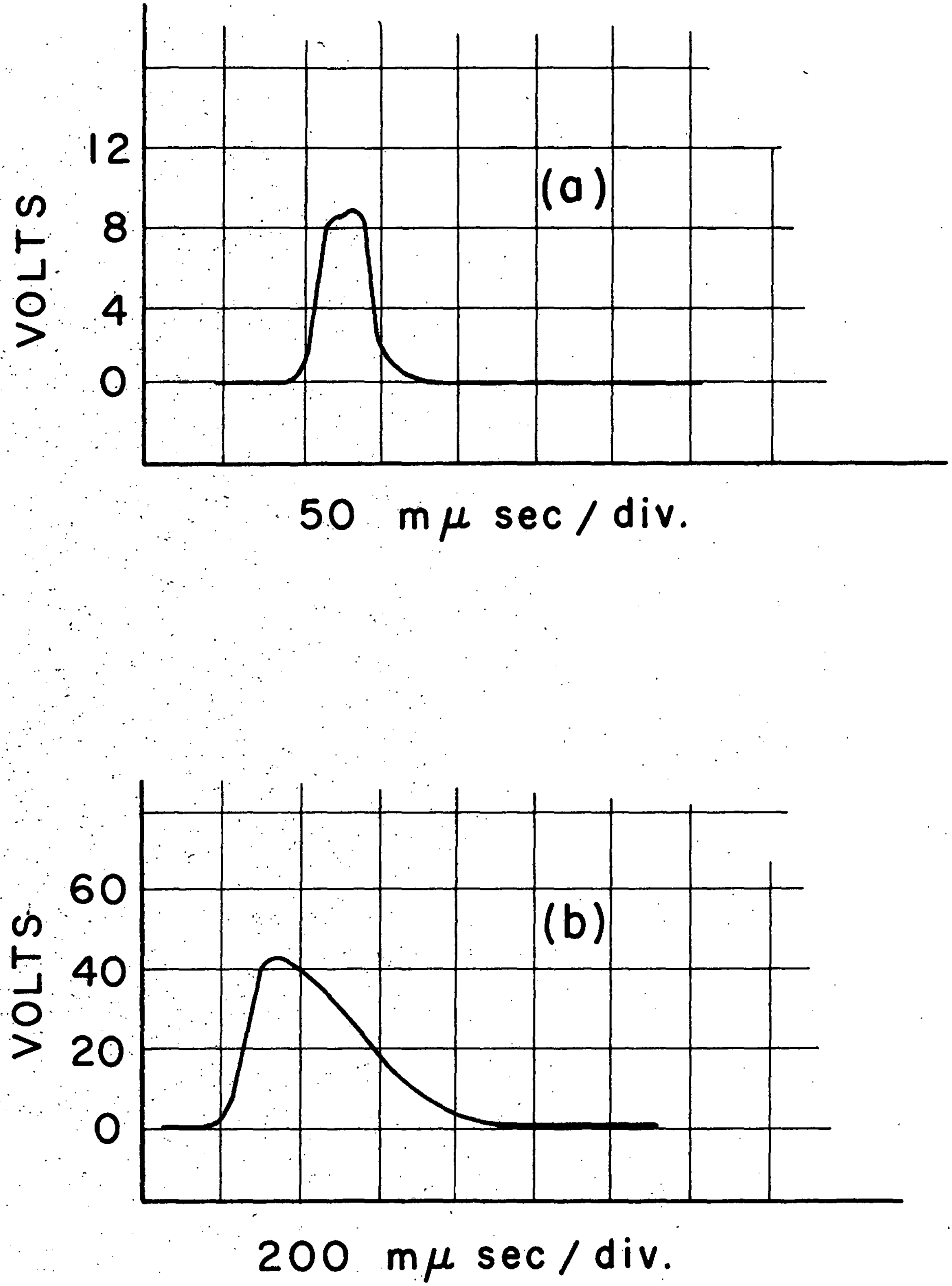


Fig. 3

55,071-1

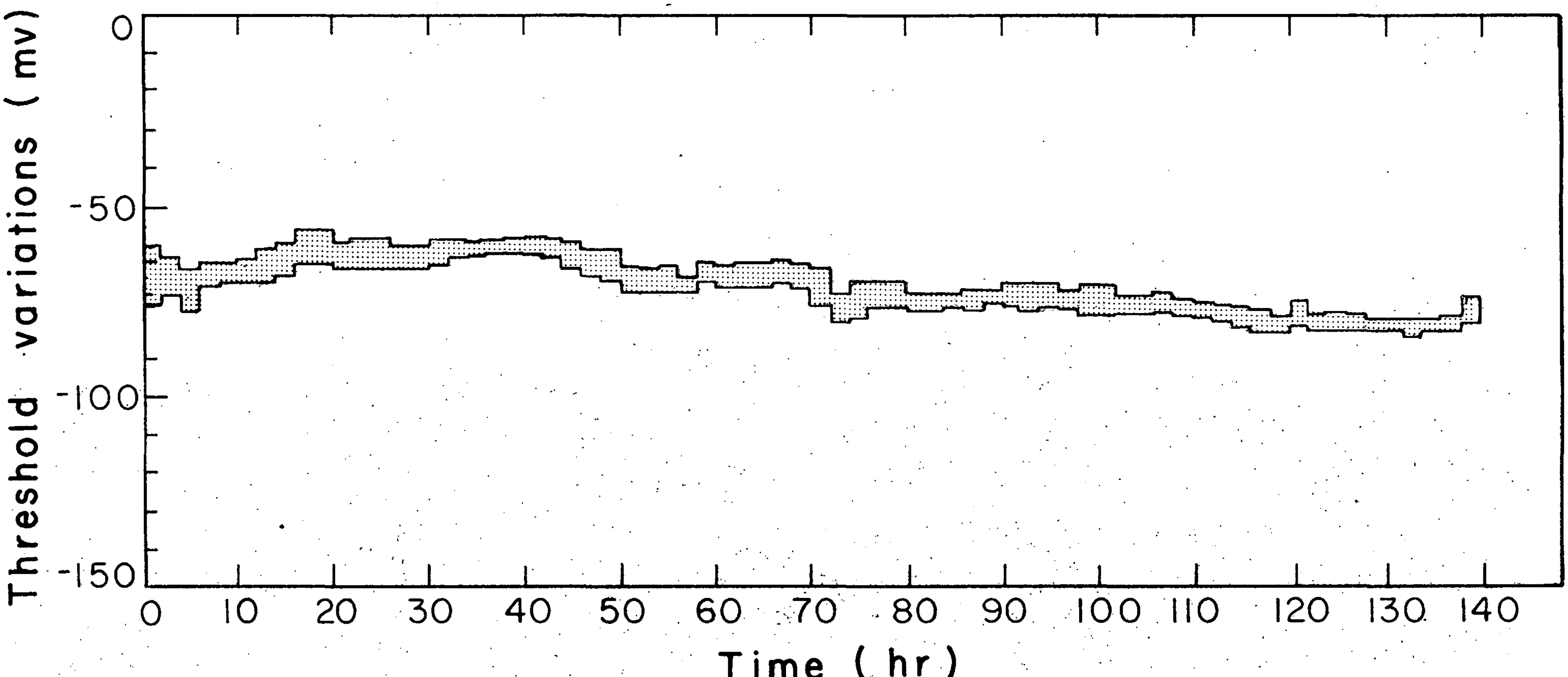


Fig. 4

55,067-1

59

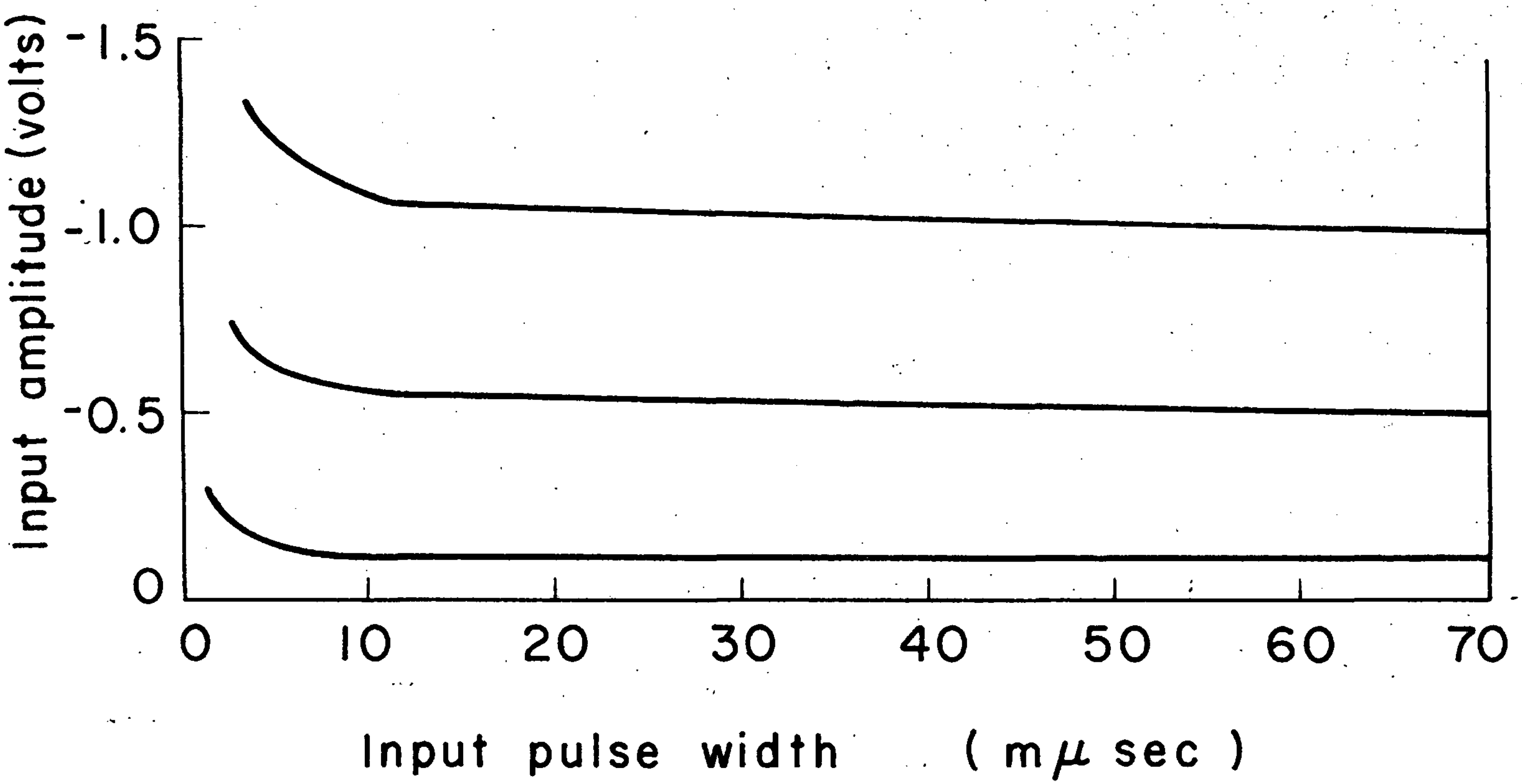

Input amplitude (volts)
-1.5
-1.0
-0.5
0
0
10
20
30
40
50
60
70
Input pulse width (mμ sec)

Fig. 5

55,068-1

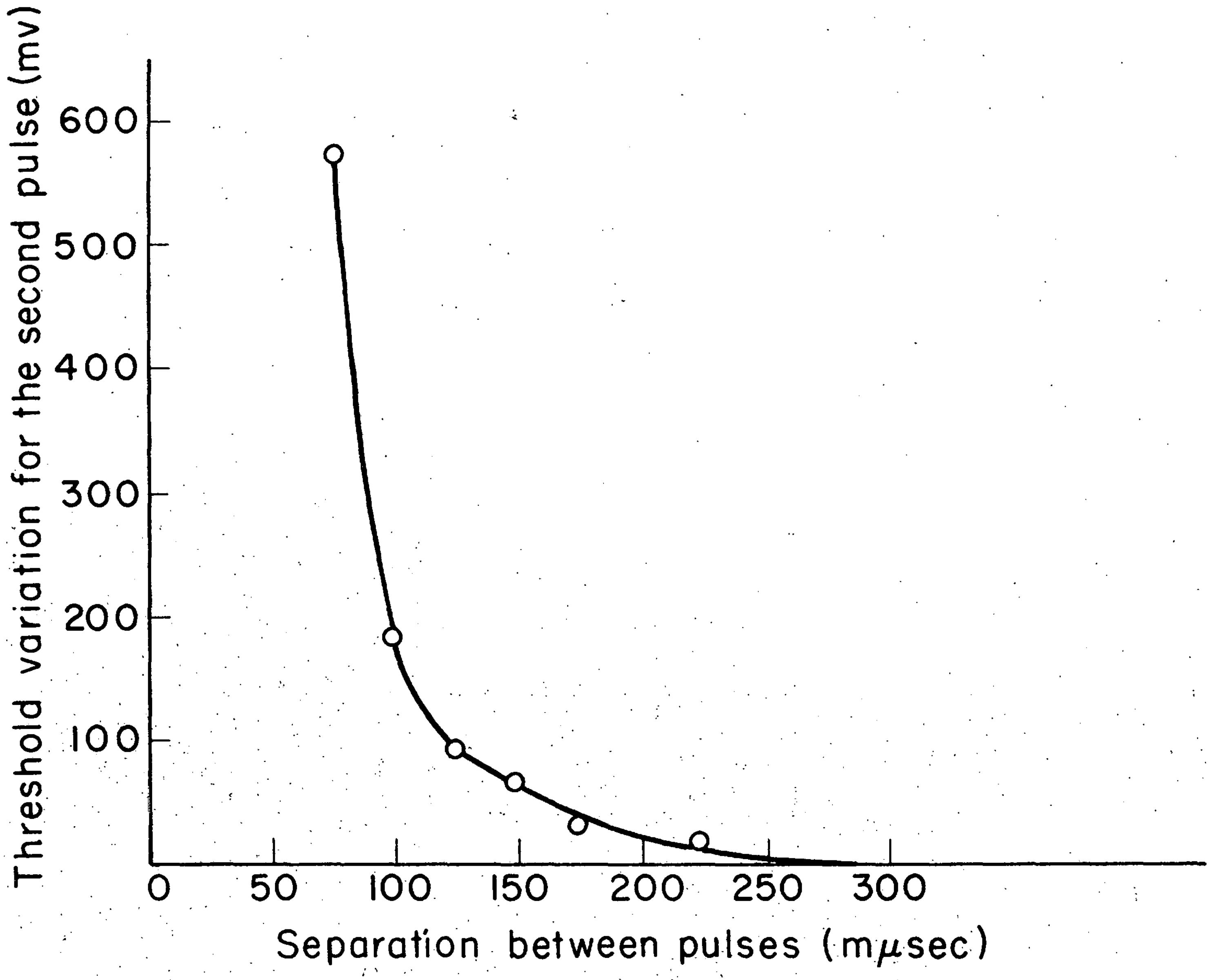

Threshold variation for the second pulse (mv)
600
500
400
300
200
100
0
50
100
150
200
250
300
Separation between pulses (mμsec)

Fig. 6
55,245-1