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Comparative testing of NIM Discriminators EG&G-TR204, Chronetics-151, LRS-161

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No. 12

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EG&G-TR204, CHRONETICS-151, LRS-161

INTRODUCTION

The High Energy Electronic Equipment Pool (H.E.E.P.) section of the EP & S Division has been making a study, for purposes of procurement, of certain catalog items of high speed logic. The class of items to be described here fall into the category of nominal 150-200 mHz discriminators.

The items tested were Edgerton, Germeshausen & Grier model TR-204, Chronetics model 151 and LeCroy Research Systems model 161. The type of tests performed were dictated by the need for using these units as standard pool items for high energy physics research.

Each test is described and a test setup shown. The results of each test on these three units are given after each test description. The analysis of these test results must be made on the basis of the individual needs. BNL analysis resulted in the initial selection of the Chronetics model 151 for H.E.E.P.

A. DISCRIMINATOR INPUT REFLECTION CO-EFFICIENT

Test Procedure

The input reflection of each test discriminator is measured by applying a step input from a Tektronix TDR Pulser. The test pulser has an amplitude of 450 mV with a .75 ns rise time. (Refer to Test Equipment Setup "1".)

Result

Fig. 1 - System reflection minimized at less than 2.5% p/p using a precision 50 ohm termination.

Fig. 2 - Reflection occuring 16 ns after applied step function (16 ns delay due to transit time of cable) in EG&G-TR204 discriminator. Reflection approximately 7% p/p.

Fig. 3 - Duplicate input to Chronetics 151 discriminator resulting in reflection approximately 20% p/p.

Fig. 4 - Duplicate input to LeCroy 161 discriminator resulting in reflection of approximately 30% p/p with simultaneous impedance shift of discriminator input.

B. TIME SHIFT WITH INPUT PULSE AMPLITUDE

Test Procedure

Each discriminator is set at minimum threshold. The input pulse amplitude is set at 0.1 db over threshold and recorded at that point (right most pulse in figs. 5, 6, 7). With the threshold at the same point the input amplitude is increased by a factor of 3, resulting in middle pulse on figs. 5, 6, 7 and then a factor of 10 resulting in left most pulse on figs. 5, 6, 7. (Refer to Test Equipment Setup "2".)

The relative time shift of the discriminator is found as follows:

Where -

Δt_a = Total time shift.

Δt_{in} = Rise time to threshold of the input pulse.

Δt_d = Relative time shift of the discriminator.

Then -

$$\Delta t_d = \Delta t_a - \Delta t_{in}$$

Result

	Discriminator Time Shift (Δt_d)	
	3 times threshold	10 times threshold
EG&G	.8 ns	1.1 ns
CHRONETICS	1.3 ns	1.8 ns
LECROY	1.8 ns	2.0 ns

C. SECOND PULSE SENSITIVITY AS A FUNCTION OF DOUBLE PULSE RESOLUTION

Test Procedure

The test discriminator threshold controls are set at 100 mV and output width at minimum. A pulse pair with variable spacing and independantly variable amplitude is applied to the input of each test discriminator.

The first pulse is adjusted 1 db above threshold on each discriminator. The second pulse is placed about 30 ns later than the first pulse, and is adjusted in 0.1 db steps for complete firing of the test discriminator and recorded at that point. (The last pulse on figs. 8, 9, 10.)

The second pulse is stepped in at 2 ns intervals, each time adjusting the second pulse amplitude for complete firing of the test discriminator. Exposures are taken at each step.

The second pulse is stepped in until the test discriminator will no longer resolve the two input pulses. (Refer to Test Equipment Setup "3".)

Result

	Input Double Pulse Res.	Output Double Pulse Res.
EG&G	7 ns	7 ns
CHRONETICS	5 ns	6 ns
LECROY	7 ns	7.2 ns

D. MAXIMUM REPETITION RATE UNDER BURST CONDITIONS AT VARIABLE AMPLITUDES

Test Procedure

A gated burst of pulses with variable repetition rate and variable amplitude is applied to each test discriminator. The thresholds of each discriminator are set to the 100 mV level and the output pulse width is set at minimum. The input amplitude is set at 200 mV and the repetition rate increased until the test discriminator malfunctions (figs. 11, 12, 13).

The input amplitude is then increased to a 500 mV level and the same test is repeated (figs. 14, 15, 16).

The EG&G and LeCroy discriminators are switched to DC pass mode and the input amplitude set at 200 mV. Maximum repetition rate was recorded in this mode, (figs. 17, 18). (Refer to Test Equipment Setup "4".)

Result

	200 mV Input	500 mV Input	DC Pass 200 mV
EG&G	167 mHz	167 mHz	150 mHz
CHRONETICS	200 mHz	200 mHz	N.A.
LECROY	170 mHz	104 mHz	82 mHz

E. HIGH RATE, HIGH DUTY CYCLE EFFECTS

Test Procedure

A 160 mHz repetition rate burst of ten pulses at 300 mV amplitude is applied to the input of each test discriminator. The threshold of the test discriminators are set at 100 mV and all width controls are at minimum, (figs. 19, 23) are examples of this operation.

The pulse width is increased until the output pulses begin to join (figs. 20, 24) then the width is increased further until the "1" state is approached (figs. 21, 25) finally the width is increased until the output is in the "1" state (figs. 22, 26). (Refer to Test Equipment Setup "5".)

The LeCroy model 161 was not tested under these conditions.

<u>Result</u>

Figures 19 through 22, the EG&G model TR-204 discriminator has erratic widening of individual output pulses causing joining of the first two pulses (fig. 20). The discriminator has intermittant widening of output pulses which is noticeable in (fig. 21) and excessive feedthrough when fully in the one state, approximately 250 mV p/p (fig. 22).

Figures 23 through 26, the Chronetics model 151 discriminator exhibited a reasonably uniform widening of each individual output pulse (figs. 24, 25) and had minimum feedthrough when fully in the one state, approximately 50 mV p/p (fig. 26).

F. <u>200 mHz BURST TEST</u>

<u>Test Procedure</u>

A 200 mHz repetition rate burst of 10 pulses is applied to each test discriminator. The discriminator thresholds are set at 100 mV and the output pulse widths are set at minimum. (Refer to Test Equipment Setup "4".)

<u>Result</u>

Fig. 27 - The Chronetics model 151 discriminator fully resolved the entire burst of ten pulses.

Fig. 28 - The EG&G model TR-204 discriminator partially resolved the first two input pulses. The remaining eight pulses in the input burst were divided by a factor of two.

Fig. 29 - The LeCroy model 161 discriminator responded to the first pulse of the input burst and failed to trigger on any of the subsequent pulses.

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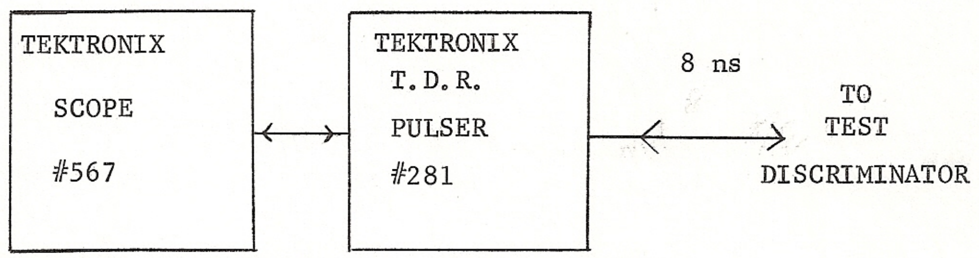
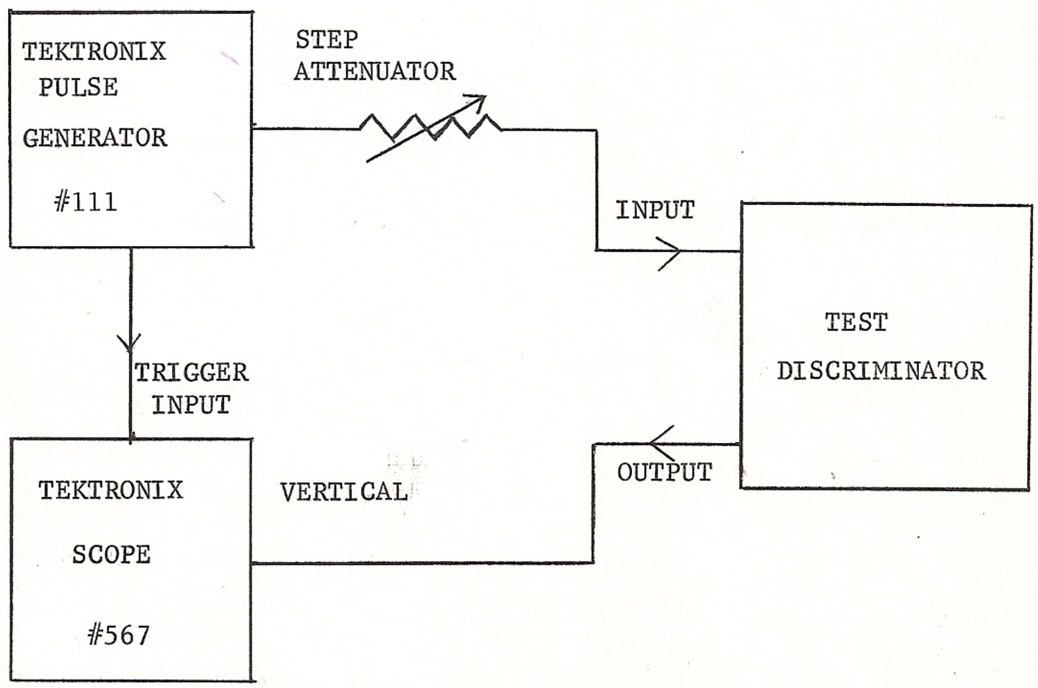
TEST EQUIPMENT SET-UP

"1"

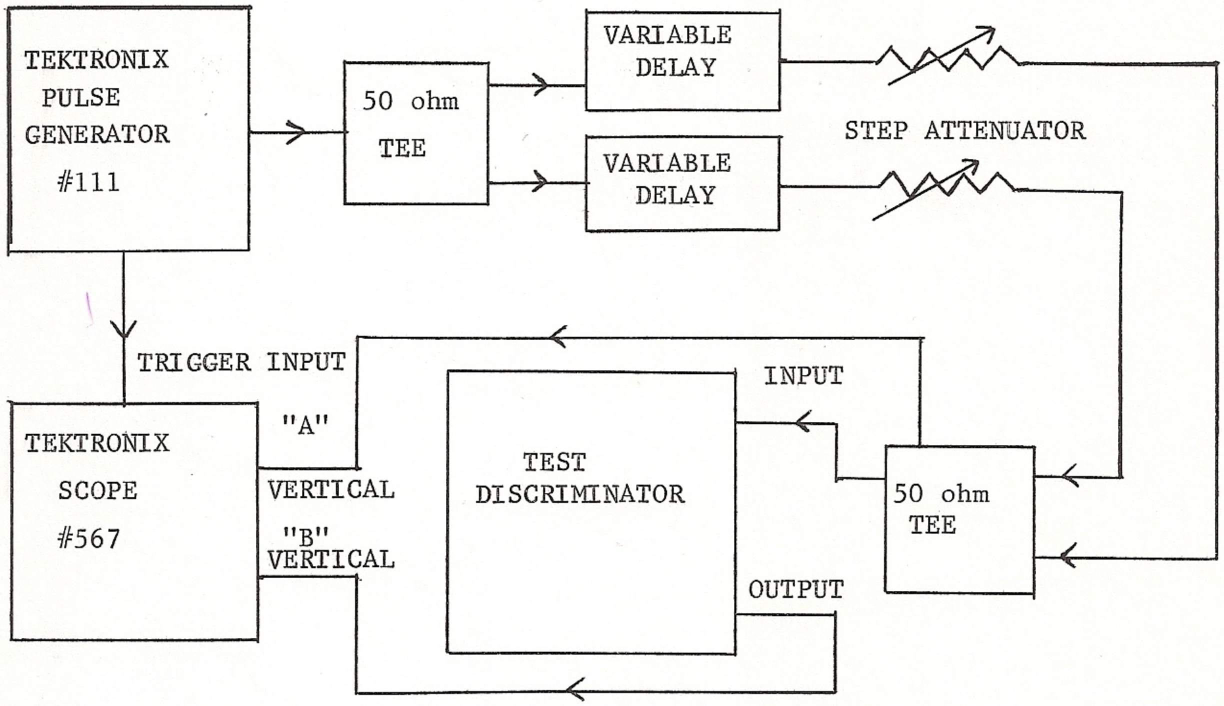


"2"

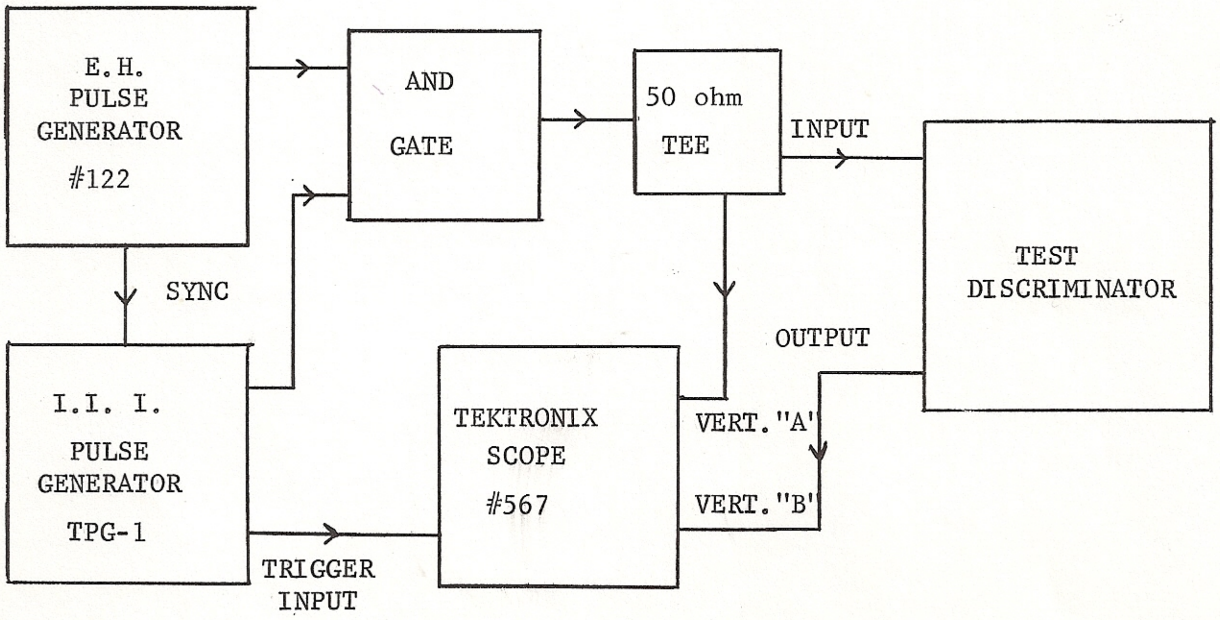


TEST EQUIPMENT SET-UP

"3"

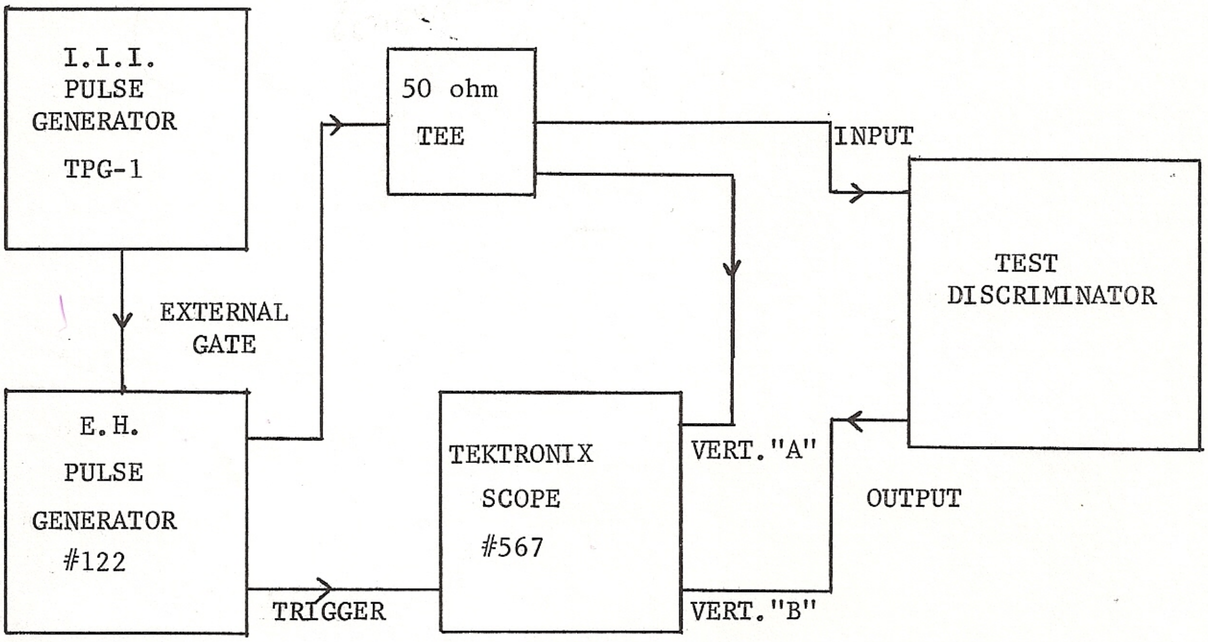


"4"



TEST EQUIPMENT SET-UP

"5"



SYSTEM REFLECTION

Rise Time .25 ns

Reflection coef. $\angle$ 2.5% p/p

Vert. - 50 mv/D

Hor. - 10 ns/D

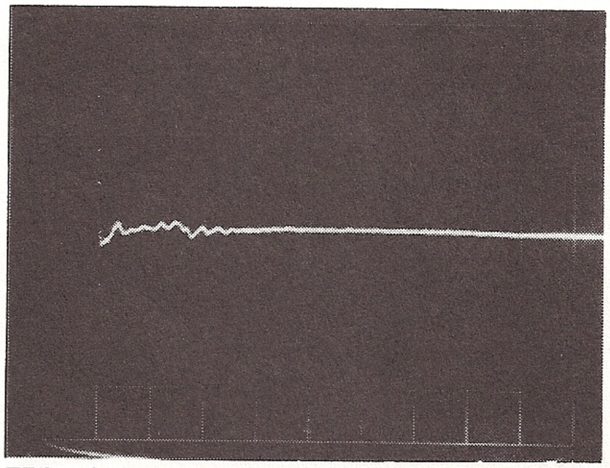


FIG.-1

REFLECTION OF INPUT STEP

EG&G TR-204 Discriminator

Function 450 mv

Rise time .25 ns

Reflection coef. approx. 7% p/p

Vert. 50 mv/D

Hor. 10 ns/D

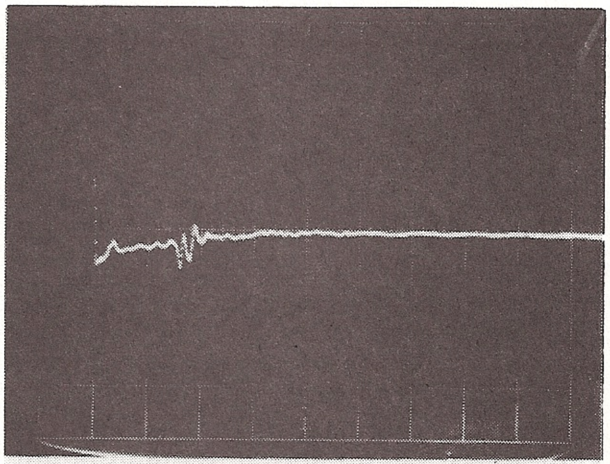


FIG.-2

Chronetics 151 Discriminator

Function 450 mv

Rise time .25 ns

Reflection coef. approx. 20% p/p

Vert. 50 mv/D

Hor. 10 ns/D

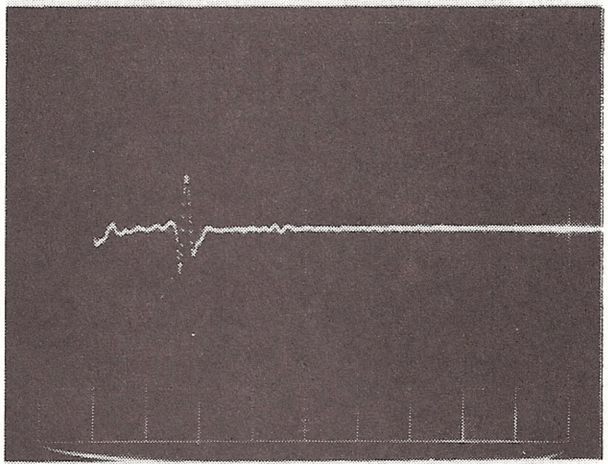


FIG.-3

LRS 161 Discriminator

Function 450 mv

Rise time .25 ns

Reflection coef. approx. 30% p/p

Vert. 50 mv/D

Hor. 10 ns/D

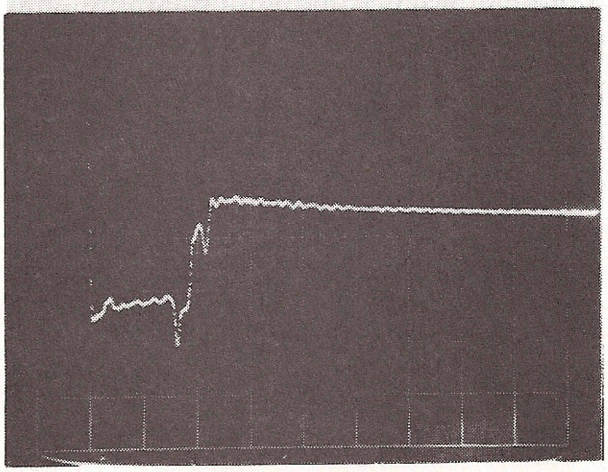


FIG.-4

TIME SLEW

EG&G TR204

Vert. 200 mv/D

Hor. 1 ns/D

Input:
1. 150 mv - Threshold
2. 450 mv - 3 x
3. 1500 mv - 10 x

3 x - .8 ns Slew
10 x - 1.1 ns Slew

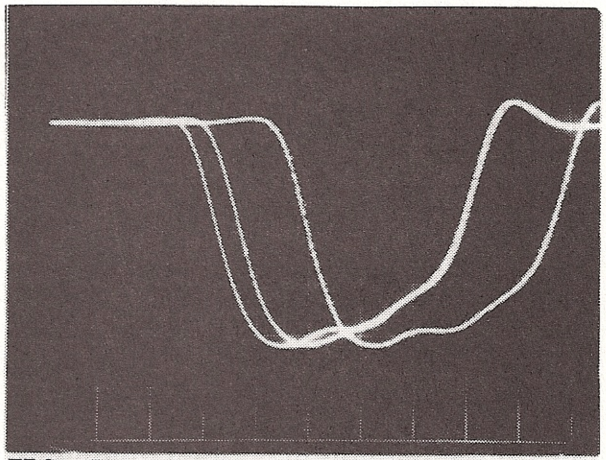


FIG.-5

Chronetics 151

Vert. 200 mv/D

Hor. 1 ns/D

Input:
1. 38 mv - Threshold
2. 117 mv - 3 x
3. 480 mv - 10 x

3 x - 1.3 ns Slew
10 x - 1.8 ns Slew

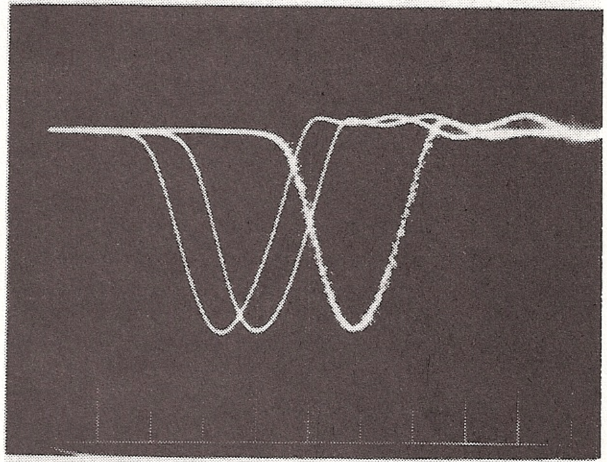


FIG.-6

LRS 161

Vert. 200 mv/D

Hor. 1 ns/D

Input:
1. 135 mv - Threshold
2. 405 mv - 3 x
3. 1350 mv - 10 x
3 x - 1.8 ns Slew
10 x - 2.0 ns Slew

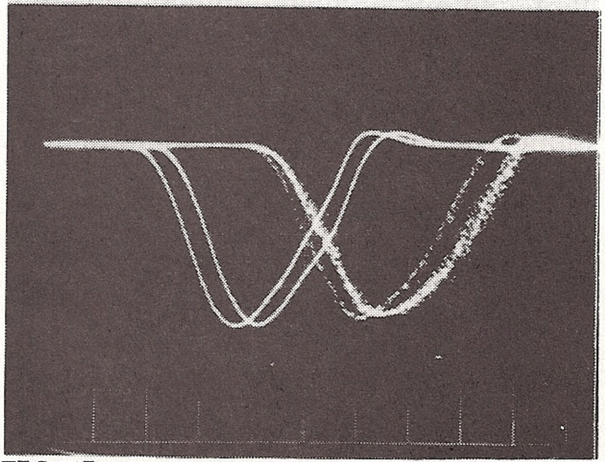


FIG.-7

DOUBLE PULSE RESOLUTION VERSUS AMPLITUDE

EG&G TR204
Top vert. 50 mv/D
Bot. vert. 200 mv/D
Hor. 5 ns/D

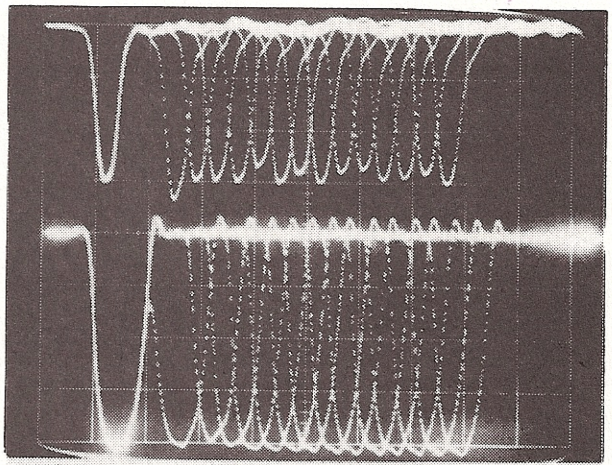


FIG.-8

Chronetics 151
Top vert. 50 mv/D
Bot. vert. 200 mv/D
Hor. 5 ns/D

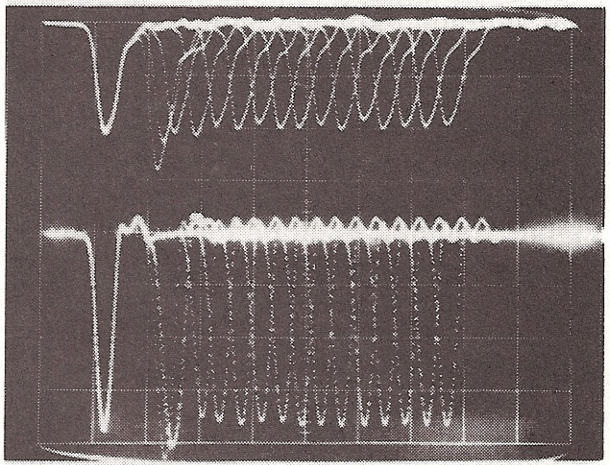


FIG.-9

LRS 161
Top vert. 50 mv/D
Bot. vert. 200 mv/D
Hor. 5 ns/D

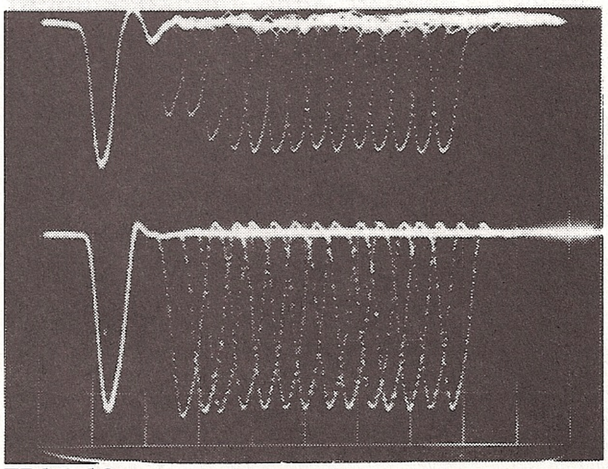


FIG.-10

EG&G 201 Discriminator

Max. CW Rate 200 mv Input (167 mHz)

Top vert. 100 mv/D

Bot vert. 200 mv/D

Hor. 10 ns/D

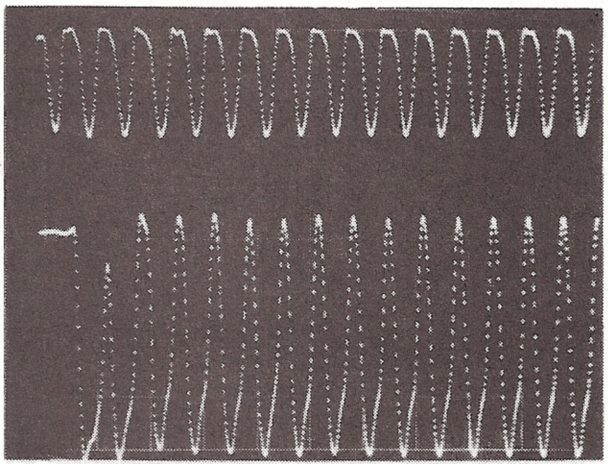


FIG.-11

Chronetics 151 Discriminator

Max CW Rate 200 mv Input (200 mHz)

Top vert. 100 mv/D

Bot vert. 200 mv/D

Hor. 5 ns/D

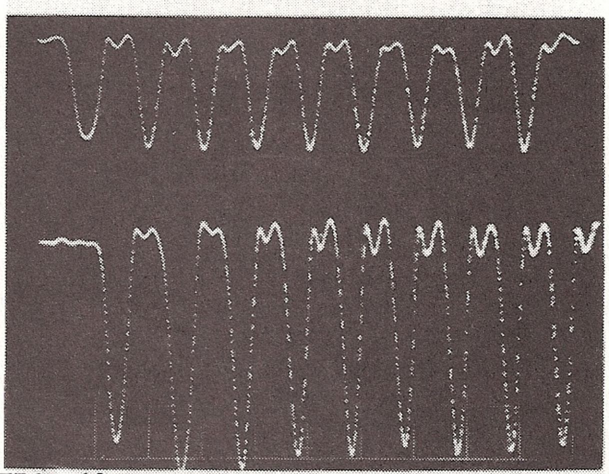


FIG.-12

LRS 161 Discriminator

Max. CW Rate 200 mv Input (170 mHz)

Top vert. 100 mv/D

Bot vert. 200 mv/D

Hor. 10 ns/D

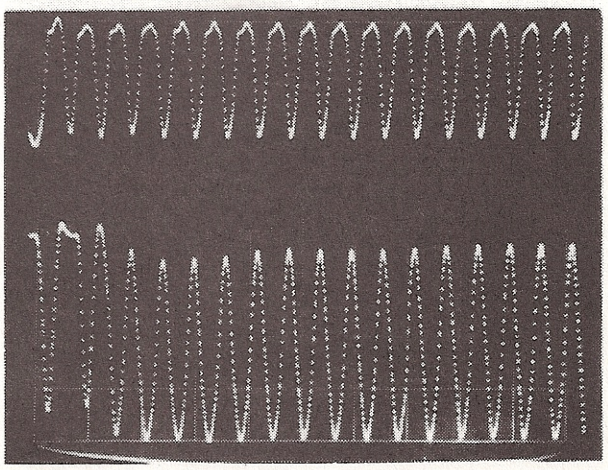


FIG.-13

EG&G 201 Discriminator

Max. CW Rate 500 mv Input (167 mHz)

Top vert. 200 mv/D

Bot vert. 200 mv/D

Hor. 5 ns/D

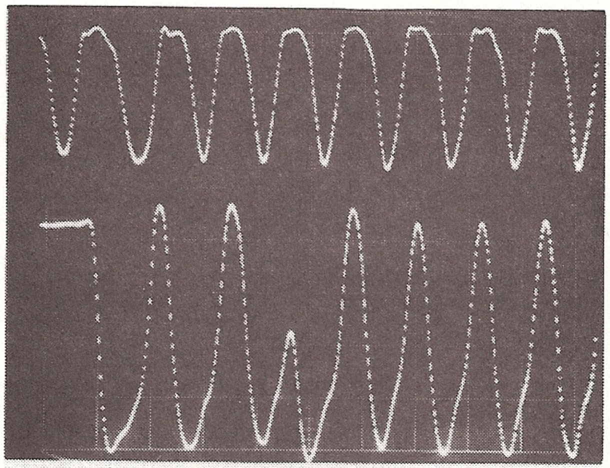


FIG.-14

Chronetics 151 Discriminator

Max. CW Rate 500 mv Input (200 mHz)

Top vert. 200 mv/D

Bot vert. 200 mv/D

Hor. 5 ns/D

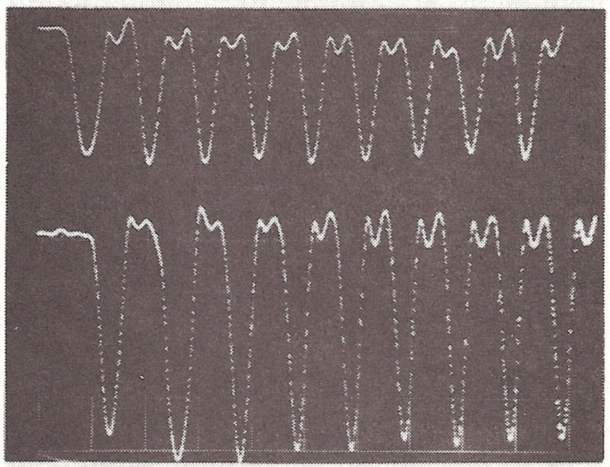


FIG.-15

LRS 161 Discriminator

Max. CW Rate 500 mv Input (104 mHz)

Top vert. 200 mv/D

Bot. vert. 200 mv/D

Hor. 10 ns/D

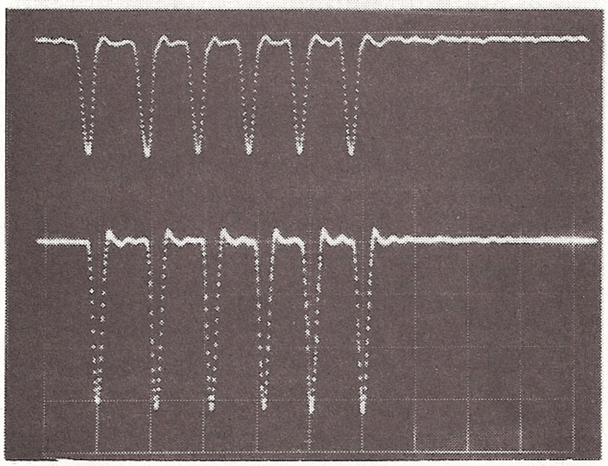


FIG.-16

EG&G 201 Discriminator
Max. CW Rate DC Pass 200 mv Input
Max. CW Rate (150 mHz)
Top vert. 100 mv/D
Bot. vert. 200 mv/D
Hor. 10 ns/D

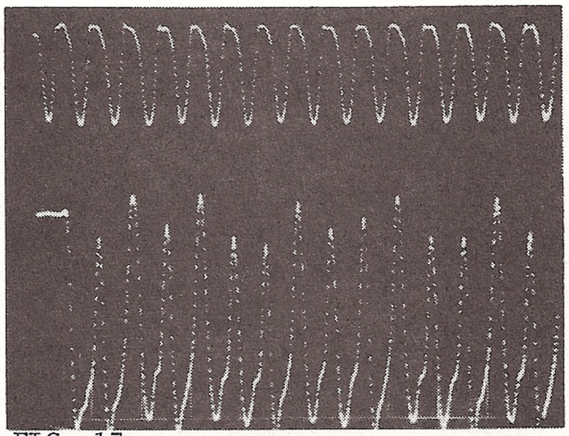


FIG.-17

LRS 161 Discriminator
Max. CW Rate DC Pass 200 mv Input
Max. CW Rate (83 mHz)
Top vert. 100 mv/D
Bot. vert. 200 mv/D
Hor. 10 ns/D

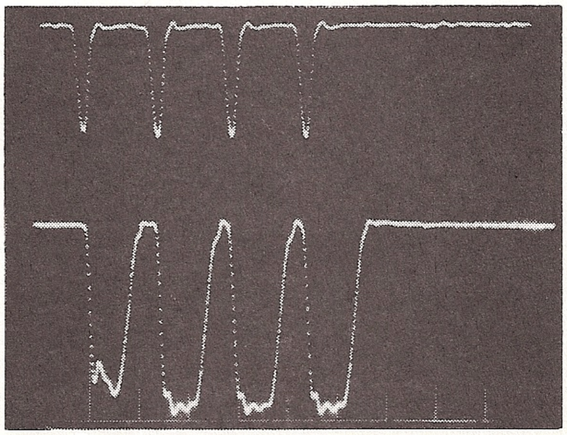


FIG.-18

VARIABLE DUTY CYCLE SERIES

E.G.&G. TR 204

160 Mhz Burst of 10 Pulses

Vertical Top - 200 mv/d

Vertical Bottom - 200 mv/d

Hor. - 5 ns/d

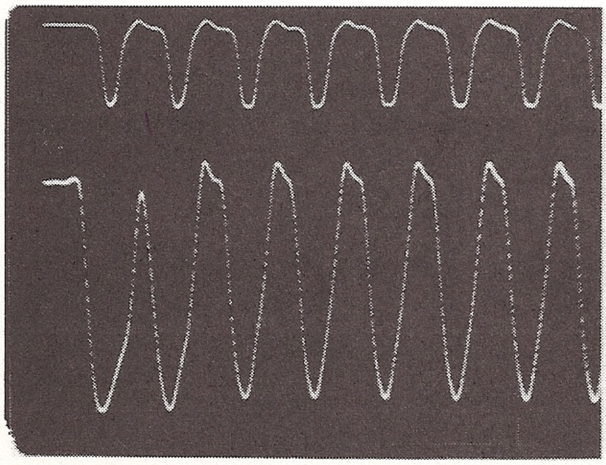


FIG.-19

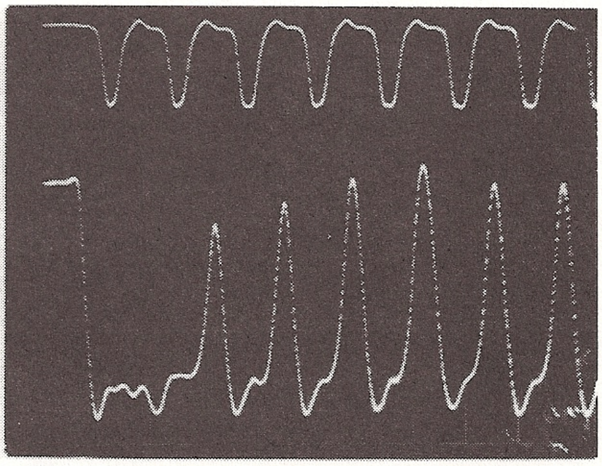


FIG.-20

Note: Dropping of first pulse.

Note: Jitter and count down.

Note: Feed through in "1" state.

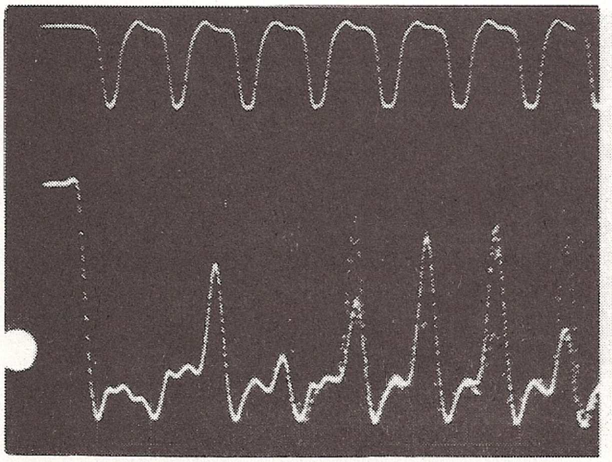


FIG.-21

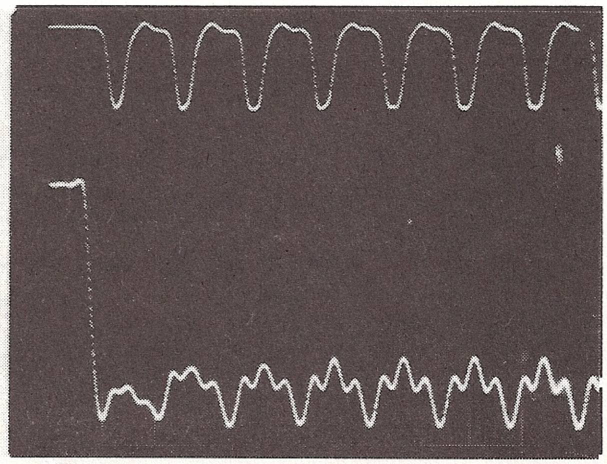


FIG.-22

VARIABLE DUTY CYCLE SERIES

Chronetics 151

160 Mhz Burst of 10 Pulses

Top Vertical - 200 mv/d

Bottom Vertical - 200 mv/d

Hor. - 5 ns/d

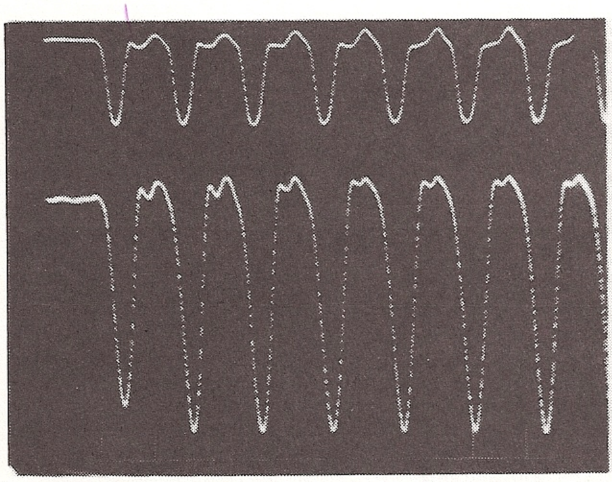


FIG.-23

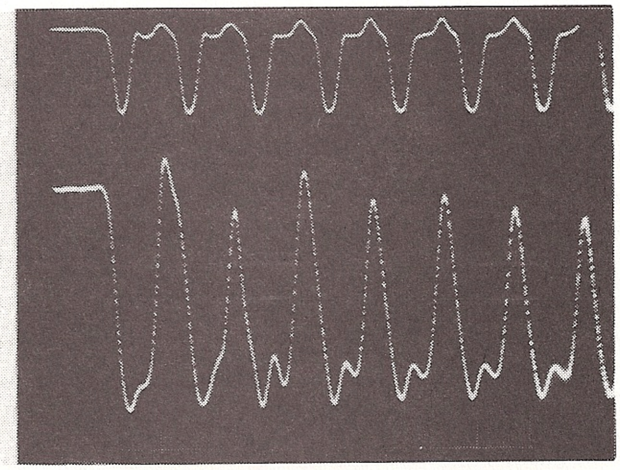


FIG.-24

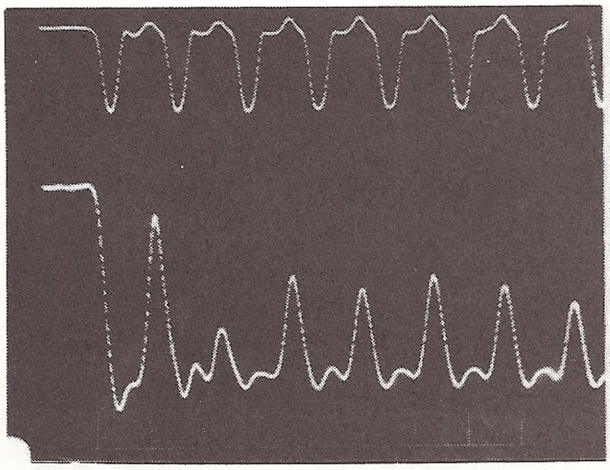


FIG.-25

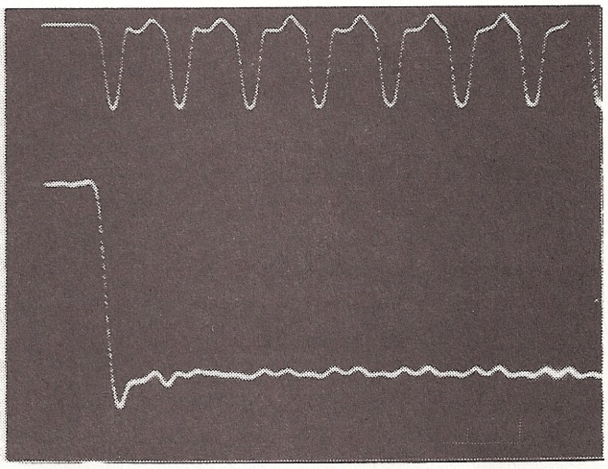


FIG.-26

Chronetics 151 Discriminator
200 Mhz Burst of 10 Pulses
Top Vertical - 200 mv/d
Bottom Vertical - 200 mv/d
Hor. - 5 ns/d

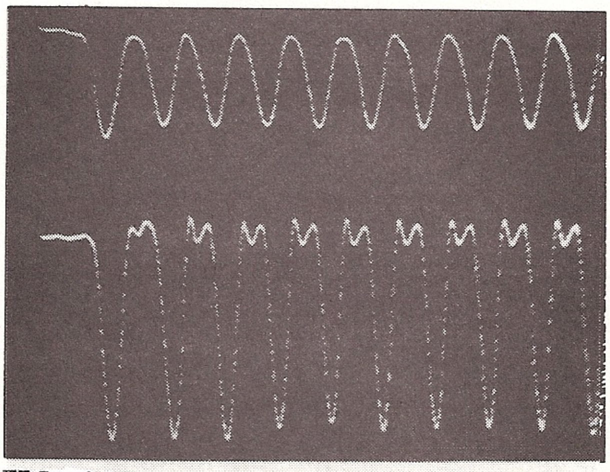


FIG.-27

E.G.&G. TR 204/N
200 Mhz Burst of 10 Pulses
Top Vertical - 200 mv/d
Bottom Vertical - 200 mv/d
Hor. - 5 ns/d

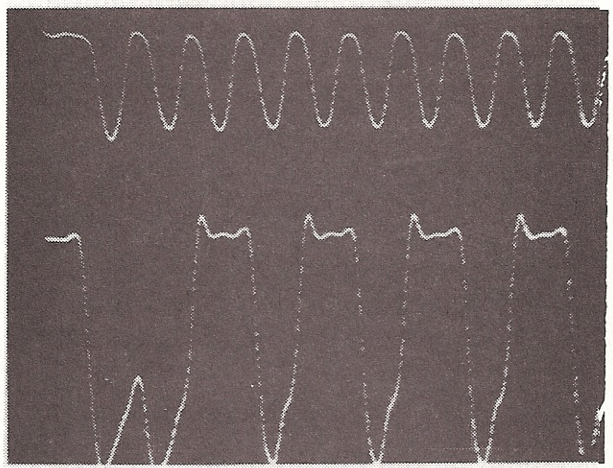


FIG.-28

LeCroy 161
200 Mhz Burst of 10 Pulses
Top Vertical - 200 mv/d
Bottom Vertical - 200 mv/d
Hor. - 5 ns/d

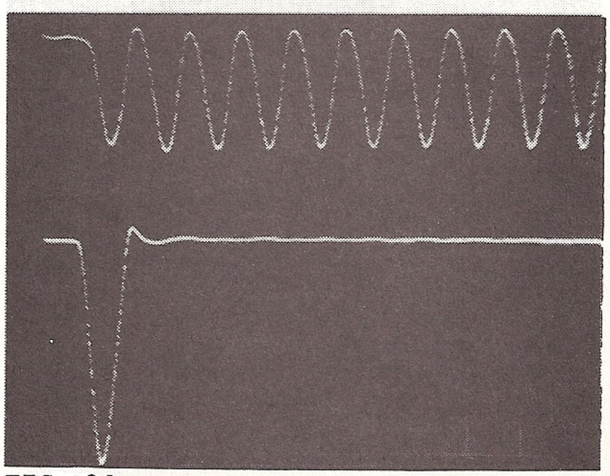


FIG.-29