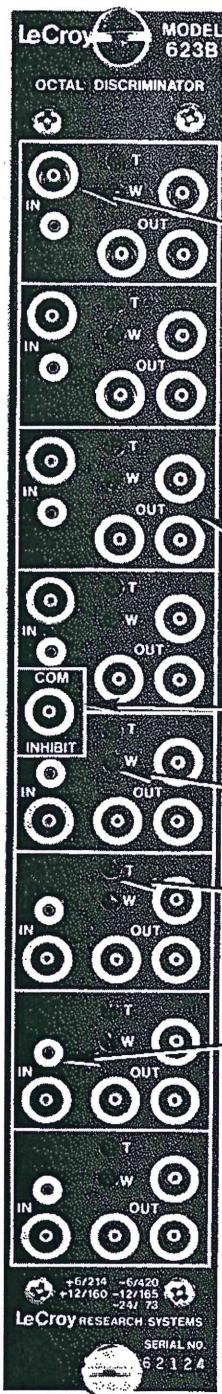


NIM Model 623B

8-Channel Updating Discriminator



50 Ω Input, <4% reflections

3 NIM level outputs; quiescently, 0 V; -800 mV during output

Common Inhibit. -600 mV disables all channels.

Continuous width adjust, ≤6 nsec to >150 nsec

Threshold Adjust, -30 mV to -1 volt; stability <0.2%/°C

Threshold monitor point; reads 10X actual threshold

STD AEC/NIM packaging, in conformance with AEC report TID-20898; #1 width module

SECTION 1

SPECIFICATIONS

1.3 Input Threshold Characteristics

1.3.1 Threshold Range

The threshold range of 623 Series Octal Discriminators is -30 mV to -1 volt. Because the front panel screwdriver-adjustable potentiometer becomes increasingly sensitive as the threshold is increased, it eventually reaches a point (approximately -600 mV) beyond which it becomes difficult to set. Thus beyond the -600 mV level it should be assumed that the discriminator will attain its maximum threshold setting of -1 volt with negligible additional turning of the pot.

The low minimum threshold of the 623 series units makes it possible to use lower gain photomultipliers, lower voltage on phototubes and to drive PM signals over longer cable lengths than would be possible with higher thresholds. Compared with a -50 mV discriminator, for instance, utilizing RG-58 cable, the -30 mV discriminator would permit cable runs 66.7 feet longer than those permitted by a -50 mV discriminator for equal amplitude pulses. In addition, the low minimum threshold helps make it possible for one to back-terminate at the photomultiplier to absorb reflections and high amplitude noise. (In this case, the PM drives 25 ohms, the tube current is shared, and the amplitude is half that of the unterminated system.)

1.3.2 Threshold Uncertainty

Often the threshold of a discriminator is assumed to be strictly that value which is written on a spec sheet or determined by a front panel potentiometer. The actual value can be a strong function of environmental conditions. The external factors with the strongest effect upon the threshold value are the temperature and the power supply voltage. The 623 Series has excellent threshold stability (see Figure 1.1) including less than 0.2%/°C change due to temperature variations.

1.3.3 Threshold Memory

In order for a user to be assured of a well defined threshold value, this value must remain constant for typical conditions encountered. If a discriminator's threshold is affected by previous events, it is said to have threshold memory. To the user, this is an additional threshold uncertainty, since the discriminator's threshold for any given event depends upon the elapsed time from the preceding threshold crossing. In most discriminators, threshold memory (or second pulse sensitivity) becomes much larger as the pulse separation is reduced. The effect can be further aggravated by the amplitude of the initial signal. In some circuits a very large input can effectively paralyze the discriminator for a long period following the overload.

Figure 1.2. shows the threshold memory of the 623 series discriminators for a signal 20 dB over threshold and when the first input is just slightly above threshold.

Note that in both cases the threshold memory effect for the second pulse is within 6% of nominal for all spacing wider than 9 nsec. The second graph (i.e., the one more favorable to the discriminator) shows exceptionally clear response with virtually no effect in evidence above 10.5 nsec.

1.3.4 Threshold Calibration

Determination of the input threshold set by the front panel control has typically required the experimenter to calibrate each change in setting with an external pulse source and oscilloscope. Newer discriminators offer a front panel test point whose DC level is proportional to the actual discriminator threshold. Not only does this allow rapid and simple determination of threshold, but it also allows the experimenter to easily return the threshold level to a previously recorded setting. The convenience, and therefore the usefulness, of this feature is strongly dependent upon the characteristics of this monitor voltage, particularly its linear proportionality with the threshold setting. Figure 1.3 indicates the characteristic curve of monitor voltage vs. threshold for the LeCroy 623 Series Discriminators.

1.3.5 623 Series Threshold Hysteresis

In standard 623 series discriminators, hysteresis is built into the front end, such that every threshold crossing will not trigger the discriminator unless the previous signal has returned to below approximately -15 mV. This avoids multiple pulsing due to, for example, fine structure riding on a flat-topped pulse. Note the examples in Figure 1.4.

In Example A, the pulse shape variations of the input pulse will not retrigger the discriminator even though they cross the threshold level at a time exceeding the double pulse resolution of the unit. In Example B, since the input signal does go back through -15 mV and then once again rises to exceed the -30 mV threshold level, two discriminator outputs would result.

1.4 Input Reflections

Input reflections probably account for the majority of multiple-pulsing problems encountered by users. As discriminator thresholds have become lower, the amount of reflected signal required to retrigger the unit has decreased accordingly. Unless the percentage of input reflections is reduced along with the minimum threshold value, the user finds himself in the situation where multiple-pulsing negates the usefulness of a lower threshold. The input reflections of a discriminator effectively determine the allowable dynamic range of event or noise input signals.

A limited dynamic range may mean that minimum threshold values will have to be set higher to prevent multiple pulsing on noise or large (shower) event signals. In addition, high input reflections also limit the ability of a discriminator to be used to restandardize logic signals which have been degraded by long cables.

Figure 1.5 shows the maximum input voltage and allowable dynamic range as a function of discriminator input reflections.

As is evident, the 623 series discriminators offer a dramatic improvement in input reflection suppression over previously available discriminators. Because of the extremely low reflection coefficient of the 623's (i.e., <2% for inputs of risetime >2 nsec), maximum input signal is more than a volt larger than it would be for a unit exhibiting the typical 10% reflections, offering five times increase in the discriminators' dynamic range.

1.5 Common Inhibit

All eight channels of the Model 623B may be disabled by a common front panel NIM input. A time difference of 6 nsec exists between the analog and the inhibit inputs. In order to inhibit, the leading edge of the veto should precede the threshold crossing by $6 +1$ nsec. The actual time inhibited is 5 nsec shorter than the duration of the veto input.

1.6 Bridged High Impedance Input Factory Option

Certain 623 series modules are offered with bridged high impedance input options. The bridged high impedance inputs permit a user to drive only one cable from the photomultiplier to the discriminator to permit subsequent fast logic decision and pattern recognition to be performed. A popular method in the absence of this discriminator input option is to run two cables, one of which is from the dynode, which then must be inverted before the ADC or discriminator could accept it.

For this bridged input option, the left lower output connector is generally sacrificed to provide the additional input. A silver-colored ring is placed around this connector (as well as around the original input connector) when the unit is modified for this option to signify the fact that there are now two input connectors. In standard usage, the silver-colored ring usually specifies complementary output.

1.7 Output Characteristics

Low Impedance Voltage Output: The Model 623 series discriminators require only one output driver (for 3 outputs) per channel. This driver requires no quiescent current, thereby permitting extremely small average power dissipation while still providing fast output response time. The output amplitude, although somewhat dependent on the number of output loads, will always be more negative than -800 mV in the logic "1" state.

The low impedance voltage output stage response times will be optimum when driving at least two 50 ohm loads.

1.7.1 Output Width

The output pulse width range for the 623 is 6 to 150 nsec. For the 623A the range is 7 to 50 nsec. Both ranges are continuously adjustable via front panel width potentiometers. The control allows coarse adjustment near maximum width and precise adjustment for narrower settings.

1.7.2 Output Width Uncertainty

The output width of most discriminators is a nominal value determined by the front panel potentiometer. Dispersion caused by variation in the discriminator input amplitude (jitter) results in a broadening of the skirts on the timing curve. In the LeCroy 623 series discriminators, this contribution is virtually non-existent as indicated in Figure 1.6.

The other main contributions to output width uncertainty are a function of external conditions in a manner similar to threshold uncertainty. Variations in both temperature and voltage can cause significant changes in output width with undesirable consequences identical to dispersion caused by input amplitude.

Figure 1.7 indicates the uncertainty in output width of the 623 series discriminators as a function of reasonable variations in temperature and supply voltage.

1.7.3 Updating

The LeCroy 623 series discriminators are all updating. In an updating discriminator the output is extended if a second pulse comes in before the first output returns to zero, as long as the second pulse arrives at a time later than the double-pulse resolution of the unit. Thus, the second pulse will be seen by the front end even though an output pulse is still present from the first signal, and that second pulse will cause a new output to be generated and added (in time) to the portion of the original output that already occurred.

1.8 Timing Characteristics

1.8.1 Double-Pulse Resolution

The speed of a discriminator is practically defined by its double-pulse resolution, or the time between the leading edges of the most closely spaced pulse pair for which the discriminator produces two distinct output pulses. Although simple in concept, this specification can be misleading unless the input conditions are precisely defined and performance fully specified. Characteristic curves which describe double-pulse resolution for the 623 series are in Figures 1.8 - 1.10.

Double-Pulse Resolution vs Input Amplitude: The double-pulse resolution of some discriminators is a strong function of the amount overdrive. Typical anomalies include substantial increases in

amplitude to achieve minimum pulse pair resolution (which is an effective threshold increase as a function of rate) and/or limited input dynamic range over which the discriminator adheres to specifications. A third effect is equivalent to tracking error. Does a discriminator have 8 nsec DPR if it never produces output pulses spaced more closely than 10 nsec apart? In some cases this effective timing error can be much larger than time shift due to intrinsic slewing or risetime dependent slewing. Figure 1.8 shows the minimum double-pulse resolution of the LeCroy 623 series discriminators as a function of input amplitude from threshold to 10X threshold.

It is worth noting that the 623's maintain a DPR of under 9 nsec for all inputs over the 10:1 dynamic range. Although not featured as part of the general specifications, the double-pulse resolution is much better than specified over most of the measured dynamic range. Also significant is the absence of tracking error at the limit of the discriminator's input performance. Throughout the measured range, the time shift of the output averages 2.54% or approximately 200 psec.

Double-Pulse Resolution vs Input Width: The DPR of a discriminator is a strong function of the duration of the first pulse in an input pair, since this width affects the recovery time allowed the discriminator input stage between the two pulses. If the double-pulse resolution is not linear with input width, it may mean that the discriminator will not respond to the second pulse following an overload photomultiplier signal. The double-pulse resolution vs input width of the 623 series discriminators is shown in Figure 1.9. This figure demonstrates that the discriminator's response is linear with input width and has a fixed recovery time of 4 nsec following an input of any duration.

1.8.2 Tracking Error

The ability of a discriminator to be used for precise timing (coincidence or TOF) in an environment which encounters narrow pulse pair separations is demonstrated by considering the time shift (or tracking error) introduced as the time interval between successive inputs is reduced. In an experiment, tracking error is equivalent to time dispersion as a function of input rate. For many experiments, this can be critical, since it is often in high rate situations that the best timing resolution is required.

Tracking error of the 623 series discriminators as a function of input pulse spacing is indicated in Figure 1.10.

1.8.3 Slewng

For input rates which do not tax the double-pulse resolution of the discriminator the most important characteristic which defines the fidelity of the discriminator output to the time information in the input signal is slewing. This is defined as variation in the input-to-output time delay of a discriminator with input amplitude.

The net measured slewing yielded by a discriminator has two components, one contributed by the discriminator itself (intrinsic slewing) and the other dependent upon the input risetime.

Intrinsic slewing might be defined as the slewing measured with a delta function input. Risetime dependent slewing arises from the fact that the discriminator fires earlier on the leading edge of a large pulse of finite risetime than on one of smaller amplitude with the same risetime. For an extreme range of pulse heights, the maximum contribution is equal to the 0 to 100% risetime of the pulse.

With most discriminators, the largest portion of the slewing occurs in the amplitude region just above threshold. Threshold being defined as the input amplitude that produces 50% triggering. Slewing specifications are frequently given over an input amplitude range from threshold to a specified overload factor (such as 10X threshold).

No commonly accepted standard exists for measuring the slewing characteristics of discriminators. One technique which LeCroy considers relevant to describing a discriminator's timing characteristics is to obtain a time spectrum of shift in input-output delay when a uniform spectrum of pulse heights from below threshold to many times threshold is used to drive the discriminator. Such an input spectrum constitutes a relatively severe test of the discriminator's timing performance for it contains a relatively higher proportion of near threshold impulses than does a usual beam-derived photomultiplier spectrum. It takes into account all aspects of discriminator slewing performance and presents their combined effect in terms of a time dispersion curve such as indicated in Figure 1.11.

1.9 Packaging

The NIM 623 series discriminators are all packaged in a #1 NIM module with LEMO-type connectors. Due to front panel space limitations, the 623's are not offered with BNC connectors. The CAMAC 2623 is packaged in a #2 CAMAC module with LEMO-type connectors.

1.10 Current Requirements

In order to provide an octal discriminator with fast response times and output levels greater than 800 mV, a large amount of supply current is required. The models 623 and 623A require about 11 watts. Therefore, if more than 9 of these units are to be used in a bin, the bin power supply must be capable of providing more than the standard 96 watts. A 200 watt NIM bin (Model 1002) is available from LeCroy.

1.11 Recommended Use of the NIM Power Bins

It is highly recommended any NIM bin be kept at as constant a temperature as possible, using air conditioning and fans to assure air flow through all modules in every bin. Elimination of large temperature variations removes the possibility of temperature drift effects upon modules and the forced air flow is good insurance against the potential failure of

components in the modules due to excessive heating for extended periods of time. Despite the fact that all components are pre-aged and burned-in before insertion into LeCroy modules, and the modules themselves are temperature cycled for days under power between initial test and final test, it is recommended that subjecting any modules to adverse operating conditions be avoided when possible.

1.12 Input Protection

The inputs of 623 series discriminators are protected to 5 A for 0.5 μ sec, clamping at +1 and -7 volts. Beyond these voltages the input is no longer terminated in 50Ω and substantial reflections will occur.

The DC protection is limited by the 0.25 watt dissipation limit on the input resistor, which can be assumed to offer protection against DC signals between -5 volts and +5 volts.

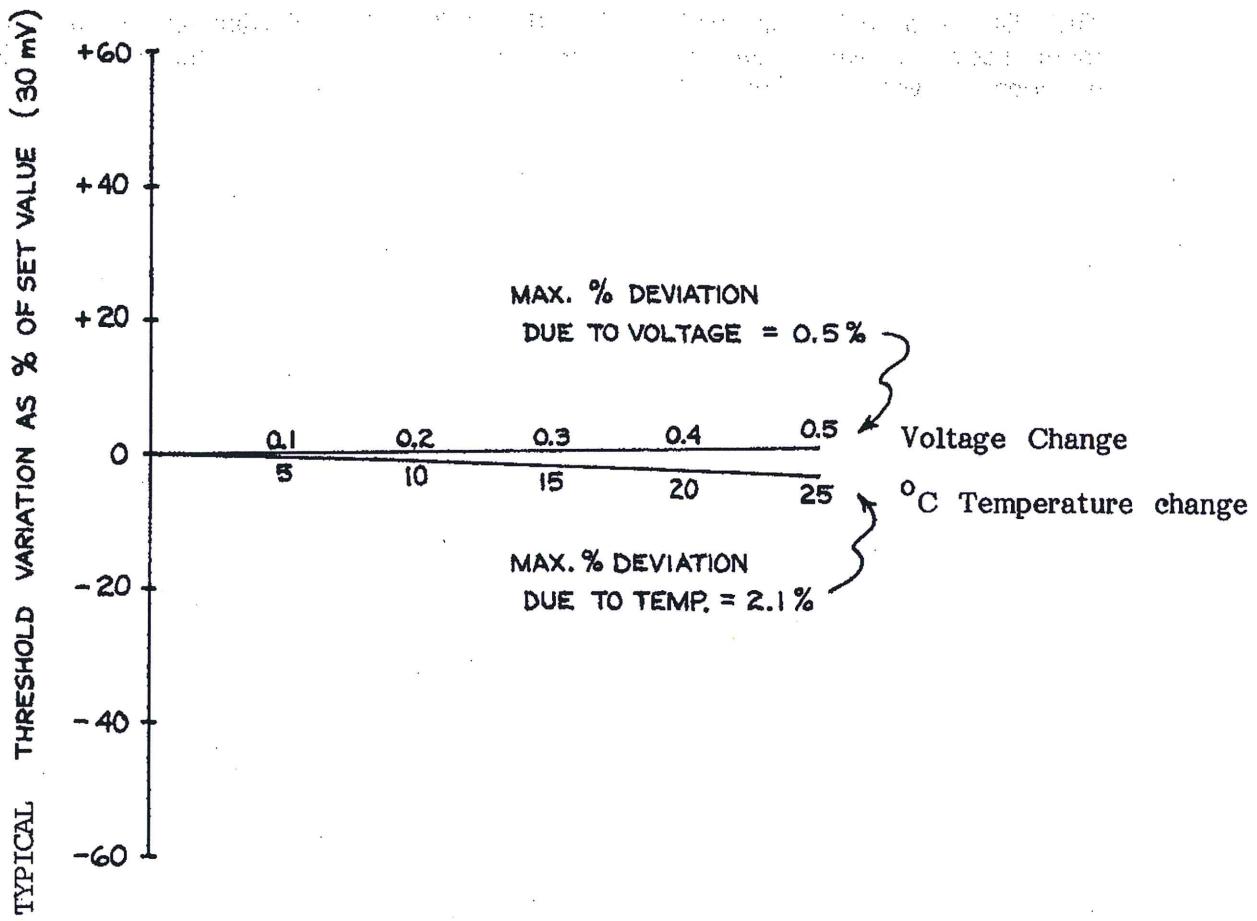
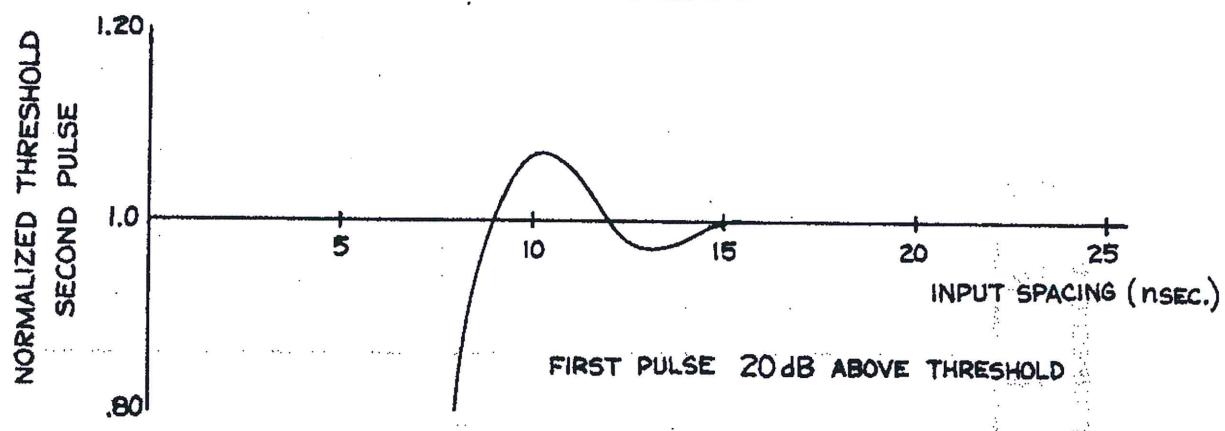


Figure 1.1

623 SERIES THRESHOLD MEMORY



623 SERIES THRESHOLD MEMORY

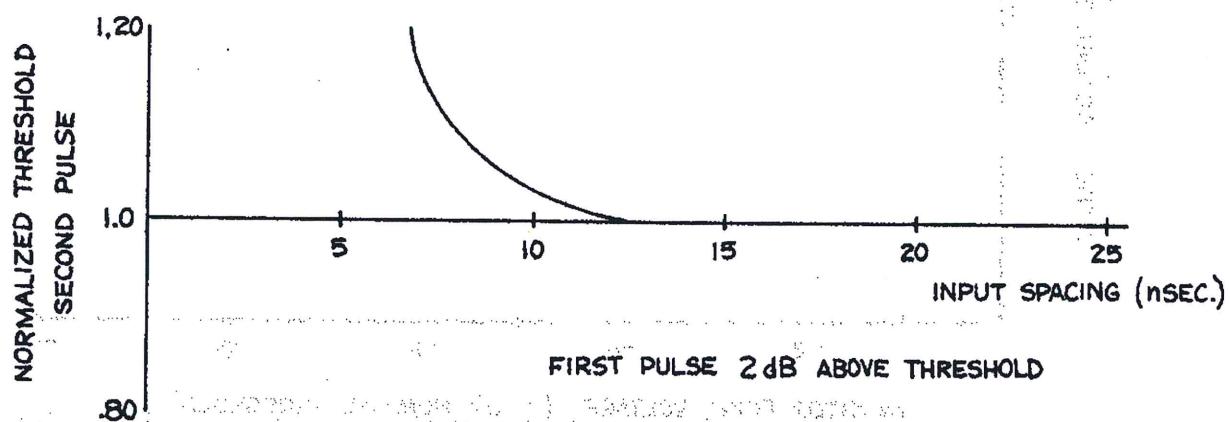


Figure 1.2

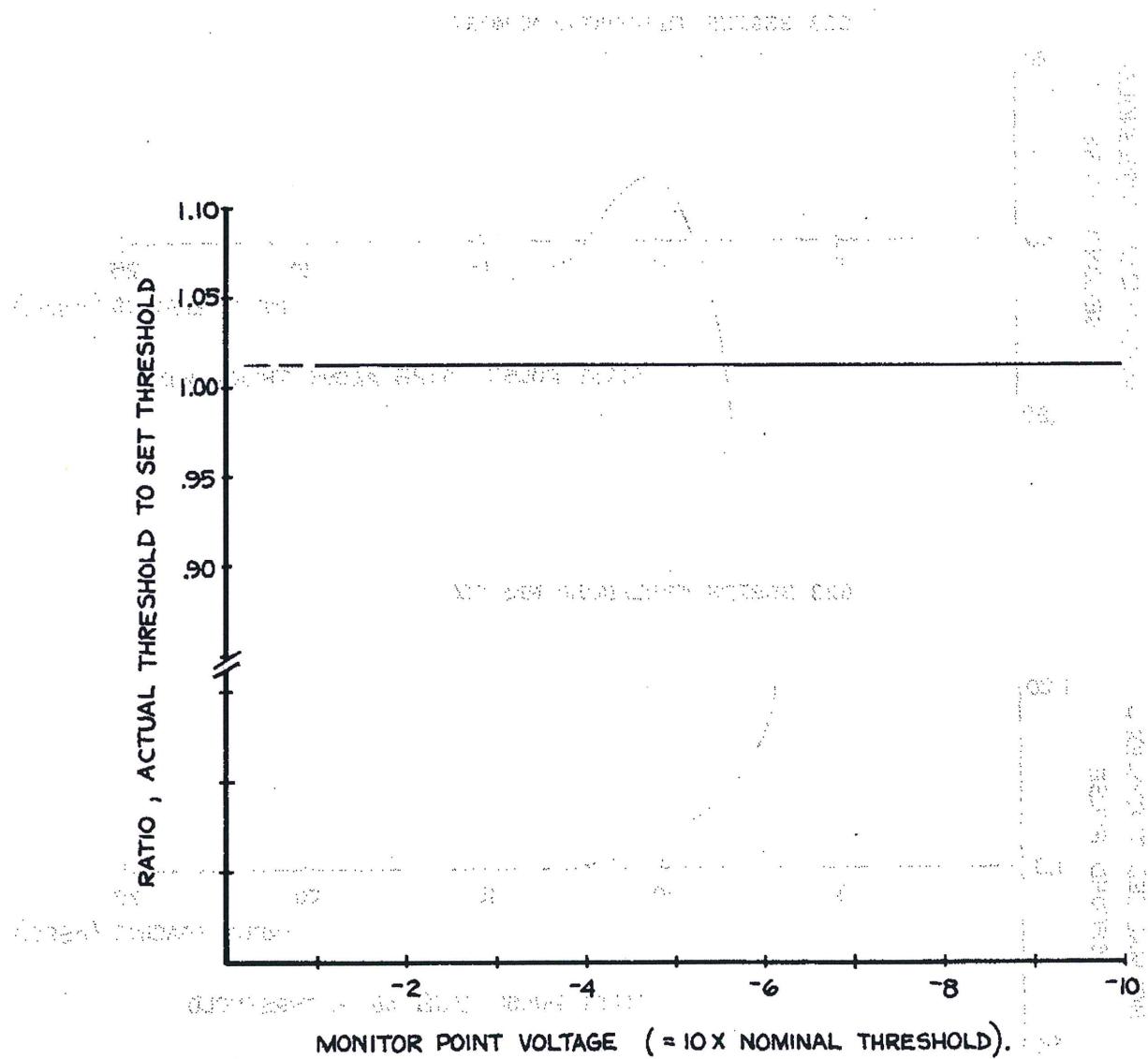


Figure 1.3

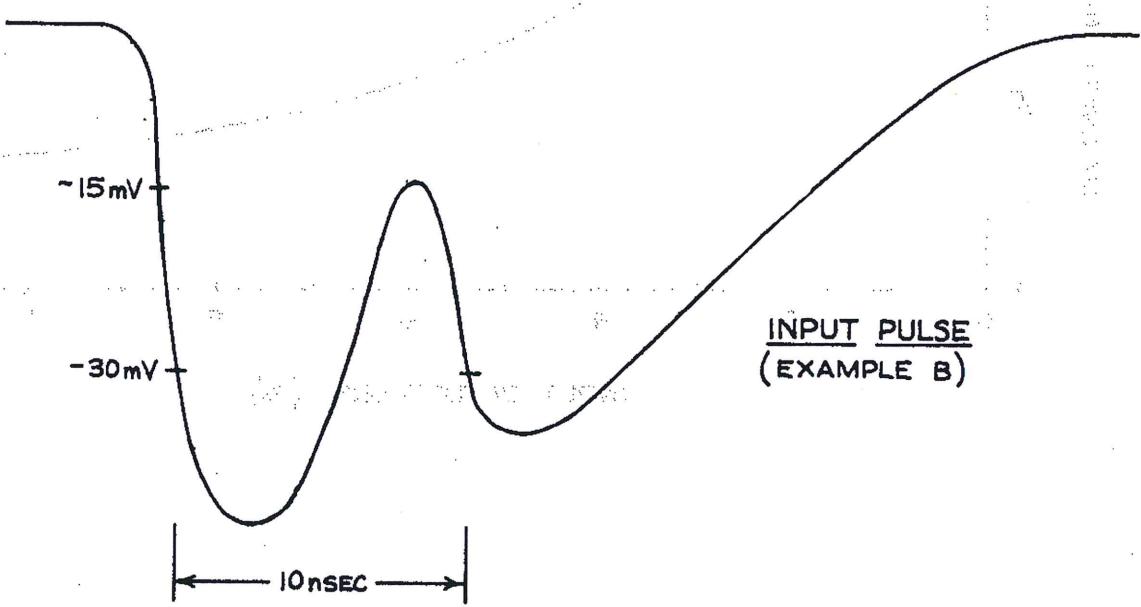
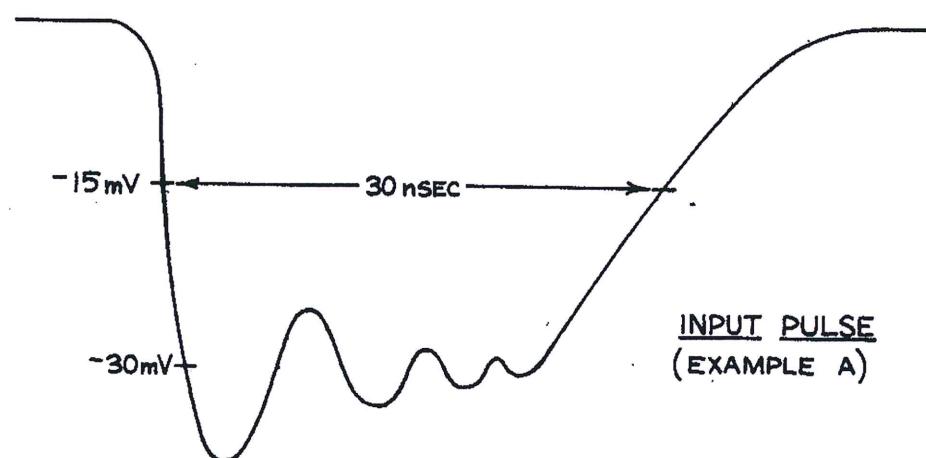


Figure 1.4

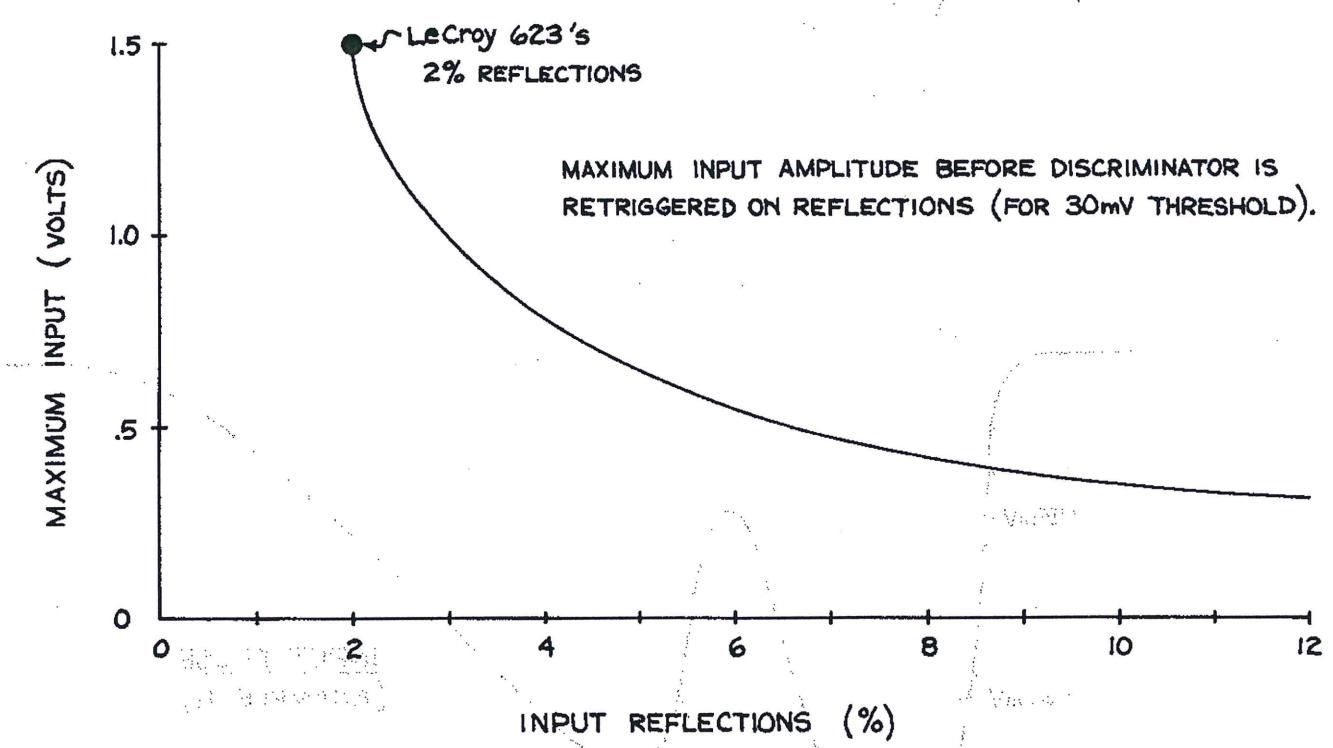


Figure 1.5

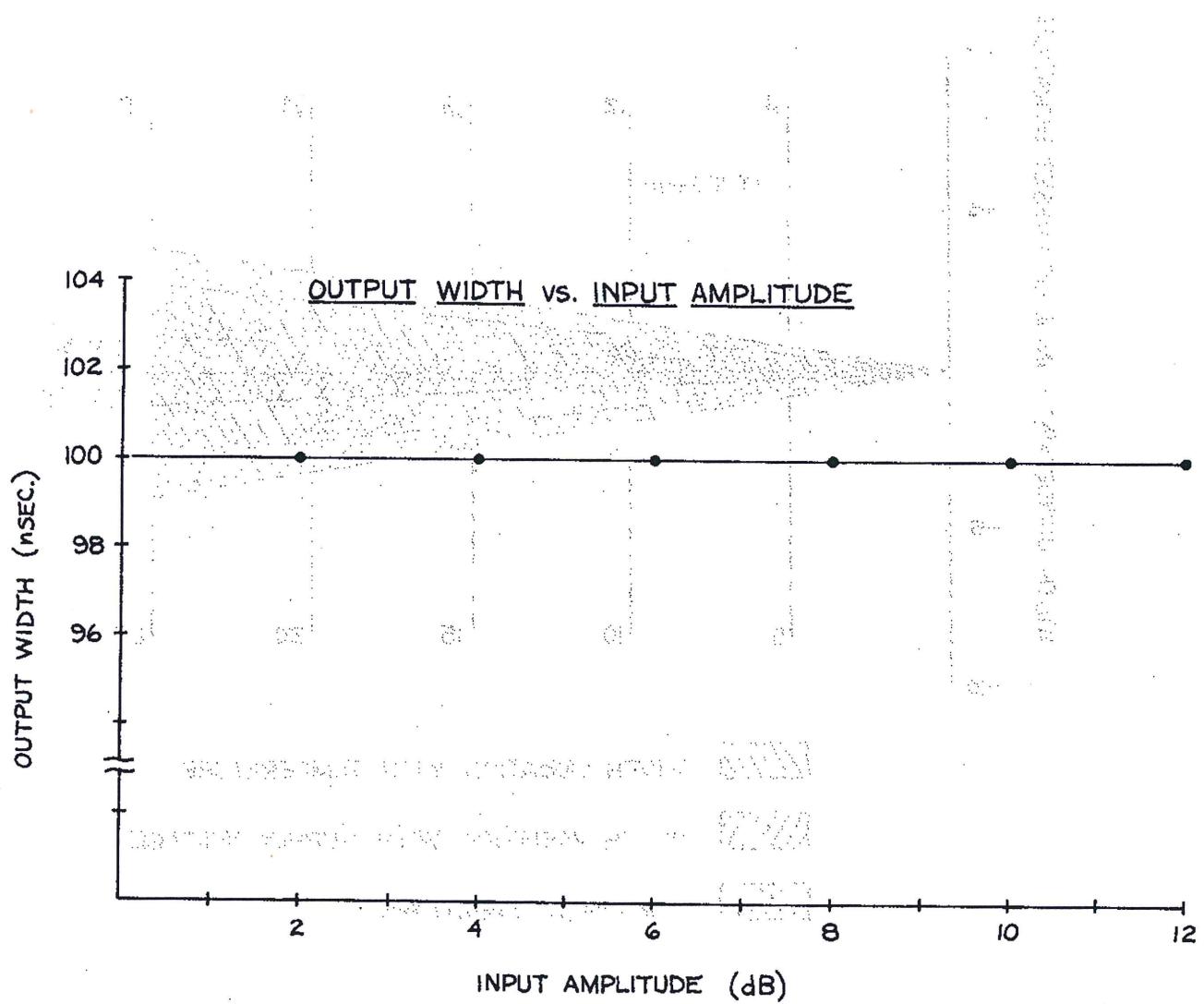


Figure 1.6

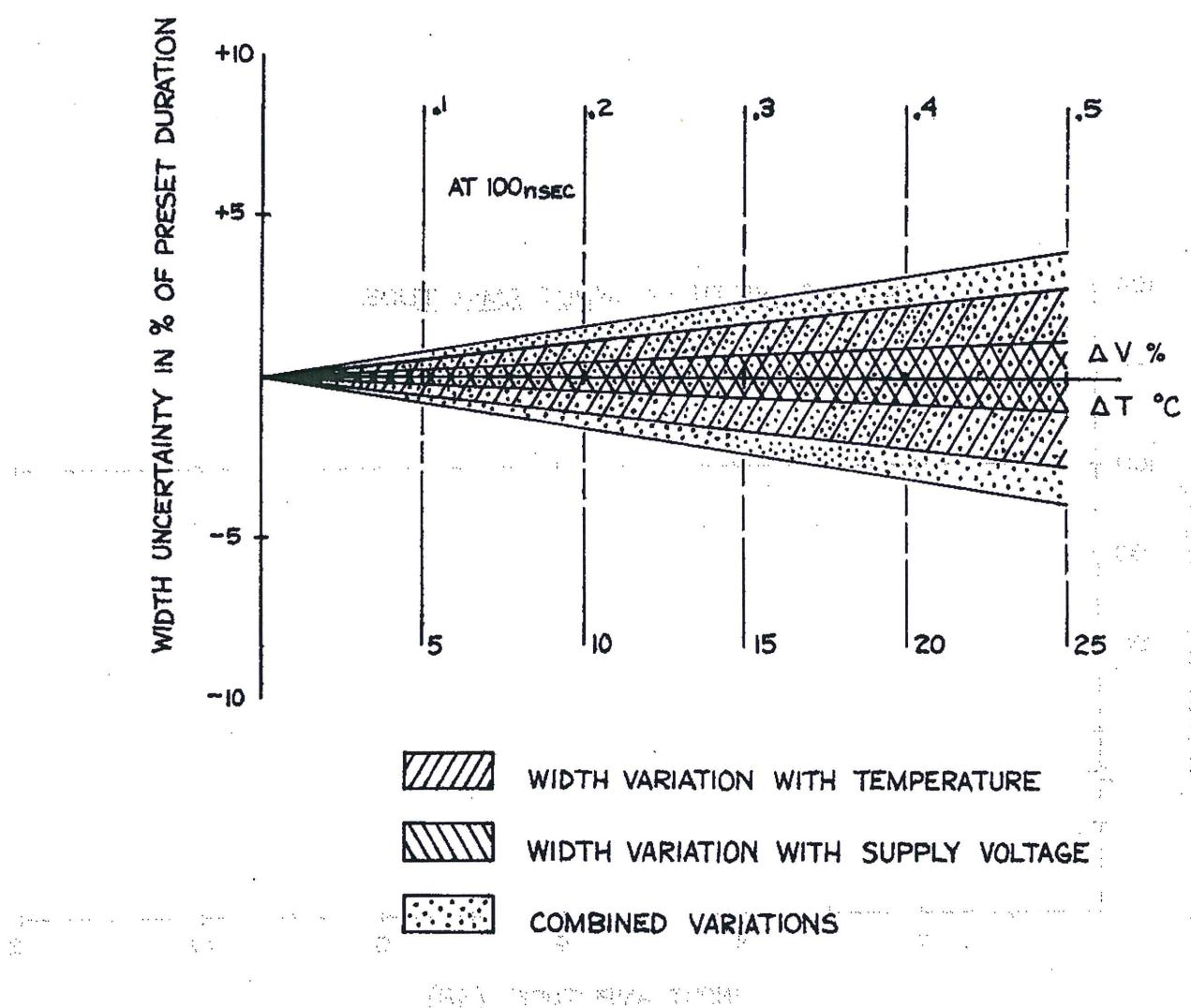


Figure 1.7

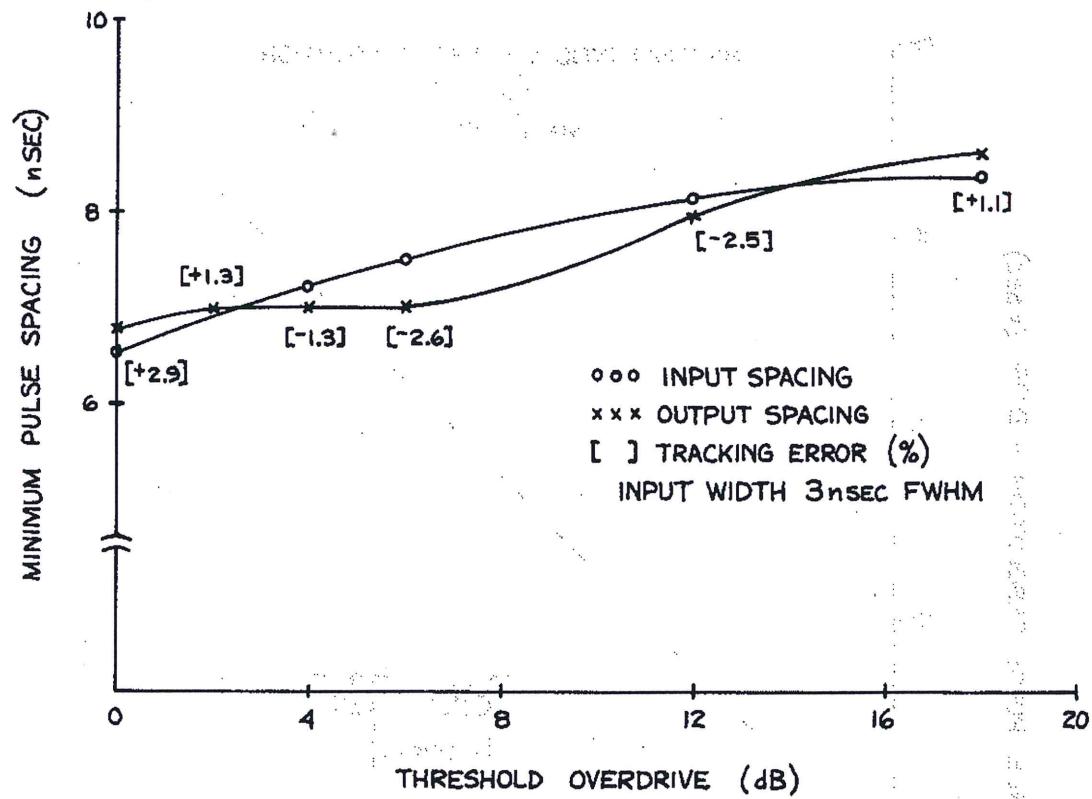


Figure 1.8

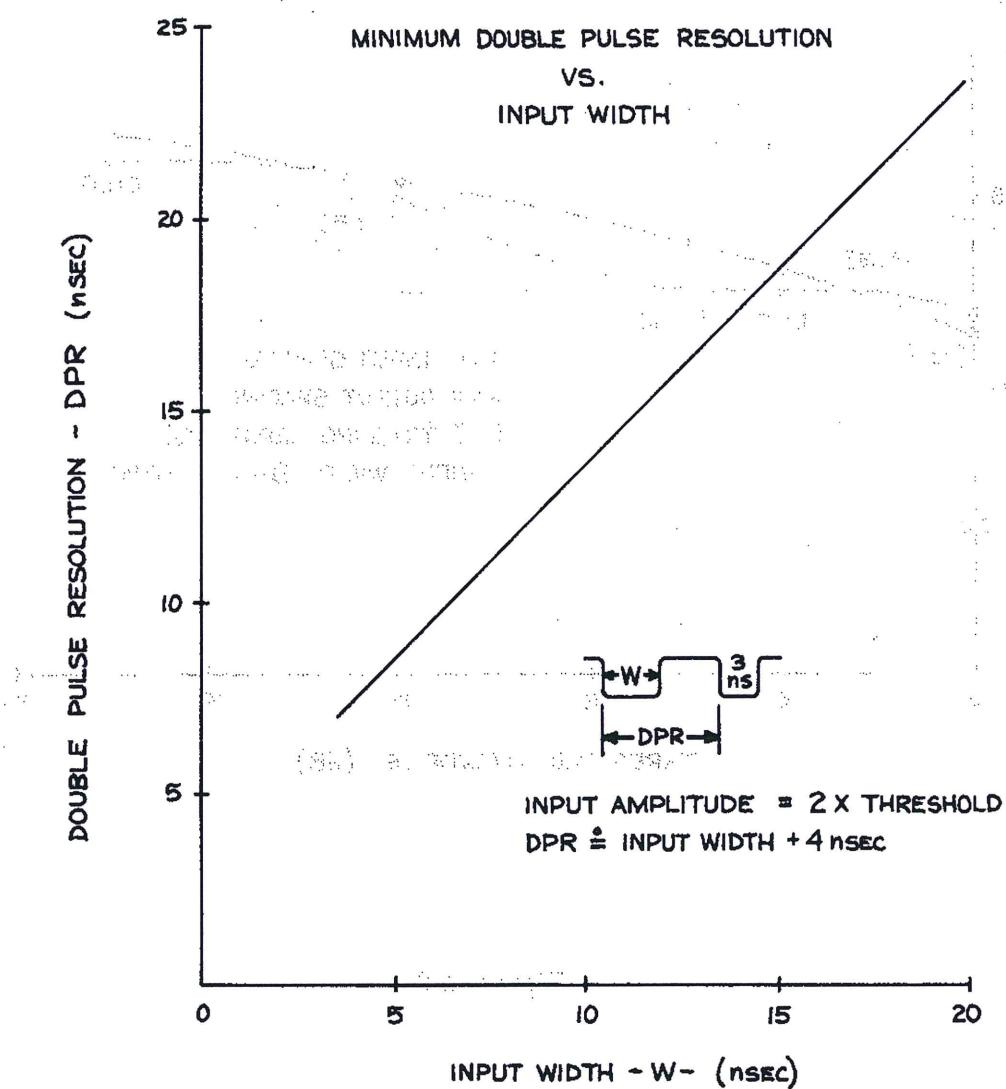


Figure 1.9

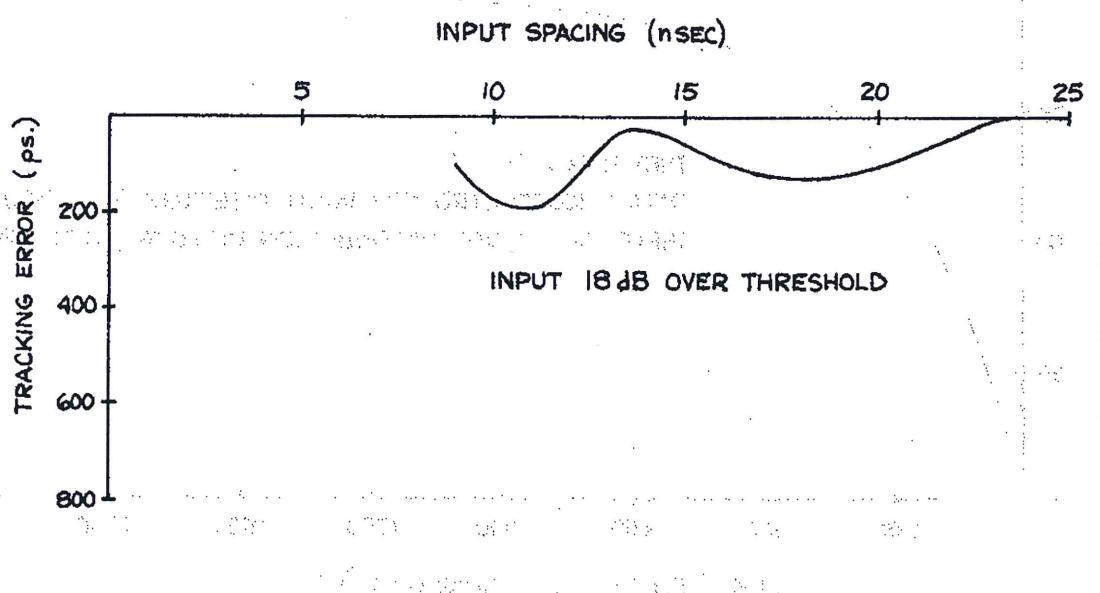
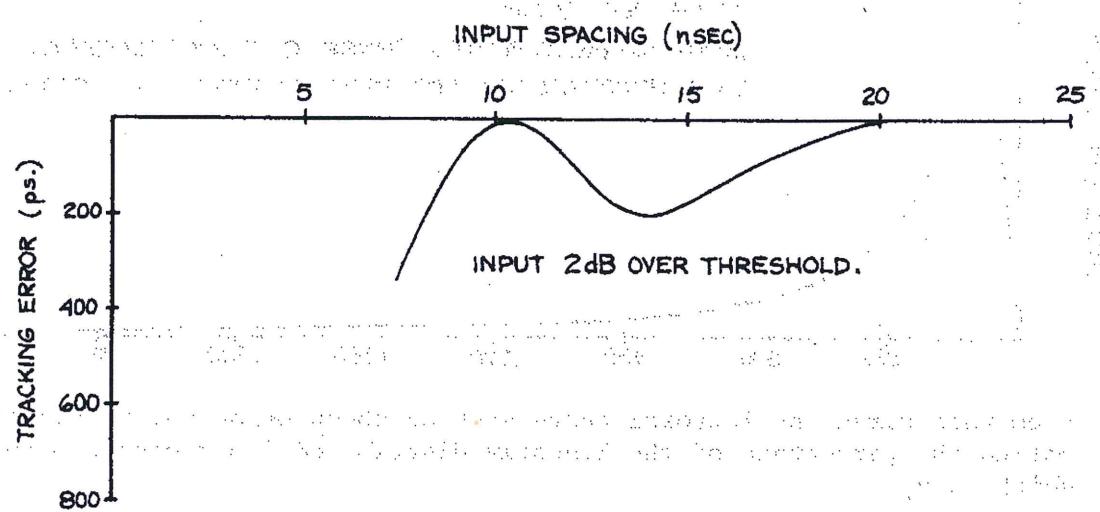
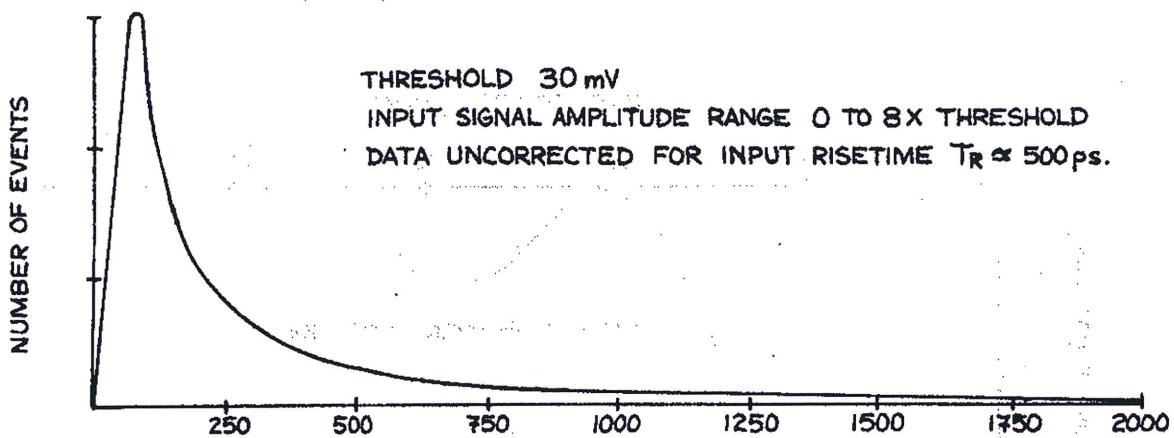


Figure 1.10



From this curve, an integral curve such as shown below may be plotted indicating the percentage of the linearly distributed input events with time shift $< s$.

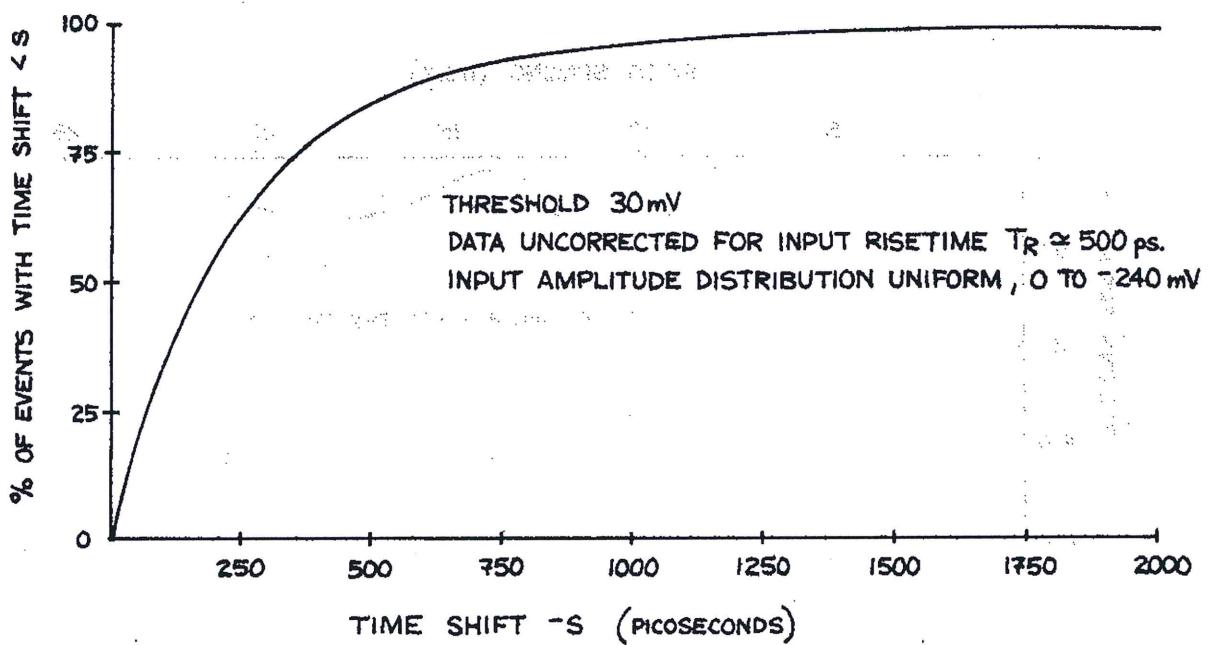


Figure 1.11

SECTION 2

TECHNICAL DESCRIPTION

2.1 General

Each of the four channels of the 623 series models is composed of three basic sections:

1. Input and discriminator stage
2. Timing or pulse-former stage
3. Output stage.

A block diagram of the 623 series models can be seen in Figure 2.1, and a complete schematic of a specific model can be found in the rear pocket of this manual.

2.2 Input and Discriminator

The input and discriminator stage is based on the LeCroy Model LD601 hybrid. This unit contains all of the circuitry of the discriminator with the exception of the input termination and high voltage protection. The LD601 is functionally presented in Figure 2.2. The threshold level is set by changing the voltage bias on a fast differential amplifier which has a small amount of positive feedback to provide regeneration at threshold. In actual operation the V_T input is grounded, and the threshold level is determined by the 10:1 voltage divider (composed of the external 999 Ω and internal 100 Ω resistors) operating from a voltage which is set by a front panel potentiometer and monitored at the front panel test point.

The measured voltage will be 10 times the actual threshold voltage. When an input signal applied to -IN is equal to the threshold voltage at +IN, the amplifier output will begin to go positive. This will force +IN closer to 0 volts, which increases the differential input voltage in such a direction that the output locks and then the cycle reverses. The amplifier output thus provides a time-over-threshold pulse with fixed amplitude. This pulse can be monitored at the AMPL. OUT point (pin 6). The quiescent level should be nominally -2.4 volts going to -1.6 volts during the pulse. The leading edge of this output sets the latch circuit which is used as a pulse width standardizer. Before the amplifier and the latch can be set, the inhibit inputs (used for the bin gate) must be off. The required level at Pins 7 and 16 of the LD601 must be 0 to -1.6 V to enable, and -2.5 to -6.0 V to disable. The purpose of the first inhibit is to avoid generating a low level transient at the output associated with the leading edge of an amplified input pulse inhibited at the dV/dt stage only. (The common bin gate driver shifts this so that 0 volts at the Bin Gate input will inhibit, greater than +3 volts will enable). Once the latch is set, a latch OUTPUT is available to start the 623 series timing stage. The OUTPUT amplitude and leading edge should be similar in appearance to the AMPL OUT above, but the width of the output will be fixed

independent of the input width. Internally, the latch output is fed back to reset the latch after a short time delay, thus generating a short output pulse whose actual width can be set by the proper external selection of RC time constant and voltage levels at Pins 3 and/or 4. It is set at approximately 3 nsec in the 623 series models.

Two trim resistors, T1 and T2, are associated with this stage (see enclosed schematic). T1 sets the minimum threshold. T2 calibrates the LD601 threshold to the test point voltage at its respective channel. If the LD601 is changed, T2 will probably require trimming.

2.3 Timing Stage

The output of the LD601 drives a fast NPN switching transistor. Normally this transistor is found in its cut off region, its collector is clamped to approximately 400 mV by a Schotkey diode. This 400 mV level biases the PNP output stage driver transistor, Q2, to its cut off state. In this state the voltage across the 7.5 pF timing cap is approximately 3.2 volts. When the LD601 provides an input pulse to the timing stage the NPN device turns on (it is prevented from saturating by the anti-saturation diodes), the voltage at the collector is negative such that the PNP driver turns on and supplies a pulse to the output stage. The duration of this pulse is determined by the time constant consisting of the equivalent resistance of the front panel potentiometer and trim resistors and the 7.5 pF cap. Since the final voltage to which the cap can charge is much greater than the point where it is clamped, a fairly linear ramp is produced on the collector of the NPN. When the capacitor voltage crosses the base threshold voltage of the PNP, the drive turns off and allows the output stage to return to its quiescent level.

2.4 Output Stage

The output stage is a simple NPN inverter stage with the emitter returned to the negative 3.8 volt supply. The stage is normally biased in the cut off region. During an output pulse, sufficient base current is supplied from the LD601 to turn the output driver on. In the on condition, the collector voltage is approximately -2.7 volts. The $110\ \Omega$ series resistor and the 50 impedance of the load form a divider to provide a -840 mV output to the output connector. In order to reduce the turn off delay time of the output stage, the output driver is prevented from entering the saturation region by an anti-saturation technique, consisting of a conventional diode and a hot carrier diode.

2.5 Internal Power Supplies

Four internal power supplies are used to generate the -0.8, -3.8, +6 V and -6 V.

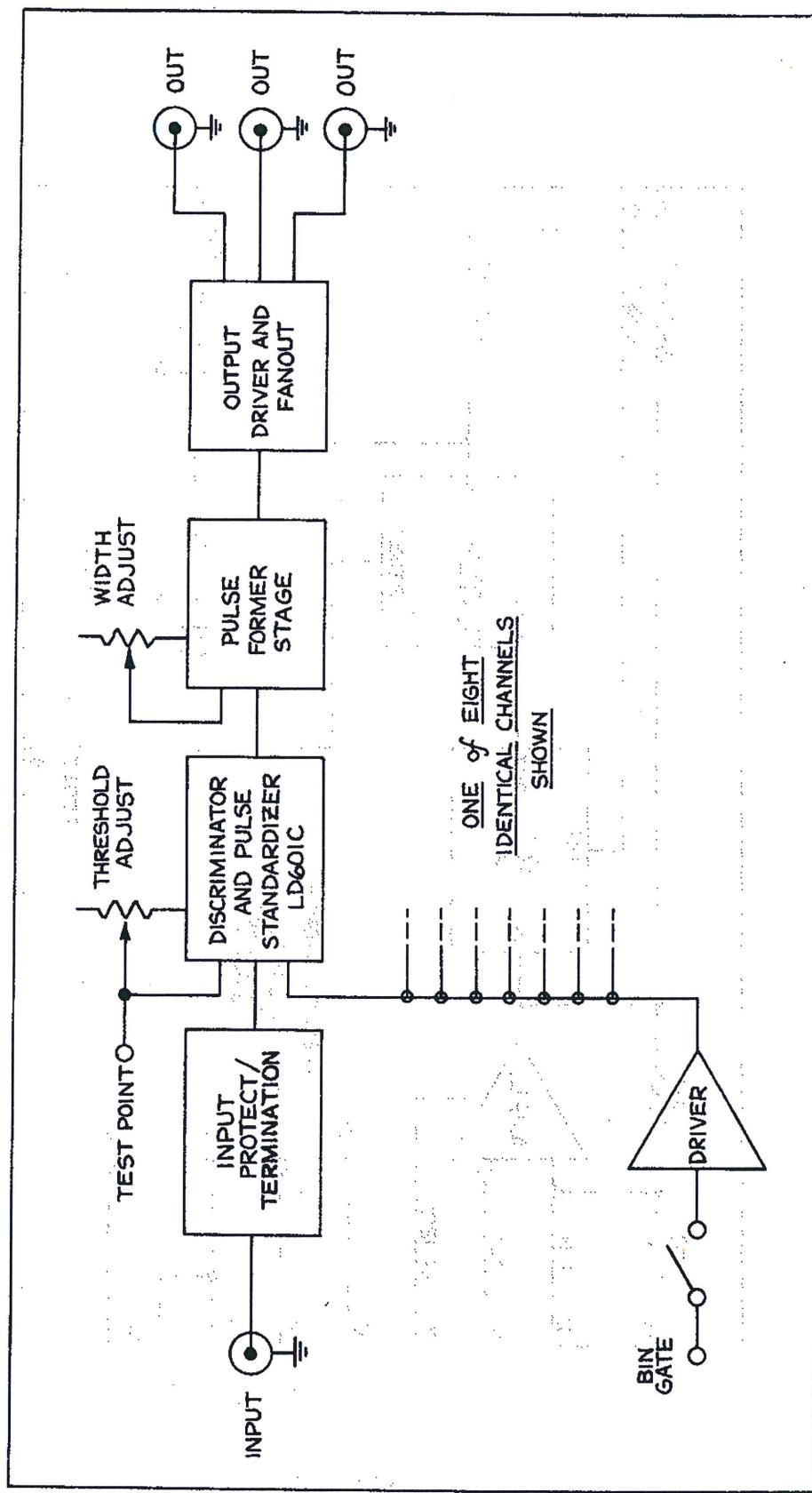


Figure 2.1

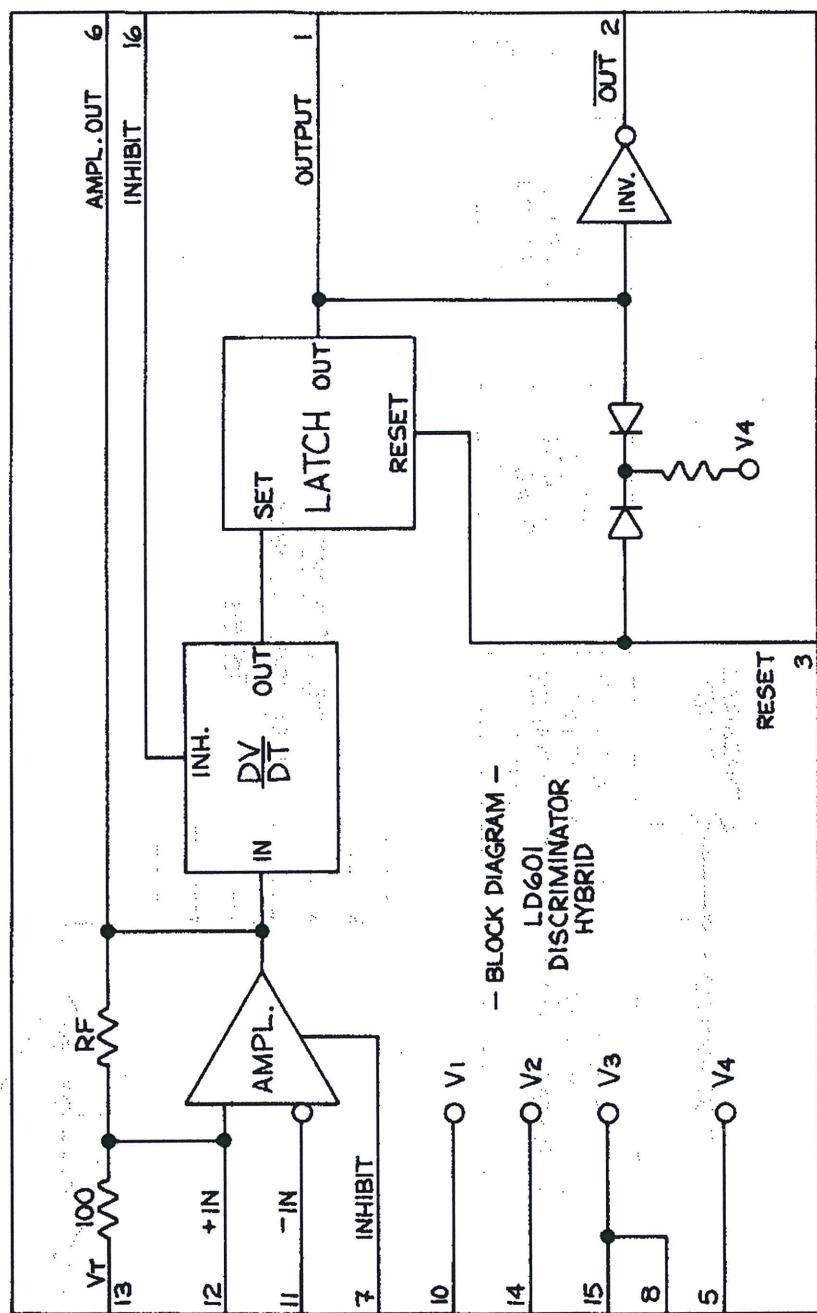


Figure 2.2

SECTION 3

TEST AND CALIBRATION

This Test and Calibration Section has been included to familiarize the service technician with the areas that should be checked when searching for sources of failures and after replacing components, especially front end hybrids (LD601's). The trouble-shooting section is by no means exhaustive, but it does provide insight into some of the problems that have occurred at LeCroy during the initial testing of the 623's. The technician should follow the "Trouble-Shooting Guide" for ease in determining the defective component. Replacement of critical components will require some recalibration.

3.1 Trouble Shooting

Equipment Required:

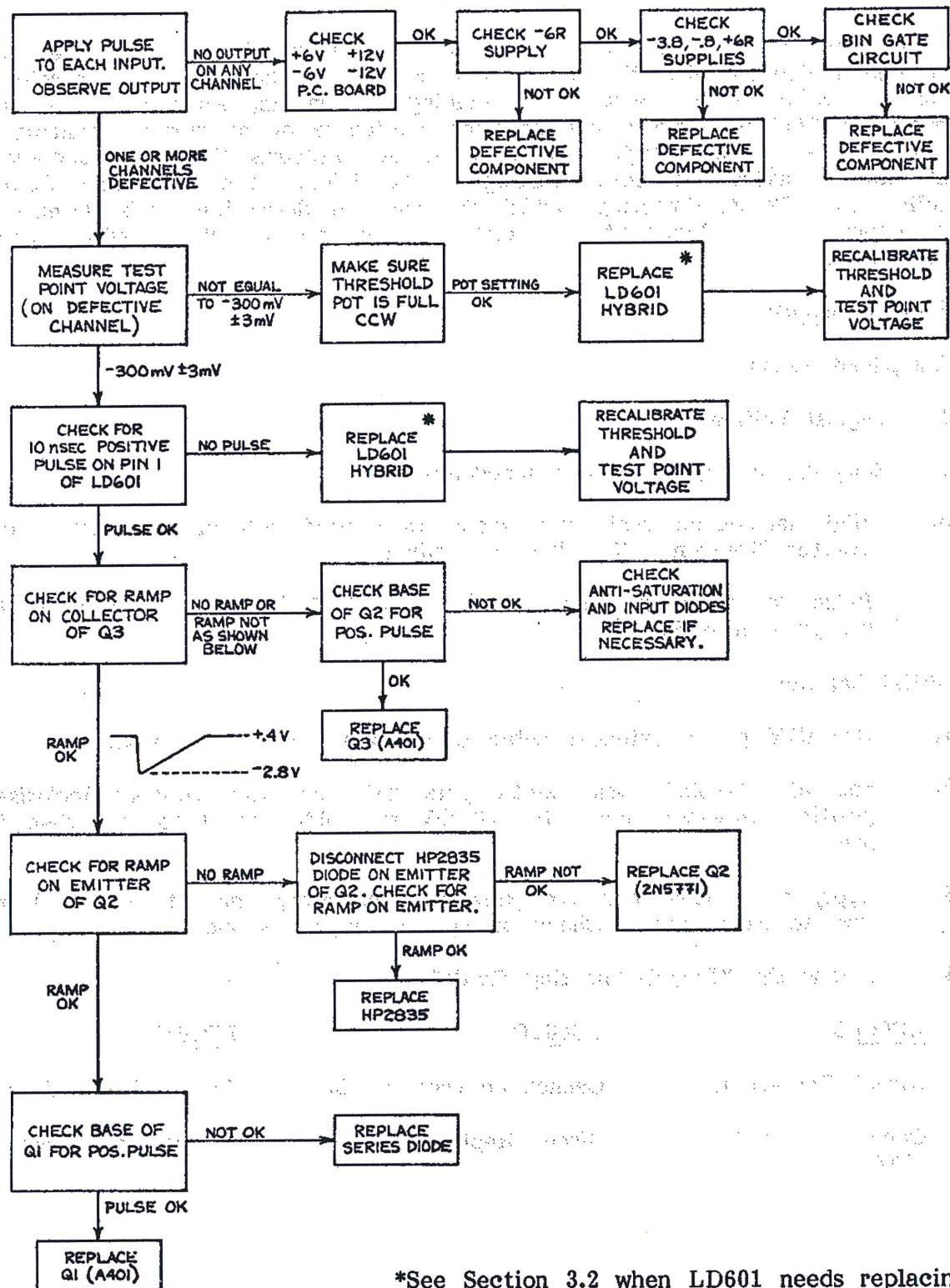
1. Digital Voltmeter.
2. Sampling scope; 50Ω input impedance.
3. High impedance real time scope with bandwidth of 150 MHz or greater (Tektronix 454, 475, or equivalent).
4. Pulse generator or signal source capable of producing 10 nsec - 50 mV pulse into 50Ω .

Initial Set-Up:

1. Use NIM power extender cable to power the 623 under test.
2. Set all threshold and width pots to their full counter-clockwise position (threshold equal to -30 mV and width equal to less than 5 nsec).
3. Apply a 10 nsec negative pulse (approximately equal to -50 mV) in turn to each input. Check output on sampling scope.
4. Follow the "Trouble-Shooting Guide".

<u>Model</u>	<u>LD601C</u>	<u>LD601D</u>	<u>LD601E</u>
623	Direct Replacement	Cannot be used in 623	Cannot be used in 623
623A	Cannot be used in 623A	Direct Replacement	Direct Replacement

TROUBLE-SHOOTING GUIDE



3.2 Required Recalibration if LD601's are Replaced:

If any LD601 was found to be defective and required replacement, the Threshold and Test Point voltage should be recalibrated.

Procedure:

1. Set front panel Threshold pot to minimum (counterclockwise).
2. Measure Test Point voltage. If not equal to -300 ± 5 mV, replacing existing trim resistor T_1 , (across 5 K Ω pot) with proper resistance to bring Test Point voltage into required range (50 K to 150 K Ω).
3. Check Threshold level with a 5 nsec wide pulse; if it is not -30 mV, replace existing trim resistor T_2 (across 12.4 K Ω resistor) with proper resistance (50 K to 150 K Ω).
4. Check minimum output width, set front panel width control pot fully counterclockwise, check pulse width - if it is not 6 nsec (or less) for model 623 or 7 nsec or less for model 623A, retrim by replacing trim resistor (across the 430 Ω) with the proper value.
5. Check maximum output width, set front panel width control pot fully clockwise, check pulse width - if it is not 150 nsec (or greater) for model 623 or 50 nsec (or greater) for model 623A, retrim by replacing the trim resistors (across the width pot) with the proper value.

Replacement of Q3 and Q4:

Observe output width of less than 1 μ sec with front panel width pot set to its full clockwise position. Retrimming will be required. (See Calibration (9) Maximum Width).

Calibration

The following is a detailed step-by-step calibration procedure for the 623 Discriminator. The sequence should be followed to avoid extraneous labor.

Important

- a. When actual trim and calibration adjustments are performed, be sure the unit had at least 5 minutes of warm-up time. (Calibration may be off if warm-up time is too short).
- b. If for any reason, long periods of time between trimming occur, be sure to double check periodically the bin voltages (Step 3). (Power supply voltage may change and calibration may be off when performed to the new changed voltage).
- c. If at any check or calibration step problems occur, refer to the Trouble-Shooting Guide.

Procedure

1. Check (on board) the presence and verify the following correct voltages: +6 V, +12 V, -24 V. These voltage points are clearly marked on the rear of the P. C. board.
2. -0.8 Volt Regulator - Measure the voltage on the -0.8 V bus. Readjust pot if voltage is not -0.8 V \pm 8 mV.
3. -3.8 Volt Regulator - Measure the voltage on the -3.8 V bus. Readjust pot if voltage is not -3.8 V \pm 38 mV.
4. +6 Volt Regulator - Measure the voltage on the +6 VR bus. Readjust pot if voltage is not +6 V \pm 60 mV.
5. -6 Volt Regulator - Measure the voltage on the -6 VR bus. Readjust pot if voltage is not -6 V \pm 60 mV.
6. Test Point - Set front panel threshold pot to minimum (counterclockwise). Measure test point voltage. If not equal to -300 \pm 5 mV replace existing trim resistor T1 (across 5 K Ω pot) with proper resistance (50 K Ω to 150 K Ω) to bring test point voltage into required range.
7. Threshold - With front panel threshold pot to minimum (counterclockwise), check threshold level with a 5 nsec wide pulse applied to input. If it is not -30 mV, replace existing trim resistor, T2, (across 12.4 K Ω resistor) with proper resistance (50 K Ω to 150 K Ω).
8. Minimum Output Width - With front panel width control pot fully counterclockwise, check output width. If it is not between 5.75 and 6 nsec for 623 and 7 nsec for 623A, retrim by replacing the trim resistor (across the 430 Ω) with the proper value.
9. Maximum Output Width - With front panel width control pot fully clockwise, check output width. If it is not between 150 and 160 nsec for the 623 and 50 nsec for the 623A, retrim by replacing the trim resistor (across the width pot) with the proper value.

Compaq Confidential Information: Unauthorized use or disclosure is prohibited.

MODEL NO 623B
ECON 1001
FAN HIST. NO

OCTAL DISCRIMINATOR

9144

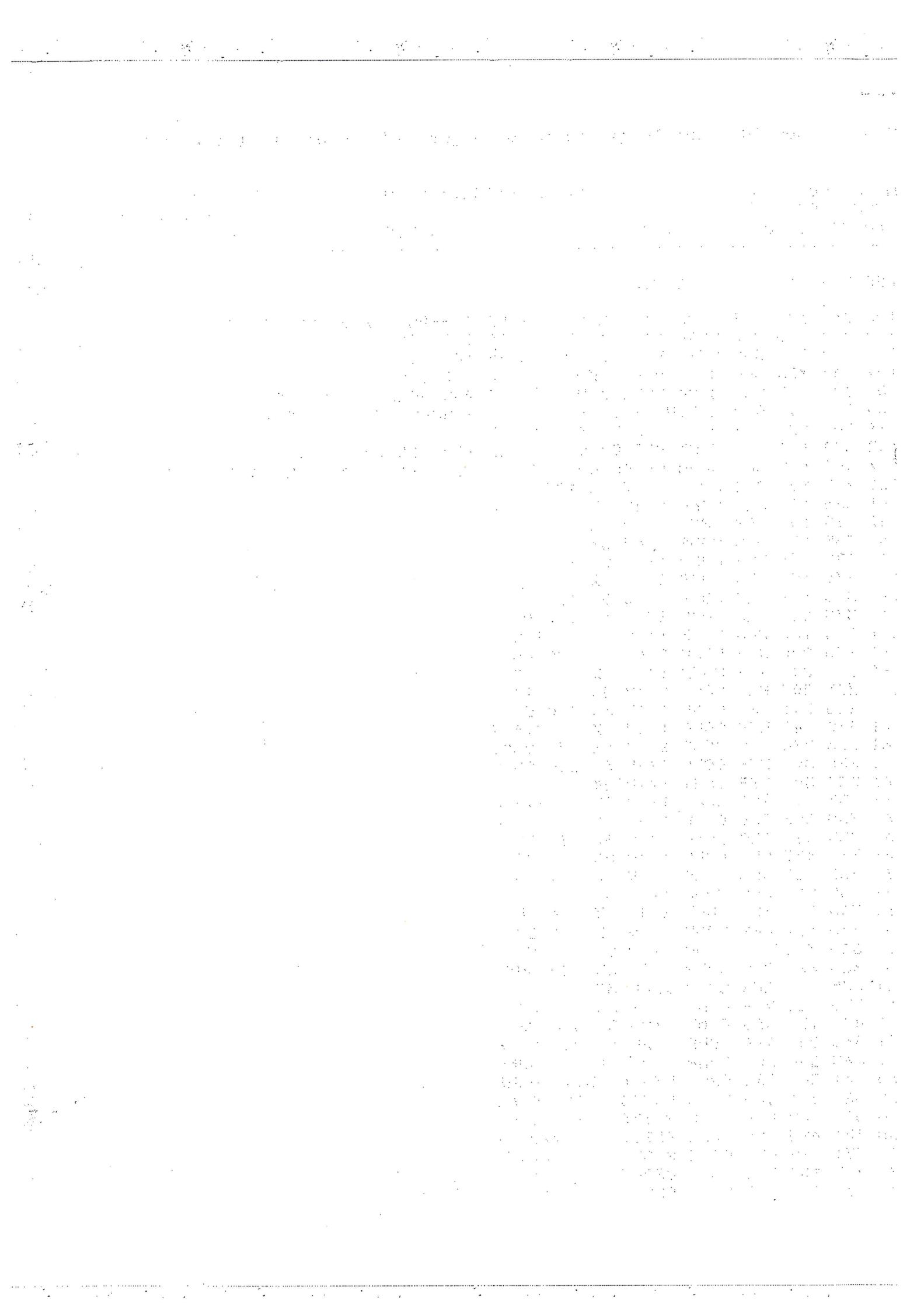
PRINTED 20-May-
REV DATE 19-May-

FAN HIST. DATE 24-May-79

LRS PART NO DESCRIPTION

102 245 103 CAP CERA DISC 25V .01 UF PT-FDCL-1/32 LEADS 3/8 AWG 22
102 444 220 CAP CERA DISC 100V 22 PF 10% S2L
102 444 560 CAP CERA DISC 100V 56 PF 10% S3N
102 944 *75 CAP CERA DISC 1KV 7.5 PF 10% S2L
103 327 103 CAP CERA MONO 50V .01 UF 20% GENERAL PURPOSE
105 217 102 CAP MUCON RIBB LD .001 UF HIGH-K CERA 25V 20%
116 305 180 CAP DIP MICA BM 5 18 PF
142 824 685 CAP TANT DIP CASE 6.8 UF 35V 20% ,256 X ,374
147 447 *50 CAP ALUM METAL CAN 50 UF 15 (16)V -10 +75% ,328 X ,578 *

161 335 101 RES COMP 1/4W 5% 100 OHMS
161 335 102 RES COMP 1/4W 5% 1 K
161 335 103 RES COMP 1/4W 5% 10 K
161 335 104 RES COMP 1/4W 5% 100 K
161 335 111 RES COMP 1/4W 5% 110 OHMS
161 335 153 RES COMP 1/4W 5% 15 K
161 335 161 RES COMP 1/4W 5% 160 OHMS
161 335 181 RES COMP 1/4W 5% 180 OHMS
161 335 182 RES COMP 1/4W 5% 1.8 K
161 335 200 RES COMP 1/4W 5% 20 OHMS
161 335 202 RES COMP 1/4W 5% 2 K
161 335 203 RES COMP 1/4W 5% 20 K
161 335 241 RES COMP 1/4W 5% 240 OHMS
161 335 242 RES COMP 1/4W 5% 2.4 K
161 335 271 RES COMP 1/4W 5% 270 OHMS
161 335 301 RES COMP 1/4W 5% 300 OHMS
161 335 303 RES COMP 1/4W 5% 30 K
161 335 362 RES COMP 1/4W 5% 3.6 K
161 335 393 RES COMP 1/4W 5% 39 K
161 335 431 RES COMP 1/4W 5% 430 OHMS
161 335 473 RES COMP 1/4W 5% 47 K
161 335 510 RES COMP 1/4W 5% 51 OHMS
161 335 513 RES COMP 1/4W 5% 51 K
161 335 560 RES COMP 1/4W 5% 56 OHMS
161 335 561 RES COMP 1/4W 5% 560 OHMS
161 335 563 RES COMP 1/4W 5% 56 K
161 335 681 RES COMP 1/4W 5% 680 OHMS
161 335 752 RES COMP 1/4W 5% 7.5 K
161 335 823 RES COMP 1/4W 5% 82 K
161 445 *56 RES COMP 1/2W 5% 5.6 OHMS
161 665 241 RES COMP 2W 5% 240 OHMS
161 665 390 RES COMP 2W 5% 39 OHMS
168 531 269 RES PREC RN55D 51.1 OHMS
168 531 326 RES PREC RN55D 200 OHMS
168 531 389 RES PREC RN55D 909 OHMS
168 531 485 RES PREC RN55D 9.09 K
168 531 498 RES PREC RN55D 12.4 K
181 457 103 RES VARI CERMET 10 K 1/2W 10%
181 457 104 RES VARI CERMET 100 K 1/2W 10%



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MODEL NO 623B
ECON 1001
FAN HIST. NO

OCTAL DISCRIMINATOR

9144

PRINTED 20-May-86
REV DATE 19-May-86
FAN HIST. DATE 24-May-79

LRS PART NO	DESCRIPTION	QT
181 457 503	RES VART CERMET	50 K 1/2W 10%
182 537 103	RES VARI CERMET	10 K 3/4W 10%
182 537 502	RES VARI CERMET	5 K 3/4W 10%
208 *11 **3	IC SINGLE OP AMP	LM301AN DIP-8
208 *74 **3	IC DIODE ARRAY	CA3039 12-LEAD "TO" CAN
210 *40 **2	IC AMPLITUDE DISCR	LD601C DIP-16
230 110 **5	DIODE SWITCHING	1N4448
53 *10 835	DIODE HOT CARRIER	HP2835 H-P CASE 15
0 130 401	TRANSISTOR NPN	4401 TO-72
270 180 **2	TRANSISTOR NPN PWR	2N3055 TO-3
270 190 **1	TRANSISTOR NPN PWR	2N3054 TO-66
275 150 **3	TRANSISTOR PNP	40319 TO-5
275 170 **2	TRANSISTOR PNP	2N5771 TO-92
275 190 **1	TRANSISTOR PNP PWR	2N3740 TO-66
300 *10 **1	BEAD SHIELDING	FERRITE
300 *50 **1	CHOKE FERRITE SINGLE LEAD	
400 *10 **8	SOCKET IC ST	DIP-8 .300 SEP/TIN CONT/COPP-NICKEL PINS
400 *30 *16	SOCKET IC ST	DIP-16 .300 SEP/TIN CONT/COPP-NICKEL PINS
402 *30 **0	CONNECTOR CO-AXIAL	LEMO
402 *30 **1	HOOD FOR BULKHD LEMO CONN	LEMO CR00.001.250
402 *30 **2	SPANNER NUT SMALL OD LEMO	
402 *30 **3	GROUND LUG NONLOCK	LEMO
405 112 **1	CONNECTOR BLOCK	(PIN) 42 "MIXED"
405 212 **2	GUIDE PIN	(MALE) CADMIUM PLATED BRASS
405 213 **1	GUIDE PIN	(MALE) BRASS
405 312 **1	GUIDE PIN	(FEMALE) CADMIUM PLATED BRASS
405 410 *16	CONNECTOR PIN	(MALE)
405 613 **1	CONNECTOR HOOD	CADMUM PLATED STEEL/INT CLOSED END
420 212 **1	SWITCH SIDE	DPDT
468 911 **1	TEST POINT (JACK)	WHT SKT-14 WHIT
500 120 **2	TRANSIPAD	"LARGE"
540 103 102	SIDE COVER	NIM LEFT
540 103 103	SIDE COVER	NIM RIGHT
540 105 **1	BRACKET	NIM WRAP SIZE #1
555 611 **1	CAPTIVE SCREW	6-32
555 621 **2	CAPTIVE SCREW RETAINER	NICKEL PLATED BRASS
567 256 **4	SCREW FLAT PHIL	2-56X1/4
710 623 *33	PC BD PREASS'Y	623B
720 623 *53	FRONT PNL PREASS'Y	623B 540102001(1)555621002(2)
740 **0 **2	WRAPAROUND NIM 1 BIN GATE	540104101(1) PER DWG NIM-M47

30 110 005 24 MUST BE 1N4448

NOTE 2 253 010 835 DO NOT SUBSTITUTE

NOTE 3

NOTE 4

NOTE 5

