

NIM MODEL 4608B

OCTAL 150 MHz

UPDATING DISCRIMINATOR

USER'S MANUAL

April 1983

NOTICE OF SPECIFICATION CHANGES

Due to a performance change of the Hybrid LD401 used in this unit, the European Products Division of LeCroy Research Systems has replaced the Model 4608 Octal 200 MHz Updating Discriminator described in this version of the manual by the Model 4608B Octal 150 MHz Updating Discriminator.

The following specifications have been changed:

Model	4608	4608B
Maximum Rate	200 MHz	150 MHz
Typical Double Pulse Resolution	4 nsec	5 nsec
Maximum Threshold	-1000 mV	-900 mV
Min. Output Width	4 nsec	3 nsec

LeCroy Research Systems SA

European Products Division

WARRANTY

LeCroy Research Systems warrants its instrument and software products to operate within specifications under normal use and service for the period of one year from date of shipment. Custom monolithics and hybrids sold separately and all spare or replacement parts and repairs are warranted for 90-days. This warranty extends only to the original purchaser and shall not apply to fuses, magnetic recording media, disposable batteries, or any equipment not manufactured by the company. All non-LeCroy products are provided with the original equipment manufacturer's warranty, which is typically 90-days from the date of shipment.

In exercising this warranty, LeCroy will repair or, at its option, replace any product returned to the factory or an authorized service facility within the warranty period, provided that the warrantor's examination discloses that the product is defective due to workmanship or materials. If the failure has been caused by misuse, neglect, accident, or abnormal conditions or operations, repairs will be billed at a nominal cost. In such cases, an estimate will be submitted before work is started.

The purchaser is responsible for the transportation charges arising from the return of products to the factory or authorized service facility. LeCroy will return all in-warranty products with transportation prepaid.

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For all LeCroy products in need of repair after the warranty period, the customer must provide a Purchase Order Number before any inoperative equipment can be repaired or replaced. The customer will be billed for the parts and labor for the repair as well as for shipping.

RETURN PROCEDURE

To determine your nearest authorized service facility, contact the factory or your local field office. All products returned for repair should be identified by the model and serial numbers and include a description of the defect or failure, name and phone number of the user, and, in the case of products returned to the factory, a Return Authorization Number (RAN). The RAN may be obtained by contacting the Customer Services Department at 914-425-2000.

Return shipments should be made prepaid. LeCroy will not accept C.O.D. or Collect Return shipments. Air-freight is generally recommended. Wherever possible, the original shipping carton should be used. If a substitute carton is used, it should be rigid and be packed such that the product is surrounded with a minimum of four inches of excelsior or similar shock-absorbing material. In addressing the shipment, it is important that the Return Authorization Number be displayed on the outside of the container to insure its prompt routing to the proper department within LeCroy.

INITIAL INSPECTION

It is recommended that the shipment be thoroughly inspected immediately upon delivery to purchaser. All material in the container should be checked against the enclosed Packing List. LeCroy cannot accept responsibility for shortages in comparison with the Packing List unless notified promptly. If the shipment is damaged in any way, please contact the factory or local field office immediately.

DOCUMENTATION DISCREPANCIES

LeCroy Research Systems is committed to providing state-of-the-art instrumentation. As a result, the Engineering Department at LeCroy is continually refining and improving the performance of products. While physical modifications can be implemented quite rapidly, the corrected documentation frequently requires more time to produce. Consequently, this manual may not agree in every detail with the accompanying unit. There may be small discrepancies in the values of components for the purposes of pulse shape, timing, offset, etc., and, occasionally, minor logic changes. Where any such inconsistencies exist, please be assured that the unit is correct and incorporates the most up-to-date circuitry.

APPLICATIONS ASSISTANCE

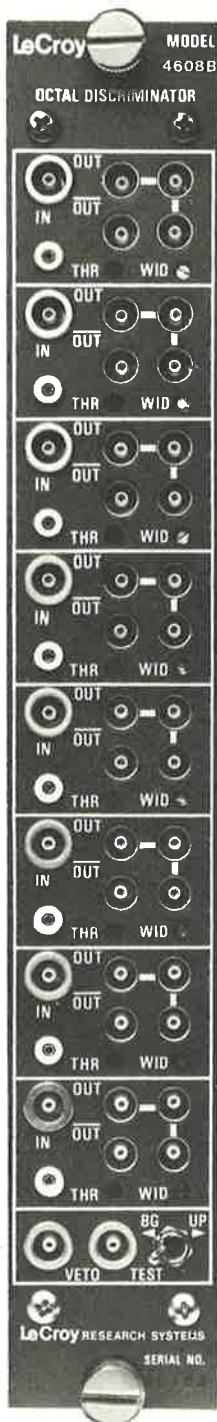
Answers to questions concerning the installation, calibration, and use of LeCroy equipment are available from the Customer Services Department, LeCroy Research Systems Corp., 700 South Main Street, Spring Valley, New York, telephone 914-425-2000, or your local field sales office.

A T T E N T I O N

CRATE POWER SHOULD BE TURNED OFF DURING INSERTION AND REMOVAL OF UNIT TO AVOID POSSIBLE DAMAGE CAUSED BY MOMENTARY MISALIGNMENT OF CONTACTS.

SEE POCKET IN BACK OF MANUAL FOR SCHEMATICS, PARTS LISTS AND ADDITIONAL ADDENDA WITH ANY CHANGES TO MANUAL.

A T T E N T I O N



NIM Model 4608B

Octal 150 MHz Updating Discriminator

- High counting rate
- High density
- High fan-out
- Low threshold
- Burst Guard mode
- Fast veto
- Built-in test feature

The Model 4608B is a high performance, 8 channel leading edge discriminator featuring high sensitivity, high speed, and updating or Burst Guard mode. A common inhibit adds to the versatility of the Model 4608B, which may be used as an enable for pulsed-mode applications. A built-in test feature simulates an input signal for each channel upon receipt of a NIM level signal applied to a Lemo type front panel test input connector. This permits rapid, simultaneous testing of all discriminator channels.

The minimum threshold of the Model 4608B is -30 mV, variable up to -900 mV via front panel screwdriver adjustment. A monitor point is provided to permit measurement of the threshold level with a voltmeter rather than the more difficult and less precise analog measurement via oscilloscope, assuring accurate results even in varied operating environments. Because of the extremely low reflections from its input (4%), the Model 4608B is significantly better protected against the multiple pulsing due to reflections.

The Model 4608B operates at maximum rates of 150 MHz. Its updating design permits retriggering even while an output from a previous input is still present. The Model 4608B will respond to a second pulse within 5 nsec of the leading edge of the first pulse. Propagation delay through the Model 4608B is approximately 12 nsec.

In the Burst Guard mode (front panel switch selected), the output pulse duration is equal to the input pulse time over threshold or the preset output width, whichever is larger. In case of very high frequency bursts (above 500 MHz), the output will be true from the leading edge of the first pulse to the trailing edge of the last pulse in the burst.

The outputs of the Model 4608B are high impedance -48 mA current switching stages, providing output levels of -800 mV into three $50\ \Omega$ loads. Unused outputs need not be terminated; the maximum output swing is amplitude limited to -1.2 V for a single output load. The single complementary output provides -16 mA (-800 mV into $50\ \Omega$) in the quiescent state. The output durations may be independently set via front panel screwdriver adjustment from 3 nsec to 40 nsec. Up to 100 nsec output width is possible with the restriction that input and output pulse widths cannot be equal. Output risetimes and falltimes are less than 2 nsec.

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Innovators in Instrumentation

SPECIFICATIONS

NIM Model 4608B

OCTAL 150 MHz UPDATING DISCRIMINATOR

INPUT CHARACTERISTICS

Signal Inputs:

8, Lemo type front panel connectors, $50\ \Omega \pm 2\%$ protected to $\pm 5\text{ A}$ for $0.5\ \mu\text{sec}$ clamping at $+1$ and -6 volts.

Reflections $< 4\%$ for input pulses of 2 nsec risetime.

Stability better than $0.25\%/^{\circ}\text{C}$ over 20°C to 60°C operating range.

Offset $\pm 1\text{ mV}$

Threshold, -30 mV to $-900\text{ mV} \pm 5\%$; front panel screwdriver adjustable.

Threshold, monitor point on front panel has 10:1 ratio of monitor voltage to actual voltage, $\pm 5\%$.

Hysteresis, typical 6 mV .

Test Input:

1, Lemo type connector on the front panel, $50\ \Omega \pm 2\%$, triggers all channels. Requires NIM level direct coupled signal ($> -600\text{ mV}$).

Minimum width: 3.5 nsec .

Maximum rate: 150 MHz .

Veto Input:

1, Lemo type front panel connector, $50\ \Omega \pm 2\%$, permits simultaneous fast inhibiting of all channels; requires NIM level signal ($> -600\text{ mV}$).

Direct coupled.

Must precede input signal by approximately 3.5 nsec and overlap its leading edge in update mode or overlap complete input signal in Burst Guard mode.

Minimum duration: 4 nsec .

OUTPUT CHARACTERISTICS

Negative Outputs:

3, 0 mA quiescently, $-50\text{ mA} \pm 6\text{ mA}$ during output, -800 mV into three $50\ \Omega$ loads. Amplitude limited to -1.2 V .

Duration, 3 nsec to 40 nsec . 100 nsec output duration possible with the restriction that input and output pulse width cannot be equal.

Risetimes and falltimes less than 2 nsec .

Width stability better than $0.2\%/^{\circ}\text{C}$ max.

Complementary Output:

1, $-16\text{ mA} \pm 2\text{ mA}$ quiescently, 0 mA during output. Duration, risetimes, falltimes, and width stability specifications are identical to those of negative outputs.

GENERAL

Maximum Rate:

150 MHz .

Double Pulse Resolution:

Typical, 5 nsec .

Time Slewing:

500 psec for input amplitudes from 2 times to 20 times over threshold.

Input-Output Delay:

$< 12\text{ nsec}$.

Test Output Delay:

$< 14\text{ nsec}$.

Multiple Pulsing:

None, one and only one output pulse is produced for each input pulse regardless of input pulse amplitude and duration.

Burst Guard:

A front panel switch enables the Burst Guard operation for all channels.

Power Requirements:

40 mA at $+6\text{ V}$

1.9 A at -6 V

150 mA at -12 V

40 mA at $+24\text{ V}$

25 mA at -24 V

INTRODUCTION

The LeCroy NIM Model 4608 is an octal discriminator representing the state of the art in its field.

Its features include indeed all the experience gained in the field up to now. The most important improvements are a higher max. working frequency, a better slewing time, a general veto and a general test input.

The high density is made possible through extensive use of hybrid circuits. Except for few external components, a discriminator channel is contained in a single hybrid, called LD401. The use of hybrid circuits is dictated by the sophisticated technique needed for a 200 MHz discriminator. The test and calibration procedures being quite sophisticated, this manual will not contain a test and calibration section. We recommend the customer to contact the nearest LRS sales agent, any time a problem is encountered in the use of the 4608 discriminator.

INPUT CHARACTERISTICS

Threshold Range:

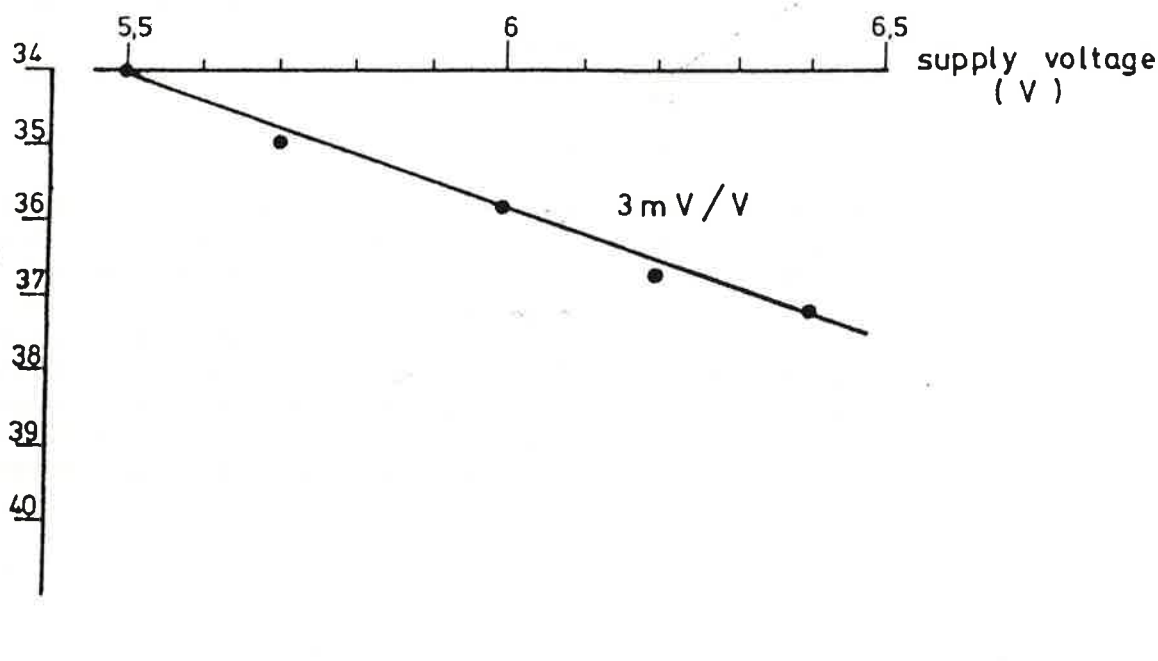
The threshold range of the 4608 octal discriminator is -30 mV to -1 V. Each channel is settable by a front-panel, 15 turns potentiometer. In the above range the adjustment is uniform and does not present any discontinuity nor changes in sensibility.

The low minimum threshold of the 4608 makes it possible to use lower gain photomultipliers, lower high voltage in the phototubes, and to drive PM signals over longer cable lengths than would be possible with higher thresholds. In addition, the low minimum threshold permits back-termination 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.)

Threshold Uncertainty: While most people consider the threshold of a discriminator to be that value which is written on a data sheet or determined by a front-panel setting, in reality the actual value not only varies from channel to channel, but can be a strong function of other environmental conditions. The external factors with the strongest effect upon the threshold value are the temperature coefficient of threshold and the power supply coefficient of threshold. Combining these, the actual threshold value V_T is given by:

V_T : Threshold according to front-panel control setting \pm dc offset \pm temperature coefficient \times temperature change from calibration temperature \pm supply coefficient \times voltage change from nominal supply voltage.

In the case of 4608 the measured offset value is 0.6 mV; the supply coefficient comes out to be 3 mV/Volt and the temperature coefficient 0.65 mV/C⁰.

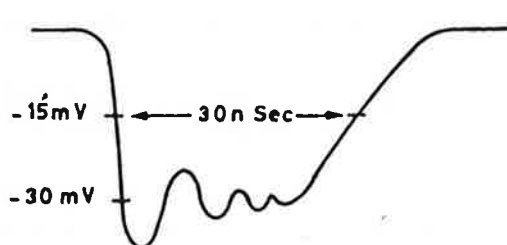


Threshold calibration:

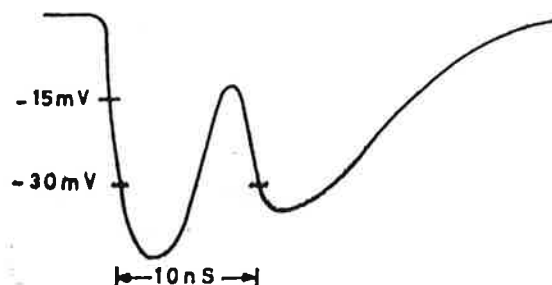
A front panel test point allows a 10:1 monitor of the threshold. That is the dc value, read on the test point, is proportional to the actual threshold value. The proportionality is all over the threshold range, within $\pm 5\%$. The output impedance of the test point is $10\text{ K}\Omega$, so a high impedance digital voltmeter should be used.

4608 Threshold Hysteresis:

The 4608 discriminator 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 -24 mV for a threshold setting of -30 mV . This avoids multiple pulsing due to fine structure, riding on a flat-topped pulse, that may bring the pulse above and below threshold. Note the examples below.



INPUT PULSE
(example A)



INPUT PULSE
(example B)

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 DPR of the unit. In Example B, since the input signal does go back through -24 mV and then once again rises to exceed the -30 mV threshold level, two discriminator outputs would result. Since LeCroy discriminators are most often used with photomultipliers and plastic scintillators, and since the characteristic pulses, out of this type of detector, are typically smooth for each individual event, multiple outputs should only occur when they represent multiple events.

-15 mV Minimum Threshold Option: By special request and at added cost, LeCroy can provide the 4608 Discriminator with its minimum threshold set at -15 mV instead of -30 mV . Extreme care must be taken in the use of these modified units. The hysteresis level (described above) is only 5 mV for the -15 mV unit, such that any input pulse with variations exceeding 5 mV may cause the discriminator to retrigger. Care should be taken to avoid any small DC offset. It is actually recommended that AC coupling be used if the input rates are low enough to permit it. Special care must be taken regarding ground loops which would result in 50/60 cycles threshold sensitivity modulation.

Input Reflections: Input reflections probably account for the majority of multiple-pulsing problems encountered in an experiment. 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 experimenter finds himself in the situation where multiple-pulsing negates the usefulness of lower threshold. The input reflections of a discriminator effectively determine the allowable dynamic range of event or noise input signals.

On the experimental floor, 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.

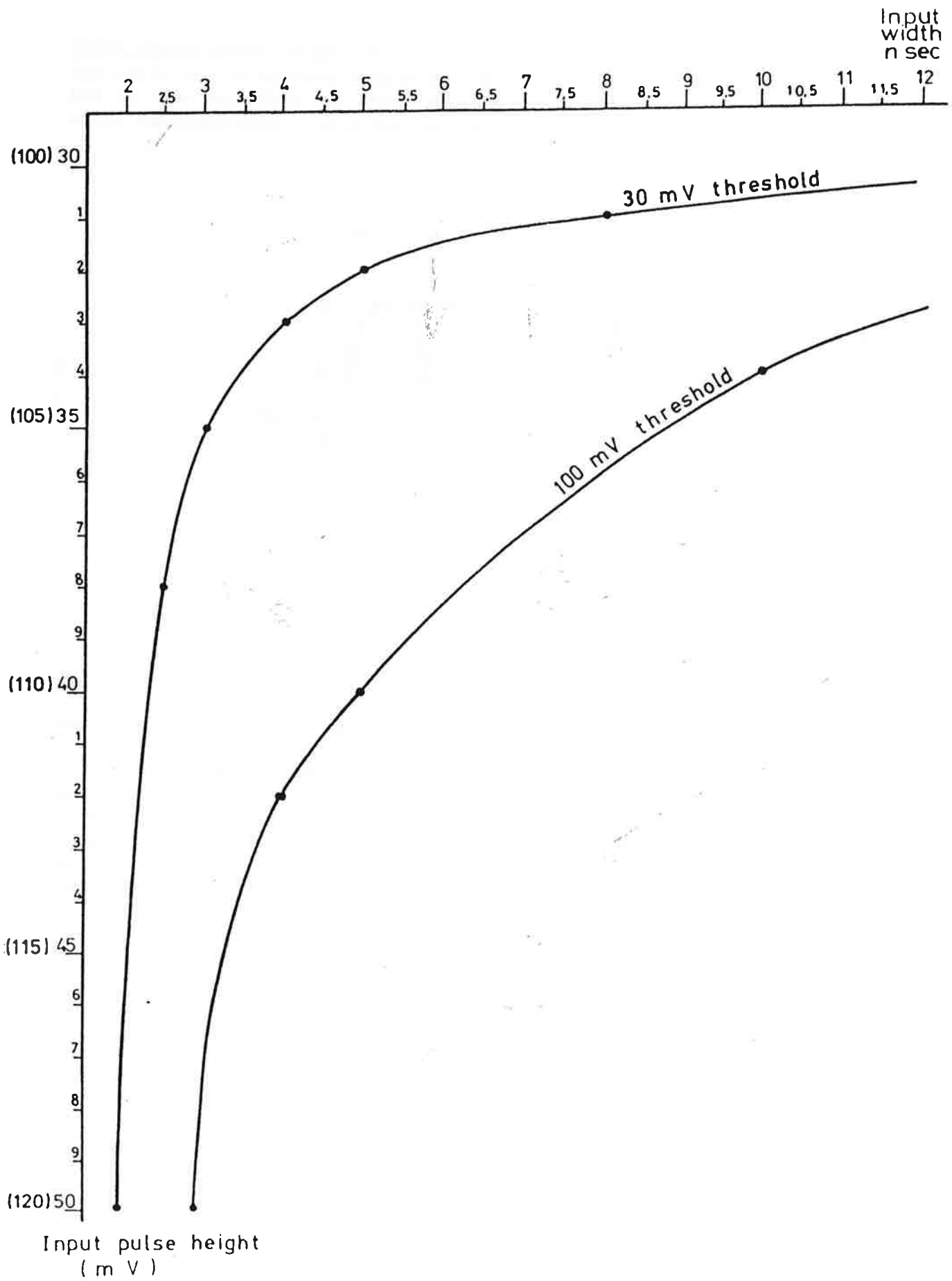
The Model 4608 presents <4% reflections for input pulses of 2 nsec. risetime.

Input Protection: The inputs of 4608 Discriminator are protected to 5 A for 0.5 μ sec., clamping at +1 and -6 volts.

The DC protection is limited by the 0.25 watt dissipation limit of the input resistor, which can be assumed to offer protection against DC signals less than 5 volts.

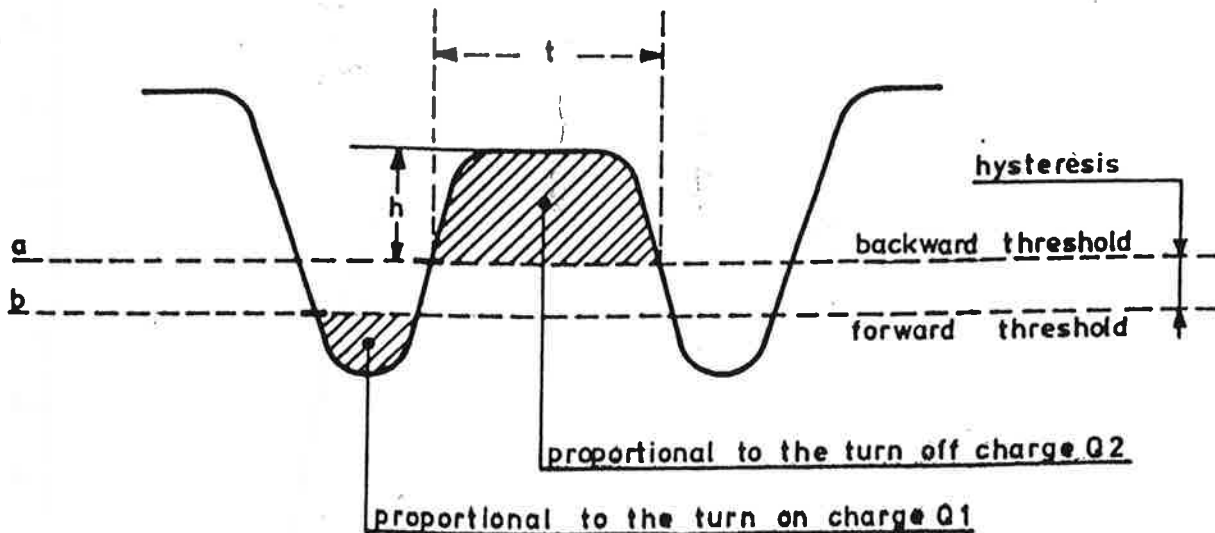
Input charge over Threshold:

Alike all discriminators, the 4608 needs a minimum input charge above threshold to trigger. As a result, the discriminator threshold is input pulse width dependent, and this effect will be more apparent for smaller input pulse widths. The following figure shows a typical threshold behaviour as function of the input pulse width, for two values of the nominal threshold. The pulse widths given have been measured at the nominal threshold value.



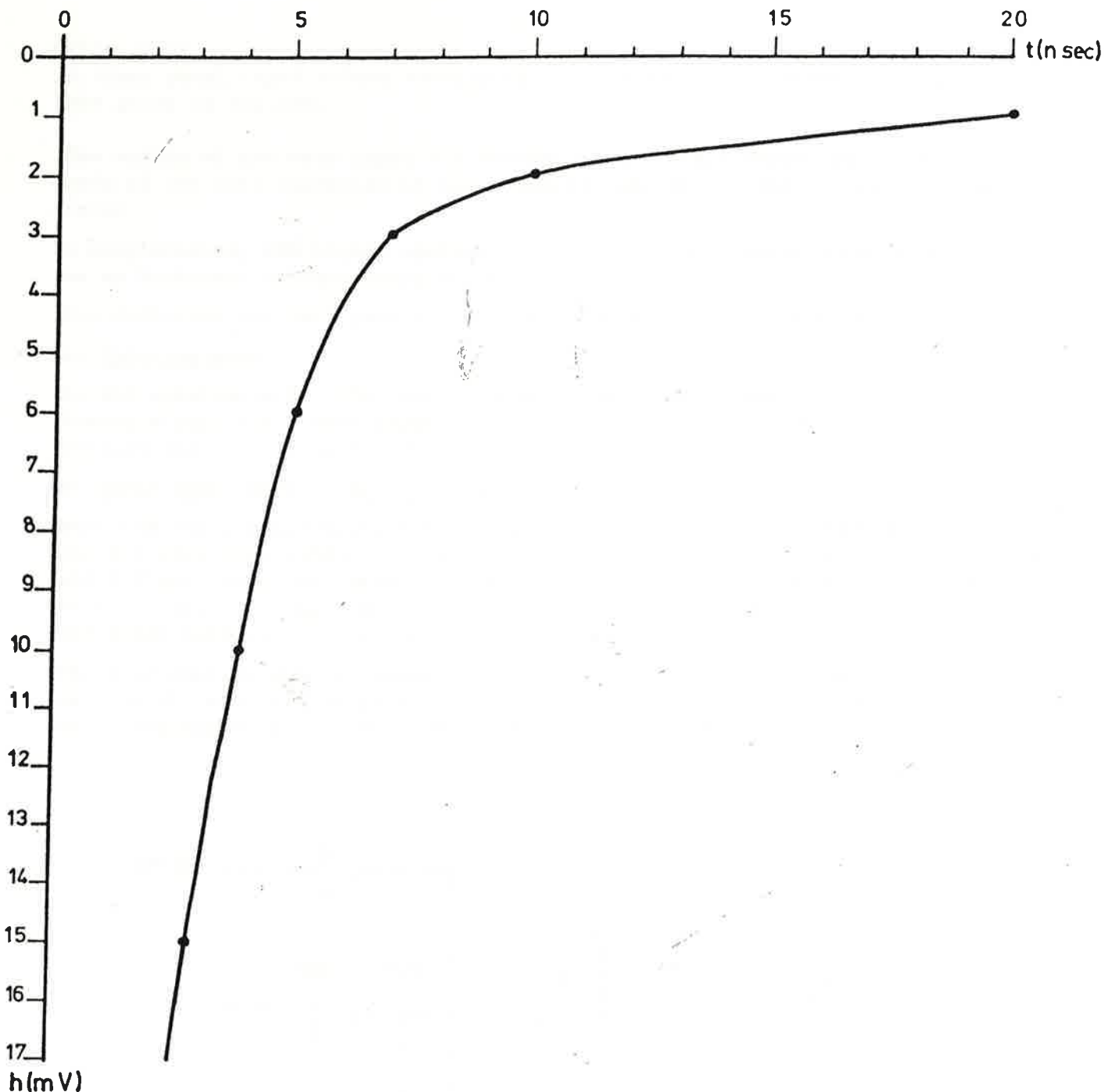
Input charge under Threshold:

Similarly to the minimum charge needed above threshold, a minimum charge has to flow back from the input between two pulses, to make the discriminator retriggerable. The situation is depicted in figure below.



If the turn-off charge is not above the minimum value, the discriminator will see the input pulses as they were a single pulse.

Of course, one should be aware of this effect especially at high frequency and make sure that the voltage, between two pulses, is really going to zero or even to positive values. A pulse clipping with a delay line, should have indeed, in general, an improving effect. The following figure shows how the hole between two pulses, represented by its height h , typically behaves as function of the distance t between the pulses themselves.



Test input:

A front panel test input allows the unique feature to trigger all channels at once, as soon as a NIM pulse is sent. This useful feature allows complete test of the module without removing any input cable, and also permits the use of the 4608 as a 24 fold negative fan-out and 8-fold complementary fan-out.

The test pulse will have on all channels the same effect as a similar pulse on the normal inputs. In particular the output width in burst guard mode, will be proportional to the input width.

Veto input:

A front panel input allows vetoing of all channels simultaneously, when a negative NIM pulse is applied.

The action of the veto input can however be different depending on the operation mode of the unit (updating or burst guard), and on the static level of the veto input.

A complementary NIM signal applied to the veto input, permits the 4608 to be used as an 8-channel strobed coincidence.

The different possibilities to use the veto are in the following:

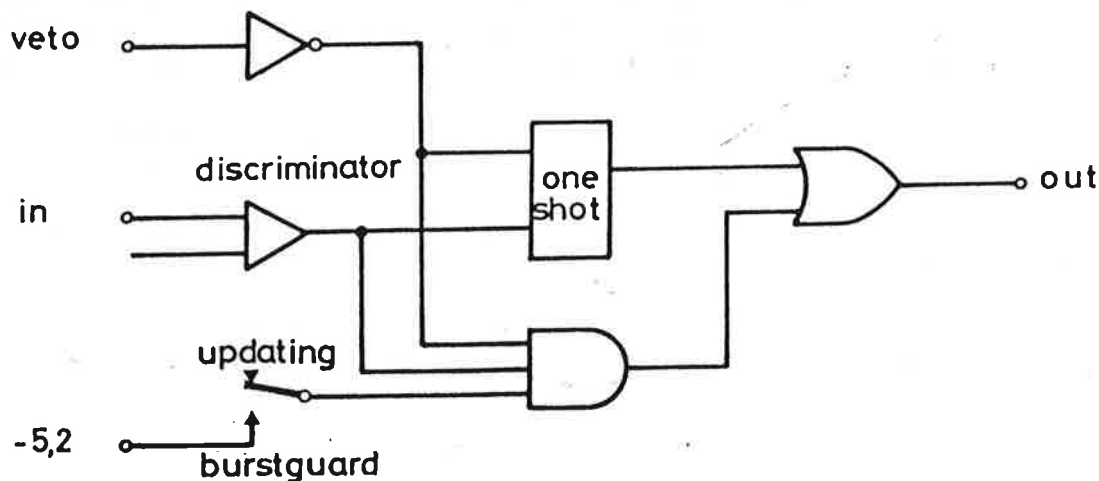
a) Updating mode

In the updating mode, the leading edge of the input pulse triggers the discriminator timing stage, and a veto input is to be coincident and precede the input pulse leading edge by 3.5 ns to be operative.

b) Burst guard mode (time over threshold)

When the burst guard section is on (see figure), an overlap coincidence between the discriminator output and the veto pulse is activated. A negative veto pulse of width T will veto the output during this time. If a pulse wider than T is applied at the input, an output will result due to the part of the pulse exceeding T . An efficient veto should overlap completely the input pulses.

The same applies when a complementary NIM veto pulse is applied to gate the unit, instead of veto it. The gate pulse should completely overlap the input pulses. In this case the unit is working as a strobed overlap coincidence.



OUTPUT CHARACTERISTICS

The 4608 provides three negative NIM outputs and one complementary NIM output. The negative outputs are bridged and all coming from the same differential type current source, providing 0 mA statically and -48 mA dynamically, into three 50 Ω loads. The output pulse height, even within NIM specifications, can vary then, depending from the number of outputs used, from -0.7 V to -1.2 V.

The outputs present normally an overshoot which does not exceed the 15% of the pulse amplitude. The risetime and falltime are typically ≤ 2 nsec.

The single complementary output is actually the output from the collector of the other half of the differential pair supplying current to the fast negative timing output. It is a 50 Ω output with quiescent level at -16 mA, and logical 1 at 0 mA. Risetime and other characteristics are similar to that of the negative outputs.

Output width

The output width, in standard updating mode, is continuously adjustable, independently for each channel, via front panel potentiometers in range 4 nsec. to 40 nsec.

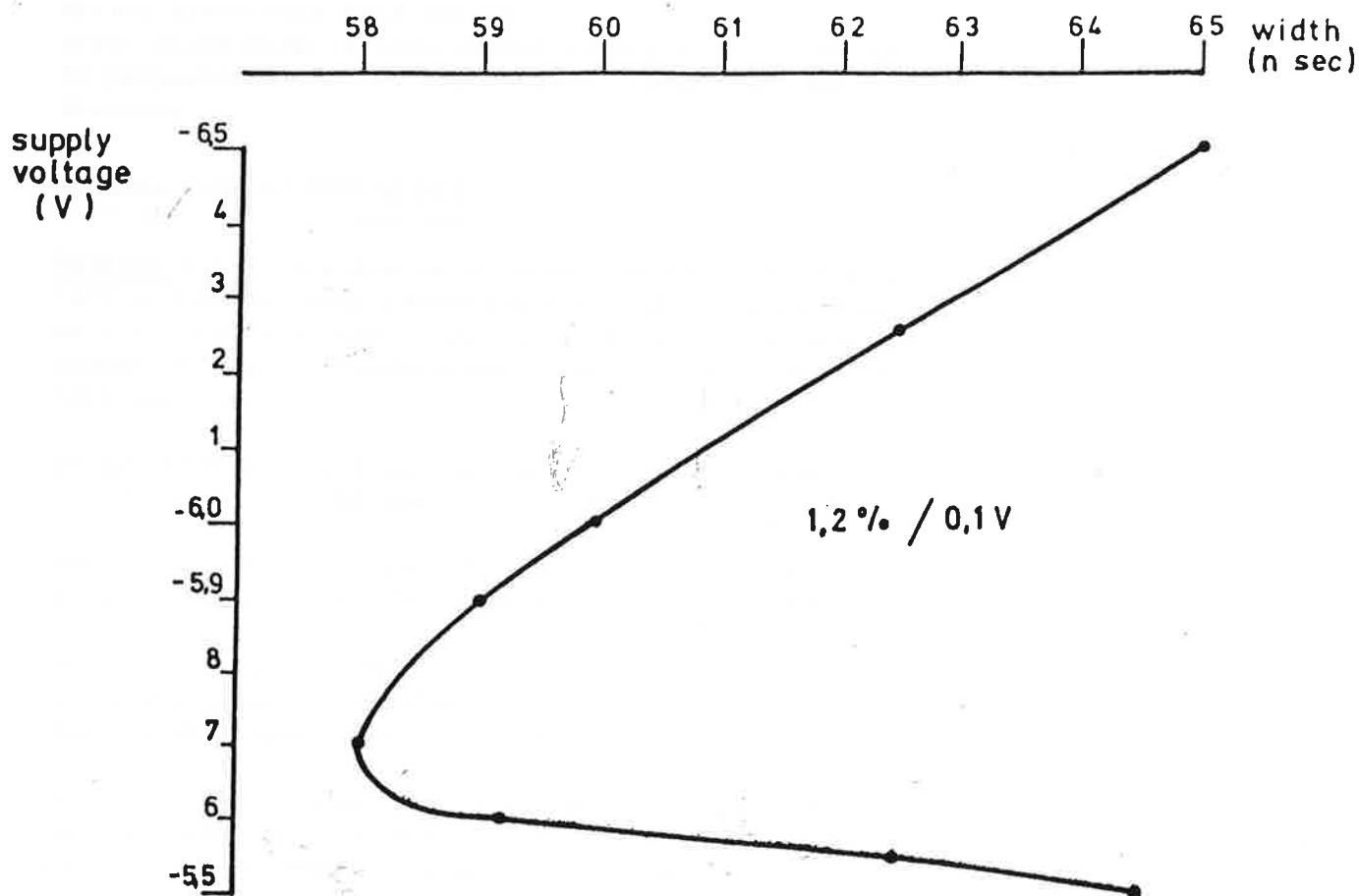
Larger widths, up to 100 nsec, can be obtained with a different trimming of the circuit, which can be made on customer request. It must be stressed however that in the range 40 to 100 nsec. a modulation of the output width may occur if the input and output widths will be equal. This modulation affects mainly the trailing edge of the output which can be deteriorated or it can move in time. The amount of the width modulation is $\leq 10\%$.

Output width stability

The main contributions to output width uncertainty are a function of the external conditions in a manner similar to threshold uncertainty. Variations in both temperature and supply voltage can cause significant changes in output width.

Width temperature coefficient has been measured to be $\leq 0.25\%/^{\circ}\text{C}$. while the voltage coefficient is 1.2%/0.1 V.

The last one has in fact a funny behaviour, better understood on the graph below.



UPDATING AND BURST GUARD OPERATION MODES

The module has a front panel switch which allows to chose between two possible operation modes.

Updating:

In updating mode 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 already occurred.

Burst Guard:

In Burst Guard mode, the output of the front end is ORed with the conventional mode output. Thus, for input pulses arriving at a rate which exceeds the double-pulse resolution of the unit, the discriminator output duration will be equal to the time interval between the first leading edge threshold crossing and the last trailing edge threshold recrossing, or the preset output width, whichever is greater. This feature is expecially important in veto applications, where it is desired to keep the discriminator output on when the detector is being hit by unwanted and unmeasurable high rates. A discriminator without Burst Guard would

see the first pulse and generate the preset output width, but would be paralyzed at quiescent level or would trigger only randomly for subsequent pulses separated by less time than the DPR of the unit. Burst Guard assures a logical 1 output level during these high rate bursts.

Burst guard mode is also useful in any application where the output width has to be proportional to the input width. Figure at page 7 could help for a better understanding.

TIMING CHARACTERISTICS

Maximum rate: Maximum rate capability of 4608 is guaranteed at 200 MHz. but in fact a discriminator frequency behaviour is more complicated than that. Depending on the operation mode, burst guard or updating, one can define indeed a certain number of typical frequencies defining ranges of frequencies where different behaviours occur.

In updating mode one can define three typical frequencies:

$a \approx 205 \text{ MHz}$, $b \approx 220 \text{ MHz}$, $c > 500 \text{ MHz}$

For $v < a$ the output will follow identically the input; so that the same frequency structure present at the input will be reproduced at the output.

For $a < v < b$, the input stage is still capable of distinguish the input pulse, while the output stage does not. The output will be then a long pulse of width as long as the input burst duration.

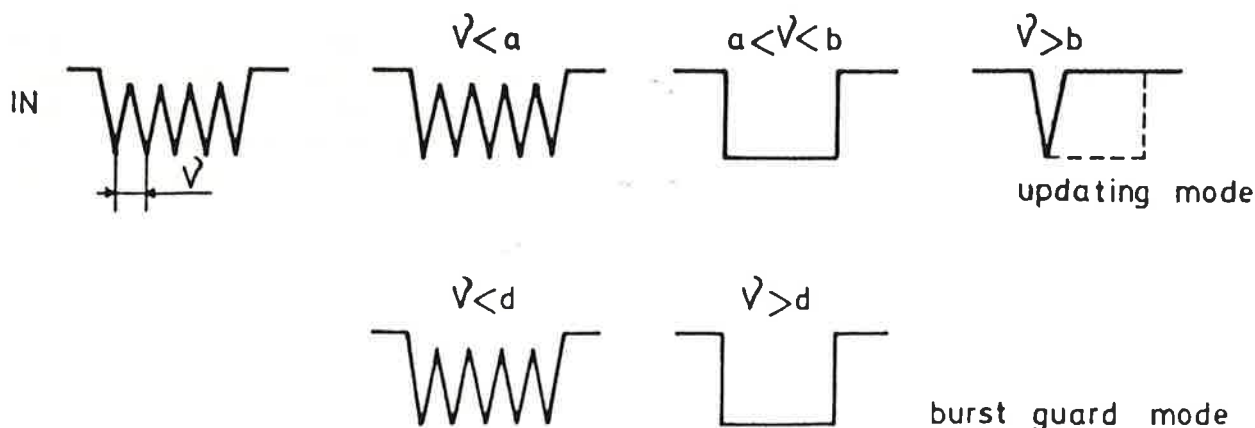
For $v > b$ and at least up to 500 MHz even the input stage is no more able to separate the input pulses and the input burst will be taken as a single pulse. The output will be then a single pulse triggered by the first pulse in the burst.

In burst guard mode only one frequency, $d \approx 180 \text{ MHz}$, is the most critical.

For $v < d$ the discriminator will reproduce the input frequency structure at the output.

For $v > d$ and at least up to 500 MHz, the output will be a single pulse of width as long as the input burst duration.

BURST



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 ambiguities in performance are disclosed. One should indeed investigate the double pulse resolution as function of the input amplitude over threshold and of the input width. Tests on 4608 gave a double pulse resolution which is never worse than 4 nsec.

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.

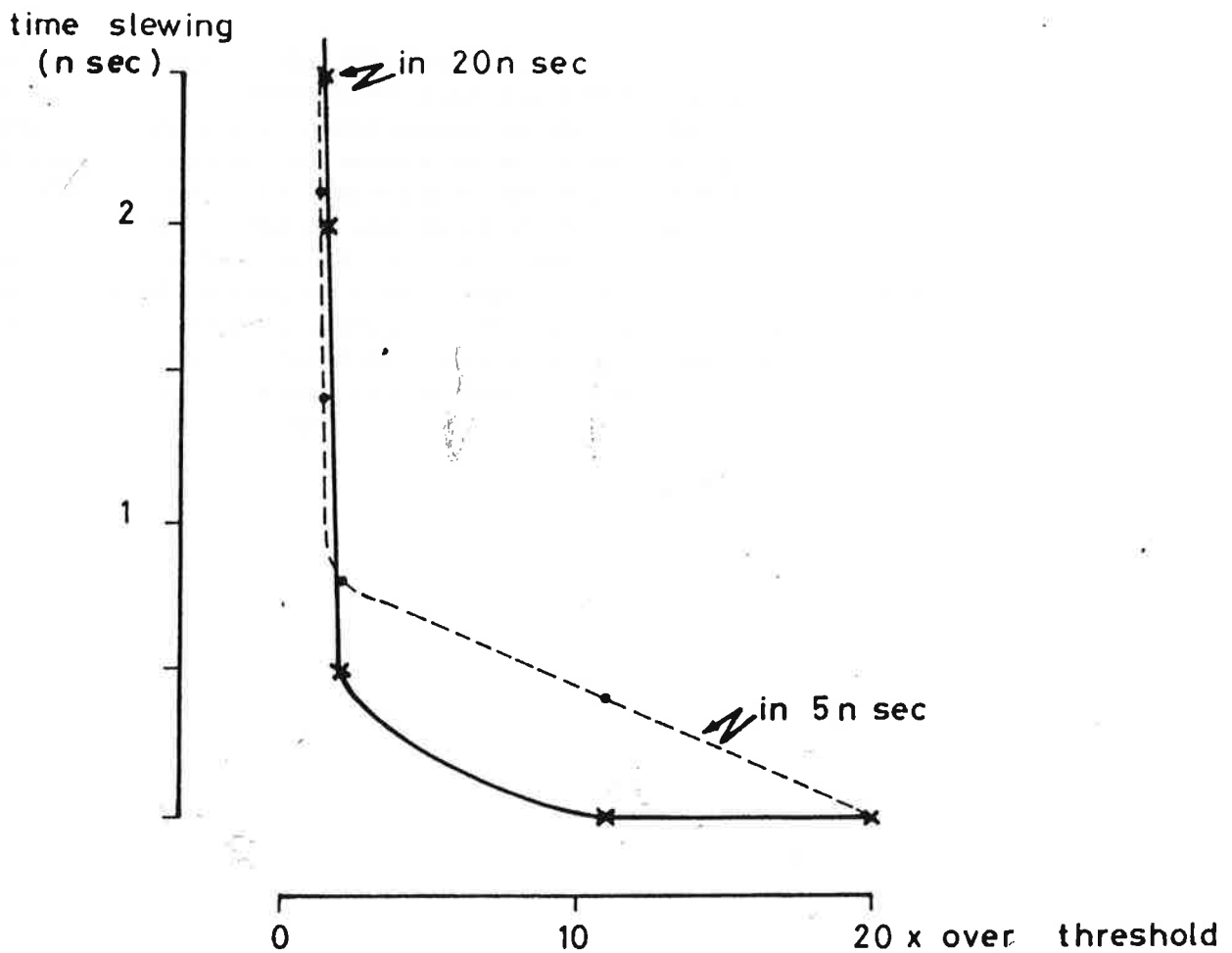
Tests on 4608 gave a tracking error typically not in excess of 200 psec.

Slewing

At less than maximum input rates which do not tax the double-pulse resolution of the discriminator, a class of characteristics comes into play which defines the fidelity of the discriminator output to the time information in the input signal. The most important of these, and the most difficult to strictly define and to measure, is time slewing or walk. This is 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. For an extreme range of pulse heights, the maximum contribution is equal to the 0 to 100% risetime of the pulse.

With most discriminators, by far 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 10 X threshold).



The picture shows how the time slewing behaves, for two different input widths, taking as reference in time the output corresponding to the input 20 X over threshold.

PACKAGING

The 4608 discriminator is packaged in a No. 1 NIM module with Lemo type connectors.

POWER CONSUMPTION

The model 4608 requires considerably more current than does any other LRS discriminator, and that because of the very high working frequency. The current drain upon the - 6 V supply is 1.9 A, the total power dissipation of the module is 15 W, so it is highly recommended to use a NIM bin with higher dissipation limits, or to take care to carefully choose low power modules for the remaining slots in the bin, or to perhaps leave some NIM slots blank.

Recommended Use of the NIM Power Bins:

It is highly recommended to keep any NIM bin at as constant a temperature as possible, using air conditioning in the trailer or experimental station and definitely using fans to assure an air flow through all modules in every bin.

Elimination of large temperature variations removes the worry of temperature drift effects upon modules of any manufacturer, 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 LRS modules, and the modules themselves are temperature cycled for days under power between initial test and final test, it is recommended to avoid subjecting any modules to adverse operating conditions if it could be avoided.

Addendum to the "Model 4608, 8 chs discriminator" manual, describing Model 4608 Z, high input impedance, 8 chs discriminator.

Model 4608 Z is a modified version of Model 4608.

The same manual of 4608 will apply then to Model 4608 Z except for the differences discussed in this addendum.

The distinguishing differences of model 4608 Z are:

- High input impedance: static $2.2\text{ K } \Omega \pm 10\%$
dynamic $500\text{ } \Omega \pm 5\%$
- Input: two bridged Lemo type connector per channel on the front panel, so that one connector can be used as input for the analog signal, and the other as output for the same. This line has to be necessarily terminated at the end on 50 to avoid reflections.

MODEL NO M4608B

LOOSE PARTS

PRINTED 05-Feb-86

ECON 1008

REV DATE 04-Apr-84

MCN 2

MCN DATE 05-Feb-86

FAN HIST. NO

2008

FAN HIST. DATE

LRS PART NO	DESCRIPTION	QTY
402 *30 **0	CONNECTOR CO-AXIAL LEMO	10
402 *30 **1	HOOD FOR BULKHD LEMO CONN LEMO CRO0.001.250	10
402 *30 **2	SPANNER NUT SMALL OD LEMO	10
402 112 **1	CONN PC MTG LEMO NICKEL	32
405 112 **1	CONNECTOR BLOCK (PIN) 42 "MIXED"	1
405 212 **2	GUIDE PIN (MALE) CADMIUM PLATED BRASS	1
405 213 **1	GUIDE PIN (MALE) BRASS	1
405 312 **1	GUIDE PIN (FEMALE) CADMIUM PLATED BRASS	2
405 613 **1	CONNECTOR HOOD CADMIUM PLATED STEEL/INT CLOSED END	1
410 162 **0	SWITCH TOGGLE N/LOCK SPDT SUBMINIATURE/NON-LOCKING	1
468 911 **1	TEST POINT (JACK) WHT 5KT-14 WHIT	8
521 400 *22	SPACER ROUND #4 11/16	2
523 400 *24	ROLL PIN SIZE #4 3/4 LG	8
540 103 102	SIDE COVER NIM LEFT	1
540 103 103	SIDE COVER NIM RIGHT	1
540 104 101	WRAPAROUND NIM SIZE #1 WITH BIN GATE	1
540 105 *11	BRACKET NIM WRAP SIZE #1 MADE IN SWITZERLAND/DO NOT SUBST	2
540 109 100	SWITCH HOLE PATTERN COVER	1
555 611 **1	CAPTIVE SCREW 6-32	2
555 621 **2	CAPTIVE SCREW RETAINER NICKEL PLATED BRASS	2
560 440 **5	SCREW PHILIPS 4-40X5/16	6
567 256 **4	SCREW FLAT PHIL 2-56X1/4	4
567 440 **4	SCREW FLAT PHIL 4-40X1/4	10
590 991 *22	WIRE TEFL 7-STRAND WHT 22	4
593 910 **1	CABLE CO-AX RG196 OR 178 50 OHMS/JACKET WHT OR NATURAL (TAN)	4
724 608 **1	FRONT PNL PREASS'Y 4608B PER DWG 4608B-M1	1
724 608 **3	FRONT PANEL 4608B 724608001(1) PAINTED & SCREENED	1
750 **0 101	WIRE 11" BLK W/PIN AWG 22 405410016(1)590001022(0)	1
750 **0 111	WIRE 11" BRN W/PIN AWG 22 405410016(1)590111022(0)	1
750 **0 121	WIRE 11" RED W/PIN AWG 22 405410016(1)590221022(0)	1
750 **0 131	WIRE 11" ORA W/PIN AWG 22 405410016(1)590331022(0)	1
750 **0 161	WIRE 11" BLU W/PIN AWG 22 405410016(1)590661022(0)	1
750 **0 181	WIRE 11" GRAY W/PIN AWG 22 405410016(1)590881022(0)	1

NOTE: 1 PER DWG 4608B-L1

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NOTE: 11

MODEL NO S4608B

SOLDERED BOARD

PRINTED 05-Feb-86

ECON 1008

REV DATE 04-Apr-84

MCN 2

MCN DATE 05-Feb-86

FAN HIST. NO

2008

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LRS	PART NO	DESCRIPTION	QTY
102	412 *39	CAP CERA DISC 100V 3.9 PF 2% RED/VID '3P9'	1
103	307 103	CAP CERA MONO 50V .01 UF 20% GEN PURP/LEADS CUT TO 1/2"	72
142	824 685	CAP TANT DIP CASE 6.8 UF 35V 20%	19
158	819 **1	CAP VARI CERA 3.5 - 18 PF	8
161	335 *33	RES COMP 1/4W 5% 3.3 OHMS	16
161	335 100	RES COMP 1/4W 5% 10 OHMS	2
161	335 101	RES COMP 1/4W 5% 100 OHMS	1
161	335 102	RES COMP 1/4W 5% 1 K	10
161	335 113	RES COMP 1/4W 5% 11 K	8
161	335 151	RES COMP 1/4W 5% 150 OHMS	3
161	335 152	RES COMP 1/4W 5% 1.5 K	1
161	335 153	RES COMP 1/4W 5% 15 K	1
161	335 154	RES COMP 1/4W 5% 150 K	1
161	335 182	RES COMP 1/4W 5% 1.8 K	2
161	335 203	RES COMP 1/4W 5% 20 K	8
161	335 220	RES COMP 1/4W 5% 22 OHMS	1
161	335 223	RES COMP 1/4W 5% 22 K	1
161	335 240	RES COMP 1/4W 5% 24 OHMS	8
161	335 241	RES COMP 1/4W 5% 240 OHMS	6
161	335 272	RES COMP 1/4W 5% 2.7 K	3
161	335 393	RES COMP 1/4W 5% 39 K	1
161	335 430	RES COMP 1/4W 5% 43 OHMS	2
161	335 471	RES COMP 1/4W 5% 470 OHMS	16
161	335 510	RES COMP 1/4W 5% 51 OHMS	5
161	335 560	RES COMP 1/4W 5% 56 OHMS	3
161	335 561	RES COMP 1/4W 5% 560 OHMS	2
161	335 680	RES COMP 1/4W 5% 68 OHMS	8
161	335 681	RES COMP 1/4W 5% 680 OHMS	2
161	335 682	RES COMP 1/4W 5% 6.8 K	9
161	335 750	RES COMP 1/4W 5% 75 OHMS	1
161	335 751	RES COMP 1/4W 5% 750 OHMS	1
161	335 911	RES COMP 1/4W 5% 910 OHMS	3
181	457 103	RES VARI CERMET 10 K 1/2W 10%	1
181	457 104	RES VARI CERMET 100 K 1/2W 10%	16
181	457 202	RES VARI CERMET 2 K 1/2W 10%	2
182	537 103	RES VARI CERMET 10 K 3/4W 10%	16
230	110 **3	DIODE SWITCHING FD 777	16
230	110 **5	DIODE SWITCHING 1N4448	44
235	*50 **1	DIODE RECTIFIER 1N4139	1
253	*10 835	DIODE HOT CARRIER HP2835 H-P CASE 15	9
270	130 401	TRANSISTOR NPN A401 TO-72	22
275	170 **2	TRANSISTOR PNP 2N5771 TO-92	6
300	*20 **1	BEAD SHIELDING '1/2" SIZE	8
300	*50 **1	CHOKE FERRITE SINGLE LEAD	5
400	*20 308	SOCKET IC OPEN FRAME 8 .300 WIDE	9
400	*20 314	SOCKET IC OPEN FRAME 14 .300 WIDE	1
400	*40 *24	SOCKET IC ST DIP-24 BONDED TIN CONTACTS/COFF-NICKEL PINS	8

MODEL NO S4608B

SOLDERED BOARD

PRINTED 05-Feb-86

ECON 1008

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MCN 2

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2008

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LRS PART NO	DESCRIPTION	QTY
454 310 **2 HDR DIP SOLD TO PC BD	2 .100 CTRS/STRAIGHT/BREAKAWAY STOCK	11
714 608 **3 PC BD PREASS'Y	4608 NIM	1

NOTE: 1 PER DWG 4608B-L1

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MODEL NO V4608B

VARIANT BD ASS'Y

PRINTED 05-Feb-86

ECON 1008

REV DATE 04-Apr-84

MCN 2

MCN DATE 05-Feb-86

FAN HIST. NO

2008

FAN HIST. DATE

LRS PART NO	DESCRIPTION	QTY
208 *21 501	IC VOLT REG DUAL SG4501J DIP-14/CERAMIC	1
208 110 353	IC DUAL OP AMP LF353N DIP-8/JFET INPUT	9
210 *81 401	IC DISCRIMINATOR LD401BH DIP-24	8
834 608 **0	SOLDERED BOARD S4608B 714608000(1)	1

PL:S4608B

NOTE: 1 PER DWG 4608B-L1

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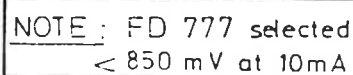
MODEL NO 4608B
ECON 2008
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OCTAL DISCRIMINATO

PRINTED 05-Feb-86
REV DATE 04-Apr-84
MCN DATE 05-Feb-86

LRS PART NO	DESCRIPTION		QTY
824 608 **0 LOOSE PARTS	M4608B	M4608B	1
874 608 **0 VARIANT BD ASS'Y	V4608B 834608000(1)	PL:V4608B	1

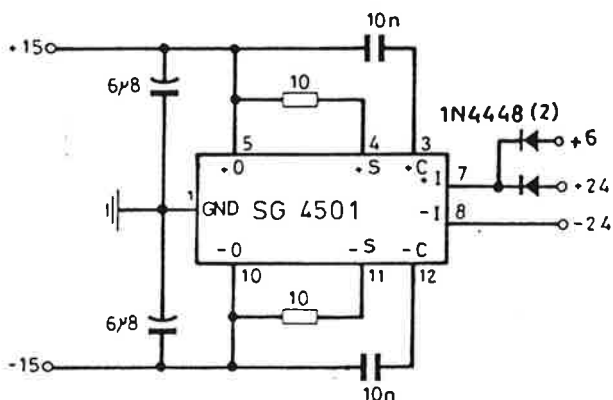
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MODEL	4608 BZ
OCTAL	DISCRIM

DRAWING NUMBER	4608 BZ-S1	SHEET 2	1	ECO NO 1008 4484
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ECO NO 1008
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MODEL NO 4608BZ
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OCTAL DISCRI HIGH

PRINTED 05-Apr-84
REV DATE 04-Apr-84
MCN DATE 04-Apr-84

LRS PART NO	DESCRIPTION		QTY
824 608 *90 LOOSE PARTS	M4608BZ	PL:M4608BZ	1
874 608 *90 VARIANT BD ASS'Y	V4608BZ	PL:V4608BZ	1

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MODEL NO M4608BZ

LOOSE PARTS

PRINTED 05-Apr-84

ECON 1008

REV DATE 04-Apr-84

MCN 0

MCN DATE 04-Apr-84

FAN HIST. NO

2008

FAN HIST. DATE

LRS PART NO	DESCRIPTION	QTY
402 *30 **0	CONNECTOR CO-AXIAL LEMO	18
402 *30 **1	HOOD FOR BULKHD LEMO CONN LEMO CR00.001.250	18
402 *30 **2	SPANNER NUT SMALL OD LEMO	18
402 112 **1	CONN PC MTG LEMO NICKEL	32
405 112 **1	CONNECTOR BLOCK (PIN) 42 "MIXED"	1
405 212 **2	GUIDE PIN (MALE) CADMIUM PLATED BRASS	1
405 213 **1	GUIDE PIN (MALE) BRASS	1
405 312 **1	GUIDE PIN (FEMALE) CADMIUM PLATED BRASS	2
405 613 **1	CONNECTOR HOOD CADMIUM PLATED STEEL/INT CLOSED END	1
410 162 **0	SWITCH TOGGLE N/LOCK SPDT SUBMINIATURE/NON-LOCKING	1
468 911 **1	TEST POINT (JACK) WHT 5KT-14 WHIT	8
521 400 *22	SPACER ROUND #4 11/16	2
523 400 *24	ROLL PIN SIZE #4 3/4 LG	8
540 103 102	SIDE COVER NIM LEFT	1
540 103 103	SIDE COVER NIM RIGHT	1
540 104 101	WRAPAROUND NIM SIZE #1 WITH BIN GATE	1
540 105 *11	BRACKET NIM WRAP SIZE #1 MADE IN SWITZERLAND/DO NOT SUBST	2
540 109 100	SWITCH HOLE PATTERN COVER	1
555 611 **1	CAPTIVE SCREW 6-32	2
555 621 **2	CAPTIVE SCREW RETAINER NICKEL PLATED BRASS	2
560 440 **5	SCREW PHILIPS 4-40X5/16	6
567 256 **4	SCREW FLAT PHIL 2-56X1/4	4
567 440 **4	SCREW FLAT PHIL 4-40X1/4	10
590 991 *22	WIRE TEFL 7-STRAND WHT 22	4
593 910 **1	CABLE CO-AX RG196 OR 178 50 OHMS/JACKET WHT OR NATURAL (TAN)	7
724 608 *11	FRONT PNL PREASS'Y 4608BZ PER DWG 4608BZ-M1	1
724 608 *13	FRONT PANEL 4608BZ 724608011(1) PAINTED & SCREENED	1
750 **0 101	WIRE 11" BLK W/PIN AWG 22 405410016(1)590001022(0)	1
750 **0 111	WIRE 11" BRN W/PIN AWG 22 405410016(1)590111022(0)	1
750 **0 121	WIRE 11" RED W/PIN AWG 22 405410016(1)590221022(0)	1
750 **0 131	WIRE 11" ORA W/PIN AWG 22 405410016(1)590331022(0)	1
750 **0 161	WIRE 11" BLU W/PIN AWG 22 405410016(1)590661022(0)	1
750 **0 181	WIRE 11" GRAY W/PIN AWG 22 405410016(1)590881022(0)	1

NOTE: 1 PER DWG 4608BZ-L1

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MODEL NO V4608BZ

VARIANT BD ASS'Y

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MCN DATE 04-APR-84

FAN HIST. NO

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LRS PART NO	DESCRIPTION	QTY
161 225 222	RES COMP 1/8W 5% 2.2 K	8
208 *11 *11	IC JFET OP AMP TL082CP DIP-8	9
208 *21 501	IC VOLT REG DUAL SG4501J DIP-14/CERAMIC	1
210 *81 401	IC DISCRIMINATOR LD401BH DIP-24	8
834 608 **0	SOLDERED BOARD S4608R 714608000(1)	1

FL:S4608B

NOTE: 1 PER DWG 4608BZ-L1
NOTE: 2
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