CEBAF
The Continuous Electron Beam Accelerator Facility
Newport News, Virginia
UNITED STATES DEPARTMENT OF ENERGY

Physics Division -- *Fast* Electronics Group

CLAS-NOTE 95-017

Description and Instructions for an Automated CAMAC Test System for the LeCroy 2313 Discriminators of Hall B

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1.0 Introduction

This document describes the setup and use of the automated test developed for the LeCroy 2313 16 channel discriminators. The test station uses standard CAMAC hardware and the software routines have been developed in LabView™ for Windows 3.1®.

1.1 Purpose of Test Station

The 2313 Lecroy CAMAC discriminator module was designed to meet CEBAF specification 66340-S-01107 Revision A. The test station will automatically test the functions of the discriminator modules. The following tests are performed automatically and verify performance to the CEBAF specification:

1. Programmable Read/Write Threshold Register [12 bits]
2. Programmable Read/Write Internal Mask Register [16 bits]
3. Programmable Read/Write Output Pulse Width Register [12 bits]
4. Programmable Remote/Local Function
5. External Inhibit operation
6. Mask operation
7. Threshold operation
8. Global Veto operation
9. Interchannel Isolation
10. Test Input operation
11. Calibrate Output Pulse Width as a function of DAC counts
12. Check for double pulsing

2.0 Test Procedures

2.1 Hardware Configuration

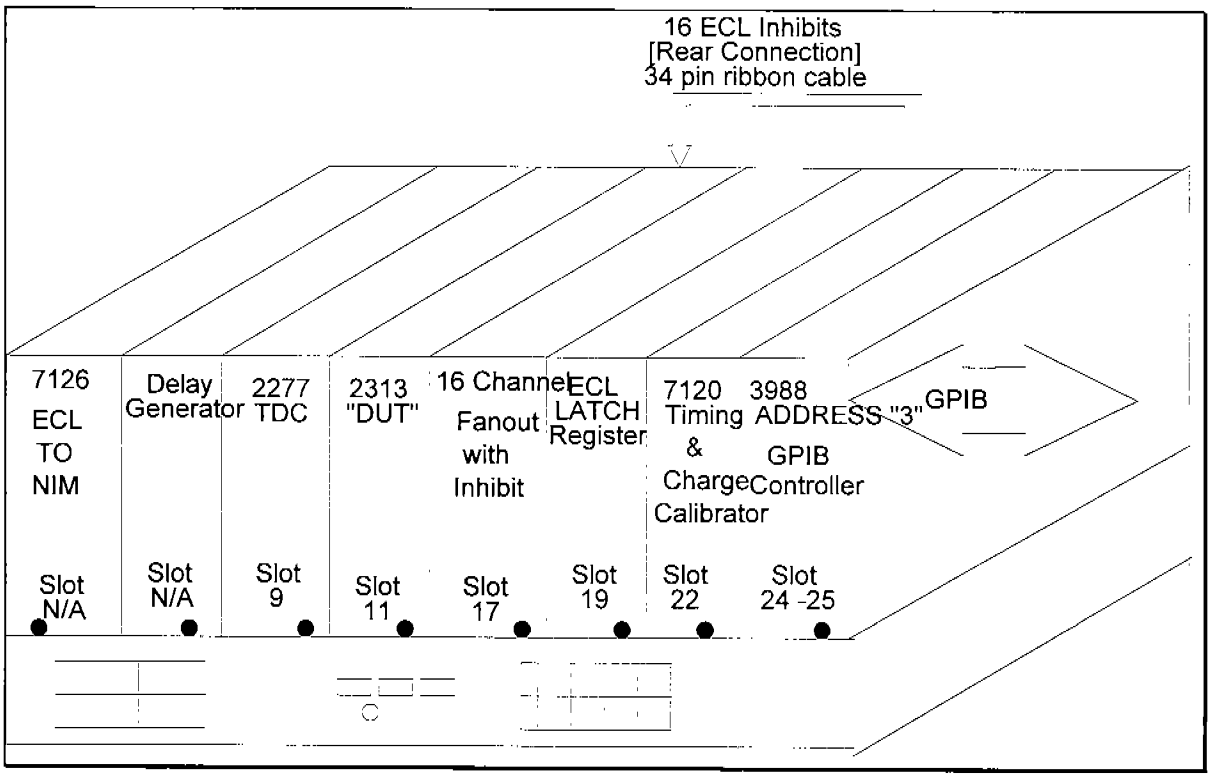

Figure 1

The CAMAC crate is controlled via a 3988 GPIB Crate Controller in slots 24 and 25, and is connected to the computer with a GPIB cable. The GPIB address of the 3988 is set to three(3).

Place a Phillips 7120 Charge/Time Generator in slots 21 and 22. The switch settings on the 7120 should be as follows:

> The Primary DAC switch should be on "T". The next two switches dealing with Charge are unimportant. The Time control switch should be set to "CAMAC" and the full range set to 512 ns. If these are not set correctly when the program is run, dialog boxes will appear requesting these changes, however if they are still not changed the program will continue running as if they were.

Place the ECL Latch in slot 20 and the 16 channel fan-out in slot 19. The LeCroy 2277 TDC should be placed in slot 9. A ECL to NIM converter and a delayed gate generator (for creating the global veto pulse) should be placed anywhere to the left of the TDC. Slots 11-17 may be used for the discriminators being tested. Use only slot 17 if you wish to open the side panel of the module to make hysteresis adjustments while the module is powered.

Also required are a Hewlett-Packard 8082A pulse generator and an attenuator. The attenuator should be initially set to 39.2 dB. The pulse generator should be configured as follows:

Pulse set to normal mode. Set to Ext. Trig with the Ext. Input Level vernier knob given a 1/8th turn to the left of the center mark. Set slope of Ext. Input to negative. Set the pulse period to anything (doesn't matter in ext.trigger mode) and the pulse delay to the minimum value. Set the pulse width switch to 50n-.5micro and the vernier to slightly less than one notch to the right of center. Set transition time switch to second setting from the left, the leading edge vernier to one notch right of center, and the trailing edge vernier to halfway between the 2nd and 3rd notch right of center. Set the left switch of the amplitude to its highest setting, the right switch to the second from the bottom, and the vernier to maximum right. The offset should be off and the output set to negative and normal. It is recommended that you use an oscilloscope to help set the generator correctly the first time. The goal is to get a smooth pulse, as much like a photomultiplier tube pulse as possible, out of the fan-out minimizing oscillations. Use the pictures of the three input pulse types used by the program to model the shape of your pulses (Fig. 2-4).

Connections between the modules are as follows:

1) A Lemo cable from the start on the 7120 trigger to the ECL/NIM converter and on to the Com Start on the TDC Another Lemo cable from the stop to the external trigger of the function generator.
2) A Lemo cable from the output of the generator to an attenuator and from the attenuator to the input of the fan-out.
3) 16 Lemo cables from the fan-out outputs to the 2313 inputs.
4) A 34 pin connector from one of the Discriminator outputs to the ECL input of the 2277 TDC.
5) A 34 pin connector (w/ adapter) from the ECL Latch output to the back input of the 2313.
6) A Lemo cables from the delay generator to the veto of the 2313.

2.2 Software Configuration

Click on the icon labeled TRIG2277 under the LabView subgroup. This will start LabView and load the program trig2277.vi which will be later used to conduct the global veto test. Next, click on the icon labeled AUTO 2313 TEST under the LabView subgroup (See Figure 6). This will load the program automatd.vi which is the main testing program. Refer to following sections for details.

Press the Execute arrow (the first button on the left of the control bar) in the Automatd.vi control panel. You will be required by dialog boxes to choose filenames for the results of width calibration, the threshold test, and the double pulse test. You will also be instructed to make adjustments to the attenuator during the threshold test. Passing of a test is indicated by the appearance of a colored light in its corresponding box in the checklist. After the program has finished running (the execute arrow returns to its normal appearance), you may close or minimize the window and open the one containing trig2277.vi. Push the button on the tool bar at the top which looks like two arrows forming a circle. This begins the program in continuous run mode. All lights in the diode array should be off to begin with (unless the module failed to have total efficiency at 10 mV threshold in the threshold test). Press the trigger button on the delay generator, and observe if the diode array turns completely on for the duration of the veto pulse created by the generator. If it does, the discriminator passes the global veto test. See the section on Excel 5.0 below to see how to enter that data into the file containing all the other pass/fail data and how to access and format all acquired data.

2.3 Virtual Instrument Test Routines [Sub Vi's]

These are the tests conducted by the automatd.vi program along with the names of the subvi's that run them. For a description of the test in addition to information on running the all the vi's (or virtual instruments), including automatd.vi, see the following section containing vi descriptions. All VI's mentioned below are available in the LabView/vi.lib/Alex directory.

Local/Remote	Locrmtst.vi	Verifies programmable local/remote function
Threshold I/O	Threshio.vi	Verifies programmable read/write threshold register
Interchannel Isolation	Interiso.vi	Verifies interchannel isolation
Mask I/O	Mask.vi	Verifies programmable read/write mask register
Mask	Trimaloo.vi	Verifies mask operation
Ext. Inhibit I/O	ECLoop.vi	Verifies programmable read/write mask register through external inhibits
Ext. Inhibit	Trigeclo.vi	Verifies external inhibit operation
Width	Width.vi	Determines the relationship between the internal DAC and the actual output widths and checked uniformity of output widths from channel to channel
Threshold	Thresh.vi	Verifies threshold operation
Double Pulsing	Double.vi	Checks for double pulsing

Failure of any of these tests may be investigated in detail using the appropriate subvi (unless otherwise recommended in the descriptions below) and/or using the two primary tool vi's: 2313tool.vi, which gives complete control of all registers of the discriminator, the fan-out, and the ECLlatch, and trig2277.vi, which initiates a pulse from the trigger, through the discriminator, and then reads the results from the TDC. Trig2277.vi is usually placed in continuous run mode while altering variables using 2313tool or the attenuator or function generator.

Other Tests:

Global Veto This test is easily done using trig2277.vi in continuous run mode while manually sending a NIM pulse to the global veto on the 2313 and watching the overflow LED's light up on the vi's front panel. Note: If the 2313 being tested failed the low end of the threshold test it will be necessary to change the threshold of the 2313 using 2313tool.vi to ensure that all channels are firing *before* the global veto. This is necessary because the automated test leaves the 2313 set to the 10 mV threshold.

Maximum Rate This is the only test that must be done completely by hand. Recommended that it only be done for selected boards after the automated tests are all complete.

3.0 VI's in the ALEX directory of the VI Library:

2277: This VI is the main, general purpose vi for reading from the LeCroy 2277 TDC. It outputs a timing array where each row represents a different channel and each column a timing event. A return of 131072 (20000 hex) indicates that a time-out occurred. The array is automatically sized with enough columns to accommodate the channel with the greatest number of hits filling all empty spots with the time-out code of 131072. The vi also allows the user to choose whether to read out all 32 channels of the TDC's capability or only the first 16. Thus, if the "# of channels to read" switch is set to 16 and one or no hit is recorded for each channel the output will be a 16x1 array. Should one of the channels receive two hits and the rest still receive only one, the output will be a 16x2 array with the time-out code filling every entry in column 2 except for the one corresponding to the channel with the double hit which will contain valid timing datum. The other output is an XY graph multiplot which displays the timing data as a series of logic pulses with each line's height corresponding to its channel number. Also displayed, as a vertical line stretching from top to bottom, is the location of the time-out. Logic pulses are set to a default width of 20nsec (the effective resolution of the TDC) unless both the leading and the trailing edge hits are enabled via the control register of the TDC in which case the true widths of the pulses are shown. The graphing capability may be turned on and off to increase efficiency by means of a button on the front panel of the vi.

2277read, sort, and graf: These are the three vi's comprising the 2277.vi program. 2277read is responsible for reading out the raw data from the TDC exactly as it comes in a sort of Q-Stop mode. 2277sort takes the data from 2277read and begins the process of sorting it. 2277graf takes the sorted data, finishes formatting it into useable time data, and creates the logic graph display. Great care is recommended if attempting to alter these programs.

2277test: This simple vi makes use of the 2277's internal test function to generate, then output and display pulses. A knowledge of the correct number to write to the Control Status Register of the TDC is required. The primary purpose of this vi is to test the 2277 only.

2313tool: This is one of the two primary vi's for pinpointing problems with the 2313's (the other is trig2277.vi). It allows the user to do a number of things to the discriminator modules including: local/remote control, reading and writing to the threshold, the output width, and the mask register. It also allows the user to write to the ECLlatch for external inhibits and to the fan-out and to start a test pulse in the discriminator (Fig. 5 shows the front panel controls). The DAC for the threshold is internally calculated so the user may simply enter the desired threshold in millivolts. The output width, however, is nonlinear to the DAC and so the actual DAC number must be entered. This can be obtained from the graph created by the width.vi program. Numbers written to the fan-out, the mask, or the ECLlatch should all be in hexadecimal and have the effect (when working correctly), of preventing output from designated channels. There is a button which allows you to toggle between the fan-out in slot number 18 (left) and one in slot 19 (right). This was required because two fan-outs are necessary for the test of the pre-trigger boards. Only one is required for the test of the 2313's and it should be placed in slot 19.

Automatd: This is the main vi used for testing the 2313's (Fig. 6 shows the front panel). The only required inputs are the slot number of the discriminator, its serial number, and whether or not the pass/fail data should be added to the records file. A colored light in the checklist indicates passage of a test. During the course of the program, the user will be given the opportunity to save the width calibration (shown on the front panel as the graph in the upper right-hand corner) and the results of the threshold efficiency test (the large array filling most of the screen), the results of the double pulsing test (the array to the far right), also to acknowledge the choice of file to which the pass/fail data will be added if that option is enabled on the front panel. Before using any of these saved files, it is highly recommended that you read the Excel section of this manual. The user will also be required, during the course of the program, to make manual adjustments to the attenuator for the threshold test as directed by the dialog boxes. To begin with, the attenuator should be set to 39.2 dB. It also finishes with this value, so that no adjustment is necessary between multiple runs. During the double pulse test or after the programs completion, the user may opt to examine the threshold efficiency data array. The array has 3 pages, one for each input pulse height: 15, 30, and 50 mV. The different pages may be viewed one at a time by changing the page number (0, 1, or 2) in the box to the left of the array. Should you decide after the program's completion that you want the data in the array saved to a file (and you had opted not to before or want another copy), open the vi named thresh.vi and copy the data to the storage array and run the program with the vertical switch on (See Thresh below). The threshold test is actually composed of three different parts and for a module to pass the threshold test it must pass all three parts. The pass/fail records of the individual parts are what get written to the records file. The "Ambiguity in Threshold Spread" LED will light up if there is an error in the threshold spread part of the test. Also provided for easy inspection, are the results of the width test and of the double pulse test. The results of the latter are provided by two arrays. One gives the total number of times that each channel double pulses, the other gives the width setting at which each double or multiple pulse occurs. Use the lower indice box to scroll sideways through each of the widths. The numbers in the top row correspond to the entry in the width register. Many of the controls and options for the tests are not visible on the front panel to avoid unnecessary clutter and confusion. They are, however, visible within the diagram as constants and inputs wired to the various test sub-vi's. If one of these "invisible" control needs changing (for example, the TDC is in a slot other than that specified in the manual), use the third mouse button on the control's icon and go to the item on the menu called "show control". This will allow you to make adjustments to that variable from the front panel.

CSRread and CSRwrite: these two vi's are used for reading and writing to the control status register of the 3988 GPIB Crate Controller (used to check for "Q" in the remote test and in trig2277.vi). It should be noted here that, for some unknown reason, the 3988 sends back an additional, but empty, byte in addition to bits 1-16 and therefore, CSRread makes an internal adjustment, rotating the empty byte to the front and placing the important bits positions where they are expected.

Double and Double2: These vi's scan through a variety of output widths for a fixed threshold and input pulse. Note: THIS IS NOT A DOUBLE PULSE RESOLUTION TEST. The main output is an array, like for the threshold test below. The first number in a column is the DAC number corresponding to the width of the output pulses (we are presuming a low deviation between channels, but it works even without this). The numbers below are the percentage of times for each channel that a single input caused a double pulse. The total number of times that each channel is triggered at each width is controllable via the front panel. The vertical array to the right of the main array simply shows the total number of times each channel double pulsed. The data may be saved if the "Save Data" switch is turned on before running. The default location is C:\Excel\Alex\Double\D(serial # of the 2313).xls. The D in the default file name is to help distinguish this file from the width files and the threshold files. The main difference between Double.vi and double2.vi is in the algorithm choosing which widths are tested. The automated program uses double2 where the widths are input from an array. Changing the default of this array will therefore change the values used by the main program, proceed at your own risk. In general, changing the array is a pain anyway. Double.vi allows you to increment through ranges of your choice by whatever values you wish. Thus you might choose to increment by 5 for low DAC values, go up to 10 or 15 at higher values, drop back to 5 to look at an area in-depth, then shoot up to 50 to finish the sweep off. Any combination of the four ranges may be used at the same time. They are turned on and off by the buttons to their left. Thus, when using the double programs as a tool, you should use double.vi for "exploratory" tests and double2.vi only if you wish to duplicate the test run by the automatd.vi.

ECLoop: This vi runs the External Inhibit I/O test of the automated program by walking the bit through the ECLlatch and reading back the mask register on the 2313. It should never be necessary to alter or even open this vi.

Interiso: This vi runs the interchannel isolation test of the automated program by turning off each input channel in turn and seeing if any signals come through anyway. It should never be necessary to alter or even open this vi. Very likely, a failure of this test will be accompanied by a failure of all "real input" tests (i.e. External Inhibit (actual), Mask (actual), Width, and Threshold) and points to a possible error in wiring or entering of slot numbers by the user (it never failed for me except when that was the case)..

LocRmTst: This vi runs the Local/Remote Mode test of the automated program. As the first test conducted by the automatd.vi, it begins with a CAMAC initialize (Z). It finishes with the discriminator in remote mode. Failure of this test indicates a problem with the 2313 in changing from local to remote mode and back. Use "2313test.vi" to toggle between local and remote mode and visually check to see if the remote light indeed fails to come on as it is supposed to. A final way to insure that the module is not in reality toggling between the two but failing to display that fact is to try writing a different width to the output pulse using an oscilloscope triggered by a NIM output channel on the ECL/NIM converter. The written width will only be displayed when the 2313 is in remote mode. It is otherwise governed by the potentiometer on its front panel (usually set at maximum width).

Mask: This vi runs the Mask I/O test of the automated program by walking the bit through the mask and then reading it back. This vi offers a graph of the input vs. the output, but better information and control can be obtained through the 2313tool.vi and trig2277.vi combination and so this vi should not be needed independently.

Spread: This program is purely for use as a sub-vi. It takes the data from thresh.vi and determines if the module passes the three-part test. See Thresh below for a description of the parts.

Thresh: This important vi runs the threshold test of the automated program. It is designed to sweep the threshold from -5 to +9 mV by increments of 2 mV around predecided input pulse heights. At each threshold level the trigger fires the number of times entered in the control labeled "Hits per channel per setting" giving the output return of the discriminator as a hit percentage for each channel at each setting in the large output array. The preset input values are 15mV, 30mV, and 50mV. Changing the page number in the box to the left of the output array displays the results for each in ascending order. Should more, or different, values of input pulse heights be desired, there are controls which allow this. The pulse height should be entered in the one labeled "Actual Input Levels" and the corresponding Attenuator settings in the one labeled, coincidentally, "Attenuator Settings". However, they are hidden on the front panel. You must go into the diagram and click on the controls there with the third mouse button and choose "show control" from the menu. Then they may be adjusted from the front panel. You have the option of saving the data from a run both before the run (using the Save Data button) or after the run. If you choose to save the data only after the program has begun or finished running, you may do so by clicking the third button on the indices box, choosing "select all", then choosing "copy data" from the same menu and pasting the data in the storage array at the bottom. After the data has been pasted in this array, flip the switch there on and run the program again. This time it will not perform the threshold test again, but will present a dialog box asking where you wish the data saved. This will have the side effect of clearing the data in the main array, so be aware. Also, be sure to flip the switch back if you are going to continue using either thresh.vi or automatd.vi. The analysis of the threshold data is carried out by spread.vi. There are three parts to the analysis all of which must be passed by the module to pass the threshold test. First, there must be no inefficiencies at the input minus 5 mV threshold level. Second, there must be no hits at the input plus 5 mV level. Finally, the thresholds of each channel must be within 4 mV of each other. If there is a reason why this spread of threshold values may not be calculated precisely, the "Ambiguity in Threshold Spread" LED will light up.

Thresh2: This vi does the same thing as thresh.vi except that it tests each channel individually with all the others turned off. It does not offer you the option of saving the data to disk, but you may do so as with the array in automatd.vi by waiting until it is done running and then copying the data into the storage array of Thresh.vi and saving it that way. Warning: This program does take a very long time to run compared to the others.

Threshio: This vi checks the read and write theshold commands on the 2313 by walking the bit through the threshold register and reading the register back. Failure of this test indicates a failure of one of these two commands. It does offer a graph of input vs. output (in which a correct plot would be a straight line of the form x=y) but should not ever be needed (2313tool.vi offering better control) independently.

Trig2228: This program, like the trig2277.vi, first triggers a pulse out of the 7120 CTG the reads from a TDC, in this case two eight channel 2228A TDC's. It is not used in any current vi for the testing of the 2313's but still remains as a useful tool for controlling the 2228A's.

Trig2277: This is an extremely useful vi (Fig. 7 Shows the front panel), used usually in conjunction with 2313tool.vi, making full use of the 2277's multi-hit capabilities. It begins by generating a pulse in the 7120 CTG. Then reading from the 2277 using the 2277.vi. Outputs consist of a numeric array of timing data, a quick-reference column of LED's to indicate time-outs, and an optional logic analyzer display. Full control of the TDC (minus test functions and the trigger option) is offered by a collection of switches which may be overridden by the numeric control if the exact number to be written to the TDC's Control Register is known. The array output is sized to show only the first three hits to the first 16 channels, but should more be required, using the third mouse button on the edge of the array and choosing "show index display" will bring up a control to show the rest of the array. The pulses shown in the logic display are 20 ns in width by default unless both leading and trailing edge hits are activated, in which case the true width is shown.

Trigeclo: Short for "Triggered ECL Loop", this vi runs the External Inhibit test for the automated program by walking the bit through the ECLlatch and checking the TDC to see if the overflows match the inhibits. Very likely, a failure of this test will be accompanied by a failure of all "real input" tests (i.e. Interchannel isolation, Mask (actual), Width, and Threshold) in which case all connections should be rechecked before assuming module failure.

Trimaloo: Short for "Triggered Mask Loop", this vi runs the Mask test for the automated program by walking the bit through the Mask and checking the TDC to see if the overflows match the masks. This test is independent of whatever might be read back from the mask register. Very likely, a failure of this test will be accompanied by a failure of all "real input" tests (i.e. Interchannel isolation, External Inhibit (actual), Width, and Threshold) in which case all connections should be rechecked before assuming module failure.

Width: This vi runs the width test for the automated program. At a constant threshold (control on the front panel: set to 20 mV for automatd.vi) it triggers one hit at various locations along the DAC with the TDC set to pick up both leading and trailing edges. For each DAC, each channel's width is compared to the average of the other channels and is expected to be within a certain % Error (front panel control). Failure of any one channel at any one DAC causes the entire test to count as failure. Thus failure of this test does not necessarily indicate a significant problem, but should only draw the user's attention to the graph of maximum and minimum widths vs. DAC. You are given the option ahead of time to save this data to Excel if desired. See the section on Excel for directions on how to quickly return the data to graph form once in Excel. The last option, available only when the program is being run on its own, is to send the acquired data to the zoom2.vi where you may get a closer look at parts of the graph if you desire. This necessitates opening the zoom.vi program and accessing the front panel.

Zoom and Zoom2: The purpose of these vi's are to take graphs and allow the user to zoom in and out using the cursors as a frame. If used as a subvi the program must be open in order to access the front panel with the zoom controls. Zoom.vi is for waveform charts and graphs; Zoom2.vi is for XY plots. The input must be clusters which are put back into an array within the zoom2 program. It is important to match the contents of the input clusters in the zoom2 program's inputs with the output clusters of the calling vi. Zoom2 is currently configured for the width.vi program. These programs are not necessary with LabView version 3.1.1. which has zoom features included.

4.0 Records in Excel 5.0

There are three cases in which data from LabView is saved to an Excel readable format in the C:/Excel/Alex directory and subdirectories:

Threshold: Threshold efficiency arrays are, unless otherwise placed by the user while in the file dialog, saved under the C:\Excel\Alex\Threshol directory with a default name (unless another is supplied by the user) of T(entered 2313 serial #).xls. The T is to distinguish these files from those produced by the width test which are named serial#.xls.
Procedure for viewing files for the first time: Before opening the file you wish to review, open the file labeled macro.xls in the same directory. Then open the threshold file. The text Import Wizard will automatically pop up. Press Finish. Next, go immediately to the tools menu and choose the item at the bottom named 3D. It will change the array into a much more readable and understandable format. The macro doesn't include page setup for printing as this is a case in which the

macro is actually a lot slower than doing it manually. The recommended procedure is: First, select all three sheets. Then go to the Page Setup in the File menu and choose landscape, 130%, the title for the header, the page number for the footer, and center vertically and horizontally. When you are done working with the file, before closing it you should save it under the same name but as a Microsoft Excel Workbook instead of as tab deliminated. If you do not, all changes created by the macro and possibly others will be erased.

Width: Width vs. DAC data, unless otherwise stated by the user at the time of saving, will be saved directly in the C:\Excel\Alex directory with the default name (serial#).xls.
Procedure for opening file for first time: First open the file named amacro.xls. Then open the file you wish to review. The Text Import Wizard will automatically pop up. Press Finish to import the data, then go to the tool menu and pick GraphWidth at the bottom. This will create a graph and will also prepare the data for printing. When you are done working with the file, before closing it you should save it under the same name but as a Microsoft Excel Workbook instead of as tab deliminated. If you do not, all changes created by the macro and possibly others will be erased.

Double: The percentage array from either of the double.vi's or from that portion of the automated test are by default put in the C:\Excel\Alex\Double directory under the default name D(serial #).xls.
Procedure for opening file for first time: First open the file named admacro.xls. Then open the file you wish to review. The Text Import Wizard will automatically pop up. Press Finish to import the data, then go to the tool menu and pick Double at the bottom. This will create a column showing the total number of double or multiple pulses for each channel (It assumes 10 hits per setting, if it is otherwise, that portion of the macro must be changed) and the total number for the entire module.

Records: When running the automated test procedure, you have the option of saving the data on which tests a module passes and which it fails to a file. The default is the file C:\Excel\Alex\Records\Passfail.txt. Note that this is a .txt file and thus will not show up in the Excel Open File Dialog box until this type of file is shown. Upon opening, the Text Import Wizard will pop up. Press Finish. DO NOT SAVE THIS FILE IN EXCEL WORKBOOK FORMAT WHEN YOU ARE THROUGH WITH IT. This will prevent you from adding on to the file the next time you wish to save data to it. X's indicate failure of a test, except in the case of the double pulsing test where the presence of a number indicates failure (the number is the total number of times the discriminator double pulses at all settings on all channels). NT stands for "Not Tested" and is automatically placed, whenever a new line is added by the automated program, in the spots where the global veto and maximum rate test results are listed. If these tests are conducted the new values must be entered manually. New test results are always added to the end of the list. To put the results in order by serial number, push the button that selects all. Go to the Data menu and choose Sort. Check the circle making the first row a header row, then press OK. THE RECORDS FILE MUST BE CLOSED BEFORE THE NEXT TEST IS RUN OR THE PASS/FAIL DATA WILL NOT BE RECORDED TO IT.

Header key for passrec.txt

L/R	Local/Remote Test	T. I/O	Threshold Register Input/Output
Inter. Iso.	Interchannel Isolation Test	M. I/O	Mask Register Input/Output
Mask	Mask Test	E. I/O	External Inhibit Control of Mask Register
Ext. Inh.	External Inhibit Test	Width	Output Width Test
T.L.E.	Threshold Low Efficiencies	T.H.E.	Threshold High Efficiencies
	(< 100% efficiency at thresh = input - 5 mV)		(>0% Efficiency at thresh = input + 5 mV)
Spread	Threshold Spread	Double	Double Pulsing Test
Glob. Veto	Global Veto Test	Max. Rate	Maximum Rate Test (selected boards)

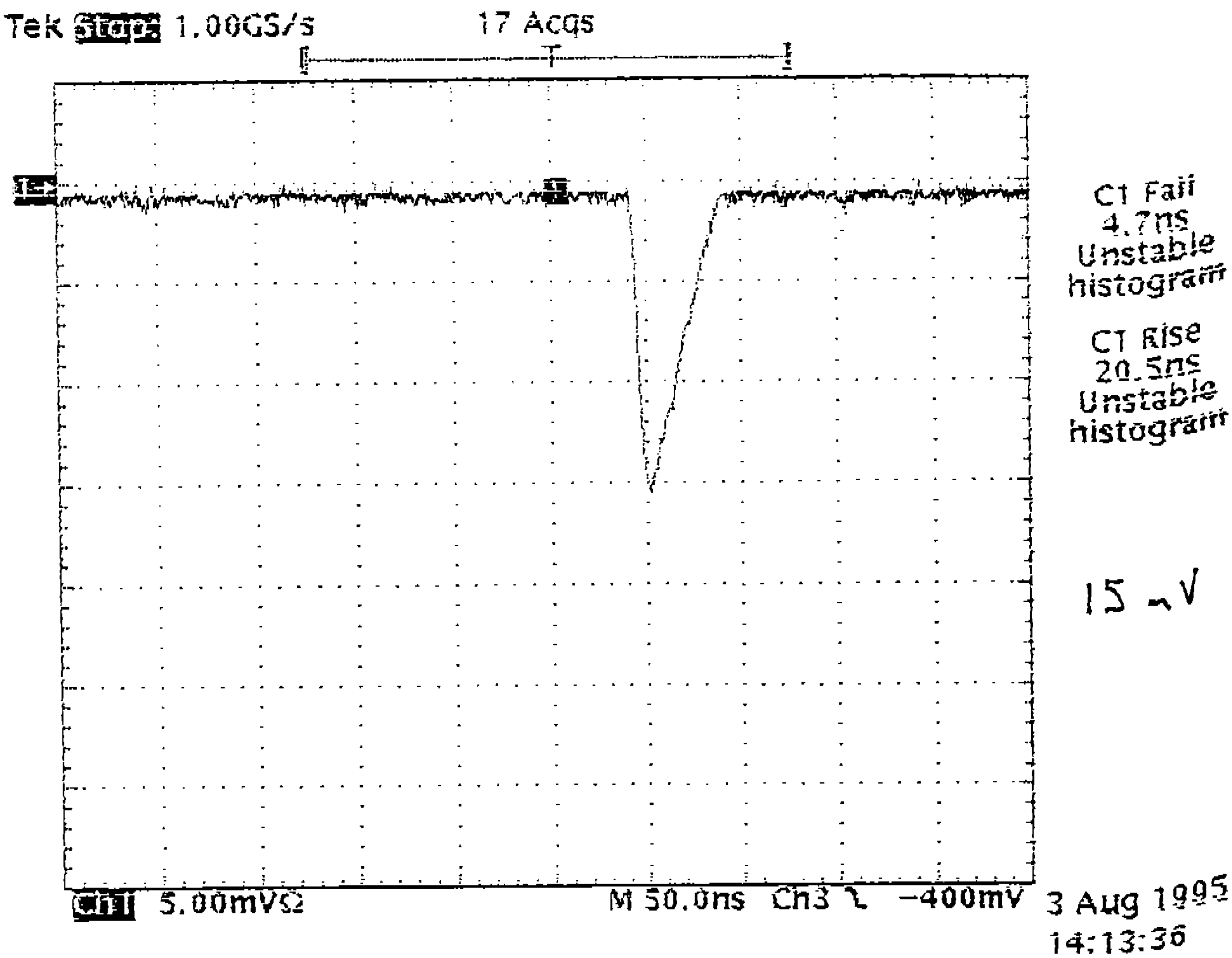
Tek Stop 1.00GS/s
17 Acqs
C1 Fall
4.7ns
Unstable
histogram
C1 Rise
20.5ns
Unstable
histogram
15 mV
Ch1 5.00mVΩ
M 50.0ns Ch3 ⤵ −400mV
3 Aug 1995
14:13:36

Figure 2

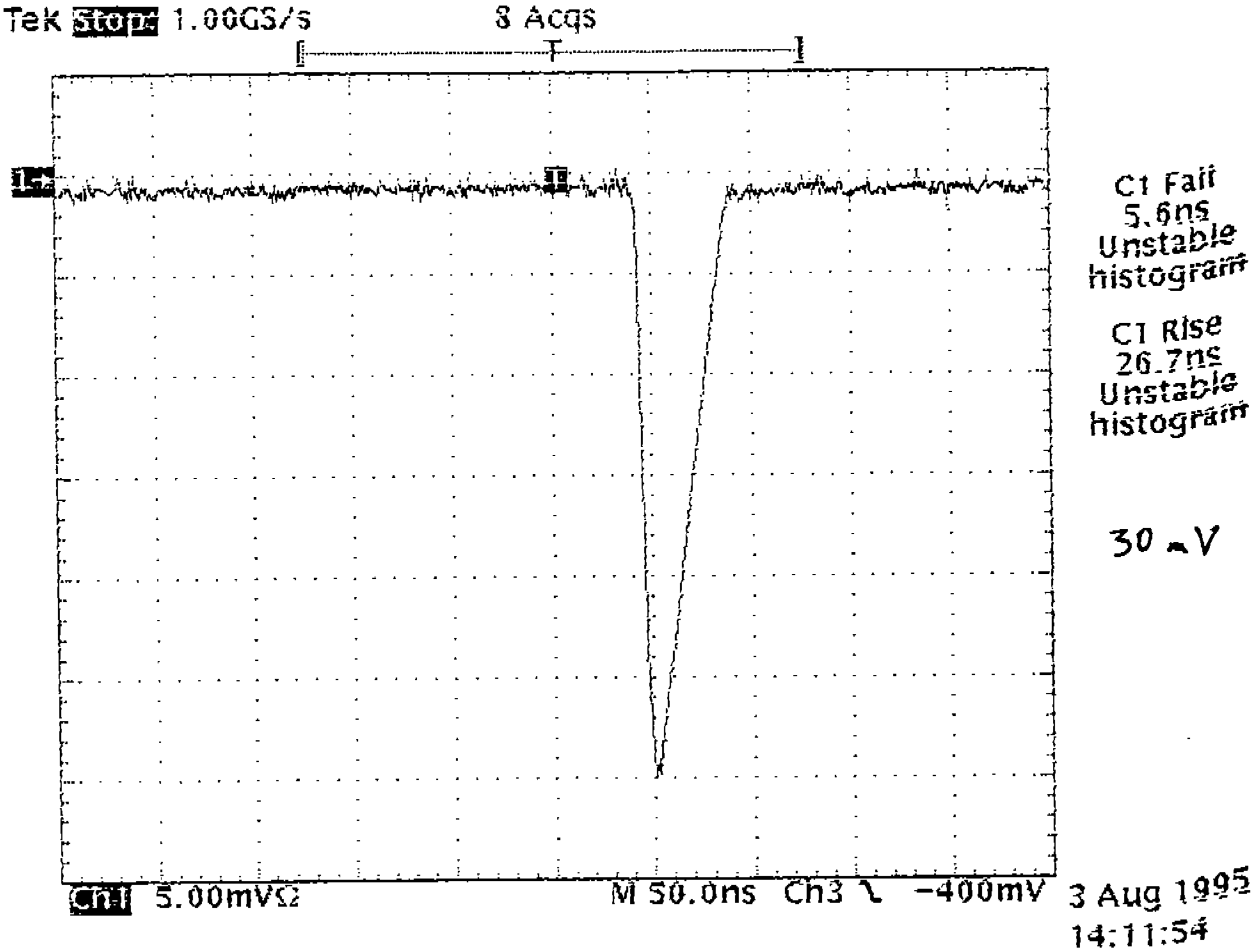
Tek Stop: 1.00GS/s
8 Acqs
C1 Fall
5.6ns
Unstable
histogram
C1 Rise
26.7ns
Unstable
histogram
30 mV
Ch1 5.00mVΩ
M 50.0ns Ch3 ↘ -400mV
3 Aug 1995
14:11:54

Figure 3

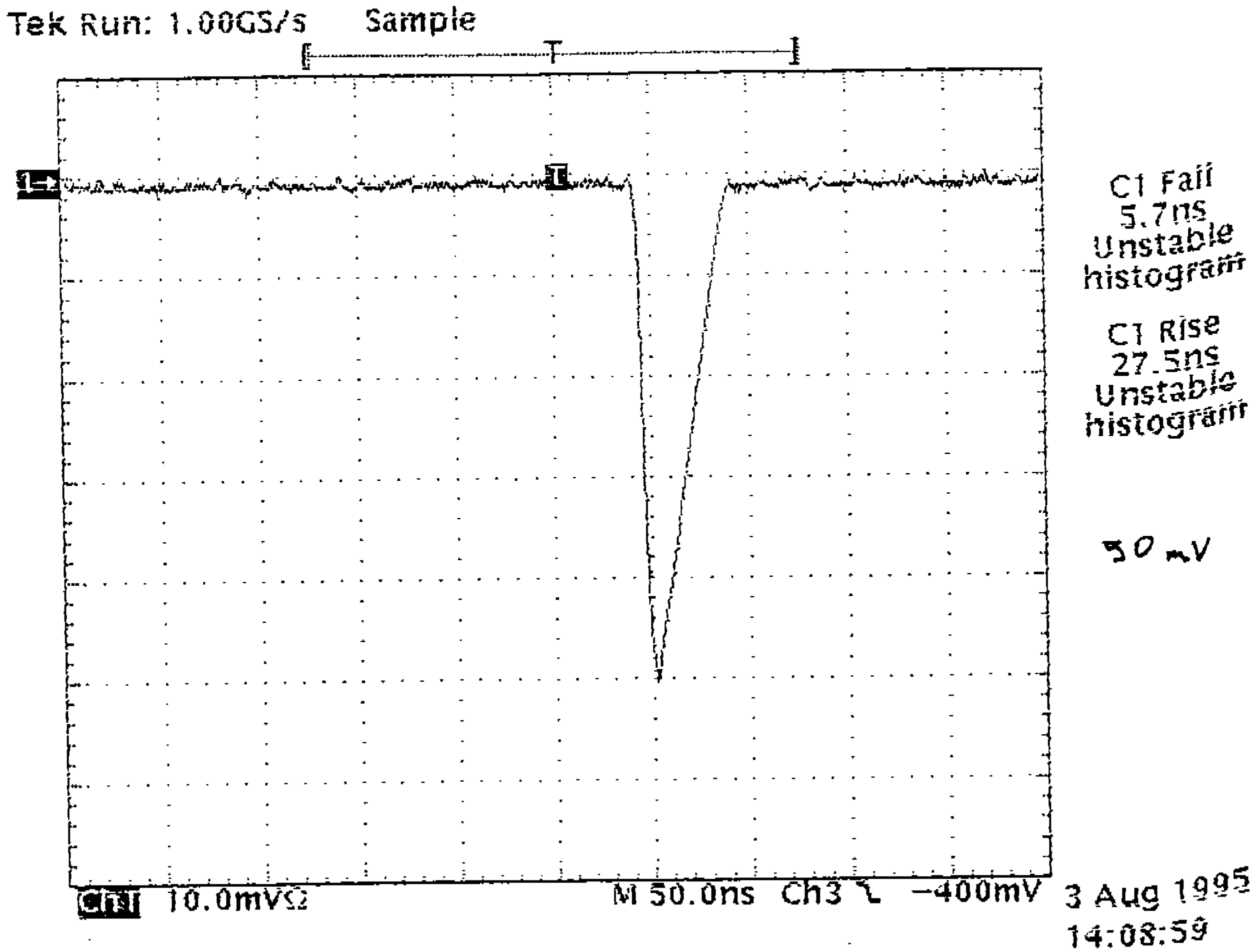
Tek Run: 1.00GS/s Sample
C1 Fall
5.7ns
Unstable
histogram
C1 Rise
27.5ns
Unstable
histogram
50 mV
Ch1 10.0mVΩ
M 50.0ns Ch3 ∖ −400mV
3 Aug 1995
14:08:59

Figure 4

2313TOOL.VI
08/09/95 03:46 PM

Front Panel

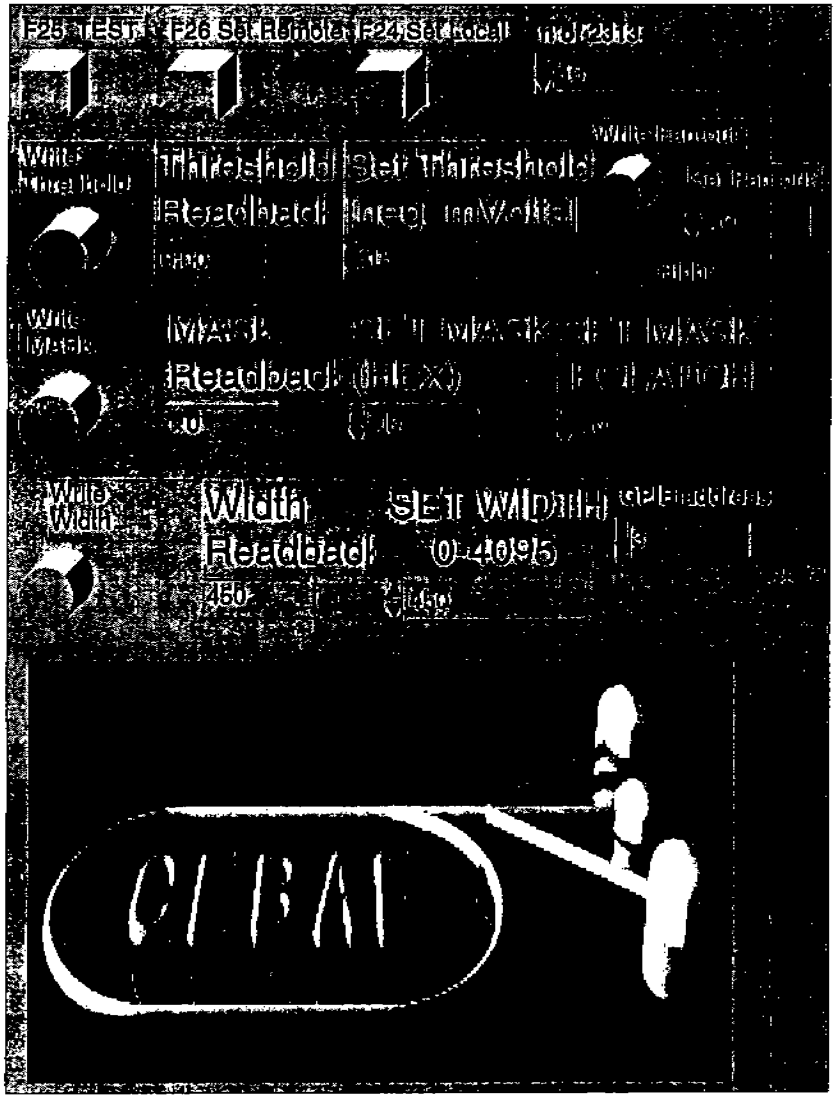

Figure 5

AUTOMATD.VI
08/09/95 03:46 PM

Front Panel

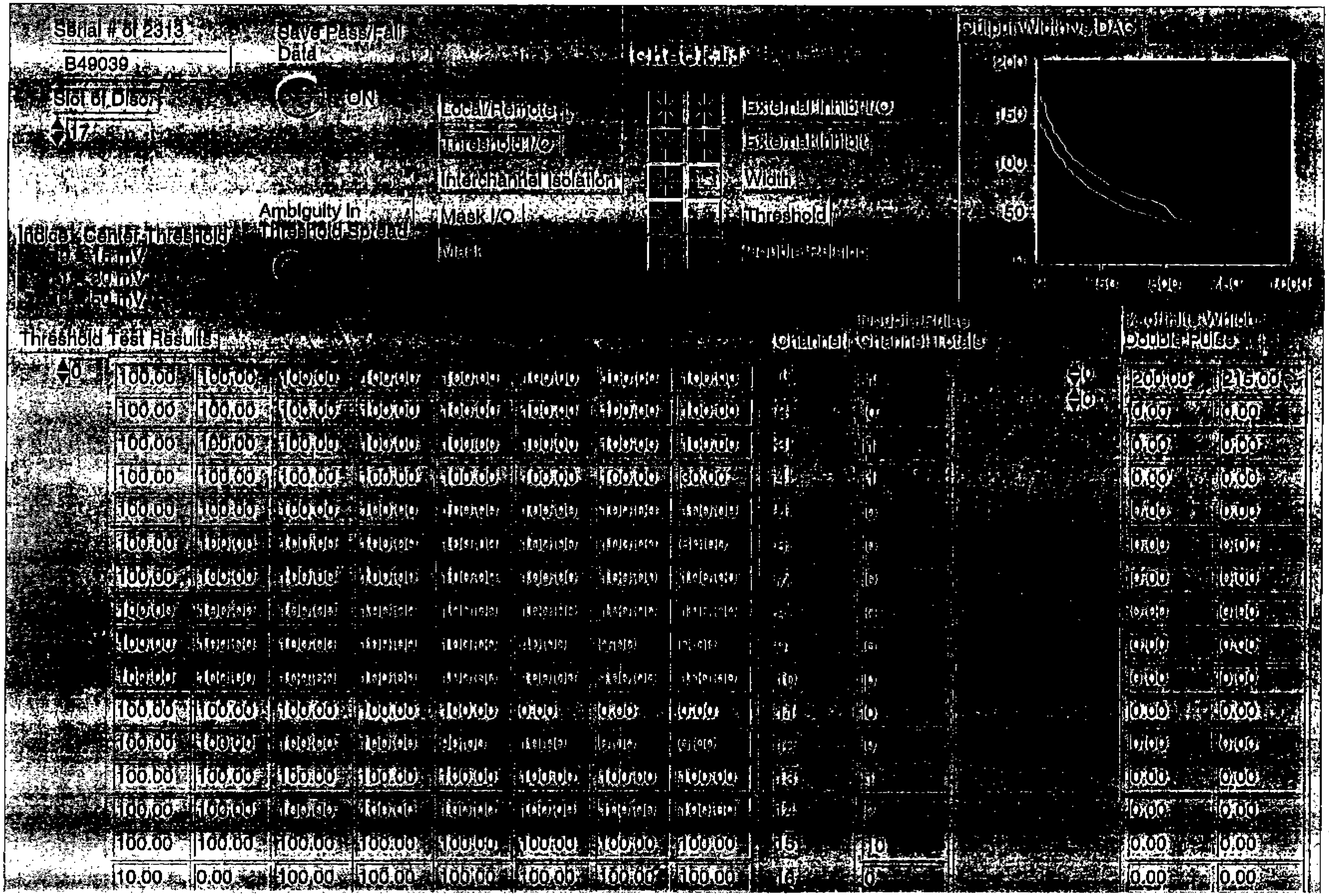

Figure 6

TRIG2277.VI
08/08/95 07:37 AM

Front Panel

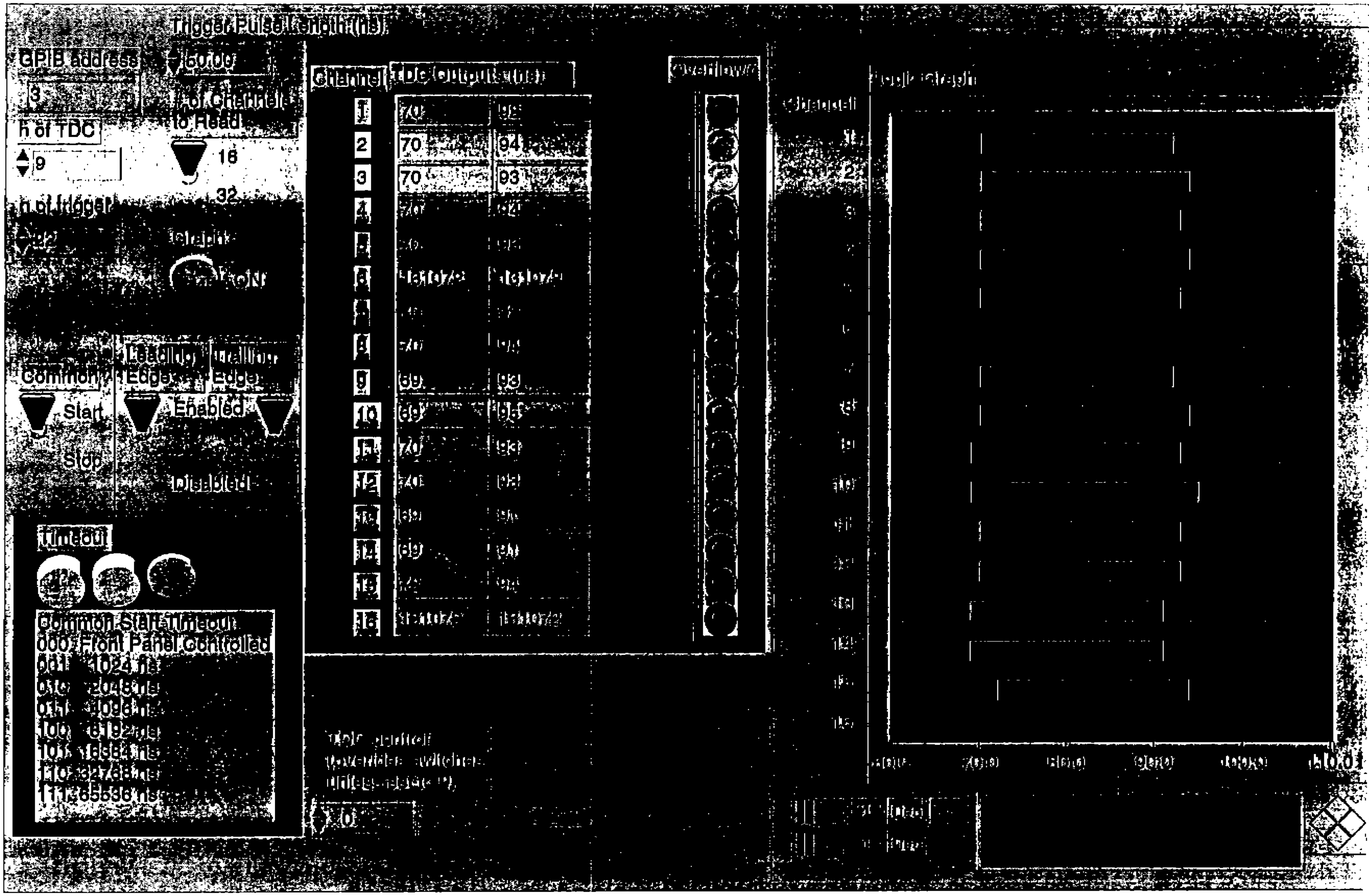

Figure 7