User Manual

Tektronix

CAT200
Virtual Instrument Software Package

070–7940–01

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Instrument Serial Numbers

Each instrument manufactured by Tektronix has a serial number on a panel insert or tag, or stamped on the chassis. The first letter in the serial number designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B010000	Tektronix, Inc., Beaverton, Oregon, USA
E200000	Tektronix United Kingdom, Ltd., London
J300000	Sony/Tektronix, Japan
H700000	Tektronix Holland, NV, Heerenveen, The Netherlands

Instruments manufactured for Tektronix by external vendors outside the United States are assigned a two digit alpha code to identify the country of manufacture (e.g., JP for Japan, HK for Hong Kong, IL for Israel, etc.).

Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077

Printed in U.S.A.

The code that performs graphics hardcopy output to printers was developed using Baby Driver, a software product developed by Ithaca Street Software, Inc., 1145 Ithaca Dr., Boulder, CO 80303.

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1.0 INTRODUCTION

This book will explain how to use your Personal Computer (PC) to display the same waveforms as appear on the screen of your TEK222 Digital Storage Oscilloscope (DSO). You can do this whether the scope is sitting next to you, across the room, or across the country. All you need is the scope, a PC, a copy of CAT200, and some way to connect the scope to the PC.

The section on operating CAT200 includes many examples that are designed to give hands on experience making CAT200 perform. In addition, many of these exercises contain waveforms and situations that you may encounter in the field with your scope and CAT200.

1.1 ASSUMPTIONS ABOUT YOU

This book assumes you are familiar with the operation of your TEK222 DSO. Further, it assumes that you are familiar with the operation of your PC, and that you are familiar with the operation of MS-DOS. If you feel uncomfortable with any of these subjects, DON'T PANIC. Detailed information required for each area is presented either in this book, or in another book which accompanied your DSO.

1.2 ABOUT THIS BOOK

This book is divided into six sections and two appendices. Section 1 is this section. In this section a quick example is given on using the CAT200 and TEK222 combination. In addition, information is given about the rest of the book.

Section 2 covers installation of CAT200 on your computer. It can be run from either floppy or hard disk.

Section 3 details the configuration procedure. CAT200 must be configured to respond properly to your mouse and printer.

Section 4 is primarily examples of how to do many of the functions that can be performed by the CAT200 and TEK222 combination. It does not attempt to cover all possible activities since this is limited only by your needs and imagination. However, the examples given are to illustrate the basic capabilities, interactions, and dependencies of various controls.

Section 5 is a thorough discussion of each button available on the CAT200 graphics monitor. A quick glance indicates that there are many more buttons than actually appear on the monitor. This is because many functions are implemented as auxiliary control panels that appear as needed in the lower left corner of the monitor.

Section 6 is a list of all the error messages that can appear on the monitor.

Appendix A is a list of pinouts of all the cables needed to use your PC and TEK222. Included are cables for PC/XTs, PC/ATs, and modems.

Appendix B is a complete discussion of the voltage waveforms used in the examples in Section 4. This includes schematic diagrams.

1.3 YOUR FIRST REMOTE WAVEFORM

Before you can see waveforms on your PC, you must complete 3 steps:

1) Install CAT200 on a disk.

2) Connect your PC and TEK222 together.

3) Provide a signal source to display a waveform on the TEK222.

---

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STEP 1 - INSTALLING CAT200

CAT200 can be run from a floppy or hard disk drive. However, before you can use CAT200, it must be installed. Quite simply, CAT200 cannot be used while it is on the multiply floppy disks it was delivered on. The files must all be on the same disk, either a hard disk, or a single, high density floppy. See Section 2 of this manual for complete information about installing CAT200.

If you received a single, 3-1/2 inch floppy, then CAT200 is installed on the disk it came on (the distribution disk). However, making a copy of this disk first is strongly encouraged. Some of the examples we will be doing will require writing data to disk, and writing data to your distribution disk runs the risk of overwriting information already there. You should first copy all the files on the distribution disk to another disk, or install CAT200 on a hard disk. Again, detailed installation instructions are in Section 2 of this manual.

STEP 2 - CONNECTING THE TEK222 TO THE PC

The minimum connection between your TEK222 and PC is a multiconductor cable. If you did not purchase the cable, one must be constructed. Instructions for making one are in Appendix A. Once the cable is in hand, simply connect the end marked "SCOPE" to the TEK222 and the other to a serial port on the PC. Note: If you connect the TEK222 to any serial port other than COM1, then you must configure CAT200. Configuration instructions are in Section 3 of this manual.

STEP 3 - PROVIDING A SIGNAL

The actual signal to view is unimportant, except that there needs to be one. You must make arrangements for a voltage to measure. Appendix B contains descriptions of all the voltage patterns used in the examples in this manual. These descriptions not only describe the appearance of the signal, but how it was generated. If you can arrange for one of these, you can use it, otherwise, you must use some signal that is available to you. Once you have identified a waveform to use, connect the channel 1 probe to it. (Note: For this example, the drawings will depict the IOR- signal from Appendix B.)

PROCEDURE

Starting and Stopping CAT200

Before actually viewing our first waveform, let's practice starting and stopping CAT200.
To start CAT200, do the following steps:

1. Make sure you are in the directory that contains the CAT200 files. If you are not, type
cd \CAT and press ⌐ . (NOTE: If you copied your CAT200 files into another directory,
use that name instead of "**\CAT.**")

2. Type CAT and press ⌐ .

3. At the opening screen of CAT200, press ⌐ .

This should start the CAT200 program and present you with the screen shown below:
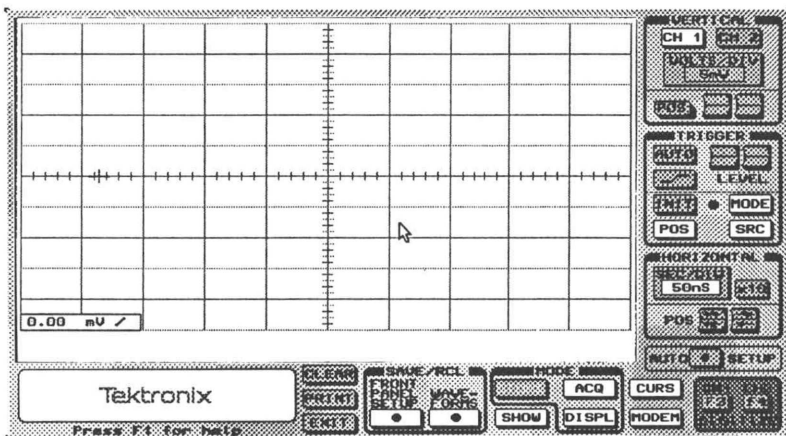
Figure 1-1. *Typical display after starting CAT200*

Stopping CAT200 and returning to DOS is a simple process. Move the pointer using the
arrow keys to the **EXIT** button, then press "⌐ " (often marked as "Enter"). CAT200 will
display a trapdoor menu. Move the pointer to the EXIT trapdoor button, then press ⌐ .
CAT200 will exit to DOS.

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BACK TO THE WAVEFORM

Now its time to get a taste of what your TEK222, PC, and CAT200, combination can do. We will start this first example by verifying your operation of the TEK222. Make sure you have connected the signal above, and then turn on the scope. Now use the following procedure to get a trace on your computer:

1. In order for CAT200 and the TEK222 to communicate, both must be set to the same baud rate, or bit rate. CAT200 defaults to 2400 baud. Use the following procedure to set your TEK222 to 2400 baud:

1A. Press **AUX FUNCT** on the top of the scope.

1B. Press the clear button on the front of the scope next to the word CONFIG that appeared in the graticule area.

1C. Press the clear button on the front of the scope next to the word BAUD that appeared in the graticule area.

1D. Press the clear button on the front of the scope next to the number 2400 that appeared in the graticule area. You have now set the serial communications port of the TEK222 to 2400 baud.

2. Press **AUTO SETUP** on the scope. This should result in a trace resembling that below. (Note: This physical control of the TEK222 is used here to verify your ability to control the TEK222 from its front panel. Such control is not necessary to use CAT200, and will not be used in future examples.)
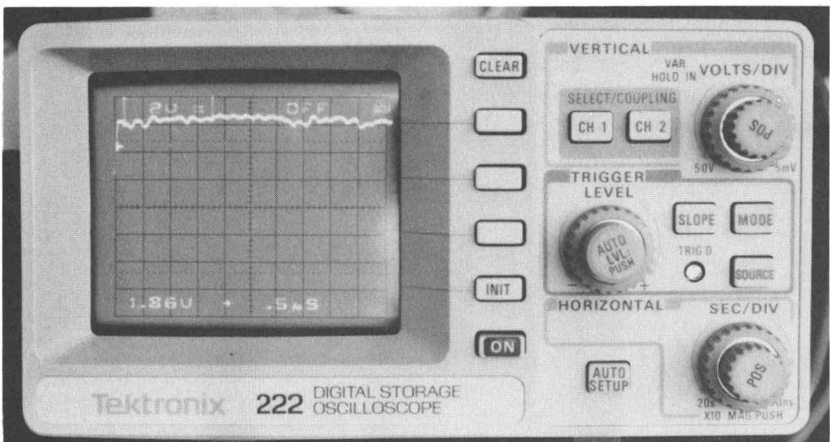
Figure 1-2. 1OR- Signal on scope after AUTO SETUP.

3. If not already running, start CAT200 using the procedure above. (Note: At this point, it is assumed that the PC serial communications link and the TEK222 are set to the same baud rate. CAT200 by default uses 2400 baud, 8 bits, and no parity. It may be necessary to configure the TEK222 to this setup. This is accomplished from the **AUX FUNCT** menu. This menu is displayed after pressing the **AUX FUNCT** key on the top of the scope. From this menu, press the **CONFIG** option. The next menu will have a button to allow setting of the baud rate.)

4. Press the **F3** key on the PC keyboard. This should make your PC screen look similar to this:
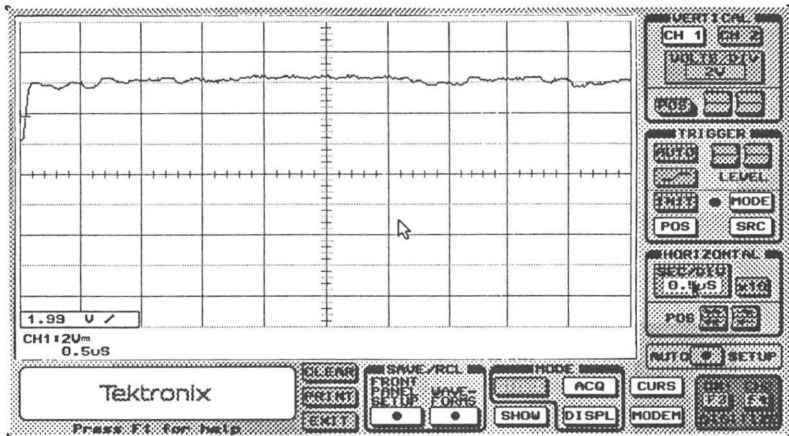
Figure 1-3. *IOR- on monitor after pressing AUTO SETUP and F3*

Note: The waveform information that is transferred from the scope to the PC consists of more than 500 bytes of data. At 2400 baud, this transfer will take several seconds. Thus, when **F3** (or, as we will see later, **F4**) is pressed, there will be a delay, of at least several seconds, while the data is sent to the PC. During this time, CAT200 will not respond to any user inputs and will appear dead, even though it is not.

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WHAT YOU JUST DID

The preceding was a very quick and simple introduction to the ability to display oscillo-
scope data on a PC screen. In that example, only one key was used to get data from the
scope to the PC. Pressing the F3 key caused CAT200 to send a request to the scope to
cause it to return the current channel 1 digital data. The returned data included the digitized
waveform and the current control panel settings. Naturally, CAT200 and your TEK222 can
do much more. The subject areas in the list below will be covered in this manual in roughly
the order listed. In addition, many topics will involve one of the real world signals de-
scribed in Appendix B. Each will include a sequence of instructions to get the desired
waveforms on the scope and PC, and then an explanation of what each keystroke did.

1.4 IF YOU NEED HELP

CAT200 has an extensive help facility. Any time you need more information about any
button on the monitor, simply place the pointer on that button and press the **F1** key on the
computer keyboard. A help window will appear with information about the specified
button.

2.0 MINIMUM EQUIPMENT REQUIREMENT

The following minimum equipment is necessary for CAT200 to operate:

- .IBM compatible personal computer
- 512K random access memory (RAM)
- 1 floppy disk drive (720K minimum capacity)
- EGA video adapter (VGA acceptable)

Operation of CAT200 will be easier or faster if the following optional equipment is available:

- Hard disk drive
- Additional RAM

2.1 HARD DISK INSTALLATION

No special programs or files are required to install CAT200 on your hard disk. All that needs to be done is the creation of a directory to hold the files on the distribution diskette(s). The following instructions can be used to put CAT200 on your hard disk:

1. Boot your PC and get the system prompt. This prompt should resemble **C:\>.**

2. Insert the CAT200 distribution disk 1 into a floppy drive. (This procedure assumes you have placed the diskette in drive A:.)

3. Enter the command **md cat** ↵ .

4. Enter the command **cd cat** ↵ .

5A. Enter the command **copy a:*.*** ↵ .
5B. If installing from two 5-1/4 inch floppies, insert disk 2 into drive A: and repeat step 5A.

6. At the completion of step 5, CAT200 is installed on your hard disk. Before using CAT200, you should go through the configuration process described in Section 3.

2.2 FLOPPY DISK INSTALLATION

CAT200 can be executed from a single floppy disk, but it must be a high density floppy.
(That is, a floppy with at least 720K bytes of storage.) If you will be using CAT200 on a
single 5-1/4 inch floppy, proceed to section 2.121. Three and 1/2 inch floppy disk users
should refer to Section 2.122.

2.21 Installation on a single 5-1/4 inch floppy.

To transfer from a 3-1/2 inch disk to a 5-1/4 inch disk, omit steps five and six (CAT200 is
delivered on a single disk in 3-1/2 inch format).

1. Boot your PC and get the system prompt. This prompt should resemble A:\> or C:\>.

2. Insert a formatted high density disk in the high density drive.

3. Insert CAT200 disk 1 into another floppy drive.

4. For this step, assume the high density drive is drive A: and the other drive is drive B:.
Now enter the command **copy b: a:** ↵ . (This copies all the files from the low density
CAT200 disk to the high density disk.)

5. Remove CAT200 disk 1 from the drive it is in and insert CAT200 disk 2 into that drive.

6. Repeat step 4.

7. At the completion of step 6, CAT200 is installed on your high density floppy disk.
Before using CAT200, you should go through the configuration process described in
Section 3.

2.22 Installation on a single 3-1/2 inch floppy from the 3-1/2 inch distribution disk.

1. Boot your PC and get the system prompt. This prompt should resemble A:\> or B:\>.

2. Insert a formatted 3-1/2 inch floppy into a 3-1/2 inch drive.

3. Insert the CAT200 disk into another floppy drive. (Note: If your computer has only one 3-1/2 inch drive, then the copy command below will prompt you to insert this disk at the proper time.)

4. For this step, assume the blank 3-1/2 inch disk is drive A: and the other disk is in drive B:. Now enter the command **copy b:a:** ↲ . (This copies all the files from the CAT200 disk to the blank 3-1/2 inch disk.

5. At the completion of step 4, CAT200 is installed on your 3-1/2 inch disk. Before using CAT200, you should go through the configuration process described in Section 3.

2.23 Installation on a single 3-1/2 inch floppy from multiple 5-1/4 inch floppies.

1. Boot your PC and get the system prompt. This prompt should resemble A:\> or C:\>.

2. Insert a formatted 3-1'2 inch floppy in the 3-1/2 inch drive.

3. Insert CAT200 disk 1 into another floppy drive.

4. For this step, assume the 3-1/2 inch drive is drive A: and the other drive is drive B:. Now enter the command copy **b: a:** ↲ . (This copies all the files from the low density CAT200 disk to the 3-1/2 inch disk.)

5. Remove CAT200 disk 1 from the drive it is in and insert CAT200 disk 2 into that drive

6. Repeat step 4.

7. At the completion of step 6, CAT200 is installed on your 3-1/2 inch disk. Before using CAT200, you should go through the configuration process described in Section 3.

3.0 CONFIGURING CAT200

This version includes changes that support operation with the Tek 222PS oscilloscope while maintaining compatibility with the 222. The CAT200 software automatically determines which model it is connected to, requiring no special configuration.

To configure CAT200 follow these steps:

1. If using a hard disk then Change to the directory that contains the CAT200 files. If you followed the recommended installation procedure, CAT200 is in a directory called "C:\CAT." If using a floppy, then insert the CAT200 disk into a drive corresponding to the density of the floppy.

2. Enter the following command at a DOS prompt (A DOS prompt is typically "C:\CAT>" if you went through step 1.): **SETUP**. Then press the "Enter" key. This will start the configuration program and bring up the first selection.

3. The first selection is for the type of pointing device you will be using to move the on-screen pointer. Press the appropriate letter from the list of selections. Note that the pointing device is typically a mouse, but that CAT200 can be used without a mouse. Also note that some of the mouse selections do not require that the mouse driver be loaded. Check your mouse and computer system. If you normally need to load a mouse driver for your other software, then choose one of the options that expects the mouse driver.

4. The second selection is the serial data (or COM) port that will be connected to the TEK222 (or the modem used to communicate with the TEK222). The selection is made by pressing a number key followed by the "Enter" key. If you do not know what serial data ports your computer has, or where the connectors are, you must refer to the reference material for your computer or to someone who does know this information.

5. The next selection is for the baud rate for the just selected serial data port. CAT200 supports four baud rates: 300, 1200, 2400, and 9600 baud. If you have no specific criteria for baud rate selection, then a good choice is 2400 baud. Type **2400** ⤶. Note that the TEK222 must be configured for the same baud rate that you select. If you do not know what it is set for, or you want to set it yourself, follow the following steps on the scope:

5A. Turn on the TEK222.

5B. Press the **AUX FUNCT** button.

5C. Press the button next to the word **CONFIG** in the menu that appears on the screen.

5D. Press the button next to the word **BAUD** that appears in the next menu.

5E. In the menu that appears next, press the button next to the desired baud rate.

Note: If you are using, or plan to use, a modem, it is important that the baud rate you select here is compatible with your modem. In other words, if you have a 1200 baud modem, then the TEK222 must be configured for 1200 baud in order for data to be exchanged using the modem.

Note: Operation of CAT200 at less than 1200 baud is not recommended. A digitized waveform has more than 500 bytes of information. Transferring this information between the scope and the PC takes more than 15 seconds at 300 baud. During this transfer time, CAT200 will not respond to any user input and will appear dead. In addition, CAT200 and the scope engage in continuous communication while CAT200 is operating. When the baud rate is less than 1200, the communication time lags cause the operation with a mouse device to become difficult as the pointer appears to jump around the screen rather than move smoothly as the mouse is dragged around.

Baud rates are now supported to 9600. Realistically, however, most PCs cannot support transfers of large blocks of data at continuous 9600 baud rates. Since the only form of flow control available with the 222 is XON/XOFF (no hardware flow control), it is quite possible for a scope-to-PC waveform transfer at 9600 baud to overflow the PC's serial communication buffers before a flow control message can be issued to stop it. Thoroughly test 9600 baud operation with your particular equipment before becoming dependent on it.

6. Next you must specify what port your printer, if any, is connected to. Your choices are parallel, serial, or none. If you choose either serial or parallel, you will go on to step 7. If you choose none, the setup program will be finished. If you are not sure about what port your printer is connected to, you must refer to the reference material for your computer and printer or to someone who does know this information.

7. Selecting either parallel or serial above will cause a list of printers to be displayed. The list is too large for a single screen. If you do not see your printer in the list, press the "**0**" key (followed by the "**Enter**" key) to see more of the list. Once you have found your printer on the list, type in its number followed by the "**Enter**" key. If you are not sure about what type of printer you have, you must refer to the reference material that came with it or to someone who knows this information. If your printer is not on the list, then it is not supported by CAT200 and you cannot make hard copies of the waveforms. (You must enter some printer number to get past this point. If you wish, you can enter any supported printer and then rerun the configuration program and specify "none" in step 6.) This completes the setup program. It will terminate and return to the DOS prompt.

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3.1 SETTING UP FOR REMOTE OPERATION USING MODEMS

Preparations for remote operation using CAT200 can be broken down into the following steps:

a) Select the appropriate modems, and configure them properly.
b) Acquire all the correct cables and adapters to interconnect computer, scope and modems.
c) Configure CAT200 and scope for correct baud rate.

3.11 MODEM SELECTION AND CONFIGURATION

CAT200 supports only Hayes compatible modems. Modems of this type are widely available, desk top, and PC card form. 2400 baud models are recommended for best response time. Because most PCs cannot realistically absorb large blocks of data (such as waveforms) at 9600 baud with just the XON/XOFF flow control available from the 222, 9600 baud operations are not recommended.

The modem to be used with the PC is configured by CAT200 and requires no special configuration.

The modem used with the scope must be configured with initialization commands, and the modem must have a non-volatile memory where the commands can be saved. To configure the modem, connect it to a PC and enter the commands through its RS232 port using a communications utility, since neither CAT200 nor the scope have the necessary capabilities. Once you have made the connection and started the communication utility, enter the following commands:

ATS0=2&W(↵)	Auto answer after two rings
ATQ1&W(↵)	Don't transmit status information
ATE0&W(↵)	Don't echo commands
ATX1&W(↵)	Enable connect 1200/2400 code
AT&C1&W(↵)	Enable CD line to track actual carrier state
AT&D0&W(↵)	Ignore DTR

These codes may be concatenated together into one string as follows:

ATS0=2Q1E0X1&C1&D0&W(↵)

The **&W** at the end of each command tells the modem to save the command into non-volatile memory.

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3.12 CABLES AND INTERCONNECTION

Appendix A contains detailed information showing how to connect PC to modem and modem to scope. Find the diagrams that fit your collection of equipment, and make sure the cables you are using are wired correctly.

If you plan to operate with a 222PS, be sure to use the recommended null modem adapter. Other null modem adapter configurations can interfere with the remote power up feature of the 222PS. Most common null modem adapters will work with the 222 but not the 222PS.

3.13 BAUD RATES

The baud rates for CAT200, the modems and the scope must all match. Follow the steps in section 3.0 step 5 to set CAT200 and the scope to the baud rate you want.

During operation, if you wish to change CAT200 baud rates, you can do so with the following steps:

1)   Move the pointer to and press the MODEM button.

2)   Move the pointer to and select the CFG button.

3)   Move the pointer to the number next to the word BAUD and click it until the desired baud rate appears.

This rate is temporary and will be lost when you exit.

The modems have built-in baud rate sensing and all other baud rate configuration is determined by the initialization commands in section 3.11. When used with CAT200, the modems will use the baud rate you specify.

3.2 CONSIDERATIONS FOR REMOTE POWER UP OPERATION WITH THE 222PS

If you wish to operate the 222PS remotely from its self contained batteries utilizing the remote power-up capability to conserve battery life, you must choose whether or not to disable the auto-timeout feature of the 222PS. If the connection between computer and scope is very unreliable and communication may be interrupted mid-session, you may wish to keep the auto timeout feature enabled, thereby avoiding the possibility that such an interruption will lead to an exhausted battery.

On the other hand, sessions will be interrupted by the auto-timeout feature if there are lapses in front panel related activity (like changes in Volts/Div settings) lasting longer than about two minutes. In applications such as these, auto-timeout can be disabled. In general for remote operation, it is best to disable auto-timeout.

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Setting the auto-timeout state must be done directly from the scope front panel.

1) Press the AUX FUNCT button on top of the scope.

2) Press the CONFIG menu button.

3) Press the TIME OUT button to toggle the box on and off. Auto-timeout is disabled when TIME OUT is not boxed.

When the 222PS is connected directly to a PC, pressing F5 will cause it to power-up during the process of establishing communication. When the 222PS is connected to a modem, the instrument will power-up when the modem asserts its carrier detect (CD) line as data communication begins.

4.0   OPERATING CAT200

4.01 THE OSCILLOSCOPE ON THE PC
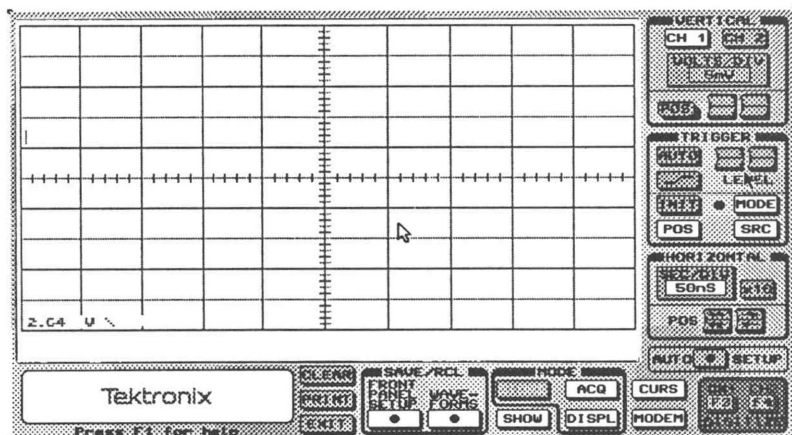
Figure 4-1. *Typical monitor after startup of CAT200*

During our discussions we will need to differentiate between the scope as it appears on the computer screen and the face of the actual scope. The computer screen will be referred to as the *monitor*, and the actual scope will be referred to as the *oscilloscope*.

The monitor is broken up into two major areas: the display grid, or display area, and the control area. Some of the controls on the scope are modified in appearance on the monitor. Notably, the rotary switches have been replaced by rocker switches, and the buttons on top of the scope had to be moved to the front.   The functional grouping of the controls has been maintained.   You will notice that many of the pushbutton controls on the scope appear as pushbuttons on the monitor. As we will see in a moment, they operate in much the same conceptual fashion.

The careful observer will also note that the grid in the display area is larger than the grid on the oscilloscope. The TEK222 CRT has 8 major vertical divisions and 10 major horizontal divisions. The monitor, on the other hand, has 10 major divisions in both the horizontal and vertical directions. In answer to the question "Does this mean that the TEK222 has less resolution than the PC?" The answer is no. The TEK222 always has 256 steps of vertical resolution, it simply does not display data in the fifth vertical division above and below center.
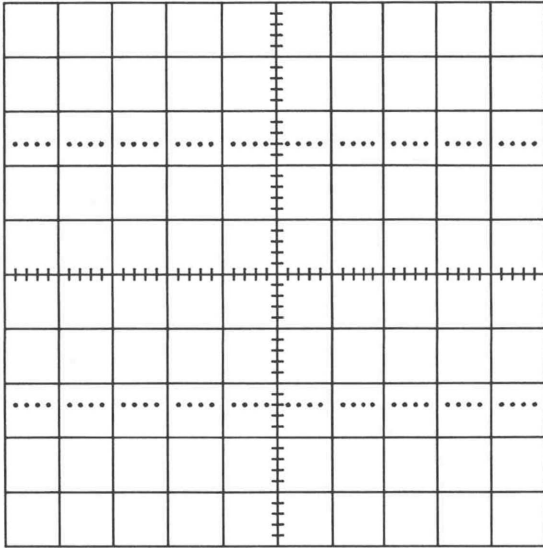
Figure 4-2. *Waveform display area on monitor.*
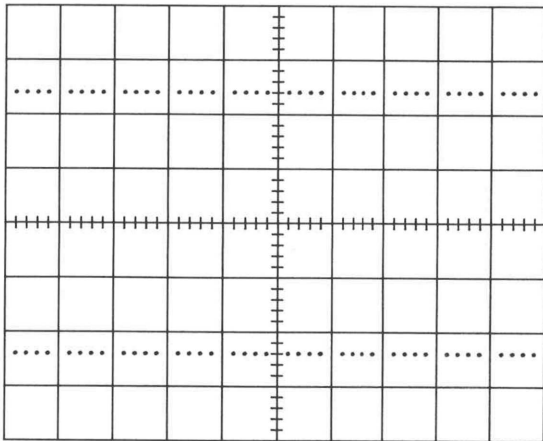
Figure 4.3 .*CRT display on Tektronix 222.*

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The display of waveform parameters on the screen graphic is different than on the scope. On the scope, the parameters for each displayed waveform appear on the crt screen. CAT200 puts very little parameter information in the display. Instead, the area between the display grid and the buttons on the bottom of the screen is used to show the vertical sensitivity and time base information. The only data that does show up in the display grid is the trigger level, trigger slope, the delta time information, and delta voltage information; all of which will be discussed later. The two illustrations below depict the same waveform as seen on the TEK222 and the CAT200 display areas.
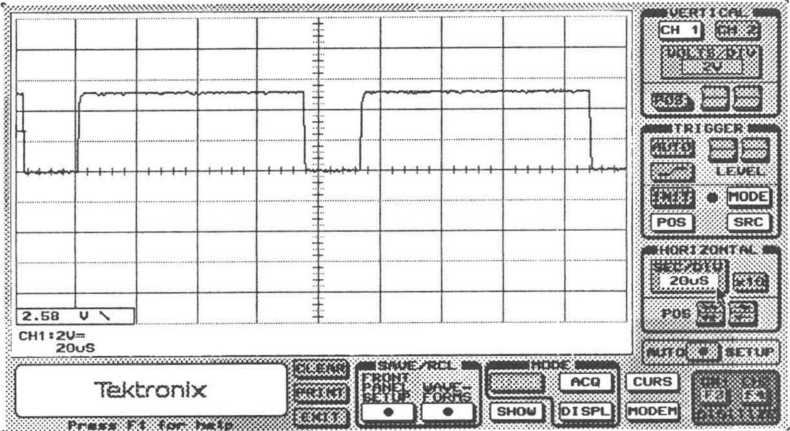
Figure 4-4 .Waveform in monitor waveform display area.
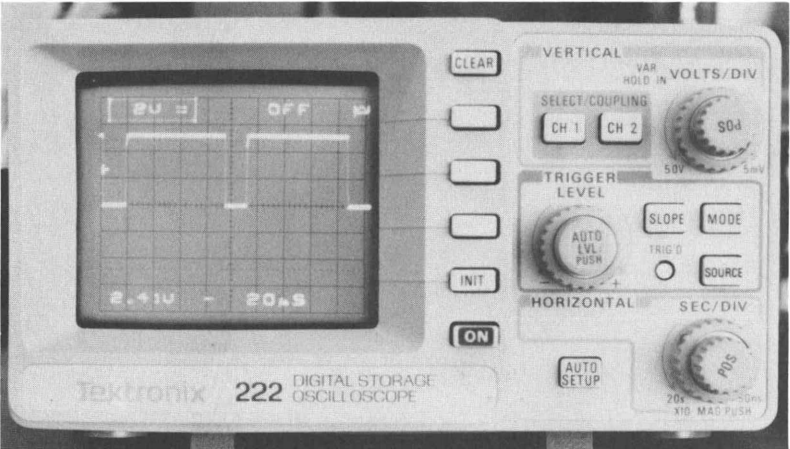
Figure 4-5. Same waveform on Tektronix 222.

Another notable feature is the *TRAPDOOR*. All of the pushbuttons that appear white on the screen will cause a secondary menu to appear in the lower left corner of the monitor. These secondary menus are functionally equivalent to the menus presented on the scope. For instance, pressing **CH 1** on the scope will cause a menu of selections to appear to the left of the unlabeled pushbuttons next to the screen. Pressing **CH 1** on the monitor will cause the trapdoor to open. Under it will be five pushbuttons. All, but one, are equivalent to one of the selections on the scope. Details of all the trapdoors selections will be discussed as they are encountered below. Below are illustrations of the same menus. One is a trapdoor on the CAT200 graphic display, and the other is the same menu on the TEK222 oscilloscope face.
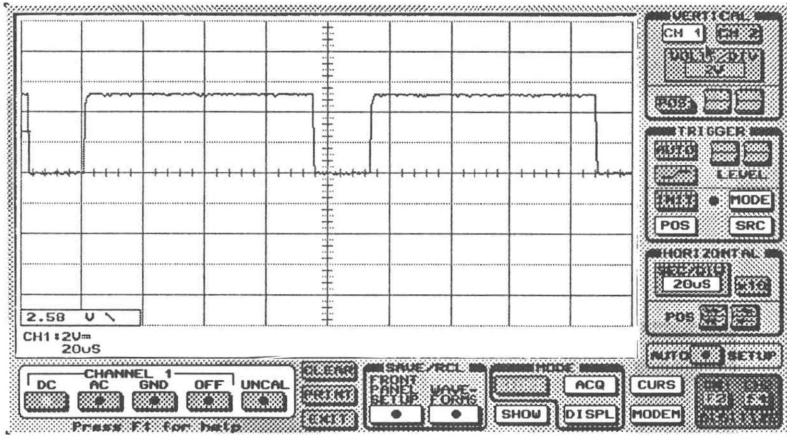
Figure 4-6. A Trapdoor menu, in this case, channel 1 coupling.
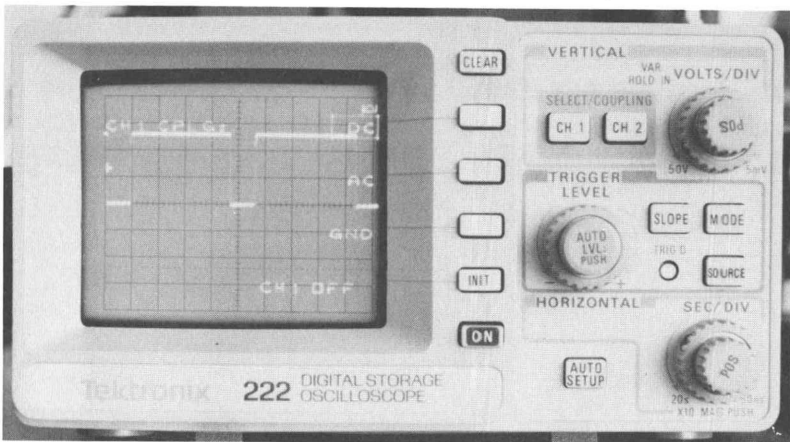
Figure 4-7. Same menu on Tektronix 222.

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4.1 NAVIGATING AROUND THE SCREEN

PRESSING A BUTTON WITHOUT LIFTING A FINGER

Getting to the switches on the monitor is done by moving the pointer around the screen until it covers the switch of interest. This is most easily done with a mouse, but it can be accomplished with the arrow keys on the keyboard.

4.11 NOTES ON USING THE MOUSE

The only special note about using the mouse is that, in some cases, the mouse driver must be loaded before the mouse can be used with CAT200. You will have to refer to the instructions that came with your mouse for the details of accomplishing this. However, a mouse driver is usually loaded automatically when the computer is booted up, or it is loaded manually by typing **MOUSE** from the keyboard. The requirement for a mouse driver was determined during configuration. If you are unsure about your mouse, refer to the instructions that came with it and then, if necessary, repeat the configuration in Section 3.

4.12 NOTES ON USING THE KEYBOARD

The keyboard has essentially two modes of movement: DIRECT PLACEMENT and SERIAL. Direct placement is the ability to specify which button on the monitor the pointer should be placed on. This is accomplished by pressing the **ALT** key and another key. The table below lists the available direct placement buttons.

ALT KEY	CAT200 BUTTON
1	CH1 Button
2	CH2 Button
V	Vertical (Volts/Div)
T	Trigger Level
H	Horizontal (Time/Div)
S	Save/Recall Buttons
M	Mode Buttons
C	CLEAR Button
D	DOOR (Leftmost of open door)

The other method of pointer movement with the keyboard is referred to as serial. This simply means that the pointer can be moved from one button to the one logically next to it by pressing the arrow keys on the keyboard. For instance, if the pointer is on the **INIT** button in the **TRIGGER** control area, pressing the right arrow key will move the pointer to the **MODE** button. Pressing the up arrow key will move it to the +/- key, and pressing the down arrow key will move it to the **POS** button.

4.13 RESPONSE OF BUTTON TYPES

Once the pointer is on top of the switch of interest, the **Enter** key, or any mouse button is used to select the switch. The switches will respond according to the following rules:

NORMAL PUSHBUTTON: A normal push button is one that is not white, such as the **AUTO SETUP** button. Pressing such a button will activate the function associated with it. Each button will be covered in the following sections.

WHITE PUSHBUTTON: A white pushbutton is one that causes the trapdoor, at the lower left of the PC screen, to appear to open. Most of these buttons are similar to those on the scope of the same name. However, on the monitor, the menus that these buttons bring up are placed behind the trapdoor rather than on the waveform display area. Likewise, pressing a button under the trapdoor is similar to pressing one of the unlabeled keys on the scope when the menu is displayed.

ROCKER SWITCH: The rocker switches, such as the one just to the right of the **POS** pushbutton in the **VERTICAL** control area of the monitor take the place of continuously variable rotary adjustments on the scope. In this case, we are referring to vertical position control. On the scope, this is a rotary knob inside the volts per division knob. On the monitor, this knob becomes two rocker switches, one for coarse changes and the other for fine changes. Pressing the upper half of the switch emulates clockwise rotation of the knob on the scope. Pressing of the top or bottom of the switch is controlled by the right and left mouse buttons, and the + and - keys on the computer keyboard. The left mouse button and the - key actuate the bottom of the switch, while the right mouse button and the + key actuate the top of the switch.

THUMBWHEEL SWITCHES: On the monitor, thumbwheel switches replace rotary switches. An example is the vertical sensitivity adjustment. On the scope, it is the larger knob in the **VERTICAL** control section. On the monitor, it is a window with the label "**VOLTS/DIV.**" By placing the pointer inside this window, the vertical sensitivity can be adjusted. Pressing the left mouse button causes the sensitivity to increase. This makes the traces on the scope taller, and makes the numbers in the box get smaller. Conversely, pressing the right mouse button makes the traces smaller and the numbers larger. The same effect is achieved from the keyboard using the - and + keys respectively.

4.2 REAL TIME DATA

If you started at the beginning of this book, you have already done a simple acquisition of some real time data. Real time data is simply a waveform that represents events as they occur. In the following example, another real time waveform will be observed and manipulated.

Note: All the following examples assume that you have your TEK222 turned on, that you have CAT200 running, and that communication between CAT200 and the TEK222 has been established.

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EXAMPLE 1 - WATCHING PULSES

1. Refer to Appendix B for a description of the pulse signal generated by the 555 oscillator. If you prefer, any signal will do.

2. Attach the channel 1 probe to the pulse (pin 3 of the 555).

3. Place the pointer over the **AUTO SETUP** button and press it by either pressing the left mouse button or the **Enter** key on the PC keyboard.
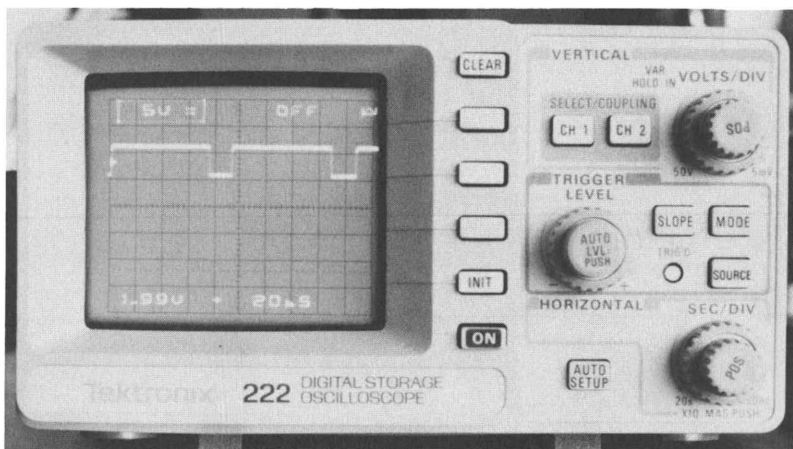
Figure 4-8. *Typical view of 555 waveform on Tektronix 222 after pressing AUTO SETUP*

DISCUSSION:

The result of this action is that the signal appears in the upper half of the crt on the scope. The specific action of the **AUTO SETUP** key on the scope is explained in the *Operators Manual*. Pressing the **AUTO SETUP** key on the monitor sent a command to the scope causing it to take the same action as pressing the key on the scope. In this case, it caused the signal on channel 1 to be scaled and positioned such that it is in the upper half of the crt. If a signal is present on channel 2, then it was scaled and placed in the lower half of the display. Note that in many cases, if the channel 2 probe is not connected to anything, there will be enough noise picked up on the probe to cause that channel to be enabled and displayed on the lower portion of the scope. If this is a problem, the best thing to do is connect the channel 2 probe tip to the ground clip attached to the channel 2 probe. This will result in the internal logic of the TEK222 determining that channel 2 is not connected to anything, and the **AUTO SETUP** button will not display channel 2 on the scope.

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Also, notice that no waveform was displayed on the monitor. In order for any waveform that is on the scope to be transferred to the monitor, you must explicitly request it. To get the signal that is now on the scope to the PC, you must press **F3**.
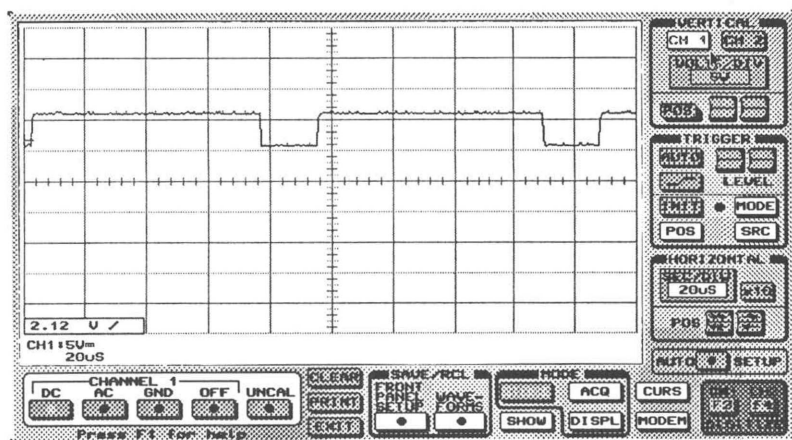
Figure 4-9. 555 signal in waveform display area after pressing F3.

F3 causes the transfer of channel 1 data, while **F4** gets channel 2. These keys can be pressed directly on the keyboard, or they can be pressed using the graphic pointer. **F3** and **F4** are located on the lower right corner of the monitor. Now, move the pointer to the **F3** key and press it. (Once again, a key on the monitor is pressed by either pressing the left mouse button or the **Enter** key on the keyboard.)

Within a few seconds, an exact replica of the waveform on the scope crt will appear in the waveform display area of the monitor. In addition, the vertical sensitivity, the volts per division, and time base parameters will be written to the area just below the waveform display area.

EXAMPLE 2 - ESTABLISHING A BASELINE

Often, while using a scope, it is handy to have a baseline that corresponds with an etched division line, or graticule line, on the crt. By this it is meant that when a voltage of 0 volts is displayed, the trace on the crt is a straight line that covers one of the graticule lines. This simplifies the task of calculating the actual voltage level of a signal by simplifying the determination of how many vertical divisions the signal occupies. For channel 1, a good choice is either the horizontal line exactly in the center of the screen, or the one just above it. The next set of instructions is to establish the center line as the channel 1 base line.

1. First, the position of the baseline must be found. This is done by simply moving the pointer to the vertical position rocker switch. Start by moving the pointer to the button just to the left of the two rocker switches in the **VERTICAL** control section.

2. If this button says **POS**, go to the next step. If not, press the button. It should now say **POS**. Now move the pointer to either of the rocker switches in the **VERTICAL** control section. This will cause a dashed, horizontal, line to appear on the monitor waveform display area. This line is the baseline for the currently active vertical channel.

3. Depending on how far the display line is from the graticule line, choose either the coarse or fine adjust rocker switch. The coarse adjust is the rocker with two arrows on top and two arrows on bottom. The fine adjust switch is just to the right of the coarse switch and has only one arrow on top and one arrow on bottom. The base line is displayed as a dashed line that appears whenever the pointer is positioned on one of the rocker switches. If the line is more than 1 major division above the center horizontal line, move the pointer to the coarse rocker switch and press it using the left mouse button or - key on the computer keyboard. Pressing the coarse rocker switch moves the trace one major division. If the data line is less than 1 major division from the center line, use the fine control rocker switch to move it to the center line. If the data line is below the center graticule line, press the upper portion of the appropriate rocker switch by moving the pointer to the fine rocker switch and then using the right mouse button or the + key on the computer keyboard.
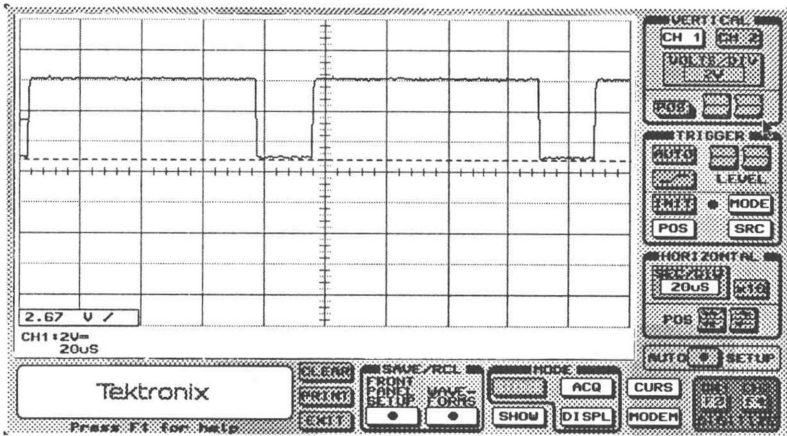
Figure 4-10. Waveform before adjusting baseline. Baseline is dashed line that becomes visible when pointer is on either *"POS"* rocker switch..
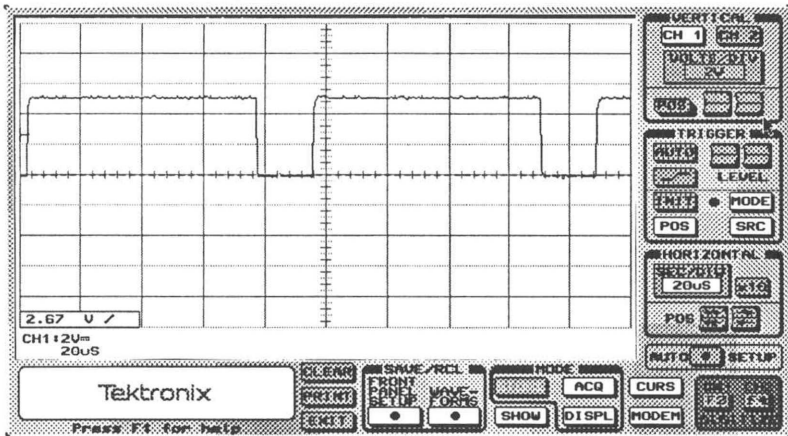
Figure 4-11. Waveform after adjusting baseline

4. Press the **F3** key, either on the keyboard or monitor.

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DISCUSSION:

The rocker switches are used in place of continuously variable rotary adjustments. The rocker switch analogy is easier to represent and use on a computer screen. The function is divided up into a coarse and fine adjustment. The rocker switch on the left has two arrows on top and two arrows on bottom, and it is used to make coarse, or large, changes in whatever parameter it is controlling. Conversely, just to the right of the coarse rocker switch is another with only one arrow on top and bottom. This switch makes the same adjustments, however, they have less effect and are thus fine adjustments.

For vertical position adjustments, the coarse rocker will move the trace one major division. The fine rocker will move the trace one pixel. On an actual oscilloscope, one generally has to set the input voltage to ground to obtain a flat trace of exactly zero volts. However, CAT200 presents you with a simulated zero volt line. This line appears whenever the pointer is moved onto one of the vertical position rocker switches.

There is a difference between the vertical controls on the scope and the controls on the monitor. On the scope, the vertical sensitivity (the volts per division) and the vertical position are concentric controls. That is, both controls are mounted in the same hole on the face of the scope. On the monitor, this same functionality was implemented using a single set of rocker switches for both purposes. The function of the rocker switches is chosen with the pushbutton located just to their left. The button is marked "**POS**," and pressing it causes the rocker switches to control the variable volts per division capability, which will be discussed later. In the variable volts per division mode, the label on the button will change to the letters **VAR**, and be yellow. Pushing the **POS** again, or *unpushing* it, as the case may be, will cause the rocker switches to affect the vertical position of the trace. Note that pressing the top or bottom of the rocker switch is selected by pressing the right or left mouse button, or the + or - key on the computer keyboard. The right mouse button (and the + key) presses the top of the rocker switch, while the left mouse button (and the - key) press the bottom of the rocker switch.

The last step in the process above should have brought back the waveform that was previously being viewed. However, now its zero voltage point is the center graticule line. If you have a signal exactly like the sample signal on the screen, you can easily measure the maximum voltage the signal reaches. In our example it is 4.8 volts. This is determined by observing that the waveform reaches approximately 2.4 divisions above the center line. The 2.4 is then multiplied by the scale factor of 2V per division. The result is 4.8 volts.

4.3 STORING WAVEFORMS

You are probably already familiar with the capability of your TEK222 to save a displayed waveform in memory. This waveform is thus available for future reference. The CAT200 program has very similar capabilities. In addition to controlling storage of waveforms in the scope memory, CAT200 can save waveforms in PC memory and PC disk. Let's explore these functions:

4.31 STORING WAVEFORMS IN SCOPE MEMORY

EXAMPLE 3 - CAPTURING A WAVEFORM IN SCOPE MEMORY

1. Refer to Appendix B for a description of the IOR- signal.

2. Attach the channel 1 probe to the IOR- signal.

3. Move the pointer to the **AUTO SETUP** button and press it.

4. Press the **F3** key to get the channel 1 waveform to the PC screen.

5. If you are using the sample waveform, it may be necessary to adjust the timebase to get the waveform as described in the appendix. If there are too few pulses in the channel 1 trace, one must make the seconds per division larger. If there are too many pulses in the trace, or if they are all bunched up on the left, one must make the seconds per division smaller. If the timebase needs adjusting, perform the following steps:

5A. Move the pointer to **SEC/DIV** thumbwheel switch in the horizontal control area.

5B. If the seconds per division must be raised (too few pulses on screen), press the right mouse button, or the + key on the keyboard.

5C. If the seconds per division must be lowered (too many pulses on the screen), press the left mouse button, or the - key on the keyboard.

5D. Press the **F3** key to get the new waveform to the PC screen.

5E. Repeat steps 5A, 5B, 5C, and 5D, until the display resembles the sample as closely as possible.

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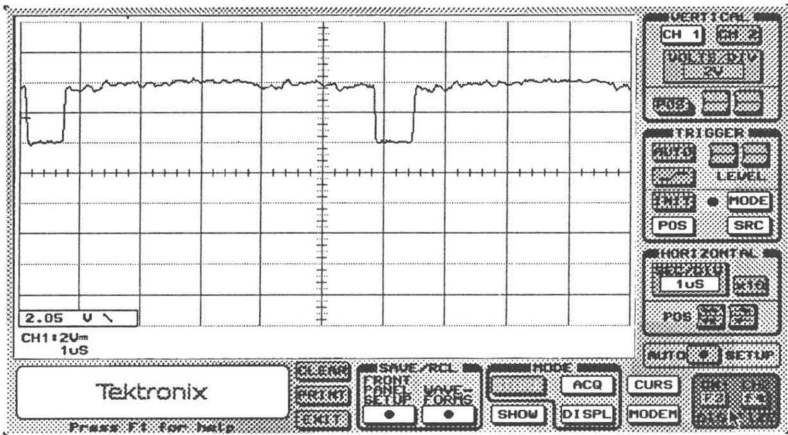
Figure 4-12. IOR- (Z80) after adjusting.

6. Move the pointer to the **SAVE/RCL** control area and press the **WAVEFORMS** button.

7. This opens a trapdoor with additional buttons. Move the pointer to, and then press the **INSTR** button in this trapdoor.

8. Move the pointer to and then press the button labeled **CH1** under the trapdoor that opened from the previous step.

9. Move the pointer to and then press the button labeled **INSTR** under the trapdoor that opened from the previous step.

10. Move the pointer to and then press the button labeled **1** under the trapdoor that opened from the previous step.

DISCUSSION:

In this example, we used the **AUTO SETUP** key. This key causes the scope to go through a normal auto setup sequence. This sequence is described in the *Operators Manual* in Section 6. The auto setup procedure does not necessarily result in a display that is usable for a particular purpose. Thus, when the waveforms are brought over to the PC, it may be found that the timebase, the *seconds per division*, may need to be adjusted to get a usable trace. As before, this takes some interaction because the traces on the scope are only displayed on the PC when explicitly asked for. This interaction is what causes the procedure in step 5 to be used to get the desired trace on the graphic. The bottom line is that the scope trace is not automatically transferred to the graphic screen. The channel 1 and channel 2 data must be asked for. This also means that the actual display on the scope may

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not match the display on the graphic if the waveform being monitored by the scope has changed since it was last transferred to CAT200.

Step 6 is the beginning of the process of getting the display on the scope into a scope memory. This is accomplished using the facilities of the buttons in the **SAVE/RCL** control section. These buttons are for the movement of waveform and front panel control setting data. The basic process is to specify a source and destination. After these are fully specified, the data is automatically moved. After the move, the trapdoor closes.

In this case, we aren't moving the data very far, simply from the scope to the scope memory. Following the spirit of selecting the source and destination, the first button we press, the **INSTR** button, indicates that the source of our data is in the *instrument*, the scope. This opens a secondary trapdoor menu to let us pick exactly what scope data to move. There are six sources of data in the scope: channel 1, channel 2, and the four scope wave-form memories, called **REF WAVEFORMS**. There is a push button for each of these sources. In the example, channel one data is picked.

Choosing channel one fully specifies the source of the data to move. This causes the first *destination* menu to appear. It is essentially the same as the first trapdoor menu seen after pressing **WAVEFORMS**, except that it is labeled **DESTINATION**: rather than **SOURCE**:. The same process of selection can be performed. In this example, data is to be moved from the scope screen to a scope, or reference, memory. (In CAT200 menus, the scope reference memories are referred to as **REF** memories.) Thus, selecting **INSTR** followed by **1** fully specifies the destination as instrument, or scope, reference memory number 1.

4.32 STORING WAVEFORMS IN PC

Waveform storage in the PC is divided into two categories: on line, or memory; and off line, or disk. CAT200 operates slightly different than the scope in that waveforms that are in CAT200's memory are lost when CAT200 is stopped. In order to use captured waveforms from one session to the next, they must be left in scope memory or saved on a PC disk.

4.321 STORING WAVEFORMS IN PC (CAT200) MEMORY

EXAMPLE 4 - CAPTURING A DATA LINE

1. Refer to Appendix B for a description of the IOR- and D0 signals.

2. Attach the channel 1 probe to the IOR- signal.

3. Attach the channel 2 probe to the D0 signal.

4. If the volts per division and seconds per division have not already been set up (as in the previous example) then move the pointer to the **AUTO SETUP** button and press it.

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5. Press the **F3** key to get the channel 1 waveform to the PC screen.

6. Press the **F4** key to get the channel 2 waveform to the PC screen.

7. If you are using the sample waveform, it may be necessary to adjust the timebase to get the waveform as described in the appendix. If there are too few pulses in the channel 1 trace, one must make the seconds per division larger. If there are too many pulses in the trace, or if they are all bunched up on the left, one must make the seconds per division smaller. If the timebase needs adjusting, perform the following steps:

7A. Move the pointer to **SEC/DIV** thumbwheel switch in the horizontal control area.

7B. If the seconds per division must be raised (too few pulses on screen), press the right mouse button, or the + key on the keyboard.

7C. If the seconds per division must be lowered (too many pulses on the screen), press the left mouse button, or the - key on the keyboard.

7D. Press the **F3** key to get the new waveform to the PC screen.

7E. Repeat steps 5A, 5B, 5C, and 5D, until the display resembles the sample as closely as possible.
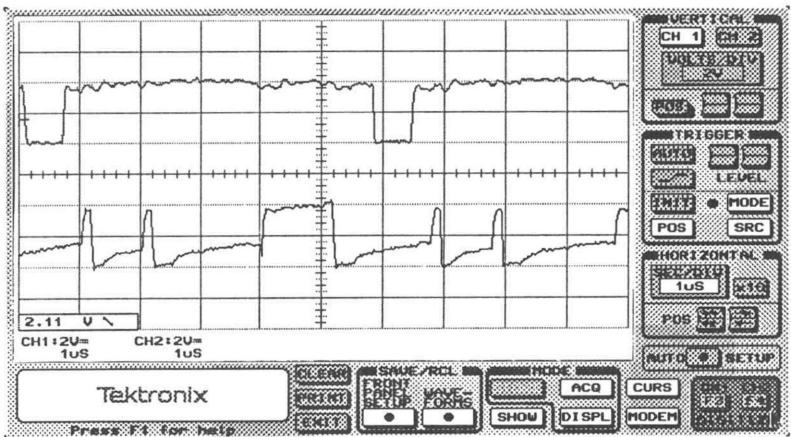
Figure 4-13. IOR- (Z80) and D0 after adjusting. Note that at the rising edge of IOR-, D0 is at an undefined, or float, voltage level.

Note: This same basic procedure can be used to adjust the appearance of channel 2 data, just substitute **F4** for **F3** above. However, do not forget that adjusting the time base (**SEC/DIV**) affects the entire display, channel 1 and channel 2.

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8. Move the pointer to the **SAVE/RCL** control area and press the **WAVEFORMS** button.

9. This opens a trapdoor with additional buttons. Move the pointer to, and then press the **INSTR** button in this trapdoor.

10. Move the pointer to and then press the button labeled **CH1** under the trapdoor that opened from the previous step.

11. Move the pointer to and then press the button labeled **DISPL** under the trapdoor that opened from the previous step.

12. Move the pointer to and then press the button labeled **A** under the trapdoor that opened from the previous step.

13. Move the pointer to the **SAVE/RCL** control area and press the **WAVEFORMS** button.

14. Move the pointer to and then press the button labeled **INSTR** under the trapdoor that opened from the previous step.

15. Move the pointer to and then press the button labeled **CH2** under the trapdoor that opened from the previous step.

16. Move the pointer to and then press the button labeled **DISPL** under the trapdoor that opened from the previous step.

17. Move the pointer to and then press the button labeled **B** under the trapdoor that opened from the previous step.

18. Move the pointer to and press the **SHOW** button.

19. Move the pointer to and press the **CH1** button in the trapdoor menu that opened.

20. Move the pointer to and press the **CH2** button in the trapdoor menu.

DISCUSSION:

The goal of this example is to capture waveforms in the memory of the PC connected to the scope. This memory is set aside by CAT200. As long as CAT200 is running, then the waveform data stored in PC memory is available. There are four memories set aside by CAT200. They are referred to as *AUX* memories and are numbered 1 through 4. When CAT200 is stopped, the data in these memories is lost.

Getting data into these memories is controlled by the **WAVEFORMS** key. Pressing this key opens a trapdoor menu. (*pressing* a key on the monitor has already been discussed. Briefly, it is the process of moving the pointer to the button and pressing a mouse button or the "**Enter**" key on the PC keyboard.) This trapdoor menu allows selection of the source and destination for the digitized waveform. Some of the actions of the menus started with the **WAVEFORMS** were discussed in the previous example.

In this example we choose an active scope channel as the source of the waveform data. This is done by first pressing **INSTR**, for instrument, or the scope, and then pressing **CH1** as the specific waveform of interest. The destination this time is in the PC display area. This route is chosen by pressing the **DISPL** button.

Note that when the data was transferred to an **AUX** memory, that data was also displayed on the monitor waveform display area. In addition, the vertical and horizontal settings for this data are displayed in the **AUX** waveform data area below the waveform display area. This parameter data is displayed in the same color as the **AUX** waveform itself.

Steps 18, 19, and 20, illustrate the ability to display specified waveforms in the waveform display area. Pressing the **SHOW** key opens a trapdoor to allow selection of what waveforms to display. When the SHOW trapdoor menu opens, a row of six buttons appears. These buttons correspond to the six different places that waveform data is stored by CAT200. These are channel 1, channel 2, and the four AUX memories. Each of these trapdoor buttons has a dot in the center. This dot is yellow if the corresponding waveform data is on the display. It is black if the data is not being displayed. Pressing a button will attempt to toggle the color of the button from black to yellow, or yellow to black, and likewise toggle the state of the waveform data. If a button with a yellow dot is pressed, the dot will turn black and the waveform data for that button will be erased from the waveform display area. The data is not erased from memory. It can be recalled later.

If a button with a black dot is pressed, the dot will turn yellow. If there is waveform data in the memory represented by the button, the trace will be plotted in the waveform display area, and the vertical and horizontal settings that were in effect for the waveform will be displayed in the data area at the bottom of the display area. If there is no data in the memory for the button, then the dot will simply turn back to black with no data being displayed.

You will have noticed that as the waveform data was brought over from the scope, it covered the existing channel 1 and 2 data that was in the display area. Using the *SHOW* trapdoor menu allows erasing the channel 1 and 2 data so you could see the *AUX* data, or conversely hiding the *AUX* data to bring channel 1 and 2 back into view.

Note: If the instrument has not acquired a valid waveform since it was last initialized (possible in NORM and Single Sequence trigger modes), the waveform transferred after you press F3 or F4 will be nonsense data. In Single Sequence you can avoid this by first checking the trigger status indicator and making sure it is lit, signifying that a valid waveform has been captured. In NORM, simply avoid pressing the INIT button when using the instrument in a babysitting mode, using CLEAR instead. When transferred to the CAT200 display, this results in a straight baseline displayed at the bottom of the screen.

4.322 STORING WAVEFORMS ON DISK

EXAMPLE 5 - NON-VOLATILE WAVEFORM STORAGE

1. Perform steps 1 through 7 in EXAMPLE 4.

2. Move the pointer to and press the **WAVEFORMS** button in the **SAVE/RCL** section.

3. In the trapdoor menu that opens, press the **DISPL** button.

4. In the trapdoor menu that opens, press the **CH1** button.

5. In the new trapdoor menu that opens, press the **DISK** button.

6. In the new trapdoor menu that opens, move the pointer to the **PATH**: box, and then press the "**Enter**" key or any mouse button. Using the computer keyboard, type the path where you want to store your waveform data files. For these examples, the same path (or directory/sub-directory) where you have CAT200 is satisfactory. If you have followed all the installation instructions, and CAT200 is on a hard disk, this path is probably "C:\CAT." After entering the path name, press the "**Enter**" key or any mouse button. If you do not enter anything in the **PATH**: window, then the directory that you were in when CAT200 was started will be used.

7. Move the pointer to the **FILE:** box. Using the "**Enter**" key, or any mouse button, and the computer keyboard, type the name of the file where you want your waveform data to be stored. For this example, a good name is "SAMPLE1."
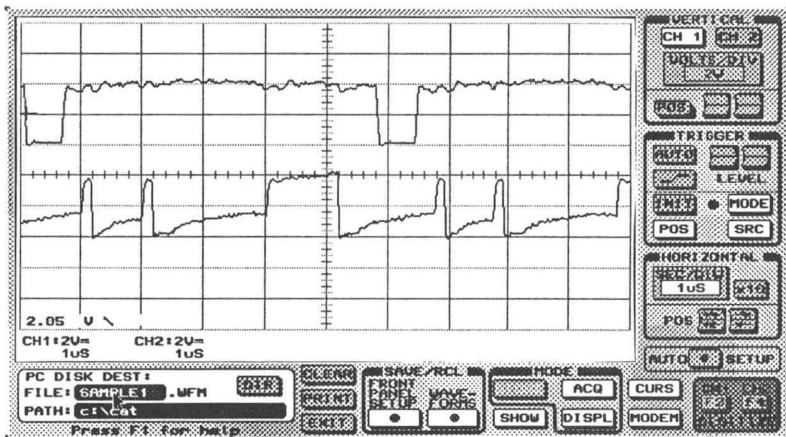
Figure 4-14. The disk destination trapdoor menu with path and file name defined. Placing the pointer in a window and pressing A button allowed typing in the names.

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8. Now press any mouse button or the "Enter" key on the computer keyboard.

9. Move the pointer to and press the **WAVEFORMS** button.

10. In the trapdoor menu that opens, press the **DISPL** button.

11. In the trapdoor menu that opens press the **CH2** button.

12. In the new trapdoor menu that opens, press the **DISK** button.

13. In the new trapdoor menu that opens, move the pointer to the **PATH:** box. Using the computer keyboard, type the path where you want to store your waveform data files. For these examples, the same path (or directory/sub-directory) where you have CAT200 is satisfactory. If you have followed all the installation instructions, and CAT200 is on a hard disk, this path is probably "C:\CAT."

14. Move the pointer to the **FILE** box. Using the computer keyboard, type the name of the file where you want your wave form data to be stored. For this example, a good name is "SAMPLE2."

15. Now press any mouse button or the "Enter" key on the computer keyboard.

DISCUSSION:

The main goal of this example is to save waveform data in non-volatile storage, the PC disk. Non-volatile means that the waveform data is not lost when CAT200 is stopped. It also means that you can use CAT200 to review any such waveform at any later time you wish to. You do not need to have the TEK222 connected to the PC to see these waveforms. (Note: When using CAT200 without the scope connected to the computer, you should press the **F6** key. This action disconnects CAT200 from the scope. Unless this is done, CAT200 will continuously attempt to communicate with the scope and, thus, cause response times to increase dramatically while it waits for the unconnected scope to respond. **F6**, and all other active keyboard keys, as well as all CAT200 buttons, are described in detail in Section 5.)

The first step simply takes you through a sequence that was used before to get a display into the waveform display area of the monitor. In doing this, the waveform data is now in the channel 1 and channel 2 data buffers that are part of CAT200. This means that this data is now available for moving into some other place, such as memory in the TEK222 or the disk of the PC. In order to permanently save this data, it must be moved to non-volatile storage, such as a disk file. This transfer is part of what can be done with the **WAVEFORMS** key.

Transferring waveform data was covered in a previous example, but this example illustrates another aspect of the capability. The transfer of waveform data (and front panel setup data, which we are not covering here) is essentially a two step process that involves selection of a source for the data and then its destination. Pressing the **WAVEFORMS** key opens a trapdoor menu that allows selection of the source. The source can be the scope (the **INSTR**, or instrument, button), a memory associated with CAT200 (the **DISPL** button to get display channel 1, display channel 2, or one of the four online memories known as **AUX** memories), or a disk file (the **DISK** button). Pushing any of these source buttons will cause a secondary trapdoor menu to appear. This menu is for further specification of the source. Detailed information about each is given in the button reference section later in this book.

Once the source has been fully identified, another trapdoor menu is automatically opened. This menu looks much like the first menu that opened when the **WAVEFORMS** menu was opened. However, this new menu is the *destination*, rather than *source* menu. This menu allows selection of the destination for the waveform data in much the same way as the source. The destinations can be any of the four TEK222 memories (**REF** 1 through 4), any of the four CAT200 memories (**AUX** 1 through 4), or a disk file. Selecting one of the TEK222 memories causes the data to be immediately transferred to the TEK222. Specifying a disk file will bring up another trapdoor menu. This new menu is for instructing CAT200 as to the name of the disk file to receive the waveform data. The menu has two boxes. One is for the path (or name of the directory/sub-directory) for the data file. The other box is simply for the name of the file. CAT200 will automatically add the characters ".**WFM**" to the file name. In order to type characters into either box, you must place the pointer on the box and then select it with the "Enter" key or any mouse button. To make CAT200 accept the name you have typed, press "Enter", or any mouse button, again. Once these boxes contain the file name that you want, pressing any mouse button, or the "Enter" key on the computer keyboard will cause the specified waveform data to be transferred to disk. This data is then available to be viewed at any time. Note that as a minimum, the file name box must be selected before any disk menu will disappear. Even if both the PATH: and FILE: boxes have the correct data, the FILE: box must be selected, and then deselected, before CAT200 accepts the specified file name.

The trapdoor menu associated with the **DISK** button has a feature to assist you in selecting a file name. It is the **DIR** key. As the name suggests, it will present a list of all the files, in the currently specified directory, with the extension **.WFM**. In addition, once the directory is on the screen, any of the presented names can automatically moved to the **FILE**: box by moving the pointer to the name and pressing any mouse button or the **Enter** key. The directory can be changed by typing a new directory path into the **PATH**: box which is in the trapdoor area.

4.4 RECALLING WAVEFORMS

We are already familiar with the concept that waveform data can be saved. Thus, to be useful, this data must be retrievable. This section is going to describe various ways that stored data can be recalled. There are three basic areas where waveform data can be stored: the TEK222 itself, temporary memory in CAT200, and permanently on PC disk files.

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4.41 RECALLING WAVEFORMS FROM SCOPE MEMORY

EXAMPLE 6 - GETTING DATA FROM A SCOPE MEMORY

1. Make sure that memory 2 in the TEK222 has data in it. Performing example 4 will cause this to happen.

2. Move the pointer to the **WAVEFORMS** button and press it.

3. In the trapdoor menu that opens, move the pointer to the **INSTR** button and press it.

4. In the trapdoor menu that opens, move the pointer to the **2** button and press it.

5. In the trapdoor menu that opens, move the pointer to the **DISPL** button and press it.

6. In the trapdoor menu that opens, move the pointer to the **A** button and press it.

DISCUSSION:

As can be seen, the waveform data movement capabilities provided by the **WAVEFORMS** button are quite flexible. In this case, data that had been previously saved in scope a scope memory was moved into one of CAT200's online memories and placed in the waveform display area at the same time. One of the advantages of using the scope to save waveform memory is that it is non-volatile. Thus, as you carry the scope from place to place, the saved waveforms are available, whether you have CAT200 with you or not.

4.42 RECALLING WAVEFORMS FROM PC

As has already been established, waveform data is stored in the PC in two conceptual places: on line memory, called **AUX** memories; and disk files. The next two sections illustrate retrieving data from these two types of storage.

4.421 RECALLING WAVEFORMS FROM PC MEMORY

EXAMPLE 7 - DISPLAYING DATA IN AUX MEMORIES

1. Make sure you have a waveform stored in **AUX** memory A. If you do not, performing example four results in this memory having data.

2. Move the pointer to and press the **SHOW** button.

3. On the trapdoor menu that opens, press the **A** button.
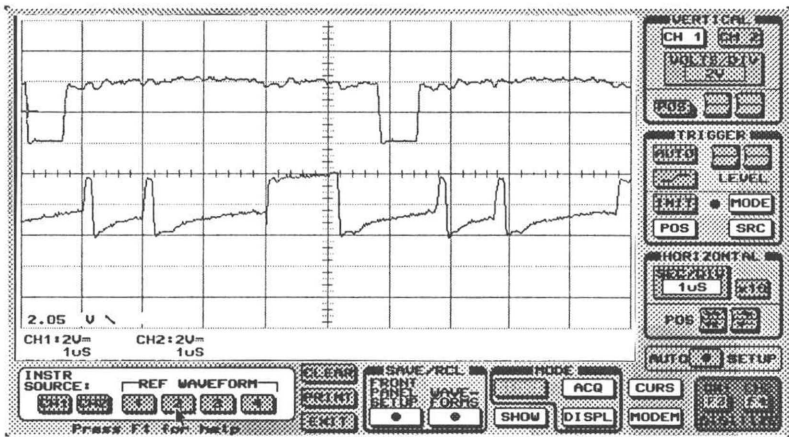
Figure 4-15. *No change to monitor waveform display area when trace recalled from scope memory.*

DISCUSSION:

This example is really just an exercise with the **SHOW** button. This button allows control of what waveforms appear in the monitor waveform display area. Operation of this button was covered in Example 4, but a review will be done here.

Pressing **SHOW** causes a trapdoor menu to open. A row of six buttons appears. These buttons allow selection of the data to be displayed in the waveform display area. Each of these trapdoor buttons has a dot in the center. This dot is yellow if the corresponding waveform data is on the display. It is black if the data is not being displayed. Pressing a button will cause the specified data to be placed on the display. If there is no data in the memory, then the dot will not stay yellow, and nothing happens to the display. If a button with a yellow dot is pressed, the dot will turn black and the waveform data for that button will be erased from the waveform display area. The data is not erased from memory. It can be recalled later.

Keep in mind that recalled waveforms are displayed exactly as they were saved. The display is not adjusted or scaled in any fashion. This means that if you have changed the vertical sensitivity or horizontal time per division, then the displayed waveform may not be accurately scaled for the settings now in effect. This is why the vertical and horizontal settings for each waveform are saved and displayed with the data. The major effect of this is that the display may be confusing if you are trying to compare various waveforms on the screen. None of them are guaranteed to be scaled the same as any other unless you specifically saved them with the same vertical and horizontal settings.

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4.422 RECALLING WAVEFORMS FROM PC DISK

EXAMPLE 8 - DISPLAYING WAVEFORM DATA IN DISK FILES

1. If you do not have a waveform stored on disk, example 5 can be used to generate one.

2. Move the pointer to and press the **WAVEFORMS** button.

3. On the trapdoor menu that opens, press the **DISK** button.

4. In the new trapdoor menu that opens, move the pointer to the **PATH:** box. Using the computer keyboard, type the path where your waveform data files are stored. For these examples, the same path (or directory/sub-directory) where you have CAT200 is probably where these files are located. If you have followed all the installation instructions, and CAT200 is on a hard disk, this path is probably "C:\CAT."

5. Move the pointer to the **FILE:** box. Using the computer keyboard, type the name of the file where you want your waveform data to be stored. If you are using data developed in previous examples then a good name is "SAMPLE1."
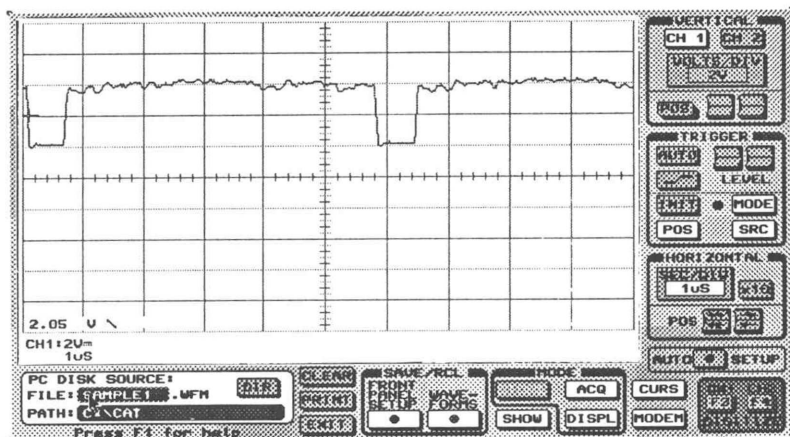
Figure 4-16. Disk source trapdoor menu ready to read "C:\CAT\SAMPLE 1.WFM."

6. Now press any mouse button or the "Enter" key on the computer keyboard.

7. On the trapdoor menu that opens, press the **DISPL** button.

8. On the trapdoor menu that opens. press the **A** button.

DISCUSSION:

This is another straight forward use of the facilities of the **WAVEFORMS** button. One thing to note is that any time that one of the **AUX** memories is the destination of data, the memory data is displayed in the waveform display area after it is put into the memory.

4.5 SENDING WAVEFORMS TO SCOPE

EXAMPLE 9 - PUTTING PC WAVEFORM DATA INTO SCOPE MEMORIES

1. Make sure you have a waveform stored in **AUX** memory A. If you do not, example 4 will result in this memory having data.

2. Move the pointer to and press the **WAVEFORMS** button.

3. On the trapdoor menu that opens press the **DISPL** button.

4. On the secondary trapdoor menu that opens, press the **A** button.

5. On the secondary trapdoor menu that opens, press the **INSTR** button.

6. On the secondary trapdoor menu that opens, press the **1** button.
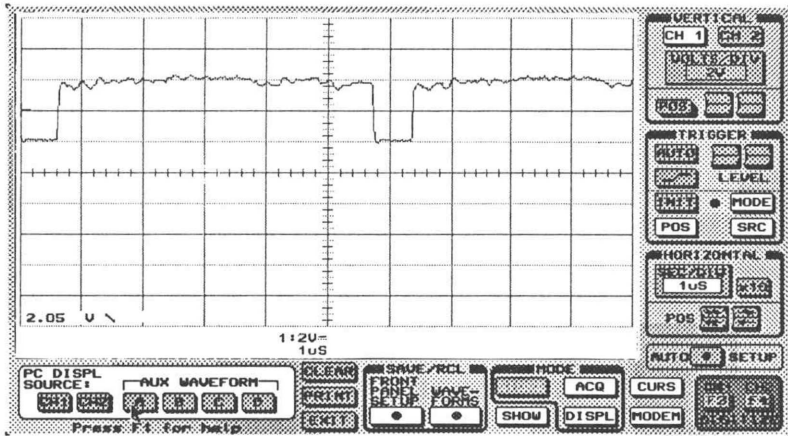
Figure 4-17. *Instrument destination trapdoor menu ready to transfer AUX MEMORY A data to REF MEMORY 1.*

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DISCUSSION:

This example moved the data that was in CAT200's **AUX** memory A into **REF** memory 1 in the scope. Note that simply moving the data from the PC to a scope memory did not affect the display on the monitor waveform display area. However, the data did appear on the scope. That is, if the monitor waveform display area was blank when the source and destination were selected, it was still blank after the data was moved.

4.6 DELTA TIME / DELTA VOLTAGE MEASUREMENTS

EXAMPLE 10 - THE UNKNOWN BAUD RATE

1. Refer to Appendix B for a description of the serial data signal.

2. Attach the channel 1 probe to the serial data signal.

3. Move the pointer to the **AUTO SETUP** button and press it.

4. Press the **F3** key to get the channel 1 waveform to the waveform display area.

5. If necessary, adjust the vertical and horizontal scales until a single pulse of the data occupies at least 1/3 of the screen.
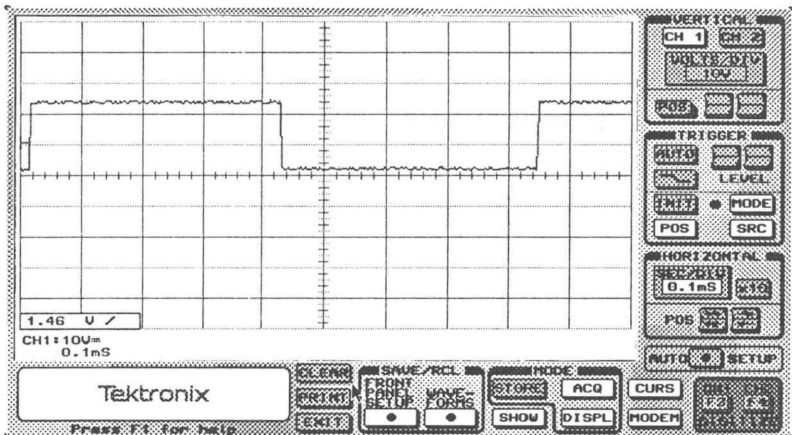
Figure 4-18. *A good view of the serial data signal for calculating the baud rate.*

6. Once a good signal is on the waveform display area, move the pointer to and press the **CURS** button.

7. If the dot in the Δt button is not yellow, then move the pointer to this button and press it until the dot turns yellow.

8. If the dot in the **TRACK** button is yellow, move the pointer to it and press it so that the dot turns black.

Note that the **CURS** trapdoor menu has two boxes in it. At the top of each box is a short section of a line. One of these lines is a series of dots, and the other is a series of dashes. The rocker switches in each box control the line on the screen that matches the line in the box. That is, the box on the left, with the dots, controls the line made up of dots, while the box on the right, with the dashes, controls the line made up of dashes.

9. Now use the rocker switches in the box, marked with the **TRACK** button, to move one of the vertical dashed lines to the left edge of the pulse displayed in the waveform display area. Remember, the rocker switch with two arrows on top and bottom moves the dashed line one graticule division. The other switch, with only one arrow on top and bottom, will move the line one pixel.

10. After positioning the movable vertical dashed line on the left edge of the pulse, move the pointer to the rocker switches in the other box. Using these switches move the other vertical dashed line to the right edge of the pulse.

11. Now the length of the pulse and its period can be read in the data window near the bottom of the waveform display area.
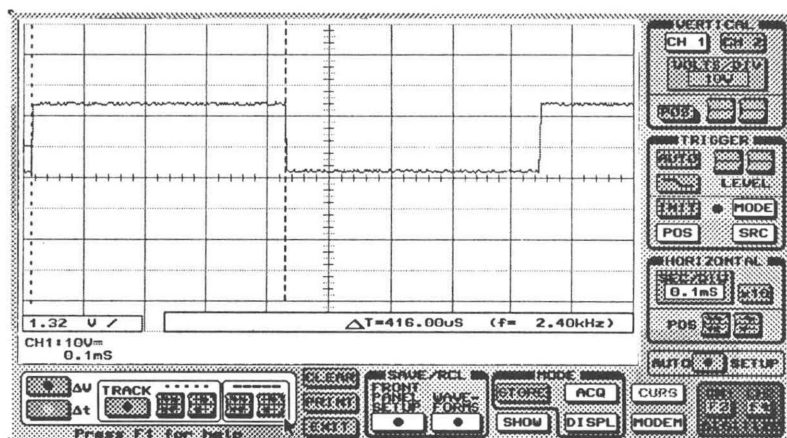
Figure 4-19. *1 bit of serial data bracketed with "Δt" measurement lines. The baud rate (or bit rate) appears in the delta measurement box in the waveform display area.*

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DISCUSSION:

The delta time and delta voltage facility is something that is not in the TEK222 at all. It is a feature of CAT200. This example shows one of the many uses it may have. By performing the steps in the example, you have measured the bit time, or baud rate, of a serial data stream.

The first five steps simply got a usable waveform on the PC screen. Starting with step 6, you were using the delta time/voltage measurement facility. When the **CURS** button was pressed, a trapdoor menu was opened that is actually a control panel for the delta measurement facility. In addition, a window was placed near the bottom of the waveform display area that displays the current value of the distance between the two vertical lines (and the two horizontal lines, if present).

This example measured time and frequency. This started with enabling the delta time measurement logic. This is done with a button that functions like the buttons on the **SHOW** trapdoor menu in that the color of the dot in its center defines what operational mode it is in. If the dot in either the Δt or ΔV button is black, then that logic is disabled and its set of dashed lines is not on the screen. Pressing the button will turn the dot to yellow, the corresponding dashed lines appear in the waveform display area, and that logic is then active. If the pointer is moved to the other button (that is, one of the Δ buttons) and it is pressed, then the dot in the first button will turn from yellow to green. The green dot indicates the logic is active, but the rocker switches will not affect its dashed lines. The rocker switches affect whichever of the two buttons has its dot yellow. Thus, unlike the buttons in the **SHOW** trapdoor menu, the dots in these two buttons have three colors: black (off), yellow (on and currently controllable), and green (on but not currently controllable).

The other button in the **CURS** trapdoor menu is labeled **TRACK**. Its purpose is to keep the dashed lines separated by the same distance as they are moved. In this way, once the dashed lines have been set up on one trace, they can be moved to another to compare some feature on the second to that on the first. The dot in the **TRACK** button is black for off and yellow for on.

When either of the delta functions (voltage or time) is enabled, not only do the dashed lines appear, but a white box appears in the lower right of the waveform display area. The numbers in this box represent the voltage or time difference between the dashed lines. These quantities are expressed in units relative to the current setting of the horizontal and vertical controls on the monitor. They are not related to the actual settings on the scope, or to the settings that were used when any waveform in the waveform display area may have been captured.

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Two of the numbers in the box are directly measured, the voltage is simply the vertical separation of the horizontal lines, in divisions, multiplied by the volts per division setting of the vertical channel. Likewise, the time is the horizontal separation of the vertical dashed lines, in divisions, multiplied by the setting of the horizontal time per division. The frequency, the quantity in parentheses, is the calculated time divided into 1.

4.7 MODEM OPERATIONS

EXAMPLE 11 - VIEWING A WAVEFORM FROM A REMOTE SITE

In order to perform this example, you will need some additional equipment, and initial preparations must be made to allow it all to work properly together. Refer to section 3.1 for details on how to configure your equipment. When this is completed, proceed to the following steps:

1. Move the pointer to, and press, the button labeled MODEM.
2. Move the pointer to, and click, the box below the button labeled DIAL.
3. Type in the phone number of the modem connected to the scope followed by a carriage return.
4. Move the pointer to, and press, the DIAL button.

DISCUSSION

Assuming all initial configuration has been done properly, then after a short delay, CAT200 should display a message that you need to press F5 to establish connection with the scope. Once this connection is established, then you can perform any of the preceding examples, just as if the computer were connected directly to the scope.

To end your session continue with the following steps.

5. Move the pointer to, and press, the MODEM button to reveal a trapdoor menu containing the HANG UP button (if it is not already open).
6. Move the pointer to, and press the HANG UP button.
7. Move the pointer to the appropriate button in the exit trapdoor menu and press it.

DISCUSSION

When using a conventional dial-up telephone connection, end your session by pressing the HANG UP button. This will first disconnect the modem from the telephone line, terminating the call. Your selection from the exit trapdoor menu then causes CAT200 to exit to DOS.

If you end your session by pressing the EXIT button, CAT200 will exit without disconnecting the modem from the telephone line. To terminate the telephone call, it is then necessary to physically disconnect the modem from the telephone line, or otherwise instruct the modem to disconnect.

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4.71 STARTING AND ENDING SESSIONS - PRIVATE or LEASED LINES

You will probably conduct most remote sessions using a "Dial up" or "Switched" telephone line like the one you have at home. In some cases, however, you may wish to use a "Private" line which is always active and requires no dialing to establish a connection. These lines are also known as "Dedicated" or "Leased" lines. To establish a connection after starting CAT200, use the following steps.

Computer Site (CAT200):	Remote Site (222):
Select and press MODEM button	Press AUX FUNCT button on top of the scope.
On the trapdoor menu, press the GO OFF HOOK button.	Press the CONFIG menu button on the front of the scope.
	Press the MODEM on menu button on the front of the scope.

Within a few seconds, data communication should begin. If you wish to exit CAT200 leaving the connection you have established in operation, simply exit by selecting the EXIT button on the CAT200 front panel. When the trapdoor exit menu appears, be sure NOT to turn off the scope. Since the remote power up feature depends on the onset of carrier detect to initiate power up, and the carrier has been active continuously, you will not be able to remotely power up the instrument after turning it off. Remote power up cannot be made to work over a private line.

4.72 VOICE AND DATA

CAT200 allows voice communication between the computer and the operator at the scope. However, this requires additional equipment.

Each person must have a telephone equipped with a voice/data switch. Once the modems are connected to the voice/data switches, proceed as follows:

4.721 INITIAL CONNECTION

Start CAT200. Initiate the telephone call as if it were a normal two person conversation, by dialing the telephone manually.

4.722 SWITCHING FROM VOICE TO DATA

Computer Site (CAT200):	Remote Site (222):
Establish voice communication.	Establish voice communication.
When ready, switch voice/data switch to data.	When ready, switch voice/data switch to data.
Select and press MODEM button.	Press AUX FUNCT button on top of the scope.
On the trapdoor menu, press the GO OFF HOOK button.	Press the CONFIG menu button on the front of the scope.
	Press the MODEM ON menu button on the front of the scope.

The MODEM ON button should be pressed within about 30 seconds before or after the GO OFF HOOK button is pressed at the computer site. If the time is longer, a "NO carrier signal detected" message will appear on the CAT200 screen.

Many modems use a small speaker allowing the operator to acoustically monitor the first few seconds of a session. When the GO OFF HOOK button is pressed, the audible carrier signal that results serves as an excellent cue to the operator at the remote site that it is time to press the MODEM ON button.

4.723 SWITCHING FROM DATA TO VOICE

Once data communications is established, voice communication can be resumed by following these steps:

1) If the modem trapdoor is not displayed, press the MODEM button.

2) On the modem trapdoor menu, press the VOICE button.

3) This will cause CAT200 to send commands to the scope to display its configuration menu. (This is the menu reached by pressing AUX FUNCT followed by CONFIG on the scope.)

4) When the Tek 222 operator sees this menu, he must press the MODEM ON menu button. He should then switch his voice/data switch to voice. (It is important to do this as soon as practical. The line will be disconnected if the voice switch is not pressed within a certain time. Depending on the telephone company, this period will be from a few seconds up to about 10 seconds.)

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5. When CAT200 senses the pressing of the **MODEM ON**, it then sends commands to the modem to drop its carrier signal. (This is accomplished by sending characters "+ + +," a one second wait, followed by "ATZ⏎.")

Sec 4.724 ENDING THE SESSION

To terminate the session, switch from data to voice communication, hang up the telephone, and exit CAT200.

4.8 TRIGGER QUERIES

Trigger status indicated by the "trig'd" light on the virtual front panel is updated continuously by default. At lower baud rates, this can slow down the response of the pointer to mouse movements, making them seem "jerky". To disable continuous trigger queries, press F8. This will keep the response of the pointer to mouse movement fast at the expense of trigger status displays. To enable trigger status displays again, press F7.

This section details each button and switch that is on the CAT200 screen. It includes the buttons that appear under the trapdoor, and all the areas set aside for data display.

BUTTONS AND SWITCHES

+/-   This button is located in the **TRIGGER** control section. It is used change the polarity of the trigger level. When in the normal trigger mode, the TEK222 will only trigger when the input voltage passes through the trigger voltage level. The trigger voltage slope further defines the trigger point by differentiating between a voltage that is falling through the trigger voltage or one that is rising through trigger voltage. A positive slope, indicated by a "/" as in "**123mV** /," in the trigger level display, will cause the scope to only trigger when the input voltage is rising through the trigger level. In this case, 123mV, if the previous trace has ended, then the scope will start a new one as the input voltage goes from just below 123mV to just above 123mV.

Δt   This button is on the trapdoor menu that appears after pressing the **CURS** button. It enables the logic to measure the time difference between the vertical delta cursors that are on the screen. The center of this button can be three different colors: black, green, and yellow. Each has a different meaning and is selected by sequential presses of the button. The yellow center indicates this button is active. In this mode, the delta time measurement lines (dashed vertical lines) can be positioned on the screen. A green center means that the delta time mode is turned on, but not affected by the delta positioning controls. The black center indicates that the delta time function is turned off, and the associated vertical measurement lines will be removed from the screen.

ΔV   This button is on the trapdoor menu that appears after pressing the **CURS** button. It enables the logic to measure the voltage difference between the horizontal delta cursors that are on the screen. The center of this button can be three different colors: black, green, and yellow. Each has a different meaning and is selected by sequential presses of the button. The yellow center indicates this button is active. In this mode, the delta voltage measurement lines (dashed horizontal lines) can be moved around the screen. A green center means that the delta voltage mode is turned on, but not affected by the delta positioning controls. The black center indicates that the delta voltage function is turned off, and the associated horizontal measurement lines will be removed from the screen.

1   This button is found in several trapdoor menus. In all cases, it is used to select one of four memories in the scope. There are actually eight. Four are used for waveform data and four are used for front panel setup data. The waveform memories are known as **REF** memories 1 through 4. See the definitions of these buttons: **FRONT PANEL SETUP** and **WAVEFORMS**.

2   See definition of **1**.

3   See definition of **1**.
4   See definition of **1**.

A   This button is used to select one of the four CAT200 online memories. When waveform data is moved from one place to another, one class of source and destinations is waveform data buffers maintained by CAT200. There are four of these buffers and they are called **AUX** memories A through D. These buttons are reached after pressing the **DISPL** button associated with waveform data movement began by pressing the **WAVEFORMS** button.

One other way to get to the selection of the **AUX** memories is through pressing the SHOW button. Refer to the definitions of **WAVEFORMS** and **SHOW** for additional information.

AC   This button is used to select **AC** coupling for a vertical channel. Whenever the button of the active vertical channel, **CH 1** or **CH 2,** is pressed, a trap door opens revealing the coupling choices. Refer to the **CH 1** or **CH 2** definitions.

ACQ   This button is located in the **MODE** control section. It serves the same purpose as the **ACQ** button on the top of the scope. Pressing the **ACQ** button opens a trap door menu to allow selection of the acquisition mode. The available mode buttons are **NORM, ENV, AVG**, and **CONT ENV.** Refer to the definitions of these buttons and the *Operators Manual* for a discussion of these acquisition modes.

AUTO   This button is in the **TRIGGER** control section. It causes a trigger level to be automatically determined.   This means that when a waveform is present on the channel that is the trigger source, the highest and lowest voltage in the waveform will be found and the trigger level set midway between them.

AUTO BL This button is found on the trapdoor menu that appears when the **MODE** button is pressed. **AUTO BL** is an acronym for *auto baseline*. In this mode, if a trigger condition is not met within a certain time after a trace is finished, another trace is started to insure that a visible trace is on the screen. Note that this only affects the scope. No trace will automatically be transferred from the scope to CAT200. All traces that will be used by CAT200 must be explicitly requested.

AUTO LVL This button is on the trapdoor menu that appears when the **MODE** button is pressed. It serves the same purpose as the **AUTO** button in the **TRIGGER** control section.

AUTO SETUP This button is located just below the **HORIZONTAL** control section. Its purpose is to provide a quick setup of the vertical, horizontal, and trigger, controls to give a stable, usable, display of the voltage waveform present on the probe tips. For details of specific actions the **AUTO SETUP** button takes, refer to the *Operators Manual*.

AVG   This button appears on the trapdoor menu that appears when the **ACQ** button is pressed. In this mode, the scope displays a moving, four-point average of the last four samples of the input waveform.

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B   See the definition of the **A** button.

BAUD   This thumbwheel switch icon is in a trapdoor menu which appears after pressing
the **CFG** button. Its purpose is to set the serial communications channel bit rate.
Specifying a baud rate with this switch will change the baud rate for only the PC. It will
not necessarily change the baud rate of any modem that may be in the communications
line.

C   See the definition of the **A** button.

CANCEL This button is on a trapdoor menu that is reached after pressing the EXIT button.
Pressing this button will clear the trapdoor menu from the screen with no other action.

CFG   This button is on the trapdoor menu that appears when the **MODEM** button is
pressed. Pressing the **CFG** button opens a secondary trapdoor menu that allows
configuration of the modem and serial data channels.

CH 1   This button is located in the top left of the **VERTICAL** control section. Pressing
this button selects channel 1 as the active vertical channel. Once channel 1 is the active
channel, pressing the button again opens a trapdoor menu that allows specification of the
coupling method to use for vertical channel 1. The active vertical channel is the one that
will be affected by the vertical position and variable gain rocker switches. When
channel 1 is the active channel, its button will have a light colored background, and the
CH 2 button will have a darker background.

CH 2   This button is located in the top right of the **VERTICAL** control section. Its
function is similar to the **CH 1** button.

CH1   This button is on the trapdoor menu that appears when the **SHOW** button is
pressed. It specifies that the channel 1 vertical channel data is to be displayed on
the PC screen. Up to 6 different waveforms can be displayed at one time on the
PC screen. They are channel 1, channel 2, and auxiliary waveforms A through D.
Note, no active data for the channel will be displayed on the screen graphic display
area until **F3** is pressed. Deselecting this channel for display will erase any
waveform on the screen that is associated with it. The channel is deselected by
pressing its button if the center of the button is yellow. This turns off the channel
and turns the center to black. Conversely, pressing the button while the center is
black, will enable the channel to be shown on the waveform display area and will
change the center back to yellow.

Another way to encounter the **CH1** button is while moving waveform data. After
pressing the **WAVEFORMS** button, two of the possible sources of waveform data,
INSTR and **DISPL**, will allow the selection of **CH1**. In the case of the **INSTR** button,

the digitized data for channel 1 in the scope will be moved to some destination. Pressing **DISPL** allows you to move the digitized data for channel 1 that is currently stored in CAT200 to some other storage location.

CH2   This button is on a trapdoor menu that appears when the **SHOW** button is pressed. It specifies that the channel 2 vertical channel data is to be displayed on the PC screen. Up to 6 different waveforms can be displayed at one time on the PC screen. They are channel 1, channel 2, and auxiliary waveforms A through D. Note, no active data for the channel will be displayed on the screen graphic display area until **F4** is pressed. Deselecting this channel for display will erase any waveform on the screen that is associated with it. The channel is deselected by pressing its button if the center of the button is yellow. This turns off the channel and turns the center to black. Conversely, pressing the button while the center is black, will enable the channel to be shown on the waveform display area and will change the center back to yellow.

Refer to the definition of **CH1** for additional information.

CLEAR   This button is located just to the left of the **WAVEFORMS** control area. This button simply closes the trapdoor on any menu that may be visible there. This is similar to the action of the clear button on the scope.   In addition, pressing the clear button, while no trapdoor menu is visible, will erase any waveforms that are currently on the waveform display area of the monitor. This button has no effect on the scope.

COM   This button is on the trapdoor menu that appears after pressing the **CFG** button. It allows specification of which PC serial data port is connected to the modem.

CONT ENV   This button is on the trapdoor menu that appears after pressing the **ACQ** button. It specifies that the waveform data acquisition mode should be **CONT ENV**. In this mode, the positive and negative peak values of the input waveform that occur during the sampling period are displayed.

CURS   Pressing the **CURS** button, which is located just to the right of the **MODE** control area opens a trapdoor menu to allow making voltage and time measurements on a displayed waveform.

D   See the definition of the **A** button.

DATA   This button is on a trapdoor menu that is reached after pressing the **MODEM** button. If the telephone is off hook when the **MODEM** button is pressed, or if it is taken off hook after the **MODEM** button is pressed (by pressing the **GO OFF HOOK** button), this menu is presented.   Pressing the **DATA** button will cause the necessary commands to be sent to the modem to enable data, rather than voice, transmission through the connected modem. Note, not all modems have this capability. Thus, the switch from voice to data may require manual intervention. Moreover, the TEK222 does not have this capability.   Switching the remote modem from voice to data will have to be done manually.

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DC This button is on the trapdoor menu that appears after pressing either the **CH 1** or **CH 2** buttons. It specifies that the selected channel use **DC** coupling for its voltage input.

DIAL This button is on the trapdoor menu that appears after pressing the **MODEM** button. It causes the commands to be sent to the modem to dial the number specified in the number window on the same menu.

DIR This button appears in several trapdoor menus. All of these menus are reached after pressing the **DISK** button (which itself appears in several trapdoor menus). In each case, it displays a list of the files that are in the directory specified in the **PATH:** window. (If no path is specified, the current directory is used.) The directory list is made up of files with the extension specified as part of the trapdoor menu. After pressing the **WAVEFORMS** key this extension is **.WFM**. After pressing the **FRONT PANEL SETUP** button, the extension is **.SET**. The list of files is displayed in the monitor waveform display area. Once the list is displayed, the pointer can be moved to a file name in the list. At that time, pressing any mouse button, or the **Enter** key will cause that file name to be copied to the **FILE:** window in the trapdoor menu.

DISK This button appears on several secondary trapdoor menus. In each case it is to specify that a disk file is to be used as the source or destination of data. This data can be waveforms or front panel setup information.

DISPL This button is located in the **MODE** control area and several trapdoor menus. In the **MODE** control area, it opens a trapdoor menu to allow selection of the display mode. These modes are: **INV1, INV2, XY**, and **RO OFF**.

In all the other cases, it is part of the sequence of trapdoor menus opened when the **WAVEFORMS** button is pressed. This menu allows for the specification of data to be moved and the source and destination of this data. The **DISPL** button is one of the options when selecting the source or destination of the data. After pressing this button, one of the internal data storage areas of CAT200 can become the source or destination of the data to be moved.

ENV This button is on a trapdoor menu that appears after the **ACQ** button is pressed. It specifies that the scope acquire data in the **ENV** mode. In this mode the positive and negative peak signal values that occur during a sample interval are acquired and displayed. See the *Operators Manual* for more information on the **ENV** mode.

ERASE This button is located on the trapdoor menu that opens when the **FRONT PANEL SETUP** button is pressed. It is used to erase previously saved setup data. Which data to erase is selected by a secondary menu.

ERASE ALL This button is located on the trapdoor menu that appears when the **FRONT PANEL SETUP** button is pressed. It will erase all setup information that is stored in scope memory.

EXIT   This button is located at the bottom center of the monitor. It will open one of two trapdoor menus depending on whether the connected scope is a 222 or a 222PS. If the scope is a 222PS, the trapdoor menu allows control over whether or not the scope is turned off as the program exits. If the scope is a 222, the menu only allows CAT200 to exit leaving the scope turned on.

EXT   This button is on the trapdoor menu that appears when the **SRC** button is pressed. Pressing the **EXT** button specifies that the trigger voltage is to come from the external trigger voltage input on the back of the scope.

F1   This button is located near the lower right corner of the monitor. Its purpose is to present information to the operator to assist him in the operation of CAT200. This button can be pressed either from the screen graphic or directly from the computer keyboard. If pressed from the computer keyboard, then the help information presented will be context sensitive. That is, it will be related to the button that the pointer is on when the **F1** key is pressed.

F2   There is no function defined for this key.

F3   This button is located near the lower right corner of the screen graphic. Pressing this button either on the graphic, or on the PC keyboard, will cause the current channel 1 waveform displayed on the scope to be transferred to the screen graphic waveform display area. The old channel 1 waveform on the display area, if there was one, will be replaced by the new data from the scope.

F4   This button is located near the lower right corner of the screen graphic. Pressing this button either on the graphic, or on the PC keyboard, will cause the current channel 2 waveform displayed on the scope to be transferred to the screen graphic waveform display area. The old channel 2 waveform on the display area, if there was one, will be replaced by the new data from the scope.

F5   This key must be pressed on the PC keyboard. Its function is to establish communication between CAT200 and the TEK222. When CAT200 is started, it automatically attempts to communicate with the scope. If this attempt fails, the operator will then be notified. It will then be necessary to use the **F5** key to attempt to establish communication. Similarly, any time communication is discontinued with the scope after starting CAT200 (see *F6*) it will be necessary to press **F5**.

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F6   This key must be pressed on the PC keyboard. Its function is to discontinue communication between CAT200 and the scope. This is necessary if you wish to perform operations on the front panel that you do not want sent to the scope. This includes changing the baud rate, or channel number, of the serial channel connected to the scope. It is also handy to disconnect from the scope if you wish to view any stored waveforms while not using the scope. That is, if you wish to use CAT200 simply to view saved waveforms while the TEK222 is turned off, then being disconnected from the scope makes things go faster. If **F6** has not been pressed, then after each action, CAT200 will attempt to establish communication with the scope. During this process, which lasts several seconds, CAT200 will not respond to user inputs. Use **F5** to re-establish communication.

F7   This key must be pressed on the PC keyboard. It enables continuous trigger status displays. This is the default when CAT200 is started.

F8   This key must be pressed on the PC keyboard. It disables continuous trigger status displays.

F9   Pressing this key on the PC keyboard will cause CAT200 to pause and display a DOS prompt. At this point, any DOS command can be executed. When done with DOS, type **EXIT** at a DOS prompt to return to CAT200.

F10   There is no function defined for this key.

FILE: This is a window on the trapdoor menu that appears after pressing the **DISK** button. It allows specification of a disk file to use as the source or destination of waveform data. Also see the definition of the **DIR** button.

FRONT PANEL SETUP This button allows the saving of the positions of all the front panel controls. This is very handy when waveforms are saved. Whenever any stored waveform is redisplayed on the waveform display area of the monitor (or on the scope) it is not scaled in any manner. That is, it paints exactly the same pixels that it did when it was first captured. Thus, if the horizontal or vertical controls have changed, the waveform is not scaled to the new settings. Thus, in order to use the graticule to measure portions of the waveform, you must observe the parameter information that is displayed with the data, or change the horizontal and vertical controls to match those in effect when the waveform was saved. This last chore is much easier if the front panel settings are saved separately. This coordination of waveform to panel settings is most important if you are attempting to use the delta voltage or delta time facility to measure portions of the data. These measurements are based on the current settings of the horizontal and vertical controls, not the setting that may have been in effect when the data was saved.

GND   This button is on the trapdoor menu that appears whenever the **CH 1** or **CH 2** button is pressed. It allows selection of ground coupling to the specified vertical channel. This has the same effect as connecting the ground clip to the scope probe tip. It is often useful for determining the 0 volts position on the crt of the trace for the specified channel. However, CAT200 makes this determination particularly easy. Simply moving the pointer to the vertical position rocker switches will replace the active vertical channel trace with a horizontal dashed line that represents the 0 volts point for that channel. At that point, the vertical position rocker switches can be used to move the 0 volts point to wherever the user wants it. Commands to make the selected position the 0 volts point on the scope crt will then be sent to the scope.

GO OFF HOOK   This button is on the trapdoor menu that appears when the **MODEM** button is pressed. It causes the commands to be sent to the modem to take the phone *off hook*. This is the same as lifting a telephone handset off the telephone and thus causing the dial tone to start. It is the inverse action to *hanging up* the phone.

HANG UP   This button is on a trapdoor menu that is reached after pressing the **MODEM** button. If the telephone is off hook when the **MODEM** button is pressed, or if it is taken off hook after the **MODEM** button is pressed (by pressing the **GO OFF HOOK** button), this menu is presented. Pressing the **HANG UP** button causes the commands to be sent to the modem to hang up the phone line. This is the same action that is done when a telephone handset is put back on a telephone. It is the inverse of taking a telephone *off hook*.

INIT   This button is located in the **TRIGGER** control area. Pressing this button causes any acquisition in progress to restart. It terminates the sweep in progress and resets the trigger to wait for the next trigger event to start the next sweep. It is particularly useful in re-enabling a single sweep, **SSEQ** trigger mode, acquisition.

INSTR   This button is on the first trapdoor menu that appears whenever a source or destination of waveform data needs to be specified, such as after pressing **WAVE-FORMS**. Pressing **INSTR** allows selection of either channel 1, channel 2, or one of the four scope data memories. (Channel 1 and channel 2 are not eligible as destinations.) The scope data memories are referred to as **REF 1** through **4.**

INV1   This button is located on the trapdoor menu that appears after pressing the **DISPL** button. It will cause the trace for channel 1 on the scope to be inverted. This means that the displayed polarity of the voltage on the probe tip is reversed. For instance, if a square wave that goes from 0 to 5 volts is being displayed, pressing the **INV1** will cause the trace to display a waveform that goes from 0 to -5 volts. Note that the inverted trace will not be visible on the monitor until it is transferred from the scope to the PC by pressing **F3** or **F4**.

INV2   This has the same effect on channel 2 that **INV1** has on channel 1.

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LEVEL This is a set of rocker switches that allows adjusting the voltage threshold of the trigger if the trigger is not in the auto trigger mode.

MID This button is on the trapdoor menu that appears after pressing the **POS** button located in the **TRIGGER** control area. It only affects waveform display in the **STORE** mode. It sets the trigger position to **MID**, or MID-TRIGGER. In this position, each sweep is displayed with the trigger point positioned at the middle of the screen. (The TEK222 has 512 data points from the left edge to the right edge. The **MID** posi-tion is the 256th data point.) Note that after pressing this button, the **F3**, or **F4**, key must be pressed to observe the next trace.

MODE This button is in the **TRIGGER** control area. Pressing this button opens a trapdoor menu that allows selection of the trigger mode. The following modes are available: **NORM, AUTO LVL, AUTO BL**, and **SSEQ**. Refer to each of these button definitions for additional details.

MODEM This button is located just to the right of the **MODE** control area. Pressing this button opens a series of trapdoor menus that allow controlling the modem for starting and ending a communications session with a scope at a remote site.

NO This button is on a trapdoor menu that is reached after pressing the EXIT button if the scope is a 222PS. Pressing this button will stop CAT200 and return to DOS without turning off the 222PS.

NORM This button is on two different trapdoor menus. One is the trapdoor menu that appears after pressing the **MODE** button. In this case, it specifies that the **NORM** trigger mode be used. In this mode, no signal acquisition or trace display will occur until a trigger signal occurs. The trigger level must be set such that a trigger threshold will be reached by the trigger voltage. This mode is good for observing repetitive waveforms. If a simple DC voltage is to be measured, then this is a bad choice because the input voltage, being steady, will not cross the trigger threshold, no matter where the threshold is set. On the other hand, this mode may be useful for determining if there are pulses or glitches in what is supposed to be a steady DC voltage.

The other occurrence of the **NORM** button is on the trapdoor menu that appears after the **ACQ** button is pressed. This sets the scope into a *normal* acquisition mode. That is, one data sample is made for each sample interval. The result is a trace that repre-sents the real time activity of the input waveform, as is usually associated with an analog oscilloscope.

OFF This button is located on the trap door that appears whenever the **CH 1** or **CH 2** button is pressed. When this button is pressed, the specified channel will become inactive. No further traces for that channel will appear on the scope. If a trace for that channel was on the monitor, it will be deleted. The vertical sensitivity setting, displayed just below the waveform display area, will be removed.

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PATH: This is a window located on the trapdoor menu that appears whenever the **DISK** button is pressed. It allows specification of the directory where a file may be found. Refer to the definitions of **DISK** and **FILE:**.

POS This button is located in several control areas. In some cases it is associated with a rocker switch that controls the position of a waveform in the waveform display area. Note that the **POS** button in the lower left portion of the **VERTICAL** control area serves double duty. It selects the function of the rocker switches just to its right. If not pressed down, the rocker switches control the vertical position of the active channel. If pressed, the rocker switches control the variable volts per division of the active channel.

The **POS** button in the **TRIGGER** control area is used to select the position of the trigger point when the **STORE** mode is active. The available options are **PRE, MID,** and **POST**. Refer to these definitions for additional information.

POST This button is located on the trapdoor menu that appears after pressing the **POS** button. This button only affects waveforms while the **STORE** mode is active. Specifying **POST**, or *POST-TRIGGER*, makes most of the displayed waveform appear after the trigger point. (The TEK222 has 512 data points from the left edge to the right edge. In **POST** mode, only 64 of the 512 data points occur before the trigger point.) Thus, the trigger point is displayed near the left edge of the screen. Note that after pressing this button, the **F3**, or **F4**, key must be pressed to observe the next trace.

PRE This button is located on the trapdoor menu that appears after pressing the **POS** button. This button only affects waveforms while the **STORE** mode is active. Specifying **PRE**, or *PRE-TRIGGER*, makes most of the displayed waveform appear before the trigger point. (The TEK222 has 512 data points from the left edge to the right edge. In **PRE** mode, 448 of the 512 data points occur before the trigger point.) Thus, the trigger point is displayed near the right edge of the screen. Note that after pressing this button, the **F3**, or **F4**, key must be pressed to observe the next trace.

PRINT This button is located just to the right of the **MODE** control area. Pressing this button causes an image of the screen, and thus the waveforms and control settings, to be routed to the printer. CAT200 must be configured for the type of printer connected to the PC in order for the graphics representation to be reproduced properly.

PULSE This button appears on the trapdoor that appears after the **CFG** button is pressed. It sends the commands to the modem necessary to tell the modem to use pulse dialing, rather than tone dialing, when dialing a telephone number.

RCL This button is on the trapdoor menu that appears after pressing the **FRONT PANEL SETUP** button. It is used to recall a previously saved setup.

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RO OFF This button is on the trapdoor menu that appears after pressing the **DISPL** button. *RO OFF* is an acronym for *Read Out Off*. Pressing this button will cause all read out information displayed on the scope to disappear. To restore this information, this button must be pressed again. Since CAT200 does not display any readout information in the waveform display area, this button has no effect on the PC screen.

SAVE This button is on the trapdoor menu that appears after pressing the **FRONT PANEL SETUP** button. It is used to save the current front panel setup. This setup can be stored either in one of the four scope memories set aside for this purpose, or on disk in the PC.

SEC/DIV This thumbwheel switch icon is located in the **HORIZONTAL** control area. It is used to set the time per division on the scope. The time per division is the length of time it takes the scope trace to move from one major vertical division line to another. For instance, if the time per division is set to 500mS per division, and a square wave makes an entire cycle in two divisions, then the time per cycle is 2 divisions times 500mS per division, or 1 second. Thus, the square wave has a frequency of 1 hertz. Moving the pointer to this area enables this function. Pressing the left mouse button, or the + key on the PC keyboard, increases the seconds per division, while pressing the right mouse button, or the - key, decreases the seconds per division.

SHOW This button is located in the **WAVEFORMS** control area. This button is used to select which waveform(s) is displayed on the waveform display area of the monitor. Up to 6 waveforms can be displayed simultaneously: channel 1, channel 2, or auxiliary waveforms A through D. The selection is made via a trapdoor menu that appears when **SHOW** is pressed. Note that this is not a real time selection for channel 1 and channel 2. In order to get the actual waveform for either of these channels from the scope, you must subsequently press **F3** or **F4**.

SRC This button is located in the **TRIGGER** control area. It is used to select the source of the trigger voltage. The button opens a trapdoor menu with the following selections: **VERT, CH1, CH2,** and **EXT**.

SSEQ This button is on the trapdoor menu that appears when the **MODE** button is pressed. It sets the scope to the *single sequence*, or *single trace* mode. In this mode, when a trigger event occurs, only a single trace is made. In the non-store display mode the data captured on the screen remains until the **INIT** button is pressed. In the store mode, the data will remain on the screen until the next enabled trigger event. Pressing **INIT** also enables the trigger for another trace. At that point, another trigger will not occur until the trigger voltage passes through the trigger threshold.

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STORE   This button is located in the **MODE** control section.   It is used to toggle the display mode between store and non-store.   Store mode is indicated on the display by turning the letters "STORE" in the button to yellow.   In store mode, a waveform is retained on the face of the scope between triggers.   Thus, if in the normal or single sweep mode, a trace will remain on the screen until the next trigger.   In the non-store mode, arming the trigger for the next trace causes the old trace to be cleared from the display.

TONE   This button is located on the trapdoor menu that appears after pressing the **CFG** button.   This button causes the commands to be sent to the modem to make it use tone dialing rather than pulse dialing.

TRACK   This button is on the trapdoor menu that appears when the **CURS** button is pressed.   It is used to cause both delta cursors to move together.   This is handy to check the exact time, or voltage, of one waveform against another.   Refer to the definition of **CURS** elsewhere.

UNCAL   This button is located on the trapdoor that appears when a white **CH 1** or **CH 2** button is pressed.   It is used to indicate the status of the vertical channel sensitivity. The vertical sensitivity can be set to a specific value, or it can be varied in ranges between these values.   If the **POS** button is pressed, the variable gain mode is entered. Whenever the gain is then adjusted, the center of the **UNCAL** button will turn yellow. If the center is yellow, the vertical channel can be returned to the set sensitivity if the button is pressed, making the center turn black.   (The uncalibrated mode cannot be entered by pressing the **UNCAL** button, nor can you reestablish the calibrated mode by simply unpressing the **VAR** button.)

VAR   This one of the two labels that appears in the pushbutton located just to the left of the rocker switches located just below the **VERTICAL** control area.   If this button is pushed in, then the label turns yellow and displays **VAR**.   In this mode the sensitivity of the vertical channel can be changed.   This is handy if a particular waveform needs to occupy a specific number of vertical divisions.   When the **VAR** button is activated, the actual voltage of the displayed waveform can no longer be determined by its height on the display.   This state is indicated by the vertical sensitivity display below the waveform display area changing.   The setting will now have a > sign included in it. This mode can be disabled by adjusting the voltage back to full scale with the rocker switches or by pressing the **UNCAL** button.

VERT   This button is located on the trapdoor menu that appears when the **SRC** button is pressed.   It is used to select the lowest numbered, displayed channel, as the source of the trigger voltage.   Normally, this is channel 1.   If channel 1 is turned off, then the trigger voltage will be supplied by channel 2.   Other sources of trigger voltage are available, see the definition of **SRC**.

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VOICE   This button is on a trapdoor menu that is reached after pressing the **MODEM** button. If the telephone is off hook when the **MODEM** button is pressed, or if it is taken off hook after the **MODEM** button is pressed (by pressing the **GO OFF HOOK** button), this menu is presented. It is used to switch the telephone line from the modem to the telephone that is connected to it. This allows for the exchange of voice communication with a person who may be operating the scope at a remote site. This is handy for instructing the remote operator as to which circuit points should be connected to which probe. Note that not all modems support this mode and other arrangements may need to be made if it is necessary to use a single telephone line for voice and data communications. Moreover, the TEK222 has no similar capability. Thus, the remote modem will have to be manually manipulated to switch between voice and data.

VOLTS/DIV   This thumbwheel switch icon is located in the **VERTICAL** control area. It allows for setting the vertical sensitivity of the active vertical channel. Since there is only one such control, it is shared by channel 1 and channel 2. Whichever was the last channel selected by pressing the **CH 1** or **CH 2** switch will be the channel affected by the **VOLTS/DIV** control. To use this control, simply move the pointer into its area. Then, pressing the left mouse button, or the - key on the PC keyboard, will increase the sensitivity. This is the same as making the numbers in the window smaller. Conversely, pressing the right mouse button, or + key, will decrease the sensitivity. This makes the numbers in the window larger.

The vertical sensitivity setting specifies how many volts it takes to make the scope trace move one major horizontal division line. For instance, if one is viewing a square wave that goes from 0 to 5 volts, and the scope vertical sensitivity is set to 5 volts per division, then the waveform will be one major division tall. That is, if the 0 volt line, or the base line, is set at the center horizontal line on the scope, then the top of the square wave will be on the next highest major division.

WAVEFORMS   This button opens a sequence of trapdoor menus that allows the movement of waveform data from various locations to other locations. Refer to the definitions of **INSTR, DISPL**, and **DISK**.

x10   This button is located in the **HORIZONTAL** control area. Its purpose is to expand the displayed waveform. It does this by artificially multiplying the time base. That is, if the timebase is set to 500mS per division, activating the **x10** button will make the trace appear as if the time base were set to 50mS per division. This action does not actually change the sampling rate, it simply expands the display of data in the scope by making the distance between data points on the screen ten times as far. (That is, the normal display has 512 data points from the left edge to the right edge. The **x10** display has only 51 data points.) When the **x10** button is pressed, the label will change from black to yellow. Pressing it again will disable the times 10 mode and turn the label from yellow to black.

XY This button is located on the trapdoor menu that appears when the **DISPL** button is pressed. It is used to select the **X-Y** display mode. Normally, an oscilloscope is used to present a graphical representation of a voltage as if it were graphed with respect to time. That is, the Y axis is the magnitude of the voltage, and the X axis is time. In the *X-Y* mode, the Y axis is still voltage, but the X axis is also voltage. The source of the X axis voltage signal is channel 1, and the source of the Y axis voltage signal is channel 2.
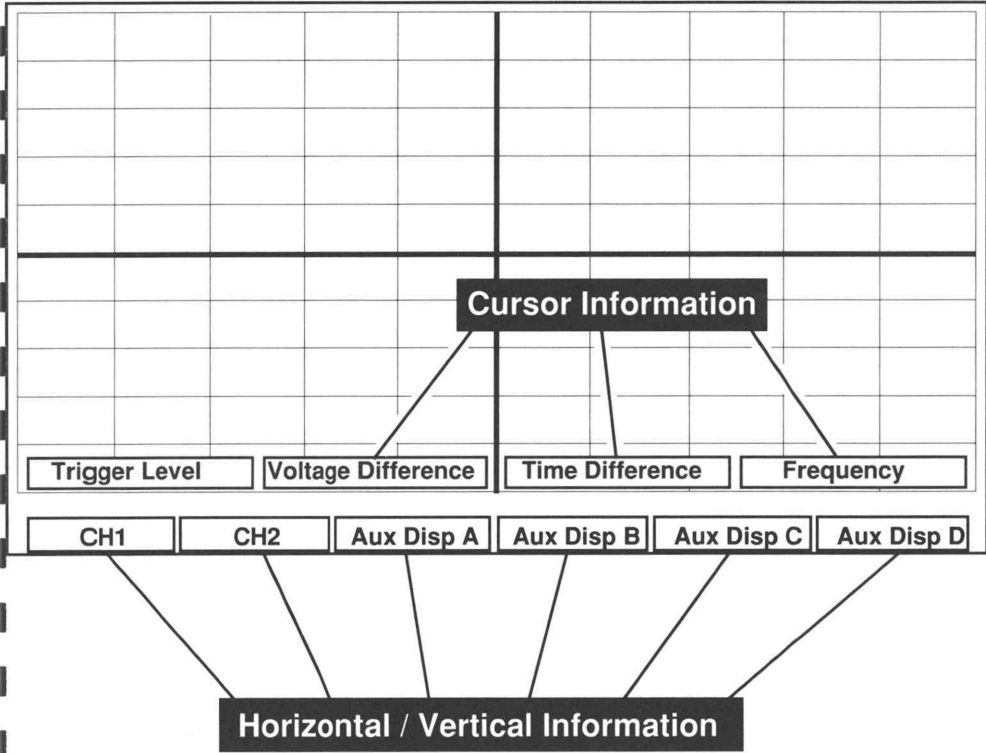
Note that the positioning of the display is different in the X-Y mode. Both vertical and horizontal position are set with the vertical position control. To set the vertical position, you must first select channel 2 with the **CH 2** button. Then using the vertical position rocker switches, the trace can be moved vertically. Likewise, you must select and use channel 1 for horizontal positioning.

Note further that no trace can be seen on the monitor unless it is requested from the scope. In this case, there is no channel 2 signal, and the actual waveform can be retrieved by pressing **F3** or **F4**.

YES This button is on a trapdoor menu that is reached after pressing the EXIT button if the scope is a 222PS. Pressing this button turns off the 222PS and then will stop CAT200 and return to DOS.

DATA DISPLAY AREAS

| | Cursor Information |

| Trigger Level | Voltage Difference | Time Difference | Frequency |

| CH1 | CH2 | Aux Disp A | Aux Disp B | Aux Disp C | Aux Disp D |

Horizontal / Vertical Information

6.0 ERROR MESSAGES

CAT200 communicates status, progress, and errors to the operator through messages. These messages appear just below the waveform display area in the space normally occupied by the channel and **AUX** memory parameters. Some of these messages will disappear by themselves, others may require the pressing of the **CLEAR** button to make them vanish. The following is a list of error messages the operator may see. All these messages will be presented with a red background.

6.1 ERROR MESSAGE LIST

6.11 INITIALIZATION ERRORS

- CANNOT ESTABLISH COMMUNICATION WITH TEK222 SCOPE - This message indicates that CAT200 cannot communicate with the scope. Make sure that the scope and CAT200 (and any intervening modems) are all at the same baud rate. You might also check that the scope is connected to the configured serial port. CAT200 and the TEK222 must be connected to serial ports, not parallel ports.

- COM PORT XX NOT FOUND - The internal CAT200 device driver cannot perform I/O with the specified serial port hardware. Go through the configuration process in Section 3 again, or, if using a modem, check the serial port by pressing **MODEM** followed by **CFG**.

- MEMORY ALLOCATION ERROR IN CREATING BUFFERS FOR RS-232 I/O OPERATIONS - This is most likely caused by insufficient memory in your computer. There is only one solution: Get more memory. There are two basic ways to get more memory. First, buy and install more, or, second, run fewer concurrent processes. In this case, a concurrent process is a *terminate and stay resident* program (a TSR), such as *SIDEKICK*. These programs are usually started at system boot time by instructions in the *autoexec*.bat file. Try removing these instructions from autoexec.bat.

- SERIAL DEVICE NOT IDENTIFIED AS TEK222 SCOPE - CAT200 found a serial device connected to the configured port, but it is not responding as expected from a scope. This often happens if a modem is connected to the configured port when CAT200 is started.

6.12 ILLEGAL OPERATION ERRORS

- CANNOT READ WAVEFORMS IN X10 MODE - The **x10** mode replots the digital data that has already been collected. In this mode, new data from the scope cannot be received.

- NO WAVEFORM STORED AT PC DISPLAY SOURCE - You have attempted to specify a source for waveform data to transfer that has no data in it.

- TEK222 HARDWARE NOT ENABLED - Many functions of CAT200 require that it be in communication with the TEK222. If communication was broken for some reason, such as pressing **F6**, try pressing **F5** to reestablish communication.

- THIS CHANNEL CANNOT BE READ - This message is most likely the result of attempting to read data from a vertical channel that is turned off. Press the button for that channel, **CH 1** or **CH 2**, until the trapdoor menu opens. At that time, the channel can be turned on by selecting any coupling option except **OFF**.

6.13 COMMUNICATION ERRORS

All the errors in this section are most likely caused by one of two circumstances: First, CAT200 is not in communication with the scope; or, second, there is significant noise on the serial data line (such as caused by a loose wire or connection). In many cases, noise on communications lines is temporary. Thus, whenever one of these errors is encountered, the command that resulted in the error should be tried again.

- ERROR SETTING UP AFTER RECALLING DISK FILE SETUP
- ERROR IN DATA FORMAT
- ERROR READING TRIGGER STATUS
- ERROR RECEIVING DATA FROM THE SCOPE
- ERROR SENDING DATA TO THE SCOPE
- RS-232 OPERATION TIMED OUT
- THE WAVEFORM READ FROM SCOPE MEMORY IS NOT VALID DATA

6.14 FILE OPERATION ERRORS

- ERROR READING FROM FILE - This is most likely caused by specifying a file that does not have the expected type of data in it. For instance, you have given some file an extension of **.WFM**, and it does not contain waveform data. A subsequent attempt to read it as waveform data could cause an error. This could also occur if the specified file does not exist. This error could also indicate some type of hardware error in your computer.

- ERROR WRITING TO FILE - This is probably an indication of an operating system error. Most likely the disk you are attempting to write to is full.

- NO FILES MATCH IN THIS DIRECTORY - After you pushed the **DIR** button, CAT200 was unable to find any **.WFM** or **.SET** files in the specified directory.

- UNABLE TO OPEN FILE - This is most likely caused by specifying a file, or path, that does not exist.

6.15 MODEM ERRORS

In many of the errors below, the problem is likely to be a configuration error. These are such things as an incorrect serial port or baud rate. They could also be caused by a bad cable or loose connection.

70 Error Message Summary

- CANNOT INITIALIZE MODEM - CAT200 sent a sequence of setup commands to the modem and no, or an incorrect, response was received verifying the setup was successful. This could be caused by a baud rate incompatibility or a non-Hayes compatible modem.

- ERROR IN MODEM I/O OPERATION - See notes above.

- LINE IS BUSY - The modem returned a line busy status after dialing the specified number.

- MODEM NOT READY ERROR - An attempt was made to communicate with the modem, however it did not respond properly.

- NO ANSWER - The modem returned a no answer status after dialing the specified number.

- NO CARRIER SIGNAL DETECTED - The specified number was dialed and it answered, however, no modem signal was returned to the CAT200 modem.

- NO DIAL NUMBER HAS BEEN ENTERED - You have pressed the *DIAL* button without specifying a number to dial.

- NO DIAL TONE DETECTED - When the modem went off hook in preparation to dialing, it did not detect a dial tone.

- NO RESPONSE FROM THE MODEM - An attempt was made to communicate with the modem, however it did not respond.

6.16 PRINTER ERRORS

- NO PRINTER WAS SPECIFIED IN SETUP PROGRAM - In order to print waveform data, a printer must be specified during the configuration procedure described in Section 3.

- UNABLE TO OPEN PRINTER PORT - When a printer is specified, the port it is connected to must also be specified (LPT1, LPT2, COM1, etc.). If this hardware is not present, or the printer is not connected to it, this error may result.

DB25 (FEMALE) PC END		DB9 (MALE) SCOPE END
8	CD	1
3	RX	2
2	TX	3
20	DTR	4
7	GND	5
6	DSR	6
4	RTS	7
5	CTS	8
22	RI	9
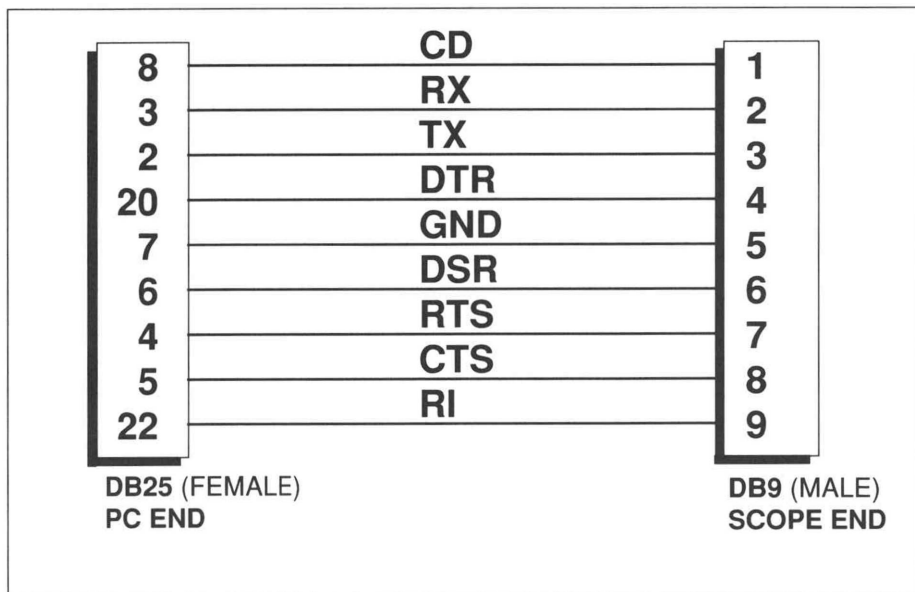
Figure A-1. RS 232 CABLE PC TO TEK 222

DB9 (FEMALE) PC END		DB9 (MALE) SCOPE END
1	CD	1
2	RX	2
3	TX	3
4	DTR	4
5	GND	5
6	DSR	6
7	RTS	7
8	CTS	8
9	RI	9
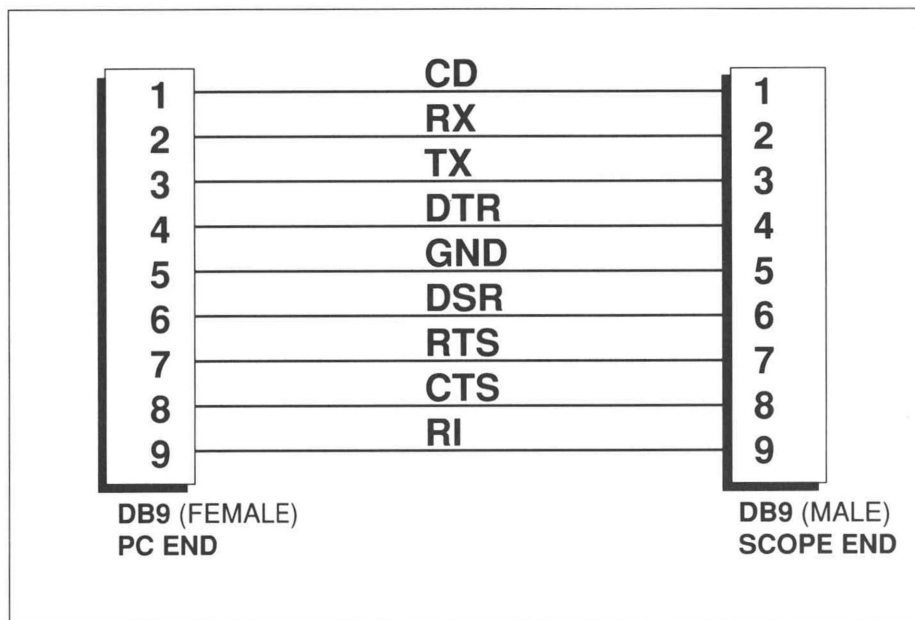
Figure A-2. RS232 CABLE PC/AT TO TEK 222

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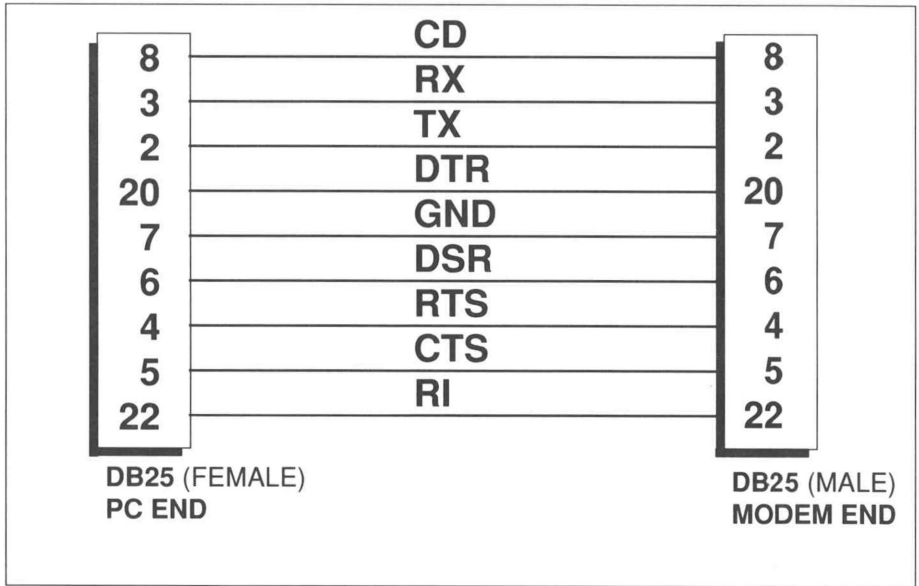
Figure A-3. RS 232 CABLE PC TO MODEM

DB25 (FEMALE) PC END		DB25 (MALE) MODEM END
8	CD	8
3	RX	3
2	TX	2
20	DTR	20
7	GND	7
6	DSR	6
4	RTS	4
5	CTS	5
22	RI	22
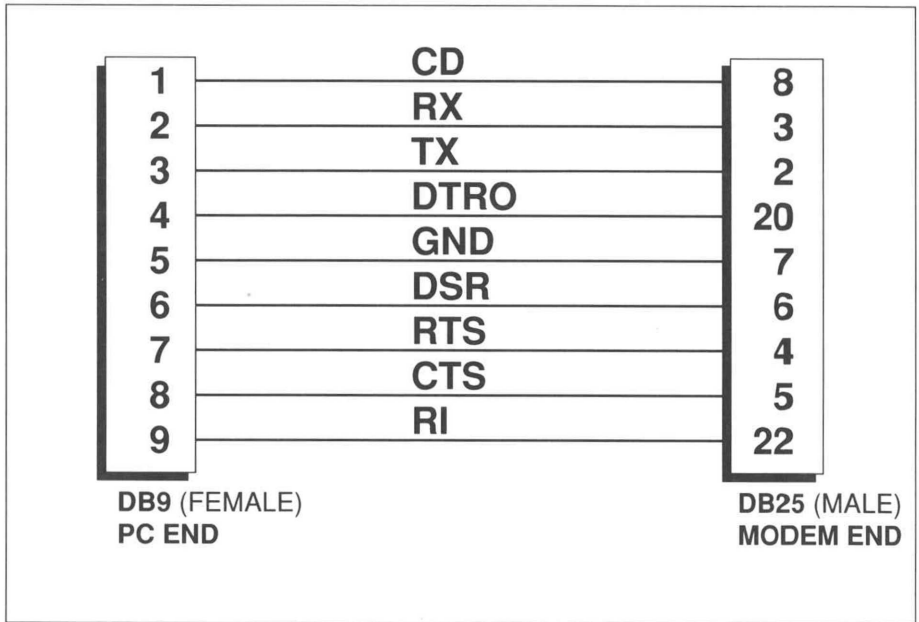
Figure A-4. RS232 CABLE PC/AT TO MODEM

| DB9 (FEMALE) PC END		DB25 (MALE) MODEM END
1	CD	8
2	RX	3
3	TX	2
4	DTRO	20
5	GND	7
6	DSR	6
7	RTS	4
8	CTS	5
9	RI	22

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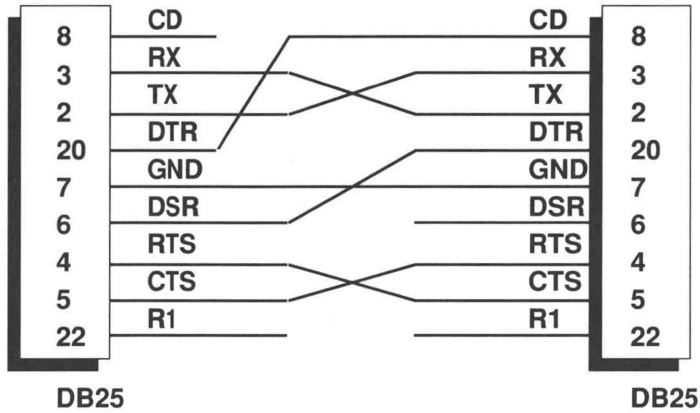
Note: This non-standard adapter must be constructed with a 25-pin RS232 jumper box.

Figure A5. Null modem adapter RS232 cable to modem; may be used with Tek 222, but is required to support 222PS remote power up. (Most common null modem adapters will work with Tek 222.)
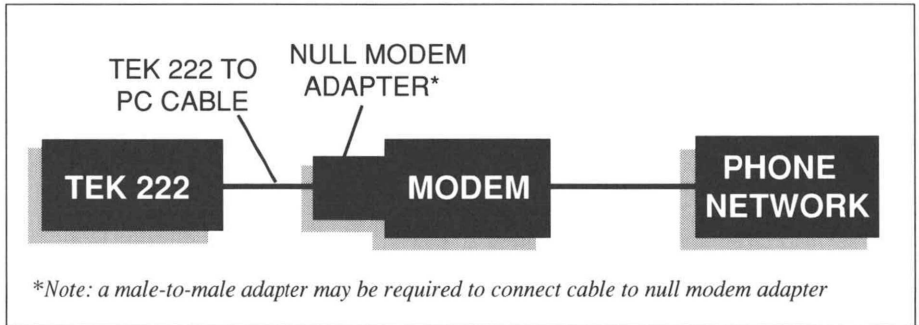
*Note: a male-to-male adapter may be required to connect cable to null modem adapter
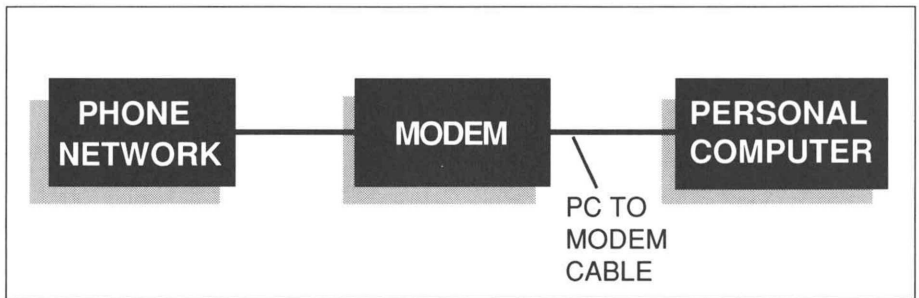
Figure A-6A. Tek 222 to modem connection.

Figure A-6B. PC to modem connection

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B.0. INTRODUCTION

This appendix will describe the signals that are used in the examples in the first portion of this book. The goal in choosing these particular signals was that they represent waveforms that should be familiar to many owners of the TEK222, and that they should be readily available.

The following sections will discuss where to find, or how to generate, the sample signals. Each discussion will include additional explanatory information that may be helpful in future observations using the TEK222 and CAT200.

B.1 I/O REQUEST - IOR

EXPLANATION OF SIGNAL

IOR- is an acronym for I/O *Request*. The - sign indicates that the active state of this signal is low, or a logic 0. The IOR- signal is present in virtually all microprocessor based systems. It is used by the hardware to determine that the microprocessor is transferring information between itself and a peripheral device, rather than between itself and memory. In some cases, the I/O signal is divided into two functions. The IOR- function indicates a read, or transfer of information from the peripheral to the microprocessor. The other will be IOW-, which indicates a write, or a transfer from the microprocessor to the peripheral device. Any CP/M or MS-DOS computer will have a microprocessor in it that has a signal like IOR-. To display this signal on an oscilloscope, the probe should be connected to pin 20 of a Z80, or pin 12 of an 8288.

Note that in the 8088 based circuit, the IOR- signal comes from the 8288, not the 8088. This is because the identity of the bus cycle is used to determine if a memory or I/O transfer is being done, and it is the function of the 8288 to identify the bus cycle to all the hardware external to the 8088. This identification is made by interpreting the state of the S0-, S1-, and S2, lines. In addition, the address lines from the 8088 are latched externally to allow enough current to drive all the components external to the 8088. Also, the lower 8 address lines are multiplexed with the data bus, so the external latch is required to make sure the hardware gets the proper address information.

GENERATION OF SIGNAL

The IOR- signal is normally high and goes low during a microprocessor bus cycle where an I/O transfer occurs. In order to cause an I/O data transfer, the microprocessor must execute an I/O instruction. After boot up, most desktop microcomputers will execute I/O instructions while the system prompt is displayed, and thus make a good source for this signal. However, the samples in this book were generated with a program specifically designed for demonstration purposes. If you wish to use this program, follow these instructions: first for MS-DOS computers:

1. Boot your computer. Make sure that the debug program is in the path that will be searched.

2. Type in **DEBUG<cr>**.

3. At the - prompt type in the following:

```
A<cr>
CLI<cr>
IN AL,40<cr>
JMP 101<cr>
```

4. Then press **<cr>**.

5. Now enter **G<cr>**.

The trace on pin 12 of the 8288 should resemble the following illustration (Note, when done with this program, it will be necessary to reset the computer to stop the loop.):
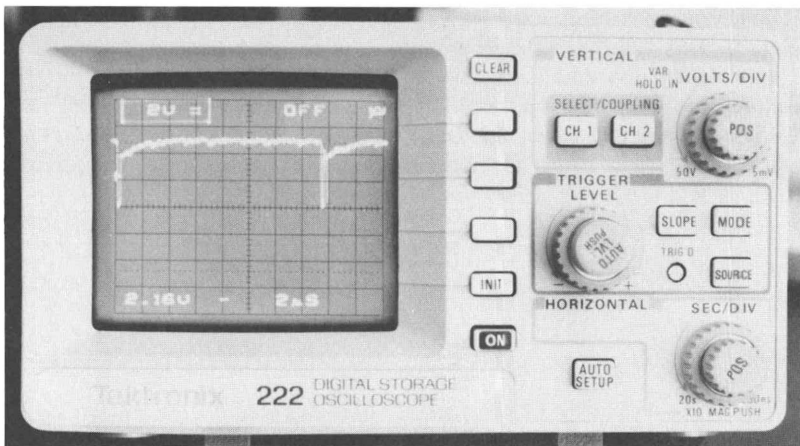

Figure B-1. IOR- signal in a PC compatible computer.

For a Z80 based computer, using CP/M-80, a similar program can be used to generate a continuous stream of IOR- signals. If you have DDT, SID, ZSID, or some similar debugger you can enter and run the following program:

1. Boot your computer. Make sure that the debug program is on the logged drive and current user area.

2. Type in **DDT<cr>** (or the name of whatever debugger you are using).

3. At the - prompt type in the following:

```
A<cr>
IN A,(0)<cr>
JR 100<cr>
```

4. Then press **<cr>**.

5. Now enter **G100<cr>**.

This simple program simply gets the data at I/O address 0 and puts it into the A register. It then branches back to the input instruction. If you have a 4mhz Z80 computer, then pin 20 should resemble the following illustration while that program is running (Note: when you are finished with the program, you will need to reset the computer to stop the loop.):
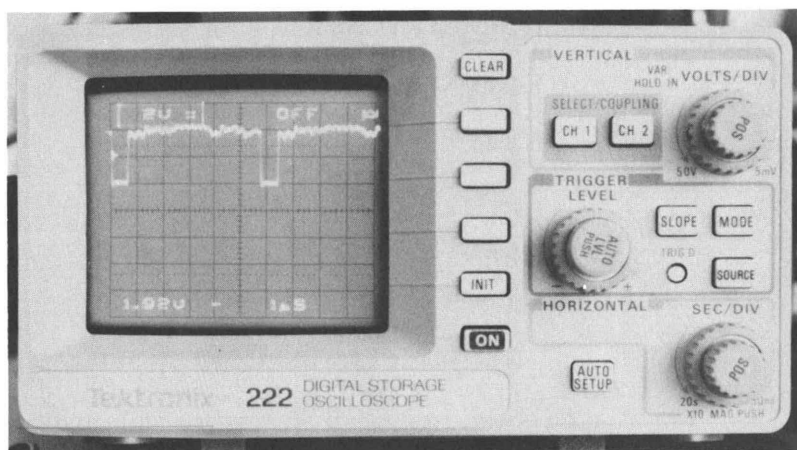
Figure B-2. Z80 IORQ- Signal in a 4 MHz CPM computer.

Note: If your scope does not display this exact waveform, you may need to adjust the horizontal time per division and vertical volts per division to obtain an image similar to this depiction.

USES OF SIGNAL

For trouble shooting purposes, the IOR- signal is handy to use as a trigger source. Its presence indicates that the microprocessor is at least capable of fetching instructions from memory and executing I/O transfer instructions.

Further, by using IOR- as a trigger source, the other vertical channel can be used to investigate the state of logic in the microcomputer. Typical signals to investigate are the chip selects of the peripheral devices, the data bus, and the address bus. The illustrations below detail typical microprocessor circuits and the locations of the IOR- signal.
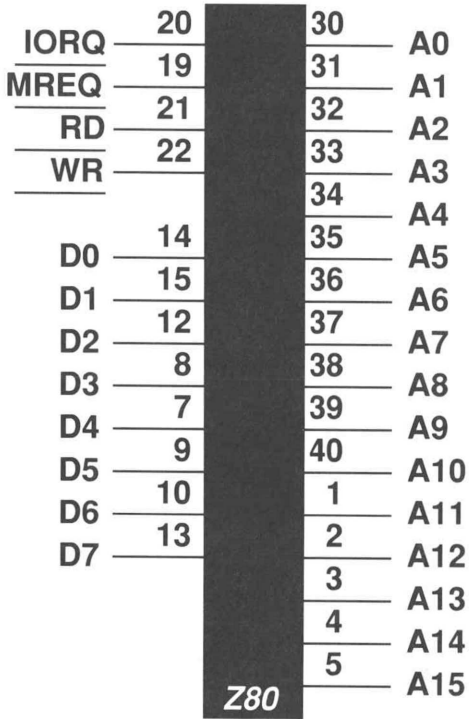
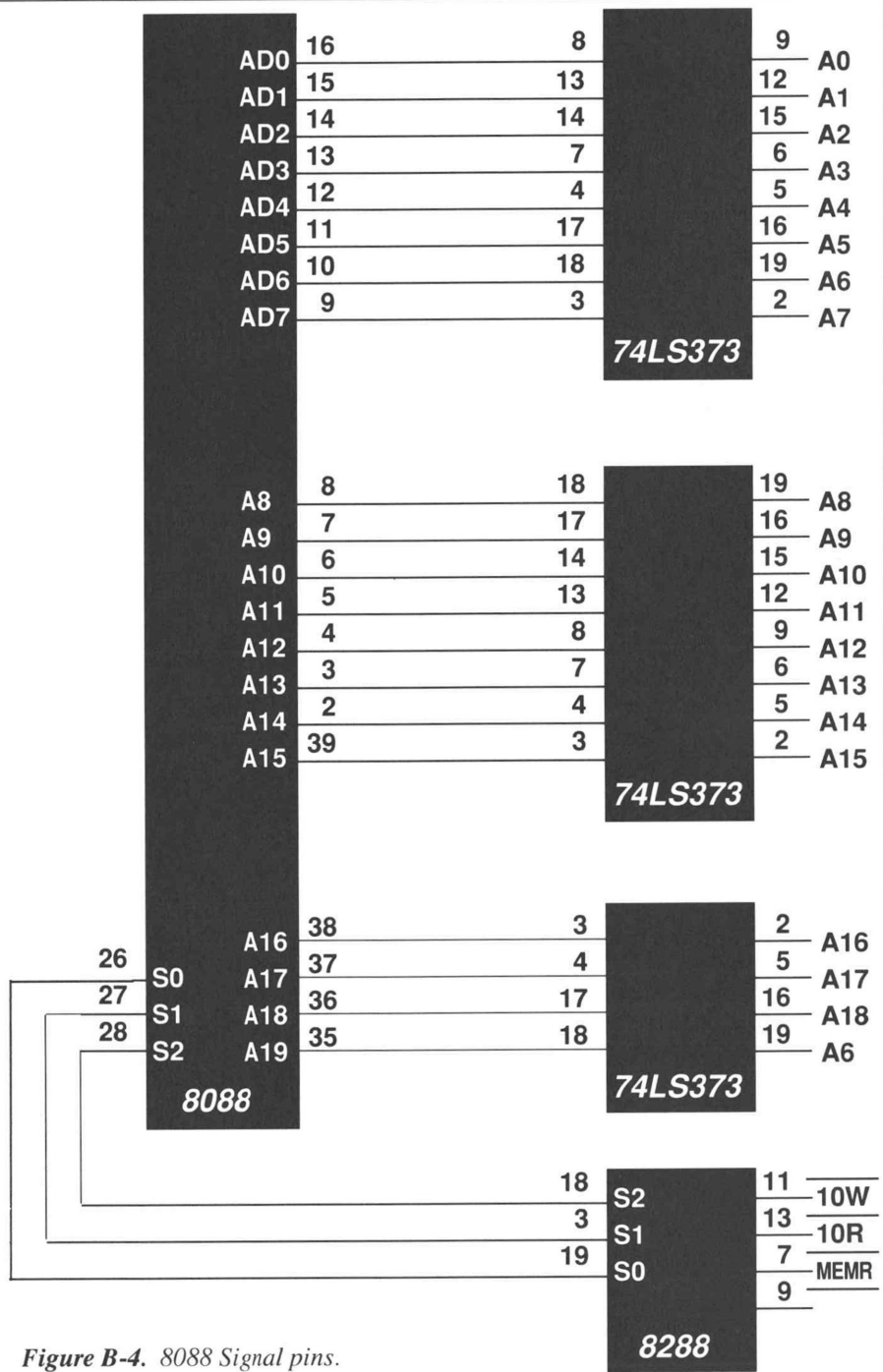|		
IORQ	20	30 — A0
MREQ	19	31 — A1
RD	21	32 — A2
WR	22	33 — A3
		34 — A4
D0	14	35 — A5
D1	15	36 — A6
D2	12	37 — A7
D3	8	38 — A8
D4	7	39 — A9
D5	9	40 — A10
D6	10	1 — A11
D7	13	2 — A12
		3 — A13
		4 — A14
	Z80	5 — A15

Figure B-3. Z80 Signal pins.

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Figure B-4. *8088 Signal pins.*

B.2 ASYNCHRONOUS DATA - *RS232/RS422*

EXPLANATION OF SIGNAL

This is the commonly used RS232 serial data signal found on many PCs. RS422 is a variant of this signal that uses different voltage levels, but the same data formats.

GENERATION OF SIGNAL

This section will discuss the generation of serial data. If you are using a PC, you will probably not have access to RS422 signal levels. However, the discussion still applies. RS422 is the same as RS232 from a data point of view, the only difference is the voltage levels involved. RS232 requires that the signal voltage swing above and below 0 volts, while RS422 uses two wires to send the same data. One wire will have a signal that goes from 0 to a positive voltage, and the other wire has the inverse, that is, the voltage goes from a positive voltage to 0. These signals are thus mirror images of each other, and this is known as a differential signal.

The simplest way to generate one of these signals is to cause a PC to print something to the serial port. However, unless the serial port has the proper handshake signals on it MS-DOS will not send any data. The next easiest process is to write a simple BASIC program to send a continuous stream of data out the serial port. Such a program is illustrated below:

```
1 REM THIS PROGRAM IS DESIGNED TO GENERATE A STREAM
2 REM OF DATA OUT THE SERIAL PORT FOR USE WITH THE
3 REM CAT200 INSTRUCTION MANUAL.
10 OPEN "COM1:2400,N,8,1,CS,DS,CD" AS # 1
20 A$=""
30 A$=INKEY$
40 IF A$<>"" THEN 90
50 PRINT #1,"U";
60 GOTO 20
90 END
```

Figure B-5.

USES OF SIGNAL

Generally, one observes serial data to determine whether or not it is there, and to determine its baud rate. Most of the problems with serial data transmission in PCs is related to getting the proper hand shake signals and getting the data pins connected correctly. A secondary problem often arises when a serial data stream from some external device exists, but the baud rate is unknown. An oscilloscope is often handy in solving these problems. It offers a good way to monitor the data while simultaneously checking the hand shake lines. It offers a good way to determine if two serial transmit lines have been connected together. And it offers a good way to measure the bit time, and thus determine the baud rate, of unknown data.

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The figures below give the pertinent pinouts of serial data connectors for PC/XTs, PC/ATs, and your TEK222.

CONNECTOR ON TEK222 OSCILLOSCOPE	
DB9 (FEMALE)	SIGNAL
1	CD (OUT)
2	TX (OUT)
3	RX (IN)
4	DTR (IN)
5	GND
6	DSR (OUT)
7	RTS (IN)
8	CTS (OUT)
9	RI (OUT)

Figure B-6.

CONNECTOR ON PC/XT	
DB25 (MALE)	SIGNAL
2	TX (OUT)
3	RX (IN)
4	RTS (OUT)
5	CTS (IN)
6	DSR (IN)
7	GND
8	CD (IN)
20	DTR (OUT)
22	RI (IN)

Figure B-7.

CONNECTOR ON PC/AT	
DB9 (MALE)	SIGNAL
1	CD (IN)
2	RX (IN)
3	TX (OUT)
4	DTR (OUT)
5	GND
6	DSR (IN)
7	RTS (OUT)
8	CTS (IN)
9	RI (IN)

Figure B-8.

B.3 A SIMPLE PULSE

EXPLANATION OF SIGNAL

This signal is described here because the circuit that generates it can be constructed from components found on most work benches. It is a simple repeating pulse.

GENERATION OF SIGNAL

The waveform is generated by a 555 timer IC. It is wired as an astable oscillator. This means that once started, it will continue to run, changing its output from high to low and back, and so on. The resistor and capacitor values connected to pins 6, 7, and 8, determine the frequency of oscillation. The values in the diagram should result in a frequency of about 11.2 kilohertz.

Figure B-9. *555 Oscillator*
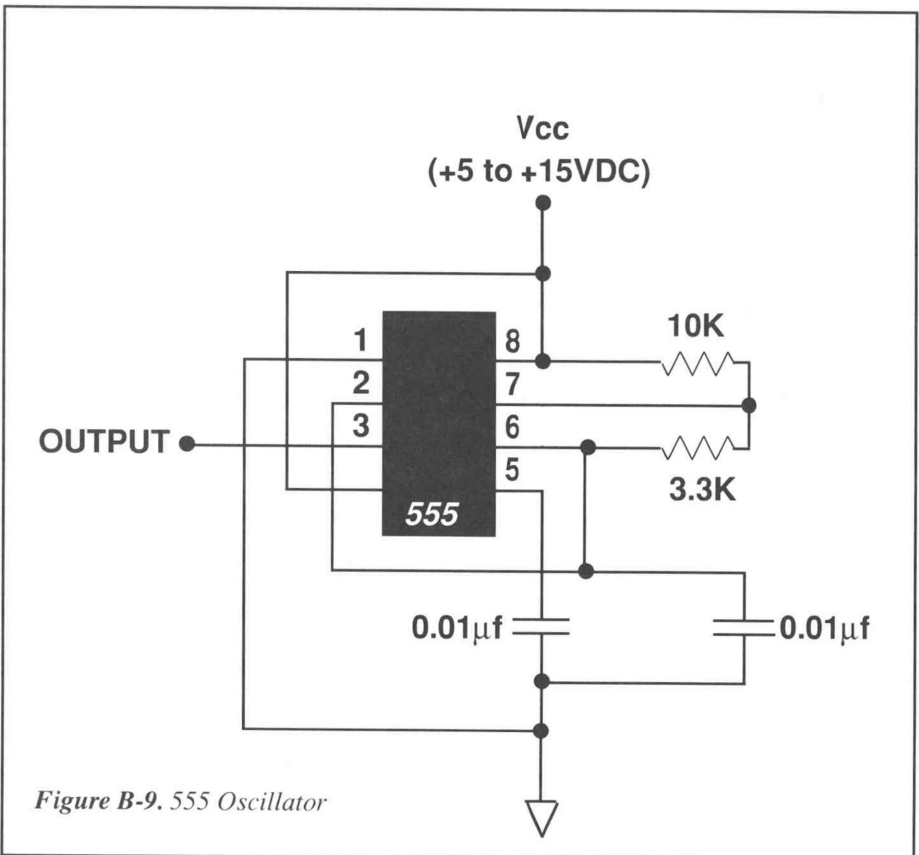
USES OF SIGNAL

The voltage generated here is simply for use in experimenting with your TEK222 and CAT200. It is a good clean pulse and can be used instead of any of the above signals for many of the experiments in the book. The figures below illustrate the circuit for generating the pulses, and how it should look on the CAT200 waveform display area.
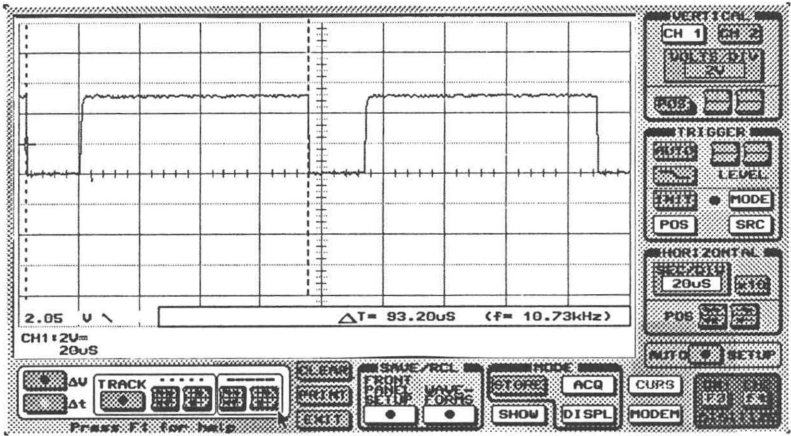
Figure B-10. *555 Signal with Δt facility measuring frequency of oscillation.*

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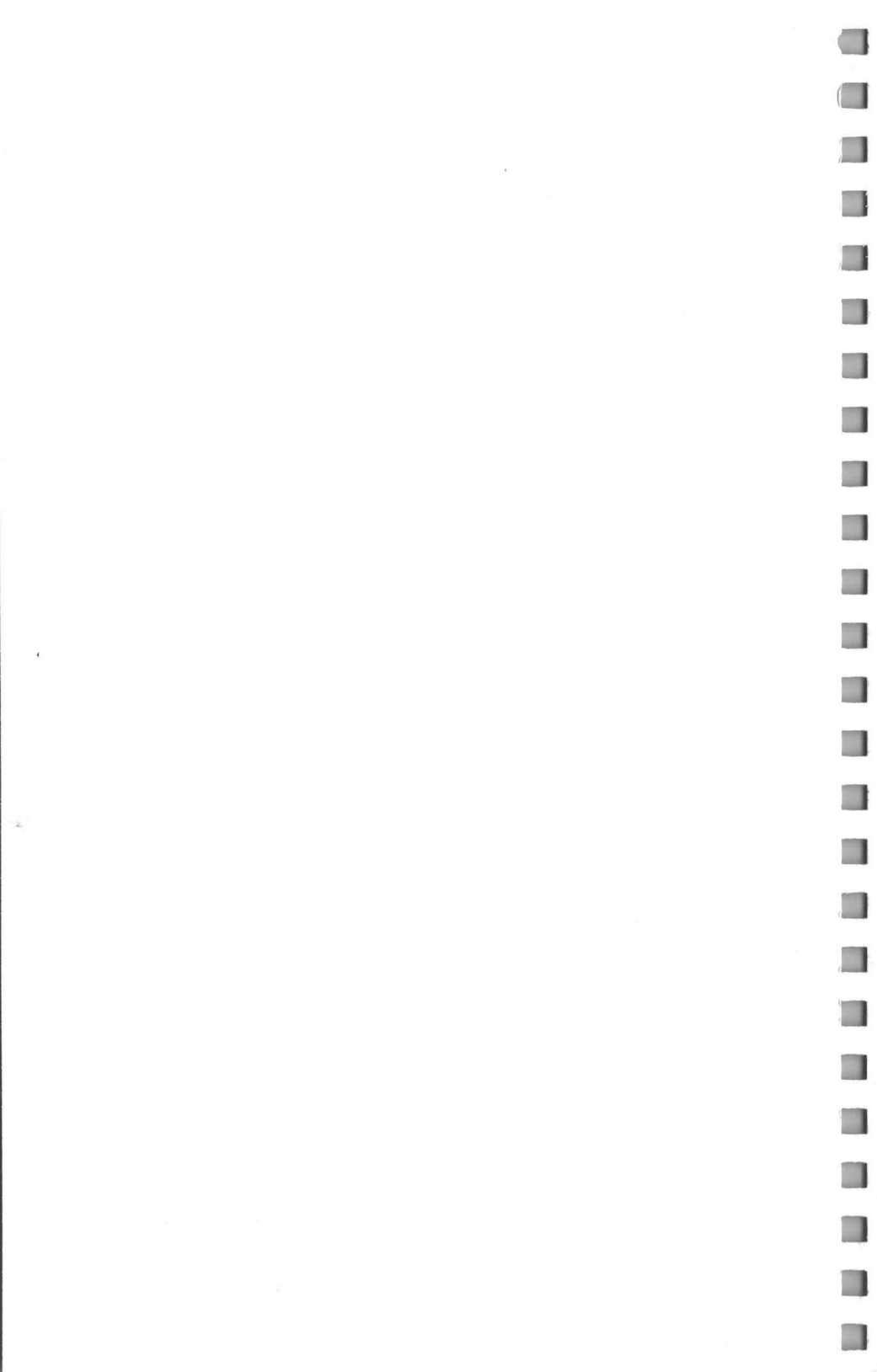
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Attn: Warranty Repairworkmanship, Customer may terminate the license for the software product and return the software product and any associated materials to Tektronix for credit or refund. This Warranty shall not apply to any software product that has been modified or altered by Customer. Tektronix shall not be obligated to furnish servi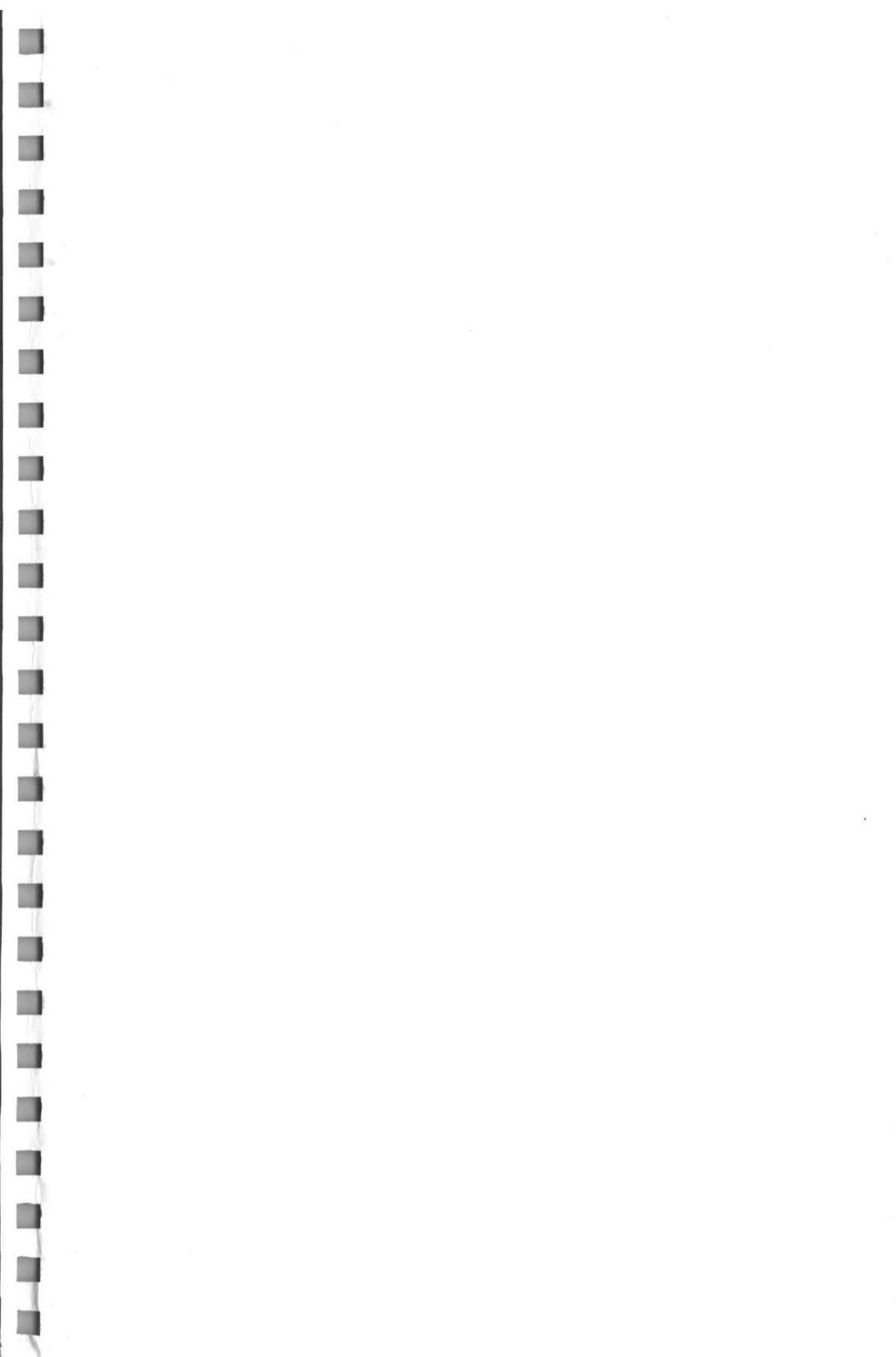ce under this warranty with respect to any software.