Tektronix®
COMMITTED TO EXCELLENCE

7D02
LOGIC ANALYZER
OPERATORS

INSTRUCTION MANUAL

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INSTRUCTION MANUAL

Tektronix, Inc.
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FOREWORD

The 7D02 Operators Reference Manual is divided into seven sections and several appendices.

Section 1—The Learning Guide. This section teaches the new 7D02 user enough of the instrument's operation to allow him to perform useful logic analysis after a minimal amount of learning time.

Section 2—General Description. This section is an overview of the 7D02. It contains a hardware functional description, a brief description of the keyboard, and describes the screen display formats.

Section 3—Modes Of Operation. This section discusses each of the five modes of operation of the 7D02, the keys that are permitted in each mode, how each mode is entered and exited, and the various types of data displays. It also provides further information on screen display formats.

Section 4—Programming The 7D02. This section explains each component that can be included in a 7D02 program, data qualification, and the difference between conflicting and contradictory commands. It discusses and illustrates the problem solving abilities of the 7D02, and provides some information on problem solving techniques.

Section 5—Key Encyclopedia. This section is a detailed discussion of the functions and limitations of each front panel key.

Section 6—The Timing Option. This section presents the information a user needs to have if his 7D02 has the Timing Option installed. This section discusses the timing option displays and illustrates some of the more frequently used tests which utilize the 7D02's unique timing data acquisition capabilities.

Section 7—Rules Of Operation And Special Notes. This section describes the run-time operation of the 7D02 (when it is "running", what stops data acquisition, what messages appear), use of the Timing Option "link" bit, the rules of operation for the External Trigger Out, and clock qualification.

The appendices contain the less frequently used operational reference information such as the glossary, shipping information, mainframe controls, system and diagnostic messages, and a foldout containing a diagram of the front panel.

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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS

In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

In This Manual

This symbol indicates where applicable cautionary or other information is to be found.

As Marked on Equipment

DANGER — High voltage.

Protective ground (earth) terminal.

ATTENTION — refer to manual.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Use only a power cord that is in good condition.

For detailed information on power cords and connectors, see maintenance section.

Refer cord and connector changes to qualified service personnel.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

The 7D02 Logic Analyzer.

Section 1
7D02 LEARNING GUIDE

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7D02 LEARNING GUIDE

INTRODUCTION

This section tells how to install the 7D02 and describes its use in the most frequently encountered logic/data analyses. These analyses are performed by using the 10 front panel programming keys to create a program. Most of these keys are explained through the use of examples found in the Learning Guide. Each example illustrates a type of logic analysis that you may want to perform.

INSTALLING AND REMOVING THE 7D02

The 7D02 Logic Analyzer is designed to occupy a three-compartment segment of any TEKTRONIX non-storage 7000-Series Oscilloscope mainframe.

Due to the unique requirements of the 7D02, best results will be obtained with 7603 or 7704A mainframes. Use of storage mainframes is not recommended as these CRTs are optimized for storage applications only.

Installing the 7D02 in the Mainframe

To install the 7D02 in the mainframe, first make sure that there is no power to the mainframe. Then align the 7D02 tracks with the rails of a vertical and left horizontal plug-in compartment. Gently slide the 7D02 into the mainframe; then push firmly to lock the 7D02 front panel flush with the mainframe. See Figure 1-1.

NOTE

Some rack-mounted mainframes have vertically-mounted rods in the front of the plug-in compartments; these rods interfere with the installation of the 7D02. Detach these rods by removing the mounting screws at each end before installing the 7D02.

Selecting the 7000-Series Mainframe Controls

Each 7000-Series mainframe has a number of front panel controls which may need to be adjusted if the 7D02 is to operate properly. See Appendix C for a list of adjustments required for your mainframe. In general, for 7000-Series mainframes:

1. Select horizontal mode as the rightmost mainframe compartment occupied by the 7D02;
2. Select vertical mode as the leftmost mainframe compartment occupied by the 7D02;
3. Adjust intensity and focus (some mainframes have separate intensity controls for each horizontal compartment); and
4. If the 7D02 is installed in a storage mainframe, the mainframe should be set to the non-store mode.

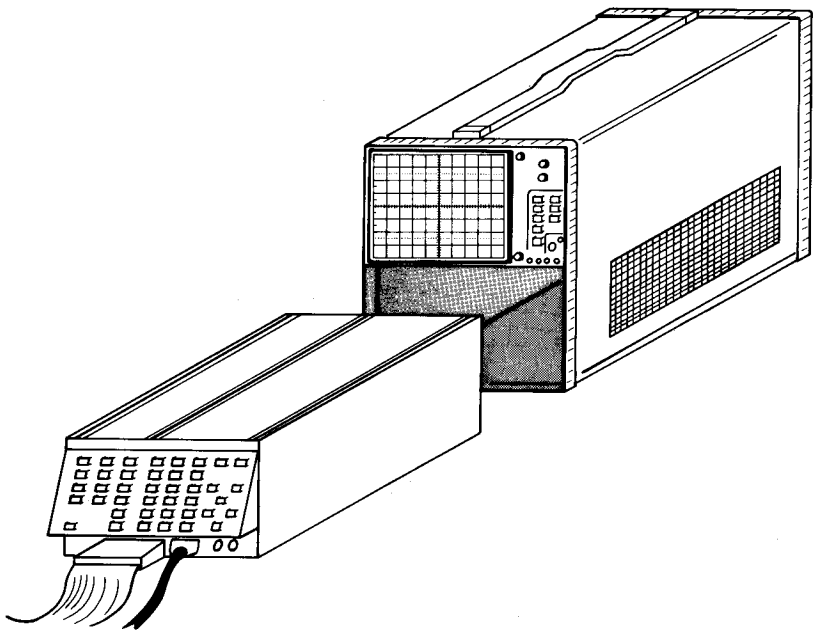

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Figure 1-1. Installing the 7D02 in a 7000-series oscilloscope.

Removing the 7D02 From the Mainframe

To remove the 7D02, first make sure that there is no power to the mainframe. Disconnect all probes and connectors from the front panel. Then grasp the release latch at the bottom center of the 7D02 and pull the 7D02 out of the mainframe. See Figure 1-2.

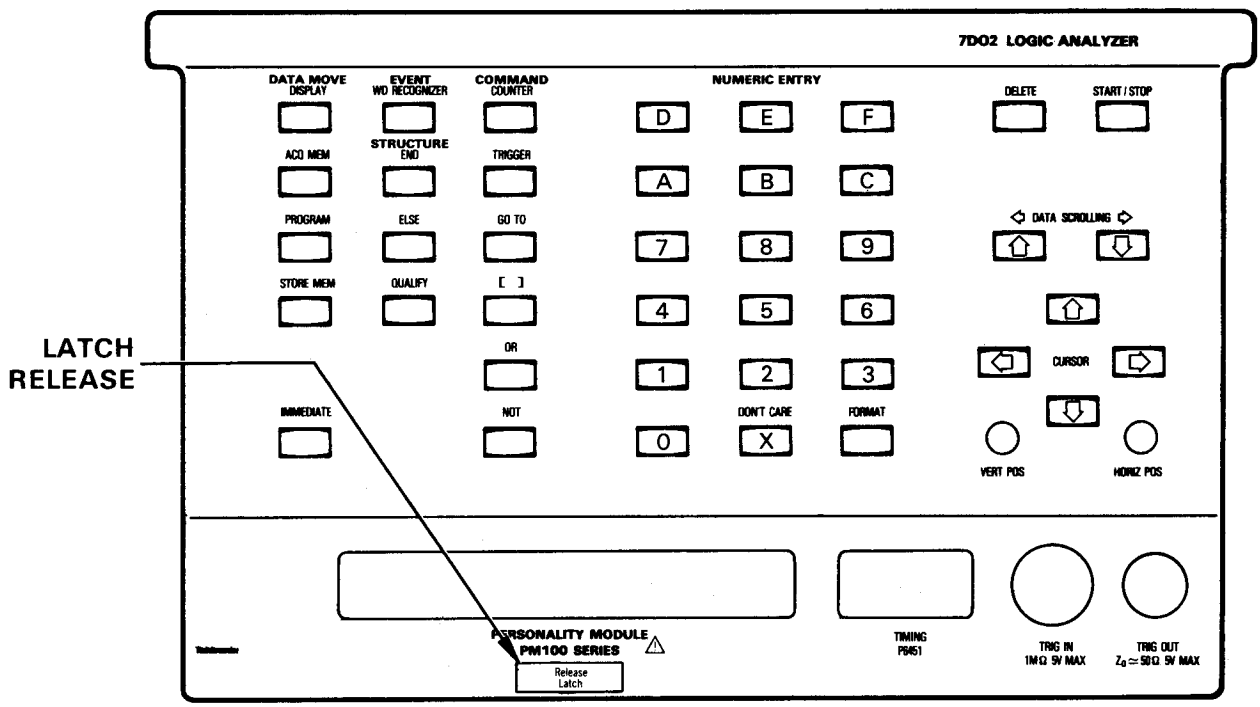

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Figure 1-2. Location of the 7D02 release latch.

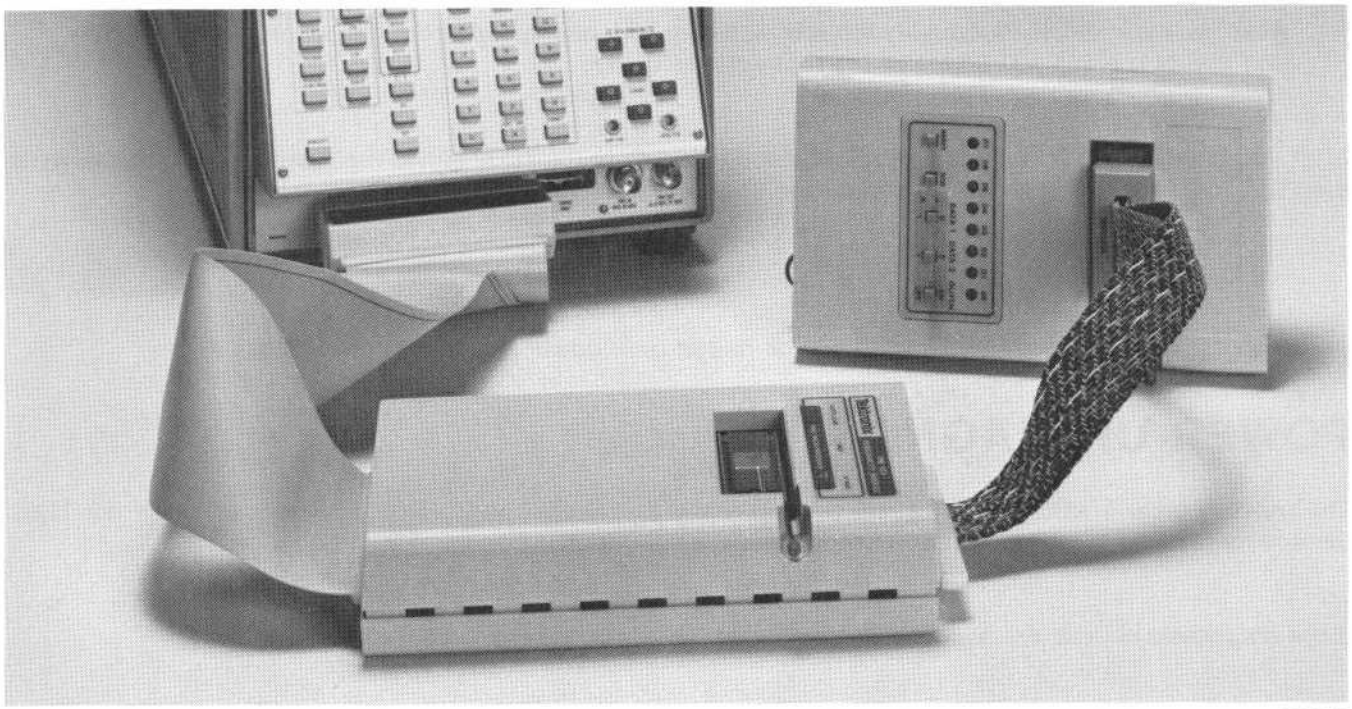
HOW TO CONNECT A 7D02 TO A SYSTEM-UNDER-TEST

How To Connect A Personality Module To A Logic Analyzer

CAUTION

Always turn the mainframe power switch OFF before connecting or disconnecting the Personality Module.

Turn the mainframe power switch to the OFF position. Insert the plug of the Personality Module into the designated socket on the front of the 7D02 Logic Analyzer. Make sure that the label is facing up. The shape of the plug makes it difficult to insert it incorrectly. See Figure 1-3.



2918-4

Figure 1-3. PM-102 Personality Module plug and prototype socket.

How To Connect A Personality Module To A System-Under-Test

CAUTION

1. *Always turn off power to the system-under-test (s.u.t.) before connecting or disconnecting the Personality Module Plug.*
2. *Before handling the microprocessor in your test circuit, ground yourself to the 7D02 mainframe and to the system-under-test to discharge any static electricity you may have built up.*

Whether you are using the General Purpose Personality Module or a microprocessor-specific Personality Module, initial connections of the 7D02 to the system-under-test (s.u.t.) should be made according to the directions in the manual for that Personality Module.

Do not remove the processor when using the General Purpose Personality Module or when using a low-profile DIP-clip.

Turn off the power to the system-under-test. Ground yourself to discharge static electricity. Remove the microprocessor from your test circuit and insert it into the Zero Insertion Force (ZIF) socket on the Personality Module. Be sure to insert it correctly, with pin 1 of your microprocessor aligned with the pin 1 indicator on the ZIF socket.

Now insert the Personality Module plug into the socket on the system-under-test. Again, make sure to insert the plug correctly.

CAUTION

Read the appropriate Personality Module Instruction Manual for specific instructions on installation and use of the PM-100 Series probe that you are using.

After you have finished connecting the Personality Module to the 7D02 and to the system-under-test, turn on the 7D02 mainframe power switch and power up the system-under-test.

NOTE

Most microprocessors will be halted until power is applied to the 7D02.

POWER-UP DIAGNOSTICS

The power-up verification routines run automatically each time the 7D02 is powered up. (See the 7D02 Service manual for more information on power-up diagnostics.)

If the diagnostic checks are successful, the display shown in Figure 1-4 should appear.

NOTES

1. *The Expansion Option and the Timing Option checks will not be listed on the screen unless the appropriate hardware is installed.*
2. *It is normal for the display to flash check patterns during power-up diagnostics.*

If one or more of the power-up verification checks fails, the diagnostics program assumes that you will want to run additional diagnostic checks. To run them, you must press the X key. (See Figure 1-5.) The requirement that you must press the X key allows you to note which checks failed, and then to decide which check you want to run first. These additional diagnostic checks are described in Appendix D.

If neither of the above displays appears, or if the 7D02 screen appears unreadable in any way, check your 7000-Series mainframe control settings against those given for it in Appendix C.

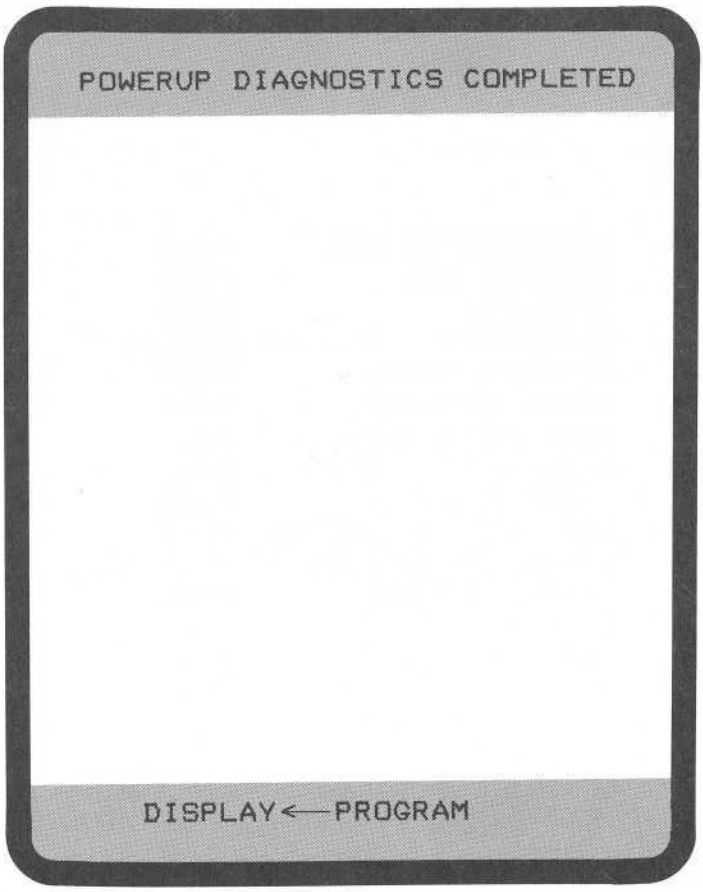


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Figure 1-4. Successful power-up verification display.

PROGRAM STRUCTURE

A 7D02 program consists of one or more TESTS (up to a total of four) plus, optionally, one block Qualification clause which may be placed before or after any TEST. Basically, a TEST consists of:

TEST #
IF event clause
THEN DO command clause
OR IF event clause
THEN DO command clause } Optional, may occur any number of times.
ELSE command clause (optional)
END TEST #

An event clause describes a condition which at any instant is either TRUE or FALSE. It may be either word recognition on the s.u.t. bus, or a counter reaching a previously specified value, or a negation of either of those events, or a combination of any or all of the preceding.

A command clause specifies what action is to be taken by the 7D02 when an event occurs.

An ELSE clause specifies what action is to be taken if none of the previously defined events in the TEST are found.

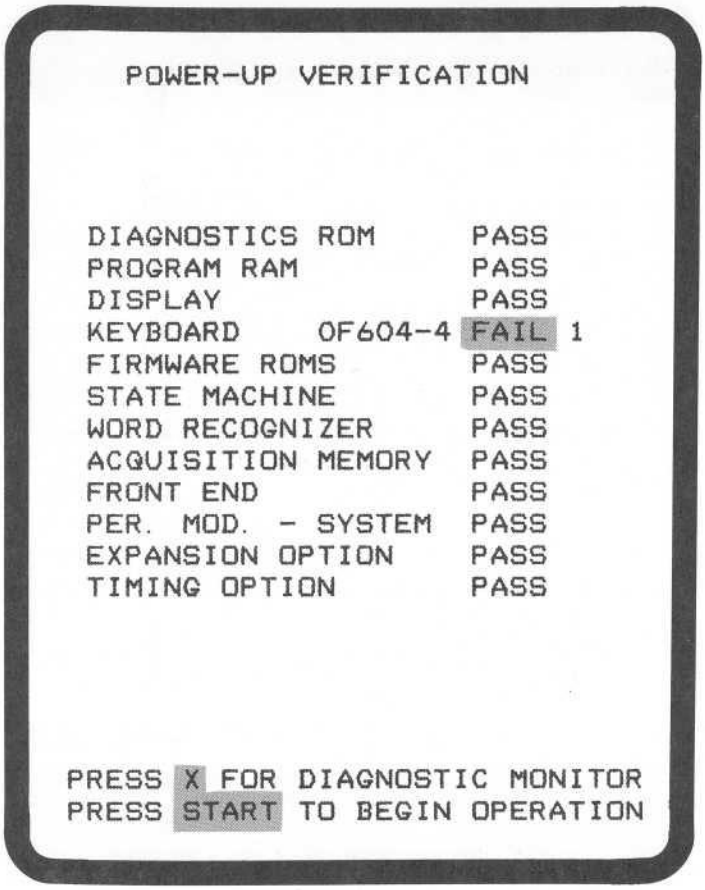

Figure 1-5. Typical power-up verification display with a failed component.

Only one TEST in the program is active at a time. Pressing the START key is an implied GOTO TEST #1. Other TESTS are executed as the result of a GOTO from some other TEST, or as the result of an IMMEDIATE GOTO <test #> command.

All conditions, i.e., events, in a single test are looked for simultaneously.

DISPLAY SCREEN CHARACTERISTICS

The 7D02's screen is divided into three parts. (See Figure 1-6.) At the top of the screen is a two-line band of inverse video, called the Status Area, in which statistics, error, prompting, run-time, and diagnostic messages appear.

There is a similar band of inverse video at the bottom of the screen, called the Immediate mode area, which is used to display Immediate Mode commands. (Immediate Mode commands will be explained later.)

The central portion of the screen is used to display the test program, the FORMAT mode display, or the acquired data or STORE MEM contents. If the program display exceeds about 20 lines (depending on the size of the Immediate Mode area), not all of the program is visible at once. The program is scrolled automatically as the cursor is moved about in it.

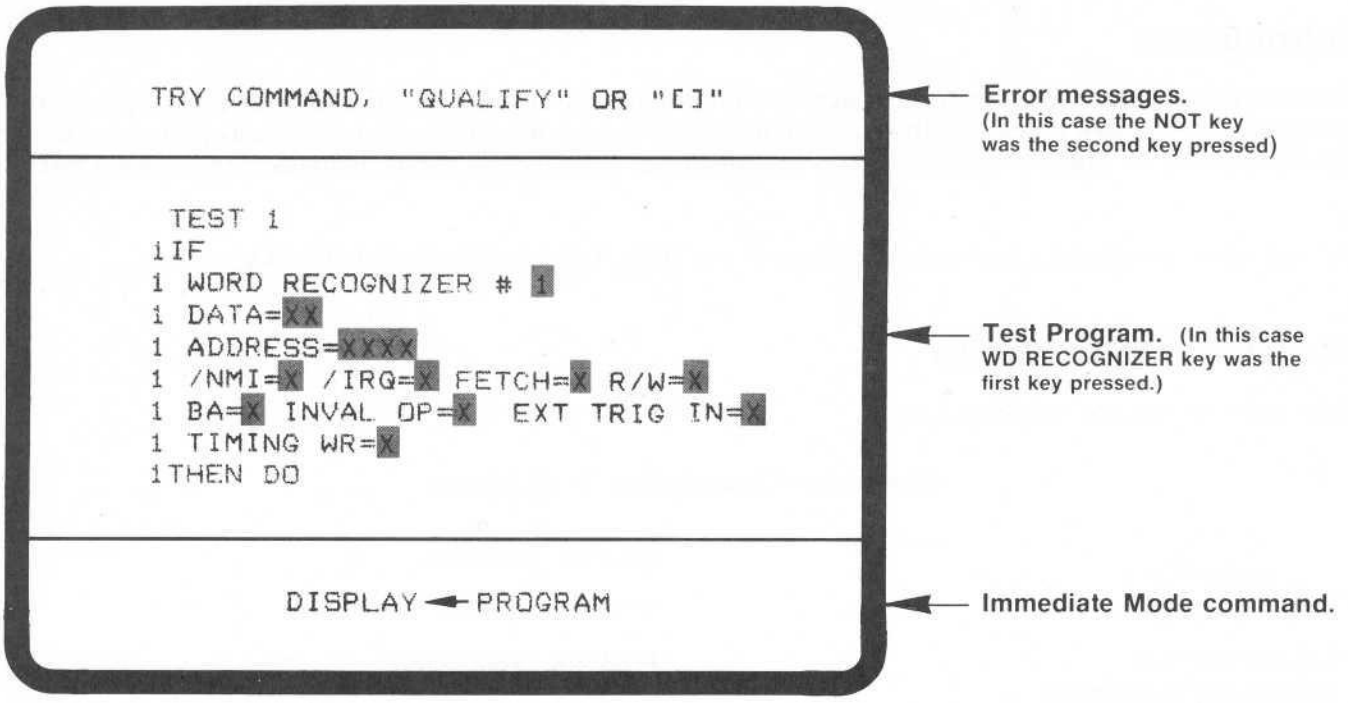

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Figure 1-6. 7D02 screen display components.

A blinking cursor also appears on the screen. This cursor can be positioned on a character which can be changed, at the end of the program, or in the Immediate Mode area during data displays and IMMEDIATE command sequences. In order to change a program entry, first move the cursor to the selected field using the cursor movement keys. If the field is a "Menu", then the possible choices for it will be listed on the lines following the cursor position. The desired choice can be selected with the numeric keypad. If it is a numeric field (such as a Word Recognizer value), then the desired value can be entered.

NOTES

1. *In this manual, the word "field" is to denote any numeric value or menu selection displayed in inverse video.*
2. *Throughout this manual all examples, unless otherwise specified, are 6800/6802 displays. Refer to the Instruction manual for your Personality Module for a detailed description of the mnemonics displayed.*
3. *To decrease the visibility of a CRT's graticule lines, use of a green screen filter is recommended. In addition, a very low level of graticule illumination can significantly decrease their visibility in the central area of the display.*

7D02 PROGRAMMING EXAMPLES

Introduction

Because of the versatility of the 7D02's keystroke programming, it is impossible to describe every type of logic analysis measurement procedure that you can make. However, some of the most commonly performed tasks are discussed here. Many of these tasks can be repeated or combined to create complex measurement tests.

For reference purposes, a fold-out illustration of the 7D02 front panel is included as Appendix I.

Format of the Examples

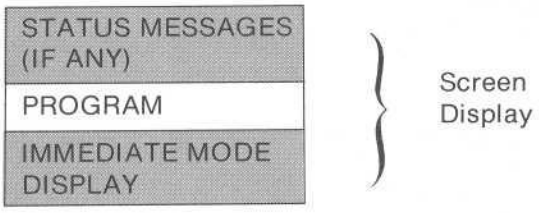
Each example has the following format:

Example—Descriptive Task Name

Program Definition

What this program does.

Program Displays



Program Explanation

A list of keys pressed, with a description of what occurs on the screen, and other helpful information explaining what this program does.

Used in the manual to indicate that information on the screen has changed. The test is a repeat of the previous screen display with the changes included.

Run-time Displays (Optional)

Explanation of Run-time Displays

An explanation of visible changes in the error/status display area.

Data Displays (Optional)

Data Display Explanations (Optional)

An explanation of what the data acquisition display could look like.

@

Assumptions Made in the Examples

In the following examples, several assumptions are made:

1. A 6802 Personality Module is used,
2. The Timing Option is installed, and
3. All user-selectable radices are hexadecimal.

Documentation Conventions Used in the Manual

The following documentation conventions are used:

1.  — Represents an inverse video field;
2.  — Represents a key to be pressed.

Word Recognizer Examples

Example 1—Simple Word Recognition—User-defined Data and Address Words

Program Definition

This program is a simple word recognition. It looks at the bus transactions surrounding data F6.

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=F6
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1
```

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Program Explanation

WD RECOGNIZER key is pressed. The 7D02 provides the first nine lines of the program.

Figure 1-7 explains some of the basic program display concepts.

The blinking cursor is positioned on the first digit of the DATA field.

You can now enter any hex digit to replace the X; i.e., DON'T CARE, characters. The DATA= field will accept two hexadecimal digits. In this example those digits (F6) define the value on the system data bus the 7D02 is to trigger on.

The next line, ADDRESS=, is used to specify the address that is to be recognized as it moves on the system-under-test address data bus. In this example it's all DON'T CARE digits, meaning that the address is to be ignored by this Word Recognizer. F6 is to be found regardless of its address.

The next two lines on the display contain six control line parameters (/NMI, /IRQ, FETCH, R/W, BA, INVAL OP) and the external trigger input (EXT TRIG IN). The control line parameters and screen display (/NMI, /IRQ, etc.) are Personality Module-dependent. Changing the DON'T CARE to a 0 or a 1 indicates that that control line is to be used as part of the event. In this example none of the control lines are used.

The presence or absence of the external signal (specified by EXT TRIG IN) is used in the same manner as the control lines.

The last parameter, TIMING WR, is only displayed if the Timing Option is installed in the 7D02. This parameter is discussed in Section 6.

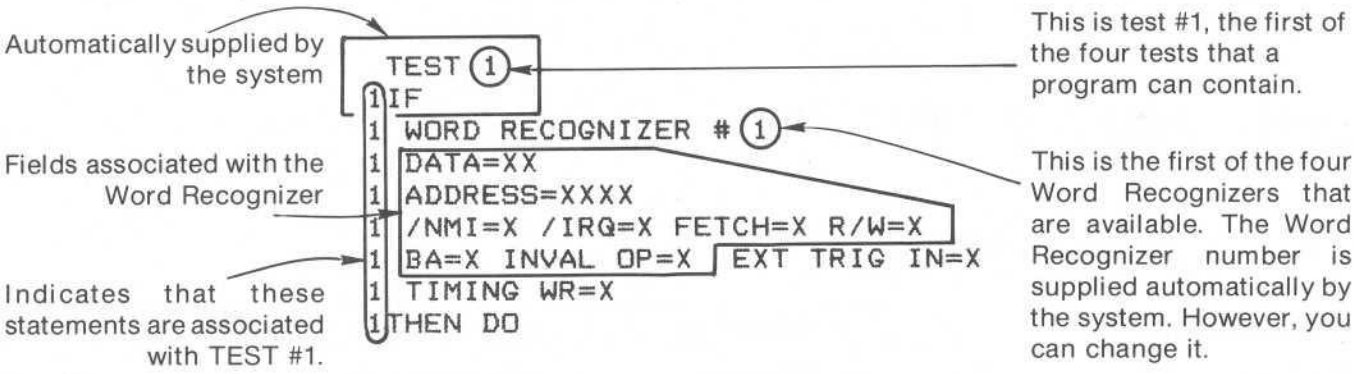
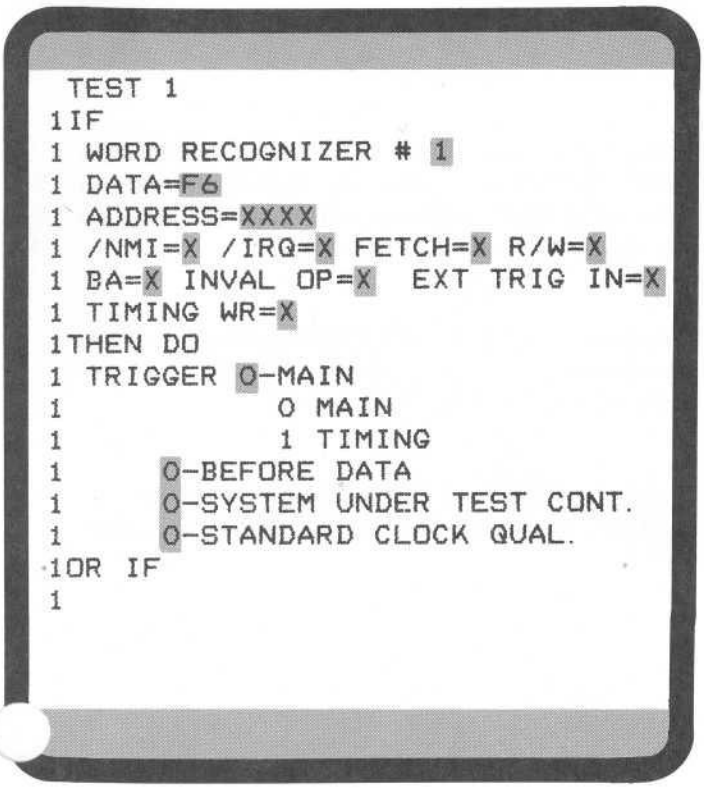


Figure 1-7. Program display concepts (a WORD RECOGNIZER key was pressed).



NOTE

All fields of the Word Recognizer definition are ANDed together. A field with a DON'T CARE in it is considered as always TRUE.

TRIGGER key is pressed. The 7D02 provides the next 7 lines of the program. The cursor is positioned at the 0-MAIN field in the new block of program lines; the choices you have available for that parameter are listed below 0-MAIN. You can now specify whether you want to trigger the main memory or the Timing Option memory. Main memory is the default value and is used here. Note that this choice will not appear if there is no Timing Option installed.

NOTE

A menu is expanded only when the blinking cursor is placed on the inverse video portion of a field; in this case, 0-MAIN.

When you position the cursor in the next field (0-BEFORE DATA), the choices for 0-MAIN disappear and the choices for 0-BEFORE DATA are presented.

You can now specify the position of the trigger in relation to the acquired data. See Figure 1-8 for a graphic explanation of the four trigger locations.

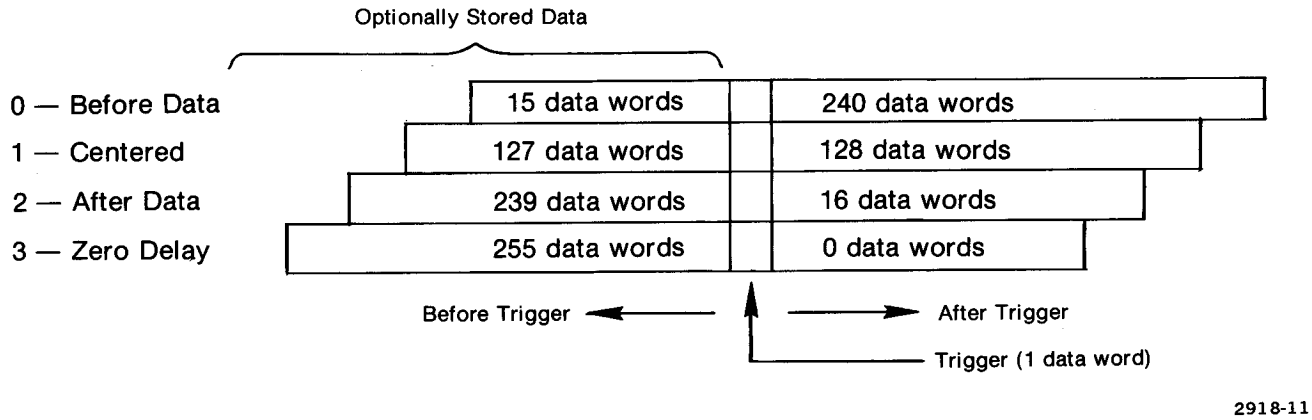


Figure 1-8. Trigger locations with respect to acquired data.

Moving the cursor again places it at 0-SYSTEM UNDER TEST CONT. Here you specify the action you want the 7D02 to take once it has found the data field, triggered, and acquired data.

0-SYSTEM UNDER TEST CONT indicates that the microprocessor of the system-under-test is to continue running after data is acquired.

1-SYSTEM UNDER TEST HALT would indicate that the microprocessor is to halt after data is acquired.

@

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=F6
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 TRIGGER 0-MAIN
1      0-BEFORE DATA
1      0-SYSTEM UNDER TEST CONT.
1      0-STANDARD CLOCK QUAL.
 END TEST 1
```

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Moving the cursor to the next menu item allows you to specify the clock to be used for determining clock cycles. 0-STANDARD CLOCK QUAL says that the clock is to be defined by the Personality Module; i.e., the microprocessor. 1-USER CLOCK QUAL says that you want to define the clock using the microprocessor clock as the basic signal source. (Proper disassembly is NOT guaranteed in this case.)

This example uses the default values 0-SYSTEM UNDER TEST CONT and 0-STANDARD CLOCK QUAL. (The parameters for 1-USER CLOCK QUAL will be discussed in another section of the manual.

NOTE

The cursor can be positioned at any field at any time. That is, fields can be specified or changed in any sequence.

END key is pressed. The 7D02 replaces:

1 OR IF

1

with the END statement for the TEST.

START key is pressed. The 7D02 begins monitoring for the data value.

Run-time Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=F6
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 TRIGGER 0-MAIN
1     0-BEFORE DATA
1     0-SYSTEM UNDER TEST CONT.
1     0-STANDARD CLOCK QUAL.
 END TEST 1

        DISPLAY<—PROGRAM
```

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```
RUNNING
                    PRESENT TEST=1
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=F6
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 TRIGGER 0-MAIN
1     0-BEFORE DATA
1     0-SYSTEM UNDER TEST CONT.
1     0-STANDARD CLOCK QUAL.
 END TEST 1

        DISPLAY<—PROGRAM
```

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Explanation of Run-time Displays

When the START key is pressed, the screen display changes from:

to:

Then, when the trigger statement is executed, the screen display changes to:

```
RUNNING
                MAIN TRIGGER TEST = 1
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=F6
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 TRIGGER 0-MAIN
1     0-BEFORE DATA
1     0-SYSTEM UNDER TEST CONT.
1     0-STANDARD CLOCK QUAL.
 END TEST 1

          DISPLAY<— PROGRAM
```

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Data Displays

```
 CTR1=00000 EVT    TRIG LOC = 015
 CTR2=00000 EVT    TRIG IN TEST 1
LINE   ADDRESS   OPERATION /IRQ/NMI
015T——F835———F6 READ ———11
016     F82C    INC     $0006   11
017     F82D     00 READ        11
018     F82E     06 READ        11
019     0006     01 READ        11
020     0006     02 WRITE       11
021     F82F    BEQ     $F865   11
022     F830     34 READ        11
023     F831    TST     $0004   11
024     F832     00 READ        11
025     F833     04 READ        11
026     0004     80 READ        11
027     F834    BNE     $F82C   11
028     F835     F6 READ        11
029     F82C    INC     $0006   11
030     F82D     00 READ        11
031     F82E     06 READ        11
    DISPLAY<— ACQMEM 0-MAIN
                      0 MAIN
                      1 TIMING
        1-MNEMONIC
```

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Explanation of Data Displays

After the trigger event occurs, i.e., F6 is found, and the data acquisition is complete, the screen display changes from the program to the acquired data (in mnemonic format).

```
CTR1=00000 EVT    TRIG LOC = 015
CTR2=00000 EVT    TRIG IN TEST 1
LINE        ADDRESS        DATA   CNTL
015T————————F835————————F6———R11
016             F82C          7C     F11
017             F82D          00     R11
018             F82E          06     R11
019             0006          01     R11
020             0006          02     W11
021             F82F          27     F11
022             F830          34     R11
023             F831          7D     F11
024             F832          00     R11
025             F833          04     R11
026             0004          80     R11
027             F834          26     F11
028             F835          F6     R11
029             F82C          7C     F11
030             F82D          00     R11
031             F82E          06     R11
032             0006          02     R11
033             0006          03     W11
     DISPLAY←—ACQMEM 0-MAIN
       0-ABSOLUTE
```

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NOTE

Although the 7D02 monitors and tests for up to six control lines, only two (/IRQ and /NMI) are explicitly displayed by the 6802 Personality Module in mnemonic mode.

Up to 256 data words may be stored in acquisition memory. In this example, the trigger word and at least 240 other data words will be stored. The total number of words stored will be trigger word plus 240 data words plus the number of data words (up to 16) stored before the trigger word.

Press the SCROLLING keys to see data that is not on the screen. The trigger word is at location 015 and is indicated by a T next to the location number and a horizontal bar, as shown in the example.

Moving the cursor to the 1-MNEMONIC field changes the Immediate mode display to:

DISPLAY ← ACQMEM 0-MAIN
1-MNEMONIC
0 ABSOLUTE
1 MNEMONIC

The same acquired data can be presented as an absolute display by pressing the 0 key.

@

Getting Back to Program Mode

Once you have finished with the acquired data and you want to run another program, you need to change the operating mode of the 7D02 from Display mode to Program mode. You do this by pressing the following key sequence:

IMMEDIATE DISPLAY PROGRAM

At this point the screen display will change from the acquired data to the program which was run to acquire the data.

Now you can delete the current program, then enter a new program. Just move the cursor to the end of the program, then press the DELETE key. Each keystroke will delete one or more lines of the current program, starting with the last line of the program. The DELETE key will repeat if you keep the key pressed down. More information on the use of the DELETE command is presented later in this section.

NOTE

If you want to run the same program again, just press the START *key. You may be in either Display mode or Program mode when you press the* START *key.*

Example 2—Simple Word Recognition—A Shorter Way

Program Description

This is a "short cut" way of creating the same basic program as shown in Example 1.

Program Displays

```
 TEST 1
11F
1 WORD RECOGNIZER # 1
1 DATA=F6
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 TRIGGER 0-MAIN
1           0 MAIN
1           1 TIMING
1      0-BEFORE DATA
1      0-SYSTEM UNDER TEST CONT.
1      0-STANDARD CLOCK QUAL.
 END TEST 1
```

2918-18

Program Explanation

TRIGGER key is pressed. The 7D02 provides an entire test program.

All of the previous values for the Word Recognizer and the trigger are assumed.

Now press the START key.

NOTE

When an item with numeric fields is deleted (for instance, a Word Recognizer), its value is not set back to default. When it is used again, the previously entered value will still be there.

@

Example 3—Sequential Word Recognition (Arming Function)

Program Definition

This program monitors the system-under-test for Word Recognizer #1. When Word Recognizer #1 comes TRUE, the bus is monitored for Word Recognizer #2. When it comes TRUE, the trigger occurs and data is acquired.

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=17
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 GOTO 2
 END TEST 1
 TEST 2
2IF
2 WORD RECOGNIZER # 2
2 DATA=7D
2 ADDRESS=F831
2 /NMI=X /IRQ=X FETCH=X R/W=X
2 BA=X INVAL OP=X  EXT TRIG IN=X
2 TIMING WR=X
2THEN DO
2 TRIGGER 0-MAIN
2     0-BEFORE DATA
2     0-SYSTEM UNDER TEST CONT.
2     0-STANDARD CLOCK QUAL.
 END TEST 2
```

2918-19

Program Explanation

WD RECOGNIZER key is pressed. Define the first Word Recognizer value (17) to be found on the data bus. Once this value has been found, then the 7D02 will look for the next specified value. Naturally, you can specify any value, but 17 was chosen here.

WD RECOGNIZER key is pressed again. Now you can define the second Word Recognizer value to be found in the sequential testing. In this example, data of 7D and address F831.

NOTE

You do not have to press either the GOTO or END keys. The system will supply them automatically when you press the next WD RECOGNIZER key.

TRIGGER key is pressed and any changes to the previous trigger parameters are entered. In this case there are no changes to be made.

START key is pressed, the 7D02 starts monitoring the s.u.t. data bus for Word Recognizer #1. The 7D02 automatically replaces the OR IF prompt with END TEST 2.

Data Displays

```
 CTR1=00000 EVT    TRIG LOC = 015
 CTR2=00000 EVT    TRIG IN TEST 2
LINE   ADDRESS   OPERATION /IRQ/NMI
015T——F831——TST     $0004—11
016      F832     00 READ       11
017      F833     04 READ       11
018      0004     5F READ       11
019      F834    BNE     $F82C  11
020      F835     F6 READ       11
021      F82C    INC     $0006  11
022      F82D     00 READ       11
023      F82E     06 READ       11
024      0006     17 READ       11
025      0006     18 WRITE      11
026      F82F    BEQ     $F865  11
027      F830     34 READ       11
028      F831    TST     $0004  11
029      F832     00 READ       11
030      F833     04 READ       11
031      0004     5F READ       11
032      F834    BNE     $F82C  11
033      F835     F6 READ       11
  DISPLAY<—ACQMEM 0-MAIN
    1-MNEMONIC
```

2918-20

Explanation of Data Displays

This is a standard mnemonic display of the acquired data.

The run-time information now shows that the Main trigger occurred in TEST 2. If you have multiple tests that can cause the Main trigger to occur, this message tells you which one actually occurred.

Example 4—Sequential Word Recognition (Count Data Word Occurrences)

Program Definition

In TEST 1, the 7D02 monitors the s.u.t. bus for a value (DATA=34 in this example) on the data bus, counts 23 occurrences of that event, then transfers to TEST 2. TEST 2 monitors the bus for the data value F6. After the twelfth occurrence of F6, the program transfers to TEST 3. In TEST 3 the 7D02 looks for the first occurrence of the data value FF, then triggers.

Program Displays

2918-21

```
 TEST 1
11F
1 WORD RECOGNIZER # 1
1 DATA=34
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 COUNTER # 1 0-EVENTS
1    0-INCREMENT
1OR IF
1 COUNTER # 1 = 00023 0-EVENTS
1THEN DO
1
```

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=34
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 COUNTER # 1 0-EVENTS
1    0-INCREMENT
1OR IF
1 COUNTER # 1 = 00023 0-EVENTS
1THEN DO
1 GOTO 2
```

2918-22

Program Explanation

WD RECOGNIZER key is pressed and the parameters defined. The data word is specified to be 34. This word must be found on the s.u.t. data bus and counted the specified number of times before the 7D02 will look for the next data word.

COUNTER key is pressed. The default values are correct for this example: EVENTS are to be counted and the COUNTER is to be INCREMENTED. (COUNTER is used here as a command.

COUNTER key is pressed again and the number of occurrences (23) of the first event specified via the numeric keypad. Note that the counter field defaults to 00002. (The COUNTER key is used here to define an event.)

GOTO key is pressed. Once the TEST 1 counter has reached the specified value, go to TEST 2. This provides for the sequential testing of events. Without the GO TO, both events (Word Recognizer 1 and Word Recognizer 2) would be tested for simultaneously.

NOTE

The ONLY way to transfer program execution from one test to another is via the GO TO command.

END key is pressed to specify the end of TEST 1. The OR IF prompt is replaced by END TEST 1.

```
 END TEST 1
 TEST 2
2IF
2 WORD RECOGNIZER # 2
2 DATA=F6
2 ADDRESS=XXXX
2 /NMI=X /IRQ=X FETCH=X R/W=X
2 BA=X INVAL OP=X  EXT TRIG IN=X
2 TIMING WR=X
2THEN DO
2 COUNTER # 2 0-EVENTS
2    0-INCREMENT
2OR IF
2 COUNTER # 2 = 00012 0-EVENTS
2THEN DO
2 GOTO 3
 END TEST 2
 TEST 3
3IF
3 WORD RECOGNIZER # 3
3 DATA=FF
3 ADDRESS=XXXX
3 /NMI=X /IRQ=X FETCH=X R/W=X
3 BA=X INVAL OP=X  EXT TRIG IN=X
3 TIMING WR=X
3THEN DO
3 TRIGGER 0-MAIN
3    0-BEFORE DATA
3    0-SYSTEM UNDER TEST CONT.
3    0-STANDARD CLOCK QUAL.
 END TEST 3
```

2918-23

WD RECOGNIZER COUNTER COUNTER GOTO keys are pressed to define TEST 2 (it has the same logic as TEST 1). The Word Recognizer and counter values are entered. END key is pressed to specify the end of TEST 2. Again, the OR IF prompt is replaced, this time by END TEST 2.

NOTE

The COUNTER number must be changed to a 2 before you enter the counter value; i.e., the default counter number is always 1. Otherwise, when you enter the value 12 in TEST 2, the value of the counter in TEST 1, i.e., 23, will change to 12. The reason for this is that each of the two available counters can only count one value in any one program.

WD RECOGNIZER key is pressed. The 7D02 looks for the third data word (FF) on the s.u.t. data bus only after the specified number of occurrences of data word #2 (4C) have been counted.

TRIGGER key is pressed. The default parameters are used in this example. Once the third data word is found, the trigger will occur.

START key is pressed and the 7D02 begins to look for the first Word Recognizer.

NOTE

When this program reaches TEST 3, it will remain in TEST 3. There is no GO TO to another test.

Data Displays

```
 CTR1=00023 EVT  TRIG LOC = 015
 CTR2=00012 EVT  TRIG IN TEST 3
LINE       ADDRESS        DATA   CNTL
015T———————0011———————————FF———R11
016          0012           F7     R11
017          0013           F6     R11
018          0014           FF     R11
019          0015           B7     R11
020          0016           A3     R11
021          0017           BA     R11
022          0018           56     F11
023          0019           AC     R11
024          001A           6E     F11
025          001B           73     R11
026          001C           75     R11
027          001D           FC     R11
028          001E           F7     F11
029          001F           C9     R11
030          0020           D9     R11
031          0021           18     R11
  DISPLAY<—ACQMEM 0-MAIN
    0-ABSOLUTE
      0 ABSOLUTE
      1 MNEMONIC
```

2918-24

Explanation of Data Displays

This is an absolute display of acquired data.

The run-time information indicates that the event in TEST 1 occurred 23 times (CTR1=00023). In TEST 2, event 2 occurred 12 times (CTR2=00012). Then control was transferred to TEST 3 where the trigger occurred (TRIG IN TEST 3).

Example 5—Sequential Word Recognition With Else Clause

Program Definition

This program checks to see if a specific value on the address bus (783D) is immediately followed by another specific value (9107) on the address bus. If it is, then the trigger occurs. If it is not, then counter #1 is incremented and then program execution is transferred back to TEST 1.

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=XX
1 ADDRESS=783D
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 GOTO 2
 END TEST 1
 TEST 2
2IF
2 WORD RECOGNIZER # 2
2 DATA=XX
2 ADDRESS=9107
2 /NMI=X /IRQ=X FETCH=X R/W=X
2 BA=X INVAL OP=X  EXT TRIG IN=X
2 TIMING WR=X
2THEN DO
2 TRIGGER 0-MAIN
2    0-BEFORE DATA
2    0-SYSTEM UNDER TEST CONT.
2    0-STANDARD CLOCK QUAL.
2ELSE
2
2 GOTO 1
2 COUNTER # 1 0-EVENTS
2    0-INCREMENT
2
 END TEST 2
```

2918-25

Program Explanation

WD RECOGNIZER key is pressed and the address specified as 783D.

GOTO key is pressed.

END key is pressed to end TEST 1.

WD RECOGNIZER key is pressed and the address is specified as 9107.

TRIGGER key is pressed.

ELSE key is pressed.

[] key is pressed.

GOTO key is pressed.

COUNTER key is pressed and the default value 0-INCREMENT is used.

[] key is pressed.

END key is pressed.

Example 6—Simultaneous Event Recognition

Program Definition

This program simultaneously monitors the data bus for two different word recognitions. If the data value for Word Recognizer #1 or the address specified for Word Recognizer #2 is found, the trigger occurs.

Program Displays

```
 TEST 1
1IF
1
1 WORD RECOGNIZER # 1
1 DATA=41
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1 OR
1 WORD RECOGNIZER # 2
1 DATA=XX
1 ADDRESS=F836
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1
1THEN DO
1  TRIGGER O-MAIN
1     O-BEFORE DATA
1     O-SYSTEM UNDER TEST CONT.
1     O-STANDARD CLOCK QUAL.
 END TEST 1
```

2918-26

Program Explanation

[ ] (square brackets) key is pressed. The first three lines of the program appear on the screen.

This key must precede the first WD RECOGNIZER or COUNTER key that defines an item that is to be included in the simultaneous testing.

This construction is used to create compound events (in this case) or compound commands.

WD RECOGNIZER key is pressed.

The next six lines of the program are displayed. This is the first of the two Word Recognizers to be checked for simultaneously. The data is defined as a 41.

OR key is pressed. Notice that no THEN DO statement is provided inside the square brackets.

WD RECOGNIZER key is pressed again. This is the second of the two Word Recognizers to be included in the simultaneous testing. The address is defined as F836.

[ ] key is pressed again. This indicates the end of the events to be included in the simultaneous testing. The end of the square bracket is displayed, followed by a THEN DO.

TRIGGER key is pressed. Its parameters can then be defined. This example uses the default values.

END key is pressed.

START is pressed. As in the previous examples, the display at the bottom of the screen changes.

NOTE

The key sequence WD RECOGNIZER TRIGGER WD RECOGNIZER TRIGGER *will produce the following program. It gives the same results (once the same data values are entered in Word Recognizers #1 and #2) as the first program shown in this example.*

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=41
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 TRIGGER 0-MAIN
1     0-BEFORE DATA
1     0-SYSTEM UNDER TEST CONT.
1     0-STANDARD CLOCK QUAL.
1OR IF
1 WORD RECOGNIZER # 2
1 DATA=XX
1 ADDRESS=F836
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 TRIGGER 0-MAIN
1     0-BEFORE DATA
1     0-SYSTEM UNDER TEST CONT.
1     0-STANDARD CLOCK QUAL.
 END TEST 1
```

2918-27

COUNTER EXAMPLES

Example 7—Count Time Interval

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=1D
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 COUNTER # 1 0-EVENTS
1     0-INCREMENT
1OR IF
1
```

2918-28

Program Definition

This program will trigger a specified period of time (12 μS) after the data value (1D) is found.

Program Explanation

WD RECOGNIZER key is pressed and the parameters specified.

COUNTER key is pressed. This is where you define what is to be counted, events or time. In this case it is time.

When you position the cursor in the EVENTS field, the menu expands to:

0-EVENTS
- 0 EVENTS
- 1 μS
- 2 MS

Selecting a 1 or a 2 causes the 0-EVENTS prompt to be replaced with:

1-μS

if a 1 is selected, or with:

2-MS

if a 2 is selected. In either case the 0-INCREMENT menu changes to:

0-RUN
- 0 RUN
- 1 STOP
- 2 RESET AND RUN

This menu item is expanded to three choices. 0-RUN says continue counting from whatever value the counter contains. 1-STOP says stop counting intervals of time. 2-RESET AND RUN says reset the counter to 0 and begin counting intervals of time again.

This example requires the counter to reach a value of 12 for the counter event to occur, so 0-RUN is used.

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=1D
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 COUNTER # 1 1-uS
1    0-RUN
1OR IF
1 COUNTER # 1 = 00012 1-uS
1THEN DO
1 TRIGGER 0-MAIN
1    0-BEFORE DATA
1    0-SYSTEM UNDER TEST CONT.
1    0-STANDARD CLOCK QUAL.
 END TEST 1
```

2918-29

Data Displays

```
CTR1=00012 uS   TRIG LOC = 015
CTR2=00000 EVT  TRIG IN TEST 1
```

2918-30

COUNTER key is pressed and the number of microseconds to be counted, i.e., 12, is specified.

TRIGGER is pressed and its parameters defined. The default values are used here.

END key is pressed.

START key is pressed and the 7D02 starts monitoring the s.u.t. data bus. When the trigger event occurs the 7D02 will display the acquired data.

Explanation of Data Displays

Counter 1 shows the number of microseconds counted. Note that the time is shown, i.e., EVTS changed to μS.

Example 8—Trigger If Event Occurs Within Time "Window"

Program Definition

If Word Recognizer 2 occurs within 100 MS after Word Recognizer 1 occurs, then trigger the 7D02 and show the time period between the occurrence of the two Word Recognizers.

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=XX
1 ADDRESS=0006
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1
1 GOTO 2
1 COUNTER # 1 2-MS
1   2-RESET AND RUN
1
 END TEST 1
 TEST 2
2IF
2 WORD RECOGNIZER # 2
2 DATA=XX
2 ADDRESS=F82E
2 /NMI=X /IRQ=X FETCH=X R/W=X
2 BA=X INVAL OP=X  EXT TRIG IN=X
2 TIMING WR=X
2THEN DO
2
2 TRIGGER 0-MAIN
2    0-BEFORE DATA
2    0-SYSTEM UNDER TEST CONT.
2    0-STANDARD CLOCK QUAL.
2 GOTO 3
2 COUNTER # 1 2-MS
2    1-STOP
2
```

2918-31

Program Explanation

WD RECOGNIZER key is pressed and the address 0006 is specified.

[] key is pressed. The commands within the square brackets will be executed simultaneously.

GOTO key is pressed.

COUNTER key is pressed and EVENTS changed to 2-MS and 0-RUN to 2-RESET AND RUN.

[] key is pressed to end the compound command.

END key is pressed to end TEST 1.

WD RECOGNIZER key is pressed and the address is specified (F82E).

[] key is pressed. Starts compound command.

TRIGGER key is pressed. The default values are used in this example.

GOTO key is pressed.

COUNTER key is pressed. STOP is specified.

[] key is pressed to end compound command.

WD RECOGNIZER key is pressed. Address 0006 is specified.

```
2OR IF
2 WORD RECOGNIZER # 1
2 DATA=XX
2 ADDRESS=0006
2 /NMI=X /IRQ=X FETCH=X R/W=X
2 BA=X INVAL OP=X  EXT TRIG IN=X
2 TIMING WR=X
2THEN DO
2 COUNTER # 1 2-MS
2    2-RESET AND RUN
2OR IF
2 COUNTER # 1 = 00100 2-MS
2THEN DO
2 GOTO 1
 END TEST 2
 TEST 3
 END TEST 3
```

2918-32

COUNTER key is pressed and is specified as RESET AND RUN.

COUNTER key is pressed. The default value of 00002 has to be changed to 00100 to define the time "window" in which Word Recognizer 2 must occur if triggering is to occur.

GOTO key is pressed. The 3 must be changed to a 1. This completes the timing loop.

END key is pressed twice: once to end TEST 2 and once to create the dummy program TEST 3.

START key must be pressed to start program execution.

Program Discussion

In this program the 7D02 uses one Word Recognizer to enable a time window during which it searches for a second Word Recognizer, the trigger event.

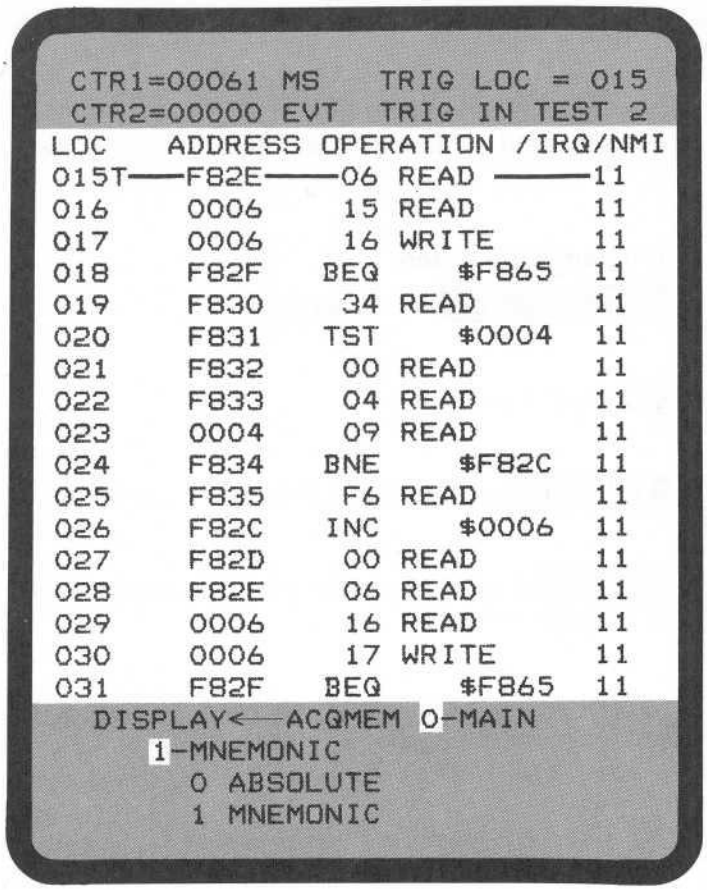
Each of the TESTS in this program has a specific purpose. In TEST 1 the 7D02 is waiting for its enabling event (ADDRESS=0006). When it is found, the timer is started and the 7D02 goes to TEST 2.

TEST 2 is more complicated. Here there is a race between the occurrence of the trigger event (ADDRESS=F82E) and the expiration of the time window. Whenever the enabling event (Word Recognizer 1) is found, the time window is restarted. If the time window expires, i.e., 100 MS after the enabling event, the 7D02 goes back to TEST 1 to look for the enabling event again. If, on the other hand, ADDRESS F82E (Word Recognizer 2) is found, then the 7D02 triggers to capture the data, stops the counter so as to tell how long into the window it was, and goes to TEST 3.

TEST 3 might seem unnecessary, but it isn't. TEST 3 tells the 7D02 to "ignore all inputs and do nothing". The 7D02 will simply wait until the delay counter is satisfied. TEST 3 is used to protect the value in the counter from further occurrences of Word Recognizer 1 after the trigger. If the 7D02 were to stay in TEST 2, a further occurrence of Word Recognizer 1 would cause the counter to be reset, and the value would be lost.

It is important to note that if the trigger event (Word Recognizer 2) happens while the 7D02 is in TEST 1 (looking for the enabling event), then no trigger will occur because Word Recognizer 2 is not used in TEST 1.

Data Displays



2918-33

Explanation of Data Displays

This is the mnemonic display of data acquired with this program. The trigger is at location 015 and it occurred at address F82E. Counter #1 has a value of 61 MS, i.e., the distance into the window at which the trigger occurred.

Example 9—Counter Tips

Program Definition

This program illustrates the fact that counters continue to count until they reach their specified value or until the last data acquisition takes place.

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=XX
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1
1 COUNTER # 1 0-EVENTS
1    0-INCREMENT
1 COUNTER # 2 0-EVENTS
1    0-INCREMENT
1
1OR IF
1 COUNTER # 1 = 00500 0-EVENTS
1THEN DO
1 TRIGGER 0-MAIN
1    0-BEFORE DATA
1    0-SYSTEM UNDER TEST CONT.
1    0-STANDARD CLOCK QUAL.
 END TEST 1
```

2918-34

Program Explanation

WD RECOGNIZER key is pressed.

[] key is pressed.

COUNTER key is pressed. This gives counter #1.

COUNTER key is pressed and the 1 is changed to a 2, giving counter #2.

In both counter commands, the default parameter, 0-INCREMENT, is selected.

[] key is pressed to end the compound command.

COUNTER key is pressed and a value of 00500 is specified for the event for counter #1.

TRIGGER key is pressed.

END key is pressed.

Data Displays

```
CTR1=00500 EVT  TRIG LOC = 015
CTR2=00741 EVT  TRIG IN TEST 1
```

2918-35

Data Explanations

This example points out one of the basic operating principles of 7D02 counters . . . counters continue to count until they either reach their specified value (500 for count #1) or until the delay counter reaches its programmed value (741 for counter #2).

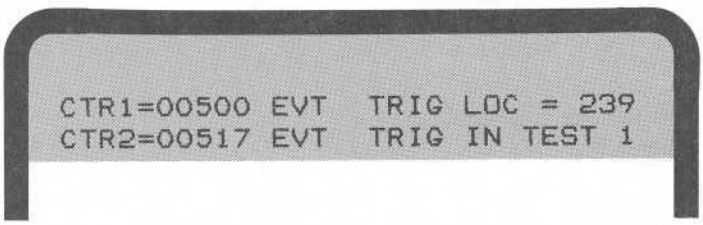
If you change the trigger parameter from

0-BEFORE DATA

to:

2-AFTER DATA

the display changes to:



2918-36

The reason for the change in the display for counter #2 is that the counter has less time to run, i.e., continue counting, until the delay counter reaches its programmed value.

Note that for 3-ZERO DELAY, counter #2 stops counting on the next clock cycle. As a result, its value would be 501 in this example.

Test for the Absence of an Event

Example 10—NOT Word Recognition

Program Definition

This program triggers whenever any interrupt, either IRQ or NMI, occurs.

Program Displays

```
 TEST 1
1IF
1
1 NOT
1 WORD RECOGNIZER # 1
1 DATA=XX
1 ADDRESS=XXXX
1 /NMI=1 /IRQ=1 FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1
1THEN DO
1  TRIGGER O-MAIN
1      O-BEFORE DATA
1      O-SYSTEM UNDER TEST CONT.
1      O-STANDARD CLOCK QUAL.
 END TEST 1
```

2918-37

NOT [no interrupt] = any interrupt

Program Explanation

NOT key is pressed. The first four lines of the program appear on the screen. The system automatically provides a square brackets ([ ]) key. The NOT applies only to the event which immediately follows it in the program. In this case, Word Recognizer #1.

WD RECOGNIZER key is pressed and the next six lines of the program are displayed. A 1 is entered for both /NMI and /IRQ. Since these are negative logic fields (indicated by the slash), a 1 means "no interrupt". Word Recognizer 1 will be TRUE when there is no interrupt. The total event clause, therefore, will be TRUE when either interrupt occurs.

[] key is pressed. This specifies the end of a compound event. The end of the square bracket is followed by the THEN DO prompt.

NOTE

The NOT key must always appear within square brackets. The NOT key only influences the first event immediately after the NOT. A NOT [] key sequence is illegal.

TRIGGER key is pressed.

END key is pressed.

START key is pressed and the 7D02 starts acquiring data. When an interrupt occurs, the 7D02 will trigger..

@

Qualified Data Storage

Use of the Qualify key allows you to screen data as it passes on the s.u.t. system bus and to select the data that you want to be stored in acquisition memory. This process is called data qualification.

The QUALIFY key can be used to implement two types of data qualification: block and command.

Example 11—Block Qualification

Block qualification is defined once for the entire program. It may be defined before or after any TEST. When QUALIFY is used as a block qualifier, data will only be stored on clock cycles in which data on the system-under-test bus satisfies the Qualify event.

The program in Example 11 will store only on occurrence of instruction fetches.

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=XX
1 ADDRESS=F82F
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 TRIGGER 0-MAIN
1     0-BEFORE DATA
1     0-SYSTEM UNDER TEST CONT.
1     0-STANDARD CLOCK QUAL.
 END TEST 1
 QUALIFY
Q STORE ON
Q WORD RECOGNIZER # 2
Q DATA=XX
Q ADDRESS=XXXX
Q /NMI=X /IRQ=X FETCH=1 R/W=X
Q BA=X INVAL OP=X  EXT TRIG IN=X
Q TIMING WR=X
 END QUALIFY
```

2918-38

Program Explanations

WD RECOGNIZER key is pressed and the trigger event entered (ADDRESS=F82F).

TRIGGER key is pressed and the default values used.

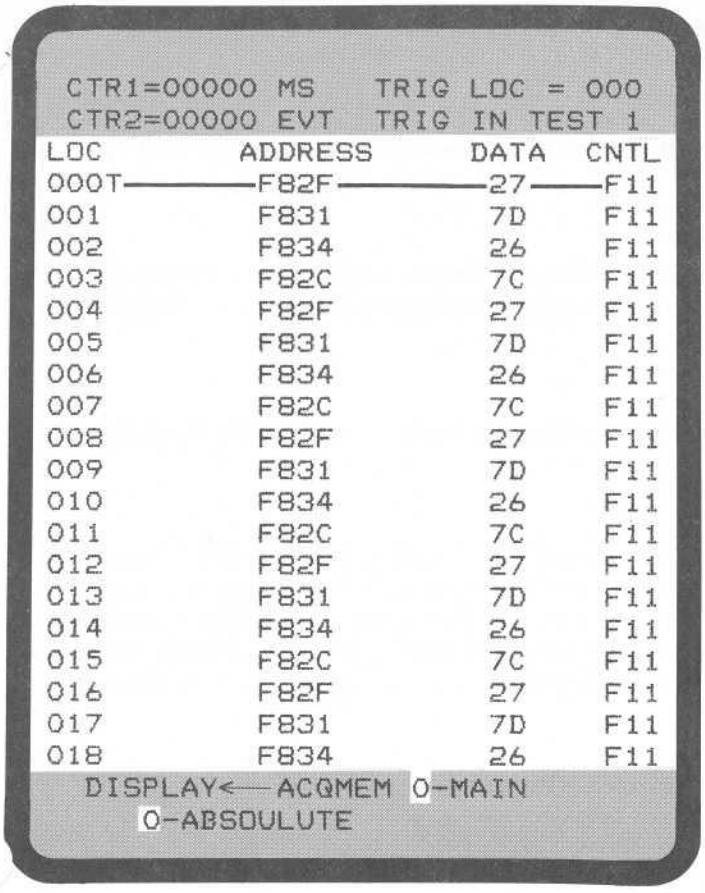
END key is pressed.

QUALIFY key is pressed to start the block qualification.

WD RECOGNIZER key is pressed and FETCH is entered as a 1.

END key is pressed to end the block qualification.

Data Displays



2918-29

Explanation of Data Displays

This display was changed from the mnemonic display to emphazise the fact that every data acquisition that was stored was, in fact, a FETCH. Note that each entry has an F in the CNTL column, indicating that this was a fetch.

Example 12—Qualify Command

Command qualification allows data to be stored only on those clock cycles in which a Qualify command is executed. Command qualification is defined in the individual tests and can be defined as often as you need it.

The program in example 12 stores 100 WRITEs, then stores the trigger word, then stores the next 127 data acquisitions following the trigger word.

In TEST 1, each time a WRITE is found (Word Recognizer 1), the cycle is stored (by the QUALIFY command) and counted. When 100 WRITEs have been found, the trigger occurs, the trigger word is stored, and the 7D02 transfers to TEST 2.

TEST 2 is written to say "store every cycle". When the delay counter reaches its programmed value, the 7D02 goes to Display mode.

It is very important to note that if there were no QUALIFY command in TEST 2, that the 7D02 would never automatically stop. If TEST 2 had been a null TEST (like TEST 3 in example 8), then the memory of the 7D02 would never fill because no further QUALIFY commands would be executed once the TRIGGER occurred. If data qualification is used anywhere in a 7D02 program, only cycles which are QUALIFIED will ever be stored. Since the 7D02 only stops when its delay counter reaches its programmed value, the 7D02 would run until the STOP key was pressed.

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=XX
1 ADDRESS=XXXX
1 /NMI=X /IRQ=X FETCH=X R/W=0
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1
1 QUALIFY
1 COUNTER # 1 = 00100 0-EVENTS
1    0-INCREMENT
1
1OR IF
1 COUNTER # 1 = 00100 0-EVENTS
1THEN DO
1
1 QUALIFY
1 TRIGGER 0-MAIN
1    1-CENTERED
1    0-SYSTEM UNDER TEST CONT.
1    0-STANDARD CLOCK QUAL.
1 GOTO 2
1
```

2918-39

Program Explanations

WD RECOGNIZER key is pressed and the R/W parameter is specified as a 0; i.e., a WRITE.

[] key is pressed to begin a compound command.

QUALIFY key is pressed.

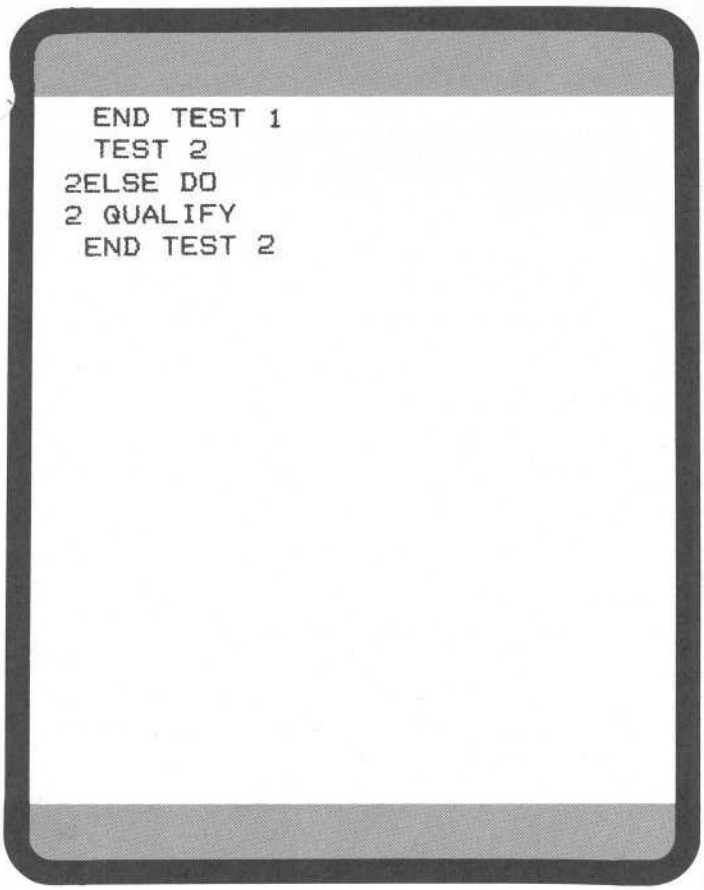
COUNTER key is pressed and 0-EVENTS and 0-INCREMENTS used.

[] key is pressed to end the compound command.

COUNTER key is pressed and a value of 00100 is specified.

[] key is pressed to begin another compound command.

QUALIFY key is pressed.



2918-40

TRIGGER key is pressed and 1-CENTERED, 0-SYSTEM UNDER TEST CONT., and 0-STANDARD CLOCK QUAL. are used.

GOTO key is pressed.

[] key is pressed to end the second compound command.

END key is pressed to end TEST.

ELSE key is pressed.

QUALIFY key is pressed.

END key is pressed to end TEST 2.

Example 13—Block Qualification and Qualify Command Combined

If both a QUALIFY block and a QUALIFY command are used, then storage occurs if either of the following conditions is true:

1. The current event satisfies the QUALIFY block event, or
2. A QUALIFY command is executed.

The program in example 13 demonstrates this concept. Data will be stored if Word Recognizer 2 (address F832) is found in TEST 1, if Word Recognizer 3 (address F82E) is found in TEST 2, or in any case when Word Recognizer 4 (data 7C) is found.

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=XX
1 ADDRESS=0004
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 GOTO 2
1OR IF
1 WORD RECOGNIZER # 2
1 DATA=XX
1 ADDRESS=F832
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING WR=X
1THEN DO
1 QUALIFY
 END TEST 1
 TEST 2
2IF
2 WORD RECOGNIZER # 3
2 DATA=XX
2 ADDRESS=F82E
2 /NMI=X /IRQ=X FETCH=X R/W=X
2 BA=X INVAL OP=X  EXT TRIG IN=X
2 TIMING WR=X
2THEN DO
2
2 TRIGGER 0-MAIN
2    0-BEFORE DATA
2    0-SYSTEM UNDER TEST CONT.
2    0-STANDARD CLOCK QUAL.
2 QUALIFY
2 GOTO 1
2
```

2918-42

Program Explanations

WD RECOGNIZER key is pressed and address 0004 is specified.

GOTO key is pressed.

WD RECOGNIZER key is pressed and address F832 is specified.

QUALIFY key is pressed for the line qualify command.

END key is pressed to end TEST 1.

WD RECOGNIZER key is pressed and address F82E is specified.

[] key is pressed to begin the compound command.

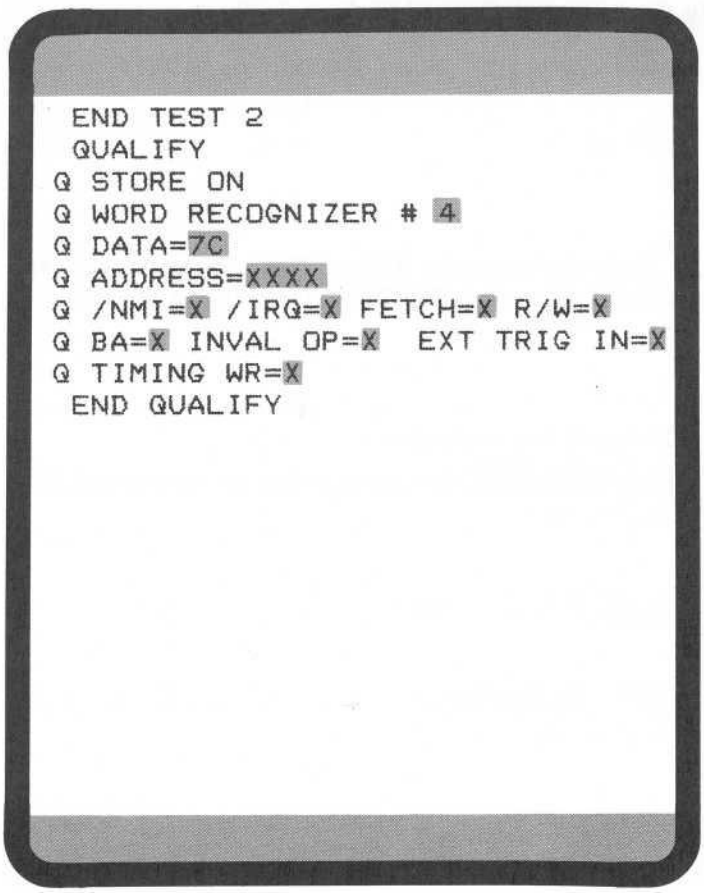
TRIGGER key is pressed.

QUALIFY key is pressed.

GOTO key is pressed and 3 changed to 1.

[] key is pressed to end the compound command.

END key is pressed to end TEST 2.



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QUALIFY key is pressed to begin the block qualification.

WD RECOGNIZER key is pressed and data 7C is specified.

END key is pressed to end the block qualification.

Example 14—Start and Stop Qualification

This program starts data qualification on the occurrence of Word Recognizer 1, stops data qualification on the following occurrence of Word Recognizer 3, and triggers only if Word Recognizer 2 occurs during data qualification.

Program Displays

```
 TEST 1
1IF
1 WORD RECOGNIZER # 1
1 DATA=XX
1 ADDRESS=0004
1 /NMI=X /IRQ=X FETCH=X R/W=X
1 BA=X INVAL OP=X  EXT TRIG IN=X
1 TIMING=X
1THEN
1
1 QUALIFY
1 GOTO 2
1
 END TEST 1
 TEST 2
2IF
2 WORD RECOGNIZER # 2
2 DATA=XX
2 ADDRESS=F82E
2 /NMI=X /IRQ=X FETCH=X R/W=X
2 BA=X INVAL OP=X  EXT TRIG IN=X
2 TIMING=X
2THEN DO
```

2918-44

Program Explanation

WD RECOGNIZER key is pressed and the address (0004) is specified.

[] key is pressed to start definition of a compound command.

QUALIFY key is pressed. Information on the data bus is stored each time 0004 is found.

GOTO key is pressed.

[] key is pressed to end the compound command definition.

END key is pressed to end TEST 1.

WD RECOGNIZER key is pressed and the address is specified as F82E.

[] key is pressed to start definition of the compound command.

TRIGGER key is pressed and the trigger location changed to AFTER DATA.

QUALIFY key is pressed. This causes the trigger word to be stored.

[] key is pressed to end the compound command definition.

WD RECOGNIZER key is pressed and an address of 0006 is specified.

```
2
2 TRIGGER 0-MAIN
2    2-AFTER DATA
2    0-PROCESSOR CONTINUE
2    0-STANDARD CLOCK QUAL.
2 QUALIFY
2
2OR IF
2 WORD RECOGNIZER # 3
2 DATA=XX
2 ADDRESS=0006
2 /NMI=X /IRQ=X FETCH=X R/W=X
2 BA=X INVAL OP=X  EXT TRIG IN=X
2 TIMING=X
2THEN DO
2
2 QUALIFY
2 GOTO 1
2
2ELSE
2 QUALIFY
 END TEST 2
```

2918-45

[] key is pressed to start a compound command qualification.

QUALIFY key is pressed. Information is to be stored each time 0006 is found.

GOTO key is pressed and the TEST number is changed from 3 to 1. This allows the program to transfer to TEST 1.

[] key is pressed to end the compound command definition.

ELSE key is pressed.

QUALIFY key is pressed. (If none of the events in TEST 2 occur, then store this data in acquisition memory.)

END key is pressed to end TEST 2.

START key can now be pressed to begin program execution.

NOTES

1. *No data is stored in TEST 1 if Word Recognizer #1 is not TRUE.*
2. *Every cycle in TEST 2 will be stored.*

CORRECTING PROGRAMMING MISTAKES

As a rule, people make three kinds of programming mistakes when they use the 7D02:

pressing the wrong event or command key; i.e., structural errors;

entering the wrong menu or parameter value; and

designing a logically incorrect program.

This section will not help you to correct problems in programming logic.

To correct a wrong menu entry, move the cursor to the incorrect entry. Then enter the correct value via the numeric keypad. The new value will replace the old one.

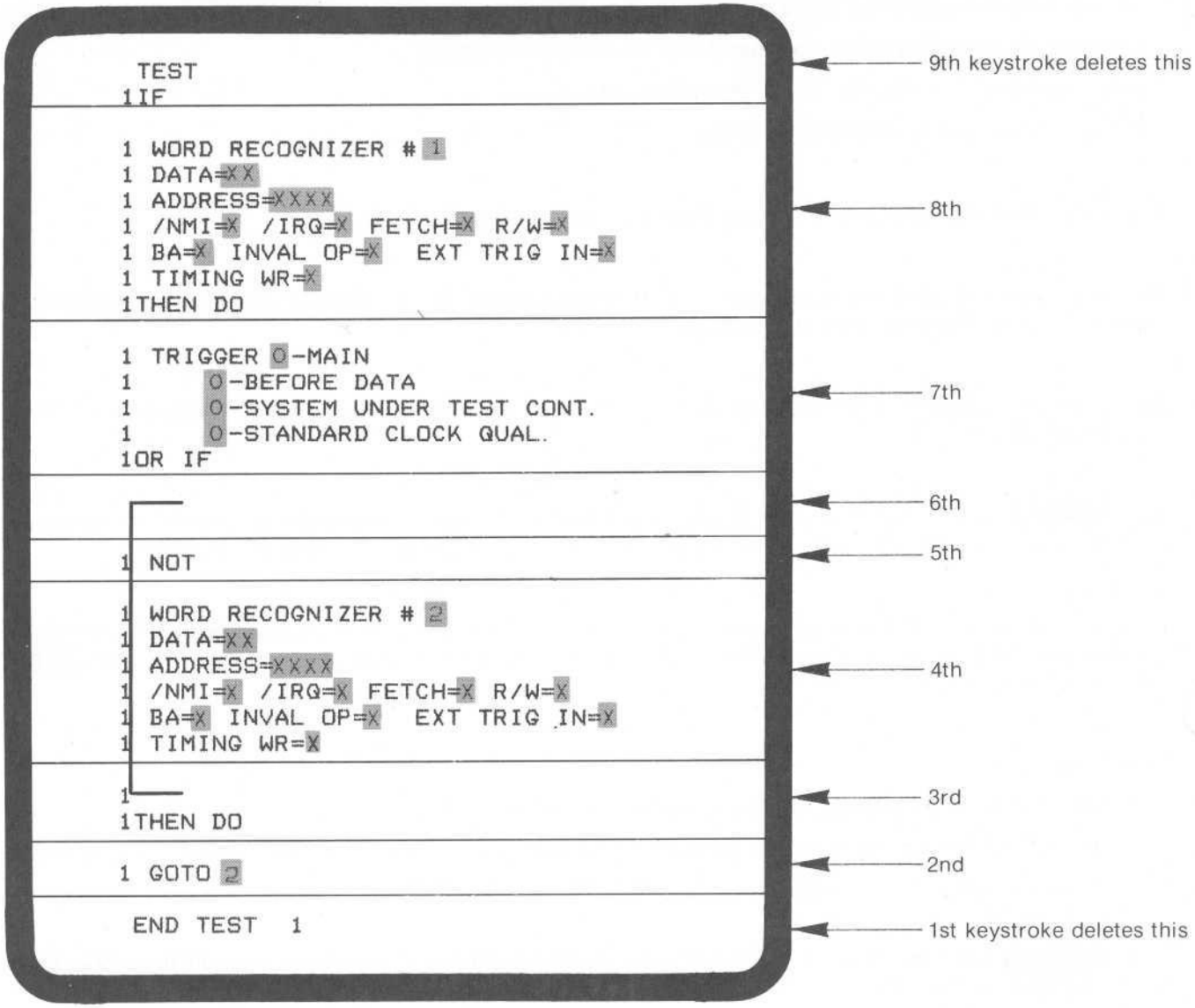
To correct an incorrect event or command keystroke, move the cursor to the end of the program and then use the DELETE key.

The DELETE key is used to correct structural mistakes in a program and to delete an entire program from memory. It only works from the end of the program back toward the beginning of the program.

In Figure 1-9 the program is boxed into groups of lines. Each group is deleted by one DELETE keystroke. The boxes are only for instructional purposes, and each box is numbered in the sequence in which the DELETE keystroke removes it from the screen.

In general:

1. Menus and numeric fields, i.e., parameters, are treated as a single unit.
2. Groups of lines are deleted regardless of where the cursor is positioned within that group of lines.
3. System-supplied lines, such as, IF, OR IF, THEN DO, STORE ON, are automatically deleted when appropriate.
4. DELETE can only be used on the last entry in the program; i.e., you can only delete lines from the last keystroke to the first.



2918-46

Figure 1-9. How the DELETE command works.

STORING AND DISPLAYING MEMORY WITH IMMEDIATE MODE COMMANDS

Storing data and programs in memory and retrieving information from memory is a three-keystroke sequence. The first key is always the IMMEDIATE key. It is followed by one of the two-keystroke sequences listed below. The second key specifies the destination of the information. The third key specifies the source of the information. The resulting command is shown in the Immediate mode area at the bottom of the screen.

DISPLAY, ACQ MEM — Displays the contents of the acquisition memory.

DISPLAY, PROGRAM — Displays the contents of program memory.

STORE MEM, PROGRAM — Stores the program in storage memory. Swaps programs if STOREMEM contains a program.[1]

STORE MEM, ACQ MEM — Stores the current data (residing in one of the acquisition memories) in storage memory.[1]

DISPLAY, STORE MEM — Displays the contents of storage memory.

[1] **These commands require moving the cursor to the EXECUTE field in order for the command to be executed.**

Section 2
GENERAL DESCRIPTION

TABLE OF CONTENTS

GENERAL DESCRIPTION

INTRODUCTION

The 7D02 Logic Analyzer is a design, debugging, and troubleshooting aid for use in the development of digital systems, especially microprocessor-based systems. It is capable of supporting both 8-bit and 16-bit microprocessors. The 7D02 is a plug-in for any 3-wide (or larger) Tektronix 7000-Series oscilloscope mainframe. Due to the unique requirements of the 7D02, best results will be obtained with 7603 or 7704A mainframes. Use of storage mainframes is not recommended as these crts are optimized for storage applications only.

7D02 COMPONENTS

The basic 7D02 offers a wide (28-channel) Acquisition Memory, four-word recognizers, two general purpose counters, a user-configurable clock, data qualification circuitry, a state machine architecture, three memories, and a simple facility for customizing the 7D02 for a wide variety of microprocessors.

The basic 7D02 will acquire data from the system under test (s.u.t.) on 28 channels, usually organized as:

16 address bus lines
8 data bus lines
4 control lines

The word recognizers perform recognition on these 28 channels plus an additional three channels (an external trigger line and two additional control lines from the s.u.t.). Any of the four word recognizers can be used to recognize user-defined patterns on all 31 channels or on any subset of the channels. The word recognizers can also be complemented, i.e., they can recognize the absence of a pattern.

The counters can count up to 65,534 events, microseconds, or milliseconds. Execution of commands (such as qualifying data or triggering) can be conditioned on a counter reaching a user-specified value.

The state machine architecture provides tremendous flexibility in triggering. Occurrences of events (counters reaching user-specified values, word recognitions) are input to the state machine. The state machine can examine all of its inputs simultaneously and generate a set of simultaneous commands to the counters, trigger(s), and data qualification circuitry. The commands can include a transition into a new state. Different states can associate different commands with the same inputs. The state machine executes in real time with the s.u.t. and can enter any of its states in any order, any number of times. This makes the 7D02 ideal for following the complicated, convoluted sequences of bus transactions often associated with software/firmware-based systems. A simple yet powerful user language makes detailed understanding of the state machine unnecessary.

The basic 7D02 contains three memories:

1. Program Memory contains the current user-entered program.
2. Acquisition Memory (or Main Acquisition Memory) contains the data acquired the last time a 7D02 program was run.
3. Storage Memory can be used to save either a program or the contents of the Acquisition Memory.

The PM-100 series of Personality Modules makes it possible to reconfigure the 7D02 for a wide range of microprocessors by simply plugging the appropriate module into the front panel of the 7D02. A General Purpose Personality Module (PM-101) is available for non-microprocessor systems, or for systems based on microprocessors for which a specific Personality Module is not available.

Expansion Option

Option 3 increases the width of Acquisition Memory and word recognition by 16 channels. The 44 channels of memory are generally assigned as:

24 address bus lines
16 data bus lines
4 control lines

As in the basic 7D02, two additional control lines and the external trigger line are also available for word recognition.

Timing Option

Option 1 turns the 7D02 into two logic analyzers in one box. The Timing Option has its own trigger, acquisition memory (Timing Option Acquisition Memory), and word recognizer.

Used synchronously, the Timing Option acts as an 8-channel extension of the Main Acquisition hardware.

Used asynchronously (with its own internally-generated time base), it is a timing logic analyzer that recognizes (and stores) both data and glitch information on 8 channels.

The Timing Option can be used to trigger the Main section, and vice versa.

FUNCTIONAL OVERVIEW

This overview will introduce some important terms and concepts. Understanding them will make programming of the 7D02 easier.

Using the 7D02 keyboard, the user enters a program describing an event or sequence of events in the system-under-test. The program usually directs the 7D02 to trigger (acquire data and stop running) when the event or sequence is detected. It may also describe the type of data the user wishes to acquire.

When the program is run, information is extracted from the program to set up the various acquisition hardware components (counters, word recognizers, state machine, clock and data qualifiers, trigger delay counter, etc.).

The acquisition hardware is then activated and data sampling beings. Data is always sampled on an edge of the system-under-test (s.u.t.) master clock, but not necessarily on every s.u.t. clock edge. The clock qualification circuitry (which was set up with information from the user's program and/or Personality Module-defined defaults) selects the edges of the s.u.t. master clock on which data is considered to be valid. This qualified s.u.t. clock becomes the 7D02 State Clock, which defines a single cycle of the 7D02. Data is sampled only on the State Clock.

On each cycle of the 7D02 (at the State Clock), s.u.t. data is sampled, program-defined conditions are tested, and commands associated with conditions that have occurred are executed. For example, the occurrence of a particular word recognition can cause a counter to be incremented. The state machine checks all of its inputs simultaneously and causes the relevant programmed commands to be executed simultaneously in real time with the system-under-test.

Although data is sampled on every State Clock, it is not necessarily stored in the Acquisition Memory. The data qualification circuitry uses program-defined (or default) criteria to determine whether or not each particular word of sampled data is to be stored. A word of data consists of the values on all channels being sampled on the system-under-test at a State Clock.

Words of data that meet the data qualification criteria are stored in consecutive locations in the Acquisition Memory. Data is stored continuously from the moment the 7D02 begins running the program. Data will continue to be stored even after the Acquisition Memory is filled, with the oldest word of data being lost every time a new one is stored.

Execution of a trigger command has the effect of activating a delay counter associated with the Acquisition Memory. Once activated, the delay counter will increment every time a word of data is stored into the Acquisition Memory. When the value in the delay counter reaches the user-specified value, acquisition is considered to be complete and the 7D02 stops executing the program.

NOTE

The Timing Option has its own trigger and delay counter. If the Timing Option is installed and data is being acquired with both the Main and Timing Option sections of the 7D02, then both sections must trigger and both delay counters must reach their programmed values before the program stops executing.

Once the program has stopped executing, acquired data is formatted and displayed. The user is now free to move acquired data to Storage Memory; to move programs to or from Storage Memory; to examine acquired data in different formats; to enter a new program; to rerun the program, etc.

MODES OF OPERATION

Powering-up the 7D02 causes diagnostic routines to be run automatically. Assuming there is no failure, the routines will require 5—10 seconds to complete. If the 7000-Series mainframe is "cold", the diagnostics will be completed before the crt even warms up. Otherwise, diagnostic displays and test patterns may be seen by the user on the crt.

After the completion of diagnostic testing, the 7D02 will always be in one of five modes of operation. They are discussed in depth in Section 3. Briefly, in the order they are likely to be encountered, they are:

1. Programming Mode

This is the mode into which the 7D02 powers-up. The user enters the program describing the data to be sought and stored.

2. Run Mode

Data is acquired under the direction of the program in Program Memory.

3. Display Mode

The acquired data is formatted and displayed on the crt display.

4. Immediate Mode

The user enters commands that are executed immediately, rather than when the program is run. These include moving information to or from Storage Memory, changing displays, and changing operation modes.

5. Format Mode

Characteristics of program and data displays (such as the radices in which word recognizer fields and acquired data are displayed) can be changed by the user.

FRONT PANEL FAMILIARIZATION

The 7D02 front panel appears in Figure 2-1.

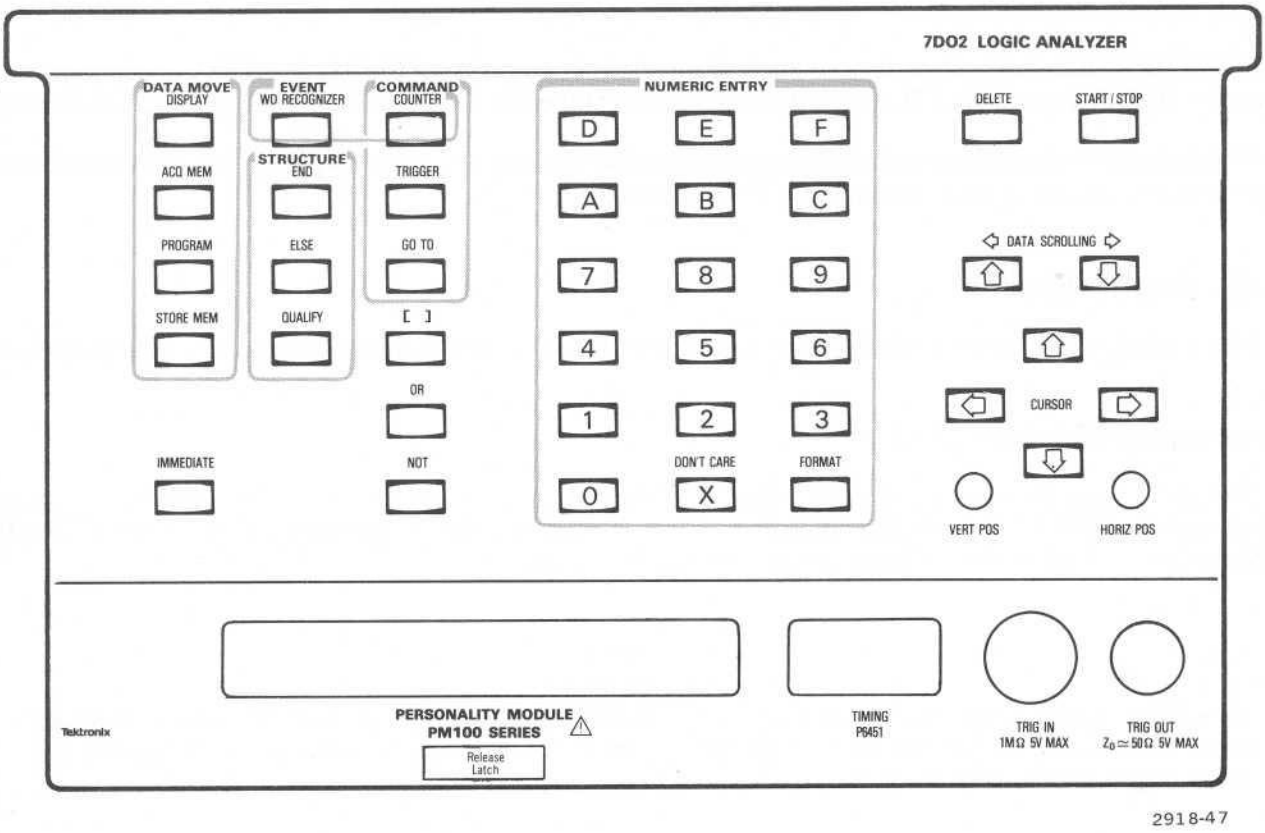


Figure 2-1. 7D02 front panel.

Keys

Each key on the front panel is described in detail in Section 5. Most keys are grouped by function within colored borders. Briefly, the functions of the key groups are as follows:

1. The Data Movement keys are used to move information among the 7D02 memories and to/from the display.
2. The Event, Command, and Structure keys, together with the [ ], OR, and NOT keys, are used to enter the user's program.
3. The IMMEDIATE key is used to enter Immediate mode commands.
4. The Numeric Entry keys are used to enter command and display parameters.
5. The DELETE key removes unwanted items from a program.
6. The START/STOP key runs or aborts execution of the current program.
7. The DATA SCROLLING keys move a display "window" through acquired data or a stored program.
8. The CURSOR keys move the blinking cursor around the screen, allowing programs to be entered/deleted and parameters to be changed.

Display Positioning Potentiometers

The VERT POS and HORIZ POS potentiometers allow the user to position the display vertically and horizontally. Due to differences in 7000-Series mainframes, it may be necessary to adjust the display position for a particular mainframe. Once adjusted, there should be little need to readjust.

BNCs

The "TRIG IN" BNC allows other devices such as a coded scope probe or the A6701 18-bit word recognizer to trigger the 7D02. This input is TTL-compatible. This line is labeled "EXT TRIG IN" in 7D02 program displays.

The "TRIG OUT" BNC allows the 7D02 to trigger other instruments. The TRIG OUT signal is generated when a trigger command is executed. See Section 7 for details.

P6451 Probe Slot

The P6451 probe plugs into the P6451 Probe slot. The P6451 is used to acquire data with the Timing Option.

Personality Module Slot

The PM-100 Series Personality Module plugs into the Personality Module slot. The Personality Module configures the 7D02 for a particular microprocessor. It acquires data from the s.u.t. and determines data display formats, disassembly of data, word recognizer formats, etc.

CAUTION

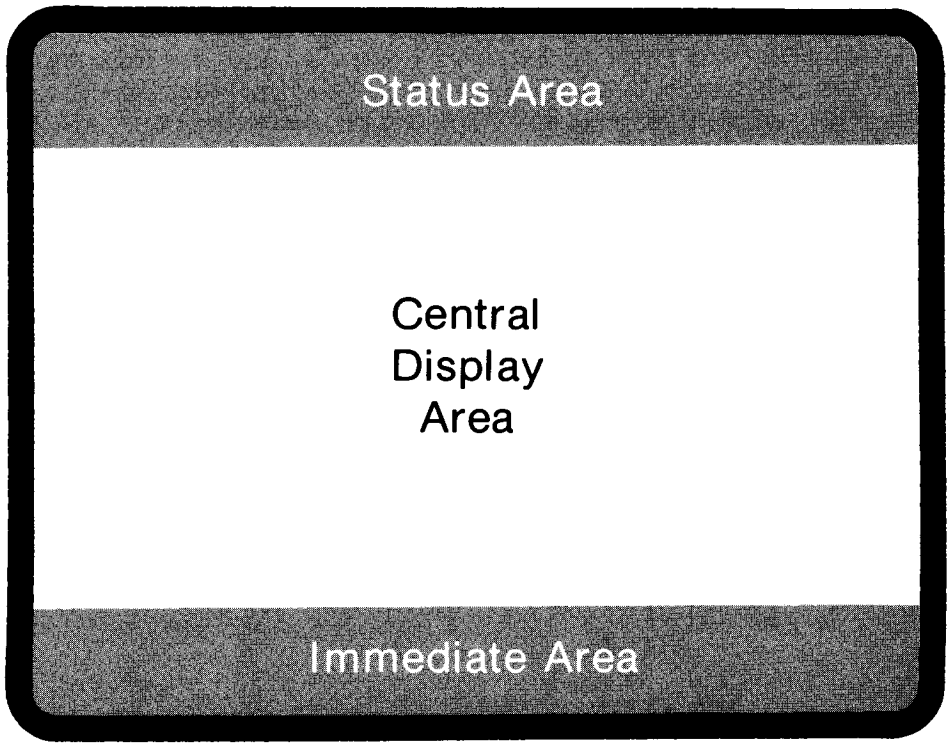
The 7D02 should never be operated without a Personality Module attached. The Module should never be plugged in with the 7D02 powered-on. To do so could cause permanent damage to the 7D02 or the Personality Module.

@

DISPLAY SCREEN CHARACTERISTICS

Screen Layout

Once diagnostics have been completed, the 7D02 display is generally divided into three regions (see Figure 2-2).



2918-48

Figure 2-2. 7D02 screen display areas.

They are:

1. Status area

   Two lines of inverse video at the top of the screen are reserved for error and status messages. Monitoring information appears here during Run mode. Vital statistics (such as final counter values) appear during Display mode.

2. Central Display Area

   The bulk of the display (a varying number of lines, depending on the size of the Immediate area) is used to display the contents of one of the memories (Program, Acquisition, or Storage) or the Format mode display.

3. Immediate Area

   An inverse-video area at the bottom of the screen is used for the entry of Immediate mode commands. When the user is not in Immediate mode, the area contains the display command that was last entered in Immediate mode (i.e., the one that was responsible for, and identifies, the current contents of the Central Display area). During Display mode, parameters associated with the display command can be manipulated. During Format mode, this area goes away completely.