Hewlett-Packard
9825A Desktop Computer
98035A Real Time Clock
Operating Note

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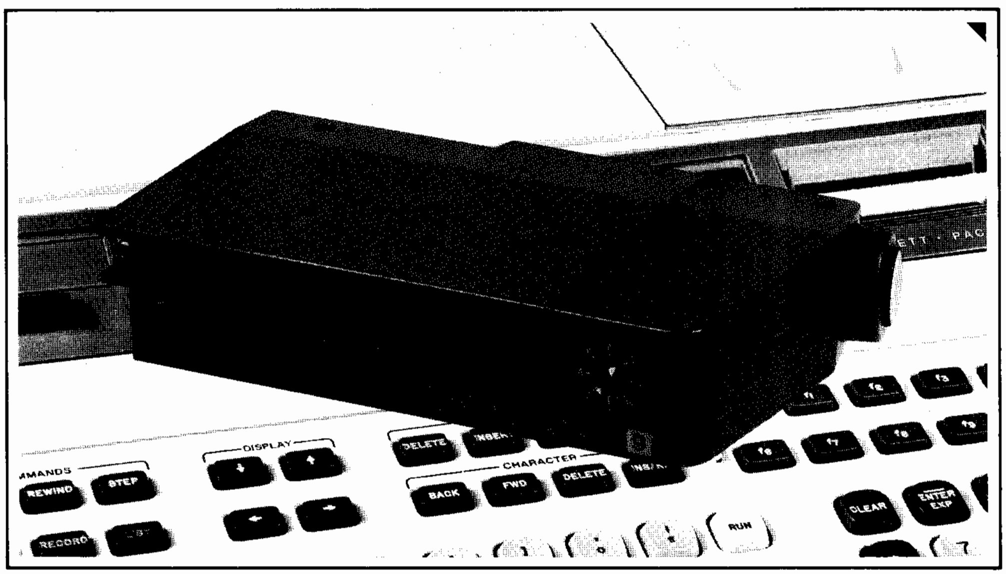

98035A Real Time Clock

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Preface

The 98035A Real Time Clock requires the presence of the General I/O ROM to function with the 9825A. The String Programming and Extended I/O ROMs are optional but recommended to facilitate programming. If you have any questions regarding installation or detailed operating characteristics of the 98035A Real Time Clock, please refer to the 98035A Installation and Operation Manual.

Initial Time-Set and Battery Charging Procedures

When you receive your 98035A Real Time Clock, the internal ni-cad battery may be discharged due to a long interval of time with no power applied to the interface for battery recharging. (Battery recharging is automatic as long as the interface card is plugged into the calculator and the calculator is turned on.)

The initial turn-on procedure of the Real Time Clock should be as follows:

1. Turn off power to the 9825A.
2. Plug in the Real Time Clock. (Set select code to 9*)
3. Turn on 9825A power.
4. Wait two minutes.
5. Set the time (format for Option 001 shown below.)

   Type in:

   wrt 9, "S mo, da, hr, mn, sc" EXECUTE

   mo: 2 digit month number
   da: 2 digit date
   hr: 2 digit hour (24 hr. format)
   mn: 2 digit minute
   sc: 2 digit second

6. If the calculator hangs up, press RESET and wait five or six minutes.
7. Repeat step 5.
8. If the calculator hangs up, press RESET.
9. Wait fifteen minutes.
10. Repeat step 5.
11. If the calculator hangs up, the real time clock is probably damaged in some way, therefore contact the HP Sales and Service Office nearest you.

* factory setting

Chapter 1
Clock Operation

Introduction

The 98035A Real Time Clock is an easy to use interface that adds a wide variety of functions and capabilities to the 9825A Calculator.

With the 98035A Real Time Clock, data read from an external device can be printed or stored with the date and time of the reading, accurately timed intervals can be established to interrupt the calculator as a real-time reference point, and an "alarm" type function that matches at a specified real time can interrupt the calculator at that specified time. With the optional cable (Option 100), external events can be sensed, and timed with millisecond accuracy using the four input lines to the Real Time Clock, and external devices can also be controlled using the five output lines.

Programming the Real Time Clock from the 9825A involves using the write (wrt), write byte (wtb), read (red), and read byte (rdb)statements available from the General I/O ROM. Using a few precautions when programming ensures the proper operation of the Real Time Clock with the 9825A; these precautions are listed in Appendix C for reference when writing and debugging programs on the 9825A. Note that the Real Time Clock will ignore all lower case alphabetics, allowing in-line comments to be written with each instruction.

Real Time Operations

Real Time Set

To set the real time value of the 98035A Real Time Clock , two typical methods may be used. Using only the functions of the General I/O ROM, variables may be output to the clock in the correct format as follows:

(C = Months,D = Days,H = Hours,M = Minutes,S = Seconds)

U.S. Format (Option 001)

```
2: fmt 1,c,5fz2.0;wrt 9.1,"S",C,D,H,M,S
```

or

European Format (Option 002)

```
4: fmt 1,c,5fz2.0;wrt 9.1,"S",D,C,H,M,S
```

The format statement establishes an output of a single ASCII character ("S") followed by five two-digit variables with no decimal points.

With the String Programming ROM present, a string may be constructed and output to the clock in the following manner:

```
2: dsp "Enter time as two-digit nmbers";wait 1000
3: "  "→A$[1,14]
4: ent "Month? (CC)",A$[1,2]
5: ent "Day? (DD)",A$[4,5]
6: ent "Hour? (HH)",A$[7,8]
7: ent "Minute? (MM)",A$[10,11]
8: ent "Second? (SS)",A$[13,14]
9: wrt 9,"S",A$
```

Real Time Request

To read the time from Real Time Clock, the first instruction is a write "R";

```
6: wrt 9,"Request time"
```

or

```
8: wrt 9,"R"
```

The write instruction can then be followed by a read instruction, where the real time value is read into a series of variables or a string, as follows:

```
10: red 9,C,D,H,M,S
```

or

```
12: red 9,A$
```

The variables or the string are then available for further processing or display.

Timing Units

The Real Time Clock has four timing units that can be used either as counters or interrupt units, depending on how they are defined under program control. In order to define a unit to count or interrupt, the timing unit must be in the halt state. A unit that is defined as a counter (for example, U3 = I3) either counts millisecond intervals (standard clocks) or the number of milliseconds an external event is true (Option 100 clocks). A unit defined for interrupt operation (for example, U3 = O3) can interrupt the 9825A at either a specified day and time, a specified millisecond periodic interval, or a combination of match day and time, delay, and intervals. The following sections describe these functions in more detail.

A selected unit can be defined to be either an interrupt device or a counter. To select unit one for interrupt operation (output) and unit three for counting operation (input), the following instructions can be output to the Real Time Clock:

```
13: wrt 9,"U1=O1 U3=I2"
```

or

```
15: wrt 9,"Unit1=Output1 Unit3=Input2"
```

NOTE

Timing units must be in the halt state before a unit definition command is valid.

NOTE

When the Real Time Clock is initialized by a power-on, a system reset, or a "B" instruction, **unit 1** is automatically assigned to **output port 1**, and **unit 2** is automatically assigned to **input port 1**. These ports cannot be assigned to another unit unless they are first undefined.

Unit State Control

Individual units can be started and stopped when desired. The instructions to accomplish this require a particular timing unit to be selected, as shown in the following examples:

Activate Selected Unit

```
48: wrt 9;"Unit 1 Go"
```

or

```
50: wrt 9;"U1G"
```

Halt Selected Unit

```
52: wrt 9;"Unit 1 Halt"
```

or

```
54: wrt 9;"U1H"
```

In those cases where it is desirable to operate all units simultaneously, two instructions for synchronous start and stop of the timing units are given. The "A" and "F" instructions affect all timing units regardless of the current state of the unit or its operating mode.

Activate All Units

```
56: wrt 9;"Fire all units"
```

or

```
58: wrt 9;"F"
```

Halt All Units

```
60: wrt 9;"Abort all units"
```

or

```
62: wrt 9;"A"
```

Interrupt Instructions

The Real Time Clock can combine the Match, Delay and Period instructions, allowing a flexible interrupt sequence to be established. A delay instruction may be specified to delay a match interrupt, and a periodic mode of operation can be programmed to begin after a match or match and delay combination. If a delay is specified with a match, no interrupt occurs at the "match" time, but rather at the ("match"+"delay")time.

NOTE

The 9825A can operate on an interrupt basis only if the Extended I/O ROM is installed. In addition, an interrupt service routine should be defined and interrupts enabled for the correct select code of the Real Time Clock.

Match

The Real Time Clock can generate an interrupt when the real time value equals the match value. The day, hour, minute, and second of a match interrupt can be specified by the match instruction. The match instruction can be sent to the Real Time Clock by the following statements:

```
17: fmt 1,c3,4fz2.0;wrt 9.1,"U1M",D,H,M,S
```

or

```
19: wrt 9,"U1M 06 05 10 05"
```

or

```
21: wrt 9,"Unit1 Match at 06days 05hours 10minutes 05secs"
```

The match value must be an even number of digits, and if fewer than the maximum number of digits are to be sent, the Real Time Clock builds the match from the right – for example:

```
10: wrt 9,"U1M 100500"
```

gives a match at 10:05 am.

Delay

A match interrupt can be delayed by sending the Real Time Clock a delay instruction. If no match is currently in effect on the same timing unit, the delay time is measured from the time the unit is activated.

The delay instruction can be sent by a simple write statement specifying the number of milliseconds of delay, such as:

```
24: wrt 9,"U1D 1000"
```

or

```
26: wrt 9,"Unit 1 Delay 1000 msec then interrupt"
```

If a delay instruction is sent to a timing unit defined to match, then the timing unit delays the match interrupt for the number of milliseconds specified by the delay instruction. For example, to delay a match interrupt for fifteen minutes if a flag has been set, the programming sequence would be:

```
27: wrt 9,"Unit1Halt Unit1=Output1 Unit1Match 0000000"
28: if flg3;wrt 9,"Unit1Delay 900000msec"
29: wrt 9,"U1G"
30: "Main":
```

Line 27 establishes the real time match, first placing unit 1 in a halt state, defining the unit to an interrupt mode, then setting the match value.

Line 28 checks the flag, and if set, additionally programs unit 1 for a fifteen minute delay (900000 milliseconds).

Line 30 begins main program execution.

Period

A periodic interrupt can be established from the Real Time Clock to provide interrupts on a continuing periodic basis. For example, a two second (2000 milliseconds) periodic interrupt can be programmed as follows:

```
11: oni 9,"Interrupt";eir 9
12: wrt 9,"Unit1Halt,Unit1=Out1,Unit1Period 2.000sec/Unit1Go"
13: gto +0
14: "Interrupt":wrt 9,"T";rdb(9)→C;if bit(0,C);beep;eir 9;iret
15: eir 9;iret
```

Line 11 defines an interrupt routine, "Interrupt"

Line 12 places unit 1 in the halt state, defines it to interrupt, and establishes a 2 second periodic mode. The interrupt handler (lines 14, 15) checks the trigger code to determine if unit 1 is the source of the interrupt. If it is, the routine beeps, reenables interrupts, and returns. If not, the routine simply enables interrupts and returns.

NOTE

Depending upon the amount of processing being done in the main program and the interrupt routine, the 9825A may not be able to process interrupts occurring more closely together than twenty milliseconds. Also, three units defined to interrupt the 9825A may cause the loss of one or more interrupts if occurring too close together.

Counting Instructions

To establish the counting mode for a particular timing unit, the following statements can be used:

```
34: wrt 9,"Unit1=Input counter 2"
```

or

```
36: wrt 9,"U1=I2"
```

Note that the unit does not begin counting until that unit is placed in the active state.

Two instructions can be issued to a timing unit that has been set up to count: to request the current value, and to reset the unit to zero (clear unit). The next two sections describe these operations.

Request Value

The current millisecond value of a timing unit is returned by the Real Time Clock upon receipt of a request value instruction, which can be accomplished in the following manner:

```
38: wrt 9,"Unit 1 Value request"
```

or

```
40: wrt 9,"U1V"
```

The next sequential instruction to the Real Time Clock should be a read statement in order to obtain the count returned by the unit specified in the request value command. For example, the following sequence can be used to obtain the current millisecond count from unit number three:

```
42: wrt 9,"Unit3 Value request";red 9,V;prt V
```

Unit Clear

To clear a particular counting unit to zero, a unit clear may be output to the Real Time Clock, such as:

```
44: wrt 9,"Unit1Clear counter"
```

or

```
46: wrt 9,"U1C"
```

Status and Control Instructions

The Real Time Clock returns several status words indicating existing error conditions, the interrupting timing unit(s), or any presently unserviced interrupt(s). The status and control bit descriptions are listed in Appendix B.

Error Code

To read the Real Time Clock error code, a write/read byte sequence is executed, as shown below:

```
16: wrt 9,"Error code";rdb(9)→E
```

The error code returned in variable E can be analyzed using either the Extended I/O ROM "bit" function or a subtract and compare method. A detailed explanation of the error codes is included in Appendix B for reference.

Bit Analysis Using Extended I/O Bit Functions

```
17: "Error":
18: wrt 9,"E";rdb(9)→E;if not E;ret
19: if bit(7,E);prt "Bad Clock Card"
20: if bit(6,E);prt "Bad Clock Card"
21: if bit(5,E);prt "Bad Clock Card"
22: if bit(4,E);prt "Real Time Lost"
23: if bit(3,E);prt "Invalid Command"
24: if bit(2,E);prt "Unit Mismatch"
25: if bit(1,E);prt "Data Range Error"
26: if bit(0,E);prt "Interrupt Missed"
27: ret
```

Bit Analysis Using Subtract and Compare

```
28: "Error":
29: wrt 9,"E";rdb(9)→E;if not E;ret
30: if E-128>=0;E-128→E;prt "Bad Clock Card"
31: if E-64>=0;E-64→E;prt "Bad Clock Card"
32: if E-32>=0;E-32→E;prt "Bad Clock Card"
33: if E-16>=0;E-16→E;prt "Real Time Lost"
34: if E-8>=0;E-8→E;prt "Invalid Command"
35: if E-4>=0;E-4→E;prt "Unit Mismatch"
36: if E-2>=0;E-2→E;prt "Data Range Error"
37: if E-1>=0;prt "Interrupt Missed"
38: ret
```

to the error code sequence:

```
30: "Trigger":
31: wrt 9,"T";rdb(9)→Q
```

Note that the trigger code corresponds to the output number, not the unit number. Using the above example, and assuming that unit one is assigned to output three, then a "1" in bit 2 of Q indicates that unit one has interrupted the calculator. The trigger codes and corresponding output ports are listed in Appendix B.

Unserviced Interrupt Code

The Real Time Clock returns an unserviced interrupts code in response to a "W" command. Unserviced interrupts occur when a timing unit attempts to interrupt the 9825A before a previous interrupt is serviced. This occurrence can happen when two timing units interrupt the calculator nearly simultaneously. When the calculator services the first interrupt, the second timing unit's interrupt may be missed if it occurs before interrupts are re-enabled. (Refer to the 98035A Installation and Operation Manual for further information about unserviced interrupts.)

To obtain the missed trigger code on interrupts, the following subroutine can be used:

```
33: "Missed Interrupt":
34: wrt 9,"W";rdb(9)→M;ret
```

Bypass Self Test

The "B" instruction causes the Real Time Clock to initialize to a power-on state without executing the self-tests. It can be sent as follows:

```
78: wrt 9,"Bypass self test"
```

or

```
80: wrt 9,"B"
```

After receiving the "B" instruction all units are placed in a halt mode, all registers are cleared, unit 1 is defined to output port 1, unit 2 is defined to input port 1, and the clock is disabled for interrupts.

Activate Clock Test Point

The clock chip test point can be enabled for testing or adjustment by the following instruction sent from the 9825A:

```
82: wrt 9;"Quartz crystal adjust"
```

or

```
84: wrt 9;"Q"
```

After making the necessary adjustments, an "X" instruction should be sent to clear the clock enable. For example:

```
86: wrt 9;"Q";prt "Press Continue when adjust is done";stp
87: wrt 9;"X";stp
```

Read Status

The Real Time Clock, like the 98032A, has nine interface status bits which can be monitored using the read status function. The following example checks the status code for an error indication.

```
36: "Status":
37: rds(9)→S;if bit(0,S);gto "Error"
38: "Continue":
```

A summary of the status bits is listed in Appendix B. For more detailed information concerning the interface status word, refer to the 98035A Installation and Operation Manual.

NOTES

Chapter 2

Option 100 Cable Operations

The external input and output lines provide four bits of communication (in and out). Information as to input/output voltages and loads is available in the 98035A Installation and Operation Manual.

Read External Input Lines

The Real Time Clock returns the current state of the external input lines in response to the "N" instruction. This instruction is sent and the external lines are read as follows:

```
69: wrt 9,"N";rdb(9)→A
70: if bit(3,A);gto "Input4"
71: if bit(2,A);gto "Input3"
  •
  •
  •
  •
```

If the output lines are to be pulsed (see next section) the above sequence should be preceded by the Pulse External Output Lines ("L") instruction, as shown in the example for that section.

The four output lines of the Real Time Clock can be defined by the following sequence:

```
73: 2↑0+2↑1+2↑2+2↑3→A
74: wtb 9,"L/",A,"N"
```

In the above example, the lines to be pulsed correspond to the power-of-two of the expression evaluated and sent to the interface by the write byte instruction. All following "N" instructions pulse the lines previously defined with the "L" instruction. Since only four output lines are available on the real time interface, only values corresponding to bits 0–3 are used by the clock. The correspondence is shown below:

Bit Position	Output Line Number	Bit Value	Decimal Value
Bit 0	Output 1	(send 2↑0)	1
Bit 1	Output 2	(send 2↑1)	2
Bit 2	Output 3	(send 2↑2)	4
Bit 3	Output 4	(send 2↑3)	8

The following sequence shows another method of specifying which output lines are to be pulsed by precalculating the value before sending out the line specification byte. The example enables and pulses all four output lines.

```
76: wtb 9,"L/",15,"N"
```

Chapter 3

Utility Programs

Introduction

The following subroutines are provided as a basis for programming the 9825A for the Real Time Clock. These subroutines are only suggestions of possible methods of programming for the Real Time Clock, and can be easily altered and optimized to suit your particular application.

Set Real Time Subroutine

This subroutine requests a two-digit value for each variable to be set: the current month, date, hour, minute and second. The input data is then assembled into the proper format for the Real Time Clock, then output.

```
89: "Set Time":
90: ent "Set time?",A$;if cap(A$[1,1])#"Y";ret
91: dsp "Enter time as two-digit numbers";wait 1000
92: " "→A$[1,14]
93: ent "Month? (CC)",A$[1,2]
94: ent "Day? (DD)",A$[4,5]
95: ent "Hour? (HH)",A$[7,8]
96: ent "Minute? (MM)",A$[10,11]
97: ent "Second? (SS)",A$[13,14]
98: wrt 9,"S",A$
99: ret
```

Display Real Time Subroutine

This subroutine obtains the current real time from the Real Time Clock and places the results in A$ (which should be dimensioned to at least 14 bytes). The string is then displayed.

```
100: "Readtime":
101: wrt 9,"Request time";red 9,A$[1,14];dsp A$;ret
```

Set Period Subroutine

This subroutine establishes a periodic interrupt using unit three, output three of the Real Time Clock. The subroutine set the variable "P" equal to the period between interrupts. Note the check for a period specified for less than twenty-five milliseconds. The processing time for servicing interrupts closer together than twenty-five milliseconds severely limits available program execution time and should not be specified except for special applications. An interrupt routine must be defined prior to executing this subroutine.

```
39: "Period":
40: ent "msec between periodic interrupts",P
41: if P<25;beep;ret
42: wrt 9,"Unit3Halt,Unit3=Output3,Unit3Period",P,"/Unit3Go"
43: ret
```

Error Decoding Subroutine

This subroutine checks the eight bits of the error code returned by the Real Time Clock and prints the appropriate error message. The bits of the variable E correspond to the error conditions listed under the Error Code description in Appendix B. This routine can be appended to your program and called after sending instructions to the Real Time Clock. It provides an easy means of checking instruction sequence errors, hardware failures, or data errors.

```
17: "Error":
18: wrt 9,"E";rdb(9)→E;if not E;ret
19: if bit(7,E);prt "Bad Clock Card"
20: if bit(6,E);prt "Bad Clock Card"
21: if bit(5,E);prt "Bad Clock Card"
22: if bit(4,E);prt "Real Time Lost"
23: if bit(3,E);prt "Invalid Command"
24: if bit(2,E);prt "Unit Mismatch"
25: if bit(1,E);prt "Data Range Error"
26: if bit(0,E);prt "Interrupt Missed"
27: ret
```

Subroutine Timing

Your benchmark subroutines or program loops can be easily timed using the Real Time Clock.

Initially, a timing unit must be defined as a counter and enabled. A typical program line to accomplish this looks like this:

```
44: wrt 9;"All units halt;Unit1=Input4;Unit1Go"
```

(The initial halt instruction is optional. It is included to ensure that unit 1 is in the proper mode to receive new commands or redefinition.)

Timing a subroutine now involves only clearing the counter, calling the subroutine, then reading the counter, as shown below.

```
105: wrt 9;"Unit1 Clear"
106: gsb "Delay"
107: wrt 9;"Unit1 Value";red 9;A
```

The variable A now contains the millisecond value of the time spent in the subroutine "Delay". Note that for critical timing requirements, the comment form of Real Time Clock instructions would not be used, due to the variability in handshake timing from one reading to the next. For example, the previous program code would be shortened to:

```
109: wrt 9;"U1C"
110: gsb "Delay"
111: wrt 9;"U1V";red 9;A
```

Interrupt Service Routine

The handling of multiple interrupts is one of the most critical programming tasks to undertake when using interrupt operation with the 9825A. It is possible to miss interrupts under certain conditions such as three timing units interrupting the calculator in succesion at one millisecond intervals. The 9825A cannot service the interrupts fast enough to prevent the loss of an interrupt if successive interrupts occur as close together as one millisecond. The following routine is set up to handle two interrupts occurring closely together (1 millisecond) but would miss a third interrupt if it occurred within three or four milliseconds of the first two.

```
115: if bit(X-1,T);gsb +0;jmp X+2
116: next X;wrt 9,"W";rdb(9)→W;if not W;ret
117: W→T;gto 114
118: dsp "Output 1 IRQ";ret
119: dsp "Output 2 IRQ";ret
120: dsp "Output 3 IRQ";ret
121: dsp "Output 4 IRQ";ret
```

Line 113: Read the trigger code, then reenable interrupts. If no bits of the trigger code are set, then return.

Lines 114 and 115: Check each bit of the trigger code (T); go to a service routine for each bit set.

Lines 116 and 117: When done checking the trigger code, get the missed interrupts code (W), and repeat the procedure in lines 114 and 115.

Lines 118-121: These are simple example subroutines for illustration purposes. Normally, these subroutines would perform the necessary processing to deal with the specific interrupting unit.

NOTE

The amount of processing performed in the interrupt routine determines the length of time spent in interrupt service. For optimum performance, keep the interrupt processing simple and the main program lines short. Try timing your interrupt routine to see just how long the 9825A spends servicing interrupts, and adjust your program accordingly.

Appendix A

Instruction Set of the 98035A Real Time Clock

The following list is a summary of the 98035A instructions and an example of the 9825A implementation for each instruction.

"#" represents a specific unit number (1-4).

Instruction	Description, Example
"A"	Halt All Units `wrt 9, "A"`
"B"	Fast Initialize `wrt 9, "B"`
"C"	Clear Selected Counter `wrt 9, "U# C"`
"D"	Delay Specification* `wrt 9, "U# D 9999"`
"E"	Error Code Request `wrt 9, "E"; rdb (9) → A`
"F"	Activate All Units (Start) `wrt 9, "F"`
"G"	Activate Selected Unit `wrt 9, "U# G"`
"H"	Halt Selected Unit `wrt 9, "U# H"`
"I"	Define Selected Unit to Selected Input Port `wrt 9, "U# = I#"`
"J"	Not Applicable
"K"	Not Applicable
"L"	Enable Selected External Output Lines `wtb 9, "L/" ,3`
"M"	Real Time Match Specification* `wrt 9, "U# M12 08 16 30"`

* These instructions require a delimiter after specifying the value and before chaining another instruction. Refer to the note

"P"	Set Periodic Interval*	`wrt 9,"U# P 9999"`
"Q"	Enable Clock Chip Test Point	`wrt 9,"Q"`
"R"	Read Real Time	`wrt 9,"R";red 9,A$`
"S"	Set Real Time*	`wrt 9,"S 12 24 20 30 00"`
"T"	Trigger Code Request	`wrt 9,"T";rdb9→C`
"U"	Unit Selection Specification (see "C", "D", "G", "H", "I", "M", "O", "P", "V")	
"V"	Counter Value Request	`wrt 9,"U# V";red9,D`
"W"	Misssed Interrupt Code Request	`wrt 9,"W";rdb(9)→E`
"X"	Deactivate Clock Chip Test Point	`wrt 9,"X"`
"Y"	Not Applicable	
"Z"	No Operation	

* These instructions require a delimiter after specifying the value and before chaining another instruction. Refer to the note below for clarification.

NOTE

If you are not chaining instructions, and are using the "wrt" statement to send instructions, the slash delimiter is not necessary. The "wrt" statement has an inherent linefeed delimiter that is automatically output at the end of a line.

Example: `wrt 9,"U3D1500/U3G"`

← Delimiter

Appendix B

Status/Control Codes

These code explanations are for quick reference. For a more detailed explanation of these codes please refer to the 98035A Installation and Operation Manual.

Error Codes

Bit 0-3 –	**Software Errors**
Bit 0 –	Missed interrupt.
Bit 1 –	Improper instruction sequence or data out of range.
Bit 2 –	Instruction is not consistent with current assignments of units and ports. For example, sending a Match instruction to a unit defined as a counter.
Bit 3 –	Instruction is not allowed for execution with active units.
Bits 4-7 –	**Hardware Errors**
Bit 4 –	Real time lost
Bit 5 –	Clock hardware malfunctioning
Bit 6 –	Clock memory error.
Bit 7	Clock memory error.

Trigger Codes

Bits Set	**Source**
Bit 0 –	Output #1 Interrupt
Bit 1 –	Output #2 Interrupt
Bit 2 –	Output #3 Interrupt
Bit 3 –	Output #4 Interrupt
Bits 4-7 –	Always 0

Missed Interrupt Codes

(Same as Trigger Codes)

Direct I/O Codes

Input Codes (returned in response to the "N" instruction)

Bits Set	Source
Bit 0 –	Input Line 1
Bit 1 –	Input Line 2
Bit 2 –	Input Line 3
Bit 3 –	Input Line 4
Bits 4-7 –	Always 0 (only four input lines are available)

Output Codes (Output lines are pulsed after a combination of "L" and "N" instructions)

Bits Set	Destination
Bit 0 –	Output Line 1
Bit 1 –	Output Line 2
Bit 2 –	Output Line 3
Bit 3 –	Output Line 4
Bits 4-7 –	Ignored (only four output lines are available)

Interface Status Codes

Bit 0 –	Error Flag
Bit 1 –	Interrupt Enable Flag
Bits 2-4 –	Always 0
Bit 5 –	Always 1
Bit 6 –	Always 0
Bit 7 –	Interrupt Status
Bit 8 –	Peripheral OK (should be 1)

Appendix C

If the 9825A fails to interrupt as specified in your program, several factors may be suspect. Some of the different possible causes are covered here to help you analyze your programs.

1. No interrupts. Possible causes may be:

   a) Sending an "A" instruction after enabling the clock for interrupts.
   Example:
   ```
   15: oni 9, "IRQ" ;eir9
   16: wrt 9, "A U3 = 03 U3P1000/U3G"
   ```
   ↑ (The "A" follows eir9)

   b) Defining a unit to an output port already dedicated to another timing unit. This can easily happen after interface initialization (reset or power-up).
   Example:
   RESET
   ```
   18: wrt 9, "U2 = 01 U2P1000/U2G"
   ```
   ↑ (Output port 1 is automatically assigned to unit 1 upon initialization.)

   This sequence generates an error that can be detected by requesting the error code from the Real Time Clock. To free output port 1, clear its automatic assignment by executing the following:
   ```
   3: wrt 9, "U1="
   ```

   c) Failing to follow numeric data with a slash ("/") or linefeed.
   Example:
   ```
   6: wrt 9, "U2P1000 U2G"
   ```
   ↑ (No slash followed the 1000 millisecond numeric value.)

2. Single interrupt only, when more interrupts were expected to follow. Two of the possible causes are:

   a) Failing to reenable interrupts from the interrupt routine.
   Example:

   ```
   24: "IRQ":
   25: wrt 9,"T";rdb(9)→I;if bit(3,I);beep;iret
   26: if bit(2,I);prt "Process2";eir9;iret
   27: iret
   ```

   (The two underlined "iret's" do not reenable interrupts from the real time card.)

   b) Sending a "Go" instruction to a periodic timing unit from the interrupt routine. If a timing unit is in the "match + periodic" mode of operation, sending a "G" from the match interrupt routine resets the timing unit back to the match comparison.
   Example:

   ```
   24: "IRQ":
   25: wrt 9,"U3G";beep
   26: eir 9;iret
   ```

   (Unit 3 has been set for periodic operation; sending the "Go" instruction resets the unit and is not necessary for periodic operation.)

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PRINTED IN U.S.A.
APRIL 3, 1979