HP 3437A System Voltmeter

HP-IB

HP 1000 Computer

Programming Guide

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Application Note 401-10

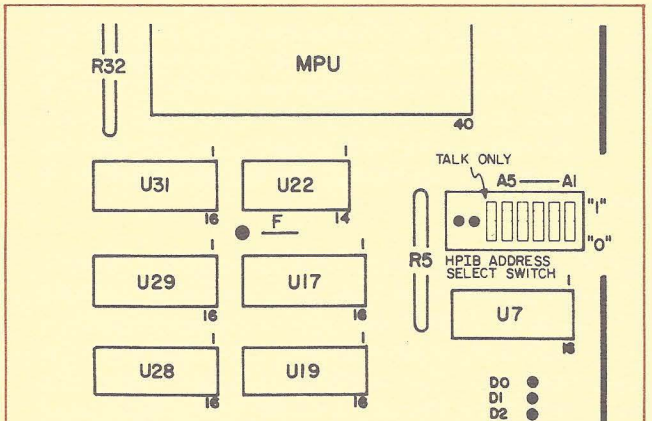
Device Introduction

The 3437A is a microprocessor-controlled 3-1/2 digit, successive approximation system voltmeter, capable of sampling voltages at rates up to 5700 samples per second.[1]

The HP-IB is standard with the 3437A. All front panel functions are programmable. Output formats are selectable (either ASCII or binary) allowing the 3437A to perform and return measurements at rapid speeds. A delay (up to one second) between readings may also be programmed.

Addressing

The 3437A address switches are located inside the instrument. The top cover and three screws on the upper PC board should be removed. This board is on hinges. Figure 10-1 shows how to set the HP-IB address. Note that an octal address of 30 is set at the factory.



1. To select address 24 (decimal equivalent), set switch positions A1-A5 as follows:

   A5 A1
   1 1 0 0 0 16 + 8 = 24
   (16 8 4 2 1) Binary weight

2. To set the 3437A to TALK ONLY, set switch position 6 to "1".

Figure 10-1. 3437A Switches

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[1]*This application note should be used in conjunction with the 3437A Operating and Service Manual (03437-90002) and Application Note 401-1 (5953-2800).*

System Preparations

LU Assignment

File Manager can be used to assign a logical unit to the 3437A. If EQT 11 represents the HP-IB and LU 20 is free to be assigned to the 3437A,

```
:SYLU,20,11,30B
```

will set up LU 20 on EQT 11 for the 3437A (assuming 30 octal is the address set in the 3437A address switches).

Buffering

Buffering should be turned off initially during device checkout. The statement,

```
:SYEQ,11,UN
```

will unbuffer EQT 11 from File Manager. User program error checking is the final consideration which should be used to determine whether output buffering can be implemented. Usually, 3437A programming is minimal, so buffering is not a significant performance factor. (Buffering only works on output from the computer.)

Time-out

Device time-outs can be used for recognizing errors in the 3437A. Sometimes the 3437A may stop taking and returning readings to the computer if the external signal is temporarily discontinued. This may not be an error, and the user should guard against these occurrences by setting the time-out value large enough. (The user program can also evaluate time-out causes by configuring the LU as described in "Configuration.")

A 3437A hardware malfunction will also cause a time-out. The time-out is important in these situations and indicates the source of trouble. If the trigger signal is well understood and consistent, the time-out error condition will be infrequent and the operating system may be left to handle the situation. The default condition for the 3437A device configuration word allows for such "system" error checking.

Configuration

The device configuration word controls SRQ handling, DMA device allocation, end of record handling, and user program error checking. SRQ handling will be discussed under "SRQ Processing".

DMA should be used when the delay between readings is less than 10 milliseconds. During rapid measurements in "non-DMA" transfer mode, the 3437A is capable of dominating the system, and it is possible for the system clock to lose time. The File Manager statement,

```
:CN,18,25B,37000B
```

will allocate DMA to the 3437A, and allow other conditions to default to their standard values.

End of record handling is standard in the 3437A and the default values for the device configuration word can be used. User program error checking is at the discretion of the user. (See the "Time-out" section for more information as this relates to device time-outs.) The File Manager sequence,

```
:CN,18,25B,37400B
```

will allocate DMA, user program error checking, standard end of record requirements, and standard SRQ processing.

Remote

The 3437A must be in remote for programming. From File Manager,

```
CN,18,16B
```

will set the device to remote.

Programming

In most applications, six points should be considered before taking measurements with the 3437A:

1. How many readings will be taken in one operation?
2. How will each 3437A reading be triggered (i.e., using an external signal, triggering within the 3437A, or triggering manually from the HP-IB controller)?
3. What time delay should occur between each reading? (Or what delay after the 3437A has been triggered should occur before a reading is taken?)
4. What is the voltage range of the readings?
5. How will the readings be requested by the controller (i.e., will a read request be made or is the delay between readings significantly long that a service request should be generated for each reading)?
6. Will measurements be returned in ASCII or binary format?

The 3437A is designed to easily implement the answers to the above six questions, either from the front panel or from a user program as follows.

During initial setup, the 3437A can be programmed from File Manager to verify operation and obtain an understanding of the 3437A programming commands. There is one command which corresponds to each of the six questions above.

Table 10-1 shows a summary of 3437A programming commands, and a brief description of each.

Table 10-1. 3437A Programming Commands

Program Code (ASCII Character)	Description	Octal Code
D	Delay	104
N	NRDGS	116
E	ENAB RQS	105
S	Store	123
R	Range	122
1	.1 volt	061
2	1 volt	062
3	10 volts	063
T	Trigger	124
1	Internal	061
2	External	062
3	Hold/Man	063
F	Format	106
1	ASCII	061
2	Packed	062
B	Binary Prgm	102

"D" means "delay between readings" and is followed by a numeric value between .0 and .9999999 indicating a delay between 0 and one second. This programming string must be followed by the letter 'S' to save the value in the 3437A's memory and terminate this particular programming mode.

An "R" means "voltage range" and is followed by 1,2, or 3, indicating the ranges shown in Table 10-1. Suppose the 10 volts scale is selected. "R3" represents the complete programming string needed to set a range of 10 volts.

A "T" means "select trigger mode." Triggering options should be evaluated to decide which method of triggering should be used. The device is easiest to check out using internal triggering. "T1" is a string which can be used to program internal triggering for the 3437A.

An "F" meaning "media format" defaults to ASCII format when the 3437A is turned on. See "Binary Media Format" later in this chapter for information about how to return measurements in binary.

A "B" means "binary program", and is discussed later in this section. The binary program is concerned with saving the 3437A's current state, and possibly restoring the state later in time.

A remarkable amount of programming for checkout can be conducted with the 3437A by using File Manager. Complete command strings can be sent to the 3437A using the "AN" command because the 3437A ignores the blank character, which is automatically output at the beginning of the string. Also, portions of a complete command string can be output and the results viewed on the 3437A front panel.

For example, suppose LU 14 is assigned to the 3437A. Make sure the 3437A time-out is greater than the delay between measurements. Figure 10-2 shows an example File Manager sequence to verify that functions are working correctly in the 3437A.

The 3437A doesn't save each measurement in an internal buffer, but it can be programmed so that one controller read request can be used to input measurements continuously until the maximum number of readings has been satisfied in the 3437A. For example, if the 3437A is programmed "N5S", one File Manager read request will obtain five 3437A measurements separated by commas. After the fifth measurement, a carriage return linefeed is returned, terminating each request.

This is a real advantage in the HP 1000 since the greatest overhead for an RTE I/O request is the setup time required to get the I/O request started. Once the setup has completed, data can be transferred at the maximum 3437A speed until a carriage return linefeed is received.

The 3437A has an LED visible from the front panel labeled "ignore trigger". When internal or external triggering is implemented in the 3437A, it is possible that the instrument will be ready to trigger the next reading before the previous reading has been taken by the computer. In this situation, the 3437A will ignore the trigger for one or more time periods and allow the computer to catch up.

Using File Manager, the programmer can see these performance effects on line. At the terminal, the user shortens the delay between readings (using the "D" command) until the LED (ignore trigger light) appears on the 3437A front panel. This delay represents the maximum rate at which the HP 1000 can accept readings from the digital voltmeter.[2]

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[2] *The number of readings "N" must be greater than one for the LED to be seen on the front panel.*

:LL,14	Set list device to the 3437A LU.
:AN,D.5	A decimal point must precede the numeric value for the delay. Note that after this command is executed, the delay value will appear on the front panel of the 3437A.
:AN,S	Save the delay value in the 3437A's memory and terminate delay mode.
:AN,N5	Set the number of readings between end of record terminators (in one operation) to 5. Note, after this command is executed, the number of readings will appear on the 3437A front panel.
:AN,S	Save the number of readings value and terminate this mode.
:AN,T1R1F1	Set internal trigger, 10 volt range, and ASCII format.
:DU,14,0G	Starts a series of readings with the output on the user terminal.

```
+04.99,+04.99,+04.99,+04.99,+04.99
+04.99,+04.99,+04.99,+04.99,+04.99
+04.99,+04.99,+04.99,+04.99,+04.99
+04.99,+04.99,+04.99,+04.99,+04.99
+04.99,+04.99,+04.99,+04.99,+04.99
```

11>BR,FMG11	Stop Measurements

Figure 10-2. File Manager Sequence 3437A Checkout

ASCII measurements using FORTRAN are especially easy to obtain from the 3437A. Figure 10-3 shows a simple program using free field input to obtain the measurements.

Overflow information is supplied within the reading as the value "9999" and can be checked using a FORTRAN "IF" statement.

```
0001  FTN4,L
0002        PROGRAM A3437(3),12-08-78 (GWG) ASCII READS
0003        REAL          READS(200)
0004        COMMON        ILU,ILST,IDLU
0005        DATA          NO/2HNO/
0006        IF(INPRM(ID).EQ.NO)GO TO 999          Obtain input parameters.
0007        WRITE(IDLU,10)
0008     10 FORMAT("D.0025S N1S R3 T1 F1")        Delay 25ms, one reading per request, 10 volt
                                                  range, internal trigger, ASCII media format.
0009        DO 25 I=1,200                         Take 200 readings.
0010     25 READ(IDLU,*)READS(I)                  Free field input.
0011        WRITE(ILU,20)READS                    Output readings to the user terminal.
0012     20 FORMAT(5F10.2)
0013        STOP
0014    999 WRITE(ILU,30)
0015     30 FORMAT(":RU,A3437,ILU,IDLU"/)
0016        END
```

Figure 10-3. FORTRAN Free Field Input Example

Binary Media Format

Better performance may be obtained from the 3437A using the "binary output" format which allows an entire reading to be packed into one word of data. Each digit is forced into the 16-bit word by translating it to BCD. Table 10-2 shows how a reading is organized.

Table 10-2. Binary Read Format

Byte	Function	DIO 8 7 6 5 4 3 2 1	Description
1st	Range Multiplier	0 1	.1 Volt Range
		1 1	1 Volt Range
		1 0	10 Volt Range
	Sign bit	1	Positive
		0	Negative
	MSD	1	Numeric Value of Sampled Input Voltage
		0	
	2 SD	X X X X	
2nd	3 SD	X X X X	
	LSD	X X X X	

A performance improvement in communication speed occurs because fewer bytes need to be transmitted per reading from the 3437A.

In most cases, data from the 3437A must be translated into HP 1000 binary for data reduction and processing. Figure 10-4 shows both a function subprogram "CNVRT" and the main program "B3437" to test the subroutine. "CNVRT" is a routine which may be used to convert 3437A BCD media format to HP 1000 binary.

Rapid rate measurements may be taken using an RTE EXEC call (Figure 10-4 shows up to 5000 readings) and then the input buffer can be processed by "CNVRT". Once the conversion has been performed, each consecutive measurement will be contained in "OUTBUF".

```
0001   FTN4,L
0002         PROGRAM B3437(3),12-08-78 (GWG) TEST CNVRT
0003         INTEGER INBFR(5000),LNTH,IREG(2),CNVRT
0004         REAL OUTBUF(5000)
0005         EQUIVALENCE (REG,IREG,IA),(IREG(2),IB)
0006         COMMON ILU,ILST,IDLU
0007         DATA NO/2HNO/
0008         IF(INPRM(ID).EQ.NO)GO TO 999              Get input parameters.
0009         WRITE(IDLU,10)                            Binary media format.
0010      10 FORMAT("F2")
0011         REG=EXEC(1,IDLU+100B,INBFR,5000)          Obtain 5000 readings from the 3437A, one
                                                       reading per word.
0012         IF(CNVRT(INBFR,IB,OUTBUF).LT.0)GO TO 998  Convert the readings to real binary values.
```

Figure 10-4. Read Binary from the 3437A Using a Function

```
0013         DO 30 I=1,IB
0014         IF(IFBRK(ID).LT.0)GO TO 50                  Check the system break flag to see if
                                                         finished.
0015      30 WRITE(ILU,40)I,OUTBUF(I)                    Print the results.
0016      40 FORMAT(I3,5F10.2)
0017      50 STOP
0018     999 WRITE(ILU,20)
0019      20 FORMAT(" RU,B3437,ILU,IDLU"/)
0020     998 END
0021  C
0022  C
0023  C
0024         INTEGER FUNCTION CNVRT(INBFR,LNTH,OUTBUF),12-08-78 (GWG)
0025        &3437A BINARY CONVERSION.
0026  C
0027  C CNVRT = -1 MEANS 3437A OVERFLOW.
0028  C
0029         LOGICAL         OFLG
0030         INTEGER         INBFR(1),SIGN
0031         REAL            MULT,OUTBUF(1)
0032         COMMON          ILU,ILST,IDLU
0033         OFLG=.FALSE.
0034         DO 10 I=1,LNTH
0035         MULT=INBFR(I)/16384
0036         IF(INBFR(I).LT.0)MULT=IAND(INBFR(I),40000B)/16384+2
0037         IF(MULT.EQ.1)MULT=.1
0038         IF(MULT.EQ.2)MULT=10.
0039         IF(MULT.EQ.3)MULT=1.
0040         SIGN=IAND(20000B,INBFR(I))/8192 - 1
0041         IF(SIGN.EQ.0)SIGN=1
0042         ID3=IAND(10000B,INBFR(I))/4096
0043         ID2=IAND( 7400B,INBFR(I))/256
0044         ID1=IAND(  360B,INBFR(I))/16
0045         ID0=IAND(   17B,INBFR(I))
0046         IF(ID2.EQ.9.AND.ID1.EQ.9.AND.ID0.EQ.9) OFLG=.TRUE.
0047         VALUE=(ID3*1000 + ID2*100 + ID1*10 + ID0)/1000.
0048      10 OUTBUF(I)=SIGN*VALUE*MULT
0049         IF(OFLG) 30,20
0050      20 CNVRT=0
0051         RETURN
0052      30 WRITE(ILU,40)
0053      40 FORMAT(" 3437A OVERFLOW.")
0054         CNVRT=-1
0055         RETURN
0056         END
```

Figure 10-4. Read Binary from the 3437A Using a Function (Continued)

Binary Program (Learn Mode)

The 3437A has a binary program mode which lets the programmer request the complete dynamic state of the 3437A by sending an ASCII "B" with no end of record terminator. The user program then makes a binary read request for seven bytes of coded data which contain the needed information.

This application can be used when one 3437A must be removed from the bus for recalibration and is replaced with another 3437A. The complete state is restored to the new 3437A by again sending "B" followed by the seven bytes of status information saved from the original 3437A. Figure 10-5 demonstrates the application. Table 10-3 shows the format of the seven bytes returned from the 3437A.

```
0001  FTN4,L
0002        PROGRAM F3437(3),01-09-79 (GWG) BINARY LEARN
0003        INTEGER     IREG(2),ILRN(4)
0004        EQUIVALENCE (REG,IREG,IA),(IREG(2),IB)
0005        COMMON      ILU,ILST,IDLU
0006        DATA        NO/2HNO/
0007        IF(INPRM(ID).EQ.NO)GO TO 100          Get input parameters.
0008        WRITE(IDLU,10)
0009     10 FORMAT("B_")                          Program binary learn mode. Underline character
                                                  removes end-of-RECORD terminator.

0010        REG=REIO(1,IDLU+100B,ILRN,-7)         Use a binary input request to input the seven
                                                  status bytes.

0011        PAUSE                                 Pause and replace the 3437A with a new one.

0012        WRITE(IDLU,10)                        Reprogram binary listen mode in the new
                                                  3437A.

0013        CALL EXEC(2,IDLU+100B,ILRN,-7)        Use a binary output request to output the seven
                                                  bytes
0014        STOP
0015   100  WRITE(ILU,20)
0016    20  FORMAT(" :RU,F3437,ILST,IDLU"/)
0017        END
```

Figure 10-5. Example Binary Program Mode for the 3437A

Table 10-3. 3437A Learn Mode Status Bytes

Byte	Function	DIO 8	7	6	5	4	3	2	1	Description
1	Range							0	0	Invalid
								0	1	.1 Volt
								1	0	10 Volt
								1	1	1 Volt
	Trigger					0	0			Invalid
						0	1			Internal
						1	0			External
						1	1			Hold/Man
			(4	2	1)					
	ENAB RQS		0	0	0					Does not request service
			0	0	1					Invalid Prgm
			0	1	0					Ignore Trig
			0	1	1					Invalid Prgm/Ignore Trig
			1	0	0					Data Ready
			1	0	1					Data Ready/Invalid Prgm
			1	1	0					Data Ready/Ignore Trig
			1	1	1					Data Ready/Ignore Trig/Invalid Prgm
	Data Format	0								Packed
		1								ASCII
		(8	4	2	1)					
2	NRDGS	X	X	X	X					MSD
						X	X	X	X	2SD
3		X	X	X	X					3SD
						X	X	X	X	LSD
4	Delay	X	X	X	X					Not Used (May or may not be set)
						X	X	X	X	MSD
5	Delay	X	X	X	X					2SD
						X	X	X	X	3SD
6	Delay	X	X	X	X					4SD
						X	X	X	X	5SD
7	Delay	X	X	X	X					6SD
						X	X	X	X	LSD

SRQ Processing

The 3437A has sophisticated service request capabilities which are programmable. These include the ability to generate an SRQ from the device when invalid programming (an error condition) has occured, timing is inappropriate (an error condition), or data is ready (a measurement condition). Configurations (within the 3437A) are available which also allow multiple conditions to generate these SRQ's. See Table 10-4 for the programming (byte) format which is sent to the 3437A for SRQ configuration.

Table 10-4. 3437A SRQ Configuration Byte Format

RQS Mask[1] (4 2 1)	(Octal)	Conditions for Initiating SRQ
0 0 0	0	No SRQ Capabilities
0 0 1	1	Invalid Program
0 1 0	2	Trigger Ignore
0 1 1	3	Trigger Ignore or Invalid Program
1 0 0	4	Data Ready
1 0 1	5	Data Ready or Invalid Program
1 1 0	6	Data Ready or Trigger Ignore
1 1 1	7	Data Ready or Trigger Ignore or Invalid Program

[1] a. Invalid PGM
b. Trig Ignore
c. Data Ready

Table 10-5 contains the format of the 3437A status byte which is returned to the HP 1000 on a serial poll sequence.

Table 10-5. 3437A SRQ Status Byte Format

Function	DIO 8	7	6	5	4	3	2	1	Description
ENAB RQS						X	X	X	Binary Code (0-7)*
RQS STATUS			X	X	X				Binary Code (0-7)
RQS Bit		X							Identifies the 3437A as the instrument that set SRQ True. (1 α True and 0 α False)
Not Used	X								Don't care.

**See Table 10-3.*

The device configuration word for the 3437A LU allows the user to set the priority of SRQ response for the 3437A. Although the configuration word may be set so that the occurrence of an SRQ will abort a current I/O request, unpredictable results will occur when this is used. This is not a problem however. When an "invalid program" sequence is sent to the 3437A, the device simply discards the invalid sequence, accepts the entire message, while asserting the SRQ line. There is no need to discontinue the message. Similiarly, the "trigger ignore" is a performance condition and there is no need to discontinue the message abruptly in this case. The "data ready" condition is used only when the SRQ program also reads the 3437A measurement. Aborting the I/O request is not needed here. Although the "S" and "R" bits of the device configuration word may be set to one, they should be left at their default value of "0", in all situations with the 3437A.

NOTE

If the 3437A has been configured internally to generate service requests, there must be an existing SRQ program for the device. Otherwise, when an SRQ occurs, the message "ILL INT xx" will be printed on the error log device and the bus will be set "down".

In some cases, SRQ can be used when the 3437A pauses long periods of time between measurements. Automatic program scheduling can be used to pick up and save these measurements on a mass storage device, and free the user partition during long waiting periods. Figure 10-6 shows a FORTRAN program which addresses this application.

In Figure 10-6, the SRQ program is triggered manually after each measurement is taken. (See the "TRIGR" message line 29 and line 44.)

NOTE

It is important that the user understand the ramifications concerning program "copies" in the more sophisticated versions of File Manager. We suggest that SRQ programs should NOT be saved as type six files to simplify the copying problem. Once SRQ has been setup, the HP-IB driver will expect to schedule a program by a specific name. If a copy has been created from the original name, the copy will not be found and an error will occur.

```
0001  FTN4,L
0002        PROGRAM C3437(3),09-12-78 (GWG) SRQ PROGRAM
0003  C
0004  C SYSTEM PREPARATIONS:
0005  C SET THE E BIT IN THE DEVICE CONFIGURATION WORD
0006  C UNBUFFER THE EQT
0007  C
0008  C THE RTE SAVE RESOURCES OPTION HAS BEEN
0009  C USED IN THIS PROGRAM. IT IS SCHEDULED
0010  C ONCE MANUALLY FOR SETUP, THEN N TIMES
0011  C BY 3437A INTERRUPTS.
0012  C
0013  C RMPAR IS CALLED N TIMES.
0014  C
0015  C
```

Figure 10-6. 3437A SRQ Program

```
0016          INTEGER IPM(5),IPRG(4),ISTT(2)
0017          COMMON  ILU,ILST,IDLU
0018          DATA    NO/2HNO/
0019          DATA    IPRG/5,2HC3,2H43,2H7 /,LOOP/0/
0020    C
0021          IF(INPRM(ID).EQ.NO)  GO TO 999          Get run parameters.
0022          WRITE(ILU,100)IDLU
0023      100 FORMAT(" 3437A: SRQ PROGRAM SETUP",
0024         &" IN PROGRESS FOR LU "I2"."/)
0025          CALL SRQ(IDLU,16,IPRG)                  Setup SRQ program
                                                      scheduling.
0026          IF(IERR(NN).LT.0) GO TO 20              Check for errors.
0027          WRITE(IDLU,144)
0028      144 FORMAT("T3")                            Hold/manual trigger.
0029          CALL TRIGR(IDLU)                        Trigger from user program.
0030       10 CALL EXEC(6,0,1)                        Terminate saving
                                                      resources.
0031          CALL RMPAR(IPM)                         Obtain status on rerun.
0032          IF(IAND(IPM,100B).NE.100B)GO TO 20
0033          IPM=IAND(IPM,7B)
0034          ASSIGN 8000 TO IFM
0035          IF(IPM.EQ.1)ASSIGN 1000 TO IFM
0036          IF(IPM.EQ.4)ASSIGN 4000 TO IFM
0037          IF(IPM.EQ.5)ASSIGN 5000 TO IFM
0038          IF(IPM.EQ.6)ASSIGN 6000 TO IFM
0039          IF(IPM.EQ.7)ASSIGN 7000 TO IFM
0040          WRITE(ILST,IFM)
0041          READ(IDLU,*)A
0042          WRITE(ILST,145)A
0043      145 FORMAT(F10.2)
0044          CALL TRIGR(IDLU)
0045     1000 FORMAT(/" 3437A: INVALID PROGRAMMING.")
0046     2000 FORMAT(/" 3437A: TRIGGER IGNORED.")
0047     3000 FORMAT(/" 3437A: TRIGGER IGNORED OR INVALID PROGRAMMING.")
0048     4000 FORMAT(/" 3437A: DATA READY.")
0049     5000 FORMAT(/" 3437A: DATA READY OR INVALID PROGRAMMING.")
0050     6000 FORMAT(/" 3437A: DATA READY OR TRIGGER IGNORED.")
0051     7000 FORMAT(/" 3437A: DATA READY, TRIGGER IGNORED, OR INVALID PGM.")
0052     8000 FORMAT(/" 3437A: INVALID STATUS BYTE FROM THE 3437A.")
0053          GO TO 10
0054      999 WRITE(ILU,130)
0055      130 FORMAT(" :RU,C3437,ILST,IDLU"/)
0056          STOP
0057       20 END
0058    C
```

Figure 10-6. 3437A SRQ Program (Continued)

```
0059  C
0060        FUNCTION IERR(N),
0061       &07-26-78 (GWG) HANDLE BUS ERRORS
0062        COMMON ILU,ILST,IDLU
0063        I=IBERR(IDLU)
0064        IERR=0
0065        IF(I.EQ.0)GO TO 10
0066        IERR=-I
0067        WRITE(ILU,30)I,IDLU
0068  30    FORMAT(" 3437A: BUS ERROR "I2" ON LU ",
0069       &I2," (HP-IB USERS GUIDE).")
0070  10    RETURN
0071        END
0072  C
0073  C
0074  C
0075        INTEGER FUNCTION INPRM(ID),11-29-78 (GWG) RUN PRM FOR HP-IB
0076        INTEGER         ISTRNG(40),OSTRNG(10),STRT
0077        COMMON          ILU,ILST,IDLU
0078  C
0079  C 'INPRM' GETS:
0080  C
0081  C   A. THE INPUT LOGICAL UNIT (INTERACTIVE TERMINAL).
0082  C   B. THE LIST LOGICAL UNIT FROM PARAMETER ONE (IT
0083  C      SETS THE LIST LU EQUAL TO THE INPUT LU IF THE
0084  C      LIST LU IS 0).
0085  C   C. THE DEVICE LOGICAL UNIT(INPRM CHECKS TO SEE
0086  C      IF IDLU IS NON-ZERO. IF NOT INPRM IS SET TO
0087  C      '2HNO').
0088  C
0089        INPRM=2HNO
0090        ILU=LOGLU(ID)
0091        CALL GETST(ISTRNG,-80,RTNCLN)
0092  C
0093        STRT=1
0094        DO 600 I=1,2
0095        IF(NAMR(OSTRNG,ISTRNG,RTNCLN,STRT))700,100
0096   100  ITYP=IAND(OSTRNG(4),3B)
0097        IF(I.EQ.1)GO TO 200
0098        IF(ITYP.NE.1) RETURN
0099        IDLU=OSTRNG
0100        GO TO 600
0101   200  ILST=OSTRNG
0102        IF(ITYP.EQ.0) ILST=ILU
0103   600  CONTINUE
0104   700  IF(IDLU.GT.0)INPRM=2HYE
0105        RETURN
0106        END
```

Figure 10-6. 3437A SRQ Program (Continued)

This manual trigger method could also be removed from the program as shown in Figure 10-7.

```
0001  FTN4,L
0002        PROGRAM E3437(3),09-12-78 (GWG) SRQ PROGRAM
0003  C
0004  C SYSTEM PREPARATIONS:
0005  C SET THE E BIT IN THE DEVICE CONFIGURATION WORD
0006  C UNBUFFER THE EQT
0007  C
0008  C THE RTE SAVE RESOURCES OPTION HAS BEEN
0009  C USED IN THIS PROGRAM. IT IS SCHEDULED
0010  C ONCE MANUALLY FOR SETUP, THEN N TIMES
0011  C BY 3437A INTERRUPTS.
0012  C
0013  C RMPAR IS CALLED N TIMES.
0014  C
0015  C
0016        INTEGER IPM(5),IPRG(4),ISTT(2)
0017        COMMON  ILU,ILST,IDLU
0018        DATA    NO/2HNO/
0019        DATA    IPRG/5,2HE3,2H43,2H7 /,LOOP/0/
0020  C
0021        IF(INPRM(ID).EQ.NO)  GO TO 999
0022        WRITE(ILU,100)IDLU
0023    100 FORMAT(" 3437A: SRQ PROGRAM SETUP",
0024       &" IN PROGRESS FOR LU "I2"."/)
0025        CALL SRQ(IDLU,16,IPRG)
0026        IF(IERR(NN).LT.0) GO TO 20
0027     10 CALL EXEC(6,0,1)
0028        CALL RMPAR(IPM)
0029        IF(IAND(IPM,100B).NE.100B)GO TO 20
0030        IPM=IAND(IPM,7B)
0031        ASSIGN 8000 TO IFM
0032        IF(IPM.EQ.1)ASSIGN 1000 TO IFM
0033        IF(IPM.EQ.4)ASSIGN 4000 TO IFM
0034        IF(IPM.EQ.5)ASSIGN 5000 TO IFM
0035        IF(IPM.EQ.6)ASSIGN 6000 TO IFM
0036        IF(IPM.EQ.7)ASSIGN 7000 TO IFM
0037        WRITE(ILST,IFM)
0038        READ(IDLU,*)A
0039        WRITE(ILST,145)A
0040    145 FORMAT(F10.2)
0041   1000 FORMAT(/" 3437A: INVALID PROGRAMMING.")
0042   2000 FORMAT(/" 3437A: TRIGGER IGNORED.")
0043   3000 FORMAT(/" 3437A: TRIGGER IGNORED OR INVALID PROGRAMMING.")
0044   4000 FORMAT(/" 3437A: DATA READY.")
0045   5000 FORMAT(/" 3437A: DATA READY OR INVALID PROGRAMMING.")
0046   6000 FORMAT(/" 3437A: DATA READY OR TRIGGER IGNORED.")
0047   7000 FORMAT(/" 3437A: DATA READY, TRIGGER IGNORED, OR INVALID PGM.")
0048   8000 FORMAT(/" 3437A: INVALID STATUS BYTE FROM THE 3437A.")
0049        GO TO 10
0050    999 WRITE(ILU,130)
0051    130 FORMAT(" :RU,E3437,ILST,IDLU"/)
0052        STOP
0053     20 END
```

Figure 10-7. 3437A SRQ Program Without Trigger

The program in figure 10-7 allows any number of tricks to be used with the 3437A.

a. Triggering can be done externally from another device. Simply program "T2E2" from File Manager, or the 3437A front panel (push the LOCAL button first), and schedule the program in figure 10-7 once to set up SRQ program scheduling.

b. Triggering can be done internally in the 3437A. Set the trigger mode to "T1" and the service request mask to "E2", then schedule the program in figure 10-7 once to set up SRQ program scheduling. Usually the 3437A needs to be prompted once from the front panel to get the measurements started.

c. Hold/Manual triggering can be accomplished from the 3437A front panel using the same procedure as in a. and b. above.

Note that in all three methods above, the delay between readings and the number of readings on each trigger should be programmed into the 3437A. (Remember the device must be in remote to be programmed.)

The FORTRAN program in Figure 10-8 can be used to detect "programming errors" and "trigger ignore" situations in the 3437A. The idea here is to schedule "D3437" once from a user terminal to set up SRQ program scheduling and a "device monitor" for the 3437A. Then, whenever an SRQ occurs, the message corresponding to the SRQ condition will be printed on "ILST". Remember that all of the program scheduling parameters apply as they do to an ordinary RTE program. Priority of the SRQ program is important. The SRQ program will be scheduled only if its priority is highest in the list of currently scheduled programs.

```
0001  FTN4,L
0002        PROGRAM D3437(3),09-12-78 (GWG) SRQ PROGRAM
0003  C
0004  C SYSTEM PREPARATIONS:
0005  C SET THE E BIT IN THE DEVICE CONFIGURATION WORD
0006  C UNBUFFER THE EQT
0007  C
0008  C THE RTE SAVE RESOURCES OPTION HAS BEEN
0009  C USED IN THIS PROGRAM. IT IS SCHEDULED
0010  C ONCE MANUALLY FOR SETUP, THEN N TIMES
0011  C BY 3437A INTERRUPTS.
0012  C
0013  C RMPAR IS CALLED N TIMES.
0014  C
0015  C
0016        INTEGER IPM(5),IPRG(4),ISTT(2)
0017        COMMON  ILU,ILST,IDLU
0018        DATA    NO/2HNO/
0019        DATA    IPRG/5,2HD3,2H43,2H7 /,LOOP/0/
0020  C
0021        IF(INPRM(ID).EQ.NO)  GO TO 999
0022        WRITE(ILU,100)IDLU
0023    100 FORMAT(/" 3437A: SRQ PROGRAM SETUP",
0024       &" IN PROGRESS FOR LU "I2"."/)
0025        CALL SRQ(IDLU,16,IPRG)
0026        IF(IERR(NN).LT.0) WRITE(ILU,15)
0027     15 FORMAT(" ERROR!")
0028        WRITE(ILU,101)
0029    101 FORMAT(" 3437A: SRQ SETUP FINISHED."/)
0030     10 CALL EXEC(6,0,1)
0031        CALL RMPAR(IPM)
0032        IPM=IAND(IPM,7B)
0033        ASSIGN 8000 TO IFM
0034        IF(IPM.EQ.1)ASSIGN 1000 TO IFM
0035        IF(IPM.EQ.2)ASSIGN 2000 TO IFM
```

Figure 10-8. 3437A SRQ Program for Checking Errors

```
0036          IF(IPM.EQ.3)ASSIGN 3000 TO IFM
0037          IF(IPM.EQ.4)ASSIGN 4000 TO IFM
0038          IF(IPM.EQ.5)ASSIGN 5000 TO IFM
0039          IF(IPM.EQ.6)ASSIGN 6000 TO IFM
0040          IF(IPM.EQ.7)ASSIGN 7000 TO IFM
0041          WRITE(ILST,IFM)
0042     1000 FORMAT(/" 3437A: INVALID PROGRAMMING.")
0043     2000 FORMAT(/" 3437A: TRIGGER IGNORED.")
0044     3000 FORMAT(/" 3437A: TRIGGER IGNORED OR INVALID PROGRAMMING.")
0045     4000 FORMAT(/" 3437A: DATA READY.")
0046     5000 FORMAT(/" 3437A: DATA READY OR INVALID PROGRAMMING.")
0047     6000 FORMAT(/" 3437A: DATA READY OR TRIGGER IGNORED.")
0048     7000 FORMAT(/" 3437A: DATA READY, TRIGGER IGNORED, OR INVALID PGM.")
0049     8000 FORMAT(/" 3437A: INVALID STATUS BYTE FROM THE 3437A.")
0050          GO TO 10
0051      999 WRITE(ILU,130)
0052      130 FORMAT(" :RU,D3437,ILST,IDLU"/)
0053          STOP
0054       20 END
```

Figure 10-8. 3437A SRQ Program for Checking Errors (Continued)

Performance

The 3437A performance evaluation has been broken down into three catagories:

1. FORTRAN free field input.

2. BCD formatted input (BCD is sent from the 3437A).

3. BCD formatted input including the time necessary to convert the measurements to HP 1000 binary, using the subroutine "CNVRT" shown in figure 10-4.

Method 1 is optimized for user program simplicity. System utilization and measurement speed are moderate. Figure 10-9 shows the performance curve; figure 10-10 shows the FORTRAN statements used for the measurements.

Methods 2 and 3 (figure 10-11) require binary input "EXEC" requests but satisfy rapid measurement speed requirements. At the same time these methods reduce system utilization considerably. Figure 10-12 shows the FORTRAN statements for both methods 2 and 3.

```
0043  C=====================================================================
0044  C ENTER USER STATEMENTS OUT OF TEST HERE.
0045  C
0046        WRITE(IDLU,1110)ILN
0047   1110 FORMAT)"N"I3"S")
0048        WRITE(IDLU,1111)
0049   1111 FORMAT("D.00001SR3T1F2")
0050  C
0051  C
0052  C=====================================================================

0060  C=====================================================================
0061  C ENTER USER STATEMENTS FOR TEST HERE.
0062  C
0063  C
0064        CALL EXEC(1,IDLU+100B,IBUF,ILN)
0064  C USER STATEMENTS FOR TEST END HERE.
0066  C=====================================================================
```

Using subroutine CNVRT:

```
0044  C=====================================================================
0045  C ENTER USER STATEMENTS OUT OF TEST HERE.
0046  C
0047        WRITE(IDLU,1110)ILN
0048   1110 FORMAT("N"I3"S")
0049        WRITE(IDLU,1111)
0050   1111 FORMAT("D.00001SR3T1F2")
0051  C
0052  C
0053  C=====================================================================

0061  C=====================================================================
0062  C ENTER USER STATEMENTS FOR TEST HERE.
0063  C     DO 100 IJ=1,ILN
0064  C
0065        REG= EXEC(1,IDLU+100B,IBUF,ILN)
0066        IF(CNVRT(IBUF,IB,OUTBUF).LT.0) GO TO 800
0067  C USER STATEMENTS FOR TEST END HERE.
0068  C=====================================================================
```

Figure 10-12. 3437A "EXEC" Input FORTRAN Statements

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