

## Errata

**Document Title:** 3325A Synthesizer / Function Generator and  
1000 Computer HP-IB Programming Guide (AN 401-13)

**Part Number:** 5953-2812

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### HP References in this Application Note

This application note may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, semiconductor products and chemical analysis businesses are now part of Agilent Technologies. We have made no changes to this application note copy. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A.

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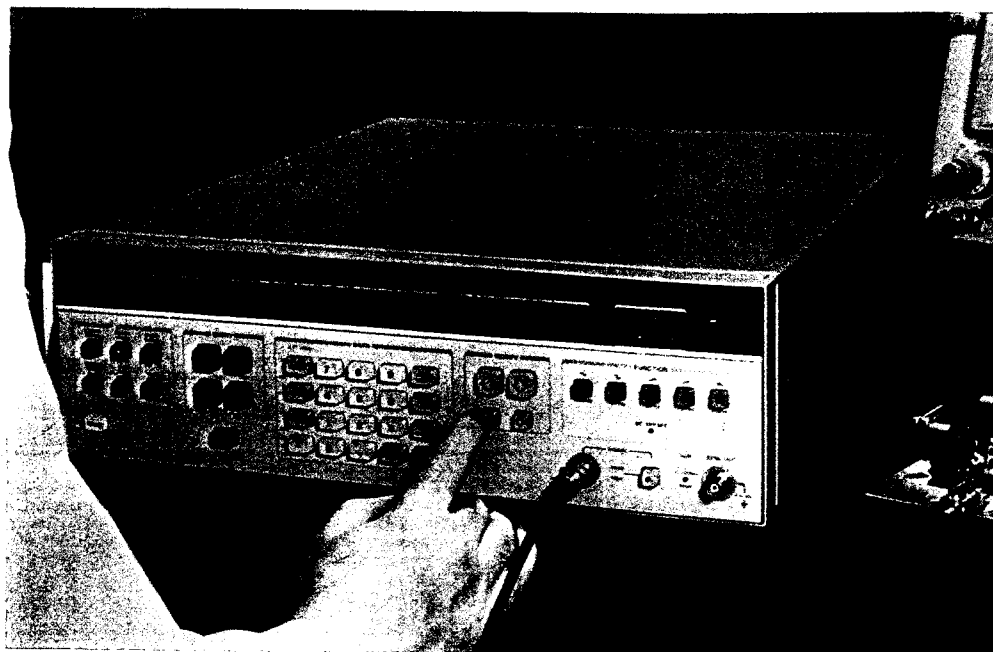
# HP 3325A Synthesizer/ Function Generator



# HP 1000 Computer

## Programming Guide

Application Note 401-13



### Device Introduction

The HP 3325A Synthesizer/Function Generator<sup>1</sup> produces the following signals from a minimum frequency of 1  $\mu$ Hz to a maximum frequency of:

Sine wave	20 MHz
Square wave	10 MHz
Triangle	10 kHz
Positive slope ramp	10 kHz
Negative slope ramp	10 kHz

Frequencies may be selected with up to 11 digits of resolution. Output amplitude is from 1 millivolt to 10 volts peak-to-peak. The output level may also be selected or displayed in RMS volts or in dBm (50 ohms). Any function may be DC offset up to + 5 volts. An optional high voltage output produces up to 40 volts peak-to-peak given that the load is more than 500 ohms.

For all functions, frequency sweep is provided in linear or log sweep, at sweep times of 10 milliseconds to 99.99 seconds.

<sup>1</sup>The 3325A Operating and Service Manual (03325-90000) and Application Note 401-1 (5953-2800) should be used in conjunction with this note.

Minimum time is 2 seconds for single sweep and 0.1 seconds for continuous sweep. Single linear sweep may be up or down, while continuous sweep is up/down/up, etc., in the linear mode and up/up, etc., in log mode.

The 3325A can be programmed remotely in the same manner as it is programmed from the front panel. All of the HP-IB messages are available except "trigger," the "status bit" (also known as parallel poll), and "pass control". The 3325A has sophisticated error checking facilities which can be combined with SRQ functions to provide powerful diagnostic analysis of on-line problems.

All applicable functions are programmable using an organized mnemonic message structure. Various 3325A modes can be programmed and tested separately in sub-routines, then combined for application-specific problems.

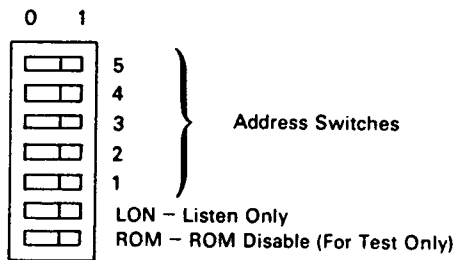
### Addressing

The 3325A is normally shipped from the factory with the TALK/LISTEN address set to 21 octal (17 decimal). Its address switches are located inside the top cover near the center of the instrument. The possible HP-IB addresses are shown in figure 13-1.

# HP 3325A/HP 1000

ASCII Characters		Address Switches (Binary Code)	Equivalent Codes (To 5-Bit Binary Switches)		
Listen Address	Talk Address		Octal	Decimal	Hexadecimal
SP	@	0 0 0 0 0	00	00	00
!	A	0 0 0 0 1	01	01	01
"	B	0 0 0 1 0	02	02	02
#	C	0 0 0 1 1	03	03	03
\$	D	0 0 1 0 0	04	04	04
%	E	0 0 1 0 1	05	05	05
&	F	0 0 1 1 0	06	06	06
'	G	0 0 1 1 1	07	07	07
(	H	0 1 0 0 0	10	08	08
)	I	0 1 0 0 1	11	09	09
*	J	0 1 0 1 0	12	10	0A
+	K	0 1 0 1 1	13	11	0B
,	L	0 1 1 0 0	14	12	0C
-	M	0 1 1 0 1	15	13	0D
.	N	0 1 1 1 0	16	14	0E
/	O	0 1 1 1 1	17	15	0F
0	P	1 0 0 0 0	20	16	10
1	Q	1 0 0 0 1	21	17	11
2	R	1 0 0 1 0	22	18	12
3	S	1 0 0 1 1	23	19	13
4	T	1 0 1 0 0	24	20	14
5	U	1 0 1 0 1	25	21	15
6	V	1 0 1 1 0	26	22	16
7	W	1 0 1 1 1	27	23	17
8	X	1 1 0 0 0	30	24	18
9	Y	1 1 0 0 1	31	25	19
:	Z	1 1 0 1 0	32	26	1A
:	[	1 1 0 1 1	33	27	1B
<	\	1 1 1 0 0	34	28	1C
=	]	1 1 1 0 1	35	29	1D
>	~	1 1 1 1 0	36	30	1E

Factory Selected Address →



NOTE: The Equivalent Codes shown correspond only to the 5-bit binary switch code. These bits are the same for both listen and talk addresses, and the sixth and seventh bits determine whether the address is listen (01) or talk (10). Some controllers distinguish between listen and talk automatically, requiring only the 5-bit code equivalent to designate a device.

Figure 13-1. 3325A TALK/LISTEN Addresses

## System Preparations

### LU Assignment

One LU should be assigned to the 3325A's TALK/LISTEN address. Assuming the factory set address of 21B will be used, the File Manager command,

```
:SYLU,16,10,21B
```

will assign LU 16, mapped through EQT 10, to the 3325A.

### Output Buffering

Buffering may be used on output from the HP 1000 to the 3325A once the instrument has been checked out and user software has been thoroughly verified. To unbuffer EQT 10 for hardware and software verification, a File Manager request may be used,

```
:SYEQ,10,UN
```

To buffer EQT 10,

```
:SYEQ,10,BU
```

Buffering affects all devices on the same EQT. Make sure that timing (on output from the HP 1000) will not be adversely changed for other HP-IB devices.

### Time-Out

A time-out occurrence is considered to be an error condition within the 3325A. Triggering is not applicable, and the instrument does not return measurements to the computer. Time-outs may be handled by the operating system by allowing the device configuration word to default to its normal setting. The EQT time-out value may be set as short as one second, but other devices on the same bus must be considered also.

### Configuration Word

DMA should not be allocated to the 3325A. The configuration word should be verified or set to reflect this condition. From File Manager,

```
:CN,16,25B,17000B
```

will set non-DMA and operating system processing of time-out errors. End-of-record processing is standard in the 3325A and will need no reconfiguration.

### Remote

The 3325A must be programmed into remote before data messages will be recognized. The File Manager command,

```
:CN,16,16B
```

will set LU 16 into remote. The FORTRAN request,

```
CALL RMOTE(16)
```

will perform the same operation.

### Programming

The 3325A communicates in ASCII only. Triggering and taking measurements are not applicable to the 3325A. The instrument may, however, be interrogated for internal status, so the essentials of programming are very simple.

Table 13-1 contains a list of 3325A programming commands. The documentation supplied in the 3325A Operating and Service Manual (03325-90000) is very good and should be read for instrument operation.

The 3325A recognizes programming strings (data messages) of the form shown in figure 13-2. Mnemonics, data, and delimiters are shown in their various columns in Table 13-1. EOS means "end of string" and is handled automatically by the HP 1000 as a carriage return linefeed (CRLF).

#### NOTE

Programming mode 2 should be used when operating the instrument with the HP 1000. The string "MD2" should be sent first.

Mnemonic, Data, Delimiter, EOS Mnemonic, Data, EOS Mnemonic, EOS I, Mnemonic, EOS
--------------------------------------------------------------------------------------------

Figure 13-2. 3325A Mnemonic Programming Structure

# HP 3325A/HP 1000

**Table 13-1. 3325A Programming Commands**

Parameter or Operation	Mnemonics ASCII Code	Data	ASCII Code	Delimiters	Approximate Programming Time*
Data Transfer Mode Data Mode 1 Data Mode 2	= MD = MD	1 2		NA	MD = 4.5 ms
Function	= FU	0 = DC Only 1 = Sine 2 = Square 3 = Triangle 4 = Positive Ramp 5 = Negative Ramp		NA	FU = 1500 ms
Frequency	= FR	≤ 11 Digits and Decimal	HZ = Hertz KH = Kilohertz MH = Megahertz		FR = 7.0 ms Each digit or decimal = 2.8 ms HZ, KH, or MH = 12.5 ms
Amplitude	= AM	≤ 4 Digits and Decimal. Also - sign if negative dBm. + sign is valid but not required.	VO = Volts (p-p) MV = Millivolts (p-p) VR = Volts rms MR = Millivolts rms DB = dBm		AM = 6.8 ms Each digit, decimal or decimal = 2.8 ms VO or MV = 90 ms VR or MR = 130 ms DB = 250 ms
DC Offset	= OF	≤ 4 Digits and Decimal. Also - sign if negative dc offset. + sign is valid but not required.	VO = Volts MV = Millivolts		OF = 6.8 ms Each digit, decimal, or - sign = 2.8 ms VO or MV = 82 ms
Phase	= PH	≤ 4 Digits - minus sign	DE = Degrees		PH = 5 ms; DE = 28 ms Each digit and - sign = 2.8 ms
Sweep Start Frequency Sweep Stop Frequency Sweep Marker Frequency	= ST = SP = MF	≤ 11 Digits and Decimal	HZ = Hertz KH = Kilohertz MH = Megahertz		ST, SP, or MF = 7.0 ms Each digit or decimal = 2.8 ms HZ, KH, or MH = 10.3 ms
Sweep Time	= TI	≤ 4 Digits and Decimal	SE = Seconds		TI = 5.5 ms; SE = 7.0 ms Each digit and decimal = 2.8 ms
Sweep Mode Linear Logarithmic	= SM	1 2		NA	SM = 4.5 ms
Rear or Front Panel Output Rear Panel Front Panel	= RF	1 2		NA	RF = 44.5 ms
Store Program Recall Program	= SR = RE	1 Digit, 0-9		NA	SR = 11 ms; RE = 1700 ms
Execution Functions Assign Zero Phase Perform Auto-Cal Start Single Sweep Start Continuous Sweep Perform Self-Test	= AP = AC = SS = SC = TE	NA		NA	AP = 5.2 ms AC = 1500 ms SS = 300 ms SC = 300 ms TE = 10,000 ms
Interrogate Program Error	= IER	NA		NA	IER = 11.5 ms

\*Program times are in addition to the data transfer time of 225 to 250 μs per byte.

**Table 13-1. 3325A Programming Commands (Continued)**

Parameter or Operation	Mnemonics ASCII Code	Data	ASCII Code Delimiters	Approximate Programming Time*
Interrogate Entry Parameters Frequency Amplitude Offset Phase Sweep Start Frequency Sweep Stop Frequency Sweep Marker Frequency Sweep Time	= IFR = IAM = IOF = IPH = IST = ISP = IMF = ITI	NA	NA	IFR = 10 ms IAM = 9.8 ms IOF = 9.8 ms IPH = 8 ms IST = 10 ms ISP = 10 ms IMF = 10 ms ITI = 8.5 ms
Interrogate Function	= IFU	NA	NA	IFU = 1603 ms
Mask Service Requests	= MS	See Para. 3-144	NA	MS = 4.5 ms
Binary (ON/OFF) Functions High Voltage Output Amplitude Modulation Phase Modulation	= HV = MA = MP	OFF = 0 ON = 1	NA	HV = 48 ms MA = 7.0 ms MP = 7.0 ms

\*Program times are in addition to the data transfer time of 225 to 250  $\mu$ s per byte.

The 3325A does not default to mode 2 on power up. For this reason, the instrument should be initialized programmatically before any other operations are attempted. Figure 13-3 shows an example File Manager sequence for 3325A programming.

The output waveform from the 3325A after the sequence should be a sine wave, of amplitude 10 volts, with a frequency of 1000 Hz.

Later in the "Service Requests" section, an SRQ program is introduced which analyzes errors in the 3325A. This program can be set up independently and will print error messages whenever an invalid sequence is entered from the user terminal or a user program.

Programming strings may be sent to the 3325A using FORTRAN "WRITE" statements. For example,

```
WRITE(16,10)
10 FORMAT("MD2FU1FR1000.0HZ")
```

will send the ASCII message "MD2FU1FR1000.0HZ" to LU 16. At completion, the 3325A should be set to Mode 2, sine wave function, and a frequency of 1000 Hz.

Figure 13-4 contains a FORTRAN program and several function subprograms which remotely program waveform type, frequency, and amplitude in the 3325A. The program uses an interesting method for sending programming strings to the 3325A. In figure 13-4, strings are concatenated and when complete information has been obtained, the entire set of programming commands is sent using a "CALL EXEC" request.

```
:LL,16 . . . . .Output to the 3325A.
:AN,MD2 . . . . .Set Mode 2.
:AN,FU1 . . . . .Sine wave.
:AN,FR1000.0HZ . . . . .Frequency 1000.0 hz.
:AN,AM10VD . . . . .Amplitude 10 Volts.
:LL,0G . . . . .Set output back to user's terminal.
```

**Figure 13-3. Example File Manager Sequence**

# HP 3325A/HP 1000

```

0001 FTN4,L
0002 PROGRAM A3325(3),02-08-79 (GWG) PROGRAM FUNCTIONS
0003 INTEGER FUNC,YES,ISTR,FREQ,AMPL
0004 COMMON ILU,ILST,IDLU,ISTR(8)
0005 DATA NO/2HND/,YES/2HYE/
0006 IF(INPRM(ID).EQ.NO)GO TO 999
0007 10 ISTR=0
0008 WRITE(ILU,20)
0009 20 FORMAT("FINISHED? _")
0010 CALL REIO(1,ILU+400B,IANS,1)
0011 IF(IANS.EQ.YES)STOP
0012 IF(FUNC(LEN).EQ.YES) CALL ADSTR(ISTR,LEN)
0013 IF(FREQ(LEN).EQ.YES) CALL ADSTR(ISTR,LEN)
0014 IF(AMPL(LEN).EQ.YES) CALL ADSTR(ISTR,LEN)
0015 CALL ADSTR(ISTR,-1)
0016 GO TO 10
0017 999 WRITE(ILU,1000)
0018 1000 FORMAT(":RU,A3325,ILST,IDLU")
0019 END
0020 C
0021 C
0022 INTEGER FUNCTION FUNC(LNTH),02-08-79 (GWG) FUNCTION
0023 INTEGER FTBL(2,6),DTBL(12),ISTR,YES,FVAL,FUN,FUNCT,IREG(2)
0024 EQUIVALENCE (DTBL,FTBL),(FUN,ISTR),(FVAL,ISTR(2)),
0025 & (IA,IREG,REG),(IB,IREG(2))
0026 COMMON ILU,ILST,IDLU,ISTR(8)
0027 DATA DTBL/30040B,2HDC,30440B,2HSI,31040B,2HSQ,
0028 & 31440B,2HTR,32040B,2HPS,32440B,2HNS/,
0029 & NO/2HND/,YES/2HYE/
0030 FUNC= YES
0031 FUN = 2HFU
0032 LNTH = 2
0033 5 WRITE(ILU,10)
0034 10 FORMAT(/"WAVEFORM FUNCTIONS. VALID ENTRIES ARE:",//,
0035 & " DC = FUNCTION OFF (DC ONLY)",/,
0036 & " SI = SINE",/,
0037 & " SQ = SQUARE",/,
0038 & " TR = TRIANGLE",/,
0039 & " PS = POSITIVE SLOPE RAMP",/,
0040 & " NS = NEGATIVE SLOPE RAMP",//,
0041 & "ENTER A FUNCTION: _")
0042 REG= EXEC(1,ILU+400B,FUNCT,1)
0043 FVAL=NO
0044 DO 20 I=1,6
0045 20 IF(FTBL(2,I).EQ.FUNCT)FVAL=FTBL(1,I)
0046 IF(FVAL.EQ.NO)FUNC=NO
0047 RETURN
0048 END
0049 C
0050 C
0051 INTEGER FUNCTION FREQ(LNTH),02-08-79 (GWG) FREQUENCY
0052 C MAY RETURN:
0053 C FREQ = YES WHEN VALUES ARE ENTERED
0054 C = NO WHEN NONE ENTERED OR JUST RETURN
0055 C LNTH = 0 WHEN FREQ = NO
0056 C > 0 WHEN FREQ = YES

```

Figure 13-4. FORTRAN Program for the 3325A

```

0057 C
0058     INTEGER      HERTZ,DVAL(6),MNMENM,ISTR,YES,IREG(2)
0059     EQUIVALENCE (ISTR,MNMENM),(ISTR(2),DVAL),
0060     &              (IREG,IA,REG),(IREG(2),IB)
0061     COMMON        ILU,ILST,IDLU,ISTR(8)
0062     DATA NO/2HND/,YES/2HYE/
0063     DO 20 I=1,8
0064     20 ISTR(I)=2H
0065     FREQ=NO
0066     MNMENM=2HFR
0067     LNTH=0
0068     WRITE(ILU,5000)
0069     5000 FORMAT(/"FREQUENCY:"/,
0070     &           "                HZ = HERTZ"/,
0071     &           "                KH = KILOHERTZ"/,
0072     &           "                MH = MEGAHERTZ"/,
0073     &           "?? _")
0074     REG= REID(1,ILU+400B,HERTZ,1)
0075     IF(HERTZ.EQ.2HHZ.OR.
0076     &   HERTZ.EQ.2HKH.OR.
0077     &   HERTZ.EQ.2MH) GO TO 10
0078     RETURN
0079 C
0080     10 WRITE(ILU,5020)
0081     5020 FORMAT(/"DECIMAL VALUE (12.34 for example) : _")
0082     REG= EXEC(1,ILU+400B,DVAL,6)
0083     WRITE(ILU,144)IB
0084     144 FORMAT(I6)
0085     IF(IB.EQ.6)DVAL(6)=IAND(DVAL(6),177400B)+40B
0086     IF(IB.EQ.0) RETURN
0087     LNTH=IB+2
0088     DVAL(IB+1)=HERTZ
0089     FREQ=YES
0090     CALL EXEC(2,ILU,ISTR,LNTH)
0091     RETURN
0092     END
0093 C
0094 C
0095     INTEGER FUNCTION AMPL(LNTH),02-08-79 (GWG) AMPLITUDE
0096     INTEGER      VOLTS,DVAL(2),MNMENM,ISTR,YES,IREG(2)
0097     EQUIVALENCE (ISTR,MNMENM),(ISTR(2),DVAL),(ISTR(4),VOLTS),
0098     &              (REG,IREG,IA),(IREG(2),IB)
0099     COMMON        ILU,ILST,IDLU,ISTR(8)
0100     DATA NO/2HND/,YES/2HYE/
0101     DO 20 I=1,4
0102     20 ISTR(I)=2H
0103     AMPL=NO
0104     MNMENM=2HAM
0105     LNTH=0
0106     WRITE(ILU,5000)

```

Figure 13-4. FORTRAN Program for the 3325A (Continued)



```

0107 5000 FORMAT(/"AMPLITUDE:"/,
0108 & "          VO = VOLTS (p-p)"/,
0109 & "          MV = MILLIVOLTS"/,
0110 & "          VR = VOLTS (rms)"/,
0111 & "          MR = MILLIVOLTS (rms)"/,
0112 & "          DB = dBm"/,
0113 & "          "? _")
0114     REG= REIO(1,ILU+400B,VOLTS,1)
0115     IF(VOLTS.EQ.2HVO.OR.
0116 & VOLTS.EQ.2HVV.OR.
0117 & VOLTS.EQ.2HVR.OR.
0118 & VOLTS.EQ.2HMR.OR.
0119 & VOLTS.EQ.2HDB) GO TO 10
0120     RETURN
0121 C
0122     10 WRITE(ILU,5020)
0123 5020 FORMAT(/"DECIMAL VALUE (12.34 for example) : _")
0124     REG= EXEC(1,ILU+400B,DVAL,2)
0125     IF(IB.EQ.0)RETURN
0126     LNTH=IB+2
0127     DVAL(IB+2)=VOLTS
0128     AMPL=YES
0129     CALL EXEC(2,ILU,ISTR,LNTH)
0130     RETURN
0131     END
0132 C
0133 C
0134     SUBROUTINE ADSTR(INDX,LEN),02-08-79 (GWG) CONCATENATE
0135     INTEGER OSTR(24)
0136     COMMON ILU,ILST,IDLU,ISTR(8)
0137     IF(LEN.LT.0)GO TO 5
0138     IF(LEN.EQ.0)RETURN
0139     IA=0
0140     LENA=LEN
0141     DO 10 I = 1,LEN
0142     IA=IA+1
0143     IF(INDX+I.LT.24)GO TO 20
0144     CALL EXEC(2,IDLU,OSTR,24)
0145     INDX=0
0146     LENA=LEN-I+1
0147     IA=1
0148     20 OSTR(INDX+IA)=ISTR(I)
0149     10 CONTINUE
0150     INDX=INDX+LENA
0151     RETURN
0152     5 CALL EXEC(2,IDLU,OSTR,INDX)
0153     INDX=0
0154     RETURN
0155     END
0156     END$

```

Figure 13-4. FORTRAN Program for the 3325A (Continued)

Subroutines "FUNC", "FREQ", and "AMPL" request the waveform function, frequency, and amplitude, respectively, from the user at a CRT terminal. Each subroutine builds a programming string in "ISTR" (line 4). After each string of characters has been determined, the subroutine "ADSTR" is called which,

1. concatenates the last string received onto the current string "OSTR" (line 136 in subroutine "ADSTR"), or
2. sends the complete string "OSTR" to the 3325A.

A 3325A programming string can be output from subroutine "ADSTR" only when,

1. parameter "LEN" (line 134) is negative, or
2. the number of characters in "OSTR" reaches a length of 48.

In subroutine "FUNC" (lines 23 through 29 of figure 13-4), a correspondence is set up between the 3325A waveform numbers and mnemonic values for each waveform. For example,

- 0 = DC = DC
- 1 = SI = Sine
- 2 = SQ = Square
- 3 = TR = Triangle
- 4 = PS = Positive slope ramp
- 5 = NS = Negative slope ramp

Table "FTBL" creates a match for the ASCII translation of "DC" to "0", etc. If a user entered "DC" in answer to the

prompt "ENTER A FUNCTION," the subroutine would create the string "FU0".

The programs and subroutines in figure 13-4 do not contain a significant amount of error checking. In fact, erroneous or unrecognizable 3325A program statements may be entered and sent to the instrument. Figure 13-4 should be used with the SRQ error processor program (figure 13-8) discussed under "Service Requests" in this section. The SRQ program will diagnose syntax errors and print the error message on the user's terminal when an input error occurs.

## Status and Interrogation Features

Status may be obtained from the 3325A in two ways:

1. Serial Poll, which produces a status byte.
2. Interrogation, when the HP 1000 interrogates program errors, or entry parameters.

## Artificial Status

A serial poll may be produced artificially or left to be handled automatically by the service request abilities of the HP 1000 system (discussed under "Service Request" in this section). Status can be produced artificially by calling the subroutine STATS.<sup>2</sup> In FORTRAN,

```
CALL STATS(IDLU, ISTAT)
```

will conduct a serial poll, obtain the instrument status byte, and return the value in ISTAT. A simple program which performs this function is shown in figure 13-5. The format of the 3325A status byte is shown in figure 13-6.

```

0001  FTN4,L
0002      PROGRAM TDYN(3),03-29-79 (GWG) DYNAMIC STATUS
0003      INTEGER DYNS,YES
0004      COMMON ILU,ILST,IDLU
0005      DATA NO/2HNO/,YES/2HYE/
0006      IF(INPRM(ID).EQ.NO) STOP           Obtain input parameters.
0007      CALL STATS(IDLU,ISTAT)           Request status.
0008      WRITE(ILU,10)ISTAT
0009      10 FORMAT(K6)
0010      END

```

Figure 13-5. Obtaining 3325A Status Manually

<sup>2</sup>Subroutine "STATS" is documented in the HP-IB User's Manual (part number 59310-90064).

# HP 3325A/HP 1000

Some 3325A status byte information does not cause an SRQ. "Sweep in progress" is one such example. The sweep flag can be monitored by the HP 1000 to determine when the end of a sweep occurs. The 3325A will dynamically output status while internal processing is in progress.

## Interrogation

When the "program string error" occurs and is detected within the 3325A status byte, further interrogation may be performed by requesting more error information from the instrument. Table 13-2 shows the numeric values returned when the 3325A is interrogated using the mnemonic "IER" (see "Service Requests").

In figure 13-8, the subroutine PCHCK performs a WRITE request in line 63 to send the message "IER". The READ statement in line 65 with format "A2,I1" then obtains the error information from the 3325A. The remainder of subroutine PCHCK evaluates possible errors.

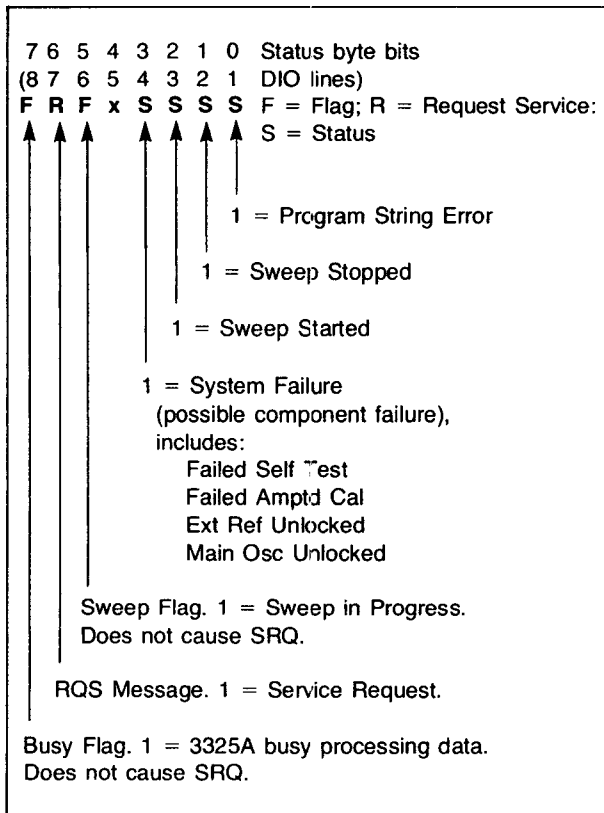


Figure 13-6. 3325A Status Byte Format

Table 13-2. 3325A Request "IER"

ASCII Numeric	Error
1	Entry parameter out of bounds (for example, Freq $\geq$ 61 MHz).
2	Invalid delimiter.
3	Frequency too large for function (for example, Function = Triangle, Freq $\geq$ 11 kHz).
4	Sweep time too small or too large.
5	Offset incompatible with amplitude, or amplitude incompatible with offset.
6	Sweep frequency too large for function; sweep bandwidth too small; start frequency too small (log sweep); start frequency greater than stop frequency (log sweep).
7	Unrecognizable mnemonic received.
8	Unrecognizable data character received.
9	Option does not exist (High Voltage or Rear/Front).

Subroutine STATS<sup>3</sup> can also be used with "S3325" (figure 13-8) to perform a complete 3325A status check.

## Interrogating Past Programming Parameters

Entry parameters indicating the current frequency, amplitude, phase, etc., may also be interrogated from the 3325A. A typical FORTRAN sequence may be used. The FORTRAN example in figure 13-7 requests the current frequency setting and prints the result on the user's terminal.

Using this feature, a simple application program can be written which will actually learn various states in the 3325A. For example, a user can program the 3325A for various functions from the front panel. A user program is then executed which interrogates the instrument and saves its state in an FMP

<sup>3</sup>An interesting program which performs a similar function for the 3582A Spectrum Analyzer is shown in AN 401-12 (5953-2811).

disc file. Later this state could be restored using the sub-routines documented earlier in this application note. This application may find use in test beds and assembly lines where many different devices are being tested.

The functions and programs in this section can be combined to satisfy this application.

## Service Requests

The 3325A is capable of generating SRQ's for up to four conditions:

1. Program Error
2. Sweep Stop
3. Sweep Start
4. System Failure

Any combination of these may also be configured to generate the request for service (see Table 13-3).

When the 3325A is turned on, all service requests are masked out. This means that none of the above conditions will generate a service request. Different configurations can be enabled by sending the mask request "MS" and the corresponding ASCII character representing the status options desired. Table 13-3 shows the correspondence between the ASCII characters and the available mask options.

A feature known as "automatic program scheduling" may be used in the HP 1000 to process SRQ occurrences from the 3325A. When a 3325A SRQ occurs, the HP 1000 automatically does a serial poll and reads the 3325A status byte into memory. The operating system then schedules a user program previously designed and configured for processing 3325A service requests. One such program is shown in figure 13-8. This program, when scheduled, retrieves the 3325A status byte from system memory and analyzes it. Analysis is performed using subroutine "S3325" which sequentially checks each bit. When bit zero has been enabled, a programming error has occurred and further 3325A interrogation is required. Subroutine "PCHCK" is then called to do the required processing.

In program C3325 (figure 13-8), the message "MS0" is sent to the 3325A in line 28. This enables the instrument to generate SRQ's for all potential service request situations.

Program C3325 is scheduled once from a user terminal to prepare the HP 1000 for further automatic SRQ program scheduling. It is during this first run sequence that the 3325A mask is enabled for all SRQ situations. Program C3325 then finishes execution, saving the values of the input terminal LU (ILU) and the 3325A LU (IDLU) on the HP 1000 mass storage system disc. (This is called "termination saving resources" by most programmers.)

```

      INTEGER IBFR(20),IREG)20
      EQUIVALENCE (IREG,REG,IA),(IREG(2),IB)
      :
      :
      :
      WRITE(IDLU,10)
10  FORMAT ("IFR")
      REG=EXEC(I,IDLU,IBFR,20)
      CALL EXEC(2,ILU,IBFR,IB)
      NCHAR=IB2
      :
      :
      :
      END
  
```

Figure 13-7. Interrogating Entry Parameters in FORTRAN

**Table 13-3. SRQ Mask Configurations**

ASCII Character	Bits 3 thru 0	System Fail Bit 3	Sweep Start Bit 2	Sweep Stop Bit 1	Program Error Bit 0
@	*0000	Mask	Mask	Mask	Mask
A	0001	Mask	Mask	Mask	Enable
B	0010	Mask	Mask	Enable	Mask
C	0011	Mask	Mask	Enable	Enable
D	0100	Mask	Enable	Mask	Mask
E	0101	Mask	Enable	Mask	Enable
F	0110	Mask	Enable	Enable	Mask
G	0111	Mask	Enable	Enable	Enable
H	1000	Enable	Mask	Mask	Mask
I	1001	Enable	Mask	Mask	Enable
J	1010	Enable	Mask	Enable	Mask
K	1011	Enable	Mask	Enable	Enable
L	1100	Enable	Enable	Mask	Mask
M	1101	Enable	Enable	Mask	Enable
N	1110	Enable	Enable	Enable	Mask
O	1111	Enable	Enable	Enable	Enable

\* Initial turn-on conditions .

The program C3325 can be used in applications when 3325A program development is being done and on-line error checking is needed. Any error messages will be printed on "ILST".

## Performance

Performance data for the 3325A instrument is shown in Table 13-4.

Within the device, a quantum of time is required for each mnemonic and/or ASCII digit. Time is also required for processing the data once received. These times, when combined with setup times in the HP 1000,<sup>4</sup> will approximate transfer rates. The time required per byte for the 3325A should be compared to the time per byte for the HP 1000. The value which is larger should be used in the equation.

More sophisticated operations using the 3325A become very cumbersome to analyze. The performance information, equations, and programs in Chapters 4 and 5 of Application Note 401-1 (part no. 5953-2800) can be used when a detailed analysis is required.

<sup>4</sup>See Application Note 201-4, "Performance Evaluation of HP-IB Using RTE Operating Systems." Setup times and performance equations can be found in this document.

Table 13-4. 3325A Performance Information

Function	Mnemonic	Input Data Transfer Time	Device Time	Output Data Transfer Time
Function (Waveform) 1 Digit	FU	450-500 $\mu$ s 225-250 $\mu$ s	1600 ms 2.8 ms	450-500 $\mu$ s 225-250 $\mu$ s
Frequency $\leq$ 11 Digits + Decimal Delimiters	FR HZ, KH, or MH	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s	7.0 ms 2.8 ms each 12.5 ms	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s
Amplitude $\leq$ 4 Digits + Decimal Delimiters	AM VO or MV VR or MR DB	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s 450-500 $\mu$ s 450-500 $\mu$ s	6.8 ms 2.8 ms each 90 ms 130 ms 250 ms	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s 450-500 $\mu$ s 450-500 $\mu$ s
DC Offset $\leq$ 4 Digits + Decimal Delimiters	OF VO or MV	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s	6.8 ms 2.8 ms each 82 ms	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s
Phase $\leq$ 4 Digits + Decimal Delimiter	PH DE	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s	5 ms 2.8 ms each 28 ms	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s
Sweep Start Frequency $\leq$ 11 Digits + Decimal Delimiters	ST HZ, KH, or MH	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s	7.0 ms 2.8 ms each 10.3 ms	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s
Sweep Stop Frequency $\leq$ 11 Digits + Decimal Delimiters	SP HZ, KH or MH	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s	7.0 ms 2.8 ms each 10.3 ms	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s
Sweep Marker Frequency $\leq$ 11 Digits + Decimal Delimiters	MF HZ, KH or MH	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s	7.0 ms 2.8 ms each 10.3 ms	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s
Sweep Time $\leq$ 4 Digits + Decimal Delimiter	T1 SE	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s	5.5 ms 2.8 ms each 7.0 ms	450-500 $\mu$ s 225-250 $\mu$ s each 450-500 $\mu$ s
Store	SR	450-500 $\mu$ s	11 ms	
Recall	RE	450-500 $\mu$ s	1700 ms	
Assign Zero Phase	AP	450-500 $\mu$ s	5.2 ms	
Amptd Cal	AC	450-500 $\mu$ s	1500 ms	
Start Single Sweep	SS	450-500 $\mu$ s	300 ms	
Start Continuous Sweep	SC	450-500 $\mu$ s	300 ms	
Interrogate (Add Parameter Mnemonic Time)	I	225-250 $\mu$ s	3 ms	
Mask Service Request	MS	450-500 $\mu$ s	4.5 ms	
High Voltage Output	HV	450-500 $\mu$ s	48 ms	
Rear/Front Output	RF	450-500 $\mu$ s	44.5 ms	
Self Test	TE	450-500 $\mu$ s	10,000 ms	
Sweep Mode	SM	450-500 $\mu$ s	4.5 ms	
Data Transfer Mode	MD	450-500 $\mu$ s	4.5 ms	
Interrogate Function	IFU	675-750 $\mu$ s	1603 ms	
Interrogate Error	IER	675-750 $\mu$ s	11.5 ms	
Universal Commands		$\sim$ 225 $\mu$ s per byte		
Amplitude Modulation	MA	450-500 $\mu$ s	7.0 ms	
Phase Modulation	MP	450-500 $\mu$ s	7.0 ms	

# HP 3325A/HP 1000

```

0001 FTN4,L
0002     PROGRAM C3325(3),02-08-79 (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 3325A 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/5,2HC3,2H32,2H5 /,LOOP/0/
0020 C
0021     IF(INPRM(ID).EQ.NO) GO TO 999
0022     WRITE(ILU,100)IDLU
0023 100 FORMAT(" 3325A: SRQ PROGRAM SETUP",
0024     &" IN PROGRESS FOR FOR LU "I2"."/)
0025     CALL SRQ(IDLU,17)
0026     CALL SRQ(IDLU,16,IPRG)
0027     IF(IERR(NN).LT.0) GO TO 20
0028     WRITE(IDLU,5)
0029     5 FORMAT("MS0")
0030     10 CALL EXEC(6,0,1)
0031     CALL RMPAR(IPM)
0032     CALL S3325(IPM)
0033     GO TO 10
0034 999 WRITE(ILU,130)
0035 130 FORMAT(" :RU,A3325,ILST,IDLU"/)
0036     STOP
0037 20 END
0038 C
0039 C
0040     SUBROUTINE S3325(ISTAT),02-08-79 (GWG) SRQ FUNCTIONS
0041     COMMON ILU,ILST,IDLU
0042     IF(IAND(ISTAT,1).EQ.1)CALL PCHCK
0043     IF(IAND(ISTAT,2).EQ.2)WRITE(ILST,10)
0044     IF(IAND(ISTAT,4).EQ.4)WRITE(ILST,20)
0045     IF(IAND(ISTAT,8).EQ.8)WRITE(ILST,30)
0046     IF(IAND(ISTAT,32).EQ.32)WRITE(ILST,40)
0047     IF(IAND(ISTAT,128).EQ.128)WRITE(ILST,50)
0048     10 FORMAT(" 3325A SWEEP STOPPED."/)
0049     20 FORMAT(" 3325A SWEEP STARTED."/)
0050     30 FORMAT(" 3325A SYSTEM FAILURE. POSSIBILITIES INCLUDE:"/
0051     & " " FAILED SELF TEST."/,
0052     & " " FAILED AMPLITUDE CALIBRATE."/,
0053     & " " EXTERNAL REFERENCE UNLOCKED."/,
0054     & " " MAIN OSCILLATOR UNLOCKED."//)

```

Figure 13-8. SRQ Program to Diagnose Errors

```

0055     40 FORMAT(" 3325A SWEEP IN PROGRESS."/)
0056     50 FORMAT(" 3325A BUSY PROCESSING DATA."/)
0057     RETURN
0058     END
0059     C
0060     C
0061     SUBROUTINE PCHCK,02-08-79 (GWG) PROGRAM ERRORS
0062     COMMON ILU,ILST,IDLU
0063     WRITE(IDLU,10)
0064     10 FORMAT("IER")
0065     READ(IDLU,50)IEER,IVAL
0066     50 FORMAT(A2,I1)
0067     IF(IVAL.EQ.1)WRITE(ILST,1)
0068     IF(IVAL.EQ.2)WRITE(ILST,2)
0069     IF(IVAL.EQ.3)WRITE(ILST,3)
0070     IF(IVAL.EQ.4)WRITE(ILST,4)
0071     IF(IVAL.EQ.5)WRITE(ILST,5)
0072     IF(IVAL.EQ.6)WRITE(ILST,6)
0073     IF(IVAL.EQ.7)WRITE(ILST,7)
0074     IF(IVAL.EQ.8)WRITE(ILST,8)
0075     IF(IVAL.EQ.9)WRITE(ILST,9)
0076     1 FORMAT(" ENTRY PARAMETER OUT OF BOUNDS."/)
0077     2 FORMAT(" INVALID PROGRAM DELIMITER."/)
0078     3 FORMAT(" FREQUENCY TO LARGE FOR FUNCTION."/)
0079     4 FORMAT(" SWEEP TIME TOO SMALL OR TOO LARGE."/)
0080     5 FORMAT(" OFFSET INCOMPATIBLE WITH AMPLITUDE."/)
0081     6 FORMAT(" SWEEP FREQUENCY OUT OF RANGE FOR FUNCTION."/)
0082     7 FORMAT(" UNRECOGNIZABLE MNEMONIC RECEIVED."/)
0083     8 FJRMAT(" UNRECOGNIZABLE DATA CHARACTER RECEIVED."/)
0084     9 FJRMAT(" OPTION DOES NOT EXIST."/)
0085     RETURN
0086     END
0087     C
0088     C
0089     FUNCTION IERR(N),07-26-78 (GWG) HANDLE BUS ERRORS
0090     COMMON ILU,ILST,IDLU
0091     I=IBERR(IDLU)
0092     IERR=0
0093     IF(I.EQ.0)GO TO 10
0094     IERR=-I
0095     WRITE(ILU,30)I,IDLU
0096     30 FORMAT(" 3437A: BUS ERROR "I2" ON LU ",
0097     &I2," (HP-IB USERS GUIDE).")
0098     10 RETURN
0099     END
0100     C
0101     C
0102     C
0103     INTEGER FUNCTION INPRM(ID),11-29-78 (GWG) RUN PRM FOR HP-IB
0104     INTEGER ISTRNG(40),OSTRNG(10),STRT
0105     COMMON ILU,ILST,IDLU
0106     C

```

Figure 13-8. SRQ Program to Diagnose Errors (Continued)



```
0107 C 'INPRM' GETS:
0108 C
0109 C A. THE INPUT LOGICAL UNIT (INTERACTIVE TERMINAL).
0110 C B. THE LIST LOGICAL UNIT FROM PARAMETER ONE (IT
0111 C SETS THE LIST LU EQUAL TO THE INPUT LU IF THE
0112 C LIST LU IS 0).
0113 C C. THE DEVICE LOGICAL UNIT(INPRM CHECKS TO SEE
0114 C IF IDLU IS NON-ZERO. IF NOT INPRM IS SET TO
0115 C '2HND').
0116 C
0117 INPRM=2HND
0118 ILU=LOGLU(ID)
0119 CALL GETST(ISTRNG,-80,RTNCLN)
0120 STRT=1
0121 DO 600 I=1,2
0122 IF(NAMR(OSTRNG,ISTRNG,RTNCLN,STRT))700,100
0123 100 ITYP=IAND(OSTRNG(4),3B)
0124 IF(I.EQ.1)GO TO 200
0125 IF(ITYP.NE.1) RETURN
0126 IDLU=OSTRNG
0127 GO TO 600
0128 200 ILST=OSTRNG
0129 IF(ITYP.EQ.0) ILST=ILU
0130 600 CONTINUE
0131 700 IF(IDLU.GT.0)INPRM=2HYE
0132 RETURN
0133 END
```

Figure 13-8. SRQ Program to Diagnose Errors (Continued)