NBSIR 77-1384

Interactive Computer Program for the Determination of Sound Power

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U.S. DEPARTMENT OF COMMERCE

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ABSTRACT

A description of the computer program used to measure the sound power output of a sound source in a reverberation room is presented. The program controls the operation of a real-time analyzer and a microphone multiplexer. The sound power is computed according to ANSI S1.21. The program is written in FORTRAN V and requires approximately 37,000 eight-bit bytes of core memory. Flow charts, source listings, and sample printouts are included.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

I. INTRODUCTION

This report describes the computer program used to measure the sound power output of a sound source in a reverberation room according to the American National Standard Methods for the Determination of Sound Power Levels of Small Sources in Reverberation Rooms, S1.21-1972. The program is written to control the instrumentation system used for the NBS reverberation room. It could, however, be suitable for use in any laboratory with a similar instrumentation system.

II. INSTRUMENTATION

The program assumes that two elements of the instrumentation system are under computer control. These elements are a real-time analyzer and a microphone multiplexer. The real-time analyzer filters the input signal through 30 contiguous 1/3-octave band-pass filter channels, samples each channel simultaneously for an integration period, determines the rms level for each channel, and transmits the results to the computer. For the NBS system, the time required to transmit the levels in all the 1/3-octave bands to the computer is approximately 1 ms. The real-time analyzer integration time, under computer control, is entered by the operator from a CRT terminal.

The computer controls the channel selection of a microphone multiplexer. In the NBS system, the multiplexer has 16 channels, of which 12 are used with the 12-microphone array installed in the reverberation room.

III. PROGRAM SEQUENCE

The execution of the sound power measurement is summarized in the abbreviated flowchart given in Appendix A. At the beginning of the program, the table of reverberation times for the room are entered. The operator has the option of entering the data from the CRT terminal keyboard or from the disc file output of program REVERB.

The microphone array calibrations are then acquired. These are necessary in order to convert the real-time analyzer data from voltage levels, in dB re 1 mV to sound pressure levels, in dB re 20 μPa. The calibrations for each channel, in the form of corrections to be added to the RTA data, may be determined in advance and entered from the CRT terminal keyboard, or they may be measured at this point in the program by relating the real-time analyzer output to a reference signal, such as an acoustic calibrator.

The frequency response corrections for the microphones are then entered from either a disc file or from the CRT keyboard. These corrections may include the frequency response characteristics of the microphones and the responses of the 1/3-octave frequency channels of the real-time analyzer, relative to the 1000 Hz band.

The atmospheric pressure, temperature and humidity (which the program computes from the wet and dry bulb temperatures), the vane speed and the integration time are now entered. The ambient noise is then measured, if desired, followed by a sound pressure level measurement at each microphone with the sound source operating.

The sound power levels are computed and printed out. The operator has the option of either proceeding immediately with another measurement using the same reverberation time data and the same system gain settings, or terminating the program.

IV. COMPUTATIONS

The following quantities are computed:

1. Sound pressure level in the kth 1/3-octave band at microphone j.

$$L_{jk} = X_{jk} - A_k + B_j$$

where X_{jk} is the reading in the kth 1/3-octave band at microphone j, A_k is the frequency response correction for the kth 1/3-octave band for both the microphone* and analyzer, and B_j is the level correction at 1000 Hz for microphone j.

The X_{jk} are printed in the columns labeled MIC 1 to MIC 12 in Printout 1 of Appendix B. The A_k are printed in the column labeled FREQUENCY RESPONSE CORRECTION. The B_j are printed in the column labeled CORRECTION TO RTA DATA. The L_{jk} are printed in the columns labeled MIC 1 to MIC 12 in Printout 2 of Appendix B.

The uncertainty in the sound pressure levels is dependent upon the sampling characteristics of the real-time analyzer, which, in the NBS system, has a resolution of 0.25 dB. The levels are printed to the nearest 0.01 dB in order to aid in tracing the computations performed on the data, rather than to represent the uncertainty of the data.

2. Standard deviation of L_{jk} (according to ANSI S1.21).

$$\sigma_k = \left[(N_m-1)^{-1} \sum_{j=1}^{N_m} (L_{jk}-\langle L_k \rangle)^2 \right]^{1/2}$$

where N_m is the number of microphones,

$$\langle L_k \rangle = \frac{1}{N_m} \sum_{j=1}^{N_m} L_{jk}$$

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*The program can be modified to permit the input of a separate frequency response for each microphone channel to allow for differences among the microphone cartridges used in the array. As presently written it is assumed that all the microphones have the same frequency response corrections.

The σ_k are printed in the column labeled STD. DEV. in Printout 4 of Appendix B.

3. Mean sound pressure level in the kth 1/3-octave band.

$$\bar{L}_k = 10 \log_{10} \left[\frac{1}{N_m} \sum_{j=1}^{N_m} 10^{(L_{jk}/10)} \right]$$

The $\bar{L}_k$ are printed in the column labeled SOUND PRESSURE in Printout 4 of Appendix B.

4. Sound power level in the kth 1/3-octave band.

$$P_k = \bar{L}_k - 10 \log_{10} (T_k/T_o) + 10 \log_{10} (V/V_o)$$

$$+ 10 \log_{10} (1 + S\lambda_k/8V) - 10 \log_{10} (B/1000) - 14$$

where T_k is reverberation time in the kth 1/3-octave band in seconds, T_o is 1 s, V is the volume of the room in cubic meters, V_o is 1 m^3, λ_k is the wavelength in meters at the center frequency of the kth 1/3-octave band, S is the total surface area of the room in square meters, and B is the barometric pressure in mbars.

The P_k are printed in the column labeled 1/3 OCTAVE BAND SOUND POWER in Printout 4 of Appendix B.

V. SOFTWARE DETAILS

The programming language used is the Interdata FORTRAN V Level 1 Software System.* It is a superset of ANSI Standard X3.9-1966 FORTRAN and should be compatible or nearly compatible with the FORTRAN V used on other computer systems. Users of this program on other systems should check the compatibility of FORMAT statements using the A Format and INTEGER* 2 statements which define the storage size of integers to be two 8-bit bytes.

The program for measuring sound power consists of a main program, SPOWER, written in FORTRAN V, several FORTRAN subroutines, and several assembly language subroutines written for use on an Interdata Model 70 minicomputer. These elements are listed in Table 1. The corresponding flow charts, sample printouts, and listings are given in Appendices B and C.

In the NBS system, the complete task occupies 37,066 eight-bit bytes of memory.

The flow charts, given in the appendices, conform to the American National Standard Flowchart Symbols and Their Usage in Information Processing, X3.5-1970. In these flow charts, the small numbers enclosed in parentheses refer to FORTRAN statement labels in the program listings.

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*The commercial computer products utilized are identified in order to adequately describe the program elements discussed in this report. In no case does such identification imply recommendation or endorsement by the National Bureau of Standards, nor does it imply that these products are necessarily the best available for the purpose.

In the program listings, the first three statements of every program or subprogram are control statements used to insert the program name, in the form of a binary label, into the compiled object code.

VI. INPUT/OUTPUT LOGICAL UNITS

The following logical units are used for input/output operations:

LU1 - File containing a table of the reverberation time. This file is generated by the program REVERB.

LU2 - Output file for storing the computed sound power levels. This file is rewound at the start of the program and the results of each sound power measurement are successively stored on it.

LU3 - Hard copy printout device. Should be assigned to a 132-character line printer. During execution of the program, the operator may choose the printout device logical unit to obtain either a hard copy printout or a view of the results on the CRT terminal.

LU4 - File containing frequency response corrections of the microphones. These corrections consist of a set of 30 numbers, one per band, representing the difference in total system sensitivity between each band and band 30 (1000 Hz). The microphone frequency response and the differences in gain between the real-time analyzer's multi-filter channels are to be incorporated in these corrections.

LU5 - Operator communication device. Should be assigned to a CRT terminal. Through this device the operator controls the course of the measurement, making decisions that are called for and entering certain measurement parameters. These parameters include:

1. The reverberation times, if not read from a disc file.
2. The microphone calibration data, if not obtained during the measurement with a reference signal.

3. The frequency response corrections, if not read from a disc file.

4. The temperature, relative humidity, and atmospheric pressure.

5. The real-time analyzer integration time.

Transmission of data to and from the real-time analyzer and the microphone multiplexer is not handled through logical units, but through separate subroutines written in the computer's assembly language. These subroutines are included in Table 1.

TABLE 1. SOUND POWER PROGRAM ELEMENTS

PROGRAM NAME	TYPE OF PROGRAM	FUNCTION	SUBROUTINES CALLED
SPOWER	FORTRAN Program	Performs measurements and computations to determine sound power levels.	HUMID, SPLCAL, SAMPLE, BAND, MEANLG, MEANAR, SUBMUX, MUX, RTA, DELAY
SPLCAL	FORTRAN Subroutine	Relates real-time analyzer data to a reference signal of known amplitude.	SAMPLE, BAND, MEANLG, RTA
MEANLG	FORTRAN Subroutine	Computes logarithmic mean of a number of samples.	None
MEANAR	FORTRAN Subroutine	Computes arithmetic mean and standard deviation of a number of samples.	None
HUMID*	FORTRAN Subroutine	Computes relative humidity from wet and dry bulb temperatures. Also computes speed of sound.	None
SAMPLE*	FORTRAN Subroutine	Takes a specified number of real-time analyzer samples and checks for signal levels that exceed its maximum input level.	RTA
BAND*	FORTRAN Subroutine	Converts one band of real-time analyzer samples from fixed-point to floating-point numbers.	None
SUBMUX*	FORTRAN Subroutine	Steps the microphone multiplexer to a given microphone channel.	MUX

*Details of these routines are given in T. Bartel, "Interactive Computer Program for the Determination of Reverberation time," NBSIR 77-1383, National Bureau of Standards, Washington, D.C. 20234, December 1977.

TABLE 1. (Continued)

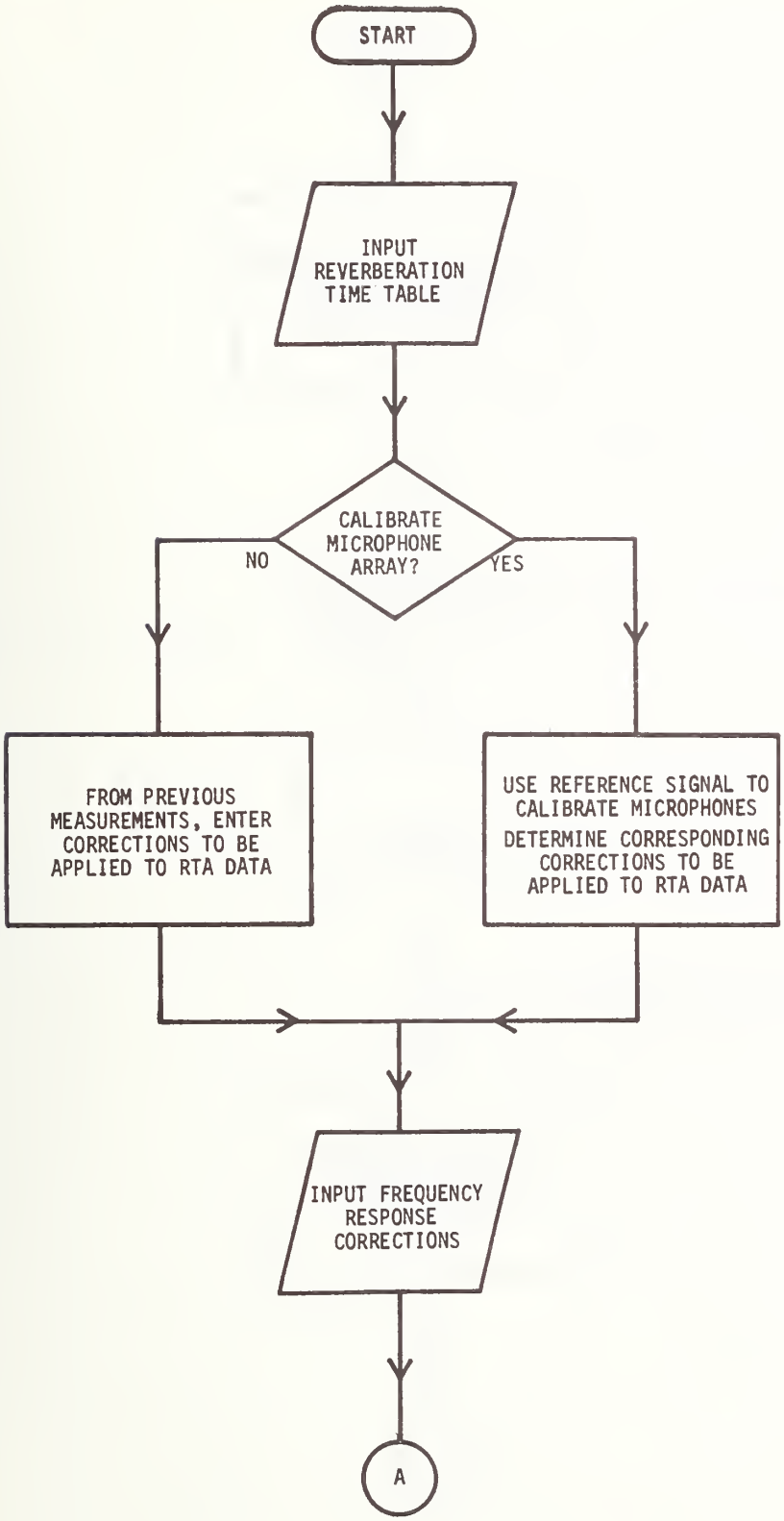
PROGRAM NAME	TYPE OF PROGRAM	FUNCTION	SUBROUTINES CALLED
MUX*	Assembly Language Subroutine, FORTRAN Callable	Steps and reads multiplexer	None
RTA*	Assembly Language Subroutine, FORTRAN Callable	Controls and reads real-time analyzer.	None
DELAY*	Assembly Language Subroutine, FORTRAN Callable	Provides a delay of 0 to 32.767 s in approximate 1-ms increments.	None

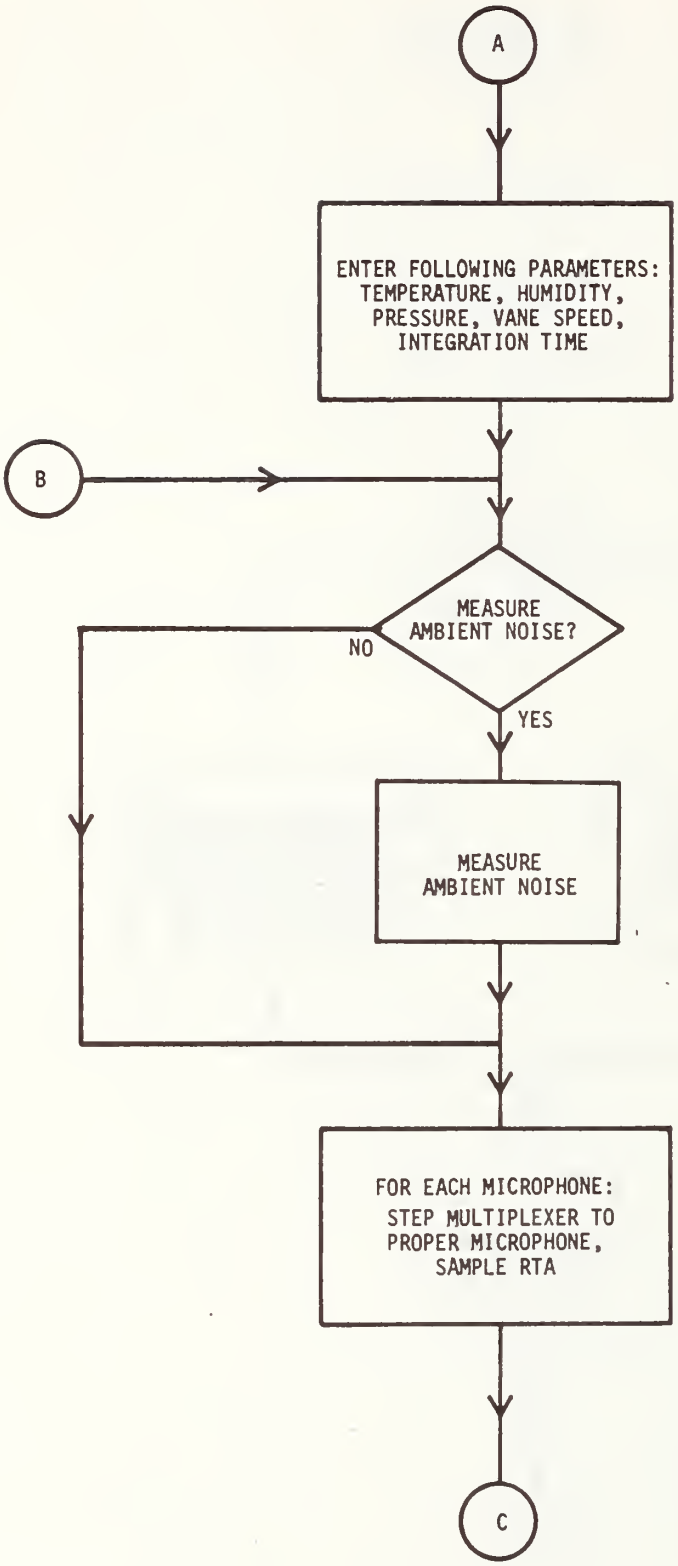
*Details of these routines are given in T. Bartel, "Interactive Computer Program for the Determination of Reverberation Time," NBSIR 77-1383, National Bureau of Standards, Washington, D.C. 20234, December 1977.

APPENDIX A

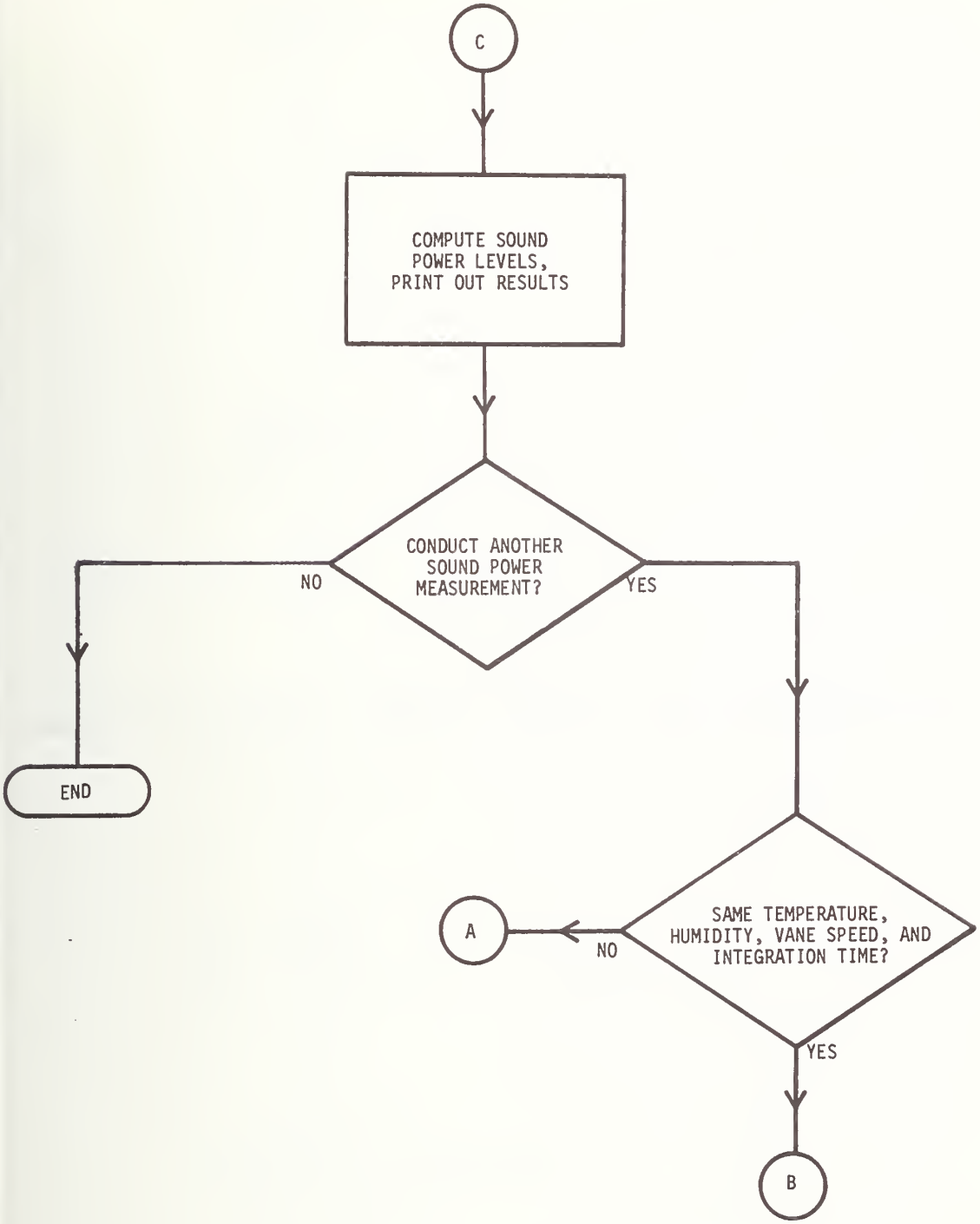
Abbreviated Flow Chart of Sound Power Program

ABBREVIATED FLOW CHART: SPOWER




A
ENTER FOLLOWING PARAMETERS:
TEMPERATURE, HUMIDITY,
PRESSURE, VANE SPEED,
INTEGRATION TIME
B
MEASURE
AMBIENT NOISE?
NO
YES
MEASURE
AMBIENT NOISE
FOR EACH MICROPHONE:
STEP MULTIPLEXER TO
PROPER MICROPHONE,
SAMPLE RTA
C

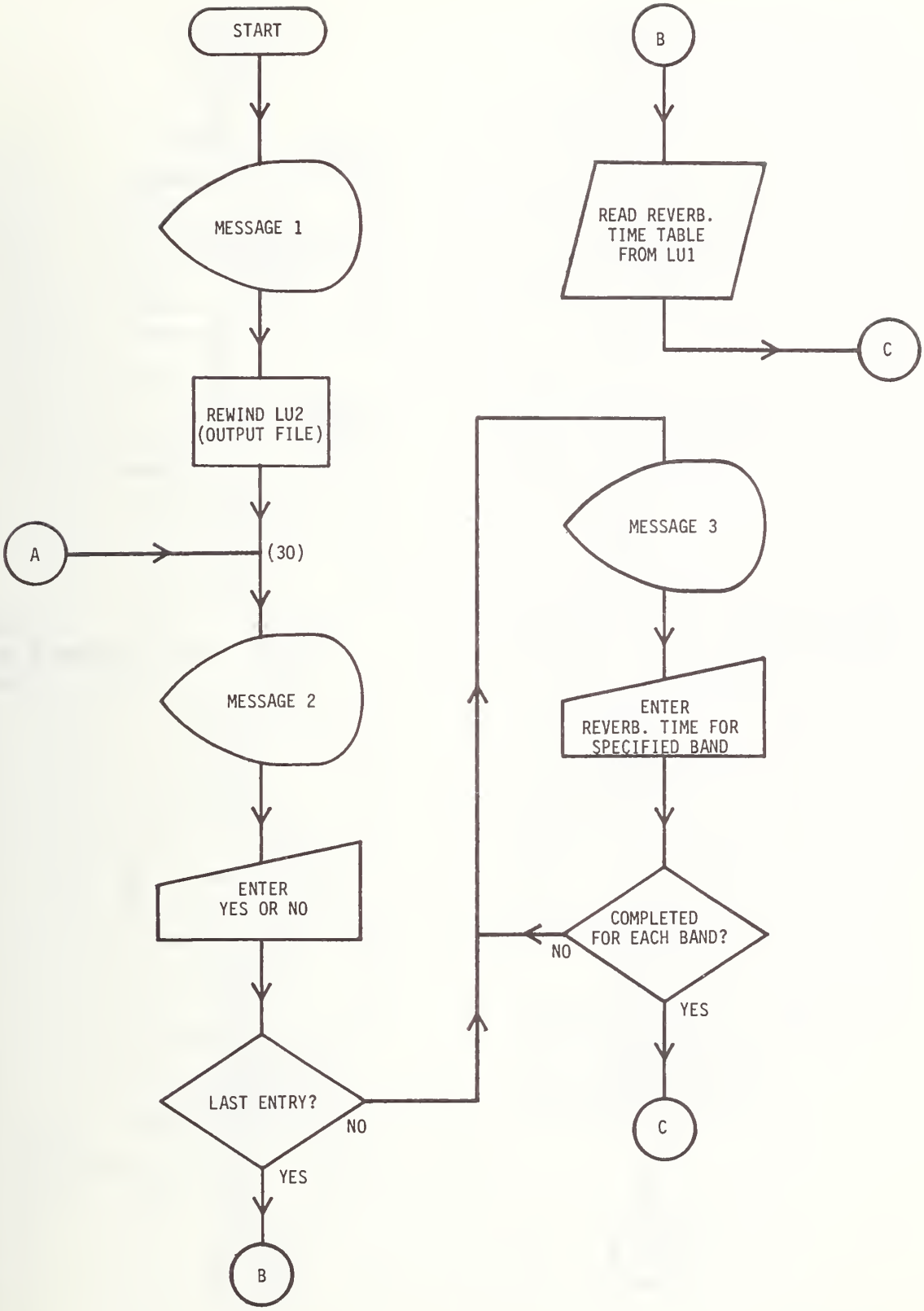
ABBREVIATED SPOWER-3

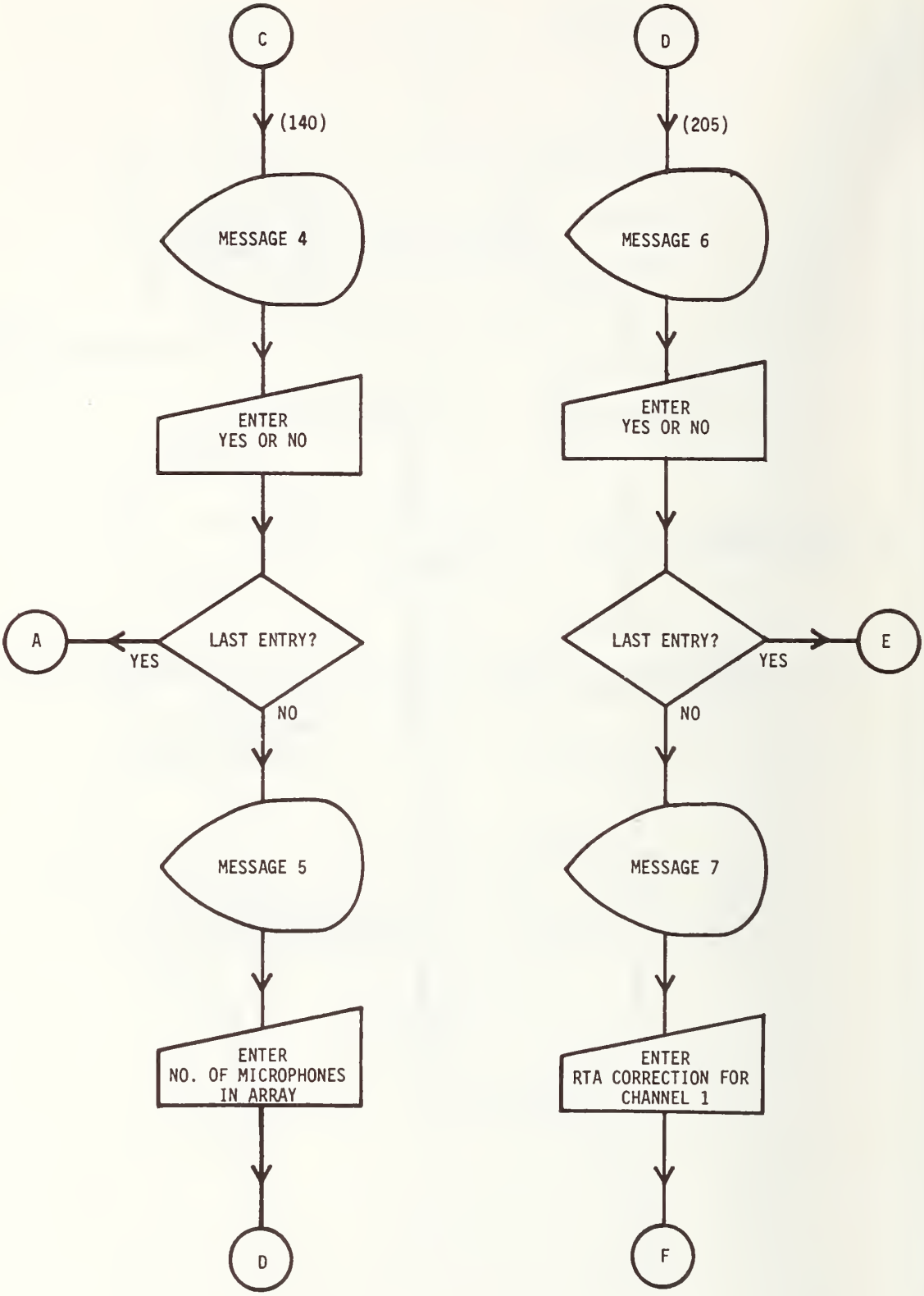


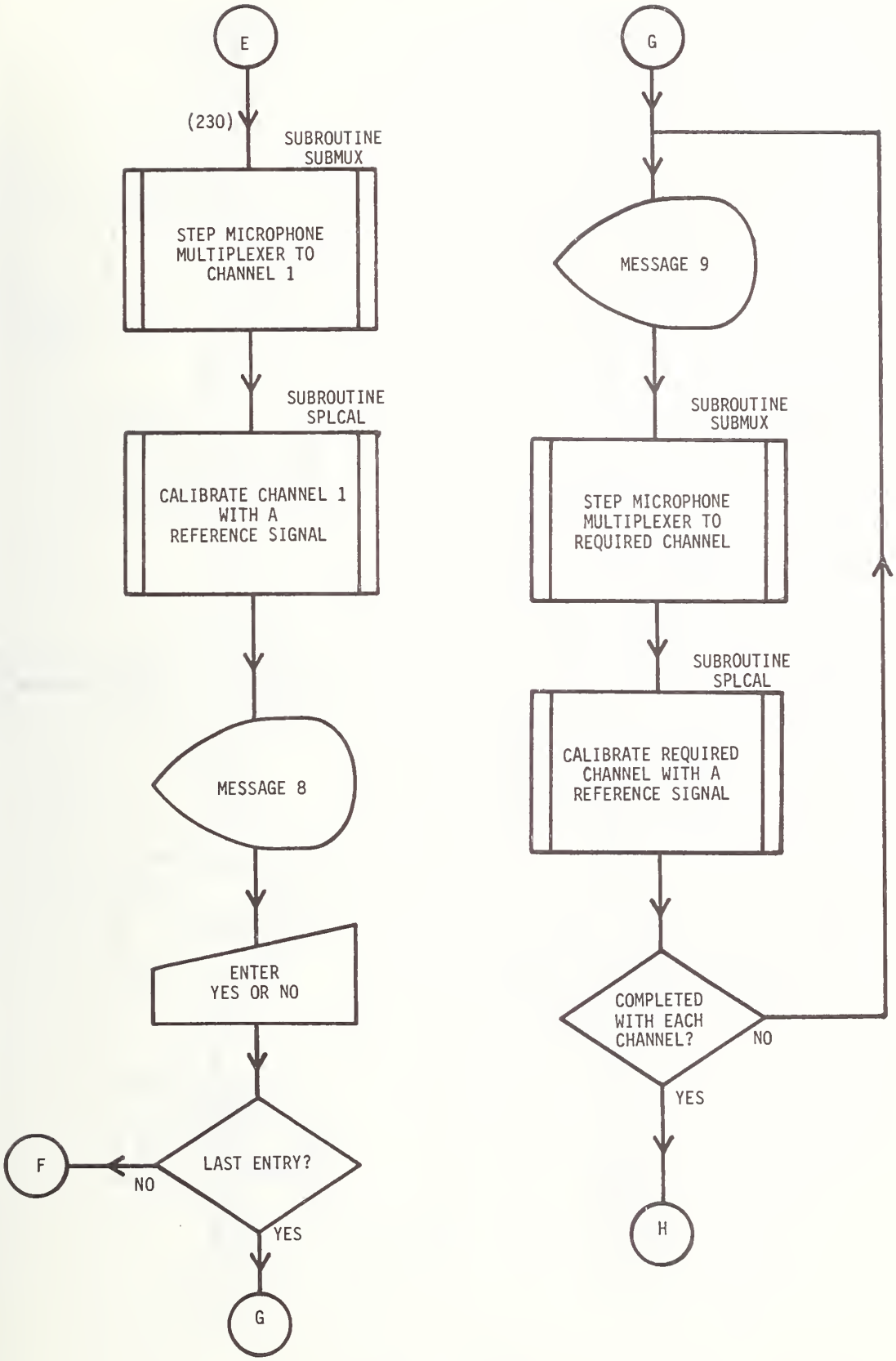
APPENDIX B

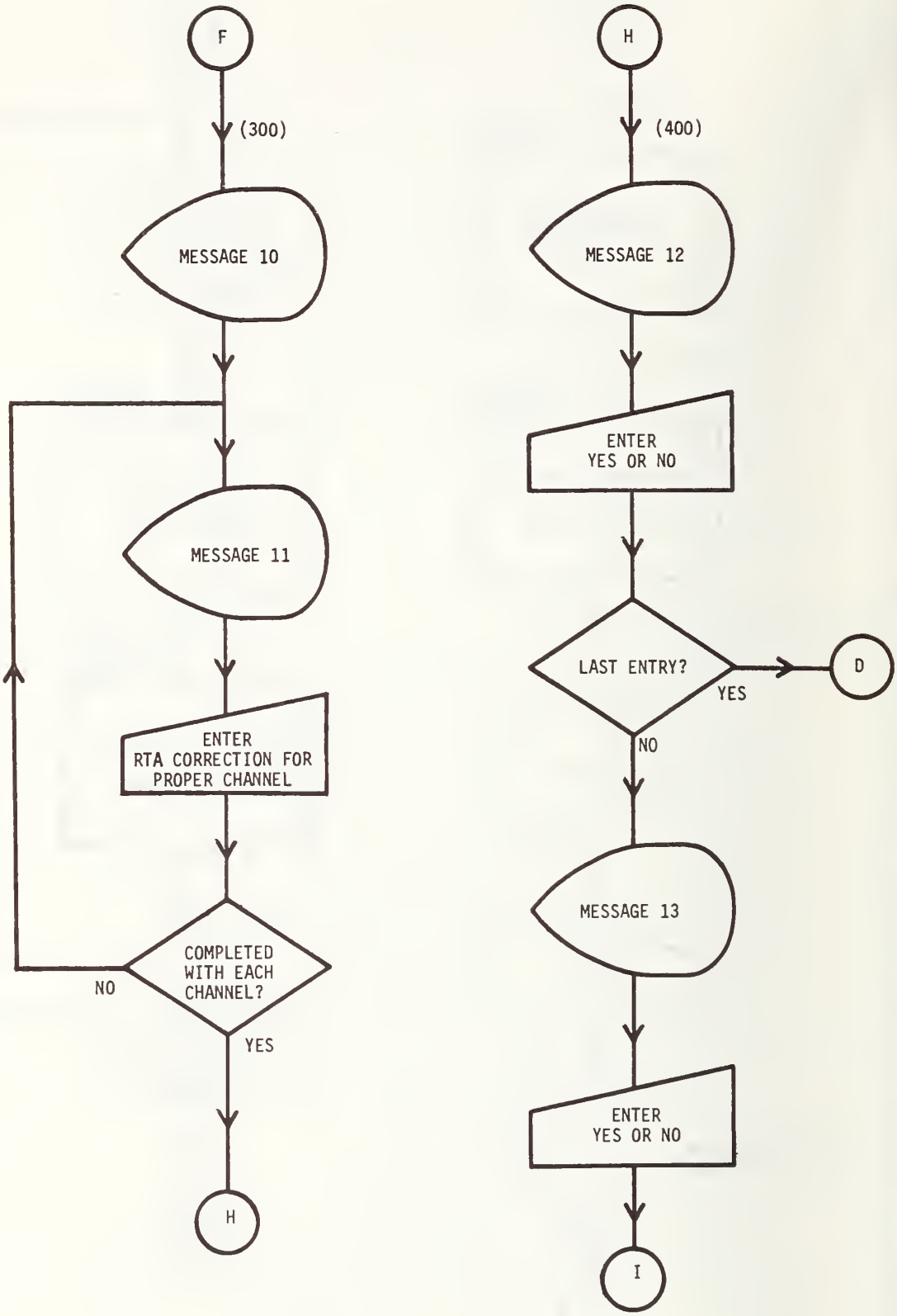
Program SPOWER Flow Chart, Terminal Messages, Printouts and Listings

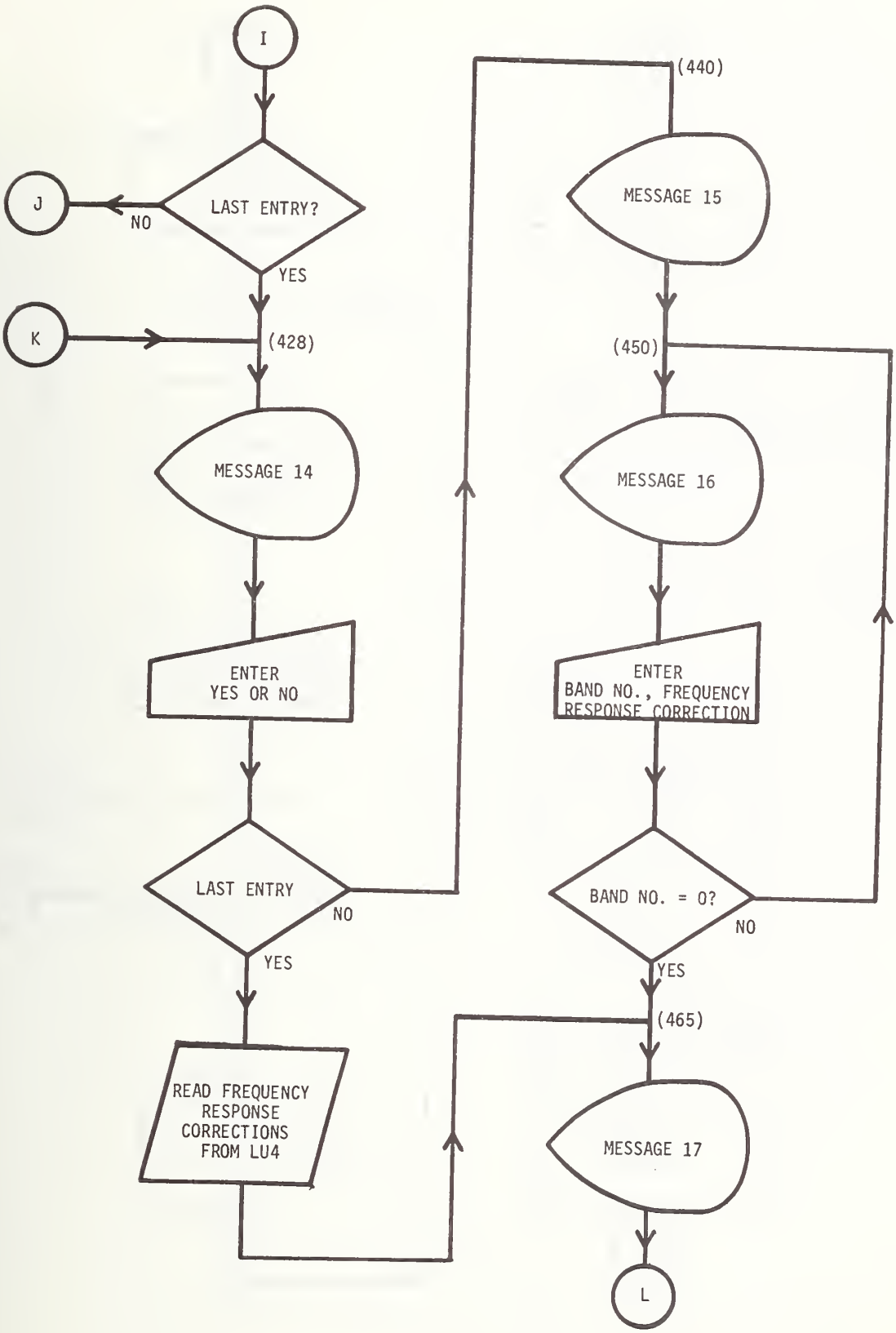
FLOW CHART: SPOWER

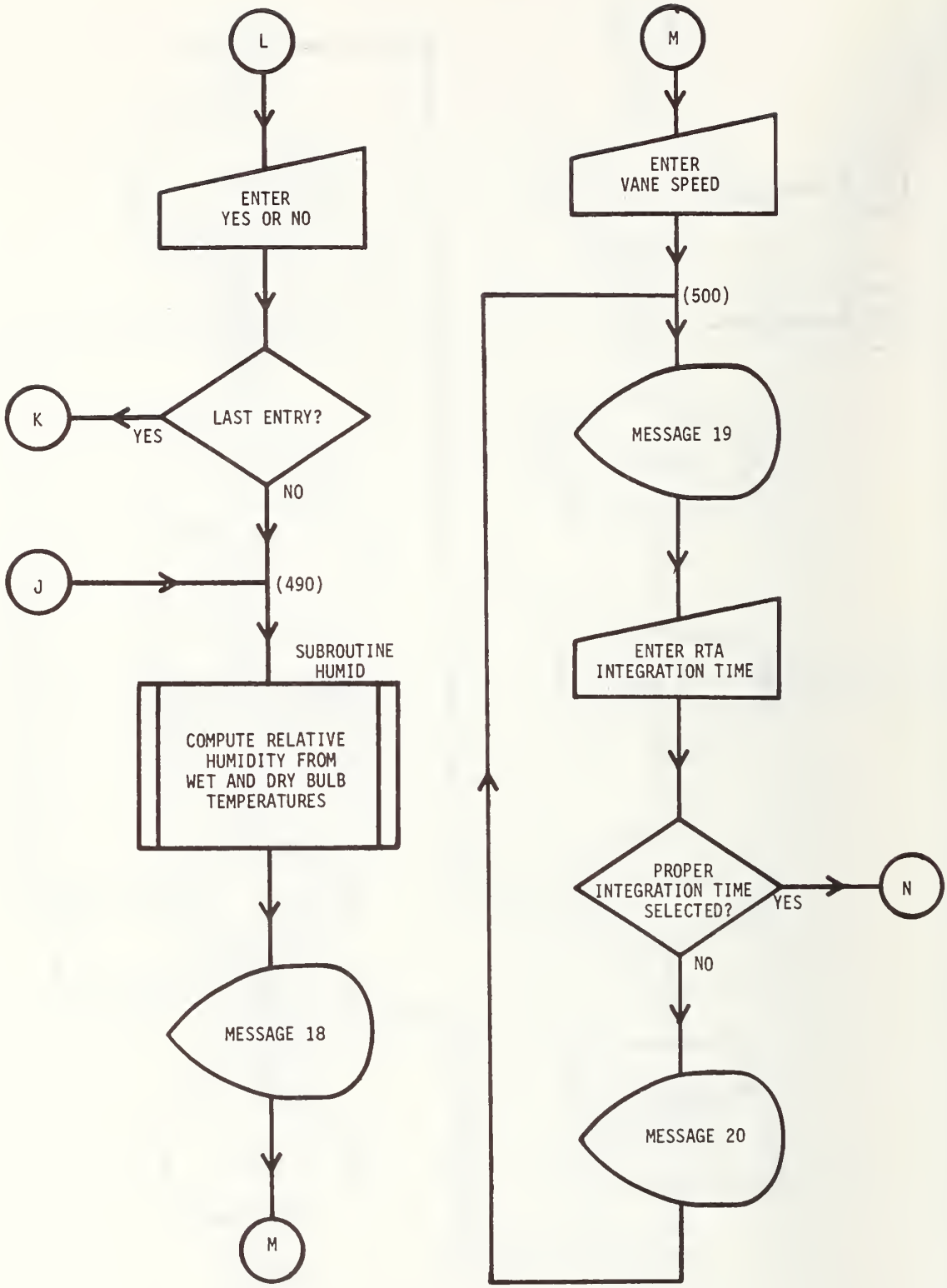


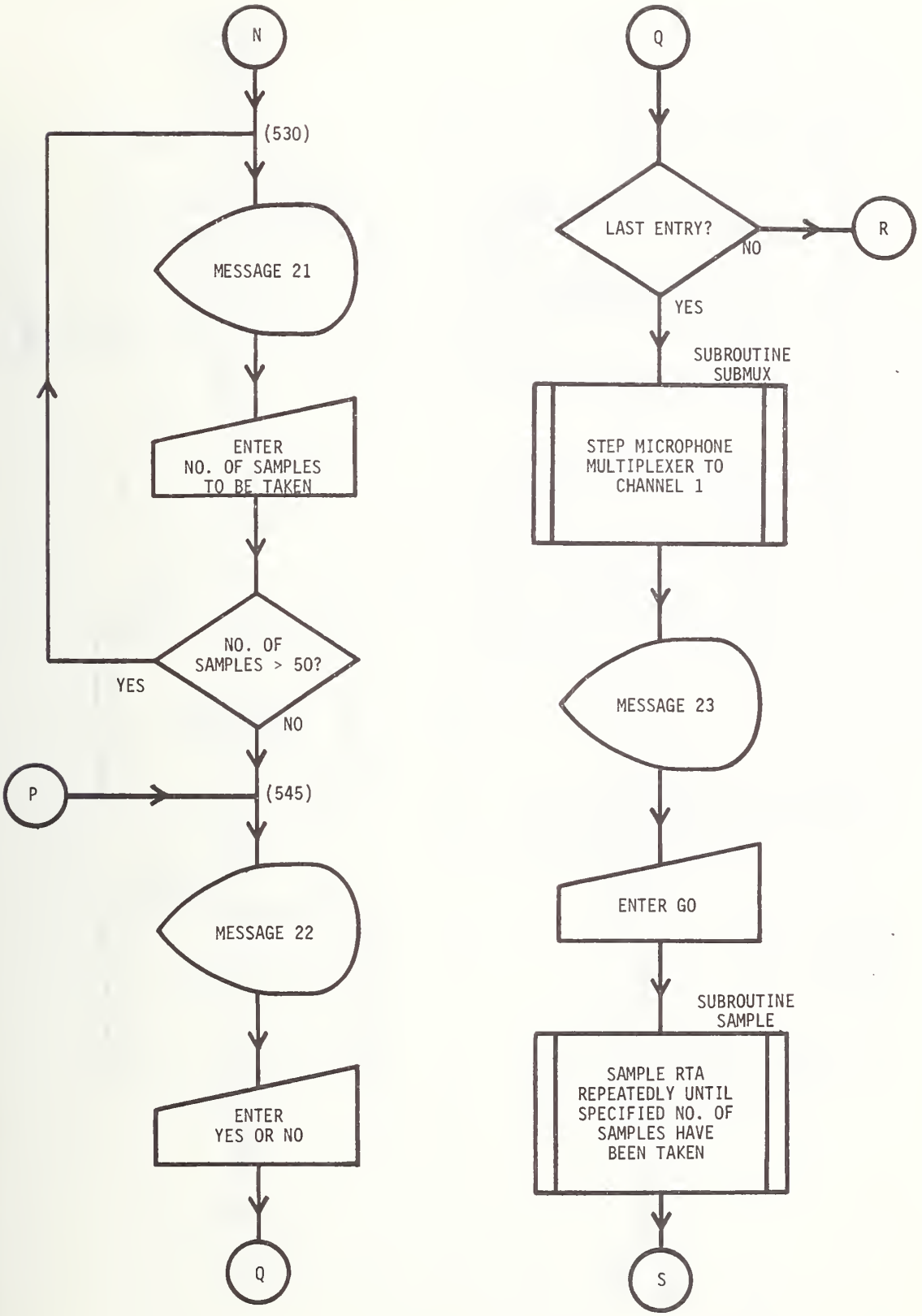

C
(140)
MESSAGE 4
ENTER
YES OR NO
A
YES
LAST ENTRY?
NO
MESSAGE 5
ENTER
NO. OF MICROPHONES
IN ARRAY
D
D
(205)
MESSAGE 6
ENTER
YES OR NO
LAST ENTRY?
YES
E
NO
MESSAGE 7
ENTER
RTA CORRECTION FOR
CHANNEL 1
F

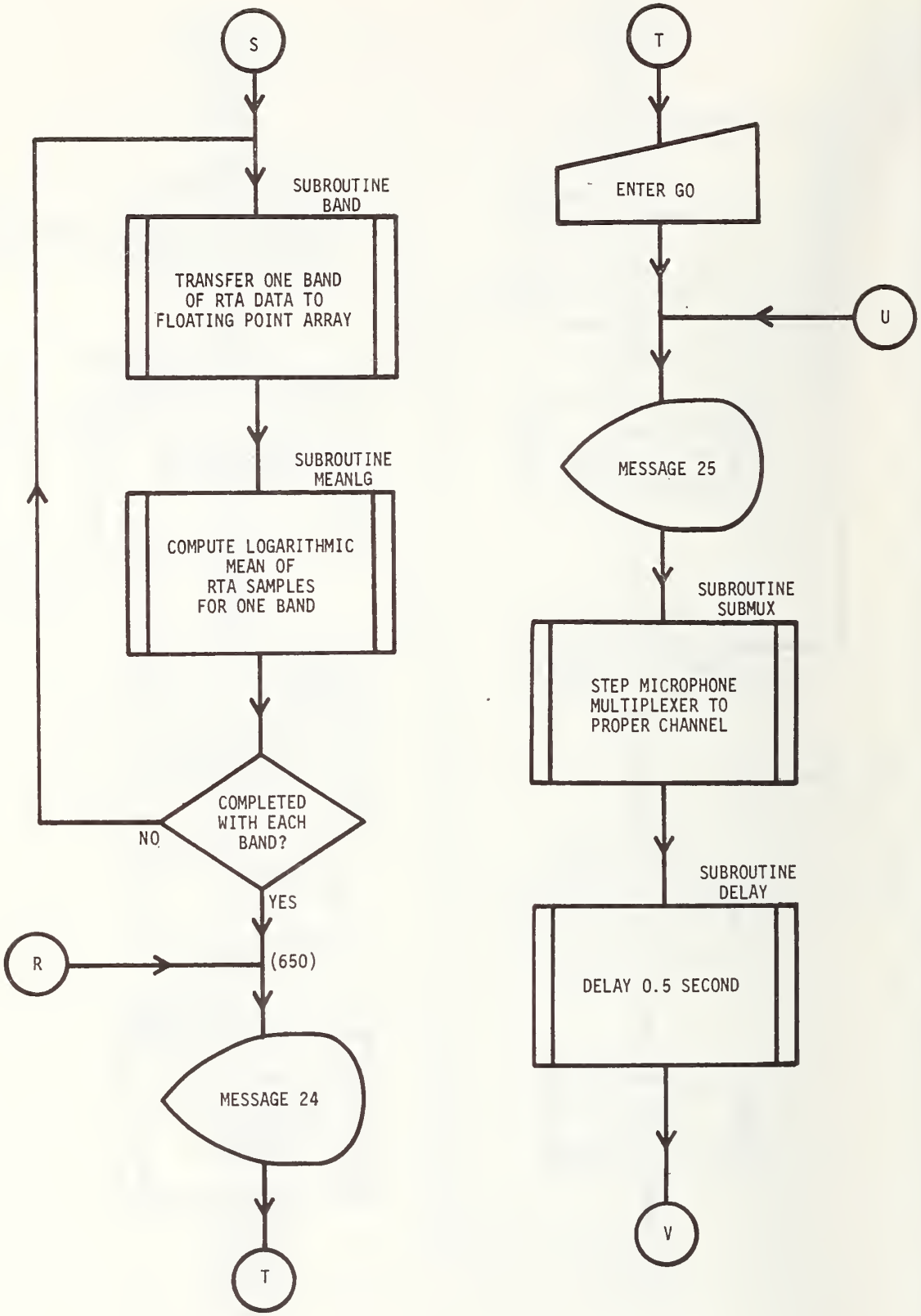

E
(230)
SUBROUTINE SUBMUX
STEP MICROPHONE MULTIPLEXER TO CHANNEL 1
SUBROUTINE SPLCAL
CALIBRATE CHANNEL 1 WITH A REFERENCE SIGNAL
MESSAGE 8
ENTER YES OR NO
LAST ENTRY?
NO
F
YES
G
G
MESSAGE 9
SUBROUTINE SUBMUX
STEP MICROPHONE MULTIPLEXER TO REQUIRED CHANNEL
SUBROUTINE SPLCAL
CALIBRATE REQUIRED CHANNEL WITH A REFERENCE SIGNAL
COMPLETED WITH EACH CHANNEL?
NO
YES
H

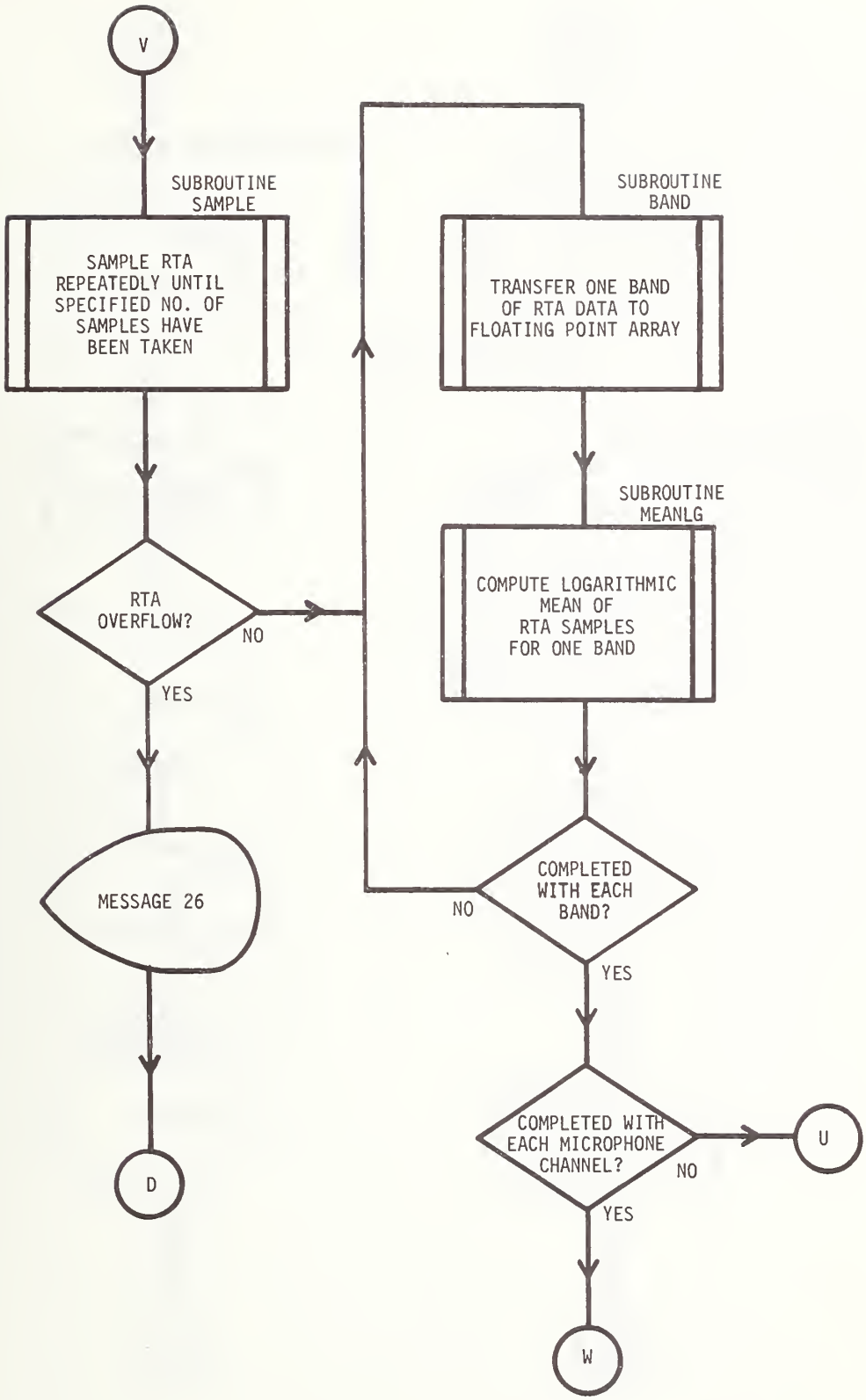

F
(300)
MESSAGE 10
MESSAGE 11
ENTER
RTA CORRECTION FOR
PROPER CHANNEL
COMPLETED
WITH EACH
CHANNEL?
NO
YES
H
H
(400)
MESSAGE 12
ENTER
YES OR NO
LAST ENTRY?
YES
D
NO
MESSAGE 13
ENTER
YES OR NO
I

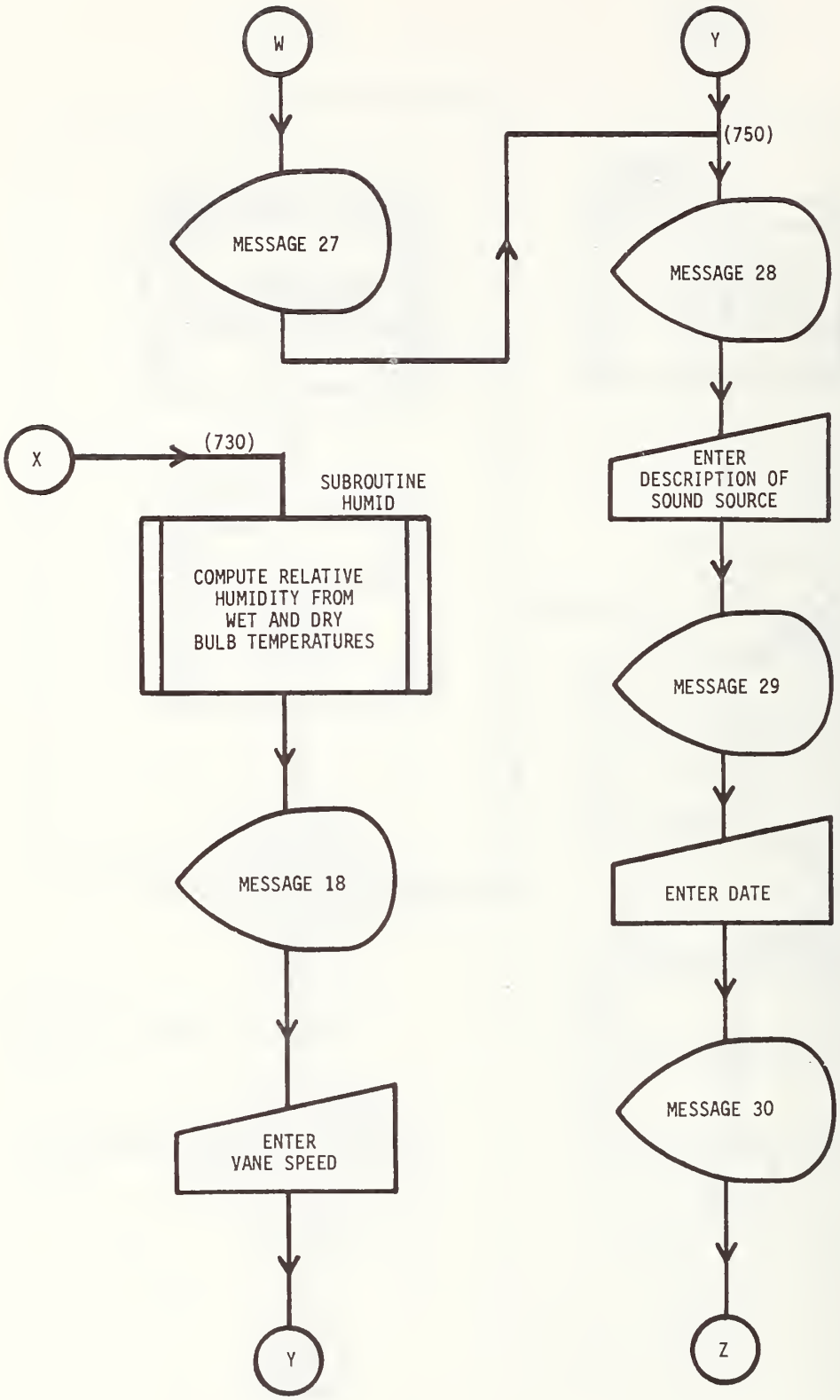

I
J
LAST ENTRY?
NO
YES
K
(428)
MESSAGE 14
ENTER
YES OR NO
LAST ENTRY
NO
YES
READ FREQUENCY
RESPONSE
CORRECTIONS
FROM LU4
(440)
MESSAGE 15
(450)
MESSAGE 16
ENTER
BAND NO., FREQUENCY
RESPONSE CORRECTION
BAND NO. = 0?
NO
YES
(465)
MESSAGE 17
L

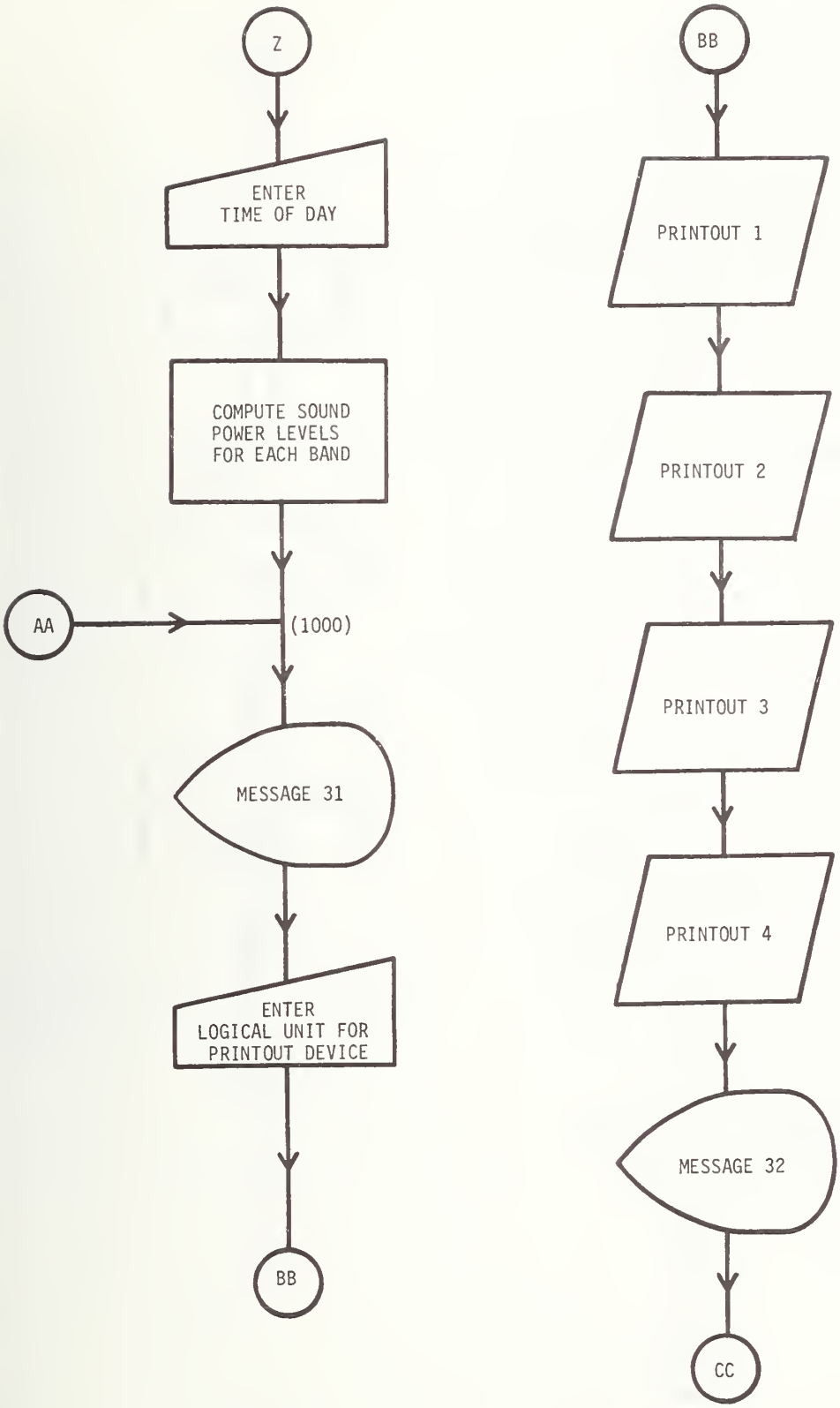

L
ENTER
YES OR NO
LAST ENTRY?
K
YES
NO
J
(490)
SUBROUTINE
HUMID
COMPUTE RELATIVE
HUMIDITY FROM
WET AND DRY BULB
TEMPERATURES
MESSAGE 18
M
M
ENTER
VANE SPEED
(500)
MESSAGE 19
ENTER RTA
INTEGRATION TIME
PROPER
INTEGRATION TIME
SELECTED?
YES
N
NO
MESSAGE 20

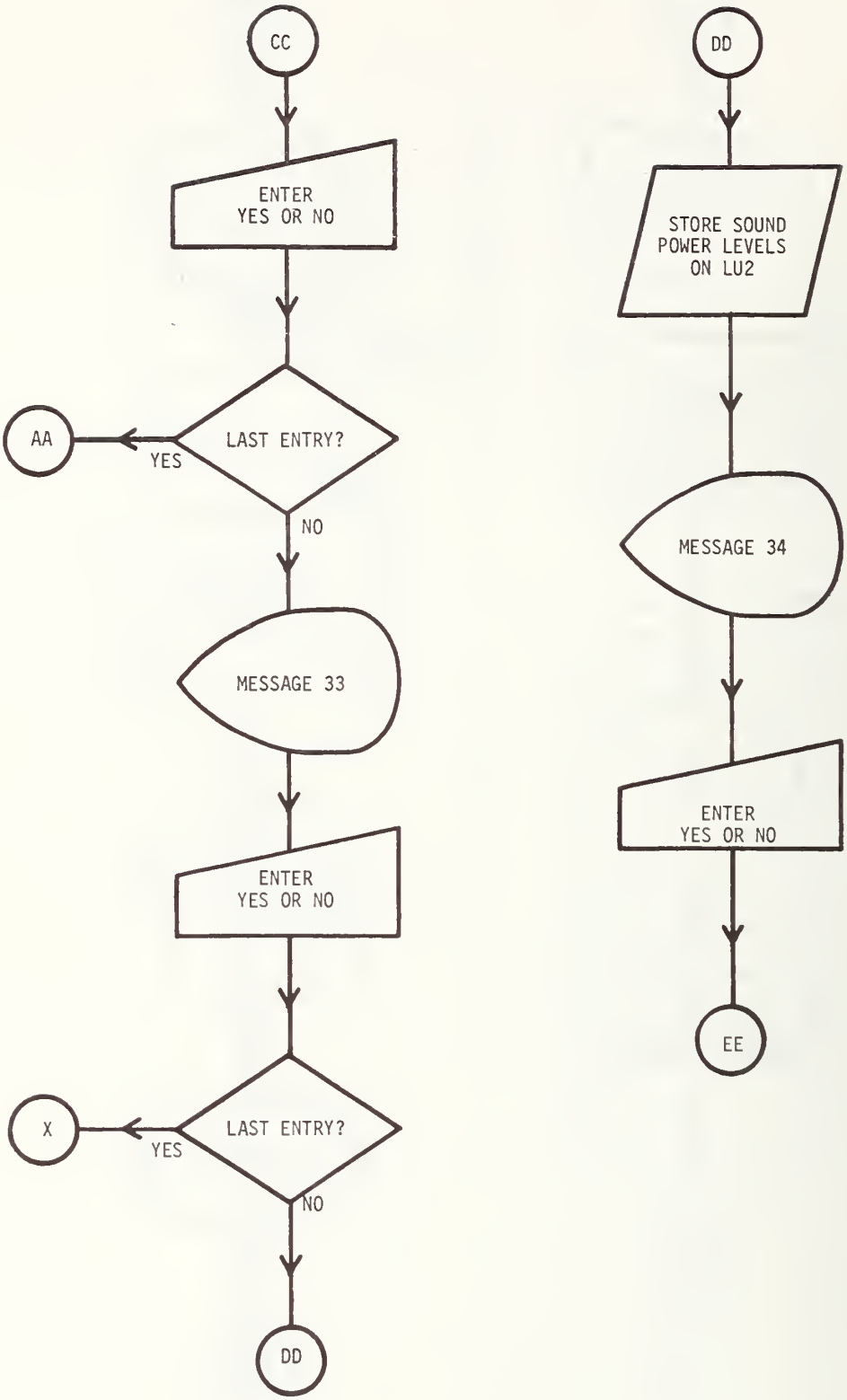

N
(530)
MESSAGE 21
ENTER
NO. OF SAMPLES
TO BE TAKEN
NO. OF
SAMPLES > 50?
YES
NO
P
(545)
MESSAGE 22
ENTER
YES OR NO
Q
Q
LAST ENTRY?
NO
R
YES
SUBROUTINE
SUBMUX
STEP MICROPHONE
MULTIPLEXER TO
CHANNEL 1
MESSAGE 23
ENTER GO
SUBROUTINE
SAMPLE
SAMPLE RTA
REPEATEDLY UNTIL
SPECIFIED NO. OF
SAMPLES HAVE
BEEN TAKEN
S

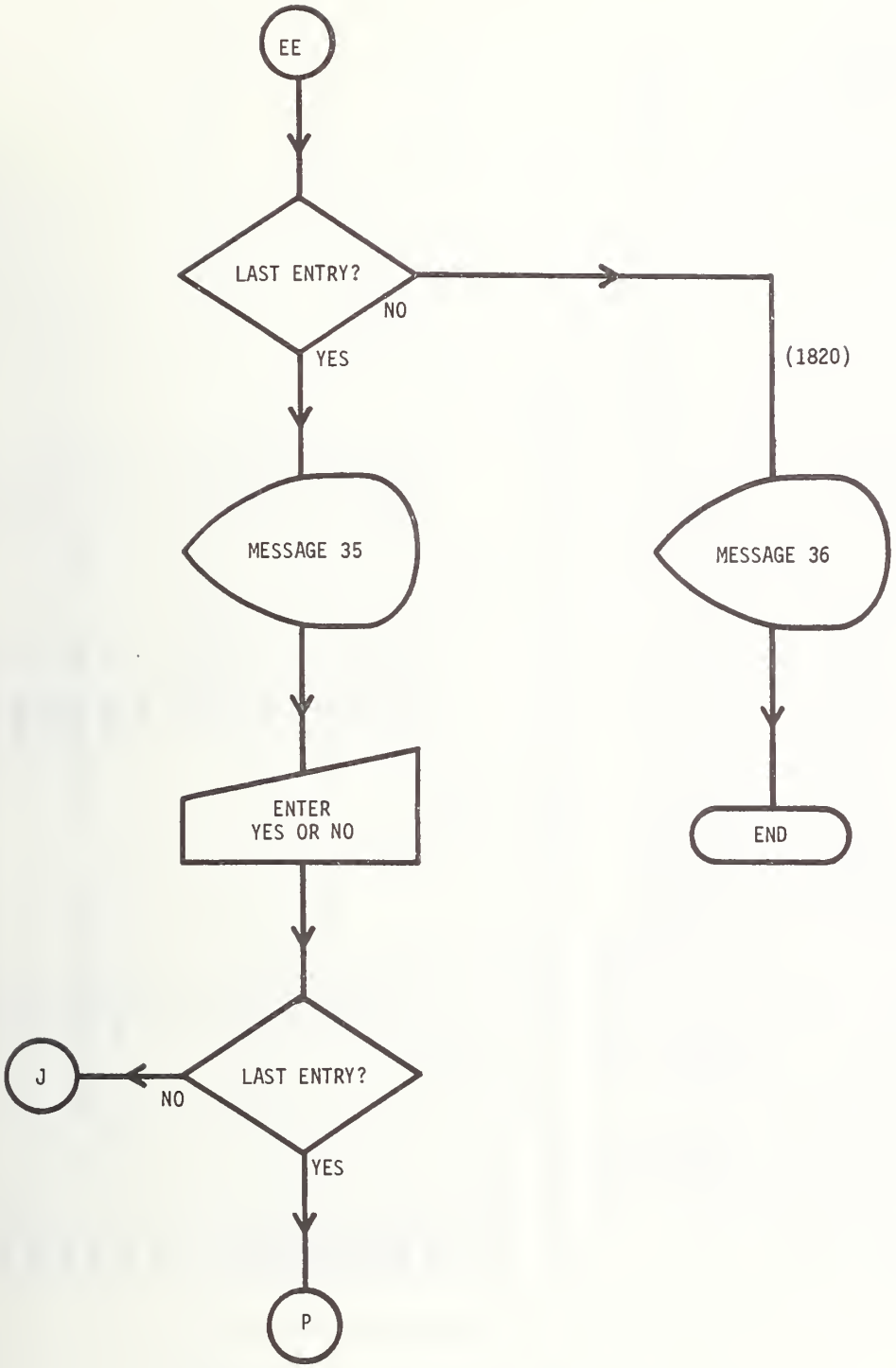

S
SUBROUTINE BAND
TRANSFER ONE BAND OF RTA DATA TO FLOATING POINT ARRAY
SUBROUTINE MEANLG
COMPUTE LOGARITHMIC MEAN OF RTA SAMPLES FOR ONE BAND
COMPLETED WITH EACH BAND?
NO
YES
R
(650)
MESSAGE 24
T
T
ENTER GO
U
MESSAGE 25
SUBROUTINE SUBMUX
STEP MICROPHONE MULTIPLEXER TO PROPER CHANNEL
SUBROUTINE DELAY
DELAY 0.5 SECOND
V


V
SUBROUTINE SAMPLE
SAMPLE RTA REPEATEDLY UNTIL SPECIFIED NO. OF SAMPLES HAVE BEEN TAKEN
RTA OVERFLOW?
NO
YES
MESSAGE 26
D
SUBROUTINE BAND
TRANSFER ONE BAND OF RTA DATA TO FLOATING POINT ARRAY
SUBROUTINE MEANLG
COMPUTE LOGARITHMIC MEAN OF RTA SAMPLES FOR ONE BAND
COMPLETED WITH EACH BAND?
NO
YES
COMPLETED WITH EACH MICROPHONE CHANNEL?
NO
U
YES
W


W
MESSAGE 27
Y
(750)
MESSAGE 28
ENTER
DESCRIPTION OF
SOUND SOURCE
MESSAGE 29
ENTER DATE
MESSAGE 30
Z
X
(730)
SUBROUTINE
HUMID
COMPUTE RELATIVE
HUMIDITY FROM
WET AND DRY
BULB TEMPERATURES
MESSAGE 18
ENTER
VANE SPEED
Y


Z
ENTER
TIME OF DAY
COMPUTE SOUND
POWER LEVELS
FOR EACH BAND
AA
(1000)
MESSAGE 31
ENTER
LOGICAL UNIT FOR
PRINTOUT DEVICE
BB
BB
PRINTOUT 1
PRINTOUT 2
PRINTOUT 3
PRINTOUT 4
MESSAGE 32
CC


CC
ENTER
YES OR NO
AA
LAST ENTRY?
YES
NO
MESSAGE 33
ENTER
YES OR NO
X
LAST ENTRY?
YES
NO
DD
DD
STORE SOUND
POWER LEVELS
ON LU2
MESSAGE 34
ENTER
YES OR NO
EE


EE
LAST ENTRY?
NO
YES
(1820)
MESSAGE 35
MESSAGE 36
ENTER
YES OR NO
END
J
LAST ENTRY?
NO
YES
P

CRT TERMINAL MESSAGES: PROGRAM SPOWER

MESSAGE NO.	FORMAT NO.	MESSAGE
		THIS PROGRAM RUNS AND ANALYZES ONE SOUND POWER MEASUREMENT RE S1.21 WITH 1 SOURCE LOCATION AND UP TO 12 MICROPHONE POSITIONS
		THE FOLLOWING LOGICAL UNIT ASSIGNMENTS ARE REQUIRED:
1	10	LU1 -- INPUT FILE CONTAINING REVERBERATION TIME DATA LU2 -- OUTPUT FILE FOR STORING SOUND POWER DATA LU3 -- HIGH SPEED PRINTER LU4 -- INPUT FILE CONTAINING FREQUENCY RESPONSE CORRECTIONS LU5 -- CRT TERMINAL
2	40	DO YOU WANT TO INPUT THE REVERBERATION TIMES FROM THE DISC?
3	110	ENTER REVERBERATION TIME FOR BAND XX (XX.XX)
4	150 & 170	BAND 14 -- T = 22.11 BAND 15 -- T = 17.82 BAND 16 -- T = 14.85 BAND 17 -- T = 9.51 BAND 18 -- T = 4.14 BAND 19 -- T = 4.57 BAND 20 -- T = 3.02 BAND 21 -- T = 3.71 BAND 22 -- T = 4.51 BAND 23 -- T = 5.19 BAND 24 -- T = 6.31 BAND 25 -- T = 6.80 BAND 26 -- T = 6.97 BAND 27 -- T = 6.76 BAND 28 -- T = 6.18 BAND 29 -- T = 5.91 BAND 30 -- T = 5.94 BAND 31 -- T = 5.92 BAND 32 -- T = 5.66 BAND 33 -- T = 5.19 BAND 34 -- T = 4.63 BAND 35 -- T = 4.01 BAND 36 -- T = 3.34 BAND 37 -- T = 2.70 BAND 38 -- T = 2.12 BAND 39 -- T = 1.58 BAND 40 -- T = 1.16 BAND 41 -- T = 0.84 BAND 42 -- T = 0.61 BAND 43 -- T = 0.00
		DO YOU WANT TO RE-ENTER THESE DATA?

CRT TERMINAL MESSAGES: PROGRAM SPOWER (page 2)

MESSAGE NO.	FORMAT NO.	MESSAGE
5	190	ENTER NO. OF MICROPHONES IN MICROPHONE ARRAY (2 DIGITS) ENSURE THAT THE MULTIPLEXER DIGISWITCH IS SET TO 12
6	210	DO YOU WANT TO CALIBRATE MICROPHONE CHANNEL NO. 1 WITH A REFERENCE SIGNAL?
7	220	ENTER THE CORRECTION TO BE ADDED TO THE RTA DATA TO GET SOUND PRESSURE LEVELS FOR CHANNEL 1 (XX.XX)
8	250	DO YOU WANT TO CALIBRATE CHANNELS 2 THROUGH 12 IN THE SAME MANNER?
9	260	MICROPHONE CHANNEL XX
10	310	THE CALIBRATIONS FOR CHANNELS 2 THROUGH 12 RELATIVE TO CHANNEL 1 MUST BE ENTERED (CALIBRATION FOR X = RESPONSE OF X - RESPONSE OF 1)
11	320	ENTER CALIBRATION FOR CHANNEL 2 (+ OR - XX.XX)

CRT TERMINAL MESSAGES: PROGRAM SPOWER (page 3)

MESSAGE NO.	FORMAT NO.	MESSAGE
12	405, 410, & 170	MICROPHONE CALIBRATION DATA MICROPHONE CHANNEL NUMBER / CORRECTION TO RTA DATA / CALIBRATION RELATIVE TO CHANNEL 1 1 35.85 0.00 2 35.92 -0.07 3 37.42 -1.57 4 35.98 -0.13 5 34.65 1.20 6 36.42 -0.57 7 35.97 -0.12 8 36.60 -0.75 9 35.02 0.83 10 35.20 0.65 11 35.70 0.15 12 34.97 0.88 DO YOU WANT TO RE-ENTER THESE DATA?
13	425	DO YOU WANT TO CORRECT FOR THE FREQUENCY RESPONSE OF THE RTA MULTIFILTER AND/OR MICROPHONE?
14	430	DO YOU WANT TO INPUT THE FREQUENCY RESPONSE CORRECTIONS FROM THE DISC?
15	445	FREQ. RESPONSE CORRECTION(BAND X) = RESPONSE(BAND X) - RESPONSE(BAND 30)
16	455	ENTER BAND NO., CORRECTION (XX,YY.YY) (ENTER 00,0. IF NO FURTHER CORRECTION ARE DESIRED)

CRT TERMINAL MESSAGES: PROGRAM SPOWER (page 4)

MESSAGE NO.	FORMAT NO.	MESSAGE
17	470 & 170	BAND 14: CORRECTION = 0.11 BAND 29: CORRECTION = -0.64 BAND 15: CORRECTION = -0.39 BAND 30: CORRECTION = 0.00 BAND 16: CORRECTION = -0.21 BAND 31: CORRECTION = -0.13 BAND 17: CORRECTION = -0.13 BAND 32: CORRECTION = -0.08 BAND 18: CORRECTION = -0.21 BAND 33: CORRECTION = -0.06 BAND 19: CORRECTION = -0.27 BAND 34: CORRECTION = -0.07 BAND 20: CORRECTION = -0.00 BAND 35: CORRECTION = -0.01 BAND 21: CORRECTION = 0.11 BAND 36: CORRECTION = 0.08 BAND 22: CORRECTION = 0.02 BAND 37: CORRECTION = 0.24 BAND 23: CORRECTION = 0.09 BAND 38: CORRECTION = 0.42 BAND 24: CORRECTION = -0.25 BAND 39: CORRECTION = 0.58 BAND 25: CORRECTION = -0.22 BAND 40: CORRECTION = 1.07 BAND 26: CORRECTION = -0.23 BAND 41: CORRECTION = 1.42 BAND 27: CORRECTION = -0.19 BAND 42: CORRECTION = 0.92 BAND 28: CORRECTION = -0.10 BAND 43: CORRECTION = -0.24 DO YOU WANT TO RE-ENTER THESE DATA?
18	740	ENTER VANE SPEED IN REV/MIN (XX.X)
19	510	ENTER THE RTA INTEGRATION TIME IN SECONDS (XX.XX)
20	520	YOU HAVE ENTERED AN IMPROPER INTEGRATION TIME
21	540	ENTER THE NO. OF CONSECUTIVE SAMPLES TO BE TAKEN (2 DIGITS, MAX=50)
22	550 & 560	TOTAL INTEGRATION TIME: 30 SAMPLES X 1.00 SECONDS = 30.00 SECONDS DO YOU WANT TO CONDUCT A NOISE MEASUREMENT?
23	570	ENTER "GO" TO START NOISE MEASUREMENT

CRT TERMINAL MESSAGES: PROGRAM SPOWER (page 5)

MESSAGE NO.	FORMAT NO.	MESSAGE
24	660	ENTER "GO" TO START SOUND POWER MEASUREMENT
25	680	MICROPHONE 1
26	690	THE SYSTEM GAIN MUST BE RE-ADJUSTED
27	720	SOUND POWER MEASUREMENT IS FINISHED
28	800	IDENTIFY SOUND SOURCE (LIMIT: 1 LINE)
29	820	ENTER DATE
30	840	ENTER TIME OF DAY
31	1002	ENTER LOGICAL UNIT FOR DESIRED PRINTOUT DEVICE
32	1700	DO YOU WANT ANOTHER PRINT OF THESE RESULTS?
33	1710	DO YOU WANT TO CORRECT ANY TYPING MISTAKES IN THE PRINTOUT?
34	1800	DO YOU WANT TO CONDUCT ANOTHER SOUND POWER MEASUREMENT USING THE SAME REVERBERATION TIME DATA AND THE SAME SYSTEM GAIN SETTINGS?
35	1810	DO YOU WANT TO USE THE SAME TEMPERATURE, HUMIDITY, VANE SPEED, AND INTEGRATION TIME?
36	1830	END OF JOB

PRINTOUT 1 - PROGRAM SPOWER

RTA DATA READOUT

BAND NO.	FREQ.	NOISE LEVEL	MIC 1	MIC 2	MIC 3	MIC 4	MIC 5	MIC 6	MIC 7	MIC 8	MIC 9	MIC 10	MIC 11	MIC 12	FREQUENCY RESPONSE CORRECTION
14	25	6.43	14.89	16.87	17.64	14.15	21.72	18.01	24.23	20.17	21.48	14.12	21.94	25.13	0.11
15	32	5.75	21.41	18.09	22.68	17.71	21.68	21.74	20.97	14.05	25.41	14.42	26.97	26.37	-0.39
16	40	1.99	23.85	26.47	23.82	21.38	27.97	21.81	27.55	7.75	25.35	23.72	25.40	31.27	-0.21
17	50	6.82	27.60	26.84	24.24	26.52	27.66	18.17	26.43	20.50	26.55	27.91	20.90	28.06	-0.13
18	63	4.16	27.72	25.51	27.41	25.07	26.45	25.32	26.41	25.43	28.40	25.33	25.08	28.01	-0.21
19	80	5.61	30.31	34.21	28.47	29.81	33.91	29.45	28.85	27.61	31.63	28.52	28.70	27.83	-0.27
20	100	5.98	31.05	30.86	32.34	32.14	33.60	31.29	32.78	29.72	29.53	31.43	30.55	31.68	-0.00
21	125	4.52	33.06	33.30	31.84	33.26	33.36	33.63	33.15	31.99	32.42	32.96	32.81	33.22	0.11
22	160	0.17	35.11	36.18	32.97	36.05	37.43	34.23	35.41	33.45	35.30	35.20	34.24	35.62	0.02
23	200	0.00	38.49	37.30	36.50	36.84	37.69	36.96	37.51	36.40	36.17	38.01	36.88	37.44	0.09
24	250	0.00	39.33	38.93	37.49	38.16	39.97	38.28	39.40	37.64	38.82	39.26	38.65	39.48	-0.25
25	315	0.00	39.13	38.93	37.24	38.61	40.18	38.46	39.62	38.11	39.13	39.28	38.80	39.39	-0.22
26	400	0.00	39.07	39.01	37.31	38.66	39.73	38.59	39.14	37.56	39.27	39.43	38.60	39.05	-0.23
27	500	0.00	39.27	39.03	37.55	38.74	40.23	38.60	39.44	37.70	39.13	39.21	38.55	39.49	-0.19
28	630	0.00	39.73	39.59	38.56	39.22	40.64	39.18	39.98	38.44	39.63	39.94	39.19	40.11	-0.10
29	800	0.00	41.87	42.05	40.61	41.88	43.12	41.22	42.35	40.71	42.10	42.18	41.44	42.61	-0.64
30	1000	0.00	43.83	44.32	42.64	43.82	45.25	43.29	44.63	42.77	44.14	44.27	43.53	44.61	0.00
31	1250	0.00	44.93	44.95	43.26	44.83	45.84	44.20	45.19	43.62	44.90	45.13	44.34	45.42	-0.13
32	1600	0.00	44.23	44.37	42.63	43.84	45.24	43.42	44.69	42.98	44.23	44.51	43.82	44.80	-0.08
33	2000	0.00	43.45	43.73	42.01	43.36	44.77	42.89	44.17	42.44	43.59	43.94	43.19	44.04	-0.06
34	2500	0.00	41.71	41.70	40.04	41.63	42.76	40.81	42.25	40.53	41.68	41.97	41.20	42.15	-0.07
35	3150	0.00	39.24	39.23	37.60	39.28	40.44	38.51	39.82	38.15	39.26	39.57	38.70	39.81	-0.01
36	4000	0.00	38.68	38.81	37.11	38.65	39.93	37.79	39.36	37.73	38.85	39.10	38.38	39.41	0.08
37	5000	0.00	36.97	37.42	35.68	37.24	38.41	36.40	37.91	36.34	37.41	37.68	36.74	37.85	0.24
38	6300	0.00	35.00	35.30	33.67	35.39	36.45	34.24	35.92	34.31	35.37	35.63	34.65	35.81	0.42
39	8000	0.00	32.32	33.00	31.17	32.80	33.87	31.50	33.51	31.85	32.93	32.97	32.03	33.34	0.58
40	10000	0.00	29.35	30.50	28.77	30.33	31.23	28.46	31.19	29.39	30.50	30.41	29.10	30.75	1.07
41	12500	0.00	25.87	27.41	25.87	26.98	28.41	25.18	28.80	26.83	27.77	27.70	25.85	28.03	1.42
42	16000	0.00	21.13	22.72	21.20	21.43	23.21	19.92	24.85	22.85	23.71	23.52	21.41	23.41	0.92
43	20000	0.00	15.79	16.96	16.49	14.83	17.35	14.40	20.25	18.00	18.75	18.24	16.43	18.33	-0.24

MICROPHONE CALIBRATION DATA

MICROPHONE CHANNEL NUMBER	CORRECTION TO RTA DATA	CALIBRATION RELATIVE TO CHANNEL 1
1	35.85	0.00
2	35.92	-0.07
3	37.42	-1.57
4	35.98	-0.13
5	34.65	1.20
6	36.42	-0.57
7	35.97	-0.12
8	36.60	-0.75
9	35.02	0.83
10	35.20	0.65
11	35.70	0.15
12	34.97	0.88

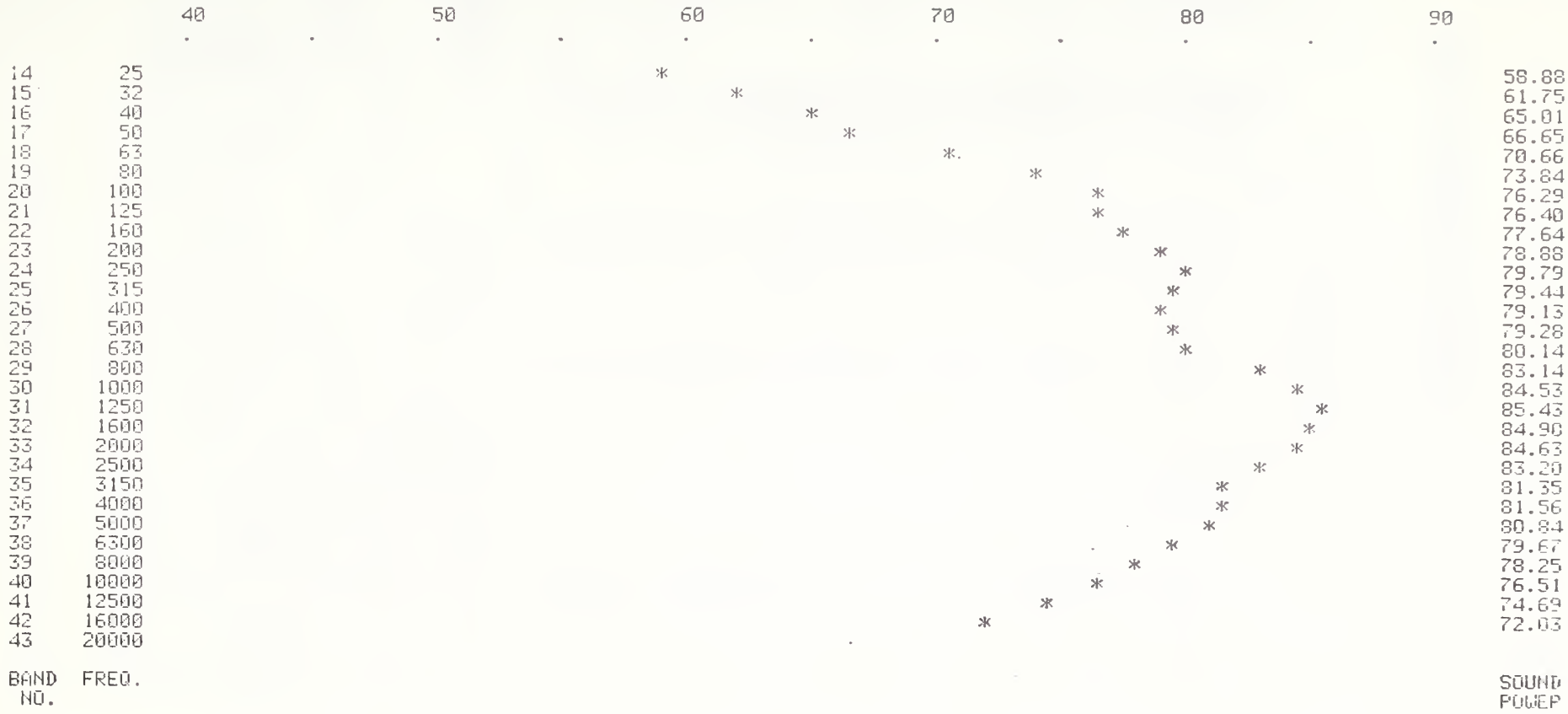
PRINTOUT 2 - PROGRAM SPOWER

SOUND PRESSURE LEVELS

BAND NO.	FREQ.	NOISE LEVEL	MIC 1	MIC 2	MIC 3	MIC 4	MIC 5	MIC 6	MIC 7	MIC 8	MIC 9	MIC 10	MIC 11	MIC 12
14	25	42.16	50.63	52.68	54.94	50.01	56.25	54.32	60.08	56.65	56.39	49.20	57.53	59.98
15	32	41.98	57.64	54.39	60.49	54.07	56.72	58.54	57.33	51.03	60.81	50.01	63.05	61.73
16	40	38.05	59.90	62.60	61.45	57.57	62.83	58.44	63.72	44.56	60.58	59.13	61.30	66.45
17	50	42.80	63.57	62.88	61.78	62.62	62.44	54.72	62.52	57.23	61.70	63.23	56.73	63.15
18	63	40.22	63.78	61.64	65.04	61.26	61.31	61.95	62.59	62.25	63.63	60.74	61.00	63.19
19	80	41.72	66.42	70.40	66.15	66.06	68.83	66.13	65.08	64.47	66.91	63.99	64.66	63.07
20	100	41.83	66.91	66.78	69.76	68.12	68.25	67.71	68.75	66.32	64.55	66.63	66.25	66.65
21	125	40.25	68.79	69.10	69.15	69.13	67.89	69.93	69.00	68.48	67.33	68.05	68.40	68.08
22	160	36.01	70.95	72.08	70.37	72.02	72.06	70.63	71.36	70.03	70.30	70.38	69.92	70.57
23	200	35.76	74.26	73.13	73.83	72.73	72.25	73.29	73.39	72.92	71.10	73.12	72.49	72.32
24	250	36.10	75.43	75.10	75.16	74.39	74.87	74.95	75.61	74.49	74.08	74.71	74.59	74.70
25	315	36.07	75.20	75.07	74.88	74.81	75.05	75.10	75.80	74.92	74.37	74.70	74.71	74.58
26	400	36.07	75.14	75.15	74.96	74.86	74.60	75.24	75.34	74.38	74.51	74.86	74.52	74.25
27	500	36.04	75.31	75.13	75.16	74.91	75.07	75.21	75.59	74.49	74.34	74.60	74.44	74.65
28	630	35.95	75.68	75.61	76.08	75.30	75.39	75.70	76.05	75.14	74.75	75.24	74.99	75.18
29	800	36.49	78.36	78.62	78.67	78.51	78.41	78.28	78.96	77.95	77.76	78.02	77.79	78.22
30	1000	35.85	79.68	80.23	80.06	79.80	79.90	79.71	80.60	79.37	79.16	79.47	79.23	79.58
31	1250	35.98	80.91	81.00	80.82	80.94	80.62	80.76	81.29	80.36	80.05	80.46	80.18	80.52
32	1600	35.93	80.16	80.37	80.13	79.90	79.97	79.92	80.74	79.66	79.33	79.79	79.60	79.85
33	2000	35.91	79.36	79.71	79.49	79.39	79.48	79.37	80.20	79.10	78.67	79.20	78.95	79.07
34	2500	35.92	77.63	77.70	77.53	77.68	77.48	77.30	78.29	77.20	76.77	77.24	76.97	77.19
35	3150	35.86	75.10	75.16	75.03	75.27	75.09	74.94	75.80	74.75	74.29	74.77	74.40	74.78
36	4000	35.77	74.45	74.65	74.45	74.55	74.50	74.13	75.24	74.25	73.79	74.22	74.00	74.30
37	5000	35.61	72.58	73.10	72.86	72.98	72.82	72.58	73.64	72.70	72.19	72.64	72.20	72.57
38	6300	35.43	70.43	70.80	70.66	70.95	70.68	70.24	71.46	70.49	69.97	70.41	69.93	70.35
39	8000	35.27	67.59	68.33	68.01	68.19	67.94	67.33	68.90	67.87	67.37	67.58	67.15	67.73
40	10000	34.78	64.12	65.34	65.12	65.23	64.81	63.81	66.09	64.92	64.44	64.54	63.72	64.65
41	12500	34.43	60.30	61.91	61.87	61.54	61.64	60.18	63.35	62.01	61.37	61.47	60.12	61.57
42	16000	34.93	56.06	57.72	57.70	56.49	56.94	55.42	59.90	58.53	57.81	57.79	56.19	57.46
43	20000	36.09	51.88	53.12	54.15	51.05	52.24	51.06	56.45	54.83	54.00	53.68	52.37	53.54

PRINTOUT 3 - PROGRAM SPOWER

1/3 OCTAVE BAND SOUND POWER (DB)



BAND NO.	FREQ.	SOUND POWER
14	25	58.88
15	32	61.75
16	40	65.01
17	50	66.65
18	63	70.66
19	80	73.84
20	100	76.29
21	125	76.40
22	160	77.64
23	200	78.88
24	250	79.79
25	315	79.44
26	400	79.13
27	500	79.28
28	630	80.14
29	800	83.14
30	1000	84.53
31	1250	85.43
32	1600	84.90
33	2000	84.63
34	2500	83.20
35	3150	81.35
36	4000	81.56
37	5000	80.84
38	6300	79.67
39	8000	78.25
40	10000	76.51
41	12500	74.69
42	16000	72.03
43	20000	

PRINTOUT 4 - PROGRAM SPOWER

SOUND POWER

BAND NO.	FREQ. (HZ)	REVERB TIME (SEC)	STD. DEV. (DB)	SOUND PRESSURE (DB)	1/3 OCTAVE BAND SOUND POWER (DB)	OCTAVE BAND SOUND POWER (DB)
14	25	22.11	3.65	56.17	58.88	
15	32	17.82	4.14	58.70	61.75	67.35
16	40	14.85	5.41	61.64	65.01	
17	50	9.51	3.01	61.77	66.65	
18	63	4.14	1.32	62.56	70.66	76.07
19	80	4.57	2.04	66.50	73.84	
20	100	3.02	1.37	67.42	76.29	
21	125	3.71	0.71	68.66	76.40	81.59
22	160	4.51	0.80	70.96	77.64	
23	200	5.19	0.82	72.97	78.88	
24	250	6.31	0.44	74.86	79.79	84.16
25	315	6.80	0.36	74.95	79.44	
26	400	6.97	0.36	74.83	79.13	
27	500	6.76	0.40	74.93	79.28	84.31
28	630	6.18	0.41	75.45	80.14	
29	800	5.91	0.37	78.31	83.14	
30	1000	5.94	0.42	79.75	84.53	89.24
31	1250	5.92	0.36	80.67	85.43	
32	1600	5.66	0.37	79.97	84.90	
33	2000	5.19	0.39	79.35	84.63	89.08
34	2500	4.63	0.40	77.43	83.20	
35	3150	4.01	0.40	74.97	81.35	
36	4000	3.34	0.37	74.39	81.56	86.03
37	5000	2.70	0.39	72.76	80.84	
38	6300	2.12	0.42	70.55	79.67	
39	8000	1.58	0.49	67.86	78.25	83.10
40	10000	1.16	0.68	64.78	76.51	
41	12500	0.84	0.91	61.53	74.69	
42	16000	0.61	1.21	57.50	72.03	
43	20000		1.59	53.47		

A-WEIGHTED SOUND POWER = 94.42 DB (2.77 MILLIWATTS)
UNWEIGHTED SOUND POWER = 94.80 DB (3.02 MILLIWATTS)
A-WEIGHTED SOUND PRESSURE = 88.89 DB
UNWEIGHTED SOUND PRESSURE = 89.21 DB

VANE SPEED = 7.5 RPM
NO. OF MICROPHONES = 12
SAMPLE TIME AT EACH MICROPHONE: 30 SAMPLES X 1.00 SECONDS = 30.00 SECONDS

DRY BULB TEMPERATURE = 21.8 DEG. C (71.2 DEG. F)
WET BULB TEMPERATURE = 16.7 DEG. C (62.0 DEG. F)
RELATIVE HUMIDITY = 59.7 %
BAROMETRIC PRESSURE = 980.8 MILLIBARS (735.7 MM HG)

SOUND SOURCE: B & K TYPE 4204 REFERENCE SOUND SOURCE

DATE: 3/18/77
TIME: 7:50 A.M.

PROGRAM SPOWER

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$ASSM
SPOWER PROG SPOWER - PROGRAM TO MEASURE SOUND POWER
$FORT
C    ------------------------------
C    SUBPROGRAMS CALLED:  SAMPLE,SPLCAL,DELAY,SUBMUX,MUX,HUMID,BAND,
C                         MEANLG,MEANAR,RTA
C    ------------------------------
      DIMENSION X(50),RDATA(30,12),SPL(30,12),STD(30),SPLM(30),T60(30),
     1POWER(30),WEIGHT(30),FLOOR(30),SPLCOR(12),RELCAL(12),ARRAY(12),
     2SOURCE(18),DATE(5),TIME(5),DATE0(5),TIME0(5),FRCOR(30)
      INTEGER*2 X0(1560),FREQ(30),B,OVFLOW,FF,TX100,LINE(101),
     1DOT,STAR,SPACE,LCARET,RCARET
      DATA DOT,STAR,SPACE,LCARET,RCARET,FF/X'2E00',X'2A00',X'2000',
     1X'3C00',X'3E00',X'0C00'/
      DATA FREQ/25,32,40,50,63,80,100,125,160,200,250,315,400,500,
     1630,800,1000,1250,1600,2000,2500,3150,4000,5000,6300,8000,
     210000,12500,16000,20000/
      DATA WEIGHT/-44.7,-39.4,-34.6,-30.2,-26.2,-22.5,-19.1,-16.1,
     1-13.4,-10.9,-8.6,-6.6,-4.8,-3.2,-1.9,-.8,0.,.6,1.,1.2,1.3,
     21.2,1.,.5,-.1,-1.1,-2.5,-4.3,-6.6,-9.3/
      WRITE (5,10)
10    FORMAT (X/X/'THIS PROGRAM RUNS AND ANALYZES ONE SOUND POWER
     1 MEASUREMENT RE S1.21'/'WITH 1 SOURCE LOCATION AND UP TO 12
     2 MICROPHONE POSITIONS'/X/X/
     3'THE FOLLOWING LOGICAL UNIT ASSIGNMENTS ARE REQUIRED:'/X/
     45X,'LU1 -- INPUT FILE CONTAINING REVERBERATION TIME DATA'/
     55X,'LU2 -- OUTPUT FILE FOR STORING SOUND POWER DATA'/
     65X,'LU3 -- HIGH SPEED PRINTER'/
     75X,'LU4 -- INPUT FILE CONTAINING FREQUENCY RESPONSE CORRECTIONS'/
     85X,'LU5 -- CRT TERMINAL'/X/X)
20    FORMAT (A4)
      REWIND 2
30    WRITE (5,40)
40    FORMAT ('DO YOU WANT TO INPUT THE REVERBERATION TIMES FROM
     1 THE DISC?')
      READ (5,20) QS
      IF (QS.EQ.'NO') GO TO 100
      REWIND 1
      READ (1,20) C
      DO 90 I=1,30
      READ (1,80) J,J,C,T60(I),C,C,J
80    FORMAT (I2,X,I5,X,2(F8.4,X),F9.5,X,F6.3,X,I3)
90    CONTINUE
      GO TO 140
100   DO 130 I=1,30
      B=I+13
      WRITE (5,110) B
110   FORMAT ('ENTER REVERBERATION TIME FOR BAND ',I2,4X,'(XX.XX)')
      READ (5,120) T60(I)
120   FORMAT (F10.5)
130   CONTINUE
140   DO 160 I=1,15
      B=I+13
      J=B+15
      WRITE (5,150) B,T60(I),J,T60(I+15)
150   FORMAT ('BAND ',I2,' -- T =',F6.2,15X,'BAND ',I2,' -- T =',F6.2)
160   CONTINUE
      WRITE (5,170)
170   FORMAT (X/'DO YOU WANT TO RE-ENTER THESE DATA?')
      READ (5,20) QS
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      IF (QS.NE.'NO') GO TO 30
      DO 180 I=1,30
      FLOOR(I)=0.
      DO 180 J=1,12
      RDATA(I,J)=0.
      SPL(I,J)=0.
180   CONTINUE
      WRITE (5,190)
190   FORMAT ('ENTER NO. OF MICROPHONES IN MICROPHONE ARRAY
     1    (2 DIGITS)')
      READ (5,200) NMIC
200   FORMAT (I2)
      RELCAL(1)=0
205   WRITE (5,210) NMIC
210   FORMAT ('ENSURE THAT THE MULTIPLEXER DIGISWITCH IS SET TO ',I2/X/
     1'DO YOU WANT TO CALIBRATE MICROPHONE CHANNEL NO. 1'/
     2'WITH A REFERENCE SIGNAL?')
      READ (5,20) QS
      IF (QS.NE.'NO') GO TO 230
      WRITE (5,220)
220   FORMAT ('ENTER THE CORRECTION TO BE ADDED TO THE RTA DATA'/
     1'TO GET SOUND PRESSURE LEVELS FOR CHANNEL 1    (XX.XX)')
      READ (5,120) SPLCOR(1)
      GO TO 300
230   CALL SUBMUX(1)
      CALL SPLCAL(SPLCOR(1),50,X,X0,1560)
      WRITE (5,250) NMIC
250   FORMAT ('DO YOU WANT TO CALIBRATE CHANNELS 2 THROUGH ',I2,
     1' IN THE SAME MANNER?')
      READ (5,20) QS
      IF (QS.EQ.'NO') GO TO 300
      DO 270 I=2,NMIC
      WRITE (5,260) I
260   FORMAT (X,X/'MICROPHONE CHANNEL ',I2)
      CALL SUBMUX(I)
      CALL SPLCAL(SPLCOR(I),50,X,X0,1560)
      RELCAL(I)=SPLCOR(1)-SPLCOR(I)
270   CONTINUE
      GO TO 400
300   WRITE (5,310) NMIC
310   FORMAT (X,'THE CALIBRATIONS FOR CHANNELS 2 THROUGH ',I2,
     1' RELATIVE TO CHANNEL 1'/'MUST BE ENTERED'/
     2'(CALIBRATION FOR X  =  RESPONSE OF X  -  RESPONSE OF 1)'/X)
      DO 330 I=2,NMIC
      WRITE (5,320) I
320   FORMAT ('ENTER CALIBRATION FOR CHANNEL ',I2,5X,
     1'(+ OR - XX.XX)')
      READ (5,120) RELCAL(I)
      SPLCOR(I)=SPLCOR(1)-RELCAL(I)
330   CONTINUE
400   WRITE (5,405)
405   FORMAT (X/X/T7,'MICROPHONE CALIBRATION DATA'/X/X/
     1'MICROPHONE',T15,'CORRECTION',T30,'CALIBRATION'/
     2T3,'CHANNEL',T19,'TO',T30,'RELATIVE TO'/
     3T3,'NUMBER',T16,'RTA DATA',T31,'CHANNEL 1'/X)
      DO 415 I=1,NMIC
      WRITE (5,410) I,SPLCOR(I),RELCAL(I)
410   FORMAT (T5,I2,T16,F7.2,T32,F6.2)
415   CONTINUE
      WRITE (5,170)
```

```
121         READ (5,20) QS
122         IF (QS.NE.'NO') GO TO 205
123         DO 420 I=1,30
124         FRCOR(I)=0.
125  420    CONTINUE
126         WRITE (5,425)
127  425    FORMAT ('DO YOU WANT TO CORRECT FOR THE FREQUENCY RESPONSE
128        1 OF THE'/'RTA MULTIFILTER AND/OR MICROPHONE?')
129         READ (5,20) QS
130         IF (QS.EQ.'NO') GO TO 490
131  428    WRITE (5,430)
132  430    FORMAT ('DO YOU WANT TO INPUT THE FREQUENCY RESPONSE
133        1 CORRECTIONS FROM THE DISC?')
134         READ (5,20) QS
135         INDTR=0
136         IF (QS.EQ.'NO') GO TO 440
137         INDTR=1
138         REWIND 4
139         READ (4) FRCOR
140         READ (4) DATE0,TIME0
141         GO TO 465
142  440    WRITE (5,445)
143  445    FORMAT ('FREQ. RESPONSE CORRECTION(BAND X) =
144        1 RESPONSE(BAND X) - RESPONSE(BAND 30)'/X)
145  450    WRITE (5,455)
146  455    FORMAT ('ENTER BAND NO., CORRECTION   (XX,YY.YY)'/
147        1'(ENTER 00.0. IF NO FURTHER CORRECTIONS ARE DESIRED)')
148         READ (5,460) B,I,C
149  460    FORMAT (I2,A1,F10.5)
150         IF (B.EQ.0) GO TO 465
151         FRCOR(B-13)=C
152         GO TO 450
153  465    DO 475 I=1,15
154         B=I+13
155         J=B+15
156         WRITE (5,470) B,FRCOR(I),J,FRCOR(I+15)
157  470    FORMAT (2('BAND ',I2,':  CORRECTION = ',F7.2,9X))
158  475    CONTINUE
159         WRITE (5,170)
160         READ (5,20) QS
161         IF (QS.NE.'NO') GO TO 428
162  490    CALL HUMID(HUMDTY,DTEMPF,DTEMPC,WTEMPF,WTEMPC,
163        1PRESS1,PRESS2,VSOUND)
164         WRITE (5,740)
165         READ (5,120) VANE
166  500    WRITE (5,510)
167  510    FORMAT ('ENTER THE RTA INTEGRATION TIME IN SECONDS    (XX.XX)')
168         READ (5,120) T
169         IF ((T.EQ..1).OR.(T.EQ..25).OR.(T.EQ..5).OR.(T.EQ.1.).OR.
170        1(T.EQ.2.).OR.(T.EQ.4.).OR.(T.EQ.8.).OR.(T.EQ.16.).OR.
171        2(T.EQ.32.)) GO TO 525
172         WRITE (5,520)
173  520    FORMAT ('YOU HAVE ENTERED AN IMPROPER INTEGRATION TIME')
174         GO TO 500
175  525    TX100=T*100.
176  530    WRITE (5,540)
177  540    FORMAT ('ENTER THE NO. OF CONSECUTIVE SAMPLES TO BE TAKEN',4X,
178        1'(2 DIGITS, MAX=50)')
179         READ (5,200) NSAMP
180         IF (NSAMP.GT.50) GO TO 530
```

```
181 545   C=T*NSAMP
182       WRITE (5,550) NSAMP,T,C
183 550   FORMAT (X/'TOTAL INTEGRATION TIME:  ',I2,' SAMPLES X ',F5.2,
184      1' SECONDS = ',F6.2,' SECONDS'/X)
185       WRITE (5,560)
186 560   FORMAT ('DO YOU WANT TO CONDUCT A NOISE MEASUREMENT?')
187       READ (5,20)QS
188       IF (QS.EQ.'NO') GO TO 650
189       CALL SUBMUX(1)
190       WRITE (5,570)
191 570   FORMAT ('ENTER "GO" TO START NOISE MEASUREMENT')
192       READ (5,20) QS
193       CALL SAMPLE(0,NSAMP,TX100,OVFLOW,X0,1560)
194       DO 600 I=1,30
195       B=I+13
196       CALL BAND(B,NSAMP,X,X0,1560)
197       CALL MEANLG(NSAMP,X,FLOOR(I),C)
198 600   CONTINUE
199 650   WRITE (5,660)
200 660   FORMAT ('ENTER "GO" TO START SOUND POWER MEASUREMENT')
201 670   READ (5,20) QS
202       DO 710 J=1,NMIC
203       WRITE (5,680) J
204 680   FORMAT ('MICROPHONE ',I2)
205       CALL SUBMUX(J)
206       CALL DELAY(500)
207       CALL SAMPLE(0,NSAMP,TX100,OVFLOW,X0,1560)
208       IF (OVFLOW.EQ.0) GO TO 700
209       WRITE (5,690)
210 690   FORMAT ('THE SYSTEM GAIN MUST BE RE-ADJUSTED')
211       GO TO 205
212 700   DO 710 I=1,30
213       B=I+13
214       CALL BAND(B,NSAMP,X,X0,1560)
215       CALL MEANLG(NSAMP,X,RDATA(I,J),C)
216 710   CONTINUE
217       WRITE (5,720)
218 720   FORMAT (X,X/'SOUND POWER MEASUREMENT IS FINISHED')
219       GO TO 750
220 730   CALL HUMID(HUMDTY,DTEMPF,DTEMPC,WTEMPF,WTEMPC,PRESS1,PRESS2,
221      1VSOUND)
222       WRITE (5,740)
223 740   FORMAT ('ENTER VANE SPEED IN REV/MIN   (XX.X)')
224       READ (5,120) VANE
225 750   WRITE (5,800)
226 800   FORMAT ('IDENTIFY SOUND SOURCE      (LIMIT:  1 LINE)')
227       READ (5,810) (SOURCE(I),I=1,18)
228 810   FORMAT (18A4)
229       WRITE (5,820)
230 820   FORMAT (X/'ENTER DATE')
231       READ (5,830) (DATE(I),I=1,5)
232 830   FORMAT (5A4)
233       WRITE (5,840)
234 840   FORMAT ('ENTER TIME OF DAY')
235       READ (5,830) (TIME(I),I=1,5)
236       VOLUME=424.8
237       AREA=343.73
238       DO 950 I=1,30
239       DO 900 J=1,NMIC
240       SPL(I,J)=RDATA(I,J)+SPLCOR(J)-FRCOR(I)
```

```
241         ARRAY(J)=SPL(I,J)
242  900    CONTINUE
243         CALL MEANAR(NMIC,ARRAY,C,STD(I))
244         CALL MEANLG(NMIC,ARRAY,SPLM(I),C)
245         IF (T60(I).EQ.0.) GO TO 950
246         WAVELG=VSOUND/FREQ(I)
247         POWER(I)=SPLM(I)+10*ALOG10(VOLUME*(1+(AREA*WAVELG)/(8*VOLUME))
248        1*1000./(PRESS2*T60(I)))-14
249  950    CONTINUE
250  1000   WRITE (5,1002)
251  1002   FORMAT ('ENTER LOGICAL UNIT FOR DESIRED PRINTOUT DEVICE')
252         READ (5,1005) LU
253  1005   FORMAT (I1)
254         WRITE (LU,1010) (I,I=1,12)
255  1010   FORMAT (X/T62,'RTA DATA READOUT',T121,'FREQUENCY'/
256        1'BAND',T16,'NOISE',T121,'RESPONSE'/
257        2T2,'NO.',T8,'FREQ.',T16,'LEVEL',T24,9('MIC ',I1,3X),
258        33('MIC ',I2,2X),T121,'CORRECTION'/X)
259         DO 1030 I=1,30
260         B=I+13
261         WRITE (LU,1020) B,FREQ(I),FLOOR(I),(RDATA(I,J),J=1,12),
262        1FRCOR(I)
263  1020   FORMAT (T2,I2,T7,I5,T15,F6.2,T23,12(F6.2,2X),T122,F6.2)
264  1030   CONTINUE
265         IF (INDTR.EQ.0) WRITE (LU,1032)
266         IF (LU.EQ.5) GO TO 1034
267         IF (INDTR.EQ.1) WRITE (LU,1033) DATE0,TIME0
268  1032   FORMAT (X/X/X)
269  1033   FORMAT (X/T90,'FREQUENCY RESPONSE MEASURED:  ',5A4/
270        1T120,5A4)
271  1034   WRITE (LU,405)
272         DO 1035 I=1,NMIC
273         WRITE (LU,410) I,SPLCOR(I),RELCAL(I)
274  1035   CONTINUE
275         WRITE (LU,1040) FF
276  1040   FORMAT (A1)
277         WRITE (LU,1100)
278  1100   FORMAT (X/X/X/T49,'SOUND PRESSURE LEVELS')
279         WRITE (LU,1105) (I,I=1,12)
280  1105   FORMAT (X/X/X/X/'BAND',T16,'NOISE'/
281        1T2,'NO.',T8,'FREQ.',T16,'LEVEL',T24,9('MIC ',I1,3X),
282        23('MIC ',I2,2X)/X)
283         DO 1110 I=1,30
284         B=I+13
285         C=FLOOR(I)+SPLCOR(1)-ERCOR(I)
286         WRITE (LU,1107) B,FREQ(I),C,(SPL(I,J),J=1,12)
287  1107   FORMAT (T2,I2,T7,I5,T15,F6.2,T23,12(F6.2,2X))
288  1110   CONTINUE
289         WRITE (LU,1040) FF
290         C=0.
291         DO 1150 I=1,30
292         IF (T60(I).EQ.0.) GO TO 1150
293         IF (POWER(I).GT.C) C=POWER(I)
294  1150   CONTINUE
295         NSCALE=10*(INT(C/10.)+1)
296         IF (NSCALE.LT.50) NSCALE=50
297         J=NSCALE-50
298         WRITE (LU,1160) (I,I=J,NSCALE,10)
299  1160   FORMAT (X/X/X/T46,'1/3 OCTAVE BAND SOUND POWER  (DB)'/
300        1X/X/X/T14,5(I3,17X),I3/T15,10('.',9X),'.'/X)
```

```
      DO 1220 I=1,30
      B=I+13
      DO 1170 J=1,101
      LINE(J)=SPACE
1170  CONTINUE
      IF (T60(I).NE.0.) GO TO 1175
      WRITE (LU,1172) B,FREQ(I)
1172  FORMAT (I2,T7,I5)
      GO TO 1220
1175  J=INT(2.*POWER(I)+.5)-2*(NSCALE-50)+1
      IF (J.GE.1) GO TO 1180
      LINE(1)=LCARET
      GO TO 1200
1180  IF (J.LE.101) GO TO 1190
      LINE(101)=RCARET
      GO TO 1200
1190  LINE(J)=STAR
1200  WRITE (LU,1210) B,FREQ(I),(LINE(J),J=1,101),POWER(I)
1210  FORMAT (I2,T7,I5,T15,101A1,T120,F6.2)
1220  CONTINUE
      WRITE (LU,1230) FF
1230  FORMAT (X/'BAND',T7,'FREQ.',T121,'SOUND'/
     1T2,'NO.',T121,'POWER'/A1)
      WRITE (LU,1400)
1400  FORMAT (T23,'SOUND POWER'/X/X/
     1T41,'1/3 OCTAVE',T54,'OCTAVE'/
     2T44,'BAND',T54,'BAND'/
     3'BAND',T16,'REVERB',T25,'STD.',T34,'SOUND',T44,'SOUND',T54,
     4'SOUND'/
     5T2,'NO.',T7,'FREQ.',T16,'TIME',T25,'DEV.',T33,'PRESSURE',
     6T44,'POWER',T54,'POWER'/
     7T7,'(HZ)',T16,'(SEC)',T25,'(DB)',T34,'(DB)',T44,'(DB)',
     8T54,'(DB)'/X)
      DO 1500 I=1,30
      B=I+13
      IF (T60(I).NE.0.) GO TO 1420
      WRITE (LU,1410) B,FREQ(I),STD(I),SPLM(I)
1410  FORMAT (T2,I2,T6,I5,T24,F5.2,T33,F6.2)
      GO TO 1500
1420  IF (INT(B/3.+.9).EQ.INT(B/3.+.001)) GO TO 1450
1430  WRITE (LU,1440) B,FREQ(I),T60(I),STD(I),SPLM(I),POWER(I)
1440  FORMAT (T2,I2,T6,I5,T15,F6.2,T24,F5.2,T33,F6.2,T43,F6.2)
      GO TO 1500
1450  IF ((T60(I-1).EQ.0.).OR.(T60(I+1).EQ.0.)) GO TO 1430
      C=10.*ALOG10(10.**(POWER(I-1)/10.)+10.**(POWER(I)/10.)+
     110.**(POWER(I+1)/10.))
      WRITE (LU,1460)B,FREQ(I),T60(I),STD(I),SPLM(I),POWER(I),C
1460  FORMAT (T2,I2,T6,I5,T15,F6.2,T24,F5.2,T33,F6.2,T43,F6.2,
     1T53,F6.2)
1500  CONTINUE
      X(1)=0.
      X(2)=0.
      X(3)=0.
      X(4)=0.
      DO 1530 B=14,43
      I=B-13
      IF (T60(I).EQ.0.) GO TO 1520
      X(1)=X(1)+10.**((POWER(I)+WEIGHT(I))/10.)
      X(2)=X(2)+10.**(POWER(I)/10.)
1520  X(3)=X(3)+10.**((SPLM(I)+WEIGHT(I))/10.)
```

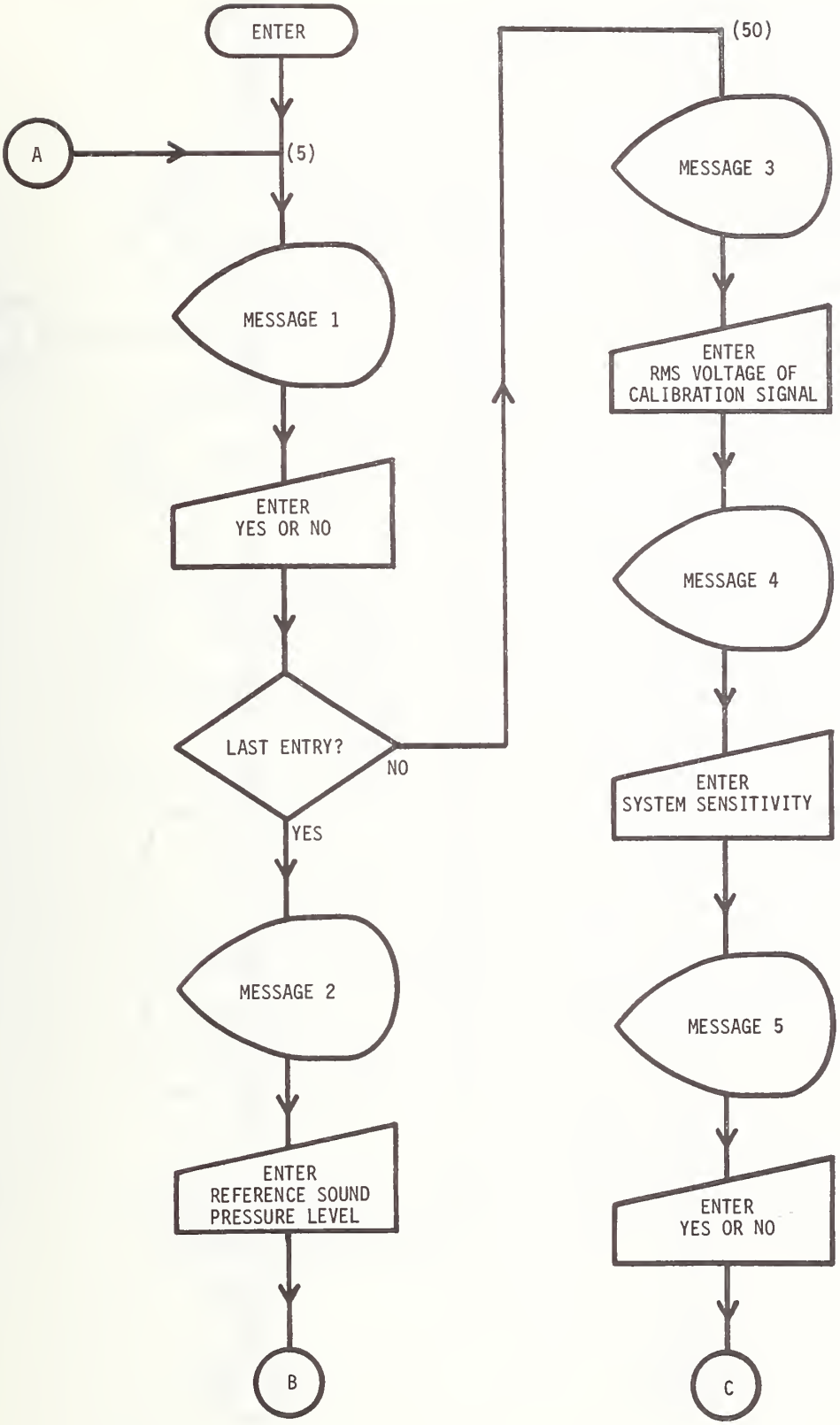
```
      X(4)=X(4)+10.**(SPLM(I)/10.)
1530  CONTINUE
      X(5)=10.*ALOG10(X(1))
      X(6)=X(1)*1.E-9
      X(7)=10.*ALOG10(X(2))
      X(8)=X(2)*1.E-9
      X(9)=10.*ALOG10(X(3))
      X(10)=10.*ALOG10(X(4))
      WRITE (LU,1540) (X(I),I=5,10)
1540  FORMAT (X/X/'A-WEIGHTED SOUND POWER    = ',F6.2,' DB',
     14X,'(',F8.2,' MILLIWATTS)'/
     2'UNWEIGHTED SOUND POWER    = ',F6.2,' DB',4X,'(',F8.2,
     3' MILLIWATTS)'/
     4'A-WEIGHTED SOUND PRESSURE = ',F6.2,' DB'/
     5'UNWEIGHTED SOUND PRESSURE = ',F6.2,' DB'/X)
      C=T*NSAMP
      WRITE (LU,1550) VANE,NMIC,NSAMP,T,C, DTEMPC,DTEMPF
1550  FORMAT ('VANE SPEED = ',F4.1,' RPM'/
     1'NO. OF MICROPHONES = ',I2/
     2'SAMPLE TIME AT EACH MICROPHONE:  ',I2,' SAMPLES X ',F5.2,
     3' SECONDS = ',F6.2,' SECONDS'/X/
     4'DRY BULB TEMPERATURE = ',F4.1,' DEG. C',7X,'(',F4.1,' DEG. F)')
      IF (WTEMPC.EQ.-1000.) GO TO 1570
      WRITE (LU,1560) WTEMPC,WTEMPF
1560  FORMAT ('WET BULB TEMPERATURE = ',F4.1,' DEG. C',7X,'(',F4.1,
     1' DEG. F)')
1570  WRITE (LU,1580) HUMDTY,PRESS2,PRESS1,(SOURCE(I),I=1,18),
     1(DATE(I),I=1,5),(TIME(I),I=1,3),FF,FF
1580  FORMAT ('RELATIVE HUMIDITY    = ',F4.1,' %'/
     1'BAROMETRIC PRESSURE  = ',F6.1,' MILLIBARS  (',
     2F5.1,' MM HG)'/X/
     2'SOUND SOURCE:  ',18A4/X/'DATE:  ',5A4/'TIME:  ',5A4/A1/A1)
      WRITE (5,1700)
1700  FORMAT ('DO YOU WANT ANOTHER PRINT OF THESE RESULTS?')
      READ (5,20) QS
      IF (QS.NE.'NO') GO TO 1000
      WRITE (5,1710)
1710  FORMAT ('DO YOU WANT TO CORRECT ANY TYPING MISTAKES IN THE
     1 PRINTOUT?')
      READ (5,20) QS
      IF (QS.NE.'NO') GO TO 730
      WRITE (2) POWER
      WRITE (5,1800)
1800  FORMAT ('DO YOU WANT TO CONDUCT ANOTHER SOUND POWER MEASUREMENT'/
     1'USING THE SAME REVERBERATION TIME DATA AND THE SAME'/
     2'SYSTEM GAIN SETTINGS?')
      READ (5,20) QS
      IF (QS.EQ.'NO') GO TO 1820
      WRITE (5,1810)
1810  FORMAT ('DO YOU WANT TO USE THE SAME TEMPERATURE,HUMIDITY,'/
     1'VANE SPEED, AND INTEGRATION TIME?')
      READ (5,20) QS
      IF (QS.EQ.'NO') GO TO 490
      GO TO 545
1820  WRITE (5,1830)
1830  FORMAT (X/X/'END OF JOB')
      END
```

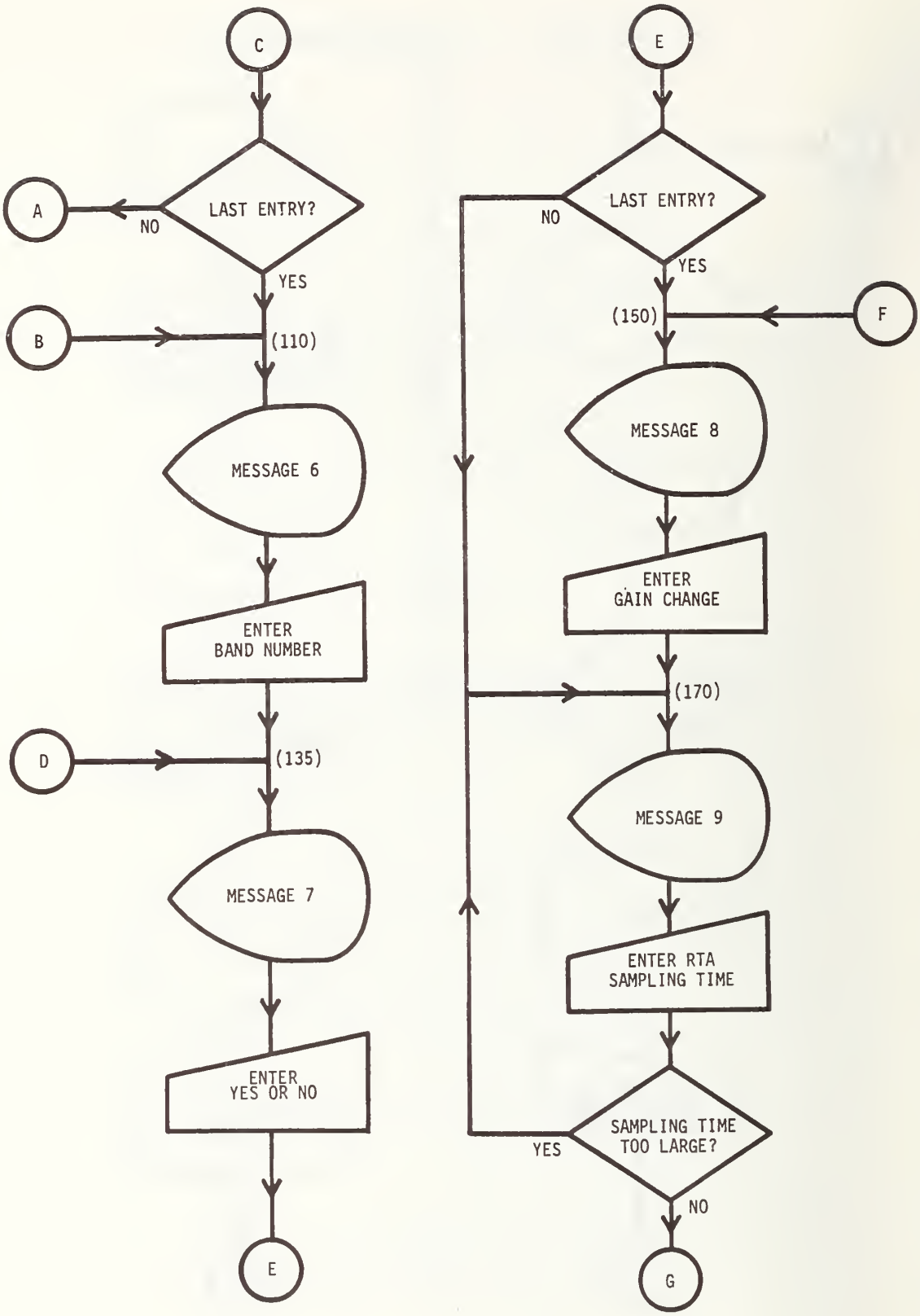
APPENDIX C

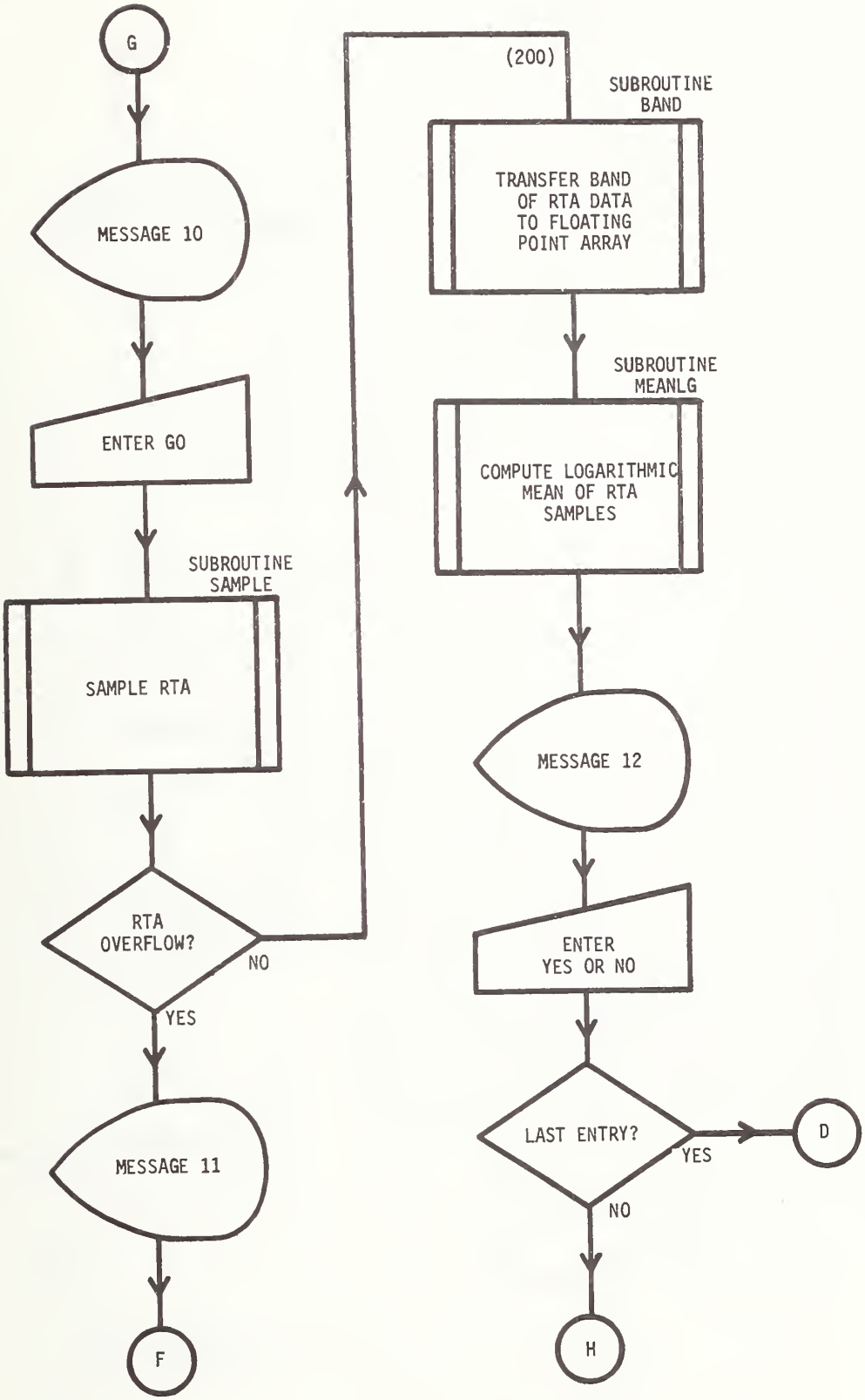
Flow Charts, Terminal Messages and Listings

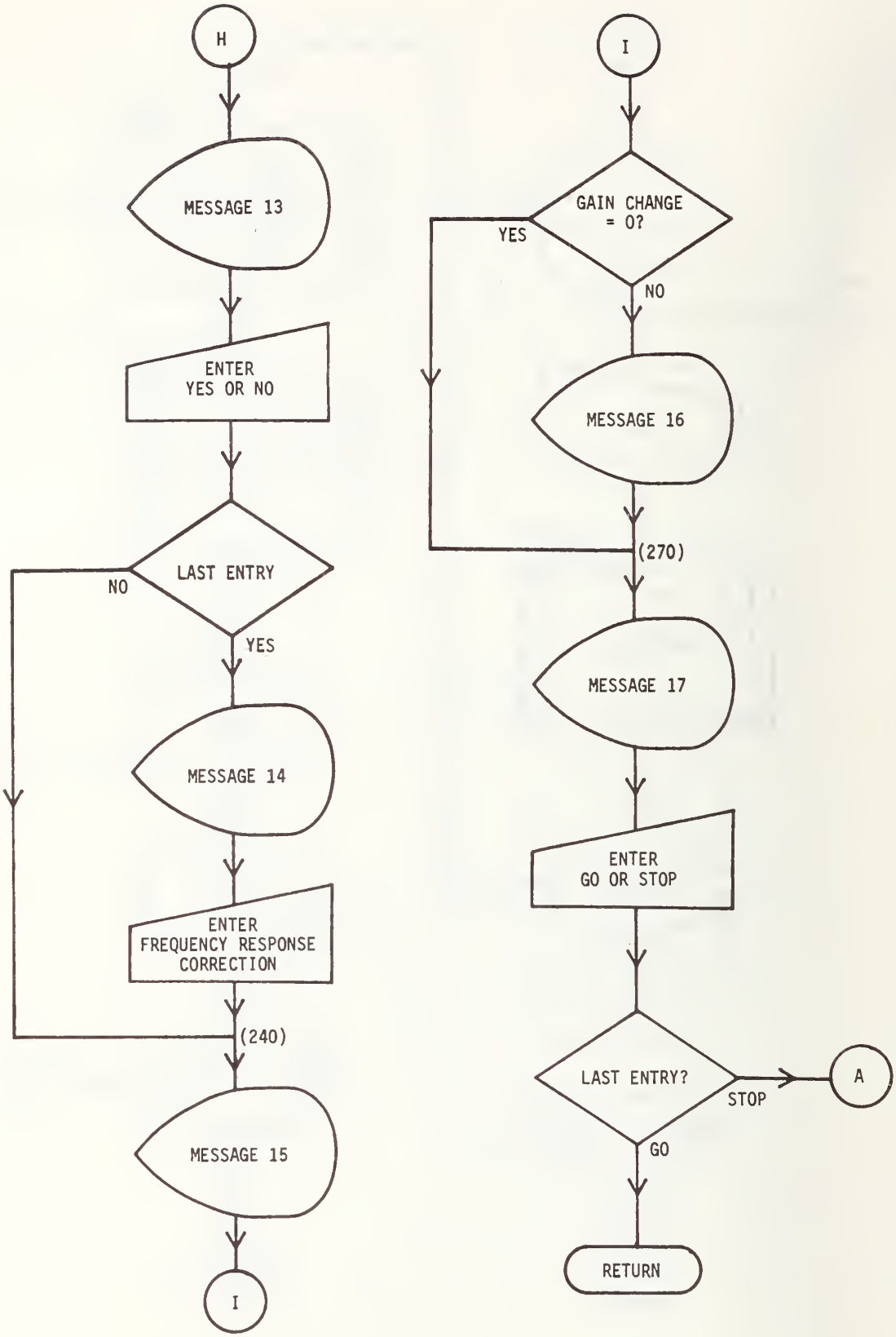
for Subroutines SPLCAL, MEANLG, and MEANAR

FLOW CHART: SUBROUTINE SPLCAL




C
A
LAST ENTRY?
NO
YES
B
(110)
MESSAGE 6
ENTER
BAND NUMBER
D
(135)
MESSAGE 7
ENTER
YES OR NO
E
E
LAST ENTRY?
NO
YES
(150)
F
MESSAGE 8
ENTER
GAIN CHANGE
(170)
MESSAGE 9
ENTER RTA
SAMPLING TIME
SAMPLING TIME
TOO LARGE?
YES
NO
G


G
MESSAGE 10
ENTER GO
SUBROUTINE SAMPLE
SAMPLE RTA
RTA OVERFLOW?
NO
YES
MESSAGE 11
F
(200)
SUBROUTINE BAND
TRANSFER BAND OF RTA DATA TO FLOATING POINT ARRAY
SUBROUTINE MEANLG
COMPUTE LOGARITHMIC MEAN OF RTA SAMPLES
MESSAGE 12
ENTER YES OR NO
LAST ENTRY?
YES
D
NO
H


H
MESSAGE 13
ENTER
YES OR NO
LAST ENTRY
NO
YES
MESSAGE 14
ENTER
FREQUENCY RESPONSE
CORRECTION
(240)
MESSAGE 15
I
I
GAIN CHANGE
= 0?
YES
NO
MESSAGE 16
(270)
MESSAGE 17
ENTER
GO OR STOP
LAST ENTRY?
STOP
A
GO
RETURN

CRT TERMINAL MESSAGES: SUBROUTINE SPLCAL

MESSAGE NO.	FORMAT NO.	MESSAGE
1	10	TO RELATE THE RTA DATA TO A KNOWN REFERENCE SIGNAL, TWO CALIBRATION OPTIONS ARE AVAILABLE: OPTION 1: USE AN ACOUSTIC CALIBRATING DEVICE AS A REFERENCE SOUND SOURCE OPTION 2: MEASURE THE RMS VOLTAGE OF A REFERENCE SIGNAL, AND COMPUTE THE SOUND PRESSURE LEVEL FROM THE SYSTEM SENSITIVITY DO YOU WANT TO USE OPTION 1?
2	30	ENTER THE REFERENCE SOUND PRESSURE LEVEL IN DB (XXX.XX)
3	60	APPLY CALIBRATION SIGNAL TO SYSTEM, AND MEASURE RMS VOLTAGE OF SIGNAL AT INPUT TO RTA MULTIFILTER ENTER RMS VALUE IN VOLTS (X.XXXXX)
4	80	ENTER SYSTEM SENSITIVITY IN DB RE 1V/N/SQ. METER (-XX.XX)
5	100	SOUND PRESSURE LEVEL CORRESPONDING TO CALIBRATION SIGNAL = 113.98 DB RE .00002 N/SQ. METER DO YOU WANT TO CONTINUE?
6	120	ENTER THE BAND NO. CORRESPONDING TO THE FREQ. OF THE CALIBRATION SIGNAL (IF BAND 14 IS USED TO SAMPLE UNFILTERED SIGNAL, ENTER "14")

CRT TERMINAL MESSAGES: SUBROUTINE SPLCAL (page 2)

MESSAGE NO.	FORMAT NO.	MESSAGE
7	140	HAVE YOU MADE ANY CHANGE IN THE SYSTEM GAIN TO ACCOMMODATE THE CALIBRATION SIGNAL?
8	160	ENTER TOTAL AMOUNT OF GAIN CHANGE IN DB (MINUS = REDUCTION) (-XX.XXX)
9	175	ENTER TOTAL RTA SAMPLING TIME DESIRED FOR REFERENCE SIGNAL MEASUREMENT (IN SECONDS, 2 DIGITS, MAX = 50)
10	180	ENTER "GO" TO START SAMPLING
11	190	RE-ADJUST SYSTEM GAIN
12	210	AVERAGED RTA READING = 58.15 DB STANDARD DEVIATION = 0.13 DB DO YOU WANT TO REPEAT THE RTA SAMPLING?
13	220	DO YOU WANT TO CORRECT FOR FREQUENCY RESPONSE?
14	230	FROM SYSTEM FREQUENCY RESPONSE CALIBRATION DATA, DETERMINE RESPONSE (CALIBRATION FREQUENCY) - RESPONSE (1000 HZ) ENTER THIS DIFFERENCE (-XX.XX)
15	250	THE CORRECTION TO BE ADDED TO THE RTA READINGS = 35.85 DB REMOVE CALIBRATION SIGNAL
16	260	ADJUST SYSTEM GAIN BY -XX.XX DB (BACK TO ORIGINAL SETTING)
17	280	ENTER "GO" TO CONTINUE, OR "STOP" TO REPEAT CALIBRATION

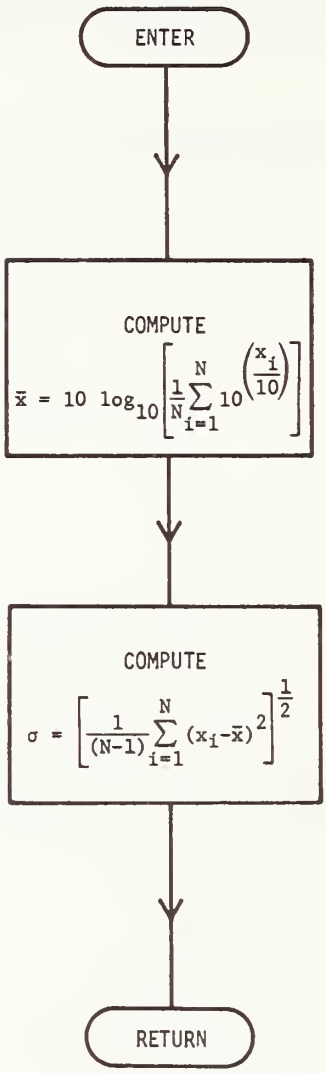
SUBROUTINE SPLCAL

```
$ASSM
SPLCAL PROG SPLCAL - SUBROUTINE FOR RELATING RTA DATA TO SPL
$FORT
C     ------------------------------
C     THIS SUBROUTINE RELATES THE RTA DATA TO A REFERENCE SIGNAL
C     OF KNOWN AMPLITUDE.
C
C     FORTRAN CALL STATEMENT:
C    -CALL SPLCAL (SPLCOR,NMAX,X,X0,NX0)
C
C     SPLCOR (REAL)   = CORRECTION TO BE ADDED TO SUBSEQUENT RTA DATA
C                       TO GET SPL
C     NMAX    (INT)   = MAX. NO. OF RTA SAMPLES ALLOWED BY CALLING PROGRAM
C     X       (REAL)  = ARRAY CONTAINING RTA FLOATING POINT DATA FOR 1 BAND
C     X0      (INT*2) = ARRAY CONTAINING THE FIXED-POINT RTA DATA
C     NX0     (INT)   = NO. OF ELEMENTS IN THE ARRAY X0:
C                       SHOULD BE CHOSEN SO THAT NX0=(30*NSAMP)+60
C
C     OTHER SUBROUTINES CALLED:  SAMPLE,BAND,MEANLG
C     ------------------------------
      SUBROUTINE SPLCAL(SPLCOR,NMAX,X,X0,NX0)
      DIMENSION X(NMAX)
      INTEGER*2 X0(NX0),TX100,OVFLOW,BANDNO
      REAL MEAN
5     WRITE (5,10)
10    FORMAT ('TO RELATE THE RTA DATA TO A KNOWN REFERENCE SIGNAL,'/
     1'TWO CALIBRATION OPTIONS ARE AVAILABLE:'/X/
     2'  OPTION 1:  USE AN ACOUSTIC CALIBRATING DEVICE AS A'/
     3'              REFERENCE SOUND SOURCE'/X/
     4'  OPTION 2:  MEASURE THE RMS VOLTAGE OF A REFERENCE SIGNAL, AND'/
     5'              COMPUTE THE SOUND PRESSURE LEVEL FROM THE'/
     6'              SYSTEM SENSITIVITY'/X/
     7'DO YOU WANT TO USE OPTION 1?')
      READ (5,20) GS
20    FORMAT (A4)
      IF (GS.EQ.'NO') GO TO 50
      WRITE (5,30)
30    FORMAT ('ENTER THE REFERENCE SOUND PRESSURE LEVEL
     1 IN DB   (XXX.XX)')
      READ (5,40) SPL
40    FORMAT (F6.2)
      GO TO 110
50    WRITE (5,60)
60    FORMAT ('APPLY CALIBRATION SIGNAL TO SYSTEM, AND MEASURE RMS
     1 VOLTAGE'/'OF SIGNAL AT INPUT TO RTA MULTIFILTER'/X/
     2'ENTER RMS VALUE IN VOLTS  (X.XXXXX)')
      READ (5,70) VRMS
70    FORMAT (F7.5)
      WRITE (5,80)
80    FORMAT ('ENTER SYSTEM SENSITIVITY IN DB RE 1V/N/SQ. METER
     1   (-XX.XX)')
      READ (5,90) SENS
90    FORMAT (F6.2)
      SPL=20*ALOG10(VRMS/.00002)-SENS
      WRITE (5,100)SPL
100   FORMAT (X/'SOUND PRESSURE LEVEL CORRESPONDING TO CALIBRATION
     1 SIGNAL'/'= ',F7.2,' DB RE .00002 N/SQ. METER'/X/
     2'DO YOU WANT TO CONTINUE?')
      READ (5,20) GS
      IF (GS.EQ.'NO') GO TO 5
```

```
 61 110   WRITE (5,120)
 62 120   FORMAT ('ENTER THE BAND NO. CORRESPONDING TO THE FREQ.
 63      1 OF THE CALIBRATION SIGNAL'/
 64      2'(IF BAND 14 IS USED TO SAMPLE UNFILTERED SIGNAL, ENTER "14")')
 65       READ (5,130) BANDNO
 66 130   FORMAT (I2)
 67 135   WRITE (5,140)
 68 140   FORMAT ('HAVE YOU MADE ANY CHANGE IN THE SYSTEM GAIN TO
 69      1 ACCOMMODATE'/'THE CALIBRATION SIGNAL?')
 70       READ (5,20) GS
 71       DGAIN=0.
 72       IF (GS.EQ.'NO') GO TO 170
 73 150   WRITE (5,160)
 74 160   FORMAT ('ENTER TOTAL AMOUNT OF GAIN CHANGE IN DB
 75      1  (MINUS = REDUCTION)'/'(-XX.XXX)')
 76       READ (5,90) DGAIN
 77 170   WRITE (5,175) NMAX
 78 175   FORMAT ('ENTER TOTAL RTA SAMPLING TIME DESIRED FOR
 79      1 REFERENCE SIGNAL MEASUREMENT'/
 80      2'(IN SECONDS.  2 DIGITS.  MAX = ',I2,')')
 81       READ (5,130) NSAMP
 82       IF (NSAMP.GT.NMAX) GO TO 170
 83       WRITE (5,180)
 84 180   FORMAT ('ENTER "GO" TO START SAMPLING')
 85       READ (5,20) GS
 86       TX100=100
 87       CALL SAMPLE(0,NSAMP,TX100,OVFLOW,X0,NX0)
 88       IF (OVFLOW.EQ.0) GO TO 200
 89       WRITE (5,190)
 90 190   FORMAT ('READJUST SYSTEM GAIN')
 91       GO TO 150
 92 200   CALL BAND(BANDNO,NSAMP,X,X0,NX0)
 93       CALL MEANLG(NSAMP,X,MEAN,STDEV)
 94       WRITE (5,210) MEAN,STDEV
 95 210   FORMAT ('AVEPAGED RTA READING = '.F6.2.' DB'/
 96      1'STANDARD DEVIATION    = '.F6.2.' DB'/X/
 97      2'DO YOU WANT TO REPEAT THE RTA SAMPLING?')
 98       READ (5,20) GS
 99       IF (GS.NE.'NO') GO TO 135
100       FRECOR=0.
101       WRITE (5,220)
102 220   FORMAT ('DO YOU WANT TO CORRECT FOR FREQUENCY RESPONSE?')
103       READ (5,20) GS
104       IF (GS.EQ.'NO') GO TO 240
105       WRITE (5,230)
106 230   FORMAT ('FROM SYSTEM FREQUENCY RESPONSE CALIBRATION DATA,
107      1 DETERMINE'/
108      2'RESPONSE (CALIBRATION FREQUENCY) - RESPONSE (1000 HZ)'/X/
109      3'ENTER THIS DIFFERENCE      (-XX.XX)')
110       READ (5,90)FRECOR
111 240   SPLCOR=SPL-MEAN+FRECOR+DGAIN
112       WRITE (5,250) SPLCOR
113 250   FORMAT ('THE CORRECTION TO BE ADDED TO THE RTA READINGS  = ',
114      1F7.2,' DB'/X/'REMOVE CALIBRATION SIGNAL')
115       IF (DGAIN.EQ.0.) GO TO 270
116       DGAIN=-1.*DGAIN
117       WRITE (5,260) DGAIN
118 260   FORMAT ('ADJUST SYSTEM GAIN BY ',F6.2,' DB  (BACK TO
119      1 ORIGINAL SETTING)')
120 270   WRITE (5,280)
```

```
121 280   FORMAT ('ENTER "GO" TO CONTINUE, OR "STOP" TO REPEAT
122      1 CALIBRATION')
123       READ (5,20) GS
124       IF (GS.EQ.'STOP') GO TO 5
125       RETURN
126       END
```

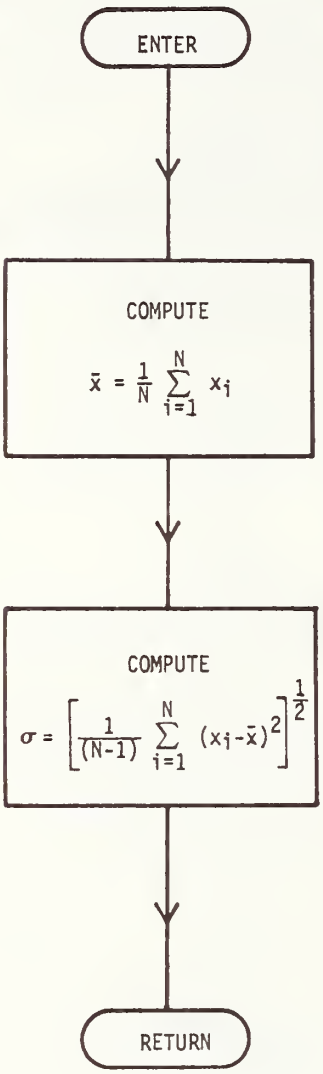
FLOW CHART: SUBROUTINE MEANLG



SUBROUTINE MEANLG

```
$ASSM
MEANLG PROG MEANLG - SUBROUTINE FOR FINDING LOGARITHMIC MEAN AND STD
$FORT
C     ------------------------------
C     THIS SUBROUTINE COMPUTES THE LOGARITHMIC MEAN AND
C     STANDARD DEVIATION OF A NUMBER OF SAMPLES
C     FORTRAN CALL STATEMENT:
C    -CALL MEANLG (N,X,MEAN,STDEV)
C     N      (INT)   = NUMBER OF SAMPLES
C     X      (REAL)  = ARRAY OF SAMPLES
C     MEAN   (REAL)  = MEAN VALUE OF THE SAMPLES
C     STDEV  (REAL)  = STANDARD DEVIATION OF THE SAMPLES
C
C     NO OTHER SUBROUTINES CALLED
C     ------------------------------
      SUBROUTINE MEANLG(N,X,MEAN,STDEV)
      DIMENSION X(N)
      REAL MEAN
      C=0.
      DO 10 I=1,N
      C=C+10.**(X(I)/10.)
10    CONTINUE
      C=C/N
      MEAN=10.*ALOG10(C)
      C=0.
      DO 20 I=1,N
      C=C+(X(I)-MEAN)*(X(I)-MEAN)
20    CONTINUE
      IF (N.EQ.1) GO TO 30
      C=C/(N-1)
30    STDEV=SQRT(C)
      RETURN
      END
```

FLOW CHART: SUBROUTINE MEANAR



SUBROUTINE MEANAR

```
$ASSM
MEANAR PROG MEANAR - SUBROUTINE FOR FINDING ARITHMETIC MEAN AND STD
$FORT
C    ------------------------------
C    THIS SUBROUTINE COMPUTES THE ARITHMETIC MEAN AND
C    STANDARD DEVIATION OF A NUMBER OF SAMPLES
C    FORTRAN CALL STATEMENT:
C   -CALL MEANAR (N,X,MEAN,STDEV)
C    N      (INT)   = NUMBER OF SAMPLES
C    X      (REAL)  = ARRAY OF SAMPLES
C    MEAN   (REAL)  = MEAN VALUE OF THE SAMPLES
C    STDEV  (REAL)  = STANDARD DEVIATION OF THE SAMPLES
C
C    NO OTHER SUBROUTINES CALLED
C    ------------------------------
       SUBROUTINE MEANAR(N,X,MEAN,STDEV)
       DIMENSION X(N)
       REAL MEAN
       C=0.
       DO 10 I=1,N
       C=C+X(I)
10     CONTINUE
       MEAN=C/N
       C=0.
       DO 20 I=1,N
       C=C+(X(I)-MEAN)*(X(I)-MEAN)
20     CONTINUE
       IF (N.EQ.1) GO TO 30
       C=C/(N-1)
30     STDEV=SQRT(C)
       RETURN
       END
```

FEDERAL INFORMATION PROCESSING STANDARD SOFTWARE SUMMARY

01. Summary data — Yr. 77 Mo. 10 Day 28

02. Summary prepared by (Name and Phone): Thomas W. Bartel (301) 921-3783

03. Summary action: New [X] Replacement [ ] Deletion [ ]
Previous Internal Software ID:

04. Software data — Yr. 76 Mo. 12 Day 30

05. Software title: Interactive Program for the Determination of Sound Power

06. Short title: SPOWER

07. Internal Software ID: None

08. Software type:
- Automated Data System [ ]
- Computer Program [X]
- Subroutine/Module [ ]

09. Processing mode:
- Interactive [X]
- Batch [ ]
- Combination [ ]

10. Application area:

General:
- Computer Systems Support/Utility [ ]
- Scientific/Engineering [X]
- Bibliographic/Taxtual [ ]
- Management/Business [ ]
- Process Control [ ]
- Other [ ]

Specific: Acoustics; reverberation room measurements

11. Submitting organization and address:
Institute for Basic Standards
National Bureau of Standards
Washington, D.C. 20234

12. Technical contact(s) and phone:
Thomas W. Bartel
(301) 921-3783

13. Narrative:
The program is used to measure the acoustic sound power output of a source in a reverberation room according to ANSI S1.21-1972, American National Standard Methods for the Determination of Sound Power Levels of Small Sources in Reverberation Rooms. The computer controls elements of the instrumentation system through a special interface, acquires the digitized sound pressure levels of the reverberant sound field, and computes the sound power levels. Transmission of data to and from the instrumentation system is handled through separate subroutines written in the computer's assembly language.

14. Keywords:
Acoustics; computer-controlled instrumentation system; real-time analyzer; reverberation room; sound power.

15. Computer manuf'r and model	16. Computer operating system	17. Programing language(s)	18. Number of source program statements
Interdata Model 70	RTOS	Fortran V, Level 1 Interdata Assembly lang.	1058

19. Computer memory requirements	20. Tape drives	21. Disk/Drum units	22. Terminals
37,066 8-bit bytes	None	One/2.5 megabyte unit	One

23. Other operational requirements:
132-character line printer
real-time analyzer, microphone multiplexer interfaced to computer

24. Software availability:
- Available [X]
- Limited [ ]
- In-house only [ ]

Paper or mag tape

25. Documentation availability:
- Available [X]
- Inadequate [ ]
- In-house only [ ]

Internal report

26. FOR SUBMITTING ORGANIZATION USE

185-101

Standard Form 185
1974 July
U.S. Dept. of Commerce—NBS
(FIPS. Pub. 30)

INSTRUCTIONS

01. **Summary Date.** Enter date summary prepared. Use Year, Month, Day format: YYMMDD.

02. **Summary Prepared By.** Enter name and phone number (including area code) of individual who prepared this summary.

03. **Summary Action.** Mark the appropriate box for new summary, **replacement** summary or **deletion** of summary. If this software summary is a replacement, enter under "Previous Internal Software ID" the internal software identification as reported in item 07 of the original summary, and enter the new internal software identification in item 07 of this form; complete all other items as for a new summary. If a software summary is to be **deleted**, enter under "Previous Internal Software ID" the internal software identification as reported in item 07 of the original summary; complete only items 01, 02, 03 and 11 on this form.

04. **Software Date.** Enter date software was completed or last updated. Use Year, Month, Day format: YYMMDD.

05. **Software Title.** Make title as descriptive as possible.

06. **Short Title.** (Optional) Enter commonly used abbreviation or acronym which identifies the software.

07. **Internal Software ID.** Enter a unique identification number or code.

08. **Software Type.** Mark the appropriate box for an **Autometed Data System** (set of computer programs), **Computer Program**, or **Subroutine/Module**, whichever best describes the software.

09. **Processing Mode.** Mark the appropriate box for an **interactive, Batch**, or **Combination** mode, whichever best describes the software.

10. Application Area.
    General: Mark the appropriate box which best describes the general area of application from among:

Computer Systems Support/Utility	**Process Control**
Management/Business	**Bibliographic/Textual**
Scientific/Engineering	**Other**

    Specific: Specify the sub-area of application; e.g.: "COBOL optimizer" if the general area is "Computer Systems Support/Utility"; "Payroll" if the general area is "Management/Business"; etc. Elaborate here if the general area is "Other."

11. **Submitting Organization and Address.** Identify the organization responsible for the software as completely as possible, to the Branch or Division level, but including Agency, Department (Bureau/Administration), Service, Corporation, Commission, or Council. Fill in complete mailing address, including mail code, street address, city, state, and ZIP code.

12. **Technical Contact(s) and Phone:** Enter person(s) or office(s) to be contacted for technical information on subject matter and/or operational aspects of software. Include telephone area code. Provide organization name and mailing address, if different from that in item 11.

13. **Narrative.** Describe concisely the problem addressed and methods of solution. Include significant factors such as special operating system modifications, security concerns, relationships to other software, input and output media, virtual memory requirements, and unique hardware features. Cite references, if appropriate.

14. **Keywords.** List significant words or phrases which reflect the functions, applications and features of the software. Separate entries with semicolons.

15. **Computer Manufacturer and Model.** Identify mainframe computer(s) on which software is operational.

16. **Computer Operating System.** Enter name, number, and release under which software is operating. Identify enhancements in the Narrative (item 13).

17. **Programing Language(s).** Identify the language(s) in which the software is written, including version; e.g., ANSI COBOL, FORTRAN V, SIMSCRIPT II.5, SLEUTH II.

18. **Number of Source Program Statements.** Include statements in this software, separate macros, called subroutines, etc.

19. **Computer Memory Requirements.** Enter minimum internal memory necessary to execute software, exclusive of memory required for the operating system. Specify words, bytes, characters, etc., and number of bits per unit. Identify virtual memory requirements in the Narrative (item 13).

20. **Tape Drives.** Identify number needed to operate software. Specify, if critical, manufacturer, model, tracks, recording density, etc.

21. **Disk/Drum Units.** Identify number and size (in same units as "Memory"—item 19) needed to operate software. Specify, if critical, manufacturer, model, etc.

22. **Terminals.** Identify number of terminals required. Specify, if critical, type, speed, character set, screen/line size, etc.

23 **Other Operational Requirements.** Identify peripheral devices, support software, or related equipment not indicated above, e.g., optical character devices, facsimile, computer-output microfilm, graphic plotters.

24. **Software Availability.** Mark the appropriate box which best describes the software availability from among: **Available to the Public, Limited Availability** (e.g.: for government use only), and **For In-house Use Only.** If the software is "Available", include a mail or phone contact point, as well as the price and form in which the software is available, if possible.

25. **Documentation Availability.** Mark the appropriate box which best describes the documentation availability from among: **Available to the Public, Inadequate for Distribution**, and **For In-house Use Only.** If documentation is "Available", include a mail or phone contact point, as well as the price and form in which the documentation is available, if possible. If documentation is presently "Inadequate", show the expected availability date.

26. **For Submitting Organization Use.** This area is provided for the use of the organization submitting this summary. It may contain any information deemed useful for internal operation.

GPO : 1974 O - 554-055

NBS-114A (REV. 7-73)

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4. TITLE AND SUBTITLE

Interactive Computer Program for the Determination of Sound Power

5. Publication Date: December 1977

6. Performing Organization Code: 200.03

7. AUTHOR(S): Thomas W. Bartel

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

8. Performing Organ. Report No.

10. Project/Task/Work Unit No.: 2003116

11. Contract/Grant No.

12. Sponsoring Organization Name and Complete Address *(Street, City, State, ZIP)*

Same

13. Type of Report & Period Covered: Final

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

A description of the computer program used to measure the sound power output of a sound source in a reverberation room is presented. The program controls the operation of a real-time analyzer and a microphone multiplexer. The sound power is computed according to ANSI S1.21. The program is written in FORTRAN V and requires approximately 37,000 eight-bit bytes of core memory. Flow charts, source listings, and sample printouts are included.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Automated data acquisition; computer; reverberation room, software; sound power.

18. AVAILABILITY

[X] Unlimited

[ ] For Official Distribution. Do Not Release to NTIS

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