TEK TEXT

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Speaker Placement III: Calculating Loss and Uniformity of Coverage

SOME THEORY

• This third program in our series is quite a bit different than the previous two. The first major difference is that you must enter more information than before. This also makes the actual calculations simpler.

The second major difference is that the program does not use a –12 dB coverage angle, but refers to a "first listener complementary coverage angle." I mentioned last time that there is a fixed relationship between the –6 dB coverage angle and the corresponding ideal -12 dB coverage angle. If the speaker location is not correct for the -6 dB angle, the actual first listener will not be on the -12 dB axis. The dB loss values displayed for the first listener must have the loss for the calculated angle added.

For example, if the first listener loss is –26 dB+AXIS, and the first listener complementary coverage angle is 130 degrees, then the speaker's polar response chart must be checked for the off axis loss at 65 degrees off axis. If that should be 10 dB (for example), then the total loss equals –26 dB and –10 dB for a total of –36 dB.

If the speaker has a real wide –6 dB coverage angle and/or a bad location, then the entire audience may be inside the –6 dB angle. This may seem innocent at first since the coverage appears to be ±3 dB. However, the loss due to distance may create horrible variations between the first and last listener. Also, consider where the remaining off axis sound is going. The second major problem is that the loss from the speaker to the audience may be the same as the loss from the speaker to the microphone. This has a tendency to reduce the useable gain before feedback to near zero. Problem number three is that the back wall and the rest of the room will become a reverberation chamber. Such a set-up is somewhere between a distributed overhead system and a central overhead cluster. Not a good application of theory, to say the least. The program will give a message if you break the rules.

Figure 1. The sample screen.

```
                                                          08-03-1990
P.A. SPEAKER ANGLE LOSS CALCULATIONS                      07:32:41
================================================================================
H SPKR TO LAST LIST:  120 ft    0 in   V FLOOR TO AV LIST :   4 ft   6 in
H LAST LIST TO WALL:   10 ft    0 in   V FLR TO CENT SPKR :  20 ft   0 in
H 1ST TO LAST LISTN:  100 ft    0 in   ON AXIS SPKR TO REF:   4 ft   0 in
                                       SPKR -6dB COVR ANGL: 20.00 degrees
--------------------------------------------------------------------------------
                 VERTICAL      HORIZONTAL     THROW          THROW      VERTICAL
                 HEIGHT        DISTANCE       DISTANCE       dB LOSS    TO THROW
SPEAKER TO:      Feet   In.    Feet   In.     Feet   In.     decibels   degrees
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
LAST LISTENER :   15    6      120    0       121    0       -29.61      82.64
-6dB LISTENER :   15    6       49    7        51   11       -28.27      72.64
FIRST LISTENER:   15    6       20    0        25    4       -16.02+AXIS 52.22

-6dB BACK WALL:   26    0      130    0       130    2       -36.25      92.64
1ST LIST BK WL:   75    4      130    0       141    3       -30.96+AXIS 113.06
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
-6dB COVERAGE ANGLE   :  20.00 deg. SPEAKER TILT FROM VERT:   7.36 deg.
1ST LST COMP COVG ANGL:  60.83 deg. AVG LIST TO CENT OF SPKR:  15 ft.  6 in.
================================================================================
/CR/ TO START AGAIN: ~
```

THE PROGRAM

As before, the program operates basically the same as the other two. Lines 100 through 9999 are identical and may be copied directly from the other programs. Be sure to read carefully when you run the program. The entry fields are very similar, and you may type in the wrong information if you forget which program you are running. *Figure 1* is a sample screen to test your program with.

STAY TUNED

The last program will calculate direct and reflection paths from the speaker to the microphone. I will also discuss compensating for sloped floors.

Again, your comments are appreciated. Please contact me through **db Magazine**.

The Basic Program

```
10 REM SPEAKER ANGLE LOSS CALCULATIONS FOR P.A. SYSTEM
20 REM "PALOSS.BAS",A
30 REM V1.1
40 REM 08-03-90
50 REM DCR
100 REM ***** INITIALIZE
110 REM **** SYSTEM FUNCTIONS
120 ON ERROR GOTO 8000
130 CLEAR
140 KEY OFF
800 REM **** SET SYSTEM VARIABLES
810 P3$=STRING$(80," ")
820 P4$=STRING$(80,"-")
830 P5$=STRING$(80,"=")
840 P6$=CHR$(254)
900 REM **** SET PROGRAM VARIABLES
910 GOSUB 10000
1000 REM ***** DISPLAY SCREEN
1010 REM **** INITIALIZE
1020 CLS
1030 COLOR C0,C1,C
1040 FOR Y=1 TO 25
1050 LOCATE Y,1:PRINT P3$;
1060 NEXT Y
1100 REM **** HEADING
1110 REM *** FRAME
1120 LOCATE 3,1:PRINT P5$;
1130 LOCATE 22,1:PRINT P5$;
1140 IF G0>0 THEN LOCATE G1,G0:PRINT LEFT$(P4$,G2);
1150 IF G3>0 THEN LOCATE G4,G3:PRINT LEFT$(P4$,G5);
1200 REM *** SYSTEM FUNCTIONS
1210 GOSUB 6000
1220 REM *** TITLE
1230 COLOR C0,C1,C
1240 LOCATE 2,1:PRINT G$;
1300 REM **** LINES
1310 REM *** INITIALIZE
1320 RESTORE
1330 J1=0
1340 ON ERROR GOTO 1900
1350 REM *** GET DATA
1360 READ F$,F0$,F1$,F2$,F,F0,F1,F2,F3,F4,F3$
1370 J1=J1+1
1400 REM *** SET NUMBER
1410 P1$=""
1420 IF F0$="N" THEN GOTO 1500
1430 P1$=STR$(J1)
1440 FOR J3=1 TO LEN(P1$):IF LEFT$(P1$,1)=" " THEN LET P1$=RIGHT$(P1$,2):NEXT J3
1450 IF F0$="0" THEN GOTO 1490
1460 IF LEN(P1$)=1 THEN LET P1$="0"+P1$
1470 IF F0$="2" THEN IF LEN(P1$)=2 THEN LET P1$="0"+P1$
1490 P1$=P1$+ ". "
1500 REM *** DISPLAY
1510 LOCATE F0,F:PRINT P1$+F$;
1600 REM *** REPEAT 1610 GOTO 1350
1900 REM **** END OF DISPLAY
1910 RESUME
1920 1920 ON ERROR GOTO 8000
2000 REM ***** INPUT DATA
2010 REM **** INITIALIZE
2020 RESTORE
2050 REM **** START LOOP
2060 FOR J=1 TO J1
2070 REM **** GET PARAMETERS
2080 READ F$,F0$,F1$,F2$,F,F0,F1,F2,F3,F4,F3$
2100 REM **** PROMPTS
2110 COLOR C0,C1,C
2120 LOCATE 23,1:PRINT P3$;
2130 LOCATE 24,1:PRINT P3$;
2140 COLOR C2,C3,C
2150 LOCATE 23,1:PRINT F3$;
2200 REM **** GET INPUT
2210 GOSUB 7000
2300 REM **** VALIDATE
2310 IF LEN(D$)><1 THEN GOTO 2350
2320 IF J=1 THEN IF INSTR("QqEeXxTt",D$)>0 THEN GOTO 9000
2330 IF ASC(D$)=27 THEN GOTO 8100
2340 IF D$="!" THEN GOTO 6100
2345 IF D$="*" THEN GOTO 100
2350 FLAG$=""
2360 GOSUB 20000
2370 IF FLAG$="REENTER" THEN GOTO 2100
2380 IF FLAG$="START OVER" THEN GOTO 100
2390 IF FLAG$="ERROR" THEN GOTO 8000
2400 REM **** REDISPLAY
2410 COLOR C10,C11,C
2420 LOCATE F2,F1:PRINT D$;
2430 COLOR C0,C1,C
2440 PRINT LEFT$(P3$,F4-LEN(D$)+1);
2500 REM **** SLOT DATA
2510 GOSUB 30000
2600 REM **** END OF LOOP
2610 NEXT J
2700 REM ***** CALCULATIONS
2710 GOSUB 40000
2800 REM ***** DISPLAY RESULTS
2810 COLOR C12,C13,C
2820 GOSUB 50000
3000 REM ***** END OF SCREEN
3010 REM **** PROMPT
3020 F$="/CR/ TO START AGAIN:"
3030 LET F0$="0":F2$="&"
3040 F=1:F0=23:F1=22:F2=23:F3=0:F4=1
3050 COLOR C0,C1,C
3060 LOCATE 23,1:PRINT P3$;
3070 LOCATE 24,1:PRINT P3$;
3080 COLOR C2,C3,C
3090 LOCATE F0,F:PRINT F$;
3100 GOSUB 7000
3110 GOTO 1000
6000 REM ***** DATE & TIME SUBROUTINE
6010 COLOR C0,C1,C
6020 LOCATE 1,70:PRINT DATE$;
6030 LOCATE 2,70:PRINT TIME$;
6040 LET PREVT$=TIME$
6050 RETURN
6100 REM ***** BACK-UP ONE FIELD ROUTINE
6110 REM *** CLEAR CURRENT FIELD
6120 COLOR C0,C1,C
6130 LOCATE F2,F1:PRINT LEFT$(P3$,F4);
6140 IF J=1 THEN GOTO 100
6200 REM *** RESET FIELD
6210 RESTORE
6220 J2=J-1
6230 FOR J3=1 TO J2
6240 READ F$,F0$,F1$,F2$,F,F0,F1,F2,F3,F4,F3$
6250 NEXT J3
6260 J=J3-1
6270 GOTO 2100
7000 REM ***** STANDARD KEYBOARD INPUT SUBROUTINE
7010 REM **** MASK
7020 IF F2$="&" THEN LET F2$=P6$
7030 IF LEN(F2$)>1 THEN LET P$=F2$:GOTO 7060
7040 IF F2$="" THEN LET P$="":GOTO 7060
7050 LET P$=STRING$(F4,F2$)
7060 P$=P$+" "
7070 COLOR C4,C5,C
7080 LOCATE F2,F1:PRINT P$;
7090 IF BELL1$="Y" THEN PRINT CHR$(7);
7095 REM —- SET BELL PARAMS & GOSUB
7100 REM **** CLEAR INPUT VARIABLE
7110 D$=""
```

```
7200 REM **** CHECK FOR FIELD
FULL
7210 IF LEN(D$)><F4 THEN GOTO
7300
7220 COLOR C2,C3,C
7230 LOCATE 24,1:PRINT "THIS
FIELD IS FULL. /CR/ OR
BACKSPACE.";
7240 IF BELL2$="Y" THEN PRINT
CHR$(7);
7245 REM —- SET BELL PARAMS &
GOSUB
7300 REM **** INPUT
7310 LOCATE F2,F1
7320 GOSUB 7900
7330 D1$=INKEY$
7340 IF TIME$><PREVT$ THEN
GOSUB 6000
7350 IF D1$="" THEN GOTO 7330
7360 GOSUB 7900
7400 REM **** /CR/ CHECK
7410 IF ASC(D1$)<>13 THEN GOTO
7600
7420 IF F3=0 THEN GOTO 7800
7430 IF LEN(D$)>=F3 THEN GOTO
7800
7440 GOTO 7200
7600 REM **** BACKSPACE
7610 IF ASC(D1$)<>8 THEN GOTO
7700
7620 COLOR C0,C1,C
7630 IF LEN(D$)=F4 THEN LOCATE
24,1:PRINT P3$;
7640 IF LEN(D$)=0 THEN GOTO
7200
7650 COLOR C4,C5,C
7655 REM — NEXT LINE, F2$ WON'T
WORK WITH LONG MASK, NEED
MASK VARIABLE
7660 LOCATE
F2,F1+LEN(D$)-1:PRINT F2$;
7670 D$=LEFT$(D$,LEN(D$)-1)
7680 LOCATE F2,F1+LEN(D$)-1
7690 GOTO 7200
7700 REM **** ADD CHR TO STR &
DISPLAY
7710 IF LEN(D$)=F4 THEN GOTO
7200
7720 COLOR C8,C9,C
7730 LOCATE F2,F1+LEN(D$):PRINT
D1$;
7740 D$=D$+D1$
7750 REM **** LENGTH CHECK
7760 IF LEN(D$)<F4+1 THEN GOTO
7200
7800 REM **** RETURN
7810 COLOR C10,C11,C
7820 LOCATE F2,F1:PRINT D$;
7830 COLOR C0,C1,C
7840 PRINT
LEFT$(P3$,F4-LEN(D$)+1);
7850 IF LEN(D$)=F4 THEN LOCATE
24,1:PRINT P3$;
7860 RETURN
7900 REM **** SET CURRENT
CURSOR COLOR SUBROUTINE
(TOGGLE - BLINK)
7910
P2$=CHR$(SCREEN(F2,F1+LEN(D$),0
))
7920
P0=SCREEN(F2,F1+LEN(D$),1):REM
- READ CURRENT COLOR
7930 P1=P0 MOD 16:REM - GET
FOREGROUND VALUE
7940 IF P0>127 THEN LET
P1=P1+16:REM - ADJUST IF
BLINKING
7950 IF P1 = C6 THEN COLOR
C4,C5,C
7960 IF P1 = C4 THEN COLOR
C6,C7,C
7970 LOCATE F2,F1+LEN(D$):PRINT
P2$;
7980 RETURN

8000 REM ***** ERRORS
8010 RESUME
8020 8020 COLOR C14,C15,C
8030 LOCATE 23,1:PRINT P3$;
8040 LOCATE 24,1:PRINT P3$;
8050 COLOR C14,C15,C 8040
LOCATE 23,1:PRINT "ERROR AT
LINE";ERL;
8050 LOCATE 24,1:PRINT E$;
8060 INPUT "",X$
8070 GOTO 1000
8100 REM ***** STOP
8110 ON ERROR GOTO 0
8120 COLOR 15,0,0
8130 STOP

9000 REM ***** EXIT
9010 CLS
9020 RUN "MENU"

10000 REM ***** PROGRAM
VARIABLES
10010 REM **** PROGRAM TITLE
10020 LET G$="P.A. SPEAKER
ANGLE LOSS CALCULATIONS"
10030 REM **** ERROR MESSAGE
10040 LET E$="CONFIGURATION IS
NOT POSSIBLE. ANY KEY TO
RESTART: "
10050 REM **** BELL AT AFTER
MASK DISPLAY
10060 LET BELL1$="N"
10070 REM **** BELL AT FIELD FULL
PROMPT
10080 LET BELL2$="N"
10100 REM **** DIVIDING LINES
X,Y,LEN
10110 LET G0=1:LET G1=8:LET
G2=80
10120 LET G3=0:LET G4=0:LET
G5=80
10200 REM **** COLORS
10210 REM *** BORDER
10220 C = 0
10230 REM - ALL OTHERS TEXT &
BACKGROUND
10240 REM *** INITIALIZE AND
BACKGROUND TEXT
10250 C0 = 7 : C1 = 0
10260 REM *** PROMPTS
10270 C2 = 15 : C3 = 0
10280 REM *** MASK
10290 C4 = 15 : C5 = 0
10300 REM *** CURRENT CURSOR
10310 C6 = 31 : C7 = 0
10320 REM *** CURRENT INPUT
10330 C8 = 15 : C9 = 0
10340 REM *** FOREGROUND TEXT
(ACCEPTED INPUT)
10350 C10 = 15 : C11 = 0
10360 REM *** FOREGROUND TEXT
(OUTPUT DISPLAY)
10370 C12 = 15 : C13 = 0
10380 REM *** ERROR TEXT
10390 C14 = 15 : C15 = 0
10999 RETURN

11000 REM ***** DATA
11005 REM FIELD DESC,AUTO
NO.,DEFAULT,MASK CHR,X,Y,IN
X,Y,MIN,MAX,PROMPT
11006 REM
F$,F0$,F1$,F2$,F,F0,F1,F2,F3,F4,F3$
11007 REM AUTO N0.: N= OMIT
NUMBER, 0= OMIT LEADING ZERO,
1= 2 DIGIT NO., 2= 3 DIGIT NO.
11008 REM MASK CHARACTER (F2$)
= TO "&" WILL DISPLAY A BOX -
CHR$(254)
11010 DATA "H SPKR TO LAST LIST:
ft"
11011 DATA "N","0","&",1,4,22,4,0,4
11012 DATA "HORIZ. DISTANCE
FROM SPEAKER TO LAST LISTENER
(FEET + INCHES OR INCHES ONLY)"
11020 DATA "in"
11021 DATA "N","0","&",37,4,30,4,0,6
11022 DATA "HORIZ. DISTANCE
FROM SPEAKER TO LAST LISTENER
(INCHES ADDED TO FEET)"
11030 DATA "H LAST LIST TO WALL:
ft"
11031 DATA "N","0","&",1,5,22,5,0,4
11032 DATA "HORIZ. DISTANCE
FROM LAST LISTENER TO BACK
WALL"
11040 DATA "in"
11041 DATA "N","0","&",37,5,30,5,0,6
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```
 11042 DATA "HORIZ. DISTANCE
FROM LAST LISTENER TO BACK
WALL "
 11050 DATA "H 1ST TO LAST
LISTENER:    ft"
 11051 DATA "N","0","&",1,6,22,6,0,4
 11052 DATA "HORIZ. DISTANCE
FROM THE FIRST TO LAST LISTENER
(FEET + INCHES OR INCHES ONLY)"
 11060 DATA "in"
 11061 DATA "N","0","&",37,6,30,6,0,6
 11062 DATA "HORIZ. DISTANCE
FROM THE FIRST TO LAST LISTENER
(INCHES ADDED TO FEET)"
 11070 DATA "V FLOOR TO AV LIST :
ft"
 11071 DATA "N","0","&",42,4,63,4,0,4
 11072 DATA "VERT. DISTANCE FROM
FLOOR TO AVG. LISTENING HEIGHT"
 11080 DATA "in"
 11081 DATA "N","0","&",76,4,71,4,0,4
 11082 DATA "VERT. DISTANCE FROM
FLOOR TO AVG. LISTENING HEIGHT"
 11090 DATA "V FLR TO CENT SPKR :
ft"
 11091 DATA "N","0","&",42,5,63,5,0,4
 11092 DATA "VERT. DISTANCE FROM
FLOOR TO CENTER OF SPEAKER"
 11100 DATA "in"
 11101 DATA "N","0","&",76,5,71,5,0,4
 11102 DATA "VERT. DISTANCE FROM
FLOOR TO CENTER OF SPEAKER"
 11110 DATA "ON AXIS SPKR TO REF:
ft"
 11111 DATA "N","0","&",42,6,63,6,0,4
 11112 DATA "DISTANCE FROM
SPEAKER TO ON AXIS db SPL REF.
MEASUREMENT"
 11120 DATA "in"
 11121 DATA "N","0","&",76,6,71,6,0,4
 11122 DATA "DISTANCE FROM
SPEAKER TO ON AXIS db SPL REF.
MEASUREMENT"
 11130 DATA "SPKR -6dB COVR
ANGL:    degrees"
 11131 DATA "N","0","&",42,7,63,7,0,6
 11132 DATA "ENTER THE
SPEAKER'S RATED -6 dB COVERAGE
ANGLE (LESS THAN 31.05 DEG.)"

 20000 REM ***** VALIDATIONS -
USER SUBROUTINE
 20010 IF D$="" THEN LET D$=F1$
 20020 FOR J3=1 TO LEN(D$)
 20030 IF
INSTR("0123456789.-+",MID$(D$,J3,1))
=0 THEN LET FLAG$="REENTER"
 20040 NEXT J3
 29999 RETURN
 30000 REM ***** SLOT DATA - USER
SUBROUTINE
 30010 IF J=1 THEN LET A1$=D$
 30020 IF J=2 THEN LET A2$=D$
 30030 IF J=3 THEN LET A3$=D$
 30040 IF J=4 THEN LET A4$=D$
 30050 IF J=5 THEN LET A5$=D$
 30060 IF J=6 THEN LET A6$=D$
 30070 IF J=7 THEN LET A7$=D$
 30080 IF J=8 THEN LET A8$=D$
 30090 IF J=9 THEN LET A9$=D$
 30100 IF J=10 THEN LET A10$=D$
 30110 IF J=11 THEN LET A11$=D$
 30120 IF J=12 THEN LET A12$=D$
 30130 IF J=13 THEN LET A13$=D$
 39999 RETURN

 40000 REM ***** CALCULATIONS -
USER SUBROUTINE
 40010 REM **** CONVERT TO
NUMBERS AND INCHES
 40020 REM *** SPEAKER TO LAST
LISTENER
 40030
D1#=(12*VAL(A1$))+VAL(A2$)
 40050 REM *** LAST LISTENER TO
WALL
 40060
D4#=(12*VAL(A3$))+VAL(A4$)
 40070 REM *** FIRST TO LAST
LISTENER
 40080
D6#=(12*VAL(A5$))+VAL(A6$)
 40090 REM *** FLOOR TO AVERAGE
LISTENING HEIGHT
 40100
H6#=(12*VAL(A7$))+VAL(A8$)
 40110 REM *** FLOOR TO CENTER
OF SPEAKER
 40120
H7#=(12*VAL(A9$))+VAL(A10$)
 40130 REM *** DISTANCE FROM
SPEAKER FOR db SPL REFERENCE
MEASUREMENT
 40140
R#=(12*VAL(A11$))+VAL(A12$)
 40150 REM *** SPEAKER'S RATED
-6dB COVERAGE ANGLE
 40160 A4#=VAL(A13$)
 40200 REM *** CONVERSION
FACTORS
 40210 REM ** RADIANS TO
DEGREES
 40220 RD#=180/3.1415927
 40230 REM ** DEGREES TO
RADIANS
 40240 DR#=3.1415927/180
 40300 REM **** CALCULATE
SIMPLE HORIZONTAL DISTANCES
 40310 D3#=D1#-D6#
 40320 D5#=D1#+D4#
 40330 REM **** CALCULATE
SIMPLE VERTICAL DISTANCES
 40340 H1#=H7#-H6#
 40350 H2#=H1#
 40360 H3#=H1#
 40400 REM **** CALCULATE
ANGLES
 40410 REM *** 0 db ON AXIS - LAST
LISTENER
 40420 A1#=ATN(D1#/H1#)*RD#
 40430 REM *** -6 db AXIS
 40440 A2#=A1#-(A4#/2)
 40450 REM *** FIRST LISTENER
 40460 A3#=ATN(D3#/H3#)*RD#
 40470 REM *** FIRST LISTENER
COMPLEMENT COVERAGE
 40480 A5#=(A1#-A3#)*2
 40490 REM *** SPEAKER TILT FROM
VERTICAL
 40495 A6#=90-A1#
 40500 REM **** CALCULATE
SPEAKER AXIS THROW DISTANCES
 40510 REM *** 0 db ON AXIS THROW
DISTANCE
 40520 T1#=H1#/COS(A1#*DR#)
 40530 REM *** -6 db AXIS THROW
DISTANCE
 40540 T2#=H1#/COS(A2#*DR#)
 40550 REM *** FIRST LISTENER
AXIS THROW DISTANCE
 40560 T3#=H1#/COS(A3#*DR#)
 40570 REM **** -6 db HORIZONTAL
DISTANCE
 40580 D2#=SIN(A2#*DR#)*T2#
 40800 REM **** CALCULATE BACK
WALL REFLECTION
 40810 REM *** -6 db
 40820 REM ** ANGLE FROM
HORIZONTAL IN DEGREES
 40830 A9#=A4#+A2#-90
 40840 REM ** THROW DISTANCE
 40850
T4#=D5#/COS(ABS(A9#*DR#))
 40860 REM ** BACK WALL HEIGHT
 40870
H4#=H7#+((ABS(A9#)/A9#)*((TAN(A
BS(A9#*DR#)))*D5#))
 40880 REM ** ANGLE FROM
VERTICAL
 40890 A7#=A1#+A1#-A2#
 40900 REM *** FIRST LISTENER
COMPLEMENT
 40910 REM ** ANGLE FROM
HORIZONTAL IN DEGREES
 40920 A9#=A5#+A3#-90
 40930 REM ** THROW DISTANCE
 40940
T5#=D5#/COS(ABS(A9#*DR#))
 40950 REM ** BACK WALL HEIGHT
 40960
H5#=H7#+((ABS(A9#)/A9#)*((TAN(A
BS(A9#*DR#)))*D5#))
 40970 REM ** ANGLE FROM
VERTICAL
 40980 A8#=A1#+A1#-A3#
```

```
  41000 REM **** CALCULATE
DISTANCE SPL LOSS FOR AXIS
  41010 REM *** 0 db ON AXIS TO
AUDIENCE
  41020
L1#=20*(LOG(R#/T1#)/LOG(10))
  41030 REM *** -6 db AXIS TO
AUDIENCE
  41040
L2#=20*(LOG(R#/T2#)/LOG(10))-6
  41050 REM *** FIRST LISTENER
AXIS TO AUDIENCE
  41060
L3#=20*(LOG(R#/T3#)/LOG(10))
  41100 REM *** -6 db AXIS TO BACK
WALL
  41110
L4#=20*(LOG(R#/T4#)/LOG(10))-6
  41120 REM *** FIRST LISTENER _#0
0!_f  $_ff9f_##fé1130
L5#=20*(LOG(R#/T5#)/LOG(10))
  49999 RETURN
  50000 REM ***** DISPLAY RESULTS
- USER SUBROUTINE
  50010 REM **** TEXT FORMAT
  50020 REM *** DISPLAY FRAME
  50030 LOCATE 9,1:PRINT "
VERTICAL   HORIZONTAL   THROW
THROW   VERTICAL"
  50040 LOCATE 10,1:PRINT "
HEIGHT   DISTANCE   DISTANCE
dB LOSS   TO THROW"
  50050 LOCATE 11,1:PRINT
"SPEAKER TO:  Feet In.  Feet In.
Feet In.  decibels  degrees"
  50060 LOCATE 12,1:PRINT "-------
-------------------------------"
  50070 LOCATE 19,1:PRINT "-------
-------------------------------"
  50100 REM *** DISPLAY DATA
  50110 REM ** LONG LINES
  50120 REM * SET MASK
  50130 P1$=":#####  ##
#####  ##  #####  ##
####.##   ###.##"
  50140 X=1
  50200 REM * DATA
  50210 Y=13:P$="LAST LISTENER
":P0#=H1#:P1#=D1#:P2#=T1#:P3#
=L1#:P4#=A1#:GOSUB 51000
  50220 Y=14:P$="-6dB LISTENER
":P0#=H2#:P1#=D2#:P2#=T2#:P3#
=L2#:P4#=A2#:GOSUB 51000
  50230 Y=15:P$="FIRST
LISTENER":P0#=H3#:P1#=D3#:P2#=
T3#:P3#=L3#:P4#=A3#:GOSUB
51000
  50240 Y=17:P$="-6dB BACK
WALL":P0#=H4#:P1#=D5#:P2#=T4#
:P3#=L4#:P4#=A7#:GOSUB 51000
  50250 Y=18:P$="1ST LIST BK
WL":P0#=H5#:P1#=D5#:P2#=T5#:P
3#=L5#:P4#=A8#:GOSUB 51000
  50260 LOCATE 15,68:PRINT "+AXIS"
  50270 LOCATE 18,68:PRINT "+AXIS"
  50300 REM ** SINGLE DATA LINES
  50310 REM * BOTTOM OF SCREEN
  50310 X=1:Y=20:P$="-6dB
COVERAGE ANGLE  : ####.##
deg.":P0#=A4#:GOSUB 51200
  50320 X=1:Y=21:P$="1ST LST
COMP COVG ANGL: ####.##
deg.":P0#=A5#:GOSUB 51200
  50330 X=38:Y=20:P$="SPEAKER
TILT FROM VERT: ####.##
deg.":P0#=A6#:GOSUB 51200
  50340 D#=H1#:GOSUB 51500
  50350 X=38:Y=21:P$="AVG LIST TO
CENT OF SPKR: #####
ft.":P0#=DF#:GOSUB 51200
  50360 X=75:Y=21:P$="##
in.":P0#=DI#:GOSUB 51200
  50400 REM * REFRESH TOP OF
SCREEN (INPUTS)
  50410 REM HORIZ DIST FROM
SPEAKER TO LAST LISTENER
  50420 D#=D1#:GOSUB 51500
  50430
=22:Y=4:P$="####":P0#=DF#:
GOSUB 51200
  50440 X=30:Y=4:P$="
##":P0#=DI#:GOSUB 51200
  50450 REM HORIZ DIST FROM LAST
LIST TO BACK WALL
  50460 D#=D4#:GOSUB 51500
  50470
X=22:Y=5:P$="####":P0#=DF#:GO
SUB 51200
  50480 X=30:Y=5:P$="
##":P0#=DI#:GOSUB 51200
  50490 REM HORIZ DIST FROM FIRST
TO LAST LISTENER
  50500 D#=D6#:GOSUB 51500
  50510
X=22:Y=6:P$="####":P0#=DF#:GO
SUB 51200
  50520 X=30:Y=6:P$="
##":P0#=DI#:GOSUB 51200
  50530 REM VERT DIST FROM FLOOR
TO AVG LISTENING HEIGHT
  50540 D#=H6#:GOSUB 51500
  50550
X=63:Y=4:P$="####":P0#=DF#:GO
SUB 51200
  50560 X=71:Y=4:P$="
##":P0#=DI#:GOSUB 51200
  50570 REM VERT DIST FROM FLOOR
TO CENTER OF SPEAKER
  50580 D#=H7#:GOSUB 51500
  50590
X=63:Y=5:P$="####":P0#=DF#:GO
SUB 51200
  50600 X=71:Y=5:P$="
##":P0#=DI#:GOSUB 51200
  50610 REM REFERENCE DISTANCE
  50620 D#=R#:GOSUB 51500
  50630
X=63:Y=6:P$="####":P0#=DF#:GO
SUB 51200
  50640 X=71:Y=6:P$="
##":P0#=DI#:GOSUB 51200
  50650 REM SPEAKER'S RATED -6dB
COVERAGE ANGLE
  50660
X=63:Y=7:P$="###.##":P0#=A4#:G
OSUB 51200
  50700 REM *** WARNING
  50710 IF A4#<A5# THEN RETURN
  50720 LOCATE 19,1:PRINT
"WARNING !!! —- ENTIRE AUDIENCE
INSIDE -6dB COVERAGE ANGLE !!! "
  50999 RETURN
  51000 REM **** PRINT LONG LINE
SUBROUTINE
  51010 REM *** SET VARIABLES
  51020 D#=P0#:GOSUB
51500:PF0#=DF#:PI0#=DI#
  51030 D#=P1#:GOSUB
51500:PF1#=DF#:PI1#=DI#
  51040 D#=P2#:GOSUB
51500:PF2#=DF#:PI2#=DI#
  51110 REM *** PRINT 51110 LOCATE
Y,X:PRINT USING
P$+P1$;PF0#,PI0#,PF1#,PI1#,PF2#,P
I2#,P3#,P4#
  51120 RETURN
  51200 REM **** PRINT A SINGLE
LINE
  51210 LOCATE Y,X:PRINT USING
P$;P0#
  51220 RETURN
  51500 REM **** CONVERT TO FEET
AND INCHES
  51510 DF#=INT(D#/12)
  51520 DI#=INT(D#-(DF#*12)+0.5)
  51530 IF DI#<12 THEN RETURN
  51540 DF#=DF#+1
  51550 DI#=0
  51560 RETURN
  65535 END
```