DYNAMIC COLOR NEWS

* INFORMATION HANDLING
(DATA SORTING)

* COMPUTER SOUNDS
* BASIC PROGRAMMING
* QUESTIONS & ANSWERS

* MACHINE LANGUAGE PROGR.
* OPERATING HINTS

The purpose of this newsletter is to provide instruction on Basic & Machine Language programming, Computer theory, operating techniques, compsuter expansion, plus provide answers to questions from our subscribers.

The submission of questions, operating hints, and solutions to problems to be published in this newsletter are encouraged. All submissions become the property of Dynamic Electronics if the material is used. We reserve the right to edit all material used and not to use material which we determine is unsuited for publication.

We encourage the submission of Basic and Machine Language Programs as well as articles. All Programs must be well documented so the readers can understand how the program works. We will pay for programs and articles based upon their value to the newsletter. Material sent will not be returned unless return postage is included. Basic & ML programs should be sent on a tape or disk & comments should be sent as a DAT or BIN file.

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*   DYNAMIC    COLOR    NEWS     *
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*       November 1984            *
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*    Editor and Publisher        *
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EDITOR'S COMMENTS

With the holiday season approaching I can feel the excitement as new computers are being bought for personal and business use. There is much more to select from this year than there was last year. The IBM PC is very popular and still expensive, Apple has the Macintosh, Kapro has new portable CP/M computers, Radio shack has the model 2000, the Commodore 64 is very popular, and the Radio Shack Color Computer has dropped below $100. Of course there are many more that have come and gone. The prices of computers has dropped and the price of accessories has also decreased.

I receive many engineering magazines and do quite a bit of reading. The price of floppy disk drives has dropped some as has the price of hard disks. However these are still rather expensive. A few years ago a company introduced a continuous tape storage device called the stringy floppy. It seemed to operate like a disk drive and was much faster than a tape unit. I don't mind the speed of the tape recorder I use on the color computer because I can do something else while programs are being loaded or saved. The thing that is the most bothersome to me is finding programs on the cassette and identifying them. You don't have this problem with disk systems as the software finds the programs for you. A continuous tape storage medium has the same advantage as the disk drives in this respect as the computer can wait until the program is found. The name of the company was Exatron and they have reorganized into a new company which will soon market an improved version of their stringy floppy. This should be of interest to color computer owners if the price is not too high. One disadvantage of their previous product was the high cost of the tapes or waffers as they called them.

While on the subject of tape recorders, let's point out the fact that information can be saved much faster than the way it is saved by the color computer's software. The information is saved at a 2400 hertz rate which is slow. When you consider that the frequency response of a stereo amplifier goes up to 12000 hertz or higher, then it would seem feasible that a rate at least 5 times faster than the one presently used could be achieved. This is if we use only one channel. If we used both channels then a rate improvement of 10 times is possible. However the cassette recorders most of us use do not have this high frequency response and do not operate in stereo. Also the software would have to be revised if we want to try a different scheme.

Memory chips are becomming more plentiful and less expensive. You can look for the price of memory expanders to drop. Also 256K memory chips were advertised for less than $20 so you can expect to see computers with 256K memories in the near future.

In this issue we are beginning a discussion of computer generated sounds. This will enable you to understand how a computer can talk. Also included is a program that allows you to sort names in alphabetical order or sort numbers in numerical order. We have received requests for this type of program and comments are included so you can understand how the sorting works.
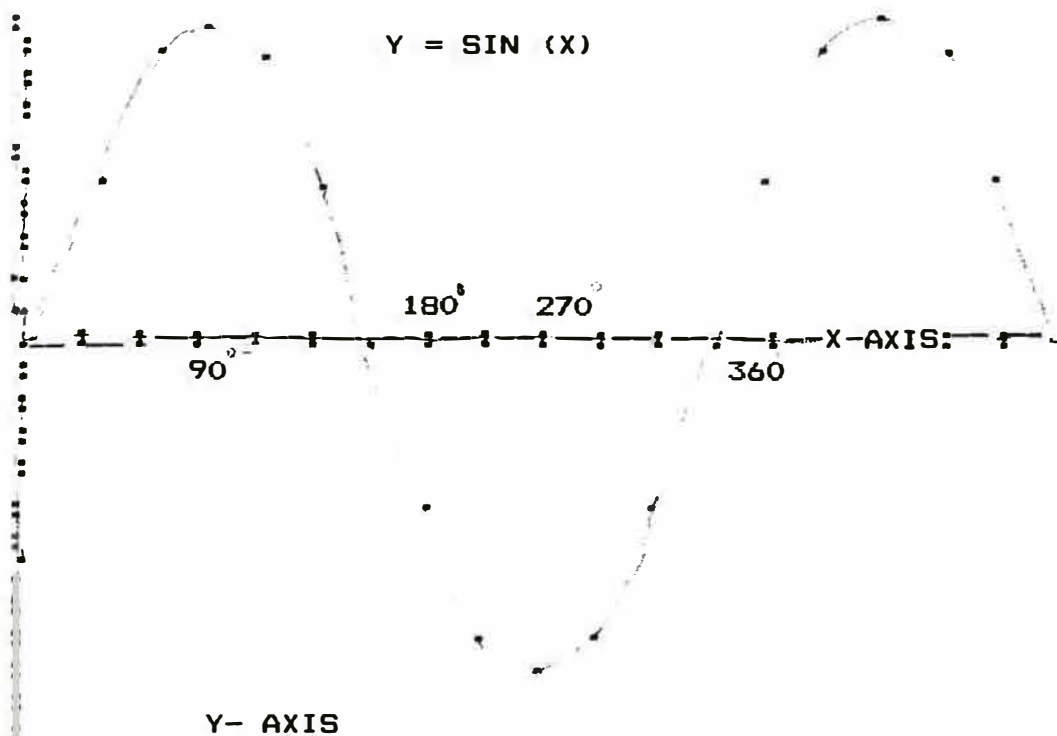
Y = SIN (X)

FIGURE 1

COMPUTER GENERATED SOUND
Part 1

We are all familiar with the sounds that can be generated through a television speaker by a color computer. In fact there is a basic command that allows us to generate sounds. The command is as follows:

SOUND X,Y

X is a number indicating relative frequencies and Y represents the length of the sound. X and Y can be any number from 1 to 255.

LINEAR FUNCTIONS

When we talk about sound, audio, voice, or music we are talking about electronic circuits that are linear in nature. Computers are digital devices which means that their circuits are either in a logical "0" or a logical "1". The computer works on instructions which are binary in nature. Let's look at what makes up a sound signal or a linear function.

A linear function is a relation that can be represented by an algebraic or trigonometric expression. An equation like Y =5 * X is a linear relationship. For any X there is a corresponding Y which is 5 times larger. The equation for generating sounds is the SINE wave equation. This is the basic equation for trigonometry and for the generation and analysis of electronic sounds. A sine wave equation is as follows:

(1)   Y = SIN (X)

Y represents the amplitude for any X. X is the angle in radians or degrees. One cycle and a half of a sine wave is shown in Figure 1. A cycle occurs when one complete repre-

4

sentation of the waveform occurs. This occurs when 360 degrees of the angle X is completed. If the dotted line represents zero then notice that the waveform goes above the line as much as it goes below it. This is the way the sound in your television, radio, or stereo changes. Also the power that comes into your home or business can be represented by a sine wave equation.

Since sounds have different volumns it is necessary to modify the above equation with an amplitude scaler. If we let A represent the amplitude then we can rewrite the equation as

(2) $Y = A * SIN (X)$

With this equation if A is small then we will have a low sound intensity. If A is large then we will have a large sound intensity. Now lets see how we get the frequency components into the equation. There are high frequencies and low frequencies in music and voice. So we need to expand X so we can see how frequencies are involved. So X can be expanded as follows:

(3) $X = w * t = 2 * PI * f * t$

X = The angle in degrees or radians
w = The angular frequency in radians
PI = 3.14159
f = The frequency in hertz
t = The instantaneous time in seconds

Some of our readers will not be familiar with algebraic or trigonometric equations. However if you will carefully follow what we are doing then you should be able to gain an understanding of what is involved to generate music or voice with a computer.

DIGITAL to ANALOG CONVERSION

The device that allows computers to generate linear waveforms is the Digital to Analog (D/A) converter. This name seems logical since computers are digital in nature. The term analog is used to indicate a voltage that is continously changing. With the D/A converter we can represent a digital word with an analog voltage. The color computer has a digital to analog converter built in it. It is 6 bits and can represent relative output voltages from 0 to 63. This can be visualized by thinking of a set of steps with 63 steps. In figure 2 is the original sine wave equation but generated by a 20 step D/A Converter.

There are many different ways the steps could have been taken but notice the lack of smoothness of the waveform. Now if we had taken 255 steps with 1 degree on the X axis instead of the 20 steps and 30 degrees, then the approximation would have been much closer to the actual waveform in Figure 1. Notice that the waveform goes above and below the X - Axis. This means that the X - Axis is at the midpoint of the range. It is standard practice for generating audio from digital signals to let 1/2 of the maximum value be the reference. For the 20 step waveform in Figure 2, 10 is the mid point and the location of the X - Axis.

Let's notice that if the steps are increased then we can come closer to the desired value in the Y-direction or the vertical. Also we need to take smaller angles to get better representation in the X-direstion. Of course if we had 10000 steps in the vertical and .1 degree in the horizonal then we could generate the linear waveform with almost no error. To

Y = SIN (X) digital
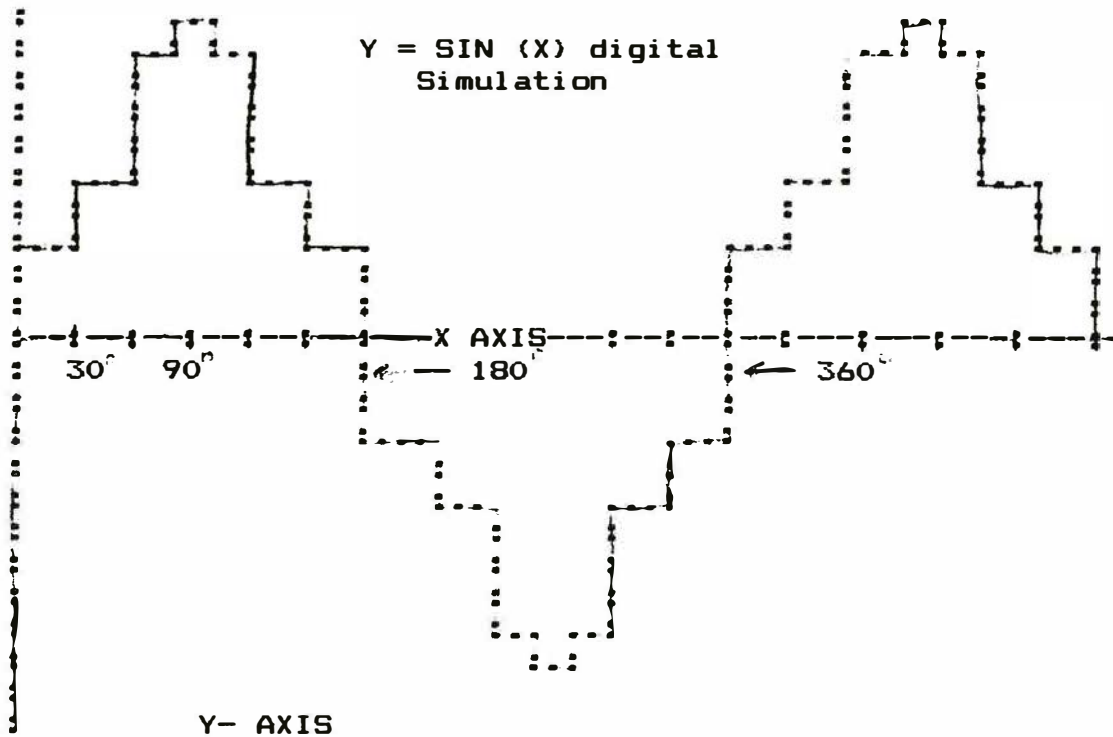Simulation

X AXIS

30° 90°   ← 180°   ← 360°

Y- AXIS

Figure 2

reproduce good sound we need to generate frequencies of from 5000 to 10000 hertz. The higher frequencies occur faster than lower frequencies so they must be generated in a shorter time. For the digitally generated sine wave shown in Figure 2, each output step is generated by writing a byte to some memory location. Since we changed steps every 30 degrees, we had 12 changes for one cycle. This means that we have to be storing bytes to the memory locations at least 12 times for each cycle or if the frequency of the digital sine wave is 10000 hertz then we must be able to store bytes at the rate of 120000 hertz. This rate becomes the limiting factor for increasing resolution in the X or angular direction.

Color computers have software routines built in for generating the sound frequencies. This software is contained in the Basic ROM chip and is automatically done when the Basic sound command is encountered. Next month we will look at analog to digital conversion. This is the process by which the positions of the joysticks is deter-mined.

BASIC PROGRAMMING
SORTING INFORMATION

If you have a lot of informa-tion it is advantageous to have it presented in a form that is convenient. Last month we pre-sented an address file program that displayed information about each file by telephone number, ZIP code, or last name.

This month we want to look at additional ways of presenting information. For example we could have it displayed by putting the last names in alphabetical order. Another way would be to put the zip codes or area codes in numerical order. Ho do we make the computer do these operations?

There are two ways in which we need to sort. The simplest way is to sort numbers in assending or desending order. The second way is to sort names in alphabetical order. How can the computer sort nams? Before discussing this let's look at a method of sorting.

Let's assume that we have a list of ball players with their jersey numbers. For our convenience we will also assume that no two have the same last name. We will set up arrays with the names and numbers plus a working array for the results of our sorting. To demonstrate the principle let's use 10 names and numbers. We will use the DIMENSION statement plus READ and DATA statements for getting the information into the computer.

```
10 DIM N$(10),N(10),X(10)
15 DATA 25,JONES,15,SMITH
20 DATA 03,ALLEN,92,POKE
25 DATA 87,BEST,65,WREN
30 DATA 18,LEGG,12,YOUNG
35 DATA 27,CHASTAIN,32,AKRON
40 'READ THE DATA INTO THE
   ARRAYS
45 FOR J=1 TO 10
50 READ N(J),N$(J)
55 ?N(J);N$(J)
60 NEXT J
```

Statements 10-60 will enter the information into the arrays N(J) and N$(J) and print the information on the screen. Now let's write a menu so we can decide what to do.

```
70 ?"1 DISPLAY ALL INFORMATION
75 ?"2 DISPLAY IN NUMERICAL
ORDER
80 ?"3 DISPLAY IN ALPHA ORDER
85 INPUT Y
90 ON Y GO SUB 200, 400, 600
95 GO TO 70
```

The subroutine at 200 will display all of the information. The subroutine at 400 will display the information in numerical order and the subroutine at 600 will display the information in alphabetical order.

Displaying All Information
```
200 PRINT"THIS DISPLAYS
ALL THE INFORMATION
210 FOR J=1 TO Z
215 PRINTN(J);N$(J)
220 NEXT J
225 RETURN
```

This is the standard method of printing information contained in an array. Notice the small amount of programming that is required when this method is used. The use of arrays and FOR-NEXT loops make programming easy.

Displaying Information
in Numerical Order

```
400 PRINT"THESE ARE THE PLAYERS
    IN NUMERICAL ORDER
405 L=1000:Y=1
410 FOR J=1 TO Z
415 IF N(J)<L THEN L=N(J): Y=J
420 NEXT J
425 X(1)=Y
430 FOR J=2 TO Z
435 Y=1
440 L=1000:V=X(J-1):S=N(V)
445 FOR K=1 TO Z
450 IF N(K)<=S THEN 465
455 IF N(K)<L THEN L=N(K):Y=K
460 X(J)=Y
465 NEXT K
470 NEXT J
475 FOR Q=1 TO Z
480 V=X(Q):PRINTN(V);N$(V)
485 NEXT Q
490 RETURN
```

This subroutine is at 400 in our program. To display information in numerical order re-

quires us to sort the jersey numbers. The sort routine we are using assumes that the smallest number is greater than any number. This is in statement 405 and we let L=1000 which is larger than any player's number. Statements 410 through 420 compare each number with L and replace L with the number if it is less than L. Statement 425 puts the array number that contains the smallest number into X(1).

Next we go through the numbers Z-1 times and pick the next smallest number. This is statements 430 through 470. Notice we have a double FOR - NEXT loop because we have to compare each value with all of the rest to get the smallest. If the value is less than or equal to the last smallest value then we go to the next number. This is in statement 450. If a number is less than the one we are holding for the smallest then we let the number be our new smallest number. This is statement 455 and 460.

After we have done all of our sorting then we print the numbers and players names in numerical order. This is statements 470 ⁻ 490. Notice that the array X(Q) contains the array numbers of N(V) so that all we need to put in the X(Q) arrays is the ordering of the data to be printed from the N(V) array.

Sorting on Last Names

This is the hardest part of the program because you can't sort on letters. Remember that computers only work on numbers and to sort on letters they have to be converted to numbers. To convert letters to numbers we use the ASC command.

From our previous discussions on ASCII we showed that each keyboard character is given a standard number. What we do is to use the left two characters of the last name and convert

them to numbers then we check the numbers to see which is the smallest. The steps for finding the first name follows.

```
600 PRINT"THIS SORTS ON LAST
    NAMES
605 'FIND THE FIRST NAME
610 Y=1
615 A=90:B=90
620 FOR J=1 TO Z
625 L$=LEFT$(N$(J),2)
630 A$=LEFT$(L$,1):
    B$=RIGHT$(L$,1)
635 C=ASC(A$):D=ASC(B$)
640 IF C>A THEN 655
645 IF C<A THEN A=C:B=D:
    Y=J:GO TO 655
650 IF D>B THEN Y=J:B=D
655 NEXT J
660 X(1)=Y:PRINT"FIRST
    NAME IS "N$(Y)
```

Notice step 645. This is very powerful in that if the conditional test is not true then basic goes to the next statement. If the test is true then basic does all of the steps within the statement.

We did the second part of the name sort subroutine twice. The first time we used a method similar to statements 600 -660. However it became messy and we revised our procedure. We calculated one numerical value for each name. We multiplied the value of the left character by 100 and added the value of the next to the left character. The rest of the program follows.

```
665 FOR K=2 TO Z
670 U=10000:Y=1:Q=X(K-1)
675 L$=LEFT$(N$(Q),2)
680 A$=LEFT$(L$,1):
    B$=RIGHT$(L$,1)
685 A=ASC(A$):B=ASC(B$)
690 A1=100*A + B
695 FOR J=1 TO Z
700 M$=LEFT$(N$(J),2)
705 C$=LEFT$(M$,1):
    D$=RIGHT$(M$,1)
710 C=ASC(C$):D=ASC(D$)
715 A2=100*C+D
720 'CHECK FOR EARLIER NAMES
725 IF A2<A1 THEN 745
```

```
730 IF A1=A2 THEN 745
735 IF A2>U THEN 745
740 IF A2<U THEN U=A2:Y=J
745 NEXT J
750 X(K)=Y
755 NEXT K
760 FOR W=1 TO Z
765 P=X(W):PRINTN$(P);N(P)
770 NEXT W
775 RETURN
```

Notice A2 in 715 is the value of the name. Statements 725 – 740 do the logic checks to compare the number A2 with the last smallest number A1 and the smallest number U. Y is the array number. Statements 760 – 770 print the results and statement 775 returns the subroutine to the main program.

The complete program follows. This program was run and was saved as an ASCII program and merged with our word processor so we could present it here.

```
1 'BALL TEAM SORT PROGRAM
2 'THIS PROGRAM WAS WRITTEN BY
3 '***** BILL CHAPPLE ********
5 Z=10
10 DIM N(Z),N$(Z),X(Z)
15 DATA 25,JONES,15,SMITH
20 DATA 3,ALLEN,92,POKE
25 DATA 87,BEST,65,WREN
30 DATA18,LEGG,12,YOUNG
35 DATA 27,CHASTAIN,32,
   WILLIAMS
45 FOR J=1 TO 10
50 READ N(J),N$(J)
55 PRINTN(J);N$(J)
60 NEXT J
70 PRINT"1 DISPLAY ALL
   INFORMATION
75 PRINT"2 DISPLAY IN NUMERICAL
   ORDER
80 PRINT"3 DISPLAY IN ALPHA
   ORDER
85 INPUT Y
90 ON Y GO SUB 200,400,600
95 GO TO 70
200 PRINT"THIS DISPLAYS ALL
    THE INFORMATION
210 FOR J=1 TO Z
215 PRINTN(J);N$(J)
220 NEXT J
225 RETURN
```

```
400 PRINT"THESE ARE THE PLAYERS
    IN NUMERICAL ORDER
405 L=1000:Y=1
410 FOR J=1 TO Z
415 IF N(J)<L THEN L=N(J): Y=J
420 NEXT J
425 X(1)=Y
430 FOR J=2 TO Z
435 Y=1
440 L=1000:V=X(J-1):S=N(V)
445 FOR K=1 TO Z
450 IF N(K)<=S THEN 465
455 IF N(K)<L THEN L=N(K):Y=K
460 X(J)=Y
465 NEXT K
470 NEXT J
475 FOR Q=1 TO Z
480 V=X(Q):PRINTN(V);N$(V)
485 NEXT Q
490 RETURN
590 '
600 PRINT"THIS SORTS ON LAST
    NAMES
605 'FIND THE FIRST NAME
610 Y=1
615 A=90:B=90
620 FOR J=1 TO Z
625 L$=LEFT$(N$(J),2)
630 A$=LEFT$(L$,1):
    B$=RIGHT$(L$,1)
635 C=ASC(A$):D=ASC(B$)
640 IF C>A THEN 655
645 IF C<A THEN A=C:B=D:Y=J:
    GO TO 655
650 IF D>B THEN Y=J:B=D
655 NEXT J
660 X(1)=Y:PRINT"FIRST NAME
    IS "N$(Y)
665 FOR K=2 TO Z
670 U=10000:Y=1:Q=X(K-1)
675 L$=LEFT$(N$(Q),2)
680 A$=LEFT$(L$,1):
    B$=RIGHT$(L$,1)
685 A=ASC(A$):B=ASC(B$)
690 A1=100*A + B
695 FOR J=1 TO Z
700 M$=LEFT$(N$(J),2)
705 C$=LEFT$(M$,1):
    D$=RIGHT$(M$,1)
710 C=ASC(C$):D=ASC(D$)
715 A2=100*C+D
720 'CHECK FOR EARLIER NAMES
725 IF A2<A1 THEN 745
730 IF A1=A2 THEN 745
735 IF A2>U THEN 745
740 IF A2<U THEN U=A2:Y=J
745 NEXT J
750 X(K)=Y
```

```
755 NEXT K
760 FOR W=1 TO Z
765 P=X(W):PRINTN$(P);N(P)
770 NEXT W
775 RETURN
```

****

OPERATING HINTS

CONTINUOUS TAPES

If you have a program that you use frequently it can be saved on a continuous tape like those used in telephone answerers. This will save you the trouble of having to rewind the tape everytime you want to load the program. The only problem is that these cassettes generally are only 30 to 45 seconds in length limiting the length of program you can save.

GOOD QUALITY TAPES

C60 Tapes can be purchased in some discount stores for 30 - 40 cents each. These tapes will not retain programs over a long time period and should not be used for computer programs. You can not expect good results if you use poor quality tapes. Good computer tapes can be purchased for around 50 cents for a C10 and should be used to guarantee that programs will load after a long period of storage.

PRINT DISK DIRECTORY

To print the disk directory POKE 111, 254 and then type DIR <ENTER>. The entire disk directory for your disk will be printed on a printer.

EASY MOTOR OFF

It is not necessary to type "MOTOR OFF when you want to stop the cassette. Just enter some unauthorized code such as "Y"

creating an error message on the screen which will also stop the cassette.

****

QUESTIONS
&
ANSWERS

Question: My computer doesn't work right. I have a 96KX-M installed and ran a memory check program which indicated bad memory around 8000. Could the 96KX-M be the problem?

Answer: The 96KX-M works in the ROM area from 57344 up. The procedure for isolating problems is to disconnect the suspected circuits. Since the 96KX software occupies a different memory area than where the memory test indicated a problem, it is probably not the 96KX-M. However to verify this remove the 96KX-M and again run the memory test. If it performs OK then perhaps the 96KX-M was causing a faulty indication.

Question: My computer gives an error message when I try to load some tapes. What could be the problem?

Answer: When the computer gives an error message it means that it is not receiving the information correctly. You can adjust the volume on the output of your recorder and the program may load with a different level.

```
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