PRICE $2.00

TRIADEX INC

"MUSE"

COMPUTER MUSICAL SYNTHESIZER

COMPUTERS FOR PEOPLE

PROGRAMMING THE "MUSE" COMPUTER

The three regions of the "Muse" generate ones and zeroes in slightly different ways. The On-Off region is the simplest. The "Off" position is always in the zero state, while the "On" position is always in the one state. The positions in the Count region shift between zero and one states in the following manner. After starting the"Muse", C1 alternates between zero and one at each beat of the tempo clock. Thus, an Interval slide placed on C1 sees an alternate zero and one. The C2 position is in the zero state for the first two beats of the tempo clock and then goes to the one state for the next two beats before returning to the zero state for the following two beats, etc. The C3 position is in the zero state for three beats of the tempo clock before switching to the one state for three beats. C4, C6, and C8 operate in a similar manner. C½ is in the zero state for one half beat and then switches to the one state for the second half beat.

The B region is actually a 31-bit shift register which advances one position with each beat of the tempo clock. The information (i.e. a one or a zero) which is entered into the first position of the shift register depends on the positions of the four Theme slides. The Theme slides can be positioned in one or any combination of the three regions described. The Theme slides have a combination of ones and zeroes on them. If the four Theme slides have an even number of ones on them (i.e. 0, 2, or 4), then a zero is introduced into the first bit of the shift register at the next tempo beat. If the number of ones is odd (i.e., 1 or 3) then a zero is introduced into the first bit of the shift register at the next tempo beat. Regardless of whether a one or a zero is introduced into the first bit, it is shifted along the register until 31 tempo beats later when it is lost out the end of the register. Thus the B region contains a random pattern of ones and zeroes generated by the positions of the Theme slides. If one or more of the Theme slides are in the B region, the patterns perpetuate themselves producing more complex patterns which could last up to thirty years before repeating at typical rates of one tempo beat per second.

The Interval slides control the note played by the "Muse". As ones and zeroes pass these slides, a note is generated. Since there are four slides, there are sixteen possible combinations of ones and zeroes--namely, 0000, 0001, 0010. . . 1110, 1111 which correspond to the sixteen notes the "Muse" is capable of playing. The ones and zeroes which pass by these slides can be generated in several ways. In the On-Off region the slides can be operated manually to generate the sixteen note combinations. In the Count region the various notes can be generated automatically. If the slides A, B, C, D are set in the Count region, the note played depends on the ones and zeroes that each of the four slides see in the same manner described above. Because the Count region is changing, the notes change without manual intervention as was required in the On-Off region; however, the same pattern and note correspondence applies as in the On-Off region. In the B region the same rules apply to note selection. As the ones and zeroes pass by the Interval slides, a note is generated. The slides can be positioned in any region or any combination of regions to produce notes.

Three of the four signals from the Interval slides are encoded into an eight-bit pattern which is used as a preset input to an eight-bit counter. The counter input comes from a clock controlled by the Pitch slide. The divisor of this frequency is the eight-bit encoded pattern. The quotient or output frequency is the tone or audio output of the "Muse". This output is further controlled by the fourth Interval slide. When a one passes this slide, the signal is passed just as it is. When a zero passes the slide, the signal is divided by two in a flip flop thus lowering the frequency or tone by one octave.

Armed with this information, it is possible to predict a note sequence from the positions of the eight slide switches. First write the shift register pattern for the first ten or twelve tempo beats by applying the rules described above pertaining to the Theme slides. Next define the pattern which each Interval slide will see at each beat. These then correspond to the first ten or twelve notes the "Muse" will play when started. Using this method, it is possible to predict as far into the piece as the programmer wishes.

Example: Assume the slides are set in the following manner.

A	B	C	D	W	X	Y	Z
C1	B4	B2	B7	OFF	B1	B3	B6

We can now define the contents of the shift register after each beat of the clock. The column t1 represents the contents of the various shift register positions after the first beat of the clock. No entry indicates a zero. Since all Theme slides had a zero on them prior to the first beat and no ones is an even number, a one was shifted in. At time t2, B1 was a one and all other Theme slides had zeroes on them. One one is an odd number, and so a zero was shifted in. The following table can be generated for the first ten beats.

Shift Register Pattern

	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}
B_1	1	0	1	1	0	0	1	0	0	1
B_2		1	0	1	1	0	0	1	0	0
B_3			1	0	1	1	0	0	1	0
B_4				1	0	1	1	0	0	1
B_5					1	0	1	1	0	0
B_6						1	0	1	1	0
B_7							1	0	1	1
B_8								1	0	1
B_9									1	0
B_{10}										1

The notes can now be determined at each beat time. At time t1, the Interval slide of C1 would be a one while the slides at B4, B2, and B7 would be zeroes. The encoded pattern would be 1000 producing a low D. At t2, the Interval slide C2 would be a zero; B4 is still zero; B2 would be one; and B7 would be zero. This would produce the pattern 0010 and a low G note. At time t3, C2 would again be one, B4 is still zero, B2 is again zero, and B7 is also zero. The pattern would again be 1000 giving a low D. The following table gives the pattern and corresponding notes for the remainder of the table constructed above.

	C1	B4	B2	B7	
t_4	0	1	1	0	low B
t_5	1	0	1	0	low A
t_6	0	1	0	0	low E
t_7	1	1	0	1	high F
t_8	0	0	1	0	low G
t9	1	0	0	1	high D
t10	0	1	0	1	high E

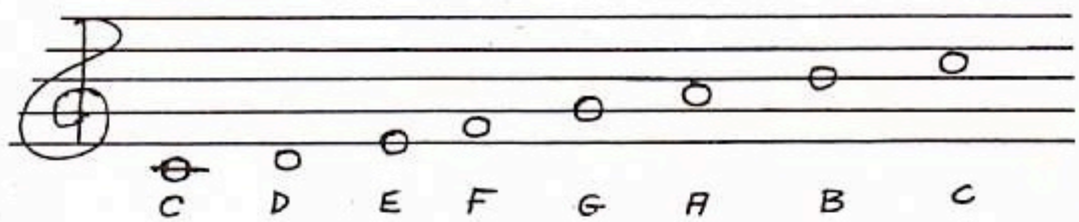
This can be accomplished for any setting of the slide switches and for any length tune. Verification of predictions can be made by activating the "Muse". The reverse process of picking slide switch positions to generate a selected pattern becomes a cut and try method, and the interested programmer will find this challenging and rewarding.

The major scale in music consists of seven tones called notes.

The first seven letters of the alphabet are used to identify the seven tones of the scale:

A, B, C, D, E, F and G

In music notation, these tones are translated into symbols called notes and placed on five lines and spaces called a staff. These notes and staff indicate the pitch and duration of a tone.



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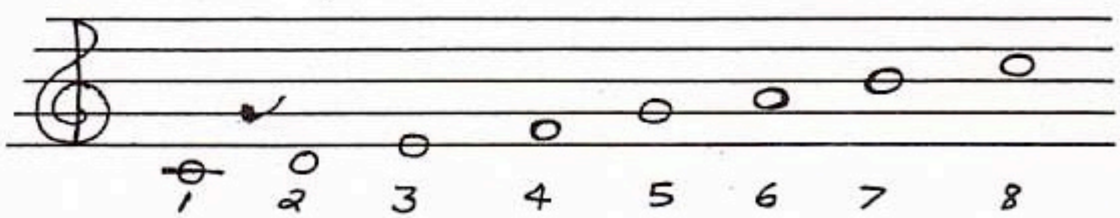
The notes of the scale can be referred to by number:



Example:

D is the second note of the C scale.

A is the sixth note of the C scale.

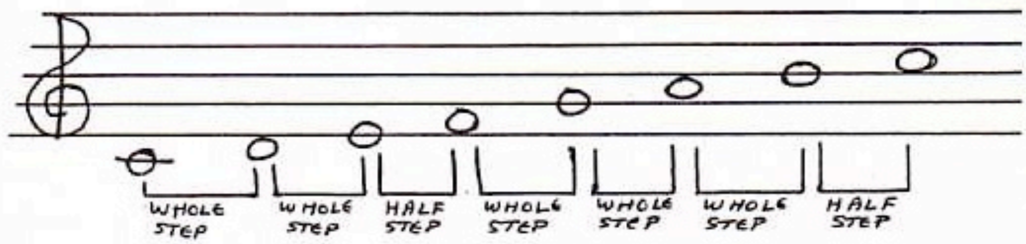
INTERVALS

An interval is the distance between one note and another.

There are a number of ways to define the intervals of a scale.

WHOLE AND HALF STEPS

We can create an order of intervals based on the distance between each note of the scale, calling them whole steps and half steps. This system is most useful when working with the 12 tone chromatic scale.



Example:

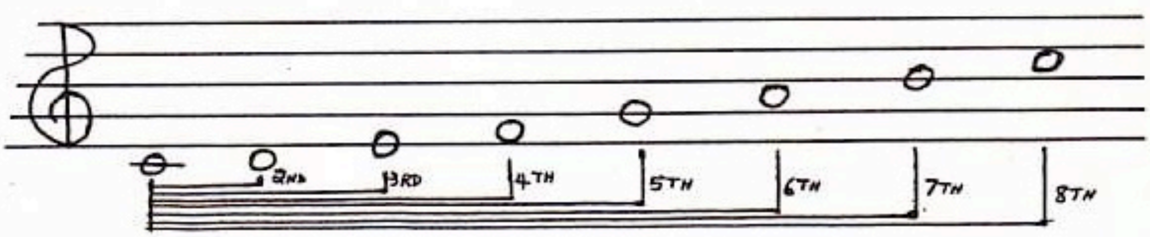
The distance between D and E is a whole step in the Key of C.

C to E is two whole steps.

E to F is one half step

NUMBERED INTERVALS

A theory of music, based on the distance of all the notes from the first note of a scale can be a useful aid.



Example: The distance from C to G is a fifth (G being the fifth note of the scale)

B is the seventh note of the scale, hence the interval is a seventh.

The Muse uses a very interesting innovation in the organization of the scale tones which is a combination of the above concepts, ie, intervals to create all the steps of a major scale.

The interval slides are assigned intervals as follows:

Slide A is a Second (or whole step)

Slide B is a Third

Slide C is a Fifth

Slide D is an octave (or eigth)

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The Muse is a binary computer, meaning it uses ones and zeroes, exclusively.

Any interval slide will be activated when it recieves a one, and inactive when it recieves a zero.

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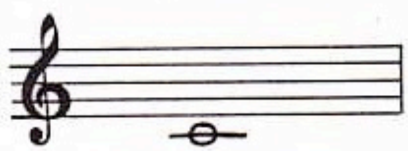
The Muse generates the first note of a major scale if all the interval slides are at Off or have zeroes:

A B C D

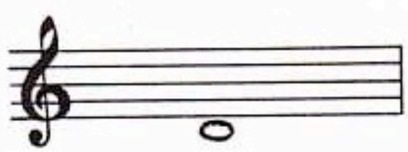
0 0 0 0



If the interval slide-A (a second) recieves a one, the Muse will play the second note of the scale:

A B C D

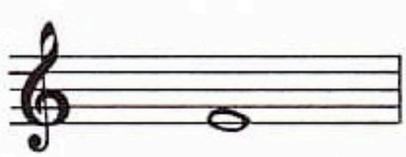
1 0 0 0



If the interval slide-B (a third) recieves a one, and the other slides are zero, the Muse will play the third note of a scale:

A B C D

0 1 0 0

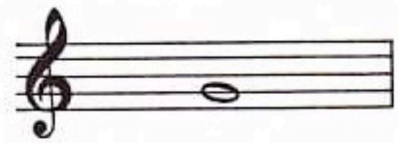


If the interval slides-A and B recieve ones, together, the Muse will combine these intervals, a second and a third, and play the fourth note of the scale:

A	B	C	D
1	1	0	0

If the interval slide-C (a fifth) recieves a one and the other slides have zeroes, the fifth note of the scale will be played:

A	B	C	D
0	0	1	0

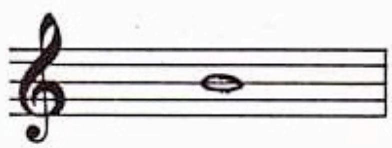


If the interval slides-A and C recieve ones, the Muse will combine the intervals of a second and a fifth and play the sixth step of the scale:

A	B	C	D
1	0	1	0

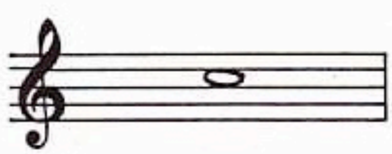
If the interval slides-B and C have ones, the Muse will combine the intervals of a third and a fifth to play the seventh note of the scale:

A	B	C	D
0	1	1	0



If the interval slides A, B and C have ones, the Muse will combine the intervals of a second, a third, and a fifth to play the octave.

A	B	C	D
1	1	1	0



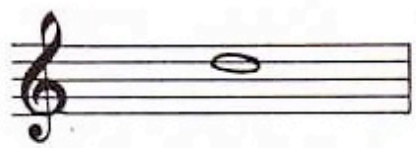
If the interval slide-D (8th or Octave) recieves a one at any time, whatever note is being played will be sounded one octave higher:

A B C D

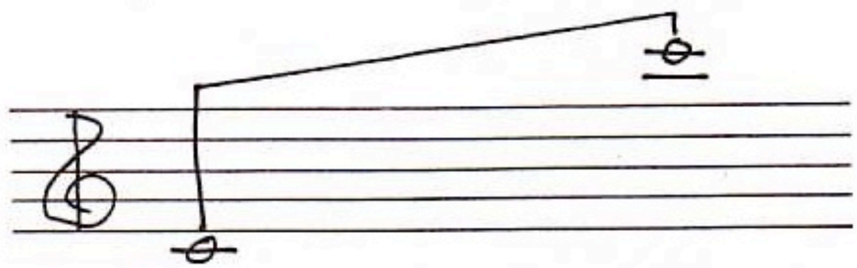
0 0 0 1

A B C D

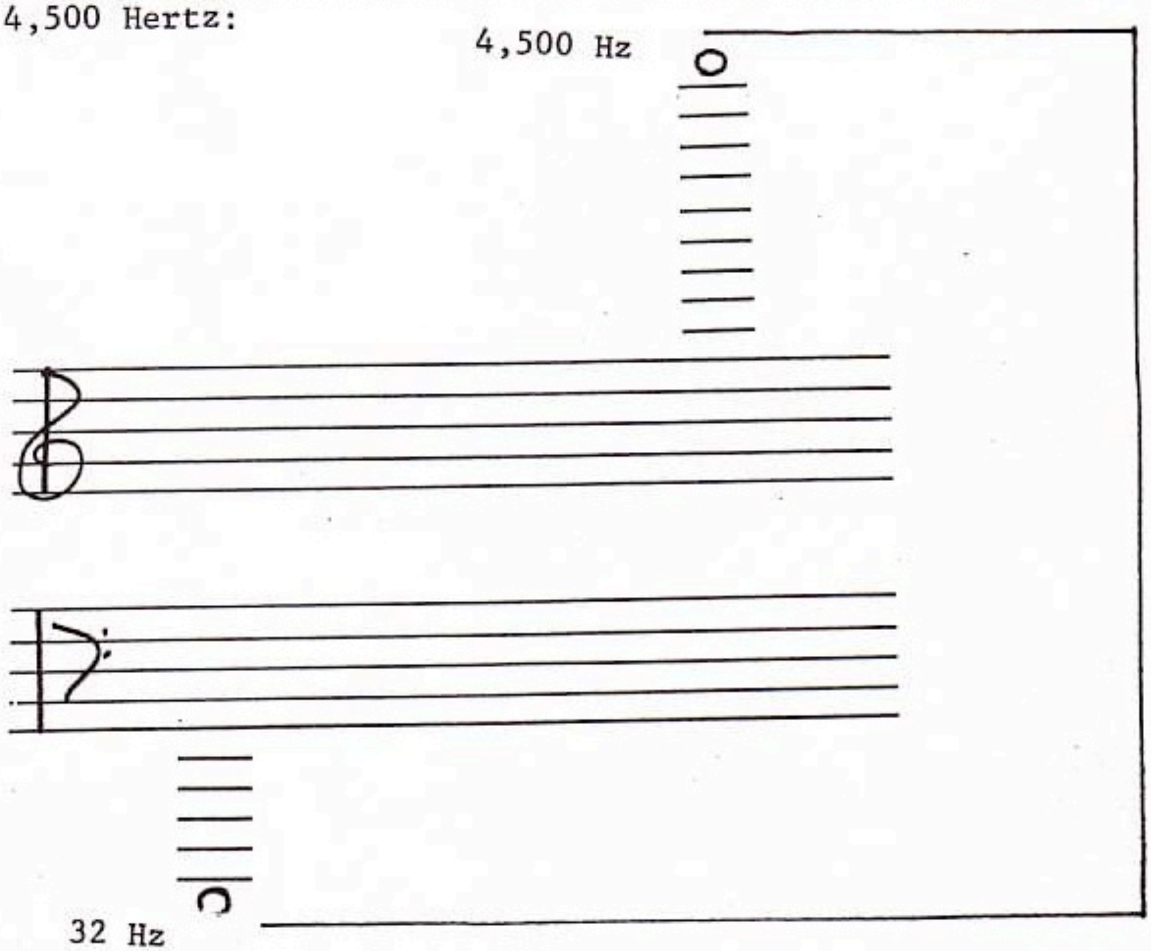
1 0 0 1



In this way a two octave range is available:



The true range of the Muse is approximately 32 Hertz, to 4,500 Hertz:

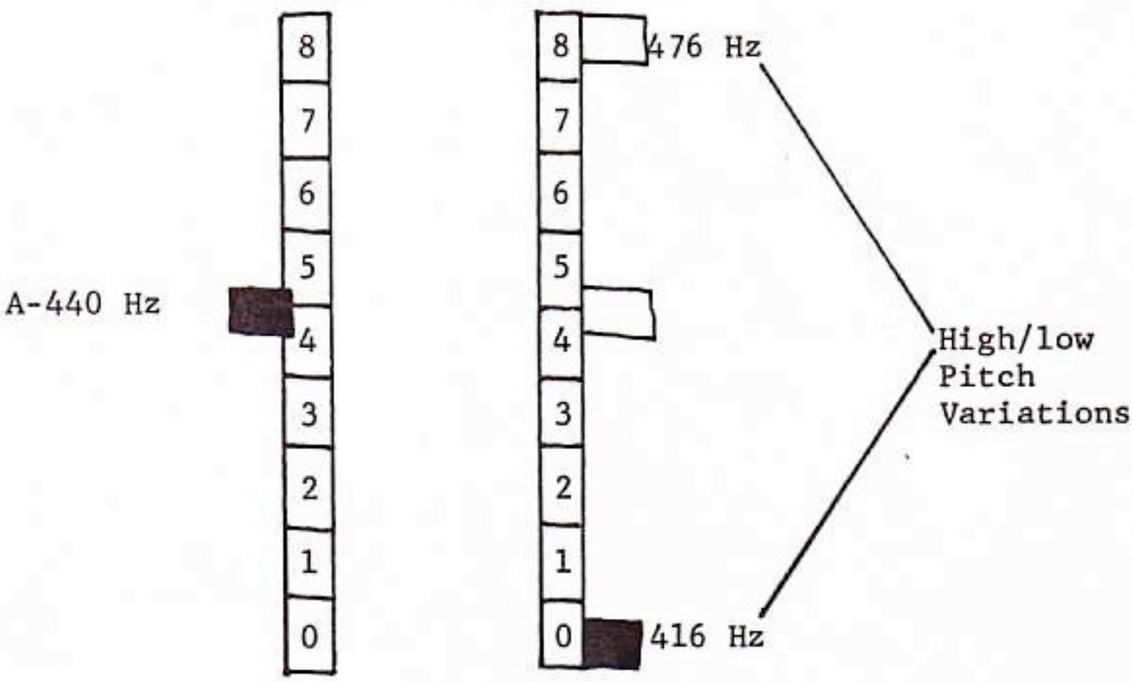


In relationship to a piano, it is over seven octaves.

A ten percent variation is allowable because of the component systems involved.

FINE PITCH CONTROL SLIDE:

The range of the fine pitch control slide is approximately 10 percent of the fundamental frequency:



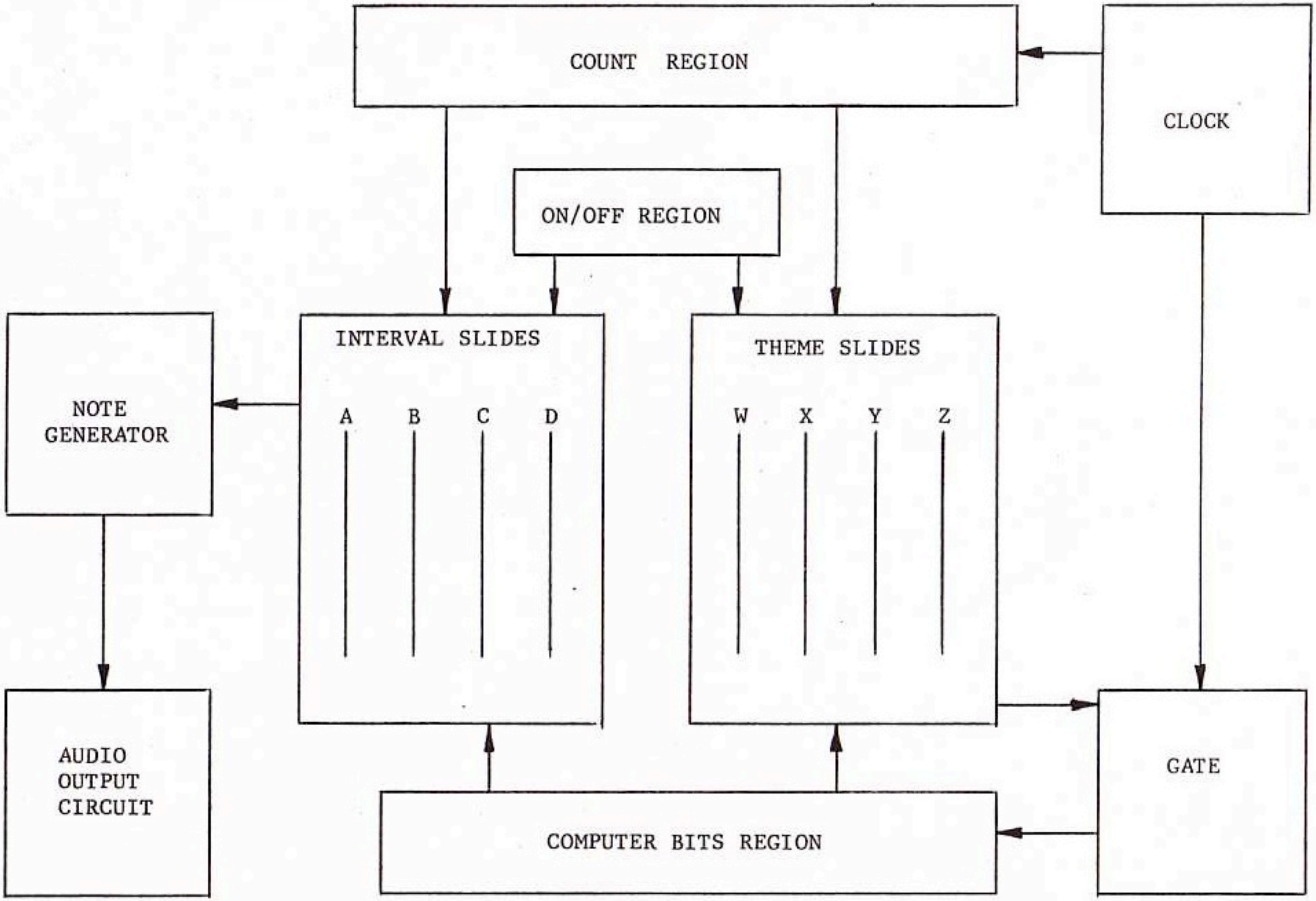
TEMPO SLIDE CONTROL SETTINGS CHART:

The range of the tempo slide is from approximately 54 beats per minute to 1,662 beats per minute.

	1,662	8
	660	7
	564	6
	480	5
BEATS PER MINUTE:	350	4
	300	3
	120	2
	60	1
	54	0

APPX. TEMPO POSITION CHART

The above figures are doubled when an Interval Slide is placed at position C ½.


COUNT REGION
CLOCK
ON/OFF REGION
NOTE GENERATOR
INTERVAL SLIDES
A
B
C
D
THEME SLIDES
W
X
Y
Z
AUDIO OUTPUT CIRCUIT
GATE
COMPUTER BITS REGION