How to make Muse music.

The Muse* is a completely new form of musical self-expression.

It makes composing and playing music almost as easy as adjusting your television set.

This booklet shows you how to make Muse music. How to re-create some of the music that has already been composed on the Muse. And how to go on from there, composing music that has never been heard before.

The Muse was invented by two M.I.T. professors. It's a small digital computer that uses the latest electronic technology.

But no experience is required, either in computers or in music. First get used to playing the Muse by following the step-by-step instructions in this booklet. Then become a composer in your own right.

Incidentally, the Muse is not a "music box." You can't get it to play "Twinkle, Twinkle, Little Star," or "Yankee Doodle," etc. At least we don't *think* you can.

The Muse *starts* where all the music that has ever been composed leaves off. The Muse is for tomorrow's music. Music that has never been heard before . . . until you.

That's what is ahead for you — a unique experience.

The Muse is one of the products of Triadex, Incorporated.

Triadex, Incorporated, 1238 Chestnut Street, Newton Upper Falls, Massachusetts 02164 (617) 969-3239.

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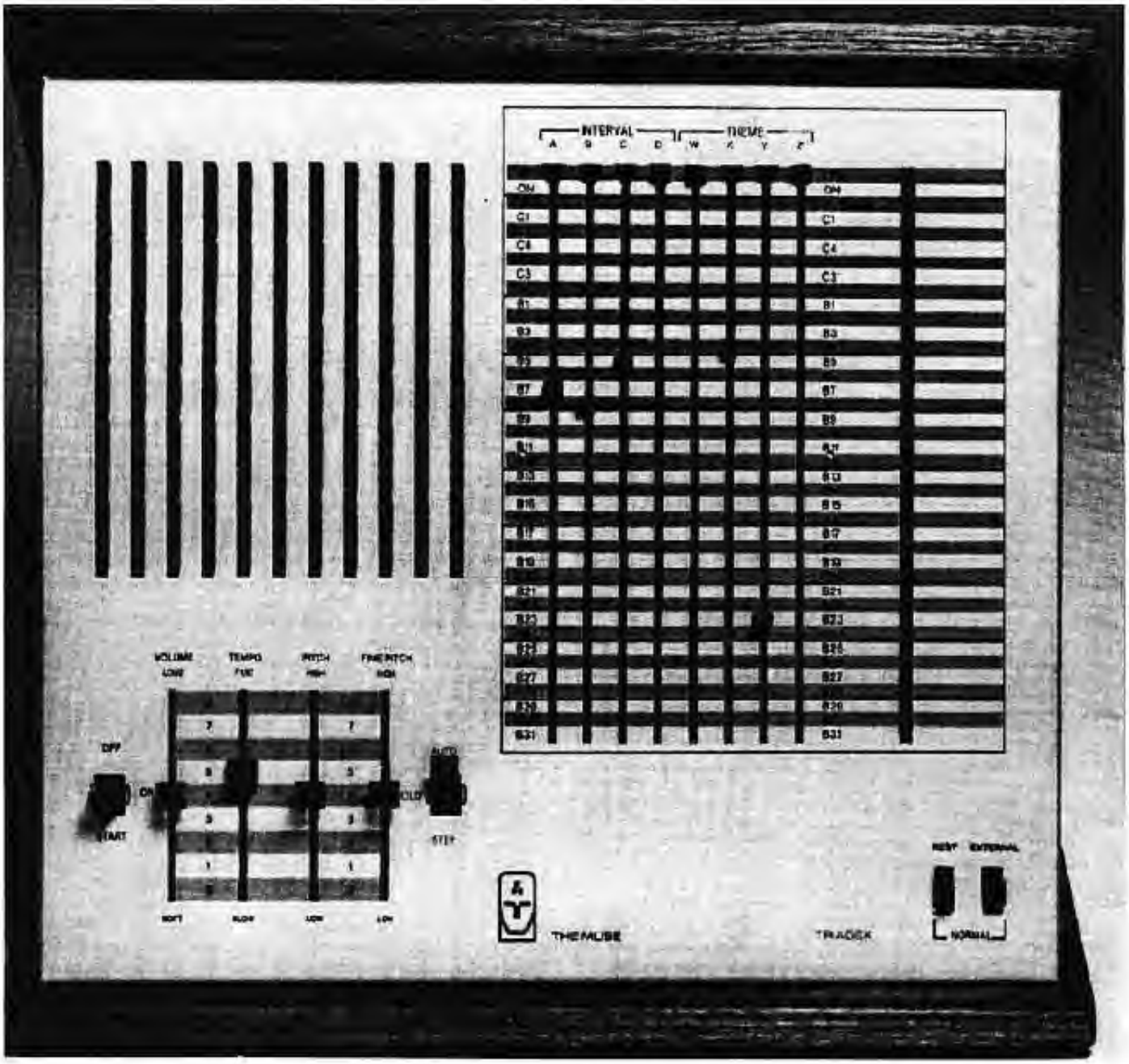
Newton Upper Falls, MA

Acknowledgements for invaluable assistance in preparing this book to Prof. Marvin L. Minsky, Ph.D., Professor Edward Fredkin (the co-inventors of the Muse) and to Mr. Ted Lagodmos, Director of Music, Triadex, Incorporated.



TITLE	INTERVAL				THEME				Volume	Tempo	Pitch	Rest
	A	B	C	D	W	X	Y	Z				
Michael's Tune	B-7	B-8	B-5	OFF	OFF	B-4	B-23	OFF	4	5	4	Normal

The best way to begin is to begin.

So . . .

Match the slide switch settings on your Muse to the settings shown in the picture (as also shown on the Recipe Chart below the picture).

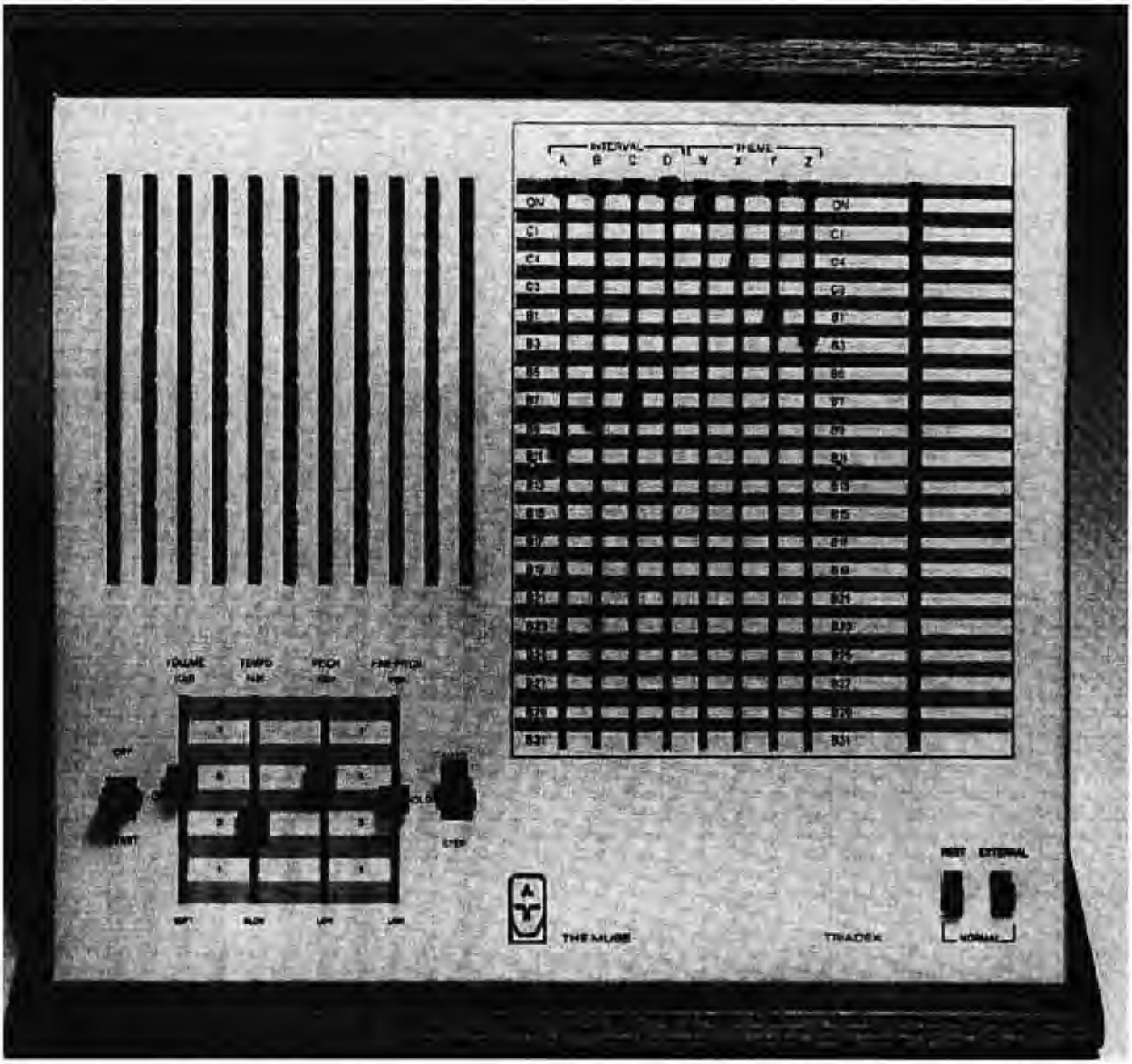
This means the four slide switches in the "Conductor" section of the Muse's face-plate — the lower left hand corner — are set as follows: Volume at 4, Tempo at 5, Pitch at 4, and Fine Pitch at 4. The settings for the eight long slide switches in the "Composer" section — upper right on the face plate — should be: A at B7, B at B8, C B5, D off, W off, X B4, Y B23, Z off.

Plug in the Muse, put the Auto-Hold-Step switch on Auto . . . push the Off-On-Start switch down to Start and let it jump back to On.

Now sit back and listen.

That's Michael's Tune — named after the little boy who discovered it.

There now. You've played your first piece of Muse music.



TITLE	INTERVAL				THEME				Volume	Tempo	Pitch	Rest
	A	B	C	D	W	X	Y	Z				
Muser's Waltz	B-10	B-8	B-7	OFF	ON	C-4	B-1	B-2	5	3	5	Normal

There's a million compositions for you to make on your Muse.

Most of them undiscovered. Most of them waiting for you to pry them loose.

One of the *known* tunes is The Muser's Waltz.

Let's hear it.

First put the On-Off-Start switch . . . (lower left hand corner in the Conductor section) . . . to Off.

Now match the slide switch settings on your Muse to the photograph and the Recipe Chart below it.

Press On-Off-Start down to Start and let it come back up to On.

Voila — The Muser's Waltz.

Here's how The Muser's Waltz looks in conventional music notation. (Conventional notation is unnecessary with the Muse, but interesting to see.)

1.	I	hear	the	mu-	sic	I	play	on	my	Muse
2.	Ev-	ery-	one	knows	what	I'm	talk-	ing	a-	bout
3.	Lum	Bum	Boo	Bum	Dee	Doo	Bum	Ditty	Doo	Da
4.	A-	Maz-	ing	a-	rous-	ing	I	love	it	so.
5.	Me-	lo-	dies	rhy-	thms	I'm	sure	you'll	a-	gree.
6.	Lum	Bum	Boo	Ditty	Dee	Do	Lum	Ditty	Do	Wee.

1.	Now	I	know	why	I'm	not	sing-	ing	the	Blues.
2.	Mus-	ing's	for	pe-	ople	who	know	how	to	shout.
3.	Bum	Ditty	Ditty	Taddle	Doo	Wee	Bum	Bee	Do	Da
4.	My	Muse	is,	your	Muse	is	such	fun	we	know.
5.	Souls	stir	and	swing	when	the	Muse	sets	them	free.
6.	Sadar	Soo	Wee	Sattle	Lee	Wee	Bum	Dee	Do	Wee.

If you'd like to sing along, you may want to slow the Muse's tempo down. That, of course, is the function of the Tempo switch in your Conductor section. Slide it downward toward "Slow" to the tempo that's most comfortable for you — probably around 2 or 3.

Now, just for the heck of it, speed the tempo way up to "Fast." Then slide it all the way down and up quickly. Play around with the tempo a bit, and see the kinds of effects you get.

All right, back to business.

Notice the three-position switch to the right of "Fine Pitch?" It's called Auto-Hold-Step. Up to now it's been in Auto.

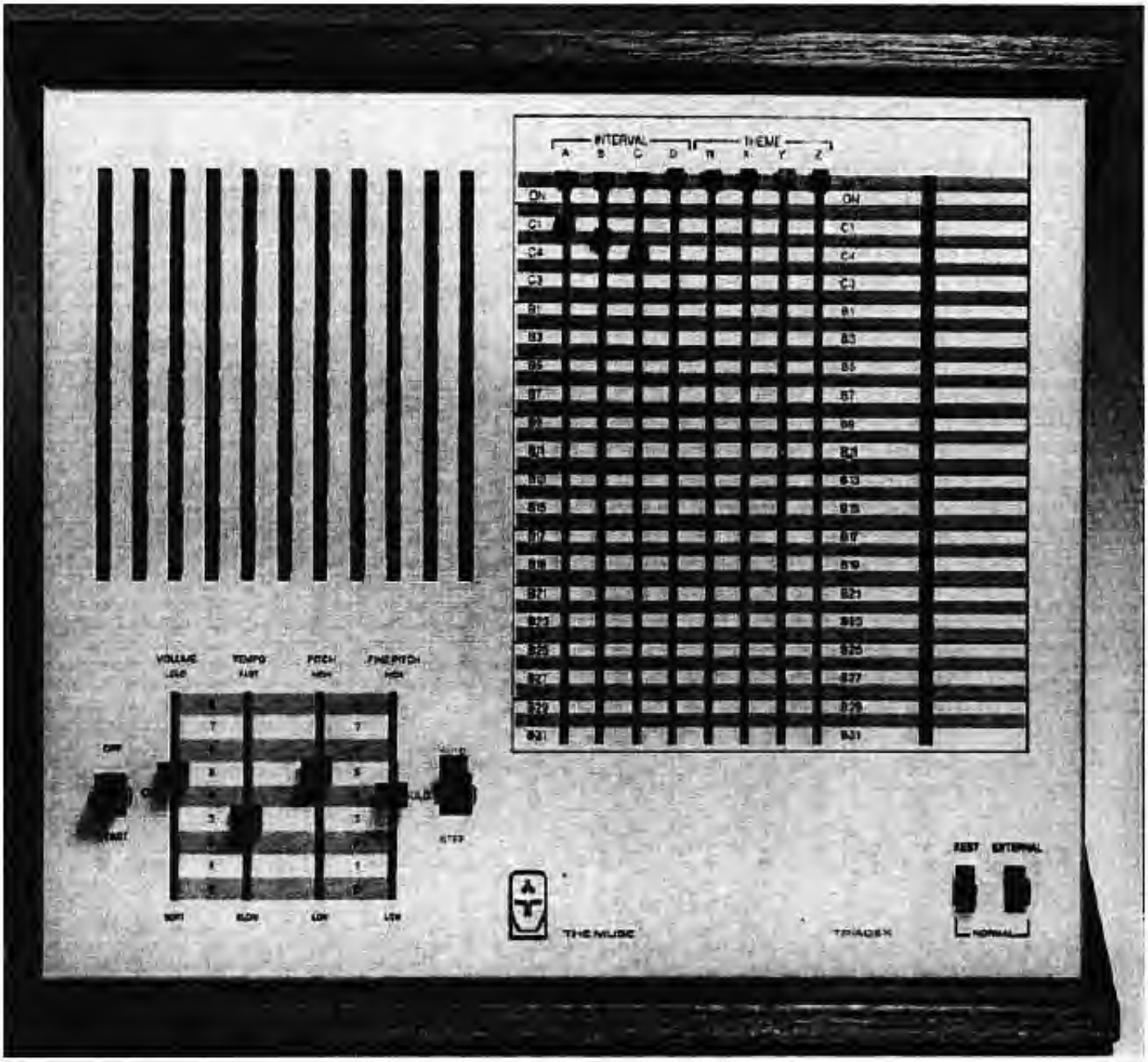
Keep playing The Muser's Waltz, but now, put Auto-Hold-Step from Auto to Hold. The Muse is now *holding* on one note — just like you thought it would.

Now flick the switch down to Step. Do it again. Again. Faster. Every time you flick down into Step, the Muse plays the next note — or step — in the composition it's working on.

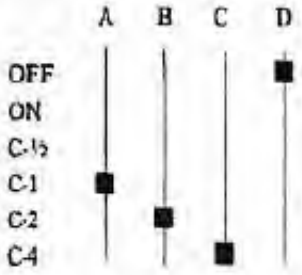
So now you know how to play the Muse manually.

Congratulations.

Put the switch back to Auto, and we'll go on to something else.



TITLE	INTERVAL				THEME				Volume	Tempo	Pitch	Rest
	A	B	C	D	W	X	Y	Z				
Scale	C-1	C-2	C-4	OFF	OFF	OFF	OFF	OFF	5	3	5	Normal



Back, as they say, to basics.

Turn the Muse off.

Set your switches to match the photograph and Recipe Chart.

Push Off-On-Start down to Start and let it back up to On.

Right — it's the good old scale; eight notes in ascending sequence repeated over and over.

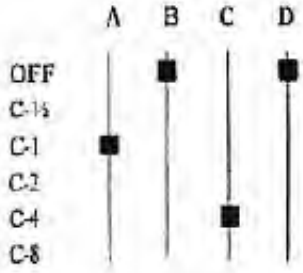
The time has come to work with the Composer of the Muse — the Interval and Theme switches.

Every time you set them in the pattern they are now the Muse will play the scale. So let's see what happens when you change the switch pattern.

Push the fourth Interval switch — called "D" — down to position C-8 like this.

Now you're playing a *two*-octave scale instead of one. Interval switch D controls octaves.

Next slide Interval switches B and D up to OFF.



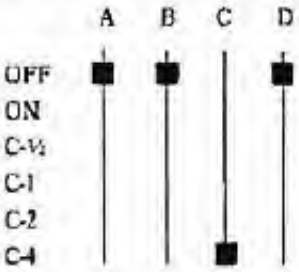
That makes a sort of "trill" pattern like this:

Move Interval switch A up to C-½. The speed of the trill is doubled. It would look like this:

Now experiment with all four Interval switches: A, B, C, and D. Move them individually around to different positions in the "Count Region" — that's from Off down to C-6. (Blue area).

Notice that you are generating more complex tonal patterns when you put the Theme switches in the C-3 and C-6 positions. That's because those two positions group the notes of your melody in threes and sixes, suggesting waltz-like musical ideas.

How does this work? Probably the best way to explain it is to have you hear a simple example. Set your Interval and Theme switches in this pattern:



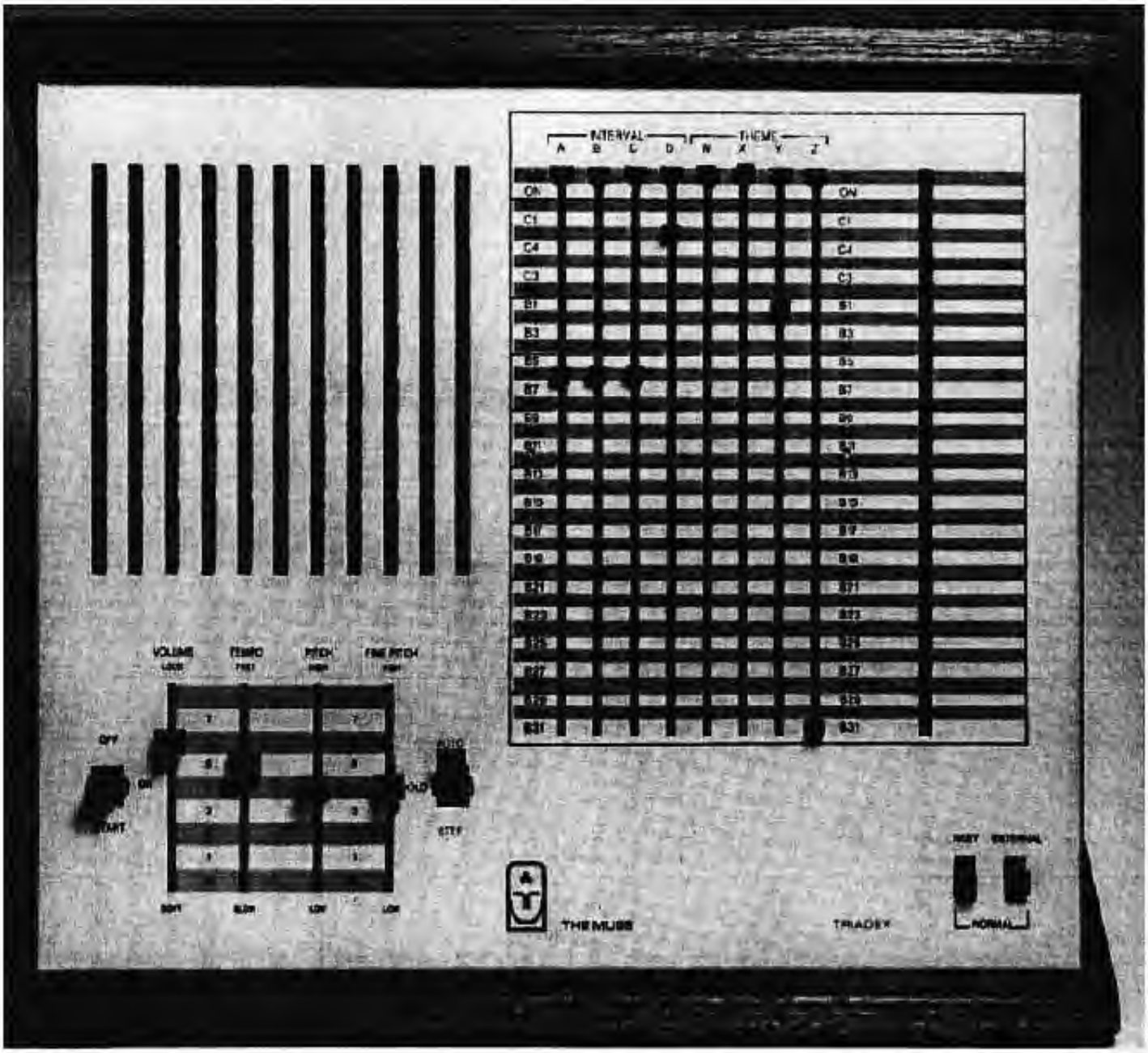
Press Off-On-Start to Start and back to On. What you are hearing is what musicians call a "perfect fifth."

By putting Interval switch C in the C-4 position you have made the Muse move four notes higher whenever the blue light at the end of the C-4 row is lit. The "A" switch moves one note higher, the "B" switch two notes, and the "C"-switch four notes.

Again, experiment around with this, and notice how the blue lights indicate what's happening note-wise.

Incidentally, it's a good idea to slow the Tempo switch down to position 1 or 2 while you experiment, so that you can see and hear the differences which the Interval switches create.

And one more thing: Whenever you feel like taking a break, to just hear the Muse play something, turn to page 15. There you'll find Recipe Charts of several compositions. Set your Muse switches to the positions indicated and see what you get. (Or rather *hear* what you get.)



TITLE	INTERVAL				THEME				Volume	Tempo	Pitch	Rest
	A	B	C	D	W	X	Y	Z				
Ed's Rhythm Piece	B-6	B-6	B-6	C-2	OFF	OFF	B-1	B-31	6	5	4	Normal

Finally — the Theme switches.

This is where most of the musical excitement comes from. The Theme switches tell the Muse how a melody is to be developed. Of particular importance in this area are the positions from B-1 through B-31. They control what computer people call "a non-random shift-register sequence."

Want to hear what one of those sounds like?

Then set up for "Ed's Rhythm Piece." Match your switches to the photograph and/or Recipe Chart.

Notice that at the beginning of this piece, the rhythm is quite simple, but then develops into a much more complex and interesting sequence. But that it is still based on the same musical idea.

Because only two of the Theme switches have been used, the piece doesn't last very long before it starts back at the beginning. If you move all four Theme switches down to different rows of the B region (B-4 through B-31) you might produce a composition that will last for several months before starting back at the beginning.

(Unless you have lots of time on your hands, it's best to take our word for it.)

So instead, let the interesting rhythm you've already established with the Theme switches run, and vary the melodic pattern by moving the Interval slides around into various positions. This is a good way to get the feel of the entire Composer section — and the relationship between Theme and Interval switches.

Suggestion: Whenever you move a Theme switch it is a good idea to press the Start button. This makes the composition you have created start at its very beginning.

On the following 2 pages you'll find a complete diagram of all the Muse switches. You may want to use it as a general reference guide in going on to create Muse music.

Further on in this booklet are Recipe Charts of some of the pieces that have already been composed on the Muse. You'll also find many blank Recipe Charts. Whenever you create something you enjoy, write the Recipe down so you'll always be able to recreate it.

There is also a section which shows you some of the accessories that are available to make your Muse-ings even more interesting.

And finally there is a more technical discussion of how the Muse does what it does.

The whole point of the Muse is to give you the chance to express yourself in an absolutely unique way.

It's for you to create something which has never been created before.

It's for you to enjoy.

Conductor Section

Off-On-Start. When you press down to Start position, the composition goes back to the very beginning.

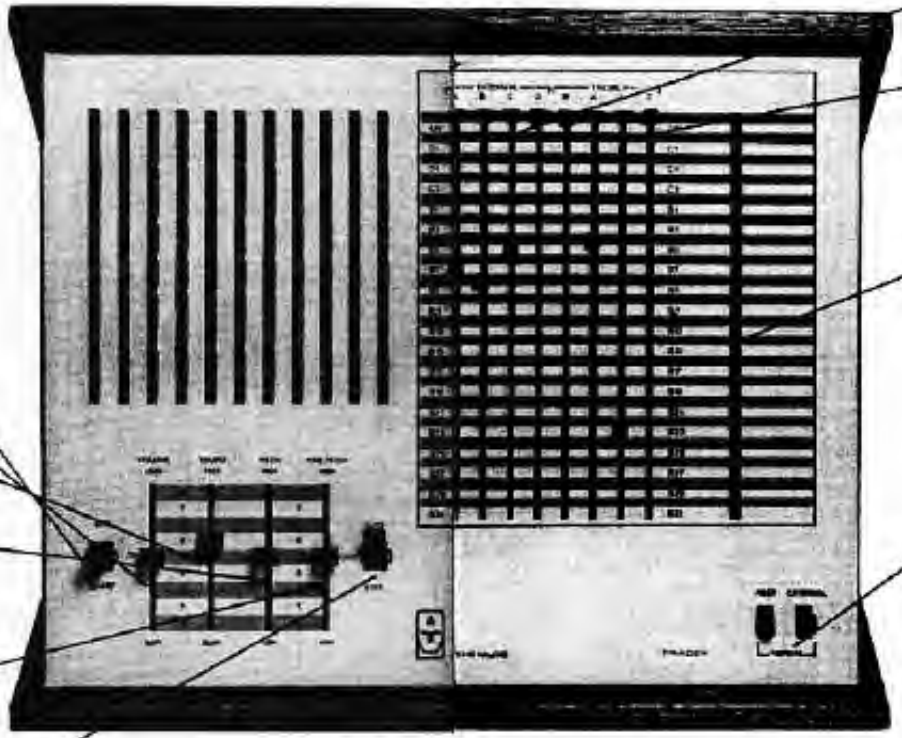
Volume. Upward for loud, down for soft.

Tempo. Upward for very fast, down for slow.

Pitch. Upward for high soprano, down for bass. If you move the Pitch switch rapidly while the Muse is playing, you can get many unusual siren effects. Moving it slowly while the Muse is playing is a good way to get most people to leave the room.

Fine Pitch. This is for making delicate adjustments of pitch. Mainly for use when playing the Muse with other instruments.

Auto-Hold-Step. Should normally be up in the Auto position for general use. Placed in the center or Hold position, the Muse will instantly stop wherever it is in the music. By pressing it down to the Step position, the Muse will play one note at a time. Note: try pressing down to Step many times. You are now controlling the Muse's playing by yourself, which means you can play any rhythm you can "tap" on the switch.



Composer Section

Interval. Switches A, B, C, and D. These control the notes to be used in a particular composition.

Theme. Switches W, X, Y, and Z. These switches, particularly when placed in the B-regions (corresponding to the green lights) create complex and intricate variations on a basic melody.

Indicator lights, blue and green. The lights represent the three regions: Off/On, the C region (blue), and the B region. (green) Each row, and its light, represents one position for the Composer switches. The various positions are *off* or *on* as indicated by the lights being *off* or *on*. Any Composer switch will be *on* at any given moment when its corresponding light is on.

Rest and External Switches. The Rest switch, when in the up or Rest position, introduces silent pauses in the development of your composition, in place of the lowest note. Many, but not all, tunes are improved by this.
The External switch should be kept in the Normal position.

Accessories

External Amplifier/Speaker. This single unit brings an added depth of sound, and a new dimension of effects which you can have your Muse produce.

Amplifier/Speaker Extension Cord.

The Light Show. See the music you create on your Muse expressed in color and motion, with light. The colors are not the ordinary meaningless psychedelic effects found in other popular gadgets, but depend precisely on what musical notes are being played. Less spectacular, perhaps, but more meaningful. The Light Show makes your Muse-ings that much more fascinating.

Inter-Muse Cable and Adapter. These enable you to connect two or more Muses together for greater depth in musical expression. (See page 17 for Recipe Charts of Multi-Muse compositions.)

All Muse accessories are available where you bought your Muse or by writing direct to Triadex, Inc.

TITLE	INTERVAL				THEME				Volume	Tempo	Pitch	Rest
	A	B	C	D	W	X	Y	Z				
The Crazy Cuckoo	C-1	B-1	B-31	C-8	OFF	OFF	B-1	B-31	4	6	5	Normal
Michael's Tune	B-7	B-8	B-5	OFF	OFF	B-4	B-23	OFF	4	5	4	Normal
Birds	B-1 B-28	B-2 B-29	B-3 B-30	C-4 B-30	B-30	B-31	B-31	B-31	6	8	8	Normal
Dorian Muse	ON	B-1	B-3	C-8	B-1	B-16	OFF	OFF	5	4	4	Normal
Mesopotamia	C-2	B-5	B-9	OFF	C-8	B-9	B-24	C-4	5	6	5	Normal
Muser's Waltz	B-10	B-8	B-7	OFF	ON	C-4	B-1	B-2	5	4	4	Normal
Swiss Yodeler	B-8	C-1	B-16	OFF	B-22	B-21	B-16	OFF	5	5	4	Normal
Ron's Rhapsody	B-6	B-9	B-6	C-½	B-31	C-4	OFF	C-8	6	8	5	Rest On
Christmas Bells	B-31	B-30	B-29	B-28	B-28	B-29	B-30	B-31	5	4	3	Normal
Marvin's Yodel	B-1	B-17	B-9	B-25	B-16	OFF	B-15	C-1	6	4	4	Rest On
Federal Row	B-14	B-5	B-12	B-2	B-21	B-24	C-2	OFF	5	5	5	Normal
Al's Surprise	B-1	B-5	B-7	C-½	C-8	B-1	B-7	B-11	5	4	4	Normal
Meditation	B-1	B-31	B-14	OFF	OFF	OFF	B-16	B-31	4	4	4	Normal
Flat Baroque	C-1	B-15	B-1	C-½	B-30	B-29	B-24	OFF	5	5	3	Rest
Polka	B-1	B-13	B-11	C-½	C-8	B-11	B-7	B-1	6	5	5	Rest

Muse Music Recipe Charts

Here are the settings for some of the Muse music we have found to be interesting. Simply position the switches on your Muse as indicated.

There are also many more blank charts for you to fill in with settings for any of your compositions you might want to play later.

TITLE	INTERVAL				THEME				Volume	Tempo	Pitch	Rest
	A	B	C	D	W	X	Y	Z				
Rhyming Couplets	B1	B2	C4	C8	OFF	OFF	B31	C4	5	3,4,5	3-6	OFF
yodle	C8	B2	B5	B6	OFF	OFF	B1	B31	5	5	5	OFF

Multi-Muse Recipe Charts

TITLE	INTERVAL				THEME				Volume	Tempo	Pitch	Rest
	A	B	C	D	W	X	Y	Z				
Levin's Duet BOX #1	B-1	B-9	B-17	C-8	C-3	B-31	OFF	OFF	5	5	4	Normal
BOX #2	B-1	B-24	B-9	C-8	C-3	B-31	OFF	OFF	5	5	4	Normal
Marvin's Duet Box #1	B-1	B-5	B-9	B-13	B-1	B-31	B-15	C-8	4	4	4	Rest
Box #2	B-17	B-21	B-17	C-8	B-1	B-31	B-30	C-8	4	4	4	Rest
Roger's Duet Box #1	B-11	B-1	B-4	ON	C-1	B-2	B-3	B-15	4	4	4	Normal
Box #2	B-11	B-17	B-4	C-½	C-1	B-2	B-3	B-15	4	4	4	Normal
Finder's Duet Box #1	B-10	B-9	B-7	C-½	B-17	B-31	B-1	B-9	5	4	3	Normal
Box #2	B-10	B-8	B-7	B-13	B-17	B-3	B-1	B-9	5	4	3	Normal
Blue Slur Box #1	B-1	B-2	B-3	OFF	C-1	B-1	B-2	B-3	5	4	6	Normal
Box #2	B-20	B-19	B-18	B-17	B-1	B-2	B-3	B-4	5	4	6	Normal

Multi-Muse Music

Connect two or more Muses with Inter-Muse Cable Adapter(s). The first Muse in the series will be the master. *Its controls will govern the pitch and tempo of the other Muse or Muses in the series — the "slaves."* However, all other controls (Theme, Interval, Volume, etc.) will work independently in the slaves.*

Now select one of the compositions from the Multi-Muse Recipe Chart to get an idea of the possibilities available to you.

Suggestions for when you're ready to compose on your own:

Compositions much like traditional harmony can be made by putting all the Theme switches in matching positions (e.g., all X switches at C-6, all Ys at B-31, etc.) Now put Interval switches "A" in the same position and pair Interval switches "B" and "C" in the same position respectively. (Master: B switch on C-1, C switch on C-5. Slave: B switch on C-5, and C switch on C-1).

Once you hear how this works for a start, move the various Theme and Interval switches to different positions, one or two at a time. Be sure to press *Start* each time.

To compose in the milieu of classical counterpoint, set the Theme switches identically. But, however you set the Interval switches on the Master, put them eight rows further down, respectively, on the slave. Here again, you can achieve many exciting and complex results by making careful variations . . . making sure to press *Start* after each change.

Incidentally, the compositions spelled out in these Recipes are just a few of the ones we have discovered while testing the Muse to see what it could do. There are millions more that are yet to be made.

If you come up with one that is particularly exciting, we'd be very happy to have you tell us about it. Just drop us a note with your recipe.

Who knows, you may end up being a famous Muse composer.

*Slave's External Switch must be in external

What is going on inside the Muse

Well, obviously one thing that happens in the Muse is sound generation. The Muse makes notes. That's what makes it like any conventional musical instrument.

But the other thing that is happening in there is what makes the Muse completely different. *Decisions.*

The Muse makes *choices*. It *selects* the notes to make.

In other words, the Muse is a computer.

A computer, basically, is a machine that makes choices. In billions of instances it chooses between Yes or No; On or Off. That is to say that the Muse or any computer is a *binary* device.

And this is how it works.

Notice that alongside the Interval and Theme switches of the Muse there is a column of lights — one light for each of the positions the switches can be in. These indicator lights are our window to the mind of the Muse — its *decision* making capability. By understanding why the indicator lights behave as they do, you'll understand how the Muse makes the music it does.

Once you understand that, you'll be able to predict what the Muse will play for any given set of switch positions.

Take an ordinary light bulb as a simple example of a "binary device" — because it has the potential of always being in one of two states; *on* or *off*. Digital computers (the Muse included) are nothing more than a vast system of binary devices — devices that have the potential of always being in one of two states; on or off. (They are *off* when no electricity is flowing through, and *on* when electricity does flow.)

When any one of the binary devices in the system is off (no flow) it stands for the number 0 (zero). When it's on (electricity flowing), it stands for the number 1 (one).

A single light — like one of the indicator lights — can count from 0 to 1. Not terribly far.

So what to do if you want your system to count to 2?

Add a second light.

When the first light is off and the second is on, that stands for the number two.

Okay. But if you turn the first light back on, so that now both are lighted, you have the number 3. (Light #1 is on, which stands for the number 1. Light #2 is on, which stands for the number 2. So just add them together: 1 plus 2 = 3.)

Now put a third light in the series. When it's off it stands for zero just like the others. And when it's on it represents the number 4 (four). With three lights — three binary devices — we can have our series count up to seven:

● ● ● = 0

○ ● ● = 1

● ○ ● = 2

○ ○ ● = 3

● ● ○ = 4

○ ● ○ = 5

● ○ ○ = 6

○ ○ ○ = 7

Seven just happens to be the number of musical notes in a scale. Remember? — do, re, mi, fah, sol, la, ti, do. (The "do" at the end is the same *note* as the first "do", only sounded an octave higher.)

Up to this point we have been talking about *numbers* instead of notes, but the principle is the same. While other computers harness their binary systems to numbers, the Muse harnesses *its* binary system to *notes*.

Let's go back to the three lights. When none are on, let's say that instead of standing for the *number* 0, it stands for the *note* C. When light #1 is on, it stands for the note D. When light #2 is on it stands for the note E. And so forth.

Whether your code is numbers or notes, the digital system works the same way. In a numerical code each binary device represents zero when it's off, and a number when it's on — that number, of course, depending on the light's location within the series. While in a musical code it represents a musical note, still depending on its location within the series.

Up to now we have been discussing imaginary lights standing for imaginary numbers and notes.

Now it's time to localize our discussion . . to the Muse.

The Muse — a computer.

It contains a very long series of binary devices.

The Muse's binary devices are tiny transistors that are either in a state of *on* or *off*. (Don't be confused by the row of lights on the panel — they merely *indicate* the *on*-ness or *off*-ness of the binary devices — transistors — inside.) Here's our previous example of lights and numbers, but now with notes added.

Interval Slides

A B C

● ● ● = "0" or C or "do"

0 ● ● = 1 or D or "re"

● 0 ● = 2 or E or "mi"

0 0 ● = 3 or F or "fah"

● ● 0 = 4 or G or "sol"

0 ● 0 = 5 or A or "la"

● 0 0 = 6 or B or "ti"

0 0 0 = 7 or C or "do"

Inside the Muse as you play, thousands of tiny transistors are turning on and off having specific notes generated. The transistors are governed by a clock mechanism which is in turn governed by the setting you have made on the "Tempo" switch.

But there's a lot more to it than that. The on-ing and off-ing of the transistors is further governed by the "input" you feed in. The framework you establish.

And that's the job of the Theme and Interval switches. A job which is being continually indicated by the indicator lights.

For example, let's look at the green lights in the Muse's B region. They show what is happening in a series of transistors inside. The transistors are arranged in a sort of "chain" which is controlled by the clock mechanism.

At each tick of the clock mechanism, the state — the on-ness or off-ness — of each transistor in the chain is passed on from one to the next. That's what makes the green lights almost seem to move down the panel.

But as the pattern moves down, the chain needs to get new information at its beginning. It has to be told, for instance, whether the first green light (row B-1) should be on or off during the next time around. And *that* information depends on the position of the switches. To make a very long story short, at each tick of the clock mechanism, the B-1 light will go *on* whenever (at the previous tick) the Theme switches were connected to — that is in the same row as — an even number of lights that were on.

It's that kind of activity that is going on within the Muse during any given moment.

That's how the Muse combines notes to make music. And since there are more than 14 billion possible note combinations for the Muse to use, it's making decisions or choices from an incredible variety.

In the Muse you have an instrument that has harnessed the most advanced computer technology to put notes together in virtually unlimited ways.

That's why the Muse is so intriguing. It's almost impossible for you to exhaust its possibilities.

Almost...

The Muse

By Triadex, Incorporated

Triadex, Incorporated,
1238 Chestnut Street, Newton Upper Falls, Massachusetts

PRICE $2.00

TRIADEX
INC

"MUSE"

COMPUTER
MUSICAL
SYNTHESIZER

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

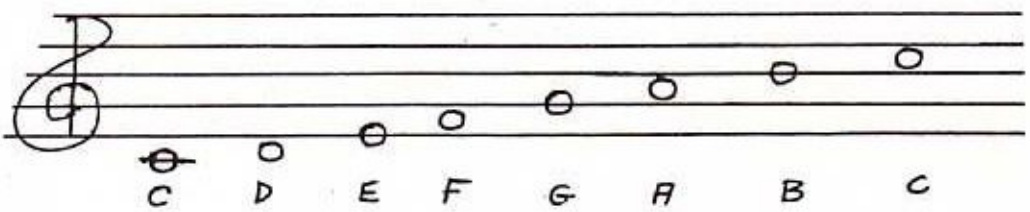
This can be accomplished for any setting of the slide switches and for any length tune. Verification of predictions can be made by activating the "Muse". The reverse process of picking slide switch positions to generate a selected pattern becomes a cut and try method, and the interested programmer will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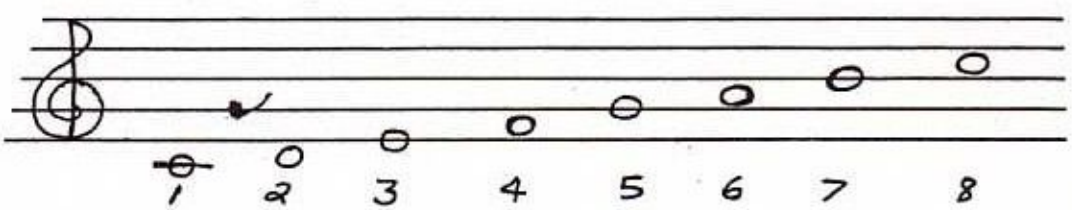
The notes of the scale can be referred to by number:



Example:

D is the second note of the C scale.

A is the sixth note of the C scale.

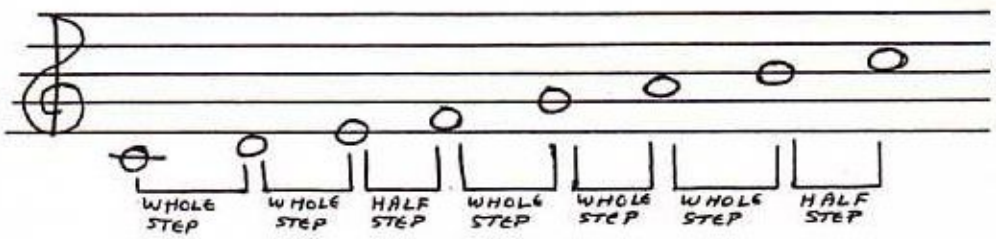
INTERVALS

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.



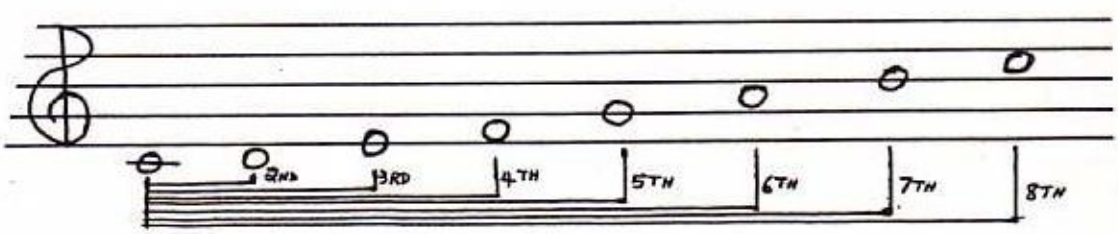
Example: The distance between D and E is a whole step in the Key of C.

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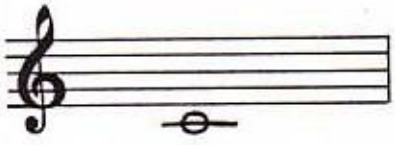
The Muse generates the first note of a major scale if all the interval slides are at Off or have zeroes:

A B C D

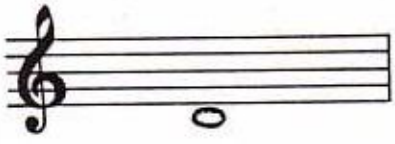
0 0 0 0



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

A B C D

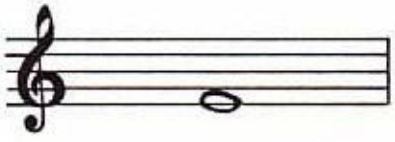
1 0 0 0



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

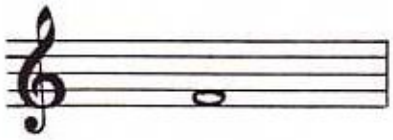
0 1 0 0



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

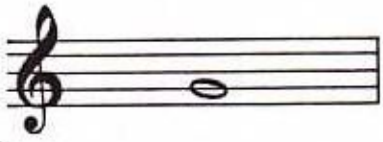
1 1 0 0



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:

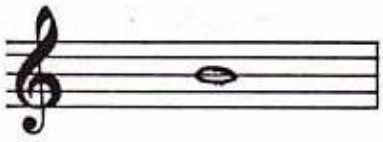
A B C D

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

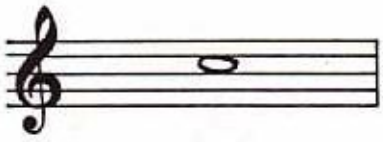
0 1 1 0



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

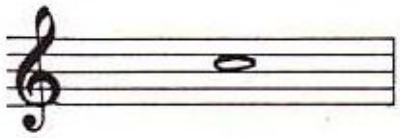
1 1 1 0



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:

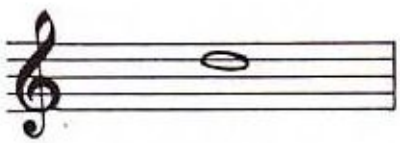
A B C D

0 0 0 1

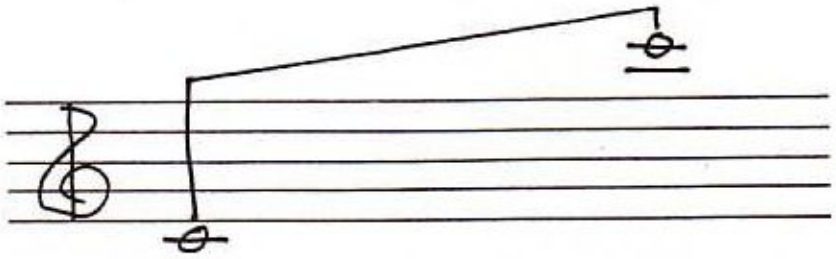


A B C D

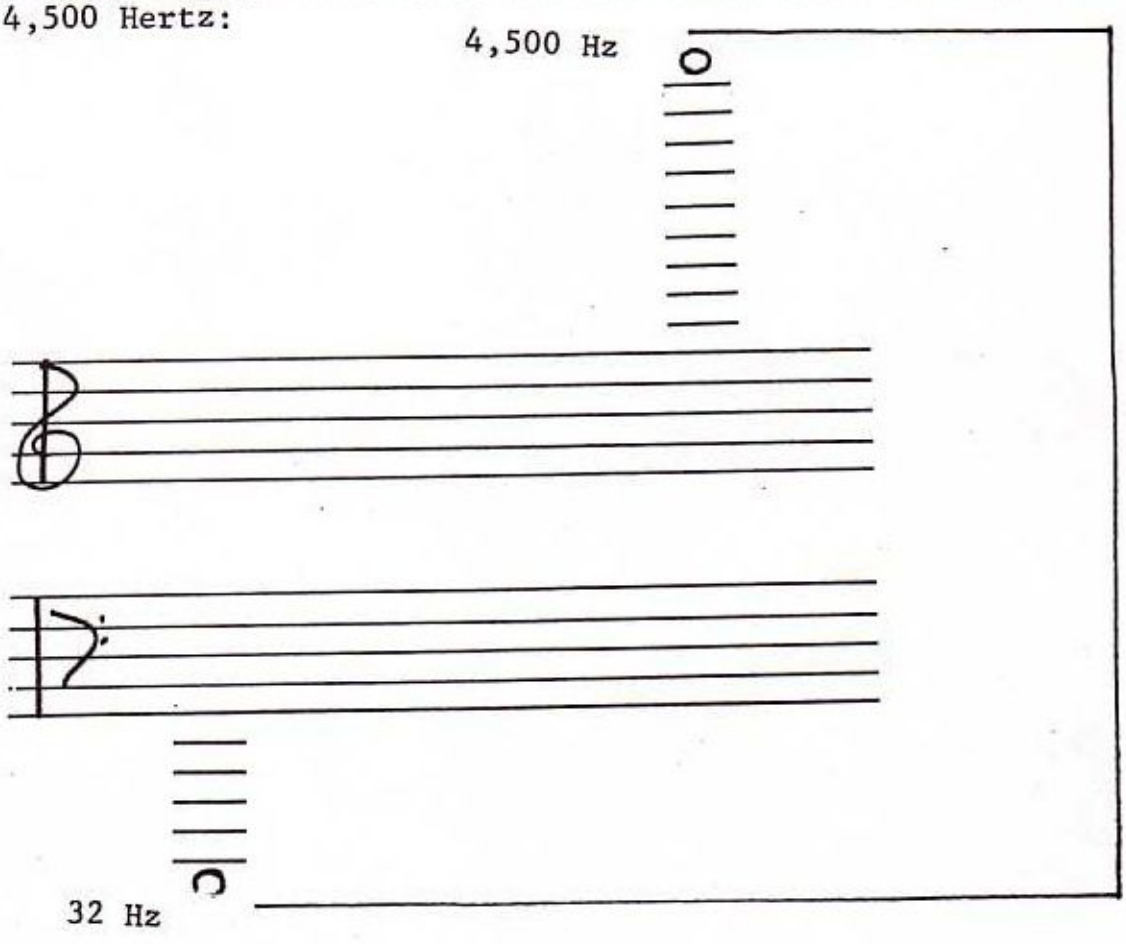
1 0 0 1



In this way a two octave range is available:



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

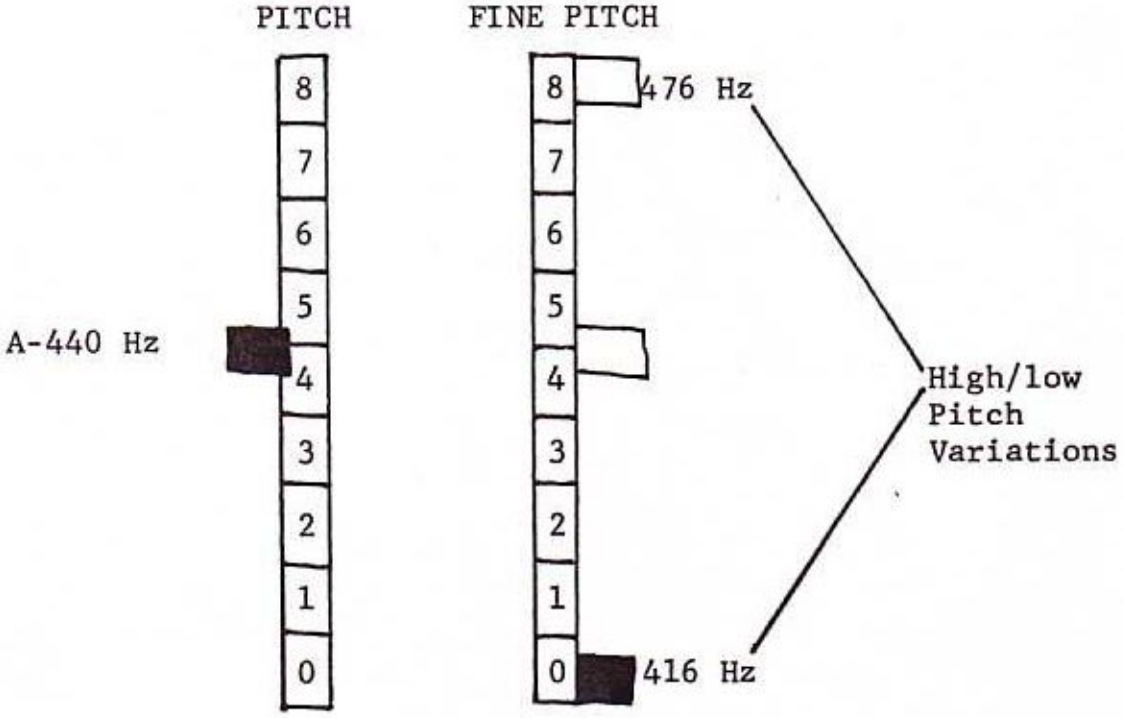


In relationship to a piano, it is over seven octaves.

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

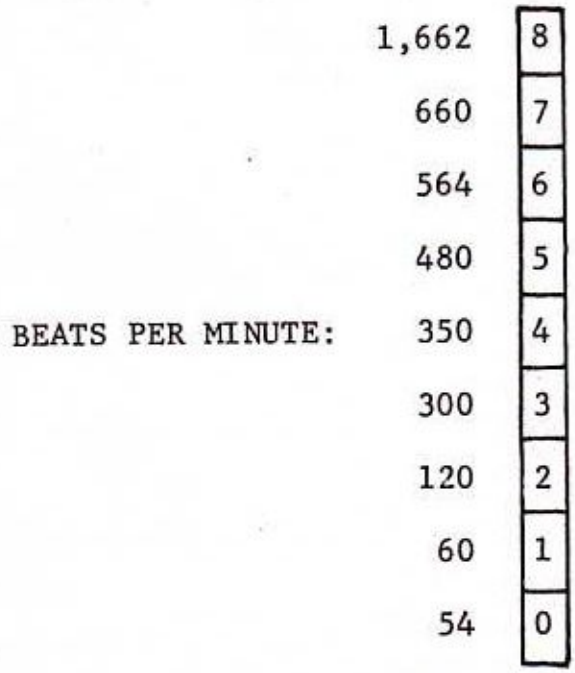
FINE PITCH CONTROL SLIDE:

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



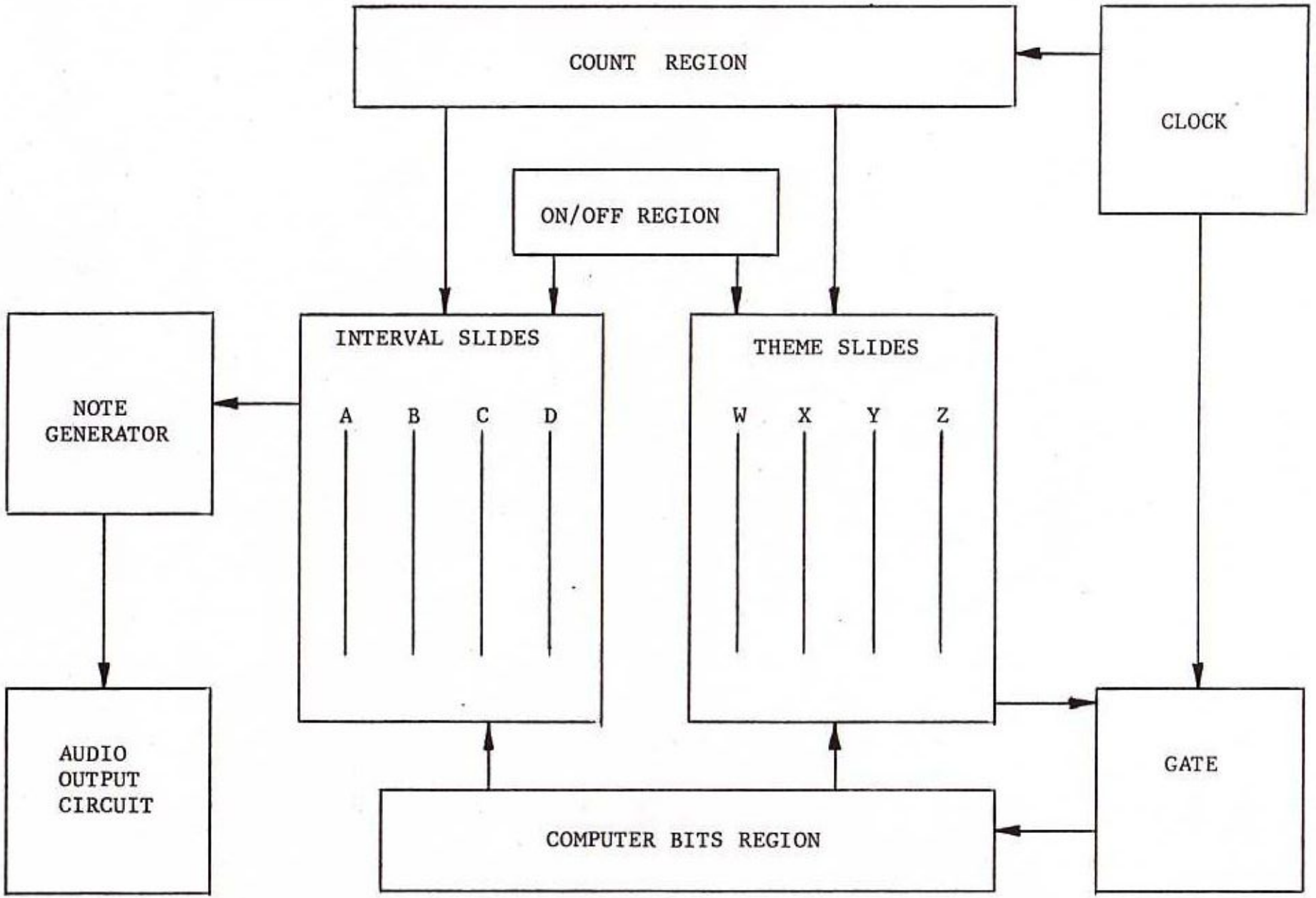
TEMPO SLIDE CONTROL SETTINGS CHART:

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



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