MORE INFORMATION ON THE SOUND SYNTHESIZER

By: Chuck Thomka

Whenever "RESET" is pushed, the &16 to &23 registers are set to fixed values. This also happens at POWER TURN ON. &16 is set to 71 and &17 through &23 are set to zero.

Since pushing most keys on the keypad will generate a sound, one of the voices must be used. This means that since most keys have unique tones when pushed, they must be loading unique values into one or more of the registers. The voice used is the 'A' counter. Each key, when pushed, puts a value into the &17 register that the 'A' counter will count up to. It also will put value 15 into the &22 register, that will adjust the 'A' volume to maximum so that the resultant frequency can be heard. At the end of the time of outputting the tone the &17 and &22 are both put back to zero.

At anytime that the computer is stopped, the &16 register will be set to 71, and &17 and &22 will be set to zero. This may affect some results of sound effects in programs where you want those registers to be left at some other values. All the other registers will be as they were last adjusted to, so remember this if you still have a tone or noise remaining on after the computer has stopped.

Later in this article is a table of all the sound generating keys, their &17 values, the resultant frequencies, and any special notes about them.

The keys that do not generate sounds are ÷, X, + and -. These keys will modify the sounds created by the other keys if the modifying keys are used just prior to the normal sound keys.

The ÷ (divide) key will make the sound one octave lower in frequency than normal. This is done by temporarily making the master counter &16 count twice as far. So while &16 is normally at 71, for this one note, it will be set to 143. As soon as the note has finished &16 will again return to 71 unless the next note is also preceeded by a ÷.

The X (multiply) key will make the sound one octave higher in frequency. This is done by making &16 equal 35 for the time the concerned note is sounding. At the end of which, &16 will again return to 71.

The + (plus) and - (minus) keys are only used in conjunction with the numbers 1 through 7. This was arranged so that the plus and minus sign would be meaningful in playing musical sharps or flats in the Bally mentioned 3 octave musical scale.

Another thing to mention is the "Note Timer" or NT; for each number of NT, the notes played will be approximately 17 milliseconds long. An NT=Ø results in no sound, while the maximum number of NT=255 results in about a 4.335 second (.017X255=4.335) note. It is interesting to observe the effect of printing a character on the TV that is followed by a Ø. The "player piano" program in the Bally Programmed Instruction Course uses the Ø (zero) to extend the duration of a played note. How it does this, (for only the one note to be played) it takes the note timer and increases it an additional NT quantity for each Ø following the note to be

heard. For example, say we are to play a note while the NT=10, and that this note is followed by 3 zeros, the resultant NT will be 40. After playing that modified NT, the NT will again return to normal (10, in this example) until called upon again.

A funny thing about this method of extending the duration of a played note is that you still cannot play any note longer than 4.335 seconds. This is because if you had a note timer extended by way of using zeros after a printed character, and it would result in an NT>255, the final result would probably be less than 255. To explain what I mean, you have to know about binary numbers and that the NT register is only 8 bits wide. If, for example, we had an NT of 50 and that some program that we are running is to print a character followed by 5 zeros, we would expect a temporary NT result of 300 (1+5=6,6X50=300) but an 8 bit register's maximum bit count is only 255, while a binary conversion of decimal 300 requires 9 bits (1 0010 1100). The result is that only the least 8 bits (0010 1100) will be loaded into the NT register, so NT will temporarily be 44. This, you see is a lot shorter than we had at first expected and even shorter than the normal NT of 50.

Finishing up, I am now giving you a table of all the possible frequencies generated by printing to the TV, the characters that will create them and also resultant frequencies if the character is preceeded by a ÷ or X sign.

&(17) VALUE	CHARACTER(S)	RESULTANT FREQUENCY NORMAL &(16)=71	÷ PREFIX &(16)=143	× PREFIX &(16)=35
225	!	54.63 Hz	27.32 Hz	109.26 Hz
212	"	57.97	28.98	115.93
200	#	61.43	30.71	122.85
189	$	64.98	32.49	129.97
178	%	68.98	34.49	137.95
168	&	73.06	36.53	146.12
159	' (APOST.)	77.17	38.58	154.34
150	(	81.77	40.88	163.53
141	)	86.95	43.47	173.90
133	*	92.14	46.07	184.28
119	, (COMMA)	102.89	51.45	205.78
106	. (PERIOD)	115.39	57.70	230.78
100	/ Y -1	122.25	61.12	244.49
94	Z 1	129.97	64.98	259.93
89	[+1 -2	137.19	68.59	274.37
84	\ 2	145.26	72.63	290.51
79	] +2 -3	154.34	77.17	308.67
74	↑ 3	164.62	82.31	329.25
70	← 4	173.90	86.95	347.80
66	↓ +4	184.28	92.14	368.56
62	→ 5	195.98	97.99	391.96
59	+5 -6	205.78	102.89	411.56
55	6	220.48	110.24	440.96
52	+6 -7	232.96	116.48	465.92
49	7	246.94	123.47	493.87
46	+7 8	262.70	131.35	525.40
44	9	274.37	137.19	548.75
41	:	293.97	146.99	587.94
39	;	308.67	154.34	617.34

&(17) VALUE	CHARACTER(S)	RESULTANT FREQUENCY NORMAL &(16)=71	÷ PREFIX &(16)=143	× PREFIX &(16)=35
37	<	324.92 Hz	162.46 Hz	649.83 Hz
34	=	352.77	176.38	705.53
32	>	374.15	187.07	748.29
31	?	385.84	192.92	771.68
29	@	411.56	205.78	823.12
27	A	440.96	220.48	881.91
26	B	457.29	228.64	914.58
24	C	493.87	246.94	987.74
23	D	514.45	257.23	1028.90
21	E	561.22	280.61	1122.44
20	F	587.94	293.97	1175.89
19	G	617.34	308.67	1234.68
18	H	649.83	324.92	1299.66
17	I	685.93	342.97	1371.87
16	J	726.28	363.14	1452.57
15	K	771.68	385.84	1543.35
14	L	823.12	411.56	1646.24
13	M	881.91	440.96	1763.83
11	N	1028.90	514.45	2057.80
10	O	1122.44	561.22	2244.87
9	P	1234.68	617.34	2469.36
8	Q	1371.87	685.93	2743.73
7	R	1543.35	771.68	3086.70
6	S	1763.83	881.91	3527.66
5	T	2057.80	1028.90	4115.60
4	U	2469.36	1234.68	4938.72
3	V	3086.70	1543.35	6173.40
2	W	4115.60	2057.80	8231.20
1	X	6173.40	3086.70	12346.81

		RESULTANT FREQUENCY		
		NORMAL	÷ PREFIX	X PREFIX
&(17) VALUE	CHARACTER(S)	&(16)=71	&(16)=143	&(16)=35
225	!	54.63 HZ	27.32 HZ	109.26 HZ
212	"	57.97	28.98	115.93
200	#	61.43	30.71	122.85
189	$	64.98	32.49	129.97
178	%	68.98	34.49	137.95
168	&	73.06	36.53	146.12
159	' (APOST.)	77.17	38.58	154.34
150	(	81.77	40.88	163.53
141	)	86.95	43.47	173.90
133	*	92.14	46.07	184.28
119	, (COMMA)	102.89	51.45	205.78
106	. (PERIOD)	115.39	57.70	230.78
100	/ Y -1	122.25	61.12	244.49
94	Z 1	129.97	64.98	259.93
89	[+1 -2	137.19	68.59	274.37
84	\ 2	145.26	72.63	290.51
79	] +2 -3	154.34	77.17	308.67
74	↑ 3	164.62	82.31	329.25
70	← 4	173.90	86.95	347.80
66	↓ +4	184.28	92.14	368.56
62	→ 5	195.98	97.99	391.96
59	+5 -6	205.78	102.89	411.56
55	6	220.48	110.24	440.96
52	+6 -7	232.96	116.48	465.92
49	7	246.94	123.47	493.87
46	+7 8	262.70	131.35	525.40

		RESULTANT FREQUENCY		
		NORMAL	÷ PREFIX	X PREFIX
&(17) VALUE	CHARACTER(S)	&(16)=71	&(16)=143	&(16)=35
44	9	274.37 HZ	137.19 HZ	548.75 HZ
41	:	293.97	146.99	587.94
39	;	308.67	154.34	617.34
37	<	324.92	162.46	649.83
34	=	352.77	176.38	705.53
32	>	374.15	187.07	748.29
31	?	385.84	192.92	771.68
29	@	411.56	205.78	823.12
27	A	440.96	220.48	881.91
26	B	457.29	228.64	914.58
24	C	493.87	246.94	987.74
23	D	514.45	257.23	1028.90
21	E	561.22	280.61	1122.44
20	F	587.94	293.97	1175.89
19	G	617.34	308.67	1234.68
18	H	649.83	324.92	1299.66
17	I	685.93	342.97	1371.87
16	J	726.28	363.14	1452.57
15	K	771.68	385.84	1543.35
14	L	823.12	411.56	1646.24
13	M	881.91	440.96	1763.83
11	N	1028.90	514.45	2057.80
10	O	1122.44	561.22	2244.87
9	P	1234.68	617.34	2469.36
8	Q	1371.87	685.93	2743.73
7	R	1543.35	771.68	3086.70

		RESULTANT FREQUENCY		
		NORMAL	÷PREFIX	x PREFIX
&(17) VALUE	CHARACTER(S)	&(16) = 71	&(16) = 143	&(16) = 35
6	S	1763.83 HZ.	881.91 HZ.	3527.66 HZ
5	T	2057.80	1028.90	4115.60
4	U	2469.36	1234.68	4938.72
3	V	3086.70	1543.35	6173.40
2	W	4115.60	2057.80	8231.20
1	X	6173.40	3086.70	12346.81