THE MUSIC CASSETTE
a technical description

by Scot L. Norris

The music cassette is an easy way to write music on the Bally Arcade. In fact, one needs to know nothing about music to use the Music Cassette. At present, the beginner who want to simply write and hear music, and the advanced user, who wants complex SOUNDS (not just music) can write music (in the broad sense) from the comfort of their easy chair; thanks to gun control 1, which has almost all the editing functions on it. And if your easy chair is close to the keyboard, all the functions of the Music Cassette are at your fingertips. The ~~knowledge and variety available~~ to the user is as deep as all the musical sounds ever heard.

The operation of this cassette for music writing, with the exception of rests, can be be done entirely from gun control 1. Joystick 1 controls the location of the note on the staves (the lines on the screen). The note currently being worked on is flashed on and off the screen. The trigger inserts the note into the score at the location specified by the joystick. The note will then remain after the cursor (the flashing note) is moved away.

The Arcade allows three-note chords. That is, three notes on any imaginary vertical line. Twisting pot 1 displays the different note durations at the cursor, as well as sharped notes. Starting at the left and twisting right, the first note encountered
is an eighth note (♪),
then a sharped eighth note (#♪),
a dotted eighth note (♪.),
and a sharped, dotted eighth note (#♪.).
The sequence is repeated for
quarter notes (♩, #♩, ♩., #♩.),
half notes (𝅗𝅥, #𝅗𝅥, 𝅗𝅥., #𝅗𝅥.),
but, just two whole notes, (𝅝, #𝅝).
At the far left end of the Pot is a "P" for "play" and at the right end a "D" for "delete".

Pulling the trigger with the "P" displayed will play the current music in memory, while placing the "D" on a note and pulling the trigger will delete that note from the score.

The program has several features worth "note-ing". As each note is entered, the program plays the entire chord ~~that note.~~ ~~is in~~ When the last chord is still being played and the trigger is pulled for the next chord, the next chord may not sound because of the last chord not being finished. Set the tempo faster (see pot 2) to alleviate this problem. Delete also plays the remaining chord after deleting the required note. If no note is found to delete, the existing chord is played as written.

One way to hear a small section of music is to find a staff line that has no notes on it and place the cursor on "D", then moving the cursor right and pulling the trigger will give the general flow of a portion of music. Another way to hear just part of a song is to use the Partial Play option from the keyboard. When "PP" is set, the music cassette will only play 5 chords from the current cursor location. Conveniently, if the cursor is on the left or first displayed chord, the currently displayed screen is played. During playback mode, the left-most chord on the screen is the chord currently being played so the user can see what lies ahead in the next four notes.

Another feature is the scrolling notes. Since the screen only has room for five chords, the screen is actually a "window" into the score. "Bumping" the right edge (brings the next note onto the screen or leaves room for one more note at the right end of the screen, dropping the left-most note or chord off the screen. Similiarly, moving the cursor, or cursoring, (not CURSING) against the left edge scrolls the music towards the beginning of the score. While cursoring, one notices a space between the first note and the left edge of the screen. In fact, each pair of chords has a space between them. This space is for the auto-insert mode.

To insert a note between two chords, place the appropriate cursor-note between the desired chords and pull the trigger. The program will move the notes over, and display the new note one step to right of where the old cursor was located.

The music cassette lets the user choose the speed by twisting pot 2 to the desired value. A tempo setting of one though five (1-5) is too fast for the notes to scroll with the the music, so scrolling will not occur, but the music will continue to speed up. Fast tempos create tremendous effects.

The tempo setting is in sixtieths (1/60) of a second. If the tempo is set at 1, a sixteenth note (𝅘𝅥𝅯), if it were available, would be one "tick" or one-sixteenth of a second long. An eighth note (♪), the shortest note available, is then two ticks long. A "dot" makes the note one-half longer then before, so dotted eighth note is three ticks long if the tempo was set to 1. Quarter notes are four ticks, dotted quarters are six ticks, half notes are eight ticks, dotted half notes are twelve ticks, and a whole note is sixteen ticks long.

In tabular form, if the tempo setting equals 't',

WRITTEN NOTE	VISIBLE NOTE	DURATION f(t)
EIGHT	♪	2t
DOTTED-EIGHT	♪.	3t
QUARTER	♩	4t
DOTTED-QUARTER	♩.	6t
HALF	𝅗𝅥	8t
DOTTED-HALF	𝅗𝅥.	12t
WHOLE	𝅝	16t

Where an eighth note is two times the tempo setting 't' in length. The tempo 't' can vary from 1 to 63.

Gun control 1 has different features while a song in playing. Pot 1 controls the pitch or Master Oscillator (MO). Pulling the trigger toggles pot 1 over to controlling the vibrato (VI). Pulling it again toggles back to the (MO). Or more simply, trigger 1 toggles Pot 1 between the Master Oscillator and VIbrato. When controlling the vibrato, there are 64 depth settings (0-63), and 4 speed setting, 0 being the fastest, 3, is the slowest. To change a speed setting, one must walk thru all the depth settings, as 263, speed=2, depth=63 is directly before 300, speed=3, depth=0.
Joystick 1 controls the volume (under MS) during the played score. When a score is not being played, gun control 1 controls the editing features as described before; so there are also keyboard buttons to control the functions that gun 1 controls during play mode. The buttons from the keyboard function during editing or during a song.

Pot 2 controls the tempo (TM) and toggles on the trigger to the Noise (NO). Joystick 2 controls the Master Oscillator Setting (MS). The MS is a complex interaction between the MO, the VIbs, and the NOise. The interaction will be explained after the video display of the gun control information is made clearer.

On the bottom of the TV screen is a display as follows:

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MO  VI  TM  NO  MS
000 000 000 000 000    ALIGN
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Where:

MO = Master Oscillstor, 0 to 255
VI = VIbrato, left-most digit is speed of vibrato,
and the right 2 digits are depth of the vibrato.
TM = Tempo, ranged 1 to 63
NO = Noise, 0 to 255
MS = Master Oscillator Setting AND volumes, with the
right 2 digits being the volumes 0 to 15,
as in the vibrato example,
and the left digit is a code
for the interaction of the MO, NO, and VI.
The line above these two lines of numerical display is an information line that will be discussed later.

The interaction between the MO, VIbs, and the NOise is controlled by the Master Oscillator Setting (MS) described as follows:

An MS of 0 causes the MO to be modulated (summed) with the depth portion of the vibrato at a speed set by speed portion of the vibrato. The values going out are:
MO, MO+VI, MO, MO+VI, ...

An MS of 1 causes the noise generator to be summed into the MO according to the level in the NO display. This is called frequency modulated or FM noise. In this case, the values going out are:
MO+NO, MO-NO, MO+NO, MO-NO, ...

A MS of 2 allows vibrato modulation with white noise or Amplitude Modulated (AM) noise, which is not related to pitch. In reality, the NOise generator value goes straight to the speaker.

A MS of 3 has FM noise with AM noise.
The realm of exciting and rich sounds lies in the MS selecting the modulation of various values with the MO. One other note, when summing a value with the MO, a 'wrap-around' occurs at 256, which becomes 0. So an MO=3 and an NO=8 with MS=1 or 3 produces a very deep, noisy sound and some high tones because of wrap-around.

The keyboard is currently capable of entering any note thru that would be from gun control 1. The C, C#, ... F# are the 12 available notes. The 1,2, and 3 are the 3 octave range in the staves. The 1/8, 1/4, 1/2, and 'whole' are the 4 basic notes with the dot added to each on a different key. The major difference between the keyboard and the gun control is in the manner in which the notes are entered.

The keyboard enters notes in a melodic sequence, that is, when a note is entered, the cursor moves to the next

vertical chord location laterally left. In this manner a song can be entered as a melody line, then a 1st harmony line, then a second harmony line. Thus, the three keys 'Master, 1st, and 2nd' are for melody line or Master note, then 1st slave to the master, or 1st harmony note, then 2nd slave or 2nd harmony note.

Similiarly, if the 2nd slave is being worked on from the keyboard, "DEL" or delete will only delete the 2nd slave in the chord, not any other notes. If the Master in being worked on, the Master is deleted,, and the first slave becomes the new master, if it existed, otherwise the cursor is moved to the next chord, still on the master. Large amounts of score can be deleted by holding the DEL key down and deleting master after master.

The information line on the screen, not the pot-status line, but above it, contains an M,1, or 2 for the note currently being inserted or deleted. The cursor does not need to be on top of the note to delete, because the current Master, Slave1, or Slave2 is chosen.

The other ~~manner item that differs for~~ difference between the keyboard ~~from~~ and the gun control, is ~~t~~ the note to be entered must be "built" ~~before~~ hat it is entered. For example, entering a G# in the top or 3rd octave as a dotted half-note is entered as follows:

3 - move to octave 3. The cursor will jump to the highest octave.

1/2 - make the cursor a half-note.

dot - add the dot to the half-note

At this point, the cursor is somewhere in the highest octave and is flashing a dotted half-note.

G# - choose a G# in this octave with the current cursor features.

The note G thru F# is the "~~t~~rigger" to the program to enter the current note. The 'octave' keys can be depressed anywhere in the sequence before the note is entered. The 'dot' must be added after one of the durations 1/8 to 'whole' is entered. Any errors in setting up a note can be retyped, ~~like~~ If a 2 was mistakenly punched, just punch a 3 before entering the note. Where this method really gains speed is ~~that~~ generally, several notes in the same octave and of the same duration are together in a score, so only the new note to be entered has to be typed, since the cursor has already move to the next chord.

Rests are implemented in a simple manner. Anywhere in the note building process the "REST" key can make the following notes rests. Placing a note into the score does not remove the rest from the cursor, so many rests can be placed in a row. To remove the rest, hit the "REST" key again, as it toggles between rests and notes. Incidentally,

the note entered, G thru F#, is disregarded in the playing of the tune. However, the display does not disregard the note. A rest note is displayed as an "R" displaced slightly above and right of the note entered, so the user can move the rests away from the rest of the score.

Other keyboard functions include:

HALT, which will halt a song in progress;

PARTIAL, which will play part of a song, as previously described;

A DECAY button which goes from Legato, or smooth notes, to Staccato, or chopped short notes, to an envelope control with an attack, decay, sustain, structure, and then back to legato notes;

MS0, MS1, MS2, and MS3, which set the Master Oscillator Setting;

There are rapid left & rapid right movement buttons, <-- and -->, to facilitate moving quickly through large scores;

LOAD and STORE buttons for a future audio cassette interface;

A "SEE DATA" on/off button which allows the user to see how much memory has been used up;

The MO-up and MO-down buttons for smooth movement of the Master Oscillator;

The VI-more and VI-less buttons for increasing and decreasing the depth and speed of the vibrato;

The VOL-up and VOL-down buttons for controlling the volume;

The "SHIFT" button which allows access to the upper commands and also produces an "S" display in the information line;

A "REPEAT" key automatically repeats a score when the end is reached, and displays "INF" for "infinite" on the information line.

and,

A "PLAY" key for starting execution of the score or part of it from the keyboard.

The information line can look like:

#NOTES 00 M INFPP @

The info line contains several important displays. The right-most display is an "@" sign for the SHIFT keyboard. Proceeding left, at first a single "P" is displayed for "Play" mode. Turning on "Partial" play adds a "P" in front of the "Play" "P". Turning "repeat" on displays "INF" in front of the "PP". In the middle of the info line is an "M". This changes to a "1" or a "2" depending on which note, Master, 1st or 2nd slave, is being looked at from the keyboard. Initially, at the left is a space for counting the notes going into the Music Generator. When turned on, it appears as "#NOTES 00".

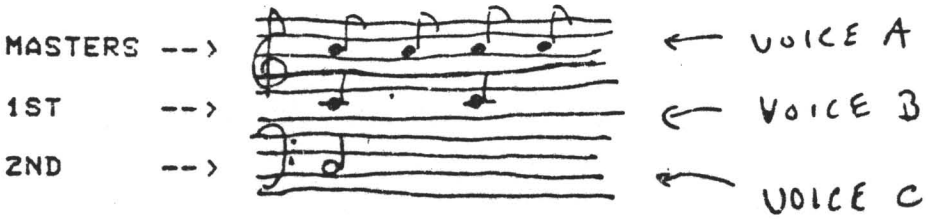
The only untrod area is the Computor Music Generator. The Music Cassette has the ability to generate its own music. The concept used is if the user tells the cassette to play a non-existent (empty) score, the cassette will generate it's own score to play. The easiest way to do this is to reset the cassette, turn Pot 1 to play, the cursored "P", and pull the trigger. Since there is no score to play, the Music Cassette will use melodic, countrapuntal, harmonic, and rhythmic rules to generate a song.

And for sport, entering PLAY off of the keyboard will allow the user to put in 12 notes to be used as the "key signature". In this case, the music generator will only pick notes from the one's the user has given it. It is also willing to generate 1,2, or 3 notes per chord if the user wants to do so. The default is three notes per chord, but before entering 12th note, press the numbers 1, 2, or 3 from the octaves and that will be the number of notes per chord generated. On the information line, "#NOTES 00" will appear to count the 12 notes the user enters.

Upon completion of the 12 notes from the keyboard, or on the trigger pull in "play" position, the Music Cassette will change colors and display "COMPOSING MUSIC" at the bottom of the screen. The color change actually shows the data of the notes being generated.

When the Music Cassette is through generating the score, it will play its composition. Its true! You don't need to know anything about music to use the Music Cassette !!

One last technical point, in order to get three different simultaneous rhythms out of the Music Cassette, the Master notes must be in the sequence of notes that needs to be refreshed. For example, the score:



Where voice A (arbitrarily chosen) is the medody consisting of all eighth notes. Voice B is a harmony line made of quarter notes. And Voice C is a bass line of half notes. To do this correctly, the eighth notes must be made the masters so that

THE MASTER MUST EXPIRE TO REPLACE ANY EXPIRED NOTES.

In this case, the eighth notes must expire to replace the quarter and half notes. If, for example, a half note was the master, then when the eighth note "ran out" of time, it would be silent for the remainder of the half note, that is, until the master expired. Similiarly, the quarter note would be silent for the last half of the half note. Of course, one can use this to an advantage as part of a "built-in rest", and it saves space; but a listener may be confused as to what has transpired when watching a score play, since what the ear hears, the eye does not see.

The intention of this manual is to explain the features of the Music Cassette. This manual is not intended to be music instruction. I hope that it is satisfactory for your specific purposes. Please get back to me with any ideas, comments, or criticisms that you may have.

SINCERELY,

Scott L. Norris

Scott L. Norris
Dave Nutting Assoc.
(212) 956-0710

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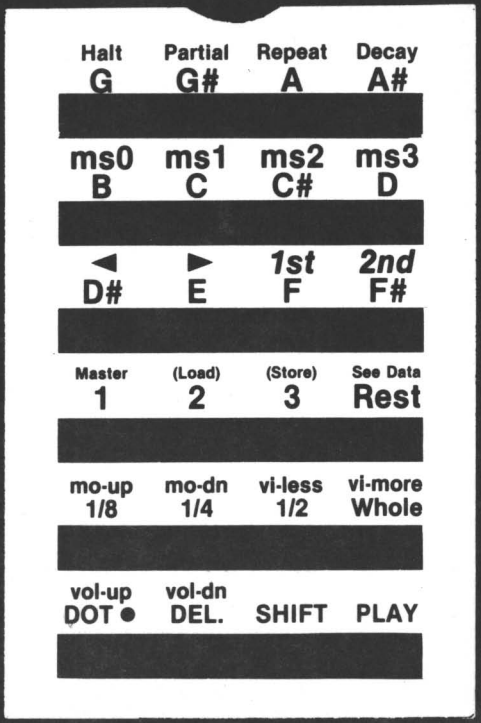
Halt
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Partial
G#
Repeat
A
Decay
A#
ms0
B
ms1
C
ms2
C#
ms3
D
◄
D#
►
E
1st
F
2nd
F#
Master
1
(Load)
2
(Store)
3
See Data
Rest
mo-up
1/8
mo-dn
1/4
vi-less
1/2
vi-more
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vol-dn
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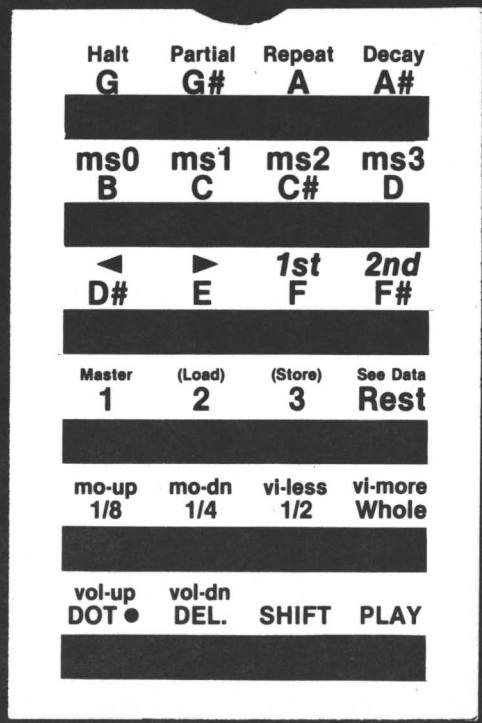
SHIFT
PLAY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