

Lab Notes

Blessed are the SEQUE.

By: John S. Simonton, Jr.

Last time, we looked at the live performance features of SEQUE 1.0. Now we turn our attention to the studio-oriented options offered by this "universal" monotonic sequencer program.

Some of the distinctions between stage and studio use are somewhat arbitrary.

For example:

EVENT PROGRAM

The real-time SCORE melody programming mode that we examined in this first section of this piece can obviously be used in a recording studio as well as it can on stage, providing that you're interested in recording only those things that are within the limits of your physical abilities. But the real promise of a small studio (or a big one, for that matter) is that it allows us to produce music that we don't have the chops to do in real time. After all, not everyone has the hours per day that it takes to gain physical mastery of a keyboard - but that doesn't mean that we don't have valid musical ideas, only that we need a little help in expressing them.

If a recording studio is a single thing, it's a time machine that allows days or weeks of work to be compressed into a few minutes of music. One of the programming modes that we have available (EVENT) is specifically designed to operate in this type of time-compression environment. In this mode we enter the music not so much as a melody, but as a series of notes and rests. A series of events which, when reproduced by the computer, turn out to be a melody (maybe).

There is of course nothing

new about this mode of operation, this is the way sequencers have always worked. About the only new part is that instead of entering the events as positions of a knob or a series of numbers, we have an AGO keyboard on which to program.

Touching the command keyboard's PROGRAM EVENT pad puts us in this programming mode. (See Figure 1.) Melody lines are entered much as they were with the SCORE mode, except that the computer is no longer watching for how long we hold a key down or how rapidly the notes are played. It is now only interested in whether a key is up or down.



Figure 1

One of the major implications of this is that notes in the melody are "jammed" together in time, and on playback will come out exactly equally

spaced, one note per beat. While this is OK in some cases, as a general rule it is unacceptable; because it is unacceptable, we have a REST pad on the command keyboard. The REST pad provides for syncopation. It is a means of "extending" an event so that it takes more than a single beat.

If you're familiar with the operation of the rest key on something like PAIA's Programmable Drum Set, you already have a good idea what's going on, but there still are some surprises here.

Your first thought may be that when you press and release a key on the AGO keyboard, that constitutes an event. Actually, it's two events as far as SEQUE 1.0 is concerned - the first when the key was pressed and the next when it was released. It's important to keep in mind that the REST pad can extend either of these events.

For example, this simple phrase:



Figure 2

would be entered from the keyboard by pressing F and releasing, press A and release, press C, release, press D, release, press F and while holding the F key down, hit the REST block on the keypad, release the F key, tap the REST block, play A, touch the rest block before letting up the A key, release the key, and hit the rest block once more. The measure is now completely entered, and may be played by using the REPEAT or SINGLE keys as described last time. Note particularly that on the fifth note (the second F)

where we wanted to extend the note to a full beat, the REST pad had to be touched twice; once to extend the "key down" event and again to extend the "key up" event.

At first, having to enter two RESTs when we actually want to extend a note for a single beat may seem a pain in the neck (undeniably, it is) but the slight inconvenience buys us a number of things. For example, the ability to slur notes.

In the above example, the D could have been slurred into the F by first touching the REST pad before releasing the D key. This will lengthen the note to occupy the time normally used when the key is released. Then press the F key before releasing the D. This will cause the D to be entered in the next time slot without any articulation (triggering). Now, while holding the F key, touch the REST pad to lengthen it to a quarter note as covered earlier. After releasing the key, enter the additional REST required and proceed as usual.

Having each REST pad activation correspond to a "half" event (kind of) also allows us to produce dotted notes as the exceptions that they are rather than having to make specific tempo provisions for them which must be carried over to all notes in the sequence.

It is also possible to generate articulation changes whenever a note is extended beyond a basic "dual" event. If, for example, you are generating a series of notes where each note uses a key depression plus a REST and a key release plus a REST (four events), these notes can be performed in three different manners. If entered as listed above, the note has equal time allotted for note performance and release. For a staccato style, the note could be entered with a key depression, release, and then two RESTs. For legato styles, the two RESTs could be entered while the key is held down, yielding three "on" events and one "off" event. Each of the above would occupy the same execution time during playback, but would reflect the different articulation styles.

Once the melody is in the computer's memory, it makes no difference whether it got there with SCORE or EVENT programming modes as far as the playback and options are concerned. All of

these features (real time or programmed transpositions, single or repeat play, tempo up and down, and tape saves or loads, etc.) work the same.

CLICK TRACK SYNC

Even more powerful in the studio than the EVENT programming mode are the features added by two other command pads; CLIK and (in the option box) SYNC. These provide a means of synchronizing multiple tracks of sequencer operation.

Once you start using a sequencer for recording, you begin to find more and more places where it can be used to relieve a lot of tedium. The problem in the past has been that it is, for all practical purposes, impossible to manually synchronize a sequencer to a track that's already on tape. Even slight differences in tempo soon build up to an intolerable variation in when a note is supposed to happen and when it actually does happen. Maybe there are people who could manually twiddle a tempo knob and keep things locked together, but that's a hassle.

Most of us are familiar with the classical "click track" approach in which a metronome-like "tick" is recorded on one track of a tape so live musicians can easily maintain the tempo of the original work in over-dubs. Our CLIK and SYNC command pads are simply this old concept extended into the realm of automation.

Touching the CLIK pad causes SEQUE 1.0 to begin producing a very rapid series of "clicks" that are machine readable and represent a standard clock rate which the SYNC option can read and synchronize to. The click appears at the normal cassette output jack (where programs, etc., that are to be saved to tape come from) and when using this option, this output is tied to one of the channels of the tape recorder on which you're recording your audio tracks.

To use the click track option, the tape that you will be recording and mixing your audio onto must always be prepared first; you can't record a lead part and then come back and lay down the click, it won't work like that. Before doing anything else, connect the 8700's cassette output to the input of one track

of your recorder, start the tape rolling in record mode, and after allowing a comfortable quiet leader, punch the CLIK pad. Allow the tape to run much longer than you think you'll ever need for what you're going to be recording, one thing you don't want to do is run out of click in the middle of things.

Synchronizing to the click track is simply a matter of connecting the output of the tape channel that contains the click to the normal cassette input jack of the computer, but note that some juggling of the record and playback levels of this channel may be necessary for the computer to properly write and read the channel. In many cases, unless your recorder is capable of providing very high outputs (similar to the earphone levels from the cassette recorders which the computer was designed to work with), you may need to use a small external amp to provide the extra gain and current drive required. If your SYNC fails to respond, try using the earphone jack signal usually provided on multi-track recorders. If this doesn't provide enough power, try using a small portable practice amp (such as a Pygmy or Pignose) whose earphone output should adequately drive the cassette input jack of the computer.

Assuming that you have some rhythm sequence (ordinarily the first laid down) in the computer memory and that you're getting ready to record it as audio, proceed by first punching into the T-SEQ option (if you plan to use it) then touch the SYNC control pad. Roll the tape with the click track channel set to playback and the audio going to one of the other tracks which is naturally in record mode. Before the quiet leader ends, touch the REPT/PLAY command pad and hold it. When the click track starts, so will the sequence. When enough of the track is laid down, terminate the play mode by touching the NORMAL pad.

It is necessary to select the SYNC OPTION last in the above sequence of events because once this option is asserted, a click track must be coming in on the cassette port for the computer to recognize any further commands. If you find yourself with a "dead" computer caused by CLIK being selected with no click track present, you can either run a tape which has a click track or

reset the computer and run the program again.

In situations where the sequence is not to be played from the first down-beat, the SYNC OPTION should be enabled before rolling the tape and REPT/PLAY punched in when the time comes for the sequence to start.

A little constructive play will go a long way toward familiarizing you with the capabilities of this powerful option. Here are some we haven't mentioned yet:

You have probably already noticed the somewhat cryptic METR designations that appear in both the OPTION and TEMPO control boxes. And probably you've figured out that it means metronome (a handy thing in any studio). But this is kind of a super metronome because not only does it have a "pendulum" (which shows in the computer's twin displays) and an audible click (which you hear from the beeper) but it also provides an electrical output in the form of a short positive going pulse that appears as D7 of the D/A output channel (which in turn shows up on the Flag 2 pin jack of the D/A's front panel). This pulse is enormously useful in synchronizing external devices (a Programmable Drum Set, for example).

Since both the SYNC and METR options may be asserted at the same time, the external device can be synched to a pre-recorded audio track.

The METR pad in the TEMPO control box is obviously the tempo control for the metronome. Like the other tempo controls that we looked at last time, this one works in octaves. Each time the pad is touched the metronome tempo doubles until the maximum rate is reached, then the next touch causes the tempo to "fold back" to the minimum rate.

It may be somewhat out of sequence (?) to mention here that the tempo of the metronome is the tempo at which sequences stored in EVENT mode will play back, though of course, the TEMPO UP and DOWN command pads will also alter the tempo of the sequence once saved, as outlined last time.

Another point - When electrically synchronizing things to the click track, the METR TEMPO can still be varied to accomodate different timings, and

since it operates by outaves the integrity of the timing will be preserved.

And a hint - the metronome "beep" can also be recorded on tape to provide a "human readable" click track (though it must be saved on a different track than the CLIK).

The only other command pads that we've added are STOP/STEP (a means of stopping the sequence without "forgetting" where we were as well as single stepping through the sequence) and CONT (continue) which allows us to pick up from the point where we STOPped. This feature can provide easy introductions to songs. STOP/STEP through the piece until you reach the REST just prior to the point where the introduction should start. When the CONTINUE pad is touched, the introduction will play, leading into the

next big sequence.

I wish I had the space and time (and for that matter, knowledge) to go into some expository statements on the art of small studio multi-tracking, but I leave that to an old friend and new-comer to Polyphony's pages, Craig Anderton. I hope that Craig's and my work will complement one another in this area - I think it will.

I also wish I had the space to go into a detailed analysis of how SEQUE 1.0 works. I don't. If you're really interested, the documented assembler listing which follows is tremendously meaty (though sketchy in parts). Careful study of the code used, in conjunction with the comments given, should be valuable in learning more about software generation and execution.

SEQUE 1.0 COMMAND SUMMARY

PROGRAM		OPTIONS	
SCORE	- Saves melody sequence in real time.	TABLE	- Selects transpose sequence table as source of transpositions (otherwise AGO is source).
EVENT	Saves melody sequence as regularly spaced events.	METRONOME	-Initiates visual metronome display and a "beep".
TRANPOSE	- Saves transpose sequence as events.	SYNC.	- Shuts down internal timing and accepts pre-recorded click-track for timing information.
PLAY		CANCEL	- Turns all selected options off.
REPEAT	- Plays sequence from beginning, cycles until stopped.	TEMPO	
SINGLE	- Waits for key on AGO then plays sequence from the beginning. Stops at end of melody.	UP	- Doubles tempo of melody sequence.
STOP/STEP	- Allows stops or pauses during playback.	DOWN	- Halves tempo of melody sequence.
CONTINUE	- Starts melody playback from where you are in memory.	METRONOME	- Doubles speed of metronome display and "beep".
TAPE		MISC	
SAVE	- Dumps current Melody and Transpose sequences to mag. tape.	NORMAL	- The "normal synthesizer" mode. Does not alter stored sequences.
LOAD	- Loads M & T sequences from tape.		

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0010 *****
0020 *
0030 *          SEQUE 1.0          *
0040 *          *                  *
0050 * MONOTONIC SEQUENCER PROGRAMS *
0060 *          *                  *
0070 *          BY                  *
0080 * JOHN S. SIMONTON, JR.      *
0090 *          *                  *
0100 * (C) 1978 PAIA ELECTRONICS, INC *
0110 * ALL RIGHTS RESERVED      *
0120 *          *                  *
0130 *****
0140
0150 : DEFINE ADDRESSES OF LABELS
0160
0170 BEEP DL 1F22
0180 DECD DL 1F00
0190 CRSS DL 1EAA
0200 DBIT DL 1E49
0210 SBIT DL 1E25
0220 OUTP DL 0840
0230 DSP DL 0820
0240 KBD DL 0810
0250
0260 MTB3 DL 0303
0270 MTB2 DL 0302
0280 MTB1 DL 0301
0290 MTBL DL 0300
0300 TTBL DL 02C0
0310
0320 BUFF DL 0AF0
0330 KBUF DL 08EC
0340 PBUF DL 08EB
0350 MPNT DL 08EA
0360 TPNT DL 08E9
0370 MEND DL 08E8
0380 TEND DL 08E7
0390 TRNS DL 08E6
0400 CNTR DL 08E5
0410 TTRN DL 08E4
0420 LSTL DL 08E3
0430 STUS DL 08E2
0440 TPO DL 08E1
0450 METF DL 08E0
0460 MTRC DL 08DF
0470 DUMY DL 08D3
0480
0490
0500
0510 : OR 1000
0520
0530 STAR LDA 00 : START / RESTART
0540 STA *STUS : CANCEL OPTIONS
0550 LDA 0C : NRML COMMAND LINK
0560 STA ACTN+01 : PLACE COMMAND LINK
0570 JMP COM : JUMP TO COMMON
0580
0590 : NORMAL OPERATING MODE - DOES NOT ALTER
0600 : T-SEQUENCE OR M-SEQUENCE
0610
0620 NRML BCS NRML : FIRST PASS THROUGH
0630 STA *TRNS : ZERO TRANSPOSE
0640 STA DSP : AND DISPLAYS
0650 NRML LDA *KBUF : CHECK FOR NOTES
0660 NRML2 BNE STOR : ZERO - NO NEW KEY
0670 LDA *PBUF : SO GET OLD KEY
0680 AND 3F : CLEAR BOTH FLAGS
0690 STOR STA *PBUF : SAVE AGAIN
0700 RTS : AND RETURN
0710
0720 : PROGRAM TRANSPOSE MODE - NOTE PLAYED
0730 : IS "KILLED" WHEN KEY IS RELEASED
0740
0750 TLOD BCS TL1 : FIRST PASS, INITIALIZE
0760 STA *TRNS : ZERO TRANSPOSE FIGURE
0770 STA *PBUF : ZERO OUTPUT NOTE
0780 STA *TEND : ZERO TABLE END POINTER
0790 LDA 80 : TURN T-SEQUENCE OPTION
0800 STA *STUS : ON
0810 TL1 LDX *TEND : GET TRANSPOSE POINTER
0820 STX DSP : SHOW IT

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102F- AS EC 0830 LDA *KBUF : GET THE NOTE
1031- F0 06 0840 BEQ TL2 : ZERO- NO KEY, SAVE
1033- C5 EB 0850 CMP *PBUF : KEY SAME AS LAST?
1035- F0 05 0860 BEQ TRTN : YES - LEAVE
1037- E6 E7 0870 INC *TEND : POINT TO NEXT LOCATION
1039- 9D C0 02 0880 TL2 STA TTBL,X : SAVE TRANSPOSE
103C- 85 EB 0890 TRTN STA *PBUF : AND OUTPUT AS NOTE
103E- 60 0900 RTS : THEN RETURN
0910
0920 : PROGRAM SCORE MODE - USES REAL-TIME CLOCK
0930
103F- 20 84 11 0940 MSAY JSR MSV1 : CALL SAVE MODULE
1042- E6 E5 0950 INC *CNTR : INCREMENT THE TEMPO
1044- 60 0960 RTS : COUNTER AND RETURN
0970
0980 : CONTINUE PLAY MODE - DOES NOT RESET
0990 : M-SEQUENCE OR T-SEQUENCE POINTERS
1000
1045- 38 1010 CNTU SEC : SKIP INITIALIZATION
1020
1030 : REPEAT PLAY MODE - WHEN FIRST ENTERED
1040 : M-SEQ AND T-SEQ POINTERS ARE SET TO ZERO
1050 : BY THE PLAY MODULE (PLR1)
1060
1046- 20 AC 11 1070 RPLA JSR PLA1 : CALL PLAY MODULE
1049- AD 14 11 1080 LDA STBL+14 : WAS THE PREVIOUS MODE
104C- C5 E3 1090 CMP *LSTL : MSAY (PROG. SCORE)?
104E- D0 02 1100 BNE RPL1 : NO-SKIP INCREMENT
1050- E6 E9 1110 INC *TPNT : INC. T-SEQ POINTER
1052- 24 E2 1120 RPL1 BIT *STUS : T-SEQ ASSERTED ?
1054- 30 0A 1130 BMI ROUT : OPTION ON - LEAVE
1056- AS EC 1140 LDA *KBUF : OPTION OFF- GET NOTE
1058- F0 02 1150 BEQ OLDK : AND IF NO NOTE, BRANCH
105A- 85 E4 1160 STA *TTRN : SAVE NOTE FOR NEXT TIME
105C- AS E4 1170 OLDK LDA *TTRN : GET LAST ACTIVE NOTE
105E- 85 E6 1180 STA *TRNS : USE AS TRANSPOSE
1060- E6 E5 1190 ROUT INC *CNTR : INCREMENT TEMPO COUNTER
1062- 60 1200 RTS : AND RETURN
1210
1220 : SINGLE PLAY MODE - WAITS FOR AGO KEY
1230 : THEN PLAYS SEQUENCE ONCE THROUGH
1240 : TRANSPPOSED TO INDICATED KEY
1250
1063- 90 04 1260 SING BCC SNG1 : FIRST PASS, BRANCH
1065- AS EC 1270 LDA *KBUF : AGO KEY DOWN ?
1067- D0 D0 1280 BNE RPLA : YES - PLAY SEQUENCE
1069- 20 46 10 1290 SNG1 JSR RPLA : NO - "PLAY" THEN RETURN
106C- AS EA 1300 LDA *MPNT : M-SEQ POINTER > 0 ?
106E- D0 0B 1310 BNE SRTN : YES - RETURN
1070- A9 00 1320 LDA 00 : NO - PREPARE
1072- 85 E5 1330 STA *CNTR : ZERO TEMPO COUNTER
1074- A6 E8 1340 LDX *MEND : POINT TO LAST NOTE
1076- BD 01 03 1350 LDA MTBL,X OF M-SEQ AND GET IT
1079- 85 EB 1360 STA *PBUF : PLACE IN PLAY BUFFER
107B- 60 1370 SRTN RTS : THEN RETURN
1380
1390 : UP TEMPO AND DOWN TEMPO - COMMON PORTION
1400 : OF BOTH PROGRAMS ON PAGE 2
1410
107C- A9 7E 1420 UTMP LDA 7E : THE OP-CODE FOR ROR
107E- D0 02 1430 BNE U3E : BRANCH ALWAYS
1080- A9 3E 1440 DTMP LDA 3E : THE OP-CODE FOR ROL
1082- 4C 00 12 1450 U/D JMP TCOM : JUMP FOR THE REST
1460
1470 : REST MODE - EXTENDS NOTES OR UN-NOTES
1480 : WHEN IN PROGRAM EVENT MODE
1490
1085- 18 1500 REST CLC : PREPARE FOR ADDITION
1086- AS E5 1510 LDA *CNTR : GET TEMPO COUNTER
1088- 65 E1 1520 ADC *TPO : ADD TEMPO VALUE
108A- 85 E5 1530 STA *CNTR : PUT COUNTER BACK
108C- AS E3 1540 LDA *LSTL : AND RETURN TO
108E- 80 7B 11 1550 STA ACTN+01 : PREVIOUS OPERATING
1091- 60 1560 RTS : MODE
1570
1580 : STOP/STEP MODE - STOPS PLAY WITHOUT
1590 : CHANGING POINTERS. SINGLE STEPS THROUGH
1600 : SEQUENCE
1610
1092- B0 0E 1620 STEP BCS STP1 : NOT FIRST PASS-BRANCH
1094- A9 FF 1630 LDA FF : SET TEMPO COUNTER AT
1096- 85 E5 1640 STA *CNTR : "TIMED OUT" VALUE

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1098- 20 06 11 1650 JSR CONT CALL PART OF PLAY MODULE
1098- 0E 20 00 1660 STX DSP DISPLAY M-SEQ POINTER
1098- A9 00 1670 LDA #0 MAKE TRANSPOSE VALUE
1098- 85 E6 1680 STA *TRNS EQUAL TO ZERO
1092- 60 1690 STPL RTS AND RETURN
1700 :
1710 : PROGRAM EVENT MODE - SAVES M-SEQUENCE
1720 : BUT SUBSTITUTES EVENT CLOCK FOR REAL-TIME
1730 : CLOCK
1740 :
10A3- 00 02 1750 ESAY BCS ESI FIRST PASS, INITIALIZE
10A5- 85 E5 1760 STA *CNTR TEMPO COUNT AS ZERO
10A7- 20 04 11 1770 ESI JSR MSV1 CALL SAVE MODULE
10AA- A5 E5 1780 LDA *CNTR GET TEMPO COUNTER
10AC- D0 05 1790 BNE EOUT NO ENTRY-RETURN
10AE- 18 1800 CLC PREPARE
10AF- 65 E1 1810 ADC *TPO ADD TEMPO VALUE
10B1- 85 E5 1820 STA *CNTR SAVE AS TEMPO COUNTER
10B3- 60 1830 EOUT RTS THEN RETURN
1840 :
1850 : OPTION MENU - RETURNS TO PREVIOUS
1860 : OPERATING MODE AFTER TURNING ON OR
1870 : CANCELLING OPTIONS
1880 :
10B4- 85 E9 1890 TBLM STA *TPNT T-SEQ POINTER TO BEQ
10B6- A5 E2 1900 LDA *STUS ASSERT T-SEQ OPTION
10B8- 09 00 1910 ORA #0
10BA- D0 0E 1920 BNE MCOM BRANCH ALWAYS
10BC- A5 E2 1930 MET LDA *STUS TURN METRONOME ON
10BE- 09 40 1940 ORA #0
10B8- D0 08 1950 BNE MCOM BRANCH ALWAYS
10C2- A5 E2 1960 SYNC LDA *STUS TURN ON SYNC TO
10C4- 09 01 1970 ORA #0 CLICK TRACK OPTION
10C6- D0 02 1980 BNE MCOM BRANCH ALWAYS
10C8- A9 00 1990 CNCL LDA #0 PREPARE AND
10CA- 85 E2 2000 MCOM STA *STUS CANCEL ALL OPTIONS
10CC- 4C 0F 12 2010 JMP TCM1 JUMP FOR THE REST
2020 :
2030 : CLICK MODE - SENDS CLICK TRACK TO TAPE
2110 :
2040 : AGO KEYBOARD SCAN RATE IS TIMER
2050 :
10CF- 18 2060 CLIK CLC PREPARE TO SEND "0"
10D0- 20 25 1E 2070 JSR SBIT SEND IT
10D3- 60 2080 RTS RETURN FOR KEYBOARD DELAY
2090 :
2100 : METRONOME TEMPO CHANGE - PROGRAM ON PAGE 2
2110 :
10D4- 4C 54 12 2120 TCHG JMP TCH JUMP TO PROGRAM
2130 :
2140 : DUMP M&T-SEQ TO TAPE - PROGRAM ON PAGE 2
2150 :
10D7- 4C 20 12 2160 OTAP JMP TOUT JUMP TO PROGRAM
2170 :
2180 : LOAD M&T-SEQ FROM TAPE - PROGRAM ON PAGE 2
2190 :
10DA- 4C 33 12 2200 ITAP JMP TIN JUMP TO PROGRAM
2210 :
2280 :
2290 : COMMAND LINKS-- LOW BYTE OF ADDRESS OF SUBS
2300 :
1100- 85 85 85 85 C2 BC B4 C8
1108- CF D4 00 7C DA 07 0C 0C
1110- 45 92 63 46 3F A3 1E 46
2790 :
2800 : OR 1118
2810 :
2820 : COMMON PROGRAM - DOES METRONOME WHEN ON
2830 : ADDS PLAY AND TRANSPOSE BUFFERS TO GET
2840 : OUTPUT NOTE, PLAYS NOTE, READS COMMAND
2850 : KEYBOARD AND JUMPS TO SELECTED MODE
2860 : SUBSTITUTES CLICK SYNC FOR KEYBOARD
2870 : TIMING LOOP WHEN SYNC OPTION IS ASSERTED
2880 :
1118- A5 E2 2890 COM LDA *STUS CHECK OPTIONS
111A- 48 2900 PHA SAVE A COPY
111B- 0A 2910 ASL METRONOME ON ?
111C- 10 22 2920 BPL COM0 NO - BRANCH
111E- C6 DF 2930 DEC *MTRC DECREMENT METRONOME COUNTER
1120- 10 1E 2940 BPL COM0 NOT <0 YET, BRANCH
1122- A6 E1 2950 LDX *TPO TIME UP, GET TEMPO VALUE
1124- CA 2960 DEX DECREMENT ONCE
1125- 86 DF 2970 STX *MTRC THEN SAVE AS COUNTER

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1127- A9 80 2980 LDA #0 TO DETERMINE ALTERNATE DISPLAY
1129- AA 2990 TRX CYCLE AND "PENDULUM" LEFT
112A- 18 3000 CLC PREPARE FOR ADDITION
112B- 65 E0 3010 ADC *METF ADD FLIP-FLOP VALUE
112D- 85 E0 3020 STA *METF SAVE NEW VALUE
112F- 10 0C 3030 BPL MET1 ALTERNATE? - DISPLAY
1131- A5 E0 3040 LDA *PBUF OTHERWISE, GET OUTPUT
1133- 09 00 3050 ORA #0 SET D7
1135- 85 E0 3060 STA *PBUF SAVE IN PLAY BUFFER
1137- 18 3070 CLC PREPARE AND
1139- 20 25 1E 3080 JSR SBIT CALL BEEP
113B- A2 00 3090 LDX #0 "PENDULUM" RIGHT
113D- 8E 20 08 3100 MET1 STX DSP SHOW PENDULUM
1140- A5 E6 3110 COM0 LDA *TRNS IS THERE A TRANSPOSE ?
1142- F0 03 3120 BEQ COM1 NO - BRANCH
1144- 18 3130 TRN CLC YES - PREPARE
1145- 69 A4 3140 ADC #0A4 CALCULATE TRANSPOSE VALUE
1147- 18 3150 COM1 CLC MORE PREPARATION
1148- 65 E0 3160 LDA *PBUF CALCULATE NOTE
114A- 80 40 08 3170 COUT STA OUTP PLAY NOTE
114D- 68 3180 PLA GET STUS (OPTION CODES)
114E- 6A 3190 ROR SYNC OPTION ON ?
114F- 90 06 3200 BCC KRED NO - SKIP
1151- 20 49 1E 3210 JSR DBIT WAIT FOR CLIK
1154- 40 60 11 3220 JMP CTRL CTRL READING AGO
1157- 2C 10 08 3230 KRED BIT KB WAIT FOR DUMMY SCAN
1159- 10 FB 3240 BPL KRED LOOP UNTIL STARTED
115C- A0 10 08 3250 KR2 LDA KB WAIT FOR SCAN TO START
115F- 30 FB 3260 BMI KR2 LOOP UNTIL STARTED
1161- 2C 10 08 3270 KR3 BIT KB CHECK FOR KEYS DOWN
1164- 30 05 3280 BMI KR3 WHEN SCAN DONE, RETURN
1166- 50 F9 3290 BVC KR3 CURRENT KEY NOT DOWN, LOOP
1168- A0 10 08 3300 LDA KB KEY DOWN, GET IT
116B- 85 EC 3310 KRTN STA *KBUF SAVE RESULT
116D- 20 00 1F 3320 CTRL JSR DECD GET COMMAND
1170- B0 06 3330 BCS D0 OLD COMMAND - DO IT
1172- 89 00 11 3340 LDA STBL,Y NEW COMMAND - GET LINK
1175- 80 78 11 3350 STA ACTN+01 PLACE LINK
1178- A9 00 3360 D0 LDA #0 THIS WILL BE HANDY
117A- 20 03 00 3370 ACTN JSR DUMV CALL OPERATING MODE
117D- A0 78 11 3380 LDA ACTN+01 SAVE CURRENT COMMAND
1180- 85 E3 3390 STA *LSTL LINK FOR LATER
1182- D0 94 3400 BNE COM AND LOOP ALWAYS
3410 :
3420 : SAVE MODULE - TAKES CARE OF ALTERNATELY
3430 : STACKING DURATIONS AND NOTES IN M-SEQUENCE
3440 : USES WHAT WILL BE "END OF SEQUENCE"
3450 : INDICATOR IN PLAY MODE AS POINTER
3460 :
1184- B0 09 3470 MSV1 BCS MS1 FIRST PASS?
1186- 80 01 03 3480 STA MTBL+01 YES-ZERO PROGRAM NOTE
1189- 85 E0 3490 STA *MEND ZERO M-SEQ POINTER
118B- 85 E6 3500 STA *TRNS ZERO TRANSPOSE
118D- 85 EB 3510 LDA *PBUF ZERO OUTPUT NOTE
118F- A5 E5 3520 MS1 LDA *CNTR GET TIME SINCE LAST NOTE
1191- A6 E8 3530 LDX *MEND M-SEQ END POINTER
1193- 90 00 03 3540 STA MTBL,X SAVE THE TIME
1196- 20 13 10 3550 JSR NRM1 IN CASE NO KEYS DOWN
1199- 29 7F 3560 AND 7F CLEAR D7 IN OUTPUT NOTE
119B- D0 01 03 3570 CMP MTBL,X SAME AS LAST NOTE?
119E- F0 08 3580 BEQ OUT YES, LEAVE
11A0- E8 3590 INX NO, SAVE BY INCREMENTING
11A1- E8 3600 INX M-SEQ POINTER TWICE
11A2- 86 E8 3610 STX *MEND AND SAVING AS END
11A4- 90 01 03 3620 STA MTBL,X THEN SAVE NOTE
11A7- A9 00 3630 LDA #0 AND ZERO TIME SINCE
11A9- 85 E5 3640 STA *CNTR LAST NOTE
11AB- 60 3650 OUT RTS AND RETURN
3660 :
3670 : PLAY MODULE - MANAGES M-SEQ AND T-SEQ
3680 : POINTERS AS WELL AS TEMPO CLOCK
3690 : DETERMINES WHEN NOTES ARE TO BE PLAYED
3700 :
11AC- B0 08 3710 PLA1 BCS CONT FIRST PASS ?
11AE- 85 E4 3720 STA *TTRN YES-ZERO TEMP. TRANSPOSE
11B0- 85 E9 3730 LP1 STA *TPNT ZERO T-SEQ POINTER
11B2- 85 EA 3740 LP2 STA *MPNT AND M-SEQ POINTER
11B4- 85 E5 3750 STA *CNTR AND CLOCK (TEMPO COUNTER)
11B6- A5 E5 3760 CONT LDA *CNTR GET CLOCK
11B8- A4 E9 3770 LDX *TPNT LDX T-SEQ POINTER
11BA- A6 EA 3780 LDX *MPNT GET M-SEQ POINTER
11BC- D0 02 03 3790 CMP MTB2,X TIME UP?

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11BF- 90 15 3800 BCC PL1 :NO - BRANCH
11C1- A9 00 3810 LDA 00 :YES, PREP. COUNTER, ETC.
11C3- 85 E5 3820 STA *CNTR :FOR NEXT ACCUMULATION
11C5- E8 3830 INX :INCREMENT M-SEQ POINTER
11C6- E8 3840 INX :TWICE
11C7- 86 EA 3850 STX *MEND :AND SAVE NEW POINTER
11C9- E4 E8 3860 CPX *MEND :END OF M-SEQ?
11CB- D0 09 3870 BNE PL1 :NO - BRANCH
11CD- C8 3880 INY :YES, INC T-SEQ POINTER
11CE- C4 E7 3890 CPY *TEND :END OF T-SEQ ?
11D0- B0 E2 3900 BCS LP1 :YES-START T&M-SEQ AGAIN
11D2- 84 E9 3910 STY *TPNT :NO-SAVE T-SEQ POINTER
11D4- D0 DC 3920 BNE LP2 :BRANCH-START M-SEQ AGAIN
11D6- B0 03 03 3930 PL1 LDA MTB3,X :GET THE NOTE
11D9- 85 E8 3940 STA *PBUF :SAVE IN PLAY BUFFER
11DB- B9 00 02 3950 LDA TTBL,Y :GET TRANSPOSE
11DE- 85 E6 3960 STA *TRNS :TO TRANSPOSE BUFFER
11E0- 60 3970 RTS :RETURN
      3980
      3990 :TAPE TRANSFER PARAMETER TABLE
      4000
      4010 TAPE H5 FF00FF03C002C002
      4020
      4030 :OR 1200
      4040
      4050 :COMMON PORTION OF TEMPO UP & DOWN -
      4060 :ROTATES RIGHT OR LEFT THE DURATIONS
      4070 :SAVED WITH M-SEQUENCE
      4080
1200- 80 06 12 4090 TCOM STA PLAC :PLACE ROR OR ROL OP CODE
1203- A2 00 4100 LDX 00 :ZERO A COUNTER/POINTER
1205- 18 4110 TLP CLC :PREPARE
1206- 7E 02 03 4120 PLAC ROR MTB2,X :ROTATE SAVED TEMPO
1209- E8 4130 INX :INCREMENT POINTER TWICE
120A- E8 4140 INX :TO POINT TO NEXT
120B- E4 E8 4150 CPX *MEND :END OF M-SEQ ?
120D- D0 F6 4160 BNE TLP :NO - LOOP FOR MORE
120F- A5 E3 4170 TCM1 LDA *LSTL :DONE, GET LINK AND
1211- 80 7B 11 4180 STA ACTN*01 :SET UP FOR PREVIOUS MODE
1214- 60 4190 RTS :THEN RETURN
      4200
      4210 :SET UP PROCEDURE FOR TAPE TRANSFER
      4220
1215- A2 07 4230 STTP LDX 07 :TRANSFER 7 BYTES
1217- B0 E1 11 4240 STP LDA TAPE,X :GET PARAMETER FROM TABLE
121A- 95 F0 4250 STA *BUFF,X :PLACE IN POT-SHOT BUFFER
121C- CA 4260 DEX :POINT TO NEXT, MORE ?
121D- D0 F8 4270 BNE STP :YES - LOOP
121F- 60 4280 RTS :NO - RETURN
      4290
      4300 :DUMP M-SEQ AND T-SEQ TO TAPE
      4310
1220- 20 15 12 4320 TOUT JSR STTP :SET UP FOR TRANSFER
1223- A5 E8 4330 LDA *MEND :SAVE M-SEQ END WITH
1225- 80 00 03 4340 STA MTBL :M&T-SEQUENCE
1228- A5 E7 4350 LDA *TEND :ALSO T-SEQUENCE END
122A- 80 01 03 4360 STA MTB1
122D- A9 D0 4370 LDA 00D :SET UP FOR DUMP
122F- 20 46 12 4380 JSR DOTP :AND DO IT
1232- 60 4390 RTS :THEN RETURN
      4400
      4410 :LOAD M-SEQ AND T-SEQ FROM TAPE
      4420
1233- 20 15 12 4430 TIN JSR STTP :SET UP FOR TRANSFER
1236- A9 11 4440 LDA 11 :SET UP FOR LOAD
1238- 20 46 12 4450 JSR DOTP :AND DO IT
123B- A0 00 03 4460 LDA MTBL :PLACE M-SEQUENCE END
123E- 85 E8 4470 STA *MEND :AND T-SEQUENCE END
1240- A0 01 03 4480 LDA MTB1
1243- 85 E7 4490 STA *TEND
1245- 60 4500 RTS :THEN RETURN
      4510
      4520 :PERFORM TAPE TRANSFER
      4530
1246- 20 A9 1E 4540 DOTP JSR CASS :CALL POT-SHOT
1249- A0 0F 11 4550 LDA STBL*0F :SET UP TO RETURN
124C- 80 7B 11 4560 STA ACTN*01 :IN NORMAL MODE
124F- 18 4570 CLC :PREPARE
1250- 20 22 1F 4580 JSR BEEP :SIGNAL DONE
1253- 60 4590 RTS :AND RETURN
      4600
      4610 :CHANGE METRONOME TEMPO

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1254- 85 DF 4630 TCH STA *MTRC :ZERO METRONOME CLOCK
1256- 66 E1 4640 ROR *TPO :HALVE TEMPO VALUE
1258- 90 02 4650 BCC TCHR :IF NOT ZERO, LEAVE
125A- 66 E1 4660 ROR *TPO :ZERO, MAKE NOT ZERO
125C- D0 B1 4670 TCHR BNE TCM1 :GO SET UP PREVIOUS MODE
      4680
      4690 END :.EN
      4700

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NOTE: The following is available from PAIA Electronics, PO Box 14359, Oklahoma City, OK 73114:

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