

# 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 SYNCH

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 octaves 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

repeating 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.		



```

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 CASS .DL 1EAA
0200 DBIT .DL 1E49
0210 SBIT .DL 1E25
0220 OUTP .DL 0040
0230 DSP .DL 0020
0240 KBD .DL 0010
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 00F0
0330 KBUF .DL 00EC
0340 PBUF .DL 00EB
0350 MPNT .DL 00EA
0360 TPNT .DL 00E9
0370 MEND .DL 00E8
0380 TEND .DL 00E7
0390 TRNS .DL 00E6
0400 CNTR .DL 00E5
0410 TTRN .DL 00E4
0420 LSTL .DL 00E3
0430 STUS .DL 00E2
0440 TPO .DL 00E1
0450 METF .DL 00E0
0460 MTRC .DL 00DF
0470 DUMY .DL 0003
0480 :
0490 :
0500 :
0510 : OR 1000
0520 :
1000- A9 00 0530 STAR LDA 00 :START / RESTART
1002- 85 E2 0540 STA *STUS :CANCEL OPTIONS
1004- A9 0C 0550 LDA 0C :NRML COMMAND LINK
1006- 8D 7B 11 0560 STA ACTN+01 :PLACE COMMAND LINK
1009- 4C 18 11 0570 JMP COM :JUMP TO COMMON
0580 :
0590 :NORMAL OPERATING MODE - DOES NOT ALTER
0600 :T-SEQUENCE OR M-SEQUENCE
0610 :
100C- B0 05 0620 NRML BCS NRML :FIRST PASS THROUGH
100E- 85 E6 0630 STA *TRNS :ZERO TRANSPOSE
1010- 8D 20 08 0640 STA DSP :AND DISPLAYS
1013- A5 EC 0650 NRML LDA *KBUF :CHECK FOR NOTES
1015- D0 04 0660 NRML BNE STOR :ZERO- NO NEW KEY
1017- A5 EB 0670 LDA *PBUF :SO GET OLD KEY
1019- 29 3F 0680 AND 3F :CLEAR BOTH FLAGS
101B- 85 EB 0690 STOR STA *PBUF :SAVE AGAIN
101D- 60 0700 RTS :AND RETURN
0710 :
0720 :PROGRAM TRANSPOSE MODE - NOTE PLAYED
0730 :IS "KILLED" WHEN KEY IS RELEASED
0740 :
101E- B0 0A 0750 TLOD BCS TL1 :FIRST PASS, INITIALIZE
1020- 85 E6 0760 STA *TRNS :ZERO TRANSPOSE FIGURE
1022- 85 EB 0770 STA *PBUF :ZERO OUTPUT NOTE
1024- 85 E7 0780 STA *TEND :ZERO TABLE END POINTER
1026- A9 00 0790 LDA 00 :TURN T-SEQUE OPTION
1028- 85 E2 0800 STA *STUS :ON
102A- A6 E7 0810 TL1 LDX *TEND :GET TRANSPOSE POINTER
102C- 8E 20 08 0820 STX DSP :SHOW IT

```

```

102F- A5 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- 90 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 04 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 (PLA1)
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- A5 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- A5 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 :TRANSPOSED TO INDICATED KEY
1250 :
1063- 90 04 1260 SING BCC SNG1 :FIRST PASS, BRANCH
1065- A5 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- A5 EA 1300 LDA *MPNT :M-SEQ POINTER > 0 ?
106E- D0 00 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- 8D 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 U/D :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- A5 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- A5 E3 1540 LDA *LSTL :AND RETURN TO
108E- 8D 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 0FF :SET TEMPO COUNTER AT
1096- 85 E5 1640 STA *CNTR :"TIMED OUT" VALUE

```

1090-	20 06 11	1650	JSR CONT	:CALL PART OF PLAY MODULE	1127-	A9 00	2980	LDA 00	:TO DETERMINE ALTERNATE DISPLAY
1098-	0E 20 00	1660	STX DSP	:DISPLAY M-SEQ POINTER	1129-	AA	2990	TAX	:CYCLE AND "PENDULUM" LEFT
109E-	A9 00	1670	LDA 00	:MAKE TRANSPOSE VALUE	112A-	18	3000	CLC	:PREPARE FOR ADDITION
10A0-	85 E6	1680	STA *TRNS	:EQUAL TO ZERO	112B-	65 E0	3010	ADC *METF	:ADD FLIP-FLOP VALUE
10A2-	60	1690	STP1 RTS	:AND RETURN	112D-	85 E0	3020	STA *METF	:SAVE NEW VALUE
		1700	:		112F-	10 0C	3030	BPL MET1	:ALTERNATE? - DISPLAY
		1710	:	:PROGRAM EVENT MODE - SAVES M-SEQUENCE	1131-	A5 EB	3040	LDA *PBUF	:OTHERWISE, GET OUTPUT
		1720	:	:BUT SUBSTITUTES EVENT CLOCK FOR REAL-TIME	1133-	09 00	3050	ORA 00	:SET D7
		1730	:	:CLOCK	1135-	85 EB	3060	STA *PBUF	:SAVE IN PLAY BUFFER
		1740	:		1137-	18	3070	CLC	:PREPARE AND
10A3-	00 02	1750	ESAV BCS ES1	:FIRST PASS, INITIALIZE	1138-	20 25 1E	3080	JSR SBIT	:CALL BEEP
10A5-	85 E5	1760	STA *CNTR	:TEMPO COUNTER AS ZERO	113B-	A2 00	3090	LDX 00	: "PENDULUM" RIGHT
10A7-	20 04 11	1770	ES1 JSR MSV1	:CALL SAVE MODULE	113D-	0E 20 00	3100	MET1 STX DSP	:SHOW PENDULUM
10AA-	A5 E5	1780	LDA *CNTR	:GET TEMPO COUNTER	1140-	A5 E6	3110	COM0 LDA *TRNS	:IS THERE A TRANSPOSE ?
10AC-	D0 05	1790	BNE EOUT	:NO ENTRY-RETURN	1142-	F0 03	3120	BEQ COM1	:NO - BRANCH
10AE-	18	1800	CLC	:PREPARE	1144-	18	3130	TRAN CLC	:YES - PREPARE
10AF-	65 E1	1810	ADC *TPO	:ADD TEMPO VALUE	1145-	69 A4	3140	ADC 0A4	:CALCULATE TRANSPOSE VALUE
10B1-	85 E5	1820	STA *CNTR	:SAVE AS TEMPO COUNTER	1147-	18	3150	COM1 CLC	:MORE PREPARATION
10B3-	60	1830	EOUT RTS	:THEN RETURN	1148-	65 EB	3160	ADC *PBUF	:CALCULATE NOTE
		1840	:		114A-	8D 40 00	3170	COUT STA OUTP	:PLAY NOTE
		1850	:	:OPTION MENU - RETURNS TO PREVIOUS	114D-	68	3180	PLA	:GET STUS (OPTION CODES)
		1860	:	:OPERATING MODE AFTER TURNING ON OR	114E-	6A	3190	ROR	:SYNC OPTION ON ?
		1870	:	:CANCELLING OPTIONS	114F-	90 06	3200	BCC KRED	:NO - SKIP
		1880	:		1151-	20 49 1E	3210	JSR DBIT	:WAIT FOR CLIK
10B4-	85 E9	1890	TBLM STA *TPNT	:T-SEQ POINTER TO BEQ	1154-	4C 6D 11	3220	JMP CTRL	:SKIP READING AGO
10B6-	A5 E2	1900	LDA *STUS	:ASSERT T-SEQ OPTION	1157-	2C 10 00	3230	KRED BIT KBD	:WAIT FOR DUMMY SCAN
10B8-	09 00	1910	ORA 00		115A-	10 FB	3240	BPL KRED	:LOOP UNTIL STARTED
10BA-	D0 0E	1920	BNE MCOM	:BRANCH ALWAYS	115C-	AD 10 00	3250	KR2 LDA KBD	:WAIT FOR SCAN TO START
10BC-	A5 E2	1930	MET LDA *STUS	:TURN METRONOME ON	115F-	30 FB	3260	BMI KR2	:LOOP UNTIL STARTED
10BE-	09 40	1940	ORA 40		1161-	2C 10 00	3270	KR3 BIT KBD	:CHECK FOR KEYS DOWN
10C0-	D0 00	1950	BNE MCOM	:BRANCH ALWAYS	1164-	30 05	3280	BMI KRTN	:WHEN SCAN DONE, RETURN
10C2-	A5 E2	1960	SYNC LDA *STUS	:TURN ON SYNC TO	1166-	50 F9	3290	BVC KR3	:CURRENT KEY NOT DOWN, LOOP
10C4-	09 01	1970	ORA 01	:CLICK TRACK OPTION	1168-	AD 10 00	3300	LDA KBD	:KEY DOWN, GET IT
10C6-	D0 02	1980	BNE MCOM	:BRANCH ALWAYS	116B-	85 EC	3310	KRTN STA *KBUF	:SAVE RESULT
10C8-	A9 00	1990	CNCL LDA 00	:PREPARE AND	116D-	20 00 1F	3320	CTRL JSR DECD	:GET COMMAND
10CA-	85 E2	2000	MCOM STA *STUS	:CANCEL ALL OPTIONS	1170-	00 06	3330	BCS DO	:OLD COMMAND - DO IT
10CC-	4C 0F 12	2010	JMP TCM1	:JUMP FOR THE REST	1172-	89 00 11	3340	LDA STBL,Y	:NEW COMMAND - GET LINK
		2020	:		1175-	8D 7B 11	3350	STA ACTN+01	:PLACE LINK
		2030	:	:CLICK MODE - SENDS CLICK TRACK TO TAPE	1178-	A9 00	3360	DO LDA 00	:THIS WILL BE HANDY
		2040	:	:AGO KEYBOARD SCAN RATE IS TIMER	117A-	20 03 00	3370	ACTN JSR DUMY	:CALL OPERATING MODE
		2050	:		117D-	AD 7B 11	3380	LDA ACTN+01	:SAVE CURRENT COMMAND
10CF-	18	2060	CLIK CLC	:PREPARE TO SEND "0"	1180-	85 E3	3390	STA *LSTL	:LINK FOR LATER
10D0-	20 25 1E	2070	JSR SBIT	:SEND IT	1182-	D0 94	3400	BNE COM	:AND LOOP ALWAYS
10D3-	60	2080	RTS	:RETURN FOR KEYBOARD DELAY			3410	:	
		2090	:				3420	:	:SAVE MODULE - TAKES CARE OF ALTERNATELY
		2100	:	:METRONOME TEMPO CHANGE - PROGRAM ON PAGE 2			3430	:	:STACKING DURATIONS AND NOTES IN M-SEQUENCE
		2110	:				3440	:	:USES WHAT WILL BE "END OF SEQUENCE"
10D4-	4C 54 12	2120	TCHG JMP TCH	:JUMP TO PROGRAM			3450	:	:INDICATOR IN PLAY MODES AS POINTER
		2130	:				3460	:	
		2140	:	:DUMP M&T-SEQ TO TAPE - PROGRAM ON PAGE 2	1184-	00 09	3470	MSV1 BCS MS1	:FIRST PASS?
		2150	:		1186-	8D 01 03	3480	STA MTBL+01	:YES-ZERO PROGRAM NOTE
10D7-	4C 20 12	2160	OTAP JMP TOUT	:JUMP TO PROGRAM	1189-	85 E8	3490	STA *MEND	:ZERO M-SEQ POINTER
		2170	:		118B-	85 E6	3500	STA *TRNS	:ZERO TRANSPOSE
		2180	:	:LOAD M&T-SEQ FROM TAPE - PROGRAM ON PAGE 2	118D-	85 E8	3510	STA *PBUF	:ZERO OUTPUT NOTE
		2190	:		118F-	A5 E5	3520	MS1 LDA *CNTR	:GET TIME SINCE LAST NOTE
10DA-	4C 33 12	2200	ITAP JMP TIN	:JUMP TO PROGRAM	1191-	A6 E8	3530	LDX *MEND	:AND M-SEQ END POINTER
		2210	:		1193-	9D 00 03	3540	STA MTBL,X	:SAVE THE TIME
		2220	:		1196-	20 13 10	3550	JSR NRM1	:IN CASE NO KEYS DOWN
		2230	:	:COMMAND LINKS - LOW BYTE OF ADDRESS OF SUBS	1199-	29 7F	3560	AND 7F	:CLEAR D7 IN OUTPUT NOTE
		2240	:		119B-	D0 01 03	3570	CMP MTBL,X	:SAME AS LAST NOTE?
		2250	:		119E-	F0 08	3580	BEQ OUT	:YES, LEAVE
1100-	85 85 85 85 C2 BC B4 C8				11A0-	E8	3590	INX	:NO, SAVE BY INCREMENTING
1108-	CF D4 00 7C DA D7 0C 0C				11A1-	E8	3600	INX	:M-SEQ POINTER TWICE
1110-	45 92 63 46 3F A3 1E 46				11A2-	06 E8	3610	STX *MEND	:AND SAVING AS END
		2790	:		11A4-	9D 01 03	3620	STA MTBL,X	:THEN SAVE NOTE
		2800	:	:OR 1118	11A7-	A9 00	3630	LDA 00	:AND ZERO TIME SINCE
		2810	:		11A9-	85 E5	3640	STA *CNTR	:LAST NOTE
		2820	:	:COMMON PROGRAM - DOES METRONOME WHEN ON	11AB-	60	3650	OUT RTS	:AND RETURN
		2830	:	:ADDS PLAY AND TRANSPOSE BUFFERS TO GET			3660	:	
		2840	:	:OUTPUT NOTE, PLAYS NOTE, READS COMMAND			3670	:	:PLAY MODULE - MANAGES M-SEQ AND T-SEQ
		2850	:	:KEYBOARD AND JUMPS TO SELECTED MODE			3680	:	:POINTERS AS WELL AS TEMPO CLOCK
		2860	:	:SUBSTITUTES CLICK SYNCH FOR KEYBOARD			3690	:	:DETERMINES WHEN NOTES ARE TO BE PLAYED
		2870	:	:TIMING LOOP WHEN SYNC OPTION IS ASSERTED			3700	:	
		2880	:		11AC-	00 00	3710	PLA1 BCS CONT	:FIRST PASS ?
1118-	A5 E2	2890	COM LDA *STUS	:CHECK OPTIONS	11AE-	85 E4	3720	STA *TTRN	:YES-ZERO TEMP. TRANSPOSE
111A-	48	2900	PHA	:SAVE A COPY	11B0-	85 E9	3730	LP1 STA *TPNT	:ZERO T-SEQ POINTER
111B-	0A	2910	ASL	:METRONOME ON ?	11B2-	85 EA	3740	LP2 STA *MPNT	:AND M-SEQ POINTER
111C-	10 22	2920	BPL COM0	:NO - BRANCH	11B4-	85 E5	3750	STA *CNTR	:AND CLOCK (TEMPO CONTER)
111E-	C6 DF	2930	DEC *MTRC	:DECREMENT METRONOME COUNTER	11B6-	A5 E5	3760	CONT LDA *CNTR	:GET CLOCK
1120-	10 1E	2940	BPL COM0	:NOT <0 YET, BRANCH	11B8-	A4 E9	3770	LDY *TPNT	:GET T-SEQ POINTER
1122-	A6 E1	2950	LDX *TPO	:TIME UP, GET TEMPO VALUE	11BA-	A6 EA	3780	LDX *MPNT	:GET M-SEQ POINTER
1124-	CA	2960	DEX	:DECREMENT ONCE	11BC-	D0 02 03	3790	CMP MTB2,X	:TIME UP?
1125-	06 DF	2970	STX *MTRC	:THEN SAVE AS COUNTER					

```

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 *MPNT :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 DE 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 EB 3940 STA *PBUF :SAVE IN PLAY BUFFER
11DB- B9 C0 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 .HS 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 :
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 :
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 :
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 :
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 :
1240- A0 01 03 4480 LDA MTB1 :AND T-SEQUENCE END
1243- 85 E7 4490 STA *TEND :
1245- 60 4500 RTS :THEN RETURN
4510 :
4520 :PERFORM TAPE TRANSFER
4530 :
4540 DOTP JSR CRSS :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

```

```

1254- 85 DF 4620 :
1256- 66 E1 4630 TCH STA *MTRC :ZERO METRONOME CLOCK
1258- 90 02 4640 ROR *TPO :HALVE TEMPO VALUE
125A- 66 E1 4650 BCC TCHR :IF NOT ZERO, LEAVE
125C- D0 B1 4660 ROR *TPO :ZERO, MAKE NOT ZERO
4670 TCHR BNE TCM1 :GO SET UP PREVIOUS MODE
4680 :
4690 END .EN
4700 :

```

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

Seque 1.0 cassette data tape with complete documentation and plastic computer keyboard overlay.....\$6.95 postpaid

## FOR AUDIO ADVENTURE



A new, exciting discovery in great sound awaits you in *THE AUDIO AMATEUR* MAGAZINE.

It's delightfully easy to improve, maintain, and even build your own audio components. Thorough articles—everything from amps to speakers, simple add-ons or improvements to intricate modifications—help even our non-technical readers develop superior sound equipment.

Subscribe now on a guaranteed satisfaction basis or send for our **FREE** prospectus.

### HANDY COUPON

Fill in the coupon, include a check or money order payable to The Audio Amateur and send to: TAA Dept M48, Box 176, Peterborough NH 03458 USA.

Enter my sub for TAA for one year, four issues for \$12

I want to know more. I enclose \$3.50 plus 50 cents postage for the current issue of The Audio Amateur

Send free prospectus

Name

Street

City  State

ZIP

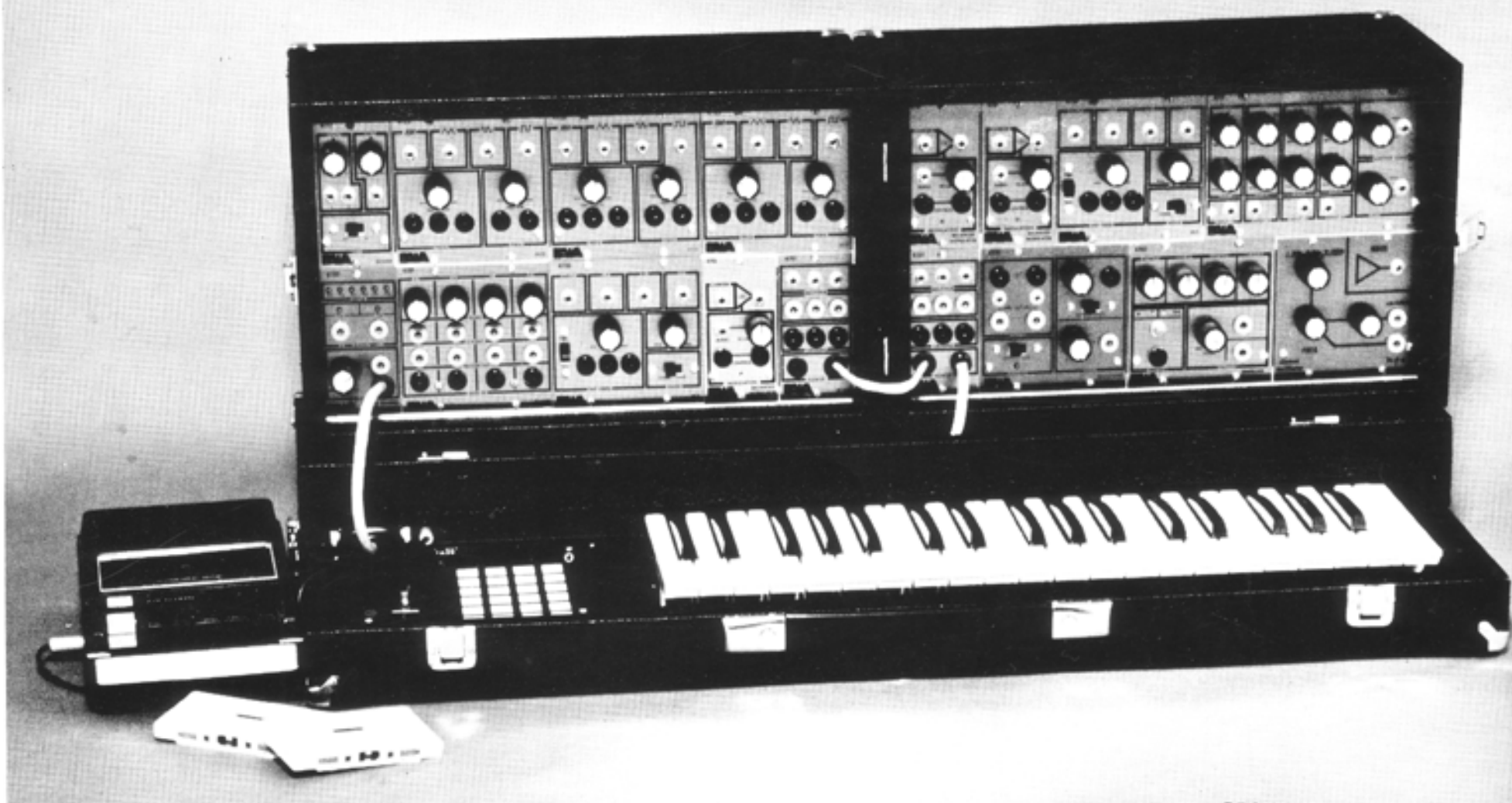
Foreign subscriptions are \$13 per year and all remittances must be in US funds



# PAIA P-4700/J

## SYNTHESIZER/COMPUTER

# POLYPHONIC... Of Course!



But that's just the beginning, because only PAIA Synthesizer/Computers Allow you to use any of a growing number of personality programs. Including:

### POLYPHONIC

MUS 1.0 - a 16 voice polyphonic synthesizer with software transient generators.

### SEQUENCERS

SEQUE 1.0 - a general purpose monotonetic sequencer.

POLY SEQUE - a 4 voice sequencer.

### COMPOSERS

PINK TUNES- Composes 4 part harmonies

PINK FREUD - Composes 4 part canons.

### SPECIAL EFFECTS

SHAZAM - Multiple keyboard split and chorusing.

AND MANY MORE COMING SOON!

The P-4700/J Synthesizer/Computer package includes the following module complement: two 4710 Balanced Modulator VCAs, 4711 Stereo Mixer, 4712 Reverb, three 4720 Wide Range VCOs, two 4730 Multi-Modal VCFs, 4740 ADSR Envelope Generator, 2720-5 Control Oscillator/Noise Source, 8780 Digital to Analog Converter, 8781 QuASH (Quad Addressable Sample & Hold), and the 8782

Intelligent Keyboard with 8700 Computer Controller housed in sturdy vinyl covered road cases.

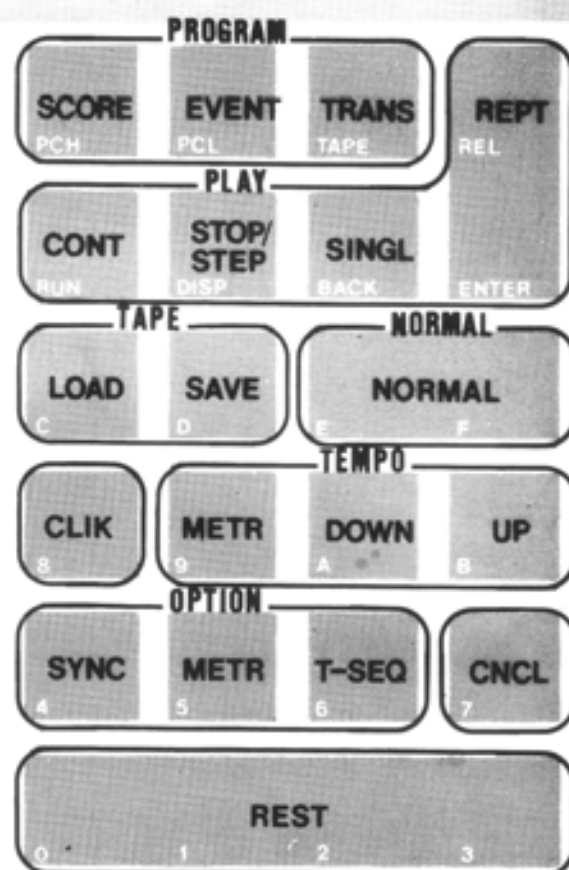
System firmware includes: PIEBUG - system monitor; POT-SHOT - cassette interface and MUS 1.0 synthesizer operating system.

P-4700/J Synthesizer/Computer Kit .....\$749.00  
Includes all listed software (shipped freight collect)

- ( ) Sounds intriguing, but I need a lot more information. Please send the most recent edition of your "Friendly Stories About Computers/Synthesizers" .....\$3.00 postpaid
- ( ) Please also send complete instruction manual set for the P-4700/J .....\$10.00 (refundable upon purchase of P-4700/J Kit)
- ( ) I've been with you all along. Please send complete P-4700/J Synthesizer/Computer Kit. ....\$749.00 .....shipped freight collect .....

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_  
Visa/BAC \_\_\_\_\_ Master Charge \_\_\_\_\_ Card No. \_\_\_\_\_  
Expiration date: \_\_\_\_\_

PAIA ELECTRONICS DEPT. 1020 W. WILSHIRE BLVD., OKLAHOMA CITY, OK 73116 (signature)



Typical control panel configuration

ONLY FROM:

PAIA ELECTRONICS, INC.

1020 WEST WILSHIRE BLVD.

OKLAHOMA CITY, OKLAHOMA 73116

(405) 843-9626