PROGRAM SUBMITTAL

☒ New Program ☐ Revision to Program

Model No. ☐ 67 ☐ 97 ☒ 41C

Program Title Audio Tape counter/ time conversions

No. of Steps/Lines ~~1929~~ 076 Category No. 840

Category Name HOBBIES

Abstract — 50 Word Maximum This program makes conversions between a tape counter (cassette, reel to reel, you name it), and real time. Functions include skipping a passage, elapsed time for a given counter reading and vice versa, and time between readings. Easy to write your own routines. Comes with separate routine to compute 2 necessary constants for your player experimentally.

Necessary Accessories: 1 working tape deck

Name David Hayden

Company

Address 38 Washington Street

City Rocky Hill State/Country N. J. Zip Code 08553

Phone Number (609) 921-8259

If my program is accepted, my bonus choice is:

☐ FOUR PROGRAMS OR XXCREDIT FOR FOUR PROGRAMS*

* No partial credit will be given. Select all four programs at the same time.

Submittal Checklist: Please use the checklist below to insure submittal of all proper program documentation.

☐ Program Submittal	☐ Program Description II	☐ Program Listing(s)	☐ Registers, Status ...
☐ Program Description I	☐ User Instructions	☐ Magnetic Card(s)	☐ Keyboard, Card Labeling (optional)

ACKNOWLEDGMENT AND AGREEMENT

To the best of my knowledge, I have the right to contribute this program material without breaching any obligation concerning nondisclosure of proprietary or confidential information of other persons or organizations. I am contributing this program material on a nonconfidential nonobligatory basis to Hewlett-Packard Company ("HP") for inclusion in its program library, and I agree that HP may use, duplicate, modify, publish, and sell the program material, and authorize others to do so without obligation or liability of any kind. HP may publish my name and address, as the contributor, to facilitate user inquiries pertaining to this program material.

Signature David M Hayden Date 2/5/83

PROGRAM DESCRIPTION I

Program Title Audio tape counter / time conversions

Contributor's Name David Hayden

Address 38 Washington Street

City Rocky Hill **State/Country** N.J. **Zip Code** 08553

Program Description, Equations, Variables Tape counters measure not how much tape has gone by the heads, but rather how many revolutions one reel has undergone. Because the amount of tape that wraps onto a reel depends on how much tape is already there, the tape counter does not directly reflect the length of tape (and hence time) that has elapsed. The actual relation between counter reading and elapsed time is:

$$t = \frac{2\pi r_0 \alpha}{v} c + \frac{T\pi\alpha^2}{v} c^2$$

where:

t = elapsed time
α = revs. / ctr. reading
c = counter reading
r_0 = radius of tape hub
v = tape velocity (speed)
T = Tape thickness

See the appendix for the derivation of this formula. T, v, r_0, and α are all constants so the formula is simply $t=Ac + Bc^2$. The TAPINT procedure figures these constants from easily found experimental data. Once the constants are stored, the program is fully operational. You can skip passages (give counter reading at beginning of passage and length of passage to get counter reading ~~reading~~ at end of passage), figure elapsed time from a counter reading, and vice versa, and get the elapsed time between two readings.

Necessary Accessories The program works better if you have a tape deck to use it with.... Aside from that, any HP-41 can use it.

Operating Limits and Warnings Be as accurate as possible when using the TAPINT program, your results will only be as good as your measurements. You will need to re-run TAPINT should any of the variables T, α, or v change. Note that 60, 90, and 120 minute cassette tapes <u>all</u> have different thicknesses. Finally, the program assumes that counter reading 0000 is for the fully rewound tape.

Reference(s) This one's entirely my fault.

This program has been verified only with respect to the numerical example given in *Program Description II*. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired)

Determine constants for a 90 minute tape on a Nakamichi 480 and play with the program.

Put a 90 minute tape in the deck, rewind it, reset the counter, and start it playing. After exactly 20 minutes, the counter reads 406. After 45 minutes, it reads 749.

1) A song begins at counter reading 214 and is 6:24 long. At what reading does it end?

2) Another song starts at 314 and ends at 510. How long is it?

3) A tape has been on for 8:34. What is the counter reading?

4) If the counter reads 522, for how long have you been listening to the tape?

SOLUTION:

Input	Function	Display	Comments
Load TAPINT			
	XEQ "TAPINT"	"TIME1?"	Enter time in MM.SS form
20	RUN	"COUNT1?"	Corresponding reading
406	RUN	"TIME2?"	Enter second time
45	RUN	"COUNT2?"	Corresponding reading
749	RUN		A and B have now been stored and the program is ready to run.
Load TAPE			
Set USER mode			
1)			
	XEQ A	COUNT=?	Enter initial reading
214	RUN	TIME ⟨MM.SS⟩?	Enter time in given format
6.24	RUN	COUNT=333.	The desired counter reading
2)			
	XEQ B	COUNT1?	Enter first reading
314	RUN	COUNT2?	Enter second reading
510	RUN	TIME=12.14	Time in MM.SS format
3)			
	XEQ C	MM.SS?	Enter time
8.34	RUN	COUNT=200.	Desired counter reading
4)			
	XEQ D	COUNT?	Enter counter reading
522	RUN	TIME=27.37	Desired time

USER INSTRUCTIONS

TAPE

SIZE (HP-41C) 011

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Insure constants A and B are in proper registers. Run TAPINT if not.			
2	Enter program, set USER mode.			
3	-To skip a passage:		(A)	COUNT=?
	Enter counter reading at beginning of passage.	c	RUN	TIME <MM.SS>?
	Enter time of passage in correct format	MM.SS	RUN	COUNT= ccc
	-To calculate time between two readings:		(B)	COUNT1?
	Enter first reading	c1	RUN	COUNT2?
	Enter second reading	c2	RUN	TIME=MM.SS
	-To calculate reading from elapsed time:		(C)	MM.SS?
	Enter elapsed time	MM.SS	RUN	COUNT=ccc
	-To calculate elapsed time from counter reading		(D)	COUNT?
	Enter counter reading	c	RUN	TIME=MM.SS
4	To repeat any conversion, go to step 3			

USER INSTRUCTIONS

TAPINT

SIZE: (HP-41C) 011

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Enter program			
2	Put a tape of the desired type into/on the machine. Rewind it, reset the tape counter and then simultaneously start the tape playing and start a timer (a wrist watch with a sweep second hand will do, a stop watch is better.) After the tape is about half way done, note the counter reading and the exact time elapsed. You will probably want to write these values down. When the tape is almost done, take the exact time for another counter reading.			
3	Calculate the constants:		XEQ "TAPINT"	TIME1?
	Enter time in MM.SS format from the first reading-elapsed time pair.	t1	RUN	COUNT1?
	Enter counter reading for the above time.	c1	RUN	TIME2?
	Enter second time reading (MM.SS)	t2	RUN	COUNT2?
	Enter coresponding counter reading	c2	RUN	
	The constants A and B are now stored in their proper registers			

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

TAPE

STEP/LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	♦LBL "TAPE"		
02	♦LBL A		
03	"COUNT=?"		
04	PROMPT		
05	XEQ 21		Count to sec.
06	"TIME <MM.SS>?"		
07	PROMPT		
08	HR		Convert MM.SS
09	60		to seconds
10	*		
11	+		Total time
12	XEQ 22		Sec. to count
13	RTN		
14	♦LBL B		
15	"COUNT1?"		
16	PROMPT		
17	XEQ 21		Count1 to sec.
18	"COUNT2?"		
19	PROMPT		
20	XEQ 21		Count2 to sec.
21	-		Time1-Time2
22	ABS		Make time 0
23	60		Convert seconds
24	/		to MM.SS
25	HMS		
26	GTO 23		Display time
27	♦LBL C		
28	"MM.SS?"		
29	PROMPT		
30	HR		MM.SS to sec.
31	60		
32	*		
33	XEQ 22		Sec. to count
34	RTN		
35	♦LBL D		
36	"COUNT?"		
37	PROMPT		
38	XEQ 21		Count to sec.
39	60		Seconds to MM.SS
40	/		
41	HMS		
42	GTO 23		Display time
43	♦LBL 21		
44	RCL X		c
45	RCL 10		B
46	*		cB
47	RCL 09		A
48	+		A+cB
49	*		$c(A+cB)=Ac+Bc^2$
50	RTN		
51	♦LBL 22		
52	RCL 10		B
53	/		t/B
54	RCL 09		A
55	RCL 10		B
56	/		A/B
57	2		
58	/		A/2B
59	STO Z		
60	X↑2		$(A/2B)^2$
61	+		$t/B + (A/2B)^2$
62	SQRT		
63	X<>Y		
64	-		$\sqrt{t/B + (A/2B)^2} - \frac{t}{B}$
65	FIX 0		Display count
66	"COUNT="		
67	ARCL X		
68	FIX 2		
69	AVIEW		
70	RTN		
71	♦LBL 23		
72	FIX 0		
73	"TIME="		
74	ARCL X		
75	AVIEW		
76	END		

50 00

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

TAPINT


```
01◆LBL "TAP
INT"
02 "TIME1?"
03 PROMPT
04 60
05 *
06 STO 01
07 "COUNT1?
"
08 PROMPT
09 STO 02
10 "TIME2?"
11 PROMPT
12 60
13 *
14 STO 03
15 "COUNT2?
"
16 PROMPT
17 STO 04
```

Input 2 pairs of experimental data points

```
18 RCL 02
19 RCL 04
20 X↑2
21 *
22 RCL 04
23 RCL 02
24 X↑2
25 *
26 -
27 STO 00
28 RCL 01
29 RCL 04
30 X↑2
31 *
32 RCL 03
33 RCL 02
34 X↑2
35 *
36 -
37 RCL 00
38 /
39 STO 09
40 RCL 02
41 RCL 03
42 *
43 RCL 04
44 RCL 01
45 *
46 -
47 RCL 00
48 /
49 STO 10
50 END
```

Calculate determinant

Calculate and store A

Calculate and store B

See the appendix for an explanation of how this works

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 82104 or 82105 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

TAPE

DATA REGISTERS

09 A
10 B

STATUS

SIZE 011 TOT. REG. 037 USER MODE
ENG FIX 2 SCI ON XX OFF
DEG RAD GRAD

FLAGS

#	INIT S/C	SET INDICATES	CLEAR INDICATES

ASSIGNMENTS

FUNCTION	KEY	FUNCTION	KEY

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

TAPINT

DATA REGISTERS

00	Determinant	50	
	Time1		
	Count1		
	Time2		
	Count2		
05		55	
	A		
10	B	60	
15		65	
20		70	
25		75	
30		80	
35		85	
40		90	
45		95	

STATUS

SIZE 011 TOT. REG. 025 USER MODE

ENG _____ FIX _____ SCI _____ ON _____ OFF _____

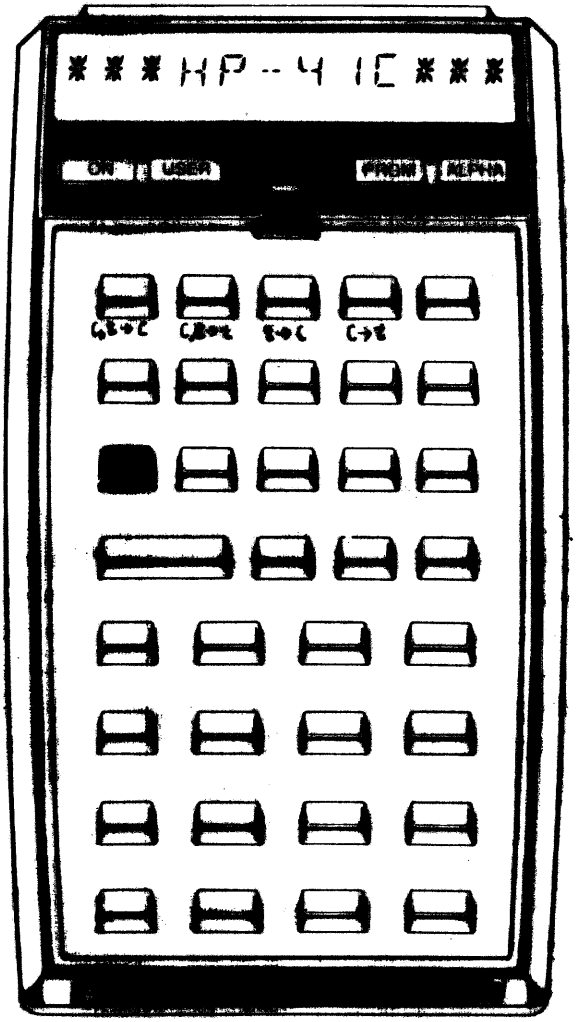
DEG _____ RAD _____ GRAD _____

FLAGS

#	INIT S/C	SET INDICATES	CLEAR INDICATES

KEYBOARD CARD LABELING

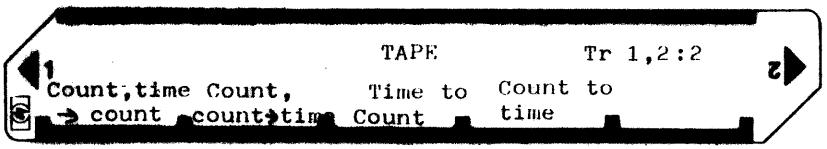
TAPE



KEYBOARD

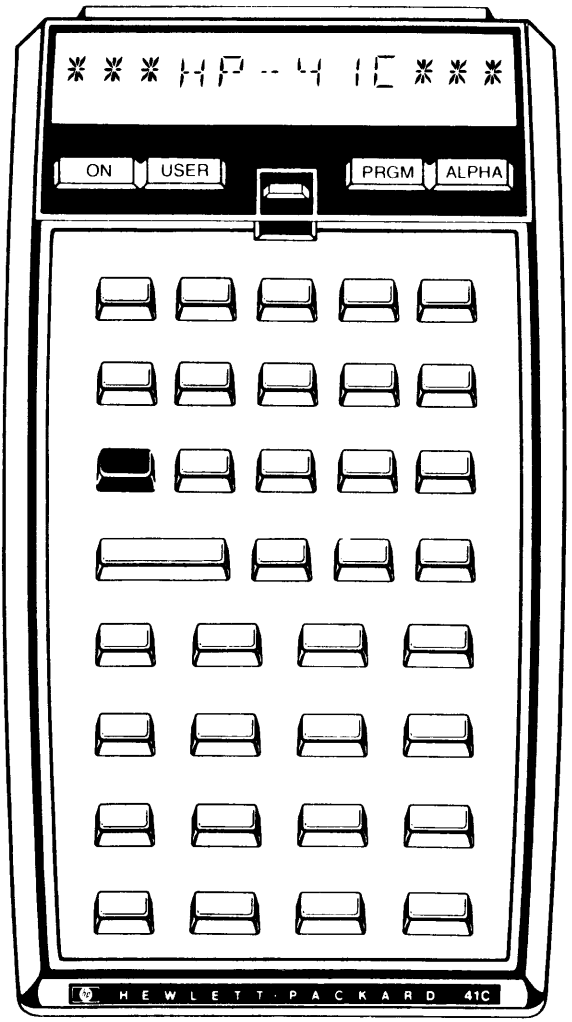
SYSTEM CONFIGURATION

CARD



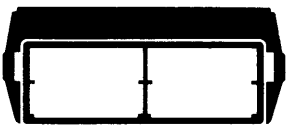
KEYBOARD CARD LABELING

TAPINT



KEYBOARD

SYSTEM CONFIGURATION



CARD

APPENDIX

I Derivation of general formula

At any given time, the length of tape that winds onto the take up real is given by the equation

$$ds = r d\theta$$

where r is the radius of the circle formed by the hub and the tape already on the hub and θ is in radians. But at any time, the radius of this circle is given by

$$r = r_0 + \frac{\theta}{2\pi} T$$

where T is the thickness of the tape. This equation says that the radius is equal to the radius of the hub plus the thickness of the tape times the number of revolutions the tape has undergone. Substituting into the first equation we have

$$ds = \left(r_0 + \frac{\theta}{2\pi} T\right) d\theta$$

Integrating the left and right sides from 0 to s and from 0 to θ respectively gives

$$s = r_0 \theta + \frac{T}{2\pi} \frac{\theta^2}{2}$$

We now have to make some substitutions to get this into the final form. The substutions used are

$$s = vt$$
$$\theta = 2\pi n$$
$$n = \alpha c$$

Substuting these in one at a time and simplifying we get

$$vt = r_0 \theta + \frac{T}{2\pi} \frac{\theta^2}{2}$$

$$= r_0 2\pi n + \frac{T}{2\pi} \cdot \frac{(2\pi n)^2}{2}$$

$$= r_0 2\pi n + \frac{T}{4\pi} \cdot 4\pi^2 n^2$$

$$= r_0 2\pi n + T\pi n^2$$

$$vt = r_0 2\pi\alpha c + T\pi\alpha^2 c^2$$

$$t = \frac{2\pi r_0 \alpha}{v} c + \frac{T\pi\alpha^2}{v} c^2$$

II Explanation of TAPINT

Given our equation $t = Ac + Bc^2$, we can solve for A and B if we know 2 time-counter reading pairs that satisfy the equation as follows:

APPENDIX

we know that $t_1 = Ac_1 + Bc_1^2$

and $t2 = Ac_2 + Bc_2^2$

if we let $D = \begin{vmatrix} c_1 & c_1^2 \\ c_2 & c_2^2 \end{vmatrix}$ then by Cramer's rule

$$A = \frac{\begin{vmatrix} t_1 & c_1^2 \\ t_2 & c_2^2 \end{vmatrix}}{D}$$

and

$$B = \frac{\begin{vmatrix} c_1 & t_1 \\ c_2 & t_2 \end{vmatrix}}{D}$$

TAPINT uses these formulas.