

01010C PROGRAM DESCRIPTION I

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Program Title Precession of Right Ascension and Declination

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Program Description, Equations, Variables Program calculates the right ascension and declination of an astronomical object at any selected epoch, given the object's position at a known initial epoch. Output is displayed in Hours/Degress, Minutes, Seconds format.

Equations used: $t_0 = \text{initial epoch}$, $t = \text{final epoch}$, $\alpha_0 = \text{initial RA}$, $\delta_0 = \text{initial Dec}$, $\alpha = \text{final RA}$, $\delta = \text{final Dec}$. $T = t - t_0 / 1000$, $\tau = t_0 - 1900 / 1000$

$$z_0 = [(23042''.53 + 139''.73\tau + 0''.06\tau^2)T + (30''.23 - 0''.27\tau)T^2 + 18''.06\tau^3]$$

$$z = [(z_0) + (79''.27 + 0''.66\tau)T^2 + 0''.32\tau^3]$$

$$\theta = [(20046''.85 - 85''.33\tau - 0''.37\tau^2)T + (-42''.67 - 0''.37\tau)T^2 - 41''.80\tau^3]$$

$$q = \sin \theta [\tan \delta_0 + \cos(\alpha_0 + \delta_0) \tan \frac{1}{2} \theta], \quad \mu = \delta_0 + z$$

$$\Delta \alpha = \tan^{-1} \left[\frac{q \sin(\alpha_0 + \delta_0)}{1 - q \cos(\alpha_0 + \delta_0)} \right] + \mu$$

$$\Delta \delta = 2 \tan^{-1} [\tan \frac{1}{2} \theta (\cos[\alpha_0 + \delta_0] - \sin[\alpha_0 + \delta_0] \tan \frac{1}{2} [\Delta \alpha - \mu])]$$

$$\alpha = \alpha_0 + \Delta \alpha, \quad \delta = \delta_0 + \Delta \delta$$

Necessary Accessories One memory module. Printer optional.

Operating Limits and Warnings Proper motion is not accounted for by this program.

Reference(s) Jones, A., Mathematical Astronomy with a Pocket Calculator, John Wiley and Sons, New York, 1978

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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TO OUR CUSTOMERS:

The following information was supplied by our reviewer for your use with this program. The comments are intended to be helpful in avoiding any complications that may inadvertently arise.

THE HEWLETT PACKARD USERS' LIBRARY STAFF

This program does not consider the status of flag 21 in conjunction with its use of VIEW/AVIEW.

Sample Problem (Sketch if Desired)

1. The epoch 1950.0 Rt Ascension and Declination of Polaris (Alpha Ursae Minoris) was 1hr, 48min, 48sec and +89deg, 2min, respectively. What is the position of Polaris at epoch 1981.0?

SOLUTION:

1.

Input	Function	Display	Comments
	[USER]		Set user mode.
	[XEQ] SIZE 017		Minimum size.
	[FIX] 2		Set display.
	[XEQ] PRECESS	EPOCH 1?	Prompt for epoch 1.
1950.00	[R/S]	EPOCH 2?	Prompt for epoch 2.
1981.00	[R/S]	PERIOD=31.00YRS OBJECT?	Prompt for object name.
POLARIS	[R/S]	RA 1? HH.MMSS	Prompt for initial RA.
1.4848	[R/S]	DEC 1? DD.MMSS	Prompt for initial Dec.
89.02	[R/S]	POLARIS EPOCH=1981.00 RA2=2H,12M,41S DEC2=89D,10M,58S	Object name. Final epoch Final RA. Final Dec.

USER INSTRUCTIONS

				SIZE: (HP-41C) 017
STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1.	Load program, set status, set USER mode.			
2.	Start program.		[XEQ] PRECESS	EPOCH 1?
3.	Enter initial epoch, (YYYY.FF format)	Epoch 1	[R/S]	EPOCH 2?
4.	Enter final epoch. (YYYY.FF)	Epoch 2	[R/S]	PERIOD=() YRS OBJECT?
5a.	(Optional) Enter object name.	Name	[R/S]	
5b.	Or simply press		[R/S]	RA 1? HH.MMSS
6.	Enter initial Rt Ascension.(HH.MMSS)	RA 1	[R/S]	DEC 1? DD.MMSS
7.	Enter initial Declination.(DD.MMSS)	Dec 1	[R/S]	* Name(if entered) * RA2= H, M, S * DEC2= D, M, S
8.	To enter new initial/final epochs, press and go to step 3.		[A]	EPOCH 1?
9.	To enter the position of a new object, press and go to step 5.		[B]	OBJECT?
	* indicates output values			
	Note: The optional printer will print program title, object name, and results.			

PROGRAM LISTING

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	*LBL "PRE		Display "Precession"	45	+		Compute I ₀ (cont.)
02	CESS"			46	18		
03	02 SF 12			47	RCL 02		
04	03 "PRECESS			48	3		
05	ION"			49	Y↑X		
06	04 AVIEW			50	*		
07	05 CF 12		Enter to, t	51	+		Compute Z
08	06 ABV			52	3.6 E3		
09	*LBL A			53	/		
10	"EPOCH 1			54	STO 04		
11	?"			55	LASTX		
12	PROMPT			56	*		
13	STO 00		Compute T	57	RCL 02		Compute Z
14	"EPOCH 2			58	3		
15	?"			59	Y↑X		
16	PROMPT			60	.32		
17	STO 01			61	*		
18	X<>Y			62	+		
19	-		Compute T	63	RCL 03		Compute Z
20	1 E3			64	.66		
21	/			65	*		
22	STO 02			66	79.27		
23	RCL 00			67	+		
24	1.9 E3			68	RCL 02		
25	-		Compute T	69	X↑2		Compute Z
26	1 E3			70	*		
27	/			71	+		
28	STO 03			72	3.6 E3		
29	X↑2			73	/		
30	.06			74	STO 05		
31	*		Compute I ₀	75	RCL 03		Compute Z
32	RCL 03			76	X↑2		
33	139.73			77	<u>.32</u> - .37		
34	*			78	*		
35	+			79	CHS		
36	23042.53			80	RCL 03		
37	+		Compute I ₀	81	85.33		Compute Z
38	RCL 02			82	*		
39	*			83	-		
40	LASTX			84	20046.85		
41	X↑2			85	+		
42	RCL 03			86	RCL 02		
43	<u>.27</u> - .27		Compute I ₀	87	*		Compute Z
44	*			88	LASTX		
	CHS			89	X↑2		
	30.23			90	RCL 03		
	+			91	<u>.37</u> - .37		
	*			92	*		

PROGRAM LISTING

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
93	CHS			137	RCL 04		
94	42.67			138	+		
95	-			139	STO 09		
96	*		Compute	140	COS		Compute
97	+		θ	141	RCL 06		
98	RCL 02			142	2		
99	3		(cont.)	143	/		q
100	Y↑X			144	TAN		
101	41.8			145	*		
102	*			146	RCL 08		
103	-			147	TAN		
104	3.6 E3			148	+		
105	/			149	RCL 06		
106	STO 06			150	SIN		
107	"PERIOD="			151	*		
108	FIX 2		Display	152	STO 10		
109	RCL 02		"Period="	153	RCL 09		
110	1 E3		(t-to) YRS"	154	SIN		
111	*			155	*		
112	ARCL X			156	RCL 09		
113	"FYRS"			157	COS		
114	AVIEW			158	RCL 10		
115	PSE			159	*		
116	LBL B			160	1		Compute
117	"OBJECT?"			161	X<>Y		
118	AON		Enter	162	-		
119	PROMPT		object	163	/		
120	AOFF		name	164	ATAN		α
121	ASTO 14			165	STO 11		
122	ASHF			166	RCL 04		
123	ASTO 15			167	RCL 05		
124	"RA 1? H			168	+		
125	H.MMSS"			169	+		
126	PROMPT		Enter	170	RCL 07		
127	HR		RA 1	171	+		
128	24		and	172	360		
129	/		Dec 1	173	/		
130	360			174	24		
131	*			175	*		
132	STO 07			176	24		
133	"DEC 1?"			177	MOD		
134	DD.MMSS"			178	HMS		
135	PROMPT			179	STO 12		
136	HR			180	ADV		Display
	STO 08			181	FS?C 23		"Epoch=(t)"
	RCL 07			182	XEQ 01		
				183	"EPOCH="		
				184	ARCL 01		

PROGRAM LISTING

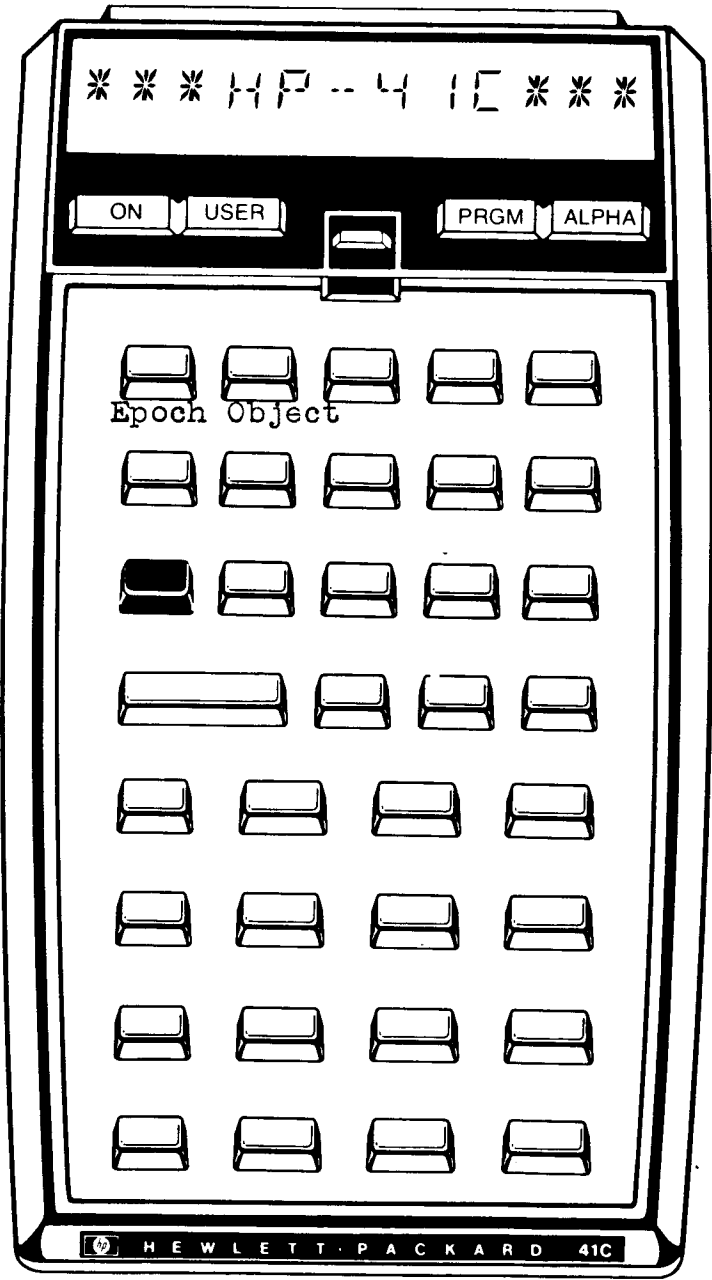
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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS	STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
185	AVIEW			233	RTN		
186	PSE			234	LBL 00		
187	"RA2="			235	RCL IND		
188	FIX 0		Display	16			Display
189	CF 29		α	236	FRC		subroutine
190	INT			237	1 E2		
191	ARCL X			238	*		
192	"FH,"			239	INT		
193	12			240	ABS		
194	STO 16			241	ARCL X		
195	XEQ 00			242	"FM,"		
196	RCL 11			243	RCL IND		
197	2			16			
198	/			244	1 E2		
199	TAN			245	*		
200	RCL 09			246	FRC		
201	SIN		Compute	247	1 E2		
202	*		δ	248	*		
203	CHS			249	RND		
204	RCL 09			250	ABS		
205	COS			251	ARCL X		
206	+			252	"FS"		
207	RCL 06			253	AVIEW		
208	2			254	PSE		
209	/			255	RTN		
210	TAN			256	LBL 01		
211	*			257	CLA		Object
212	ATAN			258	ARCL 14		name
213	2			259	ARCL 15		subroutine
214	*			260	AVIEW		
215	RCL 08			261	PSE		
216	+			262	RTN		
217	HMS			263	END		
218	STO 13						
219	"DEC2="						
220	X<0?						
221	"F--"						
222	INT		Display				
223	ABS		δ	90			
224	ARCL X						
225	"FD,"						
226	13						
227	STO 16						
228	XEQ 00						
229	SF 29						
230	FIX 2						
231	ADV						
232	ADV			00			

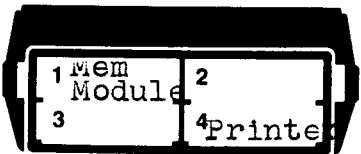
[illegible]

KEYBOARD CARD LABELING

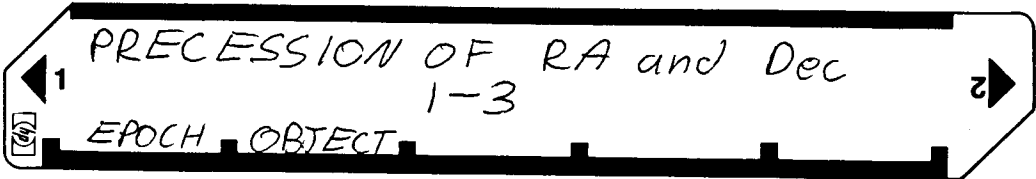
KEYBOARD



SYSTEM
CONFIGURATION



CARD



ROW 1 (1 : 2)



ROW 2 (3 : 5)



ROW 3 (5 : 8)



ROW 4 (9 : 13)



ROW 5 (14 : 20)



ROW 6 (21 : 29)



ROW 7 (29 : 32)



ROW 8 (32 : 41)



ROW 9 (42 : 49)



ROW 10 (50 : 58)



ROW 11 (59 : 66)



ROW 12 (66 : 72)



ROW 13 (73 : 81)



ROW 14 (81 : 85)



ROW 15 (86 : 94)



ROW 16 (94 : 102)



ROW 17 (103 : 107)



ROW 18 (107 : 113)



ROW 19 (113 : 117)



ROW 20 (117 : 124)



ROW 21 (124 : 125)



ROW 22 (126 : 132)



ROW 23 (132 : 134)



ROW 24 (135 : 147)



ROW 25 (148 : 160)



ROW 26 (161 : 172)



ROW 27 (172 : 181)



ROW 28 (182 : 185)



ROW 29 (186 : 191)



ROW 30 (192 : 197)



ROW 31 (198 : 210)



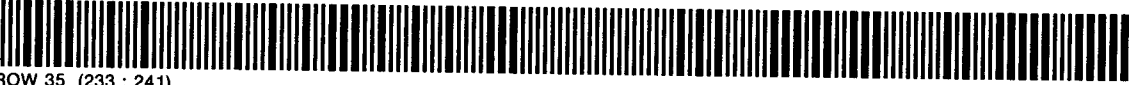
ROW 32 (211 : 219)



ROW 33 (219 : 225)



ROW 34 (226 : 232)



ROW 35 (233 : 241)



ROW 36 (242 : 247)



ROW 37 (247 : 256)



ROW 38 (257 : 263)

