Program Title LUNAR DAY CONVERTER/ASTROPHOTOGRAPHY EXPOSURE GUIDE (HP-41C)

Contributor's Name JAMES P. PATTERSON

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City CAMBRIDGE BAY **State/Country** N.W.T. CANADA **Zip Code** XOE OCO

Program Description, Equations, Variables "LUNAR DAY CONVERTER" - Equations for this particular program were derived using the relation of the lunar day verses its brightness, then converting this to a stellar magnitude. The following formulae are used:

Lunar Day → Brightness: $B = ae^{bx}$ where: "a" & "b" are constants (13 pairs) & "x" is the lunar day

Brightness → Magnitude: $M = \frac{LN\ x/a}{b}$ where: "a" = 13.23542635, "b" = -0.222233214, & "x" is the brightness

"ASTROPHOTOGRAPHY EXPOSURE GUIDE" - Exposure time is based on formula: $T = \frac{f^2}{A.B}$

where "f" = Telecamera F/no., "A" = Film ASA, & "B" = Brightness

The following formula is used to determine brightness from magnitude: $B = ae^{bx}$ where: "a" = 13.23542635, "b" = -0.222233214, & "x" = Magnitude

Correction for atmospheric absorption when elevation angle is less than 45 degrees is approximated by: $M_{\Delta} = a + bLNx$ where: "a" = 2.995551676, "b" = -0.819135677, & "x" = Elevation angle. *NOTE* For elevation angles from 33 to 44 degrees, a correction of +0.1 is used as above formula breaks down with these angles. For angles less than

Necessary Accessories 3 Memory Modules.
Will work with printer if desired(Flag 21)

Operating Limits and Warnings "LUNAR DAY CONVERTER" - Input must not exceed 28.00 days, as this represents a new moon. When using Δ FIELD, data inputted must be of same type. ie - minutes or seconds of arc, not both. They should not be mixed.

WARNING

Reference(s) When film has been exposed for a long period, a correction has to be applied to its development time. This is a result of the reciprocity problem. The correction applied shortens the developing time as the exposure time increases. I hope to include this correction at a later date when more memory space becomes available with newer RAM's. For this correction factor, refer to Handbook mentioned on next page.

Program Title L.D.C./A.E.G. (HP-41C)

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Program Description, Equations, Variables "A.E.G." (Continued)

34 degrees, this program gives a good fit(+0.1-0.0). See Tables.

Reciprocity rate is based on "Mark Hilburn's Reciprocity Compensation Table", which only applies to B & W film. When using color film, a cold camera should be used, using the uncorrected times($T\mu$). This is because the color bases react differently to long exposure times. The formula used in this program is approximated by: $T_c = ax^b$ where: "x" = $T\mu$(Uncorrected time), & "a" & "b" are constants(8 pair) with each pair being determined by the value of $T\mu$. It was felt that anything greater than $T\mu$ = 400 secs was meaningless as this gave a corrected time = 5195 secs ≃ 1½ hrs.

When applying the above times to actual photography, one should realize that these values are based on perfect conditions, something which rarely happens. In order to guarantee at least one useable photograph, bracketing should be done based on $T\mu$, using values of ¼ $T\mu$, ½ $T\mu$, $T\mu$, 2.$T\mu$, & 4.$T\mu$. If filter(s) are also used, their value must be applied first. A factor of 2.5, means that $T\mu$ becomes 2.5 times greater. By keeping records of all exposures, you will be able to know which values will work best under various conditions.

Necessary Accessories

Operating Limits and Warnings Elevation angle not important when greater than 44 degrees. Reciprocity times only computed when $T\mu > 0.5$ secs & $\leq$ 400 secs. Reciprocity times should be ignored if using color film. Be sure that filter factor is applied first before computing reciprocity times.

Reference(s) "HANDBOOK OF ASTROPHOTOGRAPHY FOR AMATEUR ASTRONOMERS - 1974" by G.N. PATTERSON. *NOTE* A new 1981 edition is being published by HERREM PUBLISHING COMPANY, 1004 TAYLOR STREET EAST, SASKATOON, SASKATCHEWAN, CANADA

Sample Problem (Sketch if Desired) "LUNAR DAY CONVERTER"

1. Find brightness and stellar magnitude of moon 5 days, 3 hours old.

2. Convert a brightness of 45.00 to a stellar magnitude.

3. Find the brightness and stellar magnitude for a camera using Example # 1 and with lunar diameter of 31.00 minutes of arc and camera field of 10.00 minutes of arc. *NOTE* Assume moon fills field completely.

Use inverse rule against new brightness if moon does not fill field completely. -ie- if moon only in 1/2 of field, divide brightness by 4; if only in 1/3, divide by 9, etc.

SOLUTION: IN "USER" MODE, PRINTER USED IN "NORM" MODE

Input	Function	Display	Comments
(1) "X<>Y"	"LDC"	XEQ "LDC"	Lunar Day Converter Program
		LUNAR DD/HH?	Prompt for input
5.03 "R/S"	"RUN"	5.03 RUN	Lunar day/hour entered
		LUNAR DAY	
		5.13 ***	Lunar DD.dd
		BRIGHTNESS	
		25.76 ***	Lunar Brightness
		MAGNITUDE	
		-3.00 ***	Lunar Magnitude
(2) 45 "R↓"	"B/M"	XEQ "B/M"	Brightness→Magnitude Program
		BRIGHTNESS	
		45.00 ***	Brightness
		MAGNITUDE	
		-5.50 ***	Magnitude
(3) "SIN"	"DF"	XEQ "DF"	Δ Field Program
		BRIGHTNESS?	Prompt for Brightness
25.76 "R/S"	"RUN"	25.76 RUN	Brightness entered
		LUNAR DIAM?	Prompt for Lunar Diameter
31 "R/S"	"RUN"	31.00 RUN	Lunar Diameter entered
		FIELD DIAM?	Prompt for Field Diameter
10 "R/S"	"RUN"	10.00 RUN	Field Diameter entered
		BRIGHTNESS	
		3.23 ***	Field Brightness
		MAGNITUDE	
		6.35 ***	Field Magnitude

Sample Problem (Sketch if Desired) "ASTROPHOTOGRAPHY EXPOSURE GUIDE"

1. Elevation = 50°, Magnitude = -1.2, F/NO. = 15, ASA = 100, Filter factor = 1.0 Find exposure times.
2. Elevation is now 30°. Find new exposure times.
3. Film is changed to ASA 32, remainder same. Find new exposure times.
4. Telecamera F/NO. is changed to 35, with rest of data same. Find new exposure times.
5. Filter factor is changed to 2.5, with rest of data same. Find new exposure times.
6. Stellar Magnitude = -2.2. Find its Brightness
7. Tμ = 5.0 secs. Find the Corrected exposure time.

NOTE Should you change objects, but rest of data remains same(Different mag) you can enter magnitude change in similar manner as done for Steps 2 through 5 except assigned key is "LN" which is "D/M".

NOTE During bracketing, reciprocity times not computed for Tμ ≤ 0.5 secs.

SOLUTION: IN "USER" MODE, PRINTER USED IN "NORM" MODE

Input	Function	Display	Comments
(1) "Σ+"	"AEG"	XEQ "AEG"	Exposure Guide Program started
		ELEVATION ∠ ?	Prompt for elevation angle
50 "R/S"	"RUN"	50.00 RUN	Elevation angle entered
		MAGNITUDE ?	Prompt for magnitude
1.2 CHS "R/S"	"RUN"	-1.20 RUN	Magnitude entered
		F/NO ?	Prompt for Telecamera F/no.
15 "R/S"	"RUN"	15.00 RUN	F/no. entered
		FILM ASA ?	Prompt for film ASA
100 "R/S"	"RUN"	100.00 RUN	ASA entered
		FILTER/FACT?	Prompt for filter factor
1 "R/S"	"RUN"	1.00 RUN	Filter factor entered
		MAGNITUDE	
		-1.20 ***	Corrected magnitude
		BRIGHTNESS	
		17.28 ***	Brightness
		1 T/U =SEC	
		0.13 ***	Tμ (Uncorrected time - secs)
		1/4 T/U =SEC	Bracketing. All times in seconds.
		0.03 ***	
		T/C = SEC	
		0.03 ***	
		1/2 T/U =SEC	
		0.07 ***	
		T/C = SEC	
		0.07 ***	
		1 T/U =SEC	
		0.13 ***	
		T/C = SEC	
		0.13 ***	
		2*T/U =SEC	
		0.26 ***	
		T/C = SEC	
		0.26 ***	

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired) "ASTROPHOTOGRAPHY EXPOSURE GUIDE" (Continued)

1. Elevation = 50°, Magnitude = -1.2, F/NO. = 15, ASA = 100, Filter factor = 1.0 Find exposure times.
2. Elevation is now 30°. Find new exposure times.
3. Film is changed to ASA 32, remainder same. Find new exposure times.
4. Telecamera F/NO. is changed to 35, with rest of data same. Find new exposure times.
5. Filter factor is changed to 2.5, with rest of data same. Find new exposure times.
6. Stellar Magnitude = -2.2. Find its Brightness.
7. Tμ = 5.0 secs. Find the Corrected exposure time.

NOTE Should you change objects(different mag), but rest of data remains same, you can enter Magnitude changes in similar manner as done for Steps 2 through 5 except assigned key is "LN" which is "D/M".

NOTE During bracketing, reciprocity times not computed for Tμ $\leq$ 0.5 secs.

SOLUTION: IN "USER" MODE, PRINTER USED IN "NORM" MODE

Input	Function	Display	Comments
(1)(Continued)		4*T/U =SEC	
		0.52 ***	
		T/C = SEC	
		1.18 ***	
(2) 30 "1/x"	"D/E"	XEQ "D/E"	Δ Elevation Program started
		MAGNITUDE	
		-0.99 ***	Corrected Magnitude
		BRIGHTNESS	
		16.49 ***	New Brightness
		1 T/U =SEC	
		0.14 ***	Tμ = 0.14 secs
		1/4 T/U =SEC	Bracketing. All times in seconds.
		0.03 ***	
		T/C = SEC	
		0.03 ***	
		1/2 T/U =SEC	
		0.07 ***	
		T/C = SEC	
		0.07 ***	
		1 T/U =SEC	
		0.14 ***	
		T/C = SEC	
		0.14 ***	
		2*T/U =SEC	
		0.27 ***	
		T/C = SEC	
		0.27 ***	
		4*T/U =SEC	
		0.55 ***	
		T/C = SEC	
		1.26 ***	
(3) 32 "$\sqrt{x}$"	"D/A"	32.00 XEQ "D/A"	Δ ASA Program started
		MAGNITUDE	

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired) "ASTROPHOTOGRAPHY EXPOSURE GUIDE" (Continued)

3. Film is changed to ASA 32, remainder same. Find new exposure times.
4. Telecamera F/NO. changed to 35, remainder same. Find new exposure times.
5. Filter factor changed to 2.5, remainder same. Find new exposure times.
6. Stellar Magnitude = -2.2. Find its Brightness.
7. Tμ = 5.0 secs. Find the Corrected exposure time.

NOTE Should you change objects(different mag), but rest of data remains same, you can enter Magnitude changes in similar manner as done for Steps 2 through 5 except assigned key is "LN" which is "D/M".

NOTE During bracketing, reciprocity times not computed for Tμ $\leq$ 0.5 secs.

SOLUTION: IN "USER" MODE, PRINTER USED IN "NORM" MODE

Input	Function	Display	Comments
(3)(Continued)		-0.99 ***	Magnitude remains unchanged
		BRIGHTNESS	
		16.49 ***	Same Brightness
		1 T/U =SEC	
		0.43 ***	New Tμ = 0.43 secs
		1/4 T/U =SEC	Bracketing. All times in seconds
		0.11 ***	
		T/C = SEC	
		0.11 ***	
		1/2 T/U =SEC	
		0.21 ***	
		T/C = SEC	
		0.21 ***	
		1 T/U =SEC	
		0.43 ***	
		T/C = SEC	
		0.43 ***	
		2*T/U =SEC	
		0.85 ***	
		T/C = SEC	
		2.32 ***	
		4*T/U =SEC	
		1.71 ***	
		T/C = SEC	
		6.00 ***	
(4) 35 "LOG"	"D/F"	35.00 XEQ "D/F"	Δ F/NO. Program started
		MAGNITUDE	
		-0.99 ***	Magnitude still same
		BRIGHTNESS	
		16.49 ***	Brightness still same
		1 T/U =SEC	
		2.32 ***	New Tμ = 2.32 secs

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired) "ASTROPHTOGRAPHY EXPOSURE GUIDE" (Continued)

4. Telecamera F/NO. changed to 35, remainder same. Find new exposure times.
5. Filter factor changed to 2.5, remainder same. Find new exposure times.
6. Stellar Magnitude = -2.2. Find its Brightness.
7. Tμ = 5.0 secs. Find the Corrected exposure time.

NOTE Should you change objects(different mag), but rest of data remains same, you can enter Magnitude changes in similar manner as done for Steps 2 through 5 except assigned key is "LN" which is "D/M"

SOLUTION: IN "USER" MODE , PRINTER USED IN "NORM" MODE

Input	Function	Display	Comments
(4)(Continued)		1/4 T/U =SEC 0.58 ***	Bracketing. All times in seconds.
		T/C = SEC 1.37 ***	
		1/2 T/U =SEC 1.16 ***	
		T/C = SEC 3.54 ***	
		1 T/U =SEC 2.32 ***	
		T/C = SEC 9.16 ***	
		2*T/U =SEC 4.64 ***	
		T/C = SEC 23.73 ***	
		4*T/U =SEC 9.28 ***	
		T/C = SEC 59.75 ***	
(5) 2.5 "SST"	"D/FF"	2.50 XEQ "D/FF"	Δ Filter Factor Program started
		MAGNITUDE -0.99 ***	Magnitude unchanged
		BRIGHTNESS 16.49 ***	Brightness same
		1 T/U =SEC 5.80 ***	New Tμ = 5.80 secs
		1/4 T/U =SEC 1.45 ***	Bracketing. All times in seconds.
		T/C = SEC 4.81 ***	
		1/2 T/U =SEC 2.90 ***	

PROGRAM DESCRIPTION II

Sample Problem (Sketch if Desired) "ASTROPHOTOGRAPHY EXPOSURE GUIDE" (Continued)

5. Filter factor changed to 2.5, remainder same. Find new exposure times.
6. Stellar Magnitude = -2.2. Find its Brightness.
7. Tμ = 5.0 secs. Find the Corrected exposure time.

NOTE Should you change objects(different mag), but rest of data remains same, you can enter Magnitude changes in similar manner as done for Steps 2 through 5 except assigned key is "LN" which is "D/M".

SOLUTION: IN "USER" MODE, PRINTER USED IN "NORM" MODE

Input	Function	Display	Comments
(5)(Continued)		T/C = SEC 12.45 ***	
		1 T/U =SEC 5.80 ***	
		T/C = SEC 32.24 ***	
		2*T/U =SEC 11.60 ***	
		T/C = SEC 78.03 ***	
		4*T/U =SEC 23.21 ***	
		T/C = SEC 179.62 ***	
(6) 2.2 CHS "TAN"	"M/B"	-2.20 XEQ "M/B" MAGNITUDE -2.20 *** BRIGHTNESS 21.58 ***	Magnitude to Brightness Program started
(7) 5 "COS"	"T/T"	5.00 XEQ "T/T" 5.00 *** T/C = SEC 26.28 ***	Uncorrected to corrected time Program started

USER INSTRUCTIONS

SIZE: (HP-41C) 008

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
01	Install Card Reader and 3 Memory Modules and load the Cards			
02	If you have Printer, replace Card Reader with Printer. Set to "USER" Mode and go to Program Description II for instruction and examples on how program works.			
03	If you do not have a Card Reader, install 3 Memory Modules, execute SIZE "000", switch to "PRGM" Mode, and load program as shown in Program Listings.			
04	Switch to "USER" Mode and proceed with key assignments. Again refer to last two pages for their locations.	"ASN"	ALPHA "AEG" ALPHA	"Σ+"
		"ASN"	ALPHA "D/E" ALPHA	"1/x"
		"ASN"	ALPHA "D/A" ALPHA	"$\sqrt{x}$ "
		"ASN"	ALPHA "D/F" ALPHA	"LOG"
		"ASN"	ALPHA "D/M" ALPHA	"LN"
		"ASN"	ALPHA "LDC" ALPHA	"X<>Y"
		"ASN"	ALPHA "B/M" ALPHA	"R↓"
		"ASN"	ALPHA "DF" ALPHA	"SIN"
		"ASN"	ALPHA "T/T" ALPHA	"COS"
		"ASN"	ALPHA "M/B" ALPHA	"TAN"
		"ASN"	ALPHA "D/FF" ALPHA	"SST"
05	Execute SIZE "008". Program may require packing before this step will work.	"XEQ"	ALPHA "SIZE" ALPHA	"008"
06	See examples and instructions on Program Descriptions I & II on how to work this program.			

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
01	♦LBL "LDC		"LUNAR DAY CONVERTER"
	"		
02	"LUNAR D		
	D/HH?"		
03	PROMPT		Prompting for
04	INT		DD.hh
05	LASTX		
06	FRC		
07	1 E2		
08	*		Converted to DD.dd
09	24		
10	/		
11	+		
12	14		
13	X<>Y		
14	X<=Y?		Is it a full moon?
15	GTO 00		
16	28		
17	X<>Y		Converts days >14
18	-		to <14 (28- DD.dd)
19	♦LBL 00		
20	FIX 2		
21	"LUNAR D		"LUNAR DAY"
	AY"		
22	XEQ "DSP		
	"		
23	PSE		DD.DD
24	FS? 21		Is printer in?
25	PRX		
26	2		
27	X<>Y		
28	X<=Y?		If ≤ 2 days
29	GTO 00		
30	4		
31	X<>Y		
32	X<=Y?		If ≤ 4 days
33	GTO 01		
34	6		
35	X<>Y		
36	X<=Y?		If ≤ 6 days
37	GTO 02		
38	8		
39	X<>Y		
40	X<=Y?		If ≤ 8 days
41	GTO 03		
42	10		
43	X<>Y		
44	X<=Y?		If ≤ 10 days
45	GTO 04		
46	12		
47	X<>Y		
48	X<=Y?		If ≤ 12 days
49	GTO 05		
50	GTO 06		
51	♦LBL 00		If = 2 days
52	2		
53	X<>Y		
54	X≠Y?		If ≠ 2 days
55	GTO 07		
56	.2231435		
	52		
57	XEQ 14		
58	7.999999		B = ae^{bx}
	995		
59	GTO 13		
60	♦LBL 01		If = 4 days
61	4		
62	X<>Y		
63	X≠Y?		If ≠ 4 days
64	GTO 08		
65	.1325189		
	2		
66	XEQ 14		
67	10.44012		B = ae^{bx}
	535		
68	GTO 13		
69	♦LBL 02		If = 6 days
70	6		
71	X<>Y		
72	X≠Y?		If ≠ 6 days
73	GTO 09		
74	.2468600		
	8		
75	XEQ 14		
76	7.275957		B = ae^{bx}
	533		
77	GTO 13		
78	♦LBL 03		If = 8 days
79	8		
80	X<>Y		
81	X≠Y?		If ≠ 8 days

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

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
82	GTO 10		
83	.2376716 4		
84	XEQ 14		
85	7.766895 951		$B = ae^{bx}$
86	GTO 13		
87	✦LBL 04		If = 10 days
88	10		
89	X<>Y		
90	X≠Y?		If ≠ 10 days
91	GTO 11		
92	.2379586 6		
93	XEQ 14		
94	7.870051 986		$B = ae^{bx}$
95	GTO 13		
96	✦LBL 05		If = 12 days
97	12		
98	X<>Y		
99	X≠Y?		If ≠ 12 days
100	GTO 12		
101	.2513144		
102	XEQ 14		
103	6.616072 818		$B = ae^{bx}$
104	GTO 13		
105	✦LBL 06		If > 12 ≤ 14 days
106	.257829		
107	XEQ 14		
108	5.953751 291		$B = ae^{bx}$
109	GTO 13		
110	✦LBL 07		If > 0 < 2 days
111	.3074847		
112	XEQ 14		
113	6.758217 988		$B = ae^{bx}$
114	GTO 13		
115	✦LBL 08		If > 2 < 4 days
116	.2231435 6		
117	XEQ 14		
118	8.191999 686		$B = ae^{bx}$
119	GTO 13		
120	✦LBL 09		If > 4 < 6 days
121	.2478361 6		
122	XEQ 14		
123	7.233470 574		$B = ae^{bx}$
124	GTO 13		
125	✦LBL 10		If > 6 < 8 days
126	.2534489 4		
127	XEQ 14		
128	6.845915 376		$B = ae^{bx}$
129	GTO 13		
130	✦LBL 11		If > 8 < 10 days
131	.2113091 2		
132	XEQ 14		
133	10.27342 068		$B = ae^{bx}$
134	GTO 13		
135	✦LBL 12		If > 10 < 12 days
136	.2305234		
137	XEQ 14		
138	8.490892 428		
139	✦LBL 13		Subroutine
140	*		
141	FIX 2		
142	✦LBL "B/M "		
143	"BRIGHTN ESS"		
144	XEQ "DSP "		"BRIGHTNESS"
145	PSE		Brightness
146	FS? 21		Is printer in?
147	PRX		

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
148	ENTER↑		
149	-.222332 14		
150	1/X		
151	13.23542 635		$M = \frac{LN\ x/a}{b}$
152	R↑		
153	R↑		
154	X<>Y		
155	RDN		
156	X<>Y		
157	/		
158	LN		
159	*		
160	FIX 2		
161	"MAGNITU DE"		
162	XEQ "DSP "		"MAGNITUDE"
163	FS? 21		Is printer in?
164	PRX		Magnitude
165	STOP		
166	◆LBL 14		Subroutine
167	*		
168	E↑X		
169	RTN		
170	◆LBL "DF"		Δ FIELD
171	"BRIGHTN ESS?"		"BRIGHTNESS?"
172	PROMPT		Prompt
173	ENTER↑		
174	"LUNAR D IAM?"		"LUNAR DIAM?"
175	PROMPT		Prompt
176	ENTER↑		
177	"FIELD D IAM?"		"FIELD DIAM?"
178	PROMPT		Prompt
179	2		
180	/		
181	X↑2		
182	PI		
183	*		Lunar area
184	X<>Y		
185	2		
186	/		
187	X↑2		
188	PI		
189	*		Field area
190	X<>Y		
191	/		
192	/		Ratio of fields
193	GTO "B/M "		Δ Brightness
01	◆LBL "AEG "		"ASTROPHOTOGRAPHY EXPOSURE GUIDE"
02	"ELEVATI ON ∠?"		"ELEVATION ∠?"
03	PROMPT		Prompt
04	STO 00		
05	"MAGNITU DE ?"		"MAGNITUDE ?"
06	PROMPT		Prompt
07	STO 03		
08	STO 05		
09	"F/NO ?"		"F/NO ?"
10	PROMPT		Prompt
11	STO 02		
12	"FILM AS A ?"		"FILM ASA ?"
13	PROMPT		Prompt
14	STO 01		
15	"FILTER/ FACT?"		"FILTER/FACT?"
16	PROMPT		Prompt
17	STO 07		
18	◆LBL 01		Beginning
19	SF 00		Indicates inputs
20	44		completed
21	RCL 00		
22	X>Y?		Elevation>44°?
23	GTO 04		
24	32		
25	X<>Y		
26	X>Y?		Elevation>32°?
27	GTO 02		
28	LN		
29	-.819135 677		
30	*		
31	2.995551 676		ΔM = a + bLNx
32	+		

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.

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STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
33	GTO 03		
34	◆LBL 02		
35	.1		
36	◆LBL 03		
37	RCL 03		Magnitude(Uncorrected)
38	+		Correction applied
39	STO 05		Corrected Magnitude
40	SF 01		Indicates Magnitude
41	CF 00		was corrected
42	◆LBL 04		
43	FS? 01		Is there a correction?
44	RCL 05		Corrected Magnitude
45	FS? 00		No correction
46	RCL 03		Uncorrected Magnitude
47	FIX 2		
48	"MAGNITUDE"		"MAGNITUDE"
49	XEQ "DSP"		
50	PSE		Magnitude
51	FS? 21		Is printer in?
52	PRX		
53	-.222233214		
54	*		$B = ae^{bx}$
55	E↑X		
56	13.23542635		
57	*		
58	"BRIGHTNESS"		"BRIGHTNESS"
59	XEQ "DSP"		
60	PSE		Brightness
61	FS? 21		Is printer in?
62	PRX		
63	STO 05		Brightness stored
64	RCL 01		ASA
65	*		
66	RCL 02		
67	X↑2		
68	X<>Y		$T\mu = \frac{f^2}{A.B}$
69	/		
70	GTO "BRK"		
71	◆LBL "T/T"		Uncorrected to Corrected Routine
72	STO 04		Uncorrected time
73	PSE		
74	PSE		T/U
75	FS? 21		Is printer in?
76	PRX		
77	.5		
78	X<>Y		
79	X<=Y?		T/U ≤ 0.5 secs?
80	GTO 09		
81	8		
82	X<>Y		
83	X<=Y?		If ≤ 8 secs
84	GTO 01		
85	20		
86	X<>Y		
87	X<=Y?		If ≤ 20 secs
88	GTO 02		
89	31		
90	X<>Y		
91	X<=Y?		If ≤ 31 secs
92	GTO 03		
93	47		
94	X<>Y		
95	X<=Y?		If ≤ 47 secs
96	GTO 04		
97	60		
98	X<>Y		
99	X<=Y?		If ≤ 60 secs
100	GTO 05		
101	85		
102	X<>Y		
103	X<=Y?		If ≤ 85 secs
104	GTO 06		
105	120		
106	X<>Y		
107	X<=Y?		If ≤ 120 secs
108	GTO 07		
109	400		
110	X<>Y		
111	X<=Y?		If ≤ 400 secs
112	GTO 08		
113	"OUT OF LIMIT"		"OUT OF LIMITS"
114	XEQ "DSP"		

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

☐ 67 ☐ 97 ☑ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
115	FS? 21		Is printer in?
116	PRX		
117	STOP		
118	◆LBL 01		If > 0.5 ≤ 8 secs
119	1.373107 58		
120	Y↑X		
121	2.883495 158		$T_c = ax^b$
122	*		
123	GTO 09		
124	◆LBL 02		If > 8 ≤ 20 secs
125	1.196393 259		
126	Y↑X		
127	4.154781 156		$T_c = ax^b$
128	*		
129	GTO 09		
130	◆LBL 03		If > 20 ≤ 31 secs
131	1.138134 576		
132	Y↑X		
133	5.012671 187		$T_c = ax^b$
134	*		
135	GTO 09		
136	◆LBL 04		If > 31 ≤ 47 secs
137	1.184720 603		
138	Y↑X		
139	4.288527 552		$T_c = ax^b$
140	*		
141	GTO 09		
142	◆LBL 05		If > 47 ≤ 60 secs
143	1.123202 596		
144	Y↑X		
145	5.436262 314		$T_c = ax^b$
146	*		
147	GTO 09		
148	◆LBL 06		If > 60 ≤ 85 secs
149	1.115065 909		
150	Y↑X		
151	5.668287 223		$T_c = ax^b$
152	*		
153	GTO 09		
154	◆LBL 07		If > 85 ≤ 120 secs
155	1.209269 216		
156	Y↑X		
157	3.732131 253		$T_c = ax^b$
158	*		
159	GTO 09		
160	◆LBL 08		If > 120 ≤ 400 secs
161	1.184939 78		
162	Y↑X		
163	4.288302 466		$T_c = ax^b$
164	*		
165	◆LBL 09		
166	"T/C = S EC"		"T/C = SEC"
167	XEQ "DSP "		
168	PSE		
169	PSE		Corrected time
170	FS? 21		Is printer in?
171	PRX		
172	CF 00		
173	CF 01		
174	RTN		
175	◆LBL "BRK "		Bracketing Routine
176	RCL 07		Uncorrected time
177	*		Bracketed time
178	STO 06		
179	"1 T/U = SEC"		1 T/U =SEC"
180	XEQ "DSP "		

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00771C PROGRAM LISTING

☐ 67 ☐ 97 ☑ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
181	PSE		1 T/U
182	FS? 21		Is printer in?
183	PRX		
184	4		¼ T/U
185	/		
186	"1/4 T/U =SEC"		"1/4 T/U =SEC"
187	XEQ "DSP "		
188	XEQ "T/T "		Reciprocity Routine
189	RCL 06		
190	2		½ T/U
191	/		
192	"1/2 T/U =SEC"		"1/2 T/U =SEC"
193	XEQ "DSP "		
194	XEQ "T/T "		Reciprocity Routine T/U
195	RCL 06		
196	"1 T/U = SEC"		"1 T/U =SEC"
197	XEQ "DSP "		
198	XEQ "T/T "		Reciprocity Routine
199	RCL 06		
200	2		
201	*		2*T/U
202	"2*T/U = SEC"		"2*T/U =SEC"
203	XEQ "DSP "		
204	XEQ "T/T "		Reciprocity Routine
205	RCL 06		
206	4		
207	*		4*T/U
208	"4*T/U = SEC"		"4*T/U =SEC"
209	XEQ "DSP "		
210	GTO "T/T "		Reciprocity Routine
211	◆LBL "D/E "		Δ ELEVATION
212	STO 00		New elevation angle
213	GTO 01		
214	◆LBL "D/A "		Δ ASA
215	STO 01		New ASA
216	GTO 01		
217	◆LBL "D/F "		Δ F/NO.
218	STO 02		New F/NO.
219	GTO 01		
220	◆LBL "D/M "		Δ MAGNITUDE
221	STO 03		New Magnitude
222	STO 05		
223	GTO 01		
224	◆LBL "D/F F"		Δ FILTER FACTOR
225	STO 07		New filter factor
226	GTO 01		
227	◆LBL "M/B "		MAGNITUDE → BRIGHTNESS
228	FIX 2		
229	"MAGNITUDE"		"MAGNITUDE"
230	XEQ "DSP "		
231	PSE		Magnitude
232	FS? 21		Is printer in?
233	PRX		
234	-.222233214		
235	*		
236	E↑X		$B = ae^{bx}$
237	13.23542635		
238	*		
239	"BRIGHTNESS"		"BRIGHTNESS"
240	XEQ "DSP "		
241	FS? 21		Is printer in?
242	PRX		Brightness
243	STOP		

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.

00771C PROGRAM LISTING

☐ 67 ☐ 97 ☑ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
	244*LBL "DSP "		Display Routine used by both programs
	245 BEEP		
	246 AVIEW		
	247 PSE		
	248 CLD		
	249 RTN		
	250 .END.		
20			
30			
40			
50			
51			
60			
70			
80			
90			
00			

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REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

00	Elevation angle
01	Film ASA
02	Telecamera F/NO.
03	Stellar Magnitude
04	Uncorrected times for bracketing
05	Stellar Magnitude corrected for absorption
06	1 Tμ - Original Uncorrected time
07	Filter factor
06	Brightness(Replaces Corrected Magnitude)

STATUS

SIZE 008	TOT. REG. 7	USER MODE
ENG	FIX 2 SCI	ON ✓ OFF
DEG	RAD GRAD	

FLAGS

#	INIT S/C	SET INDICATES	CLEAR INDICATES
"LUNAR DAY CONVERTER"			
21	OFF	Printer plugged in. Data printed	No printer plugged in
"ASTROPHOTOGRAPHY EXPOSURE GUIDE"			
00	OFF	Data entries made	Program finished Or Elevation is less than 45°
01	OFF	Elevation angle is less than 45°	Elevation angle is ≥ 45° or program finished
21	OFF	Printer plugged in. Data printed	No printer plugged in

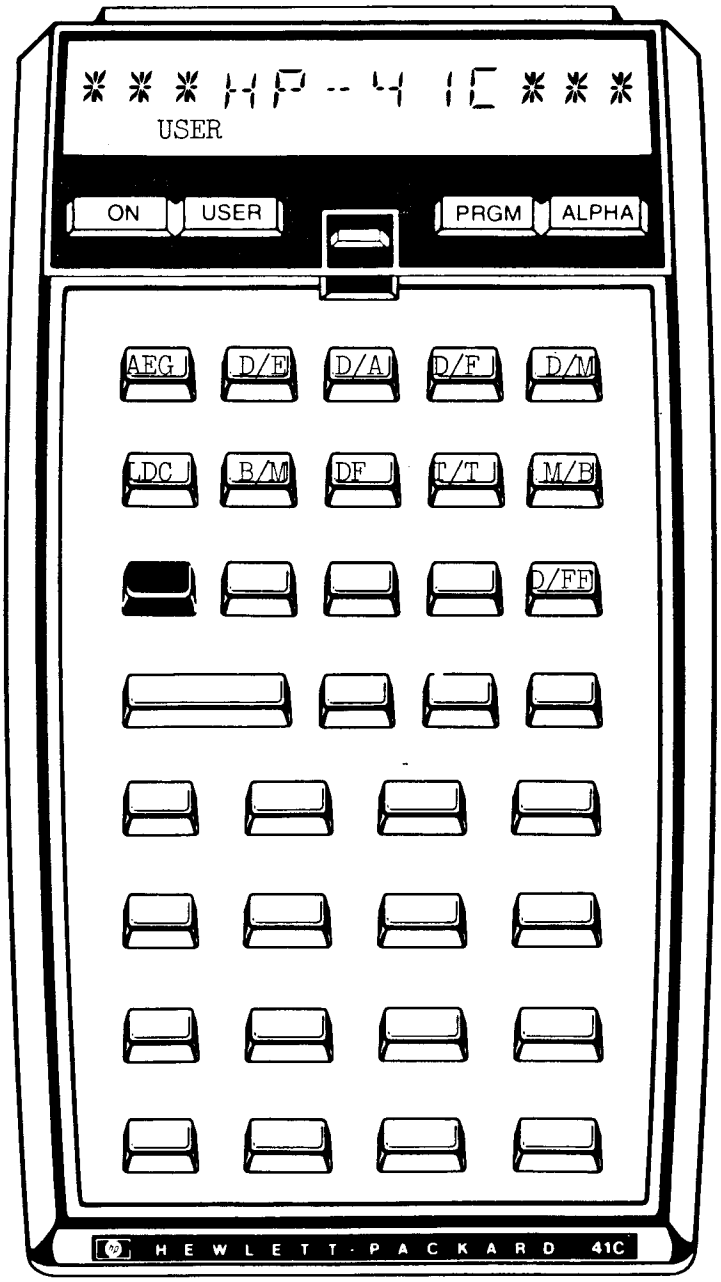
ASSIGNMENTS

FUNCTION	KEY	FUNCTION	KEY
"AEG"	Σ+	"D/FF"	SST
"D/E"	1/x		
"D/A"	√x		
"D/F"	LOG		
"D/M"	LN		
"LDC"	X<>Y		
"B/M"	R↓		
"DF"	SIN		
"T/T"	COS		
"M/B"	TAN		

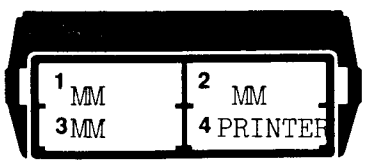
00771C

KEYBOARD CARD LABELING

KEYBOARD



SYSTEM CONFIGURATION



CARD

ROW 1 (1 : 2)

ROW 2 (2 : 5)

ROW 3 (5 : 9)

ROW 4 (9 : 12)

ROW 5 (12 : 15)

ROW 6 (15 : 20)

ROW 7 (20 : 29)

ROW 8 (29 : 31)

ROW 9 (31 : 34)

ROW 10 (35 : 43)

ROW 11 (44 : 48)

ROW 12 (48 : 52)

ROW 13 (53 : 55)

ROW 14 (56 : 58)

ROW 15 (58 : 59)

ROW 16 (59 : 68)

ROW 17 (69 : 71)

ROW 18 (72 : 80)

ROW 19 (81 : 89)

ROW 20 (90 : 98)

ROW 21 (99 : 106)

ROW 22 (107 : 113)

ROW 23 (113 : 114)

ROW 24 (114 : 119)

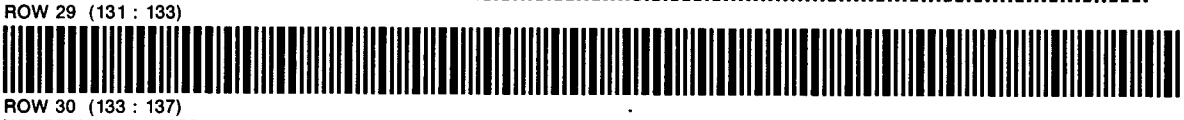
ROW 25 (119 : 121)

ROW 26 (121 : 125)

ROW 27 (125 : 127)

ROW 28 (127 : 131)

ROW 29 (131 : 133)



ROW 30 (133 : 137)

ROW 31 (137 : 139)

ROW 32 (139 : 143)

ROW 33 (143 : 145)

ROW 34 (145 : 149)

ROW 35 (149 : 151)

ROW 36 (151 : 154)

ROW 37 (155 : 157)

ROW 38 (157 : 159)

ROW 39 (160 : 163)

ROW 40 (163 : 166)

ROW 41 (166 : 167)

ROW 42 (167 : 175)

ROW 43 (175 : 179)

ROW 44 (179 : 181)

ROW 45 (182 : 186)

ROW 46 (186 : 188)

ROW 47 (188 : 192)

ROW 48 (192 : 194)

ROW 49 (194 : 196)

ROW 50 (196 : 199)

ROW 51 (200 : 202)

ROW 52 (203 : 207)

ROW 53 (208 : 209)

ROW 54 (209 : 211)

ROW 55 (211 : 215)

ROW 56 (216 : 220)

ROW 57 (220 : 224)

ROW 58 (224 : 227)

ROW 59 (227 : 229)

ROW 60 (229 : 234)

ROW 61 (234 : 237)

ROW 62 (237 : 239)

ROW 63 (239 : 240)

ROW 64 (241 : 245)

ROW 65 (246 : 250)

ROW 1 (1 : 2)

ROW 2 (2 : 7)

ROW 3 (7 : 16)

ROW 4 (16 : 21)

ROW 5 (21 : 25)

ROW 6 (26 : 36)

ROW 7 (37 : 45)

ROW 8 (46 : 55)

ROW 9 (55 : 57)

ROW 10 (57 : 59)

ROW 11 (59 : 65)

ROW 12 (65 : 67)

ROW 13 (67 : 74)

ROW 14 (74 : 76)

ROW 15 (76 : 79)

ROW 16 (80 : 83)

ROW 17 (84 : 85)

ROW 18 (85 : 92)

ROW 19 (92 : 94)

ROW 20 (94 : 98)

ROW 21 (99 : 102)

ROW 22 (102 : 104)

ROW 23 (104 : 108)

ROW 24 (108 : 110)

ROW 25 (111 : 113)

ROW 26 (113 : 116)

ROW 27 (116 : 118)

ROW 28 (118 : 121)

ROW 29 (121 : 123)

ROW 30 (123 : 126)

ROW 31 (126 : 128)

ROW 32 (128 : 131)

ROW 33 (131 : 133)

ROW 34 (133 : 136)

ROW 35 (136 : 138)

ROW 36 (138 : 142)

ROW 37 (142 : 143)

ROW 38 (143 : 147)

ROW 39 (147 : 150)

ROW 40 (151 : 153)

ROW 41 (154 : 161)

ROW 42 (161 : 164)

ROW 43 (164 : 171)

ROW 44 (171 : 173)

ROW 45 (174 : 175)

ROW 46 (176 : 177)

ROW 47 (178 : 190)

ROW 48 (191 : 194)