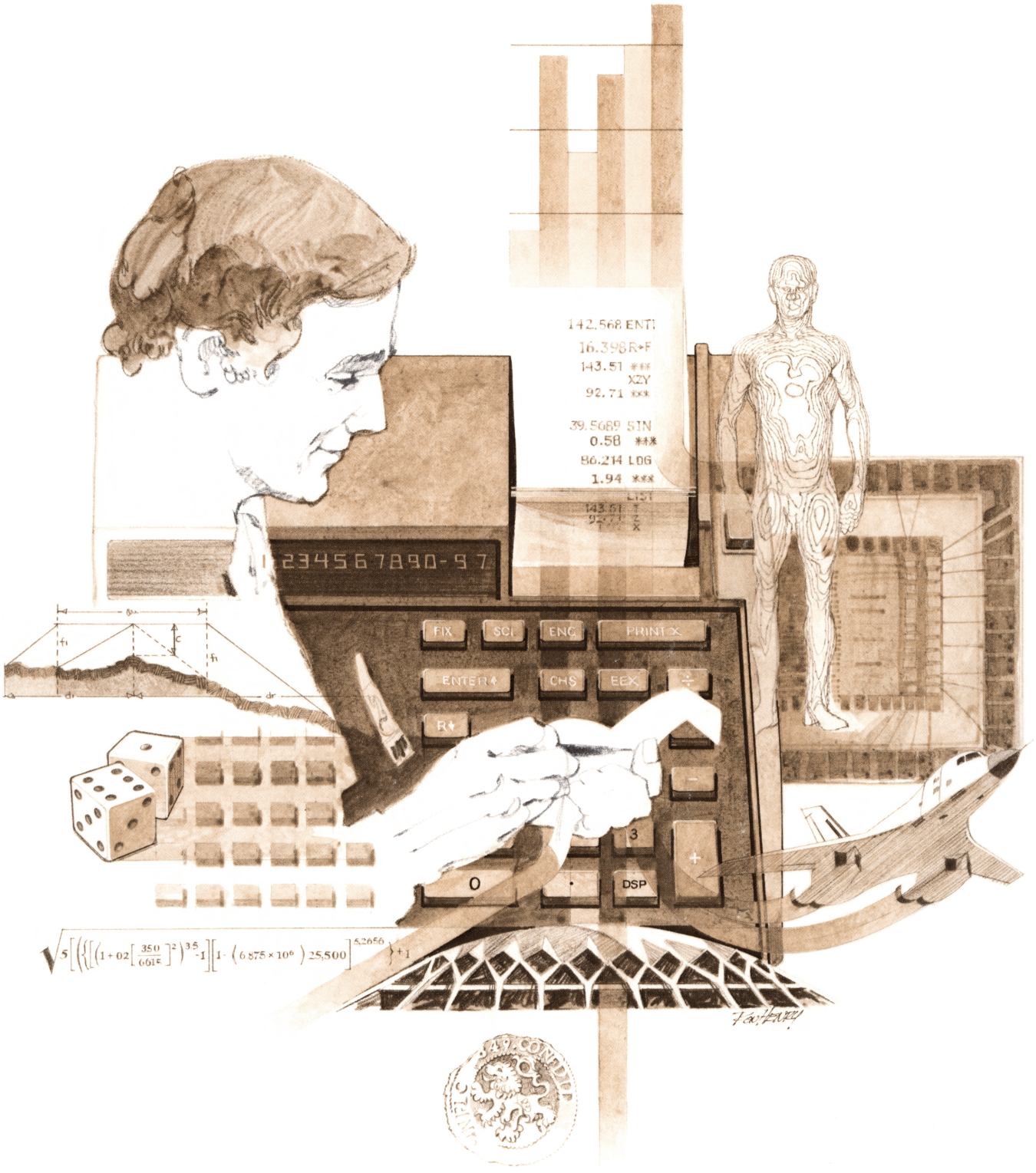
HEWLETT-PACKARD

HP-67/HP-97

Users' Library Solutions

Photo Dark Room



INTRODUCTION

In an effort to provide continued value to it's customers, Hewlett-Packard is introducing a unique service for the HP fully programmable calculator user. This service is designed to save you time and programming effort. As users are aware, Programmable Calculators are capable of delivering tremendous problem solving potential in terms of power and flexibility, but the real genie in the bottle is program solutions. HP's introduction of the first handheld programmable calculator in 1974 immediately led to a request for program **solutions** — hence the beginning of the HP-65 Users' Library. In order to save HP calculator customers time, users wrote their own programs and sent them to the Library for the benefit of other program users. In a short period of time over 5,000 programs were accepted and made available. This overwhelming response indicated the value of the program library and a Users' Library was then established for the HP-67/97 users.

To extend the value of the Users' Library, Hewlett-Packard is introducing a unique service—a service designed to save you time and money. The Users' Library has collected the best programs in the most popular categories from the HP-67/97 and HP-65 Libraries. These programs have been packaged into a series of low-cost books, resulting in substantial savings for our valued HP-67/97 users.

We feel this new software service will extend the capabilities of our programmable calculators and provide a great benefit to our HP-67/97 users.

A WORD ABOUT PROGRAM USAGE

Each program contained herein is reproduced on the standard forms used by the Users' Library. Magnetic cards are not included. The Program Description I page gives a basic description of the program. The Program Description II page provides a sample problem and the keystrokes used to solve it. The User Instructions page contains a description of the keystrokes used to solve problems in general and the options which are available to the user. The Program Listing I and Program Listing II pages list the program steps necessary to operate the calculator. The comments, listed next to the steps, describe the reason for a step or group of steps. Other pertinent information about data register contents, uses of labels and flags and the initial calculator status mode is also found on these pages. Following the directions in your HP-67 or HP-97 **Owners' Handbook and Programming Guide,** "Loading a Program" (page 134, HP-67; page 119, HP-97), key in the program from the Program Listing I and Program Listing II pages. A number at the top of the Program Listing indicates on which calculator the program was written (HP-67 or HP-97). If the calculator indicated differs from the calculator you will be using, consult Appendix E of your **Owner's Handbook** for the corresponding keycodes and keystrokes converting HP-67 to HP-97 keycodes and vice versa. No program conversion is necessary. The HP-67 and HP-97 are totally compatible, but some differences do occur in the keycodes used to represent some of the functions.

A program loaded into the HP-67 or HP-97 is not permanent—once the calculator is turned off, the program will not be retained. You can, however, permanently save any program by recording it on a blank magnetic card, several of which were provided in the Standard Pac that was shipped with your calculator. Consult your **Owner's Handbook** for full instructions. A few points to remember:

> The Set Status section indicates the status of flags, angular mode, and display setting. After keying in your program, review the status section and set the conditions as indicated before using or permanently recording the program.
>
> REMEMBER! To save the program permanently, **clip** the corners of the magnetic card once you have recorded the program. This simple step will protect the magnetic card and keep the program from being inadvertently erased.

As a part of HP's continuing effort to provide value to our customers, we hope you will enjoy our newest concept.

TABLE OF CONTENTS

Program Description I

Program Title Macro-photography and Enlarging

Contributor's Name Hewlett-Packard
Address Corvallis Division, 1000 N. E. Circle Blvd.,
City Corvallis, **State** OR **Zip Code** 97330

Program Description, Equations, Variables Given the focal length of a lens, the distance from the physical front of the lens barrel to the first principal plane, and only one of the following four quantities, the program will calculate any or all of the other three: object distance (or for enlarging, projection distance) to front of lens barrel, bellows extension, magnification, number of stops additional exposure required.

The principal planes of a thick lens or a lens system are two planes so located that if object distances are measured from the first principal plane and image distances are measured from the second principal plane, the thin-lens formula will hold.

The distance, "a", between the front of the lens barrel and the first principal plane is found by using the lens backwards to form an image of a distant object and then measuring the distance from the front of the lens barrel to the image. Subtract this distance from the marked focal length to obtain "a" (the result may be negative). For an enlarging lens, the distant object should be on the same side of the lens as the negatives normally are. "a" may be set to 0 if the object distance, "ℓ", is not to be an input or output, or $\ell \gg a$.

Operating Limits and Warnings Be aware that many lenses have focal lengths a few millimeters longer or shorter than the nominal values marked on them.

Program Description I

Program Title 97 - Macro-photography and Enlarging

Contributor's Name Hewlett-Packard, Corvallis Division

Address 1000 N. E. Circle Blvd.

City Corvallis, **State** OR **Zip Code** 97330

Program Description, Equations, Variables See sketch, next page.

$\frac{1}{s} + \frac{1}{s} = \frac{1}{f}$ Gaussian form of lens equation.

$xx' = f^2$ Newtonian form of lens equation.

$M = \frac{s'}{s} = \frac{f}{x} = \frac{x'}{s}$ Magnification.

$E = (\frac{s'}{f})^2 = (1 + M)^2$ Exposure correction factor.

$\# = \frac{\ln E}{\ln 2} = [2\ln (1+M)]/\ln 2$ Number of stops.

These equations are used in the following combinations:

$x' = fM$

$M = 2^{\#/2} - 1$

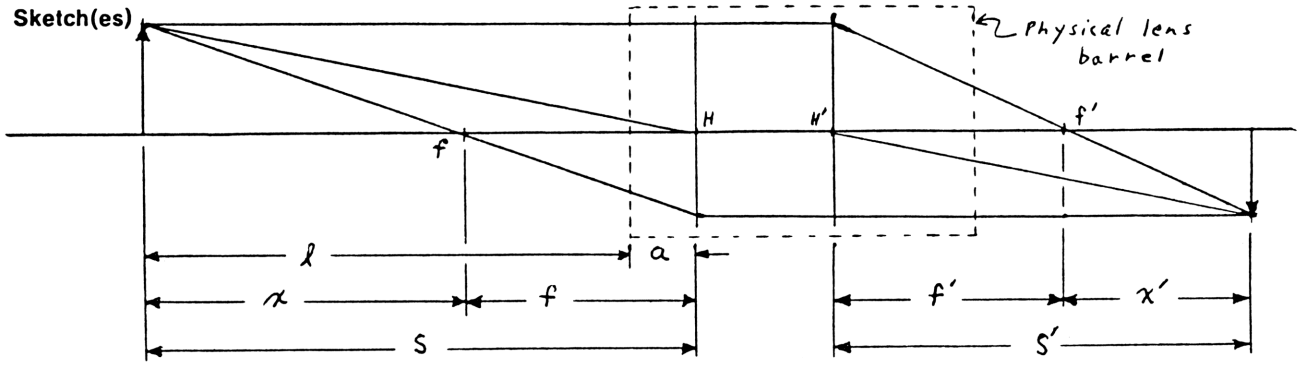
$\# = 2 \ln (\frac{1+a}{1+a-f})$

$1 = \frac{f^2}{x'} + f - a$

Operating Limits and Warnings

Program Description II

Sketch(es)



Sample Problem(s) f = 50 mm, a = 5 mm

a) ℓ = 95 mm; find x', M, #

b) x' = 85 mm; find ℓ, M, #

c) M = 5; find ℓ, x', #

d) # = 3 stops; find ℓ, x', M

Solution(s)

50 [ENTER] 50 [A]

(a) 95 [B]→ 1 (M)
0 [C]→50 (X')
0 [E]→ 2 (#)

(b) 85 [C]→ 1.70 (M)
0 [B]→74.41 (ℓ)
0 [E]→ 2.87 (#)

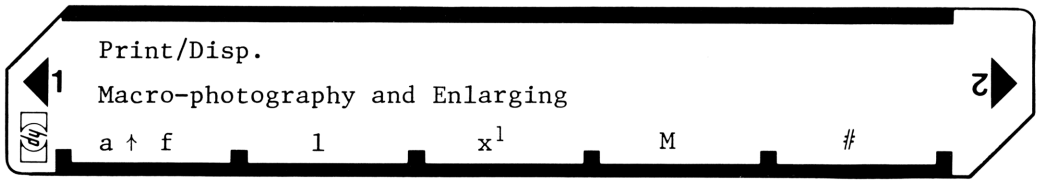
(c) 5 [D]→ 5 (M)
0 [B]→ 55 (ℓ)
0 [C]→250 (X')
0 [E]→ 5.17 (#)

(d) 3 [E]→ 1.83 (M)
0 [B]→ 72.35 (ℓ)
0 [C]→ 91.72 (X')

Reference(s)

THIS PROGRAM IS A MODIFICATION OF THE USERS' LIBRARY PROGRAM # 02412A SUBMITTED BY DAVID FINK

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program			
2	Enter "a"	a	↑	a
3	Enter focal length	f	A	a
4	Enter any one of object distance	1	B	M
	or bellows exten.	x'	C	M
	or magnification	M	D	M
	or # of stops	#	E	M
	For incorrect entry, redo step 4.			
5	Print on 97 or display on 67		f A	
	object distance,			1
	bellows exten.,			x'
	magnification,			M
	and # of stops.			#
6	For a new case with same lens, go to 4			
7	For a new lens, go to 2.			
	To use these instructions for enlarging,			
	consider the photographic paper as the			
	object, and the negative as the image.			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	
002	STO1	35 01	Store f
003	X⇄Y	-41	
004	STO6	35 06	Store a
005	RTN	24	
006	*LBLB	21 12	Initialize flag and
007	SF1	16 21 01	use 1 to calculate
008	GTO2	22 02	all other
009	*LBLC	21 13	quantities.
010	SF1	16 21 01	Initialize flag and
011	GTO3	22 03	use χ' to calculate
012	*LBLD	21 14	all other quantities
013	SF1	16 21 01	Initialize flag and
014	GTO4	22 04	use M to calculate
015	*LBLE	21 15	all other quantities
016	SF1	16 21 01	Initialize flag and
017	*LBL5	21 05	use # to calculate
018	STO5	35 05	all other quantities
019	2	02	Store #
020	RCL5	36 05	
021	2	02	Calculate M (#)
022	÷	-24	
023	Y^x	31	
024	1	01	
025	-	-45	If flag 1 is off,
026	F1?	16 23 01	Store M and stop;
027	GTO6	22 06	otherwise, turn
028	STO4	35 04	flag 1 off and
029	RTN	24	calculate all
030	*LBL6	21 06	quantities.
031	CF1	16 22 01	
032	*LBL4	21 04	
033	STO4	35 04	Store M
034	RCL1	36 01	
035	x	-35	Calculate x'(M)
036	*LBL3	21 03	
037	STO3	35 03	
038	RCL1	36 01	Store x'
039	ENT↑	-21	
040	x	-35	Calculate 1 (x')
041	RCL3	36 03	
042	÷	-24	
043	RCL1	36 01	
044	+	-55	
045	RCL6	36 06	
046	-	-45	
047	*LBL2	21 02	
048	STO2	35 02	Store 1
049	RCL6	36 06	
050	+	-55	
051	ENT↑	-21	Calculate # (1)
052	ENT↑	-21	
053	RCL1	36 01	
054	-	-45	
055	÷	-24	
056	LN	32	
057	2	02	
058	x	-35	
059	2	02	
060	LN	32	
061	÷	-24	
062	GTO5	22 05	
063	*LBLa	21 16 11	
064	RCL2	36 02	
065	RCL3	36 03	Print/disp results
066	RCL4	36 04	
067	RCL5	36 05	
068	PRST	16-14	
069	RTN	24	

070 080 090 100 110

SET STATUS

FLAGS			TRIG	DISP	
	ON	OFF			
0	☐	☒	DEG ☒	FIX ☒	
1	☐	☒	GRAD ☐	SCI ☐	
2	☐	☒	RAD ☐	ENG ☐	
3	☐	☒		n 2	

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

Program Description I

Program Title TIME, F-STOP, MAGNIFICATION, PAPER SPEED ENLARGING FACTORS

Contributor's Name Hewlett-Packard, Corvallis Division

Address 1000 N. E. Circle Blvd.

City Corvallis, **State** OR **Zip Code** 97330

Program Description, Equations, Variables The program relates four variables used in photographic printing or enlarging: Time (seconds), f-stop, MAGNIFICATION (M) and paper PRINTING INDEX (P_I). It uses the following formulas:

1) $\text{seconds} = \frac{K}{P_I} \cdot M^2 \cdot f^2$

2) $\text{f-stop} = \frac{\text{sec} \cdot P_I}{\sqrt{K \cdot M^2}}$

3) $M = \frac{\text{sec} \cdot P_I}{\sqrt{K \cdot f^2}}$

4) $P_I = \frac{K}{\text{sec}} \cdot M^2 f^2$

The factor K must be determined once by the user. It varies with the equipment used (Type enlarger, Lamp Wattage, etc.) To obtain K, a satisfactory print is made and the printing data entered in this formula:

$$K = \frac{\text{Exposure Time (sec)} \cdot P_I}{(\text{f-stop})^2 \cdot (\text{Magn.})^2}$$

Operating Limits and Warnings The program will accept all practical values of f-stop, Magnification M, Paper Printing Index (P_I) and exposure times. Paper printing indexes are published by KODAK (see page 2 References) or may be obtained by comparison printing when using brands with no published P_I data. Certain f: stops on lenses are rounded off. Program will compute exact f-stop.

Program Description II

Sketch(es)

64	32	16	8	4	2	1	Relative Transmission f-stop as marked true f-stop (see Reference below).
2.8	4.0	5.6	8.0	11	16	22	
2.83	4.0	5.66	8.0	11.3	16	22.63	

Sample Problem(s) Note: The following sample problem was run with a K-factor (see page 1) of 31.25:

1) First Print Data: P_I = 3200, f-11, M = 4.5, 24 seconds
   New Print: M=10, P_I = 2000, f-5.6, sec = ?
2) Printing Time for f:56, M = 50 (largeprint), P_I = 3200, sec = ?
3) P_I = 3200, M = 5, Time = 16 sec, f-stop = ?

Typical P_I values: Kodabromide: Grade 1 = 5000
Grade 2 = 3200
Grade 3 = 2000
Grade 4 = 1250

Solution(s)

1) New exposure time: [E]5.6 [B]10 [C]2000 [D][F][A] 49 seconds
2) 5.6[B] 50[C] 3200[D][F][A] 765 seconds
3) 16[A] 5[C] (3200[D]) [F][B]

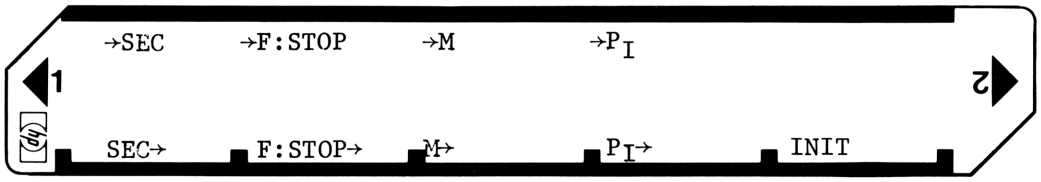
Reference(s)

PHOTOGRAPHIC PAPERS, KODAK PROFESSIONAL DATA BOOK #G-1;
ENCYCLOPEDIA OF PHOTOGRAPHY, FOCAL PRESS, ENTRY: DIAPHRAGMS (f-numbers)

THIS PROGRAM IS A MODIFICATION OF THE USERS' LIBRARY PROGRAM # 02411A

SUBMITTED BY HARRY C. JOEL

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Determine K factor (see page 1)			
	and enter in Program Form (page 4)			
	Key entry 1 through 5 in form KK.kk (tens,			
	units, tenths and one-hundreds)			
2	Enter Program			
3	INITIALIZE		E	
4	INPUT 3 of the following			
	TIME	seconds	A	sec.
	f:STOP	f-stop	B	f-stop
	MAGNIFICATION	M	C	M
	PAPER PRINTING INDEX	P_I	D	P_I
5	COMPUTE REMAINING VARIABLE			
	TIME		F A	
	f-STOP		F B	
	MAGNIFICATION		F C	
	(see note) PAPER PRINTING INDEX		F D	
6	To change any input and calculate effect on			
	remaining variables go to step 4. ONE, TWO			
	OR THREE VALUES MAY BE CHANGED.			
*	Note: K can be stored in register 5 instead			
	of changing the program.			
	Note: P_I is usually an Input but may be			
	computed for other purposes.			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLE	21 15	
002	3	03	
003	1	01	
004	.	-62	
005	2	02	This factor must be
006	5	05	determined by user,
007	STO5	35 05	see page 1 31.25
008	RTN	24	is sample only
009	*LBLA	21 11	
010	STO1	35 01	
011	RTN	24	
012	*LBLa	21 16 11	Store or calculate
013	RCL5	36 05	time
014	RCL3	36 03	
015	RCL2	36 02	
016	×	-35	
017	ENT↑	-21	
018	×	-35	
019	RCL5	36 05	
020	×	-35	
021	RCL4	36 04	
022	÷	-24	
023	STO1	35 01	
024	RTN	24	
025	*LBLB	21 12	
026	STO2	35 02	Store or Calc.
027	RTN	24	f-stop
028	*LBLb	21 16 12	
029	RCL1	36 01	
030	RCL5	36 05	
031	÷	-24	
032	RCL4	36 04	
033	×	-35	
034	RCL3	36 03	
035	ENT↑	-21	
036	×	-35	
037	÷	-24	
038	√X	54	
039	STO2	35 02	
040	RTN	24	
041	*LBLC	21 13	
042	STO3	35 03	Store or Calc.
043	RTN	24	M
044	*LBLc	21 16 13	
045	RCL1	36 01	
046	RCL5	36 05	
047	÷	-24	
048	RCL4	36 04	
049	×	-35	
050	RCL2	36 02	
051	ENT↑	-21	
052	×	-35	
053	÷	-24	
054	√X	54	
055	STO3	35 03	
056	RTN	24	
057	*LBLD	21 14	Store P_I
058	STO4	35 04	(or calculate for
059	RTN	24	special purpose
060	*LBLd	21 16 14	e.g., unknown P_I)
061	RCL5	36 05	
062	RCL1	36 01	
063	÷	-24	
064	RCL3	36 03	
065	RCL2	36 02	
066	×	-35	
067	ENT↑	-21	
068	×	-35	
069	×	-35	
070	STO4	35 04	
071	RTN	24	

080 090 100 110

SET STATUS

FLAGS	ON	OFF	TRIG		DISP	
0	☐	☒	DEG	☒	FIX	☒
1	☐	☒	GRAD	☐	SCI	☐
2	☐	☒	RAD	☐	ENG	☐
3	☐	☒			n 2	

REGISTERS

0	1 seconds	2 f-stop	3 magn	4 P_I	5 k	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

Program Description I

Program Title 67 - COLOR PRINTING FACTORS

Contributor's Name CARY ENOCH REINSTEIN
Address 3939 BIDWELL DR., #D438
City FREMONT **State** CA **Zip Code** 94538

Program Description, Equations, Variables THIS PROGRAM COMPUTES VARIABLES IN PRINTING MOST COLOR MATERIALS, EKTACOLOR RC, EKTACHROME RC AND PANALURE FOR EXAMPLE. MAGNIFICATION AND LENS-TO-PAPER DISTANCE FACTORS, FILTER PACK CHANGES AND LENS APERTURE CHANGES ARE OUTPUT. RECIPROCITY CORRECTION IS APPLIED WHEN PRINTING TIME IS CHANGED. VALUES ARE PROJECTED BY CURVE FITING ROUTINES AND HAVE BEEN CHECKED AGAINST KODAK'S "COLOR DATAGUIDE."

$\frac{\text{EXPOSURE FACTOR LOG}}{2 \text{ LOG}}$ = F/STOP CHANGE $\left(\log_B A = \frac{\log A}{\log B}\right)$

THE ENLARGER LENS IS CONSIDERED A POINT LIGHT SOURCE WHERE LIGHT INCREASES AND DECREASES INVERSELY WITH THE SQUARE OF THE DISTANCE. (AN APPROXIMATE RECIPROCITY FACTOR FOR BLACK AND WHITE WOULD BE: FACTOR $1.192 \times .176 -$). ALSO SEE "PETERSON'S PHOTOGRAPHIC, June 1976 p.7

Operating Limits and Warnings Y, M, C Filter values apply to Kodak CC and CP filters and may vary slightly according to different manufacturers. For dichroic filters see Printing Color Slides, Kodak, 1975 p. 14. Reciprocity is approximate with Cibachrome and will require testing. Accuracy decreases over extreme limits. Answers (time) are rounded to nearest 1/10 second.

Program Description II

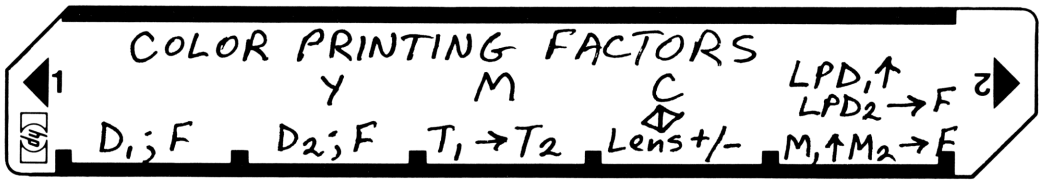
Sketch(es)

Sample Problem(s) 1.) a trial print has been exposed for 20 seconds with filter pack 40Y, 10Y, 20M at a magnification of 5x. A new print will be made with a modified filter pack: 40Y, 20Y, 20M, 5M. The magnification will be 9x. Determine the required exposure, and (2.) the aperture increase required if the time is not changed.
(3.) The print has been exposed at f/11 for 23 seconds. The optimum f/stop of your EL-Nikkor lens is 5.6. What should the exposure be?

Solution(s) (1.) 40 [f/b] [A] [B] 10 [f/B] [A] 20 [f/c] [A] .25
20 [f/b] [B] 20 [f/c] [B] 5 [f/c] [B] [R/S] 1.18
5 [ENTER↑] 9 [E] 2.78 [R/S] 3.29 (combined factor 20 [C] 85 seconds
(2.) [D] 1.72 f/stops
(3.) 2 [CHS] [D] .25 23 [C] 4.3 seconds

Reference(s) Kodak Color Dataguide, 1974 ed. p 37-41
(The Kodak "CC Computer" is the basis of the program.)

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
{	OPTIONAL: Find density of filters	e.g.	4 0	
{	in CP filter pack.	40 M	f c	.28
1.	Load sides 1 and 2.			
2.	densities ($\bar{D}$) of original filter pack (individually or grouped)	$\bar{D}$ .nn	A	$\Sigma \bar{D}_1$
3.	densities of new filter pack	$\bar{D}$ .nn	B	$\Sigma \bar{D}_2$
4.	exposure factor for filter change		R/S	Factor
5.	clear [A][B] for new calculations	0.	A	0.00
6.	change one filter only add	$\bar{D}$	B	
			R/S	Factor
	subtract	$\bar{D}$	A	
			R/S	Factor
7.	change to different aperture			
	a. open lens	n.n stops	CHS D	factor
	b. stop down	n.n "	D	factor
	c. factor computed (or time)			
	compute f/stop change	—	D	f/s for —
8.	original magnification	n.n	ENTER↑	
	new magnification	"	E	factor
9.	or original lens to paper distance	n.n in. or cm.	ENTER↑	
	new lens to paper distance	" "	f e	factor
10.	Combination of factors			
	first factor computed A, B, D, E	or f/e		
	second factor computed " " "	" "	R/S	combined factor
11.	after computing any of above factors or combinations			
	input previous time (T_1)	n.n		
		seconds	C	T_2
12.	F/stop change required if time remains constant, after computing any factors or combinations		D	f/s incr. decr.

67 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	f LBL C	21 25 13	
	STO C	33 13	
	RCL D	34 14	
	X	71	
	STO 9	33 09	
	RCL D	34 14	
	1	01	enlarge
	g X>Y	32 81	or reduce?
	GTO 1	22 01	
010	h X≷Y	35 52	
	f GSB 2	31 22 02	
	RCL 9	34 09	
	X	71	
	GTO 0	22 00	
	f LBL 1	31 25 01	
	RCL D	34 14	
	h 1/x	35 62	Reduce
	f GSB 2	31 22 02	exposure,
	RCL C	34 13	remove
020	÷	81	reciprocity
	RCL D	34 14	correction
	÷	81	
	h 1/x	35 62	
	f LBL 0	31 25 00	
	h CF 3	35 61 03	
	DSP 1	23 01	
	f RND	31 24	
	DSP 2	23 02	
	h RTN	35 22	
030	f LBL 2	31 25 02	
	f LN	31 52	
	.	83	
	2	02	Reciprocity
	5	05	Correction
	8	08	Log projection
	7	07	
	X	71	
	.	83	
	9	09	
040	8	08	
	3	03	
	4	04	
	+	61	
	h RTN	35 22	
	f LBL D	31 25 14	
	h F? 3	35 71 03	f/stop
	GTO 3	22 03	change
	RCL D	34 14	
	f LOG	31 53	
050	2	02	
	f LOG	31 53	
	÷	81	
	h RTN	35 22	
	f LBL 3	31 25 03	
	2	02	
	f LOG	31 53	

STEP	KEY ENTRY	KEY CODE	COMMENTS
	X	71	
	g 10^x	32 53	
	GTO 5	22 05	
060	f LBL E	31 25 15	
	1	01	
	+	61	magnification
	g x^2	32 54	
	h X≷Y	35 52	
	1	01	
	+	61	
	g x^2	32 54	
	÷	81	
	GTO 5	22 05	
070	g LBL e	32 25 15	
	g x^2	32 54	Lens to
	h X≷Y	35 52	paper
	g x^2	32 54	distance
	÷	81	
	GTO 5	22 05	
	f LBL A	31 25 11	
	X=0	31 51	
	GTO 0	22 00	
	2	02	
080	0	00	
	GTO 4	22 04	
	f LBL 0	31 25 00	
	STO A	33 11	initialize
	STO B	33 12	A, B
	h RTN	35 22	
	f LBL B	31 25 12	
	2	02	
	1	01	sum
	f LBL 4	31 25 04	A, B
090	h ST I	35 33	
	h X≷Y	35 52	
	STO+(i)	33 61 24	
	RCL(i)	34 24	
	h RTN	35 22	
	RCL B	34 12	
	RCL A	34 11	
	−	51	
	g 10^x	32 53	
	f LBL 5	31 25 05	hold previous
100	RCL D	34 14	filter in STK
	h X≷Y	35 52	for possible
	STO D	33 14	combination
	h CF 3	35 61 03	of factors
	h RTN	35 22	
	X	71	
	STO D	33 14	
	h RTN	35 22	
	g LBL b	32 25 12	Yellow
	.	83	filters
110	1	01	
	1	01	Power projection
	8	08	

REGISTERS

0	1	2	3	4	5	6	7	8	9 uncorr. time
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A Σ D̄	B Σ D̄	C	D	E	I
Trial Filters	New Filters	Input time	expos. Factor		A, B control

67 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
	h y^x	35 63	
	.	83	
	0	00	
	3	03	
	1	01	
	x	71	
	h RTN	35 22	
120	g LBL C	32 25 13	
	.	83	
	0	00	Magenta
	0	00	filter
	6	06	density
	x	71	
	.	83	linear
	0	00	projection
	4	04	
	+	61	
130	h RTN	35 22	
	g LBL D	32 25 14	
	.	83	
	0	00	
	0	00	Cyan
	3	03	filter
	x	71	density
	.	83	
	0	00	linear
	5	05	projection
140	+	61	
	h RTN	35 22	
150			
160			
170			
180			
190			
200			
210			
220			

LABELS

A $\Sigma \bar{D}_1$	B $\Sigma \bar{D}_2$	C TIME → NEW TIME	D LENS CHG	E MAG ↑ NEW MAG → F
a	b $Y = \bar{D}$	c $M = \bar{D}$	d $C = \bar{D}$	e LPD ↑ NEW LPD → F
0 used	1 REDUCE EXPOSURE	2 RECIPR. LOG CURVE	3 F/STOP	4 $\Sigma \bar{D}$
5 COMPUTE FACTOR	6	7	8	9

FLAGS

0	
1	
2	
3	input

SET STATUS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

TRIG	
DEG	☒
GRAD	☐
RAD	☐

DISP	
FIX	☒
SCI	☐
ENG	☐
n	2

Program Description I

Program Title COLOR PRINTING-FACTORS; NEW PAPER

Contributor's Name Hewlett-Packard, Corvallis Division

Address 1000 N. E. Circle Blvd.

City Corvallis **State** OR **Zip Code** 97330

Program Description, Equations, Variables

$$\text{New Printing-Pack} = (\text{New Box C Factors}) - (\text{Old Box C Factors}) + (\text{Old Printing-Pack})$$

$$\text{New Exposure Time} = \frac{(\text{Old Exposure Time})\ (\text{New Box Speed})}{(\text{Old Box Speed})}$$

$$\text{New Exposure Value} = \left[\frac{(\text{New Exposure Time}) - (\text{Old Exp. Time})}{100 + (\text{working f/number})}\right] (\text{Old Exp. Time})$$

Operating Limits and Warnings

Program Description II

Sketch(es)

Sample Problem(s) You are printing color prints with a filter pack of 35y + 20M with a working f/number of f/5.6 and a 35-second exposure time when you run out of paper. The printing factors of the old box are: 00y + 10 M + 25C, Speed = 105. The printing factors of the new box are: 20y + 00M + 05C, speed = 85.

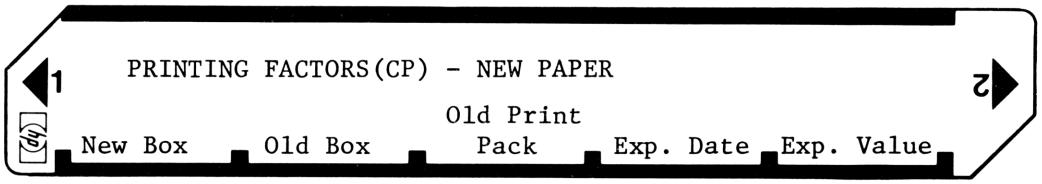
1) What is your new printing pack?
2) What is your new exposure time?
3) If you leave your exposure time constant, what will your new f/number be?

Solution(s)

1) 20[↑] 0[↑] 5[A] / 0[↑] 10[↑] 25[B] / 35 [↑] 20 [↑] 0[C] →
   → New Printing pack = 75y + 30M
2) 35[↑] 105[↑] 85[0] = 28.33 seconds
3) 5.6[E] = 7.93 ≃ f/8

Reference(s) THIS PROGRAM IS A TRANSLATION OF THE HP-65 USERS LIBRARY PROGRAM #01410A SUBMITTED BY STUART A. RIGG.

User Instructions



STEP	INSTRUCTIONS		INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter Program				
2	New Box Printing Factors:				
		Yellow	CP Value	↑	
		Magenta	CP Value	↑	
		Cyan	CP Value	A	0.00
3	Old Box Printing Factors:				
		Yellow	CP Value	↑	
		Magenta	CP	↑	
		Cyan	CP	B	0.00
4	Old Printing Pack:				
		Yellow	CP Value	↑	
		Magenta	CP	↑	
		Cyan	CP	C	yellow-new pack
				R/S	magenta new pack
				R/S	cyan-new pack
5	New Exposure Time:				
		Old Exposure	Seconds	↑	
		Old Box Speed		↑	
		New Box Speed		D	new expos. (seconds)
6	New Exposure Value:				
		Working F/Number		E	new F/number
	For a new case, go to step 2.				

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	
002	CLRG	16-53	
003	STO 3	35 03	
004	R↓	-31	
005	STO 2	35 02	New Box Color Correction Storage
006	R↓	-31	
007	STO 1	35 01	
008	CLX	-51	
009	RTN	24	
010	*LBL B	21 12	
011	ST- 3	35-45 03	
012	R↓	-31	Old Box Color Correction Factors; initial computations.
013	ST- 2	35-45 02	
014	R↓	-31	
015	ST- 1	35-45 01	
016	CLX	-51	
017	RTN	24	
018	*LBL C	21 13	Old Color-Printing Pack → Secondary Computations; Elimination of neutral density.
019	CHS	-22	
020	R↓	-31	
021	CHS	-22	
022	R↓	-31	
023	CHS	-22	
024	R↑	16-31	
025	R↑	16-31	
026	GSB B	23 12	
027	RCL 3	36 03	
028	RCL 2	36 02	
029	X>Y?	16-34	
030	X≠Y	-41	
031	RCL 1	36 01	
032	X>Y?	16-34	
033	X≠Y	-41	
034	ENT↑	-21	Final Printing Pack
035	ENT↑	-21	
036	GSB B	23 12	
037	RCL 1	36 01	
038	FRTX	-14	
039	R/S	51	
040	RCL 2	36 02	
041	FRTX	-14	
042	R/S	51	
043	RCL 3	36 03	
044	FRTX	-14	
045	RTN	24	
046	*LBL D	21 14	
047	X≠Y	-41	
048	÷	-24	
049	X≠Y	-41	
050	STO 0	35 00	New Exposure Time Seconds
051	X	-35	
052	STO 7	35 07	
053	FRTX	-14	
054	RTN	24	New Exposure Value F/Number
055	*LBL E	21 15	
056	RCL 7	36 07	
057	RCL 0	36 00	
058	-	-45	
059	EEX	-23	
060	2	02	
061	÷	-24	
062	RCL 0	36 00	
063	X	-35	
064	CHS	-22	
065	+	-55	
066	FRTX	-14	
067	RTN	24	
068	R/S	51	
070			
080			
090			
100			
110			

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☒	DEG ☒	FIX ☒
1	☐	☒	GRAD ☐	SCI ☐
2	☐	☒	RAD ☐	ENG ☐
3	☐	☐		n 2

REGISTERS

0	1 Yellow	2 Magenta	3 Cyan	4	5	6	New Exp. Rate	8 Old Exp.Rate	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

Program Description I

Program Title SUBTRACTIVE COLOR-PRINTING FILTERS; DENSITY CORRECTION

Contributor's Name Hewlett-Packard, Corvallis Division

Address 1000 N. E. Circle Blvd.

City Corvallis **State** OR **Zip Code** 97330

Program Description, Equations, Variables Program compares given values with the pre-programmed values to provide running sum of f-number corrections. Given the working f-Number (in step 2), program will provide running working f number

Operating Limits and Warnings Value of filters must be $\leq \pm$ 50 CP or cc.

Program Description II

Sketch(es)

Sample Problem(s) (Filters: 25; 5; 10; 20; 30; 40; 50 CP) ← Standard Values

1) Your initial printing-pack is 15y + 20M. You find you must add 35y + 10M to correct the color-balance of your print. By how many f/numbers will your exposure change?
2) You change a printing-pack from 90M + 40C to 5M + 50C; if your initial F-number is 5.6, what is your final f/number?
3) Changing your last CP Pack (5M + 50C) to 5y + 35C will give what f/number?
4) Your printing-pack is 25y + 40C; changing your pack to 10y + 5C will require what adjustment in exposure?

Solution(s)

1) [E]10[A] 5[A] 20[B] → -0.67 f/stops (increase in exposure)
(decrease in f-number)

2) [E]5.6 [STO] [7] 50 [CHS] [B] 30[CHS][B] 5[CHS][B] 10[C] → f/6.93
(new f/number)

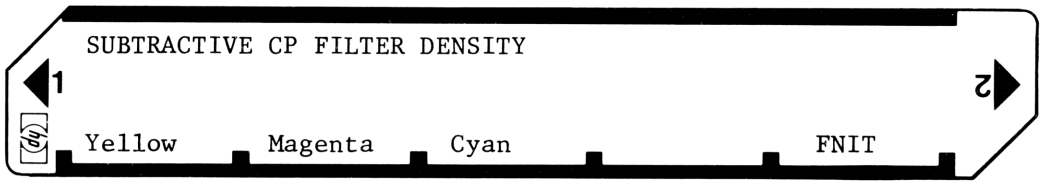
3) 5 [CHS] [B] 5[A] 10[CHS][C] 5[CHS][C] → f/7.93 (new f/number)

4) [E]10[CHS][A] 5[CHS][A] 30[CHS][C] 5[CHS][C] →Increase of 1.33 F/stops
(Decrease in exposure)

Reference(s)

THIS PROGRAM IS A MODIFICATION OF THE USERS' LIBRARY PROGRAM # 01412A
SUBMITTED BY STUART A. RIGG.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	ENTER PROGRAM			
2	TO INITIALIZE FOR NEW CASE		E	
3	FOR RUNNING - WORKING F-NUMBER	Starting F/#	STO 7	
	*OPTIONAL			
4	YELLOW FILTERS	FILTER +VALUES	A	F-VALUE
	OR/AND			
4	MAGENTA FILTERS	FILTER ± VALUES	B	F-VALUE
	OR/AND			
	CYAN FILTERS	FILTER +VALUES	C	F-VALUE
	* POSITIVE VALUES DENOTE: INCREASE IN F-			
	NUMBER AND ∴ DECREASE IN EXPOSURE			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	Computation of yellow-filter factors
002	0	00	
003	X>Y?	16-34	
004	SF2	16 21 02	
005	R↓	-31	
006	ABS	16 31	
007	1	01	
008	0	00	
009	X>Y?	16-34	
010	GTO0	22 00	
011	R↓	-31	
012	4	04	
013	1	01	If factor is neg, set flag 2
014	X>Y?	16-34	
015	GTO1	22 01	
016	R↓	-31	
017	5	05	
018	1	01	
019	X>Y?	16-34	
020	GTO2	22 02	Value to large: display error.
021	0	00	
022	÷	-24	
023	*LBLB	21 12	Compute magenta-filter factors.
024	0	00	
025	X>Y?	16-34	
026	SF2	16 21 02	
027	R↓	-31	
028	ABS	16 31	
029	5	05	
030	X>Y?	16-34	
031	GTO0	22 00	
032	R↓	-31	
033	2	02	If value is neg, set flag 2.
034	1	01	
035	X>Y?	16-34	
036	GTO1	22 01	
037	R↓	-31	
038	5	05	
039	1	01	
040	X>Y?	16-34	
041	GTO2	22 02	
042	0	00	Value too large; display error.
043	÷	-24	
044	*LBLC	21 13	Compute cyan-filter factors.
045	0	00	
046	X>Y?	16-34	
047	SF2	16 21 02	If value is neg, set flag 2.
048	R↓	-31	
049	ABS	16 31	
050	2	02	
051	1	01	
052	X>Y?	16-34	
053	GTO1	22 01	
054	R↓	-31	
055	4	04	
056	1	01	
057	X>Y?	16-34	
058	GTO2	22 02	
059	R↓	-31	
060	5	05	
061	1	01	
062	X>Y?	16-34	
063	GTO3	22 03	
064	0	00	
065	÷	-24	
066	*LBL0	21 00	
067	RCL7	36 07	
068	RTN	24	
069	*LBLE	21 15	
070	CLRG	16-53	
071	RTN	24	Value too large; display error.
072	*LBL1	21 01	
073	1	01	
074	GTOD	22 14	
075	*LBL2	21 02	
076	2	02	
077	GTOD	22 14	
078	*LBL3	21 03	
079	3	03	
080	*LBLD	21 14	
081	ENT↑	-21	Finish computations.
082	3	03	
083	÷	-24	Was entered value neg?
084	F2?	16 23 02	Yes → CHS
085	CHS	-22	No → Continue
086	CF2	16 22 02	
087	ST-7	35-45 07	Σ Factor to R-7
088	RCL7	36 07	
089	R/S	51	Read Σ

100

110

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☒	DEG ☒	FIX ☒
1	☐	☒	GRAD ☐	SCI ☐
2	☐	☒	RAD ☐	ENG ☐
3	☐	☒		n 2

REGISTERS

0	1	2	3	4	5	6	7 Σ F/#	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

Program Description I

Program Title TRI-COLOR PRINT EXPOSURE (PHOTO)

Contributor's Name Hewlett-Packard, Corvallis Division

Address 1000 N. E. Circle Blve.

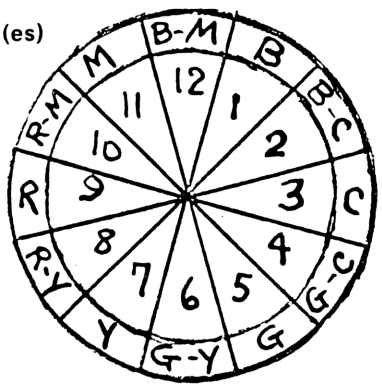
City Corvallis **State** OR **Zip Code** 97330

Program Description, Equations, Variables Red, green, and blue exposure times, in seconds, used to produce a color test print by the tri-color additive exposure system are stored in HP67/97. If test print is off-color or too dark, or too light, the desired correction is inserted and new exposure times calculated to bring new print into color balance and proper density. This program balances a color wheel in the same manner as an automobile wheel by adding and subtracting weights placed 120° around the circumference to pull center of balance into the hub. Sine curve is used to place the red, green, and blue weights on the wheel and exposure factors are calculated logarithmically. LBLA will shift color without changing print density since weight added to one side is subtracted from the other. Overall print density is corrected with LBL B.

Operating Limits and Warnings No correction is made for extremely short (under 10 seconds) or long (more than 60 seconds) exposure reciprocity.

Program Description 11

Sketch(es)



COLOR WHEEL

COLOR	SECTOR
BLUE	1
BLUE-CYAN	2
CYAN	3
GREEN CYAN	4
GREEN	5
GREEN-YELLOW	6
YELLOW	7
RED-YELLOW	8
RED	9
RED-MAGENTA	10
MAGENTA	11
BLUE-MAGENTA	12

Sample Problem(s) A trial print is made by exposing the color print paper f11 through the red, green, and blue filters for 25 secs. each. After processing and drying the print and inspecting it in white light, it is determined to be 7 1/2 units too red-yellow and 1/2 stop too light. If badly off color, it may require two attempts to zero in. Bear in mind that if too dark and test print is not ad badly off color as it appears and vice-versa, add an extra 10 units of color compensation for each 1/3 to 1/2 stops of under exposure and vice-versa.

Solution(s)

25 [ENT↑] [ENT↑] [C] which was the red, green, and blue test print exposure times.

8 [ENT↑] for red-yellow sector

17.5 [CHS] for 7 1/2 units too much and 1/2 stop too light.

[A] →

For density correction:

.5 (for half stop darker) [B] →

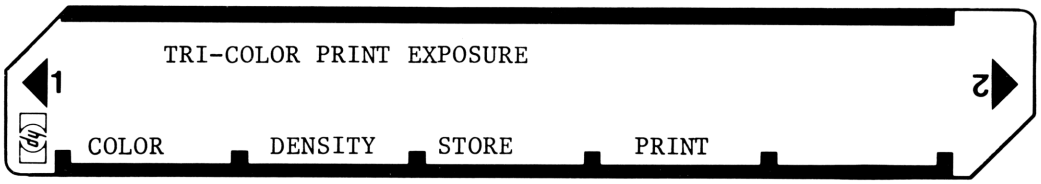
Reference(s) CAMERA 35 JAN/FEB, 1972 ISSUE

A NEW LOOK AT ADDITIVE FILTRATION PRINTING TRY TRI-COLOR BY JOHN J. SCOTT.

THIS PROGRAM IS A MODIFICATION OF THE USERS' LIBRARY PROGRAM #01620A

SUBMITTED BY JOHN J. SCOTT.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	ENTER PROGRAM			
2	STORE TEST PRINT RED TIME IN R1	SECONDS	ENTER↑ N	RED SECS
3	STORE TEST PRINT GREEN TIME IN R2	SECONDS	ENTER↑ N	GREEN
4	STORE TEST PRINT BLUE TIME IN R3	SECONDS	C 3	BLUE
5	ENTER COLOR SECTOR NUMBER OF COLOR TO BE		ENTER↑	
	CHANGED FROM WHEEL PAGE 2	1 THRU 12	↑	
6	INSERT UNITS OF DESIRED COLOR CHANGE (SAME			
	UNITS AS COMMON SUBTRACTIVE FILTERS 10 OR 20			
	OR 30, ETC.). IF COLOR IN PRINT IS TO BE			
	INCREASED, USE POSITIVE VALUE. IF COLOR IN			
	THIS SECTOR IS TO BE DECREASED CHS TO			
	NEGATIVE. ACTUALLY COLOR WILL BE AFFECTED			
	ALL AROUND THE WHEEL. IT IS THE PRE-			
	DOMINANT SECTOR WE DEAL WITH. COMPUTE			
	COLOR-CORRECTED TIMES TO BE USED FOR NEXT			ANSWERS IN STACK
	PRINT.	UNITS OF COLOR CHANGE	A	0.0 T
				RED SECONDS Z
				GREEN SECONDS Y
				BLUE SECONDS X
7	IF LIGHTER OR DARKER PRINT IS DESIRED, WITH-			
	OUT CHANGING LENS SETTING, INSERT SHIFT IN f			
	STOPS (INCLUDING FRACTIONAL VALUES) POSITIVE			
	FOR DARKER AND NEG. FOR LIGHTER. TIMES			ANSWERS IN
	STORED IN R1, R2, AND R3 WILL BE COMPUTED			STACK
	AND RE-STORED.		B	0.0 T
	EXAMPLE: INSERT - .25			RED SECONDS
	FOR 1/4 f STOP CHANGE TO A			GREEN Y
	LIGHTER PRINT.			BLUE X
8	TO RECALL TIMES FOR NEXT PRINT AND PRINT ON		D	0.0 T
	97 OR DISPLAY ON 67.			RED Z
				GREEN Y
				BLUE X

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL A	21 11	
002	.	-52	
003	0	00	Calculate new
004	2	02	color times.
005	×	-35	
006	3	03	
007	÷	-24	Color shift factor.
008	STO 4	35 04	
009	X≠Y	-41	
010	3	03	
011	0	00	
012	×	-35	Short deg. on
013	STO 5	35 05	color wheel
014	SIN	41	
015	×	-35	Sine plot
016	10^x	16 33	
017	ST×1	35-35 01	Red exposure factor
018	RCL 5	36 05	
019	1	01	Corrected red
020	2	02	seconds
021	0	00	
022	+	-55	
023	SIN	41	Sin curve phase shift
024	RCL 4	36 04	
025	×	-35	
026	10^x	16 33	Green exposure factor
027	ST×2	35-35 02	
028	RCL 5	36 05	
029	2	02	Corrected gr. seconds
030	4	04	
031	0	00	
032	+	-55	Sin curve phase shift
033	SIN	41	
034	RCL 4	36 04	
035	×	-35	
036	10^x	16 33	Blue exposure factor
037	ST×3	35-35 03	Corrected blue
038	DSP 1	-63 01	secs
039	GTO D	22 14	
040	*LBL B	21 12	
041	.	-62	
042	3	03	Calculate print
043	×	-35	density change
044	1	01	
045	0	00	
046	X≠Y	-41	
047	Y^x	31	Exposure factor
048	ENT↑	-21	
049	ENT↑	-21	
050	ENT↑	-21	
051	ST×1	35-35 01	Red seconds
052	R↓	-31	
053	ST×2	35-35 02	Green seconds
054	R↓	-31	Blue seconds
055	ST×3	35-35 03	Print/disp times
056	*LBL D	21 14	
057	0	00	
058	RCL 1	36 01	
059	RCL 2	36 02	
060	RCL 3	36 03	
061	FRST	16-14	
062	RTN	24	Store times
063	*LBL C	21 13	
064	STO 3	35 03	
065	R↓	-31	
066	STO 2	35 02	
067	R↓	-31	
068	STO 1	35 01	
069	RTN	24	
070	R/S	51	

080 090 100 110

SET STATUS

FLAGS	ON	OFF	TRIG	DISP
0	☐	☒	DEG ☒	FIX ☒
1	☐	☒	GRAD ☐	SCI ☐
2	☐	☒	RAD ☐	ENG ☐
3	☐	☒		n 2

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

Program Description I

Program Title COLOR PRINT PROCESSING IN DRUM

Contributor's Name Hewlett-Packard, Corvallis Division

Address 1000 N. E. Circle Blvd.

City Corvallis **State** OR **Zip Code** 97330

Program Description, Equations, Variables Gives the color print developing time in a drum (Unidrum) for any value of presoak water temperature in the drum, and developer temperature, from 70 degrees F to 120 degrees F, for Unicolor B, RZ, and AR chemistry. The formula is as follows:

$\log_{10} t = K - .012\ Tps - .00643\ T_D$

Where Tps = presoak water temperature in degrees F.

T_D = developer temperature in degrees F.

K = a constant which depends on the Unicolor chemistry being used.

t = developing time

The values of K are:

Chemistry	K
B	1.983
AR	2.290
R2	2.427

Operating Limits and Warnings Develop by time and temperature using the programs if you choose, but remember that a different color balance will probably be apparent at each set of temperatures. So, be consistent, keep processing temperatures constant, at least during one processing session.

Program Description II

Sketch(es)

Sample Problem(s) Find the developing time in minutes when using Unicolor Type AR chemistry, with 110 degrees F. Presoak water temperature in the Unicolor Drum, and 80 degrees F. developer temperature.

Solution(s) Enter 2[D] for Unicolor AR Chemistry. Key in 110 degrees F. Presoak water temperature, and press key [A].

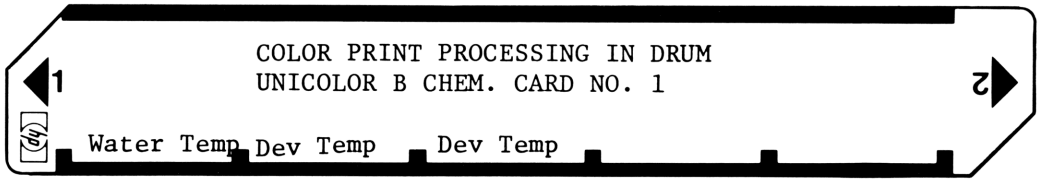
Key in 80 degrees F. developer temperature, and press key [B].

Press key [C] for the answer = 2.85 minutes developing time. Since developing times to the nearest 1/2 minute are usually used, this answer would be considered as 3 minutes.

Reference(s) Unicolor Tech Newsletter #21, July 21, 1975, prepared by Mr. Bob Chapman of Unicolor Division Photo Systems, Inc., 7200 Huron River Drive, Dexter, Michigan 48130.

THIS PROGRAM IS A MODIFICATION OF THE USERS' LIBRARY PROGRAM #04587A SUBMITTED BY ROBERT W. KOTZEBUE, SR.

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter 1 for B chemistry or enter 2 for AR chemistry or enter 3 for R2 chemistry	~~CHEMISTRY~~ CODE	D	
2	Key in presoak water temperature in degrees F.	DDD.	A	
3	Key in developer temperature in degrees F.	DDD.	B	
4	Press key [C] to calculate the developing time in minutes.		C	M.MM

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL2	21 14	
002	1	01	
003	X≠Y?	16-34	
004	GTO8	22 08	
005	R↓	-31	Enter chemistry code
006	4	04	
007	X≠Y?	16-35	
008	GTO8	22 08	
009	R↓	-31	
010	STOA	35 11	
011	RTN	24	
012	*LBL0	21 00	
013	0	00	Error
014	÷	-24	
015	*LBLC	21 13	
016	RCLA	36 11	
017	6	06	
018	+	-55	Developing time
019	STO1	35 46	
020	GTO1	22 45	
021	*LBLA	21 11	
022	.	-62	
023	3	03	
024	1	01	
025	2	02	Presoak temp.
026	×	-35	
027	STO1	35 01	
028	RTN	24	
029	*LBLB	21 12	
030	.	-62	
031	0	00	
032	0	00	
033	6	06	Developer temp
034	4	04	
035	3	03	
036	×	-35	
037	STO2	35 02	
038	RTN	24	
039	*LBL7	21 07	
040	1	01	
041	.	-62	
042	3	03	
043	8	08	
044	3	03	B Chem
045	ENT↑	-21	
046	RCL1	36 01	
047	-	-45	
048	RCL2	36 02	
049	-	-45	
050	10ˣ	16 33	
051	RTN	24	
052	*LBL8	21 08	
053	2	02	
054	.	-62	AR Chem
055	2	02	
056	9	09	
057	ENT↑	-21	
058	RCL1	36 01	
059	-	-45	
060	RCL2	36 02	
061	-	-45	
062	10ˣ	16 33	
063	RTN	24	
064	*LBL9	21 09	
065	2	02	
066	.	-62	
067	4	04	
068	2	02	
069	7	07	
070	ENT↑	-21	R2 Chem
071	RCL1	36 01	
072	-	-45	
073	RCL2	36 02	
074	-	-45	
075	10ˣ	16 33	
076	RTN	24	
077	R/S	51	

080

090

100

110

REGISTERS

0	1 Presoak Temp.	2 Dev. Temp.	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

Program Description I

Program Title	CIBACHROME RECIPROCITY CORRECTION
Contributor's Name	HEWLETT-PACKARD
Address	1000 NE. CIRCLE BLVD.
City	CORVALLIS **State** OR **Zip Code** 97330

Program Description, Equations, Variables Computes exposure times and filter pack corrections from desired theoretical exposure change. Reciprocity failure and filter correction data from the reference are programmed as

$$\log t_2 = 1.279\ D + \log t_1$$

$$Y = -3 \log^2 t_2 + 15 \log t_2 - 6.4$$

$$C = \begin{cases} -7.2 \log^2 t_2 + 1.08 \log t_2 + 1.12 & ; t_2 < 30 \text{ sec} \\ -20 \log t_2 + 16.5 & ; t_2 > 30 \text{ sec} \end{cases}$$

where t_1 = Exposure time for test print
D = Desired Log exposure change
t_2 = Exposure time for new print
Y = Yellow filtration correction for reciprocity failure
C = Cyan filtration correction for reciprocity failure

Note: 0 filtration correction corresponds to 3 sec exposure

Operating Limits and Warnings 1. Published data are given from 3 to 300 sec. actual exposure time. Reciprocity curve is log-log linear over entire region and can thus probably be extrapolated beyond 300 sec. Yellow filtration appears assymptotic to +12 as 300 sec is approached and cyan filtration is log-log linear beyond 30 sec. User should understand that numbers computed beyond 300 sec. are extrapolations. 2. Filters are accurate to $\pm$ 2 units (0.02 density).
3. Published data pertain to type D material but program is primarily used by author successfully with type A.

Program Description II

Sketch(es)

Sample Problem(s) 1) A test print was correctly color balanced but 1 stop (0.3 log units) under exposed at 15 sec. Find the new exposure and filter pack changes required.

2) A pleasing print is made with 300 sec. exposure time. It is desired to shorten this time to speed production. The enlarger lens is opened 3 stops (.9 log units) requiring a reduction of a like amount in exposure time. Find the new exposure time and filter pack changes.

Note: a) A 1 stop change corresponds to a doubling or halving of exposure. Log 2 = .3 Thus a .1 change corresponds to 1/3 stop.

b) Filtration changes are given as 100 times the log of the filter density as is the common practice.

Solution(s)

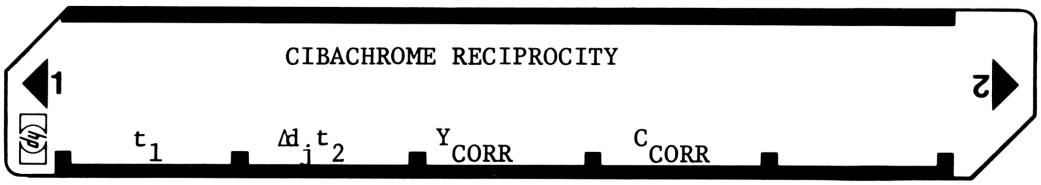
1) 15 A 7 (Yel filter Rel. to 3 sec. exp.)
R/S -8 (Cyan filter Rel. to 3 sec. exp.) optional
.3 B 36 New exposure time, sec
C 3 Add 3 yel (log Dens = .03)
D -7 Subtract 7 Cyan (log Dens = .07)

2) 300A 12 (Cyan filter Rel. to 3 sec.)
.9[CHS]B 21 New exposure time, sec.
C -4 Remove 4 yel (.04)
D 23 Add 23 Cyan (.23)

Reference(s)

CIBACHROME PRINT TYPE D CCP-D 182
Technical Data Booklet No. 23, Feb., 1973
Ciba-Geigy Photochemie Ltd., Fribourg, Switzerland.
THIS PROGRAM IS A TRANSLATION OF THE HP-65 USERS' LIBRARY PROGRAM #04507A SUBMITTED BY ANDREW J. DELANGE

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load program			
2	Enter last print t_1	sec.	A	Y filter log units
2a*	Compute C Filter		R/S	C filter log units
3	Compute New t	Log Exp. Change	B	t_2 sec
4	Compute Y Filter Chg		C	ΔY log units
5	Compute C Filter Chg		D	ΔC log units
6*	New Y filter		RCL 7	Y new log units
7*	New C Filter		RCL 8	C new log units
	*OPTIONAL, CORRECTIONS RELATIVE TO 3-SECOND EXPOSURE			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	
002	DSP0	-63 00	
003	LOG	16 32	Input Test Exp., t_1
004	STO1	35 01	
005	GSBE	23 15	Compute Y and C
006	RCL8	36 08	
007	STO3	35 03	STO C IN3
008	RCL7	36 07	
009	STO2	35 02	STO Y in 2 & DSPLY
010	R/S	51	
011	RCL3	36 03	
012	R/S	51	DSPLY C
013	*LBLB	21 12	
014	1	01	
015	.	-62	
016	2	02	
017	7	07	
018	9	09	
019	X	-35	
020	RCL1	36 01	Input Desired Dens.
021	+	-55	log t_2=1.279d + log
022	STO1	35 01	new exp.
023	10^x	16 33	
024	RTN	24	Display new exp.
025	*LBLC	21 13	
026	GSBE	23 15	Compute filter
027	RCL7	36 07	changes
028	RCL2	36 02	Compute new Y
029	-	-45	Recall new Y
030	RTN	24	Recall old Y
031	*LBLD	21 14	Difference
032	RCL8	36 08	Change in Y filtration
033	RCL3	36 03	Compute C change
034	-	-45	Recall new C
035	RTN	24	Recall old C
036	*LBLE	21 15	Difference
037	6	06	Change in C filtration
038	.	-62	Y & C computation
039	4	04	
040	CHS	-22	-6.4
041	ENT↑	-21	
042	1	01	
043	5	05	
044	RCL1	36 01	log t_2
045	X	-35	
046	+	-55	15 log t_2-6.4
047	RCL1	36 01	log t_2
048	ENT↑	-21	
049	X	-35	
050	3	03	
051	X	-35	3 log $2t_2$
052	-	-45	
053	STO7	35 07	15 log t_2-3 log^2
054	1	01	t_2-6.4
055	.	-62	STO Y
056	1	01	
057	2	02	
058	ENT↑	-21	
059	1	01	
060	.	-62	
061	0	00	
062	8	08	
063	RCL1	36 01	
064	X	-35	1.08 log t_2+1.12
065	+	-55	
066	RCL1	36 01	
067	ENT↑	-21	
068	X	-35	
069	7	07	
070	.	-62	
071	2	02	1.08 logt_2^2+1.12-
072	X	-35	2.2 log^2 t_2
073	-	-45	
074	STO8	35 08	
075	1	01	Sto C
076	.	-62	
077	4	04	
078	8	08	
079	RCL1	36 01	
080	X≤Y?	16-35	log t_2, log 30
081	RTN	24	
082	RCL1	36 01	linear portion
083	2	02	
084	0	00	
085	X	-35	
086	CHS	-22	
087	1	01	
088	6	06	
089	.	-62	
090	5	05	16.5-20 log t_2
091	+	-55	
092	STO8	35 08	STO C
093	RTN	24	
094	R/S	51	

100

110

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☒	DEG ☒	FIX ☒
1	☐	☒	GRAD ☐	SCI ☐
2	☐	☒	RAD ☐	ENG ☐
3	☐	☒		n 2

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

Program Description 1

Program Title PRINT VIEWING DISTANCE

Contributor's Name Hewlett-Packard, Corvallis Division

Address 1000 N. E. Circle Blvd.

City Corvallis **State** OR **Zip Code** 97330

Program Description, Equations, Variables

$$\text{(LENS FOCAL LENGTH)} = \frac{\text{(VIEWING DISTANCE)}}{\text{("X"- ENLARGEMENT)}}$$

$$\text{("X" ENLARGEMENT)} = \frac{\text{(VIEWING DISTANCE)}}{\text{(LENS FOCAL LENGTH)}}$$

$$\text{(VIEWING DISTANCE)} = \text{("X" ENLARGEMENT)(LENS FOCAL LENGTH)}$$

PRINT MAGNIFICATION DIAMETERS:

$$(N_1)^2 + (N_2)^2$$

$$(P_1)^2 + (P_2)^2$$

WHERE:

N_1 ≡ ONE NEGATIVE SIDE

N_2 ≡ SECOND AND PERPENDICULAR NEGATIVE SIDE

P_1 ≡ ONE PRINT SIDE

P_2 ≡ 2ND 1 PRINT SIDE

Operating Limits and Warnings LENS FOCAL LENGTH AND VIEWING DISTANCE VALUES MUST BE A MILLIMETER INPUT.

Program Description II

Sketch(es)

Sample Problem(s) A) A photo was taken with a 135 mm lens and enlarged 8 times (negative size). What is the proper viewing distance in feet necessary to maintain proper subject perspective?

B) You have a photo you wish to be viewed from 20 feet. It was taken with a 105 mm lens. How many diameters enlargement should the print be?

C) You wish a 12X print which will be viewed from 1800 mm. What focal length lens should you use?

D) Your negative size is 24 mm X 36 mm; your print size is 508.00 mm X 762.00 mm. What is the magnification factor?

Solution(s)

A) 3.54 feet. [D]135 [A]8 [B][E][R/S] → 3.54

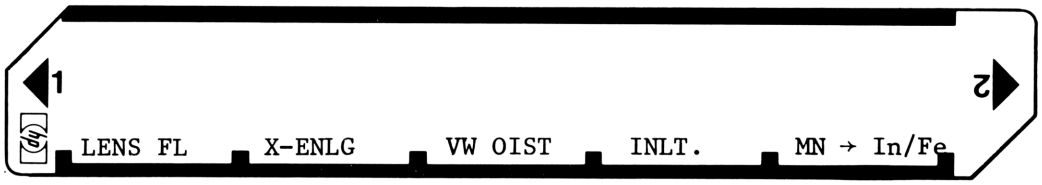
B) 58.06X[D]105 [A]20[f][B][C] → 58.06X (negative size)

C) 150.00 mm lense [D]12 [B]1800 [C] → 150.00

D) 21.17 X 24[ENT↑]36[ENT↑] 508[ENT↑] 762[F][A] → 21.17 X

Reference(s) THIS PROGRAM IS A MODIFICATION OF THE USERS' LIBRARY PROGRAM #01411A SUBMITTED BY STUART A. RIGG.

User Instructions



STEP	INSTRUCTIONS		INPUT DATA/UNITS	KEYS		OUTPUT DATA/UNITS
1	ENTER PROGRAM					
2	INITIALIZE			D		
	(TO FIND:)					
3	LENS FOCAL LENGTH		"X"-ENLG	B		0.00
	(OR)	MM	VW. OST	C		LENS FL(MM)
3	DIAMETERS ENLARGEMENT	MM	LENS FL	A		0.00
	(OR)	MM	VW. OST	C		"X" ENLG
3	VIEWING DISTANCE FOR PRINTS	MM	LENS FL	A		0.00
			"X"-ENLG	B		VW-OST(MM)
4	MM → INCHES-FEET		MM	E		INCHES
				R/S		FEET
	TO FIND DIAMETERS ENLARGEMENT					
5	NEGATIVE SIZE (TWO SIDES 1)		MM	↑		
			MM	↑		
	PRINT SIZE (TWO SIDES 1)		MM	↑		
			MM	f	A	"X"-ENLG
6	FEET → MM		FEET	f	C	MM
7	INCHES → MM		INCHES	f	C	MM
	(FOR A NEW CASE GO TO STEP 2)					
	* LENS FOCAL LENGTH AND VIEWING DISTANCE					
	MUST BE IN MILLIMETERS.					

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	LENS FOCAL LENGTH ROUTINE
002	STO1	35 01	
003	CLX	-51	
004	RCL2	36 02	
005	X≠Y?	16-32	CHECK FOR PREVIOUS ENTRIES
006	GTO4	22 04	
007	RCL1	36 01	
008	GTO1	22 01	
009	*LBL4	21 04	
010	1	01	
011	RCL1	36 01	
012	×	-35	
013	×	-35	
014	RTN	24	
015	*LBLB	21 12	DIAMETERS ENLARGEMENT
016	STO2	35 02	
017	CLX	-51	
018	RCL1	36 01	
019	X≠Y?	16-32	
020	GTO5	22 05	
021	RCL2	36 02	
022	GTO1	22 01	
023	*LBL5	21 05	CHECK FOR PREVIOUS ENTRIES
024	1	01	
025	RCL2	36 02	
026	^	-35	
027	×	-35	
028	RTN	24	
029	*LBLC	21 13	VIEWING DISTANCE
030	STO3	35 03	
031	CLX	-51	
032	RCL1	36 01	
033	X=Y?	16-33	CHECK FOR PREVIOUS ENTRIES
034	GTO2	22 02	
035	RCL3	36 03	
036	X≠Y	-41	
037	÷	-24	
038	RTN	24	
039	*LBLD	21 14	
040	CLRG	16-53	INITIALIZE
041	RTN	24	
042	*LBLE	21 15	
043	2	02	
044	5	05	
045	.	-62	
046	4	04	NM → IN → FT
047	÷	-24	
048	R/S	51	
049	1	01	
050	2	02	
051	÷	-24	
052	RTN	24	
053	*LBL1	21 01	
054	RCL3	36 03	END ROUTINE
055	0	00	
056	X=Y?	16-33	
057	RTN	24	
058	+	-55	
059	X≠Y	-41	
060	÷	-24	
061	RTN	24	
062	*LBL2	21 02	
063	RCL3	36 03	
064	RCL2	36 02	
065	0	00	END ROUTINE
066	X=Y?	16-33	
067	RTN	24	
068	+	-55	
069	÷	-24	
070	RTN	24	
071	*LBLa	21 16 11	
072	→F	34	
073	STO4	35 04	
074	R↓	-31	DIAMETERS MAGNIFICATION
075	R↓	-31	
076	→P	34	
077	RCL4	36 04	
078	X≠Y	-41	
079	÷	-24	
080	RTN	24	
081	*LBLb	21 16 12	FE → MM
082	1	01	
083	2	02	
084	×	-35	
085	*LBLc	21 16 13	
086	2	02	
087	5	05	IN → MM
088	.	-62	
089	4	04	
090	×	-35	
091	RTN	24	
092	R/S	51	

100

110

SET STATUS

FLAGS			TRIG	DISP
	ON	OFF		
0	☐	☒	DEG ☒	FIX ☒
1	☐	☒	GRAD ☐	SCI ☐
2	☐	☒	RAD ☐	ENG ☐
3	☐	☒		n 2

REGISTERS

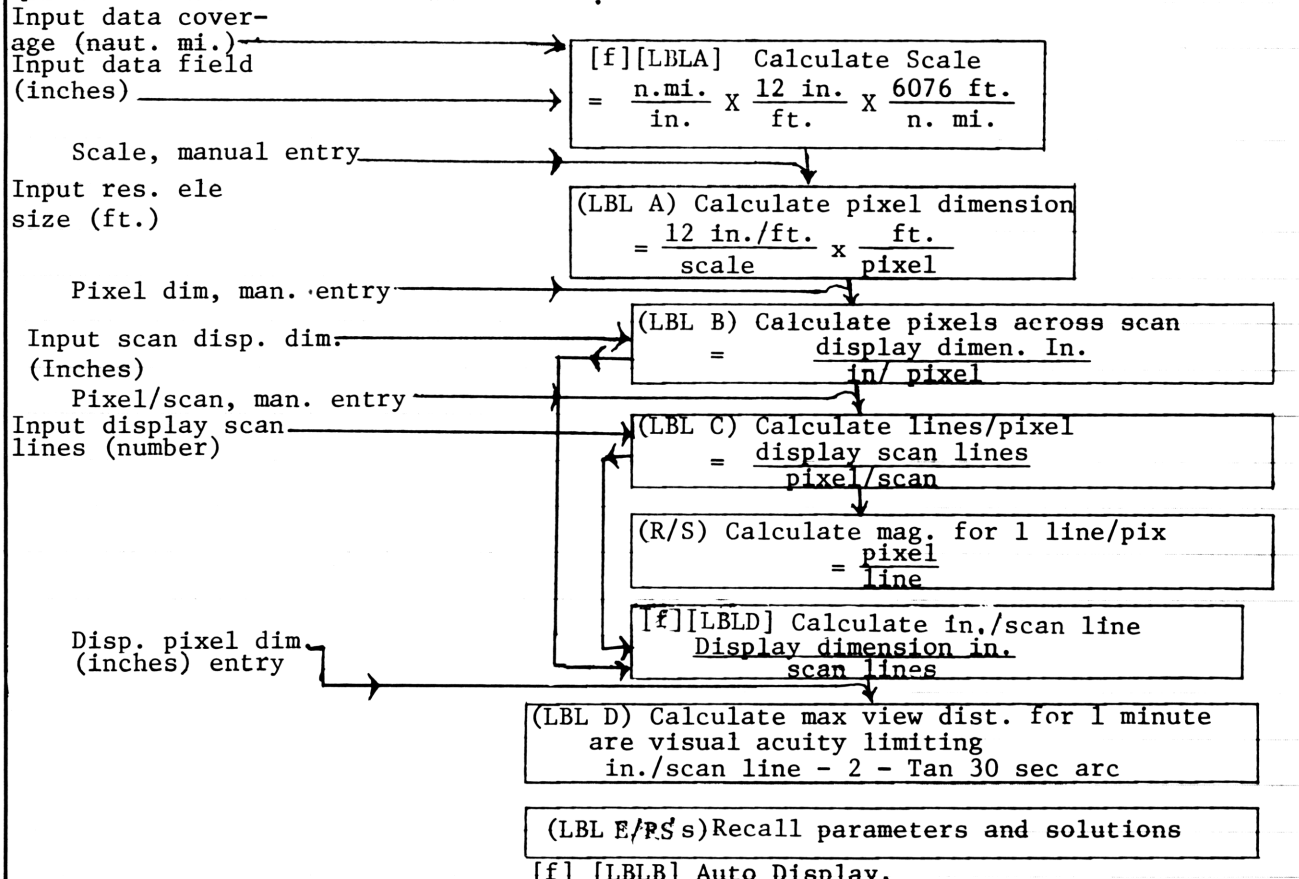
0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

Program Description I

Program Title	PHOTO/IMAGE DISPLAY PARAMETERS
Contributor's Name	Hewlett-Packard, Corvallis Division
Address	1000 N. E. Circle Blve.
City	Corvallis **State** OR **Zip Code** 97330

Program Description, Equations, Variables Photo or image interpretation can be accomplished from photographic film, projected, or displayed on closed circuit TV viewing systems. This program computes parameters of interest that can be determined from known system and data characteristics. Computation sequence is to solve for scale, pixel dimensions, number of pixels, scan lines per pixel, magnification for 1 line/pixel portrayal, and maximum viewing distance for visual acuity limiting. All quantities are stored for later review.



The manual entry provision allows starting anywhere in the program for individual computation.

Program Description II

Sketch(es)

Sample Problem(s)

Utilize the program to determine parameters for a photo image covering 10 nautical miles over a 2.5-inch field. Assume 50 foot resolution. Consider TV display on a 17-inch monitor with a 10.2-inch vertical dimension (4/3 aspect ratio), utilizing a 1225 line raster (1190 active line scans).

Enter data coverage	10 nmi.	↑	
Enter data field	2.5 in. [f][A]		291648 (: 1)
Enter resolution element	50 ft.	A	0.00206 in.
Enter scan display dimins.	10.2 in.	B	4958.02
Enter display lines	1190	C	0.24
Find magnification		R/S	4.17
Find Max. viewing dist.	[f][D][D]		29.47 in.
Recall quantities.		E	291648
		R/S	0.0021
		R/S	4958.0160
		R/S	0.2400
		R/S	4.1664
		R/S	29.4672
		R/S	1190.0000
		R/S	10.2000

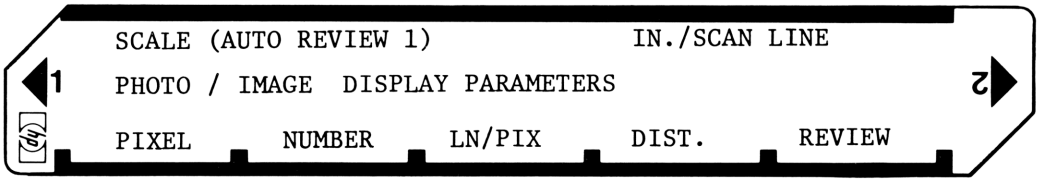
Solution(s)

#2 Find pixel dimensions for a resolution element of 20 ft. on a 100,000 : 1 scale.

Enter scale	100,000	↑	
Enter Resolution ele.	20 ft.	A	0.00240 in.

Reference(s)

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Enter program			
2	Enter data coverage (naut. miles)	Naut. mi.	↑	
3	Enter data field dimension (inches).	Inches	f A	Scale
4	If step 2 & 3 not used, enter scale	Scale	↑	
5	Enter resolution element size (feet)	Feet	A	pixel size
6	If step 5 not used, ent data pixel dim.	(inches)	↑	
7	Enter scanning display dimension (inches)	Inches	B	number pixels
8	If step 7 not used, ent 1 dim. pixel number	Dim	↑	
9	Enter number of display scan lines		C	lines pixel
10	Find magnification for 1 line/pixel		R/S	mag
11	If steps 7 & 9 used (for 1 line/pixel)		F D	inches scan line
12	If steps 7 & 9 not used, ent display pixel			
	dim.	(inches)		
13	Find limiting visual acuity distance		D	inches
14	Recal quantities			
	Reg. 1 Scale		E	
	Reg. 2 Data pixel dimension		R/S	
	Reg. 3 Number of pixels across disp.		R/S	
	Reg. 4 Scan lines/pixel		R/S	
	Reg. 5 Magnification for 1 line/pixel		R/S	
	Reg. 6 Visual acuity limit distance		R/S	
	Reg. 7 Display scan lines		R/S	
	Reg. 8 Display dimension		R/S	
	Return to step 14 Reg. 1		R/S	
15	To automatically display the quantities or		F B	
	print them on 97			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL a	21 16 11	ENTER DATA COV. (↑)
002	÷	-24	ENTER DATA FIELD
003	7	07	
004	2	02	
005	9	09	
006	1	01	
007	2	02	
008	×	-35	CALCULATE SCALE
009	DSP2	-63 02	
010	STO1	35 01	
011	RTN	24	
012	*LBL A	21 11	ENT. RES ELE SIZE
013	1	01	
014	2	02	
015	×	-35	CALCULATE PIXEL
016	X≷Y	-41	DIMENSION
017	÷	-24	
018	DSP5	-63 05	
019	STO2	35 02	
020	RTN	24	
021	*LBL E	21 12	ENT SCAN. DISP DIM
022	STO8	35 08	
023	X≷Y	-41	CALCULATE NUMBER
024	÷	-24	OF PIXELS ACROSS
025	DSP2	-63 02	DISPLAY
026	STO3	35 03	
027	RTN	24	
028	*LBL C	21 13	ENT DISPLAY SCAN
029	STO7	35 07	LINES
030	X≷Y	-41	
031	÷	-24	CALCULATE LINES/
032	DSP2	-63 02	PIXEL
033	STO4	35 04	
034	R/S	51	
035	1/X	52	
036	STO5	35 05	CALCULATE MAG FOR
037	RTN	24	1 LINE/PIXEL
038	*LBL D	21 14	ENT. SCAN DISP
039	2	02	PIX
040	÷	-24	
041	.	-62	CALCULATE MAX.
042	0	00	VIEWING DISTANCE
043	0	00	FOR 1 MIN. ARC
044	0	00	VISUAL ACUITY
045	1	01	
046	4	04	
047	5	05	
048	4	04	
049	4	04	
050	÷	-24	
051	DSP2	-63 02	
052	STO6	35 06	
053	RTN	24	RECALL ALL STORED
054	*LBL E	21 15	QUANTITIES.
055	DSP4	-63 04	
056	RCL1	36 01	
057	R/S	51	
058	RCL2	36 02	
059	R/S	51	
060	RCL3	36 03	
061	R/S	51	
062	RCL4	36 04	
063	R/S	51	
064	RCL5	36 05	
065	R/S	51	
066	RCL6	36 06	
067	R/S	51	
068	RCL7	36 07	
069	R/S	51	
070	RCL8	36 08	
071	R/S	51	
072	GTOE	22 15	
073	*LBL b	21 16 12	
074	DSP4	-63 04	AUTOMATIC PRINT
075	RCL1	36 01	
076	RCL2	36 02	
077	RCL3	36 03	
078	RCL4	36 04	
079	PRST	16-14	
080	RCL5	36 05	
081	RCL6	36 06	
082	RCL7	36 07	
083	RCL8	36 08	
084	PRST	16-14	
085	RTN	24	SET UP FOR SCAN-
086	*LBL a	21 16 14	NING DISPLAY
087	RCL8	36 08	PIXEL DIMENSION
088	RCL7	36 07	
089	÷	-24	
090	RTN	24	
091	R/S	51	
100			
110			

FLAGS	SET STATUS		
0	FLAGS	TRIG	DISP
1	ON OFF		
2	0 ☐ ☒	DEG ☒	FIX ☒
3	1 ☐ ☒	GRAD ☐	SCI ☐
	2 ☐ ☒	RAD ☐	ENG ☐
	3 ☐ ☒		n 2

REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				

Program Description I

Program Title IMAGE PROJECTION DATA

Contributor's Name Hewlett-Packard, Corvallis Division
Address 1000 N. E. Circle Blvd.
City Corvallis **State** OR **Zip Code** 97330

Program Description, Equations, Variables Provides unknown required to select proper lens, projection distance, screen size when 2 are known, then gives maximum viewing area, estimates seating capacity, gives minimum and maximum viewing distances, uses film format factor stores in R4, works for 8, Super 8, 16 mm 35 full and half frame, 110, 126, 127, 120 (2 1/4 sq) film sizes and for 5, 7, 10 "overhead projectors. [Format factors for different sizes can be figures closely by formula 2.16 x width of original (in mm)] provides for conversion formula 2.16 x width of original (in mm)] provides for conversion of inches to feet and mm to inches.

Formula(s) F = Factor L = Full Length S = Screen width 0 = Distance

To find Distance	= (s ÷ F) X L
To find Lens	= D ÷ (s ÷ F)
To find Screen	= F X (D ÷ L)
Viewing Area	= S^2 ÷ 11
Minimum Dist.	= S X 2
Maximum Dist.	= S X 4
Capacity	= (Viewing Area) ÷ 6 (6 sq' per person)

Operating Limits and Warnings FORMAT VS. FACTOR ROUTINE

Run or store new factor in R4 to change format. — 110 film factor assumes 110 projector is used, which may result in slight error if 35 mm projector used. Similarly for other sizes not shown in proper projector. - Viewing area, capacitiesetc., are estimated and actual figures vary depending on room characteristics and seating arrangement, etc.

Recommend reduction by 25% for audience comfort.

Program Description 11

Sketch(es)

FORMAT VS. FACTOR REFERENCE (F)

[A] 16 (mm) F (4.68)	[B] 127 F (18)	[C] 120 (21/4^{sq}) F(26.4)	[D] 10 (10x10) F(120)	[E] STORES "F" IN R 4
[R/S] 8 (mm) F (2.54)	[R/S] 126 F (12.6)	[R/S] 35 (mm) F (15.96)	[R/S] 7 (7x7) F (84)	
[R/S] 58 ($^{super}_{8}$) F (2.09)	[R/S] 110 F (7.35)	[R/S] 35.5 1/2 frame F (10.8)	[R/S] 5 (5x5) F (60)	

Sample Problem(s) Projector showing 35 mm slides on 8' screen requires what distance [1] to fill screen? Lens is 80 mm. Being limited to 6' projection distance what size [2] is image? This is unsatisfactory, so what lens [3] would solve problem? Since only the projection distance is limited, what is the estimated viewing area [4], audience capacity [5], and minimum [6] and maximum [7] viewing distances?

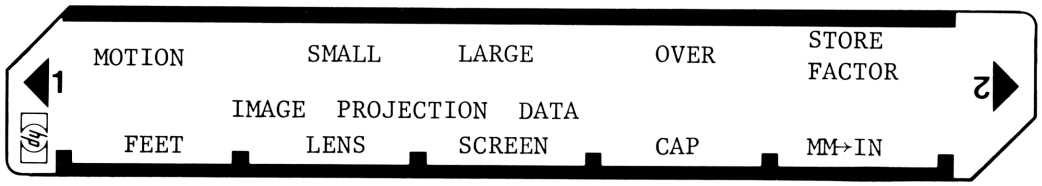
NOTE: Screen or image size is only required data for [4], [5], [6], [7], and previous problems need not be solved first.

Solution(s) [f] [C] = 120, [R/S] = 35 (mm), [f] [E] = 15.96; 80 [E] = 3.15", [B] = 0, 8 (ENTER), 12 (X), (C)=0; A 18.9' [1]; 6[A] = 0, [C] = 30.4" [2]; 96[C] = 0, [B] = 1.0" [3] [D] = 8.37.8$^{sq'}$ [4]; R/S = 140 people [5]; R/S = 16.0' min [6]; R/S = 48.0' max [7]

Reference(s) Various slide rule calculators as available from knox, radiant, daylite screen manufacturers.

This program is a modification of the Users' Library program #0377A submitted by Harry M. Sweeney

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load side 1 and 2			
2	Select proper format from			
	a. Motion picture label 16mm		f A	16
	and for regular 8mm		R/S	8
	and for super 8mm		R/S	58
	b. Small format label (127)		f B	127
	and for 127 Instamatic		R/S	126
	and for 110 Instamatic		R/S	110
	c. Large format label (120/220)		f C	120
	and for 35mm full frame		R/S	36
	and for 35mm 1/2 frame		R/S	35.5
	or			
	d. Overhead format label (10X10)		f D	10
	and for 7 X 7 size		R/S	7
	and for 5 X 5 size		R/S	5
3	Convert and store factor	Format	f E	Factor
	or			
4	Enter other format			
	a. Store any known format factor without			
	use of tables	Factor	STO 4	
	or			
	b. Estimate unknown format factor without use			
	of tables by entering original image			
	width (longest 01M.) and	MM	↑ 2	
	multiply by 2.16		. 1	
			6 X	Factor
	Store in R4		STO 4	
5	Input known variables:			
	a. Projection distance	Feet	A	0
	and/or			
6	Focal length or	Inches	B	0
	Focal Length	MM	E	0
	and/or			
	c. Screen image size (width)	Inch	C	0
	then			
6	Find unknown:			

User Instructions

STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
6	a. Projection distance	0	A	Feet
	or			
	b. Focal length	0	B	Inch
	or			
	c. Screen image size (width)	0	C	Inch
	Then: (Optional)			
7	Find Suggested Seating Area		D	Sq. Feet
	and then: (Optional)			
8	Find capacity of area	Area	R/S	People
	and then: (Optional)			
9	Find minimum viewing distance		R/S	Feet
	And then: (Optional)			
10	Find maximum viewing distance		R/S	Feet
	NOTE: Only screen size (Step 3) is			
	required for computations in Steps 7			
	through 10.			
	For new problem, repeat Steps			
	5 through correcting variables affected only.			
	Repeat Steps 2 through 4 only if format			
	changed.			

97 Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	"FEET" PROJECTION DISTANCE
002	DSP1	-63 01	
003	0	00	
004	X=Y?	16-33	"FEET" UNKNOWN?
005	GTO1	22 01	CALCULATE!
006	R↓	-31	
007	STO1	35 01	
008	0	00	"FEET" KNOWN-STORE
009	RTN	24	R1 - DISPLAY
010	*LBL1	21 01	CALCULATE "FEET" ROUTINE
011	RCL3	36 03	RCL "SCREEN"
012	RCL4	36 04	RCL FACTOR
013	÷	-24	
014	RCL2	36 02	RCL "LENS"
015	×	-35	(S÷F) X L = "FEET"
016	STO1	35 01	STORE "FEET"
017	RTN	24	DISPLAY "FEET"
018	*LBLB	21 12	
019	DSF1	-63 01	"LENS" ROUTINE
020	0	00	
021	X=Y?	16-33	"LENS" UNKNOWN?
022	GTO2	22 02	CALCULATE!
023	R↓	-31	
024	STO2	35 02	STORE "LENS" R2
025	0	00	
026	RTN	24	DISPLAY 0
027	*LBL2	21 02	CALCULATE "LENS"
028	RCL1	36 01	RCL "FEET"
029	RCL3	36 03	RCL "SCREEN"
030	RCL4	36 04	RCL "FACTOR"
031	÷	-24	
032	÷	-24	FEET ÷ (S÷F) =
033	STO2	35 02	"LENS" STORE R2
034	RTN	24	DISPLAY "LENS"
035	*LBLC	21 13	
036	DSP1	-63 01	"SCREEN" ROUTINE
037	0	00	
038	X=Y?	16-33	"SCREEN" UNKNOWN
039	GTO3	22 03	CALCULATE!
040	R↓	-31	
041	STO3	35 03	"SCREEN" KNOWN
042	0	00	
043	RTN	24	STORE R3-DISPLAY 0
044	*LBL3	21 03	CALCULATE SCREEN
045	RCL1	36 01	RCL "FEET"
046	RCL2	36 02	RCL "LENS"
047	÷	-24	
048	RCL4	36 04	RCL "FACTOR"
049	×	-35	"SCREENS"=FX(FEET ÷L)
050	STO3	35 03	STORE "SCREEN" R3
051	R/S	51	AND DISPLAY
052	1	01	
053	2	02	CONVERT TO FEET
054	÷	-24	VIEWING ROUTINE
055	RTN	24	
056	*LBLD	21 14	
057	DSP1	-63 01	
058	RCL3	36 03	RCL "SCREEN"
059	ENT↑	-21	
060	×	-35	SQUARE
061	1	01	
062	1	01	
063	÷	-24	$S^2 \div 11$
064	R/S	51	DISPLAY AREA
065	6	06	
066	÷	-24	$(S^2 \div 11) \div 6$
067	DSP0	-63 00	AUDIENCE CAPACITY
068	R/S	51	
069	DSP1	-63 01	
070	RCL3	36 03	RCL "SCREEN"
071	6	06	S ÷ 12 X 2 = } SAME
072	÷	-24	S ÷ 6 }
073	R/S	51	MINIMUM DISTANCE
074	3	03	S ÷ 12 X 6 = } SAME
075	×	-35	S ÷ 6 X 3 = }
076	R/S	51	MINIMUM DISTANCE
077	*LBLE	21 15	
078	DSF2	-63 02	CONVERT MM INTO INCHES
079	2	02	
080	5	05	
081	.	-62	
082	4	04	
083	÷	-24	
084	RTN	24	INCHES
085	*LBLe	21 16 15	STORE FACTOR IN R4
086	DSF2	-63 02	
087	R↓	-31	
088	STO4	35 04	
089	RTN	24	
090	*LBLa	21 16 11	
091	DSP0	-63 00	
092	4	04	
093	.	-62	
094	6	06	16 MM FACTOR
095	8	08	
096	ENT↑	-21	
097	1	01	
098	6	06	16MM DISPLAY
099	R/S	51	
100	2	02	
101	.	-62	
102	5	05	REGULAR 8MM
103	4	04	FACTOR
104	ENT↑	-21	
105	8	08	8MM DISPLAY
106	R/S	51	
107	2	02	
108	.	-62	
109	0	00	8 FACTOR
110	9	09	
111	ENT↑	-21	

REGISTERS

0	1	2	3	4 FACTOR	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9

A	B	C	D	E	I

97 Program Listing II

STEP	KEY ENTRY	KEY CODE	COMMENTS
112	5	05	
113	8	08	
114	R/S	51	"S"8 DISPLAY
115	*LBL8	21 16 12	
116	DSP0	-63 00	
117	1	01	
118	2	02	127 FACTOR
119	ENT↑	-21	
120	1	01	
121	2	02	
122	7	07	
123	R/S	51	127 DISPLAY
124	1	01	
125	2	02	126 FACTOR
126	.	-62	
127	6	06	
128	ENT↑	-21	
129	1	01	
130	2	02	
131	6	06	
132	R/S	51	126 DISPLAY
133	7	07	
134	.	-62	
135	3	03	110 FACTOR
136	5	05	
137	ENT↑	-21	
138	1	01	
139	1	01	
140	0	00	
141	R/S	51	110 DISPLAY
142	*LBL3	21 16 13	
143	DSP0	-63 00	
144	2	02	
145	6	06	120 FACTOR
146	.	-62	
147	4	04	
148	ENT↑	-21	
149	1	01	
150	2	02	
151	0	00	
152	R/S	51	120 DISPLAY
153	1	01	
154	5	05	
155	.	-62	35 FULL FRAME
156	9	09	FACTOR
157	6	06	
158	ENT↑	-21	
159	3	03	
160	5	05	
161	R/S	51	35MM DISPLAY
162	1	01	
163	0	00	
164	.	-62	35MM HALF FRAME
165	8	08	FACTOR
166	ENT↑	-21	
167	3	03	
168	5	05	
169	.	-62	
170	5	05	
171	DSP1	-63 01	
172	R/S	51	35MM 1/2 FRAME
173	*LBL4	21 16 14	DISPLAY (.5 = 1/2)
174	DSP6	-63 00	
175	1	01	
176	2	02	120 = "10X10"
177	0	00	FACTOR
178	ENT↑	-21	
179	1	01	
180	0	00	
181	R/S	51	"10X10" DISPLAY
182	0	00	
183	4	04	"7X7" FACTOR
184	ENT↑	-21	
185	7	07	
186	R/S	51	"7X7" DISPLAY
187	6	06	
188	0	00	"5X5" FACTOR
189	ENT↑	-21	
190	5	05	
191	R/S	51	"5X5" DISPLAY

200

210

220

LABELS					FLAGS
A	B	C	D	E	0
a	b	c	d	e	1
0	1	2	3	4	2
5	6	7	8	9	3

SET STATUS

FLAGS	TRIG	DISP
ON OFF		
0 ☐ ☒	DEG ☒	FIX ☒
1 ☐ ☒	GRAD ☐	SCI ☐
2 ☐ ☒	RAD ☐	ENG ☐
3 ☐ ☒		n 2

NOTES

NOTES

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