FOCALWARE 1200™

Program Documentation
Pocket Computer Version
Sharp PC-1270

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FOCALWARE 1200

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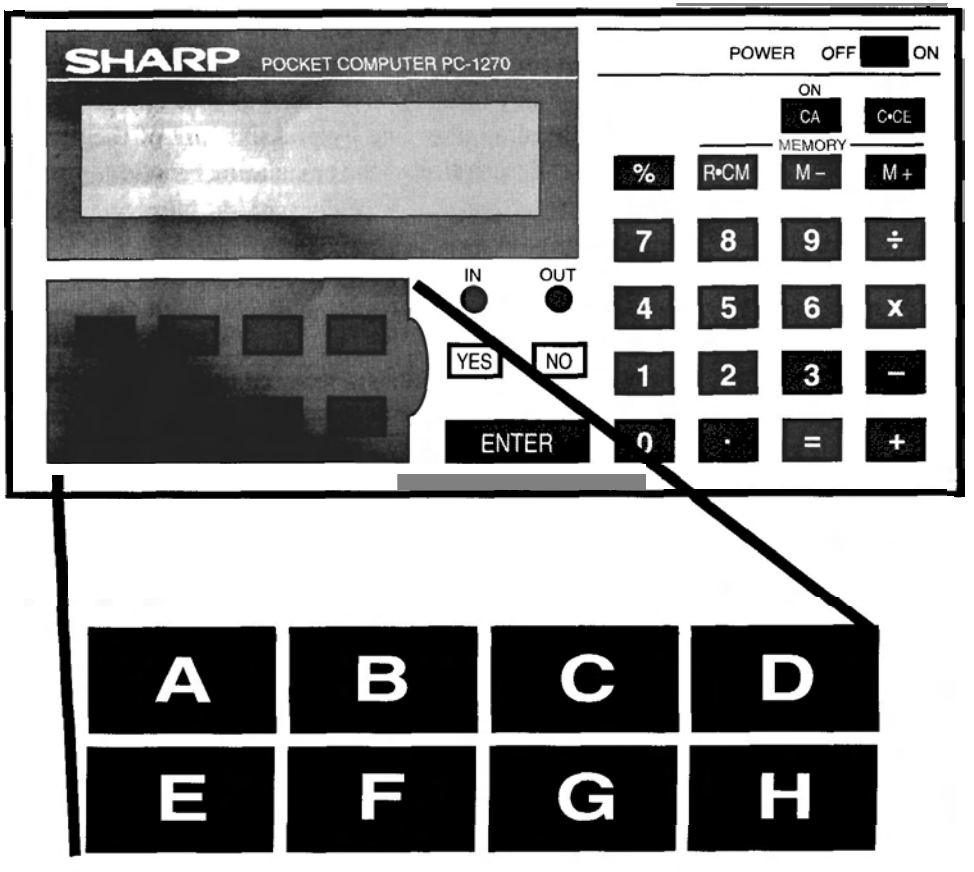
INTRODUCTION

The photograph below identifies the photography program keys with the letters A through H. Although these letters do not appear on the computer itself (that would be too easy), the documentation examples refer to these letters to describe access to the programs.



Below is a crash course to get your started by acquainting you with the main hardware points. Your Instruction Manual is a good source of detailed information, and is recommended.

1. Turn unit on by pressing the ON button. The display will read:

DEG 0.

It is ready to be used as a standard calculator using the keypad on the right. The photography programs are accessed by pressing one of eight keys on the left. If you are into one of the photography programs and want to get back to the calculator just press the **ON(CA)** key and you are back in the calculator mode. You can turn off the computer at any time. You can also choose any program you desire even if in the middle of another one by pressing any of the photo software keys on the left. A brief description of the calculating functions are on the inside of the computer cover.

2. The computer is designed to turn the display off, to save batteries, 7 minutes following no activity on the keyboard. Reactivate the display with ON.

3. In the following documentation, the YES key is referred to as YES; the NO key as NO and the ENTER key as ENTER

Initialization Instructions: To prepare the 1270 computer after a battery change or replaced EPROM do the following: Turn unit on and press pen or pencil into small hole in back of the computer called All Reset. The screen goes: ** ** . Press ENTER and the screen goes *. Turn it off then on and the computer is ready to go. Consult your manual for further information.

SUN'S AZIMUTH & ELEVATION

PURPOSE: This program predicts when and if the sun will shine at a predetermined angle anytime of the year, anywhere in the world. The program takes into account the month, day, year, longitude, and latitude. In the USA, it additionally prompts for daylight savings and time zone. The computer then asks for the desired compass reading. The result is the time of day and the elevation. The computer can also provide sunrise and sunset times at the chosen locations and the azimuth of the sun at that time.

APPLICATION: In architectural photography, the photographer can take compass readings of important angles before the camera is out of the bag. Then the photographer can plan the day, exteriors and interiors, around when the light will be worth looking at for each of the shots which the computer predicts. Fashion, portrait and commercial photographers who need to shoot at a particular location where sunlight contributes to the lighting scheme would benefit as well. The only thing the program will not do, however, is predict a cloudy day. This worry is left to you!

KEYSTROKE	DISPLAY	COMMENTS
Menu key "A" ** Note ** if this is the first time you are using the computer & this program it will automatically prompt for new data with-asking permission to do so.	NEW DATA, Y/N?	This option is useful for updating internal information like date and location which are essential to the program. Typically you need new data the first time you use the Sun Program each day. Choose New here.
YES	MONTH= ? __	Requests the month you need the information for. Try June. Input 6 for 6th month.
6 & ENTER	DAY= ? __	Day request. Try 1st.
1 & ENTER	YEAR= ? __	Try 1991 for example.

KEYSTROKE	DISPLAY	COMMENTS
1991 & ENTER	LONGITUDE= ? __	Requests the east or west longitude of the desired location. Try New York City for this with a 74 West input.
74 & ENTER	1=EAST 2=WEST__	Choose West option.
2 &ENTER	LATITUDE= ?__	NYC latitude is 40.45 North. Input 40.45
40.45 & ENTER	1=NRTH 2=STH__	Choose North option.
1 & ENTER	EASTERN, Y/N?	Since New York City is in the Eastern Time Zone answer yes. Other US zones are: Central, Mountain, Pacific, Yukon and Alaska.
YES	DAYLT SAV= ?_	Asks whether daylight savings is in effect.
YES	NEW DATA, Y/N?	No need for new data, rather: sun's angle.
NO then YES	SUNS AZIMUTH? at ANGLE, Y/N?	Requests actual azimuth of the sun where you want it to appear. Assume you are shooting a building which faces 145°. A 75° sun angle shows the texture and form of a structure through its sidelighting. To find out what time of day the sun shines at 75°, input 75.

KEYSTROKE	DISPLAY	COMMENTS
75 & ENTER	COMPUTING ...!	Allow 20 seconds...
Wait on display. Hit ENTER after you view the time to display the AZ & EV.	7:08AM AZ= 75 EV= 16.7	At 7:08am on June 1, 1991 in New York City the sun will appear at a 75" azimuth (or compass reading) with an elevation (how high in the sky) of 16.7".
ENTER	NEW DATA, Y/N?	Try Sunrise option.
NO twice	SUNRISE, Y/N?	Correct option.
YES. ENTER after time display for azimuth	COMPUTING ...! SUNRISE= 5:33AM AZ= 60	Sunrise occurs in NYC on June 1, 1991 at 5:33am and will be located at 60° on the compass.
ENTER	NEW DATA, Y/N?	NO until sunset.
YES at Sunset and ENTER after time for azimuth	COMPUTING ...! SUNSET= 8:16 PM AZ= 299	Sunset on the same day would occur at 8:16pm and would set at 299" azimuth.
ENTER until you reach time option then YES	TIME H.M ?	Prompts for a time of day and then provides sun info for then. It works just the opposite of the angle option since here you already know the time of day and want to see what the sun is doing. A help for preproduction, etc.

KEYSTROKE	DISPLAY	COMMENTS
5.15 & ENTER	1=AM 2=PM	Try 5:15pm. Choose PM (option 2)
2 & ENTER	COMPUTING ...!	Wait on display.
ENTER to show sun azimuth & EV.	5:15PM AZ= 272 EV= 32.6	Azimuth and elevation provided for 5:15pm.
ENTER	NEW DATA, Y/N?	Let's look at NYC for January 1, 1991.
YES	MONTH= 6?__	Change to January by replacing 6 with 1.
1 and ENTER	DAY= 1?__ ENTER	Since we are changing only the month, and all other info will be the same for this one example, you need only to ENTER each time to keep the same data intact. An even quicker method here is to type "+" to accept the current settings.
+ and ENTER	NEW DATA, Y/N?	No. Choose Angle.
NO then YES	SUNS AZIMUTH?	Try 75 degrees.
75 & ENTER	NOT AVAILABLE	The computer indicates no sunshine at 75° on January 1. You can try inputting other months to find out if the sun will shine at 75 degrees and amaze your clients and friends.

KEYSTROKE	DISPLAY	COMMENTS
ENTER & YES	MONTH= 1?	Try September here.
9 and ENTER	DAY= 1?__	Keep the same day.
ENTER	YEAR= 1991?__	Keep year the same.
ENTER	LONGITUDE= 74W?_	Try Sydney Australia. Their Longitude there is 152 degrees East.
152 and ENTER	1=EAST 2=WEST	Option 1 for East.
1 & ENTER	LATITUDE= 40.45	Latitude is 34° South.
34 & ENTER	1=NRTH 2=STH	Choose option 2
2 & ENTER	CALIBRATING	The computer enters the calibration mode whenever a location outside the USA is chosen. It ignores daylite savings & time zones. Instead it displays its guess at sunrise for that date and location and then needs verification.
Wait on Display ENTER after time display two times to get Y/N question.	SUNRISE =7:20AM AZ= 79 OK (Y/Time?)	For this calibration check sunrise for the inputted day from the local paper. If you agree with the time, type YES. Otherwise type in the correct sunrise and ENTER. For this example, say sunrise is 6:20am.

SUNLIGHT (Continued)

KEYSTROKE	DISPLAY	COMMENTS
6.2 & ENTER	NEW DATA, Y/N?	No need to calibrate further unless you change the location or the date or both. The computer is ready to take your option. Answer NO to New data and select the option of your choice.

MINOLTA COLOR TEMPERATURE TO CC FILTERS

PURPOSE: This program converts the Minolta Color temperature meter LB & CC #'s into their equivalent CC filters.

APPLICATION: Eliminates the need to use the light balancing filters since the final filter pack is in CC filters.

KEYSTROKE	DISPLAY	COMMENTS
"B"	CCF, Y/N?	We need LB option.
NO then YES	LB#?	Say the meter gives a reading of -21 LB #.
–21 & ENTER	CC#?	Try 18 for this.
18 & ENTER	15B 32M 2.3 FF	The CC equivalent is 15 Blue + 32 Magenta. Filter factor = 2.3
ENTER	OR + 1.2 STOPS	Or open aperture 1.2 stops.
ENTER	LB#?	Enter 0 this time.
0 & ENTER	CC#?	Try 13 here.
13 & ENTER	30M 1.6 FF	30 Magenta called for Filter factor = 1.6
ENTER	OR +0.6 STOP	Or open aperture .6 (2/3's) of a stop

COLOR COMPENSATING FILTERS

A	B	C	D
E	F	G	H

PURPOSE: This program adds together all CC filters used on a lens, or in the enlarger; subtracts neutral density, then provides the equivalent color correction usingone or two CC filters and their filter factor.

APPLICATION: This program is helpful when a situation calls for more than one CC filter. Typically a location interior shot requires filtration for the light source, the film emulsion color balance, & CC filters to correct for the reciprocity failure color shifts. The required correction could easily average 3 or more filters. By removing neutral density you provide more light for the exposure and put less filter material between the lens and film for better optical results. Applications also include duping film and color printing corrections.

KEYSTROKE	DISPLAY	COMMENTS
"B" menu key.	CCF, Y/N?	Answer YES here since we want CC routine.
"YES"	CC FILTER?	CC filter inputs now. Assume a 40 Yellow is needed. Input 40Y.
40 & ENTER	CYAN, Y/N?	NO until Yellow
YES at Yellow	CC FILTER?	Requests another CC Try 15 Red this time.
15 & ENTER	CYAN, Y/N?	NO until RED, Y/N?
YES at Red	CC FILTER?	Now add 25 Cyan.
25 & ENTER	CYAN, Y/N?	Answer YES this time.
YES	CC FILTER?	Inputs are finished. To compute the answer press ENTER only.
ENTER once for color & factor then again.	10G 30Y 1.5 FF OR +0.5 STOP	Simplified equivalent color. 1.5 factor or open lens 1/2 stop

CC FILTERS (Continued)

KEYSTROKE	DISPLAY	COMMENTS
ENTER	CC FILTER?	Example 2. 30 Green.
30 & ENTER	CYAN, Y/N?	NO until Green.
YES at GREEN	CC FILTER?	Now input 30 Magenta.
30 & ENTER	CYAN Y/N?	NO till Magenta
YES at MAGENTA	CC FILTER?	ENTER to conclude.
ENTER	NO CC NEEDED	Since complementary colors of equal CC value cancel each other-no CC filter is needed.
ENTER	CC FILTER?	This program can also find complementary colors. Use - before the number to subtract that color.
20 and ENTER	CYAN, Y/N?	Answer YES.
YES	CC FILTER ?	ENTER to conclude.
ENTER	20R 1.4 FF or +0.4 STOP	Adding 20 Red removes 20 Cyan.
ENTER	CC FILTER ?	Now combine plus & values. Enter 40R, -20Y, 10C, then -20B.
Per Instructions.	30R 1.6 FF or +0.6 STOP	Adding & subtracting are ok. Should you overshoot the color menu (ie CYAN, Y/N?), keep hitting NO until your color cycles around. Also, when a given color doesn't match your filter (ie 16B 34M) round them off to 15B and 35M.

CALCULATING BELLOWS & FILTER FACTORS

A	B	C	D
E	F	G	H

PURPOSE: This program utilizes lens focal length, bellows draw & filter factor to provide an exposure correction for either shutter speed or aperture.

APPLICATION: Whenever a scene is metered outside the camera, as is often the case with medium and large format cameras, the final exposure is affected by both the bellows draw (if the camera is focused at shorter-than-infinity) and filter factor.

KEYSTROKE	DISPLAY	COMMENTS
"C" at Menu	FACTORS, Y/N?	Choose this option.
YES	FOCAL LENGTH?	Requests focal length of the lens in use. Try a 55 mm lens.
55 & ENTER	INCHES, Y/N?	We need millimeters.
NO & YES to millimeter option.	BELLOWS DRAW ?	Requests the total bellows extension. For this example try 60mm.
60 & ENTER	FILTER FACTOR?	Input the factors of the filters in use. If more than one filter is used, multiply factors together. If no filters in use, press ENTER. Try 2.
2 & ENTER	SHUTTER * 2.3	Need to multiply our shutter speed by 2.3 due to the light lost through bellows draw and filter factors.
ENTER	OR +1.2 STOPS	We could instead open aperture by 1.2 stops for equivalent effect.
	DIST=2FT 21N	Distance to subject is 2 feet 2 inches.

LIGHTING RATIOS

A	B	C	D
E	F	G	H

PURPOSE: This program gives lighting ratios for either strobe or continuous light.

APPLICATION: Lighting ratios are important in all aspects of photography from portraiture to balancing a room interior to outside sunlight. They also come in handy in synchro-flash situations outdoors where a flash unit is used in a fill-flash application. The amount of fill is a component of lighting ratios.

KEYSTROKE	DISPLAY	COMMENTS
"C" on Menu	FACTORS, Y/N?	We need ratios.
NO	RATIOS, Y/N?	Correct option. Yes.
YES	1:2, Y/N?	Requests the lighting ratio you desire. Try a 1:3 ratio here.
NO until the 1:3 option appears then press YES	METERED F/INT?	Enter the whole # only of the f/ stop metered from your strobe or continuous lite meter. Try f11 & 213 here.
11 & ENTER	METERED F/FRAC?	Now enter the fraction metered, if any. When no fraction exists, press ENTER only. Here we need to input 213
2÷3 & ENTER	MAIN, Y/N?	Computer prompts for whether this reading if main or fill. Try main for this one.
YES then ENTER	MAIN= F/11 +2/3 FILL= F/8	With a main of f11 & 2/3 and a fill of f/8 you have accomplished a 1:3 ratio.
ENTER for another choice.		

ACCUMULATED FLASH

A	B	C	D
E	F	G	H

PURPOSE: Provides required 'pops' or bursts of flash to yield more light for a desired f/ stop when a smaller f/ stop has been metered.

APPLICATION: This program is helpful to those photographers who own strobe meters without the accumulated flash modes.

KEYSTROKE	DISPLAY	COMMENTS
"C" at Menu	FACTORS, Y/N?	NO until Flash option.
NO until ACC FLASH then YES	DESIRED F/INT?	Requests whole f/ stop desired. For example, f/22 & 1/3 is needed f/ stop to achieve the critical depth of field for a table top shot. Enter only the whole number here.
22 & ENTER	DESIRED F/FRAC?	Now enter the fraction (if any) of your f/ desired. ENTER only if no fraction. In this example, we input 113 (use the ÷ key for /).
1÷3 & ENTER	METERED F/INT?	Requests the f/ stop from strobe meter. In this e example, try a reading of f/8 from the flash meter.
8 & ENTER	METERED F/FRAC?	No fraction indicated.
ENTER	F22 +1/3	
ENTER	12 FLASH POPS	12 pops of flash with recycle between each. Test for color shifts since the intermittency effect can shift the film's color.

RECIPROCITY FAILURE CORRECTIONS

A	B	C	D
E	F	G	H

PURPOSE: To provide reciprocity effect corrections for selected Polaroid films, color & black & white films at long exposures. Films included are Polaroid 52, 55 and 665. The color films featured: 64T, VPL, EPT, K25, RFP, RDP, RVP, RTP, RHP, & RSP. Black & white films are: TMX, TMY, TP, TX, PX & HP5.

APPLICATION: When using slow ASA films in low light conditions where a small aperture is required for depth-of-field. In these situations where the meter indicates an exposure of one second or longer, the program provides a quick and accurate method of coping with reciprocity failure.

KEYSTROKE	DISPLAY	COMMENTS
"D" at Menu	Polaroid Y/N?	Film category choice. To select the Polaroid category answer yes.
YES	TYPE 52 Y/N?	Choose Type 52 Polaroid for this example.
YES	METERED TIME?	Requests the metered shutter speed. Try 20 seconds here.
20 & ENTER then ENTER again	SHUTTER SPEED= 30.5 SEC	The corrected exposure time is 30.5 seconds. No color correction is indicated for any of the transparency films because this varies from emulsion to emulsion. You will need to test your film for these shifts.
ENTER	Polaroid Y/N?	Main menu again. Look at color films this time.

Reciprocity Corrections (Continued)

KEYSTROKE	DISPLAY	COMMENTS
NO	Color Y/N?	Select color with yes.
YES	KODAK, Y/N?	Select Kodak menu with yes.
YES	64T, Y/N?	Choose this for the new Kodak Tungsten film. Press ves.
YES	METERED TIME?	Input 60 seconds.
60 & ENTER then ENTER again	SHUTTER SPEED= 68.5 seconds	Corrected time for Kodak Tungsten film
ENTER	POLARIOD, Y/N?	Select YES at COLOR option and YES at FUJI, Y/N?
ENTER	RFP+DP+VP, Y/N?	Since the reciprocity curves are the same for Fuji's RFP, RDP & RVP select YES at this prompt, using Velvia (RVP) in this example.
YES	MEASURED TIME?	Try 20 seconds here.
20 & ENTER	SHUTTER SPEED= 35.5 SECONDS	Use 35.5 seconds for Velvia film when a metered reading is 20 seconds. This would also apply to Fuji 50 (RFP) and Fuji 100 (RDP).
ENTER	POLARIOD, Y/N?	Try for black & white films this time Press NO until B&W menu then YES.
YES at B&W	TMX Y/N?	Select YES here for T-100 T-Max films.
YES for T-MAX	METERED TIME?	Try 15 seconds.

Reciprocity Corrections (Continued)

KEYSTROKE	DISPLAY	COMMENTS
15 & ENTER then ENTER again	SHUTTER SPEED= 24.5 SECONDS	Corrected time for T-MAX for 15 second metered time.
ENTER	POLARIOD, Y/N?	

DEPTH OF FIELD

A	B	C	D
E	F	G	H

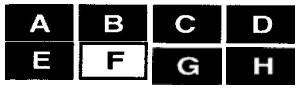
PURPOSE: To provide the appropriate f/ stop and focus point to achieve depth of field between near and far desired points of focus.

APPLICATION: Eliminates the need to consult tables since this program works for 35mm, 120, 4x5 and 8x10 formats.

KEYSTROKE	DISPLAY	COMMENTS
Menu key "E" under DOF	FOCAL LENGTH?	Requests focal length of lens in use. Try 90 millimeters here..
90 & ENTER	INCHES, Y/N?	We want millimeters.
NO	MM, Y/N?	Correct option.
YES	LENS F/# MAX?	Here you put in your largest f/# on your lens which is your minimum aperture (ie f/22 or 32). Try 32.
32 & ENTER	35, Y/N?	Prompts for camera format. Assume 4x5 is camera of choice.
NO until 4x5	4x5, Y/N?	Correct option.
YES	NEAR FOCUS FT?	Requests the nearest distance in a scene to be in focus. Try a point 7' 8" away from camera as near focus.
7 and ENTER	NEAR FOCUS IN?	Now for inches input.
8 & ENTER	FAR FOCUS FT?	Requests far focus. Try 50 feet here.
50 and ENTER	FAR FOCUS IN?	No inches just ENTER.
ENTER	FOCUS...	Hit ENTER for answer.

KEYSTROKE	DISPLAY	COMMENTS
ENTER	13 FT 3.5 IN F22	Focus your camera at this distance. Pressing ENTER yields flstop required for your desired near to far focus.
ENTER	FOCAL LENGTH?	Try a 10 inch lens.
10 & ENTER	INCHES, Y/N?	We want inches here.
YES	LENS F/# MAX?	Suppose this lens is f/45.
45 & ENTER	35, Y/N?	Try the 120 format.
NO	120, Y/N?	Correct option.
YES	NEAR FOCUS FT?	Try 10 feet for near.
10 & ENTER	NEAR FOCUS IN?	No inches input here.
ENTER	FAR FOCUS FT?	Try 50 feet far point.
50 then ENTER	EXCEEDING F/45	The required f/# exceeds your minimum aperture. Your options include backing up from the subject, using a wider angle lens or both to increase the depth of field for the shot. Then retry. Press ENTER to keep same format/lens. Try 30' and 45' for new near & far points.
ENTER	NEAR FOCUS FT?	Input 30 feet.
30 then ENTER twice.	FAR FOCUS FT?	Input 45 feet.
45 then ENTER three times.	FOCUS... 36 FT 0 IN F22+1/2	New focus distances result in an acceptable flstop required.

LENS EQUIVALENTS



PURPOSE: This program gives equivalent lens focal lengths for various camera formats.

APPLICATION: When you are shooting a scene on two different camera formats at the same time and want to know the which focal length lens on one camera will give the same viewing angle as the other lens and camera.

KEYSTROKE	DISPLAY	COMMENTS
" **F** at Menu	LENS?	Requests focal length of the lens in use. Try a 55 mm lens.
55 & ENTER	IN Y/N?	We need millimeters.
NO	MM, Y/N?	Correct option.
YES	FORMAT NOW... 35, Y/N?	Requests format used. 35 mm for example.
"YES"	FORMAT NEEDED... 35, Y/N?	Requests the other format to use. Try 645.
NO until 120 then YES then YES again at 645 promt.	92 MM or ... 3.59 INCHES	A 92mm (which is also a 3.59inch) lens on a 645 camera has the same angle of view as a 55mm lens on 35mm.
ENTER	LENS?	Repeats step #1 above.

TIME CHANGES BY PERCENT

PURPOSE: This program calculates a percentage + or - change in a given inputted time.

APPLICATION: Changes in film processing times from normal are anecessary part of controlling the contrast index of agiven black & white **film.** Thus it can be utilized as a method of accommodating scene contrast with an appropriately developed negative.

KEYSTROKE	DISPLAY	COMMENTS
"G" at Menu then select % Change.	TIME (M.S)?_	Prompts for the time to be changed. Enter it as number of minutes then decimal then seconds. For example: 10.5 = 10 min 5 sec 10.45= 10 min 45 sec 10 = 10 min
10.3 & ENTER	% CHANGE?—	Requests the amount of change desired. A "-" preceding the number means a time decrease, no sign means an increase. Try a decrease of 15% for example.
15 & ENTER	8M 55S	The new time is 8 minutes & 55 seconds — 15% less than the original time of 10 minutes 30 seconds. ENTER here if you want to input other times.

INCHES TO MILLIMETERS: MILLIMETERS TO INCHES

A	B	C	D
E	F	G	H

PURPOSE: To provide conversion of inches to millimeters and millimeters to inches.

APPLICATION: Helpful in programs where the focal length of your lens is marked in inches. Since the program calls for millimeters; you could convert your values with this program. Other uses occur whenever you need English to Metric and Metric to English conversions.

KEYSTROKE	DISPLAY	COMMENTS
" H at Menu	IN TO MM, Y/N?	This option converts inches to millimeters.
YES	INCHES?	Requests full number of whole # & decimal. Say we have a 7 & 1/2 inch lens.
7.5 & ENTER	190.5 MM	A 7.5" lens is a 190.5 millimeter lens.
ENTER	INCHES?—	Asks for new inches value. To get to the millimeters conversion part press "H" key & choose MM to IN option
" H key then YES at MM TO IN option	MILLIMETERS?	This program requests a value in millimeters to convert to inches. Try 350.75 mm.
350.75 & ENTER	13.8 IN	350.75 millimeters = 13.8 inches. If you press ENTER you will bring up the mm-in conversion again.

BELLOWS MEASUREMENT: The bellows draw is the total lens to film plane distance, which at infinity is equal to the lens focal length. At closer than infinity focus, the bellows draw equals the focal length plus bellows exten- sion beyond focal length. For example, a 90 mm lens at infinity focus has a bellows draw of 90mm. But when focused at 5.6 feet, the bellows extension is 5 mm beyond 90mm (the focal length), giving a bellows draw of 95mm.

COLOR COMPENSATING: Another application for this program is helpful when you are using duplicate slide film which requires different CC filter packs from one emulsion to another. Normally you subtract the old filter pack from the new to get a starting puck for the new film. Since this program handles both subtraction and addition; enter numbers which you are subtracting as negative ones.

SUN'S AZIMUTH: You are not restricted to inputting only the actual month and day you are operating the computer. Sometimes it is helpful to predict what the light will be doing at some future date. For example, when the computer indicates 'Not Available' due to a negative Elevation, either you have the north facing angle (which never gets light), or you have the wrong time of year. To speed up your predictions, increase the month by two each time and leave the day the same. For example, if February 12th revealed a negative elevation for a certain angle; try April 12, then June 12, and so on until (and if) you get a month that works. For specific predictions you could further vary the days once the month has been found.

Compass readings are more critical in the early morning and late afternoon, since the sun's azimuth changes more slowly during those hours; especially in the summer months.

For critical readings within 15 minutes of accuracy, consult the library for the location of isogonic lines in your area. These lines show the difference between the magnetic north of your compass and true north of the map. For example, say your magnetic north is 15° West of true north as it is in areas of the upper Northeastern United States. If you wanted to know when the sun would shine at a 120° azimuth from your compass reading, you need to subtract the 15 before inputting your angle

into the computer. So, you would input 105 in response to angle desired to find time of 120" magnetic azimuth (as desired from your compass reading).

When you are using the TIME, Y/N? option of the Sun's program, the computer will give you the time for a true north azimuth. Here we add our factor to get the final corrected figure. For example, if the computer indicated a 130 Azimuth for 11:30am input, we need to add 15 to 130 to give us a compass azimuth of 145° for that time of 11:30am.

If this seems complicated, it is. To clarify:
Compass ——————> True (subtract variation)
True ——————> Compass (add variation)

So, when going from a compass reading to true north based reading, subtract the variation; otherwise add the variation when going from true to compass.

When your isogonic map indicates a magnetic north which is EAST of true north, it is a negative number; a magnetic north which is WEST of true north is a positive number.

15°E = -15 variation
15°W = 15 variation

LONGITUDE & LATITUDE LISTINGS FOR THE USA

CODES FOR TIME ZONES:
E Eastern Standard
C Central Standard
M Mountain Standard
P Pacific Standard

City	Lati-tude	Longi-tude	Time Zone	City	Lati-tude	Longi-tude	Time Zone
Aberdeen, SD	45.28	98.29	C	Bismarck, ND	46.48	100.47	C
Akron, OH	41.5	81.31	E	Boise, ID	43.37	116.12	M
Albany, NY	42.39	73.45	E	Brattleboro, VT	42.51	72.34	E
Albert Lea, MN	43.39	93.22	C	Bridgeport, CT	41.11	73.11	E
Albuquerque, NM	35.5	106.39	M	Brockton, MA	42.5	71.1	E
Alexandria, LA	31.18	92.27	C	Buffalo, NY	42.53	78.52	E
Allentown -				Burlington, VT	44.29	73.13	E
Bethlehem, PA	40.36	75.28	E	Butte, MT	46.1	112.32	M
Amarillo, TX	35.12	101.50	C	Cairo, IL	37.0	89.11	C
Ardmore, OK	34.10	97.8	C	Camden, NJ	39.57	75.7	E
Asheville, NC	35.36	82.33	E	Canton, OH	40.48	81.23	E
Atlanta, GA	33.45	84.24	E	Cape May, NJ	38.56	74.56	E
Atlantic City, NJ	39.22	74.26	E	Carson City-			
Augusta, GA	33.28	81.58	E	Reno, NV	39.10	119.46	P
Augusta, ME	44.19	69.46	E	Casper, WY	42.51	106.19	M
Austin, TX	30.16	97.45	C	Chadron, NE	42.50	103.0	M
Bakersfield, CA	35.23	119.1	P	Charleston, SC	32.47	79.56	E
Baltimore, MD	39.17	76.37	E	Charleston, WV	38.21	81.38	E
Bangor, ME	44.48	68.46	E	Charlotte, NC	35.14	80.51	E
Barstow, CA	34.54	117.1	P	Charlottesville. VA	38.2	78.30	E
Baton Rouge, LA	30.27	91.11	C	Chattanooga, TN	35.3	85.19	E
Beaumont, TX	30.5	94.6	C	Cheboygan, MI	45.39	84.29	E
Bellingham, WA	48.45	122.29	P	Cheyenne, WY	41.8	104.49	M
Bemidji, MN	47.28	94.53	C	Chicago			
Berlin, NH	44.28	71.11	E	Oak Park, IL	41.52	87.38	C
Billings, MT	45.47	108.30	M	Cincinnati-			
Biloxi, MS	30.24	88.53	C	Hamilton, OH	39.6	84.31	E
Binghampton, NY	42.6	75.55	E	Cleveland -			
Birmingham, AL	33.31	86.49	C	Lakewood, OH	41.30	81.42	E

City	Latitude	Longitude	Time Zone
Columbia, SC	34.0	81.2	E
Columbus, OH	39.57	83.1	E
Corpus Christi, TX	27.48	97.24	C
Craig, CO	40.31	107.33	M
Dallas-Fort Worth, TX	32.47	96.48	C
Danville, IL	40.8	87.37	C
Danville, VA	36.36	79.23	E
Davenport, IA	41.32	90.35	C
Dayton, OH	39.45	84.10	E
Decatur, A L	34.36	86.59	C
Decatur, IL	39.51	88.57	C
Denver-Boulder, CO	40.0	104.59	M
Des Moines, IA	41.35	93.37	C
Detroit-Dearborn, MI	42.20	83.3	E
Dubuque, IA	42.30	90.41	C
Duluth, MN	46.4 7	92.6	C
Durham, NC	36.0	78.55	E
Eastport, ME	44.54	67.0	E
Eau Claire, WI	44.49	91.30	C
El Paso, TX	31.45	106.29	M
Elko, NV	40.50	115.46	P
Ellsworth, ME	44.33	68.25	E
Erie, PA	42.7	80.5	E
Eugene, OR	44.3	123.6	P
Fall River-New Bedford, MA	41.42	71.9	E
Fargo, ND	46.53	96.47	C
Flagstaff, AZ	35.12	111.39	M
Flint, MI	43.1	83.41	E
Fort Scott, KS	37.50	94.42	C
Fort Smith, AR	35.23	94.25	C
Fort Wayne, IN	41.4	85.9	E
Fresno, CA	36.44	119.47	P
Gallup, NM	35.32	108.45	M
Galveston, TX	29.18	94.48	C
Gary, IN	41.36	87.20	C
Glasgow, MT	48.12	106.38	M
Grand Forks, ND	47.55	97.3	C
Grand Island, NE	40.55	98.21	C
Grand Junction, CO	39.4	108.33	M
Great Falls, MT	47.30	111.17	M
Green Bay, WI	44.31	88.0	C
Greensboro, NC	36.4	79.47	E
Hagerstown, MD	39.39	77.43	E
Harrisburg, PA	40.16	76.53	E
Hartford - New Britain, CT	41.46	72.41	E
Helena, MT	46.36	112.2	M
Houston, TX	29.45	95.22	C
Indianapolis, IN	39.46	86.10	E
Ironwood, MI	46.27	90.9	C
Jackson, MI	42.15	84.24	E
Jackson, MS	32.18	90.11	C
Jacksonville, FL	30.20	81.40	E
Jefferson City, MO	38.34	92.10	C
Joplin, MO	37.6	94.31	C
Juneau, AK	58.18	134.25	p
Kalamazoo, MI	42.17	85.35	E
Kanab, UT	37.3	112.32	M
Keene, NH	42.56	72.17	E
Ketchikan, AK	55.21	131.39	P
Knoxville, TN	35.58	83.55	E
Lacrosse, WI	43.48	91.15	C
Lake Charles, LA	30.14	93.13	C
Lancaster, PA	40.2	76.18	E
Lansing, MI	42.44	84.33	E
Las Cruces, NM	32.19	106.47	M
Las Vegas, NV	36.10	115.9	P
Lawrence - Lowell, MA	42.42	71.10	E
Lewiston, ID	46.25	117.1	P

City	Latitude	Longitude	Time Zone
Lexington-Frankfort, KY	38.3	84.30	E
Liberal, KS	37.3	100.55	C
Lincoln, NE	40.49	96.41	C
Little Rock, AR	34.45	92.17	C
Los Angeles including Pasadena and Santa, Monica, CA	34.3	118.14	P
Louisville, KY	38.15	85.46	E
Macon, GA	32.50	83.38	E
Madison, WI	43.4	89.23	C
Manchester-Concord, NH	42.59	71.28	E
Memphis, TN	35.9	90.3	C
Meridian, MS	32.22	88.42	C
Miami, FL	25.47	80.12	E
Miles City, MT	46.25	105.51	M
Milwaukee, WI	43.2	87.54	C
Minneapolis - St. Paul, MN	44.59	93.16	C
Minot, ND	48.14	101.18	C
Moab, UT	38.35	109.33	M
Mobile, AL	30.42	88.3	C
Monroe, LA	32.30	92.7	C
Montgomery, AL	32.23	86.19	C
Muncie, IN	40.12	85.23	E
Murdo, SD	43.53	100.43	C
Nashville, TN	36.10	86.47	C
New Haven, CT	41.18	72.56	E
New London, CT	41.22	72.6	E
New Orleans, LA	29.57	90.4	C
New York, NY	40.45	74.0	E
Newark -Irvington-East Orange, NJ	40.44	74.10	E
Norfolk, VA	36.51	76.17	E
North Platte, NE	41.8	100.46	C
Norwalk-Stamford, CT	41.7	73.22	E
Oakley, KS	39.8	100.51	C
Ogden, UT	41.13	111.58	M
Ogdensbury, NY	44.42	75.30	E
Oklahoma City, OK	35.28	97.31	C
Omaha, NE	41.16	95.56	C
Ortonville, MN	45.19	96.27	C
Oshkosh, WI	44.1	88.33	C
Parkersburg, WV	39.16	81.34	E
Paterson, NJ	40.55	74.10	E
Pendleton, OR	45.40	118.47	P
Pensacola, FL	30.25	87.13	C
Peoria, IL	40.42	89.36	C
Philadelphia-Chester, PA	39.57	75.9	E
Phoenix, AZ	33.27	112.4	M
Pierre, SD	44.22	100.21	C
Pittsburgh-McKeesport, PA	40.26	80.0	E
Pittsfield, MA	42.27	73.15	E
Pocatello, ID	42.52	112.27	M
Poplar Bluff, MO	36.46	90.24	C
Portland, ME	43.40	70.15	E
Portland, OR	45.31	122.41	P
Portsmouth, NH	43.5	70.45	E
Presque Isle, ME	46.41	68.1	E
Providence, RI	41.50	71.25	E
Pueblo, CO	38.16	104.37	M
Raleigh, NC	35.47	78.38	E
Rapid City, SD	44.5	103.14	M
Reading, PA	40.20	75.56	E
Redding, CA	40.35	122.24	P
Richmond, VA	37.32	77.26	E
Roanoke, VA	37.16	79.57	E
Roswell, NM	33.24	104.32	M
Rutland, VT	43.37	72.58	E
Sacramento, CA	38.35	121.30	P
Salina, KS	38.50	97.37	C

City	Latitude	Longitude	Time Zone
Salisbury, MD	38.22	75.36	E
Salt Lake City, UT	40.45	111.53	M
SanAntonio, TX	29.25	98.30	C
San Diego, CA	32.43	117.9	P
San Francisco-Oakland-San Jose, CA	37.47	122.25	P
Santa Fe, NM	35.41	105.56	M
Savannah, GA	32.5	81.6	E
Scranton-Wilkes Barre, PA	41.25	75.40	E
Seattle -Tacoma-Olympia, WA	47.37	122.20	P
Sheridan, WY	44.48	106.58	M
Shreveport, LA	32.31	93.45	C
Sioux Falls, SD	43.33	96.44	C
South Bend. IN	41.41	86.15	E
Spartanburg, SC	34.56	81.57	E
Spokane, WA	47.40	117.24	P
Springfield, IL	39.48	89.3 9	C
Springfield-Holyoke, MA	42.6	72.36	E
Springfield, MO	37.13	93.18	C
St. Johnsbury, VT	44.25	72.1	E
St. Joseph, MO	39.46	94.50	C
St. Louis, MO	38.3 7	90.12	C
St. Petersburg, FL	27.46	82.3 9	E
Syracuse, NY	43.3	76.9	E
Tallahassee, FL	30.2 7	84.17	E
Tampa, FL	27.57	82.27	E
Terre Haute, IN	39.28	87.24	C
Texarkana, AR	33.26	94.3	C
Toledo, OH	41.39	83.33	E
Topeka, KS	39.3	95.40	C
Traverse City, MI	44.46	85.38	E
Trenton, NJ	40.13	74.46	E
Trinidad, CO	37.10	104.31	M
Tucson, AZ	32.13	110.58	M
Tulsa, OK	36.9	95.60	C
Tupelo, MS	34.16	88.34	C
Vernal, UT	40.27	109.32	M
Walla Walla, WA	46.4	118.20	P
Washington, DC	38.54	77.1	E
Waterbury - Meriden, CT	41.33	73.3	E
Waterloo, IA	42.30	92.20	C
Wausau, WI	44.58	89.38	
West Palm Beach, FL	26.43	80.3	E
Wichita, KS	37.42	97.20	C
Williston, ND	48.9	103.37	C
Wilmington, DE	39.45	75.33	E
Wilmington, NC	34.14	77.55	E
Winchester, VA	39.11	78.10	E
Worcester, MA	42.16	71.48	E
York, PA	39.58	76.47	E
Youngstown, OH	41.6	80.39	E
Yuma. AZ	32.43	114.37	M

NOTES

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