

# SPREADSHEETS

**Microsoft Office ~ Excel ~ .xls**  
**Open Office ~ .ods**  
**Palm Pilot ~ Documents To Go**

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- **To get started with the Excel version (Office 2003 is much easier to use than Office 2007 if you plan to modify the sheets)**
  - **Why Open Office has a different version**
  - **Why the Palm Pilot has a different set of sheets**
  - **How to hot synch on Windows Vista**
  - **Spread sheet notes when programming them**

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**NOTE:** The front page of the main spreadsheet may look different to the examples Here because it will evolve and improve over time. See next page for an example of a revised spreadsheet.

**NOTE:** If you run this directly from an internet download, the hyperlinks will not work. Do a SAVE first from that download, and then do a RUN.

**Simon Wheaton-Smith**  
**Sept 26, 2011**

SPREADSHEETS RELATING TO SUNDIAL DESIGN  
Open Source

**CURRENT INITIAL SCREEN as of Sept 26, 2011**  
**BEFORE ENTERING THE JULIAN DAY YOU DESIRE**

MAIN SCREEN YELLOW boxes can be changed BLUE boxes are computed updated: Sept 26, 2011 EXCEL and OPEN OFFICE version

Latitude: 33.50 Longitude: 112.10  
Legal meridian: 105  
Gnomon linear height (nodus usage): 1  
today is: 9/25/2011 2011268 268  
you want: Julian day (1-366) 0

NOTE: You must enter a JULIAN DATE to START: this sheet shows today's Julian day, but you must enter a Julian date (any date). This also enables the main menu.

DECIMAL EOT VALUES mm.mm  
ASTRONOMICAL EOT (non leap year)  
Today: -8.01  
Tomorrow: -8.22

GENERIC EOT TABLE

	GENERIC EOT TABLE			SUN'S DECLINATION			JULIAN DAYS		
	5th	15th	25th	5th	15th	25th	5th	15th	25th
JAN	5.1	9.0	12.0	-22.7	-21.3	-19.2	5	15	25
FEB	13.9	14.2	13.4	-16.2	-13.0	-9.4	36	46	56
MAR	11.9	9.3	6.3	-6.3	-2.4	1.5	64	74	84
APR	2.8	0.0	-2.3	5.8	9.5	12.9	95	105	115
MAY	-3.6	-4.0	-3.5	16.0	18.7	20.8	125	135	145
JUN	-2.0	-0.1	2.0	22.3	23.3	23.4	156	166	176
JULY	3.9	5.3	5.9	22.9	21.7	19.8	186	196	206
AUG	5.4	3.8	1.4	17.2	14.3	11.0	217	227	237
SEP	-2.2	-5.8	-9.4	7.1	3.3	-0.5	248	258	268
OCT	-12.7	-15.1	-16.5	-4.4	-8.2	-11.8	278	288	298
NOV	-16.5	-15.1	-12.5	-15.5	-18.3	-20.6	309	319	329
DEC	-8.8	-4.5	0.2	-22.3	-23.2	-23.4	339	349	359

QUICK SPREADSHEET WITH MOST FUNCTIONS

**AFTER ENTERING THE JULIAN DAY YOU DESIRE**

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today is: 9/25/2011 2011268 268  
you want: Julian day (1-366) 268

DECIMAL EOT VALUES mm.mm  
ASTRONOMICAL EOT (non leap year)  
Today: -8.01  
Tomorrow: -8.22

for JD 268 astronomical EOT is: -8.01  
eot(3wv) -8.44 eot(2wv) -8.66

NOTE: EOT formulae do clearly differ

correction mm.mm h:hh  
long.corr 28.40 0.47  
astro.EOT -8.01 -0.16  
total.corr 20.39 0.32

SUN FAST  
long.corr4 eot4 net astro compass  
-7.100 2.003 corr: -5.10

For astrocompass, adjust the standard 15 degrees per hour setting by this angle (opposite sign to dial correction)

GENERAL  
Almanac page with lots of data  
Noon transit by day and location  
Astro Compass time -> LHA  
Sunrise-set-EOT mn Italian line  
Sunrise-set EOT deci data  
astronomical EOT any year  
Static astro-EOT for a few years  
EOT with longitude correction  
Wall declination from south  
Lunar phases

HOOR ANGLE  
Horizontal dial (h-dial)  
Equatorial & Armillary dials  
Vertical dial non declining (v-dial)  
Vertical decliner (v-dec)  
Vertical great decliner  
Ceiling or reflecting dials  
Meridian dial (pure east or west)  
Polar dial  
Inclined decliners  
Analemma curve (figure 8)  
Declination/calendar curve data  
Pie charts for hr line angles  
Midpoint scales  
Reverse engineering an h-dial

AZIMUTH  
Analemmatic (hours on ellipse)  
Almanac page with lots of data

ALTITUDE  
Astrolabe almucenters  
Almanac page with lots of data

TOOLS  
angle-xy converter  
Astro compass

To copy/distribute this spreadsheet give credit to www.illustratingshadows.com  
The books ILLUSTRATING TIME'S SHADOW explains these tools in detail.  
Always make models of dials when using automated data and test them before casting the final dial plate.  
Just because figures are presented, does not mean that they make sense. These are only tools.  
Several variations of the EOT are used here. ALWAYS check to ensure accuracy for your preferred method.

GENERIC EOT TABLE

	GENERIC EOT TABLE			SUN'S DECLINATION			JULIAN DAYS		
	5th	15th	25th	5th	15th	25th	5th	15th	25th
JAN	5.1	9.0	12.0	-22.7	-21.3	-19.2	5	15	25
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QUICK SPREADSHEET WITH MOST FUNCTIONS

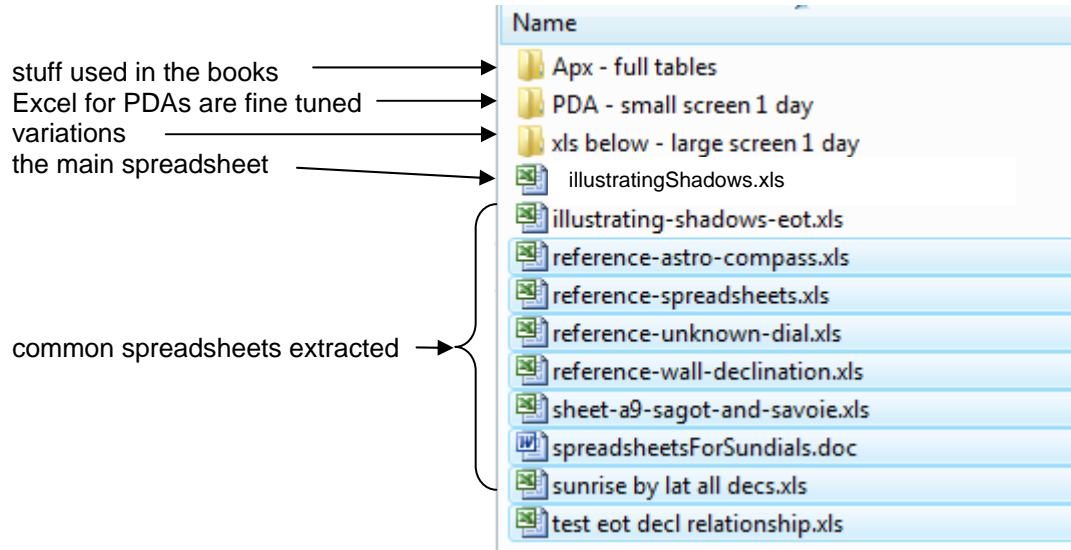
Selected Julian day: 268 QUICK ALMANAC  
day's sunrise hh:mm: 6.20 sunrise azimuth: 89.36  
sunset: hh:mm: 18.18  
solar declination: -0.5  
EOT mm.mm: -8.44  
noon transit hh:mm: 12:20.4 noon altitude: 55.37

## TO GET STARTED WITH THE EXCEL VERSION

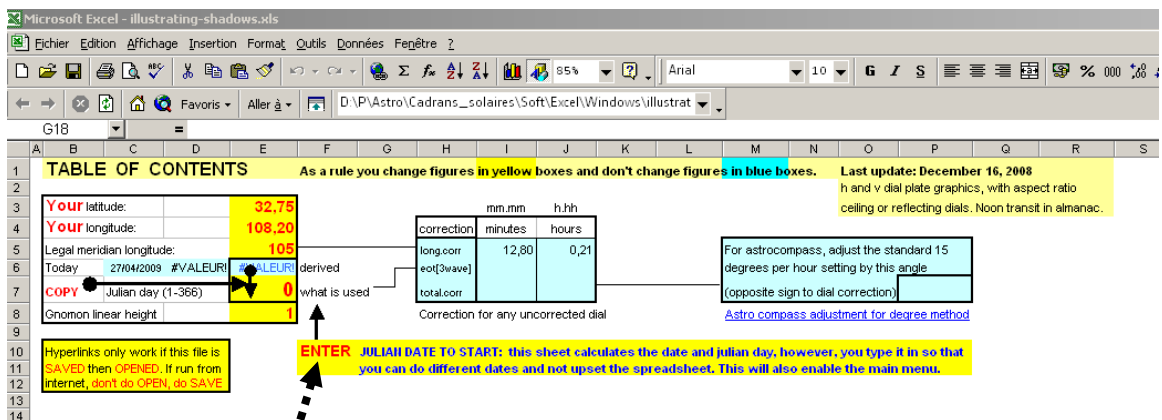
The Microsoft Office Excel version of this major spreadsheet, actually two separate master sheets, uses what is called conditional formatting, and has extensive use of macros.

illustratingShadows.xls

all common sundial needs, this included the astronomical EOT spreadsheet: illustrating-shadows-eot.xls



The Excel, and Open Office, spreadsheets have many functions. The Excel begins with a blank screen.



Nothing much else will appear until you enter a Julian day. The reason for this is to let you select any day of the year while still telling you what the Julian day is today. While you could alter this cell to equal the cell immediately above it, you may forget that change the day on a subsequent day and thus make mistakes.

# SPREADSHEETS RELATING TO SUNDIAL DESIGN

## Open Source

As soon as the Julian day is entered in that cell, a list of options then appears.

**TABLE OF CONTENTS** As a rule you change figures in yellow boxes and don't change figures in blue. Last update: April 27, 2009

h and v dial plate graphics, with aspect ratio ceiling or reflecting dials. Noon transit in almanac.

Your latitude: 32.75  
 Your longitude: 108.20  
 Legal meridian longitude: 105  
 Today: 6/28/2009 2009179  
 COPY Julian day (1-366) 179  
 Gnomon linear height: 1

derived what is used

correction	mm.mm	h.hh
lanq.corr	12.80	0.21
east3uave	2.58	0.04
total.corr	15.38	0.26

Correction for any uncorrected dial

For astrocompass, adjust the standard 15 degrees per hour setting by this angle: -3.85  
 (opposite sign to dial correction)  
 Astro compass adjustment for degree math

**EXCEL VERSION NOT FOR OPEN OFFICE use open office version instead**

Hyperlinks only work if this file is SAVED then OPENED. If run from internet, don't do OPEN, do SAVE

**INFO:** illustrating-shadows.xls is linked to illustrating-shadows-eot.xls

Date	Julian
1/1	1
1/10	10
1/20	20
2/1	32
2/10	41
2/20	51
3/1	60
3/10	69
3/20	79
4/1	91
4/10	100
4/20	110
5/1	121
5/10	130
5/20	140
6/1	152
6/10	161
6/20	171
7/1	182
7/10	191
7/20	201
8/1	213
8/10	222
8/20	232
9/1	244
9/10	253
9/20	263
10/1	274
10/10	283
10/20	293
11/1	304
11/10	314
11/20	324
12/1	335
12/10	344
12/20	354

**NOTE:** You may copy or distribute this spreadsheet provided credit is given to www.illustratingshadows.com  
**NOTE:** The books ILLUSTRATING SHADOWS and ILLUSTRATING MORE SHADOWS explain these tools in detail.  
**CAUTION:** Always make models of dials when using automated data and test them before casting the final dial plate.  
 Just because figures are presented, does not mean that they make sense. These are tools, not final products.  
**CAUTION:** Several variations of the EOT are used here. ALWAYS check to ensure accuracy for your preferred method.  
 \*\*\* END \*\*\*

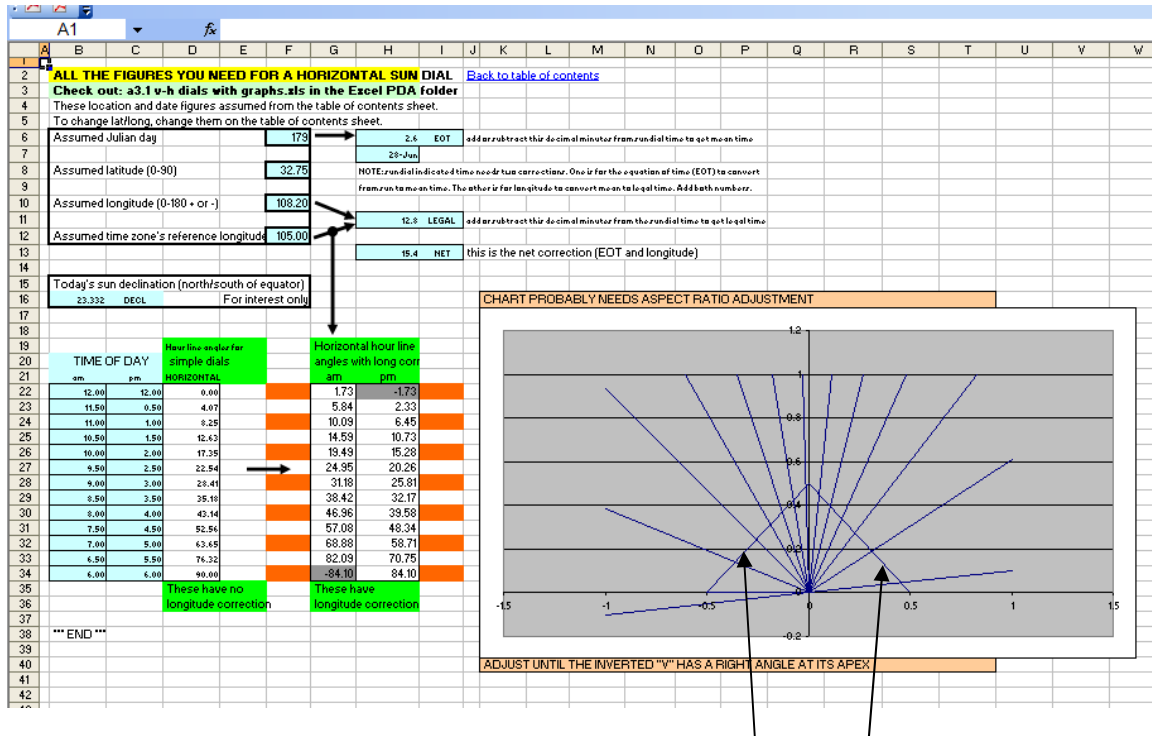
Table of Contents | Almanac | Transit | h dial | v dial | v-dec | v decliner detailed | v meridian | polar | ceiling

The important point to remember is that formulae are used extensively, and if you alter a formula with data or vice versa, that becomes a permanent change.

Secondly, if you download the sheet from the website, you must SAVE it before using it. If you download and then open without an intermediate save, then hyperlinks will cause problems.

## SPREADSHEETS RELATING TO SUNDIAL DESIGN Open Source

The spreadsheet and its sub sheets are self explanatory. However some sheets use graphics, such as the horizontal dial.



There is an inverted V in the graph, a technique used in some other graphical depictions programmed in other languages.

The apex should be a 90 degree angle. So if you do a screen capture and the aspect ration is questionable, simple stretch or compress one axis until the apex measures 90 degrees.

The astronomical equation of time sheet (EOT) is a separate spreadsheet due to its size. It always provides two tables of results. One assumes a leap year while the other does not. You select the appropriate table.

## WHY OPEN OFFICE HAS A DIFFERENT VERSION

Open Offices is free, unlike Microsoft's Office. While it is almost compatible, it is not quite.

	A	B	C	D	E	F	G	H	I
1									
2	NOON TRANSIT FOR THE YEAR BUT FOR ANY GIVEN LOCATION								
3									
4	NOON TRANSIT FOR A SPECIFIED LOCATION						hhmm.m		
5	Longitude of design dial:				108.20	Longitude of standard time:		105.00	
6									
7			1	2	3	4	5	6	7
8		Jan	Feb	Mar	Apr	May	Jun	Jly	Aug
9	1	1216.11	1226.12	1225.07	1216.81	1210.30	1210.65	1216.25	
10	2	1216.58	1226.20	1224.96	1216.24	1210.23	1210.74	1216.36	

	A	B	C	D	E	F	G	H	I	J
1										
2	NOON TRANSIT FOR THE YEAR BUT FOR ANY GIVEN LOCATION									
3										
4	NOON TRANSIT FOR A SPECIFIED LOCATION						hhmm.m			
5	Longitude of design dial:				108.20	Longitude of standard time:		105.00		
6										
7			1	2	3	4	5	6	7	
8		Jan	Feb	Mar	Apr	May	Jun	Jly	Aug	
9	1	1216.11	1226.12	1225.07	1216.81	1210.30	1210.65	1216.25	1219.	
10	2	1216.58	1226.20	1224.96	1216.24	1210.23	1210.74	1216.36	1218.	

The top spreadsheet is Microsoft Excel in action. The circled area shows a comma “,” in a conditional formula, whereas the Open Office below has a semi colon “;”. These differences happen only when formulae or special features are used, but explain why there have to be two different versions.

Further, the Open Office handling of conditional formatting is different, which is why the Open Office version shows the menu of choices on the main sheet right at startup whereas the Excel version does not. Conditional formatting and hyperlinks have issues.

**NOTE:** Open Office auto-fill can be a pain, and data validation does not help. So specific notes have been added in the Open Office versions to guide the user. In essence the most common cell to be auto-filled is the GNOMON LINEAR HEIGHT. If it auto-fills, just hit DELETE, or, you can do TOOLS, CELL CONTENT, and click AUTOFILL off.

## WHY THE PALM PILOT HAS A DIFFERENT SET OF SHEETS

The Palm Pilot has a small screen and scrolling around the screen is tedious. For that reason, the PDA (Pocket Digital Assistant) has special sheets designed for the small screen. Further, graphig is managed differently, and hyperlinks are not functional.

	A	B	C	D	E	F
1	<b>HORIZONTAL SUN DIAL</b>					
2	Latitude (0-90)			32.75		corr
3	Longitude (0-180 + or -)			108.20	→	12.8
4	Legal reference longitude			105.00	→	
5			Horizontal hour line			
6	TIME OF DAY		angles with long corr			
7	am	pm	am	pm		
8	12.00	12.00	1.73	-1.73		
9	11.50	0.50	5.84	2.33		
10	11.00	1.00	10.09	6.45		
11	10.50	1.50	14.59	10.73		
12	10.00	2.00	19.49	15.28		
13	9.50	2.50	24.95	20.26		
14	9.00	3.00	31.18	25.81		
15	8.50	3.50	38.42	32.17		
16	8.00	4.00	46.96	39.58		
17	7.50	4.50	57.08	48.34		
18	7.00	5.00	68.88	58.71		
19	6.50	5.50	82.09	70.75		
20	6.00	6.00	-84.10	84.10		
21	These have		longitude correction			

These sheets are great in Excel and in Open Office as they are VERY SIMPLE to use.

## HOW TO HOT SYNCH ON WINDOWS VISTA

Vista win64 can only hot synch by using a Bluetooth adapter, USB and WIFI do not work, see:

[http://kb.palm.com/wps/portal/kb/na/tungsten/tx/unlocked/solutions/article/49229\\_en.html](http://kb.palm.com/wps/portal/kb/na/tungsten/tx/unlocked/solutions/article/49229_en.html)

Install a cheap USB Bluetooth, then configure Hotsynch to use Bluetooth, eg COM2. Initial Hotsynch attempts may fail, and the PDA may need rebooting if you get "serial port in use" error on the Palm. Vista win64 will ask for a code (like WIFI), such as: a1a2b1b2c1, and the PDA will ask for the same code. Vista will ask for permission to proceed, then hotsync will work. You do not need the blue light to be on for the Bluetooth machine to be listening, so just because there is no blue light does not mean that "it needs turning on".

## SPREAD SHEET NOTES WHEN PROGRAMMING THEM

[Extracted from several pages in the Illustrating Shadows books] Describing a formula or set of formulae (English) or formulas (American) is easier said than actually getting them into a spreadsheet for real usage. The following points all relate to a common spreadsheet, the one used for this book.

### ANGULAR MEASURE

Angular measures are commonly in degrees, 90 degrees being a right angle and there are 360 degrees in a circle. However, spreadsheets use radians, which are different to degrees. There are  $2 * \pi$  radians in a circle of 360 degrees.

Thus, every formula that uses degrees needs the measure to be converted to radians.

=RADIANS(360)                      would return 6.283

Thus the trigonometric functions SIN, COS, TAN, COTAN, and so on, need the radian conversion first.

=TAN(RADIANS(45))                would return 1.0

Similarly, any function that returns an angular measure, such as ATAN, ACOS, ASIN, or ARCTAN, ARCOS, ARCSIN, also printed as  $TAN^{-1}$ ,  $COS^{-1}$ ,  $SIN^{-1}$ , would need to be converted back to degrees, and this is done using the DEGREES function.

=DEGREES(6.283)                    would return 359.984 or 360.0 depending on precision

Which raises another issue, that of rounding and precision. The number of significant digits on the fractional side not only determines accuracy, it also controls rounding. Thus when the above function is given one decimal position, the results is 360.0 rather than 359.9.

### ROUNDING

The number of significant digits after the decimal point is controlled by the FORMAT, CELLS, NUMBER option. Some functions do rounding of their own, and in some surprising ways.

=INT(5.1)      =INT(5.9)      =INT(-5.1)      =INT(-5.9)      returns  
5                    5                    -6                    -6

The INT (integer) function returns the integer part of a number on the left side of the decimal point, rounds down. And the number below 5.9 is 5, however the number below -5.1 is -6 because this is already in the negative scale.

However, the ABS (absolute) function which removes the sign may be used if the above rounding down on the negative side is not desired.

=INT(ABS(5.5))                      =INT(ABS(-5.5))                    returns  
5    5

If the sign must be retained, then the SIGN function can be used. Assume that cell B3 has a value of 5.5 and cell B4 has value of -5.5 then the following results can be obtained:

=SIGN(B3)\*INT(ABS(B3))            =SIGN(B3)\*INT(ABS(B3))            returns  
5    -5